



# Subaru 4EAT Transmission Operation

The Subaru 4EAT transmission went through several design changes for the 1999 model year. Although the basic function (four-speed, AWD automatic transmission) remains the same, significant changes were made to the internal components. This article provides an overview of the new 4EAT design, including its components and transmission powerflow.

## Reverse Clutch

During operation, hydraulic pressure is applied to the reverse clutch piston from the control valve when shifting in reverse. The drive plate and driven plate are connected by pressure, and engine power from the high clutch drum is transmitted to the front sun gear through the 2-4 brake hub.

During non-operation, when the shift lever is in any position other than reverse, no hydraulic pressure is applied to the reverse clutch piston. Hence the drive plate and driven plate are separated, and no power is transmitted.

The check ball is built into the clutch piston. This check ball releases oil pressure from the clutch piston while the drum rotates idle. This avoids a build-

up of residual pressure in the clutch drum and a resultant half-engaged clutch, which may otherwise be caused by centrifugal oil pressure.

## High Clutch

In 3rd and 4th speed operation, hydraulic pressure is applied to the high clutch from the control valve and another hydraulic pressure controller. The clutch plates (drive and driven plates) are connected by this hydraulic pressure, and engine power from the input shaft is transmitted to the front planetary carrier through the high clutch hub.

A cover is placed inside the piston, and the space between the high clutch piston and the cover is filled with ATF. The centrifugal force of this ATF, when the high clutch is not in engagement, acts to cancel the centrifugal force generated by ATF remaining in the oil chamber in the high clutch piston, which otherwise is likely to push the piston, preventing the clutch from being disengaged completely.

When the high clutch is in operation, the piston is not pushed back because a large hydraulic pressure is being applied on it, thereby the high clutch being kept engaged.

## 2-4 Brake Construction

The 2-4 brake is composed of a 2-4 brake piston, spring retainer, pressure plate, drive plates and driven plates.

This clutch operates with hydraulic pressure from the transmission control valve to fix the front sun gear when the 2nd gear is selected in D, 3 or 2 range, or when the 4th gear is selected in D range.

## Low & Reverse Brake Construction

The piston, dish plate, drive plate, driven plate, retaining plate and snap ring are mounted directly to the transmission case. The spring retainer which is integral with the spring is secured to the inner race of the transmission case engagement surface.

## Low & Reverse Brake Function

During 1st speed of the “1st”, and reverse, hydraulic pressure from the hydraulic pressure controller is applied to the low & reverse piston. This pressure causes the drive plate and driven plate to engage, and the low clutch to be fixed.

## Low Clutch Construction

The low clutch consists of a clutch drum, clutch piston, return spring, cover, drive plates, driven plates, etc.

The low clutch drum is manufactured of pressed sheet metal. The clutch drum, outer race and sleeve are welded together by the electron beam welding technique.

## Low Clutch Function

The low clutch operates in “D” (1st, 2nd, 3rd speed), “3” (1st, 2nd, 3rd speed), “2” and “1” ranges. This clutch engages when the hydraulic pressure from the transmission control valve is applied to the low clutch piston, transmitting the power to the reduction drive shaft.

A cover is placed inside the piston, and the space between the low clutch piston and the cover is filled with ATF. The centrifugal force of this ATF, when the low clutch is not in engagement, acts to cancel the centrifugal force generated by ATF remaining in the oil chamber in the low clutch piston, which otherwise is likely to push the piston, preventing the clutch from being disengaged completely.

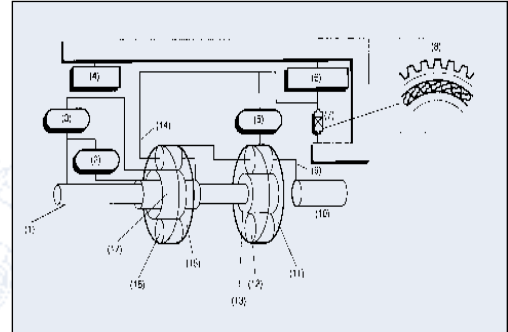
When the low clutch is in operation, the piston is not pushed back because a large hydraulic pressure is being applied on it, thereby the low clutch being kept engaged.

## Hydraulic Control Valve

The hydraulic control system consists of an oil pump, control valve bodies, clutches and connecting passages and pipes. When it is activated manually, or automatically by the electronic control system, it hydraulically controls the gearshifting mechanism.

## Power Train Construction

The gear train consists of two sets of planetary gears, three sets of multi-plate clutches, two sets of multi-plate brakes and one set of one-way clutches.



- |   |                             |
|---|-----------------------------|
| 1. Input shaft  | 9. Rear planetary carrier   |
| 2. High clutch (Operates at 3rd and 4th speeds.)      | 10. Reduction drive shaft   |
| 3. Reverse clutch (Operates while moving in reverse.) | 11. Rear internal gear      |
| 4. 2-4 brake  | 12. Rear pinion gear        |
| 5. Low clutch   | 13. Rear sun gear           |
| 6. Low & reverse brake                                | 14. Front planetary carrier |
| 7. One-way clutch                                     | 15. Front internal gear     |
| 8. Free/Locked  | 16. Front pinion gear       |
|   | 17. Front sun gear          |

## 4EAT Transmission Operation

### N Range

Since the rear sun gear and the high clutch drum are in mesh with the input shaft, they rotate together with the input shaft.

The high clutch drum does not transmit the rotation torque to the planetary unit since the reverse clutch and the high clutch are in the free state.

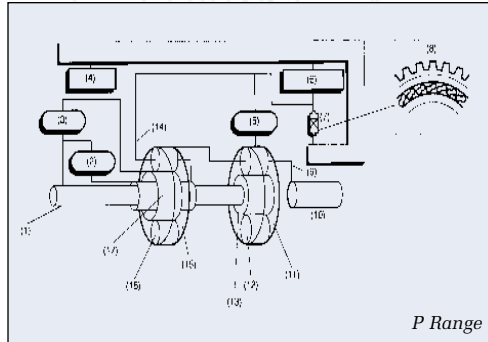
The rotation torque of the rear sun gear is transmitted to the rear internal gear through the pinion gear.

However, the rotation torque of the

rear sun gear is not transmitted to the rear planetary carrier since the rear internal gear idles because of the disengaged low clutch. Accordingly, the rotation torque of the input shaft is not transmitted to the reduction drive shaft.

### P Range

All controls do not operate, just as in the N range. The parking pawl locks the power train by pawling the parking gear, which is integrated with the reduction drive gear.



- |                            |                            |
|----------------------------|----------------------------|
| (1) Input shaft            | (10) Reduction drive shaft |
| (2) High clutch            | (11) Rear internal gear    |
| (3) Reverse clutch         | (12) Rear pinion gear      |
| (4) 2-4 brake              | (13) Rear sun gear         |
| (5) Low clutch             | (14) Input                 |
| (6) Low & reverse brake    | (15) Output                |
| (7) One-way clutch         | (16) Locked                |
| (8) No effect              | (17) Component             |
| (9) Rear planetary carrier |                            |

### First Speed Of D or 3 Range (D<sub>1</sub>, 3<sub>1</sub>)

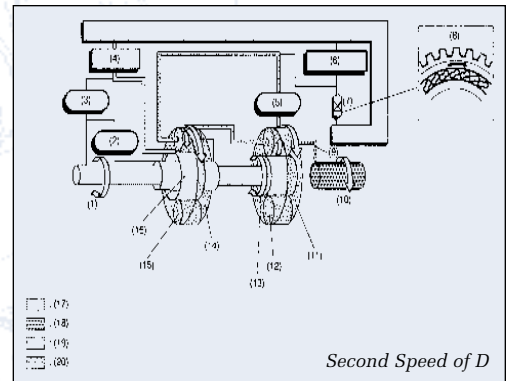
At 1st speed of these ranges, only the low clutch is in engagement. The rear internal gear which rotates idly in P and N ranges tries to rotate counterclockwise due to the engaged low clutch. However, this is blocked by the one-way clutch and secured to the transmission case. Therefore, the rotation of the rear sun gear is converted to the revolution of the pinion gears around the sun gear, causing the planetary carrier to rotate. In this way, the rotation of the input shaft is transmitted to the reduction drive shaft after subjected to speed reduction by the planetary gear. On the other hand, the rear internal gear rotates clockwise if the reverse driving force is applied from the reduction drive shaft during coasting. This rotation frees the one-way clutch. Accordingly, since the connection between the reduction drive shaft and the input shaft is lost, the

engine braking effect is not available.

### Second Speed Of D, 3 or 2 Range (D<sub>2</sub>, 3<sub>2</sub>, 2<sub>2</sub>)

At 2nd speed, the 2-4 brake as well as the low clutch is in engagement. In addition to the elements operating at 1st speed, the front sun gear which idles at 1st speed is connected to the transmission case because of engaged 2-4 brake. In this state, the rotation torque of the rear sun gear is transmitted to the rear internal gear, front pinion gears, low clutch drum and low clutch. At this time, the one-way clutch is free since the low clutch drum rotates clockwise. For this reason, the rotation speed is higher than that at 1st gear by an amount of the rear internal gear rotation speed.

At 2nd speed, the driving power is transmitted without being affected by the one-way clutch. Therefore, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the engine braking effect is available.



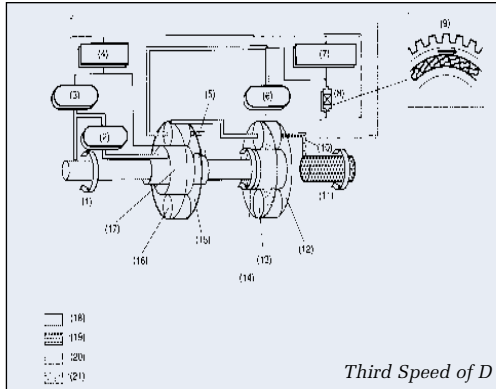
- |                            |                          |
|----------------------------|--------------------------|
| (1) Input shaft            | (11) Rear internal gear  |
| (2) High clutch            | (12) Rear pinion gear    |
| (3) Reverse clutch         | (13) Rear sun gear       |
| (4) 2-4 brake              | (14) Front internal gear |
| (5) Low clutch             | (15) Front pinion gear   |
| (6) Low & reverse brake    | (16) Front sun gear      |
| (7) One-way clutch         | (17) Input               |
| (8) Free                   | (18) Output              |
| (9) Rear planetary carrier | (19) Locked              |
| (10) Reduction drive shaft | (20) Component           |

### Third Speed Of D or 3 Range (D<sub>3</sub>, 3<sub>3</sub>)

At 3rd speed, the low clutch and the high clutch are thrown into engagement. With the high clutch engaged, the high clutch drum rotates, which is turn rotates the rear internal gear through the front planetary carrier, low clutch drum and low clutch. This means that the rear

*Continued on page 10.*

sun gear and the rear internal gear rotate at the same speed. That is, the rear pinion gear stop rotation on its axis and revolves around the sun gear as a planetary assembly. As a result, the input shaft and the reduction drive shaft rotate at the same speed.



Third Speed of D

- |                             |                          |
|-----------------------------|--------------------------|
| (1) Input shaft             | (12) Rear internal gear  |
| (2) High clutch             | (13) Rear pinion gear    |
| (3) Reverse clutch          | (14) Rear sun gear       |
| (4) 2-4 brake               | (15) Front internal gear |
| (5) Front planetary carrier | (16) Front pinion gear   |
| (6) Low clutch              | (17) Front sun gear      |
| (7) Low & reverse brake     | (18) Input               |
| (8) One-way clutch          | (19) Output              |
| (9) Free                    | (20) Locked              |
| (10) Rear planetary carrier | (21) Component           |
| (11) Reduction drive shaft  |                          |

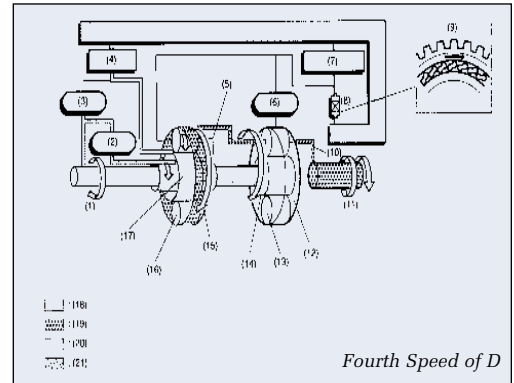
The one-way clutch is released because the low clutch rotates clockwise. Since the driving power is transmitted without being affected by the one-way clutch, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the engine braking effect is available.

#### Fourth Speed Of D Range (D<sub>4</sub>)

At 4th speed, the high clutch and the 2-4 brake are thrown into engagement. The engaged high clutch causes the front planetary carrier to rotate. The engaged 2-4 brake causes the front sun gear (which idles at 3rd speed) to be locked.

The front planetary carrier rotates at the same speed as the input shaft. The rotation of the front planetary carrier causes the front pinion gears to revolve around the stationary front sun gear, which causes the front internal gear to rotate faster than the input shaft. As a result, the reduction drive shaft is driven at a higher speed than the input shaft.

The one-way clutch is free because the low clutch rotates clockwise. Since the



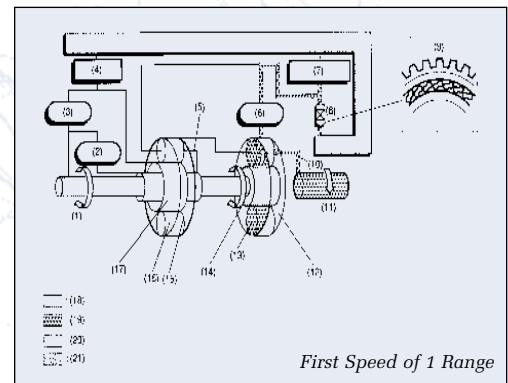
Fourth Speed of D

- |                             |                          |
|-----------------------------|--------------------------|
| (1) Input shaft             | (12) Rear internal gear  |
| (2) High clutch             | (13) Rear pinion gear    |
| (3) Reverse clutch          | (14) Rear sun gear       |
| (4) 2-4 brake               | (15) Front internal gear |
| (5) Front planetary carrier | (16) Front pinion gear   |
| (6) Low clutch              | (17) Front sun gear      |
| (7) Low & reverse brake     | (18) Input               |
| (8) One-way clutch          | (19) Output              |
| (9) Free                    | (20) Locked              |
| (10) Rear planetary carrier | (21) Component           |
| (11) Reduction drive shaft  |                          |

driving power is transmitted without being affected by the one-way clutch, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the engine braking effect is available.

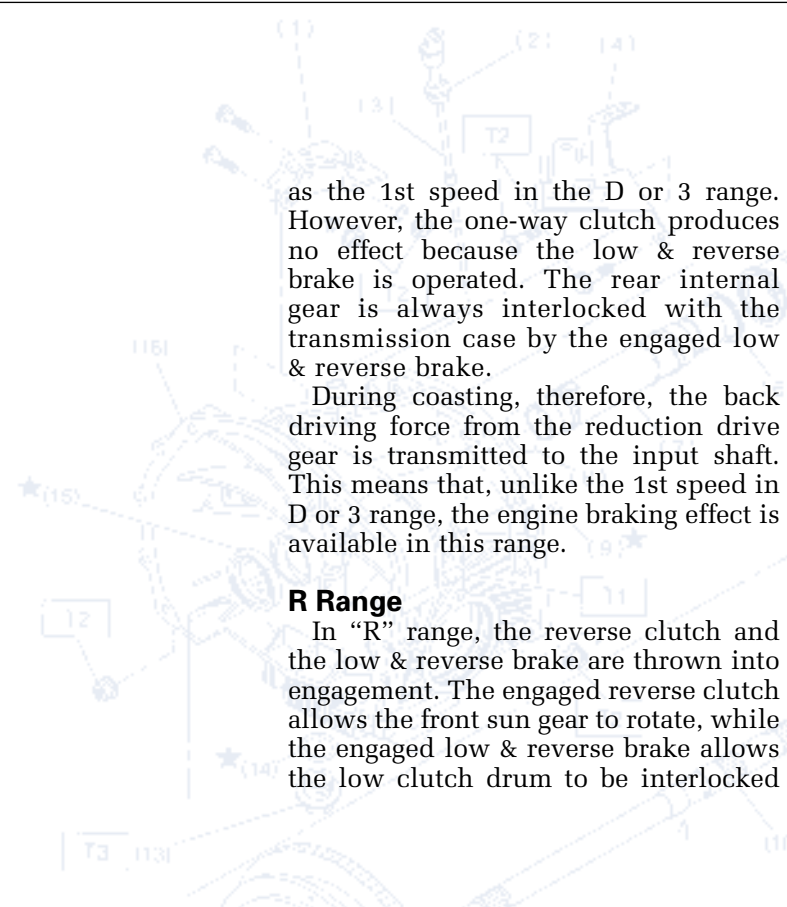
#### First Speed Of 1 Range

At the 1st speed of this range, the low clutch and the low & reverse brake are thrown into engagement. The 1st speed in this range shows the same operation



First Speed of 1 Range

- |                             |                          |
|-----------------------------|--------------------------|
| (1) Input shaft             | (12) Rear internal gear  |
| (2) High clutch             | (13) Rear pinion gear    |
| (3) Reverse clutch          | (14) Rear sun gear       |
| (4) 2-4 brake               | (15) Front internal gear |
| (5) Front planetary carrier | (16) Front pinion gear   |
| (6) Low clutch              | (17) Front sun gear      |
| (7) Low & reverse brake     | (18) Input               |
| (8) One-way clutch          | (19) Output              |
| (9) No effect               | (20) Locked              |
| (10) Rear planetary carrier | (21) Component           |
| (11) Reduction drive shaft  |                          |



as the 1st speed in the D or 3 range. However, the one-way clutch produces no effect because the low & reverse brake is operated. The rear internal gear is always interlocked with the transmission case by the engaged low & reverse brake.

During coasting, therefore, the back driving force from the reduction drive gear is transmitted to the input shaft. This means that, unlike the 1st speed in D or 3 range, the engine braking effect is available in this range.

### **R Range**

In “R” range, the reverse clutch and the low & reverse brake are thrown into engagement. The engaged reverse clutch allows the front sun gear to rotate, while the engaged low & reverse brake allows the low clutch drum to be interlocked

with the transmission case.

The rotation of the input shaft causes the front sun gear to rotate, which in turn causes the front pinion gears to rotate in the reverse direction. Thus, the rotation torque of the input shaft is transmitted to the front internal gear.

At this time, the rotation speed transmitted to the front internal gear is reduced by the front sun gear and the front pinion gears.

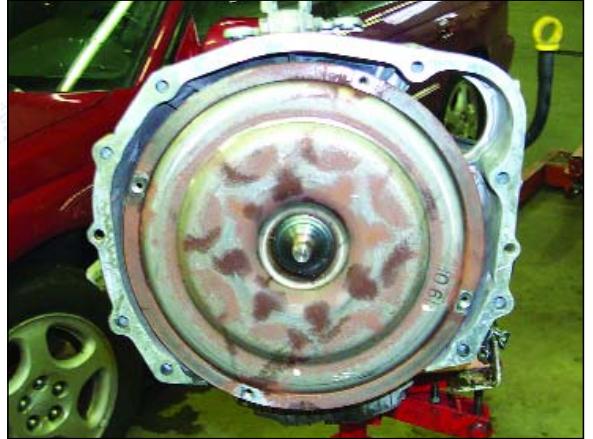
The one-way clutch produces no effect because the low & reverse brake is in engagement. In this range, since the power transmission is made without influence of the one-way clutch, the back driving force from the reduction drive shaft is transmitted to the input shaft, thus the braking effect of the engine is available.

## 4EAT Transmission Identification

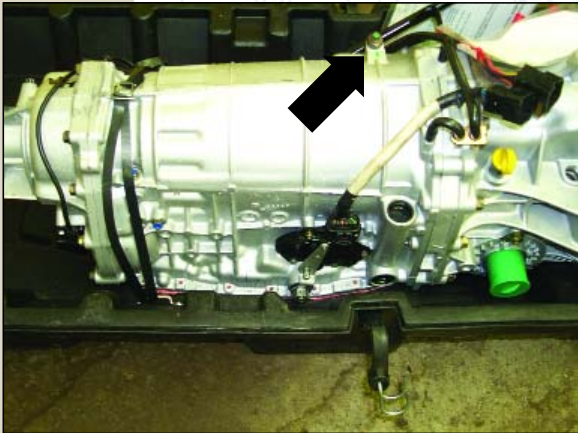
Several changes to the external design of the new 4EAT transmission make it easy to identify which version (early or late) is installed in the Subaru in your work bay. The photos on this page can serve as your 'spotter's guide' for 4EAT identification.



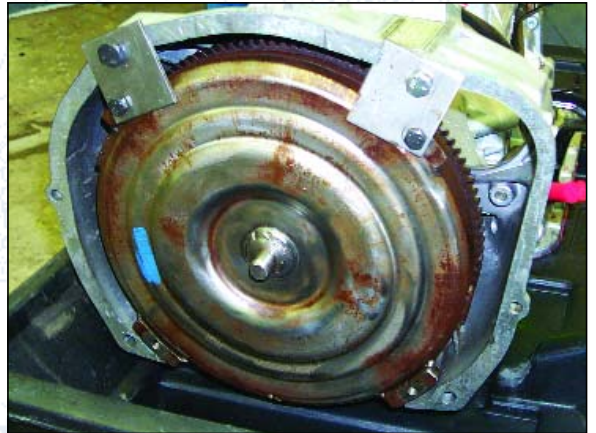
The 2-4 clutch is now splined to the case. Note the external case ribbing.



The bolt pattern and number of bolts has been changed on later 4EAT transmissions. Additional mounting bolts and studs are used.



This early 4EAT has a smooth case, A 2-4 band is used. Note the band adjustment at the upper right.



This early 4EAT has just four mounting bolts and two studs.



The late model 4EAT has a transmission filter, This filter does not require periodic replacement.



If the transmission must be removed, make sure both dowel pins are in the engine before reinstalling the transmission. Missing dowels will cause alignment problems.