2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

2009 TRANSMISSION

Automatic Transaxle (U151E) - Highlander

AUTOMATIC TRANSAXLE SYSTEM

PRECAUTION

NOTE:

- **When disconnecting the negative (-) battery cable, initialize the following systems after the cable is reconnected.**

SYSTEM REFERENCE

System	See procedure
Power Back Door System	INITIALIZATION

- **Perform the RESET MEMORY (AT initialization) when replacing the automatic transaxle assembly, engine assembly or ECM (See INITIALIZATION).**
- **Perform the REGISTRATION (VIN registration) when replacing the ECM (See CHECKING MONITOR STATUS).**
- **If the ECM is replaced, register the ECM communication ID for Immobiliser System (Refer to the Service Bulletin for Registration).**

HINT:

RESET MEMORY can not be completed by only disconnecting the battery cable.

1. **EXPRESSION OF IGNITION SWITCH**

   The type of ignition switch used on this model differs according to the specifications of the vehicle. The expressions listed in the table below are used in this article.

   IGNITION SWITCH POSITION

Expression	Switch Type	
	Ignition switch (Position)	Engine Switch (Condition)
Ignition switch off	LOCK	Off
Ignition switch on (IG)	ON	On (IG)
Ignition switch on (ACC)	ACC	On (ACC)
Engine Start	START	Start

2. **The automatic transaxle is composed of highly precision-finished parts which need careful inspection before reassembly. Even a small nick could cause fluid leakage or affect the performance. The instructions here are organized so that you work on only one component group at a time. This will help avoid confusion caused by similar-looking parts of different sub-assemblies**

cardiagn.com

being on your workbench at the same time. The component groups are inspected and repaired from the converter housing side. Complete the inspection, repair and reassembly before proceeding to the next component group as much as possible. If a defect is found in a certain component group during reassembly, inspect and repair this group immediately. If a component group cannot be assembled because some parts are being ordered, be sure to keep all parts of the group in a separate container while proceeding with disassembly, inspection, repair and reassembly of other component groups. Recommended: Toyota Genuine ATF WS

3. **All disassembled parts should be washed clean and any fluid passages and holes should be blown through with compressed air.**
4. **Dry all parts with compressed air. Never use a shop rag or a piece of cloth to dry them.**
5. **When using compressed air, always aim away from yourself to prevent accidentally spraying ATF or kerosene in your face.**
6. **Only recommended automatic transaxle fluid or kerosene should be used for cleaning.**
7. **After cleaning, the parts should be arranged in the correct order for efficient inspection, repair, and reassembly.**
8. **When disassembling a valve body, be sure to match each valve together with the corresponding spring.**
9. **New discs for the brakes and clutches that are to be used for replacement must be soaked in ATF for at least 15 minutes before reassembly.**
10. **All oil seal rings, clutch discs, clutch plates, rotating parts, and sliding surfaces should be coated with ATF prior to reassembly.**
11. **All gaskets and rubber O-rings should be replaced with new ones.**
12. **Do not apply adhesive cements to gaskets and similar parts.**
13. **Make sure that the ends of a snap ring are not aligned with one of the cutouts and are installed in the groove correctly.**
14. **When replacing a worn bushing, the sub-assembly containing the bushing must also be replaced.**
15. **Check thrust bearings and races for wear or damage. Replace them as necessary.**
16. **When working with FIPG material, you must observe the following:**
    - Using a razor blade and a gasket scraper, remove all the old packing (FIPG) material from the gasket surface.
    - Thoroughly clean all components to remove any loose material.
    - Clean both sealing surfaces with a non-residue solvent.
    - Parts must be reassembled within 10 minutes of application. Otherwise, the packing (FIPG) material must be removed and reapplied.

DEFINITION OF TERMS

DEFINITION OF TERMS

Term	Definition
Monitor description	Description of what the ECM monitors and how it detects malfunctions (monitoring purpose and its details).
Related DTCs	Diagnostic code

cardiagn.com

Typical enabling condition	Preconditions that allow the ECM to detect malfunctions. With all preconditions satisfied, the ECM sets the DTC when the monitored value (s) exceeds the malfunction threshold(s).
Sequence of operation	The priority order that is applied to monitoring, if multiple sensors and components are used to detect the malfunction. While another sensor is being monitored, the next sensor or component will not be monitored until the previous monitoring has concluded.
Required sensor/components	The sensors and components that are used by the ECM to detect malfunctions.
Frequency of operation	The number of times that the ECM checks for malfunctions per driving cycle. "Once per driving cycle" means that the ECM detects malfunction only one time during a single driving cycle. "Continuous" means that the ECM detects malfunction every time when enabling condition is met.
Duration	The minimum time that the ECM must sense a continuous deviation in the monitored value(s) before setting a DTC. This timing begins after the "typical enabling conditions" are met.
Malfunction thresholds	Beyond this value, the ECM will conclude that there is a malfunction and set a DTC.
MIL operation	MIL illumination timing after a defect is detected. "Immediately" means that the ECM illuminates MIL the instant the ECM determines that there is a malfunction. "2 driving cycle" means that the ECM illuminates MIL if the same malfunction is detected again in the 2nd driving cycle.
Component operating range	Normal operation range of sensors and solenoids under normal driving conditions. Use these ranges as a reference. They cannot be used to judge if a sensor or solenoid is defective or not.

PARTS LOCATION

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

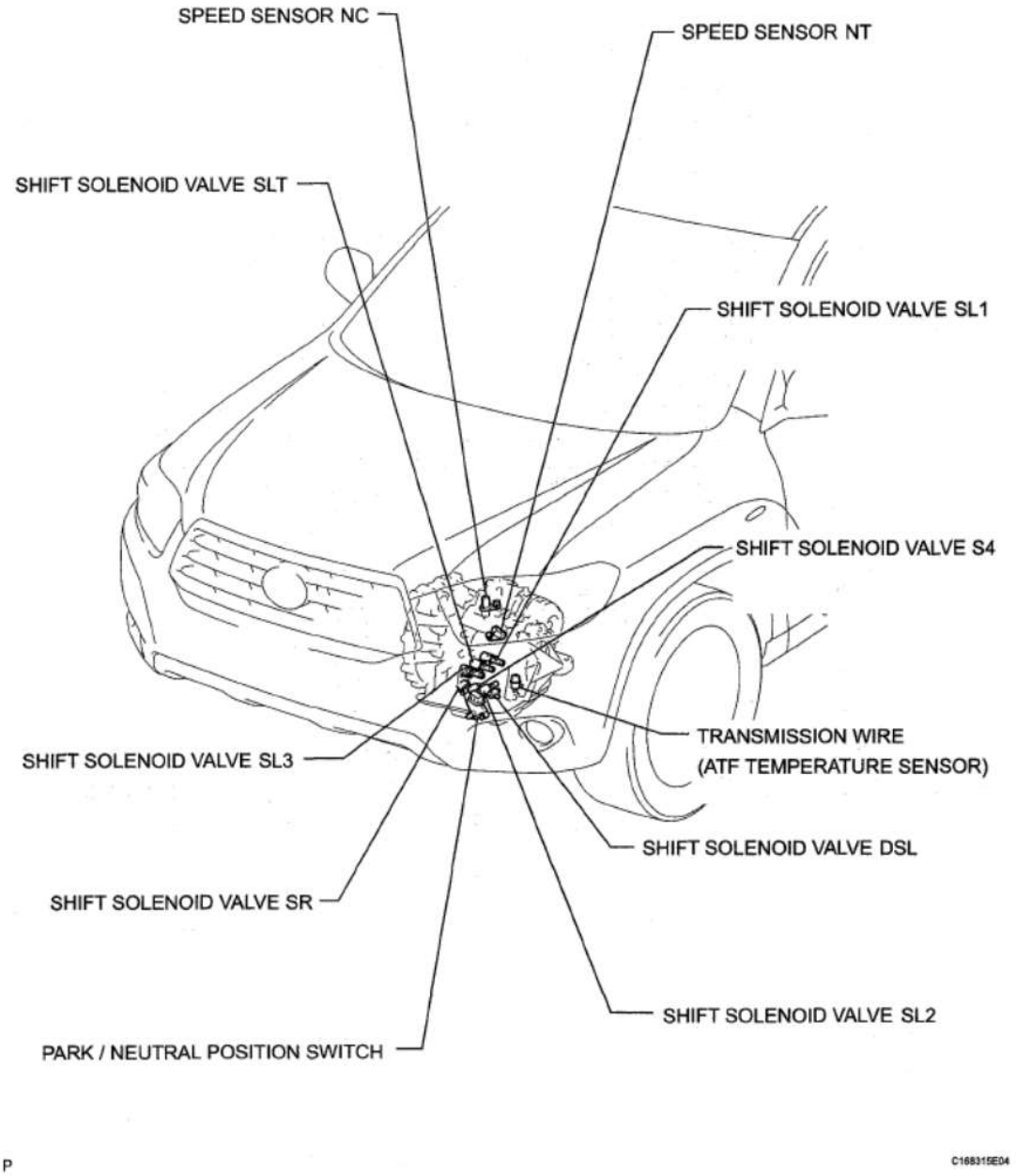
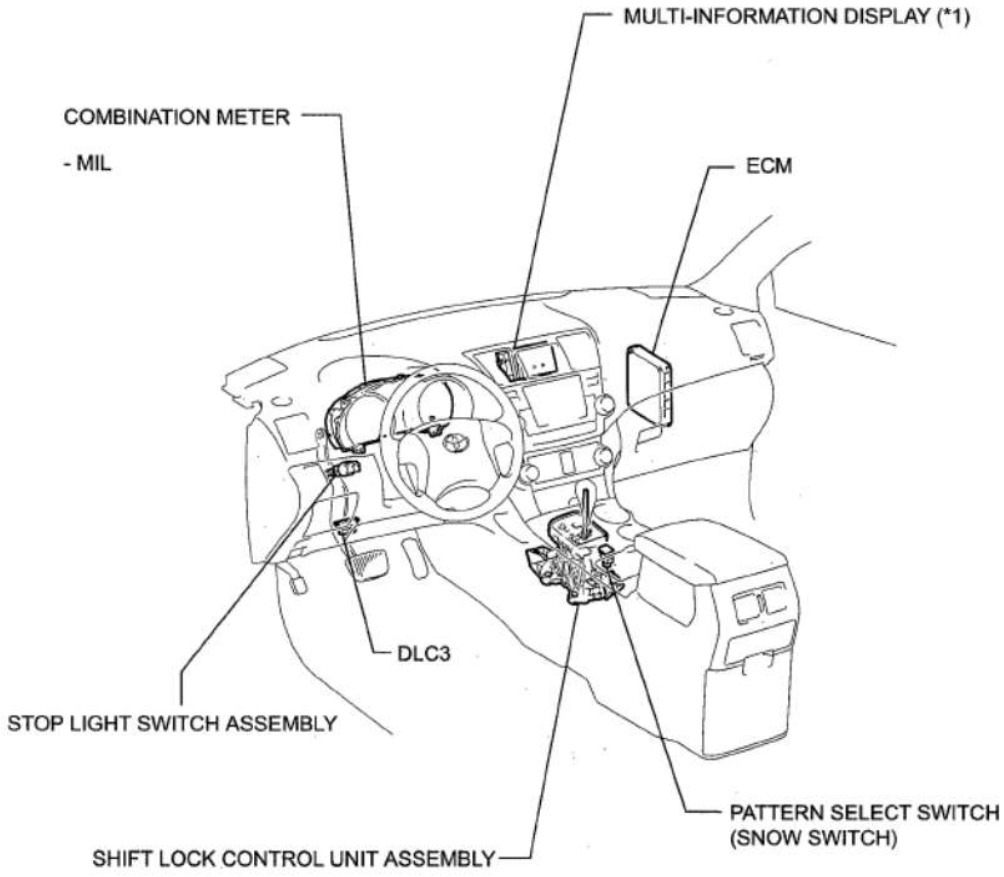


Fig. 1: Identifying Automatic Transaxle System Parts Location (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



*1: with MULTI-INFORMATION DISPLAY

P C166317E01

Fig. 2: Identifying Automatic Transaxle System Parts Location (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SYSTEM DIAGRAM

The configuration of the electronic control system in the U151E automatic transaxles is as shown in the following chart.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

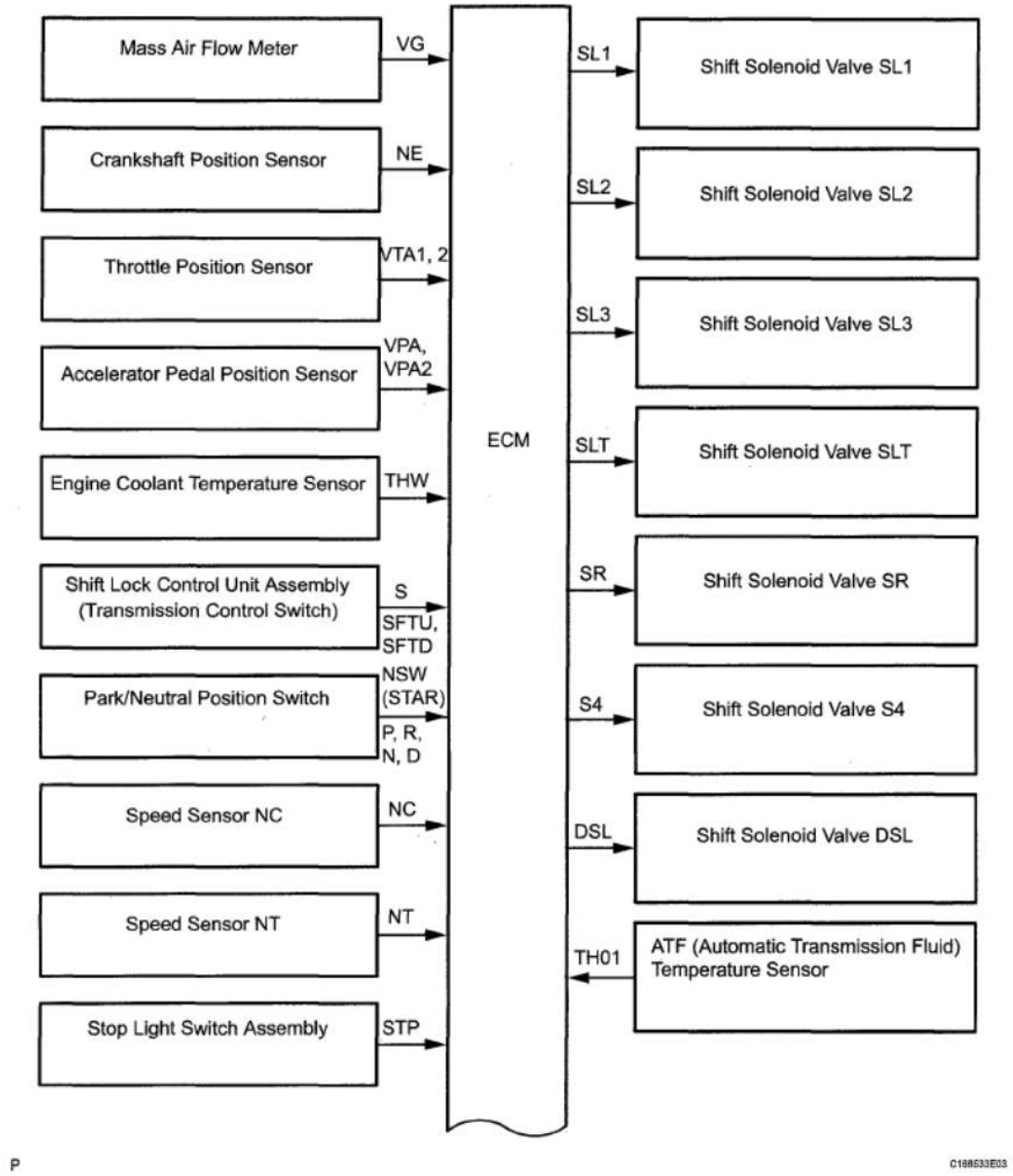


Fig. 3: Automatic Transaxle System Diagram (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

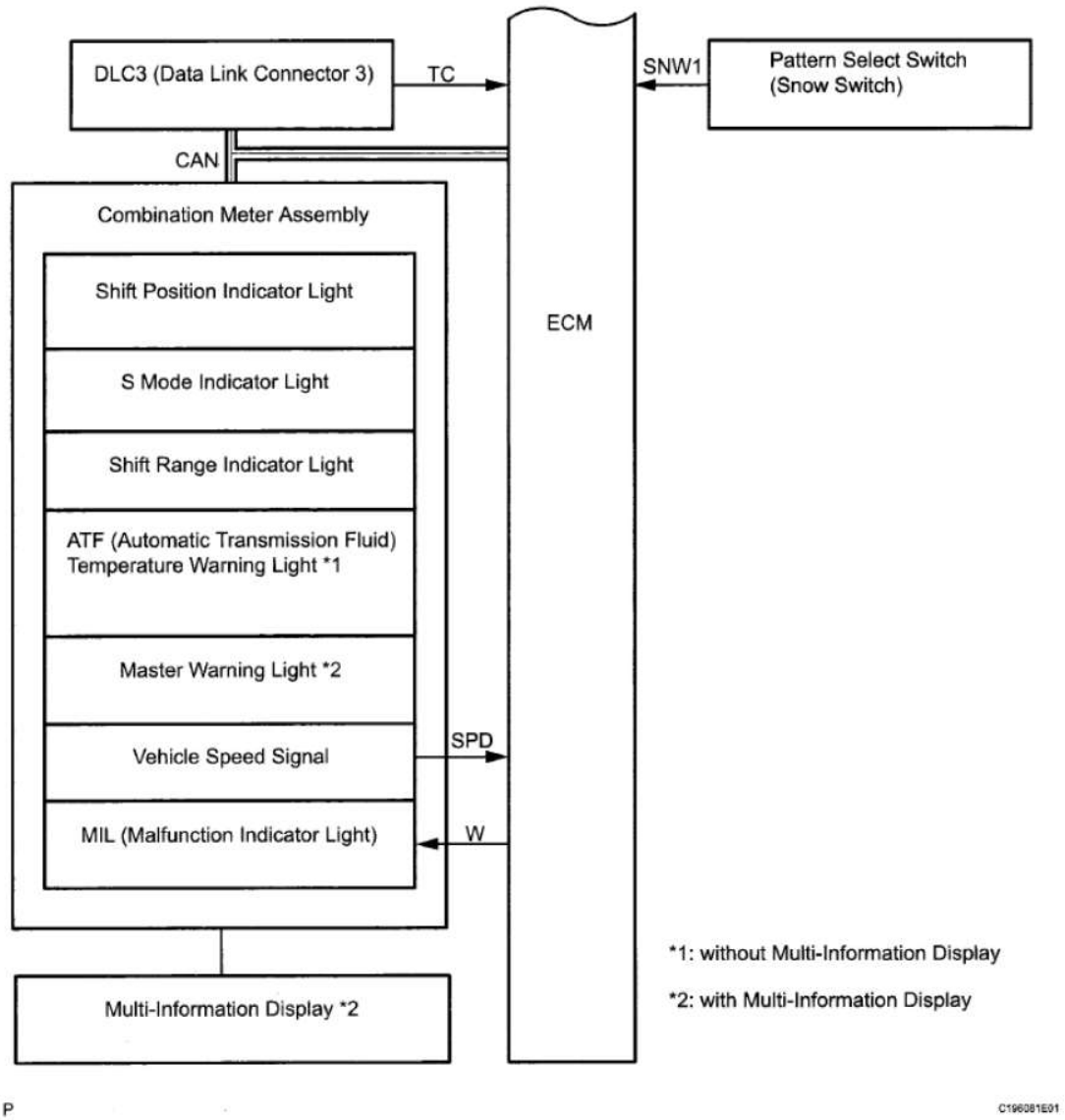


Fig. 4: Automatic Transaxle System Diagram (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SYSTEM DESCRIPTION

1. **SYSTEM DESCRIPTION**
   a. The ECT (Electronic controlled automatic transmission/transaxle) is an automatic transmission/transaxle that electronically controls shift timing using the ECM. The ECM detects electrical signals that indicate engine and driving conditions, and controls the shift point, based on driver habits and road conditions. As a result, fuel efficiency and power transmission performance are improved.

      Shift shock has been reduced by controlling the engine and transmission simultaneously.

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

In addition, the ECT has features such as follows:

- Diagnostic function
- Fail-safe function when a malfunction occurs

HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

- The ECM of this system is connected to the CAN and multiplex communication system. Therefore, before starting troubleshooting, make sure to check that there is no trouble in the CAN and multiplex communication systems.
- *: Use Techstream

1. **Vehicle Brought to Workshop**
2. **Customer Problem Analysis**
3. **Inspect Battery Voltage**

   Standard voltage: 11 to 14 V

   If the voltage is below 11V, recharge or replace the battery before proceeding.

4. **Connect Techstream to the DLC3***
5. **Check and Clear DTCs and Freeze Frame Data***

   HINT:

   (See **DTC CHECK/CLEAR**).

6. **Visual Inspection**
7. **Setting the Check Mode Diagnosis***

   HINT:

   (See **CHECK MODE PROCEDURE**).

8. **Problem Symptom Confirmation**

   HINT:

   (See **ROAD TEST**).

   Result

   RESULT REFERENCE

cardiagn.com

Result	Proceed to
Symptom does not occur	A
Symptom occurs	B

B: Go to step 10

A: Go to next step

9. **Symptom Simulation**

HINT:

(See **HOW TO PROCEED WITH TROUBLESHOOTING**).

10. **DTC Check***

HINT:

(See **DTC CHECK/CLEAR**).

Result

RESULT REFERENCE

Result	Proceed to
DTC is not output	A
DTC is output	B

B: Go to step 18

A: Go to next step

11. **Basic Inspection**

HINT:

(See **ON-VEHICLE INSPECTION** , **INSPECTION** and **ADJUSTMENT**).

NG: Go to step 21

OK: Go to next step

12. **Mechanical System Test**

HINT:

(See **MECHANICAL SYSTEM TESTS**).

cardiagn.com

NG: Go to step 17

OK: Go to next step

13. **Hydraulic Test**

HINT:

(See **HYDRAULIC TEST**).

NG: Go to step 17

OK: Go to next step

14. **Manual Shifting Test**

HINT:

(See **MANUAL SHIFTING TEST**).

NG: Go to step 16

OK: Go to next step

15. **Problem Symptoms Table Chapter 1**

HINT:

(See **PROBLEM SYMPTOMS TABLE**).

NG: Go to step 19

OK: Go to next step

16. **Problem Symptoms Table Chapter 2**

HINT:

(See **PROBLEM SYMPTOMS TABLE**).

17. **Part Inspection**

NEXT: Go to step 21

18. **DTC Chart**

HINT:

cardiagn.com

(See **DIAGNOSTIC TROUBLE CODE CHART**).

19. **Circuit Inspection**
20. **Identification of Problem**
21. **Repair or Replace**
22. **Confirmation Test**

NEXT: End

ROAD TEST

1. **PROBLEM SYMPTOM CONFIRMATION**
   a. Based on the result of the customer problem analysis, try to reproduce the symptoms. If the problem is that the transaxle does not shift up, shift down, or the shift point is too high or too low, conduct the following road test referring to the automatic shift schedule and simulate the problem symptoms.
2. **ROAD TEST**

NOTE: Perform the test at the ATF temperature 50 to 80°C (122 to 176°F) in the normal operation.

a. D position test:

Shift into the D position and fully depress the accelerator pedal and check the following points.

1. Check up-shift operation.

Check that 1 --> 2, 2 --> 3, 3 --> 4 and 4 --> 5th upshifts take place, and that the shift points conform to the automatic shift schedule (See **U151E AUTOMATIC TRANSAXLE**).

HINT:

5th Gear Up-shift Prohibition Control

- Coolant temperature is 70°C (158°F) or less and vehicle speed is at 80 km/h (50 mph) or less.
- ATF temperature is -2°C (28°F) or less.

4th Gear Up-shift Prohibition Control

- Coolant temperature is 70°C (158°F) or less and vehicle speed is at 55 km/h (34 mph) or less.

5th and 4th Gear Lock-up Prohibition Control

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

- Brake pedal is depressed.
- Accelerator pedal is released.
- Coolant temperature is 60°C (140°F) or less.

2. Check for shift shock and slip.

   Check for shock and slip at the 1 --> 2, 2 --> 3, 3 --> 4 and 4 --> 5th up-shifts.

3. Check for abnormal noise and vibration.

   Drive in the D position lock-up or 5th gear and check for abnormal noises and vibration.

   HINT:

   The check for the cause of abnormal noise and vibration must be done very thoroughly as it could also be due to loss of balance in the differential, torque converter clutch, etc.

4. Check kick-down operation.

   Check that the possible kick-down vehicle speed limits for 2nd to 1st, 3rd to 2nd, 4th to 3rd, 5th to 4th kick-downs conform to those indicated on the automatic shift schedule while driving through all gears with the shift lever in the D position (See **U151E AUTOMATIC TRANSAXLE**).

5. Check abnormal shock and slip at kick-down.
6. Check the lock-up mechanism.
   - Drive in D position (5th gear), at a steady speed (lock-up ON).
   - Lightly depress the accelerator pedal and check that the engine speed does not change abruptly.

   HINT:

   - There is no lock-up in the 1st, 2nd, and 3rd gear.
   - 3rd lock-up operates while uphill control is active.
   - If there is a big jump in engine speed, there is no lock-up.

b. S position test

   Shift to the S position, depress the accelerator pedal and check the following points:

   1. Check shift operation.
      - While driving in the D position and 5th gear, shift into the D position and S position and back to the D position. Check that the gear change 5 --> 4 down-shift and 4 --> 5 up-shift can be performed.
      - With the shift lever in the S position (with the vehicle stopped), shift into the "+" position to check that the shift position on the combination meter changes as follows :

cardiagn.com

1 --> 2, 2 --> 3, 3 --> 4 and 4 --> 5.

- While driving in the 4 (S) position and 4th gear (at a vehicle speed of about 40 to 50 km/h (25 to 31 mph)), shift into the "-" position and check if the 3rd gear down-shift occurs and the engine brake performs properly.
- While driving in the 3 (S) position and 3rd gear (at a vehicle speed of about 30 to 40 km/h (19 to 25 mph)), shift into the "-" position and check if the 2nd gear down-shift occurs and the engine brake performs properly.
- While driving in the 2 (S) position and 2nd gear (at a vehicle speed of about 20 to 30 km/h (12 to 19 mph)), shift into the "-" position and check if the 1st gear down-shift occurs and the engine brake performs properly.

HINT:

Manual shift (S position) prohibition control

- Down-shifting causes engine overrun.
- Down-shifting is required continuously. (Down-shifting to 1st gear may not be performed.)

c. R position test:

Shift into the R position, lightly depress the accelerator pedal, and check that the vehicle moves backward without any abnormal noise or vibration.

CAUTION: Before conducting this test ensure that the test area is free from people and obstruction.

d. P position test:

Stop the vehicle on a grade (more the 5°) and after shifting into the P position, release the parking brake. Then, check that the parking lock pawl holds the vehicle in place.

e. Uphill/downhill control function test:

1. Check that the gear does not up-shift to the 3rd to 4th or 4th to 5th gear while the vehicle is driving uphill.
2. Check that the gear automatically down-shifts from the 5th to 4th or from the 4th to 3rd gear when brake is applied while the vehicle is driving downhill.

MECHANICAL SYSTEM TESTS

1. PERFORM MECHANICAL SYSTEM TESTS

a. Measure the stall speed.

The object of this test is to check the overall performance of the transaxle and engine by measuring the stall speeds in the D position.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

NOTE:

- **Driving test should be done on a paved road (a nonskid road).**
- **Perform the test at the normal operating ATF (Automatic Transmission Fluid) temperature 50 to 80°C (122 to 176°F).**
- **Do not continuously run this test for longer than 10 seconds.**
- **To ensure safety, do this test in a wide, clear level area which provides good traction.**
- **The stall test should always be carried out in pairs. One technician should observe the conditions of wheels or wheel stoppers outside the vehicle while the other is doing the test.**

1. Chock the 4 wheels.
2. Connect Techstream to the DLC3.
3. Fully apply the parking brake.
4. Keep your left foot pressed firmly on the brake pedal.
5. Start the engine.
6. Shift into the D position. Press all the way down on the accelerator pedal with your right foot.
7. Quickly read the stall speed at this time.

Stall speed: 2180 +- 150 rpm

Evaluation:

PROBLEM SYMPTOMS

Problem	Possible cause
(a) Stall engine speed is low in D position	• Engine power output may be insufficient • Stator one-way clutch not operating properly HINT: If the value is less than the specified value by 600 rpm or more, the torque converter could be faulty.
(b) Stall engine speed is high in D position	• Line pressure is too low • Forward clutch slipping • U/D (Under drive) brake slipping • U/D (Under drive) one-way clutch is not operating properly • No.1 one-way clutch not operating properly • Improper fluid level

b. Measure the time lag.

cardiagn.com

1. When the shift lever is shifted while the engine is idling, there will be a certain time lapse or lag before the shock can be felt. This is used for checking the condition of the clutch and brake.

NOTE:

- **Perform the test at the normal operating ATF (Automatic Transmission Fluid) temperature: 50 to 80°C (122 to 176°F).**
- **Be sure to allow 1 minute interval between tests.**
- **Perform the test three times, and measure the time lags. Calculate the average value of the three time lags.**

2. Connect Techstream to the DLC3.
3. Fully apply the parking brake.
4. Start and warm up the engine and check idle speed.

   Idle speed: approx. 700 rpm (In N position and A/C OFF)

5. Shift the lever from N to D position. Using a stop watch, measure the time from when the lever is shifted until the shock is felt.

   Time lag: N --> D less than 1.2 seconds

6. In the same way, measure the time lag for N --> R.

   Time lag: N --> R less than 1.5 seconds

   Evaluation (If N --> D or N --> R time lag is longer than the specified):

PROBLEM SYMPTOMS

Problem	Possible cause
N --> D time lag is longer	• Line pressure is too low • Forward clutch worn • No.1 one-way clutch is not operating properly • U/D (Under drive) one-way clutch is not operating • U/D (Under drive) brake worn
N --> R time lag is longer	• Line pressure is too low • Reverse clutch worn • 1st and reverse brake worn • U/D (Under drive) brake worn

HYDRAULIC TEST

1. **PERFORM HYDRAULIC TEST**

cardiagn.com

a. Measure the line pressure.

NOTE:

- **Perform the test at the normal operating ATF (Automatic Transmission Fluid) temperature: 50 to 80°C (122 to 176°F).**
- **The line pressure test should always be carried out in pairs. One technician should observe the conditions of wheels or wheel stoppers outside the vehicle while the other is performing the test.**
- **Be careful to prevent SST hose from interfering with the exhaust pipe.**
- **This Check must be conducted after checking and adjusting engine.**
- **Perform under condition that A/C is OFF.**
- **When conducting stall test, do not continue more than 10 seconds.**

1. Warm up the ATF (Automatic Transmission Fluid).
2. Lift the vehicle up.
3. Remove the engine under cover.
4. Connect Techstream to the DLC3.
5. Remove the test plug A on the transaxle case front left side and install the SST.

SST 09992-00095 (09992-00231, 09992-00271)

NOTE: **There is a difference in installation point between D position and R position.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

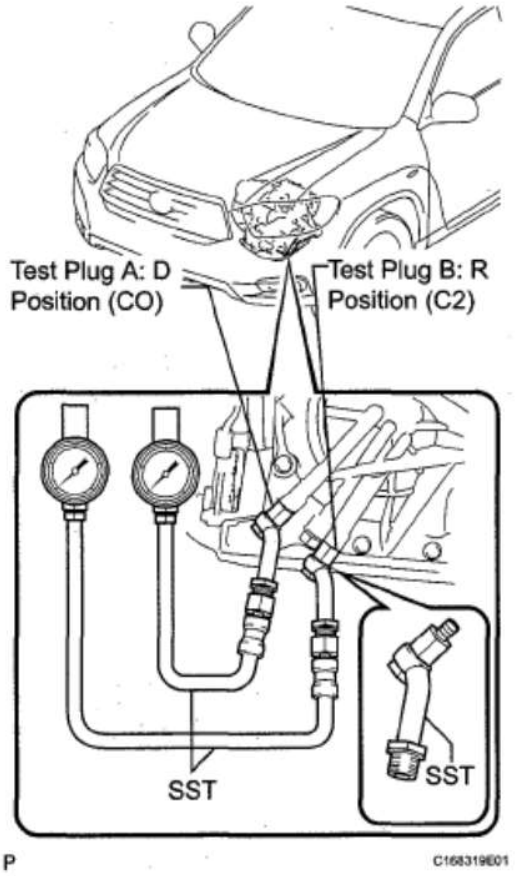


Fig. 5: Measuring Line Pressure
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Start the engine.
7. Using Techstream, shift to D position and hold 3rd gear by active test, and measure the line pressure in idling.

Specified line pressure:

LINE PRESSURE SPECIFICATION

Condition	D position kPa (kgf/cm^2 , psi)
Idling	372 to 412kPa (3.8 to 4.2 kgf/cm^2 , 54 to 60 psi)

8. Turn the ignition switch off.
9. Disconnect the connector of the transmission wire.

HINT:

Disconnect the connector only when performing the D position stall test.

cardiagn.com

10. Start the engine.
11. Firmly depress the brake pedal, shift to the D position, depress the accelerator pedal all the way down and check the line pressure while the stall test is performed.

Specified line pressure:

LINE PRESSURE SPECIFICATION

Condition	D position kPa (kgf/cm^2 , psi)
Stall test	931 to 1031 kPa (9.5 to 10.5 kgf/cm^2 , 135 to 150 psi)

12. Turn the ignition switch off.
13. Remove the SST, install the test plug A.
14. Remove the test plug B, install the SST and start engine.

SST 09992-00095 (09992-00231, 09992-00271)

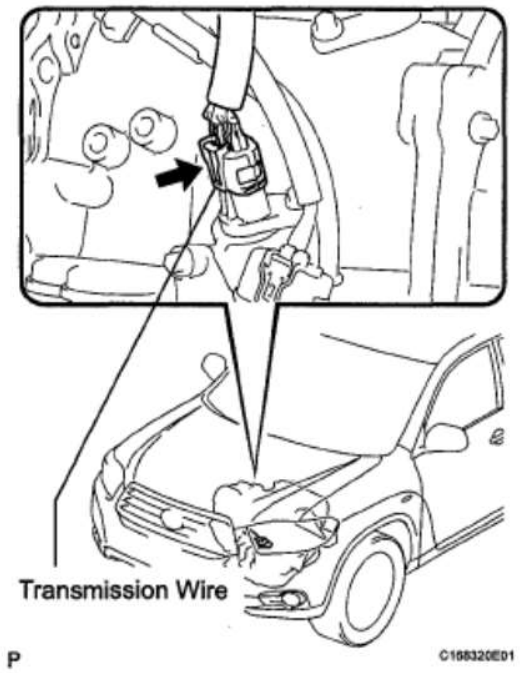


Fig. 6: Locating Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. Connect the transmission wire connector, depress the brake pedal firmly, shift to the R position and check that the line pressure while the engine is idling and during the stall test.

Specified line pressure:

LINE PRESSURE SPECIFICATION

cardiagn.com

Condition	R position kPa (kgf/cm^2 , psi)
Idling	672 to 742 kPa (6.9 to 7.6 kgf/cm^2 , 97 to 108 psi)
Stall test	1768 to 1968 kPa (18.0 to 20.1 kgf/cm^2 , 256 to 285 psi)

16. Remove the SST, install the test plug B.
17. Clear the DTC.

Evaluation:

PROBLEM SYMPTOMS

Problem	Possible cause
Measured values are higher than specified in all positions	• Shift solenoid valve (SLT) defective • Regulator valve defective
Measured values are lower than specified in all positions	• Shift solenoid valve (SLT) defective • Regulator valve defective • Oil pump defective • U/D (Under drive) direct clutch defective
Pressure is low in the D position only	• D position circuit fluid leak • Forward clutch defective
Pressure is low in the R position only	• R position circuit fluid leak • Reverse clutch defective • 1st and reverse brake defective

MANUAL SHIFTING TEST

1. **PERFORM MANUAL SHIFTING TEST**

HINT:

- With this test, it can be determined whether the trouble occurs in the electrical circuit or is a mechanical problem in the transaxle.
- If any abnormalities are found in the following test, the problem is in the transaxle itself.

a. Disconnect the connector of the transmission wire.
b. Drive with the transmission wire disconnected. Shifting the shift lever to the D position to check whether the shifting condition changes the table below.

SHIFT POSITION

Shift Position	Shifting Condition

cardiagn.com

D	No Shift (Not Change)

HINT:

When driving with the transmission wire disconnected, the shift lever position is in D, the gear position is held in 4th. However, when the shift position is in R or P, the operation is same as usual.

c. Connect the connector of the transmission wire.
d. Clear the DTC.

INITIALIZATION

1. **RESET MEMORY**

NOTE:

- **Perform the RESET MEMORY (AT initialization) when replacing the automatic transaxle assembly, engine assembly or ECM.**
- **The RESET MEMORY can be performed only with Techstream.**

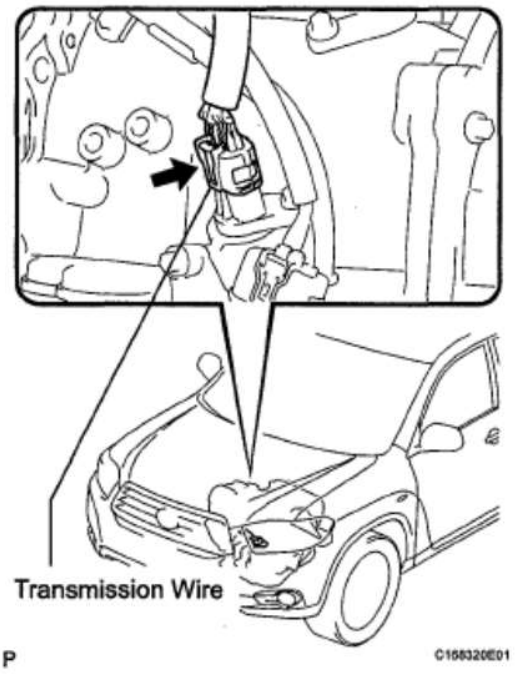


Fig. 7: Locating Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

The ECM memorizes the condition that the ECT controls the automatic transaxle assembly and engine assembly according to those characteristics. Therefore, when the automatic transaxle assembly, engine assembly, or ECM has been replaced, it is necessary to reset the memory so that the ECM can memorize

cardiagn.com

the new information. Reset procedure is as follows.

a. Turn the ignition switch off.
b. Connect Techstream to the DLC3.
c. Turn the ignition switch on (IG) and push the Techstream main switch on.
d. Enter the following menu: Powertrain/Engine and ECT/Utility/Reset Memory. Then, press "Next".
e. Perform the reset memory procedure from the main menu.

CAUTION: After performing the RESET MEMORY, be sure to perform the ROAD TEST (See ROAD TEST) described earlier.

HINT:

The ECM is learned by performing the ROAD TEST.

MONITOR DRIVE PATTERN

1. **MONITOR DRIVE PATTERN FOR ECT TEST**
   a. Perform this drive pattern as one method to simulate the detection conditions of the ECT malfunctions. (The DTCs may not be detected due the actual driving conditions. And some codes may not be detected through this drive pattern.)

   HINT:

   Preparation for driving

   - Warm up the engine sufficiently. (Engine coolant temperature is 60°C (140°F) or higher)
   - Drive the vehicle when the atmospheric temperature is -10°C (14°F) or higher. (Malfunction is not detected when the atmospheric temperature is less than -10°C (14°F))

   Driving note

   - Drive the vehicle through all gears.

     Stop --> 1st --> 2nd --> 3rd --> 4th --> 5th --> 5th (lock-up ON).

   - Perform engine brake test in the S position. While driving in the 5 (S) position and 5th gear lock-up, shift into the "-" position and down-shift from 5th to 4th, 4th to 3rd, 3rd to 2nd, 2nd to 1st. Check that the engine brake performs properly whenever down-shift takes place.
   - Repeat the above driving pattern three times or more.

   NOTE:

   - **The monitor status can be checked using Techstream. When using Techstream, monitor status can be found in the "Powertrain/Engine and ECT/Data List".**

cardiagn.com

- **In the event that the drive pattern must be interrupted (possibly due to traffic conditions or other factors), the drive pattern can be resumed and, in most cases, the monitor can be completed.**
- **Perform this drive pattern on a level road as much as possible and strictly observe the posted speed limits and traffic laws while driving.**

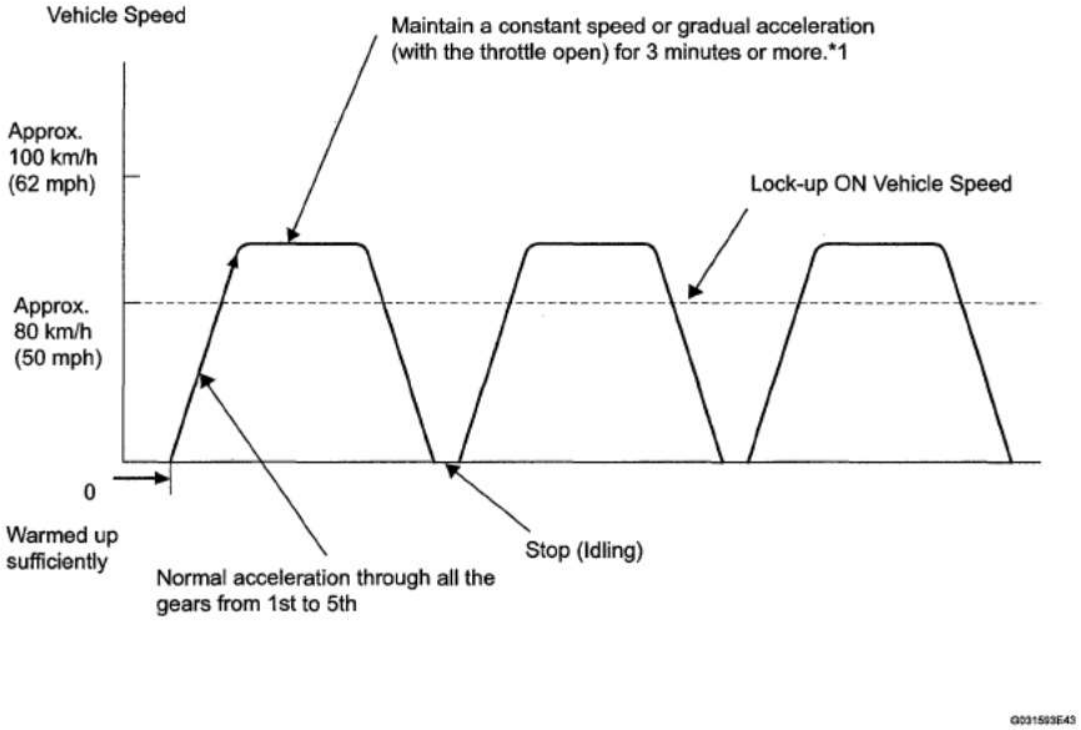


Fig. 8: Monitor Drive Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

*1: Drive at such a speed in the uppermost gear, to engage lock-up. The vehicle can be driven at a speed lower than that in the above diagram under the lock-up condition.

NOTE: If necessary to drive the vehicle for approximately 30 minutes to detect DTC P0711 (ATF temperature sensor malfunction).

PROBLEM SYMPTOMS TABLE

HINT:

- If a normal code is displayed during the diagnostic trouble code check although the trouble still occurs, check the electrical circuits for each symptom in the order given in the charts on the following pages and

cardiagn.com

proceed to the page given for troubleshooting.

- The Matrix Chart is divided into 2 chapters.
- When the circuit on which mark *1 is attached is a malfunction, DTC could be output.

Chapter 1:

Refer to the table below when the trouble cause is considered to be electrical. If the instruction PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE is given in the flowchart of each circuit, inspect the suspected areas in descending order for each symptom. If the trouble still occurs even though there are no abnormalities in the inspections listed for the symptoms, check and replace the ECM.

1. **Chapter 1: Electronic Circuit Matrix Chart**

ELECTRONIC CIRCUIT MATRIX CHART

Symptom	Suspected Area	Refer to
No down-shift (A particular gear, from 1st to 4th gear, is not down-shifted)	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No down-shift (5th -> 4th)	Park/neutral position switch circuit *1	**DTC P0705 TRANSMISSION RANGE SENSOR CIRCUIT MALFUNCTION (PRNDL INPUT)**
	Shift solenoid valve (S4) circuit *1	**DTC P0982 SHIFT SOLENOID "D" CONTROL CIRCUIT LOW (SHIFT SOLENOID VALVE S4); DTC P0983 SHIFT SOLENOID "D" CONTROL CIRCUIT HIGH (SHIFT SOLENOID VALVE S4)**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No up-shift (A particular gear, from 1st to 4th gear, is not up-shifted)	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No up-shift (4th -> 5th)	Park/neutral position switch circuit *1	**DTC P0705 TRANSMISSION RANGE SENSOR CIRCUIT MALFUNCTION (PRNDL INPUT)**
	Shift solenoid valve (S4) circuit *1	**DTC P0982 SHIFT SOLENOID "D" CONTROL CIRCUIT LOW (SHIFT SOLENOID VALVE S4); DTC P0983 SHIFT SOLENOID "D" CONTROL CIRCUIT HIGH (SHIFT SOLENOID VALVE S4)**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No lock-up	Stop light switch circuit *1	**DTC P0724 BRAKE SWITCH "B" CIRCUIT HIGH**
	Engine coolant temp, sensor circuit *1	**DATA LIST/ACTIVE TEST**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No lock-up off	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Shift point too high or too low	Throttle position sensor circuit *1	**DATA LIST/ACTIVE TEST**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Up-shift to 5th from 4th while engine is cold	Engine coolant temp, sensor circuit *1	**DATA LIST/ACTIVE TEST**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No gear change by shifting into "+" or "-" while the shifting lever is in the S position	Transmission control switch circuit	**TRANSMISSION CONTROL SWITCH CIRCUIT**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Harsh engagement (N -> D)	Shift solenoid valve (SL1) circuit *1	**DTC P0748 PRESSURE CONTROL SOLENOID "A" ELECTRICAL (SHIFT SOLENOID VALVE SL1)**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Harsh engagement (Lock-up)	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Harsh engagement (Any driving position)	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Poor acceleration	Pattern select switch circuit (ECT SNOW switch)	**PATTERN SELECT SWITCH CIRCUIT**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
No kick-down	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
Engine stalls when starting off or stopping	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
ECT SNOW does not operate	Pattern select switch circuit (ECT SNOW switch)	**PATTERN SELECT SWITCH CIRCUIT**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
	Park/neutral position switch circuit *1	**DTC P0705 TRANSMISSION RANGE SENSOR CIRCUIT MALFUNCTION (PRNDL INPUT)**
	Transmission	

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Malfunction in shifting	control switch circuit	**TRANSMISSION CONTROL SWITCH CIRCUIT**
	ECM	**ELECTRONIC CIRCUIT INSPECTION PROCEDURE**
HINT: *1: When the circuit on which mark *1 is detective, a DTC may be output.		

2. **Chapter 2: On-Vehicle Repair and Off-Vehicle Repair**

ON-VEHICLE REPAIR AND OFF-VEHICLE REPAIR

Symptom	Suspected Area	Refer to
Vehicle does not move in any forward position and in reverse positions	Valve body assembly	**VALVE BODY ASSEMBLY**
	U/D brake (B3)	**AUTOMATIC TRANSAXLE UNIT**
	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**
Vehicle does not move in R position	Valve body assembly	**VALVE BODY ASSEMBLY**
	Reverse clutch (C2)	**AUTOMATIC TRANSAXLE UNIT**
	1st and reverse brake (B2)	**AUTOMATIC TRANSAXLE UNIT**
No up-shift (1st->2nd)	Valve body assembly	**VALVE BODY ASSEMBLY**
	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
No up-shift (2nd -> 3rd)	Valve body assembly	**VALVE BODY ASSEMBLY**
	Direct and O/D clutch (CO)	**AUTOMATIC TRANSAXLE UNIT**
No up-shift (3rd -> 4th)	Valve body assembly	**VALVE BODY ASSEMBLY**
	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
No up-shift (4th -> 5th)	Shift solenoid valve (S4)	**DTC P0766 SHIFT SOLENOID "D" PERFORMANCE (SHIFT SOLENOID VALVE S4)**
	Valve body assembly	**VALVE BODY ASSEMBLY**
	U/D clutch (C3)	**AUTOMATIC TRANSAXLE UNIT**
No down-shift (5th -> 4th)	Shift solenoid (S4)	**DTC P0766 SHIFT SOLENOID "D" PERFORMANCE (SHIFT SOLENOID VALVE S4)**
	Valve body	**VALVE BODY ASSEMBLY**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	assembly	
No down-shift (4th -> 3rd)	Valve body assembly	**VALVE BODY ASSEMBLY**
No down-shift (3rd -> 2nd)	Valve body assembly	**VALVE BODY ASSEMBLY**
No down-shift (2nd -> 1st)	Valve body assembly	**VALVE BODY ASSEMBLY**
No lock-up or No lock-up off	Shift solenoid valve (DSL)	**DTC P0741 TORQUE CONVERTER CLUTCH SOLENOID PERFORMANCE (SHIFT SOLENOID VALVE DSL)**
	Valve body assembly	**VALVE BODY ASSEMBLY**
	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**
Harsh engagement (N -> D)	Shift solenoid valve (SL1)	**DTC P0746 PRESSURE CONTROL SOLENOID "A" PERFORMANCE (SHIFT SOLENOID VALVE SL1)**
	Valve body assembly	**VALVE BODY ASSEMBLY**
	C1 accumulator	**AUTOMATIC TRANSAXLE UNIT**
	Forward clutch (C1)	**AUTOMATIC TRANSAXLE UNIT**
	No.1 one-way clutch (F1)	**AUTOMATIC TRANSAXLE UNIT**
	U/D one-way clutch (F2)	**AUTOMATIC TRANSAXLE UNIT**
Harsh engagement (Lock-up)	Shift solenoid valve (SL2)	**DTC P0776 PRESSURE CONTROL SOLENOID "B" PERFORMANCE (SHIFT SOLENOID VALVE SL2)**
	Valve body assembly	**VALVE BODY ASSEMBLY**
	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**
Harsh engagement (N -> R)	Valve body assembly	**VALVE BODY ASSEMBLY**
	C2 accumulator	**AUTOMATIC TRANSAXLE UNIT**
	Reverse clutch (C2)	**AUTOMATIC TRANSAXLE UNIT**
	1st and reverse brake (B2)	**AUTOMATIC TRANSAXLE UNIT**
Harsh engagement (1st -> 2nd -> 3rd -> 4th -> 5th)	Shift solenoid valve (SLT)	**DTC P2716 PRESSURE CONTROL SOLENOID "D" ELECTRICAL (SHIFT SOLENOID VALVE SLT)**
	Valve body	**VALVE BODY ASSEMBLY**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	assembly	
Harsh engagement (1st -> 2nd)	Valve body assembly	**VALVE BODY ASSEMBLY**
	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
Harsh engagement (2nd -> 3rd)	Valve body assembly	**VALVE BODY ASSEMBLY**
	CO accumulator	**AUTOMATIC TRANSAXLE UNIT**
	Direct and O/D clutch (CO)	**AUTOMATIC TRANSAXLE UNIT**
Harsh engagement (3rd -> 4th)	Valve body assembly	**VALVE BODY ASSEMBLY**
	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
Harsh engagement (4th -> 5th)	Valve body assembly	**VALVE BODY ASSEMBLY**
	C3 accumulator	**AUTOMATIC TRANSAXLE UNIT**
	U/D clutch (C3)	**AUTOMATIC TRANSAXLE UNIT**
Harsh engagement (5th -> 4th)	Valve body assembly	**VALVE BODY ASSEMBLY**
	B3 accumulator	**AUTOMATIC TRANSAXLE UNIT**
Slip or shudder (Forward and reverse: After warm-up)	Valve body assembly	**VALVE BODY ASSEMBLY**
	Oil strainer	**VALVE BODY ASSEMBLY**
	Direct and O/D clutch (CO)	**AUTOMATIC TRANSAXLE UNIT**
	Forward clutch (C1)	**AUTOMATIC TRANSAXLE UNIT**
	U/D clutch (C3)	**AUTOMATIC TRANSAXLE UNIT**
	2nd and brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
	U/D brake (B3)	**AUTOMATIC TRANSAXLE UNIT**
	No.1 one-way clutch (F1)	**AUTOMATIC TRANSAXLE UNIT**
	U/D one-way clutch (F2)	**AUTOMATIC TRANSAXLE UNIT**
	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**
Slip or shudder (Particular position: Just after engine starts)	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**
Slip or shudder (R position)	Reverse clutch (C2)	**AUTOMATIC TRANSAXLE UNIT**
	1st and reverse	

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	brake (B2)	**AUTOMATIC TRANSAXLE UNIT**
Slip or shudder (1st)	Forward clutch (C1)	**AUTOMATIC TRANSAXLE UNIT**
	No.1 one-way clutch (F1)	**AUTOMATIC TRANSAXLE UNIT**
	U/D one-way clutch (F2)	**AUTOMATIC TRANSAXLE UNIT**
Slip or shudder (2nd)	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
Slip or shudder (3rd)	Direct and O/D clutch (CO)	**AUTOMATIC TRANSAXLE UNIT**
Slip or shudder (4th)	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
Slip or shudder (5th)	U/D clutch (C3)	**AUTOMATIC TRANSAXLE UNIT**
Shift position too high or too low	Shift solenoid valve (SLT)	**DTC P2716 PRESSURE CONTROL SOLENOID "D" ELECTRICAL (SHIFT SOLENOID VALVE SLT)**
No engine braking (1st +- 4th: D position)	U/D brake (B3)	**AUTOMATIC TRANSAXLE UNIT**
No engine braking (1st: L (1) position)	Valve body assembly	**VALVE BODY ASSEMBLY**
	1st and reverse brake (B2)	**AUTOMATIC TRANSAXLE UNIT**
No engine braking (2nd: 2 position)	Valve body assembly	**VALVE BODY ASSEMBLY**
	2nd and O/D brake (B1)	**AUTOMATIC TRANSAXLE UNIT**
No engine braking (3rd: 3 position)	U/D brake (B3)	**AUTOMATIC TRANSAXLE UNIT**
No kick-down	Valve body assembly	**VALVE BODY ASSEMBLY**
Poor acceleration (All positions)	Shift solenoid valve (SLT)	**DTC P2716 PRESSURE CONTROL SOLENOID "D" ELECTRICAL (SHIFT SOLENOID VALVE SLT)**
	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**
Poor acceleration (5th)	U/D clutch (C3)	**AUTOMATIC TRANSAXLE UNIT**
	U/D planetary gear unit	**AUTOMATIC TRANSAXLE UNIT**
Engine stalls when starting off or stopping	Shift solenoid valve DSL)	**DTC P0741 TORQUE CONVERTER CLUTCH SOLENOID PERFORMANCE (SHIFT SOLENOID VALVE DSL)**
	Torque converter clutch	**TORQUE CONVERTER CLUTCH AND DRIVE PLATE**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TERMINALS OF ECM

1. **ECM**

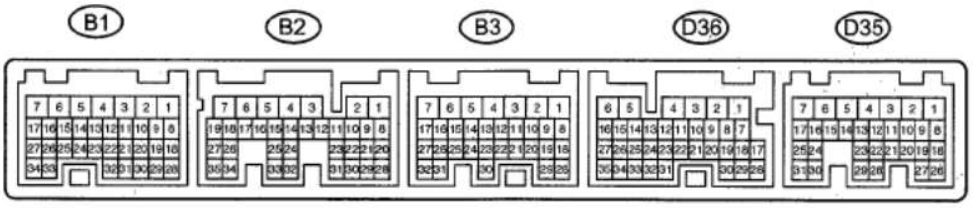


Fig. 9: Identifying Terminals Of ECM
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Each ECM terminal's standard voltage is shown in the table below.

In the table, first follow the information under "Condition". Look under "Terminal No. (Symbols)" for the terminals to inspected. The standard voltage between the terminals is shown under "Specified Condition".

Use the illustration above as a reference for the ECM terminals.

CONNECTOR TERMINAL REFERENCE

Terminals No. (Symbols)	Wiring Color	Terminal Description	Condition	Specified Condition
D36-21 (D) - B3-1 (E1)	BR - W-B	D shift position switch signal	Ignition switch on (IG) and shift lever D and S position	11 to 14 V
			Ignition switch on (IG) and shift lever except D and S position	Below 1 V
D36-11 (R) - B3-1 (E1)	G - W-B	R shift position switch signal	Ignition switch on (IG) and shift lever R position	11 to 14 V
			Ignition switch on (IG) and shift lever except R position	Below 1 V
D36-8 (SPD) - B3-1 (E1)	LG - W-B	Speed signal	Vehicle speed 20 km/h (12 mph)	Pulse generation (See waveform 8 g)
D35-15 (STP) - B3-1 (E1)	R - W-B	Stop light switch signal	Brake pedal is depressed	7.5 to 14 V
			Brake pedal is released	Below 1.5 V
D36-5 (SFTD) - B3-1 (E1)	BR - W-B	Down shift switch signal	Ignition switch on (IG) and shift lever S position	11 to 14 V
			Ignition switch on (IG) and shift lever "-" position (Down shift)	Below 1 V
D36-6 (SFTU) -		Up shift switch	Ignition switch on (IG) and shift lever S position	11 to 14 V

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

B3-1 (E1)	V - W-B	signal	Ignition switch on (IG) and shift lever "+" position (Up shift)	Below 1 V
D36-20 (S) - B3-1 (E1)	SB - W-B	S shift position switch signal	Ignition switch on (IG) and shift lever S position	11 to 14 V
			Ignition switch on (IG) and shift lever except S position	Below 1 V
D36-23 (P) - B3-1 (E1)	LG - W-B	Park position switch signal	Ignition switch on (IG) and shift lever P position	11 to 14 V
			Ignition switch on (IG) and shift lever except P position	Below 1 V
D36-22 (N) - B3-1 (E1)	R - W-B	Neutral position switch signal	Ignition switch on (IG) and shift lever N position	11 to 14 V
			Ignition switch on (IG) and shift lever except N position	Below 1 V
B2-8 (NSW (STAR)) - B3-1 (E1)	GR - W-B	Park neutral switch signal	Ignition switch on (IG) and shift lever P and N position	Below 1 V
			Ignition switch on (IG) and shift lever except P and N position	11 to 14 V
B2-11 (DSL) - B3-1 (E1)	B - W-B	DSL solenoid signal	Vehicle speed 65 km/h (40 mph), lock-up (ON to OFF)	Pulse generation (See waveform 2 a)
B2-9 (SR) - B3-1 (E1)	Y - W-B	SR solenoid signal	Ignition switch on (IG)	Below 1 V
			3rd, 4th or 5th gear	11 to 14 V
			1st or 2nd gear	Below 1 V
B2-10 (S4) - B3-1 (E1)	L - W-B	S4 solenoid signal	Ignition switch on (IG)	Below 1 V
			5th gear	11 to 14 V
			Except 5th gear	Below 1 V
B2-17 (SL3+) - B2-16 (SL3-)	W - G	SL3 solenoid signal	Engine idle speed	Pulse generation (See waveform 3 b)
B2-15 (SL2+) - B2-14 (SL2-)	Y - L	SL2 solenoid signal	Engine idle speed	Pulse generation (See waveform 4 c)
B2-19 (SL1+) - B2-18 (SL1-)	G - GR	SL1 solenoid signal	Engine idle speed	Pulse generation (See waveform 5 d)
B2-34 (NC+) - B2-26 (NC-)	R - BR	Speed sensor (NC) signal	Vehicle speed 30 km/h (19 mph): (3rd gear) Engine speed 1400 rpm	Pulse generation (See waveform 6 e)
B2-35 (NT+) - B2-27 (NT-)	W - L	Speed sensor (NT) signal	Vehicle speed 20 km/h (12 mph)	Pulse generation (See waveform 7 f)
B2-13 (SLT+) - B2-12 (SLT-)	R - G	SLT solenoid signal	Engine idle speed	Pulse generation (See waveform 1)
B2-24 (THO1) -	P - BR	ATF temperature	ATF temperature: 115°C (239°F) or	Below 1.5 V

cardiagn.com

B1-28 (E2)		sensor signal	more	
D36-27 (SNW1) - B3-1 (E1)	V - W-B	ECT SNOW switch signal	Ignition switch on (IG)	11 to 14 V
			Ignition switch on (IG) and press continuously pattern select switch (ect snow switch)	Below 1 V

a. Waveform 1

Reference:

WAVEFORM REFERENCE

Terminal	SLT+ - SLT-
Tool setting	5 V/DIV, 1 ms/DIV
Vehicle condition	Engine idle speed

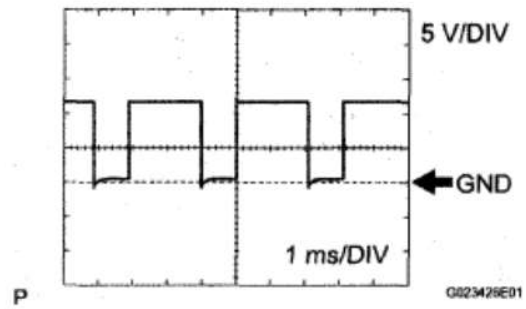


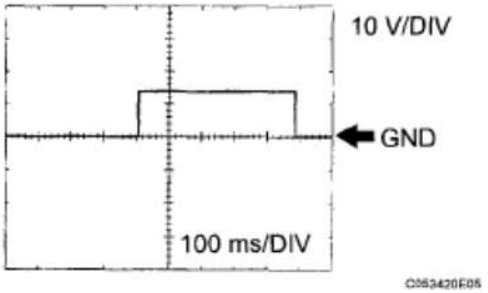
Fig. 10: Waveform Graph 1
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Waveform 2

Reference:

WAVEFORM REFERENCE

Terminal	DSL - E1
Tool setting	10 V/DIV, 100 ms/DIV
Vehicle condition	Vehicle speed 65 km/h (40 mph), lock-up (ON to OFF)



cardiagn.com

Fig. 11: Waveform Graph 2
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Waveform 3

Reference:

WAVEFORM REFERENCE

Terminal	SL3+ - SL3-
Tool setting	5 V/DIV, 1 ms/DIV
Vehicle condition	Engine idle speed

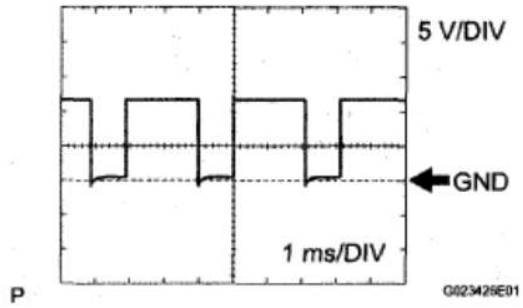


Fig. 12: Waveform Graph 3
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Waveform 4

Reference:

WAVEFORM REFERENCE

Terminal	SL2+ - SL2-
Tool setting	5 V/DIV, 1 ms/DIV
Vehicle condition	Engine idle speed

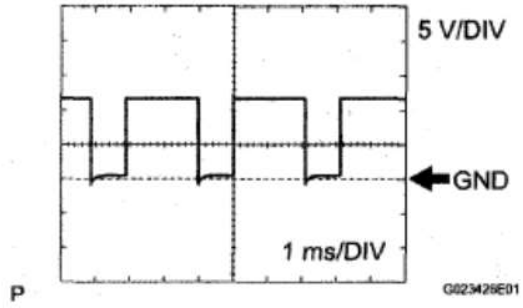


Fig. 13: Waveform Graph 4
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

e. Waveform 5

Reference:

WAVEFORM REFERENCE

Terminal	SL1+ - SL1-
Tool setting	5 V/DIV, 1 ms/DIV
Vehicle condition	Engine idle speed

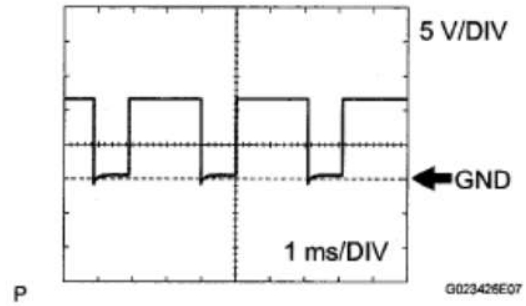


Fig. 14: Waveform Graph 5
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Waveform 6

Reference:

WAVEFORM REFERENCE

Terminal	NC+ - NC-
Tool setting	1 V/DIV, 1 ms/DIV
Vehicle condition	Vehicle speed 30 km/h (19 mph): (3rd gear) Engine speed 1400 rpm

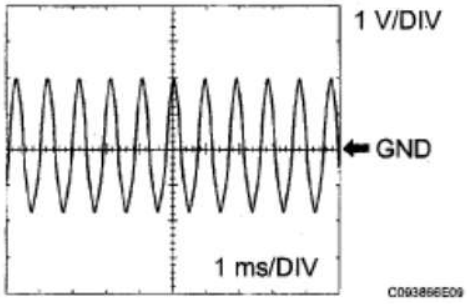


Fig. 15: Waveform Graph 6
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Waveform 7

cardiagn.com

Reference:

WAVEFORM REFERENCE

Terminal	NT+ - NT-
Tool setting	5 V/DIV, 0.5 ms/DIV
Vehicle condition	Vehicle speed 20 km/h (12 mph)

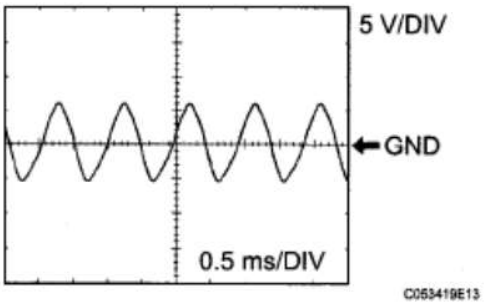


Fig. 16: Waveform Graph 7
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Waveform 8

Reference:

WAVEFORM REFERENCE

Terminal	SPD - E1
Tool setting	5 V/DIV, 20 ms/DIV
Vehicle condition	Vehicle speed 20 km/h (12 mph)

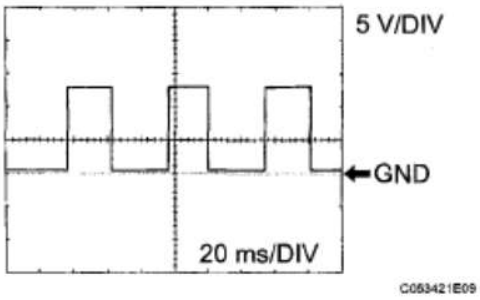


Fig. 17: Waveform Graph 8
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DIAGNOSIS SYSTEM

1. DESCRIPTION

a. When troubleshooting OBD II vehicles, the only difference from the usual troubleshooting procedure is to connect Techstream to the vehicle, and read off various data output from the

cardiagn.com

vehicle's ECM.

b. OBD II regulations require that the vehicle's onboard computer illuminate the Malfunction Indicator Lamp (MIL) on the instrument panel when the computer detects a malfunction in the computer itself or in the drive system components which affect the vehicle emissions. In addition to illuminating the MIL when a malfunction is detected, the applicable DTCs prescribed by SAE J2012 are recorded in the ECM memory (See **DIAGNOSTIC TROUBLE CODE CHART**).

   If the malfunction does not occur in 3 consecutive trips, the MIL goes off but the DTCs remain in the ECM memory.



Fig. 18: Identifying Malfunction Indicator Lamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. To check the DTCs, connect Techstream to the DLC3 of the vehicle. Techstream also enables you to erase the DTCs and check freeze frame data and various forms of engine data (For operating instructions, see the instruction book).

d. The DTCs include SAE controlled codes and Manufacturer controlled codes. SAE controlled codes must be set as prescribed by the SAE, while manufacturer controlled codes can be set freely by a manufacturer within the prescribed limits (See **DIAGNOSTIC TROUBLE CODE CHART**).

2. **NORMAL MODE AND CHECK MODE**

   a. The diagnosis system operates in "normal mode" during the normal vehicle use. In normal mode, "2-trip detection logic" is used to ensure accurate detection of malfunction. "Check mode" is also available to technicians as an option. In check mode, "1 -trip detection logic" is used for simulating malfunction symptoms and increasing the system's ability to detect malfunctions, including intermittent malfunction.

3. **2-TRIP DETECTION LOGIC**

   a. When a malfunction is first detected, the malfunction is temporarily stored in the ECM memory (1st trip). If the ignition switch is turned off and then turned on (IG) again, and same malfunction is detected again, the MIL will illuminate.

4. **FREEZE FRAME DATA**

   a. The ECM records vehicle and driving condition information as freeze frame data the moment a DTC is stored. When troubleshooting, freeze frame data can be helpful in determining whether the vehicle was running or stopped, whether the engine was warmed up or not, whether the air-fuel ratio was lean or rich, as well as other data recorded at the time of a malfunction.

   HINT:

cardiagn.com

If it is impossible to duplicate the problem even though a DTC is detected, confirm the freeze frame data.

b. The ECM records engine conditions in the form of freeze frame data every 0.5 seconds. Using Techstream, five separate sets of freeze frame data, including the data values at the time when the DTC was set, can be checked.
   - 3 data sets before the DTC was set
   - 1 data set when the DTC was set
   - 1 data set after the DTC was set

   These data sets can be used to simulate the condition of the vehicle around the time of the occurrence of the malfunction. The data may assist in identifying of the cause of the malfunction, and in judging whether it was temporary or not.

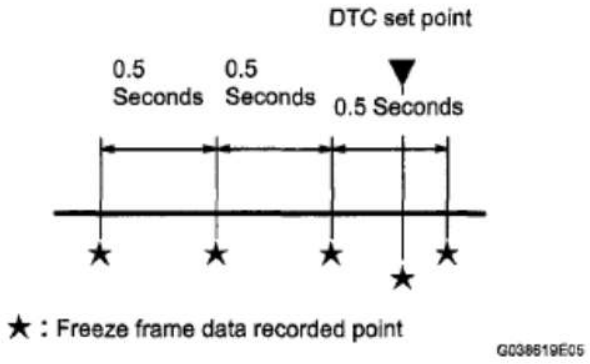


Fig. 19: Freeze Frame Data Recorded Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **CHECK DLC3**
   a. Check the DLC3 (See **HOW TO TROUBLESHOOT ECU CONTROLLED SYSTEMS**).
6. **CHECK BATTERY VOLTAGE**
   a. Measure the battery voltage.

      Battery voltage: 11 to 14 V

      If voltage is below 11 V, replace the battery before proceeding.

7. **CHECK MIL**
   a. The MIL comes on when the ignition switch is turned on (IG) and the engine is not running.

      HINT:

      If the MIL does not light up, troubleshoot the combination meter.

   b. When the engine is started, the MIL should go off. If the lamp remains on, it means that the

cardiagn.com

diagnosis system has detected a malfunction or abnormality in the system.

DTC CHECK/CLEAR

1. **DTC CHECK (NORMAL MODE)**

NOTE: When the diagnostic system is switched from the normal mode to the check mode, all the DTCs and freeze frame data recorded in the normal mode will be erased. So before switching modes, always check the DTCs and freeze frame data, and note them down.

a. Checking DTCs using Techstream.
   1. Turn the ignition switch off.
   2. Connect Techstream to the DLC3.
   3. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   4. Enter the following menus: Powertrain/Engine and ECT/Trouble Codes.
   5. Use Techstream to check the DTCs and freeze frame data and note them down (For operating instructions, see the Techstream instruction book).

NOTE: When simulating symptoms with Techstream to check the DTCs, use the normal mode. For codes on the DTCs chart which are subject to "2 trip detection logic";

Turn the ignition switch off after the symptom is simulated once. Then repeat the simulation process again. When the problem has been simulated twice, the MIL illuminates and the DTCs are recorded in the ECM.

2. **DTC CLEAR**

a. When using Techstream: Clearing the DTCs.
   1. Connect Techstream to the DLC3.
   2. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   3. Enter the following menus: Powertrain/Engine and ECT/Trouble Codes/Clear.

HINT:

When operating Techstream to erase the codes, the DTCs and freeze frame data will be erased. (See the Techstream instruction book for operating instructions.)

b. When not using Techstream: Clearing the DTCs.
   1. Disconnect the battery terminal or remove the EFI and ETCS fuses from the engine room junction block for 60 seconds or more. However, if you disconnect the battery terminal, perform do the "INITIALIZATION (See **INITIALIZATION**)" procedure.

CHECK MODE PROCEDURE

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

HINT:

Check mode has a higher sensitivity to malfunctions and can detect malfunction that normal mode cannot detect. Check mode can also detect all the malfunctions that normal mode can detect. In check mode, DTCs are detected with 1-trip detection logic.

1. **DTC CHECK (CHECK MODE)**

   HINT:

   Techstream only: Compared to the normal mode, the check mode is more sensitive for detecting malfunctions. Furthermore, the same diagnostic items which are detected in the normal mode can also be detected in the check mode.

   a. Procedure for Check Mode using Techstream.
      1. Check the initial conditions.
         - Battery positive voltage 11 V or more
         - Throttle valve fully closed
         - Transaxle in the P or N position
         - A/C switch is off
      2. Turn the ignition switch off.
      3. Connect Techstream to the DLC3.
      4. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
      5. Enter the following menus: Powertrain/Engine and ECT/Utility/Check Mode.

         NOTE: All DTCs and freeze frame data recorded will be erased if: 1) Techstream is used to change the ECM from normal mode to check mode or vice-versa; or 2) during check mode, the ignition switch is turned from the on (IG) to on (ACC) or turned OFF.

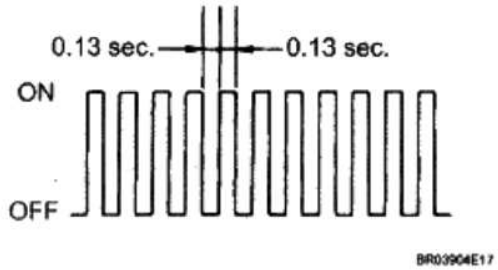


Fig. 20: Malfunction Indicator Lamp Blinking Pattern
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

      6. Start the engine (the MIL goes off after the engine starts).
      7. Perform "MONITOR DRIVE PATTERN" for the ECT test (See **MONITOR DRIVE PATTERN**), or simulate the conditions of the malfunction described by the customer.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

NOTE: Leave the ignition switch on (IG) until you have checked the DTCs, etc.

8. After simulating malfunction conditions, use the Techstream diagnosis selector to check the DTCs and freeze frame data, etc.
9. When you use Techstream: Enter the following menus: Powertrain/Engine and ECT/Trouble Codes.
10. After checking the DTC, inspect the applicable circuit.
11. (See **DIAGNOSTIC TROUBLE CODE CHART**) to confirm the details of the DTCs.

2. **DTC CLEAR**
   a. When using Techstream: Clearing the DTCs.
      1. Connect Techstream to the DLC3.
      2. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
      3. When you use Techstream: Enter the following menus: Powertrain/Engine and ECT/Trouble Codes/Clear.

         HINT:

         When operating Techstream to erase the codes, the DTCs and freeze frame data will be erased. (See the Techstream instruction book for operating instructions.)

   b. When not using Techstream: Clearing the DTCs.
      1. Disconnect the battery cable or remove the EFI and ETCS fuses from the engine room junction block for 60 seconds or more. However, if you disconnect the battery cable, perform do the "INITIALIZATION (See **INITIALIZATION**)" procedure.

FAIL-SAFE CHART

1. **FAIL-SAFE**

   This function minimizes the loss of the ECT functions when any malfunction occurs in a sensor or solenoid.

   a. ATF (Automatic Transmission Fluid) temperature sensor:

      When the ATF temperature sensor has a malfunction, 5th upshift is prohibited.

   b. Counter gear speed sensor NC (Speed sensor NC): When the counter gear speed sensor has a malfunction, 5th upshift is prohibited.
   c. Shift solenoid valve DSL:

      When the solenoid valve DSL has a malfunction, the current to the solenoid valve is stopped.

      This stops lock-up control, then fuel economy decreases.

cardiagn.com

d. Shift solenoid valve SL1, SL2, SL3 and S4:

Fail safe function:

If either of the shift solenoid valve circuits develops an open or short, the ECM turns the other shift solenoid "ON" and "OFF" in order to shift into the gear positions shown in the table below.

Manual shifting as shown in the following table must be done (In case of a short circuit, the ECM stops sending the current to the short circuited solenoid). Even if starting the engine in the fail-safe mode, the gear position remains in the same position.

HINT:

FL: Flex Lock-up

FAIL-SAFE CHART

Normal	Solenoid Valve	SL1	ON	OFF	ON	OFF	OFF
		SL2	ON	ON	OFF	FL	FL
		SL3	OFF	OFF	OFF	ON	ON
		S4	OFF	OFF	OFF	OFF	ON
	Gear Position		1st	2nd	3rd	4th	5th
SL1 Malfunction (During driving at 1st or 2nd)	Solenoid Valve	SL1	OFF				
		SL2	ON				
		SL3	OFF	OFF	OFF	ON to OFF	ON to OFF
		S4	OFF	OFF	OFF	OFF	ON to OFF
	Gear Position		1st to 2nd	2nd	3rd to 2nd	4th to 2nd	5th to 2nd
SL1 Malfunction (During driving at 3rd)	Solenoid Valve	SL1	OFF				
		SL2	ON to FL	ON to FL	FL	FL	FL
		SL3	OFF	OFF	OFF	ON to OFF	ON to OFF
		S4	OFF to ON	OFF to ON	OFF to ON	OFF to ON	ON
	Gear Position		1st to 4th	2nd to 4th	3rd to 4th	4th	5th to 4th
SL1 Malfunction (During driving at 4th or 5th)	Solenoid Valve	SL1	OFF				
		SL2	ON to FL	ON to FL	FL	FL	FL
		SL3	OFF to ON	OFF to ON	OFF to ON	ON	ON
		S4	OFF	OFF	OFF	OFF	ON

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	Gear Position		1st to 4th	2nd to 4th	3rd to 4th	4th	5th
SL2 Malfunction	Solenoid Valve	SL1	ON	OFF to ON	ON	OFF to ON	OFF to ON
		SL2	OFF				
		SL3	OFF	OFF	OFF	ON to OFF	ON to OFF
		S4	OFF to ON	OFF to ON	OFF to ON	OFF to ON	ON
	Gear Position		1st to 4th	2nd to 4th	3rd to 4th	4th	5th to 4th
SL3 Malfunction	Solenoid Valve	SL1	ON	OFF	ON	OFF to ON	OFF to ON
		SL2	ON	ON	OFF	FL	FL
		SL3	OFF				
		S4	OFF	OFF	OFF	OFF to ON	ON
	Gear Position		1st	2nd	3rd	4th	5th to 4th
S4 Malfunction	Solenoid Valve	SL1	ON	OFF	ON	OFF	OFF
		SL2	ON	ON	OFF	FL	FL
		SL3	OFF	OFF	OFF	ON	ON
		S4	OFF				
	Gear Position		1st	2nd	3rd	4th	5th to 4th
SL1, SL2, SL3, and S4 Malfunction	Solenoid Valve	SL1	OFF				
		SL2	OFF				
		SL3	OFF				
		S4	OFF				
	Gear Position		1st to 4th	2nd to 4th	3rd to 4th	4th	5th to 4th

DATA LIST/ACTIVE TEST

1. DATA LIST

HINT:

Using Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTE: In the table below, the values listed under "Normal Condition" are

cardiagn.com

reference values. Do not depend solely on these reference values when deciding whether a part is faulty or not.

a. Warm up the engine.
b. Turn the ignition switch off.
c. Connect Techstream to the DLC3.
d. Turn the ignition switch on (IG).
e. Turn on the tester.
f. Select the item "Powertrain/Engine and ECT/Data List".
g. According to the display on the tester, read the "Data List".

TESTER DISPLAY REFERENCE

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Stop Light Switch	Stop light switch Status/ON or OFF	Brake Pedal is depressed: ON Brake Pedal is released: OFF	-
Neutral Position SW Signal	PNP switch Status/ON or OFF	Shift lever position is: P and N: ON Except P and N: OFF	When the shift lever position displayed on Techstream differs from the actual position, adjustment of the PNP switch or the shift cable may be incorrect. HINT: When the failure still occurs even after adjusting these parts, See **DTC P0705 TRANSMISSION RANGE SENSOR CIRCUIT MALFUNCTION (PRNDL INPUT)** .
Shift SW Status (P Range)	PNP switch Status/ON or OFF	Shift lever position is: P: ON Except P: OFF	?
Shift SW Status (N Range)	PNP switch Status/ON or OFF	Shift lever position is: N: ON Except N: OFF	?
Shift SW Status (R Range)	PNP switch Status/ON or OFF	Shift lever position is: R: ON Except R: OFF	?
Shift SW Status (D Range)	PNP switch Status/ON or OFF	Shift lever position is: D, and S : ON Except D, and S: OFF	?
Sports Mode Selection SW	Sport Mode Select switch Status/ON or OFF	Shift lever position is: S, "+" and "-": ON Except S, "+" and "-": OFF	-

cardiagn.com

Sports Shift Up SW	Sport Shift Up switch Status/ON or OFF	Press continuously "+" (Up shift): ON Release "+" (Up shift): OFF	-
Sports Shift Down SW	Sport Shift Down switch Status/ON or OFF	Press continuously "-" (Down shift): ON Release "-" (Down shift): OFF	-
Shift Status	Actual Gear Position/1st, 2nd, 3rd, 4th or 5th	Shift Lever Position is: D: 1st, 2nd, 3rd, 4th or 5th S: 1st, 2nd, 3rd, 4th or 5th	-
Lock Up	Lock Up Status/ON or OFF	Lock Up: ON Except Lock Up: OFF	-
Lock Up Solenoid Status	Lock Up Solenoid Status/ON or OFF	Lock Up Solenoid: ON Except Lock Up Solenoid: OFF	-
SLT Solenoid Status	Shift Solenoid SLT Status/ON or OFF	Accelerator pedal is depressed: OFF Accelerator pedal is released: ON	-
A/T Oil Temperature 1	ATF Temp. Sensor Value/ min.: -40°C (-40°F) max.: 215°C (419°F)	After Stall Test: Approx. 80°C (176°F) Equal to ambient temperature when cold soak	If the value is "-40°C (-40°F)" or "215°C (419°F)", ATF temp, sensor circuit is opened or shorted.
SPD (NC)	Counter Gear Speed/display: 50 r/min	HINT: 3rd when shift lever position is D position (After warming up the engine): • Intermediate shaft speed (NC) becomes close to the engine speed.	-
SPD (NT)	Input Turbine Speed/display: 50 r/min	HINT: • Lock-up ON (After warming up the engine): Input Turbine speed (NT) equal to the engine speed. • Lock-up OFF (Idling at N position): Input	-

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		Turbine speed (NT) nearly equal to the engine speed.	
Snow Switch Status	Pattern SW (ECT SNOW) status/ON or OFF	Engine switch ON: OFF ? Pattern switch (ECT SNOW) Push: ON ? Pattern switch (ECT SNOW) Push: OFF	-

2. **ACTIVE TEST**

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

a. Warm up the engine.
b. Turn the ignition switch off.
c. Connect Techstream to the DLC3.
d. Turn the ignition switch on (IG).
e. Push the "ON" button of Techstream.
f. Select the item "Powertrain/Engine and ECT/Active Test".
g. According to the display on tester, perform the "Active Test".

TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Shift Position	[Test Details] Operate the shift solenoid valve and set each shift position by yourself. [Vehicle Condition] • IDL: ON • Less than 50 km/h (31 mph) [Others] • Press "-->" button: Shift up • Press "<--" button: Shift down	1st/2nd/3rd/4th/5th	Possible to check the operation of the shift solenoid valves.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Activate the Lock Up	[Test Details] Control the shift solenoid DSL to set the automatic transaxle to the lock-up condition. [Vehicle Condition] • Throttle valve opening angle: Less than 35 % • Vehicle Speed: 60 km/h (37 mph) or more	ON/OFF	Possible to check the DSL operation.
Activate the Solenoid (SL1)	[Test Details] Operate the shift solenoid SL1 [Vehicle Condition] • Vehicle Stopped. • Shift lever P or N position	ON/OFF	-
Activate the Solenoid (SL2)	[Test Details] Operate the shift solenoid SL2 [Vehicle Condition] • Vehicle Stopped. • Shift lever P or N position	ON/OFF	-
Activate the Solenoid (SL3)	[Test Details] Operate the shift solenoid SL3 [Vehicle Condition] • Vehicle Stopped. • Shift lever P or N position	ON/OFF	-
Activate the Solenoid (S4)	[Test Details] Operate the shift solenoid S4 [Vehicle Condition] • Vehicle Stopped. • Shift lever P or N position	ON/OFF	-
Activate the Solenoid (SR)	[Test Details] Operate the shift solenoid SR [Vehicle Condition] • Vehicle Stopped. • Shift lever P or N position	ON/OFF	-
Activate the Solenoid (DSL)	[Test Details] Operate the shift solenoid DSL [Vehicle Condition] • Vehicle Stopped. • Shift lever P or N position	ON/OFF	-

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Activate the Solenoid (SLT)(1)	[Test Details] Operate the shift solenoid SLT and raise the line pressure. [Vehicle Condition] • Vehicle Stopped. • IDL: ON HINT: OFF: Line pressure up (When the active test of "Activate the Solenoid (SLT)" is performed, the ECM commands the SLT solenoid to turn off). ON: No action (normal operation)	ON/OFF	-

(1) "Activate the Solenoid (SLT)" in the Active Test is performed to check the line pressure changes by connecting the SST to the automatic transaxle, which is used in the HYDRAULIC TEST (See **HYDRAULIC TEST**) as well.

HINT:

The pressure values in Active Test and HYDRAULIC TEST are different from each other.

DIAGNOSTIC TROUBLE CODE CHART

If a DTC is displayed during the DTC check, check the parts listed in the table below and proceed to the page given.

HINT:

- *1: Comes on MIL (Malfunction Indicator Lamp) light up
- *2: "DTC stored" mark means ECM memorizes the malfunction code if the ECM detects the DTC detection condition.
- This DTC may be output when the clutch, brake and gear components etc. inside the automatic transaxle are damaged.

AUTOMATIC TRANSAXLE SYSTEM

DIAGNOSTIC TROUBLE CODE CHART

DTC Code	Detection Item	Trouble Area	MIL*1	Memory *2
P0705	Transmission Range Sensor Circuit Malfunction (PRNDL Input)	1. Open or short in park/neutral position switch circuit	Comes on	DTC stored

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		2. Park/neutral position switch 3. ECM		
P0711	Transmission Fluid Temperature Sensor "A" Performance	1. Transmission wire (ATF temperature sensor)	Comes on	DTC stored
P0712	Transmission Fluid Temperature Sensor "A" Circuit Low Input	1. Short in ATF temperature sensor circuit 2. Transmission wire (ATF temperature sensor) 3. ECM	Comes on	DTC stored
P0713	Transmission Fluid Temperature Sensor "A" Circuit High Input	1. Open in ATF temperature sensor circuit 2. Transmission wire (ATF temperature sensor) 3. ECM	Comes on	DTC stored
P0717	Turbine Speed Sensor Circuit No Signal	1. Open or short in transmission revolution sensor NT (speed sensor NT) circuit 2. Transmission revolution sensor NT (speed sensor NT) 3. ECM 4. Automatic transaxle assembly	Comes on	DTC stored
P0724	Brake Switch "B" Circuit High	1. Short in stop light switch circuit	Comes on	DTC stored

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		2. Stop light switch 3. ECM		
P0741	Torque Converter Clutch Solenoid Performance (Shift Solenoid Valve DSL)	1. Shift solenoid valve DSL remains open or closed 2. Valve body is blocked 3. Torque converter clutch 4. Automatic transaxle (clutch, brake or gear etc.) 5. Line pressure is too low	Comes on	DTC stored
P0746	Pressure Control Solenoid "A" Performance (Shift Solenoid Valve SL1)	1. Shift solenoid valve SL1 remains open or closed 2. Valve body is blocked 3. Automatic transaxle (clutch, brake or gear etc.)	Comes on	DTC stored
P0748	Pressure Control Solenoid "A" Electrical (Shift Solenoid Valve SL1)	1. Open or short in shift solenoid valve SL1 circuit 2. Shift solenoid valve SL1 3. ECM	Comes on	DTC stored
P0766	Shift Solenoid "D" Performance (Shift Solenoid Valve S4)	1. Shift solenoid valve S4 remains open or closed 2. Valve body is blocked 3. Automatic	Comes on	DTC stored

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		transaxle (clutch, brake or gear, etc.)		
P0771	Shift Solenoid "E" Performance (Shift Solenoid Valve SR)	1. Shift solenoid valve SR remains open or closed 2. Valve body is blocked 3. Automatic transaxle (clutch, brake or gear, etc.)	Comes on	DTC stored
P0776	Pressure Control Solenoid "B" Performance (Shift Solenoid Valve SL2)	1. Shift solenoid valve SL2 remains open or closed 2. Valve body is blocked 3. Automatic transaxle (clutch, brake or gear, etc.)	Comes on	DTC stored
P0778	Pressure Control Solenoid "B" Electrical (Shift Solenoid Valve SL2)	1. Open or short in shift solenoid valve SL2 circuit 2. Shift solenoid valve SL2 3. ECM	Comes on	DTC stored
P0793	Intermediate Shaft Speed Sensor "A"	1. Open or short in transmission revolution sensor NC (speed sensor NC) circuit 2. Transmission revolution sensor NC (speed sensor NC) 3. ECM	Comes on	DTC stored

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

P0796	Pressure Control Solenoid "C" Performance (Shift Solenoid Valve SL3)	1. Shift solenoid valve SL3 remains open or closed 2. Valve body is blocked 3. Automatic transaxle (clutch, brake or gear, etc.)	Comes on	DTC stored
P0798	Pressure Control Solenoid "C" Electrical (Shift Solenoid Valve SL3)	1. Open or short in shift solenoid valve SL3 circuit 2. Shift solenoid valve SL3 3. ECM	Comes on	DTC stored
P0982	Shift Solenoid "D" Control Circuit Low (Shift Solenoid Valve S4)	1. Short in shift solenoid valve S4 circuit 2. Shift solenoid valve S4 3. ECM	Comes on	DTC stored
P0983	Shift Solenoid "D" Control Circuit High (Shift Solenoid Valve S4)	1. Open in shift solenoid valve S4 circuit 2. Shift solenoid valve S4 3. ECM	Comes on	DTC stored
P0985	Shift Solenoid "E" Control Circuit Low (Shift Solenoid Valve SR)	1. Short in shift solenoid valve SR circuit 2. Shift solenoid valve SR 3. ECM	Comes on	DTC stored
P0986	Shift Solenoid "E" Control Circuit High (Shift Solenoid Valve SR)	1. Open in shift solenoid valve SR circuit	Comes on	DTC stored

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		2. Shift solenoid valve SR 3. ECM		
P2714	Pressure Control Solenoid "D" Performance (Shift Solenoid Valve SLT)	1. Shift solenoid valve SLT remains closed 2. Valve body is blocked 3. Torque converter clutch 4. Automatic transaxle (clutch, brake or gear, etc.)	Comes on	DTC stored
P2716	Pressure Control Solenoid "D" Electrical (Shift Solenoid Valve SLT)	1. Open or short in shift solenoid valve SLT circuit 2. Shift solenoid valve SLT 3. ECM	Comes on	DTC stored
P2769	Torque Converter Clutch Solenoid Circuit Low (Shift Solenoid Valve DSL)	1. Short in shift solenoid valve DSL circuit 2. Shift solenoid valve DSL 3. ECM	Comes on	DTC stored
P2770	Torque Converter Clutch Solenoid Circuit High (Shift Solenoid Valve DSL)	1. Open in shift solenoid valve DSL circuit 2. Shift solenoid valve DSL 3. ECM	Comes on	DTC stored

DTC P0705 TRANSMISSION RANGE SENSOR CIRCUIT MALFUNCTION (PRNDL INPUT)

DESCRIPTION

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

The park/neutral position switch detects the shift lever position and sends signals to the ECM.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0705	A. Any 2 or more signals of the following are ON simultaneously (2-trip detection logic) • P input signal is ON. • N input signal is ON. • R input signal is ON. • D input signal is ON. B. Any 2 or more signals of the following are ON simultaneously (2-trip detection logic) • NSW (STAR) input signal is ON. • R input signal is ON. • D input signal is ON. C. All switches are OFF simultaneously for NSW (STAR), P, R, N, D, positions (2-trip detection logic). D. When any of following conditions for 2 sec. or more in the S position (2-trip detection logic) • NSW (STAR) input signal is ON. • P input signal is ON. • N input signal is ON. • R input signal is ON.	• Open or short in park/neutral position switch circuit • Park/neutral position switch • ECM

MONITOR DESCRIPTION

These DTCs indicate a problem with the park/neutral position switch and the wire harness in the park/neutral position switch circuit.

The park/neutral position switch detects the shift lever position and sends a signal to the ECM.

For security, the park/neutral position switch detects the shift lever position so that engine can be started only when the shift lever is in the P or N position.

The park/neutral position switch sends a signal to the ECM according to the shift position (P, R, N or D). The ECM determines that there is a problem with the switch or related parts if in receives more than 1 position signal simultaneously. The ECM will turn on the MIL and store the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0705: Park/neutral position switch/Verify switch input

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Required sensors/Components	Park/neutral position switch
Frequency of operation	Continuous
Duration	Condition (A), (B), (D) 2 sec. Condition (C) 60 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Ignition switch	ON
Battery voltage	10.5 V or more

TYPICAL MALFUNCTION THRESHOLDS

1. **One of the following conditions are met: Condition (A), (B), (C) and (D)**

   Condition (A):

   TYPICAL MALFUNCTION THRESHOLDS

Number of the following signal input at the same time	2 or more
P switch	ON
N switch	ON
R switch	ON
D switch	ON

   Condition (B):

   TYPICAL MALFUNCTION THRESHOLDS

Number of the following signal input at the same time	2 or more
NSW (STAR) switch	ON
R switch	ON
D switch	ON

   Condition (C):

   TYPICAL MALFUNCTION THRESHOLDS

NSW (STAR) switch	OFF
P switch	OFF

cardiagn.com

N switch	OFF
R switch	OFF
D switch	OFF

Condition (D):

When shift lever is in the S position switch (M switch)

TYPICAL MALFUNCTION THRESHOLDS

One of the following conditions are met:	-
NSW (STAR) switch	ON
P switch	ON
N switch	ON
R switch	ON

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Park/neutral Position switch	The park/neutral position switch sends only one signal to the ECM.

WIRING DIAGRAM

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

w/ Smart Key System:

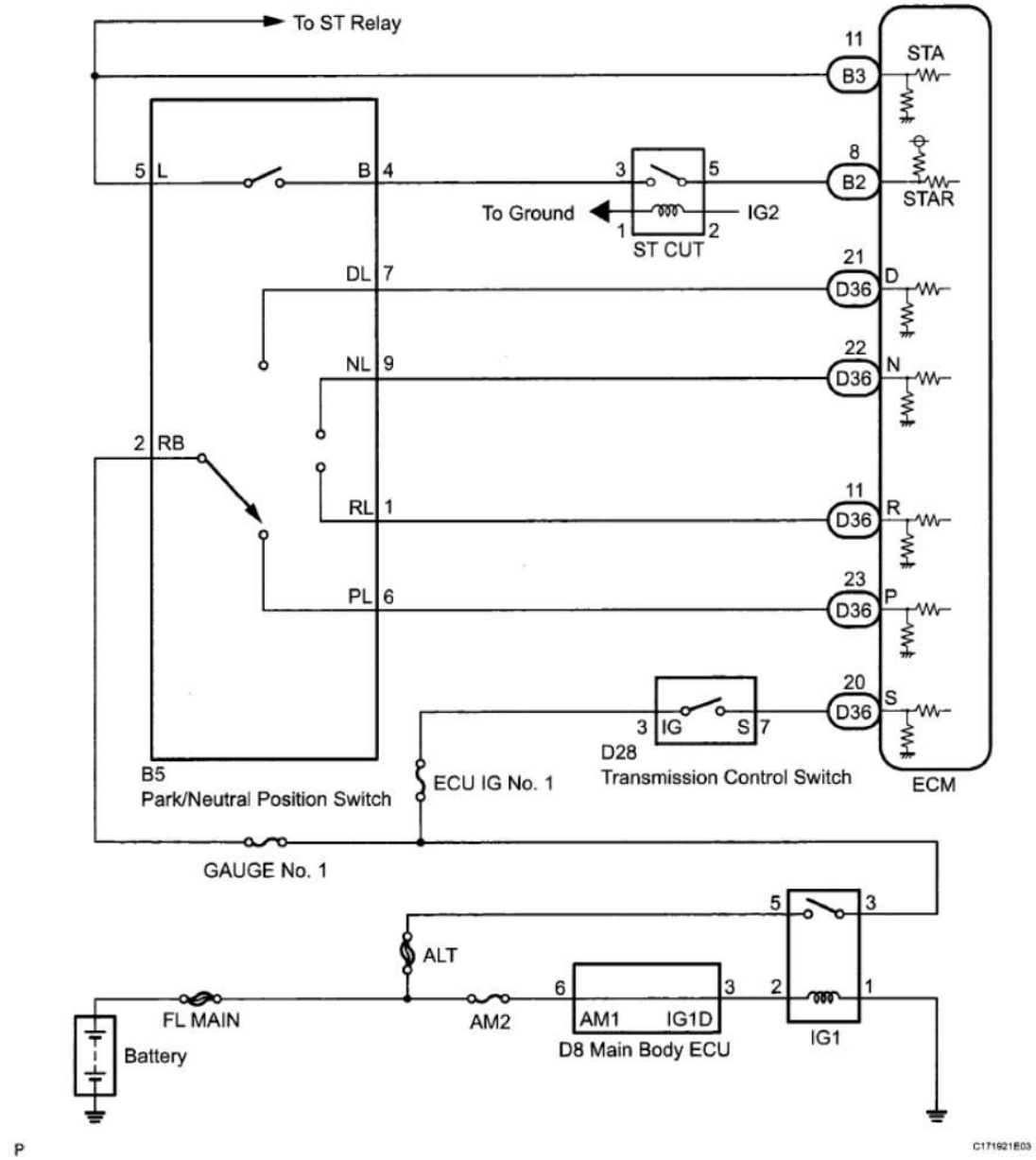


Fig. 21: Transmission Range Sensor Circuit Malfunction (W/Smart Key) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

w/o Smart Key System:

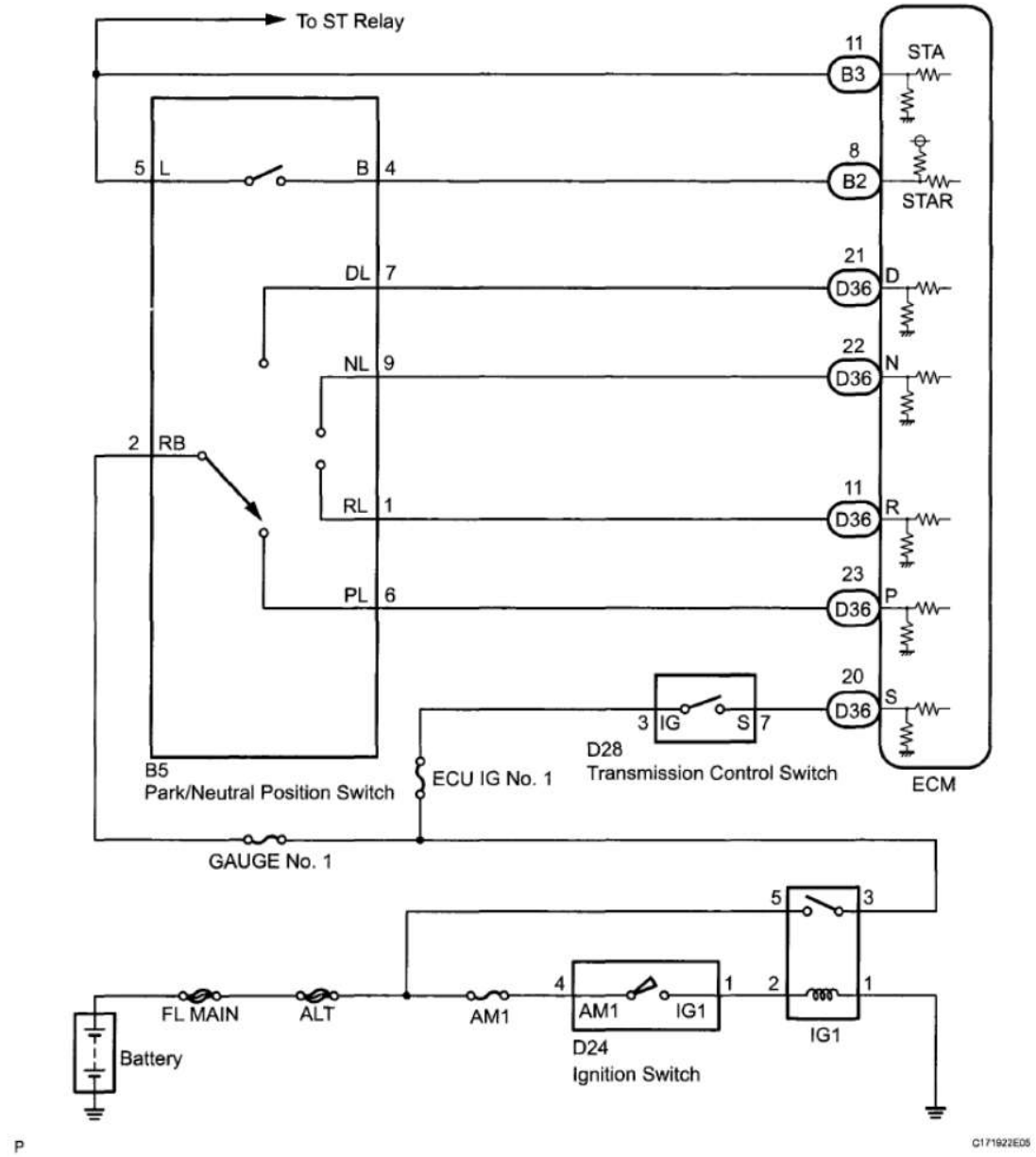


Fig. 22: Transmission Range Sensor Circuit Malfunction (W/O Smart Key) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK HARNESS AND CONNECTOR (BATTERY - PARK/NEUTRAL POSITION SWITCH)**
   a. Disconnect the park/neutral position switch connector.
   b. Turn the ignition switch on (IG).
   c. Measure the voltage according to the value(s) in the table below.

cardiagn.com

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
B5-2 (RB) - Body ground	Ignition switch on (IG)	11 to 14 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Y C117645E76

Fig. 23: Identifying Terminal RB Of B5 Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (OUTPUT SIGNAL)**
   a. Measure the voltage according to the value(s) in the table below.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
B5-4 (B) - Body ground	Ignition switch on (IG)	11 to 14 V

Result

RESULT REFERENCE

Result	Proceed to
OK	A
NG (w/o Smart Key System)	B
NG (w/Smart Key System)	C

cardiagn.com

B: Go to step 8

C: CHECK CRANKING HOLDING FUNCTION CIRCUIT (for 2GR-FE) (See **CRANKING HOLDING FUNCTION CIRCUIT**)

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Y C117645E77

Fig. 24: Identifying Terminal B Of B5 Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

A: Go to next step

3. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

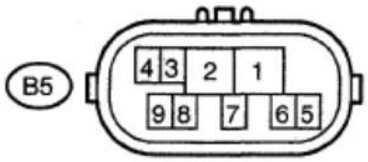
Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
4 - 5	P and N	Below 1 ohms
	Except P and N	10 kohms or higher
2 - 6	P	Below 1 ohms
	Except P	10 kohms or higher
2 - 1	R	Below 1 ohms
	Except R	10 kohms or higher
2 - 9	N	Below 1 ohms
	Except N	10 kohms or higher
2 - 7	D, S, "+" and "-"	Below 1 ohms
	Except D, S, "+" and "-"	10 kohms or higher

cardiagn.com

Component without harness connected:
(Park/Neutral Position Switch)



C110340E96

Fig. 25: Identifying Terminal Of B5 Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPLACE PARK/NEUTRAL POSITION SWITCH ASSEMBLY (See **REMOVAL**)

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (BATTERY - SHIFT LOCK CONTROL UNIT ASSEMBLY)**
   a. Disconnect the transmission control switch connector of shift lock control unit assembly.
   b. Measure the voltage according to the value(s) in the table below.

Standard voltage

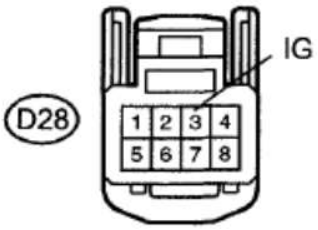
STANDARD VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
D28-3 (IG) - Body ground	Ignition switch on (IG)	11 to 14 V
	Ignition switch off	Below 1 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Front view of wire harness connector:
(to Transmission Control Switch)



C168574E06

Fig. 26: Identifying Terminal IG Of D28 Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **INSPECT SHIFT LOCK CONTROL UNIT ASSEMBLY**
   a. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
3 - 7	S, "+" and "-"	Below 1 ohms
	Except S, "+" and "-"	10 kohms or higher

NG: REPLACE SHIFT LOCK CONTROL UNIT ASSEMBLY (See **REMOVAL**)

cardiagn.com

Component without harness connected:
(Transmission Control Switch)



C168599E04

Fig. 27: Identifying Terminal Of D28 Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

6. **CHECK HARNESS AND CONNECTOR (SHIFT LOCK CONTROL UNIT ASSEMBLY - ECM)**
   a. Connect the transmission control switch connector of shift lock control unit assembly.
   b. Disconnect the ECM connector.
   c. Measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
D36-20 (S) - Body ground	S, "+" and "-"	11 to 14 V
	Except S, "+" and "-"	Below 1 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Rear view of wire harness connector:
(to ECM)

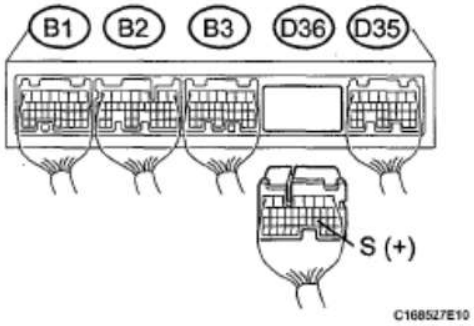


Fig. 28: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

7. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ECM)**
   a. Connect the park/neutral position switch connector.
   b. Measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
D36-23 (P) - Body ground	P	11 to 14 V
	Except P	Below 1 V
D36-22 (N) - Body ground	N	11 to 14 V
	Except N	Below 1 V
D36-11 (R) - Body ground	R	11 to 14 V*
	Except R	Below 1 V
D36-21 (D) - Body ground	D and S	11 to 14 V
	Except D and S	Below 1 V
HINT: *: The voltage will drop slightly due to lighting up of the back up light.		

cardiagn.com

Rear view of wire harness connector:
(to ECM)

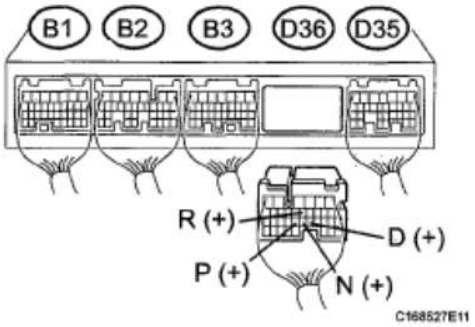


Fig. 29: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

8. **CHECK HARNESS AND CONNECTOR (PARK/NEUTRAL POSITION SWITCH - ECM)**
   a. Turn the ignition switch off.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for open)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B5-4 (B) - B2-8 (STAR)	Always	Below 1 ohms

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B5-4 (B) or B2-8 (STAR) - Body ground	Always	10 kohms or higher

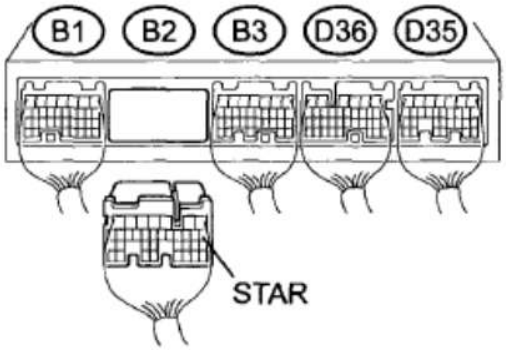
NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Front view of wire harness connector:
(to Park/Neutral Position Switch)



Rear view of wire harness connector:
(to ECM)



P C169035E05

Fig. 30: Identifying Terminal B Of B5 Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

DTC P0711 TRANSMISSION FLUID TEMPERATURE SENSOR "A" PERFORMANCE

DESCRIPTION

The ATF (Automatic Transmission Fluid) temperature sensor converts the fluid temperature into a resistance value which is input into the ECM.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
	One of the following conditions (A), (B) or (C) is met: A. (a), (b) and (c) are detected: (2-trip detection logic)	

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

P0711	• (a) Intake air and engine coolant temperatures are more than 10°C (50°F) at engine start • (b) Soak time is more than 5 hours • (c) After normal driving for over 10 min. and 5 km (3 mile) or more, ATF temperature is less than 20°C (68°F) B. Both (a) and (b) are detected: (2-trip detection logic) • (a) Intake air and engine coolant temperatures are more than -10°C (14°F) at engine start • (b) After normal driving for over 19 min. and 9 km (6 mile) or more, ATF temperature is less than 20°C (68°F) C. Both (a) and (b) are detected: (2-trip detection logic) • (a) Engine coolant temperature is less than 35°C (95°F) at engine start • (b) ATF temperature is 110°C (230°F) or more when engine coolant temperature reaches 60°C (140°F)	Transmission wire (ATF temperature sensor)

MONITOR DESCRIPTION

The ATF temperature sensor converts the ATF temperature to an electrical resistance value. Based on the resistance, the ECM determines the ATF temperature and detects an open or short in the ATF temperature circuit or a fault in the ATF temperature sensor.

After running the vehicle for a certain period, the ATF temperature should increase. If the ATF temperature is below 20°C (68°F) after running the vehicle for a certain period, the ECM interprets this as a fault, and turns on the MIL, and stores the DTC.

When the ATF temperature is 110°C (230°F) or more and engine coolant temperature reaches 60°C (140°F) after cold start, the ECM also determines this as a fault, turns on the MIL, and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0711: ATF temperature sensor/Rationality check
Required sensors/Components	ATF temperature sensor (TFT sensor)
Frequency of operation	Continuous
Duration	3 sec: Condition (A), (B) Continuous.: Condition (C)
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0112, P0113 (IAT sensor circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable)) P2610 (Soak timer circuit)

Condition (A):

TYPICAL ENABLING CONDITIONS

Time after engine start	10 min.
Driving distance after engine start	5 km (3 mile) or more
IAT (Intake air temperature) (12 sec. after starting engine)	10°C (50°F) or more
ECT (12 sec. after starting engine)	10°C (50°F) or more
Soak time	5 hours

Condition (B):

TYPICAL ENABLING CONDITIONS

Time after engine start	18 min. and 20 sec.
Driving distance after engine start	9 km (6 mile) or more
IAT (Intake air temperature) (12 sec. after starting engine)	-10°C (14°F) or more
ECT (12 sec. after starting engine)	-10°C (14°F) or more

Condition (C):

TYPICAL ENABLING CONDITIONS

ECT (Current temperature)	60°C (140°F) or more
ECT (12 sec. after engine start)	Less than 35°C (95°F)

TYPICAL MALFUNCTION THRESHOLDS

Condition (A), (B):

TYPICAL MALFUNCTION THRESHOLDS

ATF temperature sensor	Less than 20°C (68°F)

Condition (C):

TYPICAL MALFUNCTION THRESHOLDS

ATF temperature sensor	110°C (230°F) or more

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

ATF temperature sensor	Atmospheric temperature to approx. 130°C (266°F)

WIRING DIAGRAM

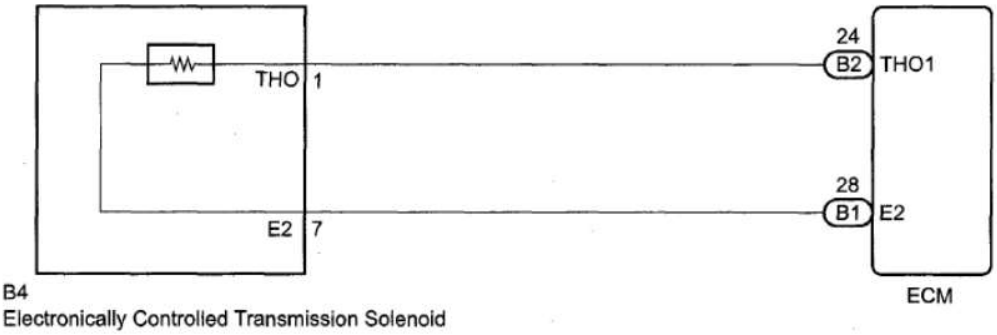


Fig. 31: Transmission Fluid Temperature Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

NOTE:

- **If DTCs P0711 and P2610 are output simultaneously, confirm that the ATF temperature is as specified in "Normal Condition" using the Techstream first. When the ATF temperature is as specified in "Normal Condition", perform troubleshooting for DTC P2610 (See DATA LIST/ACTIVE TEST).**
- **In the table below, the value listed under "Normal Condition" are reference values.**

HINT:

Using Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

1. Warm up the engine.
2. Turn the ignition switch off.
3. Connect Techstream to the DLC3.
4. Turn the ignition switch on (IG).
5. Turn on the tester.
6. Enter the following menus: Powertrain/Engine and ECT/Data List.

cardiagn.com

7. According to the display on the Techstream, read the Data List.

TESTER DISPLAY REFERENCE

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
A/T Oil Temperature 1	ATF temperature sensor value/ Min.: -40°C (-40°F) Max.: 215°C (419°F)	• After stall speed test: Approximately 80°C (176°F) • While engine is cold: Equal to ambient temperature	If value is -40°C (-40°F) or 150°C (302°F), ATF temperature sensor circuit is open or short circuited

HINT:

When DTC P0712 is output and the Techstream indicates 150°C (302°F) or more, there is a short circuit.

When DTC P0713 is output and the Techstream indicates -40°C (-40°F), there is an open circuit.

Measure the resistance between terminal THO1 (OT) and body ground.

TEMPERATURE SPECIFICATION

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
150°C (302°F) or more	Short circuit

HINT:

If a circuit related to the ATF temperature sensor becomes open, P0713 is immediately set (in 0.5 seconds). When P0713 is set, P0711 cannot be detected.

It is not necessary to inspect the circuit when P0711 is set.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0711)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and push the Techstream main switch ON.
   c. When you use Techstream:

      Select the item "Powertrain/Engine and ECT/Trouble Codes".

   d. Read the DTCs using Techstream.

      Result

      RESULT REFERENCE

cardiagn.com

Result	Proceed to
P0711	A
P0711 and other DTCs	B

HINT:

If any other codes besides "P0711" are output, perform troubleshooting for those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **CHECK TRANSMISSION FLUID LEVEL**

OK: Automatic transmission fluid level is correct.

NG: ADD FLUID

OK: REPLACE TRANSMISSION WIRE (ATF TEMPERATURE SENSOR) (See **REMOVAL**)

DTC P0712 TRANSMISSION FLUID TEMPERATURE SENSOR "A" CIRCUIT LOW INPUT; DTC P0713 TRANSMISSION FLUID TEMPERATURE SENSOR "A" CIRCUIT HIGH INPUT

DESCRIPTION

The ATF (Automatic Transmission Fluid) temperature sensor converts the fluid temperature into a resistance value which is input into the ECM.

The ECM applies a voltage to the temperature sensor through ECM terminal THO1.

The sensor resistance changes with the transmission fluid temperature. As the temperature becomes higher, the sensor resistance decreases.

One terminal of the sensor is grounded so that the sensor resistance decreases and the voltage goes down as the temperature becomes higher.

The ECM calculates the fluid temperature based on the voltage signal.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

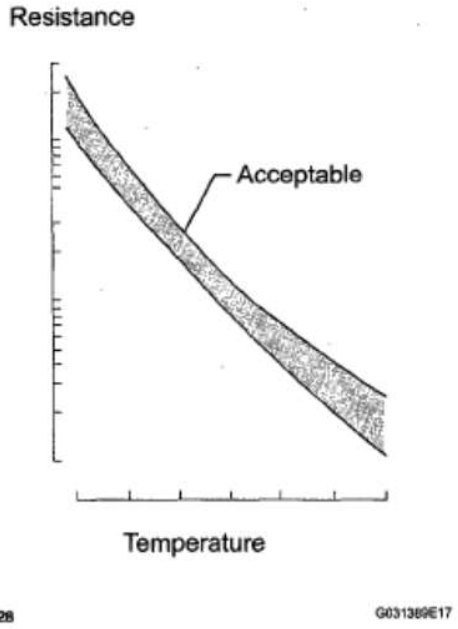


Fig. 32: Automatic Transmission Fluid Temperature Sensor Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0712	ATF temperature sensor resistance is less than 79 ohms for 0.5 sec. or more (1-trip detection logic)	• Short in ATF temperature sensor circuit • Transmission wire (ATF temperature sensor) • ECM
P0713	Either of the following conditions is met (1 -trip detection logic) A. 15 minutes or more after the engine is started, ATF temperature sensor resistance is more than 156 kohms for 0.5 sec. or more. B. The condition (A) of "TYPICAL ENABLING CONDITIONS" for DTC P0711 is met and ATF temperature sensor resistance is more than 156 kohms for 0.5 sec. or more.	• Open in ATF temperature sensor circuit • Transmission wire (ATF temperature sensor) • ECM

MONITOR DESCRIPTION

These DTCs indicate an open or short in the automatic transmission fluid (ATF) temperature sensor (TFT sensor) circuit. The automatic transmission fluid (ATF) temperature sensor converts ATF temperature to an

cardiagn.com

electrical resistance value. Based on the resistance, the ECM determines the ATF temperature, and the ECM detects an opens or shorts in the ATF temperature circuit. If the resistance value of the ATF temperature is less than 79 ohms*1 or more than 156 kohms*2 , the ECM interprets this as a fault in the ATF sensor or wiring. The ECM will turn on the MIL and store the DTC.

*1: 150°C (302°F) or more is indicated regardless of the actual ATF temperature.

*2: -40°C (-40°F) is indicated regardless of the actual ATF temperature.

HINT:

The ATF temperature can be checked on the Techstream display.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0712: ATF temperature sensor/Range check (Low resistance) P0713: ATF temperature sensor/Range check (High resistance)
Required sensors/Components	ATF temperature sensor (TFT sensor)
Frequency of operation	Continuous
Duration	0.5 sec.
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0712: Range check (Low resistance)

TYPICAL ENABLING CONDITIONS

The monitor will run whenever these DTCs are not present.	None
The typical enabling condition is not available.	-

P0713: Range check (High resistance)

One of the following conditions is met: Condition (A) or (B)

Condition (A)

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Time after engine start	15 min. or more

Condition (B)

The condition (A) of "TYPICAL ENABLING CONDITIONS" for DTC P0711 is met

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL MALFUNCTION THRESHOLDS

P0712: Range check (Low resistance)

TYPICAL MALFUNCTION THRESHOLDS

TFT sensor resistance	Less than 79 ohms

P0713: Range check (High resistance)

TYPICAL MALFUNCTION THRESHOLDS

TFT sensor resistance	More than 156 kohms

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

TFT sensor	Atmospheric temperature to approx. 130°C (266°F)

WIRING DIAGRAM

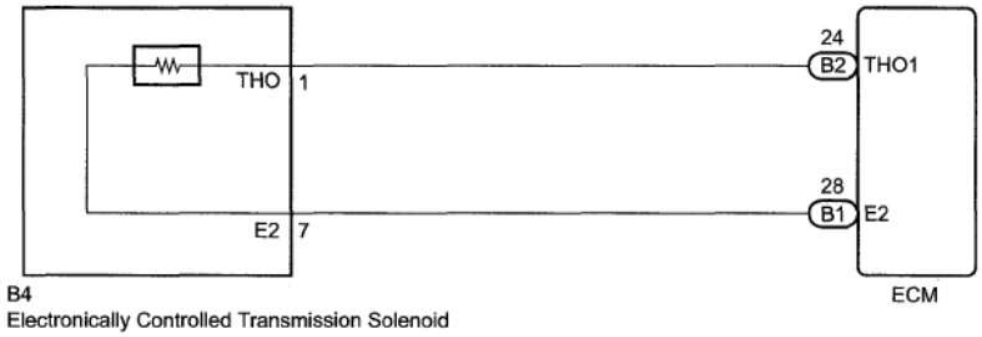


Fig. 33: Automatic Transmission Fluid Temperature Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Using Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

NOTE: In the table below, the value listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether apart is faulty or not.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

1. **READ DATA LIST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.
   f. Select the item "Powertrain/Engine and ECT/Data List".
   g. According to the display on the tester, read the "Data List".

TESTER DISPLAY REFERENCE

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
A/T Oil Temperature 1	ATF Temp. Sensor Value/ min.: -40°C (-40° F) max.: 215°C (419° F)	After Stall Test: Approx. 80°C (176°F) Equal to ambient temperature when cold soak	If the value is "-40°C (-40°F)" or "215° C (419°F)", ATF temp, sensor circuit is opened or shorted.

HINT:

When DTC P0712 is output and Techstream output is 150°C (302°F), there is a short circuit.

When DTC P0713 is output and Techstream output is -40°C (-40°F), there is an open circuit.

Measure the resistance between terminal THO1 (THO) and body ground.

TEMPERATURE SPECIFICATION

Temperature Displayed	Malfunction
-40°C (-40°F)	Open circuit
150°C (302°F) or more	Short circuit

HINT:

If a circuit related to the ATF temperature sensor becomes open, P0713 is immediately set (in 0.5 seconds).

When P0713 is set, P0711 cannot be detected.

It is not necessary to inspect the circuit when P0711 is set.

1. **INSPECT TRANSMISSION WIRE (ATF TEMPERATURE SENSOR)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

cardiagn.com

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 (THO) - 7 (E2)	Always	79 ohms to 156 kohms
1 (THO) - Body ground	Always	10 kohms or higher
7 (E2) - Body ground	Always	?

HINT:

If the resistance is out of the specified range with either the ATF temperature shown in the table below, the driveability of the vehicle may decrease.

ATF TEMPERATURE SPECIFICATION

ATF Temperature	Specified Condition
10°C (50°F)	5 to 8 kohms
25°C (77°F)	2.5 to 4.5 kohms
110°C (230°F)	0.22 to 0.28 kohms

Component without harness connected:
(Transmission Wire)

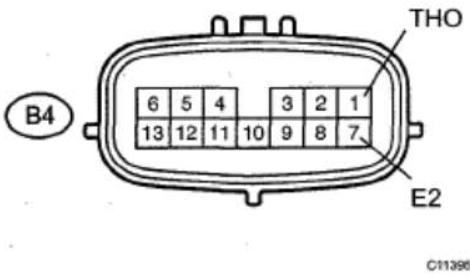


Fig. 34: Identifying B4 ATF Temperature Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connectors.
   c. Measure the resistance according to the value(s) in the table below.

cardiagn.com

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-24 (THO1) - B1-28 (E2)	Always	79 ohms to 156 kohms

d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-24 (THO1) - Body ground	Always	10 kohms or higher
B1-28 (E2) - Body ground		

Rear view of wire harness connector:
(to ECM)

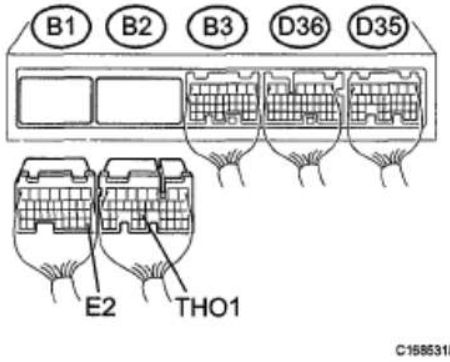


Fig. 35: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

DTC P0717 TURBINE SPEED SENSOR CIRCUIT NO SIGNAL

DESCRIPTION

This sensor detects the rotation speed of the input turbine. By comparing the input turbine speed signal (NT) with the counter gear speed sensor signal (NC), the ECM detects the shift timing of the gears and appropriately controls the engine torque and hydraulic pressure according to various conditions. Thus, providing smooth gear shift.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0717	ECM detects conditions (a), (b) and (c) continuously for 5 sec. or more: (1 -trip detection logic) a. Vehicle speed: 50 km/h (31 mph) or more b. Park/neutral position switch (NSW (STAR) and R) is OFF c. Speed sensor (NT): less than 300 rpm	• Open or short in transmission revolution sensor NT (speed sensor NT) circuit • Transmission revolution sensor NT (speed sensor NT) • ECM • Automatic transaxle assembly

Reference (Using an oscilloscope):

Check the waveform between terminals NT+ and NT- of the ECM connector.

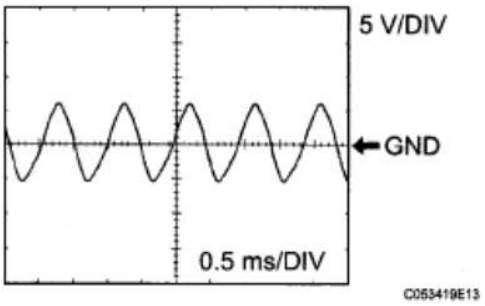


Fig. 36: Waveform Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard: Refer to the illustration.

TERMINAL REFERENCE

Terminal	NT+ - NT-
Tool setting	5 V/DIV, 0.5 ms/DIV
Vehicle condition	Vehicle speed 20 km/h (12 mph)

MONITOR DESCRIPTION

The NT terminal of the ECM detects a revolution signal from the speed sensor (NT) (input RPM). The ECM calculates a gearshift comparing the speed sensor (NT) with the speed sensor (NC).

While the vehicle is operating in 2nd, 3rd, 4th or 5th gear in the shift position of D, if the input shaft revolution is less than 300 rpm*1 although the output shaft revolution is more than 1000 rpm*2 , the ECM detects the trouble, illuminates the MIL and stores the DTC.

*1: Pulse is not output or is irregularly output.

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

*2: The vehicle speed is 50 km/h (31 mph) or more.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0717: Speed sensor (NT)/Verify pulse input
Required sensors/Components	Speed sensor (NT), Speed sensor (NC)
Frequency of operation	Continuous
Duration	5 sec.
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0746, P0748 (Shift solenoid valve SL1 circuit) P0776, P0778 (Shift solenoid valve SL2 circuit) P0796, P0798 (Shift solenoid valve SL3 circuit) P0766, P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit)
Shift change	Shift change is completed and before starting next shift change operation
ECM selected gear	2nd, 3rd, 4th or 5th
Output shaft rpm	1000 rpm or more
NSW (STAR) switch	OFF
R switch	OFF
Engine	Running
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Sensor signal rpm	Less than 300 rpm

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Speed sensor (NT)	Turbine speed is equal to engine speed with lock-up ON

WIRING DIAGRAM

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

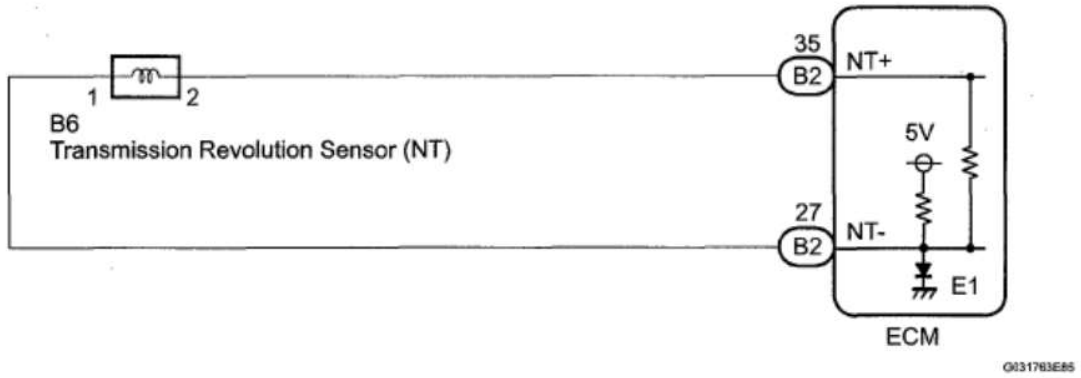


Fig. 37: Turbine Speed Sensor - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT SPEED SENSOR INSTALLATION**
   a. Check the speed sensor installation.

   OK: The installation bolt is tightened properly and there is no clearance between the sensor and transaxle case.

   NG: REPLACE SPEED SENSOR (NT) (See **REMOVAL**)

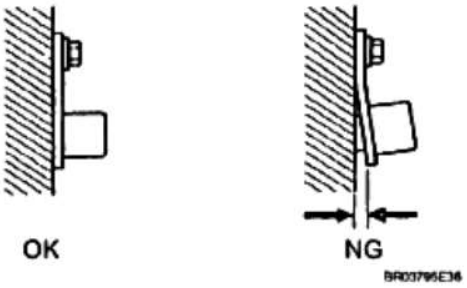


Fig. 38: Identifying Clearance Between Sensor And Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   OK: Go to next step

2. **INSPECT SPEED SENSOR (NT)**
   a. Disconnect the speed sensor connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

STANDARD RESISTANCE SPECIFICATION

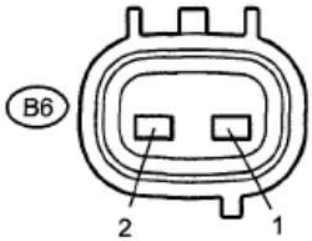
Tester Connection	Condition	Specified Condition

cardiagn.com

1 - 2	20°C (68°F)	560 to 680 ohms

NG: REPLACE SPEED SENSOR (NT) (See **REMOVAL**)

Component without harness connected:
(Speed Sensor)



C110343E70

Fig. 39: Identifying B6 Speed Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (SPEED SENSOR - ECM)**
   a. Connect the speed sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-35 (NT+) - B2-27 (NT-)	20°C (68°F)	560 to 680 ohms

   d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-35 (NT+) - Body ground	Always	10 kohms or higher
B2-27 (NT-) - Body ground		

cardiagn.com

Rear view of wire harness connector:
(to ECM)

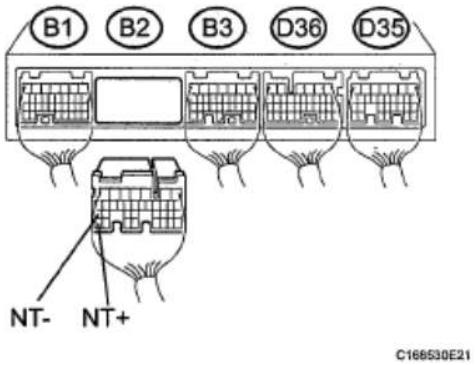


Fig. 40: Identifying ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

DTC P0724 BRAKE SWITCH "B" CIRCUIT HIGH

DESCRIPTION

The purpose of this circuit is to prevent the engine from stalling while driving in lock-up condition when brakes are suddenly applied.

When the brake pedal is depressed, this switch sends a signals to the ECM. Then the ECM cancels the operation of the lock-up clutch while braking is in progress.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0724	The stop light switch remains ON even when the vehicle is driven in a STOP (less than 3 km/h (2 mph) and GO (30 km/h (19 mph) or more) fashion 5 times. (2-trip detection logic).	• Short in stop light switch circuit • Stop light switch • ECM

MONITOR DESCRIPTION

This DTC indicates that the stop light switch remains on. When the stop light switch remains ON during "stop and go" driving, the ECM interprets this as a fault in the stop light switch and the MIL comes on and the ECM

cardiagn.com

stores the DTC. The vehicle must stop (less than 3 km/h (2 mph)) and go (30 km/h (19 mph) or more) 5 times for two driving cycles in order to detect a malfunction.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0724: Stop light switch/Rationality
Required sensors/Components	Stop light switch, Vehicle speed sensor
Frequency of operation	Continuous
Duration	GO and STOP 5 times
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Ignition switch	ON
Starter	OFF
Battery voltage	8 V or more
GO (Vehicle speed is 30 km/h (19 mph) or more)	Once
STOP (Vehicle speed is less than 3 km/h (2 mph))	Once

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Brake switch	Remain ON during GO and STOP 5 times

WIRING DIAGRAM

See **DTC P0500 VEHICLE SPEED SENSOR "A"** .

INSPECTION PROCEDURE

1. **READ VALUE USING DATA LIST**

   HINT:

   Using Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

   a. Warm up the engine.
   b. Turn the ignition switch off.

cardiagn.com

c. Connect Techstream to the DLC3.
d. Turn the ignition switch on (IG).
e. Turn on the tester.
f. Select the item "Powertrain/Engine and ECT/Data List".
g. According to the display on the tester, read the "Data List".

TESTER DISPLAY REFERENCE

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
Stop Light Switch	Stop light switch Status/ON or OFF	Brake Pedal is depressed: ON Brake Pedal is released: OFF	-

NOTE: In the table below, the value listed under "Normal Condition" are reference values. Do not depend solely on these reference values when deciding whether apart is faulty or not.

Result

RESULT REFERENCE

Result	Proceed to
NG	A
OK	B

B: Go to step 3

A: Go to next step

2. **INSPECT STOP LIGHT SWITCH ASSEMBLY**
   a. Remove the stop light switch assembly.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Switch position	Specified Condition
1 - 2	Switch pin free	Below 1 ohms
?	Switch pin pushed in	10 kohms or higher
3 - 4	Switch pin free	10 kohms or higher
?	Switch pin pushed in	Below 1 ohms

NG: REPLACE STOP LIGHT SWITCH ASSEMBLY (See **STOP LIGHT SWITCH**)

cardiagn.com

Component without harness connected:
(Stop Light Switch Assembly)

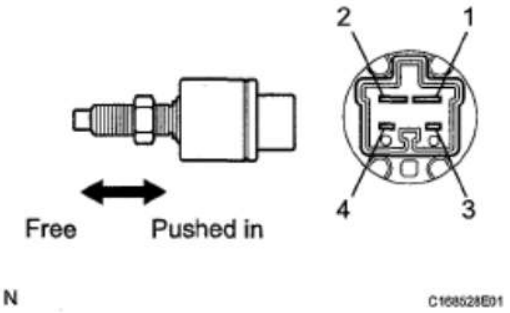


Fig. 41: Inspecting Stop Light Switch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (STOP LIGHT SWITCH ASSEMBLY - ECM)**
   a. Install the stop light switch assembly.
   b. Measure the voltage according to the value(s) in the table below when the brake pedal is depressed and released.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
D35-15 (STP) - Body ground	Brake pedal is depressed	11 to 14 V
	Brake pedal is released	Below 1 V

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Rear view of wire harness connector:
(to ECM)

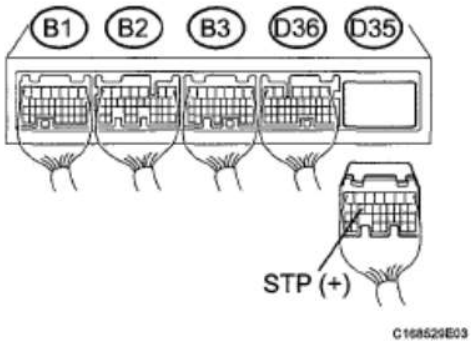


Fig. 42: Identifying ECM Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

DTC P0741 TORQUE CONVERTER CLUTCH SOLENOID PERFORMANCE (SHIFT SOLENOID VALVE DSL)

SYSTEM DESCRIPTION

The ECM uses the signals from the throttle position sensor, air-flow meter, turbine (input) speed sensor, intermediate (counter) shaft speed sensor and crankshaft position sensor to monitor the engagement condition of the lock-up clutch.

Then the ECM compares the engagement condition of the lock-up clutch with the lock-up schedule in the ECM memory to detect a mechanical problems of the shift solenoid valve DSL, valve body and torque converter clutch.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0741	Lock-up does not occur when driving in the lock-up range (normal driving at 80 km/h [50 mph]), or lock up remains ON in the lock-up OFF range. (2-trip detection logic)	• Shift solenoid valve DSL remains open or closed • Valve body is blocked • Torque converter clutch • Automatic transaxle (clutch, brake or gear etc.) • Line pressure is too low

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

MONITOR DESCRIPTION

Torque converter lock-up is controlled by the ECM based on the speed sensor (NT), speed sensor (NC), engine rpm, engine load, engine temperature, vehicle speed, transmission temperature, and gear selection. The ECM determines the lock-up status of the torque converter by comparing the engine rpm (NE) to the input turbine rpm (NT). The ECM calculates the actual transmission gear by comparing input turbine rpm (NT) to counter gear rpm (NC). When conditions are appropriate, the ECM requests "lock-up" by applying control voltage to the shift solenoid DSL. When the shift solenoid DSL is turned on, it applies pressure to the lock-up relay valve and locks the torque converter clutch.

If the ECM detects no lock-up after lock-up has been requested or if it detects lock-up when it is not requested, the ECM interprets this as a fault in the shift solenoid valve DSL or lock-up system performance. The ECM will turn on the MIL and store the DTC.

HINT:

Example:

When any of the following is met, the system judges it as a malfunction.

- There is a difference in rotation between the input side (engine speed) and output side (input turbine speed) of the torque converter when the ECM commands lock-up.

  (Engine speed is at least 75 rpm greater than input turbine speed.)

- There is no difference in rotation between the input side (engine speed) and output side (input turbine speed) of the torque converter when the ECM commands lock-up off.

  (The difference between engine speed and input turbine speed is less than 35 rpm.)

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0741: Shift solenoid valve DSL/OFF malfunction Shift solenoid valve DSL/ON malfunction
Required sensors/Components	Shift solenoid valve DSL, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE), Throttle position sensor (VPA1), Mass airflow sensor (MAF), Transmission temperature sensor (THO1), Engine coolant temperature sensor (ECT)
Frequency of operation	Continuous
Duration	OFF malfunction (A) Continuous. OFF malfunction (B) 1 sec. OFF malfunction (C) 3.5 sec.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	ON malfunction 1.8 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
ECT (Engine coolant temperature)	10°C (50°F) or more
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

OFF malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	3rd
Throttle valve opening angle	4.5% or more at engine speed gear 1900 rpm (varies with engine speed)

OFF malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	5th
Vehicle speed	10 km/h (6 mph) or more

OFF malfunction (C):

TYPICAL ENABLING CONDITIONS

ECM lock-up command	ON
ECM selected gear	3rd, 4th or 5th

cardiagn.com

Vehicle speed	25 km/h (16 mph) or more

ON malfunction:

TYPICAL ENABLING CONDITIONS

ECM lock-up command	OFF
ECM selected gear	3rd, 4th or 5th
Throttle valve opening angle	7% or more
Vehicle speed	3rd 25 to 60 km/h (16 to 37 mph)
	4th, 5th 25 to 120 km/h (16 to 75 mph)

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met: OFF malfunction or ON malfunction OFF malfunction:

TYPICAL MALFUNCTION THRESHOLDS

Engine Speed - Input (turbine) speed	100 rpm or more

ON malfunction:

TYPICAL MALFUNCTION THRESHOLDS

Difference between engine speed and input (turbine) speed	Less than 35 rpm

INSPECTION PROCEDURE

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

1. **PERFORM ACTIVE TEST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Select the item "Powertrain/Engine and ECT/Active Test".
   f. According to the display on the tester, perform the "Active Test".

TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
	[Test Details]		

cardiagn.com

Activate the Lock Up	Control the shift solenoid DSL to set the automatic transaxle to the lock-up condition. [Vehicle Condition] • Throttle valve opening angle: Less than 35 % • Vehicle Speed: 60 km/h (37 mph) or more	ON/OFF	Possible to check the DSL operation.

HINT:

- This test can be conducted when the vehicle speed is 60 km/h (37 mph) or more.
- This test can be conducted in the 5th gear.

g. Lightly depress the accelerator pedal and check that the engine speed does not change abruptly.

HINT:

- When changing the accelerator pedal opening angle while driving, if the engine speed does not change, lock-up is on.
- Slowly release, but not fully, the accelerator pedal in order to decelerate. (Fully releasing the pedal will close the throttle valve and lock-up may be turned off.)

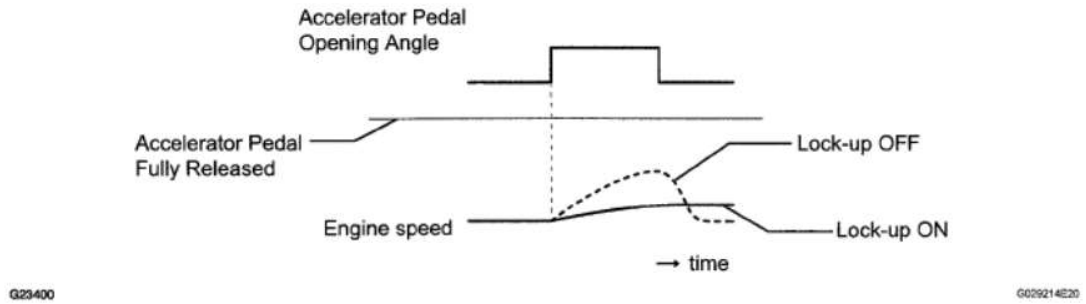


Fig. 43: Accelerator Pedal Opening Angle Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0741)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   c. When you use Techstream:

      Select the item "Powertrain/Engine and ECT/Trouble Codes".

   d. Read the DTCs using Techstream.

      Result

cardiagn.com

RESULT REFERENCE

Result	Proceed to
P0741	A
P0741 and other DTCs	B

HINT:

If any other codes besides "P0741" are output, perform the troubleshooting for those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT TRANSMISSION WIRE (DSL)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
10 (DSL) - Body ground	20°C (68°F)	11 to 13 ohms

NG: Go to step 4

Component without harness connected:
(Transmission Wire)

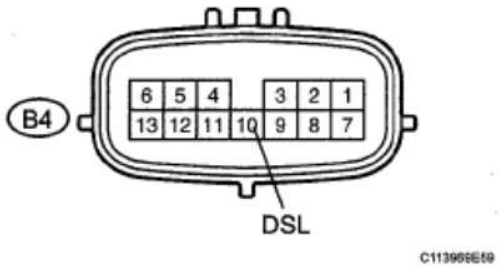


Fig. 44: Identifying Terminal DSL Of B4 Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**

cardiagn.com

a. Connect the transmission wire connector.
b. Disconnect the ECM connector.
c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-11 (DSL) - Body ground	20°C (68°F)	11 to 13 ohms

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Rear view of wire harness connector:
(to ECM)

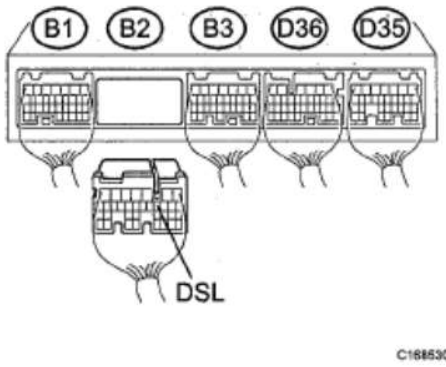


Fig. 45: Identifying Terminal DSL Of ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

4. **INSPECT SHIFT SOLENOID VALVE (DSL)**
   a. Remove the shift solenoid valve DSL.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (DSL) - Solenoid Body (DSL)	20°C (68°F)	11 to 13 ohms

   c. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

cardiagn.com

OK: The solenoid valve makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (DSL) (See **REMOVAL**)

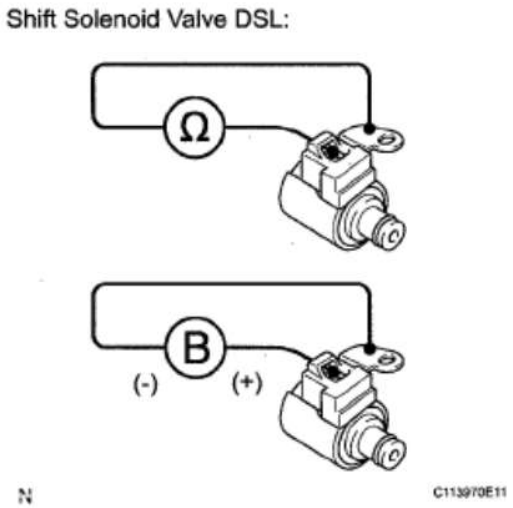


Fig. 46: Inspecting Shift Solenoid Valve (DSL)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

5. **CHECK TRANSMISSION WIRE**

   OK: The connectors and pins are securely installed. There is no open or short on the wire harness.

   NG: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

   OK: Go to next step

6. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

   OK: There are no foreign objects on each valve and they operate smoothly.

   NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

   OK: Go to next step

7. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

   OK: The torque converter clutch operates normally.

   NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

   OK: REPAIR AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

DTC P0746 PRESSURE CONTROL SOLENOID "A" PERFORMANCE (SHIFT SOLENOID VALVE SL1)

SYSTEM DESCRIPTION

The ECM uses signals from the vehicle speed sensor to detect the actual gear position (1st, 2nd, 3rd, 4th or 5th gear).

Then the ECM compares the actual gear with the shift schedule in the ECM memory to detect mechanical problems of the shift solenoid valves, valve body or automatic transaxle (clutch, brake or gear, etc.).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0746	The gear required by the ECM does not match the actual gear when driving (2-trip detection logic)	• Shift solenoid valve SL1 remains open or closed • Valve body is blocked • Automatic transaxle (clutch, brake or gear, etc.)

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". According to the input shaft revolution, intermediate (counter) shaft revolution and output shaft revolution, the ECM detects the actual gear position (1st, 2nd, 3rd, 4th or 5th gear position). When the gear position commanded by the ECM and the actual gear position are not the same, the ECM illuminates the MIL.

HINT:

Example:

When either condition (a) or (b) is met, the ECM detects a malfunction.

a. The ECM commands the 1st gear, but the actual gear is 2nd.
b. The ECM commands the 2nd gear, but the actual gear is 1st.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0746: Shift solenoid valve SL1/OFF malfunction Shift solenoid valve SL1/ON malfunction
Required sensors/Components	Shift solenoid valve SL1, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE)
Frequency of operation	Continuous
Duration	0.8 sec.

cardiagn.com

MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

ALL:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
ECT (Engine coolant temperature)	10°C (50°F)or more
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

OFF malfunction:

TYPICAL ENABLING CONDITIONS

ECM selected gear	1st
Vehicle speed	Less than 40 km/h (25 mph)
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

ON malfunction:

TYPICAL ENABLING CONDITIONS

ECM selected gear	2nd
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met: OFF malfunction or ON malfunction

OFF malfunction:

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

2 detections are necessary per driving cycle:

1st detection; temporary flag ON

2nd detection; pending fault code ON

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	1.49 to 1.63

ON malfunction:

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	2.72 to 2.86

INSPECTION PROCEDURE

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

1. **PERFORM ACTIVE TEST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.
   f. Select the item "Powertrain/Engine and ECT/Active Test/Shift Status".
   g. According to the display on the tester, perform the "Active Test".

      HINT:

      While driving, the shift position can be forcibly changed with Techstream.

      Comparing the shift position commanded by the Active Test with the actual shift position enables you to confirm the problem (See **FAIL-SAFE CHART**).

TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
	[Test Details] Operate the shift solenoid valve and set each shift position by		

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Control the Shift Position	yourself. [Vehicle Condition] • IDL: ON • Less than 50 km/h (31 mph) [Others] • Press "-->" button: Shift up • Press "<--" button: Shift down	1st/2nd/3rd/4th/5th	Possible to check the operation of the shift solenoid valves.

HINT:

- This test can be conducted when the vehicle speed is 50 km/h (31 mph) or less.
- The shift position commanded by the ECM is shown in the Data List/Shift Status display on Techstream.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0746)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   c. When you use Techstream:

      Select the item "Powertrain/Engine and ECT/Trouble Codes".

   d. Read the DTCs using Techstream.

      Result

      RESULT REFERENCE

Result	Proceed to
P0746	A
P0746 and other DTCs	B

      HINT:

      If any other codes besides "P0746" are output, perform the troubleshooting for those DTCs first.

      B: GO TO **DTC CHART**

      A: Go to next step

2. **INSPECT SHIFT SOLENOID VALVE (SL1)**

cardiagn.com

a. Remove the shift solenoid valve SL1.
b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SL1) (See **REMOVAL**)

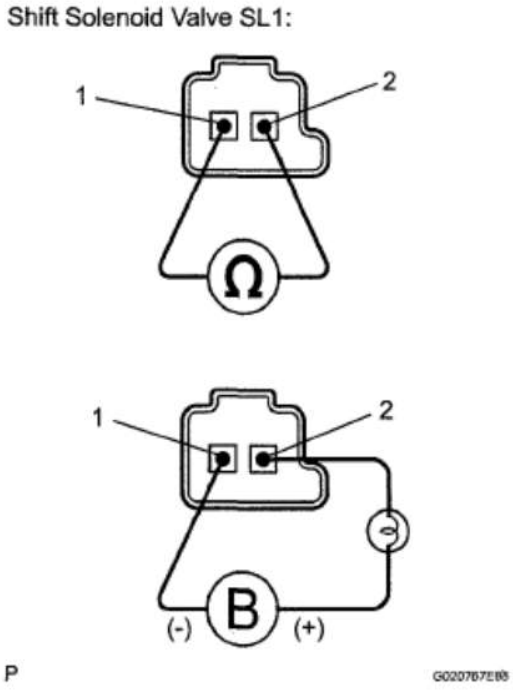


Fig. 47: Inspecting Shift Solenoid Valve (SL1)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

OK: There are no foreign objects on each valve and they operate smoothly.

NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

cardiagn.com

OK: Go to next step

4. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

OK: The torque converter clutch operates normally.

NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

OK: REPAIR OR REPLACE AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

DTC P0748 PRESSURE CONTROL SOLENOID "A" ELECTRICAL (SHIFT SOLENOID VALVE SL1)

DESCRIPTION

Shifting from 1st to 5th is performed in combination with "ON" and "OFF" operation of the shift solenoid valves SL1, SL2, SL3, S4 and SR which are controlled by the ECM. If an open or short circuit occurs in either of the shift solenoid valves, the ECM controls the remaining normal shift solenoid valves to allow the vehicle to be operated smoothly (Fail safe function).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0748	The ECM checks for an open or short in the shift solenoid valve SL1 circuit while driving and shift gears. (1-trip detection logic) • Output signal duty equals to 100 %. (NOTE: SL1 output signal duty is less than 100 % under normal condition.)	• Open or short in shift solenoid valve SL1 circuit • Shift solenoid valve SL1 • ECM

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". When there is an open or short circuit in any shift solenoid valve circuit, the ECM detects the problem and illuminates the MIL and stores the DTC. And the ECM performs the fail-safe function and turns the other normal shift solenoid valves "ON/OFF" (In case of an open or short circuit, the ECM stops sending current to the circuit.) (See **FAIL-SAFE CHART**).

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0748: Shift solenoid valve SL1/Range check
Required sensors/Components	Shift solenoid valve SL1
Frequency of operation	Continuous
Duration	1 sec.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Battery voltage	10 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Output signal duty	100%

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Output signal duty	Less than 100%

WIRING DIAGRAM

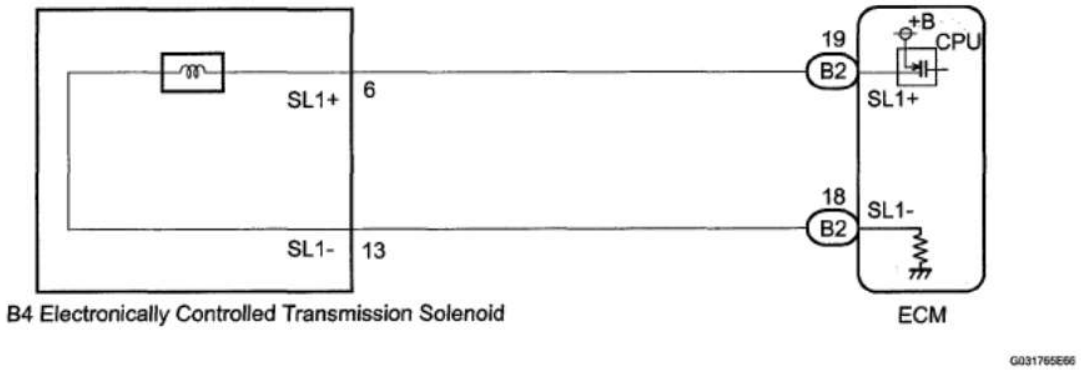


Fig. 48: Pressure Control Solenoid "A" Electrical (Shift Solenoid Valve SL1) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (SL1)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

cardiagn.com

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
6 (SL1+) - 13 (SL1-)	20°C (68°F)	5.0 to 5.6 ohms

c. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
6 (SL1+) - Body ground	Always	10 kohms or higher
13 (SL1-) - Body ground	Always	?

Component without harness connected:
(Transmission Wire)

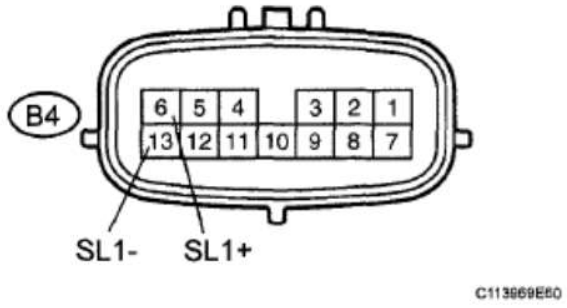


Fig. 49: Identifying B4 Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 3

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

cardiagn.com

Tester Connection	Condition	Specified Condition
B2-19 (SL1+) - B2-18 (SL1-)	20°C (68°F)	5.0 to 5.6 ohms

d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-19 (SL1+) - Body ground	Always	10 kohms or higher
B2-18 (SL1-) - Body ground		

Rear view of wire harness connector:
(to ECM)

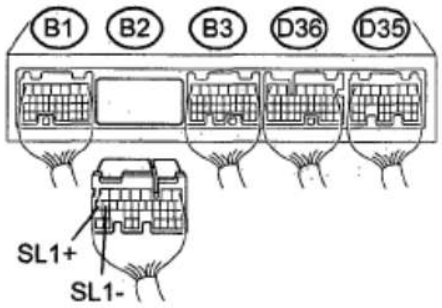


Fig. 50: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (SL1)**
   a. Remove the shift solenoid valve SL1.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1

cardiagn.com

of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SL1) (See **REMOVAL**)

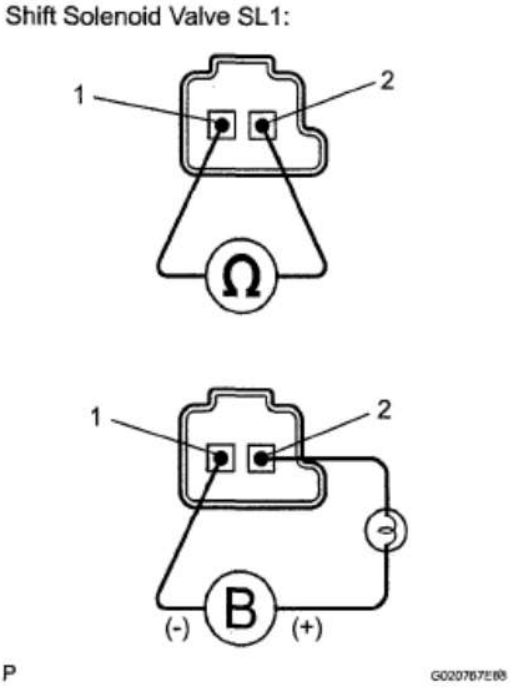


Fig. 51: Inspecting Shift Solenoid Valve (SL1)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

DTC P0766 SHIFT SOLENOID "D" PERFORMANCE (SHIFT SOLENOID VALVE S4)

SYSTEM DESCRIPTION

The ECM uses signals from the vehicle speed sensor to detect the actual gear position (1st, 2nd, 3rd, 4th or 5th gear).

Then the ECM compares the actual gear with the shift schedule in the ECM memory to detect mechanical problems of the shift solenoid valves, valve body or automatic transaxle (clutch, brake or gear, etc.).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
	The gear required by the ECM does not match the actual	• Shift solenoid valve S4 remains open or closed

cardiagn.com

P0766	gear when driving (2-trip detection logic)	• Valve body is blocked • Automatic transaxle (clutch, brake or gear, etc.)

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". According to the input shaft revolution, intermediate (counter) shaft revolution and output shaft revolution, the ECM detects the actual gear position (1st, 2nd, 3rd, 4th or 5th gear position). When the gear position commanded by the ECM and the actual gear position are not the same, the ECM illuminates the MIL and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0766: Shift solenoid valve S4/OFF malfunction Shift solenoid valve S4/ON malfunction
Required sensors/Components	Shift solenoid valve S4, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE)
Frequency of operation	Continuous
Duration	OFF malfunction (A) and ON malfunction (B) 1 sec. OFF malfunction (B) 1.2 sec. ON malfunction (A) 0.8 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505,

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

	P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
ECT (Engine coolant temperature)	10°C (50°F) or more
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

OFF malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	5th
Throttle valve opening angle	5% or more
Vehicle speed	10 km/h (6 mph) or more

OFF malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM lock-up command	ON
ECM selected gear	3rd, 4th or 5th
Throttle valve opening angle	10% or more
Vehicle speed	3rd 25 to 100 km/h (16 to 62 mph)
	4th, 5th 25 to 120 km/h (16 to 75 mph)

ON malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	4th or 5th
Throttle valve opening angle	4.5% or more at engine speed 1,900 rpm (Varies with engine speed)

ON malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	4th
Throttle valve opening angle	5% or more
Vehicle speed	10 km/h (6 mph) or more

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met: OFF malfunction (A) and (B), or ON malfunction (A) and (B)

2 detections are necessary per driving cycle:

1st detection; temporary flag ON

2nd detection; pending fault code ON

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

OFF malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Intermediate shaft speed/Output speed	1.44 to 1.58

OFF malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Difference between engine speed and input (turbine) speed	Less than 35 rpm

ON malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.64 to 0.74

ON malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Intermediate shaft speed/Output speed	1.02 to 1.16

INSPECTION PROCEDURE

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

1. **PERFORM ACTIVE TEST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.
   f. Select the item "Powertrain/Engine and ECT/Active Test/Shift Status".
   g. According to the display on the tester, perform the "Active Test".

      HINT:

      While driving, the shift position can be forcibly changed with Techstream.

      Comparing the shift position commanded by the Active Test with the actual shift position enables you to confirm the problem (See **FAIL-SAFE CHART**).

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Shift Position	[Test Details] Operate the shift solenoid valve and set each shift position by yourself. [Vehicle Condition] • IDL: ON • Less than 50 km/h (31 mph) [Others] • Press "-->" button: Shift up • Press "<--" button: Shift down	1st/2nd/3rd/4th/5th	Possible to check the operation of the shift solenoid valves.

HINT:

- This test can be conducted when the vehicle speed is 50 km/h (31 mph) or less.
- The shift position commanded by the ECM is shown in the Data List/Shift Status display on Techstream.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0766)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   c. Select the item "Powertrain/Engine and ECT/Trouble Codes".
   d. Read the DTCs using Techstream.

   Result

RESULT REFERENCE

Result	Proceed to
P0766	A
P0766 and other DTCs	B

HINT:

If any other codes besides "P0766" are output, perform the troubleshooting for those DTCs first.

B: GO TO **DTC CHART**

cardiagn.com

A: Go to next step

2. **INSPECT SHIFT SOLENOID VALVE S4**
   a. Remove the shift solenoid valve S4.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (S4) - Solenoid Body (S4)	20°C (68°F)	11 to 15 ohms

   c. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (S4) (See **REMOVAL**)

Shift Solenoid Valve S4:

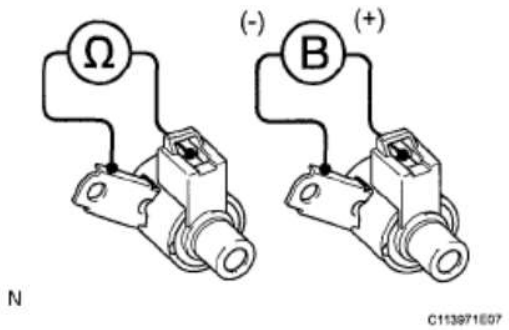


Fig. 52: Inspecting Shift Solenoid Valve S4
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

OK: There are no foreign objects on each valve and they operate smoothly.

NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

OK: Go to next step

cardiagn.com

4. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

OK: The torque converter clutch operates normally.

NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

OK: REPAIR OR REPLACE AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

DTC P0771 SHIFT SOLENOID "E" PERFORMANCE (SHIFT SOLENOID VALVE SR)

SYSTEM DESCRIPTION

The ECM uses signals from the vehicle speed sensor to detect the actual gear position (1st, 2nd, 3rd, 4th or 5th gear).

Then the ECM compares the actual gear with the shift schedule in the ECM memory to detect mechanical problems of the shift solenoid valves, valve body or automatic transaxle (clutch, brake or gear, etc.).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0771	The gear required by the ECM does not match the actual gear when driving (2-trip detection logic)	• Shift solenoid valve SR remains open or closed • Valve body is blocked • Automatic transaxle (clutch, brake or gear, etc.)

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". According to the input shaft revolution, intermediate (counter) shaft revolution and output shaft revolution, the ECM detects the actual gear position (1st, 2nd, 3rd, 4th or 5th gear position). When the gear position commanded by the ECM and the actual gear position are not the same, the ECM illuminates the MIL and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0771: Shift solenoid valve SR/Rationality check
Required sensors/Components	Shift solenoid valve SR, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE)
Frequency of operation	Continuous
	OFF malfunction (A) 1 sec. OFF malfunction (B) 3.5 sec.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Duration	ON malfunction (A) Continuous ON malfunction (B), (C) and (D) 0.8 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
ECT (Engine coolant temperature)	10°C (50°F)or more
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

OFF malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	5th
Throttle valve opening angle	5% or more
Vehicle speed	10km/h (6mph) or more

OFF malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM lock-up command	ON
ECM selected gear	3rd, 4th or 5th
Vehicle speed	25 km/h (16 mph) or more

ON malfunction (A):

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL ENABLING CONDITIONS

ECM lock-up command	OFF

ON malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	1st
Vehicle speed	Less than 40 km/h (25 mph)
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

ON malfunction (C):

TYPICAL ENABLING CONDITIONS

ECM selected gear	3rd
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

ON malfunction (D):

TYPICAL ENABLING CONDITIONS

Duration time from shift command of ECM	15 sec. or more
ECM selected gear	4th or 5th

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met: OFF malfunction (A) and (B), or ON malfunction (A), (B), (C) and (D)

OFF malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Intermediate shaft speed/Output speed	1.44 to 1.58

OFF malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Engine speed - Input (turbine) speed When condition "OFF" malfunction (A)" of shift solenoid "D" is detected;	75 rpm or more
Engine speed - Input (turbine) speed When condition "OFF" malfunction (A)" of shift solenoid "D" is not detected;	100 rpm or more

ON malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Difference between engine speed and input (turbine) speed	150 rpm or more

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

ON malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.93 to 1.07

ON malfunction (C):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.93 to 1.07

ON malfunction (D):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.64 to 0.74

INSPECTION PROCEDURE

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

1. **PERFORM ACTIVE TEST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.
   f. Select the item "Powertrain/Engine and ECT/Active Test/Shift Status".
   g. According to the display on the tester, perform the "Active Test".

      HINT:

      While driving, the shift position can be forcibly changed with Techstream.

      Comparing the shift position commanded by the Active Test with the actual shift position enables you to confirm the problem (See **FAIL-SAFE CHART**).

      TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
	[Test Details]		

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Control the Shift Position	Operate the shift solenoid valve and set each shift position by yourself. [Vehicle Condition] • IDL: ON • Less than 50 km/h (31 mph) [Others] • Press "-->" button: Shift up • Press "<--" button: Shift down	1st/2nd/3rd/4th/5th	Possible to check the operation of the shift solenoid valves.

HINT:

- This test can be conducted when the vehicle speed is 50 km/h (31 mph) or less.
- The shift position commanded by the ECM is shown in the Data List/Shift Status display on Techstream.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0771)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   c. When you use Techstream:

      Select the item "Powertrain/Engine and ECT/Trouble Codes".

   d. Read the DTCs using Techstream.

      Result

      RESULT REFERENCE

Result	Proceed to
P0771	A
P0771 and other DTCs	B

HINT:

If any other codes besides "P0771" are output, perform the troubleshooting for those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

2. **INSPECT SHIFT SOLENOID VALVE (SR)**
   a. Remove the shift solenoid valve SR.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (SR) - Solenoid Body (SR)	20°C (68°F)	11 to 15 ohms

   c. Connect positive (+) lead to the terminal of solenoid connector, negative (-) lead to the solenoid body.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SR) (See **REMOVAL**)

Shift Solenoid Valve SR:

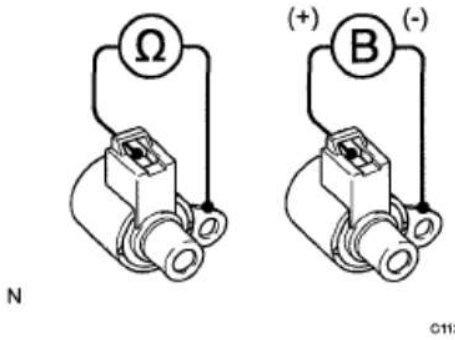


Fig. 53: Inspecting Shift Solenoid Valve (SR)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

OK: There are no foreign objects on each valve and they operate smoothly.

NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

OK: Go to next step

4. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

OK: The torque converter clutch operates normally.

NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

OK: REPAIR OR REPLACE AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

DTC P0776 PRESSURE CONTROL SOLENOID "B" PERFORMANCE (SHIFT SOLENOID VALVE SL2)

SYSTEM DESCRIPTION

The ECM uses signals from the vehicle speed sensor to detect the actual gear position (1st, 2nd, 3rd, 4th or 5th gear).

Then the ECM compares the actual gear with the shift schedule in the ECM memory to detect mechanical problems of the shift solenoid valves, valve body or automatic transaxle (clutch, brake or gear, etc.).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0776	The gear required by the ECM does not match the actual gear when driving (2-trip detection logic)	• Shift solenoid valve SL2 remains open or closed • Valve body is blocked • Automatic transaxle (clutch, brake or gear, etc.)

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". According to the input shaft revolution, intermediate (counter) shaft revolution and output shaft revolution, the ECM detects the actual gear position (1st, 2nd, 3rd, 4th or 5th gear position). When the gear position commanded by the ECM and the actual gear position are not the same, the ECM illuminates the MIL and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0776: Shift solenoid valve SL2/OFF malfunction Shift solenoid valve SL2/ON malfunction
Required sensors/Components	Shift solenoid valve SL2, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE)
Frequency of operation	Continuous
	OFF malfunction (A) 1.8 sec. OFF malfunction (B) and (C) 0.8 sec.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Duration	ON malfunction (A) and (B) 0.8 sec. ON malfunction (C) 0.4 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

All:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
ECT (Engine coolant temperature)	10°C (50°F) or more
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

OFF malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM lock-up command	OFF
Vehicle speed	3rd Less than 60 km/h (37 mph)
	4th, 5th Less than 120 km/h (75 mph)
Throttle valve opening angle	7% or more

OFF malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	1st
Vehicle speed	Less than 40 km/h (25 mph)
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

OFF malfunction (C):

TYPICAL ENABLING CONDITIONS

ECM selected gear	3rd
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

OFF malfunction (D):

TYPICAL ENABLING CONDITIONS

Duration time from shift command of ECM	15 sec. or more
ECM selected gear	4th or 5th

ON malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	1st
Vehicle speed	Less than 40 km/h (25 mph)
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

ON malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	3rd
Throttle valve opening angle	5% or more at output speed 1400 rpm (Varies with engine speed)
Malfunction of pressure control solenoid "B" (SL2) and "C" (SL3)	Not detected

ON malfunction (C):

TYPICAL ENABLING CONDITIONS

Throttle valve opening angle	7.0% or more at output speed 1050 rpm (Varies with engine speed)
Malfunction of pressure control solenoid "B" (SL2)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met: OFF malfunction (A), (B), (C) and (D), or ON malfunction (A), (B) and (C)

OFF malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

cardiagn.com

Difference between engine speed and input (turbine) speed	Less than 35 rpm

OFF malfunction (B) and (C):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.93 to 1.07

OFF malfunction (D):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.64 to 0.74

ON malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	2.72 to 2.86

ON malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed - Intermediate shaft speed	700 rpm or more

ON malfunction (C):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed - Intermediate shaft speed	Less than -500 rpm or 700 rpm or more

INSPECTION PROCEDURE

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

1. **PERFORM ACTIVE TEST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.

cardiagn.com

f. Select the item "Powertrain/Engine and ECT/Active Test/Shift Status".

g. According to the display on the tester, perform the "Active Test".

HINT:

While driving, the shift position can be forcibly changed with Techstream.

Comparing the shift position commanded by the Active Test with the actual shift position enables you to confirm the problem (See **FAIL-SAFE CHART**).

TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Shift Position	[Test Details] Operate the shift solenoid valve and set each shift position by yourself. [Vehicle Condition] • IDL: ON • Less than 50 km/h (31 mph) [Others] • Press "-->" button: Shift up • Press "<--" button: Shift down	1st/2nd/3rd/4th/5th	Possible to check the operation of the shift solenoid valves.

HINT:

- This test can be conducted when the vehicle speed is 50 km/h (31 mph) or less.
- The shift position commanded by the ECM is shown in the Data List/Shift Status display on Techstream.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0776)**

a. Connect Techstream to the DLC3.

b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.

c. When you use Techstream:

Select the item "Powertrain/Engine and ECT/Trouble Codes".

d. Read the DTCs using Techstream.

Result

cardiagn.com

RESULT REFERENCE

Result	Proceed to
P0776	A
P0776 and other DTCs	B

HINT:

If any other codes besides "P0776" are output, perform the troubleshooting for those DTCs first.

B: GO TO **DTC CHART**

A: Go to next step

2. **INSPECT SHIFT SOLENOID VALVE (SL2)**
   a. Remove the shift solenoid valve SL2.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SL2) (See **REMOVAL**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

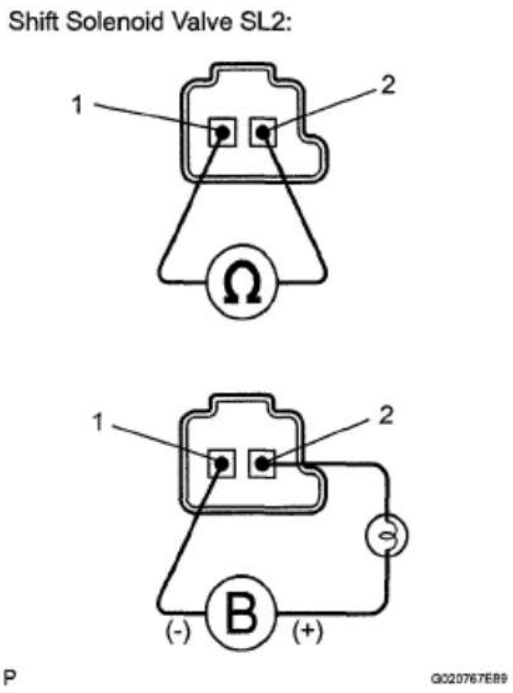


Fig. 54: Inspecting Shift Solenoid Valve (SL2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

   OK: There are no foreign objects on each valve and they operate smoothly.

   NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

   OK: Go to next step

4. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

   OK: The torque converter clutch operates normally.

   NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

   OK: REPAIR OR REPLACE AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

DTC P0778 PRESSURE CONTROL SOLENOID "B" ELECTRICAL (SHIFT SOLENOID VALVE SL2)

DESCRIPTION

Shifting from 1st to 5th is performed in combination with "ON" and "OFF" operation of the shift solenoid

cardiagn.com

valves SL1, SL2, SL3, S4 and SR which are controlled by the ECM. If an open or short circuit occurs in either of the shift solenoid valves, the ECM controls the remaining normal shift solenoid valves to allow the vehicle to be operated smoothly (Fail safe function).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0778	ECM checks for an open or short circuit in shift solenoid valves SL2 (1-trip detection logic) Hybrid IC for solenoid indicates fail.	• Open or short in shift solenoid valve SL2 circuit • Shift solenoid valve SL2 • ECM

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". When there is an open or short circuit in any shift solenoid valve circuit, the ECM detects the problem and illuminates the MIL, and stores the DTC. And the ECM performs the fail-safe function and turns the other normal shift solenoid valves "ON/OFF" (In case of an open or short circuit, the ECM stops sending current to the circuit.) (See **FAIL-SAFE CHART**).

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0778: Shift solenoid valve SL2/Range check
Required sensors/Components	Shift solenoid valve SL2
Frequency of operation	Continuous
Duration	1 sec.
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Solenoid current cut status	Not cut
Battery voltage	11 V or more
Ignition switch	ON
Starter	OFF
CPU commanded duty ratio to SL2	19% or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Solenoid status from IC	Fail (Open or short)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Output signal duty	Less than 100%

WIRING DIAGRAM

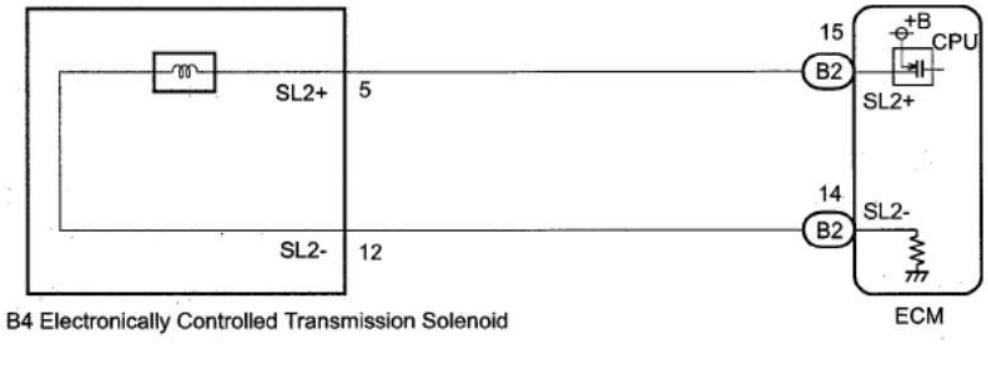


Fig. 55: Pressure Control Solenoid "B" Electrical (Shift Solenoid Valve SL2) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (SL2)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
5 (SL2+) - 12 (SL2-)	20°C (68°F)	5.0 to 5.6 ohms

   c. Measure the resistance according to the value(s) in the table below.

   Standard resistance (Check for short)

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
5 (SL2+) - Body ground	Always	10 kohms or higher
12 (SL2-) - Body ground	Always	10 kohms or higher

   NG: Go to step 3

cardiagn.com

Component without harness connected:
(Transmission Wire)

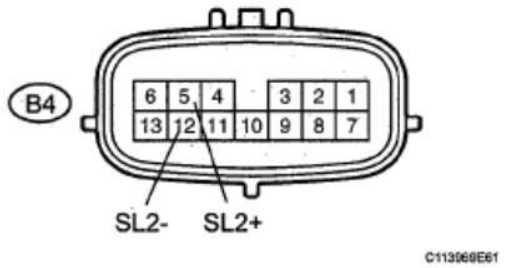


Fig. 56: Identifying B4 Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-15 (SL2+) - B2-14 (SL2-)	20°C (68°F)	5.0 to 5.6 ohms

   d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-15 (SL2+) - Body ground	Always	10 kohms or higher
B2-14 (SL2-) - Body ground		

cardiagn.com

Rear view of wire harness connector:
(to ECM)

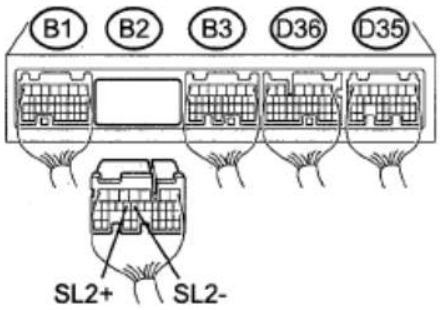


Fig. 57: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (SL2)**
   a. Remove the shift solenoid valve SL2.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SL2) (See **REMOVAL**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

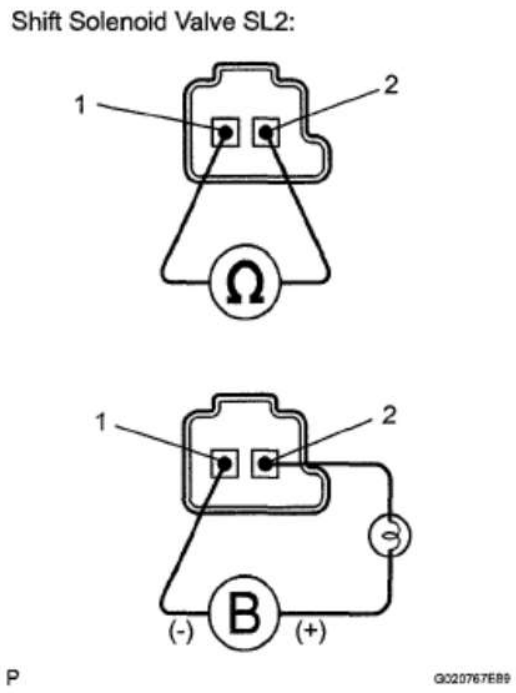


Fig. 58: Inspecting Shift Solenoid Valve (SL2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

DTC P0793 INTERMEDIATE SHAFT SPEED SENSOR "A"

DESCRIPTION

This sensor detects the rotation speed of the counter gear. By comparing the counter gear speed signal (NC) with the direct clutch speed sensor signal (NT), the ECM detects the shift timing of the gears and appropriately controls the engine torque and hydraulic pressure according to various conditions. Thus smooth gear shifting is performed.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0793	ECM detects conditions (a), (b) and (c) continuously for 5 sec. or more: (1-trip detection logic) a. Vehicle speed: 50 km/h (31 mph) or more b. Park/neutral position switch (NSW (STAR)) is OFF c. Speed sensor (NC): less than 300 rpm	• Open or short in transmission revolution sensor NC (speed sensor NC) circuit • Transmission revolution sensor NC (speed sensor NC) • ECM

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Reference (Using an oscilloscope):

Check the waveform between terminals NC+ and NC- of the ECM connector.

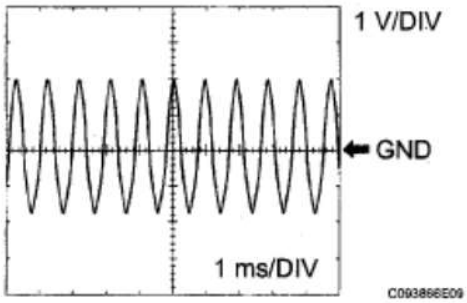


Fig. 59: Waveform Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard: Refer to the illustration.

TERMINAL REFERENCE

Terminal	NC+ - NC-
Tool setting	1 V/DIV, 1 ms/DIV
Vehicle condition	Vehicle speed 30 km/h (19 mph): (3rd gear) Engine speed 1400 rpm

MONITOR DESCRIPTION

The NC terminal of the ECM detects a revolution signal from the speed sensor (NC) (counter gear rpm). The ECM calculates a gearshift comparing the speed sensor (NT) with the speed sensor (NC). While the vehicle is operating in 2nd, 3rd, 4th or 5th gear in the shift position of D, if the counter gear revolution is less than 300 rpm*1 although the output shaft revolution is more than 1,000 rpm*2 , the ECM detects the trouble, illuminates the MIL and stores the DTC.

*1: Pulse is not output or is irregularly output.

*2: The vehicle speed is 50 km/h (31 mph) or more.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0793: Speed sensor (NC)/Verify pulse input
Required sensors/Components	Speed sensor (NC), Speed sensor (NT), Park/neutral position switch
Frequency of operation	Continuous
Duration	5 sec.
MIL operation	Immediate
Sequence of operation	None

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	P0500 (VSS) P0748, P0778, P0798 (Shift solenoid valve (range))
Engine	Running
NSW (STAR) switch	OFF
Output shaft rpm	1000 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Sensor signal rpm	Less than 300 rpm

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Counter gear speed sensor (NC)	HINT: 3rd when shift lever position is D position (After warming up the engine): • Intermediate shaft speed (NC) becomes close to the engine speed.

WIRING DIAGRAM

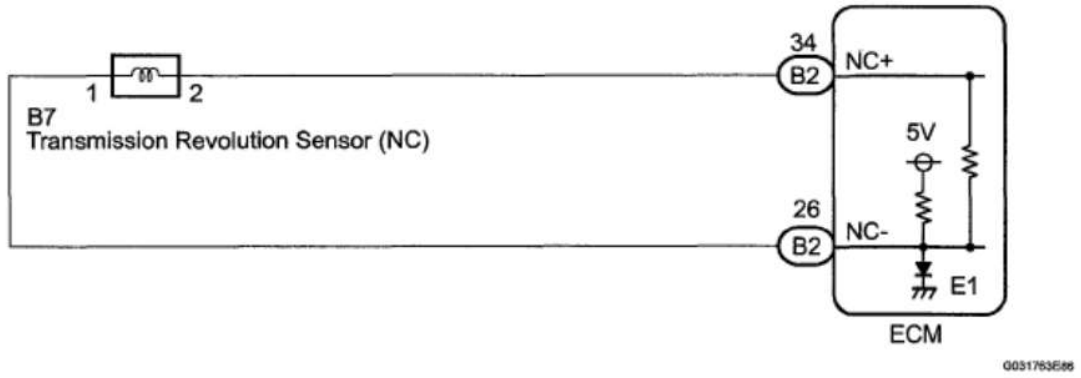


Fig. 60: Intermediate Shaft Speed Sensor "A" - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

HINT:

Using Techstream to read the Data List allows the values or states of switches, sensors, actuators and other items to be read without removing any parts. This non-intrusive inspection can be very useful because

cardiagn.com

intermittent conditions or signals may be discovered before parts or wiring is disturbed. Reading the Data List information early in troubleshooting is one way to save diagnostic time.

1. **READ DATA LIST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.
   f. Select the item "Powertrain/Engine and ECT/Data List".
   g. According to the display on the tester, read the "Data List".

TESTER DISPLAY REFERENCE

Tester Display	Measurement Item/Range	Normal Condition	Diagnostic Note
SPD (NC)	Counter Gear Speed/display: 50 r/min	HINT: 3rd when shift lever position is D position (After warming up the engine): • Intermediate shaft speed (NC) becomes close to the engine speed.	-

HINT:

- SPD (NC) is always 0 while driving:

  Open or short in the sensor or circuit.

- SPD (NC) is always more than 0 and less than 300 rpm while driving the vehicle at 50 km/h (31 mph) or more:

  Sensor trouble, improper installation, or intermittent connection trouble of the circuit.

1. **INSPECT SPEED SENSOR INSTALLATION**
   a. Check the speed sensor installation.

OK: The installation bolt is tightened properly and there is no clearance between the sensor and transaxle case.

NG: REPLACE SPEED SENSOR (NC) (See **REMOVAL**)

cardiagn.com

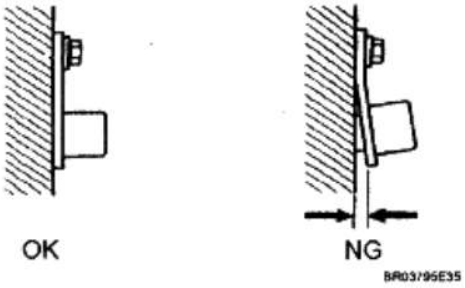


Fig. 61: Identifying Clearance Between Sensor And Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **INSPECT SPEED SENSOR (NC)**
   a. Disconnect the speed sensor connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	560 to 680 ohms

NG: REPLACE SPEED SENSOR (NC) (See **REMOVAL**)

Component without harness connected:
(Speed Sensor)

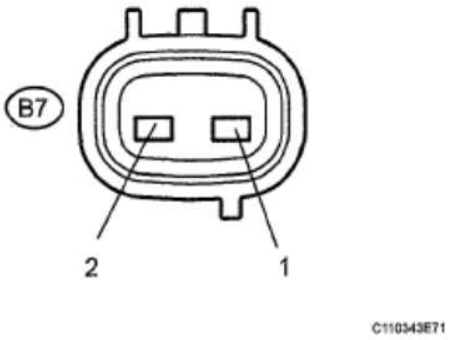


Fig. 62: Identifying B7 Speed Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

cardiagn.com

3. **CHECK HARNESS AND CONNECTOR (SPEED SENSOR - ECM)**
   a. Connect the speed sensor connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-34 (NC+) - B2-26 (NC-)	20°C (68°F)	560 to 680 ohms

   d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-34 (NC+) - Body ground	Always	10 kohms or higher
B2-26 (NC-) - Body ground		

Rear view of wire harness connector:
(to ECM)

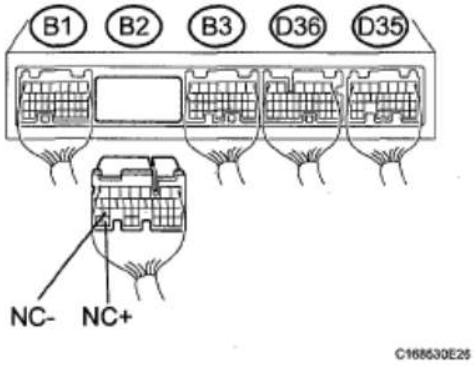


Fig. 63: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

DTC P0796 PRESSURE CONTROL SOLENOID "C" PERFORMANCE (SHIFT SOLENOID VALVE SL3)

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

SYSTEM DESCRIPTION

The ECM uses signals from the vehicle speed sensor to detect the actual gear position (1st, 2nd, 3rd, 4th or 5th gear).

Then the ECM compares the actual gear with the shift schedule in the ECM memory to detect mechanical troubles of the shift solenoid valves and valve body.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0796	The gear required by the ECM does not match the actual gear when driving (2-trip detection logic)	• Shift solenoid valve SL3 remains open or closed • Valve body is blocked • Automatic transaxle (clutch, brake or gear, etc.)

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". According to the input shaft revolution, intermediate (counter) shaft revolution and output shaft revolution, the ECM detects the actual gear position (1st, 2nd, 3rd, 4th or 5th gear position). When the gear position commanded by the ECM and the actual gear position are not the same, the ECM illuminates the MIL and stores the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0796: Shift solenoid valve SL3/OFF malfunction Shift solenoid valve SL3/ON malfunction
Required sensors/Components	Shift solenoid valve SL3, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE)
Frequency of operation	Continuous
Duration	OFF malfunction (A) 0.8 sec. OFF malfunction (B) 1 sec. ON malfunction (A) and (B) 0.8 sec. ON malfunction (C) 0.4 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

All:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0115, P0117, P0118 (ECT sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
ECT (Engine coolant temperature)	10°C (50°F)or more
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

OFF malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	4th or 5th
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

OFF malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	4th
Throttle valve opening angle	5% or more
Vehicle speed	10 km/h (6 mph) or more

ON malfunction (A):

TYPICAL ENABLING CONDITIONS

ECM selected gear	1st
Vehicle speed	Less than 40 km/h (25 mph)
Throttle valve opening angle	4.5% or more at engine speed 1900 rpm (Varies with engine speed)

ON malfunction (B):

TYPICAL ENABLING CONDITIONS

ECM selected gear	3rd

cardiagn.com

Throttle valve opening angle	5% or more at output speed 1400 rpm (Varies with engine speed)
Malfunction of pressure control solenoid "B" (SL2) and "C" (SL3)	Not detected

ON malfunction (C):

TYPICAL ENABLING CONDITIONS

Throttle valve opening angle	7.0% or more at output speed 1050 rpm (Varies with engine speed)
Malfunction of pressure control solenoid "B" (SL2)	Not detected

TYPICAL MALFUNCTION THRESHOLDS

Either of the following conditions is met: OFF malfunction (A) and (B), or ON malfunctions (A), (B) and (C)

2 detections are necessary per driving cycle:

1st detection; temporary flag ON

2nd detection; pending fault code ON

OFF malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.93 to 1.07

OFF malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Intermediate shaft speed/Output speed*	1.02 to 1.16

ON malfunction (A):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed/Intermediate shaft speed	0.93 to 1.07

ON malfunction (B):

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed - Intermediate shaft speed	700 rpm or more

ON malfunction (C):

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL MALFUNCTION THRESHOLDS

Input (turbine) speed - Intermediate shaft speed	Less than -500 rpm or 700 rpm or more

INSPECTION PROCEDURE

HINT:

Using Techstream to perform Active Test allows relays, VSVs, actuators and other items to be operated without removing any parts. This non-intrusive functional inspection can be very useful because intermittent operation may be discovered before parts or wiring is disturbed. Performing Active Test early in troubleshooting is one way to save diagnostic time. Data List information can be displayed while performing Active Test.

1. **PERFORM ACTIVE TEST**
   a. Warm up the engine.
   b. Turn the ignition switch off.
   c. Connect Techstream to the DLC3.
   d. Turn the ignition switch on (IG).
   e. Turn on the tester.
   f. Select the item "Powertrain/Engine and ECT/Active Test/Shift Status".
   g. According to the display on the tester, perform the "Active Test".

   HINT:

   While driving, the shift position can be forcibly changed with Techstream.

   Comparing the shift position commanded by the Active Test with the actual shift position enables you to confirm the problem (See **FAIL-SAFE CHART**).

TESTER DISPLAY REFERENCE

Tester Display	Test Part	Control Range	Diagnostic Note
Control the Shift Position	[Test Details] Operate the shift solenoid valve and set each shift position by yourself. [Vehicle Condition] • IDL: ON • Less than 50 km/h (31 mph) [Others]	1st/2nd/3rd/4th/5th	Possible to check the operation of the shift solenoid valves.

cardiagn.com

	• Press "-->" button: Shift up • Press "<--" button: Shift down		

HINT:

- This test can be conducted when the vehicle speed is 50 km/h (31 mph) or less.
- The shift position commanded by the ECM is shown in the Data List/Shift Status display on Techstream.

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P0796)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   c. When you use Techstream:

      Select the item "Powertrain/Engine and ECT/Trouble Codes".

   d. Read the DTCs using Techstream.

      Result

      RESULT REFERENCE

Result	Proceed to
P0796	A
P0796 and other DTCs	B

      HINT:

      If any other codes besides "P0796" are output, perform the troubleshooting for those DTCs first.

      B: GO TO **DTC CHART**

      A: Go to next step

2. **INSPECT SHIFT SOLENOID VALVE (SL3)**
   a. Remove the shift solenoid valve SL3.
   b. Measure the resistance according to the value(s) in the table below.

      Standard resistance

      STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

cardiagn.com

c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SL3) (See **REMOVAL**)

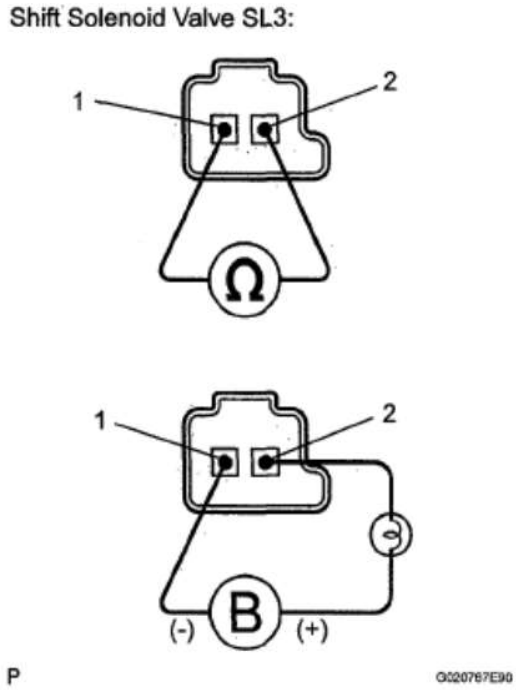


Fig. 64: Inspecting Shift Solenoid Valve (SL3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

OK: There are no foreign objects on each valve and they operate smoothly.

NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

OK: Go to next step

4. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

OK: The torque converter clutch operates normally.

NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

OK: REPAIR OR REPLACE AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

DTC P0798 PRESSURE CONTROL SOLENOID "C" ELECTRICAL (SHIFT SOLENOID VALVE SL3)

DESCRIPTION

Shifting from 1st to 5th is performed in combination with "ON" and "OFF" operation of the shift solenoid valves SL1, SL2, SL3, S4 and SR which are controlled by the ECM. If an open or short circuit occurs in either of the shift solenoid valves, the ECM controls the remaining normal shift solenoid valves to allow the vehicle to be operated smoothly (Fail safe function).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0798	The ECM checks for an open or short in the shift solenoid valve SL3 circuit while driving and shifting gears. (1-trip detection logic) ○ Output signal duty equals to 100 %. (NOTE: SL3 output signal duty is less than 100 % under normal condition.)	• Open or short in shift solenoid valve SL3 circuit • Shift solenoid valve SL3 • ECM

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". When there is an open or short circuit in any shift solenoid valve circuit, the ECM detects the problem and illuminates the MIL, and stores the DTC. And the ECM performs the fail-safe function and turns the other normal shift solenoid valves "ON/OFF" (In case of an open or short circuit, the ECM stops sending current to the circuit.) (See **FAIL-SAFE CHART**).

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0798: Shift solenoid valve SL3/Range check
Required sensors/Components	Shift solenoid valve SL3
Frequency of operation	Continuous
Duration	1 sec.
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Battery voltage	10 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Output signal duty	100%

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Output signal duty	Less than 100%

WIRING DIAGRAM

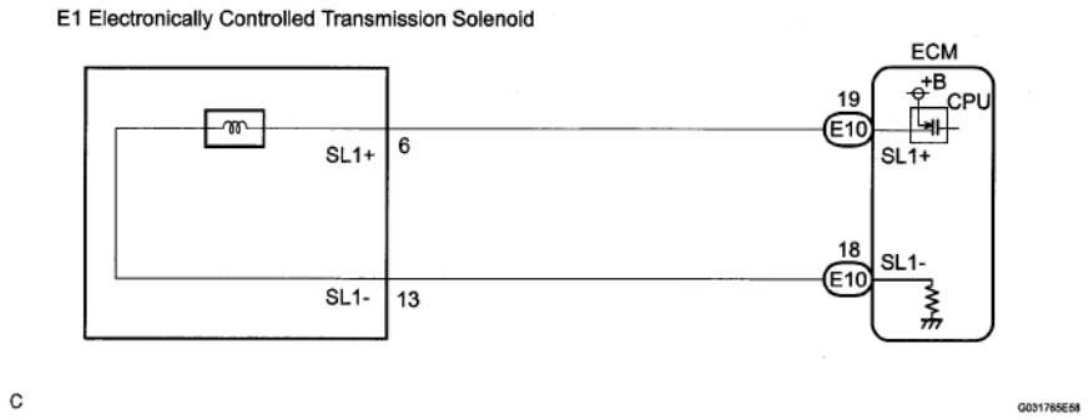


Fig. 65: Pressure Control Solenoid "C" Electrical (Shift Solenoid Valve SL3) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (SL3)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
4 (SL3+) -11 (SL3-)	20°C (68°F)	5.0 to 5.6 ohms

   c. Measure the resistance according to the value(s) in the table below.

cardiagn.com

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
4 (SL3+) - Body ground	Always	10 kohms or higher
11 (SL3-) - Body ground	Always	?

NG: Go to step 3

Component without harness connected:
(Transmission Wire)

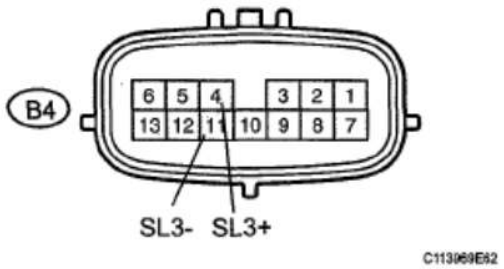


Fig. 66: Identifying B4 Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-17 (SL3+) - B2-16 (SL3-)	20°C (68°F)	5.0 to 5.6 ohms

   d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

cardiagn.com

Tester Connection	Condition	Specified Condition
B2-17 (SL3+) - Body ground	Always	10 kohms or higher
B2-16 (SL3-) - Body ground		

Rear view of wire harness connector:
(to ECM)

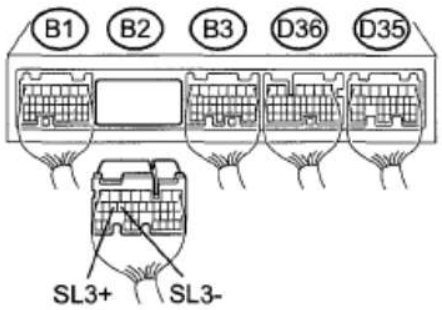


Fig. 67: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (SL3)**
   a. Remove the shift solenoid valve SL3.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SL3) (See **REMOVAL**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

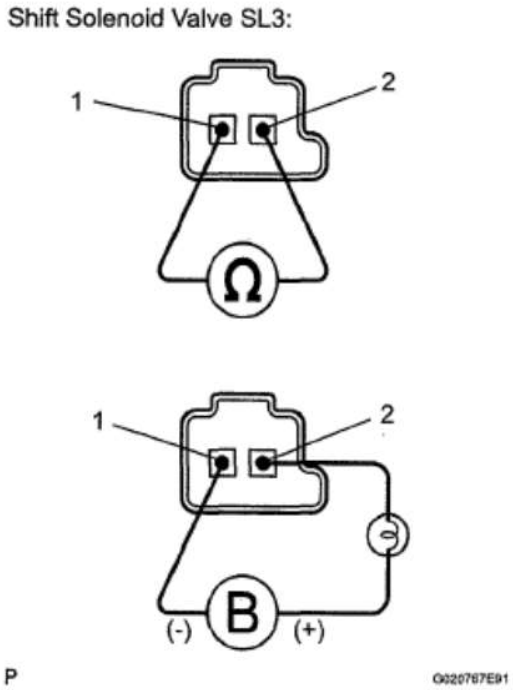


Fig. 68: Inspecting Shift Solenoid Valve (SL3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

DTC P0982 SHIFT SOLENOID "D" CONTROL CIRCUIT LOW (SHIFT SOLENOID VALVE S4); DTC P0983 SHIFT SOLENOID "D" CONTROL CIRCUIT HIGH (SHIFT SOLENOID VALVE S4)

DESCRIPTION

Shifting from 1st to 5th is performed in combination with "ON" and "OFF" operation of the shift solenoid valves SL1, SL2, SL3, S4 and SR which are controlled by the ECM. If an open or short circuit occurs in either of the shift solenoid valves, the ECM controls the remaining normal shift solenoid valves to allow the vehicle to be operated smoothly (Fail safe function).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0982	ECM detects short in solenoid valve S4 circuit 2 times when solenoid valve S4 is operated (1-trip detection logic)	• Short in shift solenoid valve S4 circuit • Shift solenoid valve S4 • ECM
P0983	ECM detects open in solenoid valve S4 circuit 2 times when solenoid valve S4 is not operated (1-trip detection logic)	• Open in shift solenoid valve S4 circuit • Shift solenoid valve S4

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		• ECM

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". When there is an open or short circuit in any shift solenoid valve circuit, the ECM detects the problem and illuminates the MIL, and stores the DTC. And the ECM performs the fail-safe function and turns the other normal shift solenoid valves "ON/OFF" (In case of an open or short circuit, the ECM stops sending current to the circuit.) (See **FAIL-SAFE CHART**).

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0982: Shift solenoid valve S4/Range check (Low resistance) P0983: Shift solenoid valve S4/Range check (High resistance)
Required sensors/Components	Shift solenoid valve S4
Frequency of operation	Continuous
Duration	0.064 sec. or more
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0982: Range check (Low resistance):

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Shift solenoid valve S4	ON
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

P0983: Range check (High resistance):

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Shift solenoid valve S4	OFF
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P0982: Range check (Low resistance):

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL MALFUNCTION THRESHOLDS

Shift solenoid valve S4 resistance	8 ohms or less

P0983: Range check (High resistance):

TYPICAL MALFUNCTION THRESHOLDS

Shift solenoid valve S4 resistance	100 kohms or more

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Shift solenoid valve S4	Resistance: 11 to 15 ohms at 20°C (68°F)

WIRING DIAGRAM

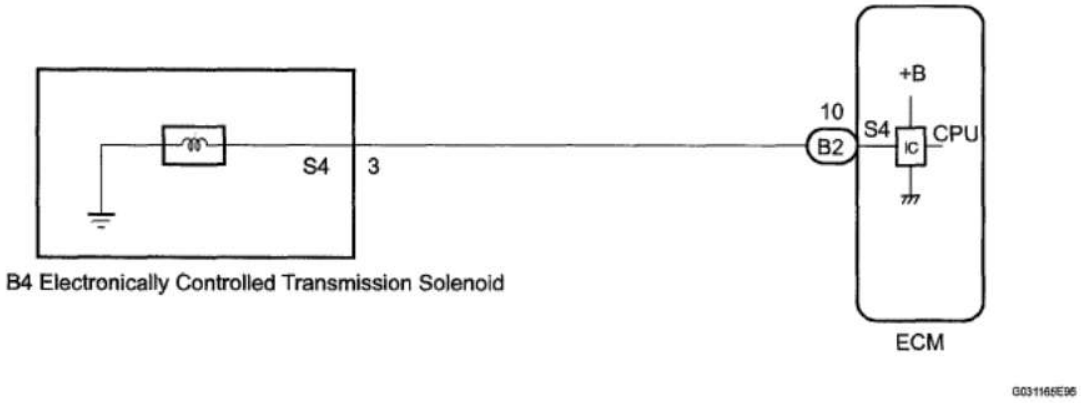


Fig. 69: Shift Solenoid "D" Control (Shift Solenoid Valve S4) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (S4)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
3 (S4) - Body ground	20°C (68°F)	11 to 15 ohms

NG: Go to step 3

cardiagn.com

Component without harness connected:
(Transmission Wire)

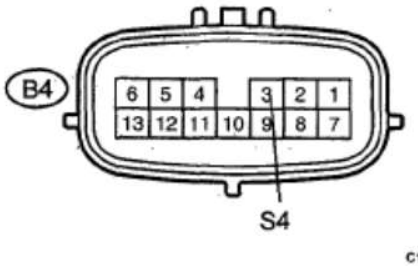


Fig. 70: Identifying Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-10 (S4) - Body ground	20°C (68°F)	11 to 15 ohms

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Rear view of wire harness connector:
(to ECM)

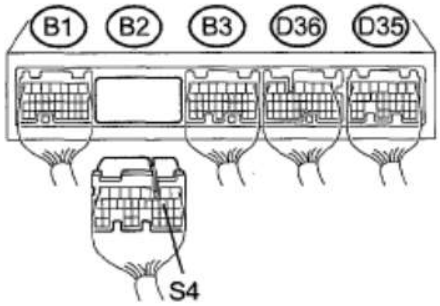


Fig. 71: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (S4)**
   a. Remove the shift solenoid valve S4.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (S4) - Solenoid Body (S4)	20°C (68°F)	11 to 15 ohms

   c. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (S4) (See **REMOVAL**)

cardiagn.com

Shift Solenoid Valve S4:

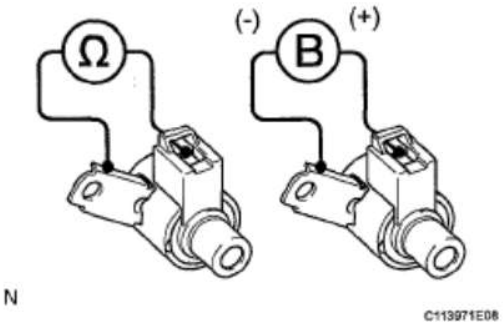


Fig. 72: Inspecting Shift Solenoid Valve (S4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

DTC P0985 SHIFT SOLENOID "E" CONTROL CIRCUIT LOW (SHIFT SOLENOID VALVE SR); DTC P0986 SHIFT SOLENOID "E" CONTROL CIRCUIT HIGH (SHIFT SOLENOID VALVE SR)

DESCRIPTION

Shifting from 1st to 5th is performed in combination with "ON" and "OFF" operation of the shift solenoid valves SL1, SL2, SL3, S4 and SR which are controlled by the ECM. If an open or short circuit occurs in either of the shift solenoid valves, the ECM controls the remaining normal shift solenoid valves to allow the vehicle to be operated smoothly (Fail safe function).

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P0985	ECM detects short in solenoid valve SR circuit 2 times when solenoid valve SR is operated (1-trip detection logic)	• Short in shift solenoid valve SR circuit • Shift solenoid valve SR • ECM
P0986	ECM detects open in solenoid valve SR circuit 2 times when solenoid valve SR is not operated (1-trip detection logic)	• Open in shift solenoid valve SR circuit • Shift solenoid valve SR • ECM

MONITOR DESCRIPTION

The ECM commands gear shifts by turning the shift solenoid valves "ON/OFF". When there is an open or short circuit in any shift solenoid valve circuit, the ECM detects the problem and illuminates the MIL and stores the

cardiagn.com

DTC. And the ECM performs the fail-safe function and turns the other normal shift solenoid valves "ON/OFF" (In case of an open or short circuit, the ECM stops sending current to the circuit.) (See **FAIL-SAFE CHART**).

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P0985: Shift solenoid valve SR/Range check (Low resistance) P0986: Shift solenoid valve SR/Range check (High resistance)
Required sensors/Components	Shift solenoid valve SR
Frequency of operation	Continuous
Duration	0.064 sec.
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P0985: Range check (Low resistance):

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Shift solenoid valve SR	ON
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

P0986: Range check (High resistance):

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Shift solenoid valve SR	OFF
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P0985: Range check (Low resistance):

TYPICAL MALFUNCTION THRESHOLDS

Shift solenoid valve SR resistance	8 ohms or less

P0986: Range check (High resistance):

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL MALFUNCTION THRESHOLDS

Shift solenoid valve SR resistance	100 kohms or more

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Shift solenoid valve SR	Resistance: 11 to 15 ohms at 20°C (68°F)

WIRING DIAGRAM

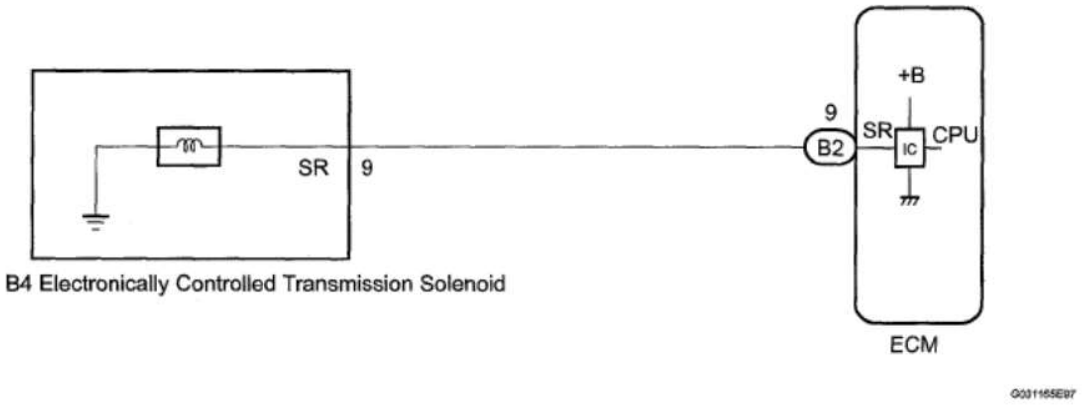


Fig. 73: Shift Solenoid "E" Control (Shift Solenoid Valve SR) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (SR)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
9 (SR) - Body ground	20°C (68°F)	11 to 15 ohms

   NG: Go to step 3

cardiagn.com

Component without harness connected:
(Transmission Wire)

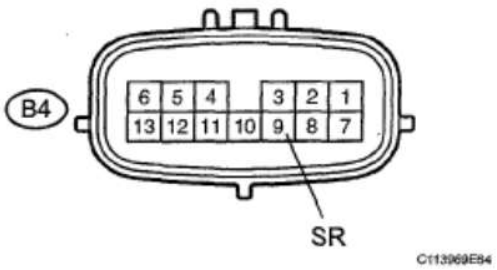


Fig. 74: Identifying Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-9 (SR) - Body ground	20°C (68°F)	11 to 15 ohms

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Rear view of wire harness connector:
(to ECM)

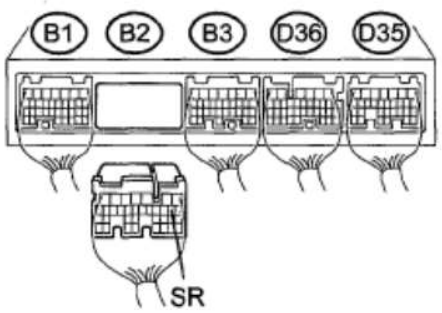


Fig. 75: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (SR)**
   a. Remove the shift solenoid valve SR.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (SR) - Solenoid Body (SR)	20°C (68°F)	11 to 15 ohms

   c. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SR) (See **REMOVAL**)

cardiagn.com

Shift Solenoid Valve SR:

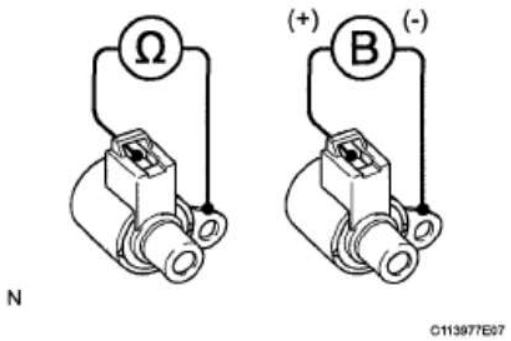


Fig. 76: Inspecting Shift Solenoid Valve (SR)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

DTC P2714 PRESSURE CONTROL SOLENOID "D" PERFORMANCE (SHIFT SOLENOID VALVE SLT)

SYSTEM DESCRIPTION

The linear solenoid valve (SLT) controls the transmission line pressure for smooth transmission operation based on signals from the throttle position sensor and the vehicle speed sensor. The ECM adjusts the duty ratio (*) of the SLT solenoid valve to control hydraulic line pressure coming from the primary regulator valve. Appropriate line pressure assures smooth shifting with varying engine outputs.

(*): Duty Ratio

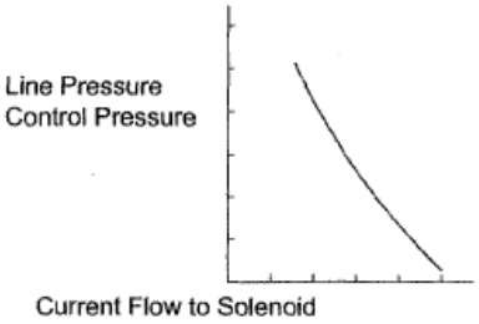
The duty ratio is the ratio of the period of continuity in one cycle. For example, if A is the period of continuity in one cycle, and B is the period of non-continuity, then

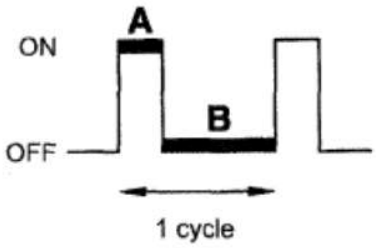
Duty Ratio=A/(A+B) x 100 (%)

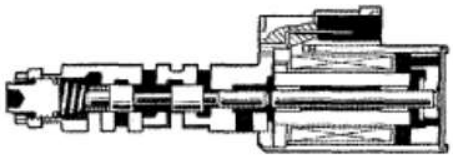
cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander







C108924E02

Fig. 77: Sectional View Of Shift Solenoid Valve SLT
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2714	ECM detects a malfunction on SLT (ON side) according to the revolution difference of the turbine, intermediate and the output shaft, and also by the oil pressure. (2-trip detection logic)	• Shift solenoid valve SLT remains closed • Valve body is blocked • Torque converter clutch • Automatic transaxle (clutch, brake or gear, etc.)

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

MONITOR DESCRIPTION

In any forward position, when the difference between the revolutions of the turbine, Intermediate and output shaft exceeds the specified value (varies with Intermediate, output speed) determined by the ECM, the ECM illuminates the MIL and outputs the DTC.

When shift solenoid valve SLT remains on, the oil pressure goes down and the clutch engagement force decreases.

NOTE: If you continue driving under these conditions, the clutch will burn out and the vehicle will no longer be drivable.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2714: Shift solenoid valve SLT/ON malfunction
Required sensors/Components	Shift solenoid valve SLT, Speed sensor (NT), Speed sensor (NC), Crankshaft position sensor (NE)
Frequency of operation	Continuous
Duration	0.5 sec.
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

ON malfunction:

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present. (Not circuit malfunction)	P0712, P0713 (ATF temperature sensor circuit) P0717 (Turbine speed sensor circuit) P0793 (Intermediate shaft speed sensor circuit) P0500 (Vehicle speed sensor circuit) P0748 (Shift solenoid valve SL1 circuit) P0778 (Shift solenoid valve SL2 circuit) P0798 (Shift solenoid valve SL3 circuit) P0982, P0983 (Shift solenoid valve S4 circuit) P0985, P0986 (Shift solenoid valve SR circuit) P2769, P2770 (Shift solenoid valve DSL circuit) P2716 (Shift solenoid valve SLT circuit) P0120, P0121, P0122, P0123, P0220, P0222, P0223, P0505, P2102, P2103, P2111, P2112, P2118, P2119, P2135 (Electronic throttle system (if applicable))
Transmission range	"D"
TFT (Transmission fluid temperature)	-20°C (-4°F) or more

ON malfunction (a):

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL ENABLING CONDITIONS

ECM selected gear	1st
Temporary MAIN gear	1st or 2nd or 3rd or 4th
NT - NC x Temporary MAIN gear ratio NT: Input (turbine) speed NC: Intermediate shaft speed	100 rpm or more at Intermediate shaft speed 1000 rpm
Temporary U/D gear	Low or High
NC - NO x Temporary U/D gear ratio NO: Output speed	300 rpm or more at Output speed 1000 rpm
TT TT: Turbine Torque	900 Nm or more
NT	250 rpm or more
NC	250 rpm or more
NO	250 rpm or more

ON malfunction (b):

TYPICAL ENABLING CONDITIONS

ECM selected gear	2nd
Temporary MAIN gear	1st or 2nd or 3rd or 4th
NT - NC x Temporary MAIN gear ratio NT: Input (turbine) speed NC: Intermediate shaft speed	100 rpm or more at Intermediate shaft speed 1000 rpm
Temporary U/D gear	Low or High
NC - NO x Temporary U/D gear ratio NO: Output speed	300 rpm or more at Output speed 1000 rpm
TT TT: Turbine Torque	192 Nm or more
NT	250 rpm or more
NC	250 rpm or more
NO	250 rpm or more

ON malfunction (c):

TYPICAL ENABLING CONDITIONS

ECM selected gear	3rd
Temporary MAIN gear	1st or 2nd or 3rd or 4th
NT - NC x Temporary MAIN gear ratio NT: Input (turbine) speed NC: Intermediate shaft speed	100 rpm or more at Intermediate shaft speed 1000 rpm
Temporary U/D gear	Low or High
NC - NO x Temporary U/D gear ratio NO: Output speed	300 rpm or more at Output speed 1000 rpm

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TT TT: Turbine Torque	900 Nm or more
NT	250 rpm or more
NC	250 rpm or more
NO	250 rpm or more

ON malfunction (d):

TYPICAL ENABLING CONDITIONS

ECM selected gear	4th or 5th
Temporary MAIN gear	1st or 2nd or 3rd or 4th
NT - NC x Temporary MAIN gear ratio NT: Input (turbine) speed NC: Intermediate shaft speed	100 rpm or more at Intermediate shaft speed 1000 rpm
Temporary U/D gear	Low or High
NC - NO x Temporary U/D gear ratio NO: Output speed	300 rpm or more at Output speed 1000 rpm
TT TT: Turbine Torque	189 Nm or more
NT	250 rpm or more
NC	250 rpm or more
NO	250 rpm or more

TYPICAL MALFUNCTION THRESHOLDS

[ON malfunction]

Detection condition: Total accumulated time of ON malfunctions (a), (b), (c) and (d) is 1 second or more

ON malfunction (a):

TYPICAL MALFUNCTION THRESHOLDS

NT-NCx 1st gear ratio	100 rpm or more at Intermediate shaft speed 1000 rpm
NC - NO x Low gear ratio	300 rpm or more at Output speed 1000 rpm
Duration	0.5 sec. or more

ON malfunction (b):

TYPICAL MALFUNCTION THRESHOLDS

NT - NC x 2rd gear ratio	100 rpm or more at Intermediate shaft speed 1000 rpm
NC - NO x Low gear ratio	300 rpm or more at Output speed 1000 rpm
Duration	0.5 sec. or more

ON malfunction (c):

cardiagn.com

2009 Toyota Highlander Limited
2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

TYPICAL MALFUNCTION THRESHOLDS

NT - NC x 3rd gear ratio	100 rpm or more at Intermediate shaft speed 1000 rpm
NC - NO x Low gear ratio	300 rpm or more at Output speed 1000 rpm
Duration	0.5 sec. or more
Shift Solenoid valve SL1 Performance	Not performance malfunction

ON malfunction (d):

TYPICAL MALFUNCTION THRESHOLDS

NT - NC x 4th gear ratio	100 rpm or more at Intermediate shaft speed 1000 rpm
NC - NO x (Low (4th) or High (5th)) gear ratio	300 rpm or more at Output speed 1000 rpm
Duration	0.5 sec. or more
Shift Solenoid valve SL1 Performance	Not performance malfunction

INSPECTION PROCEDURE

1. **CHECK OTHER DTCS OUTPUT (IN ADDITION TO DTC P2714)**
   a. Connect Techstream to the DLC3.
   b. Turn the ignition switch on (IG) and turn the Techstream main switch ON.
   c. When you use Techstream:

      Select the item "Powertrain/Engine and ECT/Trouble Codes".

   d. Read the DTCs using Techstream.

      Result

      RESULT REFERENCE

Result	Proceed to
P2714	A
P2714 and other DTCs	B

      HINT:

      If any other codes besides "P2714" are output, perform the troubleshooting for those DTCs first.

      B: GO TO **DTC CHART**

      A: Go to next step

2. **INSPECT SHIFT SOLENOID VALVE SLT**
   a. Remove the shift solenoid valve SLT.
   b. Measure the resistance according to the value(s) in the table below.

cardiagn.com

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE SLT (See **REMOVAL**)

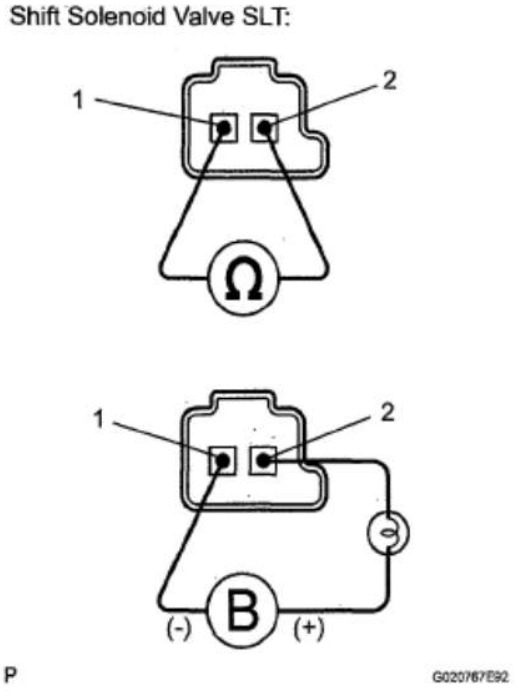


Fig. 78: Inspecting Shift Solenoid Valve SLT
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT TRANSMISSION VALVE BODY ASSEMBLY**

OK: There are no foreign objects on each valve.

NG: REPAIR OR REPLACE TRANSMISSION VALVE BODY ASSEMBLY (See **REMOVAL**)

OK: Go to next step

cardiagn.com

4. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

OK: The torque converter clutch operates normally.

NG: REPLACE TORQUE CONVERTER CLUTCH ASSEMBLY (See **REMOVAL**)

OK: REPAIR OR REPLACE AUTOMATIC TRANSAXLE ASSEMBLY (See **REMOVAL**)

DTC P2716 PRESSURE CONTROL SOLENOID "D" ELECTRICAL (SHIFT SOLENOID VALVE SLT)

DESCRIPTION

The linear solenoid valve (SLT) controls the transmission line pressure for smooth transmission operation based on signals from the throttle position sensor and the vehicle speed sensor. The ECM adjusts the duty cycle of the SLT solenoid valve to control hydraulic line pressure coming from the primary regulator valve. Appropriate line pressure assures smooth shifting with varying engine outputs.

(*): Duty Ratio

The duty ratio is the ratio of the period of continuity in one cycle.

For example, if A is the period of continuity in one cycle, and B is the period of non-continuity, then Duty Ratio=A/(A + B) x 100 (%)

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2716	Open or short is detected in shift solenoid valve SLT circuit for 1 second or more while driving (1 -trip detecting logic).	• Open or short in shift solenoid valve SLT circuit • Shift solenoid valve SLT • ECM

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

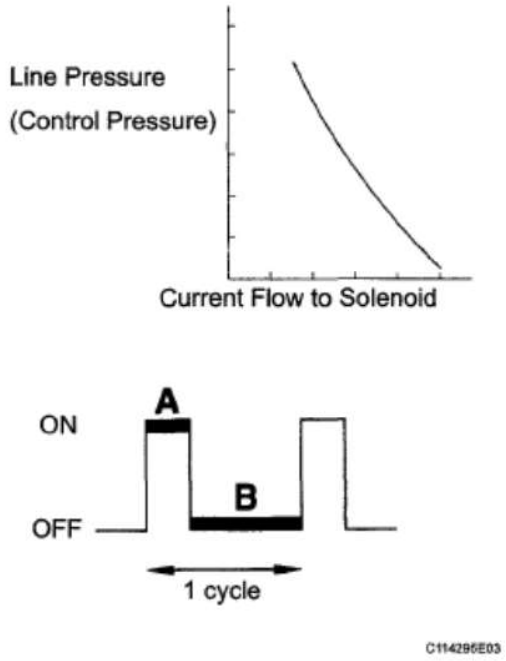


Fig. 79: Pressure Control Graph
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

MONITOR DESCRIPTION

When an open or short in the linear solenoid valve (SLT) circuit is detected, the ECM interprets this as a fault. The ECM will turn on the MIL and store the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2716: Shift solenoid valve SLT/Range check
Required sensors/Components	Shift solenoid valve SLT
Frequency of operation	Continuous
Duration	1 sec.
MIL operation	Immediate
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Solenoid current cut status	Not cut
Battery voltage	11 V or more
Ignition switch	ON
Starter	OFF

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

CPU commanded duty ratio to SLT	19% or more

TYPICAL MALFUNCTION THRESHOLDS

TYPICAL MALFUNCTION THRESHOLDS

Solenoid status from MIC	Fail (Open or short)

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Shift solenoid valve SLT	Resistance: 5.0 to 5.6 ohms at 20°C (68°F)

WIRING DIAGRAM

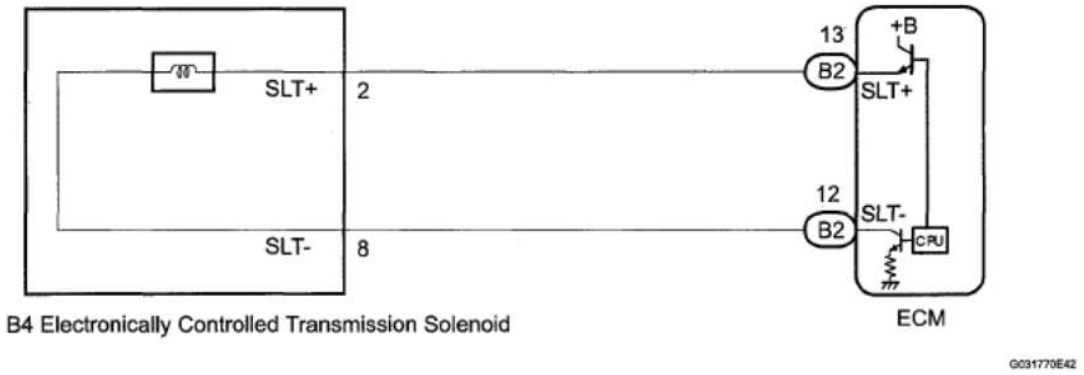


Fig. 80: Pressure Control Solenoid "D" Electrical (Shift Solenoid Valve SLT) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (SLT)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
2 (SLT+) - 8 (SLT-)	20°C (68°F)	5.0 to 5.6 ohms

   c. Measure the resistance according to the value(s) in the table below.

   Standard resistance (Check for short)

   STANDARD RESISTANCE SPECIFICATION

cardiagn.com

Tester Connection	Condition	Specified Condition
2 (SLT+) - Body ground	Always	10 kohms or higher
8 (SLT-) - Body ground	Always	?

Component without harness connected:
(Transmission Wire)

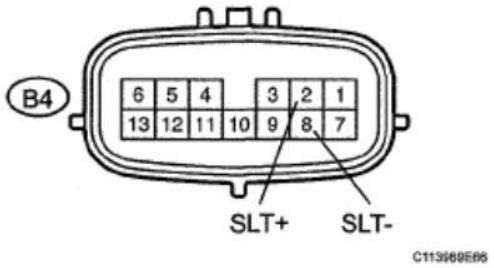


Fig. 81: Identifying B4 Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: Go to step 3

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector to the transaxle.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-13 (SLT+) - B2-12 (SLT-)	20°C (68°F)	5.0 to 5.6 ohms

   d. Measure the resistance according to the value(s) in the table below.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-13 (SLT+) - Body ground	Always	10 kohms or higher
B2-12 (SLT-) - Body ground		

cardiagn.com

Rear view of wire harness connector:
(to ECM)

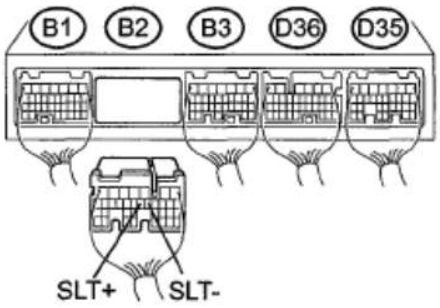


Fig. 82: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (SLT)**
   a. Remove the shift solenoid valve SLT.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   c. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

OK: The solenoid makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (SLT) (See **REMOVAL**)

cardiagn.com

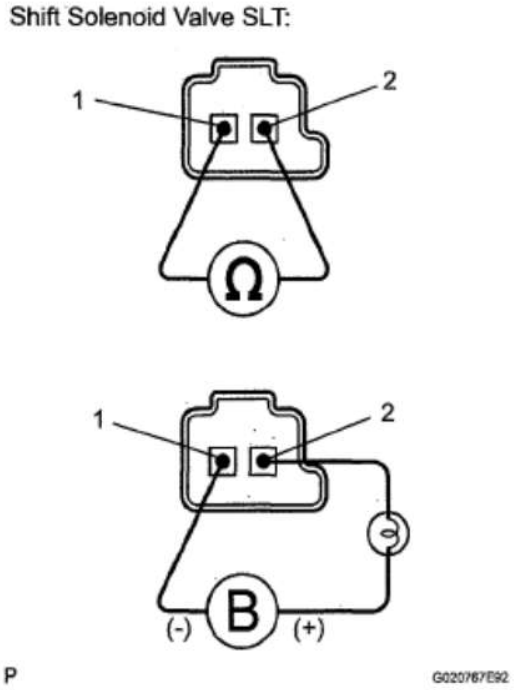


Fig. 83: Inspecting Shift Solenoid Valve (SLT)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

DTC P2769 TORQUE CONVERTER CLUTCH SOLENOID CIRCUIT LOW (SHIFT SOLENOID VALVE DSL); DTC P2770 TORQUE CONVERTER CLUTCH SOLENOID CIRCUIT HIGH (SHIFT SOLENOID VALVE DSL)

DESCRIPTION

The shift solenoid valve DSL is turned "ON" and "OFF" by signals from the ECM in order to control the hydraulic pressure operation, the lock-up relay valve, which then controls operation of the lock-up clutch.

DTC DETECTION CONDITION AND TROUBLE AREA

DTC No.	DTC Detection Condition	Trouble Area
P2769	ECM detects short in solenoid valve DSL circuit (0.1 sec.) when solenoid valve DSL is operated (2-trip detection logic)	• Short in shift solenoid valve DSL circuit • Shift solenoid valve DSL • ECM
P2770	ECM detects open in solenoid valve DSL circuit (0.1 sec) when solenoid valve DSL is not operated (2-trip detection logic)	• Open in shift solenoid valve DSL circuit • Shift solenoid valve

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

		DSL • ECM

MONITOR DESCRIPTION

Torque converter lock-up is controlled by the ECM based on engine rpm, engine load, engine temperature, vehicle speed, transmission temperature, and shift range selection. The ECM determines the lock-up status of the torque converter by comparing the engine rpm (NE) to the input turbine rpm (NT). The ECM calculates the actual transmission gear by comparing input turbine rpm (NT) to counter gear rpm (NC). When conditions are appropriate, the ECM requests "lock-up" by applying control voltage to the shift solenoid DSL. When the DSL is opened, it applies pressure to the lock-up relay valve and locks the torque converter clutch. If the ECM detects an open or short in the DSL solenoid circuit, the ECM interprets this as a fault in the DSL solenoid or circuit. The ECM will turn on the MIL and store the DTC.

MONITOR STRATEGY

MONITOR STRATEGY

Related DTCs	P2769: Shift solenoid valve DSL/Range check (Low resistance) P2770: Shift solenoid valve DSL/Range check (High resistance)
Required sensors/Components	Shift solenoid valve DSL
Frequency of operation	Continuous
Duration	0.064 sec. or more
MIL operation	2 driving cycles
Sequence of operation	None

TYPICAL ENABLING CONDITIONS

P2769: Range check (Low resistance):

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Shift solenoid valve DSL	ON
Solenoid current cut status	Not cut
Battery voltage	8 V or more
Ignition switch	ON
Starter	OFF

P2770: Range check (High resistance):

TYPICAL ENABLING CONDITIONS

The monitor will run whenever this DTC is not present.	None
Shift solenoid valve DSL	ON
Battery voltage	8 V or more
Ignition switch	ON

cardiagn.com

Starter	OFF

TYPICAL MALFUNCTION THRESHOLDS

P2769: Range check (Low resistance):

TYPICAL MALFUNCTION THRESHOLDS

Shift solenoid valve DSL resistance	8 ohms or less

P2770: Range check (High resistance):

TYPICAL MALFUNCTION THRESHOLDS

Shift solenoid valve DSL resistance	100 kohms or more

COMPONENT OPERATING RANGE

COMPONENT OPERATING RANGE

Shift solenoid valve DSL	Resistance: 11 to 13 ohms at 20°C (68°F)

WIRING DIAGRAM

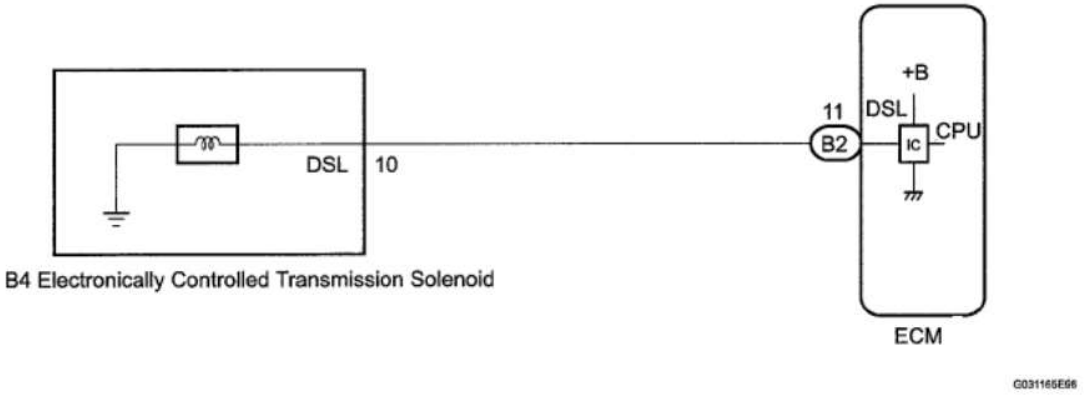


Fig. 84: Torque Converter Clutch Solenoid (Shift Solenoid Valve DSL) - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **INSPECT TRANSMISSION WIRE (DSL)**
   a. Disconnect the transmission wire connector from the transaxle.
   b. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition

cardiagn.com

10 (DSL) - Body ground	20°C (68°F)	11 to 13 ohms

NG: Go to step 3

Component without harness connected:
(Transmission Wire)

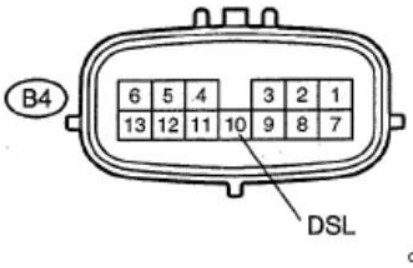


Fig. 85: Identifying B4 Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (TRANSMISSION WIRE - ECM)**
   a. Connect the transmission wire connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
B2-11 (DSL) - Body ground	20°C (68°F)	11 to 13 ohms

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

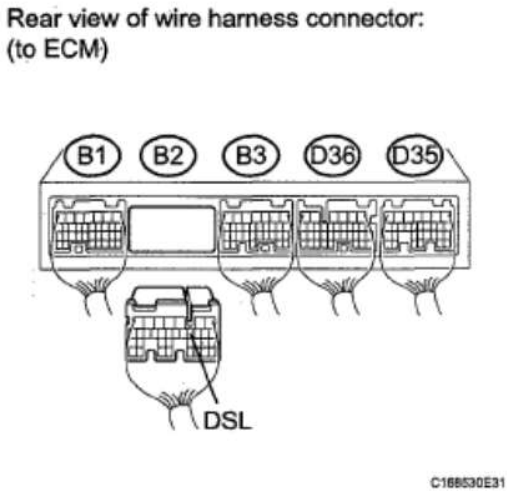


Fig. 86: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPLACE ECM (for 2GR-FE) (See **REMOVAL**)

3. **INSPECT SHIFT SOLENOID VALVE (DSL)**
   a. Remove the shift solenoid valve DSL.
   b. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (DSL) - Solenoid Body (DSL)	20°C (68°F)	11 to 13 ohms

   c. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

OK: The solenoid valve makes an operating sound.

NG: REPLACE SHIFT SOLENOID VALVE (DSL) (See **REMOVAL**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Shift Solenoid Valve DSL:

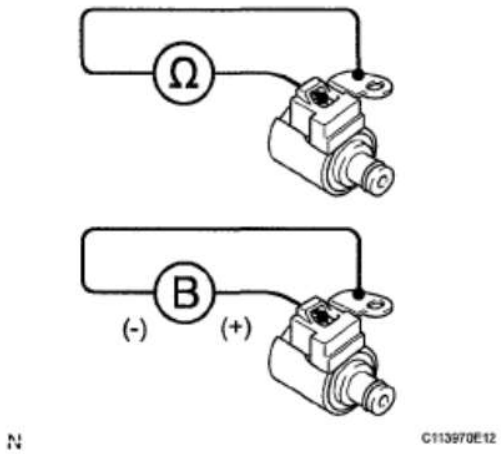


Fig. 87: Inspecting Shift Solenoid Valve (DSL)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: REPAIR OR REPLACE TRANSMISSION WIRE (See **REMOVAL**)

TRANSMISSION CONTROL SWITCH CIRCUIT

DESCRIPTION

When moving the shift lever into the S position using the transmission control switch, it is possible to switch the shift range position between "1" (first range) and "5" (fifth range).

Shifting up "+" once raises one shift range position, and shifting down "-" lowers one shift range position.

WIRING DIAGRAM

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

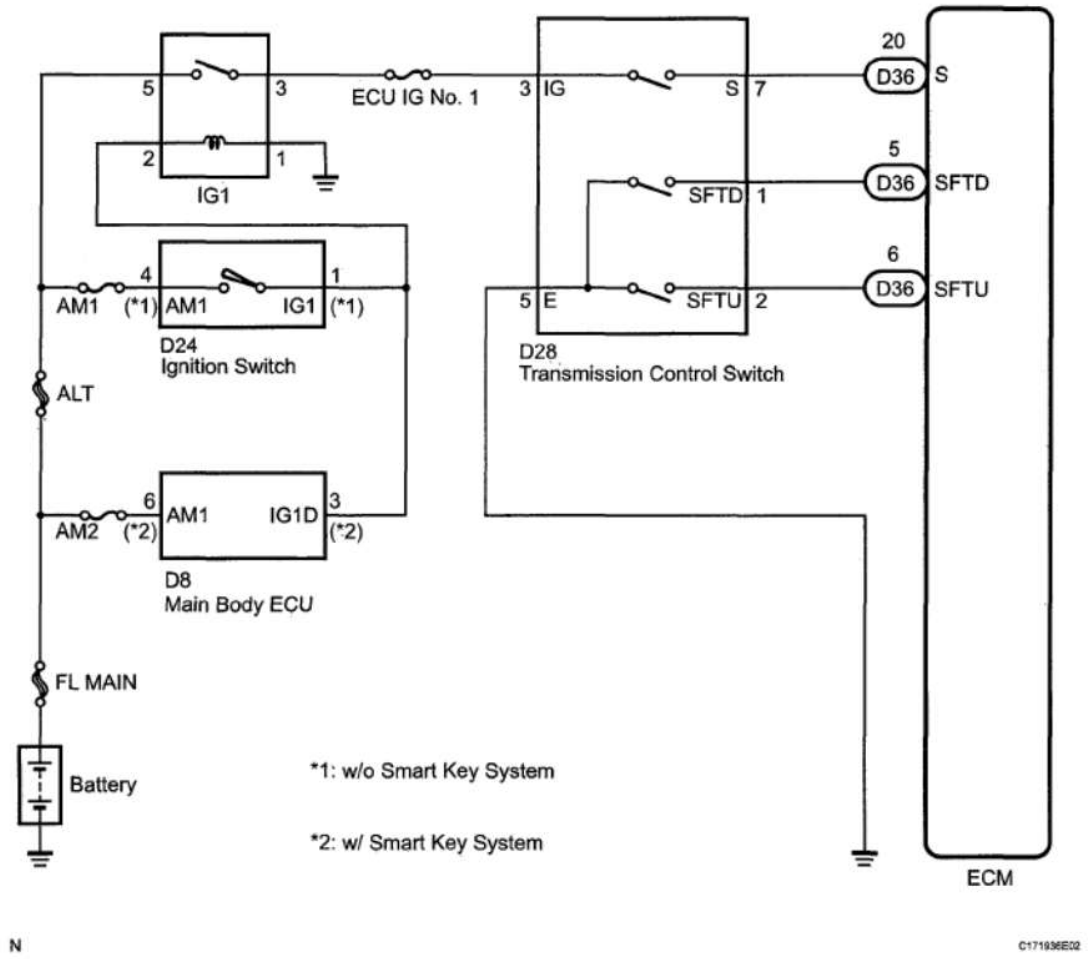


Fig. 88: Transmission Control Switch - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **CHECK HARNESS AND CONNECTOR (BATTERY - SHIFT LOCK CONTROL UNIT ASSEMBLY)**
   a. Disconnect the transmission control switch connector of shift lock control unit assembly.
   b. Turn the ignition switch on (IG), and measure the voltage according to the value(s) in the table below.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
D28-3 (IG) - Body ground	Ignition switch on (IG)	11 to 14 V
?	Ignition switch off	Below 1 V

cardiagn.com

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Transmission Control Switch)



C168574E06

Fig. 89: Identifying Terminal IG Of D28 Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

2. **CHECK HARNESS AND CONNECTOR (SHIFT LOCK CONTROL UNIT ASSEMBLY - BODY GROUND)**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
D28-5 (E) - Body ground	Always	Below 1 ohms

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Front view of wire harness connector:
(to Transmission Control Switch)



C168574E07

Fig. 90: Identifying Terminal E Of D28 Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

3. **INSPECT SHIFT LOCK CONTROL UNIT ASSEMBLY**
   a. Measure the resistance between each terminal of shift lock control unit assembly when the shift lever is moved to each position.

Standard resistance (Check for short)

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
3 - 7	S, "+" and "-"	Below 1 ohms
?	Except S, "+" and "-"	10 kohms or higher
2 - 5	Press continuously "+" (Up shift)	Below 1 ohms
?	S	10 kohms or higher
1 - 5	Press continuously "-" (Down shift)	Below 1 ohms
?	S	10 kohms or higher

cardiagn.com

Component without harness connected:
(Transmission Control Switch)



C168599E05

Fig. 91: Identifying D28 Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NG: REPLACE SHIFT LOCK CONTROL UNIT ASSEMBLY (See **REMOVAL**)

OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (SHIFT LOCK CONTROL UNIT ASSEMBLY - ECM)**
   a. Connect the transmission control switch connector of shift lock control unit assembly.
   b. Disconnect the ECM connector.
   c. Measure the voltage according to the value(s) in the table below when the shift lever is moved to each position.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
D36-20 (S) - Body ground	S, "+" and "-"	11 to 14 V
?	Except S, "+" and "-"	Below 1 V

cardiagn.com

Rear view of wire harness connector:
(to ECM)

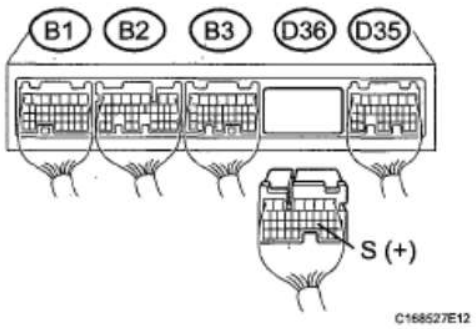


Fig. 92: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Turn the ignition switch off.
e. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
D36-6 (SFTU) - Body ground	Press continuously "+" (Up shift)	Below 1 ohms
?	S	10 kohms or higher
D36-5 (SFTD) - Body ground	Press continuously "-" (Down shift)	Below 1 ohms
?	S	10 kohms or higher

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

cardiagn.com

Rear view of wire harness connector:
(to ECM)

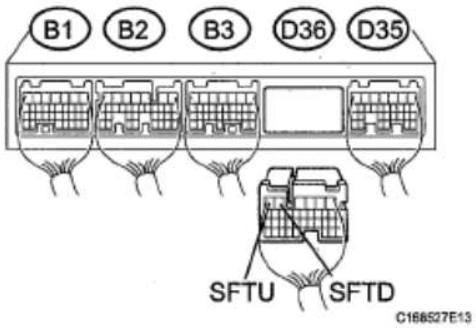


Fig. 93: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE

PATTERN SELECT SWITCH CIRCUIT

DESCRIPTION

ECT SNOW is the system that operates the throttle motor to control engine output to reduce skidding of the driving wheels, guarantee takeoff acceleration, driving straightness and turning stability.

WIRING DIAGRAM

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

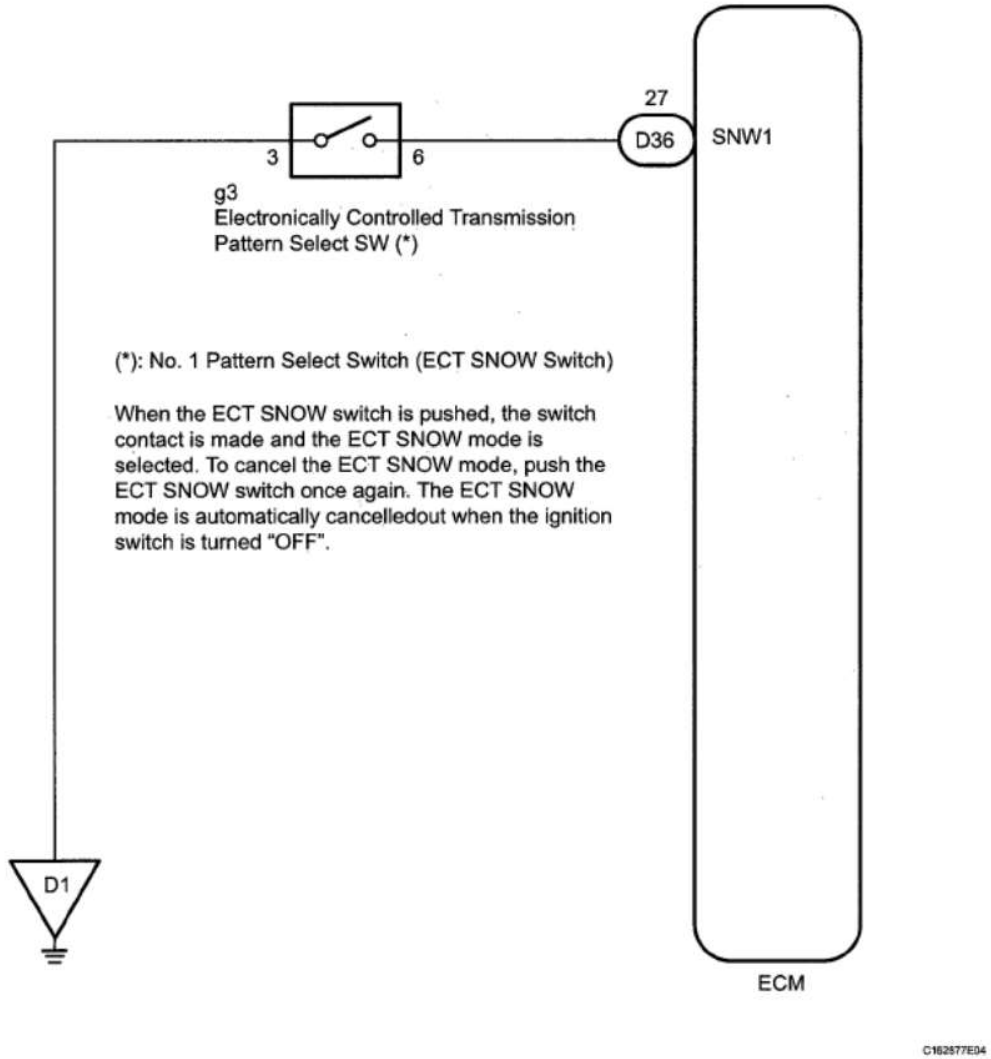


Fig. 94: Pattern Select Switch - Wiring Diagram
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION PROCEDURE

1. **DRIVING TEST**
   a. Start the engine.
   b. Turn the ECT SNOW switch "OFF" (Normal drive mode).
   c. Confirm vehicle response by driving from a parked position to fully depressing the accelerator pedal (*1).
   d. Turn the ECT SNOW switch "ON" and perform the same check as (*1).

   Confirm that there is a difference between ECT SNOW switch "ON" and "OFF".

   HINT:

cardiagn.com

- Driving test should be done on a paved road (a nonskid road).
- Make sure not to use the VSC system when testing a vehicle equipped with one.

Standard: There is a difference in acceleration between "ON" and "OFF".

NG: Go to step 2

OK: PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE

2. **CHECK HARNESS AND CONNECTOR (NO. 1 PATTERN SELECT SWITCH ASSEMBLY - BODY GROUND)**
   a. Disconnect the No. 1 pattern select switch (ECT SNOW switch) connector.
   b. Measure the resistance according to the value(s) in the table below.

HINT:

The No. 1 pattern select switch connector has no terminals in locations of 1, 2, 7 and 8.

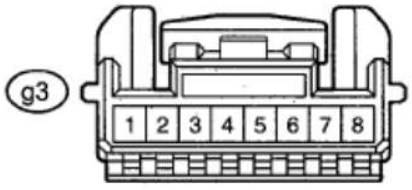
Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
3 - Body ground	Always	Below 1 ohms

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Front view of wire harness connector:
(to Pattern Select Switch)



P C168600E03

Fig. 95: Identifying G3 Pattern Select Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: Go to next step

cardiagn.com

3. **INSPECT NO. 1 PATTERN SELECT SWITCH ASSEMBLY**
   a. Measure the resistance according to the value(s) in the table below.

   HINT:

   The No. 1 pattern select switch connector has no terminals in locations of 1, 2, 7 and 8.

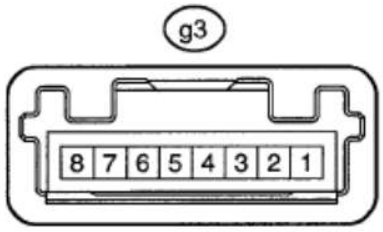
   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
3 - 6	Press continuously Pattern select switch	Below 1 ohms
	Release Pattern select switch	10 kohms or higher

   NG: REPLACE NO. 1 PATTERN SELECT SWITCH ASSEMBLY

Component without harness connected:
(Pattern Select Switch)



P C163601E03

Fig. 96: Identifying G3 Pattern Select Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   OK: Go to next step

4. **CHECK HARNESS AND CONNECTOR (NO. 1 PATTERN SELECT SWITCH ASSEMBLY - ECM)**
   a. Connect the No. 1 pattern select switch (ECT SNOW switch) connector.
   b. Disconnect the ECM connector.
   c. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

   Standard resistance

cardiagn.com

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
D36-27 (SNW1) - Body ground	Press continuously Pattern select switch	Below 1 ohms
	Release Pattern select switch	10 kohms or higher

NG: REPAIR OR REPLACE HARNESS OR CONNECTOR

Rear view of wire harness connector:
(to ECM)

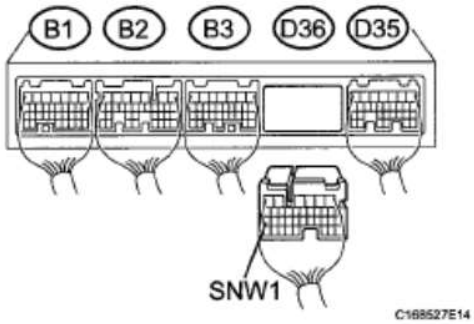


Fig. 97: Identifying ECM Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OK: PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE

AUTOMATIC TRANSAXLE FLUID

ON-VEHICLE INSPECTION

1. **CHECK FLUID LEVEL**

HINT:

Drive the vehicle so that the engine and transaxle are at normal operating temperature.

Fluid temperature: 70 to 80°C (158 to 176°F)

a. Park the vehicle on a level surface and set the parking brake.
b. With the engine idling and the brake pedal depressed, move the shift lever to all positions from P to S1 and return to the P position.
c. Take out the dipstick and wipe it clean.
d. Put the dipstick back all the way.
e. Take out the dipstick again and check that the fluid level is within the HOT range.

cardiagn.com

If the fluid level is below the HOT range, add new fluid and recheck the fluid level.

If the fluid level exceeds the HOT range, drain the fluid once, add the proper amount of new fluid and recheck the fluid level.

If there are leaks, it is necessary to repair or replace O-rings, FIPGs, oil seals, plugs and/or other parts.

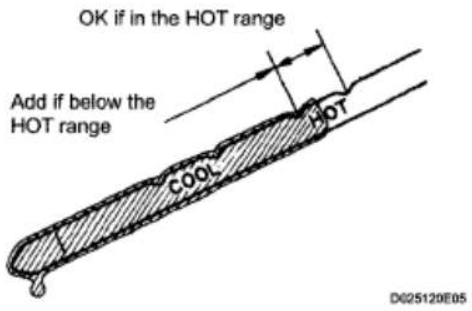


Fig. 98: Checking Fluid Level
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SPEED SENSOR

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

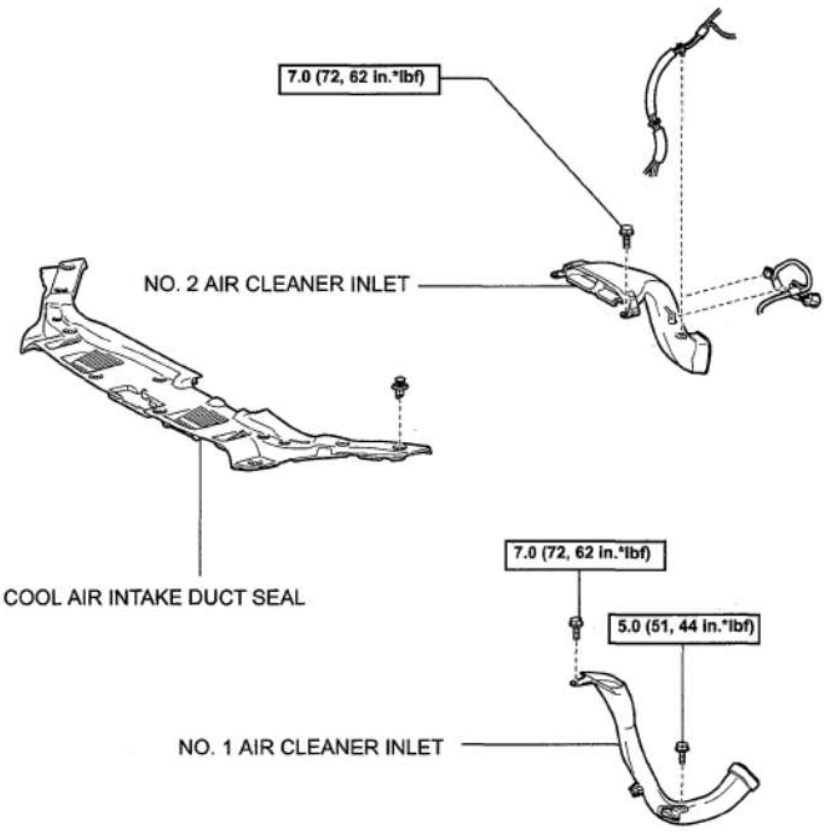


Fig. 99: Identifying Speed Sensor Components With Torque Specification (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

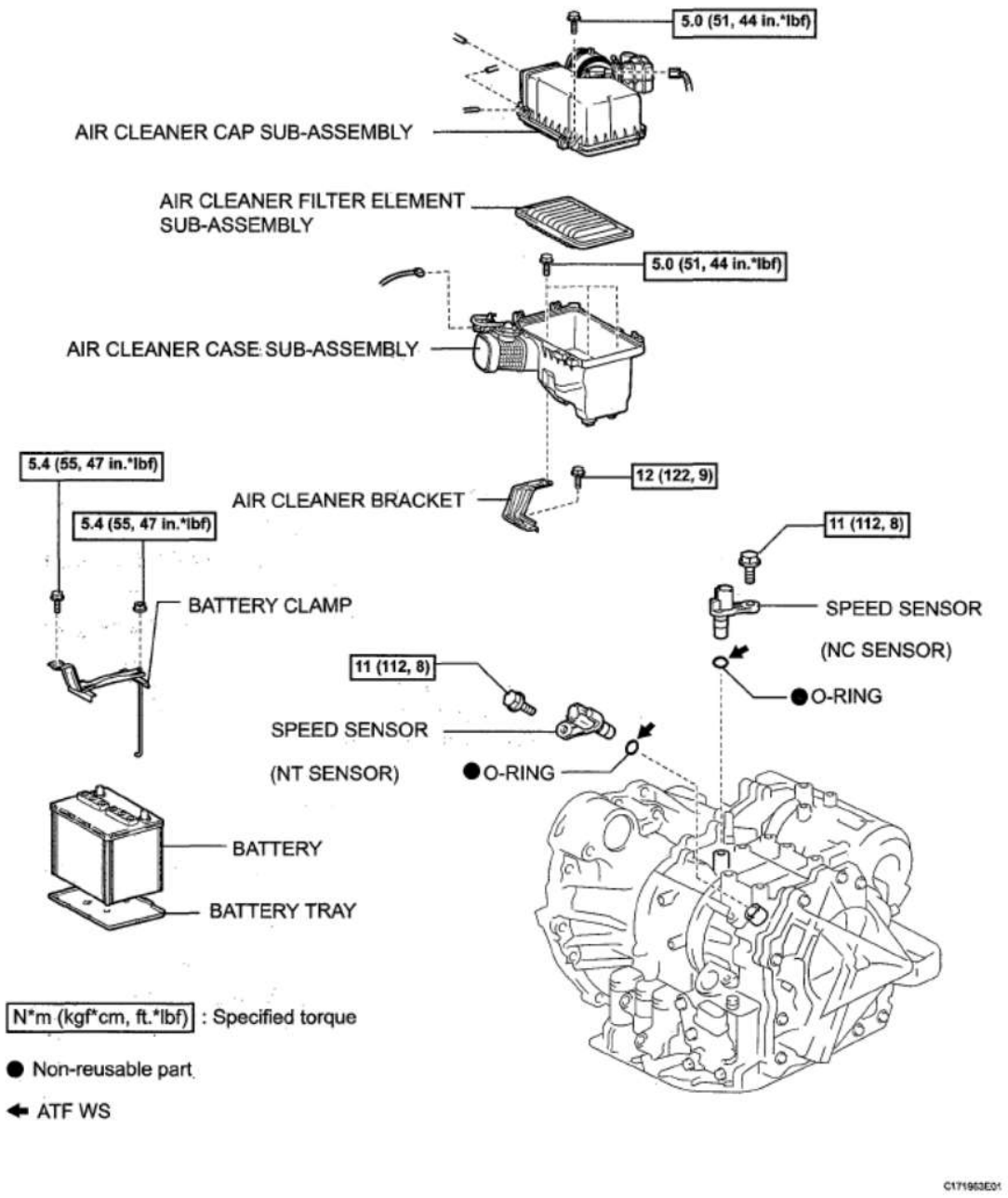


Fig. 100: Identifying Speed Sensor Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

CAUTION: Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

2. **REMOVE BATTERY** (See **REASSEMBLY**)
3. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **SYSTEM DIAGRAM**)
4. **REMOVE NO. 2 AIR CLEANER INLET** (See **SYSTEM DIAGRAM**)
5. **REMOVE NO. 1 AIR CLEANER INLET** (See **ON-VEHICLE INSPECTION**)
6. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
7. **REMOVE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
8. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
9. **REMOVE AIR CLEANER BRACKET** (See **REASSEMBLY**)
10. **REMOVE SPEED SENSOR (NT SENSOR)**
    a. Disconnect the speed sensor connector.
    b. Remove the bolt and speed sensor.

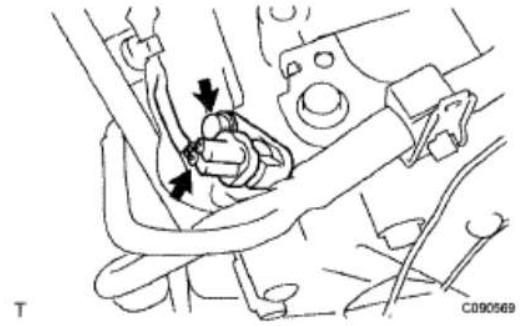


Fig. 101: Locating NT Speed Sensor With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **REMOVE SPEED SENSOR (NC SENSOR)**
    a. Disconnect the speed sensor connector.
    b. Remove the bolt and speed sensor.

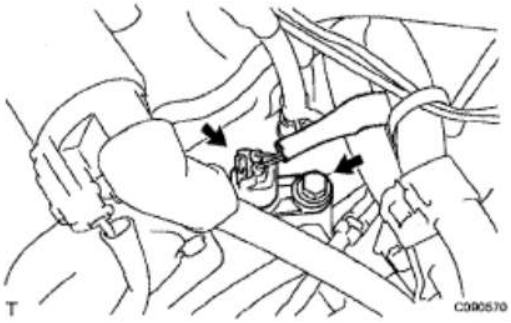


Fig. 102: Locating NC Speed Sensor Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

INSPECTION

1. **INSPECT SPEED SENSOR (NT SENSOR)**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	560 to 680 ohms

Component without harness connected:
(Speed Sensor)

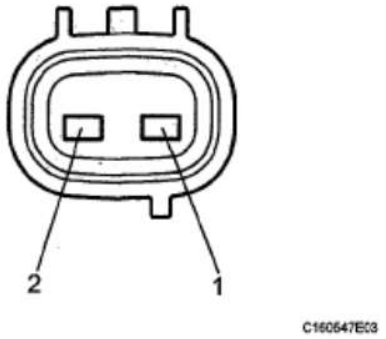


Fig. 103: Identifying NT Speed Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT SPEED SENSOR (NC SENSOR)**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	560 to 680 ohms

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Component without harness connected:
(Speed Sensor)

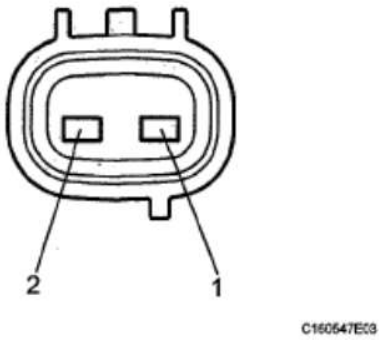


Fig. 104: Identifying NC Speed Sensor Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL SPEED SENSOR (NC SENSOR)**
   a. Coat a new O-ring with ATF.
   b. Install the speed sensor with the bolt.

      Torque: 11 N*m (112 kgf*cm, 8 ft.*lbf)

      HINT:

      Make sure to install the same manufacturer's sensor.

   c. Connect the speed sensor connector.

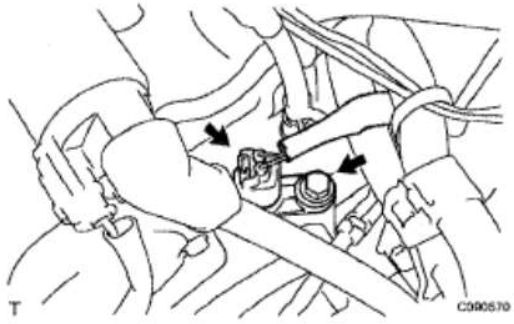


Fig. 105: Locating NC Speed Sensor Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL SPEED SENSOR (NT SENSOR)**
   a. Coat a new O-ring with ATF.

cardiagn.com

b. Install the speed sensor with the bolt.

Torque: 11 N*m (112 kgf*cm, 8 ft.*lbf)

HINT:

Make sure to install the same manufacturer's sensor.

c. Connect the speed sensor connector.

3. **INSTALL AIR CLEANER BRACKET** (See **INSTALLATION**)

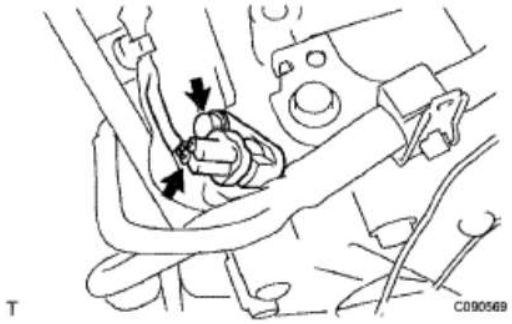


Fig. 106: Locating NT Speed Sensor With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
5. **REMOVE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
6. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INTAKE MANIFOLD**)
7. **INSTALL NO. 1 AIR CLEANER INLET** (See **INTAKE MANIFOLD**)
8. **INSTALL NO. 2 AIR CLEANER INLET** (See **COMPONENTS**)
9. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **COMPONENTS**)
10. **INSTALL BATTERY** (See **INSTALLATION**)
11. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

NOTE: **When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).**

PARK/NEUTRAL POSITION SWITCH

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

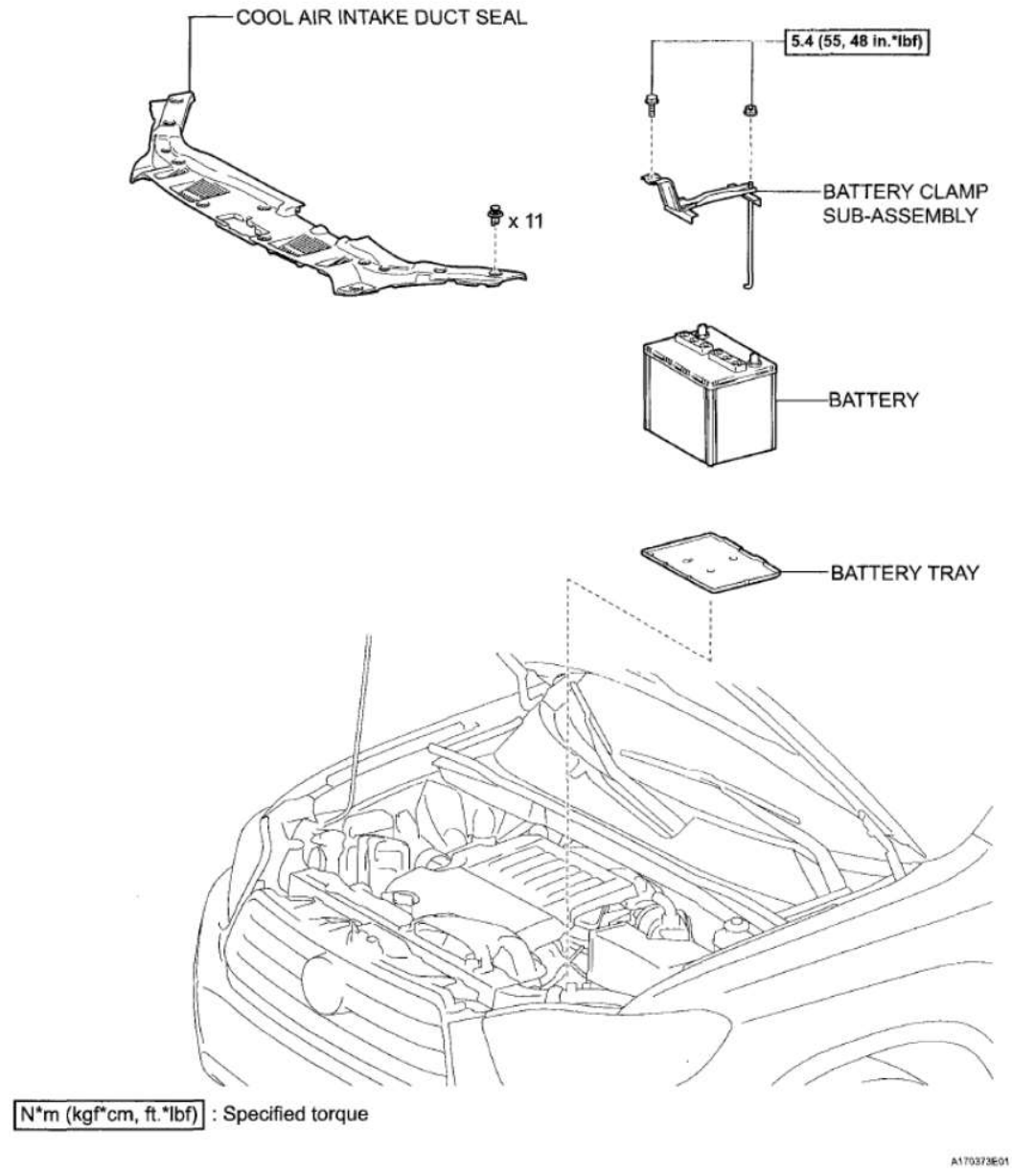


Fig. 107: Identifying Park/Neutral Position Switch Components With Torque Specification (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

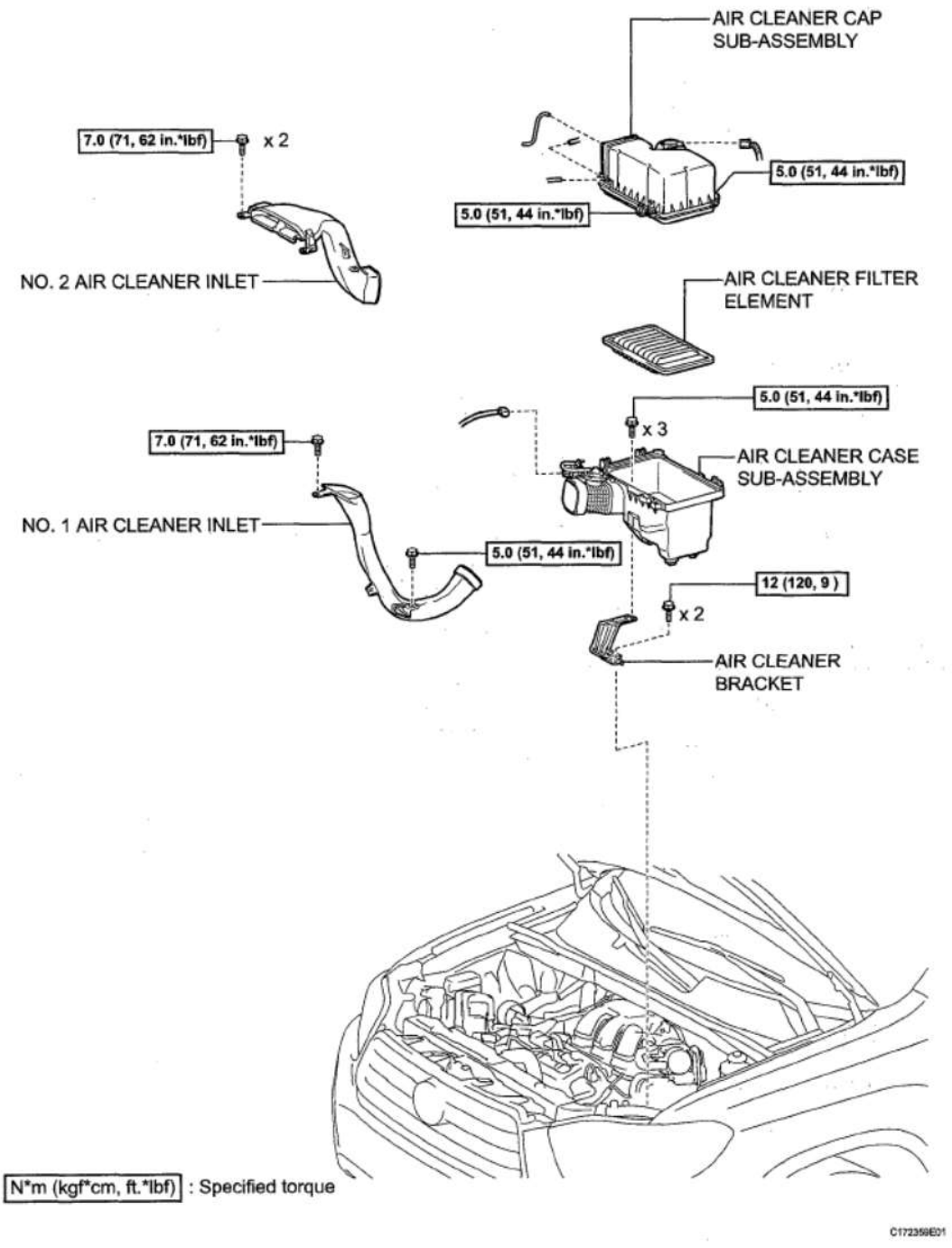


Fig. 108: Identifying Park/Neutral Position Switch Components With Torque Specification (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

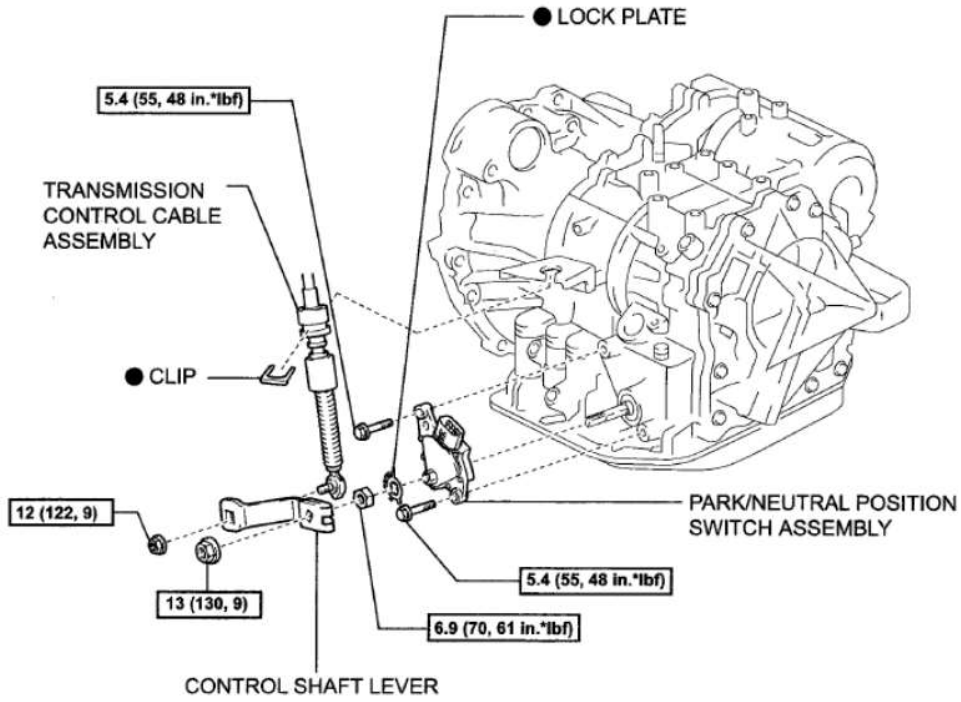


Fig. 109: Identifying Park/Neutral Position Switch Components With Torque Specification (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY OPERATION**
   a. Apply the parking brake and turn the ignition switch to ON.
   b. Depress the brake pedal and check that the engine starts when the shift lever is set in the N position or P position, but does not start with the shift lever in the other positions.
   c. Check that the back-up light illuminates when the shift lever is set in the R position, but does not function with the shift lever in the other positions. If a malfunction is found, check the park/neutral position switch for continuity.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

CAUTION: Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

2. **REMOVE BATTERY** (See **REASSEMBLY**)
3. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **SYSTEM DIAGRAM**)
4. **REMOVE NO. 2 AIR CLEANER INLET** (See **SYSTEM DIAGRAM**)
5. **REMOVE NO. 1 AIR CLEANER INLET** (See **ON-VEHICLE INSPECTION**)
6. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
7. **REMOVE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
8. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
9. **REMOVE AIR CLEANER BRACKET** (See **REASSEMBLY**)
10. **SEPARATE TRANSMISSION CONTROL CABLE ASSEMBLY**
    a. Remove the nut from the control shaft lever.
    b. Disconnect the control cable from the control shaft lever.

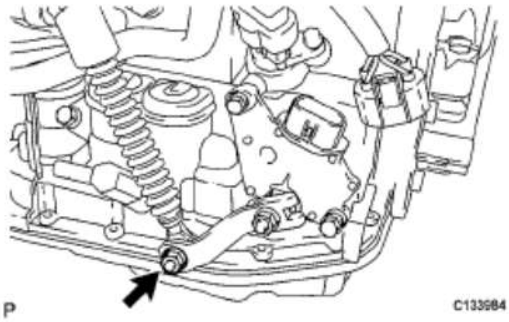


Fig. 110: Locating Control Shaft Lever Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Remove the clip and disconnect the control cable from the control cable bracket.

NOTE: Do not hold the resin guide pipe.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

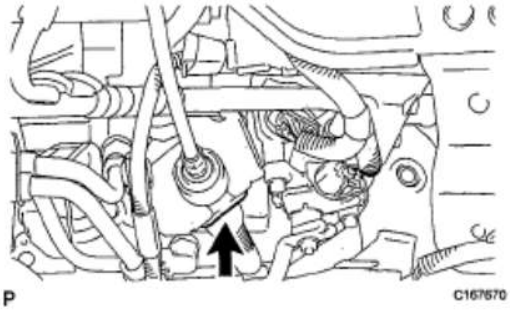


Fig. 111: Locating Control Cable Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **REMOVE PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
    a. Disconnect the park/neutral position switch connector.

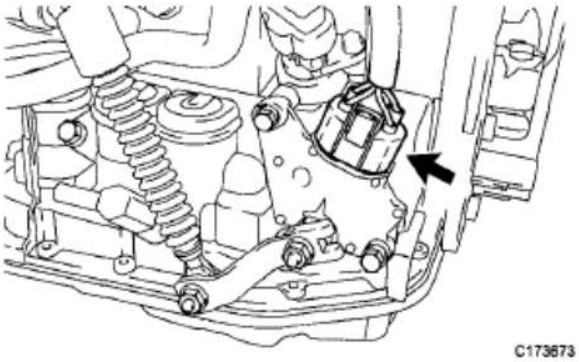


Fig. 112: Locating Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the nut, washer and control shaft lever.

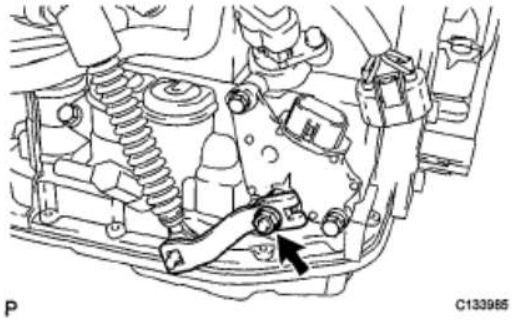


Fig. 113: Locating Nut, Washer And Control Shaft Lever
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Using a screwdriver, pry up the lock plate.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

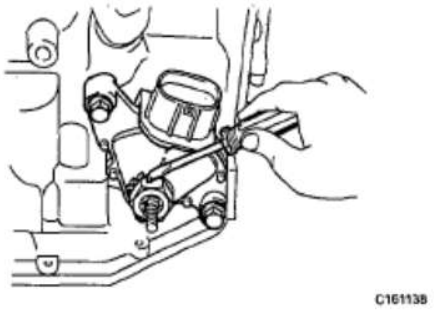


Fig. 114: Prying Up Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the lock nut and lock plate.

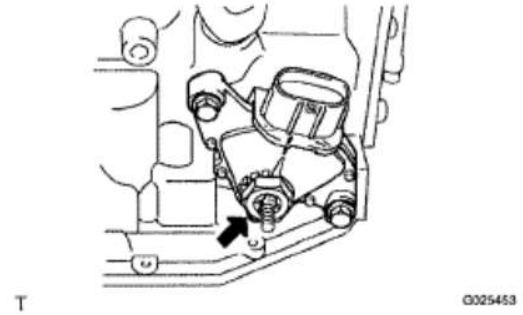


Fig. 115: Locating Lock Nut And Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Remove the 2 bolts and pull out the park/neutral position switch.

INSPECTION

1. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Jack up the vehicle.

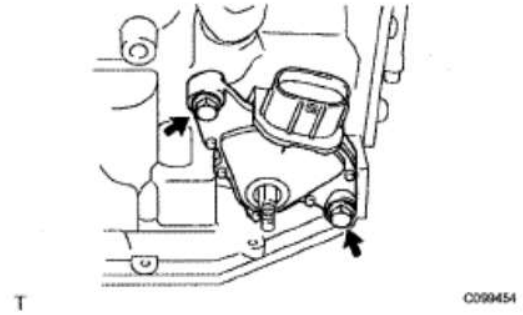


Fig. 116: Locating Park/Neutral Position Switch Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Disconnect the park/neutral position switch connector.
c. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
4 - 5	P and N	Below 1 ohms
	Except P and N	10 kohms or higher
2 - 6	P	Below 1 ohms
	Except P	10 kohms or higher
2 - 1	R	Below 1 ohms
	Except R	10 kohms or higher
2 - 9	N	Below 1 ohms
	Except N	10 kohms or higher
2 - 7	D, S, "+" and "-"	Below 1 ohms
	Except D, S, "+" and "-"	10 kohms or higher

Component without harness connected:
(Park/Neutral Position Switch)

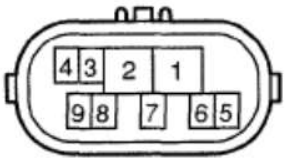


Fig. 117: Identifying Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the resistance value is not as specified, replace the park/neutral position switch.

ADJUSTMENT

1. **ADJUST PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Loosen the 2 bolts of the park/neutral position switch and move the shift lever to the N position.
   b. Align the groove with the neutral basic line.

cardiagn.com

c. Hold the switch in position and tighten the 2 bolts.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

d. After adjustment, inspect the park/neutral position switch assembly operation (See **INSPECTION**).

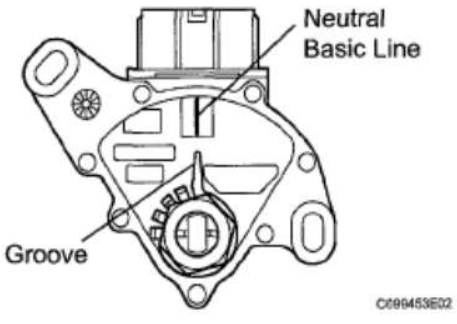


Fig. 118: Aligning Groove With Neutral Basic Line
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Install the park/neutral position switch to the manual valve shaft.
   b. Temporarily install the 2 bolts.

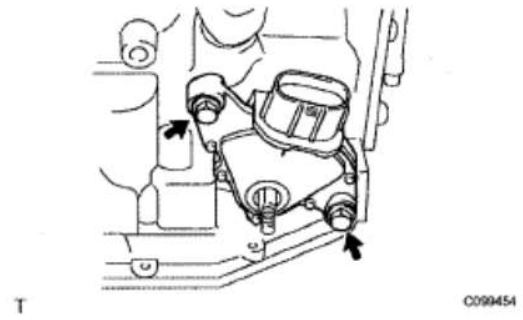


Fig. 119: Locating Park/Neutral Position Switch Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Place a new lock plate and tighten the nut.

Torque: 6.9 N*m (70 kgf*cm, 61 in.*lbf)

d. Temporarily install the control shaft lever.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

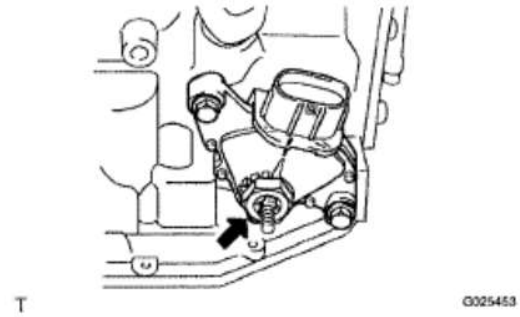


Fig. 120: Locating Lock Nut And Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Turn the lever counterclockwise until it stops and then turn it clockwise 2 notches.
f. Remove the control shaft lever.

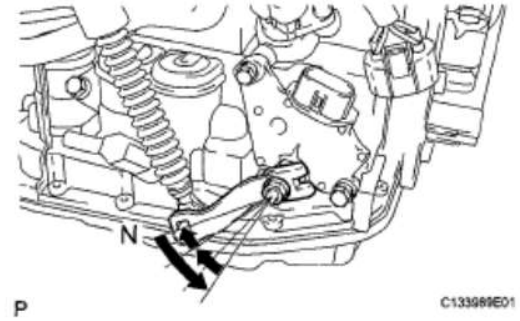


Fig. 121: Identifying Control Shaft Lever Turn Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Align the groove with the neutral basic line.
h. Hold the switch in position and tighten the 2 bolts.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

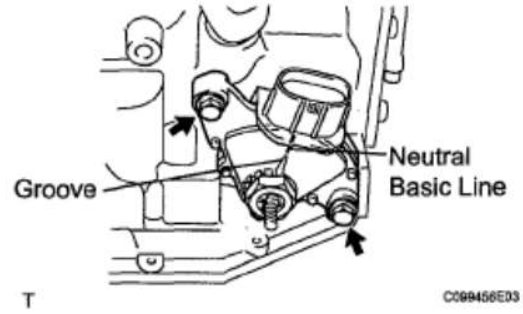


Fig. 122: Aligning Groove With Neutral Basic Line
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

i. Using a screwdriver, bend the tabs of the lock plate.

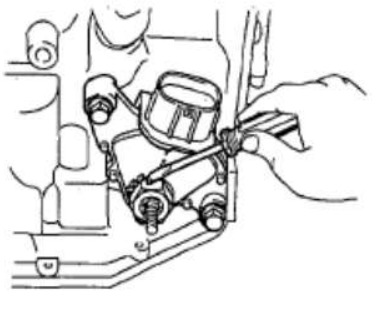


Fig. 123: Bending Tabs Of Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. Install the control shaft lever washer and nut.

Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

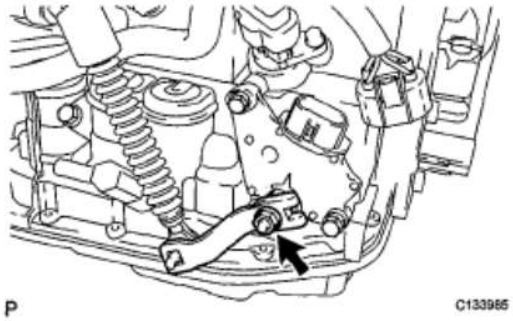


Fig. 124: Locating Nut, Washer And Control Shaft Lever
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

k. Connect the park/neutral position switch connector.

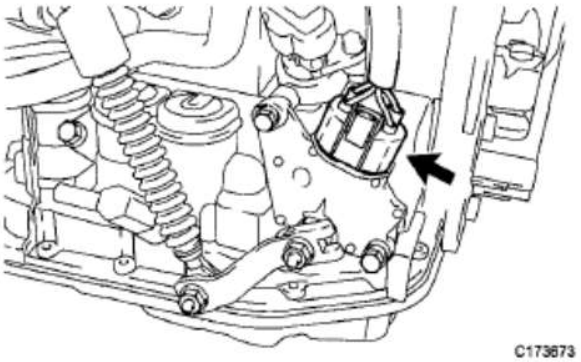


Fig. 125: Locating Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2. **CONNECT TRANSMISSION CONTROL CABLE ASSEMBLY**
   a. Connect the control cable to the control shaft lever with the nut.

   Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)

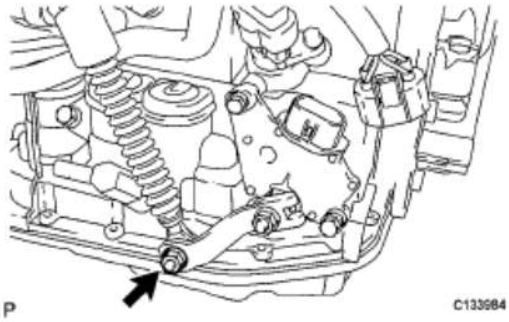


Fig. 126: Locating Control Shaft Lever Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the control cable to the bracket with a new clip.
3. **ADJUST PARK/NEUTRAL POSITION SWITCH ASSEMBLY** (See **INSPECTION**)
4. **ADJUST SHIFT LEVER POSITION** (See **ADJUSTMENT**)
5. **INSPECT PARK/NEUTRAL POSITION SWITCH ASSEMBLY OPERATION** (See **REMOVAL**)
6. **INSPECT SHIFT LEVER POSITION** (See **ON-VEHICLE INSPECTION**)

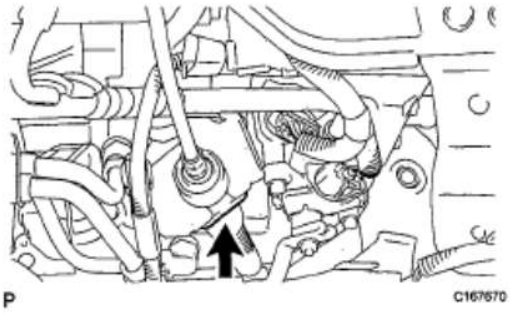


Fig. 127: Locating Control Cable Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSTALL AIR CLEANER BRACKET** (See **INSTALLATION**)
8. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
9. **INSTALL AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
10. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INTAKE MANIFOLD**)
11. **INSTALL NO. 1 AIR CLEANER INLET** (See **INTAKE MANIFOLD**)
12. **INSTALL NO. 2 AIR CLEANER INLET** (See **COMPONENTS**)
13. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **COMPONENTS**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

14. **INSTALL BATTERY** (See **INSTALLATION**)
15. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

NOTE: **When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).**

TRANSMISSION WIRE

COMPONENTS

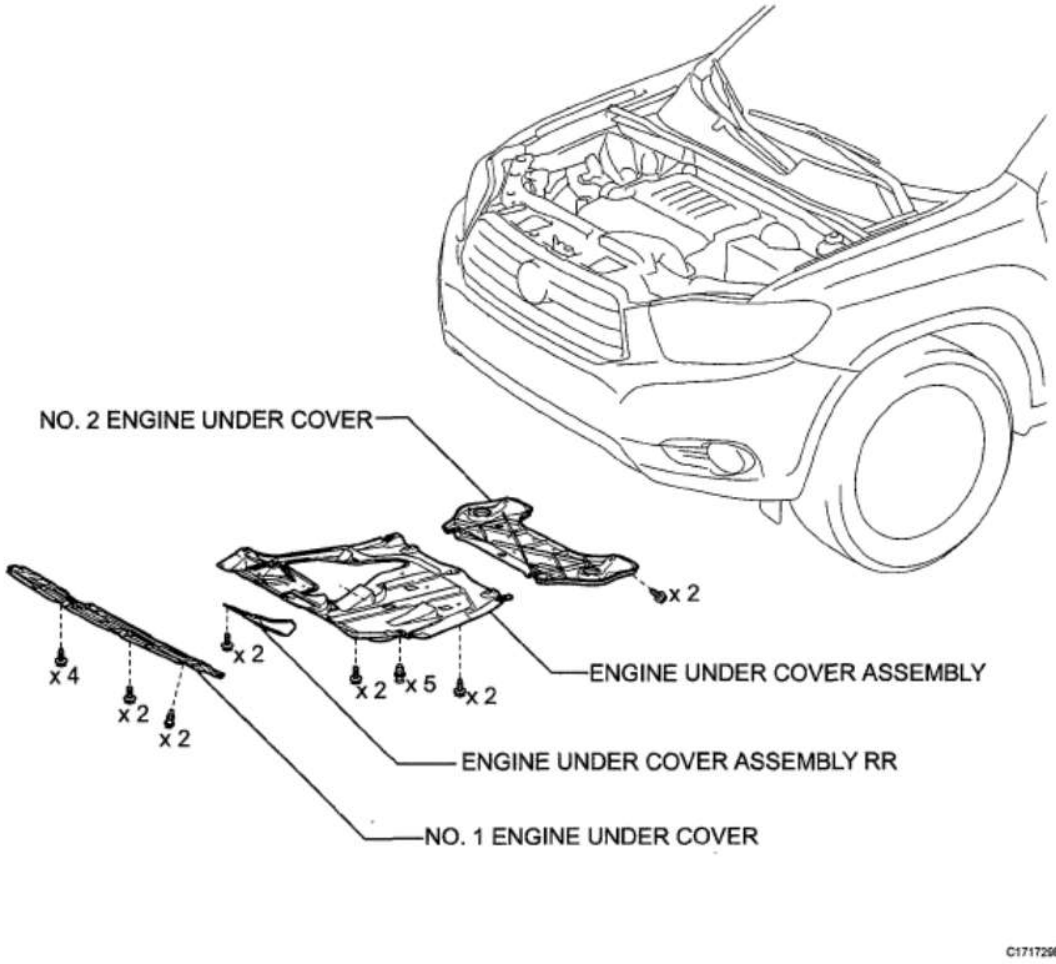


Fig. 128: Identifying Transmission Wire Components With Torque Specification (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

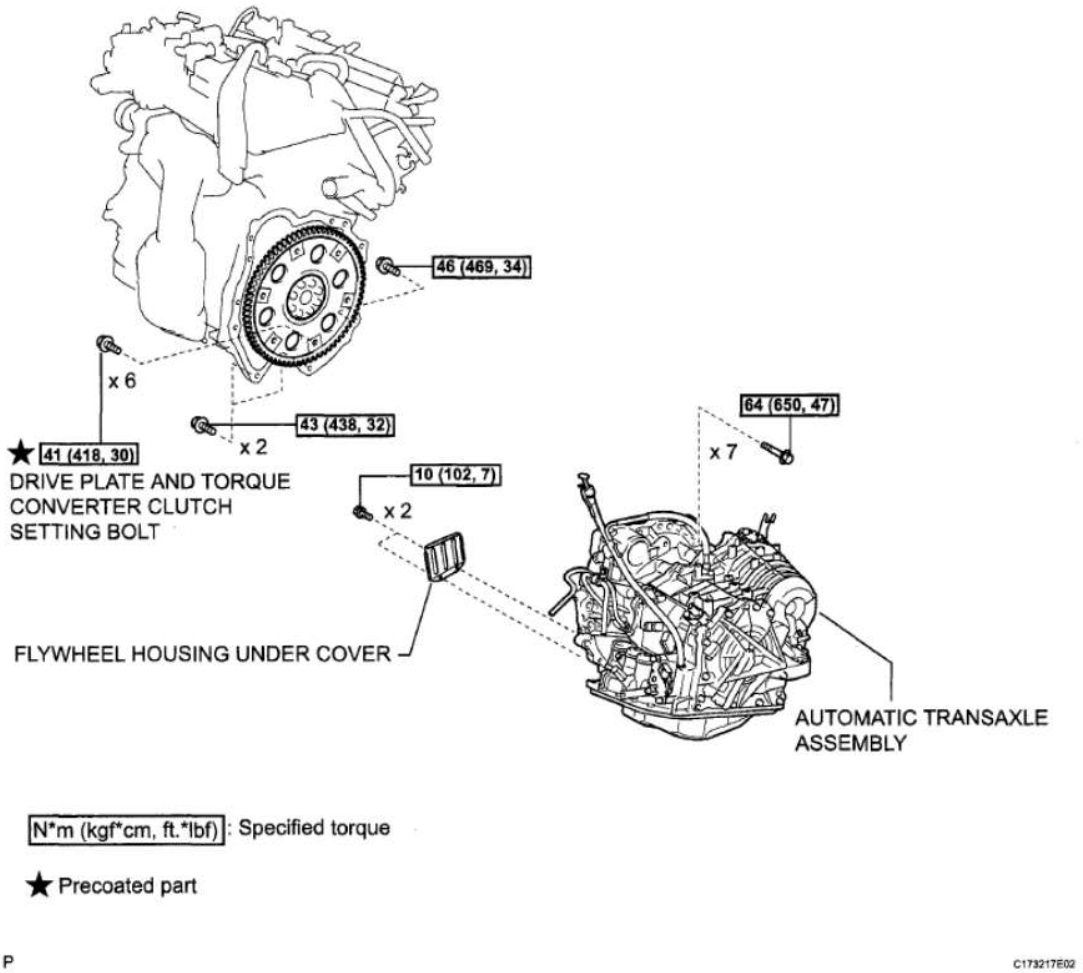


Fig. 129: Identifying Transmission Wire Components With Torque Specification (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

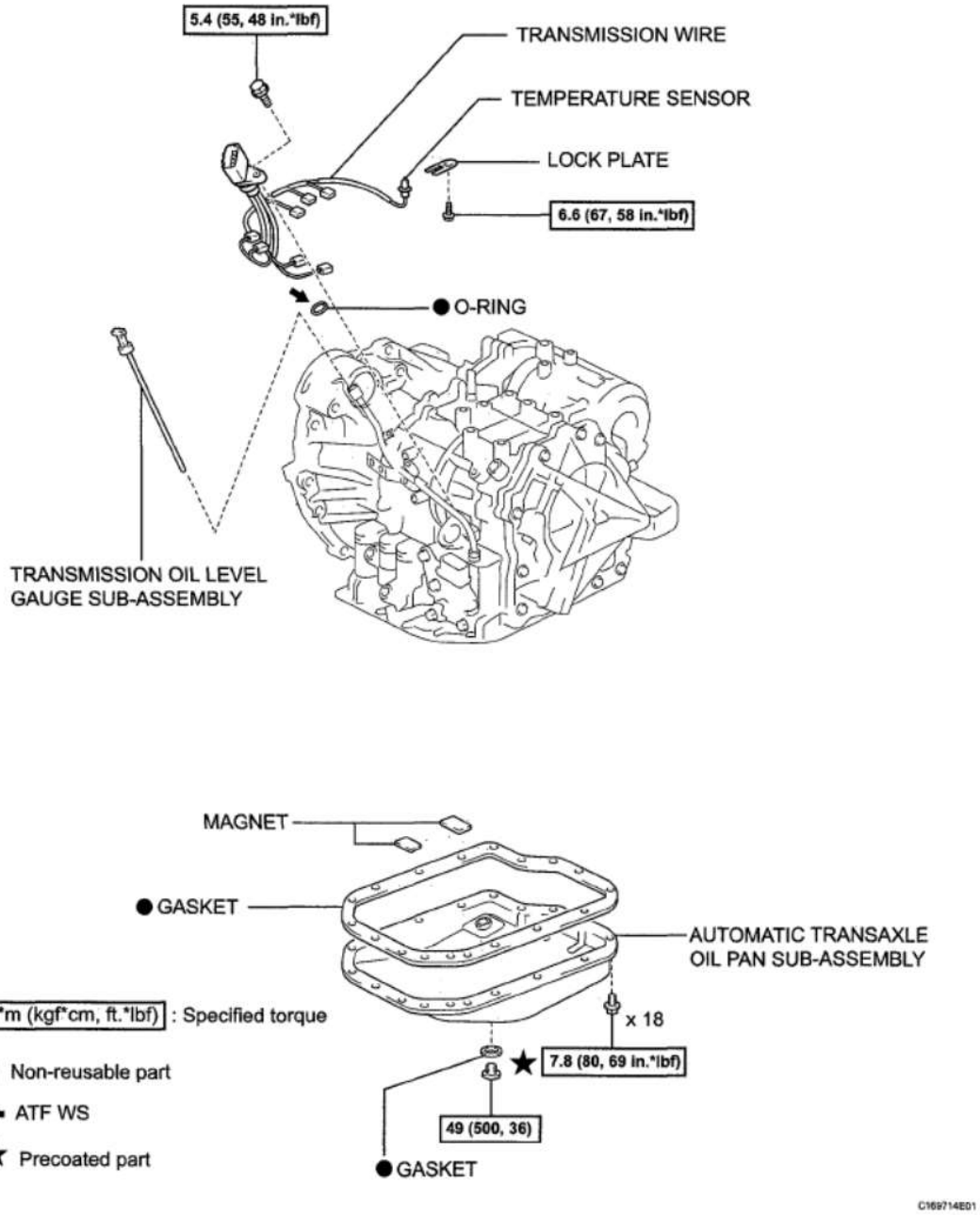


Fig. 130: Identifying Transmission Wire Components With Torque Specification (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

CAUTION: Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

2. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REASSEMBLY**)
3. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REASSEMBLY**)
4. **REMOVE NO. 2 ENGINE UNDER COVER** (See **REASSEMBLY**)
5. **DRAIN AUTOMATIC TRANSAXLE FLUID**
   a. Remove the drain plug and gasket, and drain ATF.
   b. Install a new gasket and the drain plug.

   Torque: 49 N*m (500 kgf*cm, 36 ft.*lbf)

6. **REMOVE AUTOMATIC TRANSAXLE ASSEMBLY**

   HINT:

   (See **REMOVAL**)

7. **REMOVE AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY**
   a. Remove the 18 bolts, oil pan, and gasket.

   NOTE: Some fluid will remain in the oil pan. Carefully remove the oil pan so that fluid remaining in the pan does not spill out.

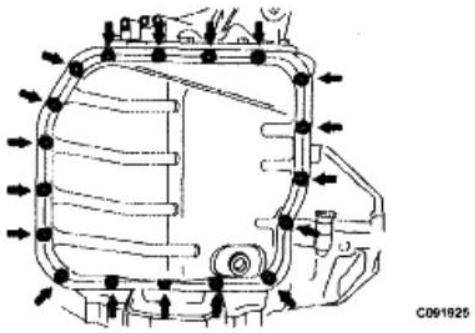


Fig. 131: Locating Oil Pan Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Remove the 2 magnets from the oil pan.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

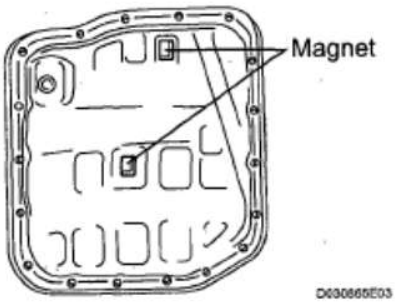


Fig. 132: Identifying Magnets From Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Examine particles in the pan.
   1. Collect any steel chips using the removed magnets. Look carefully at the chips and particles in the pan and on the magnets to see the type of wear which might be found in the transaxle.

      Result:

      Steel (magnetic): bearing, gear, or plate wear

      Brass (non-magnetic): bushing wear

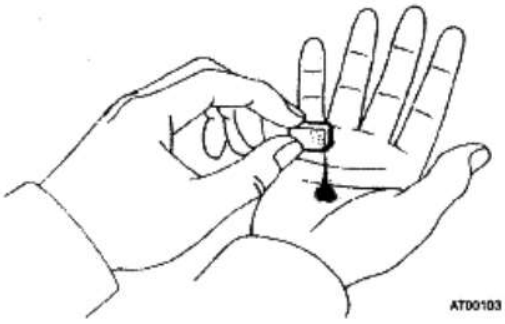


Fig. 133: Examining Particles In Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **DISCONNECT TRANSMISSION WIRE**
   a. Disconnect the 7 shift solenoid valve connectors.
   b. Remove the bolt and lock plate, and disconnect the ATF temperature sensor.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

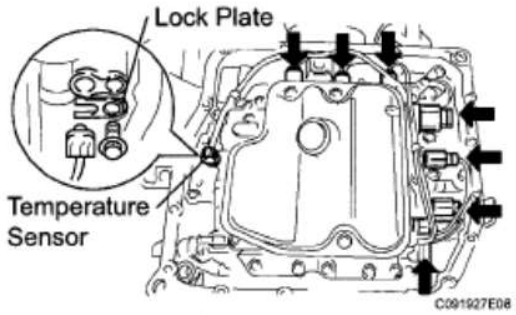


Fig. 134: Locating Shift Solenoid Valve Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **REMOVE TRANSMISSION WIRE**
   a. Disconnect the transmission wire connector.
   b. Remove the bolt and transmission wire.
   c. Remove the O-ring from the transmission wire.



Fig. 135: Locating Transmission Wire Connector Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT TRANSMISSION WIRE**
   a. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 (THO) - 6 (E2)	10°C (50°F)	5 to 8 kohms
1 (THO) - 6 (E2)	25°C (77°F)	2.5 to 4.5 kohms
1 (THO) - 6 (E2)	110°C (230°F)	0.22 to 0.28 kohms

If the resistance value is not as specified, replace or repair the transmission wire.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

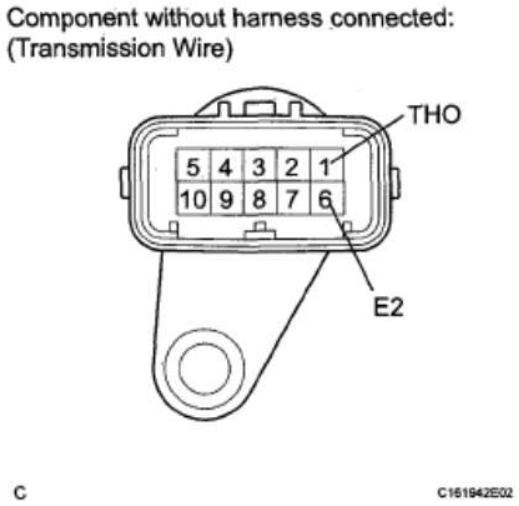


Fig. 136: Identifying Transmission Wire Connector Terminal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL TRANSMISSION WIRE**
   a. Coat a new O-ring of the transmission wire connector with ATF and install it.

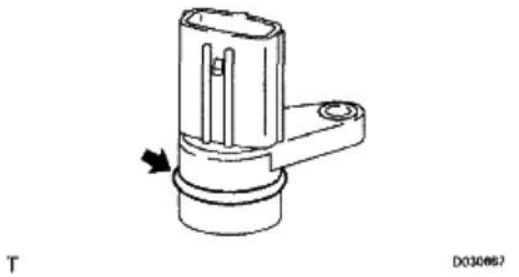


Fig. 137: Identifying O-Ring Of Transmission Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the transmission wire with the bolt.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

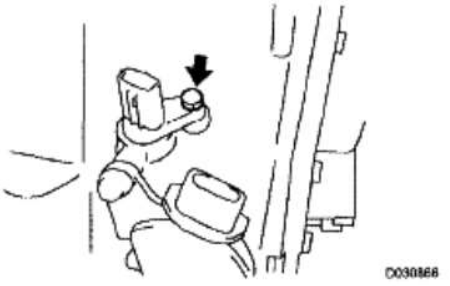


Fig. 138: Locating Transmission Wire Connector Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **CONNECT TRANSMISSION WIRE**
   a. Coat a new O-ring of the ATF temperature sensor with ATF.
   b. Install the ATF temperature sensor with the lock plate and bolt.

      Torque: 6.6 N*m (67 kgf*cm, 58 in.*lbf)

   c. Connect the 7 shift solenoid valve connectors.

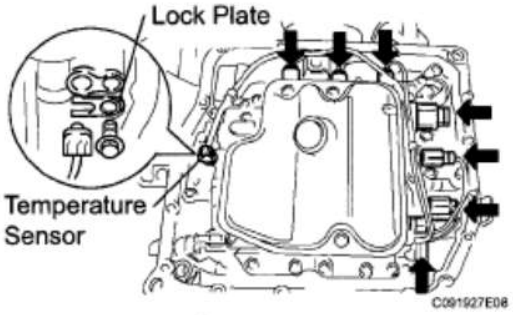


Fig. 139: Locating Shift Solenoid Valve Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY**
   a. Install the 2 magnets in the oil pan.
   b. Apply adhesive to the 18 bolts.

      Adhesive: Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

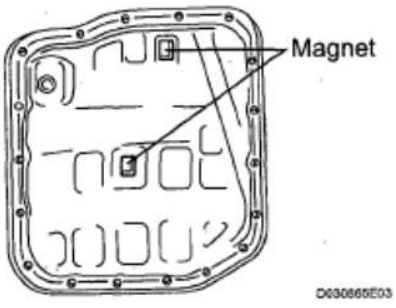


Fig. 140: Identifying Magnets From Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a new gasket, install the oil pan to the transaxle case with the 18 bolts.

Torque: 7.8 N*m (80 kgf*cm, 69 in.*lbf)

NOTE: Apply adhesive to the bolts and tighten them within 10 minutes of application.

4. **INSTALL AUTOMATIC TRANSAXLE ASSEMBLY**

HINT:

(See **INSTALLATION**)

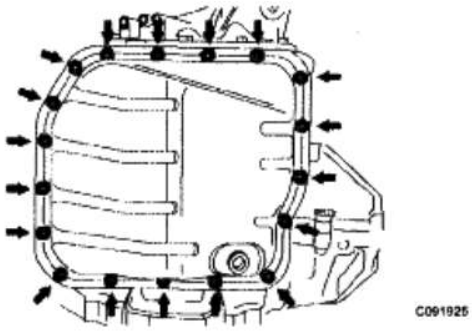


Fig. 141: Locating Oil Pan Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

6. **ADD AUTOMATIC TRANSAXLE FLUID**
7. **INSPECT AUTOMATIC TRANSAXLE FLUID** (See **ON-VEHICLE INSPECTION**)

cardiagn.com

8. **INSPECT FOR TRANSAXLE FLUID LEAK**
9. **INSTALL NO. 2 ENGINE UNDER COVER** (See **INSTALLATION**)
10. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
11. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
12. **RESET MEMORY**

HINT:

(See **INITIALIZATION**)

VALVE BODY ASSEMBLY

COMPONENTS

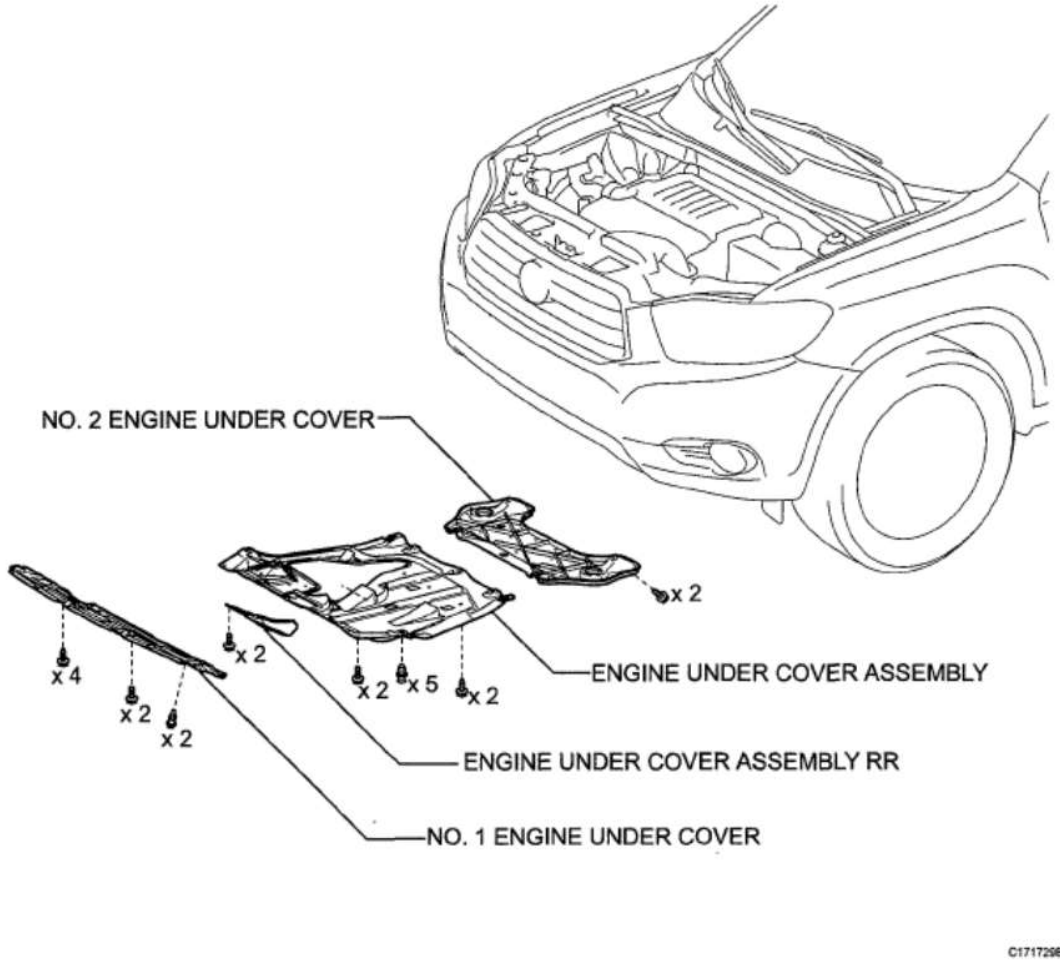


Fig. 142: Identifying Valve Body Assembly Components With Torque Specification (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

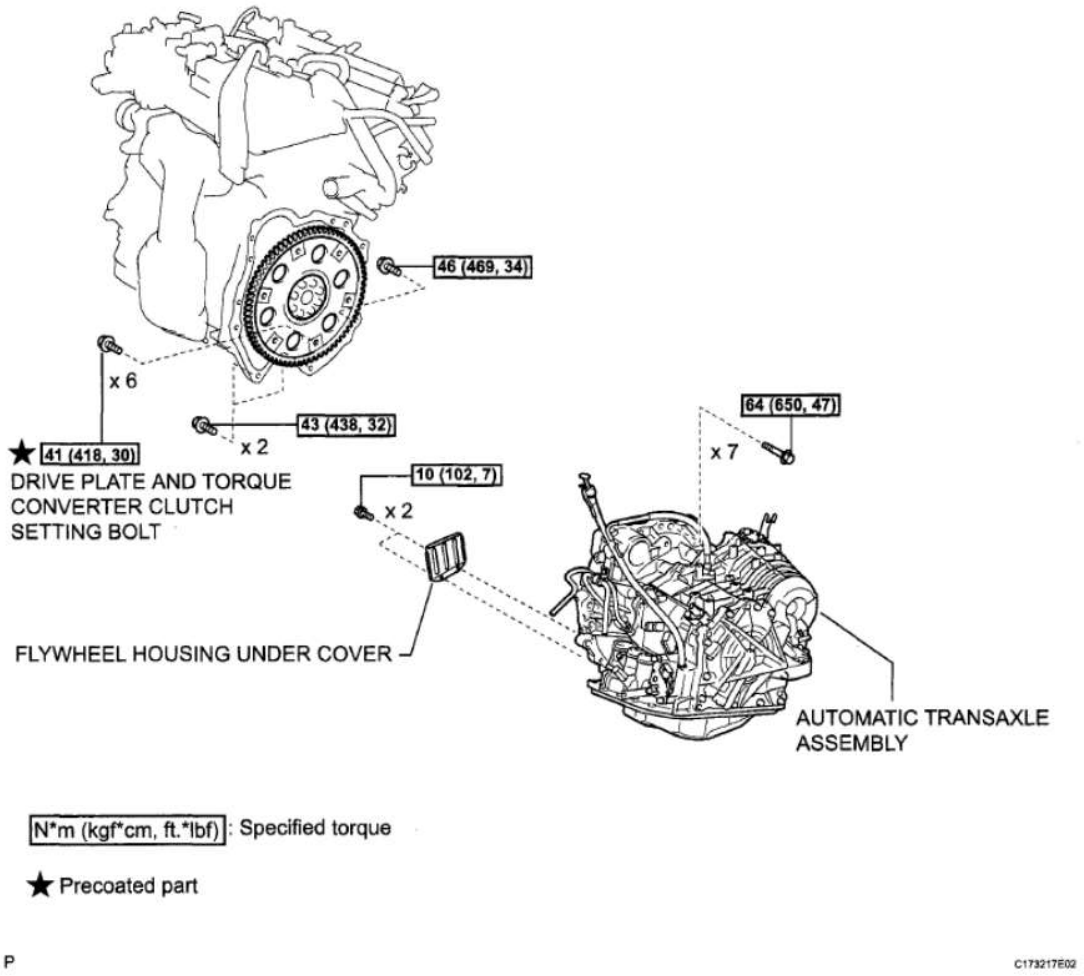


Fig. 143: Identifying Valve Body Assembly Components With Torque Specification (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

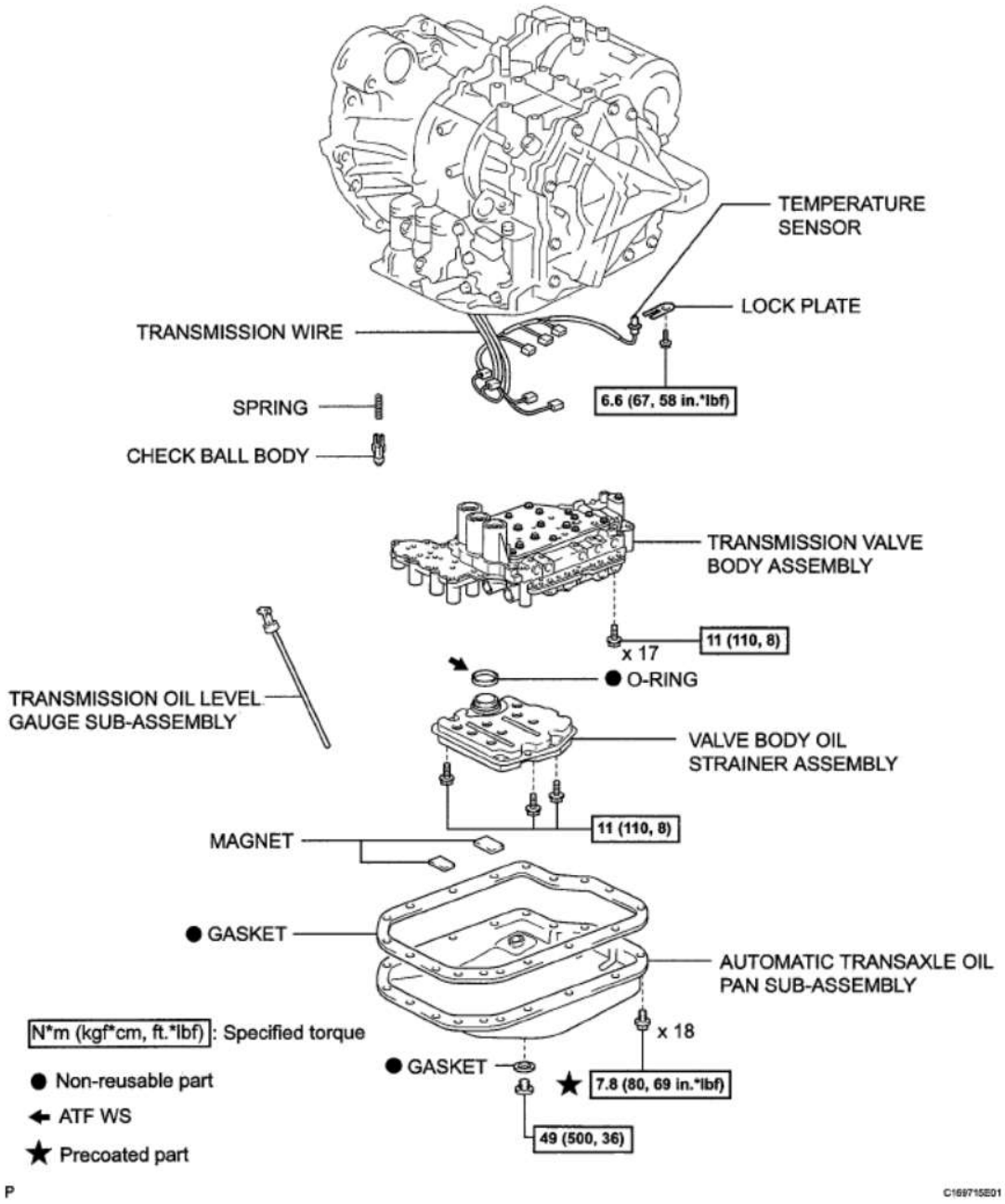


Fig. 144: Identifying Valve Body Assembly Components With Torque Specification (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL** (See **REMOVAL**)
2. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REASSEMBLY**)
3. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REASSEMBLY**)
4. **REMOVE NO. 2 ENGINE UNDER COVER** (See **REASSEMBLY**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

5. **DRAIN AUTOMATIC TRANSAXLE FLUID** (See **REMOVAL**)
6. **REMOVE AUTOMATIC TRANSAXLE ASSEMBLY**

HINT:

(See **REMOVAL**)

7. **REMOVE AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY**
   a. Remove the 18 bolts, oil pan, and gasket.

NOTE: **Some fluid will remain in the oil pan. Carefully remove the oil pan so that the fluid remaining in the pan does not spill out.**

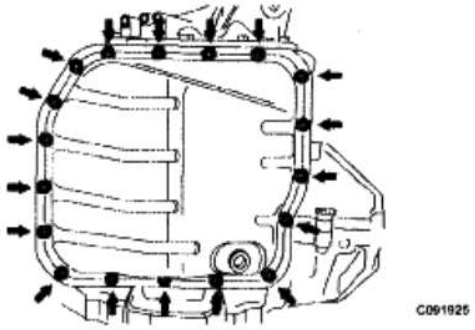


Fig. 145: Locating Oil Pan Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Remove the 2 magnets from the oil pan.

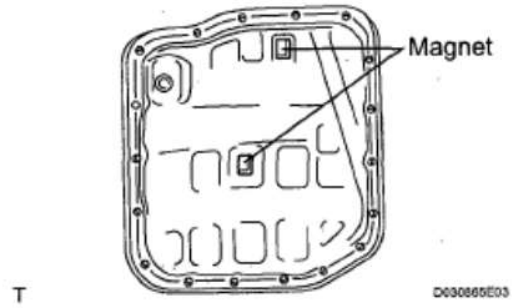


Fig. 146: Identifying Magnets From Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Examine particles in the pan.
      1. Collect any steel chips using the removed magnets. Look carefully at the chips and particles in the pan and on the magnets to see the type of wear which might be found in the transaxle.

Result:

cardiagn.com

Steel (magnetic): bearing, gear, or plate wear

Brass (non-magnetic): bushing wear

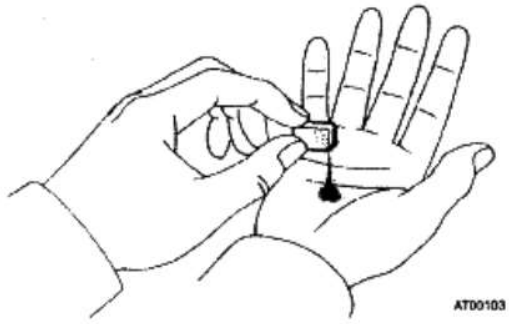


Fig. 147: Examining Particles In Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **DISCONNECT TRANSMISSION WIRE**
   a. Disconnect the 7 shift solenoid valve connectors.
   b. Remove the bolt and lock plate, and disconnect the ATF temperature sensor.

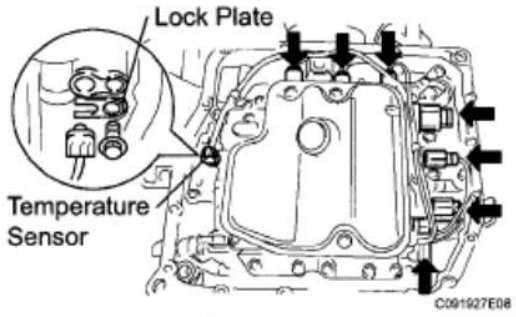


Fig. 148: Locating Shift Solenoid Valve Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **REMOVE VALVE BODY OIL STRAINER ASSEMBLY**
   a. Remove the 3 bolts and oil strainer.

NOTE: Be careful when removing the oil strainer as fluid will come out.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

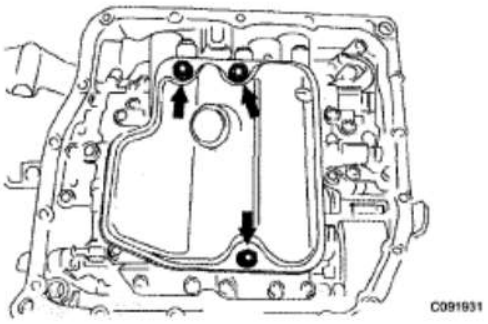


Fig. 149: Locating Oil Strainer Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the O-ring from the valve body oil strainer assembly.

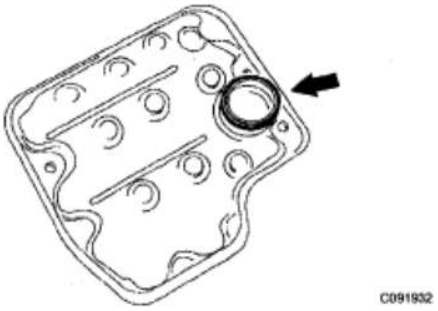


Fig. 150: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **REMOVE TRANSMISSION VALVE BODY ASSEMBLY**

a. Support the valve body assembly and remove the 17 bolts and the transmission valve body assembly.

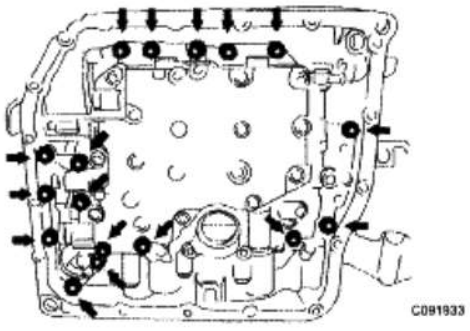


Fig. 151: Locating Transmission Valve Body Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the check ball body and the spring.

11. **REMOVE MANUAL VALVE**

cardiagn.com

a. Remove the manual valve from the valve body assembly.

INSTALLATION

1. **INSTALL MANUAL VALVE**
   a. Install the manual valve to the valve body assembly.

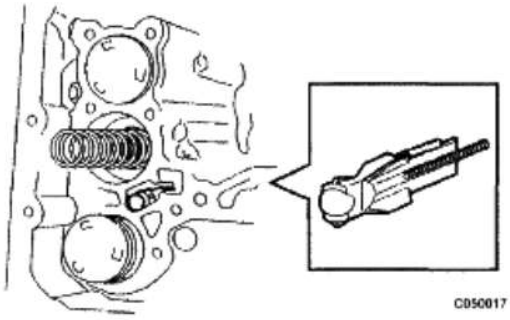


Fig. 152: Identifying Check Ball Body And Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL TRANSMISSION VALVE BODY ASSEMBLY**
   a. Install the spring and check ball body.
   b. Align the groove of the manual valve with the pin of the lever.

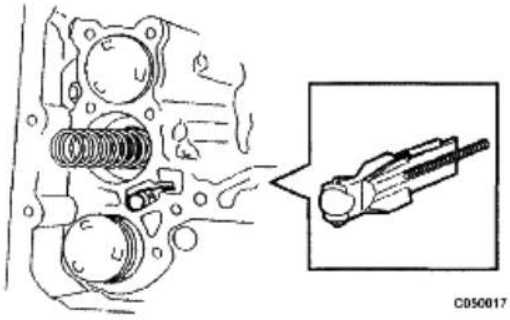


Fig. 153: Identifying Check Ball Body And Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the 17 bolts.

Torque: 11 N*m (110 kgf*cm, 8 ft.*lbf)

NOTE:

- **Push the valve body against the accumulator piston springs and check ball body to install the valve body.**
- **First, temporarily tighten the bolts marked (1) in the illustration because they are positioning bolts.**

cardiagn.com

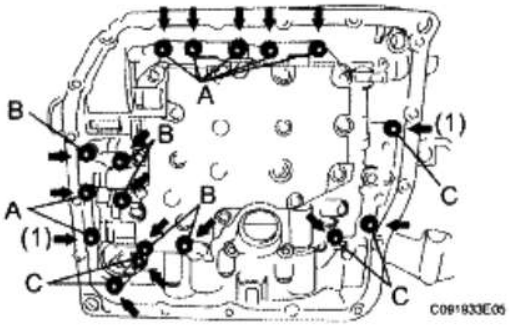


Fig. 154: Locating Valve Body Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Bolt length:

Bolt A: 25 mm (0.98 in.)

Bolt B: 57 mm (2.24 in.)

Bolt C: 41 mm (1.61 in.)

3. **INSTALL VALVE BODY OIL STRAINER ASSEMBLY**
   a. Coat a new O-ring with ATF.
   b. Install the O-ring to the oil strainer.

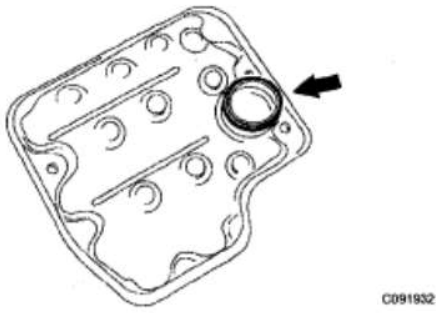


Fig. 155: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the oil strainer with the 3 bolts.

Torque: 11 N*m (110 kgf*cm, 8 ft.*lbf)

cardiagn.com

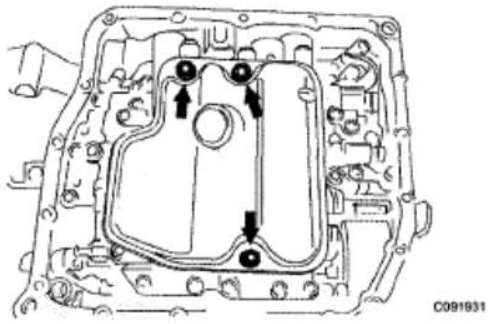


Fig. 156: Locating Oil Strainer Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL TRANSMISSION WIRE**
   a. Coat a new O-ring with ATF.
   b. Install the ATF temperature sensor with the lock plate and bolt.

      Torque: 6.6 N*m (67 kgf*cm, 58 in.*lbf)

   c. Connect the 7 shift solenoid valve connectors.

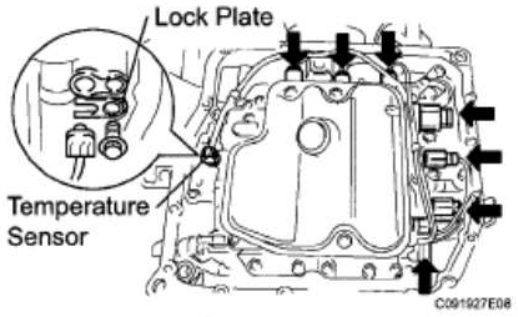


Fig. 157: Locating Shift Solenoid Valve Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY**
   a. Install the 2 magnets in the oil pan.
   b. Apply adhesive to the 18 bolts.

      Adhesive: Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

cardiagn.com

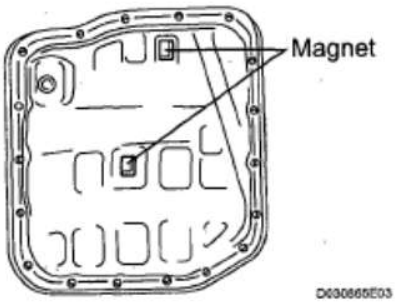


Fig. 158: Identifying Magnets From Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the oil pan and a new gasket to the transaxle case with the 18 bolts.

Torque: 7.8 N*m (80 kgf*cm, 69 in.*lbf)

NOTE: Apply adhesive to the bolts and tighten them within 10 minutes of application.

6. **INSTALL AUTOMATIC TRANSAXLE ASSEMBLY**

HINT:

(See **INSTALLATION**)

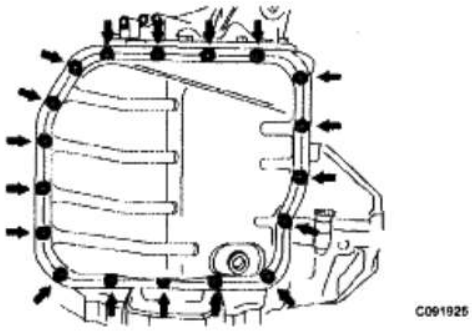


Fig. 159: Locating Oil Pan Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL** (See **INSTALLATION**)
8. **ADD AUTOMATIC TRANSAXLE FLUID**
9. **INSPECT AUTOMATIC TRANSAXLE FLUID** (See **ON-VEHICLE INSPECTION**)
10. **INSPECT FOR TRANSAXLE FLUID LEAK**
11. **INSTALL NO. 2 ENGINE UNDER COVER** (See **INSTALLATION**)
12. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)

cardiagn.com

13. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
14. **RESET MEMORY**

HINT:

(See **INITIALIZATION**)

AIR COOLED OIL COOLER

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

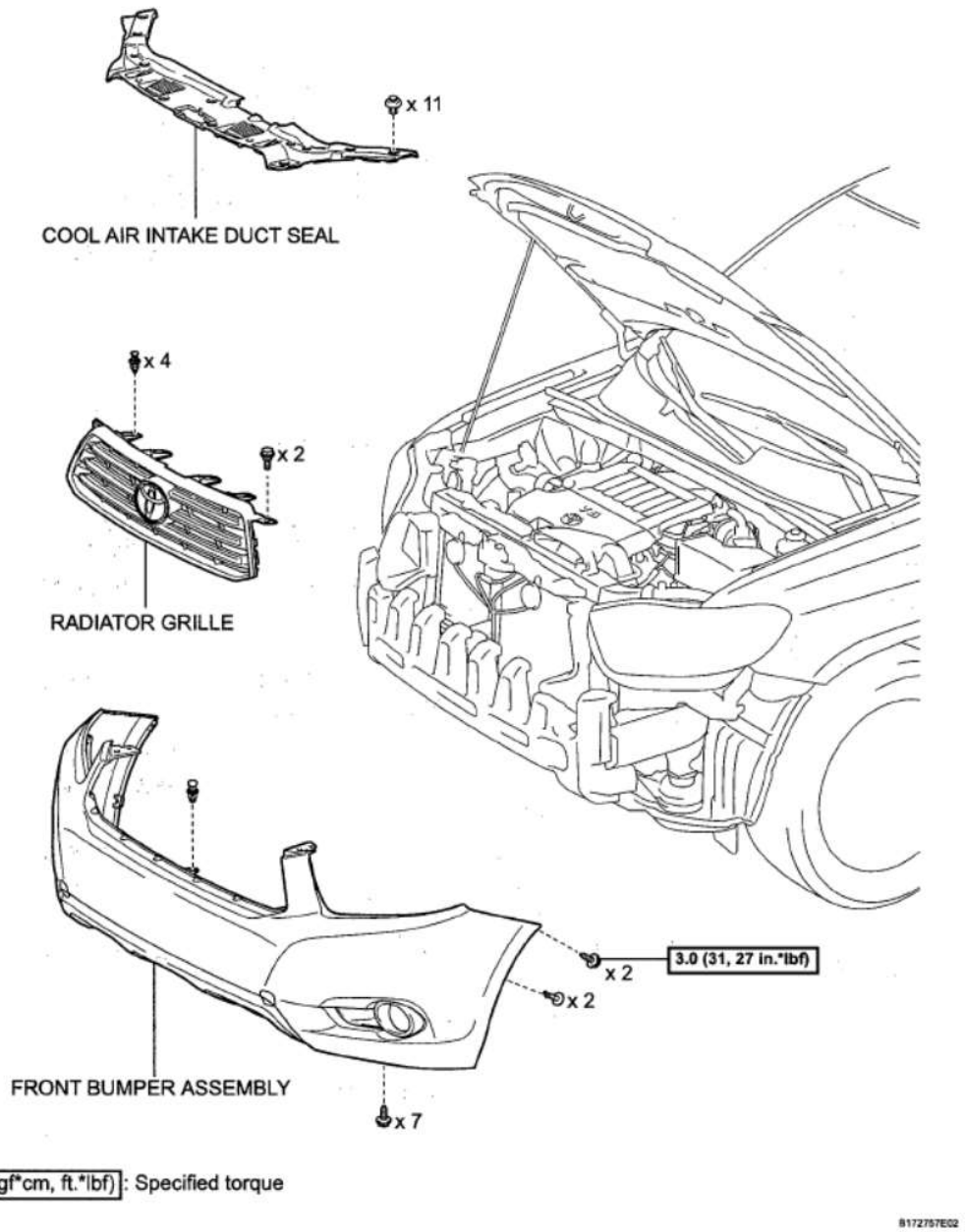


Fig. 160: Identifying Air Cooled Oil Cooler Components With Torque Specification (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

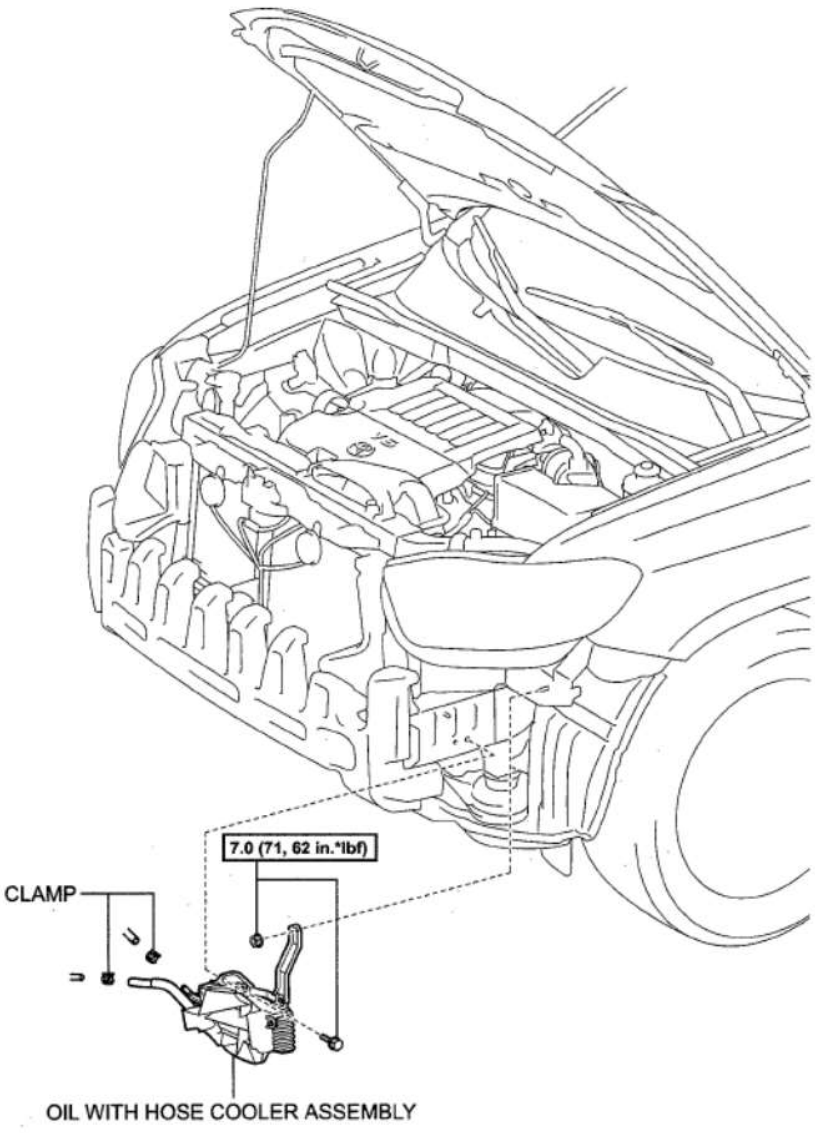


Fig. 161: Identifying Air Cooled Oil Cooler Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE FRONT BUMPER ASSEMBLY**

   HINT:

cardiagn.com

(See **REMOVAL**)

2. **DRAIN AUTOMATIC TRANSAXLE FLUID**
   a. Remove the drain plug and the gasket, and drain ATF.
   b. Install a new gasket and the drain plug.

   Torque: 49 N*m (500 kgf*cm, 36 ft.*lbf)

3. **REMOVE OIL WITH HOSE COOLER ASSEMBLY**
   a. Remove the 2 hose clamps and disconnect the 2 oil cooler hoses.
   b. Remove the bolt, nut, and the oil with hose cooler assembly.

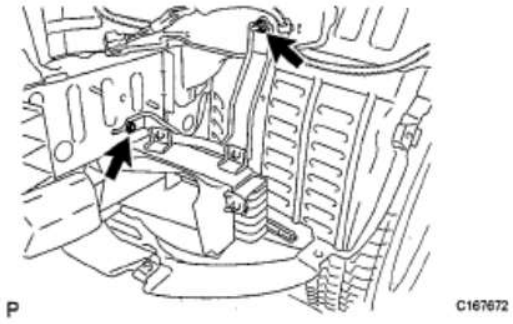


Fig. 162: Locating Hose Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL OIL WITH HOSE COOLER ASSEMBLY**
   a. Install the oil with hose cooler assembly with the bolt and the nut.

   Torque: 7.0 N*m (71 kgf*cm, 62 in.*lbf)

   HINT:

   After temporarily tightening the bolt, fully tighten the nut and then bolt.

   b. Connect the 2 oil cooler hoses and install the 2 hose clamps.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

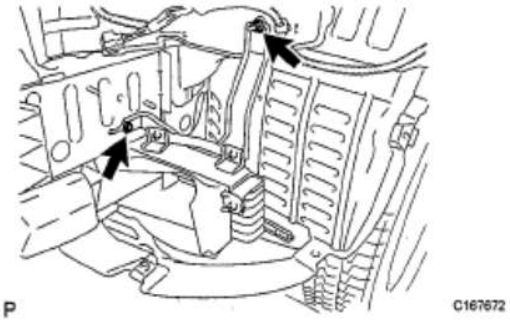


Fig. 163: Locating Hose Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL FRONT BUMPER ASSEMBLY**

   HINT:

   (See **INSTALLATION**)

3. **ADD AUTOMATIC TRANSAXLE FLUID**
4. **INSPECT AUTOMATIC TRANSAXLE FLUID** (See **ON-VEHICLE INSPECTION**)
5. **INSPECT FOR TRANSAXLE FLUID LEAK**

SHIFT LEVER

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

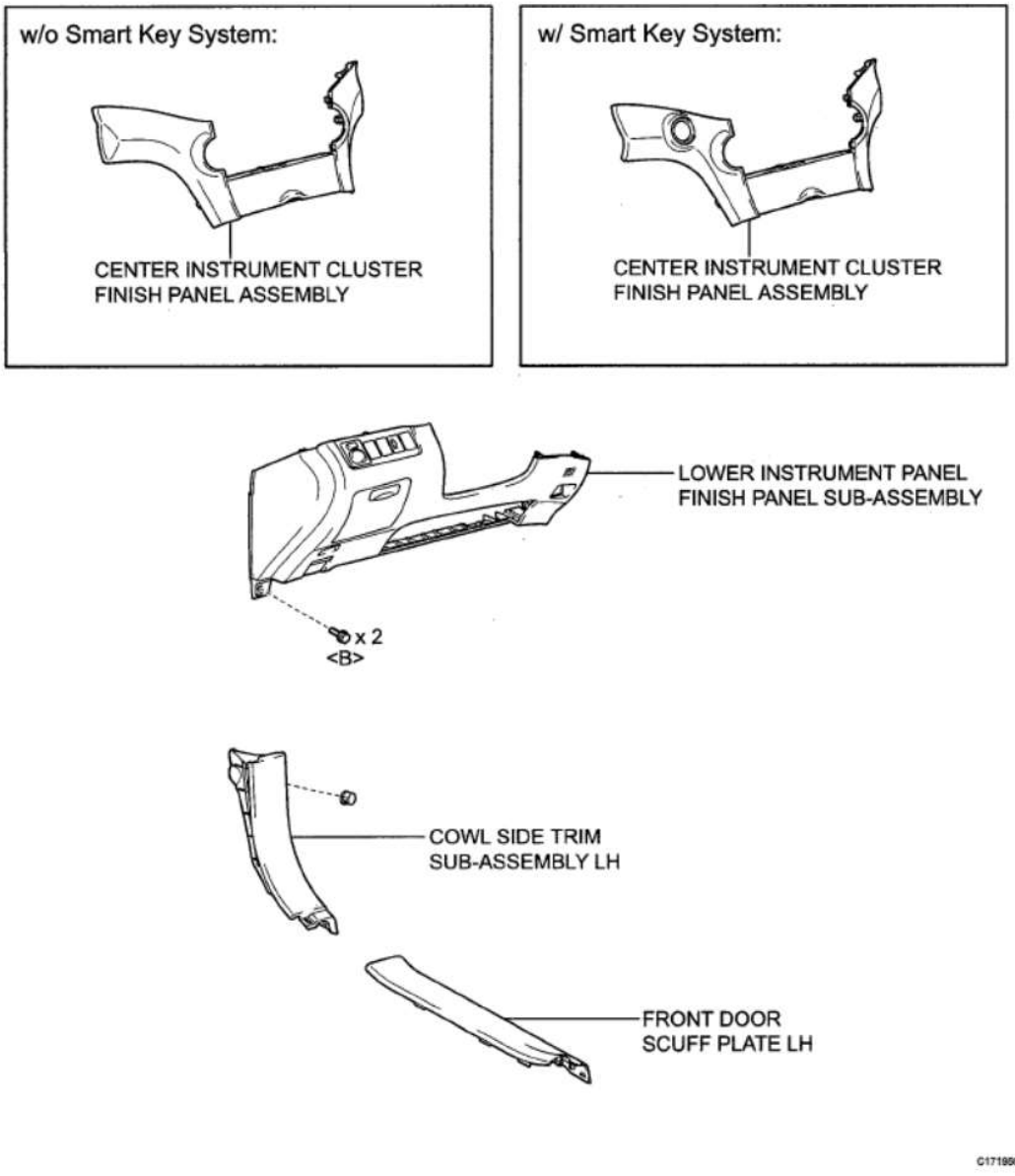


Fig. 164: Identifying Shift Lever Components With Torque Specification (1 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

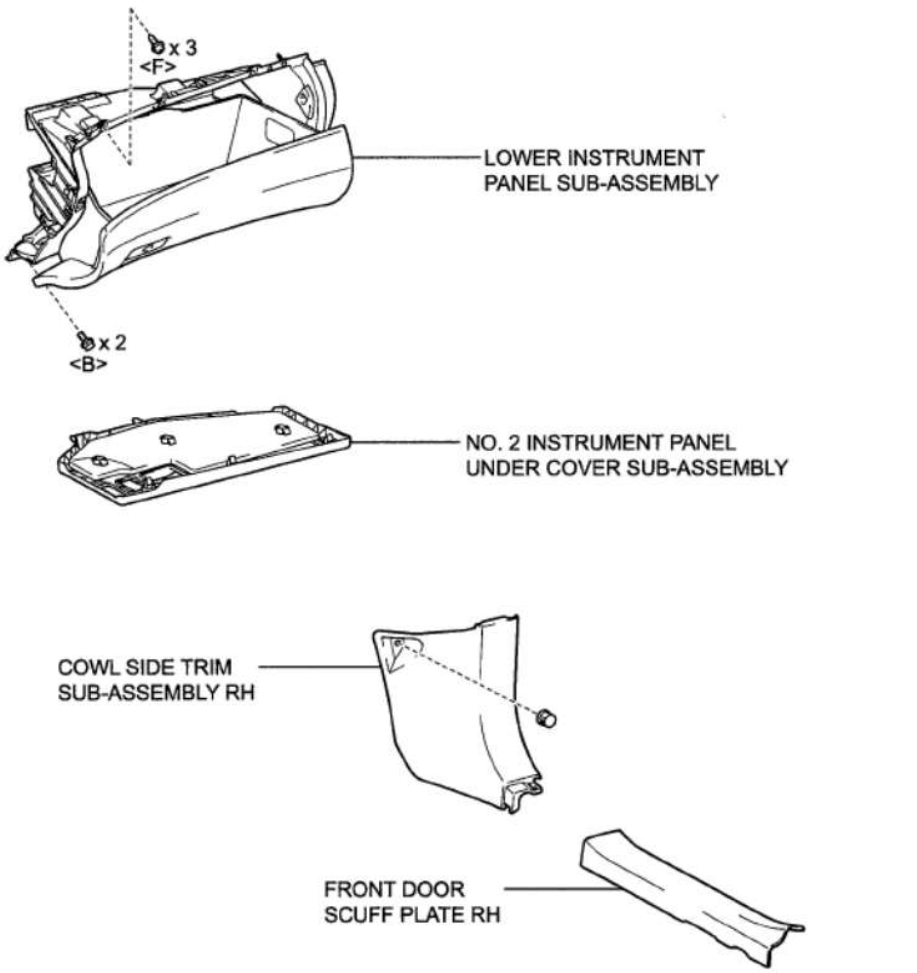


Fig. 165: Identifying Shift Lever Components With Torque Specification (2 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

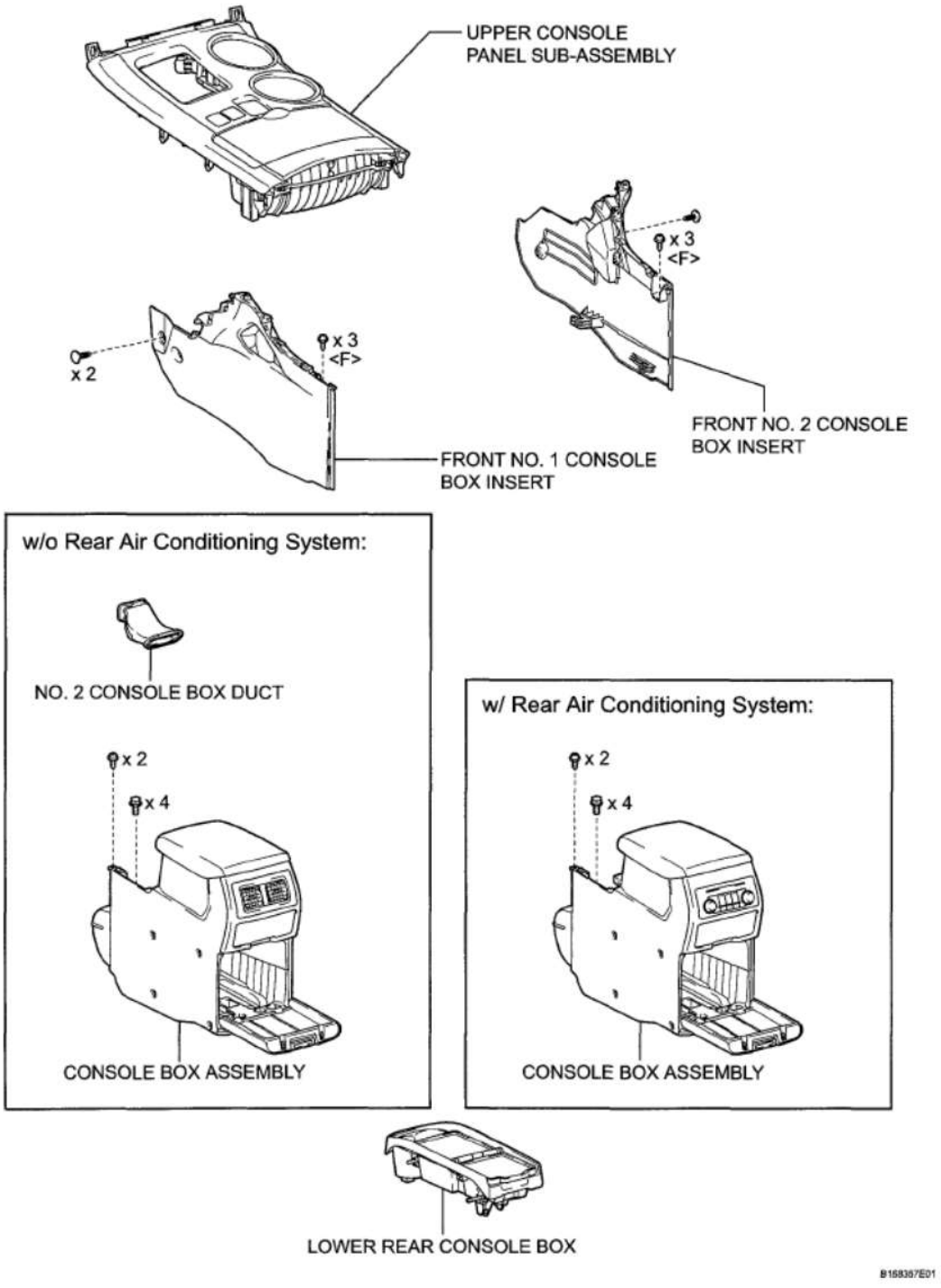


Fig. 166: Identifying Shift Lever Components With Torque Specification (3 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

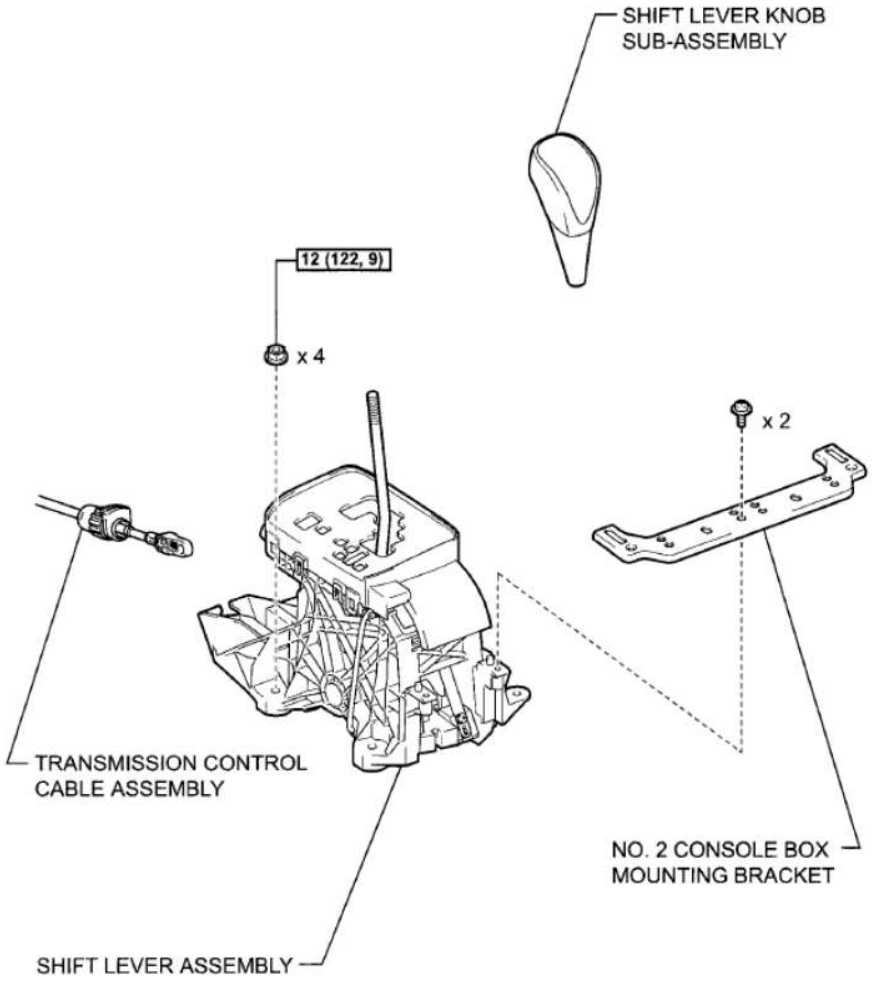


Fig. 167: Identifying Shift Lever Components With Torque Specification (4 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

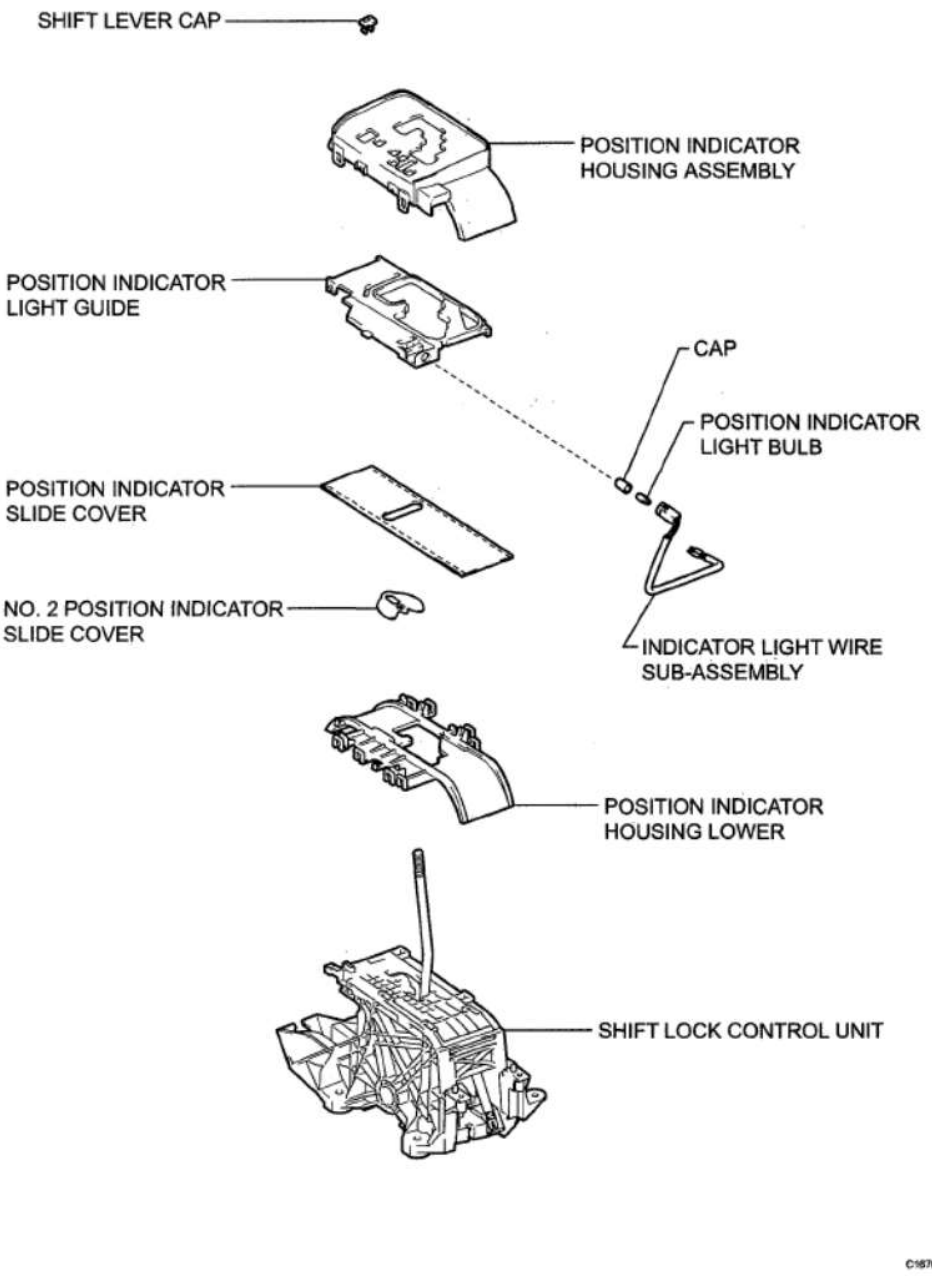


Fig. 168: Identifying Shift Lever Components With Torque Specification (5 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ON-VEHICLE INSPECTION

1. **INSPECT SHIFT LEVER POSITION**
   a. When shifting from the P position to the R position with the ignition switch to ON and the brake pedal depressed, make sure that the shift lever moves smoothly and correctly into the position.
   b. Start the engine and make sure that the vehicle moves forward when shifting from the N position to the D position and moves rearward when shifting to the R position. If the operation cannot be done

cardiagn.com

as specified, inspect the park/neutral position switch assembly and check the shift lever assembly installation condition.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

CAUTION: Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

2. **REMOVE CENTER INSTRUMENT CLUSTER FINISH PANEL ASSEMBLY (w/o Smart Key System)** (See **REMOVAL**)
3. **REMOVE CENTER INSTRUMENT CLUSTER FINISH PANEL ASSEMBLY (w/Smart Key System)** (See **REMOVAL**)
4. **REMOVE FRONT DOOR SCUFF PLATE LH** (See **REMOVAL**)
5. **REMOVE COWL SIDE TRIM SUB-ASSEMBLY LH** (See **REMOVAL**)
6. **REMOVE LOWER INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY (for Manual Air Conditioning System)** (See **REMOVAL**)
7. **REMOVE LOWER INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY (for Automatic Air Conditioning System)** (See **REMOVAL**)
8. **REMOVE FRONT DOOR SCUFF PLATE RH** (See **REMOVAL**)
9. **REMOVE COWL SIDE TRIM SUB-ASSEMBLY RH** (See **REMOVAL**)
10. **REMOVE NO. 2 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY** (See **REMOVAL**)
11. **REMOVE LOWER INSTRUMENT PANEL SUB-ASSEMBLY** (See **REMOVAL**)
12. **REMOVE UPPER CONSOLE PANEL SUB-ASSEMBLY** (See **REMOVAL**)
13. **REMOVE NO. 2 CONSOLE BOX DUCT (w/o Rear Air Conditioning System)** (See **REMOVAL**)
14. **REMOVE LOWER REAR CONSOLE BOX** (See **REMOVAL**)
15. **REMOVE CONSOLE BOX ASSEMBLY (w/o Rear Air Conditioning System)** (See **REMOVAL**)
16. **REMOVE CONSOLE BOX ASSEMBLY (w/Rear Air Conditioning System)** (See **DISASSEMBLY**)
17. **REMOVE FRONT NO. 1 CONSOLE BOX INSERT** (See **REMOVAL**)
18. **REMOVE FRONT NO. 2 CONSOLE BOX INSERT** (See **REMOVAL**)
19. **REMOVE SHIFT LEVER KNOB SUB-ASSEMBLY**
    a. Turn the shift lever knob counterclockwise and remove the shift lever knob sub-assembly.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

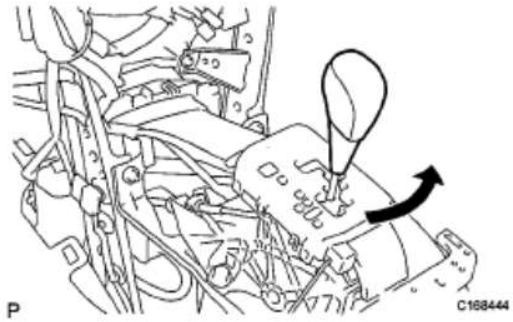


Fig. 169: Turning Shift Lever Knob
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **DISCONNECT TRANSMISSION CONTROL CABLE ASSEMBLY**
    a. Using a screwdriver, disconnect the cable end from the shift lever assembly.

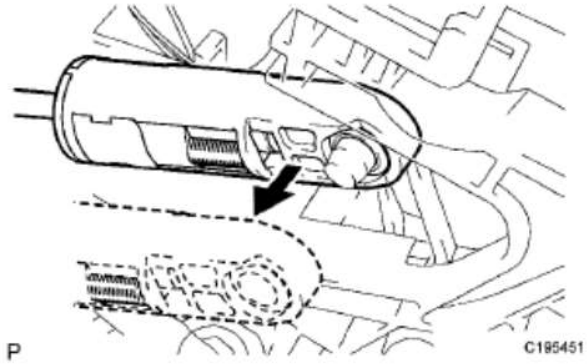


Fig. 170: Disconnecting Cable End From Shift Lever Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Turn the nut and disconnect the control cable from the shift lever retainer.

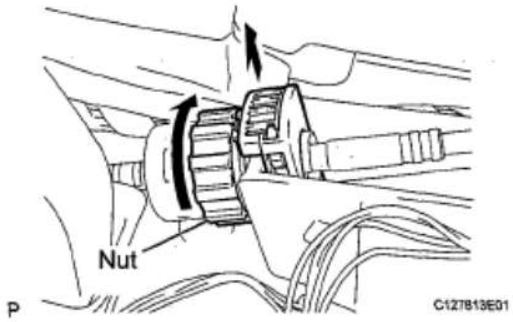


Fig. 171: Disconnecting Control Cable From Shift Lever Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

21. **REMOVE SHIFT LEVER ASSEMBLY**

cardiagn.com

a. Disconnect the 2 connectors from the shift lever assembly.

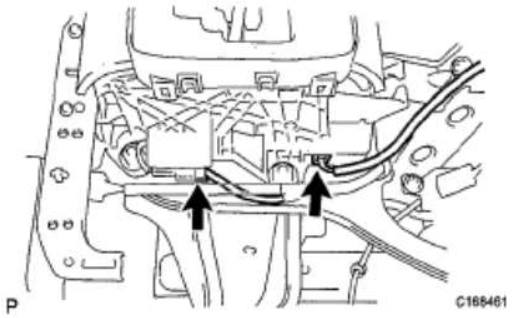


Fig. 172: Locating Shift Lever Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 4 nuts and disconnect the shift lever assembly from the vehicle.
c. Remove the 2 screws and No. 2 console box mounting bracket.

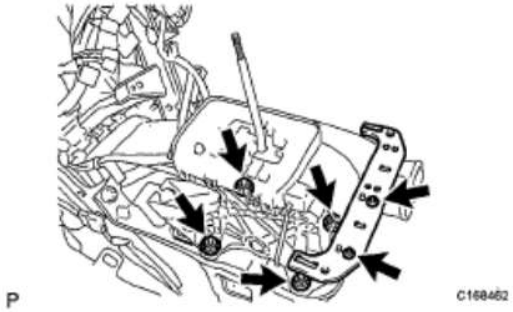


Fig. 173: Locating No. 2 Console Box Mounting Bracket With Screws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **REMOVE POSITION INDICATOR HOUSING ASSEMBLY**
   a. Separate the connector and 2 wire harness clamps from the shift lock control unit.

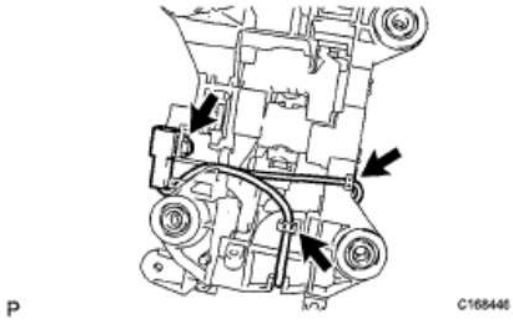


Fig. 174: Locating Wire Harness Clamps

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a screwdriver, release the stopper.
c. Using a screwdriver, disengage the locking lug of terminals 4 and 8, and pull the terminals out from the rear of the connector.

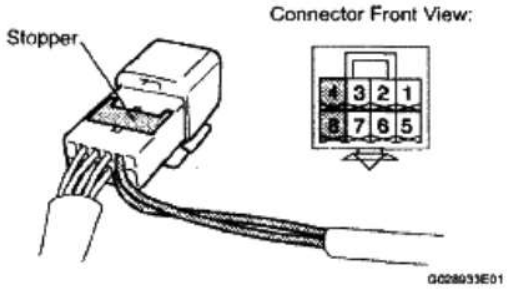


Fig. 175: Disengaging Locking Lug Of Terminals 4 And 8
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Separate the wire harness clamp from the shift lock control unit.
e. Disengage the 4 claws and remove, the position indicator housing from the shift lock control unit.

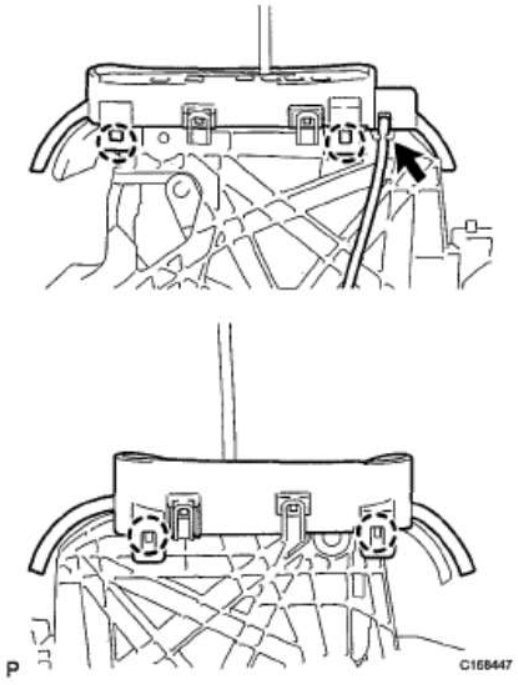


Fig. 176: Locating Position Indicator Housing Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **REMOVE POSITION INDICATOR HOUSING LOWER**
   a. Disengage the 4 claws and remove the position indicator housing lower from the position indicator

cardiagn.com

housing.

3. **REMOVE SHIFT LEVER CAP**
   a. Using a screwdriver, remove the shift lever cap from the position indicator housing.

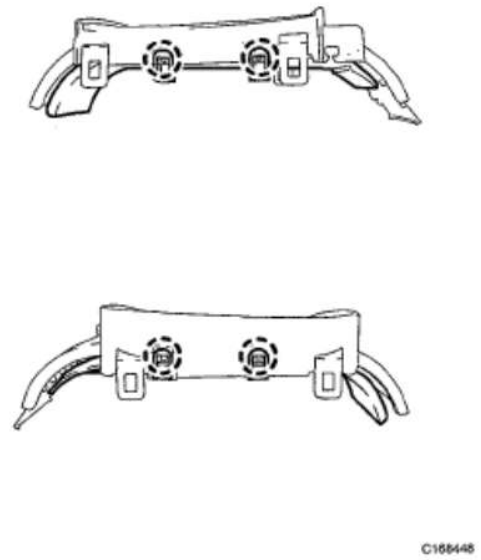


Fig. 177: Identifying Position Indicator Housing Lower Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE POSITION INDICATOR LIGHT GUIDE**
   a. Disengage the 4 claws and remove the position indicator light guide from the position indicator housing lower.

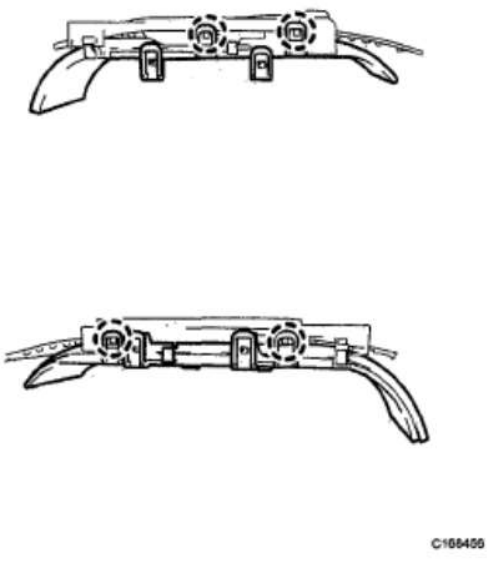


Fig. 178: Identifying Position Indicator Light Guide Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

5. **REMOVE INDICATOR LIGHT WIRE SUB-ASSEMBLY**
   a. Remove the indicator light wire sub-assembly from the position indictor light guide.
6. **REMOVE POSITION INDICATOR LIGHT BULB**
   a. Remove the bulb and cap from the indicator light wire socket.



Fig. 179: Removing Position Indicator Light Bulb
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **REMOVE POSITION INDICATOR SLIDE COVER**
   a. Remove the position indicator slide cover from the position indicator housing lower.

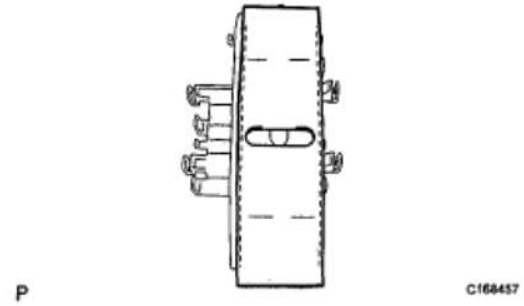


Fig. 180: Identifying Position Indicator Slide Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **REMOVE NO. 2 POSITION INDICATOR SLIDE COVER**
   a. Remove the position indicator slide cover from the No. 2 position indicator slide cover.

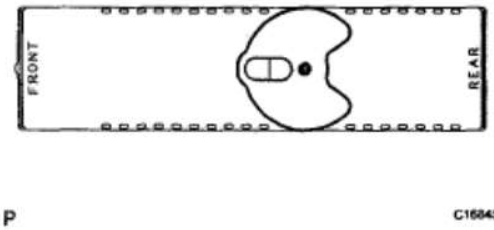


Fig. 181: Identifying No. 2 Position Indicator Slide Cover

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

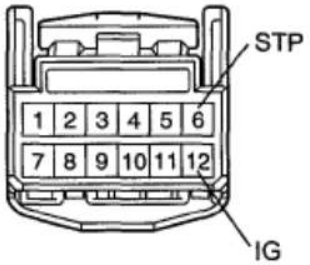
1. **INSPECT SHIFT LOCK CONTROL ECU (w/Smart Key System)**
   a. Disconnect the shift lock control ECU connector.
   b. Measure the voltage according to the value(s) in the table below.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
12 (IG) - Body ground	Ignition switch on (IG)	10 to 14 V
12 (IG) - Body ground	Ignition switch off	Below 1 V
6 (STP) - Body ground	Brake pedal depressed	10 to 14 V
6 (STP) - Body ground	Brake pedal released	Below 1 V

Front view of wire harness connector:
(to Shift Lock Control ECU)



P C168466E03

Fig. 182: Identifying Terminal IG And STP Of Shift Lock Control ECU Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Measure the resistance according to the value(s) in the table below.

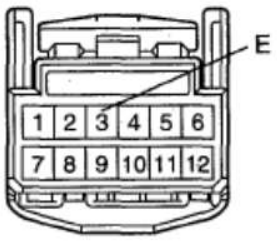
Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
3 (E) - Body ground	Always	Below 1 ohms

cardiagn.com

Front view of wire harness connector:
(to Shift Lock Control ECU)



P C168466E02

Fig. 183: Identifying Terminal E Of Shift Lock Control ECU Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT SHIFT LOCK CONTROL ECU (w/o Smart Key System)**
   a. Disconnect the shift lock control ECU connector.
   b. Measure the voltage according to the value(s) in the table below.

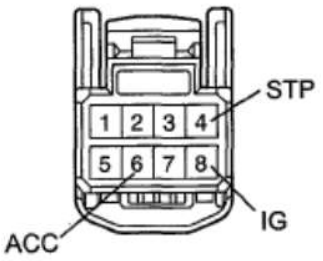
Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
6 (ACC) - Body ground	Ignition switch on (IG)	10 to 14 V
6 (ACC) - Body ground	Ignition switch on (ACC)	10 to 14 V
6 (ACC) - Body ground	Ignition switch off	Below 1 V
4 (STP) - Body ground	Brake pedal depressed	10 to 14 V
4 (STP) - Body ground	Brake pedal released	Below 1 V
8 (IG) - Body ground	Ignition switch on (IG)	10 to 14 V
8 (IG) - Body ground	Ignition switch off	Below 1 V

cardiagn.com

Front view of wire harness connector:
(to Shift Lock Control ECU)



P C168464E03

Fig. 184: Identifying Terminal Of Shift Lock Control ECU Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 (E) - Body ground	Always	Below 1 ohms

Front view of wire harness connector:
(to Shift Lock Control ECU)



P C168464E02

Fig. 185: Identifying Terminal E Of Shift Lock Control ECU Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the shift lock control ECU connector.
e. Measure the voltage according to the value(s) in the table below.

cardiagn.com

NOTE: Do not disconnect the shift lock control ECU connector.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Condition	Specified Condition
5 (KLS+) -1 (E)	Ignition switch on (ACC) and shift lever P position	Below 1 V
	Ignition switch on (ACC) and shift lever except P position ? After approx. 1 second	7.5 to 11 V ? 6 to 9.5 V

Component with harness connected:
(Shift Lock Control ECU)

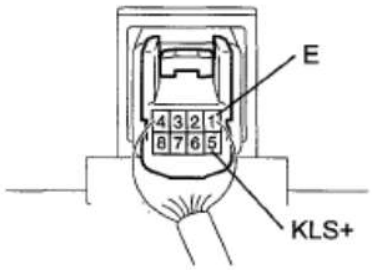


Fig. 186: Identifying Terminal E And KLS+ Of Shift Lock Control ECU Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT TRANSMISSION CONTROL SWITCH**
   a. Disconnect the transmission control switch connector from the shift lock control unit assembly.
   b. Measure the voltage according to the value(s) in the table below.

Standard voltage

STANDARD VOLTAGE SPECIFICATION

Tester Connection	Switch Condition	Specified Condition
3 - Body ground	Ignition switch on (IG)	10 to 14 V
?	Ignition switch off	Below 1 V

cardiagn.com

Front view of wire harness connector:
(to Transmission Control Switch)



P

C11C345E33

Fig. 187: Identifying Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
5 - Body ground	Always	Below 1 ohms

Front view of wire harness connector:
(to Transmission Control Switch)



P

C11C345E33

Fig. 188: Identifying Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

cardiagn.com

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
3 - 7	S, "+" and "-"	Below 1 ohms
?	Except S, "+" and "-"	10 kohms or higher
2 - 5	Press continuously "+" (Up shift)	Below 1 ohms
?	S	10 kohms or higher
1 - 5	Press continuously "-" (Down shift)	Below 1 ohms
?	S	10 kohms or higher

If the result is not as specified, replace the shift lock control unit.

Component without harness connected:
(Transmission Control Switch)



C110341E26

Fig. 189: Identifying Transmission Control Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT SHIFT LOCK SOLENOID**
   a. Disconnect the shift lock solenoid connector.
   b. Measure the resistance according to the value(s) in the table below when the shift lever is moved to each position.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Shift Position	Specified Condition
1 (P) - 2 (E2)	P	10 kohms or higher
1 (P) - 2 (E2)	Except P	Below 1 ohms

If the result is not as specified, replace the shift lock control unit.

cardiagn.com

Front view of wire harness connector:
(to Shift Lock Solenoid)

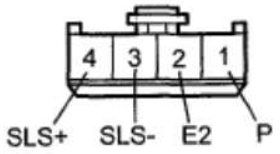


Fig. 190: Identifying Shift Lock Solenoid Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
3 (SLS-) - 4 (SLS+)	Always	112 ohms

If the result is not as specified, replace the shift lock control unit.

ADJUSTMENT

1. **ADJUST SHIFT LEVER POSITION**
   a. Move the shift lever to N.
   b. Slide the slider in the direction shown in the illustration and pull out the lock piece.
   c. Push the lock piece into the adjuster case.

NOTE: Firmly push in the lock piece until the slider locks.

   d. After adjusting the shift lever position, check the operation and function of the shift lever. If there is a problem, adjust the position again.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

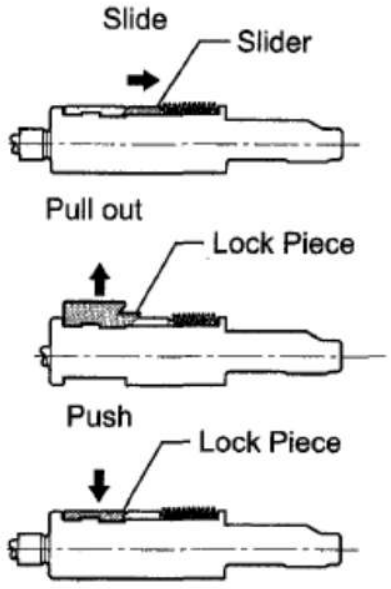


Fig. 191: Adjusting Shift Lever Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL NO. 2 POSITION INDICATOR SLIDE COVER**
   a. Install the position indicator slide cover to the No. 2 position indicator slide cover.

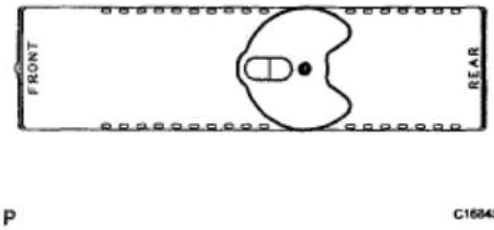


Fig. 192: Identifying No. 2 Position Indicator Slide Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL POSITION INDICATOR SLIDE COVER**
   a. Install the position indicator slide cover to the position indicator housing lower.

NOTE: Install the No. 2 position indicator slide cover with the boss facing the rear of the vehicle.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

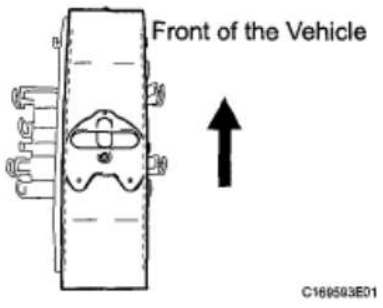


Fig. 193: Installing Position Indicator Slide Cover To Position Indicator Housing Lower
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL POSITION INDICATOR HOUSING LOWER**
   a. Engage the 4 claws and install the position indicator housing lower to the position indicator housing.

NOTE: Make sure that the claws are firmly engaged.

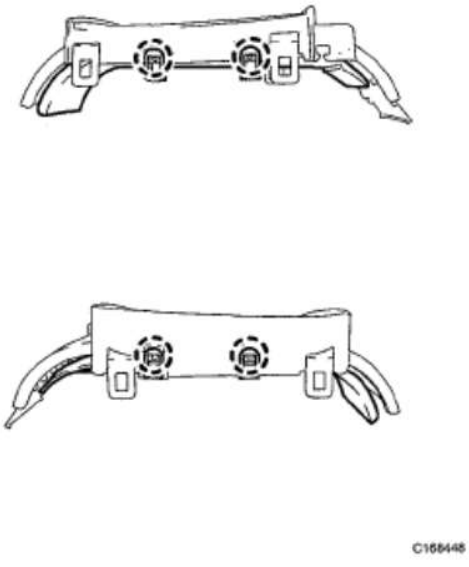


Fig. 194: Identifying Position Indicator Housing Lower Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL POSITION INDICATOR LIGHT GUIDE**
   a. Engage the 4 claws and install the position indicator light guide to the position indicator housing lower.

NOTE: Make sure that the claws are firmly engaged.

5. **INSTALL POSITION INDICATOR LIGHT BULB**

cardiagn.com

a. Install the cap to the bulb.
b. install the bulb to the position indicator light wire socket.

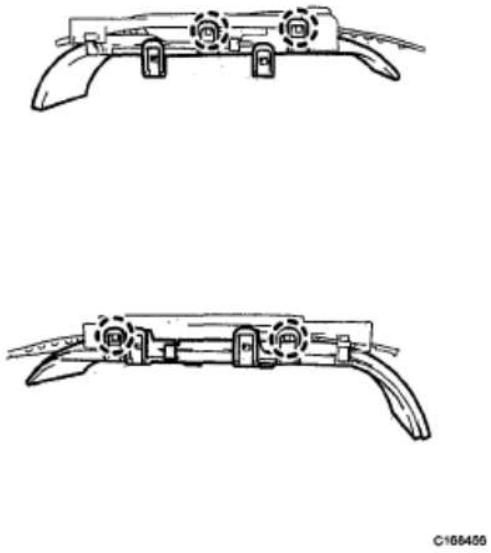


Fig. 195: Identifying Position Indicator Light Guide Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL INDICATOR LIGHT WIRE SUB-ASSEMBLY**
   a. Install the indicator light wire sub-assembly to the position indicator light guide.
7. **INSTALL SHIFT LEVER CAP**
   a. Install the shift lever cap to the position indicator housing.



Fig. 196: Installing Shift Lever Cap To Position Indicator Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSTALL POSITION INDICATOR HOUSING ASSEMBLY**
   a. Engage the 4 claws and install the position indicator housing to the shift lever assembly.

NOTE: Make sure that the claws are firmly engaged.

cardiagn.com

b. Connect the wire harness clamp to the shift lock control unit.

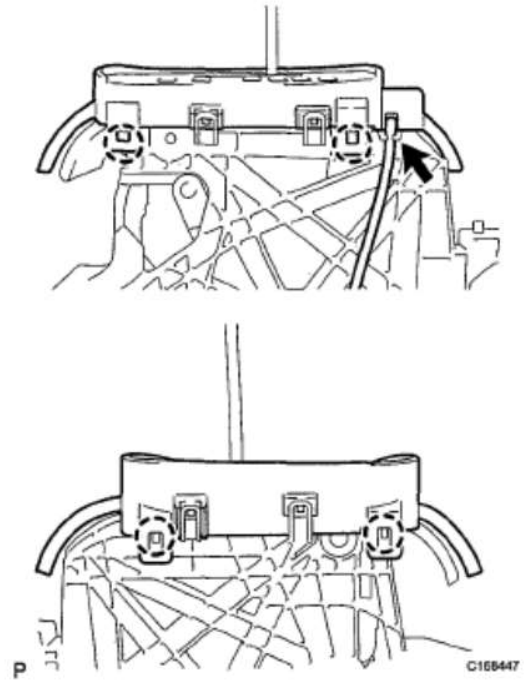


Fig. 197: Locating Position Indicator Housing Claws
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Connect terminals 4 and 8 of the indicator light wire.
d. Push the stopper.

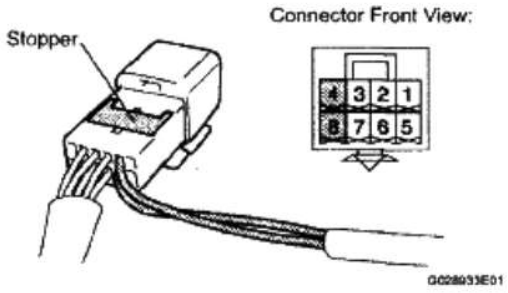


Fig. 198: Disengaging Locking Lug Of Terminals 4 And 8
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Connect the connector and 2 wire harness clamps to the shift lock control unit.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

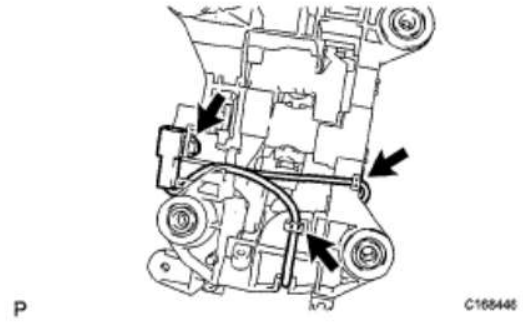


Fig. 199: Locating Wire Harness Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL SHIFT LEVER ASSEMBLY**
   a. Install the shift lever assembly with the 4 nuts.

      Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)

      HINT:

      Tighten the nuts in the order of A, B, C and D.

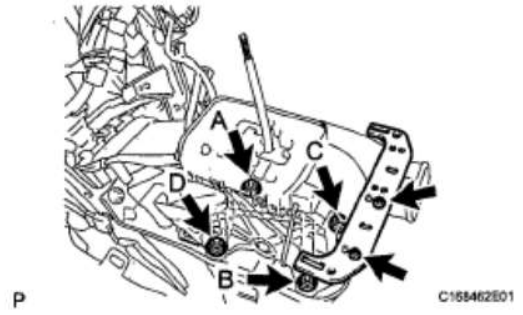


Fig. 200: Locating Shift Lever Assembly With Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to route the indicator light or shift lock system wiring between the shift lever assembly and the floor while installing the shift lever assembly.

   b. Install the No. 2 console box mounting bracket with the 2 screws.
   c. Connect the 2 connectors to the shift lever assembly.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

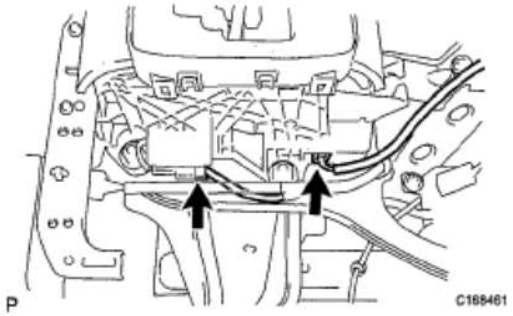


Fig. 201: Locating Shift Lever Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **CONNECT TRANSMISSION CONTROL CABLE ASSEMBLY**
   a. Rotate the transmission control cable nut counterclockwise and, while holding the nut in that position, press in the stopper.

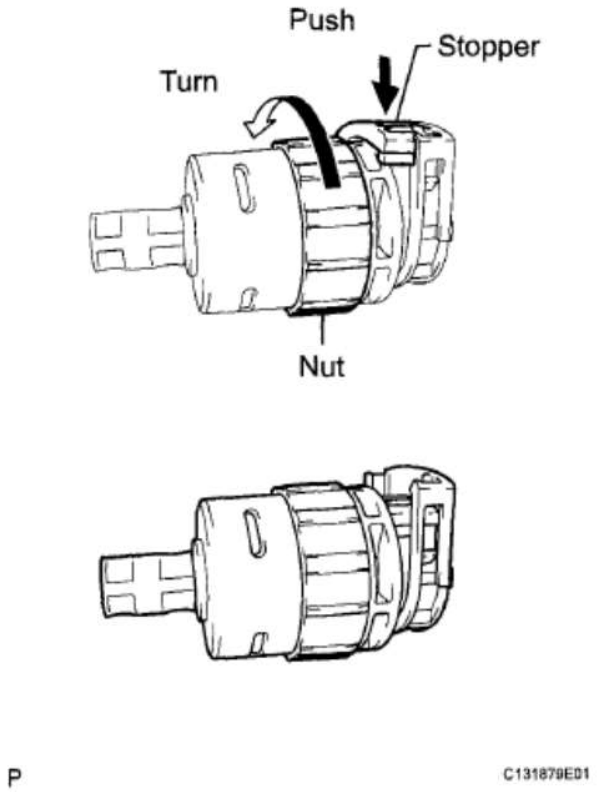


Fig. 202: Rotating Transmission Control Cable Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Connect the outer part of the transmission control cable assembly to the shift lever retainer.

NOTE: After installation, check that the outer part of the cable lock is

cardiagn.com

protruding beyond portion A-A as shown in the illustration.

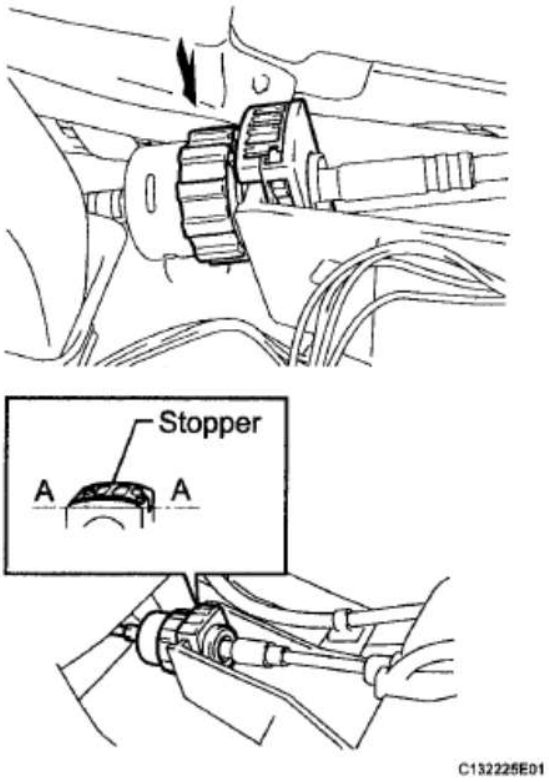


Fig. 203: Connecting Outer Part Of Transmission Control Cable Assembly To Shift Lever Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Slide the slider in the direction shown in the illustration and pull out the lock piece.

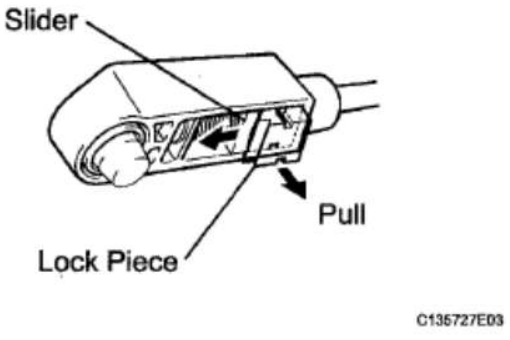


Fig. 204: Pulling Out Lock Piece
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the cable end to the shift control unit.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

NOTE:

- **Check that the lock piece is pulled up.**
- **Install the cable end all the way to the base of the pin.**

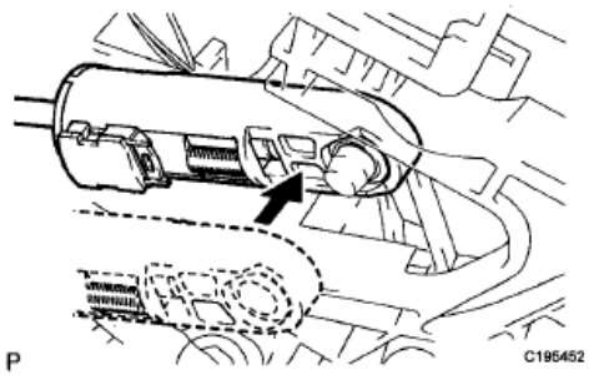


Fig. 205: Installing Cable End To Shift Control Unit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Push the lock piece into the adjuster case.

NOTE: Firmly push in the lock piece until the slider locks.

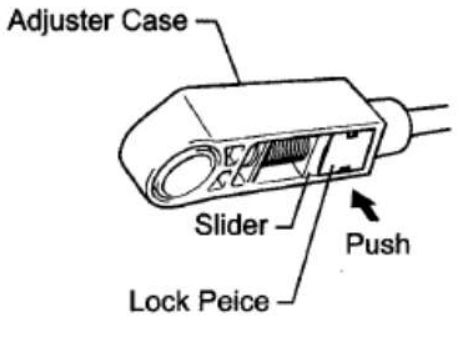


Fig. 206: Pushing Lock Piece Into Adjuster Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL SHIFT LEVER KNOB SUB-ASSEMBLY**
   a. Install the shift lever knob sub-assembly.
4. **INSTALL FRONT NO. 2 CONSOLE BOX INSERT** (See **INSTALLATION**)
5. **INSTALL FRONT NO. 1 CONSOLE BOX INSERT** (See **INSTALLATION**)
6. **INSTALL CONSOLE BOX ASSEMBLY (w/o Rear Air Conditioning System)** (See **INSTALLATION**)
7. **INSTALL CONSOLE BOX ASSEMBLY (w/Rear Air Conditioning System)** (See **INSTALLATION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

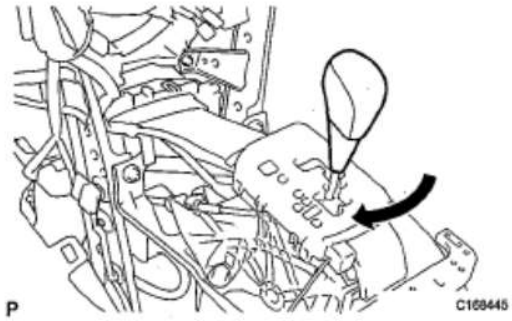


Fig. 207: Installing Shift Lever Knob Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSTALL LOWER REAR CONSOLE BOX** (See **INSTALLATION**)
9. **INSTALL NO. 2 CONSOLE BOX DUCT (w/o Rear Air Conditioning System)** (See **INSTALLATION**)
10. **INSTALL UPPER CONSOLE PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
11. **INSTALL LOWER INSTRUMENT PANEL SUB-ASSEMBLY** (See **INSTALLATION**)
12. **INSTALL NO. 2 INSTRUMENT PANEL UNDER COVER SUB-ASSEMBLY** (See **INSTALLATION**)
13. **INSTALL COWL SIDE TRIM SUB-ASSEMBLY RH** (See **INSTALLATION**)
14. **INSTALL FRONT DOOR SCUFF PLATE RH** (See **INSTALLATION**)
15. **INSTALL LOWER INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY (for Manual Air Conditioning System)** (See **INSTALLATION**)
16. **INSTALL LOWER INSTRUMENT PANEL FINISH PANEL SUB-ASSEMBLY (for Automatic Air Conditioning System)** (See **INSTALLATION**)
17. **INSTALL COWL SIDE TRIM SUB-ASSEMBLY LH** (See **INSTALLATION**)
18. **INSTALL FRONT DOOR SCUFF PLATE LH** (See **INSTALLATION**)
19. **INSTALL CENTER INSTRUMENT CLUSTER FINISH PANEL ASSEMBLY (w/o Smart Key System)** (See **INSTALLATION**)
20. **INSTALL CENTER INSTRUMENT CLUSTER FINISH PANEL ASSEMBLY (w/Smart Key System)** (See **INSTALLATION**)
21. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

NOTE: **When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).**

22. **ADJUST SHIFT LEVER POSITION** (See **ADJUSTMENT**)
23. **INSPECT SHIFT LEVER POSITION** (See **ON-VEHICLE INSPECTION**)

TRANSMISSION CONTROL CABLE ASSEMBLY

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

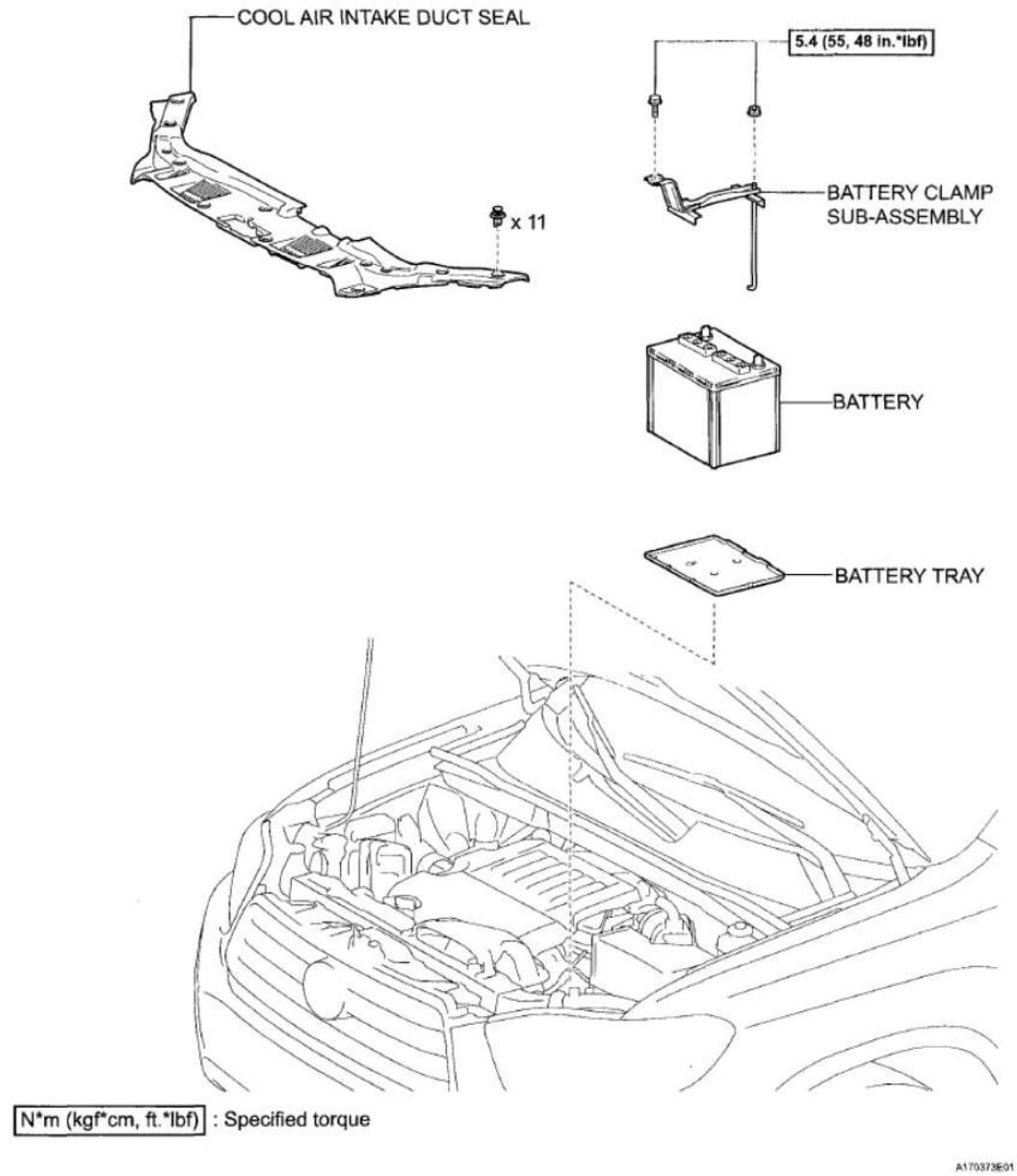


Fig. 208: Identifying Transmission Control Cable Assembly Components With Torque Specification (1 Of 5)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

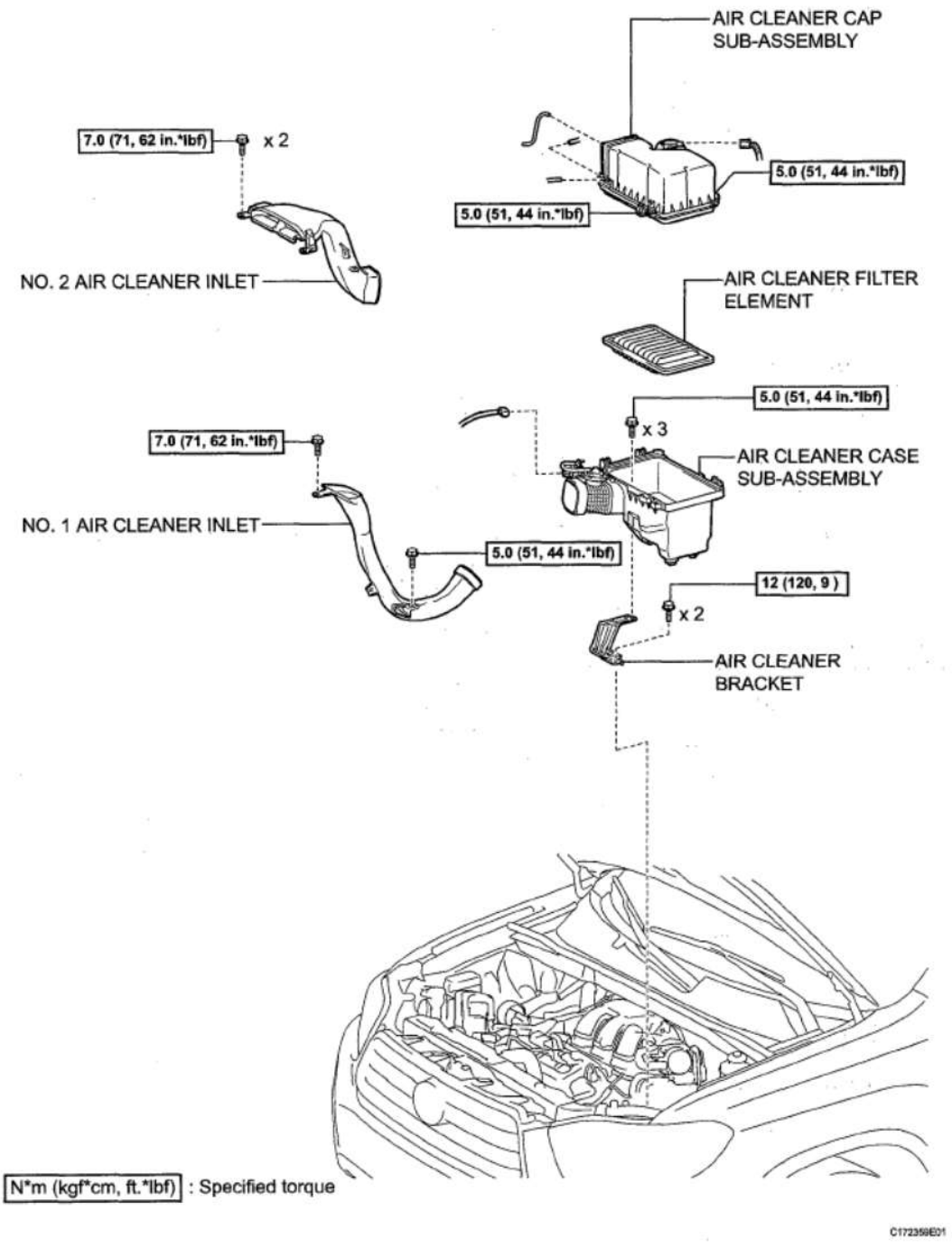


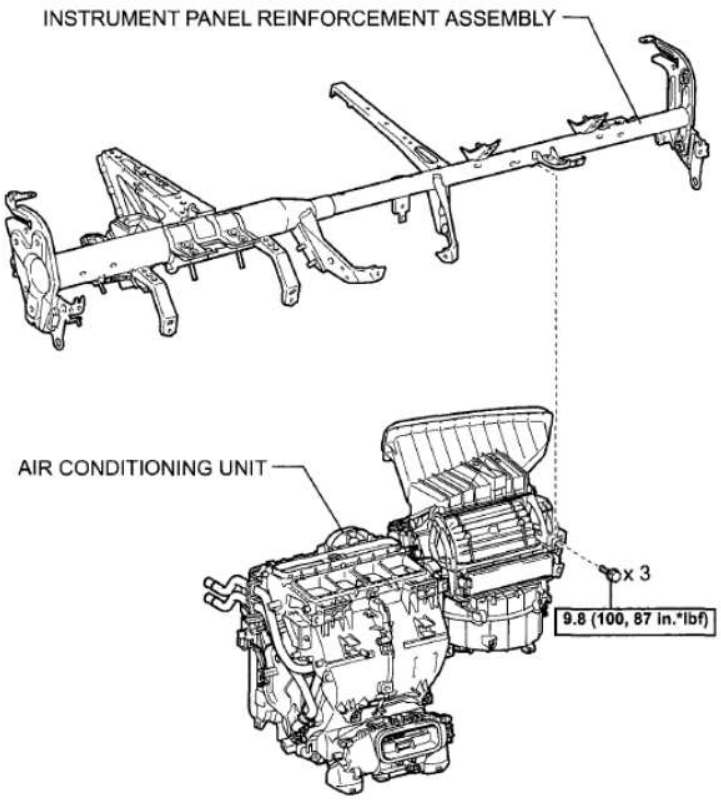
Fig. 209: Identifying Transmission Control Cable Assembly Components With Torque Specification (2 Of 5)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



N*m (kgf*cm, ft.*lbf): Specified torque

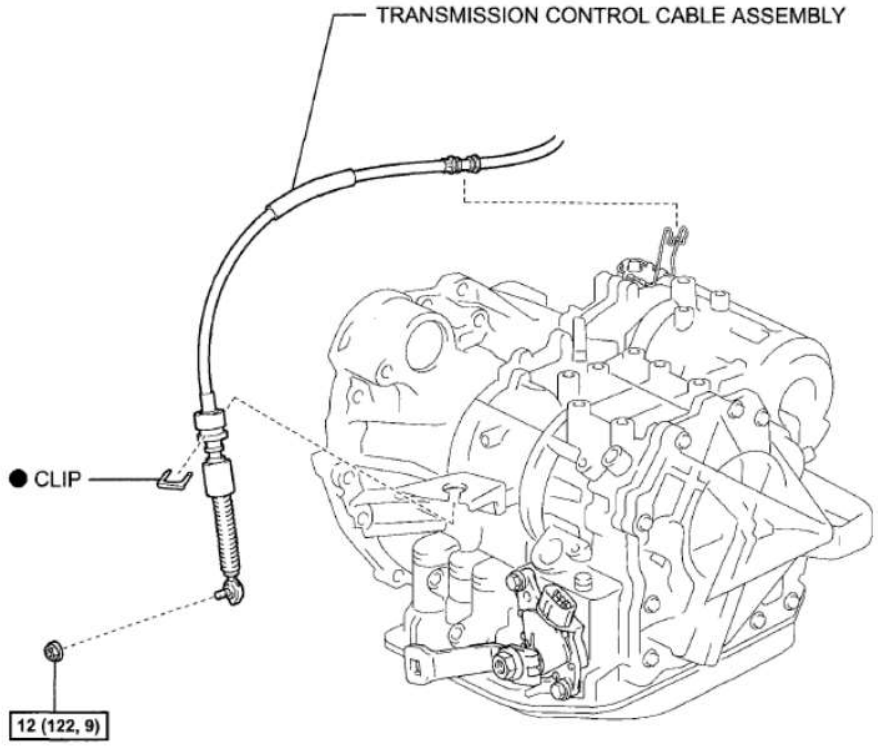
P C172612E02

Fig. 210: Identifying Transmission Control Cable Assembly Components With Torque Specification (3 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



N*m (kgf*cm, ft.*lbf): Specified torque

● Non-reusable part

C194152E01

Fig. 211: Identifying Transmission Control Cable Assembly Components With Torque Specification (4 Of 5)

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

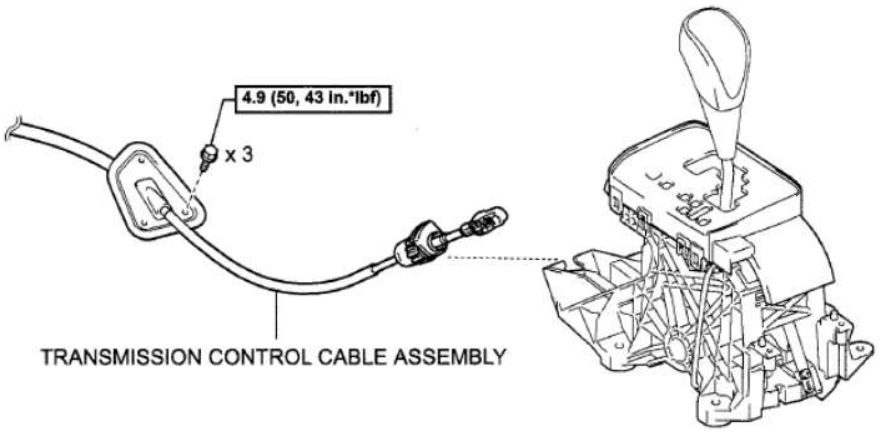


Fig. 212: Identifying Transmission Control Cable Assembly Components With Torque Specification (5 Of 5)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL** (See **REMOVAL**)
2. **REMOVE BATTERY** (See **REASSEMBLY**)
3. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **SYSTEM DIAGRAM**)
4. **REMOVE NO. 2 AIR CLEANER INLET** (See **SYSTEM DIAGRAM**)
5. **REMOVE NO. 1 AIR CLEANER INLET** (See **ON-VEHICLE INSPECTION**)
6. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
7. **REMOVE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
8. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
9. **REMOVE AIR CLEANER BRACKET** (See **REASSEMBLY**)
10. **REMOVE AIR CONDITIONING UNIT**

    HINT:

    (See **REMOVAL**)

11. **REMOVE TRANSMISSION CONTROL CABLE ASSEMBLY**
    a. Remove the nut from the control shaft lever.
    b. Disconnect the transmission control cable assembly from the control shaft lever.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

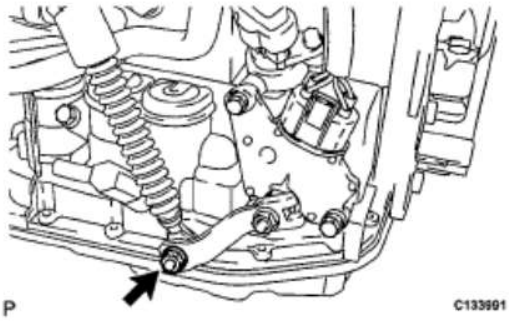


Fig. 213: Locating Control Shaft Lever Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the clip and disconnect the transmission control cable assembly from the control cable bracket.

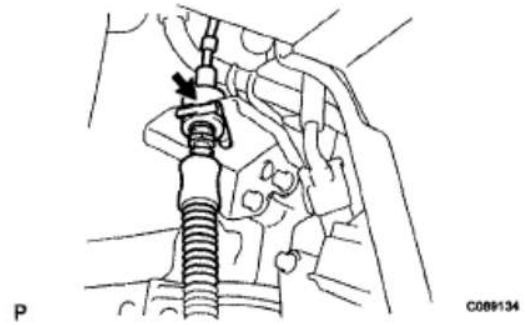


Fig. 214: Locating Transmission Control Cable Clip
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Disconnect the transmission control cable assembly from the No. 2 transmission control cable bracket.

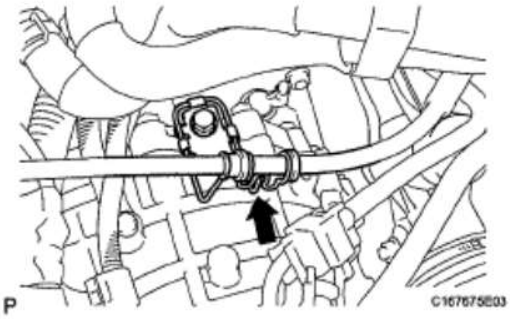


Fig. 215: Locating No. 2 Transmission Control Cable Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Remove the 3 bolts and disconnect the transmission control cable assembly from the vehicle.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

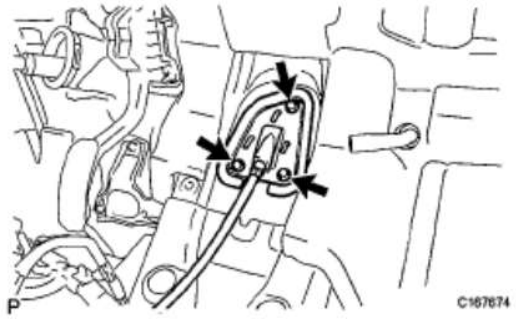


Fig. 216: Locating Transmission Control Cable Bracket Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Using a screwdriver, disconnect the cable end from the shift lever assembly.

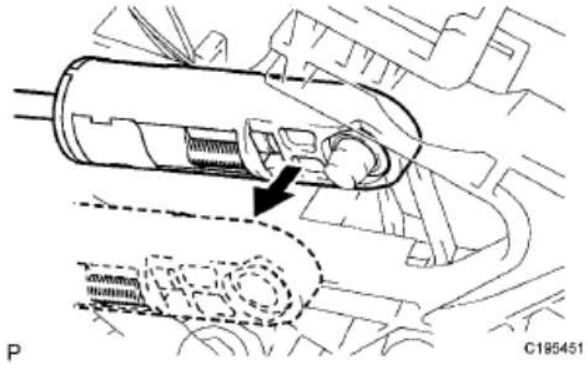


Fig. 217: Disconnecting Cable End From Shift Lever Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Turn the nut and disconnect the control cable from the shift lever retainer.

ADJUSTMENT

1. **INSPECT SHIFT LEVER POSITION**
   a. When shifting from the P position to the R position with the ignition switch to ON and brake pedal depressed, make sure that the shift lever moves smoothly and correctly into the position.
   b. Start the engine and make sure that the vehicle moves forward when shifting from the N position to the D position and moves rearward when shifting to the R position.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

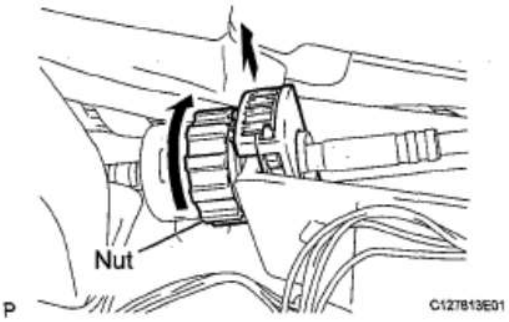


Fig. 218: Disconnecting Control Cable From Shift Lever Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **ADJUST SHIFT LEVER POSITION**
   a. Move the shift lever to N.
   b. Slide the slider in the direction shown in the illustration and pull out the lock piece.
   c. Push the lock piece into the adjuster case.

NOTE: Firmly push in the lock piece until the slider locks.

   d. After adjusting the shift lever position, check the operation and function of the shift lever. If there is a problem, adjust the position again.

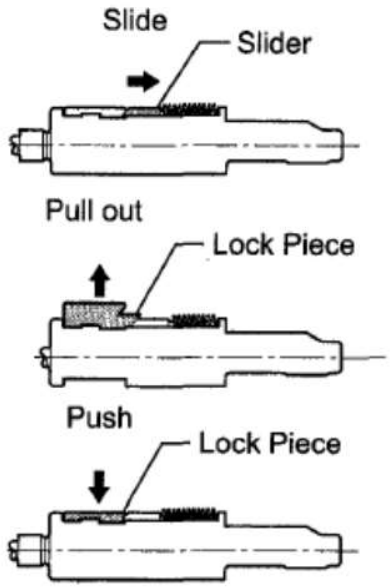


Fig. 219: Adjusting Shift Lever Position

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL TRANSMISSION CONTROL CABLE ASSEMBLY**
   a. Rotate the transmission control cable nut counterclockwise and, while holding the nut in that position, press in the stopper.

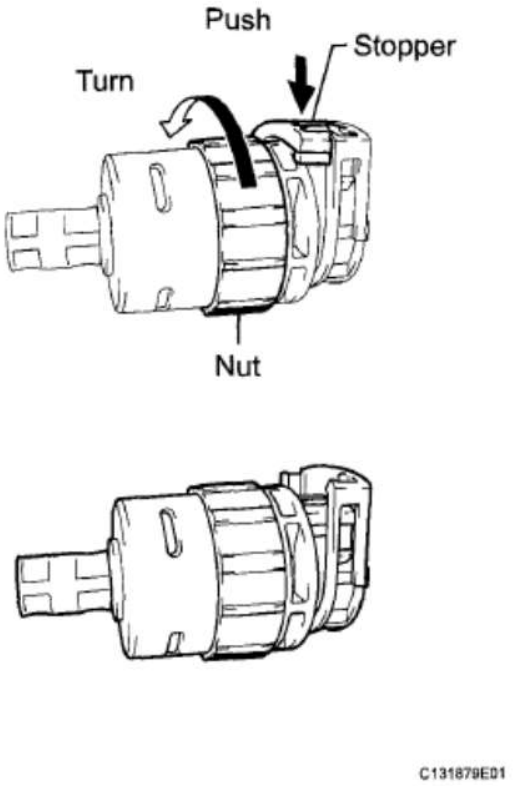


Fig. 220: Rotating Transmission Control Cable Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the outer part of the transmission control cable assembly to the shift lever retainer.

NOTE: After installation, check that the outer part of the cable lock is protruding beyond portion A-A as shown in the illustration.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

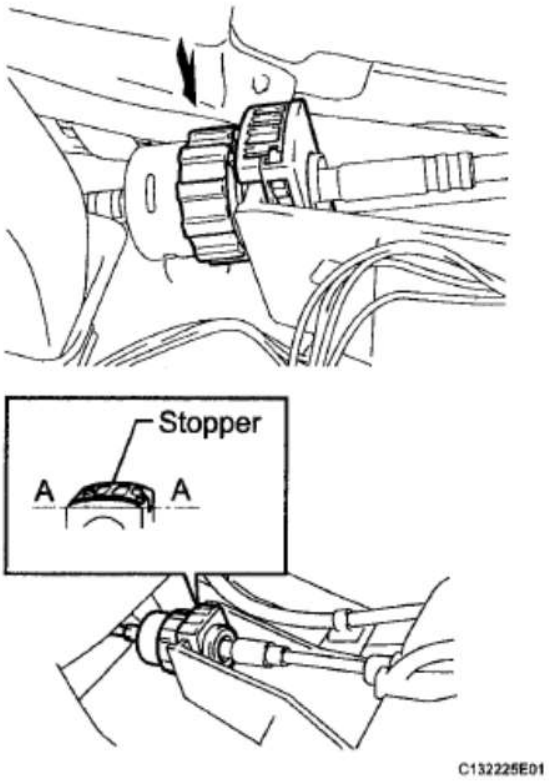


Fig. 221: Connecting Outer Part Of Transmission Control Cable Assembly To Shift Lever Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Slide the slider in the direction shown in the illustration and pull out the lock piece.

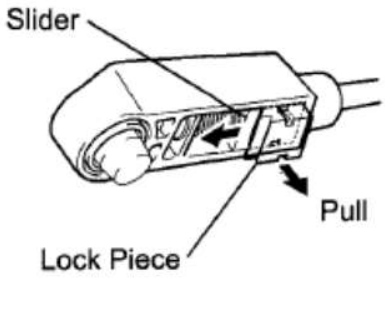


Fig. 222: Pulling Out Lock Piece
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the cable end to the shift control unit.

NOTE:

- **Check that the lock piece is pulled up.**
- **Install the cable end all the way to the base of the pin.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

- **Push in the lock piece after adjusting the shift lever position.**

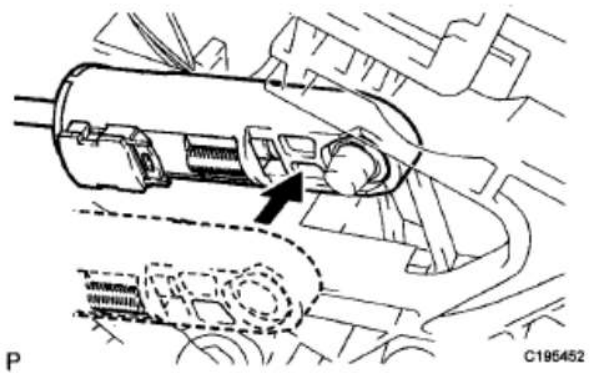


Fig. 223: Installing Cable End To Shift Control Unit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Install the transmission control cable assembly with the 3 bolts.

Torque: 4.9 N*m (50 kgf*cm, 43 in.*lbf)

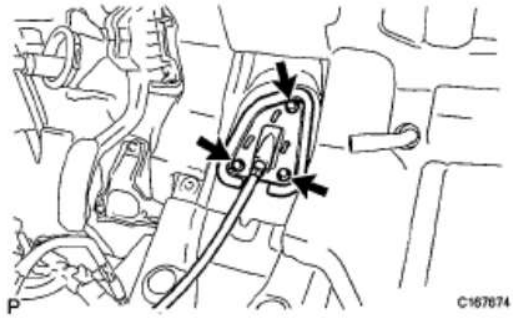


Fig. 224: Locating Transmission Control Cable Bracket Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Connect the transmission control cable assembly to the No. 2 transmission control cable bracket.

Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

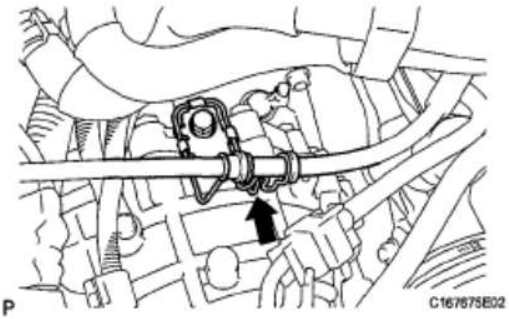


Fig. 225: Locating No. 2 Transmission Control Cable Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Temporarily install the transmission control cable assembly to the control shaft lever with the nut.

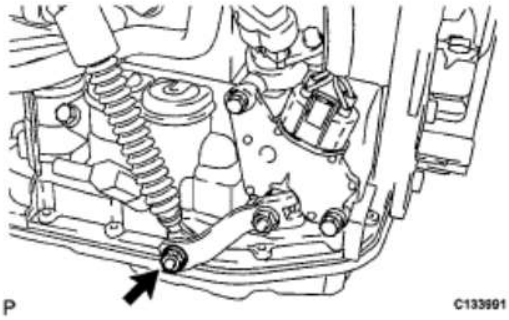


Fig. 226: Locating Control Shaft Lever Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Connect the transmission control cable assembly to the bracket with a new clip.

2. **INSTALL AIR CONDITIONING UNIT**

   HINT:

   (See **INSTALLATION**)

3. **INSTALL AIR CLEANER BRACKET** (See **INSTALLATION**)
4. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

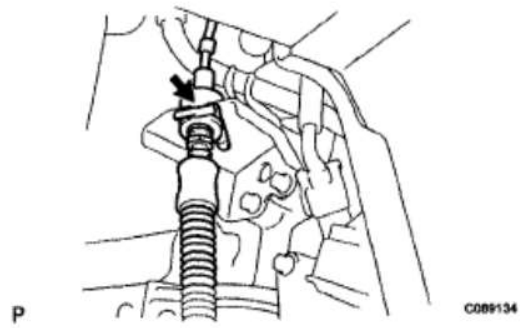


Fig. 227: Locating Transmission Control Cable Clip
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
6. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INTAKE MANIFOLD**)
7. **INSTALL NO. 1 AIR CLEANER INLET** (See **INTAKE MANIFOLD**)
8. **INSTALL NO. 2 AIR CLEANER INLET** (See **COMPONENTS**)
9. **INSTALL COOL AIR INTAKE DUCT SEAL** (See **COMPONENTS**)
10. **INSTALL BATTERY** (See **INSTALLATION**)
11. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL** (See **INSTALLATION**)
12. **ADJUST SHIFT LEVER POSITION** (See **ADJUSTMENT**)
13. **INSPECT SHIFT LEVER POSITION** (See **ON-VEHICLE INSPECTION**)

DIFFERENTIAL OIL SEAL

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

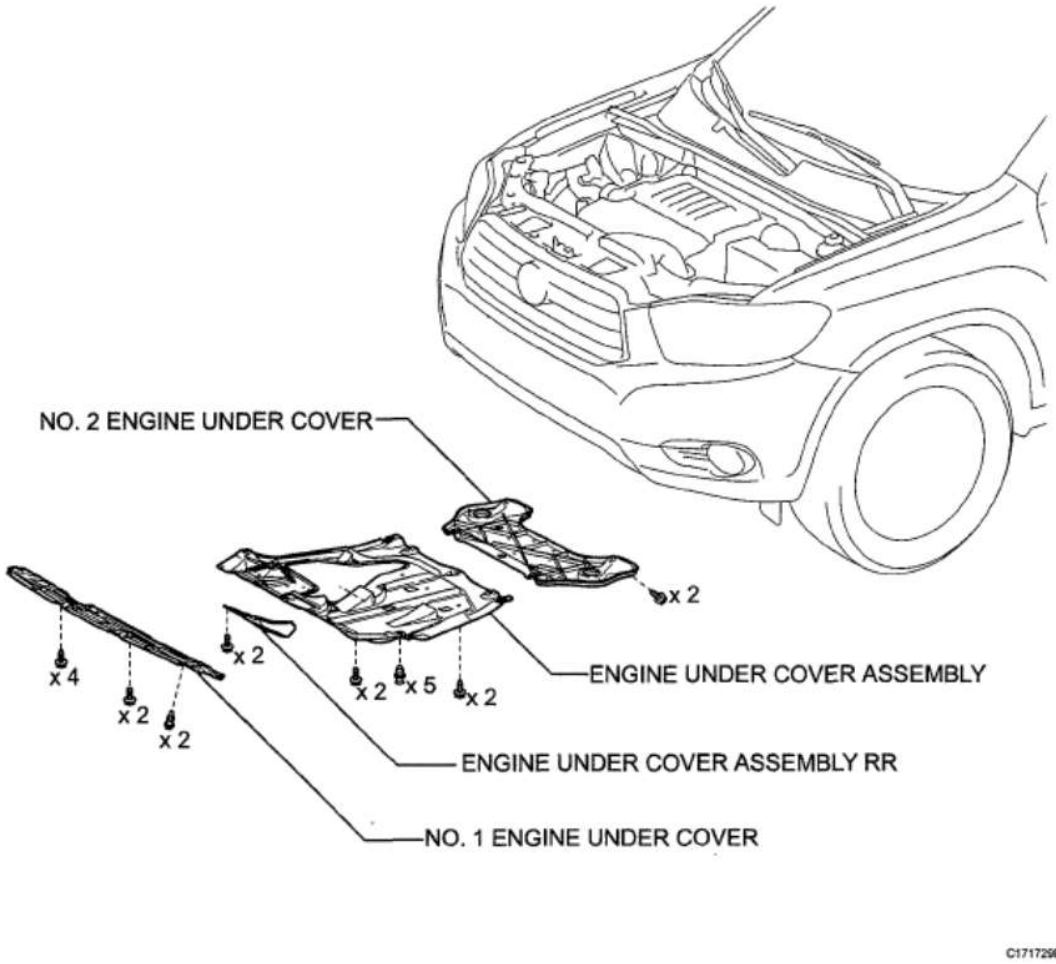


Fig. 228: Identifying Differential Oil Seal Components With Torque Specification (1 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

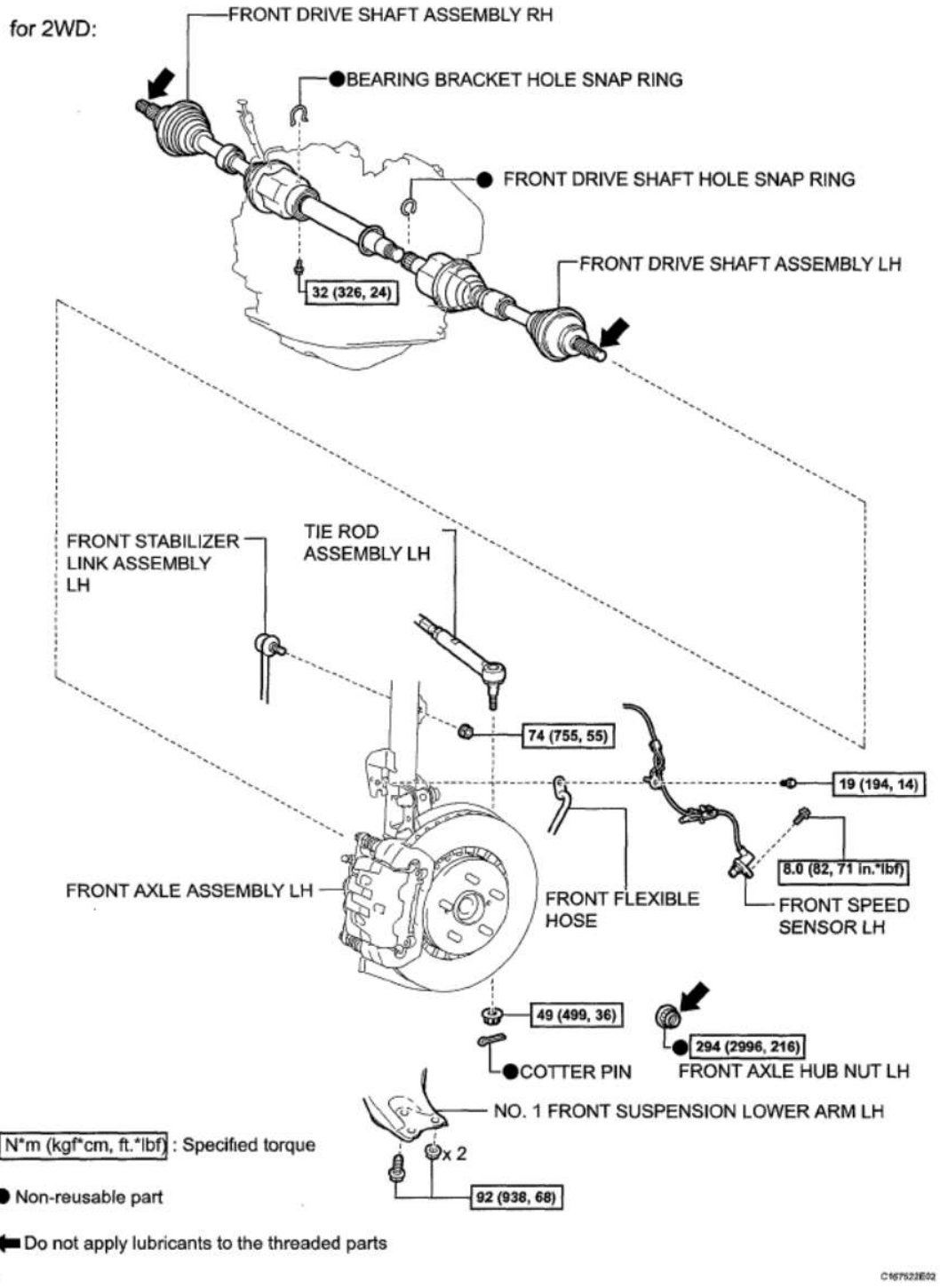


Fig. 229: Identifying Differential Oil Seal Components With Torque Specification (2 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

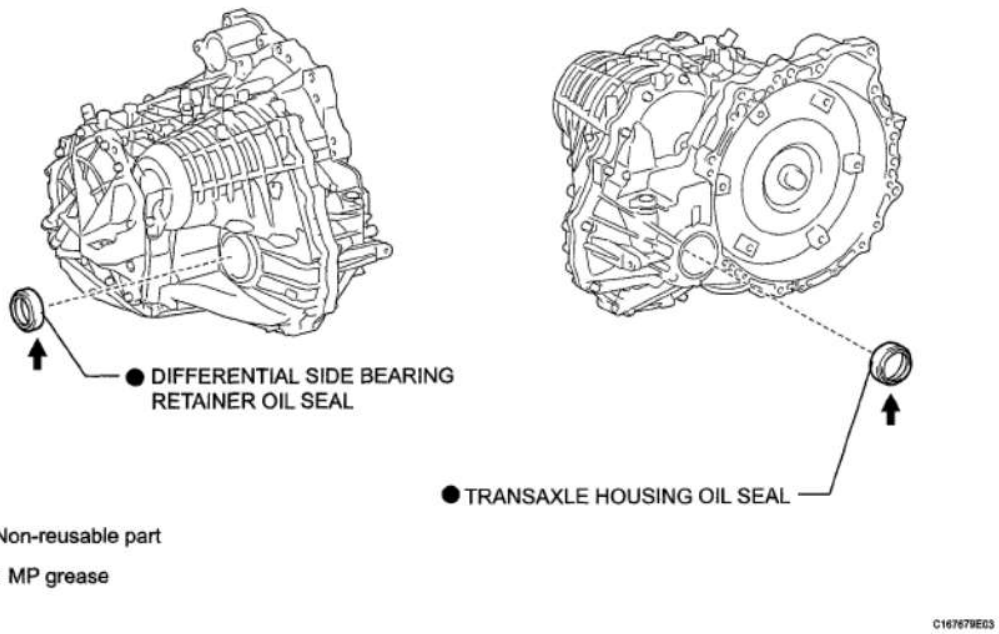


Fig. 230: Identifying Differential Oil Seal Components With Torque Specification (3 Of 3)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REPLACEMENT

1. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REASSEMBLY**)
2. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REASSEMBLY**)
3. **REMOVE NO. 2 ENGINE UNDER COVER** (See **REASSEMBLY**)
4. **DRAIN AUTOMATIC TRANSAXLE FLUID** (See **REMOVAL**)
5. **REMOVE FRONT WHEEL**
6. **REMOVE FRONT AXLE HUB NUT LH** (See **REMOVAL**)
7. **REMOVE FRONT AXLE HUB NUT RH**

   HINT:

   Perform the same procedure for the LH side.

8. **SEPARATE FRONT STABILIZER LINK ASSEMBLY LH** (See **REMOVAL**)
9. **SEPARATE FRONT STABILIZER LINK ASSEMBLY RH**

   HINT:

   Perform the same procedure for the LH side.

10. **SEPARATE FRONT SPEED SENSOR LH** (See **REMOVAL**)
11. **SEPARATE FRONT SPEED SENSOR RH**

cardiagn.com

HINT:

Perform the same procedure for the LH side.

12. **SEPARATE TIE ROD ASSEMBLY LH** (See **REMOVAL**)
13. **SEPARATE TIE ROD ASSEMBLY RH**

HINT:

Perform the same procedure for the LH side.

14. **SEPARATE NO. 1 FRONT SUSPENSION LOWER ARM LH** (See **REMOVAL**)
15. **SEPARATE NO. 1 FRONT SUSPENSION LOWER ARM RH**

HINT:

Perform the same procedure for the LH side.

16. **SEPARATE FRONT AXLE ASSEMBLY LH** (See **REMOVAL**)
17. **SEPARATE FRONT AXLE ASSEMBLY RH**

HINT:

Perform the same procedure for the LH side.

18. **REMOVE FRONT DRIVE SHAFT ASSEMBLY LH** (See **REMOVAL**)
19. **REMOVE FRONT DRIVE SHAFT ASSEMBLY RH (for 2WD)** (See **DISASSEMBLY**)
20. **SECURE FRONT AXLE HUB SUB-ASSEMBLY LH** (See **DISASSEMBLY**)
21. **SECURE FRONT AXLE HUB SUB-ASSEMBLY RH**

HINT:

Perform the same procedure for the LH side.

22. **REMOVE DIFFERENTIAL SIDE BEARING RETAINER OIL SEAL**
    a. Using SST, pull out the oil seal.

       SST 09308-00010

cardiagn.com

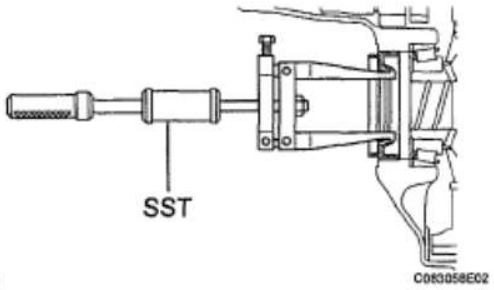


Fig. 231: Removing Differential Side Bearing Retainer Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. **REMOVE TRANSAXLE HOUSING OIL SEAL**
    a. Using SST, pull out the oil seal.

    SST 09308-00010

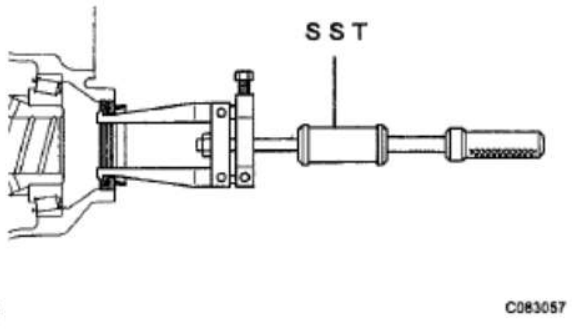


Fig. 232: Removing Transaxle Housing Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **INSTALL TRANSAXLE HOUSING OIL SEAL**
    a. Coat the lip of a new oil seal with MP grease.
    b. Using SST and a hammer, install a new oil seal.

    SST 09316-60011 (09316-00011)

    Oil seal installation depth: -0.5 to 0.5 mm (-0.020 to 0.020 in.)

cardiagn.com

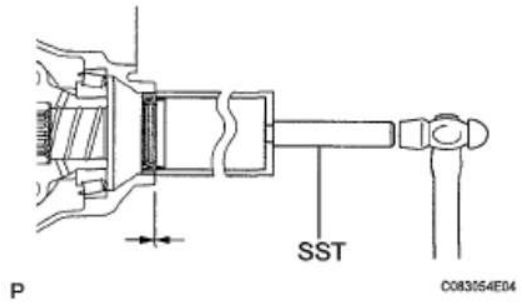


Fig. 233: Installing Transaxle Housing Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

25. **INSTALL DIFFERENTIAL SIDE BEARING RETAINER OIL SEAL**
    a. Coat the lip of a new oil seal with MP grease.
    b. Using SST and a hammer, install a new oil seal.

    SST 09223-15020, 09950-70010 (09951-07150)

    Oil seal installation depth: -0.5 to 0.2 mm (-0.020 to 0.008 in.)

26. **INSTALL FRONT DRIVE SHAFT ASSEMBLY LH** (See **INSTALLATION**)
27. **INSTALL FRONT DRIVE SHAFT ASSEMBLY RH (for 2WD)** (See **INSTALLATION**)

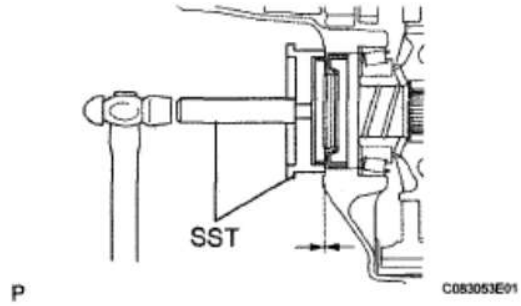


Fig. 234: Installing Differential Side Bearing Retainer Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

28. **INSTALL FRONT AXLE ASSEMBLY LH** (See **INSTALLATION**)
29. **INSTALL FRONT AXLE ASSEMBLY RH**

    HINT:

    Perform the same procedure for the LH side.

30. **INSTALL NO. 1 FRONT SUSPENSION LOWER ARM LH** (See **REMOVAL**)
31. **INSTALL NO. 1 FRONT SUSPENSION LOWER ARM RH**

cardiagn.com

HINT:

Perform the same procedure for the LH side.

32. **INSTALL TIE ROD ASSEMBLY LH** (See **INSTALLATION**)
33. **INSTALL TIE ROD ASSEMBLY RH**

HINT:

Perform the same procedure for the LH side.

34. **INSTALL FRONT SPEED SENSOR LH** (See **INSTALLATION**)
35. **INSTALL FRONT SPEED SENSOR RH**

HINT:

Perform the same procedure for the LH side.

36. **INSTALL FRONT STABILIZER LINK ASSEMBLY LH** (See **INSTALLATION**)
37. **INSTALL FRONT STABILIZER LINK ASSEMBLY RH**

HINT:

Perform the same procedure for the LH side.

38. **INSTALL FRONT AXLE HUB NUT LH** (See **INSTALLATION**)
39. **INSTALL FRONT AXLE HUB NUT RH**

HINT:

Perform the same procedure for the LH side.

40. **INSTALL FRONT WHEEL** (See **INSTALLATION**)
41. **ADD AUTOMATIC TRANSAXLE FLUID**
42. **INSPECT AUTOMATIC TRANSAXLE FLUID** (See **ON-VEHICLE INSPECTION**)
43. **INSTALL NO. 2 ENGINE UNDER COVER** (See **INSTALLATION**)
44. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
45. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
46. **INSTALL FRONT WHEEL ALIGNMENT** (See **INSTALLATION**)
47. **INSTALL ABS SPEED SENSOR SIGNAL** (See **INSTALLATION**)

AUTOMATIC TRANSAXLE ASSEMBLY

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

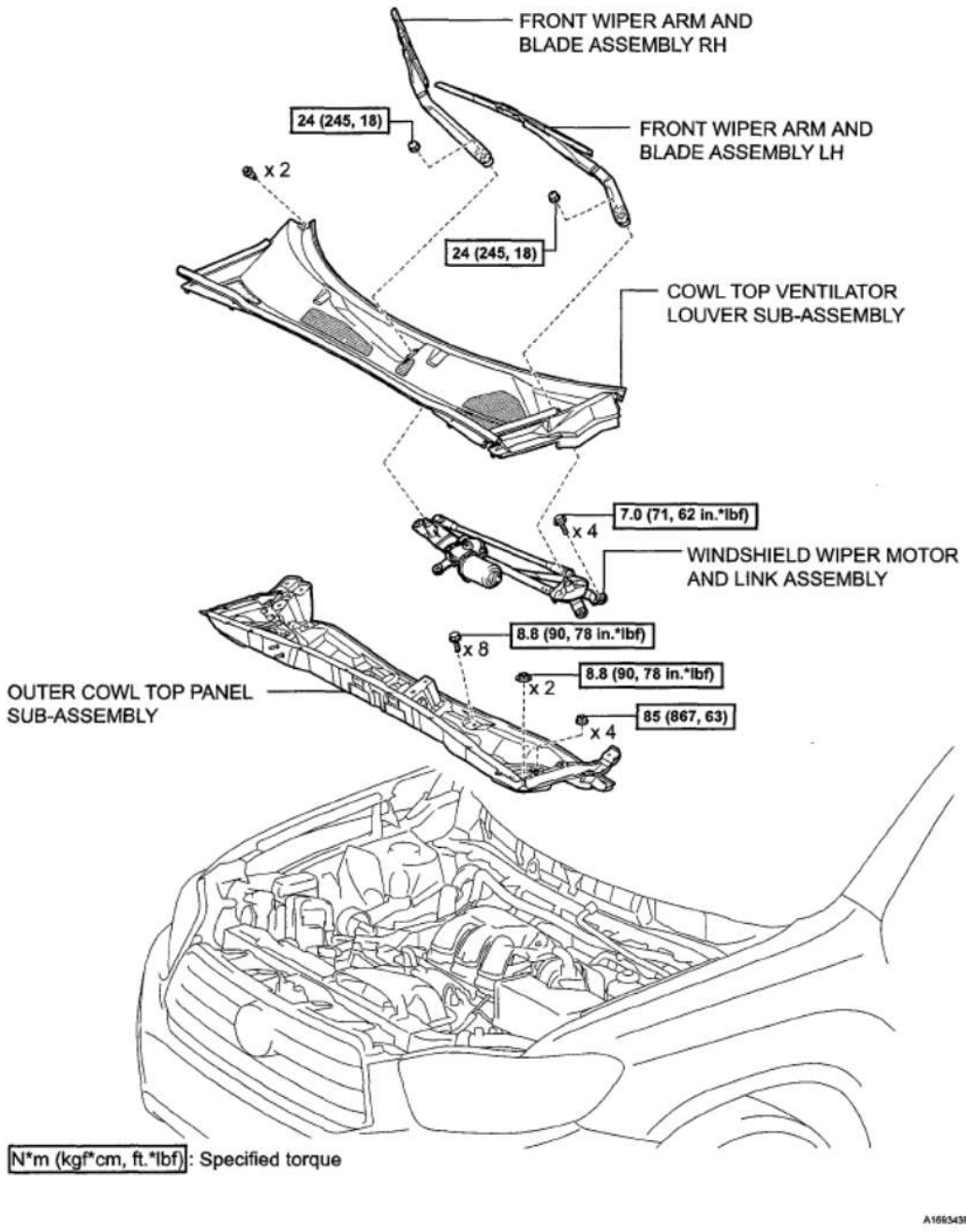


Fig. 235: Identifying Automatic Transaxle Assembly Components With Torque Specification (1 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

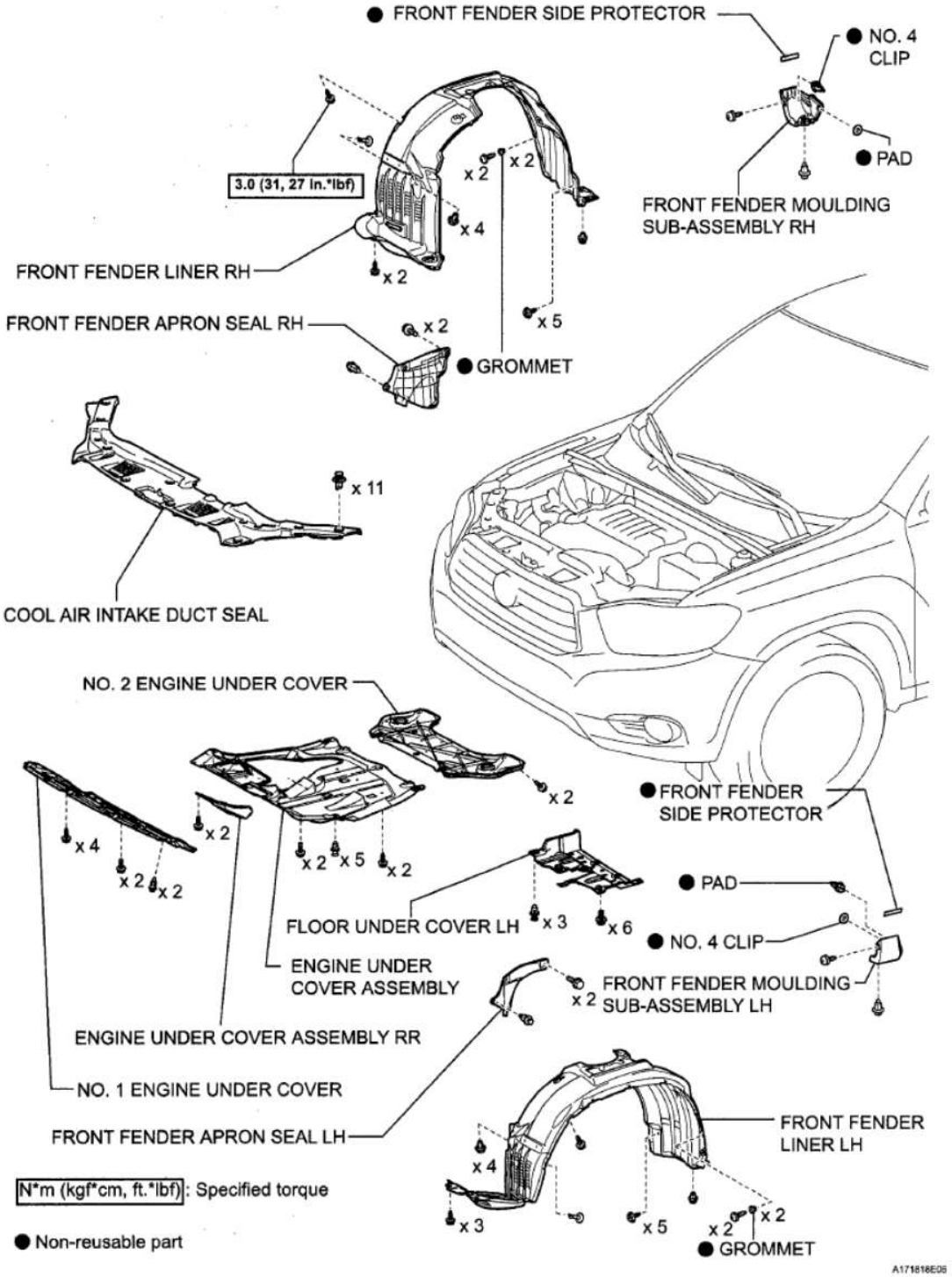


Fig. 236: Identifying Automatic Transaxle Assembly Components With Torque Specification (2 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

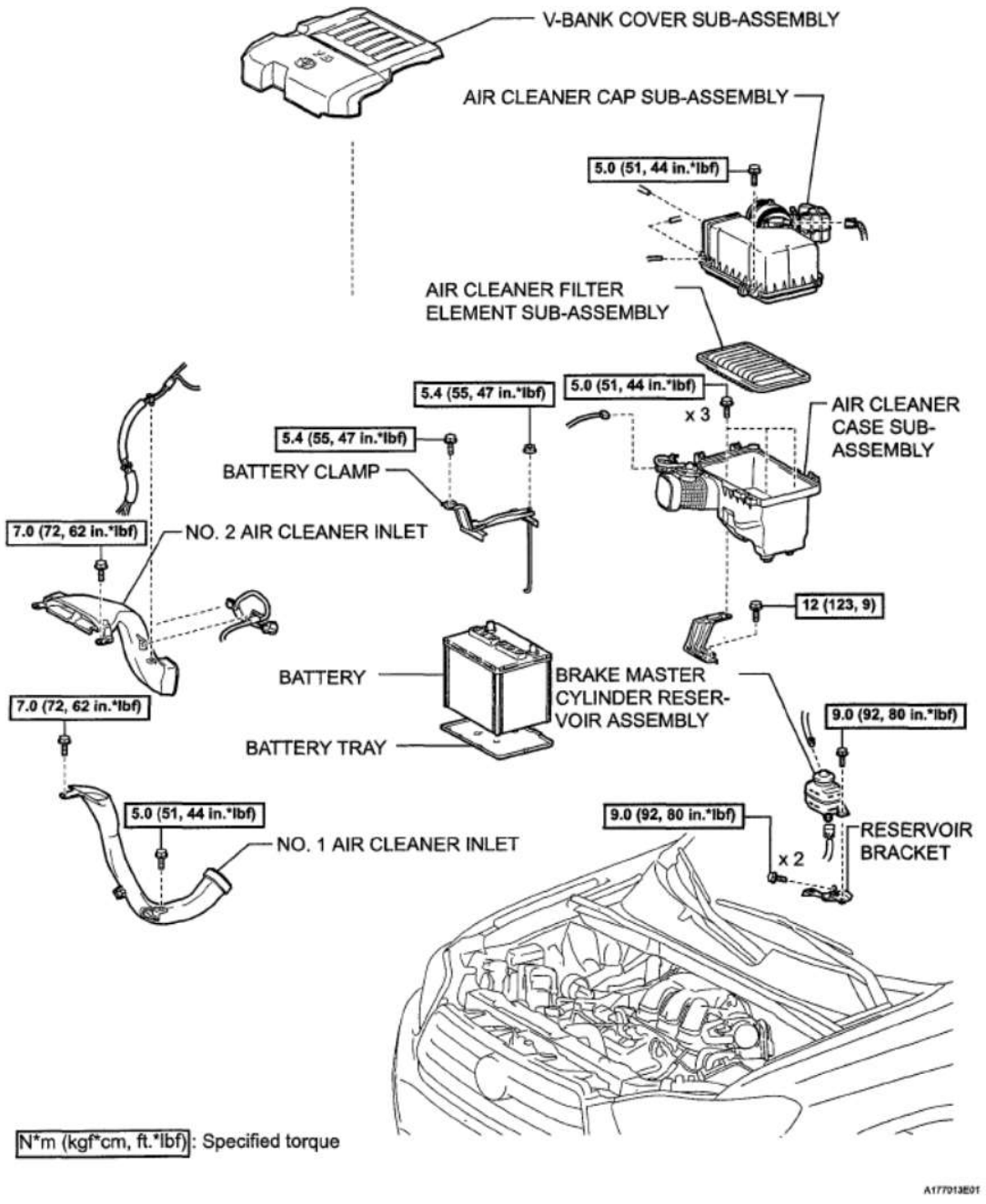


Fig. 237: Identifying Automatic Transaxle Assembly Components With Torque Specification (3 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

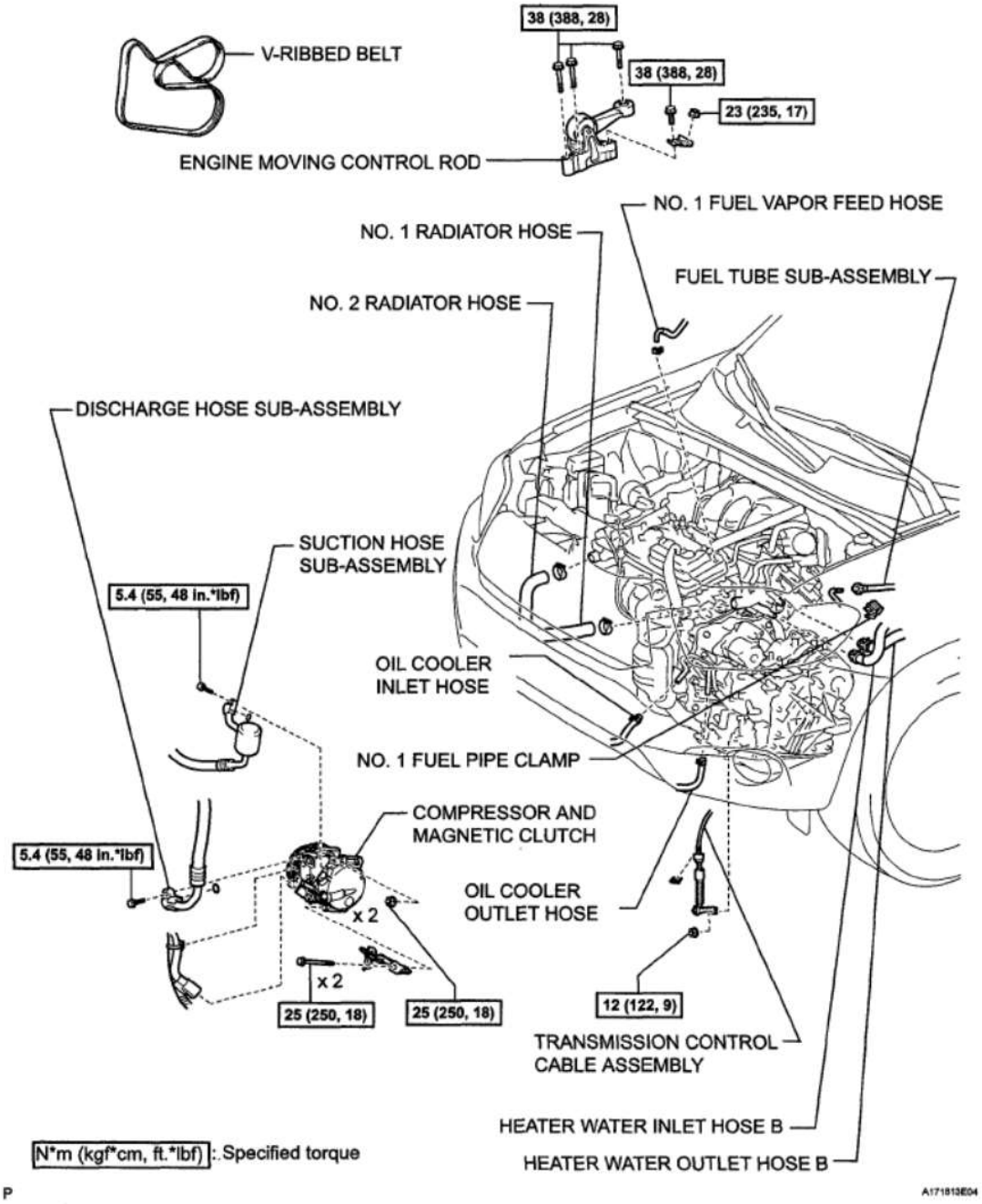


Fig. 238: Identifying Automatic Transaxle Assembly Components With Torque Specification (4 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

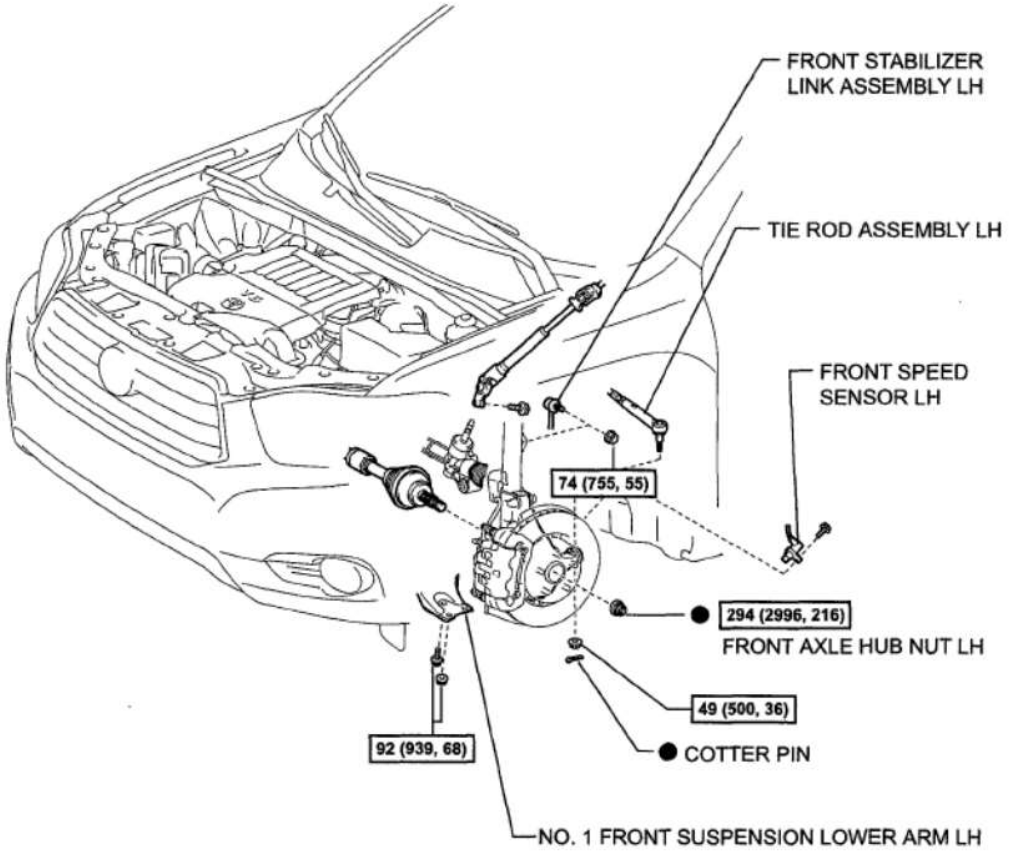


Fig. 239: Identifying Automatic Transaxle Assembly Components With Torque Specification (5 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

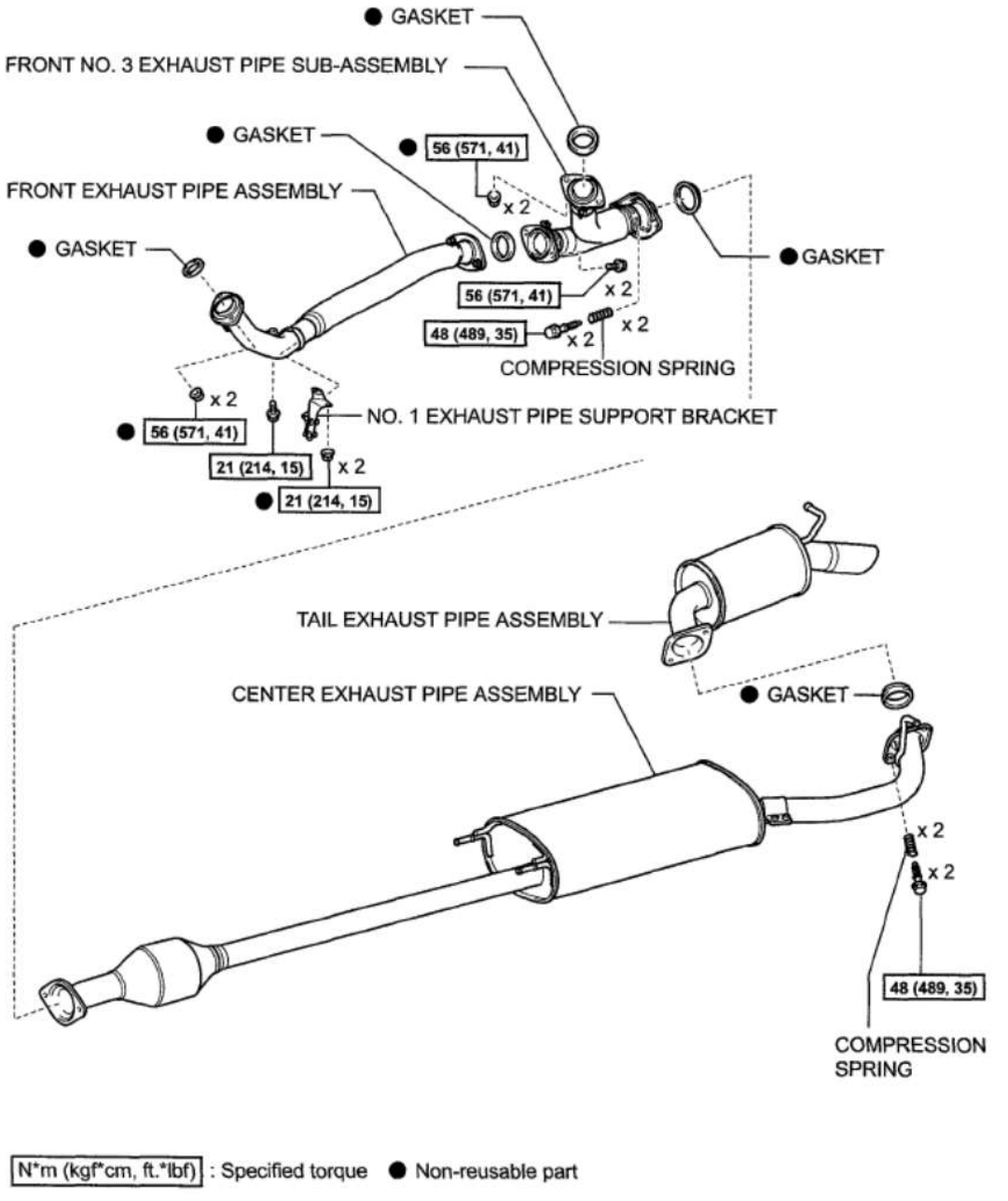


Fig. 240: Identifying Automatic Transaxle Assembly Components With Torque Specification (6 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

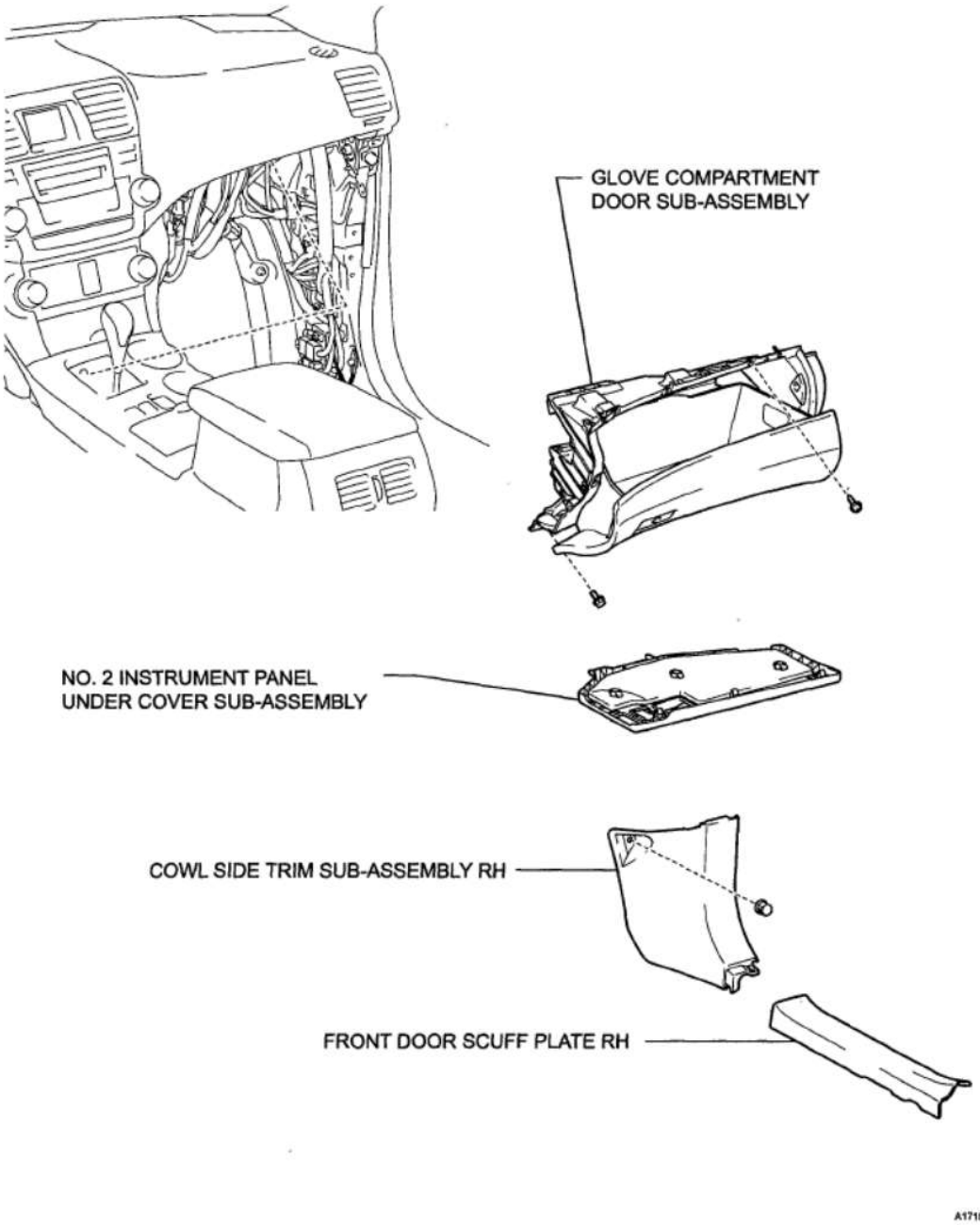


Fig. 241: Identifying Automatic Transaxle Assembly Components With Torque Specification (7 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

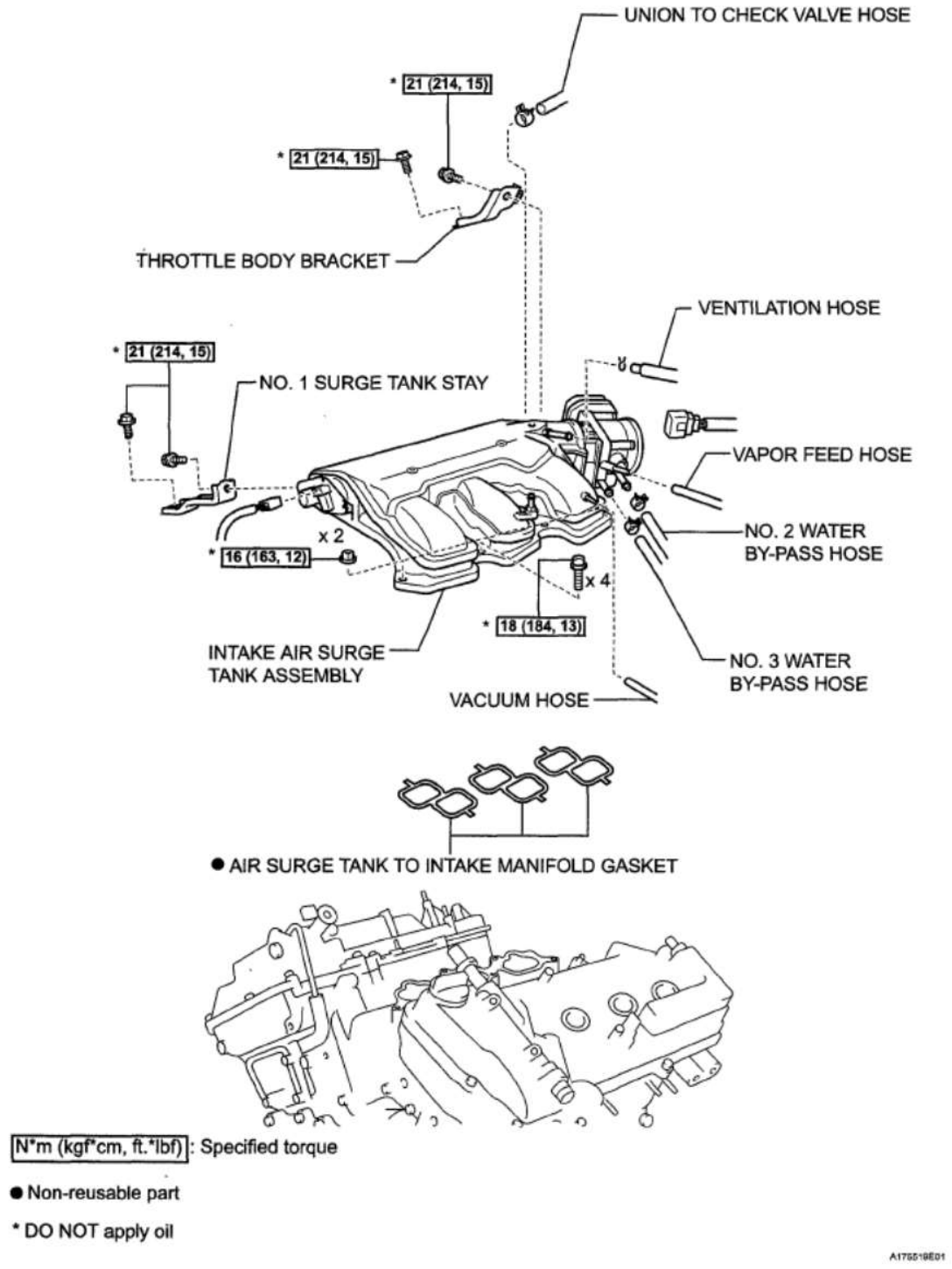


Fig. 242: Identifying Automatic Transaxle Assembly Components With Torque Specification (8 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

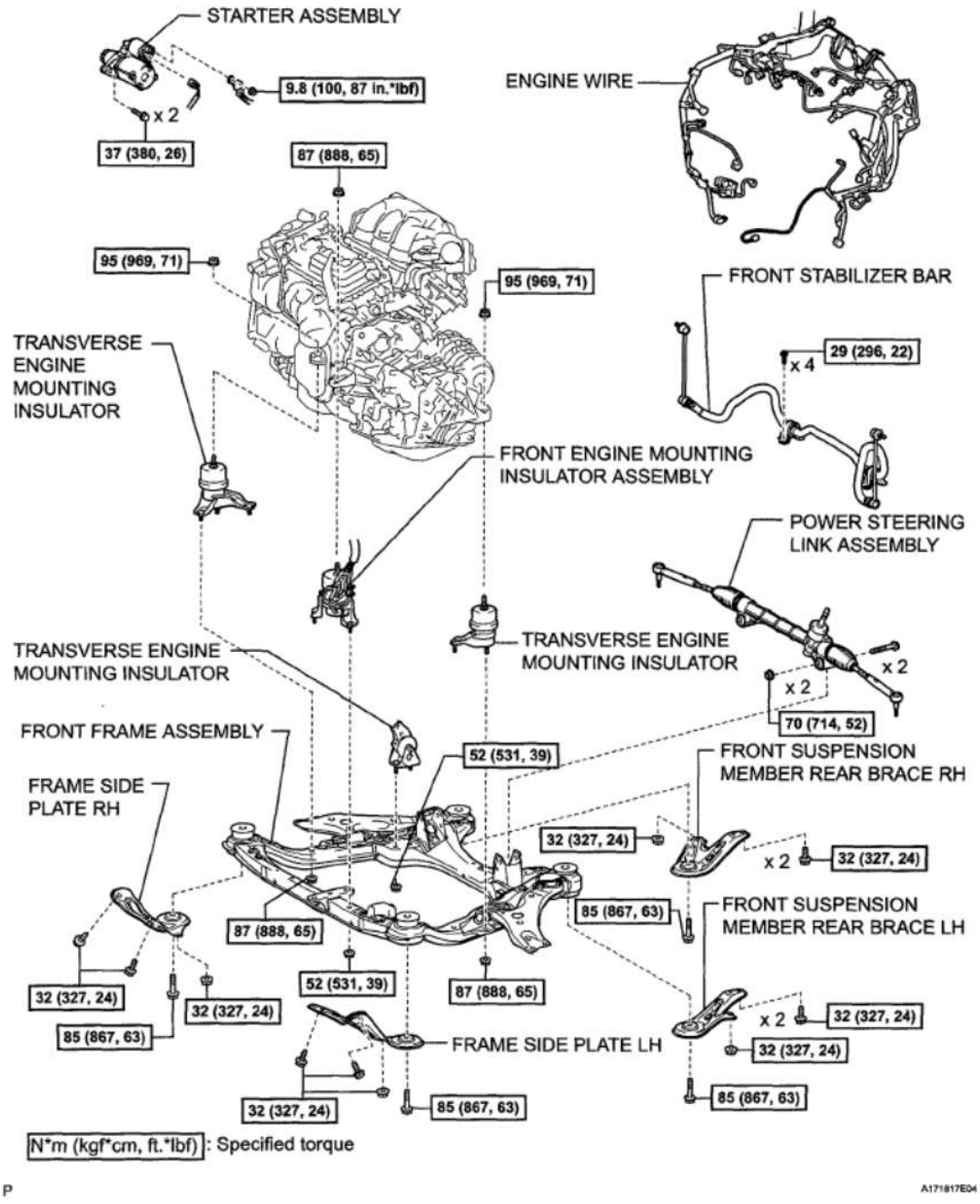


Fig. 243: Identifying Automatic Transaxle Assembly Components With Torque Specification (9 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

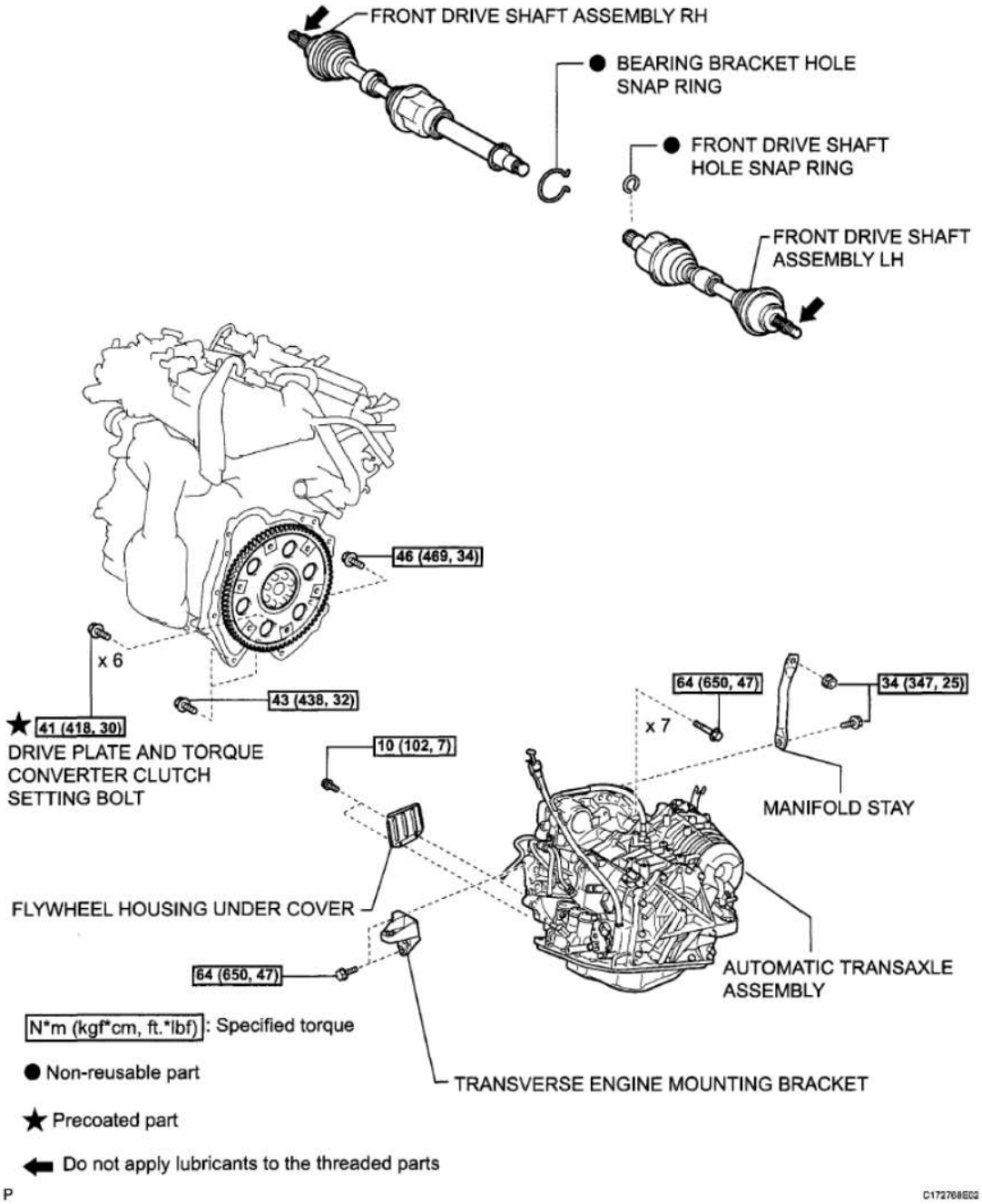


Fig. 244: Identifying Automatic Transaxle Assembly Components With Torque Specification (10 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

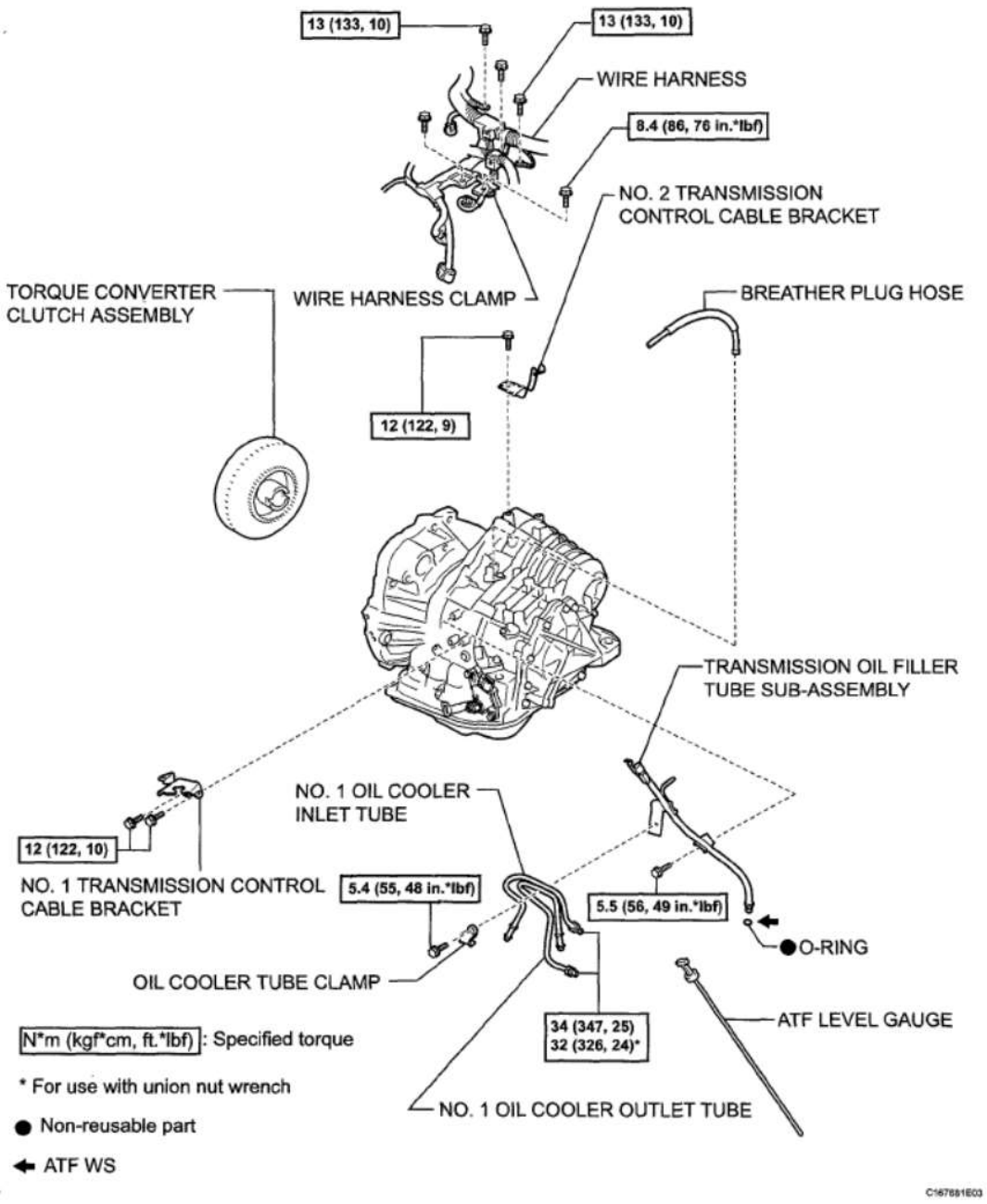


Fig. 245: Identifying Automatic Transaxle Assembly Components With Torque Specification (11 Of 11)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **DISCHARGE FUEL SYSTEM PRESSURE** (See **FUEL INJECTOR**)
2. **RECOVER REFRIGERANT FROM REFRIGERATION SYSTEM** (See **REPLACEMENT**)
3. **REMOVE COOL AIR INTAKE DUCT SEAL** (See **SYSTEM DIAGRAM**)
4. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

5. **REMOVE BATTERY** (See **REASSEMBLY**)
6. **PLACE FRONT WHEELS FACING STRAIGHT AHEAD**
7. **REMOVE FRONT WHEELS**
8. **REMOVE ENGINE UNDER COVER ASSEMBLY** (See **REASSEMBLY**)
9. **REMOVE NO. 1 ENGINE UNDER COVER** (See **REASSEMBLY**)
10. **REMOVE NO. 2 ENGINE UNDER COVER** (See **REASSEMBLY**)
11. **REMOVE FLOOR UNDER COVER LH** (See **CAMSHAFT POSITION SENSOR**)
12. **REMOVE FRONT FENDER MOULDING SUB-ASSEMBLY LH** (See **REMOVAL**)
13. **REMOVE FRONT FENDER MOULDING SUB-ASSEMBLY RH** (See **REMOVAL**)
14. **REMOVE FRONT FENDER LINER LH** (See **REMOVAL**)
15. **REMOVE FRONT FENDER LINER RH** (See **REMOVAL**)
16. **REMOVE FRONT FENDER APRON SEAL LH** (See **REASSEMBLY**)
17. **REMOVE FRONT FENDER APRON SEAL RH** (See **REASSEMBLY**)
18. **DRAIN ENGINE OIL** (See **REPLACEMENT**)
19. **DRAIN ENGINE COOLANT** (See **COMPONENTS**)
20. **DRAIN AUTOMATIC TRANSAXLE FLUID** (See **REMOVAL**)
21. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **REMOVAL**)
22. **REMOVE FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **REMOVAL**)
23. **REMOVE COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **REMOVAL**)
24. **REMOVE WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **REMOVAL**)
25. **REMOVE OUTER COWL TOP PANEL SUB-ASSEMBLY** (See **REASSEMBLY**)
26. **REMOVE V-BANK COVER SUB-ASSEMBLY** (See **REASSEMBLY**)
27. **REMOVE NO. 2 AIR CLEANER INLET** (See **SYSTEM DIAGRAM**)
28. **REMOVE NO. 1 AIR CLEANER INLET** (See **ON-VEHICLE INSPECTION**)
29. **REMOVE AIR CLEANER CAP SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
30. **REMOVE AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY** (See **REASSEMBLY**)
31. **REMOVE AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
32. **REMOVE AIR CLEANER BRACKET** (See **REASSEMBLY**)
33. **SEPARATE BRAKE MASTER CYLINDER RESERVOIR ASSEMBLY** (See **REASSEMBLY**)
34. **REMOVE RESERVOIR BRACKET** (See **REASSEMBLY**)
35. **REMOVE NO. 2 ENGINE MOUNTING STAY RH** (See **REASSEMBLY**)
36. **REMOVE ENGINE MOVING CONTROL ROD** (See **REASSEMBLY**)
37. **DISCONNECT NO. 1 FUEL VAPOR FEED HOSE** (See **REASSEMBLY**)
38. **DISCONNECT NO. 1 RADIATOR HOSE** (See **REASSEMBLY**)
39. **DISCONNECT NO. 2 RADIATOR HOSE** (See **REASSEMBLY**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

40. **DISCONNECT HEATER WATER HOSE OUTLET B** (See **REASSEMBLY**)
41. **DISCONNECT HEATER WATER HOSE INLET B** (See **REASSEMBLY**)
42. **DISCONNECT FUEL TUBE SUB-ASSEMBLY** (See **REASSEMBLY**)
43. **DISCONNECT OIL COOLER INLET HOSE** (See **REASSEMBLY**)
44. **DISCONNECT OIL COOLER OUTLET HOSE** (See **REASSEMBLY**)
45. **DISCONNECT TRANSMISSION CONTROL CABLE ASSEMBLY** (See **REASSEMBLY**)
46. **DISCONNECT ENGINE WIRE** (See **REASSEMBLY**)
47. **DISCONNECT UNION TO CHECK VALVE HOSE** (See **INSTALLATION**)
48. **REMOVE TAIL EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
49. **REMOVE CENTER EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
50. **REMOVE FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY** (See **INSTALLATION**)
51. **REMOVE FRONT EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
52. **DISCONNECT FRONT STABILIZER LINK ASSEMBLY LH** (See **REMOVAL**)
53. **DISCONNECT FRONT STABILIZER LINK ASSEMBLY RH** (See **INSTALLATION**)
54. **REMOVE FRONT AXLE HUB NUT LH** (See **REMOVAL**)
55. **REMOVE FRONT AXLE HUB NUT RH** (See **INSTALLATION**)
56. **DISCONNECT FRONT SPEED SENSOR LH** (See **REMOVAL**)
57. **DISCONNECT FRONT SPEED SENSOR RH** (See **INSTALLATION**)
58. **DISCONNECT TIE ROD ASSEMBLY LH** (See **REMOVAL**)
59. **DISCONNECT TIE ROD ASSEMBLY RH** (See **INSTALLATION**)
60. **SEPARATE NO. 1 FRONT SUSPENSION LOWER ARM LH** (See **REMOVAL**)
61. **SEPARATE NO. 1 FRONT SUSPENSION LOWER ARM RH** (See **INSTALLATION**)
62. **SEPARATE FRONT AXLE ASSEMBLY LH** (See **REMOVAL**)
63. **SEPARATE FRONT AXLE ASSEMBLY RH** (See **INSTALLATION**)
64. **DISCONNECT STEERING INTERMEDIATE SHAFT SUB-ASSEMBLY** (See **REMOVAL**)
65. **DISCONNECT DISCHARGE HOSE SUB-ASSEMBLY** (See **REMOVAL**)
66. **DISCONNECT SUCTION HOSE SUB-ASSEMBLY** (See **REMOVAL**)
67. **REMOVE ENGINE ASSEMBLY WITH TRANSAXLE** (See **INSTALLATION**)
68. **REMOVE V-RIBBED BELT** (See **ON-VEHICLE INSPECTION**)
69. **REMOVE FRONT STABILIZER BAR** (See **INSTALLATION**)
70. **REMOVE POWER STEERING LINK ASSEMBLY** (See **REMOVAL**)
71. **REMOVE COMPRESSOR AND MAGNETIC CLUTCH** (See **REMOVAL**)
72. **REMOVE VENTILATION HOSE** (See **REMOVAL**)
73. **REMOVE INTAKE AIR SURGE TANK ASSEMBLY** (See **REMOVAL**)
74. **REMOVE ENGINE WIRE** (See **REMOVAL**)
75. **REMOVE STARTER ASSEMBLY** (See **REMOVAL**)
76. **REMOVE TRANSVERSE ENGINE MOUNTING BRACKET** (See **REMOVAL**)
77. **REMOVE MANIFOLD STAY** (See **REMOVAL**)

cardiagn.com

78. **INSTALL ENGINE HANGERS** (See **REMOVAL**)
79. **REMOVE FRONT FRAME ASSEMBLY** (See **REMOVAL**)
80. **REMOVE FRONT ENGINE MOUNTING INSULATOR ASSEMBLY** (See **REMOVAL**)
81. **REMOVE TRANSVERSE ENGINE MOUNTING INSULATOR** (See **REMOVAL**)
82. **REMOVE TRANSVERSE ENGINE MOUNTING INSULATOR** (See **REMOVAL**)
83. **REMOVE FRONT DRIVE SHAFT ASSEMBLY LH** (See **REMOVAL**)
84. **REMOVE FRONT DRIVE SHAFT ASSEMBLY RH (for 2WD)** (See **DISASSEMBLY**)
85. **REMOVE NO. 2 TRANSMISSION CONTROL CABLE BRACKET**
    a. Remove the bolt and the transmission control cable bracket.

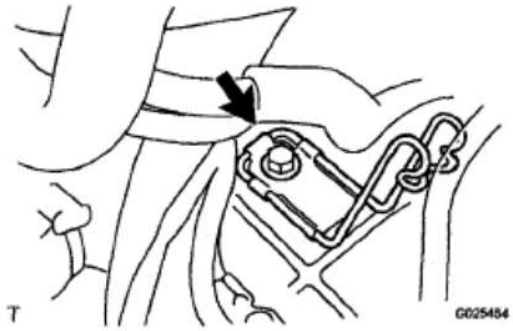


Fig. 246: Locating Transmission Control Cable Bracket Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

86. **REMOVE WIRE HARNESS CLAMP**
    a. Remove the bolt and disconnect the wire harness.
    b. Remove the 3 bolts and 3 clamps.

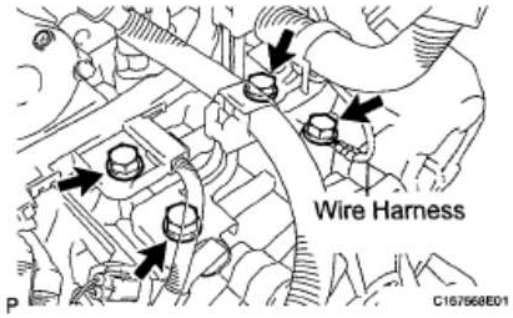


Fig. 247: Locating Wire Harness Clamp With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

87. **DISCONNECT WIRE HARNESS**
    a. Remove the bolt and disconnect the wire harness.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

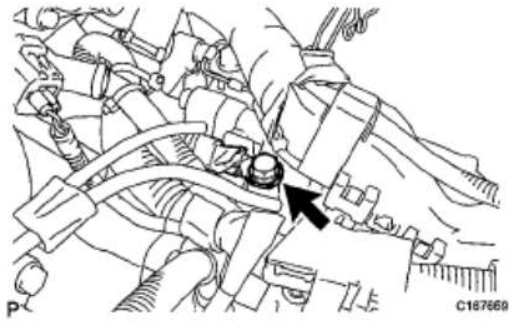


Fig. 248: Locating Wire Harness Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

88. **REMOVE BREATHER PLUG HOSE**
    a. Disconnect the breather plug hose from the oil filler tube.

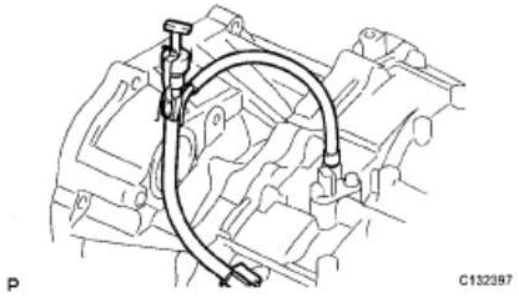


Fig. 249: Identifying Breather Plug Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

89. **DISCONNECT CONNECTORS**
    a. Disconnect the transmission wire connector.
    b. Disconnect the park/neutral position switch connector.
    c. Disconnect the 2 speed sensor connectors.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

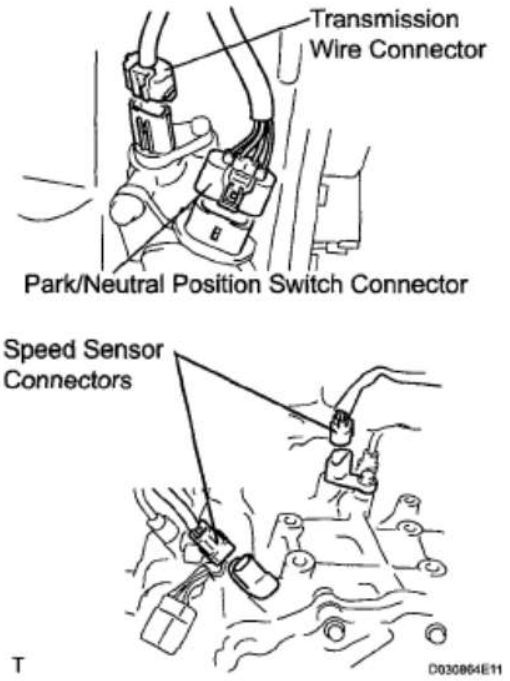


Fig. 250: Identifying Transmission Wire And Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

90. **REMOVE NO. 1 TRANSMISSION CONTROL CABLE BRACKET**
    a. Remove the 2 bolts and No. 1 transmission control cable bracket.



Fig. 251: Locating No. 1 Transmission Control Cable Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

91. **REMOVE NO. 1 OIL COOLER INLET TUBE**
    a. Using union nut wrench (17 mm) and a wrench, disconnect the No. 1 oil cooler inlet tube.

cardiagn.com

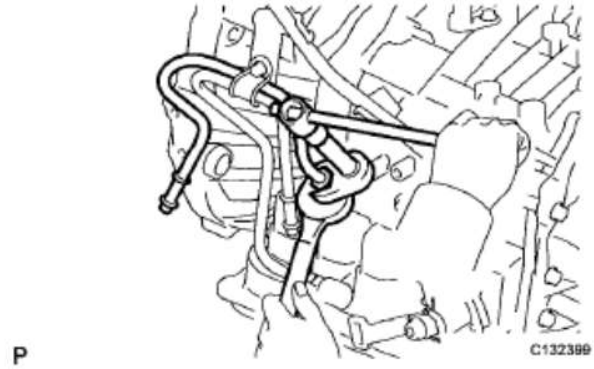


Fig. 252: Disconnecting No. 1 Oil Cooler Inlet Tube
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

92. **REMOVE NO. 1 OIL COOLER OUTLET TUBE**
    a. Using union nut wrench (17 mm) and a wrench, disconnect the No. 1 oil cooler outlet tube.
93. **REMOVE TRANSMISSION OIL FILTER TUBE SUB-ASSEMBLY**
    a. Remove the ATF level gauge.

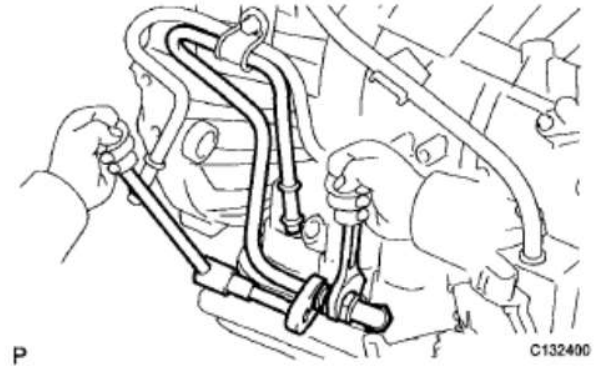


Fig. 253: Disconnecting No. 1 Oil Cooler Outlet Tube
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the bolt and oil cooler tube clamp.

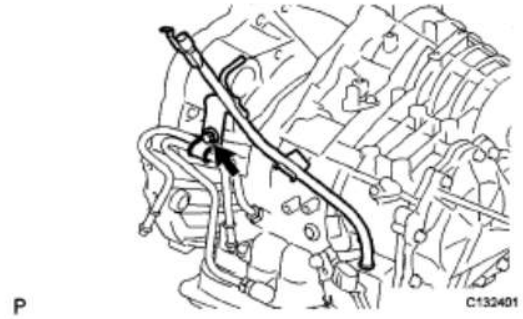


Fig. 254: Locating Oil Cooler Tube Clamp

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the bolt and transmission oil filter tube sub-assembly.
d. Remove the O-ring from the oil filter tube sub-assembly.

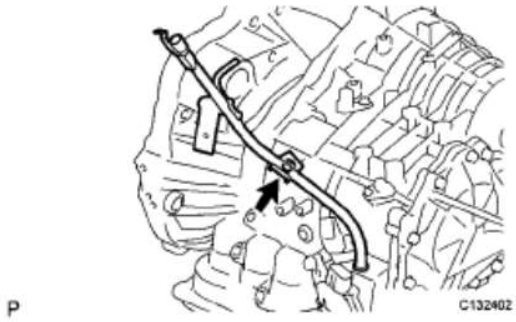


Fig. 255: Locating Transmission Oil Filter Tube Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

94. **REMOVE AUTOMATIC TRANSAXLE ASSEMBLY**
a. Remove the 2 bolts and bracket with the flywheel housing under cover.

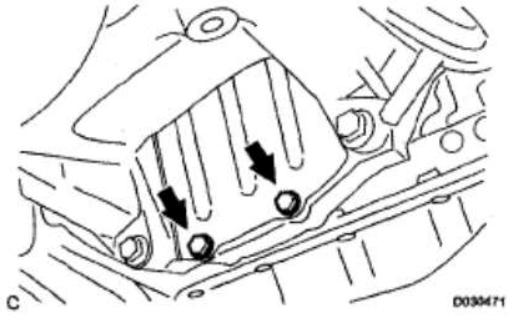


Fig. 256: Identifying Flywheel Housing Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Turn the crankshaft to gain access and remove the 6 bolts while holding the crankshaft pulley bolt with a wrench.

NOTE: One of the 6 bolts has a different color than the other ones.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

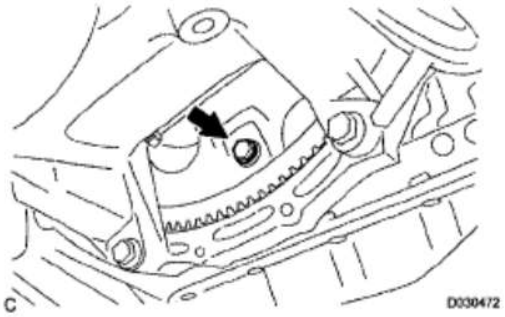


Fig. 257: Locating Flywheel Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the 10 bolts.
d. Separate and remove the automatic transaxle.

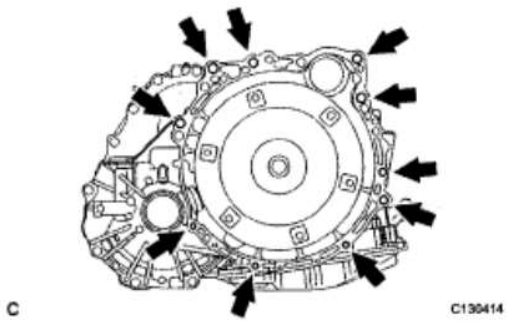


Fig. 258: Locating Automatic Transaxle Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

95. **REMOVE TORQUE CONVERTER CLUTCH ASSEMBLY**
    a. Put matchmarks on the transmission case and torque converter clutch assembly.
    b. Remove the torque converter clutch assembly from the automatic transaxle assembly.
96. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**

HINT:

(See **INSPECTION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

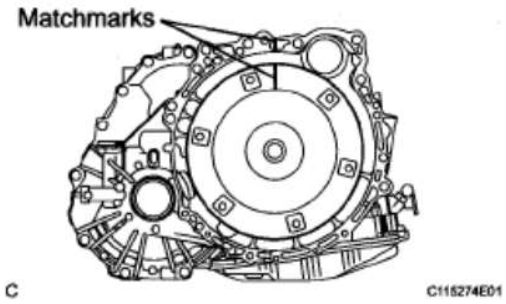


Fig. 259: Aligning Matchmarks On Transmission Case And Torque Converter Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **INSTALL TORQUE CONVERTER CLUTCH ASSEMBLY**
   a. Install the torque converter clutch to the automatic transaxle.
   b. Using a vernier caliper and a straightedge, measure dimension A between the transaxle fitting surface of the engine *1 and the torque converter fitting surface of the drive plate *2. (#)

NOTE: Subtract the thickness of the straightedge from the measured value to gain dimension A.

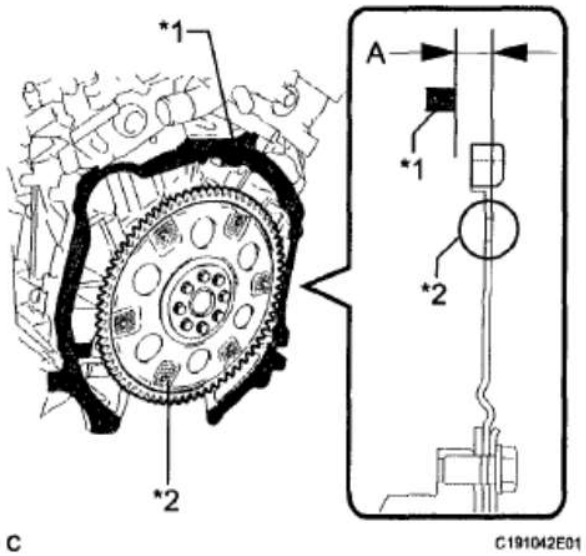


Fig. 260: Measuring Dimension A Between Transaxle Fitting Surface Of Engine And Torque Converter Fitting Surface
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Set the key at the top of the front oil pump drive gear and put a mark on the housing.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

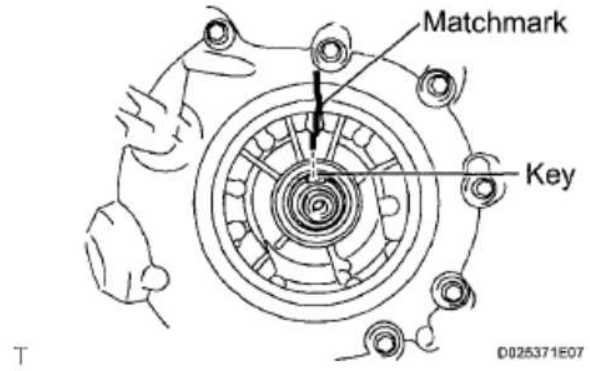


Fig. 261: Setting Key At Top Of Front Oil Pump Drive Gear And Put Mark On Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Put a mark on the torque converter so that its groove is clearly indicated.

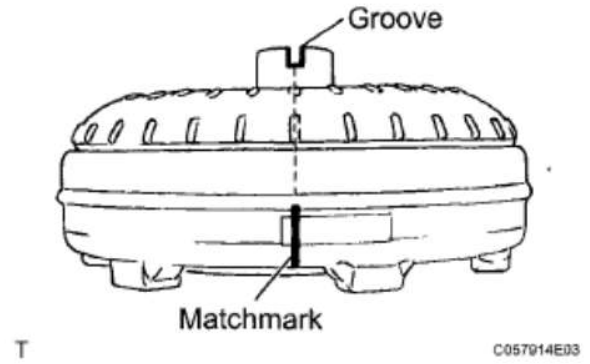


Fig. 262: Identifying Mark On Torque Converter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Align the matchmark on the case with the one on the torque converter and fit the splines of the input shaft to the turbine runner splines.

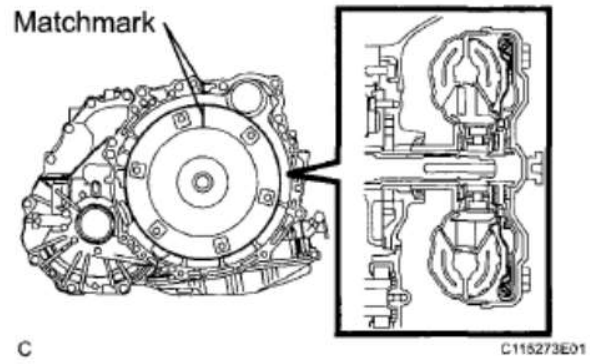


Fig. 263: Aligning Matchmark On Case With Torque Converter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

f. After rotating the torque converter, fit the splines of the stator shaft with the stator splines.

HINT:

Rotate the torque converter approximately 180 degrees.

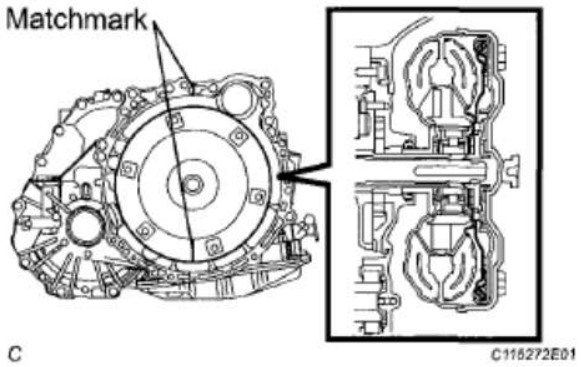


Fig. 264: Identifying Matchmark On Torque Converter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. After rotating the torque converter again, align the mark on the case with the one on the torque converter and fit the key of the oil pump drive gear into the torque converter keyway.

NOTE: Do not push the torque converter excessively when rotating it.

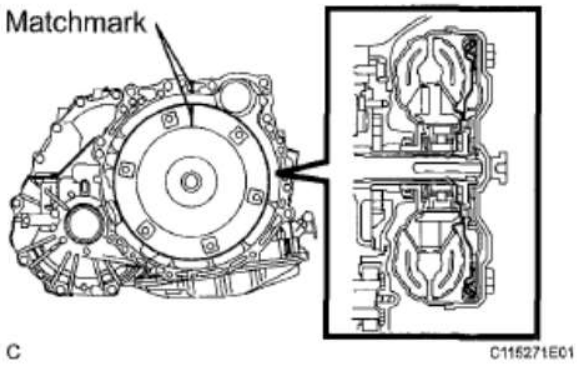


Fig. 265: Aligning Mark On Case With Torque Converter And Key
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Using a vernier caliper and a straightedge, measure dimension B shown in the illustration and check that dimension B is greater than dimension A (measured in step (#)).

Standard: A + 1 mm (0.04 in.) or more

NOTE: Make sure to deduct the thickness of the straightedge.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

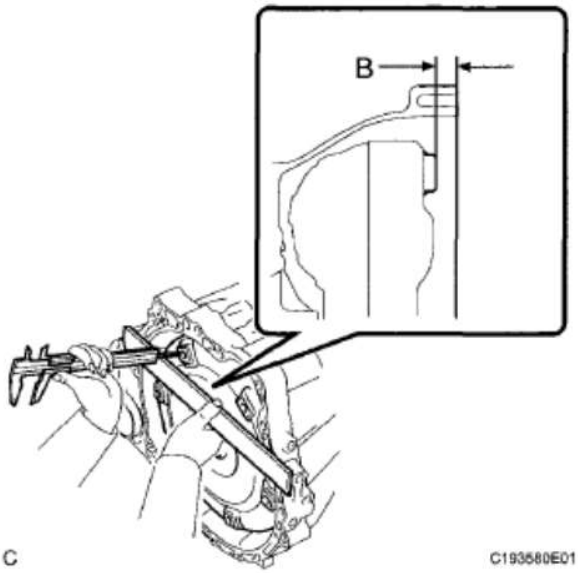


Fig. 266: Measuring Dimension B
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL AUTOMATIC TRANSAXLE ASSEMBLY**
   a. Install the automatic transaxle to the engine with the 10 bolts.

Torque: Bolt A

64 N*m (650 kgf*cm, 47 ft.*lbf)

Bolt B

46 N*m (470 kgf*cm, 34 ft.*lbf)

Bolt C

43 N*m (438 kgf*cm, 32 ft.*lbf)

NOTE: Confirm that 2 knock pins are on the transaxle fitted surface of the engine block before the transaxle installation.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

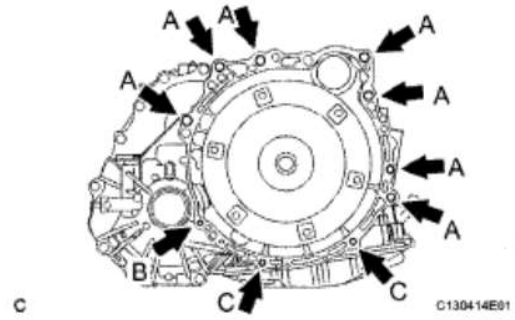


Fig. 267: Locating Automatic Transaxle With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Apply a few drops of adhesive the first of 2 or 3 threads of the 6 torque converter clutch mounting bolts.

Adhesive: Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

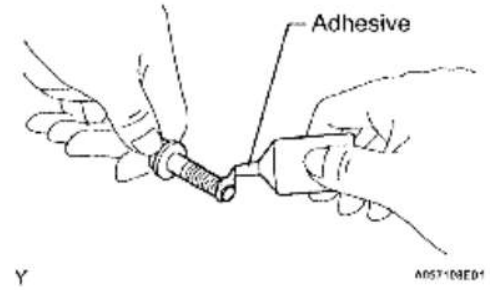


Fig. 268: Applying Drops Of Adhesive Of Torque Converter Clutch Mounting Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the 6 torque converter clutch mounting bolts.

Torque: 41 N*m (418 kgf*cm, 30 ft.*lbf)

NOTE: First install the different colored bolt, and then the remaining 5 bolts.

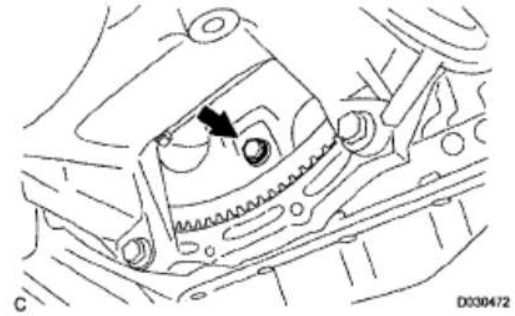


Fig. 269: Locating Torque Converter Clutch Mounting Bolts

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the flywheel housing under cover to the automatic transaxle with the 2 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

3. **INSTALL TRANSMISSION OIL FILLER TUBE SUB-ASSEMBLY**
   a. Coat a new O-ring with ATF and install it to the transmission oil filler tube sub-assembly.

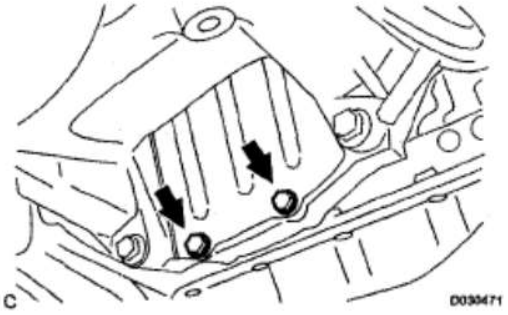


Fig. 270: Identifying Flywheel Housing Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the transmission oil filler tube sub-assembly to the automatic transaxle with the bolt.

Torque: 5.5 N*m (56 kgf*cm, 49 in.*lbf)

4. **INSTALL NO. 1 OIL COOLER INLET TUBE**
   a. Temporarily install the No. 1 oil cooler outlet tube.
   b. Temporarily install the No. 1 oil cooler inlet tube.

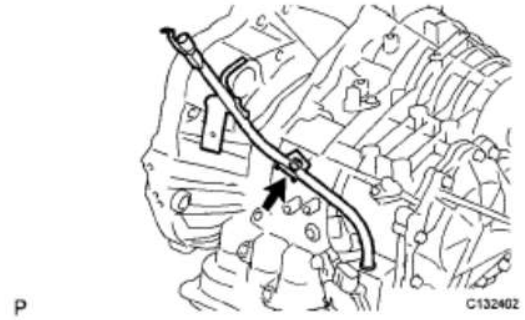


Fig. 271: Locating Transmission Oil Filter Tube Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the oil cooler tube clamp with the bolt.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

cardiagn.com

HINT:

Install them so that the oil cooler tube cushion is positioned as shown in the illustration.

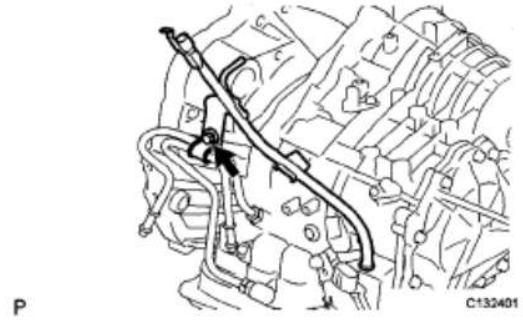


Fig. 272: Locating Oil Cooler Tube Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a union nut wrench (17 mm), install the No. 1 oil cooler inlet tube while holding the union with a wrench.

Torque: Without a union nut wrench

34 N*m (347 kgf*cm, 25 ft.*lbf)

With a union nut wrench

32 N*m (326 kgf*cm, 24 ft.*lbf)

NOTE:

- **Use a torque wrench with a fulcrum length of 380 mm (14.96 in.).**
- **This torque value is effective when the union nut wrench is parallel to the torque wrench.**

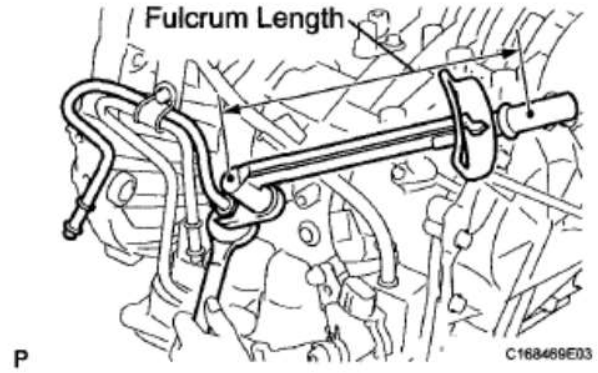


Fig. 273: Identifying Torque Wrench Fulcrum Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

5. **INSTALL NO. 1 OIL COOLER OUTLET TUBE**
   a. Using a union nut wrench, install the No. 1 oil cooler outlet tube while holding the union with a wrench.

   Torque: Without a union nut wrench

   34 N*m (347 kgf*cm, 25 ft.*lbf)

   With a union nut wrench

   32 N*m (326 kgf*cm, 24 ft.*lbf)

   NOTE:
   - **Use a torque wrench with a fulcrum length of 380 mm (14.96 in.).**
   - **This torque value is effective the when union nut wrench is parallel to the torque wrench.**

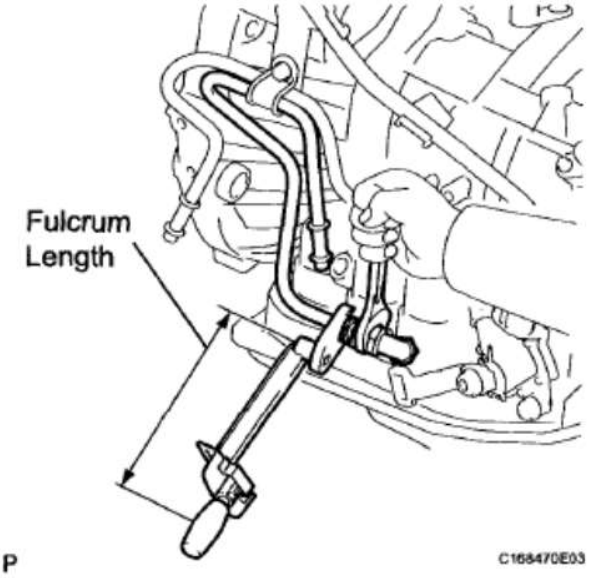


Fig. 274: Installing No. 1 Oil Cooler Outlet Tube
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL NO. 1 TRANSMISSION CONTROL CABLE BRACKET**
   a. Install the No. 1 transmission control cable bracket with the 2 bolts.

   Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

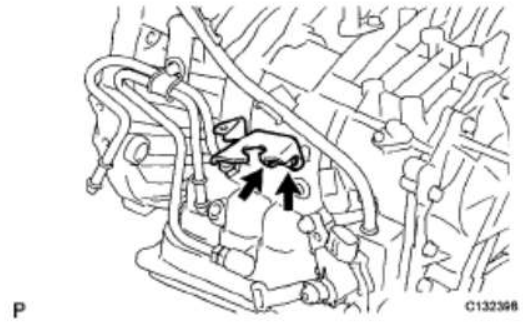


Fig. 275: Locating No. 1 Transmission Control Cable Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **CONNECT BREATHER PLUG HOSE**
   a. Connect the breather plug hose to the oil filler tube.

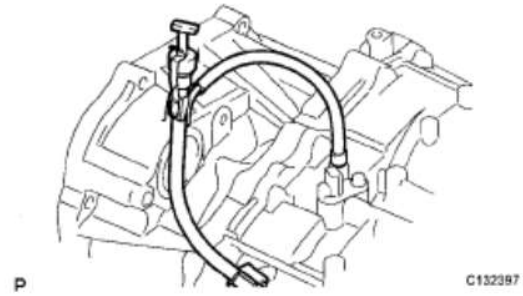


Fig. 276: Identifying Breather Plug Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **CONNECT CONNECTORS**
   a. Connect the transmission wire connector.
   b. Connect the park/neutral position switch connector.
   c. Connect the 2 speed sensor connectors.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

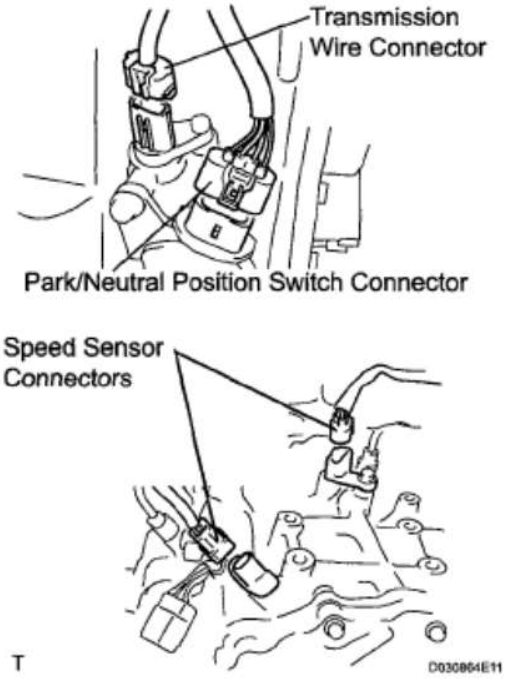


Fig. 277: Identifying Transmission Wire And Park/Neutral Position Switch Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **CONNECT WIRE HARNESS**
   a. Connect the wire harness with the bolt.

   Torque: 13 N*m (133 kgf*cm, 10 ft.*lbf)

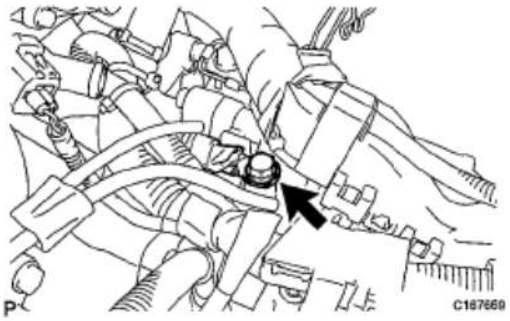


Fig. 278: Locating Wire Harness Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **INSTALL WIRE HARNESS CLAMP**
    a. Install the 3 clamps and 3 bolts.

    Torque: 8.4 N*m (86 kgf*cm, 74 in.*lbf)

    b. Connect the wire harness with the bolt.

cardiagn.com

Torque: 13 N*m (133 kgf*cm, 10 ft.*lbf)

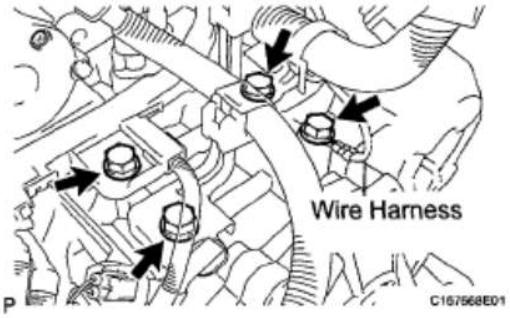


Fig. 279: Locating Wire Harness Clamp With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **INSTALL NO. 2 TRANSMISSION CONTROL CABLE BRACKET**
    a. Install the No. 2 transmission control cable bracket with the bolt.

    Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)

12. **INSTALL FRONT DRIVE SHAFT ASSEMBLY LH** (See **INSTALLATION**)
13. **INSTALL FRONT DRIVE SHAFT ASSEMBLY RH (for 2WD)** (See **INSTALLATION**)

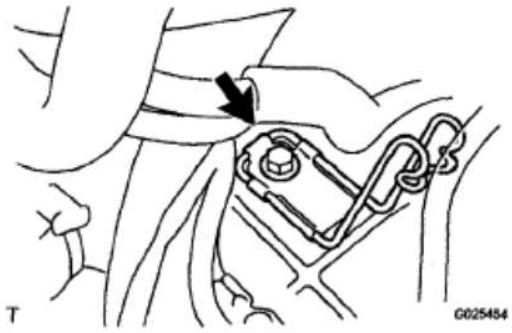


Fig. 280: Locating Transmission Control Cable Bracket Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **INSTALL TRANSVERSE ENGINE MOUNTING BRACKET** (See **INSTALLATION**)
15. **INSTALL FRONT ENGINE MOUNTING INSULATOR ASSEMBLY** (See **INSTALLATION**)
16. **INSTALL TRANSVERSE ENGINE MOUNTING INSULATOR** (See **INSTALLATION**)
17. **INSTALL TRANSVERSE ENGINE MOUNTING INSULATOR** (See **INSTALLATION**)
18. **INSTALL FRONT FRAME ASSEMBLY** (See **INSTALLATION**)
19. **INSTALL POWER STEERING LINK ASSEMBLY** (See **INSTALLATION**)
20. **INSTALL FRONT STABILIZER BAR** (See **INSTALLATION**)
21. **REMOVE ENGINE HANGERS** (See **INSTALLATION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

22. **INSTALL MANIFOLD STAY** (See **INSTALLATION**)
23. **INSTALL STARTER ASSEMBLY** (See **INSTALLATION**)
24. **INSTALL ENGINE WIRE (for LHD)** (See **INSTALLATION**)
25. **INSTALL INTAKE AIR SURGE TANK ASSEMBLY** (See **INSTALLATION**)
26. **INSTALL VENTILATION HOSE** (See **INSTALLATION**)
27. **TEMPORARILY TIGHTEN COMPRESSOR AND MAGNETIC CLUTCH** (See **INSTALLATION**)
28. **INSTALL COMPRESSOR AND MAGNETIC CLUTCH** (See **INSTALLATION**)
29. **INSTALL ENGINE ASSEMBLY WITH TRANSAXLE** (See **INSTALLATION**)
30. **CONNECT SUCTION HOSE SUB-ASSEMBLY** (See **INSTALLATION**)
31. **CONNECT DISCHARGE HOSE SUB-ASSEMBLY** (See **INSTALLATION**)
32. **INSTALL STEERING INTERMEDIATE SHAFT SUB-ASSEMBLY** (See **INSTALLATION**)
33. **INSTALL FRONT AXLE ASSEMBLY LH** (See **INSTALLATION**)
34. **INSTALL FRONT AXLE ASSEMBLY RH** (See **INSTALLATION**)
35. **INSTALL NO. 1 FRONT SUSPENSION LOWER ARM LH** (See **INSTALLATION**)
36. **INSTALL NO. 1 FRONT SUSPENSION LOWER ARM RH** (See **INSTALLATION**)
37. **CONNECT TIE ROD ASSEMBLY LH** (See **INSTALLATION**)
38. **CONNECT TIE ROD ASSEMBLY RH** (See **INSTALLATION**)
39. **INSTALL FRONT SPEED SENSOR LH** (See **INSTALLATION**)
40. **INSTALL FRONT SPEED SENSOR RH** (See **INSTALLATION**)
41. **INSTALL FRONT AXLE HUB NUT LH** (See **INSTALLATION**)
42. **INSTALL FRONT AXLE HUB NUT RH** (See **INSTALLATION**)
43. **INSTALL FRONT STABILIZER LINK ASSEMBLY LH** (See **INSTALLATION**)
44. **INSTALL FRONT STABILIZER LINK ASSEMBLY RH** (See **INSTALLATION**)
45. **INSTALL FRONT EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
46. **INSTALL FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY** (See **INSTALLATION**)
47. **INSTALL CENTER EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
48. **INSTALL TAIL EXHAUST PIPE ASSEMBLY** (See **INSTALLATION**)
49. **CONNECT ENGINE WIRE** (See **INSTALLATION**)
50. **CONNECT TRANSMISSION CONTROL CABLE ASSEMBLY** (See **INSTALLATION**)
51. **CONNECT FUEL TUBE SUB-ASSEMBLY** (See **INSTALLATION**)
52. **CONNECT OIL COOLER OUTLET HOSE** (See **INSTALLATION**)
53. **CONNECT OIL COOLER INLET HOSE** (See **INSTALLATION**)
54. **CONNECT HEATER WATER HOSE INLET B** (See **INSTALLATION**)
55. **CONNECT HEATER WATER HOSE OUTLET B** (See **INSTALLATION**)
56. **INSTALL NO. 1 RADIATOR HOSE** (See **INSTALLATION**)
57. **INSTALL NO. 2 RADIATOR HOSE** (See **INSTALLATION**)
58. **CONNECT UNION TO CHECK VALVE HOSE** (See **INSTALLATION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

59. **CONNECT NO. 1 FUEL VAPOR FEED HOSE** (See **INSTALLATION**)
60. **INSTALL ENGINE MOVING CONTROL ROD** (See **INSTALLATION**)
61. **INSTALL NO. 2 ENGINE MOUNTING STAY RH** (See **INSTALLATION**)
62. **INSTALL RESERVOIR BRACKET (for LHD)** (See **INSTALLATION**)
63. **INSTALL BRAKE MASTER CYLINDER RESERVOIR ASSEMBLY (for LHD)** (See **INSTALLATION**)
64. **INSTALL AIR CLEANER BRACKET** (See **INSTALLATION**)
65. **INSTALL BATTERY** (See **INSTALLATION**)
66. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

CAUTION: Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected (See INITIALIZATION).

67. **INSTALL AIR CLEANER CASE SUB-ASSEMBLY** (See **ON-VEHICLE INSPECTION**)
68. **INSTALL AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY** (See **INSTALLATION**)
69. **INSTALL AIR CLEANER CAP SUB-ASSEMBLY** (See **INTAKE MANIFOLD**)
70. **INSTALL NO. 1 AIR CLEANER INLET** (See **INTAKE MANIFOLD**)
71. **INSTALL NO. 2 AIR CLEANER INLET** (See **COMPONENTS**)
72. **CONNECT VACUUM HOSES** (See **INSTALLATION**)
73. **INSTALL V-RIBBED BELT** (See **INSTALLATION**)
74. **INSTALL OUTER COWL TOP PANEL SUB-ASSEMBLY (for LHD)** (See **INSTALLATION**)
75. **INSTALL WINDSHIELD WIPER MOTOR AND LINK ASSEMBLY** (See **INSTALLATION**)
76. **INSTALL COWL TOP VENTILATOR LOUVER SUB-ASSEMBLY** (See **INSTALLATION**)
77. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY RH** (See **INSTALLATION**)
78. **INSTALL FRONT WIPER ARM AND BLADE ASSEMBLY LH** (See **INSTALLATION**)
79. **INSTALL FRONT WHEELS** (See **INSTALLATION**)
80. **ADD ENGINE OIL** (See **OIL PRESSURE SWITCH**)
81. **ADD ENGINE COOLANT** (See **REMOVAL**)
82. **ADD AUTOMATIC TRANSAXLE FLUID**
83. **CHECK AUTOMATIC TRANSAXLE FLUID** (See **ON-VEHICLE INSPECTION**)
84. **INSPECT FOR FUEL LEAK** (See **PARTS LOCATION**)
85. **INSPECT FOR ENGINE OIL LEAK** (See **OIL PRESSURE SWITCH**)
86. **INSPECT FOR COOLANT LEAK** (See **COOLING SYSTEM**)
87. **INSPECT FOR EXHAUST GAS LEAK** (See **INSTALLATION**)
88. **INSPECT SHIFT LEVER POSITION** (See **ON-VEHICLE INSPECTION**)

cardiagn.com

89. **ADJUST SHIFT LEVER POSITION** (See **ADJUSTMENT**)
90. **CHECK AND ADJUST FRONT WHEEL ALIGNMENT** (See **INSTALLATION**)
91. **CHECK IGNITION TIMING** (See **ENGINE**)
92. **CHECK ENGINE IDLE SPEED** (See **ON-VEHICLE INSPECTION**)
93. **CHECK CO/HC** (See **ON-VEHICLE INSPECTION**)
94. **CHECK FUNCTION OF THROTTLE BODY ASSEMBLY** (See **INSPECTION PROCEDURE**)
95. **INSTALL FRONT FENDER APRON SEAL LH** (See **INSTALLATION**)
96. **INSTALL FRONT FENDER APRON SEAL RH** (See **INSTALLATION**)
97. **INSTALL FRONT FENDER LINER LH** (See **INSTALLATION**)
98. **INSTALL FRONT FENDER LINER RH** (See **INSTALLATION**)
99. **INSTALL FRONT FENDER MOULDING SUB-ASSEMBLY LH** (See **INSTALLATION**)
100. **INSTALL FRONT FENDER MOULDING SUB-ASSEMBLY RH** (See **INSTALLATION**)
101. **INSTALL FLOOR UNDER COVER LH**
102. **INSTALL NO. 2 ENGINE UNDER COVER** (See **INSTALLATION**)
103. **INSTALL NO. 1 ENGINE UNDER COVER** (See **INSTALLATION**)
104. **INSTALL ENGINE UNDER COVER ASSEMBLY** (See **INSTALLATION**)
105. **INSTALL V-BANK COVER SUB-ASSEMBLY** (See **INSTALLATION**)
106. **CHECK ABS SPEED SENSOR SIGNAL** (See **INSTALLATION**)
107. **RESET MEMORY** (See **INSTALLATION**)

TORQUE CONVERTER CLUTCH AND DRIVE PLATE

INSPECTION

1. **INSPECT TORQUE CONVERTER CLUTCH ASSEMBLY**
   a. Inspect the one-way clutch.
      1. Set SST into the inner race of the one-way clutch.

SST 09350-32014 (09351-32010)

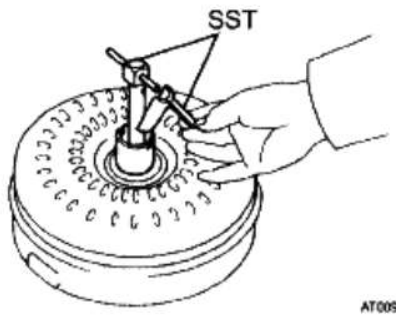


Fig. 281: Setting SST Into Inner Race Of One-Way Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2. Install SST so that it fits in the notch of the converter hub and outer race of the one-way clutch.

   SST 09350-32014 (09351 -32010, 09351-32020)

3. Stand the torque converter and turn the SST.

   OK: If the one-way clutch is turned clockwise, it rotates freely, and if turned counterclockwise, it locks.

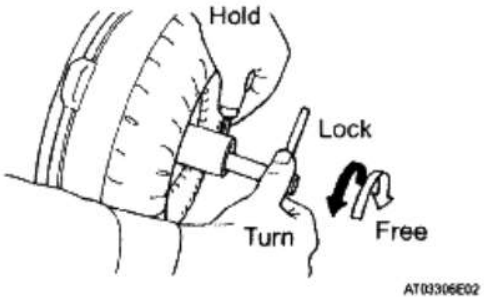


Fig. 282: Standing Torque Converter And Turning SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Determine the condition of the torque converter clutch assembly.
   1. If the inspection result of the torque converter clutch assembly satisfies the following conditions, replace the torque converter clutch assembly.

      Malfunction item:

      A metallic sound is emitted from the torque converter clutch assembly during the stall test or when the shift lever is moved to the N position.

      The one-way clutch is free or locked in both directions.

      The amount of powder in the ATF is greater than the sample shown on the illustration (see the sample).

      HINT:

      The sample shows ATF of approximately 0.25 liters (0.26 US qts, 0.22 lmp. qts) that is taken out from the removed torque converter clutch.

c. Exchange ATF in the torque converter clutch.
   1. If the ATF is discolored and/or has a foul odor, completely stir the ATF in the torque converter clutch and drain it.

cardiagn.com

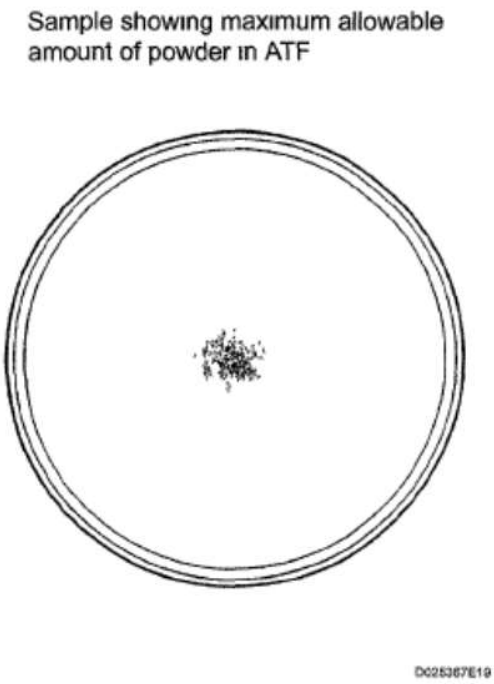


Fig. 283: Identifying ATF Powder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Clean and check the oil cooler and oil pipe line.
   1. If the torque converter clutch is inspected or the ATF is exchanged, clean the oil cooler and oil pipe line.

      HINT:

      - Apply compressed air of 196 kPa (2 kgf/cm^2 , 28 psi) into the inlet hose.
      - If an excessive amount of fine powder is identified in the ATF, add new ATF using a bucket pump and clean it again.

   2. If the ATF is cloudy, inspect the oil cooler (radiator).

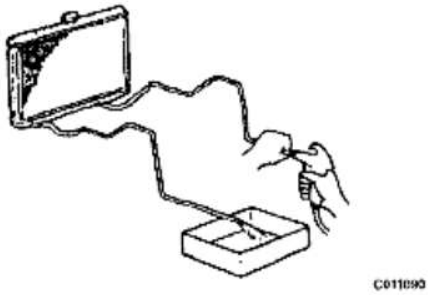


Fig. 284: Applying Compressed Air Of Into Inlet Hose
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

e. Prevent deformation of the torque converter clutch and damage to the oil pump gear.
   1. When any marks due to interference are found on the end of the bolts for the torque converter clutch and on the bottom of the bolt hole, replace the bolt and torque converter clutch.
   2. All of the bolts must be the same length.
   3. Washers must be used with bolts.

2. **INSPECT DRIVE PLATE**
   a. Check the drive plate for damage.

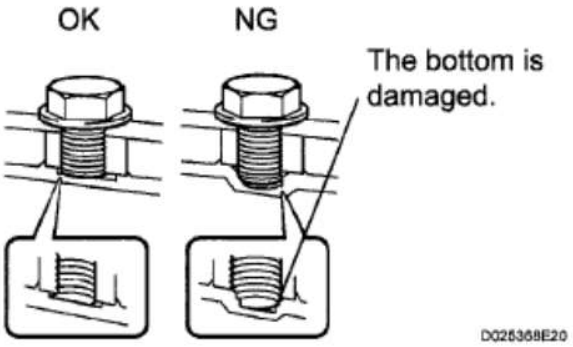


Fig. 285: Identifying Torque Converter Clutch Bolt Correct And Incorrect Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Set up a dial indicator and measure the runout of the 6 portions around the torque converter fitting surfaces.

Maximum runout: 0.30 mm (0.0118 in.)

If the runout is not within the specification or the drive plate is damaged, replace the drive plate.

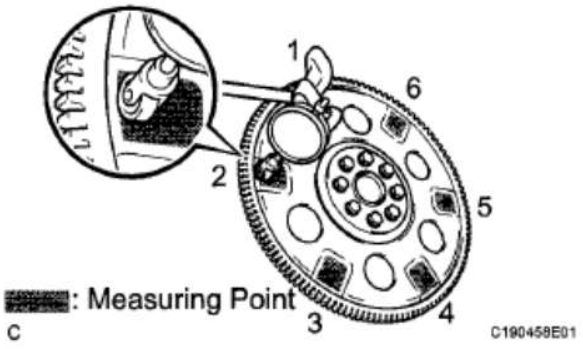


Fig. 286: Measuring Torque Converter Fitting Surfaces
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

AUTOMATIC TRANSAXLE UNIT

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

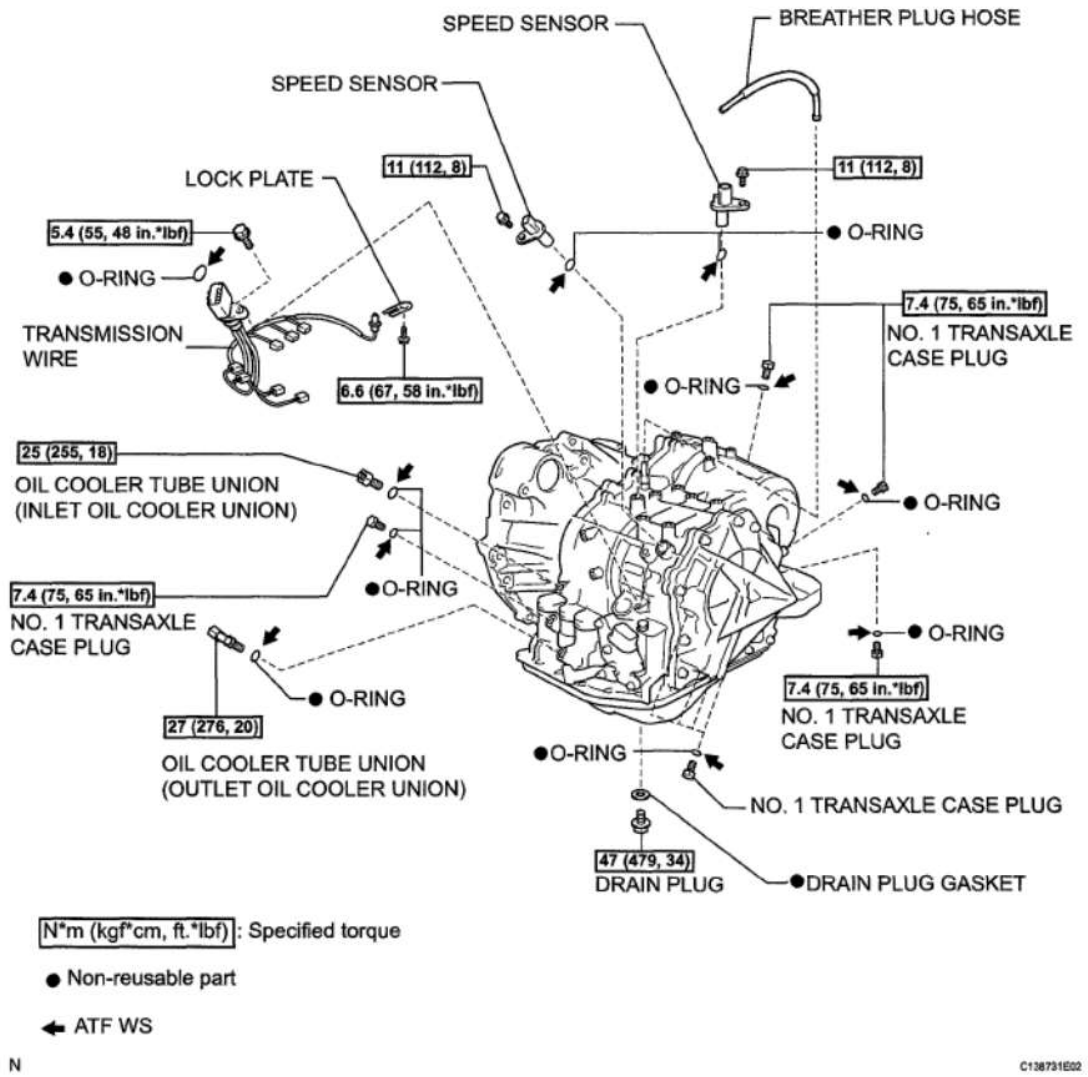


Fig. 287: Identifying Automatic Transaxle Unit Components With Torque Specification (1 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

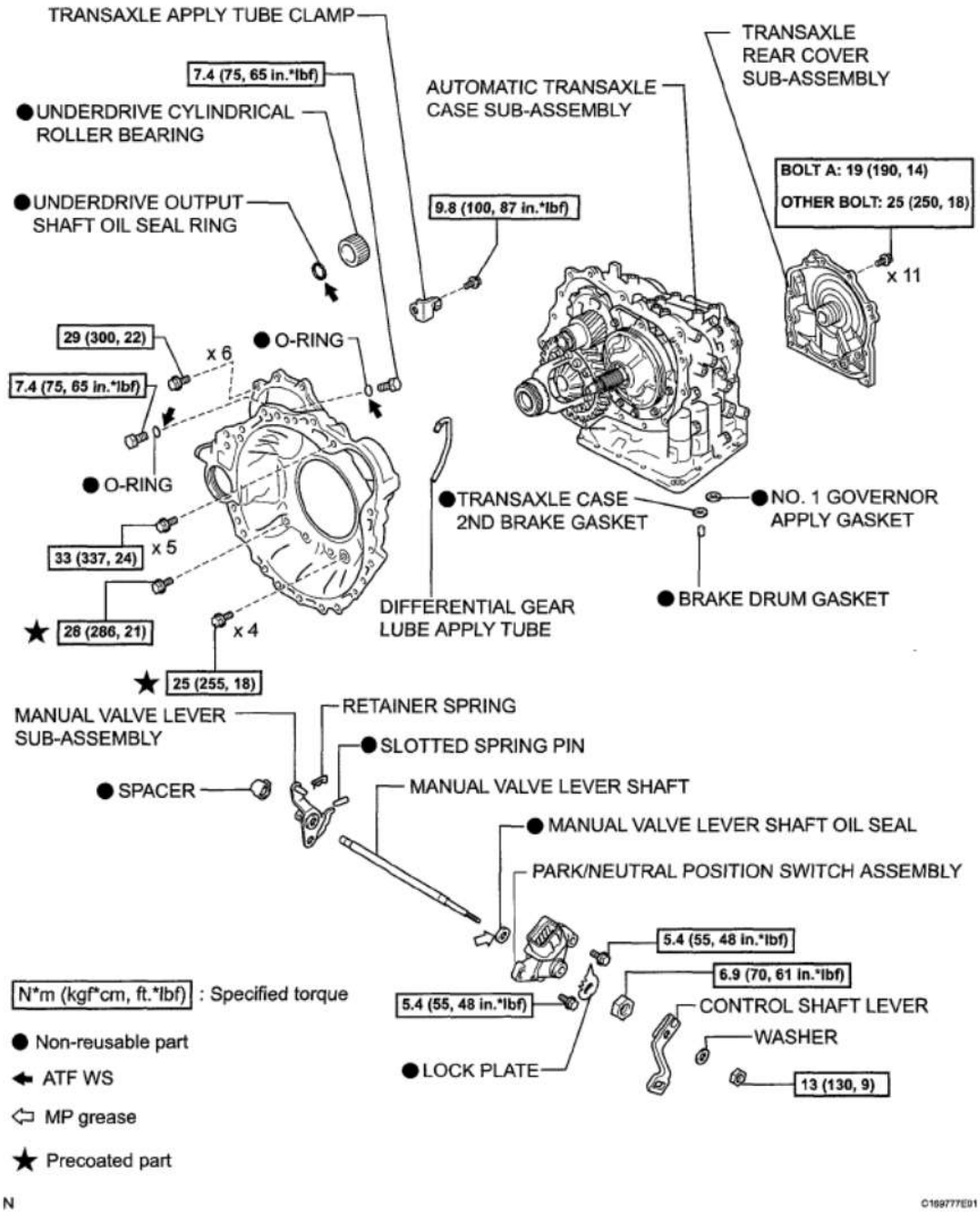


Fig. 288: Identifying Automatic Transaxle Unit Components With Torque Specification (2 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

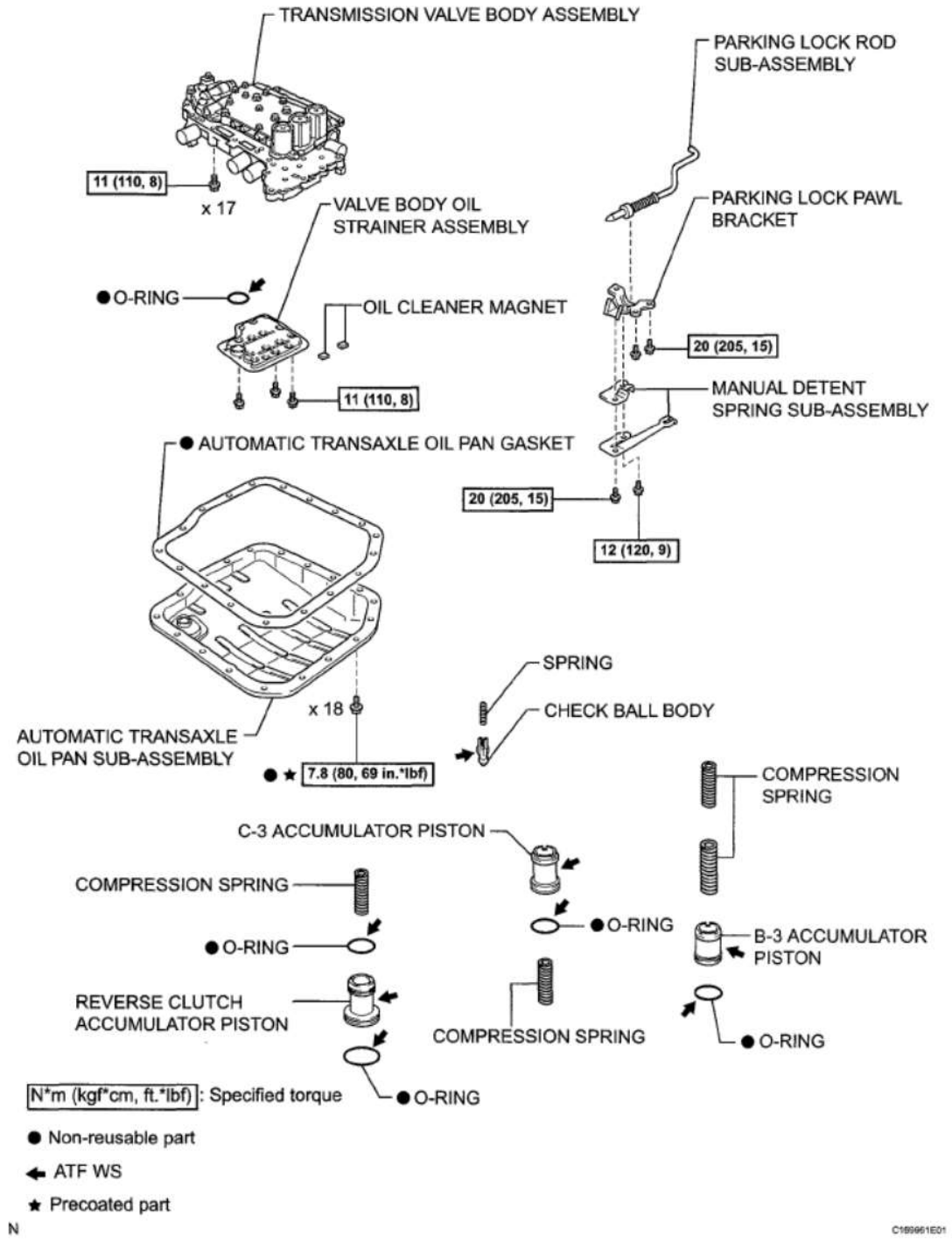


Fig. 289: Identifying Automatic Transaxle Unit Components With Torque Specification (3 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

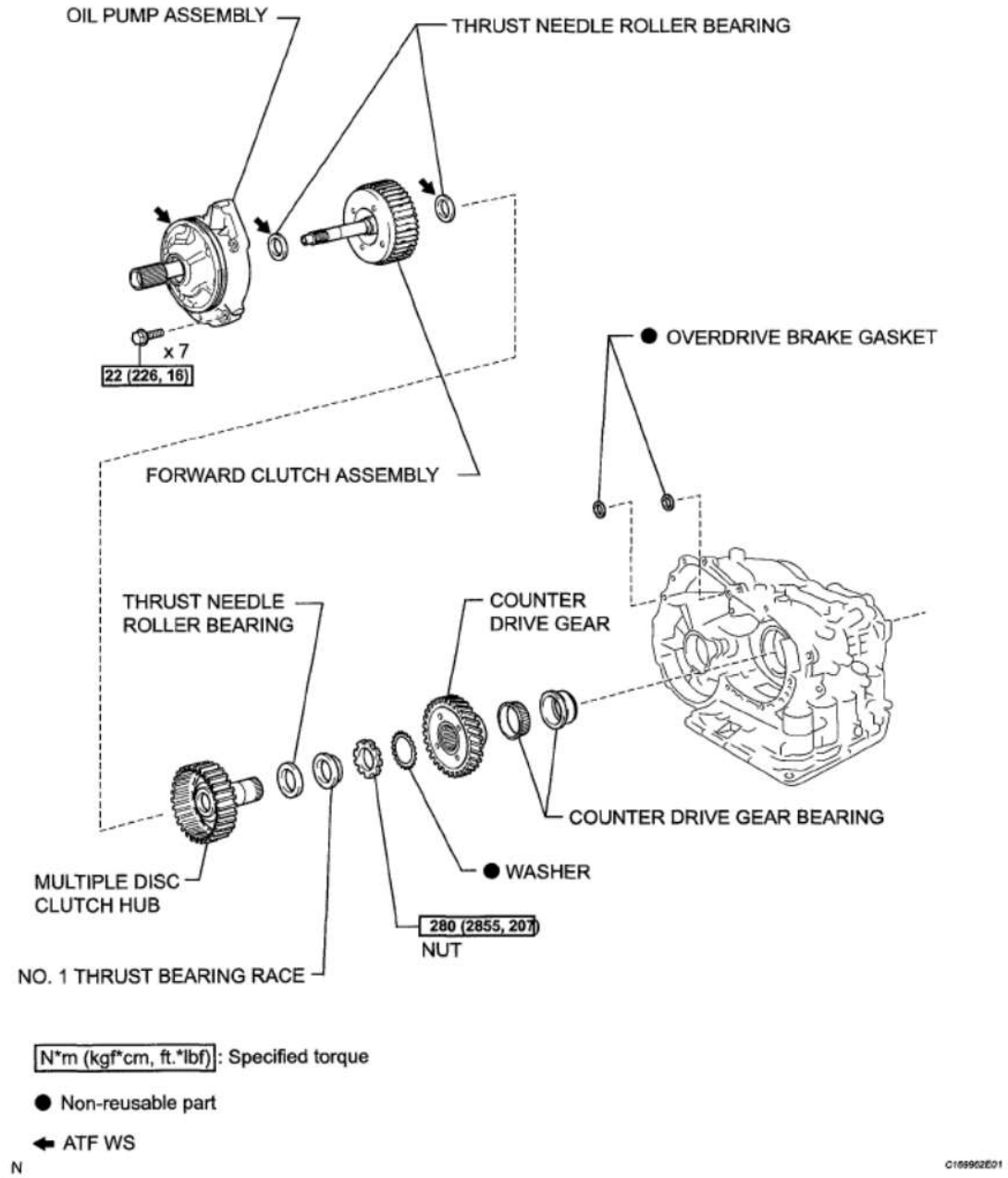


Fig. 290: Identifying Automatic Transaxle Unit Components With Torque Specification (4 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

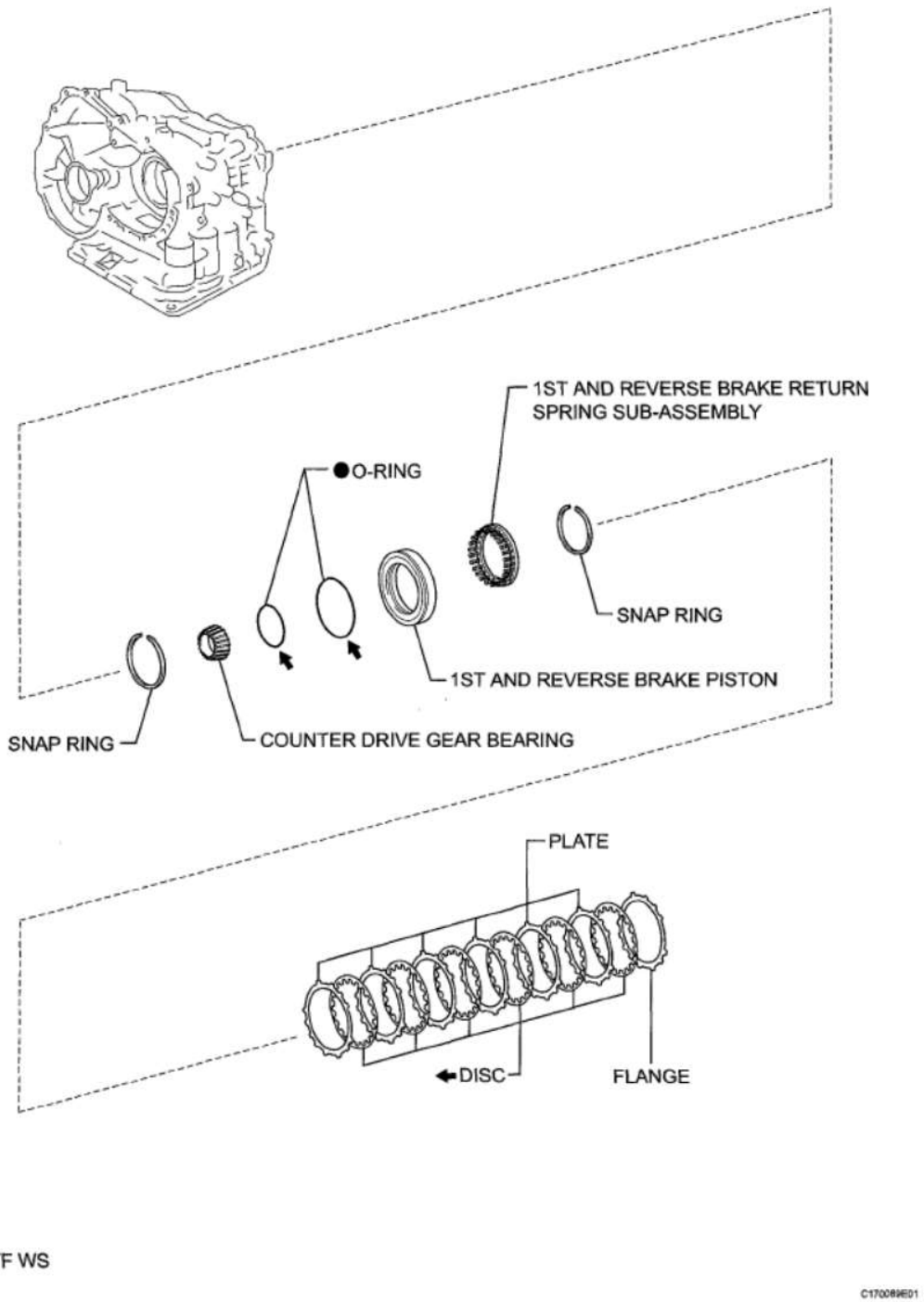


Fig. 291: Identifying Automatic Transaxle Unit Components With Torque Specification (5 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

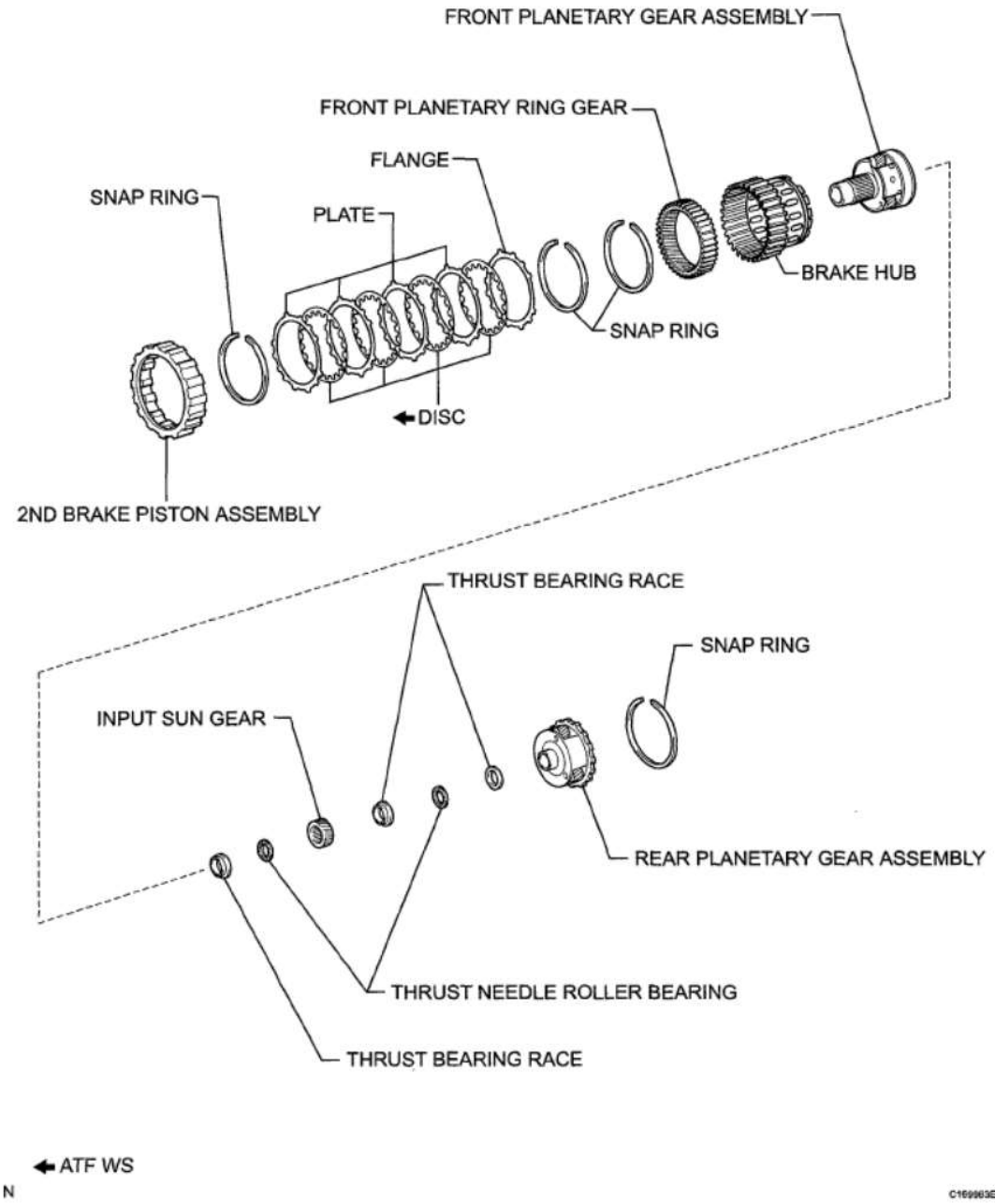


Fig. 292: Identifying Automatic Transaxle Unit Components With Torque Specification (6 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

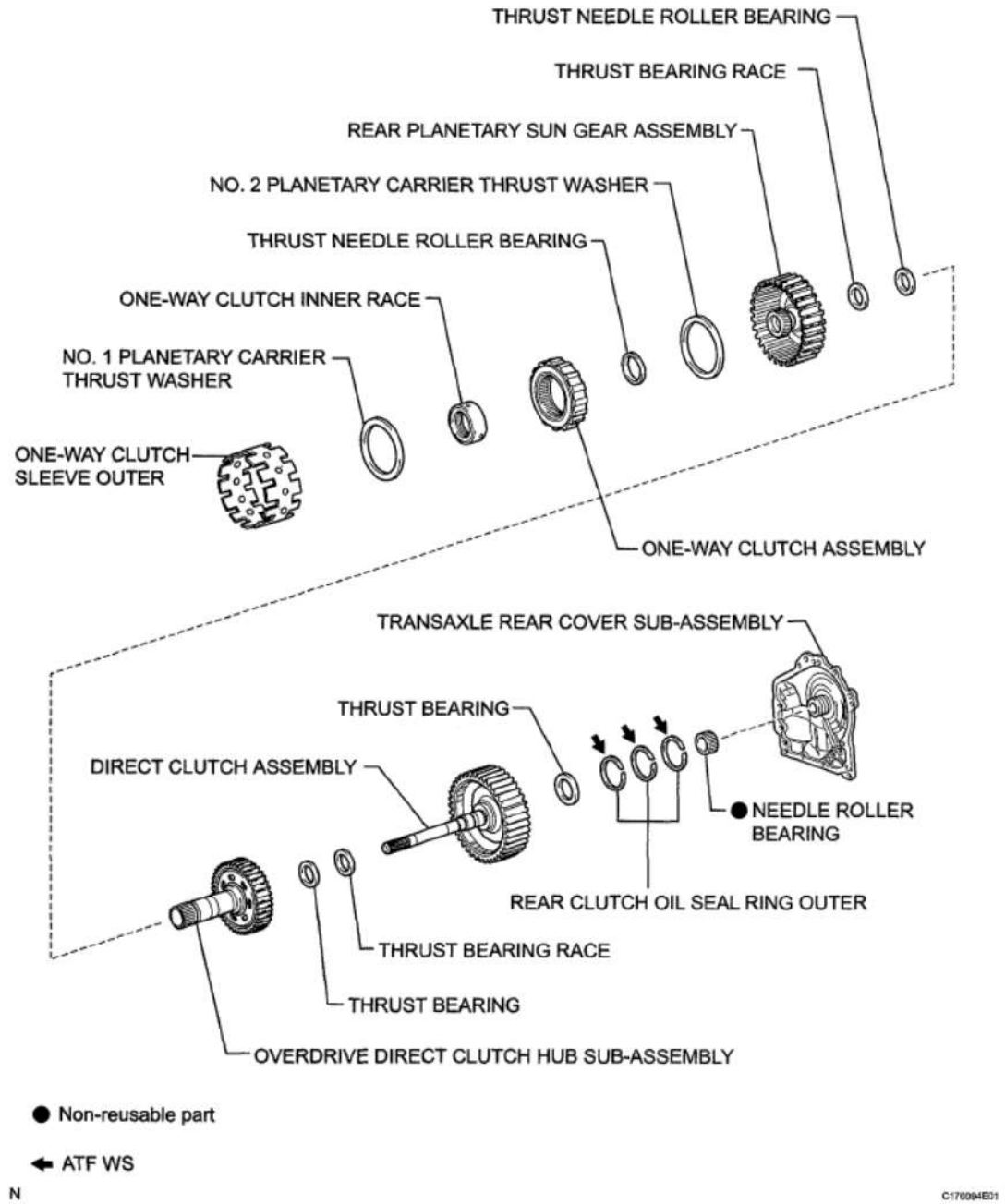


Fig. 293: Identifying Automatic Transaxle Unit Components With Torque Specification (7 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

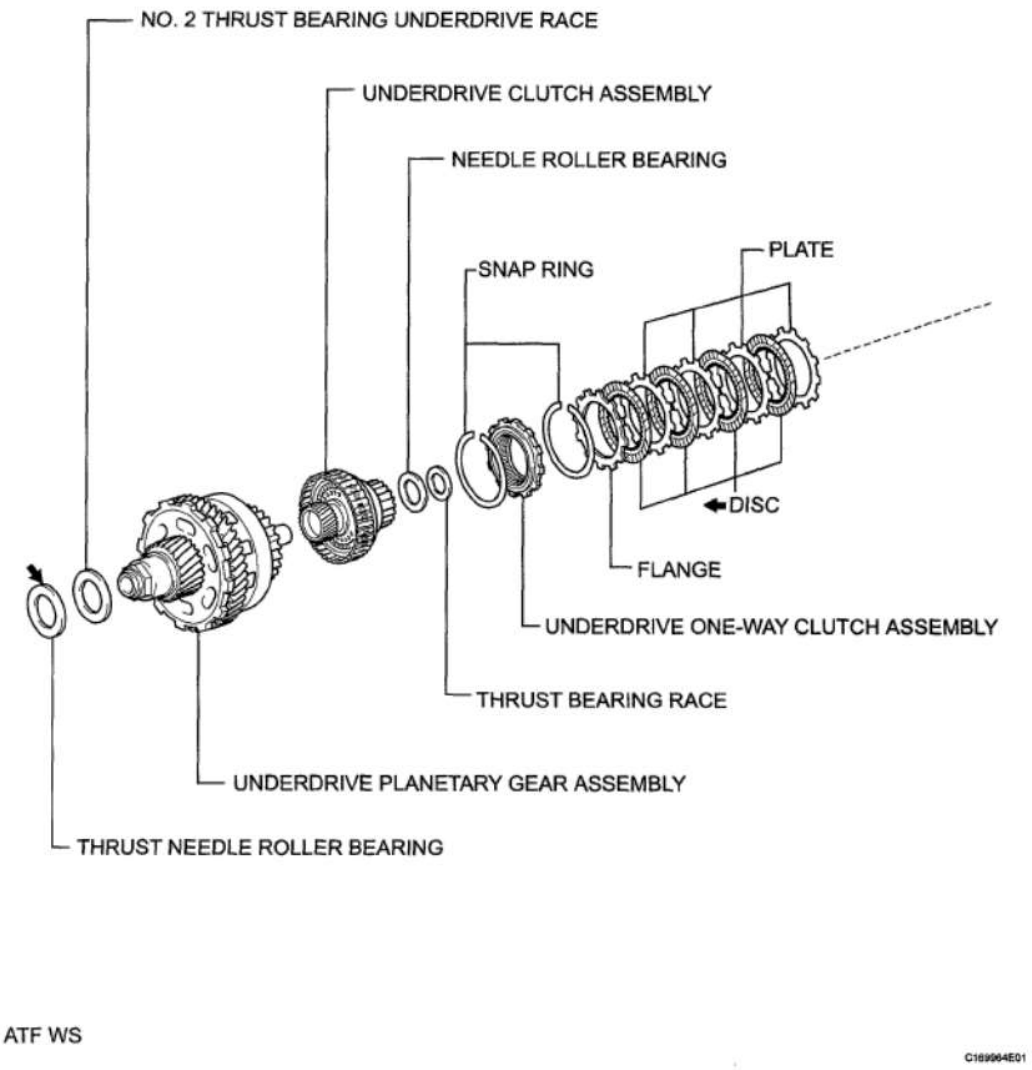


Fig. 294: Identifying Automatic Transaxle Unit Components With Torque Specification (8 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

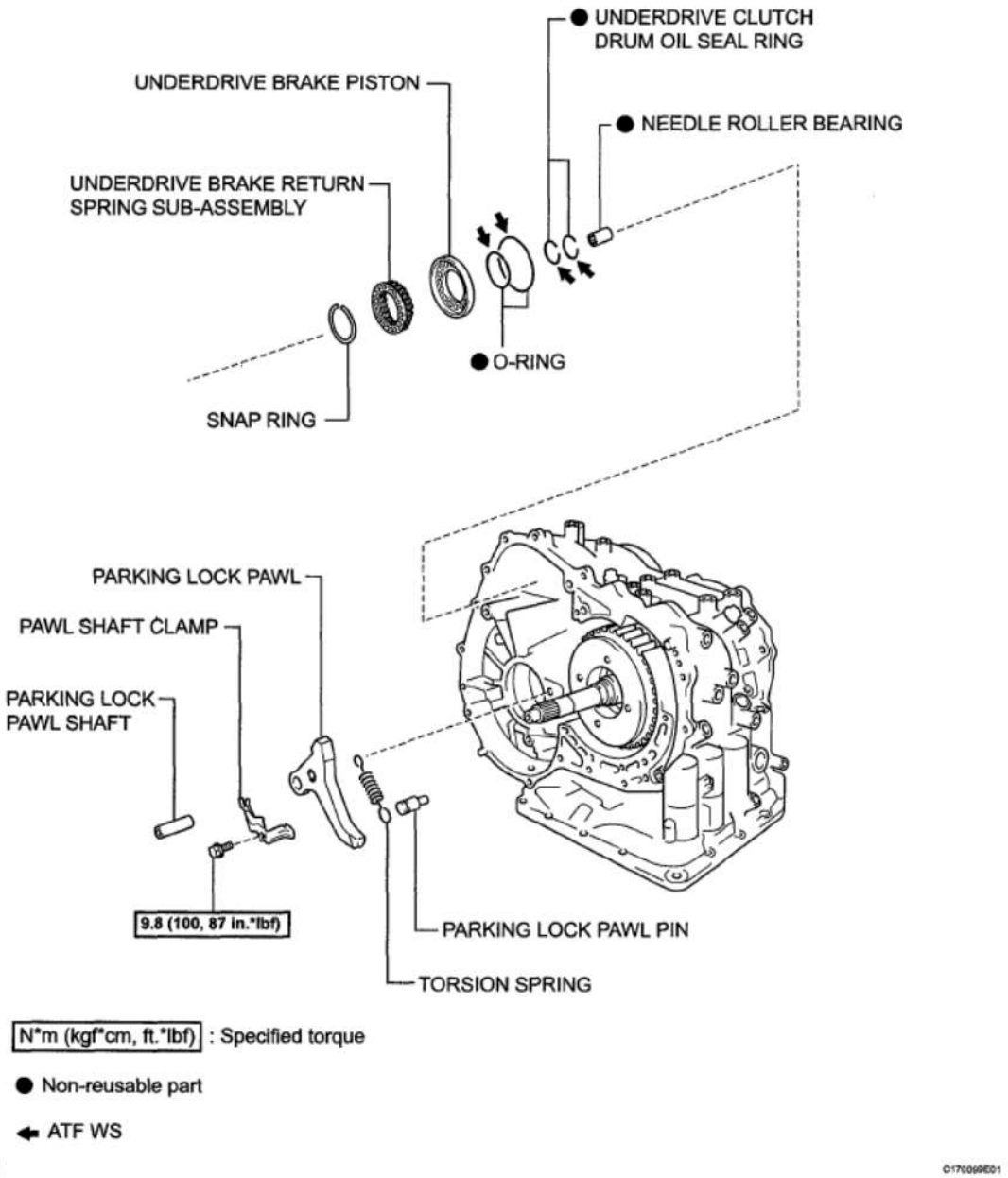
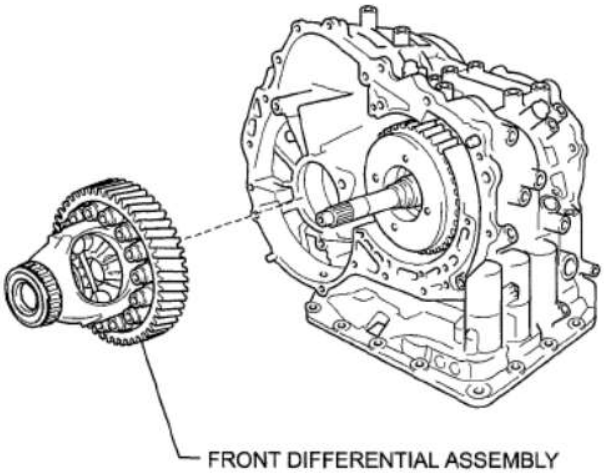


Fig. 295: Identifying Automatic Transaxle Unit Components With Torque Specification (9 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



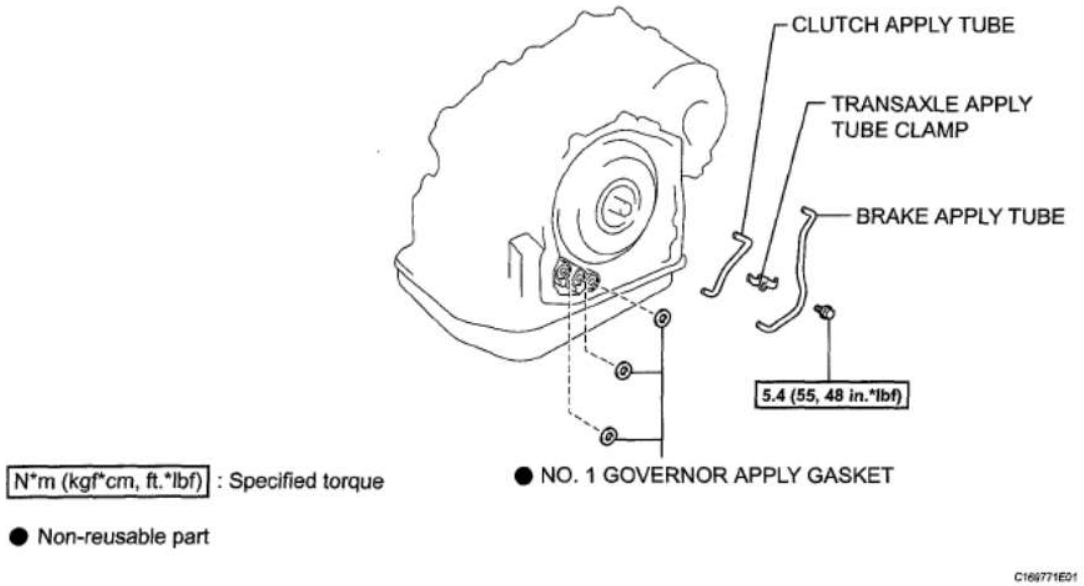


Fig. 296: Identifying Automatic Transaxle Unit Components With Torque Specification (10 Of 10)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **REMOVE PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
   a. Remove the nut, washer and the control shaft lever.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

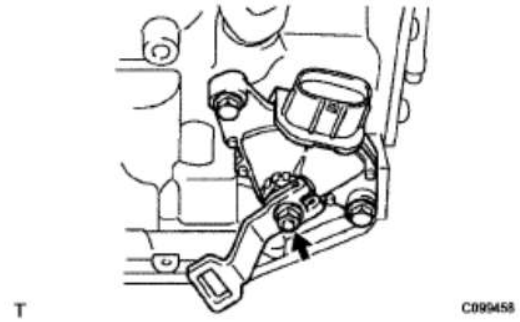


Fig. 297: Locating Nut, Washer And Control Shaft Lever
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a screwdriver, pry up the lock plate.

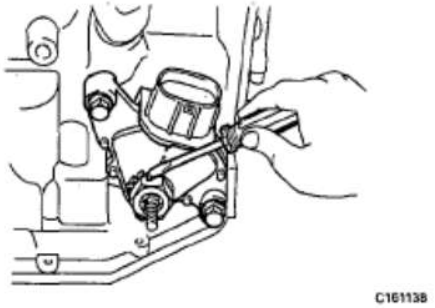


Fig. 298: Prying Up Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the lock nut and the lock plate.

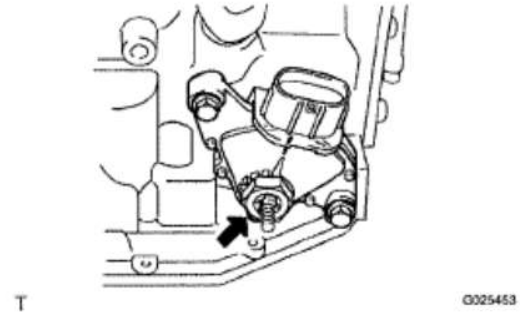


Fig. 299: Locating Lock Nut And Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the 2 bolts and pull out the park/neutral position switch.

2. **REMOVE BREATHER PLUG HOSE**
   a. Remove the breather plug hose from the transaxle case.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

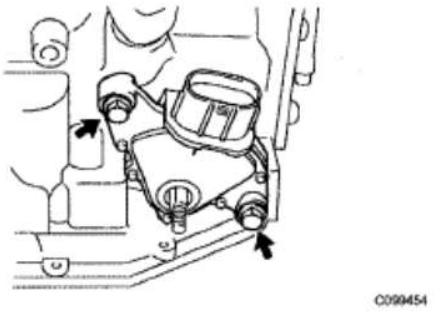


Fig. 300: Locating Park/Neutral Position Switch Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE OIL COOLER TUBE UNION (INLET OIL COOLER UNION)**
   a. Remove the union.
   b. Remove the O-ring from the union.

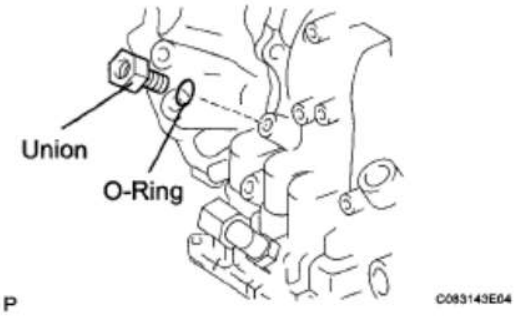


Fig. 301: Identifying O-Ring And Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE OIL COOLER TUBE UNION (OUTLET OIL COOLER UNION)**
   a. Remove the union.
   b. Remove the O-ring from the union.



Fig. 302: Identifying O-Ring And Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

5. **REMOVE SPEED SENSOR**
   a. Remove the 2 bolts and the 2 speed sensors from the transaxle assembly.

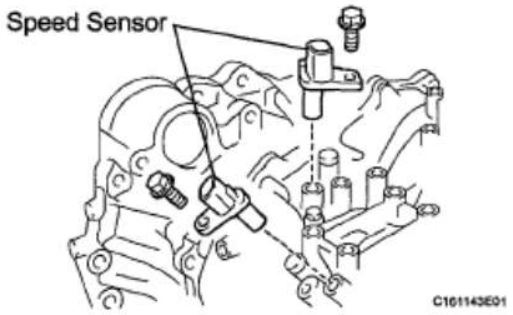


Fig. 303: Identifying Speed Sensors With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE NO. 1 TRANSAXLE CASE PLUG**
   a. Remove the 4 No. 1 transaxle case plugs from the transaxle case.
   b. Remove the 4 O-rings from the 4 No. 1 transaxle case plugs.

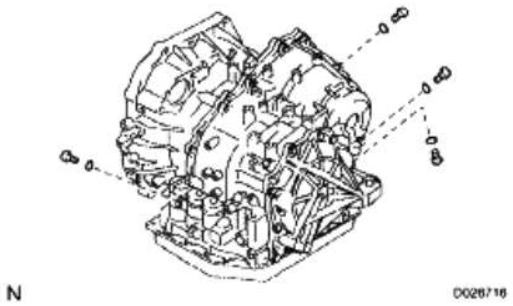


Fig. 304: Identifying No. 1 Transaxle Case Plugs
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **SUPPORT AUTOMATIC TRANSAXLE ASSEMBLY**
   a. Support the transaxle assembly on wooden blocks.

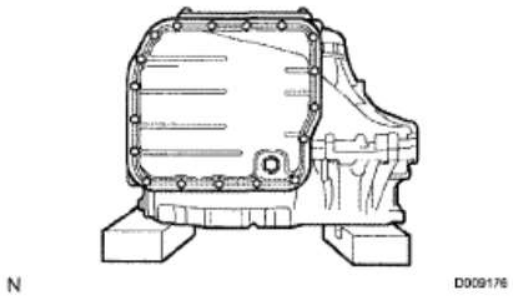


Fig. 305: Supporting Transaxle Assembly On Wooden Blocks

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **REMOVE AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY**
   a. Remove the 18 bolts, oil pan, and gasket.

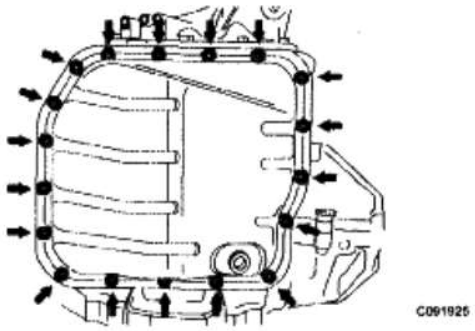


Fig. 306: Locating Oil Pan Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Remove the 2 magnets from the oil pan.

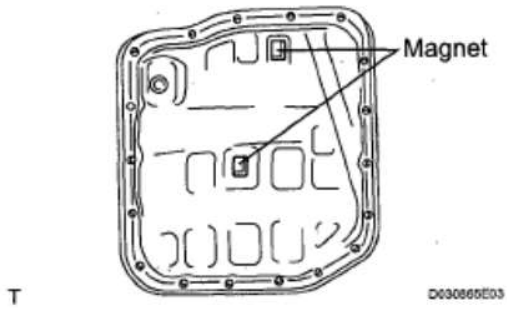


Fig. 307: Identifying Magnets From Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **INSPECT TRANSMISSION OIL CLEANER MAGNET**
   a. Remove the magnets and use them to collect any steel chips. Examine the chips and particles in the pan and on the magnet to determine what type of wear has occurred in the transaxle:

Result:

Steel (magnetic): Wear of the bearing, gear, and plate

Brass (non-magnetic): Wear of the bushing

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

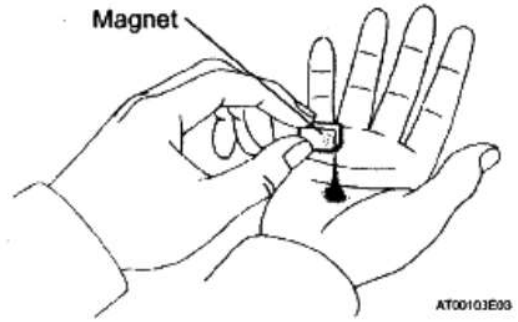


Fig. 308: Inspecting Transmission Oil Cleaner Magnet
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **DISCONNECT TRANSMISSION WIRE**
    a. Remove the 7 connectors from the shift solenoid valves.
    b. Remove the bolt, lock plate, and temperature sensor.

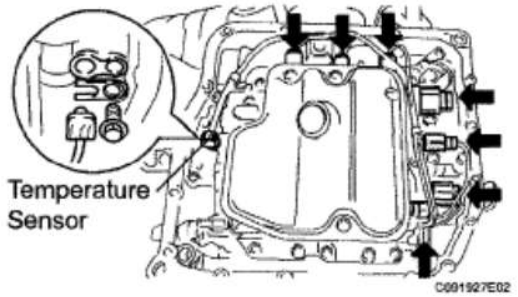


Fig. 309: Locating Temperature Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **REMOVE TRANSMISSION WIRE**
    a. Remove the bolt and transmission wire from the transaxle case.

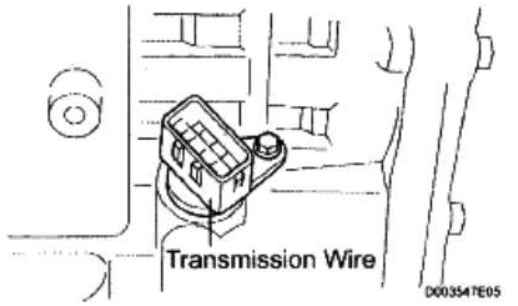


Fig. 310: Identifying Transmission Wire
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **REMOVE VALVE BODY OIL STRAINER ASSEMBLY**

cardiagn.com

a. Remove the 3 bolts and oil strainer.

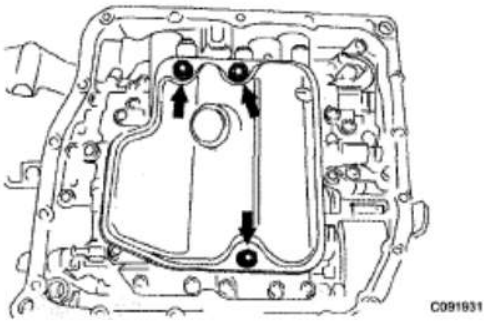


Fig. 311: Locating Oil Strainer Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the O-ring from the oil strainer.

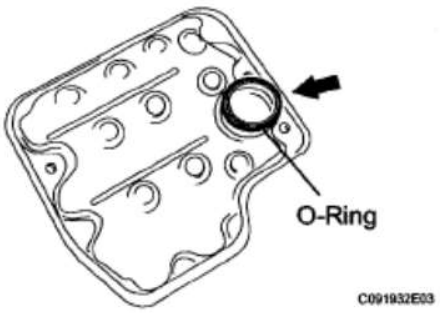


Fig. 312: Locating Oil Strainer O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **REMOVE TRANSMISSION VALVE BODY ASSEMBLY**

a. Support the valve body assembly and remove the 17 bolts and valve body assembly.

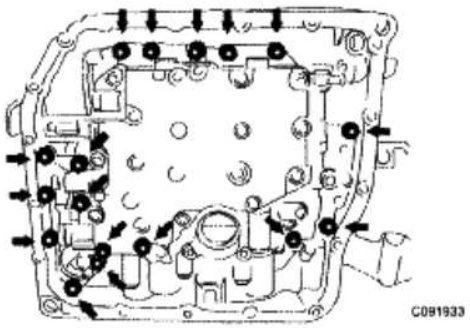


Fig. 313: Locating Valve Body Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **REMOVE NO. 1 GOVERNOR APPLY GASKET**

cardiagn.com

a. Remove the No. 1 governor apply gasket from the transaxle case.

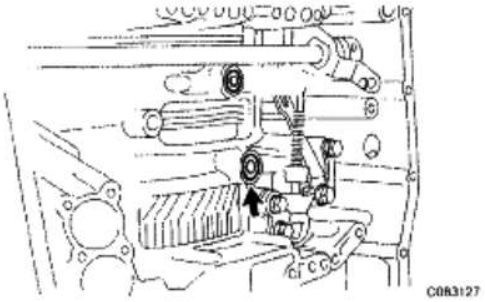


Fig. 314: Locating No. 1 Governor Apply Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **REMOVE TRANSAXLE CASE 2ND BRAKE GASKET**

a. Remove the transaxle case 2nd brake gasket from the transaxle case.

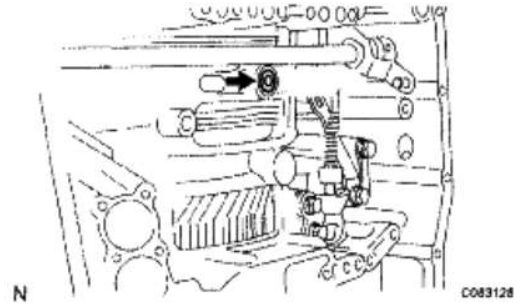


Fig. 315: Locating Transaxle Case 2nd Brake Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **REMOVE BRAKE DRUM GASKET**

a. Remove the brake drum gasket from the transaxle case.

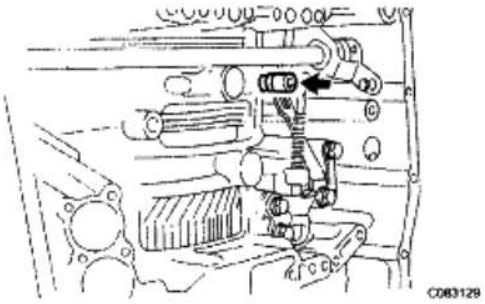


Fig. 316: Locating Brake Drum Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **REMOVE CHECK BALL BODY**

cardiagn.com

a. Remove the check ball body and spring from the transaxle case.

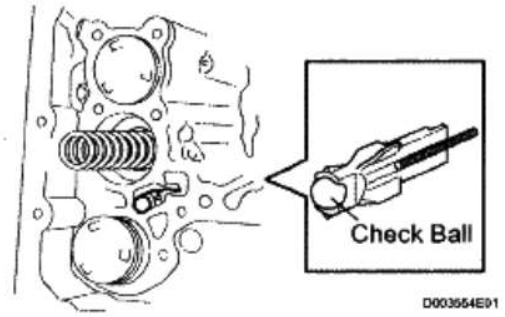


Fig. 317: Identifying Check Ball Body And Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **REMOVE C-3 ACCUMULATOR PISTON**

a. Remove the spring from the C-3 accumulator piston.

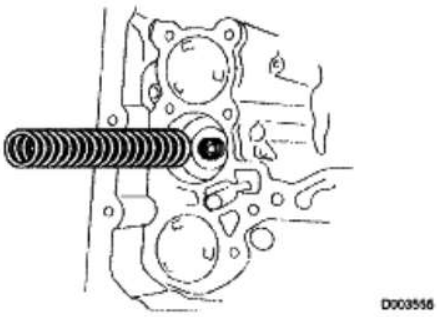


Fig. 318: Identifying C-3 Accumulator Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the oil hole and remove the C-3 accumulator piston.

NOTE:

- **Applying compressed air may cause the piston to jump-out. When removing the piston, hold it using a shop rag or a piece of cloth.**
- **Take care not to splash ATF when applying compressed air.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

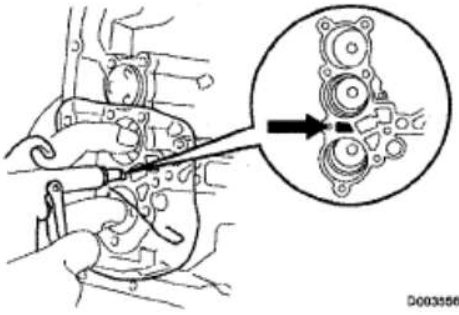


Fig. 319: Applying Compressed Air To Oil Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the O-ring from the C-3 accumulator piston.

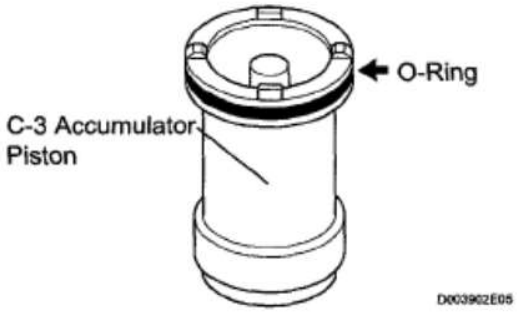


Fig. 320: Locating C-3 Accumulator Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **REMOVE REVERSE CLUTCH ACCUMULATOR PISTON**

a. Apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the oil hole and remove the reverse accumulator piston and spring.

NOTE:

- **Applying compressed air may cause the piston to jump-out. When removing the piston, hold it using a shop rag or a piece of cloth.**

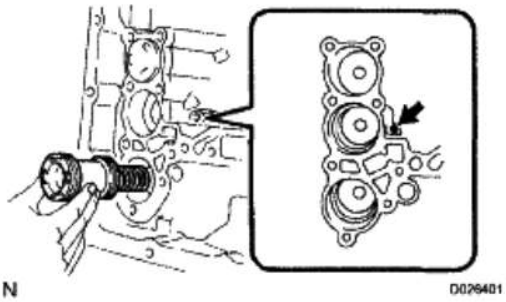


Fig. 321: Applying Compressed Air To Oil Hole

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- **Take care not to splash ATF when applying compressed air.**

b. Remove the 2 O-rings from the reverse clutch accumulator piston.

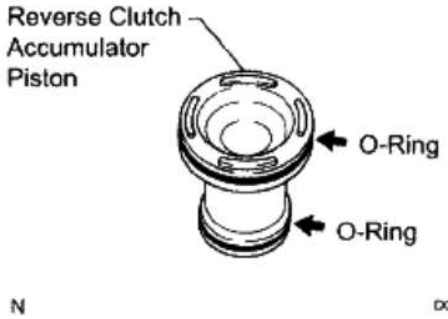


Fig. 322: Identifying Reverse Clutch Accumulator Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **REMOVE B-3 ACCUMULATOR PISTON**

a. Apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the oil hole and remove the B-3 accumulator piston and 2 springs.

NOTE:

- **Applying compressed air may cause the piston to jump-out. When removing the piston, hold it using a shop rag or a piece of cloth.**
- **Take care not to splash ATF when applying compressed air.**

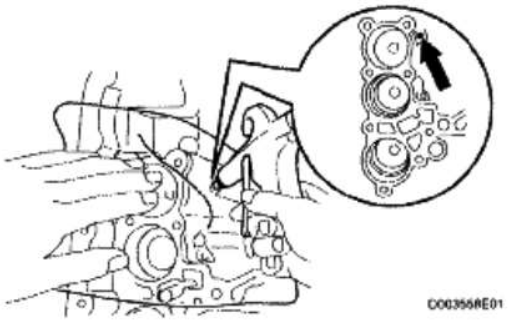


Fig. 323: Applying Compressed Air To Oil Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the O-ring from the B-3 accumulator piston.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

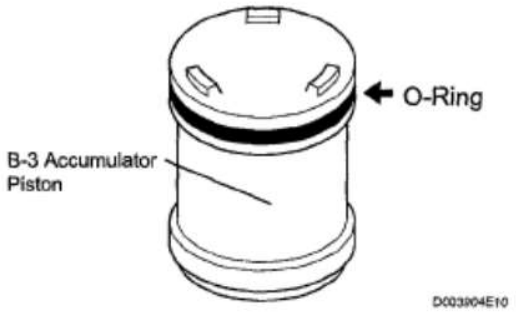


Fig. 324: Locating B-3 Accumulator Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

21. **REMOVE MANUAL VALVE LEVER SHAFT RETAINER SPRING**
    a. Using needle-nose pliers, remove the manual valve lever shaft retainer spring.

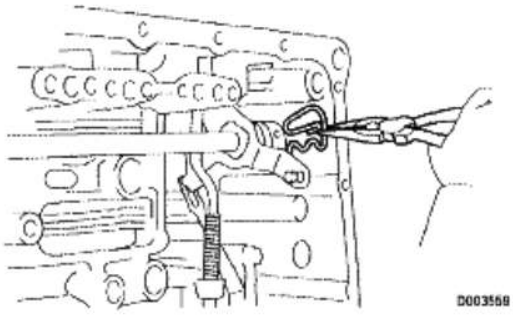


Fig. 325: Removing Manual Valve Lever Shaft Retainer Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **REMOVE MANUAL DETENT SPRING SUB-ASSEMBLY**
    a. Remove the 2 bolts, the manual detent spring sub-assembly and cover.

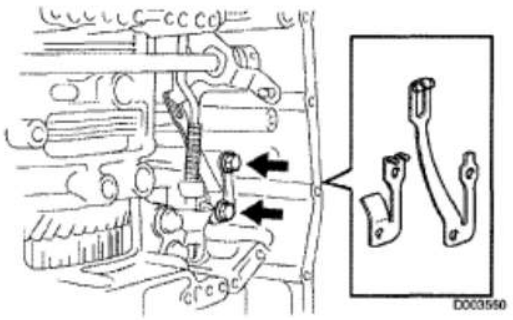


Fig. 326: Locating Manual Detent Spring Sub-Assembly And Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. **REMOVE PARKING LOCK PAWL BRACKET**
    a. Remove the 2 bolts and parking lock pawl bracket.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

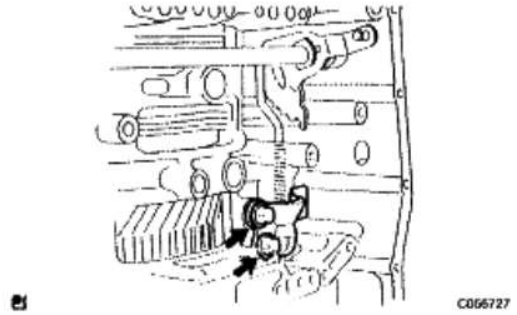


Fig. 327: Locating Parking Lock Pawl Bracket With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **REMOVE MANUAL VALVE LEVER SUB-ASSEMBLY**

a. Using a chisel and hammer, cut off and remove the spacer.

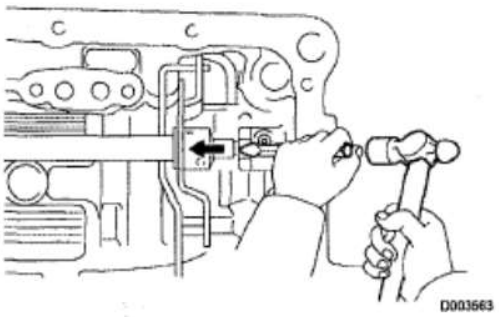


Fig. 328: Tapping Spacer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a pin punch (35 mm) and hammer, drive out the pin.

HINT:

Slowly drive out the pin so that it will not fall into the transaxle case.

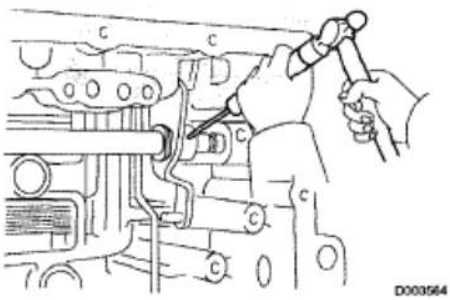


Fig. 329: Tapping Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

c. Remove the manual valve lever shaft and manual valve lever.

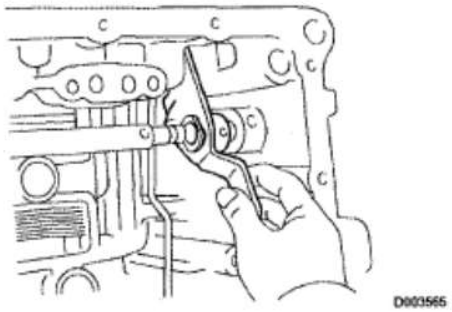


Fig. 330: Removing Manual Valve Lever Shaft And Manual Valve Lever
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

25. **REMOVE PARKING LOCK ROD SUB-ASSEMBLY**
   a. Remove the parking lock rod from the manual valve lever.

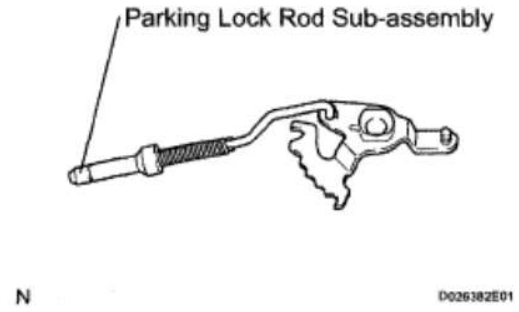


Fig. 331: Identifying Parking Lock Rod Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

26. **REMOVE MANUAL VALVE LEVER SHAFT OIL SEAL**
   a. Using a screwdriver, remove the oil seal from the transaxle case.

NOTE: Do not apply excessive force when removing the oil seal.

27. **SUPPORT AUTOMATIC TRANSAXLE ASSEMBLY**
   a. Support the transaxle case with the oil pump side facing up.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

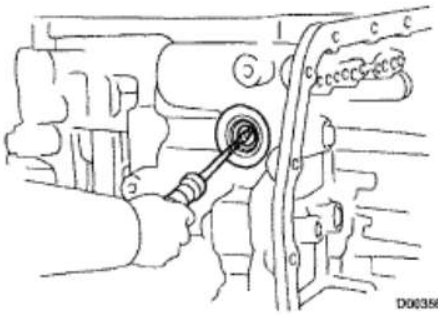


Fig. 332: Removing Oil Seal From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

28. **INSPECT INPUT SHAFT END PLAY** (See **INSPECTION**)
29. **REMOVE TRANSAXLE HOUSING**
    a. Remove the 16 bolts.
    b. Tap on the circumference of the transaxle housing with a plastic hammer to remove the transaxle housing from the transaxle case.

NOTE: The differential may be accidentally removed when the transaxle housing is removed.

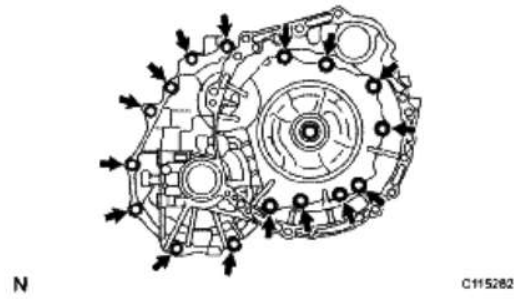


Fig. 333: Locating Transaxle Housing Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

30. **REMOVE OIL PUMP ASSEMBLY**
    a. Remove the 7 bolts and oil pump from the transaxle case.

cardiagn.com

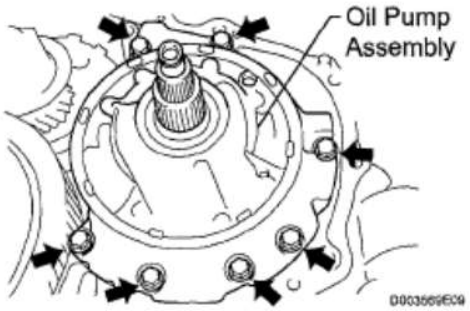


Fig. 334: Locating Oil Pump Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

31. **REMOVE THRUST NEEDLE ROLLER BEARING**
    a. Remove the thrust needle roller bearing from the underdrive planetary gear assembly.

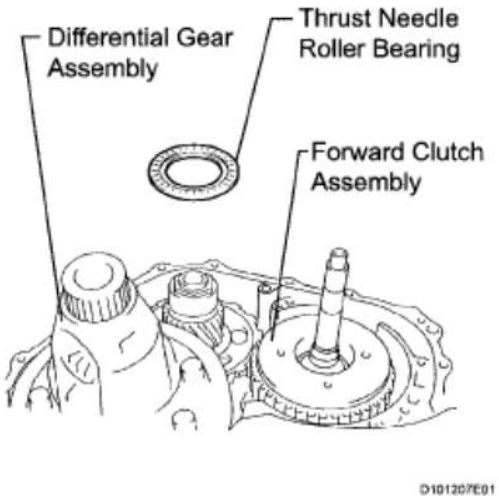


Fig. 335: Identifying Thrust Needle Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

32. **REMOVE NO. 2 THRUST BEARING UNDERDRIVE RACE**
    a. Remove the No. 2 thrust bearing underdrive race from the underdrive planetary gear assembly.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

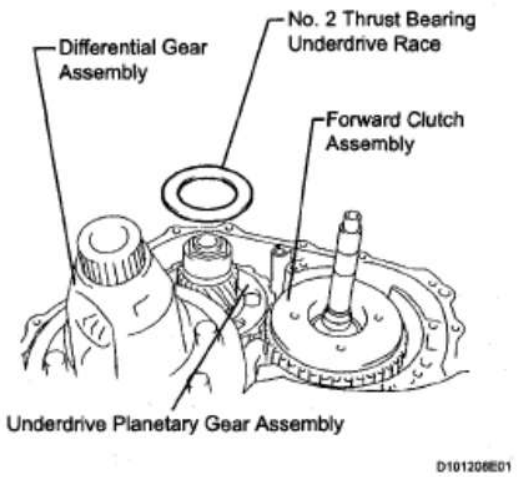


Fig. 336: Identifying No. 2 Thrust Bearing Underdrive Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

33. **REMOVE DIFFERENTIAL GEAR ASSEMBLY**
    a. Remove the differential gear assembly from the transaxle case.

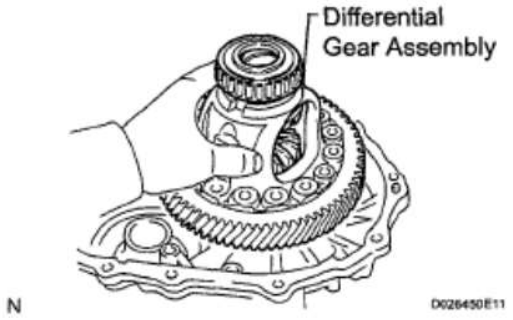
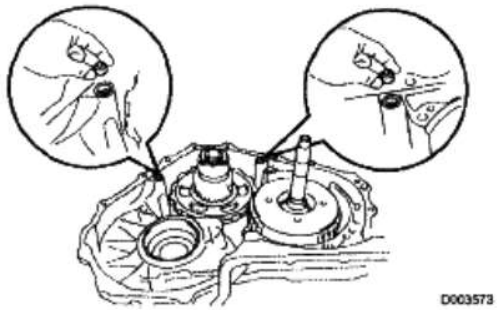


Fig. 337: Removing Differential Gear Assembly From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

34. **REMOVE OVERDRIVE BRAKE GASKET**
    a. Remove the 2 overdrive brake gaskets from the transaxle case.



cardiagn.com

Fig. 338: Removing Overdrive Brake Gaskets From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

35. **REMOVE FORWARD CLUTCH ASSEMBLY**
    a. Remove the forward clutch assembly from the transaxle case.

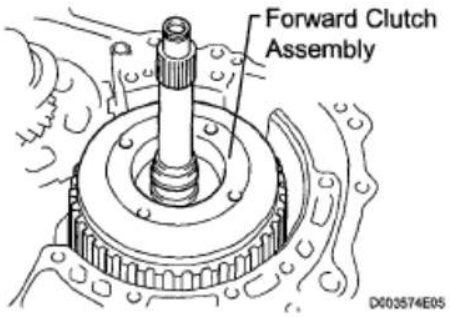


Fig. 339: Identifying Forward Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the thrust needle roller bearing from the forward clutch.

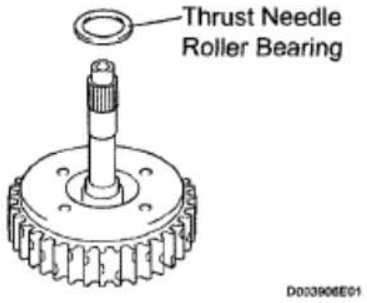


Fig. 340: Identifying Thrust Needle Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

36. **REMOVE MULTIPLE DISC CLUTCH HUB**
    a. Remove the 2 thrust needle roller bearings, multiple disc clutch hub, and No. 1 thrust bearing race.
37. **INSPECT MULTIPLE DISC CLUTCH HUB** (See **INSPECTION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

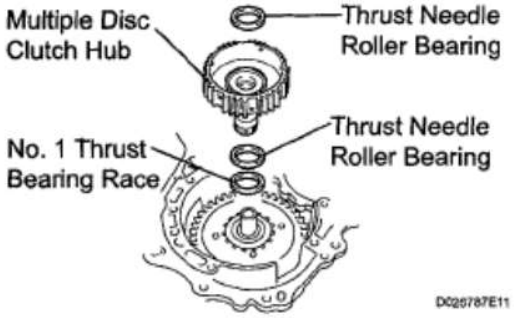


Fig. 341: Identifying Thrust Needle Roller Bearings, Multiple Disc Clutch Hub, And No. 1 Thrust Bearing Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

38. **REMOVE UNDERDRIVE PLANETARY GEAR ASSEMBLY**
    a. Remove the bolt and pawl shaft clamp.

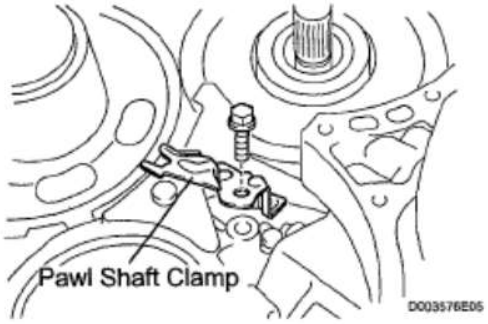


Fig. 342: Identifying Pawl Shaft Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the parking lock pawl shaft.

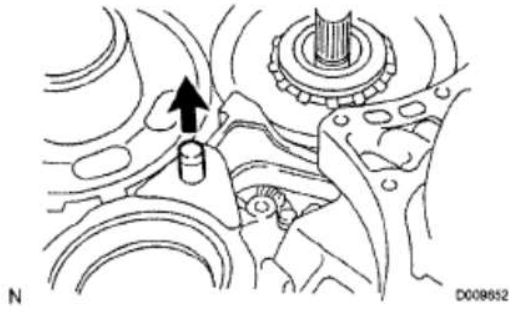


Fig. 343: Removing Parking Lock Pawl Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Push the parking lock pawl.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

HINT:

Failure to do this will cause interference when the underdrive planetary gear is removed.

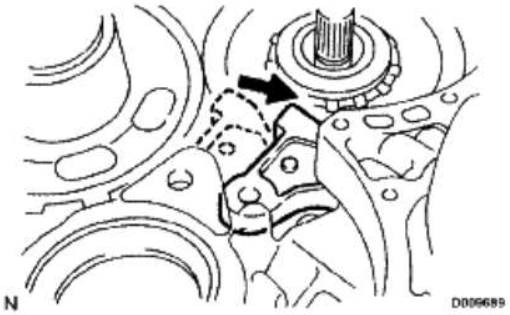


Fig. 344: Pushing Parking Lock Pawl
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the underdrive planetary gear assembly from the transaxle case.

NOTE: Be careful so that the underdrive planetary gear assembly will not fall off.

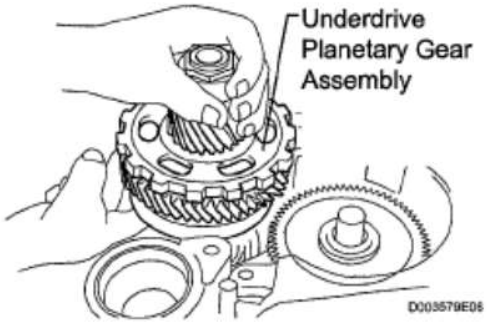


Fig. 345: Removing Underdrive Planetary Gear Assembly From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

39. **REMOVE PARKING LOCK PAWL**

a. Remove the spring, pawl pin, and parking lock pawl.

cardiagn.com

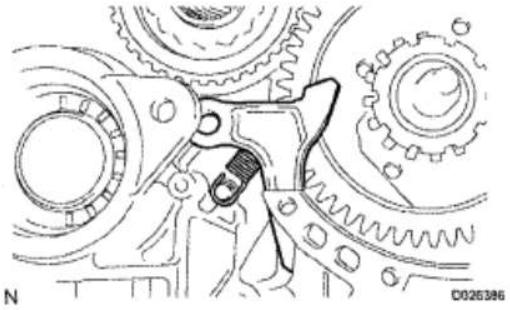


Fig. 346: Identifying Spring, Pawl Pin, And Parking Lock Pawl
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

40. **REMOVE UNDERDRIVE CLUTCH ASSEMBLY**
    a. Remove the underdrive clutch assembly, thrust bearing, and bearing race from the transaxle case.

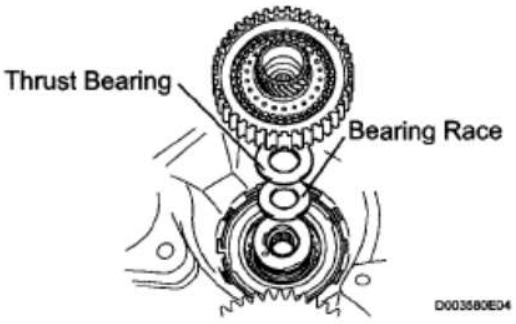


Fig. 347: Identifying Thrust Bearing And Bearing Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

41. **REMOVE UNDERDRIVE ONE-WAY CLUTCH ASSEMBLY**
    a. Using a screwdriver, remove the snap ring from the transaxle case.

NOTE: Do not apply excessive force when removing the snap ring.

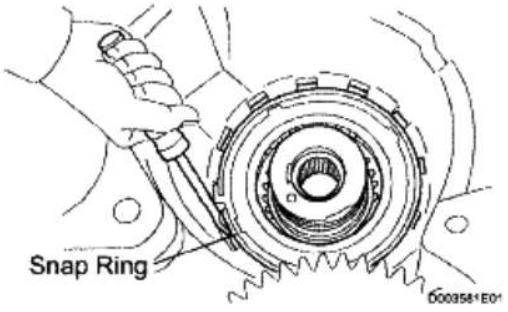


Fig. 348: Removing Snap Ring From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Remove the underdrive one-way clutch from the transaxle case.

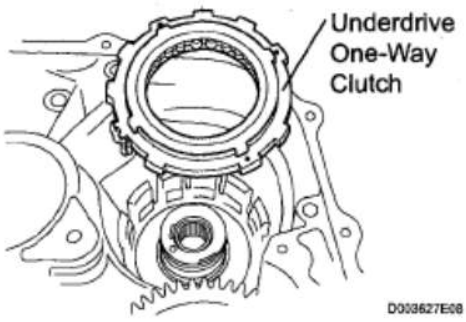


Fig. 349: Identifying Underdrive One-Way Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the outer race retainer from the one-way clutch.

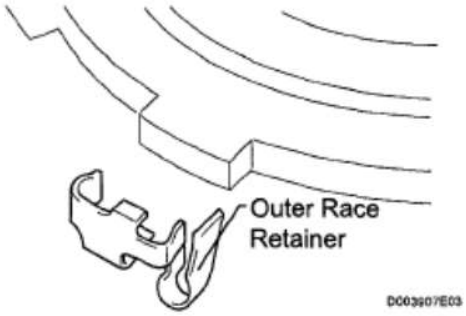


Fig. 350: Identifying Outer Race Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

42. **REMOVE NO. 2 UNDERDRIVE CLUTCH DISC**

a. Using a screwdriver, remove the snap ring.

NOTE: Do not apply excessive force when removing the snap ring.

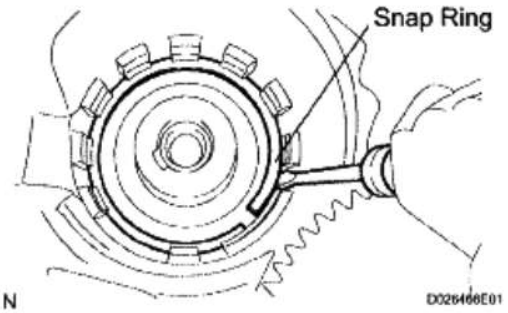


Fig. 351: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Remove the flange, 4 discs, and 4 plates from the transaxle case.

43. **INSPECT NO. 2 UNDERDRIVE CLUTCH DISC** (See **INSPECTION**)

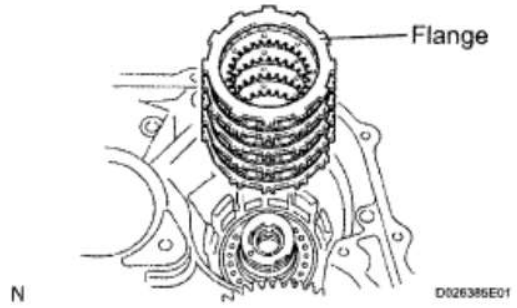


Fig. 352: Identifying Flange, Discs, And Plates
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

44. **REMOVE TRANSAXLE REAR COVER SUB-ASSEMBLY**
    a. Remove the 11 bolts.
    b. Tap on the circumference of the rear cover with a plastic hammer to remove the transaxle rear cover from the transaxle case.

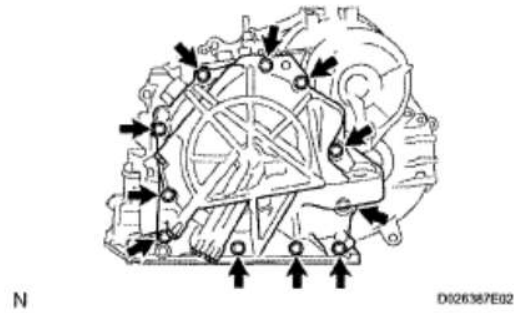


Fig. 353: Locating Transaxle Rear Cover Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

45. **REMOVE NO. 1 TRANSAXLE CASE PLUG**
    a. Remove the 4 No. 1 transaxle case plugs from the transaxle rear cover.
    b. Remove the 4 No. 1 O-rings from the 4 transaxle case plugs.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

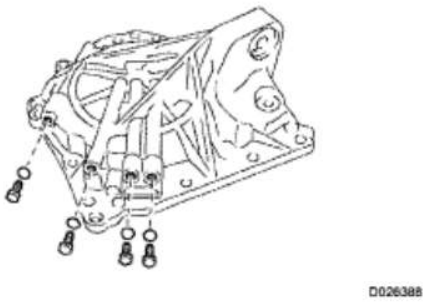


Fig. 354: Identifying No. 1 Transaxle Case Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

46. **REMOVE REAR CLUTCH OIL SEAL RING OUTER**
    a. Remove the 3 rear clutch oil seal rings from the transaxle rear cover.



Fig. 355: Identifying Rear Clutch Oil Seal Ring Outer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

47. **REMOVE NEEDLE ROLLER BEARING**
    a. Using SST, remove the needle roller bearing from the transaxle rear cover.

    SST 09387-00041 (09387-01021, 09387-01030, 09387-01040)

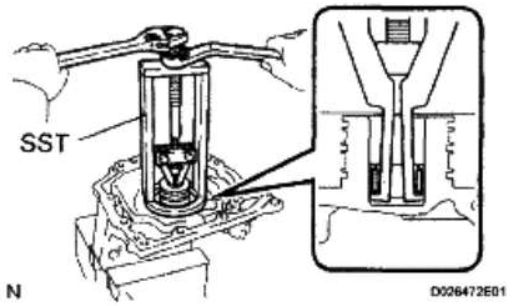


Fig. 356: Removing Needle Roller Bearing From Transaxle Rear Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

48. **REMOVE NO. 1 GOVERNOR APPLY GASKET**

cardiagn.com

a. Using a screwdriver, remove the 3 apply gaskets.

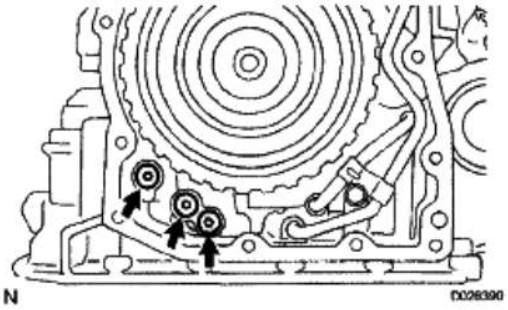


Fig. 357: Locating No. 1 Governor Apply Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

49. **REMOVE BRAKE APPLY TUBE**
   a. Remove the bolt, clamp, and brake apply tube.
   b. Remove the clutch apply tube.
   c. Remove the brake apply tube from the clamp.

NOTE: Do not bend the tubes.

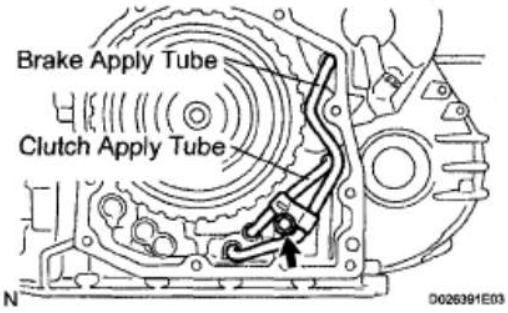


Fig. 358: Locating Brake Apply Tube
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

50. **REMOVE DIRECT CLUTCH ASSEMBLY**
   a. Remove the thrust bearing and the direct clutch assembly from the transaxle case.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

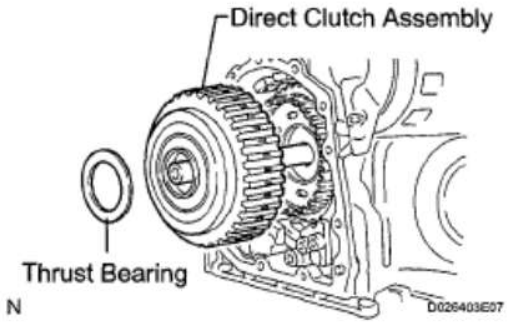


Fig. 359: Identifying Thrust Bearing And Direct Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

51. **REMOVE OVERDRIVE DIRECT CLUTCH HUB SUB-ASSEMBLY**
    a. Remove the thrust bearing race, thrust bearing, and overdrive direct clutch hub from the planetary gear assembly.
52. **INSPECT OVERDRIVE DIRECT CLUTCH DRUM SUB-ASSEMBLY** (See **INSPECTION**)

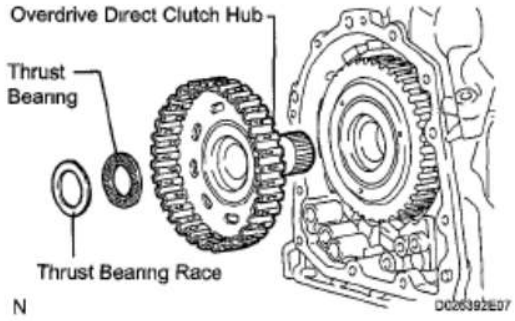


Fig. 360: Identifying Thrust Bearing Race, Thrust Bearing And Overdrive Direct Clutch Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

53. **REMOVE REAR PLANETARY SUN GEAR ASSEMBLY**
    a. Remove the rear planetary sun gear assembly from the transaxle case.

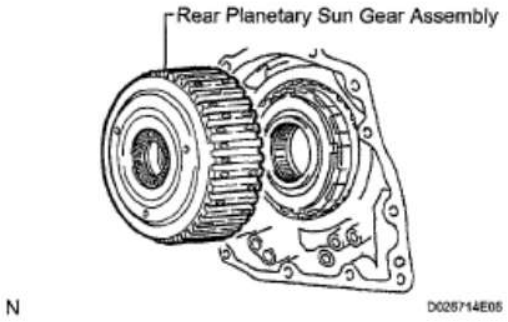


Fig. 361: Identifying Rear Planetary Sun Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Remove the thrust needle roller bearing and thrust bearing race from the rear planetary sun gear assembly.

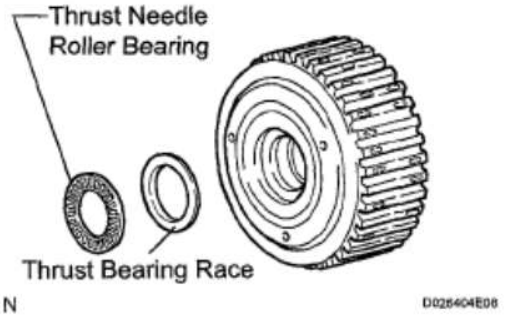


Fig. 362: Identifying Thrust Needle Roller Bearing And Thrust Bearing Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the No. 2 planetary carrier thrust washer from the rear planetary sun gear assembly.

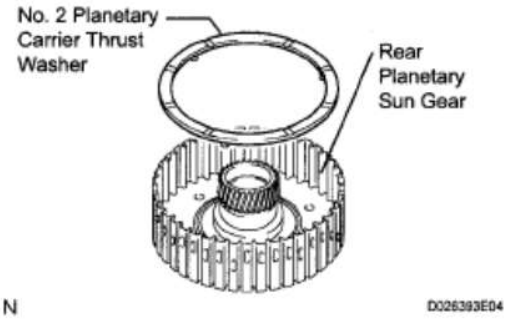


Fig. 363: Identifying No. 2 Planetary Carrier Thrust Washer And Rear Planetary Sun Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

54. **REMOVE ONE-WAY CLUTCH ASSEMBLY**

a. Remove the one-way clutch assembly and the thrust needle roller bearing from the transaxle case.

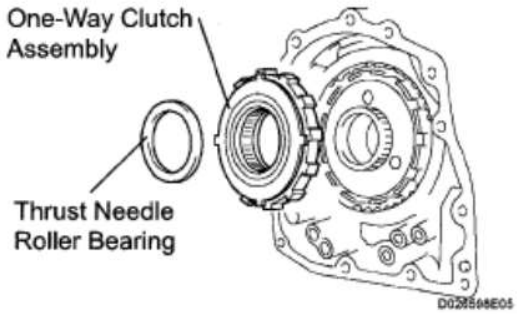


Fig. 364: Identifying One-Way Clutch Assembly And Thrust Needle Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Remove the one-way clutch inner race from the one-way clutch assembly.

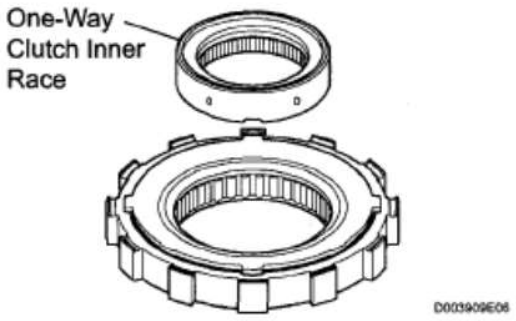


Fig. 365: Identifying One-Way Clutch Inner Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

55. **REMOVE ONE-WAY CLUTCH SLEEVE OUTER**

a. Remove the one-way clutch sleeve outer from the transaxle case.

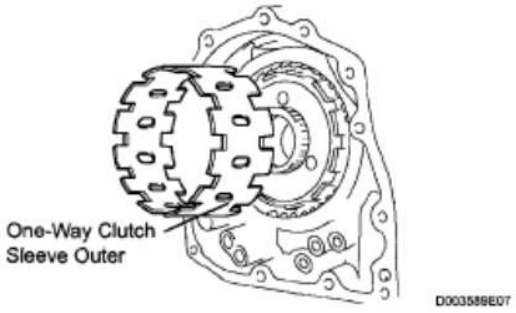


Fig. 366: Identifying One-Way Clutch Sleeve Outer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

56. **REMOVE NO. 1 PLANETARY CARRIER THRUST WASHER**

a. Remove the No. 1 planetary carrier thrust washer from the planetary gear assembly.

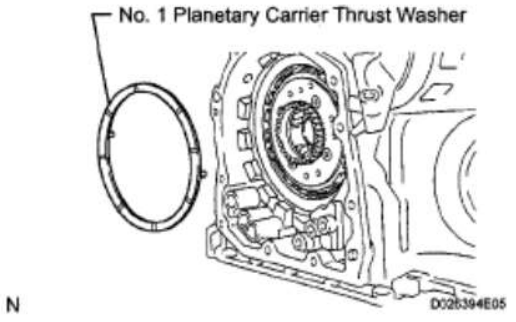


Fig. 367: Identifying No. 1 Planetary Carrier Thrust Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

57. **REMOVE 2ND BRAKE CLUTCH DISC**
    a. Using a screwdriver, remove the snap ring.
    b. Remove the flange, 4 discs, and 4 plates from the transaxle case.
58. **INSPECT 2ND BRAKE CLUTCH DISC** (See **INSPECTION**)

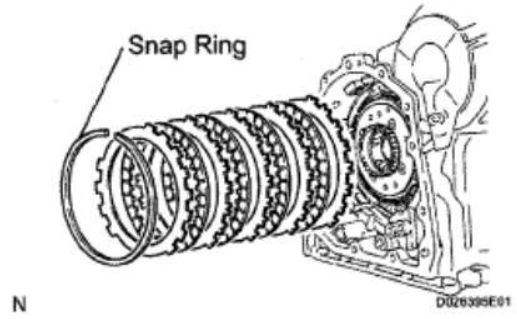


Fig. 368: Identifying 2nd Brake Clutch Disc Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

59. **REMOVE 2ND BRAKE PISTON ASSEMBLY**
    a. Using a screwdriver, remove the snap ring.

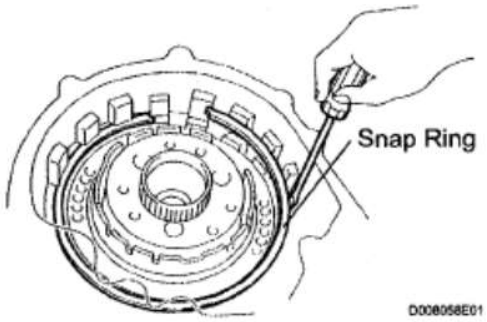
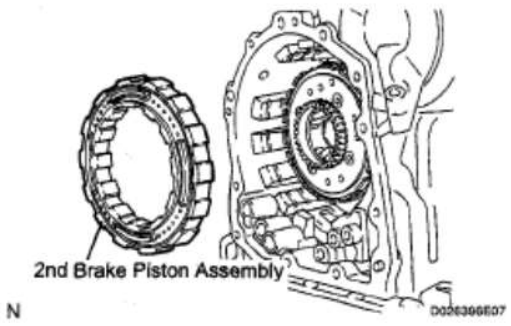


Fig. 369: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the 2nd brake piston assembly from the transaxle case.



cardiagn.com

Fig. 370: Identifying 2nd Brake Piston Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

60. **REMOVE REAR PLANETARY GEAR ASSEMBLY**
    a. Using a screwdriver, remove the snap ring.

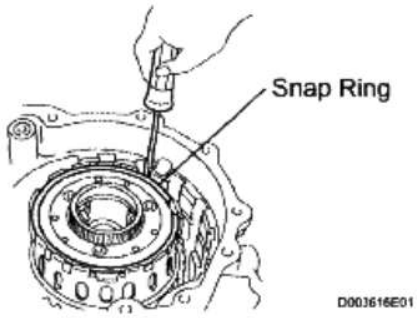


Fig. 371: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the rear planetary gear assembly from the transaxle case.

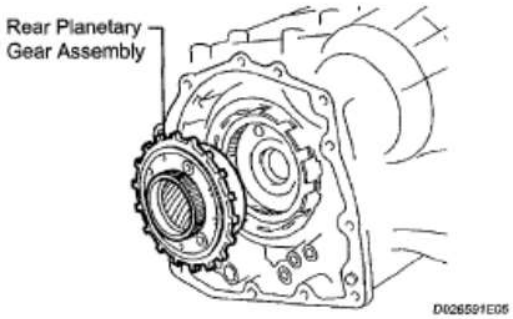


Fig. 372: Identifying Rear Planetary Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

61. **REMOVE INPUT SUN GEAR**
    a. Remove the 2 thrust needle roller bearings, No. 2 thrust bearing race, No. 3 thrust bearing race, and the input sun gear from the transaxle case.

cardiagn.com

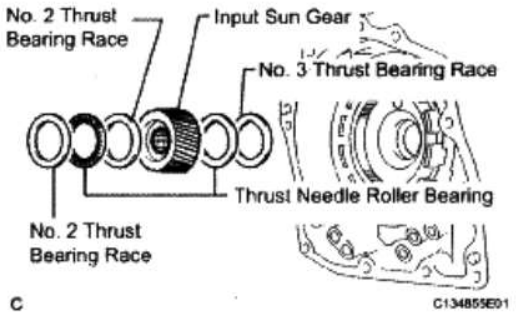


Fig. 373: Identifying Thrust Needle Roller Bearings, No. 2 Thrust Bearing Race, No. 3 Thrust Bearing Race, And Input Sun Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

62. **REMOVE 1ST AND REVERSE BRAKE CLUTCH DISC**
    a. Remove the flange, 6 discs, and 6 plates from the transaxle case.
63. **INSPECT 1ST AND REVERSE BRAKE CLUTCH DISC** (See **INSPECTION**)

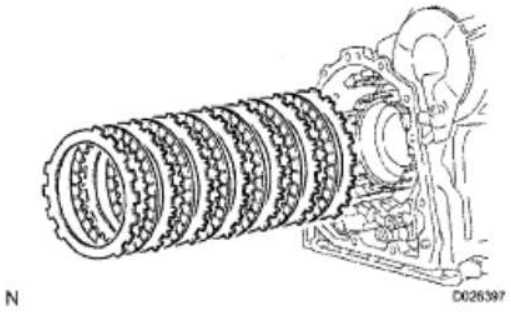
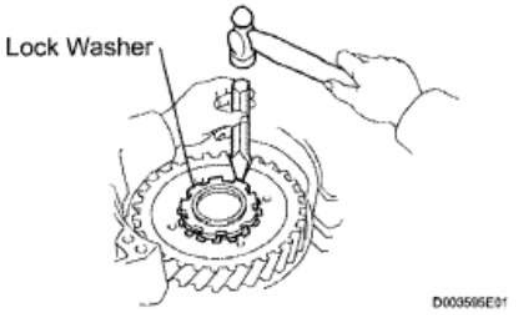


Fig. 374: Identifying Flange, Discs, And Plates
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

64. **REMOVE FRONT PLANETARY GEAR ASSEMBLY**
    a. Using a chisel and hammer, unstake the lock washer.

NOTE: Push down all claws of the washer. Otherwise, SST cannot be fully pressed against the nut, and the nut cannot be loosened.



cardiagn.com

Fig. 375: Unstaking Lock Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, remove the nut.

SST 09387-00030,09387-00080

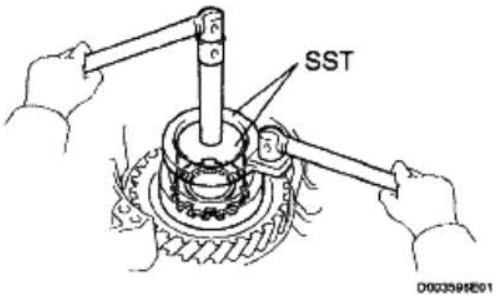


Fig. 376: Removing Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST and a press, remove the front planetary gear assembly from the counter drive gear.

SST 09950-60010 (09951-00450), 09950-70010 (09951-07100)

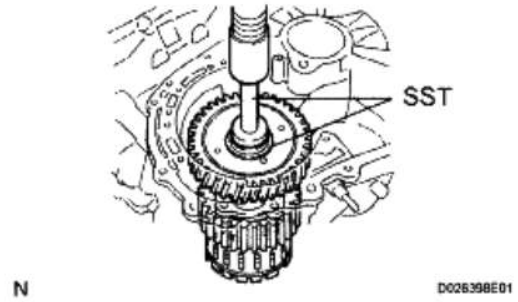
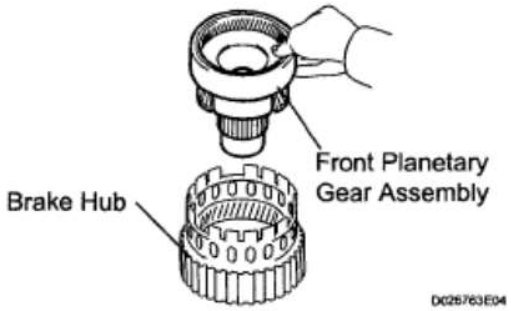


Fig. 377: Pressing Front Planetary Gear Assembly From Counter Drive Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the front planetary gear assembly from the brake hub.



cardiagn.com

Fig. 378: Identifying Front Planetary Gear Assembly And Brake Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

65. **REMOVE FRONT PLANETARY RING GEAR**
    a. Using a screwdriver, remove the snap ring and front planetary ring gear from the brake hub.

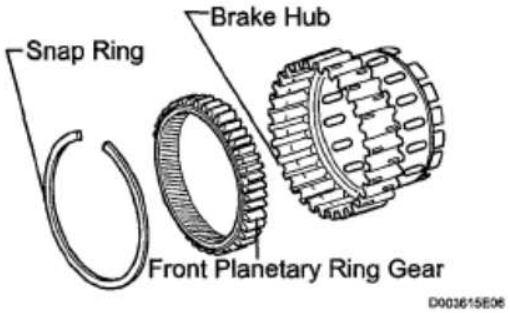


Fig. 379: Identifying Snap Ring And Front Planetary Ring Gear With Brake Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

66. **REMOVE 1ST AND REVERSE BRAKE RETURN SPRING SUB-ASSEMBLY**
    a. Place SST on the return spring, and compress the return spring with a press.

    SST 09387-00070

    b. Using a snap ring expander, remove the snap ring.

NOTE:

- **Stop the press when the spring seat is lowered 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove to prevent the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

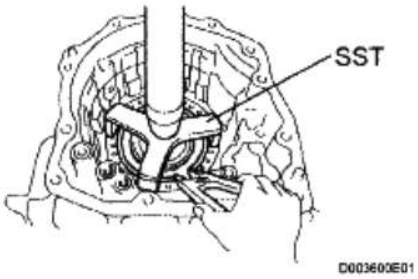


Fig. 380: Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

67. **INSPECT 1ST AND REVERSE BRAKE RETURN SPRING SUB-ASSEMBLY** (See **INSPECTION**)
68. **REMOVE 1ST AND REVERSE BRAKE PISTON**

cardiagn.com

a. Apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the transaxle case to remove the 1st and reverse brake piston.

NOTE:

- **Applying compressed air may cause the piston to jump-out. When removing the piston, hold it using a shop rag or a piece of cloth.**
- **Take care not to splash ATF when applying compressed air.**

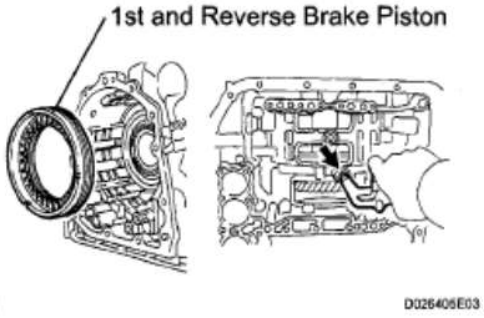


Fig. 381: Applying Compressed Air To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 2 O-rings from the 1st and reverse brake piston.

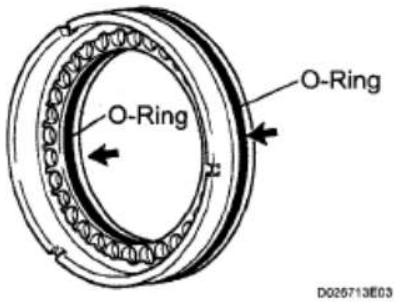


Fig. 382: Locating 1st And Reverse Brake Piston O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

69. **REMOVE COUNTER DRIVE GEAR**

a. Using SST and a press, remove the counter drive gear from the transaxle case.

SST 09950-60010 (09951-00590), 09950-70010 (09951-07100)

cardiagn.com

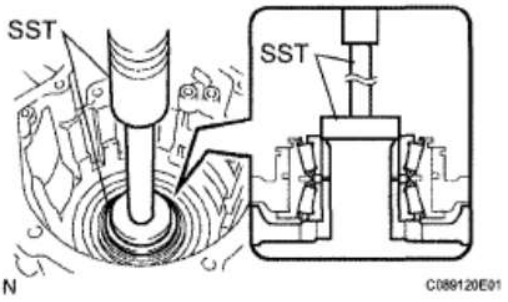


Fig. 383: Pressing Counter Drive Gear From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. As shown in the illustration, tighten the 2 bolts evenly and make clearance of approx. 20.0 mm (0.787 in.) between the counter drive gear and the inner race.

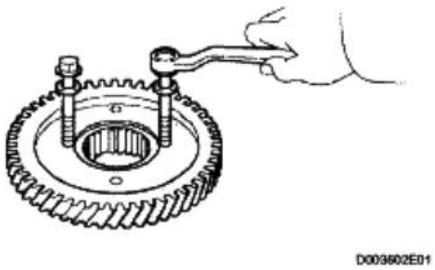


Fig. 384: Tightening Counter Drive Gear Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST, remove the tapered roller bearing.

SST 09950-60010 (09951-00590), 09950-00020, 09950-00030, 09950-40011 (09957-04010)

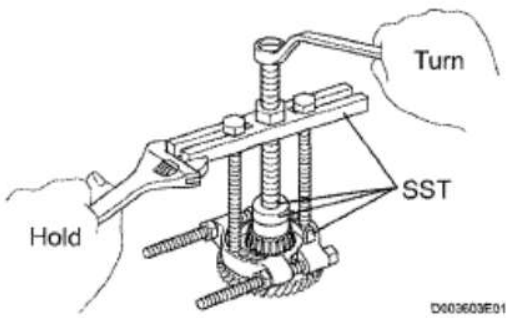


Fig. 385: Removing Tapered Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

70. **REMOVE COUNTER DRIVE GEAR BEARING**

a. Using a snap ring expander, remove the snap ring.

cardiagn.com

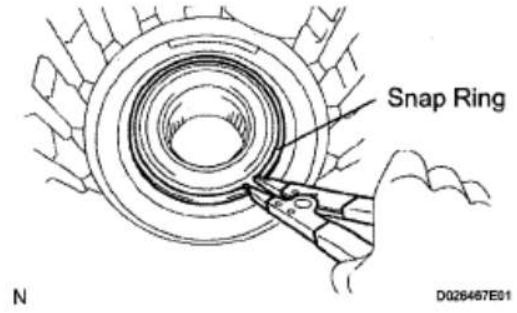


Fig. 386: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST and a press, remove the bearing outer race.

SST 09950-60020 (09951-00910)

71. **REMOVE NO. 2 BREATHER PLUG**

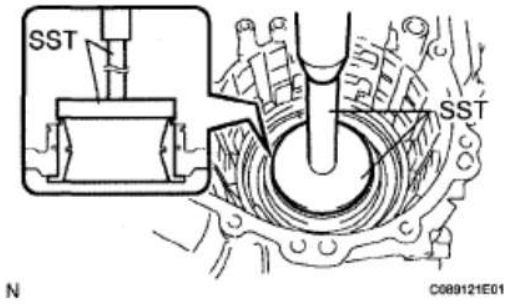


Fig. 387: Pressing Bearing Outer Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

72. **REMOVE UNDERDRIVE BRAKE RETURN SPRING SUB-ASSEMBLY**

a. Place SST on the return spring, and compress the return spring with a press.

SST 09387-00020

b. Using a snap ring expander, remove the snap ring.

NOTE:

- **Stop the press when the spring seat is lowered 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove, to prevent the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

cardiagn.com

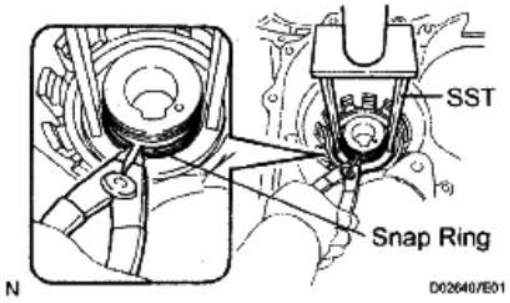


Fig. 388: Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

73. **INSPECT UNDERDRIVE BRAKE RETURN SPRING SUB-ASSEMBLY** (See **INSPECTION**)
74. **REMOVE UNDERDRIVE BRAKE PISTON**
    a. Apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the transaxle case to remove the underdrive brake piston.

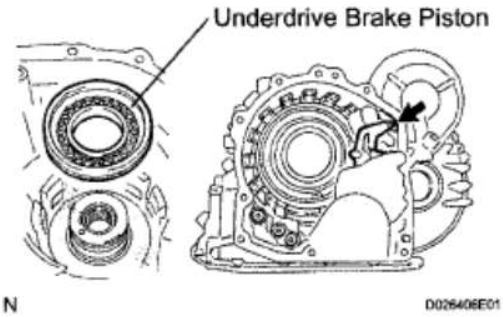


Fig. 389: Applying Compressed Air To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the 2 O-rings from the underdrive brake piston.

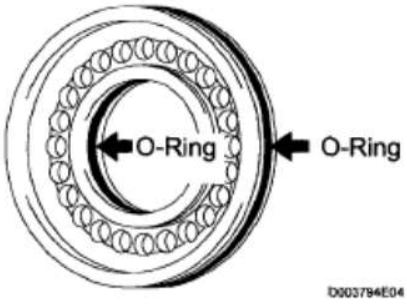


Fig. 390: Locating Underdrive Brake Piston O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

75. **REMOVE NEEDLE ROLLER BEARING**

cardiagn.com

a. Using SST, remove the needle roller bearing from the transaxle case.

SST 09387-00041 (09387-01010,09387-01030, 09387-01040)

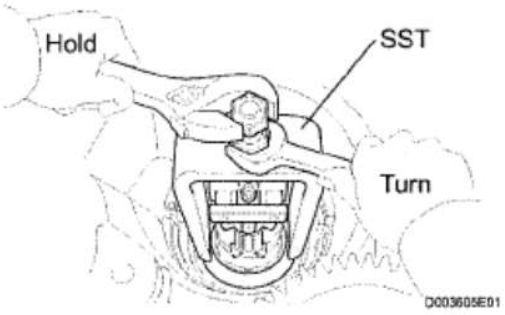


Fig. 391: Removing Needle Roller Bearing From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

76. **REMOVE UNDERDRIVE CLUTCH DRUM OIL SEAL RING**

a. Remove the 2 oil seal rings from the transaxle case.

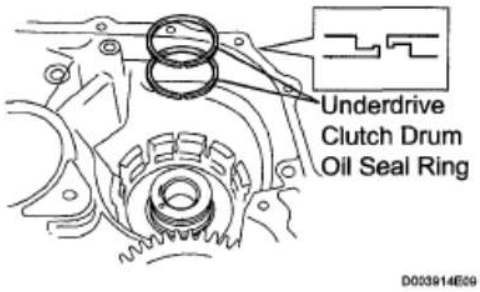


Fig. 392: Identifying Underdrive Clutch Drum Oil Seal Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

77. **REMOVE NO. 1 TRANSAXLE CASE PLUG**

a. Remove the 2 No. 1 transaxle case plugs.
b. Remove the 2 O-rings from the 2 No. 1 transaxle case plugs.

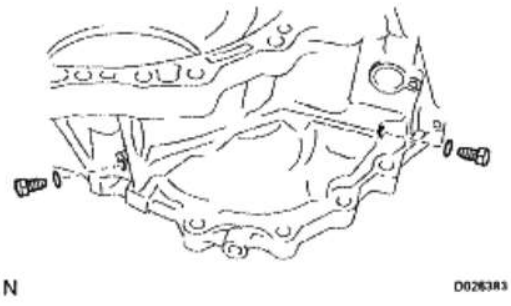


Fig. 393: Identifying No. 1 Transaxle Case Plug

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

78. **REMOVE UNDERDRIVE CYLINDRICAL ROLLER BEARING**
    a. Using SST, remove the underdrive cylindrical roller bearing from the transaxle case.

    SST 09514-35011

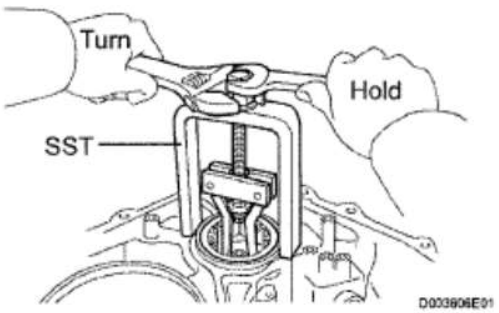


Fig. 394: Removing Underdrive Cylindrical Roller Bearing From Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

79. **REMOVE UNDERDRIVE OUTPUT SHAFT OIL SEAL RING**
    a. Remove the oil seal ring from the transaxle housing.

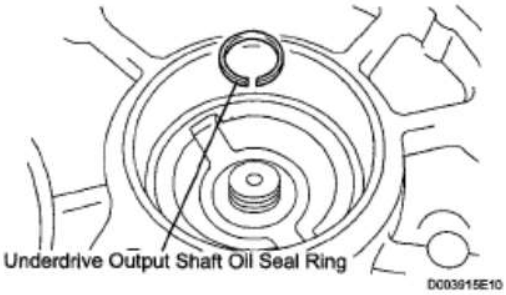


Fig. 395: Identifying Underdrive Output Shaft Oil Seal Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

80. **REMOVE DIFFERENTIAL GEAR LUBE APPLY TUBE**
    a. Remove the bolt, transaxle apply tube clamp and differential gear lube apply tube from the transaxle housing.

    NOTE: Do not bend the tubes.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

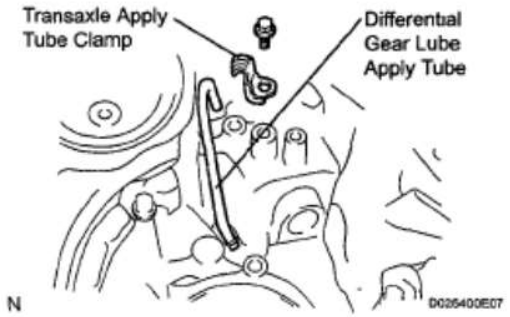


Fig. 396: Identifying Transaxle Apply Tube Clamp And Differential Gear Lube Apply Tube
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT MULTIPLE DISC CLUTCH HUB**
   a. Using a dial indicator, measure the inside diameter of the forward clutch hub bushing.

   Standard inside diameter: 23.025 to 23.046 mm (0.9065 to 0.9073 in.)

   Maximum inside diameter: 23.09 mm (0.9091 in.)

   NOTE: Check the contact surface of the bushing in the direct clutch shaft. If any scratch or discoloration is found, replace the direct clutch sub-assembly with a new one.

   If the inside diameter is greater than the maximum, replace the forward clutch hub with a new one.

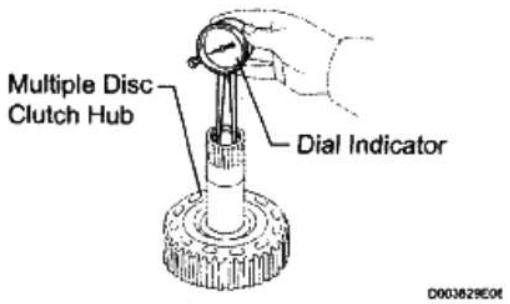


Fig. 397: Inspecting Multiple Disc Clutch Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT NO. 2 UNDERDRIVE CLUTCH DISC**
   a. Check if the sliding surfaces of the disc, plate, and flange are worn or burnt.

   If necessary, replace them.

   NOTE:

cardiagn.com

- **If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.**
- **Before installing new discs, immerse them in ATF for at least 15 minutes.**

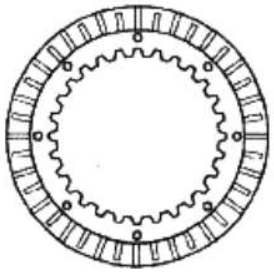


Fig. 398: Inspecting No. 2 Underdrive Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT OVERDRIVE DIRECT CLUTCH DRUM SUB-ASSEMBLY**
   a. Using a dial indicator, measure the inside diameter of the forward clutch hub bushing.

   Standard inside diameter: 23.025 to 23.046 mm (0.9065 to 0.9073 in.)

   Maximum inside diameter: 23.09 mm (0.9091 in.)

   NOTE: Check the contact surface of the bushing in the direct clutch shaft. If any scratch or discoloration is found, replace the direct clutch sub-assembly with a new one.

   If the inside diameter is greater than the maximum, replace the forward clutch hub with a new one.

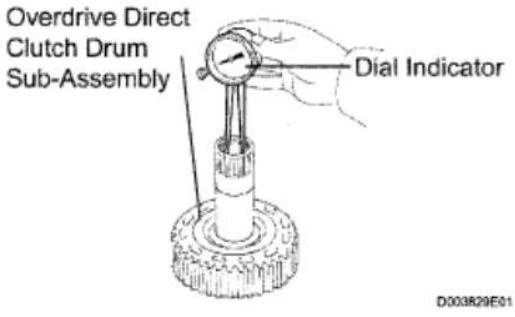


Fig. 399: Inspecting Overdrive Direct Clutch Drum Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT 2ND BRAKE CLUTCH DISC**
   a. Check if the sliding surface of the disc, plate, and flange are worn or burnt.

cardiagn.com

If necessary, replace them.

NOTE:

- **If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.**
- **Before installing new discs, immerse them in ATF for at least 15 minutes.**

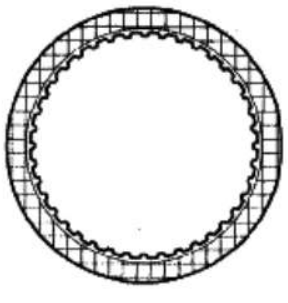


Fig. 400: Inspecting 2nd Brake Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSPECT 1ST AND REVERSE BRAKE CLUTCH DISC**
   a. Check if the sliding surface of the disc, plate, and flange are worn or burnt.

   If necessary, replace them.

NOTE:

- **If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.**
- **Before installing new discs, immerse them in ATF for at least 15 minutes.**



Fig. 401: Inspecting 1st And Reverse Brake Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSPECT 1ST AND REVERSE BRAKE RETURN SPRING SUB-ASSEMBLY**
   a. Using vernier calipers, measure the free length of the spring together with the spring seat.

cardiagn.com

Standard free length: 17.61 mm (0.6933 in.)

HINT:

If the result is not as specified, replace the spring.

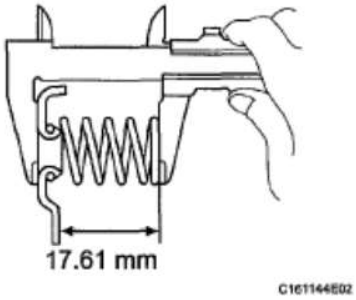


Fig. 402: Inspecting 1st And Reverse Brake Return Spring Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSPECT UNDERDRIVE BRAKE RETURN SPRING SUB-ASSEMBLY**
   a. Using vernier calipers, measure the free length of the spring together with the spring seat.

   Standard free length: 13.24 mm (0.5213 in.)

   HINT:

   If the result is not as specified, replace the spring.

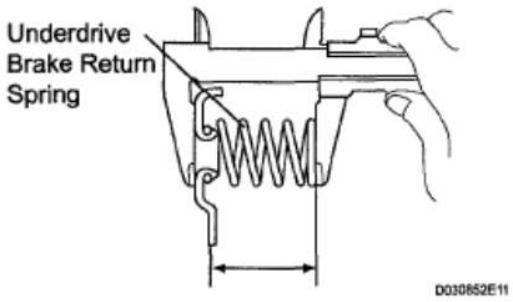


Fig. 403: Inspecting Underdrive Brake Return Spring Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSPECT PACK CLEARANCE OF 1ST AND REVERSE BRAKE**
   a. Using vernier calipers, measure the distance between the disc surface and the contact surface of the 2nd brake cylinder and transaxle case (Dimension A).
   b. Select an appropriate flange so that the pack clearance will be within the specified range.

   Pack clearance: 1.16 to 1.35 mm (0.0457 to 0.0531 in.)

cardiagn.com

HINT:

Piston stroke = Dimension A - Flange thickness

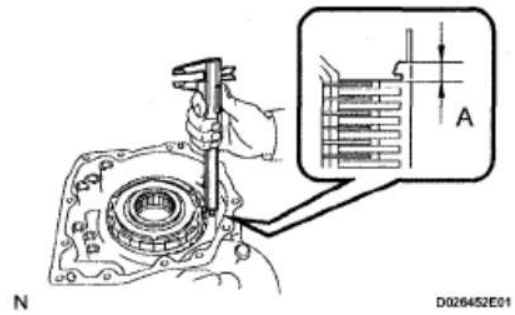


Fig. 404: Inspecting Pack Clearance Of 1st And Reverse Brake
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	1.8 (0.071)	5	2.2 (0.087)
2	1.9 (0.075)	6	2.3 (0.091)
3	2.0 (0.079)	7	2.4 (0.094)
4	2.1 (0.083)	8	2.5 (0.098)

c. Install the flange.

9. **INSPECT PACK CLEARANCE OF 2ND BRAKE**
   a. Using vernier calipers, measure the distance between the disc surface and snap ring surface (Dimension B).
   b. Select an appropriate flange so that the pack clearance will be within the specified range.

Pack clearance: 0.62 to 0.91 mm (0.0244 to 0.0358 in.)

HINT:

Piston stroke = Dimension B - Flange thickness - Snap ring thickness 1.6 mm (0.063 in.)

cardiagn.com

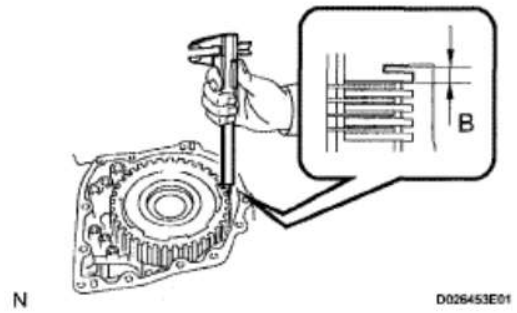


Fig. 405: Inspecting Pack Clearance Of 2nd Brake
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	3.0 (0.118)	5	3.4 (0.134)
2	3.1 (0.122)	6	3.5 (0.138)
3	3.2 (0.126)	7	3.6 (0.142)
4	3.3 (0.130)	8	-

10. **INSPECT PACK CLEARANCE OF UNDERDRIVE BRAKE**
    a. Using a dial indicator, measure the underdrive brake pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

    Pack clearance: 1.81 to 2.20 mm (0.0713 to 0.0866 in.)

    HINT:

    Select an appropriate flange from the table below so that it will be within the specified range.

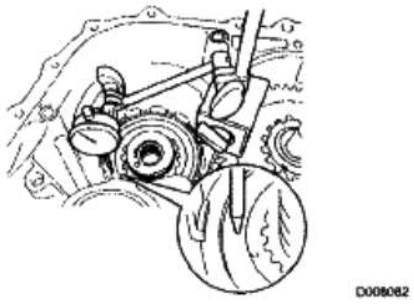


Fig. 406: Inspecting Pack Clearance Of Underdrive Brake
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Flange thickness: mm (in.)

cardiagn.com

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	3.0 (0.118)	4	3.1 (0.122)
2	3.2 (0.126)	5	3.3 (0.130)
3	3.4 (0.134)	-	-

b. Temporarily remove the snap ring and attach it to the flange.
c. Reinstall the snap ring.

11. **INSPECT UNDERDRIVE ONE-WAY CLUTCH ASSEMBLY**
    a. Install the underdrive clutch assembly to the one-way clutch.
    b. Rotate the underdrive one-way clutch assembly to check the rotating direction for the lock or free operation.

    HINT:

    If the result is not as specified, replace the underdrive one-way clutch.

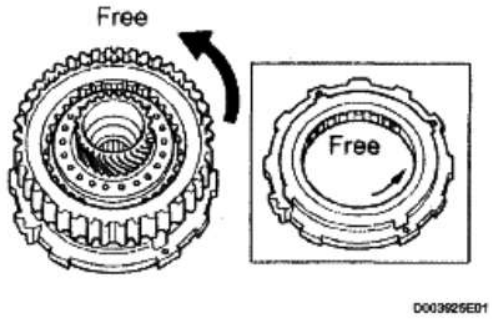


Fig. 407: Inspecting Underdrive One-Way Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **INSPECT INPUT SHAFT END PLAY**
    a. Using a dial indicator, measure the input shaft end play.

    End play: 0.262 to 1.244 mm (0.0103 to 0.0490 in.)

    HINT:

    If the result is not as specified, replace the input shaft or thrust needle roller bearing.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

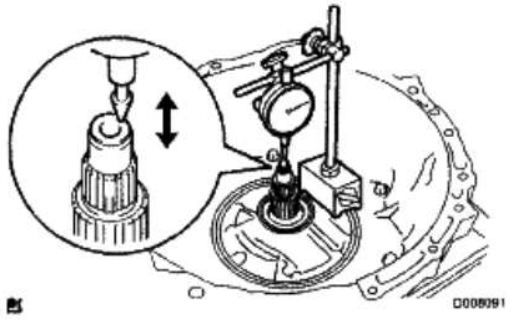


Fig. 408: Inspecting Input Shaft End Play
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **BEARING POSITION**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

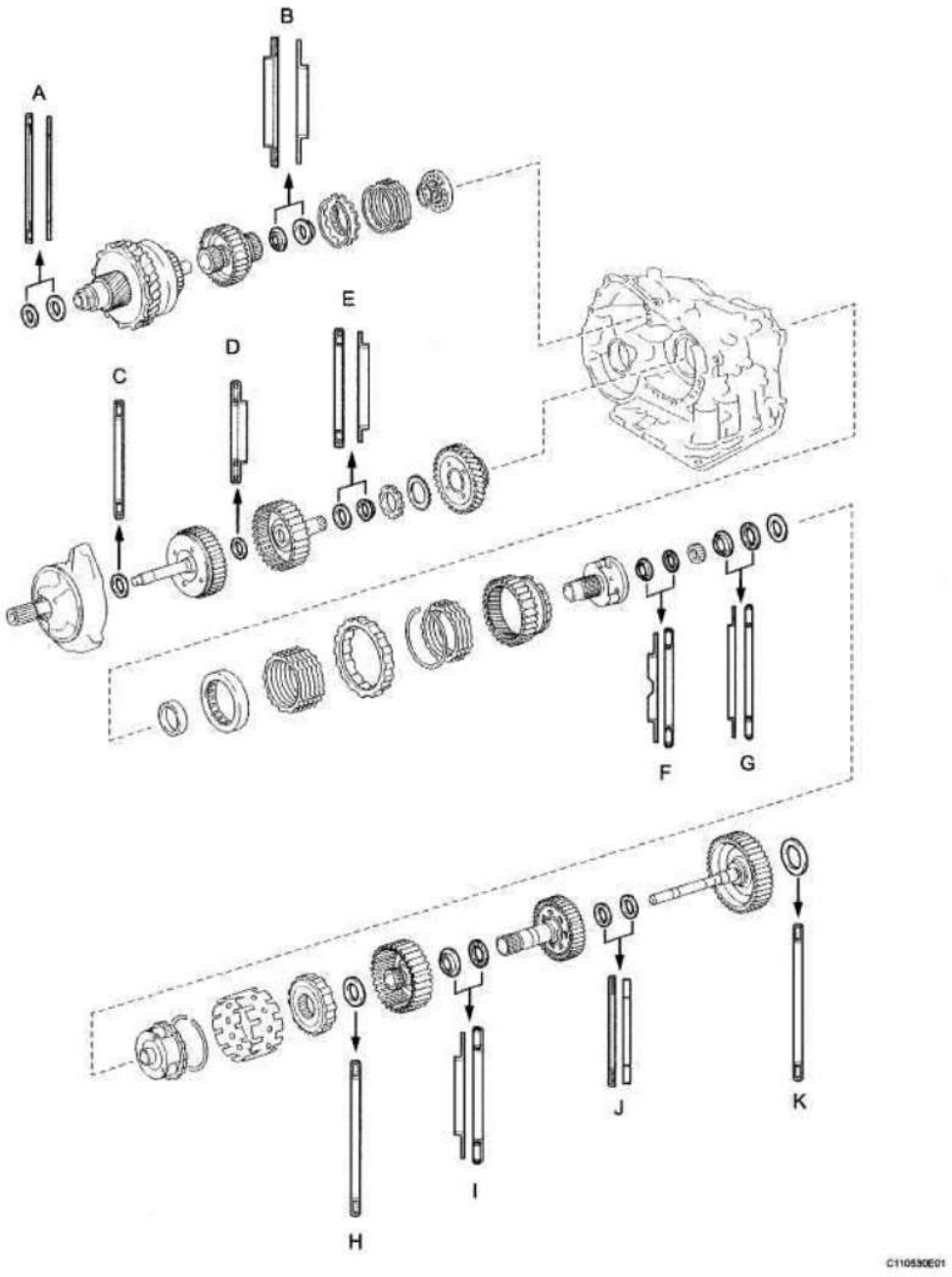


Fig. 409: Identifying Bearing Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

THRUST BEARING DIAMETER SPECIFICATION

Mark	Front Race Diameter Inside/Outside mm (in.)	Thrust Bearing Diameter Inside/Outside mm (in.)	Rear Race Diameter Inside/Outside mm (in.)
A	-	57.2 (2.252)/84.96 (3.3449)	56.4 (2.220)/83.0 (3.268)
B	-	37.73 (1.4854)/58.0 (2.283)	-
C	-	33.85 (1.3327)/52.2 (2.055)	-

cardiagn.com

D	24.94 (0.9820)	23.5 (0.925)/44.0 (1.732)	-
E	-	36.3 (1.429)/51.93 (2.0445)	34.5 (1.358)/48.35 (1.9035)
F	34.35 (1.3526)/56.57 (2.2271)	32.45 (1.2776)/56.48 (2.2236)	-
G	40.15 (1.5807)/59.25 (2.3327)	38.65 (1.5217)/59.79 (2.3539)	38.65 (1.5217)/59.25 (2.3327)
H	-	53.6 (2.110)/69.6 (2.740)	-
I	33.02 (1.3000)/45.8 (1.803)	31.85 (1.2539)/57.3 (2.256)	-
J	-	24.79 (0.976)/39.5 (1.555)	23.6 (0.929)/37.95 (1.4941)
K	-	56.3 (2.217)/75.96 (2.9905)	-

2. **INSTALL DIFFERENTIAL GEAR LUBE APPLY TUBE**
   a. Install the differential gear lube apply tube and transaxle apply tube clamp to the transaxle housing with the bolt.

   Torque: 9.8 N*m (100 kgf*cm, 87 in.*lbf)

   NOTE: Make sure to insert the pipe to the stopper.

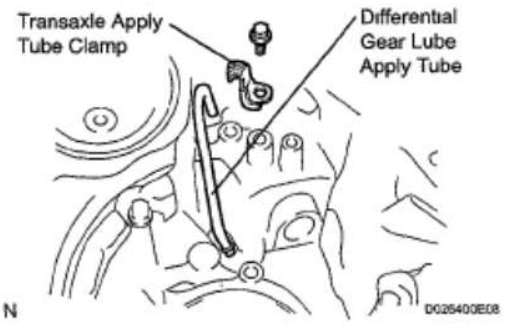
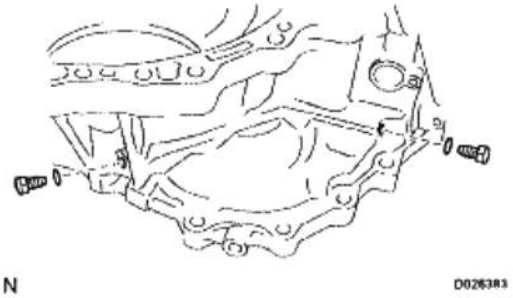


Fig. 410: Identifying Differential Gear Lube Apply Tube And Transaxle Apply Tube Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL NO. 1 TRANSAXLE CASE PLUG**
   a. Install 2 new O-rings to the 2 No. 1 transaxle case plugs.
   b. Install the 2 No. 1 transaxle case plugs to the transaxle rear cover.

   Torque: 7.4 N*m (75 kgf*cm, 65 in.*lbf)



cardiagn.com

Fig. 411: Identifying No. 1 Transaxle Case Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL UNDERDRIVE OUTPUT SHAFT OIL SEAL RING**
   a. Coat a new oil seal ring with ATF and install it to the transaxle housing.

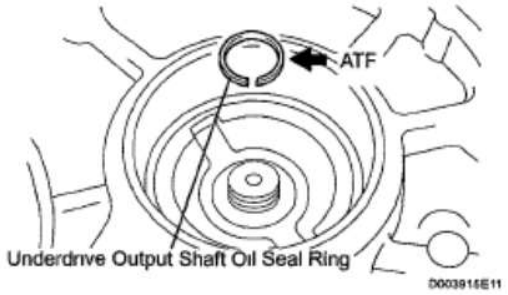


Fig. 412: Identifying Underdrive Output Shaft Oil Seal Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL UNDERDRIVE CYLINDRICAL ROLLER BEARING**
   a. Coat the underdrive cylindrical roller bearing with ATF.
   b. Using SST and a press, install the underdrive cylindrical roller bearing.

SST 09950-60020 (09951-00810), 09950-70010 (09951-07100)

NOTE: Do not apply excessive pressure to the bearing.

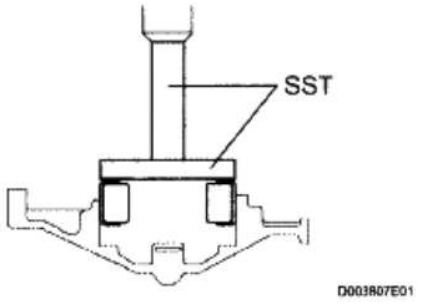


Fig. 413: Pressing Underdrive Cylindrical Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL UNDERDRIVE CLUTCH DRUM OIL SEAL RING**
   a. Coat 2 new oil seal rings with ATF and install them to the transaxle rear cover.

NOTE:
- **Do not expand the end gap of the oil seal ring too much.**
- **Secure the hooks firmly. Confirm that the oil seal ring rotates freely in its groove.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

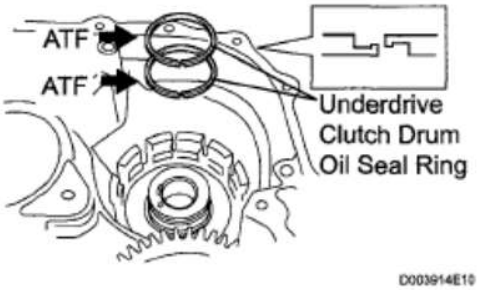


Fig. 414: Identifying Underdrive Clutch Drum Oil Seal Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSTALL NEEDLE ROLLER BEARING**

a. Wrap vinyl tape around SST 4.0 mm (0.157 in.) from the bottom of SST until the thickness of the tape is approximately 5.0 mm (0.197 in.).

SST 09950-60010 (09951-00320), 09950-70010 (09951-07100)

NOTE: Clean SST to remove deposited oil before wrapping vinyl tape.

b. Coat the needle roller bearing with ATF.

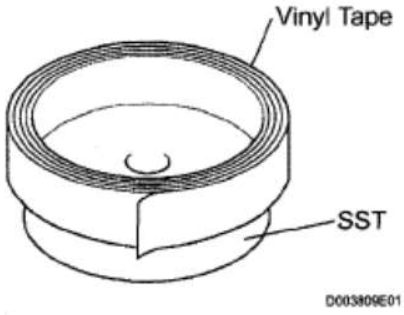


Fig. 415: Wrapping Vinyl Tape Around SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST and a press, install the needle-roller bearing to the transaxle case.

SST 09950-60010 (09951-00320), 09950-70010 (09951-07100)

NOTE: When the wrapped vinyl tape contacts the transaxle case, stop press-fitting.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

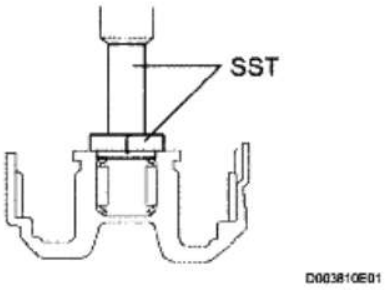


Fig. 416: Pressing Needle-Roller Bearing To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSTALL UNDERDRIVE BRAKE PISTON**
   a. Coat 2 new O-rings with ATF and install them to the underdrive brake piston.

NOTE:
- **Make sure that the O-rings are not twisted or pinched when they are installed.**
- **Apply sufficient ATF to the O-ring before installing.**

   b. Coat the underdrive brake piston with ATF.

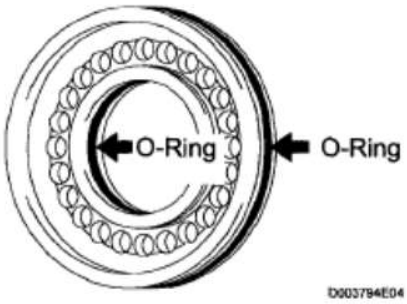


Fig. 417: Locating Underdrive Brake Piston O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the underdrive brake piston to the transaxle case.

NOTE: **Be careful not to damage the O-ring.**



cardiagn.com

Fig. 418: Identifying Underdrive Brake Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **INSTALL UNDERDRIVE BRAKE RETURN SPRING SUB-ASSEMBLY**
   a. Place SST on the return spring and compress the return spring with a press.

      SST 09387-00020

   b. Using a snap ring expander, install the snap ring to the transaxle case.

NOTE:

- **Stop the press when the spring seat is lowered 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove to prevent the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**
- **Install the spring sub-assembly and check that all of the springs are fully engaged in the piston correctly.**
- **The snap ring should be fully engaged in the groove of the transaxle case.**

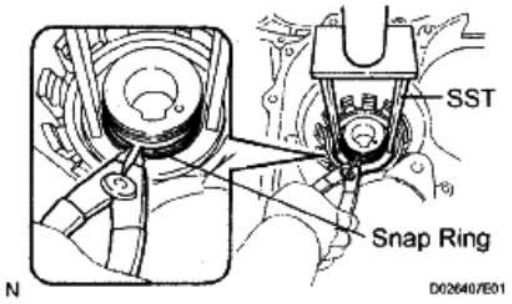


Fig. 419: Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **INSTALL NO. 2 BREATHER PLUG**
11. **INSTALL COUNTER DRIVE GEAR BEARING**
    a. Coat the counter drive gear bearing with ATF.
    b. Using SST and a press, install the bearing outer race.

SST 09950-60020 (09951-01030), 09950-70010 (09951-07150), 09649-17010

NOTE:

- **Do not apply excessive pressure to the bearing.**
- **Press-fit the bearing outer race until it contacts the transaxle case.**

cardiagn.com

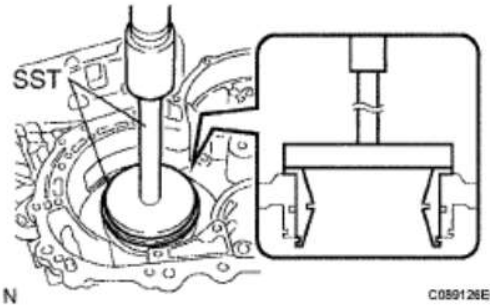


Fig. 420: Pressing Bearing Outer Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a snap ring expander, install the snap ring.

NOTE: The surface with a white mark of the snap ring should face upward.

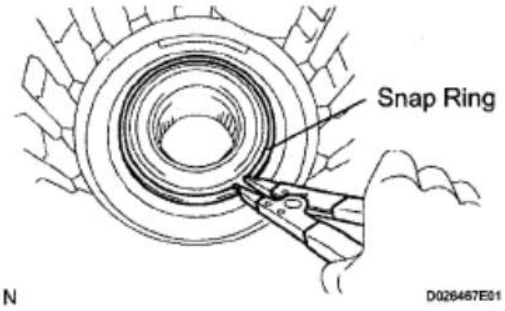


Fig. 421: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **INSTALL COUNTER DRIVE GEAR**
    a. Coat the counter drive gear with ATF.
    b. Using SST and a press, install the tapered roller bearing to the counter drive gear.

SST 09950-70010 (09951-07150), 09649-17010

NOTE: Do not apply excessive pressure to the bearing.

cardiagn.com

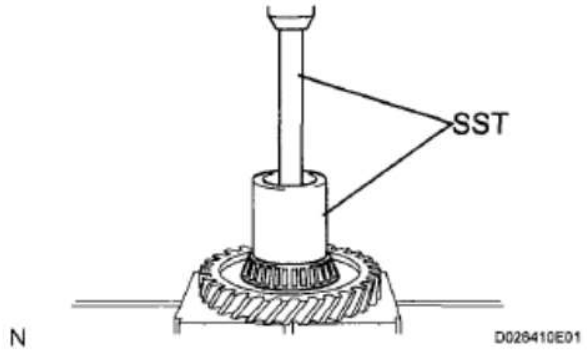


Fig. 422: Pressing Tapered Roller Bearing To Counter Drive Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST and a press, install the counter drive gear and bearing to the transaxle case.

SST 09950-70010 (09951 -07150), 09223-15030, 09527-17011, 09950-60020 (09951-00750)

NOTE: Do not apply excessive pressure to the counter drive gear.

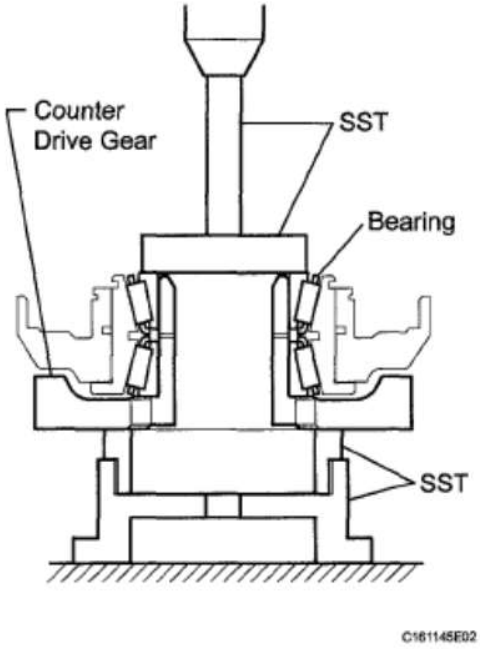


Fig. 423: Pressing Counter Drive Gear And Bearing To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **INSTALL 1ST AND REVERSE BRAKE PISTON**
    a. Coat 2 new O-rings with ATF.
    b. Install the 2 O-rings to the 1st and reverse brake piston.

cardiagn.com

NOTE:

- **Make sure that the O-rings are not twisted or pinched when they are installed.**
- **Apply sufficient ATF to the O-rings before assembling them.**

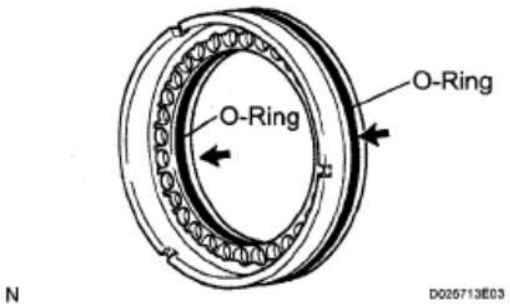


Fig. 424: Locating 1st And Reverse Brake Piston O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Coat the 1st and reverse brake piston with ATF and install it to the transaxle case.

NOTE: **Be careful not to damage the O-ring.**

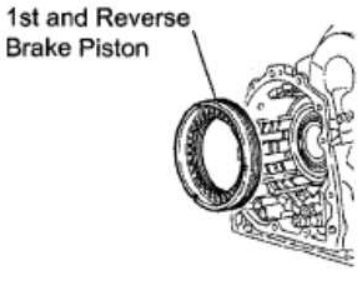


Fig. 425: Identifying 1st And Reverse Brake Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **INSTALL 1ST AND REVERSE BRAKE RETURN SPRING SUB-ASSEMBLY**

a. Place SST on the return spring and compress the return spring with a press.

SST 09387-00070

b. Using a snap ring expander, install the snap ring to the transaxle case.

NOTE:

- **Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove to prevent the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

cardiagn.com

- **Install the spring sub-assembly and check that all of the springs are fit in the piston correctly.**
- **The snap ring should be fully engaged in the groove of the cylinder.**
- **Fix the snap ring to the inside of the claw of the spring seat firmly.**

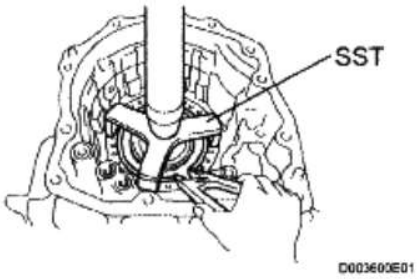


Fig. 426: Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **INSTALL FRONT PLANETARY RING GEAR**
    a. Using a screwdriver, install the front planetary ring gear and snap ring to the brake hub.

NOTE: Confirm that the snap ring is engaged in the groove of the brake hub correctly.

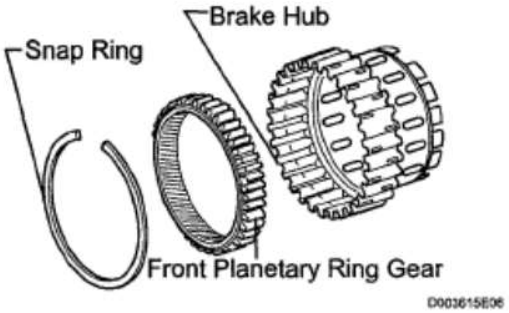


Fig. 427: Identifying Snap Ring And Front Planetary Ring Gear With Brake Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **INSTALL FRONT PLANETARY GEAR ASSEMBLY**
    a. Install the front planetary gear assembly to the brake hub.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

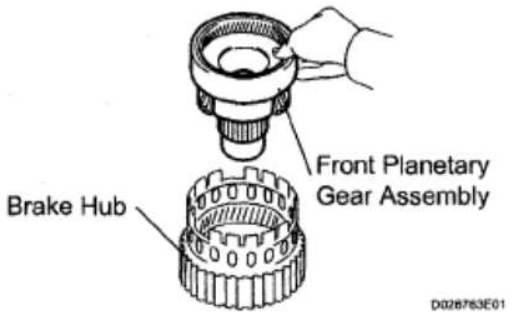


Fig. 428: Installing Front Planetary Gear Assembly To Brake Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST and a press, press-fit the front planetary gear assembly.

SST 09950-60010 (09951-00500), 09950-70010 (09951-07100)

NOTE:

- **Do not apply excessive pressure to the planetary gear assembly.**
- **Press the inner race of the LH tapered roller bearing, counter gear and front planetary gear assembly to the position where no preload should be applied to one pair of the tapered roller bearings (left and right).**

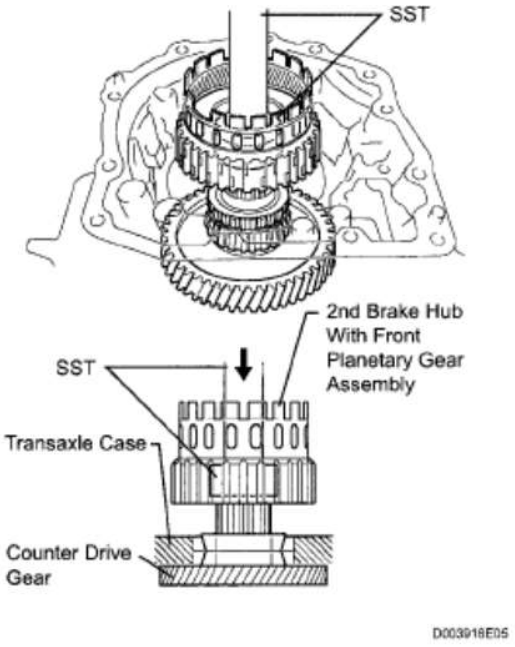


Fig. 429: Pressing Front Planetary Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

c. Install a new washer as shown in the illustration.



Fig. 430: Identifying Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using SST, install the nut.

SST 09387-00030,09387-00080

Torque: 280 N*m (2854 kgf*cm, 207 ft.*lbf)

NOTE: Assemble the washer after pressing each part, then tighten the nut to the minimum tightening torque.

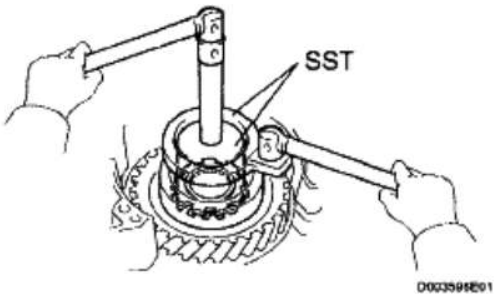


Fig. 431: Installing Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using SST and a torque wrench, measure the turning torque of the bearing while rotating SST at 60 rpm. When the measured value is not as specified, gradually tighten the nut until it reaches the specified value.

SST 09387-00080

Standard: Turning torque at 60 rpm

Bearing:

New Bearing:

cardiagn.com

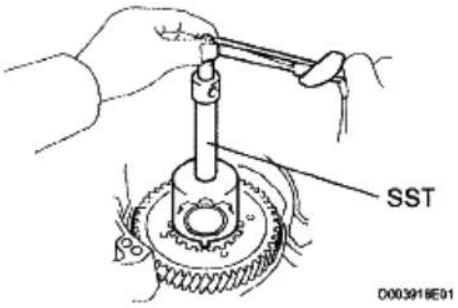


Fig. 432: Measuring Turning Torque Of Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

0.51 to 1.02 N*m (5.1 to 10.0 kgf*cm, 4.4 to 8.7 in.*lbf)

Used Bearing: 0.26 to 0.51 N*m (2.7 to 5.2 kgf*cm, 2.3 to 4.5 in.*lbf)

HINT:

Use a torque wrench with a fulcrum length of 160 mm (6.3 in.).

f. Tighten the nut gradually until the specified turning torque of the tapered roller bearing is measured.

Torque: 350 N*m (3569 kgf*cm, 258 ft.*lbf)

g. Using a chisel and hammer, stake the front lock washer.

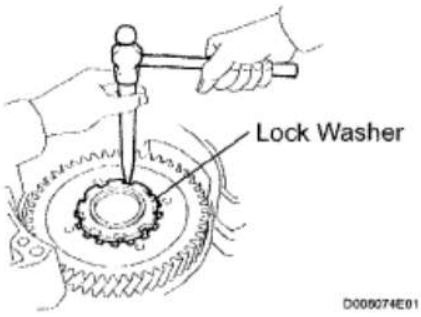


Fig. 433: Staking Front Lock Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **INSTALL INPUT SUN GEAR**
    a. Coat the 2 thrust bearings with ATF.
    b. Install the 2 thrust bearings, the 3 bearing races, and the input sun gear to the transaxle case.

NOTE:

- **Install the bearing race on the side of the front planetary carrier. Make sure that the race is installed in the correct direction.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

- **When installing the thrust bearing and front sun gears, make sure that they are installed in the correct direction.**
- **Install the bearing race on the side of the front sun gear. Make sure that the race is installed in the correct direction.**
- **Install the thrust bearing and the race after holding the parts on the input sun gear by applying grease. Make sure that the assembling order is correct.**

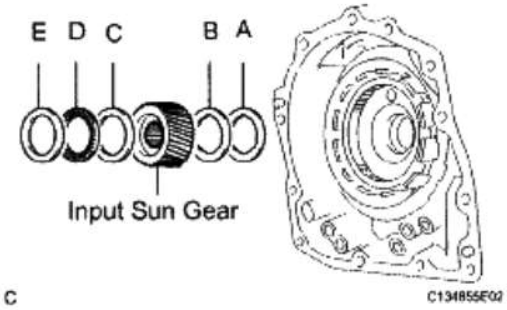


Fig. 434: Identifying Input Sun Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Thrust bearing and bearing race diameter: mm (in.)

THRUST BEARING AND BEARING RACE DIAMETER SPECIFICATION

	Inside	Outside
Bearing Race, A	34.5 (1.358)	56.82 (2.2370)
Thrust Bearing, B	32.4 (1.276)	56.62 (2.2291)
Bearing Race, C	40.3 (1.587)	58.0 (2.284)
Thrust Bearing, D	40.3 (1.587)	58.1 (2.287)
Bearing Race, E	38.6 (1.520)	58.0 (2.284)

18. **INSTALL REAR PLANETARY GEAR ASSEMBLY**
    a. Install the rear planetary gear assembly to the rear planetary ring gear.

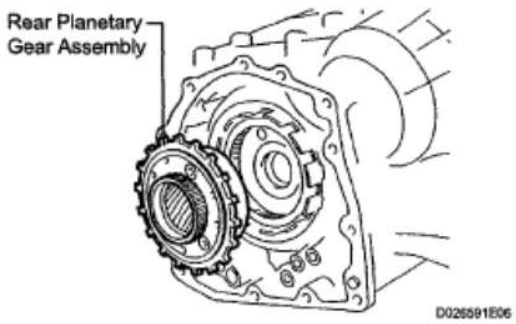


Fig. 435: Identifying Rear Planetary Gear Assembly

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a screwdriver, install the snap ring.

NOTE: Confirm that the snap ring is engaged in the groove of the 1st and reverse brake hub correctly.

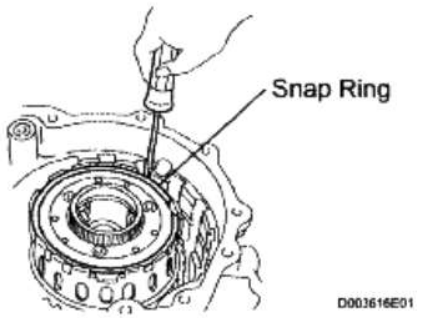


Fig. 436: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **INSTALL 1ST AND REVERSE BRAKE CLUTCH DISC**
    a. Coat the 6 discs with ATF.
    b. Install the 6 plates and 6 discs.

NOTE: Make sure that the plates, discs, and flange are installed as shown in the illustration.

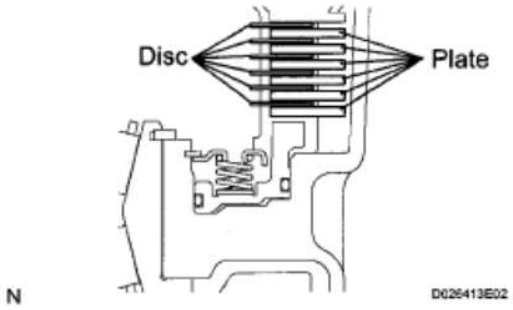


Fig. 437: Identifying Plates And Discs
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **INSPECT PACK CLEARANCE OF FIRST AND REVERSE BRAKE**
    a. Using vernier calipers, measure the distance between the disc surface and the contact surface of the 2nd brake cylinder and transaxle case (Dimension A).
    b. Select an appropriate flange so that the pack clearance will be within the specified range.

Pack clearance: 1.16 to 1.35 mm (0.0457 to 0.0531 in.)

cardiagn.com

HINT:

Piston stroke = Dimension A - Flange thickness

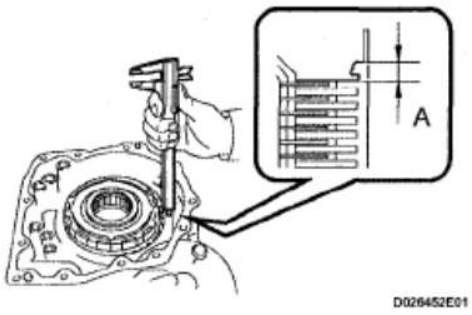


Fig. 438: Inspecting Pack Clearance Of 1st And Reverse Brake
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	1.8 (0.071)	5	2.2 (0.087)
2	1.9 (0.075)	6	2.3 (0.091)
3	2.0 (0.079)	7	2.4 (0.094)
4	2.1 (0.083)	8	2.5 (0.098)

c. Install the flange.

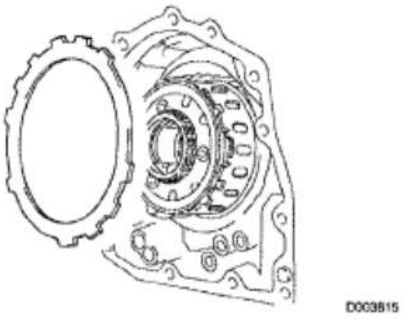


Fig. 439: Identifying Flange
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

21. **INSTALL 2ND BRAKE PISTON ASSEMBLY**
    a. Install the 2nd brake piston assembly to the transaxle case.

cardiagn.com

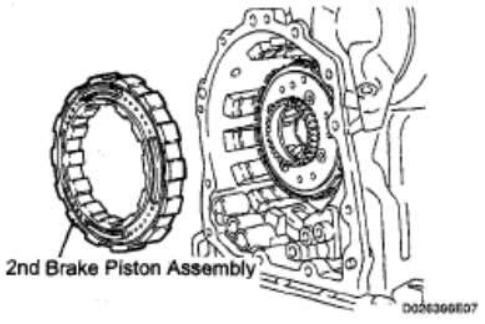


Fig. 440: Identifying 2nd Brake Piston Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the snap ring and measure the inside diameter.

Inside diameter: Greater than 167 mm (6.57 in.)

NOTE:

- **Make sure that the tapered snap ring is installed in the correct direction.**
- **When the diameter is not as specified, replace the snap ring with a new one.**
- **After installing, confirm that there is no clearance between the 2nd brake cylinder and the fitting surface of the cylinder in the transaxle case.**

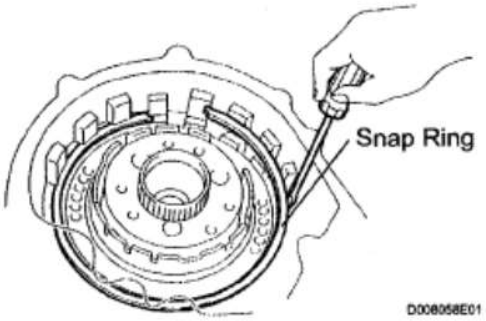


Fig. 441: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **INSTALL ONE-WAY CLUTCH SLEEVE OUTER**

a. Install the one-way clutch sleeve outer to the 2nd brake cylinder assembly.

NOTE: **Make sure that the outer sleeve is installed in the correct direction.**

cardiagn.com

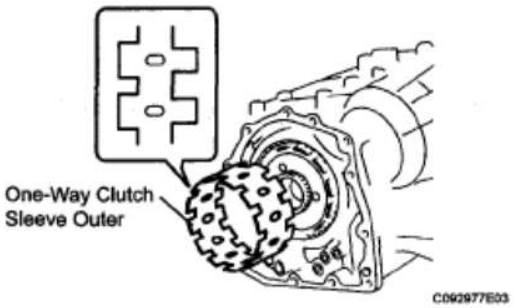


Fig. 442: Identifying One-Way Clutch Sleeve Outer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. **INSTALL ONE-WAY CLUTCH ASSEMBLY**

a. Install the one-way clutch inner race to the one-way clutch.

NOTE:

- **Make sure that the inner race is installed in the correct direction.**
- **Confirm that the discrimination mark can be seen.**

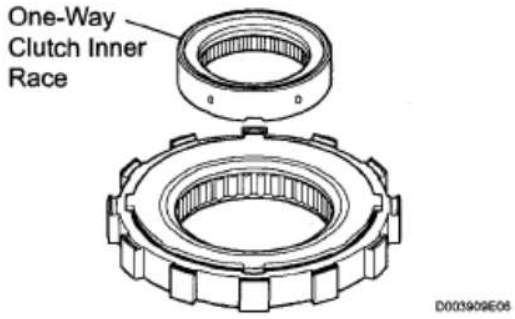


Fig. 443: Identifying One-Way Clutch Inner Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check the rotating direction of one-way clutch for the lock or free operation as shown in the illustration.

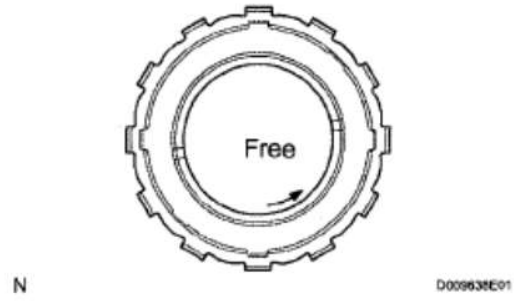


Fig. 444: Checking Rotating Direction Of One-Way Clutch For Lock Or Free Operation

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the one-way clutch and thrust needle roller bearing to the one-way clutch sleeve outer.

Bearing diameter: mm (in.)

BEARING DIAMETER SPECIFICATION

	Inside	Outside
Bearing	53.6 (2.110)	69.4 (2.732)

NOTE: Install the thrust bearing properly so that no-colored race can be seen.

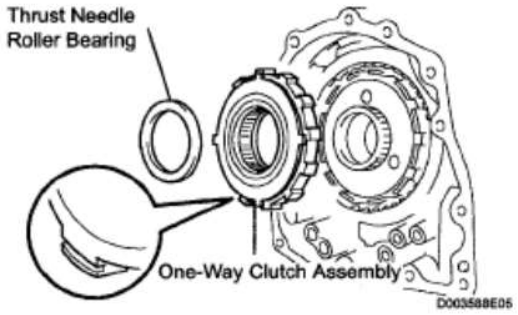


Fig. 445: Identifying One-Way Clutch And Thrust Needle Roller Bearing Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **INSTALL NO. 1 PLANETARY CARRIER THRUST WASHER**

a. Coat the No. 1 planetary carrier thrust washer with yellow petrolatum, and install the washer onto the planetary sun gear assembly.

NOTE: After installing, confirm that the projection should be firmly engaged in the hole of the planetary sun gear assembly.

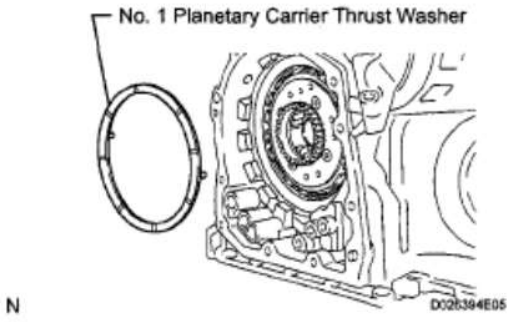


Fig. 446: Identifying No. 1 Planetary Carrier Thrust Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

25. **INSTALL REAR PLANETARY SUN GEAR ASSEMBLY**

a. Coat the No. 2 planetary carrier thrust washer with yellow petrolatum, and install the washer onto the rear planetary sun gear.

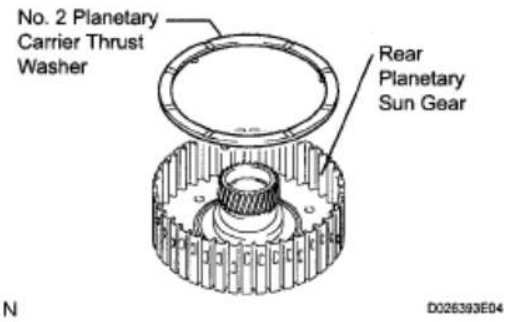


Fig. 447: Identifying Rear Planetary Sun Gear And No. 2 Planetary Carrier Thrust Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Coat the bearing with yellow petrolatum, and install the bearing onto the rear planetary sun gear.

Bearing diameter: mm (in.)

BEARING DIAMETER SPECIFICATION

	Inside	Outside
Race, A	33.0 (1.299)	45.4 (1.787)
Bearing, B	31.85 (1.254)	45.2 (1.78)

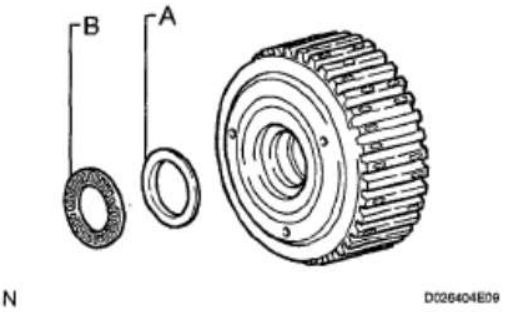


Fig. 448: Identifying Bearing And Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the rear planetary sun gear assembly to the rear planetary gear.

NOTE: After installing the rear planetary sun gear assembly, make sure that the B1 discs are engaged.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

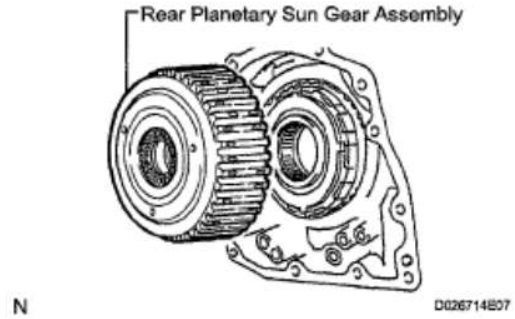


Fig. 449: Identifying Rear Planetary Sun Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

26. **INSTALL 2ND BRAKE CLUTCH DISC**
    a. Coat the 4 discs with ATF.
    b. Install the 4 discs and 4 plates to the transaxle case.
    c. Temporarily install the snap ring.

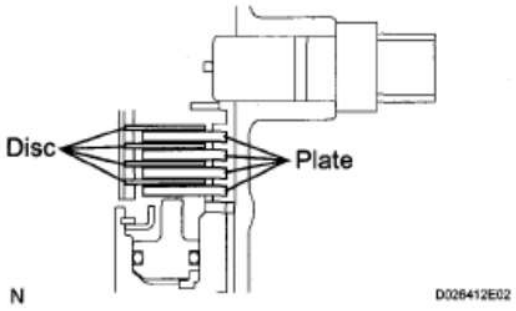


Fig. 450: Identifying Discs And Plates
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

27. **INSPECT PACK CLEARANCE OF 2ND BRAKE**
    a. Using vernier calipers, measure the distance between the disc surface and snap ring surface (Dimension B).
    b. Select an appropriate flange so that the pack clearance will be within the specified range.

    Clearance: 0.62 to 0.91 mm (0.0244 to 0.0358 in.)

    HINT:

    Piston stroke = Dimension B - Flange thickness - Snap ring thickness 1.6 mm (0.063 in.)

cardiagn.com

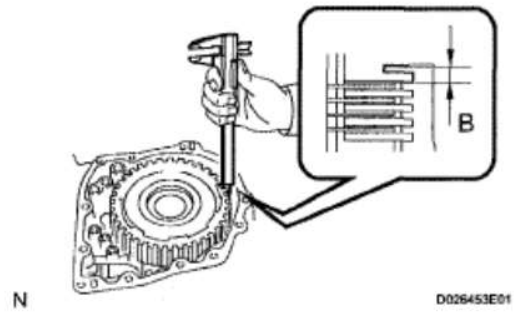


Fig. 451: Measuring Distance Between Disc Surface And Snap Ring Surface (Dimension B)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	3.0 (0.118)	5	3.4 (0.134)
2	3.1 (0.122)	6	3.5 (0.138)
3	3.2 (0.126)	7	3.6 (0.142)
4	3.3 (0.130)	8	-

c. Temporarily remove the snap ring, attach the selected flange, and reinstall the snap ring.

NOTE: Secure the snap ring so that the ends can be seen through the groove of the transaxle case.

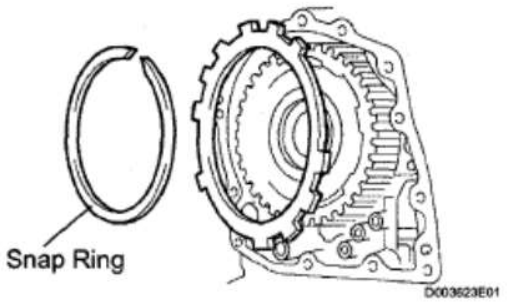


Fig. 452: Identifying Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

28. **INSTALL OVERDRIVE DIRECT CLUTCH HUB SUB-ASSEMBLY**
    a. Install the direct clutch hub to the planetary gear assembly.

NOTE: Be careful not to damage the bushing inside the overdrive clutch hub during installation.

cardiagn.com

b. Coat the thrust bearing with ATF.
c. Install the bearing race and the thrust bearing to the direct clutch hub.

NOTE: Be careful not to drop the bearing when it is installed.

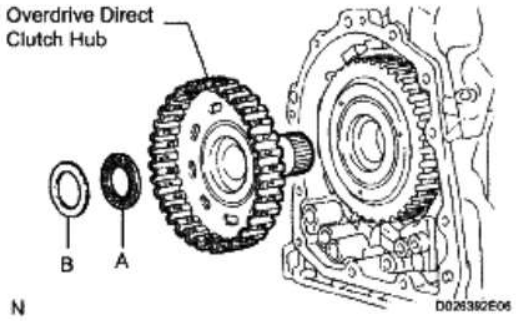


Fig. 453: Identifying Overdrive Direct Clutch Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Bearing and race diameter: mm (in.)

BEARING AND RACE DIAMETER SPECIFICATION

	Inside	Outside
Bearing, A	24.7 (0.972)	39.5 (1.555)
Race, B	23.6 (0.929)	38.0 (1.496)

29. **INSTALL DIRECT CLUTCH ASSEMBLY**
a. Coat the thrust bearing with ATF.
b. Install the direct clutch assembly and thrust bearing to the rear planetary sun gear assembly.

NOTE: The disc in the direct clutch should completely match with the hub attached outside the rear planetary sun gear. Otherwise, the rear cover cannot be installed.

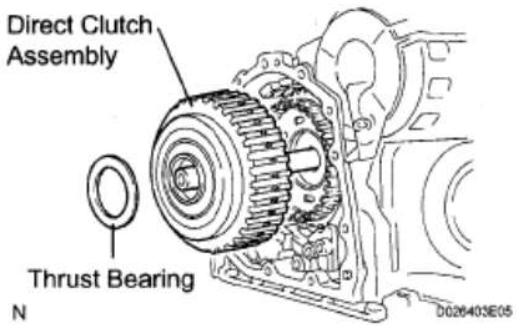


Fig. 454: Identifying Direct Clutch Assembly And Thrust Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

c. Clean the connecting part of the transaxle case and the rear cover.

d. As shown in the illustration, place a straightedge on the direct clutch drum and measure the distance between the transaxle case and the straightedge using vernier calipers (Dimension C).

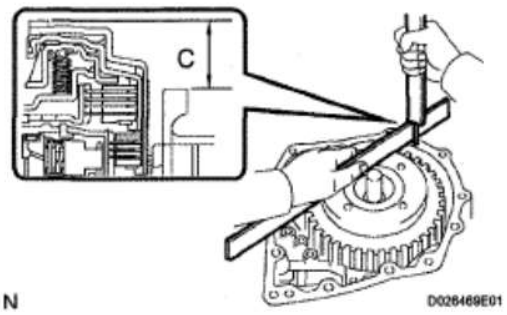


Fig. 455: Measuring Distance Between Transaxle Case And Straightedge (Dimension C)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using vernier calipers and a straightedge, measure the dimension shown in the illustration.

f. Calculate the end play using the following formula. Select a thrust bearing which satisfies the end play and install the selected bearing.

End play: 0.244 to 0.901 mm (0.0096 to 0.0355 in.)

NOTE: Make sure that the no-colored race side is facing the direct clutch assembly.

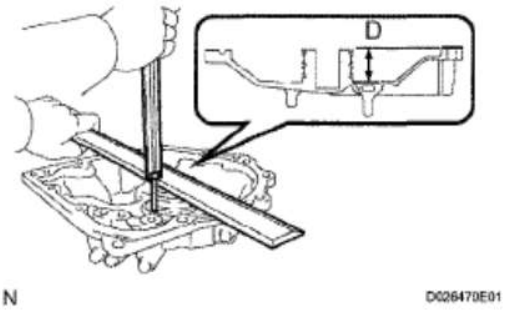


Fig. 456: Measuring Dimension
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

End play = Dimension D - Dimension C

Bearing thickness and diameter : mm (in.)

BEARING THICKNESS AND DIAMETER SPECIFICATION

cardiagn.com

Thickness	Inside	Outside
3.6 (0.1417)	56.3 (2.217)	75.7 (2.980)
3.8 (0.1496)	56.3 (2.217)	75.7 (2.980)

30. **INSTALL NO. 1 GOVERNOR APPLY GASKET**

a. Install 3 new No. 1 governor apply gaskets to the transaxle case.

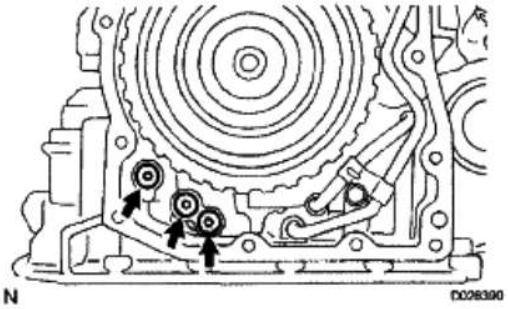


Fig. 457: Locating No. 1 Governor Apply Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

31. **INSTALL BRAKE APPLY TUBE**

a. Install the clamp to the brake apply tube.

NOTE: Make sure to install the clamp to the apply tube before installing the apply tube to the transaxle case. This prevents the apply tube from being deformed or damaged.

b. Install the clutch apply tube.

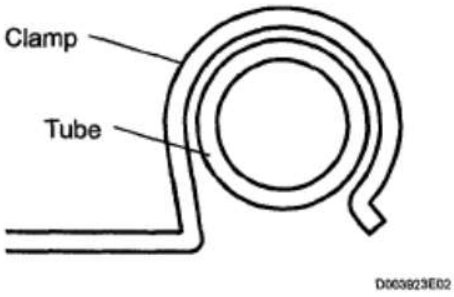


Fig. 458: Identifying Clamp And Brake Apply Tube
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the brake apply tube and a bolt to the transaxle case.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

cardiagn.com

NOTE: **The tube should be securely inserted until it reaches the stopper.**

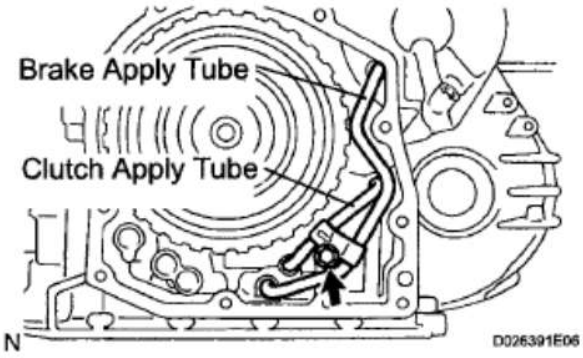


Fig. 459: Identifying Brake Apply Tube And Clutch Apply Tube With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

32. **INSTALL NEEDLE ROLLER BEARING**
    a. Using SST and a press, press the needle roller bearing into the transaxle rear cover.

    SST 09950-60010 (09951-00230, 09952-06010)

    Press fit depth: 20.55 to 21.25 mm (0.8091 to 0.8366 in.)

    NOTE:
    - **The engraved mark side of the bearing should face upward.**
    - **Repeat press fitting until the specified value is obtained.**

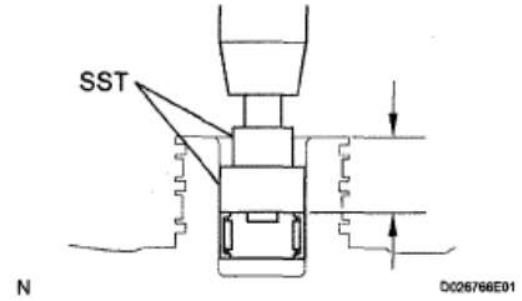


Fig. 460: Pressing Needle Roller Bearing Into Transaxle Rear Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Coat a needle roller bearing with ATF.

33. **INSTALL REAR CLUTCH OIL SEAL RING OUTER**
    a. Coat 3 new rear clutch oil seal rings with ATF, and install them to the transaxle rear cover.

    NOTE: **The snap ring should be fully engaged in the groove of the drum.**

cardiagn.com



Fig. 461: Identifying Rear Clutch Oil Seal Ring Outer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

34. **INSTALL NO. 1 TRANSAXLE CASE PLUG**
    a. Coat 4 new O-rings with ATF.
    b. Install the 4 O-rings to the 4 No. 1 transaxle case plugs.
    c. Install the 4 No. 1 transaxle case plugs to the transaxle rear cover.

    Torque: 7.4 N*m (75 kgf*cm, 65 in.*lbf)

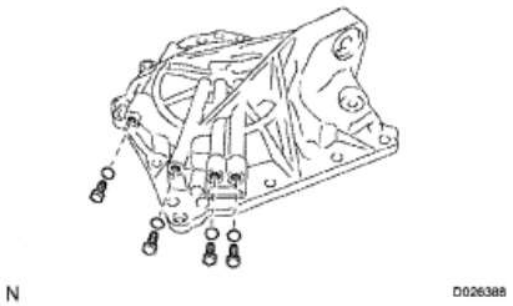


Fig. 462: Identifying No. 1 Transaxle Case Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

35. **INSTALL TRANSAXLE REAR COVER SUB-ASSEMBLY**
    a. Remove any packing material and be careful not to spill oil on the contact surfaces of the transaxle rear cover or the transaxle case.
    b. Apply seal packing to the cover.

    Seal packing: Toyota Genuine Seal Packing 1281, Three Bond 1281 or equivalent

cardiagn.com

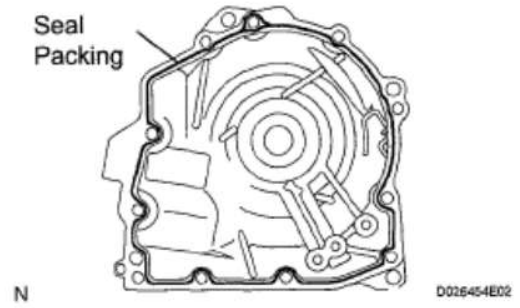


Fig. 463: Applying Seal Packing To Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **Make sure that the seal packing is applied in a bead (section diameter: 1.2) so that the entire sealing surface will be evenly sealed. The seal packing should also protrude slightly from the flange after the assembly of the parts has been completed.**

c. Apply adhesive to the "A" bolt threads.

Adhesive: Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

d. Install the 11 bolts.

Torque: Bolt A

19 N*m (190 kgf*cm, 14 ft.*lbf)

Other bolts: 25 N*m (250 kgf*cm, 18 ft.*lbf)

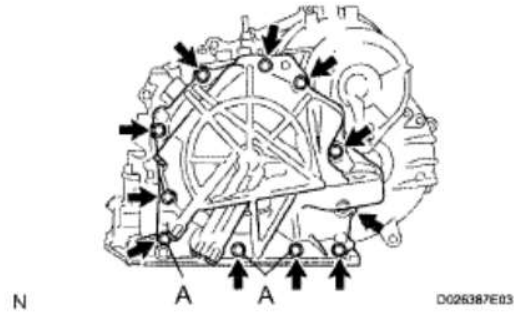


Fig. 464: Applying Adhesive To Bolt Threads
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

36. **INSTALL NO. 2 UNDERDRIVE CLUTCH DISC**
    a. Coat the 4 discs with ATF.
    b. Install the 4 discs, 4 plates, and flange to the transaxle case.

cardiagn.com

NOTE: **Make sure that discs, plate, and flange assembly are installed in the correct order.**

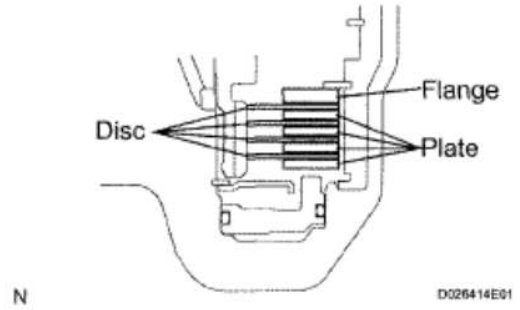


Fig. 465: Identifying Discs, Plates And Flange
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a screwdriver, install the snap ring.

NOTE: **The snap ring should be fully engaged in the groove of the drum.**

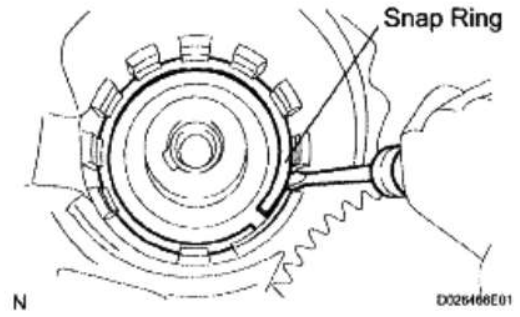


Fig. 466: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

37. **INSPECT PACK CLEARANCE OF UNDERDRIVE BRAKE**

a. Using a dial indicator, measure the underdrive brake pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

Pack clearance: 1.81 to 2.20 mm (0.0713 to 0.0866 in.)

HINT:

Select an appropriate flange from the table below so that it will be within the specified range.

cardiagn.com

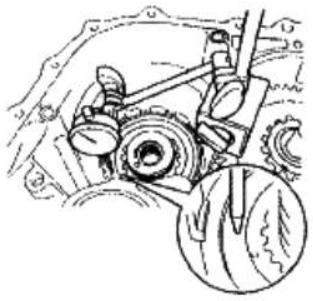


Fig. 467: Inspecting Pack Clearance Of Underdrive Brake
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	3.0 (0.118)	4	3.1 (0.122)
2	3.2 (0.126)	5	3.3 (0.130)
3	3.4 (0.134)	-	-

b. Temporarily remove the snap ring and attach it to the flange.
c. Reinstall the snap ring.

38. **INSPECT UNDERDRIVE ONE-WAY CLUTCH ASSEMBLY**
    a. Install the underdrive clutch assembly to the one-way clutch.
    b. Rotate the underdrive clutch assembly to check the rotating direction for the lock or free operation.

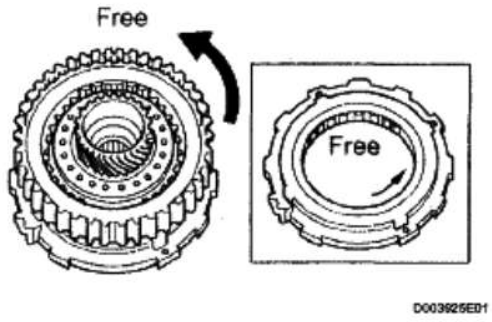


Fig. 468: Checking Rotating Direction For Lock Or Free Operation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

39. **INSTALL UNDERDRIVE ONE-WAY CLUTCH ASSEMBLY**
    a. Install the outer race retainer to the one-way clutch.

NOTE: Secure the outer race retainer to the external tooth of the one-way clutch firmly.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

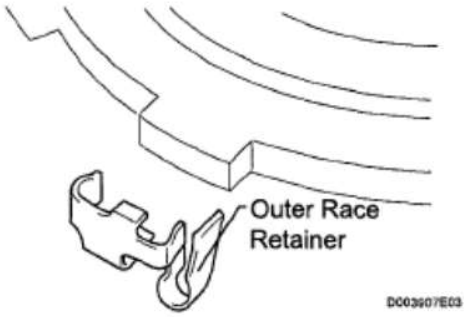


Fig. 469: Identifying Outer Race Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the one-way clutch to the transaxle case.

NOTE: Make sure that the mark on the one-way clutch outer race can be seen.

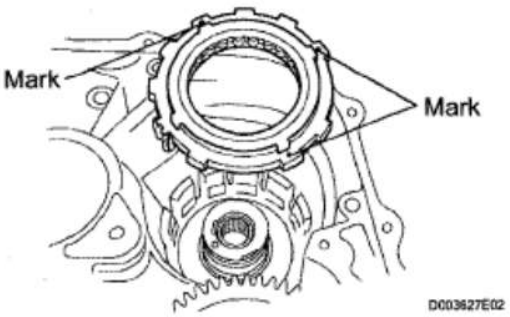


Fig. 470: Identifying Mark On One-Way Clutch Outer Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a screwdriver, install the snap ring to the transaxle case.

NOTE: The snap ring should be fully engaged in the groove of the transaxle case.

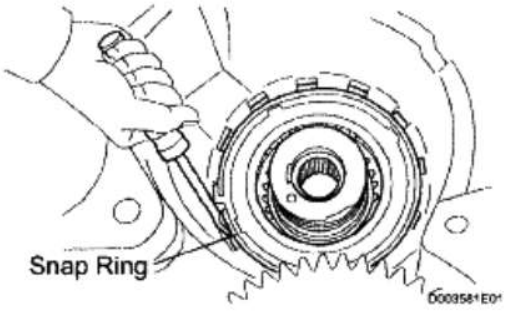


Fig. 471: Installing Snap Ring To Transaxle Case

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

40. **INSTALL UNDERDRIVE CLUTCH ASSEMBLY**
    a. Coat the bearing and bearing race with petroleum jelly, and install them onto the underdrive clutch.

Bearing and bearing race diameter: mm (in.)

BEARING AND BEARING RACE DIAMETER SPECIFICATION

	Inside	Outside
Bearing	37.73 (1.4854)	58.0 (2.2835)
Race	29.9 (1.1772)	55.5 (2.185)

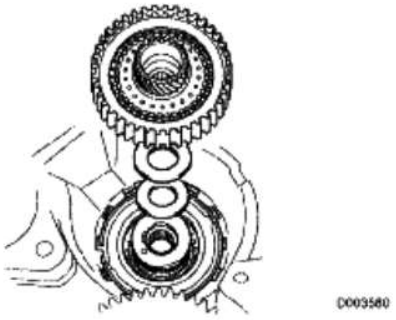


Fig. 472: Identifying Underdrive Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Install the underdrive clutch assembly to the transaxle case.

NOTE: Do not damage the oil seal when installing the underdrive clutch drum sub-assembly.

41. **INSTALL PARKING LOCK PAWL**
    a. Install the pawl pin and spring to the parking lock pawl.

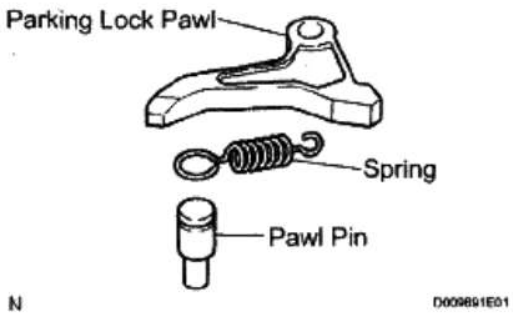


Fig. 473: Identifying Pawl Pin And Spring To Parking Lock Pawl
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Temporarily install the parking lock pawl, shaft, and spring to the transaxle case as shown in the illustration.

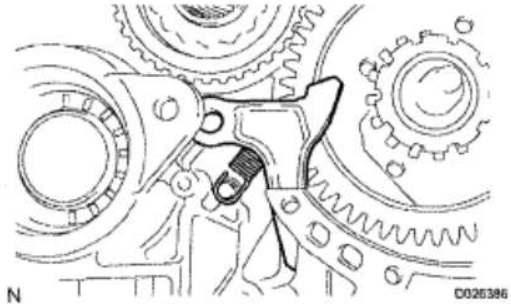


Fig. 474: Identifying Parking Lock Pawl, Shaft And Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

42. **INSTALL UNDERDRIVE PLANETARY GEAR ASSEMBLY**

a. Install the underdrive planetary gear assembly to the transaxle case.

NOTE:

- **Fully engage all the discs of the underdrive clutch and hub splines of the underdrive planetary gear assembly and install them securely.**
- **Check the number and position of the gear teeth.**

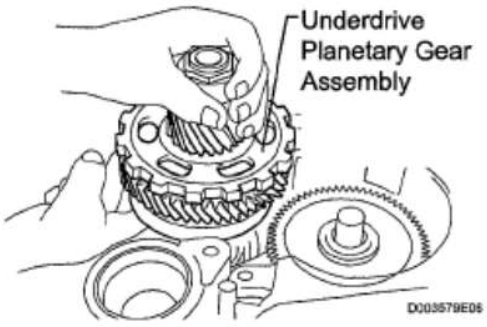


Fig. 475: Identifying Underdrive Planetary Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the parking lock pawl shaft.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

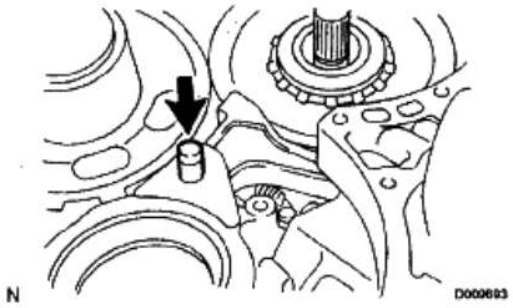


Fig. 476: Locating Parking Lock Pawl Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the pawl shaft clamp with the bolt.

Torque: 9.8 N*m (100 kgf*cm, 87 in.*lbf)

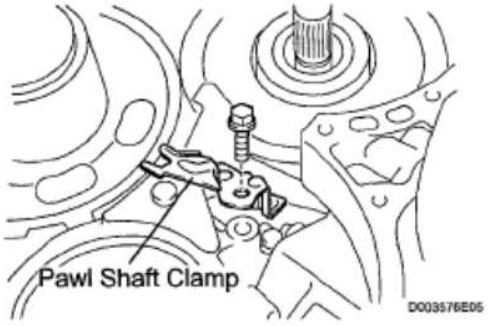


Fig. 477: Identifying Pawl Shaft Clamp With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a straightedge and vernier calipers as shown in the illustration, measure the gap between the top of the differential drive pinion in the underdrive planetary gear and the contact surface of the transaxle case and housing (Dimension E).

NOTE: Record dimension E for the following process.

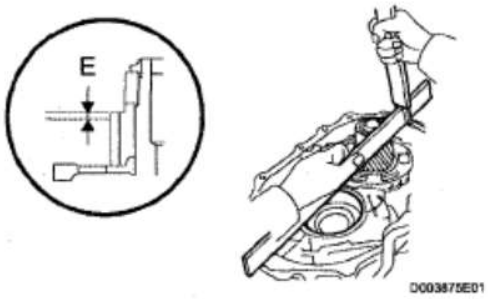


Fig. 478: Measuring Gap Between Top Of Differential Drive Pinion In Underdrive Planetary Gear And Contact Surface

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. As shown in the illustration, measure the 2 places of the transaxle housing, and calculate dimension F using the formula below.

NOTE: Record dimension F for the following process.

HINT:

Dimension F = Dimension (1) - Dimension (2)

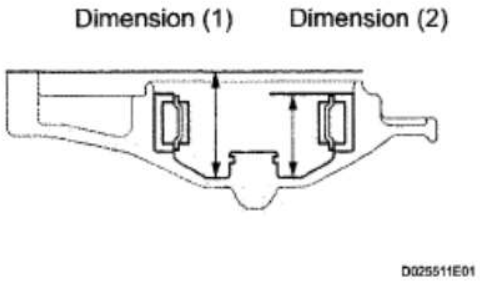


Fig. 479: Measuring Of Transaxle Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

43. **INSTALL MULTIPLE DISC CLUTCH HUB**

a. Install the No. 1 thrust bearing race to the transaxle case while checking its direction.

Bearing race diameter: mm (in.)

BEARING RACE DIAMETER SPECIFICATION

	Inside	Outside
Bearing race	39.5 (1.555)	45.8 (1.803)

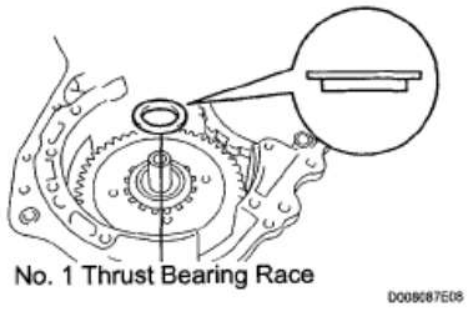


Fig. 480: Identifying No. 1 Thrust Bearing Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Coat the thrust needle roller bearing and race with yellow petrolatum, and install them onto the

cardiagn.com

multiple disc clutch hub.

Thrust bearing and race diameter: mm (in.)

THRUST BEARING AND RACE DIAMETER SPECIFICATION

	Inside	Outside
Thrust Bearing	36.4 (1.433)	52.2 (2.055)

c. Coat the needle roller bearing with ATF.

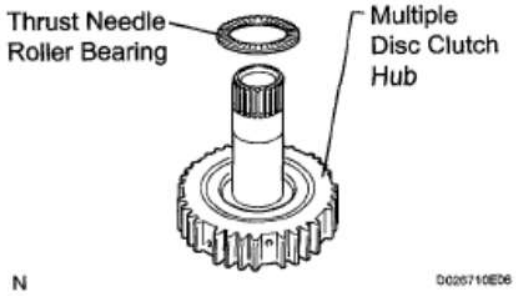


Fig. 481: Identifying Thrust Needle Roller Bearing And Multiple Disc Clutch Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the needle roller bearing to the multiple clutch hub.

Bearing diameter: mm (in.)

BEARING DIAMETER SPECIFICATION

	Inside	Outside
Bearing	23.6 (0.929)	44 (1.732)

e. Install the multiple clutch hub to the transaxle case.

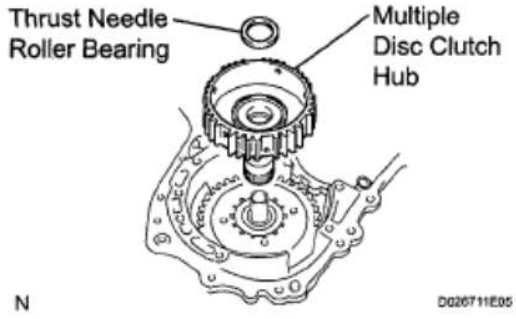


Fig. 482: Identifying Needle Roller Bearing And Multiple Clutch Hub
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

44. **INSTALL FORWARD CLUTCH ASSEMBLY**

cardiagn.com

a. Coat the thrust needle roller bearing with ATF.
b. Install the thrust needle roller bearing to the forward clutch.

Thrust bearing diameter: mm (in.)

THRUST BEARING DIAMETER SPECIFICATION

	Inside	Outside
Thrust Bearing	33.58 (1.3220)	51.9 (2.043)

NOTE: Install the thrust bearing properly so that the no-colored race or blue ink jet race can be seen.



Fig. 483: Identifying Thrust Needle Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the forward clutch to the forward clutch assembly.

NOTE:
- **Align the splines of all discs in the forward clutch with those of multiple clutch hub to install them securely.**
- **Be careful not to damage the bushing inside of the forward clutch hub during installation.**

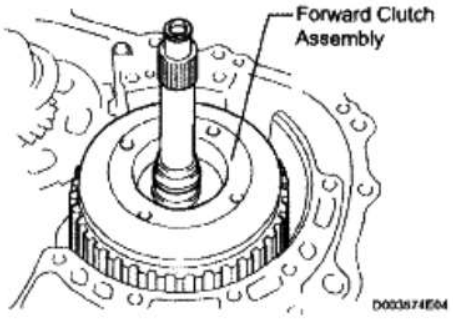


Fig. 484: Identifying Forward Clutch Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

45. **INSTALL OVERDRIVE BRAKE GASKET**

cardiagn.com

a. Install 2 new overdrive brake gaskets.

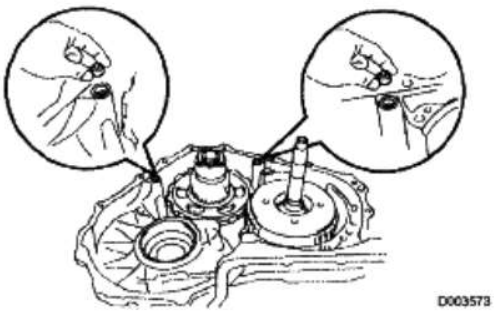


Fig. 485: Identifying Overdrive Brake Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

46. **INSTALL DIFFERENTIAL GEAR ASSEMBLY**

a. Install the differential gear assembly to the transaxle case.

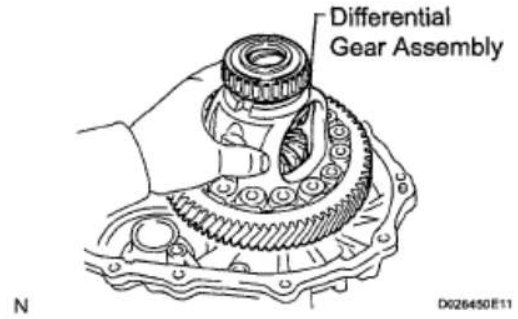


Fig. 486: Identifying Differential Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

47. **INSTALL NO. 2 THRUST BEARING UNDERDRIVE RACE**

a. Install the No. 2 thrust bearing underdrive race to the underdrive planetary gear assembly.

cardiagn.com

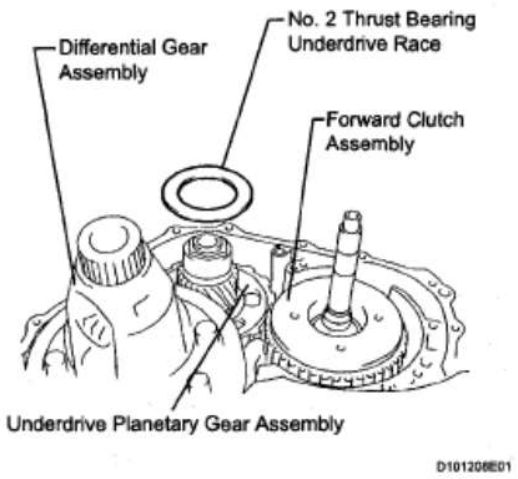


Fig. 487: Identifying No. 2 Thrust Bearing Underdrive Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

48. **INSTALL THRUST NEEDLE ROLLER BEARING**

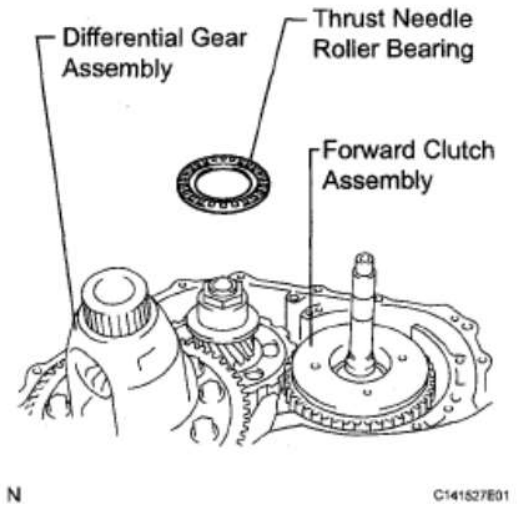
a. Coat the thrust needle roller bearing with ATF.

b. Calculate the end play using the following formula and values of dimension E and F that are measured when installing the cylindrical roller bearing and underdrive planetary gear. Select an appropriate No. 2 underdrive planetary gear thrust bearing race which satisfies the specified end play, and install the selected bearing race.

End play: 0.498 to 0.993 mm (0.01961 to 0.03909 in.)

HINT:

End play = Dimension F - Dimension E - thrust bearing thickness 2.5 mm (0.0984 in.) - No. 2 underdrive thrust bearing race thickness.



cardiagn.com

Fig. 488: Identifying Thrust Needle Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Race thickness: mm (in.)

RACE THICKNESS SPECIFICATION

F - E	Thickness
Less than 7.72 (0.3039)	3.5 (0.138)
7.72 (0.3039)	3.8 (0.150)

Bearing and bearing race diameter: mm (in.)

BEARING AND BEARING RACE DIAMETER SPECIFICATION

	Inside	Outside
Bearing	57.2 (2.252)	84.96 (3.345)
Bearing race	56.4 (2.22)	83 (3.268)

49. **INSTALL OIL PUMP ASSEMBLY**
    a. Install the oil pump to the transaxle case with the 7 bolts.

Torque: 22 N*m (226 kgf*cm, 16 ft.*lbf)

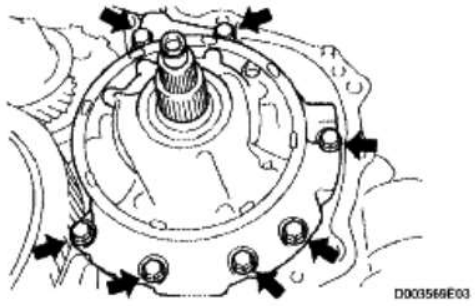


Fig. 489: Locating Oil Pump Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Coat the O-ring of the oil pump with ATF.

NOTE: Confirm that the input shaft rotates smoothly with the manual operation after installing the oil pump.

cardiagn.com

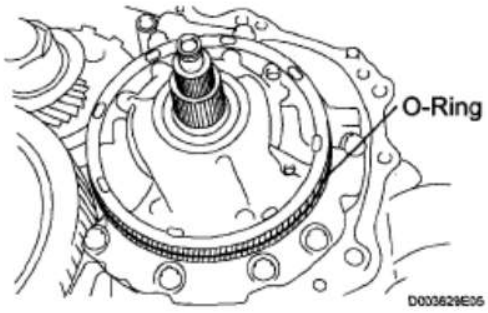


Fig. 490: Identifying Oil Pump O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

50. **INSTALL TRANSAXLE HOUSING**
    a. Remove any packing material and be careful not to spill oil on the contact surface of the transaxle case or transaxle housing.
    b. Apply seal packing to the transaxle case.

    Seal packing: Toyota Genuine Seal Packing 1281, Three Bond 1281 or equivalent

    Seal Bead Width: 1.2 mm (0.047 in.)

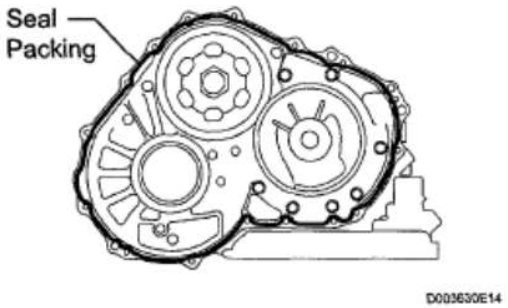


Fig. 491: Applying Seal Packing To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Install the transaxle housing and 16 bolts to the transaxle case.

    Torque: Bolt A

    25 N*m (255 kgf*cm, 18 ft.*lbf)

    Bolt B

    33 N*m (337 kgf*cm, 24 ft.*lbf)

    Bolt C

cardiagn.com

29 N*m (295 kgf*cm, 21 ft.*lbf)

Bolt D

28 N*m (286 kgf*cm, 21 ft.*lbf)

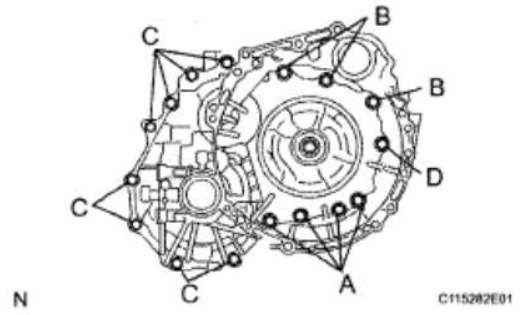


Fig. 492: Identifying Transaxle Housing And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Apply adhesive to bolts A and D.

Adhesive: Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

Bolt length

Bolt A, B: 50 mm (1.969 in.)

Bolt C: 42 mm (1.654 in.)

Bolt D: 72 mm (2.835 in.)

NOTE: Apply adhesive to the bolts and tighten them within 10 minutes of application.

HINT:

Bolt A is a non-reusable bolt. However, bolt A can be used after cleaning it.

51. **INSPECT INPUT SHAFT END PLAY**
    a. Using a dial indicator, measure the input shaft end Play.

End play: 0.262 to 1.249 mm (0.0103 to 0.0492 in.)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

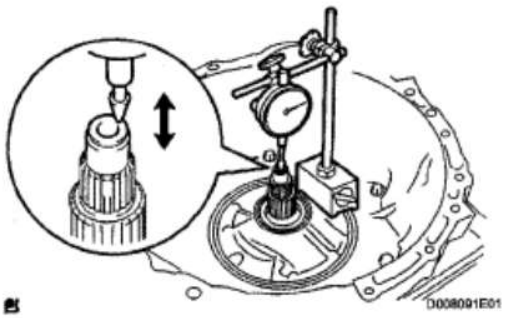


Fig. 493: Measuring Input Shaft End Play
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

52. **SUPPORT AUTOMATIC TRANSAXLE ASSEMBLY**
    a. Support the transaxle assembly on wooden blocks.

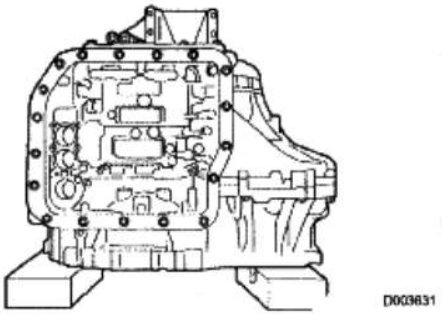
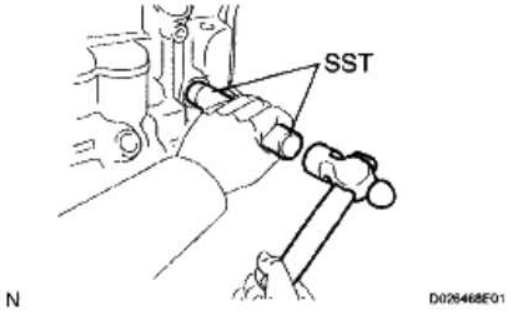


Fig. 494: Supporting Transaxle Assembly On Wooden Blocks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

53. **INSTALL MANUAL VALVE LEVER SHAFT OIL SEAL**
    a. Coat a new oil seal with MP grease.
    b. Install the oil seal to the transaxle case.

SST 09950-60010 (09951-00230), 09950-70010 (09951-07100)

Oil seal installation depth: 0.5 to -0.5 mm (0.02 to -0.02 in.)



cardiagn.com

Fig. 495: Tapping Manual Valve Lever Shaft Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

54. **INSTALL PARKING LOCK ROD SUB-ASSEMBLY**
    a. Install the parking lock rod to the manual valve lever.

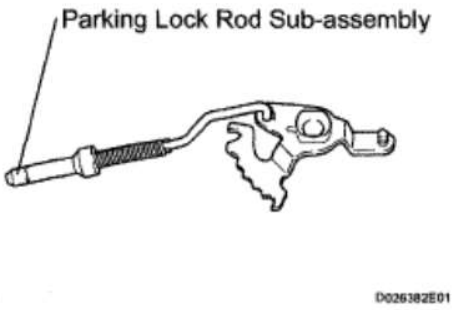


Fig. 496: Identifying Parking Lock Rod Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

55. **INSTALL MANUAL VALVE LEVER SUB-ASSEMBLY**
    a. Install a new spacer and manual valve lever shaft to the transaxle case.

NOTE: Do not damage the oil seal when installing the shaft to the transaxle case.

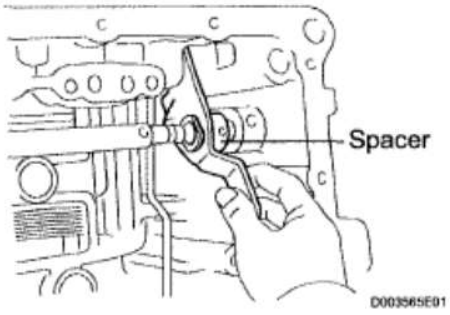


Fig. 497: Installing Spacer And Manual Valve Lever Shaft To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using a pin punch and hammer, drive in a new pin.

cardiagn.com

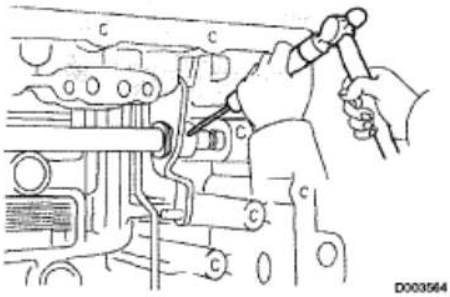


Fig. 498: Tapping Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Turn the spacer and the lever shaft to align the small hole for locating the staking position in the spacer with the staking position mark on the lever shaft.
d. Using a pin punch, stake the spacer through the small hole.
e. Check that the spacer does not turn.

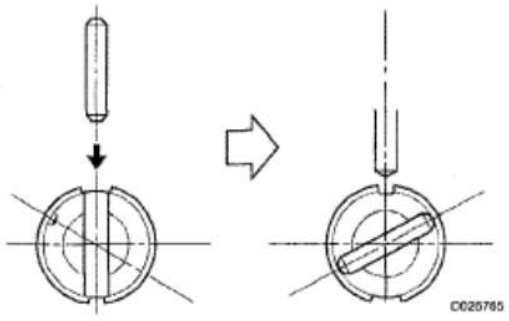


Fig. 499: Staking Spacer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

56. **INSTALL MANUAL VALVE LEVER SHAFT RETAINER SPRING**
a. Using needle-nose pliers, install the retainer spring.

NOTE: Hang the spring on the shaft firmly.

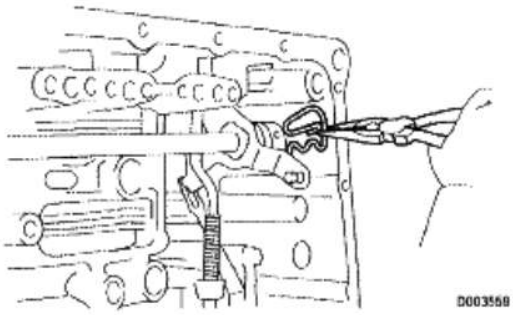


Fig. 500: Installing Retainer Spring

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

57. **INSTALL PARKING LOCK PAWL BRACKET**
    a. Install the parking lock pawl bracket with the 2 bolts.

Torque: 20 N*m (205 kgf*cm, 15 ft.*lbf)

Bolt length: 25 mm (0.984 in.)

NOTE: Make sure that the parking rod is placed between the parking pawl and the guide of the parking bracket when the parking bracket is installed.

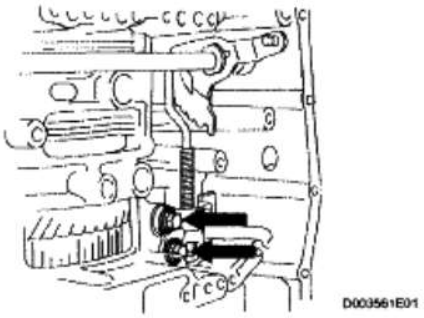


Fig. 501: Locating Parking Lock Pawl Bracket With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

58. **INSTALL MANUAL DETENT SPRING SUB-ASSEMBLY**
    a. Install the manual detent spring sub-assembly with the 2 bolts.

NOTE: Make sure to install the manual detent spring and cover in this order.

HINT:

Tighten bolt A first, and then bolt B.

Torque: Bolt A

20 N*m (205 kgf*cm, 15 ft.*lbf)

cardiagn.com

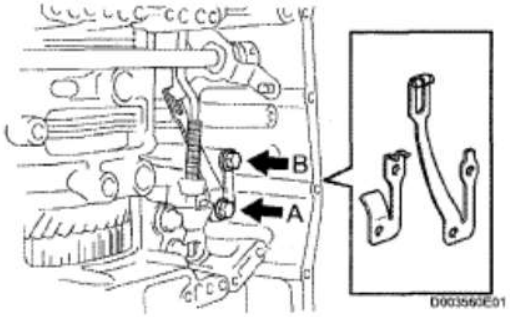


Fig. 502: Locating Manual Detent Spring Sub-Assembly With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Bolt B

12 N*m (120 kgf*cm, 9 ft.*lbf)

Bolt length:

Bolt A: 27 mm (1.063 in.)

Bolt B: 16 mm (0.630 in.)

59. **INSTALL B-3 ACCUMULATOR PISTON**
    a. Coat a new O-ring with ATF and install it to the B-3 accumulator piston.

NOTE: **Make sure that the O-ring is not twisted and that it does not protrude abnormally from the accumulator piston. Apply sufficient ATF before installing the O-ring. The O-ring must be installed in the correct position.**

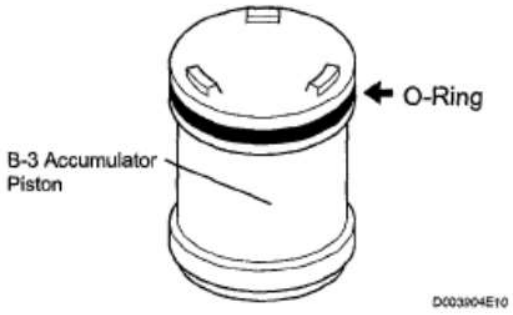


Fig. 503: Locating B-3 Accumulator Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Coat the piston with ATF and install it to the transaxle case.

NOTE: **Install the springs to each accumulator piston, checking the**

cardiagn.com

identification color or each spring.

Accumulator spring:

FREE LENGTH OUTER DIAMETER SPECIFICATION

Free length Outer diameter mm (in.)	Color
Inner 62.00 (2.4409)/15.50 (0.610)	Purple
Outer 74.23 (2.9224)/21.70 (0.854)	Purple

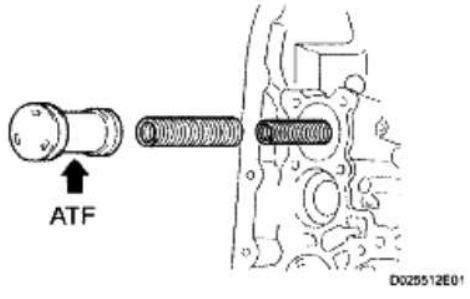


Fig. 504: Identifying Piston With ATF
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

60. **INSTALL REVERSE CLUTCH ACCUMULATOR PISTON**
    a. Coat 2 new O-rings with ATF and install them to the reverse accumulator piston.

NOTE: Make sure that the O-ring is not twisted and that it does not protrude abnormally from the accumulator piston. Apply sufficient ATF before installing the O-ring. The O-ring must be installed in the correct position.

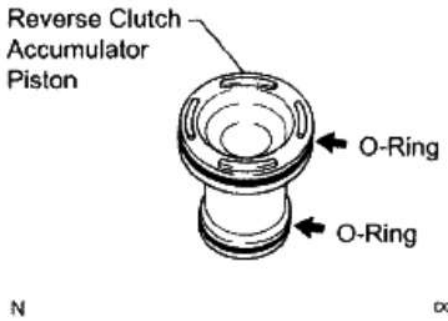


Fig. 505: Identifying Reverse Clutch Accumulator Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Coat the piston with ATF and install it to the transaxle case.

NOTE: Install the springs to each accumulator piston, checking the

cardiagn.com

identification color or each spring.

Accumulator spring:

FREE LENGTH OUTER DIAMETER SPECIFICATION

Free length Outer diameter mm (in.)	Color
60.96 (2.3999)/14.10 (0.555)	Yellow

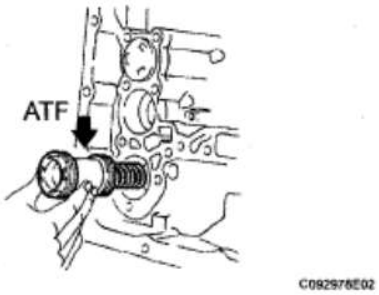


Fig. 506: Installing Accumulator Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

61. **INSTALL C-3 ACCUMULATOR PISTON**
    a. Coat a new O-ring with ATF and install it to the C-3 accumulator piston.

NOTE: **Make sure that the O-ring is not twisted and that it does not protrude abnormally from the accumulator piston. Apply sufficient ATF before installing the O-ring. The O-ring must be installed in the correct position.**

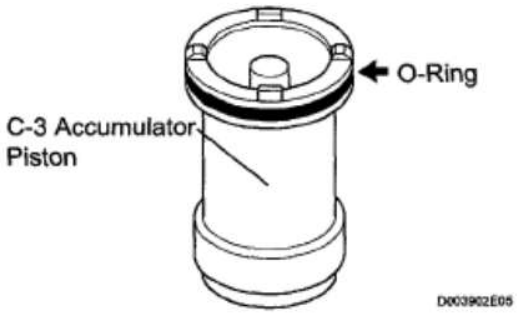


Fig. 507: Locating C-3 Accumulator Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Coat the piston with ATF and install it to the transaxle case.

NOTE: **Install the springs to each accumulator piston, checking the identification color or each spring.**

cardiagn.com

Accumulator spring:

FREE LENGTH OUTER DIAMETER SPECIFICATION

Free length Outer diameter mm (in.)	Color
72.20 (2.8425)/19.0 (0.748)	Colorless

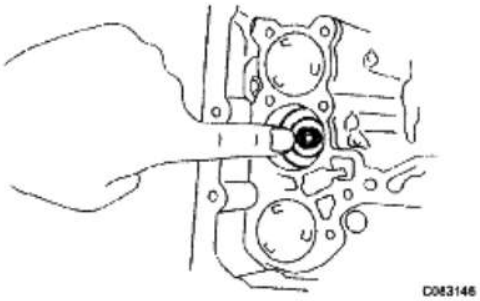


Fig. 508: Identifying Piston Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the spring to the C-3 accumulator piston.

NOTE: Install the springs to each accumulator piston, checking the identification color or each spring.

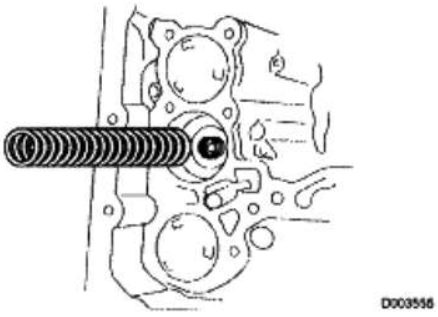


Fig. 509: Identifying Spring To C-3 Accumulator Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

62. **INSTALL CHECK BALL BODY**
    a. Coat the check ball body with ATF.
    b. Install the check ball body and spring.

NOTE: Be sure to place the spring in the hole in the check ball body. Make sure that they are installed in the correct direction.

cardiagn.com

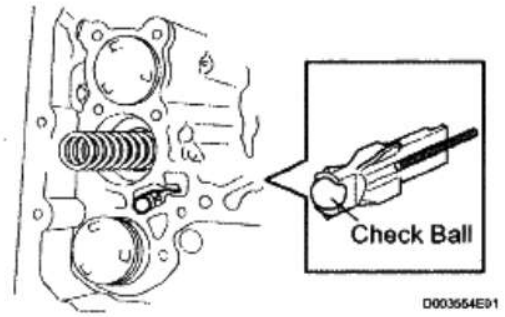


Fig. 510: Identifying Check Ball Body And Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

63. **INSTALL BRAKE DRUM GASKET**
    a. Coat a new brake drum gasket with ATF and install it to the transaxle case.

NOTE: **Be sure not to damage the lip of the transaxle case brake gasket when inserting the gasket to the case. Apply sufficient ATF to the gasket before installation. Make sure that they are installed in the correct direction.**

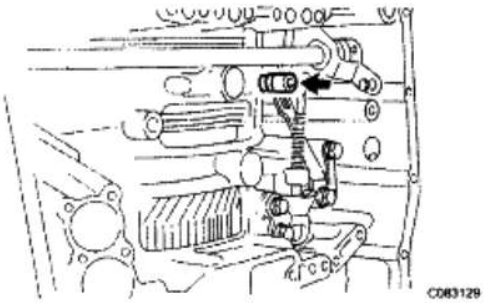


Fig. 511: Locating Brake Drum Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

64. **INSTALL TRANSAXLE CASE 2ND BRAKE GASKET**
    a. Coat a new transaxle case 2nd brake gasket with ATF and install it to the transaxle case.

NOTE: **Be sure not to damage the lip of the transaxle case brake gasket when inserting the gasket to the case. Apply sufficient ATF to the gasket before installation. Make sure that they are installed in the correct direction.**

cardiagn.com

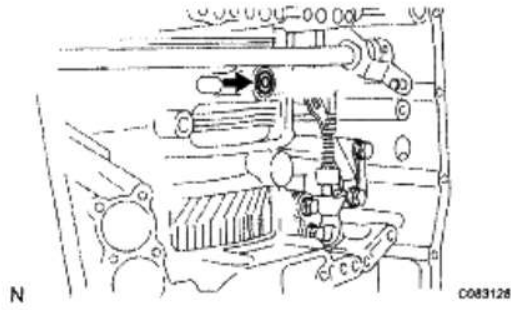


Fig. 512: Locating Transaxle Case 2nd Brake Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

65. **INSTALL NO. 1 GOVERNOR APPLY GASKET**

a. Coat a new No. 1 governor apply gasket with ATF and install it to the transaxle case.

NOTE: Be sure not to damage the lip of the transaxle case brake gasket when inserting the gasket to the case. Apply sufficient ATF to the gasket before installation. Make sure that they are installed in the correct direction.

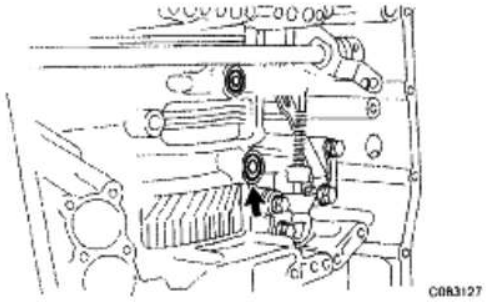


Fig. 513: Locating No. 1 Governor Apply Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

66. **INSTALL TRANSMISSION WIRE**

a. Coat a new O-ring with ATF and install it to the transmission wire.

NOTE: Make sure that the O-ring is not twisted, protruded, or pinched when installing the wire transmission to the transaxle case. Apply sufficient ATF to the O-ring before installation.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

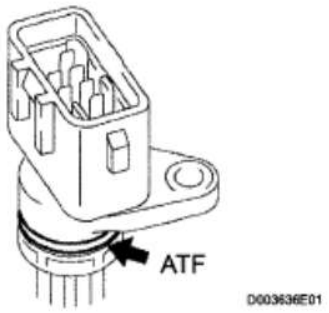


Fig. 514: Locating Transmission Wire O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the bolt that retains the transmission wire.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

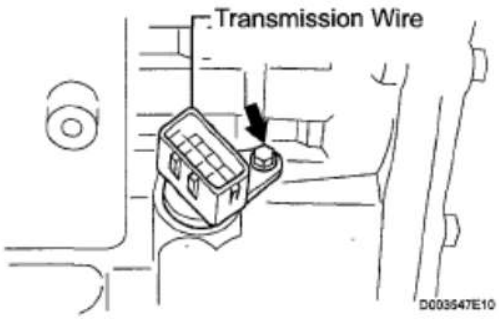


Fig. 515: Locating Transmission Wire Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

67. **CONNECT TRANSMISSION WIRE**
   a. Coat an O-ring of the ATF temperature sensor with ATF.
   b. Install the ATF temperature sensor with the lock plate and bolt.

Torque: 6.6 N*m (67 kgf*cm, 58 in.*lbf)

   c. Connect the 7 solenoid connectors.

NOTE:

- **Connect the connectors A, B, C, D, E, F, G, in the order from the shortest to longest.**
- **Apply ATF to the bolt.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

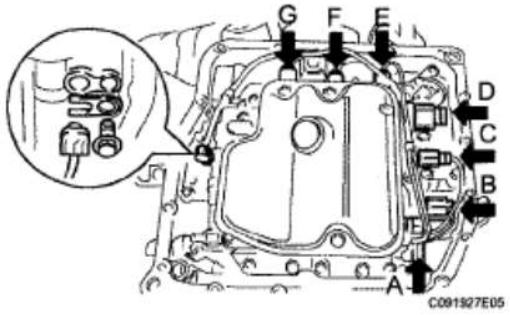


Fig. 516: Locating Solenoid Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

68. **INSTALL TRANSMISSION VALVE BODY ASSEMBLY**

a. While positioning the manual valve lever position, install the valve body to the transaxle case with the 17 bolts.

Torque: 11 N*m (110 kgf*cm, 8 ft.*lbf)

Bolt length:

Bolt A: 25 mm (0.984 in.)

Bolt B: 57 mm (2.244 in.)

Bolt C: 41 mm (1.614 in.)

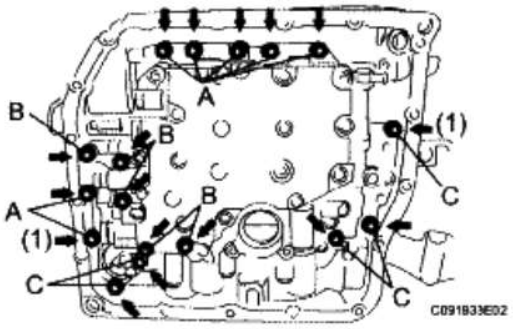


Fig. 517: Locating Transmission Valve Body Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **Push the valve body against the accumulator piston spring and the check ball body to install the valve body.**
- **When installing the valve body to the transaxle case, do not hold the solenoids.**
- **Temporarily tighten the bolts marked (1) in the illustration first**

cardiagn.com

because they are positioning bolts.

69. **INSTALL VALVE BODY OIL STRAINER ASSEMBLY**
    a. Coat a new O-ring with ATF and install it to the oil strainer.

NOTE: **Make sure that the O-ring is not twisted or pinched. Apply sufficient ATF to the O-ring before installation.**

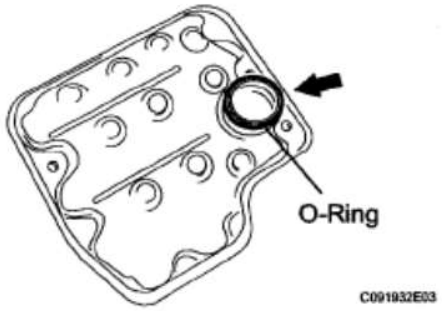


Fig. 518: Locating Oil Strainer O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Install the oil strainer and 3 bolts to the valve body.

Torque: 11 N*m (110 kgf*cm, 8 ft.*lbf)

NOTE: **Apply ATF to the bolts.**

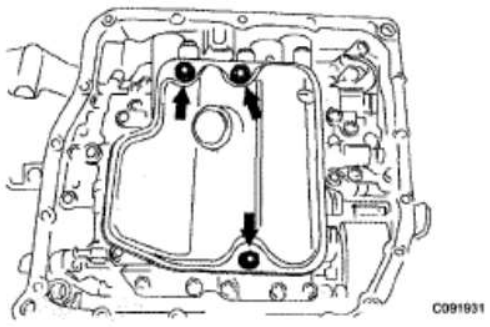


Fig. 519: Locating Oil Strainer Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

70. **INSTALL AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY**
    a. Install the 2 magnets to the oil pan.
    b. Apply adhesive to 18 new bolts.

Adhesive: Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

cardiagn.com

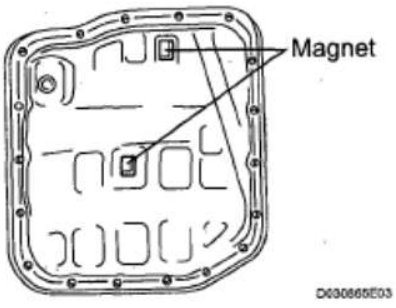


Fig. 520: Identifying Magnets From Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the oil pan and new oil pan gasket to the transaxle case with the 18 bolts.

Torque: 7.8 N*m (80 kgf*cm, 69 in.*lbf)

NOTE:

- **Apply adhesive to the bolts and tighten them within 10 minutes of application.**
- **Completely remove any oil or grease from the contact surface of the transaxle case and the oil pan with the gasket before installing the oil pan to the case.**

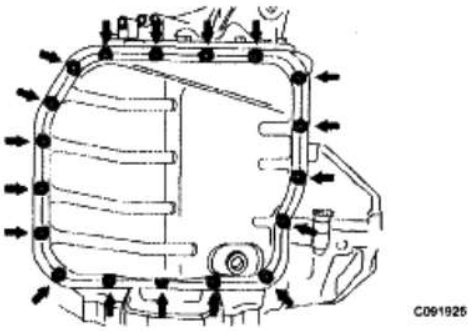


Fig. 521: Locating Oil Pan Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

71. **INSTALL NO. 1 TRANSAXLE CASE PLUG**
    a. Coat 4 new O-rings with ATF, and install them to the 4 No. 1 transaxle case plugs.
    b. Install the 4 No. 1 transaxle case plugs to the transaxle case.

Torque: 7.4 N*m (75 kgf*cm, 65 in.*lbf)

cardiagn.com

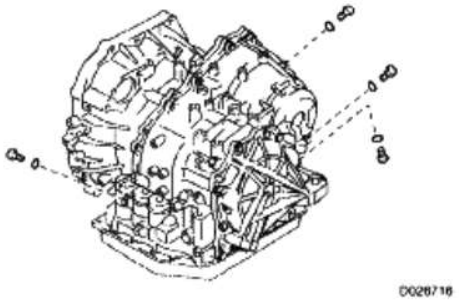


Fig. 522: Identifying No. 1 Transaxle Case Plugs
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

72. **INSTALL SPEED SENSOR**
    a. Coat 2 new O-rings with ATF and install them to the 2 sensors.
    b. Install the 2 sensors to the transaxle case with the 2 bolts.

    Torque: 11 N*m (115 kgf*cm, 8 ft.*lbf)

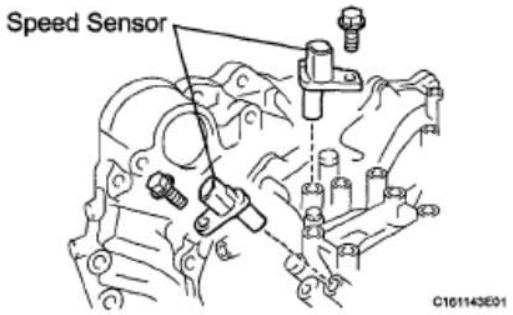


Fig. 523: Identifying Speed Sensors With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

73. **INSTALL OIL COOLER TUBE UNION (OUTLET OIL COOLER UNION)**
    a. Coat a new O-ring with ATF and install it to the elbow.
    b. Install the elbow to the transaxle case.

    Torque: 27 N*m (276 kgf*cm, 20 ft.*lbf)

cardiagn.com

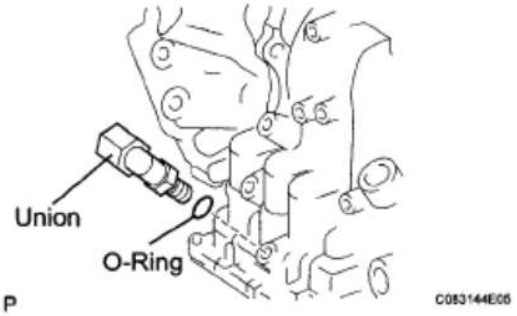


Fig. 524: Identifying O-Ring And Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

74. **INSTALL OIL COOLER TUBE UNION (INLET OIL COOLER UNION)**
    a. Coat a new O-ring with ATF and install it to the union.
    b. Install the union to the transaxle case.

    Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

75. **INSTALL BREATHER PLUG HOSE**
    a. Install the breather plug hose to the transaxle case firmly.

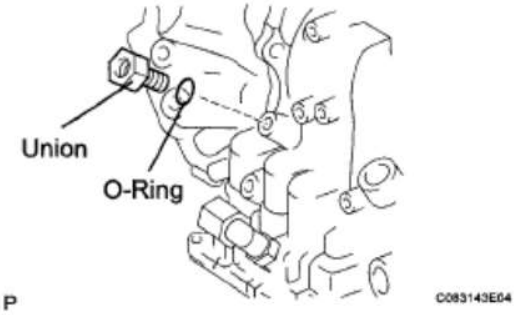


Fig. 525: Identifying O-Ring And Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

76. **INSTALL PARK/NEUTRAL POSITION SWITCH ASSEMBLY**
    a. Install the park/neutral position switch to the manual valve shaft.
    b. Temporarily install the 2 bolts.

cardiagn.com

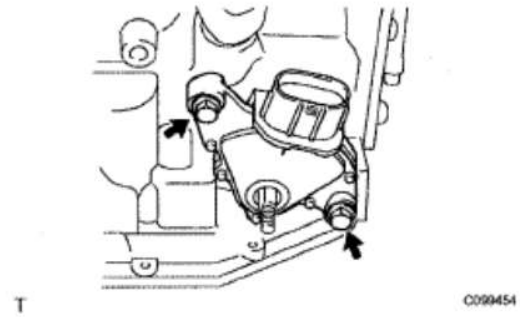


Fig. 526: Locating Park/Neutral Position Switch Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install a new lock plate and tighten the nut.

Torque: 6.9 N*m (70 kgf*cm, 61 in.*lbf)

d. Temporarily install the control shaft lever.

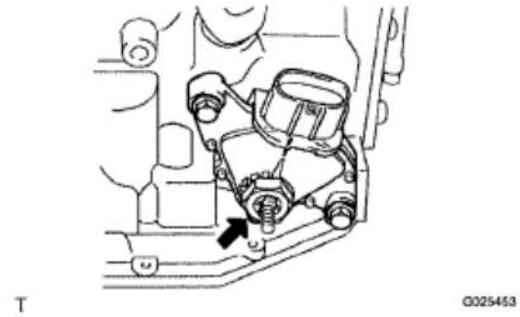


Fig. 527: Locating Lock Nut And Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Turn the lever counterclockwise until it stops and then turn it clockwise 2 notches.
f. Remove the control shaft lever.

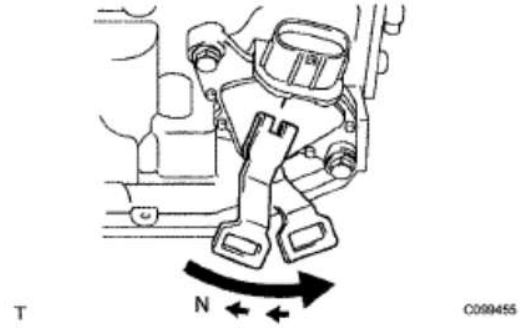


Fig. 528: Identifying Control Shaft Lever Turning Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

g. Align the groove with the neutral basic line.
h. Hold the switch in position and tighten the 2 bolts.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)

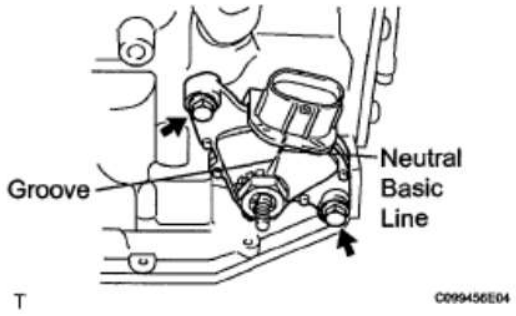


Fig. 529: Aligning Groove With Neutral Basic Line
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

i. Using a screwdriver, bend the tabs of the lock plate.

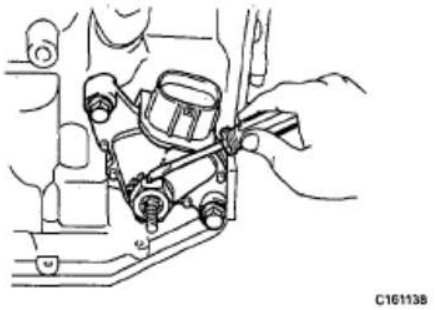


Fig. 530: Prying Up Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. Install the control shaft lever, washer and nut.

Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

77. **INSTALL SPEEDOMETER DRIVEN HOLE (ATM) COVER SUB-ASSEMBLY**
a. Coat a new O-ring with ATF and install it to the speedometer driven hole cover.
b. Install the bolt and speedometer driven hole cover sub-assembly to the transaxle assembly.

Torque: 6.9 N*m (70 kgf*cm, 61 in.*lbf)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

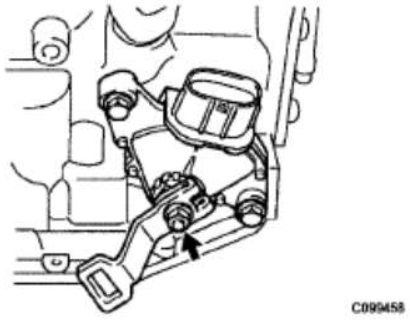


Fig. 531: Locating Nut, Washer And Control Shaft Lever
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OIL PUMP

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

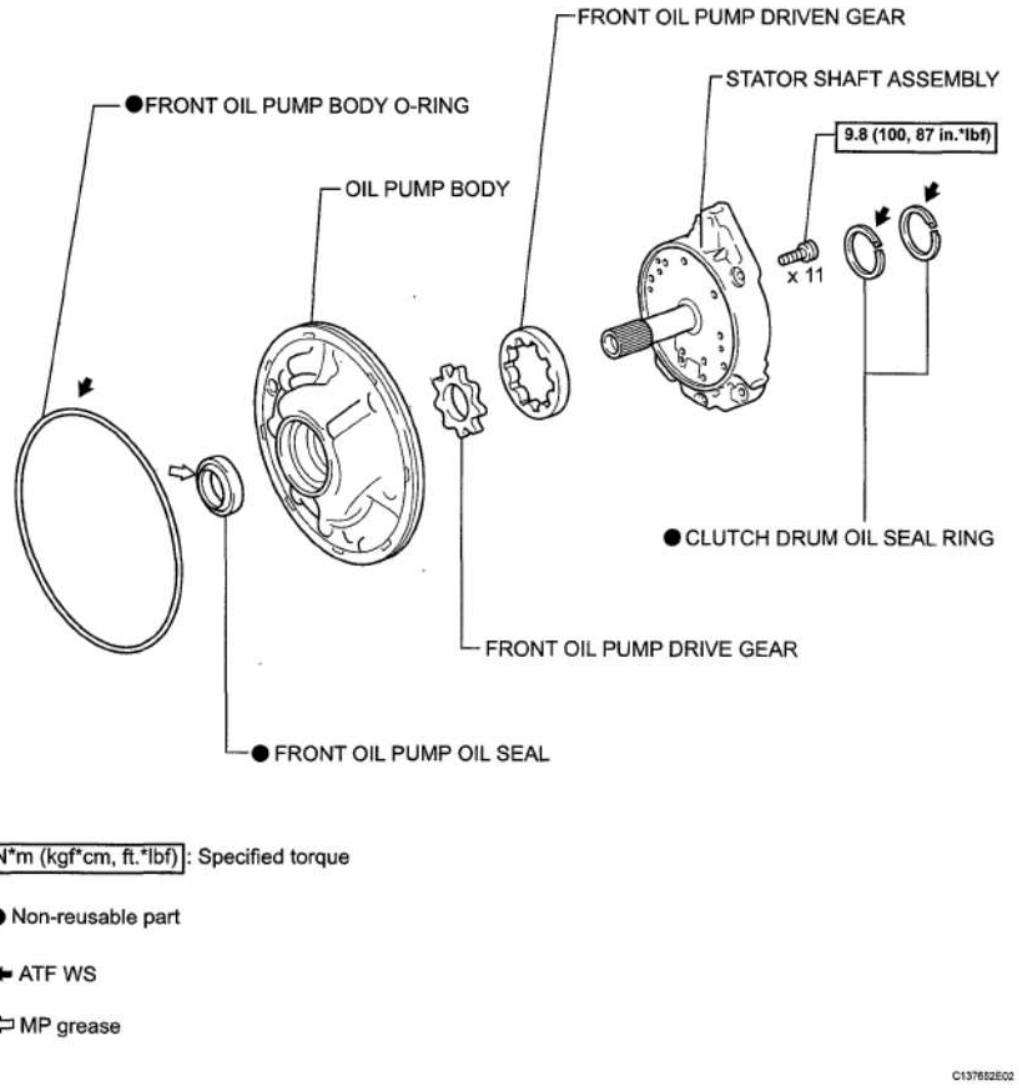


Fig. 532: Identifying Oil Pump Components With Torque Specification
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **INSPECT OIL PUMP ASSEMBLY** (See **INSPECTION**)
2. **REMOVE CLUTCH DRUM OIL SEAL RING**
   a. Remove the 2 clutch drum oil seal rings.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



Fig. 533: Identifying Clutch Drum Oil Seal Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE STATOR SHAFT ASSEMBLY**
   a. Using a "TORX" socket (T30), remove the 11 bolts and stator shaft.
4. **INSPECT CLEARANCE OF OIL PUMP ASSEMBLY** (See **INSPECTION**)

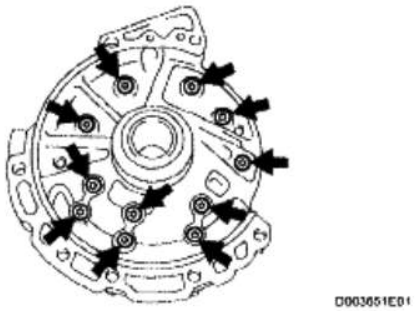


Fig. 534: Locating Stator Shaft Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE FRONT OIL PUMP DRIVE GEAR**
   a. Remove the front oil pump drive gear.

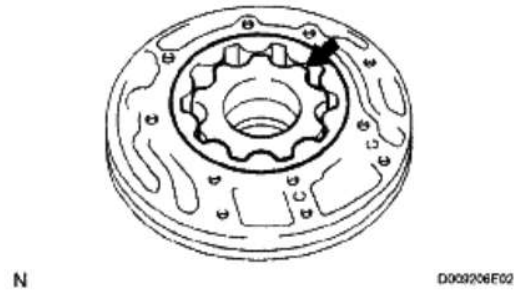


Fig. 535: Locating Front Oil Pump Drive Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE FRONT OIL PUMP DRIVEN GEAR**
   a. Remove the front oil pump driven gear.

cardiagn.com

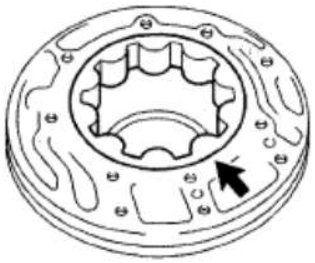


Fig. 536: Locating Front Oil Pump Driven Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **REMOVE FRONT OIL PUMP BODY O-RING**
   a. Using a screwdriver, remove the O-ring.

   HINT:

   Tape the screwdriver before use.

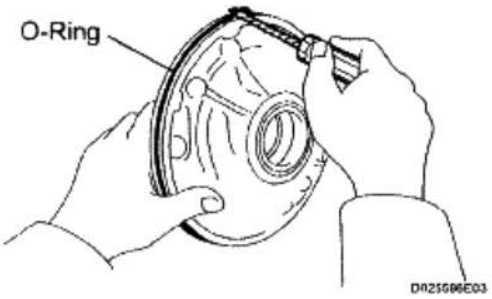
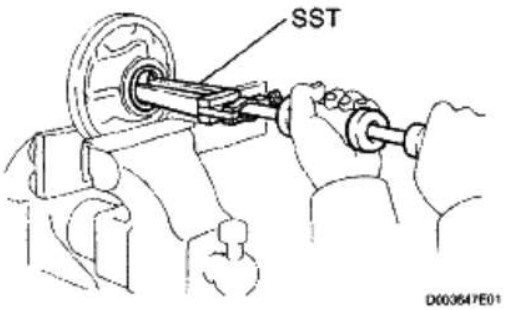


Fig. 537: Removing Front Oil Pump Body O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **REMOVE FRONT OIL PUMP OIL SEAL**
   a. Mount the oil pump in a soft jaw vise.
   b. Using SST, remove the oil seal from the oil pump body.

   SST 09308-00010



cardiagn.com

Fig. 538: Removing Oil Seal From Oil Pump Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT OIL PUMP ASSEMBLY**
   a. Turn the drive gear with 2 screwdrivers and make sure that it rotates smoothly.

NOTE: Be careful not to damage the oil seal lip.

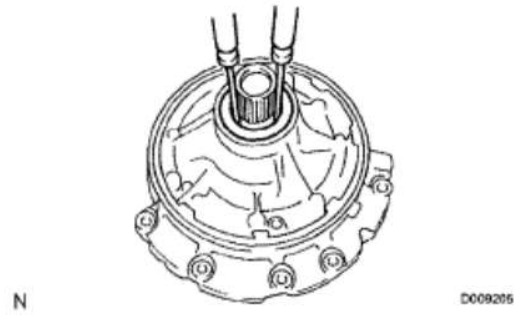


Fig. 539: Inspecting Oil Pump Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT CLEARANCE OF OIL PUMP ASSEMBLY**
   a. Push the driven gear to one side of the body.
   b. Using a feeler gauge, measure the clearance.

Standard body clearance: 0.10 to 0.17 mm (0.0039 to 0.0067 in.)

Maximum body clearance: 0.17 mm (0.0067 in.)

If the body clearance is greater than the maximum, replace the oil pump body sub-assembly.

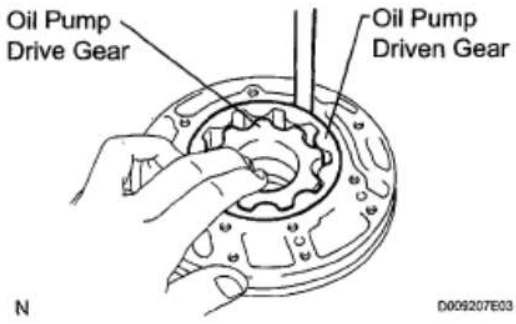


Fig. 540: Inspecting Clearance Of Oil Pump Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

c. Using a feeler gauge, measure the tip clearance between the driven gear teeth and drive gear teeth.

Standard tip clearance: 0.07 to 0.15 mm (0.0028 to 0.0059 in.)

Maximum tip clearance: 0.15 mm (0.0059 in.)

If the tip clearance is greater than the maximum, replace the oil pump body sub-assembly.

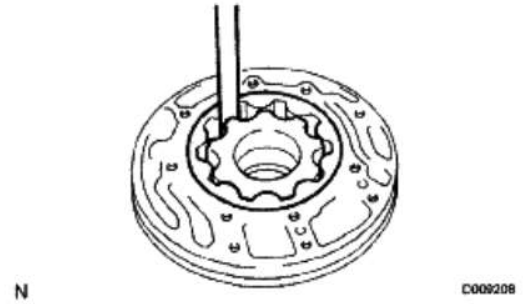


Fig. 541: Measuring Tip Clearance Between Driven Gear Teeth And Drive Gear Teeth
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a straightedge and feeler gauge, measure the side clearance of both gears.

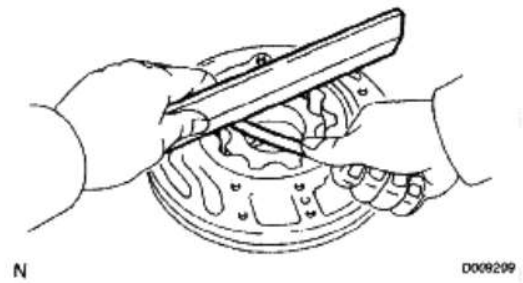
Standard side clearance: 0.02 to 0.05 mm (0.0008 to 0.0020 in.)

Maximum side clearance: 0.05 mm (0.0020 in.)

Drive gear thickness: mm (in.)

DRIVE GEAR THICKNESS SPECIFICATION

Mark	Thickness
A	11.690 to 11.699 (0.4602 to 0.4606)
B	11.700 to 11.709 (0.4606 to 0.4610)
C	11.710 to 11.720 (0.4610 to 0.4614)
D	11.721 to 11.730 (0.4615 to 0.4618)
E	11.731 to 11.740 (0.4619 to 0.4622)



cardiagn.com

Fig. 542: Measuring Side Clearance Of Both Gears
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Driven gear thickness: mm (in.)

DRIVE GEAR THICKNESS SPECIFICATION

Mark	Thickness
A	11.690 to 11.699 (0.4602 to 0.4606)
B	11.700 to 11.709 (0.4606 to 0.4610)
C	11.710 to 11.720 (0.4610 to 0.4614)
D	11.721 to 11.730 (0.4615 to 0.4618)
E	11.731 to 11.740 (0.4619 to 0.4622)

3. **INSPECT FRONT OIL PUMP AND GEAR BODY SUB-ASSEMBLY**
   a. Using a dial indicator, measure the inside diameter of the oil pump body bushing.

   Standard inside diameter: 38.113 to 38.138 mm (1.5005 to 1.5015 in.)

   Maximum inside diameter: 38.188 mm (1.5035 in.)

   If the inside diameter is greater than the maximum, replace the oil pump body sub-assembly.

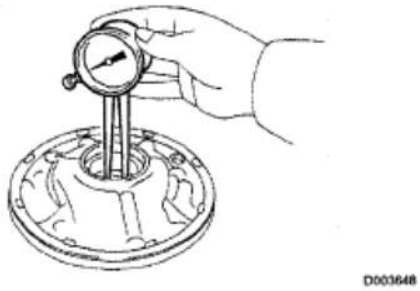


Fig. 543: Measuring Inside Diameter Of Oil Pump Body Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT STATOR SHAFT ASSEMBLY**
   a. Using a dial indicator, measure the inside diameter of the stator shaft.

   Standard inside diameter: 21.500 to 21.526 mm (0.8465 to 0.8475 in.)

   Maximum inside diameter: 21.57 mm (0.8492 in.)

   If the inside diameter is greater than the maximum, replace the stator shaft.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

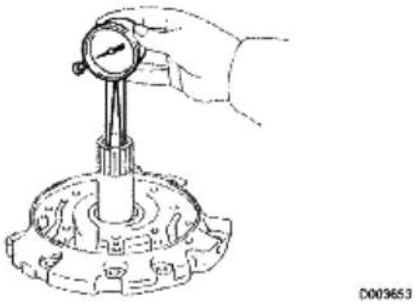


Fig. 544: Measuring Inside Diameter Of Stator Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL FRONT OIL PUMP OIL SEAL**
   a. Using SST and a hammer, install a new oil seal to the oil pump body.

      SST 09350-32014 (09351-32140)

      HINT:

      The seal end should be flush with the outer edge of the oil pump.

   b. Coat the lip of the oil seal with MP grease.

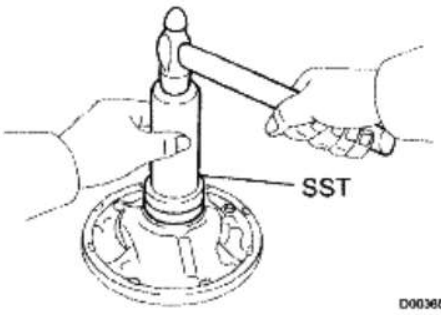


Fig. 545: Tapping Oil Seal To Oil Pump Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL FRONT OIL PUMP BODY O-RING**
   a. Coat a new O-ring with ATF and install it to the oil pump body.

NOTE: Make sure that the O-ring is not twisted or pinched. Apply enough ATF to the O-ring before installation.

cardiagn.com

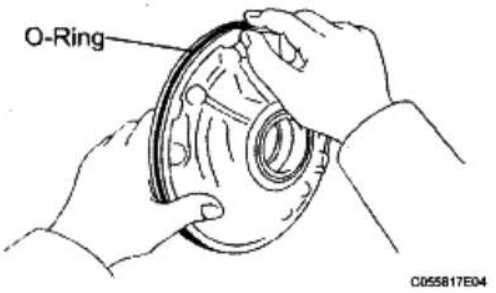


Fig. 546: Identifying Front Oil Pump Body O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL FRONT OIL PUMP DRIVEN GEAR**
   a. Coat the front oil pump driven gear with ATF, and install it to the oil pump body with the marked side facing upward.

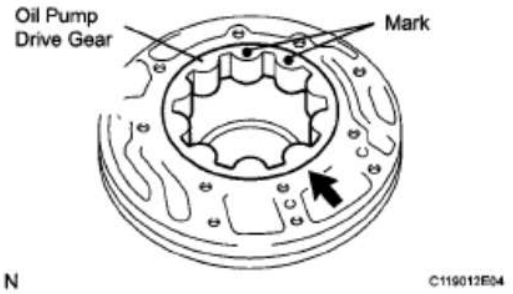


Fig. 547: Identifying Front Oil Pump Driven Gear Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL FRONT OIL PUMP DRIVE GEAR**
   a. Coat the front oil pump drive gear with ATF, and install it to the oil pump body with the marked side facing upward.

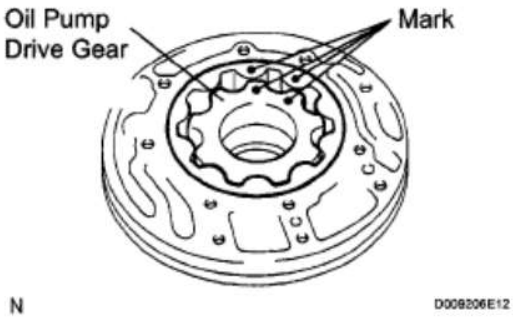


Fig. 548: Identifying Front Oil Pump Drive Gear Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL STATOR SHAFT ASSEMBLY**

cardiagn.com

a. Set the stator shaft and align it with each bolt hole.
b. Using a "TORX" socket (T30), install the 11 bolts.

Torque: 9.8 N*m (100 kgf*cm, 87 in.*lbf)

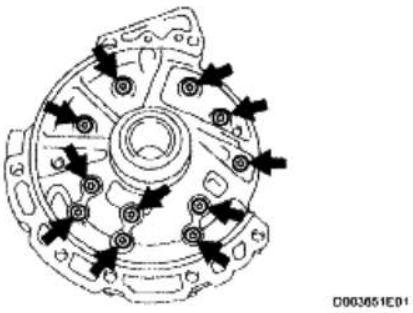


Fig. 549: Locating Stator Shaft Assembly Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL CLUTCH DRUM OIL SEAL RING**
   a. Coat 2 new clutch drum oil seal rings with ATF.
   b. Install 2 new clutch drum oil seal rings.

NOTE: Do not expand the ring ends excessively.

7. **INSPECT OIL PUMP ASSEMBLY** (See **INSPECTION**)

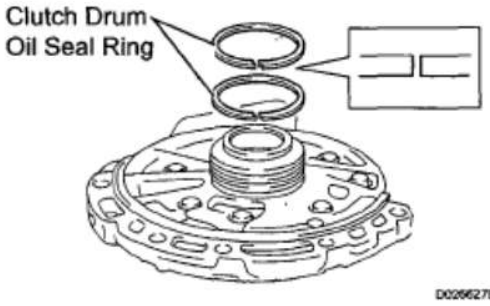


Fig. 550: Identifying Clutch Drum Oil Seal Ring Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

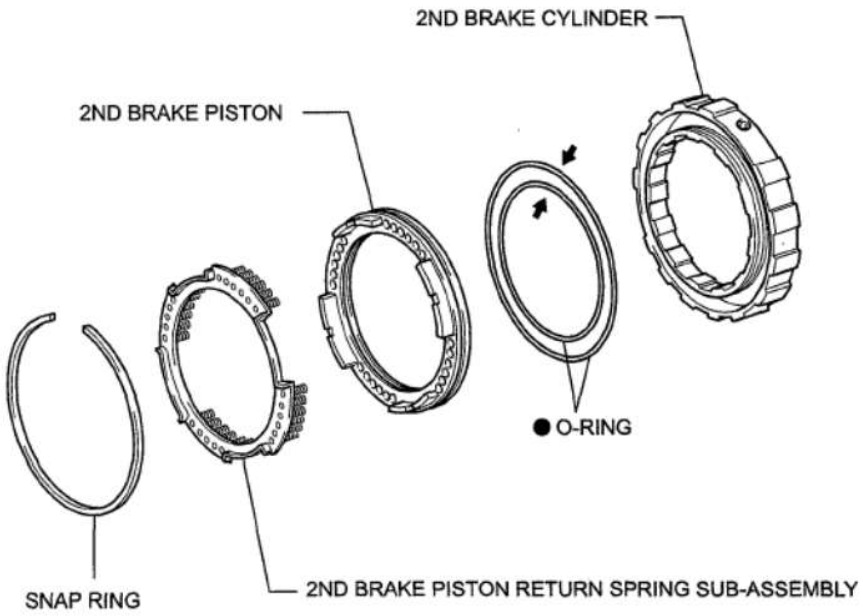
SECOND BRAKE PISTON

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



● Non-reusable part

⬅ ATF WS

N

C109736E09

Fig. 551: Identifying Second Brake Piston Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **REMOVE 2ND BRAKE PISTON RETURN SPRING SUB-ASSEMBLY**
   a. Place SST on the return spring and compress the return spring with a press.

      SST 09387-00060

   b. Using a screwdriver, remove the snap ring.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

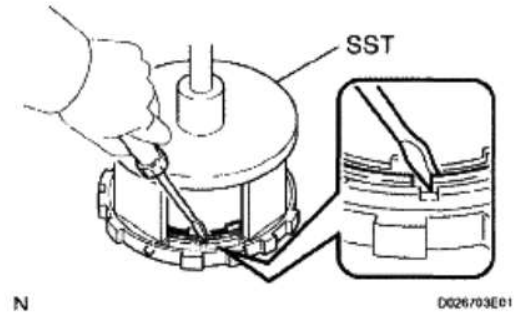


Fig. 552: Placing SST On Return Spring And Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the 2nd brake piston return spring.

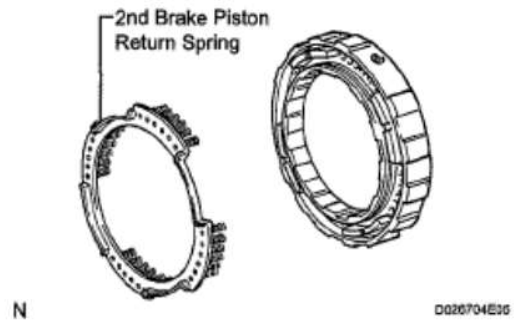


Fig. 553: Identifying 2nd Brake Piston Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **REMOVE 2ND BRAKE PISTON**

a. Hold the 2nd brake piston and apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the 2nd brake cylinder to remove the 2nd brake piston.

NOTE: Hold the piston with a shop rag or a piece of cloth when removing the piston. Failure to do so may result in the piston jumping out from the cylinder.

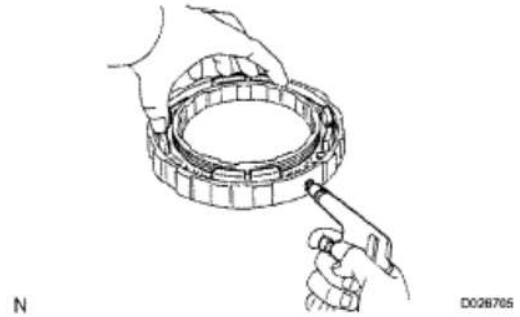


Fig. 554: Applying Compressed Air To 2nd Brake Cylinder

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE 2ND BRAKE PISTON O-RING**
   a. Remove the 2 O-rings from the 2nd brake piston.

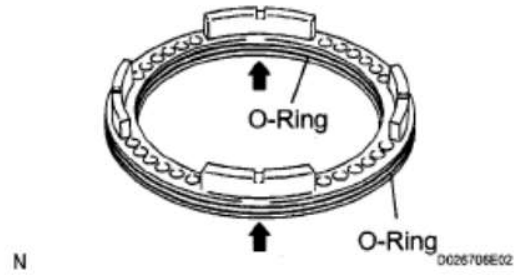


Fig. 555: Locating 2nd Brake Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT 2ND BRAKE PISTON RETURN SPRING SUB-ASSEMBLY**
   a. Using vernier calipers, measure the free length of the spring together with the spring seat.

   Standard free length: 16.61 mm (0.6539 in.)

   If the result is not as specified, replace the spring.

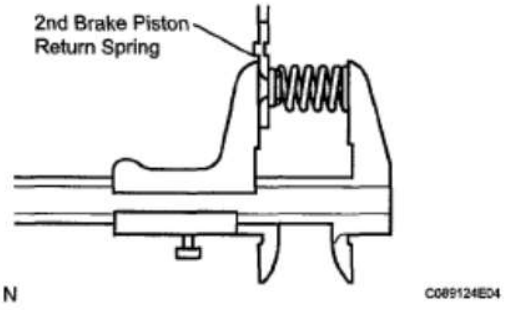


Fig. 556: Measuring Free Length Of Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL 2ND BRAKE PISTON O-RING**
   a. Coat 2 new O-rings with ATF, and install them in the 2nd brake piston.

   NOTE: Make sure that the O-ring is not twisted or pinched.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

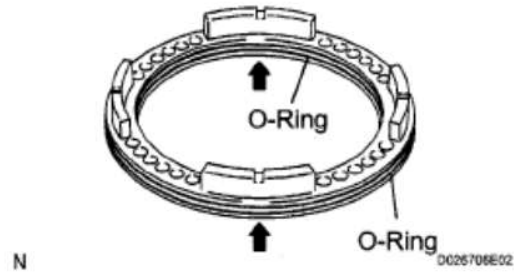


Fig. 557: Locating 2nd Brake Piston O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL 2ND BRAKE PISTON**
   a. Coat the 2nd brake piston with ATF and install it to the 2nd brake cylinder.

NOTE: Be careful not to damage the O-ring.

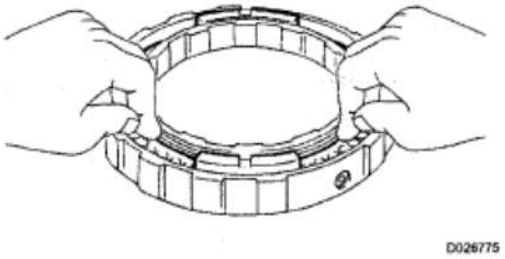


Fig. 558: Identifying 2nd Brake Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL 2ND BRAKE PISTON RETURN SPRING SUB-ASSEMBLY**
   a. Install the 2nd brake piston return spring.

NOTE: After installing the spring sub-assembly, check that all of the springs are engaged in the piston correctly.



Fig. 559: Identifying 2nd Brake Piston Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Place SST on the piston return spring and compress the piston return spring with a press.

SST 09387-00060

c. Using a screwdriver, install the snap ring.
d. Be sure that the end gap of the snap ring is not aligned with the spring retainer claw.

NOTE: Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove. This prevents the spring seat from being deformed.

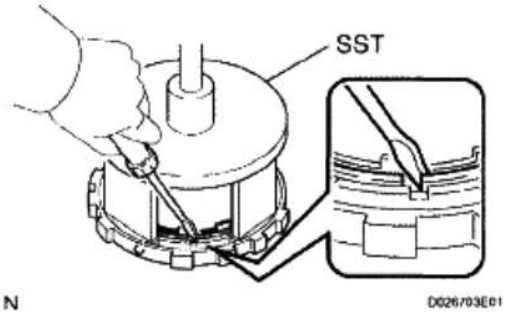


Fig. 560: Placing SST On Return Spring And Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

SHIFT SOLENOID VALVE

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

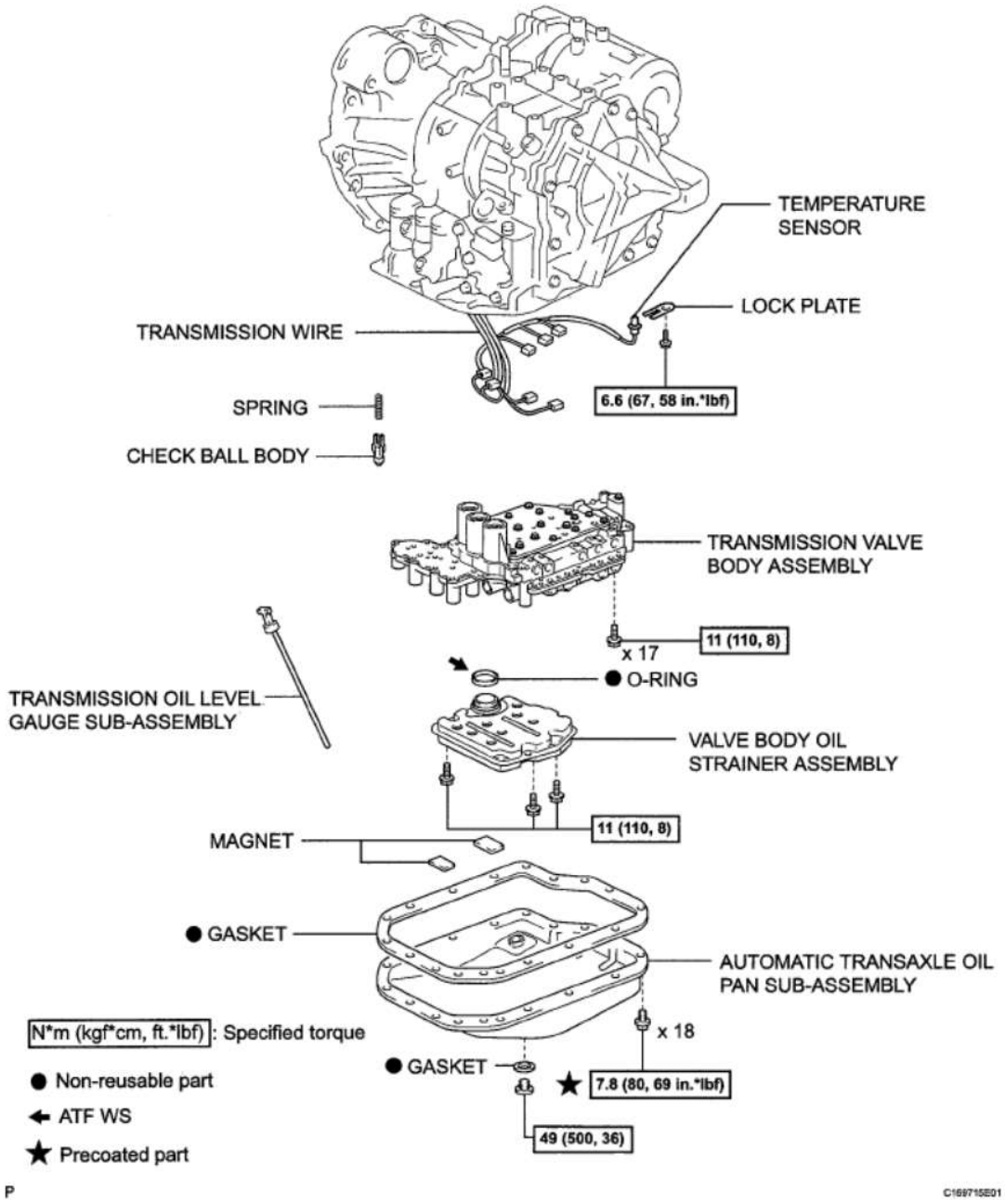


Fig. 561: Identifying Shift Solenoid Valve Components With Torque Specification (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

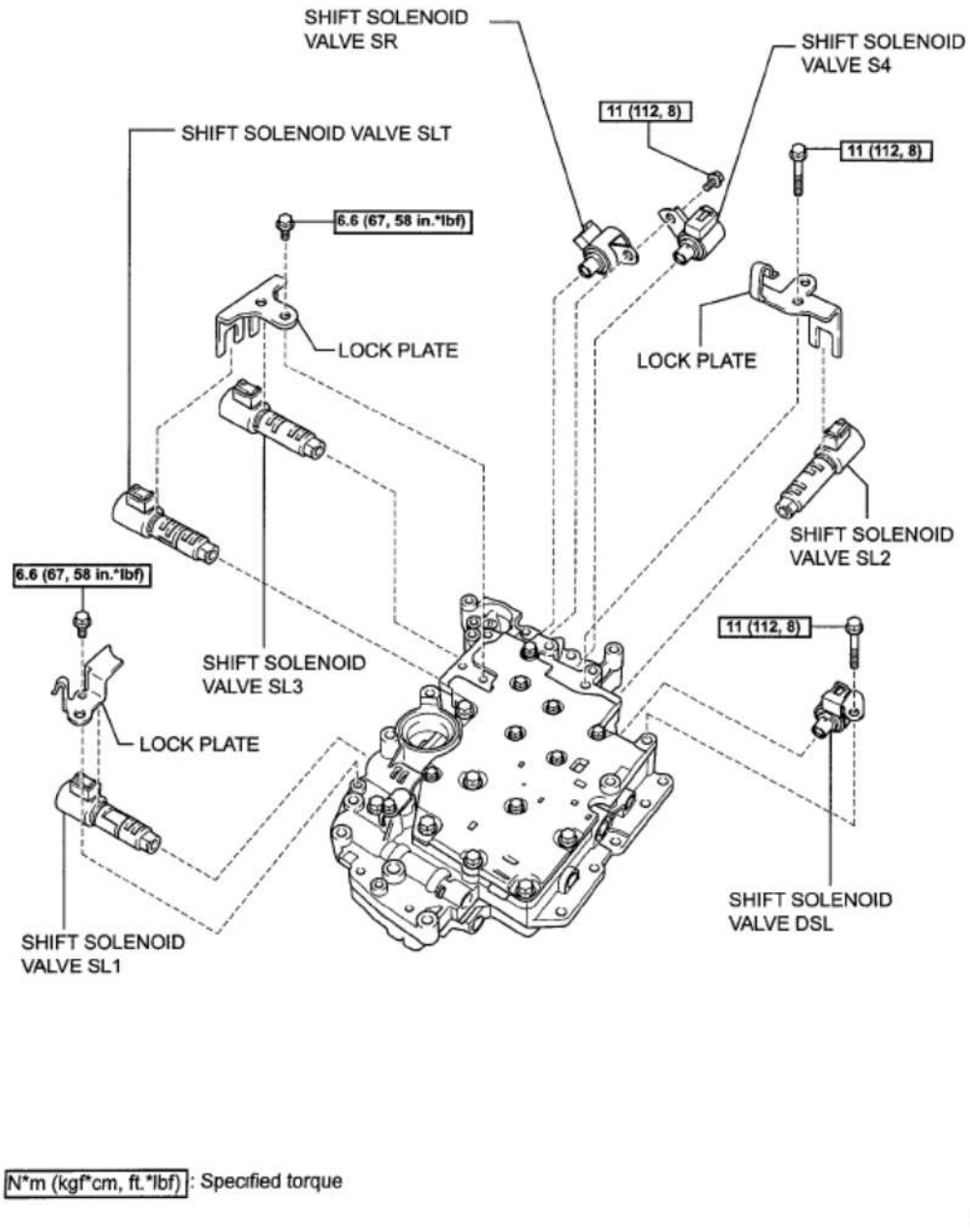


Fig. 562: Identifying Shift Solenoid Valve Components With Torque Specification (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **REMOVE AUTOMATIC TRANSAXLE ASSEMBLY**

   HINT:

   See **REMOVAL** .

cardiagn.com

2. **REMOVE AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY** (See **REMOVAL**)
3. **DISCONNECT TRANSMISSION WIRE** (See **REMOVAL**)
4. **REMOVE VALVE BODY OIL STRAINER ASSEMBLY** (See **REMOVAL**)
5. **REMOVE TRANSMISSION VALVE BODY ASSEMBLY** (See **REMOVAL**)

DISASSEMBLY

1. **REMOVE SHIFT SOLENOID VALVE SL3**
   a. Remove the bolt and lock plate from the valve body assembly.
   b. Remove the shift solenoid valve SL3 from the valve body assembly.
2. **REMOVE SHIFT SOLENOID VALVE SLT**
   a. Remove the shift solenoid valve SLT from the valve body assembly.

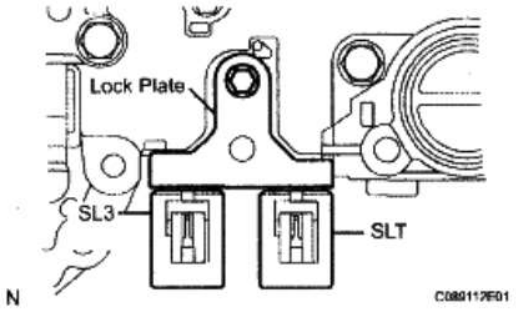


Fig. 563: Identifying Shift Solenoid Valve SLT
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE SHIFT SOLENOID VALVE S4**
   a. Remove the bolt and shift solenoid valve S4 from the valve body assembly.

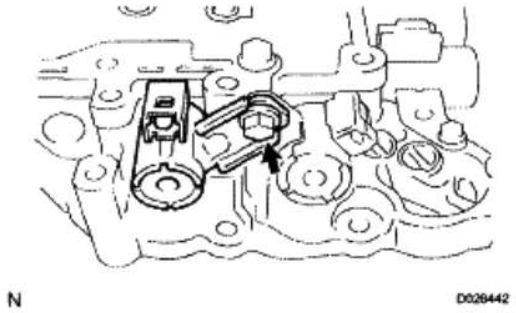


Fig. 564: Locating Shift Solenoid Valve S4 Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE SHIFT SOLENOID VALVE SR**
   a. Remove the shift solenoid valve SR from the valve body assembly.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

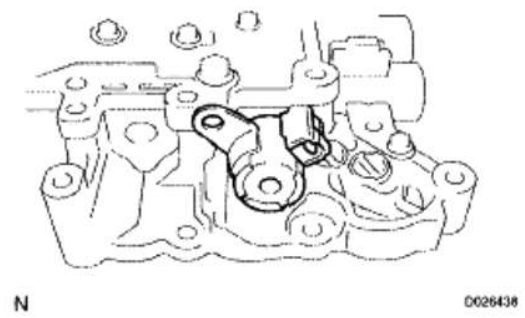


Fig. 565: Identifying Shift Solenoid Valve SR
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE SHIFT SOLENOID VALVE DSL**
   a. Remove the bolt and shift solenoid valve DSL from the valve body assembly.

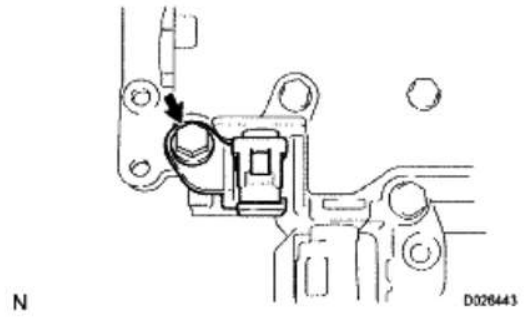


Fig. 566: Identifying Shift Solenoid Valve DSL
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE SHIFT SOLENOID VALVE SL2**
   a. Remove the bolt, lock plate and shift solenoid valve SL2 from the valve body assembly.

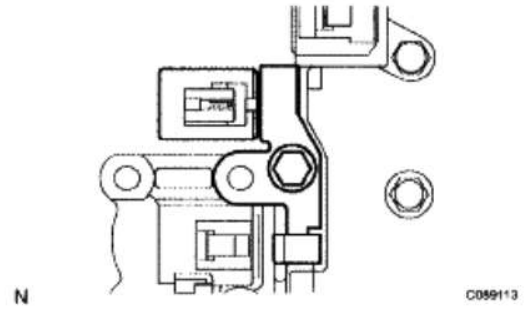


Fig. 567: Identifying Shift Solenoid Valve SL2
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **REMOVE SHIFT SOLENOID VALVE SL1**
   a. Remove the bolt, lock plate and shift solenoid valve SL1 from the valve body assembly.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

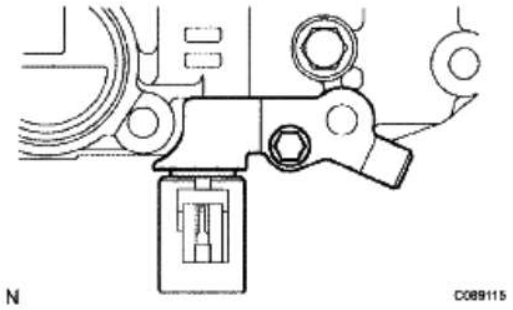


Fig. 568: Identifying Shift Solenoid Valve SL1
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT SHIFT SOLENOID VALVE SL3**
   a. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   If the value is not as specified, replace the shift solenoid valve.

   b. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

   OK: The solenoid valve makes an operating sound.

   If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

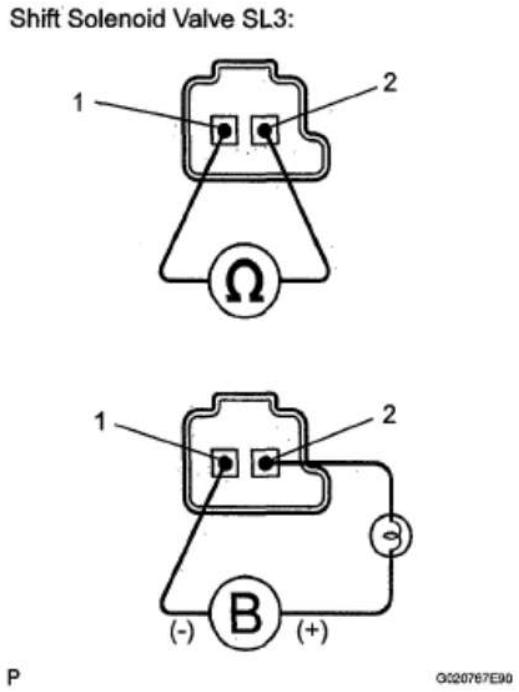


Fig. 569: Inspecting Shift Solenoid Valve SL3
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT SHIFT SOLENOID VALVE SLT**
   a. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   If the value is not as specified, replace the shift solenoid valve.

   b. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

   OK: The solenoid valve makes an operating sound.

   If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

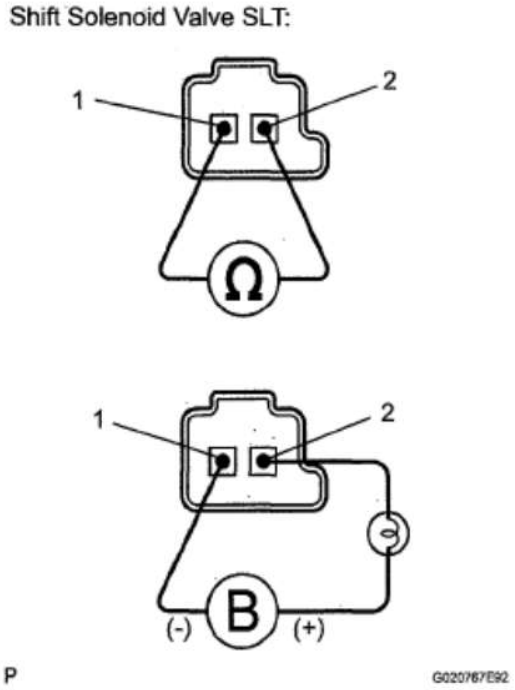


Fig. 570: Inspecting Shift Solenoid Valve SLT
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT SHIFT SOLENOID VALVE S4**
   a. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (S4) - Solenoid Body (S4)	20°C (68°F)	11 to 15 ohms

   If the value is not as specified, replace the shift solenoid valve.

   b. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

   OK: The solenoid valve makes an operating sound.

   If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

Shift Solenoid Valve S4:

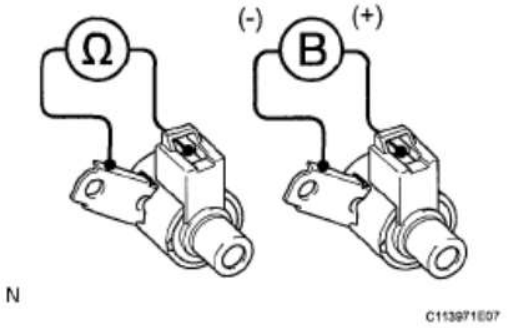


Fig. 571: Inspecting Shift Solenoid Valve S4
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT SHIFT SOLENOID VALVE SR**

a. Measure the resistance according to the value(s) in the table below.

Standard resistance

STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (SR) - Solenoid Body (SR)	20°C (68°F)	11 to 15 ohms

If the value is not as specified, replace the shift solenoid valve.

b. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

OK: The solenoid valve makes an operating sound.

If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

Shift Solenoid Valve SR:

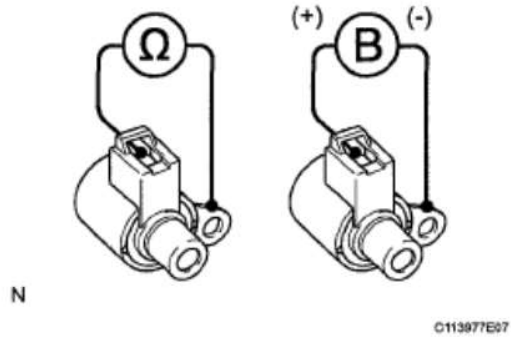


Fig. 572: Inspecting Shift Solenoid Valve SR
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSPECT SHIFT SOLENOID VALVE DSL**
   a. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
Solenoid Connector (DSL) - Solenoid Body (DSL)	20°C (68°F)	11 to 15 ohms

   If the value is not as specified, replace the shift solenoid valve.

   b. Connect the positive (+) lead to the terminal of the solenoid connector, and the negative (-) lead to the solenoid body.

   OK: The solenoid valve makes an operating sound.

   If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

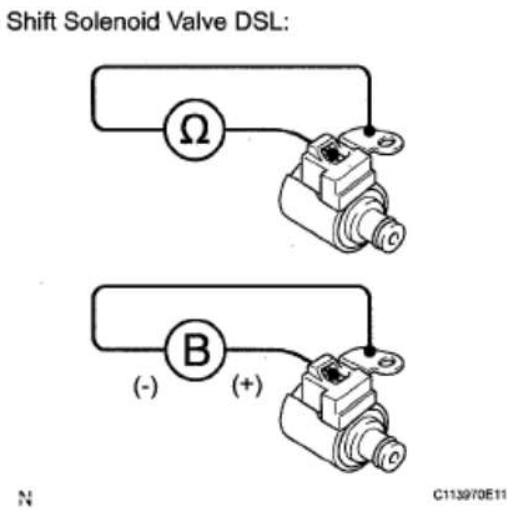


Fig. 573: Inspecting Shift Solenoid Valve DSL
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSPECT SHIFT SOLENOID VALVE SL2**
   a. Measure the resistance according to the value(s) in the table below.

      Standard resistance

      STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

      If the value is not as specified, replace the shift solenoid valve.

   b. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

      OK: The solenoid valve makes an operating sound.

      If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

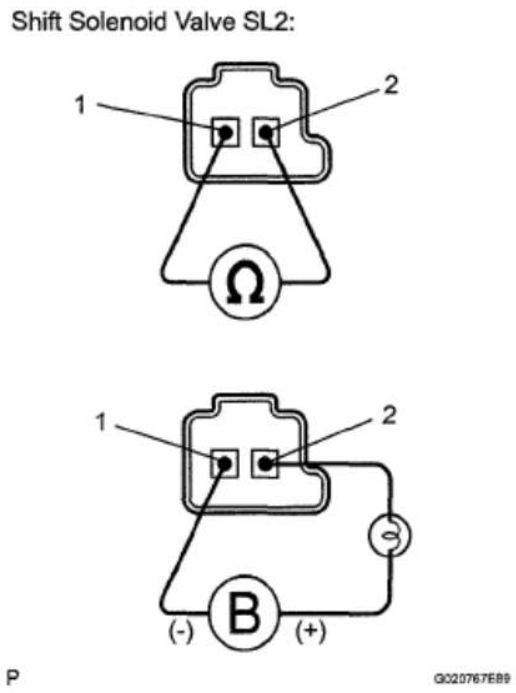


Fig. 574: Inspecting Shift Solenoid Valve SL2
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSPECT SHIFT SOLENOID VALVE SL1**
   a. Measure the resistance according to the value(s) in the table below.

   Standard resistance

   STANDARD RESISTANCE SPECIFICATION

Tester Connection	Condition	Specified Condition
1 - 2	20°C (68°F)	5.0 to 5.6 ohms

   If the value is not as specified, replace the shift solenoid valve.

   b. Connect the positive (+) lead with a 21 W bulb to terminal 2 and the negative (-) lead to terminal 1 of the solenoid valve connector, then check the movement of the valve.

   OK: The solenoid valve makes an operating sound.

   If the result is not as specified, replace the shift solenoid valve.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

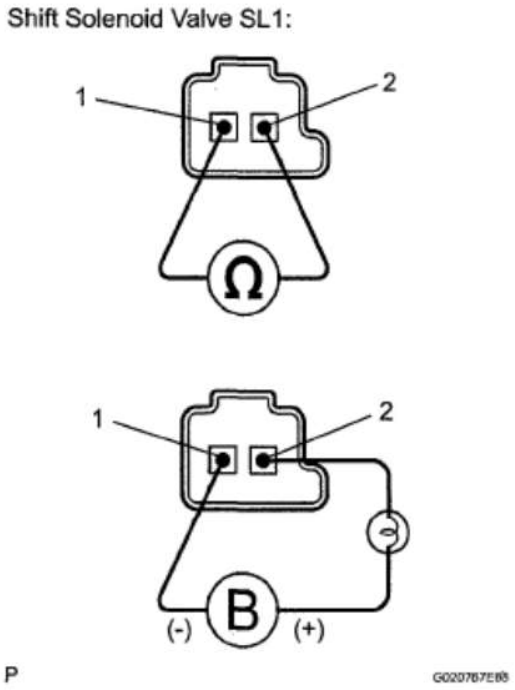


Fig. 575: Inspecting Shift Solenoid Valve SL1
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL SHIFT SOLENOID VALVE SL1**
   a. Install the shift solenoid valve SL1 and lock plate to the valve body assembly with the bolt.

   Torque: 6.6 N*m (67 kgf*cm, 58 in.*lbf)

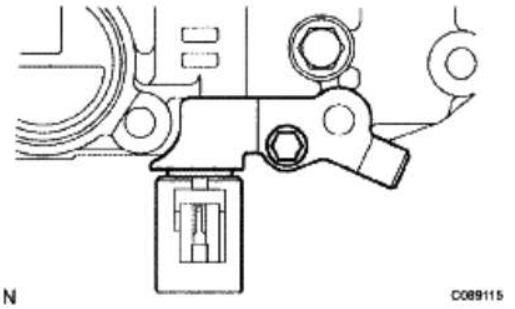


Fig. 576: Identifying Shift Solenoid Valve SL1 And Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL SHIFT SOLENOID VALVE SL2**
   a. Install the shift solenoid valve SL2 and lock plate to the valve body assembly with the bolt.

   Torque: 11 N*m (112 kgf*cm, 8 ft.*lbf)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

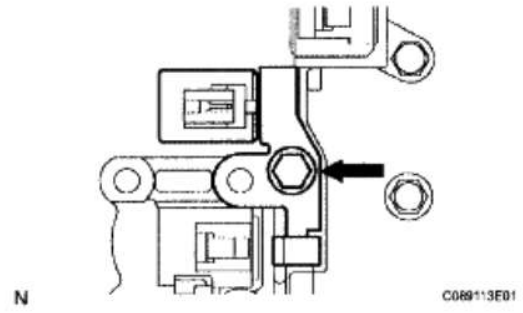


Fig. 577: Locating Shift Solenoid Valve SL2 And Lock Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL SHIFT SOLENOID VALVE DSL**
   a. Install the shift solenoid valve DSL to the valve body assembly with the bolt.

Torque: 11 N*m (112 kgf*cm, 8 ft.*lbf)

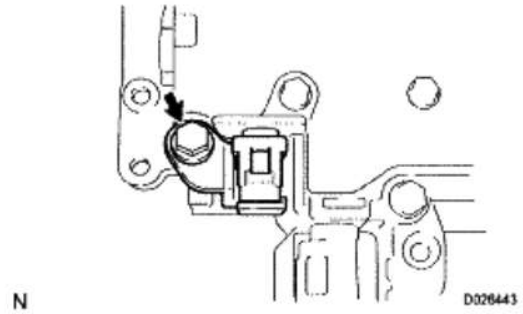


Fig. 578: Locating Shift Solenoid Valve DSL With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL SHIFT SOLENOID VALVE SR**
   a. Install the shift solenoid valve SR to the valve body assembly.

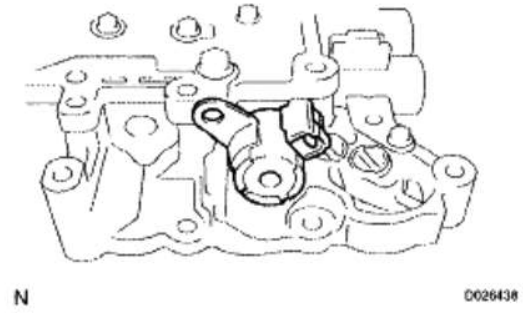


Fig. 579: Identifying Shift Solenoid Valve SR
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

5. **INSTALL SHIFT SOLENOID VALVE S4**
   a. Install the shift solenoid valve S4 to the valve body assembly with the bolt.

   Torque: 11 N*m (112 kgf*cm, 8 ft.*lbf)

6. **INSTALL SHIFT SOLENOID VALVE SL3**
   a. Install the shift solenoid valve SL3 to the valve body assembly.

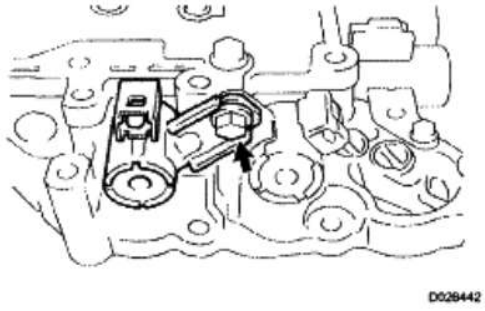


Fig. 580: Locating Shift Solenoid Valve S4 With Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSTALL SHIFT SOLENOID VALVE SLT**
   a. Install the shift solenoid valve SLT and lock plate to the valve body assembly with the bolt.

   Torque: 6.6 N*m (67 kgf*cm, 58 in.*lbf)

INSTALLATION

1. **INSTALL TRANSMISSION VALVE BODY ASSEMBLY** (See **INSTALLATION**)
2. **INSTALL VALVE BODY OIL STRAINER ASSEMBLY** (See **INSTALLATION**)

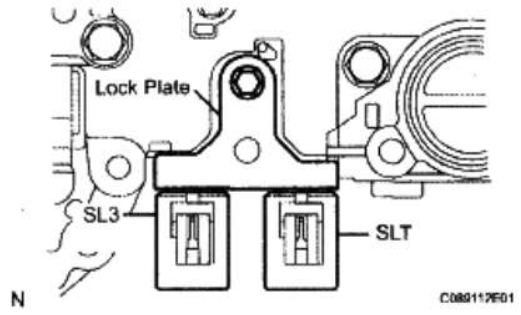


Fig. 581: Identifying Shift Solenoid Valve SLT
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL TRANSMISSION WIRE** (See **INSTALLATION**)
4. **INSTALL AUTOMATIC TRANSAXLE OIL PAN SUB-ASSEMBLY** (See **INSTALLATION**)

cardiagn.com

5. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL** (See **INSTALLATION**)
6. **INSTALL AUTOMATIC TRANSAXLE ASSEMBLY**

   (See **INSTALLATION**)

DIFFERENTIAL CASE

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

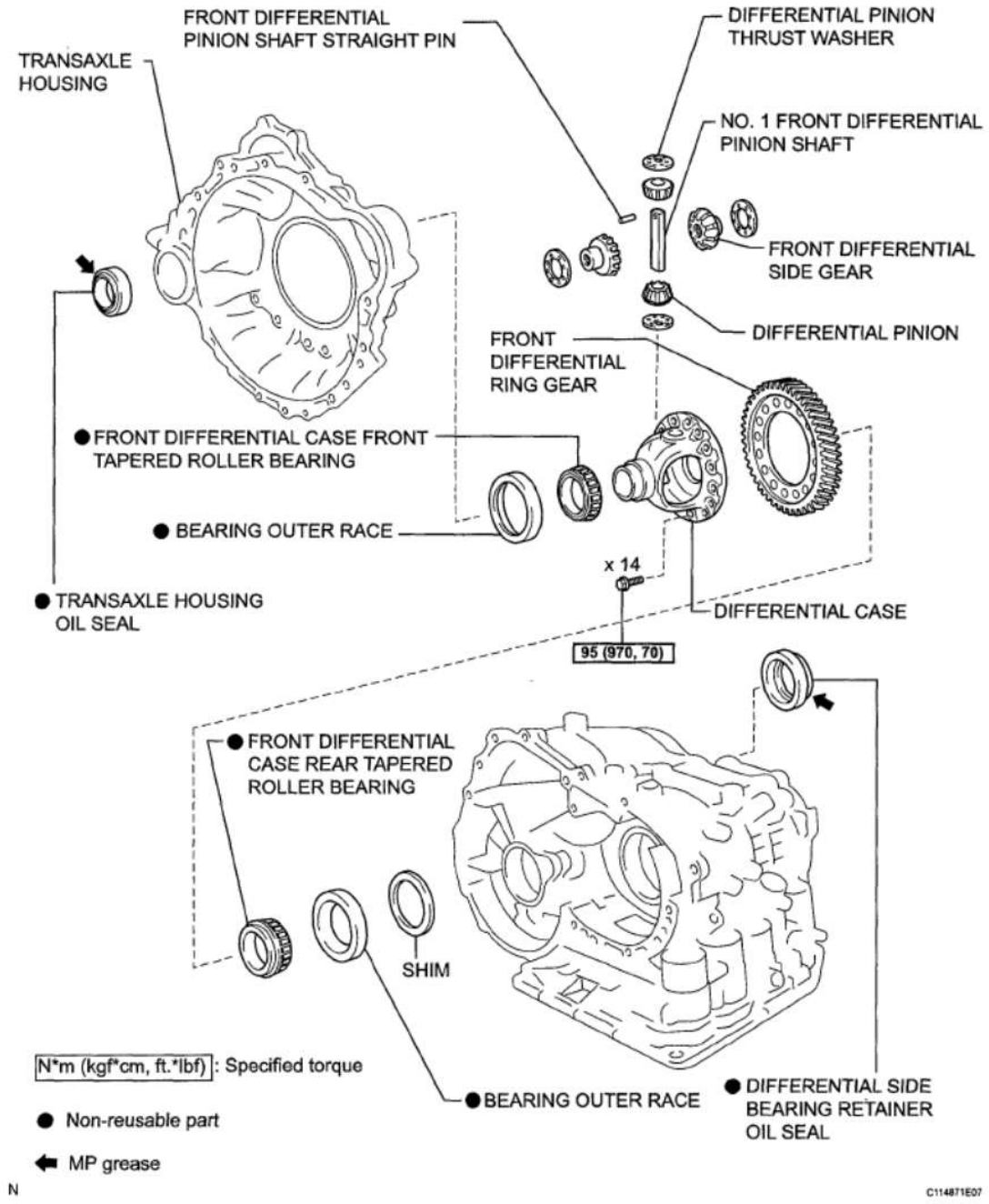


Fig. 582: Identifying Differential Case Components With Torque Specification
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **REMOVE FRONT DIFFERENTIAL RING GEAR**
   a. Place matchmarks on the front differential ring gear and differential case.

cardiagn.com

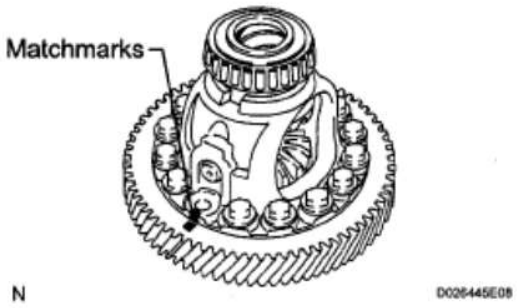


Fig. 583: Identifying Matchmarks On Front Differential Ring Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 14 bolts.

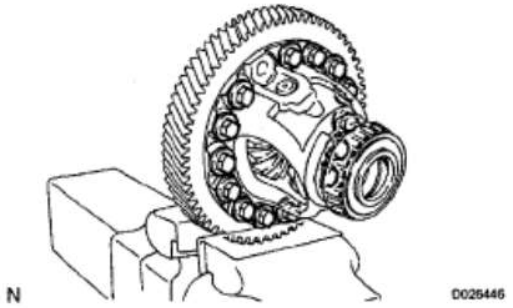


Fig. 584: Identifying Differential Ring Gear Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a plastic hammer, tap on the front differential ring gear to remove it from the case.

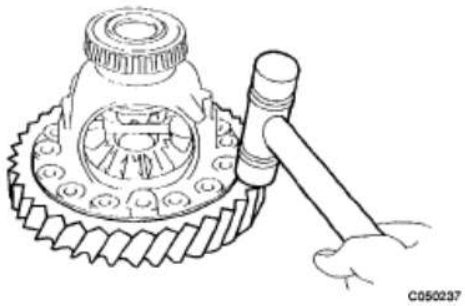


Fig. 585: Tapping Front Differential Ring Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **REMOVE FRONT DIFFERENTIAL CASE FRONT TAPERED ROLLER BEARING**

a. Using SST, remove the front differential case front differential tapered roller bearing from the differential case.

SST 09950-00020, 09950-00030, 09950-60010 (09951-00490), 09950-40011 (09957-04010)

cardiagn.com

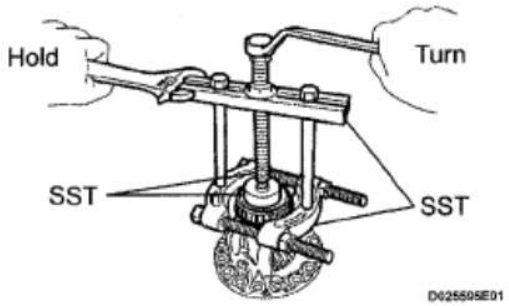


Fig. 586: Removing Front Differential Case Front Tapered Roller Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, remove the front differential case front tapered roller bearing outer race.

SST 09308-00010

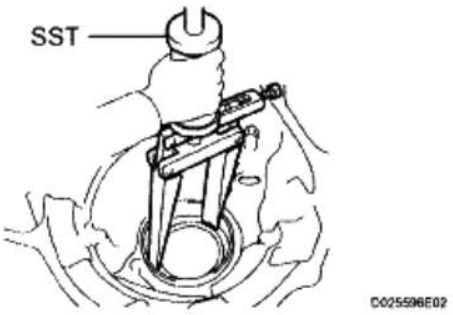


Fig. 587: Removing Front Differential Case Front Tapered Roller Bearing Outer Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE FRONT DIFFERENTIAL CASE REAR TAPERED ROLLER BEARING**

a. Using SST, remove the front differential case rear tapered roller bearing from the differential case.

SST 09950-00020, 09950-00030, 09950-60010 (09951-00490), 09950-40011 (09957-04010), 09308-00010

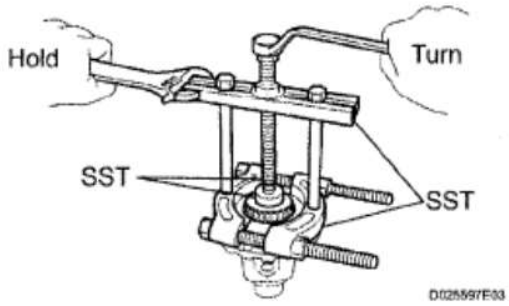


Fig. 588: Removing Front Differential Case Rear Tapered Roller Bearing From Differential Case

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, remove the front differential case rear tapered roller bearing outer race.

SST 09308-00010

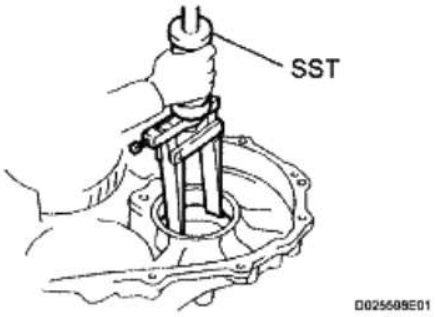


Fig. 589: Removing Front Differential Case Rear Tapered Roller Bearing Outer Race
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE FRONT DIFFERENTIAL PINION SHAFT STRAIGHT PIN**
   a. Using a pin punch and hammer, install the straight pin.

NOTE: Before removing the straight pin, unstake it with a pin punch.

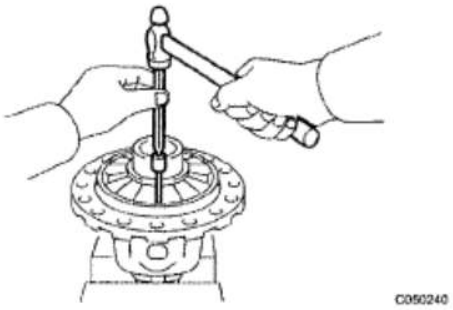


Fig. 590: Tapping Front Differential Pinion Shaft Straight Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE NO. 1 FRONT DIFFERENTIAL PINION SHAFT**
   a. Remove the No. 1 front differential pinion shaft from the differential case.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

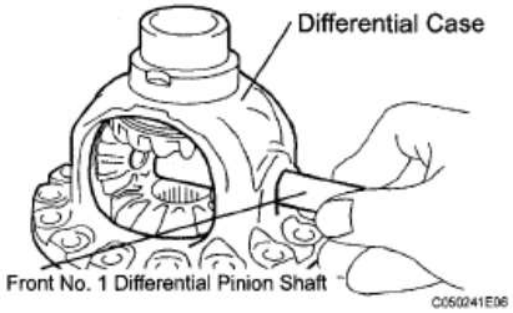


Fig. 591: Identifying No. 1 Front Differential Pinion Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE FRONT DIFFERENTIAL SIDE GEAR**
   a. Remove the 2 front differential pinions, 2 pinion thrust washers, 2 front differential side gears and 2 side gear thrust washers from the differential case.

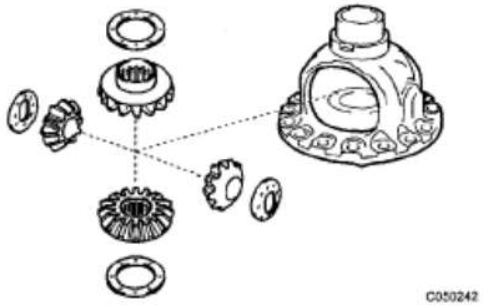


Fig. 592: Identifying Front Differential Pinions, Pinion Thrust Washers And Front Differential Side Gears
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **REMOVE TRANSAXLE HOUSING OIL SEAL**
   a. Using SST and a hammer, remove the oil seal.

SST 09950-70010 (09951-07100), 09215-00013 (09215-00471)

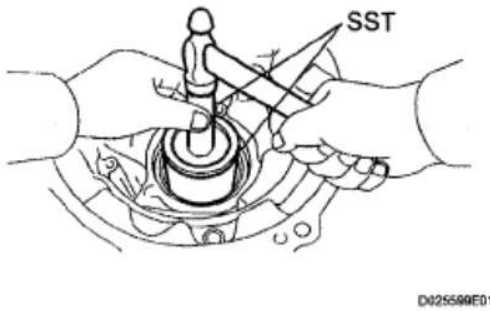


Fig. 593: Removing Transaxle Housing Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

8. **REMOVE DIFFERENTIAL SIDE BEARING RETAINER OIL SEAL**
   a. Using SST, remove the oil seal.

SST 09950-70010 (09951-07100), 09608-10010

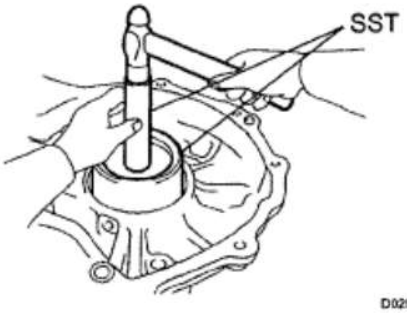


Fig. 594: Removing Differential Side Bearing Retainer Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT BACKLASH**
   a. Using a dial indicator, inspect the backlash of the side gear.

Standard backlash: 0.05 to 0.20 mm (0.0020 to 0.0079 in.)

Thrust washer thickness

THRUST WASHER THICKNESS SPECIFICATION

Mark	Thickness
-	1.625 mm (0.0640 in.)
-	1.725 mm (0.0679 in.)
-	1.825 mm (0.0719 in.)

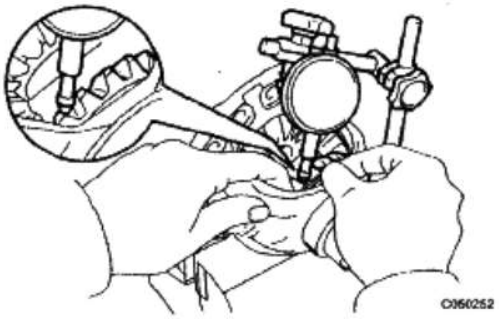


Fig. 595: Inspecting Backlash Of Side Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

REASSEMBLY

1. **INSTALL FRONT DIFFERENTIAL SIDE GEAR**
   a. Apply ATF to the 2 front differential side gears, 2 side gear thrust washers, 2 front differential pinions and 2 pinion thrust washers and install them to the differential case.

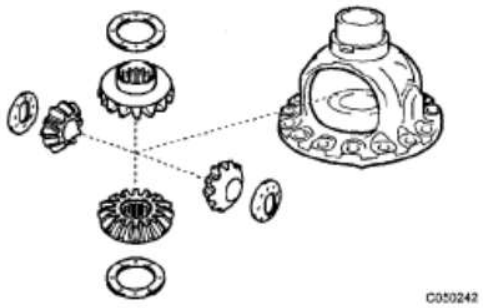


Fig. 596: Identifying Front Differential Pinions, Pinion Thrust Washers And Front Differential Side Gears
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL NO. 1 FRONT DIFFERENTIAL PINION SHAFT**
   a. Goat the No. 1 front differential pinion shaft with ATF, and install it to the differential case.
3. **INSPECT BACKLASH** (See **INSPECTION**)

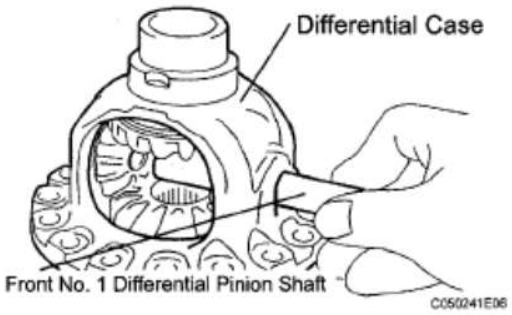


Fig. 597: Identifying No. 1 Front Differential Pinion Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL FRONT DIFFERENTIAL PINION SHAFT STRAIGHT PIN**
   a. Using a pin punch and a hammer, install the pinion shaft straight pin.

cardiagn.com



Fig. 598: Tapping Pinion Shaft Straight Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a chisel and a hammer, stake the differential case.

NOTE: Stake the differential case after adjusting the backlash.



Fig. 599: Staking Differential Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL FRONT DIFFERENTIAL CASE FRONT TAPERED ROLLER BEARING**

a. Using SST and a press, install the front differential case front tapered roller bearing to the differential case.

SST 09316-12010, 09550-60010 (09951-00490), 09950-70010 (09951-07100)

NOTE: Do not damage the bearing cage when installing the bearing inner race.

cardiagn.com

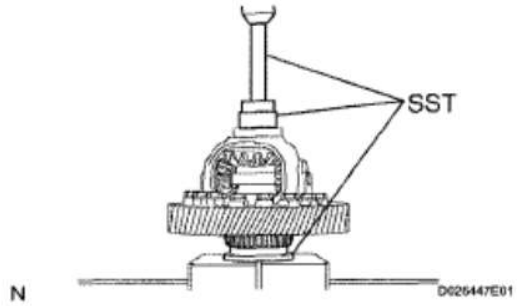


Fig. 600: Pressing Front Differential Case Front Tapered Roller Bearing To Differential Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST and a hammer, install the front differential case tapered roller bearing front outer race to the transaxle housing.

SST 09550-60010 (09951-00490), 09950-60020 (09951-00910)

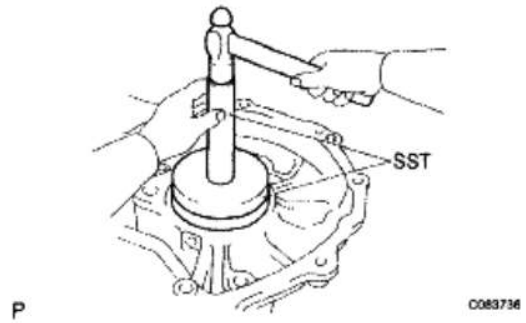


Fig. 601: Tapping Front Differential Case Tapered Roller Bearing Front Outer Race To Transaxle Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL FRONT DIFFERENTIAL CASE REAR TAPERED ROLLER BEARING**

a. Using SST and a press, install the front differential case front tapered roller bearing to the differential case.

SST 09316-12010, 09550-60010 (09951-00490), 09950-70010 (09951-07100, 09951-07150)

NOTE: Do not damage the bearing cage when installing the bearing inner race.

cardiagn.com

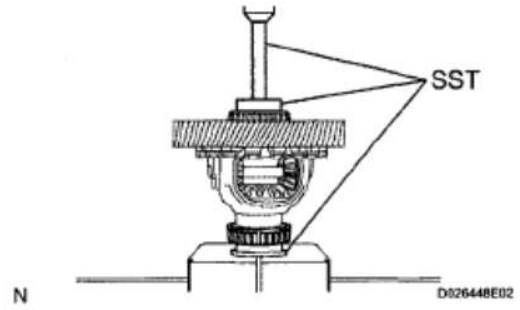


Fig. 602: Pressing Front Differential Case Front Tapered Roller Bearing To Differential Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST and a hammer, install the front differential case tapered roller bearing rear outer race to the transaxle housing.

SST 09950-70010 (09951 -07100, 09951-07150), 09950-60020 (09951-00890)

NOTE: No clearance is allowed between the bearing and transaxle housing.

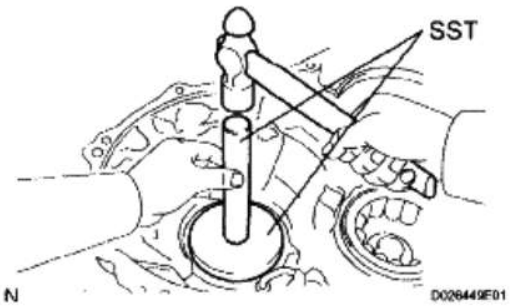


Fig. 603: Tapping Front Differential Case Tapered Roller Bearing Rear Outer Race To Transaxle Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **ADJUST DIFFERENTIAL SIDE BEARING PRELOAD**

a. Install the differential assembly to the transaxle case.

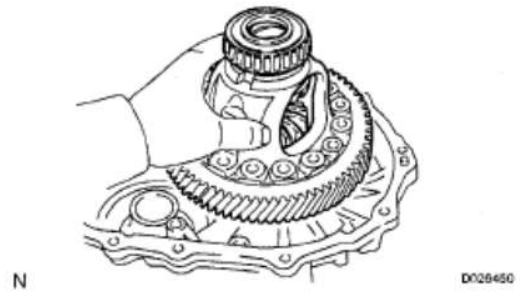


Fig. 604: Installing Differential Assembly To Transaxle Case

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Clean the mating surfaces of the transaxle case and transaxle housing.
c. Install the transaxle housing to the transaxle case and tighten them with the 16 bolts.

Torque: Bolt A

25 N*m (255 kgf*cm, 18 ft.*lbf)

Bolt B

33 N*m (337 kgf*cm, 24 ft.*lbf)

Bolt C

29 N*m (295 kgf*cm, 21 ft.*lbf)

Bolt D

28 N*m (286 kgf*cm, 21 ft.*lbf)

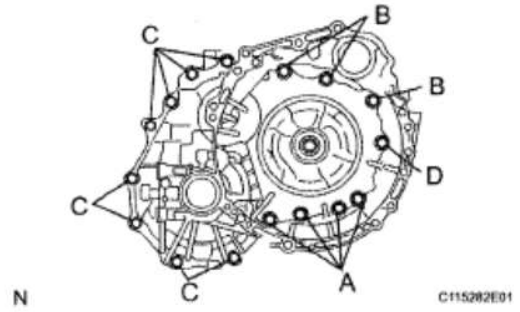


Fig. 605: Identifying Transaxle Housing And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Apply adhesive or equivalent to bolts A and D.

Adhesive: Toyota Genuine Adhesive 1344, Three Bond 1344 or equivalent

Bolt length:

Bolt A, B: 50 mm (1.969 in.)

Bolt C: 42 mm (1.654 in.)

Bolt D: 72 mm (2.835 in.)

cardiagn.com

NOTE: Apply adhesive to the bolts and tighten them within 10 minutes of application.

HINT:

Bolt A is a non-reusable bolt. However, bolt A can be used after cleaning it.

d. Using SST, turn the differential assembly to the right and left 2 or 3 times to settle the bearing.

SST 09564-32011

e. Using SST and a torque wrench, measure the turning torque of the differential.

SST 09564-32011

Turning torque at 60 rpm:

New bearing: 0.20 to 0.69 N*m (2.0 to 7.0 kgf*cm, 1.8 to 6.1 in.*lbf)

Used bearing: 0.10 to 0.35 N*m (1.0 to 3.6 kgf*cm, 0.9 to 3.1 in.*lbf)

HINT:

If the turning torque is not as specified, refer to the table below to select a thrust washer so that the specified value is achieved.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
0	2.000 (0.0787)	9	2.450 (0.0965)
j	2.025 (0.0797)	T	2.475 (0.0974)
1	2.050 (0.0807)	A	2.500 (0.0984)
K	2.075 (0.0817)	U	2.525 (0.0994)
2	2.100 (0.0827)	B	2.550 (0.1004)
L	2.125 (0.0837)	V	2.575 (0.1014)
3	2.150 (0.0846)	C	2.600 (0.1024)
M	2.175 (0.0857)	W	2.625 (0.1034)
4	2.200 (0.0866)	D	2.650 (0.1043)
N	2.225 (0.0876)	X	2.675 (0.1053)
5	2.250 (0.0886)	E	2.700 (0.1063)
P	2.275 (0.0896)	Y	2.725 (0.1073)
6	2.300 (0.0906)	F	2.750 (0.1083)
Q	2.325 (0.0915)	AA	2.775 (0.1093)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

7	2.350 (0.0925)	G	2.800 (0.1102)
R	2.375 (0.0935)	AB	2.825 (0.1112)
8	2.400 (0.0945)	H	2.850 (0.1122)
S	2.425 (0.0954)	-	-

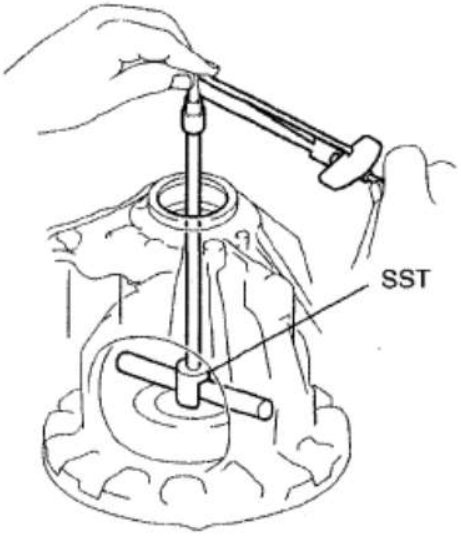


Fig. 606: Measuring Turning Torque Of Differential
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Remove the 16 bolts and the transaxle housing.

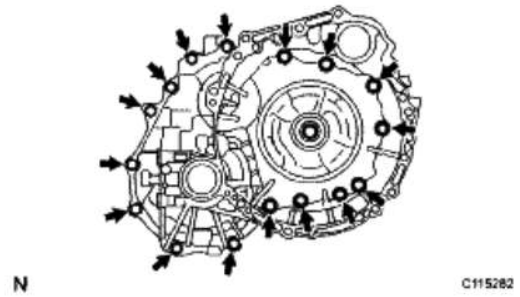


Fig. 607: Identifying Transaxle Housing Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Remove the differential assembly.

cardiagn.com

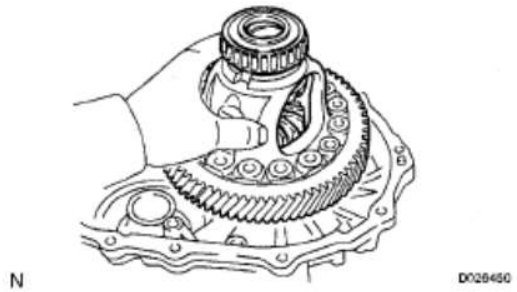


Fig. 608: Identifying Differential Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSTALL FRONT DIFFERENTIAL RING GEAR**
   a. Using ATF and heater, heat the front differential ring gear to 90 to 110°C (194.0 to 230.0°F).

NOTE: Do not heat the ring gear to more than 110°C (230.0°F).

   b. Clean the contact surface of the front differential case.

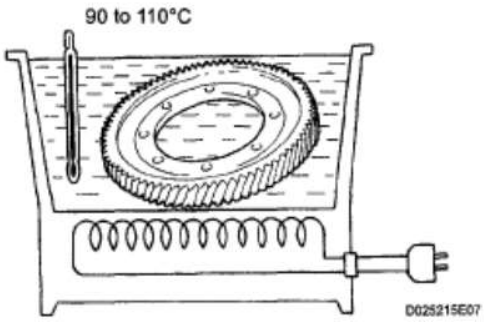


Fig. 609: Heating Front Differential Ring Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Align the matchmarks, and install the front differential ring gear case quickly.

NOTE: Do not install the bolts while the ring gear is hot.

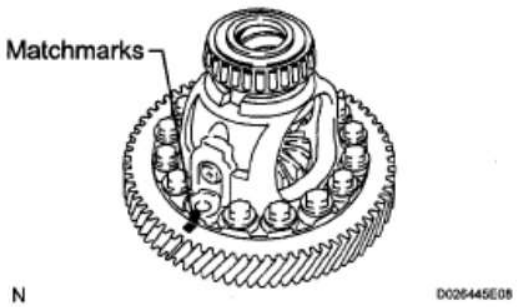


Fig. 610: Identifying Mark On Front Differential Ring Gear Case

cardiagn.com

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Tighten the 14 bolts.

Torque: 95 N*m (970 kgf*cm, 70 ft.*lbf)

NOTE: Tighten the bolts a little at a time in a diagonal pattern.

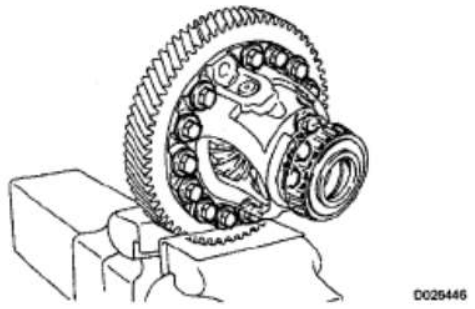


Fig. 611: Identifying Differential Ring Gear Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **INSTALL TRANSAXLE HOUSING OIL SEAL**
   a. Using SST and a hammer, install a new oil seal.

   SST 09316-60011 (09316-00011)

   b. Coat the lip of oil seal with a little MP grease.

   Oil seal installation depth: -0.5 to 0.5 mm (-0.020 to 0.020 in.)

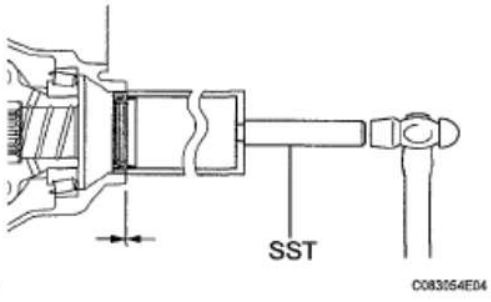


Fig. 612: Installing Transaxle Housing Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **INSTALL DIFFERENTIAL SIDE BEARING RETAINER OIL SEAL**
    a. Using SST and a hammer, install a new oil seal.

    SST 09223-15020, 09950-70010 (09951-07150)

cardiagn.com

b. Coat the lip of the oil seal with a little MP grease.

Oil seal installation depth: -0.5 to 0.2 mm (-0.020 to 0.008 in.)

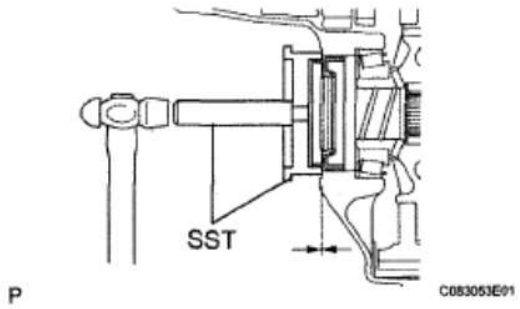


Fig. 613: Installing Differential Side Bearing Retainer Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

FORWARD CLUTCH

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

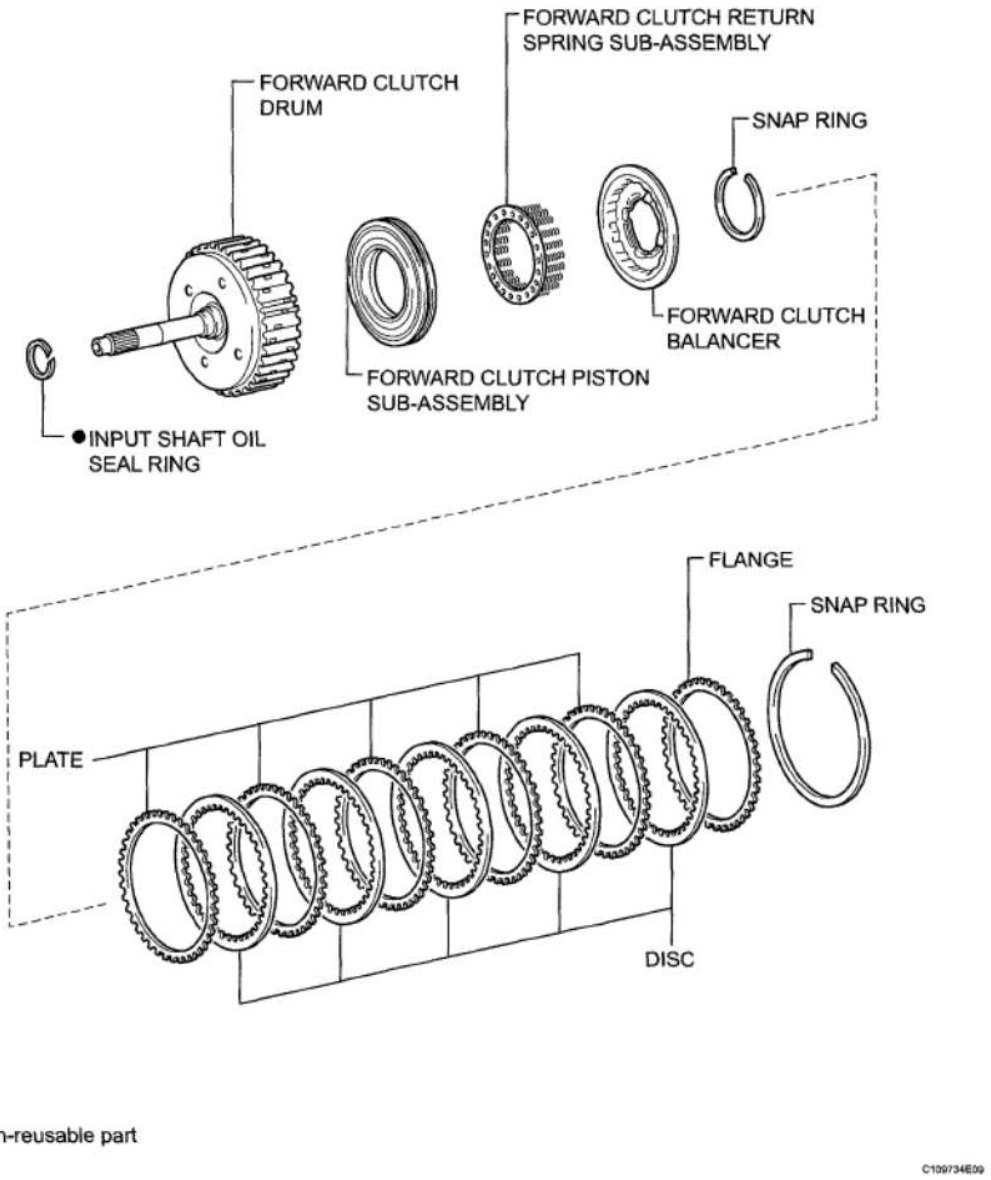


Fig. 614: Identifying Forward Clutch Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **INSPECT PACK CLEARANCE OF FORWARD CLUTCH** (See **INSPECTION**)
2. **REMOVE FORWARD MULTIPLE DISC CLUTCH DISC**
   a. Using a screwdriver, remove the snap ring.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

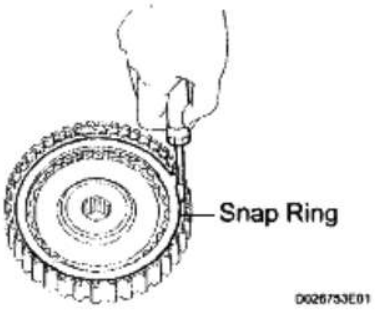


Fig. 615: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the flange, 5 discs, and 5 plates from the input shaft assembly.

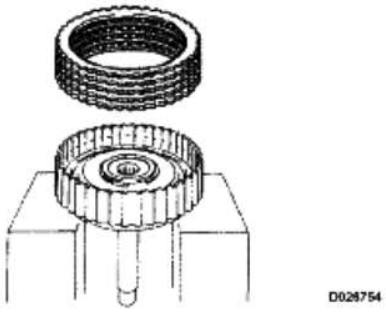


Fig. 616: Identifying Flange, Discs, And Plates
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE FORWARD CLUTCH RETURN SPRING SUB-ASSEMBLY**

a. Place SST on the spring retainer and compress the return spring with a press.

SST 09387-00020

b. Using a snap ring expander, remove the snap ring.

NOTE:

- **Stop the press when the spring seat is lowered 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove to prevent the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

cardiagn.com

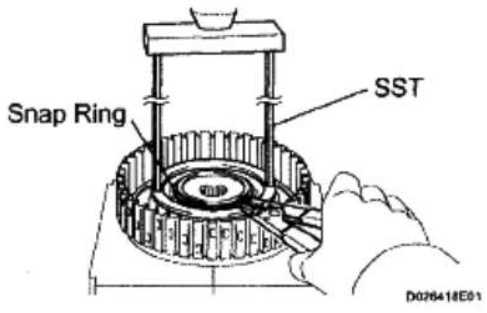


Fig. 617: Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the clutch balancer from the input shaft.

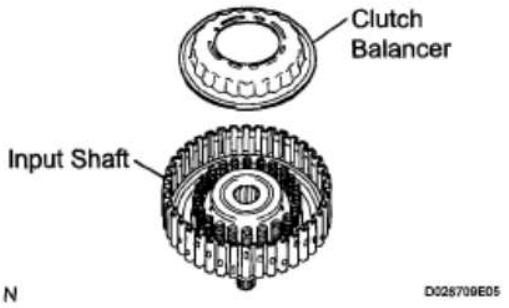


Fig. 618: Identifying Clutch Balancer And Input Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the forward clutch return spring from the input shaft.

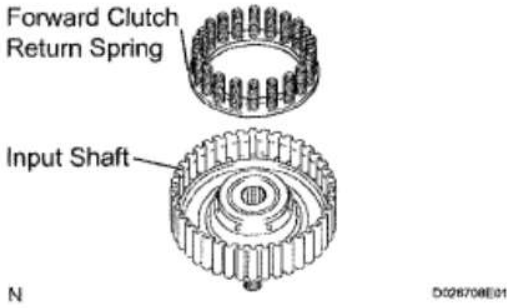


Fig. 619: Identifying Forward Clutch Return Spring And Input Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE FORWARD CLUTCH PISTON SUB-ASSEMBLY**

a. Place the forward clutch drum onto the oil pump.

b. Holding the forward clutch piston by hand, apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the oil pump to remove the forward clutch piston.

cardiagn.com

HINT:

When the piston cannot be removed as it is slanted, blow air again with the protruding side pushed, or remove the piston using needle nose pliers with its tip taped.

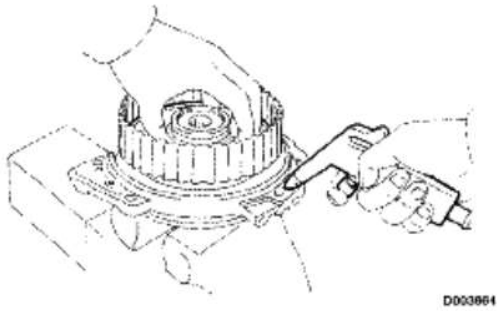


Fig. 620: Applying Compressed Air To Oil Pump
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE INPUT SHAFT OIL SEAL RING**
   a. Remove the input shaft oil seal ring from the input shaft.

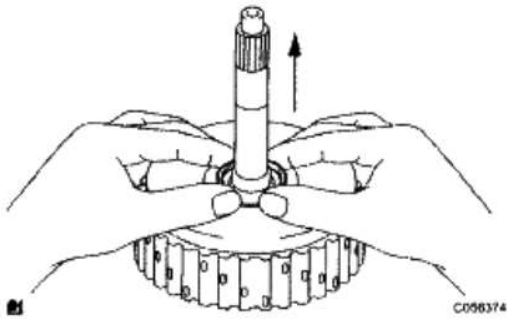


Fig. 621: Removing Input Shaft Oil Seal Ring From Input Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT PACK CLEARANCE OF FORWARD CLUTCH**
   a. Install the forward clutch on the oil pump.

NOTE: Be careful not to damage the oil seal ring of the oil pump.

   b. Using a dial indicator, measure the forward clutch pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

Pack clearance: 1.00 to 1.25 mm (0.0394 to 0.4921 in.)

cardiagn.com

If the clearance is not as specified, inspect the discs, plates, and flange.

HINT:

If the opening is large, cover it with a shop rag or a piece of cloth to prevent the compressed air from being released.

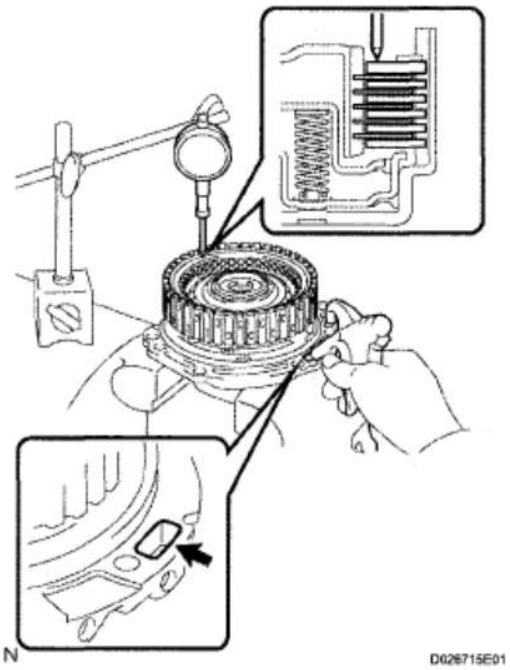


Fig. 622: Inspecting Pack Clearance Of Forward Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT FORWARD MULTIPLE DISC CLUTCH DISC**
   a. Check if the sliding surface of the disc, plate, and flange are worn or burnt.

   If necessary, replace them.

   HINT:

   - If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.
   - Before installing new discs, immerse them in ATF for at least 15 minutes.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander



Fig. 623: Identifying Forward Multiple Disc Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT FORWARD CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Using vernier calipers, measure the free length of the spring together with the spring seat.

      Standard free length: 26.74 mm (1.0528 in.)

      If the result is not as specified, replace the spring.

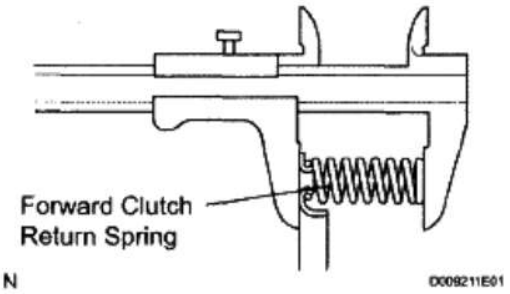


Fig. 624: Measuring Free Length Of Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT PACK CLEARANCE OF FORWARD CLUTCH**
   a. Using a dial indicator, measure the forward clutch pack clearance while applying and releasing compressed air (392 kgf/cm^2 , 4.0 kPa, 57 psi).

      Pack clearance: 1.00 to 1.25 mm (0.0394 to 0.0492 in.)

      If the piston stroke is less than the minimum, the parts may be assembled incorrectly. Check and reassemble the parts again.

      If the clearance is not as specified, select another flange.

      HINT:

      There are 5 different thicknesses of flanges available.

cardiagn.com

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

No.	Thickness	No.	Thickness
1	3.00 (0.1181)	4	3.45 (0.1358)
2	3.15 (0.1240)	5	3.60 (0.1417)
3	3.30 (0.1299)	-	-

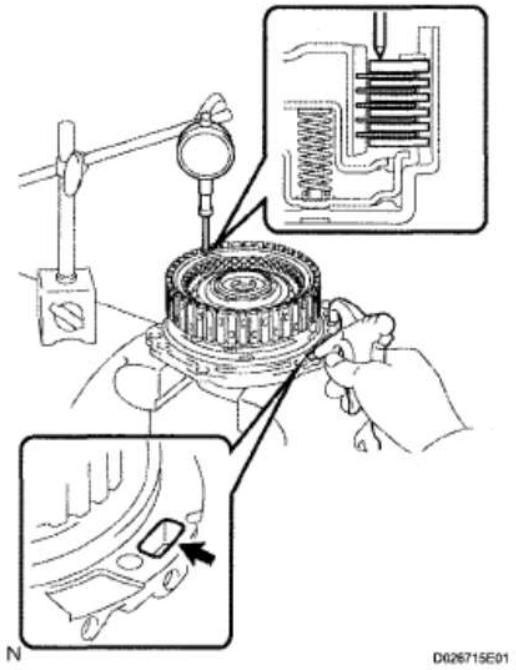


Fig. 625: Inspecting Pack Clearance Of Forward Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSPECT FORWARD MULTIPLE DISC CLUTCH DISC**
   a. Check if the disc lightly rotates when rotating the forward clutch assembly after inserting the multiple disc clutch into it.

NOTE: Do not place the forward clutch assembly in a vise.

If the result is not as specified, replace the forward multiple disc clutch disc.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

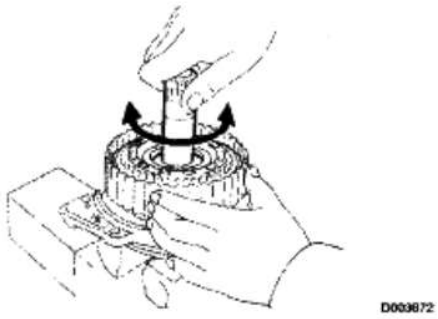


Fig. 626: Inspecting Forward Multiple Disc Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL INPUT SHAFT OIL SEAL RING**
   a. Compress a new input shaft oil seal ring from both sides to reduce dimension A.

      Dimension A: 5 mm (0.197 in.)

   b. Coat the oil seal ring with ATF and install it to the input shaft.

      NOTE: Do not expand the end gap of the oil seal ring too much. Fix the hooks firmly.

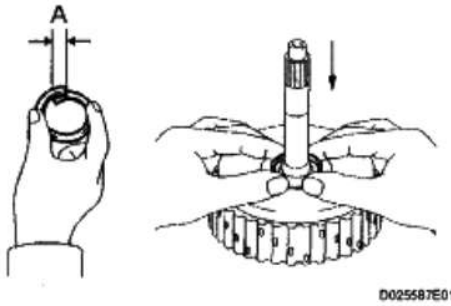


Fig. 627: Compressing Input Shaft Oil Seal Ring From Both Sides To Reduce Dimension A
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL FORWARD CLUTCH PISTON SUB-ASSEMBLY**
   a. Coat the forward clutch piston with ATF and install it to the input shaft.

      NOTE: Be careful not to damage the lip of the forward clutch piston.

cardiagn.com

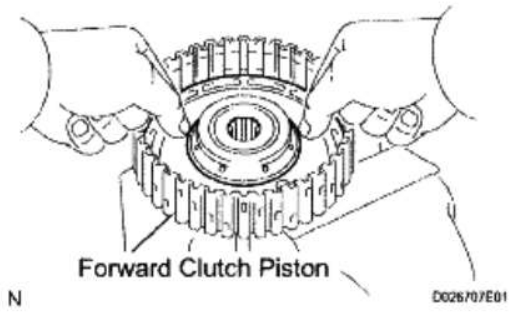


Fig. 628: Installing Forward Clutch Piston Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL FORWARD CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Install the return spring to the input shaft.

NOTE: **After installing the spring sub-assembly, check that all of the springs are engaged in the piston correctly.**

   b. Coat the clutch balancer with ATF.

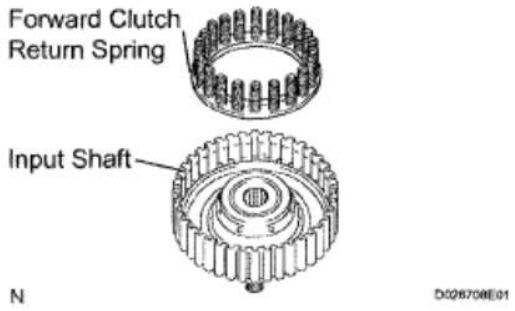


Fig. 629: Identifying Forward Clutch Return Spring And Input Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the clutch balancer to the input shaft.

NOTE:

- **Be careful not to damage the lip of the forward clutch balancer.**
- **Make sure that the clutch balancer is not pinched and that there are no other defects on the lip.**
- **Apply sufficient ATF to the sealing lip before installation.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

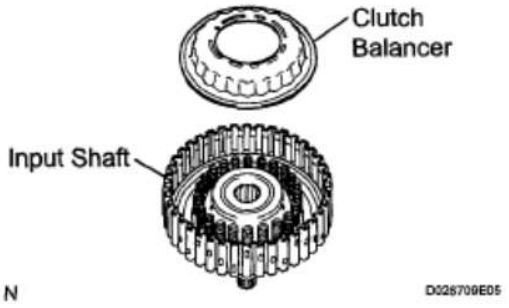


Fig. 630: Identifying Clutch Balancer And Input Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Place SST on the clutch balancer, and compress the clutch balancer with a press.

SST 09387-00020

e. Install the snap ring with a snap ring expander.
f. Be sure that the end gap of the snap ring is not aligned with the spring retainer claw.

NOTE:

- **Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove. This prevents the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

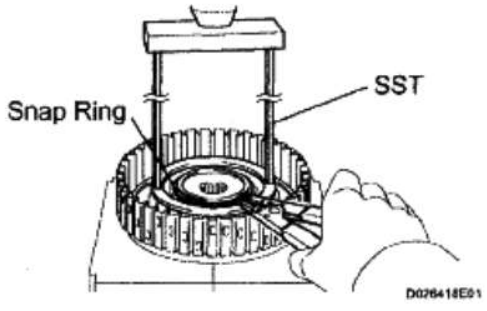


Fig. 631: Compressing Return Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Set the end gap of the snap ring in the piston as shown in the illustration.

NOTE: The end gap of the snap ring should not align with any of the stoppers.

4. **INSTALL FORWARD MULTIPLE DISC CLUTCH DISC**
   a. Coat the 5 discs with ATF.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

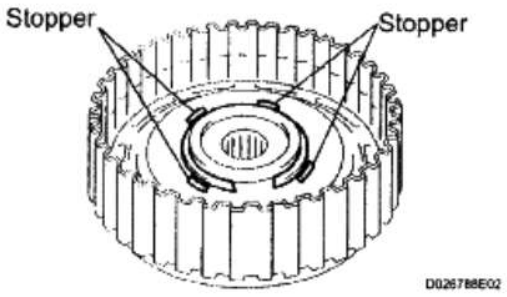


Fig. 632: Identifying Stopper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the 5 plates, 5 discs, and flange input shaft.

NOTE: Make sure that the plates, discs, and flange are installed as shown in the illustration.

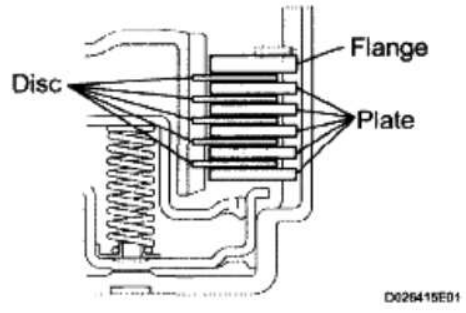


Fig. 633: Identifying Plates, Discs And Flange
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a screwdriver, install the snap ring.
d. Check that the end gap of the snap ring is not aligned with one of the cutouts.

NOTE: The snap ring should be fully engaged in the groove of the drum.

5. **INSPECT PACK CLEARANCE OF FORWARD CLUTCH** (See **INSPECTION**)
6. **INSPECT FORWARD MULTIPLE DISC CLUTCH DISC** (See **INSPECTION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

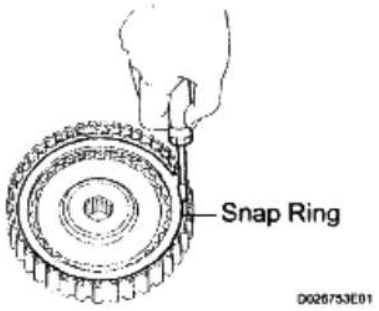


Fig. 634: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DIRECT CLUTCH

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

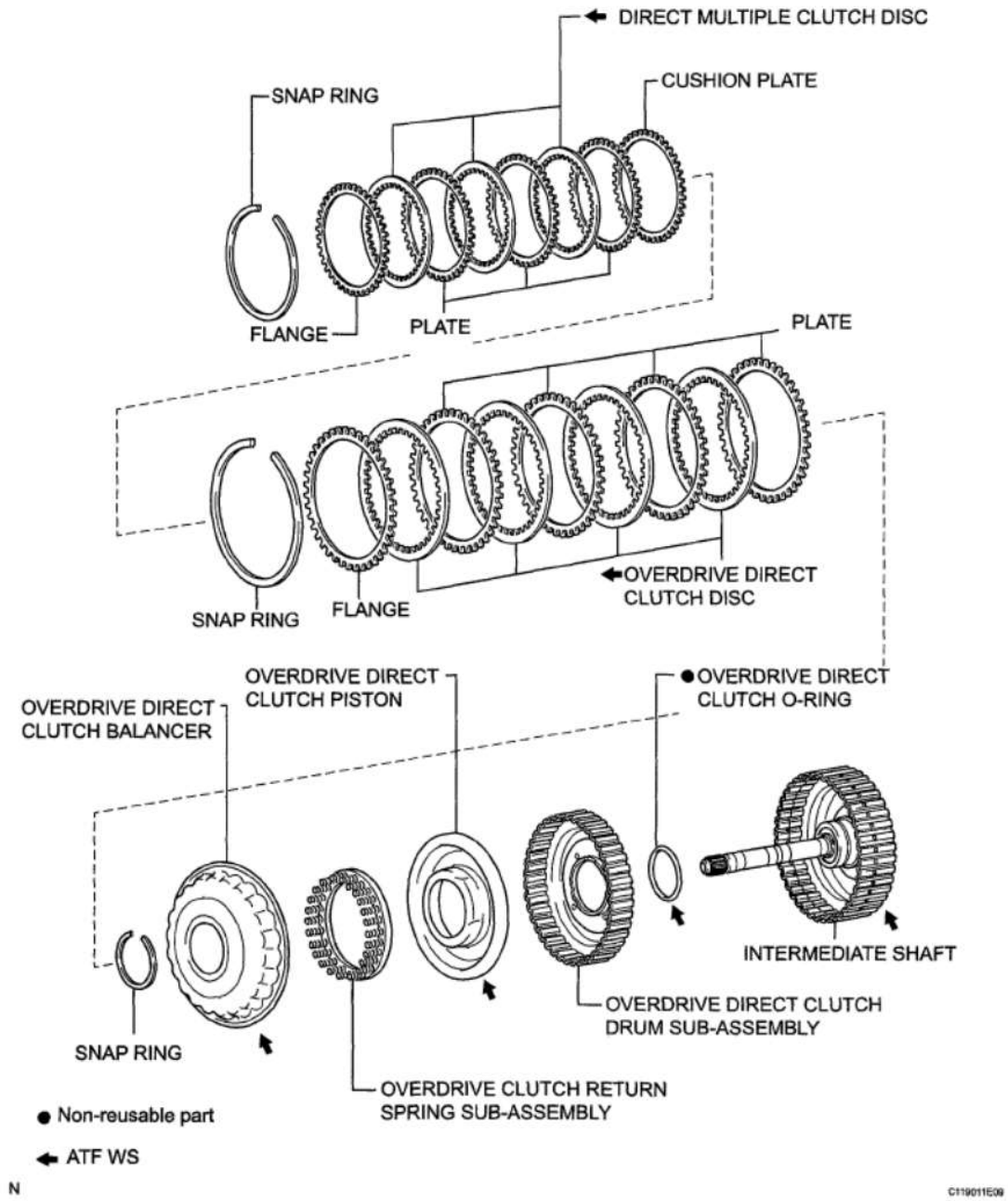


Fig. 635: Identifying Direct Clutch Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **INSPECT PACK CLEARANCE OF REVERSE CLUTCH** (See **INSPECTION**)
2. **INSPECT PACK CLEARANCE OF DIRECT CLUTCH AND OVERDRIVE CLUTCH** (See **INSPECTION**)
3. **REMOVE DIRECT MULTIPLE CLUTCH DISC**

cardiagn.com

a. Using a screwdriver, remove the snap ring from the intermediate shaft.

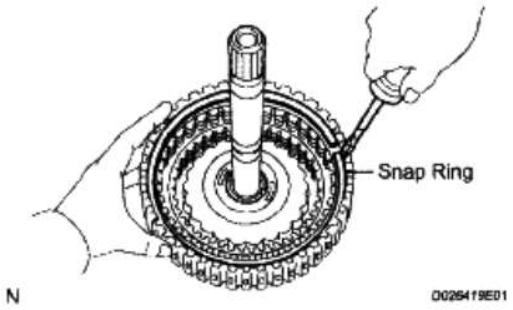


Fig. 636: Removing Snap Ring From Intermediate Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the flange, 3 discs, 3 plates, and cushion plate from the intermediate shaft.

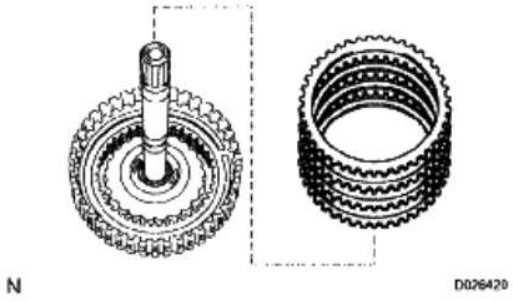


Fig. 637: Identifying Flange, Discs And Plates
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE OVERDRIVE DIRECT CLUTCH DISC**
   a. Using a screwdriver, remove the snap ring from the intermediate shaft.
   b. Remove the flange, 4 discs, and 4 plates from the intermediate shaft.

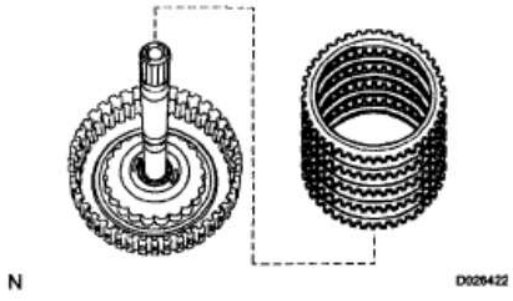


Fig. 638: Identifying Overdrive Direct Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE OVERDRIVE CLUTCH RETURN SPRING SUB-ASSEMBLY**

cardiagn.com

a. Place SST on the clutch balancer and compress the spring with a press.

SST 09387-00020

b. Using a snap ring expander, remove the snap ring from the direct clutch drum.

NOTE:

- **Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove. This prevents the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

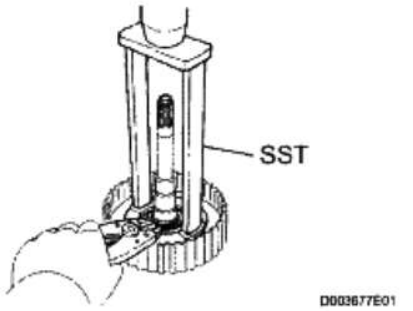


Fig. 639: Compressing Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the clutch balancer from the direct clutch drum.

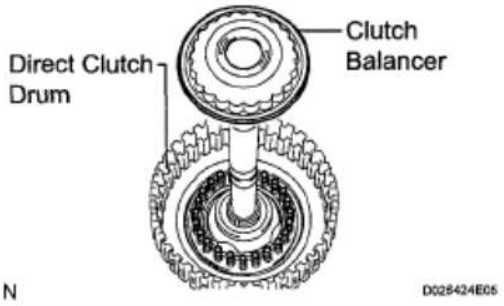


Fig. 640: Identifying Clutch Balancer And Direct Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the overdrive clutch return spring from the direct clutch drum.

cardiagn.com

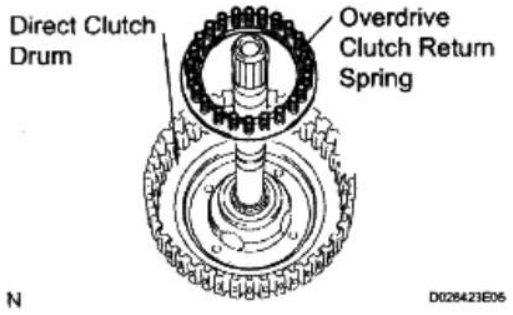


Fig. 641: Identifying Overdrive Clutch Return Spring And Direct Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE OVERDRIVE DIRECT CLUTCH PISTON**
   a. Install the intermediate shaft on the transaxle rear cover.
   b. Holding the direct clutch piston by hand, apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the transaxle rear cover to remove the direct clutch piston.

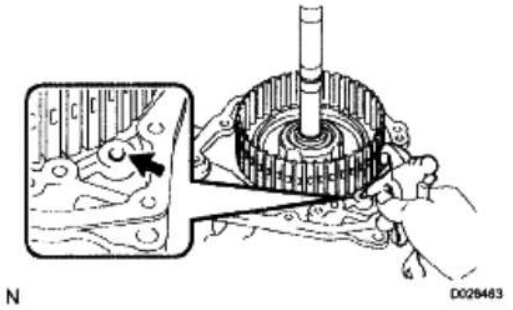


Fig. 642: Applying Compressed Air To Transaxle Rear Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **REMOVE OVERDRIVE DIRECT CLUTCH DRUM SUB-ASSEMBLY**
   a. Holding the direct clutch drum by hand, apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the transaxle rear cover to remove the direct clutch drum.

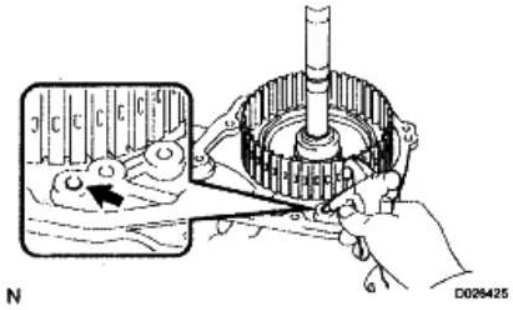


Fig. 643: Applying Compressed Air To Transaxle Rear Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

8. **REMOVE OVERDRIVE DIRECT CLUTCH O-RING**
   a. Using a screwdriver, remove the O-ring from the direct clutch drum.

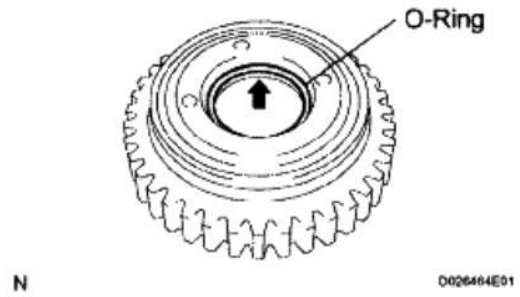


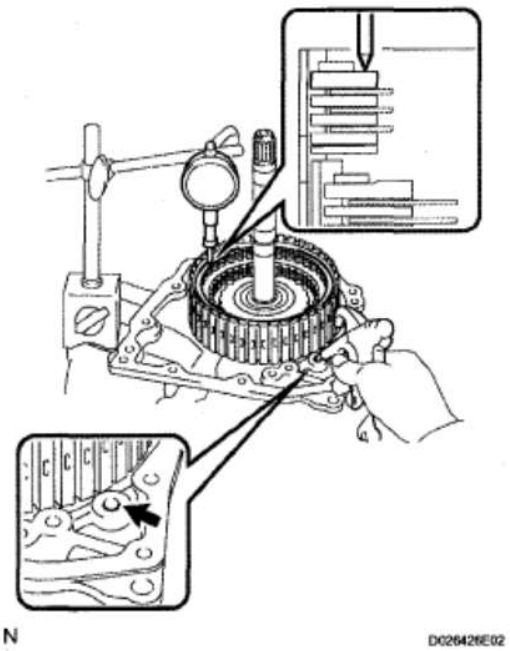
Fig. 644: Locating Overdrive Direct Clutch O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT PACK CLEARANCE OF REVERSE CLUTCH**
   a. Install the intermediate shaft and needle roller bearing onto the transaxle rear cover.
   b. Using a dial indicator, measure the reverse clutch pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

   Pack clearance: 0.60 to 0.82 mm (0.0236 to 0.0323 in.)

   If the pack clearance is not as specified, inspect the discs, plates, and flange.



cardiagn.com

Fig. 645: Inspecting Pack Clearance Of Reverse Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT PACK CLEARANCE OF DIRECT CLUTCH AND OVERDRIVE CLUTCH**
   a. Using a dial indicator, measure the direct clutch and overdrive clutch pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

      Pack clearance: 0.61 to 0.83 mm (0.0240 to 0.0327 in.)

      If the pack clearance is not as specified, inspect the discs, plates, and flange.

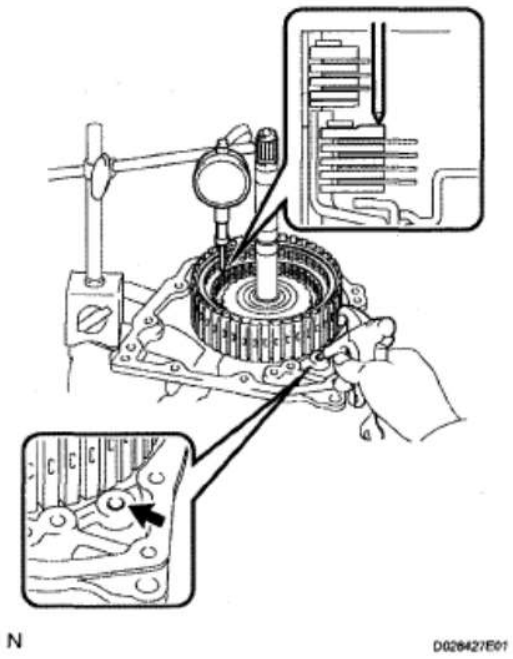


Fig. 646: Inspecting Pack Clearance Of Direct Clutch And Overdrive Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT DIRECT MULTIPLE CLUTCH DISC**
   a. Check if the sliding surfaces of the disc, plate, and flange are worn or burnt.

      If necessary, replace them.

      HINT:

      - If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.
      - Before installing new discs, immerse them in ATF for at least 15 minutes.

cardiagn.com

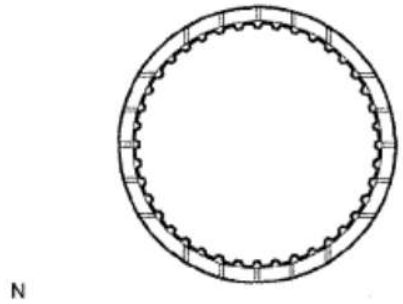


Fig. 647: Identifying Direct Multiple Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT OVERDRIVE DIRECT CLUTCH DISC**
   a. Check if the sliding surface of the disc, plate, and flange are worn or burnt.

      If necessary, replace them.

      HINT:

      - If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.
      - Before installing new discs, immerse them in ATF for at least 15 minutes.

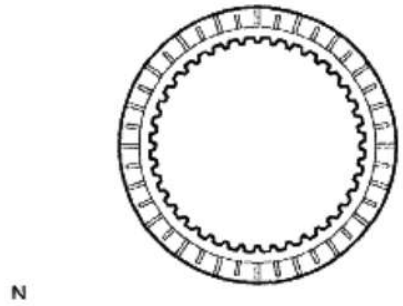


Fig. 648: Identifying Overdrive Direct Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSPECT OVERDRIVE CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Using vernier calipers, measure the free length of the spring together with the spring seat.

      Standard free length: 25.91 mm (1.0201 in.)

      If the result is not as specified, replace the spring.

cardiagn.com

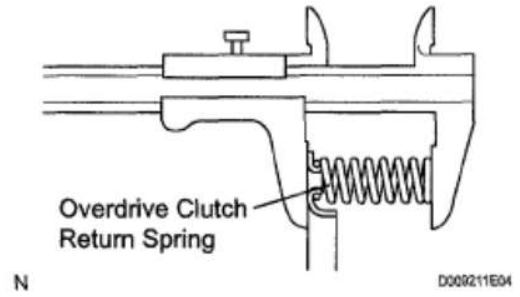


Fig. 649: Measuring Free Length Of Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSPECT PACK CLEARANCE OF REVERSE CLUTCH**
   a. Install the intermediate shaft onto the transaxle rear cover.
   b. Using a dial indicator, measure the direct clutch pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

      Clearance: 0.60 to 0.82 mm (0.0236 to 0.0323 in.)

      If the pack clearance is less than the minimum, parts may have been assembled incorrectly, so check and reassemble again. If the clearance is not as specified, select another flange.

      HINT:

      There are 7 different thicknesses of flanges available.

      Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

No.	Thickness	No.	Thickness
1	3.0 (0.118)	5	3.4 (0.134)
2	3.1 (0.122)	6	3.5 (0.138)
3	3.2 (0.126)	7	3.6 (0.142)
4	3.3 (0.130)	-	-

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

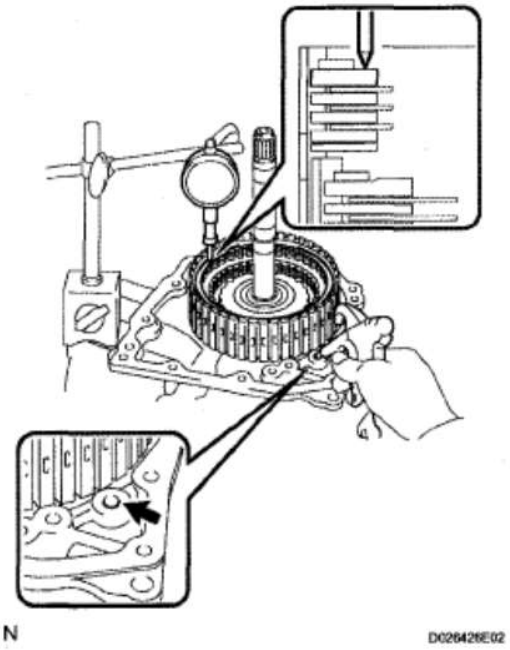


Fig. 650: Inspecting Pack Clearance Of Reverse Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSPECT PACK CLEARANCE OF DIRECT CLUTCH AND OVERDRIVE CLUTCH**
   a. Using a dial indicator, measure the direct clutch and overdrive clutch pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

      Clearance: 0.61 to 0.83 mm (0.0240 to 0.0323 in.)

      If the pack clearance is less than the minimum, parts may have been assembled incorrectly, so check and reassemble again. If the clearance is not as specified, select another flange.

      HINT:

      There are 7 different thicknesses of flanges available.

      Flange thickness: mm (in.)

      FLANGE THICKNESS SPECIFICATION

No.	Thickness	No.	Thickness
0	2.5 (0.098)	4	2.9 (0.114)
1	2.6 (0.102)	5	3.0 (0.118)
2	2.7 (0.106)	6	3.1 (0.122)
3	2.8 (0.110)	-	-

   b. Check that the disc rotates when rotating the disc after inserting the rear planetary sun gear.

cardiagn.com

NOTE: **Do not place the rear planetary sun gear in a vise.**

If the result is not as specified, replace the rear planetary sun gear.

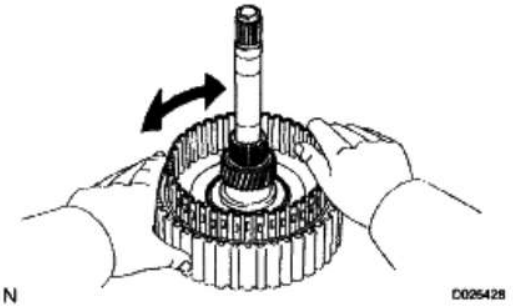


Fig. 651: Inspecting Pack Clearance Of Direct Clutch And Overdrive Clutch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL OVERDRIVE DIRECT CLUTCH O-RING**
   a. Coat a new O-ring with ATF and install it to the direct clutch drum.

NOTE: **Make sure that the O-ring is not twisted or pinched when it is installed.**

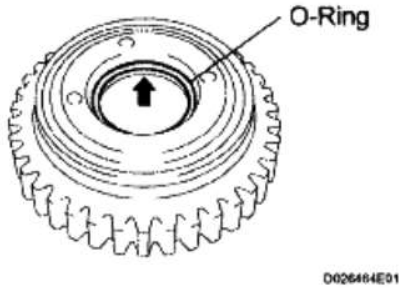


Fig. 652: Locating Overdrive Direct Clutch O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL OVERDRIVE DIRECT CLUTCH DRUM SUB-ASSEMBLY**
   a. Coat the direct clutch drum with ATF and install it to the intermediate shaft.

NOTE:
- **Be careful not to damage the O-ring.**
- **Be careful not to damage the lip of the direct clutch drum.**

cardiagn.com

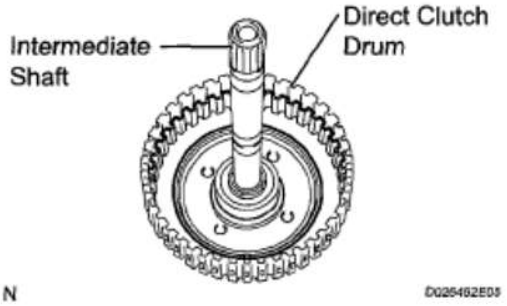


Fig. 653: Identifying Direct Clutch Drum With Intermediate Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL OVERDRIVE DIRECT CLUTCH PISTON**
   a. Coat the overdrive direct clutch piston with ATF, and install it to the direct clutch drum.

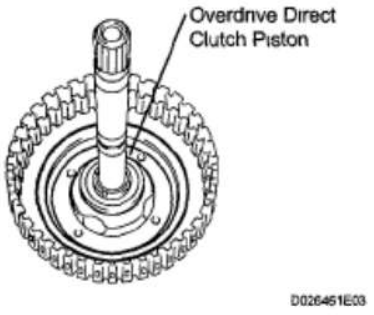
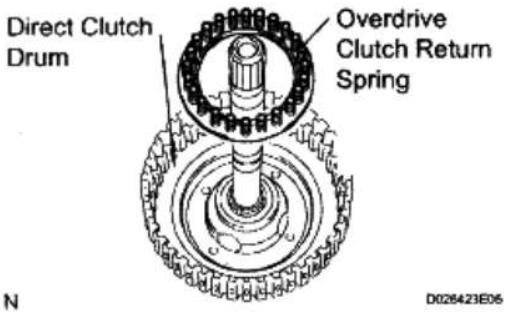


Fig. 654: Identifying Overdrive Direct Clutch Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL OVERDRIVE CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Install the overdrive clutch return spring to the direct clutch drum.

NOTE: **After installing the spring sub-assembly, check that all of the springs are engaged in the piston correctly.**

   b. Coat the clutch balancer with ATF.



cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

Fig. 655: Identifying Overdrive Clutch Return Spring And Direct Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the clutch balancer to the direct clutch drum.

NOTE:

- **Be careful not to damage the lip of the direct clutch balancer.**
- **Make sure that the lip of the seal is not pinched and that it has no other defects.**
- **Apply sufficient ATF to the sealing lip before installing the clutch balancer.**

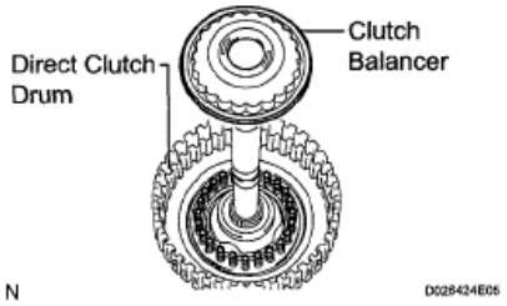


Fig. 656: Identifying Clutch Balancer And Direct Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

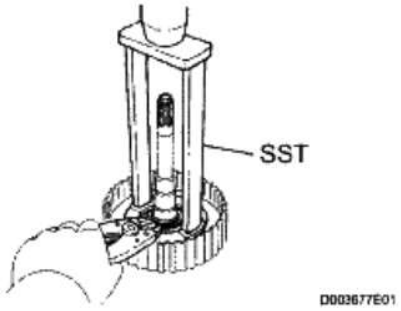
d. Place SST on the clutch balancer and compress the overdrive clutch return spring with a press.

SST 09387-00020

e. Using a snap ring expander, install the snap ring to the direct clutch drum.
f. Be sure that the end gap of the snap ring is not aligned with the spring retainer claw.

NOTE:

- **Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove. This prevents the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**



cardiagn.com

Fig. 657: Compressing Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Set the end gap of the snap ring in the piston as shown in the illustration.

NOTE: The end gap of the snap ring should not align with any of the stoppers.

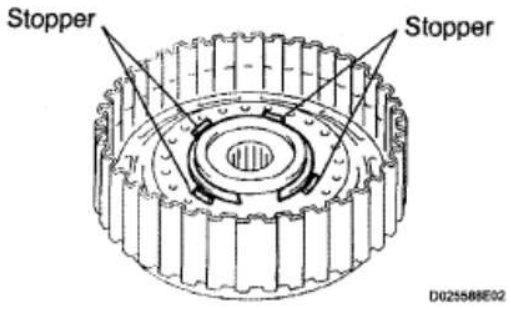


Fig. 658: Setting End Gap Of Snap Ring In Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL OVERDRIVE DIRECT CLUTCH DISC**
   a. Coat the 4 discs with ATF.
   b. Install the 4 plates, 4 discs, and flange to the intermediate shaft.

NOTE: Make sure that the plates, discs, and flange are installed as shown in the illustration.

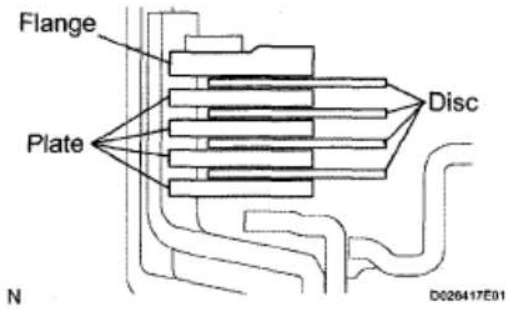


Fig. 659: Installing Plates, Discs And Flange To Intermediate Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Using a screwdriver, install the snap ring.
   d. Check that the end gap of the snap ring is not aligned with one of the cutouts.

NOTE: The snap ring should be fully engaged in the groove of the drum.

cardiagn.com

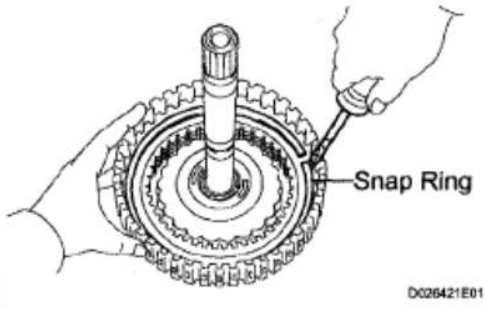


Fig. 660: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL DIRECT MULTIPLE CLUTCH DISC**
   a. Coat the 3 discs with ATF.
   b. Install the cushion plate, 3 plates, 3 discs, and flange to the intermediate shaft.

NOTE:
- **Install the cushion plate with the mark on the white surface facing to plate.**
- **Make sure that the discs, plates, and flange are installed in the correct order.**

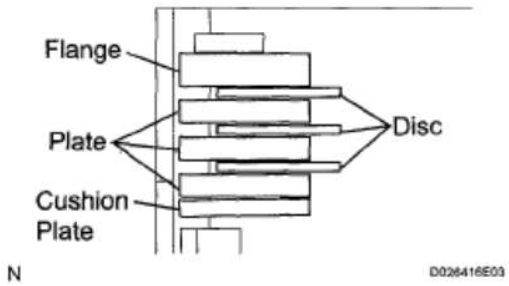


Fig. 661: Installing Cushion Plate, Plates, Discs And Flange To Intermediate Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Using a screwdriver, install the snap ring.
   d. Check that the end gap of the snap ring is not aligned with one of the cutouts.

NOTE: **The snap ring should be fully engaged in the groove of the drum.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

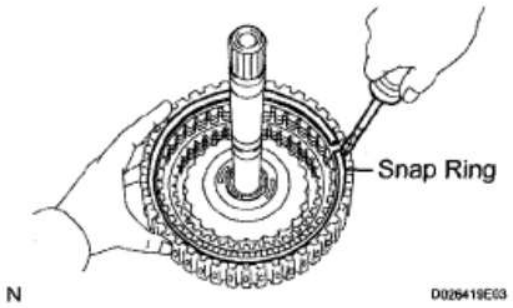


Fig. 662: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

UNDERDRIVE PLANETARY GEAR

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

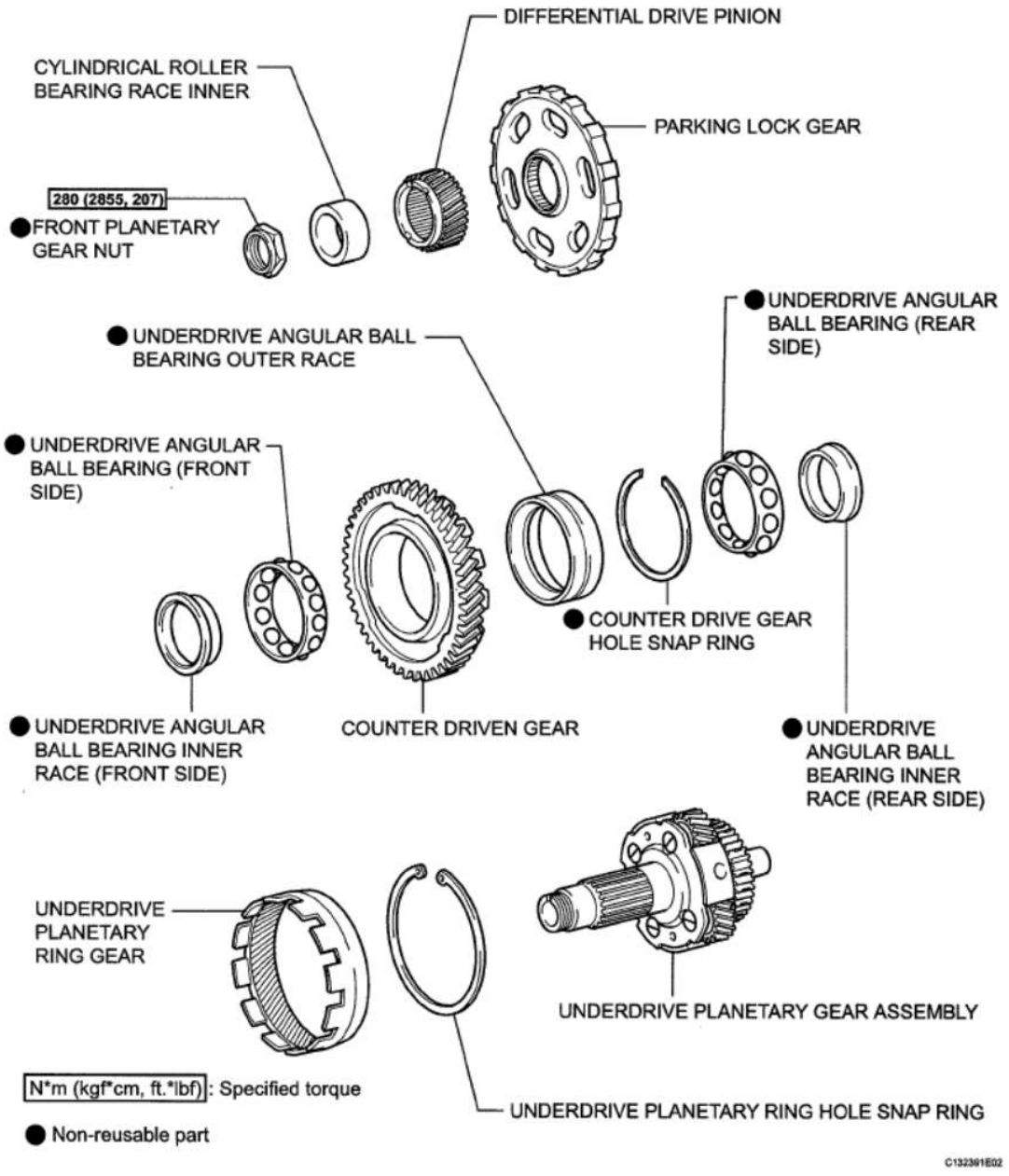


Fig. 663: Identifying Underdrive Planetary Gear Components With Torque Specification
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **INSPECT UNDERDRIVE PLANETARY GEAR PRELOAD** (See **INSPECTION**)
2. **REMOVE FRONT PLANETARY GEAR NUT**
   a. Using SST, loosen the staked part of the lock nut.

SST 09930-00010 (09931-00010, 09931-00020), 09387-00050

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

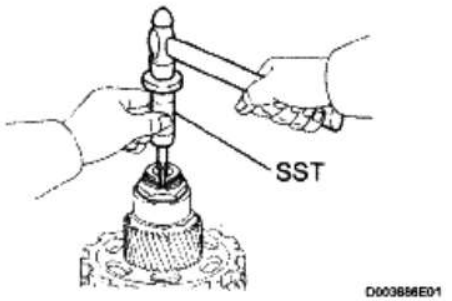


Fig. 664: Tapping Lock Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Place the underdrive planetary gear in a soft jaw vise.

NOTE: Be careful not to damage the differential drive pinion.

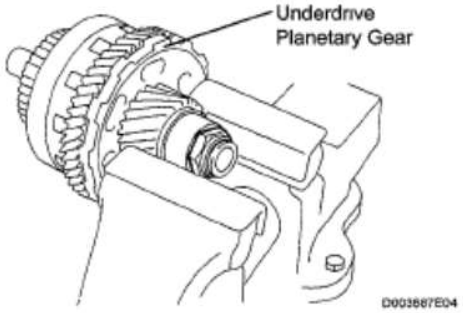


Fig. 665: Placing Underdrive Planetary Gear In Soft Jaw Vise
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a socket wrench, remove the lock nut.

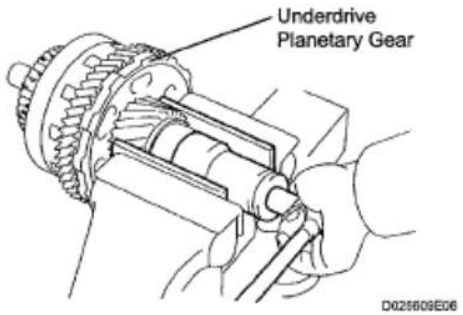


Fig. 666: Removing Lock Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE CYLINDRICAL ROLLER BEARING RACE INNER**
   a. Using SST, remove the cylindrical roller bearing race inner.

cardiagn.com

SST 09950-00020, 09950-00030, 09950-60010 (09951-00320, 09957-04010)

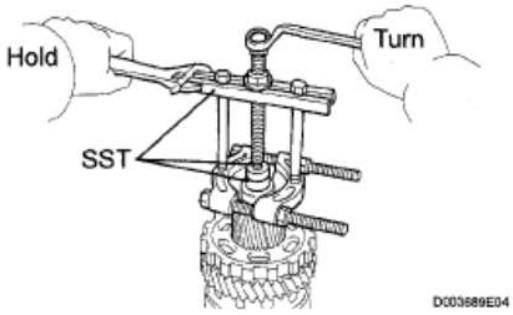


Fig. 667: Removing Cylindrical Roller Bearing Race Inner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE UNDERDRIVE PLANETARY GEAR ASSEMBLY**
   a. Using SST and a press, remove the differential drive pinion, parking lock gear, counter driven gear with underdrive planetary ring gear, and radial ball bearing front.

   SST 09950-60010 (09951-00320), 09387-00050, 09950-00020, 09950-00030, 09950-40011 (09957-04010)

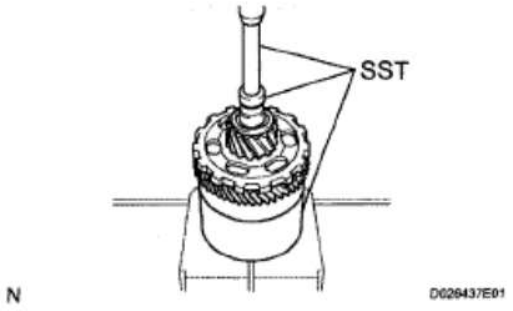


Fig. 668: Removing Differential Drive Pinion, Parking Lock Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Place the underdrive planetary gear in a soft jaw vise.
   c. Using SST, remove the radial ball bearing rear from the underdrive planetary gear.

   SST 09950-60010 (09951-00320), 09950-00030, 09950-40011 (09957-04010)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

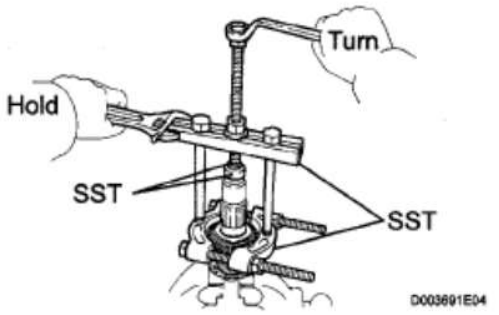


Fig. 669: Removing Radial Ball Bearing Rear From Underdrive Planetary Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE UNDERDRIVE PLANETARY RING GEAR**
   a. Using snap ring pliers, remove the snap ring.



Fig. 670: Removing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Remove the underdrive planetary ring gear from the counter driven gear.

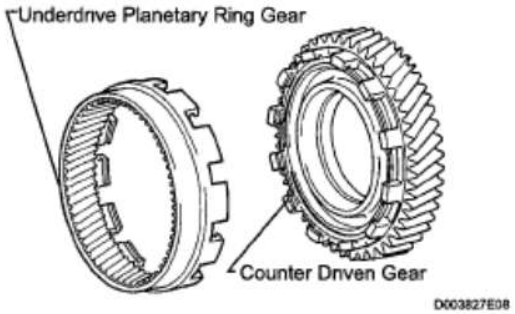


Fig. 671: Identifying Underdrive Planetary Ring Gear And Counter Driven Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT UNDERDRIVE PLANETARY GEAR PRELOAD**
   a. Using SST, secure the underdrive planetary gear assembly.

cardiagn.com

SST 09387-00050

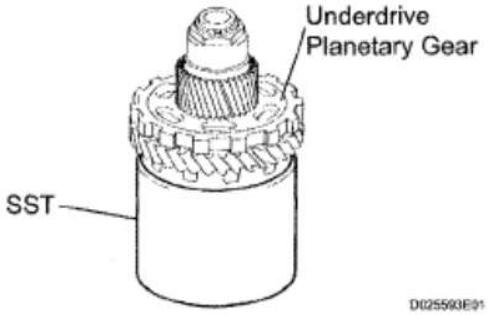


Fig. 672: Inspecting Underdrive Planetary Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST and a torque wrench, measure the turning torque of the underdrive planetary gear assembly while rotating the torque wrench at 60 rpm.

SST 09387-00050

Turning torque at 60 rpm.: 0.50 to 1.42 N*m (5.1 to 14.5 kgf*cm, 4.4 to 12.6 in.*lbf)

HINT:

Use a torque wrench with a fulcrum length of 160 mm (6.3 in.).

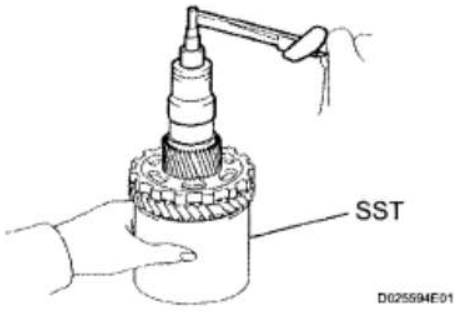


Fig. 673: Measuring Turning Torque Of Underdrive Planetary Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL UNDERDRIVE PLANETARY RING GEAR**
   a. Install a new snap ring to the outer race of a new radial ball bearing rear.

   HINT:

   When replacing the bearing, replace the counter driven gear with a new one.

cardiagn.com

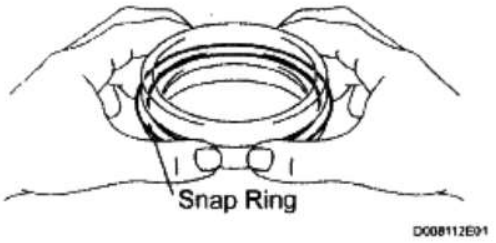


Fig. 674: Installing Snap Ring To Outer Race Of Radial Ball Bearing Rear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a piston ring compressor, squeeze the snap ring.

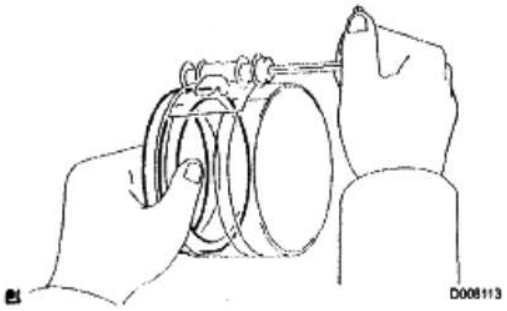


Fig. 675: Squeezing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST and a press, press in the outer race of the radial ball bearing rear.

SST 09950-60020 (09951-00890), 09950-70010 (09951-07100)

NOTE: Be sure not to damage the snap ring while installing the outer race.

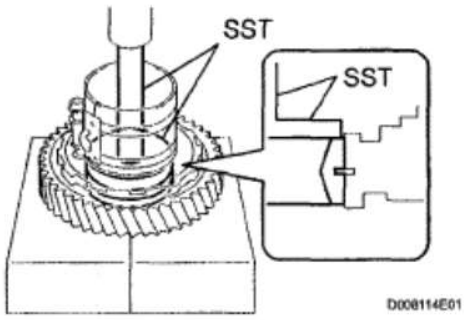


Fig. 676: Pressing Outer Race Of Radial Ball Bearing Rear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the underdrive planetary ring gear to the counter driven gear.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

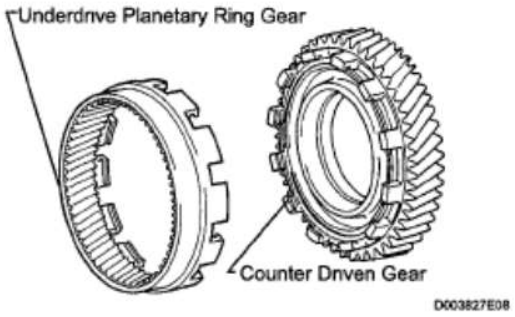


Fig. 677: Identifying Underdrive Planetary Ring Gear And Counter Driven Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using snap ring pliers, install the snap ring.

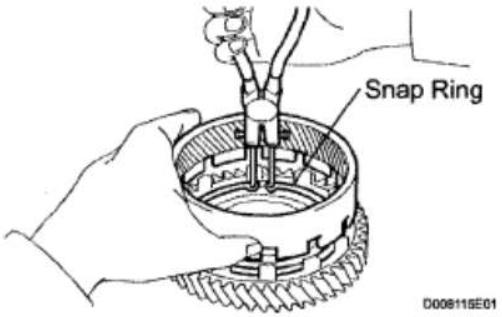


Fig. 678: Installing Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL UNDERDRIVE PLANETARY GEAR ASSEMBLY**

a. Using SST and a press, press the radial ball bearing rear in the underdrive planetary gear.

SST 09502-12010, 09950-60010 (09951-00260), 09950-70010 (09951-07100)

NOTE: Press the bearing until it becomes flat at the bottom.

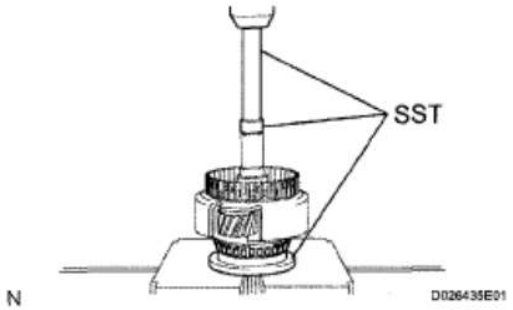


Fig. 679: Pressing Radial Ball Bearing Rear In Underdrive Planetary Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

cardiagn.com

b. Install the counter driven gear with planetary ring gear to the underdrive planetary gear.

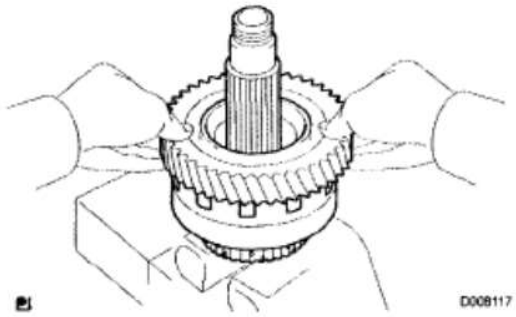


Fig. 680: Installing Counter Driven Gear With Planetary Ring Gear To Underdrive Planetary Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST and a press, press in a new radial ball bearing front.

SST 09502-12010, 09950-60010 (09951-00260), 09950-70010 (09951-07100)

NOTE: Press the counter driven gear while rotating it.

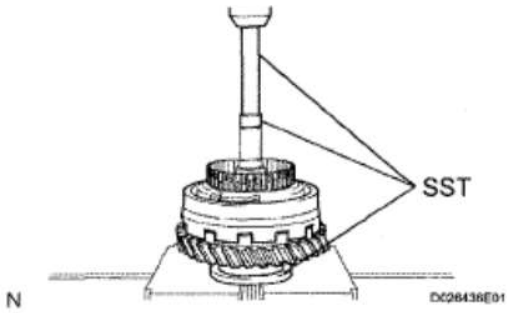


Fig. 681: Pressing Radial Ball Bearing Front
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using SST and a press, press in the parking lock gear.

SST 09502-12010, 09950-60010 (09951-00260), 09950-70010 (09951-07100)

NOTE: Press the counter driven gear while rotating it.

cardiagn.com

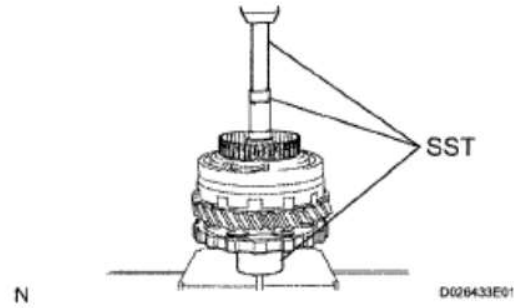


Fig. 682: Pressing Parking Lock Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL DIFFERENTIAL DRIVE PINION**
   a. Using SST and a press, press the differential drive pinion.

SST 09726-40010, 09950-60010 (09951-00260), 09950-70010 (09951-07100)

NOTE:
- **Press the counter driven gear while rotating it.**
- **Check the number and position of the gear teeth.**

NOTE: Press the counter driven gear while rotating it.

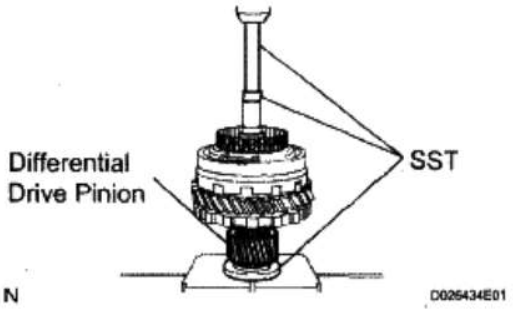


Fig. 683: Pressing Differential Drive Pinion
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL CYLINDRICAL ROLLER BEARING RACE INNER**
   a. Using SST and a press, press the cylindrical roller bearing race inner.

SST 09506-35010, 09950-60010 (09951-00260), 09950-70010 (09951-07100)

NOTE: Press the counter driven gear while rotating it.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

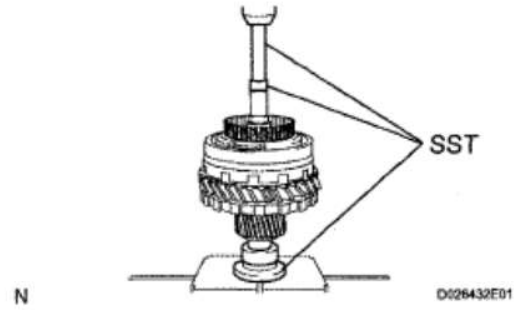


Fig. 684: Pressing Cylindrical Roller Bearing Race Inner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL FRONT PLANETARY GEAR NUT**
   a. Place the underdrive planetary gear in a soft jaw vise.

NOTE: Be careful not to damage the differential drive pinion.

   b. Using a socket wrench, install a new lock nut.

Torque: 280 N*m (2855 kgf*cm, 207 ft.*lbf)

HINT:

Use a torque wrench with a fulcrum length of 750 mm (29.53 in.).

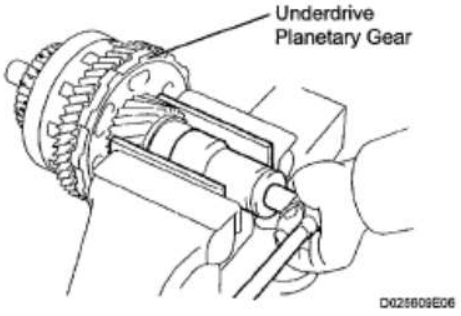


Fig. 685: Placing Underdrive Planetary Gear In Soft Jaw Vise
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Using a pin punch and hammer, stake the lock nut.

CAUTION: Be sure that there are no cracks on the nut.

6. **INSPECT UNDERDRIVE PLANETARY GEAR PRELOAD** (See **INSPECTION**)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

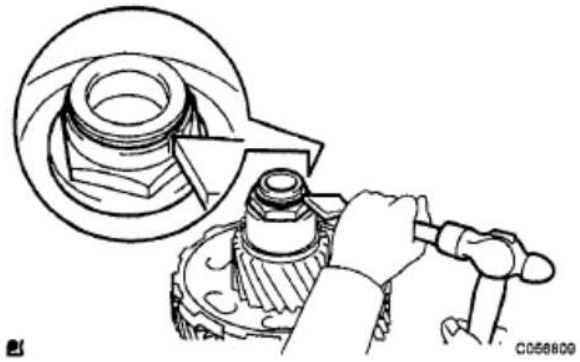


Fig. 686: Staking Lock Nut
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

UNDERDRIVE CLUTCH

COMPONENTS

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

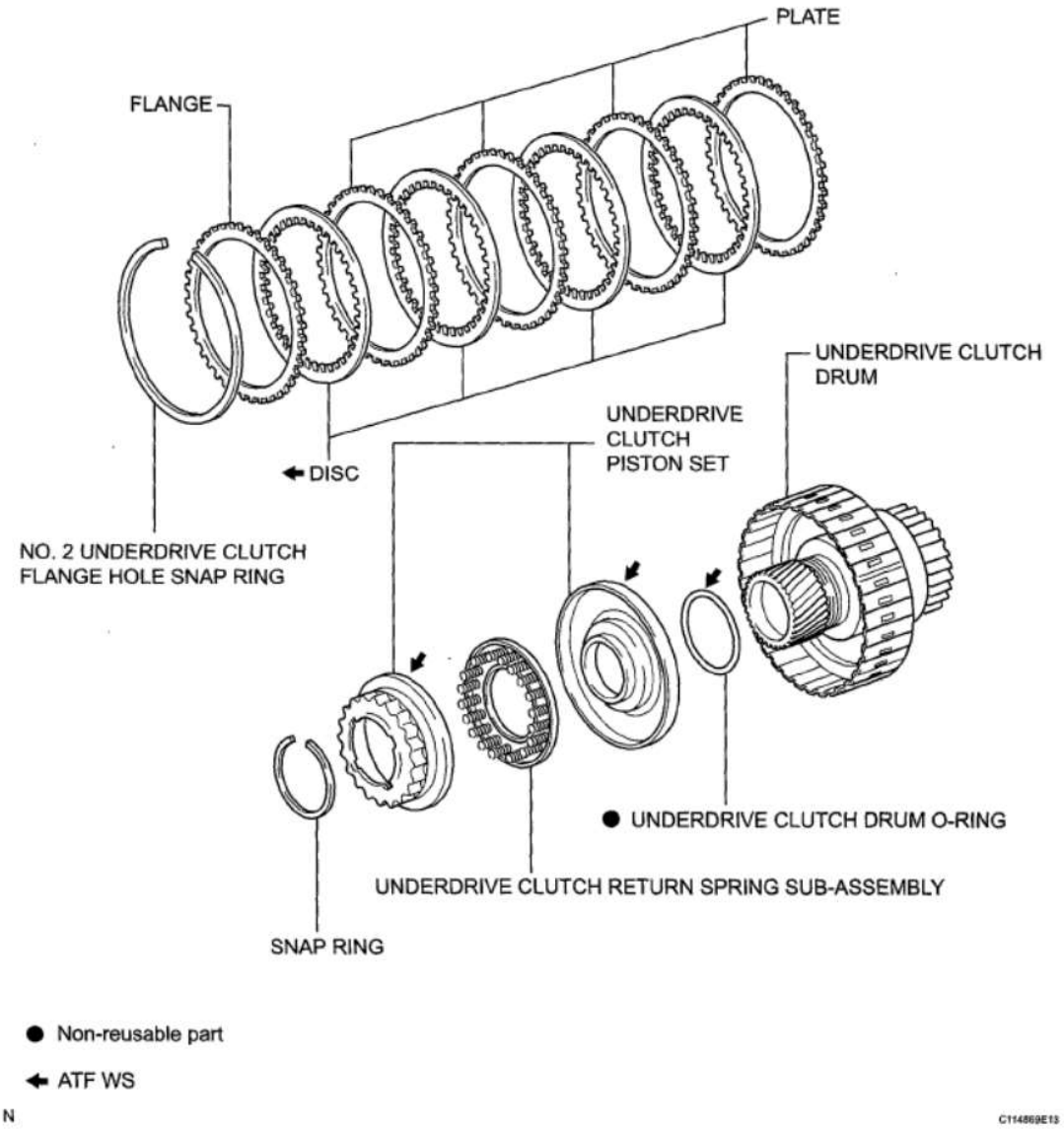


Fig. 687: Identifying Underdrive Clutch Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **INSPECT UNDERDRIVE PACK CLEARANCE** (See **INSPECTION**)
2. **REMOVE NO. 2 UNDERDRIVE CLUTCH FLANGE HOLE SNAP RING**
   a. Using a screwdriver, remove the No. 2 underdrive clutch flange snap ring.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

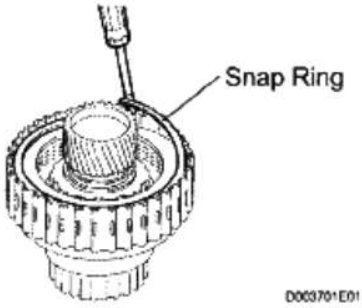


Fig. 688: Removing No. 2 Underdrive Clutch Flange Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **REMOVE NO. 1 UNDERDRIVE CLUTCH DISC**
   a. Remove the flange, 4 discs, and 4 plates from the underdrive clutch drum.

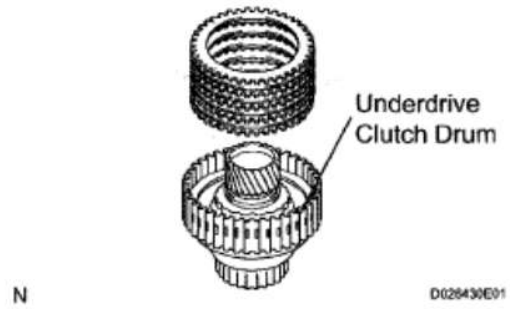


Fig. 689: Identifying No. 1 Underdrive Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE UNDERDRIVE CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Place SST on the clutch balancer and compress the spring with a press.

   SST 09350-32014

   b. Using a snap ring expander, remove the snap ring.

NOTE:

- **Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove. This prevents the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

cardiagn.com

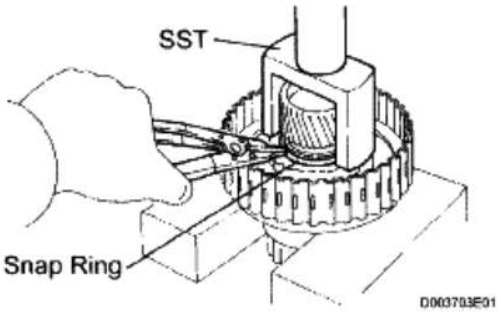


Fig. 690: Placing SST On Clutch Balancer And Compress Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the clutch balancer from the underdrive clutch drum.

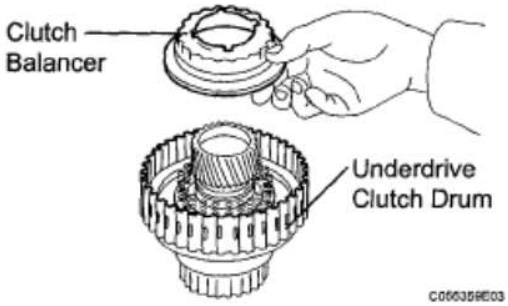


Fig. 691: Identifying Clutch Balancer And Underdrive Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the return spring from the underdrive clutch drum.

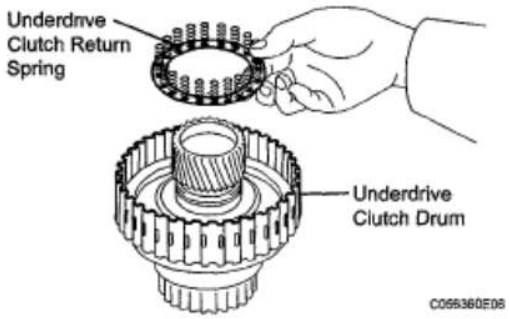


Fig. 692: Identifying Return Spring And Underdrive Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE UNDERDRIVE CLUTCH PISTON SET**

a. Install the underdrive clutch to the transaxle case.

NOTE: Be careful not to damage the oil seal ring.

cardiagn.com

b. Holding the underdrive clutch piston by hand, apply compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi) to the transaxle case to remove the underdrive clutch piston.

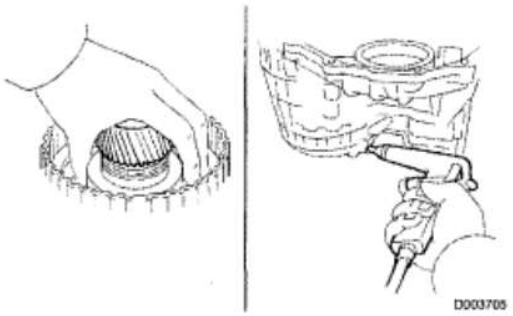


Fig. 693: Applying Compressed Air To Transaxle Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE UNDERDRIVE CLUTCH DRUM O-RING**
   a. Using a screwdriver, remove the O-ring from the underdrive clutch drum.

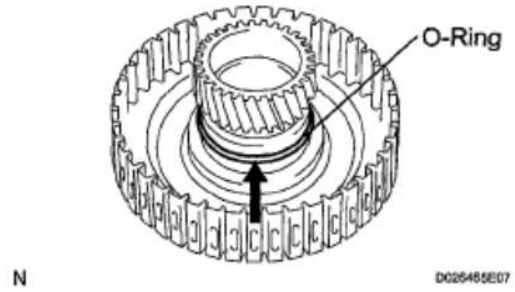


Fig. 694: Locating Underdrive Clutch Drum O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **INSPECT UNDERDRIVE PACK CLEARANCE**
   a. Install the underdrive clutch to the transaxle case.

NOTE: Be careful not to damage the oil seal rings.

   b. Install a dial indicator as shown in the illustration.
   c. Measure the underdrive clutch pack clearance while applying and releasing compressed air (392 kPa, 4.0 kgf/cm^2 , 57 psi).

Pack clearance: 1.51 to 1.71 mm (0.0594 to 0.0673 in.)

If the pack clearance is not as specified, inspect the discs, plates, and flange.

cardiagn.com

HINT:

There are 5 different thicknesses of flanges available.

Flange thickness: mm (in.)

FLANGE THICKNESS SPECIFICATION

Mark	Thickness	Mark	Thickness
1	3.0 (0.118)	4	3.6 (0.141)
2	3.2 (0.126)	5	3.8 (0.150)
3	3.4 (0.134)	-	-

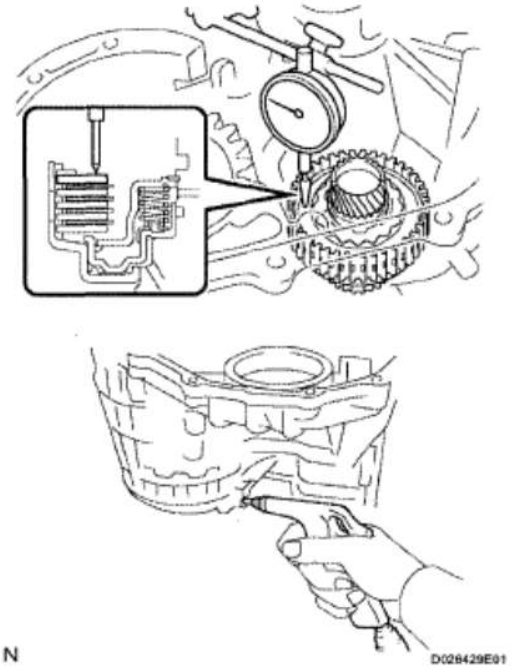


Fig. 695: Measuring Underdrive Clutch Pack Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT NO. 1 UNDERDRIVE CLUTCH DISC**
   a. Check if the sliding surface of the disc, plate, and flange are worn or burnt. If necessary, replace them.

   HINT:

   - If the lining of the disc comes off or discolors, or if a part of the groove is worn, replace all discs.
   - Before installing new discs, immerse them in ATF for at least 15 minutes.

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

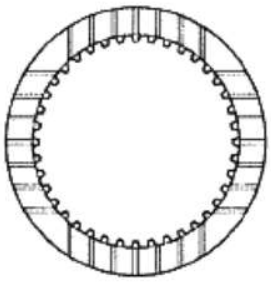


Fig. 696: Identifying No. 1 Underdrive Clutch Disc
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT UNDERDRIVE CLUTCH DRUM SUB-ASSEMBLY**
   a. Using a dial indicator, measure the inside diameter of the underdrive clutch drum bushing.

   Standard drum bushing: 37.06 to 37.08 mm (1.4591 to 1.4598 in.)

   Maximum drum bushing: 37.13 mm (1.4618 in.)

   If the inside diameter is greater than the maximum, replace the underdrive clutch drum.

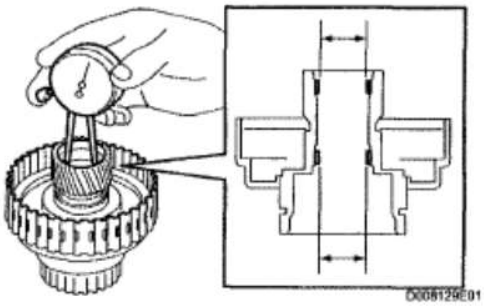


Fig. 697: Measuring Inside Diameter Of Underdrive Clutch Drum Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT UNDERDRIVE CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Using vernier calipers, measure the free length of the spring together with the spring seat.

   Standard free length: 17.14 mm (0.6748 in.)

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

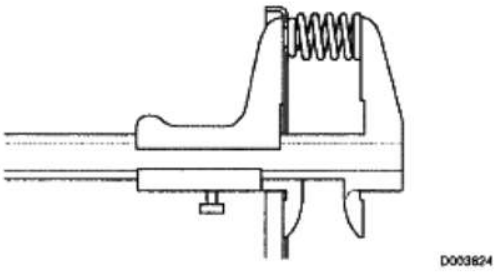


Fig. 698: Measuring Free Length Of Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL UNDERDRIVE CLUTCH DRUM O-RING**
   a. Coat a new O-ring with ATF and install it to the underdrive clutch drum.

NOTE: Make sure that the O-ring is not twisted or pinched.

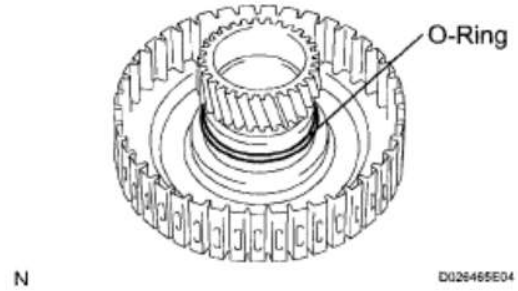
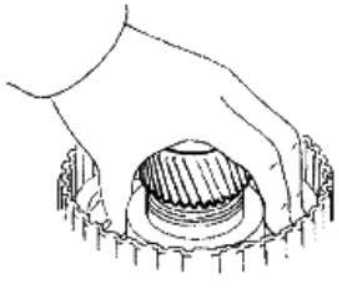


Fig. 699: Identifying Underdrive Clutch Drum O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSTALL UNDERDRIVE CLUTCH PISTON SET**
   a. Coat the underdrive clutch piston with ATF, and install it to the underdrive clutch piston drum.

NOTE:
- **Be careful not to damage the O-ring.**
- **Be careful not to damage the lip of the piston.**



cardiagn.com

Fig. 700: Installing Underdrive Clutch Piston Set
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSTALL UNDERDRIVE CLUTCH RETURN SPRING SUB-ASSEMBLY**
   a. Install the return spring to the underdrive clutch drum.

NOTE: **After installing the spring sub-assembly, check that all of the springs are engaged in the piston correctly.**

   b. Coat the clutch balancer with ATF.

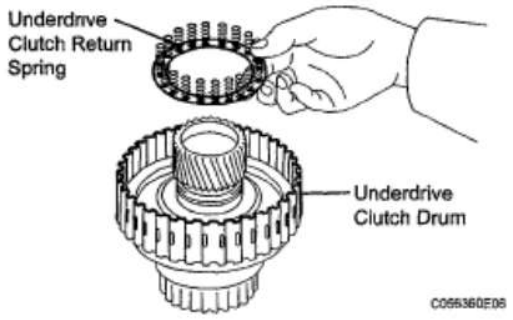


Fig. 701: Identifying Return Spring And Underdrive Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   c. Install the clutch balancer to the underdrive clutch drum.

NOTE: **Be careful not to damage the lip of the clutch balancer.**

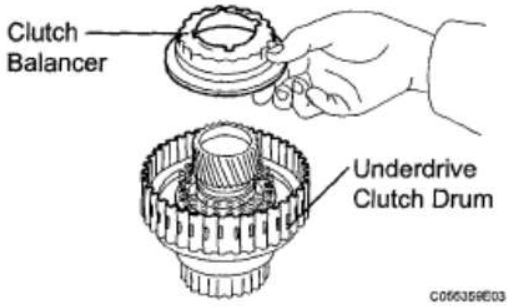


Fig. 702: Identifying Clutch Balancer And Underdrive Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   d. Place SST on the clutch balancer and compress the piston return spring with a press.

SST 09350-32014 (09351-32070)

   e. Using a snap ring expander, install the snap ring to the underdrive clutch drum.

cardiagn.com

f. Be sure that the end gap of the snap ring is not aligned with the spring retainer claw.

NOTE:

- **Stop the press when the spring seat is lowered to the place 1 to 2 mm (0.039 to 0.078 in.) from the snap ring groove. This prevents the spring seat from being deformed.**
- **Do not expand the snap ring excessively.**

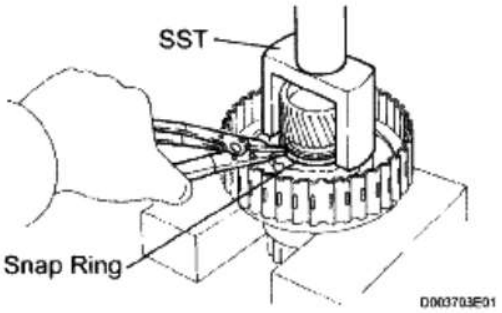


Fig. 703: Placing SST On Clutch Balancer And Compress Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Set the end gap of the snap ring in the underdrive clutch drum as shown in the illustration.

NOTE: **The end gap of the snap ring should not align with any of the stoppers.**

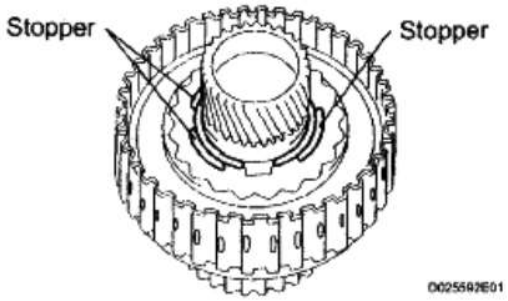


Fig. 704: Setting End Gap Of Snap Ring In Underdrive Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL NO. 1 UNDERDRIVE CLUTCH DISC**
   a. Coat the 4 discs with ATF.
   b. Install the 4 plates, 4 discs, and flange to the underdrive clutch drum.

NOTE: **Make sure that the plates, discs, and flange are installed as shown in the illustration.**

cardiagn.com

2009 Toyota Highlander Limited

2009 TRANSMISSION Automatic Transaxle (U151E) - Highlander

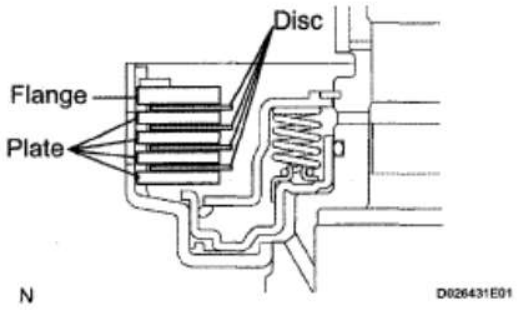


Fig. 705: Installing Plates, Discs And Flange To Underdrive Clutch Drum
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSTALL NO. 2 UNDERDRIVE CLUTCH FLANGE HOLE SNAP RING**
   a. Using a screwdriver, install the No. 2 underdrive clutch flange hole snap ring.
   b. Check that the end gap of the snap ring is not aligned with one of the cutouts.

NOTE: The snap ring should be fully engaged in the groove of the drum.

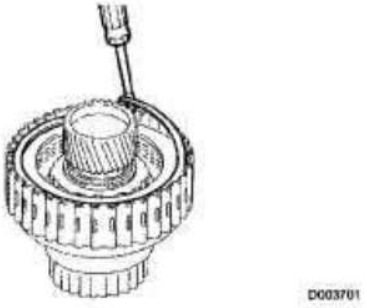


Fig. 706: Installing No. 2 Underdrive Clutch Flange Hole Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSPECT UNDERDRIVE PACK CLEARANCE** (See **INSPECTION**)

cardiagn.com