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# Workshop Manual

**1999**

***F-Super Duty 250-550***



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## 3: Powertrain

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## **GROUP 07: Automatic Transmission**

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### **SECTION 307-01: Automatic Transaxle/Transmission**

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General Specifications	
Item	Specification
<b>Fluid<sup>a</sup></b>	
MERCON® Multi-Purpose (ATF) Transmission Fluid X-2-QDX	MERCON®
<b>Fluid Capacities<sup>b</sup></b>	
20 plate oil-to-air cooler	16.1L (17.1 quarts)
26 plate oil-to-air cooler	16.7L (17.7 quarts)
<b>Fluid Filter</b>	
Inline Transmission Fluid Filter Kit XC3Z-7B155-AA	—
Inline Transmission Fluid Filter XC3Z-7B155-BA	—
<b>Lubricants</b>	
Silicone Brake Caliper Grease and Dielectric Compound XG-3	ESE-M1C171-A
Multi-Purpose Grease XG4	ESR-M1C159-A

<sup>a</sup> CAUTION: Using a transmission fluid that indicates a dual usage (MERCON ® and MERCON ®V) in a transmission application requiring only MERCON®, may cause transmission damage. Use of any fluid other than the recommended fluid may cause transmission damage.

NOTE: Refer to the fluid level indicator and the Owner's Guide for the type of transmission fluid required. Some fluid labels may indicate dual usage such as MERCON® and MERCON ®V. These dual-usage fluids are not to be used in transmissions that use only the MERCON® type fluid. These dual-usage fluids may be used in transmissions that require MERCON ®V use.

<sup>b</sup> The above fluid capacities are approximate dry fill capacity and include fluid coolers and fluid cooler tubes. Fluid level indicator should be used to determine actual fluid requirement and fluid specifications. Check level at operating temperature. DO NOT OVERFILL. The transmission fluid should be changed every 30,000 miles (48,000 km) regardless of normal or special operating conditions. 5.4L applications with in-tank coolers and OTA may require an additional few ounces.

Band and Clutch Application Chart A							
Gear	Friction Elements						
	Intermediate Band	Coast	Overdrive	Intermediate	Direct	Forward	Reverse
(D)	—	<sup>a b</sup>	—	—	—	apply	—

First							
(D) Second	—	<sup>a b</sup>	—	apply	—	apply	—
(D) Third	—	<sup>a b</sup>	—	apply	apply	apply	—
(D) Fourth	—	—	apply	apply	apply	apply	—
1	—	apply	—	—	—	apply	apply
2	apply	apply	—	apply	—	apply	—
Reverse	—	apply	—	—	apply	—	apply

<sup>a</sup> In (D) range with the transmission control switch pressed, the coast clutch is applied and the overdrive one-way clutch is bypassed.

<sup>b</sup> On certain applications in (D) range, the coast clutch solenoid and clutch is controlled by the PCM.

Band and Clutch Application Chart B						
Gear	One-Way Clutches					
	Overdrive		Intermediate		Low	
	Drive	Coast	Drive	Coast	Drive	Coast
(D) First	HOLD	<sup>a b</sup>	—	—	HOLD	O/R
(D) Second	HOLD	<sup>a b</sup>	HOLD	O/R	O/R	OFF
(D) Third	HOLD	<sup>a b</sup>	O/R	O/R	O/R	O/R
(D) Fourth	O/R	O/R	O/R	O/R	O/R	O/R
1	HOLD	CC	—	—	HOLD	—
2	HOLD	CC	HOLD	BA	O/R	O/R
Reverse	HOLD	CC	O/R	O/R	—	—

<sup>a</sup> In (D) range with the transmission control switch pressed, the coast clutch is applied and the overdrive one-way clutch is bypassed.

<sup>b</sup> On certain applications in (D) range, the coast clutch solenoid and clutch is controlled by the PCM.

O/R — Overrunning

CC — Coast Friction Clutch Applied

BA — Band Applied

Shift Speed — Approximate\* Km/h (MPH) (F-250, F-350, Excursion with 5.4L Over 8500 GVW Rating)

Throttle Position	Range	Shift	Vehicle Speed <sup>a</sup>	
			Axle Ratio	
			3.73	4.10
Closed Throttle	(D), D	4-3	64-68 (40-42)	58-61 (36-38)
	(D), D	3-2	26-29 (16-18)	24-27 (15-17)
	(D), D	2-1	14-18 (9-11)	13-16 (8-10)
Light Throttle TP Voltage 1.25 Volts	(D), D	1-2	16-19 (10-12)	14-18 (9-11)
	(D), D	2-3	27-31 (17-19)	26-29 (9-11)
	(D), D	3-4	66-69 (41-43)	60-63 (37-39)
	(D), D	4-3	64-68 (40-42)	58-61 (36-38)
	(D), D	3-2	26-29 (16-18)	24-27 (15-17)
	(D), D	2-1	14-18 (9-11)	13-16 (8-10)
Wide Open Throttle	(D), D	1-2	69-72 (43-45)	63-66 (39-41)
	(D), D	2-3	114-117 (71-73)	103-106 (64-66)
	(D), D	4-3	163-166 (101-103)	148-151 (92-94)
	(D), D	3-2	105-108 (65-67)	97-100 (60-62)
	(D), D	2-1	60-63 (37-39)	55-58 (34-36)

<sup>a</sup> Nominal shift speed at sea level is shown. Actual shift speed will depend on tire brand, size and axle ratio.

Shift Speed — Approximate\* Km/h (MPH) (F-250, F-350, F-450 Excursion, Series Super Duty with 6.8L)

Throttle Position	Range	Shift	Vehicle Speed <sup>a</sup>		
			Axle Ratio		
			3.73	4.30	4.88
Closed Throttle	(D), D	4-3	53-55 (33-34)	47-48 (29-30)	40-42 (25-26)
	(D), D	3-2	29-30 (18-19)	26-27 (16-17)	23-24 (14-15)
	(D), D	2-1	14-16 (9-10)	13-14 (8-9)	11-14 (7-8)
Light Throttle TP Voltage 1.25 Volts	(D), D	1-2	21-23 (13-14)	18-19 (11-12)	16-18 (10-11)
	(D), D	2-3	37-39 (23-24)	31-32 (19-20)	27-29 (17-18)
	(D), D	3-4	55-56 (34-35)	48-50 (30-31)	42-43 (26-27)
	(D), D	4-3	53-55 (33-34)	47-48 (29-30)	40-42 (25-26)
	(D), D	3-2	29-31 (18-19)	26-27 (16-17)	23-24 (14-15)
	(D), D	2-1	14-16 (9-10)	13-14 (8-9)	11-13 (7-8)



Wide Open Throttle	(D), D	1-2	64-66 (40-41)	56-58 (35-36)	48-50 (30-31)
	(D), D	2-3	126-127 (78-79)	108-109 (67-68)	95-97 (59-60)
	(D), D	3-4	193-196 (120-122)	169-171 (105-106)	148-150 (92-93)
	(D), D	4-3	185-187 (115-116)	161-163 (100-101)	142-143 (88-89)
	(D), D	3-2	108-109 (67-68)	93-95 (58-59)	82-84 (51-52)
	(D), D	2-1	60-61 (37-38)	51-53 (32-33)	45-47 (28-29)

<sup>a</sup> Nominal shift speed at sea level is shown. Actual shift speed will depend on tire brand, size and axle ratio.

Shift Speed — Approximate* Km/h (MPH) (F-250, F-350, F450, F550, Super Duty with 7.3L DITD)						
Throttle Position	Range	Shift	Vehicle Speed <sup>a</sup>			
			Axle Ratio			
			3.73	4.10	4.30	4.88
Closed Throttle	(D), D	4-3	66-72 (41-44)	60-65 (37-40)	51-56 (32-34)	45-49 (28-30)
	(D), D	3-2	27-29 (17-18)	24-26 (15-16)	22-24 (14-15)	20-21 (12-13)
	(D), D	2-1	13-14 (8-9)	12-13 (7-8)	11-12 (7-8)	10-11 (6-7)
Light Throttle	(D), D	1-2	25-27 (15-17)	22-24 (14-15)	23-25 (14-16)	21-22 (13-14)
	(D), D	2-3	44-48 (27-30)	40-43 (25-27)	39-42 (24-26)	35-37 (21-23)
	(D), D	3-4	75-81 (46-50)	67-73 (42-45)	69-75 (43-46)	61-66 (38-41)
TP Voltage 1.25 Volts	(D), D	4-3	66-72 (41-44)	60-65 (37-40)	51-56 (23-34)	45-49 (28-30)
	(D), D	3-2	27-29 (17-18)	24-26 (15-16)	22-24 (14-15)	20-21 (12-13)
	(D), D	2-1	13-14 (8-9)	12-13 (7-8)	11-12 (7-8)	10-11 (6-7)
Wide Open Throttle	(D), D	1-2	45-49 (28-30)	41-44 (25-27)	38-41 (24-26)	34-37 (21-23)
	(D), D	2-3	80-87 (50-54)	72-78 (45-48)	68-74 (42-46)	60-65 (37-40)
	(D), D	3-4	123-134 (76-83)	111-120 (69-75)	105-113 (65-70)	92-100 (57-62)
	(D), D	4-3	114-124 (71-77)	103-111 (64-69)	97-105 (60-65)	86-93 (53-57)
	(D), D	3-2	74-80 (46-49)	66-72 (41-45)	63-68 (39-42)	55-60 (34-37)
	(D), D	2-1	34-37 (21-23)	31-33 (19-21)	31-33 (19-21)	27-29 (17-18)

<sup>a</sup> Nominal shift speed at sea level is shown. Actual shift speed will depend on tire brand, size and axle ratio.

Forward Clutch Pack					
Clutch	Steel	Friction	Clearance mm (Inch)	Selective Snap Rings	
				Part Number	Thickness mm (Inch)
All	4 <sup>a</sup>	4	1.40-0.76 (0.055-0.030)	377437-S	1.42-1.52 (0.056-0.060)
				377127-S	1.88-1.98 (0.074-0.078)

				377444-S	2.34-2.44 (0.092-0.096)
				386841-S	2.79-2.90 (0.110-0.114)
				386842-S	3.25-3.35 (0.128-0.132)

<sup>a</sup> Plus a steel wave cushion spring installed between the front pressure plate and a steel separator plate.

Direct Clutch Pack					
Clutch	Steel	Friction	Clearance mm (Inch)	Selective Snap Rings	
				Part Number	Thickness mm (Inch)
All except 7.3L	4	4	2.06-1.14 (0.081-0.045)	377128-S	2.21-2.11 (0.087-0.083)
				377127-S	1.524-1.42 (0.06-0.056)
7.3L DI Diesel	5	5		377126-S	1.75-1.65 (0.069-0.065)

Intermediate Clutch Pack					
Clutch	Steel	Friction	Clearance mm (Inch)	Selective Snap Rings	
				Part Number	Thickness mm (Inch)
All	3 <sup>a</sup>	3	—	E9TP-7B421-BA <sup>b</sup>	1.80-1.90 (0.071-0.075)

<sup>a</sup> Plus one apply plate.

<sup>b</sup> A non-selective snap ring.

Coast Clutch Pack					
Clutch	Steel	Friction	Clearance mm (Inch)	Selective Snap Rings	
				Part Number	Thickness mm (Inch)
All applications	2	2		F81-7N169-BA	1.90-1.80 (0.075-0.071)
				F81-7N169-CA	1.65-1.55 (0.065-0.061)
				F81-7N169-DA	1.37-1.27 (0.054-0.050)
	3	3	1.09-0.74 (0.043-0.029)		

Low/Reverse Clutch Pack					
Clutch	Steel	Friction	Clearance mm (Inch)	Selective Snap Rings	
				Part Number	Thickness mm (Inch)
5.4L, 6.8L	5 <sup>a</sup>	5	2.90-0.30 (0.114-0.012)	N805207-S <sup>b</sup>	1.88-1.98 <sup>c</sup> (0.074-0.078) <sup>b</sup>
7.3L DI Diesel	6 <sup>c</sup>	6	2.67-0.30 (0.105-0.012)		

<sup>a</sup> Plus a steel wave cushion spring installed between the reverse clutch piston and a steel separator plate.

<sup>b</sup> Plus one apply plate.

<sup>c</sup> Plus a steel wave cushion spring installed between the front pressure plate and a steel separator

plate.

Overdrive Clutch Pack					
Clutch	Steel	Friction	Clearance mm (Inch)	Selective Snap Rings	
				Part Number	Thickness mm (Inch)
5.4L 2V	2	2	1.19-0.56 (0.047-0.022)	E9TP-7B421-EA	3.61-3.51 (0.142-0.138)
				E9TP-7B421-DA	3.10-3.00 (0.122-0.118)
				E9TP-7B421-CA	2.59-2.49 (0.102-0.098)
				E9TP-7B421-BA	2.06-1.96 (0.081-0.077)
5.4L 2V, 5.4L SC, 6.8L, 7.3L Diesel	3	3	1.50-0.84 (0.059-0.033)	E9TP-7B421-AA	1.55-1.45 (0.061-0.057)

Gear Ratio	
Gear	Ratio
1st	2.71 to 1
2nd	1.54 to 1
3rd	1.00 to 1
4th	0.71 to 1
Reverse	2.18 to 1

Torque Specifications			
Description	Nm	lb-ft	lb-in
Center support fluid feed bolt (two rear)	16	12	—
Cooler bypass valve (CBV) fitting to case (front)	30	22	—
Cooler bypass valve (CBV) fitting to case (rear)	37	27	—
Cooler line fitting to CBV (front and rear)	27	20	—
Connector — radiator nipple	23-31	17-23	—
Connector, radiator-to-tube	24-30	18-22	—
Connectors, radiator-to-tube	27-31	20-23	—
Auxiliary cooler tube	11-14	8-10	—
Auxiliary cooler tube	22-30	16-22	—

Control assembly to pump	24-31	18-23	—
Torque converter drain plug	24-27	18-20	—
Flexplate inspection cover (7.3L diesel)	20	15	—
Flexplate inspection cover to case, except 7.3L	34	25	—
Extension housing to case	41-54	30-40	—
Transmission insulator and retainer-to-case	81-108	60-80	—
Transmission insulator and retainer-to-crossmember (rear mount)	94	69	—
Torque converter-to-flexplate nut	35	26	—
Inner manual valve detent lever nut	47	35	—
Low/reverse OWC inner race to case	24-34	18-25	—
Line pressure to case — plug	8-16	6-12	—
Main and lower control body to case	9-11	—	80-100
Main accumulator and solenoid body to case	9-11	—	80-100
Digital transmission range sensor	8-10	—	75-85
Intermediate/overdrive cylinder fluid feed bolt (front)	16	12	—
Transmission pan to case	15	11	—
Pump body to case	24-31	18-23	—
Parking pawl abutment to case	25	18	—
Parking rod guide plate to case	25	18	—
Manual control valve detent lever spring to case	10	—	89
Reinforcing plate to case	9-11	—	80-100
Stator support to pump body	9-11	—	80-100
Transmission to engine	47	35	—
Transmission to engine (7.3L diesel)	61	45	—
Transmission support crossmember-to-frame	81	60	—
Output shaft speed (OSS) sensor	8-10	—	70-88
Turbine shaft speed (TSS) sensor	8-10	—	70-88

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### Transmission Description—4R100

The 4R100 features include:

- four speeds.
- fully automatic.
- electronically controlled.
- optional power take-off.

The main operating components include:

- Torque converter clutch.
  - Six multiple-disc friction clutches.
  - One band.
  - One sprag one-way clutch.
  - Two roller one-way clutches that provide for the desired function of three planetary gearsets.
- 

### Identification Tags

An identification tag is located on the left side of the transmission case (7005), rearward of the digital transmission range (TR) sensor.



Item	Description
1	Assembly Part Number Prefix and Suffix
2	Transmission Model
3	Serial
4	Build Date (Year, Month and Day).

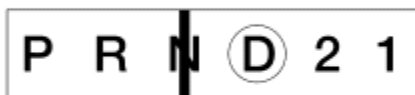
SECTION 307-01: Automatic  
Transaxle/Transmission  
DESCRIPTION AND OPERATION

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## Range Selection

The transmission has six range positions: P, R, N, [circled ], 2 and 1.



GD0065-A

## Park

In the Park position:

- There is no powerflow through the transmission.
- The parking pawl locks the output shaft to the case.
- The engine may be started.
- The ignition key may be removed.

## Reverse

In the Reverse position:

- The vehicle may be operated in a rearward direction, at a reduced gear ratio.

## Neutral

In the Neutral position:

- There is no powerflow through the transmission.
- The output shaft is not held and is free to turn.
- The engine may be started.

## **Overdrive**

Overdrive is the normal position for most forward driving.

The Overdrive position provides:

- Automatic shifts.
- Apply and release of the torque converter clutch.
- Maximum fuel economy during normal operation.

## **Second Position—2nd Gear**

This position provides:

- Second gear start and hold.
- The torque converter clutch may apply and release.
- Improved traction and engine braking on slippery roads.

## **First Position**

If this position is selected at normal road speeds, the transmission will shift into second gear, then into first when the vehicle reaches a speed within 1st gear range.

This position provides:

- First gear operation only.
- Engine braking for descending steep grades.

## **Shift Patterns**

### **Upshifts**

Transmission upshifting is controlled by the powertrain control module (PCM). The PCM receives inputs from various engine or vehicle sensors and driver demands to control shift scheduling, shift feel and torque converter clutch (TCC) operation.

## **Downshifts**

Under certain conditions the transmission will downshift automatically to a lower gear range (without moving the transmission range selector lever). There are three categories of automatic downshifts; Coastdown, Torque Demand and Forced or Kickdown shifts.

### **Coastdown**

The coastdown downshift occurs when the vehicle is coasting down to a stop.

### **Torque Demand**

The torque demand downshift occurs (automatically) during part throttle acceleration when the demand for torque is greater than the engine can provide at that gear ratio.

### **Kickdown**

For maximum acceleration, the driver can force a downshift by pressing the accelerator pedal to the floor. A forced downshift into a lower gear is possible below calibrated speeds. Specifications for downshift speeds are subject to variations due to tire size, engine and transmission calibration requirements.

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SECTION 307-01: Automatic  
Transaxle/Transmission  
DESCRIPTION AND OPERATION

1999 F-Super Duty 250-550 Workshop  
Manual

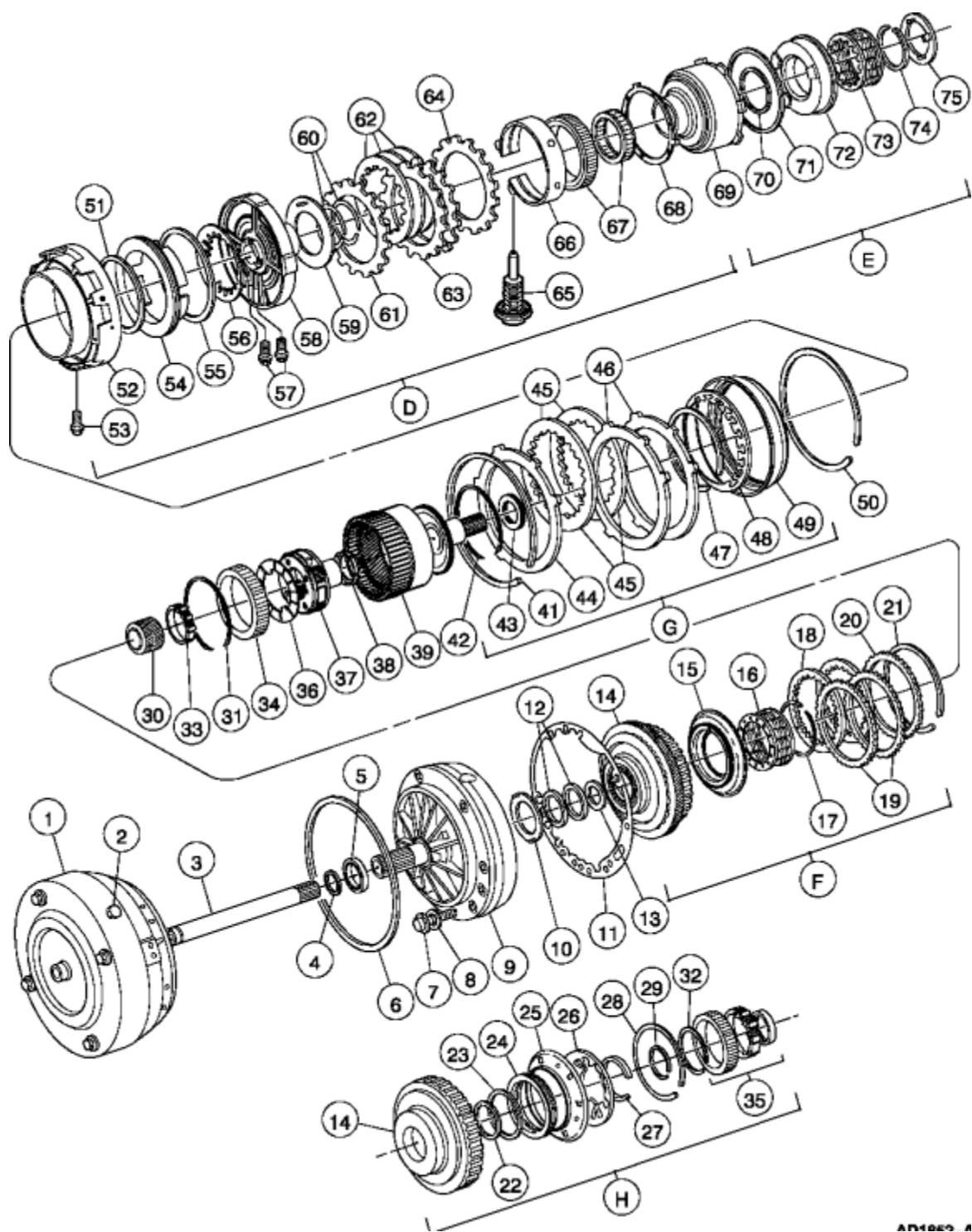
[Procedure revision date: 01/26/2000](#)

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## **Disassembled Views**

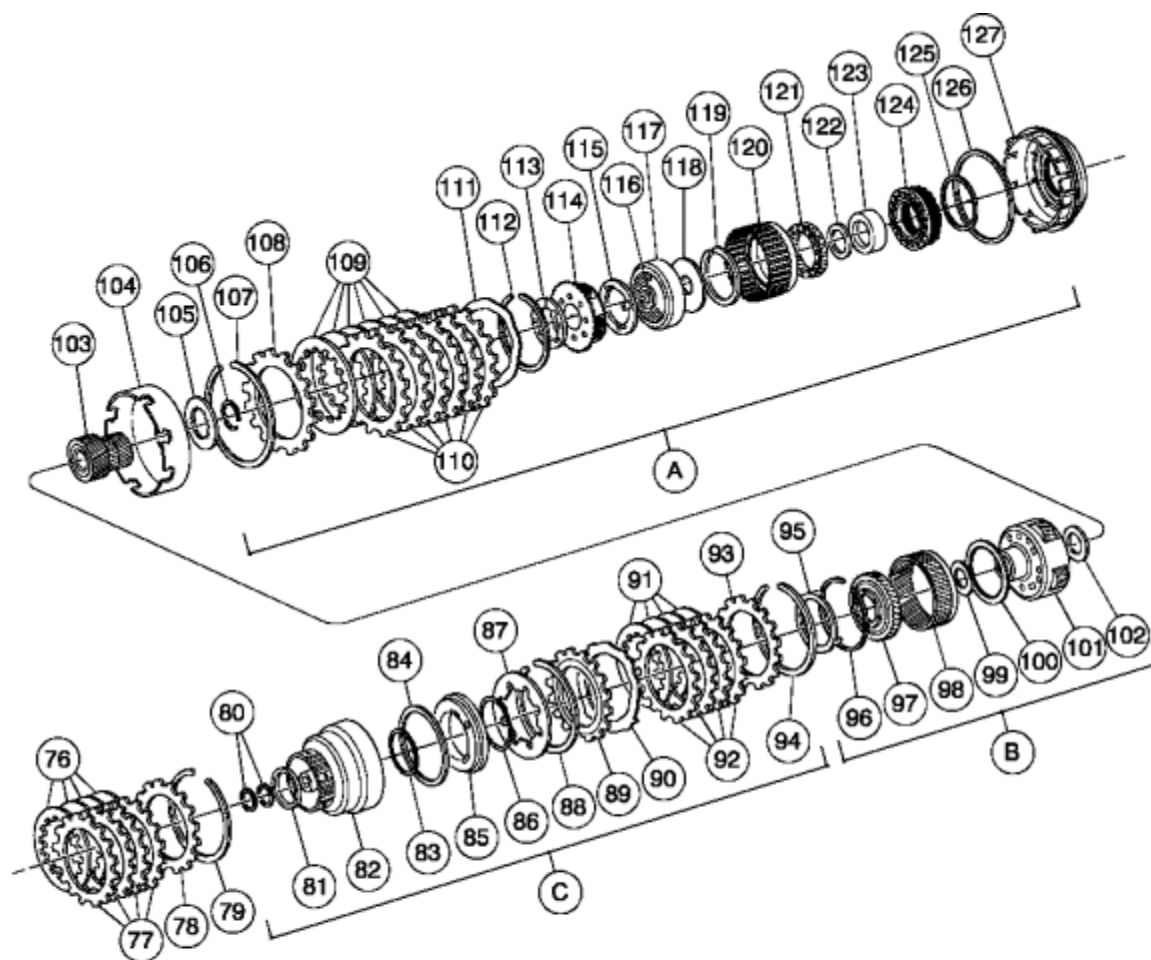
**Transmission, Disassembled View**





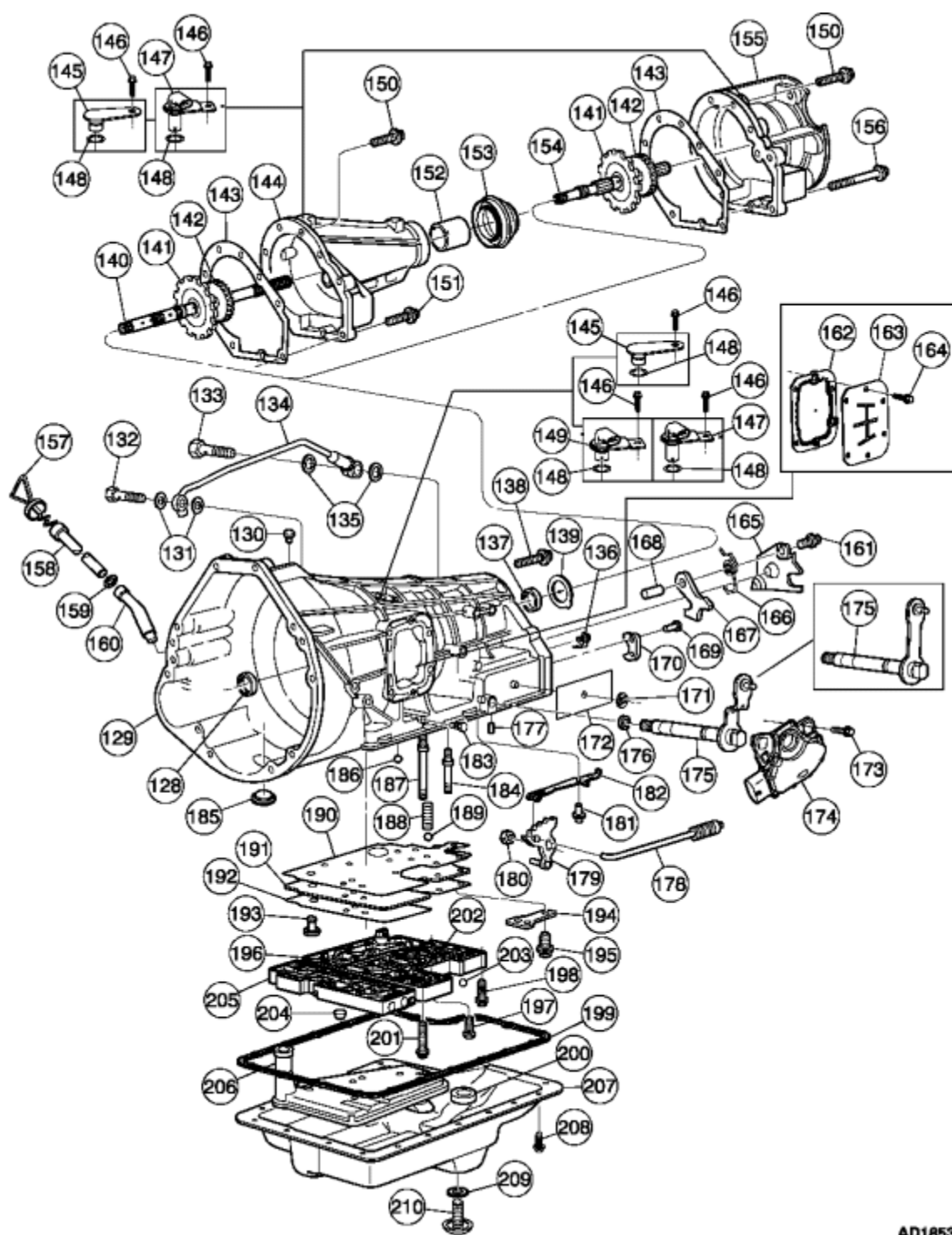
AD4025.1

Transmission, Disassembled View



AD1851-A

Transmission, Disassembled View



AD1853-A

Item	Part Number	Description
1	7902	Converter Assy (Model Dependent)
2	87650-S2	Plug — Converter Drain 1/18 in — 27 x .37
3	7017	Shaft — Input
4	7L323	Seal — Front Pump Support
5	7A248	Seal — Front Pump

6	7A248	Seal — Front Pump Square Cut OD
7	N805260-S	Screw and Washer Assy — Front Pump to Case
8	7G379	Washer — Replacement (9 Req'd)
9	7A103	Pump Assy — Front (Model Dependent)
10	7D014	Washer — Front Pump Support Thrust No. 1 (Model Dependent)
11	7A136	Gasket — Front Pump
12	7G402	Seal — Coast Clutch Ring — Teflon (2 Req'd)
13	7E486	Bearing Assy — Overdrive Sun Gear No. 2 (Model Dependent)
14	7G387	Cylinder Assy — Coast Clutch (Model Dependent)
15	7A262	Piston and Seal Assy — Coast Clutch (Model Dependent)
16	7B070	Spring — Coast Clutch Piston Disc (Model Dependent)
17	7A527	Ring — Coast Clutch Spring Retainer (Model Dependent)
18	7B164	Plate — Coast Clutch Internal Spline — Friction
19	7B442	Plate — Coast Clutch External Spline — Steel
20	7B437	Plate — Coast Clutch Pressure
21	7D483	Ring — Coast Clutch Press Plate Retaining (Sel Fit) (Model Dependent)
22	7A548	Seal — Coast Clutch — Inner (Model Dependent)
23	7A548	Seal — Coast Clutch — Outer (Model Dependent)
24	7G419	Piston — Coast Clutch (Model Dependent)
25	7N519	Ring — Coast Clutch Piston Apply (Model Dependent)
26	7B070	Spring — Coast Clutch Piston Disc (Model Dependent)
27	N804949-S	Retainer — Coast Clutch Disc Spring (Model Dependent)
28	N804950-52-S	Ring — Coast Clutch Press Plate Retaining (Sel Fit) (Model Dependent)
29	377300-S	Ring — Retaining (Model Dependent)
30	7D063	Gear Assy — Overdrive Sun
31	7G375	Ring — Retaining Flat (Outer Race to Overdrive Ring Gear)
32	377135	Ring — Retaining (Overdrive OWC to Outer Race) (Model Dependent)
33	7A089	Clutch Assy — Overdrive One-Way
34	7G389	Race — Overdrive One-Way Clutch — Outer
35	7A089	Clutch Assy — Overdrive One-Way
36	7L339	Washer — Overdrive — One-Way Clutch No. 3
37	7B446	Planet Assy — Overdrive
38	7F240	Bearing Assy — Thrust No. 4
39	7A153	Gear — Overdrive Ring
40	7A658	Shaft — Overdrive Center

41	7D483	Ring — Overdrive Retaining (Sel Fit)
42	7G375	Ring — Wavy Retaining (Center Shaft to Overdrive Ring Gear)
43	7G178	Bearing Assy — Center Shaft No. 5
44	7B066	Plate — Overdrive Clutch Pressure
45	7B164	Plate — Overdrive Clutch Internal Spline — Friction (Model Dependent)
46	7B442	Plate — Overdrive Clutch External Spline — Steel
47	7A527	Ring — Overdrive Clutch Disc Spring Retaining
48	7B070	Spring — Overdrive Clutch Piston Disc
49	7A262	Piston and Seal Assy — Overdrive Clutch (Bonded)
50	7D483	Ring — Intermediate Cylinder Retaining
51	7F225	Seal — Intermediate Clutch Piston (Inner)
52	7G384	Cylinder — Intermediate and Overdrive Clutch
53	7Z059	Bolt — M10-1.5 x 24 mm Overdrive Cylinder Fluid Feed
54	7E005	Piston — Intermediate Clutch
55	7F224	Seal — Intermediate Clutch Piston — Outer
56	7B070	Spring — Intermediate Clutch Piston Disc
57	7Z059	Bolt — M12-1.75 x 31 mm Center Support Fluid Feed (2 Req'd)
58	7A130	Support Assy — Center
59	7L326	Washer — Center Support Thrust No. 6
60	7D025	Seal — Direct Clutch Cast Iron (2 Req'd)
61	7B066	Plate — Intermediate Clutch Apply
62	7B164	Plate — Intermediate Clutch Internal Spline
63	7B442	Plate — Intermediate Clutch External Spline
64	7B066	Plate — Intermediate Clutch Pressure
65	7D021	Servo Assy — Intermediate Brake Band
66	7D034	Band Assy — Intermediate
67	7A089	Clutch Assy — Intermediate One-Way
68	7G401	Washer — Interm One-Way Clutch — Thrust No. 7
69	7D044	Drum Assy — Intermediate Brake
70	7A548	Seal — Direct Clutch Inner
71	7A548	Seal — Direct Clutch Outer
72	7A262	Piston Assy — Direct Clutch
73	7F235	Retainer and Spring Assy — Direct Clutch
74	7C122	Ring — Direct Clutch Support Spring Retaining
75	7C096	Washer — Intermediate Brake Drum Thrust No. 8A
76	7B164	Plate — Direct Clutch Internal Spline — Friction

77	7B442	Plate — Direct Clutch External Spline — Steel
78	7B066	Plate — Direct Clutch Pressure
79	377126-S	Ring — Direct Clutch Pressure Plate Retaining (Selective Fit)
79	377127-S	Ring — Retaining
79	377128-S	Ring — Direct Clutch Pressure Plate Retaining (Selective Fit)
79	377437-S	Ring — Direct Clutch Pressure Plate Retaining (Selective Fit)
80	7D019	Seal — Forward Clutch Cylinder (2 Req'd)
81	7F374	Bearing Assy — Forward Clutch Cylinder Thrust No. 8B
82	7A360	Cylinder Assy — Forward Clutch
83	7A548	Seal — Forward Clutch Piston — Inner
84	7A548	Seal — Forward Clutch Piston — Outer
85	7A262	Piston Assy — Forward Clutch
86	7D256	Ring — Piston Apply
87	7B070	Spring — Piston Return
88	377127-S	Ring — Retaining Forward Clutch Spring (FWD CL Piston Spring to FWD CL Cylinder Assy)
89	7B066	Plate — Forward Clutch Pressure
90	7E085	Spring — Forward Clutch Wave
91	7B164	Plate — Forward Clutch Internal Spline — Friction
92	7B442	Plate — Forward Clutch External Spline — Steel
93	7B066	Plate — Forward Clutch Pressure Rear
94	377127-S	Ring — Forward Clutch Pressure Plate Retaining (Selective Fit)
94	377437-S	Ring — Retaining
94	377444-S	Ring — Retaining
94	386841-S	Ring — Retaining
94	386842-S	Ring — Retaining
95	7D090	Washer — Forward Clutch Hub — Thrust No. 8C
96	377132-S	Ring — Forward Hub Retaining (FWD Ring Gear Hub to FWD Ring Gear)
97	7B067	Hub — Forward Ring Gear
98	7D392	Gear — Forward Ring
99	7D234	Bearing Assy — Forward Clutch Thrust (Between FWD Ring Gear and FWD Planet Assy) No. 9A
100	7A166	Bearing Assy — Forward Planet Carrier — Thrust No. 10A
101	7A398	Planet Assy — Forward
102	7D234	Bearing Assy — Forward Clutch Thrust (Between FWD Planet Assy and FWD Sun Gear Assy) No. 9B

103	7D063	Gear Assy — Forward/Reverse Sun
104	7D064	Shell — Input
105	7D066	Washer — Input Shell Thrust No. 14
106	377300-S	Ring — Retaining (Attaches FWD/REV Sun Gear Assy to Input Shell)
107	7D483	Ring — Reverse Clutch Pressure Plate — Retaining
108	7B066	Plate — Reverse Clutch Pressure
109	7B164	Plate — Reverse Clutch Internal Spline — Friction
110	7B442	Plate — Reverse Clutch External Spline — Steel
111	7E085	Spring — Trans Reverse Clutch Cushion
112	377155-S	Ring — Reverse Planet Retaining
113	7A166	Washer — Planet Carrier Thrust (Between Reverse Planet Assy and Input Shell) No. 10B
114	7D006	Planet Assy — Reverse
115	7A166	Washer — Planet Carrier — Thrust (Between Reverse Planet Assy and Output Shaft Hub) No. 11
116	387031-S	Ring — Retaining (Retaining Output Shaft Hub to Output Shaft Assy)
117	7A153	Gear — Output Shaft Ring
118	7D164	Hub — Output Shaft <sup>a</sup>
119	377132-S	Ring — Retaining (Retaining Output Shaft Hub to Output Shaft Ring Gear)
120	7B067	Hub Assy — Reverse Clutch
121	7A089	Clutch Assy — Reverse One-Way
122	7G178	Low/Reverse One-Way Clutch Inner Race Thrust Bearing Assy No. 12
123	7D171	Race-Low Reverse One Way Inner
124	7D406	Retainer and Spring Assy — Reverse Clutch
125	7D404	Seal — Reverse Clutch Piston — Inner
126	7D403	Seal — Reverse Clutch Piston — Outer
127	7D402	Piston — Reverse Clutch
128	7025	Bushing — Case — Front (3 Lube Grooves)
129	7005	Case Assy
130	7034	Vent Assy — Case
131	391933-S100	Sealing Washers — Case Outlet (Part of 7H322 CBV Assy)
132	7Z152	Cooler Line — Case Fitting (Part of 7H322 CBV Assy) (Model Dependent)
133	7G118	Cooler Line — Case Fitting (Part of 7H322 CBV Assy) (Model Dependent)
134	7H322	Valve Assy — Trans Cooler Bypass <sup>b</sup>
135	391932-S100	Sealing Washers — Case Outlet (Part of 7H322 CBV Assy) (Model Dependent) (2 Req'd)
136	7E380	Plug — Case Fluid Filler



137	7025	Bushing — Case — Rear (1 Lube Groove)
138	7D167	Bolt, 5/16 x 1.9 (One-Way Clutch to Case) (5 Req'd)
139	7B368	Washer — Parking Gear Thrust — Rear No. 13
140	7060	Output Shaft Assy
141	7A233	Gear — Output Shaft — Parking
142	7H150	Wheel — Tone
143	7086	Gasket — Extension Housing
144	7A039	Extension Housing
145	7H183	Plug Assy — Case (Model Dependent)
146	N605769-S101	Bolt — M6 — 1 x10 Hex Flange
147	7M101	Sensor — Turbine/Output Shaft Speed (TSS/OSS)
148	N811757-S100	O-Ring — Sensor
149	7M101	Sensor — Turbine Speed (TSS)
150	N605803-S427	Bolt — Extension Assy to Case (Top) (7 Req'd)
151	N605802-S427	Bolt — Extension Housing to Case (Bottom) (2 Req'd)
152	7A034	Bushing — Extension Housing (4 x 2)
153	7052	Seal — Extension Housing (4 x 2)
154	7060	Output Shaft Assy (4x4)
155	7A039	Extension Assy (4x4) and Super Duty
156	N606569-S427	Bolt — Ext Assy to Case (Super Duty & 4x4 Bottom) (2 Req'd)
157	7A020	Indicator Assy — Fluid Level
158	7A228	Tube Assy — Fluid Filler
159	391308-S	O-Ring — Filler Tube
160	7A160	Tube Fluid Inlet — Short
161	N805232-S	Screw and Washer Assy M8-1.25 x 23.8 (Attaches 7D419 to 7005)
162	7223	PTO — Cover Gasket
163	7222	PTO — Case Cover
164	N605799-S100	M10 x 1.5 x 20 Hex Flange Head (Attaches PTO Cover to Case)
165	7D419	Plate — Parking Rod Guide
166	7D070	Spring — Parking Pawl Return
167	7A441	Pawl — Parking
168	387640-S	Shaft — Park Pawl



169	N805261-S191	Bolt — M8-1.25 x 25.9 mm (Attaches Park Pawl Act Abutment to Case)
170	7G101	Abutment — Parking Pawl Actuating
171	372552-S2	Nut — 3/8 Spring (Attaches Service ID Tag to Case)
172	7B148	Tag — Transmission Service ID <sup>c</sup>
173	N811382-S100	Bolt Assy — Transmission Range Sensor to Case (2 Req'd)
174	7F293	Sensor Assembly — Trans Range
175	7A256	Lever Assy — Manual Control
176	7B498	Seal — Manual Control Lever
177	7B210	Pin — Manual Lever Retaining
178	7A232	Rod Assy — Parking Pawl Actuating
179	7A115	Lever — Manual Control Valve Detent — Inner
180	N800287-S36	Nut M14-1.5 Hex Inner Detent Lever (7A115 to 7A256)
181	N805503-S	Bolt — Manual Valve Detent Spring Assy to Case
182	7E332	Spring Assy — Manual Valve Detent
183	390685-S	Plug — Test Port — 1/8-27 Hex-Head <sup>c</sup>
184	N805330-S	Stud — Valve Body Assy to Case — Solenoid Valve Body to Case — Accumulator Body Assy to Case
185	7N171	Plug — Converter Access
186	7E195	Ball — Rubber Check (8 Req'd)
187	N805331-S	Stud — Main Control Assy to Case
188	7D017	Spring — EPC Blow-Off
189	353078-S	Ball — EPC Blow-Off
190	7C155	Gasket — Valve Body Separator Plate
191	7A008	Plate — Valve Body Separator
192	7D100	Gasket — Valve Body Separator Plate to Case
193	7G308	Screen Assy — Solenoid
194	7F282	Plate — Valve Body Reinforcing <sup>c</sup>
195	N805503-S	Bolt — Valve Body Reinforcing Plate to Case (3 Req'd)
196	7G391	Solenoid Valve Body — Transmission Control
197	N805329-S	Bolt — Solenoid Valve Body to Case (9 Req'd)
198	N805326-S	Bolt — Valve Body Assy to Case and Accumulator Body Assy to Case (18 Req'd)
199	7A191	Reusable Gasket — Transmission Pan
200	7L027	Magnet — Transmission Pan <sup>c</sup>

201	N805327-S	Bolt — Valve Body Assy to Case
202	7A100	Valve Body Assy
204	N805328-S	Nut — Valve Body Assy to Case — Solenoid Valve Body to Case — Accumulator Body Assy to Case
205	7G422	Control Assy — Accumulator Body
206	7A098	Screen and Seal Assy — Transmission (4x4)
207	7A194	Pan Assy — Transmission (4x4)
208	N811266-S427	Bolt — Pan Assy to Case (20 Req'd)
209	7F033	Gasket — Fluid Pan Drain Plug (Model Dependent)
210	7D479	Plug Assembly — Fluid Pan Drain (Model Dependent)
A	—	Reverse Clutch and Planetary
B	—	Forward Clutch Assembly
C	—	Forward Planetary Assembly
D	—	Intermediate Clutch Assembly
E	—	Direct Clutch Assembly
F	—	Coast Clutch Assembly (Model Dependent)
G	—	Overdrive Clutch Assembly
H	—	Coast Clutch Assembly (Model Dependent)

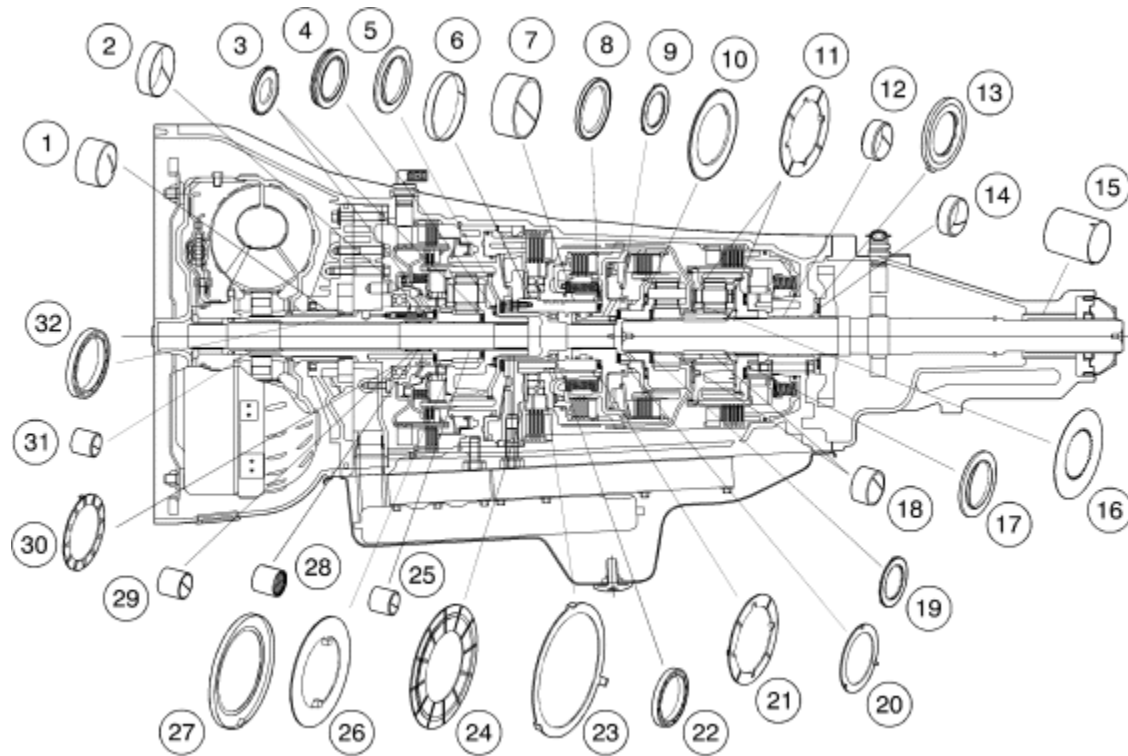
<sup>b</sup> Model dependent.

<sup>c</sup> Not available separately.

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## Bushings, Bearing and Thrust Washer Locator

### Bushings, Bearing and Thrust Washer Locator



AD1849-A

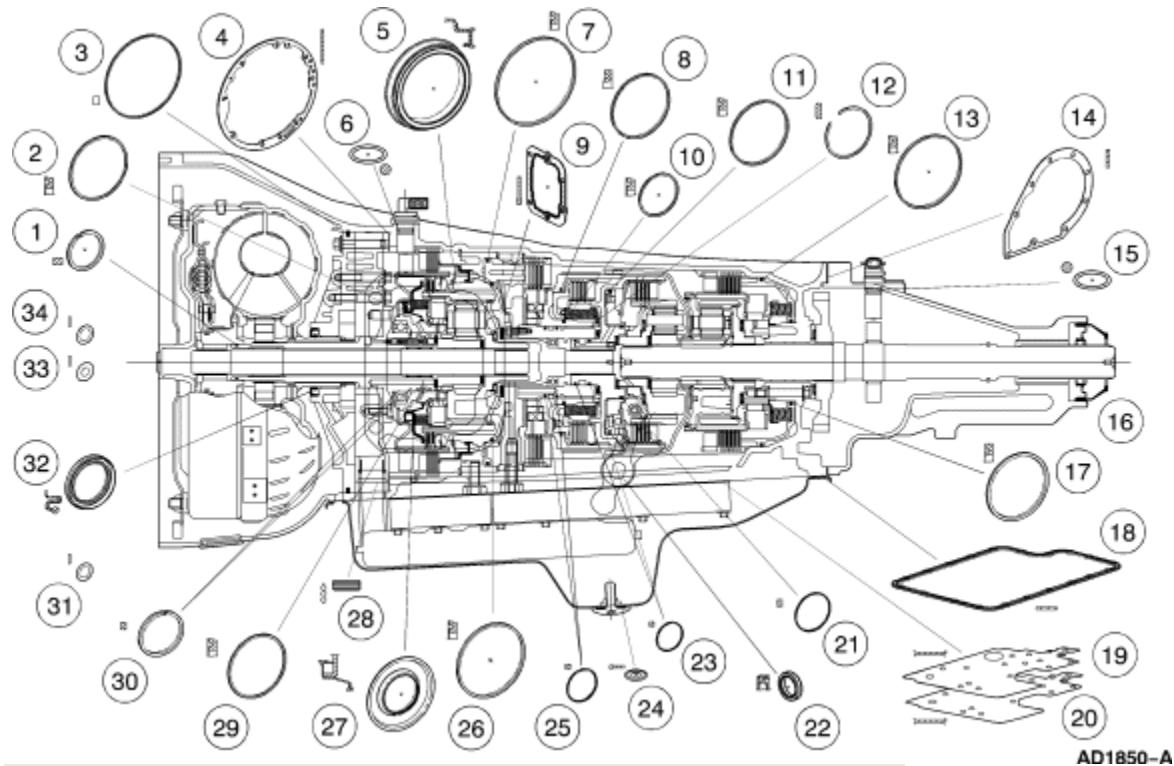
Item	Part Number	Description
1	—	Front Pump Bushing (Part of 7A103)
2	7A620	Coast Clutch Bushing (Part of 7G387) (Model Dependent)
3	7E486	Overdrive Sun Gear (Front/Rear) Thrust Bearing (2A) (2B)
4	7G128	Overdrive Carrier to Center Shaft Thrust Bearing (4)
5	7G178	Center Shaft to Center Support Thrust Bearing (5)
6	—	Intermediate Brake Drum Front Bushing (Part of 7D044)
7	—	Intermediate Brake Drum Rear Bushing (Part of 7D044)

8	7F374	Forward Clutch Hub to Center Support Hub Thrust Bearing (8B)
9	7F078	Forward Carrier (Front) Thrust Bearing (9A)
10	7H334	Planet Carrier Needle Bearing (10A)
11	7D423	Planet Carrier Thrust Washer (10B) (11)
12	7025	Front Case Bushing
13	7B368	Parking Gear Thrust Washer (13)
14	7025	Rear Case Bushing
15	7A034	Extension Housing Bushing
16	7D066	Input Shell Thrust Washer—(14)
17	7G178	Output Shaft Hub Rear Thrust Bearing (12)
18	—	Forward/Reverse (Front/Rear) Sun Gear Bushing (Part of 7D063)
19	7F087	Forward Carrier (Rear) Thrust Bearing (9B)
20	7D090	Forward Clutch Hub Thrust Washer (8C)
21	7D428	Intermediate Brake Drum Thrust Washer (8A)
22	—	Ball Bearing — Center Shaft (Part of 7A130)
23	7G401	One-Way Clutch to Intermediate Brake Drum Thrust Washer (7)
24	7L326	Center Support Thrust Washer— (6)
25	—	Overdrive Sun Gear Bushing (Part of 7D063)
26	7L339	OWC to Overdrive Carrier Thrust Washer (Model Dependent)
27	7L339	OWC to Overdrive Carrier Thrust Washer (Model Dependent)
28	7D018	Front Pump Bearing (Model Dependent)
29	7D018	Front Pump Bushing (Model Dependent)
30	7D014	Front Pump Support Thrust Washer (1)
31	—	Front Pump Support Front Bushing (Part of 7A103)
32	7F401	Grobe Coast Clutch Ball Bearing (Model Dependent)

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## Seals, Rings and Gasket Locator

### Seals, Rings and Gaskets Locator



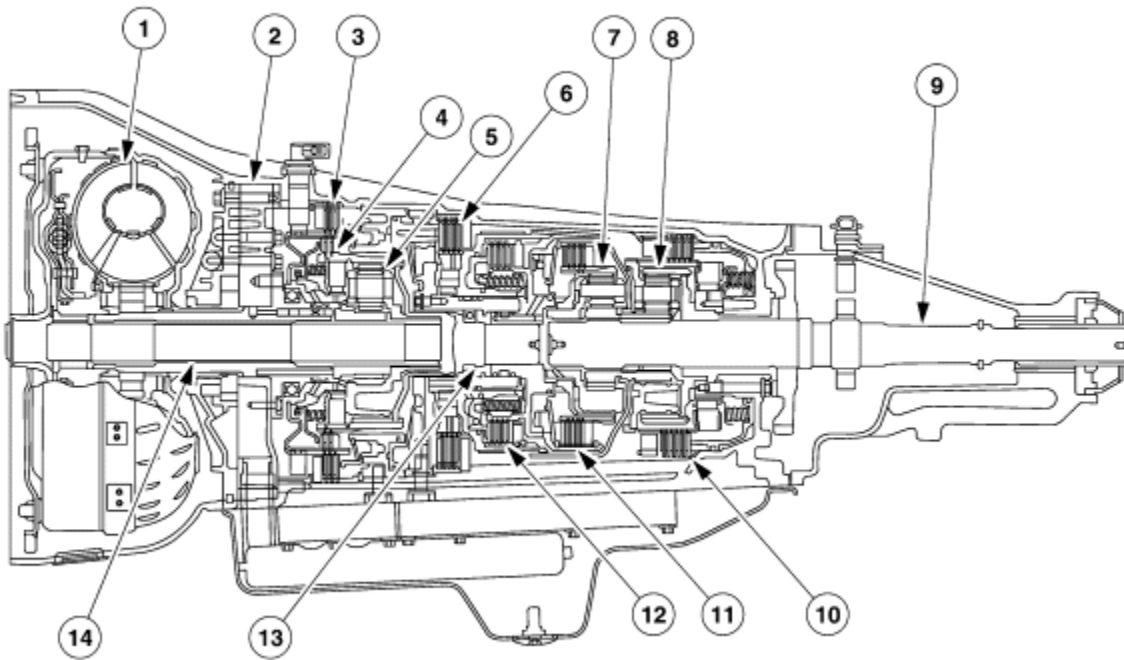
Item	Part Number	Description
1	7L323	Front Pump Stator Support Seal
2	7A548	Coast Clutch Inner Seal
3	7A248	Front Pump Square Cut OD Seal
4	7A136	Pump Gasket
5	7A262	Overdrive Clutch Piston and Seal Assy
6	N811757-S100	TSS O-Ring (Model Dependent)
7	7F224	Intermediate Clutch Piston Outer Seal
8	7A548	Direct Clutch Outer Seal
9	7223	PTO Cover Plate Gasket (Model Dependent)
10	7A548	Direct Clutch Inner Seal
11	7A548	Forward Clutch Piston Outer Seal
12	7C122	Direct Clutch Support Spring Retaining Ring

13	7D403	Reverse Clutch Piston Outer Lip Seal
14	7086	Extension Housing Gasket
16	7052	Extension Housing Seal
17	7D404	Reverse Clutch Piston Inner Lip Seal
18	7A191	Reusable Transmission Pan Gasket
19	7C155	Case to Separator Plate Gasket
20	7D100	Separator Plate to Control Body Gasket
21	7A548	Forward Clutch Piston Inner Seal
22	7B498	Manual Control Lever Seal
23	7D019	Forward Clutch Cylinder Seal (2 Req'd)
24	7F033	Drain Plug Gasket (Model Dependent)
25	7D025	Forward Clutch Seal Cast Iron (2 Req'd)
26	7F225	Intermediate Clutch Piston Inner Seal
27	7A262	Coast Clutch Seal Bonded on Piston (Model Dependent)
28	7Z302	Pump Inlet Seal
29	7A548	Coast Clutch Outer Seal
30	7G402	Coast Clutch Ring Seal, Teflon® (2 Req'd)
31	391308-S	Fluid Filler Tube O-Ring
32	7A248	Front Pump Seal Assy
33	391933-S100	Front CBV Sealing Washer (2 Req'd)
34	391932-S100	Front CBV Sealing Washer (2 Req'd)

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## Main Components and Functions

### Automatic Transmission — Sectional View



AD1869-B

Item	Part Number	Description
1	7902	Torque Converter
2	7A103	Pump Assembly
3	—	Overdrive Clutch
4	—	Coast Clutch
5	7B446	Overdrive Planet Assy
6	—	Intermediate Clutch Assy
7	7A398	Forward Planet Assy
8	7D006	Reverse Planet Assy
9	7060	Output Shaft Assy
10	—	Reverse Clutch
11	—	Forward Clutch Assy
12	—	Direct Clutch Assy

13	7A658	Center Shaft
14	7017	Input Shaft

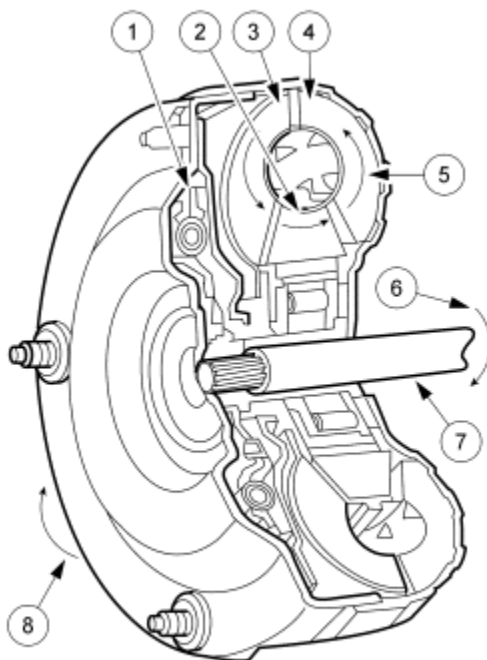
## Torque Converter

The torque converter (7902) transmits and multiplies torque. The torque converter is a four-element device:

- impeller assembly
- turbine assembly
- reactor assembly
- clutch and damper assembly

The standard torque converter components operate as follows:

- Rotation of the converter housing and impeller set the fluid in motion.
- The turbine reacts to the fluid motion from the impeller, transferring rotation to the geartrain through the input shaft.
- The reactor redirects fluid going back into the impeller, providing for torque multiplication.
- The clutch and damper assembly dampens powertrain torsional vibration and provides a direct mechanical connection for improved efficiency.
- Power is transmitted from the torque converter to the planetary gearsets and other components through the input shaft.



AD1223-A

Item	Part Number	Description
1	—	Converter Clutch and Damper (Part of 7902)
2	—	Reactor (Part of 7902)



3	—	Turbine (Part of 7902)
4	—	Impeller (Part of 7902)
5	—	Fluid Motion
6	—	Transmission Input Rotation
7	—	Input Shaft
8	—	Engine Rotation

## Geartrain

Power is transmitted from the torque converter to the geartrain components through the input shaft and forward clutch cylinder.

- By holding or driving certain members of the gearset, four forward ratios and one reverse ratio are obtained and transmitted to the output shaft (7060). The ratios are as follows:

GEAR RATIO	
1st	2.71 to 1
2nd	1.54 to 1
3rd	1.00 to 1
4th	0.71 to 1
Reverse	2.18 to 1

## Input Shaft

The input shaft (7017) is supported by two bushings in the stator support. End positioning of the input shaft is controlled by the splines in the converter turbine and the overdrive planet assembly.

## Output Shaft

The output shaft is supported by two bushings in the case (7005) and by the slip-yoke and bushing in the extension housing. End positioning is controlled by the parking pawl gear and snap ring or shoulder and by the reverse ring gear hub and snap ring.

## Overdrive System

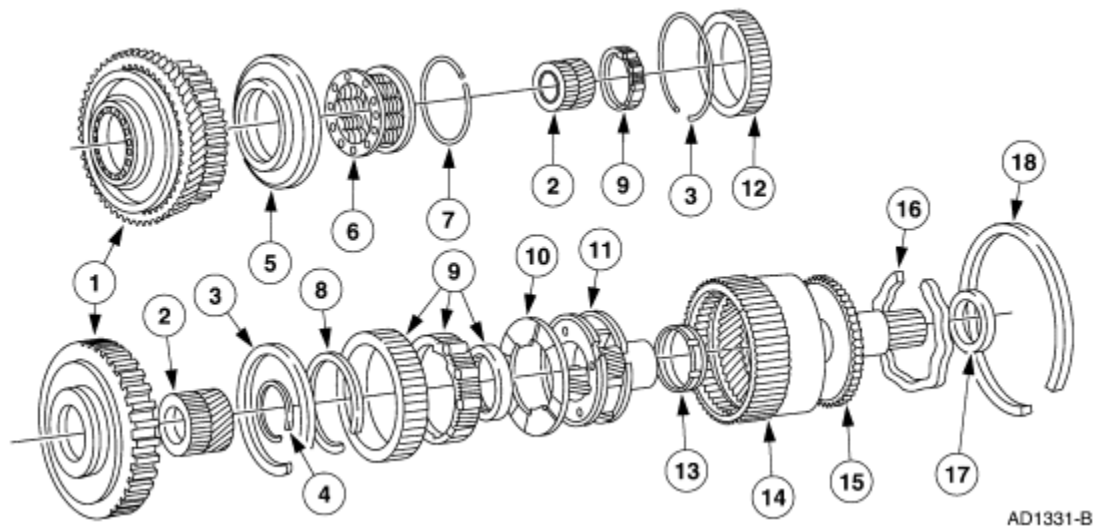
The overdrive planetary system consists of the overdrive planet assembly, overdrive sun gear (7D063), overdrive ring gear, coast clutch cylinder, overdrive one-way clutch assembly and the center shaft, as shown in the following illustration. The overdrive planet assembly is splined to the input shaft. The overdrive sun gear is centered by a bushing on the input shaft and held in place laterally by needle bearings on the reactor support and the overdrive planet assembly. The

overdrive sun gear is splined to the coast clutch cylinder, which in turn is splined to the overdrive one-way clutch inner race.

The outer race of the one-way clutch is splined to the overdrive ring gear, which is splined to the center shaft. The center shaft is centered by the forward planetary assembly and is laterally held by needle bearings on the center support and the overdrive planet assembly. The center shaft is splined into the forward clutch cylinder.

Two friction clutches are assembled in the overdrive planet assembly. The coast clutch is splined between the coast clutch cylinder and the overdrive ring gear. The coast clutch is activated to perform engine braking in MANUAL 1, MANUAL 2 and third gear with the transmission control switch engaged.

The overdrive clutch is splined between the case and the coast clutch cylinder. The overdrive clutch holds the coast clutch cylinder and, in turn, the overdrive sun gear, to permit the planet assembly to overdrive the ring gear.



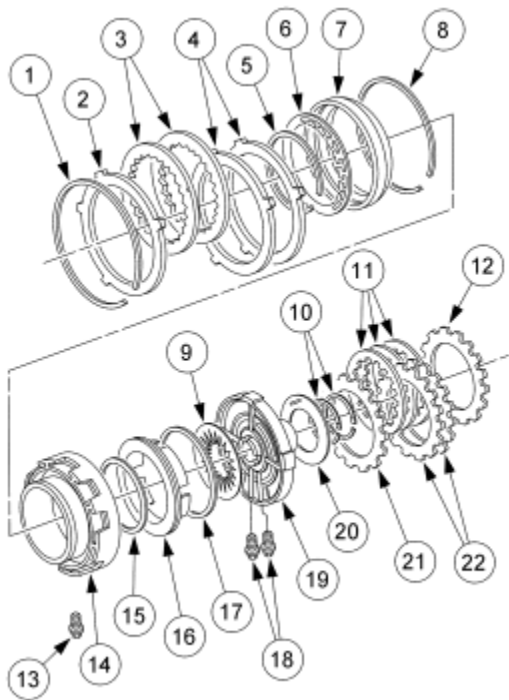
Item	Part Number	Description
1	7G387	Coast Clutch Cylinder (Model Dependent)
2	7D063	Gear Assy — Overdrive Sun (Model Dependent)
3	7G375	Ring — Retaining (Attaches Clutch Assy — O/D One-Way to O/D Ring Gear) (Model Dependent)
4	377300-S	Ring — Retaining (Attaches Gear Assy — O/D Sun to Cylinder Assy — Coast) (Model Dependent)
5	7A262	Piston and Seal Assy—Coast Clutch (Model Dependent)
6	7B070	Spring—Coast Clutch Piston Disc (Model Dependent)
7	7A527	Ring—Coast Clutch Spring Retainer (Model Dependent)

8	377135-S	Ring — Retaining (OWC to Outer Race) (Model Dependent)
9	7A089	Clutch Assy — Overdrive One-Way (Model Dependent)
10	7L339	Washer — Overdrive — Overrun Clutch Thrust No. 3 (Model Dependent)
11	7B446	Planet Assy — Overdrive (Model Dependent)
12	7G389	Race—Overdrive One-Way Clutch Outer (Model Dependent)
13	7F240	Bearing Assy — Overdrive Planet — Thrust No. 4 (Model Dependent)
14	7A153	Gear — Overdrive Ring (Model Dependent)
15	7A658	Shaft — Overdrive Center (Model Dependent)
16	7G375	Ring — Wavy Retaining (Retaining Center O/D Shaft Assy to O/D Ring Gear) (Model Dependent)
17	7G178	Bearing Assy — Overdrive Center Shaft — Thrust No. 5 (Model Dependent)
18	7D483	Ring — Overdrive CL Pressure Plate Retainer (Selective Fit) (Model Dependent)

### **Center Support and Intermediate/Overdrive Clutch Cylinder**

The center support provides a pilot for the forward clutch and direct clutch cylinders. It also provides fluid for clutch application and lube flow. The center support is held radially and laterally by the case. Fluid supply enters through feed bolts into the center support and supplies the forward clutch and the intermediate lube circuits. The direct clutch is fed by the center support.

The intermediate/overdrive clutch cylinder is radially supported by the case. Laterally, the cylinder is held in the case by a snap ring. The overdrive circuit is fed through a feed bolt into the cylinder. The intermediate clutch circuit is fed through nearby orifices.



DD0444-B

Item	Part Number	Description
1	7D483	Ring — Overdrive CL Pressure Plate Retainer (Selective Fit)
2	7B066	Plate — Overdrive Clutch Pressure
3	7B164	Plate — Overdrive Clutch Internal Spline Friction
4	7B442	Plate — Overdrive Clutch External Spline Steel
5	7A527	Ring — Overdrive Clutch Disc Spring Retaining
6	7B070	Spring — Overdrive Clutch Piston
7	7A262	Piston and (Bonded) Seal Assy — Overdrive Clutch
8	7D483	Ring — Intermediate Cylinder Retaining
9	7B070	Spring — Intermediate Clutch Piston
10	7D025	Seal — Direct Clutch (2 Req'd)
11	7B164	Plate — Intermediate Clutch Internal Spline Friction
12	7B066	Plate — Intermediate Clutch Pressure Rear
13	7Z059	Bolt — M10-1.5 x 24 mm Overdrive Cylinder Fluid Feed
14	7G384	Cylinder — Overdrive and Intermediate Clutch
15	7F225	Seal — Intermediate Clutch Piston Inner
16	7E005	Piston — Intermediate Clutch

17	7F224	Seal — Intermediate Clutch Piston Outer
18	7Z059	Bolt — M12-1.75 x 31 mm Center Support Fluid Feed (2 Req'd)
19	7A130	Support Assy — Center
20	7L326	Washer — Center Support Thrust No. 6
21	7B066	Plate — Intermediate Clutch Pressure Apply
22	7B066	Plate — Intermediate Clutch External Spline Steel

## Forward Drive System

The forward drive system consists of the forward clutch cylinder, intermediate brake drum, intermediate one-way clutch, input shell, forward ring gear, forward ring gear hub, forward/reverse sun gear and the forward planetary carrier and forward planetary gears.

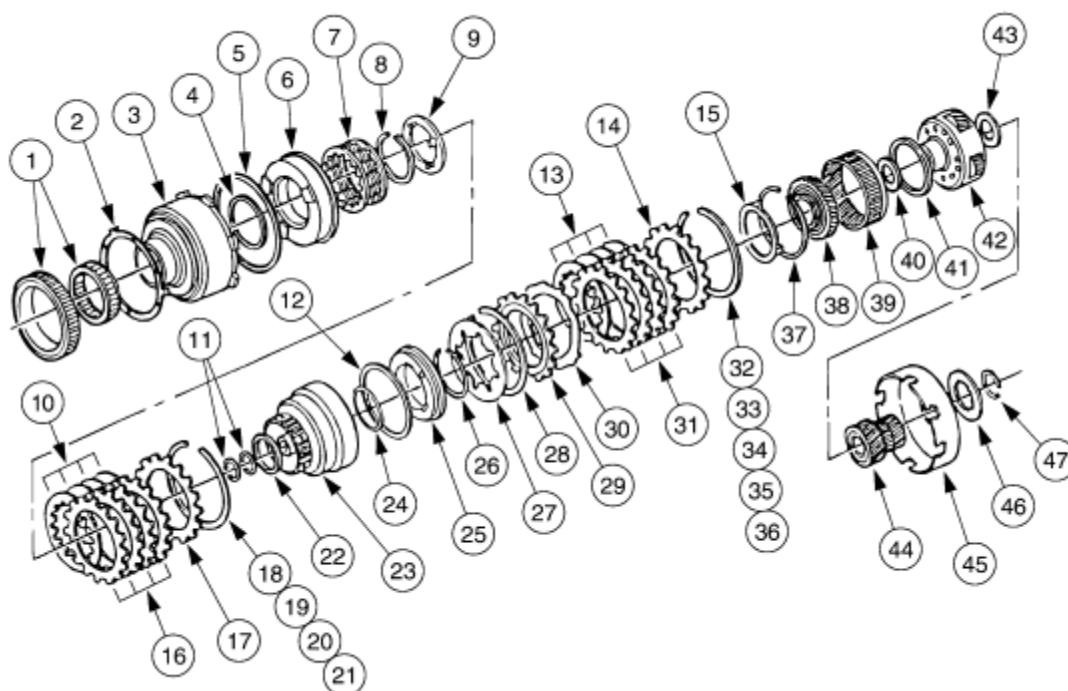
The forward clutch cylinder is splined on the center shaft. The forward ring gear is piloted on the forward ring gear hub. Thrust bearings on the forward planet assembly and forward clutch cylinder hold the forward ring gear hub in place.

The intermediate brake drum is radially supported by bushings on the center support and is laterally controlled by thrust washers on the forward clutch cylinder and center support. The intermediate brake drum has the inner race of the intermediate one-way clutch press-fitted on its pilot. The intermediate one-way clutch's outer race is splined to the intermediate friction clutch, which is splined to the case. The intermediate brake drum has lugs that are slotted into the input shell to form a mechanical connection. The input shell is splined into the forward/reverse sun gear. The forward/reverse sun gear is common to two planetary gearsets. The forward planet is splined to the output shaft and is laterally positioned by needle bearings on the sun gear and on the forward clutch cylinder, as shown in the following illustration.

Two friction clutch assemblies, the direct clutch and the forward clutch, are shown with the forward planetary assembly. The direct clutch assembly splines the forward clutch cylinder to the intermediate brake drum. The forward clutch assembly splines the forward clutch cylinder to the forward ring gear. The forward clutch is activated during all forward gears. While in third or fourth gear, both the direct and forward clutches are applied to hold the forward planetary assembly and enable it to act as a solid shaft.

In second gear, the intermediate clutch assembly holds the forward/reverse sun gears. It is applied, along with the intermediate one-way clutch, to hold the intermediate brake drum, input shell and forward/reverse sun gear. In higher gears, the one-way clutch overruns.

## Forward Drive System Components



DD0445-B

Item	Part Number	Description
1	7A089	Clutch Assy — Intermediate One-Way
2	7G401	Washer — Intermediate One-Way Clutch — Thrust No. 7
3	7D044	Drum Assy — Intermediate Brake
4	7A548	Seal — Direct Clutch Piston — Inner
5	7A548	Seal — Direct Clutch Piston — Outer
6	7A262	Piston Assy — Direct Clutch
7	7F235	Retainer and Spring Assy — Direct Clutch
8	7C122	Ring — Direct Clutch Support Spring Retaining
9	7C096	Washer — Intermediate Brake Drum — Thrust No. 8A
10	7B164	Plate — Direct Clutch Internal Spline — Friction
11	7D019	Seal — Forward Clutch Cylinder (2 Req'd)
12	7A548	Seal — Forward Clutch Piston — Outer
13	7B164	Plate — Forward Clutch Internal Spline — Friction
14	7B066	Plate — Forward Clutch Pressure — Rear
15	7D090	Washer — Forward Clutch Hub — Thrust No. 8C
16	7B442	Plate — Direct Clutch External Spline — Steel
17	7B066	Plate — Direct Clutch Pressure

18	377126-S	Ring — Direct Clutch Pressure Plate Retaining (Selective Fit)
19	377127-S	Ring — Retaining
20	377128-S	Ring — Retaining
21	377437-S	Ring — Retaining
22	7F374	Bearing Assy — Forward Clutch Needle — Thrust No. 8B
23	7A360	Cylinder Assy — Forward Clutch
24	7A548	Seal — Forward Clutch Piston — Inner
25	7A262	Piston Assy — Forward Clutch
26	7D256	Ring — Forward Clutch Piston Spring Retaining
27	7B070	Spring — Forward Clutch Piston Return
28	377127-S	Ring — Forward Clutch Spring (FWD CL Piston Spring to FWD CL Cylinder Assy)
29	7B066	Plate — Forward Clutch Pressure
30	7E085	Spring — Forward Clutch Pressure
31	7B442	Plate — Forward Clutch External Spline — Steel
32	377127-S	Ring — Forward Clutch Pressure Plate Retaining (Selective Fit)
33	377437-S	Ring — Retaining
34	377444-S	Ring — Retaining
35	386841-S	Ring — Retaining
36	386842-S	Ring — Retaining
37	377132-S	Ring — Forward Hub Retaining (Forward Ring Gear Hub to Forward Ring Gear)
38	7B067	Hub — Forward Ring Gear
39	7D392	Gear — Forward Ring
40	7D234	Bearing Assy — Forward Clutch Thrust (Between Forward Ring Gear and Forward Planet Assy) No. 9A
41	7A166	Bearing Assy — Forward Planet Carrier — Thrust No. 10A
42	7A398	Planet Assy — Forward
43	7D234	Bearing Assy — Forward Clutch Thrust (Between Forward Planet Assy and Forward Sun Gear Assy) No. 9B
44	7D063	Gear Assy — Forward/Reverse Sun
45	7D064	Shell — Input
46	7D066	Washer — Input Shell Thrust No. 14

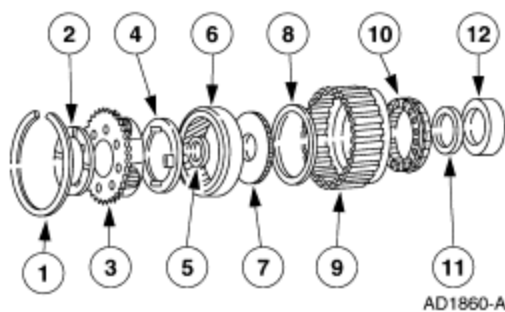
47	377300-S	Ring — Retaining (Attaches Forward/Reverse Sun Gear Assy to Input Shell)
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### Low and Reverse Drive System

The reverse planetary assembly consists of the reverse planetary carrier, reverse planet gears, the reverse ring gear, the reverse ring gear hub, the reverse clutch hub and the low-reverse one-way clutch assembly.

The reverse ring gear hub is splined to the output shaft and to the reverse ring gear. The reverse ring gear hub is laterally held by a needle bearing on the inner race of the low-reverse one-way clutch and a snap ring on the output shaft. The reverse planet (7D006) assembly is splined to the low-reverse clutch hub. The low-reverse clutch hub is connected by the reverse clutch to the case. The inner race of the one-way clutch is bolted to the case.

The reverse clutch assembly is activated in REVERSE gear and in MANUAL 1. The reverse clutch bypasses the reverse one-way clutch during coast and MANUAL 1. The reverse clutch holds the reverse planet assembly in REVERSE gear to enable the sun gear to drive the reverse ring gear in the opposite direction.



Item	Part Number	Description
1	377155-S	Ring — Reverse Planet Retaining (Model Dependent)
2	7A166	Washer — Planet Carrier Thrust (Between Reverse Planet Assy and Input Shell) No. 10B (Model Dependent)
3	7D006	Planet Assy — Reverse (Model Dependent)
4	7A166	Washer — Planet Carrier — Thrust (Between Reverse Planet Assy and Output Shaft Hub) No. 11 (Model Dependent)
5	387031-S	Ring — Retaining (Retaining Output Shaft Hub to Output Shaft Assy) (Model Dependent)
6	7A153	Gear — Output Shaft Ring (Model Dependent)
7	7D164	Hub — Output Shaft (Model Dependent)
8	377132-S	Ring — Retaining (Retaining Output Shaft Hub to



		Output Shaft Ring Gear) (Model Dependent)
9	7B067	Hub Assy — Reverse Clutch (Model Dependent)
10	7A089	Clutch Assy — Reverse One-Way (Model Dependent)
11	7G178	Thrust Bearing Assy No. 12 (Model Dependent) (Model Dependent)
12	7G178	Low/Reverse One-Way Clutch Inner Race (Model Dependent)

## Apply Components

The following information describes the operation of the three E4OD one-way clutches.

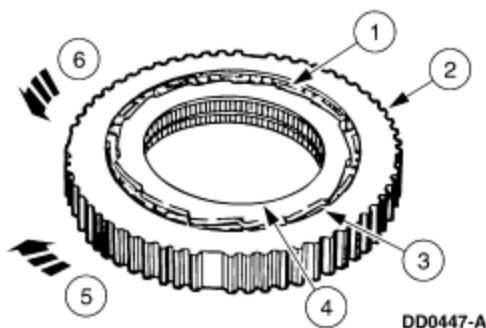
### One-Way Clutch—Overdrive

The overdrive one-way clutch, shown in the following illustration, transmits engine torque from the overdrive sun gear to the overdrive ring gear in first, second and third gear range. The overdrive one-way clutch transmits power when the sprags are engaged between the inner and outer races. The inner race is splined to the coast clutch cylinder, which in turn is splined to the overdrive sun gear. The outer race is splined to the overdrive ring gear.

The overdrive one-way clutch engages whenever the overdrive planetary system attempts to drive the overdrive sun gear clockwise when the overdrive ring gear has a counterclockwise torque from the vehicle. When torqued counterclockwise, the overdrive one-way clutch engages and acts as a wedge to lock the sun gear and the ring gear together. During coast, the overdrive one-way clutch enables the ring gear to overrun or spin at a faster rate than the sun gear.

The overdrive one-way clutch overruns when in overdrive (fourth gear). In overdrive, the coast clutch cylinder is held by the overdrive one-way clutch, which in turn holds the overdrive sun gear. This causes the overdrive planet assembly to walk around the sun gear and overdrive the overdrive ring gear. The inner race of the overdrive one-way clutch is thus held stationary while the outer race is allowed to overrun clockwise.

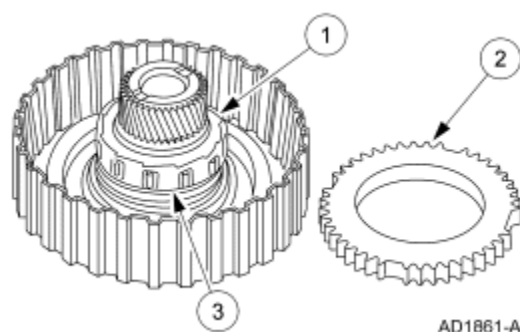
### 5.4L, 6.8L without Power Take Off (PTO) One-Way Clutch—Overdrive (Roller Design)



Item	Part Number	Description
1	—	One-Way Clutch

		(Part of 7A089)
2	—	Outer Race (Part of 7A089)
3	377135-S	Small Retaining Ring
4	—	Inner Race (Part of 7A089)
5	—	Engaged
6	—	Overrunning

#### 6.8L, 7.3L with Power Take Off (PTO) One-Way Clutch—Overdrive (Roller Design)



Item	Part Number	Description
1	—	Overdrive One-Way Clutch Inner Race
2	—	Overdrive One-Way Outer Race
3	—	Overdrive One-Way Clutch

#### One-Way Clutch—Intermediate

The intermediate one-way clutch, shown in the following illustration, holds the forward/reverse sun gear stationary relative to the case in second gear. The outer race of the intermediate one-way clutch is splined to the intermediate clutch, which in turn is splined to the case. The inner race is pressed on the intermediate brake drum, which is connected to the sun shell. The sun shell is splined to the forward/reverse sun gear.

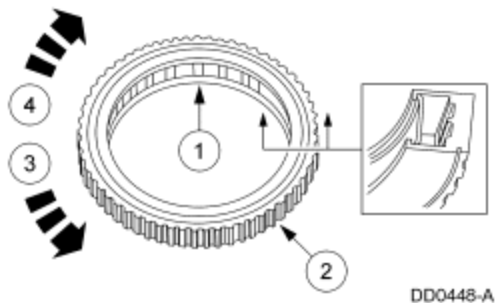
In second gear, the intermediate clutch holds the outer race of the intermediate one-way clutch. Torque from the vehicle acts counterclockwise on the output shaft, and in turn the forward planetary carrier and the reverse ring gear. Torque from the center shaft is counterclockwise.

This combination applies a counterclockwise torque on the sun gear and likewise the intermediate one-way clutch. The intermediate one-way clutch engages, causing the forward ring gear to turn the forward planetary carrier clockwise at reduced speed. During coast, the intermediate one-way clutch allows the sun gear to spin clockwise as the engine rpm coasts down.

The intermediate one-way clutch overruns in third, fourth and REVERSE gears. The direct clutch is engaged, causing the intermediate brake drum to rotate clockwise with the center shaft. With the intermediate drum rotating clockwise, the inner race also rotates clockwise, causing the intermediate one-way clutch to overrun.

In first gear, the outer race of the intermediate one-way clutch is not held, and the intermediate one-way clutch is overrunning.

#### One-Way Clutch—Intermediate(Sprag Design)



Item	Part Number	Description
1	—	Sprags (Part of 7A089)
2	—	Outer Race (Part of 7A089)
3	—	Overrunning
4	—	Engaged

#### One-Way Clutch—Low/Reverse

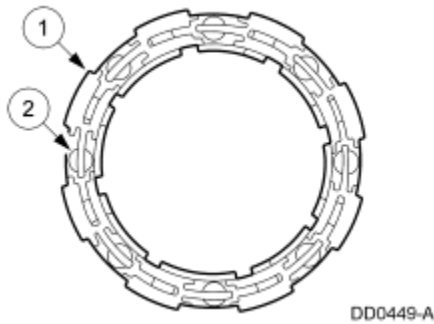
The low-reverse one-way clutch, shown in the following illustration, holds the reverse planetary carrier stationary to the case in first gear. The inner race of the low-reverse one-way clutch is bolted directly to the case. The outer race is splined to the reverse clutch hub, which is splined to the reverse planetary carrier.

In first gear, the center shaft drives the forward ring gear clockwise by way of the forward clutch. With the forward planetary carrier providing a counterclockwise resisting torque, the forward/reverse sun gear is driven counterclockwise.

As the sun gear is turned counterclockwise and the reverse ring gear is turned counterclockwise by the resistance of the vehicle, the reverse planetary carrier is also turned counterclockwise. Because the reverse planetary carrier is prevented from turning counterclockwise by the low-reverse one-way clutch, the torque is transferred from the sun gear to the reverse ring gear and the output shaft. During coast, the planetary carrier is allowed to overrun and spin clockwise.

The low-reverse one-way clutch overruns in second, third and fourth gears. In these cases the forward/reverse sun gear is stationary while the reverse ring gear turns clockwise with the output shaft. This turns the reverse planetary carrier clockwise, causing the low-reverse one-way clutch to run clockwise and overrun.

#### One-Way Clutch Low/Reverse



Item	Part Number	Description
1	—	Unitized Plastic Cage (Part of 7A089)
2	—	Roller (Part of 7A089)

### Power Take-Off (PTO)

Some 6.8L and 7.3L vehicles are equipped with power take-off (PTO) capability. These vehicles have a special transmission case, internal components and calibration for PTO usage.

The PTO can be used during mobile and stationary operation under continuous/intermittent applications.

PTO operation is inhibited in NEUTRAL, 4th gear, during engine crank and a few seconds beyond the engine crank mode.

Transmission upshift and downshift schedules will be reduced and will have a slightly firmer shift feel during PTO mobile applications.

Stationary operation of PTO will not be allowed in PARK unless the engine rpm reaches 1200-1300 rpm within 5 minutes of PTO selection.

With 12 volts applied to EEC pin 4 (gas) or 66 (diesel), the following conditions must be met to allow PTO operation:

- The transmission range selector lever is in P, R, D, 2, 1.
- The vehicle is out of the crank mode.
- Transmission fluid temp is less than maximum.

When the above conditions are met the strategy will enable PTO to function and the following conditions occur:

- SS2 (B) is turned on by the strategy which keeps the overdrive clutch from engaging and turns on the coast clutch (the coast clutch cylinder has a large ring gear pressed on the outside diameter that drives the PTO unit).
- EPC is elevated to about 55 PSI. The TCIL will illuminate (TCS is overridden and turned on). For stationary operation the operator has 5 minutes to raise the idle speed to 1200-1300 rpm, mobile operation will experience slightly lower shift schedule and firmer shift feel.

- The converter clutch will engage once the rpm reaches 1200-1300 rpm for stationary operation. For mobile operation the converter clutch will follow normal apply schedule. PTO is now operational.

**NOTE:** During PTO operation the on board diagnostics will be disabled. However the circuit checks made by the diagnostic system and the FMEM will continue. PTO must be turned off to do on board diagnostics.

The strategy cannot disable PTO in manual 3 (overdrive position with overdrive cancelled), manual 2, manual 1 since normal transmission function has the coast clutch applied hydraulically.

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SECTION 307-01: Automatic  
Transaxle/Transmission  
DESCRIPTION AND OPERATION

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Manual  
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## **Transmission Electronic Control System**

### **Electronic System Description**

The powertrain control module (PCM) (12A650) (PCM) and its input/output network control the following transmission operations.

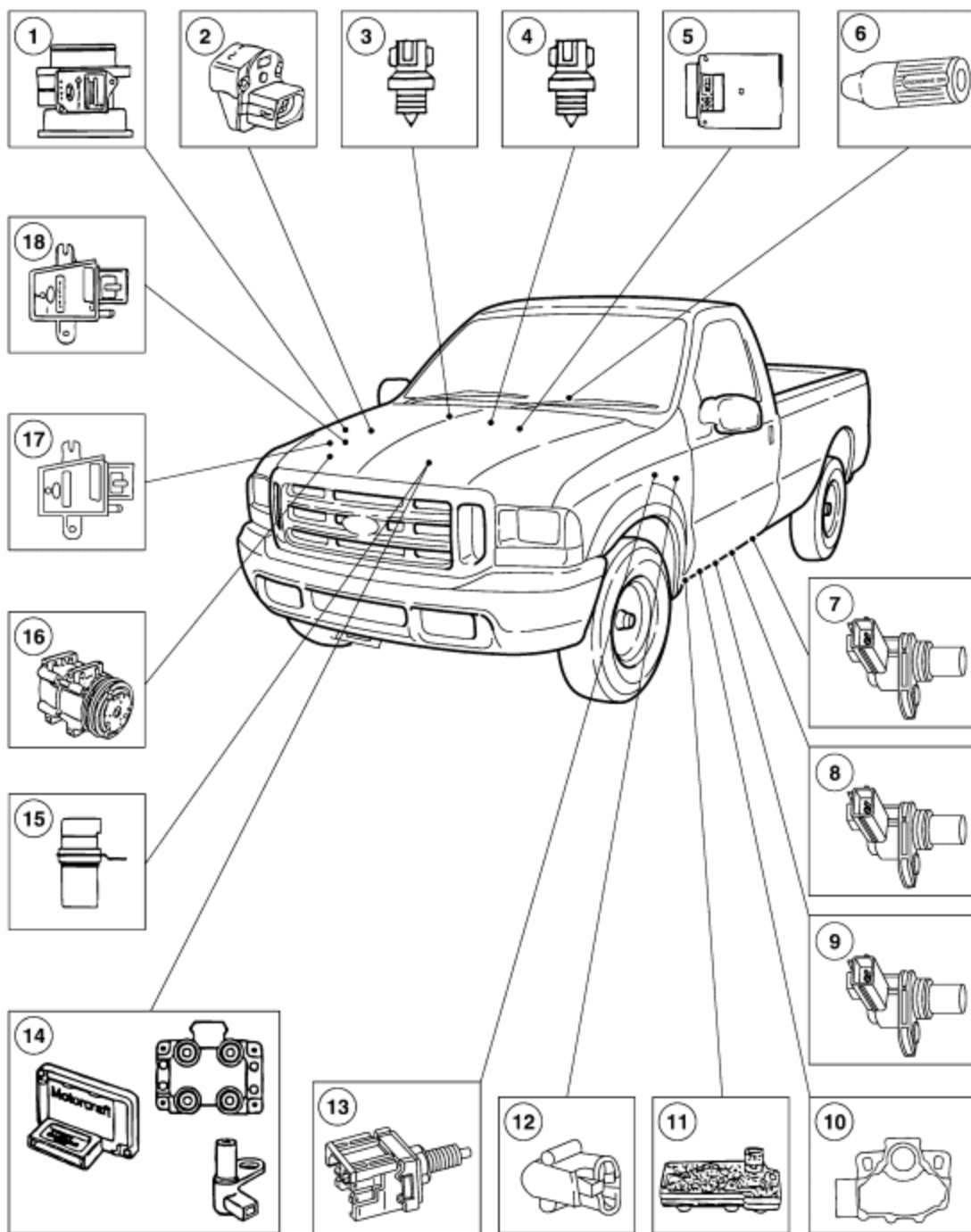
- shift timing.
- line pressure (shift feel).
- torque converter clutch operation.

The transmission control is separate from the engine control strategy in the powertrain control module, although some of the input signals are shared. When determining the best operating strategy for transmission operation, the powertrain control module uses input information from certain engine-related and driver-demand related sensors and switches.

Using all of these inputs signals, the powertrain control module can determine when the time and conditions are right for a shift, or when to apply or release the torque converter clutch. It will also determine the best line pressure needed to optimize shift feel. To accomplish this the powertrain control module uses output solenoids to control transmission operation.

The following provides a brief description of each of the sensors and actuators used by the powertrain control module for transmission operation.

### **Electronic Control Components**



AD1774-B

Item	Part Number	Description
1	12B579	Mass Air Flow Sensor
2	9B989	Throttle Position Sensor
3	—	Engine Oil Temperature (EOT) Sensor (7.3L DI Diesel)
4	—	Intake Air Temperature (IAT) Sensor (7.3L DI Diesel)

5	12A650	Powertrain Control Module
6	—	Transmission Control Switch (TCS) and Transmission Control Indicator Lamp (TCIL)
7	2L373	Anti Lock Brake Sensor
8	7M101	Turbine Shaft Speed (TSS) Sensor
9	7H103	Output Shaft Speed (OSS) Sensor
10	7A247	Digital Transmission Range (TR) Sensor
11	—	Transmission Solenoid Body
12	—	Accelerator Pedal (AP) Sensor (7.3L DI Diesel)
13	13480	Brake Pedal Position (BPP) Switch
14	—	Electronic Ignition (EI) System
15	—	Camshaft Position (CMP) Sensor (7.3L DI Diesel)
16	2884	Air Conditioning (A/C) Clutch
17	—	Barometric Pressure (BARO) Sensor (7.3L DI Diesel)
18	—	MAP/BARO Sensor

### **Mass Air Flow (MAF) Sensor**

The mass air flow sensor (MAF) measures the mass of air flowing into the engine. The MAF sensor output signal is used by the powertrain control module to calculate injector pulse width. For transmission strategies the MAF sensor is used to regulate electronic pressure control (EPC), shift and torque converter clutch scheduling.

### **Throttle Position (TP) Sensor**

The throttle position (TP) sensor is a potentiometer mounted on the throttle body. The TP sensor detects the position of the throttle plate and sends this information to the powertrain control module. The TP sensor is used for shift scheduling, electronic pressure control and torque converter clutch (TCC) control.

### **Intake Air Temperature (IAT) Sensor**

The IAT sensor is installed in the air cleaner outlet tube. The IAT sensor is used in determining electronic pressure control (EPC) pressures.

## **Powertrain Control Module (PCM)**

The operation of the transmission is controlled by the powertrain control module. Many input sensors provide information to the PCM. The PCM then controls actuators which determine transmission operation.

## **Transmission Control Switch (TCS), Transmission Control Indicator Lamp (TCIL)**

The transmission control switch (TCS) is a momentary control switch. When the switch is pressed, a signal is sent to the powertrain control module to allow automatic shifts from first through fourth gears or first through third gears only. The PCM energizes the transmission control indicator lamp (TCIL) when the switch is off. The TCIL indicates overdrive cancel mode activated (lamp on) and electronic pressure control (EPC) circuit shorted (lamp flashing) or monitored sensor failure.

## **Transmission Solenoid Body**

The powertrain control module controls the 4R100 transmission operation through four on/off solenoids and one variable force solenoid. These solenoids and transmission fluid temperature sensor are housed in the transmission solenoid body assembly. All are part of the transmission solenoid body and are not replaced individually. Additionally, in 1995, the protection diodes that were on the solenoid body were moved to the powertrain control module.

## **Transmission Fluid Temperature (TFT) Sensor**

The transmission fluid temperature sensor is located on the solenoid body assembly in the transmission sump. It is a temperature-sensitive device called a thermistor. The resistance value of the transmission fluid temperature sensor will vary with temperature change. The powertrain control module monitors voltage across the transmission fluid temperature sensor to determine the temperature of the transmission fluid. The powertrain control module uses this signal to determine whether a cold start shift schedule is necessary. The cold start shift schedule lowers shift speeds to allow for the reduced performance of cold engine operation. The powertrain control module also uses the transmission fluid temperature sensor input to adjust electronic pressure control pressure for temperature effects and to inhibit torque converter clutch operation during the warm-up period.

## **Coast Clutch Solenoid (CCS)**

The coast clutch solenoid provides coast clutch control by shifting the coast clutch shift valve. The solenoid is activated by pressing the transmission control switch or by selecting the 1 or 2 range with the transmission range selector lever. In MANUAL 1 and 2, the coast clutch is controlled by the solenoid and also hydraulically as a fail-safe to ensure engine braking. In reverse, the coast clutch is controlled hydraulically and the solenoid is not on.



## **Torque Converter Clutch (TCC) Solenoid**

The torque converter clutch solenoid (TCC solenoid) provides torque converter clutch control by shifting the converter clutch control valve to apply or release the torque converter clutch.

## **Electronic Pressure Control (EPC) Solenoid**



**CAUTION:** The electronic pressure control pressure output from the variable force solenoid is NOT adjustable. Any modification to the electronic pressure control solenoid will affect the transmission warranty.

The electronic pressure control solenoid is a variable force solenoid. The variable-force type solenoid is an electrohydraulic actuator combining a solenoid and a regulating valve. It supplies electronic pressure control that regulates transmission line pressure and line modulator pressure. This is done by producing resisting forces to the main regulator and the line modulator circuits. These two pressures control clutch application pressures.

## **Shift Solenoids A and B**

Shift solenoids A and B provide gear selection of first through fourth gears by controlling the pressure to the three shift valves.

## **Anti-Lock Brake Speed Sensor**

The programmable speedometer/odometer module (PSOM) receives input from the rear brake anti-lock sensor. After processing the signal, the PSOM relays it to the powertrain control module and the speed control module.

## **Turbine Shaft Speed (TSS) Sensor**

The turbine shaft speed (TSS) sensor is a magnetic pickup that sends the powertrain control module (PCM) information on the rotation speed of the coast clutch drum. The turbine shaft speed (TSS) sensor is mounted externally on the top of the transmission case. The powertrain control module (PCM) uses turbine shaft speed (TSS) sensor signals to help determine electronic pressure control (EPC) pressure, shift scheduling the torque converter clutch (TCC) operation.

## **Output Shaft Speed (OSS) Sensor**

The output shaft speed (OSS) sensor is a magnetic pickup that provides transmission output shaft rotation speed information to the powertrain control module.

The output shaft speed (OSS) sensor is mounted externally on the top of the transmission case. The PCM uses the output shaft speed (OSS) sensor signal to help determine electronic pressure control (EPC) pressure, shift scheduling and torque converter clutch (TCC) operation.

### **Digital Transmission Range (TR) Sensor**

The digital transmission range (TR) sensor is located on the outside of the transmission at the manual lever. The sensor completes the start circuit in Park and Neutral, the back-up lamp circuit in Reverse and a neutral sense circuit for GEM control of 4x4 low engagement. The sensor also opens/closes a set of four switches that are monitored by the powertrain control module to determine the position of the manual lever (P, R, N, [circled ], 2, 1).

### **Accelerator Pedal (AP) Sensor—7.3—Diesel Only**

The accelerator pedal (AP) sensor is mounted on the accelerator pedal on vehicles equipped with 7.3—diesel engines. The AP sensor detects the position of the accelerator pedal and sends this information as a voltage signal to the powertrain control module. If the AP sensor or related circuits fail to operate in a normal manner, the powertrain control module will recognize that the AP sensor signal is out of specification. The powertrain control module will then operate the 4R100 transmission at a higher line pressure to prevent transmission damage. This high line pressure causes harsh upshift and engagements.

### **Brake Pedal Position (BPP) Switch**

The brake pedal position (BPP) switch tells the powertrain control module when the brakes are applied. The torque converter clutch disengages when the brakes are applied. The BPP switch closes when the brakes are applied and opens when they are released.

### **Electronic Ignition (EI) System**

The electronic ignition consists of a crankshaft position sensor, two four tower ignition coils and the powertrain control module. The ignition control module operates by sending crankshaft position information from the crankshaft position sensor to the ignition control module. The ignition control module generates a profile ignition pickup (PIP) signal (engine rpm) and sends it to the powertrain control module. The PIP signal is one of the inputs that the PCM uses to determine transmission strategy, wide-open throttle (WOT) shift control, torque converter clutch control and EPC pressure.

## **Distributor Ignition (DI) System**

The profile ignition pickup sensor sends a signal to the powertrain control module indicating the engine rpm and the crankshaft (6303) position.

### **Camshaft Position (CMP) Sensor—7.3L DI Diesel Only**

On the 7.3L DI diesel engines, the CMP sensor provides engine rpm information to the powertrain control module. This rpm input is used to determine shift scheduling and EPC pressure.

## **Air Conditioning (A/C) Clutch**

An electromagnetic clutch is energized when the clutch cycling pressure switch closes. The switch is located on the suction accumulator/drier. The closing of the switch completes the circuit to the clutch and draws it into engagement with the compressor driveshaft. When the A/C clutch is engaged, electronic pressure control (EPC) pressure is adjusted by the PCM to compensate for additional load on the engine.

### **Barometric Pressure (BARO) Sensor—7.3L DI Diesel Only**

The barometric pressure sensor (BARO sensor) (12A644) operates similarly to the manifold absolute pressure sensor (MAP sensor) (9F479). It measures barometric pressure instead of intake manifold pressure. The powertrain control module uses the signal from the barometric pressure sensor to determine the altitude at which the vehicle is operating. The powertrain control module then adjusts the 4R100 shift schedule and EPC pressure for the altitude.

### **Manifold Absolute Pressure (MAP) Sensor—Gasoline Engines**

On gasoline engines, the manifold absolute pressure sensor senses atmospheric pressure to produce an electrical signal. The frequency of this signal varies with intake manifold pressure. The powertrain control module monitors this signal to determine altitude. The powertrain control module then adjusts the 4R100 shift schedule and EPC pressure for altitude. On diesel engines, the manifold absolute pressure sensor measures boost pressure. The powertrain control module monitors this signal and adjusts EPC pressure.

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## Diagnostic Strategy

**NOTE:** Do not take short cuts or assume that critical checks or adjustments have already been made.

Troubleshooting an electronically controlled automatic transmission (7003) is simplified by using the proven method of diagnosis. One of the most important things to remember is that there is a definite procedure to follow.

Follow the procedures as written to avoid missing critical components or steps.

To diagnose a concern properly, the technician should have the following publications available:

- Transmission reference manual.
- Powertrain Control/Emissions Diagnosis (PC/ED) Manual.
- OASIS messages.
- Technical Service Bulletins (TSBs).
- Electrical and Vacuum Troubleshooting Manual (EVTM).

These publications provide the information required when diagnosing transmission concerns.

Using the Diagnostic Flowchart as a guide, follow the steps as indicated.

## Preliminary Inspection

- Know and understand the customer's concern.
- Check the fluid level and condition.
- Verify the concern by operating the vehicle.
- Check for non-factory add-on items.
- Check shift linkages for proper adjustment.
- Check TSBs and OASIS messages for the concern.

## Diagnostics

- Vehicles that have power take-off capability will not have on board diagnostic capability when the power take off is in operation.
- Perform on-board diagnostic procedures key on engine off (KOEO) and key on engine running (KOER).
- Record all diagnostic trouble codes (DTCs).

- Repair all non-transmission codes first.
- Repair all transmission codes second.
- Erase all continuous codes and attempt to repeat them.
- Repair all continuous codes which reappear.
- If only pass codes are obtained, proceed to Diagnosis by Symptom Index for further information and diagnosis.

Follow the diagnostic sequence to diagnose and repair the concern the first time.

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SECTION 307-01: Automatic  
Transaxle/Transmission  
DIAGNOSIS AND TESTING

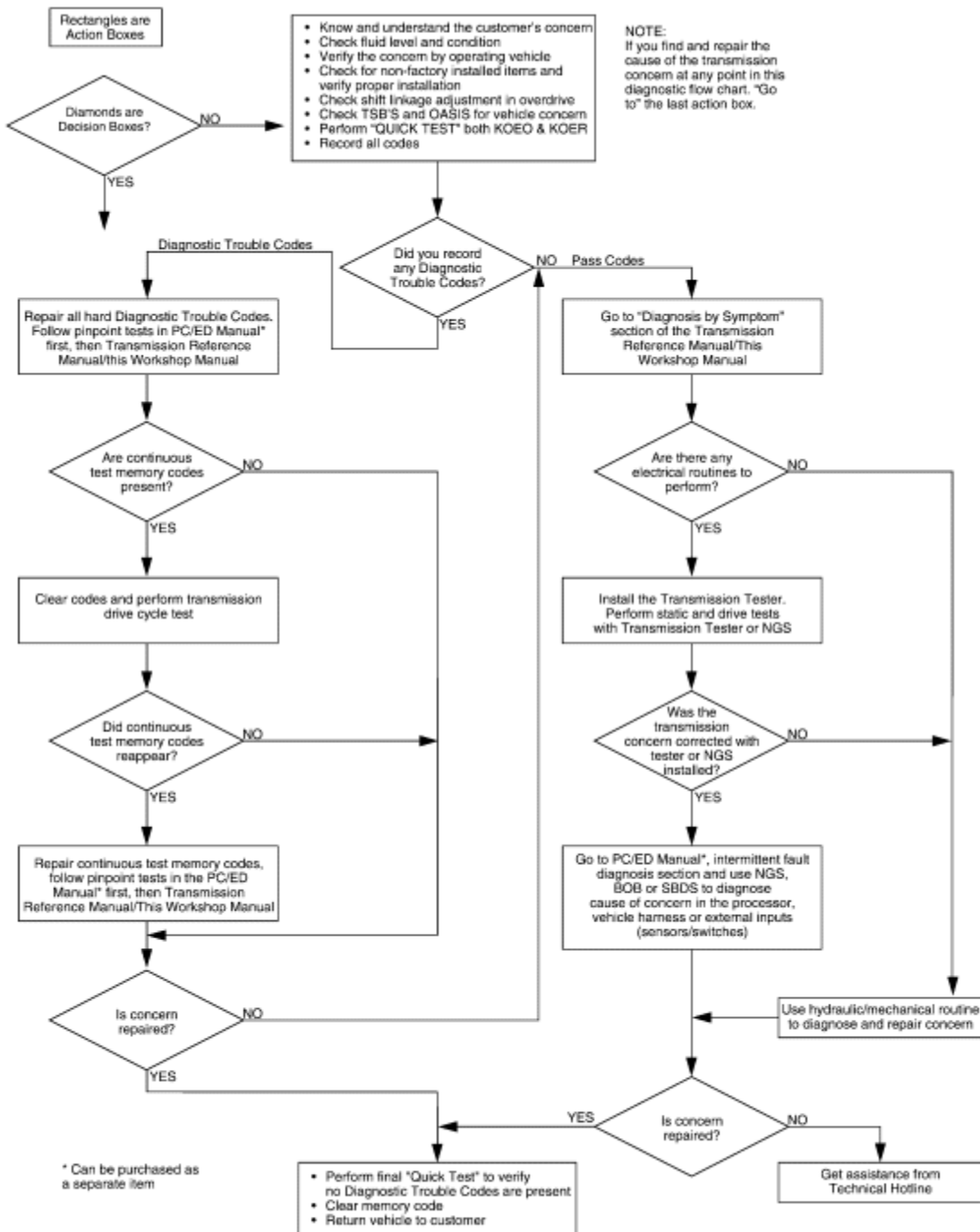
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Manual

[Procedure revision date: 01/26/2000](#)

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## **Diagnostic Flow Chart**

### **Diagnostic Flow Chart**



## **Preliminary Inspection**

The following items must be checked prior to beginning the diagnostic procedure:

## **Know/Understand the Concern**

In order to diagnose a concern properly, you must first understand the customer complaint or condition. Customer contact may be required in order for the technician to begin to verify the concern. You must also understand the conditions when the concern occurs, for example:

- Hot or cold vehicle temperature.
- Hot or cold ambient temperature.
- Vehicle driving conditions.

After understanding when and how the concern occurs, proceed to verify the condition.

## **Verification of Condition**

This section provides information that must be used in both determining the actual cause of customer concerns and performing the appropriate procedures.

The following procedures must be used when verifying customer concerns for the transmission (7003):

## **Determine Customer Concern**

**NOTE:** Some transmission conditions can cause engine concerns. An electronic pressure control short circuit can cause engine misfiring. The torque converter clutch not disengaging will stall the engine.

Determine customer concerns relative to vehicle use and dependent driving conditions, paying attention to the following items:

- Hot or cold vehicle operating temperature.
- Hot or cold ambient temperatures.
- Type of terrain.
- Vehicle loaded/unloaded.

- City/highway driving.
- Upshift.
- Downshift.
- Coasting.
- Engagement.
- Noise/vibration — check for dependencies, either rpm dependent, vehicle speed dependent, shift dependent, gear dependent, range dependent, or temperature dependent.
- Vehicles equipped with power take-off, the power take-off must be turned off.

## Check Fluid Level and Condition

### Fluid Level Check



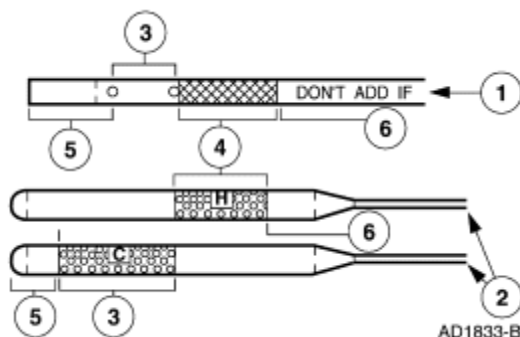
**CAUTION:** The vehicle should not be driven if the fluid level indicator shows the fluid below the do not drive mark or internal failure could result.

**NOTE:** If the vehicle has been operated for an extended period of time at highway speeds, city traffic, hot weather, or pulling a trailer the fluid needs to cool down to obtain an accurate reading.

**NOTE:** The fluid level reading on the indicator will differ depending on operating and ambient temperatures. The correct reading should be within the normal operating temperature range.

Under normal circumstances the fluid level should be checked during normal maintenance. If the transmission starts to slip, shift slowly, or has signs of leaking the fluid level should be checked.

1. With the transmission in (P) PARK the engine at idle, foot pressed on the brake, move the range selector lever through each gear and allow engagement of each gear. Place the range selector lever in the PARK position.
2. Wipe the fluid level indicator cap and remove the indicator.
3. Wipe the indicator with a clean cloth.
4. Install the indicator back in the filler tube until it is fully seated, then remove the indicator. The fluid level should be within the normal operating temperature range.





Item	Description
1	Gasoline Application (Bullet Type Indicator)
2	Diesel Application (Blade Type Indicator)
3	Cold Temperature Range
4	Normal Operating Temperature Range
5	DO NOT DRIVE IF BELOW THIS LEVEL AND OUTSIDE TEMPERATURE IS ABOVE 10°C (50°F) (Underfill). Recheck fluid level at normal operating temperature and adjust as required.
6	DO NOT DRIVE LEVEL (Overfill). Remove excess fluid. Recheck fluid level at normal operating temperature and adjust as required.

### High Fluid Level

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission malfunction and/or damage. If an overfill reading is indicated refer to Transmission Fluid Drain and Refill in this section.

### Low Fluid Level

A low fluid level could result in poor transmission engagement, slipping, malfunction and/or damage. This could also indicate a leak in one of the transmission seals or gaskets.

### Adding Fluid



**CAUTION:** The use of any other type of transmission fluid than specified could result in transmission malfunction and/or damage.

If fluid needs to be added, add fluid in 0.25L (1/2 pint) increments through the filler tube. Do not overfill the fluid. For fluid type; refer to the Fluid Type specification chart.

### Fluid Condition Check

1. Check the fluid level.
2. Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black or have a burnt odor.
3. Hold the fluid level indicator over a white facial tissue and allow the fluid to drop onto the facial tissue and examine the stain.
4. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.

5. If the stain is a foamy pink color this may indicate coolant in the transmission. The engine cooling system should also be inspected at this time.
6. If fluid contamination or transmission failure is confirmed by the sediment in the bottom of the fluid pan, the transmission must be disassembled and completely cleaned. This includes the torque converter, coolers, cooler lines and cooler bypass valve.
7. Perform diagnostic checks and adjustments; refer to Diagnosis by Symptom Index in this section.

## **Road Testing Vehicle**

The following Shift Point Road Test and Torque Converter Clutch Operation Test provide diagnostic information on transmission shift controls and torque converter operation.

### **Shift Point Road Test**

**NOTE:** Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

**NOTE:** If equipped, turn the power take-off unit off for proper test results.

This test verifies that the shift control system is operating properly.

1. Bring engine and transmission up to normal operating temperature.
2. Operate the vehicle with the transmission range selector lever in [circled ] range.
3. Apply minimum throttle and observe the speeds at which the upshift occurs and the torque converter (7902) engages. (Refer to Automatic Transmission Special Specification Bulletin FPS-12180-99 for actual speed.)
4. With the vehicle in OVERDRIVE (fourth gear), depress the transmission control switch. The transmission should downshift to third gear. Remove foot from accelerator pedal; engine braking should occur.
5. Press accelerator pedal to floor (wide-open throttle). Transmission should shift from third to second gear or third to first, depending on vehicle speed. Torque converter clutch should disengage and then reapply.
6. With vehicle [circled ] range above 80 km/h (50 mph) and less than half throttle, move the transmission range selector lever from [circled ] range to MANUAL 2 range and remove foot from accelerator pedal. The transmission should immediately downshift into second gear. With the vehicle remaining in MANUAL 2 range, move transmission range selector lever into MANUAL 1 range. Transmission should downshift into first gear at speeds BELOW 48-56 km/h (30-35 mph).

7. If transmission fails to upshift/downshift or torque converter clutch does not apply and release, refer to Diagnosis by Symptom Index under Diagnosis by Symptom in the Diagnosis and Testing portion of this section for concern diagnosis.

Applications Shift Speeds — Approximate* MPH (F-250, F-350 with 5.4L Over 8500 GVW Rating)				
Throttle Opening	Range	Shift	Axle Ratio	
			Vehicle Speed (1)	
			3.55	4.10
Light Throttle	[circled ], D	1-2	14-17	12-14
	[circled ], D	2-3	23-27	20-22
	[circled ]	3-4	46-53	42-44
	[circled ]	4-3	35-40	31-34
	[circled ], D	3-2	17-21	15-17
	[circled ], D	2-1	9-12	8-10
Wide-Open Throttle	[circled ], D	1-2	38-44	35-37
	[circled ], D	2-3	69-77	62-64
	[circled ]	3-4	98-109	88-91
	[circled ]	4-3	82-92	74-76
	[circled ], D	3-2	64-72	58-60
	[circled ], D	2-1	34-39	30-33

**NOTE:** D is the same as [circled ] with the transmission control switch actuated (light on).

\*(1) Nominal shift speed at sea level is shown. Actual shift speed will depend on tire brand, size and axle ratio. Refer to Automatic Transmission Special Specification Bulletin FPS-12180-99 for actual speeds.

Applications Shift Speeds — Approximate* MPH (F-250, F-350, Series Super Duty with 6.8L)					
Throttle Opening	Range	Shift	Axle Ratio		
			Vehicle Speed (1)		
			3.73	4.10	4.63
Light Throttle	[circled ], D	1-2	11-12	10-11	8-10
	[circled ], D	2-3	19-21	17-19	14-16
	[circled ]	3-4	36-37	32-34	29-30
	[circled ]	4-3	35-36	31-33	27-29
	[circled ], D	3-2	17-19	16-18	13-15
	[circled ], D	2-1	10-11	9-10	7-9
Wide-Open Throttle	[circled ], D	1-2	36-38	36-38	29-32
	[circled ], D	2-3	65-67	64-66	53-54

	[circled ]	3-4	91-93	94-96	76-78
	[circled ]	4-3	89-91	85-87	71-73
	[circled ], D	3-2	63-64	60-61	47-49
	[circled ], D	2-1	34-36	31-33	25-27

**NOTE:** D is the same as [circled ] with the transmission control switch actuated (light on).

\*(1) Nominal shift speed at sea level is shown. Actual shift speed will depend on tire brand, size and axle ratio. Refer to Automatic Transmission Special Specification Bulletin FPS-12180-99 for actual speeds.

Applications Shift Speeds — Approximate\* MPH (F-250, F-350, Super Duty with 7.3L DITD)

Throttle Opening	Range	Shift	Axle Ratio	
			Vehicle Speed (1)	
			3.55	4.10
Light Throttle	[circled ], D	1-2	11-14	10-13
	[circled ], D	2-3	20-24	18-21
	[circled ]	3-4	37-42.5	32-37
	[circled ]	4-3	35-40	30-35
	[circled ], D	3-2	18-21.5	16-19
	[circled ], D	2-1	9-11.5	8-11
Wide-Open Throttle	[circled ], D	1-2	24-29	21-25
	[circled ], D	2-3	49-55	42-48
	[circled ]	3-4	74-83	64-72
	[circled ]	4-3	69-77	59-67
	[circled ], D	3-2	43-49	37-42
	[circled ], D	2-1	18-22	16-19

**NOTE:** D is the same as [circled ] with the transmission control switch actuated (light on).

\*(1) Nominal shift speed at sea level is shown. Actual shift speed will depend on tire brand, size and axle ratio. Refer to Automatic Transmission Special Specification Bulletin FPS-12180-99 for actual speeds.

## Torque Converter Diagnosis

Prior to torque converter replacement, all diagnostic procedures must be followed. This is to prevent the unnecessary replacement of good torque converters. Only after a complete diagnostic evaluation can the decision be made to replace the torque converter.

**NOTE:** If equipped, turn the power take-off unit off for proper test results.

During PTO operation the on board diagnostics will be disabled. However, the circuit checks made by the diagnostic system and the FMEM will continue. PTO must be turned off to do on board diagnostics.

Begin with the normal diagnostic procedures as follows:

1. Preliminary Inspection.
2. Know and Understand the Customer's Concern.
3. Verify the Concern—Perform the Torque Converter Clutch Operation Test in this section.
4. Perform Diagnostic Procedures.
  - Run on-board diagnostics; refer to On-Board Diagnostics with NGS in this section.
    - Repair all non-transmission-related DTCs first.
    - Repair all transmission DTCs.
    - Rerun on-board diagnostics to verify repair.
  - Perform Line Pressure Test in this section.
  - Perform Stall Speed Test in this section.
  - Perform Diagnostic Routines in this section.
    - Use the Diagnosis by Symptom Index to locate the appropriate routine that best describes the symptom(s). The routine will list all possible components that may cause or contribute to the symptom. Check each component listed; diagnose and repair as required, before repairing the torque converter.

### **Torque Converter Operation Test**

This test verifies that the torque converter clutch control system and the torque converter are operating properly.

1. Perform Quick Test; refer to On-Board Diagnostics with NGS in this section. Check for DTCs; Refer to the Diagnostic Trouble Code Chart.
2. Connect a tachometer to the engine.
3. Bring the engine to normal operating temperature by driving the vehicle at highway speeds for approximately 15 minutes in [circled ] position.
4. After normal operating temperature is reached, maintain a constant vehicle speed of about 80 km/h (50 mph) and tap brake pedal with the left foot.
5. Engine rpm should increase when brake pedal is tapped and decrease about five seconds after pedal is released. If this does not occur, refer to Torque Converter Clutch Operation Concerns in the Diagnosis by Symptom Index.
6. If the vehicle stalls in [circled ] or manual 2 at idle with vehicle at a stop, move the transmission range selector lever to manual 1 position. If the vehicle stalls, refer to Torque Converter Clutch Operation Concerns in the Diagnosis by Symptom Index section. Repair as required. If the vehicle does not stall in [circled ], refer to Diagnosis by Symptom Index.

## **Visual Inspection**

This inspection will identify modifications or additions to the vehicle operating system that may affect diagnosis.

Inspect vehicle for non-Ford approved add-on devices such as:

- Electronic add-on items
  - air conditioning.
  - generators (alternators).
  - engine turbos.
  - cellular telephones.
  - cruise controls.
  - CB radios.
  - linear amplifiers.
  - backup alarm signals.
  - electronic brakes for trailer towing
  - computers.
- Vehicle modifications.

These items, if not installed properly, will affect powertrain control module or transmission function. Pay particular attention to add-on wiring splices in the powertrain control module harness or transmission wiring harness, abnormal tire size or axle ratio changes.

Leaks; refer to Leakage Inspection in this section.

## **Shift Linkage Check**

Check for a misadjustment in shift linkage by matching the detents in the transmission range selector lever with those in the transmission. If they match, the misadjustment is in the indicator. Do not adjust the shift linkage.

Hydraulic leakage at the manual control valve can cause delay in engagements and/or slipping while operating if the linkage is not correctly adjusted; refer to [Section 307-05](#) for shift linkage adjustment.

## **Check TSBs and OASIS**

Refer to all Technical Service Bulletins and OASIS messages that pertain to the transmission concerns, and follow the procedure outlined.

## **Perform On-Board Diagnostics**

**NOTE:** If equipped, turn the power take-off unit off to ensure proper test results. On-Board Diagnostic is not accessible when the power take-off is in operation.

After a road test, with the vehicle warm and before disconnecting any connectors, perform the Quick Test using the New Generation Star (NGS) Tester. Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the powertrain control system.


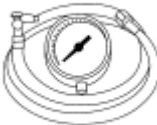


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SECTION 307-01: Automatic  
Transaxle/Transmission  
DIAGNOSIS AND TESTING

1999 F-Super Duty 250-550 Workshop  
Manual  
[Procedure revision date: 01/26/2000](#)

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**Diagnostics**

Special Tool(s)	
 ST1300-A	12 Volt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent
 ST1565-A	Pressure Gauge 307-004 (T57L-77820-A)
 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
 ST1532-A	Cable and Overlay: E4OD 95/ 418-F037 (007-00107) or equivalent

 ST1391-A	EEC-V 104-Pin Breakout Box 418-049 (014-00950) or equivalent
 ST1217-A	New Generation Star Tester 418-F048 (007-00500) or equivalent
 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
 ST1633-A	Digital Transmission Range (TR) Sensor Alignment Tool 307-351 (T97P-70010-A)
 ST1533-A	TRS-E Cable: E4OD 97 and Up 418-F107 (007-00111) or equivalent and Digital TR Overlay 007-00131 or equivalent

Diagnosing an electronically controlled automatic transmission (7003) is simplified by using the following procedures. One of the most important things to remember is that there is a definite procedure to follow. **DO NOT TAKE SHORT CUTS OR ASSUME THAT CRITICAL CHECKS OR ADJUSTMENTS HAVE ALREADY BEEN MADE.** Follow the procedures as written to avoid missing critical components or steps. By following the diagnostic sequence, the technician will be able to diagnose and repair the concern the first time.

### On-Board Diagnostics with NGS

**NOTE:** For detailed instruction and other diagnostic methods using the NGS, refer to the NGS tester manual and the Powertrain Control/Emissions Diagnosis (PC/ED) manual

These quick tests should be used to diagnose the powertrain control module (PCM) (12A650) and should be performed in order.

- Quick Test 1.0-Visual Inspection
- Quick Test 2.0-Set Up
- Quick Test 3.0-Key On, Engine Off



- Quick Test 4.0-Continuous Memory
- Quick Test 5.0-Key On, Engine Running
- Special Test Mode
  - Wiggle Test
  - Output Test Mode
- PCM Reset Mode
- Clearing DTCs
- OBD II Drive Cycle
- Other NGS Features
- For further information on other diagnostic testing features using the NGS or generic scan tool, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual. Other diagnostic methods include the following.
  - Parameter Identification (PID) Access Mode
  - Freeze Frame Data Access Mode
  - Oxygen Sensor Monitor Mode

## **Transmission Drive Cycle Test**

**NOTE:** If equipped, turn the power take-off unit off for proper test results.

**NOTE:** Always drive the vehicle in a safe manner according to driving conditions and obey all traffic laws.

**NOTE:** The Transmission Cycle Test must be followed exactly. Malfunctions must occur four times consecutively for the shift error DTC code to be set and five times consecutively for the continuous torque converter clutch code to set.

**NOTE:** When performing the Transmission Drive Cycle Test refer to the Solenoid Operation Chart for proper solenoid operation.

After performing the Quick Test, use the Transmission Drive Cycle Test for checking continuous codes.

1. Record and then erase the Quick Test codes.
2. Warm the engine to normal operating temperature.
3. Make sure the transmission fluid level is correct.
4. With the transmission in OVERDRIVE, moderately accelerate from stop to 80 km/h (50 mph). This allows the transmission to shift into fourth gear. Hold speed and throttle open steady for a minimum of 15 seconds.
5. With transmission in OVERDRIVE, press transmission control switch (TCS) (transmission control illuminator lamp (TCIL) should illuminate) and moderately accelerate from stop to 64 km/h (40 mph). This allows the transmission to shift into third gear. Hold speed and throttle open steady for a minimum of 15 seconds (30 seconds above 4000 ft altitude).

6. Press TCS (TCIL should turn off) and accelerate from 64 km/h (40 mph) to 80 km/h (50 mph). This allows transmission to shift into fourth gear. Hold speed and throttle position steady for a minimum of 15 seconds.
7. With transmission in fourth gear and maintaining steady speed and throttle opening, lightly apply and release brake to operate stoplamps. Then hold speed and throttle steady for an additional 5 seconds (minimum).
8. Brake to a stop and remain stopped for a minimum of 20 seconds.
9. Repeat Steps 4 through 8 at least five times.
10. Perform Quick Test and record continuous codes.

### **After On-Board Diagnostics**

**NOTE:** The vehicle wiring harness, powertrain control module and non-transmission sensors can affect transmission operations. Repair these concerns first.

After the On-Board Diagnostics procedures are completed, repair all DTCs.

Always repair all non-transmission-related DTCs first, then repair any transmission-related DTCs. Refer to the following Diagnostic Trouble Code Chart for information on condition and symptoms. This chart will be helpful in referring to the proper manual(s) and to aid in diagnosing internal transmission concerns and external non-transmission inputs. The pinpoint tests are used in diagnosing electrical concerns of the 4R100 transmission. Make sure the vehicle wiring harness and the powertrain control module are diagnosed as well. The Powertrain Control/Emissions Diagnosis (PC/ED) manual will aid in diagnosing non-transmission-related electronic components.

### **Before Pinpoint Tests**

**NOTE:** Prior to entering pinpoint tests, check the powertrain control module (PCM) wiring harness for proper connections, bent or broken pins, corrosion, loose wires, proper routing, proper seals and their condition. Check the PCM, sensors and actuators for damage. Refer to Powertrain Control/Emissions Diagnosis (PC/ED) manual.

**NOTE:** If a concern still exists after electrical diagnosis has been performed, refer to Diagnosis by Symptom in this section.

If DTCs appear while performing the on-board diagnostics, refer to the Diagnostic Trouble Code Chart for the appropriate procedure. Prior to entering pinpoint tests, refer to any TSBs and OASIS messages for transmission concerns.

## Diagnostic Trouble Code Charts

Diagnostic Trouble Code Chart					
Diagnostic Trouble Code	Component	Description	Condition	Symptom	Action
P1111	System	Pass	No concern detected.	Concern not detected by PCM.	Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) Manual. <sup>a</sup>
P0340, P0341, P0344	DI	DI system concern.	Engine rpm circuit failure.	CKP sensor failure/engine will stall or not run. May flash TCIL. <sup>b</sup>	Refer to PC/ED. <sup>a</sup>
P0237	Manifold Absolute Pressure Sensor	MAP sensor out of On-Board Diagnostics range.	MAP sensor signal higher or lower than expected or no response during Dynamic Response (Goose) Test.	—	Rerun On-Board Diagnostics.
P0236	Manifold Absolute Pressure Sensor	MAP sensor vacuum circuit failure.	MAP sensor signal higher or lower than expected or no response due to vacuum hose, circuit damaged, disconnected or restricted.	Firm shift feel, late shifts at altitude.	Refer to PC/ED. <sup>a</sup>
P1124	Throttle Position Sensor	TP sensor out of On-Board Diagnostics range.	TP sensor (gasoline engines) not at idle position during KOEO.	—	Rerun at appropriate TP sensor position per the engine application.
P0235	Manifold Absolute Pressure Sensor	MAP sensor inactive.	MAP sensor or circuit open, shorted to ground or 5V.	Firm shift feel, late shift at altitude.	Refer to PC/ED. <sup>a</sup>
P1711	TFT Sensor	TFT sensor out of On-Board Diagnostics range.	Transmission not at operating temperature during On-Board Diagnostics.	—	Warm vehicle to normal operating temperature and rerun On-Board Diagnostics.

P0500, P0503, P1500	VSS/ABS	Insufficient or intermittent vehicle speed input from VSS/ABS.	PCM detected a loss of vehicle speed signal during operation.	Harsh engagements, firm shift feel, abnormal shift schedule, unexpected downshifts may occur at closed throttle, abnormal TCC operation or engages only at WOT. May flash TCIL.	Refer to PC/ED. <sup>a</sup>
P0781 <sup>c</sup> , P0731 <sup>c</sup>	SSA, SSB or Internal Transmission Components	1-2 shift error.	Engine rpm drop not detected when 1-2 shift was commanded by PCM.	Improper gear selection depending on failure mode and transmission range selector lever position. Refer to Shift Solenoid Operation Chart. Shift errors may also be due to other internal transmission concerns such as stuck valves or damaged friction material. May flash TCIL.	Refer to <a href="#">Pinpoint Test A</a> .
P0123	TP or AP Sensor	TP or AP sensor circuit above maximum voltage (short to vehicle power).	Voltage above or below specification for On-Board Diagnostics or during normal vehicle operation.	Harsh engagements, firm shift feel, abnormal shift schedule, abnormal TCC operation or does not engage.	Refer to PC/ED. <sup>a</sup>
P0713	TFT Sensor	-40°C (-40°F) indicated, TFT sensor circuit open.	Voltage drop across TFT sensor exceeds scale set for temperature -40°C (-40°F).	TCC and stabilized shift schedule may be enabled sooner after cold start. May flash TCIL.	Refer to <a href="#">Pinpoint Test B</a> .
P0782 <sup>c</sup> , P0732 <sup>c</sup>	SSA, SSB or Internal Transmission Components	2-3 shift error.	Engine rpm drop not detected when 2-3 shift was commanded by PCM.	Improper gear selection depending on failure mode and transmission range	Refer to <a href="#">Pinpoint Test A</a> .

				selector lever position. Refer to Shift Solenoid Operation Chart. Shift errors may also be due to other internal transmission concerns such as stuck valves or damaged friction material. May flash TCIL.	
P1728	Transmission	Transmission slippage detection.	Excessive amount of clutch slippage was detected.	Transmission slippage, erratic or no TCC operation. May flash TCIL.	Refer to Diagnosis by Symptom.
P0122	TP or AP Sensor	TP or AP sensor circuit below minimum voltage, (open/shorted to ground).	Voltage below specification for On-Board Diagnostics or during normal vehicle operation.	Harsh engagements, firm shift feel, abnormal shift schedule, abnormal TCC operation or does not engage.	Refer to PC/ED. <sup>a</sup>
P1120	Throttle Position Sensor	TP sensor voltage lower than expected.	Voltage below specification.	Harsh engagements, firm shift feel, abnormal shift schedule, abnormal TCC operation or does not engage.	Refer to PC/ED. <sup>a</sup>
P1780	TCS	TCS not changing state.	TCS not cycled during On-Board Diagnostics/circuit open or shorted.	No overdrive cancel when switch is cycled.	Rerun diagnostics and cycle switch. Refer to PC/ED. <sup>a</sup>
P0712	TFT Sensor	157°C (315°F) indicated, TFT sensor circuit grounded.	Voltage drop across TFT sensor exceeds scale set for temperature of 157°C (315°F).	TCC and stabilized shift schedule may be enabled sooner after cold start. May flash TCIL.	Refer to <a href="#">Pinpoint Test B</a> .
P1460 P1463 P1464	A/C	A/C switch error.	DTC can result from A/C being ON during On-Board Diagnostics.	Failed on — electronic pressure control pressure slightly low with A/C off. Failed off —	Refer to PC/ED. <sup>a</sup>

				electronic pressure control pressure slightly low with A/C on.	
P1705	Digital TR Sensor	Digital TR sensor not in park or neutral.	On-Board Diagnostics not run in park or neutral.	—	Rerun On-Board Diagnostics in park. Refer to <a href="#">Pinpoint Test D</a> .
P0705	Digital TR Sensor	Digital TR sensor circuit malfunction.	Digital TR sensor circuit has incorrect output, switch states are incorrect.	Harsh engagements, firm shift feel. May flash TCIL.	Refer to <a href="#">Pinpoint Test D</a> .
P1783	TFT Sensor	Transmission overtemp condition.	Transmission fluid temperature exceeded 132°C (270°F).	Slight increase in electronic pressure control pressure. May flash TCIL.	Refer to <a href="#">Pinpoint Test B</a> .
P0708	Digital TR Sensor	Digital TR sensor circuit TR3A above maximum voltage.	Digital TR sensor, circuit or PCM indicates open.	Increase in electronic pressure control pressure.	Refer to <a href="#">Pinpoint Test D</a> .
P0102, P0103, P1100, P1101	MAF Sensor	MAF sensor DTC.	MAF sensor system fails to operate in a normal manner, which may cause a transmission concern.	High electronic pressure control pressure. Firm shifts and engagements. May flash TCIL.	Refer to PC/ED. <sup>a</sup>
P0107	BARO	BARO circuit failure.	BARO signal lower than expected.	Firm shift feel, late shifts at altitude.	Refer to PC/ED. <sup>a</sup>
P0108	BARO	BARO circuit failure.	BARO signal higher or lower than expected.	Firm shifts, late shifts at altitude.	Refer to PC/ED. <sup>a</sup>
P0783 <sup>c</sup> , P0733 <sup>c</sup>	SSA, SSB or Internal Transmission Components	3-4 shift error.	Engine rpm drop not detected when 3-4 shift was commanded by PCM.	Improper gear selection depending on failure mode and transmission range selector lever position. Refer to Shift Solenoid Operation Chart. Shift errors may also be due to other	Refer to <a href="#">Pinpoint Test A</a> .

				internal transmission concerns such as stuck valves or damaged friction material. May flash TCIL.	
P1703	BPP Switch	Brake not actuated during On-Board Diagnostics.	Brake not cycled during KOER.	Failed on or not connected — TCC will not engage at less than one-third throttle.	Rerun On-Board Diagnostic and activate BPP switch. Refer to PC/ED. <sup>a</sup>
P0703, P0571	BPP Switch	BPP switch circuit failed.	BPP circuit failure.	Failed off — TCC will not disengage when brake is applied.	Refer to PC/ED. <sup>a</sup>
P0750 <sup>d</sup>	SSA	Shift solenoid circuit failure.	SSA circuit failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Improper gear selection depending on failure mode and transmission range selector lever position. Refer to Shift Solenoid Operation Chart.	Refer to <a href="#">Pinpoint Test A</a> .
P0755 <sup>d</sup>	SSB	SSB circuit failure.	SSB circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Improper gear selection depending on failure mode and transmission range selector lever position. Refer to the Shift Solenoid Operation Chart.	Refer to <a href="#">Pinpoint Test A</a> .
P1714	SSA	SSA malfunction.	Mechanical failure of the solenoid detected.	Improper gear selection depending on condition, mode and manual lever position. Refer to Solenoid Operation Chart.	Refer to <a href="#">Pinpoint Test H</a> .
P1715	SSB	SSB malfunction.	Mechanical failure of the solenoid detected.	Improper gear selection depending on condition, mode and manual lever	Refer to <a href="#">Pinpoint Test H</a> .

				position. Refer to Solenoid Operation Chart.	
P1740	TCC	TCC malfunction.	Mechanical failure of the solenoid detected.	Harsh shift, may flash TCIL.	Refer to <a href="#">Pinpoint Test H</a> .
P1754 <sup>d</sup>	CCS	CCS circuit failure.	CCS failed to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Failed off — no third gear engine braking in overdrive cancel. Failed on — third gear engine braking in overdrive range. Coast clutch may be damaged causing eventual failure.	Refer to <a href="#">Pinpoint Test G</a> .
P0743 <sup>d</sup>	TCC Solenoid	TCC solenoid circuit failure.	TCC solenoid circuit fails to provide voltage drop across solenoid. Circuit open or shorted or PCM driver failure during KOEO.	Short circuit — engine stalls in DRIVE or MANUAL 2 at idle with brake applied. Open circuit — TCC never engaged.	Refer to <a href="#">Pinpoint Test C</a> .
P1747 <sup>d</sup>	EPC	EPC circuit failure, shorted circuit or PCM.	Current through EPC circuit is checked and compared after a time delay. An error will be noted if tolerance is exceeded during KOEO and continuous On-Board Diagnostics.	Short circuit — causes minimum electronic pressure control pressure (minimum capacity). Limits engine torque (partial fuel shut-off, heavy misfire). Flashing TCIL.	Refer to <a href="#">Pinpoint Test E</a> .
P1746 <sup>d</sup>	EPC	PCM failure — electronic pressure control driver.	Current through EPC circuit is checked and compared after a time delay. An error will be noted if tolerance is exceeded during	Open circuit — causes maximum electronic pressure control, harsh engagements and shifts. May flash TCIL.	Refer to <a href="#">Pinpoint Test E</a> .



			KOEO and continuous On-Board Diagnostics.		
P0741 <sup>c</sup> , P1744 <sup>c</sup>	TCC	TCC slippage detected.	The PCM picked up an excessive amount of TCC slippage during normal vehicle operation.	TCC slippage/erratic or no torque converter clutch operation Flash TCIL.	Refer to Diagnosis by Symptom Index.
P1713	TFT	No change in TFT - Low range	PCM has detected no TFT change at low range during operation.	May flash TCIL.	Refer to <a href="#">Pinpoint Test B.</a>
P1718	TFT	No change in TFT - High range	PCM has detected no TFT change at high range during operation.	May flash TCIL.	Refer to <a href="#">Pinpoint Test B.</a>
P1704	DIGITAL TR	Digital TR sensor failure in transition state	Digital TR sensor misaligned or failed electrically.	Increase in EPC pressure.	Refer to <a href="#">Pinpoint Test D.</a>
P1280	ICP Sensor	ICP sensor circuit failure. Out of range low.	Open/Grounded circuit, biased sensor or PCM.	May result in firm shifts.	Refer to the 7.3L DI PC/ED Manual. <sup>a</sup>
P1281	ICP Sensor	ICP sensor circuit failure. Out of range high.	Short circuit to 5 volt ref., biased sensor or PCM.	May result in firm shifts.	Refer to the 7.3L DI PC/ED Manual. <sup>a</sup>
P0721	OSS	OSS Signal Noisy	PCM has Detected an Noisy OSS Sensor Signal.	Set DTC.	Refer to <a href="#">Pinpoint Test F.</a>
P0720	OSS	Insufficient Input from OSS Sensor	PCM has Detected a Loss of OSS Signal During Operation.	Set DTC, Flash TCIL, Flash MIL.	Refer to <a href="#">Pinpoint Test F.</a>
P0722	OSS	OSS Signal Intermittent	PCM has Detected an Intermittent OSS Signal.	Set DTC, Flash TCIL.	Refer to <a href="#">Pinpoint Test F.</a>
P0718	TSS	TSS Signal Noisy	PCM has Detected and Noisy TSS Sensor Signal.	Set DTC.	Refer to <a href="#">Pinpoint Test F.</a>
P0715	TSS	Insufficient	PCM has Detected	Set DTC, Flash	Refer to <a href="#">Pinpoint</a>

		Input from TSS Sensor	Loss of TSS Signal During Operation.	TCIL, Flash MIL. Schedule Operation.	<a href="#">Test F.</a>
P0717	TSS	TSS Signal Intermittent	PCM has Detected and Intermittent TSS Signal.	Set DTC, Flash TCIL.	Refer to <a href="#">Pinpoint Test F.</a>
P1702	Digital TR	Digital TR Signal Intermittent	PCM has Detected and Intermittent Digital TR Signal.	Erratic Harsh Shift/Engagements.	Refer to <a href="#">Pinpoint Test D.</a>
P1781	4x4L	4x4 Low Switch Failure	Switch Closed or Shorted During KOEO.	Early or delayed shifts.	Refer to PC/ED. <sup>a</sup> .
P1729	4x4L	4x4 Low Switch Failure	Circuit Open/Closed. Shorted during KOEO.	Early or Delayed Shifts.	Refer to PC/ED. <sup>a</sup> .
P1760	EPC	EPC Signal Intermittent Short	PCM has Detected and Intermittent Short.	Short Circuit Causes Minimum EPC Pressure (Minimum Capacity).	Refer to <a href="#">Pinpoint Test F.</a>

<sup>a</sup> Can be purchased as a separate item.

<sup>b</sup> Distributor ignition (DI) system.

<sup>c</sup> May also be generated by other non-electronic-related transmission hardware condition.

<sup>d</sup> Output circuit check, generated only by electrical conditions.

## Rotunda Transmission Tester

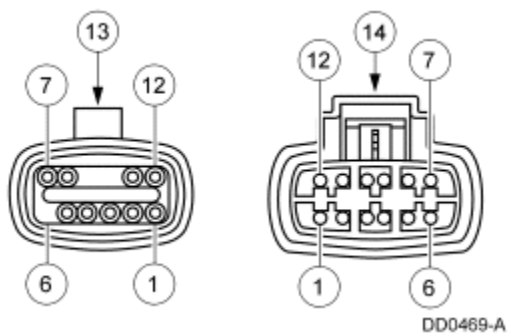
The Transmission Tester is used to diagnose the electronically controlled transmission and is used in conjunction with the pinpoint tests. The tests should be performed in order. Installing the Transmission Tester allows separation of the vehicle electronics from transmission electronics; refer to the Transmission Tester manual for these tests and instructions.

- Bench Testing—Engine Off
- Resistance/Continuity Test
- Solenoid Voltage Test
- Dynamic Testing—Engine On
- EPC Solenoid
- Transmission Engagements
- Upshifts/Downshifts
- Torque Converter Clutch (TCC) Engagement
- Coast Clutch Engagements
- Turbine Shaft Speed (TSS) Sensor
- Output Shaft Speed (OSS) Sensor
- Digital Transmission Range (TR) Sensor Testing
- Resistance/Continuity Test

- Sensor Tests
- Switch Test—Park/Neutral, Backup Lamp and Optional Circuits

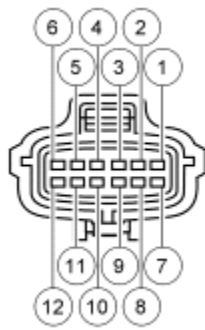
## Transmission Connector Layouts

### Transmission Vehicle Harness Connector



12-Way Connector Pin	Description	PCM Connector Pin	
		Gas/ Diesel (Cal.)	Diesel (49-State)
1	Vehicle Power (VPWR)	71, 97	71, 97
2	Shift Solenoid B (2)	11	1
3	Shift Solenoid A (1)	6	27
4	Torque Converter Clutch	54	28
5	Coast Clutch Solenoid	20	53
6	—	—	—
7	Transmission Fluid Temperature Sensor	37	37
8	Signal Return (SIG RTN)	91	91
9	—	—	—
10	—	—	—
11	Electronic Pressure Control	81	81
12	Electronic Pressure Control Power	71, 97	71, 97
13	Solenoid Body Connector	—	—
14	Harness Connector	—	—

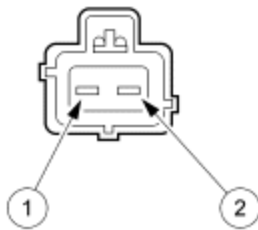
### Digital Transmission Range (TR) Sensor Connector



DD0470-A

Pin Number	Circuit Function	PCM Pin
1	Not Used	—
2	SIG RTN	91
3	TR3A	64
4	TR1	34 (17 Diesel)
5	TR2	49
6	TR4	50
7	Not Used	—
8	Not Used	—
9	FSD PWR FD	—
10	STR Control	—
11	Back Up	—
12	STR to INT	—

#### Output Shaft Speed (OSS) Sensor Connector



AD2453-A

Pin Number	Circuit	Circuit Function
1	—	Output Shaft Speed Sensor (OSS)
2	—	Signal Return

## Pinpoint Tests

**NOTE:** If equipped, turn the power take-off unit off for proper test results. On-Board Diagnostic is not accessible when the power take-off unit is in operation. SS2/SSB is on when the power take-off is in operation.

Any time an electrical connector or solenoid body is disconnected, inspect the connector for terminal condition, corrosion and contamination. Also inspect the connector seal for damage. Clean, repair or replace as required.

## Shift Solenoids Pre-Diagnosis

Use the following shift solenoid operation information when performing Pinpoint Test A.

Solenoid Operation Chart					
Transmission Range Selector Lever Position	PCM Commanded Gear	SSA	SSB	TCC	CCS
P/R/N	1	ON	OFF	<sup>a</sup>	<sup>a</sup>
[circled ]	1	ON	OFF	<sup>a</sup>	<sup>a</sup>
[circled ]	2	ON	ON	<sup>a</sup>	<sup>a</sup>
[circled ]	3	OFF	ON	<sup>a</sup>	<sup>a</sup>
[circled ]	4	OFF	OFF	<sup>a</sup>	OFF
[circled ] Cancel	First Through Third Gear Only, SSA, SSB, TCC, Same as Overdrive, CCS Always On.				
MANUAL 2	2	<sup>a</sup>	<sup>a</sup>	<sup>a</sup>	ON
MANUAL 1	2	OFF	OFF	OFF	ON
MANUAL 1	1	ON	OFF	OFF	ON

<sup>a</sup> Powertrain control module-controlled.

## Shift Solenoid Failure Mode Chart Always OFF

Failed OFF due to PCM /vehicle wiring concerns; solenoid electrically or hydraulically stuck off.

SSA Always Off			
PCM Gear Commanded	Gear Lever Position		
	[circled ]	2	1
Actual Gear Obtained			
1	4	2	1

2	3	2	2
3	3	2	2
4	4	2	2

SSB Always Off*			
PCM Gear Commanded	Gear Lever Position		
	[circled ]	2	1
Actual Gear Obtained			
1	1	2	1
2	1	2	1
3	4	2	2
4	4	2	2

\* PTO will not operate.

#### Shift Solenoid Failure Mode Chart Always ON

Failed ON due to PCM /vehicle wiring concerns; solenoid electrically or hydraulically stuck on.

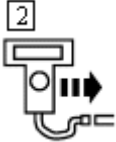


SSA Always On			
PCM Gear Commanded	Gear Lever Position		
	[circled ]	2	1
Actual Gear Obtained			
1	1	2	1
2	2	2	1
3	2	2	1
4	1	2	1

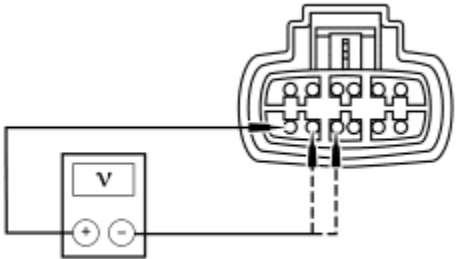



SSB Always On*			
PCM Gear Commanded	Gear Lever Position		
	[circled ]	2	1
Actual Gear Obtained			
1	2	2	1
2	2	2	1
3	3	2	2
4	3	2	2

\* PTO will always be on.

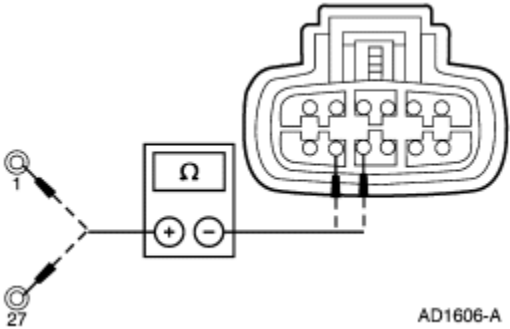
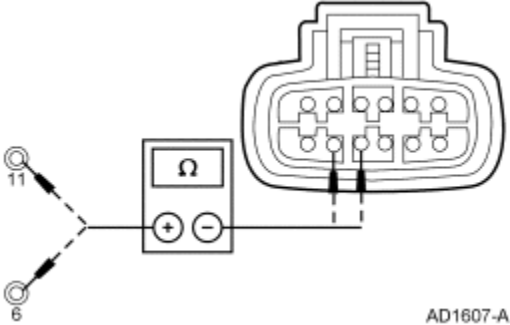
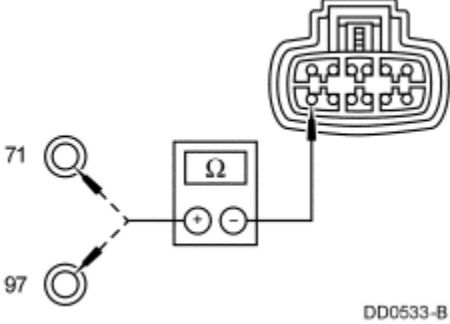
#### PINPOINT TEST A: SHIFT SOLENOIDS

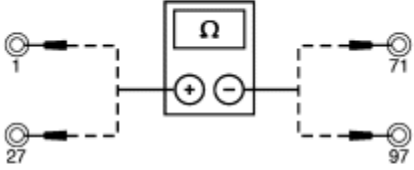
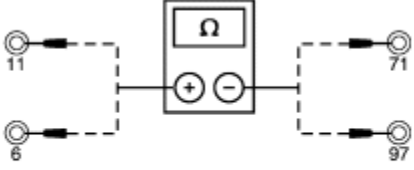
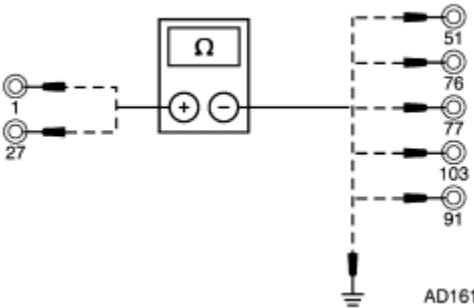
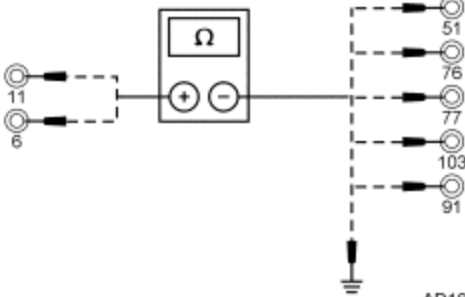
**NOTE:** Refer to the transmission vehicle harness connector illustration preceding these pinpoint tests.


CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>A1 ELECTRONIC DIAGNOSTICS</b>	
	<b>1</b> Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding.
<b>2</b>   New Generation Star Tester (NGS)	
	<b>3</b> Perform the KOEO test until continuous DTCs have been displayed.
	<b>4</b> Enter the Output Test Mode (OTM).
	<b>5</b> Select the ALL ON mode. Push START to turn outputs on. Push STOP to turn outputs off.
	<ul style="list-style-type: none"><li>• <b>Does the vehicle enter OTM?</b></li></ul> <p>→ <b>Yes</b> REMAIN in OTM. GO to <a href="#">A2</a> .</p> <p>→ <b>No</b> PRESS START. If the vehicle does not enter OTM, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p>
<b>A2 CHECK THE ELECTRICAL SIGNAL OPERATION</b>	
<b>1</b>   Transmission Connector	<b>1</b>  <b>CAUTION:</b> Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always reinstall the heat shield when the procedure is completed.

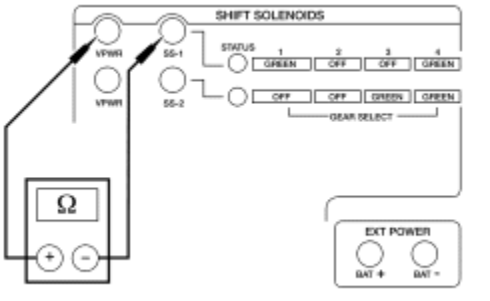
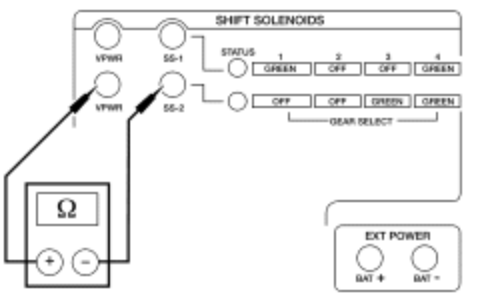
	<p>2 Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.</p>
<p>3</p>  <p>DD0531-A</p>	<p>3 Connect a VOM positive lead to the VPWR pin and the negative test lead to the appropriate solenoid signal circuit pin of the transmission vehicle harness connector.</p>
	<p>4 Place VOM on the 20-volt scale.</p>
	<p>5 While observing the VOM, press START and STOP to cycle the solenoid output on and off.</p>
	<ul style="list-style-type: none"> <li>Is the solenoid output voltage changed to approximately battery voltage?</li> </ul> <p>→ Yes GO to <a href="#">A5</a>.</p> <p>→ No GO to <a href="#">A3</a>.</p>
<p><b>A3 CHECK THE CONTINUITY OF THE SOLENOID SIGNAL AND VPWR CIRCUITS</b></p>	
<p>1</p> 	
<p>2</p>  <p>Powertrain Control Module (PCM)</p>	<p>2 Inspect for damaged or pushed-out pins, corrosion or loose wires.</p>
<p>3</p>  <p>Breakout Box</p>	

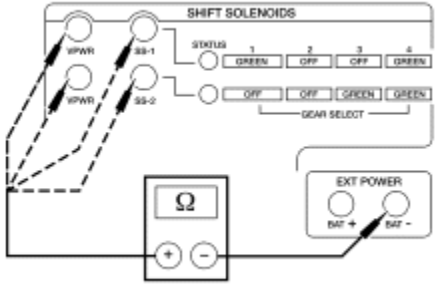


<p>4</p>  <p>AD1606-A</p>	<p>4 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pins 1 and 27 at the breakout box and the signal pins at the transmission harness connector.</p>
<p>5</p>  <p>AD1607-A</p>	<p>5 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between PCM signal test Pins 11 and 6 at the breakout box and the signal pins at the transmission harness connector.</p>
<p>6</p>  <p>DD0533-B</p>	<p>6 Measure the resistance between the VPWR test Pins 71 or 97 at the breakout box and the VPWR pin at the transmission harness connector.</p>
	<ul style="list-style-type: none"> <li>Is each resistance less than 5 ohms?</li> </ul> <p>→ <b>Yes</b> GO to <a href="#">A4</a>.</p> <p>→ <b>No</b> REPAIR the open circuit(s). REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<p><b>A4 CHECK THE SHIFT SOLENOID CIRCUITS FOR SHORTS TO POWER AND GROUND</b></p>	
<p>1</p>	<p>1 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pins 1 and 27 and the VPWR test</p>

 <p style="text-align: right;">AD1608-A</p>	<p>Pins 71 and 97 at the breakout box.</p>
<p>2</p>  <p style="text-align: right;">AD1609-A</p>	<p>2 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between PCM signal test Pins 11 and 6 and the VPWR test Pins 71 and 97 at the breakout box.</p>
<p>3</p>  <p style="text-align: right;">AD1610-A</p>	<p>3 On vehicles equipped with gasoline engines and 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pins 1 and 27 and test Pins 51, 76, 77, 103 and 91 at the breakout box and chassis ground.</p>
<p>4</p>  <p style="text-align: right;">AD1611-A</p>	<p>4 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between PCM signal test Pins 11 and 6 and test Pins 51, 76, 77, 103 and 91 at the breakout box and chassis ground.</p>
	<ul style="list-style-type: none"> <li>Is each resistance greater than 10000 ohms?</li> </ul> <p>→ Yes GO to <a href="#">A5</a>.</p>



	<p>→ <b>No</b>  REPAIR the short circuit(s). REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<b>A5 SOLENOID FUNCTIONAL TEST</b>	
	<p>1 Install the transmission tester to the transmission connector.</p>
	<p>2 <b>NOTE:</b> The LED will turn GREEN when the solenoid activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit).  Perform the Solenoid Voltage Test.</p>
	<ul style="list-style-type: none"> <li>• <b>Does the solenoid (LED GREEN) activate?</b></li> </ul> <p>→ <b>Yes</b>  GO to <a href="#">A6</a>.</p> <p>→ <b>No</b>  GO to <a href="#">A7</a>.</p>
<b>A6 TRANSMISSION DRIVE TEST</b>	
<p>1</p>  <p>Powertrain Control Module (PCM)</p>	
	<p>2 Perform the Dynamic Testing — Engine On.</p>
	<ul style="list-style-type: none"> <li>• <b>Does the vehicle upshift when commanded by the tester?</b></li> </ul> <p>→ <b>Yes</b>  REPLACE the PCM. ERASE all codes and PERFORM the Transmission Drive Cycle Test. RERUN the Quick Tests. If DTCs are still present, REFER to Diagnosis by Symptom Index.</p> <p>→ <b>No</b></p>


	GO to <a href="#">A7</a> .
<b>A7 CHECK THE RESISTANCE OF THE SOLENOIDS</b>	
<b>NOTE:</b> Refer to the transmission tester for terminal locations.	
	1 Place the bench/drive switch to the BENCH mode.
	2 Rotate the gear select switch to the OHMS CHECK position.
<p>3</p>  <p>D17292-A</p>	3 Connect the ohmmeter negative lead to the SSA/SS1 jack and the positive lead to the VPWR jack on the tester. This is to test SSA/SS1.
	4 Record the resistance. (The resistance should be between 20 and 30 ohms.)
<p>5</p>  <p>D17293-A</p>	5 Connect the ohmmeter negative lead to the SSB/SS2 jack and the positive lead to the VPWR jack on the tester. This to test SSB/SS2.
	6 Record the resistance. (The resistance should be between 20 and 30 ohms.)
	<p>• Is the resistance for each solenoid between 20 and 30 ohms?</p> <p>→ Yes GO to <a href="#">A8</a>.</p> <p>→ No REPLACE the solenoid body assembly. RECORD and ERASE the codes. REPEAT the Quick Tests.</p>
<b>A8 CHECK THE SOLENOIDS FOR SHORT TO GROUND</b>	

<div data-bbox="191 153 224 191" data-label="Text">1</div>  <div data-bbox="630 506 716 527" data-label="Text">D17294-A</div>	<div data-bbox="743 153 776 191" data-label="Text">1</div> <p>Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). (Connection should show infinite resistance [no continuity].)</p> <table border="1" data-bbox="836 342 1201 493"> <thead> <tr> <th>Solenoid</th><th>Tester Jack</th></tr> </thead> <tbody> <tr> <td>SSA/SS1</td><td>SSA/SS1/VPWR</td></tr> <tr> <td>SSB/SS2</td><td>SSB/SS2/VPWR</td></tr> </tbody> </table>	Solenoid	Tester Jack	SSA/SS1	SSA/SS1/VPWR	SSB/SS2	SSB/SS2/VPWR
Solenoid	Tester Jack						
SSA/SS1	SSA/SS1/VPWR						
SSB/SS2	SSB/SS2/VPWR						
	<ul style="list-style-type: none"> <li>Does the connection show continuity?</li> </ul> <p>→ <b>Yes</b> REPLACE the solenoid body assembly. RECORD and ERASE the codes. REPEAT the Quick Tests.</p> <p>→ <b>No</b> GO to the Diagnosis by Symptom Index.</p>						

## PINPOINT TEST B: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

**NOTE:** Refer to the transmission vehicle harness connector illustration preceding these pinpoint tests.

CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>B1 ELECTRONIC DIAGNOSTICS</b>	
	<div data-bbox="743 1293 776 1331" data-label="Text">1</div> <p>Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in the connector and in good condition before proceeding.</p>
<div data-bbox="191 1461 224 1499" data-label="Text">2</div>  <p>New Generation Star (NGS) Tester</p>	
<div data-bbox="191 1698 224 1736" data-label="Text">3</div> 	
	<div data-bbox="743 1858 776 1896" data-label="Text">4</div> <p>Select Diagnostic Data Link.</p>
	<div data-bbox="743 1911 776 1948" data-label="Text">5</div> <p>Select PCM.</p>

	<p><b>6</b> Select PID/Data Monitor and Record.</p>
<p><b>7</b></p>  <p>PIDs; TFT, TFTV</p>	
	<ul style="list-style-type: none"> <li>• <b>Does the vehicle enter PID/Data Monitor and Record?</b></li> </ul> <p>→ <b>Yes</b> REMAIN in PID/Data Control. GO to <a href="#">B2</a> .</p> <p>→ <b>No</b> REPEAT procedure to enter PID. If vehicle did not enter PID, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM and NGS.</p>
<b>B2 WARM-UP/COOL-DOWN CYCLE</b>	
	<p><b>1</b> While monitoring the TFT PIDs, perform the following test: If transmission is cold, run transmission to warm it up. If transmission is warm, allow transmission to cool down.</p>
	<ul style="list-style-type: none"> <li>• <b>Do the TFT PIDs increase as the transmission is warmed up or decrease as the transmission is cooled or does the TFT or TFTV drop in and out of range?</b></li> </ul> <p>→ <b>Yes</b> If the TFT PIDs increase as the transmission is warmed or decrease as the transmission is cooled, CLEAR all DTCs. Road test to verify if concern is still present. If concern is still present, REFER to Diagnosis by Symptom to diagnose transmission overheating.</p> <p>If the TFT or TFTV drop in and out of range, INSPECT for intermittent concern in the internal/external harness, sensor or connector.</p> <p>→ <b>No</b> GO to <a href="#">B3</a>.</p>

### B3 CHECK THE ELECTRICAL SIGNAL OPERATION

1



2



Transmission Connector

2

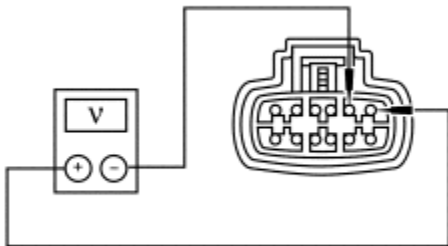


**CAUTION:** Remove the heat shield, if so equipped, from transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always reinstall the heat shield when the procedure is completed.

3

Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.

4



DD0537-A

4

Connect a VOM positive lead to the TFT signal circuit pin and the negative test lead to the SIG RTN circuit pin of the transmission harness connector.

5

Place the VOM on the 20-volt scale.

6




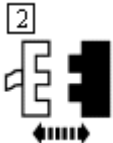

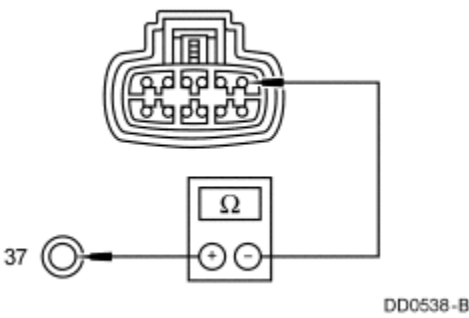
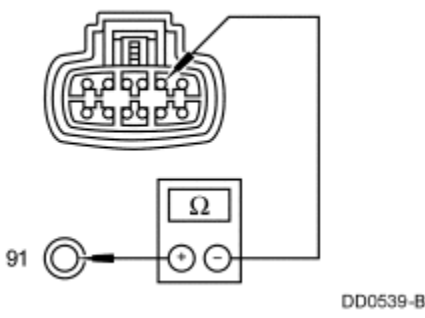
- Is the voltage between 4.75 and 5.25 volts?

→ **Yes**  
GO to [B7](#).

→ **No**  
GO to [B4](#).

### B4 CHECK THE CONTINUITY OF THE TFT SIGNAL AND SIG RTN CIRCUITS

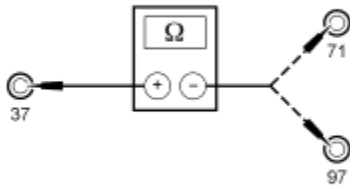
1

	
<div data-bbox="191 281 302 422">  </div> <div data-bbox="191 464 639 499"> Powertrain Control Module (PCM) </div>	<div data-bbox="743 281 1305 352"> 2 Inspect for damaged or pushed-out pins, corrosion or loose wires. </div>
<div data-bbox="191 518 302 659">  </div> <div data-bbox="191 701 367 737"> Breakout Box </div>	
<div data-bbox="191 756 224 791"> 4 </div> <div data-bbox="245 814 711 1129">  </div>	<div data-bbox="743 756 1399 863"> 4 Measure the resistance between the PCM signal test Pin 37 at the breakout box and the signal pin at the transmission harness connector. </div>
<div data-bbox="191 1148 224 1184"> 5 </div> <div data-bbox="289 1213 711 1528">  </div>	<div data-bbox="743 1148 1377 1262"> 5 Measure the resistance between the PCM SIG RTN test Pin 91 at the breakout box and the SIG RTN pin at the transmission harness connector. </div>
	<div data-bbox="786 1619 1317 1654"> <ul style="list-style-type: none"> <li>Is each resistance less than 5 ohms?</li> </ul> </div> <div data-bbox="743 1696 873 1766"> → Yes GO to <a href="#">B5</a>. </div> <div data-bbox="743 1808 1393 1955"> → No REPAIR the open circuits. REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests. </div>



## B5 CHECK THE TFT SIGNAL CIRCUIT FOR SHORT TO VPWR AND GROUND

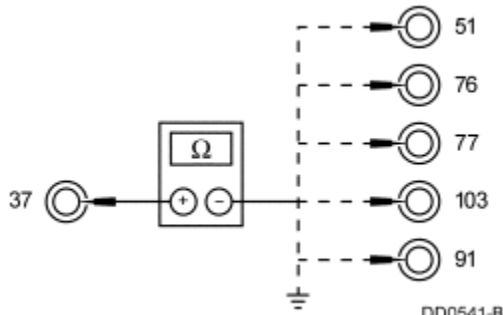
1



D17682-A

1 Measure the resistance between the PCM signal test Pin 37 and VPWR test Pins 71 and 97 at the breakout box.

2



DD0541-B

2 Measure the resistance between the PCM signal test Pin 37 and test Pins 51, 76, 77, 103, 91 at the breakout box and chassis ground.

- Is each resistance greater than 10,000 ohms?

→ Yes  
GO to [B6](#).

→ No  
REPAIR the short circuit(s). REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.

## B6 CHECK THE RESISTANCE OF THE TFT SENSOR

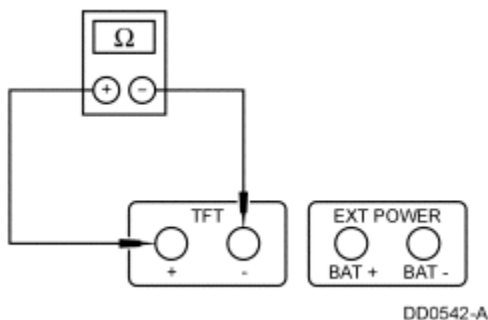
1 Install the transmission tester to the transmission connector.

2 Set the bench/drive switch to the BENCH mode.

3 Rotate the gear select switch to the OHMS CHECK position.

4

4 **NOTE:** While performing Tests 1 and 2 below, observe resistance. DTC P0713 is set if the resistance value exceeds 1062 k ohms (open circuit). DTC P0712 is set if the resistance value falls below 597 ohms (short circuit).



Connect the ohmmeter negative lead to the - TFT jack and the positive lead to the +TFT jack on the tester.

## 5 TEST 1

6 Record the resistance. Resistance should be approximately in the following ranges:

Transmission Fluid Temperature		
°C	°F	Resistance (Ohms)
-40 to -20	-40 to -4	1062 k-284 k
-19 to -1	-3-31	284 k-100 k
0-20	32-68	100 k-37 k
21-40	69-104	37 k-16 k
41-70	105-158	16 k-5 k
71-90	159-194	5 k-2.7 k
91-110	195-230	2.7 k-1.5 k
111-130	231-266	1.5 k-0.8 k
131-150	267-302	0.8 k-0.54 k

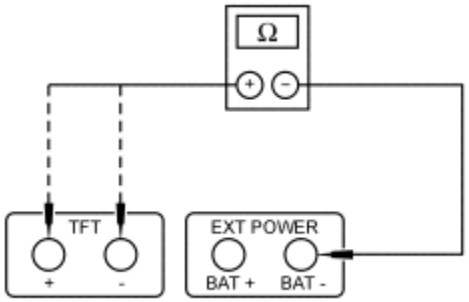
## 7 TEST 2

8 Check for an intermittent short or open.

9 If the resistance was between 0.8 k and 100 k ohms, perform the following test. If the transmission is cold, start and run the engine until transmission reaches its normal operating temperature. If the transmission is warm, allow the transmission to cool. Check the TFT sensor resistance again. Compare the resistance with the initial resistance. The resistance should decrease if the transmission was warmed and should increase if the transmission was allowed to cool. If the correct change in resistance occurs, repeat the Quick Test.

- Is the resistance in the specified range?

→ Yes  
GO to [B7](#).

	<p>→ <b>No</b>  REPLACE the solenoid assembly. RECORD and ERASE the codes. REPEAT the Quick Tests.</p>
<b>B7 CHECK THE TFT SENSOR FOR SHORT TO GROUND</b>	
<p>1</p>  <p>DD0543-A</p>	<p>1 Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack (-TFT or +TFT) with a digital ohmmeter or other low current tester (less than 200 milliamps). (Connection should show infinite resistance [no continuity].)</p>
	<ul style="list-style-type: none"> <li>• <b>Does the connection show continuity?</b></li> </ul> <p>→ <b>Yes</b>  REPLACE the solenoid assembly. REPEAT the Quick Tests.</p> <p>→ <b>No</b>  REPLACE the PCM. REPEAT the Quick Tests. If the DTC is still present and overtemp condition exists, CHECK the fluid condition. CHECK the overheat condition. REFER to Diagnosis by Symptom. REPAIR as required. REPEAT the Quick Tests.</p>

#### PINPOINT TEST C: TORQUE CONVERTER CLUTCH (TCC) SOLENOID

**NOTE:** Refer to the transmission vehicle harness connector illustration preceding these pinpoint tests.

CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>C1 ELECTRONIC DIAGNOSTICS</b>	
	<p>1 Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding.</p>
2	



New Generation Star Tester (NGS)

3 Perform KOEO test until continuous DTCs have been displayed.

4 Enter Output Test Mode (OTM).

5 Select the ALL ON mode. Push START to turn the outputs on. Push STOP to turn the outputs off.

• Does the vehicle enter OTM?

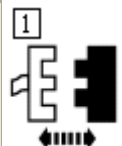
→ Yes

REMAIN in OTM. GO to [C2](#).

→ No

PRESS START. If vehicle does not enter OTM, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

C2 CHECK THE ELECTRICAL SIGNAL OPERATION

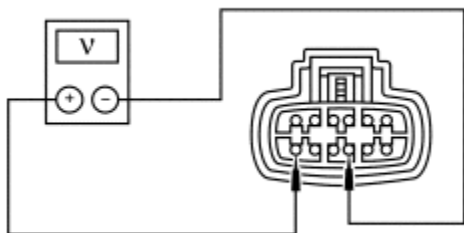


Transmission Connector

1 **CAUTION:** Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always reinstall the heat shield when the procedure is completed.




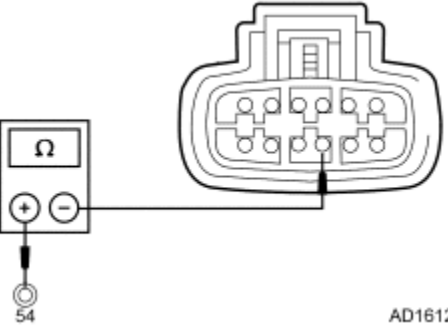
2 Use a mirror to inspect both ends of the connector for damaged or pushed-out pins, corrosion, loose wires and missing or damaged seals.

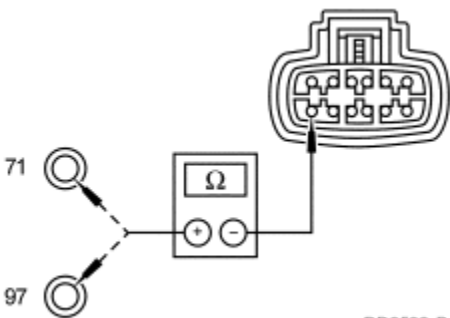
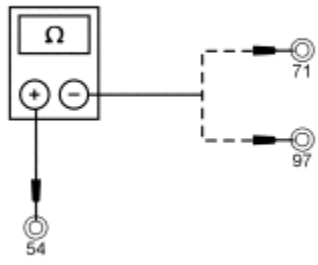
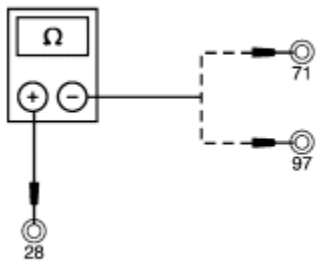
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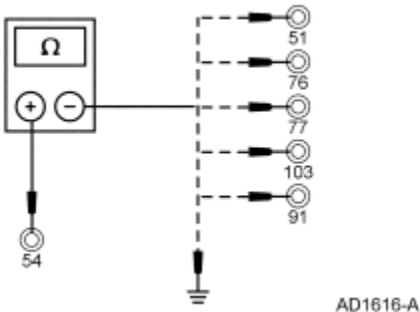
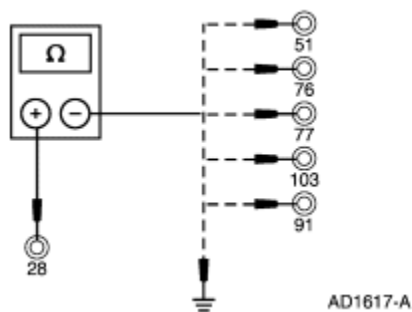



DD0545-A

3 Connect a VOM positive lead to the VPWR circuit pin and the negative test lead to the TCC signal circuit pin of the transmission vehicle harness connector.

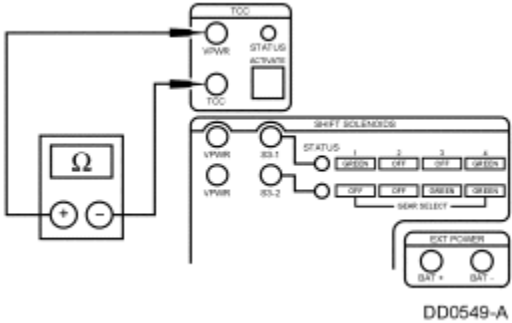
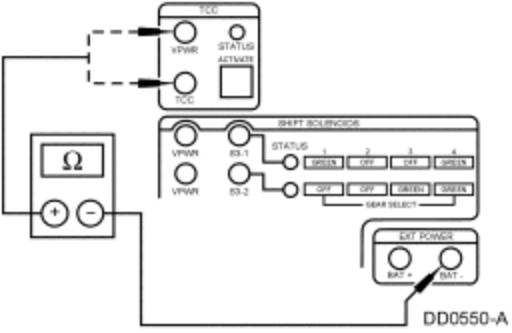
	<p>4 Place the VOM on the 20-volt scale.</p>
	<p>5 While observing the VOM, press start and stop to cycle the solenoid output on and off.</p>
	<ul style="list-style-type: none"> <li>Is the solenoid output voltage changed to approximately battery voltage?</li> </ul> <p>→ Yes GO to <a href="#">C6</a>.</p> <p>→ No GO to <a href="#">C3</a>.</p>
<b>C3 CHECK THE CONTINUITY OF THE TCC SIGNAL AND VPWR CIRCUITS</b>	
<p>1</p> 	
<p>2</p>  <p>Powertrain Control Module (PCM)</p>	<p>2 Inspect for damaged or pushed-out pins, corrosion or loose wires.</p>
<p>3</p>  <p>Breakout Box</p>	
<p>4</p>  <p>AD1612-A</p>	<p>4 Measure the resistance between the PCM signal test Pin 54 at the breakout box and the signal pin at the transmission harness connector.</p>
<p>5</p>	<p>5 Measure the resistance between the VPWR test Pin 71 or 97 at the breakout box and the VPWR pin at the transmission harness connector.</p>

 <p>DD0533-B</p>	
	<ul style="list-style-type: none"> <li>Is each resistance less than 5 ohms?</li> </ul> <p>→ <b>Yes</b> GO to <a href="#">C4</a>.</p> <p>→ <b>No</b> REPAIR the open circuits. REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<b>C4 CHECK THE TCC CIRCUIT FOR SHORT TO POWER</b>	
<p>1</p>  <p>AD1614-A</p>	<p>1 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between the PCM signal test Pin 54 and VPWR test Pins 71 and 97 at the breakout box.</p>
<p>2</p>  <p>AD1615-A</p>	<p>2 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pin 28 and VPWR test Pins 71 and 97 at the breakout box.</p>
	<ul style="list-style-type: none"> <li>Is each resistance greater than 10,000 ohms?</li> </ul>

	<p>→ <b>Yes</b> GO to <a href="#">C5</a>.</p> <p>→ <b>No</b> REPAIR the open circuits. REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<b>C5 CHECK THE TCC CIRCUIT FOR SHORT TO GROUND</b>	
<p><b>1</b></p> 	<p><b>1</b> On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between the PCM signal test Pin 54 and test Pins 51, 76, 77, 103 and 91 at the breakout box and chassis ground.</p>
<p><b>2</b></p> 	<p><b>2</b> On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pin 28 and test Pins 51, 76, 77, 103 and 91 at the breakout box and chassis ground.</p>
	<ul style="list-style-type: none"> <li>• <b>Is each resistance greater than 10,000 ohms?</b></li> </ul> <p>→ <b>Yes</b> GO to <a href="#">C6</a>.</p> <p>→ <b>No</b> REPAIR the short circuit(s). REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<b>C6 SOLENOID FUNCTIONAL TEST</b>	
	<p><b>1</b> Install the transmission tester to the transmission connector.</p>
	<p><b>2</b> <b>NOTE:</b> The LED will turn GREEN when the TCC solenoid activates and turn off when</p>



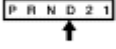

	<p>deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit).</p> <p>Perform the Solenoid Voltage Test.</p>
	<ul style="list-style-type: none"> <li>• <b>Does the solenoid (LED GREEN) activate when tester switch is pressed?</b></li> </ul> <p>→ <b>Yes</b> GO to <a href="#">C7</a>.</p> <p>→ <b>No</b> GO to <a href="#">C8</a>.</p>
<b>C7 TRANSMISSION DRIVE TEST</b>	
<div>1</div>  <p>Powertrain Control Module (PCM)</p>	
	<div>2</div> Perform the Dynamic Testing — Engine On.
	<ul style="list-style-type: none"> <li>• <b>Does the torque converter clutch solenoid activate (LED GREEN) and does the engine rpm drop?</b></li> </ul> <p>→ <b>Yes</b> REPLACE the PCM. ERASE all DTCs. PERFORM the Transmission Drive Cycle Test. REPEAT the Quick Tests. If the symptoms are still present, REFER to Diagnosis by Symptom Index — Torque Converter Clutch Operation Concerns.</p> <p>→ <b>No</b> GO to <a href="#">C8</a>.</p>
<b>C8 CHECK THE RESISTANCE OF THE SOLENOID</b>	
<b>NOTE:</b> Refer to the Transmission Tester for terminal locations.	
	<div>1</div> Place the bench/drive switch to the BENCH mode.
	<div>2</div> Rotate the gear select switch to the OHMS CHECK position.








<p>3</p>  <p>DD0549-A</p>	<p>3 Connect the ohmmeter negative lead to the TCC jack and the positive lead to the VPWR jack on the tester.</p>
	<p>4 Record the resistance. For gas applications the resistance should be between 20 and 30 ohms and for diesel application the resistance should be between 10 and 20 ohms.</p>
	<ul style="list-style-type: none"> <li>Is the resistance between 20 and 30 ohms for gas application and 10 and 20 ohms for diesel application?</li> </ul> <p>→ <b>Yes</b> GO to <a href="#">C9</a>.</p> <p>→ <b>No</b> REPLACE the solenoid body assembly.</p>
<p><b>C9 CHECK THE SOLENOID FOR SHORT TO GROUND</b></p>	
<p>1</p>  <p>DD0550-A</p>	<p>1 Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). (Connection should show infinite resistance [no continuity].)</p>
	<ul style="list-style-type: none"> <li>Does the connection show continuity?</li> </ul> <p>→ <b>Yes</b> REPLACE the solenoid body assembly.</p> <p>→ <b>No</b> REFER to the Diagnosis by Symptom Index — Torque Converter Clutch Operation Concerns.</p>

## PINPOINT TEST D: DIGITAL TRANSMISSION RANGE (TR) SENSOR

**NOTE:** Refer to the digital transmission range (TR) sensor harness connector illustration preceding these pinpoint tests.

CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>D1 VERIFY THE DIGITAL TRANSMISSION RANGE SENSOR ALIGNMENT</b>	
<b>1</b> 	
<b>2</b> 	
	<b>3</b> Check to make sure the digital TR sensor harness connector is fully seated, terminals are fully engaged in the connector and in good condition before proceeding.
	<b>4</b> Apply the parking brake.
<b>5</b> 	
	<b>6</b> Verify the shift linkage is adjusted in the OVERDRIVE position.
<b>7</b> 	
	<b>8</b> Verify that the Digital Transmission Range (TR) Sensor Alignment Tool fits in the appropriate slots.
	<ul style="list-style-type: none"><li>• <b>Is the digital TR sensor properly adjusted?</b></li></ul> <p>→ <b>Yes</b> GO to <a href="#">D2</a>.</p> <p>→ <b>No</b> ADJUST the digital TR sensor; refer to Digital</p>

	Transmission Range (TR) Sensor in this section. PLACE the transmission range selector lever into PARK. CLEAR the DTCs. REPEAT the Quick Tests.
<b>D2 CHECK THE ELECTRICAL SIGNAL OPERATION</b>	
<div>1</div> 	
<div>2</div>  <p>Digital TR Sensor</p>	<div>2</div>  <b>CAUTION: Do not pry on the connector. This will damage the connector and result in a transmission concern. Press the button and pull out on the harness connector.</b>
	<div>3</div> <p>Inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.</p>
	<ul style="list-style-type: none"> <li>• <b>Is there damage to the connector, pins or harness?</b></li> </ul> <p>→ <b>Yes</b> REPAIR as required. CLEAR the DTCs. REPEAT the Quick Tests.</p> <p>→ <b>No</b> If diagnosing a DTC, GO to <a href="#">D3</a> .</p> <p>If diagnosing a starting concern, a backup lamp concern, or an engagement concern, GO to <a href="#">D8</a> .</p>
<b>D3 CHECK THE ELECTRICAL SYSTEM OPERATION (DIGITAL TR SENSOR AND PCM)</b>	
<div>1</div> 	
<div>2</div>  <p>New Generation Star (NGS) Tester</p>	
<div>3</div>	



Digital TR Sensor

4



5



TR PIDS TR, TR\_D

6 Move the transmission range selector lever into each gear and stop.

7 Observe the PIDs, TR and TR\_D, while wiggling the harness and tapping on the sensor.

8 Compare the PIDs to the following chart.

Selector Position	TR	TR_D
Park	P/N	0000
Reverse	REV	1100
Neutral	NTRL	0110
Drive	O/D <sup>a</sup>	1111
Man 2	MAN2	1001
Man 1	MAN1	0011






<sup>a</sup> Will read DRIVE if the O/D cancel switch is ON.

- Do the PIDs, TR and TR\_D match the above chart and does the TR\_D PID remain steady when the harness is wiggled or when the sensor is tapped upon?

→ Yes

The concern is not in the digital TR sensor system. REFER to Diagnosis by Symptom for further diagnosis.

→ No

	GO to <a href="#">D4</a> . NOTE: If the TR_D PID changes when wiggling the harness or tapping on the sensor, the problem may be intermittent.
<b>D4 CHECK THE DIGITAL TRANSMISSION RANGE SENSOR OPERATION</b>	
<div>1</div>  <p>Digital TR Sensor</p>	<div>1</div>  <b>CAUTION: Do not pry on the connector. This will damage the connector and result in a transmission concern. Press the button and pull out on the harness connector.</b>
	<div>2</div> <p>Connect the tester cable E to the transmission tester. Connect the tester cable E black connector marked DIGITAL to the digital TR sensor.</p>
	<div>3</div> <p>Place the Digital TR Overlay onto the transmission tester.</p>
	<div>4</div> <p>Perform the sensor test as instructed on the Digital TR Overlay.</p>
	<ul style="list-style-type: none"> <li>• <b>Do the status lamps on the tester TR-E cable match the selected gear positions?</b></li> </ul> <p>→ <b>Yes</b> The concern is not in the digital TR sensor. GO to <a href="#">D5</a> .</p> <p>→ <b>No</b> REPLACE and ADJUST the digital TR sensor; refer to Digital Transmission Range (TR) Sensor in this section. CLEAR the DTCs. REPEAT the Quick Tests.</p>
<b>D5 CHECK THE PCM HARNESS CIRCUITS FOR OPENS</b>	
<div>1</div> 	
<div>2</div>  <p>Powertrain Control Module</p>	<div>2</div> <p>Inspect for damaged or pushed-out pins, corrosion or loose wires.</p>
<div>3</div>	<div>3</div>  <b>CAUTION: Do not pry on the connector. This will damage the connector and</b>



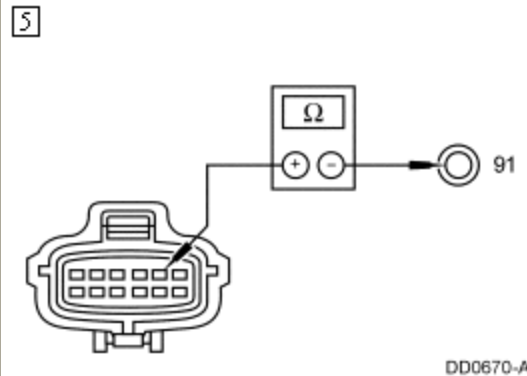
Digital TR Sensor

**result in a transmission concern. Press the button and pull out on the digital TR sensor harness connector.**



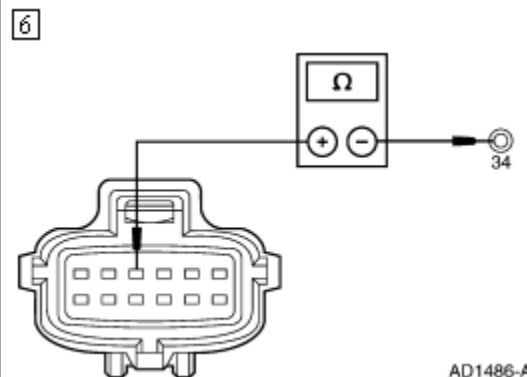
104-Pin Breakout Box

4



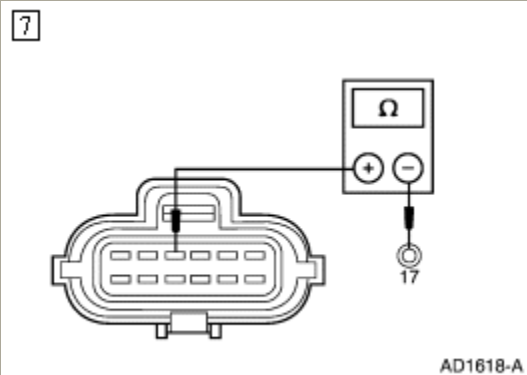
5 Measure the resistance between PCM test Pin 91 at the breakout box and the signal return circuit Pin 2 at the vehicle harness connector.

6



6 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between PCM test Pin 34 at the breakout box, and TR1 circuit Pin 4 at the vehicle harness connector.

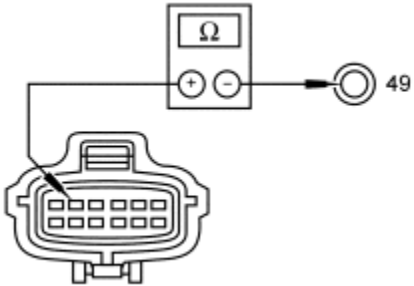
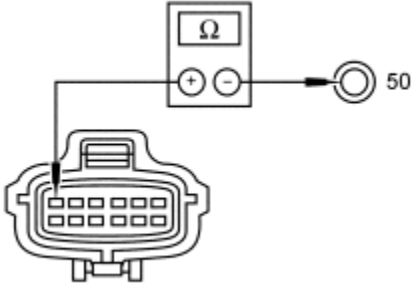
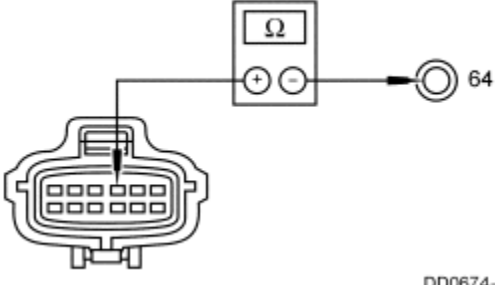
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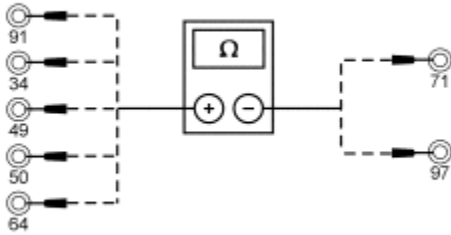


7 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pin 28 at the breakout box and the signal pin at the transmission harness connector.

8

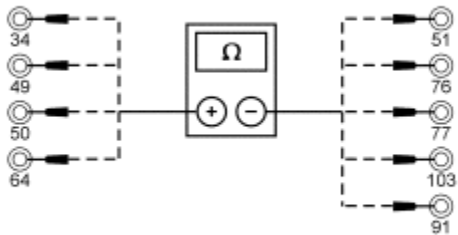
8 Measure the resistance between PCM test Pin 49 at the breakout box and TR2 circuit Pin 5 at the vehicle harness connector.

 <p>DD0672-A</p>	
<p>9</p>  <p>DD0673-A</p>	<p>9 Measure the resistance between PCM test Pin 50 at the breakout box and TR4 circuit Pin 6 at the vehicle harness connector.</p>
<p>10</p>  <p>DD0674-A</p>	<p>10 Measure the resistance between PCM test Pin 64 at the breakout box and TR3A circuit Pin 3 at the vehicle harness connector.</p>
	<ul style="list-style-type: none"> <li>Is each resistance less than 5 ohms?</li> </ul> <p>→ <b>Yes</b> GO to <a href="#">D6</a>.</p> <p>→ <b>No</b> REPAIR the open circuit(s). RECONNECT all of the components. CLEAR the DTCs. REPEAT the Quick Tests.</p>
<p><b>D6 CHECK THE PCM HARNESS CIRCUITS FOR A SHORT TO GROUND OR TO POWER</b></p>	
<p>1</p>	<p>1 Measure the resistance between PCM test Pins 91, 34, 49, 50 and 64, and VPWR test Pins 71 and 97 at the breakout box.</p>



AD1487-A

2



AD1488-A

2 Measure the resistance between PCM test Pins 34, 49, 50 and 64, and test Pins 51, 76, 77, 103 and 91 at the breakout box.

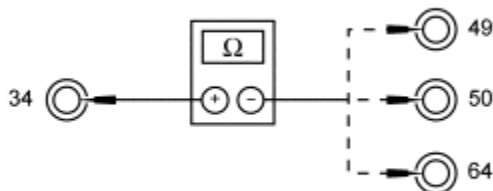
- Is each resistance greater than 10,000 ohms?

→ Yes  
GO to [D7](#).

→ No  
REPAIR the short circuit(s). RECONNECT all of the components. CLEAR the DTCs. REPEAT the Quick Tests.

## D7 CHECK FOR A SHORT BETWEEN THE TR/PCM INPUT SIGNAL CIRCUITS

1



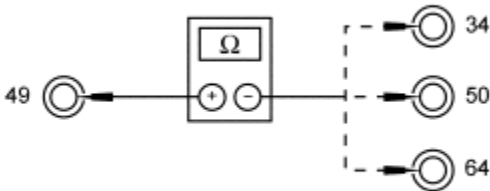
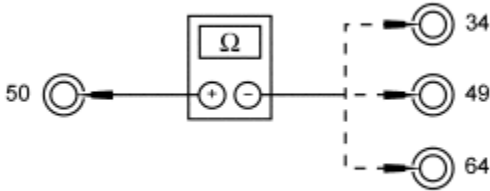
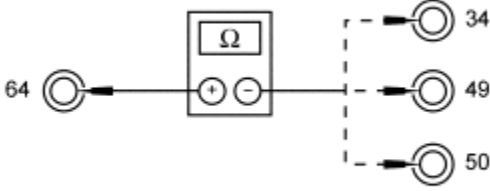
DD0677-A

1 Measure the resistance between test Pin 34 and test Pins 49, 50 and 64 at the breakout box.

2

2 Measure the resistance between test Pin 49 and test Pins 34, 50 and 64 at the breakout box.



 <p>DD0678-A</p>	
<p>3</p>  <p>DD0679-A</p>	<p>3 Measure the resistance between test Pin 50 and Test Pins 34, 49 and 64 at the breakout box.</p>
<p>4</p>  <p>DD0680-A</p>	<p>4 Measure the resistance between test Pin 64 and test Pins 34, 49 and 50 at the breakout box.</p>
	<ul style="list-style-type: none"> <li>Is each resistance greater than 10,000 ohms?</li> </ul> <p>→ <b>Yes</b> REPLACE the PCM. RECONNECT all of the components. CLEAR the DTCs. RERUN the Quick Tests.</p> <p>→ <b>No</b> REPAIR shorts on the circuits having less than 10,000 ohms resistance between other TR/PCM input signal circuits. RECONNECT all of the components. CLEAR the DTCs. REPEAT the Quick Tests.</p>
<p><b>D8 CHECK THE NON-PCM INTERNAL CIRCUITS OF SENSOR</b></p>	

	<ol style="list-style-type: none"> <li>1 Connect the tester cable E to the transmission tester.</li> </ol>
	<ol style="list-style-type: none"> <li>2 Connect the cable E connector marked DIGITAL to the digital TR sensor.</li> </ol>
	<ol style="list-style-type: none"> <li>3 Place the Digital TR Overlay onto the transmission tester.</li> </ol>
	<ol style="list-style-type: none"> <li>4 Perform the switch test as instructed on the Digital TR Overlay.</li> </ol>
	<ul style="list-style-type: none"> <li>• <b>Does the status lamp on the tester indicate RED for the correct gear position?</b></li> </ul> <p>→ <b>Yes</b>  The concern is not in the digital TR sensor. For start system concerns, REFER to <a href="#">Section 303-06A</a> (Gasoline Engines) or <a href="#">Section 303-06B</a> (Diesel Engine). For backup lamp concerns, REFER to <a href="#">Section 417-01</a>. For optional circuits; 4X4 low, neutral sense; REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual and <a href="#">Section 308-07B</a> for diagnosis.</p> <p>→ <b>No</b>  REPLACE and ADJUST the digital TR sensor; refer to the Digital Transmission Range (TR) Sensor in this section. CLEAR the DTCs. REPEAT the Quick Tests.</p>

#### PINPOINT TEST E: ELECTRONIC PRESSURE CONTROL (EPC) SOLENOID

**NOTE:** Refer to the transmission vehicle harness connector illustration preceding these pinpoint tests.

CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>E1 ELECTRONIC DIAGNOSTICS</b>	
	<ol style="list-style-type: none"> <li>1 Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding.</li> </ol>
2	



New Generation Star Tester (NGS)

3 Perform KOEO test until continuous DTCs have been displayed.

4 ENTER Output Test Mode (OTM).

5 Select the ALL ON mode. Push START to turn the outputs on. Push STOP to turn the outputs off.

- Does the vehicle enter OTM?

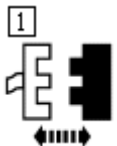
→ Yes

REMAIN in OTM. GO to [E2](#).

→ No

PRESS START. If the vehicle does not enter OTM, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

## E2 CHECK THE ELECTRICAL SIGNAL OPERATION

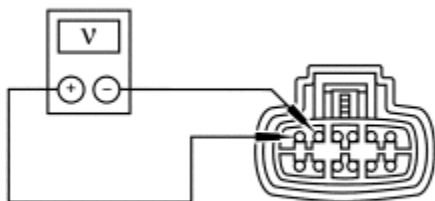


Transmission Connector




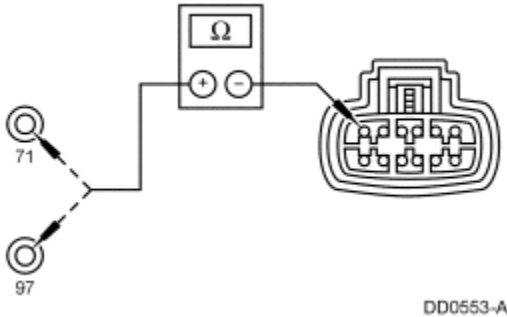
1 **CAUTION:** Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always reinstall the heat shield when the procedure is completed.

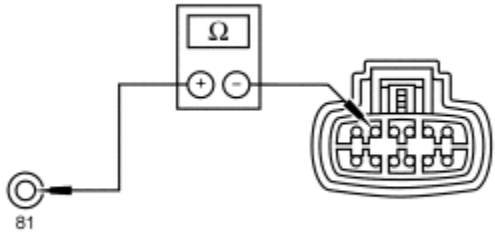
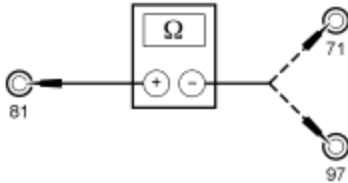
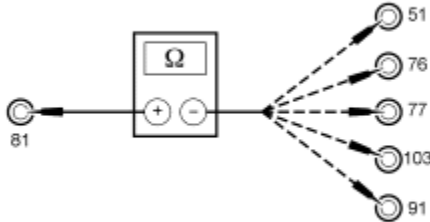
2 Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.


3



3 Connect a VOM positive lead to the EPC PWR pin and the negative test lead to the EPC signal circuit pin of the transmission vehicle harness connector.

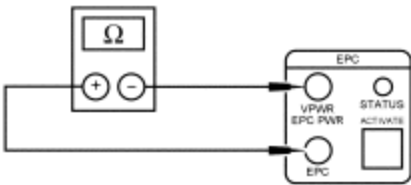

	<p>4 Place the VOM on the 20-volt scale.</p>
	<p>5 While observing the VOM, press START and STOP to cycle the solenoid output on and off.</p>
	<ul style="list-style-type: none"> <li>Is the solenoid output voltage changed to approximately battery voltage?</li> </ul> <p>→ Yes GO to <a href="#">E5</a>.</p> <p>→ No GO to <a href="#">E3</a>.</p>
<b>E3 CHECK THE CONTINUITY OF THE SOLENOID SIGNAL AND VPWR CIRCUITS</b>	
<p>1</p> 	
<p>2</p>  <p>Powertrain Control Module (PCM)</p>	<p>2 Inspect for damaged or pushed-out pins, corrosion or loose wires.</p>
<p>3</p>  <p>Breakout Box</p>	
<p>4</p>  <p>DD0553-A</p>	<p>4 Measure the resistance between the VPWR test Pins 71 and 97 at the breakout box and the EPC PWR circuit pin at the transmission harness connector.</p>
<p>5</p>	<p>5 Measure the resistance between the PCM signal test Pin 81 at the breakout box and the EPC signal pin at the transmission harness connector.</p>

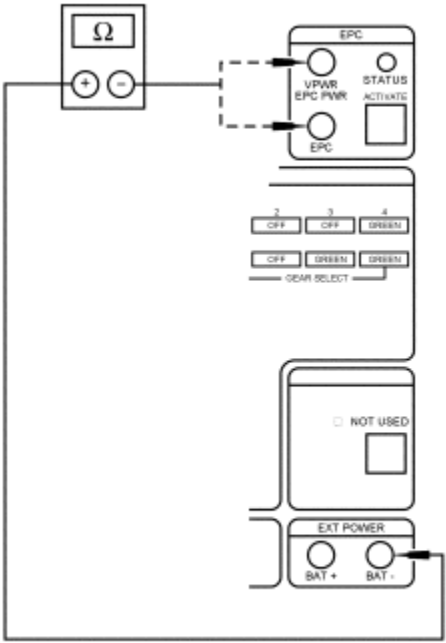
 <p>DD0554-A</p>	
	<ul style="list-style-type: none"> <li>• <b>Is each resistance less than 5 ohms?</b></li> </ul> <p>→ <b>Yes</b> GO to <a href="#">E4</a>.</p> <p>→ <b>No</b> REPAIR the open circuit(s). REMOVE the breakout box. RECONNECT all of the components. ERASE the codes. REPEAT the Quick Tests.</p>
<b>E4 CHECK THE HARNESS FOR SHORTS TO POWER AND GROUND</b>	
<p><b>1</b></p>  <p>D17329-A</p>	<p><b>1</b> Measure the resistance between the PCM signal test Pin 81 and VPWR test Pins 71 and 97 at the breakout box.</p>
<p><b>2</b></p>  <p>D17330-A</p>	<p><b>2</b> Measure the resistance between the PCM signal test Pin 81 and test Pins 51, 76, 77, 103 and 91 at the breakout box.</p>
	<ul style="list-style-type: none"> <li>• <b>Is each resistance greater than 10,000</b></li> </ul>

	<p><b>ohms?</b></p> <p>→ <b>Yes</b> GO to <a href="#">E5</a>.</p> <p>→ <b>No</b> REPAIR the short circuit(s). REMOVE the breakout box. RECONNECT all of the components. ERASE the codes. REPEAT the Quick Tests.</p>
<b>E5 TRANSMISSION FUNCTIONAL TEST</b>	
<p><b>1</b></p>  <p>Powertrain Control Module (PCM)</p>	
	<b>2</b> Install a line pressure gauge at the line tap on the case (7005).
	<b>3</b> Install the transmission tester to transmission connector.
	<b>4</b> Set the bench/drive switch to the DRIVE mode.
	<b>5</b> Rotate the gear select switch to the first gear position.
	<p><b>6</b> <b>NOTE:</b> The LED will turn GREEN when the EPC solenoid activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit).</p> <p>Perform the EPC Solenoid Functional Test.</p>
	<b>7</b> Observe line pressure on the gauge while pressing the EPC switch (engine must be running).
	<p>• <b>Does the EPC (GREEN LED) activate and line pressure drop when the EPC switch is pressed?</b></p> <p>→ <b>Yes</b> REPLACE the PCM. REPEAT the Quick Tests.</p> <p>→ <b>No</b> GO to <a href="#">E6</a>.</p>

## E6 CHECK THE RESISTANCE OF THE SOLENOID


**NOTE:** Refer to the transmission tester for terminal locations.

	<div>1</div> <div>Set the bench/drive switch to the BENCH mode.</div>				
	<div>2</div> <div>Rotate the gear select switch to the OHMS CHECK position.</div>				
<div>3</div> <div></div> <div>DD0557-A</div>	<div>3</div> <div><div></div><div><b>CAUTION: Make sure the tester power is off or damage to the ohmmeter can result.</b></div><div>Connect the ohmmeter negative lead to the VPWR jack and the positive lead to the EPC jack on the tester.</div></div>				
	<div>4</div> <div>Record the resistance. (The resistance should be between 3.0 and 5.0 ohms.)</div>				
	<div><div><div>• Is the resistance between 3.0 and 5.0 ohms?</div></div><div><div>→ Yes</div><div>GO to <a href="#">E7</a>.</div></div><div><div>→ No</div><div>REPLACE the solenoid body assembly. RECORD and ERASE all codes. REPEAT the Quick Tests.</div></div></div>				
<div>E7 CHECK THE SOLENOID FOR SHORT TO GROUND</div>					
<div>1</div>	<div>1</div> <div>Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). (The connection should show infinite resistance [no continuity].)</div> <div><table><tr><th>Solenoid</th><th>Tester Jack</th></tr><tr><td>EPC</td><td>VPWR EPC PWR</td></tr></table></div>	Solenoid	Tester Jack	EPC	VPWR EPC PWR
Solenoid	Tester Jack				
EPC	VPWR EPC PWR				




 <p>DD0558-A</p>	
	<ul style="list-style-type: none"> <li>• <b>Does the connection show continuity?</b></li> </ul> <p>→ <b>Yes</b>  REPLACE the solenoid body assembly. RECORD and ERASE codes. REPEAT the Quick Tests.</p> <p>→ <b>No</b>  GO to the Diagnosis by Symptom Index.</p>

#### PINPOINT TEST F: TURBINE SHAFT SPEED (TSS) AND OUTPUT SHAFT SPEED (OSS) SENSORS

**NOTE:** Refer to the Output Shaft Speed (OSS) Sensor Connector illustration preceding these pinpoint tests.

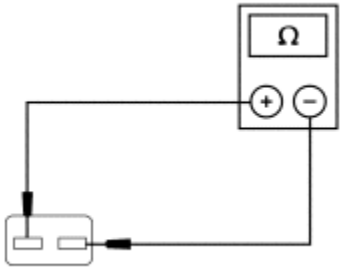
CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>F1 ELECTRONIC DIAGNOSTICS</b>	
	<ol style="list-style-type: none"> <li>1 Check to make sure the transmission harness connector is fully seated, terminals are fully engaged in connector and in good condition before proceeding.</li> </ol>
<ol style="list-style-type: none"> <li>2 </li> </ol>	



New Generation Star (NGS) Tester	
<div>3</div> 	
<div>4</div> 	
Diagnostic Data Link	
<div>5</div> 	
PCM	
	<div>6</div> Select PID/Data Monitor and Record.
	<div>7</div> Select the following PIDs: TSS, OSS.
	<ul style="list-style-type: none"> <li>Does vehicle enter PID/Data Monitor and Record?</li> </ul> <p>→ <b>Yes</b> REMAIN in PID/Data. GO to <a href="#">F2</a> .</p> <p>→ <b>No</b> REPEAT procedure to ENTER PID. If vehicle did not enter PID, REFER to Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis of PCM or NGS.</p>
<b>F2 DRIVE CYCLE TEST</b>	
	<div>1</div> While monitoring the appropriate sensor PID, drive the vehicle so that the transmission upshifts and downshifts through all gears.
	<ul style="list-style-type: none"> <li>Does the TSS, or OSS Speed PID increase and decrease with engine and vehicle speed or is the sensor signal erratic (drop to zero or near zero and return to normal operation)?</li> </ul>

	<p>→ <b>Yes</b></p> <p>If the TSS or OSS Speed PID increase and decrease with engine and vehicle speed, CLEAR all DTCs. Road test to verify if concern is still present. If concern is still present, REFER to Diagnosis by Symptom Index for diagnosis.</p> <p>If the sensor signal is erratic, INSPECT for intermittent concern in the internal/external harness, sensor, or connector.</p> <p>→ <b>No</b></p> <p>If the TSS, or OSS Speed PID does not increase and decrease with engine and vehicle speed, INSPECT for open or short in vehicle harness, sensor, a PCM concern, or internal hardware concern.</p> <p>If the sensor signal is steady, GO to <a href="#">F3</a> .</p>
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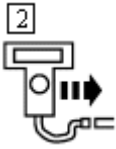
### F3 CHECK RESISTANCE OF TSS OR OSS SENSOR


	<p>1 Disconnect the appropriate vehicle harness connector from the TSS and/or OSS sensor.</p>								
<p>2</p>  <p>AD1084-B</p>	<p>2 For TSS or OSS: Connect ohmmeter negative lead to one pin of the sensor and the positive lead to the other pin on the sensor.</p>								
	<p>3 Record the resistance. Resistance should be as follows:</p> <table border="1"> <thead> <tr> <th>Sensor</th><th>Resistance (ohms)</th></tr> </thead> <tbody> <tr> <td>TSS-PTO Only Application</td><td>496-1244</td></tr> <tr> <td>TSS Non PTO Application</td><td>781-1979</td></tr> <tr> <td>OSS-All Application</td><td>781-1979</td></tr> </tbody> </table>	Sensor	Resistance (ohms)	TSS-PTO Only Application	496-1244	TSS Non PTO Application	781-1979	OSS-All Application	781-1979
Sensor	Resistance (ohms)								
TSS-PTO Only Application	496-1244								
TSS Non PTO Application	781-1979								
OSS-All Application	781-1979								
	<ul style="list-style-type: none"> <li>Is the resistance within specification for</li> </ul>								

	<p><b>the appropriate sensor?</b></p> <p>→ <b>Yes</b> REFER to Diagnosis by Symptom Index for concern diagnosis.</p> <p>→ <b>No</b> For TSS and OSS, REPLACE sensor.</p>
--	--

#### PINPOINT TEST G: COAST CLUTCH SOLENOID (CCS)

**NOTE:** Refer to the transmission vehicle harness connector illustration preceding these pinpoint tests.

CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>G1 ELECTRONIC DIAGNOSTICS</b>	
	<p><b>1</b> <b>NOTE:</b> PTO must be turned off. Check to make sure the transmission harness connector is fully seated, terminals are engaged in the connector and in good condition before proceeding.</p>
<p><b>2</b></p>  <p>New Generation Star Tester (NGS)</p>	
	<p><b>3</b> Perform the KOEO test until continuous DTCs have been displayed.</p>
	<p><b>4</b> Enter the Output Test Mode (OTM).</p>
	<p><b>5</b> Select the ALL ON mode. Push START to turn the outputs on. Push STOP to turn the outputs off.</p>
	<p>• <b>Does the vehicle enter OTM?</b></p> <p>→ <b>Yes</b> REMAIN in OTM. GO to <a href="#">G2</a> .</p> <p>→ <b>No</b> PRESS START. If the vehicle does not enter OTM, REFER to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.</p>
<b>G2 CHECK THE ELECTRICAL SIGNAL OPERATION</b>	

<div data-bbox="191 153 305 300" data-label="Image"> </div> <p>Transmission Connector</p>	<p>1  <b>CAUTION:</b> Remove the heat shield, if so equipped, from the transmission before removing the connector. Remove the solenoid body connector by pushing on the center tab and pulling on the harness connector. Do not attempt to pry the tab with a screwdriver. Always reinstall the heat shield when the procedure is completed.</p>
	<p>2 Use a mirror to inspect both ends of the connector for damage or pushed-out pins, corrosion, loose wires and missing or damaged seals.</p>
<p>3</p> <div data-bbox="280 699 618 989" data-label="Image"> </div> <p>DD0560-A</p>	<p>3 Connect a VOM positive lead to the VPWR circuit pin and the negative test lead to the CCS signal circuit pin of the transmission vehicle harness connector.</p>
	<p>4 Place the VOM on the 20-volt scale.</p>
	<p>5 While observing the VOM, press start and stop to cycle the solenoid output on and off.</p>
	<ul style="list-style-type: none"> <li>Is the solenoid output voltage changed to approximately battery voltage?</li> </ul> <p>→ <b>Yes</b> GO to <a href="#">G5</a>.</p> <p>→ <b>No</b> GO to <a href="#">G3</a>.</p>
<p><b>G3 CHECK THE CONTINUITY OF THE CCS SIGNAL AND VPWR CIRCUITS</b></p>	
<p>1</p> <div data-bbox="191 1654 305 1770" data-label="Image"> </div>	
<p>2</p> <div data-bbox="191 1818 305 1934" data-label="Image"> </div>	<p>2 Inspect for damaged or pushed-out pins, corrosion or loose wires.</p>

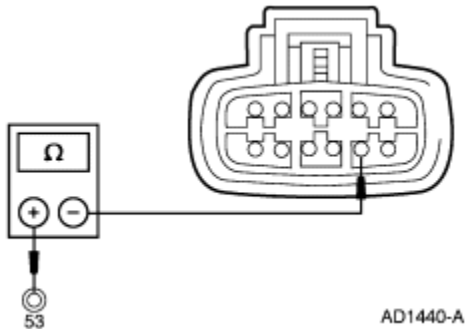
Powertrain Control Module (PCM)

3



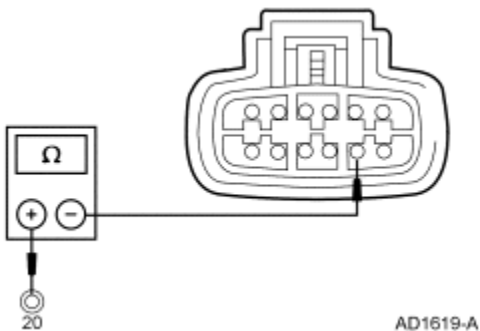
Breakout Box

4



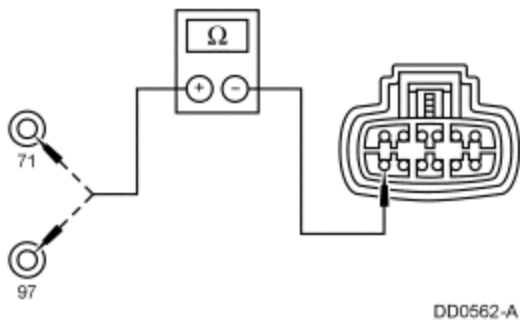
4 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pin 53 at the breakout box and the signal pin at the transmission harness connector.

5



5 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between the PCM signal test Pin 20 at the breakout box and the signal pin at the transmission harness connector.

6

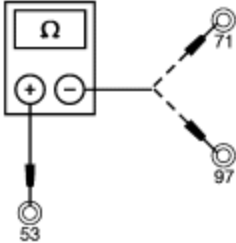
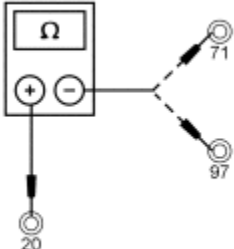
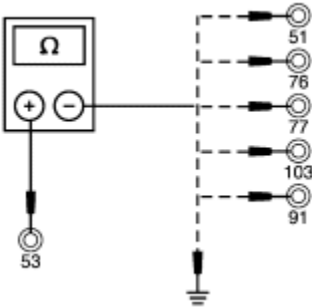
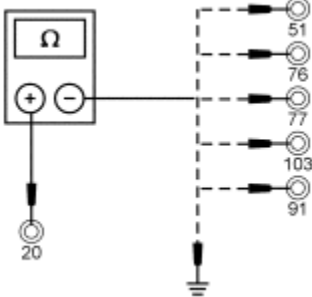



6 Measure the resistance between the VPWR test Pin 71 or 97 at the breakout box and the VPWR pin at the transmission harness connector.

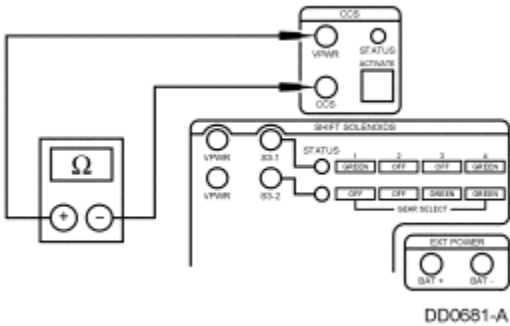
- Is each resistance less than 5 ohms?

→ Yes  
GO to [G4](#).

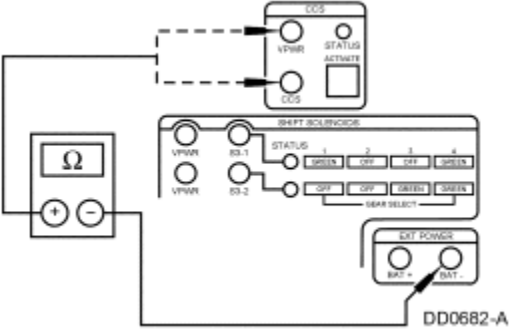
→ No

	<p>REPAIR the open circuits. REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<p><b>G4 CHECK THE CCS CIRCUIT FOR SHORTS TO POWER AND GROUND</b></p>	
<p>1</p>  <p>AD1620-A</p>	<p>1 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pin 53 and VPWR test Pins 71 and 97 at the breakout box.</p>
<p>2</p>  <p>AD1621-A</p>	<p>2 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between the PCM signal test Pin 20 and VPWR test Pins 71 and 97 at the breakout box.</p>
<p>3</p>  <p>AD1622-A</p>	<p>3 On vehicles equipped with 7.3L (49-state) DI Diesel engine, measure the resistance between the PCM signal test Pin 53 and test Pins 51, 76, 77, 103 and 91 at the breakout box and chassis ground.</p>
<p>4</p>  <p>N0000000 AD1623-A</p>	<p>4 On vehicles equipped with 7.3L (Cal.) DI Diesel engine and all gasoline engines, measure the resistance between the PCM signal test Pin 20 and test Pins 51, 76, 77, 103 and 91 at the breakout box and chassis ground.</p>

	<ul style="list-style-type: none"> <li>• <b>Is each resistance greater than 10,000 ohms?</b></li> </ul> <p>→ <b>Yes</b> GO to <a href="#">G5</a>.</p> <p>→ <b>No</b> REPAIR the short circuit(s). REMOVE the breakout box. RECONNECT all of the components. REPEAT the Quick Tests.</p>
<b>G5 SOLENOID FUNCTIONAL TEST</b>	
<div>1</div>  <p>Powertrain Control Module (PCM)</p>	
	<div>2</div> Install the transmission tester to the transmission connector.
	<div>3</div> <b>NOTE:</b> The LED will turn GREEN when the CCS activates and turn off when deactivated. The LED will turn RED if an ACTIVATED solenoid is shorted to battery positive. The LED will remain off if an ACTIVATED solenoid is shorted to ground or no continuity (open circuit). Perform the Solenoid Voltage Test.
	<ul style="list-style-type: none"> <li>• <b>Does the solenoid (LED GREEN) activate when the tester switch is pressed?</b></li> </ul> <p>→ <b>Yes</b> GO to <a href="#">G6</a>.</p> <p>→ <b>No</b> GO to <a href="#">G7</a>.</p>
<b>G6 TRANSMISSION DRIVE TEST</b>	
	<div>1</div> Perform the Dynamic Testing.
	<ul style="list-style-type: none"> <li>• <b>Does the CCS activate (LED GREEN) and engine braking occur?</b></li> </ul> <p>→ <b>Yes</b></p>


	<p>REPLACE the PCM. ERASE all DTCs. PERFORM the Transmission Drive Cycle Test. REPEAT the Quick Tests. If symptoms are still present, REFER to Diagnosis by Symptom.</p> <p>→ <b>No</b> GO to <a href="#">G7</a>.</p>
<b>G7 CHECK THE RESISTANCE OF THE SOLENOID</b>	
<b>NOTE:</b> Refer to the Transmission Tester for terminal locations.	
	<b>1</b> Place the bench/drive switch to the BENCH mode.
	<b>2</b> Rotate the Gear Select switch to the OHMS CHECK position.
<b>3</b>  <p>DD0681-A</p>	<b>3</b> Connect the ohmmeter negative lead to the CCS jack and the positive lead to the VPWR jack on the tester.
	<b>4</b> Record the resistance. (The resistance should be between 20 and 30 ohms.)
	<ul style="list-style-type: none"> <li><b>Is the resistance between 20 and 30 ohms?</b></li> </ul> <p>→ <b>Yes</b> GO to <a href="#">G8</a>.</p> <p>→ <b>No</b> REPLACE the solenoid body assembly.</p>
<b>G8 CHECK THE SOLENOID FOR SHORT TO GROUND</b>	
<b>1</b>	<b>1</b> Check for continuity between the BAT(-) jack (engine ground) and the appropriate jack with a digital ohmmeter or other low current tester (less than 200 milliamps). (Connection should show infinite resistance [no continuity].)




	
	<ul style="list-style-type: none"> <li>• <b>Does the connection show continuity?</b></li> </ul> <p>→ <b>Yes</b> REPLACE the solenoid body assembly.</p> <p>→ <b>No</b> REFER to the Diagnosis by Index.</p>

#### PINPOINT TEST H: SOLENOID MECHANICAL FAILURE

**NOTE:** Repair all other DTCs before repairing the following DTCs: P1714, P1715, P1740

CONDITIONS	DETAILS/RESULTS/ACTIONS
<b>H1 ELECTRONIC DIAGNOSIS</b>	
<div data-bbox="191 1188 305 1331"> <div>1</div>  </div> <p>New Generation STAR (NGS) Tester</p>	
	<div data-bbox="508 1461 540 1493">2</div> Perform the KOEO test until continuous DTCs have been displayed.
	<div data-bbox="508 1551 540 1583">3</div> If any of the following DTCs are present, continue with this test: P1714, P1715, P1740.
	<ul style="list-style-type: none"> <li>• <b>Are other DTCs present for TFT or shift solenoids?</b></li> </ul> <p>→ <b>Yes</b> REPAIR the DTCs for TFT or shift solenoids first. CLEAR DTCs and PERFORM transmission Drive Cycle Test. RERUN Quick Test.</p>

	<p>→ <b>No</b>  REPLACE the appropriate solenoid and/or body. REFER to the Diagnostic Trouble Code chart for code description. GO to <a href="#">H2</a> .</p>
<b>H2 TRANSMISSION DRIVE CYCLE TEST</b>	
	<b>1</b> Perform transmission drive cycle test.
	<b>2</b> Perform the On-Board Diagnostic Test.
	<ul style="list-style-type: none"> <li>• <b>Does the vehicle upshift and downshift OK?</b></li> </ul> <p>→ <b>Yes</b>  GO to <a href="#">H3</a>.</p> <p>→ <b>No</b>  REFER to Diagnosis by Symptom to diagnose shift concerns.</p>
<b>H3 RETRIEVE DTCS</b>	
<b>1</b>  New Generation STAR (NGS) Tester	
	<b>2</b> Perform KOEO test until continuous DTCs have been displayed.
	<ul style="list-style-type: none"> <li>• <b>Are DTCs P1714, P1715, P1740 still present?</b></li> </ul> <p>→ <b>Yes</b>  REPLACE PCM. Road test and RERUN Quick Test.</p> <p>→ <b>No</b>  Testing completed. If a concern still exists, REFER to the Diagnosis by Symptom Index for concern diagnosis.</p>

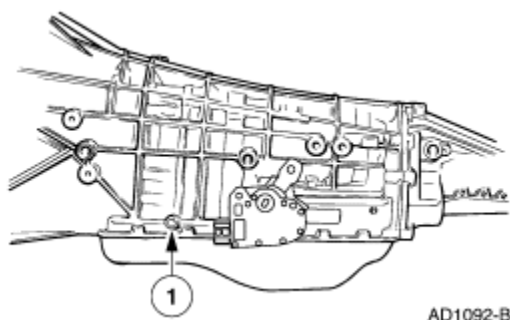
## Special Testing Procedures

The special tests are designed to aid the technician in diagnosing the hydraulic and mechanical portions of the transmission.

## Engine Idle Speed Check

Refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for diagnosis and testing of the engine idle speed.

## Line Pressure Test



Item	Part Number	Description
1	—	Line Pressure Tap

**CAUTION:** Perform the line pressure test prior to performing the stall speed test. If line pressure is low at stall, do not perform the stall speed test or further transmission damage will occur. Do not maintain wide-open throttle in any transmission range for more than 5 seconds or transmission damage may occur.

**NOTE:** If the transmission tester is installed it must be removed prior to performing the test.

**NOTE:** If equipped, turn the power take-off unit off for proper test results.

**NOTE:** Perform shift linkage check prior to performing this test; refer to [Section 307-05](#).

This test verifies the line pressure is within specifications.

1. Connect the Pressure Gauge to the line pressure tap.
2. Start the engine and check the line pressures. Refer to the Line Pressure Chart to determine if the line pressure is within specification.
3. If the line pressure is not within specifications, perform On-Board Diagnostics and Pinpoint Test E, air pressure check, and clean, inspect and replace the main control system or pump as required.

Line Pressure Chart <sup>1</sup>				
Gear	Line Pressure — Idle		Line Pressure — Stall	
	kPa	psi	kPa	psi

P,N	345-448	50-65	—	—
R	483-690	70-100	1469-1538	213-223
(D), 2	345-448	50-65	938-1076	136-156
1	483-690	70-100	938-1076	136-156

<sup>1</sup> Power take-off must be turned off prior to performing test.

Line Pressure Diagnosis Chart					
Low at Idle in All Ranges			High at Idle in All Ranges		
Check for low fluid level, restricted inlet filter, loose main body, solenoid body or accumulator body-to-case bolts, excessive leakage in pump, case, control bodies, sticking main regulator valve, damaged filter assembly and seal, damaged gaskets or valve body separating plate.			Check the main regulator valve, solenoid body and wiring harness. Run the Quick Test referred to in the Diagnostics portion of this section.		
Low Only in					
P	R	N	[circled ]	2	1
Check valve bodies 7A100	Check separator reinforcing plate, coast clutch, low/reverse clutch or direct clutch. Valve bodies 7A100, 7G422	Check valve bodies 7A100	Check forward clutch. Valve bodies 7A100	Check forward clutch, coast clutch or intermediate clutch, band, servo assy. Valve bodies 7A100, 7G422	Check forward clutch, low/reverse clutch or coast clutch. Valve bodies 7A100

## Stall Speed Test



**WARNING:** Apply the service and parking brakes firmly while performing each stall test.



**CAUTION:** Perform the line pressure test prior to performing the stall test. If line pressure is low at stall, do not perform the stall test or further transmission damage will occur.

**NOTE:** If the transmission tester is installed it must be removed prior to performing the test.


**NOTE:** If equipped, turn the power take-off unit off for proper test results.

**NOTE:** The stall test should only be performed with the engine and transmission at normal operating temperatures.

The stall test checks the operation of the following items:

- Torque converter one-way clutch.
- Forward clutch.
- Low one-way clutch.
- Reverse clutch.
- Overdrive one-way clutch.
- Direct clutch.
- Engine performance.

1. Connect a tachometer to the engine.
2. After testing each of the following ranges, [circled ], 2, 1 and R, move the transmission range selector lever to N (NEUTRAL) and run the engine for about 15 seconds to allow the torque converter (7902) to cool before testing the next range.

3.  **CAUTION: If the engine rpm recorded by the tachometer exceeds the maximum specified rpm, release the accelerator pedal immediately. Clutch or band slippage is indicated.**

 **CAUTION: Do not maintain wide-open throttle (WOT) in any gear range for more than 5 seconds or transmission damage may occur.**

Press the accelerator pedal to floor (WOT) in each range. Record the rpm reached in each range. Stall speeds should be in the appropriate range.

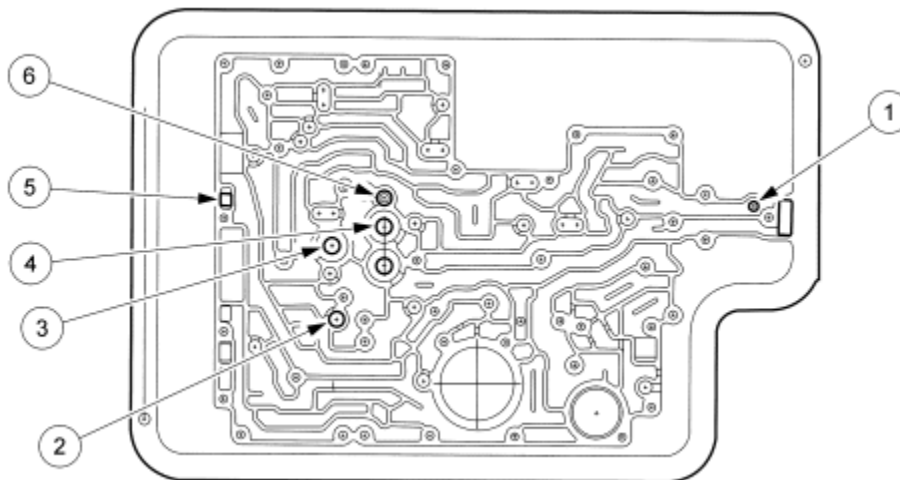
Stall Speed Chart			
Series	Engine	Min.	Max.
F-250	5.4L	2248	2631
F-250 HD	5.4L	2238	2613
F-350	5.4L	2238	2613
F-350	6.8L	1911	2283
F-Super Duty	6.8L	1911	2283
F-250	7.3L DI Diesel	1950	2285
F-Super Duty	7.3L DI Diesel	1950	2285

If the stall speeds were too high, refer to the following Stall Speed Diagnosis Chart. If the stall speeds were too low, check engine tune-up. If the engine is OK, remove the torque converter and check the torque converter reactor one-way clutch for slippage.

Stall Speed Diagnosis Chart	
Range	Possible Source
[circled ]	<ul style="list-style-type: none"> <li>• Forward Clutch</li> <li>• Overdrive One-Way Clutch</li> <li>• Low One-Way Clutch</li> </ul>
R	<ul style="list-style-type: none"> <li>• Direct Clutch</li> <li>• Overdrive One-Way Clutch and Coast Clutch</li> <li>• Reverse Clutch</li> </ul>
2	<ul style="list-style-type: none"> <li>• Forward Clutch</li> <li>• Overdrive One-Way Clutch and Coast Clutch</li> </ul>
1	<ul style="list-style-type: none"> <li>• Forward Clutch</li> <li>• Reverse Clutch and Low One-Way Clutch</li> <li>• Coast Clutch and Overdrive One-Way Clutch</li> </ul>

## Air Pressure Tests

### Air Pressure Test Port Locations



DD0566-B

Item	Part Number	Description
1	—	Reverse Clutch Feed
2	—	Intermediate Clutch Feed
3	—	Overdrive Clutch Feed
4	—	Forward Clutch Feed
5	—	Coast Clutch Feed
6	—	Direct Clutch Feed

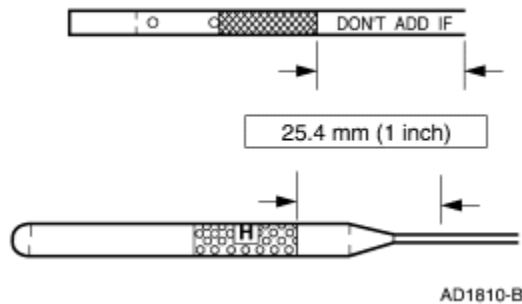
A no-drive condition can exist, even with correct transmission fluid pressure, because of inoperative clutches or bands. Refer to the Band/Clutch Application Chart No. 601 to determine the appropriate elements. A clutch concern can be located through a series of checks by substituting air pressure for fluid pressure to determine the location of the concern.

Example: When the transmission range selector lever is in a forward gear range ([circled ], 2, 1), a no-drive condition may be caused by an inoperative forward clutch.

1. Drain the transmission fluid. Remove the transmission fluid pan (7A194).
2. Remove the filter and seal assembly, the solenoid body, the control assemblies and separator plate, upper/lower gaskets.
3. The inoperative clutches can be located by applying air pressure into the appropriate clutch port. See the Air Pressure Test Port Locations illustration for clutch port locations.
4. Apply air pressure to the appropriate clutch port (see the Air Pressure Test Port Locations illustration). A dull thud may be heard or movement felt when a clutch piston is applied. If the clutch seals or check ball are leaking, a hissing may be heard.
5. If the clutches fail to operate during the air check:
  - inspect the fluid passages in the case.
  - the piston seals are not seated, damaged, not installed.
  - plugged feed holes for clutch apply in the case and/or clutch cylinder.
  - damaged piston and/or clutch cylinder.
6. Repair as required and re-check.

### **Torque Converter Drainback Test**

1. Drive the vehicle for 30-60 minutes to attain normal operating temperature.
2. Check the transmission fluid level. Add fluid only if required.
3. Drive the vehicle through 8 to 10 cycles of 1/2 throttle, 1-2 upshifts to elevate the transmission temperature. Then proceed as follows:
  - Park the vehicle on level ground.
  - Allow the vehicle to sit for 30-60 minutes.
  - Check and note the fluid level on the fluid level indicator (7A020) with the engine off, in PARK. The following example shows the fluid level after 45 minutes.



4. Allow the vehicle to sit for a minimum of 24 hours. Check and note the fluid level.
5. If the fluid has risen 25.4 mm (1 in) or more above the level in the first check, excessive converter drainback has occurred.
6. If excessive drainback has occurred:
  - stuck open check ball in rear cooler line case fitting.
  - no check ball in rear cooler line case fitting.
  - incorrect case cooler line case fitting (without check ball) installed.
7. Repair as required and recheck.

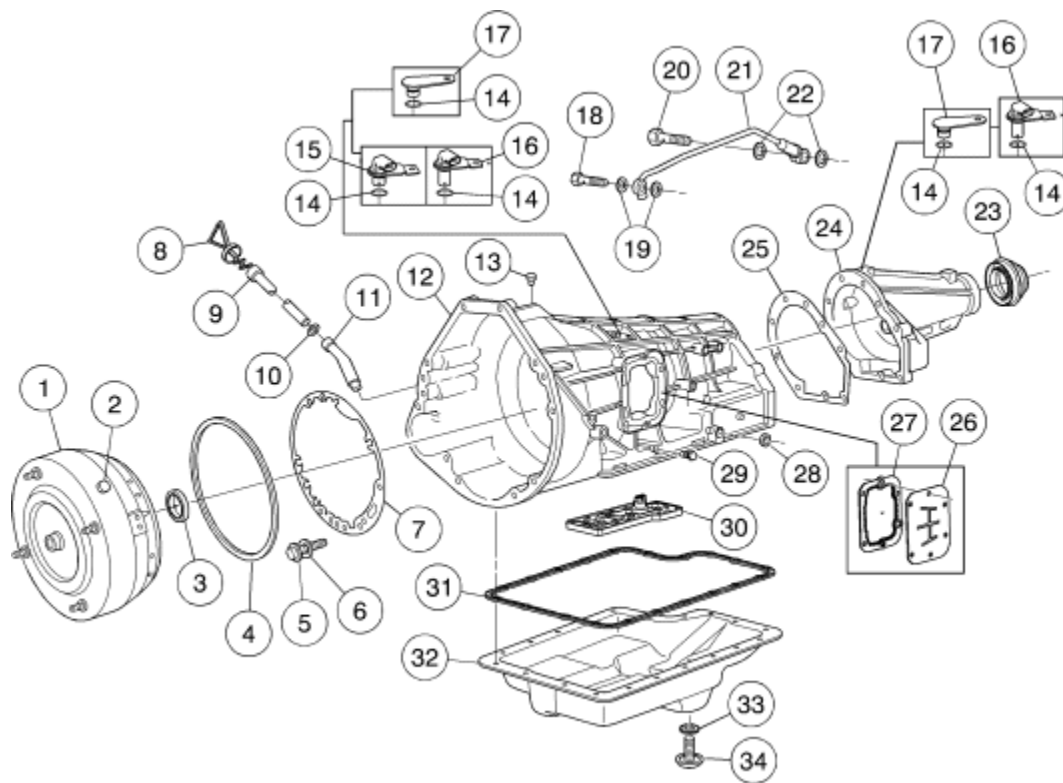
## Leakage Inspection

The transmission has the following parts to prevent external fluid leakage:

- gaskets
- lip-type seals
- O-ring seals
- seal rings
- seal grommets
- thread sealant
- cooler bypass valve (CBV) sealing washers

## External Sealing — 4R100





AD1848-A

Item	Part Number	Description
1	7902	Torque Converter Assy
2	87650-S2	Torque Converter Drain Plug
3	7A248	Front Pump Seal
4	7A248	Front Pump Seal Square-Cut O.D. Seal
5	N805260-S	Bolt and Washer Assy
6	7G379	Washer
7	7A136	Pump Gasket
8	7A020	Fluid Level Indicator
9	7A228	Fluid Filler Tube Assy
10	391308-S	Filler Tube O-Ring
11	7A160	Short Fluid Inlet Tube Assy
12	7005	Case
13	7034	Case Vent Assy
14	N118757-S100	Sensor O-Rint (Part of 7H183 and 7M101) (Model Dependent)
15	7M101	Turbine Shaft Speed (TSS) Sensor (Model Dependent)
16	7M101	Turbine/Output Shaft Speed (TSS/OSS) Sensor (Model Dependent)
17	7H183	Plug Assembly — Case (Model Dependent)

18	7Z152	Cooler Line - Case Fitting (Part of 7H332 CBV Assy)
19	391933-S100	Sealing Washers
20	7G118	Cooler Line - Case Fitting (Part of 7H332 CBV Assy)
21	7H322	Transmission Cooler Bypass Valve Assy
22	391932-S100	Sealing Washers
23	7052	Extension Housing Seal
24	7A039	Extension Housing
25	7086	Extension Housing Gasket
26	7222	PTO — Case Cover
27	7223	PTO — Cover Gasket
28	7B498	Manual Control Lever Seal
29	390685-S	Plug — Test Port — 1/8-27 Hex Head
30	7G391	Solenoid Valve Body Assy
31	7A191	Transmission Fluid Pan Gasket
32	7A194	Transmission Fluid Pan
33	7F033	Fluid Pan Drain Plug Gasket
34	7D479	Fluid Pan Drain Plug

Leakage at the transmission pan-to-case gasket often can be stopped by tightening the retaining bolts to specification. Refer to Torque Specifications in this section. If necessary, replace the pan-to-case gasket only if gasket is damaged.

If leakage is found by the solenoid body connector, refer to Main Control Valve Body in the In-Vehicle Repair portion of this section.

Check the transmission sealing washers on the cooler bypass valve (CBV), fluid filler tube connection at the transmission case. If leakage is found, install a new short fluid inlet tube.

Check the transmission sealing washers on the cooler bypass valve (CBV), fluid lines and fittings between the transmission and the fluid inlet short tube in the radiator tank for looseness, wear or damage. If leakage cannot be stopped by tightening a fluid line tube nut, replace the damaged parts. When fluid is found to be leaking between the case and the cooler line fitting, tighten the fitting to maximum specification. Refer to [Section 307-02](#).

If vehicle is equipped with power take off check the sealing gasket at the power take off unit for leaks.



**CAUTION: Do not try to stop the fluid leak by increasing the torque beyond specification. This can cause damage to the case threads and/or case fittings.**

If the leak continues, replace the cooler line fitting and/or sealing washers on cooler by-pass valve and tighten to specification. The same procedure should be followed for fluid leaks between the oil to air cooler and cooler line fittings.

If leakage is found at the manual control lever shaft, replace the seal.

When a converter drain plug leaks, remove the drain plug. Install and tighten a new drain plug to specification. Refer to Torque Specifications in this section.

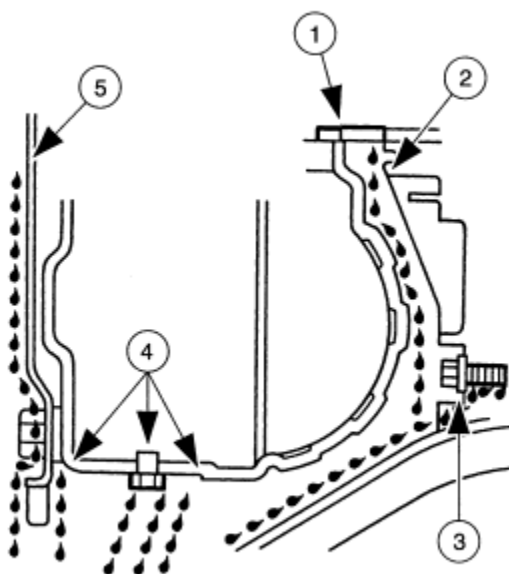
Check for fluid leaking from the end of the extension housing (7A039). Leakage can result from a damaged seal, missing garter spring or worn extension bushing, or damaged speed sensor plug. Replace the seal assembly, bushing, or both, as necessary.

Inspect the line pressure plug for leakage. Make sure it is tightened to specification. Refer to Torque Specifications in this section. If tightening the plug does not stop the leak the case threads and/or plug could be damaged. Remove the plug and inspect the plug and case thread for damage repair as necessary.

Check for leakage on or around the cooler bypass valve (CBV). Repair as required.

### **Fluid Leakage in Torque Converter Area**

In diagnosing and correcting fluid leaks in the front pump assembly and torque converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of transmission, as evidenced by fluid around the torque converter housing, may have several sources. By careful observation it is possible, in many instances, to pinpoint the source of leak before removing the transmission from the vehicle. The paths which the fluid takes to reach the bottom of the torque converter housing are shown in the illustration. The five steps following correspond with the numbers in the illustration.



1. Fluid leaking by the front pump seal lip will tend to move along the impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, fluid leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.
2. Fluid leakage by the outside diameter of the front pump seal and front pump body will follow the same path that leaks by the inside diameter of the front pump seal follow.
3. Fluid that leaks by a front pump to case bolt or pump gasket will be deposited on the inside of the torque converter housing only. Fluid will not be deposited on the back of the torque converter.
4. Fluid leakage from the converter drain plug, converter seal weld or stud weld will appear at the outside diameter of the torque converter, on the back face of the flexplate, and in the converter housing only near the flexplate. Fluid leaks from the torque converter will leave a ring of fluid around the inside of the torque converter housing.
5. **NOTE:** White facial tissue paper may aid in determining the color (red is transmission fluid) and source of the leaking fluid.

Engine oil leaks are sometimes improperly diagnosed as transmission pump gasket leaks. The following areas of possible leakage should also be checked to determine if engine oil leakage is causing the concern.

- Leakage at the valve cover gasket (6584) may allow oil to flow over the torque converter housing or seep down between the torque converter housing and cylinder block (6010) causing oil to be present in or at the bottom of the torque converter housing.
2. Oil galley plug leaks will allow oil to flow down the rear face of the cylinder block to the bottom of the torque converter housing.
  3. Leakage at the crankshaft rear oil seal (6701) will work back to the flexplate, and then into the torque converter housing.
  4. Leakage at oil pressure sensor (9278).

## Leak Check Test

Determine the cause of the leakage before repair.

1. Remove the fluid level indicator and note the color of the fluid. Original factory fill fluid is dyed red to aid in determining if leakage is from the engine or transmission. The red color should assist in pinpointing the leak.
2. Remove the torque converter housing cover. Clean off any fluid from the top and bottom of the torque converter housing, front of the case, and rear face of the engine and oil pan (6675). Clean the torque converter area by washing with a suitable non-flammable solvent, and blow dry with compressed air.

3. Wash out the torque converter housing, the front of the flexplate, and the converter drain plug. The torque converter housing may be washed out using clean solvent and a squirt-type oil can. Blow-dry all washed areas with compressed air.
4. Start and run the engine until the transmission reaches its normal operating temperature. Observe the back of the cylinder block and top of the torque converter housing for evidence of fluid leakage. Raise the vehicle on a hoist and run the engine at fast idle, then at engine idle, occasionally shifting to the Overdrive and Reverse ranges to increase pressure within the transmission. Observe the front of the flexplate, back of the cylinder block (in as far as possible), and inside the torque converter housing and front of the case. Run the engine until fluid leakage is evident and the probable source of leakage can be determined. When a converter drain plug leaks, remove drain plug and discard. Install a new drain plug and tighten plug to 24-27 Nm (18-20 lb-ft).

### **Leak Check Test with Black Light**

Oil soluble aniline or fluorescent dyes premixed at the rate of 2.5 ml (1/2 teaspoon) of dye powder to 0.24 L (0.5 pint) of automatic transmission fluid have proven helpful in locating the source of fluid leakage. Such dyes can be used to determine whether an engine fluid or transmission fluid leak is present, or if the fluid in the transmission fluid cooler hose leaks into the engine coolant system. An ultraviolet light must be used to detect the fluorescent dye solution.

### **Transmission Fluid Cooler**



**CAUTION:** Whenever a transmission has been disassembled to replace worn or damaged parts, the cooler bypass valve (CBV) and transmission fluid cooler lines must be cleaned and backflushed. Use a torque converter/oil cooler cleaner. The oil to air cooler (OTA) will need to be replaced.

**NOTE:** Cleaning and backflushing the transmission fluid cooling system along with following all the normal cleaning and inspection procedures during disassembly and reassembly will keep contamination from entering the transmission, causing a repeat repair.

When internal wear or damage has occurred in the transmission, metal particles, clutch plate material, or band material may have been carried into the torque converter and transmission fluid cooler (7A095). These contaminants are a major cause of recurring transmission troubles and must be removed from the system before the transmission is put back into use.

### **Transmission Fluid Cooler Flow Test**

**NOTE:** The transmission linkage/cable adjustment, fluid level and line pressure must be within specification before performing this test. Refer to Fluid Level Check under Verification of Condition in this section. Refer to Line Pressure Test under Special Testing Procedures in this section. Refer to [Section 307-05](#) for shift linkage/cable adjustment procedures.

1. Remove the fluid level indicator from the fluid filler tube.

2. Place a funnel in the fluid filler tube.
3. Raise and support the vehicle.
4. Disconnect the cooler return tube (rear fitting) from the transmission cooler bypass valve (CBV). Refer to [Section 307-02](#).
5. Connect one end of a hose to the cooler return tube and route the other end of the hose up to a point where it can be inserted into the funnel at the fluid filler tube.
6. Remove the supports and lower the vehicle.
7. Insert the end of a hose into the funnel.
8. Start the engine and run at idle with the transmission in the neutral range.
9. Once a steady flow of fluid (without air bubbles) is observed, remove the hose from the funnel and place the hose in a measuring container for 15 seconds. After 15 seconds place the hose back into the funnel and turn the engine off. Measure the amount of fluid in the container. If adequate flow was observed, approximately 946.24 ml (32 oz) will be in the measuring container; the test is now complete.
10. If adequate flow is not observed, turn off the engine. Disconnect the hose from the cooler return line (transmission inlet).
11. Disconnect the fluid cooler line from the front case fitting and connect the hose to the case fitting (converter out) and repeat Steps 7, 8 and 9.
12. If adequate flow is observed from the transmission then look for a plugged cooler line and/or oil to air cooler. Refer to [Section 307-02](#) for diagnosis of the transmission oil to air cooler.
13. If adequate flow is still not observed, repair and/or replacement of the pump and/or converter may be required.

### **Transmission Fluid Cooler Tube Replacement**



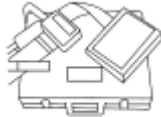



Refer to [Section 307-02](#).




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SECTION 307-01: Automatic  
Transaxle/Transmission  
DIAGNOSIS AND TESTING

1999 F-Super Duty 250-550 Workshop  
Manual  
[Procedure revision date: 01/26/2000](#)

**Diagnosis By Symptom**

Special Tool(s)	
 ST1137-A	73 Digital Multimeter 105-R0051 or equivalent
 ST1532-A	Cable and Overlay: E4OD 95 418-F037 (007-00107) or equivalent
 ST1391-A	EEC-V 104-Pin Breakout Box 418-049 (014-00950) or equivalent
 ST1533-A	TRS-E Cable: E4OD 97 and Up 418-F107 (007-00111) or equivalent and Digital TR Overlay 007-00131 or equivalent
 ST1217-A	New Generation Star Tester 418-F048 (007-00500) or equivalent
 ST1633-A	Digital Transmission Range (TR) Sensor Alignment Tool 307-351 (T97P-70010-A)

 ST1389-A	Transmission Tester 307-F016 (007-00130) or equivalent
 ST1565-A	Pressure Gauge 307-004 (T57L-77820-A)
 ST1300-A	12 Bolt Master UV Diagnostic Inspection Kit 164-R0756 or equivalent

The Diagnosis by Symptom Charts give the technician diagnostic information and direction and list possible components, using a SYMPTOM as a starting point.

The Diagnosis by Symptom Charts are divided into two categories: electrical routines, indicated by 200 series numbers, and hydraulic/mechanical routines, indicated by 300 series numbers. The electrical routines list the possible electrical components that could have caused or contributed to the symptom described. The hydraulic/mechanical routines list the possible hydraulic or mechanical components that could cause or contribute to the symptom described.

### Diagnosis by Symptom Chart Directions

Using the Diagnosis by Symptom Index, select the concern/symptom that best describes the condition.

Refer to the routine indicated in the diagnosis by symptom index.

Always begin diagnosis of a symptom with:

Preliminary inspections.

Verification of condition.

Check the fluid level.

Perform other test procedures as directed.

**NOTE:** Not all concerns and conditions with electrical components will set a diagnostic trouble code (DTC). Be aware that the components listed may still be the cause. Verify proper function of those components prior to proceeding to the hydraulic/mechanical routine listed.



Begin with the electrical routine if indicated. Follow the reference or action required statements. Always perform the On-Board Diagnostic Tests as required. NEVER SKIP STEPS. Repair as required. If the concern is still present after electrical diagnosis, proceed to the hydraulic/mechanical routine listed.

The hydraulic/mechanical routines list possible hydraulic or mechanical components that could cause the concern. These components are listed in the removal sequence and by most likely cause. You must inspect all components listed to make a proper repair.

## Diagnosis by Symptom Index

Diagnosis by Symptom Index		
4R100	Routines	
	Electrical (a)	Hydraulic/Mechanical
<b>Engagement Concerns</b>		
No forward only	201	301
	202	302
No REVERSE only	203	303
	204	304
Harsh REVERSE only	205	305
	206	306
Harsh forward only	207	307
	208	308
Delayed/soft REVERSE only	209	309
Delayed/soft forward only		
No forward and no REVERSE only		
Harsh forward and REVERSE		
Delayed/soft forward and REVERSE		
<b>Shift Concerns</b>		
Some or all shifts missing	210	310
	—	—
Timing concerns	211	311
	212	312
early/late (some/all)	—	—
	213	313
erratic/hunting (some/all)	214	314
	215	315
Feel concerns	216	316
	217	317
soft/slipping (some/all)		

harsh (some/all)		
No 1st gear in drive, engages in higher gear		
No MANUAL 1st gear		
No MANUAL 2nd gear		
<b>Torque Converter Clutch Operation Concerns</b>		
No apply	240	340
	241	341
Always applied/stalls vehicle	242	342
Cycling/shudder/chatter		
<b>Other Concerns</b>		
Shift lever efforts high	251	351
	252	352
External leaks	253	353
	254	354
Poor vehicle performance	255	355
	256	356
Noise/vibration — forward or REVERSE	257	357
	258	358
Engine will not crank	259	359
	260	360
No PARK range	261	361
Overheating		
No engine braking in MANUAL 2 position only		
No engine braking in MANUAL 1 position only		
No engine braking with OVERDRIVE cancelled		
Fluid venting or foaming		

(a) Perform electrical routines first.

### Diagnostic Routines

Engagement Concern: No Forward Only	
<b>Possible Component</b>	<b>Reference/Action</b>
<b>201 — ELECTRICAL ROUTINE</b>	
No electrical concerns	

### 301 — HYDRAULIC/MECHANICAL ROUTINE

<b>Fluid</b> Improper level Condition	Adjust fluid to proper level. Inspect according to instructions under Fluid Condition Check.
<b>Shift Linkage (Internal/External) or Cable</b> Damaged, misadjusted, disconnected	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Improper Pressures</b> Low line pressure	Check pressure at line tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If pressures are low, check the following possible components: Pump inlet filter and seal assembly, main controls, pump assembly, forward clutch assembly.
<b>Filter Assembly and Seal</b> Filter seal damaged, cut	Inspect filter assembly and seal for damage. Replace as required.
<b>Main Controls</b> Manual valve stuck, damaged Control body housing leakage Bolts not tightened to specification Gaskets damaged	Inspect for damage and repair/replace as required.  Retighten bolts to specification.  Inspect gasket for damage and replace as required.
<b>Forward Clutch Assembly</b> Assembly  Piston, seal; check ball damaged, missing, not seating Feed bolt loose, missing Center support damaged, holes blocked/missing Forward clutch sealing rings damaged Forward clutch ring gear damaged Friction elements	Air check clutch assembly; refer to Air Pressure Tests in this section.  Inspect seals for damage, check ball seating, location. Replace piston assembly as required.  Install new feed bolts and tighten to specification. Inspect for damage. Repair/replace as required.  Inspect for damage. Replace as required.  Inspect for damage. Replace as required.  Check for abnormal wear, damage. Replace as required.

damaged, worn; spline teeth damaged, missing	
<b>Forward/Reverse Sun Gear Damaged</b>	<b>Inspect for damage. Replace as required.</b>
<b>Front Planet Assembly Damaged</b>	<b>Inspect for damage. Replace as required.</b>
<b>Output Shaft</b> Splines damaged	Inspect for damage. Replace as required.
<b>Low One-Way Clutch Assembly (Planetary)</b> Worn, damaged or misassembled	Inspect for damage. Replace as required.

Engagement Concern: No Reverse Only	
<b>Possible Component</b>	<b>Reference/Action</b>
<b>202 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>302 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b> Improper level Condition	Adjust fluid to proper level. Inspect per instructions under Fluid Condition Check.
<b>Shift Linkage (Internal/External) or Cable</b> Damaged or misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Improper Pressures</b> Low line pressure	Check pressure at line pressure tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specifications. If pressures are low, check the following possible components: Pump inlet filter and seal assembly, main control, pump assembly, reverse clutch assembly, coast clutch assembly, direct clutch assembly.
<b>Filter Assembly and Seal</b> Damaged or seal missing	Inspect filter assembly and seal for damage. Replace as required.
<b>Main Controls</b>	

<p>Bolts not tightened to specification</p> <p>Gaskets damaged</p> <p>Valve springs, main control valve body, direct clutch accumulator valve damaged, stuck, missing, or misassembled</p> <p>Reinforcing plate improperly installed; bolts not torqued to specification</p>	<p>Retighten bolts to specification.</p> <p>Inspect for damage and replace.</p> <p>Inspect for damage. Repair/replace as required.</p> <p>Inspect for proper installation. Retighten bolts to specification.</p>
<p><b>Direct Clutch Assembly</b></p> <p><b>NOTE:</b> Only if third gear also is inoperative</p> <p>Assembly</p> <p>Seals or piston damaged</p> <p>Clutch plates burnt, missing</p> <p>Check ball damaged, missing</p> <p>Center support damaged or holes blocked</p> <p>Center support hub damaged</p>	<p>Air check clutch assembly; refer to Air Pressure Tests in this section.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Repair/replace as required.</p> <p>Inspect for damage. Replace as required.</p>
<p><b>Reverse Clutch Assembly</b></p> <p>Assembly</p> <p>Seals or piston damaged</p> <p>Piston bore damaged</p> <p>Friction elements damaged, worn; missing plates</p> <p>Feed hole damaged, plugged, missing</p>	<p>Air check clutch assembly; refer to Air Pressure Tests in this section.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Repair/replace as required.</p>

Engagement Concern: Harsh Reverse Only	
Possible Component	Reference/Action
<b>203 — ELECTRICAL ROUTINE</b>	
<p><b>Powertrain Control System</b></p> <p>Electrical inputs/outputs, vehicle wiring harnesses, PCM, throttle position sensor, TSS, OSS, ABS electronic pressure control</p>	<p>Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Engagement Test, Electronic Pressure Control Test. Perform <a href="#">Pinpoint Test E</a> using Transmission Tester and Cable and Overlay as outlined in this section. Repair/replace as required. Clear codes,</p>

	road test, rerun On-Board Diagnostics.
<b>303 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Improper Pressures</b> High line pressure	Check pressure at line pressure tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If high, check the main controls.
<b>Main Controls</b> Bolts not tightened to specification Gasket damaged EPC solenoid stuck or damaged	Retighten bolts to specification. Inspect for damage and replace. Perform Electronic Pressure Control Tests described in routine No. 203. Replace as required.
<b>Pump Assembly</b> Bolts not tightened to specification Gaskets damaged Main regulator/booster valve stuck, damaged, misassembled	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

Engagement Concern: Harsh Forward Only	
<b>Possible Components</b>	<b>Reference/Action</b>
<b>204 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, throttle position sensor, TSS, OSS, ABS electronic pressure control	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Engagement Test, Electronic Pressure Control Test. Perform <a href="#">Pinpoint Test E</a> using Transmission Tester and Cable and Overlay as outlined in this section. Repair/replace as required. Clear codes, road test, rerun On-Board Diagnostics.
<b>304 HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Improper Pressures</b> High line pressure	Check pressure at line pressure tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If pressures are high, check main controls.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged	Retighten bolts to specification. Inspect for damage and replace.

Electronic pressure control solenoid stuck or damaged Engagement control valve, springs — damaged, stuck, misassembled, contaminated	Perform Electronic Pressure Control Tests described in routine No. 204. Replace as required. Inspect for damage. Repair/replace as required.
<b>Pump Assembly</b> Bolts not tightened to specification Gaskets damaged Main regulator/booster valve stuck, damaged, misassembled	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.
<b>Forward Clutch Assembly</b> Assembly  Plates burnt, missing; check ball missing, damaged; hub damaged	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Engagement Concern: Delayed/Soft Reverse Only	
Possible Component	Reference/Action
<b>205 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>305 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage or Cable</b> Damaged, misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged Direct clutch accumulator regulator valve, low reverse modulator valve, springs — stuck, damaged, missing, misassembled Check ball missing, damaged	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.  Inspect for damage. Replace as required.

Reinforcing plate improperly installed, bolts not tightened to specification	Inspect for proper installation. Retighten bolts to specification
<b>Coast Clutch Assembly</b>	
Assembly	Air check clutch assembly; refer to Air Pressure Tests in this section.
Piston seals damaged, missing	Inspect for damage. Replace as required.
Stator support seals damaged	Inspect for damage. Replace as required.
<b>Reverse Clutch Assembly</b>	
Assembly	Air check clutch assembly; refer to Air Pressure Tests in this section.
Seals, piston damaged	Inspect for damage. Replace as required.
Friction elements — damaged, worn	Inspect for damage. Replace as required.
Assembly leakage	Inspect for damage. Repair/replace as required.

Engagement Concern: Delayed/Soft Forward Only	
Possible Component	Reference/Action
<b>206 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>306 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b>	
Improper level	Adjust fluid to proper level.
Condition	Inspect according to instructions under Fluid Condition Check.
<b>Shift Linkage or Cable</b>	
Damaged, misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Improper Pressures</b>	
Low line pressure	Check pressure at line tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification. If pressures are low, check the following possible components: pump inlet filter and seal assembly, main controls, pump assembly.



<b>Filter Assembly and Seal</b>  Plugged, damaged  Filter seal damaged	Inspect filter assembly and seal for damage. Replace as required.
<b>Main Controls</b>  Bolt not tightened to specification  Gaskets damaged	Retighten bolts to specification.  Inspect for damage and replace.
<b>Center Support Assembly</b>  Feedbolts missing, improperly tightened  Hub damaged, holes blocked or missing	Install new feedbolts and tighten to specification.  Inspect for damage. Repair/replace as required.
<b>Forward Clutch Assembly</b>  Assembly Seals or piston damaged  Check balls damaged, missing  Clutch hub damaged  Friction elements damaged, missing  Forward clutch cylinder seals damaged	Air check clutch assembly; refer to Air Pressure Tests in this section Inspect seals for damage. Replace as required.  Inspect for mislocation, poor seating, damage. Replace cylinder as required.  Inspect for damage. Replace as required.  Inspect for damage. Replace as required.  Inspect for damage. Replace as required.

Engagement Concern: No Forward and No Reverse Only	
Possible Component	Reference/Action

<b>207 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>307 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b> Improper level Condition Converter drainback valve	Adjust fluid to proper level. Inspect according to instructions under Fluid Condition Check.  Inspect converter drainback valve. Perform Torque Converter Drainback Test. Replace as required.
<b>Shift Linkage (Internal/External) or Cable</b> Damaged, misadjusted or disconnected	Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to Digital Transmission Range (TR) Sensor in this section.
<b>Improper Pressures</b> Low line pressures	Check pressure at line tap. Perform Line Pressure Test. Refer to the Line Pressure Chart for specification. If pressures are low, check the following possible components: pump inlet filter and seal assembly, main controls, pump assembly, forward clutch assembly.
<b>Filter Assembly and Seal</b> Plugged, damaged Filter seal damaged or cut	Inspect filter assembly and seal for damage. Replace as required.
<b>Main Controls</b> Manual valve — stuck, damaged Control body housing leakage Bolts not tightened to specification Gaskets damaged	Inspect for damage. Repair/replace as required.  Retighten bolts to specification. Inspect for damage and replace.
<b>Pump Assembly</b> Bolts not tightened to specification Gaskets damaged Main regulator/booster valve damaged, missing,	Retighten bolts to specification.  Inspect for damage and replace. Inspect for damage. Repair/replace as required.

misassembled Excessive pump gear end clearance	Perform pump gear end clearance check.
<b>Center Support Assembly</b> Damaged, holes blocked. Feedbolts missing or improperly tightened	Inspect for damage. Repair/replace as required. Install new bolts and tighten to specification.
<b>Forward/Reverse Sun Gear</b> Damaged	Inspect for damage. Replace as required.
<b>Forward Planet Assembly</b> Damaged	Inspect for damage. Replace as required.
<b>Input Shaft /Center Shaft/ Output Shaft</b> Splines damaged	Inspect for damage. Replace as required.
<b>Overdrive Carrier</b> Damaged	Inspect for damage. Replace as required.
<b>Drive in [circled ] with [circled ] Cancelled</b> Note: For diagnostic purposes only. Not for extended driving. <b>Overdrive OWC</b> Misassembled, damaged Sprags or races damaged	   Inspect for damage. Repair/replace as required. Inspect for damage. Replace as required.

Engagement Concern: Harsh Forward and Reverse	
Possible Components	Reference/Action
<b>208 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, powertrain control module, electronic pressure control, throttle position sensor	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Engagement Test, Electronic Pressure Control Test. Perform <a href="#">Pinpoint Test E</a> using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>308 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Improper Pressures</b> High line pressure	Check pressure at line pressure tap. Perform Line Pressure Test. Refer to the Line Pressure Chart for specification. If high, check main controls.

<b>Main Controls</b> Bolts not tightened to specification Gasket damaged EPC solenoid stuck or damaged Engagement control valve stuck, damaged, contaminated, misassembled	Retighten bolts to specification. Inspect for damage and replace. Perform Electronic Pressure Control Tests described in routine No. 208. Replace as required. Inspect for damage, contamination. Repair/replace as required.
<b>Pump Assembly</b> Bolts not tightened to specification Gaskets damaged Main regulator/booster valve stuck, damaged, misassembled	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

Engagement Concern: Delayed/Soft Forward and Reverse	
Possible Component	Reference/Action
<b>209 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>309 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage or Cable</b> Damaged, misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Fluid</b> Improper level	Adjust to proper level.
<b>Improper Pressures</b> Low line pressure	Check pressure at line tap. Refer to the Line Pressure Chart for specification. If low check the following components: pump inlet filter/seal assembly, main control, pump assembly.
<b>Filter Assembly and Seal</b> Plugged, damaged	Inspect filter assembly and seal for damage. Replace as required.

Seal damaged, cut	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged Springs — stuck, damaged, missing, misassembled	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.
<b>Torque Converter Drainback (Initial Engagement Only)</b>	Refer to Torque Converter Drainback Test procedures in this section for diagnosis.

Shift Concerns: Some or All Shifts Missing	
Possible Component	Reference/Action
<b>210 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harness, PCM, throttle position sensor, digital (TR) sensor, TSS, OSS, ABS, SSA, SSB	Perform Shift Point Road Test. Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A and D using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair/replace as required. Clear code, road test, rerun On-Board Diagnostics.
<b>310 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b> Improper level Condition	Adjust fluid to proper level. Inspect according to instructions under Fluid Condition Check.
<b>Shift Linkage (Internal/External) or Cable</b> Damaged, misadjusted, disconnected	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Filter Assembly and Seal</b> Plugged, damaged Filter seal damaged	Inspect filter assembly and seal for damage. Replace as required.
<b>Main Controls</b>	

Valves stuck, damaged, misassembled	Inspect for damage. Repair/replace as required.
For diagnosis related to a specific shift, see Reference/Action	<p>To diagnose specific No Shift, refer to the appropriate shift routine.</p> <p>No Shift 1-2, Routine 220/320</p> <p>No Shift 2-3, Routine 221/321</p> <p>No Shift 3-4, Routine 222/322</p> <p>No Shift 4-3, Routine 223/323</p> <p>No Shift 3-2, Routine 224/324</p> <p>No Shift 2-1, Routine 225/325</p>

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Shift Timing — Early/Late (Some/All)	
Possible Component	Reference/Action
<b>211 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, throttle position sensor, TFT sensor, TSS, OSS, ABS, SSA, SSB	Perform Shift Point Road Test.  Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A and B using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>Other Electrical Concerns</b> No power to PCM, keep-alive memory erased from PCM	Restore memory by performing Transmission Drive Cycle Test.
<b>311 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Other</b> Tire size change  Speedometer gear change (model dependent) Axle ratio change	Refer to the specification decal on door panel and verify that vehicle has original equipment. Changes in tire size or axle ratio may affect shift timing.
<b>Power/Engine Performance — Poor Engine Performance</b>	Refer to Routine No. 253/353.

<b>Main Controls</b> Valves, accumulators, stuck or damaged Gaskets damaged Bolts not tightened to specification	Inspect for damage, contamination. Repair/replace as required. Inspect for damage and replace. Retighten bolts to specification.
For diagnosis related to a specific shift or if all above are OK, see Reference/Action	To diagnose specific shift/timing concern refer to Soft/Slipping routines:  Soft/Slipping Shift 1-2, Routine 226/326  Soft/Slipping Shift 2-3, Routine 227/327  Soft/Slipping Shift 3-4, Routine 228/328  Downshifts, 229/329

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Timing — Erratic/Hunting (Some/All)	
Possible Component	Reference/Action
<b>212 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Vehicle wiring harnesses, PCM, TP sensor, TFT sensor, SSA, SSB, digital (TR) sensor, TCC solenoid	Perform Shift Point Road Test and Torque Converter Clutch Operation Tests.  Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A, B, C, D using Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>With Speed Control On</b> Torque converter cycling  Shift cycling (3-4 / 4-3 shifts)	Re-evaluate with speed control off or depress TCS (overdrive cancelled). If condition still exists, proceed with diagnosis.
<b>312 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b> Improper level	Adjust fluid to proper level.
<b>Filter Assembly and Seal</b> Plugged, damaged  Filter seal damaged	Inspect filter assembly and seal for damage. Replace as required.
<b>Main Control</b>	

Valves, accumulators, damaged, stuck	Inspect for damage. Repair/replace as required.
Bolts not tightened to specification	Retighten bolts to specification.
Gaskets damaged	Inspect for damage and replace.
Wrong parts used in rebuild	Verify that proper parts were used.
<b>Torque Converter Clutch</b>	Refer to Torque Converter Clutch Operation Concern: Cycling/Shudder/Chatter (No. 342).
For further diagnosis of timing issues, refer to Reference/Action	Refer to the following shift routine(s) for further diagnosis:

<sup>a</sup> Can be purchased as a separate item.

Shifts	No	Soft/Slip	Harsh
1-2	220/320	226/326	232/332
2-3	221/321	227/327	233/333
3-4	222/322	228/328	234/334
4-3	223/323	229/329	235/335
3-2	224/324	229/329	236/336
2-1	225/325	223/329	237/337

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Shift Concerns: Feel — Soft/Slipping (Some/All)	
Possible Component	Reference/Action
<b>213 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TP sensor, electronic pressure control, TFT sensor	Perform Shift Point Road Test.  Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests E and B in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test, rerun On-Board Diagnostics.
<b>313 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b> Improper level Condition	Adjust fluid to proper level.  Inspect according to instructions in this section under Fluid Condition Check.
<b>Improper Pressures</b> Low line pressure	Check pressures at line pressure tap. Perform Line Pressure Tests. Refer to the Line Pressure Chart for specifications. If pressures are low or all shifts are soft/slipping, go to main controls.
<b>Main Controls</b>	



<p>Bolts not tightened to specification</p> <p>Gaskets damaged</p> <p>Line modulator valve springs damaged, stuck, misassembled</p> <p>EPC solenoid failure to operate in a normal manner</p> <p>Accumulator assembly damaged or wrong assembly</p>	<p>Retighten bolts to specification.</p> <p>Inspect for damage and replace.</p> <p>Inspect for damage, contamination. Repair/replace as required.</p> <p>Refer to Electrical Routine No. 213.</p> <p>Inspect for damage. Replace as required. Verify correct assembly is used.</p>
<p><b>Pump Assembly</b></p> <p>Bolts not tightened to specification</p> <p>Gaskets damaged</p> <p>Main regulator/booster valve damaged, misassembled</p> <p>Electronic pressure control air bleed check valve damaged or missing</p>	<p>Retighten bolts to specification.</p> <p>Inspect for damage and replace.</p> <p>Inspect for damage. Repair/replace as required.</p> <p>Inspect for damage. Replace as required.</p>
<p>For diagnostics related to specific shifts, see Reference/Action</p>	<p>Refer to the following Shift Routine(s) for further diagnosis:</p> <p>Soft/Slipping Shift 1-2, Routine 226/326</p> <p>Soft/Slipping Shift 2-3, Routine 227/327</p> <p>Soft/Slipping Shift 3-4, Routine 228/328</p> <p>Downshifts, 229/329</p>

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Feel — Harsh (Some/All)	
Possible Component	Reference/Action
<b>214 — ELECTRICAL ROUTINE</b>	
<p><b>Powertrain Control System</b></p> <p>Electrical inputs/outputs, vehicle wiring harnesses, PCM, electronic pressure control, TFT sensor, TP sensor, digital (TR) sensor</p>	<p>Run On-Board Diagnostics. Refer to PC/ED<sup>a</sup> for diagnosis. Perform Pinpoint Tests B, D and E in this section using Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.</p>

<b>Engine Performance Issues</b>	Refer to PC/ED <sup>a</sup> for diagnosis.
<b>314 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid</b> Improper level Condition	Adjust fluid to proper level. Inspect according to instructions in this section under Fluid Condition Check.
<b>Improper Pressures</b> High line pressure	Check pressures at line pressure tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specifications. If pressures are high or all shifts are harsh, go to main controls.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged Line modulator valve/spring misassembled, stuck, damaged EPC solenoid failure to operate in a normal manner Accumulator assembly damaged or wrong assembly	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage, contamination.  Replace as required.  Refer to Electrical Routine No. 214.  Inspect for damage. Replace as required. Verify correct assembly is used.
<b>Pump Assembly</b> Bolts not tightened to specification Gaskets damaged Main regulator/booster valve damaged, misassembled	Retighten bolts to specification.  Inspect for damage and replace. Inspect for damage. Repair/replace as required.
For diagnostics related to a specific shift, see Reference/Action	Refer to the following Shift Routine(s) for further diagnosis:  Harsh Shift 1-2, Routine 232/332  Harsh Shift 2-3, Routine 233/333  Harsh Shift 3-4, Routine 234/334  Harsh Shift 4-3, Routine 235/335  Harsh Shift 3-2, Routine 236/336  Harsh Shift 2-1, Routine 237/337

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No 1st Gear in Drive, Engages in Higher Gear	
Possible Component	Reference/Action
<b>215 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, SSA, SSB, digital (TR) sensor	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A and D in this section using the Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>315 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cables, Digital Transmission Range (TR) Sensor</b> Damaged, not connected, misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned SSA, SSB stuck or damaged Solenoid regulator valve, 2-3 shift valve, 3-4 shift valve, D2 valve — stuck, missing, misassembled, damaged Air bleeds for S1-S2 circuits missing Wrong components used in rebuild	Retighten bolts to specification.  Inspect for damage and replace. Refer to Electrical Routine No. 215. Inspect for damage. Repair/replace as required.  Inspect for damage. Replace case.  Verify that proper components were used. Replace as required.
<b>Mechanical</b> Band servo, clutches damaged For diagnosis related to a specific gear, use Transmission Tester to determine gear	Refer to proper disassembly procedures in this section. Refer to the following routine(s) for further diagnosis: No Shift 1-2, Routine 220/320 No Shift 2-3, Routine 221/321 No Shift 3-4, Routine 222/322
<b>Reverse Ring Gear</b> Damaged gear lugs to reverse carrier	Inspect for damage. Replace as required.

<b>Low One-Way Clutch</b> Damaged, misassembled	Inspect for damage, proper assembly. Repair/replace as required.
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<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No Manual 1st Gear	
Possible Component	Reference/Action
<b>216 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, SSA1, SSB, digital (TR) sensor	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A and D in this section using Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>316 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable</b> Damaged, misadjusted, not connected	Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged Manual control lever outer and shaft assembly, manual valve, low reverse modulator valve, 1-2 shift valve, 2-3 shift valve, BS1 check ball, 4-3-2 timing valve — stuck, damaged SSA failure to operate in a normal manner Air bleed for SSA/SS1 circuit damaged or missing Wrong parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.  Refer to Electrical Routine No. 216.  Inspect for damage. Replace case.  Verify that proper parts were used.
<b>Low One-Way Clutch Assembly</b> Damaged, misassembled	Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No Manual 2nd Gear	
Possible Component	Reference/Action
<b>217 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, SSA, SSB, digital (TR) sensor	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A and D in this section using Transmission Tester, Cable and Overlay and the TRS-E Cable. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>317 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable</b> Damaged, misadjusted	Inspect for damage. Repair as required. Verify linkage/cable adjustment. After linkage/cable repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged 2-3 shift valve, 3-4 shift valve, manual 1-2 transition valve, spring — stuck, damaged, missing, misassembled BS6, BS1 — missing, leaks or seats damaged Improper parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required. Inspect for damage. Replace as required. Verify that proper parts were used.
<b>Intermediate Clutch Assembly</b> Assembly Seals or piston damaged Friction elements worn, missing, damaged, misassembled Ball check stuck/missing Feedbolt torque incorrect, leaks, missing Cylinder assembly outer diameter/case bore damaged, leaking	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required. Inspect for damage. Repair/replace as required. Inspect for damage. Repair/replace as required. Inspect and retighten bolts as required. Inspect for damage. Repair/replace as required.
<b>Intermediate One-Way Clutch Assembly</b>	

Case/sprags damaged, improperly assembled on inner race	Inspect for damage. Repair/replace as required.
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<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No 1-2 Shift (Automatic)	
Possible Component	Reference/Action
<b>220 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TP sensor, TSS, OSS, ABS, SSA, SSB	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test A</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>320 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable</b> Damage, misadjusted Digital (TR) sensor damaged, misadjusted	Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned SSB failure to operate in a normal manner D2 valve, 1-2 shift valve, 1-2 manual transition valve, intermediate clutch accumulator regulator valves, springs — stuck, damaged, missing or misassembled Air bleed for SSB circuit damaged or missing Wrong parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Refer to Electrical Routine No. 220. Inspect for damage. Repair/replace as required. Inspect for damage. Replace case. Verify that proper parts were used.
<b>Intermediate Clutch Assembly</b> Assembly Seals or piston damaged Friction elements worn, missing, damaged, misassembled	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required. Inspect for damage. Repair/replace as required.

Ball check stuck/missing Feedbolt torque incorrect, leaks, missing Cylinder assembly outer diameter/case bore damaged, leaking	Inspect for damage. Repair/replace as required. Inspect and retighten bolts as required. Inspect for damage. Replace as required.
<b>Intermediate One-Way Clutch Assembly</b>	
Cage/sprags damaged, improperly assembled on inner race Improper components used in rebuild	Inspect for damage. Repair/replace as required. Verify that proper components are used.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No 2-3 Shift (Automatic)	
Possible Component	Reference/Action
<b>221 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>	
Electrical inputs/outputs, vehicle wiring harness, PCM, TP sensor, TSS, OSS, ABS, SSA, SSB	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test A</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>321 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b>	
Bolts not tightened to specification Gaskets damaged SSA failure to operate in a normal manner Direct clutch accumulator regulator valve, 2-3 shift valve, springs — stuck, missing, damaged, misassembled Air bleed for SSB circuit damaged or missing Improper components used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Refer to Electrical Routine No. 221. Inspect for damage. Repair/replace as required. Inspect for damage. Replace case. Verify that proper components are used.
<b>Center Support Assembly</b>	
Feedbolts missing, not tightened to specification Seal rings damaged Assembly damaged Outside diameter or case bore	Inspect, install new feedbolts and tighten to specification. Inspect for damage. Replace as required. Inspect for damage. Replace as required. Inspect for damage. Replace as required.

damaged or leaking	
<b>Direct Clutch Assembly</b>	
Assembly	Air check clutch assembly; refer to Air Pressure Tests in this section.
Center support hub seals damaged	Inspect for damage. Replace as required.
Seals, piston, cylinder damaged	Inspect for damage. Replace as required.
Friction elements missing or damaged	Inspect for damage. Replace as required.
Ball check missing, damaged	Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No 3-4 Shift (Automatic)	
Possible Component	Reference/Action
<b>222 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>	
Electrical inputs/outputs, vehicle wiring harnesses, PCM, TP sensor, TSS, OSS, ABS, SSA, SSB	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test A</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>322 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b>	
Bolts not tightened to specification	Retighten bolts to specification.
Gaskets damaged or misaligned	Inspect for damage and replace.
SSA, SSB failure to operate in a normal manner	Refer to Electrical Routine No. 222.
Overdrive accumulator regulator valve and spring, 3-4 shift valve and spring — damaged, stuck, misassembled, missing	Inspect for damage. Repair/replace as required.
Improper components used in rebuild	Verify that proper components were used in the rebuild.
<b>Overdrive Clutch Assembly</b>	
Assembly	Air check clutch assembly; refer to Air Pressure Tests in this section.
Clutch plates burnt, missing	Inspect for damage. Replace as required.
Cylinder damaged	Inspect for damage. Replace as required.
Feedbolts loose, missing,	Install new feedbolts and tighten to specifications.



leaking, seals damaged Cylinder check ball missing	Inspect for damage. Replace as required.
<b>Overdrive One-Way Clutch Assembly</b> Damaged	Inspect for damage. Replace as required.
<b>Overdrive Planet Assembly</b> Damaged	Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No 4-3 Shift (Automatic)	
Possible Component	Reference/Action
<b>223 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TP sensor, TSS, OSS, ABS, SSB	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test A</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>323 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned SSB failure to operate in a normal manner BS2, 3-4 shift valve damaged, missing, misassembled, stuck	Retighten bolts to specification.  Inspect for damage and replace.  Refer to Electrical Routine No. 223.  Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: No 3-2 Shift (Automatic)	
Possible Component	Reference/Action
<b>224 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TP sensor, TSS, OSS, ABS, SSA	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests A and D in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.

### 324 — HYDRAULIC/MECHANICAL ROUTINE

<b>Main Controls</b>	
Bolts not tightened to specification	Retighten bolts to specification.
Gaskets damaged, misaligned	Inspect for damage and replace.
SSA failure to operate in a normal manner	Refer to Electrical Routine No. 224.
3-2 shift valve, stuck, damaged	Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

#### Shift Concerns: No 2-1 Shift (Automatic)

Possible Component	Reference/Action
<b>225 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>	
Electrical inputs/outputs, vehicle wiring harnesses, PCM, TP sensor, TSS, OSS, ABS, SSB	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test A</a> in this section using the Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.

### 325 — HYDRAULIC/MECHANICAL ROUTINE

<b>Main Controls</b>	
Bolts not tightened to specification	Retighten bolts to specification.
Gaskets, separator plate damaged, misaligned	Inspect for damage and replace.
SSB failure to operate in a normal manner	Refer to Electrical Routine No. 225.
D2 shift valve damaged, stuck	Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

#### Shift Concerns: Soft/Slipping 1-2 Only (Automatic)

Possible Component	Reference/Action
<b>226 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>	
Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.

**326 — HYDRAULIC/MECHANICAL ROUTINE****Main Controls**

Bolts not tightened to specification  
Gaskets damaged, misaligned  
Intermediate clutch accumulator regulator valve or plunger, springs — stuck, damaged, missing or misassembled  
Wrong parts used in rebuild

Retighten bolts to specification.  
Inspect for damage and replace.  
Inspect for damage. Repair/replace as required.  
Verify that correct parts were used.

**Intermediate Clutch Assembly**

Assembly  
  
Seals or piston damaged  
Friction elements worn, missing, misassembled or damaged  
Feedbolt torque incorrect, missing  
  
Ball check missing, not seating  
  
Cylinder assembly outer diameter/case bore damaged

Air check clutch assembly; refer to Air Pressure Tests in this section.  
Inspect for damage. Replace as required.  
Inspect for damage. Repair/replace as required.  
Inspect and install new feedbolts and tighten to specification.  
Inspect for damage. Repair/replace as required.  
Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

**Shift Concerns: Soft/Slipping 2-3 Only (Automatic)****Possible Component****Reference/Action****227 — ELECTRICAL ROUTINE****Powertrain Control System**

Electrical inputs/outputs, vehicle wiring harnesses, PCM

Run On-Board Diagnostics. Refer to PC/ED<sup>a</sup> for diagnosis. Repair/replace as required.

**327 — HYDRAULIC/MECHANICAL ROUTINE****Main Controls**

Bolts not tightened to specification  
Gaskets damaged  
Direct clutch accumulator regulator valve, plungers, springs — stuck, missing, damaged, misassembled  
Improper parts used in rebuild

Retighten bolts to specification.  
Inspect for damage and replace.  
Inspect for damage. Repair/replace as required.  
Verify that correct parts were used.

**Center Support Assembly**

Feedbolts missing, not tightened to specification  
Seal rings damaged

Inspect, install new feedbolts and tighten to specification.  
Inspect for damage. Replace as required.

Assembly damaged Outside diameter or case bore damaged or leaking	Inspect for damage. Replace as required. Inspect for damage. Replace as required.
<b>Direct Clutch Assembly</b>  Assembly  Center support hub seals damaged Seals, piston, cylinder damaged Friction elements burnt, missing  Improper quantity of plates installed  Ball check missing, not seating  Intermediate brake drum inner diameter damaged	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required. Inspect for damage. Replace as required. Inspect for damage. Repair/replace as required. Inspect for proper quantity. Repair/replace as required. Inspect for damage. Repair/replace as required. Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Soft/Slipping 3-4 Only (Automatic)	
Possible Component	Reference/Action
<b>228 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>  Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>328 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b>  Bolts not tightened to specification Gaskets damaged or misaligned Overdrive accumulator regulator valve and spring, overdrive accumulator plunger and springs, damaged, misassembled, stuck, missing Improper parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required. Verify that correct parts were used.
<b>Overdrive Clutch Assembly</b>  Assembly  Friction elements burnt, missing  Cylinder damaged, seals damaged  Feedbolts loose, missing, leaking, not tightened to	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required. Inspect for damage. Replace as required. Install new feedbolts and tighten to

specification Cylinder check ball not seating, missing	specification. Inspect for damage. Repair/replace as required.
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<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Soft/Slipping Downshifts (Automatic)	
Possible Component	Reference/Action
<b>229 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>329 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned CB7 check ball missing, wrong Valve body separator plate damaged Improper parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Replace as required. Inspect for damage. Replace as required.  Verify that correct parts were used.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Harsh 1-2 Shift Only (Automatic)	
Possible Component	Reference/Action
<b>232 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>332 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned Intermediate clutch accumulator regulator valve or plunger springs — stuck, damaged, missing or misassembled Wrong parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.  Verify that proper parts were used.
<b>Intermediate Clutch Assembly</b> Assembly	Air check clutch assembly; refer to Air Pressure Tests in this section.

Seals or piston damaged Friction elements missing or misassembled, damaged or improper quantity of plates installed	Inspect for damage. Repair as required. Inspect for damage. Repair/replace as required.
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<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Harsh 2-3 Shift Only (Automatic)	
Possible Component	Reference/Action
<b>233 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>333 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged Direct clutch accumulator regulator valve, plungers, springs stuck, missing, damaged, misassembled Wrong parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required.  Verify that proper parts were used.
<b>Center Support Assembly</b> Seal rings damaged Outside diameter or case bore damaged or leaking	Inspect for damage. Replace as required. Inspect for damage. Replace as required.
<b>Direct Clutch Assembly</b> Assembly  Seals, piston or cylinder damaged Friction elements damaged, missing or improper quantity of plates were installed	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required. Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Harsh 3-4 Shift Only (Automatic)	
Possible Component	Reference/Action
<b>234 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.

<b>334 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged or misaligned Overdrive accumulator regulator valve and spring, overdrive accumulator plunger and springs, stuck, damaged, misassembled, missing Improper parts used in rebuild	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Repair/replace as required. Verify that proper parts were used.
<b>Overdrive Clutch Assembly</b> Assembly Friction elements burnt, missing Cylinder damaged, seals damaged, retaining ring not seated	Air check clutch assembly; refer to Air Pressure Tests in this section. Inspect for damage. Replace as required. Inspect for damage. Repair/replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Harsh 4-3 Shift Only (Automatic)	
Possible Component	Reference/Action
<b>235 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>335 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned CB7 check ball missing Separator plate damaged	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Replace as required. Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Harsh 3-2 Shift Only (Automatic)	
Possible Component	Reference/Action
<b>236 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>336 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b>	

Bolts not tightened to specification	Retighten bolts to specification.
Gaskets damaged, misaligned	Inspect for damage and replace.
CB6 check ball missing	Inspect for damage. Replace as required.
Separator plate damaged	Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Shift Concerns: Harsh 2-1 Shift Only (Automatic)	
Possible Component	Reference/Action
<b>237 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Repair/replace as required.
<b>337 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification Gaskets damaged, misaligned CB14 check ball missing Separator plate damaged	Retighten bolts to specification. Inspect for damage and replace. Inspect for damage. Replace as required. Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Torque Converter Clutch Operation Concern: No Apply	
Possible Component	Reference/Action
<b>240 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TCC solenoid, BPP switch, TP sensor, TFT sensor	<b>Perform Torque Converter Clutch Operation Test.</b> Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Torque Converter Engagement Test. Perform Pinpoint Tests B and C in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>340 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification TCC solenoid or TFT sensor failure to operate in a normal manner Gaskets damaged	Retighten bolts to specification.  Refer to Electrical Routine No. 240.  Inspect gasket for damage and replace.
<b>Pump Assembly</b> Bolts not tightened to	Retighten bolts to specification.



specification Cross leaks, cup plugs missing Gaskets damaged Converter clutch control valve and regulator valve stuck, misassembled, damaged	Inspect for porosity/leaks, cup plugs missing, replace pump as required. Inspect and replace gaskets. Inspect for damage. Replace pump.
<b>Stator Support</b> Teflon® seals damaged, leaking	Inspect for damage. Replace as required.
<b>Torque Converter Assembly</b> Leakage, friction material damaged, internal seals damaged	Inspect; refer to Torque Converter Service and Replacement in this section. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Torque Converter Clutch Operation Concern: Always Applied/Stalls Vehicle (See Note in No. 241 Before Proceeding)

Possible Component	Reference/Action
<b>241 — ELECTRICAL ROUTINE</b>	
<b>NOTE:</b> Stalls in DRIVE and MANUAL 2 only (MANUAL 1 and REVERSE are OK) <b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TCC solenoid  Stalls in any range.	Go to Hydraulic/Mechanical No. 341.  Perform Torque Converter Clutch Operation Test.  Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Torque Converter Engagement Test. Perform <a href="#">Pinpoint Test C</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.  Refer to 341 Fluid Filter.
<b>341 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Improper Pressures</b> Low line pressures	Check line pressure at line tap. Perform Line Pressure and Stall Speed Tests. Refer to the Line Pressure Chart for specification.
<b>Fluid Filter</b> Damaged filter or seal  Filter/seal disengaged from pump inlet bore	Replace filter and seal assembly.

<b>Main Controls</b> Bolts not tightened to specification Torque converter clutch solenoid failure to operate in a normal manner Gaskets damaged	Retighten bolts to specification. Refer to Electrical Routine No. 241. Inspect for damage and replace.
<b>Pump Assembly</b> Bolts not tightened to specification Converter clutch control valve misassembled, stuck, damaged Porosity/cross leaks Gaskets damaged Excessive pump gear end clearance	Retighten bolts to specification. Inspect for damage. Repair/replace as required. Inspect for porosity/leaks, valve damaged, replace pump as required. Inspect for damage and replace. Perform pump gear end clearance check; refer to Pump Assembly in this section.
<b>Torque Converter Assembly</b> End play (none) Piston plate damaged/stuck to cover	Perform End Play Check in this section. Inspect for damage. Repair/replace as required. Inspect transmission cooling system for proper lube flow. Follow the procedures in this section.

<sup>a</sup> Can be purchased as a separate item.

Torque Converter Clutch Operation Concern: Cycling/Shudder/Chatter	
Possible Component	Reference/Action
<b>242 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle harnesses, PCM, TCC solenoid, digital (TR) sensor, BPP switch, PCM	Refer to PC/ED <sup>a</sup> for diagnosis. Perform Torque Converter Engagement Test. Perform Pinpoint Tests C and D in this section using Transmission Tester, Cable and Overlay and TRS-E Cable. Clear codes, road test and rerun On-Board Diagnostics.
<b>Speed Control Equipped Vehicles</b>	NOTE: Refer to Routine No. 212 before you proceed to No. 342.
<b>342 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Fluid Condition</b>	<b>Inspect fluid condition. If burnt or contaminated drain fluid from the transmission assembly and converter assembly.</b>

	<b>Check control attaching bolts for proper torque. Retighten as required. Record and erase On-Board Diagnostics codes. Bring vehicle to normal operating temperature. Perform Transmission Drive Cycle in this section. Perform On-Board Diagnostics. If condition still exists, continue diagnosis.</b>
<b>Main Controls</b> Bolts not tightened to specification Torque converter clutch solenoid failure to operate in a normal manner Gaskets damaged	Retighten bolts to specification.  Refer to Electrical Routine No. 242.  Inspect for damage and replace.
<b>Pump Assembly</b> Bolts not tightened to specification Cross leaks  Gaskets damaged Converter clutch regulator valve damaged	Retighten bolts to specification.  Inspect for porosity/leaks, valve damage; replace pump as required.  Inspect for damage and replace. Inspect for damage. Replace as required.
<b>Stator Support</b> Teflon® seal on nose of stator damaged, cut, leaking	Inspect for damage. Replace as required.
<b>Torque Converter Assembly</b> End play (excessive), internal leakage	Inspect; refer to Torque Converter Service and Replacement in this section. Repair as required.

<sup>a</sup> Can be purchased as a separate item.

Other Concerns: Shift Lever Efforts High	
Possible Component	Reference/Action
<b>251 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>351 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable</b>	
Damaged, misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify

	that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Manual Control Lever Outer and Shaft Assembly</b>  Retaining pin damaged, nut loose, detent spring — bent/damaged, park mechanism damaged	Inspect for damage. Repair/replace as required. Inspect locking nuts for proper torque, retighten to proper specification as required.
<b>Main Controls</b>  Manual valve sticking Bolts not tightened to specification	Inspect for damage. Repair/replace as required. Retighten bolts to specification.

Other Concerns: External Leaks	
Possible Component	Reference/Action
<b>252 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>352 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Engine Rear Seal</b>	<b>Locate source and replace as required.</b>
<b>Seals/Gaskets</b>  Torque converter assembly, pump, transmission fluid pan, transmission connector, extension housing — gasket seal, manual lever, fluid level indicator, fluid filler tube, pump bolts	Locate source and repair/replace as required.
<b>Other</b>  Cooler fitting, pressure taps, converter drain plug, band anchor pins, cooler tubes, case porosity, case cracked Vent blocked or damaged  Overfilled transmission  Overheating Pump assembly	Locate source and repair/replace as required. Check case vent assembly for damage or blockage. Repair as required. Check level and adjust as required. Refer to routines No. 257/357. Locate source and repair as required.

Other Concerns: Poor Vehicle Performance
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Possible Component	Reference/Action
<b>253 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>  Electrical inputs/outputs, vehicle wiring harnesses, PCM, other engine related items, TCC solenoid, TP sensor, digital (TR) sensor, TFT sensor	<b>Perform Torque Converter Clutch Operation Test.</b>  Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform Pinpoint Tests B, C and D in this section using Transmission Tester, Cable and Overlay and TRS-E Cable. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>353 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable</b>  Damaged, misadjusted	Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Shift Scheduling</b>  Improper	Perform Shift Point Road Test in this section. Go to the appropriate diagnostic routines for shift concerns No. 210-211.
<b>Engagements</b>  Improper gear selection	Go to the appropriate diagnostic routines for shift concerns No. 215/315.
<b>Converter Clutch Always Applied</b>	Go to routine No. 341.
<b>Converter One-Way Clutch</b>  Damaged	Go to Torque Converter One-Way Clutch Check in this section.

<sup>a</sup> Can be purchased as a separate item.

Other Concerns: Noise/Vibration — Forward or Reverse	
Possible Component	Reference/Action
<b>254 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>354 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>For Noises/Vibrations that change with engine speed:</b>  Torque converter components	Locate source of disturbance. Repair/replace as required.

<p>Fluid level (low) pump cavitation</p> <p>Pump assembly</p> <p>Engine drive accessories</p> <p>Transmission fluid cooler lines grounding out</p> <p>Flexplate</p> <p>Fluid filler tube grounding out</p>	
<p><b>For Noise/Vibrations that change with vehicle speed:</b></p> <p>Engine mounts</p> <p>    Loose, damaged</p> <p>Driveline concerns</p> <p>U-joints</p> <p>Rear axle assembly</p> <p>Suspension</p> <p>Modifications/misalignment</p> <p>First gear</p> <p>    one-way clutch, gear set</p> <p>    friction elements</p> <p>    torque converter assembly</p> <p>Second gear</p> <p>    intermediate OWC</p> <p>    friction elements</p> <p>    torque converter assembly</p> <p>Third gear</p> <p>    one-way clutch</p>	<p>Locate source of disturbance. Repair/replace as required.</p> <p>For specific shifts or torque converter concern, refer to appropriate routines:</p> <p>    No Shift 1-2, Routine 320</p> <p>    No Shift 2-3, Routine 321</p> <p>    No Shift 3-4, Routine 322</p> <p>    No Shift 4-3, Routine 323</p> <p>    No Shift 3-2, Routine 324</p> <p>    No Shift 2-1, Routine 325</p> <p>    No Converter Cycling, Routine 242/342</p>

torque converter assembly  friction elements  Fourth gear  one-way clutch  gear set  friction elements  torque converter assembly  <b>REVERSE</b>  gear set  friction elements  torque converter assembly  Shaft spline fit  Slip yoke, park gear	
<b>Other Noises/Vibrations:</b>  Main controls  Valve resonance  Shift cable  Vibration, grounding  transmission fluid cooler lines or fluid filler tube	Locate source of disturbance. Repair/replace as required.

Other Concerns: Engine Will Not Crank	
Possible Component	Reference/Action
<b>255 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b>  Electrical inputs/outputs, vehicle wiring harnesses, PCM, digital (TR) sensor	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test D</a> in this section using Transmission Tester, Cable and Overlay and TRS-E Cable. Repair/replace as required. Clear codes, and rerun

	On-Board Diagnostics.
<b>355 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable/Digital (TR) Sensor</b> Damaged, misadjusted	Inspect and repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Pump Assembly</b> Seized	Refer to Pump Assembly in the Disassembly and Assembly of Subassemblies portion of this section. Inspect for damage. Repair/replace as required.
<b>Flexplate</b> Damaged	Inspect for damage. Replace as required.

<sup>a</sup> Can be purchased as a separate item.

Other Concerns: No Park Range	
<b>Possible Component</b>	<b>Reference/Action</b>
<b>256 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>356 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Shift Linkage (Internal/External) or Cable</b> Damaged, misadjusted	Inspect for damage. Repair as required. Verify linkage adjustment. After linkage repair/adjustment, verify that the digital (TR) sensor is properly adjusted; refer to the Digital Transmission Range (TR) Sensor in this section.
<b>Park Mechanism</b> Park gear, parking pawl, parking pawl return spring, park guide plate, parking pawl shaft, parking pawl actuating rod, manual control lever outer and shaft assembly, inner manual valve detent lever, damaged, misassembled	Inspect for damage. Repair/replace as required.
<b>Super Duty Only</b> Parking brake drum damaged	Inspect for damage. Replace as required.

Other Concerns: Transmission Overheating
--



Possible Component	Reference/Action
<b>257 — ELECTRICAL ROUTINE</b>	
<b>Powertrain Control System</b> Electrical inputs/outputs, vehicle wiring harnesses, PCM, TCC solenoid	Run On-Board Diagnostics. Refer to PC/ED <sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test C</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.
<b>357 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Excessive Vehicle or Towing Loads, Severe Vehicle Usage</b>	Refer to the vehicle specification manual for load and GVW/GCW information. Refer to owner guide.  NOTE: If auxiliary cooler is desired, use only Ford original factory equipment installed to factory specifications.
<b>Fluid</b> Improper level  Condition	Adjust fluid to proper level. Inspect according to instructions under Fluid Condition Check.
<b>Transmission Cooling System</b> Damaged, blocked, restricted, or improperly installed  Cooler bypass valve (CBV) damaged, blocked, restricted or improperly installed.	Perform Transmission Fluid Cooler Flow Test.  Inspect for damage, restrictions. Repair/replace as required.
<b>Vehicle Concerns Causing Engine Overheating</b>	Refer to <a href="#">Section 303-03</a> .
<b>Torque Converter Clutch</b> Not engaging	See Routine No. 240/340.

<sup>a</sup> Can be purchased as a separate item.

Other Concerns: No Engine Braking in MANUAL 2 Position Only	
Possible Component	Reference/Action
<b>258 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>358 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b> Bolts not tightened to specification BS1, BS6, CB1 check balls missing, seat damaged	Retighten bolts to specification. Inspect for damage. Replace as required.

Valve body separator plate damaged	Inspect for damage. Replace as required.
4-3-2 timing valve, D2 valve, 2-3 shift valve, coast clutch shift valve, 1-2 manual transition valve, 3-4 shift valve damaged, stuck, misassembled	Inspect for damage. Repair/replace as required.
<b>Coast Clutch Assembly</b>	
Assembly	Air check clutch assembly; refer to Air Pressure Tests in this section.
Seals or piston damaged	Inspect for damage. Replace as required.
Stator support damaged or holes blocked, seal rings damaged	Inspect for damage. Repair/replace as required.
Cylinder hub damaged or holes blocked	Inspect for damage. Repair/replace as required.
Friction elements damaged, burnt	Inspect for damage. Replace as required.
<b>Intermediate Servo/Band Assembly</b>	
Servo piston or bore damaged	Inspect for damage. Replace as required.
Band or drum burnt, damaged	Inspect for damage. Replace as required.

Other Concerns: No Engine Braking in MANUAL 1 Position Only	
Possible Component	Reference/Action
<b>259 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>359 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<b>Main Controls</b>	
Bolts not tightened to specification	Retighten bolts to specification.
Gaskets damaged	Inspect for damage and replace.
3-4 shift valve, low reverse clutch modulator valve, D2 valve, 4-3-2 timing valve, 2-3 shift valve, coast clutch shift valve damaged, misassembled, stuck	Inspect for damage. Repair/replace as required.
BS1, CB1 ball damaged, missing	Inspect for damage. Replace as required.
Valve body separator plate damaged	Inspect for damage. Replace as required.
Reinforcing plate bolts loose	Retighten bolts to specification.
<b>Coast Clutch Assembly</b>	

<p>Assembly</p> <p>Seal or piston damaged</p> <p>Stator support damaged or holes blocked, seal rings damaged</p> <p>Cylinder hub damaged or holes blocked</p> <p>Friction elements damaged, burnt</p>	<p>Air check clutch assembly; refer to Air Pressure Tests in this section.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Repair/replace as required.</p> <p>Inspect for damage. Repair/replace as required.</p> <p>Inspect for damage. Replace as required.</p>
<p><b>Low One-Way Clutch Assembly</b></p> <p>Assembly</p> <p>Seals or piston damaged</p> <p>Friction elements damaged, worn</p> <p>Sealing area in case damaged</p>	<p>Air check clutch assembly; refer to Air Pressure Tests in this section.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Replace as required.</p> <p>Inspect for damage. Replace case.</p>

Other Concerns: No Engine Braking with Overdrive Cancelled (MANUAL 1st and MANUAL 2nd Have Engine Braking)

Possible Component	Reference/Action
<b>260 — ELECTRICAL ROUTINE</b>	
<p><b>Powertrain Control System</b></p> <p>Electrical inputs/outputs, vehicle wiring harnesses, PCM, CCS</p>	<p>Run On-Board Diagnostics. Refer to PC/ED<sup>a</sup> for diagnosis. Perform <a href="#">Pinpoint Test G</a> in this section using Transmission Tester and Cable and Overlay. Repair/replace as required. Clear codes, road test and rerun On-Board Diagnostics.</p>
<b>360 — HYDRAULIC/MECHANICAL ROUTINE</b>	
<p><b>Main Controls</b></p> <p>Bolts not tightened to specification</p> <p>Gaskets damaged</p> <p>CCS damaged, stuck</p> <p>BS3 check balls missing or valve body separator plate</p>	<p>Retighten bolts to specification.</p> <p>Inspect for damage and replace.</p> <p>Refer to electrical routine No. 260.</p> <p>Inspect for damage. Replace as required.</p>

seat damaged 3-4 shift valve stuck, damaged or misassembled	Inspect for damage. Repair/replace as required.
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<sup>a</sup> Can be purchased as a separate item.

Other Concerns: Fluid Venting/Foaming	
Possible Component	Reference/Action
<b>261 — ELECTRICAL ROUTINE</b>	
No electrical concerns	
<b>361 — HYDRAULIC/MECHANICAL ROUTINE</b>	
Case vent assembly blocked or damaged	Check case vent assembly for damage or blockage. Repair/replace as required.
Overfilled transmission	Check level and adjust as required.
Fluid contaminated (coolant, water)	Check for contamination, locate source of contamination. Repair as required.
Overheating	Refer to Routine No. 257/357.
Filter assembly and seal damaged or misassembled	Inspect filter assembly and seal for damage. Replace as required.
Pump to case gasket damaged, misaligned	Inspect for damage and replace.

## Transmission Fluid Cooler — Backflushing and Cleaning



**CAUTION:** Test the torque converter/fluid cooler cleaner to ensure that a vigorous fluid flow is present before proceeding. Replace the system filter if flow is weak or contaminated.


1. The Oil-to-Air (OTA) cooler should be removed prior to flushing the lines and in-tank coolers, otherwise the OTA can collect contaminants that could be released into the fluid cooling system causing a transmission failure.

2. Using a suitable torque converter/fluid cooler cleaner, flush the fluid cooler and lines.
3. **NOTE:** Rubber hoses must be attached to the ends of the fluid cooler tubes, to aid in connecting them to the cleaner.

Connect the cleaner pressure and return lines correctly.

1. Connect the pressure line to fluid cooler inlet tube.
2. Connect the return line to fluid cooler outlet tube.
3. Place the outlet end of the return line in the solvent tank reservoir.
4. **NOTE:** Cycling the solvent pump on and off will help dislodge contaminants in the cooler system.


Switch the solvent pumps on. Allow the solvent to circulate a minimum of 5 minutes.

5. Switch the solvent pump off.
6. Disconnect the cleaner pressure line at the fluid cooler tube.
7. Using compressed air, blow through the fluid cooler inlet tube until all solvent is removed.
8. Remove the rubber hoses from fluid cooler tubes.
9.  **CAUTION: Contamination can become trapped in the coolers. Clean fluid flow after flushing does not always indicate all contamination has been removed.**

Install a new OTA.

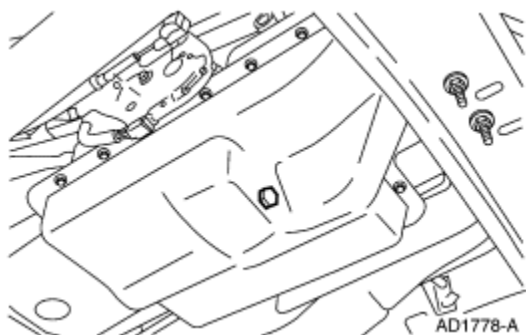
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## Transmission Fluid Drain and Refill

	Special Tool(s)
	Torque Converter/Oil Cooler Cleaner 307-F011 (014-00028) or equivalent

### Removal

1. Raise the vehicle on a hoist; refer to [Section 100-02](#).
2. If equipped, remove the drain plug to allow the fluid to drain.

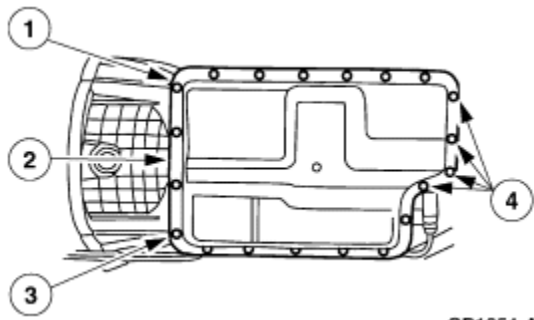


3.  **CAUTION:** When replacing the transmission fluid and filter and seal assembly; the torque converter should be drained transmission cooler, cooler lines, and cooler bypass valve must be thoroughly flushed to remove any contamination.

**NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

Remove the transmission fluid pan and gasket.

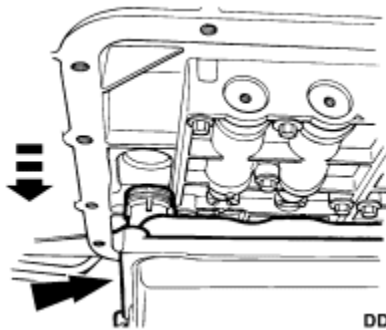
1. Loosen, but do not remove the bolts.
2. Remove the front and side bolts.
3. Lower the front of the fluid pan and allow the fluid to drain.
4. Remove the remaining fluid pan bolts and the fluid pan.



GD1354-A

4. **NOTE:** After removal, discard the filter and seal assembly.

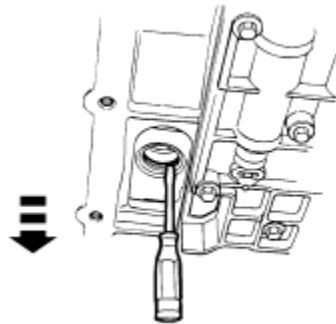
Remove the filter and seal assembly by carefully pulling and rotating the filter as necessary.



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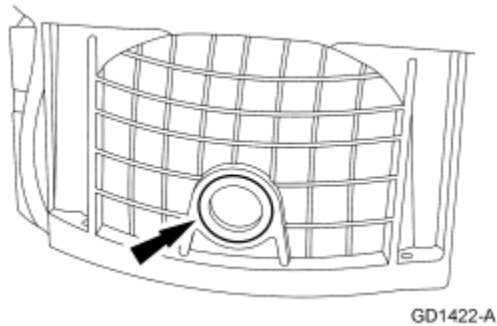
5. **CAUTION:** Be careful not to scratch or damage the aluminum bore. The new seal may leak and damage to the case will result.

If the seal remains in the pump bore, remove it carefully with a small screwdriver so as not to scratch or damage the aluminum bore.

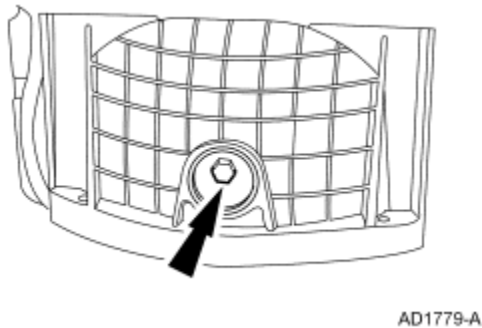


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6. Remove the torque converter drain plug cover.



7. Remove the torque converter drain plug.



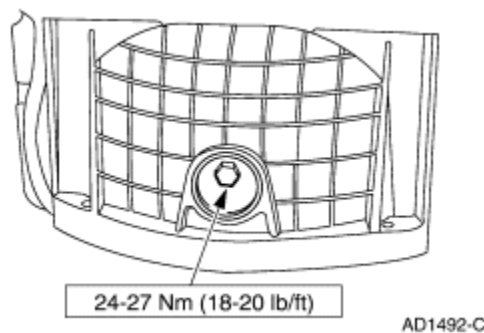
8. **NOTE:** If equipped with a radiator in-tank transmission fluid cooler (5.4L) and an oil-to-air (OTA) the in-tank fluid cooler will need to be flushed, and the OTA will need to be replaced.

**NOTE:** If performing the drain and refill procedure for maintenance the oil to air oil cooler will not need to be replaced. If performing an overhaul the oil-to-air cooler (OTA) will be required to be replaced.

Thoroughly flush the cooler lines and the cooler bypass valve.

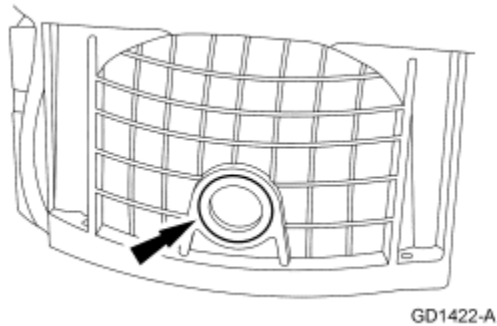
## Installation

1. After the torque converter has drained, install the drain plug.



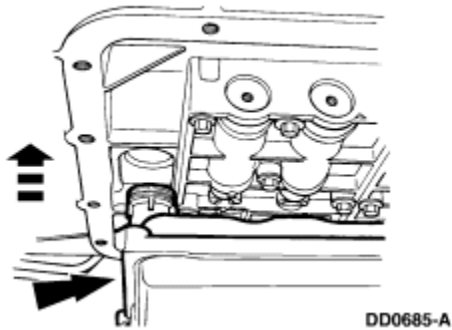
2. Install the torque converter drain plug cover.





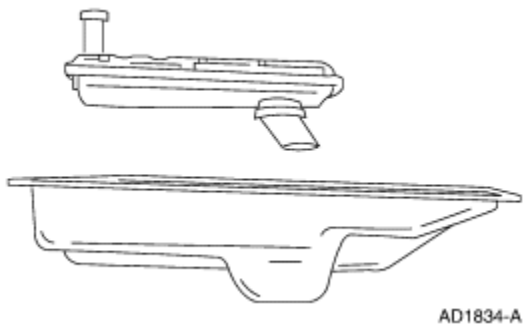
3. **NOTE:** Prior to installation, lightly lubricate the seal with clean Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or MERCON® equivalent.

Press a new fluid filter and seal assembly into the pump bore until seated.



4. **CAUTION:** Mixing (A) 4x2-style and (B) 4x4-style transmission fluid filters and transmission pan assembly components can cause transmission damage.

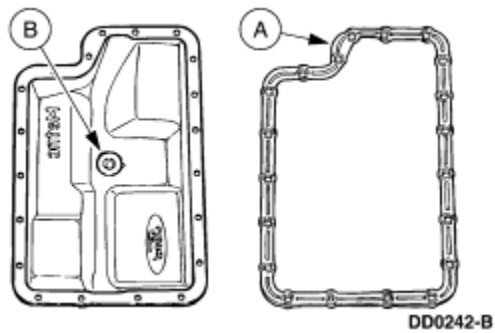
Install filter assembly and transmission pan.



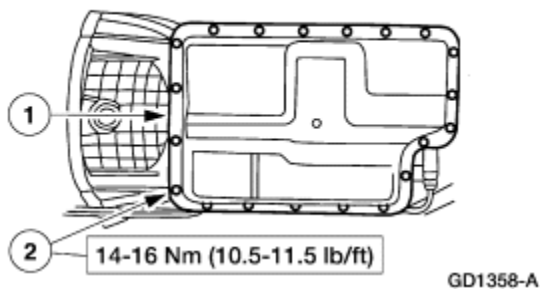
5. **NOTE:** Transmission pan gasket is reuseable unless damaged.


**NOTE:** Apply a light coat of petroleum jelly to hold the gasket to the fluid pan.

Position the (A) gasket onto the cleaned fluid pan. Make sure the (B) magnet is positioned over the dimple in the fluid pan.



6. Install the fluid pan.
  1. Position the fluid pan.
  2. Install the bolts.



7. Lower the vehicle.
8.  **CAUTION:** Use only Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or MERCON® equivalent. The use of any other fluids can result in the transmission failing to operate in a normal manner or failure.

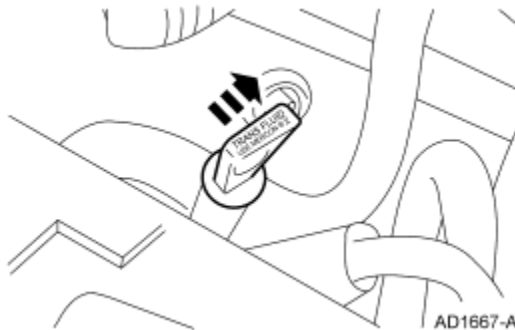
Refill the transmission (7003).

- Add 6.2 liters (6.5 quarts) of MERCON® or MERCON® equivalent transmission fluid to the transmission through the fluid filler tube.
  - Start the engine. Move the transmission range selector lever through all the gear ranges.
  - Check and adjust the transmission fluid, in 0.24-liter (0.5-pint) increments, to the proper level (cross-hatched area of the fluid level indicator (7A020) ) at normal operating temperature.
-

## Transmission Filler Tube

### Removal

1. Remove the fluid level indicator.



2. Raise the vehicle on a hoist; refer to [Section 100-02](#).
3. Remove the bolt.



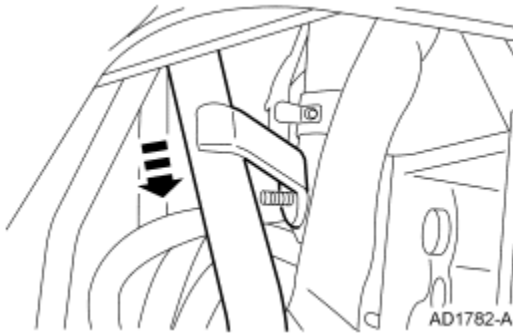
4. Remove the oil filler tube.



## Installation

1. **NOTE:** Coat the O-ring at the bottom of the oil filler tube with transmission fluid.

Install the oil filler tube.



2. Install the bolt.



3. Lower the vehicle.
4. Install the fluid level indicator.

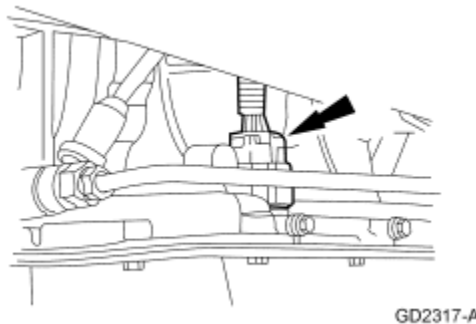


## Main Control—Valve Body, Accumulator Body, Solenoid Body

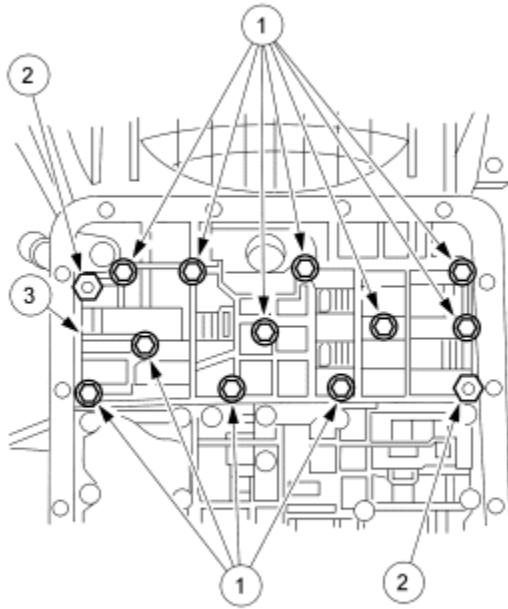
### Removal

**NOTE:** If the transmission (7003) has been disassembled to replace worn or damaged parts, and the valves in the main control valve body (7A100) stick repeatedly from foreign material, the torque converter (7902) must be removed and cleaned by using a mechanically agitated cleaner, such as the Torque Converter/Oil Cooler Cleaner.


1. Remove the transmission fluid level indicator.
2. Disconnect the solenoid body electrical connector.



3. Remove the fluid pan gasket and filter; refer to [Transmission Fluid Drain and Refill](#) in this section.
4. Remove the accumulator body.
  1. Remove the bolts.
  2. Remove the nuts.
  3. Remove the accumulator body.

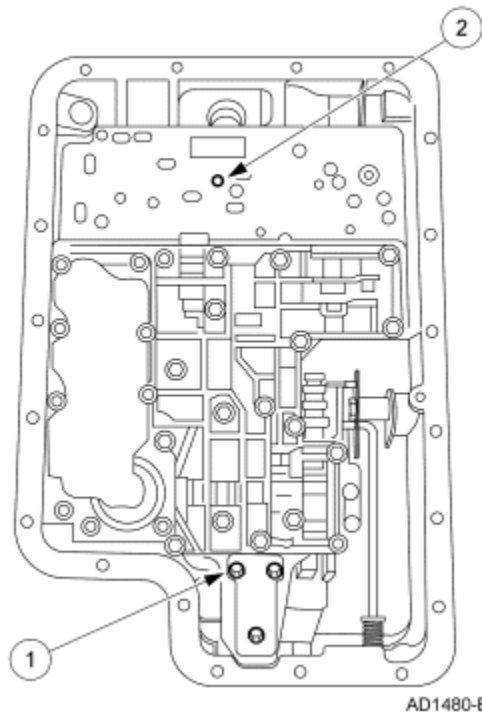


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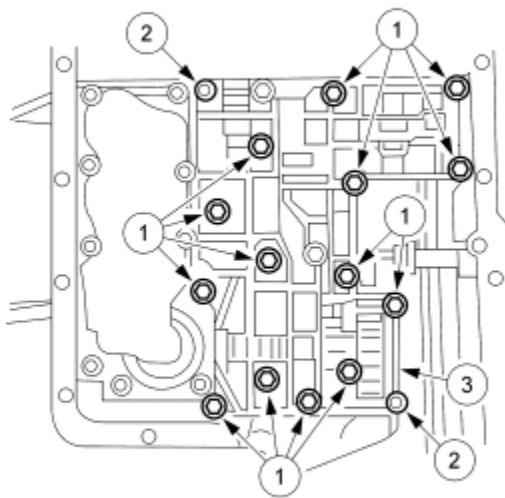
5.  **CAUTION: Prevent the front of the valve body separator plate from sagging and displacing the check balls.**

If the valve body separator plate is not being serviced:

1. Remove the bolt.
2. Install the bolt into any case threaded bolt hole on the opposite end of the separator plate.

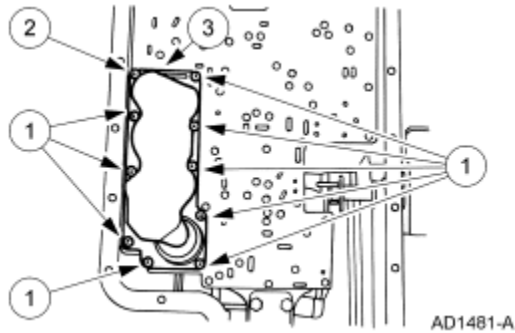


6. Remove the main control valve body assembly.
  1. Remove the bolts.
  2. Remove the nuts.
  3. Remove the main control valve body.

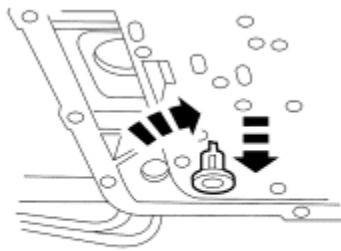


7. Remove the solenoid body assembly.

1. Remove the bolts.
2. Remove the nut.
3. Remove the solenoid body assembly.



8. Remove the solenoid screen assembly by rotating and pulling.



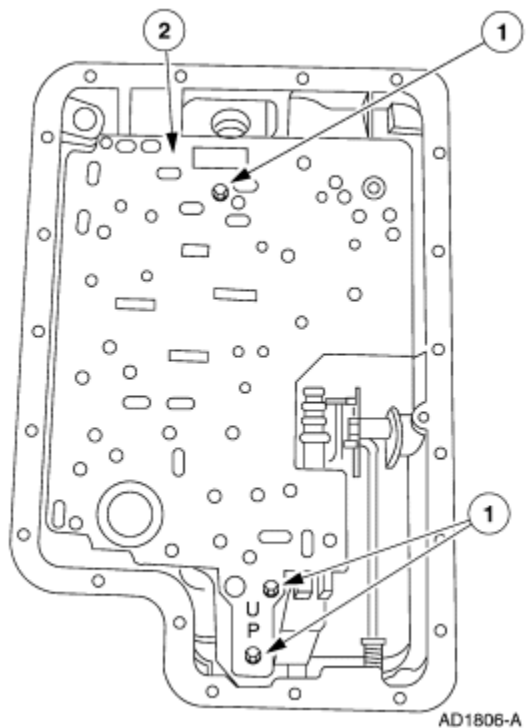
9.  **CAUTION: The steel electronic pressure control (EPC) check ball is spring-loaded under the valve body separator plate.**

**NOTE:** If the valve body separator plates are not to be serviced, proceed to installation procedure.

Remove the valve body separator plate reinforcement.

1. Remove the bolts.
2. Remove the separator plate reinforcement.





10. Lower and remove the valve body separator plate and gaskets.

- The rubber check balls and the steel EPC check ball and spring assembly will fall out and may become lost or stick to the worm trail of the case.
- Remove and discard separator plate gaskets.

## Installation



**CAUTION:** Using the incorrect gaskets can cause damage to the transmission.

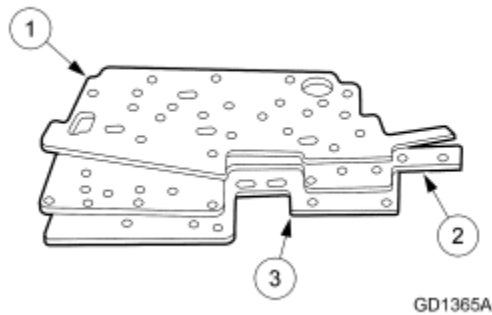
1. **NOTE:** Refer to parts catalog for proper gasket usage.

**NOTE:** If the valve body separator plate was not removed, proceed to Step 6.

**NOTE:** Apply a light film of petroleum jelly to the valve body separator plate prior to assembling the new gaskets.

Assemble the new gaskets to the valve body separator plate.

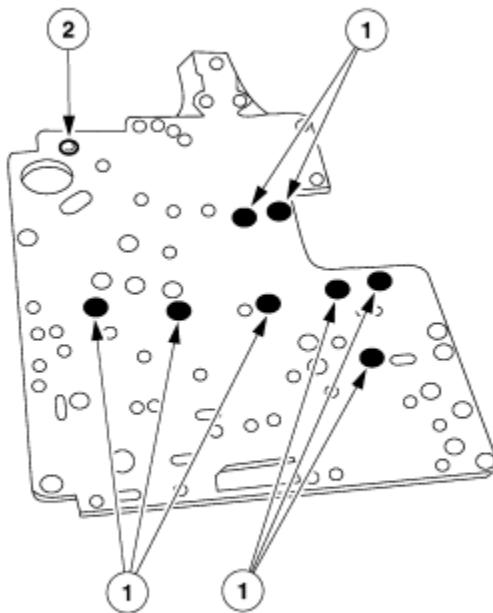
1. Main control to case gasket.
2. Valve body separator plate.
3. Main control to separator plate gasket.



2. **NOTE:** Apply a small amount of petroleum jelly to each check ball prior to positioning them on the valve body separator plate.

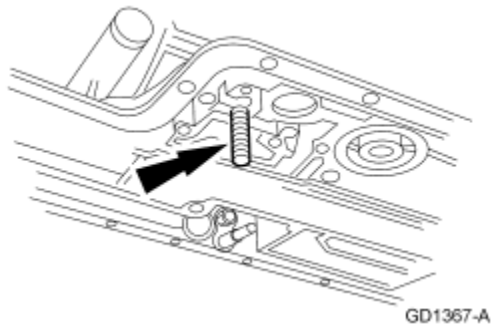
Install the check balls on the valve body separator plate.

1. Install the eight rubber check balls.
2. Install the one steel EPC check ball on the valve body separator plate.

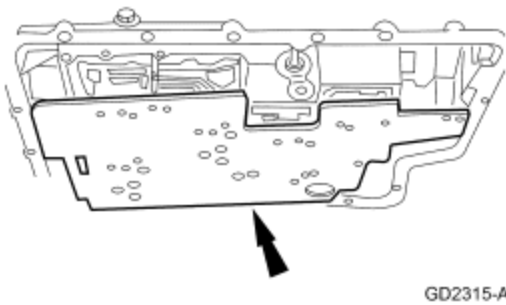


3. **NOTE:** Apply petroleum jelly to the EPC check ball spring prior to installing it into the case.

Install the EPC check ball spring.



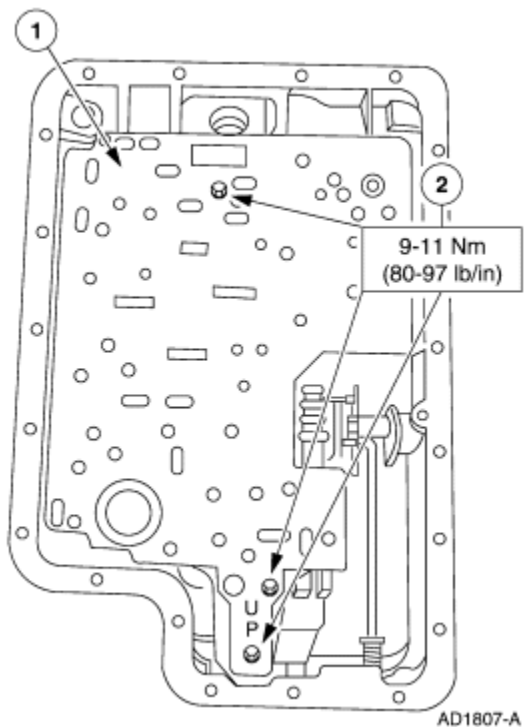
4. Position the valve body separator plate and the gaskets to the case carefully to retain the check balls.



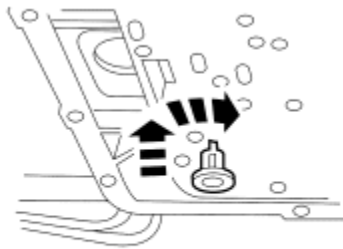
5. **NOTE:** The word "UP" stamped on the separator plate reinforcement, must be visible when installed.

Install the separator plate reinforcement plate.

1. Position the separator plate reinforcement plate.
2. Install the bolts.



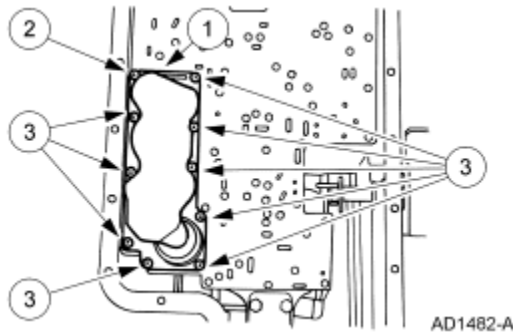
6. Install the solenoid screen assembly by pushing it in and rotating it to lock.



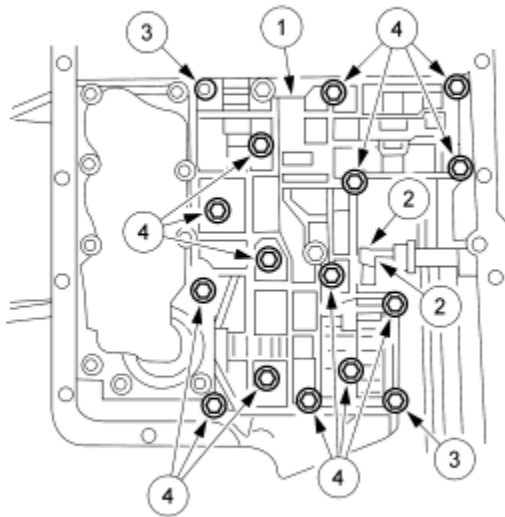
7. **NOTE:** Prior to installing the solenoid body assembly, coat the case connector bore with Silicone Dielectric Compound D7AZ-19331-A or equivalent meeting Ford specification ESE-M1C171-A.

Install the solenoid body assembly.

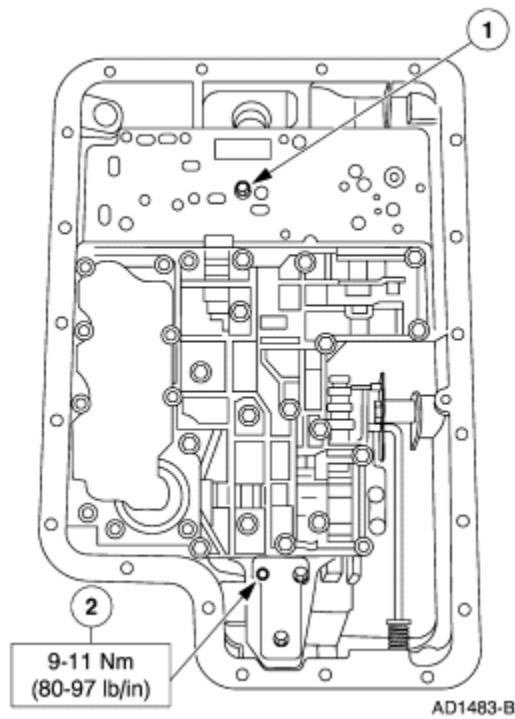
1. Install the solenoid body assembly.
2. Install the nut.
3. Install the bolts and nut finger-tight.



8. Install the main control valve body.
  1. Install the main control valve body.
  2. Aligning the manual shift valve with the manual valve detent lever.
  3. Install the nuts finger-tight.
  4. Install the bolts finger-tight.

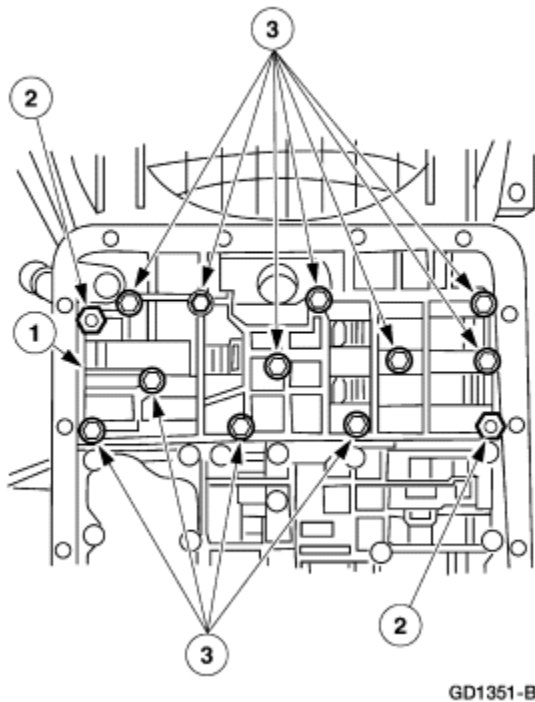


9. If previously installed, remove, then reinstall the bolt into the separator plate reinforcing plate.
  1. Remove the bolt.
  2. Install the bolt.

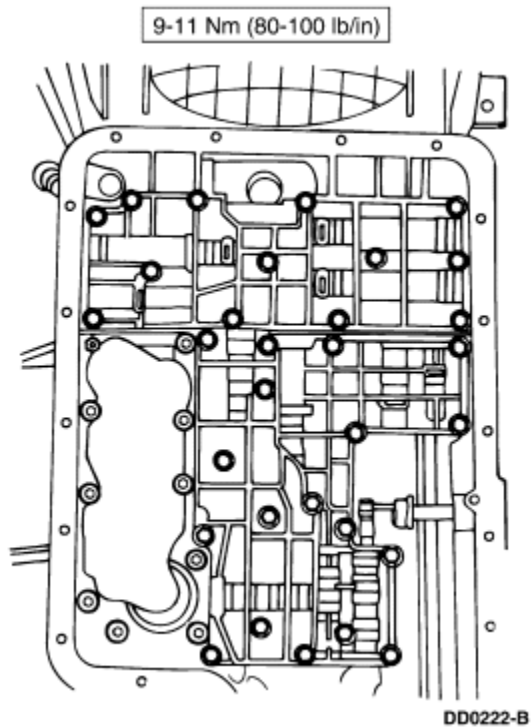


10. Install the accumulator body.

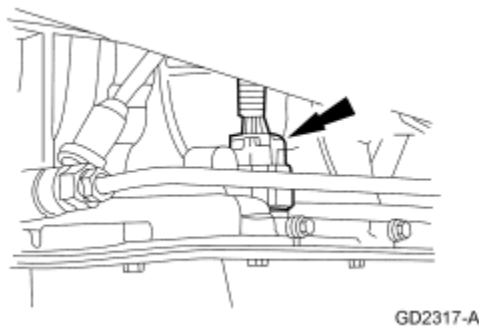
1. Install the accumulator body.
2. Install the nuts finger-tight.
3. Install the bolts finger-tight.



11. Tighten all the accumulator body, main control valve body, and solenoid body nuts and bolts. Tighten the bolts working from the center to the outside.



12. Install the fluid pan gasket and filter.
13. Connect the solenoid body electrical connector.



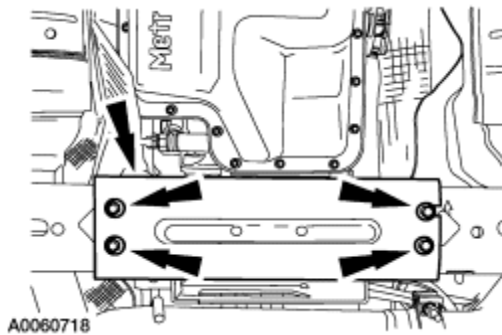
## Turbine Shaft Speed (TSS) Sensor and Output Shaft Speed (OSS) Sensor

### Removal

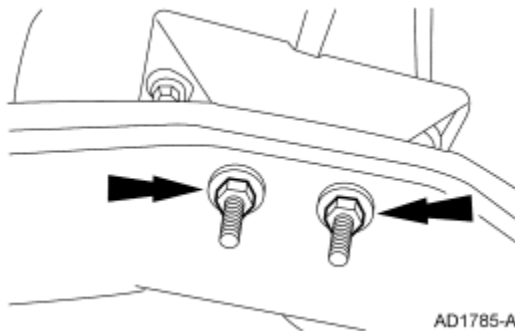
1. **NOTE:** The 4x2 application and the 4x4 application are similar.

With the vehicle in NEUTRAL, position on a hoist. For additional information, refer to [Section 100-02](#).

2. Remove the bolts and remove the dampener.

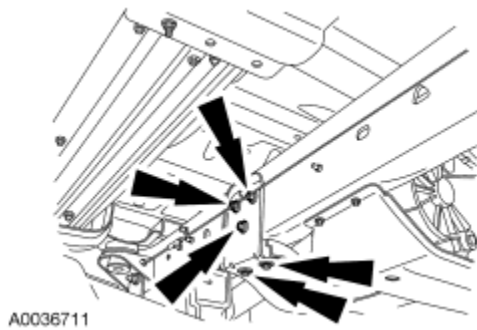


3. Remove the transmission insulator-to-crossmember support nuts.

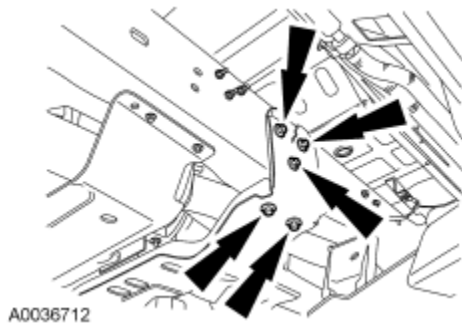


4. Attach a suitable high-lift transmission jack to the transmission.
5. Remove the crossmember bolts.

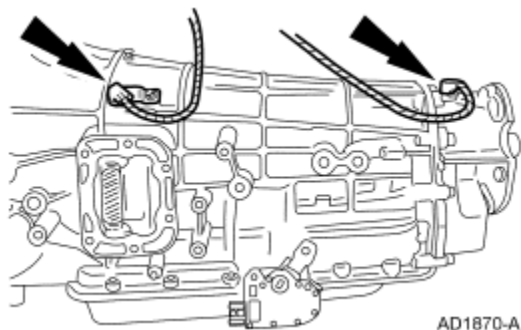




6. Remove the crossmember bolts and the crossmember.



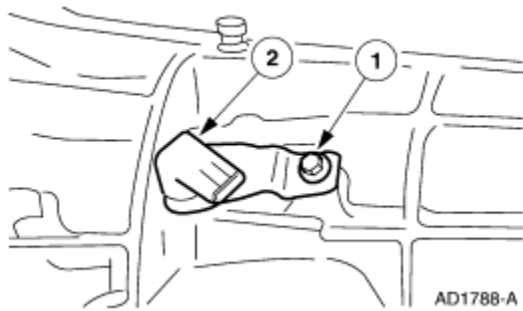
7. Lower the rear of the transmission to gain access to the sensors.
8. Disconnect the electrical connector of the affected sensor.



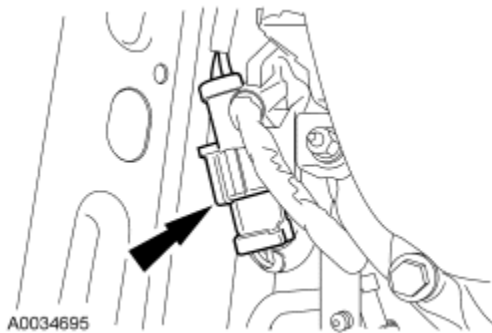
9.  **CAUTION:** Use care not to induce contamination in the form of dirt or foreign material when removing either of the sensors.

If necessary, remove the turbine shaft speed (TSS) sensor.

1. Remove the bolt.
2. Remove the TSS.

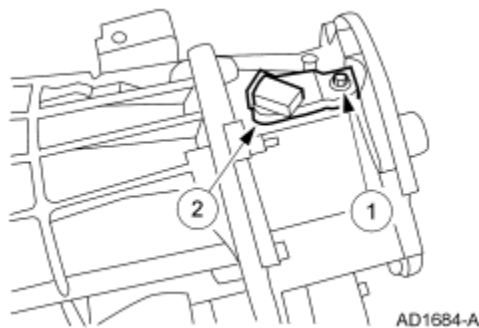


10. Position the heated oxygen sensor (HO2S) connector aside.



11. If necessary, remove the output shaft speed (OSS) sensor.

1. Remove the bolt.
2. Remove the OSS.

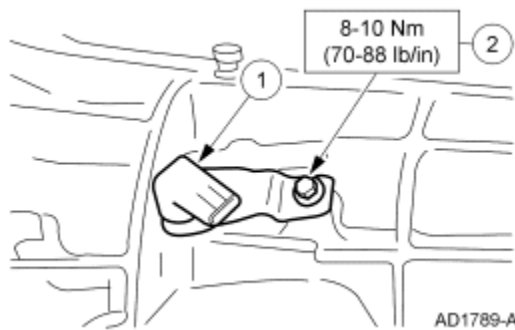


## Installation

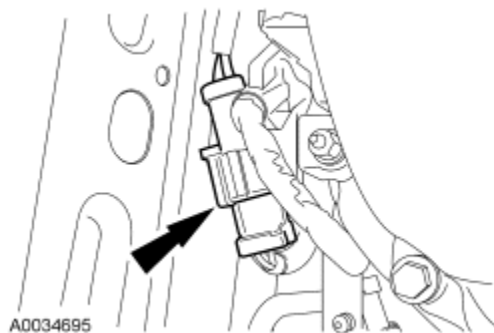
1.  **CAUTION:** Use care not to induce contamination in the form of dirt or foreign material when installing either of the sensors.

If removed, install the OSS.

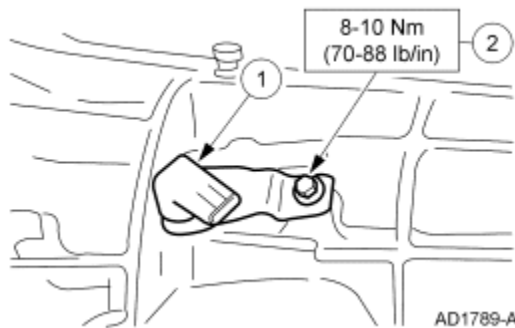
1. Lubricate the O-ring and install the OSS.
2. Install the bolt.



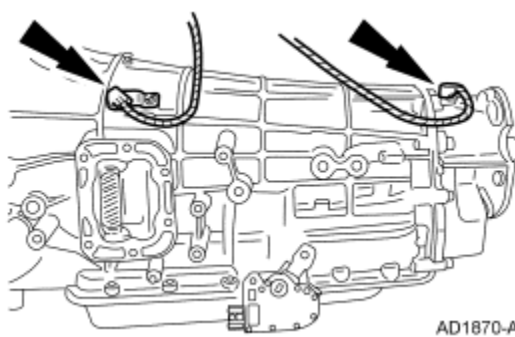
2. Position the heated oxygen sensor (HO2S) connector back in place.



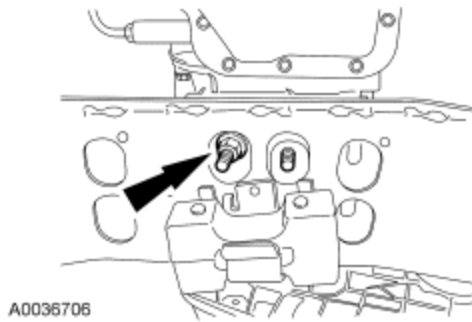
3. If removed, install the TSS.
  1. Lubricate the O-ring and install the TSS.
  2. Install the bolt.



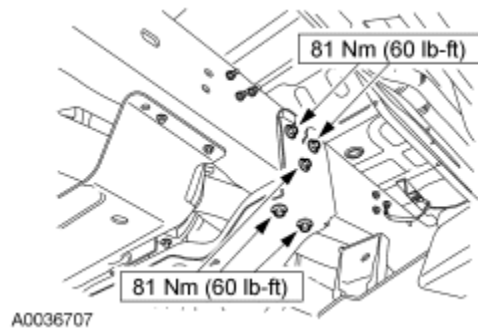
4. Connect the electrical connector to the affected sensor.



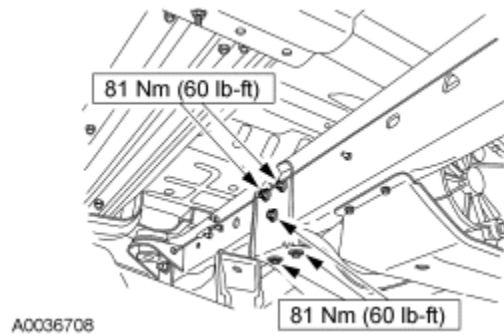
5. Install the crossmember to the transmission mount, using one nut to hold the crossmember in place. Raise the transmission and align the crossmember bolt holes.



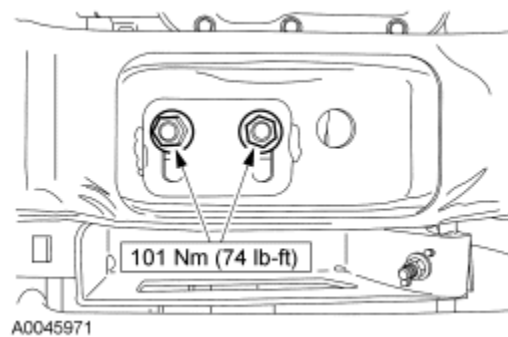
6. Install the bolts.



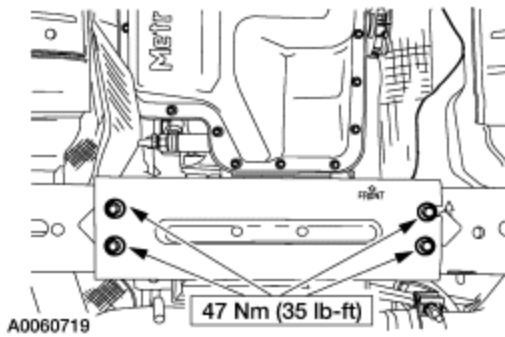
7. Install the bolts.



8. Install the remaining nut and tighten both nuts.



9. Install the dampener and install the bolts.



10. Remove the high-lift transmission jack.

11. Lower the vehicle.

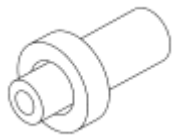
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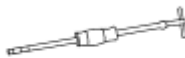
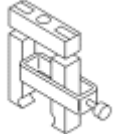
SECTION 307-01: Automatic  
Transaxle/Transmission  
IN-VEHICLE REPAIR

1999 F-Super Duty 250-550 Workshop  
Manual  
[Procedure revision date: 01/26/2000](#)

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**Extension Housing Seal and Bushing**

Special Tool(s)	
 ST1746-A	Extension Housing Bushing Remover 307-064 (T77L-7697-D) or 307-382 (Model Dependent)
 ST1745-A	Extension Housing Bushing Replacer 307-063 (T77L-7697-C) or 307-381 (Model Dependent)
 ST1740-A	Extension Housing Seal Replacer 307-013 (T61L-7657-B) or 307-380 (Model Dependent)

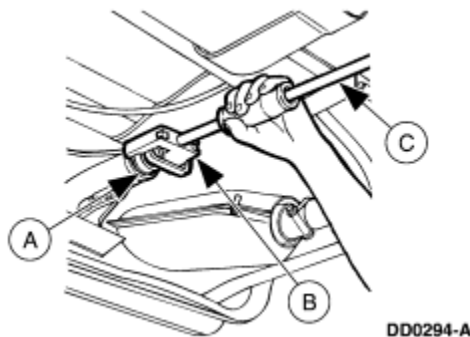
 ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
 ST1192-A	Seal Remover 307-048 (T74P-77248-A)

## Removal

1. **NOTE:** 4x2 shown, 4x4 similar.

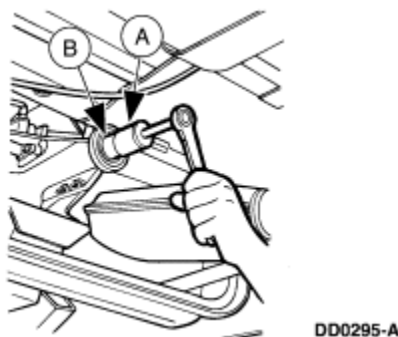
Raise the vehicle on a hoist; refer to [Section 100-02](#).

2. Remove the driveshaft (4602); refer to [Section 205-01](#).
3. With a suitable drain pan properly positioned, remove the (A) extension housing seal, using the (B) Seal Remover and the (C) Impact Slide Hammer.




4.  **CAUTION:** Do not damage any machined surfaces. Damage may cause the new seal to leak.

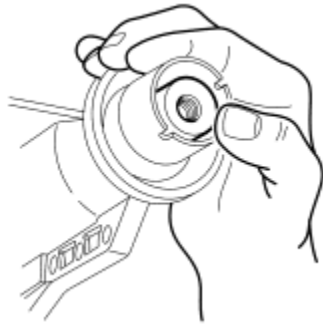
Using the (A) Extension Housing Bushing Remover, remove the (B) extension housing bushing (7A034).



## Installation

1.  **CAUTION:** Prior to installing the extension housing bushing, inspect the extension housing counterbore for burrs. If necessary, remove the burrs with an oil stone or damage to new bushing may occur.

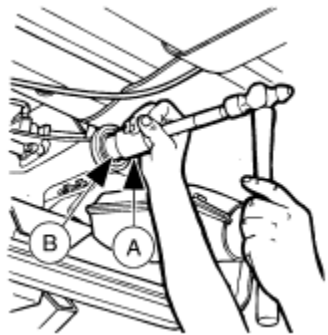
Align the extension housing bushing in the extension housing (7A039) so that the slots are in the 2 o'clock and 7 o'clock positions.



DD0296-A

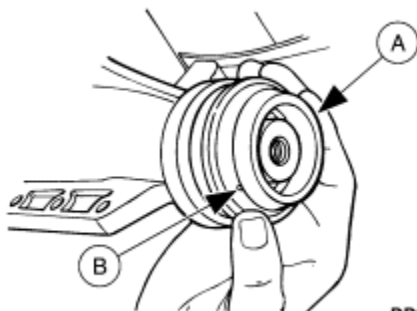
2. **NOTE:** The extension housing bushing is model-dependent. Refer to the parts catalog for the correct parts.

Using the (A) Extension Housing Bushing Replacer, install the (B) extension housing bushing.



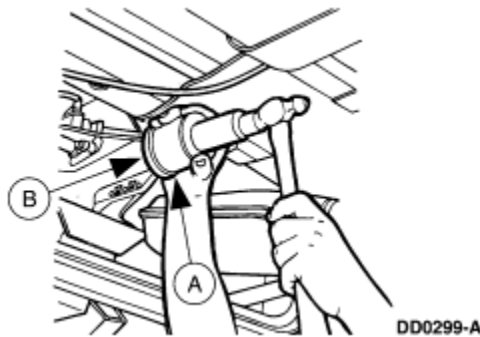
DD0297-A

3. Align the (A) extension housing seal in the extension housing, with the (B) drain hole positioned downward. The seal is model-dependent; refer to the parts catalog for the correct parts.



DD0298-A

- Using the (A) Extension Housing Seal Replacer, seat the extension housing seal into the (B) extension housing.



- Install the driveshaft; refer to [Section 205-01](#).
- Remove the supports and lower the vehicle.
- Fill the transmission (7003) to the specified level with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or MERCON® equivalent. Refer to the Fluid Capacity chart in the Specifications portion of this section.

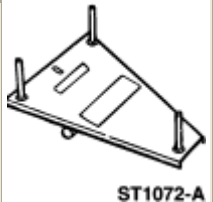
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SECTION 307-01: Automatic  
Transaxle/Transmission  
IN-VEHICLE REPAIR

1999 F-Super Duty 250-550 Workshop  
Manual  
[Procedure revision date: 01/26/2000](#)

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### Extension Housing Gasket—4x2

	Special Tool(s)
	E4OD Transmission Jack Adapter 307-F008 (014-00763) or equivalent

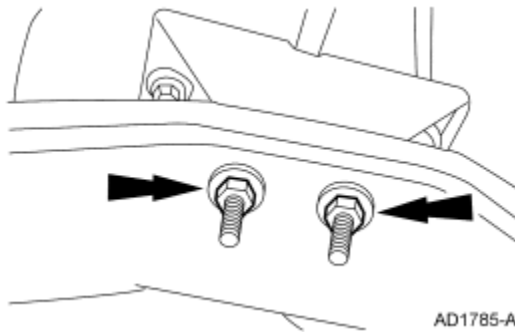
### Removal

- NOTE:** 4x2 shown, 4x4 similar.

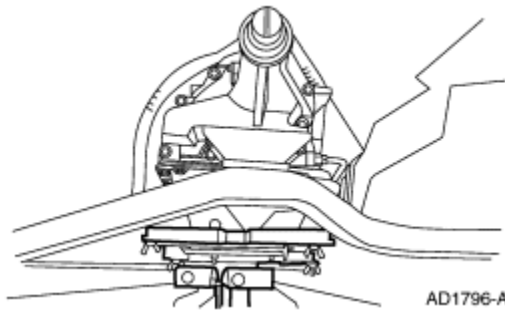
Raise the vehicle on a hoist; refer to [Section 100-02](#).



2. Remove the driveshaft; refer to [Section 205-01](#).
3. Remove the transmission insulator to crossmember support nuts.



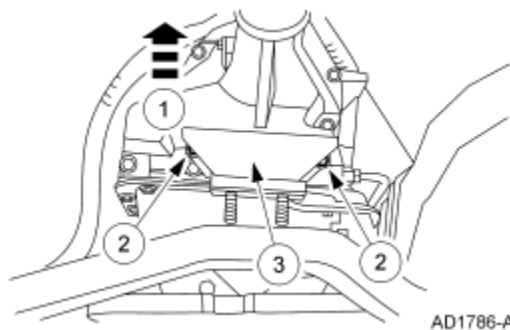
4. Remove the High Lift Transmission Jack with the E4OD Transmission Jack Adapter to the transmission.



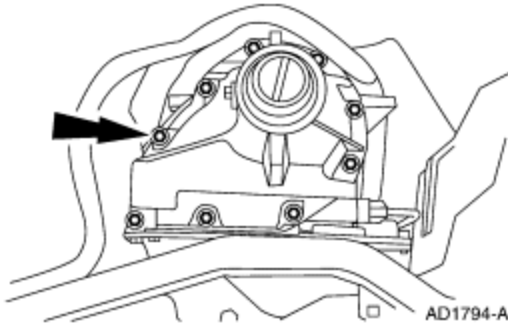
5. **CAUTION:** Be sure not to raise the back of the transmission too high, if it makes contact with the underbody damage to the TSS and OSS sensors will occur.

Remove the rear transmission mount.

1. Raise the transmission up off the rear crossmember support.
2. Remove the bolts.
3. Remove the rear transmission mount.



6. Remove the transmission extension housing.
  1. Remove the bolts.
  2. Remove the transmission extension housing.



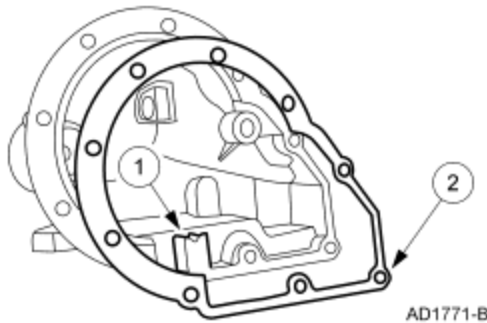
7. Remove and discard the extension housing gasket.

### Installation

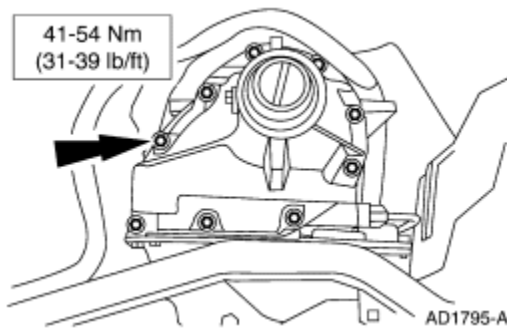
1. **NOTE:** The extension must have a shoulder or a boss cast in it to hold the orifice lube plug in the back of the case. If the wrong extension housing is used the plug may become loose and/or fall out and cause transmission damage.

**NOTE:** Lightly lubricate the gasket with petroleum jelly to hold it in place during assembly.

Verify that the extension has a shoulder cast in it.  
Install the new extension housing gasket.



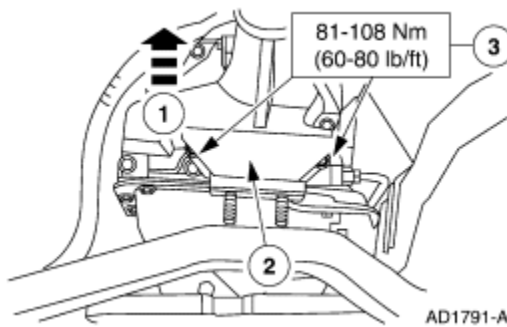
2. Install the extension housing bolts.



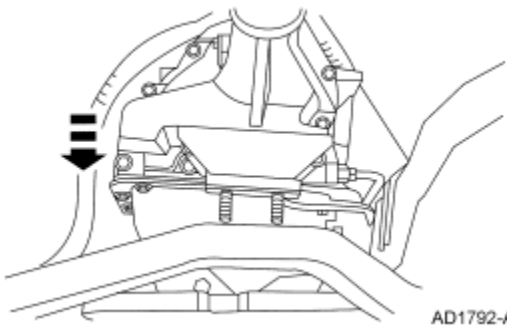
3. **⚠ CAUTION:** Be sure not to raise the back of the transmission too high, if it makes contact with the underbody, damage to the TSS and OSS sensors will occur.

Install the rear transmission mount.

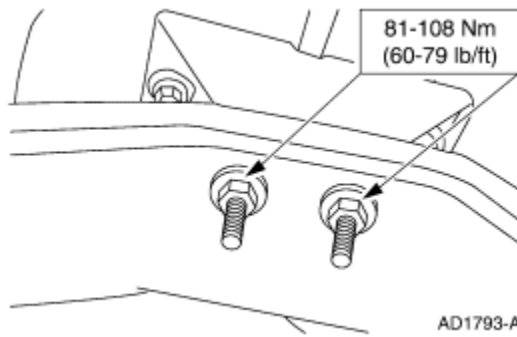
1. Raise the transmission up.
2. Install the rear transmission mount.
3. Install the bolts.



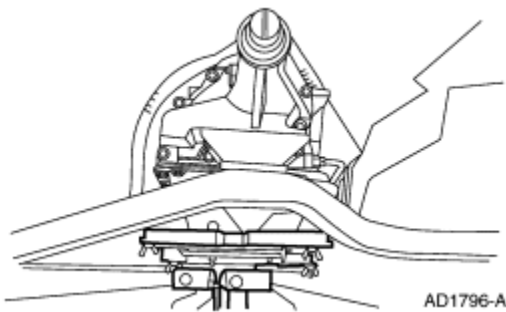
4. Lower the transmission on to the rear crossmember support.



5. Install the transmission insulator and nuts.



6. Remove the High Lift Transmission Jack with the Transmission Jack Adapter or equivalent to the transmission.



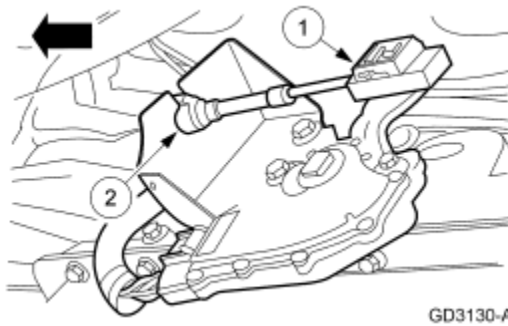
7. Install the driveshaft; refer to [Section 205-01](#).
  8. Lower the vehicle.
  9. Check fluid level, fill with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or MERCON® equivalent.
  10. Check for proper operation.
-

## Manual Control Lever Shaft and Seal

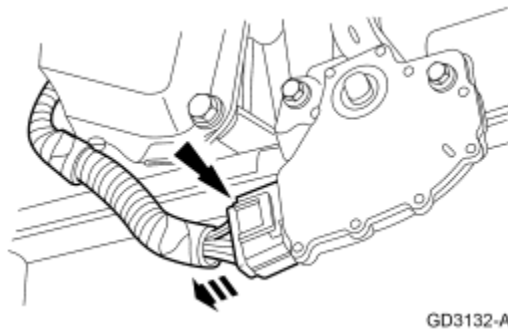
Special Tool(s)	
 ST1634-A	Lock Nut Pin Remover 211-S060 (T78P-3504-N)
 ST1282-A	Puller 308-001 (T58L-101-B)
 ST1199-A	Shift Lever Seal Replacer 307-050 (T74P-77498-A)
 ST1633-A	Digital Transmission Range (TR) Sensor Alignment Tool 307-351 (T97P-70010-A)

## Removal

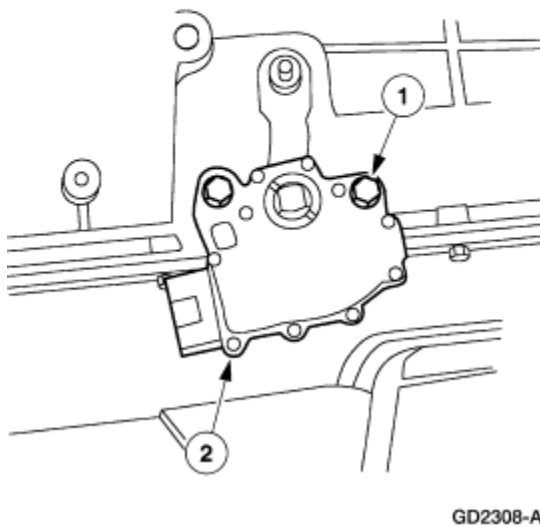
1. Remove the fluid pan gasket and filter; refer to Transmission Fluid Drain and Refill in this section.
2. Disconnect the shift cable.
  1. Disconnect the shift cable from the manual lever.
  2. Disconnect the cable housing from the bracket; position aside.



3. Disconnect the digital transmission range (TR) sensor electrical connector.



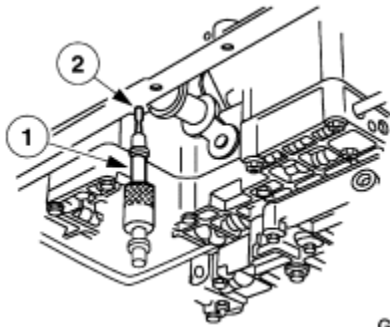
4. Remove the digital transmission (TR) sensor.
  1. Remove the bolts.
  2. Remove the digital transmission range (TR) sensor.



5. **NOTE:** A No. 53 drill bit (1/16 inch) can be used instead to remove the manual lever shaft retaining pin.

Remove the manual lever shaft retaining pin.

1. Insert the Lock Nut Pin Remover into the retaining pin.
2. Remove the manual lever shaft retaining pin.



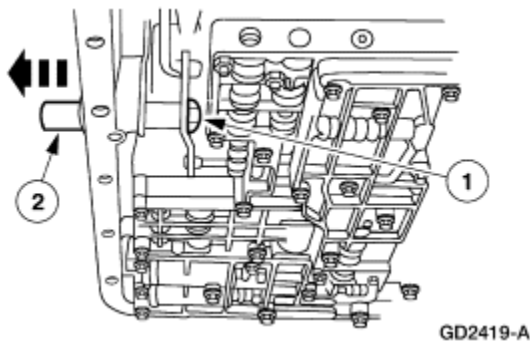
6.  **CAUTION:** Be careful not to damage the manual control lever bore.

**NOTE:** The manual control lever and manual control lever shaft are one piece.

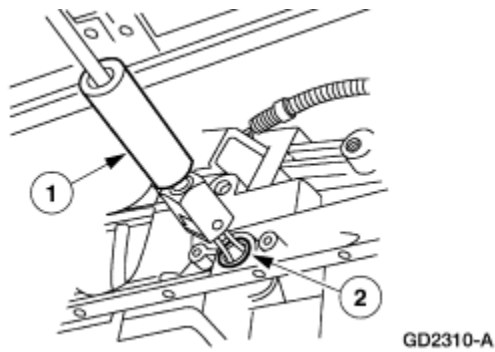
**NOTE:** Use a crescent wrench on the manual control lever or outer flats of manual control lever shaft assembly when removing the inner manual valve detent lever nut.

Remove the manual control lever shaft assembly.

1. Remove the nut.
2. Remove the manual control lever shaft assembly.



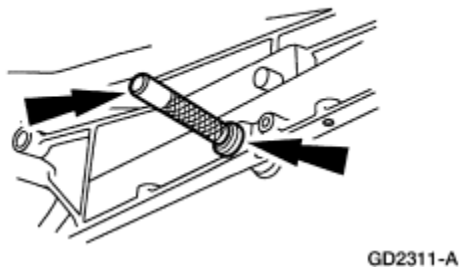
7. Remove the manual control lever seal.
1. Install the Puller.
  2. Remove the seal.



## Installation

1. **NOTE:** Prior to installing the manual control lever seal, clean the bore opening with mineral spirits.

Using the Shift Lever Seal Replacer to install the manual control lever seal.



2. Install the manual control lever shaft assembly.
  1. Install the manual control lever shaft assembly.
  2. Install and seat the manual lever shaft retaining pin below the case surface.
  3. **NOTE:** The inner manual valve detent lever must be seated on the flats of the manual control lever shaft assembly, and the parking pawl actuating rod must be through the guide plate.

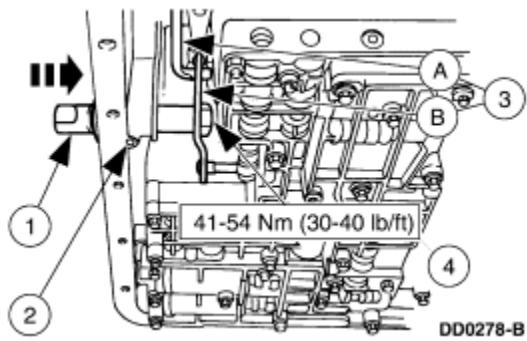
**NOTE:** The manual control valve detent lever spring must be on the inner manual valve detent lever, and the detent lever pin must align with the manual shift valve.

Install the (A) parking pawl actuating rod and the (B) inner manual valve detent lever.

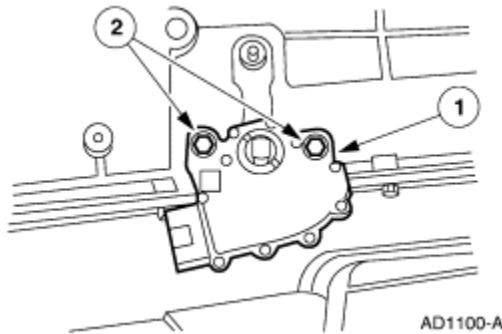
4. **NOTE:** Use a crescent wrench on the manual control lever or the outer flats of the manual control lever shaft assembly when installing the inner manual valve detent lever nut.

Install the inner manual valve detent lever nut.



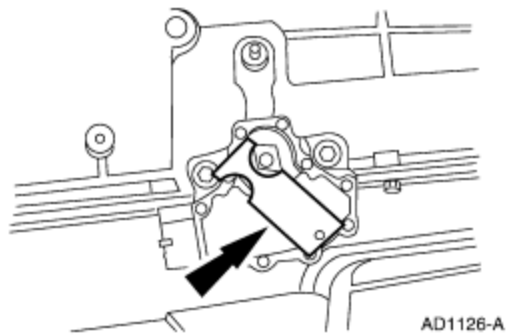


3. Install the digital transmission range (TR) sensor.
  1. Position the digital transmission range sensor.
  2. Loosely install the bolts.

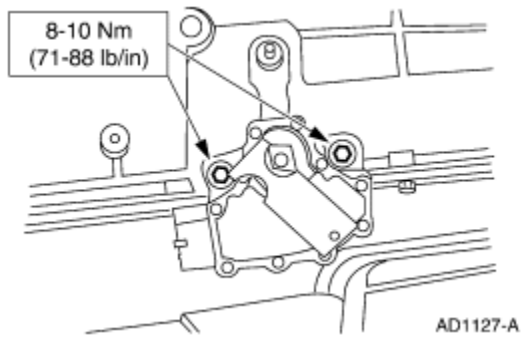


4. **NOTE:** Make sure that the manual control lever is in the neutral position.

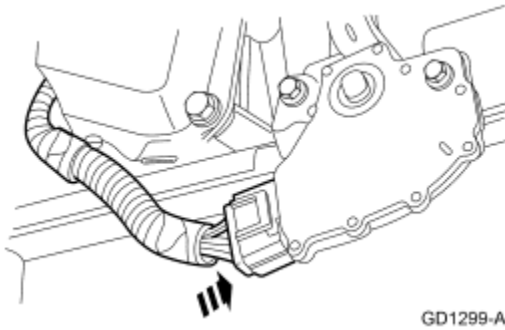
Install the Digital Transmission Range (TR) Sensor Alignment Tool.



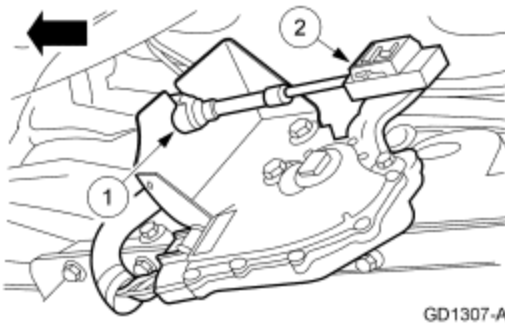
5. Tighten the bolts.



6. Connect the digital transmission range (TR) sensor electrical connector.



7. Connect the shift cable.
  1. Install the cable housing to the bracket.
  2. Install the shift cable to the manual lever.

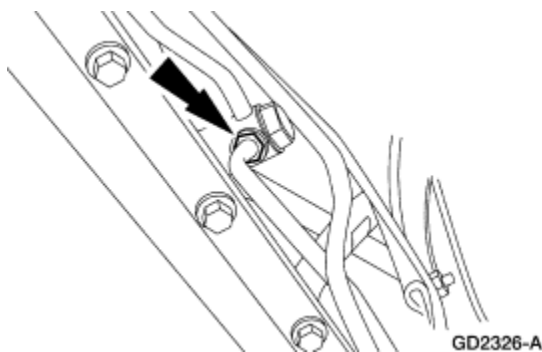


8. Install filter and seal assembly, fluid pan and gasket.
-

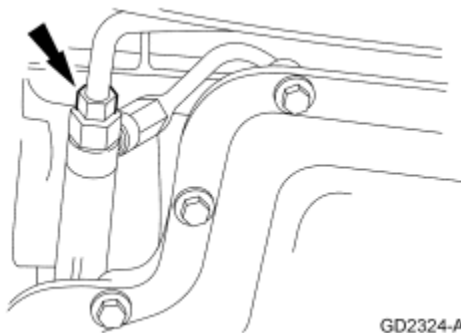
## Cooler By-Pass Valve

### Removal

1. Raise the vehicle on a hoist; refer to [Section 100-02](#).
2. Remove the front cooler tube, from the front cooler bypass valve (CBV) fitting.

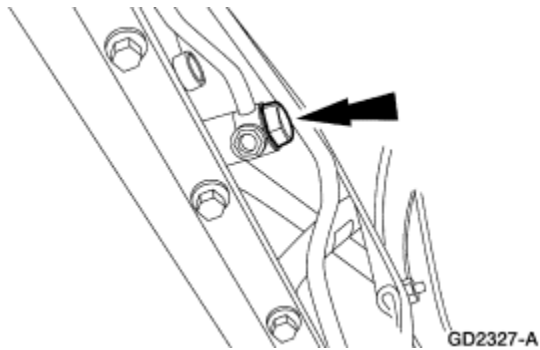


3. Remove the rear cooler tube, from the rear CBV fitting.



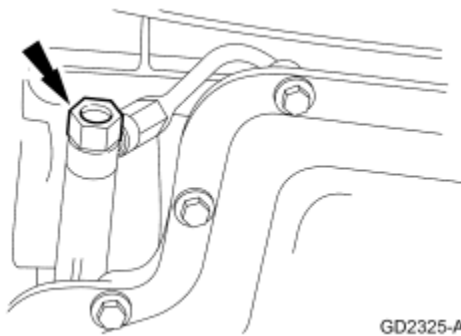
4. **NOTE:** The two rubber coated sealing washers can fall off during removal of the front CBV bolt cooler line case fitting.

Remove the front CBV bolt cooler line case fitting.




5. **NOTE:** The two rubber coated sealing washers can fall off during removal of the rear CBV bolt cooler line case fitting.

Remove the rear CBV bolt cooler line case fitting.



6. Remove, clean and flush the CBV; refer to Disassembly and Assemblies of Subassemblies, [Cooler Bypass Valve Assembly](#) in this section.

## Installation

1.  **CAUTION:** Make sure the 4 rubber coated sealing washers are on the cooler line case fittings and the CBV washers are in place. Do not over tighten.

Examine the rubber coated sealing washers for damage. Replace the washers as needed.

2. Using Threadlock and Sealer E0AZ-19554-AA or equivalent meeting Ford specification WSK-M2G351-A5, coat the line case fitting threads.

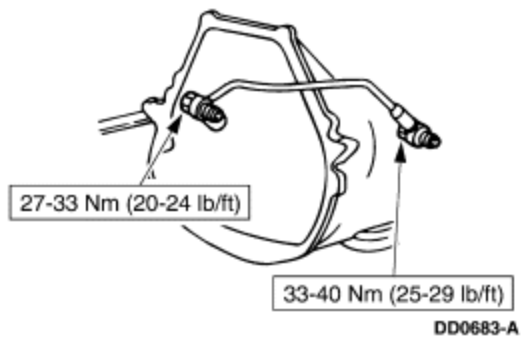
3.  **CAUTION:** Make sure the cooler bypass valve (CBV) is properly backflushed. Use dry compressed air to remove solvent.

 **CAUTION:** If the cooler line case fitting is over-tightened the rubber coated sealing washers and/or cooler line case fittings can be damaged, causing a transmission fluid leak.

**NOTE:** The CBV has a check ball in the rear fitting and will only allow flow in one direction. Make sure check ball moves freely.

**NOTE:** Align the two rubber coated sealing washers, while assembling the rear cooler line case fitting.

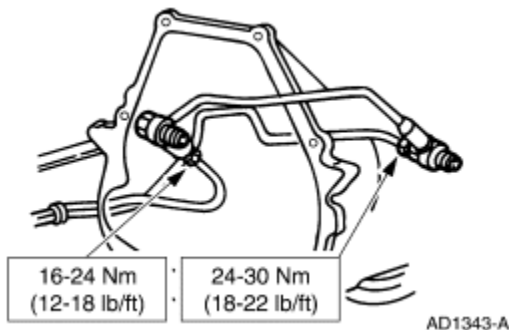
Install the CBV fitting.



4.  **CAUTION:** If an overhaul is being performed the oil-to-air (OTA) cooler will need to be replaced.

**NOTE:** The cooler lines need to be flushed out at this time and OTA replaced. Refer to [Section 307-05](#). Do not backflush the oil-to-air (OTA) cooler.

Tighten the cooler tube nuts.



5. Lower the vehicle.
6. Fill the transmission with Motorcraft MERCON® Multi-Purpose Automatic Transmission Fluid XT-2-QDX or equivalent meeting MERCON® specifications. Check for proper operation.
-

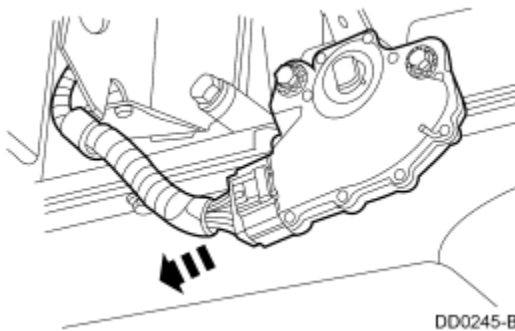
## Digital Transmission Range (TR) Sensor

	Special Tool(s)
 ST1633-A	Digital Transmission Range (TR) Sensor Alignment Tool 307-351 (T97P-70010-A)

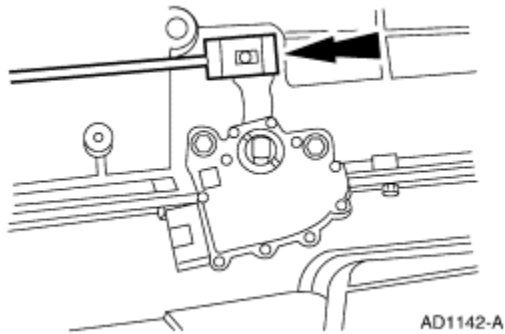
### Removal

**NOTE:** If the vehicle is equipped with a power take-off unit all or part of the PTO unit may need to be removed.

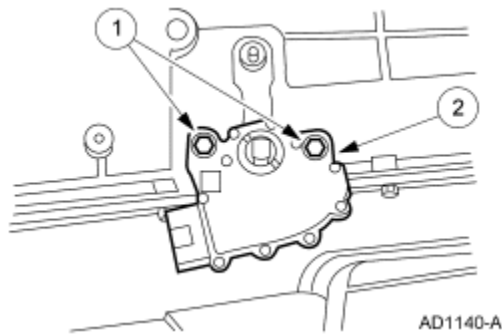
1. Disconnect the battery ground cable (14301).
2. Raise the vehicle on a hoist; refer to [Section 100-02](#).
3. Disconnect the connector.



4. Disconnect the shift cable at the manual control lever.

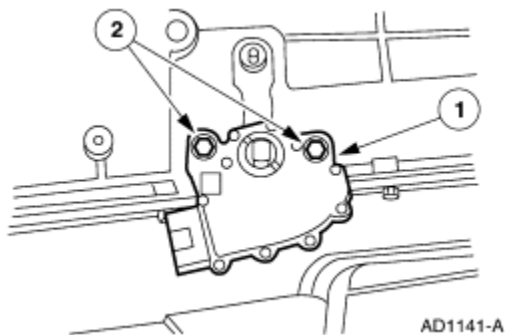


5. Remove the digital transmission range (TR) sensor.
  1. Remove the bolts.
  2. Remove the digital transmission range (TR) sensor.



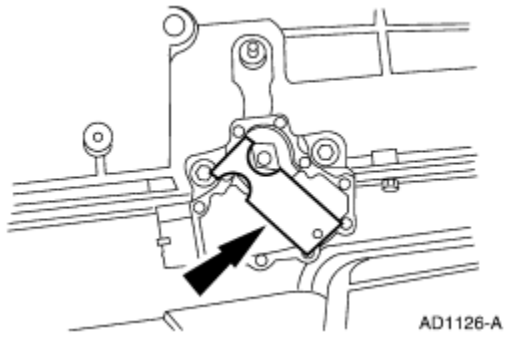
## Installation

1. Install the digital transmission range (TR) sensor.
  1. Install digital transmission range (TR) sensor.
  2. Loosely install the bolts.

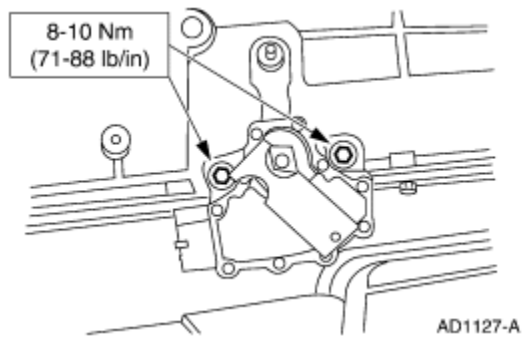


2. **NOTE:** Make sure that the manual control lever is in the neutral position.

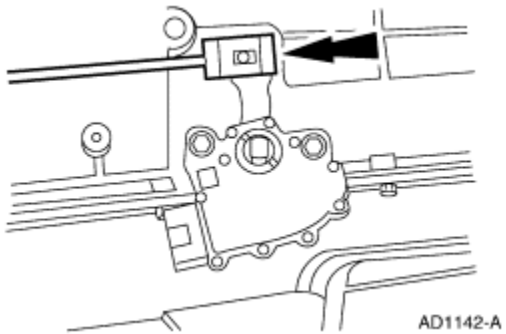
Install the Digital Transmission Range (TR) Sensor Alignment Tool.



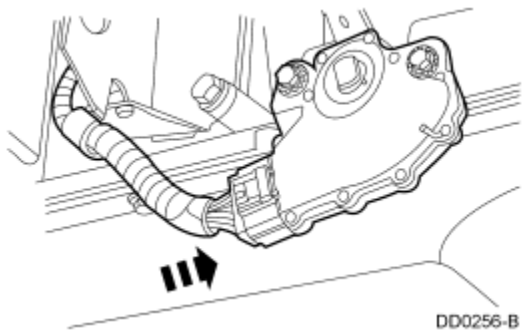
3. Tighten the bolts.



4. Reconnect the shift cable at the manual control lever.



5. Reconnect the connector.



6. Lower the vehicle.



7. Reconnect the battery ground cable.

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SECTION 307-01: Automatic  
Transaxle/Transmission  
IN-VEHICLE REPAIR

1999 F-Super Duty 250-550 Workshop  
Manual  
[Procedure revision date: 01/26/2000](#)

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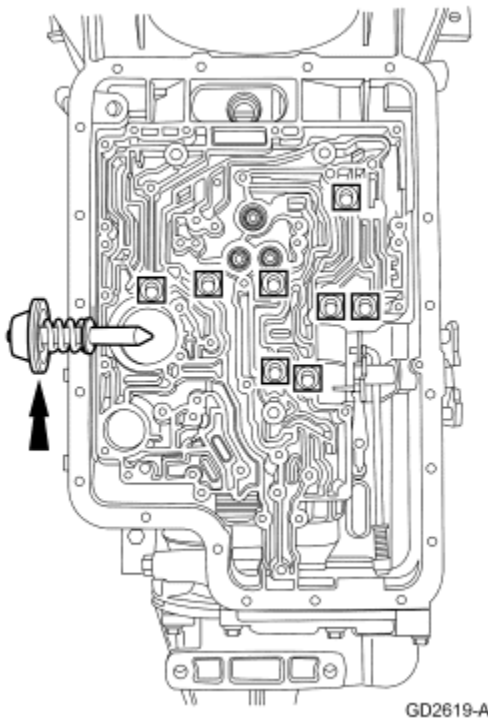
## Intermediate Servo

### Removal

1. Remove the main control valve body; refer to [Main Control—Valve Body, Accumulator Body, Solenoid Body](#) in this section.
2.  **WARNING: The intermediate servo is under spring pressure, care should be taken when removing it. It could cause bodily harm.**

**NOTE:** Gently tap on the servo cover with a rubber mallet to compress and allow servo assembly to pop up.

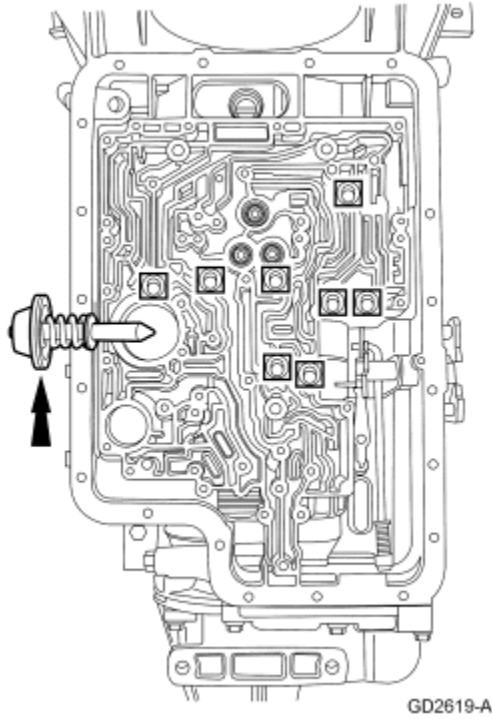
Remove the intermediate servo.



## Installation

1. **NOTE:** Lubricate the servo seal with clean transmission fluid.

Install the intermediate band servo.



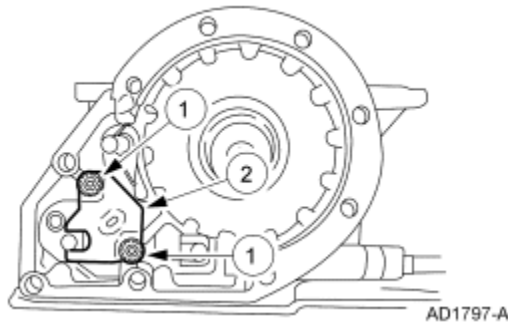
2. Install the main control valve body.
-

## Park System

### Removal

**NOTE:** For internal park mechanism service, refer to [Manual Control Lever Shaft and Seal](#) in this section.

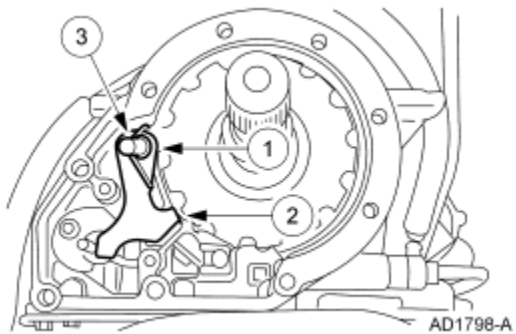
1. Remove the extension housing (7A039) and the extension housing gasket; refer to [Extension Housing Gasket—4x2](#) in this section.
2. Remove the parking rod guide plate.
  1. Remove the bolts.
  2. Remove the parking rod guide plate.



3. **NOTE:** If the park gear replacement is required; refer to [Output Shaft—Check](#) in this section.

Remove the park pawl shaft.

1. Remove the park pawl return spring.
2. Remove the park pawl.
3. Remove the park pawl shaft.

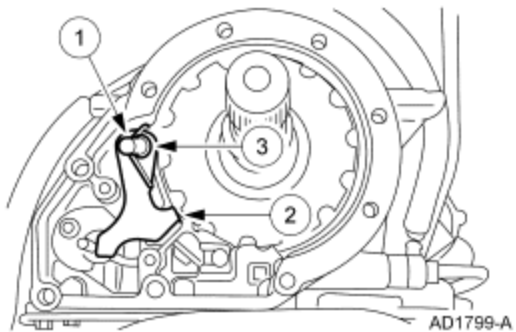


## Installation

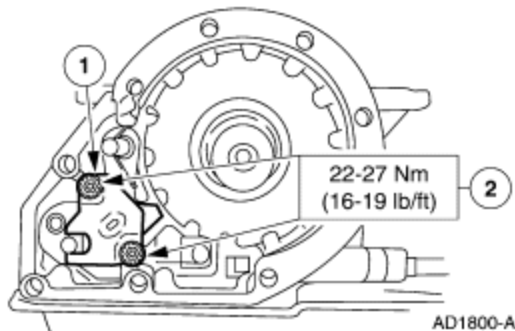
1. **NOTE:** If the park gear replacement is required; refer to [Output Shaft—Check](#) in this section.

Install the park pawl shaft.

1. Install the park pawl shaft.
2. Install the park pawl.
3. Install the park pawl return spring.



2. Install the parking rod guide plate.
  1. Install the parking rod guide plate.
  2. Install the bolts.



3. Install the extension housing gasket and the extension housing.

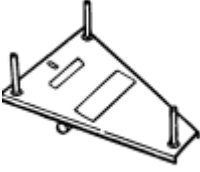
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SECTION 307-01: Automatic  
Transaxle/Transmission  
IN-VEHICLE REPAIR

1999 F-Super Duty 250-550 Workshop  
Manual  
[Procedure revision date: 01/26/2000](#)

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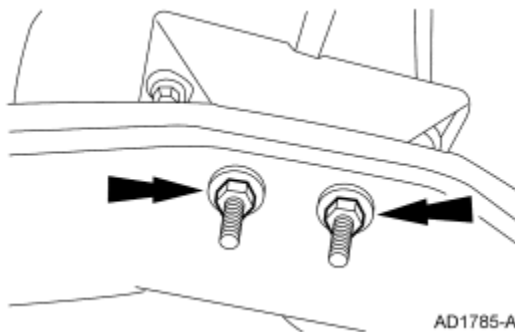
### Transmission Insulator and Retainer

	Special Tool(s)
 ST1072-A	E4OD Transmission Jack Adapter or equivalent 307-F008 (014-00763)

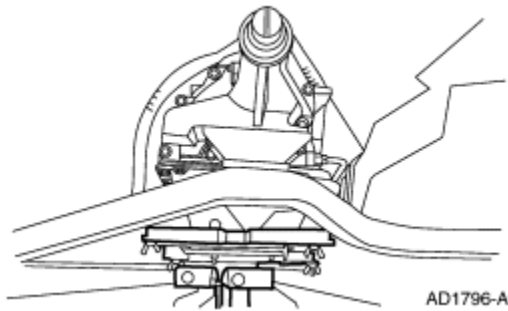
### Removal

**NOTE:** 4x2 shown, 4x4 similar.

1. Raise the vehicle on a hoist; refer to [Section 100-02](#).
2. Remove the nuts.



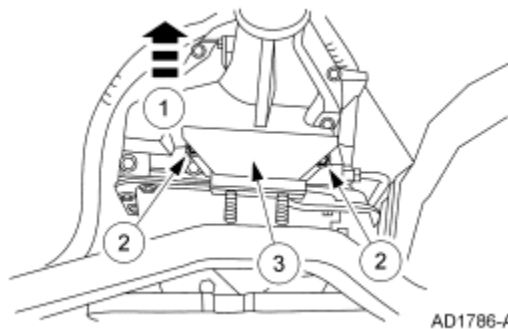
3. Install the High Lift Transmission Jack with the Transmission Jack Adapter to the transmission.



4. **CAUTION:** Be sure not to raise the back of the transmission too high, if it makes contact with the underbody, damage to the TSS and OSS sensors will occur.

Remove the rear transmission mount.

1. Raise the transmission up off the rear crossmember support.
2. Remove the bolts.
3. Remove the rear transmission mount.

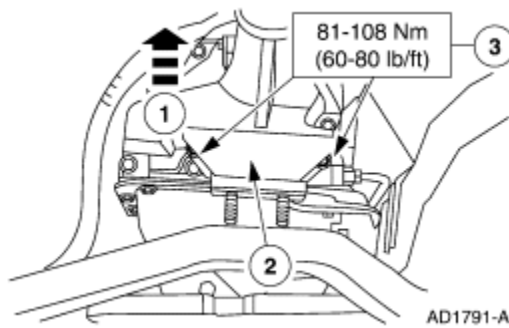


## Installation

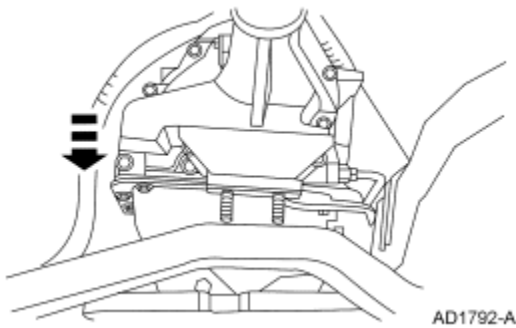
1. **CAUTION:** Be sure not to raise the back of the transmission too high, if it makes contact with the underbody, damage to the TSS and OSS sensors will occur.

Install the rear transmission mount.

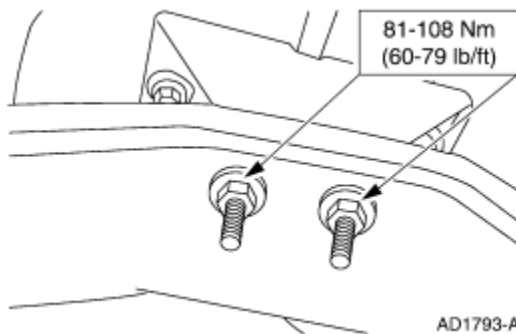
1. Raise the transmission up.
2. Install the rear transmission mount.
3. Install the bolts.



2. Lower the transmission on to the rear crossmember support.



3. Install the nuts.



4. Remove the supports and lower the vehicle.
-

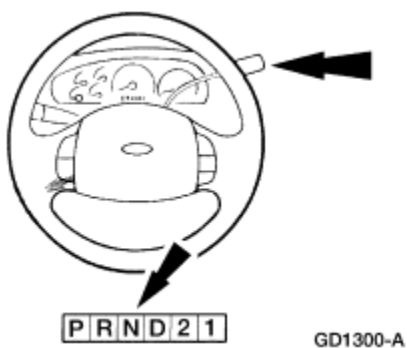
## Transmission

Special Tool(s)	
 ST1636-A	Retainer, Torque Converter 307-346 (T97T-7902-A)

## Removal

### All vehicles

1. Place the transmission range selector lever in the NEUTRAL position.



2. **NOTE:** All gasoline vehicles will have new adaptive shift strategies. Whenever the vehicle's battery has been disconnected for any type of service or repair, the strategy parameters that are stored in the keep alive memory (KAM) will be lost. The strategy will start to relearn once the battery is reconnected and the vehicle is driven. This is a temporary condition and will return to normal operating condition once the powertrain control module (PCM) relearns all the parameters from the driving conditions. There is no set time frame for this process. If a concern is present during downshifts or converter clutch apply, it is not the fault of the shift strategy and will require diagnosis as outlined in the workshop manual.

The customer needs to be notified that they may experience slightly different upshifts (either soft or firm) and that this is a temporary condition and will eventually return to normal operating condition.

Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).

### 4x4 vehicles



3. Remove the transfer case assembly. For additional information, refer to [Section 308-07B](#).

#### **4x2 vehicles**

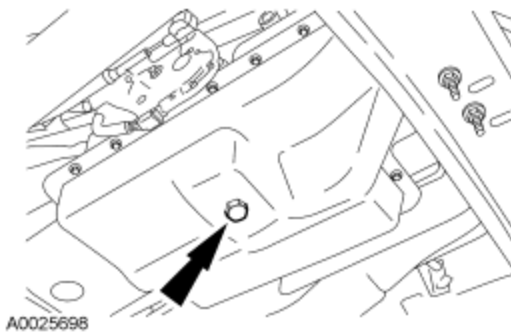
4. Remove the driveshaft. For additional information, refer to [Section 205-01](#).

#### **All vehicles**

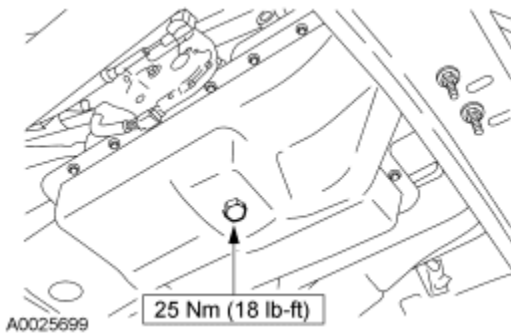
5. If transmission disassembly is required, drain the transmission fluid.

#### **Vehicles equipped with a fluid pan drain plug**

6. Remove the drain plug and allow the fluid to drain.



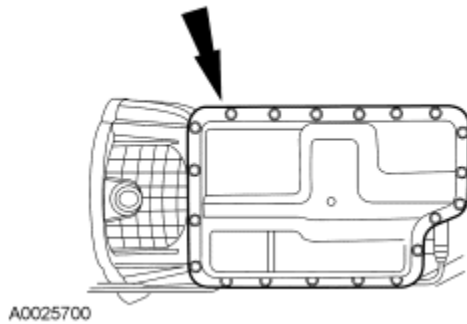
7. Install the drain plug.



#### **Vehicles not equipped with a fluid pan drain plug**

8. **NOTE:** Do not discard the gasket unless damaged. This is a reusable gasket.

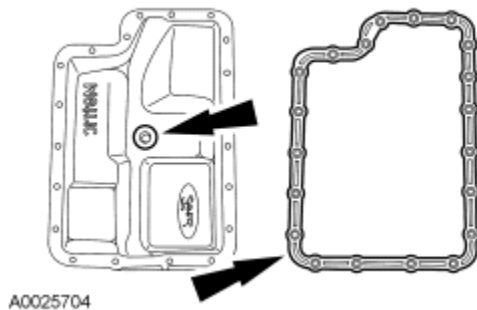
Remove the transmission fluid pan and gasket.



9. **NOTE:** The transmission pan gasket is reusable unless damaged.

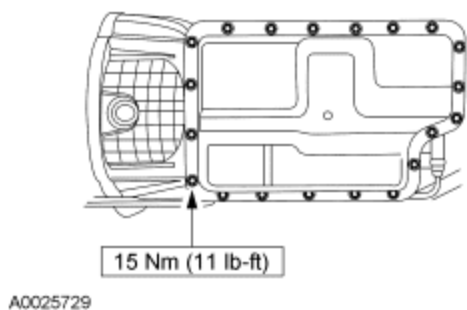
**NOTE:** Apply a light coat of petroleum jelly to hold the gasket to the fluid pan.

Position the gasket onto the cleaned fluid pan. Make sure the magnet is positioned over the dimple in the fluid pan.



10. **CAUTION:** Mixing the 4x2 and the 4x4 style transmission fluid filters and transmission pan assembly components can cause transmission damage.

Install the correct pan with gasket for this application. Alternately tighten the bolts.



11. **CAUTION:** Make sure securing straps or the transmission jack adapter do not touch the cooler bypass valve (CBV). Do not use the CBV as a handle. Damage to the CBV can cause a leak.

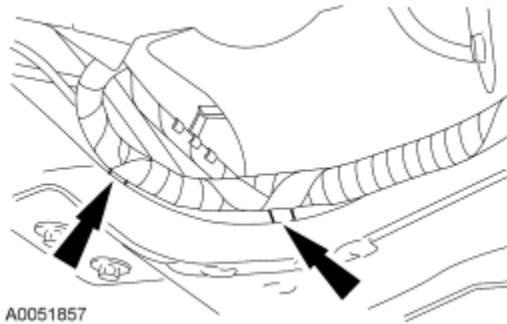
Install a suitable transmission jack and support the transmission.

## 4x4 vehicles

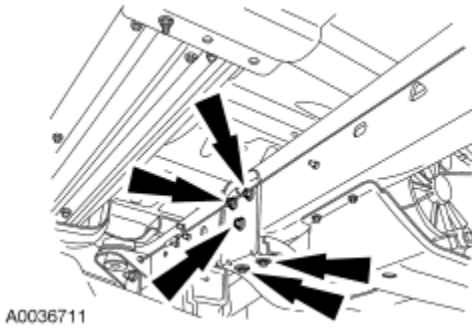
12. Remove the jack stand after installing a suitable transmission jack.

## 4x2 Excursion

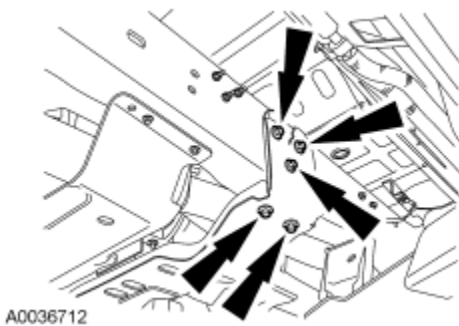
13. Disconnect the wire loom from the crossmember.



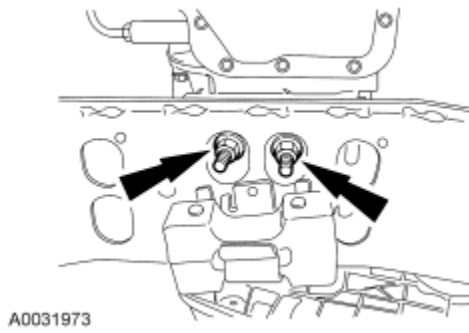
14. Remove the crossmember bolts.



15. Remove the crossmember bolts.

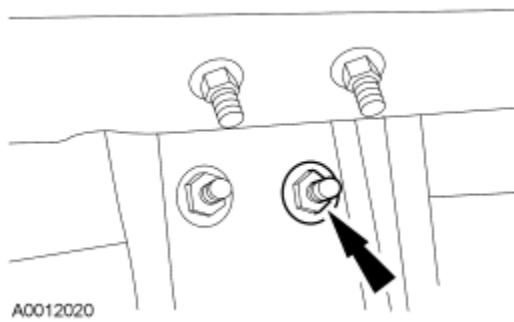


16. Remove the transmission mount nuts and the crossmember.

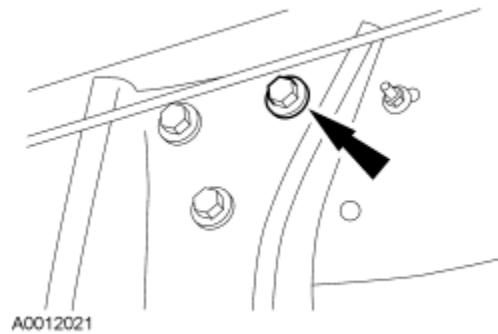


## F-Super Duty and 4x2 vehicles

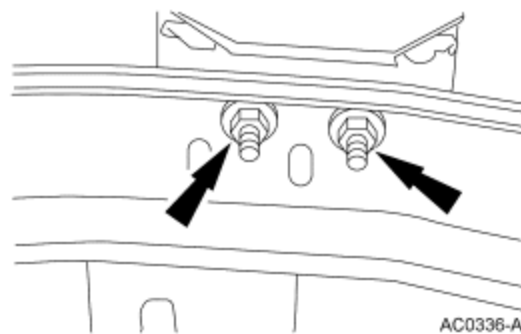
17. Remove the RH crossmember nuts.



18. Remove the LH crossmember nuts.

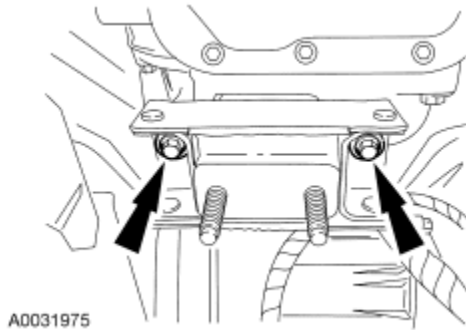


19. Remove the nuts and the crossmember.



## All 4x2 vehicles

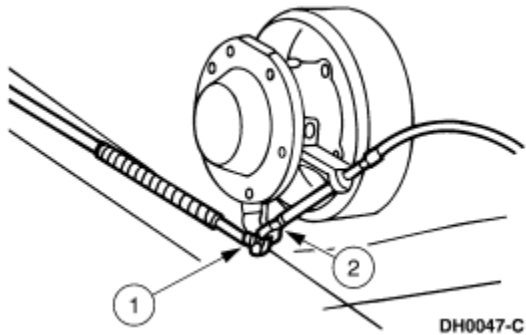
20. Remove the transmission mount.



## Vehicles equipped with a transmission-mounted parking brake

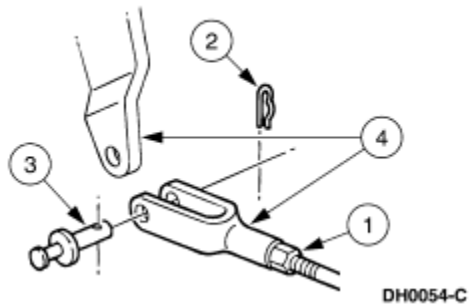
21. Disconnect and lubricate.

1. Disconnect the parking brake lever return spring from the parking brake lever.
2. Apply penetrating oil to the adjusting clevis, jam nut and the threads on the front parking brake cable and conduit.

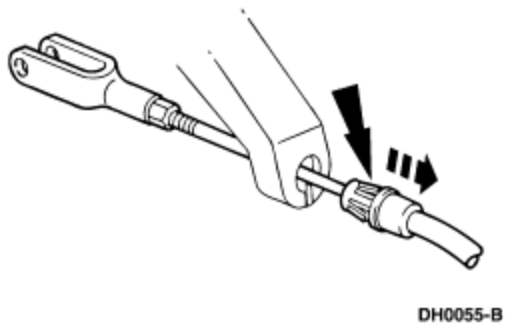


22. Disconnect the front parking brake cable and conduit.

1. Loosen the jam nut.
2. Remove the clevis locking pin.
3. Remove the clevis pin.
4. Remove the adjusting clevis from the parking brake lever.



23. Compress the retainer, and remove the front parking brake cable and conduit from the cable bracket.

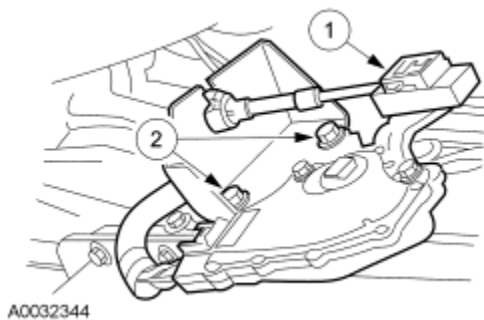


## All vehicles

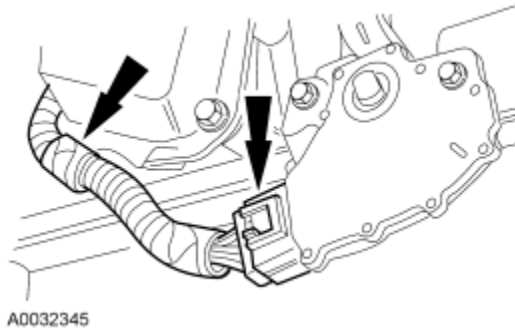
24. **NOTE:** If the vehicle is equipped with a power take-off unit, all or part of the PTO unit will need to be removed.

Disconnect the shift cable from the transmission.

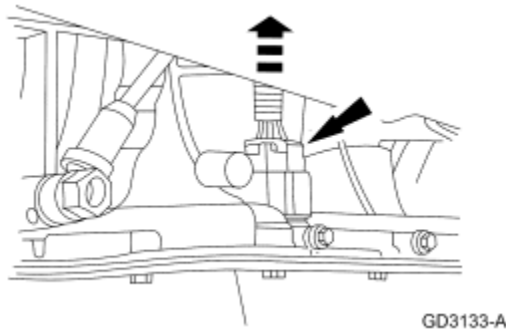
1. Disconnect the shift cable from the manual lever.
2. Remove the shift cable bracket from the transmission and position aside.



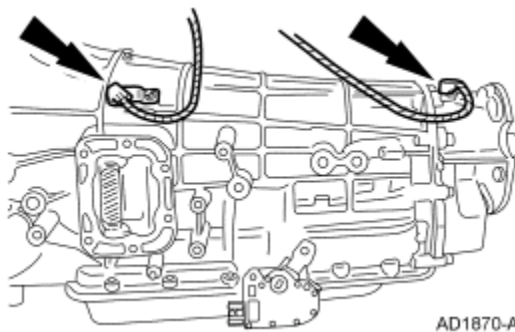
25. Disconnect the digital transmission range (TR) sensor connector and the wire loom from the shift cable bracket.



26. Disconnect the solenoid body connector.



27. Disconnect the turbine shaft speed (TSS) sensor and the output shaft speed (OSS) sensor.

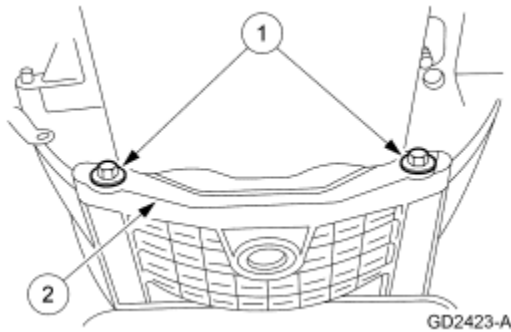


28. Remove the wiring harness from the transmission and position aside.

### **Gasoline engines**

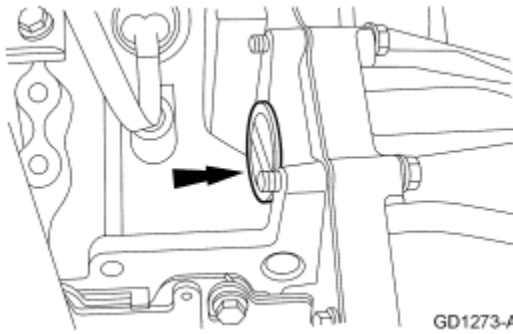
29. Remove the flexplate inspection cover.

1. Remove the bolts.
2. Remove the inspection plate.



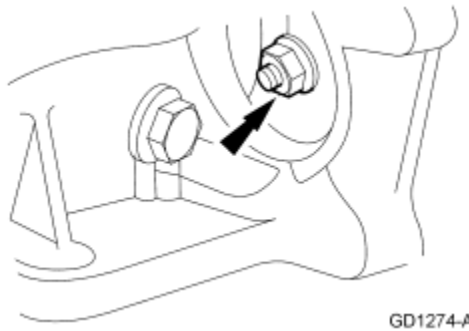
30. Remove the starter motor. For additional information, refer to [Section 303-06A](#) or [Section 303-06B](#).

31. Remove the cylinder block opening cover.



32. Remove and discard the torque converter-to-flexplate nuts.

- 5.4L engine has four nuts.
- 6.8L engine has six nuts.



## Diesel engines

33. Remove the starter. For additional information, refer to [Section 303-06A](#) or [Section 303-06B](#).

34. Remove the inspection cover.

1. Remove the bolts.
2. Remove the cover.