

# AUTOMATIC TRANSMISSION NAG1 - SERVICE INFORMATION

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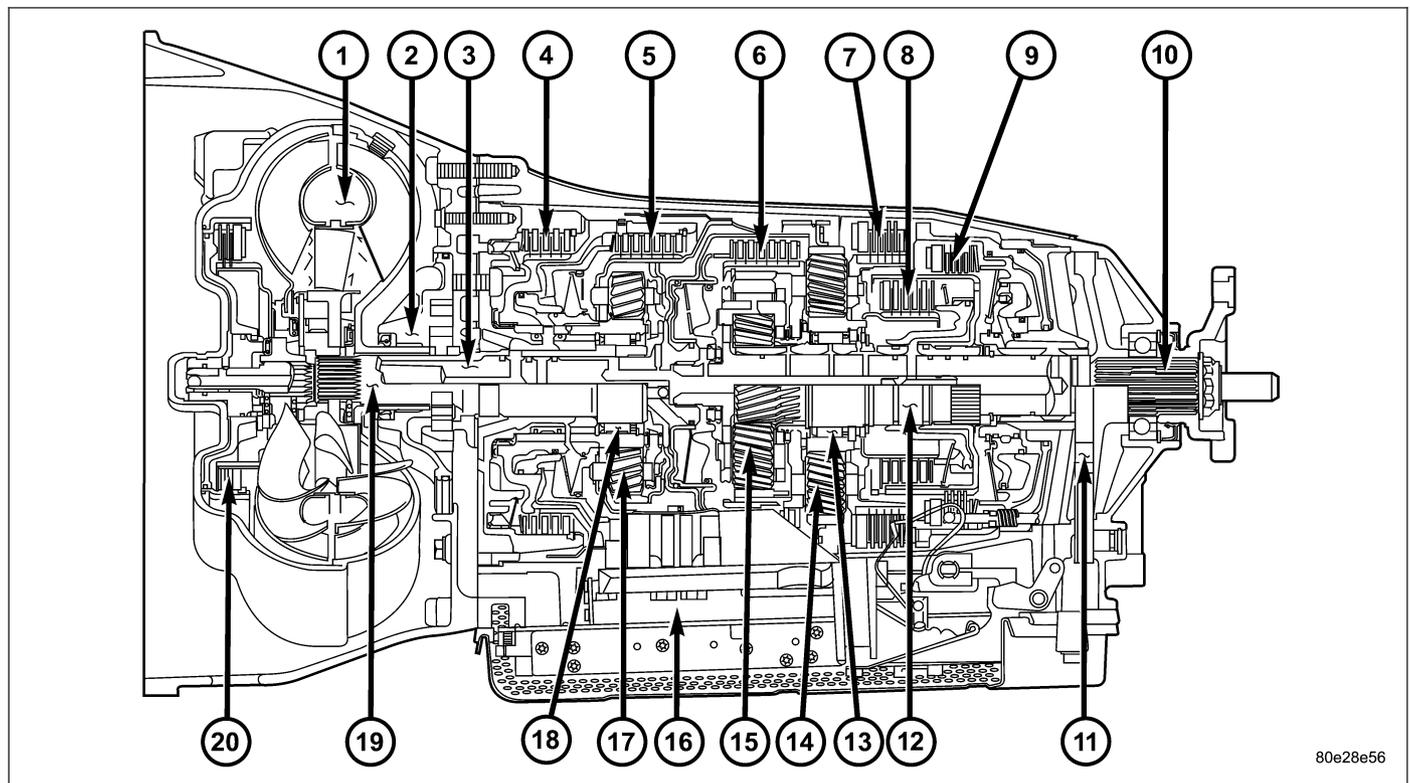
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**AUTOMATIC TRANSMISSION NAG1 - SERVICE INFORMATION**

**DESCRIPTION**



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**NAG1 Automatic Transmission**

- |                                  |                                      |
|----------------------------------|--------------------------------------|
| 1 - TORQUE CONVERTER             | 11 - PARKING LOCK GEAR               |
| 2 - OIL PUMP                     | 12 - INTERMEDIATE SHAFT              |
| 3 - DRIVESHAFT                   | 13 - FREEWHEEL F2                    |
| 4 - MULTI-DISC HOLDING CLUTCH B1 | 14 - REAR PLANETARY GEAR SET         |
| 5 - DRIVING CLUTCH K1            | 15 - CENTER PLANETARY GEAR SET       |
| 6 - DRIVING CLUTCH K2            | 16 - ELECTROHYDRAULIC CONTROL UNIT   |
| 7 - MULTI-DISC HOLDING CLUTCH B3 | 17 - FRONT PLANETARY GEAR SET        |
| 8 - DRIVING CLUTCH K3            | 18 - FREEWHEEL F1                    |
| 9 - MULTI-DISC HOLDING CLUTCH B2 | 19 - STATOR SHAFT                    |
| 10 - OUTPUT SHAFT                | 20 - TORQUE CONVERTER LOCK-UP CLUTCH |

The NAG1 automatic transmission is an electronically controlled 5-speed transmission with a lock-up clutch in the torque converter. The ratios for the gear stages are obtained by 3 planetary gear sets. Fifth gear is designed as an overdrive with a high-speed ratio.

NAG1 identifies a family of transmissions and means “N”ew “A”utomatic “G”earbox, generation 1. Various marketing names are associated with the NAG1 family of transmissions, depending on the transmission variation being used in a specific vehicle. Some examples of the marketing names are: W5A300, W5A380, and W5A580. The marketing name can be interpreted as follows:

- W = A transmission using a hydraulic torque converter.
- 5 = 5 forward gears.
- A = Automatic Transmission.
- 580 = Maximum input torque capacity in Newton meters.

The gears are actuated electronically/hydraulically. The gears are shifted by means of an appropriate combination of three multi-disc holding clutches, three multi-disc driving clutches, and two freewheeling clutches.

Electronic transmission control enables precise adaptation of pressures to the respective operating conditions and to the engine output during the shift phase which results in a significant improvement in shift quality.

Furthermore, it offers the advantage of a flexible adaptation to various vehicle and engines.

Basically, the automatic transmission with electronic control offers the following advantages:

- Reduces fuel consumption.
- Improved shift comfort.
- More favourable step-up through the five gears.
- Increased service life and reliability.
- Lower maintenance costs.

**TRANSMISSION IDENTIFICATION**

The transmission can be generically identified visually by the presence of a round 13-way connector located near the front corner of the transmission oil pan, on the right side. Specific transmission information can be found stamped into a pad on the left side of the transmission, above the oil pan rail.

**TRANSMISSION GEAR RATIOS**

The gear ratios for the NAG1 automatic transmission are as follows:

1st Gear . . . . .	3.59:1
2nd Gear . . . . .	2.19:1
3rd Gear . . . . .	1.41:1
4th Gear . . . . .	1.00:1
5th Gear . . . . .	0.83:1
Reverse . . . . .	3.16:1

**TRANSMISSION HOUSING**

The converter housing and transmission are made from a light alloy. These are bolted together and centered via the outer multi-disc carrier of multi-disc holding clutch, B1. A coated intermediate plate provides the sealing. The oil pump and the outer multi-disc carrier of the multi-disc holding clutch, B1, are bolted to the converter housing. The stator shaft is pressed into it and prevented from rotating by splines. The electrohydraulic unit is bolted to the transmission housing from underneath. A sheet metal steel oil pan forms the closure.

**MECHANICAL SECTION**

The mechanical section consists of a input shaft, output shaft, a sun gear shaft, and three planetary gear sets which are coupled to each other. The planetary gear sets each have four planetary pinion gears. The oil pressure for the torque converter lock-up clutch and clutch K2 is supplied through bores in the input shaft. The oil pressure to clutch K3 is transmitted through the output shaft. The lubricating oil is distributed through additional bores in both shafts. All the bearing points of the gear sets, as well as the freewheeling clutches and actuators, are supplied with lubricating oil. The parking lock gear is connected to the output shaft via splines.

Freewheeling clutches F1 and F2 are used to optimize the shifts. The front freewheel, F1, is supported on the extension of the stator shaft on the transmission side and, in the locking direction, connects the sun gear of the front planetary gear set to the transmission housing. In the locking direction, the rear freewheeling clutch, F2, connects the sun gear of the center planetary gear set to the sun gear of the rear planetary gear set.

## **ELECTROHYDRAULIC CONTROL UNIT**

The electrohydraulic control unit comprises the shift plate made from light alloy for the hydraulic control and an electrical control unit. The electrical control unit comprises of a supporting body made of plastic, into which the electrical components are assembled. The supporting body is mounted on the shift plate and screwed to it.

Strip conductors inserted into the supporting body make the connection between the electrical components and a plug connector. The connection to the wiring harness on the vehicle and the transmission control module (TCM) is produced via this 13-pin plug connector with a bayonet lock.

## **SHIFT GROUPS**

The hydraulic control components (including actuators) which are responsible for the pressure distribution before, during, and after a gear change are described as a shift group. Each shift group contains a command valve, a holding pressure shift valve, a shift pressure shift valve, overlap regulating valve, and a solenoid.

The hydraulic system contains three shift groups: 1-2/4-5, 2-3, and 3-4. Each shift group can also be described as being in one of two possible states. The active shift group is described as being in the shift phase when it is actively engaging/disengaging a clutch combination. The 1-2/4-5 shift group control the B1 and K1 clutches. The 2-3 shift group controls the K2 and K3 clutches. The 3-4 shift group controls the K3 and B2 clutches.

## **OPERATION**

The transmission control is divided into the electronic and hydraulic transmission control functions. While the electronic transmission control is responsible for gear selection and for matching the pressures to the torque to be transmitted, the transmission's power supply control occurs via hydraulic elements in the electrohydraulic control module. The oil supply to the hydraulic elements, such as the hydrodynamic torque converter, the shift elements and the hydraulic transmission control, is provided by way of an oil pump connected with the torque converter.

The Transmission Control Module (TCM) allows for the precise adaptation of pressures to the corresponding operating conditions and to the engine output during the gearshift phase, resulting in a noticeable improvement in shift quality. The engine speed limit can be reached in the individual gears at full throttle and kickdown. The shift range can be changed in the forward gears while driving, but the TCM employs a downshift safeguard to prevent over-revving the engine. The system offers the additional advantage of flexible adaptation to different vehicle and engine variants.

## **EMERGENCY RUNNING FUNCTION**

In order to ensure a safe driving state and to prevent damage to the automatic transmission, the TCM control module switches to limp-home mode in the event of critical faults. A diagnostic trouble code (DTC) assigned to the fault is stored in memory. All solenoid and regulating valves are thus de-energized.

The net effect is:

- The last engaged gear remains engaged.
- The modulating pressure and shift pressures rise to the maximum levels.
- The torque converter lockup clutch is deactivated.

In order to preserve the operability of the vehicle to some extent, the hydraulic control can be used to engage 2nd gear or reverse using the following procedure:

- Stop the vehicle.
- Switch off engine.
- Move selector lever to "P".
- Wait at least 10 seconds.
- Start engine.
- Move selector lever to D: 2nd gear.
- Move selector lever to R: Reverse gear.

The limp-home function remains active until the DTC is rectified or the stored DTC is erased with the appropriate scan tool. Sporadic faults can be reset via ignition OFF/ON.

## **CLUTCH APPLICATION**

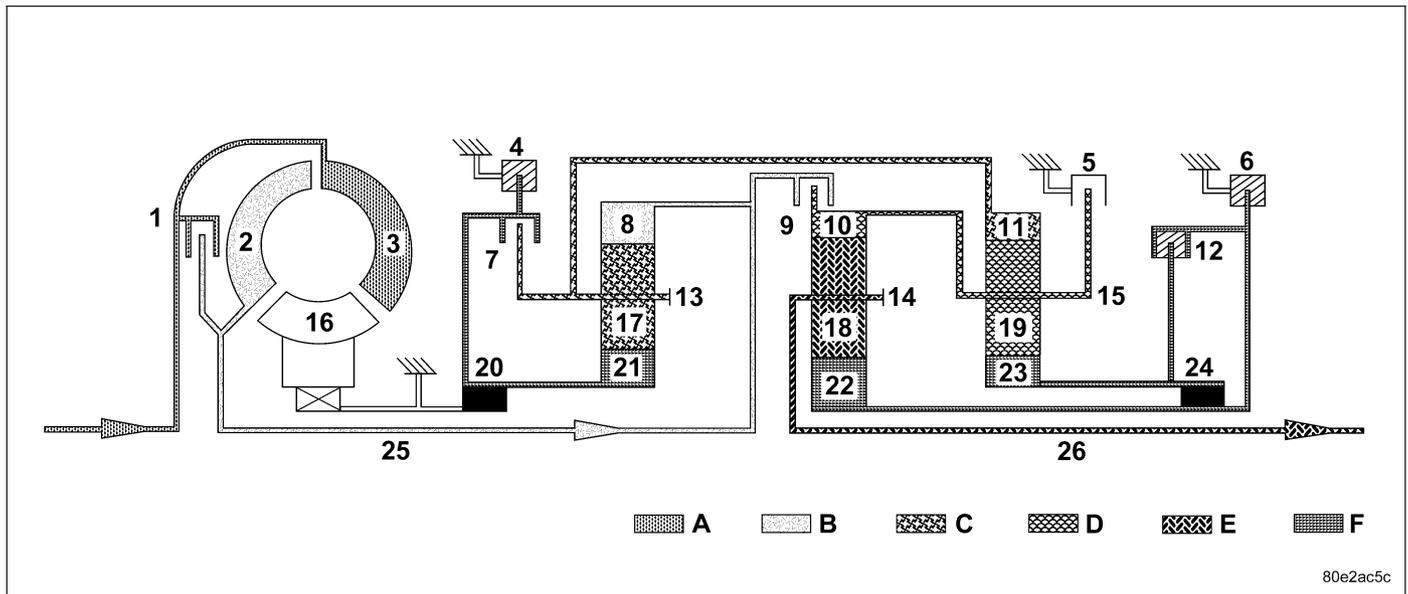
Refer to CLUTCH APPLICATION for which shift elements are applied in each gear position.

**CLUTCH APPLICATION**

GEAR	RATIO	B1	B2	B3	K1	K2	K3	F1	F2
1	3.59	X*	X				X*	X	X
2	2.19		X		X		X*		X
3	1.41		X		X	X			
4	1.00				X	X	X		
5	0.83	X				X	X	X*	
N	N/A	X					X		
R	3.16	X*		X			X	X	
R - Limp In	1.93			X	X		X		

\* = The shift components required during coast.

**FIRST GEAR POWERFLOW**

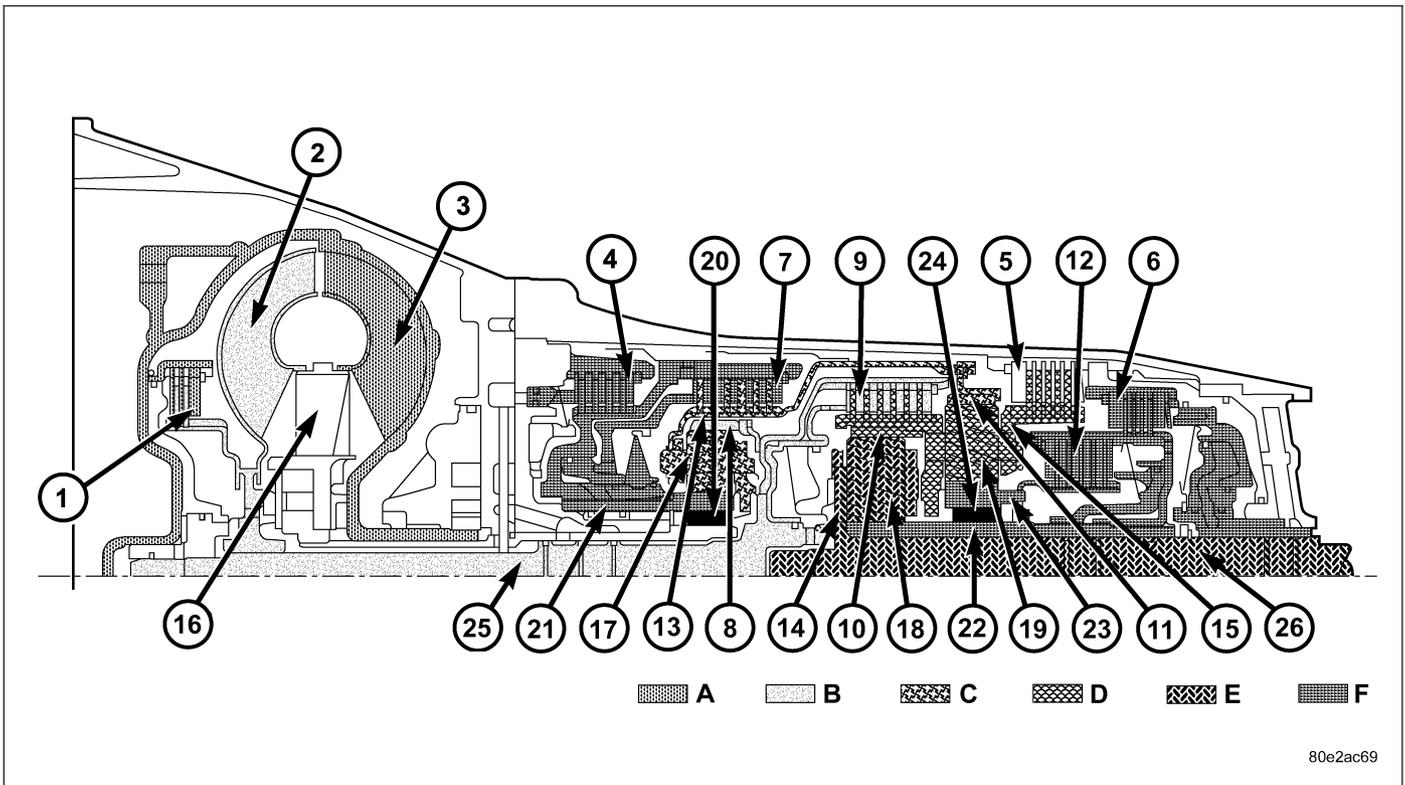


**First Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - THIRD GEAR RATIO
- F - FIXED PARTS

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**First Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - THIRD GEAR RATIO
- F - FIXED PARTS

Torque from the torque converter is increased via the input shaft (25) and all three planetary gearsets and transferred to the output shaft (26).

**Front Planetary Gear Set**

The annulus gear (8) is driven by the input shaft (25). The sun gear (21) is held against the housing by the locked freewheel F1 (20) during acceleration and via the engaged multiple-disc holding clutch B1 (4) during deceleration. The planetary pinion gears (17) turn on the fixed sun gear (21) and increase the torque from the annulus gear (8) to the planetary carrier (13). The planetary carrier (13) moves at a reduced speed in the running direction of the engine.

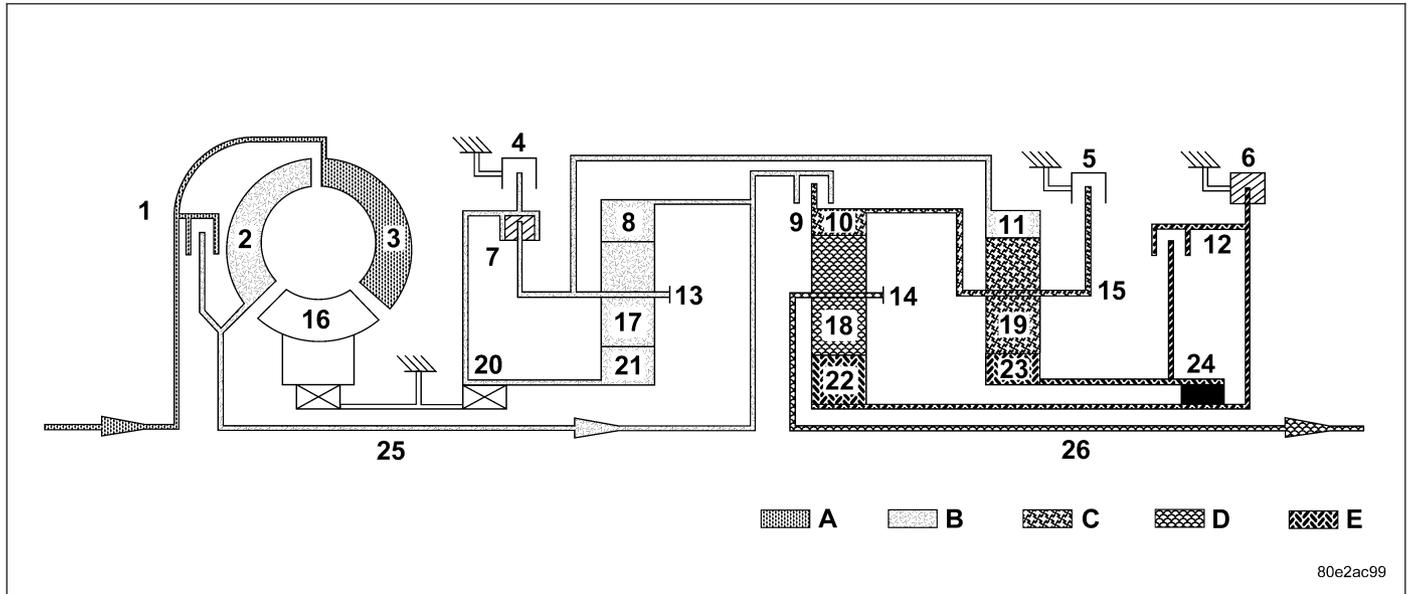
**Rear Planetary Gear Set**

The annulus gear (11) turns at a reduced speed due to the mechanical connection to the front planetary carrier (15). The sun gear (23) is held against the housing by the engaged multiple-disc holding clutch B2 (6), by the locked freewheel F2 (24) during acceleration and by the engaged multiple-disc clutch K3 (12) during deceleration. The planetary gears (19) turn on the fixed sun gear (23) and increase the torque from the annulus gear (11) to the planetary carrier (15). The planetary carrier (15) moves at a reduced speed in the running direction of the engine.

**Center Planetary Gear Set**

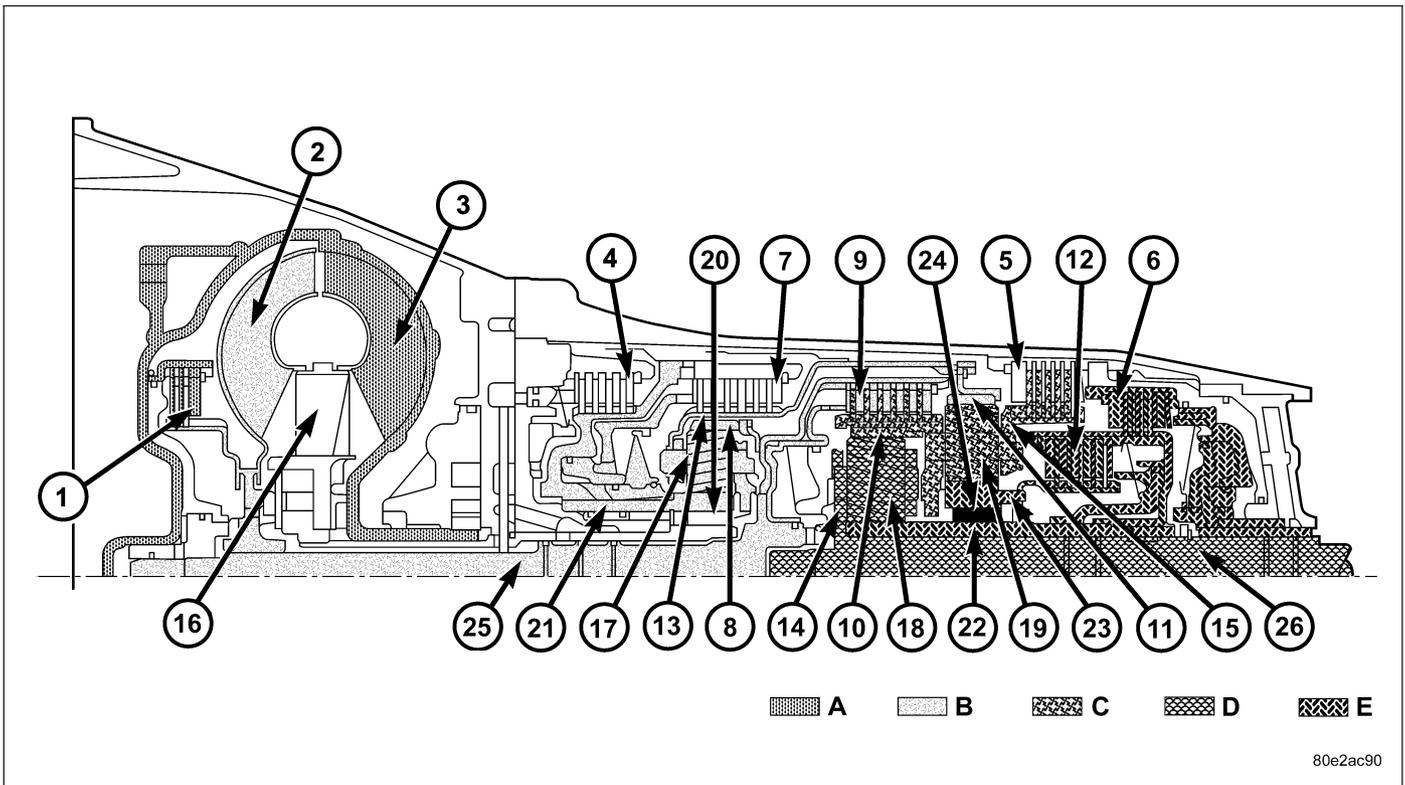
The annulus gear (10) is driven at the same speed as the rear planetary carrier (15) as a result of a mechanical connection. The sun gear (22) is held against the housing by the multiple-disc holding clutch B2 (6). The planetary pinion gears (18) turn on the fixed sun gear (22) and increase the torque from the annulus gear (10) to the planetary carrier (14). The output shaft (26) connected to the planetary carrier (14) turns at a reduced speed in the running direction of the engine.

**SECOND GEAR POWERFLOW**



**Second Gear Powerflow**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>1 - TORQUE CONVERTER LOCK-UP CLUTCH</li> <li>2 - TORQUE CONVERTER TURBINE</li> <li>3 - TORQUE CONVERTER IMPELLER</li> <li>4 - HOLDING CLUTCH B1</li> <li>5 - HOLDING CLUTCH B3</li> <li>6 - HOLDING CLUTCH B2</li> <li>7 - DRIVING CLUTCH K1</li> <li>8 - FRONT PLANETARY ANNULUS GEAR</li> <li>9 - DRIVING CLUTCH K2</li> <li>10 - CENTER PLANETARY ANNULUS GEAR</li> <li>11 - REAR PLANETARY ANNULUS GEAR</li> <li>12 - DRIVING CLUTCH K3</li> <li>13 - FRONT PLANETARY CARRIER</li> <li>A - ENGINE SPEED</li> <li>B - TRANSMISSION INPUT SPEED</li> <li>C - FIRST GEAR RATIO</li> </ul> | <ul style="list-style-type: none"> <li>14 - CENTER PLANETARY CARRIER</li> <li>15 - REAR PLANETARY CARRIER</li> <li>16 - TORQUE CONVERTER STATOR</li> <li>17 - FRONT PLANETARY PINION GEARS</li> <li>18 - CENTER PLANETARY PINION GEARS</li> <li>19 - REAR PLANETARY PINION GEARS</li> <li>20 - FREEWHEELING CLUTCH F1</li> <li>21 - FRONT PLANETARY SUN GEAR</li> <li>22 - CENTER PLANETARY SUN GEAR</li> <li>23 - REAR PLANETARY SUN GEAR</li> <li>24 - FREEWHEELING CLUTCH F2</li> <li>25 - INPUT SHAFT</li> <li>26 - OUTPUT SHAFT</li> <li>D - SECOND GEAR RATIO</li> <li>E - FIXED PARTS</li> </ul> |
|---|---|



**Second Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - FIXED PARTS

Torque from the torque converter is increased via the input shaft (25) and the center and rear planetary gearset and transferred to the output shaft (26).

**Front Planetary Gear Set**

The planetary carrier (13) and sun gear (21) are connected via the engaged multiple-disc clutch K1 (7). The planetary gearset is therefore blocked and turns as a closed unit at the input speed due to the mechanical connection of the annulus gear (8) and input shaft.

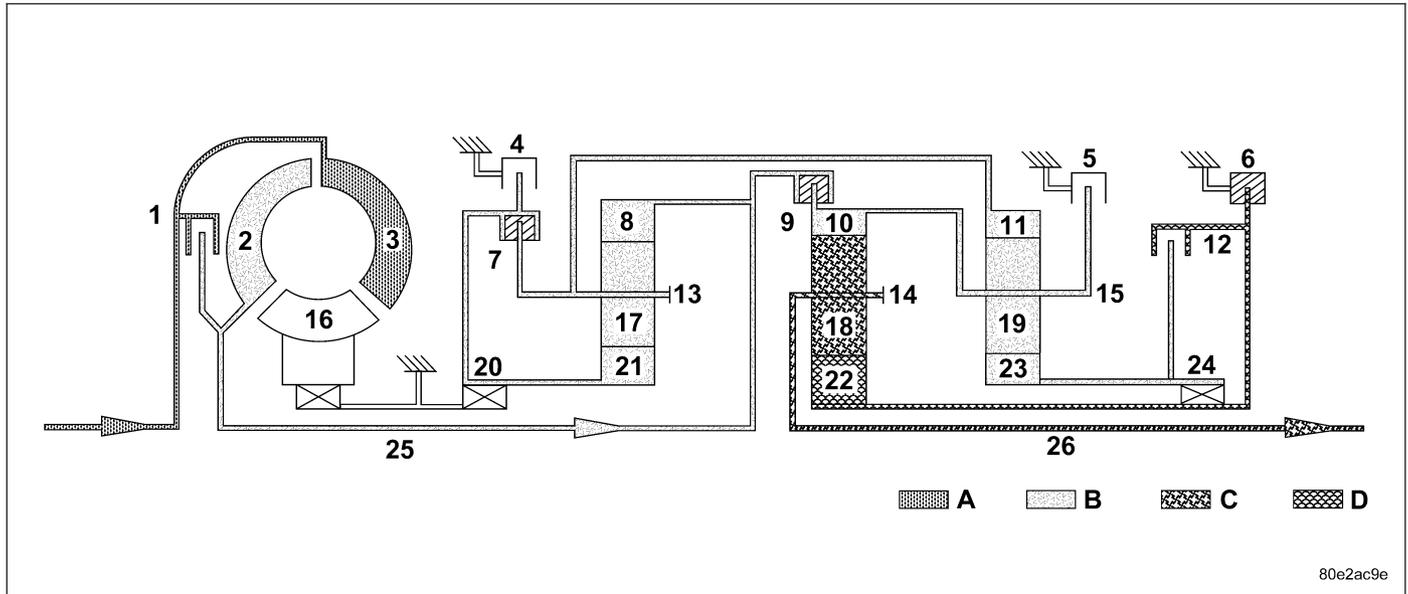
**Rear Planetary Gear Set**

The annulus gear (11) turns at the input speed as a result of the mechanical connection to the front planetary carrier (13). The sun gear (23) is held against the housing by the engaged multiple-disc holding clutch B2 (6), by the locked freewheel F2 (24) during acceleration and by the engaged multiple-disc clutch K3 (12) during deceleration. The planetary pinion gears (19) turn on the fixed sun gear (23) and increase the torque from the annulus gear (11) to the planetary carrier (15). The planetary carrier (15) moves at a reduced speed in the running direction of the engine.

**Center Planetary Gear Set**

The annulus gear (10) is driven at the same speed as the rear planetary carrier (15) as a result of a mechanical connection. The sun gear (22) is held against the housing by the multiple-disc holding clutch B2 (6). The planetary pinion gears (18) turn on the fixed sun gear (22) and increase the torque from the annulus gear (10) to the planetary carrier (14). The output shaft (5) connected to the planetary carrier (14) turns at a reduced speed in the running direction of the engine.

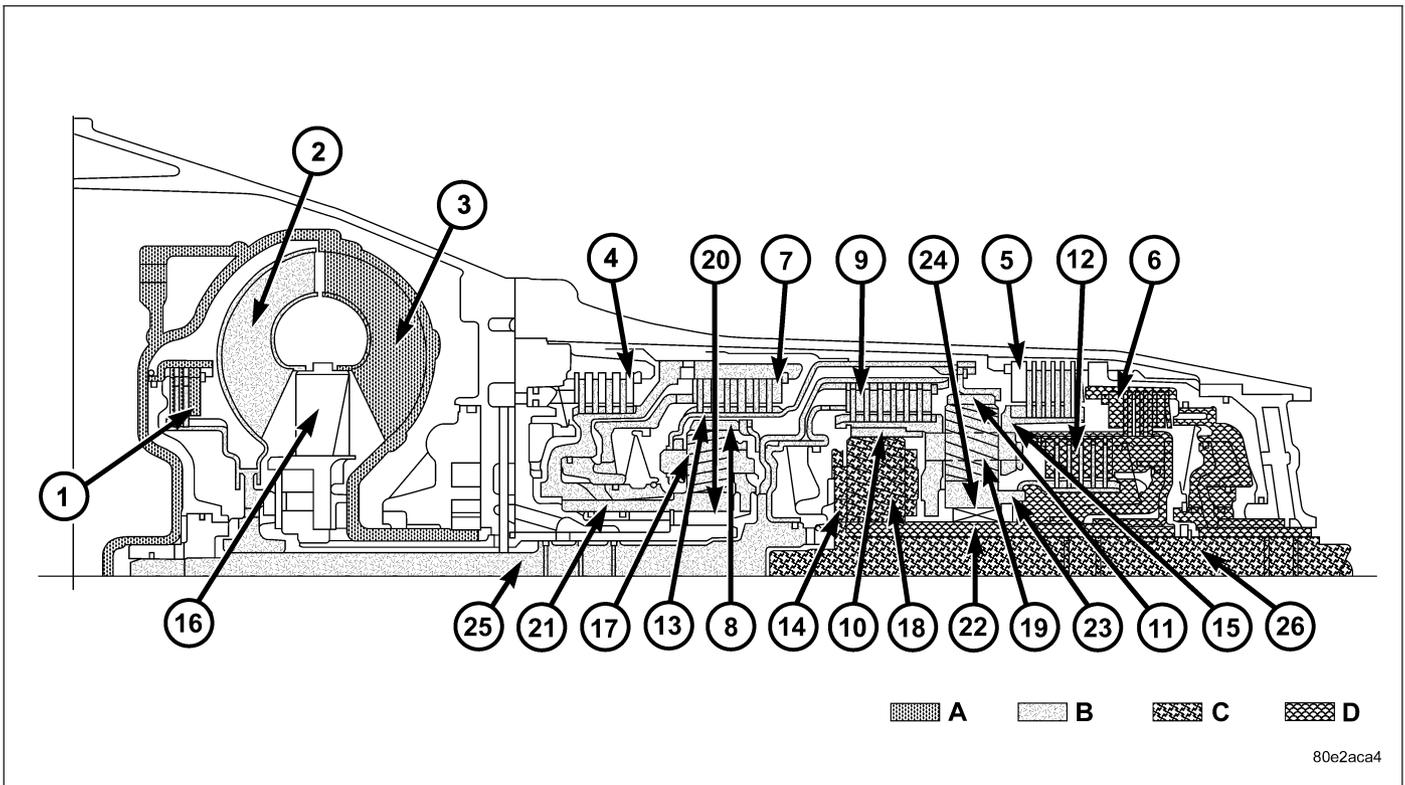
**THIRD GEAR POWERFLOW**



**Third Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- C - FIRST GEAR RATIO
- D - FIXED PARTS



**Third Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- C - FIRST GEAR RATIO
- D - FIXED PARTS

Torque from the torque converter is increased via the input shaft (25) and the center planetary gearset and transferred to the output shaft (26).

**Front Planetary Gear Set**

The planetary carrier (13) and sun gear (21) are connected via the engaged multiple-disc clutch K1 (7). The planetary gearset is therefore locked and turns as a closed unit at the input speed due to the mechanical connection of the annulus gear (8) and input shaft (25).

**Rear Planetary Gear Set**

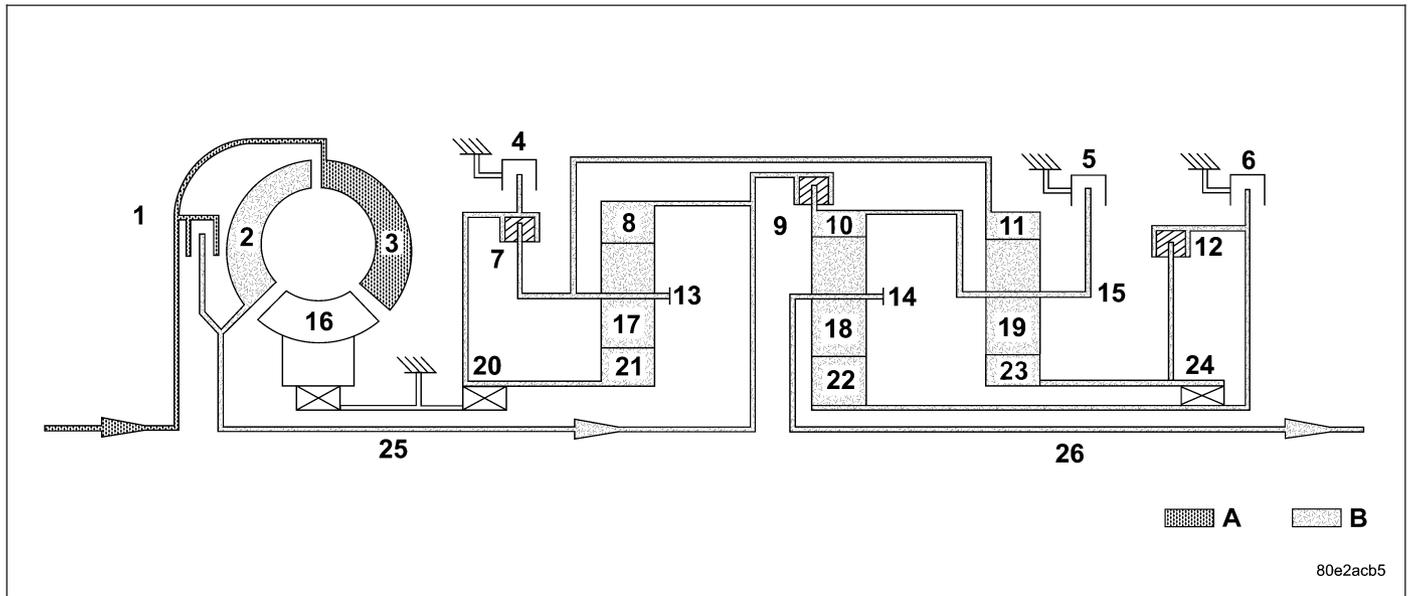
The multiple-disc clutch K2 (9) is engaged and transfers the input speed of the input shaft (25) to the planetary carrier (15) via the annulus gear (10). The annulus gear (11) turns in the same way as the planetary carrier (15) due to the mechanical connection with the locked front planetary gearset. This planetary gearset is therefore locked and turns as a closed unit.

**Center Planetary Gear Set**

The annulus gear (10) turns at the input speed as a result of the engaged multiple-disc clutch K2 (9). The sun gear (22) is held against the housing by the multiple-disc holding clutch B2 (6). The planetary pinion gears (18) turn on

the fixed sun gear (22) and increase the torque from the annulus gear (10) to the planetary carrier (14). The output shaft (26) connected to the planetary carrier (14) turns at a reduced speed in the running direction of the engine.

**FOURTH GEAR POWERFLOW**

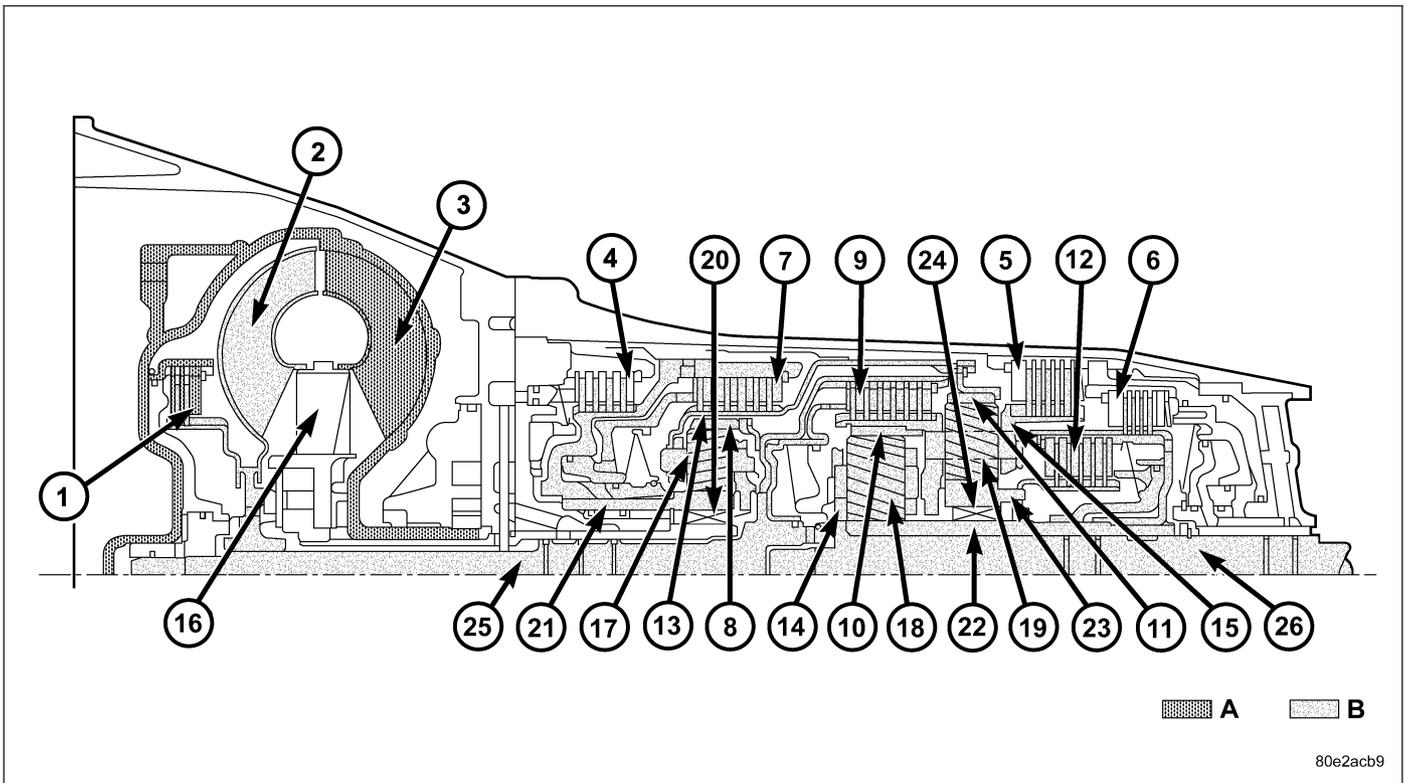


**Fourth Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- B - TRANSMISSION INPUT SPEED

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**Fourth Gear Powerflow**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>1 - TORQUE CONVERTER LOCK-UP CLUTCH</li> <li>2 - TORQUE CONVERTER TURBINE</li> <li>3 - TORQUE CONVERTER IMPELLER</li> <li>4 - HOLDING CLUTCH B1</li> <li>5 - HOLDING CLUTCH B3</li> <li>6 - HOLDING CLUTCH B2</li> <li>7 - DRIVING CLUTCH K1</li> <li>8 - FRONT PLANETARY ANNULUS GEAR</li> <li>9 - DRIVING CLUTCH K2</li> <li>10 - CENTER PLANETARY ANNULUS GEAR</li> <li>11 - REAR PLANETARY ANNULUS GEAR</li> <li>12 - DRIVING CLUTCH K3</li> <li>13 - FRONT PLANETARY CARRIER</li> <li>A - ENGINE SPEED</li> </ul> | <ul style="list-style-type: none"> <li>14 - CENTER PLANETARY CARRIER</li> <li>15 - REAR PLANETARY CARRIER</li> <li>16 - TORQUE CONVERTER STATOR</li> <li>17 - FRONT PLANETARY PINION GEARS</li> <li>18 - CENTER PLANETARY PINION GEARS</li> <li>19 - REAR PLANETARY PINION GEARS</li> <li>20 - FREEWHEELING CLUTCH F1</li> <li>21 - FRONT PLANETARY SUN GEAR</li> <li>22 - CENTER PLANETARY SUN GEAR</li> <li>23 - REAR PLANETARY SUN GEAR</li> <li>24 - FREEWHEELING CLUTCH F2</li> <li>25 - INPUT SHAFT</li> <li>26 - OUTPUT SHAFT</li> <li>B - TRANSMISSION INPUT SPEED</li> </ul> |
|---|---|

Speed and torque are not converted by the direct gear ratio of the 4th gear. Power is transferred from the input shaft (25) to the output shaft (26) via three locked planetary gearsets.

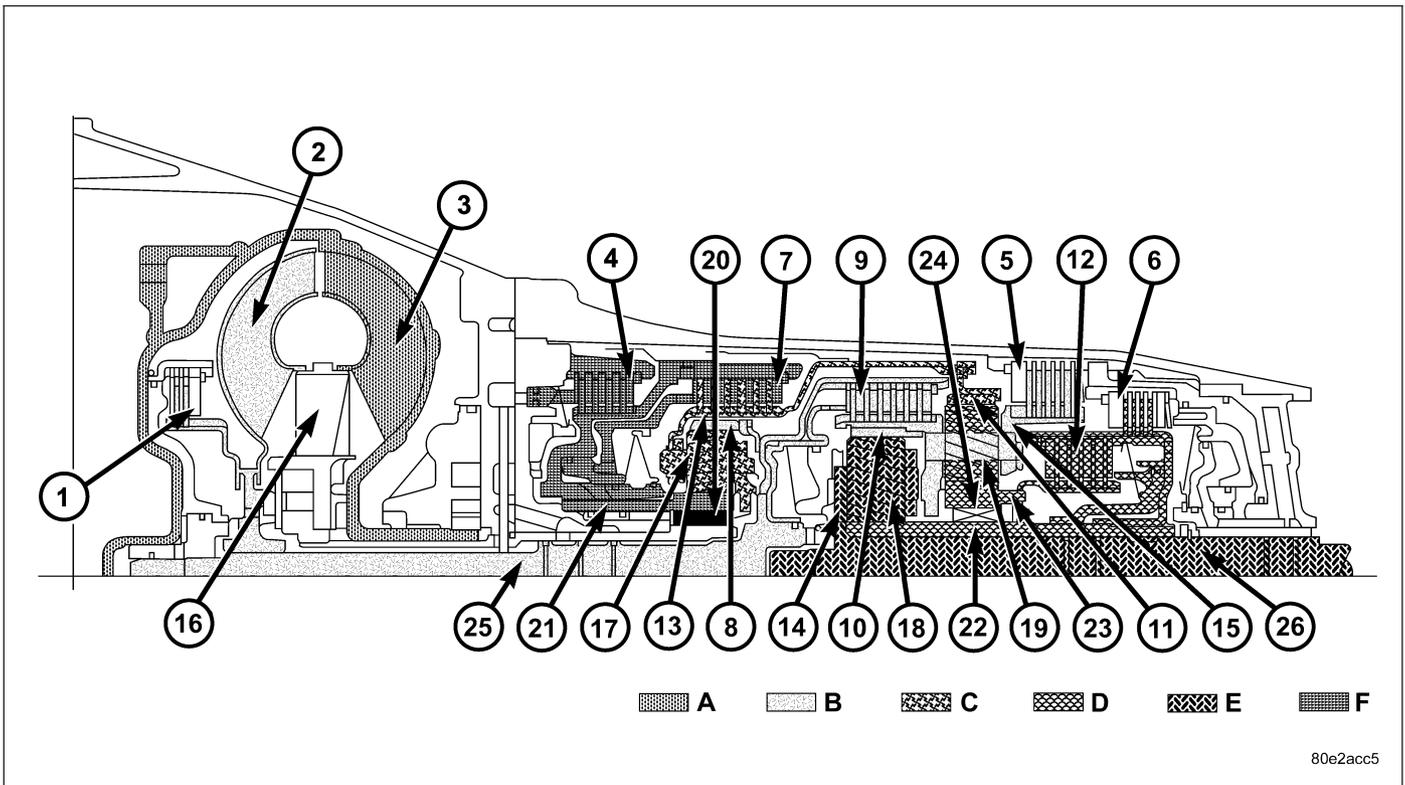
**Front Planetary Gear Set**

The planetary carrier (13) and sun gear (21) are connected via the engaged multiple-disc clutch K1 (7). The planetary gearset is therefore locked and turns as a closed unit at the input speed due to the mechanical connection of the annulus gear (8) and the input shaft (25).

**Rear Planetary Gear Set**

The multiple-disc clutch K2 (9) is engaged and transfers the input speed of the input shaft (25) to the planetary carrier (15) via the annulus gear (10). The annulus gear (11) turns in the same way as the planetary carrier (15) due to the mechanical connection with the locked front planetary gearset. The planetary gearset is therefore locked and turns as a closed unit.





**Fifth Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - THIRD GEAR RATIO
- F - FIXED PARTS

Torque from the torque converter is increased via the input shaft (25) and all three planetary gearsets and transferred to the output shaft (26).

**Front Planetary Gear Set**

The annulus gear (8) is driven by the input shaft (25). The sun gear (21) is held against the housing by the locked freewheel F1 (20) during acceleration and via the engaged multiple-disc holding clutch B1 (4) during deceleration. The planetary pinion gears (17) turn on the fixed sun gear (21) and increase the torque from the annulus gear (8) to the planetary carrier (13). The planetary carrier (13) moves at a reduced speed in the running direction of the engine.

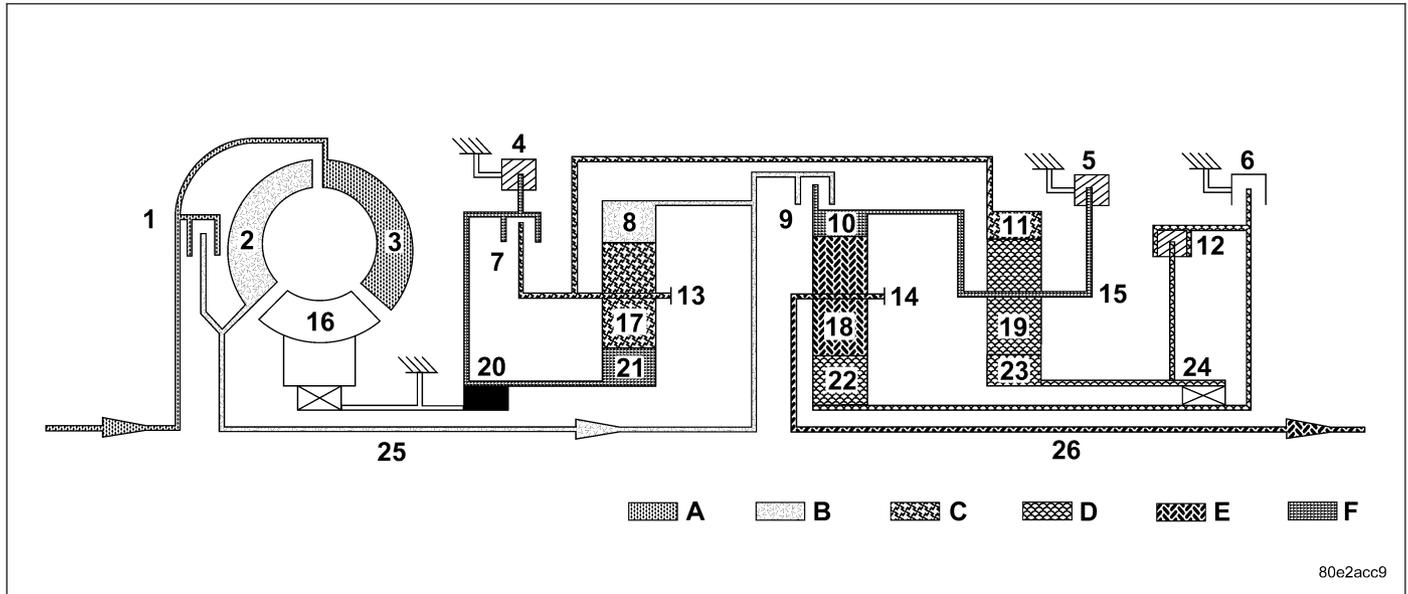
**Rear Planetary Gear Set**

The multiple-disc clutch K2 (9) is engaged and transfers the input speed of the input shaft (25) to the planetary carrier (15) via the annulus gear (10). The annulus gear (11) turns at a reduced speed due to the mechanical connection with the front planetary carrier (13). The planetary pinion gears (19) turn between the annulus gear (11) and the sun gear (23). The sun gear (23) moves at an increased speed in the running direction of the engine.

**Center Planetary Gear Set**

The annulus gear (10) turns at the input speed as a result of the engaged multiple-disc clutch K2 (9). The multiple-disc clutch K3 (12) transfers an increased speed to the sun gear (22) due to the connection with the sun gear (23). The planetary pinion gears (18) turn between the annulus gear (10) and the sun gear (22). The speed of the planetary carrier (14) and the output shaft connected to the planetary carrier (5) lies between that of the annulus gear (10) and the sun gear (22). This provides a step-up ratio.

**REVERSE GEAR POWERFLOW**

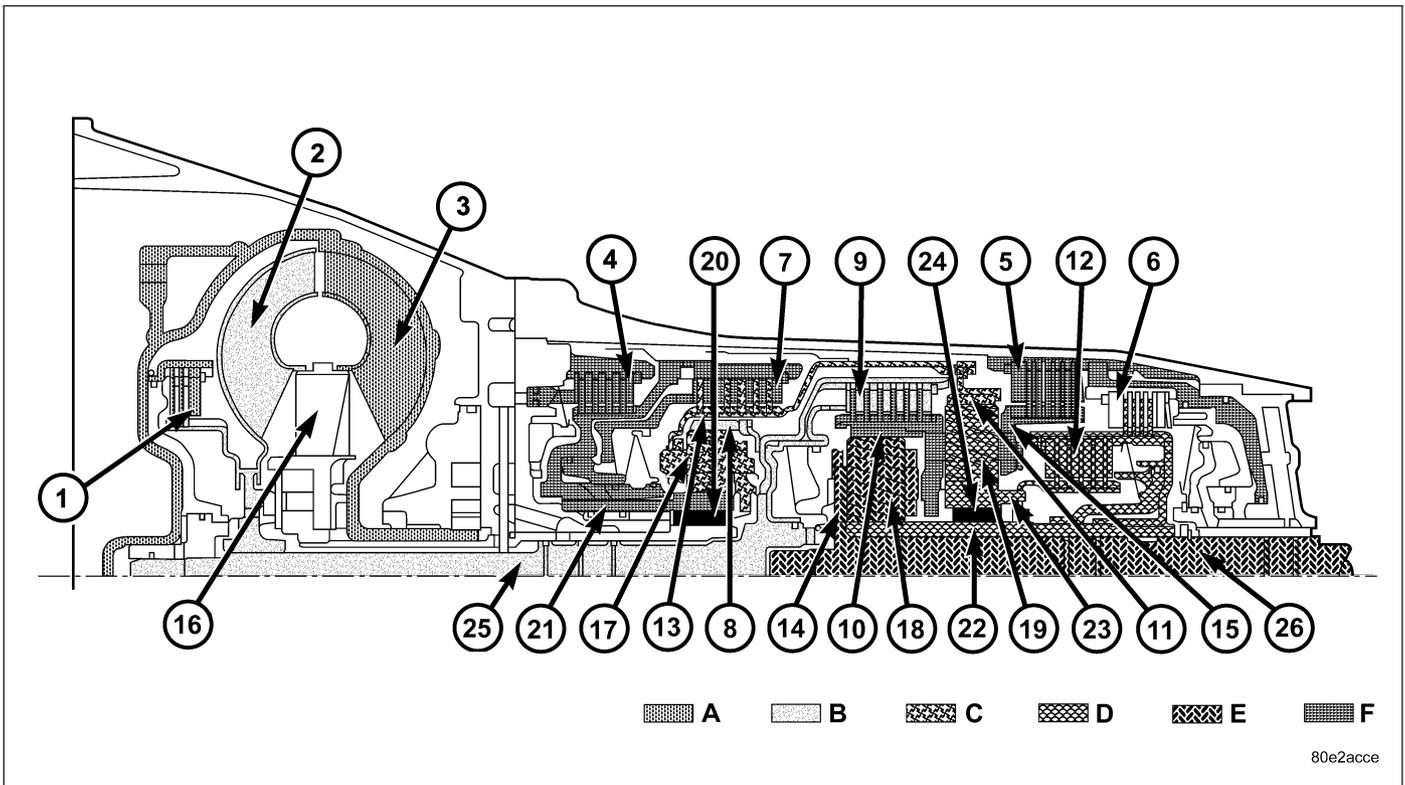


**Reverse Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - THIRD GEAR RATIO
- F - FIXED PARTS

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**Reverse Gear Powerflow**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - THIRD GEAR RATIO
- F - FIXED PARTS

Torque from the torque converter is increased via the input shaft (25) and all three planetary gearsets and transferred with reversed direction of rotation to the output shaft (26).

**Front Planetary Gear Set**

The annulus gear (8) is driven by the input shaft (25). The sun gear (21) is held against the housing by the locked freewheel F1 (20) during acceleration and via the engaged multiple-disc holding clutch B1 (4) during deceleration. The planetary pinion gears (17) turn on the fixed sun gear (21) and increase the torque from the annulus gear (8) to the planetary carrier (13). The planetary carrier (13) moves at a reduced speed in the running direction of the engine.

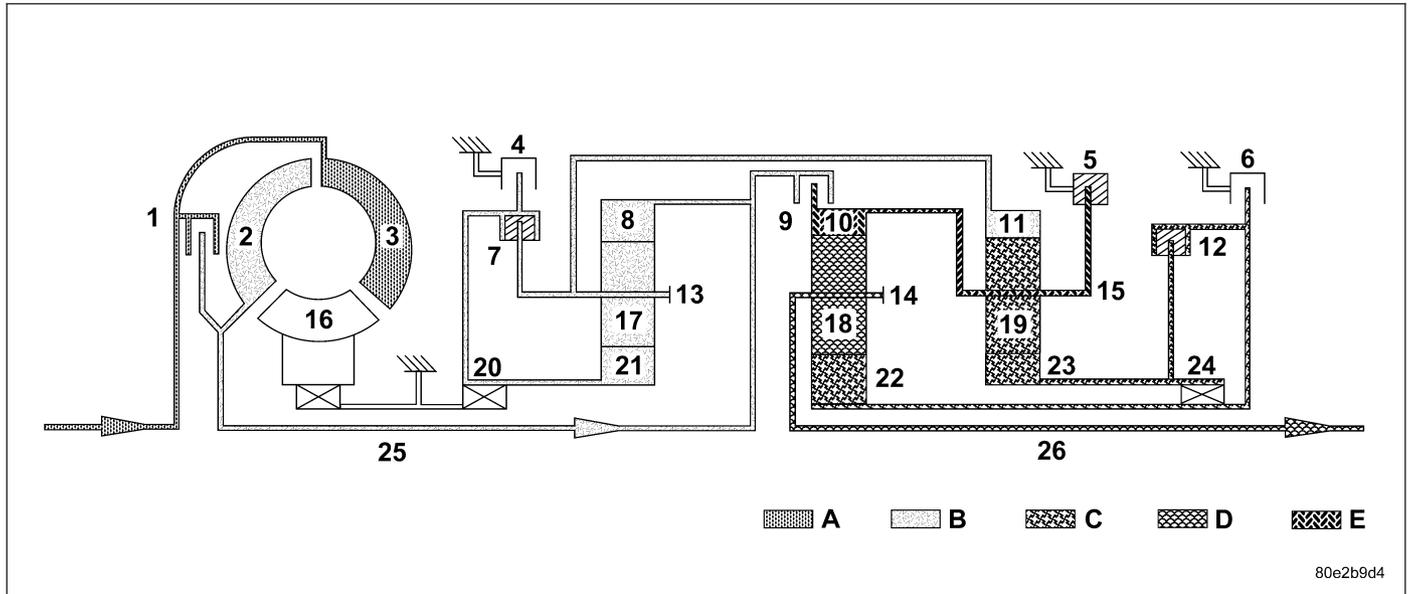
**Rear Planetary Gear Set**

The planetary carrier (15) is held against the housing by the engaged multiple-disc holding clutch B3 (5). The annulus gear (11) turns at a reduced speed due to the mechanical connection to the front planetary carrier (13). The planetary gears (19) turn between the annulus gear (11) and the sun gear (23). The direction is reversed by the held planetary carrier (15) so that the sun gear (23) turns in the opposite direction to the running direction of the engine.

**Center Planetary Gear Set**

The annulus gear (10) is held against the housing by the multiple-disc holding clutch B3 (5) via the mechanical connection to the planetary carrier (15). The sun gear (22) turns backwards due to the engaged multiple-disc clutch K3 (12). The planetary gears (18) turn on the fixed annulus gear (10) and increase the torque from the sun gear (22) to the planetary carrier (14). The output shaft (26) connected to the planetary carrier (14) turns at a reduced speed in the opposite direction to the running direction of the engine.

**REVERSE GEAR POWERFLOW - LIMP IN**

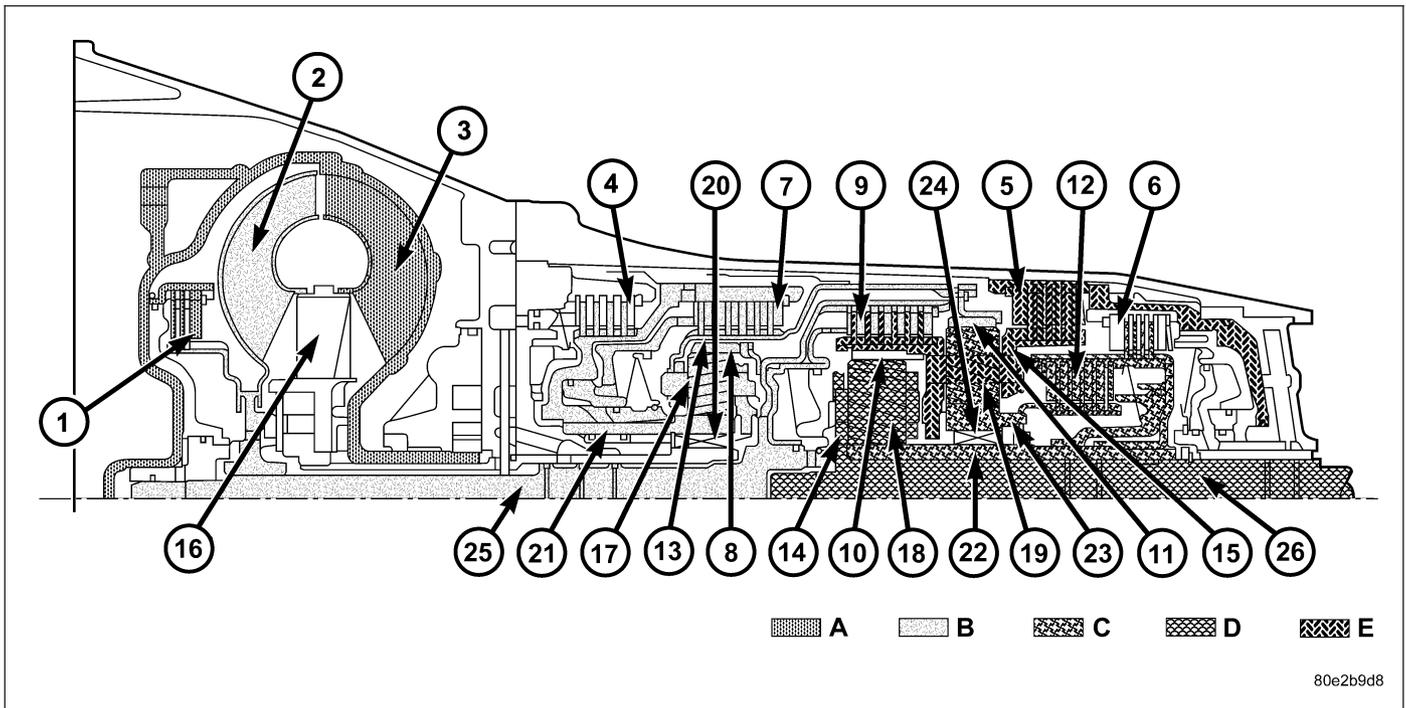


**Reverse Gear Powerflow - Limp In**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - FIXED PARTS

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**Reverse Gear Powerflow - Limp In**

- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER TURBINE
- 3 - TORQUE CONVERTER IMPELLER
- 4 - HOLDING CLUTCH B1
- 5 - HOLDING CLUTCH B3
- 6 - HOLDING CLUTCH B2
- 7 - DRIVING CLUTCH K1
- 8 - FRONT PLANETARY ANNULUS GEAR
- 9 - DRIVING CLUTCH K2
- 10 - CENTER PLANETARY ANNULUS GEAR
- 11 - REAR PLANETARY ANNULUS GEAR
- 12 - DRIVING CLUTCH K3
- 13 - FRONT PLANETARY CARRIER
- A - ENGINE SPEED
- B - TRANSMISSION INPUT SPEED
- C - FIRST GEAR RATIO

- 14 - CENTER PLANETARY CARRIER
- 15 - REAR PLANETARY CARRIER
- 16 - TORQUE CONVERTER STATOR
- 17 - FRONT PLANETARY PINION GEARS
- 18 - CENTER PLANETARY PINION GEARS
- 19 - REAR PLANETARY PINION GEARS
- 20 - FREEWHEELING CLUTCH F1
- 21 - FRONT PLANETARY SUN GEAR
- 22 - CENTER PLANETARY SUN GEAR
- 23 - REAR PLANETARY SUN GEAR
- 24 - FREEWHEELING CLUTCH F2
- 25 - INPUT SHAFT
- 26 - OUTPUT SHAFT
- D - SECOND GEAR RATIO
- E - FIXED PARTS

Torque from the torque converter is increased via the input shaft (25) and all three planetary gearsets and transferred with reversed direction of rotation to the output shaft (26) and.

**Front Planetary Gear Set**

The clutch K1 (7) is shifted. The planetary carrier (13) and sun gear (21) are connected to each other as a result. The annulus gear (8) is driven via the input shaft (25). The planetary gear set is locked and turns as a unit.

**Rear Planetary Gear Set**

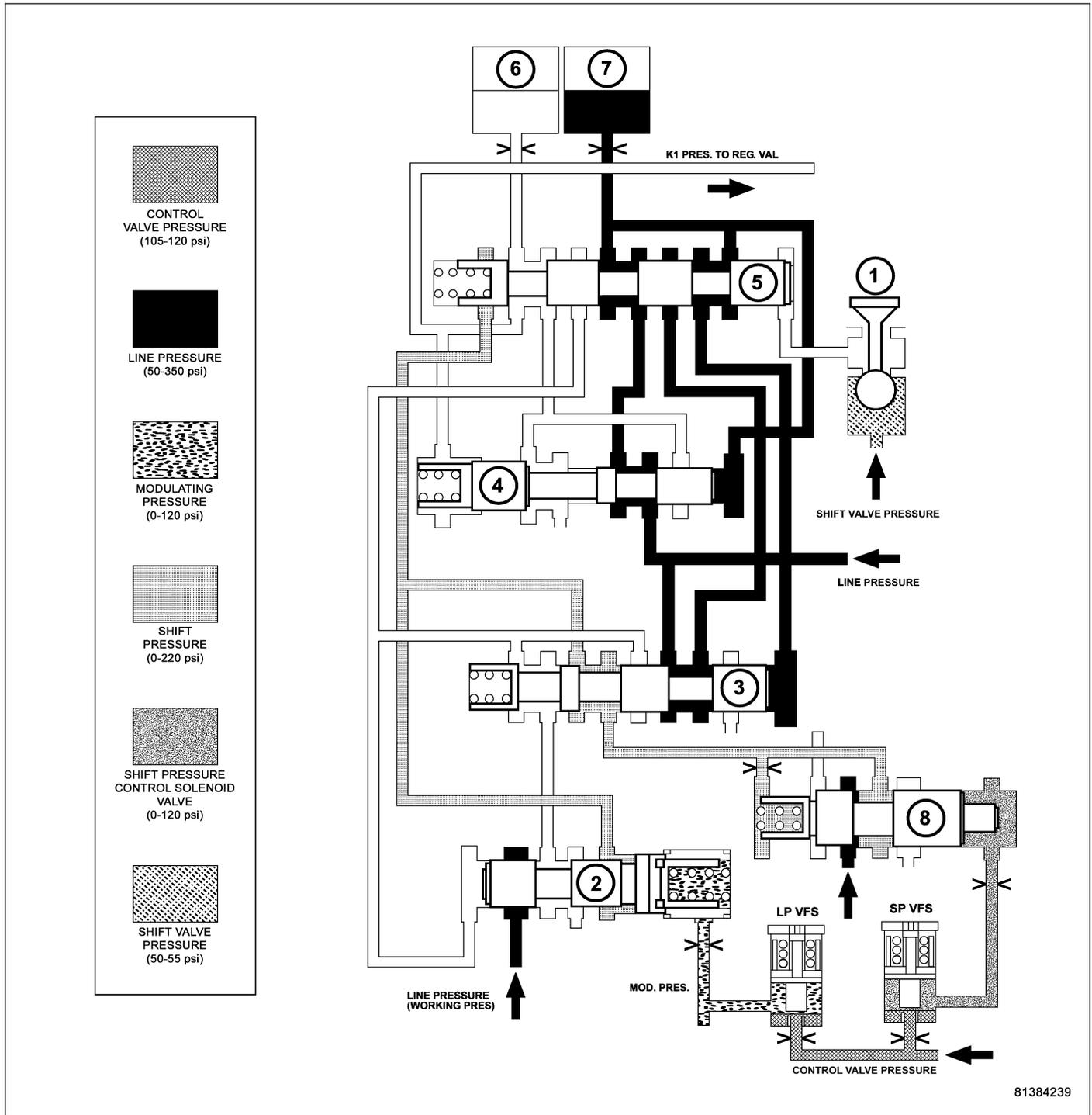
The planetary carrier (15) is held against the housing by the engaged multiple-disc holding clutch B3 (5). The annulus gear (11) turns at a reduced speed due to the mechanical connection to the front planetary carrier (13). The planetary pinion gears (19) turn between the annulus gear (11) and the sun gear (23). The direction is reversed by the held planetary carrier (15) so that the sun gear (23) turns in the opposite direction to the running direction of the engine.

**Center Planetary Gear Set**

The annulus gear (10) is held against the housing by the multiple-disc holding clutch B3 (5) via the mechanical connection to the planetary carrier (15). The sun gear (22) turns backwards due to the engaged multiple-disc clutch K3 (12). The planetary gears (18) turn on the fixed annulus gear (10) and increase the torque from the sun gear (22) to the planetary carrier (14). The output shaft (26) connected to the planetary carrier (14) turns at a reduced speed in the opposite direction to the running direction of the engine.

## SHIFT GROUPS/ SHIFT SEQUENCE

### 1-2 Shift - First Gear Engaged



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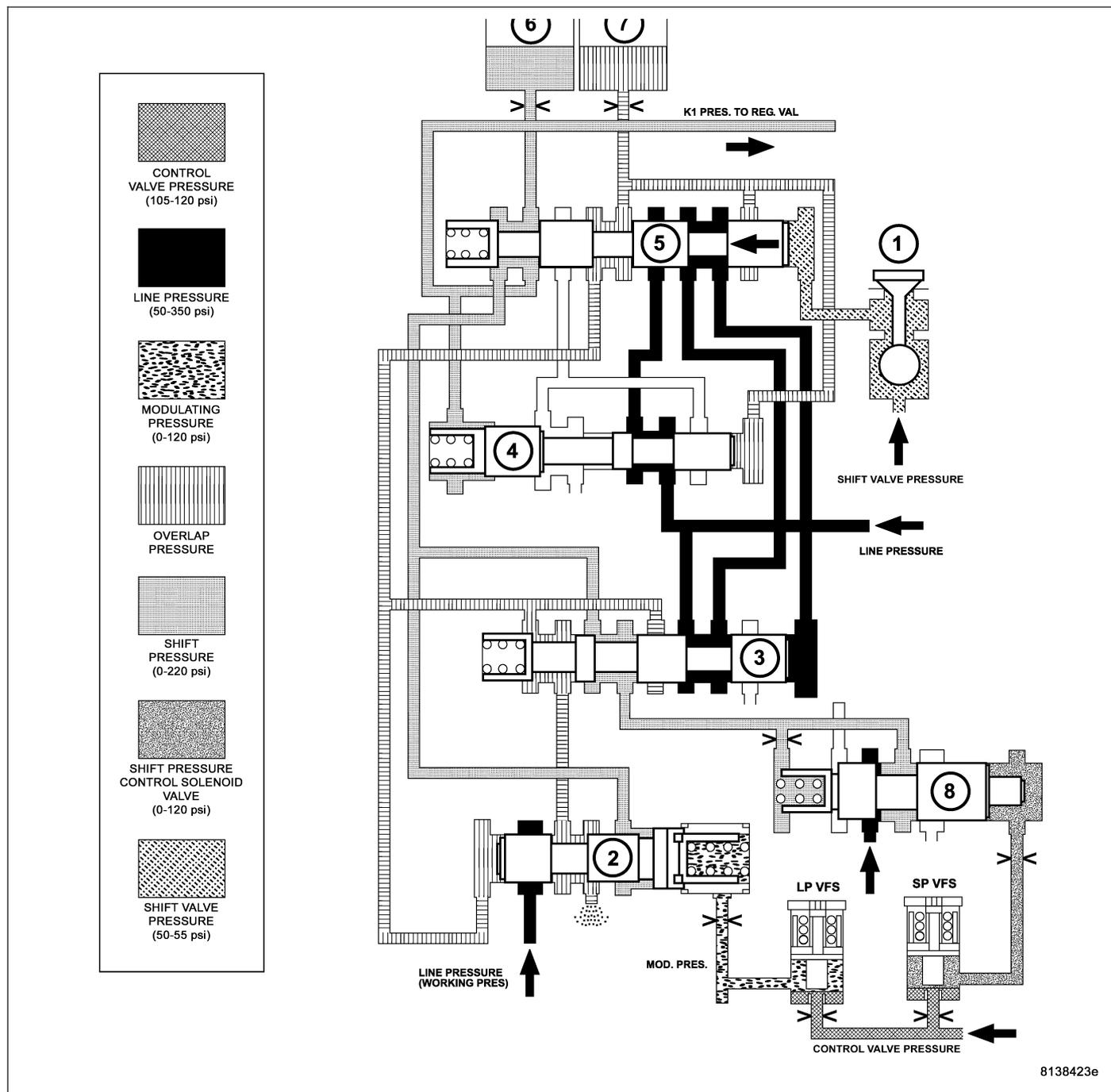
### First Gear Engaged

- 1 - 1-2/4-5 SHIFT SOLENOID
- 2 - 1-2/4-5 OVERLAP VALVE
- 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE
- 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE

- 5 - 1-2/4-5 COMMAND VALVE
- 6 - DRIVING CLUTCH K1
- 7 - HOLDING CLUTCH B1

The end face of the command valve (5) is kept unpressurized via the solenoid valve for 1-2 and 4-5 shift (1). Because of the holding pressure shift valve (4), the working pressure (p-A) is present at the multiple-disc holding clutch B1 (7). Clutch K1 (6) is unpressurized.

Shift Phase - 1-2 Shift Phase 1



Shift Phase - 1-2 Shift Phase 1

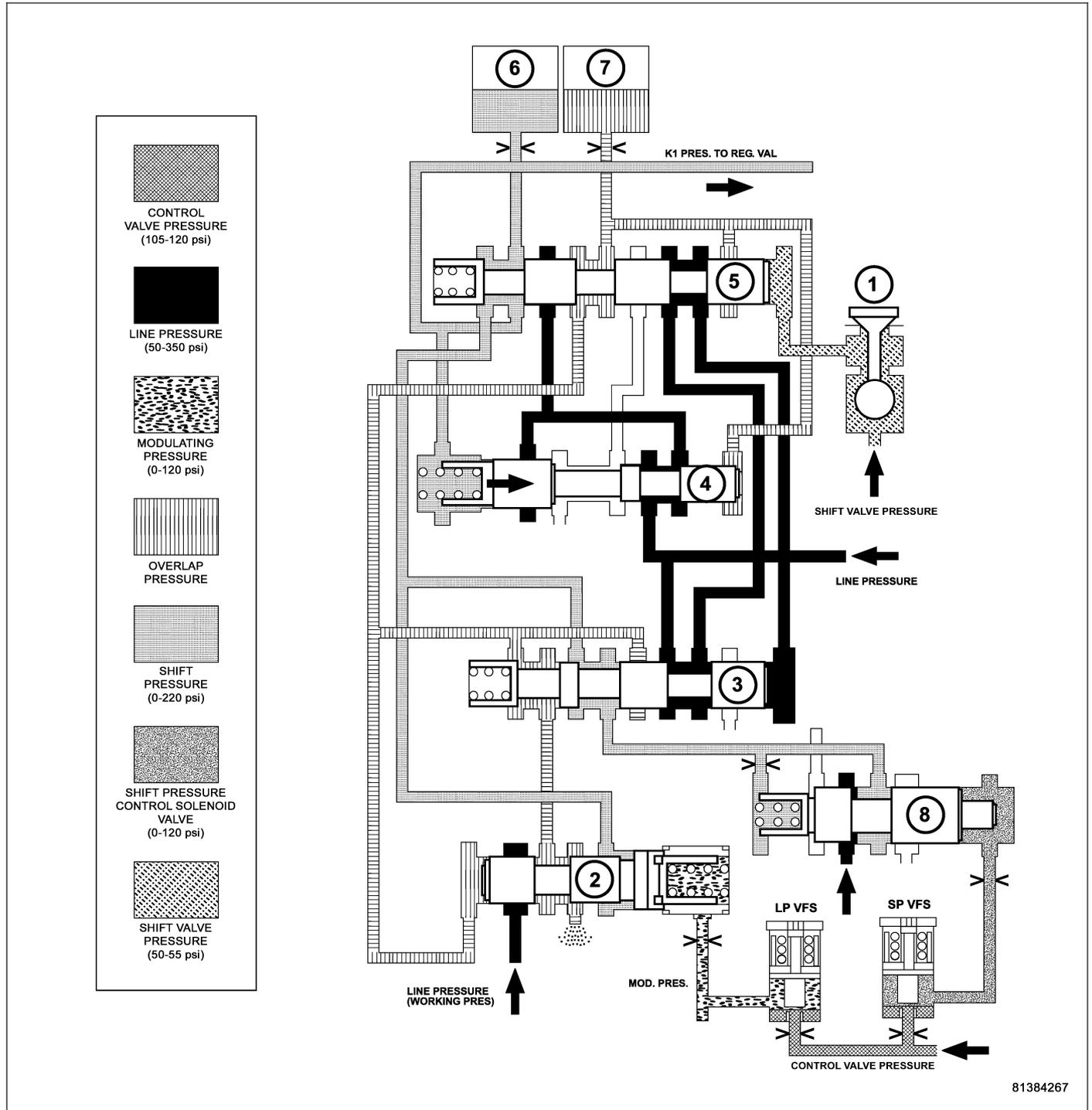
- 1 - 1-2/4-5 SHIFT SOLENOID
- 2 - 1-2/4-5 OVERLAP VALVE
- 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE
- 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE

- 5 - 1-2/4-5 COMMAND VALVE
- 6 - DRIVING CLUTCH K1
- 7 - HOLDING CLUTCH B1

When the 1-2 and 4-5 shift solenoid valve (1) is turned on, the shift valve pressure (p-SV) is directed onto the end face of the command valve (5). The command valve is moved and the shift pressure (p-S) coming from the shift pressure shift valve (3) is directed via the command valve (5) onto clutch K1 (6).

Simultaneously the clutch B1 (7) is subjected to overlap pressure by the overlap regulating valve (2). The pressure in the clutch B1 (7) as it disengages is controlled during the shift phase depending on engine load by the modulating pressure and the applying clutch pressure (the shift pressure in clutch K1). The controlled pressure in clutch B1 (7) is inversely proportional to the capacity of the clutch being engaged. The rising shift pressure (p-S) at clutch K1 (6) acts on the annular face of the overlap regulating valve (2) and reduces the overlap pressure regulated by the overlap regulating valve (2). When a corresponding pressure level is reached at the holding pressure shift valve (4), this valve switches over.

Shift Phase - 1-2 Shift Phase 2



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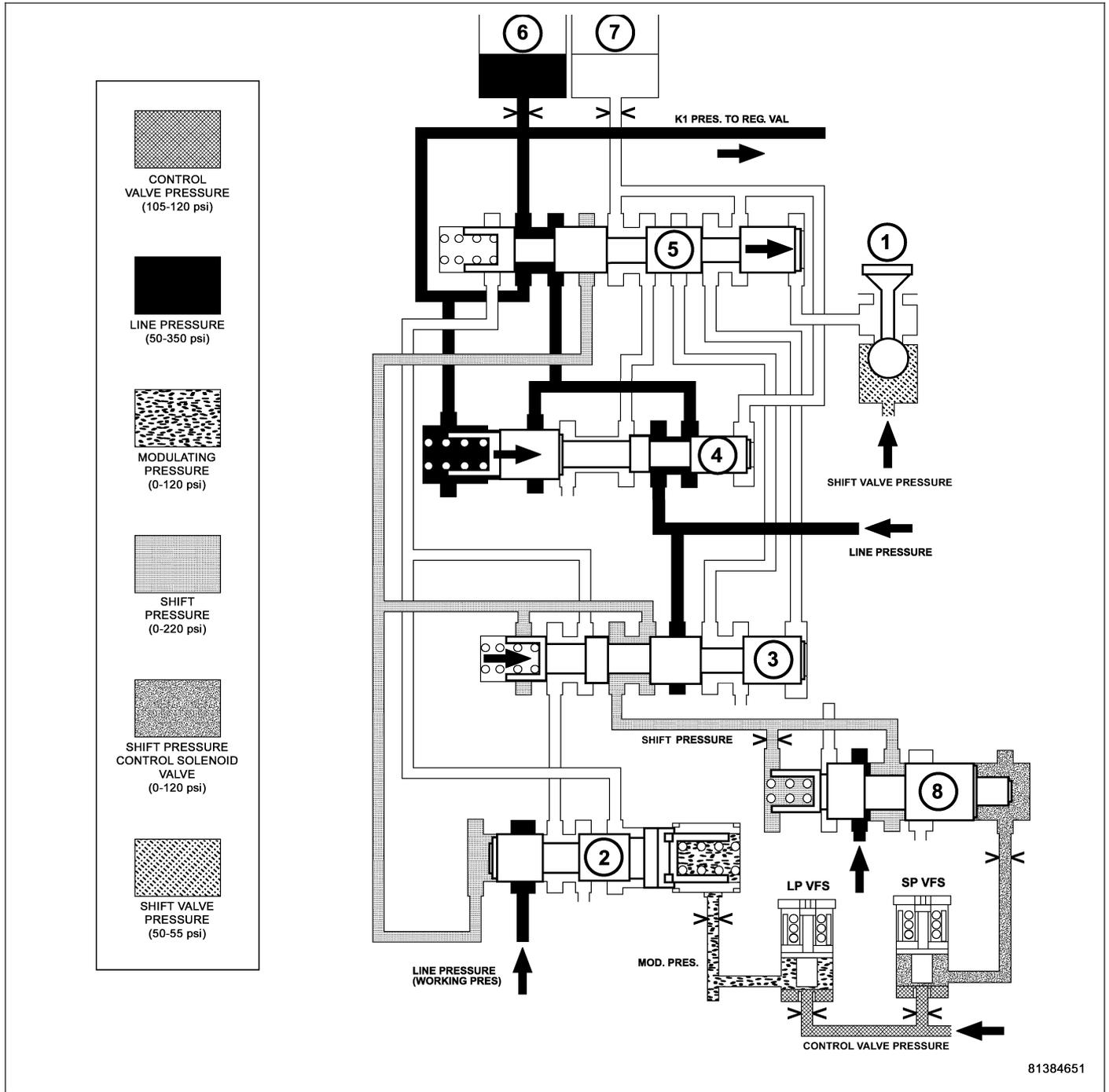
**Shift Phase - 1-2 Shift Phase 2**

- 1 - 1-2/4-5 SHIFT SOLENOID
- 2 - 1-2/4-5 OVERLAP VALVE
- 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE
- 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE

- 5 - 1-2/4-5 COMMAND VALVE
- 6 - DRIVING CLUTCH K1
- 7 - HOLDING CLUTCH B1

The B1 (7) pressure acting on the end face of the shift pressure shift valve (3) is replaced by the working pressure (p-A). The shift pressure is also routed to the spring end of the holding valve (4) and the holding valve downshifts. The line pressure is then routed to the command valve (5).

**Second Gear Engaged**



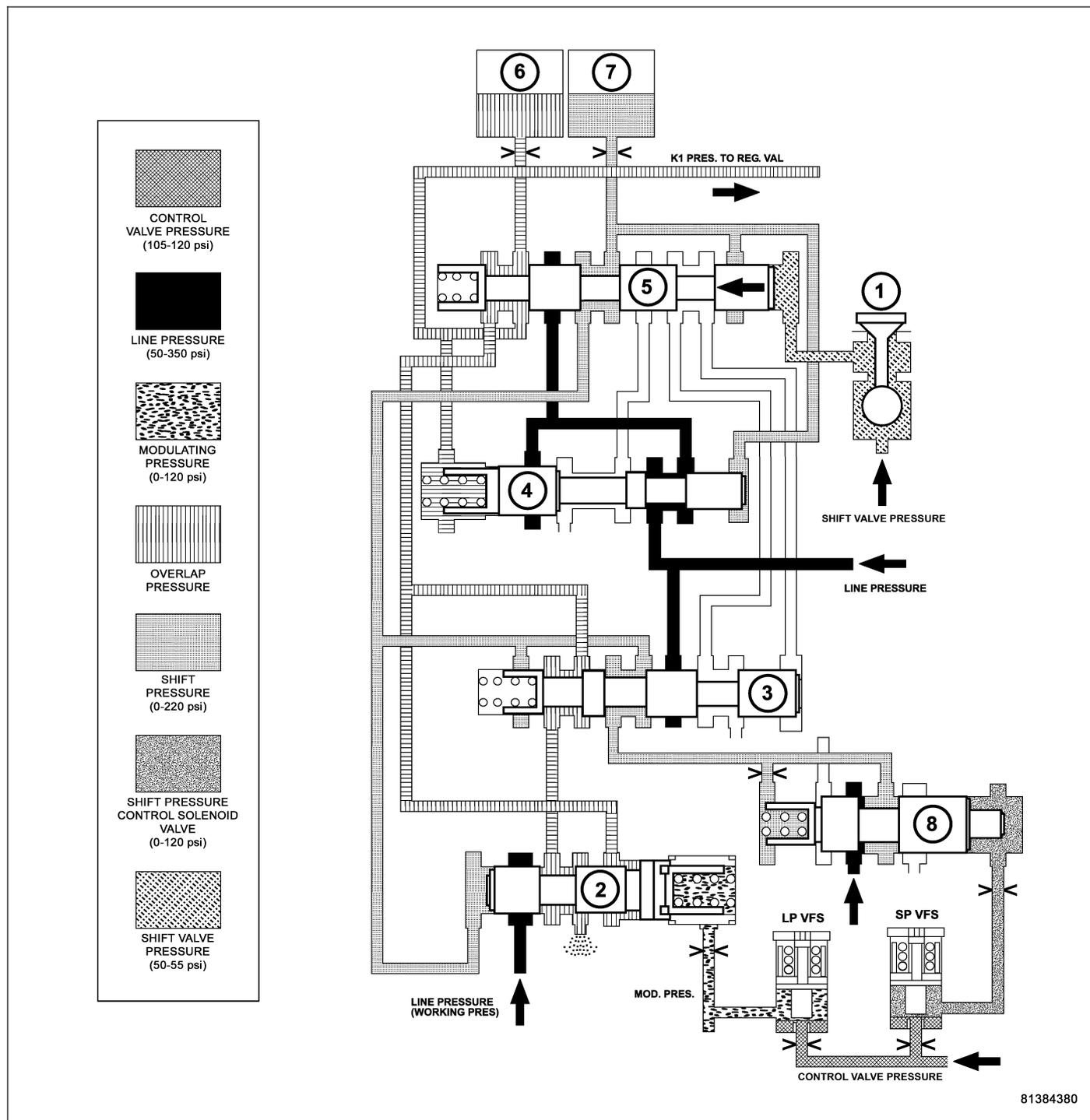
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**Second Gear Engaged**

- |  |                           |
|--|---------------------------|
| 1 - 1-2/4-5 SHIFT SOLENOID               | 5 - 1-2/4-5 COMMAND VALVE |
| 2 - 1-2/4-5 OVERLAP VALVE                | 6 - DRIVING CLUTCH K1     |
| 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE   | 7 - HOLDING CLUTCH B1     |
| 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE |                           |

After the gearchange is complete, the pressure on the end face of the command valve (5) is reduced via the 1-2 and 4-5 shift solenoid valve (1), and the command valve (5) is pushed back to its basic position. Via the holding pressure shift valve (4) the working pressure (p-A) now passes via the command valve (5) to clutch K1 (6). The multiple-disc holding clutch B1 (7) is deactivated (unpressurized). The spring of the shift pressure shift valve (3) pushes the valve back to its basic position.

Shift Phase - 2-1 Shift Phase 1



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**Shift Phase - 2-1 Shift Phase 1**

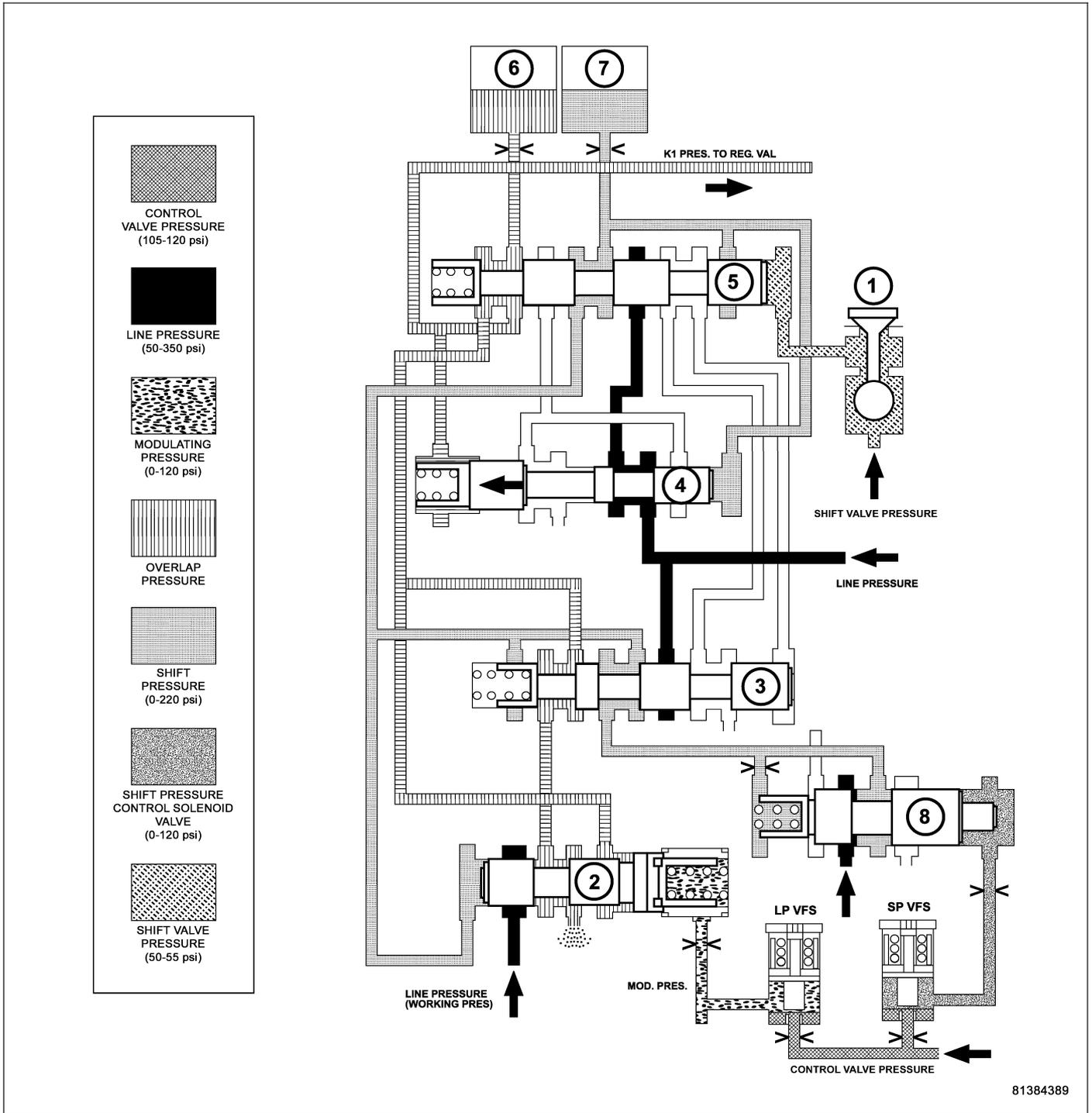
- 1 - 1-2/4-5 SHIFT SOLENOID
- 2 - 1-2/4-5 OVERLAP VALVE
- 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE
- 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE

- 5 - 1-2/4-5 COMMAND VALVE
- 6 - DRIVING CLUTCH K1
- 7 - HOLDING CLUTCH B1

The 1-2/4-5 shift solenoid (1) is turned ON to apply shift pressure (p-S) to the end face of the 1-2/4-5 command valve (5). This allows the command valve to up-shift and the shift pressure coming from the 1-2/4-5 shift valve (3) is routed to the holding clutch B1 (7) via the command valve.

Simultaneously, the pressure in the releasing clutch, K1 (6), is regulated at the 1-2/4-5 overlap valve (2). The pressure in the K1 clutch as it disengages is controlled during the shift phase depending on engine load, via the modulating pressure (p-MOD), and the shift pressure in clutch B1 (7). The increasing shift pressure in clutch B1, which also acts on the end face of the overlap valve, reduces the overlap pressure.

Shift Phase - 2-1 Shift Phase 2



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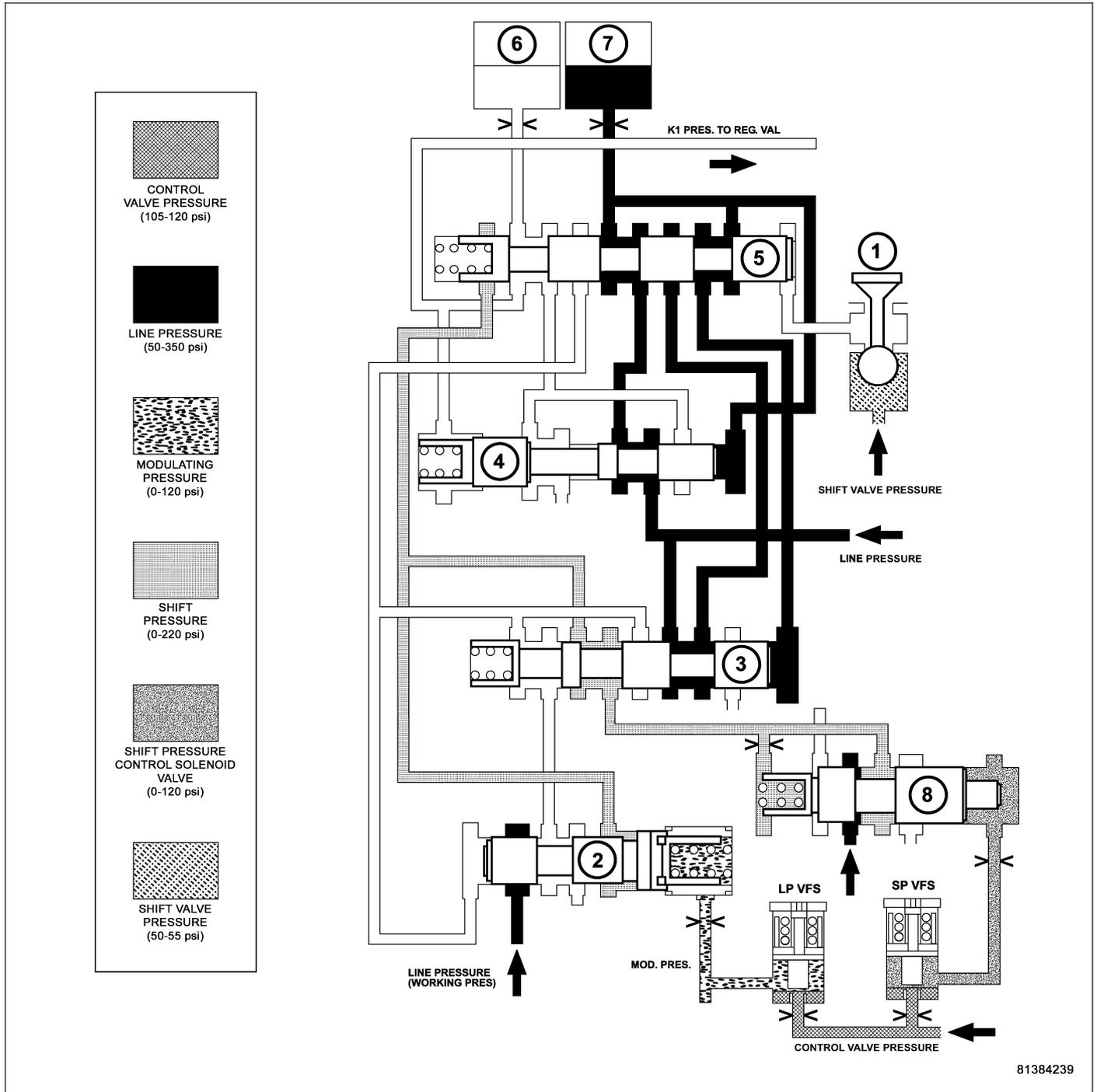
**Shift Phase - 2-1 Shift Phase 2**

- 1 - 1-2/4-5 SHIFT SOLENOID
- 2 - 1-2/4-5 OVERLAP VALVE
- 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE
- 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE

- 5 - 1-2/4-5 COMMAND VALVE
- 6 - DRIVING CLUTCH K1
- 7 - HOLDING CLUTCH B1

The pressure in clutch B1 (7) acting on the end face of the 1-2/4-5 holding valve (4) forces the valve to up-shift against the spring pressure and allows line pressure (p-A) to pass through the command valve (5).

2-1 Shift - First Gear Engaged



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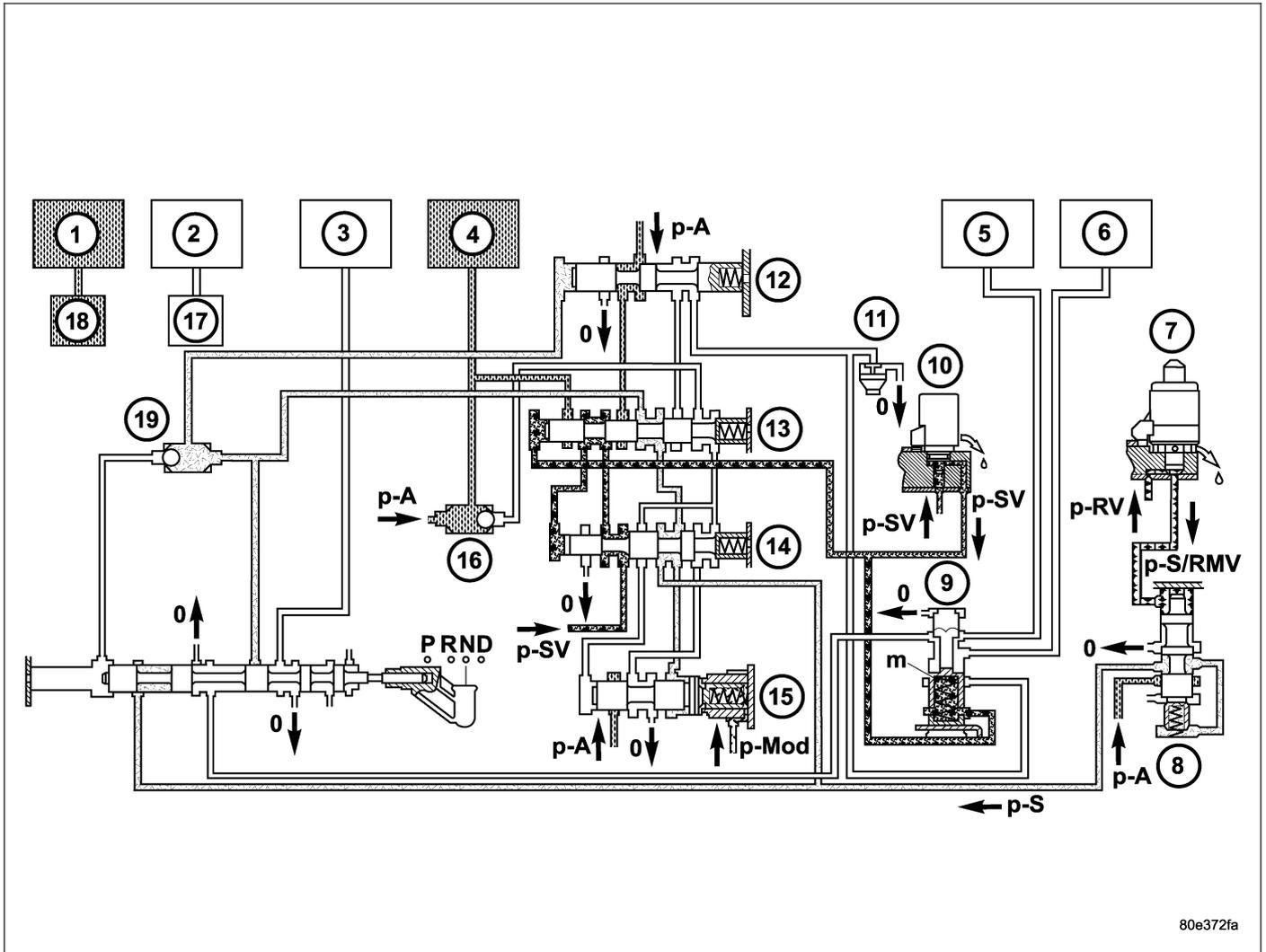
**First Gear Engaged**

- 1 - 1-2/4-5 SHIFT SOLENOID
- 2 - 1-2/4-5 OVERLAP VALVE
- 3 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE
- 4 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE

- 5 - 1-2/4-5 COMMAND VALVE
- 6 - DRIVING CLUTCH K1
- 7 - HOLDING CLUTCH B1

After the gear change is complete, the 1-2/4-5 shift solenoid (1) is turned off. This reduces the pressure on the end face of the 1-2/4-5 command valve (5) to 0 psi and the spring pressure downshifts the valve to its initial position. The line pressure (p-A) is switched to the holding clutch B1 (7) and the end face of the holding valve by the downshifted command valve. The upshifted holding valve also allows the remaining pressure in clutch K1 (6) to be vented.

**Gear Shift N to D (1st gear) - Engine Started**

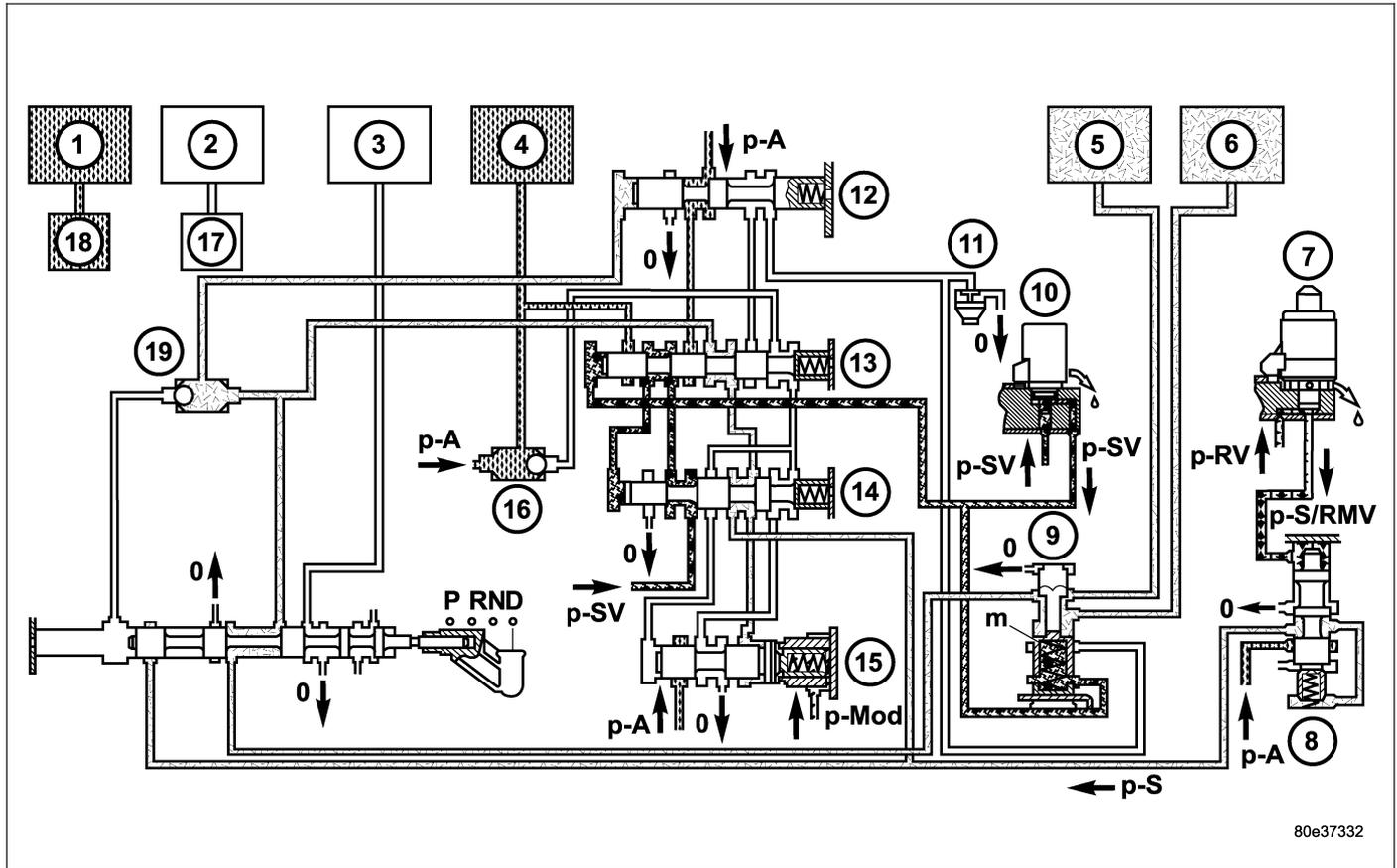


**Engine Started**

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>1 - HOLDING CLUTCH B1</li> <li>2 - DRIVING CLUTCH K1</li> <li>3 - HOLDING CLUTCH B3</li> <li>4 - DRIVING CLUTCH K3</li> <li>5 - HOLDING CLUTCH B2 PISTON</li> <li>6 - HOLDING CLUTCH B2 PISTON OPPOSING FACE</li> <li>7 - SHIFT PRESSURE REGULATING SOLENOID</li> <li>8 - SHIFT PRESSURE REGULATING VALVE</li> <li>9 - SHIFT VALVE B2</li> <li>10 - 3-4 SHIFT SOLENOID</li> </ul> | <ul style="list-style-type: none"> <li>11 - PRESSURE HOLDING VALVE</li> <li>12 - 3-4 HOLDING PRESSURE SHIFT VALVE</li> <li>13 - 3-4 COMMAND VALVE</li> <li>14 - 3-4 SHIFT PRESSURE SHIFT VALVE</li> <li>15 - 3-4 OVERLAP REGULATING VALVE</li> <li>16 - BALL VALVE</li> <li>17 - 1-2/4-5 COMMAND VALVE</li> <li>18 - 1-2/4-5 COMMAND VALVE</li> <li>19 - BALL VALVE</li> </ul> |
|--|--|

With the engine started and the gearshift lever in the NEUTRAL or PARK positions, holding clutch B1 (1) and driving clutch K3 (4) are applied and the various valves in the 1-2/4-5 shift group are positioned to apply pressure to the holding clutch B2.

Activation Sequence



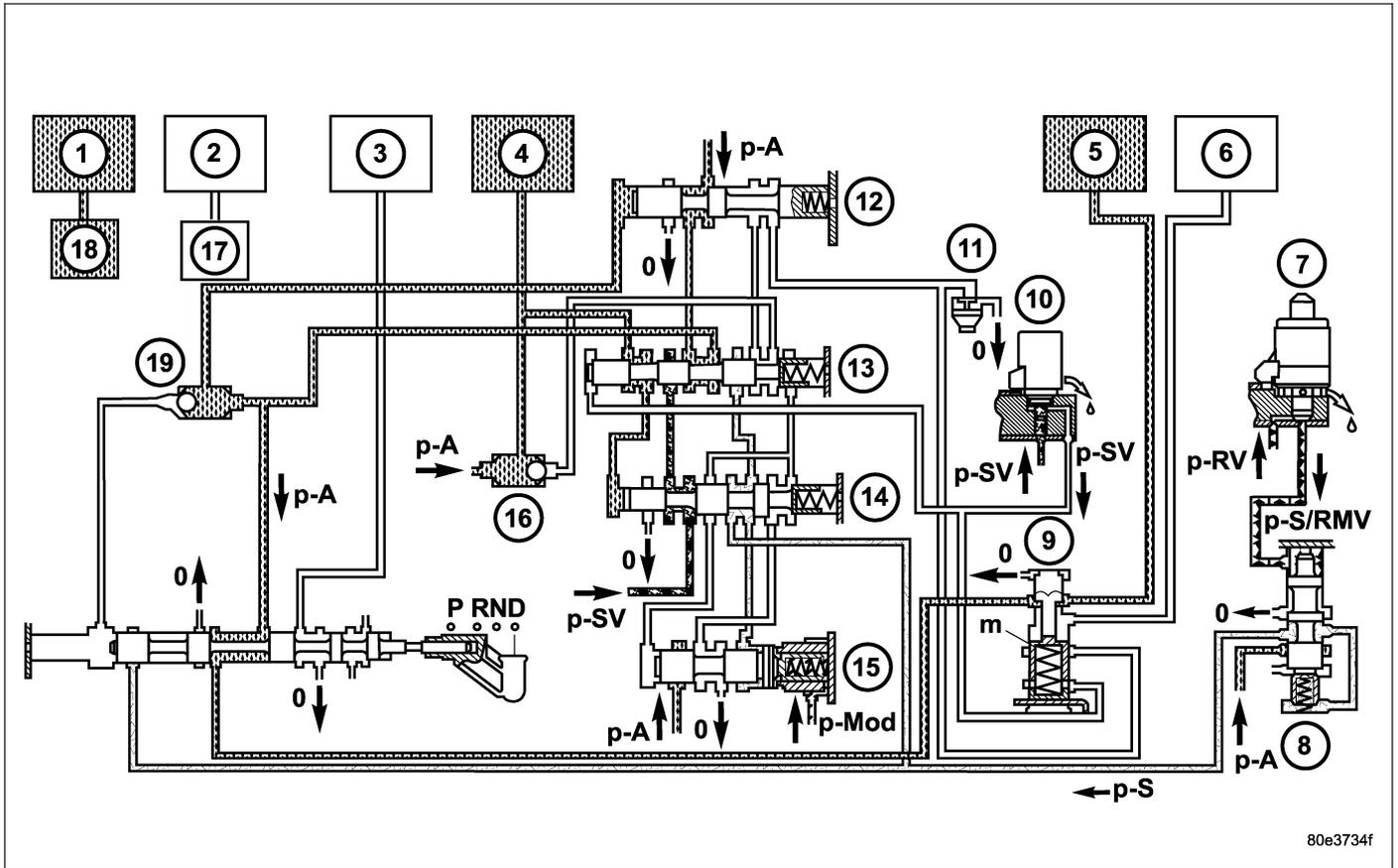
Activation Sequence

- |  |                                       |
|--|---------------------------------------|
| 1 - HOLDING CLUTCH B1                      | 11 - PRESSURE HOLDING VALVE           |
| 2 - DRIVING CLUTCH K1                      | 12 - 3-4 HOLDING PRESSURE SHIFT VALVE |
| 3 - HOLDING CLUTCH B3                      | 13 - 3-4 COMMAND VALVE                |
| 4 - DRIVING CLUTCH K3                      | 14 - 3-4 SHIFT PRESSURE SHIFT VALVE   |
| 5 - HOLDING CLUTCH B2 PISTON               | 15 - 3-4 OVERLAP REGULATING VALVE     |
| 6 - HOLDING CLUTCH B2 PISTON OPPOSING FACE | 16 - BALL VALVE                       |
| 7 - SHIFT PRESSURE REGULATING SOLENOID     | 17 - 1-2/4-5 COMMAND VALVE            |
| 8 - SHIFT PRESSURE REGULATING VALVE        | 18 - 1-2/4-5 COMMAND VALVE            |
| 9 - SHIFT VALVE B2                         | 19 - BALL VALVE                       |
| 10 - 3-4 SHIFT SOLENOID                    |                                       |

The selector valve opens the shift pressure (p-S) feed connection from the ball valve (19) with the shift valve B2 (9). With the shift valve B2 (9) in the upper position, shift pressure (p-S) travels behind the piston B2 (5) and simultaneously to the opposing face of the piston B2 (6). The multiple-disc holding clutch B2 begins to close.

The pressure on the opposing face of the piston B2 (6) ensures a soft activation of the multiple-disc holding clutch B2.

First Gear Engaged



First Gear Engaged

- |  |                                       |
|--|---------------------------------------|
| 1 - HOLDING CLUTCH B1                      | 11 - PRESSURE HOLDING VALVE           |
| 2 - DRIVING CLUTCH K1                      | 12 - 3-4 HOLDING PRESSURE SHIFT VALVE |
| 3 - HOLDING CLUTCH B3                      | 13 - 3-4 COMMAND VALVE                |
| 4 - DRIVING CLUTCH K3                      | 14 - 3-4 SHIFT PRESSURE SHIFT VALVE   |
| 5 - HOLDING CLUTCH B2 PISTON               | 15 - 3-4 OVERLAP REGULATING VALVE     |
| 6 - HOLDING CLUTCH B2 PISTON OPPOSING FACE | 16 - BALL VALVE                       |
| 7 - SHIFT PRESSURE REGULATING SOLENOID     | 17 - 1-2/4-5 COMMAND VALVE            |
| 8 - SHIFT PRESSURE REGULATING VALVE        | 18 - 1-2/4-5 COMMAND VALVE            |
| 9 - SHIFT VALVE B2                         | 19 - BALL VALVE                       |
| 10 - 3-4 SHIFT SOLENOID                    |                                       |

The TCM monitors the activation sequence via the speed of the input shaft, which slows down as the frictional connection in the multiple-disc holding clutch increases. When the speed drops to the specified level, the TCM shuts off the power to the 3-4 shift solenoid valve (10). The spring chamber of the shift valve B2 (9) is depressurized and switches downwards. This connects the line to the opposing face of the piston B2 (6) with the pressure holding valve (11). The pressure on the opposing face of the piston B2 (6) drops to a residual pressure.

The working pressure (p-A) is formed and travels via the 2-3 holding pressure shift valve, the 2-3 command valve and the ball valve (16) to multi-plate clutch K3 (4) and via the 3-4 command valve (13) to the end face of the 3-4 shift pressure shift valve (14). The 3-4 shift pressure shift valve (14) is moved against the force of the spring towards the right. At the same time the 3-4 solenoid valve (10) is energized. This allows shift valve pressure (p-SV) to enter the spring chamber of the shift valve B2 (9) and to reach the end face of the 3-4 command valve (13). The shift valve B2 (9) is held in the upper position and the 3-4 command valve (13) switches towards the right. At the end face of the 3-4 shift pressure shift valve (14) the working pressure (p-A) is replaced by shift valve pressure (p-SV).

The 3-4 command valve (13) moves to the left. Working pressure (p-A) travels via the holding pressure shift valve (12) and the 3-4 command valve (13) to the piston of multiple-disc holding clutch B2 (5).

## DIAGNOSIS AND TESTING

### AUTOMATIC TRANSMISSION

**CAUTION:** Before attempting any repair on a NAG1 automatic transmission, check for Diagnostic Trouble Codes with the appropriate scan tool.

Transmission malfunctions may be caused by these general conditions:

- Poor engine performance.
- Improper adjustments.
- Hydraulic malfunctions.
- Mechanical malfunctions.
- Electronic malfunctions.
- Transfer case performance (if equipped).

Diagnosis of these problems should always begin by checking the easily accessible variables: fluid level and condition, gearshift cable adjustment. Then perform a road test to determine if the problem has been corrected or if more diagnosis is necessary.

### PRELIMINARY

Two basic procedures are required. One procedure for vehicles that are drivable and an alternate procedure for disabled vehicles (will not back up or move forward).

#### VEHICLE IS DRIVABLE

1. Check for transmission fault codes using the appropriate scan tool.
2. Check fluid level and condition.
3. Adjust gearshift cable if complaint was based on delayed, erratic, or harsh shifts.
4. Road test and note how transmission upshifts, downshifts, and engages.

#### VEHICLE IS DISABLED

1. Check fluid level and condition.
2. Check for broken or disconnected gearshift cable.
3. Check for cracked, leaking cooler lines, or loose or missing pressure-port plugs.
4. Raise and support vehicle on safety stands, start engine, shift transmission into gear, and note following:
  - a. If propeller shaft turns but wheels do not, problem is with differential or axle shafts.
  - b. If propeller shaft does not turn and transmission is noisy, stop engine. Remove oil pan, and check for debris. If pan is clear, remove transmission and check for damaged driveplate, converter, oil pump, or input shaft.
  - c. If propeller shaft does not turn and transmission is not noisy, perform hydraulic-pressure test to determine if problem is hydraulic or mechanical.

### ROAD TESTING

Before road testing, be sure the fluid level and control cable adjustments have been checked and adjusted if necessary. Verify that all diagnostic trouble codes have been resolved.

Observe engine performance during the road test. A poorly tuned engine will not allow accurate analysis of transmission operation.

Operate the transmission in all gear ranges. Check for shift variations and engine flare which indicates slippage. Note if shifts are harsh, spongy, delayed, early, or if part throttle downshifts are sensitive.

Slippage indicated by engine flare, usually means clutch, overrunning clutch, or line pressure problems.

A slipping clutch can often be determined by comparing which internal units are applied in the various gear ranges. The Clutch Application chart CLUTCH APPLICATION provides a basis for analyzing road test results.

**CLUTCH APPLICATION**

GEAR	RATIO	B1	B2	B3	K1	K2	K3	F1	F2
1	3.59	X*	X				X*	X	X
2	2.19		X		X		X*		X
3	1.41		X		X	X			
4	1.00				X	X	X		
5	0.83	X				X	X	X*	
N	N/A	X					X		
R	3.16	X*		X			X	X	
R - Limp In	1.93			X	X		X		

\* = The shift components required during coast.

**AUTOMATIC TRANSMISSION**

CONDITION	POSSIBLE CAUSES	CORRECTION
Harsh N-D Engagement Harsh N-R Engagement	1. Transmission adaptation/ calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Transmission in limp-home mode.	2. Check TCM for DTCs. Repair as needed.
	3. Driveline lash/movement.	3. Check engine mounts, transmission mount, driveshaft couplings, rear crossmember mounts, axle mounts and axle lash.
	4. Converter clutch or lock up control valve malfunction.	4. Perform converter clutch diagnostics test. Inspect valve body for stuck or sticky lock up control valve. If valve motion is free, replace lock up solenoid and retest.
	5. Valve Body Malfunction.	5. Inspect valve body for stuck or sticky regulator valve.
	6. Clutch or planetary component damage.	6. Remove, disassemble and repair transmission as necessary.

CONDITION	POSSIBLE CAUSES	CORRECTION
Delayed N-D or N-R Engagement	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Torque converter fluid drain back, delayed soft engagement.	2. If vehicle moves normally after 3 seconds of shifting into gear, no repair is necessary. If longer, inspect pump for worn bushing.
	3. Fluid Level Low.	3. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/ AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	4. Filter plugged.	4. Check TC out pressure, if < 10psi, check for plugged filter. Replace if needed.
	5. Filter damaged or missing, missing o-ring.	5. Check for damaged/missing filter or cut/missing o-ring.
	6. Valve Body Malfunction.	6. Inspect valve body for stuck/ sticky regulator valve or shift group valves.
	7. Oil pump gears worn/damaged.	7. Inspect pump for damage or excessive clearances. Replace if needed.
No Drive or Reverse Engagement (vehicle will not move)	1. Fluid level low.	1. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/ AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	2. Misadjusted/damaged shift cable.	2. Inspect shift system. Adjust and/or replace worn/damaged parts.
	3. Filter plugged.	3. Check TC out pressure, if < 10psi, check for plugged filter. Replace if needed.
	4. Filter damaged or missing, missing filter o-ring.	4. Check for damaged/missing filter or cut/missing o-ring.
	5 Hydraulic system-Low/no line pressure.	5. Remove valve body. Inspect or sticky/stuck regulator valve. If valve motion is free, replace line pressure solenoid and retest. If condition still exists check for worn/damaged pump. Replace pump assembly if needed.

CONDITION	POSSIBLE CAUSES	CORRECTION
Shudder garage shift R-D or D-R	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Customer applying throttle while shift is in progress.	2. Instruct customer to wait until shift is complete prior to applying throttle.
Harsh rolling garage shift R-D or D-R	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Customer shifting into desired range with vehicle motion.	2. Instruct customer to only shift into the desired range with the vehicle stopped and the service brake applied.
	3. Transmission in limp-home mode.	3. Check TCM for DTCs. Repair as needed.
Engine stalls when transmission is shifted into R or D.	1. Converter clutch or lock up control valve malfunction.	1. Perform converter clutch diagnostics test. Inspect valve body for stuck or sticky lock up control valve. If valve motion is free, replace lock up solenoid and retest.
	2. Defective torque converter.	2. Replace torque converter.
Clunk/click noise during garage shift from R-D or D-R	1. Stick-slip condition between output flange and output shaft nut upon torque reversal from R to D or D to R. Click on first launch.	1. Replace output flange and nut.
Harsh Upshift or downshift	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Valve body malfunction.	2. Inspect valve body for sticky/stuck valves. Repair as needed. If valve motion is free, replace shift pressure solenoid and line pressure solenoid and retest.
	3. Damaged or misbuilt clutch.	3. Remove, disassemble and repair transmission as needed.

CONDITION	POSSIBLE CAUSES	CORRECTION
EMCC Shudder	1. Transmission adaptation/ calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Fluid condition, contamination or wrong type.	2. Change fluid per service manual procedures. (Refer to 21 - TRANSMISSION/ AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	3. Valve body malfunction.	3. Remove valve body. Inspect for sticky/stuck lock up control valve. If valve motion is free, replace the lock up solenoid and retest.
	4. Defective torque converter.	4. Replace torque converter.
Grating or Scraping Noise proportional to engine speed	1. Torque converter bolts contacting dust shield.	1. Dust shield bent. Replace if needed. Torque converter bolt backed out. Replace with new bolt and torque to proper level.
	2. Damaged/broken drive plate.	2. Inspect driveplate. Replace if needed.
Grating or Scraping Noise proportional to transmission output speed	1. Driveshaft or rear axle noise.	1. Check driveshaft, center bearing and axle for noise or contact with other components.
	2. Transmission output bearing noise.	2. Replace output bearing and retest.
	3. Internal transmission damage.	3. Remove, disassemble and repair transmission as needed.
High pitched whine/noise related to engine speed	1. Fluid level low.	1. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/ AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	2. Transmission in limp-home mode.	2. Check TCM for DTCs. Repair as needed.
	3. Filter plugged.	3. Check TC out pressure, if < 10psi, check for plugged filter. Replace if needed.
	4. Filter damaged or missing.	4. Check for damaged/missing filter or cut/missing o-ring.
	5. Oil pump bushing worn/ damaged.	5. Visually inspect for worn or damaged pump bushing. Replace pump assembly if needed.
	6. Oil pump gears worn/ damaged.	6. Inspect for worn or damaged pump gears. Replace pump assembly if needed.

CONDITION	POSSIBLE CAUSES	CORRECTION
Slips on 1-2 upshift	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Fluid level low.	2. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	3. Filter damaged or missing.	3. Check for damaged/missing filter or cut/missing o-ring.
	4. Valve body malfunction.	4. Check for sticky/stuck 2-3 shift pressure valve or regulator valve.
	5. F1 or K1 clutch damaged.	5. Disassemble transmission inspect for damaged F1 or K1 clutch. Repair as needed.
Slips on 2-3 upshift	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Fluid level low.	2. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	3. Filter damaged or missing.	3. Check for damaged/missing filter or cut/missing o-ring.
	4. Valve body malfunction.	4. Check for sticky/stuck 2-3 shift pressure valve or regulator valve.
	5. F2 or B2 clutch damaged.	5. Disassemble transmission, inspect for damaged F2 or B2 clutch. Repair as needed.

CONDITION	POSSIBLE CAUSES	CORRECTION
Slips on 3-4 upshift	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Fluid level low.	2. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	3. Filter damaged or missing.	3. Check for damaged/missing filter or cut/missing o-ring.
	4. Valve body malfunction.	4. Check for sticky/stuck 2-3 shift pressure valve or regulator valve.
	5. K3 or B2 clutch damaged.	5. Disassemble transmission, inspect for damaged K3 or B2 clutch. Repair as needed.
Slips on 4-5 upshift	1. Transmission adaptation/calibration.	1. Check for latest level TCM software. Perform the TCM adaptation procedure. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/ TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE)
	2. Fluid level low.	2. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	3. Filter damaged or missing.	3. Check for damaged/missing filter or cut/missing o-ring.
	4. Valve body malfunction.	4. Check for sticky/stuck 2-3 shift pressure valve or regulator valve.
	5. B1 or K1 clutch damaged.	5. Disassemble transmission, inspect for damaged B1 or K1 clutch. Repair as needed.
In-gear shudder on heavy acceleration	1. Fluid level low.	1. Check and adjust fluid level. (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FILTER - STANDARD PROCEDURE)
	2. Filter damaged or missing.	2. Check for damaged/missing filter or cut/missing o-ring.
No Drive engagement following a shift to N	1. Customer shifting into N at vehicle speeds greater than 25mph and tipping in on the throttle.	1. Instruct the customer that they should not shift into N at vehicle speeds greater 25mph.
	2. Shift system malfunction.	2. Inspect shift system for proper adjustment or damage. Check shifter for DTCs. Repair as needed.

CONDITION	POSSIBLE CAUSES	CORRECTION
Reverse gear position blocked engagement when moving shift lever from D position	1. Customer shifting into R at vehicle speeds greater than 7mph.	1. Instruct customer that R shifter position is blocked at vehicle speeds greater than 7mph.
	2. Shift system malfunction.	2. Inspect shift system for proper adjustment or damage. Check shifter for DTCs. Repair as needed.
No Engine Cranking in P or N	1. Gearshift cable adjustment.	1. Adjust shift cable and retest.
	2. Shift system malfunction.	2. Check shifter DTCs. Inspect shift cable and lever assembly. Adjust and/or replace worn/damaged parts.
	3. Valve body malfunction.	3. Starter lockout contact malfunction. Remove valve body, replace lead frame assembly.

CONDITION	POSSIBLE CAUSES	CORRECTION
Fluid Leak	1. Leak in area of bell housing.	1. Check bolt torque on internal bell housing bolts. If loose, replace fastener and torque to proper level. If bolts are to proper torque level, check pump outer seal and impeller seal. Replace if needed.
	2. Leak in area of control unit(valve body) electrical connector.	2. Check connector for damaged(cut) or missing o-rings. Replace as needed.
	3. Leak in area of pan gasket.	3. Check for proper torque on oil pan clamps. Check for mis-positioned or rolled gasket. Repair as needed.
	3. Free Wheeling Clutch F2 Defective.	3. Replace Free Wheeling Clutch F2, Hollow Shaft, and Rear Sun Gear/Inner Disc Carrier K3.
	4. Leak in area of park guide plug.	4. Remove park guide plug. Check for damaged(cut) or missing o-ring. If o-ring is in good condition, install new plug.
	5. Leak in area of shift lever.	5. Check for damaged shift lever seal or damaged lever. Repair as needed.
	6. Leak in area of output flange.	6. Check for worn/damaged slinger seal and output seal. Visually inspect output flange seal surface for damage. Repair as needed.
	7. Leak in area of transmission vent.	7. Check fluid level for overfill condition. Adjust as needed. If fluid level is within specification, ride check vehicle. Monitor transmission temperature. If high operating temperatures are observed, fluid may be contaminated or cooling system malfunctioning. Change fluid per service manual procedures. Refer to cooling system diagnostics if needed.
8. Leak in area of transmission fill tube.	8. Inspect fill tube cap for proper installation. Inspect fill tube grommet between case and fill tube for leakage. Repair as needed.	

## STANDARD PROCEDURE - ALUMINUM THREAD REPAIR

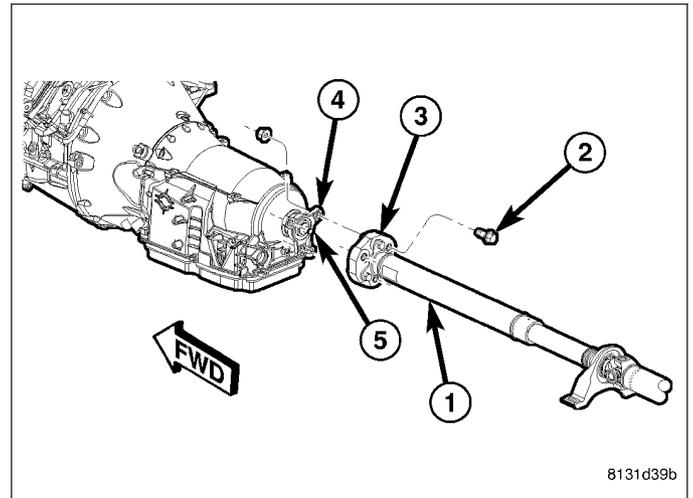
Damaged or worn threads in the aluminum transmission case and valve body can be repaired by the use of Heli-Coils™, or equivalent. This repair consists of drilling out the worn-out damaged threads. Then tap the hole with a special Heli-Coil™ tap, or equivalent, and installing a Heli-Coil™ insert, or equivalent, into the hole. This brings the hole back to its original thread size.

Heli-Coil™, or equivalent, tools and inserts are readily available from most automotive parts suppliers.

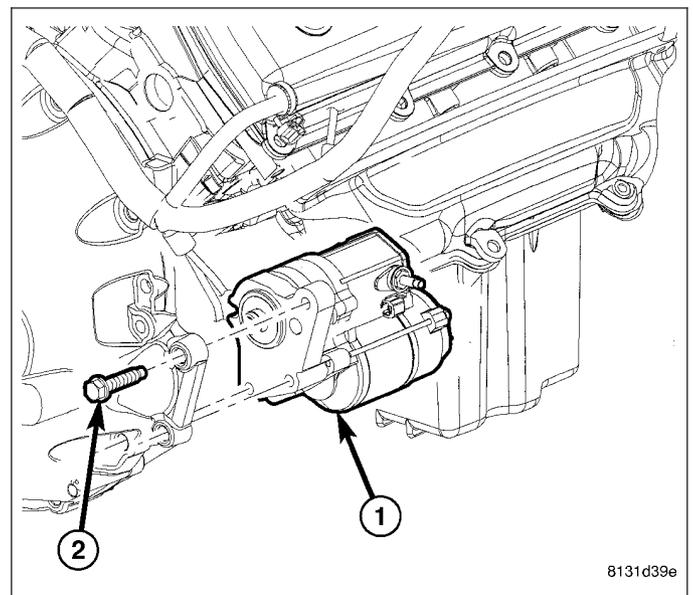
## REMOVAL

**Note: If the transmission is being reconditioned (clutch/seal replacement) or replaced, it is necessary to perform the TCM Adaptation Procedure using the scan tool (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE).**

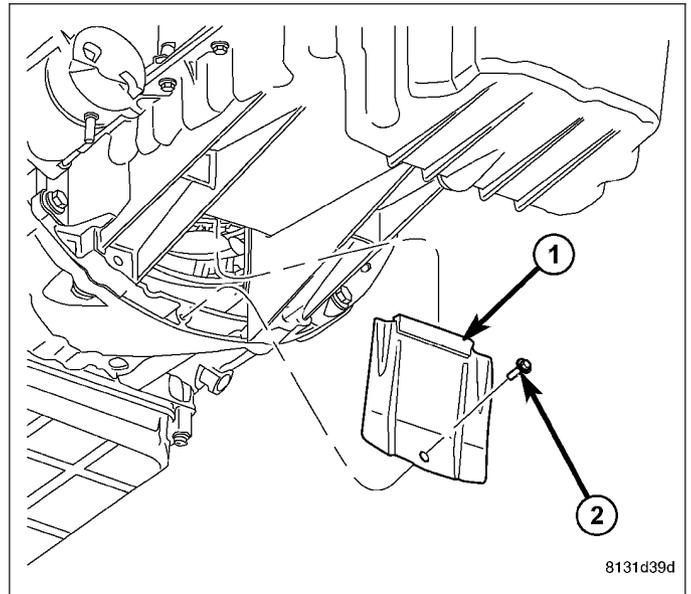
1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Mark propeller shaft (1) and the transmission flange (4) for assembly alignment.
4. Remove the bolts (2) holding the rear propeller shaft coupler (3) to the transmission flange (4).
5. Slide the propeller shaft (1) rearward until the coupler clears the propeller shaft pilot (5) on the transmission output shaft.



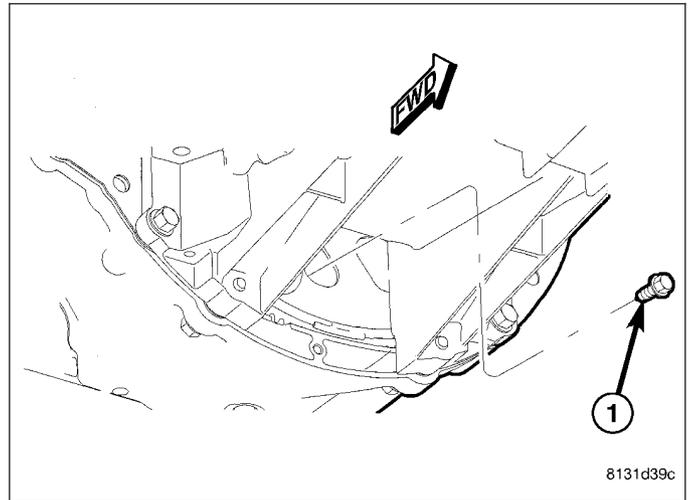
6. Remove the bolts (2) holding the starter motor (1) to the transmission. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL)
7. Remove the starter (1) from the transmission starter pocket and safely relocate.



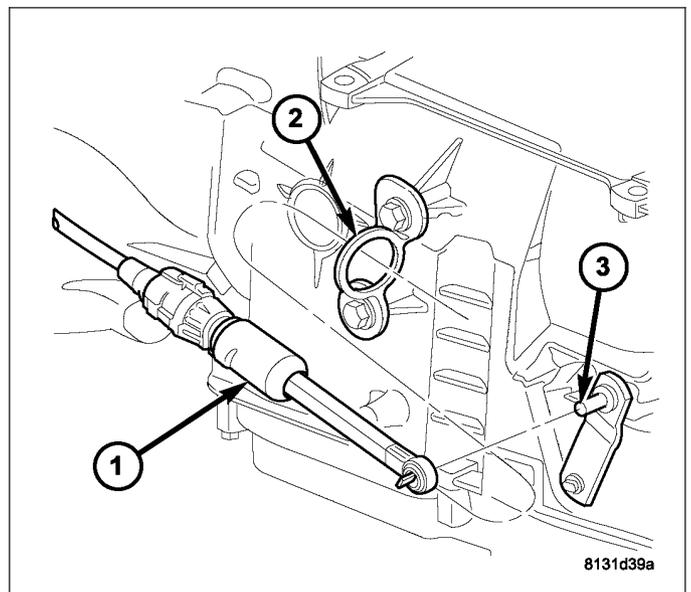
8. Remove the bolt (2) holding the torque converter access cover (1) to the transmission.
9. Remove the torque converter access cover (1) from the transmission.



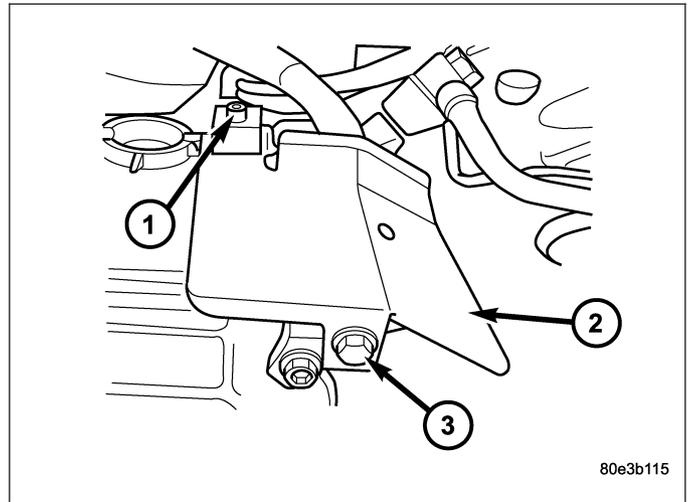
10. Rotate crankshaft in clockwise direction until converter bolts (1) are accessible. Then remove bolts (1) one at a time. Rotate crankshaft with socket wrench on dampener bolt.



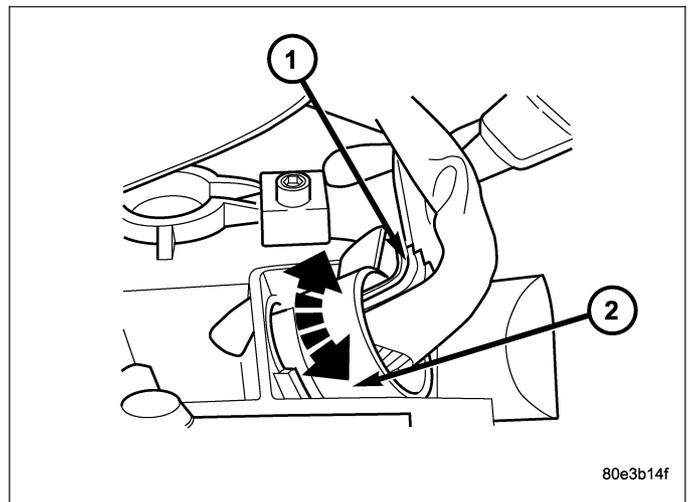
11. Disconnect the gearshift cable (1) from the transmission manual valve lever (3).
12. Loosen the bolts holding the shift cable retaining strap (2) to the transmission.



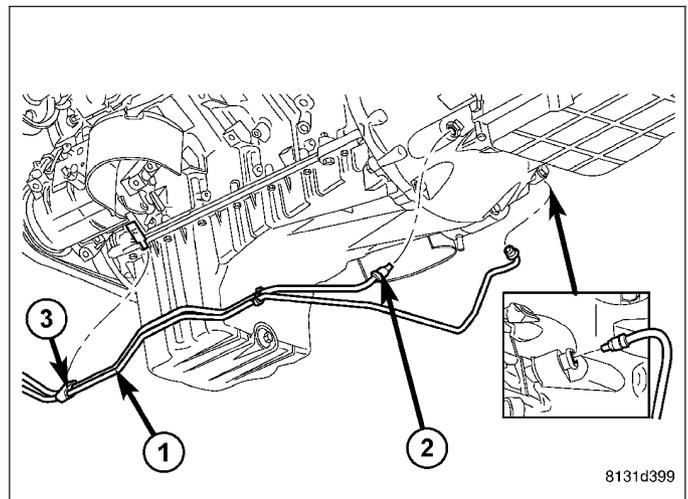
13. Remove the shift cable (1) from the transmission.
14. Remove bolt (3) and screw (1) holding the heat shield (2) to the transmission.
15. Remove the heat shield (2) from the transmission.



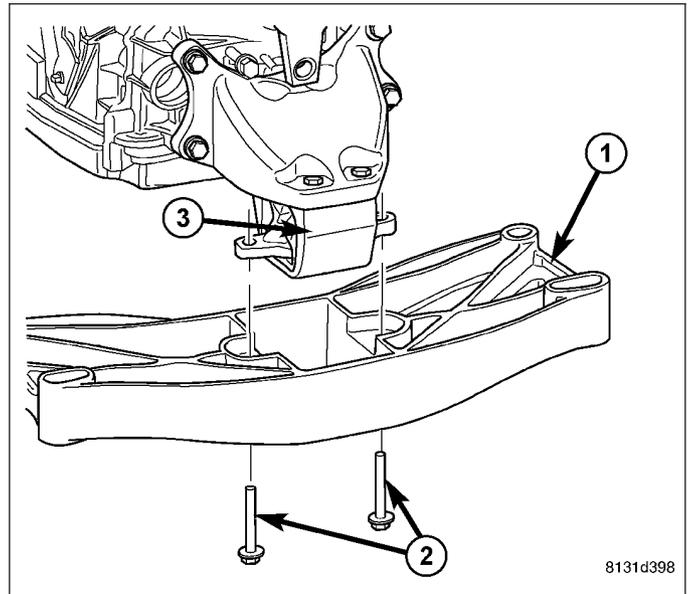
16. Disconnect 13-pin plug connector (1). Turn bayonet lock of guide bushing (2) anti-clockwise.
17. Remove the 13-pin connector (1) from the transmission.



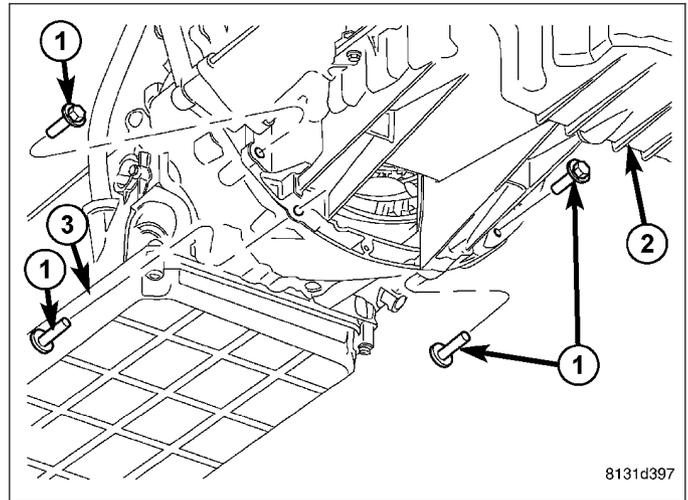
18. Disconnect transmission fluid cooler lines (1) at transmission fittings (2) and clips (3).
19. Disconnect the transmission vent hose from the transmission.



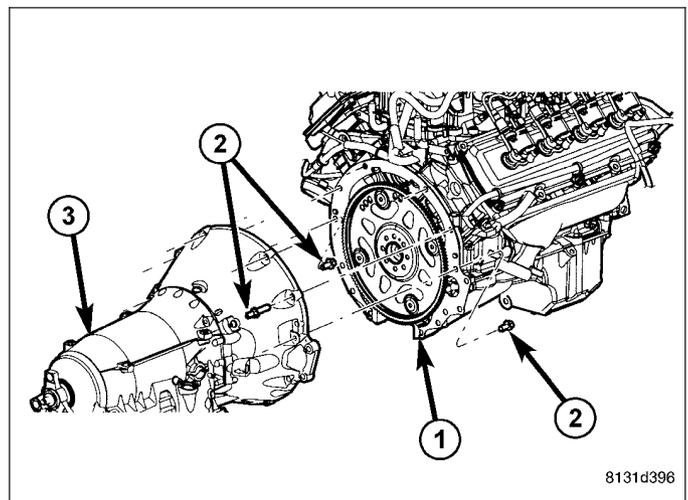
20. Support rear of engine with safety stand or jack.
21. Raise transmission slightly with service jack to relieve load on crossmember and supports.
22. Remove bolts (2) securing rear support and cushion (3) to transmission crossmember (1).
23. Remove bolts attaching crossmember (1) to frame and remove crossmember.



24. Remove the bolts (1) holding the engine oil pan (2) to the transmission (3).



25. Remove all remaining bolts (2) holding the engine (1) to the transmission (3).
26. Carefully work transmission and torque converter assembly rearward off engine block dowels.
27. Hold torque converter in place during transmission removal.
28. Lower transmission and remove assembly from under the vehicle.
29. To remove torque converter, carefully slide torque converter out of the transmission.

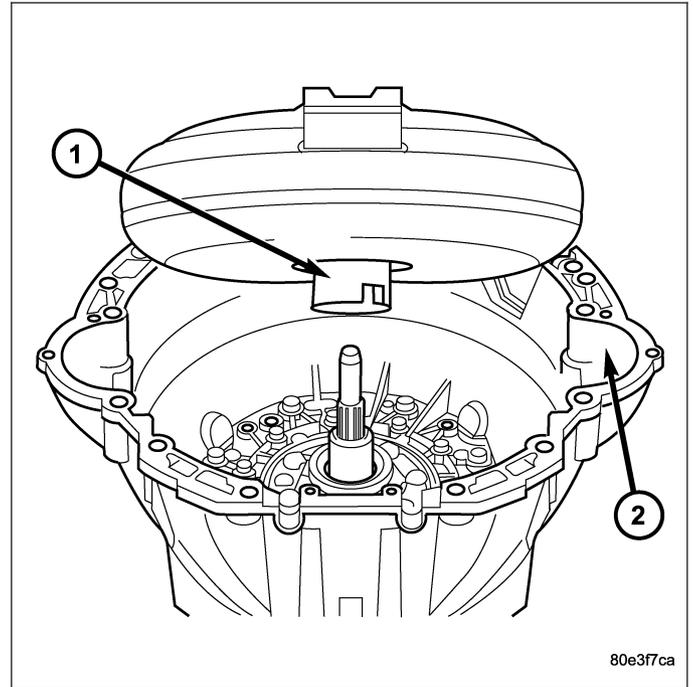


## DISASSEMBLY

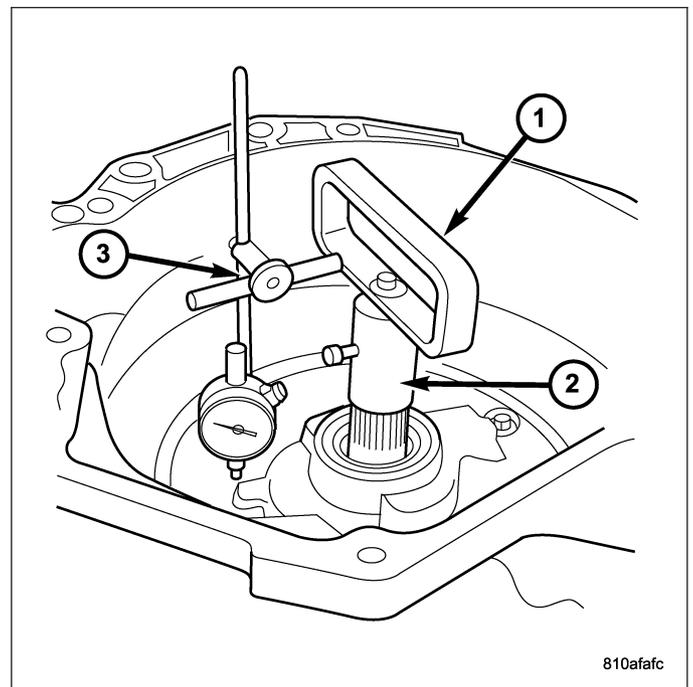
**Note:** If the transmission is being reconditioned (clutch/seal replacement) or replaced, it is necessary to perform the TCM Adaptation Procedure using the scan tool (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE).

**Note:** Tag all clutch pack assemblies, as they are removed, for reassembly identification.

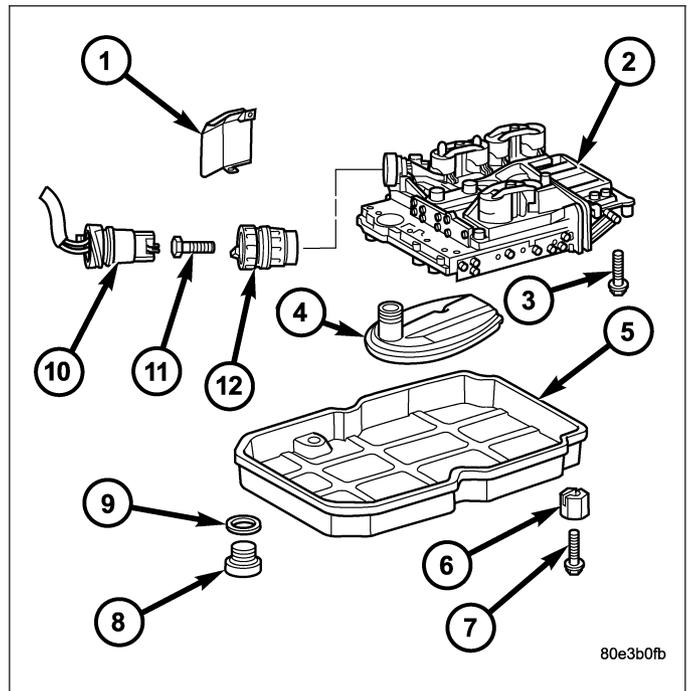
1. Remove the torque converter (1).



2. Place transmission in a vertical position.
3. Measure input shaft end play as follows:
  - a. Attach Adapter 8266-18 (2) to Handle 8266-8 (1).
  - b. Attach dial indicator C-3339 (3) to Handle 8266-8 (1).
  - c. Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-18 (2) to secure it to the input shaft.
  - d. Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.
  - e. Move the input shaft in and out. Record the maximum travel for assembly reference.

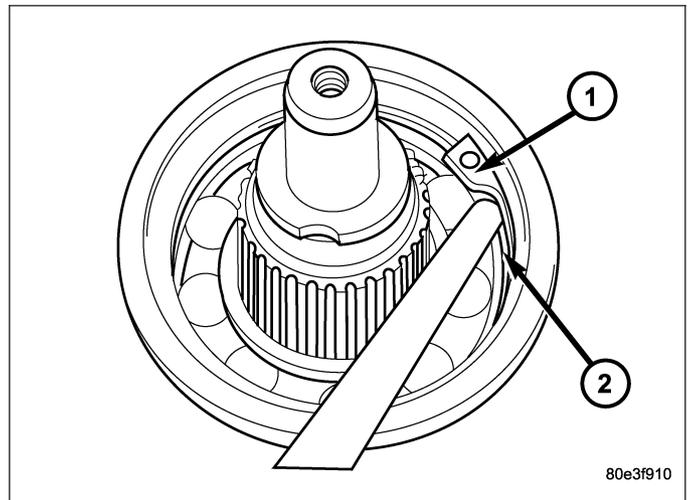


4. Loosen guide bushing (12) and remove from transmission housing.
5. Detach oil pan (5).
6. Remove oil filter (4).
7. Unscrew Torx socket bolts (3) and remove electrohydraulic unit (2).

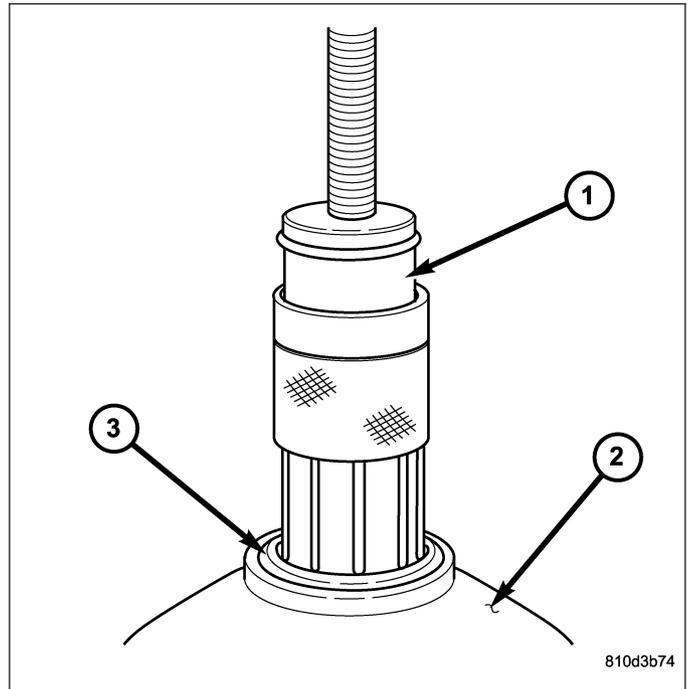


- 1 - HEAT SHIELD
- 2 - ELECTROHYDRAULIC UNIT
- 3 - BOLT
- 4 - OIL FILTER
- 5 - OIL PAN
- 6 - CLAMPING ELEMENT
- 7 - BOLT
- 8 - DRAIN PLUG
- 9 - DRAIN PLUG GASKET
- 10 - 13-PIN PLUG CONNECTOR
- 11 - BOLT
- 12 - GUIDE BUSHING

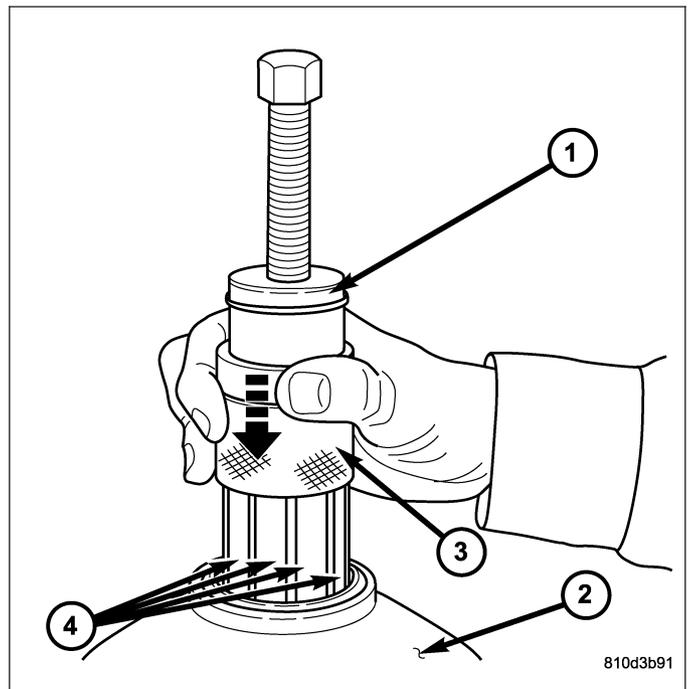
8. Place the transmission in PARK to prepare for the removal of the output shaft nut.
9. Remove the nut holding the propeller shaft flange to the output shaft and remove the flange.
10. Remove the transmission rear oil seal with a suitable slide hammer and screw.
11. Remove the transmission output shaft washer. Be sure to tag the washer since it is very similar to the geartrain end-play shim and they must not be interchanged.
12. Remove the transmission rear output shaft bearing retaining ring (1).



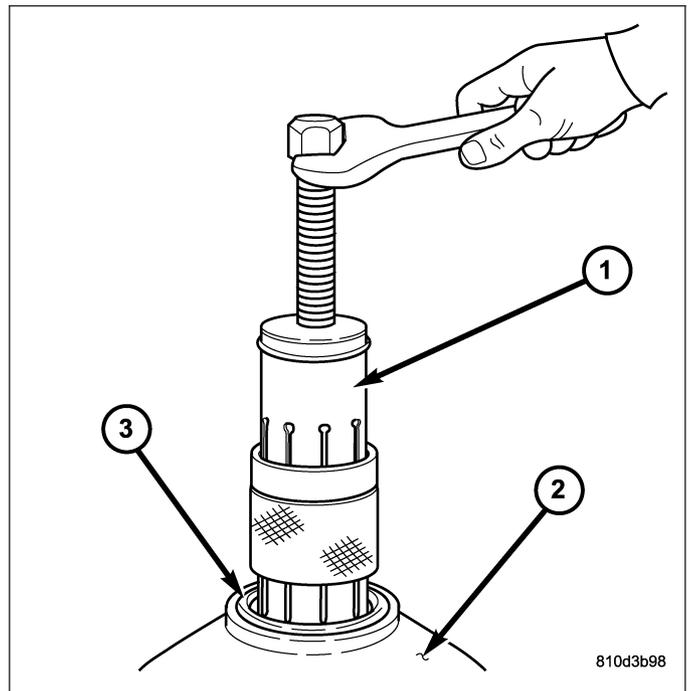
13. Position Bearing Remover 9082 (1) over the inner race of the output shaft bearing (3).

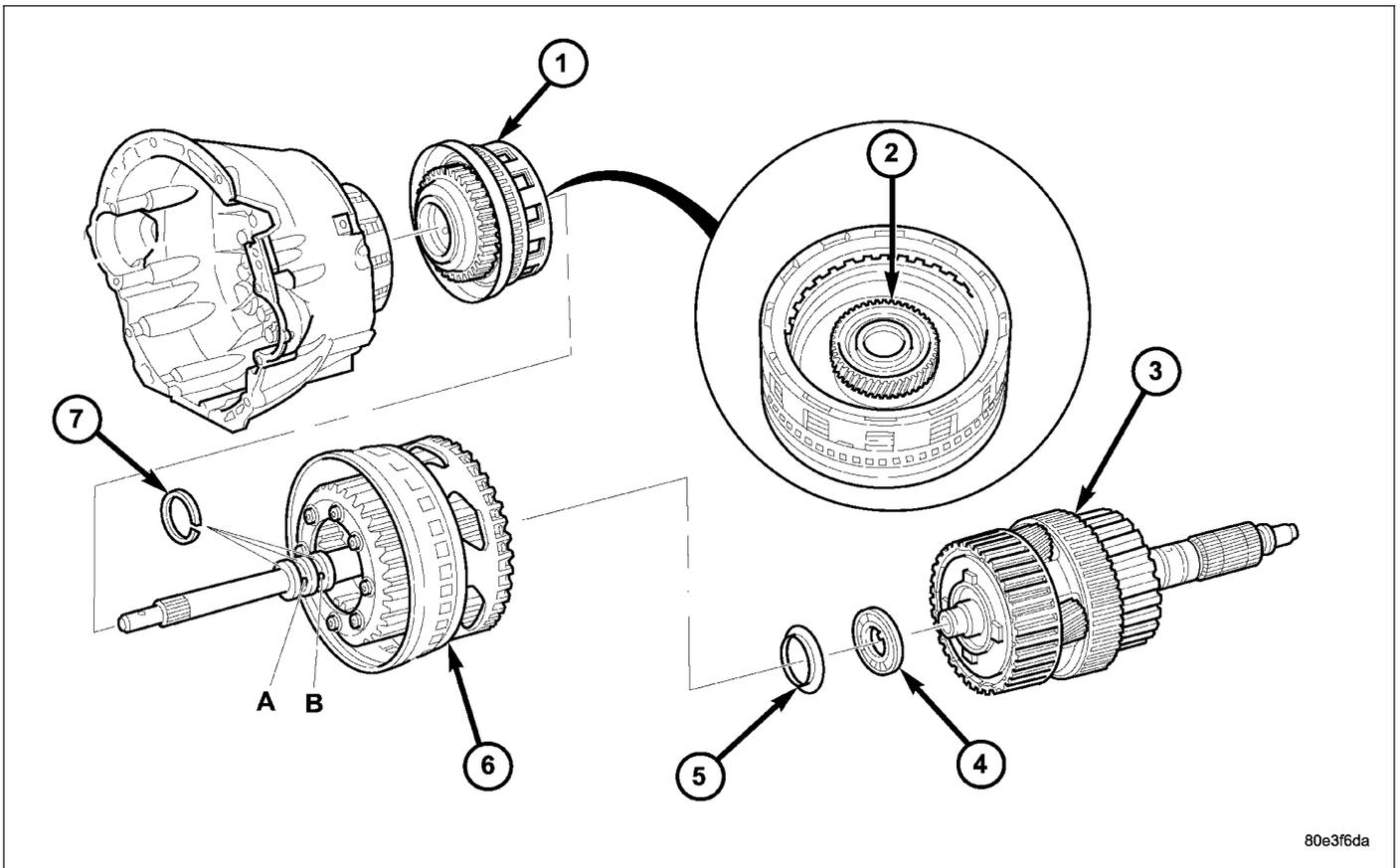


14. Slide the collar (3) on the Bearing Remover 9082 (1) downward over the fingers (4) of the tool.



15. Remove the output shaft bearing (3).
16. Remove the geartrain end-play shim from the output shaft. Be sure to tag the shim since it is very similar to the output shaft washer and they must not be interchanged.



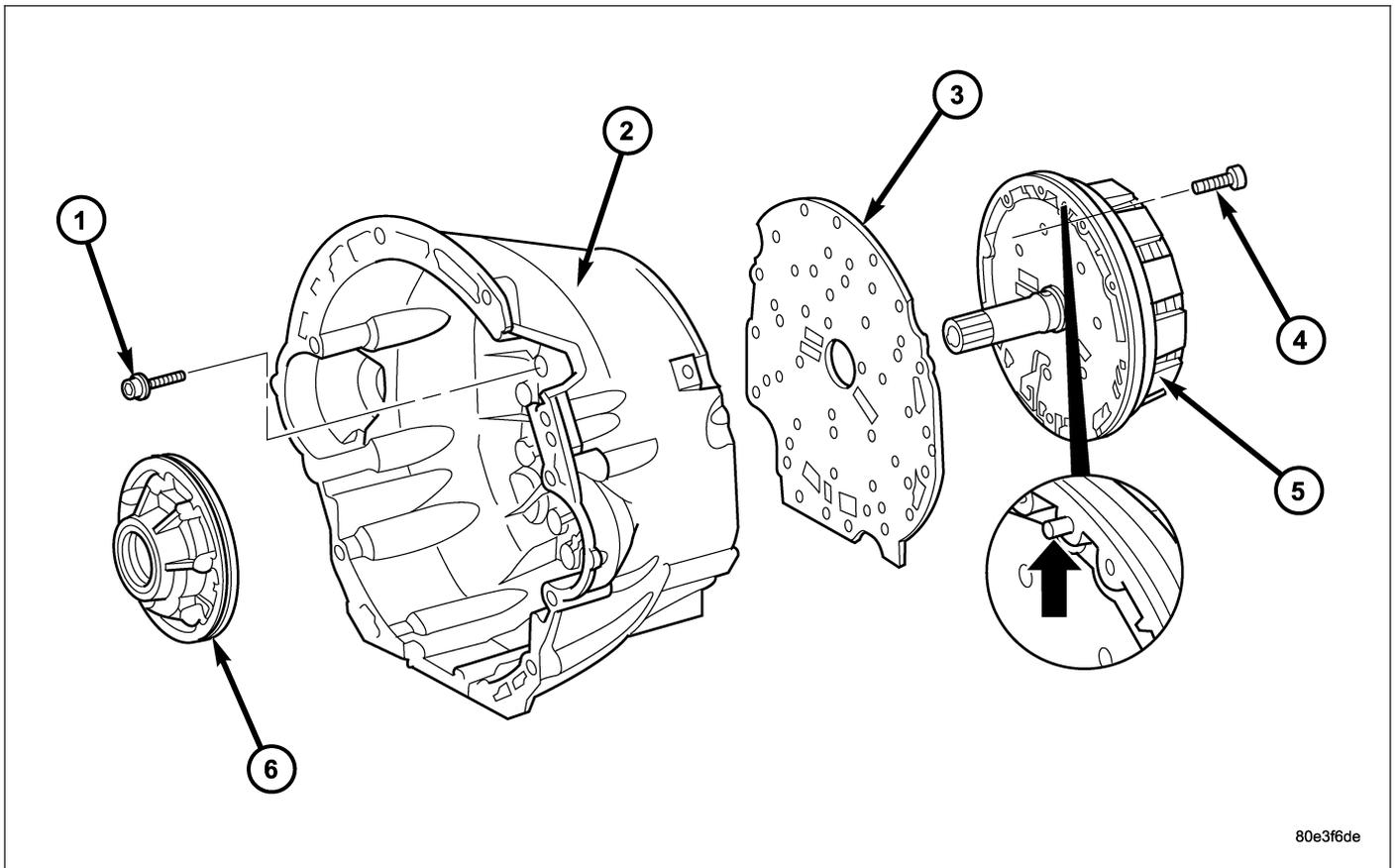


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**Remove K1, K2, and K3 Clutches**

- |  |  |
|--|--|
| 1 - DRIVING CLUTCH K1  | 5 - THRUST WASHER  |
| 2 - SUN GEAR OF FRONT PLANETARY GEAR SET                                     | 6 - FRONT PLANETARY GEAR SET, DRIVING CLUTCH K2, AND INPUT SHAFT |
| 3 - DRIVING CLUTCH K3, OUTPUT SHAFT, AND CENTER AND REAR PLANETARY GEAR SETS | 7 - SEALING RINGS  |
| 4 - THRUST NEEDLE BEARING  |  |

17. Remove the bolts holding the transmission housing to the converter housing from inside the converter housing.
18. Stand the transmission upright on the converter housing. Be sure to use suitable spacers between the bench surface and the converter housing since the input shaft protrudes past the front surface of the housing.
19. Remove the remaining bolts holding the transmission housing to the converter housing.
20. Remove the transmission housing from the converter housing.
21. Remove output shaft with center and rear gear set and clutch K3 (3).
22. Remove thrust needle bearing (4) and thrust washer (5).
23. Remove input shaft with clutch K2 and front gear set (6).
24. Remove clutch K1 (1).



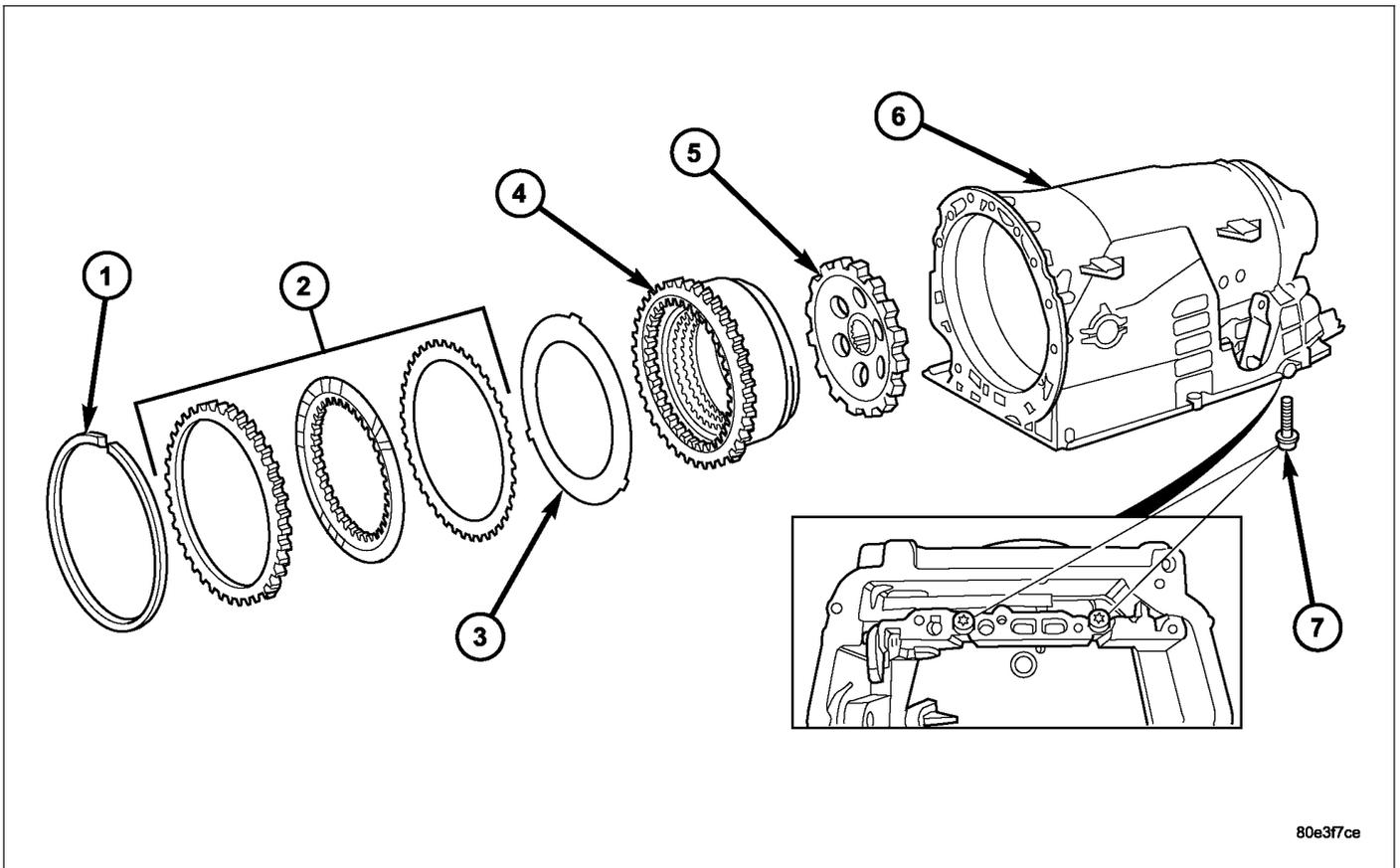
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**Remove Holding Clutch B1 and Oil Pump**

- 1 - BOLTS - M6X32
- 2 - CONVERTER HOUSING
- 3 - INTERMEDIATE PLATE

- 4 - BOLTS - M8X35
- 5 - HOLDING CLUTCH B1
- 6 - OIL PUMP

25. Unscrew Torx socket bolts (4) and remove oil pump (6). Screw two opposed bolts into the oil pump housing and press the oil pump out of the converter housing by applying light blows with a plastic hammer.
26. Remove and discard the torque converter hub seal and the oil pump outer o-ring seal from the oil pump.
27. Unscrew Torx socket bolts (1) and remove multiple-disc holding clutch B1 (5) from converter housing. Screw two opposed bolts into the multiple-disc holding clutch B1 (5) and separate from the converter housing by applying light blows with a plastic hammer.
28. Detach intermediate plate (3) from converter housing (2).



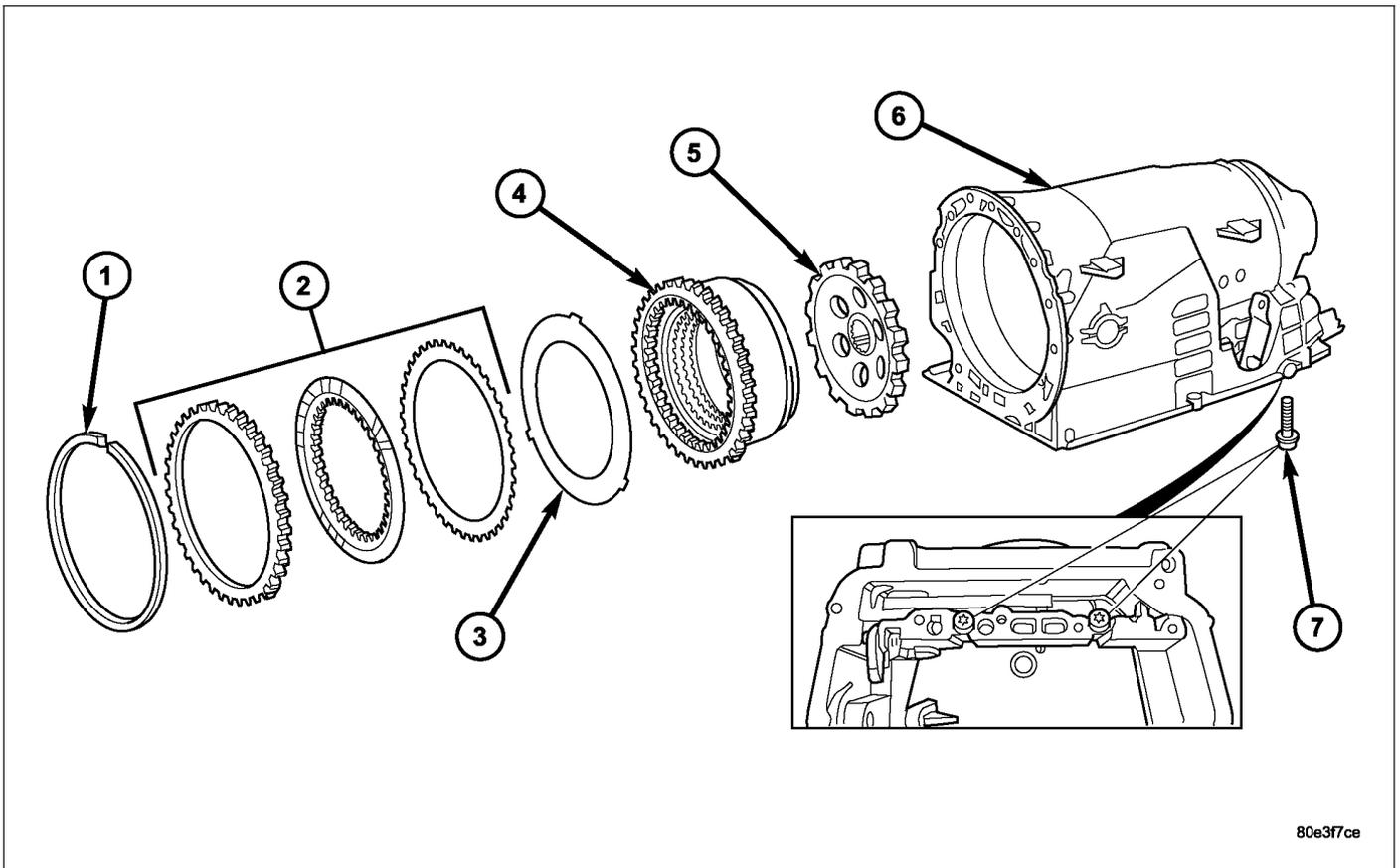
### **Remove B2, B3, and Parking Gear**

- |                             |                          |
|-----------------------------|--------------------------|
| 1 - SNAP-RING               | 5 - PARK GEAR            |
| 2 - HOLDING CLUTCH B3 DISCS | 6 - TRANSMISSION HOUSING |
| 3 - SPRING WASHER           | 7 - BOLTS - M8X60        |
| 4 - HOLDING CLUTCH B2       |                          |

29. Remove multiple-disc pack B3 (2) and spring washer (3) by removing snap-ring (1) in transmission housing. To facilitate removal of the snap-ring (1), compress the multiple-disc pack B3 (2). Note which clutch disc is removed just prior to the spring washer (3) for re-assembly. If the clutch discs are re-used, this disc must be returned to its original position on top of the spring washer.
30. Unscrew Torx socket bolts (7).
31. Remove multiple-disc holding clutch B2 (4) from transmission housing. The externally toothed disc carrier for multiple-disc holding clutch B2 is also the piston for multiple-disc holding clutch B3.
32. Remove parking lock gear (5).

## **ASSEMBLY**

**Note:** If the transmission is being reconditioned (clutch/seal replacement) or replaced, it is necessary to perform the TCM Adaptation Procedure using the scan tool (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE).



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**Install B2, B3, and Parking Gear**

- |                             |                          |
|-----------------------------|--------------------------|
| 1 - SNAP-RING               | 5 - PARK GEAR            |
| 2 - HOLDING CLUTCH B3 DISCS | 6 - TRANSMISSION HOUSING |
| 3 - SPRING WASHER           | 7 - BOLTS - M8X60        |
| 4 - HOLDING CLUTCH B2       |                          |

1. Insert parking lock gear (5).
2. Install multiple-disc holding clutch B2 (4) in transmission housing (6).
3. Screw in both Torx socket bolts (7). Tighten the bolts to 16 N·m (141 in.lbs.).

Note: During the measurement the snap ring (7) must contact the upper bearing surface of the groove in the outer multiple-disc carrier (8).

Note: Pay attention to sequence of discs. If the original clutch discs are reused, be sure to return the disc identified on disassembly as belonging on top of the spring washer (4) to its original location. Place new friction multiple-discs in ATF fluid for one hour before installing.

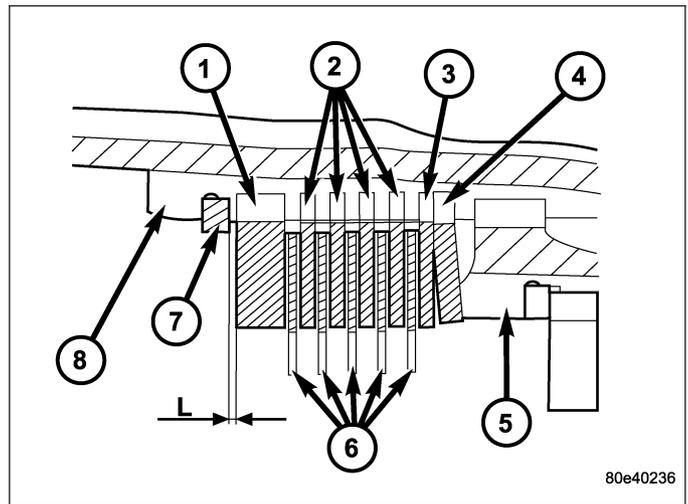
4. Insert and measure spring washer (4) and multiple-disc pack B3 (2, 6).
  - a. Put multiple-discs for multiple-disc holding clutch B3 together in the sequence shown in the illustration and insert individually.
  - b.

**CAUTION:** Apply only light pressure (less than 10 N (3 lbs.) of force) to the clutch pack when measuring the clutch clearance with the feeler gauge.

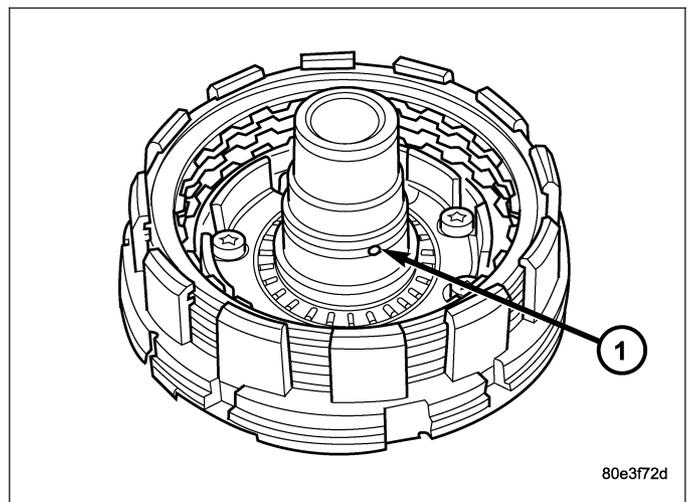
Applying excessive force to the clutch will give an incorrect reading and lead to a transmission failure. Using a feeler gauge, determine the play "L" at three points between the snap ring (7) and outer multiple-disc (1). B3 clutch clearance should be 1.0-1.4 mm (0.039-0.055 in.). Adjust the clearance as necessary.

- c. Adjust with snap-ring (7), if necessary. Snap-rings are available in thicknesses of 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), 3.8 mm (0.150 in.), 4.1 mm (0.162 in.), 4.4 mm (0.173 in.), and 4.7 mm (0.185 in.).

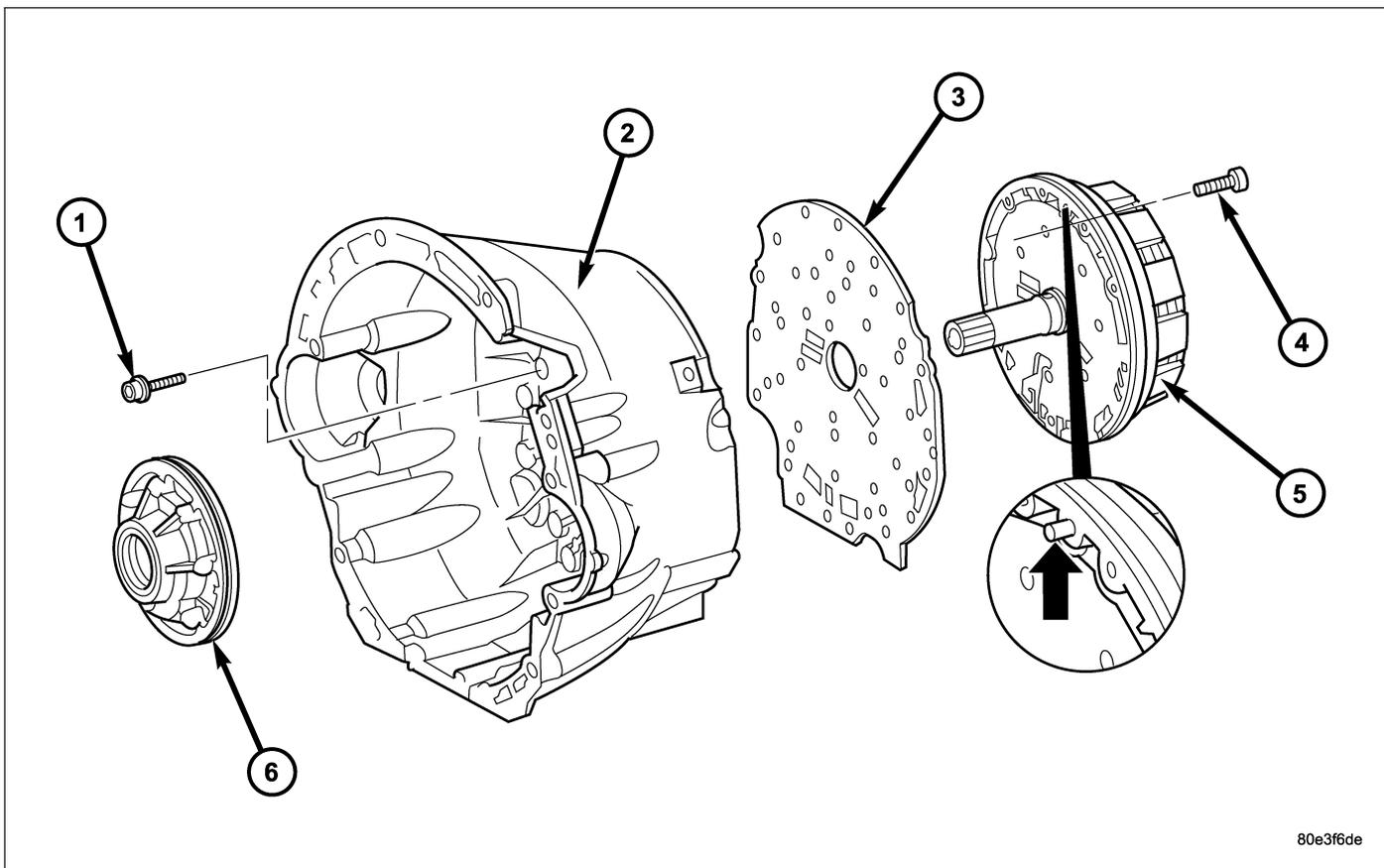
5. Check that the K1 clutch feed hole (1) in the inner hub of clutch B1 is free before installing clutch B1.



1 - OUTER DISC - 6.5 MM (0.256 IN.)	5 - PISTON
2 - OUTER DISCS - 1.8 MM (0.071 IN.)	6 - FRICTION DISCS
3 - OUTER DISCS - 1.8 MM (0.071 IN.)	7 - SNAP-RING
4 - SPRING WASHER	8 - B3 DISC CARRIER



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**Install Holding Clutch B1 and Oil Pump**

- 1 - BOLTS - M6X32
- 2 - CONVERTER HOUSING
- 3 - INTERMEDIATE PLATE

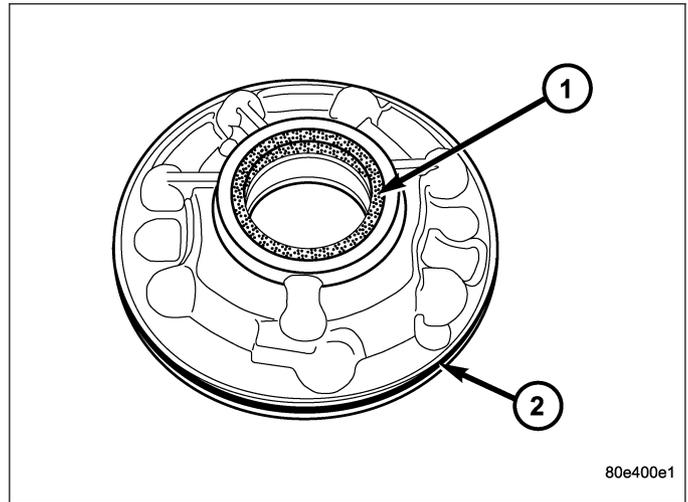
- 4 - BOLTS - M8X35
- 5 - HOLDING CLUTCH B1
- 6 - OIL PUMP

6. Place intermediate plate (3) on converter housing (2) and align.

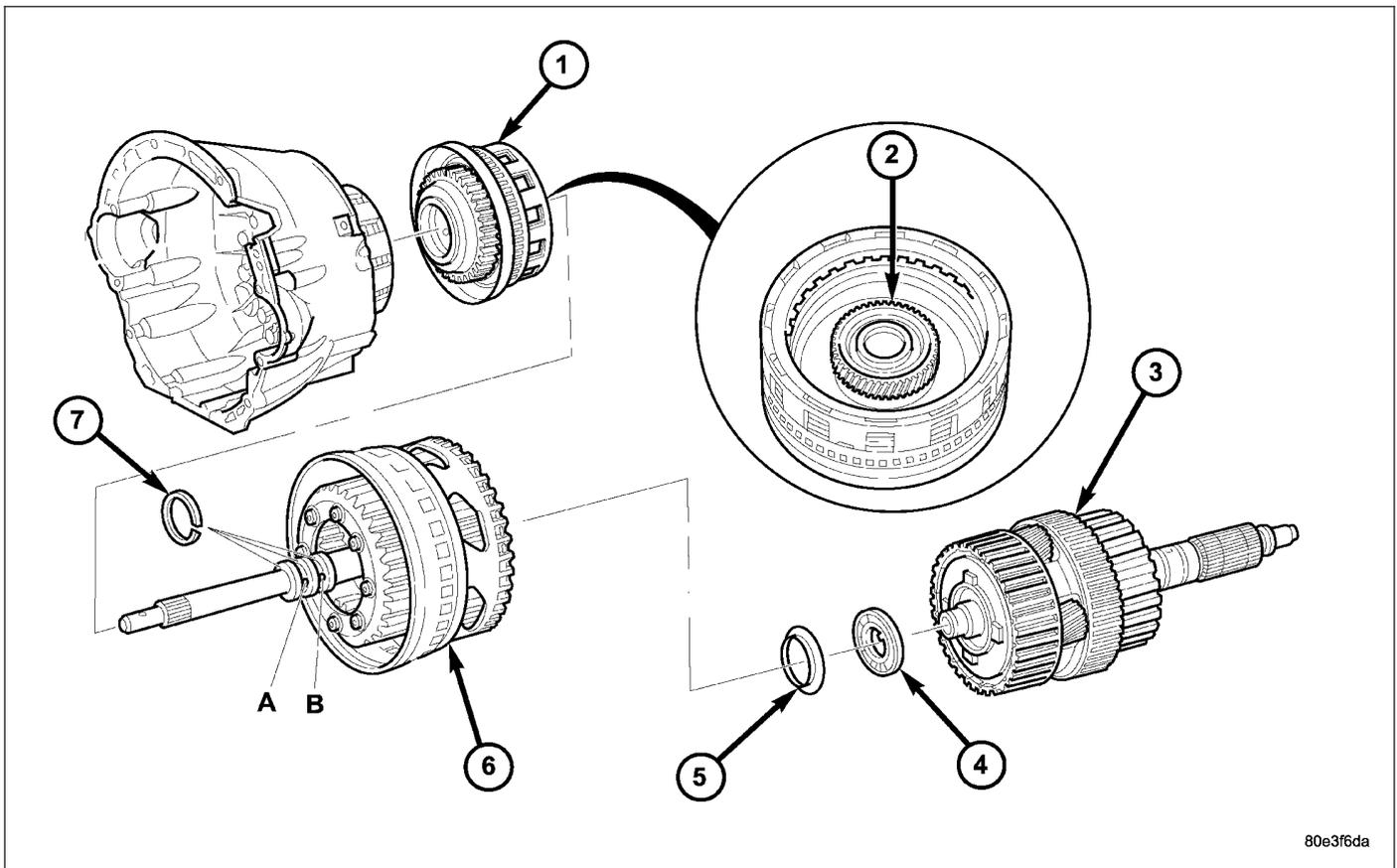
**Note: The intermediate plate can generally be used several times. The plate must not be coated with additional sealant**

- 7. Install the holding clutch B1 (5) onto the converter housing and intermediate plate. Installed position of clutch B1 in relation to converter housing is specified by a plain dowel pin in clutch B1 (arrow).
- 8. Install the bolts to hold clutch B1 (5) to the converter housing.
- 9. Securely tighten multiple-disc holding clutch B1 (5) on converter housing (2) to 10 N·m (88.5 in.lbs.).

10. Install new torque converter hub seal (1) into the oil pump using Seal Installer 8902A.
11. Install new oil pump outer o-ring seal onto oil pump.
12. Install oil pump (6) and securely tighten. Tighten the oil pump bolts to 20 N·m (177 in.lbs.).



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**Install K1, K2, and K3 Clutches**

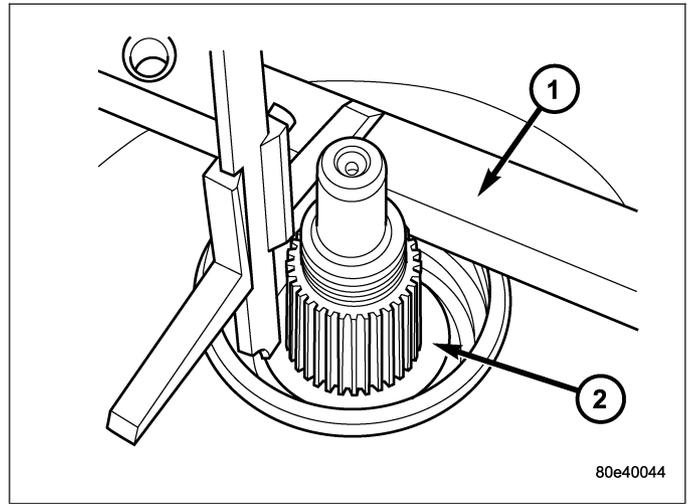
- |  |  |
|--|--|
| 1 - DRIVING CLUTCH K1  | 5 - THRUST WASHER  |
| 2 - SUN GEAR OF FRONT PLANETARY GEAR SET                                     | 6 - FRONT PLANETARY GEAR SET, DRIVING CLUTCH K2, AND INPUT SHAFT |
| 3 - DRIVING CLUTCH K3, OUTPUT SHAFT, AND CENTER AND REAR PLANETARY GEAR SETS | 7 - SEALING RINGS  |
| 4 - THRUST NEEDLE BEARING  |  |

13. Using grease, insert sealing rings (7) in the groove so that the joint remains together.
14. Install the K1 (1) clutch onto the B1 clutch.
15. Install input shaft with clutch K2 (6) and front gear set (1).
16. Install front washer (5) and thrust needle bearing (4).

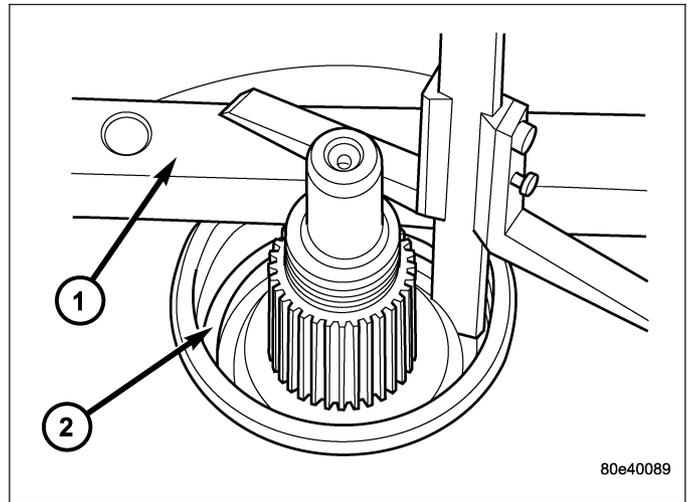
17. Install output shaft with center and rear gear set and clutch K3 (3).
18. Using grease, install both Teflon rings in the groove at the rear of the output shaft so that the joint stays together.
19. Mount transmission housing on converter housing.
20. Screw in Torx socket bolts through the transmission housing into the converter housing. Tighten the bolts to 20 N·m (177 in.lbs.).

**Note: Verify that there are no nicks or other irregularities in the surface of the transmission case that will cause an inaccurate measurement.**

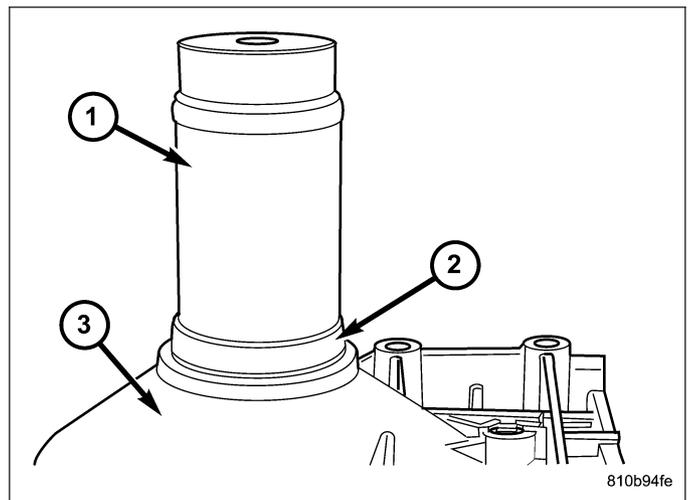
21. Measure end-play between park pawl gear and grooved ball bearing in order to select the proper geartrain end-play shim.
22. Place Gauge Bar 6311 (1) on transmission housing. Using a depth gauge, measure from the gauge bar (1) to the parking lock gear (2).



23. Using a depth gauge, measure from the Gauge Bar 6311 (1) to the contact surface of the output shaft bearing (2) in the transmission housing.
24. Subtract the first figure from the second figure to determine the current end-play of the transmission. Select a shim such that the end-play will be 0.3-0.5 mm (0.012-0.020 in.). Shims are available in thicknesses of 0.2 mm (0.008 in.), 0.3 mm (0.012 in.), 0.4 mm (0.016 in.), and 0.5 mm (0.020 in.).
25. Install the selected end-play shim.

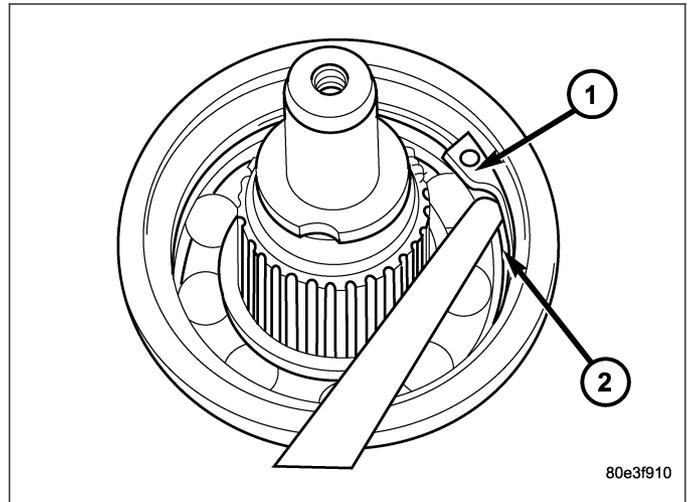


26. Screw in Torx socket bolts through the converter housing into the transmission housing. Tighten the bolts to 20 N·m (177 in.lbs.).
27. Install output shaft bearing (2) in rear transmission housing. Using Bearing Installer 9287 (1), install the output shaft bearing (2) into the transmission housing. **The closed side of the plastic cage**



must point towards the parking lock gear.

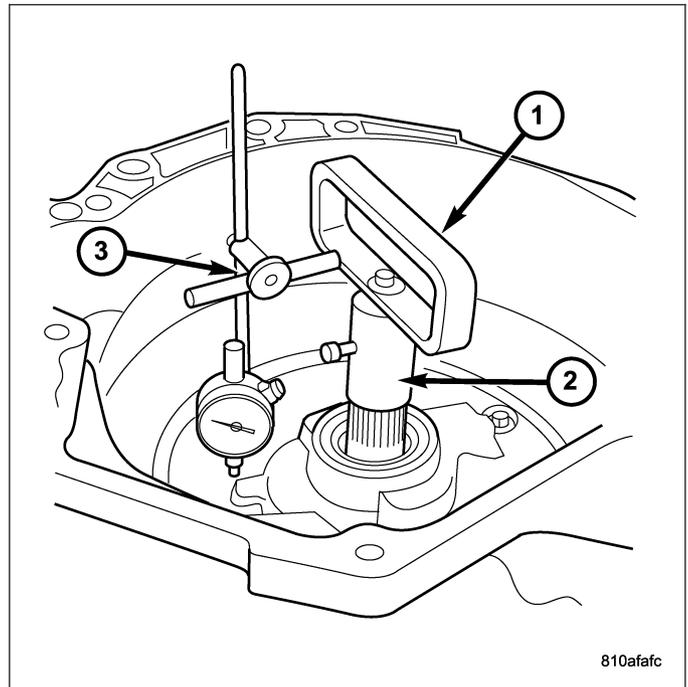
28. Install the retaining ring (1). Ensure that the retaining ring is seated correctly in the groove.
29. Check that there is no play between the bearing and the retaining ring using feeler gauge.
30. There must be no play between the retaining ring and the bearing. If the ring cannot be installed, a thinner ring must be used. If there is play between the ring and the bearing, a thicker ring must be installed. Retaining rings are available in thicknesses of 2.0 mm (0.079 in.), 2.1 mm (0.083 in.), and 2.2 mm (0.087 in.).



31. Rotate the transmission so that the bellhousing is pointed upward and ensuring that the output shaft is allowed to move freely.
32. Measure input shaft end-play.

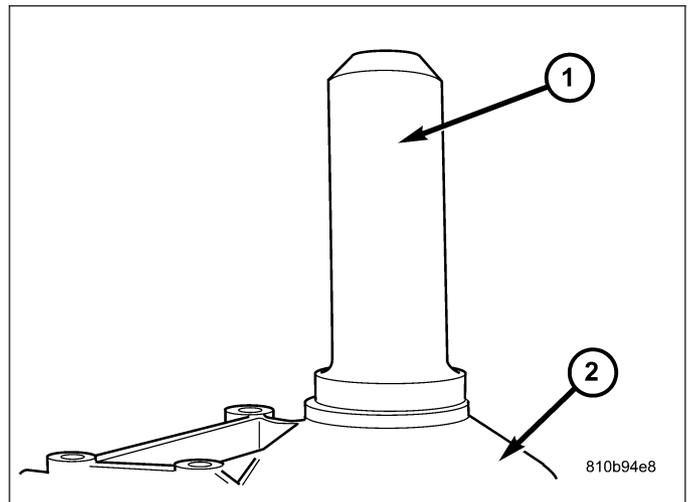
**Note: If end-play is incorrect, transmission is incorrectly assembled, or the geartrain end-play shim is incorrect. The geartrain end-play shim is selective.**

- a. Attach Adapter 8266-18 (2) to Handle 8266-8 (1).
- b. Attach dial indicator C-3339 (3) to Handle 8266-8 (1).
- c. Install the assembled tool onto the input shaft of the transmission and tighten the retaining screw on Adapter 8266-18 to secure it to the input shaft.
- d. Position the dial indicator plunger against a flat spot on the oil pump and zero the dial indicator.

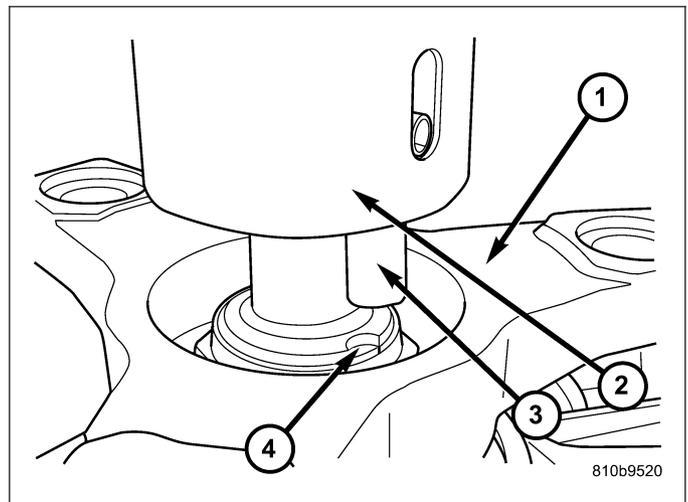


- e. Move input shaft in and out and record reading. End play should be 0.3-0.5 mm (0.012-0.020 in.). Adjust as necessary.

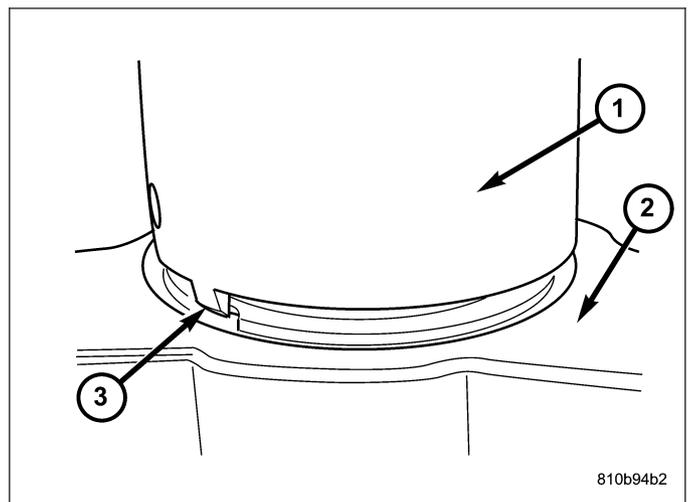
33. Install the output shaft washer onto the output shaft.
34. Install a new transmission rear seal into the transmission case with Seal Installer 8902A (1).



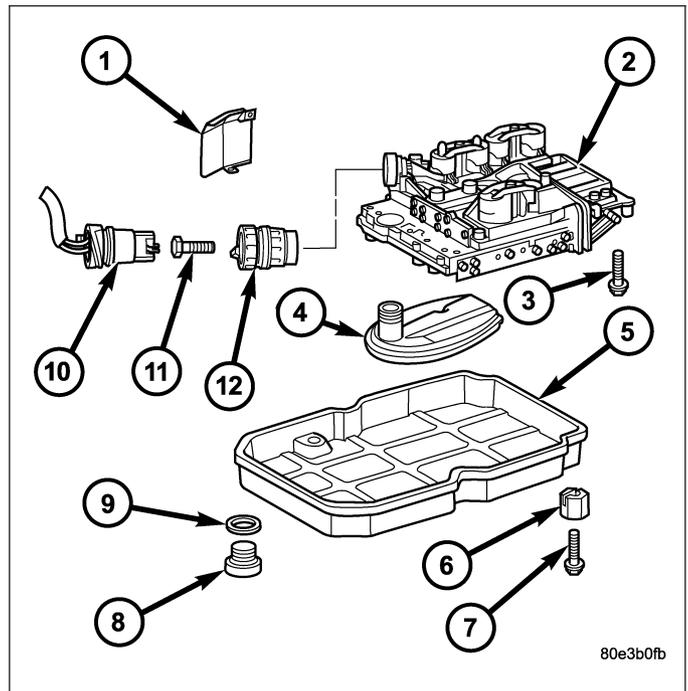
35. Place the transmission in PARK to prepare for the installation of the output shaft nut.
36. Install the propeller shaft flange onto the output shaft and install a new flange nut. Tighten the flange nut to 120 N·m (88.5 ft.lbs.).
37. Place the Staking Tool 9078 (2) and Driver Handle C-4171 onto the output shaft.
38. Rotate the Staking Tool 9078 (2) until the alignment pin (3) engages the output shaft notch (4).



39. Press downward on the staking tool (1) until the staking pin (3) contacts the output shaft nut flange (2).
40. Strike the Driver handle C-4171 with a suitable hammer until the output shaft nut is securely staked to the output shaft.

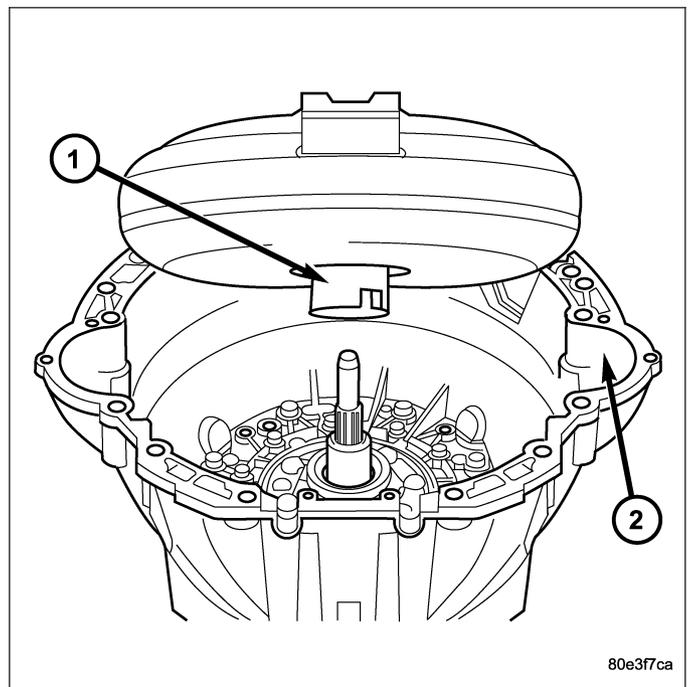


- 41. Install electrohydraulic unit (2). Tighten the bolts to 8 N·m (71 in.lbs.).
- 42. Install oil filter (4).
- 43. Install oil pan (5). Tighten the bolts to 8 N·m (71 in.lbs.).
- 44. Install guide bushing (12).



- 1 - HEAT SHIELD
- 2 - ELECTROHYDRAULIC UNIT
- 3 - BOLT
- 4 - OIL FILTER
- 5 - OIL PAN
- 6 - CLAMPING ELEMENT
- 7 - BOLT
- 8 - DRAIN PLUG
- 9 - DRAIN PLUG GASKET
- 10 - 13-PIN PLUG CONNECTOR
- 11 - BOLT
- 12 - GUIDE BUSHING

- 45. Install the torque converter.



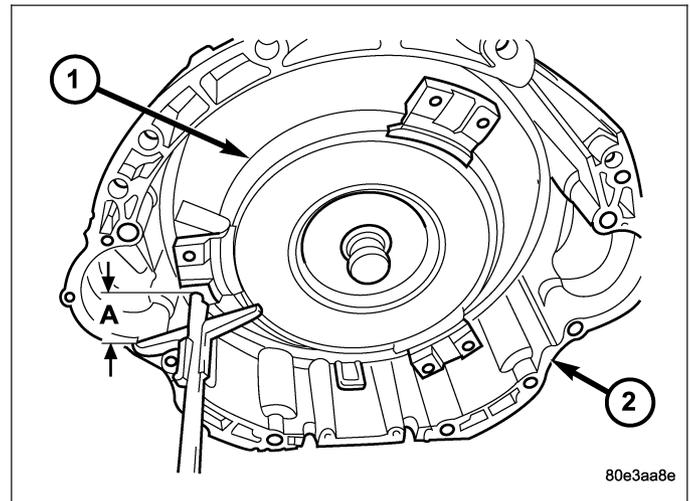
## INSTALLATION

1. Check torque converter hub and hub drive flats for sharp edges burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper and crocus cloth if necessary. The hub must be smooth to avoid damaging pump seal at installation.
2. If a replacement transmission is being installed, transfer any components necessary, such as the manual shift lever and shift cable bracket, from the original transmission onto the replacement transmission.
3. Lubricate oil pump seal lip with transmission fluid.

4. Place torque converter (1) in position in transmission (2).

**CAUTION: Do not damage oil pump seal or converter hub while inserting torque converter into the front of the transmission.**

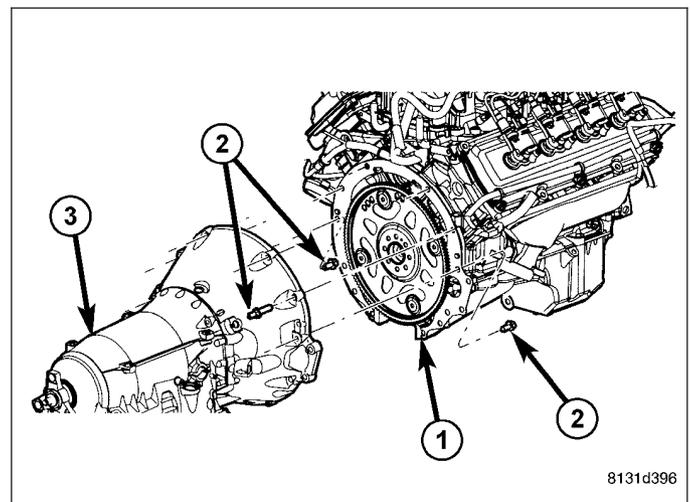
5. Align torque converter to oil pump seal opening.
6. Insert torque converter hub into oil pump.
7. While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.
8. Check converter seating with a scale and straight-edge (A). Surface of converter lugs should be at least 19 mm (3/4 in.) to rear of straightedge when converter is fully seated.



9. If necessary, temporarily secure converter with C-clamp attached to the converter housing.

10. Check condition of converter driveplate. Replace the plate if cracked, distorted or damaged. **Also be sure transmission dowel pins are seated in engine block and protrude far enough to hold transmission in alignment.**

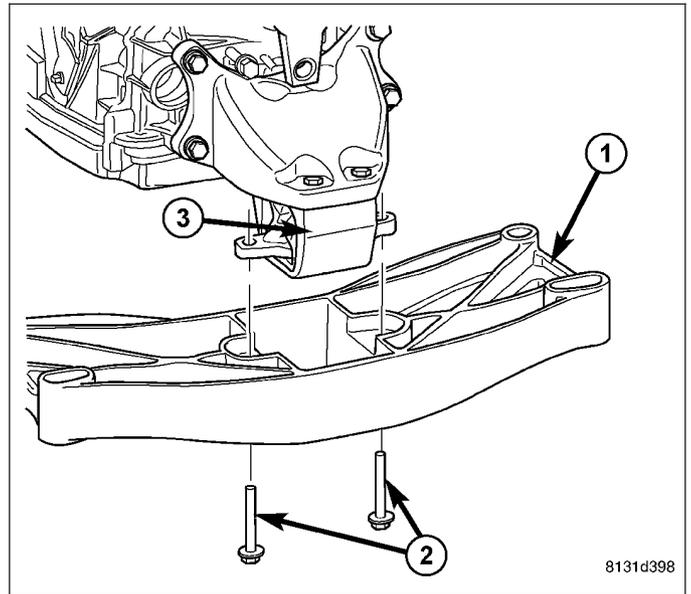
11. Apply a light coating of Mopar® High Temp Grease to the torque converter hub pocket in the rear pocket of the engine's crankshaft.
12. Raise transmission (3) and align the torque converter with the drive plate and the transmission converter housing with the engine block (1).
13. Move transmission forward. Then raise, lower, or tilt transmission to align the converter housing with the engine block dowels.



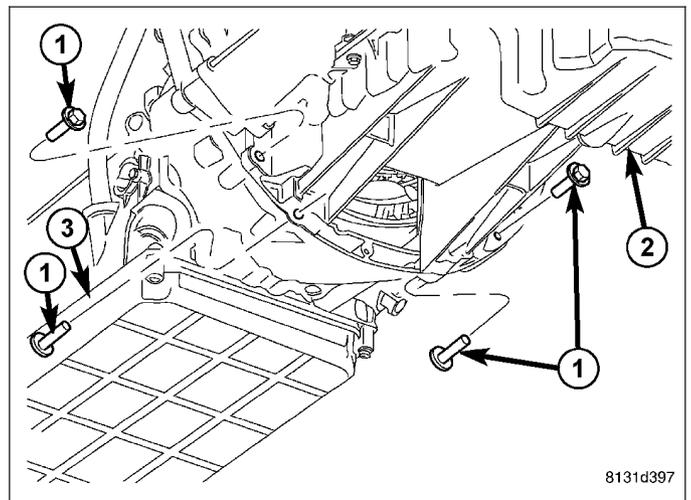
14. Carefully work transmission forward and over engine block dowels until converter hub is seated in crankshaft. Verify that no wires, or the transmission vent hose, have become trapped between the engine block and the transmission.

15. Install two bolts (2) to attach the transmission to the engine.

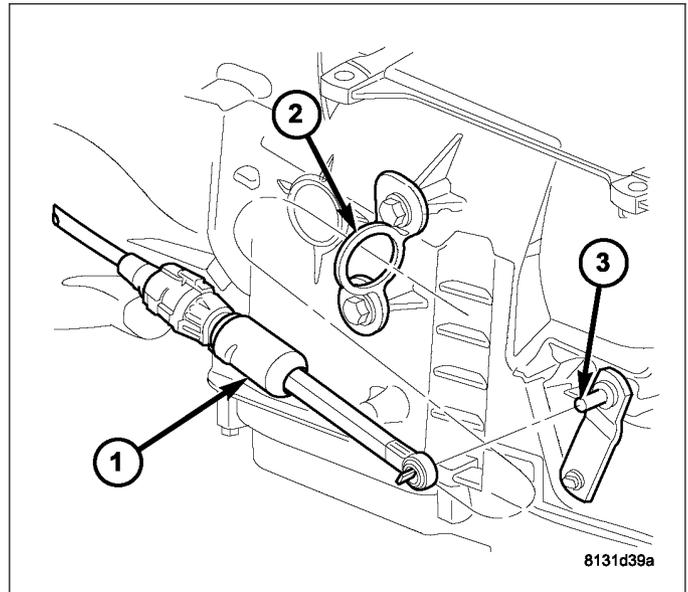
16. Install remaining torque converter housing to engine bolts (2). Tighten to 39 N·m (29 ft.lbs.).
17. Install rear transmission crossmember (1). Tighten crossmember to frame bolts to 68 N·m (50 ft.lbs.).
18. Install rear support (3) to transmission. Tighten bolts to 47 N·m (35 ft.lbs.).
19. Lower transmission onto crossmember and install bolts attaching transmission mount to crossmember. Tighten clevis bracket to crossmember bolts(2) to 47 N·m (39 ft.lbs.).
20. Remove engine support fixture.



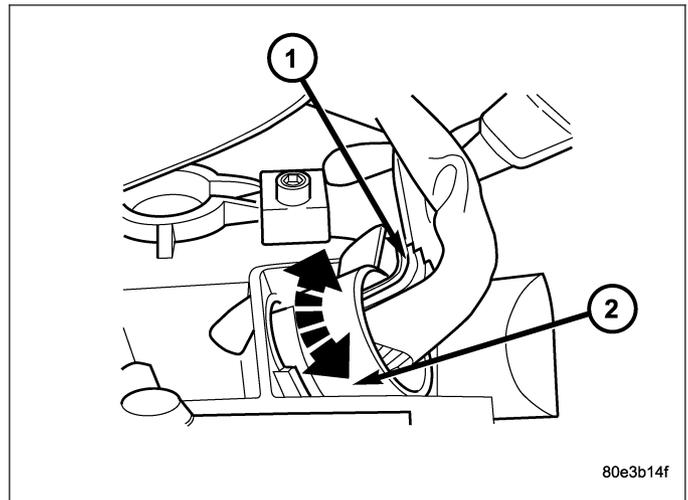
21. Install the transmission (3) to engine oil pan (2) bolts (1). Tighten to 39 N·m (29 ft.lbs.).



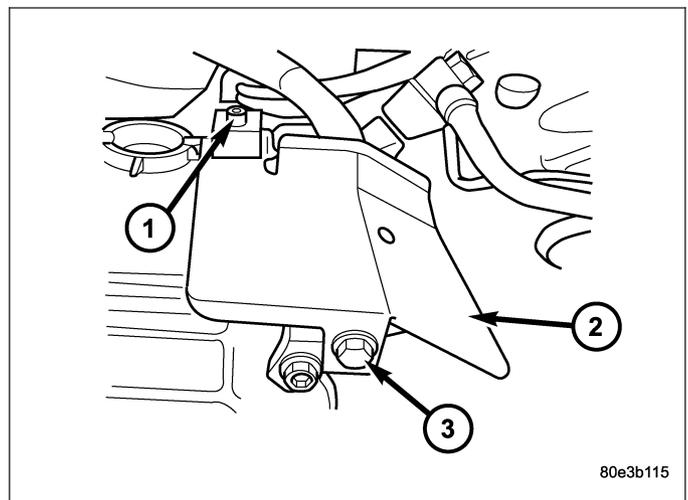
22. Connect the gearshift cable (1) to the transmission manual shift lever (3).



23. Check O-ring on plug connector (1), and replace if necessary.
24. Install the plug connector (1) into the guide bushing (2). Turn bayonet lock of guide bushing (2) clockwise to connect plug connector (1).

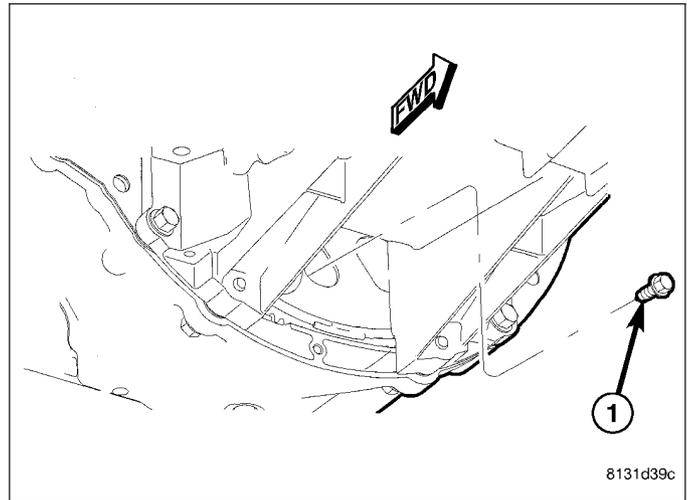


25. Position the heat shield (2) onto the transmission housing and install the screw (1) and bolt (3) to hold the shield in place.

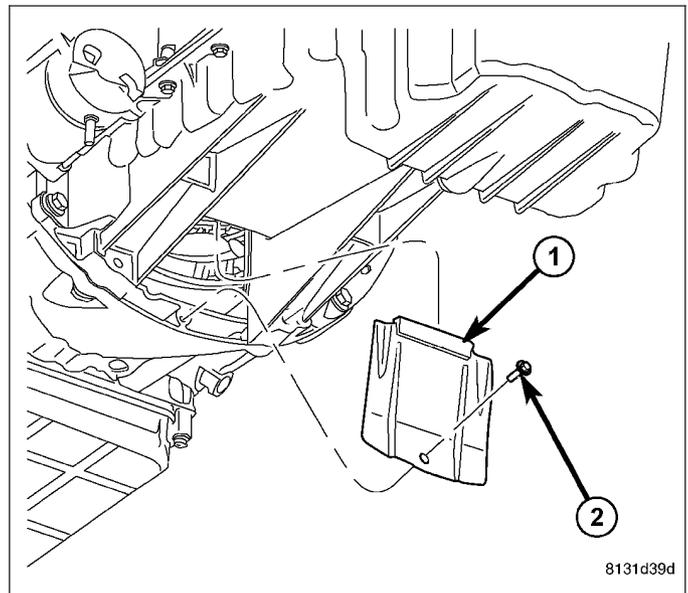


**CAUTION:** It is essential that correct length bolts be used to attach the converter to the driveplate. Bolts that are too long will damage the clutch surface inside the converter.

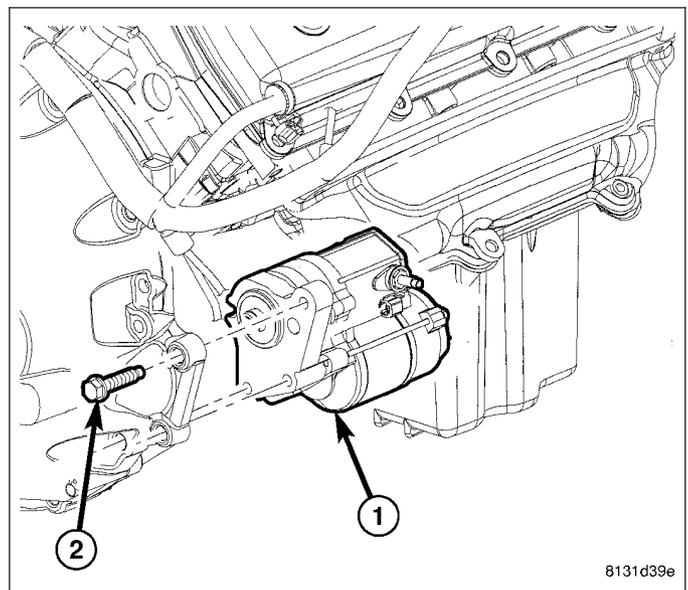
26. Install all torque converter-to-driveplate bolts (1) by hand.
27. Verify that the torque converter is pulled flush to the driveplate. Tighten bolts to 42 N·m (30.5 ft. lbs.).



28. Install the torque converter bolt access cover (1) onto the transmission. Install the access cover bolt (2) and tighten to 11 N·m (8 ft.lbs.).



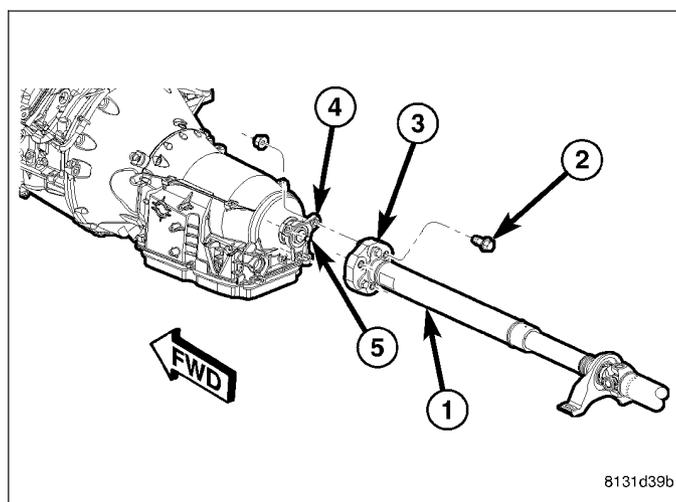
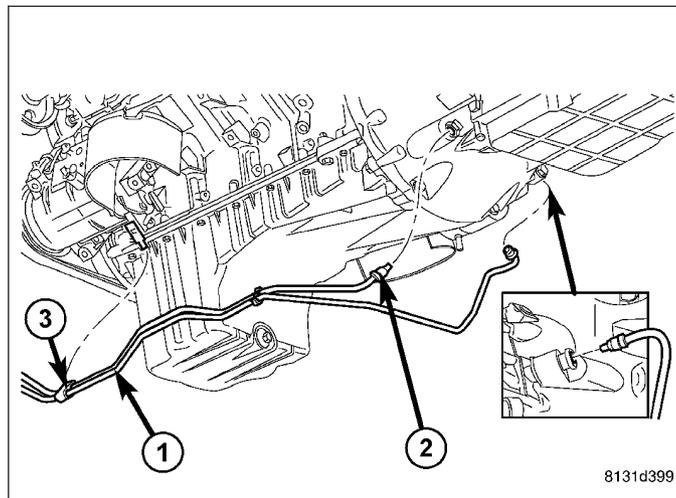
29. Install starter motor (1). (Refer to 8 - ELECTRICAL/ STARTING/STARTER MOTOR - INSTALLATION)



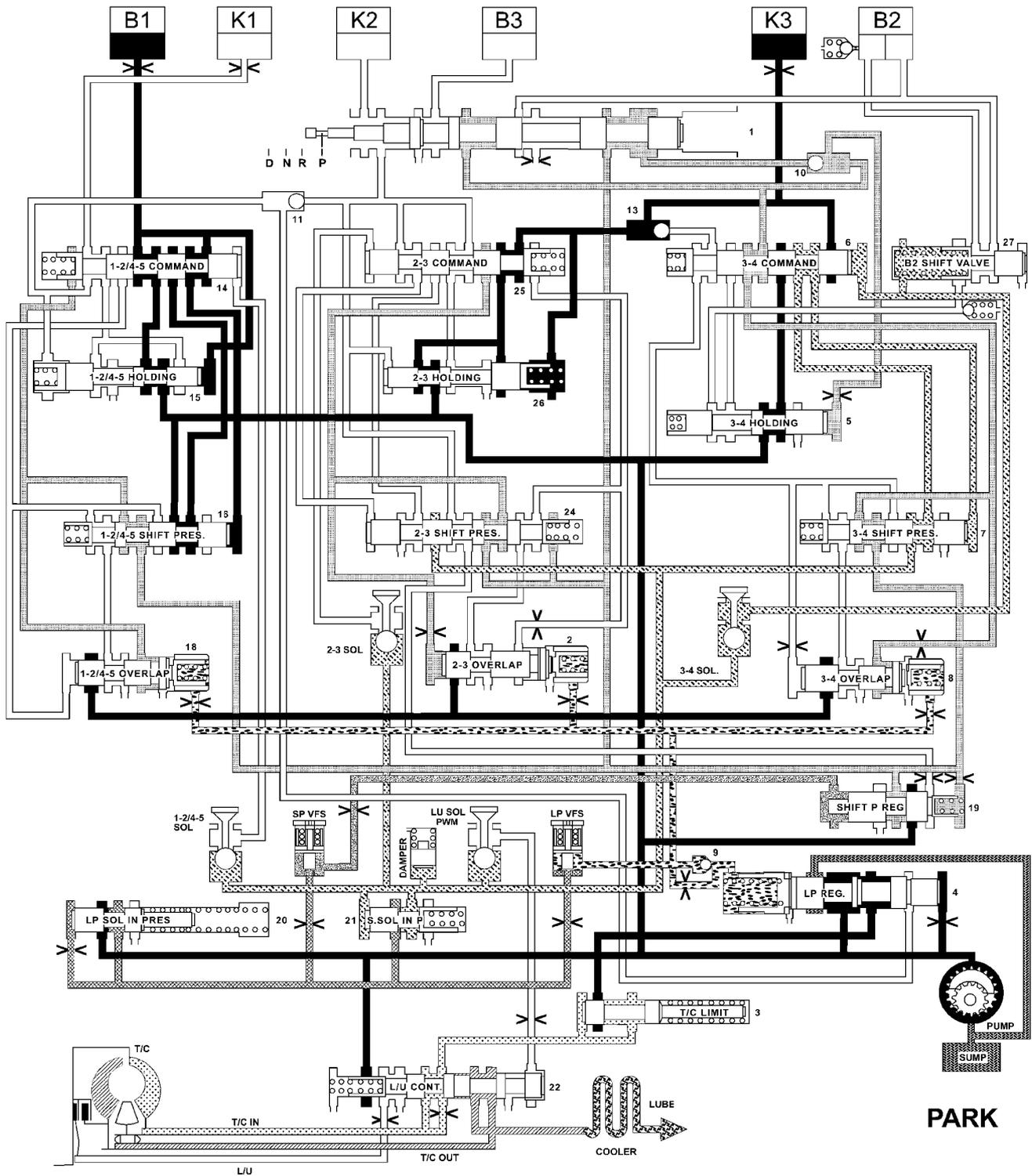
30. Connect the cooler line fittings (2) and cooler lines (1) to the transmission.
31. Install transmission fill tube.
32. Install exhaust components.
33. Align and connect the propeller shaft (1). (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT - INSTALLATION)
34. Adjust gearshift cable if necessary.
35. Lower vehicle.
36. Connect negative battery cable.
37. Fill the transmission with the appropriate transmission fluid (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) according to the standard procedure (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FLUID AND FILTER - STANDARD PROCEDURE).

**Note:** If the transmission is being reconditioned (clutch/seal replacement) or replaced, it is necessary to perform the TCM Adaptation Procedure using the scan tool (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/TRANSMISSION CONTROL MODULE - STANDARD PROCEDURE).

38. Verify proper operation.



**SCHEMATICS AND DIAGRAMS**

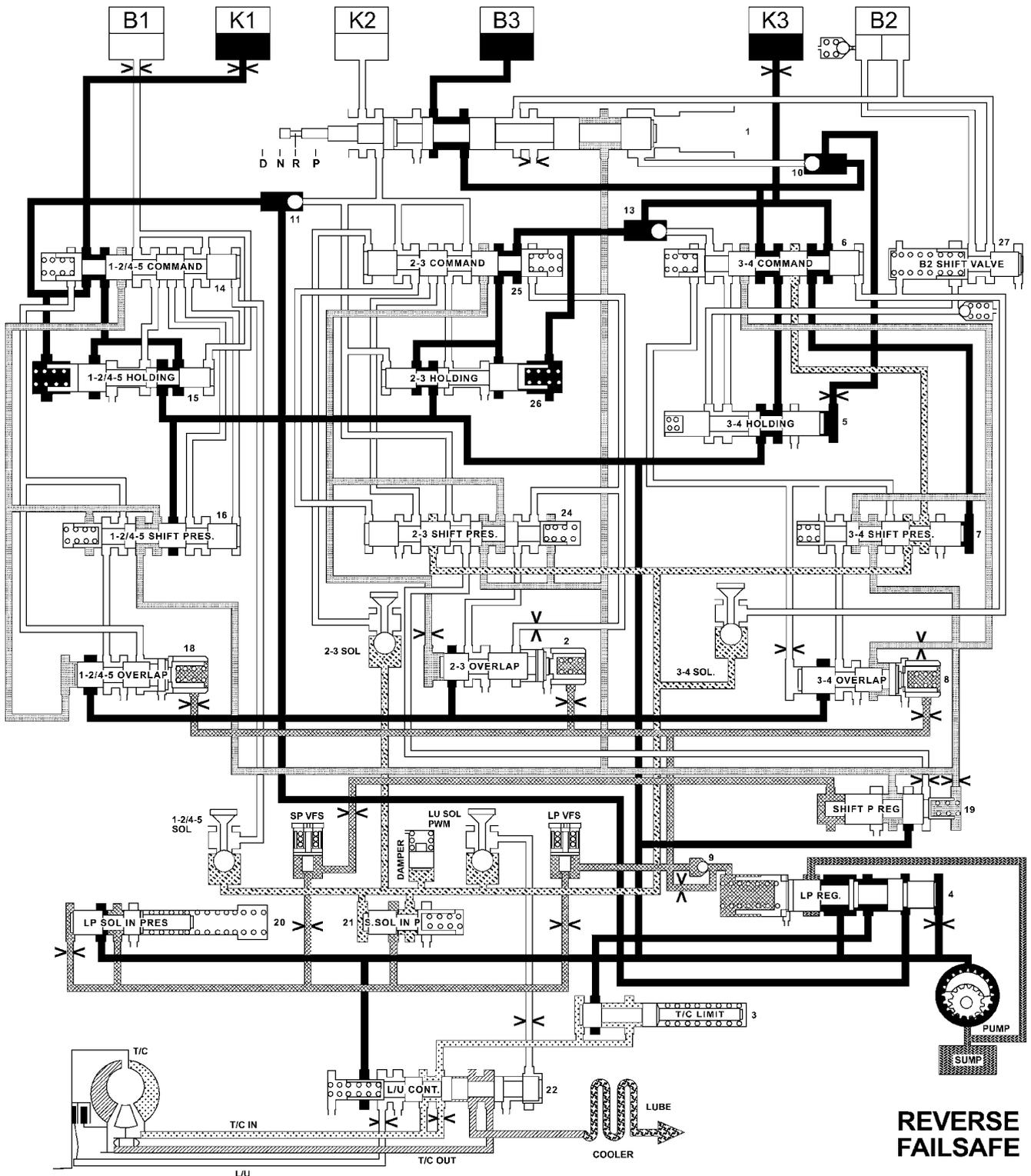


**PARK**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/ CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810ba1a

**HYDRAULIC FLOW IN PARK**

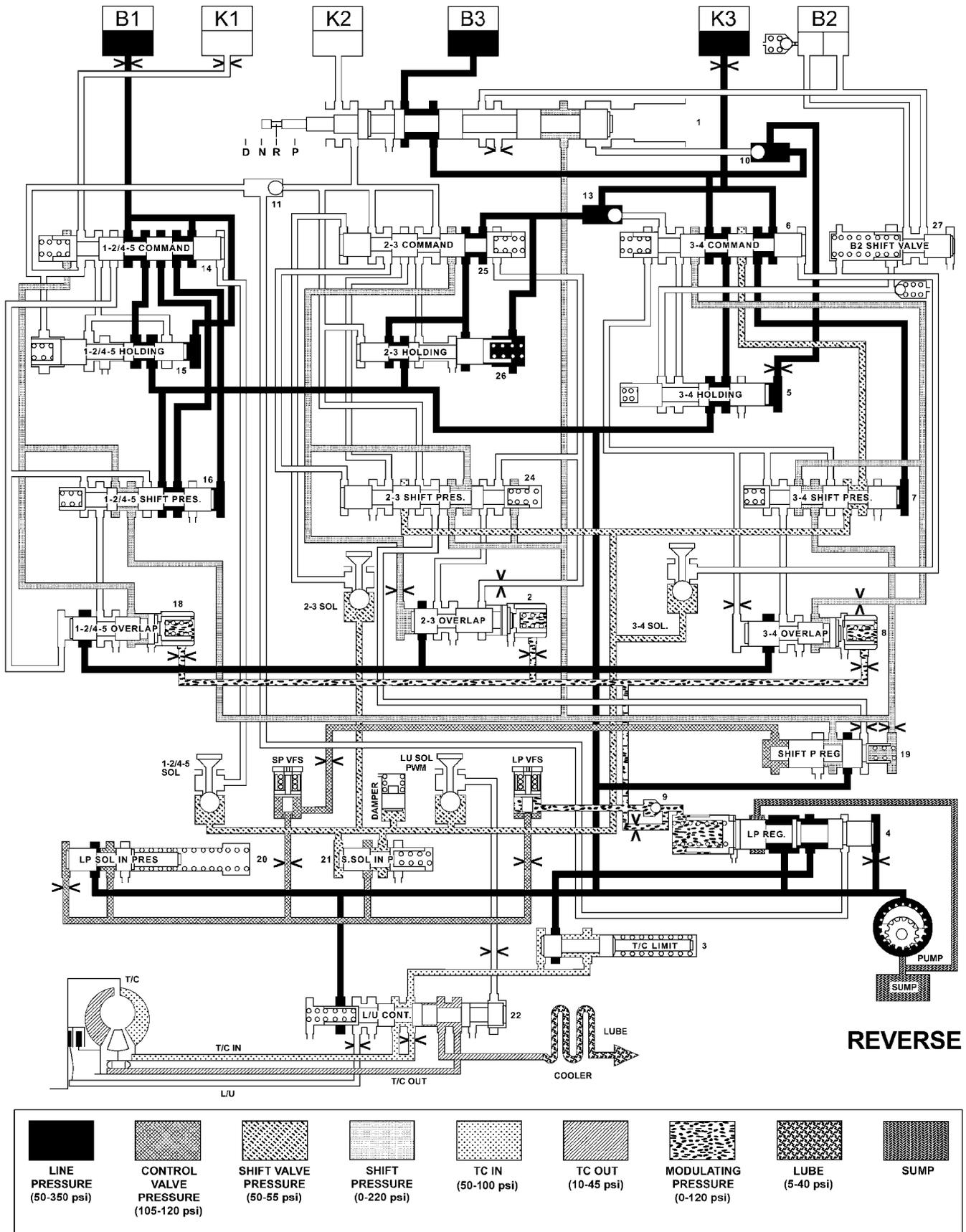


**REVERSE FAILSAFE**

							
LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	LUBE (5-40 psi)	SUMP

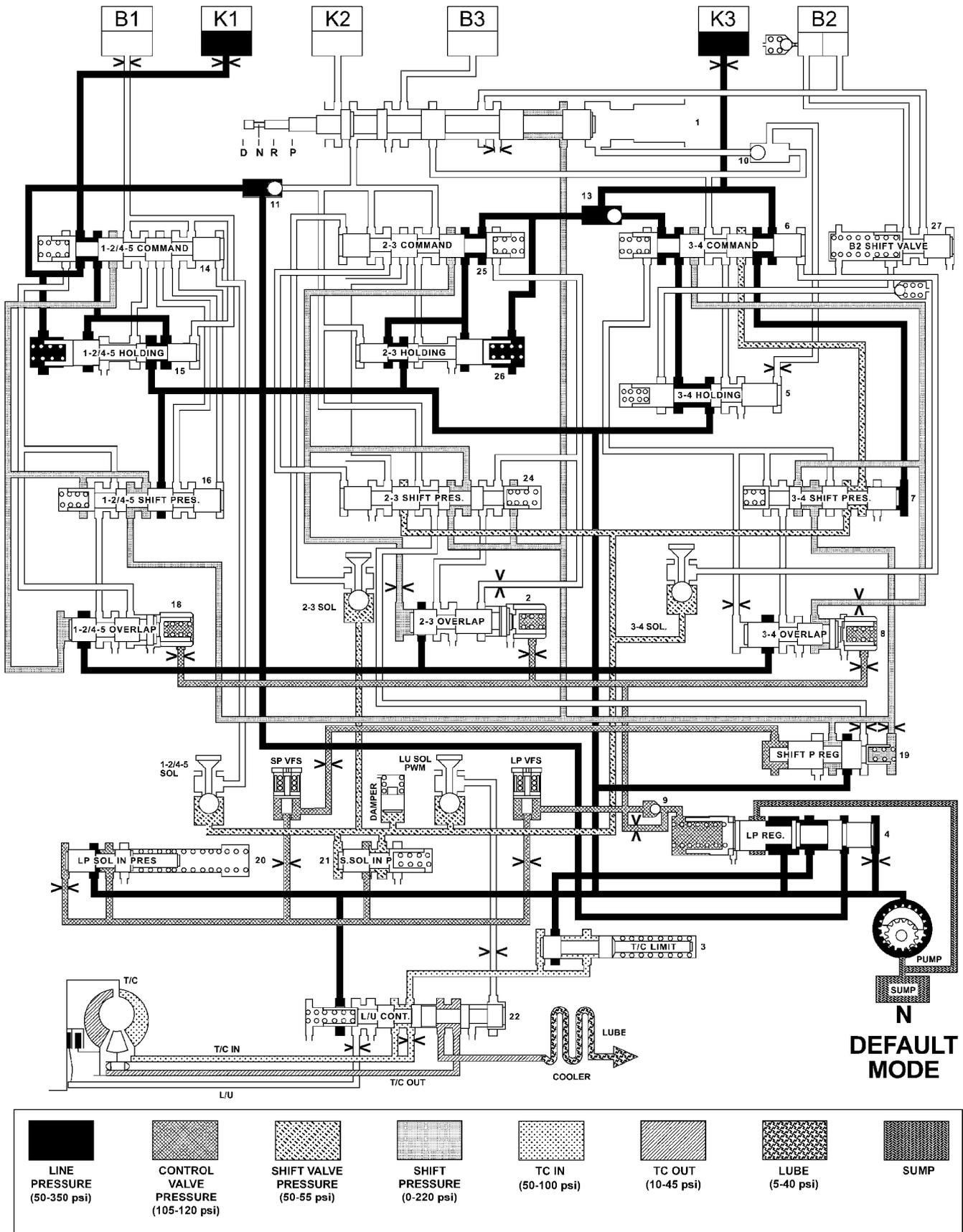
810bae77

**HYDRAULIC FLOW IN REVERSE - FAILSAFE**



810baf23

HYDRAULIC FLOW IN REVERSE

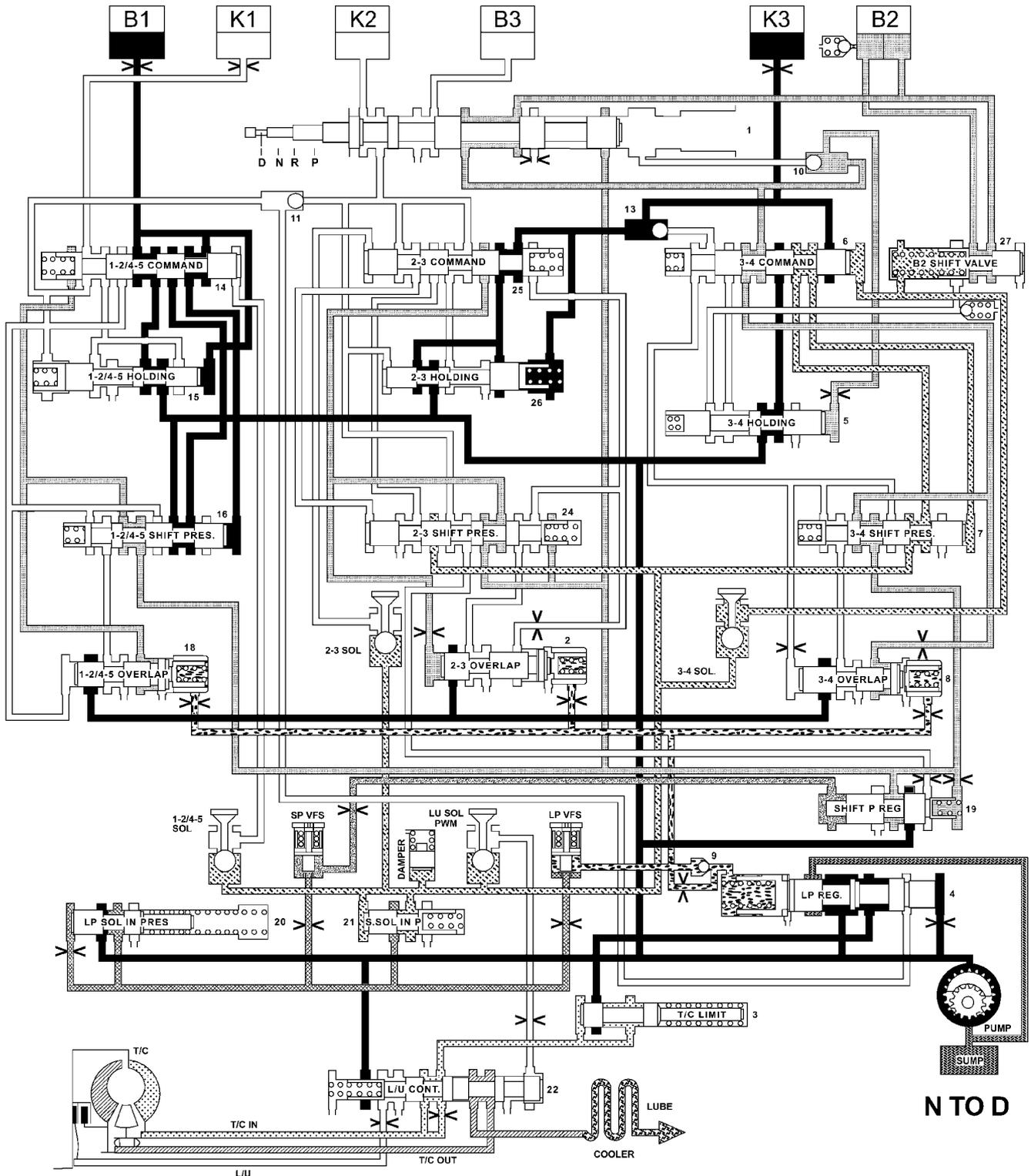


**N**  
**DEFAULT**  
**MODE**

810baf1e

**HYDRAULIC FLOW IN NEUTRAL - DEFAULT**



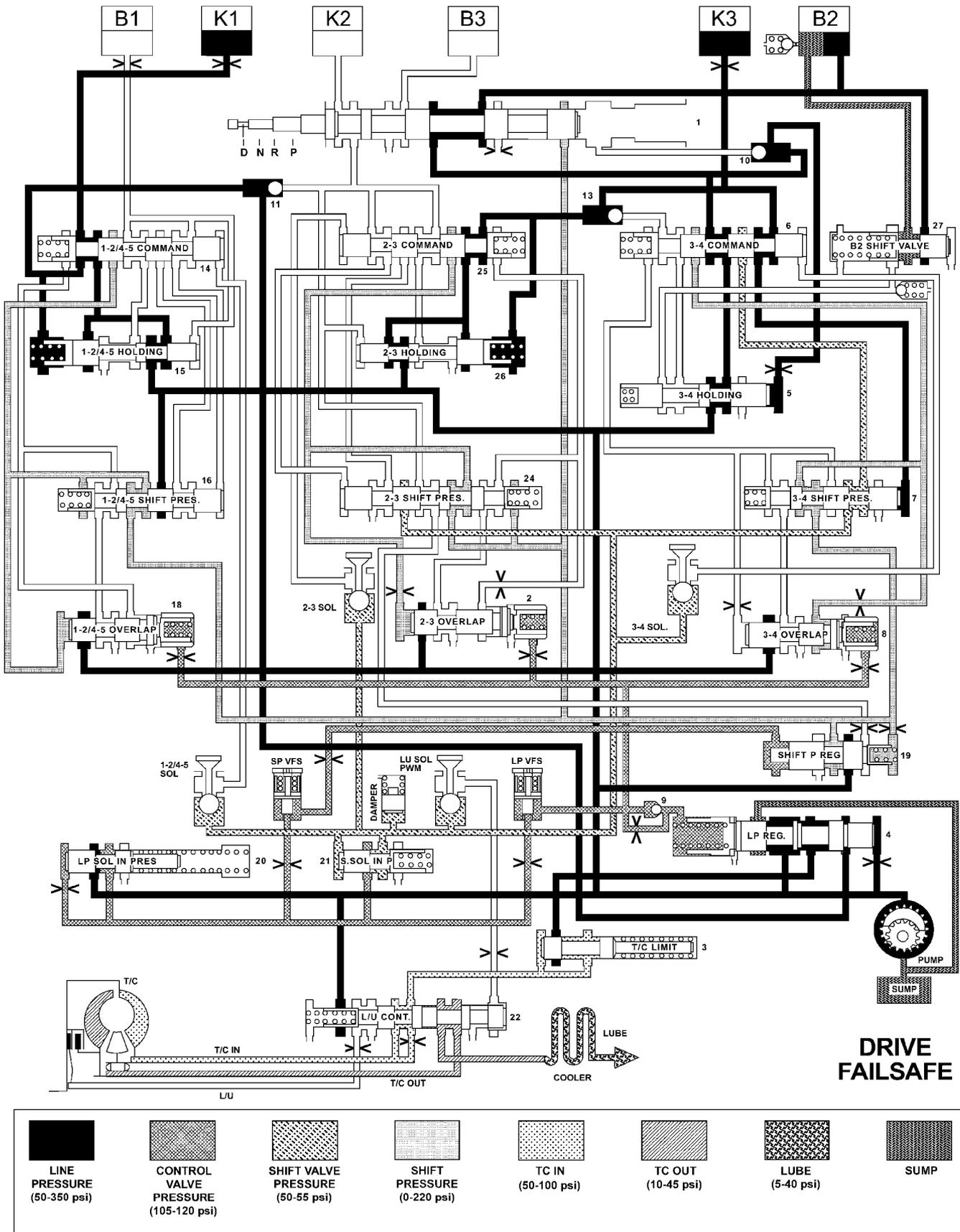


**NTOD**

<b>LINE PRESSURE</b> (50-350 psi)	<b>CONTROL VALVE PRESSURE</b> (105-120 psi)	<b>SHIFT VALVE PRESSURE</b> (50-55 psi)	<b>SHIFT PRESSURE</b> (0-220 psi)	<b>TC IN</b> (50-100 psi)	<b>TC OUT</b> (10-45 psi)	<b>MODULATING PRESSURE</b> (0-120 psi)	<b>LUBE</b> (5-40 psi)	<b>SHIFT PRESSURE/ CONTROL SOLENOID VALVE</b> (0-120 psi)	<b>SUMP</b>

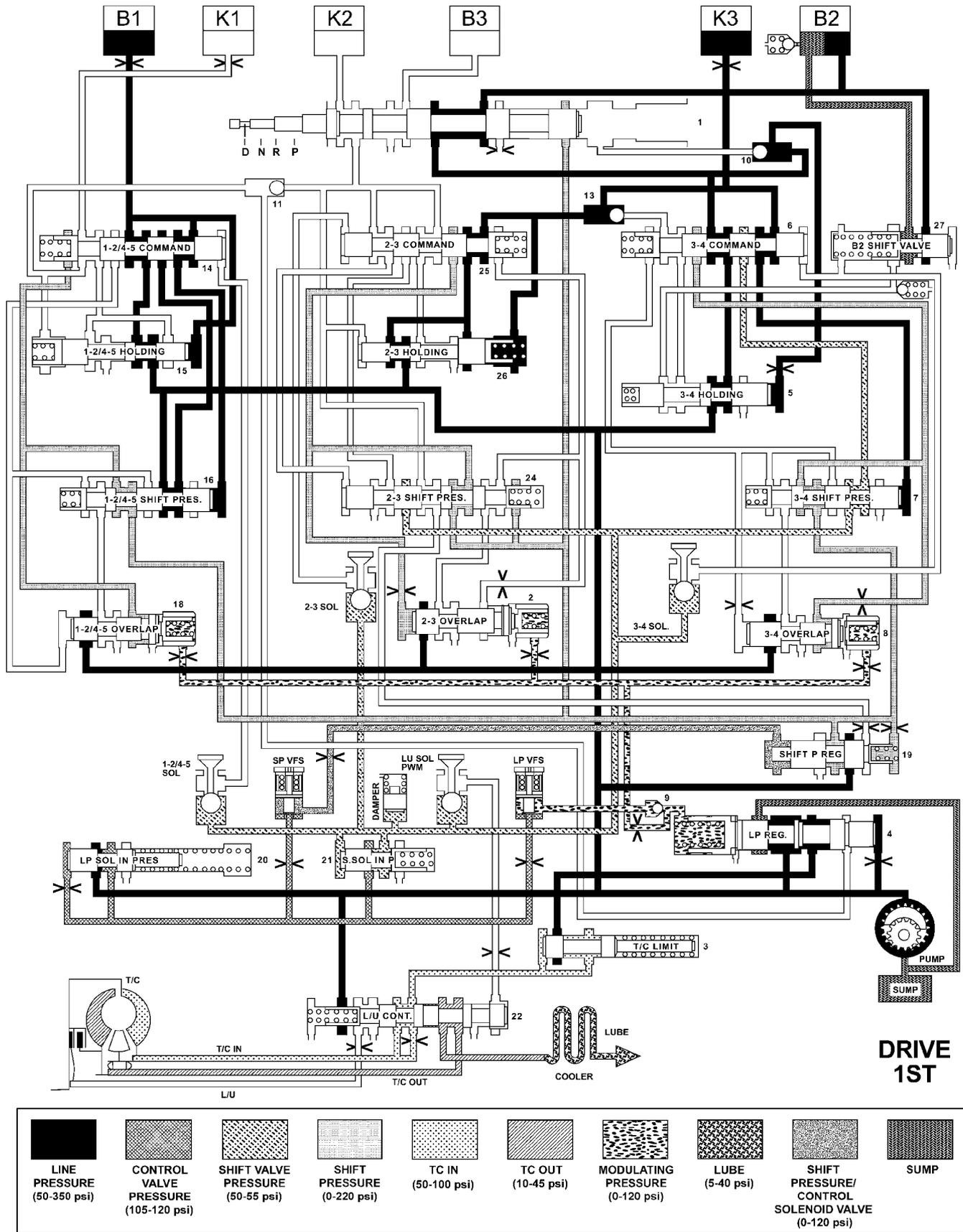
810baf80

**HYDRAULIC FLOW IN NEUTRAL TO DRIVE TRANSITION**



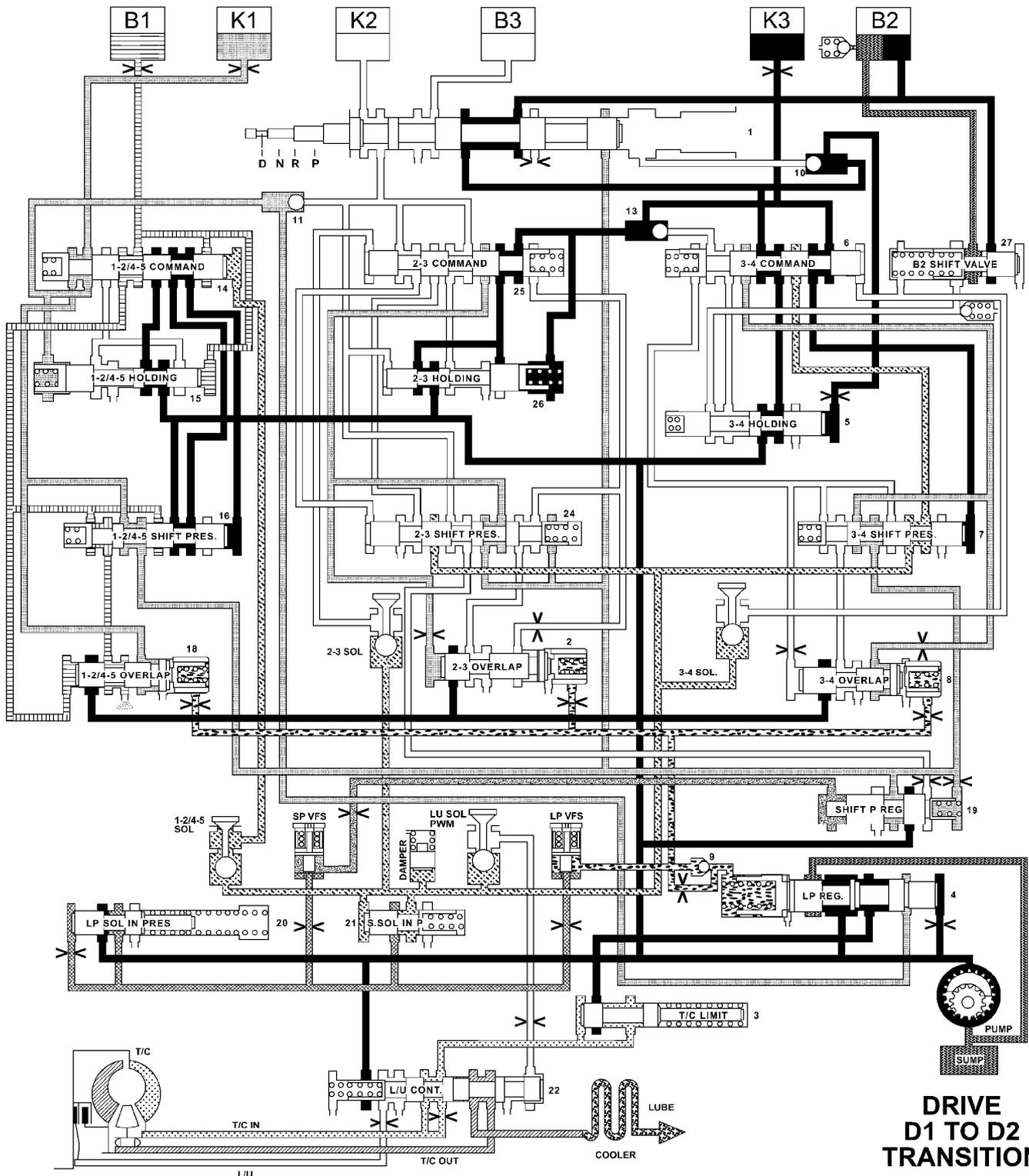
810bae73

HYDRAULIC FLOW IN DRIVE - FAILSAFE



810ba9b

**HYDRAULIC FLOW IN DRIVE - FIRST GEAR**

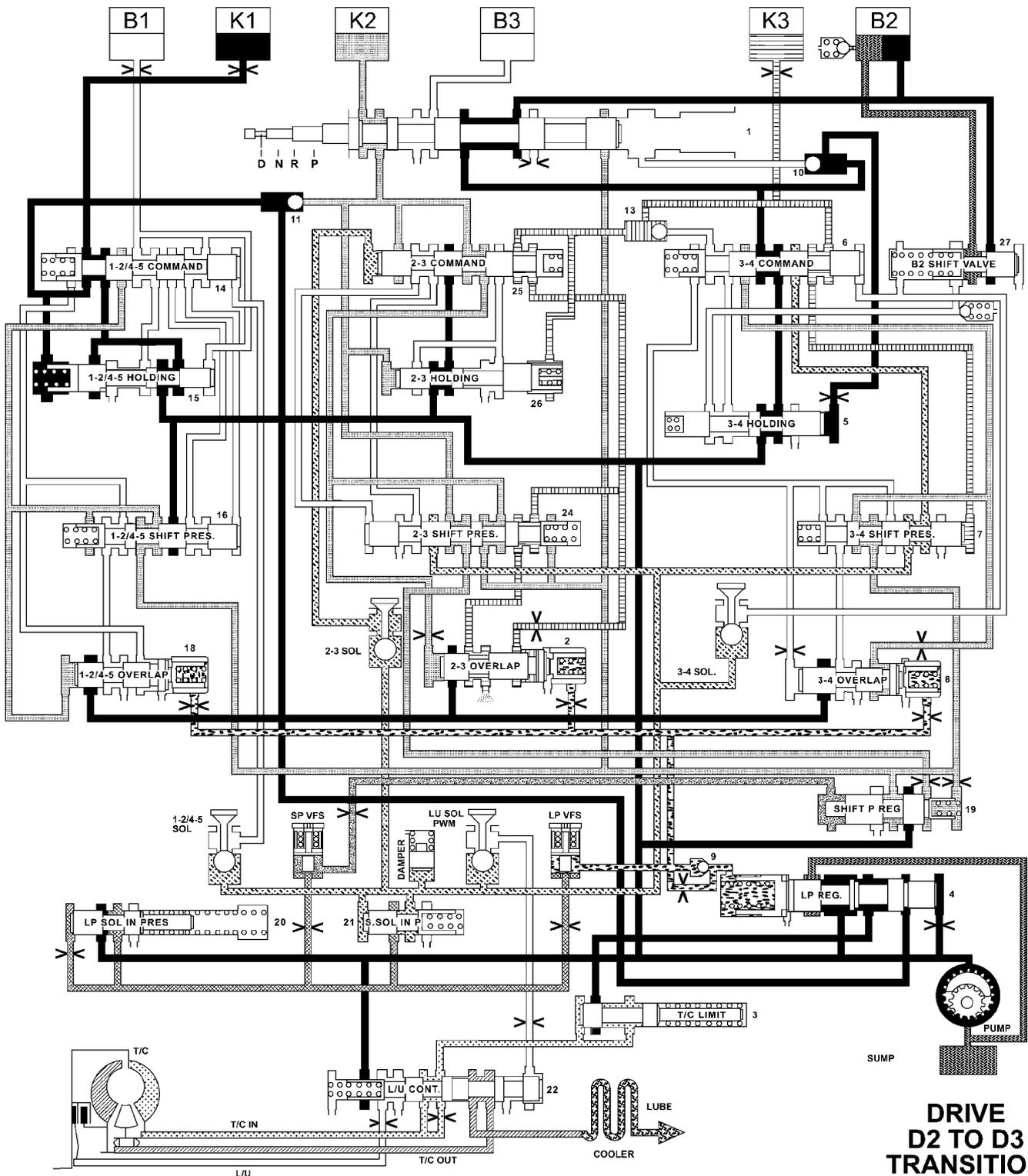


<b>LINE PRESSURE</b> (50-350 psi)	<b>CONTROL VALVE PRESSURE</b> (105-120 psi)	<b>SHIFT VALVE PRESSURE</b> (50-55 psi)	<b>SHIFT PRESSURE</b> (0-220 psi)	<b>TC IN</b> (50-100 psi)	<b>TC OUT</b> (10-45 psi)	<b>MODULATING PRESSURE</b> (0-120 psi)	<b>LUBE</b> (5-40 psi)	<b>SHIFT PRESSURE/CONTROL SOLENOID VALVE</b> (0-120psi)	<b>SUMP</b>

810bafa9

**HYDRAULIC FLOW IN DRIVE - FIRST TO SECOND GEAR TRANSITION**

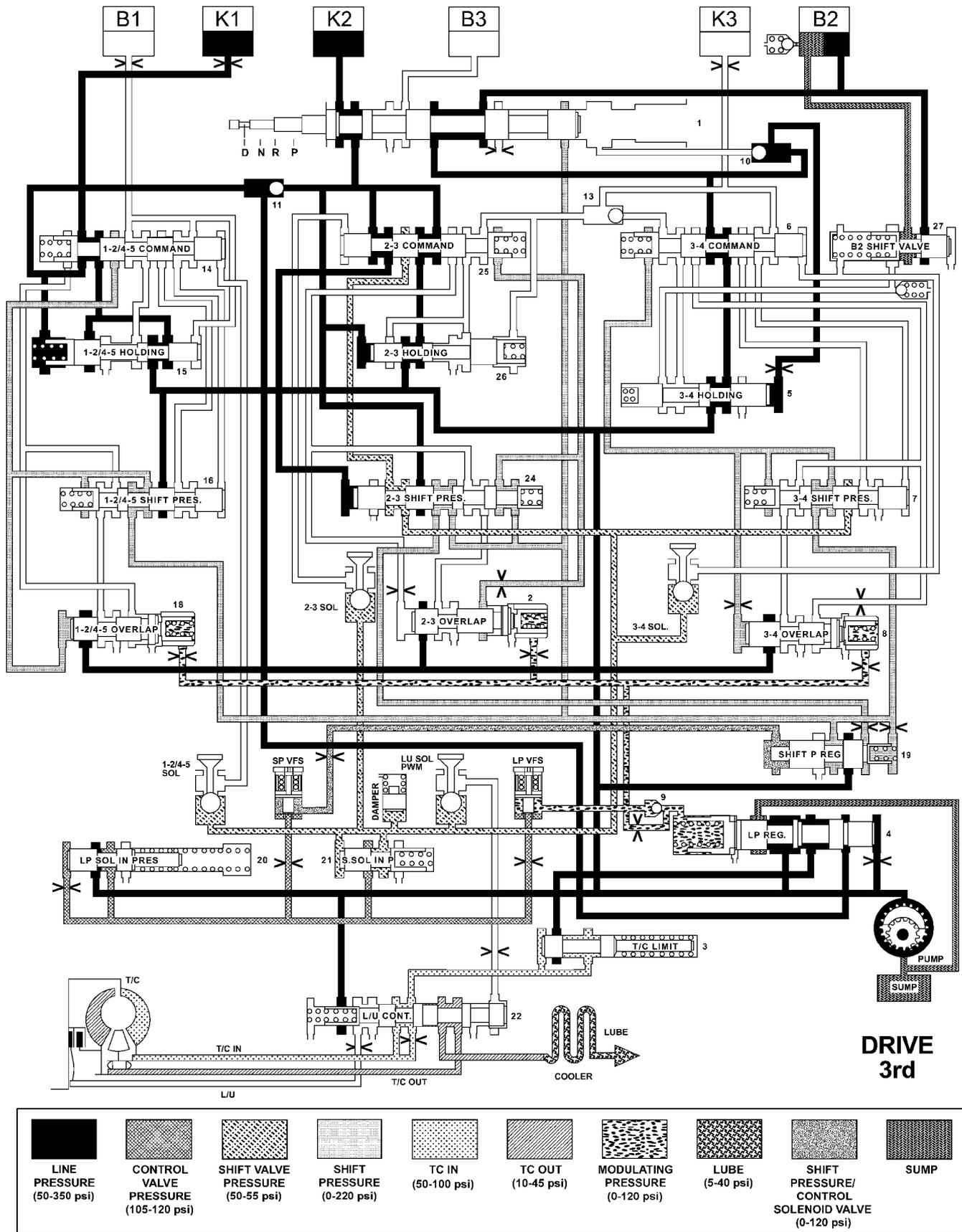




LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	OVERLAP PRESSURE	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810baff2

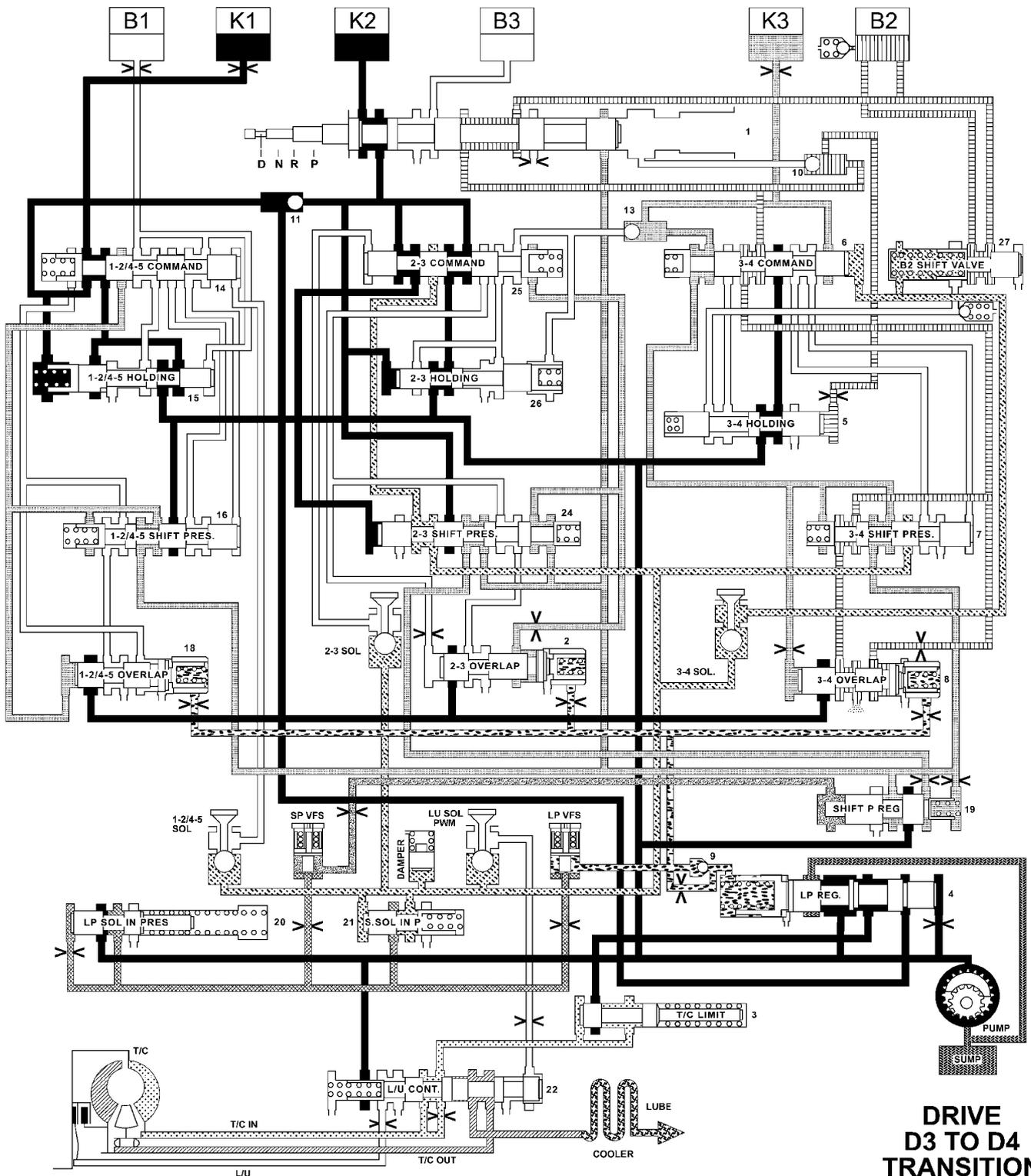
HYDRAULIC FLOW IN DRIVE - SECOND TO THIRD GEAR TRANSITION



**DRIVE  
3rd**

<b>LINE PRESSURE</b> (50-350 psi)	<b>CONTROL VALVE PRESSURE</b> (105-120 psi)	<b>SHIFT VALVE PRESSURE</b> (50-55 psi)	<b>SHIFT PRESSURE</b> (0-220 psi)	<b>TC IN</b> (50-100 psi)	<b>TC OUT</b> (10-45 psi)	<b>MODULATING PRESSURE</b> (0-120 psi)	<b>LUBE</b> (5-40 psi)	<b>SHIFT PRESSURE/CONTROL SOLENOID VALVE</b> (0-120 psi)	<b>SUMP</b>

**HYDRAULIC FLOW IN DRIVE - THIRD GEAR**

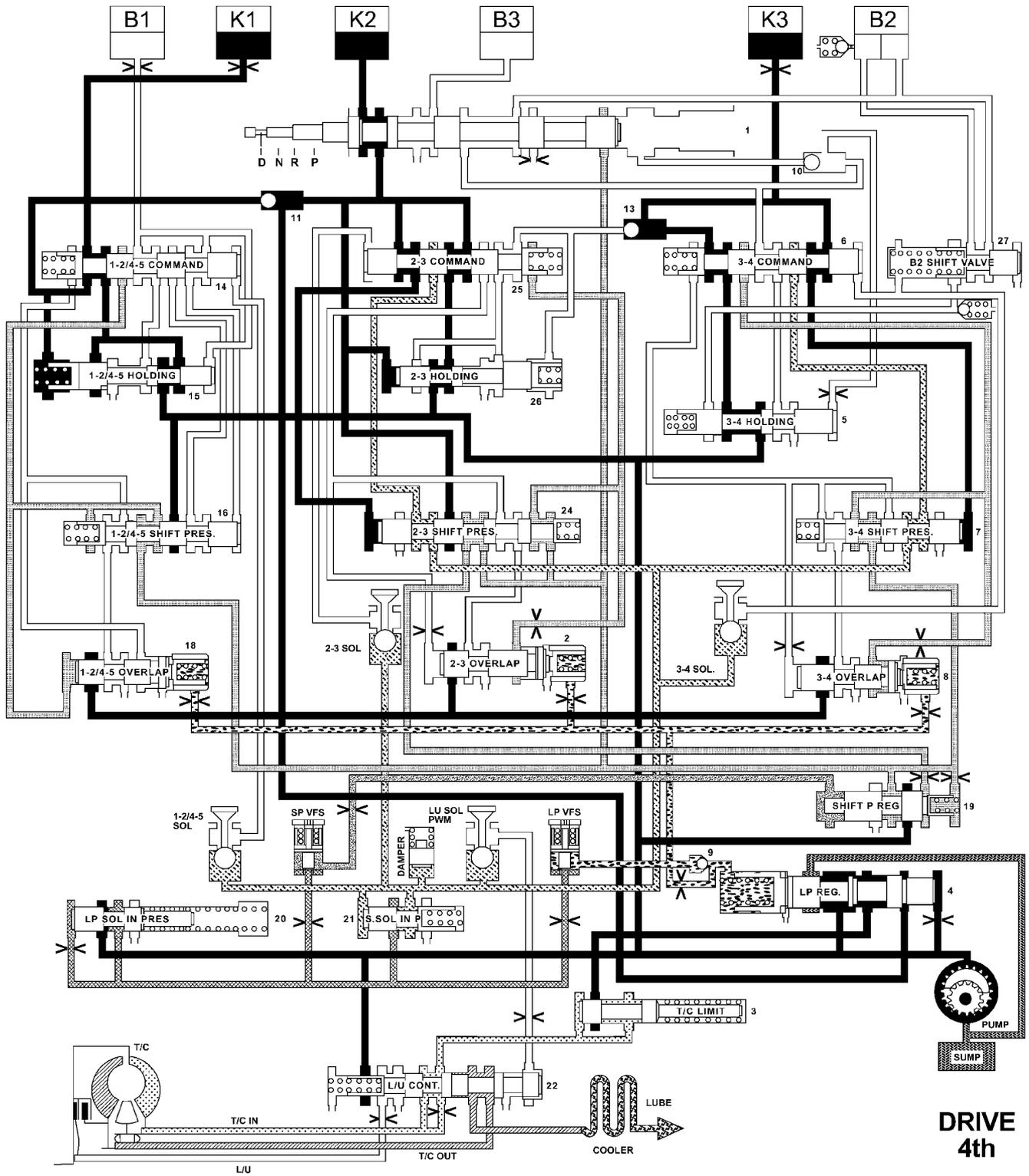


**DRIVE  
D3 TO D4  
TRANSITION**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	OVERLAP PRESSURE	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/ CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810bb0e0

**HYDRAULIC FLOW IN DRIVE - THIRD TO FOURTH GEAR TRANSITION**

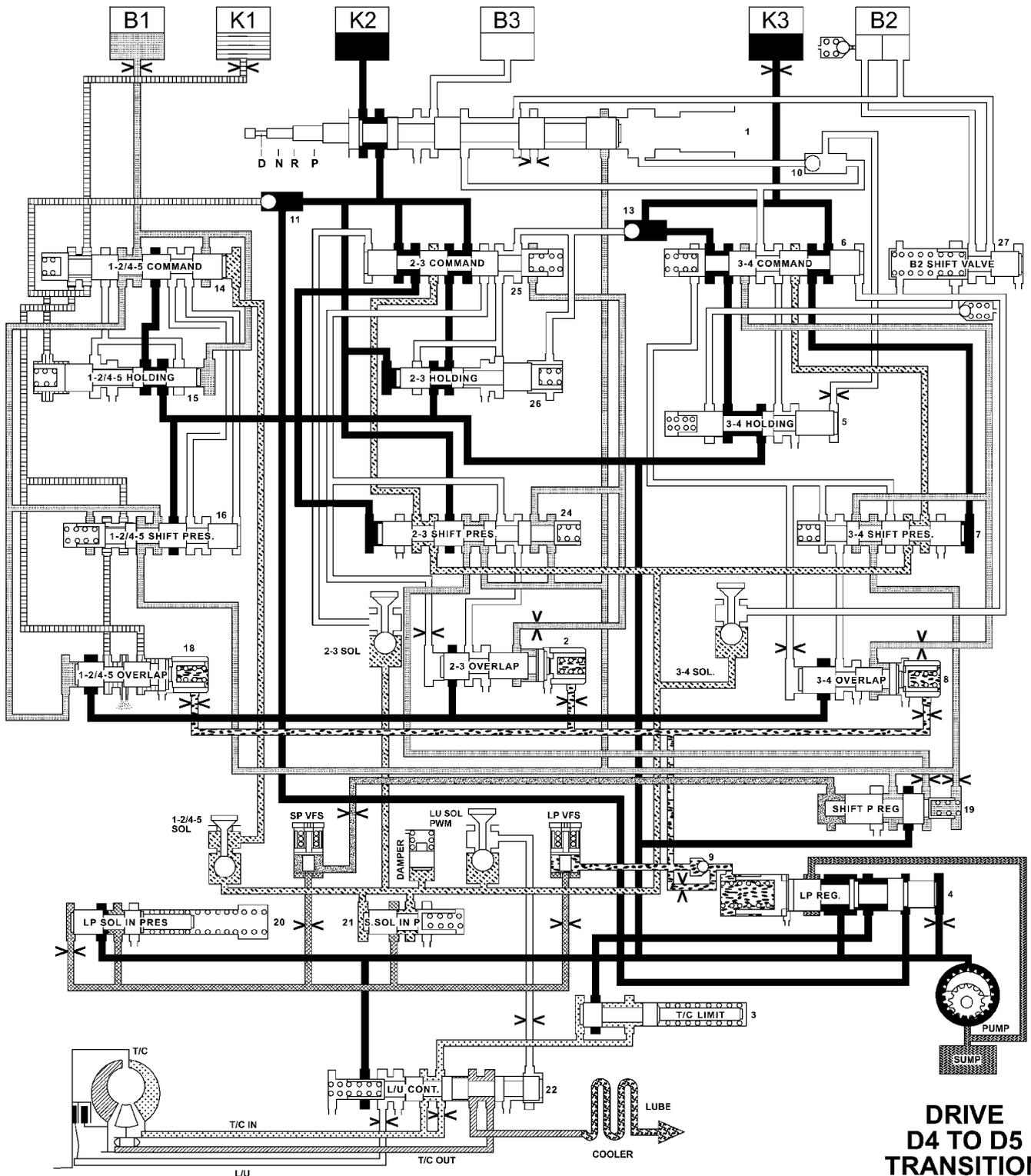


**DRIVE**  
**4th**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810bb115

**HYDRAULIC FLOW IN DRIVE - FOURTH GEAR**

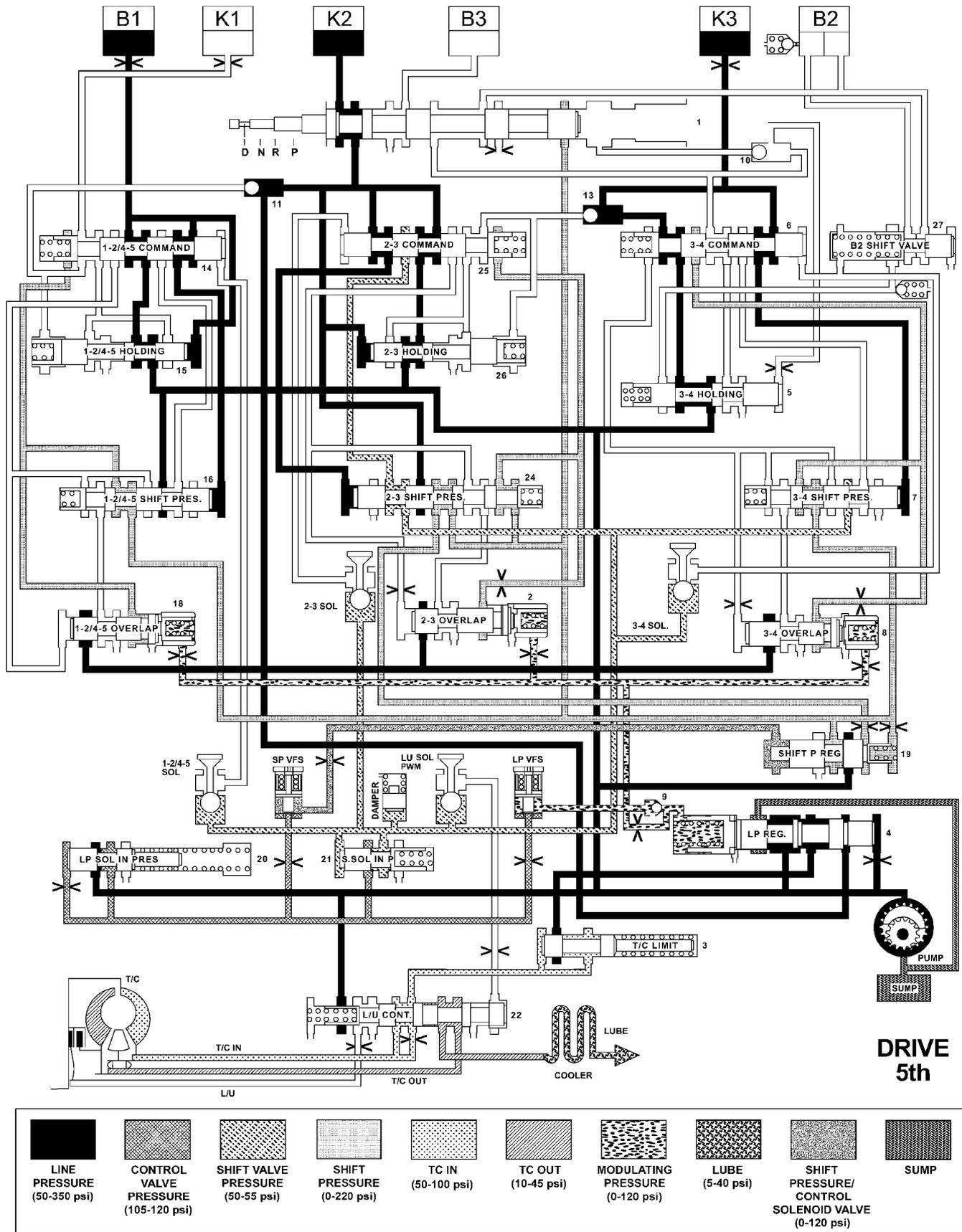


**DRIVE  
D4 TO D5  
TRANSITION**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	OVERLAP PRESSURE	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/ CONTROL SOLENOID VALVE (0-120 psi)	SUMP

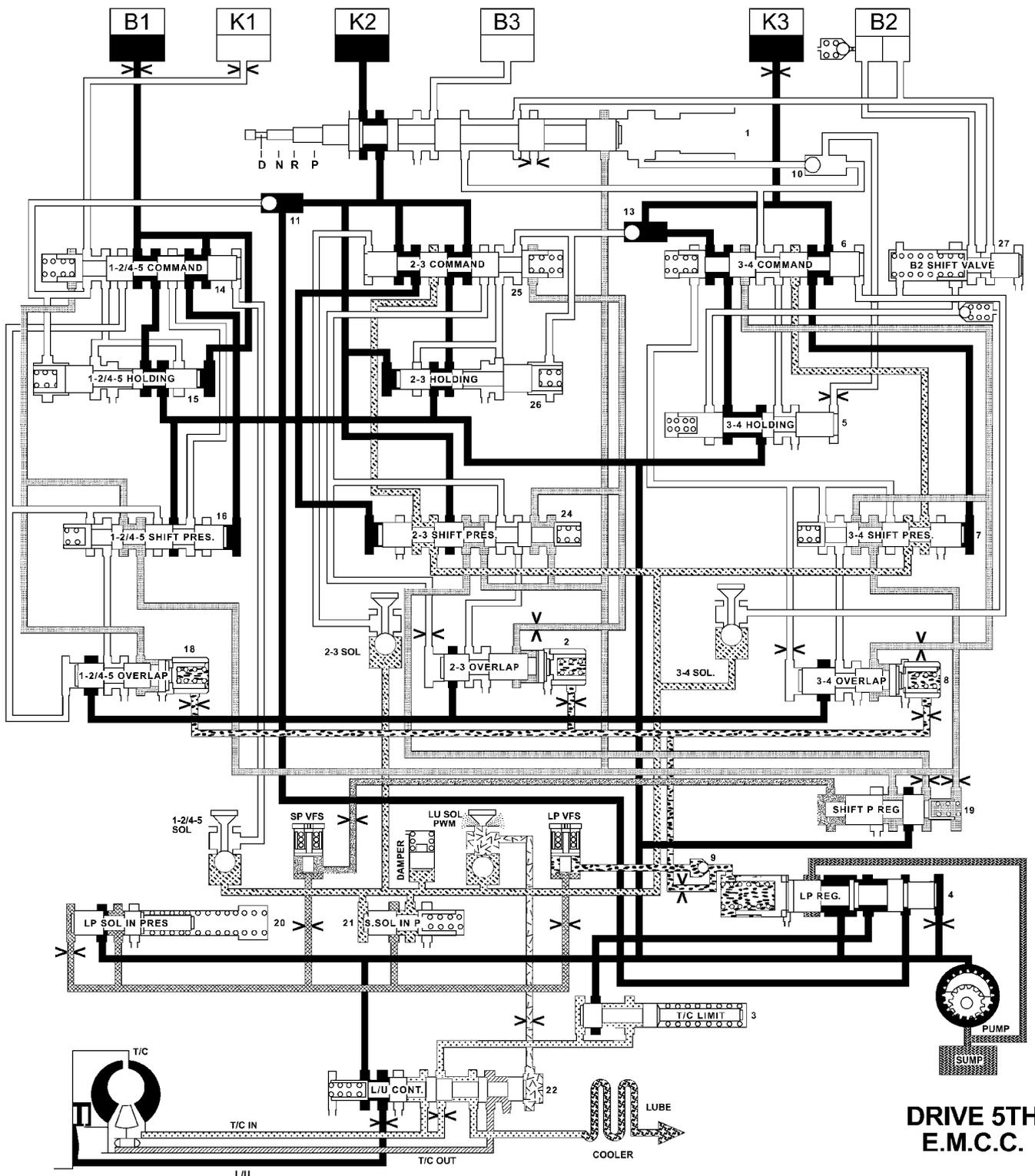
810bb20a

**HYDRAULIC FLOW IN DRIVE - FOURTH TO FIFTH GEAR TRANSITION**



810bb210

**HYDRAULIC FLOW IN DRIVE - FIFTH GEAR**

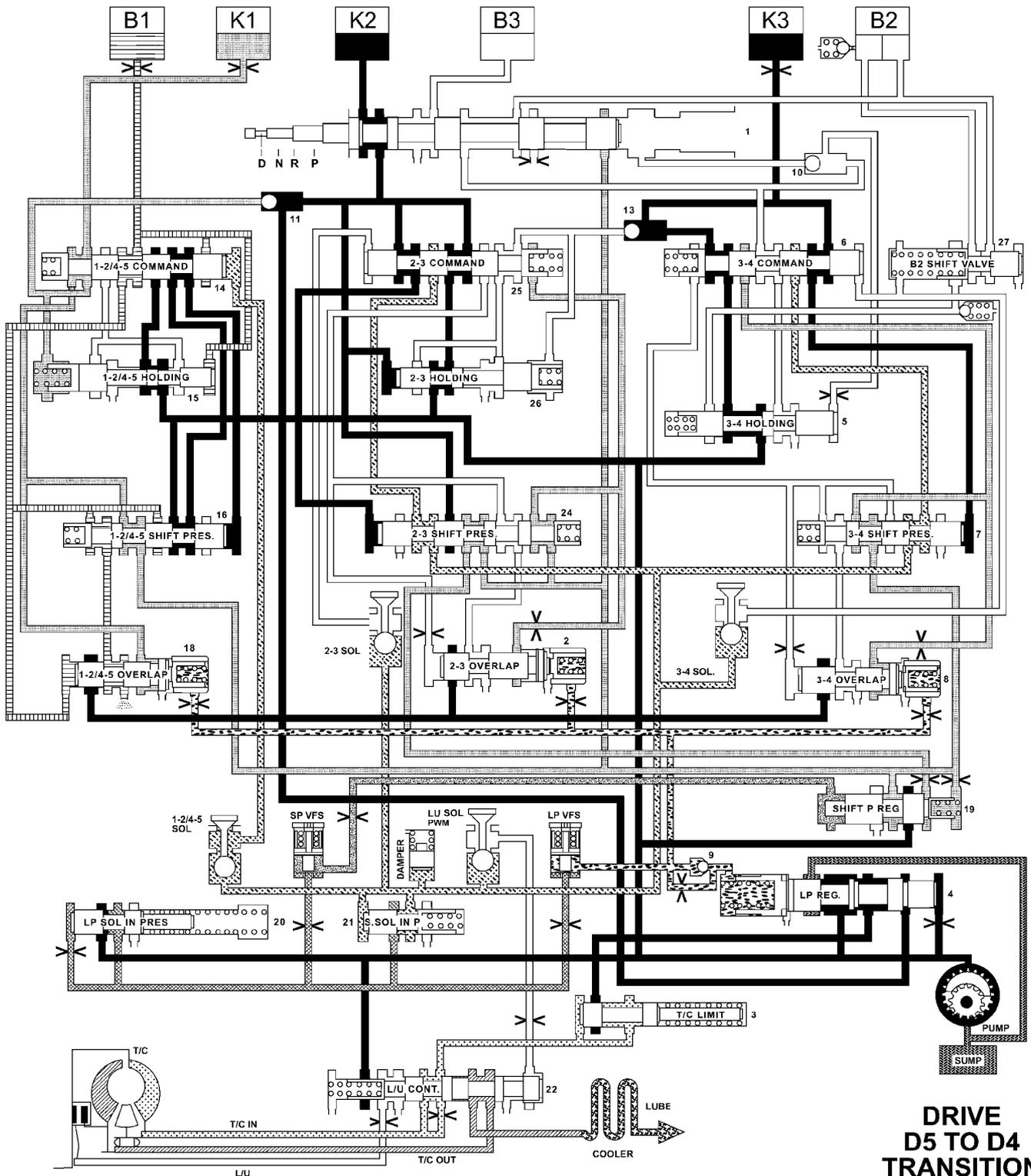


**DRIVE 5TH  
E.M.C.C.**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	OVERLAP PRESSURE	CONVERTER CONTROL PRESSURE	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/ CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810bb235

**HYDRAULIC FLOW IN DRIVE - FIFTH GEAR - EMCC**

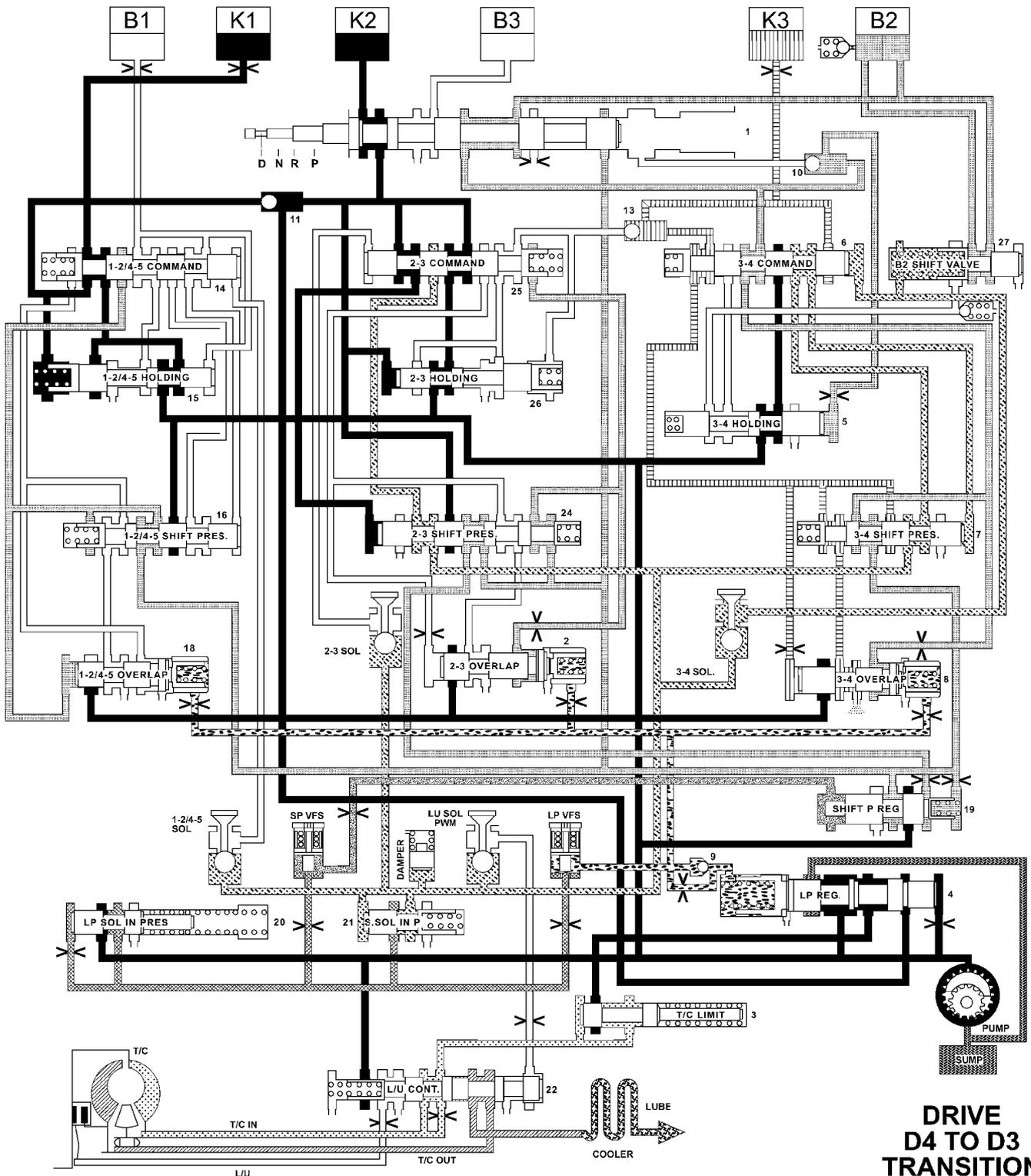


**DRIVE  
D5 TO D4  
TRANSITION**

<b>LINE PRESSURE</b> (50-350 psi)	<b>CONTROL VALVE PRESSURE</b> (105-120 psi)	<b>SHIFT VALVE PRESSURE</b> (50-55 psi)	<b>SHIFT PRESSURE</b> (0-220 psi)	<b>TC IN</b> (50-100 psi)	<b>TC OUT</b> (10-45 psi)	<b>OVERLAP PRESSURE</b>	<b>MODULATING PRESSURE</b> (0-120 psi)	<b>LUBE</b> (5-40 psi)	<b>SHIFT PRESSURE/CONTROL SOLENOID VALVE</b> (0-120 psi)	<b>SUMP</b>

810bb261

**HYDRAULIC FLOW IN DRIVE - FIFTH TO FOURTH GEAR TRANSITION**

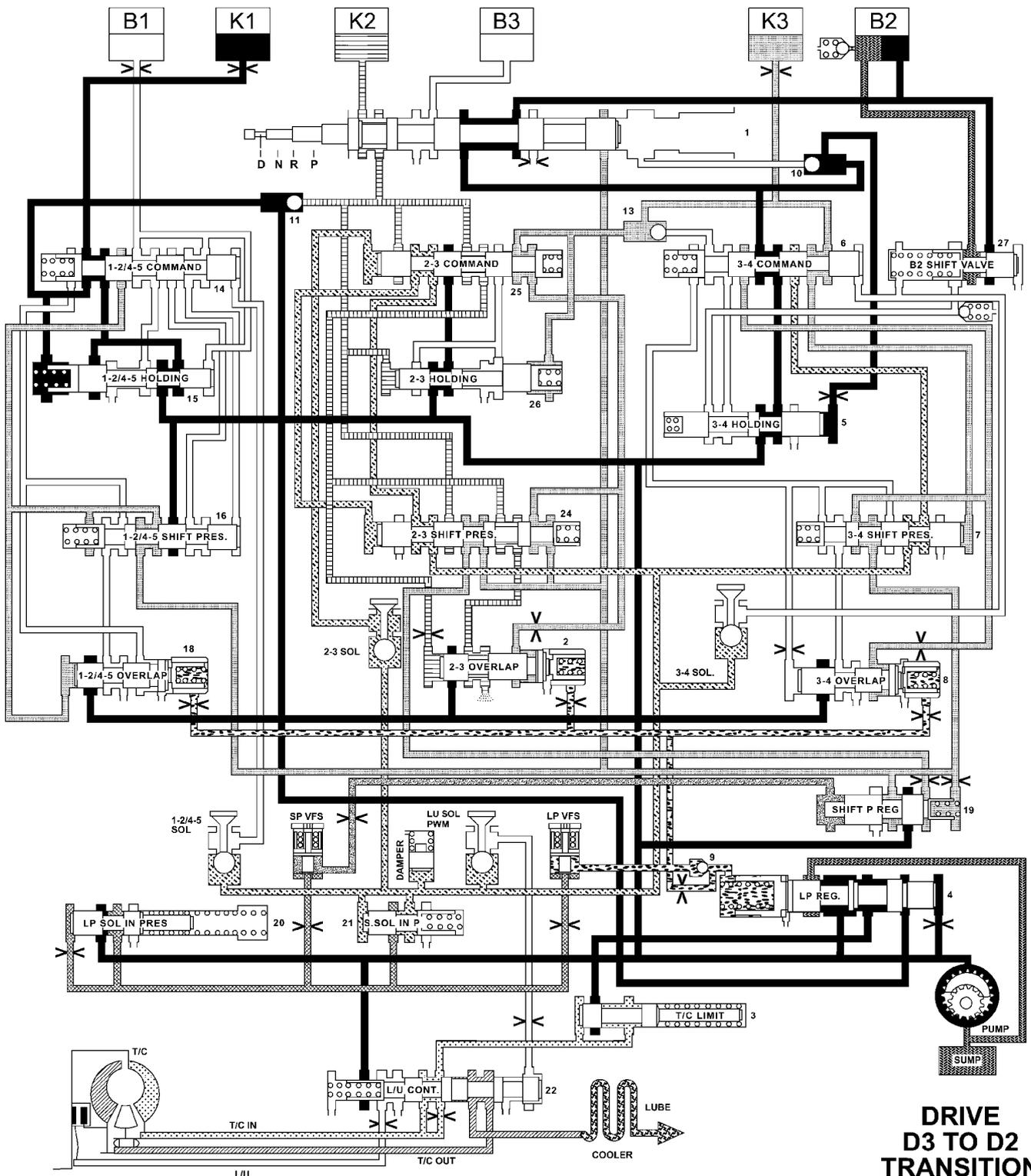


**DRIVE  
D4 TO D3  
TRANSITION**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	OVERLAP PRESSURE	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/ CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810bb2e7

**HYDRAULIC FLOW IN DRIVE - FOURTH TO THIRD GEAR TRANSITION**

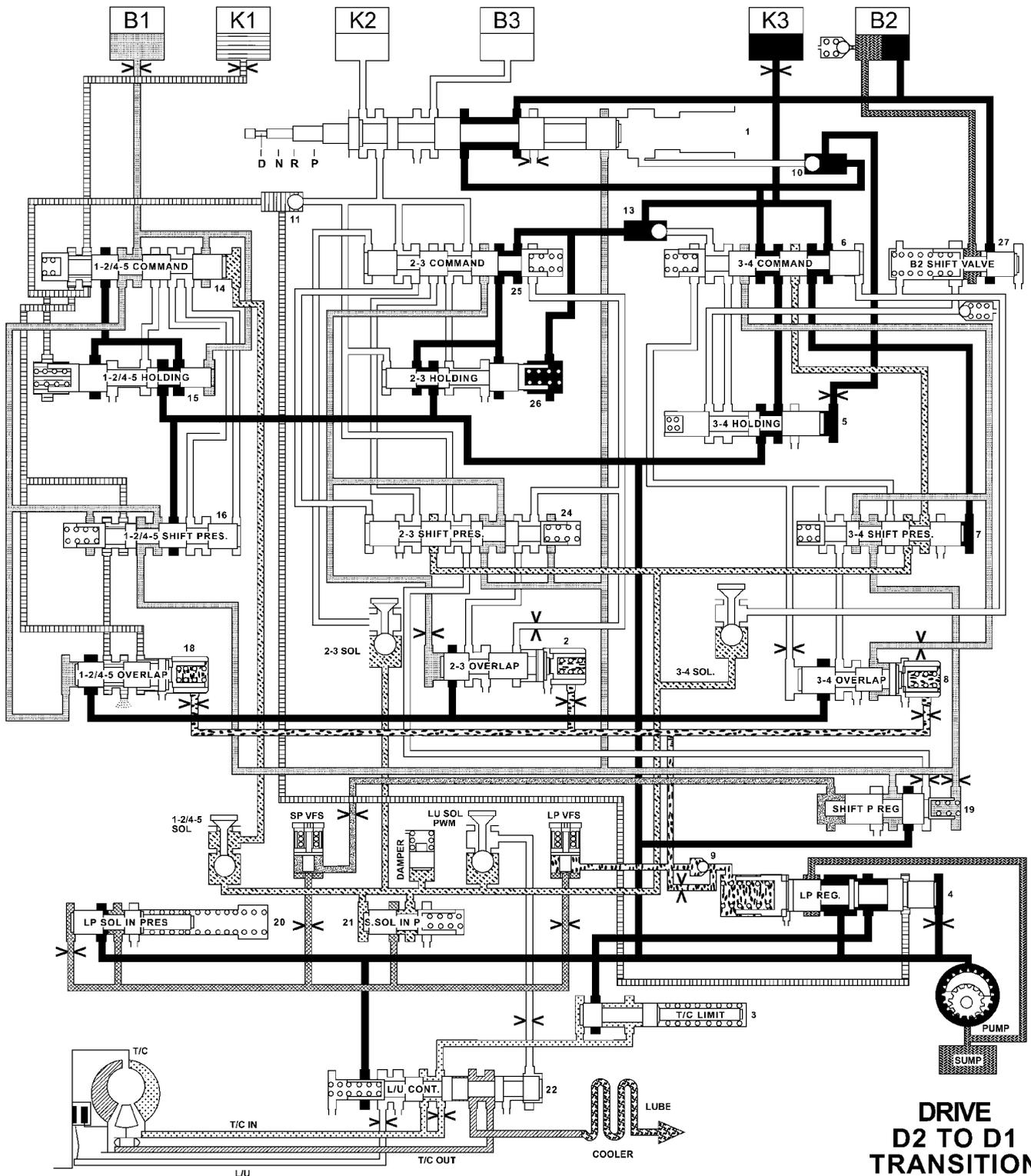


**DRIVE  
D3 TO D2  
TRANSITION**

LINE PRESSURE (50-350 psi)	CONTROL VALVE PRESSURE (105-120 psi)	SHIFT VALVE PRESSURE (50-55 psi)	SHIFT PRESSURE (0-220 psi)	TC IN (50-100 psi)	TC OUT (10-45 psi)	OVERLAP PRESSURE	MODULATING PRESSURE (0-120 psi)	LUBE (5-40 psi)	SHIFT PRESSURE/ CONTROL SOLENOID VALVE (0-120 psi)	SUMP

810bb2ec

**HYDRAULIC FLOW IN DRIVE - THIRD TO SECOND GEAR TRANSITION**



**DRIVE  
D2 TO D1  
TRANSITION**

<b>LINE PRESSURE</b> (50-350 psi)	<b>CONTROL VALVE PRESSURE</b> (105-120 psi)	<b>SHIFT VALVE PRESSURE</b> (50-55 psi)	<b>SHIFT PRESSURE</b> (0-220 psi)	<b>TC IN</b> (50-100 psi)	<b>TC OUT</b> (10-45 psi)	<b>OVERLAP PRESSURE</b>	<b>MODULATING PRESSURE</b> (0-120 psi)	<b>LUBE</b> (5-40 psi)	<b>SHIFT PRESSURE/CONTROL SOLENOID VALVE</b> (0-120 psi)	<b>SUMP</b>

810bb217

**HYDRAULIC FLOW IN DRIVE - SECOND TO FIRST GEAR TRANSITION**

## SPECIFICATIONS

### GEAR RATIOS

1ST	3.59:1
2ND	2.19:1
3RD	1.41:1
4TH	1.00:1
5TH	0.83:1
REVERSE	3.16:1

### SPECIFICATIONS

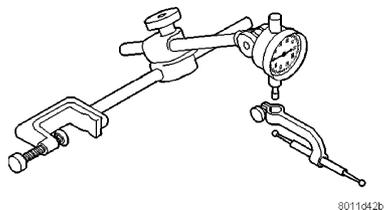
COMPONENT		METRIC (mm)	INCH (in.)
Geartrain End-play		0.3-0.5	0.012-0.020
Geartrain End-play Shim		0.2, 0.3, 0.4, and 0.5	0.008, 0.012, 0.016, 0.020
Rear Planetary Gear Set End-play		0.15-0.6	0.006-0.024
Rear Planetary Gear Set Snap-rings		3.0, 3.4, and 3.7	0.118, 0.134, 0.146
B1 Clutch Clearance - Double Sided Friction Discs	2 Disc	2.3-2.7	0.091-0.106
	3 Disc	2.7-3.1	0.106-0.122
	4 Disc	3.0-3.4	0.118-0.134
B1 Clutch Clearance - Single Sided Friction Discs	4 Disc	2.2-2.6	0.087-0.102
	6 Disc	2.4-2.8	0.095-0.110
	8 Disc	2.6-3.0	0.102-0.118
B1 Clutch Snap-rings		2.6, 2.9, 3.2, 3.5, 3.8, and 4.1	0.102, 0.114, 0.126, 0.138, 0.150, 0.162
B2 Clutch Clearance	4 Disc	1.9-2.3	0.075-0.091
	5 Disc	2.0-2.4	0.079-0.095
B2 Clutch Snap-rings		2.9, 3.2, 3.5, 3.8, and 4.1	0.114, 0.126, 0.138, 0.150, 0.162
B3 Clutch Clearance		1.0-1.4	0.039-0.055
B3 Clutch Snap-rings		3.2, 3.5, 3.8, 4.1, 4.4, and 4.7	0.126, 0.138, 0.150, 0.162, 0.173, 0.185
K1 Clutch Clearance - Double Sided Friction Discs	3 Disc	2.7-3.1	0.106-0.122
	4 Disc	3.0-3.4	0.118-0.134
	5 Disc	3.3-3.7	0.13-0.146
	6 Disc	3.6-4.0	0.142-0.158
K1 Clutch Clearance - Single Sided Friction Discs	6 Disc	2.4-2.8	0.095-0.110
	8 Disc	2.6-3.0	0.102-0.118
	10 Disc	2.8-3.2	0.110-0.126
	12 Disc	2.9-3.3	0.114-0.130
K1 Clutch Snap-rings		2.6, 2.9, 3.2, 3.5, 3.8, and 4.1	0.102, 0.114, 0.126, 0.138, 0.150, 0.162
K2 Clutch Clearance	3 Disc	2.3-2.7	0.091-0.106
	4 Disc	2.4-2.8	0.095-0.110
	5 Disc	2.5-2.9	0.099-0.114
	6 Disc	2.7-3.1	0.106-0.122

COMPONENT		METRIC (mm)	INCH (in.)
K2 Clutch Snap-rings		2.3, 2.6, 2.9, 3.2, 3.5, and 3.8	0.091, 0.102, 0.114, 0.126, 0.138, 0.150
K3 Clutch Clearance - Double Sided Friction Discs	3 Disc	2.3-2.7	0.091-0.106
	4 Disc	2.4-2.8	0.095-0.110
	5 Disc	2.5-2.9	0.099-0.114
K3 Clutch Clearance - Single Sided Friction Discs	6 Disc	2.3-2.7	0.091-0.106
	8 Disc	2.4-2.8	0.095-0.110
	10 Disc	2.5-2.9	0.099-0.114
K3 Clutch Snap-rings		2.0, 2.3, 2.6, 2.9, 3.2, and 3.5	0.079, 0.091, 0.102, 0.114, 0.126, 0.138

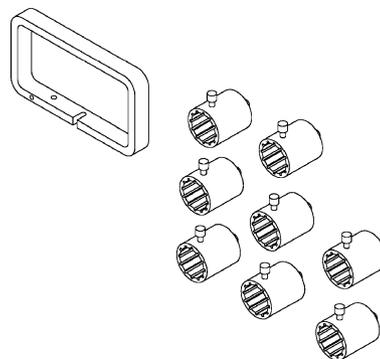
**TORQUE SPECIFICATIONS**

DESCRIPTION	N-m	Ft. Lbs.	In. Lbs.
Bolt, B2 Clutch Carrier	16	-	141
Bolt, B1 Carrier to Converter Housing	10	-	88.5
Bolt, Oil Pump	20	-	177
Nut, Propeller Flange	120	88.5	-
Bolt, Electrohydraulic Unit	8	-	71
Bolt, Transmission Housing to Converter Housing	20	-	177
Bolts, Oil Pan	8	-	71
Screws, Valve Body/ Housing Side Cover	4	-	35
Bolt, Shift Plate	8	-	71
Bolt, Solenoid Leaf Spring	8	-	71
Nut, Shifter Mechanism to Floor Pan	7	-	65

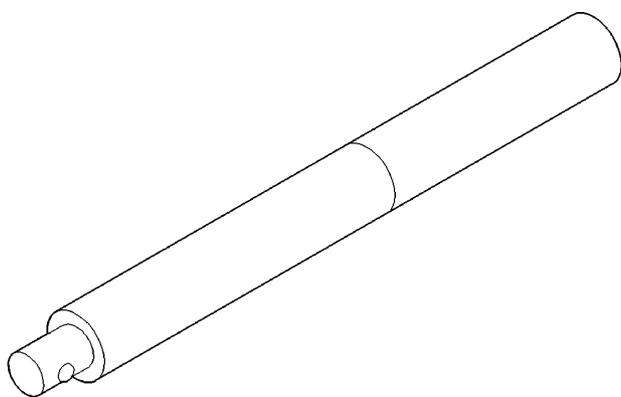
### SPECIAL TOOLS - AUTOMATIC TRANSMISSION - NAG1



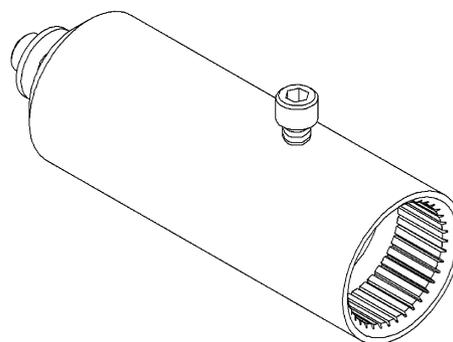
**Dial Indicator - C-3339**



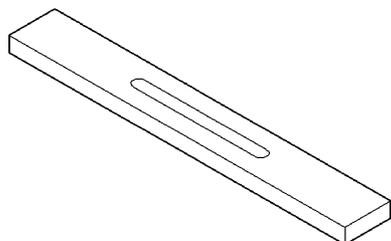
**End Play Set - 8266**



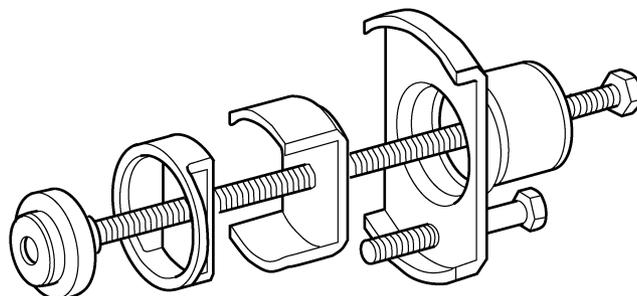
**Driver Handle C-4171**



**Adapter, Geartrain End-play - 8266-18**

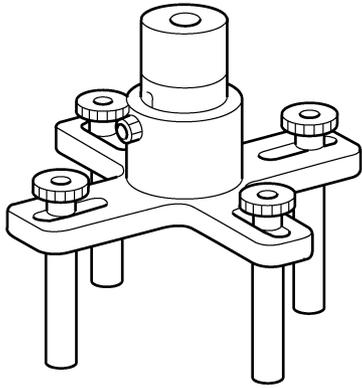


**Bar, Gauge - 6311**



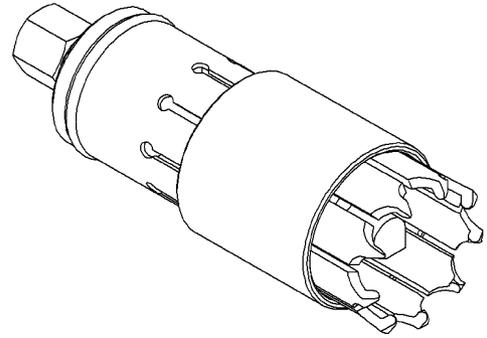
80e490db

**Compressor, Multi-use Spring - 8900**

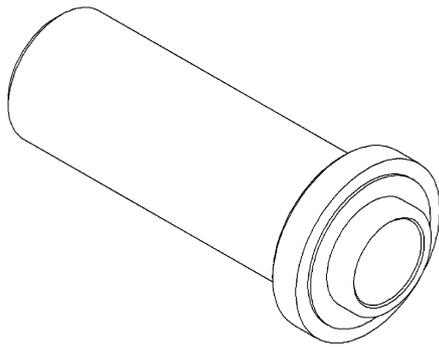


**Tool, Pressing - 8901**

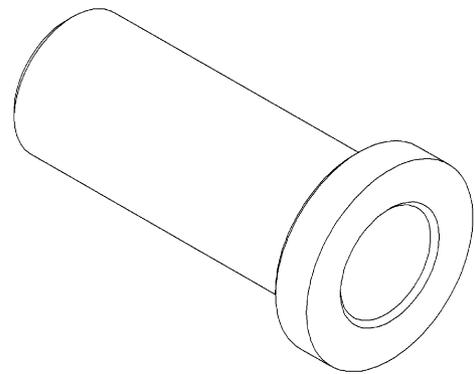
80e490e0



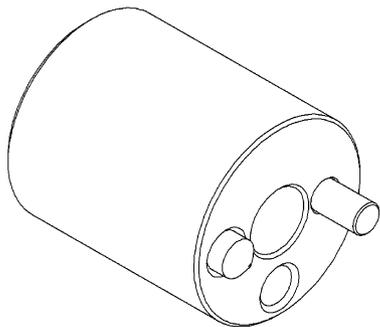
**Remover, Bearing - 9082**



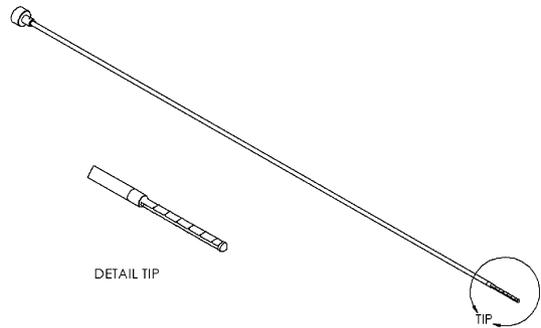
**Installer, Seal - 8902A**



**Installer, Bearing - 9287**



**Tool, Staking - 9078**



DETAIL TIP

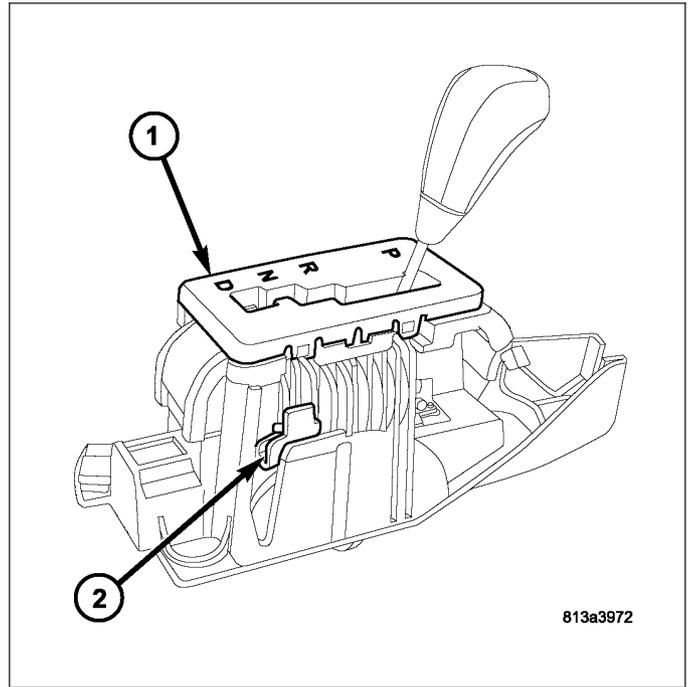
TIP

## MECHANISM-BRAKE TRANSMISSION SHIFT INTERLOCK

### DESCRIPTION

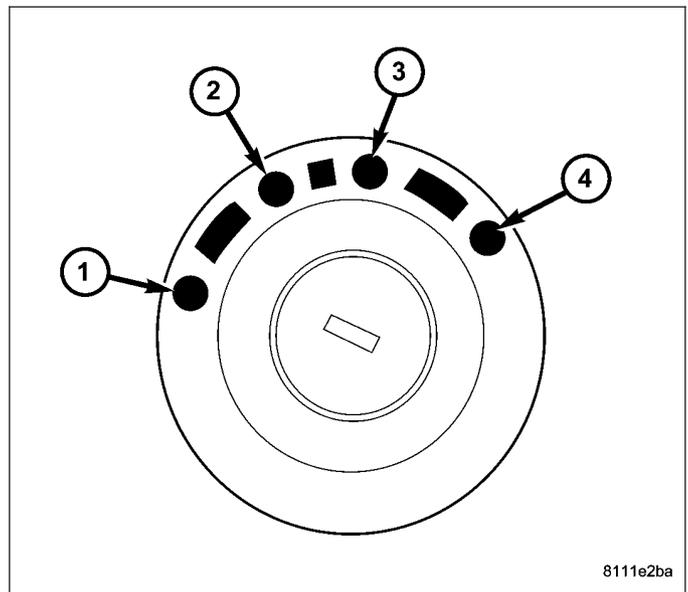
The Brake Transmission Shifter/Ignition Interlock (BTSI) is a cable operated system that prevents the transmission gear shifter from being moved out of PARK without the proper driver inputs. The system also contains a solenoid that is integral to the shifter assembly. The solenoid works in conjunction with the park lock cable to permit shifter movement out of PARK when the brake is depressed and prevents shifter movement into REVERSE unless a shift into REVERSE is permitted.

A BTSI override (2) is provided on the side of the shifter mechanism (1) to allow the vehicle to be shifted out of PARK in the event of an electrical failure.



### OPERATION

The Brake Transmission Shifter/Ignition Interlock (BTSI) is engaged whenever the ignition switch is in the LOCK (1) position. An additional electrically activated feature will prevent shifting out of the PARK position unless the brake pedal is depressed at least one-half inch. A solenoid in the shifter assembly is energized when the ignition is in the ON position and the brake pedal is depressed. When the key is in the ON position and the brake pedal is depressed, the shifter is unlocked and will move into any position. The interlock system also prevents the ignition switch from being turned to the LOCK position, unless the shifter is in the gated PARK position.



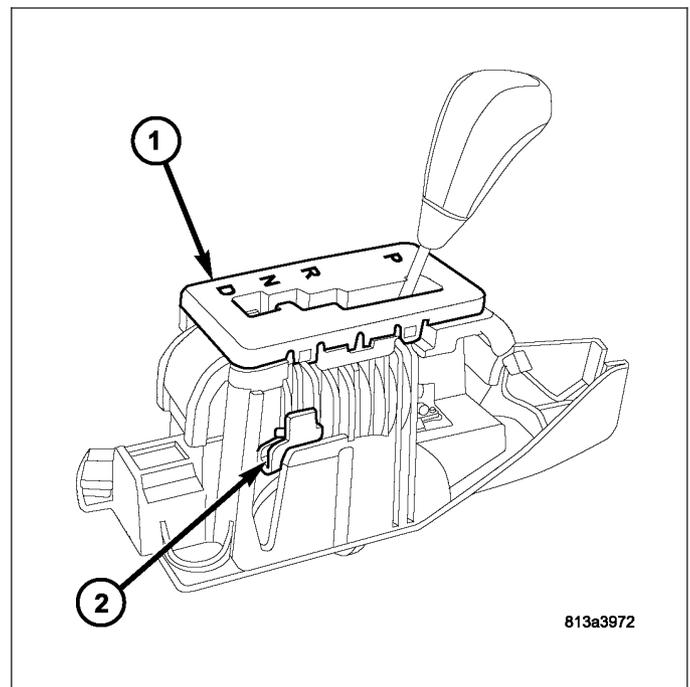
The following chart describes the normal operation of the Brake Transmission Shift Interlock (BTSI) system. If the "expected response" differs from the vehicle's response, then system repair and/or adjustment is necessary.

ACTION	EXPECTED RESPONSE
1. Turn key to the "ACC" position and depress brake pedal.	1. Shifter CAN be shifted out of park.
2. Turn key to the "ON" position, with foot off of brake pedal.	2. Shifter CANNOT be shifted out of park.
3. Turn key to the "ON" position and depress the brake pedal.	3. Shifter CAN be shifted out of park.
4. Leave shifter in any gear, except "PARK", and try to return key to the "LOCK" position.	4. Key cannot be returned to the "LOCK" position.
5. Return shifter to "PARK" and try to remove the key.	5. Key can be removed (after returning to "LOCK" position).
6. With the key removed, and the brake depressed, try to shift out of "PARK".	6. Shifter cannot be shifted out of "PARK".
<b>NOTE: Any failure to meet these expected responses requires system adjustment or repair.</b>	

### BTSI Override

In the event of an electrical failure, the vehicle can be shifted out of PARK by using the following procedure.

1. Turn the key to the ACC or ON position.
2. Remove the liner to the cubby bin to the right side of the shifter.
3. Depress the BTSI override (2) on the side of the shifter assembly (1).
4. While the override is depressed, move the shifter out of the PARK position.
5. Return the cubby bin liner to its original location.



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## DIAGNOSIS AND TESTING - BRAKE TRANSMISSION SHIFT INTERLOCK

### SYSTEM VERIFICATION

1. Verify that the key can only be removed in the PARK position
2. When the shift lever is in PARK, the ignition key cylinder should rotate freely from ACC to LOCK. When the shifter is in any other gear or neutral position, the ignition key cylinder should not rotate to the LOCK position.
3. Shifting out of PARK should not be possible when the ignition key cylinder is in the ACC position and the brake pedal is not depressed.
4. Shifting out of PARK should not be possible while applying normal force on the shift lever and ignition key cylinder is in the ACC, ON, or START positions unless the foot brake pedal is depressed approximately 1/2 inch (12mm).

5. Shifting out of PARK should not be possible when the ignition key cylinder is in the LOCK position, regardless of the brake pedal position.
6. Shifting between any gears, NEUTRAL or into PARK may be done without depressing foot brake pedal with ignition switch in ACC, ON, or START positions.

**DIAGNOSTIC CHART**

CONDITION	POSSIBLE CAUSE	CORRECTION
KEY WILL NOT ROTATE TO THE LOCK POSITION.	1. Misadjusted Park Lock cable.	1. Adjust Park Lock cable. (Refer to 21 - TRANSMISSION AND TRANSFER CASE/AUTOMATIC TRANSMISSION/BRAKE TRANSMISSION SHIFT INTERLOCK SYSTEM - ADJUSTMENTS)
	2. Misadjusted gearshift cable.	2. Adjust gearshift cable. (Refer to 21 - TRANSMISSION AND TRANSFER CASE/AUTOMATIC TRANSMISSION/GEAR SHIFT CABLE - ADJUSTMENTS)
	3. Burrs on ignition key.	3. Remove burrs and cycle key several times to verify operation.
	4. Binding or broken components.	4. Inspect system components and repair/replace components as necessary.
VEHICLE WILL NOT START UNLESS SHIFTER IS HELD FORWARD, OR REARWARD, OF THE PARK POSITION.	1. Misadjusted gearshift cable.	1. Adjust gearshift cable. (Refer to 21 - TRANSMISSION AND TRANSFER CASE/AUTOMATIC TRANSMISSION/GEAR SHIFT CABLE - ADJUSTMENTS)

**ADJUSTMENTS - BRAKE TRANSMISSION SHIFT INTERLOCK**

The park interlock cable is part of the brake/shift lever interlock system. Correct cable adjustment is important to proper interlock operation. The gear shift and park lock cables must both be correctly adjusted in order to shift out of PARK.

**ADJUSTMENT PROCEDURE**

1. Remove floor console as necessary for access to the park lock cable. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
2. Shift the transmission into the PARK position.
3. Turn ignition switch to LOCK position. **Be sure ignition key cylinder is in the LOCK position. Cable will not adjust correctly in any other position.**

**Note: If the key will not turn to the LOCK position, pull up on the cable lock button and manually move the cable in and out until the key can be turned to the LOCK position.**

4. Pull cable lock button up to release cable, if necessary.
5. Remove and discard the cable adjuster lock pin, if a new cable is being installed.
6. Ensure that the cable is free to self-adjust by pushing cable rearward and releasing.
7. Push lock button down until it snaps in place. The lock should be 1-2mm below the surface of the cylindrical portion of the cable adjustment housing.

**BTSI FUNCTION CHECK**

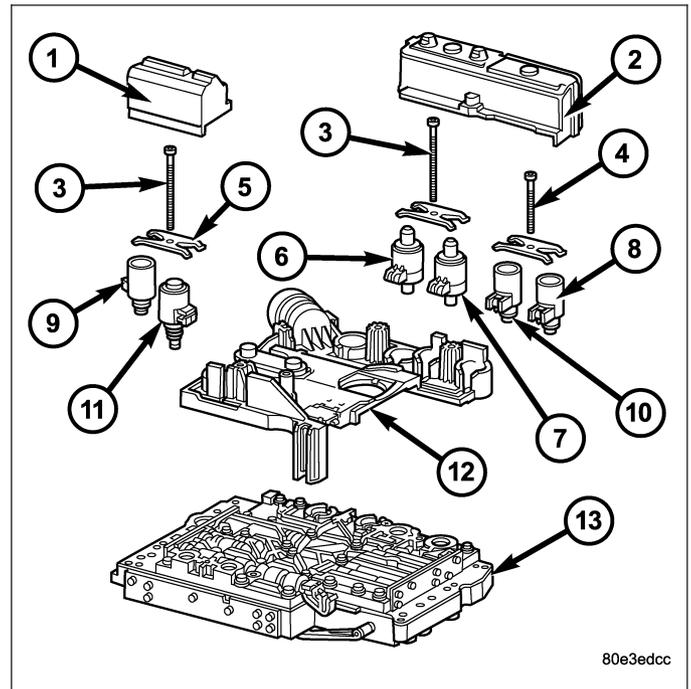
1. Verify removal of ignition key allowed in PARK position only.
2. When the shift lever is in PARK, the ignition key cylinder should rotate freely LOCK position. When the shifter is in any other position, the ignition key should not rotate to the LOCK position.
3. Shifting out of PARK should not be possible when the ignition key cylinder is in the ACC position and the brake pedal is not depressed.
4. Shifting out of PARK should not be possible while applying normal force on the shift lever and ignition key cylinder is in the ACC, ON, or START positions unless the foot brake pedal is depressed approximately 1/2 inch (12mm).
5. Shifting out of PARK should not be possible when the ignition key cylinder is in the LOCK position, regardless of the brake pedal position.
6. Shifting between any gears, NEUTRAL or into PARK may be done without depressing foot brake pedal with ignition switch in ACC, ON, or START positions.
7. The floor shifter lever and gate positions should be in alignment with all transmission detent positions.
8. Engine starts must be possible with shifter lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gate positions other than PARK or NEUTRAL.
9. With the shifter lever handle in the:
  - PARK position- apply forward force on center of handle and remove pressure. Engine start must be possible.
  - PARK position- apply rearward force on center of handle and remove pressure. Engine start must be possible.
  - NEUTRAL position- engine start must be possible.
  - NEUTRAL position, engine running and brakes applied- Apply forward force on center of shift handle. Transmission should not be able to shift into REVERSE detent.

## UNIT-ELECTROHYDRAULIC CONTROL

### DESCRIPTION

The electrohydraulic control unit comprises the shift plate (13) made from light alloy for the hydraulic control and an electrical control unit (12). The electrical control unit (12) comprises of a supporting body made of plastic, into which the electrical components (1 - 11) are assembled. The supporting body is mounted on the shift plate (13) and screwed to it.

Strip conductors inserted into the supporting body make the connection between the electrical components and a plug connector. The connection to the wiring harness on the vehicle and the transmission control module (TCM) is produced via this 13-pin plug connector with a bayonet lock.

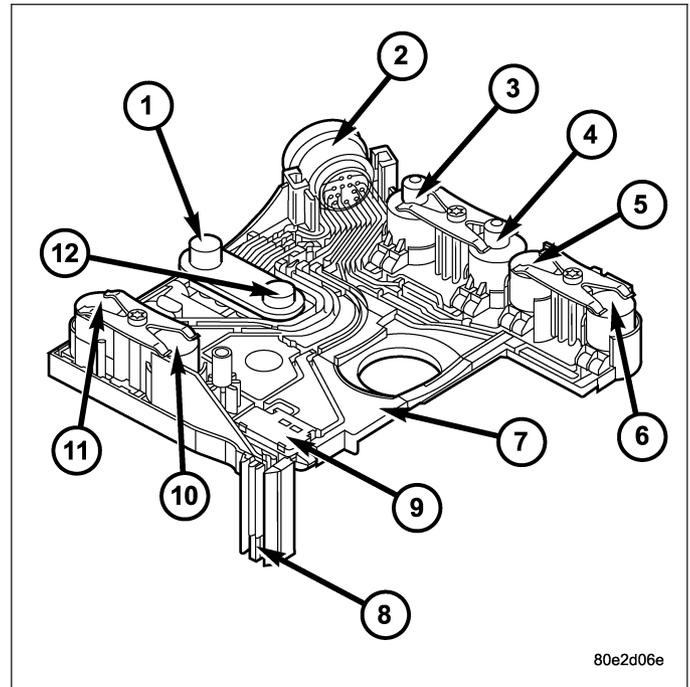


**Electrical Unit Components**

- 1 - SOLENOID CAP
- 2 - SOLENOID CAP
- 3 - BOLT - M6X32
- 4 - BOLT - M6X30
- 5 - LEAF SPRING
- 6 - MODULATING PRESSURE REGULATING SOLENOID VALVE
- 7 - SHIFT PRESSURE REGULATING SOLENOID
- 8 - 3-4 SHIFT SOLENOID
- 9 - TORQUE CONVERTER LOCK-UP SOLENOID
- 10 - 1-2/4-5 SHIFT SOLENOID
- 11 - 2-3 SHIFT SOLENOID
- 12 - ELECTRICHYDRAULIC CONTROL MODULE
- 13 - SHIFT PLATE

## ELECTRICAL CONTROL UNIT

The electric valve control unit (7) consists of a plastic shell which houses the RPM sensors (1,12), regulating solenoid valves (3, 4), solenoid valves (5, 6, 10), the TCC solenoid valve (11), the park/neutral contact (9), and the transmission oil temperature sensor (8). Conductor tracks integrated into the shell connect the electric components to a plug connection (2). This 13-pin plug connection (2) establishes the connection to the vehicle-side cable harness and to the transmission control module (TCM). With the exception of the solenoid valves, all other electric components are fixed to the conductor tracks.



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## HYDRAULIC CONTROL UNIT

### Working Pressure (Line Pressure or Operating Pressure) (p-A)

The working pressure provides the pressure supply to the hydraulic control and the transmission shift elements. It is the highest hydraulic pressure in the entire hydraulic system. The working pressure is regulated at the working pressure regulating valve in relation to the load and gear. All other pressures required for the transmission control are derived from the working pressure.

### Lubrication Pressure (p-Sm)

At the working pressure regulating valve surplus oil is diverted to the lubrication pressure regulating valve, from where it is used in regulated amounts to lubricate and cool the mechanical transmission components and the torque converter. Furthermore, the lubrication pressure (p-Sm) is also used to limit the pressure in the torque converter.

### Shift Pressure (p-S)

The shift pressure is determined by the shift pressure regulating solenoid valve and the shift pressure regulating valve. The shift pressure:

- Regulates the pressure in the activating shift element during the shift phase.
- Determines together with the modulating pressure the pressure reduction at the deactivating shift element as regulated by the overlap regulating valve.
- Initializes 2nd gear in limp-home mode.

### Modulating Pressure (p-Mod)

The modulating pressure influences the size of the working pressure and determines together with the shift pressure the pressure regulated at the overlap regulating valve. The modulating pressure is regulated at the modulating pressure regulating solenoid valve, which is under regulating valve pressure. The modulating pressure is variable and relative to the engine load.

**Regulating Valve/Control Valve Pressure (p-RV)**

The regulating valve pressure is regulated at the regulating valve pressure regulating valve in relation to the working pressure (p-A) up to a maximum pressure of 8 bar (116 psi). It supplies the modulating pressure regulating solenoid valve, the shift pressure regulating solenoid valve and the shift valve pressure regulating valve.

**Shift Valve Pressure (p-SV)**

The shift valve pressure (p-SV) is derived from the regulating valve pressure (p-RV), is regulated at the shift valve pressure regulating valve and is then present at the:

- 1-2 and 4-5 shift solenoid valve.
- 3-4 shift solenoid valve.
- 2-3 shift solenoid valve.
- Torque converter lockup solenoid valve.
- 3-4 and 2-3 shift pressure shift valve.

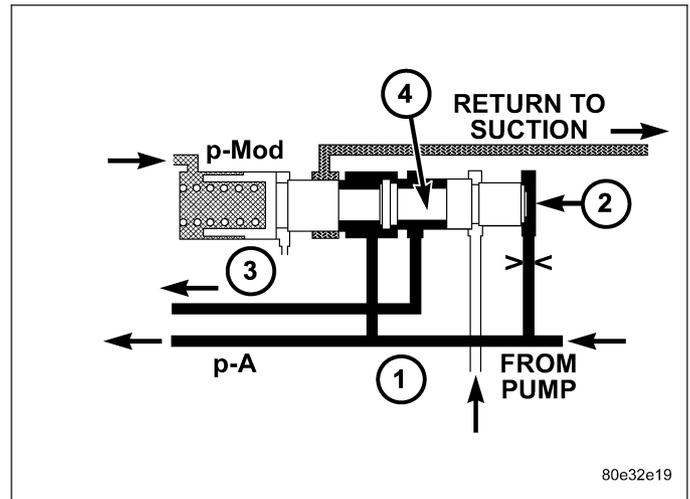
The shift valve pressure (p-SV) controls the command valves via the upshift/downshift solenoid valves.

**Overlap Pressure (p-Ü)**

The overlap pressure controls the shift component pressure reduction during a shift phase. The pressure in a shift element as it disengages is controlled during the shift phase depending on engine load (modulating pressure) and the pressure in the shift element as it engages. The adjusted pressure is inversely proportional to the transmission capability of the shift element being engaged (controlled overlap).

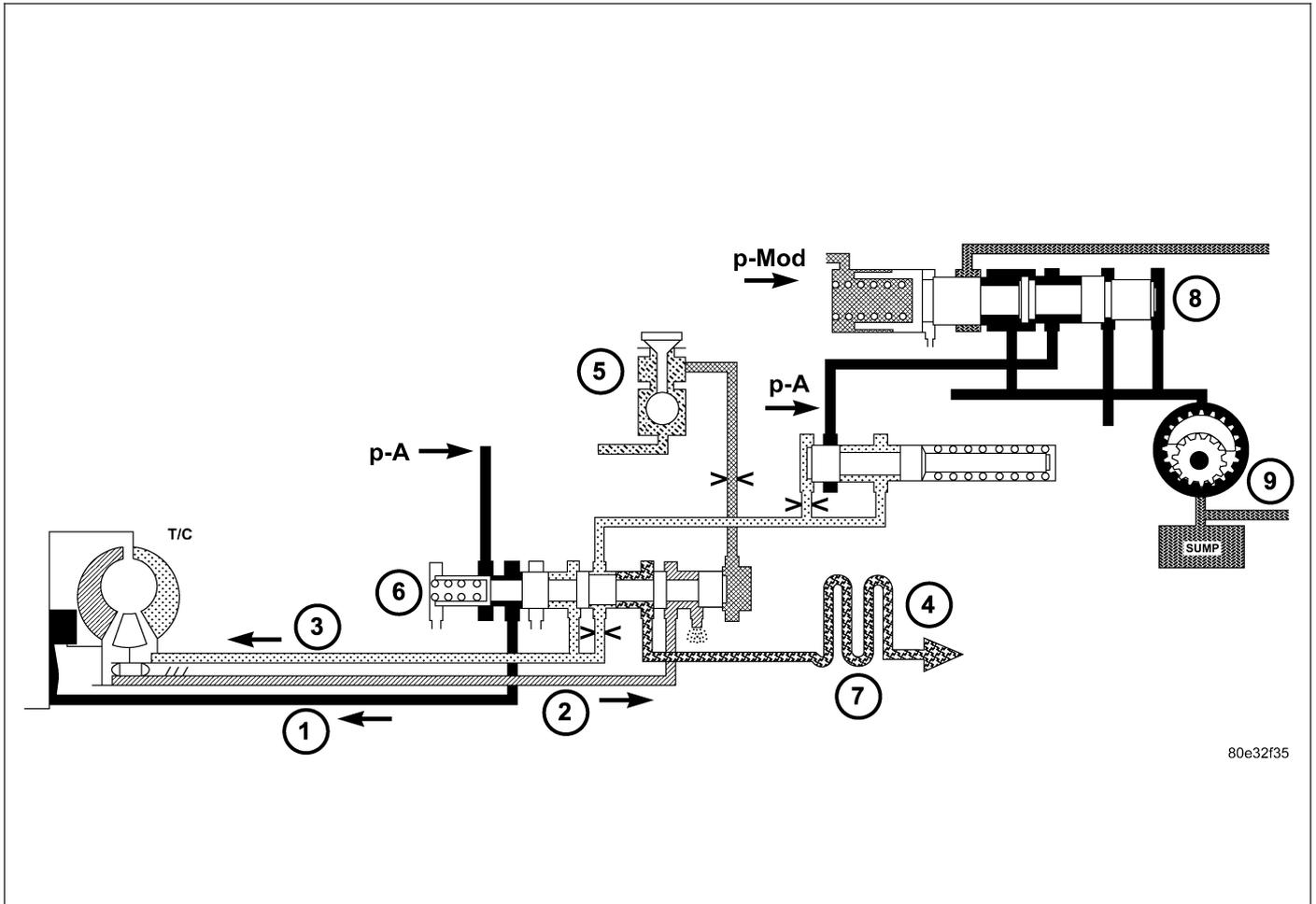
**Working Pressure Regulating Valve (Operating Pressure)**

The working pressure regulating valve (4) is located in the valve housing of the shift plate. It regulates the primary pressure of the hydraulic system.



- 1 - PRESSURE FROM K1/K2
- 2 - END FACE
- 3 - TO TORQUE CONVERTER REGULATING VALVE
- 4 - WORKING PRESSURE REGULATING VALVE

Torque Converter Lockup Clutch Regulating Valve



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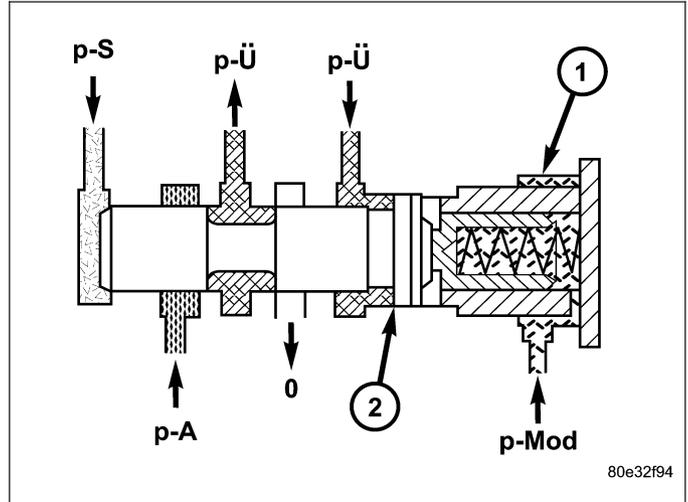
- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER OUTPUT
- 3 - TORQUE CONVERTER INPUT
- 4 - LUBRICATION
- 5 - TORQUE CONVERTER LOCK-UP SOLENOID

- 6 - TORQUE CONVERTER LOCK-UP CLUTCH REGULATING VALVE
- 7 - OIL COOLER
- 8 - LINE PRESSURE REGULATING VALVE
- 9 - OIL PUMP

The torque converter lock-up clutch regulating valve (6) is located in the valve housing of the electrohydraulic control module. The valve is responsible for the hydraulic control of the torque converter lockup clutch and distribution of the lubricating oil.

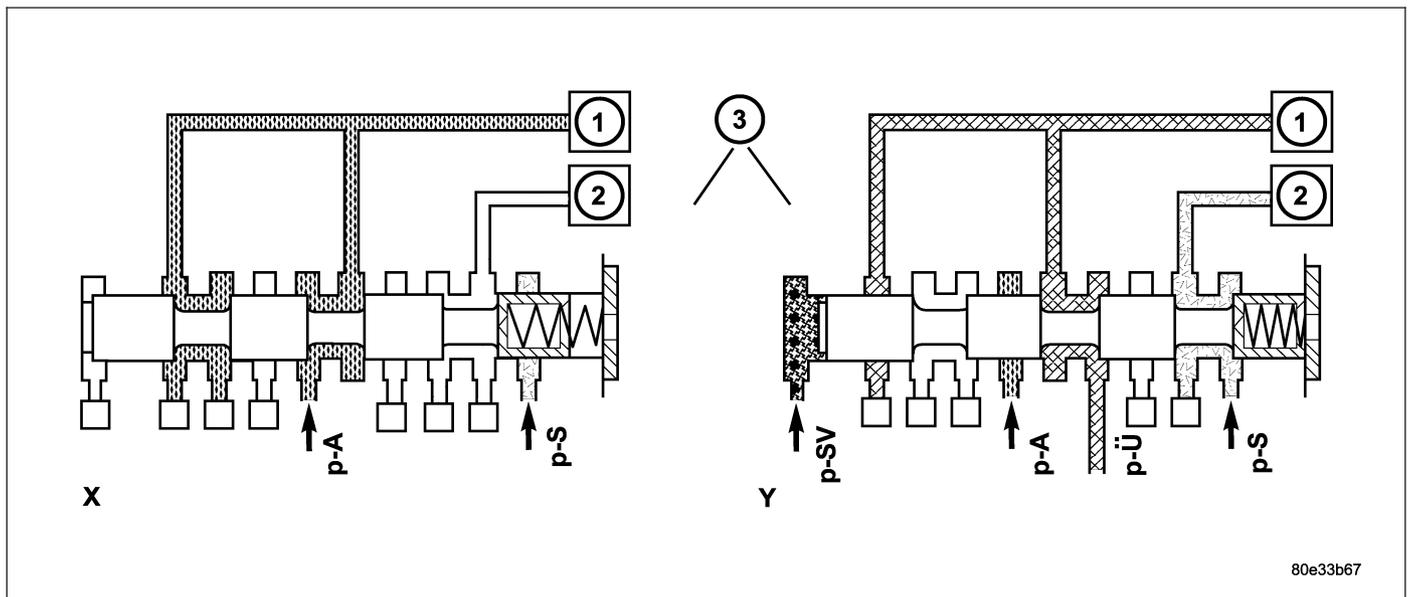
**Overlap Regulating Valve**

Each shift group is assigned one overlap regulating valve (1). The 1-2 / 4-5 overlap regulating valve is installed in the shift valve housing; the 2-3 and 3-4 overlap regulating valves are installed in the valve housing. The overlap regulating valve regulates the pressure reduction during a shift phase.



1 - OVERLAP REGULATING VALVE  
2 - ANNULAR SURFACE ON OVERLAP REGULATING VALVE

**Command Valve**



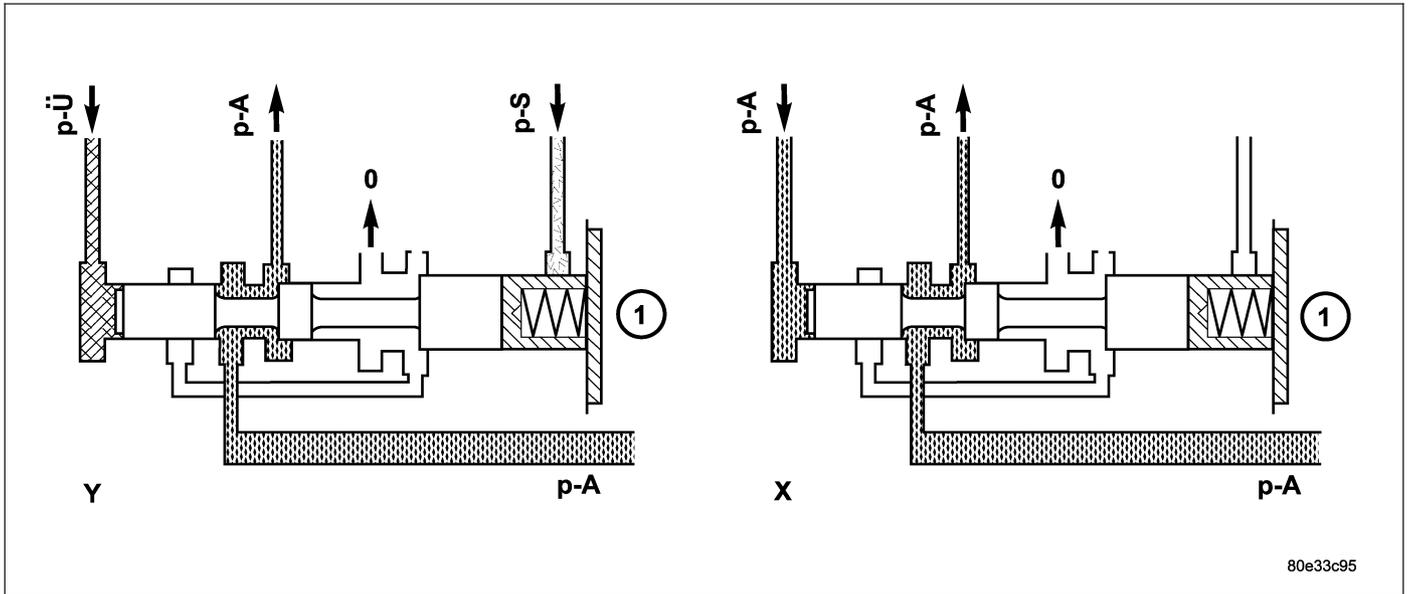
**Command Valve**

1 - HOLDING CLUTCH B1  
2 - DRIVING CLUTCH K1

3 - 1-2/4-5 COMMAND VALVE

Each shift group possesses one command valve (3). The 1-2 / 4-5 and 2-3 command valves are installed in the shift valve housing, the 3-4 command valve is installed in the valve housing. The command valve switches the shift group from the stationary phase to the shift phase and back again.

**Holding Pressure Shift Valve**

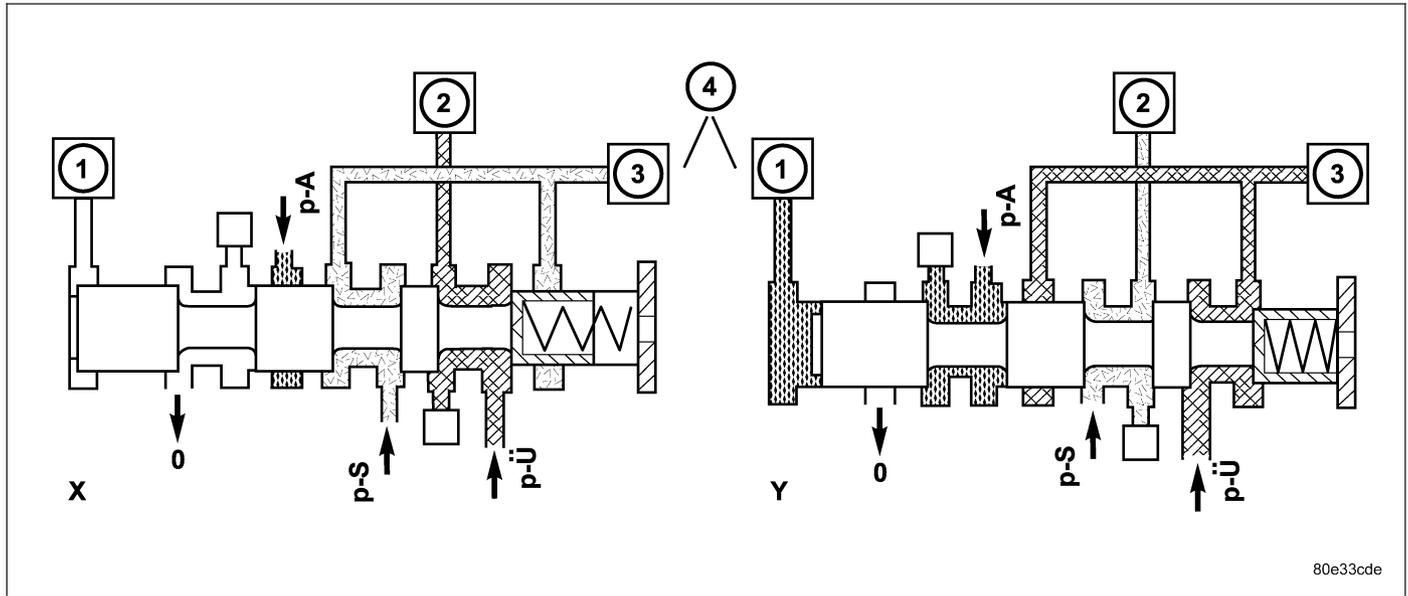


**Holding Pressure Shift Valve**

1 - HOLDING PRESSURE SHIFT VALVE

Each shift group possesses one holding pressure shift valve (1). The 1-2 / 4-5 and 2-3 holding pressure shift valves are installed in the shift valve housing; the 3-4 holding pressure shift valve is installed in the valve housing. The holding pressure shift valve allocates the working pressure to one actuator of a shift group.

**Shift Pressure Shift Valve**



**Shift Pressure Shift Valve**

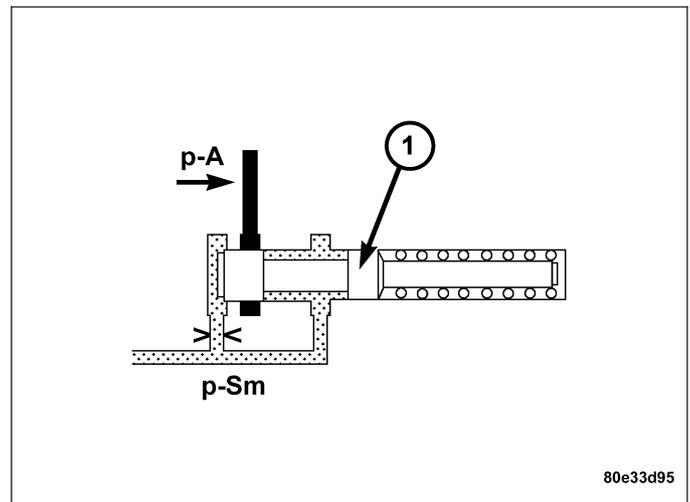
1 - 1-2/4-5 COMMAND VALVE  
2 - DRIVING CLUTCH K1

3 - HOLDING CLUTCH B1  
4 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE

Each shift group possesses one shift pressure shift valve (4). The 1-2 / 4-5 and 2-3 shift pressure shift valves are installed in the shift valve housing; the 3-4 shift pressure shift valve is installed in the valve housing. It assigns the shift pressure (p-S) to the activating actuator and the overlap pressure (p-Ü) regulated by the overlap regulating valve to the deactivating actuator.

**Lubrication Pressure Regulating Valve**

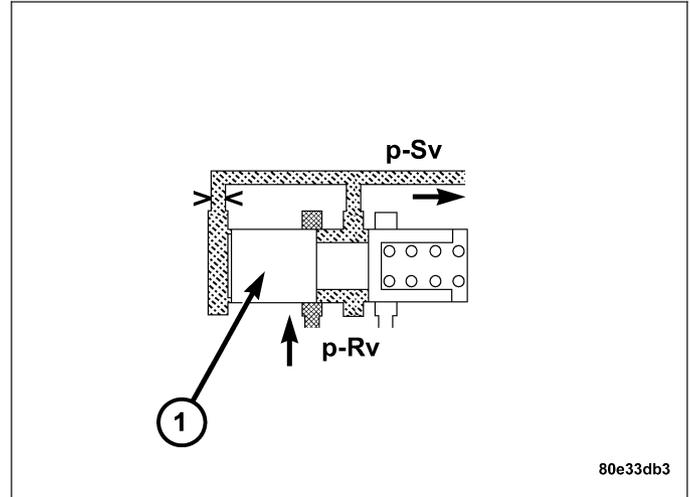
The lubrication pressure regulating valve (1) is located in the valve housing of the electrohydraulic control module. The valve controls the fluid to lubricate and cool the mechanical part of the transmission, and limits the pressure in the torque converter.



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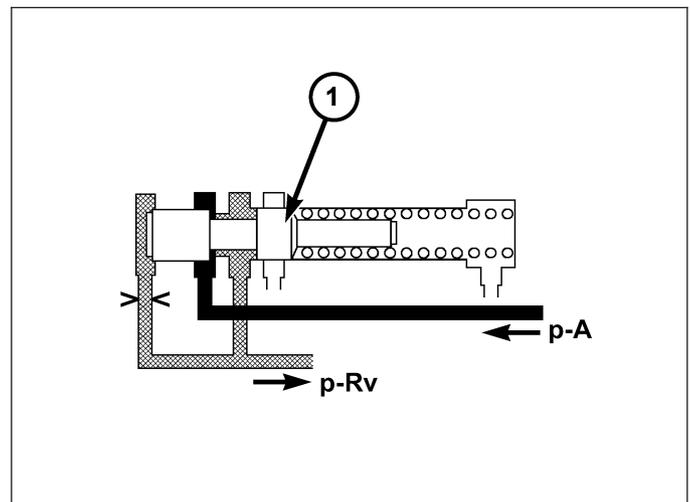
### Shift Pressure Regulating Valve

The shift pressure regulating valve (1) is located in the valve housing of the shift plate. It regulates the shift pressure (p-S).



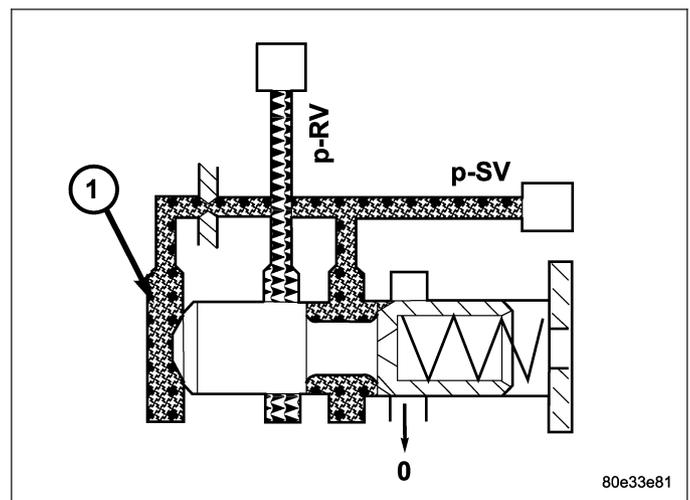
### Regulating Valve Pressure Regulating Valve

The regulating valve pressure regulating valve (1) is located in the valve housing of the electrohydraulic control module. It regulates the regulating valve/control valve pressure (p-RV).



### Shift Valve Pressure Regulating Valve

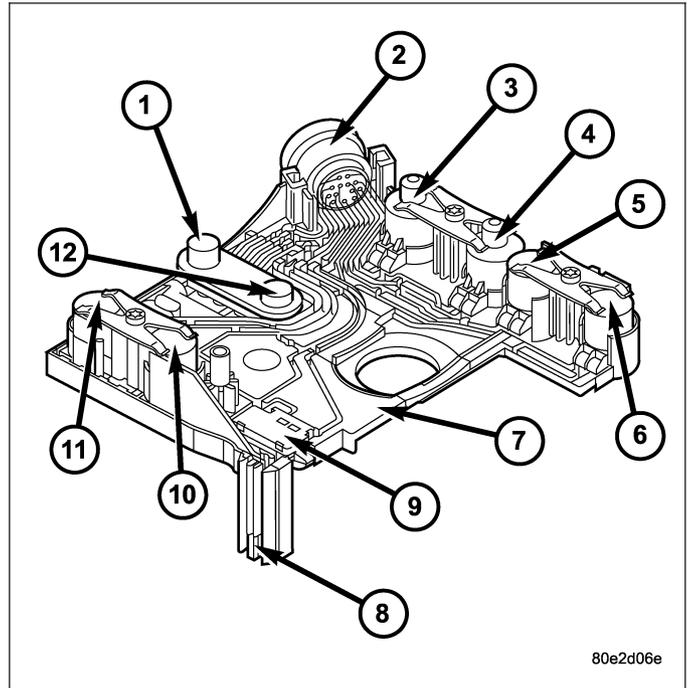
The shift valve pressure regulating valve (1) is located in the valve housing of the electrohydraulic control module. It regulates the shift valve pressure (p-SV).



## OPERATION

### ELECTRICAL CONTROL UNIT

Signals from the transmission control module (TCM) are converted into hydraulic functions in the electric valve control unit (7). The RPM sensors (1, 12), starter interlock contact (9), and transmission oil temperature sensor (8) of the electric valve control unit (7) supply the TCM with input signals. The solenoid valves are controlled by the TCM and trigger the hydraulic functions.

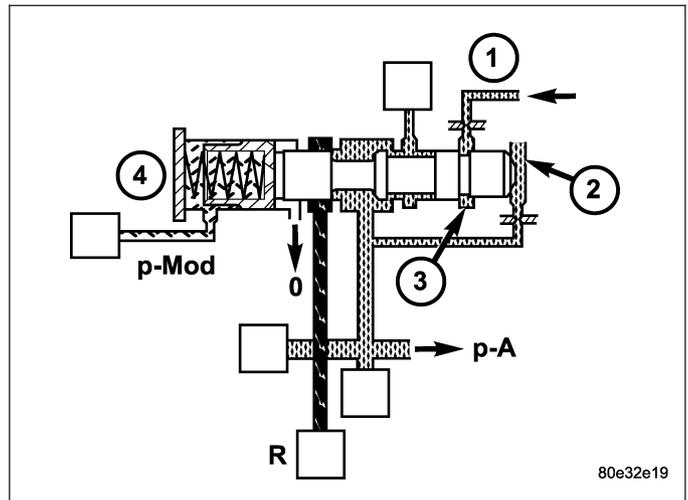


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### HYDRAULIC CONTROL UNIT

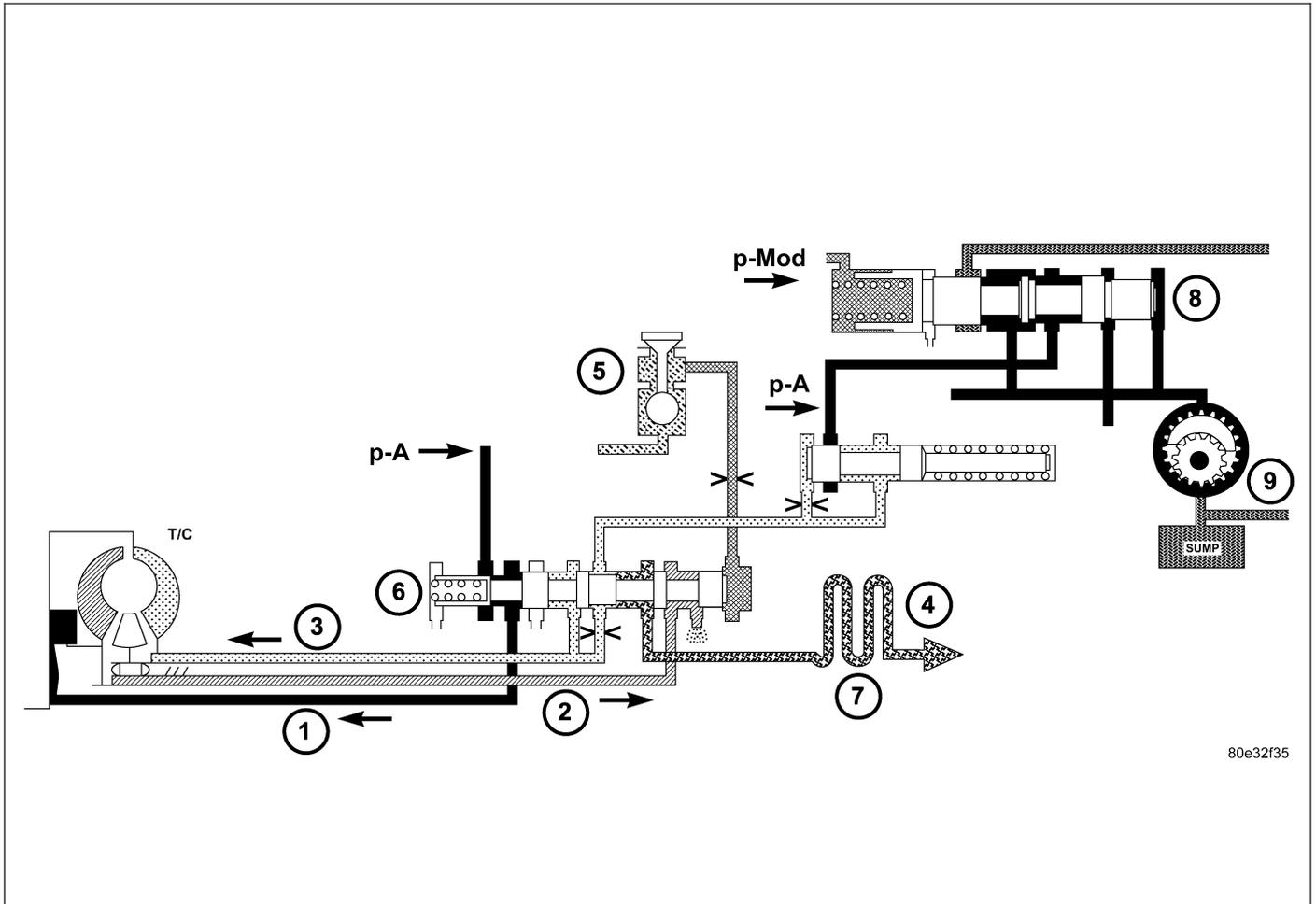
#### Working Pressure Regulating Valve (Line Pressure or Operating Pressure)

The working pressure (p-A) is regulated at the working pressure regulating valve (4) in relation to load (modulating pressure, p-Mod) and gear (K1 or K2 pressure) (1). The spring in the working pressure regulating valve sets a minimum pressure level (basic pressure).



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Torque Converter Lockup Clutch Regulating Valve



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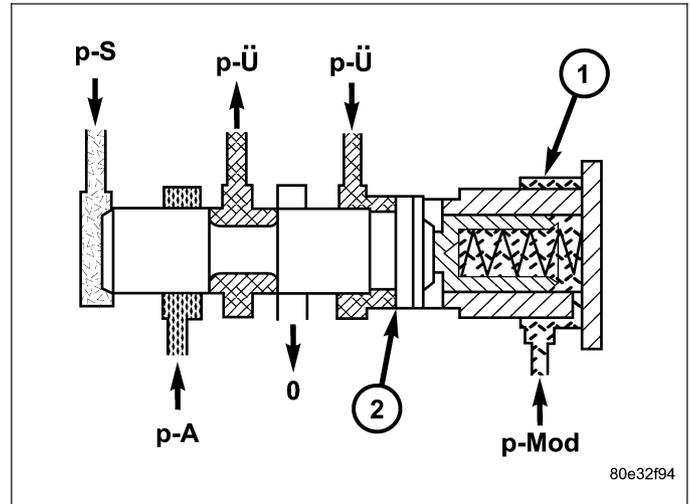
- 1 - TORQUE CONVERTER LOCK-UP CLUTCH
- 2 - TORQUE CONVERTER OUTPUT
- 3 - TORQUE CONVERTER INPUT
- 4 - LUBRICATION
- 5 - TORQUE CONVERTER LOCK-UP SOLENOID

- 6 - TORQUE CONVERTER LOCK-UP CLUTCH REGULATING VALVE
- 7 - OIL COOLER
- 8 - LINE PRESSURE REGULATING VALVE
- 9 - OIL PUMP

The torque converter lockup clutch regulating valve (6) regulates the torque converter lock-up clutch working pressure (p-TCC) in relation to the torque converter clutch control pressure (p-S/TCC). According to the size of the working pressure (p-A), the torque converter lockup clutch is either Engaged, Disengaged, or Slipping. When the regulating valve (6) is in the lower position, lubricating oil flows through the torque converter and oil cooler (8) into the transmission (torque converter lockup clutch unpressurized). In its regulating position (slipping, torque converter lockup clutch pressurized), a reduced volume of lubricating oil flows through the annular passage (7) bypassing the torque converter and passing direct through the oil cooler into the transmission. The rest of the lubricating oil is directed via the throttle "a" into the torque converter in order to cool the torque converter lockup clutch.

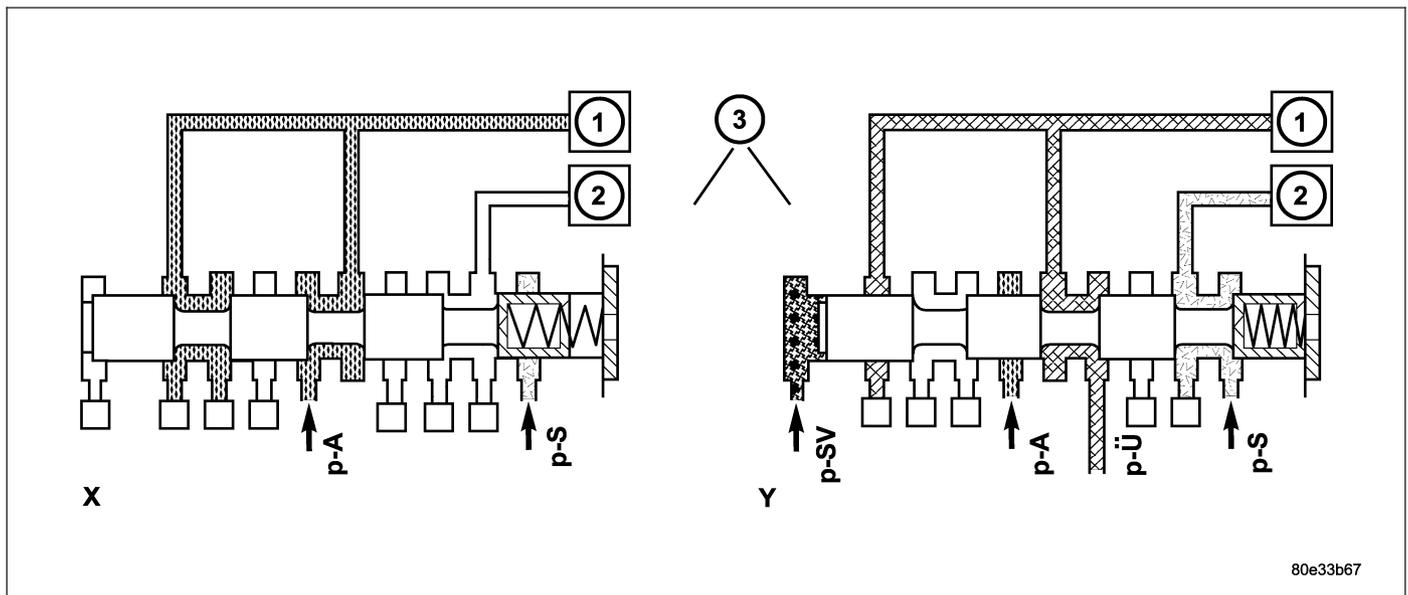
**Overlap Regulating Valve**

During the shift phase the pressure in the deactivating shift actuator is regulated in relation to the engine load (modulating pressure, p-Mod) and the pressure in the activating actuator. The regulated pressure is inversely proportional to the transfer capacity of the activating shift actuator (regulated overlap).



1 - OVERLAP REGULATING VALVE  
2 - ANNULAR SURFACE ON OVERLAP REGULATING VALVE

**Command Valve**



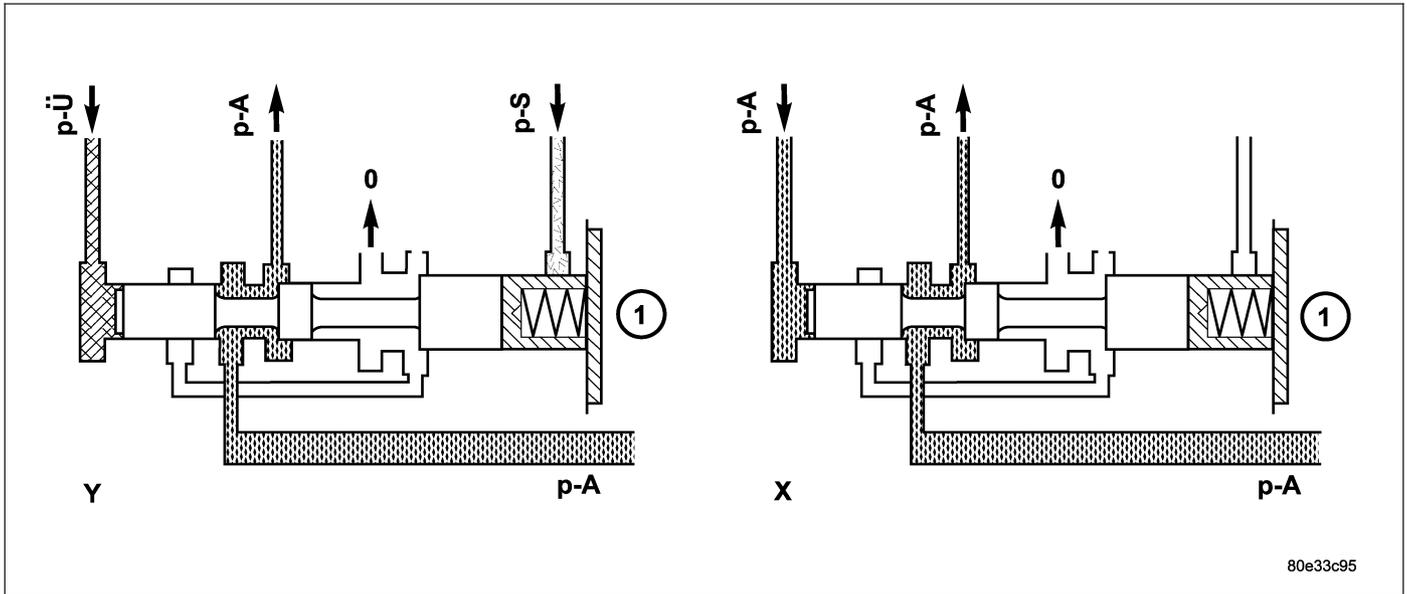
**Command Valve**

1 - HOLDING CLUTCH B1  
2 - DRIVING CLUTCH K1

3 - 1-2/4-5 COMMAND VALVE

When the end face is unpressurized (stationary phase), the working pressure (p-A) is directed to the actuated shift element. If the end face of the command valve is subjected to the shift valve pressure (p-SV) (shift phase), then the shift pressure (p-S) is switched to the activating element and the overlap pressure (p-Ü) is switched to the deactivating element.

## Shift Valve Holding Pressure

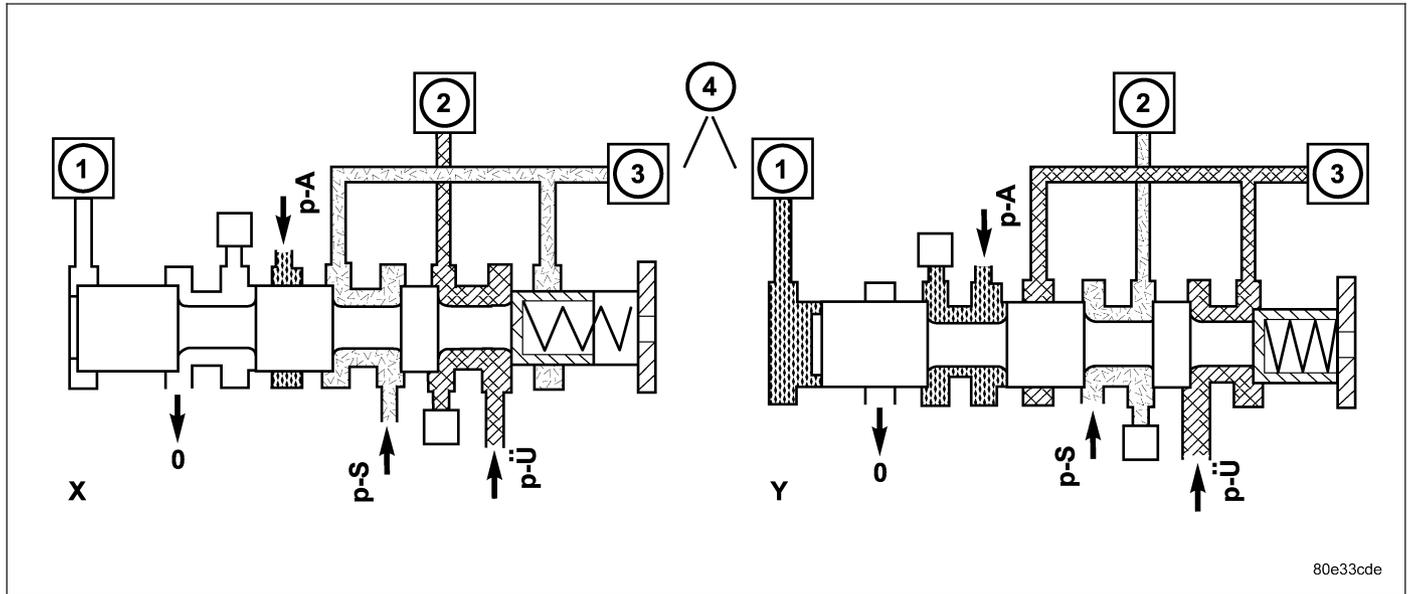


Shift Valve Holding Pressure

1 - HOLDING PRESSURE SHIFT VALVE

The holding pressure shift valve (1) is actuated by the pressures present at the end face in the actuators and a spring. It assigns the working pressure ( $p-A$ ) to the actuator with the higher pressure (taking into account the spring force and the effective surface area). The other element of the shift group is then unpressurized. The valve switches over only during the shift phase and only at a certain pressure ratio between the overlap pressure ( $p-U$ ) and the shift pressure ( $p-S$ ).

**Shift Pressure Shift Valve**



**Shift Pressure Shift Valve**

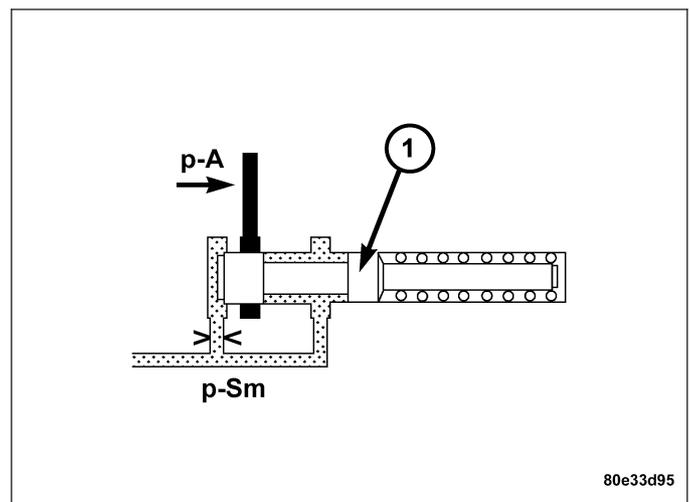
1 - 1-2/4-5 COMMAND VALVE  
2 - DRIVING CLUTCH K1

3 - HOLDING CLUTCH B1  
4 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE

When the multiple-disc brake B1 (3) is activated, the working pressure ( $p-A$ ) is applied to the end face of the 1-2 / 4-5 shift pressure shift valve (4) via the command valve (1). Its shift state is maintained during the shift phase by substituting the shift element pressure acting on its end face (and which is variable during the shift phase) with a corresponding constant pressure. When the multi-plate clutch K1 (2) is activated, the end face of the shift valve is unpressurized during the stationary and shift phases, so the shift state is maintained during the shift phase in this case too.

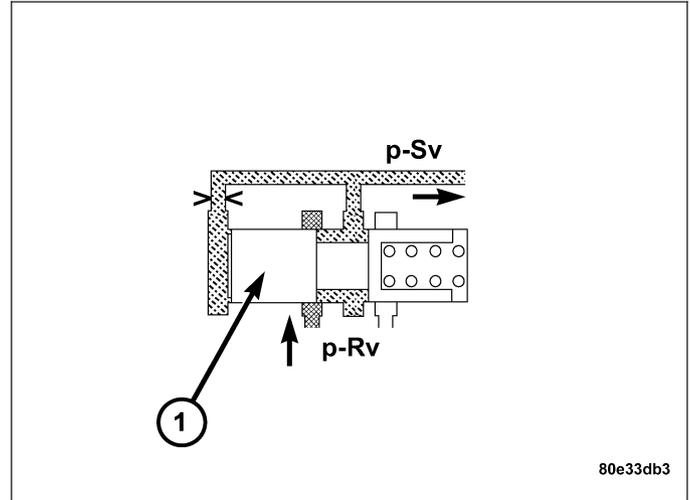
**Lubrication Pressure Regulating Valve**

At the working pressure regulating valve surplus oil is diverted to the lubrication pressure regulating valve (1), from where the lubrication pressure ( $p-S_m$ ) is used in regulated amounts to supply the transmission lubrication system including the torque converter.



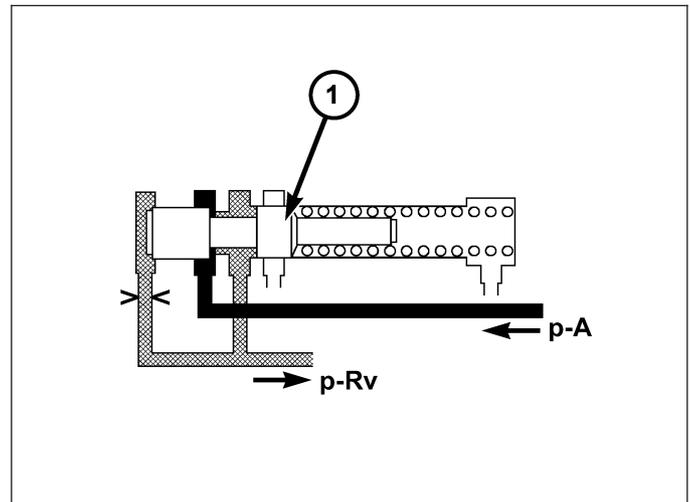
### Shift Pressure Regulating Valve

The shift pressure is determined by the shift pressure regulating solenoid valve and the shift pressure regulating valve (3). In addition, pressure from the clutch K2 (1) is also present at the annular surface (2) of the shift pressure regulating valve (3). This reduces the shift pressure in 2nd gear.



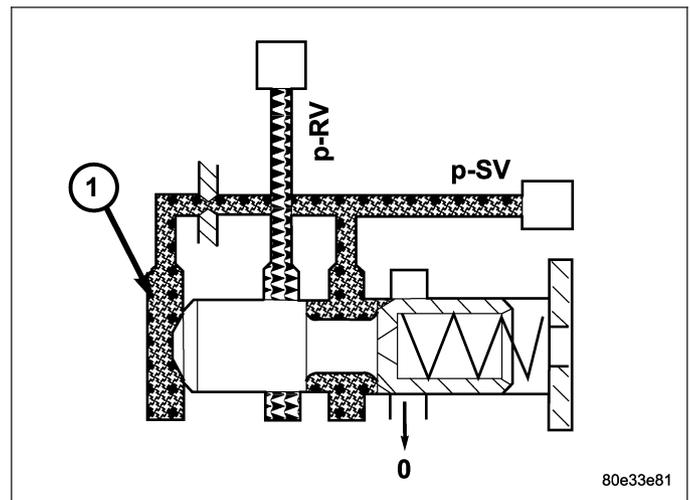
### Regulating Valve Pressure Regulating Valve

The regulating valve pressure (p-RV) is set at the regulating valve pressure regulating valve (1) in relation to the working pressure (p-A) as far as the maximum pressure.



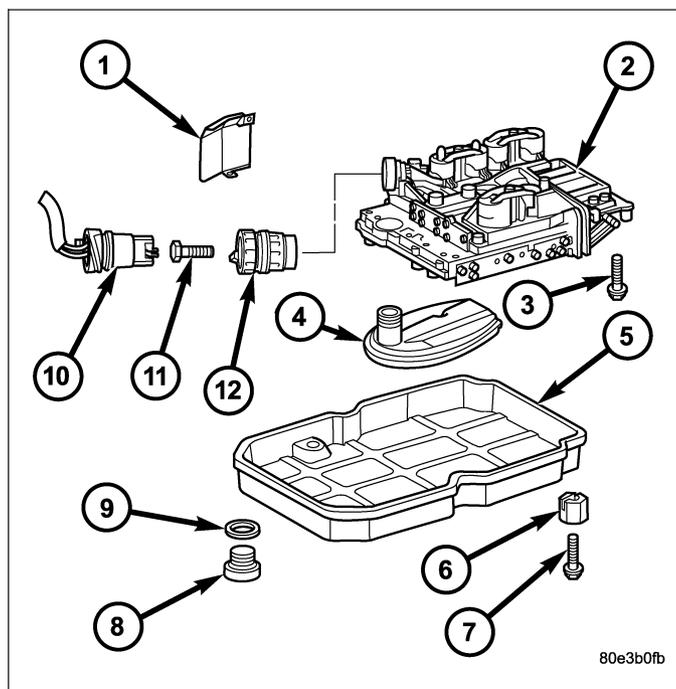
### Shift Valve Pressure Regulating Valve

The non-constant regulating valve pressure (p-RV) is regulated to a constant shift valve pressure (p-SV) at the shift valve pressure regulating valve (1) and is used to supply the 1-2 and 4-5 / 3-4 / 2-3 solenoid valves and the torque converter lockup clutch PWM solenoid valve.



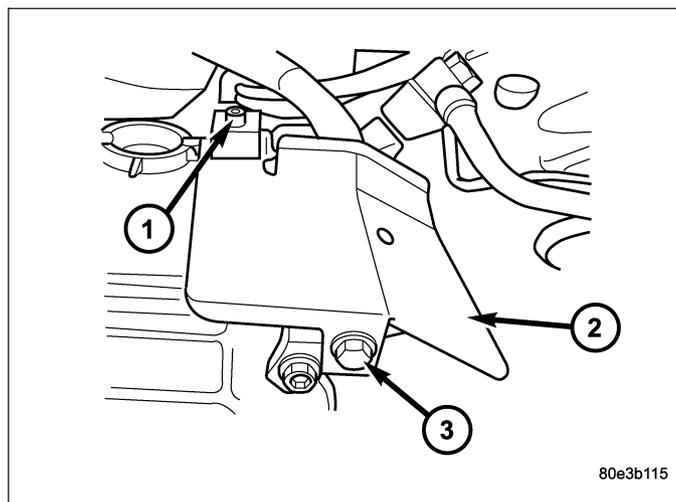
## REMOVAL

1. Drain transmission oil by unscrewing oil drain plug (8), if equipped.

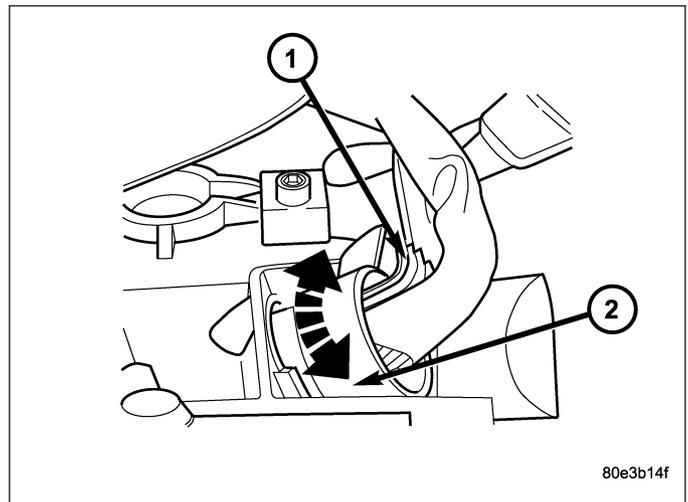


- 1 - HEAT SHIELD
- 2 - ELECTROHYDRAULIC UNIT
- 3 - BOLT
- 4 - OIL FILTER
- 5 - OIL PAN
- 6 - CLAMPING ELEMENT
- 7 - BOLT
- 8 - DRAIN PLUG
- 9 - DRAIN PLUG GASKET
- 10 - 13-PIN PLUG CONNECTOR
- 11 - BOLT
- 12 - GUIDE BUSHING

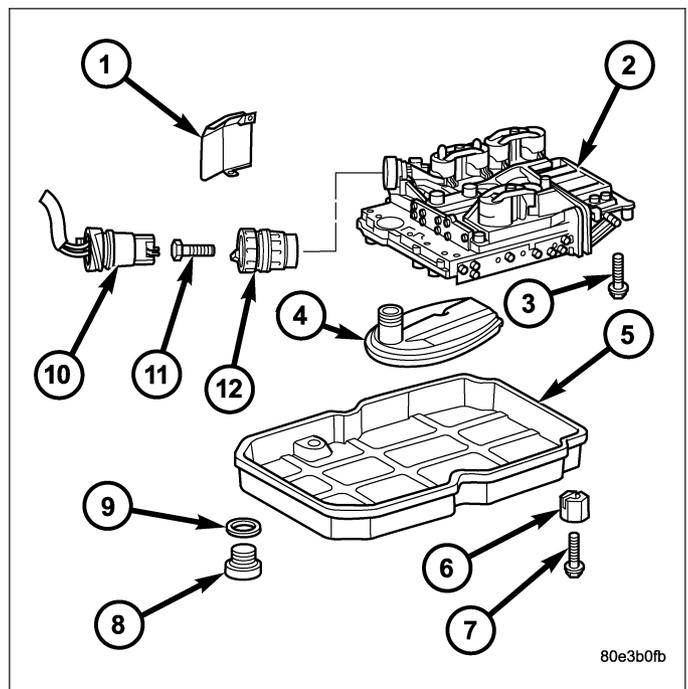
2. Move selector lever to position "P".
3. Raise vehicle.
4. Remove bolt (3) and screw (1) holding the heat shield (2) to the transmission.



5. Disconnect 13-pin plug connector (1). Turn bayonet lock of guide bushing (2) anti-clockwise.
6. Loosen guide bushing (2) and remove from transmission housing.



7. Detach oil pan (5).
8. Remove oil filter (4).
9. Unscrew Torx socket bolts (3) and remove electrohydraulic control module (2).



- 1 - HEAT SHIELD
- 2 - ELECTROHYDRAULIC UNIT
- 3 - BOLT
- 4 - OIL FILTER
- 5 - OIL PAN
- 6 - CLAMPING ELEMENT
- 7 - BOLT
- 8 - DRAIN PLUG
- 9 - DRAIN PLUG GASKET
- 10 - 13-PIN PLUG CONNECTOR
- 11 - BOLT
- 12 - GUIDE BUSHING

## DISASSEMBLY

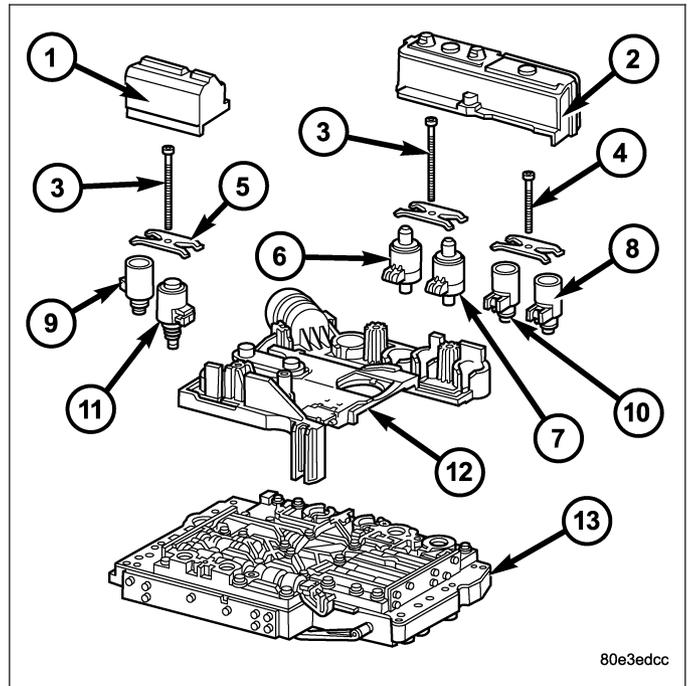
1. Remove electrohydraulic unit from the vehicle.  
(Refer to 21 - TRANSMISSION/AUTOMATIC TRANSMISSION - NAG1/ELECTROHYDRAULIC UNIT - REMOVAL)
2. Remove solenoid caps (1, 2).
3. Unscrew Torx® socket bolts (3, 4).

**Note: Pay attention to the different lengths of the Torx® socket bolts.**

4. Remove leaf springs (5).
5. Withdraw solenoid valves (6 - 11) from shift plate (13).

**Note: Check O-rings on solenoid valves for damage and replace if necessary.**

6. Bend away retaining lug on stiffening rib on transmission oil temperature sensor.
7. Remove electrohydraulic control module (12) from the shift plate (13).



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**Electrical Unit Components**

- 1 - SOLENOID CAP
- 2 - SOLENOID CAP
- 3 - BOLT - M6X32
- 4 - BOLT - M6X30
- 5 - LEAF SPRING
- 6 - MODULATING PRESSURE REGULATING SOLENOID VALVE
- 7 - SHIFT PRESSURE REGULATING SOLENOID
- 8 - 3-4 SHIFT SOLENOID
- 9 - TORQUE CONVERTER LOCK-UP SOLENOID
- 10 - 1-2/4-5 SHIFT SOLENOID
- 11 - 2-3 SHIFT SOLENOID
- 12 - ELECTRICHYDRAULIC CONTROL MODULE
- 13 - SHIFT PLATE

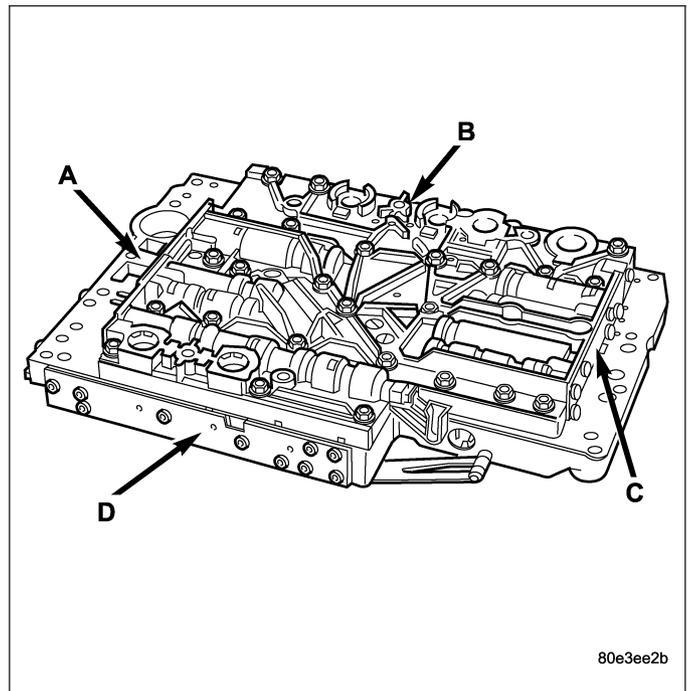
8. Note the locations of the major shift valve group components for assembly reference.

A - Operating and Lubricating Pressure Regulating valves and 2-3 Overlap valve

B - 1-2/4-5 Shift Group and Shift, Shift Valve, and Regulating Valve Pressure Regulating Valves

C - 3-4 Shift Group

D - 2-3 Shift Group, TCC Lock-up, and B2 Regulating Valves



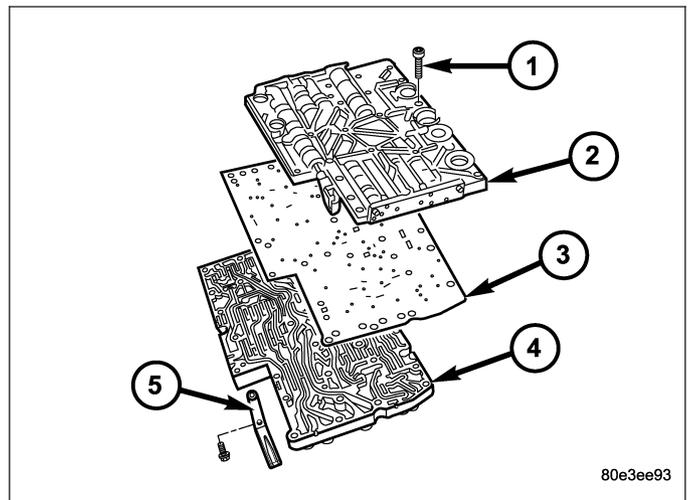
**Note:** Pay great attention to cleanliness for all work on the shift plate. Fluffy cloths must not be used. Leather cloths are particularly good. After dismantling, all parts must be washed and blown out with compressed-air, noting that parts may be blown away.

9. Unbolt leaf spring (5).

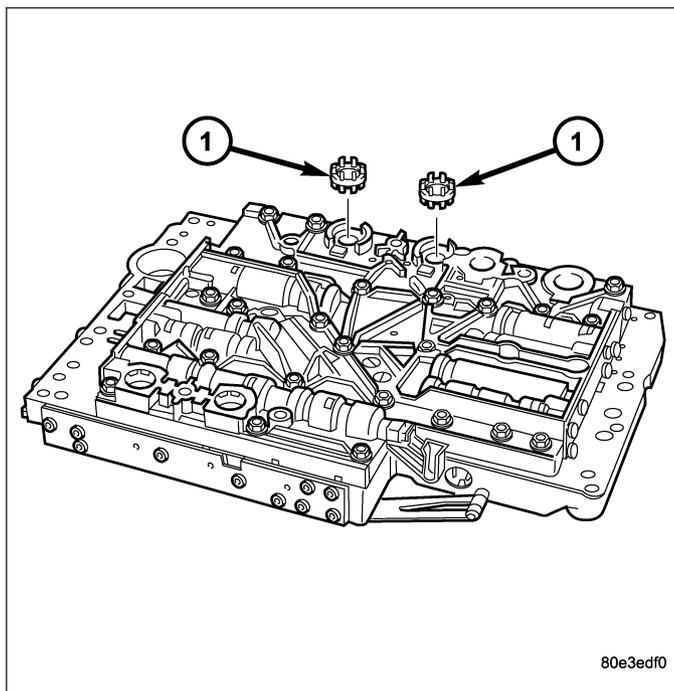
10. Unscrew Torx® bolts (1).

11. Remove valve housing (2) from valve body (4).

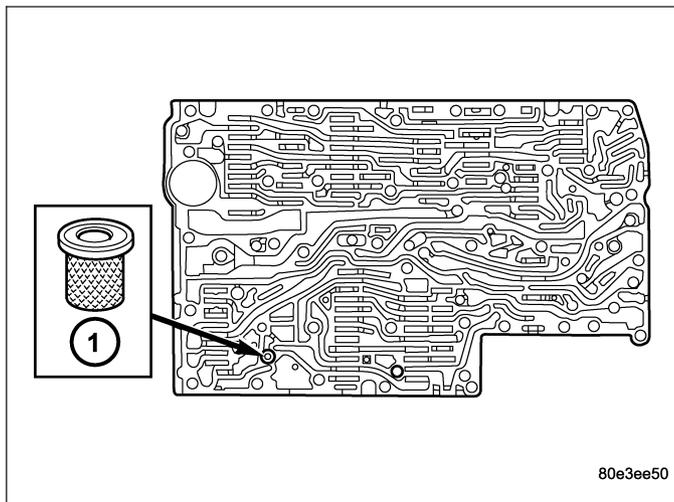
12. Remove sealing plate (3).



13. Remove the strainers (1, 2) for the modulating pressure and shift pressure control solenoid valves from the valve housing.

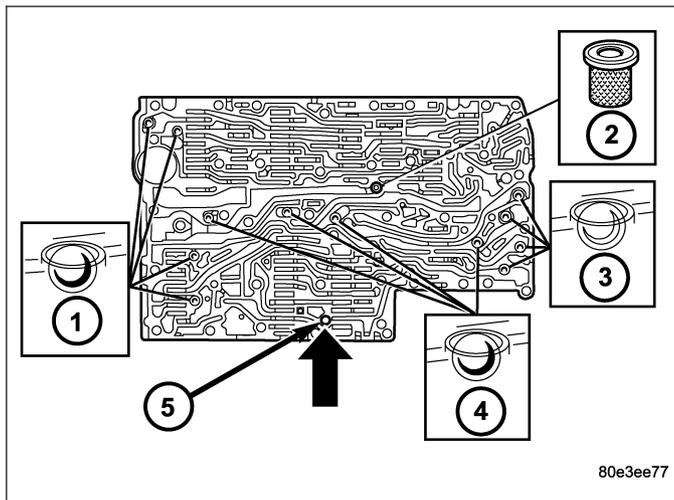


14. Remove the strainer (1) in the inlet to torque converter lock-up control solenoid valve.

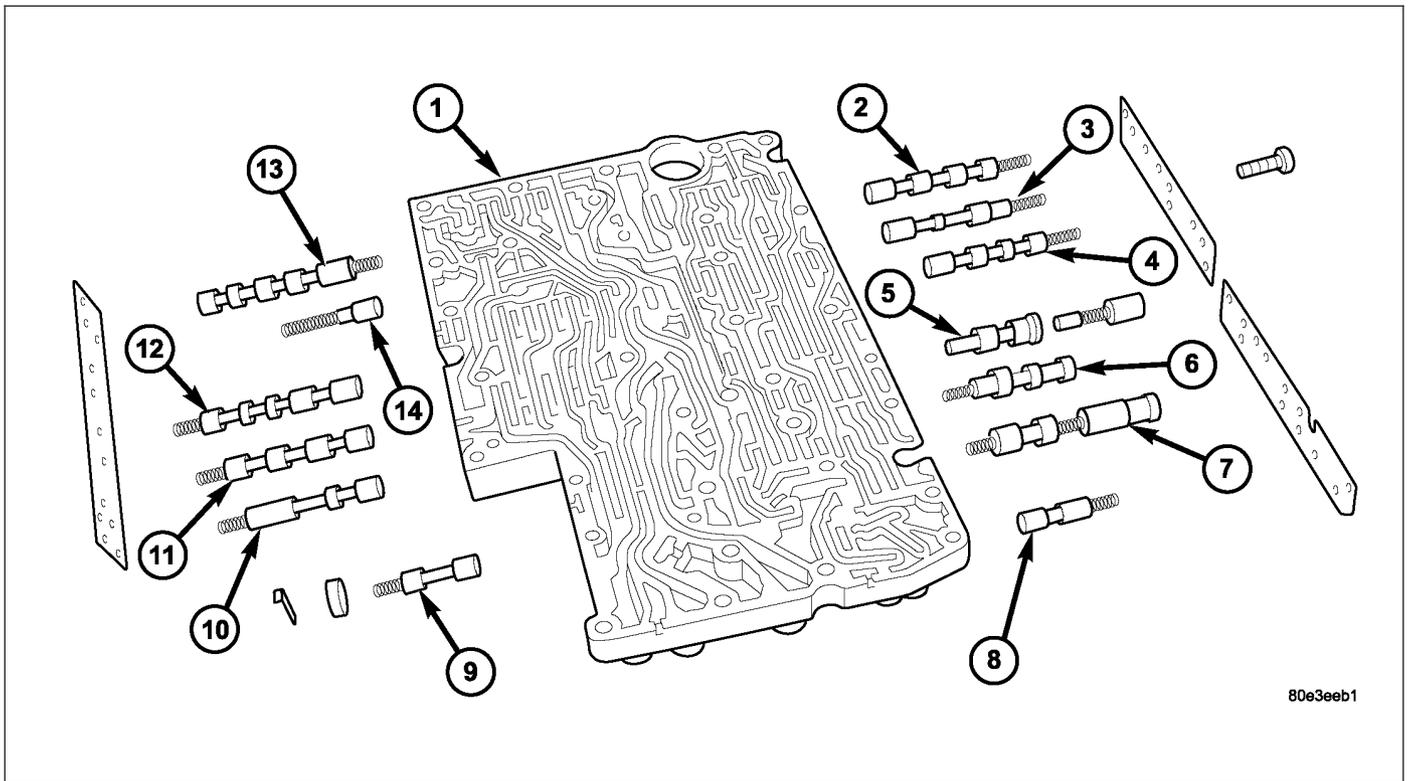


**Note:** A total of 12 valve balls are located in the valve body, four made from plastic (4) and eight from steel (1, 3).

15. Note the location of all check balls (1, 3, 4) and the central strainer (2) for re-installation. Remove all check balls (1, 3, 4) and the central strainer



(2).



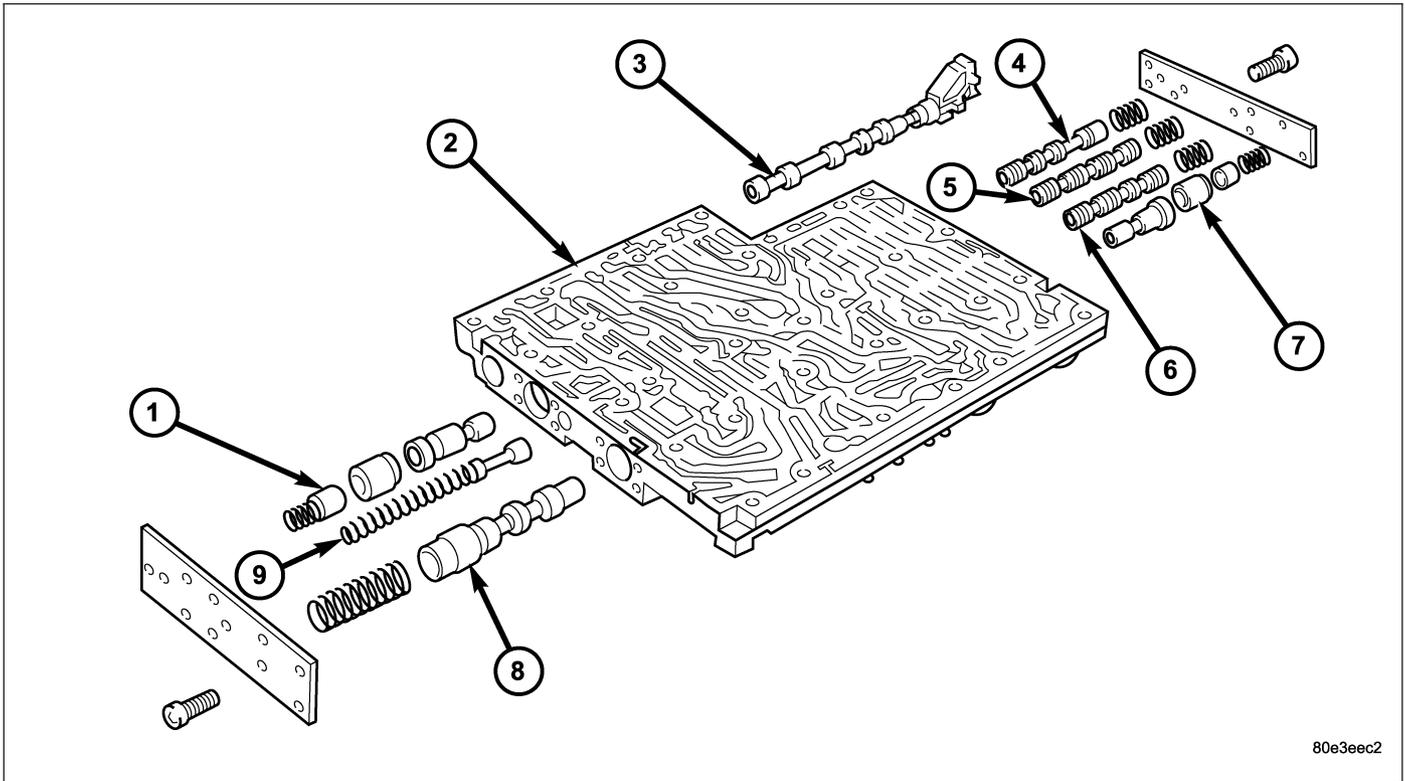
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**Valve Body Components**

- |  |   |
|--|---|
| 1 - VALVE BODY   | 8 - SHIFT VALVE PRESSURE REGULATING VALVE |
| 2 - 1-2/4-5 COMMAND VALVE                                | 9 - B2 SHIFT VALVE                        |
| 3 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE                 | 10 - 2-3 HOLDING PRESSURE SHIFT VALVE     |
| 4 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE                   | 11 - 2-3 COMMAND VALVE                    |
| 5 - 1-2/4-5 OVERLAP REGULATING VALVE, SLEEVE, AND PISTON | 12 - 2-3 SHIFT PRESSURE SHIFT VALVE       |
| 6 - SHIFT PRESSURE REGULATING VALVE                      | 13 - TCC LOCK-UP REGULATING VALVE         |
| 7 - REGULATING VALVE PRESSURE REGULATING VALVE           | 14 - TCC DAMPER VALVE - if equipped       |

16. Remove the screws holding the side covers to the valve body and valve housing.
17. Remove all valves and springs from the valve body (1). Check all valves for ease of movement and shavings.

**Note:** The sleeves and pistons of the overlap regulating valves must not be mixed up.



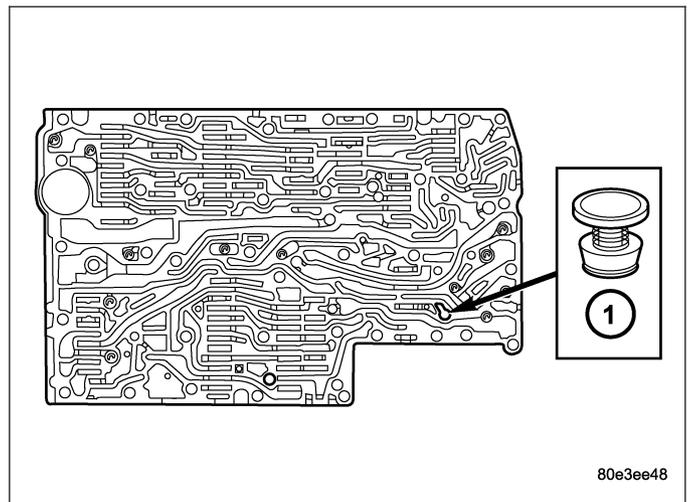
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**Valve Housing Components**

- |  |  |
|--|--|
| 1 - 2-3 OVERLAP REGULATING VALVE, SLEEVE, AND PISTON | 6 - 3-4 SHIFT PRESSURE SHIFT VALVE                   |
| 2 - VALVE HOUSING                                    | 7 - 3-4 OVERLAP REGULATING VALVE, SLEEVE, AND PISTON |
| 3 - SELECTOR VALVE                                   | 8 - OPERATING PRESSURE REGULATING VALVE              |
| 4 - 3-4 HOLDING PRESSURE SHIFT VALVE                 | 9 - LUBRICATING PRESSURE REGULATING VALVE            |
| 5 - 3-4 COMMAND VALVE                                |  |

18. Remove all valves and springs from the valve housing (2). Check all valves for ease of movement and shavings.

19. Remove the pressure supply valve (1) from the valve body.

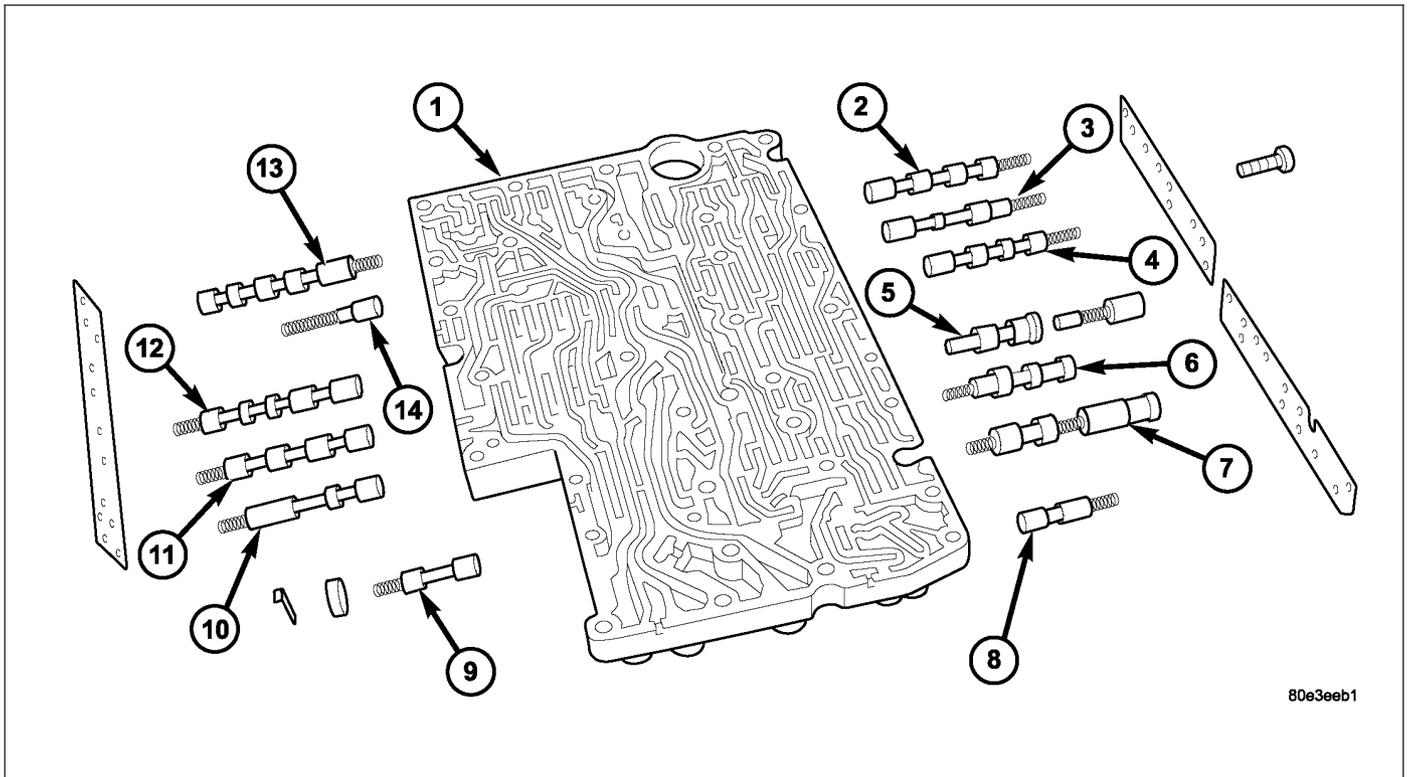
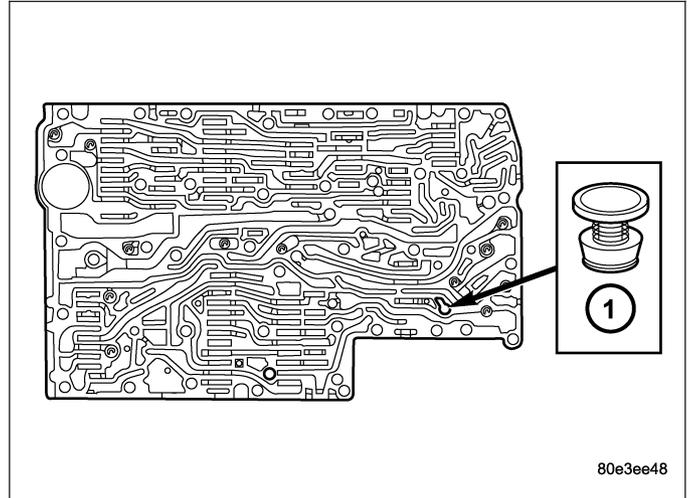


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## ASSEMBLY

**Note:** Pay great attention to cleanliness for all work on the shift plate. Fluffy cloths must not be used. Leather cloths are particularly good. After dismantling, all parts must be washed and blown out with compressed-air, noting that parts may be blown away.

1. Install the pressure supply valve (1) into the valve body.

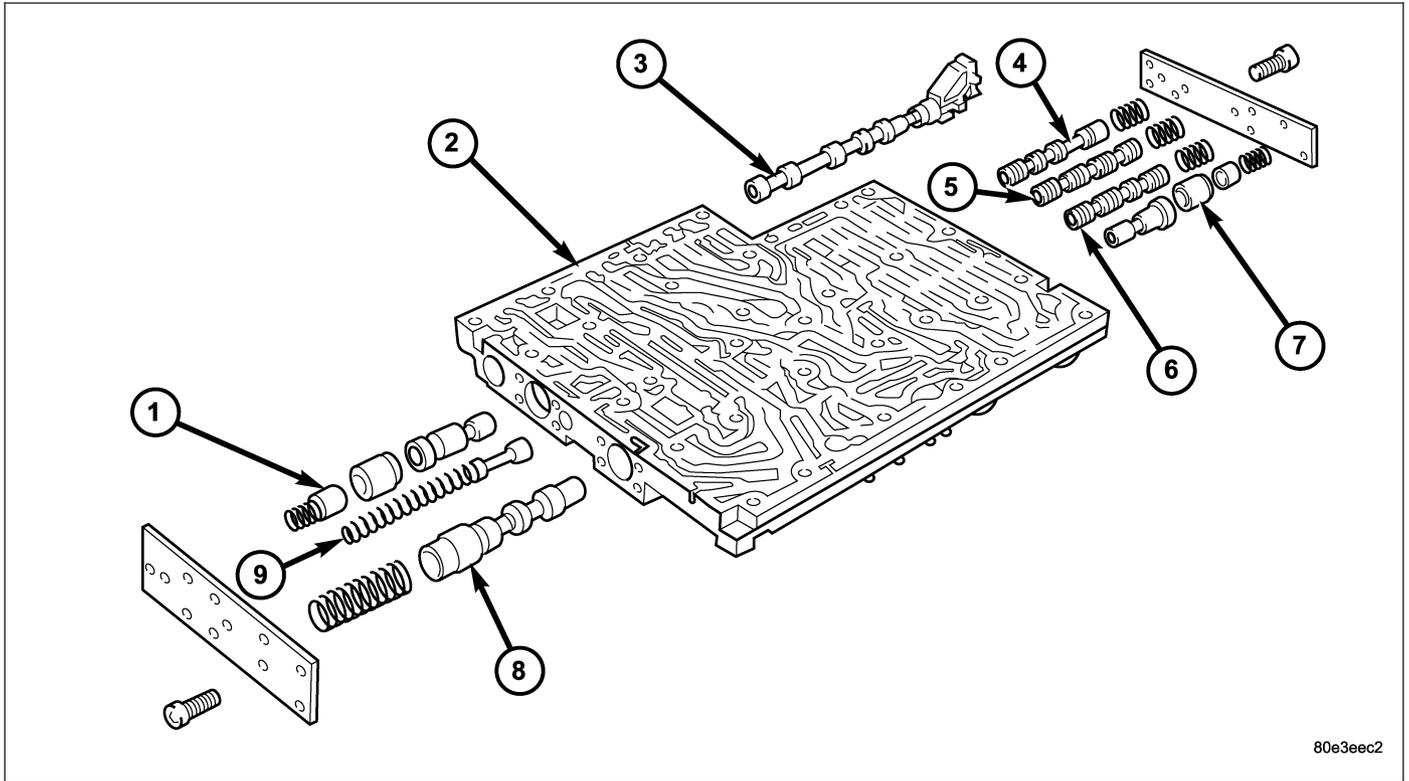


### Valve Body Components

- |  |   |
|--|---|
| 1 - VALVE BODY   | 8 - SHIFT VALVE PRESSURE REGULATING VALVE |
| 2 - 1-2/4-5 COMMAND VALVE                                | 9 - B2 SHIFT VALVE                        |
| 3 - 1-2/4-5 HOLDING PRESSURE SHIFT VALVE                 | 10 - 2-3 HOLDING PRESSURE SHIFT VALVE     |
| 4 - 1-2/4-5 SHIFT PRESSURE SHIFT VALVE                   | 11 - 2-3 COMMAND VALVE                    |
| 5 - 1-2/4-5 OVERLAP REGULATING VALVE, SLEEVE, AND PISTON | 12 - 2-3 SHIFT PRESSURE SHIFT VALVE       |
| 6 - SHIFT PRESSURE REGULATING VALVE                      | 13 - TCC LOCK-UP REGULATING VALVE         |
| 7 - REGULATING VALVE PRESSURE REGULATING VALVE           | 14 - TCC DAMPER VALVE - if equipped       |

**Note: The sleeves and pistons of the overlap regulating valves must not be mixed up.**

2. Install all valves and springs from the valve body (1). Check all valves for ease of movement and shavings.
3. Install the screws to hold the side covers to the valve body. Tighten the screws to 4 N·m (35 in.lbs.).



80e3eec2

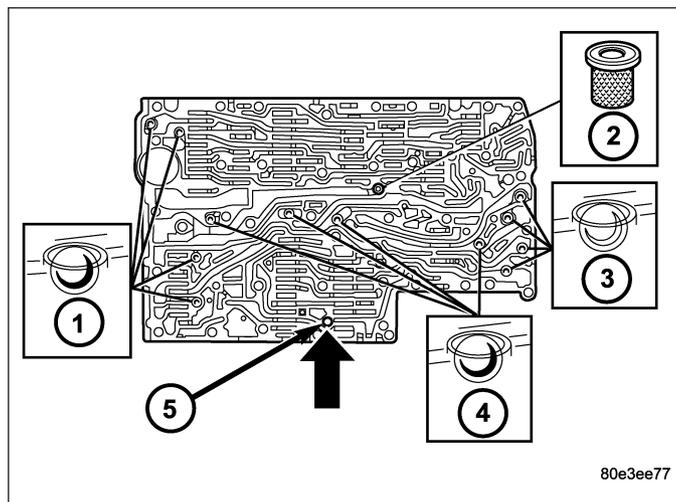
**Valve Housing Components**

- |  |  |
|--|--|
| 1 - 2-3 OVERLAP REGULATING VALVE, SLEEVE, AND PISTON | 6 - 3-4 SHIFT PRESSURE SHIFT VALVE                   |
| 2 - VALVE HOUSING                                    | 7 - 3-4 OVERLAP REGULATING VALVE, SLEEVE, AND PISTON |
| 3 - SELECTOR VALVE                                   | 8 - OPERATING PRESSURE REGULATING VALVE              |
| 4 - 3-4 HOLDING PRESSURE SHIFT VALVE                 | 9 - LUBRICATING PRESSURE REGULATING VALVE            |
| 5 - 3-4 COMMAND VALVE                                |  |

4. Install all valves and springs into the valve housing (2). Check all valves for ease of movement and shavings.
5. Install the screws to hold the side covers to the valve housing. Tighten the screws to 4 N·m (35 in.lbs.).

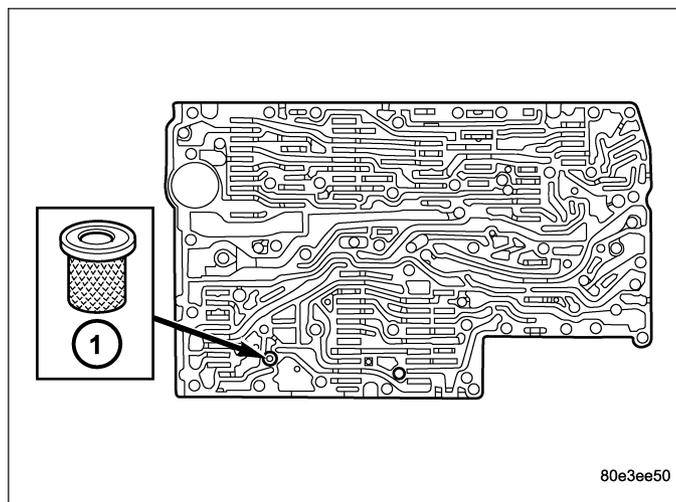
**Note:** A total of 12 valve balls are located in the valve body, four made from plastic (4) and eight from steel (1, 3).

6. Install all check balls (1, 3, 4) and the central strainer (2).



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7. Install the strainer (1) in the inlet to torque converter lock-up control solenoid valve.



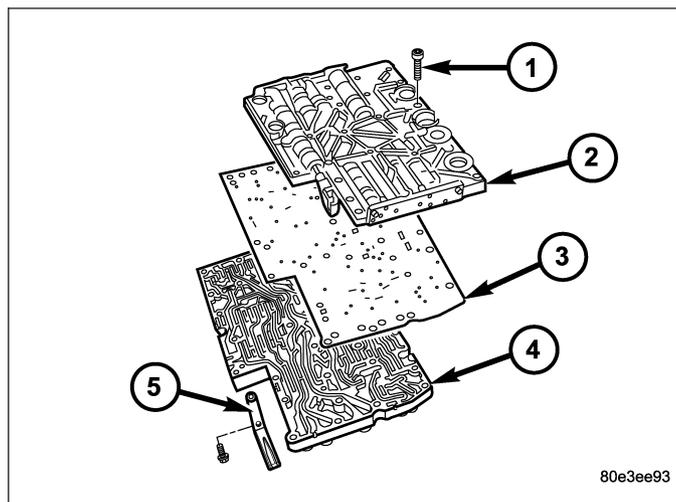
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8. Position the sealing plate (3) onto the valve body (4).

9. Install the valve housing (2) onto the valve body (4) and sealing plate (3).

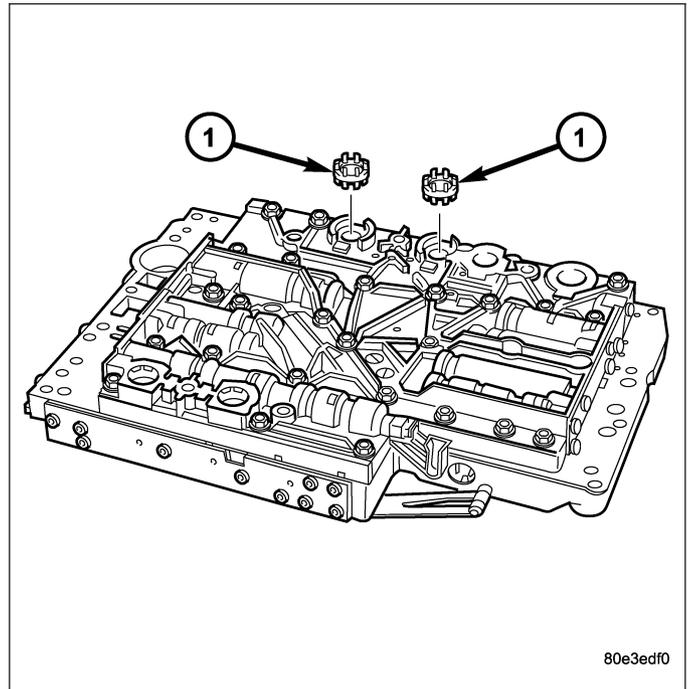
10. Install the shift plate Torx® bolts (1). Tighten the bolts to 8 N·m (71 in.lbs.).

11. Install leaf spring (5).



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12. Install the strainers (1, 2) for the modulating pressure and shift pressure control solenoid valves into the valve housing.



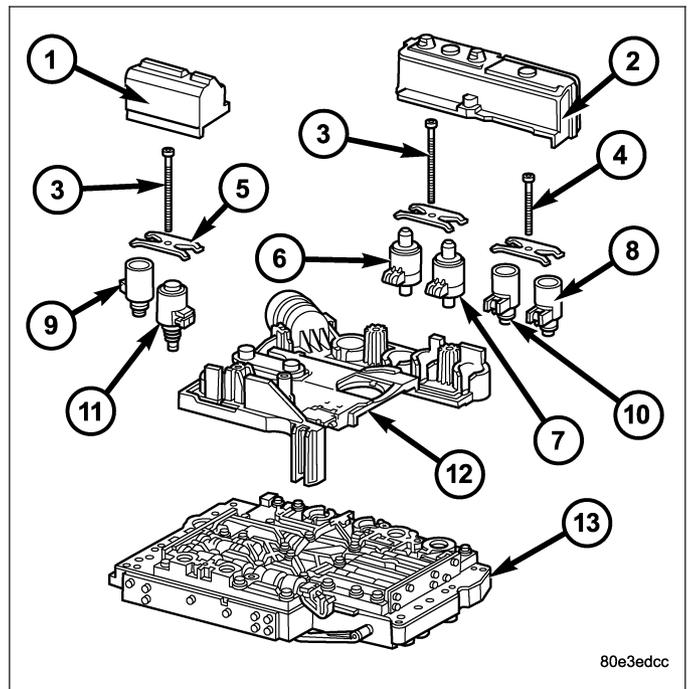
13. Install the electrohydraulic control module (12) onto the shift plate (13).
14. Bend the retaining lug on stiffening rib on transmission oil temperature sensor to retain the electrohydraulic control module.
15. Install the solenoid valves (6 - 11) into shift plate (13).

**Note: Check O-rings on solenoid valves for damage and replace if necessary.**

16. Install the leaf springs (5).
17. Install the Torx® socket bolts (3, 4). Tighten the bolts to 8 N·m (71 in.lbs.).

**Note: Pay attention to the different lengths of the Torx® socket bolts.**

18. Install the solenoid caps (1, 2).
19. Install the electrohydraulic unit into the vehicle.

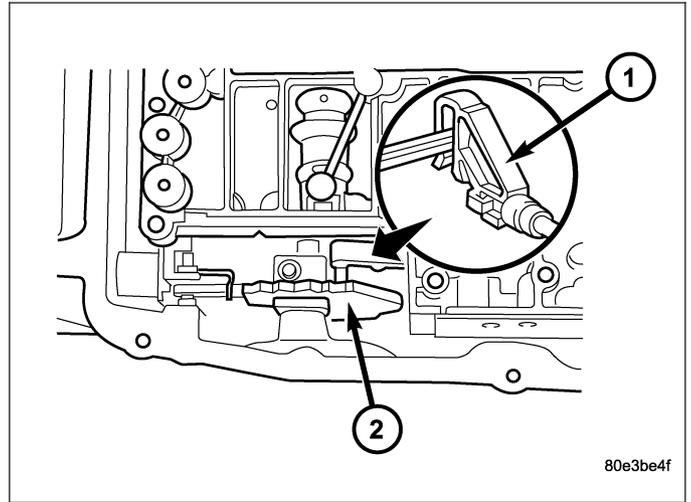


**Electrical Unit Components**

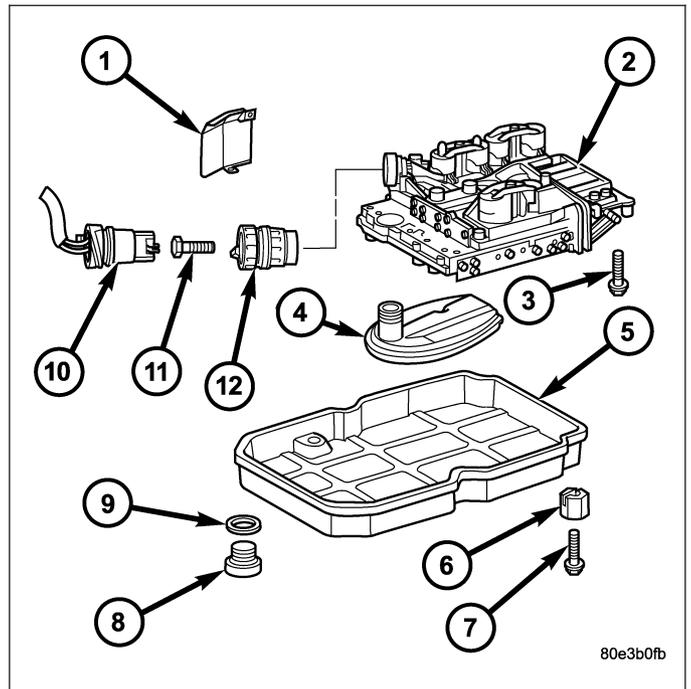
- 1 - SOLENOID CAP
- 2 - SOLENOID CAP
- 3 - BOLT - M6X32
- 4 - BOLT - M6X30
- 5 - LEAF SPRING
- 6 - MODULATING PRESSURE REGULATING SOLENOID VALVE
- 7 - SHIFT PRESSURE REGULATING SOLENOID
- 8 - 3-4 SHIFT SOLENOID
- 9 - TORQUE CONVERTER LOCK-UP SOLENOID
- 10 - 1-2/4-5 SHIFT SOLENOID
- 11 - 2-3 SHIFT SOLENOID
- 12 - ELECTRICHYDRAULIC CONTROL MODULE
- 13 - SHIFT PLATE

## INSTALLATION

1. Position the electrohydraulic unit in the transmission housing.
2. Insert selector valve (1) in driver of detent plate (2).  
When installing the electrohydraulic control module in the transmission housing, the plastic part of the selector valve (1) must engage in the driver of the detent plate (2).

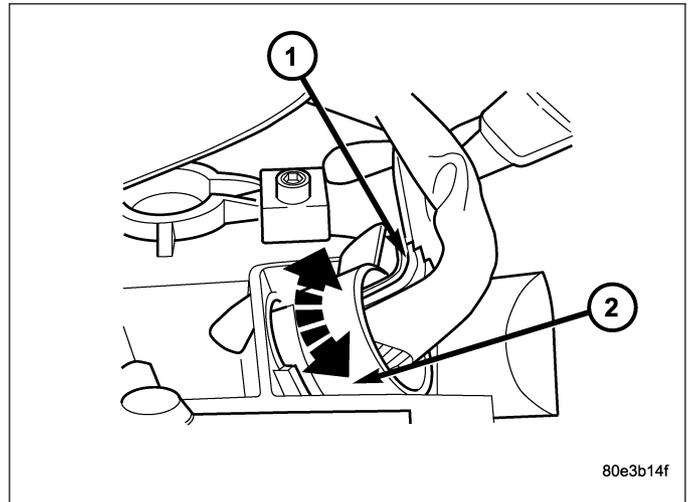


3. Install the Torx® socket bolts (3) and torque to 8 N·m (71 in.lbs.).
4. Install a new oil filter (4).
5. Install oil pan (5) and torque the oil pan bolts to 8 N·m (71 in.lbs.).
6. Install the oil drain plug (8) with a new drain plug gasket (9). Torque the drain plug to 20 N·m (177 in.lbs.).
7. Install the guide bushing (2) into the transmission housing and install the bolt (11) to hold the guide bushing in place.

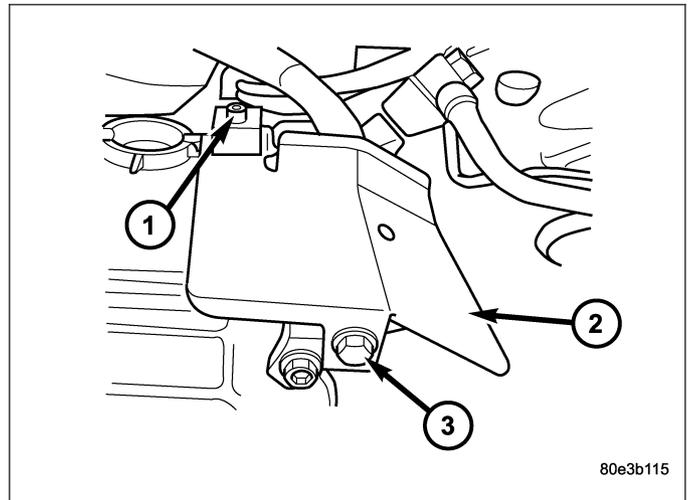


- 1 - HEAT SHIELD
- 2 - ELECTROHYDRAULIC UNIT
- 3 - BOLT
- 4 - OIL FILTER
- 5 - OIL PAN
- 6 - CLAMPING ELEMENT
- 7 - BOLT
- 8 - DRAIN PLUG
- 9 - DRAIN PLUG GASKET
- 10 - 13-PIN PLUG CONNECTOR
- 11 - BOLT
- 12 - GUIDE BUSHING

8. Check O-ring on plug connector (1), and replace if necessary.
9. Install the plug connector (1) into the guide bushing (2). Turn bayonet lock of guide bushing (2) clockwise to connect plug connector (1).



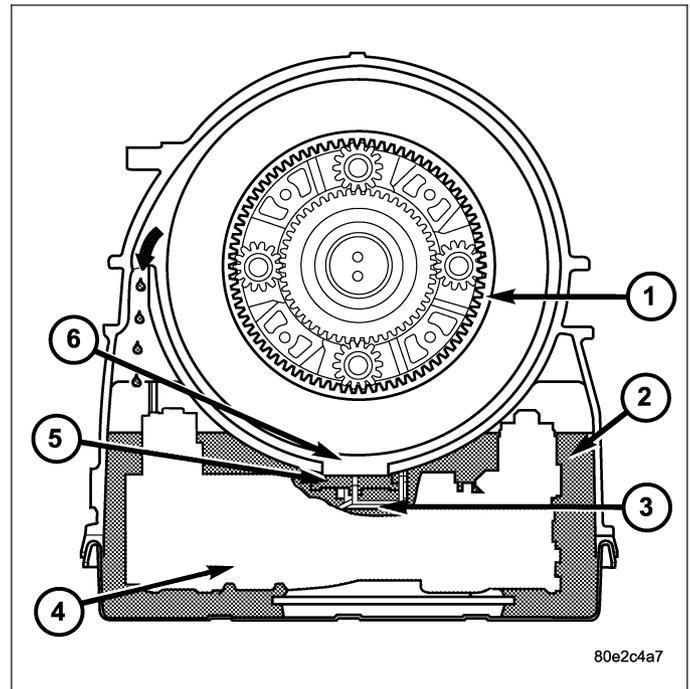
10. Position the heat shield (2) onto the transmission housing and install the screw (1) and bolt (3) to hold the shield in place.
11. Fill the transmission with the correct oil (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION) using the standard procedure (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FLUID AND FILTER - STANDARD PROCEDURE - TRANSMISSION FILL).



## FLUID AND FILTER

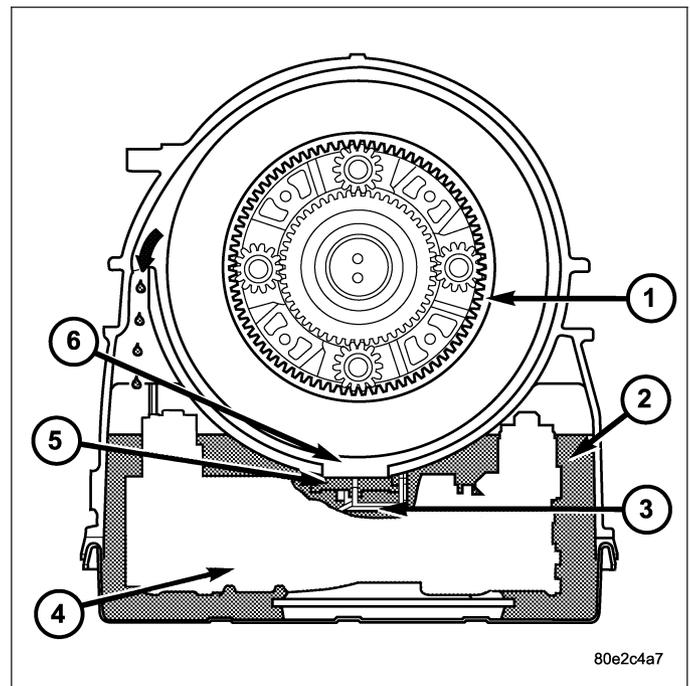
### DESCRIPTION

The oil level control is located on the electrohydraulic unit (4) and consists of the float (5) which is integrated into the electrohydraulic unit. The float is positioned to plug the opening (6) between the oil gallery (2) and gearset chamber (1) so that the rotating gearsets do not splash about in oil as the oil level rises. The oil level control reduces power loss and prevents oil from being thrown out of the transmission housing at high oil temperatures.



### OPERATION

With low oil levels, the lubricating oil which flows constantly out of the gearset, flows back to oil gallery (2) through the opening (6). If the oil level rises, the oil presses the float (5) against the housing opening (6). The float (5) therefore separates the oil gallery (2) from the gearset chamber (1). The lubricating oil which continues to flow out of the gearsets is thrown against the housing wall, incorporated by the rotating parts and flows back into the oil gallery (2) through the upper opening (arrow).



## DIAGNOSIS AND TESTING

### EFFECTS OF INCORRECT FLUID LEVEL

A low fluid level allows the pump to take in air along with the fluid. Air in the fluid will cause fluid pressures to be low and develop slower than normal. If the transmission is overfilled, the gears churn the fluid into foam. This aerates the fluid and causing the same conditions occurring with a low level. In either case, air bubbles cause fluid overheating, oxidation, and varnish buildup which interferes with valve and clutch operation. Foaming also causes fluid expansion which can result in fluid overflow from the transmission vent or fill tube. Fluid overflow can easily be mistaken for a leak if inspection is not careful.

### CAUSES OF BURNT FLUID

Burnt, discolored fluid is a result of overheating which has three primary causes.

1. Internal clutch slippage, usually caused by low line pressure, inadequate clutch apply pressure, or clutch seal failure.
2. A result of restricted fluid flow through the main and/or auxiliary cooler. This condition is usually the result of a faulty or improperly installed drainback valve, a damaged oil cooler, or severe restrictions in the coolers and lines caused by debris or kinked lines.
3. Heavy duty operation with a vehicle not properly equipped for this type of operation. Trailer towing or similar high load operation will overheat the transmission fluid if the vehicle is improperly equipped. Such vehicles should have an auxiliary transmission fluid cooler, a heavy duty cooling system, and the engine/axle ratio combination needed to handle heavy loads.

### FLUID CONTAMINATION

Transmission fluid contamination is generally a result of:

- adding incorrect fluid
- failure to clean dipstick and fill tube when checking level
- engine coolant entering the fluid
- internal failure that generates debris
- overheat that generates sludge (fluid breakdown)
- failure to replace contaminated converter after repair

The use of non-recommended fluids can result in transmission failure. The usual results are erratic shifts, slippage, abnormal wear and eventual failure due to fluid breakdown and sludge formation. Avoid this condition by using recommended fluids only.

The dipstick cap and fill tube should be wiped clean before checking fluid level. Dirt, grease and other foreign material on the cap and tube could fall into the tube if not removed beforehand. Take the time to wipe the cap and tube clean before withdrawing the dipstick.

Engine coolant in the transmission fluid is generally caused by a cooler malfunction. The only remedy is to replace the radiator as the cooler in the radiator is not a serviceable part. If coolant has circulated through the transmission, an overhaul is necessary.

The torque converter should be replaced whenever a failure generates sludge and debris. This is necessary because normal converter flushing procedures will not remove all contaminants.

## STANDARD PROCEDURE

### CHECK OIL LEVEL

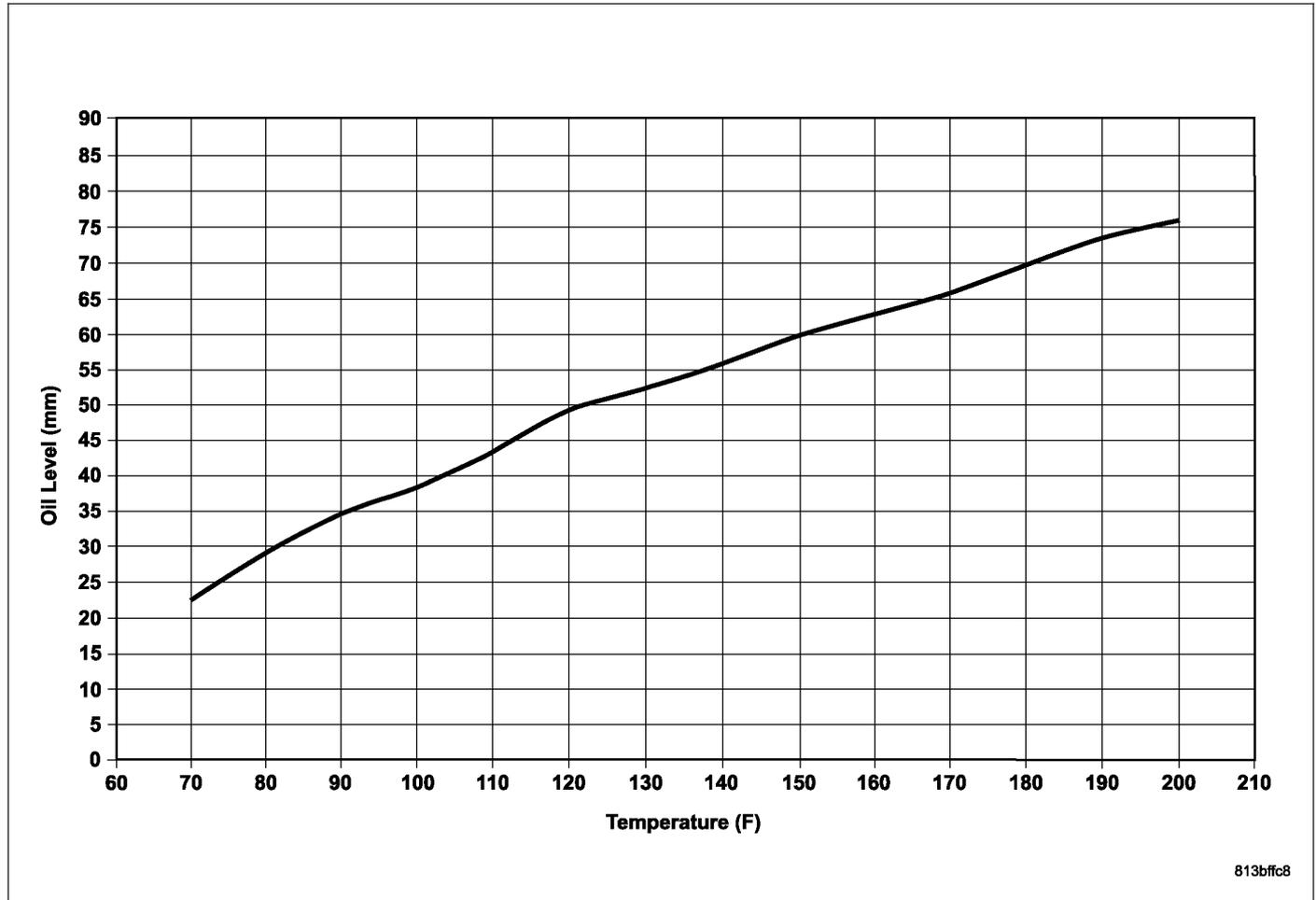
1. Verify that the vehicle is parked on a level surface.
2. Remove the dipstick tube cap.

**WARNING: Risk of accident from vehicle starting off by itself when engine running. Risk of injury from concussions and burns if you insert your hands into the engine when it is started or when it is running. Secure vehicle to prevent it from moving off by itself. Wear properly fastened and close-fitting work clothes. Do not touch hot or rotating parts.**

3. Actuate the service brake. Start engine and let it run at idle speed in selector lever position "P".

4. Shift through the transmission modes several times with the vehicle stationary and the engine idling
5. Warm up the transmission, wait at least 2 minutes and check the oil level with the engine running. Push the Oil Dipstick 9336 into transmission fill tube until the dipstick tip contacts the oil pan and pull out again, read off oil level, repeat if necessary.

**Note:** The dipstick will protrude from the fill tube when installed.



***NAG1 Transmission Fill Graph***

6. Check transmission oil temperature using the appropriate scan tool.

**Note:** The true transmission oil temperature can only be read by a scan tool in REVERSE or any forward gear position. (Refer to 21 - AUTOMATIC TRANSMISSION- NAG1/TRANSMISSION TEMPERATURE SENSOR/ PARK-NEUTRAL SWITCH - OPERATION)

7. The transmission Oil Dipstick 9336 has indicator marks every 10mm. Determine the height of the oil level on the dipstick and using the height, the transmission temperature, and the Transmission Fluid Graph, determine if the transmission oil level is correct.
8. Add or remove oil as necessary and recheck the oil level.
9. Once the oil level is correct, install the dipstick tube cap.

## TRANSMISSION FILL

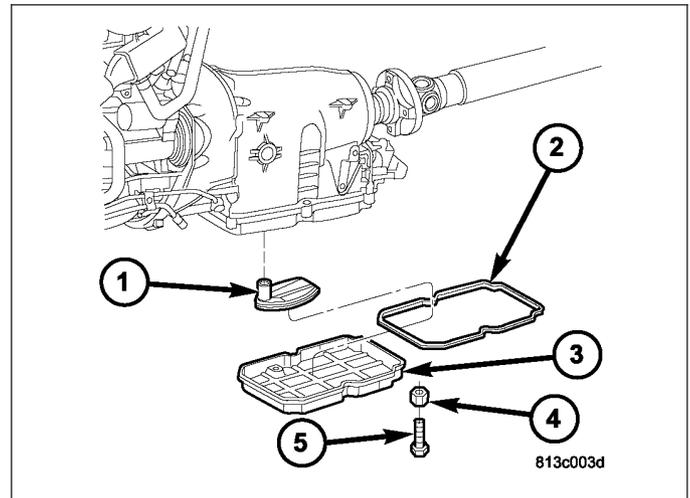
To avoid overfilling transmission after a fluid change or overhaul, perform the following procedure:

1. Verify that the vehicle is parked on a level surface.
2. Remove the dipstick tube cap.

3. Add following initial quantity of Mopar® ATF +4, Automatic Transmission Fluid, to the transmission:
  - a. If only fluid and filter were changed, add **7.4 L (14.8 pts.)** of transmission fluid to transmission.
  - b. If the transmission was completely overhauled or the torque converter was replaced or drained, add **8.1 L (17.1 pts.)** of transmission fluid to transmission.
4. Check the transmission fluid (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FLUID AND FLUID - STANDARD PROCEDURE - CHECK OIL LEVEL) and adjust as required.

## FLUID/FILTER SERVICE

1. Run the engine until the transmission oil reaches operating temperature.
2. Raise and support vehicle.
3. Remove the bolts (5) and retainers (4) holding the oil pan to the transmission.
4. Remove the transmission oil pan (3) and gasket (2) from the transmission.
5. Remove the transmission oil filter (1) and o-ring from the electrohydraulic control unit.
6. Clean the inside of the oil pan (3) of any debris. Inspect the oil pan gasket (2) and replace if necessary.
7. Install a new oil filter (1) and o-ring into the electrohydraulic control unit.
8. Install the oil pan (3) and gasket (2) onto the transmission.
9. Install the oil pan bolts (5) and retainers (4). Torque the bolts to 8 N·m (70 in.lbs.).
10. Lower the vehicle and add 7.0 L (7.4 qts.) of transmission fluid to the transmission.
11. Check the oil level (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/FLUID AND FILTER - STANDARD PROCEDURE - CHECK OIL LEVEL).



**Fluid/Filter Service Points**

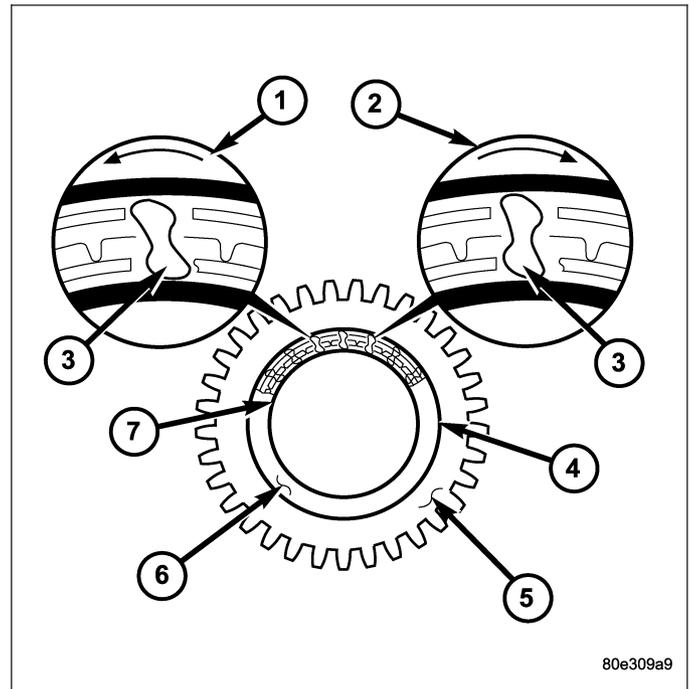
- 1 - OIL FILTER
- 2 - OIL PAN GASKET
- 3 - OIL PAN
- 4 - RETAINER
- 5 - BOLT

## CLUTCH-FREEWHEELING

### DESCRIPTION

Freewheeling clutches are installed in the front planetary gear set between the sun gear and the stator shaft, and in the rear planetary gear set between the sun gear and the intermediate shaft.

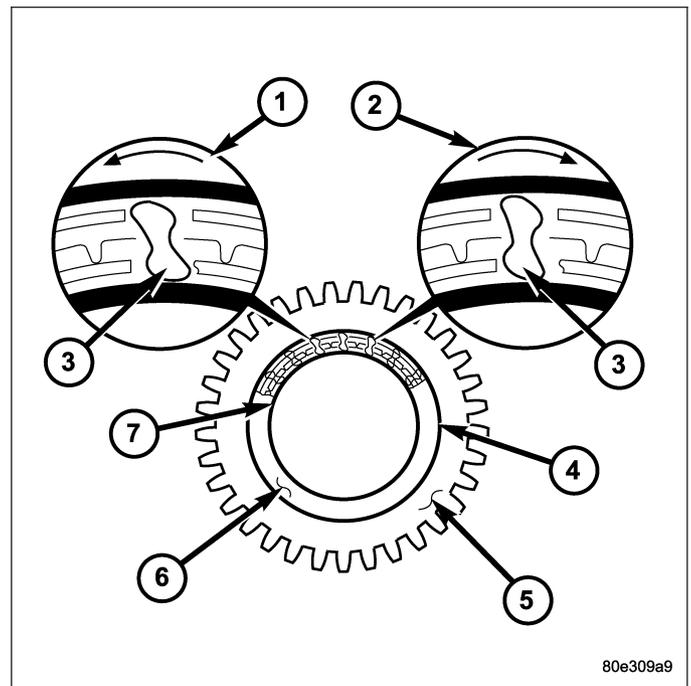
The freewheel consists of an outer race (4), an inner race (7), a number of locking elements (3) and a cage (6) for these locking elements.

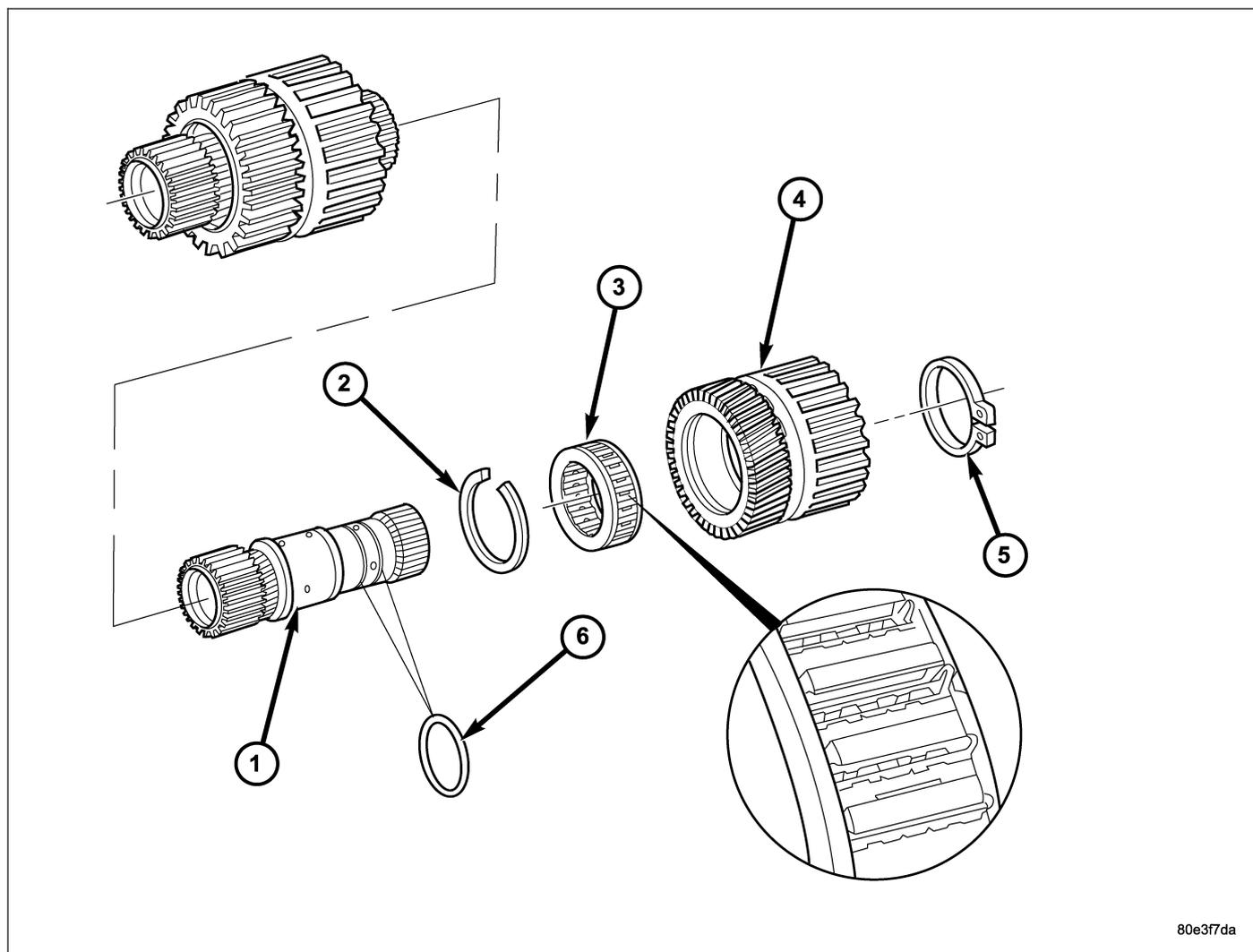


### OPERATION

The freewheeling clutch optimizes individual gear-shifts. They lock individual elements of a planetary gear set together or against the transmission housing in one direction of rotation to allow the torque to be transmitted.

If the inner race (7) of the freewheeling clutch is locked and the outer race (4) turns counter-clockwise (1), the locking elements (3) adopt a diagonal position on account of their special contours, allowing the free-wheel function. The inner race (4) slides under the locking elements (3) with minimal friction. If the rotation of the outer race (4) changes to clockwise (2), the locking elements (3) stand up and lock the outer and inner races (4, 7) together.



**DISASSEMBLY**

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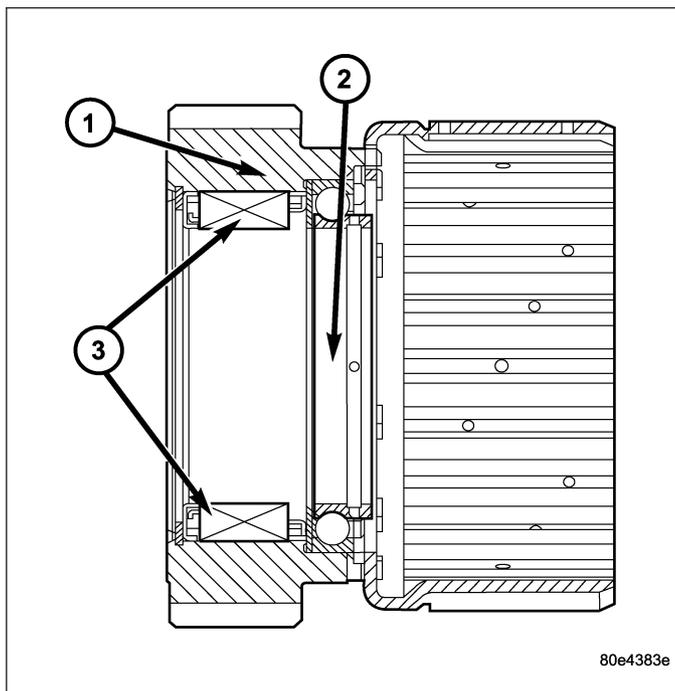
**Freewheeling Clutch F2**

1 - HOLLOW SHAFT  
 2 - F2 CLUTCH SNAP-RING  
 3 - FREEWHEELING CLUTCH F2

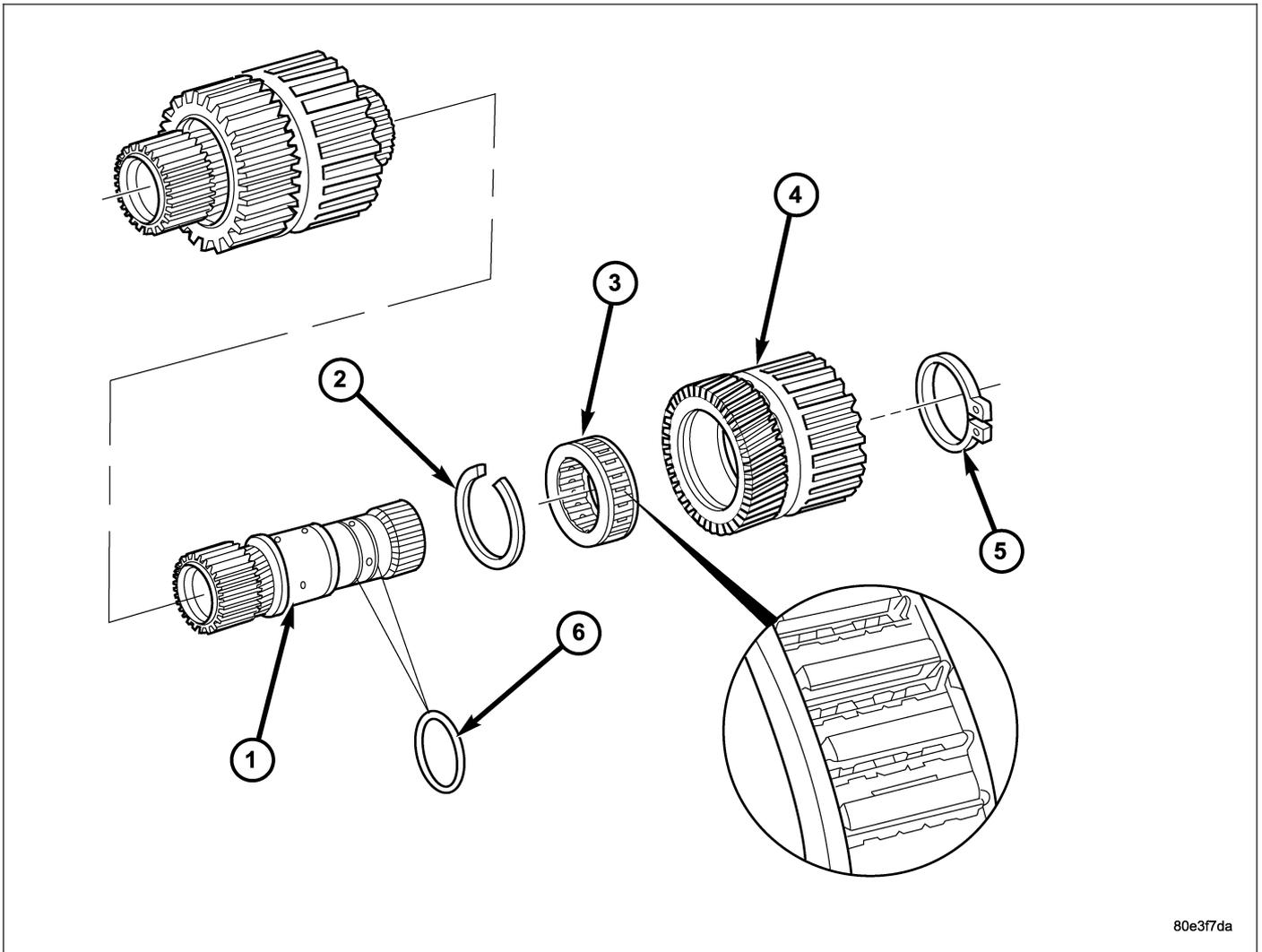
4 - K3 INNER DISC CARRIER AND REAR PLANETARY SUN GEAR  
 5 - RETAINING RING  
 6 - O-RINGS

1. Remove retaining ring (5) from hollow shaft (1).
2. Remove rear sun gear (4) with the K3 internally toothed disk carrier and rear freewheeling clutch F2 (3).
3. Remove snap-ring (2) for freewheel.
4. Press freewheeling clutch (3) out of sun gear.
5. Check O-rings (6), replace if necessary.

6. Check the anti-friction bearing (2) in the rear planetary sun gear for damage. Replace as necessary.



**ASSEMBLY**



80e37da

**Freewheeling Clutch F2**

- 1 - HOLLOW SHAFT
- 2 - F2 CLUTCH SNAP-RING
- 3 - FREEWHEELING CLUTCH F2

- 4 - K3 INNER DISC CARRIER AND REAR PLANETARY SUN GEAR
- 5 - RETAINING RING
- 6 - O-RINGS

**Note:** The side of the freewheeling clutch F2 (3) with the markings (directional arrow, part number, etc.) must be up when the clutch is installed in the sun gear (4).

1. Press freewheeling clutch F2 (3) into sun gear (4).
2. Install snap-ring (2) for freewheeling clutch.
3. Check O-rings (6) on hollow shaft, replace if necessary.
4. Install rear sun gear (4) with K3 internally toothed disc carrier and rear freewheeling clutch (3) onto the hollow shaft.
5. Verify proper operation of the freewheeling clutch F2. When the assembly is held with the F2 clutch snap-ring upward, it should be possible to rotate the hollow shaft counter-clockwise.
6. Install retaining ring (5) onto hollow shaft (1).

## CABLE-GEARSHIFT

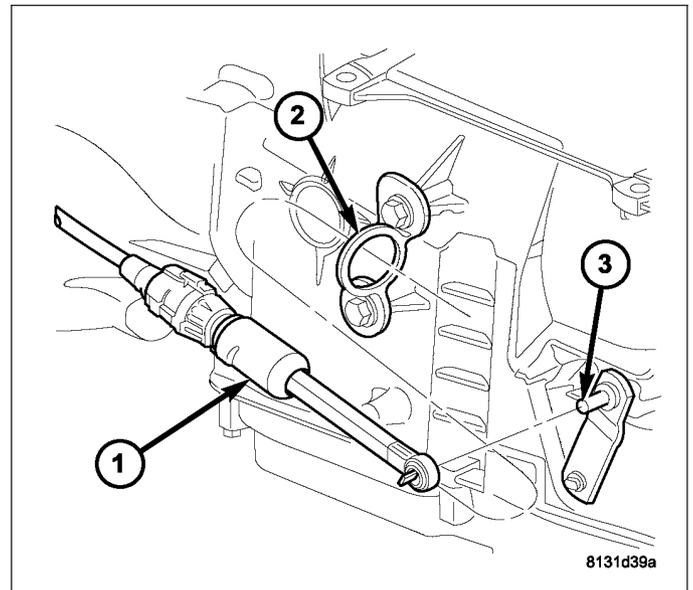
### DIAGNOSIS AND TESTING

#### GEARSHIFT CABLE

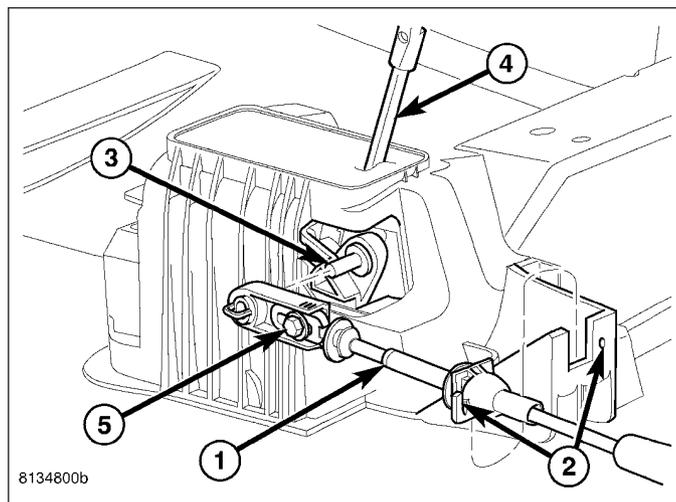
1. The floor shifter lever and gate positions should be in alignment with all transmission PARK, NEUTRAL, and gear detent positions.
2. Engine starts must be possible with floor shift lever in PARK or NEUTRAL gate positions only. Engine starts must not be possible in any other gear position.
3. With floor shift lever handle push-button not depressed and lever in:
  - a. PARK position - Apply forward force on center of handle and remove pressure. Engine starts must be possible.
  - b. PARK position - Apply rearward force on center of handle and remove pressure. Engine starts must be possible.
  - c. NEUTRAL position - Normal position. Engine starts must be possible.
  - d. NEUTRAL position - Engine running and brakes applied, apply forward force on center of shift handle. Transmission shall not be able to shift from NEUTRAL to REVERSE.

#### REMOVAL

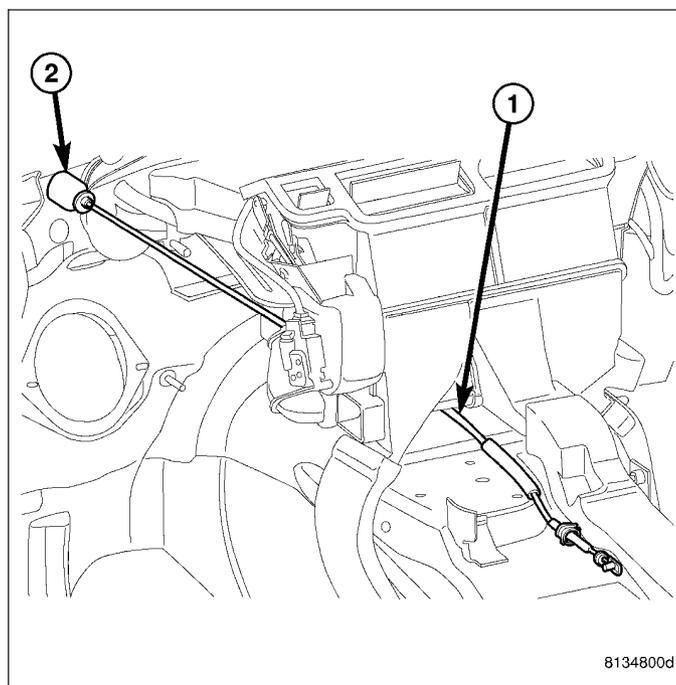
1. Shift transmission into PARK.
2. Raise vehicle.
3. Disengage the gearshift cable (1) eyelet at transmission manual shift lever (3) and pull cable out of the mounting bracket (2).



4. Lower the vehicle.
5. Remove the floor console (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL) as necessary to access the shift mechanism and cables.
6. If necessary, remove the bolts holding the shield, covering the gearshift and park lock cables, to the floorpan and remove the shield.
7. Remove the gearshift cable (1) from the shift lever pin (3).
8. Remove the gearshift cable retainer (2) from the notch (2) in the shifter assembly.

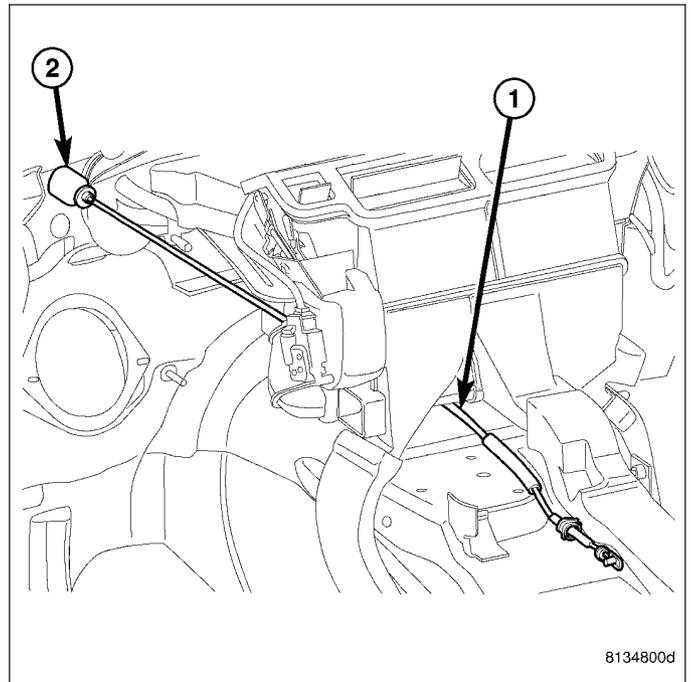


9. From under the hood, remove the shift cable grommet (2) from the dash panel.
10. Remove gearshift cable (1) from vehicle.

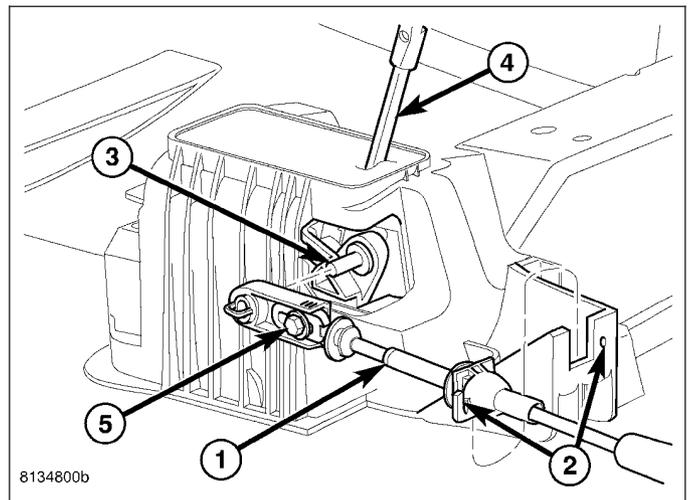


## INSTALLATION

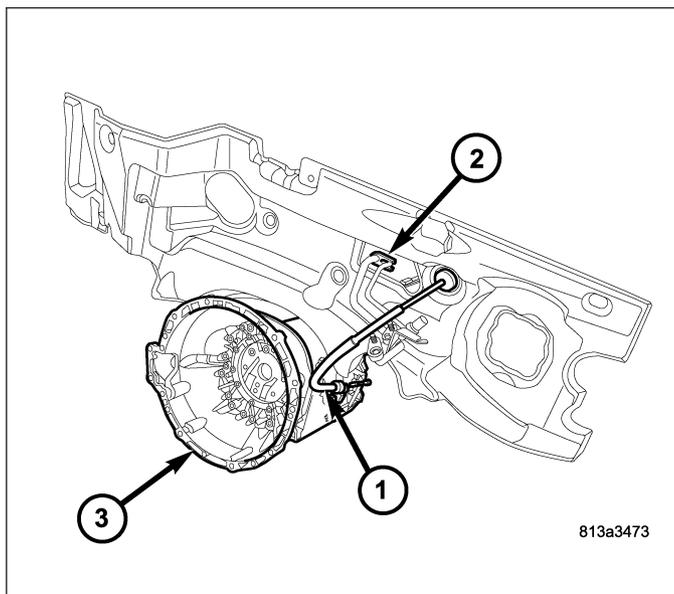
1. From under the hood, route the gearshift cable (1) through the dash panel and toward the shifter assembly.
2. From under the hood, install the grommet (2) to the dash panel.



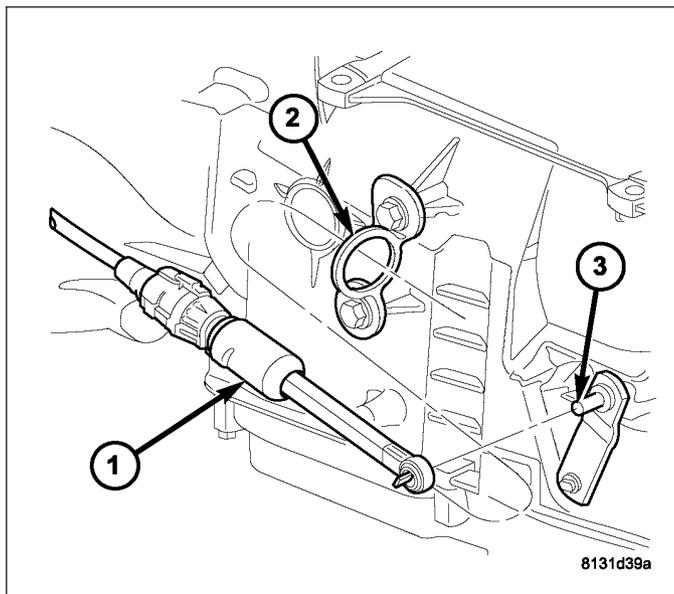
3. Engage the gearshift cable retainer (2) into the notch (2) in the shifter assembly.
4. Install the gearshift cable (1) onto the shift lever pin (3).
5. Loosen the cable adjustment screw (5), if necessary.



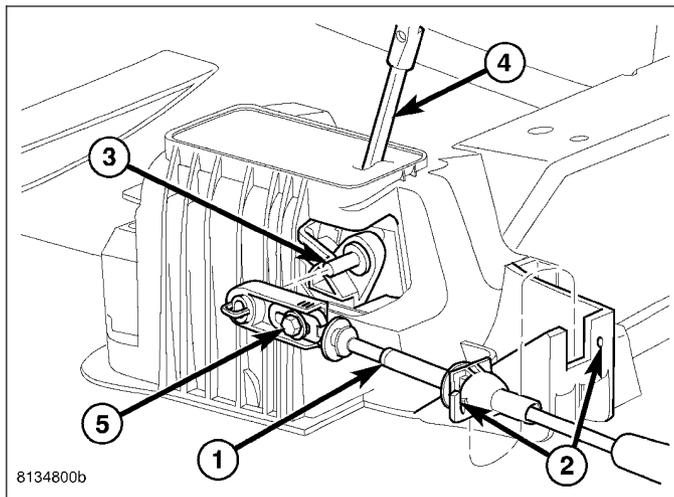
6. From under the hood, route the gearshift cable (1) forward of the air conditioning lines and the heater hoses (2) and toward the transmission (3) manual lever.



7. Raise vehicle.
8. Verify that the transmission is in the PARK position by trying to rotate the propeller shaft. If the propeller shaft rotates, move the transmission manual shift lever to the full rearward position and turn the propeller shaft until the PARK system is engaged.
9. Route the gearshift cable (1) through the mounting bracket (2).
10. Engage the gearshift cable (1) eyelet onto the transmission manual shift lever (3).



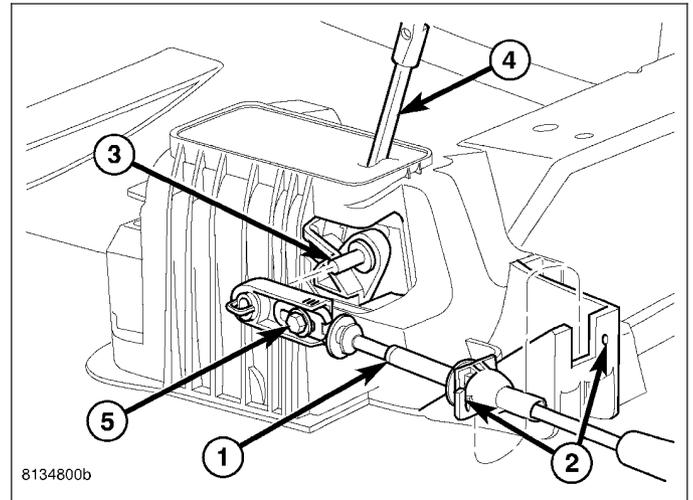
11. Lower vehicle.
12. Verify that the shifter is in the PARK position.
13. Tighten the adjustment screw (5) to 7 N-m (65 in.lbs.).
14. Verify correct shifter operation.
15. If necessary, install the shield, covering the gearshift and park lock cables, to the floorpan and install the bolts to hold the shield to the floorpan.
16. Install the floor console (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION), lower instrument panel components (Refer to 23 - BODY/INSTRUMENT PANEL/INSTRUMENT PANEL CENTER BEZEL - INSTALLATION) and dash panel insulation pad as necessary.



**ADJUSTMENTS - GEARSHIFT CABLE**

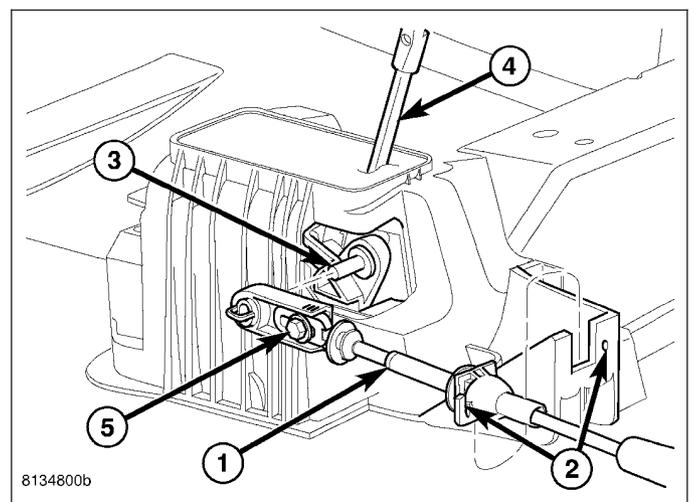
Check adjustment by starting the engine in PARK and NEUTRAL. Adjustment is CORRECT if the engine starts only in these positions. Adjustment is INCORRECT if the engine starts in one but not both positions. If the engine starts in any position other than PARK or NEUTRAL, or if the engine will not start at all, the park/neutral position contact may be faulty.

1. Shift transmission into PARK.
2. Remove floor console as necessary for access to the shift cable adjustment. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
3. Loosen the shift cable adjustment screw (5).



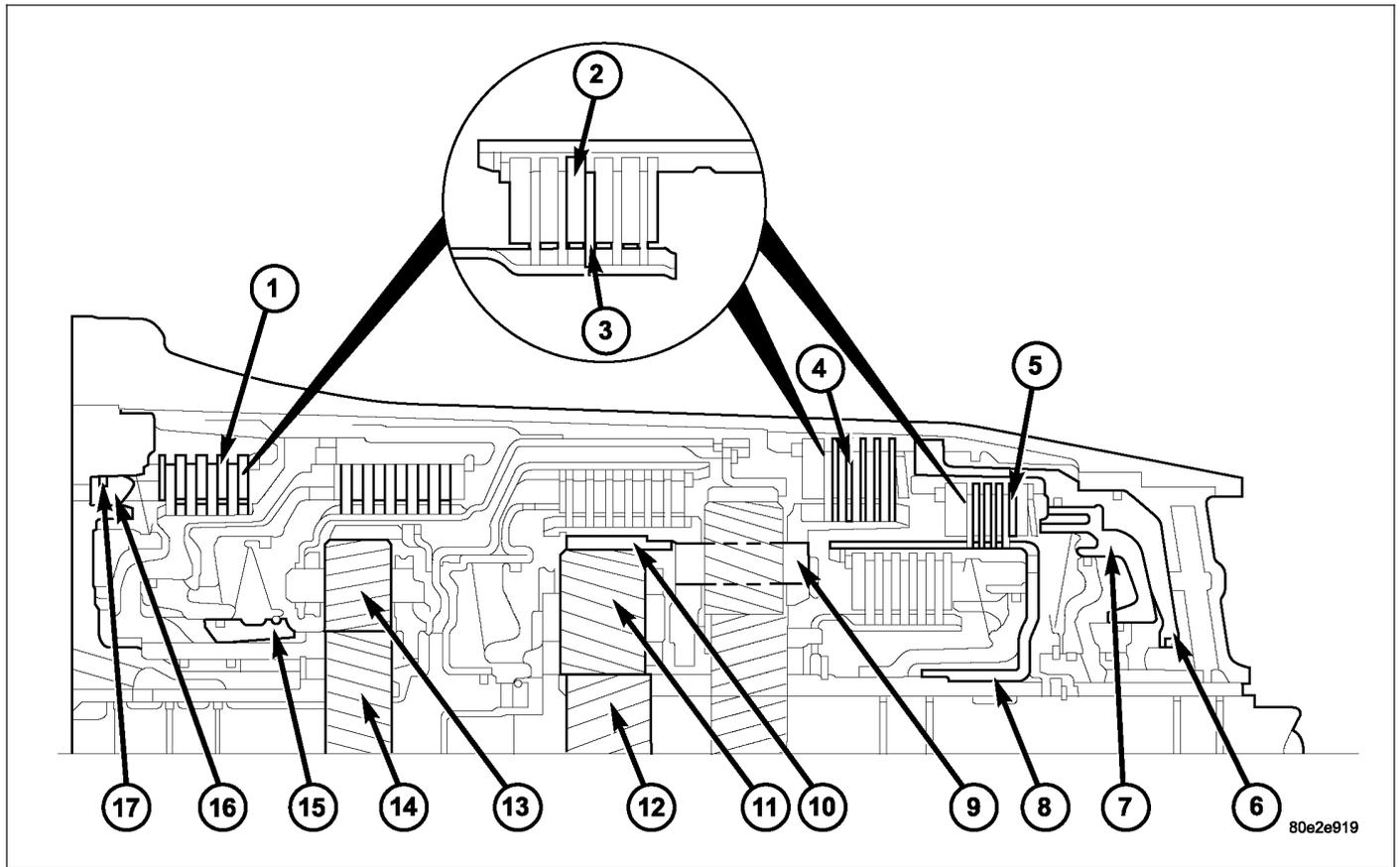
4. Raise vehicle.
5. Unsnap cable eyelet from transmission shift lever.
6. Verify transmission shift lever is in PARK detent by moving lever fully rearward. Last rearward detent is PARK position.
7. Verify positive engagement of transmission park lock by attempting to rotate propeller shaft. Shaft will not rotate when park lock is engaged.
8. Snap cable eyelet onto transmission shift lever.

9. Lower vehicle
10. Tighten the shift cable adjustment screw (5) to 7 N·m (65 in.lbs.).
11. Verify correct operation.
12. Install any floor console components removed for access. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)



# CLUTCHES-HOLDING

## DESCRIPTION



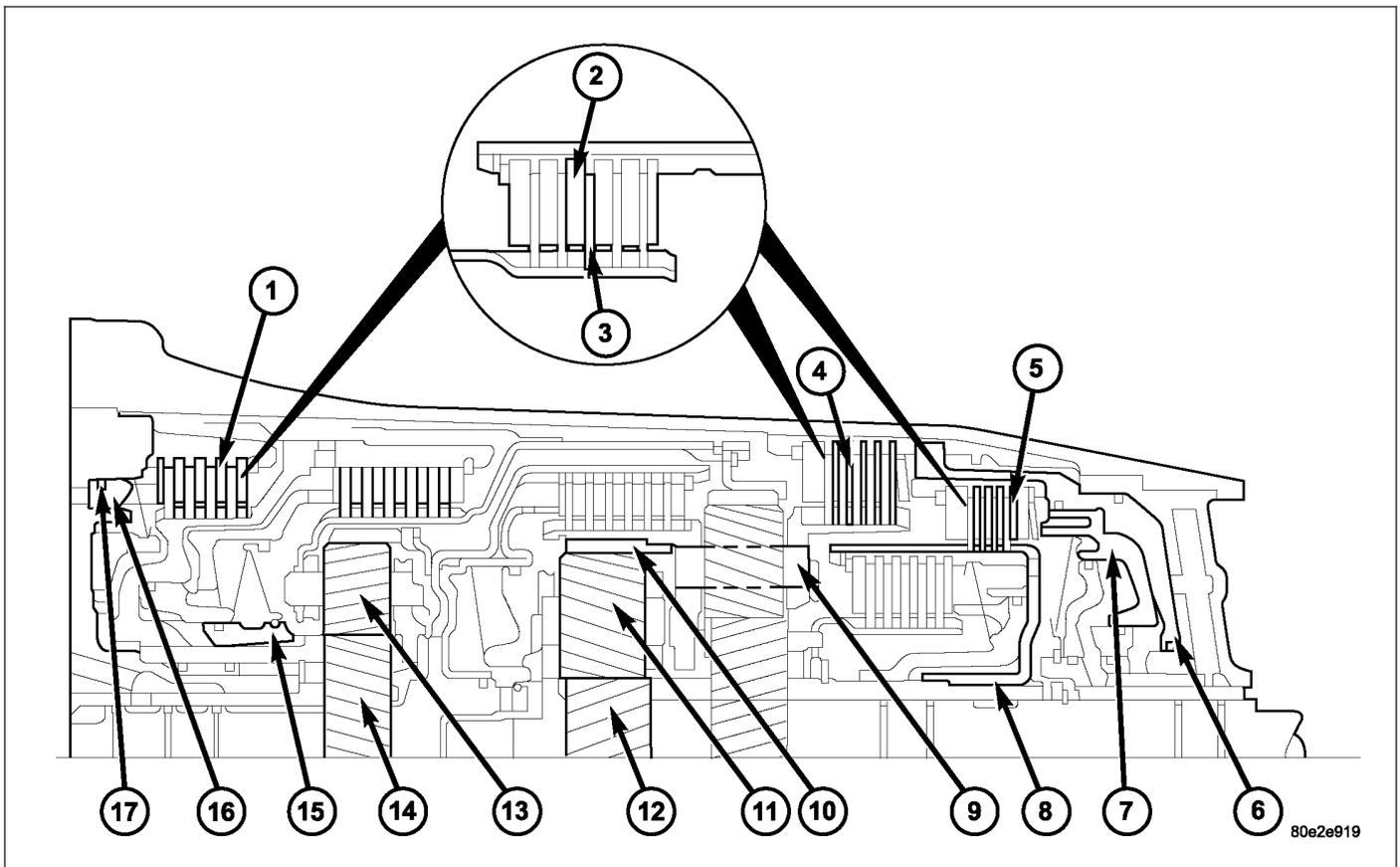
***Holding Clutches***

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>1 - B1 CLUTCH</li> <li>2 - EXTERNALLY TOOTHED DISC</li> <li>3 - INTERNALLY TOOTHED DISC</li> <li>4 - B3 CLUTCH</li> <li>5 - B2 CLUTCH</li> <li>6 - B3 CLUTCH PISTON</li> <li>7 - B2 CLUTCH PISTON</li> <li>8 - B2 CLUTCH INTERNALLY TOOTHED DISC CARRIER</li> <li>9 - REAR PLANETARY GEARSET PLANETARY CARRIER</li> </ul> | <ul style="list-style-type: none"> <li>10 - CENTER PLANETARY GEARSET ANNULUS GEAR</li> <li>11 - CENTER PLANETARY GEARSET PINION GEARS</li> <li>12 - CENTER PLANETARY GEARSET SUN GEAR</li> <li>13 - FRONT PLANETARY GEARSET PINION GEARS</li> <li>14 - FRONT PLANETARY GEARSET SUN GEAR</li> <li>15 - B1 CLUTCH INTERNALLY TOOTHED DISC CARRIER</li> <li>16 - B1 CLUTCH PISTON</li> <li>17 - B1 CLUTCH EXTERNALLY TOOTHED DISC CARRIER</li> </ul> |
|--|---|

Three multiple-disc holding clutches, the front, B1 (1), middle, B3 (4), and rear multiple disc clutches, B2 (5), are located in the planetary gear sets in the transmission housing.

A multiple-disc holding clutch consists of a number of internally toothed discs (10) on an internally toothed disc carrier and externally toothed discs (9) on an externally toothed disc carrier, which is rigidly connected to the transmission housing.

## OPERATION

***Holding Clutches***

- |   |  |
|---|--|
| 1 - B1 CLUTCH                                 | 10 - CENTER PLANETARY GEARSET ANNULUS GEAR     |
| 2 - EXTERNALLY TOOTHED DISC                   | 11 - CENTER PLANETARY GEARSET PINION GEARS     |
| 3 - INTERNALLY TOOTHED DISC                   | 12 - CENTER PLANETARY GEARSET SUN GEAR         |
| 4 - B3 CLUTCH                                 | 13 - FRONT PLANETARY GEARSET PINION GEARS      |
| 5 - B2 CLUTCH                                 | 14 - FRONT PLANETARY GEARSET SUN GEAR          |
| 6 - B3 CLUTCH PISTON                          | 15 - B1 CLUTCH INTERNALLY TOOTHED DISC CARRIER |
| 7 - B2 CLUTCH PISTON                          | 16 - B1 CLUTCH PISTON                          |
| 8 - B2 CLUTCH INTERNALLY TOOTHED DISC CARRIER | 17 - B1 CLUTCH EXTERNALLY TOOTHED DISC CARRIER |
| 9 - REAR PLANETARY GEARSET PLANETARY CARRIER  |  |

The holding clutches connect the annulus gear, sun gear, or planetary carrier of a planetary gear set against the transmission housing in order to transmit the drive torque.

If the piston (16) on multiple-disc holding clutch B1 (1) is subjected to oil pressure, it presses the internal (3) and external discs (2) of the disc set together. The internally toothed disc carrier (15) locks the sun gear (14) against the housing. The planetary pinion gears (13) turn on the sun gear (14).

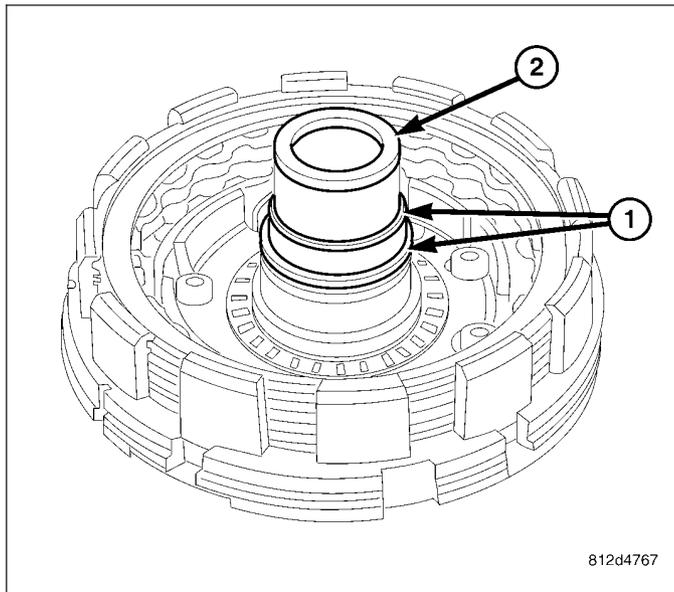
If the multiple-disc holding clutch B2 (5) is actuated via the piston (7), the piston compresses the disc set. The internally toothed disc carrier (8) locks the sun gear (12) against the housing. The planetary pinion gears (11) turn on the sun gear (12).

If the multiple-disc holding clutch B3 (4) is actuated via the piston (6), the planetary carrier (9) and the annulus gear (10) are locked. When the multiple-disc brake B3 (4) is actuated, the direction of rotation is reversed.

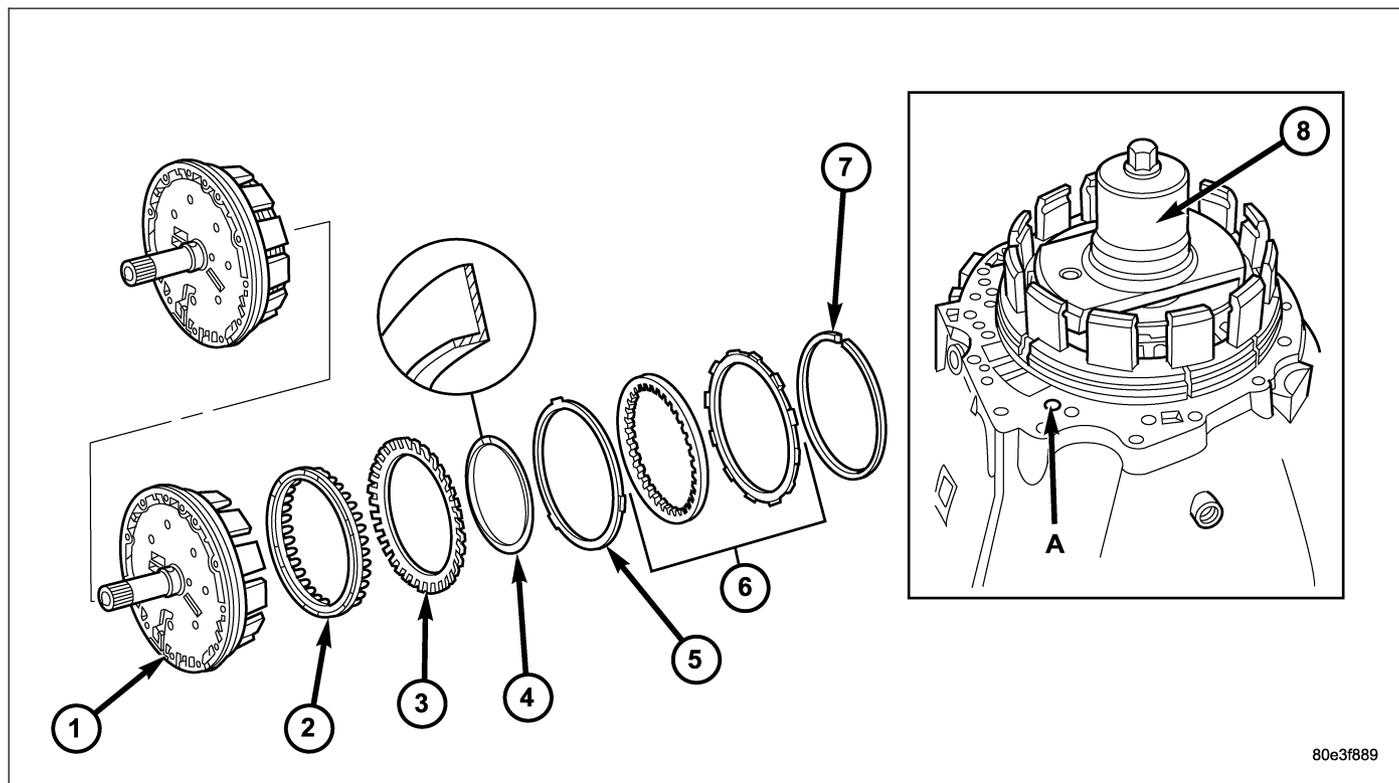
## B1-HOLDING CLUTCH

### DISASSEMBLY

1. Remove the teflon rings (1) from the B1 plate carrier hub (2).



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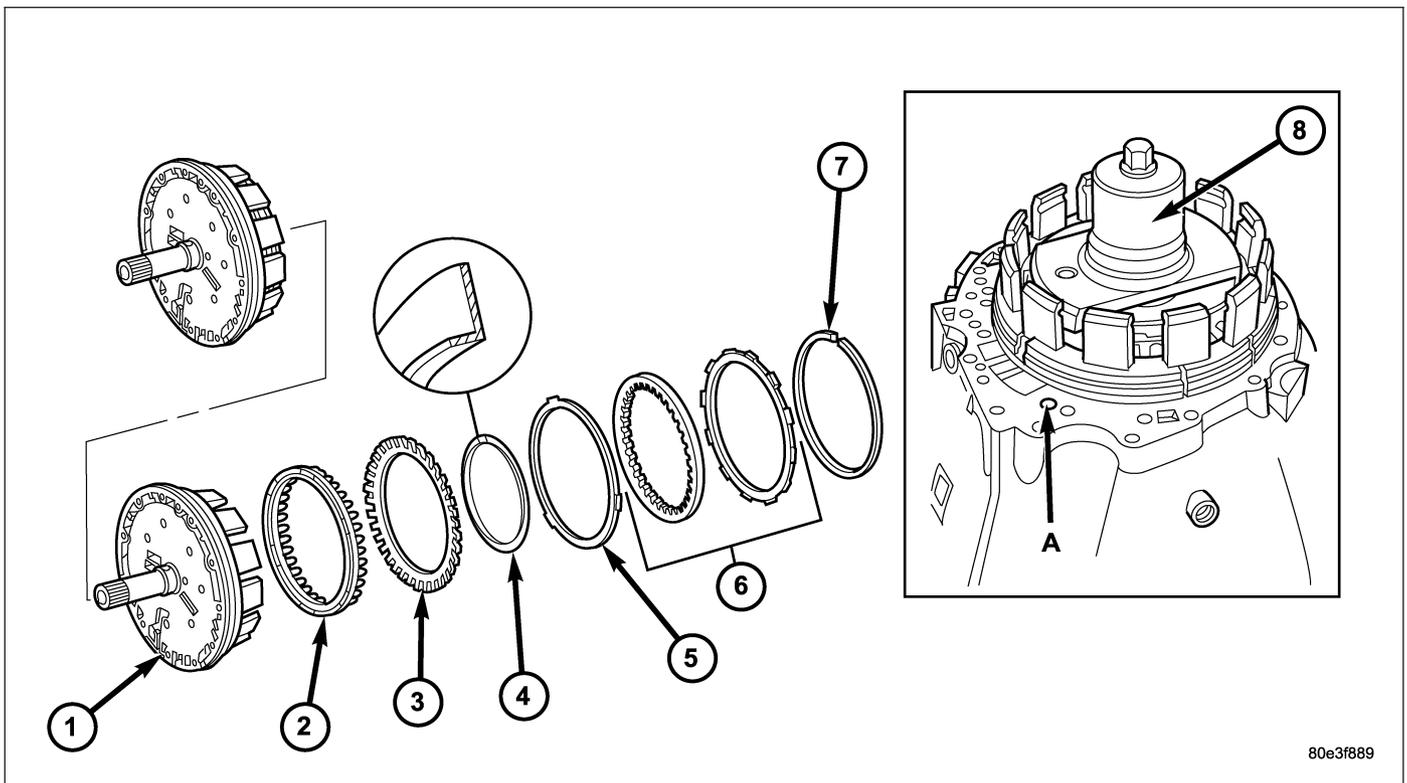
***Holding Clutch B1***

- 1 - HOLDING CLUTCH B1 OUTER CARRIER
- 2 - PISTON
- 3 - DISC SPRING
- 4 - SNAP-RING

- 5 - DISC SPRING
- 6 - MULTIPLE DISC PACK
- 7 - SNAP-RING
- 8 - MULTI-USE SPRING COMPRESSOR 8900

2. Remove snap-ring (7).
3. Remove multiple-disc pack (6) and disc spring (5) from outer multiple-disc carrier. Note which clutch disc is removed just prior to the disc spring (5) for re-assembly. If the clutch discs are re-used, this disc must be returned to its original position on top of the disc spring.
4. Place the Multi-use Spring Compressor 8900 (8) on disc spring (3) and compress the spring until the snap-ring (4) is exposed.
5. Remove snap-ring (4).
6. Remove piston (2) from the outer multiple-disc carrier by carefully blowing compressed air into the bore (A).

## ASSEMBLY



**Holding Clutch B1**

1 - HOLDING CLUTCH B1 OUTER CARRIER  
 2 - PISTON  
 3 - DISC SPRING  
 4 - SNAP-RING

5 - DISC SPRING  
 6 - MULTIPLE DISC PACK  
 7 - SNAP-RING  
 8 - MULTI-USE SPRING COMPRESSOR 8900

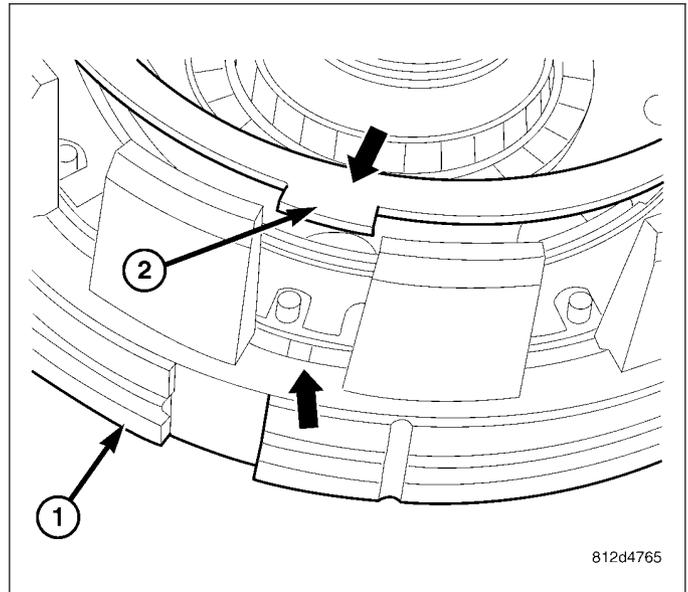
**Note: Check vulcanized gasket, replace if necessary.**

1. Install piston (2) in outer multiple-disc carrier (1).
2. Place compressor (8) on disc spring (3) and compress until the groove of the snap-ring is exposed.

**Note: The collar of the snap-ring must point towards the multiple-disc pack. After installing, check snap-ring for correct seat.**

3. Insert snap-ring (4).

4. Insert disc spring (2) in the outer multiple-disc carrier. Observe the disc spring (2) installation position. The lugs of the disc spring (2) washer must align with the 3 raised pads (arrow) of the B1 multiple-disc carrier (1). The cone of the spring washer must point downwards.

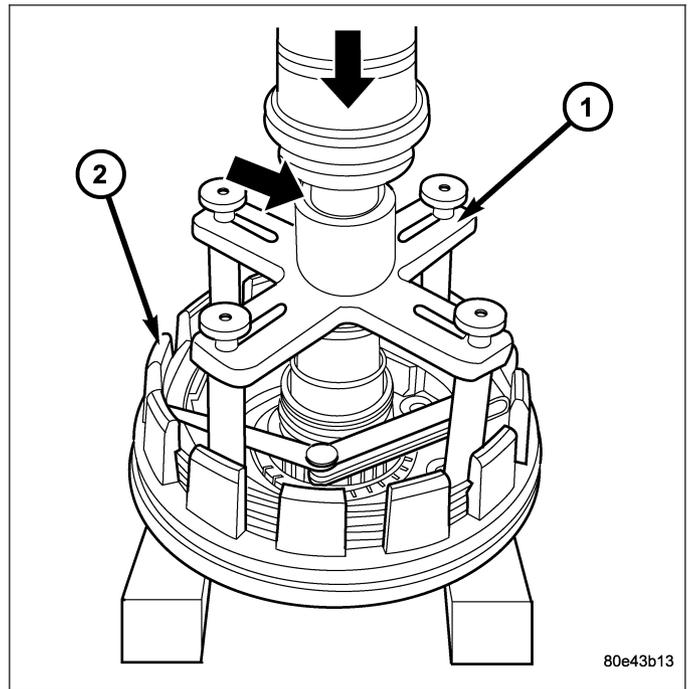


5. Insert the multiple-disc pack (6) in the outer multiple-disc carrier and measure the clutch clearance.

**Note:** Pay attention to the sequence of discs. If the original clutch discs are reused, be sure to return the disc identified on disassembly as belonging on top of the disc spring (5) to its original location.

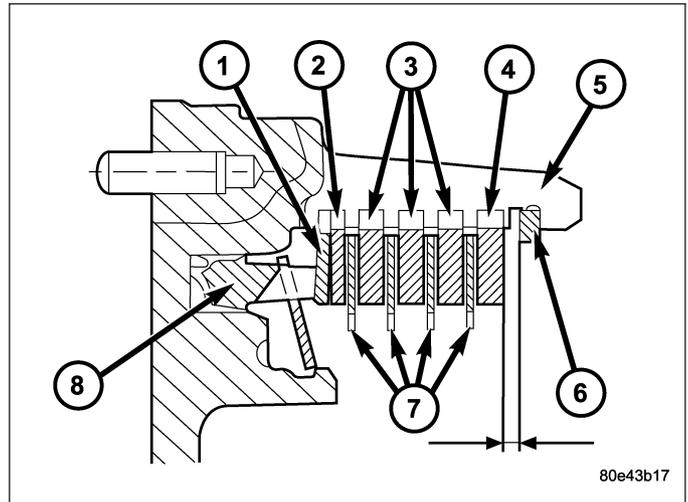
**CAUTION:** When working with double sided friction discs, an externally lugged steel plate is installed first, followed by a friction disc, and continuing on until all the required discs are installed. When working with single sided friction discs, an externally lugged disc is installed first, followed by an internally lugged disc, and continuing on until all the required discs are installed. All single sided discs are installed with the friction side up.

**Note:** Place new friction multiple-discs in ATF fluid for one hour before installing.



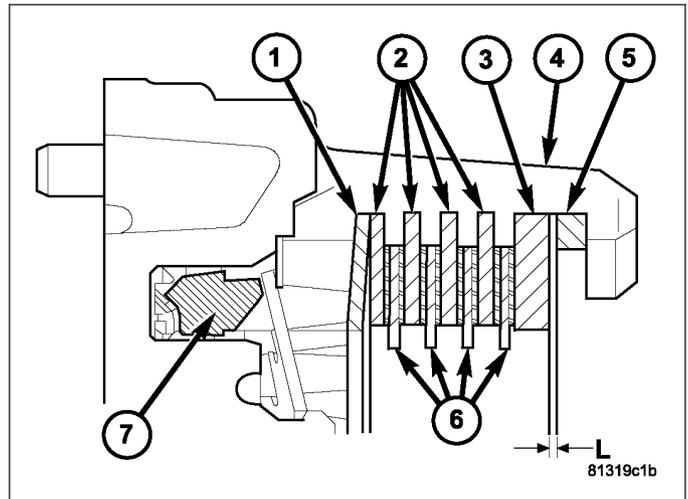
6. Measure B1 clutch clearance by mounting Pressing Tool 8901 (1) on outer multiple disc.
7. Using a lever press , compress pressing tool as far as the stop (then the marking ring is still visible, see small arrow).

8. For transmissions using double sided friction discs, use a feeler gauge to determine the play "L" at three points between the snap-ring (6) and outer multiple-disc (4). During the measurement, the snap-ring (6) must contact the upper bearing surface of the groove in the outer multiple-disc carrier (5). The correct clearance for transmissions using double sided friction discs is 2.3-2.7 mm (0.091-0.106 in.) for two friction disc versions, 2.7-3.1 mm (0.106-0.122 in.) for three disc versions, and 3.0-3.4 mm (0.118-0.134 in.) for four disc versions.
9. Adjust with snap-ring (6), if necessary. Snap-rings are available in thicknesses of 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), 3.8 mm (0.150 in.), and 4.1 mm (0.162 in.).



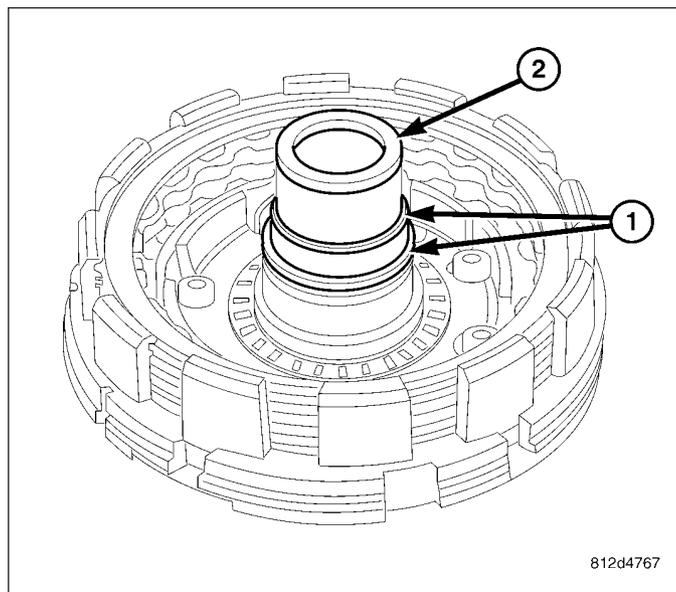
- 1 - DISC SPRING
- 2 - OUTER MULTIPLE DISC - 1.8 mm (0.071 IN.)
- 3 - OUTER MULTIPLE DISC - 2.8 mm (0.110 IN.)
- 4 - OUTER MULTIPLE DISC - 4.0 mm (0.158 IN.)
- 5 - B1 OUTER CARRIER
- 6 - SNAP-RING
- 7 - INNER MULTIPLE DISCS
- 8 - PISTON

10. For transmissions using single sided friction discs, use a feeler gauge to determine the play "L" at three points between the snap-ring (5) and outer multiple-disc (3). During the measurement, the snap-ring (5) must contact the upper bearing surface of the groove in the outer multiple-disc carrier (4). The correct clearance is 2.2-2.6 mm (0.087-0.102 in.) for four friction disc versions, 2.4-2.8 mm (0.095-0.110 in.) for six disc versions, and 2.6-3.0 mm (0.102-0.118 in.) for eight disc versions.
11. Adjust with snap-ring (5), if necessary. Snap-rings are available in thicknesses of 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), 3.8 mm (0.150 in.), and 4.1 mm (0.162 in.).



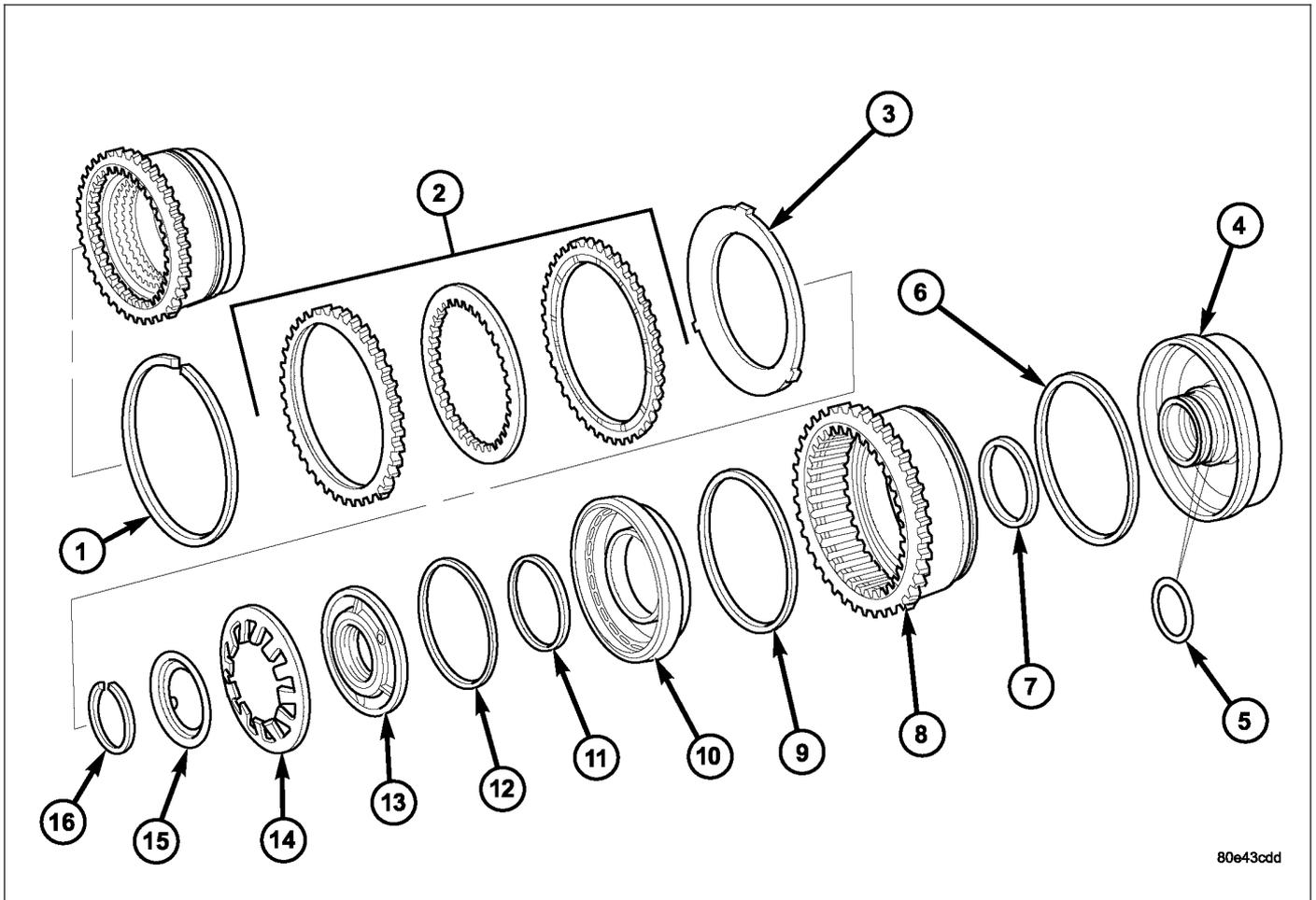
- 1 - DISC SPRING
- 2 - OUTER MULTIPLE DISC
- 3 - OUTER MULTIPLE DISC - 4.0 mm (0.158 IN.)
- 4 - B1 OUTER CARRIER
- 5 - SNAP-RING
- 6 - INNER MULTIPLE DISCS
- 7 - PISTON

12. Install the teflon rings (1) onto the B1 plate carrier hub (2).
13. Coat Teflon rings (1) lightly with grease and insert in the groove so that the joint remains together.



## B2-HOLDING CLUTCH

### DISASSEMBLY



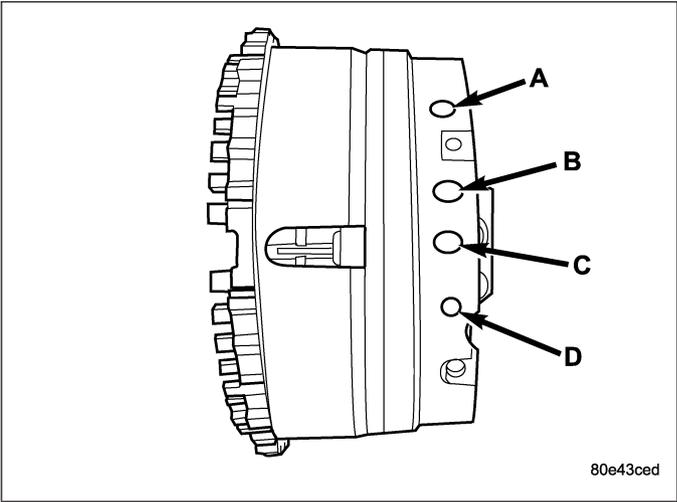
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#### *Holding Clutch B2*

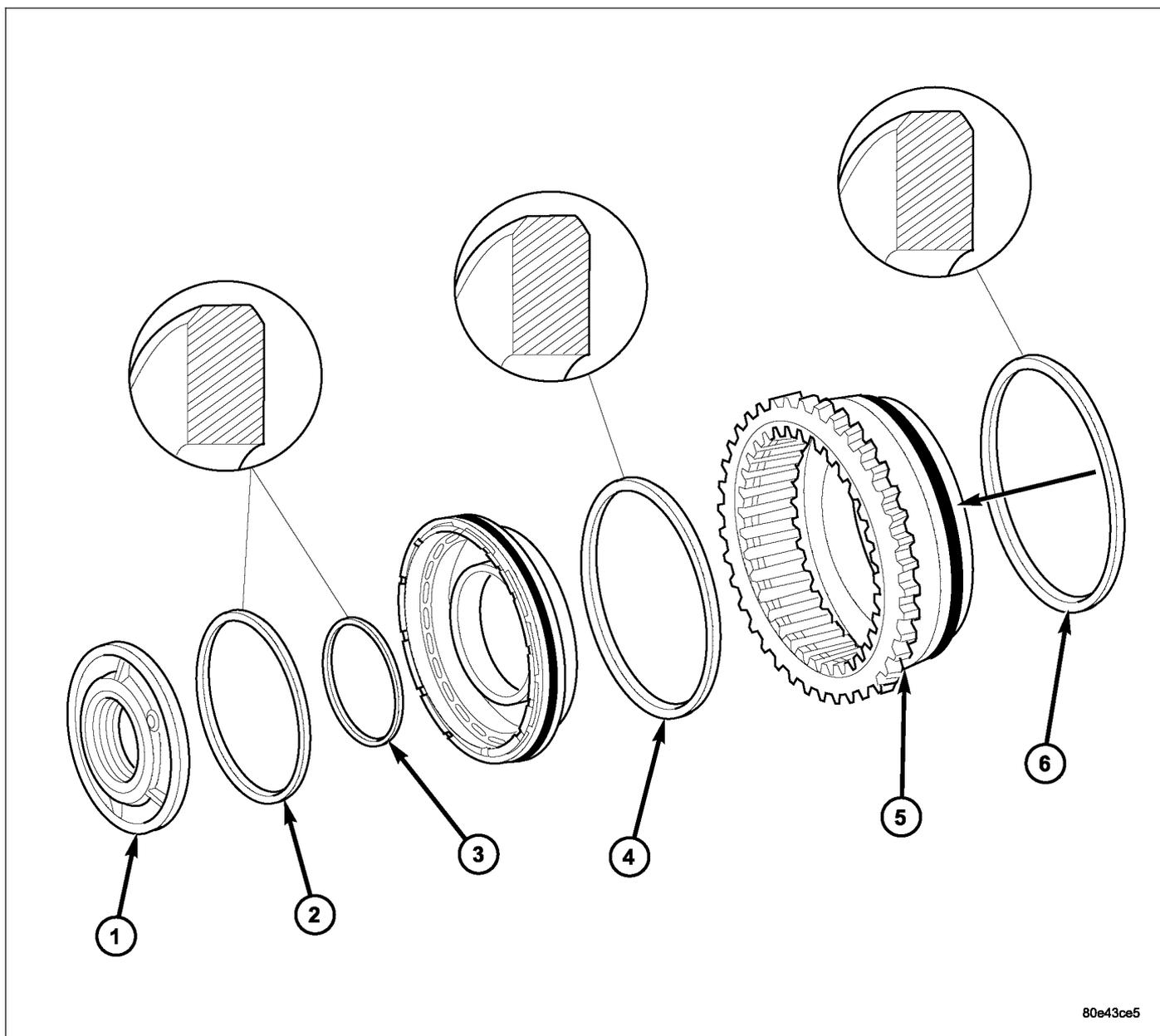
- |                                     |                                       |
|-------------------------------------|---------------------------------------|
| 1 - SNAP-RING                       | 9 - B2 PISTON SEALING RING            |
| 2 - MULTIPLE DISC PACK              | 10 - B2 PISTON                        |
| 3 - DISC SPRING                     | 11 - PISTON GUIDE SEALING RING        |
| 4 - B2 AND B3 PISTON GUIDE          | 12 - PISTON GUIDE SEALING RING        |
| 5 - O-RING                          | 13 - PISTON GUIDE RING                |
| 6 - B3 PISTON SEALING RING          | 14 - PISTON BACK PRESSURE DISC SPRING |
| 7 - B3 PISTON SEALING RING          | 15 - SPRING PLATE                     |
| 8 - B3 PISTON/B2 OUTER DISC CARRIER | 16 - SNAP-RING                        |

1. Remove snap ring (1).
2. Take multiple-disc pack B2 (2) and disc spring (3) out of the outer multiple-disc carrier B2 (8). The outer multiple-disc carrier for the multi-disc holding clutch B2 is the piston for the multiple-disc holding clutch B3 at the same time. Note which clutch disc is removed just prior to the disc spring (3) for re-assembly. If the clutch discs are re-used, this disc must be returned to its original position on top of the disc spring.
3. Place the Multi-use Spring Compressor 8900 on the spring disc (14) and compress the spring until the groove for the snap-ring is exposed.
4. Remove snap-ring (16).
5. Remove spring plate (15) and disc spring (14).

6. Separate piston guide ring (13) and the B2 piston (10) from the B3 piston (8) by blowing compressed air into the bore (D).
7. Press piston guide ring (13) out of the B2 piston (10).
8. Separate piston guide (4) from the B3 piston (8) by blowing compressed air into the bore (A).



**ASSEMBLY**



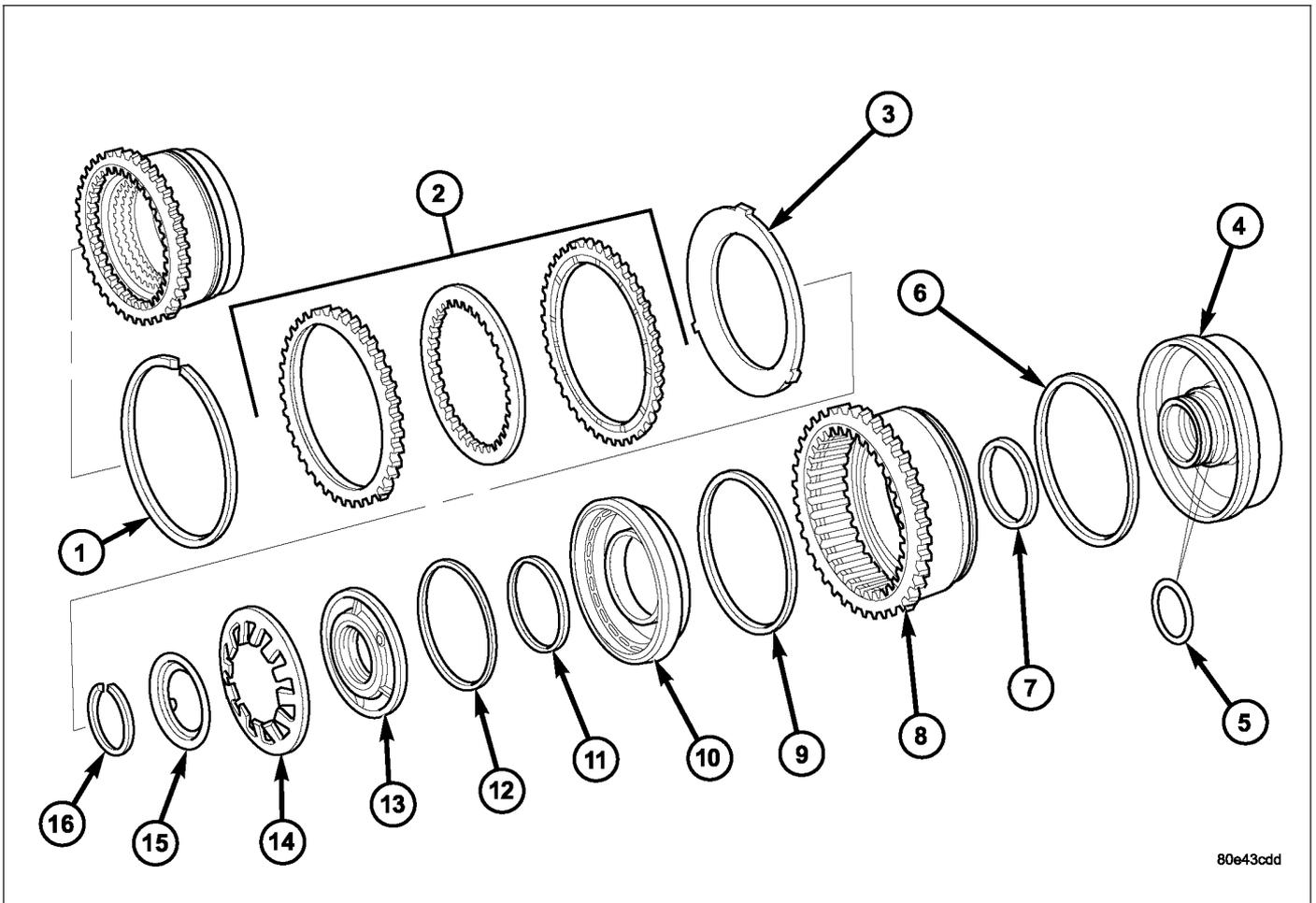
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***Holding Clutch B2/B3 Seals***

- 1 - PISTON GUIDE RING
- 2 - PISTON GUIDE RING SEALING RING
- 3 - PISTON GUIDE RING SEALING RING

- 4 - B2 PISTON SEALING RING
- 5 - B3 PISTON/B2 OUTER DISC CARRIER
- 6 - B3 PISTON SEALING RING

1. Check all sealing rings (2-4, 6), replace if necessary. The rounded off edges on the sealing rings (2, 4, 6) must point outwards.

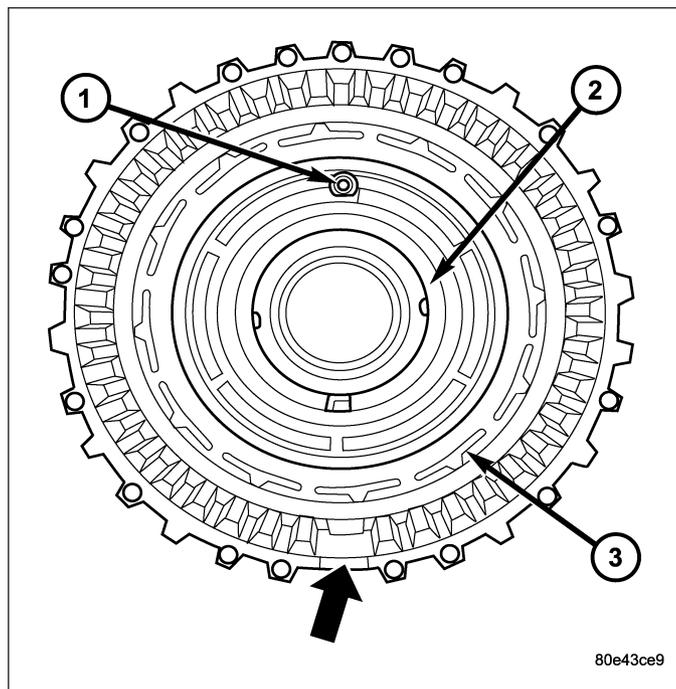


**Holding Clutch B2**

- |                                     |                                       |
|-------------------------------------|---------------------------------------|
| 1 - SNAP-RING                       | 9 - B2 PISTON SEALING RING            |
| 2 - MULTIPLE DISC PACK              | 10 - B2 PISTON                        |
| 3 - DISC SPRING                     | 11 - PISTON GUIDE SEALING RING        |
| 4 - B2 AND B3 PISTON GUIDE          | 12 - PISTON GUIDE SEALING RING        |
| 5 - O-RING                          | 13 - PISTON GUIDE RING                |
| 6 - B3 PISTON SEALING RING          | 14 - PISTON BACK PRESSURE DISC SPRING |
| 7 - B3 PISTON SEALING RING          | 15 - SPRING PLATE                     |
| 8 - B3 PISTON/B2 OUTER DISC CARRIER | 16 - SNAP-RING                        |

2. Assemble piston guide (4) and B3 piston (8) in the correct position. Verify that the missing tooth in the B3 piston/B2 outer disc carrier (8) is aligned with the centerline of the two threaded holes in the B2 and B3 piston guide (4).
3. Insert B2 piston (10) in B3 piston (8).

4. Insert piston guide ring (2). The valve (1) in the piston guide ring must be on top.



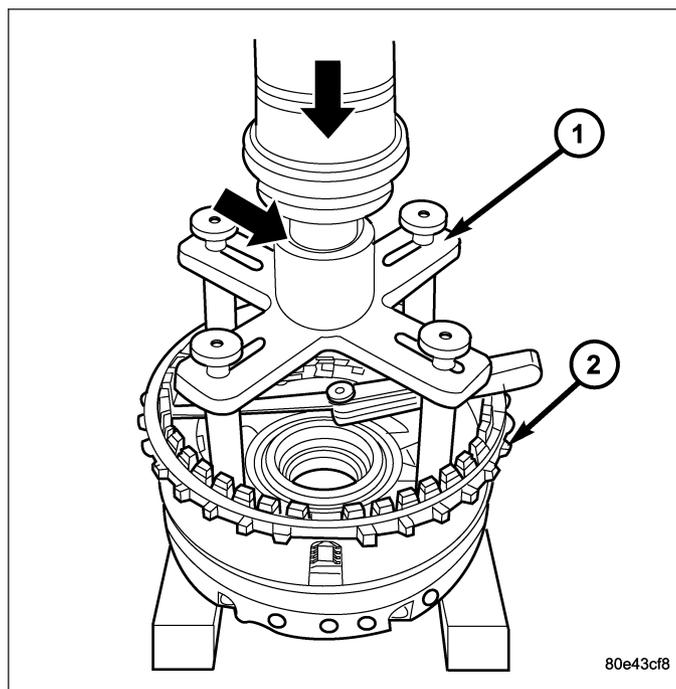
5. Insert disc spring (14) and spring plate (15). Insert disc spring with the curvature towards the spring plate  
 6. Place Multi-use Spring Compressor 8900 on the disc spring (14) and compress the spring until the groove for the snap-ring is exposed.  
 7. Insert snap-ring (16).

**Note:** Pay attention to sequence of discs. If the original clutch discs are reused, be sure to return the disc identified on disassembly as belonging on top of the disc spring (3) to its original location. Place new friction multiple-discs in ATF fluid for one hour before installing.

8. Insert disc spring (3) and multiple-disc pack (2) in the B2 outer multiple-disc carrier.  
 9. Insert snap-ring (1).

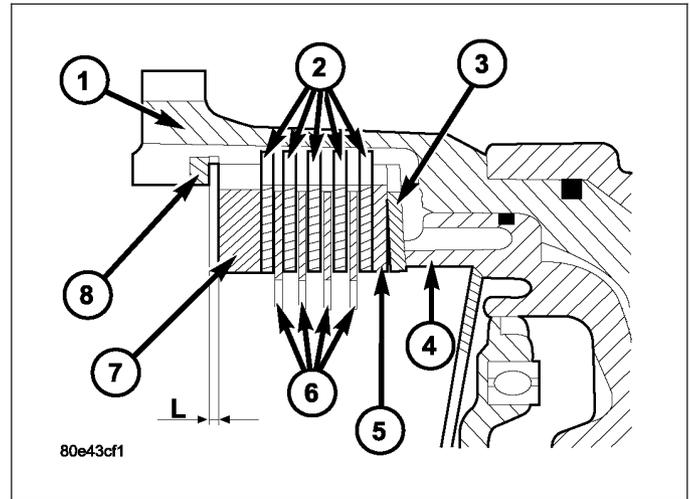
**Note:** During the measurement the snap-ring (8) must contact the upper bearing surface of the groove in the outer multiple-disc carrier.

10. Measure the B2 clutch pack clearance by mounting the Pressing Tool 8901 (1) on outer multiple disc.  
 11. Using a lever press, compress the pressing tool as far as the stop (then the marking ring is still



visible, see small arrow).

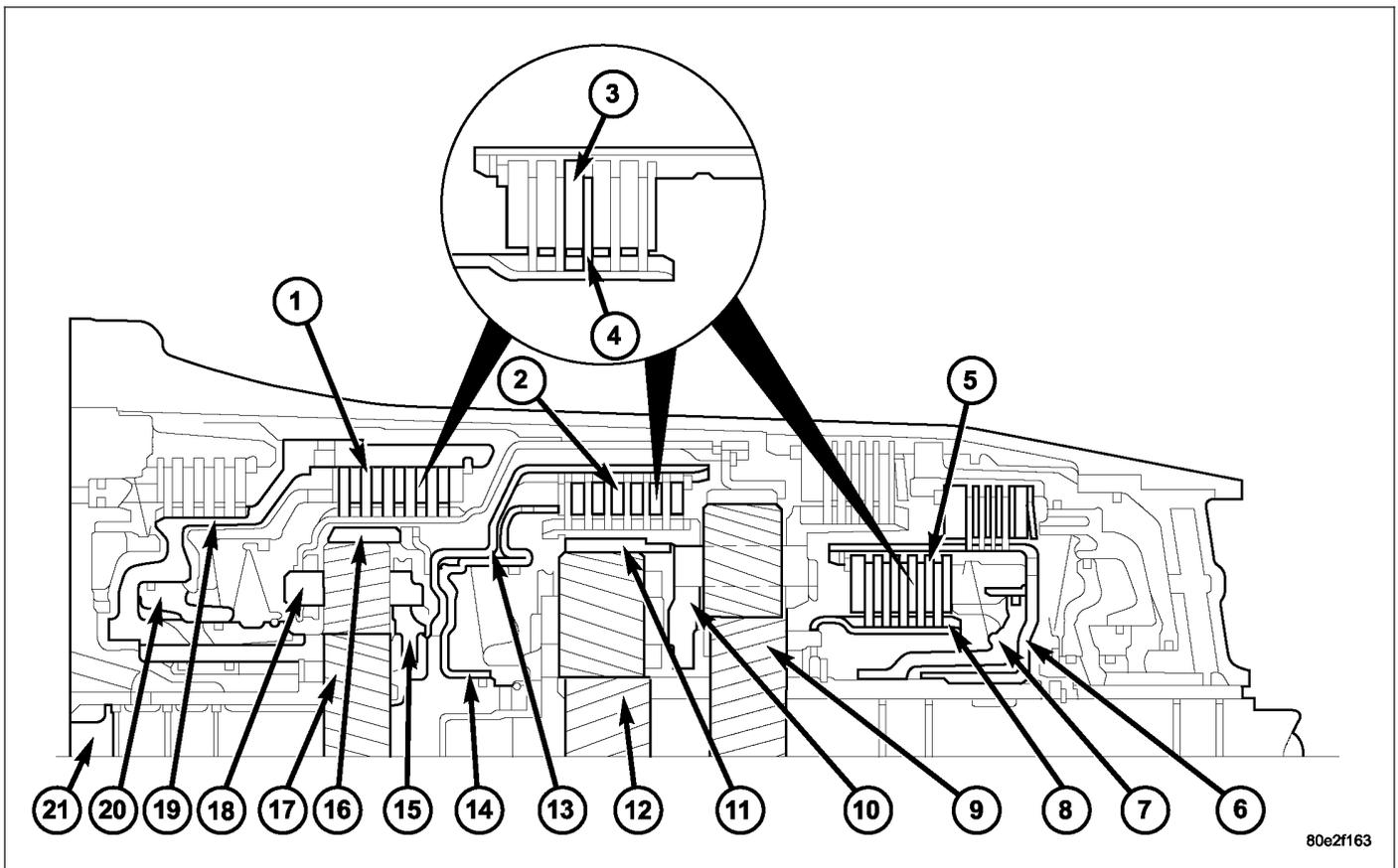
12. Using a feeler gauge, determine the play "L" at three points between the snap-ring (8) and outer multiple-disc (7).
13. The correct clutch clearance is 1.9-2.3 mm (0.075-0.091 in.) for the four friction disc versions and 2.0-2.4 mm (0.079-0.095 in.) for the five disc versions.
14. Adjust with snap-ring (8), if necessary. Snap-rings are available in thicknesses of 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), 3.8 mm (0.150 in.), and 4.1 mm (0.162 in.).



- 1 - B2 OUTER DISC CARRIER
- 2 - FRICTION DISCS
- 3 - DISC SPRING
- 4 - B2 PISTON
- 5 - OUTER MULTIPLE DISC - 1.8 MM (0.071 IN.)
- 6 - OUTER MULTIPLE DISC - 1.8 MM (0.071 IN.)
- 7 - OUTER MULTIPLE DISC - 6.5 MM (0.256 IN.)
- 8 - SNAP-RING

## CLUTCHES-INPUT

### DESCRIPTION



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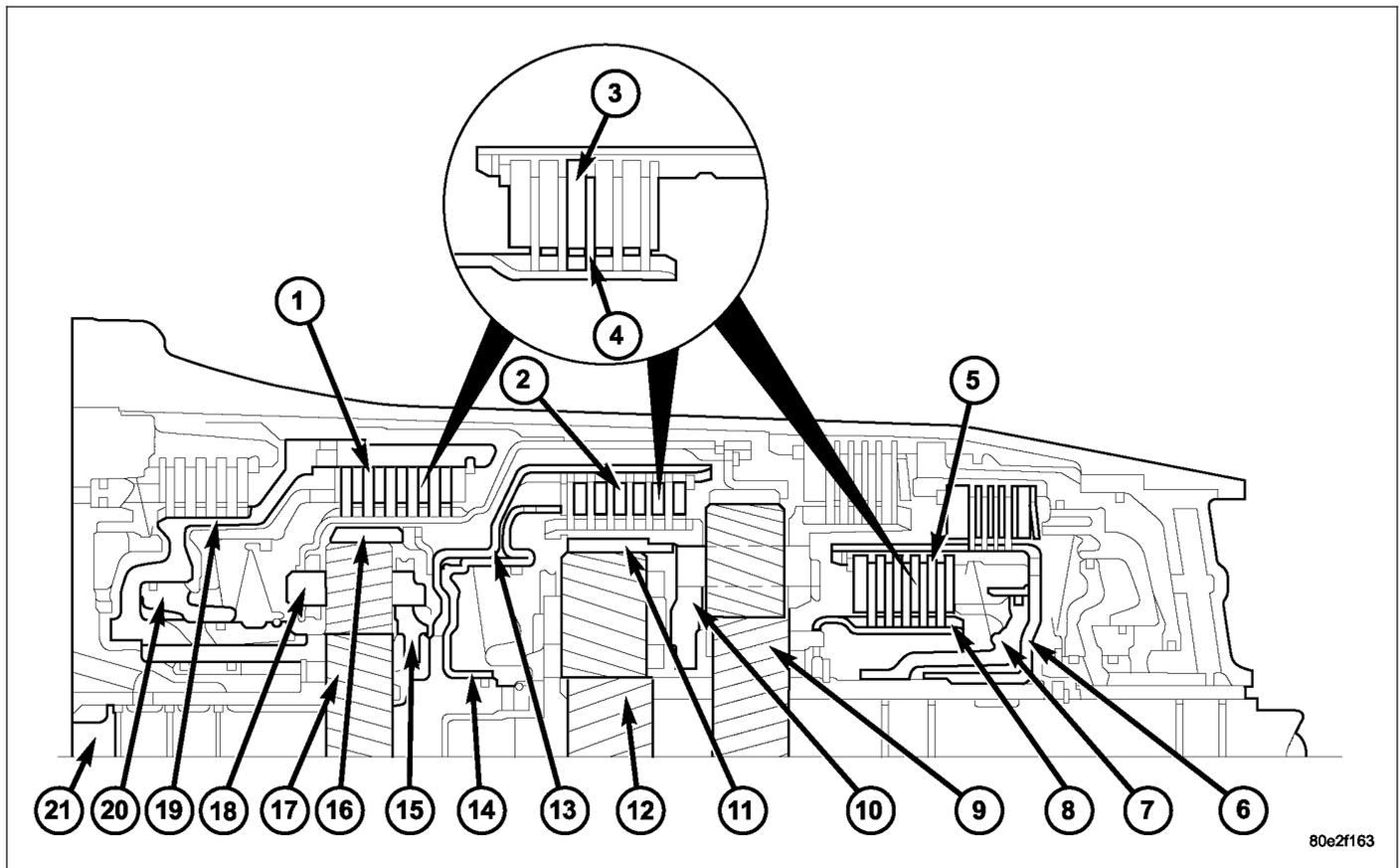
#### *Input Clutches*

- |   |  |
|---|--|
| 1 - K1 CLUTCH                                   | 12 - CENTER PLANETARY GEARSET SUN GEAR         |
| 2 - K2 CLUTCH                                   | 13 - K2 CLUTCH EXTERNALLY TOOTHED DISC CARRIER |
| 3 - EXTERNALLY TOOTHED DISC                     | 14 - K2 CLUTCH PISTON                          |
| 4 - INTERNALLY TOOTHED DISC                     | 15 - FRONT PLANETARY GEARSET PLANETARY CARRIER |
| 5 - K3 CLUTCH                                   | 16 - FRONT PLANETARY GEARSET ANNULUS GEAR      |
| 6 - K3 CLUTCH EXTERNALLY TOOTHED DISC CARRIER   | 17 - FRONT PLANETARY GEARSET SUN GEAR          |
| 7 - K3 CLUTCH PISTON                            | 18 - K1 CLUTCH INTERNALLY TOOTHED DISC CARRIER |
| 8 - K3 CLUTCH INTERNALLY TOOTHED DISC CARRIER   | 19 - K1 CLUTCH EXTERNALLY TOOTHED DISC CARRIER |
| 9 - REAR PLANETARY GEARSET SUN GEAR             | 20 - K1 CLUTCH PISTON                          |
| 10 - CENTER PLANETARY GEARSET PLANETARY CARRIER | 21 - DRIVE SHAFT                               |
| 11 - CENTER PLANETARY GEARSET ANNULUS GEAR      |  |

Three multi-plate input clutches (1, 2, 5), the front, middle and rear multi-plate clutches K1 (1), K2 (2), and K3 (5), are located in the planetary gear sets in the transmission housing.

A multi-plate input clutch consists of a number of internally toothed discs (4) on an internally toothed disc carrier and externally toothed discs (3) on an externally toothed disc carrier.

**OPERATION**



**Input Clutches**

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>1 - K1 CLUTCH</li> <li>2 - K2 CLUTCH</li> <li>3 - EXTERNALLY TOOTHED DISC</li> <li>4 - INTERNALLY TOOTHED DISC</li> <li>5 - K3 CLUTCH</li> <li>6 - K3 CLUTCH EXTERNALLY TOOTHED DISC CARRIER</li> <li>7 - K3 CLUTCH PISTON</li> <li>8 - K3 CLUTCH INTERNALLY TOOTHED DISC CARRIER</li> <li>9 - REAR PLANETARY GEARSET SUN GEAR</li> <li>10 - CENTER PLANETARY GEARSET PLANETARY CARRIER</li> <li>11 - CENTER PLANETARY GEARSET ANNULUS GEAR</li> </ul> | <ul style="list-style-type: none"> <li>12 - CENTER PLANETARY GEARSET SUN GEAR</li> <li>13 - K2 CLUTCH EXTERNALLY TOOTHED DISC CARRIER</li> <li>14 - K2 CLUTCH PISTON</li> <li>15 - FRONT PLANETARY GEARSET PLANETARY CARRIER</li> <li>16 - FRONT PLANETARY GEARSET ANNULUS GEAR</li> <li>17 - FRONT PLANETARY GEARSET SUN GEAR</li> <li>18 - K1 CLUTCH INTERNALLY TOOTHED DISC CARRIER</li> <li>19 - K1 CLUTCH EXTERNALLY TOOTHED DISC CARRIER</li> <li>20 - K1 CLUTCH PISTON</li> <li>21 - DRIVE SHAFT</li> </ul> |
|---|--|

The input clutches produce a non-positive locking connection between two elements of a planetary gear set or between one element from each of two planetary gear sets in order to transmit the drive torque.

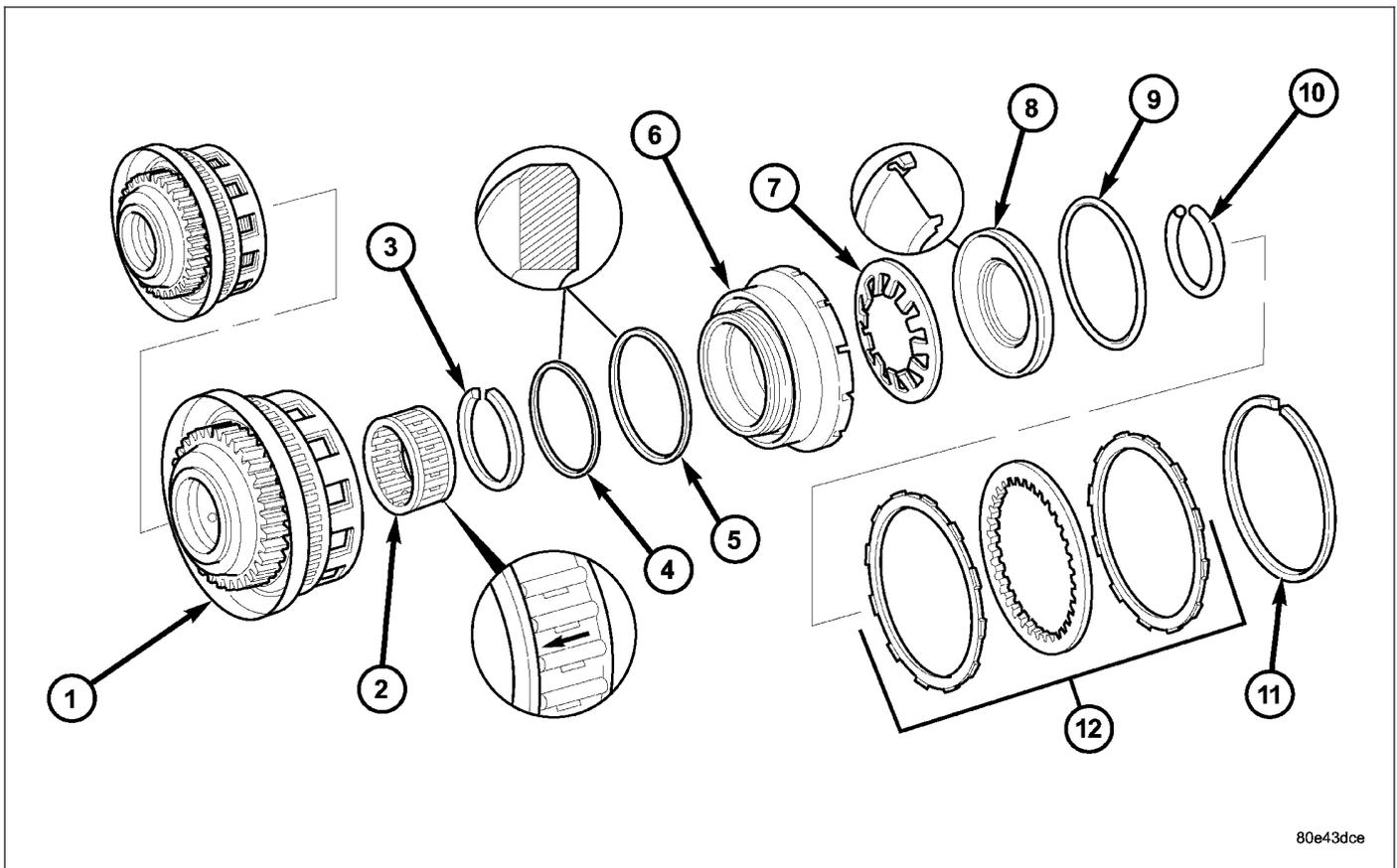
If the piston (20) on multi-plate clutch K1 (1) is subjected to oil pressure, it presses the internal and external discs of the disc set together. The sun gear (17) is locked with the planetary carrier (15) via the externally toothed disc carrier (19) and the internally toothed disc carrier (18). The front planetary gear set is thus locked and turns as a closed unit.

If the multi-plate clutch K2 (2) is actuated via the piston (14), the piston compresses the disc set. The annulus gear (16) of the front planetary gear set is locked with the annulus gear (11) of the center planetary gear set via the externally toothed disc carrier (13) and the center planetary carrier (10) on which the internally toothed discs are seated. Annulus gear (16) and annulus gear (11) turn at the same speed as the input shaft (21)

If the multi-plate clutch K3 (5) is actuated via the piston (7), the piston compresses the disc set. The sun gear (12) of the center planetary gear set is locked with the sun gear (9) of the rear planetary gear set via the externally toothed disc carrier (6) and the internally toothed disc carrier (8). Sun gear (12) and sun gear (9) turn at the same speed.

## K1-INPUT CLUTCH

### DISASSEMBLY



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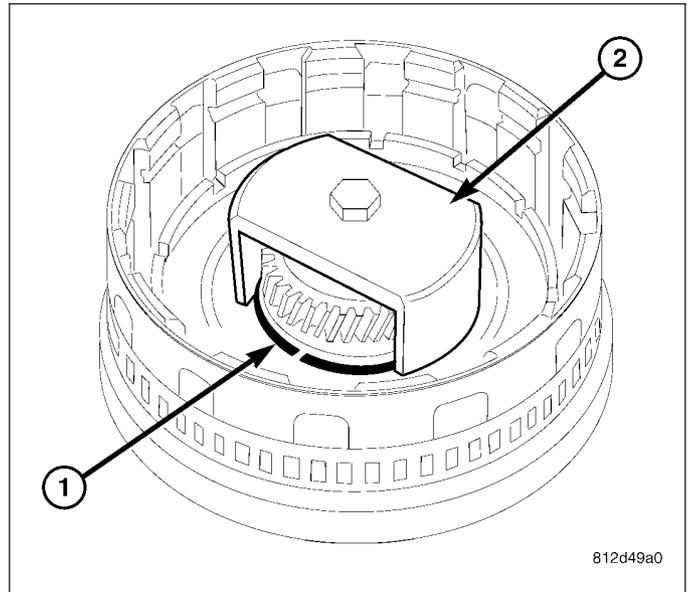
#### *Input Clutch K1 Components*

1 - K1 OUTER DISC CARRIER  
 2 - FREEWHEELING CLUTCH F1  
 3 - SNAP-RING  
 4 - OUTER DISC CARRIER SEALING RING  
 5 - PISTON SEALING RING  
 6 - PISTON

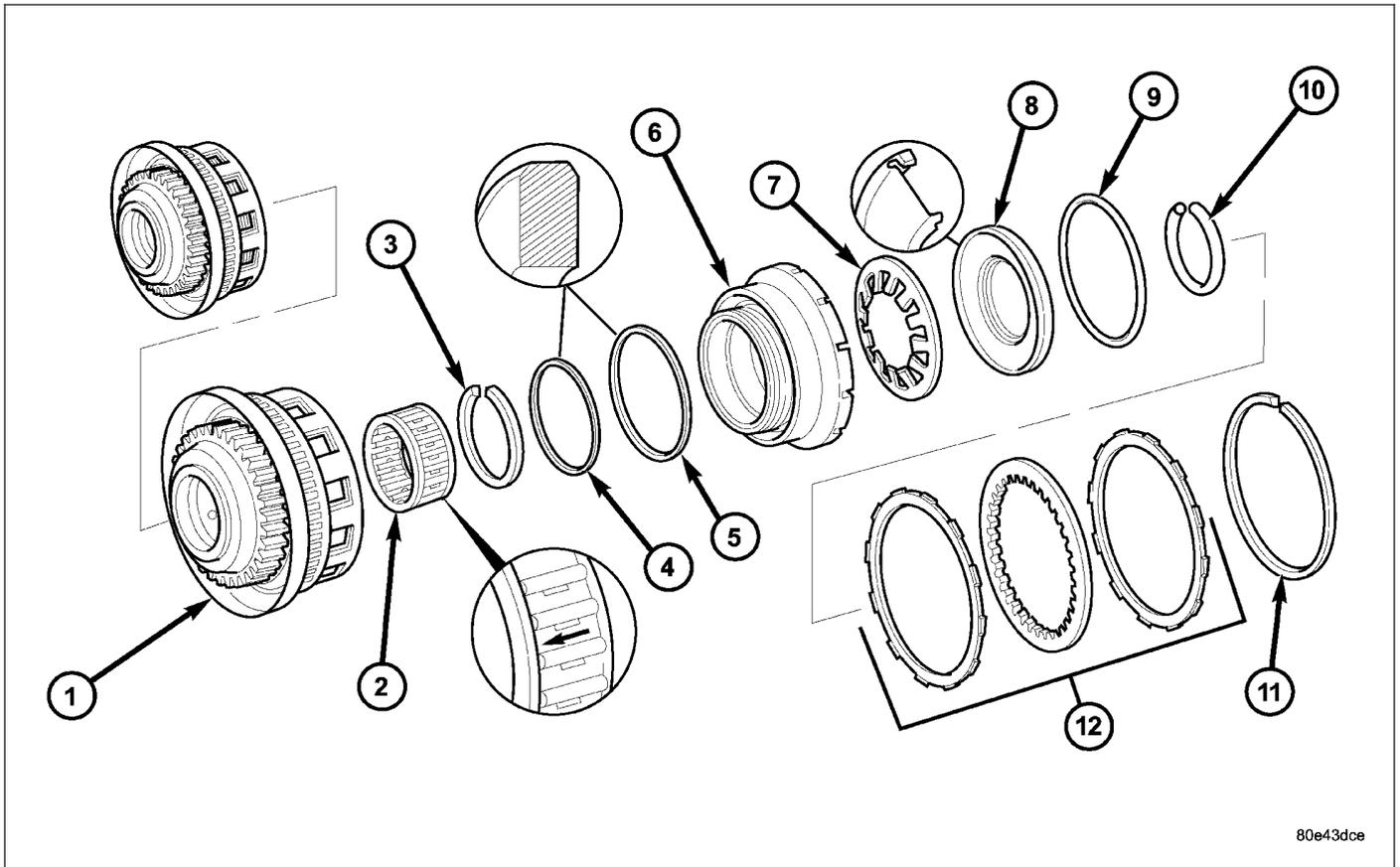
7 - DISC SPRING  
 8 - SPRING PLATE  
 9 - SPRING PLATE SEALING RING  
 10 - SNAP-RING  
 11 - SNAP-RING  
 12 - MULTIPLE DISC PACK - REFER TO TEXT FOR CORRECT ASSEMBLY ORDER

1. Remove snap-ring (11) from outer multiple-disc carrier (6).
2. Take multiple-disc pack (12) out of outer multiple-disc carrier (6). Note which clutch disc is removed just prior to the spring plate (8) for re-assembly. If the clutch discs are re-used, this disc must be returned to its original position on top of the spring plate.

3. Place Multi-use Spring Compressor 8900 (2) on the spring plate and compress the spring until the snap-ring (1) is exposed.
4. Remove snap-ring (1).
5. Take out disc spring (7) and remove piston (6) by carefully blowing compressed air into the drilled oil feed passage.
6. Remove snap-ring (3) and take out front freewheeling clutch F1 (2). Take care when removing the F1 clutch to prevent the clutch sprags from falling out. If this occurs, the clutch must be replaced.



**ASSEMBLY**



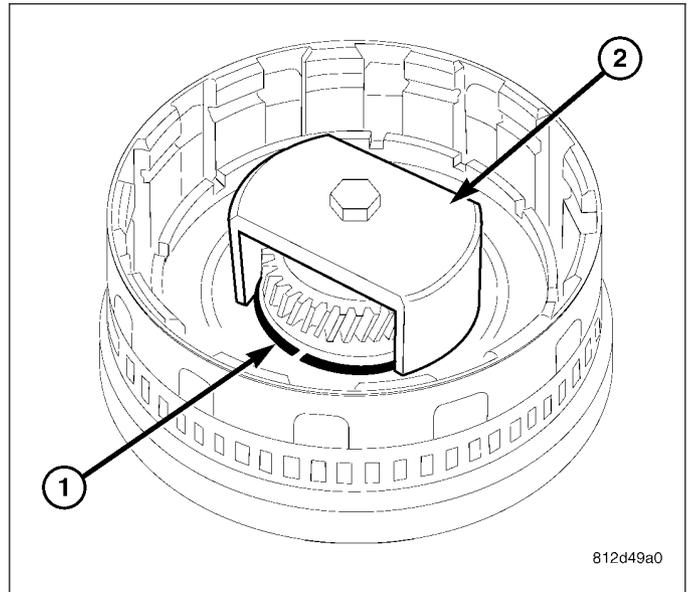
80e43dce

**Input Clutch K1 Components**

- |                                     |  |
|-------------------------------------|--|
| 1 - K1 OUTER DISC CARRIER           | 7 - DISC SPRING  |
| 2 - FREEWHEELING CLUTCH F1          | 8 - SPRING PLATE   |
| 3 - SNAP-RING                       | 9 - SPRING PLATE SEALING RING                                      |
| 4 - OUTER DISC CARRIER SEALING RING | 10 - SNAP-RING   |
| 5 - PISTON SEALING RING             | 11 - SNAP-RING   |
| 6 - PISTON                          | 12 - MULTIPLE DISC PACK - REFER TO TEXT FOR CORRECT ASSEMBLY ORDER |

1. Install piston (6) in the outer multiple-disc carrier (1). Check sealing rings (4 and 5), replace if necessary. The rounded off edges of the sealing rings must point outwards.
2. Insert disc spring (7). Insert disc spring with the curvature towards the piston.
3. Insert spring plate (8). Insert spring plate with the curvature towards the sun gear. Check sealing ring (9), replace if necessary.

4. Place Multi-use Spring Compressor 8900 (2) on spring plate and compress the spring until the groove of the snap-ring (1) is exposed.
5. Insert snap-ring (1). After installing, check snap-ring for correct seat.



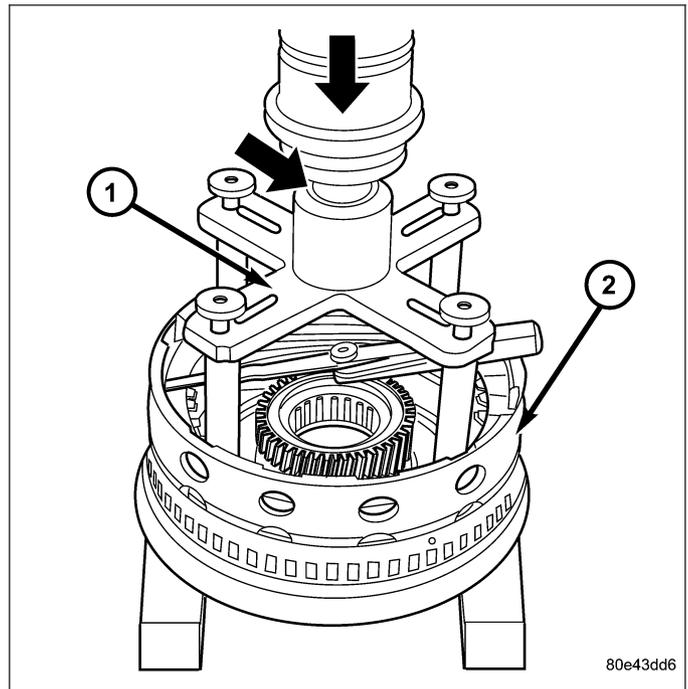
**CAUTION:** When working with double sided friction discs, an externally lugged steel plate is installed first, followed by a friction disc, and continuing on until all the required discs are installed. When working with single sided friction discs, an externally lugged disc is installed first, followed by an internally lugged disc, and continuing on until all the required discs are installed. All single sided discs are installed with the friction side up.

**Note:** Pay attention to the sequence of discs. If the original clutch discs are reused, be sure to return the disc identified on disassembly as belonging on top of the spring plate (8) to its original location.

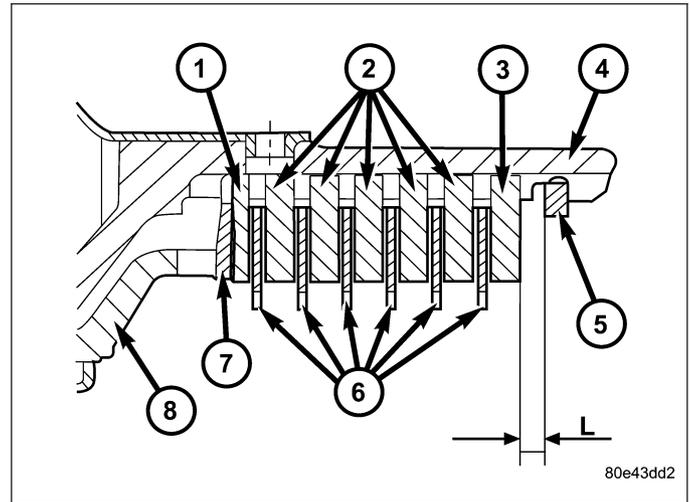
**Note:** Place new friction multiple-discs in ATF fluid for one hour before installing.

6. Insert multiple-disc pack (12) in the outer multiple-disc carrier.
7. Insert snap-ring (11).

8. Measure the K1 clutch pack clearance by mounting Pressing Tool 8901 (1) on outer multiple disc.
9. Using a lever press, compress pressing tool as far as the stop (then the marking ring is still visible, see small arrow).

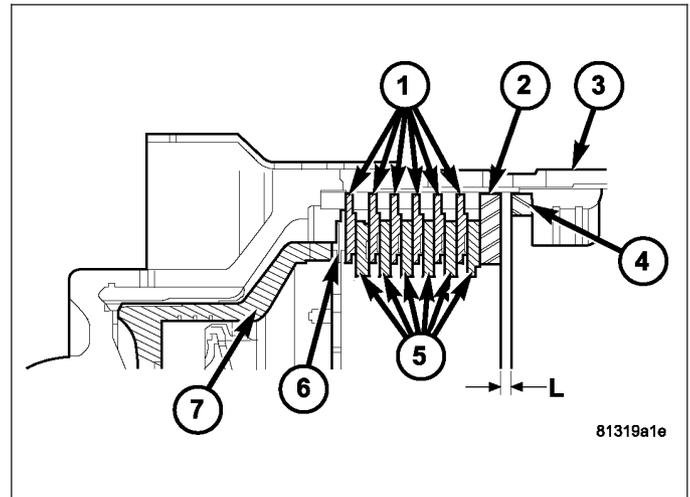


10. For transmissions using double sided friction discs, use a feeler gauge to determine the play "L" at three points between the snap-ring (5) and outer multiple-disc (3).
11. During the measurement the snap-ring (5) must contact the upper bearing surface of the groove in the outer multiple-disc carrier (4).
12. The correct clutch clearance for transmissions with double sided friction discs is 2.7-3.1 mm (0.106-0.122 in.) for three friction disc versions, 3.0-3.4 mm (0.118-0.134 in.) for four disc versions, 3.3-3.7 mm (0.130-0.146 in.) for five disc versions, and 3.6-4.0 mm (0.142-0.158 in.) for six disc versions.
13. Adjust with snap-ring (5), if necessary. Snap-rings are available in thicknesses of 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), 3.8 mm (0.150 in.), and 4.1 mm (0.162 in.).
14. Insert front freewheeling clutch F1 (2) and fit snap-ring (3). The freewheeling clutch F1 (2) must be installed in the direction of the arrow.



- 1 - OUTER MULTIPLE DISC - 1.8MM (0.071 IN.)
- 2 - OUTER MULTIPLE DISC - 2.8MM (0.110 IN.)
- 3 - OUTER MULTIPLE DISC - 4.0MM (0.158 IN.)
- 4 - K1 OUTER DISC CARRIER
- 5 - SNAP-RING
- 6 - FRICTION DISCS
- 7 - DISC SPRING
- 8 - PISTON

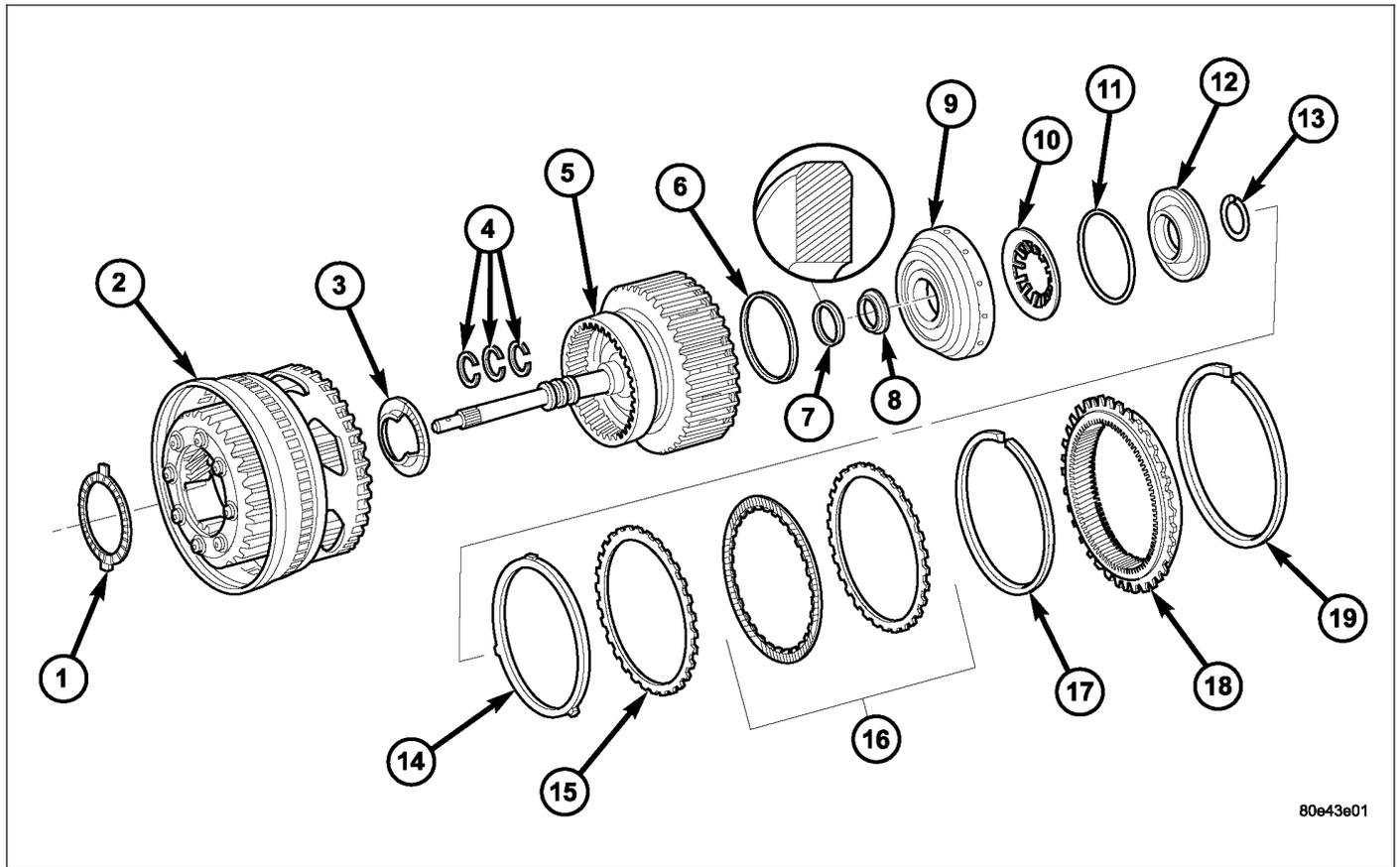
15. For transmissions using single sided friction discs, use a feeler gauge to determine the play "L" at three points between the snap-ring (4) and outer multiple-disc (2).
16. During the measurement the snap-ring (4) must contact the upper bearing surface of the groove in the outer multiple-disc carrier (3).
17. The correct clutch clearance for transmissions with single sided friction discs is 2.4-2.8 mm (0.095-0.110 in.) for six friction disc versions, 2.6-3.0 mm (0.102-0.118 in.) for eight disc versions, 2.8-3.2 mm (0.110-0.126 in.) for ten disc versions, and 2.9-3.3 mm (0.114-0.130 in.) for twelve disc versions.
18. Adjust with snap-ring (4), if necessary. Snap-rings are available in thicknesses of 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), 3.8 mm (0.150 in.), and 4.1 mm (0.162 in.).
19. Insert front freewheeling clutch F1 (2) and fit snap-ring (3). The freewheeling clutch F1 (2) must be installed in the direction of the arrow.



- 1 - OUTER MULTIPLE DISCS
- 2 - OUTER MULTIPLE DISC - 4.0MM (0.158 IN.)
- 3 - K1 OUTER DISC CARRIER
- 4 - SNAP-RING
- 5 - INNER MULTIPLE DISCS
- 6 - DISC SPRING
- 7 - PISTON

## K2-INPUT CLUTCH

### DISASSEMBLY

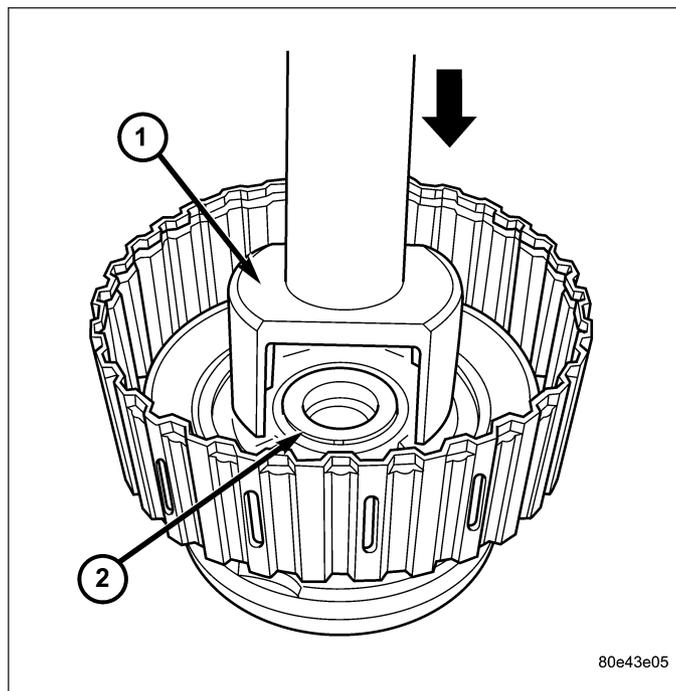


**Input Clutch K2 Components**

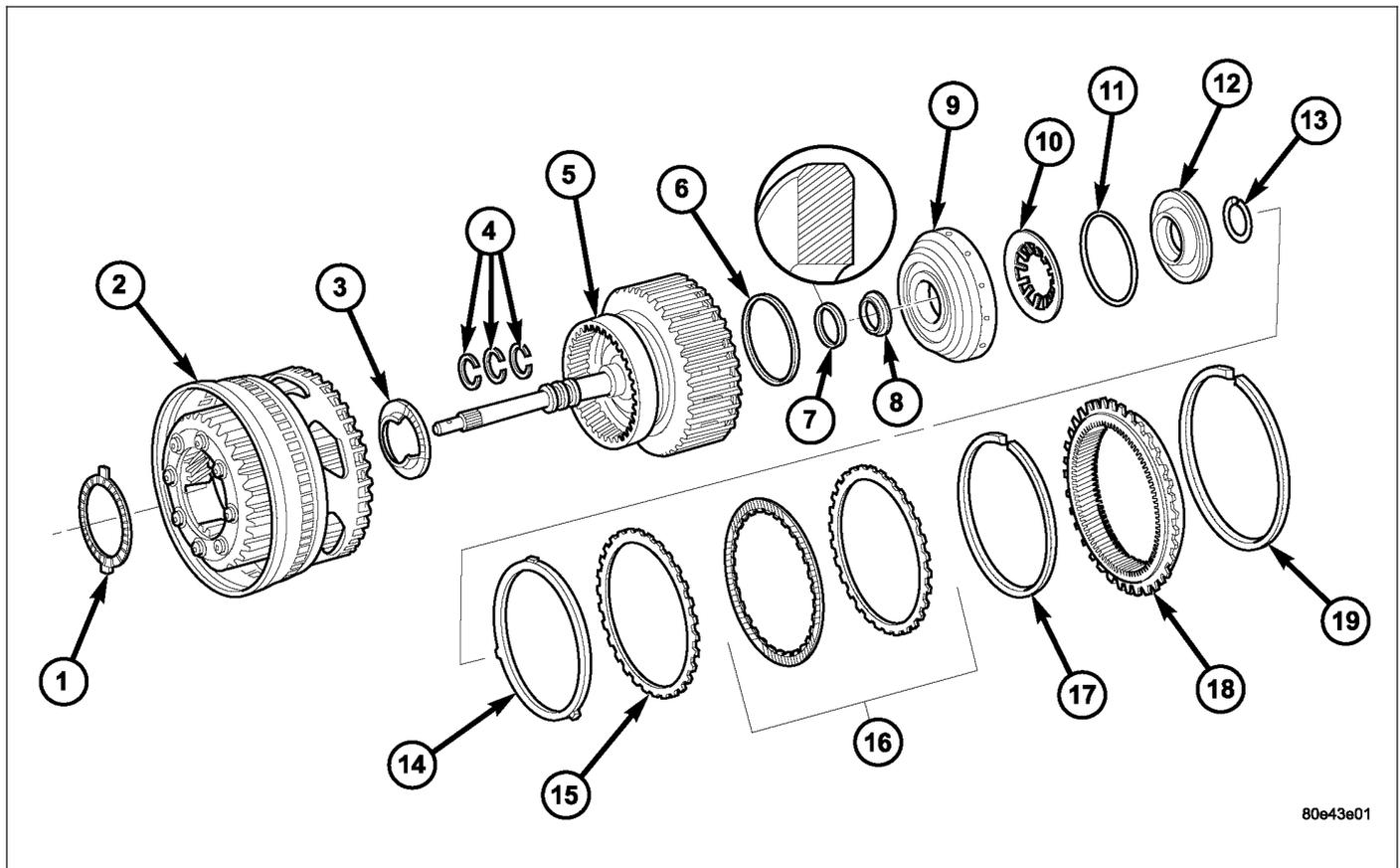
- |  |  |
|--|--|
| 1 - NEEDLE ROLLER BEARING                                | 11 - SPRING RETAINER SEALING - O-RING              |
| 2 - K1 INNER DISC CARRIER WITH INTEGRATED FRONT GEAR SET | 12 - SPRING RETAINER                               |
| 3 - THRUST BEARING                                       | 13 - SNAP-RING                                     |
| 4 - TORLON SEAL RINGS                                    | 14 - DISC SPRING                                   |
| 5 - INPUT SHAFT AND K2 CLUTCH                            | 15 - EXTERNALLY TOOTHED PLATE - 1.8 MM (0.071 IN.) |
| 6 - PISTON OUTER SEAL RING - O-RING                      | 16 - MULTIPLE DISC PACK                            |
| 7 - PISTON INNER SEAL RING                               | 17 - SNAP-RING                                     |
| 8 - THRUST WASHER  | 18 - HOLLOW GEAR                                   |
| 9 - PISTON   | 19 - SNAP-RING                                     |
| 10 - DISC SPRING   |  |

1. Remove snap-ring (19) from the K1 inner multiple-disc carrier with integrated front gear set (2) and take off hollow gear (18).
2. Remove input shaft with clutch K2 (5).
3. Remove needle thrust bearing (3).
4. Remove snap-ring (17) from K2 outer multiple-disc carrier.
5. Take out multiple-disc pack (16). Note which clutch disc is removed just prior to the disc spring (14) for re-assembly. If the clutch discs are re-used, this disc must be returned to its original position on top of the disc spring.
6. Take out disc spring (14).

7. Fit Multi-use Spring Compressor 8900 (1) onto spring retainer (12) and press until snap-ring (2) is released.
8. Remove snap-ring (2).
9. Take out disc spring (10) and pull piston (9) out of outer multiple-disc carrier.



**ASSEMBLY**

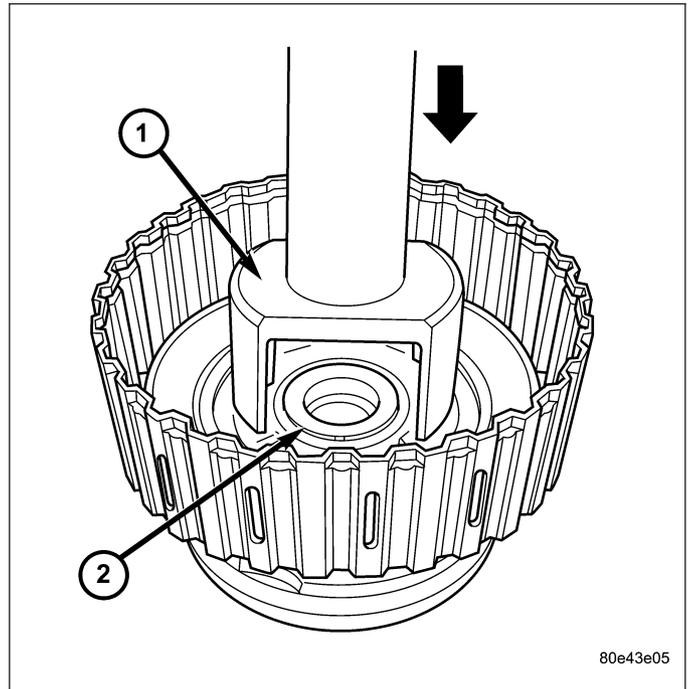


**Input Clutch K2 Components**

- |  |  |
|--|--|
| 1 - NEEDLE ROLLER BEARING                                | 11 - SPRING RETAINER SEALING - O-RING              |
| 2 - K1 INNER DISC CARRIER WITH INTEGRATED FRONT GEAR SET | 12 - SPRING RETAINER                               |
| 3 - THRUST BEARING                                       | 13 - SNAP-RING                                     |
| 4 - TORLON SEAL RINGS                                    | 14 - DISC SPRING                                   |
| 5 - INPUT SHAFT AND K2 CLUTCH                            | 15 - EXTERNALLY TOOTHED PLATE - 1.8 MM (0.071 IN.) |
| 6 - PISTON OUTER SEAL RING - O-RING                      | 16 - MULTIPLE DISC PACK                            |
| 7 - PISTON INNER SEAL RING                               | 17 - SNAP-RING                                     |
| 8 - THRUST WASHER  | 18 - HOLLOW GEAR                                   |
| 9 - PISTON   | 19 - SNAP-RING                                     |
| 10 - DISC SPRING   |  |

1. Install piston (9) in outer multiple-disc carrier. Inspect seals (6 and 7), replace if necessary. The rounded edges of the inner piston seal (7) must point to the outside.
2. Insert disk spring (10) and spring retainer (12). Insert disk spring (10) with curved side pointing toward spring retainer (12). Inspect seal (11), replace if necessary.

3. Place Multi-use Spring Compressor 8900 (1) on spring plate and press until the groove (2) of the snap-ring is exposed.
4. Insert snap-ring.

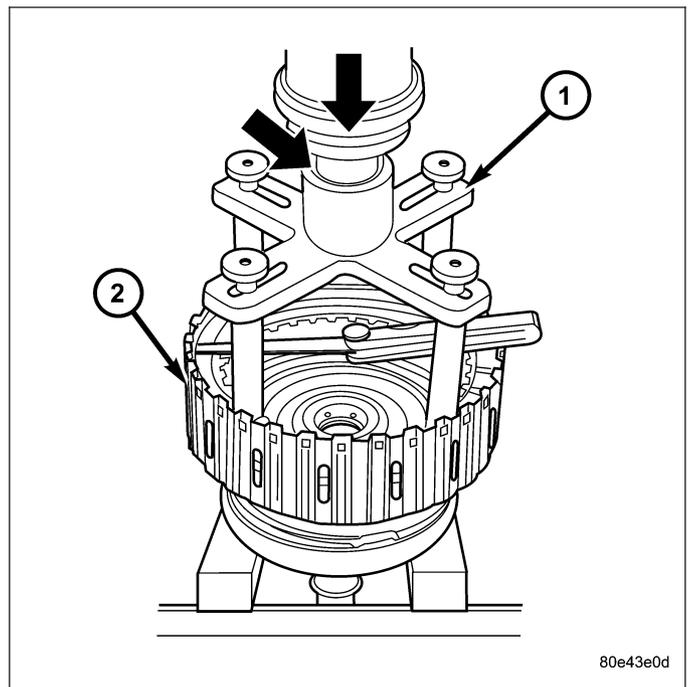


5. Insert disk spring (14).

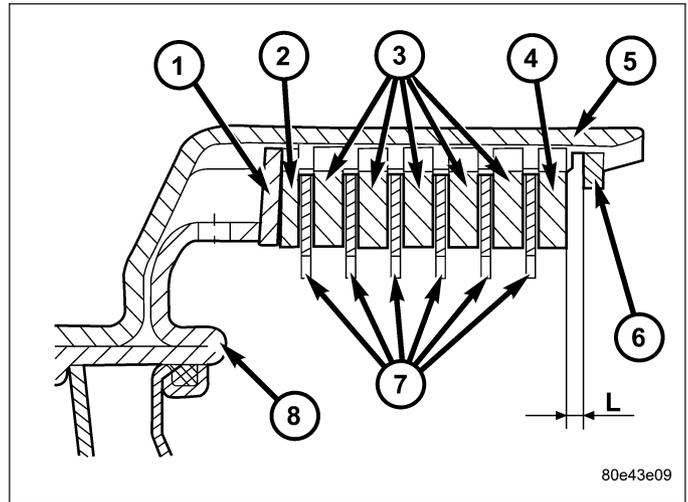
**Note: Pay attention to the sequence of discs. If the original clutch discs are reused, be sure to return the disc identified on disassembly as belonging on top of the disc spring (14) to its original location.**

6. Insert multiple-disk set (16) into outer multiple-disk carrier.
7. Fit snap-ring (17).

8. Measure K2 clutch clearance by mounting Pressing Tool 8901 (1) on outer multiple disc.
9. Using a lever press, compress pressing tool as far as the stop (then the marking ring is still visible, see small arrow).

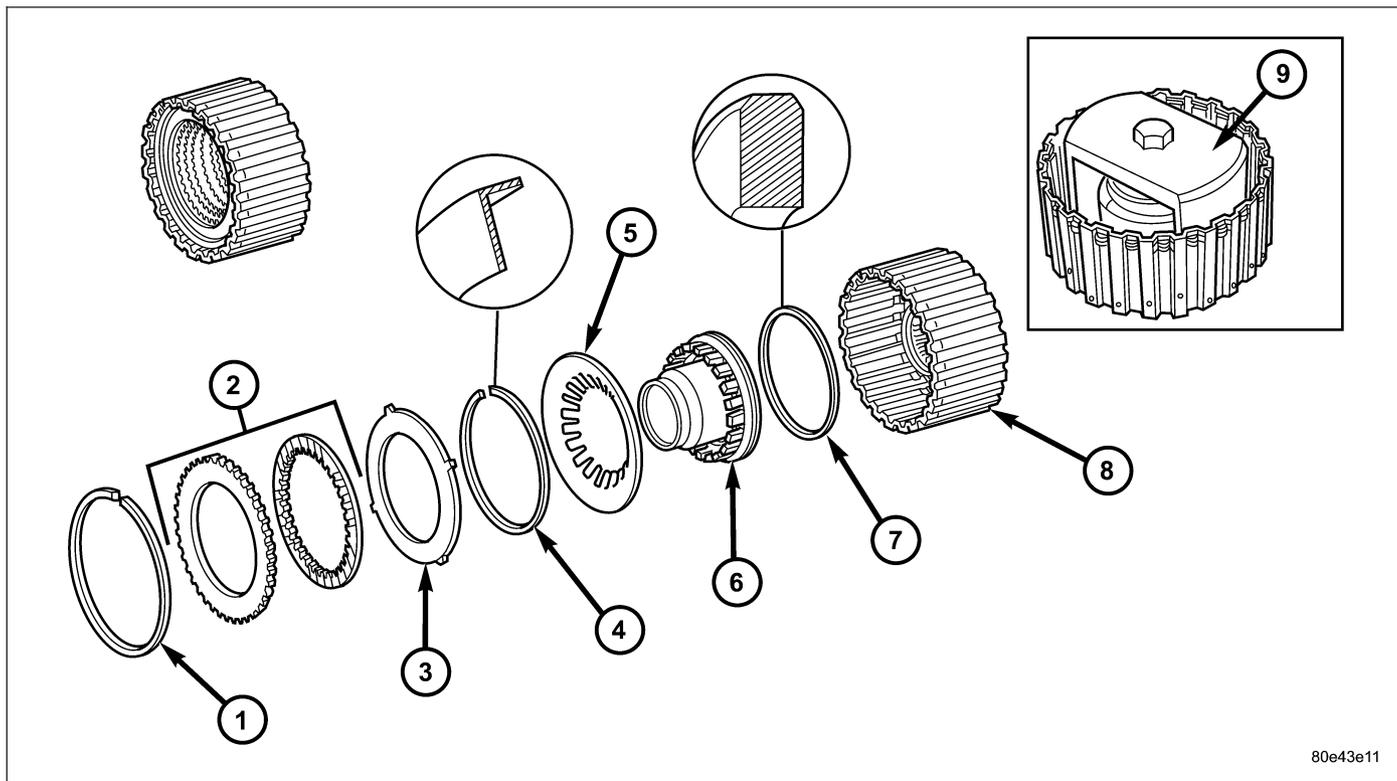


10. Using a feeler gauge, determine the play "L" at three points between the snap-ring (6) and outer multiple-disc (4).
11. During the measurement the snap-ring (6) must contact the upper bearing surface of the groove in the outer multiple-disc carrier.
12. The correct clutch clearance is 2.3-2.7 mm (0.091-0.106 in.) for three friction disc versions, 2.4-2.8 mm (0.095-0.110 in.) for four disc versions, 2.5-2.9 mm (0.099-0.114 in.) for five disc versions, and 2.7-3.1 mm (0.106-0.122 in.) for six disc versions.
13. Adjust with snap-ring (6), if necessary. Snap-rings are available in thicknesses of 2.3 mm (0.091 in.), 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), 3.5 mm (0.138 in.), and 3.8 mm (0.150 in.).



- 1 - DISC SPRING
- 2 - OUTER MULTIPLE DISC - 1.8 MM (0.071 IN.)
- 3 - OUTER MULTIPLE DISC - 3.5 MM (0.138 IN.)
- 4 - OUTER MULTIPLE DISC - 4.0 MM (0.158 IN.)
- 5 - K2 OUTER DISC CARRIER
- 6 - SNAP-RING
- 7 - FRICTION DISCS
- 8 - PISTON

14. Insert axial needle bearing (3) into K1 inner multiple-disk carrier. Insert axial needle bearing (3) with a little grease to prevent it slipping.
15. Install input shaft in K1 inner multiple-disk carrier with integrated front gear set (2).
16. Fit internally-gear wheel (18) and install snap-ring (19). Pay attention to installation position.

**K3-INPUT CLUTCH****DISASSEMBLY**

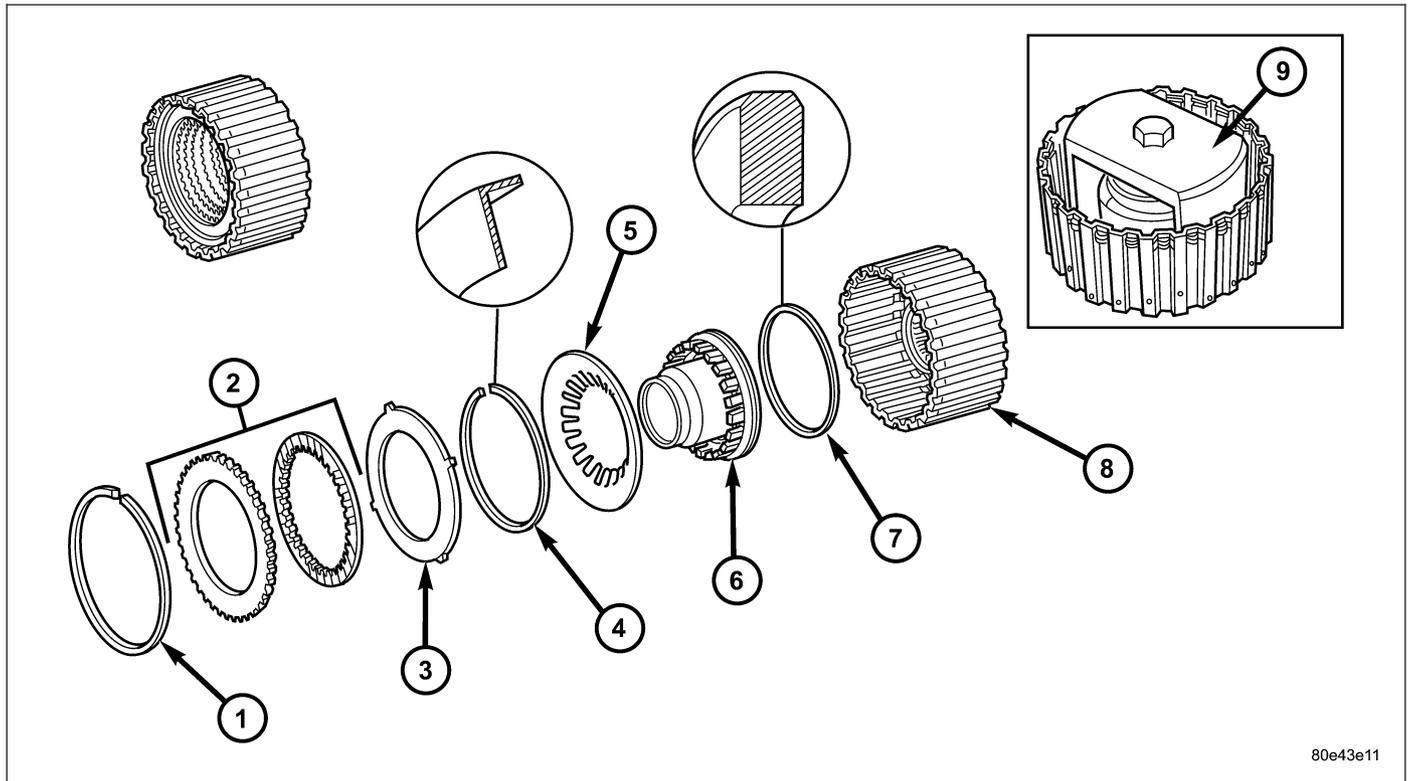
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**Input Clutch K3 Components**

- |                        |                                      |
|------------------------|--------------------------------------|
| 1 - SNAP-RING          | 6 - PISTON                           |
| 2 - MULTIPLE DISC PACK | 7 - SEALING RING                     |
| 3 - DISC SPRING        | 8 - OUTER DISC CARRIER               |
| 4 - SNAP-RING          | 9 - MULTI-USE SPRING COMPRESSOR 8900 |
| 5 - SPRING PLATE       |                                      |

1. Remove snap-ring (1) from outer multiple-disc carrier.
2. Remove multiple-disc pack (2) and disk spring (3) from outer multiple-disc carrier. Note which clutch disc is removed just prior to the spring plate (3) for re-assembly. If the clutch discs are re-used, this disc must be returned to its original position on top of the spring plate.
3. Place Multi-use Spring Compressor 8900 (9) on disc spring (5) and compress the spring until the snap-ring (4) is exposed.
4. Remove snap-ring (4).
5. Remove spring plate (5) and piston (6) from outer multiple-disc carrier.

**ASSEMBLY**



**Input Clutch K3 Components**

- 1 - SNAP-RING
- 2 - MULTIPLE DISC PACK
- 3 - DISC SPRING
- 4 - SNAP-RING
- 5 - SPRING PLATE

- 6 - PISTON
- 7 - SEALING RING
- 8 - OUTER DISC CARRIER
- 9 - MULTI-USE SPRING COMPRESSOR 8900

1. Install piston (6) in the outer multiple-disc carrier (8). Check sealing ring (7), replace if necessary. The rounded off edges of the sealing ring must point outwards.
2. Insert disc spring (5). Insert disc spring with the curvature towards the piston.
3. Mount the Multi-use Spring Compressor 8900 (9) on the spring plate and clamp until the snap-ring groove is exposed.
4. Insert snap-ring (4). The collar of the snap-ring must point towards the multiple-disc pack.

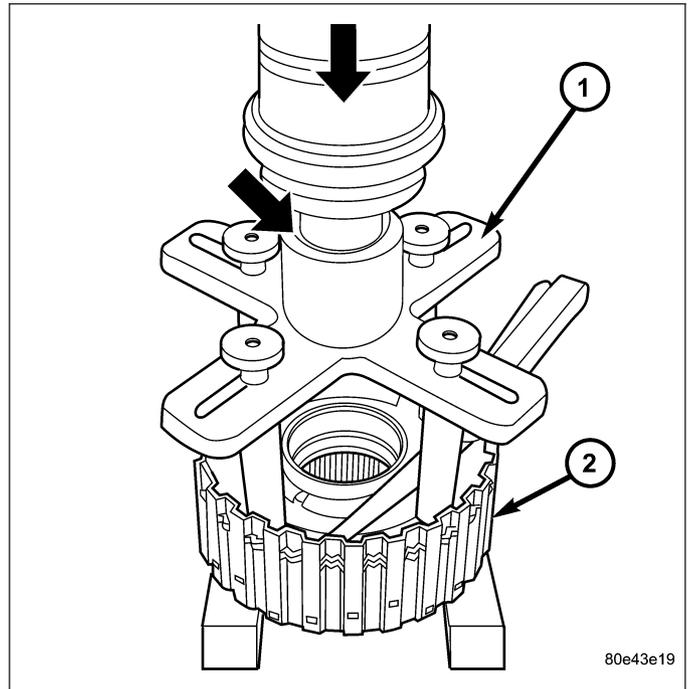
**CAUTION:** When working with double sided friction discs, an externally lugged steel plate is installed first, followed by a friction disc, and continuing on until all the required discs are installed. When working with single sided friction discs, an externally lugged disc is installed first, followed by an internally lugged disc, and continuing on until all the required discs are installed. All single sided discs are installed with the friction side up.

**Note:** Pay attention to the sequence of discs. If the original clutch discs are reused, be sure to return the disc identified on disassembly as belonging on top of the spring plate (3) to its original location.

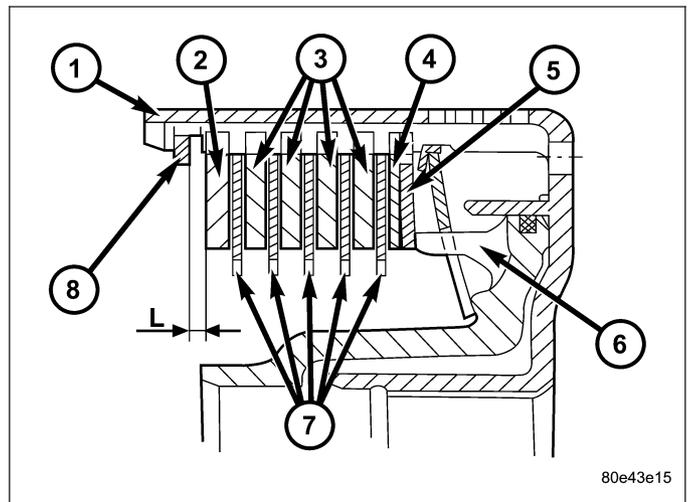
**Note:** Place new friction multiple-discs in ATF fluid for one hour before installing.

5. Install disk spring (3) and multiple-disc pack (2) in outer multiple-disc carrier (8).
6. Insert snap-ring (1).

7. Measure the K3 clutch clearance by mounting Pressing Tool 8901 (1) on outer multiple disc.
8. Using a lever press, compress pressing tool as far as the stop (then the marking ring is still visible, see small arrow).

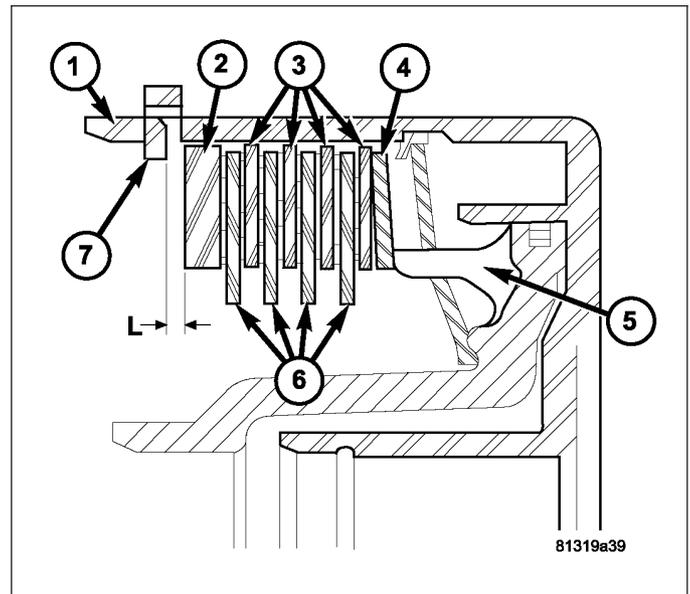


9. For transmissions using double sided friction discs, use a feeler gauge to determine the play "L" at three points between the snap-ring (8) and outer multiple-disc (2).
10. During the measurement the snap-ring (8) must contact the upper bearing surface of the groove in the outer multiple-disc carrier.
11. The correct clutch clearance for transmissions with double sided friction discs is 2.3-2.7 mm (0.091-0.106 in.) for three friction disc versions, 2.4-2.8 mm (0.095-0.110 in.) for four disc versions, and 2.5-2.9 mm (0.099-0.114 in.) for five disc versions.
12. Adjust with snap-ring (8), if necessary. Snap-rings are available in thicknesses of 2.0 mm (0.079 in.), 2.3 mm (0.091 in.), 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), and 3.5 mm (0.138 in.).



- 1 - OUTER DISC CARRIER
- 2 - OUTER MULTIPLE DISC - 4.0 MM (0.158 IN.)
- 3 - OUTER MULTIPLE DISC - 2.8 MM (0.110 IN.)
- 4 - OUTER MULTIPLE DISC - 1.8 MM (0.079 IN.)
- 5 - DISC SPRING
- 6 - PISTON
- 7 - FRICTION DISCS - 2.1 MM (0.083 IN.)
- 8 - SNAP-RING

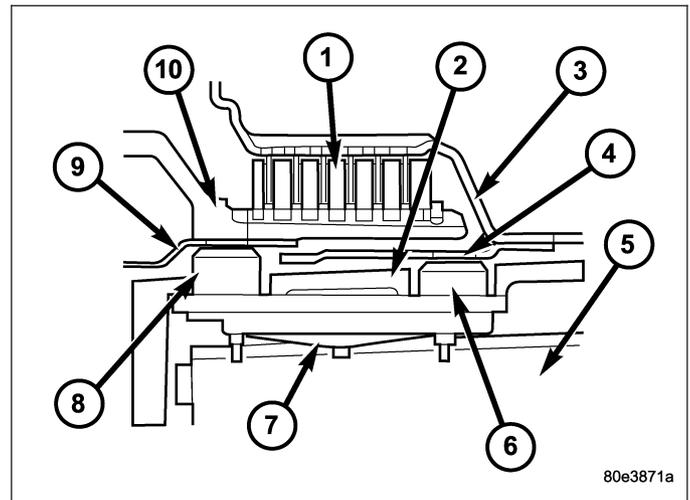
13. For transmissions using single sided friction discs, use a feeler gauge to determine the play "L" at three points between the snap-ring (7) and outer multiple-disc (2).
14. During the measurement the snap-ring (7) must contact the upper bearing surface of the groove in the outer multiple-disc carrier.
15. The correct clutch clearance for transmissions with single sided friction discs is 2.3-2.7 mm (0.091-0.106 in.) for six friction disc versions, 2.4-2.8 mm (0.095-0.110 in.) for eight disc versions, and 2.5-2.9 mm (0.099-0.114 in.) for ten disc versions.
16. Adjust with snap-ring (7), if necessary. Snap-rings are available in thicknesses of 2.0 mm (0.079 in.), 2.3 mm (0.091 in.), 2.6 mm (0.102 in.), 2.9 mm (0.114 in.), 3.2 mm (0.126 in.), and 3.5 mm (0.138 in.).



## SENSORS-INPUT SPEED

### DESCRIPTION

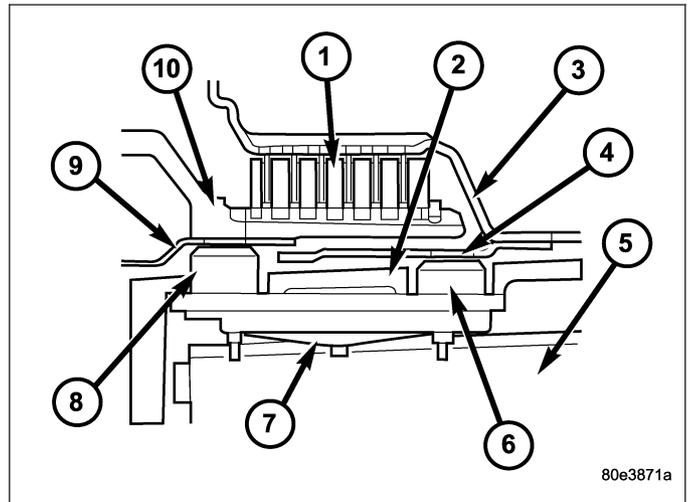
The input speed sensors (6, 8) are fixed to the shell of the control unit via contact blades (9). The speed sensors are pressed against the transmission housing (2) by a spring (7) which is held against the valve housing of the shift plate (5). This ensures a defined distance (4) between the speed sensors and the exciter ring (4).



## OPERATION

Signals from the input speed sensors (6, 8) are recorded in the transmission control module (TCM) together with the wheel and engine speeds and other information and are processed into an input signal for electronic control.

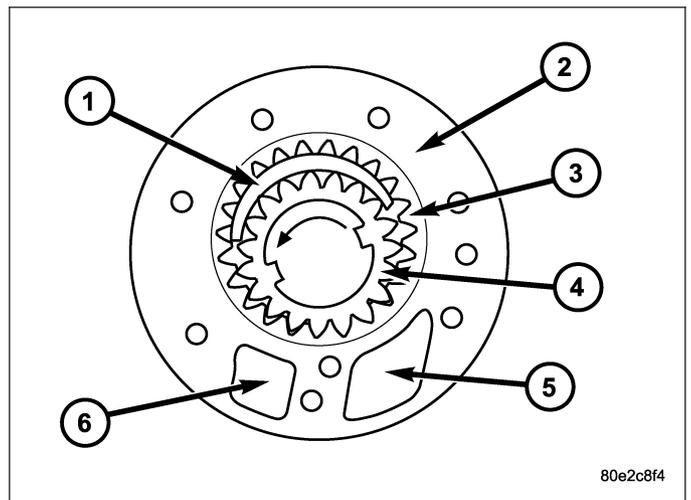
Input speed sensor N2 (6) records the speed of the front sun gear via the externally toothed disc carrier of the multiple-disc clutch K1 (10) and input speed sensor N3 (8) records the speed of the front planet carrier via the internally toothed disc carrier of multiple-disc clutch K1 (3).



## PUMP-OIL

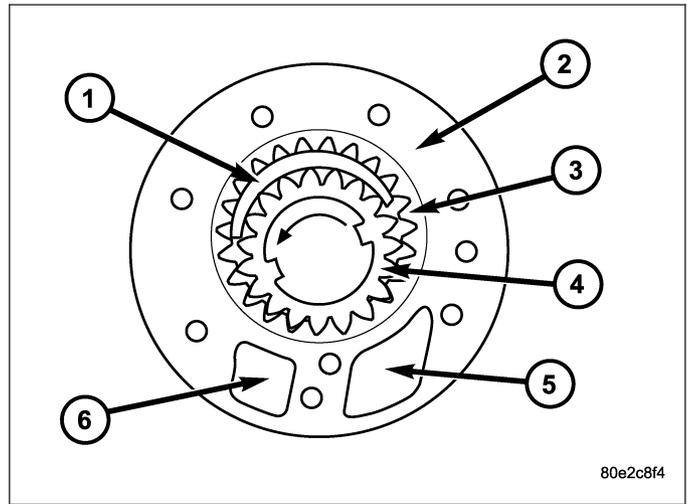
### DESCRIPTION

The oil pump (2) (crescent-type pump) is installed in the bellhousing behind the torque converter and is driven by the drive flange of the torque converter. The pump creates the oil pressure required for the hydraulic procedures.



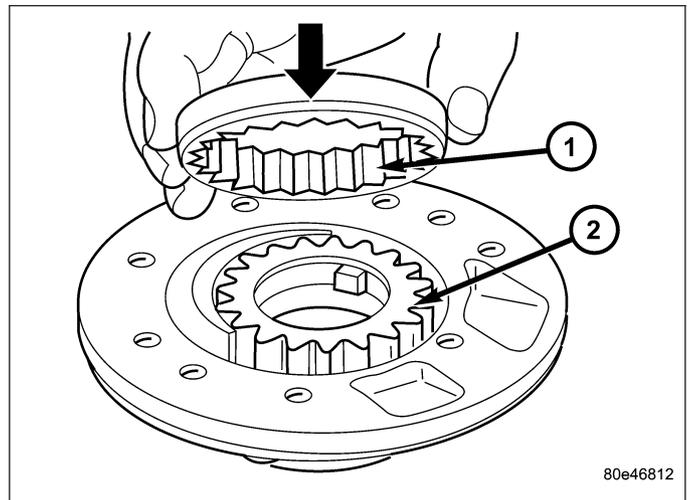
## OPERATION

When the engine is running, the oil is pumped through the inlet chamber (5) along the upper and lower side of the crescent (1) to the pressure chamber (6) of the housing. The meshing of the teeth prevents oil flowing from the delivery side to the intake side. An external gear (3) is eccentrically mounted in the pump housing. The external gear is driven by the internal gear (4) which is connected to the torque converter hub.

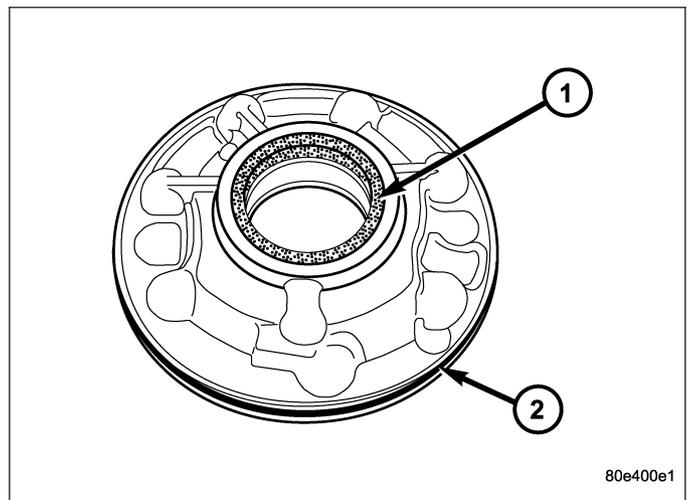


## DISASSEMBLY

1. Remove pump gears (1 and 2) from pump housing.



2. Remove the inner oil pump seal (1).
3. Replace the outer oil pump O-ring (2).



## INSPECTION

Before measuring any oil pump components, perform a thorough visual inspection of all the components. If any sign of scoring, scratches, or other damage is seen, replace the oil pump as an assembly.

## SIDE CLEARANCE

Side clearance is the difference between the thickness of the pump gears and the depth of the pocket in the pump housing. Side clearance can be measured by laying a flat plate across the mounting face of the pump housing, and measuring the distance between the plate and the gears.

### *Acceptable side clearance:*

- Inner gear: 0.064 mm (0.0025 in) max
- Outer gear: 0.069 mm (0.0027 in) max

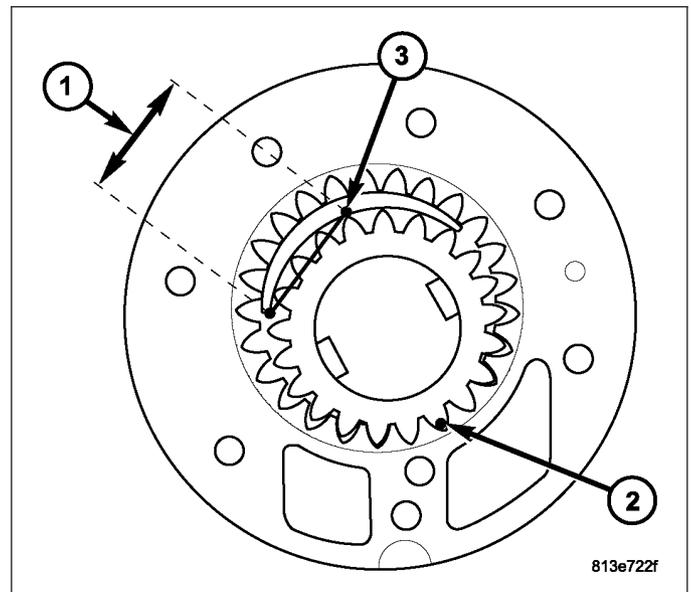
## TIP CLEARANCE

Tip clearance is the difference between the tip diameters of the gear teeth and the corresponding diameters of the pocket in the pump housing.

Tip clearance for the inner gear can be checked by moving the inner gear into tight mesh (2) with the outer gear as shown. Clearance between the ID of the crescent feature of the housing and the OD of the teeth of the inner gear (3) should then be measured at a point 37 mm from the corner of the crescent (1) feature, as shown below.

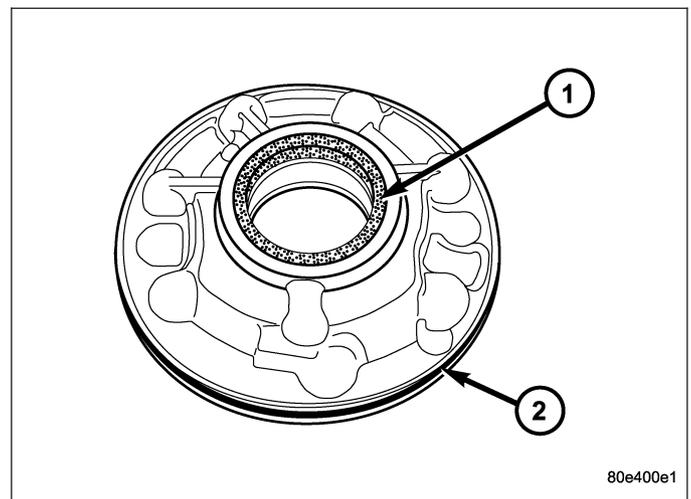
### *Acceptable tip clearance for inner gear:*

- 0.85 mm (0.033 in) max

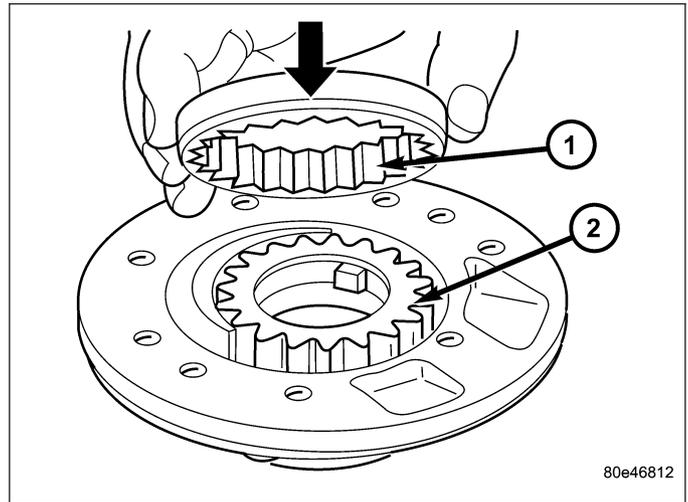


## ASSEMBLY

1. Install new inner oil pump seal (1) with Seal Installer 8902-A.
2. Replace O-ring (2).



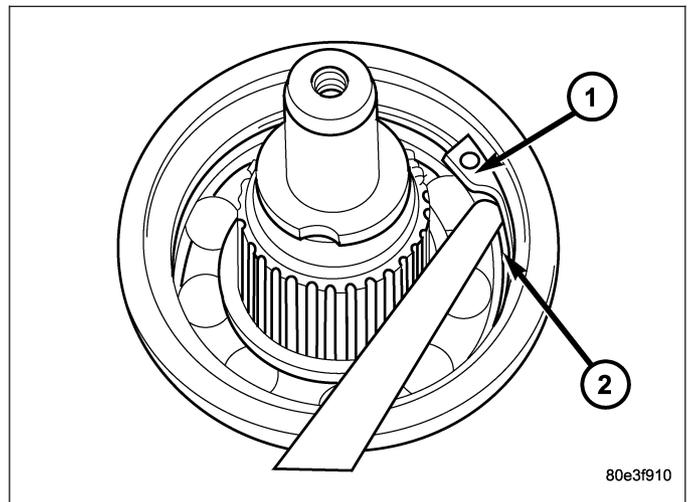
3. Lubricate pump gears and place in the pump housing. Insert pump gear (1) so that the chamfer (arrow) points towards the pump housing.



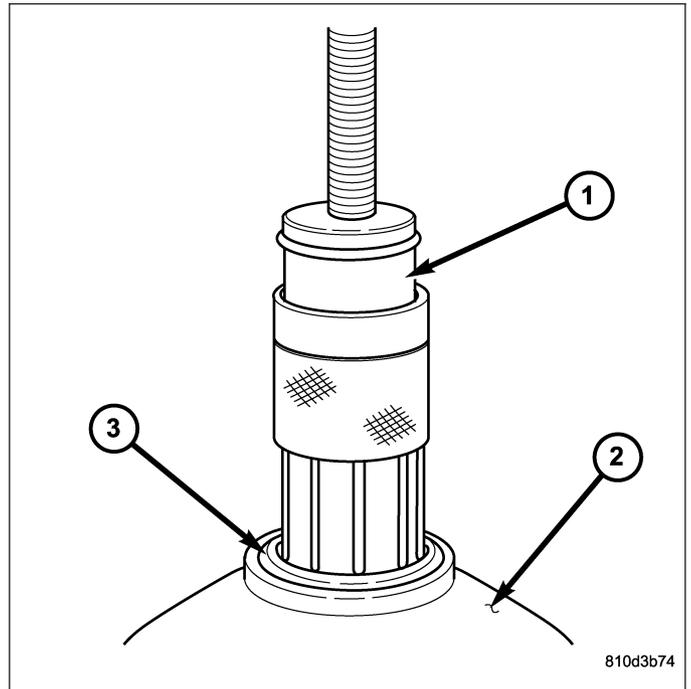
## BEARING-OUTPUT SHAFT

### REMOVAL

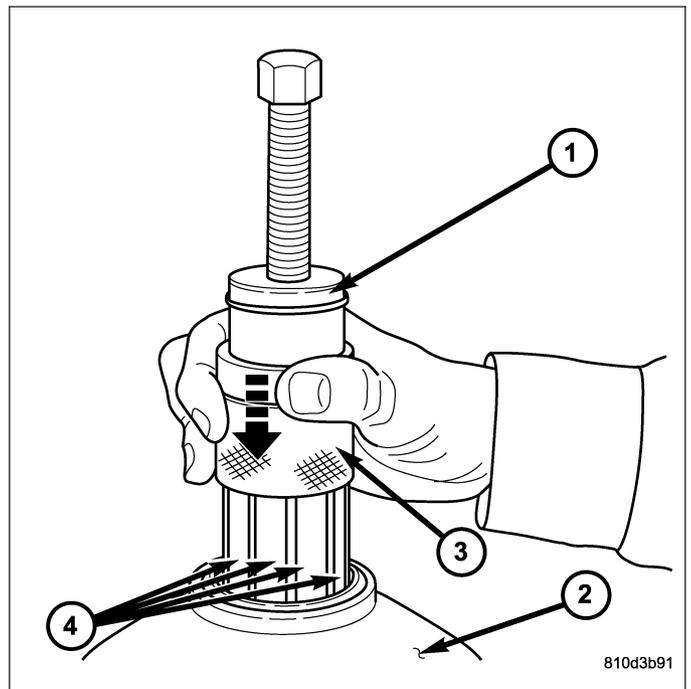
1. Raise and support vehicle.
2. Remove the propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL).
3. Verify that the transmission is in PARK in order to prepare for the removal of the output shaft nut.
4. Remove the nut holding the propeller shaft flange to the output shaft and remove the flange.
5. Remove the transmission rear oil seal with a suitable slide hammer and screw.
6. Remove the transmission output shaft washer. Be sure to tag the washer since it is very similar to the geartrain end-play shim and they must not be interchanged.
7. Remove the transmission rear output shaft bearing retaining ring (1).



8. Position Bearing Remover 9082 (1) over the inner race of the output shaft bearing.

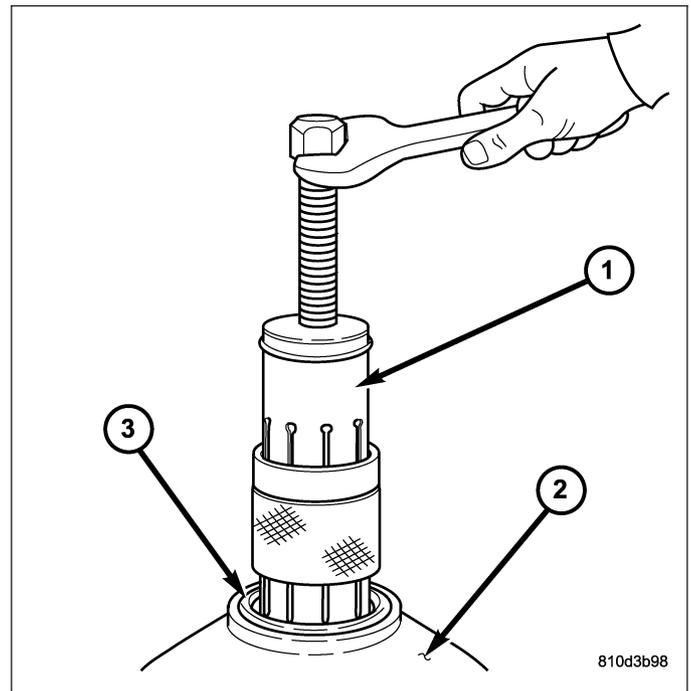


9. Slide the collar (3) on the Bearing Remover 9082 (1) downward over the fingers (3) of the tool.



**CAUTION:** Verify that the geartrain end-play shim has remained on the output shaft and against the park gear. The shim may be adhered to the bearing inner race. Retrieve the shim from the bearing and install over the output shaft and against the park gear.

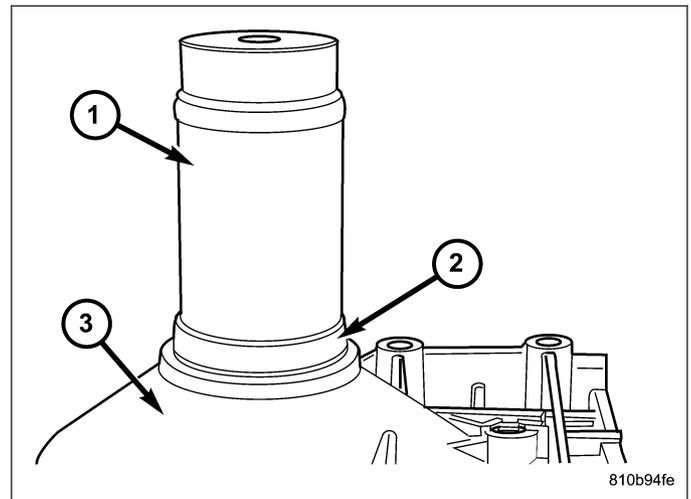
10. Remove the output shaft bearing (3).



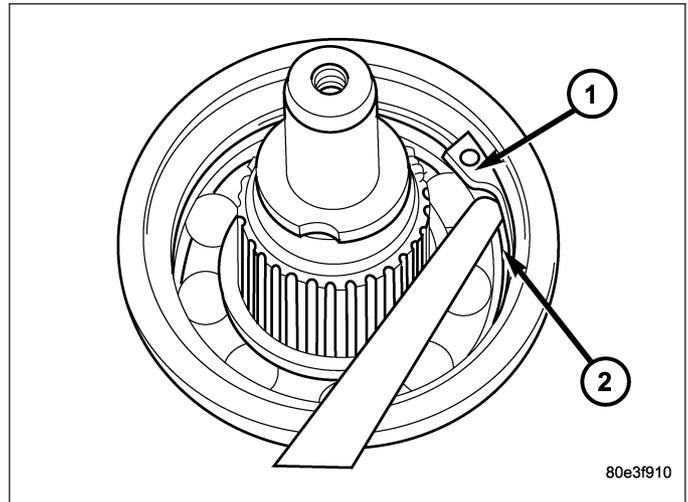
## INSTALLATION

**CAUTION:** Verify that the geartrain end-play shim is properly installed over the output shaft and against the park gear.

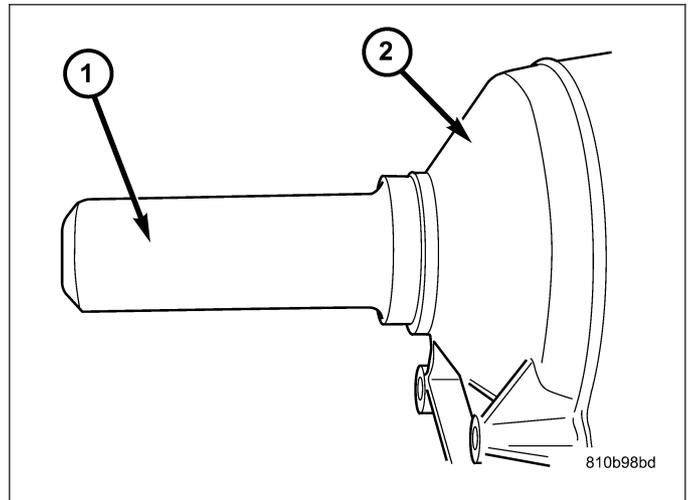
1. Install output shaft bearing in the rear transmission housing. Using Bearing Installer 9287 (1), install the output shaft bearing (2) into the transmission housing. **The closed side of the plastic cage must point towards the parking lock gear.**



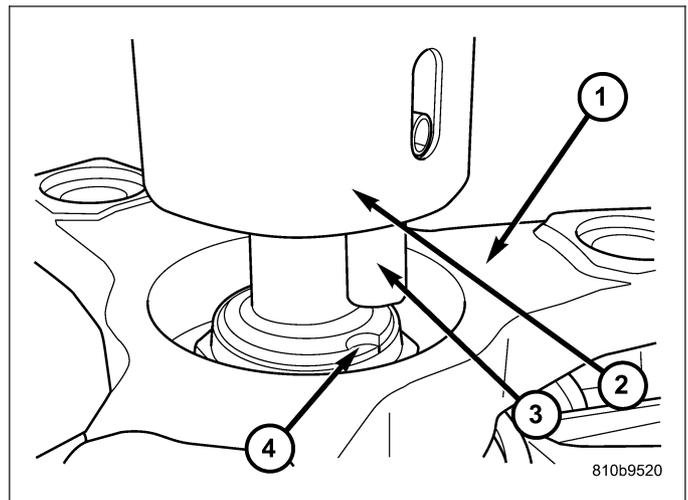
2. Install the retaining ring (1). Ensure that the retaining ring is seated correctly in the groove.
3. Check that there is no play between the bearing and the retaining ring using feeler gauge.
4. There must be no play between the retaining ring and the bearing. If the ring cannot be installed, a thinner ring must be used. If there is play between the ring and the bearing, a thicker ring must be installed. Retaining rings are available in thicknesses of 2.0 mm (0.079 in.), 2.1 mm (0.083 in.), and 2.2 mm (0.087 in.).
5. Install the output shaft washer onto the output shaft.



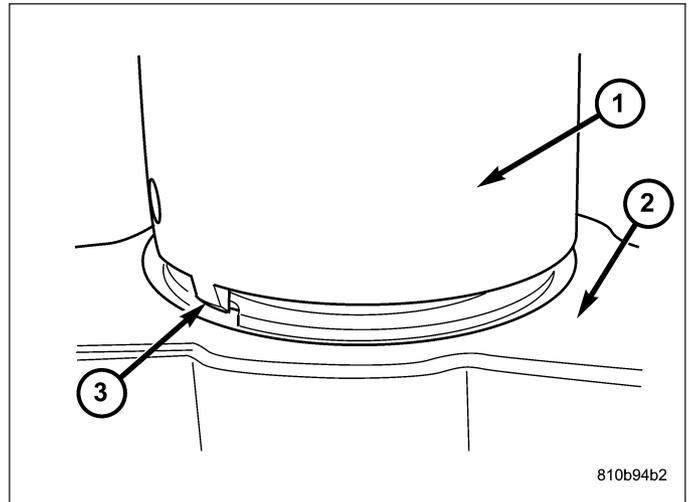
6. Install a new transmission rear seal into the transmission case with Seal Installer 8902A (1).
7. Verify that the transmission is in PARK in order to prepare for the installation of the output shaft nut.
8. Install the propeller shaft flange onto the output shaft and install an new flange nut. Tighten the flange nut to 120 N·m (88.5 ft.lbs.).



9. Stake the output shaft nut to the output shaft as follows. Place the Staking Tool 9078 (2) and Driver Handle C-4171 onto the output shaft.
10. Rotate the Staking Tool 9078 (2) until the alignment pin (3) engages the output shaft notch (4).



11. Press downward on the staking tool (1) until the staking pin (3) contacts the output shaft nut flange (2).
12. Strike the Driver handle C-4171 with a suitable hammer until the output shaft nut is securely staked to the output shaft.
13. Install the propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).



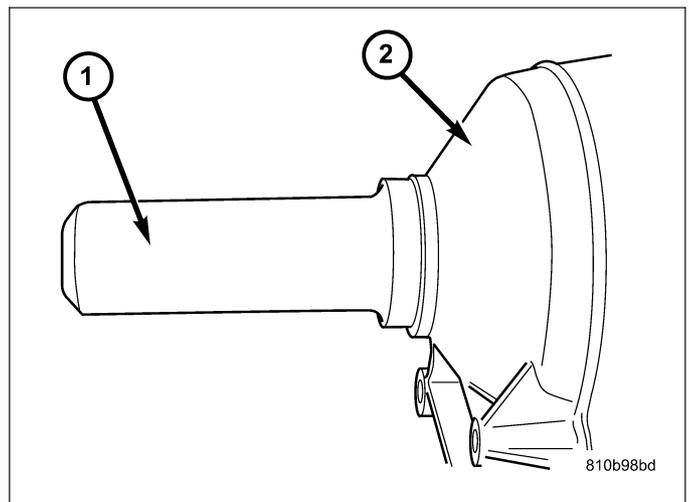
## SEAL-OUTPUT SHAFT

### REMOVAL

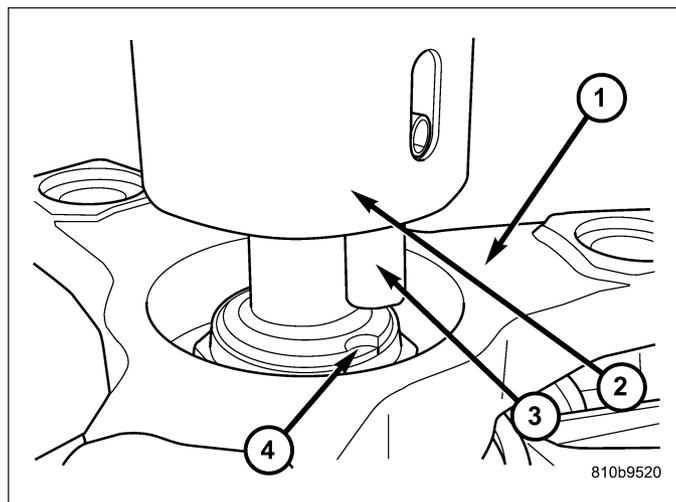
1. Remove the propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - REMOVAL). Move propeller shaft to the right and tie up.
2. Verify that the transmission is in PARK in order to prepare for the removal of the output shaft nut.
3. Remove the nut holding the propeller shaft flange to the output shaft and remove the flange.
4. Remove the output shaft seal with suitable screw and slide hammer.

### INSTALLATION

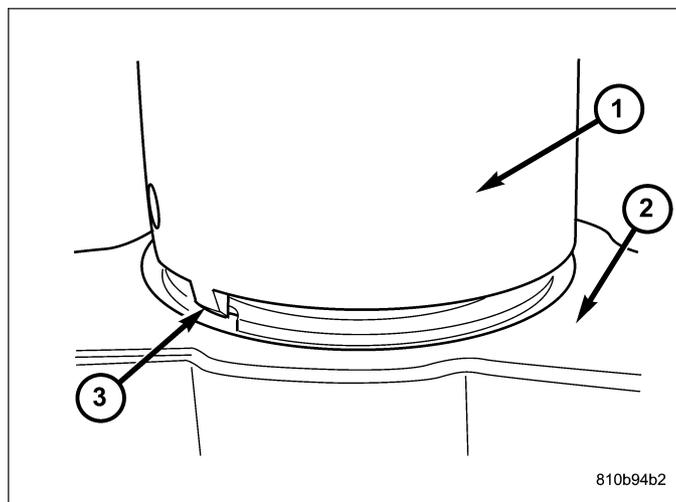
1. Position the new output shaft seal over the output shaft and against the transmission case.
2. Use Seal Installer 8902A (1) to install the seal.
3. Verify that the transmission is in PARK in order to prepare for the installation of the output shaft nut.
4. Install the propeller shaft flange onto the output shaft and install a new flange nut. Tighten the flange nut to 120 N·m (88.5 ft.lbs.).



5. Stake the output shaft nut to the output shaft as follows. Place the Staking Tool 9078 (2) and Driver Handle C-4171 onto the output shaft.
6. Rotate the Staking Tool 9078 (2) until the alignment pin (3) engages the output shaft notch (4).



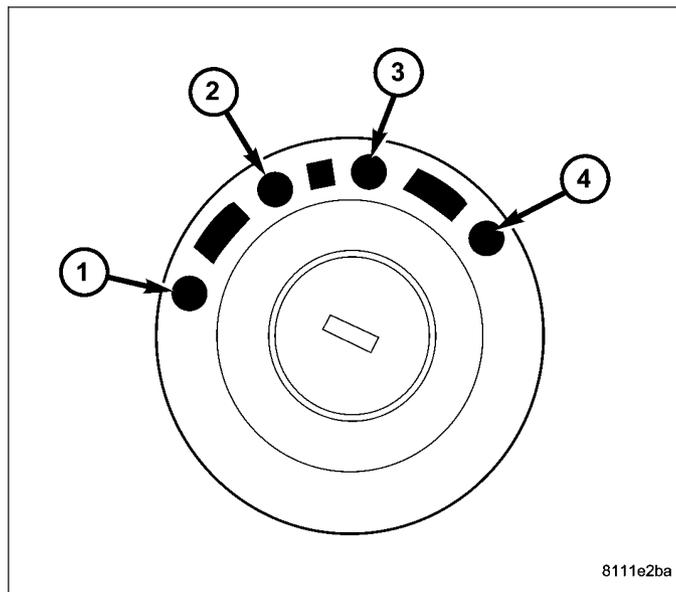
7. Press downward on the staking tool until the staking pin (3) contacts the output shaft nut flange (2).
8. Strike the Driver handle C-4171 with a suitable hammer until the output shaft nut is securely staked to the output shaft.
9. Install the propeller shaft (Refer to 3 - DIFFERENTIAL & DRIVELINE/PROPELLER SHAFT/PROPELLER SHAFT - INSTALLATION).



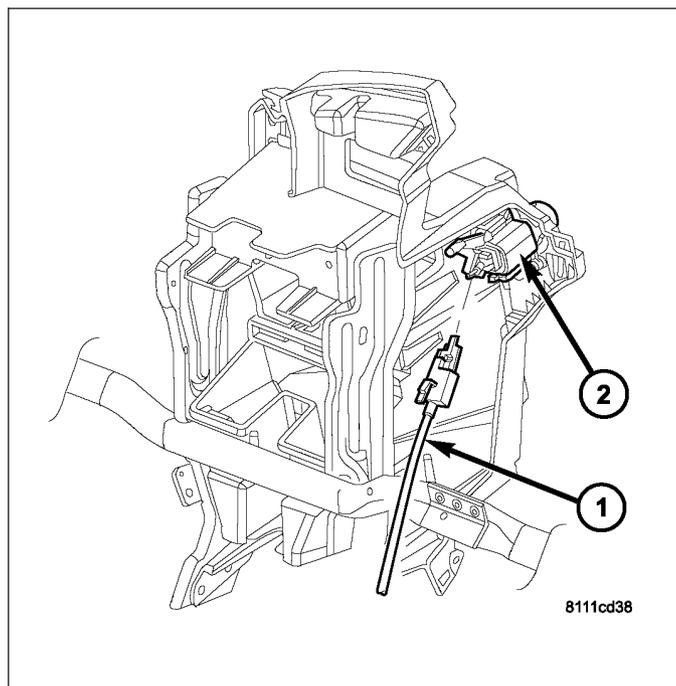
## CABLE-PARK LOCK

### REMOVAL

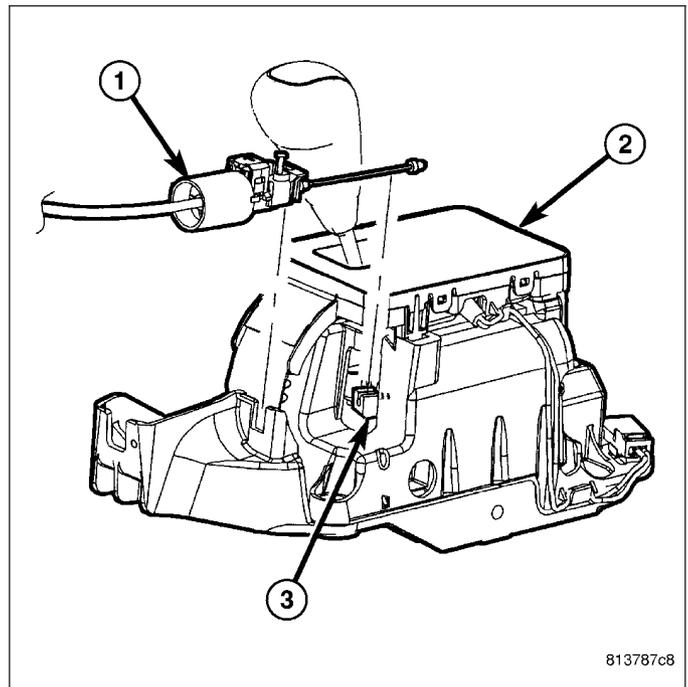
1. Place ignition key in the ACC (2) position.



2. Remove the lower instrument panel trim as necessary to access the park lock cable.
3. Disconnect park lock cable (4) from ignition cylinder (3).



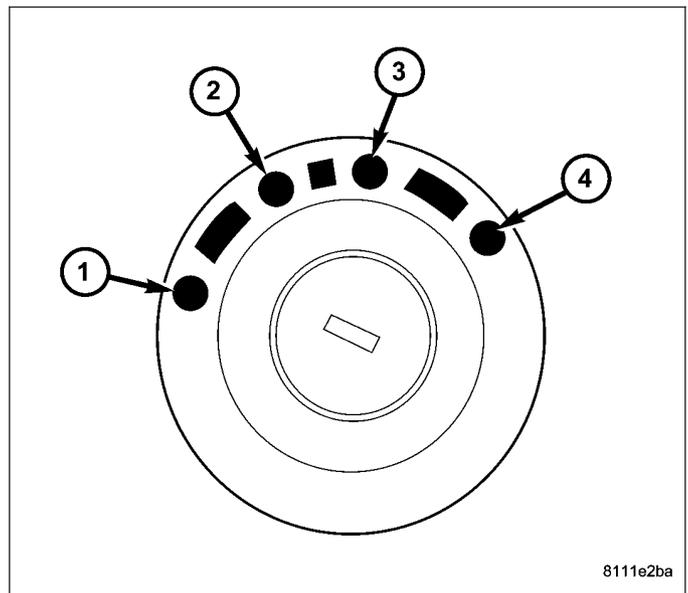
4. Remove the floor console as necessary for access to the park lock cable. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
5. If necessary, remove the bolts holding the shield, covering the gearshift and park lock cables, to the floorpan and remove the shield.
6. Disconnect the park lock cable from the shift mechanism. Release retention tab using suitable screwdriver.



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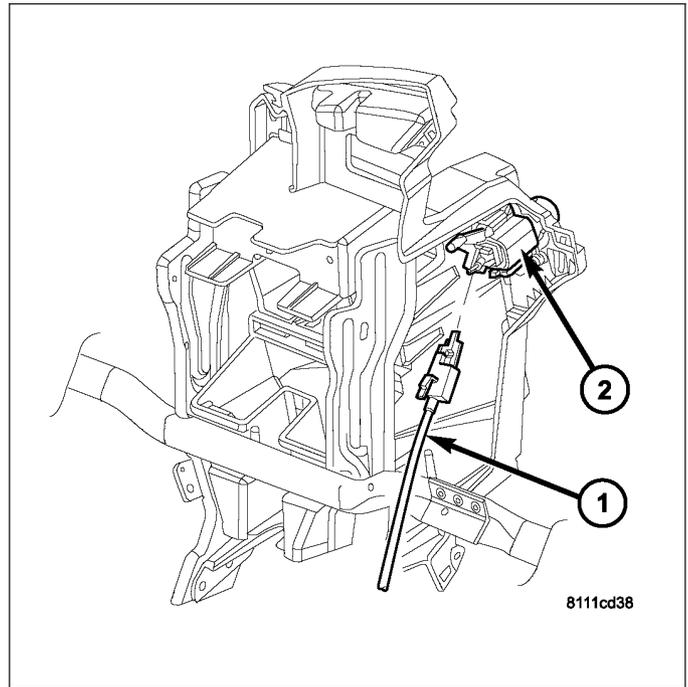
## INSTALLATION

1. Verify that ignition key is in ACC (2) position.

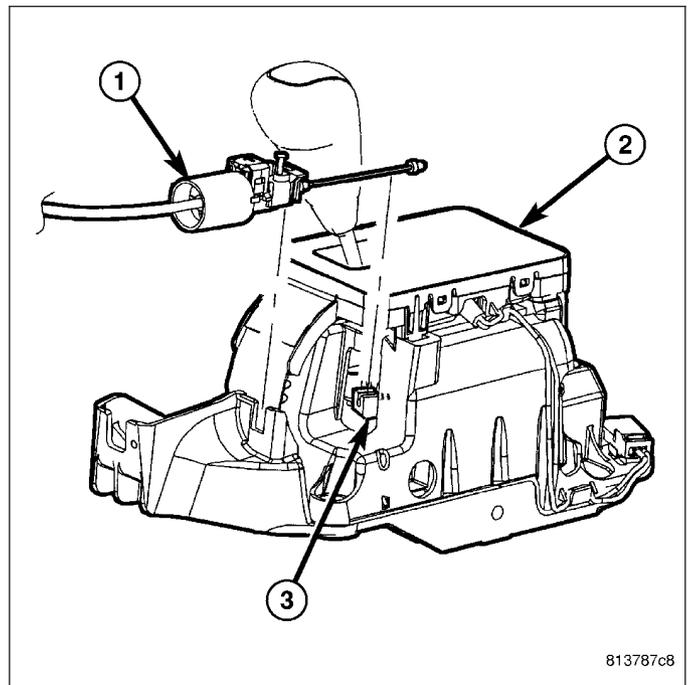


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2. Install the park lock cable (4) to the ignition cylinder (3). Secure the cable to instrument panel at retainer.
3. Install any instrument panel trim that was removed to access the park lock cable.



4. Route park lock cable towards shift mechanism.
5. Connect the park lock cable core to shift mechanism cam (3), and then secure cable housing to shift mechanism.

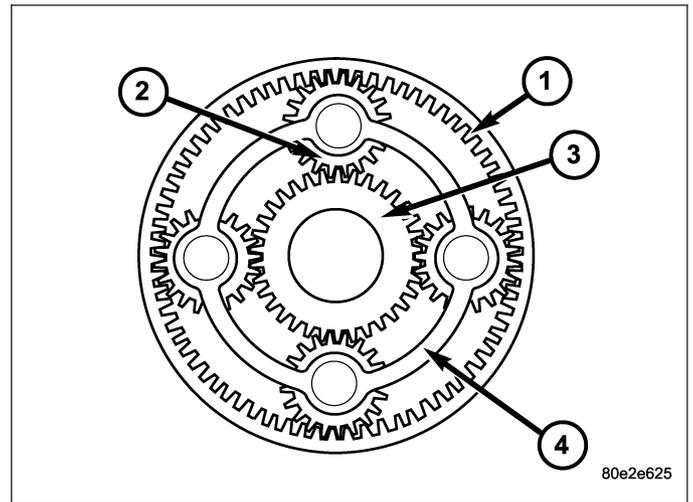


6. Adjust the park lock cable. (Refer to 21 - TRANSMISSION/AUTOMATIC TRANSMISSION/SHIFT INTERLOCK MECHANISM - ADJUSTMENTS)
7. If necessary, install the shield, covering the gearshift and park lock cables, to the floorpan and install the bolts to hold the shield to the floorpan.
8. Install the floor console assembly. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)

## GEARTRAIN-PLANETARY

### DESCRIPTION

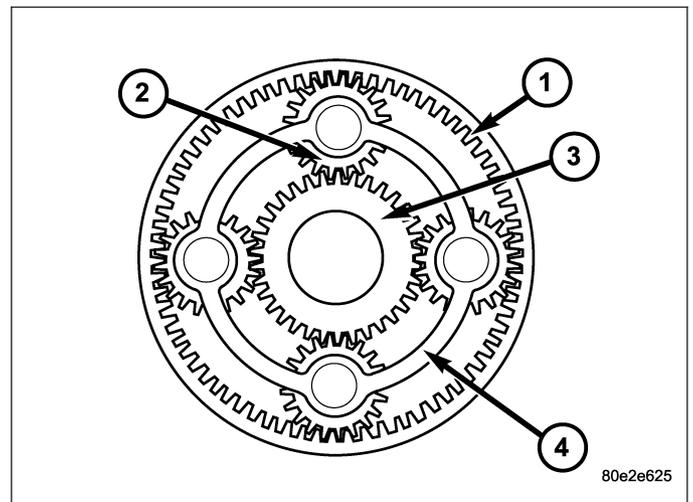
Three planetary gear sets are used to produce the different gear ratios. These are located in the mechanical part of the transmission as the front, middle and rear planetary gear sets.



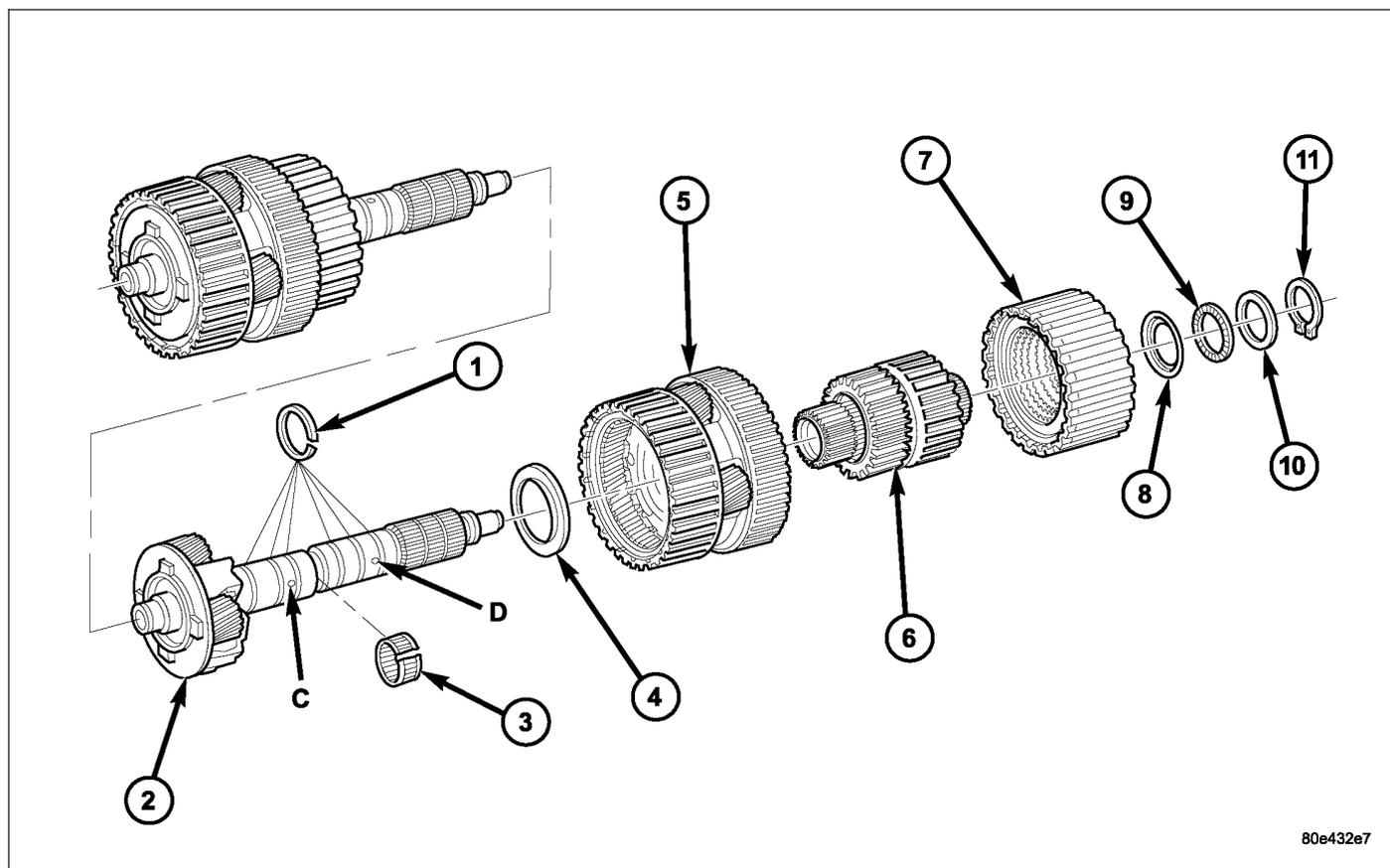
### OPERATION

The annulus gear (1) and sun gear (3) elements of a planetary gear system are alternately driven and braked by the actuating elements of the multi-plate clutch and multiple-disc brake. The planetary pinion gears (2) can turn on the internal gearing of the annulus gear (1) and on the external gearing of the sun gear (3). This allows for a variety of gear ratios and the reversal of the rotation direction without the need for moving gear wheels or shift collars. When two components of the planetary gear set are locked together, the planetary gear set is locked and turns as a closed unit.

The torque and engine speed are converted according to the lever ratios and the ratio of the number of teeth on the driven gears to that on the drive gears, and is referred to as the gear ratio. The overall ratio of a number of planetary gear sets connected in series is obtained by multiplying the partial ratios.



**DISASSEMBLY**



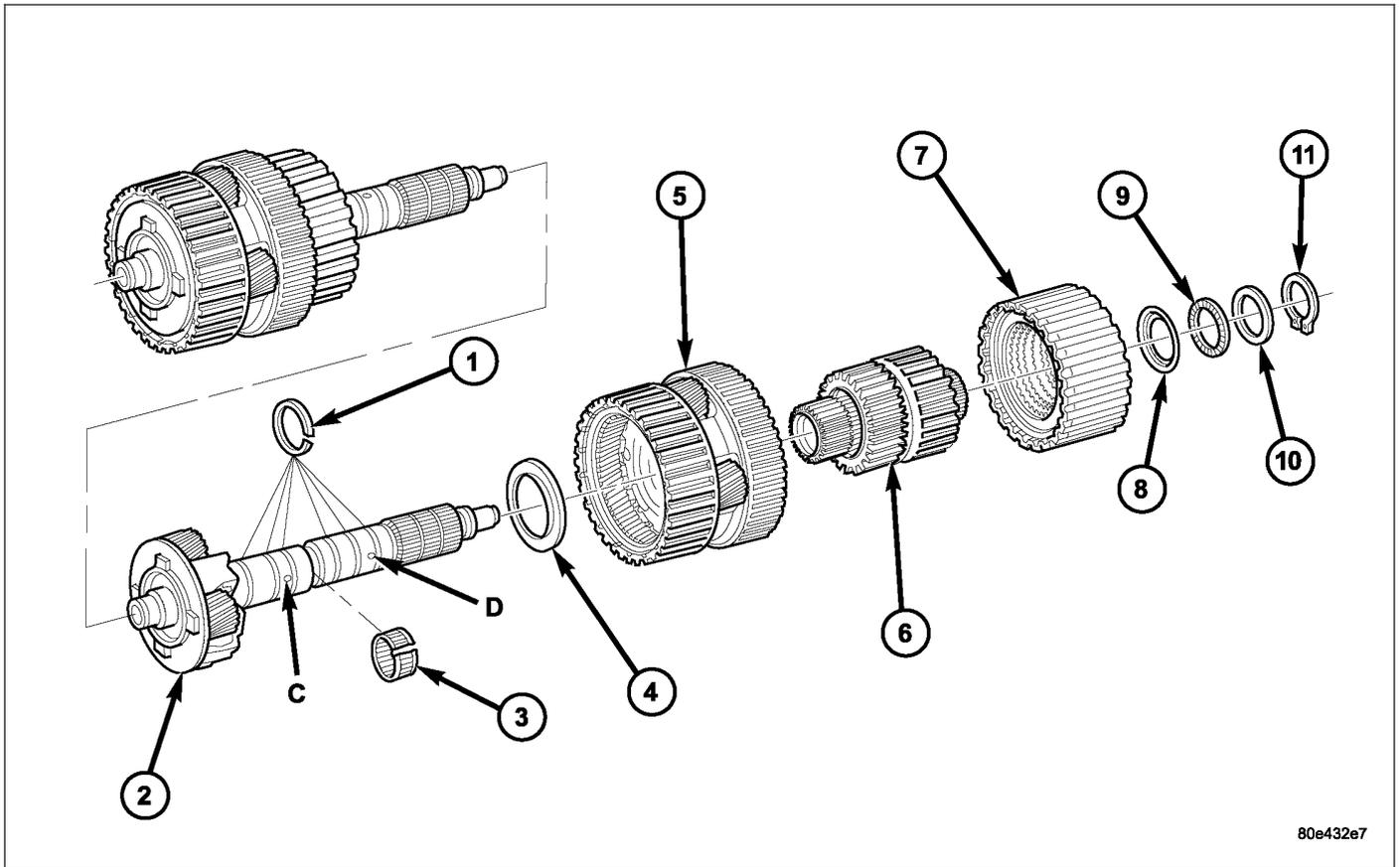
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***Output Shaft with Center and Rear Planetary Geartrain***

- |  |                          |
|--|--------------------------|
| 1 - TEFLON RINGS                               | 7 - DRIVING CLUTCH K3    |
| 2 - OUTPUT SHAFT WITH CENTER PLANETARY CARRIER | 8 - THRUST WASHER        |
| 3 - NEEDLE BEARING                             | 9 - AXIAL NEEDLE BEARING |
| 4 - THRUST WASHER                              | 10 - SHIM                |
| 5 - REAR PLANETARY GEAR SET                    | 11 - RETAINING RING      |
| 6 - REAR HOLLOW SHAFT/FREEWHEELING CLUTCH F2   |                          |

1. Remove upper two visible Teflon rings (1) from output shaft.
2. Remove retaining ring (11), shim (10), thrust needle bearing (9) and thrust washer (8) from output shaft.
3. Remove clutch K3 (7).
4. Remove rear tubular shaft/freewheeling clutch F2 (6) from output shaft.
5. Remove rear gear set (5) with integrated tubular shaft of center gear set from output shaft.
6. Remove thrust washer (4).

**ASSEMBLY**



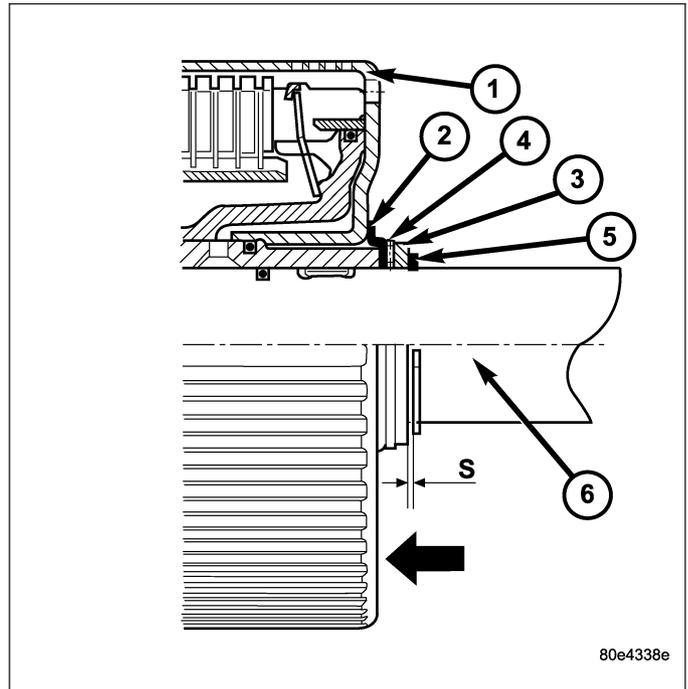
**Output Shaft with Center and Rear Planetary Geartrain**

- |  |                          |
|--|--------------------------|
| 1 - TEFLON RINGS                               | 7 - DRIVING CLUTCH K3    |
| 2 - OUTPUT SHAFT WITH CENTER PLANETARY CARRIER | 8 - THRUST WASHER        |
| 3 - NEEDLE BEARING                             | 9 - AXIAL NEEDLE BEARING |
| 4 - THRUST WASHER                              | 10 - SHIM                |
| 5 - REAR PLANETARY GEAR SET                    | 11 - RETAINING RING      |
| 6 - REAR HOLLOW SHAFT/FREEWHEELING CLUTCH F2   |                          |

1. Mount thrust washer (4) with the collar pointing towards the planet carrier.
2. Mount the rear gear set (5) on the rear hollow shaft (6).
3. Using grease, install lower three Teflon rings (1) in the groove so that the joint stays together
4. Put rear hollow shaft/freewheeling clutch F2 (6) with rear gear set (5) onto output shaft.
5. Install clutch K3 (7).
6. Mount retaining ring, shim, thrust needle bearing and thrust washer (8 - 11).
7. Using grease, insert the upper two Teflon rings (1) in the groove so that the joint remains together.

**Note:** During the test, apply a contact force by hand to K3 in the direction of the arrow.

8. Inspect axial play between shim (10) and retaining ring (11). Check axial play "S" between shim (10) and retaining ring (1) using a feeler gauge. Clearance should be 0.15-0.6 mm (0.006-0.024 in.). Shims are available in thicknesses of 3.0 mm (0.118 in.), 3.4 mm (0.134 in.), and 3.7 mm (0.146 in.). Adjust as necessary



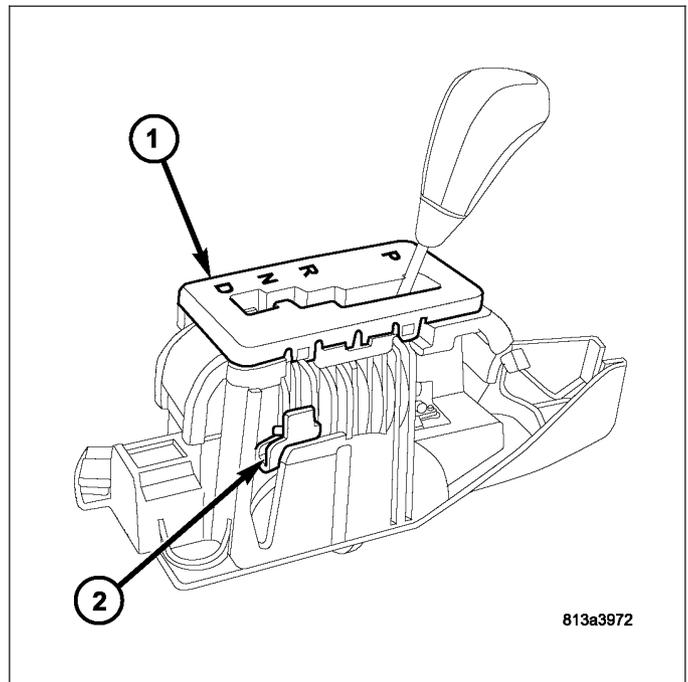
- 1 - DRIVING CLUTCH K3
- 2 - THRUST WASHER
- 3 - SHIM
- 4 - AXIAL NEEDLE BEARING
- 5 - RETAINING RING
- 6 - OUTPUT SHAFT WITH CENTER PLANETARY CARRIER

## MECHANISM-SHIFT

### DESCRIPTION

The automatic transmission is operated with the help of a shift lever assembly (SLA) (1) located in the floor console. There are four positions to which the selection lever can be shifted: P, R, N, D. In addition, the selector lever can be moved sideways (+/-) in position "D" to adjust the shift range.

All selector lever positions, as well as selected shift ranges in position "D", are identified by the SLA. The information is then sent to the transmission control module (TCM) via a hardwire connection. At the same time, the selector lever positions "P", "R", "N" and "D" are transmitted by a shift cable to the selector shaft in the transmission.



The SLA is comprised of the following functions:

- **Key lock:** Depending on the selector lever position, the ignition cylinder is locked/unlocked, i.e., the ignition key can be removed only if the selector lever is in position "P". A park lock cable is used to perform this function.
- **Park lock:** The selector lever is not released from position "P" until the brake pedal has been applied and the ignition key is in "ACC" or "ON" positions. Shift lock is controlled by the brake light switch in conjunction with a locking solenoid in the SLA. As soon as the brake pedal is applied firmly, the locking solenoid is energized and retracted to unlock the selector lever. If the selector lever cannot be moved out of position "P" due to a malfunction, the shift lock function can be overridden (2). (Refer to 21 - TRANSMISSION/AUTOMATIC TRANSMISSION - NAG1/SHIFT INTERLOCK MECHANISM - OPERATION)
- **Reverse inhibitor:** As soon as the vehicle speed exceeds approximately 4-7 mph, it is no longer possible to move the selector lever from position "N" to position "R". The reverse inhibit functionality is controlled by the same solenoid as the park lock. As the vehicle accelerates past the calibrated speed threshold, the solenoid is energized to block the sideways motion of the shift lever necessary to move from NEUTRAL to REVERSE. The reverse inhibit is not released until the vehicle speed falls below approximately 4-7 mph and the shifter is moved out of the "D" shifter position.

## OPERATION

With the selector lever in position "D", the transmission control module (TCM) automatically shifts the gears that are best-suited to the current operating situation. This means that shifting of gears is continuously adjusted to current driving and operating conditions in line with the selected shift range and the accelerator pedal position. Starting off is always performed in 1st gear.

The selector lever positions are determined by a sensor assembly internal to the shift lever assembly (SLA). The sensor assembly identifies the various positions of the SLA according to the following table.

Shift Lever Position	Bit 0	Bit 1	Bit 2	Bit 3
Default	0	0	0	0
"D"	1	0	1	0
"N"	0	1	1	0
"R"	1	1	1	0
"P"	0	0	0	1
"+"	1	0	0	1
"-"	0	1	0	1
"ND"	1	1	0	1
"RN"	0	0	1	1
"PR"	1	0	1	1
Implausible	1	1	1	1

The current selector lever position or, if the shift range has been limited, the current shift range is indicated in the instrument cluster display.

The permissible shifter positions and transmission operating ranges are:

- P = Parking lock and engine starting.
- R = Reverse.
- N = Neutral and engine starting (no power is transmitted to the axles).
- D = The shift range includes all forward gears.
- 4= Shift range is limited to gears 1 to 4.
- 3= Shift range is limited to gears 1 to 3.
- 2= Shift range is limited to gears 1 to 2.
- 1= Shift range is limited to the 1st gear.

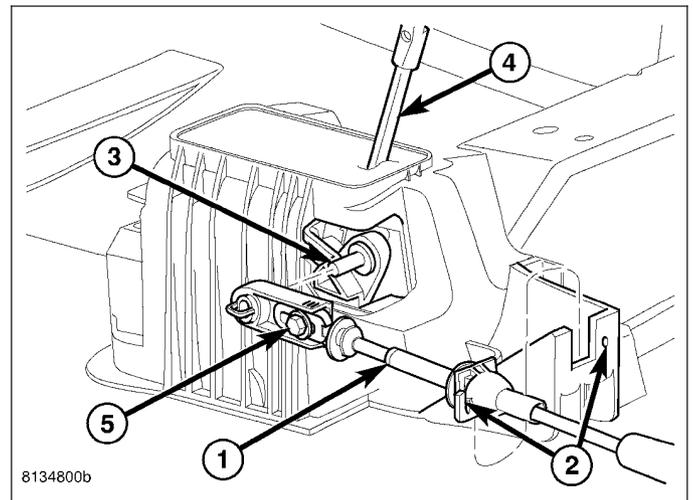
The shift range can be adjusted to the current operating conditions by tipping the selector lever to the left-hand side ("-") or the right-hand side ("+") when in position "D". If the shift range is limited, the display in the instrument cluster indicates the selected shift range and not the currently engaged gear.

Tipping the shift lever will have the following results:

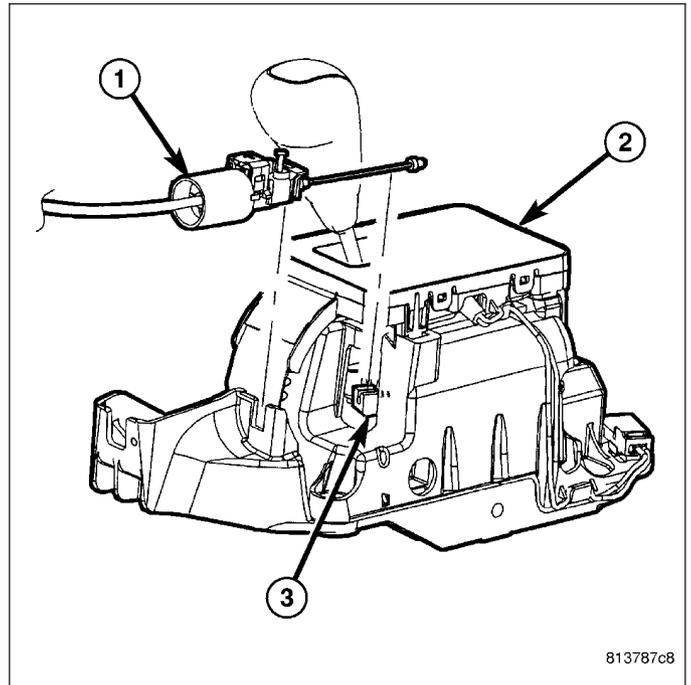
- **Tipping the selector lever toward "-" one time after another:** The shift range is reduced in descending sequence by one gear each time, i.e., from D - 4 - 3 - 2 - 1. If the selected limitation of the shift range would result in a downshift causing excessive engine speed, the shifting is not executed and the engaged gear as well as the shift range remain unchanged. This is to prevent the engine from overspeeding. Engine retardation is low with the selector lever in position "D". To make use of the full braking power of the engine, "manual" downshifting by tipping the lever towards the left-hand side is recommended. If this has been done, subsequent upshifting must be carried out manually as well.
- **Tipping the selector lever toward "-" and holding it in this position:** The currently engaged gear in range "D" is indicated in the instrument cluster display and the shift range is limited to this gear.
- **Tipping the selector lever toward "+" one time after another:** The shift range is increased by one gear each time and the increased shift range is displayed in the instrument cluster; possibly, the transmission upshifts to a faster gear.
- **Tipping the selector lever toward "+" several times:** The shift range is increased by one gear each time the lever is tipped until the shift range ends up in "D".
- **Tipping the selector lever toward "+" and holding it in this position:** The shift range is extended immediately to "D", shift ranges are indicated in ascending sequence; possibly, the transmission upshifts to a faster gear due to the extension of the shift range.

## REMOVAL

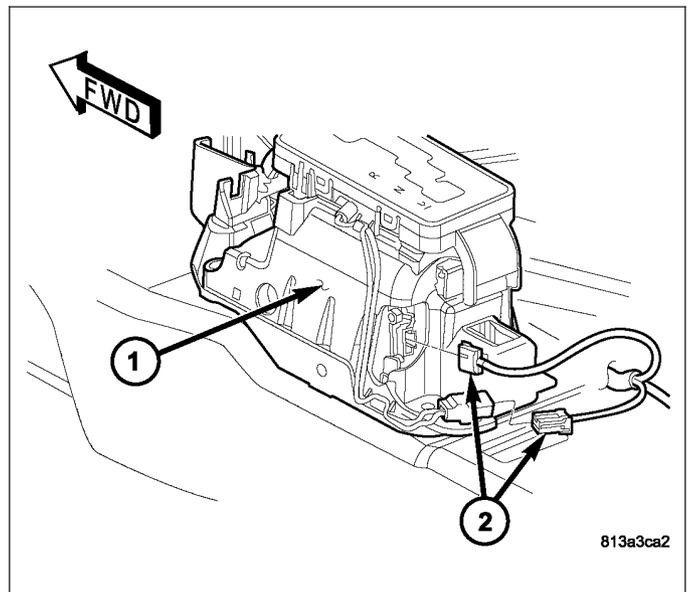
1. Remove any necessary console parts for access to shift lever assembly and shifter cables. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - REMOVAL)
2. If necessary, remove the bolts holding the shield, covering the gearshift and park lock cables, to the floorpan and remove the shield.
3. Shift transmission into PARK.
4. Disconnect the transmission shift cable (1) at shift lever (3) and shifter assembly bracket (2).
5. Remove the shift cable retainer (2) from the notch in the shifter assembly (2).



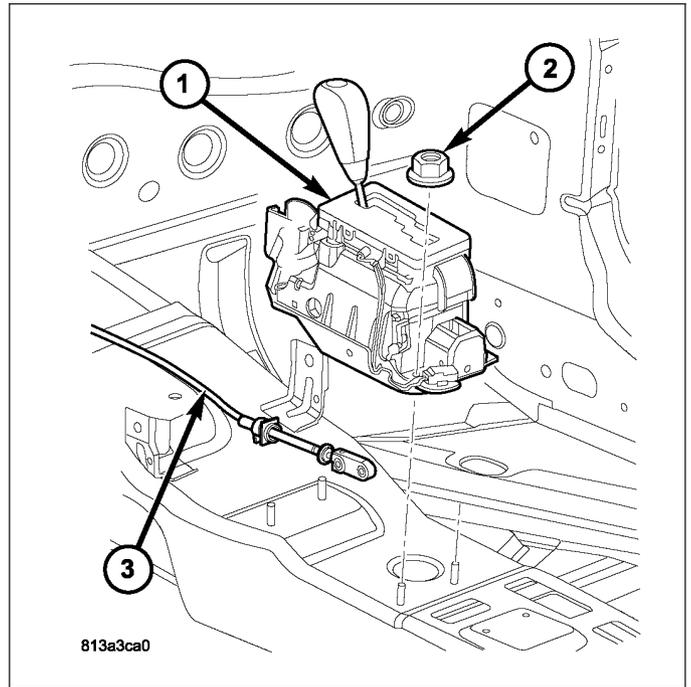
6. Verify the key is in the LOCK position and disconnect the park lock cable (1) from the shifter mechanism cam (3) and the notch in the shifter assembly (2).



7. Disengage all wiring connectors (2) from the shifter assembly (1).

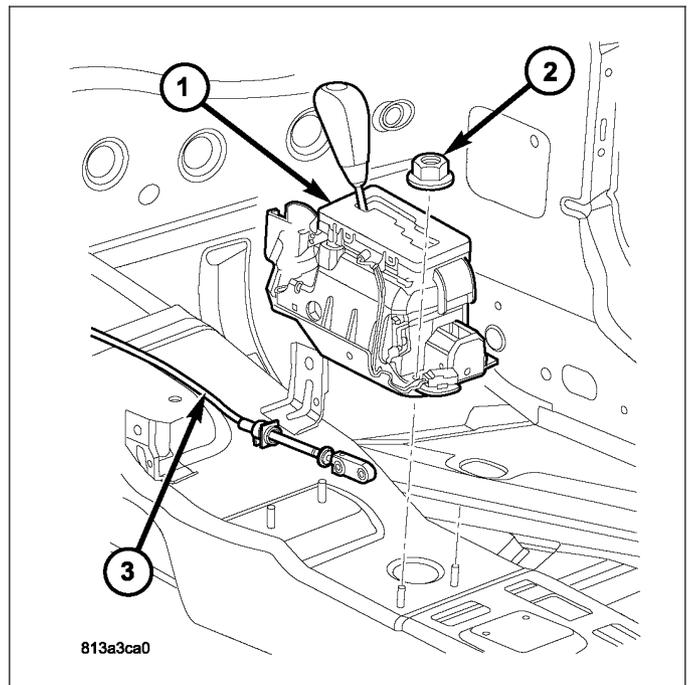


8. Remove all nuts (2) holding the shifter assembly (1) to the floor pan.
9. Remove the shifter assembly (1) from the vehicle.

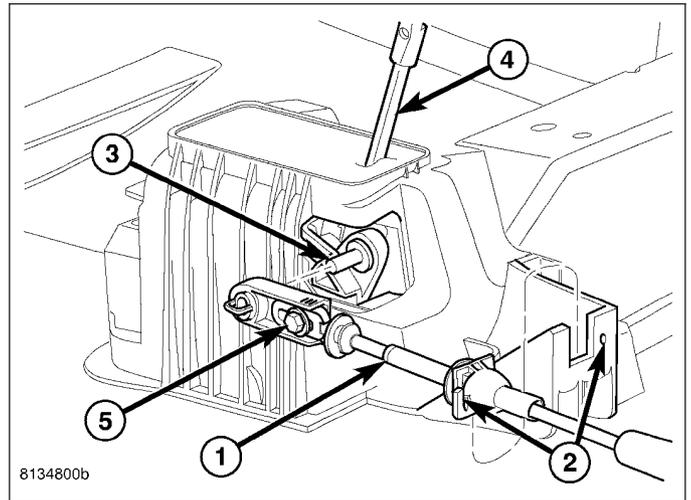


## INSTALLATION

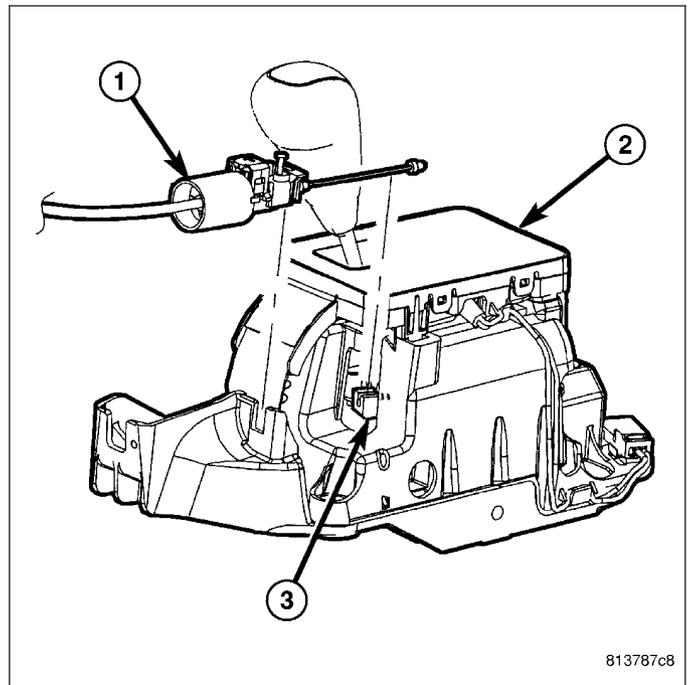
1. Install shifter assembly (1) onto the shifter assembly studs on the floor pan.
2. Install the nuts (2) to hold the shifter assembly (1) onto the floor pan. Tighten nuts to 7 N·m (652 in.lbs.).



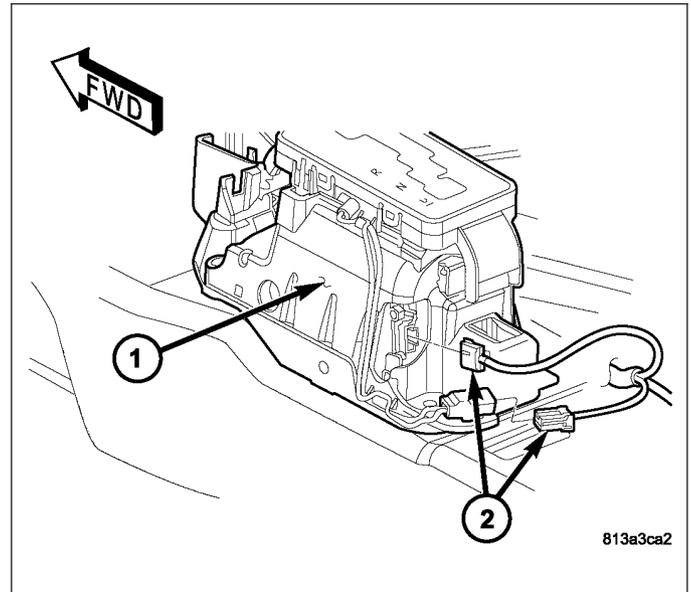
3. Place the floor shifter lever in PARK position.
4. Loosen the adjustment screw (5) on the gearshift cable (1).
5. Install the gearshift cable (1) to the shift lever pin (3).



6. Install the park lock cable (1) to the shift mechanism cam (3) and the notch in the shifter assembly (2).
7. Verify that the key is in the LOCK position and remains there until the cable is fully adjusted.
8. Verify that the park lock cable adjustment tab is pulled upward to the unlocked position.



9. Install the wiring harness connectors (2) to the shifter assembly.
10. Verify that the shift lever is in the PARK position.
11. Tighten the adjustment screw to 7 N·m (65 in.lbs.).
12. Verify that the key in the LOCK position and the shifter is in PARK.
13. Push downward on the park lock cable adjustment tab to lock the adjustment.
14. Verify correct shifter, park lock, and BTSI operation.
15. If necessary, install the shield, covering the gear-shift and park lock cables, to the floorpan and install the bolts to hold the shield to the floorpan.
16. Install any console parts removed for access to shift lever assembly and shift cables. (Refer to 23 - BODY/INTERIOR/FLOOR CONSOLE - INSTALLATION)



## SOLENOID

### DESCRIPTION

The typical electrical solenoid used in automotive applications is a linear actuator. It is a device that produces motion in a straight line. This straight line motion can be either forward or backward in direction, and short or long distance.

A solenoid is an electromechanical device that uses a magnetic force to perform work. It consists of a coil of wire, wrapped around a magnetic core made from steel or iron, and a spring loaded, movable plunger, which performs the work, or straight line motion.

The solenoids used in transmission applications are attached to valves which can be classified as **normally open** or **normally closed**. The **normally open** solenoid valve is defined as a valve which allows hydraulic flow when no current or voltage is applied to the solenoid. The **normally closed** solenoid valve is defined as a valve which does not allow hydraulic flow when no current or voltage is applied to the solenoid. These valves perform hydraulic control functions for the transmission and must therefore be durable and tolerant of dirt particles. For these reasons, the valves have hardened steel poppets and ball valves. The solenoids operate the valves directly, which means that the solenoids must have very high outputs to close the valves against the sizable flow areas and line pressures found in current transmissions. Fast response time is also necessary to ensure accurate control of the transmission.

The strength of the magnetic field is the primary force that determines the speed of operation in a particular solenoid design. A stronger magnetic field will cause the plunger to move at a greater speed than a weaker one. There are basically two ways to increase the force of the magnetic field:

1. Increase the amount of current applied to the coil or
2. Increase the number of turns of wire in the coil.

The most common practice is to increase the number of turns by using thin wire that can completely fill the available space within the solenoid housing. The strength of the spring and the length of the plunger also contribute to the response speed possible by a particular solenoid design.

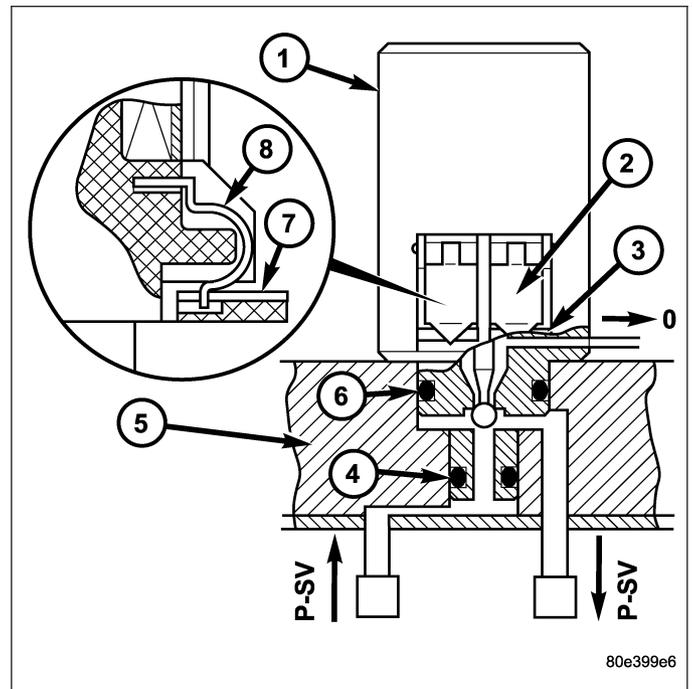
A solenoid can also be described by the method by which it is controlled. Some of the possibilities include variable force, pulse-width modulated, constant ON, or duty cycle. The variable force and pulse-width modulated versions utilize similar methods to control the current flow through the solenoid to position the solenoid plunger at a desired position somewhere between full ON and full OFF. The constant ON and duty cycled versions control the voltage across the solenoid to allow either full flow or no flow through the solenoid's valve.

### UPSHIFT/DOWNSHIFT SOLENOID VALVES

The solenoid valves (1) for upshifts and downshifts are located in the shell of the electric control unit and pressed against the shift plate with a spring.

The solenoid valves (1) initiate the upshift and downshift procedures in the shift plate.

The solenoid valves (1) are sealed off from the valve housing of the shift plate (5) by two O-rings (4, 6). The contact springs (8) at the solenoid valve engage in a slot in the conductor tracks (7). The force of the contact spring (8) ensures safe contacts.

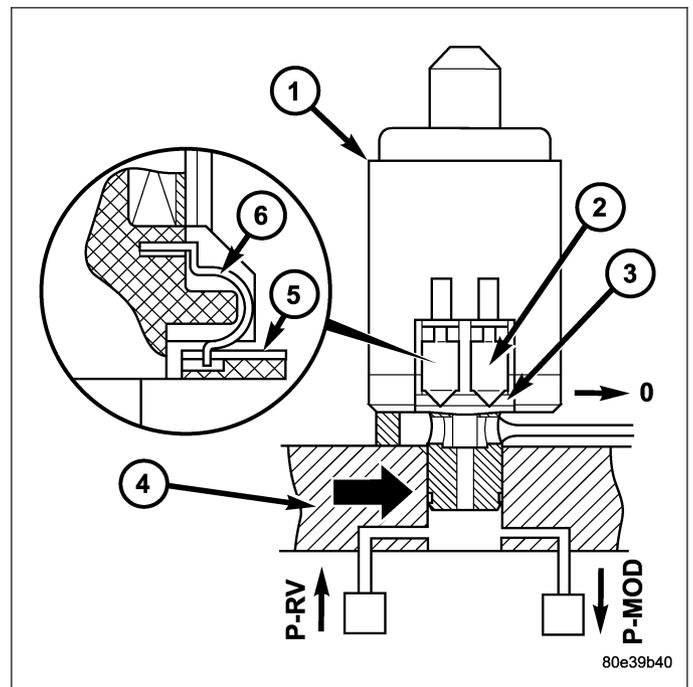


### MODULATING PRESSURE CONTROL SOLENOID VALVE

The modulating pressure control solenoid valve (1) is located in the shell of the electric valve control unit and pressed against the shift plate by a spring.

Its purpose is control the modulating pressure depending on the continuously changing operating conditions, such as load and gear change.

The modulating pressure regulating solenoid valve (1) has an interference fit and is sealed off to the valve body of the shift plate (4) by a seal (arrow). The contact springs (2) at the solenoid valve engage in a slot in the conductor tracks (3). The force of the contact springs (2) ensures secure contacts.

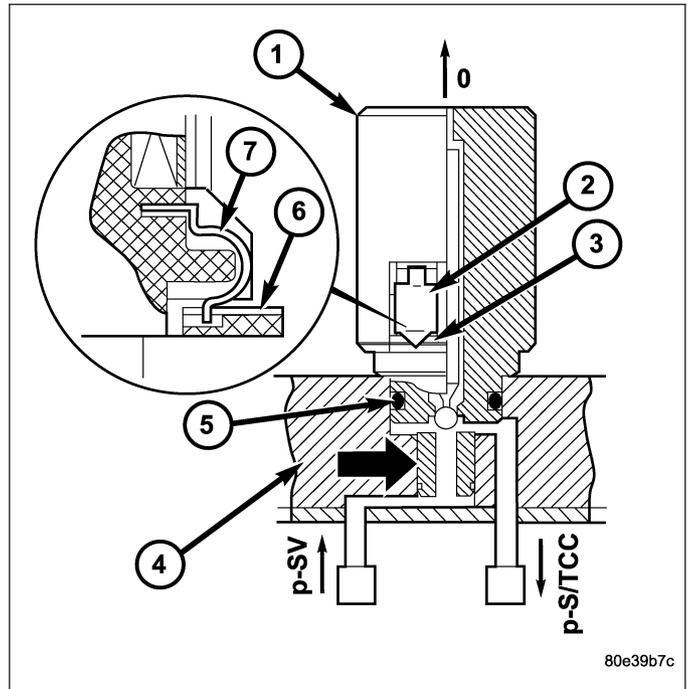


### TORQUE CONVERTER LOCKUP CLUTCH PWM SOLENOID VALVE

The torque converter lockup clutch PWM solenoid valve (1) is located in the shell of the electric valve control unit and pressed against the shift plate by a spring.

The PWM solenoid valve (1) for the torque converter lockup controls the pressure for the torque converter lockup clutch.

The torque converter lockup PWM solenoid valve (1) is sealed off to the valve body of the shift plate (4) by an O-ring (5) and a seal (arrow). The contact springs (2) at the solenoid valve engage in a slot in the conductor tracks (3). The force of the contact springs (2) ensures secure contacts.

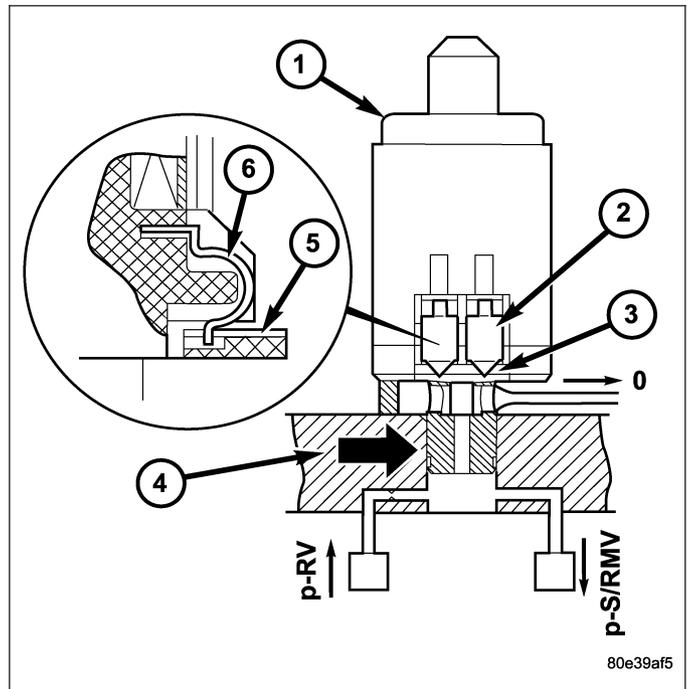


### SHIFT PRESSURE CONTROL SOLENOID VALVE

The shift pressure control solenoid valve (1) is located in the shell of the electric valve control unit and pressed against the shift plate by a spring.

Its purpose is to control the shift pressure depending on the continuously changing operating conditions, such as load and gear change.

The shift pressure regulating solenoid valve (1) has an interference fit and is sealed off to the valve body of the shift plate (4) by a seal (arrow). The contact springs (2) at the solenoid valve engage in a slot in the conductor tracks (3). The force of the contact springs (2) ensures secure contacts.



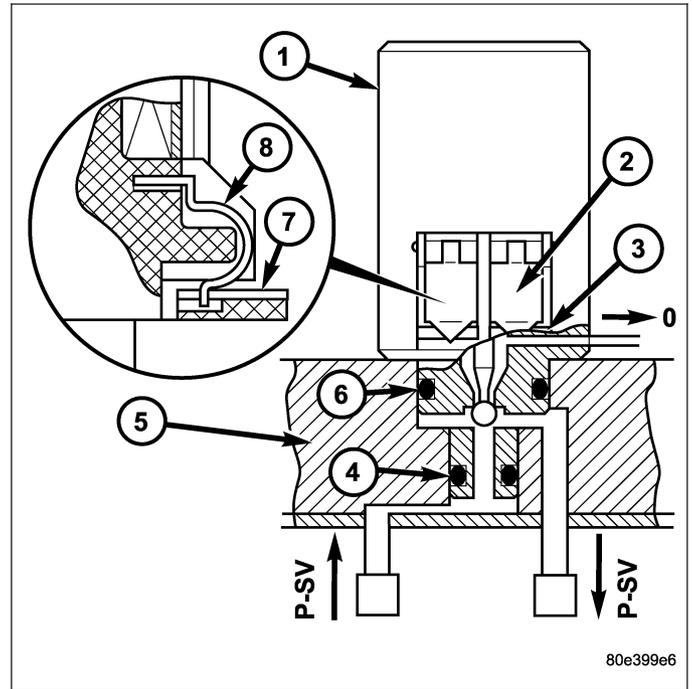
### OPERATION

When an electrical current is applied to the solenoid coil, a magnetic field is created which produces an attraction to the plunger, causing the plunger to move and work against the spring pressure and the load applied by the fluid the valve is controlling. The plunger is normally directly attached to the valve which it is to operate. When the current is removed from the coil, the attraction is removed and the plunger will return to its original position due to spring pressure.

The plunger is made of a conductive material and accomplishes this movement by providing a path for the magnetic field to flow. By keeping the air gap between the plunger and the coil to the minimum necessary to allow free movement of the plunger, the magnetic field is maximized.

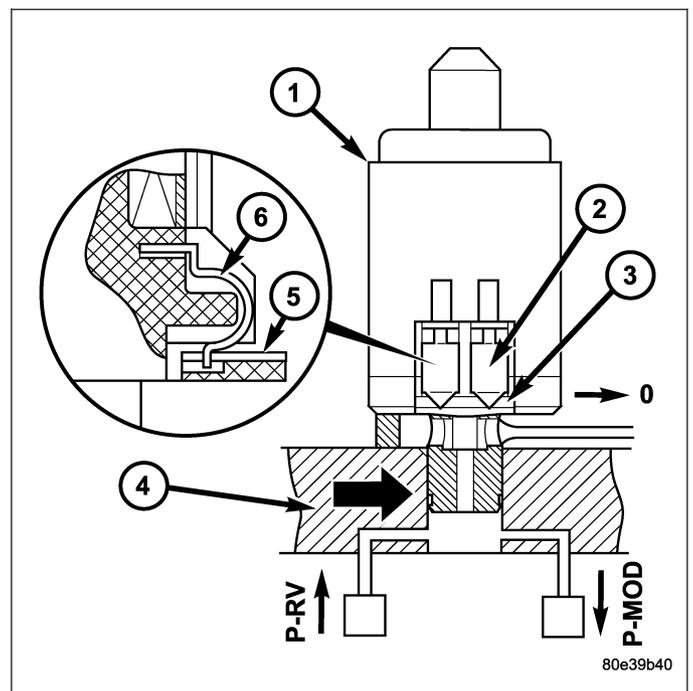
### UPSHIFT/DOWNSHIFT SOLENOID VALVES

If a solenoid valve (1) is actuated by the TCM, it opens and guides the control pressure (p-SV) to the assigned command valve. The solenoid valve remains actuated and therefore open until the shifting process is complete. The shift pressure (p-SV) to the command valve is reduced to zero as soon as the power supply to the solenoid valve is interrupted.



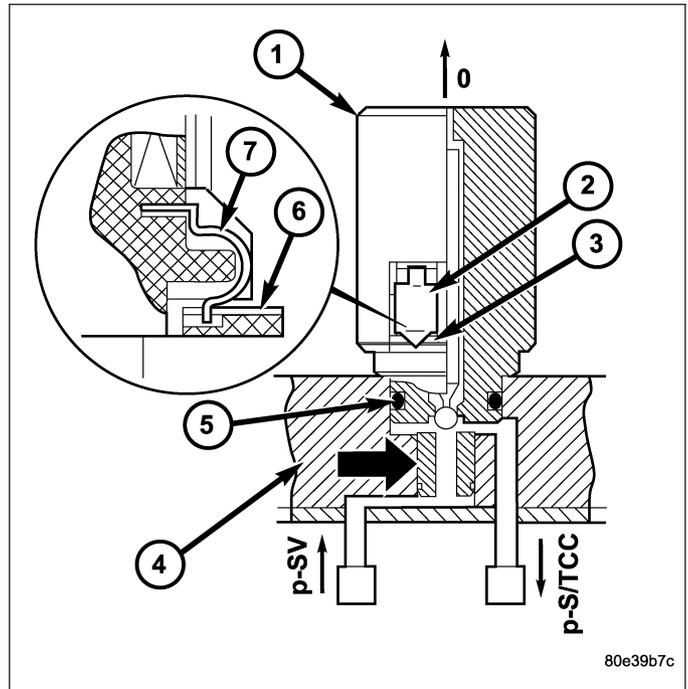
### MODULATING PRESSURE CONTROL SOLENOID VALVE

The modulating pressure regulating solenoid valve (1) assigns a proportional pressure to the current which is controlled by the TCM according to the load.



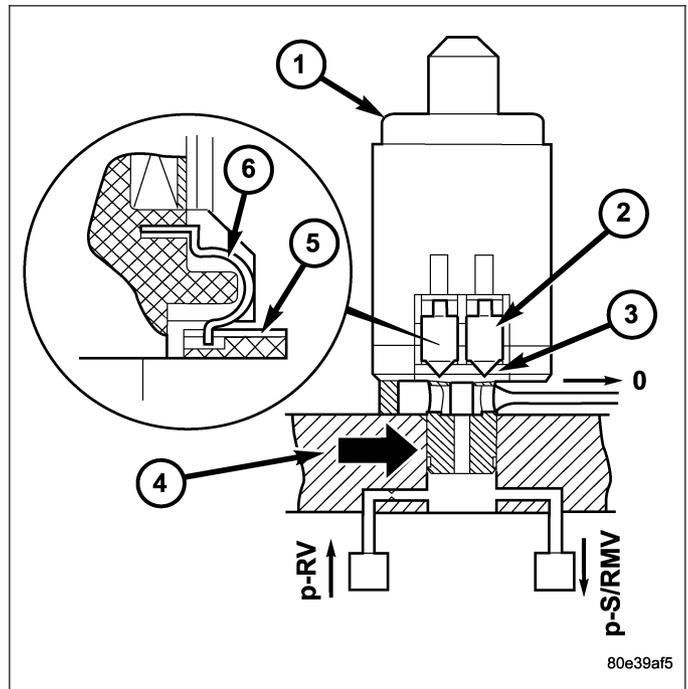
### TORQUE CONVERTER LOCKUP CLUTCH PWM SOLENOID VALVE

The torque converter lockup PWM solenoid (1) valve converts pulse-wave-modulated current controlled by the TCM into the appropriate hydraulic control pressure (p-S/TCC).



### SHIFT PRESSURE CONTROL SOLENOID VALVE

The shift pressure regulating solenoid valve (1) assigns a proportional pressure to the current which is controlled by the TCM according to the load.



## CONTACT-TEMPERATURE SENSOR/PARK-NEUTRAL

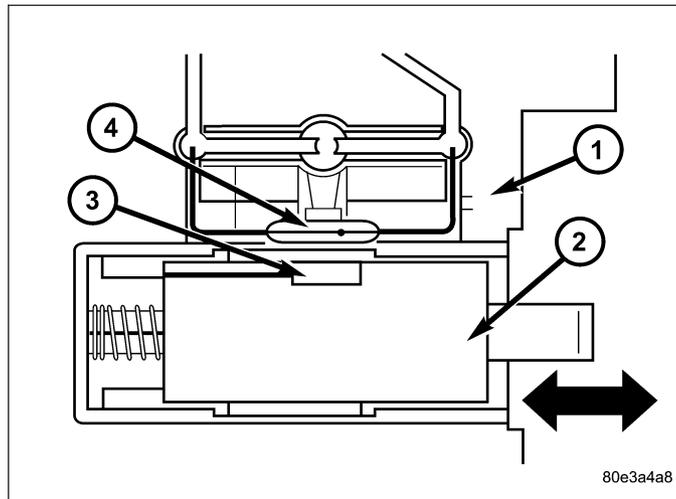
### DESCRIPTION

#### PARK/NEUTRAL CONTACT

The park/neutral contact (4) is located in the shell of the electric control unit and is fixed to the conductor tracks.

Its purpose is to recognize selector valve and selector lever positions "P" and "N". The park/neutral contact consists of:

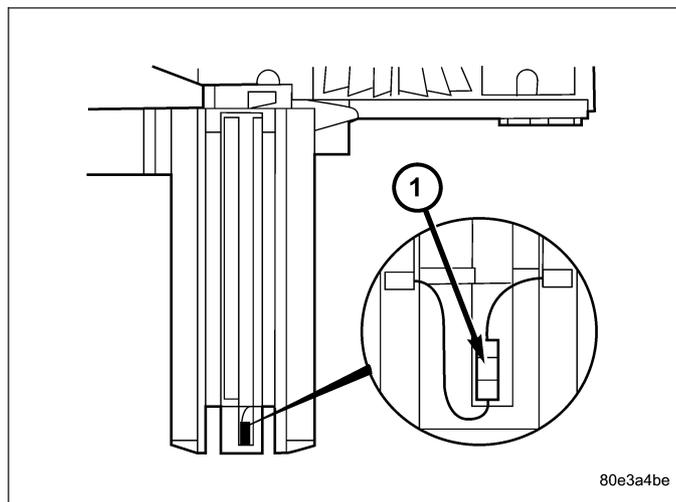
- the plunger (2).
- the permanent magnet (3).
- the dry-reed contact (4).



#### TRANSMISSION TEMPERATURE SENSOR

The transmission oil temperature sensor (1) is located in the shell of the electric valve control unit and is fixed to the conductor tracks.

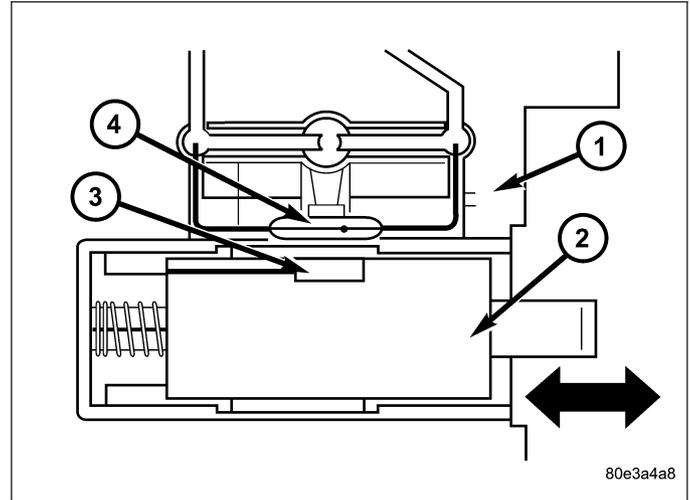
Its purpose is to measure the temperature of the transmission oil and pass the temperature to the TCM as an input signal. It is a temperature-dependent resistor (PTC).



## OPERATION

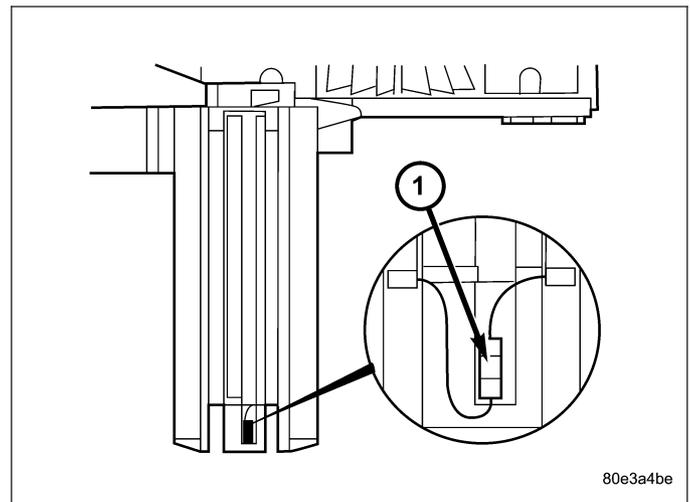
### PARK/NEUTRAL CONTACT

In selector lever positions "P" and "N" the park/neutral contact (4) is actuated by a cam track which is located on the detent plate. The permanent magnet (3) is moved away from the dry-reed contact (4). The dry-reed contact (4) is opened. The TCM receives an electric signal. The circuit to the starter in the selector lever positions "P" and "N" is closed.



### TRANSMISSION TEMPERATURE SENSOR

The temperature of the transmission oil has a considerable effect on the shifting time and therefore the shift quality. By measuring the oil temperature, shift operations can be optimized in all temperature ranges. The transmission oil temperature sensor (1) is switched in series with the park/neutral contact. The temperature signal is transferred to the TCM only when the dry-reed contact of the park/neutral contact is closed in REVERSE or a forward gear position.



Refer to the Transmission Temperature Sensor Specifications table for the relationship between transmission temperature, sensor voltage, and sensor resistance.

**TRANSMISSION TEMP SENSOR SPECIFICATIONS  
TEMPERATURE/VOLTAGE/RESISTANCE CHART**

TEMPERATURE (C)	TEMPERATURE (F)	VOLTAGE	RESISTANCE
-50	-58	0.73	506.0
-45	-49	0.77	534.0
-40	-40	0.80	564.0
-35	-31	0.84	593.0
-30	-22	0.88	624.0
-25	-13	0.91	654.0
-20	-4	0.95	686.0
-15	5	0.98	718.0
-10	14	1.02	750.0
-5	23	1.05	783.0
0	32	1.09	817.0
5	41	1.12	851.0
10	50	1.16	886.0
15	59	1.19	921.0
20	68	1.23	957.0
25	77	1.26	994.0
30	86	1.30	1032.0
35	95	1.33	1070.0
40	104	1.37	1109.0
45	113	1.40	1149.0
50	122	1.44	1189.0
55	131	1.48	1231.0
60	140	1.51	1273.0
65	149	1.55	1316.0
70	158	1.58	1360.0
75	167	1.62	1405.0
80	176	1.65	1450.0
85	185	1.69	1497.0
90	194	1.72	1545.0
95	203	1.76	1594.0
100	212	1.79	1644.0
105	221	1.83	1695.0
110	230	1.86	1747.0
115	239	1.90	1800.0
120	248	1.93	1855.0
125	257	1.97	1911.0
130	266	2.00	1968.0
135	275	2.04	2027.0
140	284	2.08	2087.0
145	293	2.11	2148.0
150	302	2.15	2211.0
155	311	2.18	2276.0
160	320	2.22	2342.0
165	329	2.25	2410.0
170	338	2.29	2479.0
175	347	2.32	2551.0

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## CONVERTER-TORQUE

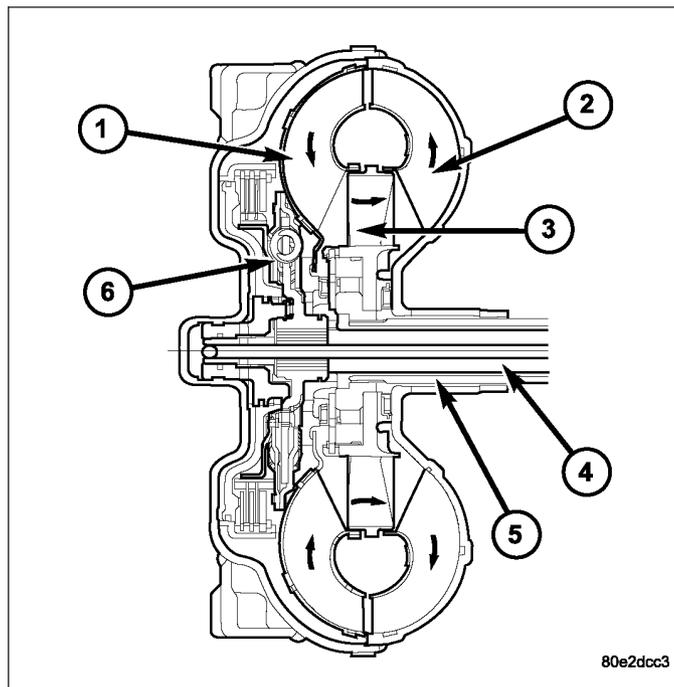
### DESCRIPTION

**CAUTION:** The torque converter must be replaced if a transmission failure resulted in large amounts of metal or fiber contamination in the fluid.

The torque converter is a hydraulic device that couples the engine crankshaft to the transmission. The torque converter consists of an outer shell with an internal turbine (1), a stator (3), an overrunning clutch, an impeller (2), and an electronically applied converter clutch. The converter clutch provides reduced engine speed and greater fuel economy when engaged. Clutch engagement also provides reduced transmission fluid temperatures. The converter clutch engages in third through fifth gears. The torque converter hub drives the transmission oil (fluid) pump.

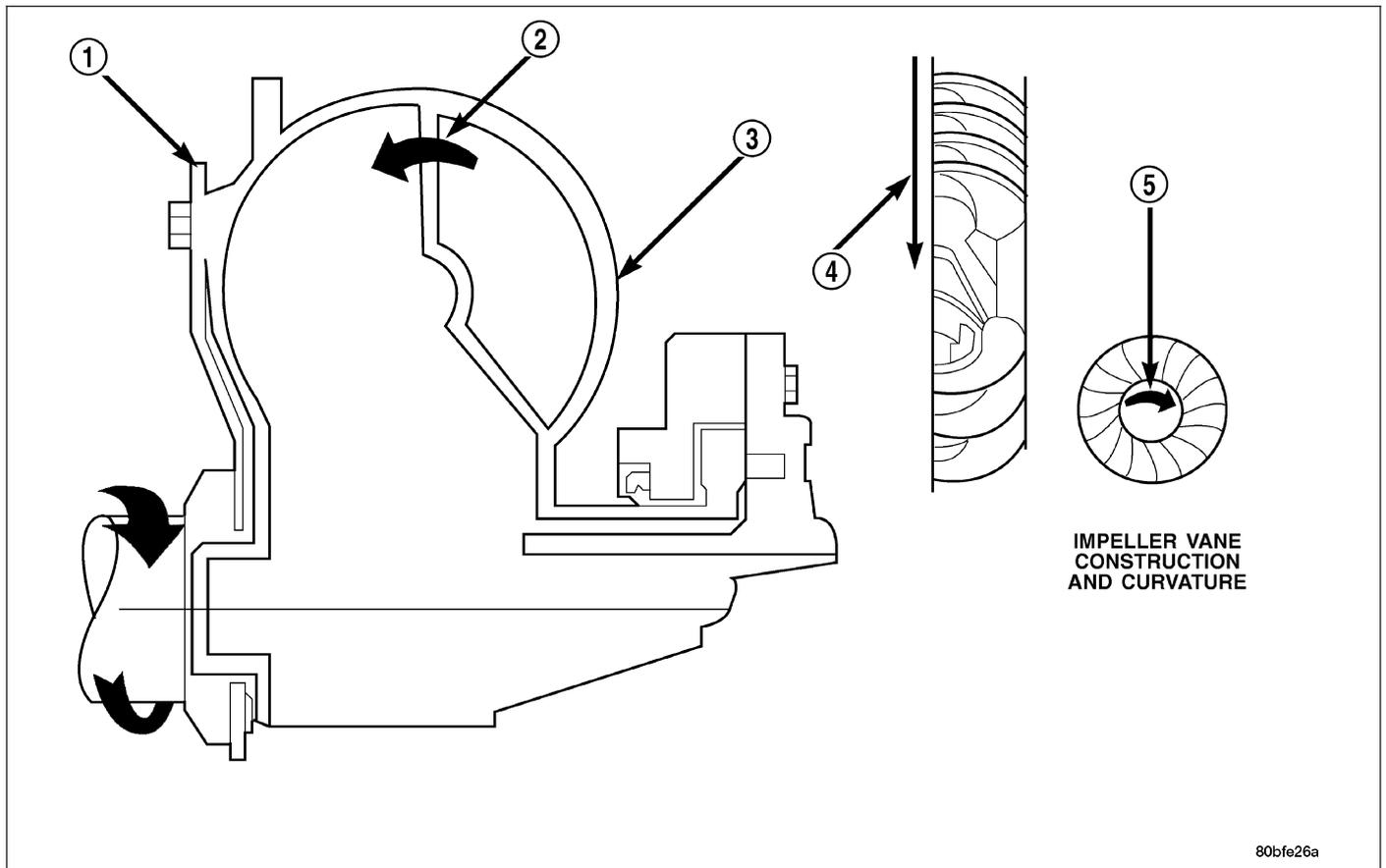
A turbine damper (6) has been added for some applications to help improve vehicle noise, vibration, and harshness (NVH) characteristics.

The torque converter is a sealed, welded unit that is not repairable and is serviced as an assembly.



- 1 - TURBINE
- 2 - IMPELLER
- 3 - STATOR
- 4 - INPUT SHAFT
- 5 - STATOR SHAFT
- 6 - TURBINE DAMPER

**IMPELLER**

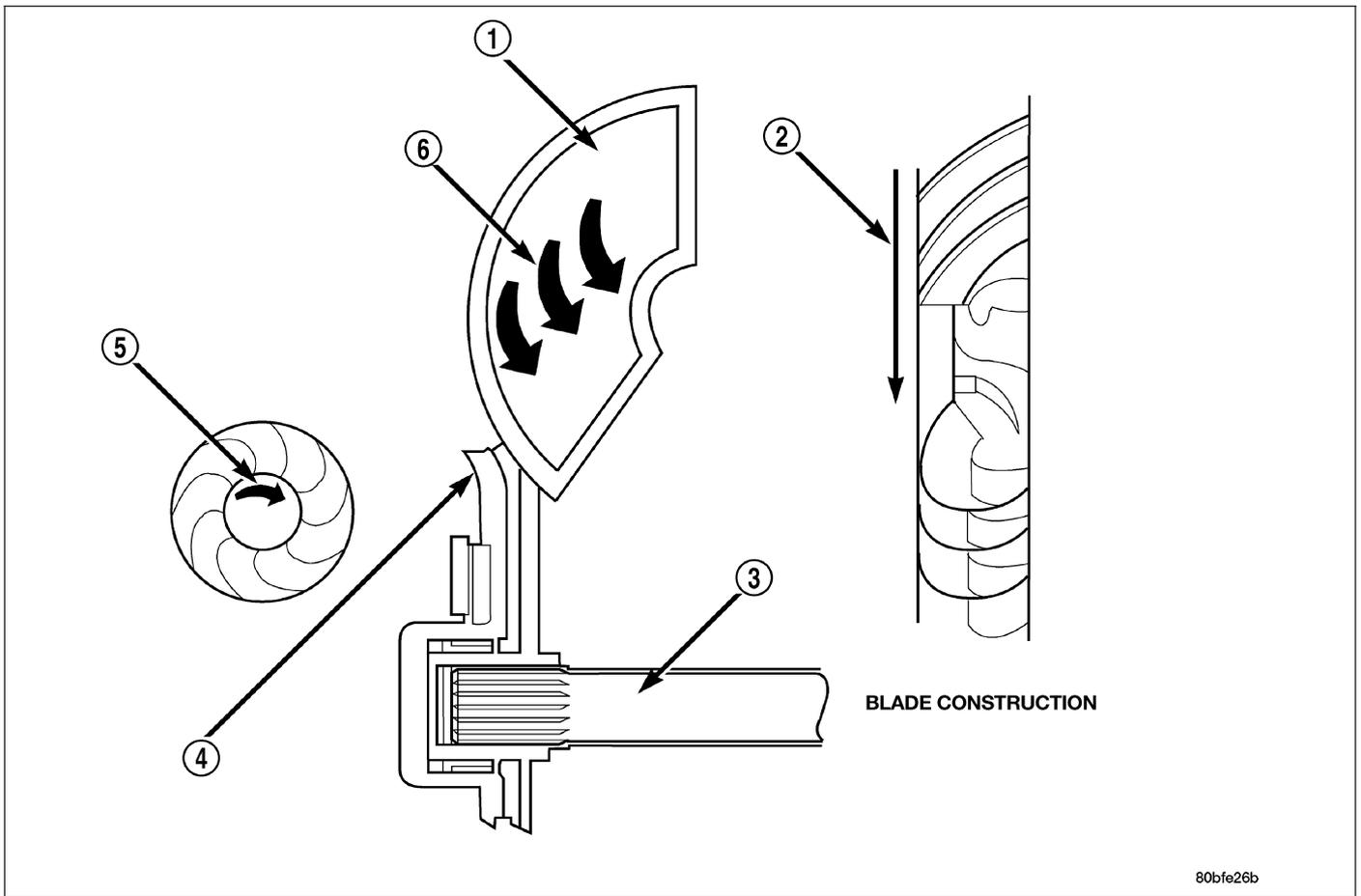


**Impeller**

- |   |                     |
|---|---------------------|
| 1 - ENGINE FLEXPLATE                                    | 4 - ENGINE ROTATION |
| 2 - OIL FLOW FROM IMPELLER SECTION INTO TURBINE SECTION | 5 - ENGINE ROTATION |
| 3 - IMPELLER VANES AND COVER ARE INTEGRAL               |                     |

The impeller (3) is an integral part of the converter housing. The impeller consists of curved blades placed radially along the inside of the housing on the transmission side of the converter. As the converter housing is rotated by the engine, so is the impeller, because they are one and the same and are the driving members of the system.

**TURBINE**



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**Turbine**

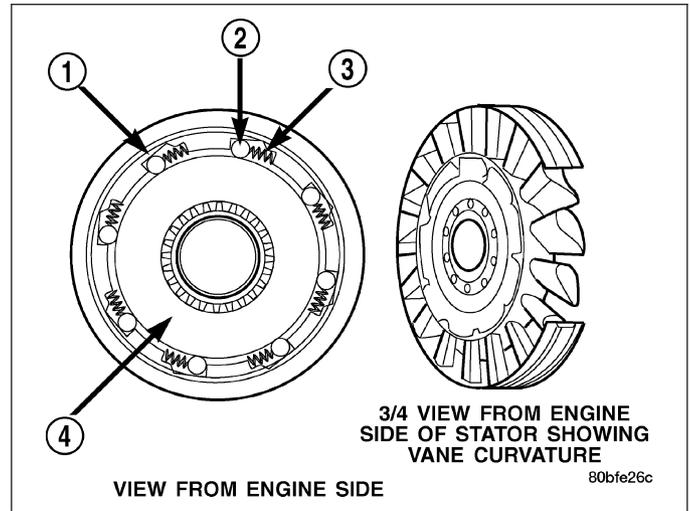
- 1 - TURBINE VANE
- 2 - ENGINE ROTATION
- 3 - INPUT SHAFT

- 4 - PORTION OF TORQUE CONVERTER COVER
- 5 - ENGINE ROTATION
- 6 - OIL FLOW WITHIN TURBINE SECTION

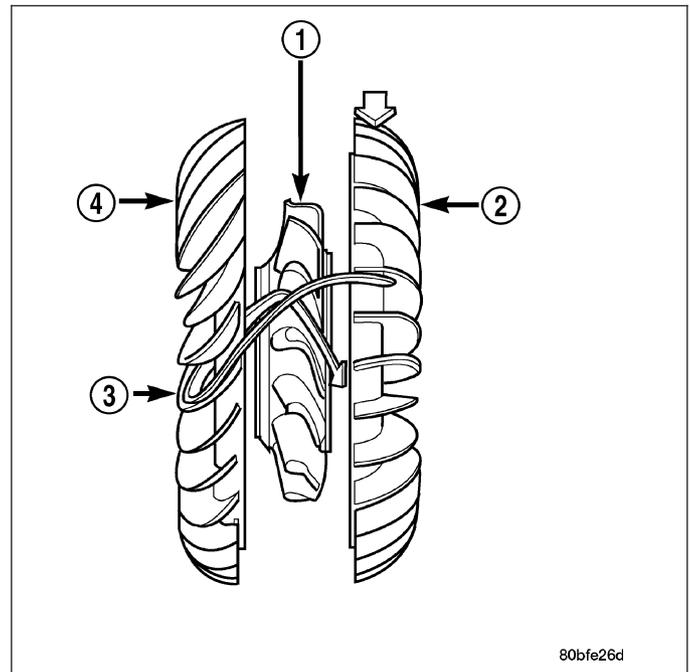
The turbine (1) is the output, or driven, member of the converter. The turbine is mounted within the housing opposite the impeller, but is not attached to the housing. The input shaft is inserted through the center of the impeller and splined into the turbine. The design of the turbine is similar to the impeller, except the blades of the turbine are curved in the opposite direction.

## STATOR

The stator assembly (1-4) is mounted on a stationary shaft which is an integral part of the oil pump.



The stator (1) is located between the impeller (2) and turbine (4) within the torque converter case. The stator contains a freewheeling clutch, which allows the stator to rotate only in a clockwise direction. When the stator is locked against the freewheeling clutch, the torque multiplication feature of the torque converter is operational.

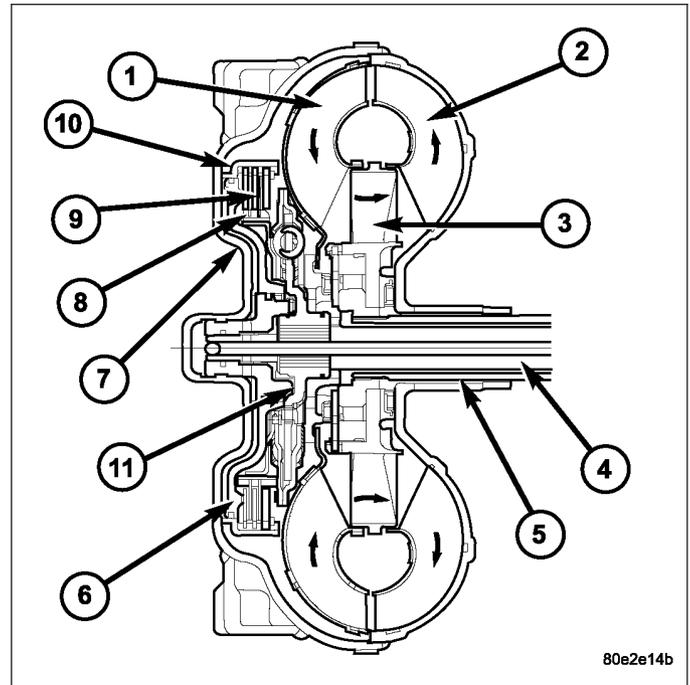


## TORQUE CONVERTER CLUTCH (TCC)

The TCC (9) was installed to improve the efficiency of the torque converter that is lost to the slippage of the fluid coupling. Although the fluid coupling provides smooth, shock-free power transfer, it is natural for all fluid couplings to slip. If the impeller and turbine were mechanically locked together, a zero slippage condition could be obtained. A hydraulic piston with friction material was added to the turbine assembly to provide this mechanical lock-up.

In order to reduce heat build-up in the transmission and buffer the powertrain against torsional vibrations, the TCM can duty cycle the torque converter lock-up solenoid to achieve a smooth application of the torque converter clutch. This function, referred to as Electronically Modulated Converter Clutch (EMCC) can occur at various times depending on the following variables:

- Shift lever position
- Current gear range
- Transmission fluid temperature
- Engine coolant temperature
- Input speed
- Throttle angle
- Engine speed

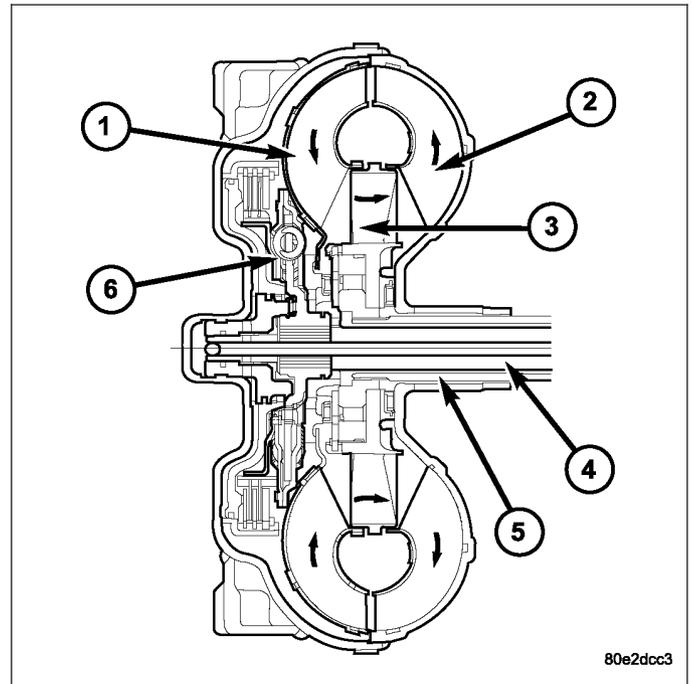


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- 1 - TURBINE
- 2 - IMPELLER
- 3 - STATOR
- 4 - INPUT SHAFT
- 5 - STATOR SHAFT
- 6 - PISTON
- 7 - COVER SHELL
- 8 - INTERNALLY TOOTHED DISC CARRIER
- 9 - CLUTCH PLATE SET
- 10 - EXTERNALLY TOOTHED DISC CARRIER
- 11 - TURBINE DAMPER

## OPERATION

The converter impeller (driving member) (2), which is integral to the converter housing and bolted to the engine drive plate, rotates at engine speed. The converter turbine (driven member) (1), which reacts from fluid pressure generated by the impeller, rotates and turns the transmission input shaft (4).



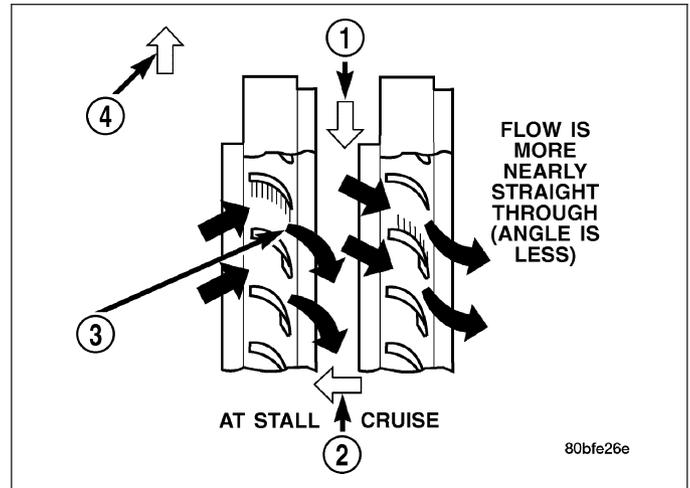
- 1 - TURBINE
- 2 - IMPELLER
- 3 - STATOR
- 4 - INPUT SHAFT
- 5 - STATOR SHAFT
- 6 - TURBINE DAMPER

## TURBINE

As the fluid that was put into motion by the impeller blades strikes the blades of the turbine, some of the energy and rotational force is transferred into the turbine and the input shaft. This causes both of them (turbine and input shaft) to rotate in a clockwise direction following the impeller. As the fluid is leaving the trailing edges of the turbine's blades it continues in a "hindering" direction back toward the impeller. If the fluid is not redirected before it strikes the impeller, it will strike the impeller in such a direction that it would tend to slow it down.

## STATOR

Torque multiplication is achieved by locking the stator's over-running clutch to its shaft. Under stall conditions (the turbine is stationary), the oil leaving the turbine blades strikes the face of the stator blades and tries to rotate them in a counterclockwise direction. When this happens the over-running clutch of the stator locks and holds the stator from rotating. With the stator locked, the oil strikes the stator blades and is redirected into a "helping" direction before it enters the impeller. This circulation of oil from impeller to turbine, turbine to stator, and stator to impeller, can produce a maximum torque multiplication of about 2.0:1. As the turbine begins to match the speed of the impeller, the fluid that was hitting the stator in such a way as to cause it to lock-up is no longer doing so. In this condition of operation, the stator begins to free wheel and the converter acts as a fluid coupling.



- 1 - DIRECTION STATOR WILL FREE WHEEL DUE TO OIL PUSHING ON BACKSIDE OF VANES
- 2 - FRONT OF ENGINE
- 3 - INCREASED ANGLE AS OIL STRIKES VANES
- 4 - DIRECTION STATOR IS LOCKED UP DUE TO OIL PUSHING AGAINST STATOR VANES

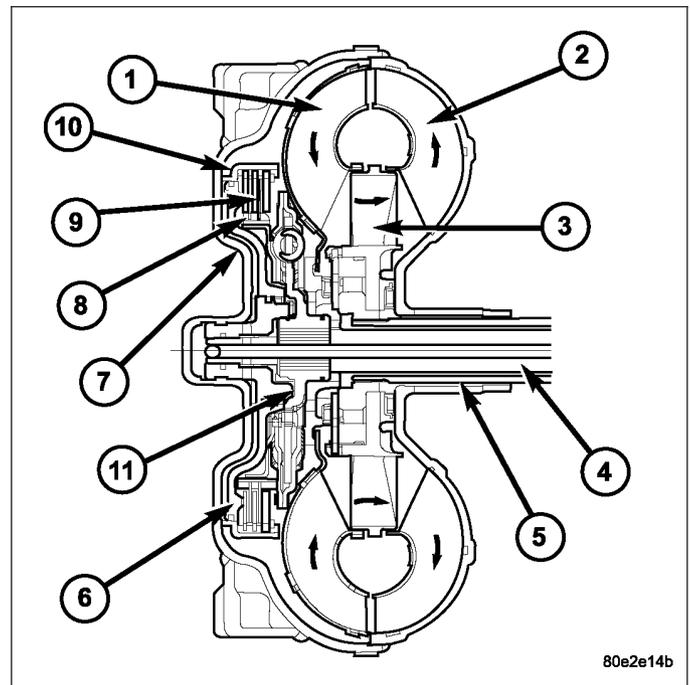
## TORQUE CONVERTER CLUTCH (TCC)

In a standard torque converter, the impeller (2) and turbine (1) are rotating at about the same speed and the stator (3) is freewheeling, providing no torque multiplication. By applying the turbine's piston and friction material (9), a total converter engagement can be obtained. The result of this engagement is a direct 1:1 mechanical link between the engine and the transmission.

The clutch can be engaged in second, third, fourth, and fifth gear ranges.

The TCM controls the torque converter by way of internal logic software. The programming of the software provides the TCM with control over the torque converter solenoid. There are four output logic states that can be applied as follows:

- No EMCC
- Partial EMCC
- Full EMCC
- Gradual-to-no EMCC



- 1 - TURBINE
- 2 - IMPELLER
- 3 - STATOR
- 4 - INPUT SHAFT
- 5 - STATOR SHAFT
- 6 - PISTON
- 7 - COVER SHELL
- 8 - INTERNALLY TOOTHED DISC CARRIER
- 9 - CLUTCH PLATE SET
- 10 - EXTERNALLY TOOTHED DISC CARRIER
- 11 - TURBINE DAMPER

## NO EMCC

Under No EMCC conditions, the TCC Solenoid is OFF. There are several conditions that can result in NO EMCC operations. No EMCC can be initiated due to a fault in the transmission or because the TCM does not see the need for EMCC under current driving conditions.

## PARTIAL EMCC

Partial EMCC operation modulates the TCC Solenoid (duty cycle) to obtain partial torque converter clutch application. Partial EMCC operation is maintained until Full EMCC is called for and actuated. During Partial EMCC some slip does occur. Partial EMCC will usually occur at low speeds, low load and light throttle situations.

## FULL EMCC

During Full EMCC operation, the TCM increases the TCC Solenoid duty cycle to full ON after Partial EMCC control brings the engine speed within the desired slip range of transmission input speed relative to engine rpm.

## GRADUAL-TO-NO EMCC

This operation is to soften the change from Full or Partial EMCC to No EMCC. This is done at mid-throttle by decreasing the TCC Solenoid duty cycle.

## REMOVAL

1. Remove transmission and torque converter from vehicle.
2. Place a suitable drain pan under the converter housing end of the transmission.

**CAUTION: Verify that transmission is secure on the lifting device or work surface, the center of gravity of the transmission will shift when the torque converter is removed creating an unstable condition. The torque converter is a heavy unit. Use caution when separating the torque converter from the transmission.**

3. Pull the torque converter forward until the center hub clears the oil pump seal.
4. Separate the torque converter from the transmission.

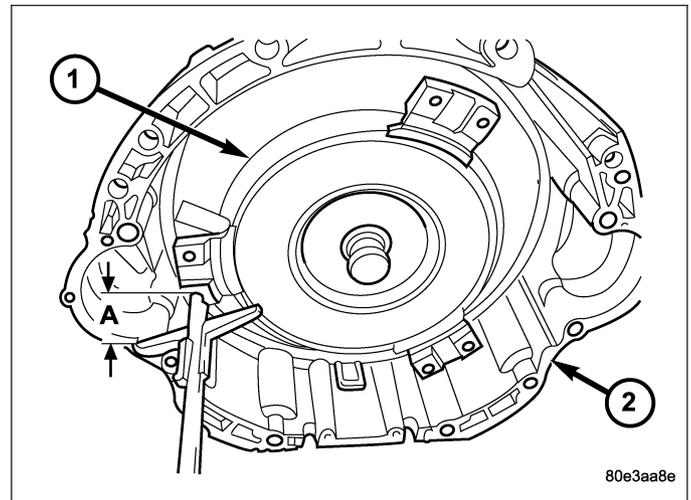
## INSTALLATION

Check converter hub and drive flats for sharp edges, burrs, scratches, or nicks. Polish the hub and flats with 320/400 grit paper or crocus cloth if necessary. The hub must be smooth to avoid damaging the pump seal at installation.

1. Lubricate oil pump seal lip with transmission fluid.
2. Place torque converter in position on transmission.

**CAUTION: Do not damage oil pump seal or converter hub while inserting torque converter into the front of the transmission.**

3. Align torque converter to oil pump seal opening.
4. Insert torque converter hub into oil pump.
5. While pushing torque converter inward, rotate converter until converter is fully seated in the oil pump gears.
6. Check converter seating with a scale and straightedge. Surface of converter lugs should be at least 19 mm (3/4 in.) to rear of straightedge when converter is fully seated.
7. If necessary, temporarily secure converter with C-clamp attached to the converter housing.
8. Install the transmission in the vehicle.
9. Fill the transmission with the recommended fluid.



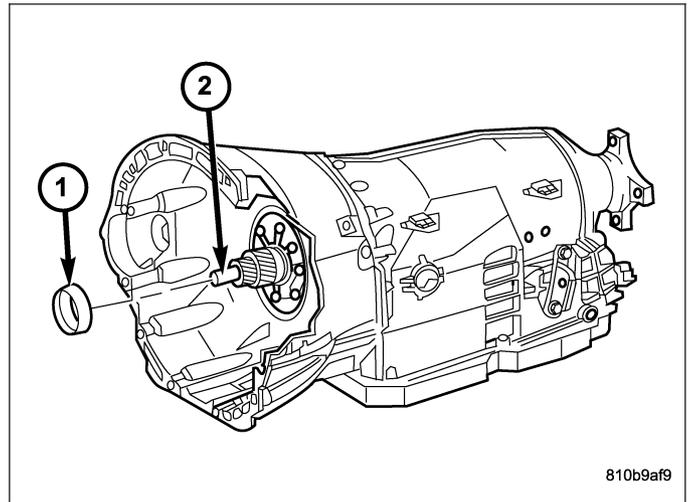
## SEAL-TORQUE CONVERTER HUB

### REMOVAL

1. Remove the torque converter (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/TORQUE CONVERTER - REMOVAL).
2. Remove the torque converter hub seal with suitable screw and slide hammer.

### INSTALLATION

1. Position the torque converter hub seal (1) over the input shaft and against the transmission oil pump.



2. Using Seal Installer 8902A (2), install a new torque converter hub seal.
3. Install the torque converter (Refer to 21 - TRANSMISSION/AUTOMATIC - NAG1/TORQUE CONVERTER - INSTALLATION).

