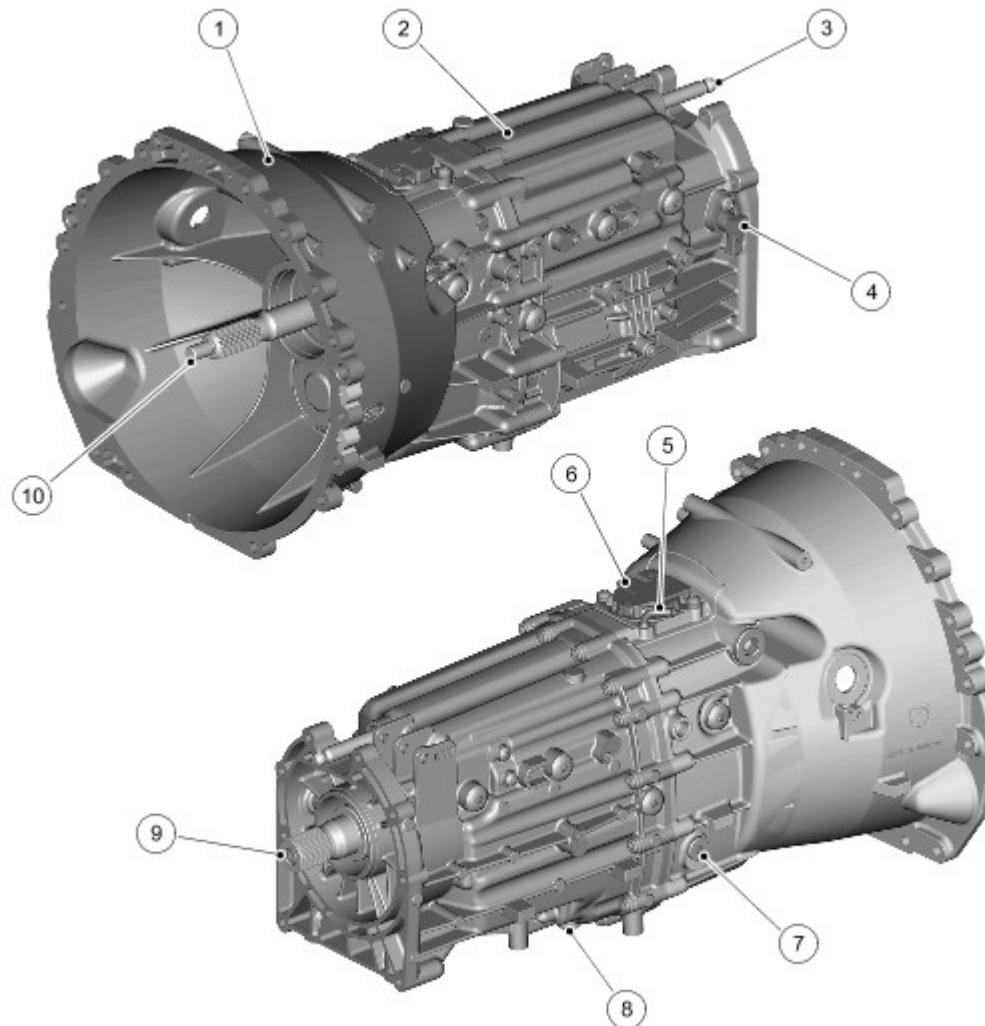


Published : Apr 30, 2004



## Manual Transmission

### External View



E47702

| Item | Part Number | Description          |
|------|-------------|----------------------|
| 1    | -           | Front housing        |
| 2    | -           | Rear housing         |
| 3    | -           | Gear selector shaft  |
| 4    | -           | Speed sensor         |
| 5    | -           | Breather             |
| 6    | -           | Gear position sensor |
| 7    | -           | Oil filler plug      |
| 8    | -           | Oil drain plug       |
| 9    | -           | Output shaft         |
| 10   | -           | Input shaft          |

### GENERAL

The ZF S6-53 all synchromesh transmission has six forward gears and a reverse. It is mounted longitudinally and has a maximum torque capacity of 472Nm. The aluminium die-cast front housing is bolted to the front of the transmission and the DD295 transfer box is mounted at the rear.

The sixth gear has been set up as an economic overdrive to ensure comfortable travel at higher vehicle speeds. Optimum gear steps ensure highly fuel-efficient utilisation of the engine torque.

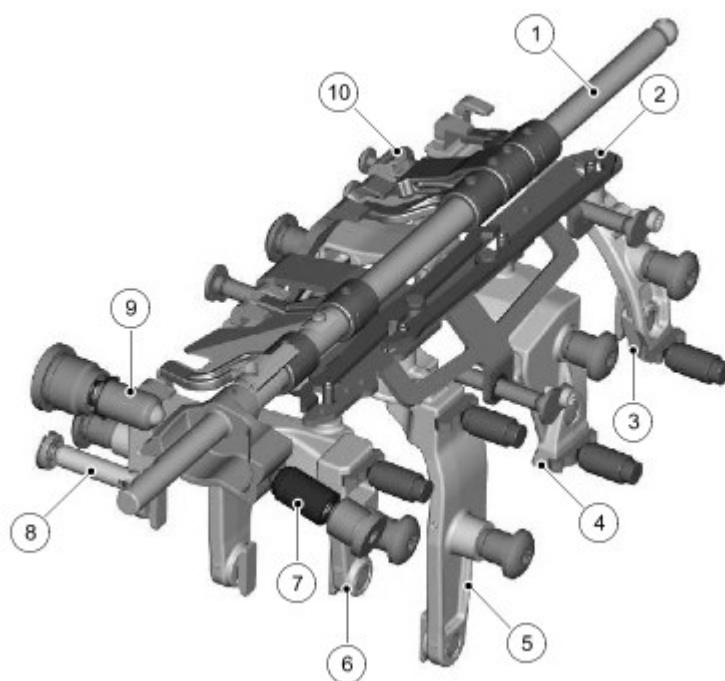
The idler gears of the 1st, 2nd, 6th and reverse gears are located on the main shaft, while the 3rd and 4th gears are located on the layshaft. The mating gears are solidly attached to the opposite shaft. Changing direction, via the reverse gear, is achieved with the assistance of an intermediate gear situated between the layshaft and main shaft. The layshaft and main shaft are hollow to reduce weight.

The transmission is a fill for life unit and no level check is required at service unless a leak is present.

## Technical Data

| Input Torque | Ratios |      |      |      |      |      |      | Weight including oil | Oil fill, from dry | Oil grade       |
|--------------|--------|------|------|------|------|------|------|----------------------|--------------------|-----------------|
|              | 1st    | 2nd  | 3rd  | 4th  | 5th  | 6th  | Rev. |                      |                    |                 |
| 472Nm        | 5,08   | 2,80 | 1,78 | 1,26 | 1,00 | 0,84 | 4,61 | 57kg                 | 1.6L               | Castrol BOT 338 |

## INTERNAL SHIFTING SYSTEM



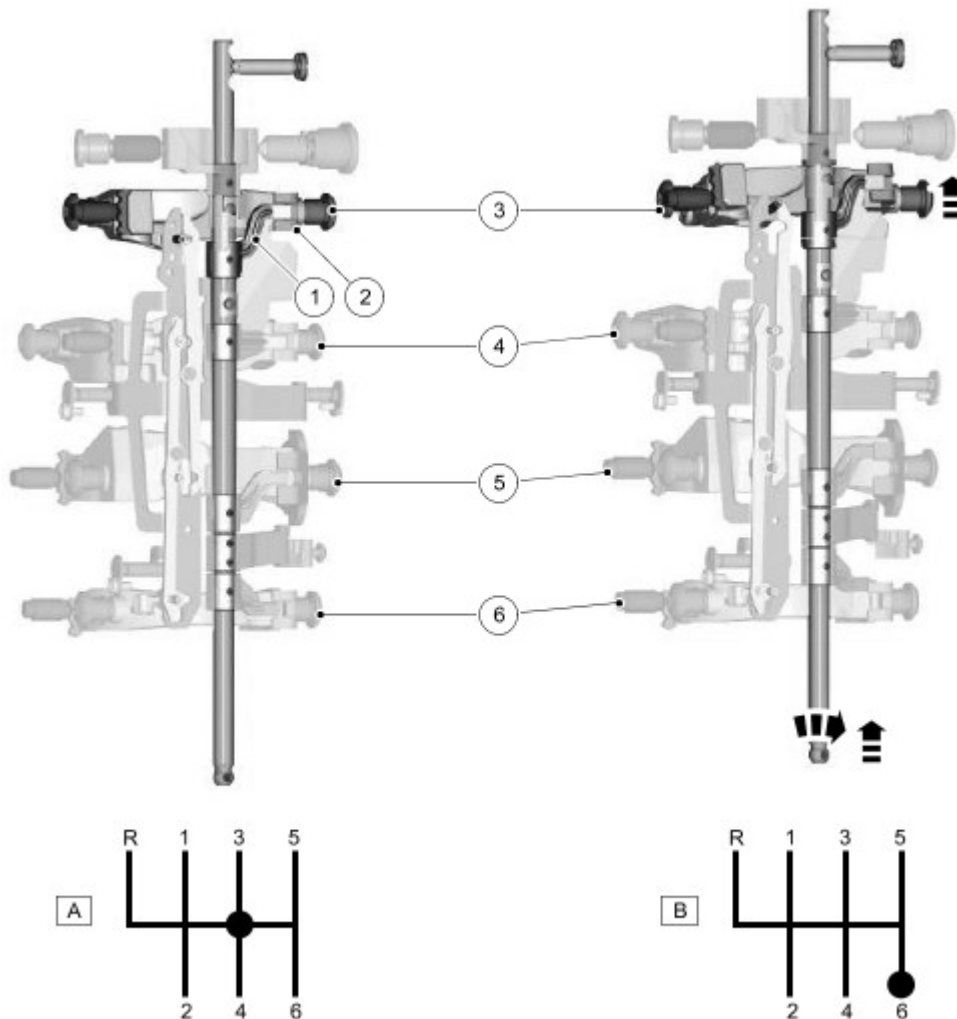
E47703

| Item | Part Number | Description                            |
|------|-------------|--|
| 1    | -           | Gear selector shaft                    |
| 2    | -           | Locking bracket (interlock)            |
| 3    | -           | Swing fork reverse gear                |
| 4    | -           | Swing fork 1st/2nd speed               |
| 5    | -           | Swing fork 3rd/4th speed               |
| 6    | -           | Swing fork 5th/6th speed               |
| 7    | -           | X-gate bias load detent, forward gears |
| 8    | -           | Central detent                         |
| 9    | -           | X-gate bias load detent, reverse gear  |

|    |   |      |
|----|---|------|
| 10 | - | Gate |
|----|---|------|

In contrast to a traditional manual transmission where there are typically three forks, fixed to and controlled by three shafts, that are engaged by the shift lever, the ZF S6-53 transmission utilises a single central gear selector shaft and aluminium die-cast swing forks to generate the axial motion needed in the sliding sleeve for changing gears. This reduces friction in the internal shifting system.

The central gear selector shaft transfers the selection and shifting motion to the transmission. The gear shift fingers, located at different angles on the central control shaft, mesh with one of the swing fork engaging pieces.



E47704

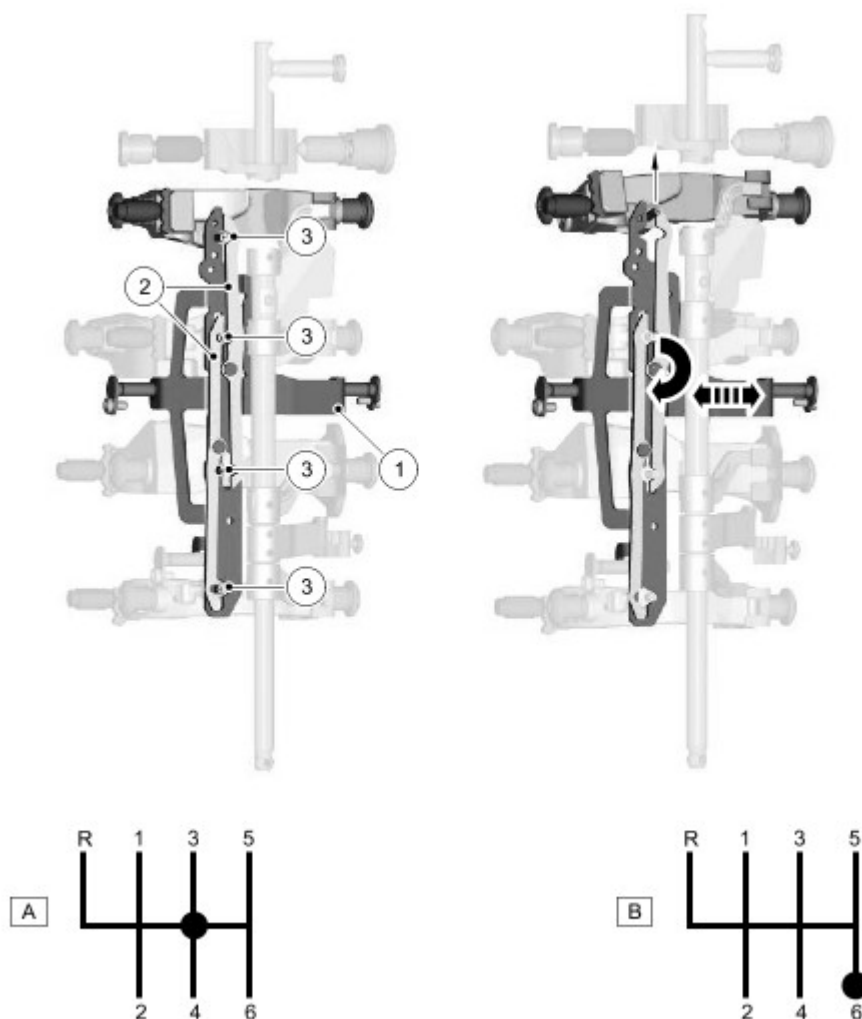
| Item | Part Number | Description                |
|------|-------------|----------------------------|
| A    | -           | Neutral position           |
| B    | -           | 6th gear position          |
| 1    | -           | Gear shift fingers         |
| 2    | -           | Swing fork engaging pieces |
| 3    | -           | Swing fork 5th/6th         |
| 4    | -           | Swing fork 3rd/4th         |
| 5    | -           | Swing fork 1st/2nd         |
| 6    | -           | Swing fork reverse         |

The axial displacement of the central gear selector shaft leads to a tilting motion of the swing fork above the corresponding engaging piece. This tilting motion of the swing fork is forwarded, via two sliding pads, as an axial motion

to the sliding sleeve guided by the synchroniser body. The sliding sleeve is moved from the neutral position towards the free-wheeling gear and, once synchronisation is complete, connects the free-wheeling gear to the main and/or layshafts.

## INTERLOCK

The interlock prevents the simultaneous engagement of several gears.



E47705

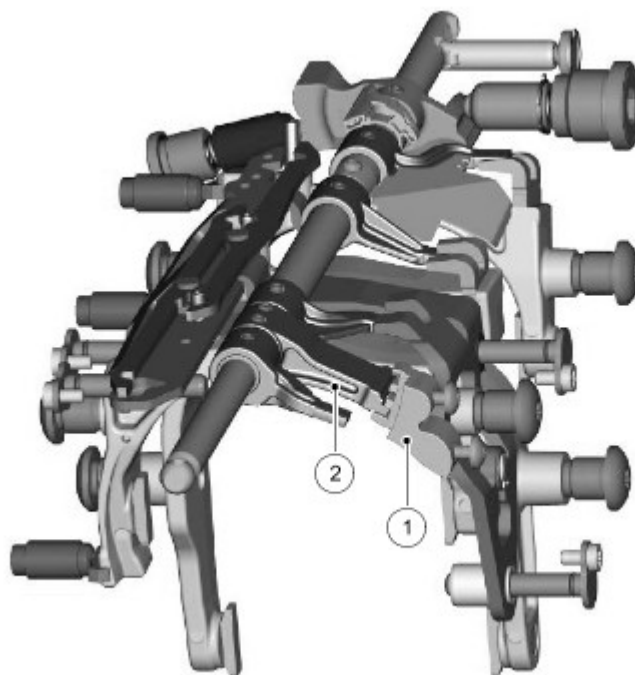
| Item | Part Number | Description       |
|------|-------------|-------------------|
| A    | -           | Neutral position  |
| B    | -           | 6th gear position |
| 1    | -           | Locking bracket   |
| 2    | -           | Locking lever     |
| 3    | -           | Locking pins      |

Two locking levers, attached to a locking bracket, control the interlock. The locking system works passively, i.e. the locking mechanism is actuated through the swing fork motion itself. The swing forks are therefore designed with locking pins.

During gear engagement, the locking levers are turned by the locking pins on the swing forks in the direction of the selected gear and the locking bracket is shifted axially. The shifted swing fork remains moveable and all other swing forks are fixed in place by their respective locking pins and the recesses at the locking levers and/or locking bracket.

## GATE

An exact H-shifting pattern is used through the gear change shaft guide in the gate.



E47706

| Item | Part Number | Description |
|------|-------------|-------------|
| 1    | -           | Gate guide  |
| 2    | -           | Finger      |

A finger attached to the gear change shaft ensures alignment of the corresponding guide groove in the gate, depending upon the selected shift gate. In the engaged gear, the gate limits the side-to-side freeplay at the shift lever.

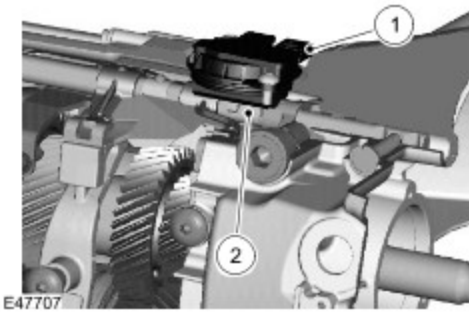
## SYNCHRONISATION

The purpose of a synchromesh is to allow the collar and the gear to make frictional contact before the dogteeth make contact. This lets the collar and the gear synchronize their speeds before the teeth need to engage. The cone/s on the gear fits into the cone-shaped area in the collar, and friction between the cone and the collar synchronize the collar and the gear. The outer portion of the collar then slides so that the dogteeth can engage the gear.

Fast and easy shift engagement of the transmission is achieved by single, double and triple cone synchroniser mechanisms.

| Gear    | Synchro |
|---------|---------|
| 1st     | Triple  |
| 2nd     | Dual    |
| 3rd     | Dual    |
| 4th     | Dual    |
| 5th     | Single  |
| 6th     | Single  |
| Reverse | Dual    |

## GEAR POSITION SENSOR



| Item | Part Number | Description     |
|------|-------------|-----------------|
| 1    | -           | Sensor body     |
| 2    | -           | Magnet assembly |

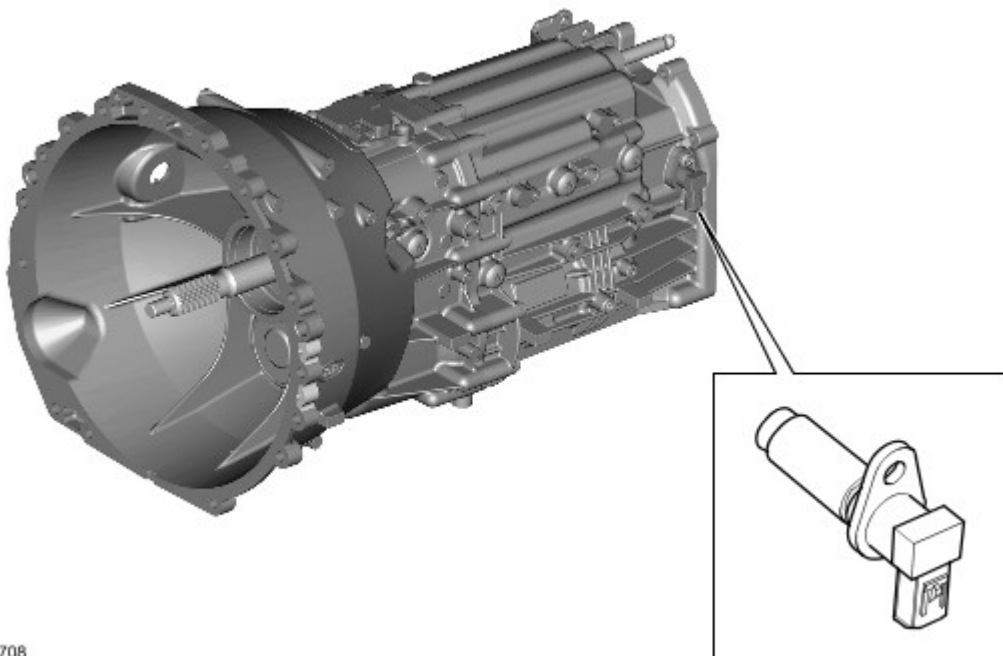
A gear position sensor, located on top of the front housing, is used to enable the transfer box to determine which gear the transmission is in. This information is used for both instrumentation and range change functions.

The transfer box control module receives a gear position signal and publishes the status on the CAN bus. The selected gear is shown in the information display of the instrument cluster. The transfer box also uses the status message to check the vehicle is in neutral before attempting a range change.

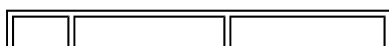
The gear position sensor is a Permanent Linear Contact less Displacement (PLCD) type sensor. It uses the 'X' axis as the left and right position of the lever and the 'Y' axis as the forward and backward position. The sensor gives a voltage in 'X' and 'Y' directions, which is used to deduce the gear position.

The PLCD sensor uses the electromagnetic induction principle, which has a primary winding around a soft magnetic core. On each end of the core is a second short coil winding and when a permanent magnet is in the vicinity of the sensor, the core is interrupted at that point and two separate transformers are created. Each transformer generates an induced voltage in the secondary coils. The induced voltage of 0 to 5 V in turn provides proportional feedback to the transfer box control module relative to the position of the magnet assembly.

## SPEED SENSOR



E47708



| Item | Part Number | Description  |
|------|-------------|--------------|
| 1    | -           | Speed sensor |

The transfer box is designed to allow range changes when the vehicle is moving, providing the transmission speed complies with the preset thresholds determined by the transfer box control module. For additional information, refer to [Four-Wheel Drive Systems](#) (308-07A Four-Wheel Drive Systems)

The transmission speed sensor is a Hall effect sensor and is located at the rear of the transmission. The sensor measures the speed of the transmission output shaft from a single tooth reluctor on the output shaft.

Hall effect sensors require a supply current, which allows the sensor to detect zero movement. Hall sensors use the principle of a voltage, which is generated across a semiconductor carrying an electric current. The voltage is generated when the transmission output shaft reluctor is exposed to magnetic flux.

When the semiconductor is exposed to a magnetic flux, the electron flow through the semiconductor is deflected creating a potential difference across the semiconductor. This difference in voltage is called the Hall effect. It is this voltage that the transfer box control module uses to establish the speed of the transmission output shaft.

When the reluctor is near the sensor, the sensor produces a low voltage output. When the reluctor is away from the sensor, the sensor produces a high output voltage (battery voltage).

The sensor connector has three wires; one is used for sensor earth, one is supply current, from the transfer box control module, and the other is the signal output to the transfer box control module.

## SERVICE

The ZF S6-53 manual transmission is a black box unit. Therefore the repairs permitted are limited to:

- Oil drain plug
- Oil filler plug
- Layshaft sealing cap
- Input shaft seal
- Gear position sensor and magnet assembly
- Selector shaft seal
- Speed sensor
- Output shaft and output shaft seal.