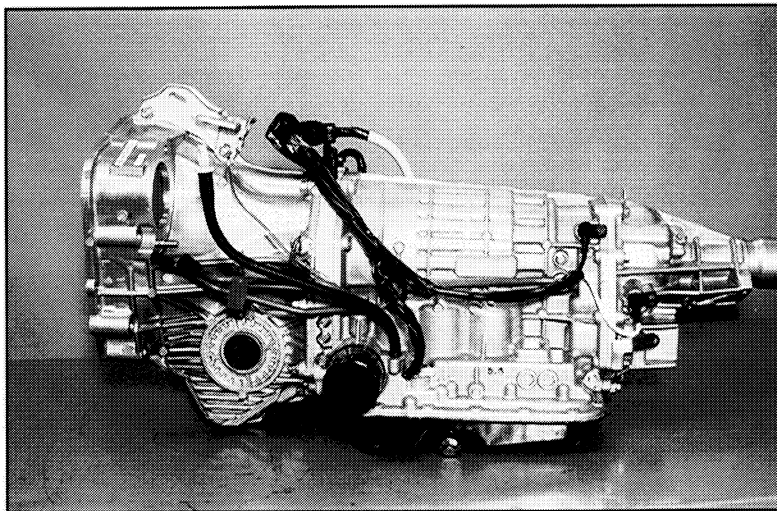




Introduction To The 1999 4EAT Transmission



Video Reference Booklet

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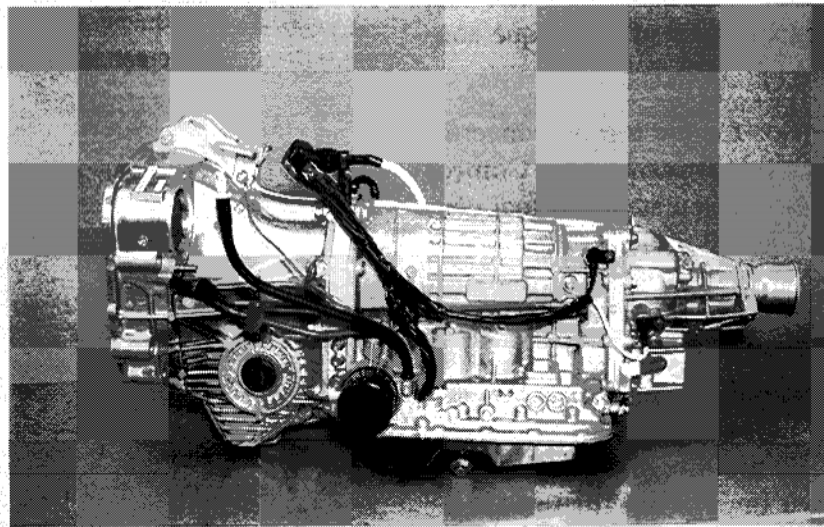
INTRODUCTION TO THE 1999 4EAT TRANSMISSION

INTRODUCTION

The new 4EAT transmission on 1999 Subaru cars provides smoother and more precise shifting than previous versions of the 4EAT. It's used on all 1999 Legacys, Foresters, and Imprezas. If you're familiar with previous versions of the 4EAT, you'll have no trouble getting up to speed on the 1999 model.

This Video Reference Booklet summarizes changes to the 1999 4EAT automatic transmission including:

- mechanical changes,
- the disassembly procedure,
- what's new about reassembly,
- changes in the hydraulic circuits, and
- diagnosis with the New Select Monitor.



1999 4EAT Transmission

INTRODUCTION TO THE 1999 4EAT TRANSMISSION

MECHANICAL CHANGES

Several mechanical changes have been made for the 1999 4EAT automatic transmission. These changes include a new external oil filter; an additional speed sensor, for a total of three instead of just two; three new solenoids; and the elimination of the 3-4 one-way clutch. These changes are described in more detail below.

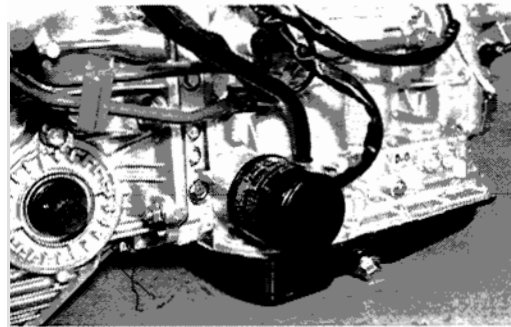
External Oil Filter

The 1999 4EAT has a new external oil filter, which can be changed if necessary. This can be done easily. The new filter is in addition to the metal screen in the valve body, on previous models, that is still present and can still be flushed when the 4EAT is disassembled.

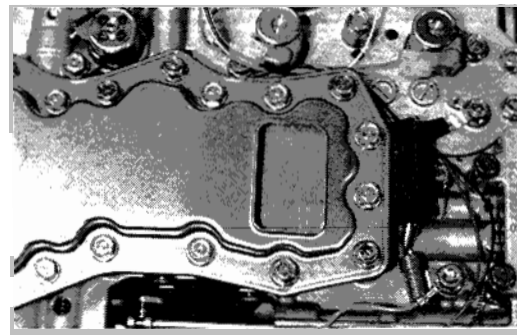
Three Speed Sensors

The 1999 4EAT has *three* speed sensors instead of two: one for the front output shaft, one for the rear, and a new one that monitors the input speed of the torque converter turbine.

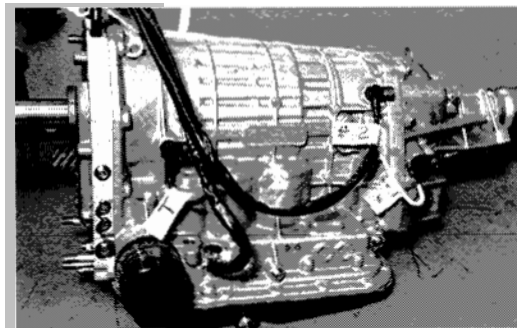
The speed sensor for the torque converter turbine allows the Transmission Control Module (TCM) to calculate the actual gear ratio in real time, by dividing the turbine speed by the output speed. To avoid shift shock and sluggish shifting, the rate of change of the actual gear ratio needs to be kept within a certain range. The TCM controls the duty ratios for the 2-4 brake, the high clutch, and the low clutch so that the rate of change occurs within the target range.



External Oil Filter



Screen in Valve Body



Speed Sensors

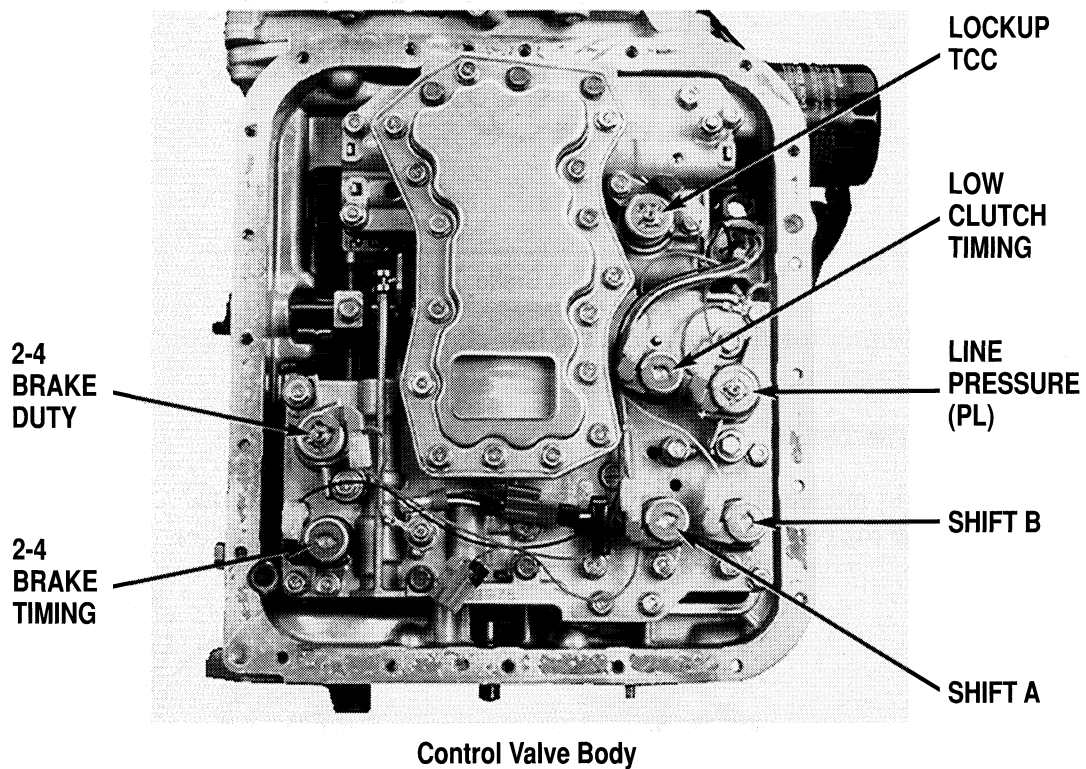
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Three New Solenoids

In addition to four of the solenoids used on the older 4EAT, the 1999 model has three *new* solenoids:

- the 2-4 brake duty solenoid,
- the 2-4 brake timing solenoid, and
- the low clutch timing solenoid.

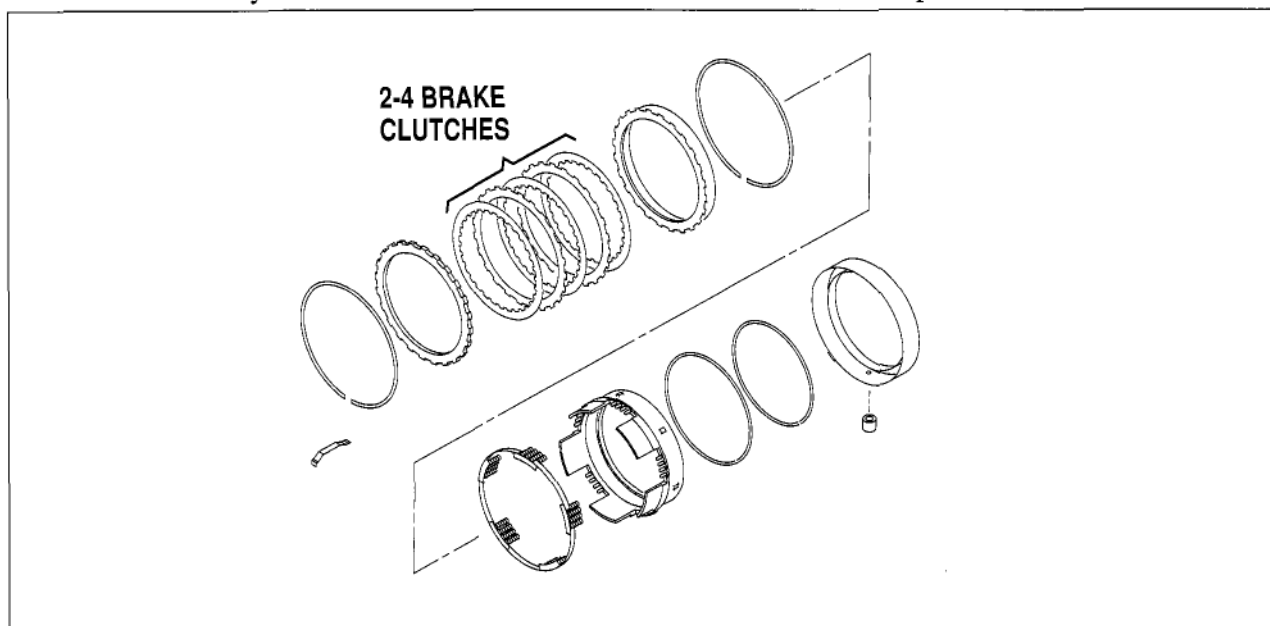
These new solenoids, which take the place of some previous components, provide smoother and more precise shifting.



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The 2-4 brake duty and 2-4 brake timing solenoids control a new 2-4 brake clutch, which takes the place of the previous brake band in controlling 2nd and 4th gear. When activated, this brake clutch locks the front sun gear to the case of the transmission.

The 2-4 brake duty solenoid controls the on/off function of the clutch pack.

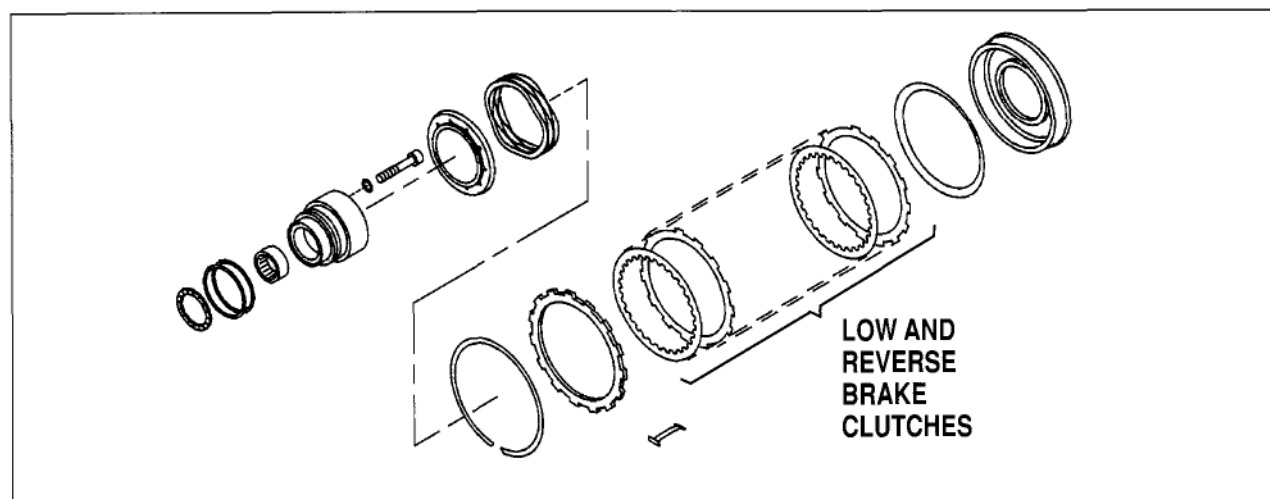


2-4 Brake Clutch

The low clutch timing solenoid controls the low clutch, which replaces the overrunning clutch in providing engine braking.

Low and Reverse Brake

Engine braking in manual first and reverse is achieved by applying the low and reverse brake. This connects the road wheels with the engine, causing the engine to slow the wheels.

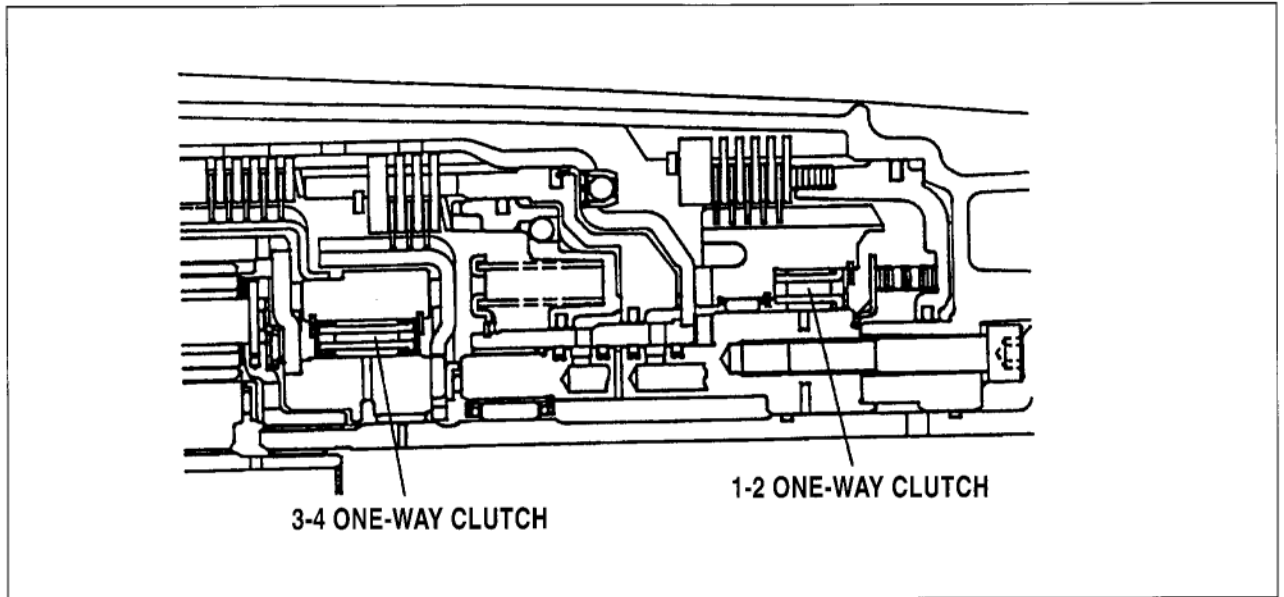


Low-and-Reverse Brake

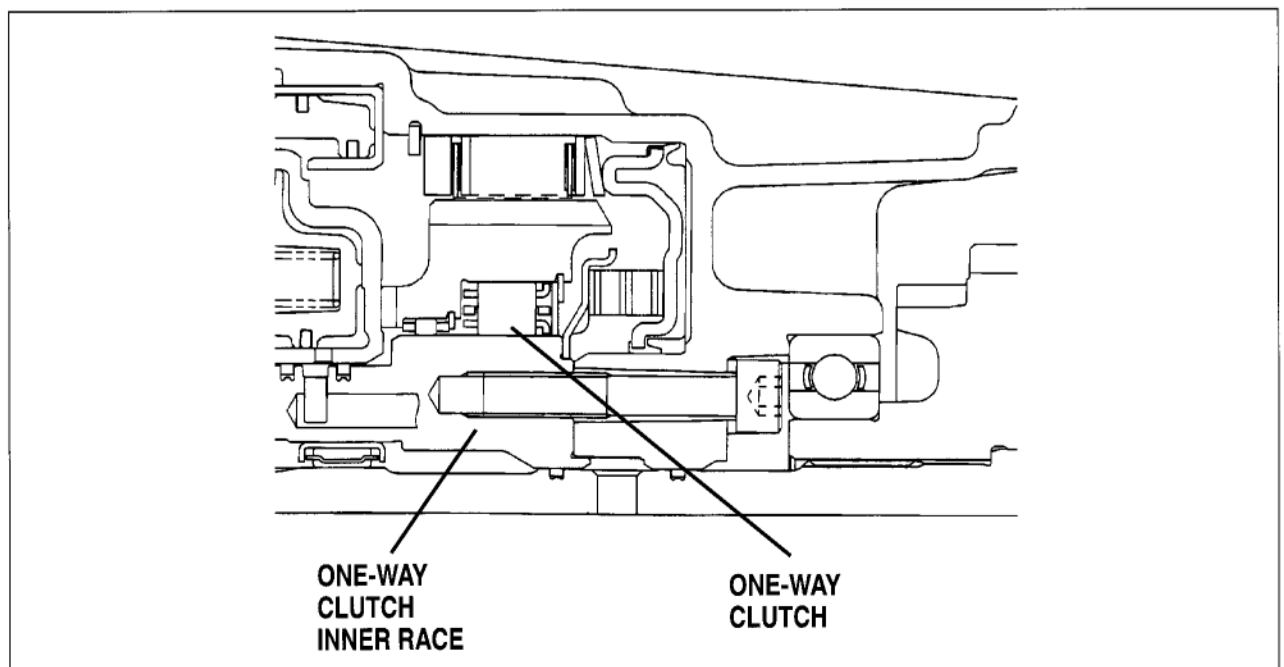
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One-Way Clutch

The 3-4 one-way clutch has also been eliminated. There is still a 1-2 one-way clutch, but it's now called the "one-way clutch," since it's the only one.



3-4 One-Way Clutch



One-Way Clutch

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DISASSEMBLY PROCEDURE

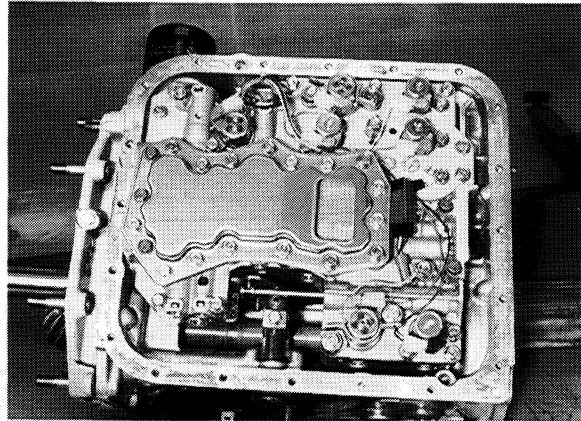
Before beginning disassembly, be sure to label the three sensors, so you don't install them incorrectly when you reassemble the transmission.

Remove vehicle speed sensor 1 from the extension case.

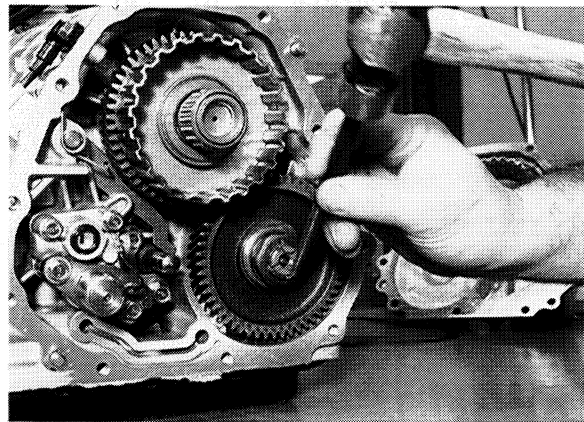
Next, remove the bolts that secure the extension case to the rear of the transmission and remove the extension case. Note that the valve body is now part of the main housing.

Put the gear selector in Park to engage the parking pawl.

Straighten the peening mark of the lock nut. The lock nut is designed to be used only **once**. Remove it and its washer.



Valve Body



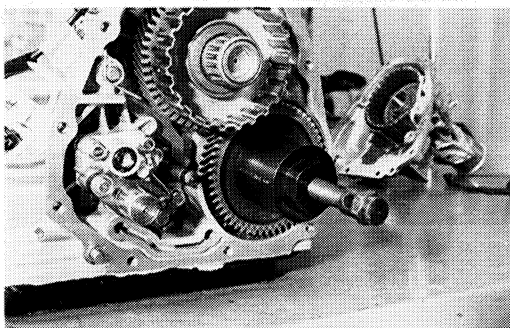
Straightening Peening Mark of Lock Nut

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Removing the Drive and Driven Gears

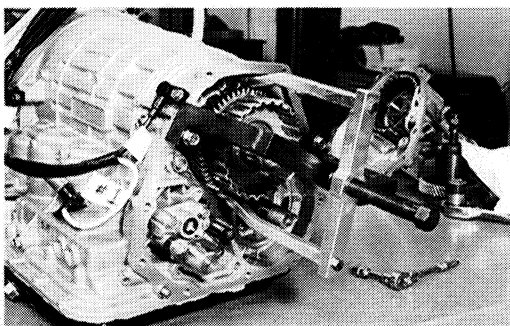
Clean the threaded portion of the back of the reduction driven gear and install the new driven gear puller - **499737000** and the threaded drive screw **899524100**.

Turn the puller until the reduction driven gear has cleared the pinion shaft.



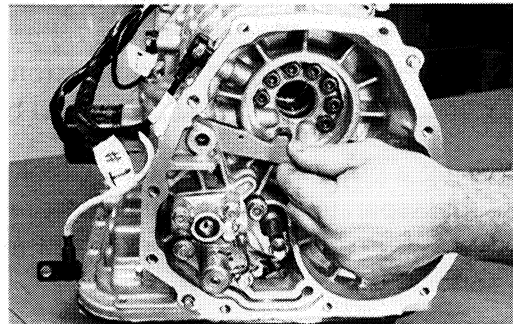
Installing Driven Gear Puller

Install the new reduction drive gear puller - **499737100** and the threaded drive screw **899524100** - on the rear of the transmission and remove the drive gear assembly.



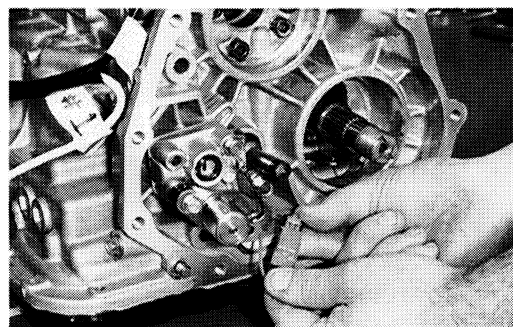
Reduction Drive Gear Puller Installed

Remove the parking pawl, the spring, and the parking pawl shaft.



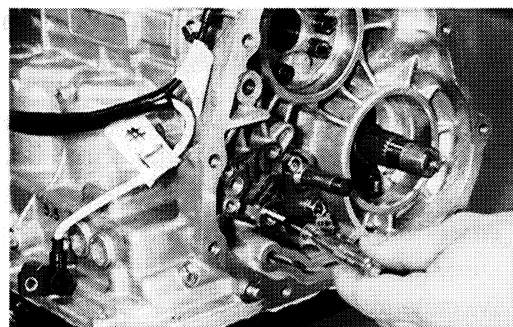
Removing Parking Pawl

Disconnect the transfer duty solenoid connector and remove the bolts that secure the solenoid and transfer control valve to the transmission case.



Disconnecting Transfer Duty Solenoid Connector)

Remove the small filter behind the valve body.



Removing Small Filter

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Removing the Control Valve Body

Remove the oil pan. Position the transmission on the workbench with the oil pan facing upward and hold it in position with wooden blocks. Remove the oil pan bolts.

Using a putty knife or a similar tool, carefully separate the pan from the transmission. Be careful not to scratch the mating surface.

Carefully disconnect and remove the wiring harness.

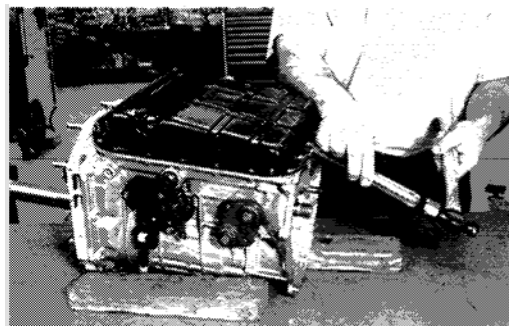
Carefully disconnect all the solenoids:

- shift A solenoid,
- shift B solenoid,
- PL solenoid,
- lock-up solenoid,
- 2-4 brake duty solenoid,
- 2-4 brake timing solenoid, and
- low clutch timing solenoid.

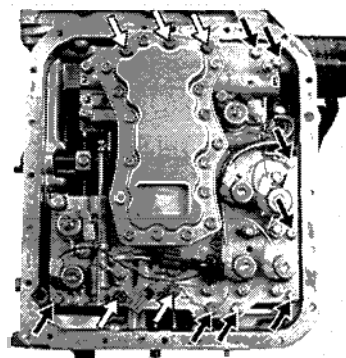
(The connectors and their corresponding wires have matching colors, although the match is not always close.)

Remove the control valve body. Note the positions of the eight short bolts marked with an "8" and the five long bolts marked "7."

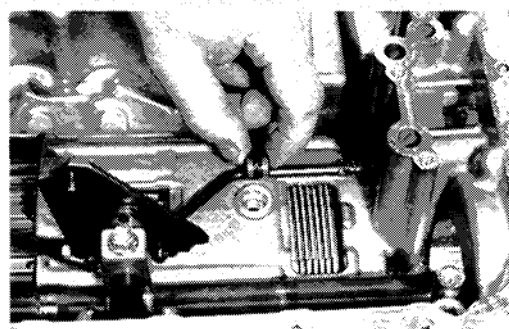
Remove the new seal pipe, which routes hydraulic pressure from the valve body to the 2-4 brake clutch piston. The seal pipe is **easily damaged**; if it leaks or loses pressure, the 2-4 brake clutch may act erratically, causing slip in 2nd and 4th gear. After removal, always replace the seal pipe with a new one.



Separating Pan from Transmission



Control Valve Body



Seal Pipe

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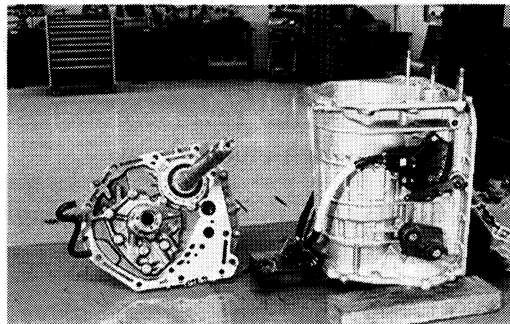
Removing the Pump Assembly

Put the transmission back in the vertical position and stabilize it with wooden blocks. Remove the nuts and bolts that secure the pump assembly to the transmission case.

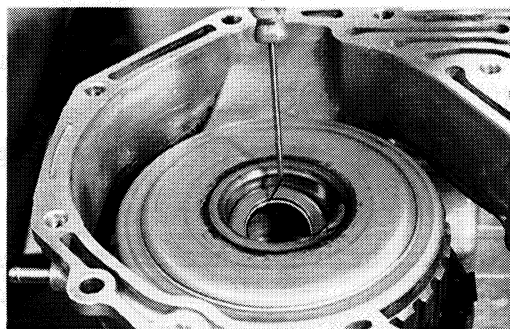
Using the stator support as a handle, remove the pump assembly and gasket.

Remove the thrust needle bearing and save it. You may be able to reuse it during assembly, depending on the transmission total end play.

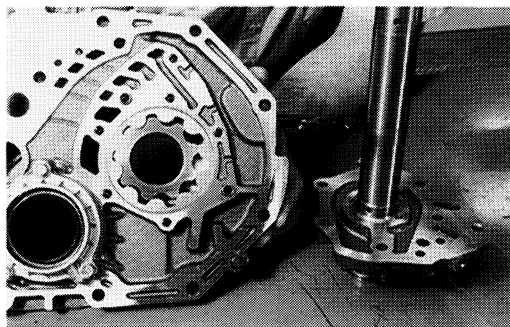
The pump is a new trochoid design with one thrust washer, instead of two. The inner and outer rotors are the only serviceable parts. If the rotor is damaged, check to see whether the pump case is also worn or damaged. If it is, it must be replaced.



Pump Assembly (Removed)



Removing Thrust Needle Bearing



Trochoid Pump

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Removing the High-Clutch Drum and 2-4 Brake Clutch

Remove the high-clutch drum, the thrust needle bearing, and the high clutch hub. Both the high and reverse clutches are housed in the high-clutch drum.

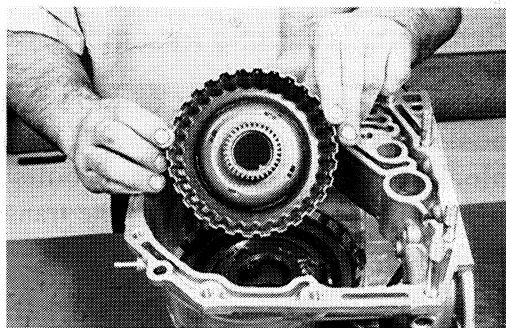
Next, remove the thrust needle bearing and the front sun gear.

Remove the snap ring and the drive and driven plates of the new 2-4 brake clutch, together with its pressure plate.

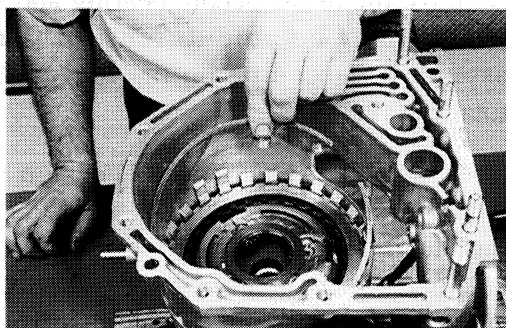
Remove the new upper leaf spring, which reduces chatter and vibration. Observe the location of the tang so you can reassemble the spring correctly.

Removing the Planetary Gear Assembly

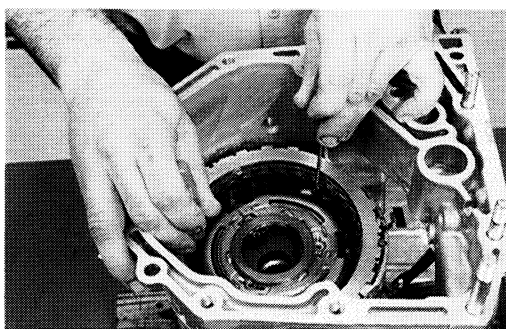
Remove the redesigned planetary gear assembly as a unit. (It is similar to the one used on previous models but is more compact.) The remaining one-way clutch is located at the bottom of this assembly.



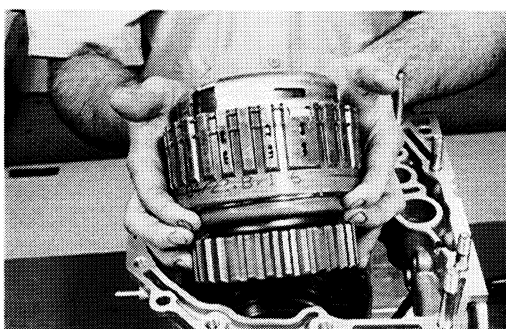
Removing High Clutch Drum



Removing Front Sun Gear



Removing Snap Ring



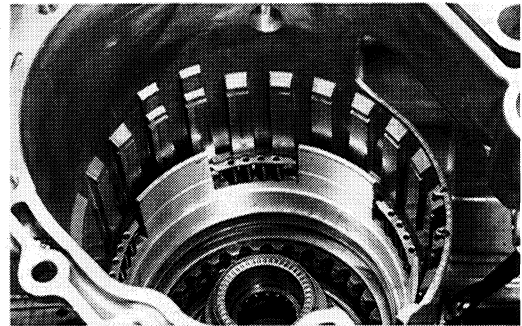
Removing Planetary Assembly

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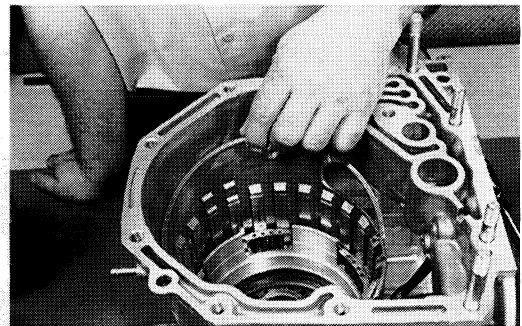
Removing the 2-4 Brake Assembly

At this point, you can see the 2-4 brake assembly, including the 2-4 brake spring retainer. To remove the 2-4 brake assembly, first remove the snap ring. Then remove the spring retainer, the piston, and the piston retainer.

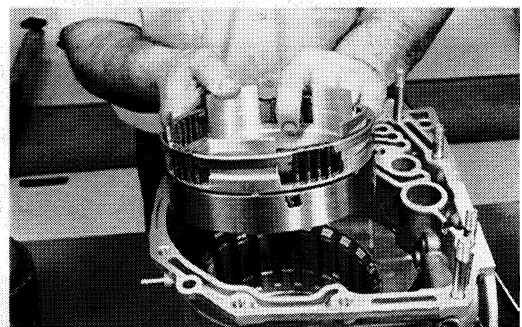
Next, carefully observe the location of the locating lug on the piston retainer, so that during reassembly you will position it correctly. This lug ensures that the piston retainer is properly positioned so the seal pipe lines up with its hole in the piston retainer.



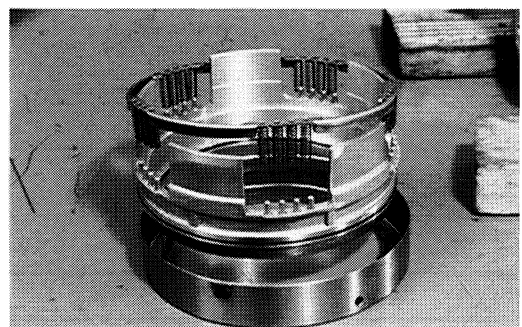
2-4 Brake Assembly (Installed)



Removing Snap Ring



**Removing Spring Retainer, Piston,
and Piston Retainer**



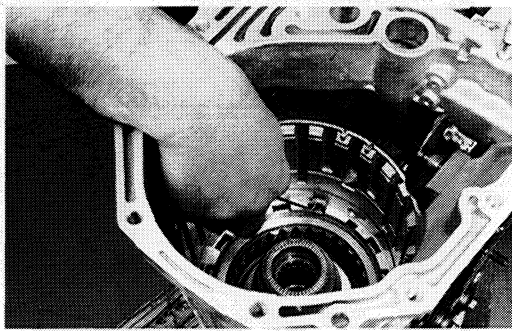
**Spring Retainer, Piston, and
Piston Retainer**

AN INTRODUCTION TO KEYLESS ENTRY AND THEFT DETERRENT SYSTEMS

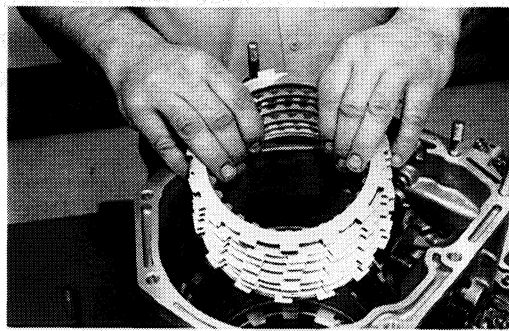
Note that the piston has posts; the springs of the spring retainer fit on top of these posts.

Remove the lower leaf spring, followed by the snap ring, and the low and reverse brake clutches. Note how the dish plate is oriented, so you can reassemble it correctly.

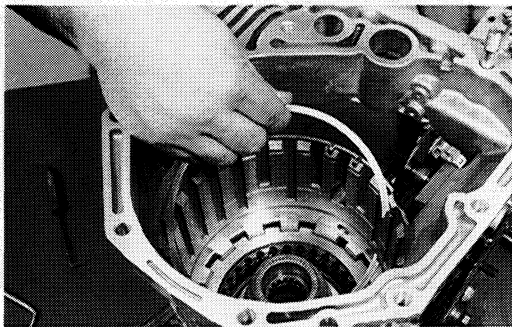
Remove the thrust needle bearing from the one-way clutch inner race.



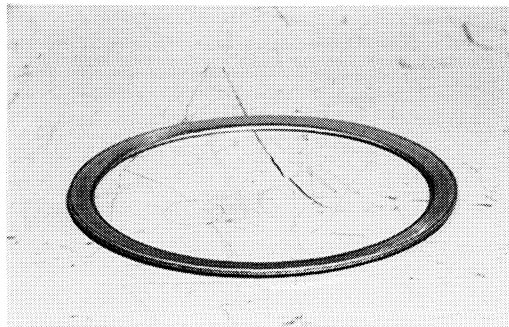
Removing Lower Leaf Spring



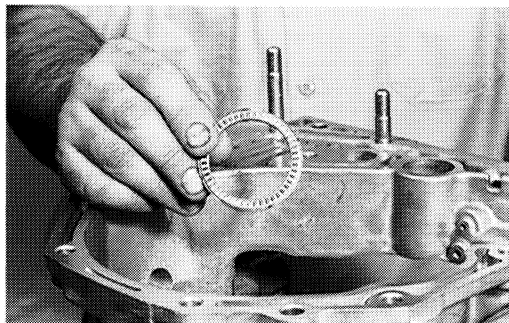
Removing Low-and-Reverse Clutches



Removing Snap Ring



Removing Dish Plate



Removing Thrust Needle Bearing

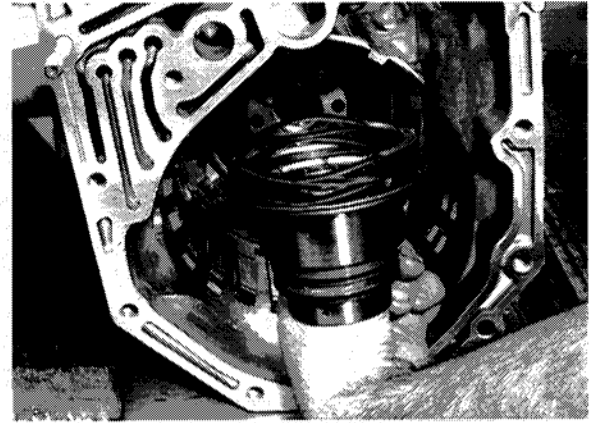
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Removing the Low and Reverse Brake Piston

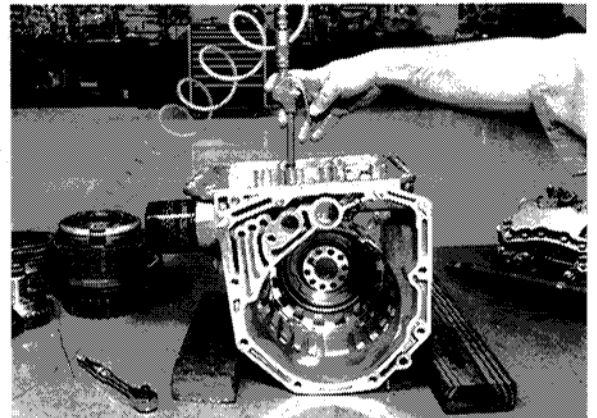
Reposition the transmission case horizontally and remove the bolts that secure the one-way inner race to the case. Carefully remove the inner race, the spring retainer, and the wave washer.

Remove the low and reverse brake piston, using compressed air. At the bottom of this piston, notice the one-piece rubber diaphragm that serves as a seal at both the inner and outer edges of the piston.

This completes the disassembly of the 4EAT transmission.



Removing One-Way Inner Race, Spring Retainer, and Wave Washer

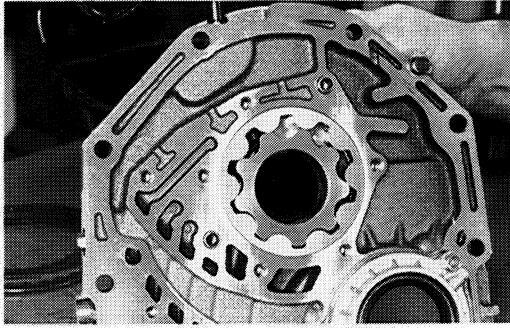


Removing Low and Reverse Brake Piston

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NEW REASSEMBLY INFORMATION

Rather than covering all the steps in the reassembly procedure, we'll highlight some of the more important points about new steps in the reassembly procedure.

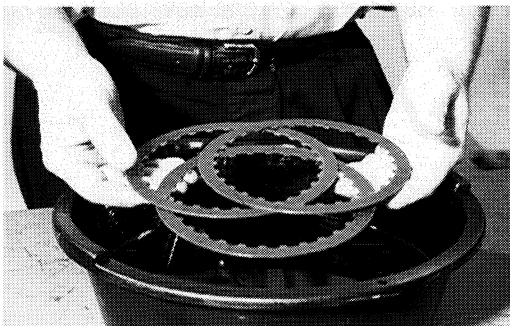


**Dowel Alignment Pins in the
Oil Pump Housing**

Reassembling the Pump

When reassembling the pump, be sure the oil pump cover is completely seated over the dowel alignment pins in the oil pump housing. To avoid breaking components, do not tighten the bolts until you can see there is no gap between the pump cover and the housing. Before torquing the bolts, check that the pump drive shaft turns smoothly.

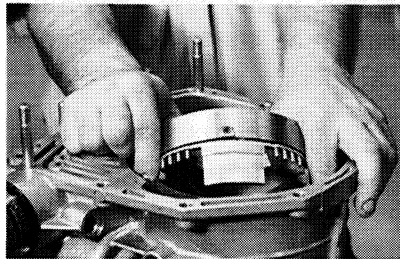
When installing new friction plates, soak them in Automatic Transmission Fluid (ATF) for at least two hours before installation.



Soaking Friction Plates in ATF

Reassembling the 2-4 Brake Assembly

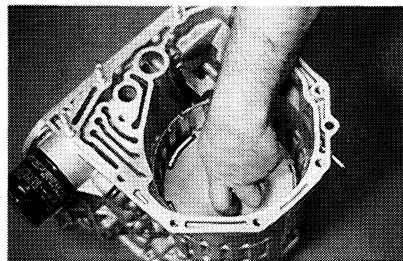
When reassembling the 2-4 brake remember to line up the tang on the piston retainer with the slot in the transmission case, so



Lining up Piston Retainer

the piston and piston retainer are lined up properly.

When you reassemble the snap ring for the 2-4 brake piston, you'll need to use special tool 498677100. Carefully position the snap ring over the piston spring retainer and place the special tool on top



**Using Special Tool 498677100 to
Reinstall Snap Ring**

of the snap ring. Apply steady, firm pressure until you hear the snap ring fully seat. Remove the tool and check that it is seated properly.

Note: when reassembling the 2-4 brake



**2-4 Brake Clutch Stack (Note
Space Where There Is No Tooth)**

clutch, line up the stack first. Position the clutches so the sides where there is no tooth are lined up vertically. Position the leaf spring at

the 6:00 position. Then install the clutches so the groove in the tooth opposite the side where there is no tooth slides over the leaf spring.

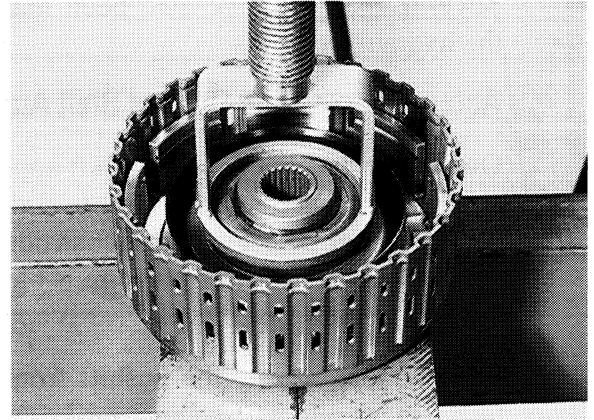
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Reassembling the High Clutch Drum

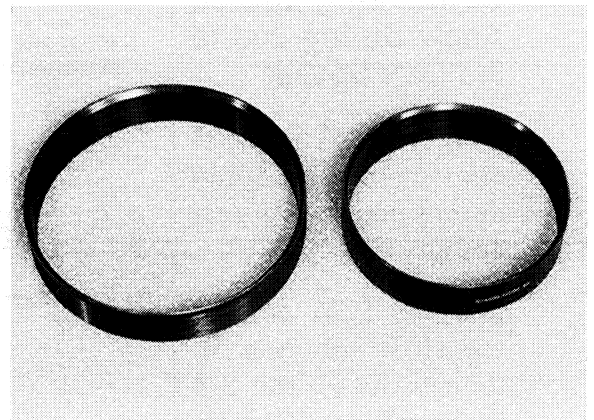
If you have to disassemble the high clutch drum, during reassembly first install a new special tool number **498437000** which will correctly position the spring retainer and the cover. Install the spring retainer and the cover, apply a hydraulic press, install the snap ring, then release the pressure, and withdraw the tool.

Reassembling the Planetary Gear

Similarly, if you have to disassemble the planetary gear, there's a new special tool, number **498437100** for centering the low clutch piston. It's slightly larger than the special tool for installing the high clutch spring retainer and cover, **498437000**.



Using Special Tool 498437000 to Reinstall
High Clutch Spring Retainer and Cover



Special Tools 498437100
(Left) and 498437000 (Right)

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CHANGES IN HYDRAULIC CIRCUITS

Several changes have also been made in the hydraulic circuits.

Accumulators Now Control Shift Apply

One important change is that shift apply for some shifts (such as from 2nd to 3rd gear and from 3rd gear to 4th) is controlled by accumulators. How fast pressure is bled off determines how quickly the gear is applied.

For example, during the upshift from 2nd to 3rd gear, the TCM temporarily applies the 2-4 brake clutch and the high clutch, halfway, to prevent shift shock and engine racing.

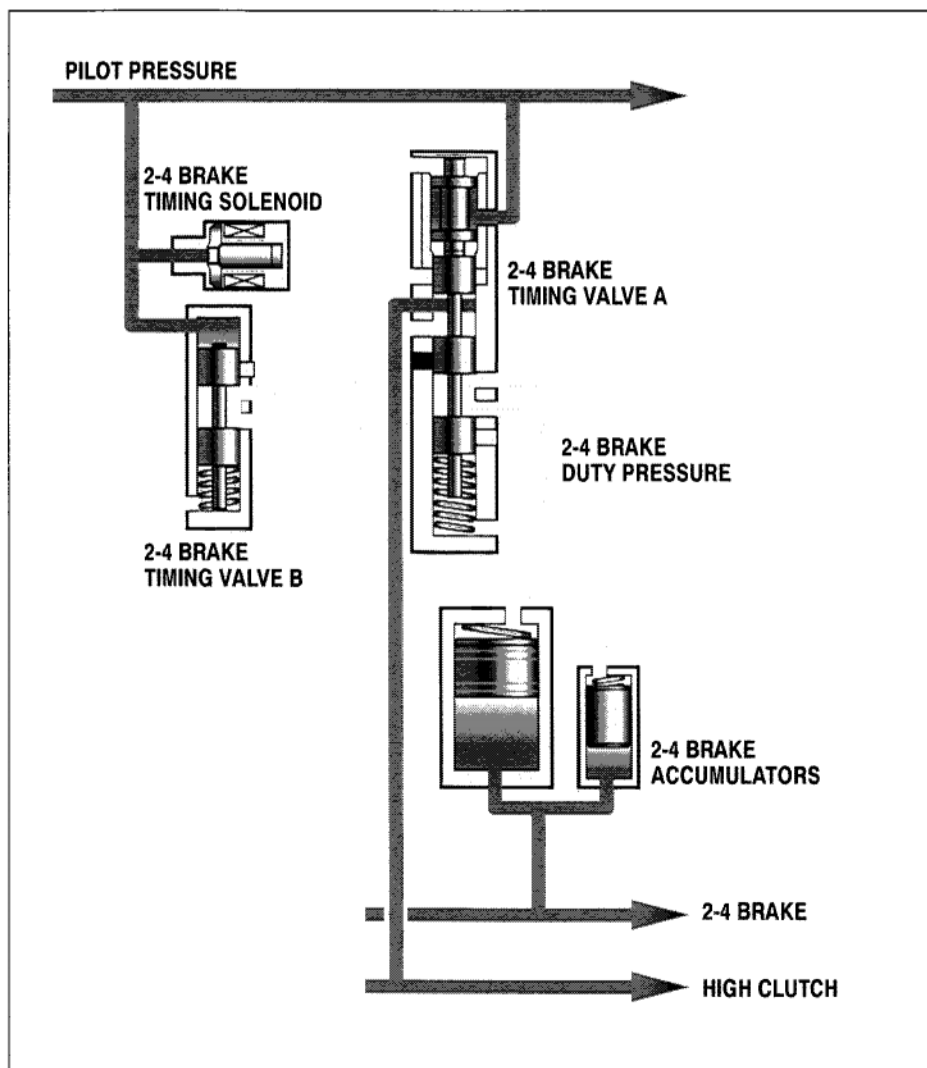
Controlling Clutch Apply During 2nd to 3rd Gear Upshift

Here's how the TCM controls clutch apply during 2nd to 3rd gear upshift.

First, the TCM turns off the shift solenoid B, then turns on the 2-4 brake timing solenoid. This applies pilot pressure to the top of 2-4 brake timing valve B, sending high clutch pressure to the top side of 2-4 brake timing valve A. But at this stage, high clutch pressure is not high enough to push down valve A, so the 2-4 brake is kept on halfway.

When high clutch pressure increases to a sufficient level, it pushes down the spool valve in 2-4 brake timing valve A, which drains the 2-4 brake accumulator back pressure, and releases the 2-4 brake.

After the upshift from 2nd to 3rd gear is complete, the TCM turns off the 2-4 brake timing solenoid. The accumulator piston is pushed down to its bottom position, in preparation for the next 2-4 brake operation.



2-4 Brake Accumulator Circuits

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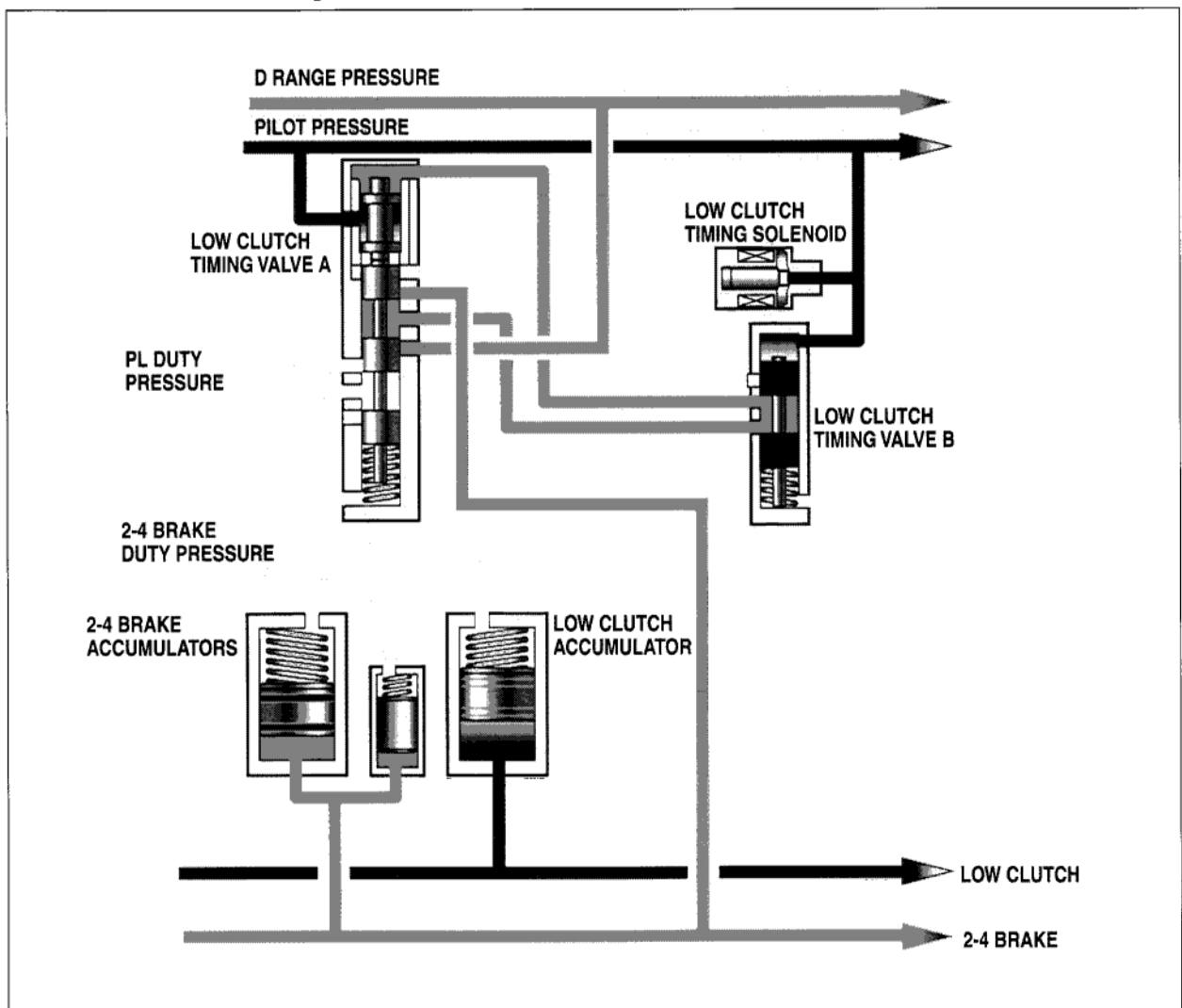
Controlling Clutch Apply During 3rd to 4th Gear Upshift

Similarly, during the upshift from 3rd to 4th gear, the TCM temporarily applies the low clutch and the 2-4 brake clutch, halfway, to prevent shift shock and engine racing.

After turning on shift solenoid A, the TCM turns on the low clutch timing solenoid, applying pilot pressure to the top side of the low clutch timing valve B.

When pilot pressure is applied to the top of the low clutch timing valve B, it sends 2-4 brake apply pressure to the top of low clutch timing valve A. But at this stage, 2-4 brake pressure is not high enough to push down the spool valve of low clutch timing valve A, and the low clutch accumulator back pressure is held on, keeping the low clutch partly engaged. As a result, both the low clutch and the 2-4 brake are temporarily applied.

When 2-4 brake pressure has increased to a sufficient level, low clutch timing valve A drains the low clutch accumulator pressure, releasing the low clutch.



Low Clutch Accumulator Circuits

INTRODUCTION TO THE 1999 4EAT TRANSMISSION

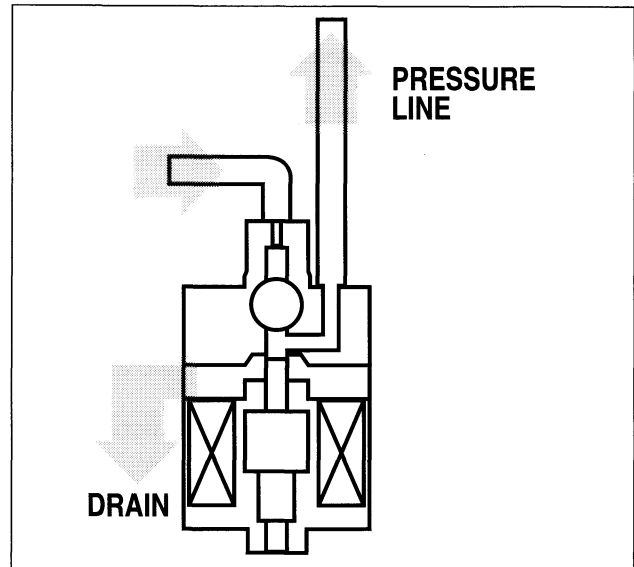
New 3-Way Solenoids

Another difference with the 1999 4EAT is that some of the solenoids, such as the line pressure solenoid, are now 3-way solenoids.

When the solenoid is Off, hydraulic pressure is directed to a specific part of the circuit, for example, the pressure line. When the solenoid is On, hydraulic pressure is allowed to bleed off.

Slope Control

Like previous models, the 1999 4EAT has slope control. This means that the TCM monitors the inputs from the vehicle speed sensors, the throttle, and the turbine sensor, and regulates the upshift from 3rd to 4th gear when traveling uphill, and downshifts from 4th to 3rd when traveling downhill.



3-Way Solenoid

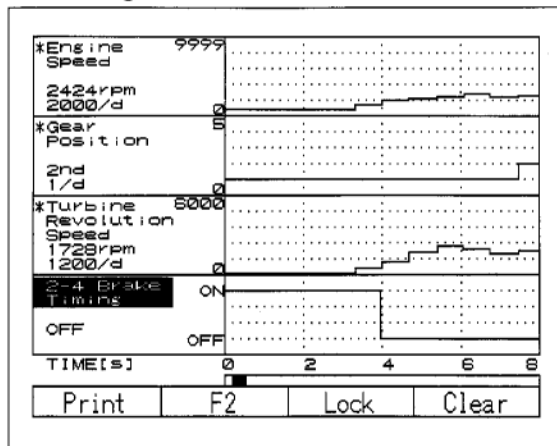
INTRODUCTION TO THE 1999 4EAT TRANSMISSION

DIAGNOSIS WITH THE NEW SELECT MONITOR

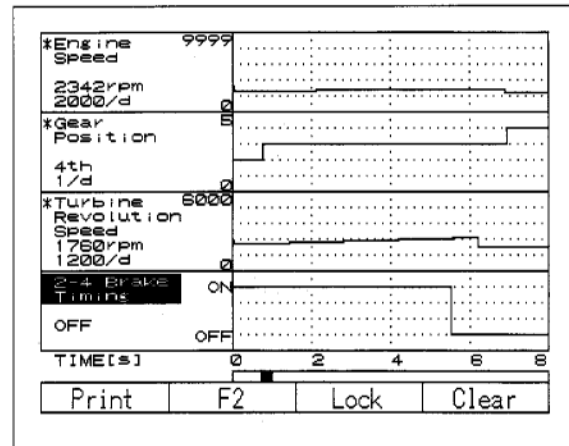
NOTE: Most of the Transmission Diagnostic Trouble Codes (DTCs) are different. For a list of the 1999 Transmission DTCs, see the appropriate Service Manual or your Video Reference Booklet.

Because shift timing and apply are electronically controlled, you can use the New Select Monitor to look, for example, at the relationship between brake clutch duty ratio and 2-4 brake timing.

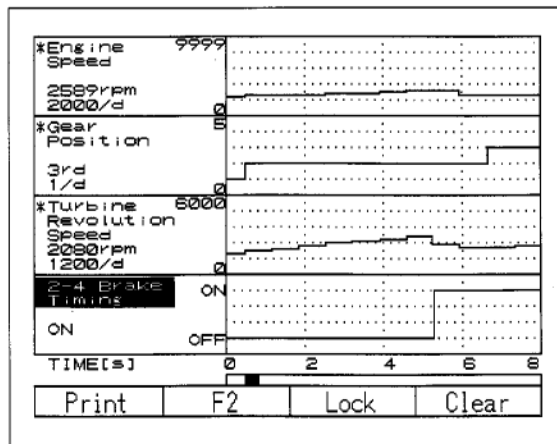
Here's what gear position, engine rpm, turbine revolution speed, and the 2-4 brake timing solenoid look like in 1st, 2nd, 3rd, and 4th gears:



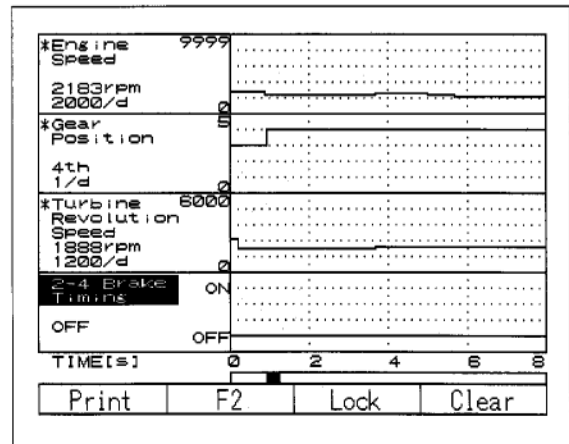
New Select Monitor Display - 1st Gear



New Select Monitor Display - 3rd Gear



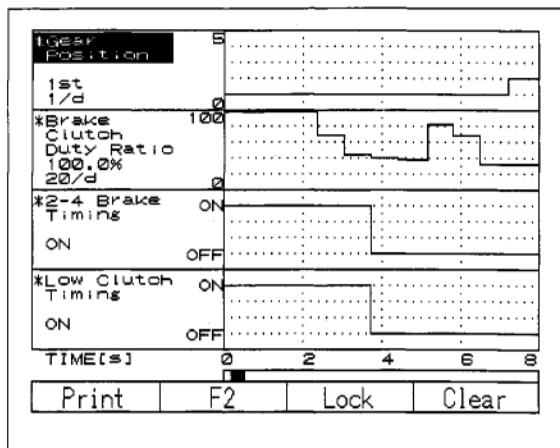
New Select Monitor Display - 2nd Gear



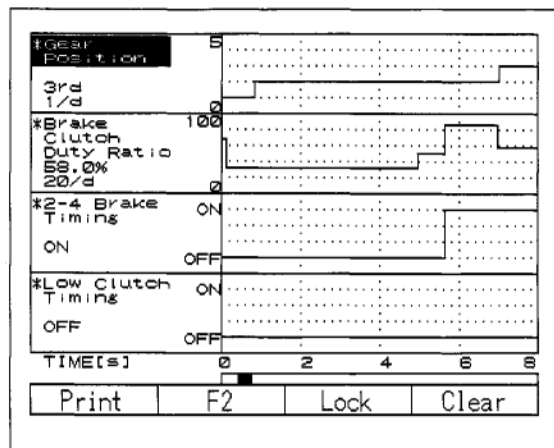
New Select Monitor Display - 4th Gear

INTRODUCTION TO THE 1999 4EAT TRANSMISSION

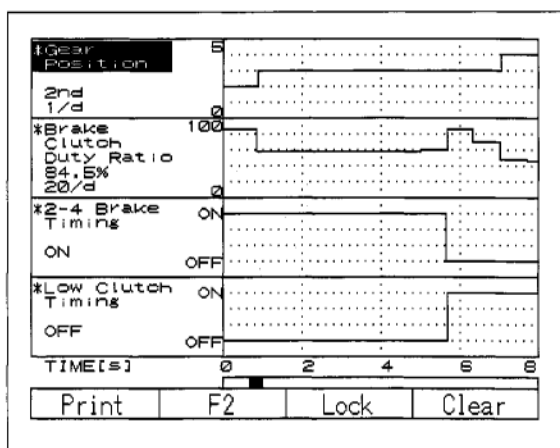
Here's what gear position, brake clutch duty ratio, the 2-4 brake timing solenoid, and the low clutch timing solenoid look like in 1st, 2nd, 3rd, and 4th gears:



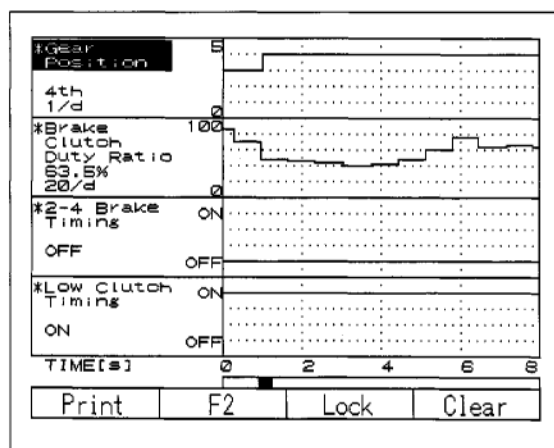
New Select Monitor Display - 1st Gear



New Select Monitor Display - 3rd Gear



New Select Monitor Display - 2nd Gear



New Select Monitor Display - 4th Gear

Get to know the way the display of transmission inputs and outputs should look, as the 4EAT goes through the gears. When there's no DTC, these displays will often give you valuable information about the inputs to the TCM and its outputs.

CONCLUSION

The information contained in this introduction to the new 4EAT transmission should help you become more proficient at disassembling and reassembling the 4EAT transmission, as well as recognizing what has changed in the hydraulic system. You'll also have a jump on diagnosing Transmission DTCs using the New Select Monitor. And remember to use the Service Manual and your Video Reference Booklet, too. They'll make diagnosis and rebuilding easier.

INTRODUCTION TO THE 1999 4EAT TRANSMISSION

Mark your answers to the following questions and mail the quiz to Subaru Video Training Program Headquarters.

Name _____

Dealer _____

Dealer Code _____

1. To prevent shift shock and engine racing during the upshift from 2nd to 3rd gear, the TCM temporarily applies:
 - A. the 2-4 brake clutch.
 - B. the high clutch.
 - C. the low clutch.
 - D. both the 2-4 brake clutch and the high clutch.
2. To prevent shift shock and engine racing during the upshift from 3rd to 4th gear, the TCM temporarily applies:
 - A. the 2-4 brake clutch.
 - B. the high clutch.
 - C. the low clutch.
 - D. both the 2-4 brake clutch and the low clutch.
3. Mechanical changes to the 1999 4EAT automatic transmission include:
 - A. four speed sensors.
 - B. an external oil filter.
 - C. four new solenoids
 - D. all of the above
4. The TCM controls the duty ratios for all of the following except:
 - A. the 2-4 brake.
 - B. the 3-4 one-way clutch.
 - C. the high clutch.
 - D. the low clutch.
5. The low clutch timing solenoid controls the low clutch to provide engine braking.
 - A. True.
 - B. False.
6. The new seal pipe routes hydraulic pressure from the valve body to:
 - A. low clutch timing valve A.
 - B. low clutch timing valve B.
 - C. the 2-4 brake clutch piston.
 - D. none of the above.
7. You should note the location of the lock nut during disassembly, so that you can easily reinstall it later.
 - A. True.
 - B. False.
8. The external oil filter, which has replaced the metal screen in the valve body, can be flushed when the 4EAT is disassembled.
 - A. True.
 - B. False.
9. During slope control the TCM monitors inputs from all of the following except:
 - A. vehicle speed sensors.
 - B. line pressure 3-way solenoid.
 - C. turbine sensor.
 - D. throttle.
10. In diagnosing the 4EAT transmission, you can only use the New Select Monitor to display Transmission Diagnostic Trouble Codes (DTC's).
 - A. True
 - B. False.

Tear out answer sheet, fold, tape, and mail back. Prizes will be sent to the first 1,000 technicians who return this quiz and earn a passing grade.