SPECIFICATIONS

TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR SPECIFICATIONS

Transmission Fluid Temperature (TFT) Sensor Specifications

Temperature °F	Temperature °C	Minimum Resistance ohm	Nominal Resistance ohm	Maximum Resistance ohm	Signal Volts
-40	-40	90636	100707	110778	5.00
-22	-30	47416	52684	57952	4.78
-4	-20	25809	28677	31545	4.34
14	-10	14558	16176	17794	3.89
32	0	8481	9423	10365	3.45
50	10	5104	5671	6238	3.01
68	20	3164	3515	3867	2.56
86	30	2013	2237	2461	1.80
104	40	1313	1459	1605	1.10
122	50	876	973	1070	3.25
140	60	600	667	734	2.88
158	70	420	467	514	2.56
176	80	299	332	365	2.24
194	90	217	241	265	1.70
212	100	159	177	195	1.42
230	110	119	132	145	1.15
248	120	89.9	99.9	109.9	0.87
266	130	69.1	76.8	84.5	0.60
284	140	53.8	59.8	65.8	0.32
302	150	42.5	47.2	51.9	0.00

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accumulator Cover to Case Bolt	8.0-14.0 N.m	6-10 lb ft
Case Extension to Case Bolt	42.0-48.0 N.m	31-35 lb ft
Case Extension to Case Bolt (4WD Shipping)	11.2-22.6 N.m	8.3-16.7 lb ft

Converter Cover Bolt	10 N.m	89 lb in
Converter Housing to Case Screw	65.0-75.0 N.m	48-55 lb ft
Cooler Pipe Connector	35.0-41.0 N.m	26-30 lb ft
Detent Spring to Valve Body Bolt	20.0-27.0 N.m	15-20 lb ft
Floorshift Control Bolt	10 N.m	89 lb in
Flywheel to Torque Converter Bolt	63 N.m	46 lb ft
Forward Accumulator Cover to Valve Body Bolt	8.0-14.0 N.m	6-10 lb ft
Heat Shield to Transmission Bolt	17 N.m	13 lb ft
Line Pressure Plug	8.0-14.0 N.m	6-10 lb ft
Manual Shaft to Inside Detent Lever Nut	27.0-34.0 N.m	20-25 lb ft
Negative Battery Cable Bolt	15 N.m	11 lb ft
Oil Level Indicator Bolt	47 N.m	35 lb ft
Oil Pan to Transmission Case Bolt	11 N.m	97 lb in
Oil Passage Cover to Case Bolt	8-14.0 N.m	6-10 lb ft
Park Brake Bracket to Case Bolt	27.0-34.0 N.m	20-25 lb ft
Park/Neutral Position Switch Screw	3 N.m	27 lb in
Plate to Case Bolt (Shipping)	27.0-34.0 N.m	20-25 lb ft
Plate to Converter Bolt (Shipping)	27.0-34.0 N.m	20-25 lb ft
Pressure Control Solenoid Bracket to Valve Body Bolt	8.0-14.0 N.m	6-10 lb ft
Pump Assembly to Case Bolt	26.0-32.0 N.m	19-24 lb ft
Pump Cover to Pump Body Bolt	20.0-27.0 N.m	15-20 lb ft
Shift Cable Grommet Screw	1.7 N.m	15 lb in
Shift Control Cable Attachment	20 N.m	15 lb ft
Speed Sensor Retainer Bolt	10.5-13.5 N.m	7.7-10 lb ft
TCC Solenoid Assembly to Case Bolt	8.0-14.0 N.m	6-10 lb ft
Transmission Fluid Pressure Manual Valve Position Switch to Valve Body Bolt	8.0-14.0 N.m	6-10 lb ft
Transmission Mount to Transmission Bolt	60 N.m	44 lb ft
Transmission Mount Retaining Nut	40 N.m	30 lb ft
Transmission Oil Cooler Pipe Fitting	35.0-41.0 N.m	26-30 lb ft
Transmission Oil Pan to Case Bolt	9.5-13.8 N.m	7-10 lb ft

Transmission to Engine Bolt	47 N.m	35 lb ft
Valve Body to Case Bolt	8.0-14.0 N.m	6-10 lb ft

TRANSMISSION GENERAL SPECIFICATIONS

Transmission General Specifications

Name	Hydra-Matic 4L65-E
RPO Codes	M32
Production Location	Toledo, Ohio Romulus, MI
Vehicle Platform, Engine/Transmission, Usage	N Truck (H2)
Transmission Drive	Longitudinally - Mounted Rear Wheel Drive
1st Gear Ratio	3.059:1
2nd Gear Ratio	1.625:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.696:1
Reverse	2.294:1
Torque Converter Size, Diameter of Torque Converter Turbine	300 mm
Pressure Taps	Line Pressure
Transmission Fluid Type	DEXRON(R) III
Transmission Fluid Capacity, Approximate	300 mm Converter Dry: 11.50 l (12.1 qt)
Transmission Type: 4	Four Forward Gears
Transmission Type: L	Longitudinal Mount
Transmission Type: 65	Product Series
Transmission Type: E	Electronic Controls
Position Quadrant	P, R, N, Overdrive (Circle D), D, 2, 1 P, R, N, Overdrive (Circle D), 3, 2, 1
Case Material	Die Cast Aluminum
Transmission Weight Dry, Approximate	300 mm Converter 85.57 kg (188.6 lbs)
Transmission Weight Wet, Approximate	300 mm Converter 98.4 kg (218.0 lb)
Maximum Trailer Towing Capacity	6 130 kg (13,500 lb)

FLUID CAPACITY SPECIFICATIONS

Fluid Capacity

Application	Specification	
	Metric	English

Pan Removal - Approximate Capacity	4.7 liters	5 quarts
Overhaul - Approximate Capacity	10.6 liters	11 quarts

END PLAY SPECIFICATIONS

Transmission End Play Washer Selection Chart

Identification	Washer Thickness (mm)	Washer Thickness (in)
67	1.87-1.97	0.074-0.078
68	2.04-2.14	0.080-0.084
69	2.21-2.31	0.087-0.091
70	2.38-2.48	0.094-0.098
71	2.55-2.65	0.100-0.104
72	2.72-2.82	0.107-0.111
73	2.89-2.99	0.113-0.117
74	3.06-3.16	0.120-0.124

LOW AND REVERSE CLUTCH SPACER PLATE SELECTION

Low and Reverse Clutch Plate Selection Table

or	Selective Plate	
Measured Dimension	Identification	Thickness
28.065-27.545 mm (1.105-1.084 in)	None	1.684-1.829 mm (0.066-0.072 in)
28.586-28.066 mm (1.125-1.105 in)	0	1.314-1.168 mm (0.052-0.046 in)
27.544-27.026 mm (1.084-1.064 in)	1	2.198-2.344 mm (0.087-0.092 in)

FORWARD CLUTCH BACKING PLATE SELECTION

Forward Clutch Backing Plate Selection

Plate Thickness	Identification
6.92-7.07 mm (0.272-0.278 in)	A
6.33-6.48 mm (0.249-0.255 in)	B
5.74-5.89 mm (0.226-0.232 in)	C
5.15-5.30 mm (0.203-0.208 in)	D
4.56-4.71 mm (0.180-0.185 in)	E
Backing Plate Travel • 245 mm = 0.766-1.756 mm (0.030-0.069 in) • 298 mm/300 mm = 0.866-1.876 mm (0.034-0.074 in)	

THIRD AND FOURTH CLUTCH BACKING PLATE SELECTION

3rd and 4th Clutch Backing Plate Selection Table

Dimension	Identification
5.88-5.68 mm (0.231-0.224 in)	A
4.99-4.76 mm (0.196-0.187 in)	B
4.10-3.90 mm (0.161-0.154 in)	C
Use a backing plate which gives the correct travel. The travel should be 2.10-0.90 mm (0.083-0.035 in).	

REVERSE INPUT CLUTCH BACKING PLATE SELECTION

Reverse Input Clutch Backing Plate Selection Table

Plate Thickness	Identification
7.249-7.409 mm (0.285-0.292 in)	2
6.678-6.519 mm (0.263-0.257 in)	3
5.947-5.787 mm (0.234-0.228 in)	4
Backing Plate Travel: 1.02-1.94 mm (0.40-0.76 in)	

OIL PUMP ROTOR AND SLIDE MEASUREMENT

Oil Pump Rotor and Slide Measurement

Thickness (mm)	Thickness (in)
Oil Pump Rotor	
17.948-17.961	0.7066-0.7071
17.961-17.974	0.7071-0.7076
17.974-17.987	0.7076-0.7081
17.987-18.000	0.7081-0.7086
18.000-18.013	0.7086-0.7091
Oil Pump Slide	
17.948-17.961	0.7066-0.7071
17.961-17.974	0.7071-0.7076
17.974-17.987	0.7076-0.7081
17.987-18.000	0.7081-0.7086
18.000-18.013	0.7086-0.7091

2-4 SERVO PIN SELECTION

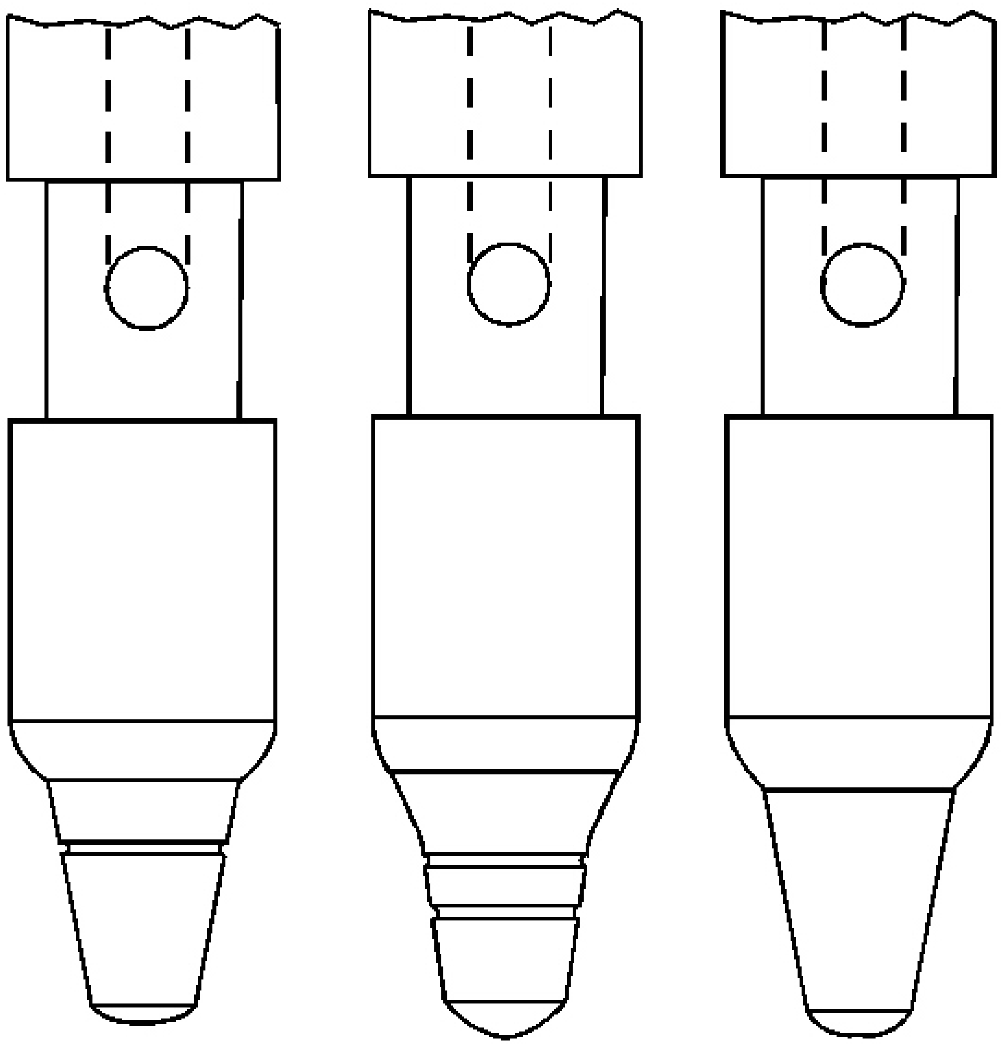


Fig. 1: 2-4 Servo Pin
Courtesy of GENERAL MOTORS CORP.

2-4 Servo Pin Selection

Pin Length		Pin Identification
mm	inch	
65.82-66.12	2.59-2.60	1 Groove
67.23-67.53	2.65-2.66	2 Grooves
68.64-68.94	2.70-2.71	No Groove

TORQUE CONVERTER END PLAY SPECIFICATIONS

Torque Converter End Play Check

Torque Converter Size	Specification
300 mm (11.81 in)	0.1-0.5 mm (0.004-0.020 in)

RANGE REFERENCE

Range Reference Table

Range	Park	Reverse	Neutral	OD				D			2	
Gear	or	or	or	1st	2nd	3rd	4th	1st	2nd	3rd	1st**	2nd
1-2 Shift Solenoid	ON*	ON*	ON*	ON	OFF	OFF	ON	ON	OFF	OFF	ON	OFF
2-3 Shift Solenoid	ON*	ON*	ON*	ON	ON	OFF	OFF	ON	ON	OFF	ON	ON
2-4 Band	-	-	-	-	A	-	A	-	A	-	-	A
Reverse Input Clutch	-	A	-	-	-	-	-	-	-	-	-	-
Overrun Clutch	-	-	-	-	-	-	-	-	-	A	A	A
Forward Clutch	-	-	-	A	A	A	A	A	A	A	A	A
Forward Sprag Clutch Assembly	-	-	-	H	H	H	-	H	H	H	H	H
3-4 Clutch	-	-	-	-	-	A	A	-	-	A	-	-
Lo/Roller Clutch	-	-	-	H	-	-	-	H	-	-	H	-
Lo/Rev Clutch	A	A	-	-	-	-	-	-	-	-	-	-

- A = Applied
- H = Holding
- ON = The solenoid is energized.
- OFF = The solenoid is de-energized.
- *Shift Solenoid state is a function of vehicle speed and may change if the vehicle speed increases sufficie Reverse or Neutral. However, this does not affect the operation of the transmission.
- **Manual Second-First gear is electronically prevented under normal operating conditions.
- ***Manual First-Second gear is only available above approximately 48-56 km/h (30-35 mph).

SHIFT SOLENOID VALVE STATE AND GEAR RATIO

Shift Solenoid Valve State and Gear Ratio 4L60-E

Gear	1-2 Shift Solenoid	2-3 Shift Solenoid	Gear Ratio
1	ON	ON	3.059:1
2	OFF	ON	1.625:1
3	OFF	OFF	1.000:1
4	ON	OFF	0.696:1

SHIFT SPEED

Shift Speed (N Truck 4L60-E)

or			1-2 Upshift @ +/- 250 RPM Output Shaft Speed			2-3 Upshift @ +/- 250 RPM Output Shaft Speed			3-4 Upshift @ +/- 250 RPM Output Shaft Speed			1-2 Upshif @ Wid Open Throttl +/- 250 RPM, Output Shaft Speed
% of TPS			12	25	50	12	25	50	12	25	50	
Trans Cal	Body	Axle	-			-			-			-
4.8L (LR4)												
A	C10	3.42	431	607	1038	764	999	1666	1078	1509	2547	1815
B	C10 K10/20	3.73	419	608	1027	755	1006	1677	1070	1488	2537	1816
C	K10/20	4.10	410	615	1048	775	1025	1686	1071	1504	2552	1827
5.3L (LM7)												
A	C10/20	3.42	431	607	1038	764	1000	1666	1077	1509	2547	1815
B	C10/20 K10	3.73	391	568	960	705	940	1568	1000	1391	2370	1697
C	C20 K10	4.10	410	615	1048	775	1025	1686	1071	1503	2552	1827
6.0L (LQ4)												
A	820D 830D	3.73	472	615	1313	739	944	2011	1026	1436	2790	1785
6.0L (LQ9)												
A	820C	3.73	472	615	1313	739	944	2011	1026	1436	2872	1785

TRANSMISSION FLUID PRESSURE (TFP) MANUAL VALVE POSITION SWITCH LOGIC

TFP Manual Valve Position Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C
Park/Neutral	HI	LOW	HI
Reverse	LOW	LOW	HI
Drive 4	HI	LOW	LOW
Drive 3	HI	HI	LOW
Drive 2	HI	HI	HI
Drive 1	LOW	HI	HI
Invalid	LOW	HI	LOW
	LOW	LOW	LOW

- HI = Ignition voltage
- LOW = 0 voltage

TRANSMISSION RANGE SWITCH LOGIC

Transmission Range Switch Logic

Gear Selector Position	Signal A	Signal B	Signal C	Signal P
Park (P)	LOW	HI	HI	LOW
Reverse (R)	LOW	LOW	HI	HI
Neutral (N)	HI	LOW	HI	LOW
Drive 4 (OD)	HI	LOW	LOW	HI
Drive 3 (3)	LOW	LOW	LOW	LOW
Drive 2 (2)	LOW	HI	LOW	HI
Drive 1 (1)	HI	HI	LOW	LOW

HI = Ignition voltage
LOW = 0 volts

LINE PRESSURE

Line Pressure (4L60-E)

Pressure Control Solenoid Current (Amp)	Approximate Line Pressure (PSI)
4.8L/5.3L/6.0L	
0.00	198-227
0.10	197-226
0.20	189-221
0.30	181-216
0.40	168-205
0.50	154-193
0.60	137-175
0.70	114-156
0.80	90-132
0.90	64-105

1.00	53-85
1.10	53-68

COMPONENT RESISTANCE

Component Resistance

Component	Pass Thru Pins	Resistance at 20°C (68°F)	Resistance at 100°C (212°F)	Resistance to Ground (Case)
1-2 Shift Solenoid Valve	A, E	19-24 ohm	24-31 ohm	Greater than 250 K ohm
2-3 Shift Solenoid Valve	B, E	19-24 ohm	24-31 ohm	Greater than 250 K ohm
TCC Solenoid Valve	T, E	21-26 ohm	26-33 ohm	Greater than 250 K ohm
TCC PWM Solenoid Valve	U, E	10-11 ohm	13-15 ohm	Greater than 250 K ohm
3-2 Shift Solenoid Valve Assembly	S, E	20-24 ohm	29-32 ohm	Greater than 250 K ohm
Pressure Control Solenoid Valve	C, D	3-5 ohm	4-7 ohm	Greater than 250 K ohm
*Transmission Fluid Temperature (TFT) Sensor	M, L	3088-3942 ohm	159.3-198.0 ohm	Greater than 10 M ohm
Vehicle Speed Sensor	A, B VSS CONN	1420 ohm @ 25°C (77°F) (AWD/4WD)	2140 ohm @ 150°C (302°F) (AWD/4WD)	Greater than 10 M ohm

IMPORTANT:

The resistance of this device is necessarily temperature dependent and will therefore vary far more than any other device. Refer to Transmission Fluid Temperature (TFT) Sensor Specifications .

SCHEMATIC AND ROUTING DIAGRAMS

AUTOMATIC TRANSMISSION SCHEMATIC ICONS

Automatic Transmission Schematic Icons

Icon	Icon Definition
	NOTE: **The OBD II symbol is used on the circuit diagrams in order to alert the technician that the circuit is essential for proper OBD II emission control circuit operation. Any circuit which fails and causes the malfunction indicator lamp (MIL) to turn ON, or causes emissions-related component damage, is identified as an OBD II circuit.**

IMPORTANT:

Twisted-pair wires provide an effective "shield" that helps protect sensitive electronic components from electrical interference. If the wires were covered with shielding, install new shielding.
In order to prevent electrical interference from degrading the performance of the connected components, you must maintain the proper specification when making any repairs to the twisted-pair wires shown :

- **The wires must be twisted a minimum of 10 turns per 31 cm (12 in) as measured anywhere along the length of the wires**
- **The outside diameter of the twisted wires must not exceed 6.0 mm**

AUTOMATIC TRANSMISSION CONTROLS SCHEMATICS

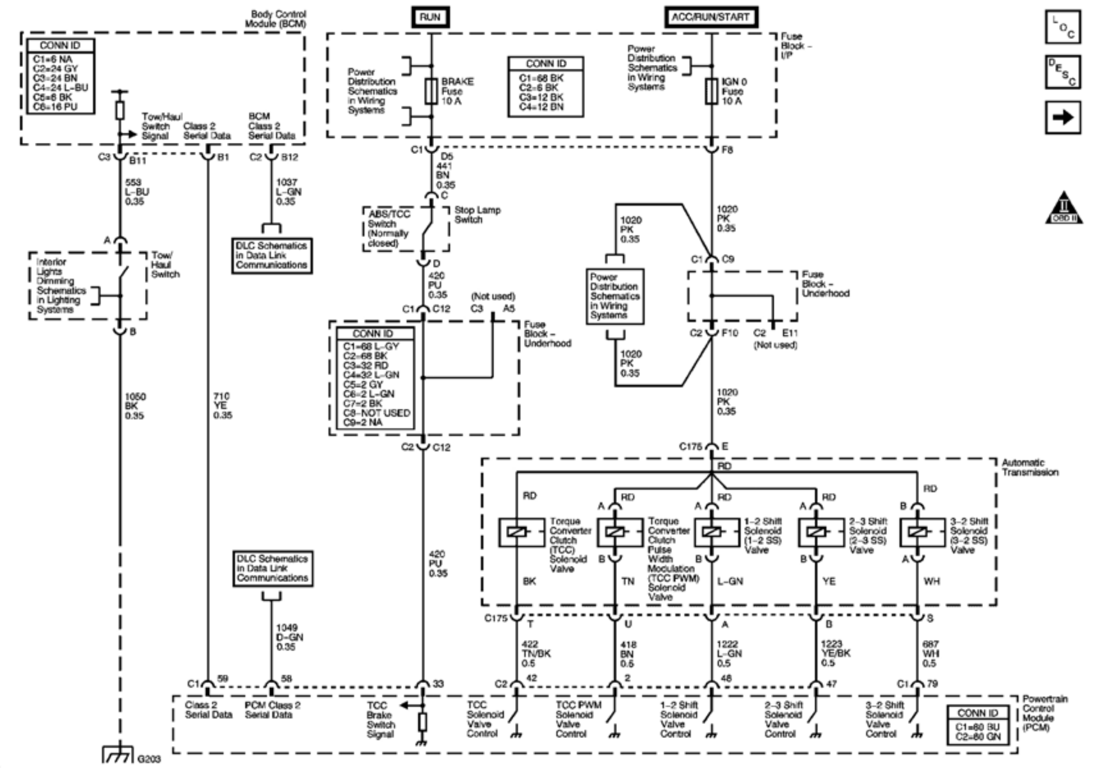


Fig. 2: Power, BCM, PCM, Class 2, Stop Lamp Switch, Tow/Haul Switch, and Shift Solenoids
Courtesy of GENERAL MOTORS CORP.

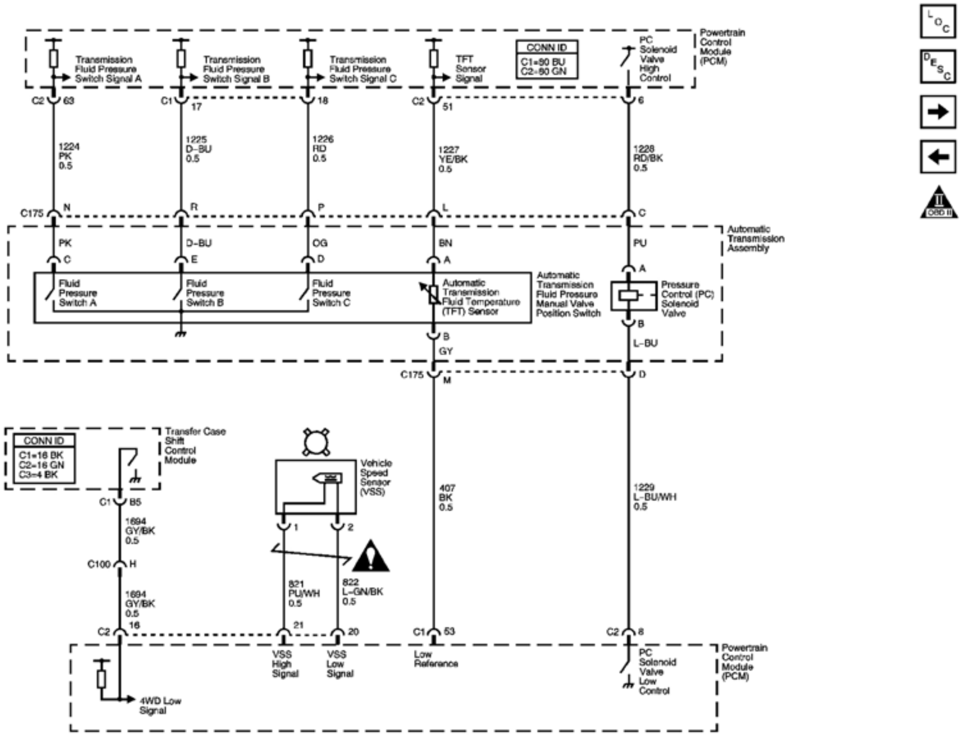


Fig. 3: Fluid Pressure Control Switch, TFT Sensor, PC Solenoid Valve, Transfer Case Control Module, and Vehicle Speed Sensor
Courtesy of GENERAL MOTORS CORP.

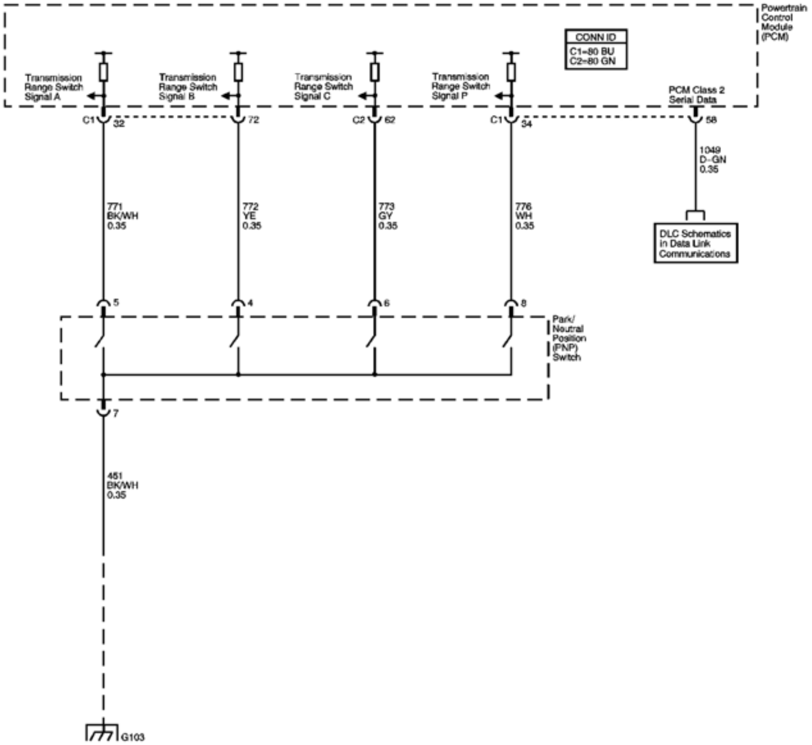


Fig. 4: Transmission Range Display
Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

AUTOMATIC TRANSMISSION ELECTRONIC COMPONENT VIEWS

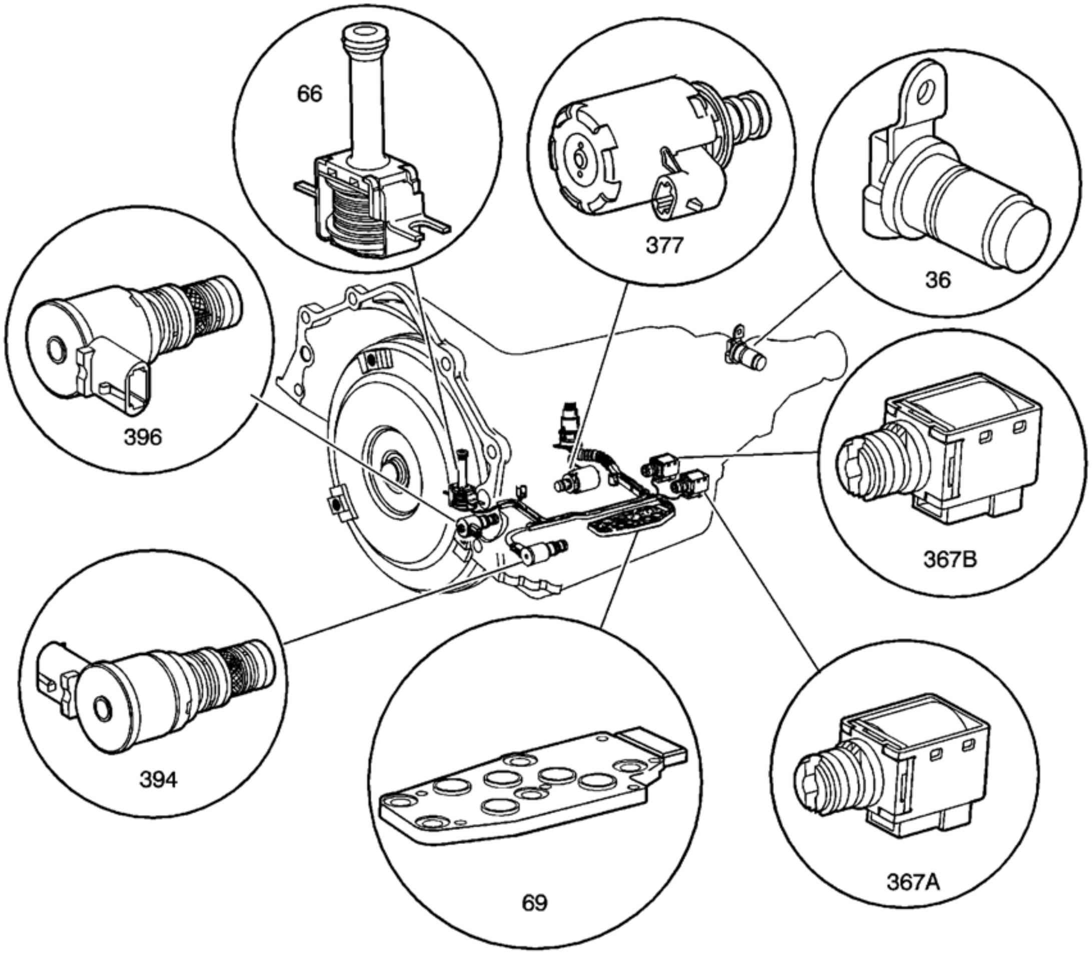


Fig. 5: Electronic Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
36	Vehicle Speed Sensor (VSS)
66	Torque Converter Clutch (TCC) Solenoid Valve
69	Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch
367a	1-2 Shift Solenoid (SS) Valve
367b	2-3 Shift Solenoid (SS) Valve
377	Pressure Control (PC) Solenoid Valve
394	3-2 Shift Solenoid (SS) Valve Assembly
396	Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve

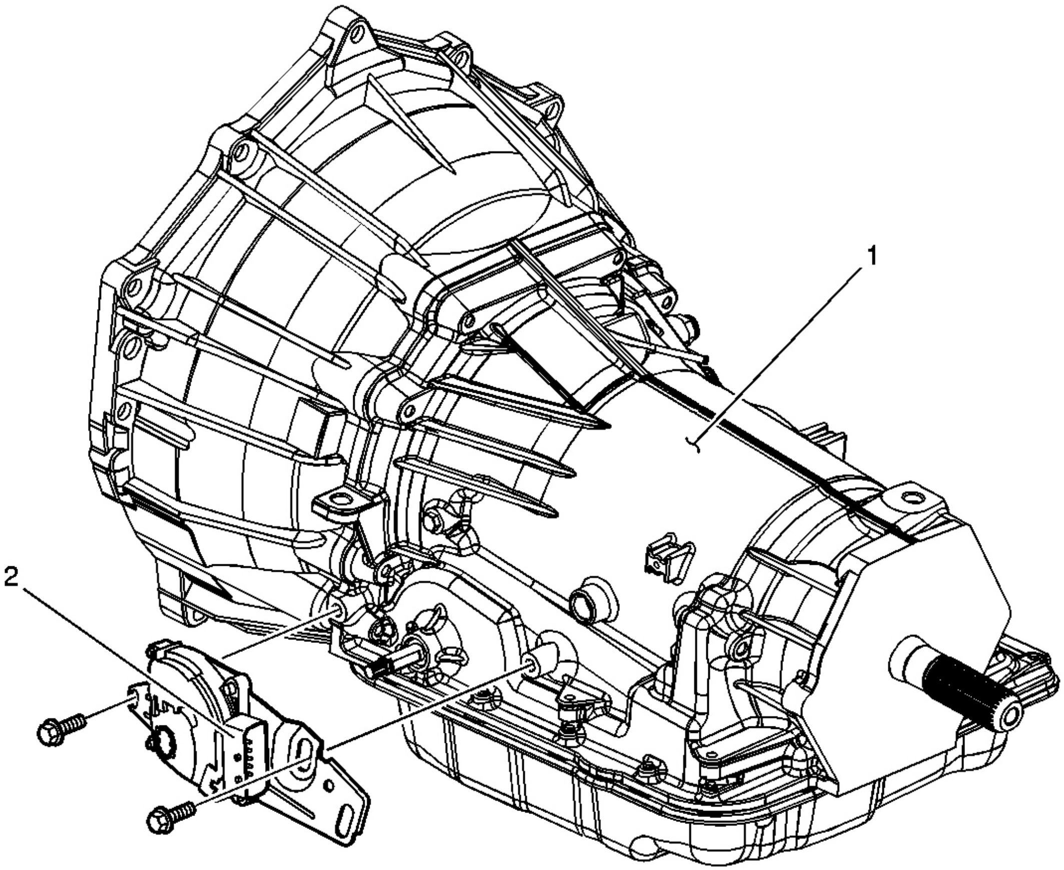


Fig. 6: Park Neutral Position (PNP) Switch Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
1	Automatic Transmission 4L60-E/4L65-E
2	Park/Neutral Position (PNP) Switch

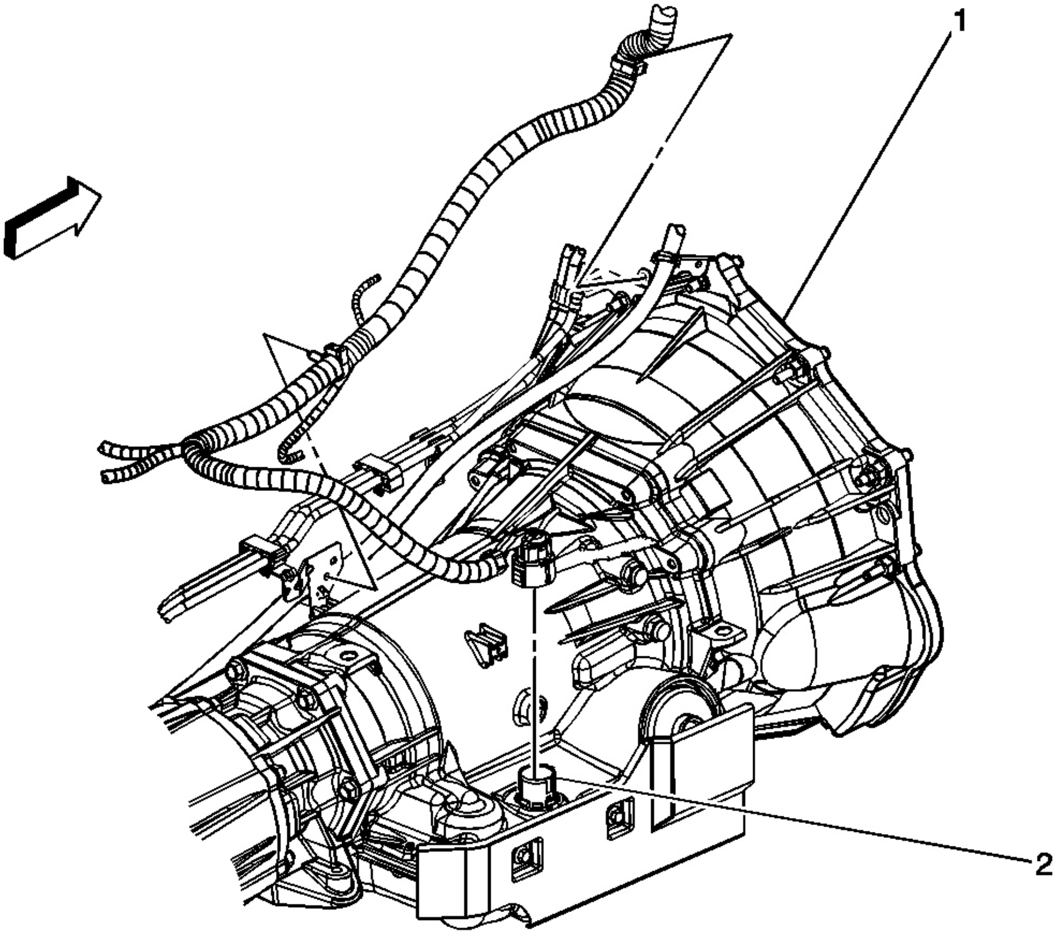


Fig. 7: C175 Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
1	Automatic Transmission
2	C175

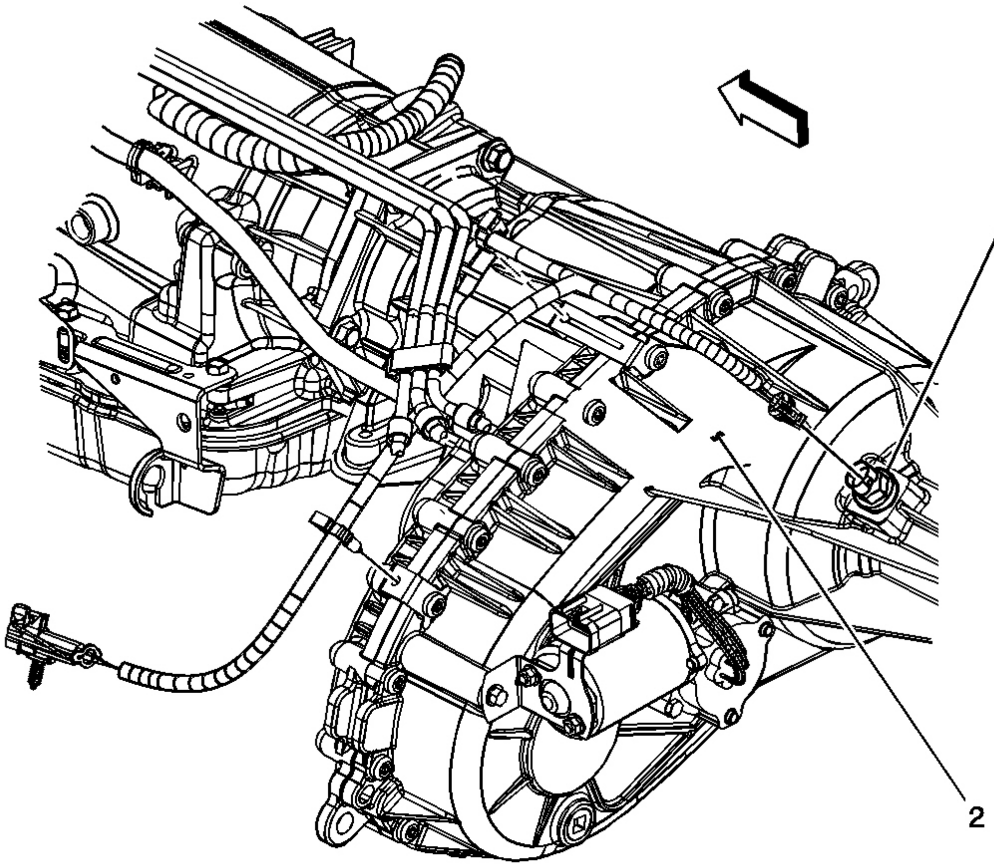


Fig. 8: Vehicle Speed Sensor (VSS) Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

Callout	Component Name
1	VSS Sensor
2	Transfer Case

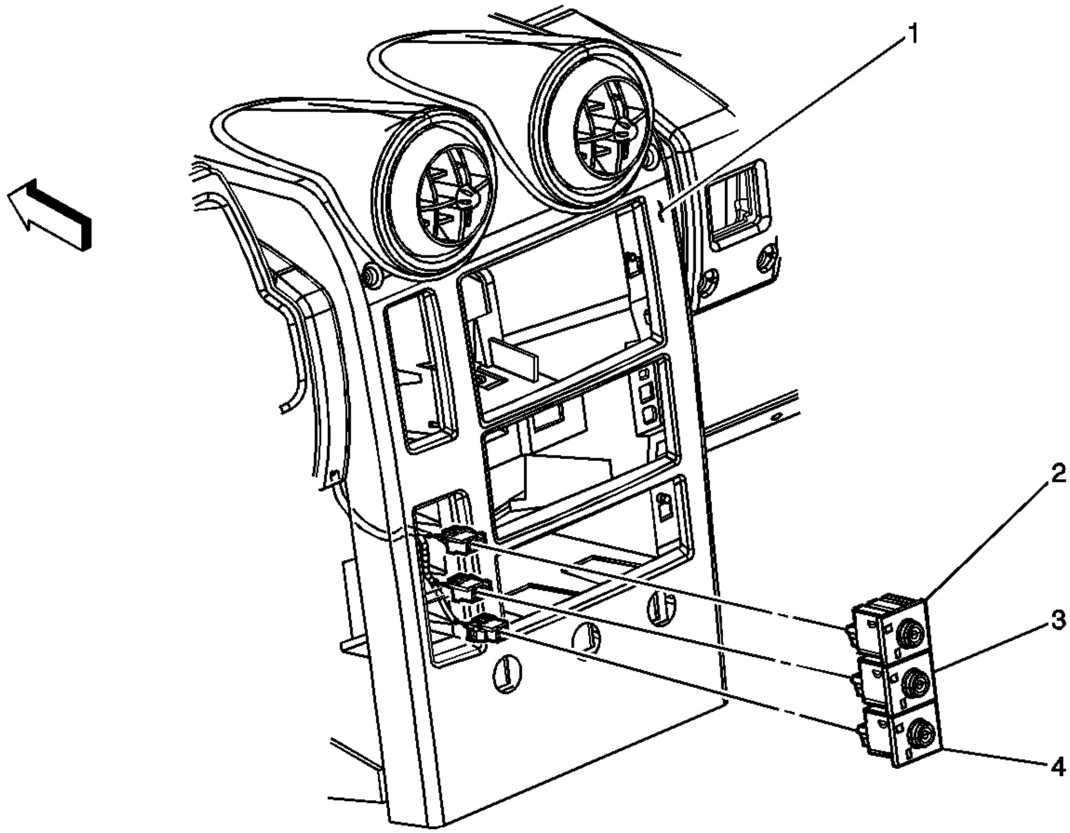


Fig. 9: Ride Height Switch Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
1	IP Compartment
2	Traction Control Switch
3	Tow/Haul Switch
4	Ride Height Switch

DISASSEMBLED VIEWS

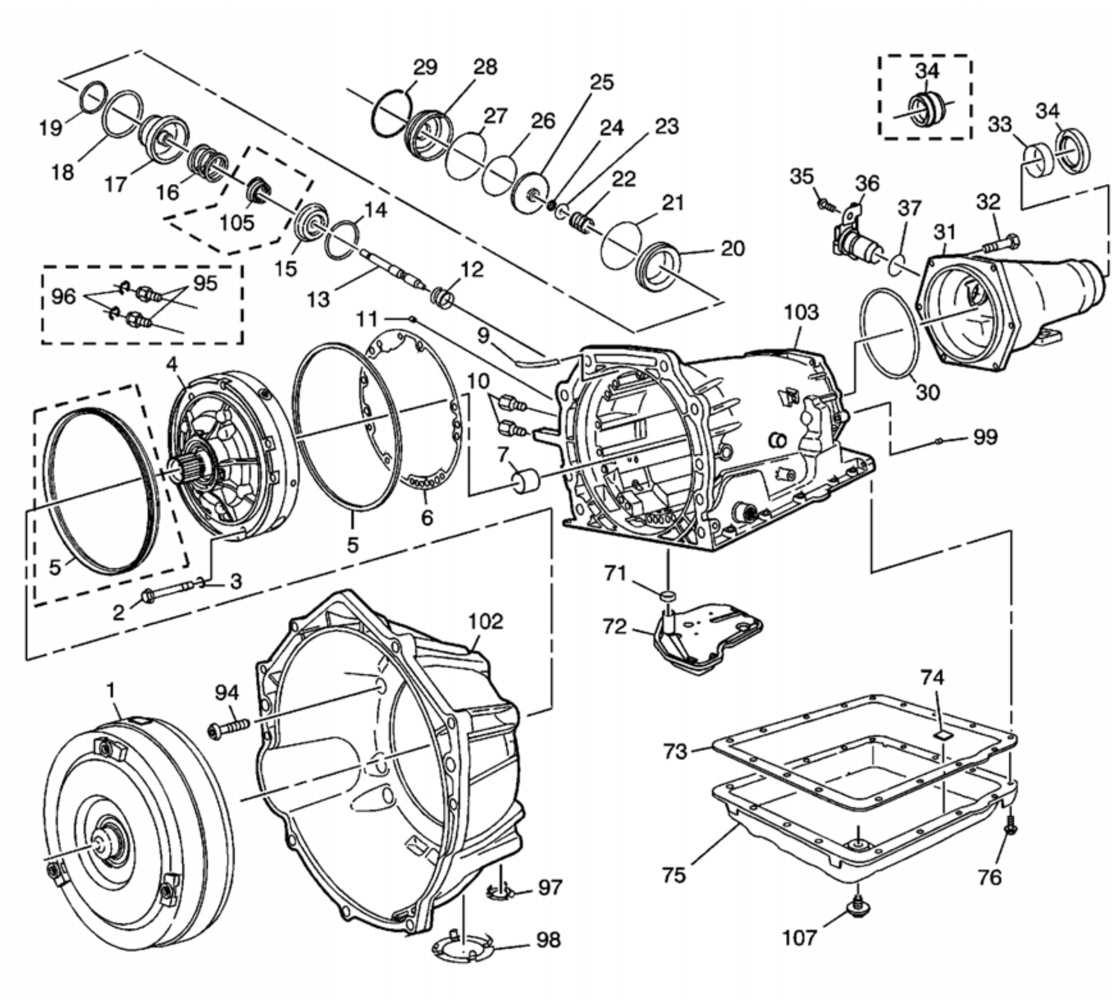


Fig. 10: Case and Associated Parts Component Views (1 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 10

Callout	Component Name
1	Torque Converter Assembly - Model Dependent On Size
2	Pump to Case Bolt
3	Pump to Case Bolt O-Ring
4	Oil Pump Assembly
5	A/T Fluid Pump Seal - Pump to Case - Model Dependent
5	A/T Fluid Pump Seal - Pump to Case - Model Dependent
6	Pump Cover to Case Gasket
7	Case Bushing
9	Transmission Vent Assembly
10	Oil Cooler Pipe Connector - Model Dependent
11	Case Servo Plug
12	Servo Return Spring

13	2nd Apply Piston Pin
14	Retainer Ring - 2nd Apply Piston
15	Servo Cushion Spring Retainer
16	Servo Cushion Spring - Outer
17	2nd Apply Piston
18	Oil Seal Ring - 2nd Apply Piston - Outer
19	Oil Seal Ring - 2nd Apply Piston - Inner
20	Servo Piston Housing - Inner
21	O-Ring Seal
22	Servo Apply Pin Spring
23	Servo Apply Pin Washer
24	Retainer Ring - Apply Pin
25	4th Apply Piston
26	Oil Seal Ring - 4th Apply Piston - Outer
27	O-Ring Seal - 2-4 Servo Cover
28	2-4 Servo Cover
29	Servo Cover Retaining Ring
30	Case Extension to Case Seal
31	Case Extension - Model Dependent
32	Case Extension to Case Bolt
33	Case Extension Bushing
34	Case Extension Oil Seal Assembly - Model Dependent
34	Case Extension Oil Seal Assembly - Model Dependent
35	Speed Sensor Retaining Bolt
36	Internal Transmission Speed Sensor
37	O-Ring Seal - ITSS to Case Extension
71	Filter Seal
72	Transmission Oil Filter Assembly - Model Dependent
73	Transmission Oil Pan Gasket
74	Chip Collector Magnet
75	Transmission Oil Pan - Model Dependent
76	Transmission Oil Pan Screw
94	Converter Housing to Case Bolt
95	Oil Cooler Quick Connector - Model Dependent
96	Oil Cooler Quick Connect Clip - Model Dependent
97	Converter Housing Access Hole Plug - Model Dependent
98	Converter Bolt Inspection Plate - Model Dependent
99	Cup D4 Orifice Plug
102	Converter Housing - Model Dependent
103	Main Section Case - Model Dependent
105	Servo Cushion Spring - Inner - Model Dependent

107	A/T Oil Pan Hex Head Plug Assembly - Model Dependent

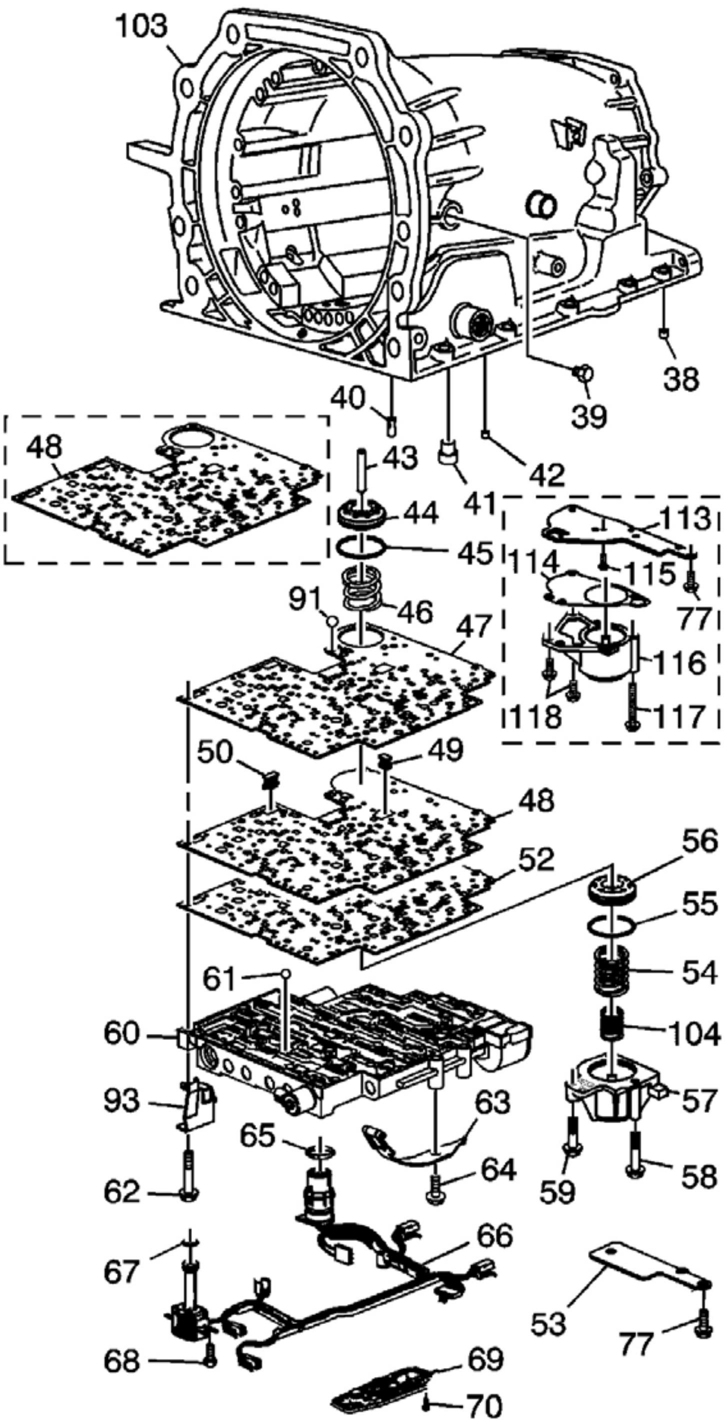


Fig. 11: Case and Associated Parts Component Views (2 of 2) - M30/M32
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 11

Callout	Component Name
38	Transmission Case Plug - Accumulator Bleed
39	Pressure Plug
40	Third Accumulator (#7) Retainer and Ball Assembly
41	Band Anchor Pin
42	Retainer and Ball Assembly - Double Orifice (#10)
43	Accumulator Piston Pin
44	3-4 Accumulator Piston
45	Oil Seal Ring - 3-4 Accumulator Piston
46	3-4 Accumulator Spring - Model Dependent
47	Spacer Plate to Case Gasket
48	Valve Body Spacer Plate
48	Valve Body Spacer Plate
49	Shift Solenoids Screen
50	Pressure Control Solenoid Screen
52	Spacer Plate to Valve Body Gasket
53	Spacer Plate Support Plate
54	1-2 Accumulator Spring - Outer
55	Oil Seal Ring - 1-2 Accumulator
56	1-2 Accumulator Piston
57	1-2 Accumulator Cover and Pin Assembly - Model Dependent
58	Accumulator Cover Bolt
59	Accumulator Cover Bolt
60	Control Body Valve Assembly - Model Dependent
61	Checkball (#2, 3, 4, 5, 6, 8, 12)
62	Valve Body Bolt
63	Manual Detent Spring Assembly
64	Manual Detent Spring Bolt
65	Wiring Harness Pass-Through Connector O-Ring Seal
66	Wiring Harness Solenoid Assembly - Model Dependent
67	O-Ring Seal - Solenoid
68	Hex Washer Head Bolt - Solenoid
69	Transmission Fluid Pressure Manual Valve Position Switch Assembly
70	Pressure Switch Assembly Bolt
77	Spacer Plate Support Bolt
77	Spacer Plate Support Bolt
91	Number 1 Checkball
93	Dipstick Stop Bracket - Model Dependent
103	Main Section Case - Model Dependent
104	1-2 Accumulator Spring - Inner

113	Spacer Plate Support Plate - Colorado/Canyon
114	Accumulator Gasket - Colorado/Canyon
115	Accumulator Bolt - Colorado/Canyon
116	Accumulator Cover - Colorado/Canyon
117	Accumulator Bolt - Colorado/Canyon
118	Accumulator Bolt - Colorado/Canyon

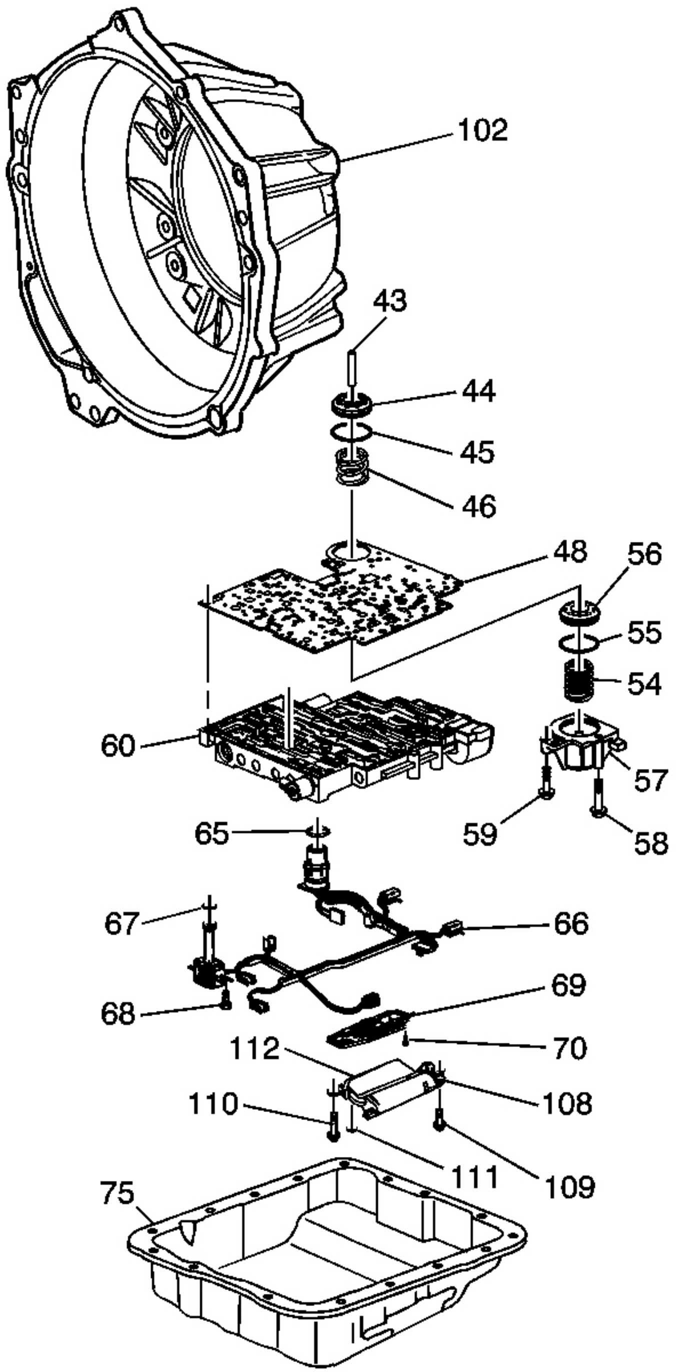


Fig. 12: Case and Associated Parts Component Views (2 of 2) - M33 Only
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 12

Callout	Component Name
43	Accumulator Piston Pin
44	3-4 Accumulator Piston
45	Oil Seal Ring - 3-4 Accumulator Piston
46	3-4 Accumulator Spring - Model Dependent
48	Valve Body Spacer Plate with Bonded Gasket
54	1-2 Accumulator Spring - Outer
55	Oil Seal Ring - 1-2 Accumulator
56	1-2 Accumulator Piston
57	1-2 Accumulator Cover and Pin Assembly
58	Accumulator Cover Bolt
59	Accumulator Cover Bolt
60	Control Body Valve Assembly - Model Dependent
65	Wiring Harness Pass-through Connector O-Ring Seal
66	Wiring Harness Solenoid Assembly - Model Dependent
67	O-Ring Seal - Solenoid
68	Hex Washer Head Bolt - Solenoid
69	Transmission Fluid Pressure Manual Valve Position Switch Assembly
70	Pressure Switch Assembly Bolt
75	Transmission Oil Pan
102	Converter Housing
108	Secondary Fluid Pump Assembly
109	Secondary Fluid Pump Bolts
110	Secondary Fluid Pump Bolt
111	Filter Retainer
112	Secondary Fluid Pump Filter

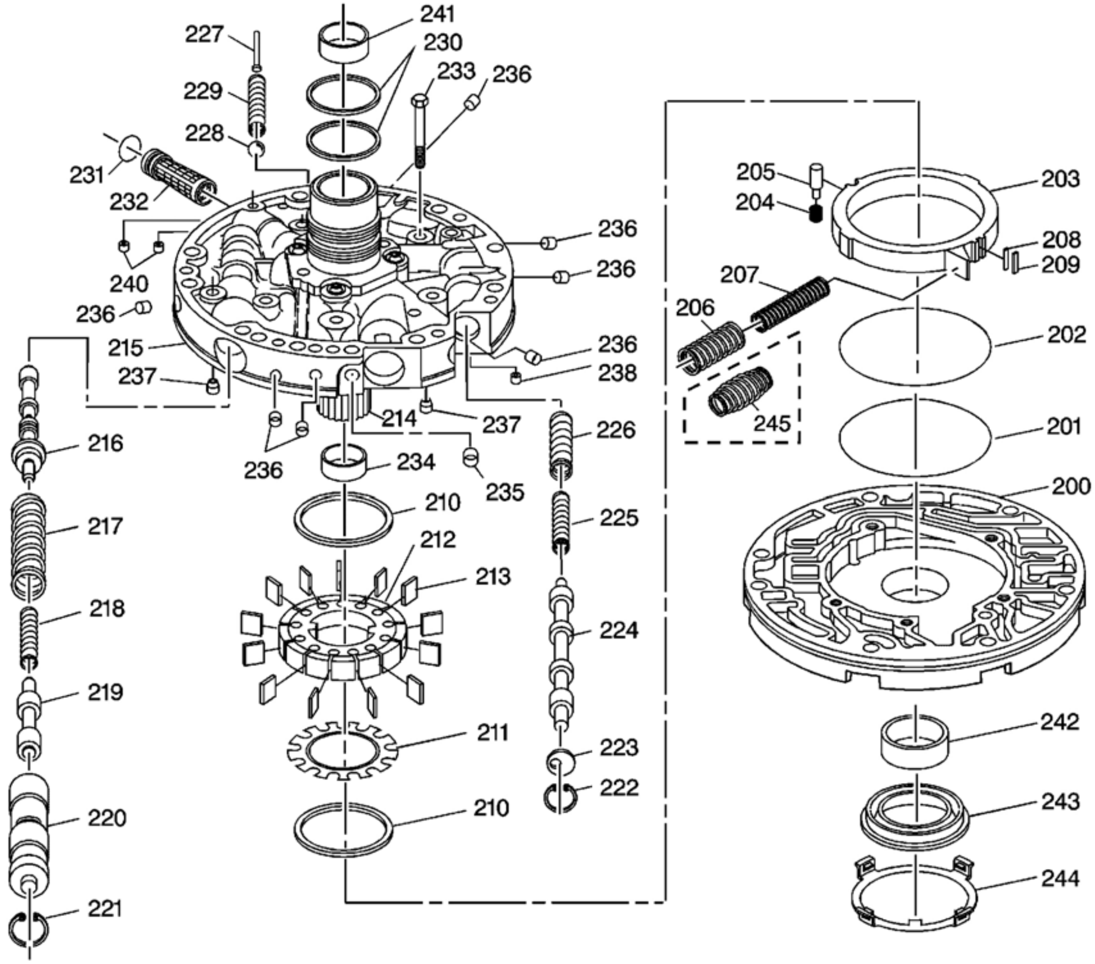


Fig. 13: Oil Pump Assembly Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 13

Callout	Component Name
200	Pump Body
201	Oil Seal Ring - Slide to Wear Plate
202	O-Ring Seal - Slide Seal Back-Up
203	Pump Slide
204	Pivot Pin Spring
205	Pivot Slide Pin
206	Pump Slide Spring - Outer
207	Pump Slide Spring - Inner
208	Pump Slide Seal Support
209	Pump Slide Seal
210	Pump Vane Ring

210	Pump Vane Ring
211	Rotor Guide
212	Oil Pump Rotor
213	Pump Vane
214	Stator Shaft
215	Pump Cover
216	Pressure Regulator Valve
217	Pressure Regulator Valve Spring
218	Pressure Regulator Isolator Spring
219	Reverse Boost Valve
220	Reverse Boost Valve Sleeve
221	Oil Pump Reverse Boost Valve Retaining Ring
222	Oil Pump Converter Clutch Valve Retaining Ring
223	Stop Valve
224	Converter Clutch Valve
225	Converter Clutch Valve Spring - Inner
226	Converter Clutch Valve Spring - Outer
227	Pressure Relief Bolt Rivet
228	Pressure Relief Ball
229	Pressure Relief Spring
230	Oil Seal Ring - Stator Shaft
231	Oil Pump Cover Screen Seal
232	Oil Pump Cover Screen
233	Bolt M8 X 1.25 X 40 - Cover to Body
234	Stator Shaft Bushing - Front
235	Oil Pump Cover Plug - FWD Clutch Feed
236	Oil Pump Cover Plug
236	Oil Pump Cover Plug
236	Oil Pump Cover Plug
236	Oil Pump Cover Plug
236	Oil Pump Cover Plug
236	Oil Pump Cover Plug
237	Check Valve Retainer and Ball Assembly
237	Check Valve Retainer and Ball Assembly
238	Converter Clutch Signal Orifice - Cup Plug
240	Cup Orifice Plug
241	Stator Shaft Bushing - Rear
242	Pump Body Bushing
243	Oil Seal Assembly
244	Front Helix Retainer
245	A/T Fluid Pump Slide Outer Spring

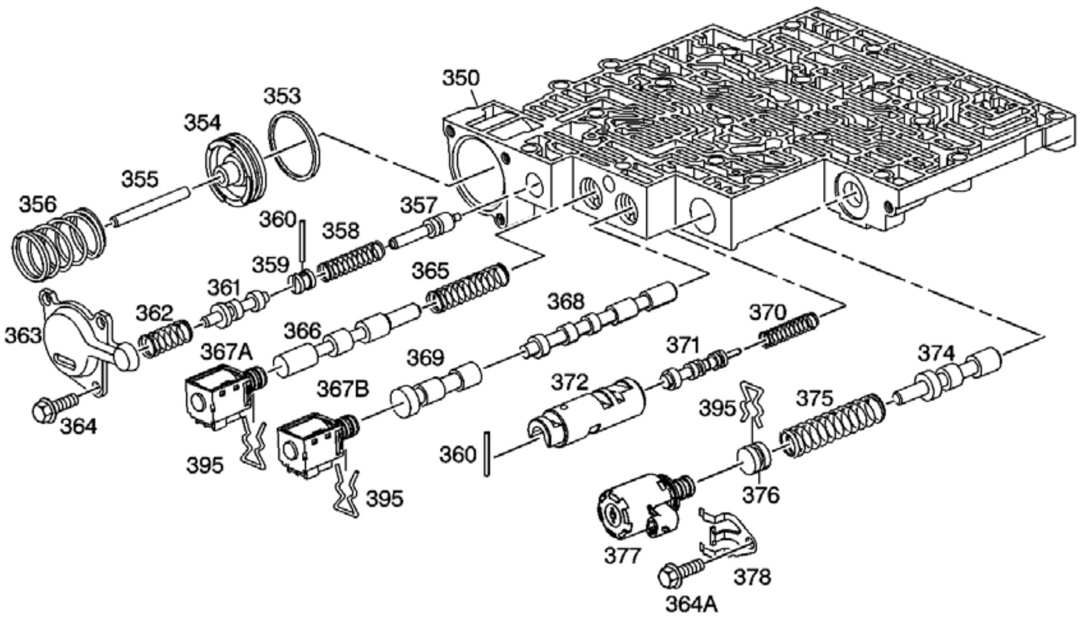


Fig. 14: Control Valve Body Assembly Component Views (1 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 14

Callout	Component Name
350	Control Valve Body Assembly
353	Forward Accumulator Oil Seal
354	Forward Accumulator Piston
355	Forward Accumulator Pin
356	Forward Accumulator Spring
357	Forward Abuse Valve
358	Forward Abuse Valve Spring
359	Bore Plug
360	Coiled Spring Pin
360	Coiled Spring Pin
361	Low Overrun Valve
362	Low Overrun Valve Spring
363	Forward Accumulator Cover
364	Forward Accumulator Cover Bolt
364a	Pressure Control Solenoid Retainer Bolt
365	1-2 Shift Valve Spring - Model Dependent
366	1-2 Shift Valve - Model Dependent
367a	1-2 Shift Solenoid Valve

367b	2-3 Shift Solenoid Valve
368	2-3 Shift Valve
369	2-3 Shuttle Valve
370	1-2 Accumulator Valve Spring
371	1-2 Accumulator Valve
372	1-2 Accumulator Valve Sleeve
374	Actuator Feed Limit Valve
375	Actuator Feed Limit Valve Spring
376	Bore Plug
377	Pressure Control Solenoid Valve
378	Pressure Control Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer

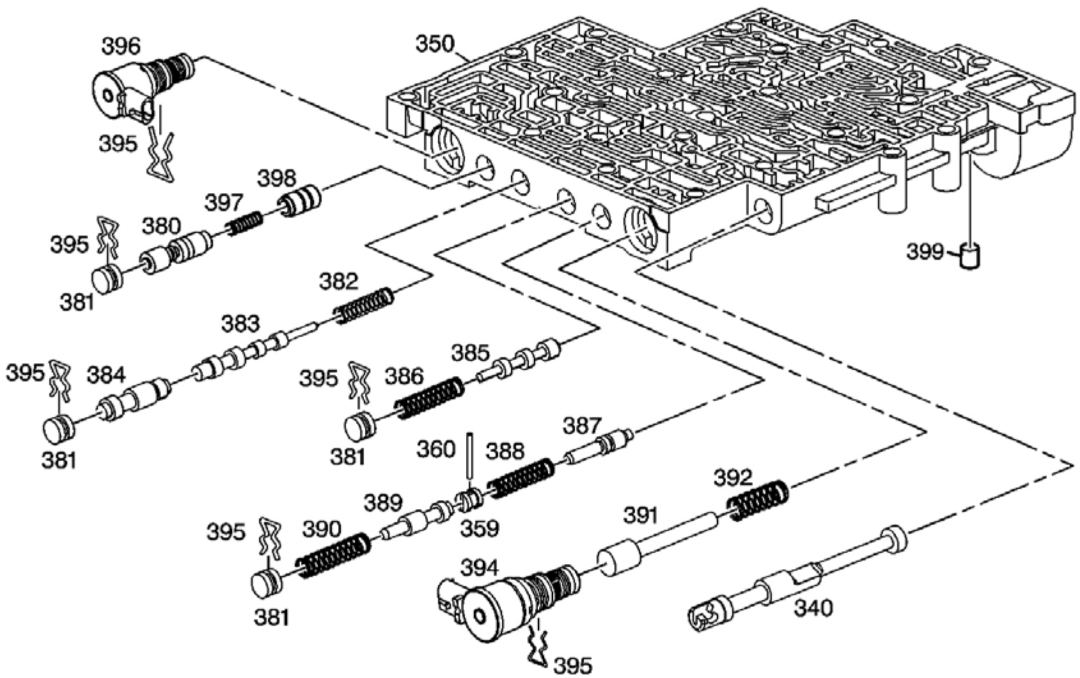


Fig. 15: Control Valve Body Assembly Component Views (2 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 15

Callout	Component Name
340	Manual Valve
350	Control Valve Body Assembly

359	Bore Plug
360	Coiled Spring Pin
380	Regulator Apply Valve
381	Bore Plug
381	Bore Plug
381	Bore Plug
381	Bore Plug
382	4-3 Sequence Valve Spring
383	4-3 Sequence Valve
384	3-4 Relay Valve
385	3-4 Shift Valve
386	3-4 Shift Valve Spring
387	Reverse Abuse Valve
388	Reverse Abuse Valve Spring
389	3-2 Downshift Valve
390	3-2 Downshift Valve Spring
391	3-2 Control Valve
392	3-2 Control Valve Spring
394	3-2 Control Solenoid Valve
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
396	TCC PWM Solenoid Valve
397	Regulator Apply Spring
398	Isolator Valve
399	Pump Ball Check Valve - M33 Only

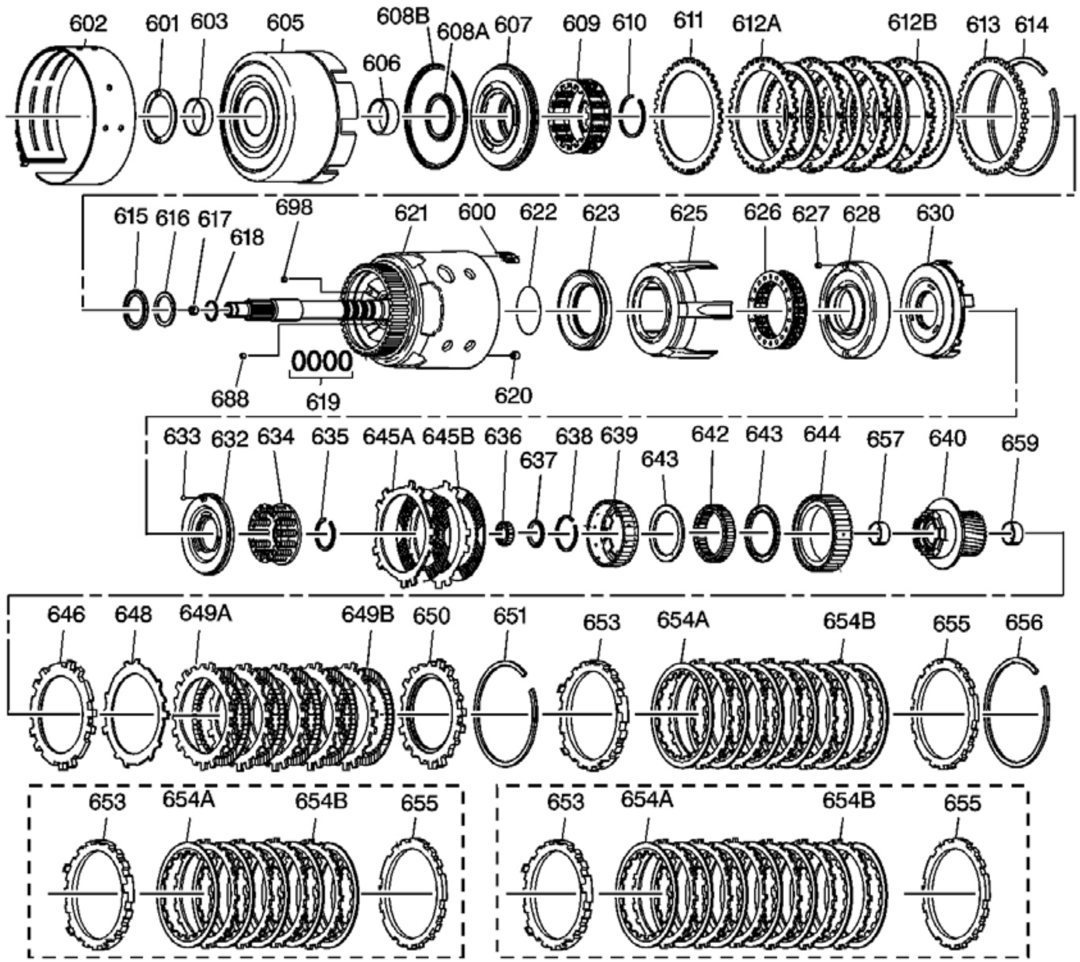


Fig. 16: Internal Parts Component Views (1 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 16

Callout	Component Name
600	3-4 Clutch Boost (5) Spring Assembly
601	Thrust Washer - Pump to Drum
602	2-4 Band Assembly
603	Reverse Input Clutch Bushing - Front
605	Reverse Input Clutch Housing and Drum Assembly
606	Reverse Input Clutch Bushing - Rear
607	Reverse Input Clutch Piston Assembly
608a	Reverse Input Clutch Seal - Inner
608b	Reverse Input Clutch Seal - Outer
609	Reverse Input Clutch Spring Assembly

610	Reverse Input Clutch Spring Retainer Ring
611	Reverse Input Clutch Plate - Belleville
612a	Reverse Input Clutch Turbulator Plate - Steel
612b	Reverse Input Clutch Plate Assembly - Fiber
613	Reverse Input Clutch Backing Plate - Selective
614	Reverse Input Clutch Retaining Ring
615	Stator Shaft/Selective Washer Bearing Assembly
616	Thrust Washer - Selective
617	Check Valve Retainer and Ball Assembly
618	O-Ring Seal - Location Model Dependent
619	Oil Seal Ring - Solid
620	Retainer and Checkball Assembly
621	Input Housing and Shaft Assembly - Model Dependent
622	O-Ring Input to Forward Clutch Housing Seal
623	3rd and 4th Clutch Piston
625	3rd and 4th Clutch Ring - Apply
626	3rd and 4th Clutch Spring Assembly
627	Forward Clutch Housing Retainer and Ball Assembly
628	Forward Clutch Housing
630	Forward Clutch Piston
632	Overrun Clutch Piston
633	Overrun Clutch Ball
634	Overrun Clutch Spring Assembly
635	Overrun Clutch Spring Retainer Snap Ring
636	Input Housing to Output Shaft Seal
637	Input Sun Gear Bearing Assembly
638	Overrun Clutch Hub Retaining Snap Ring
639	Overrun Clutch Hub
640	Forward Sprag Clutch Inner Race and Input Sun Gear Assembly
642	Forward Sprag Assembly
643	Sprag Assembly Retainer Ring
643	Sprag Assembly Retainer Ring
644	Forward Clutch Race - Outer
645a	Overrun Clutch Plate - Steel
645b	Overrun Clutch Plate Assembly - Fiber
646	Forward Clutch Plate - Apply
648	Forward Clutch Plate - Waved
649a	Forward Clutch Plate - Steel
649b	Forward Clutch Plate Assembly - Fiber
650	Forward Clutch Backing Plate - Selective
651	Forward Clutch Backing Plate Retainer Ring

653	3rd and 4th Clutch Apply Plate - Stepped
653	3rd and 4th Clutch Apply Plate - Stepped
653	3rd and 4th Clutch Apply Plate - Stepped
654a	3rd and 4th Clutch Plate Assembly - Fiber - Quantity Model Dependent 5, 6 or 7 Plates
654a	3rd and 4th Clutch Plate Assembly - Fiber - Quantity Model Dependent 5, 6 or 7 plates
654a	3rd and 4th Clutch Plate Assembly - Fiber - Quantity Model Dependent 5, 6 or 7 plates
654b	3rd and 4th Clutch Plate - Steel - Quantity Model Dependent
654b	3rd and 4th Clutch Plate - Steel - Quantity Model Dependent
654b	3rd and 4th Clutch Plate - Steel - Quantity Model Dependent
655	3rd and 4th Clutch Backing Plate - Selective - Model Dependent
655	3rd and 4th Clutch Backing Plate - Selective - Model Dependent
655	3rd and 4th Clutch Backing Plate - Selective - Model Dependent
656	3rd and 4th Clutch Backing Plate Retainer Ring
657	Input Sun Gear Front Bushing
659	Input Sun Gear Rear Bushing
688	Cup Plug
698	Orificed Cup Plug

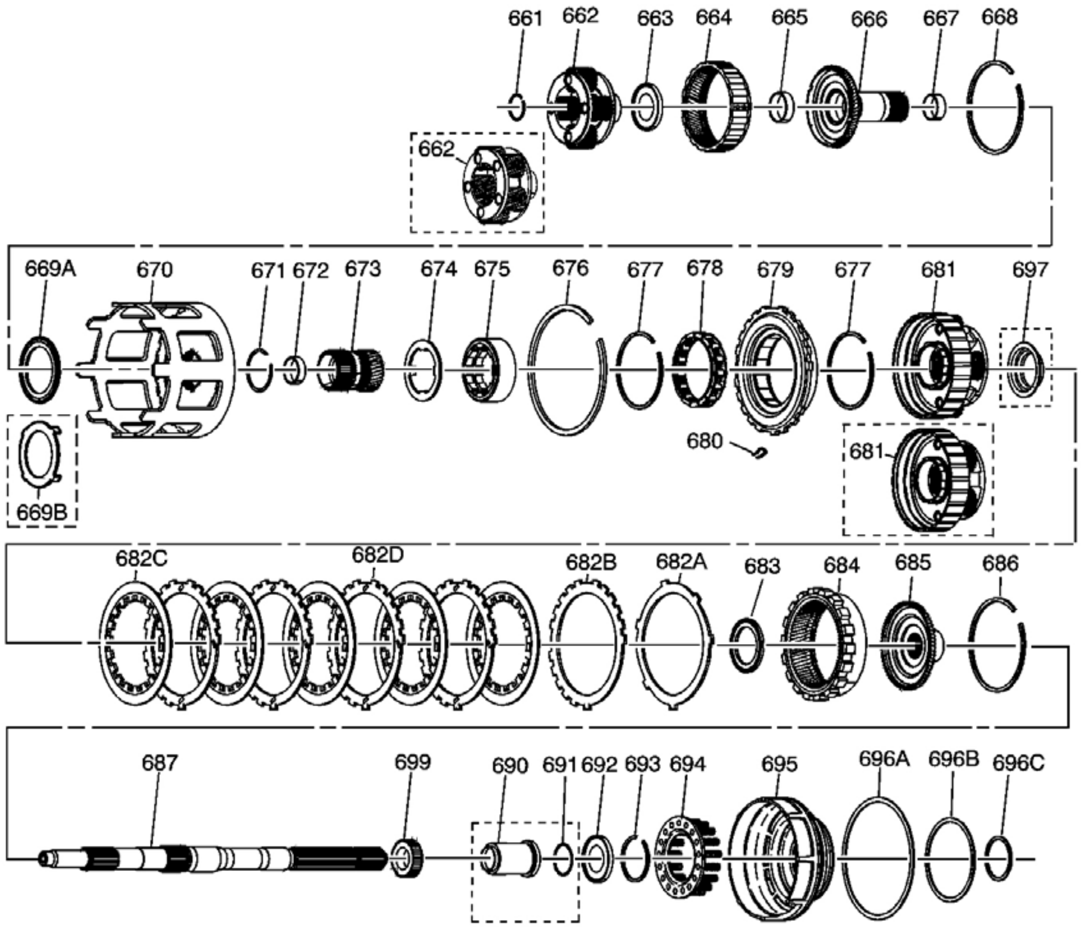


Fig. 17: Internal Parts Component Views (2 of 2)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 17

Callout	Component Name
661	Output Shaft to Input Carrier Retainer
662	Input Carrier Assembly - 4 or 5 Pinion-Model Dependent
662	Input Carrier Assembly
663	Thrust Bearing Assembly - Input Carrier to Reaction Shaft
664	Input Internal Gear
665	Reaction Carrier Shaft Front Bushing
666	Reaction Carrier Shaft
667	Reaction Carrier Shaft Rear Bushing
668	Reaction Shaft/Internal Gear Retainer Ring
669a	Thrust Bearing Assembly - Reaction Shaft Shell
669b	Thrust Bearing Assembly - Reaction Shaft Shell - Some Models

670	Reaction Sun Shell
671	Reaction Sun Gear Retainer Ring
672	Reaction Sun Bushing
673	Reaction Sun Gear
674	Thrust Washer - Race/Reaction Shell
675	Low and Reverse Roller Clutch Race
676	Low and Reverse Support to Case Retainer Ring
677	Low and Reverse Roller Assembly Retainer Ring - Cam
677	Low and Reverse Roller Assembly Retainer Ring - Cam
678	Low and Reverse Roller Clutch Assembly
679	Low and Reverse Clutch Support Assembly
680	Low and Reverse Clutch Support Retainer Spring
681	Reaction Carrier Assembly - 4 or 5 Pinion-Model Dependent
681	Reaction Carrier Assembly - 4 or 5 Pinion-Model Dependent
682a	Low and Reverse Clutch Plat - Waved
682b	Spacer Low and Reverse Clutch Plate - Selective
682c	Low and Reverse Clutch Plate Assembly - Fiber
682d	Low and Reverse Clutch Turbulator Plate - Steel
683	Thrust Bearing Assembly - Reaction Carrier/Support
684	Internal Reaction Gear
685	Internal Reaction Gear Support
686	Reaction Gear/Support Retainer Ring
687	Output Shaft
690	Output Shaft Sleeve - Model Dependent 2WD only
691	Output Shaft Seal - Model Dependent 2WD only
692	Reaction Gear Support to Case Bearing
693	Low and Reverse Clutch Retainer Ring
694	Low and Reverse Clutch Spring Assembly
695	Low and Reverse Clutch Piston
696a	Low and Reverse Clutch Seal - Outer
696b	Low and Reverse Clutch Seal - Center
696c	Low and Reverse Clutch Seal - Inner
697	Oil Deflector - High Output Models Only
699	Internal Transmission Speed Sensor Rotor

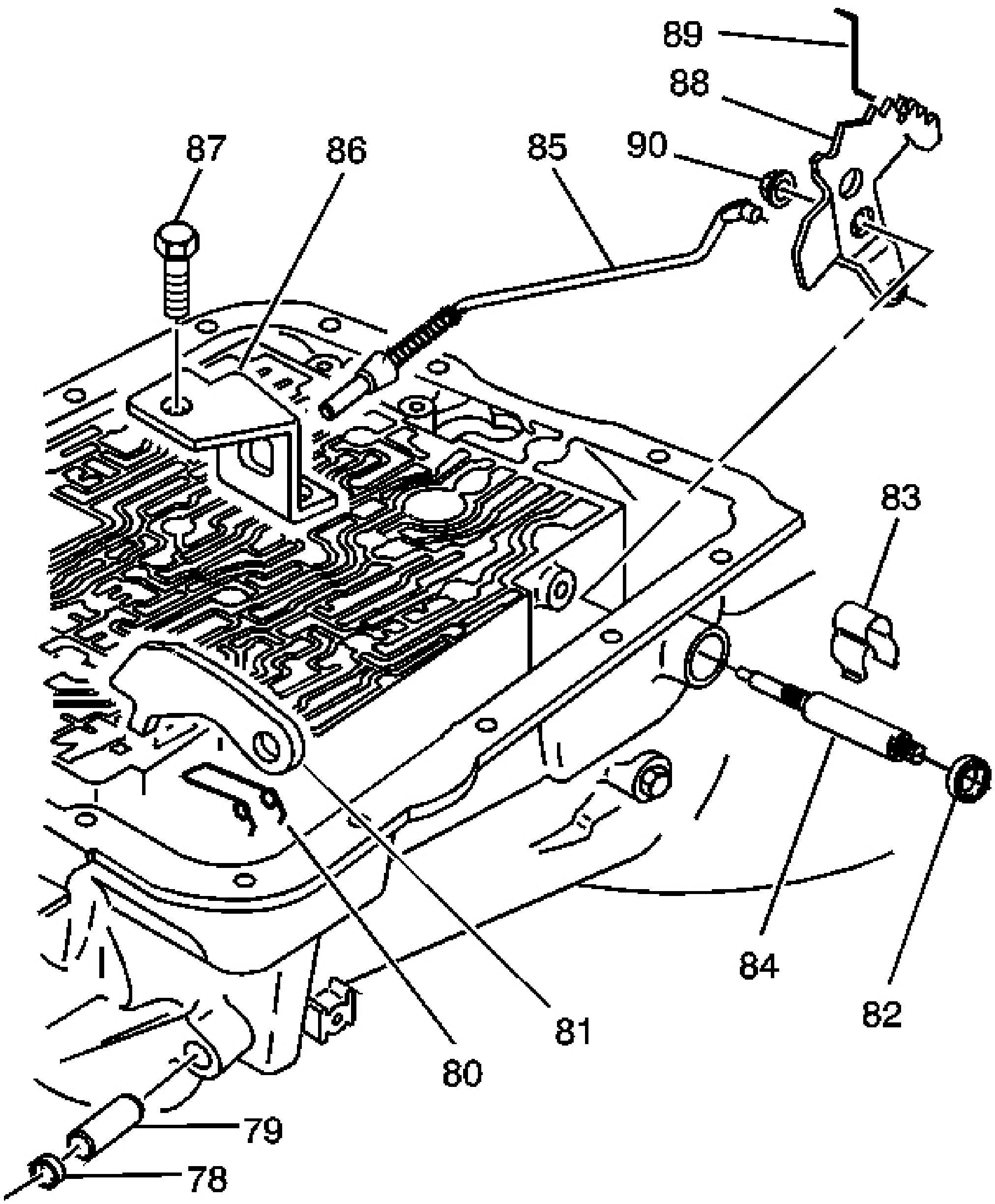


Fig. 18: Parking Lock and Manual Shift Shaft Assembly Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 18

Callout	Component Name
78	Steel Cup Plug

79	Parking Brake Pawl Shaft
80	Parking Pawl Return Spring
81	Parking Brake Pawl
82	Manual Shaft Seal
83	Manual Shaft Retainer
84	Manual Shaft - Model Dependent
85	Parking Lock Actuator Assembly
86	Parking Lock Bracket
87	Parking Lock Bracket Bolt
88	Inside Detent Lever
89	Manual Valve Link
90	Hex Head Nut

COMPONENT LOCATION

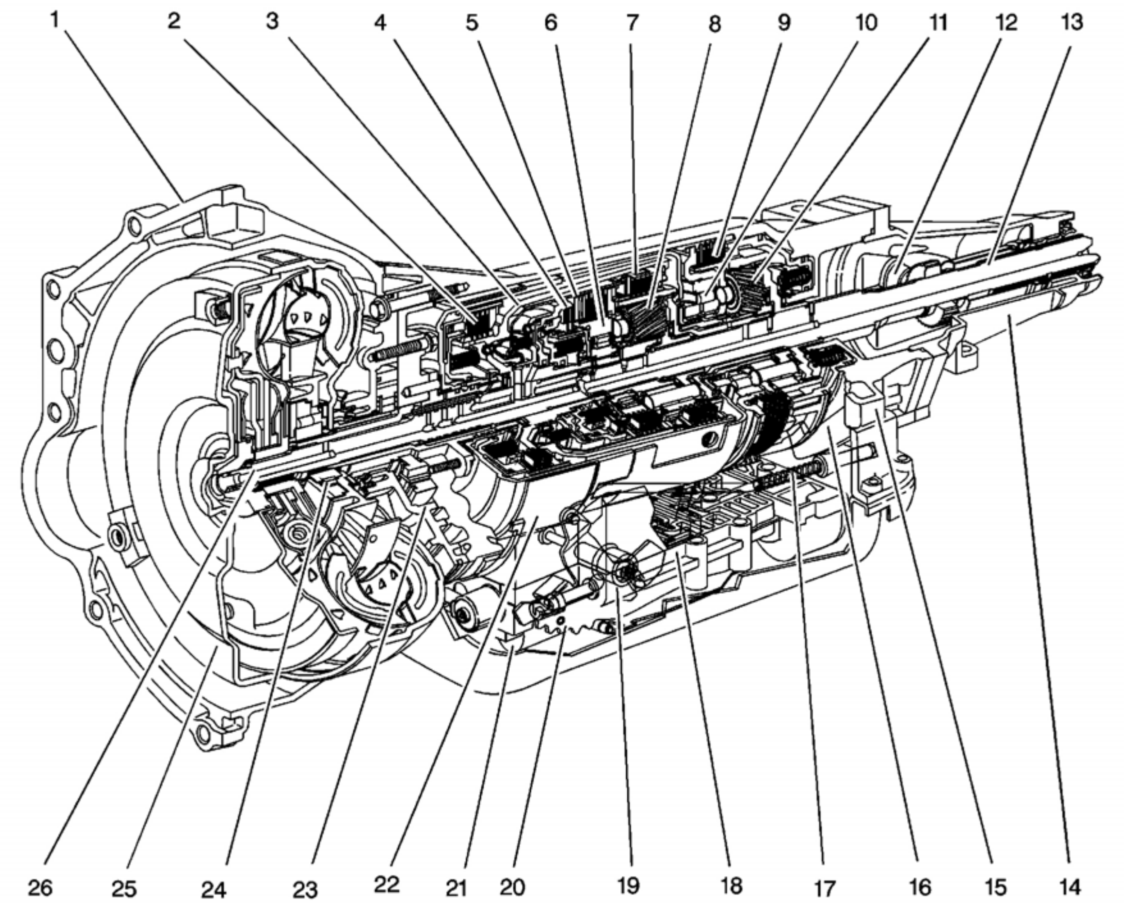


Fig. 19: Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 19

Callout	Component Name
1	Converter Housing
2	Reverse Input Clutch
3	Input Clutch Housing
4	Overrun Clutch
5	Forward Clutch
6	Forward Sprag Clutch Assembly
7	3-4 Clutch
8	Input Planetary Gear Set
9	Lo and Reverse Clutch
10	Lo Roller Clutch Assembly
11	Reaction Planetary Gear Set
12	Speed Sensor
13	Output Shaft
14	Case Extension
15	Main Section Case
16	Parking Pawl
17	Parking Lock Actuator Assembly
18	Control Valve Assembly
19	Manual Shaft
20	Inside Detent Lever
21	Secondary Fluid Pump Assembly - M33 Models Only
22	2-4 Band Assembly
23	Pump Assembly
24	Stator Roller Clutch
25	Torque Converter Assembly
26	Turbine Shaft

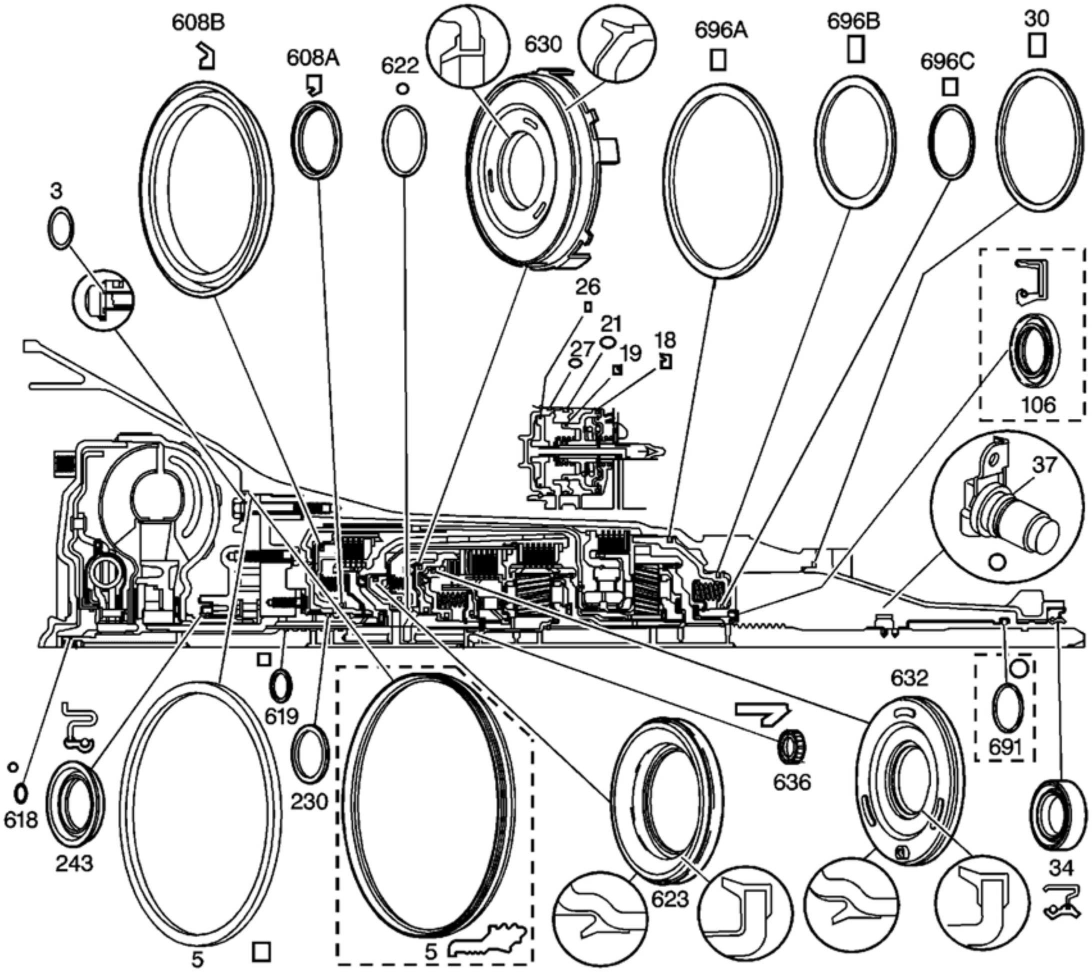


Fig. 20: Seals Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 20

Callout	Component Name
3	Pump to Case Bolt O-Ring
5	Oil Seal - Pump to Case - Model Dependent
5	Oil Seal - Pump to Case - Model Dependent
18	Oil Seal Ring - 2nd Apply Piston-Outer
19	Oil Seal Ring - 2nd Apply Piston-Inner
21	O-Ring Seal
26	Oil Seal Ring - 4th Apply Piston-Outer
27	O-Ring Seal - 2-4 Servo Cover
30	Case Extension to Case Seal
34	Case Extension Oil Seal Assembly

37	O-Ring Seal - Speed Sensor to Case Extension
106	Case Oil Seal Assembly - Y-Car Only
230	Oil Seal Ring - Stator Shaft
243	Oil Seal Assembly
608a	Reverse Input Clutch Seal - Inner
608b	Reverse Input Clutch Seal - Outer
618	O-Ring Seal - Turbine Shaft/Selective Washer
619	Oil Seal Ring - Solid
622	O-Ring Input to Forward Housing Seal
623	3rd and 4th Clutch Piston
630	Forward Clutch Piston
632	Overrun Clutch Piston
636	Input Housing to Output Shaft Seal
691	Output Shaft - Model Dependent Seal
696a	Low and Reverse Clutch - Outer Seal
696b	Low and Reverse Clutch - Center Seal
696c	Low and Reverse Clutch - Inner Seal

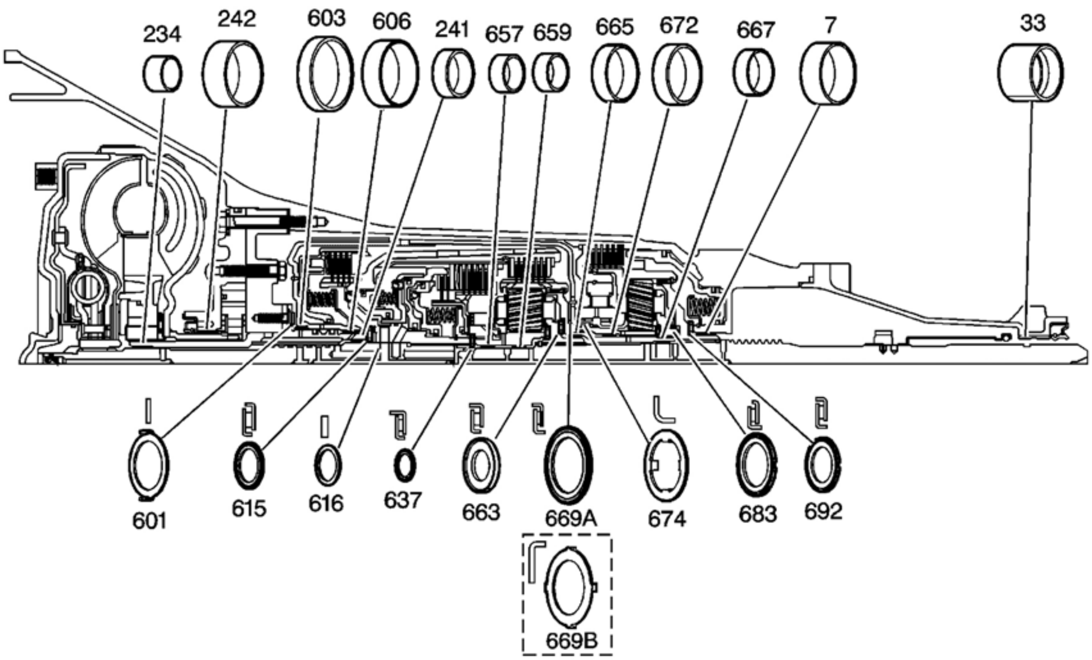


Fig. 21: Bearings and Bushings Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 21

Callout	Component Name

7	Case Bushing
33	Case Extension Bushing
234	Stator Shaft Bushing - Front
241	Stator Shaft Bushing - Rear
242	Oil Pump Body Bushing
601	Thrust Washer - Pump to Drum
603	Reverse Input Cl. Bushing - Front
606	Reverse Input Clutch Bushing - Rear
615	Stator Shaft/Selective Washer Bearing Assembly
616	Thrust Washer - Selective
637	Input Sun Gear Bearing Assembly
657	Input Sun Gear Bushing - Front
659	Input Sun Gear Bushing - Rear
663	Thrust Bearing Assembly - Input Carrier to Reaction Shaft
665	Reaction Carrier Shaft Bushing - Front
667	Reaction Carrier Shaft Bushing - Rear
669a	Thrust Washer - Reaction Shaft/Shell
669b	Thrust Washer - Reaction Shaft/Shell - Some Models
672	Reaction Gear Bushing
674	Thrust Washer - Race/Reaction Shell
683	Thrust Bearing Assembly - Reaction Carrier/Support
692	Reaction Gear Support to Case Bearing

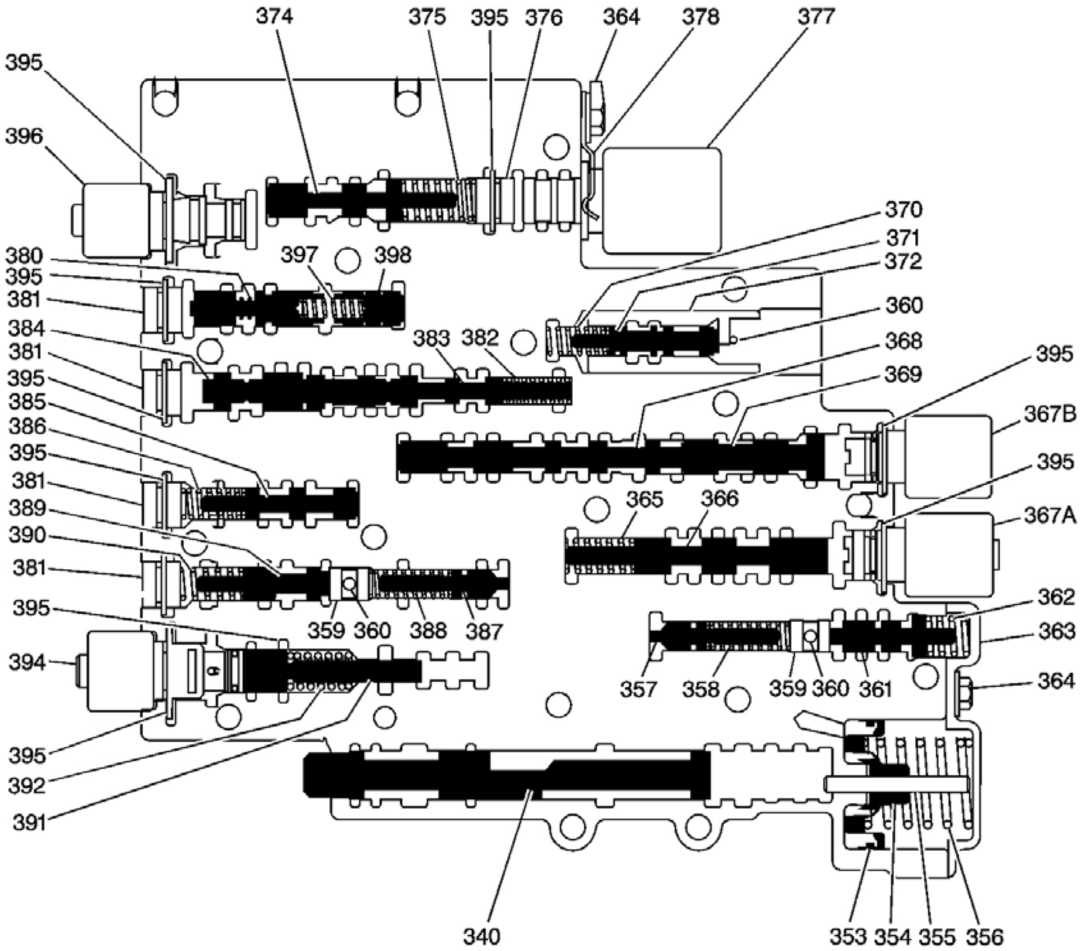


Fig. 22: Valve Trains Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 22

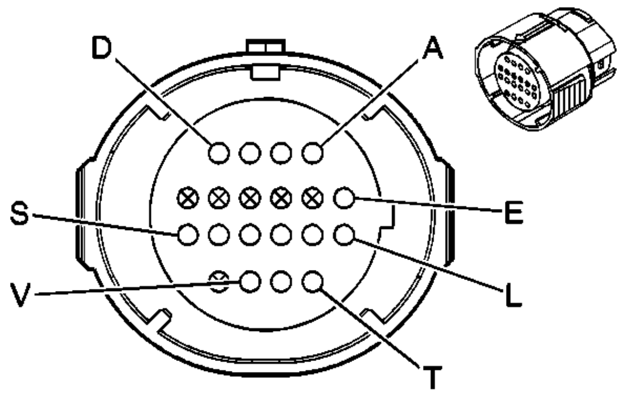
Callout	Component Name
340	Manual Valve
353	Forward Accumulator Oil Seal
354	Forward Accumulator Piston
355	Forward Accumulator Pin
356	Forward Accumulator Spring
357	Forward Abuse Valve
358	Forward Abuse Valve Spring
359	Bore Plug
359	Bore Plug
360	Coiled Spring Pin

360	Coiled Spring Pin
360	Coiled Spring Pin
361	Low Overrun Valve
362	Low Overrun Valve Spring
363	Forward Accumulator Cover
364	Forward Accumulator Cover Bolt
364	Forward Accumulator Cover Bolt
365	1-2 Shift Valve Spring - Model Dependent
366	1-2 Shift Valve - Model Dependent
367a	1-2 Shift Solenoid Valve
367b	2-3 Shift Solenoid Valve
368	2-3 Shift Valve
369	2-3 Shuttle Valve
370	1-2 Accumulator Valve Spring
371	1-2 Accumulator Valve
372	1-2 Accumulator Valve Sleeve
374	Actuator Feed Limit Valve
375	Actuator Feed Limit Valve Spring
376	Bore Plug
377	Pressure Control Solenoid Valve
378	Pressure Control Solenoid Retainer
380	Regulator Apply Valve - Model Dependent
381	Bore Plug
381	Bore Plug
381	Bore Plug
381	Bore Plug
382	4-3 Sequence Valve Spring
383	4-3 Sequence Valve
384	3-4 Relay Valve
385	3-4 Shift Valve
386	3-4 Shift Valve Spring
387	Reverse Abuse Valve
388	Reverse Abuse Valve Spring
389	3-2 Downshift Valve
390	3-2 Downshift Valve Spring
391	3-2 Control Valve
392	3-2 Control Valve Spring
394	3-2 Control Solenoid Valve
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer

395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
395	Bore Plug and Solenoid Retainer
396	TCC PWM Solenoid Valve
397	Regulator Apply Spring
398	Isolator Valve

AUTOMATIC TRANSMISSION INLINE 20-WAY CONNECTOR END VIEW

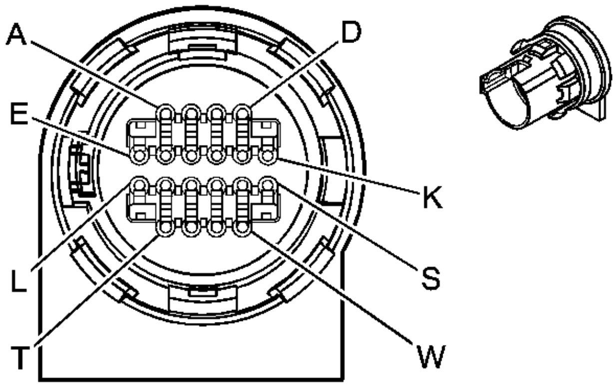
AT Inline 20-Way Connector Terminal Identification, Engine Side



Connector Part Information			• **12160493** • **Engine Harness Side 20 Way F Micro-Pack 100 W Series (GRY)**
Pin	**Wire Color**	**Circuit No.**	**Function**
A	L-GN	1222	1-2 Shift Solenoid Valve Control
B	YE/BK	1223	2-3 Shift Solenoid Valve Control
C	RD/BK	1228	Pressure Control (PC) Solenoid Valve High Control
D	L-BU /WH	1229	PC Solenoid Valve Low Control
E	PK	1020	Ignition 0 Voltage
F-K	-	-	Not Used
L	YE/ BK	1227	Transmission Fluid Temperature (TFT) Sensor Signal
M	BK	407	Low Reference
N	PK	1224	TFP Switch Signal A

P	RD	1226	TFP Switch Signal C
R	D-BU	1225	TFP Switch Signal B
S	WH	687	3-2 Downshift Solenoid Valve Control
T	TN/BK	422	Torque Converter Clutch Solenoid Valve Control
U	BN	418	Torque Converter Clutch Pulse Width Modulation Solenoid Valve Control
V-W	-	-	Not Used

AT Inline 20-Way Connector Terminal Identification, Transmission Side

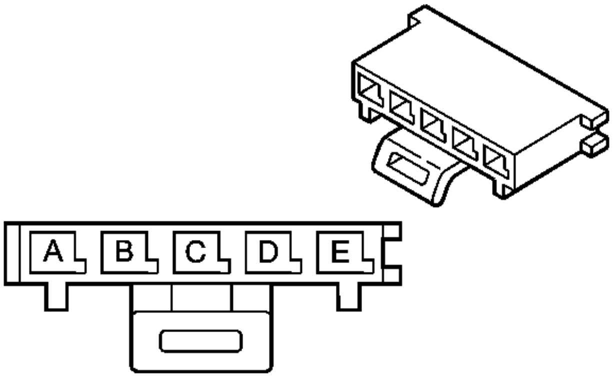


Connector Part Information		• **12160782** • **Transmission Harness Side 20 Way M Micro-Pack 100 W Series (GRY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	L-GN	1222	1-2 Shift Solenoid Valve Control
B	YE	1223	2-3 Shift Solenoid Valve Control
C	PU	1228	Pressure Control (PC) Solenoid Valve High Control
D	L-BU	1229	PC Solenoid Valve Low Control
E	RD	839	Ignition 1 Voltage
L	BN	1227	Transmission Fluid Temperature (TFT) Sensor Signal
M	GY	452	Low Reference
N	PK	1224	TFP Switch Signal A
P	OG	1226	TFP Switch Signal C
R	D-BU	1225	TFP Switch Signal B
S	WH	687	3-2 Shift Solenoid Valve Control
T	BK	422	Torque Converter Clutch Solenoid Valve Control
U	TN	418	Torque Converter Clutch Pulse Width Modulation Solenoid Valve Control

V-W	-	-	Not Used

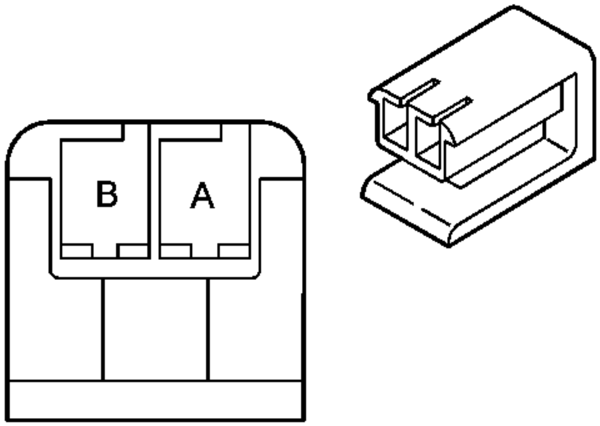
AUTOMATIC TRANSMISSION INTERNAL CONNECTOR END VIEWS

Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch Connector Terminal Identification, Wiring Harness Side



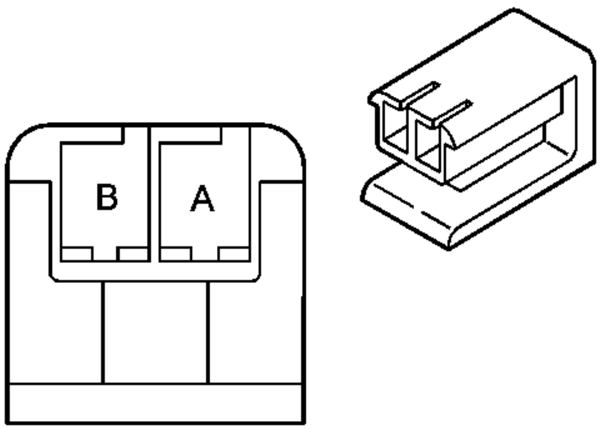
Connector Part Information		• **12162213** • **Conn 5-Way F M/P 150.2 P2S (NA)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BN	1227	Transmission Fluid Temperature (TFT) Sensor Signal
B	GY	452	Low Reference
C	PK	1224	TFP Switch Signal A
D	OG	1226	TFP Switch Signal C
E	D-BU	1225	TFP Switch Signal B

1-2 Shift Solenoid (SS) Valve Connector Terminal Identification, Wiring Harness Side



Connector Part Information		• 12162201 • Conn 2-Way F M/P 150.2 P2S (NA)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RD	839B	Ignition 1 Voltage
B	L-GN	1222	1-2 Shift Solenoid Valve Control

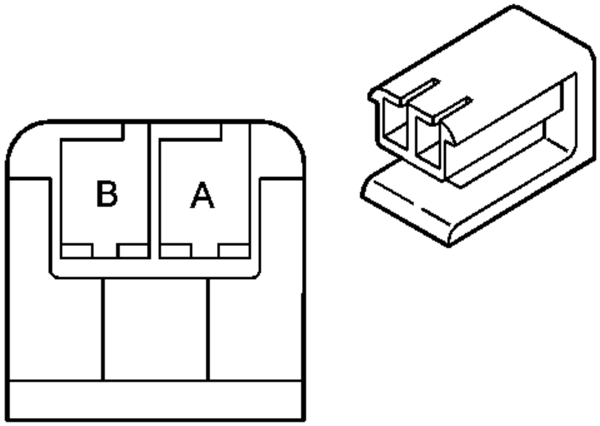
2-3 Shift Solenoid (SS) Valve Connector Terminal Identification, Wiring Harness Side



Connector Part Information		• 12162201 • Conn 2-Way F M/P 150.2 P2S (NA)	
Pin	**Wire Color**	**Circuit No.**	**Function**

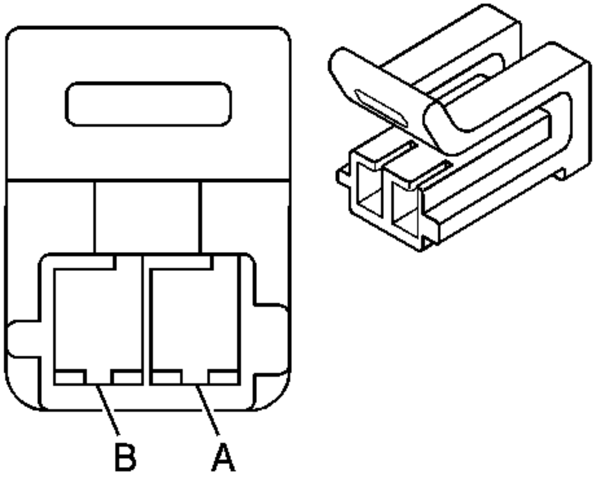
A	RD	839A	Ignition 1 Voltage
B	YE	1223	2-3 Shift Solenoid Valve Control

Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid Valve Connector Terminal Identification, Wiring Harness Side



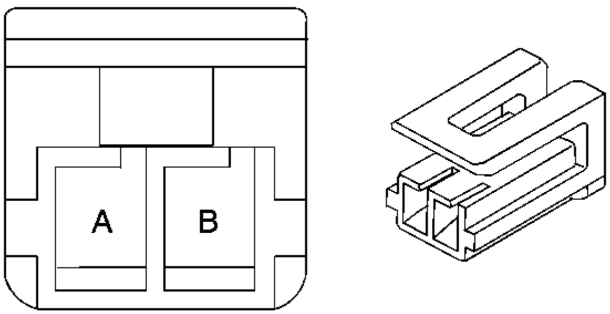
Connector Part Information		• **12162202** • **Conn 2-Way F M/P 150.2 P2S (BU)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RD	839E	Ignition 1 Voltage
B	TN	418	Torque Converter Clutch Pulse Width Modulated Solenoid Valve Control

3-2 Shift Solenoid (SS) Valve Assembly Connector Terminal Identification, Wiring Harness Side



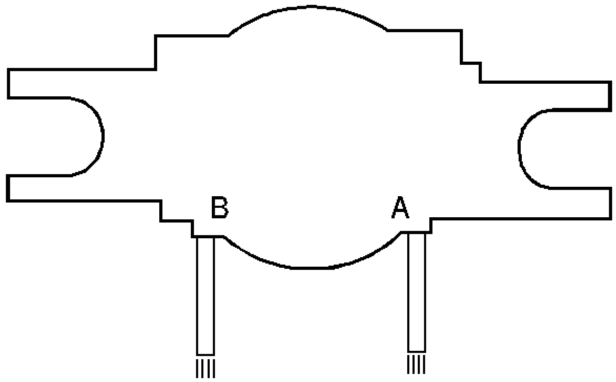
Connector Part Information		• 12146094 • Conn 2-Way F M/P 150.2 P2S (M-GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RD	839C	Ignition 1 Voltage
B	WH	687	3-2 Shift Solenoid Valve Control

Pressure Control (PC) Solenoid Valve Connector Terminal Identification, Wiring Harness Side



Connector Part Information		• 12146800 • Conn 2-Way F M/P 150.2 (L-GY) Delphi	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PU	1228	Pressure Control (PC) Solenoid Valve High Control
B	L-BU	1229	PC Solenoid Valve Low Control

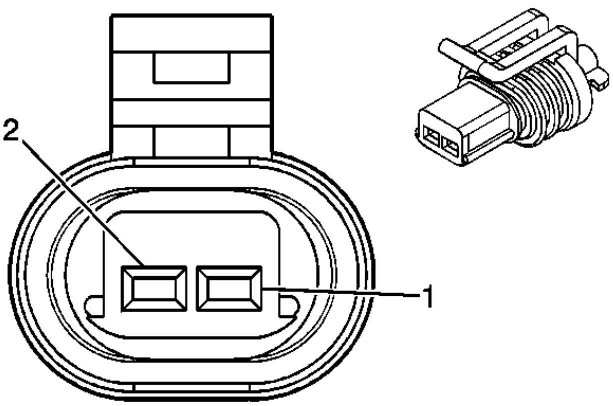
Torque Converter Clutch (TCC) Solenoid Valve Connector Terminal Identification, Wiring Harness Side



Connector Part Information		• 10478128 • CBL Solenoid Valve	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	RD	839D	Ignition 1 Voltage
B	BK	422	Torque Converter Clutch Solenoid Valve Control

AUTOMATIC TRANSMISSION RELATED CONNECTOR END VIEWS

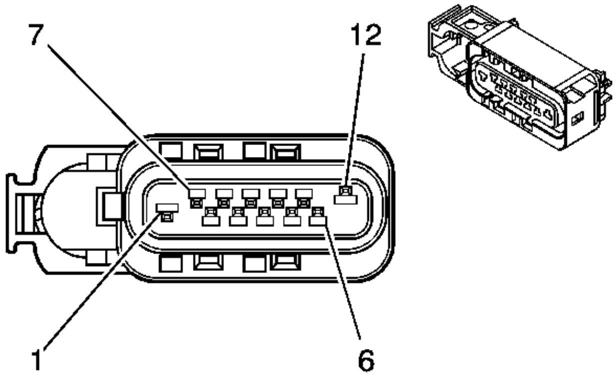
Vehicle Speed Sensor Assembly Connector Terminal Identification, Wiring Harness Side



Connector Part Information		• 12162194 • Asm Conn 2F M/P 150.2 P2S (BLK)	
Pin	**Wire Color**	**Circuit No.**	**Function**

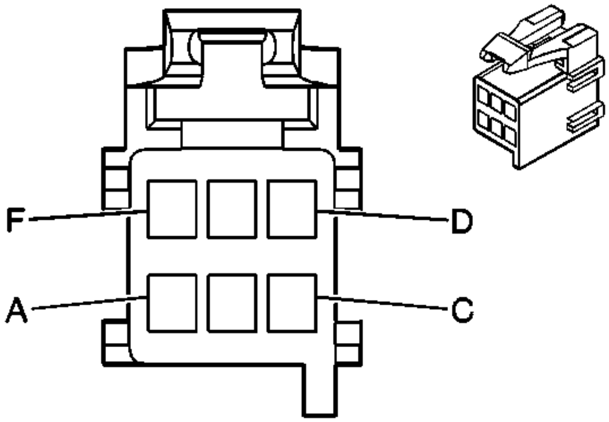
1	PU/WH	821	VSS High Signal
2	L GN /BK	822	VSS Low Signal

Transmission Range Terminal Identification Switch Connector, Wiring Harness Side



Connector Part Information		• 15416722 BK • ASM Conn 12 F GT	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	D-GN	1433	Clutch Start Switch Signal
2	-	-	Not Used
3	Plug GN	15305171	Not Used
4	YE	772	Transmission Range Switch Signal B
5	BK	771	Transmission Range Switch Signal A
6	GY	773	Transmission Range Switch Signal C
7	BK	451	Ground
8	WH	776	Transmission Range Switch Signal P
9	L-GN	275	P/N Position Switch Signal
10	GY	1524	Back-up Lamp Supply Voltage
11	PK	839	IGN 1 Voltage
12	PK	639	IGN 1 Voltage

Tow/Haul Terminal Identification Switch Connector, Wiring Harness Side



Connector Part Information		• 12177196 • 6-way Conn 6 F M/P 150 (BN)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	L-BU	553	Tow/Haul Switch Signal
B	BK	1050	Ground
C-D	-	-	Not Used
E	BN/WH	230	Switch Illumination Supply Voltage
F	-	-	Not Used

REPAIR INSTRUCTIONS

FLOOR SHIFT CONTROL KNOB REPLACEMENT

Removal Procedure

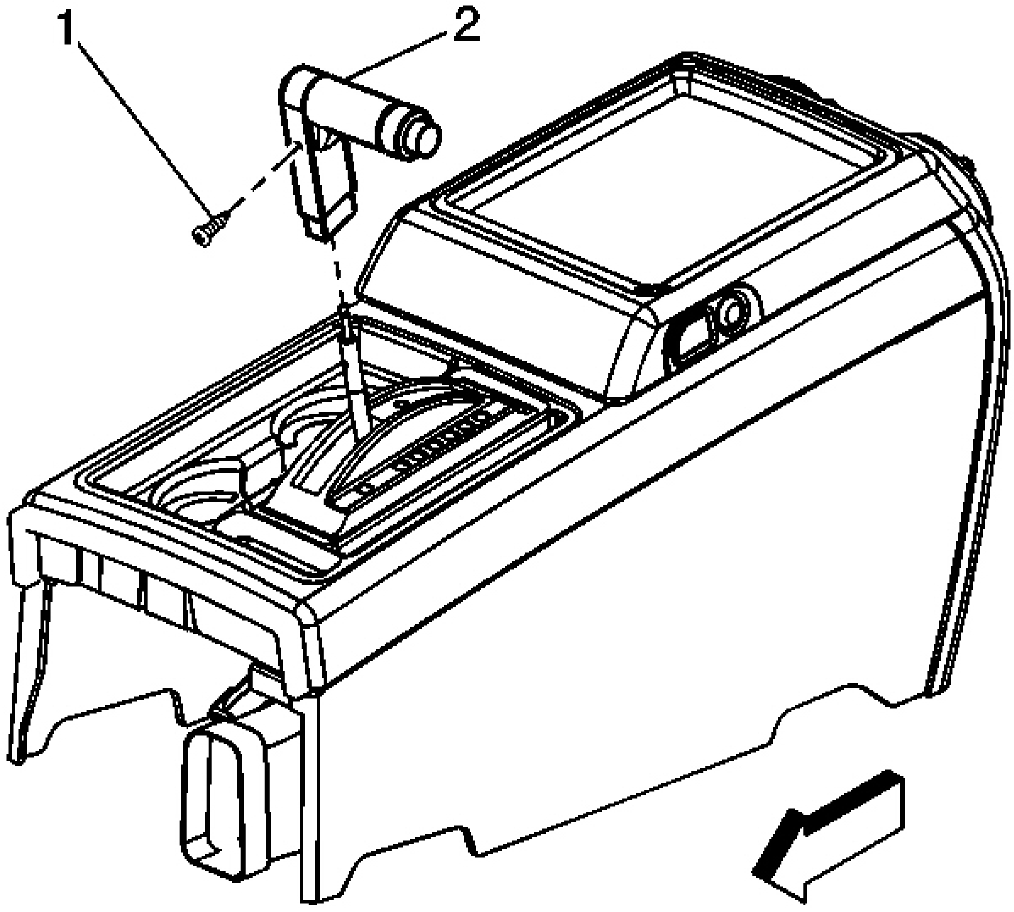


Fig. 23: Floor Shift Control Knob
Courtesy of GENERAL MOTORS CORP.

1. Loosen the set screw (1).
2. Pull up to remove the shift control knob (2) from the transmission control assembly.

Installation Procedure

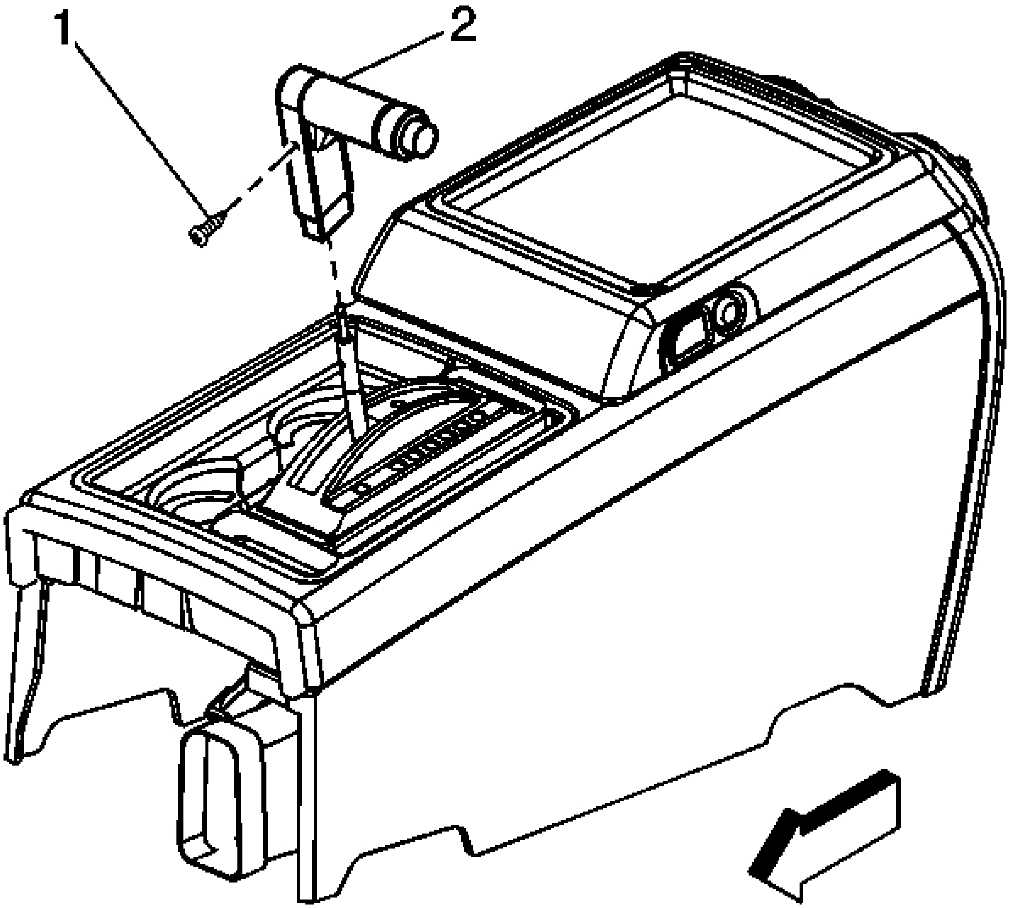


Fig. 24: Floor Shift Control Knob
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the shift control knob (2) to the transmission shift control assembly.
2. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the shift knob set screw.

   Tighten: Tighten the shift control knob set screw (1) to 2 N.m (18 lb in).

AUTOMATIC TRANSMISSION RANGE SELECTOR CABLE REPLACEMENT

Removal Procedure

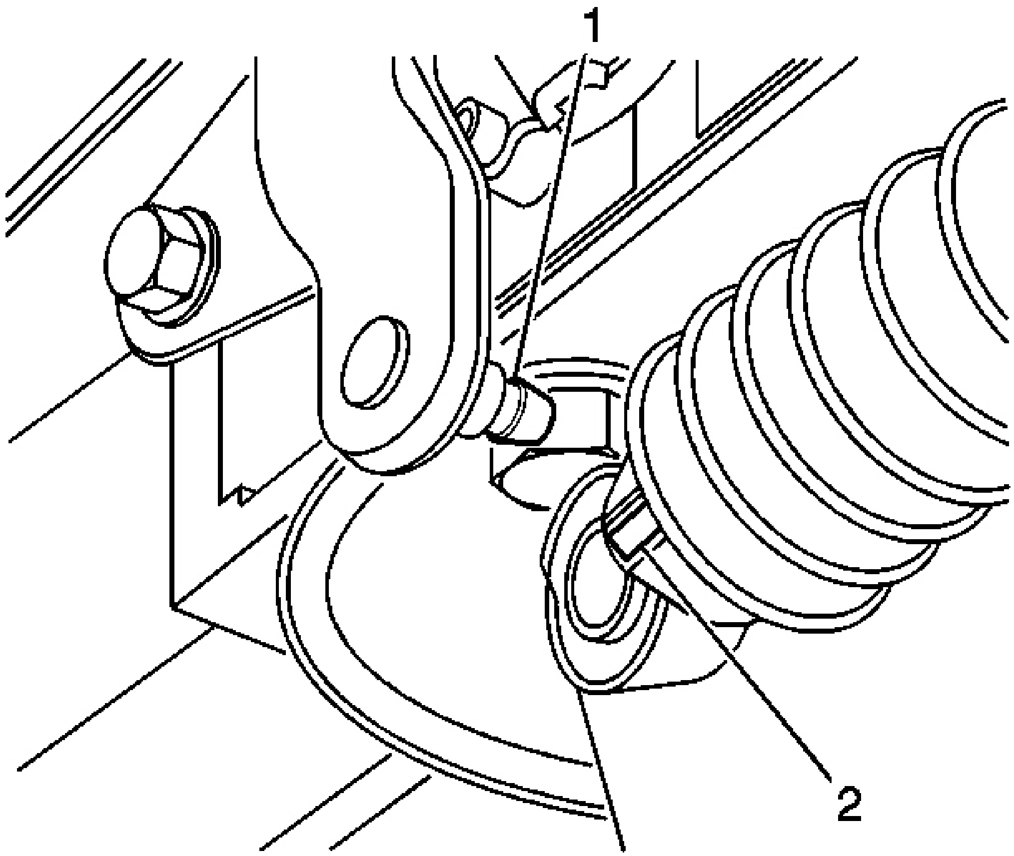


Fig. 25: Aligning & Installing Cable To Bracket
Courtesy of GENERAL MOTORS CORP.

1. Position the shift lever to the park position.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Ensure the transmission manual shaft is positioned to mechanical park.
4. Remove the range selector retaining clip and then the cable from the bracket at the transmission.
5. Remove the range selector cable end (2) from the transmission range selector lever ball stud (1).
6. Lower the vehicle and ensure that the shift lever is still in the park position.
7. Remove the console. Refer to **Console Replacement** in Instrument Panel, Gauges and Console.

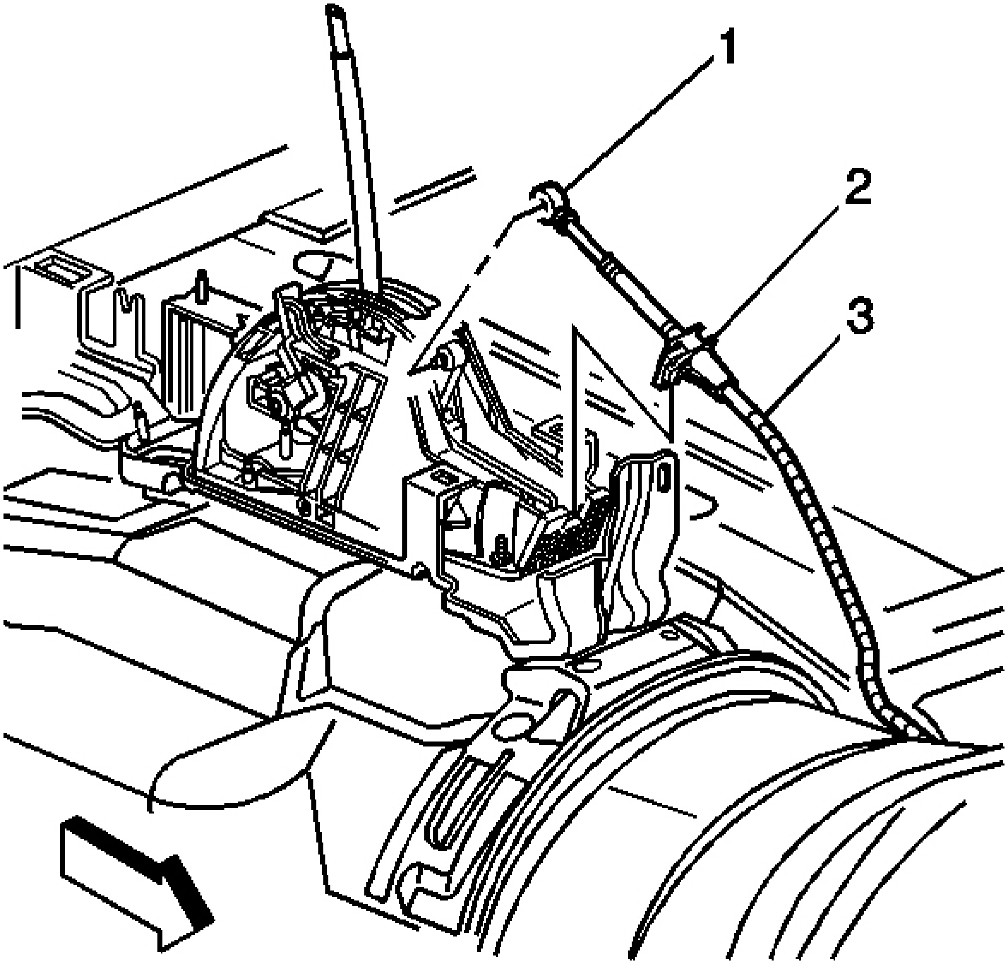


Fig. 26: Shift Control Cable & Shifter
Courtesy of GENERAL MOTORS CORP.

8. Remove the cable end (1) from the floor shift control assembly ball stud.
9. Remove the range selector cable (2) from the floor shift control assembly.
10. Remove the grommet on the shift cable from the floor panel.
11. Remove the range selector cable from the vehicle.

Installation Procedure

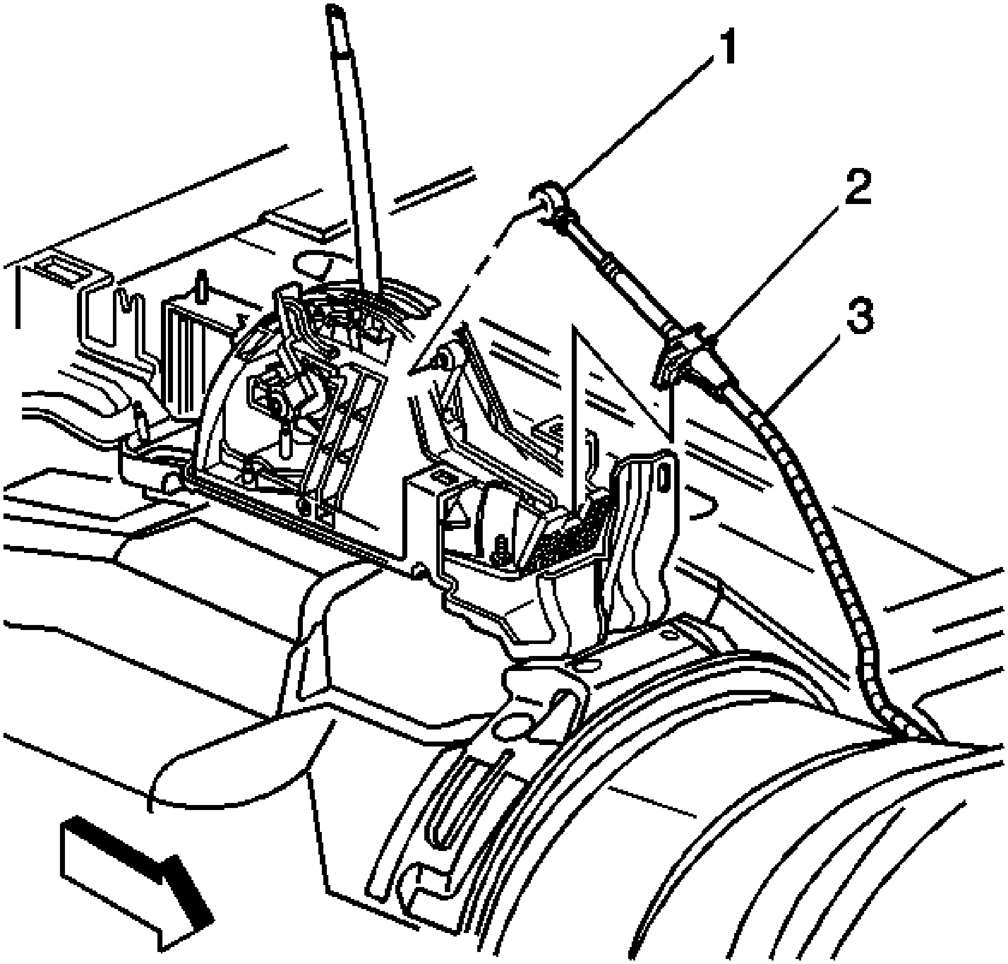


Fig. 27: Shift Control Cable & Shifter
Courtesy of GENERAL MOTORS CORP.

1. Route the cable through the hole in the floor panel.
2. Ensure that the steering column shift lever is in the park position.
3. Install the cable grommet to the floor panel.
4. Install the cable end (1) to the floor shift control assembly ball stud.
5. Install the console. Refer to **Console Replacement** in Instrument Panel, Gauges and Console.
6. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

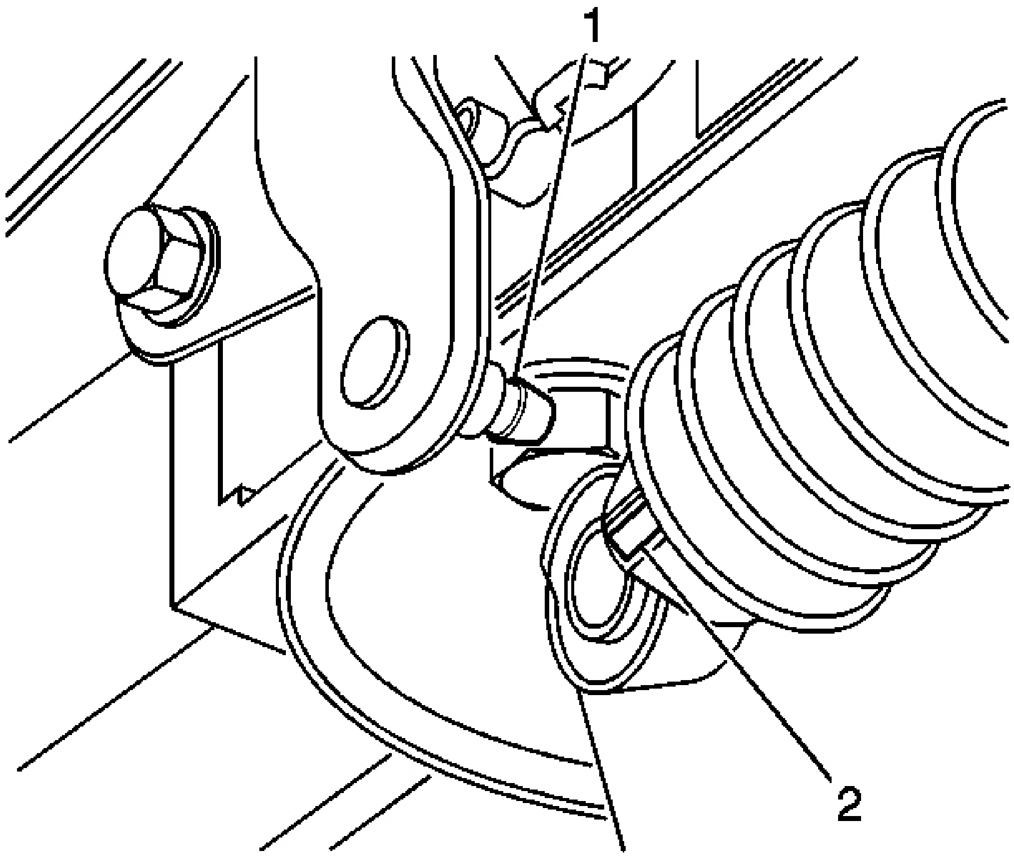


Fig. 28: Aligning & Installing Cable To Bracket
Courtesy of GENERAL MOTORS CORP.

7. Ensure that the transmission manual shaft lever is in the mechanical park position.
8. Install the range selector cable into the bracket at the transmission.
9. Install the cable retaining clip.
10. Install the range selector cable end (2) to the transmission range selector lever ball stud (1).
11. Lower the vehicle.

AUTOMATIC TRANSMISSION RANGE SELECTOR CABLE BRACKET REPLACEMENT

Removal Procedure

1. Apply the parking brake.
2. Shift the transmission into neutral.

3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

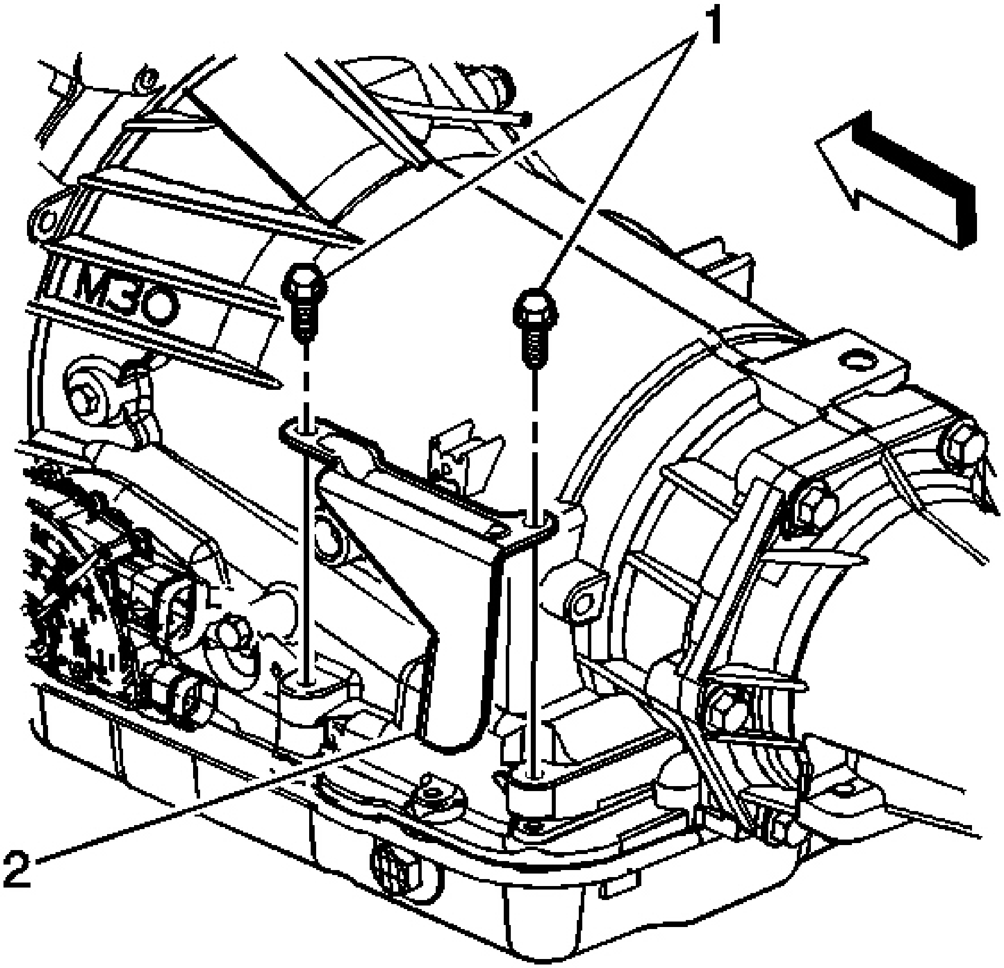


Fig. 29: Positioning Selector Cable Bracket & Cable
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the transmission range selector cable from the shift lever and the bracket (2). Refer to **Automatic Transmission Range Selector Cable Replacement** .
5. Remove the bolts (1) securing the transmission range selector cable bracket (2) to the transmission.
6. Remove the transmission range selector cable bracket from the vehicle.

Installation Procedure

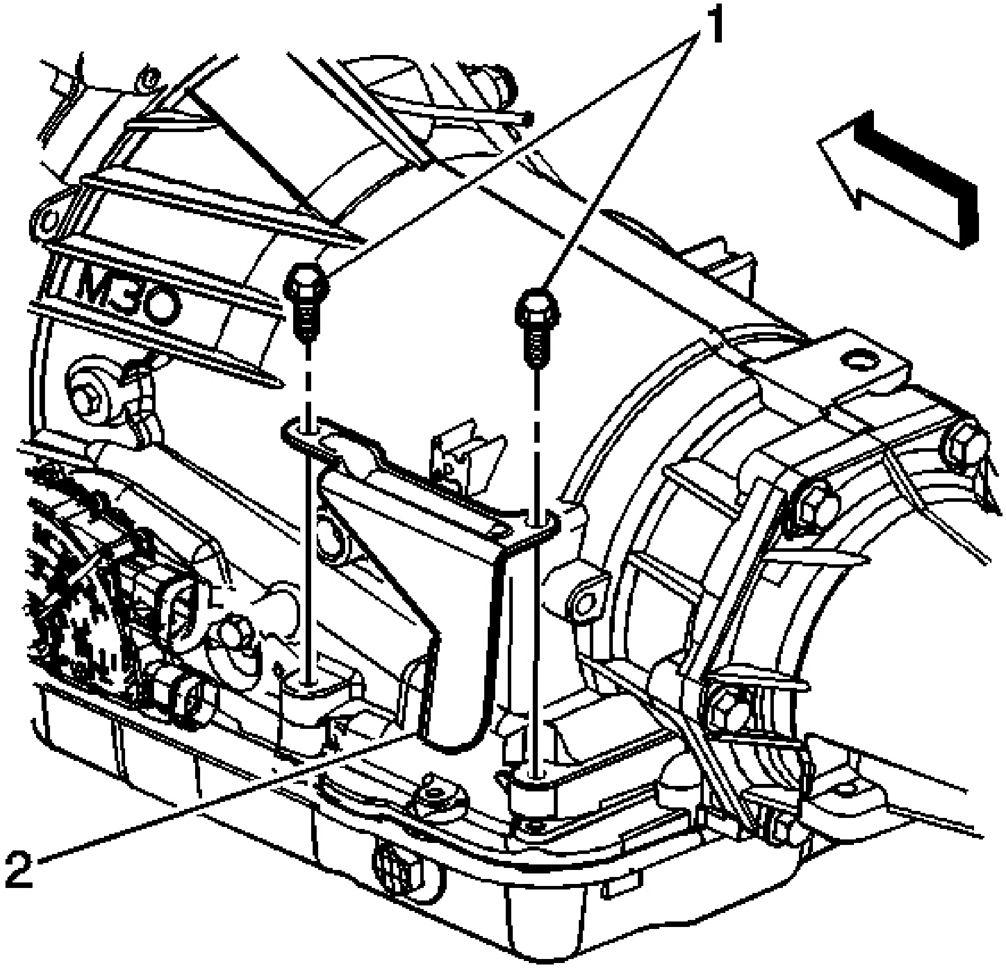


Fig. 30: Positioning Selector Cable Bracket & Cable
Courtesy of GENERAL MOTORS CORP.

1. Install the transmission range selector cable bracket to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the transmission range selector cable bracket bolts (1).

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

3. Install the transmission range selector cable to the bracket (2) and the lever. Refer to **Automatic**

Transmission Range Selector Cable Replacement .

4. Lower the vehicle.
5. Check the vehicle for proper operation. If adjustment of the cable is necessary, refer to **Automatic Transmission Range Selector Cable Adjustment** .

AUTOMATIC TRANSMISSION RANGE SELECTOR CABLE ADJUSTMENT

1. Ensure that the steering column shift lever and the transmission manual shaft lever are in the park position.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

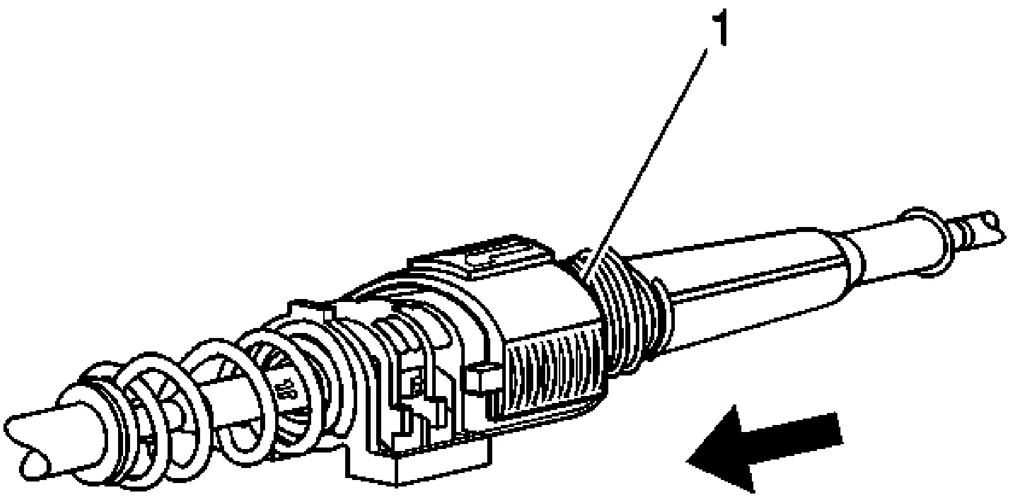


Fig. 31: Pulling White Plastic Cover On Center Connector
Courtesy of GENERAL MOTORS CORP.

3. Pull back the white plastic cover (1) on the center connector.

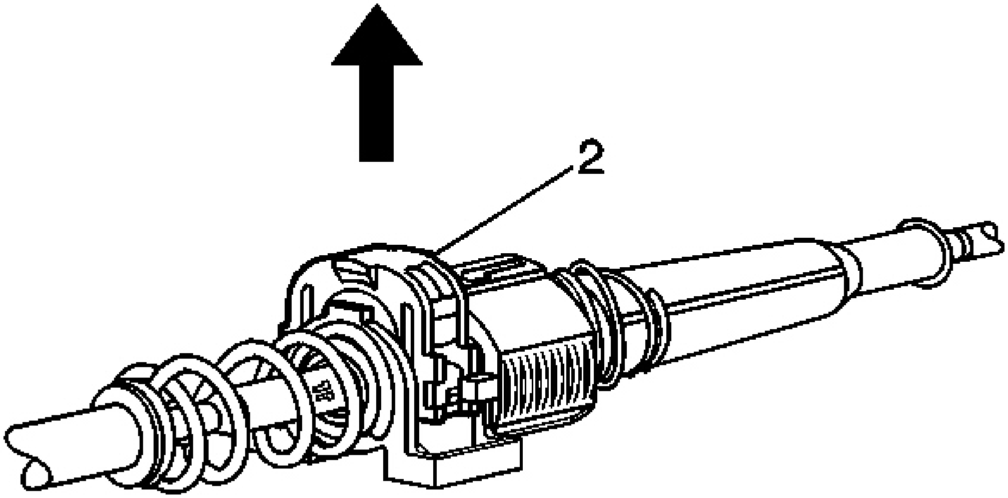


Fig. 32: Pulling Center Tabs Of Lock Button
Courtesy of GENERAL MOTORS CORP.

4. Pull up on the center tabs of the lock button (2).

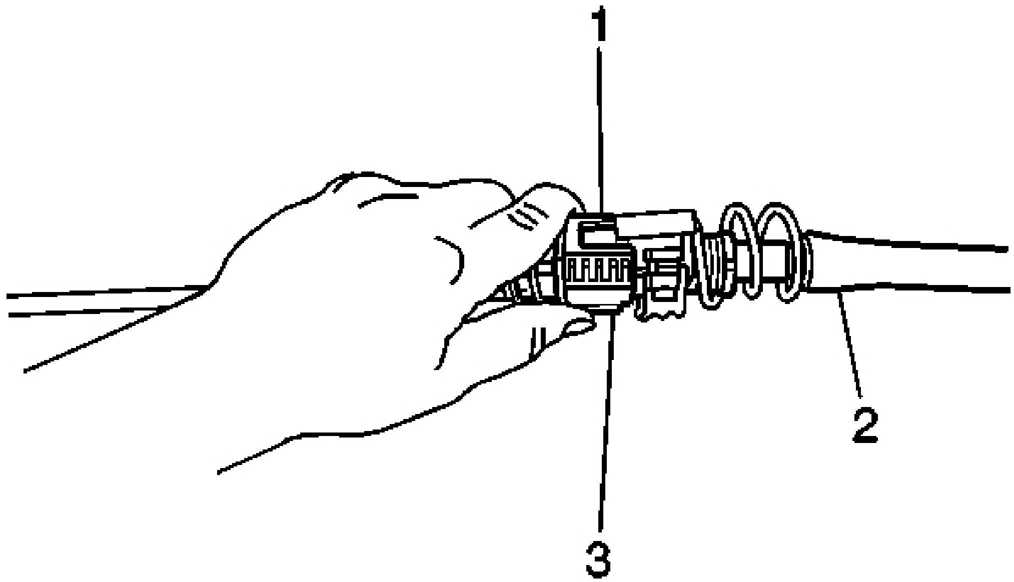


Fig. 33: Releasing Shift Cable End & Pulling White Cover On Shift Cable End
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: This step must be performed correctly to avoid a misadjusted cable. Do not grasp the shift cable end (2) during this procedure.

5. Release the shift cable end (2) and allow the blue spring to tension/adjust the shift cable system.
6. Pull the white cover (3) on the shift cable end (1) back.

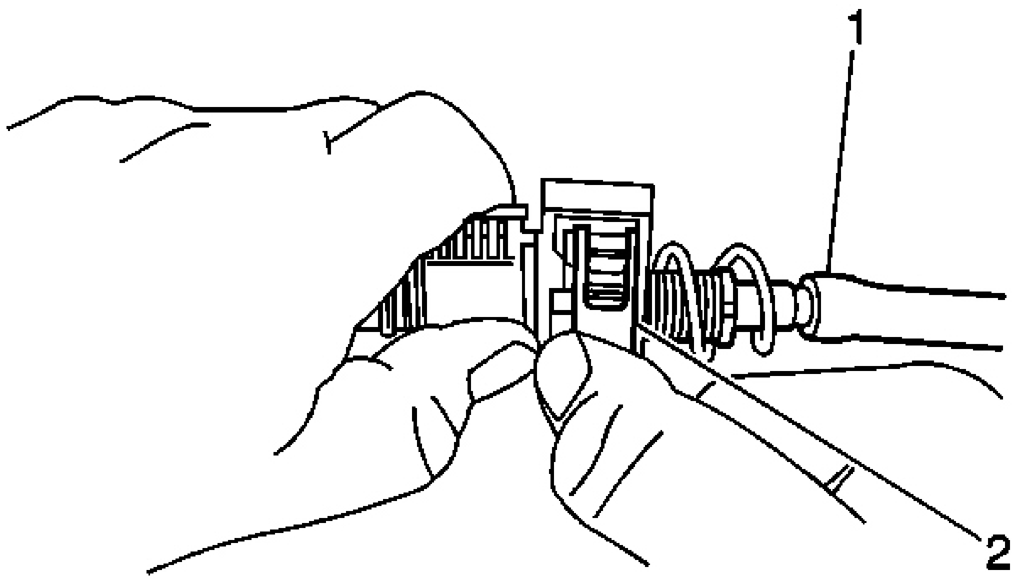


Fig. 34: Pushing Natural Colored Lock Button Down
Courtesy of GENERAL MOTORS CORP.

7. Push the natural colored lock button (2) down to engage the locking teeth on the shift cable end (1).

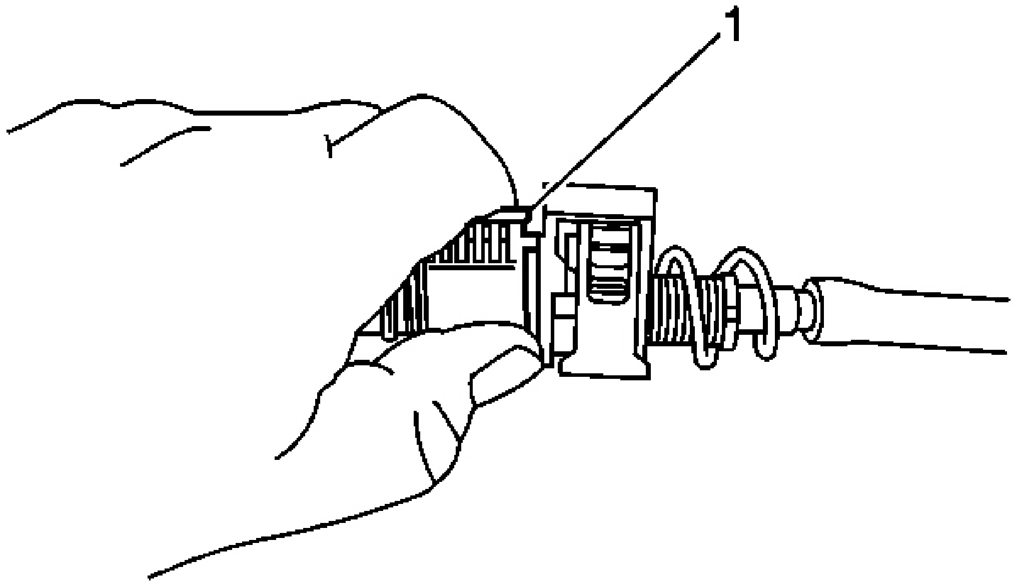


Fig. 35: Releasing White Cover
Courtesy of GENERAL MOTORS CORP.

8. Release the white cover (1).

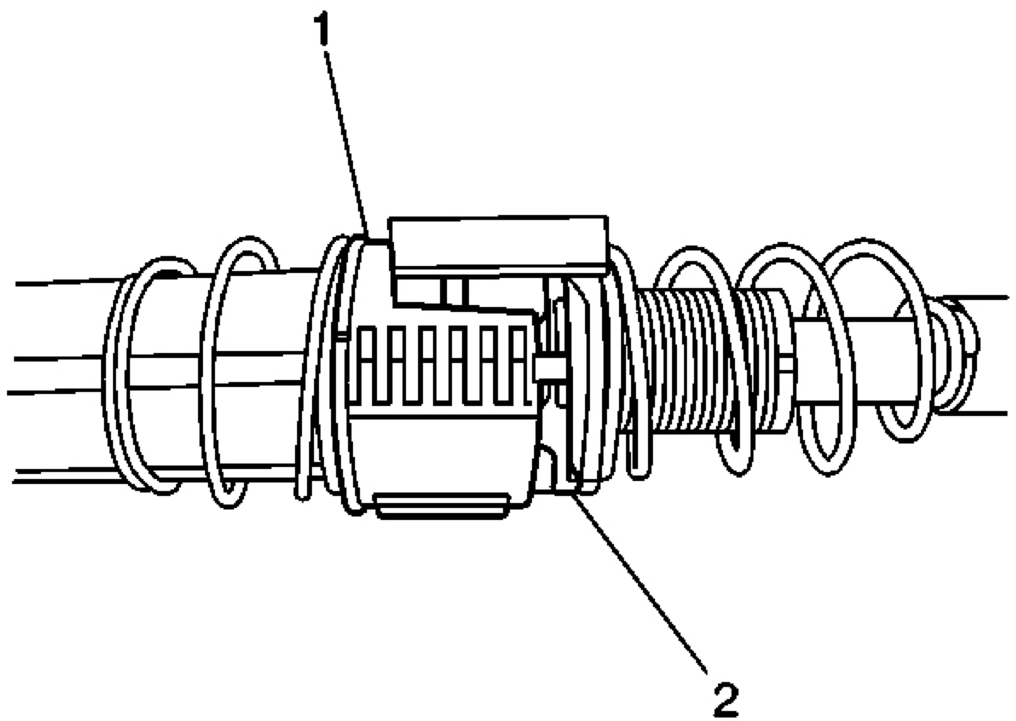


Fig. 36: Placing Steering Column Shift Lever Back Into Park (P) Position
Courtesy of GENERAL MOTORS CORP.

9. Verify the white cover (1) conceals the natural colored lock (2).
10. If the white cover (1) does not conceal the natural colored lock (2), the shift cable must be readjusted.
11. Test the transmission for proper shift operation.
12. If all of the gear positions cannot be achieved, the shift cable must be readjusted.

FLOOR SHIFT CONTROL REPLACEMENT

Removal Procedure

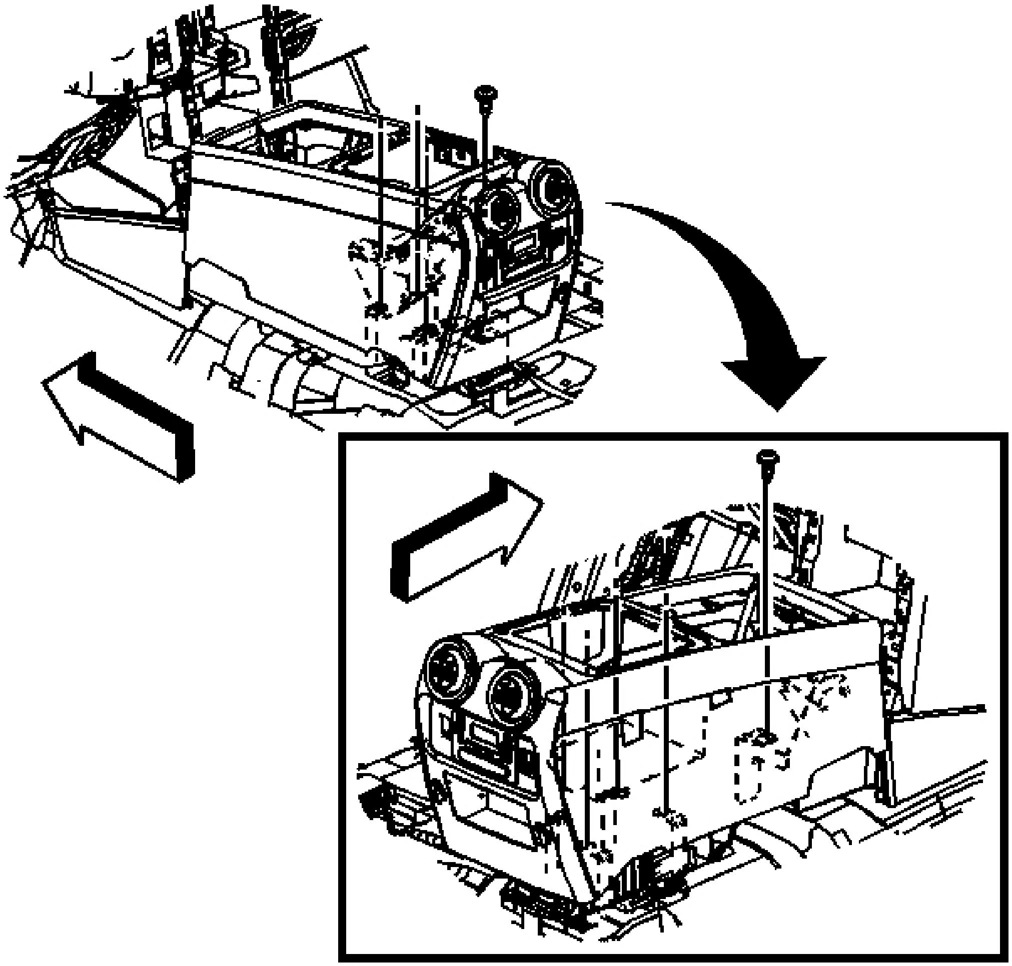


Fig. 37: Front Floor Console
Courtesy of GENERAL MOTORS CORP.

1. Remove the front floor console. Refer to **Console Replacement** in Instrument Panel, Gauges and Console.

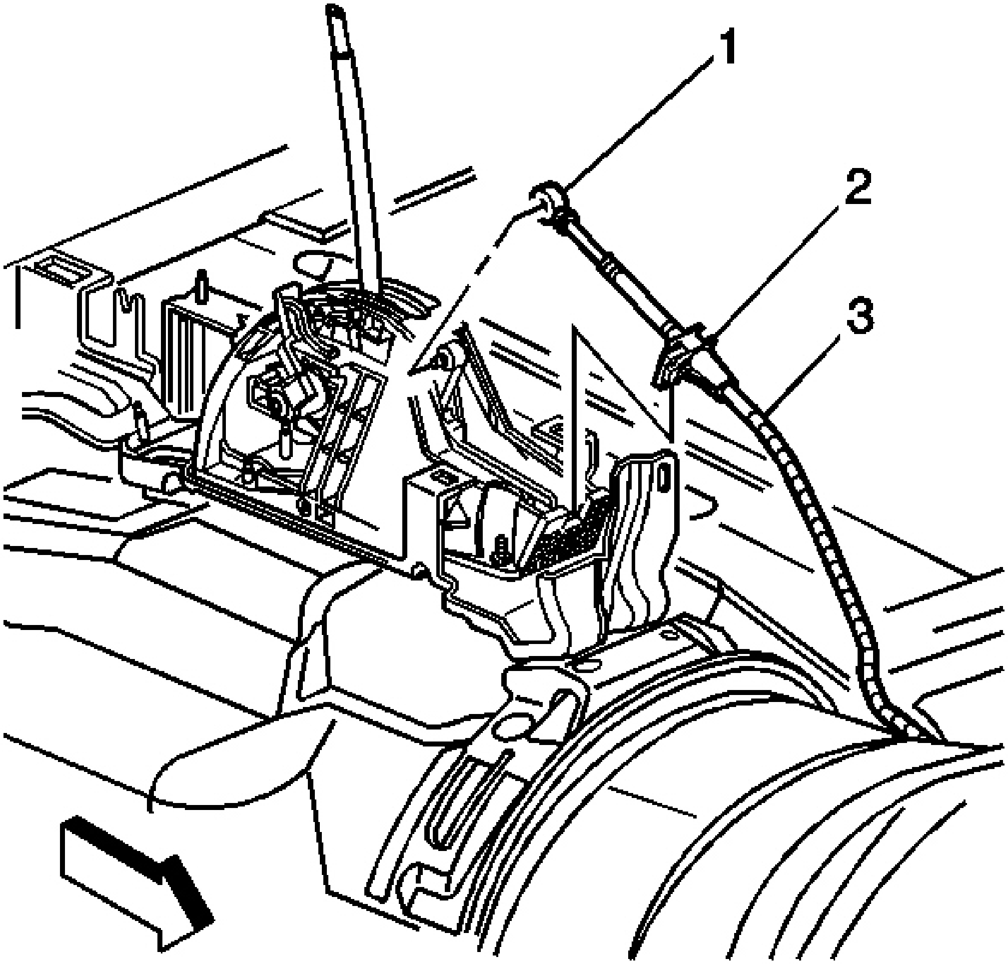


Fig. 38: Shift Control Cable & Shifter
Courtesy of GENERAL MOTORS CORP.

2. Remove the end of the range selector cable (1) from the transmission control ball stud.
3. Remove the range selector cable (2) from the floor shift control.

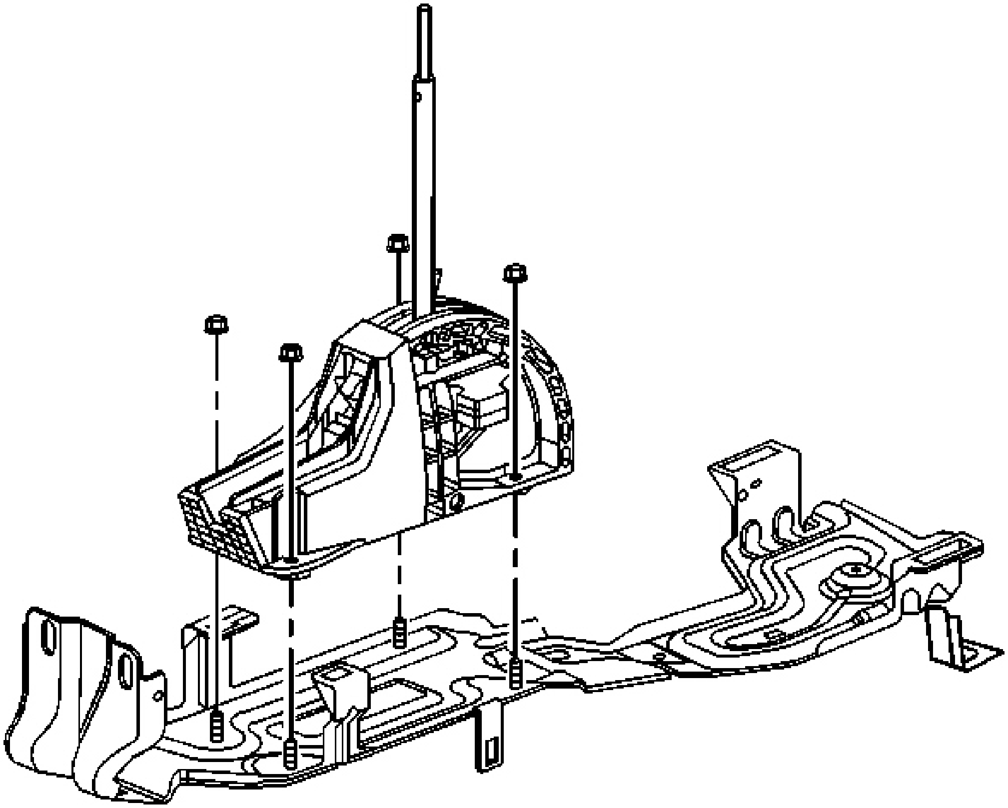


Fig. 39: Transmission Control & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the transmission control bolts.
5. Remove the transmission control.

Installation Procedure

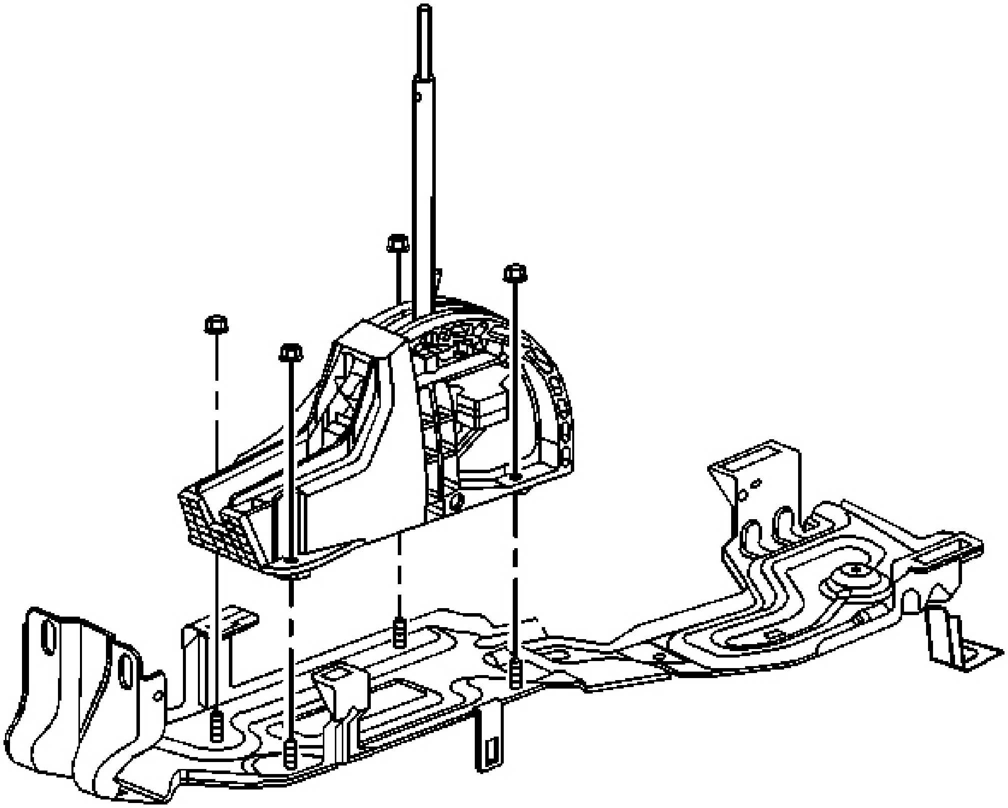


Fig. 40: Transmission Control & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the transmission control.
2. Install the transmission control bolts.

   Tighten: Tighten the transmission control bolts to 25 N.m (18 lb ft).

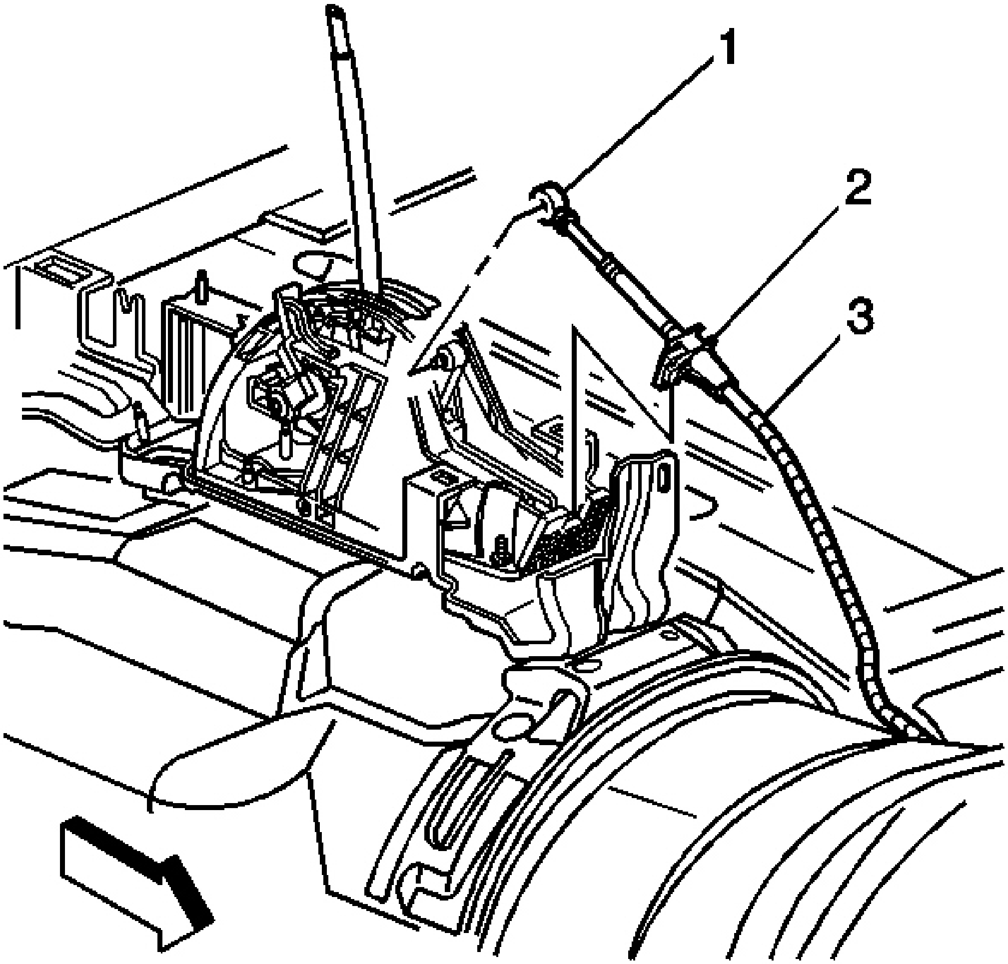


Fig. 41: Shift Control Cable & Shifter
Courtesy of GENERAL MOTORS CORP.

3. Install the range selector cable (2) to the floor shift control.
4. Install the end of the range selector cable (1) to the transmission control ball stud.

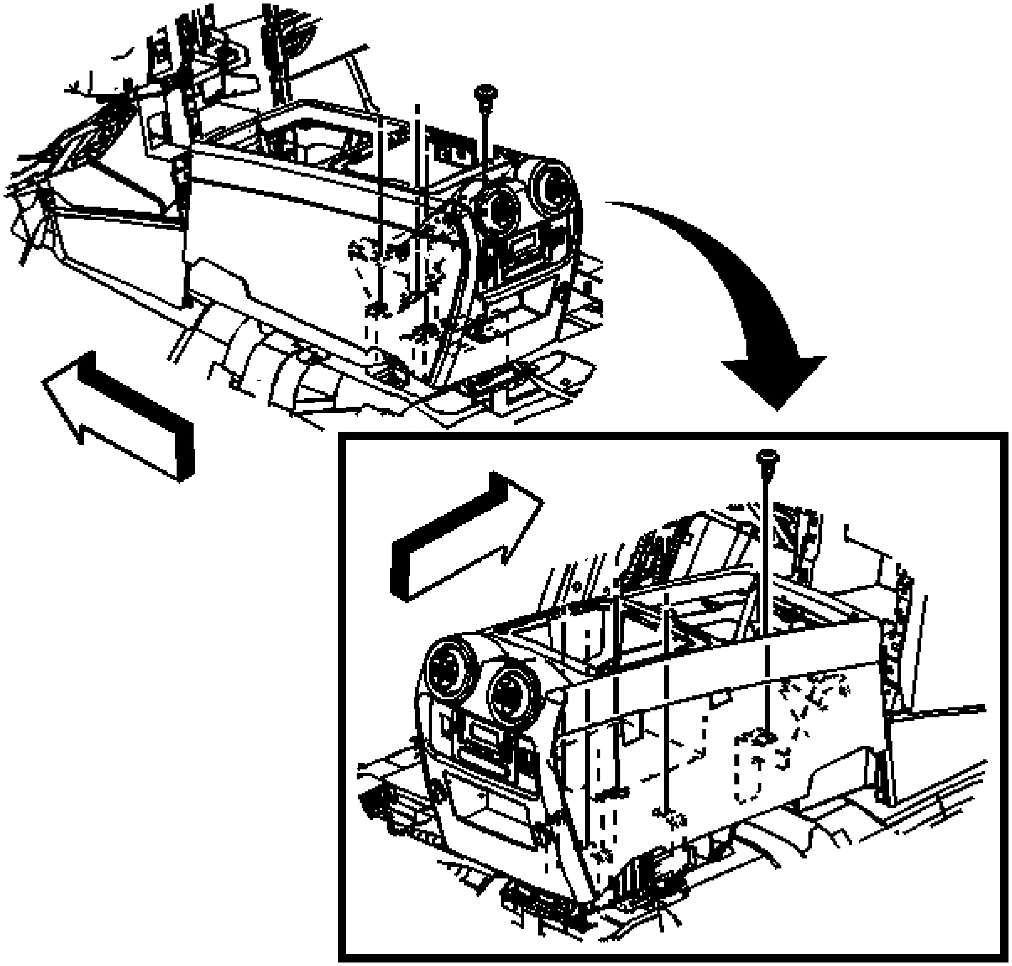


Fig. 42: Front Floor Console
Courtesy of GENERAL MOTORS CORP.

5. Install the front floor console. Refer to **Console Replacement** in Instrument Panel, Gauges and Console.
6. Check for proper operation of the floor shift control.
7. Adjust the range selector cable if necessary. Refer to **Automatic Transmission Range Selector Cable Adjustment** .

PARK/NEUTRAL POSITION SWITCH REPLACEMENT

Tools Required

J 41364-A Park/Neutral Switch Aligner

Removal Procedure

1. Apply the parking brake.
2. Shift the transmission into neutral.
3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

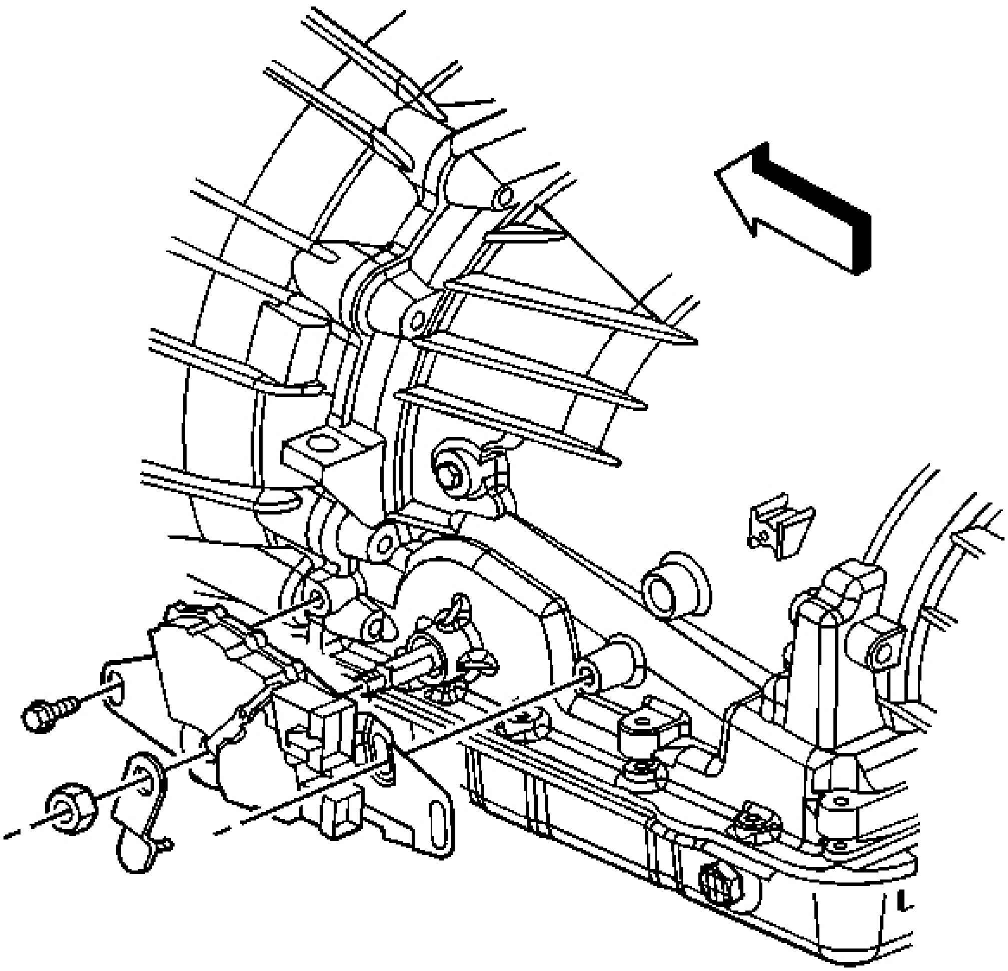


Fig. 43: PNP Switch
Courtesy of GENERAL MOTORS CORP.

4. Remove the nut securing the transmission control lever to the manual shaft.
5. Remove the transmission control lever from the manual shaft.
6. Disconnect the electrical connectors from the switch.

7. Remove the bolts securing the park/neutral position switch to the transmission.
8. Remove the park/neutral position switch from the manual shaft. If the park/neutral position switch did not slide off the manual shaft, file the outer edge of the manual shaft in order to remove any burrs.

Installation Procedure

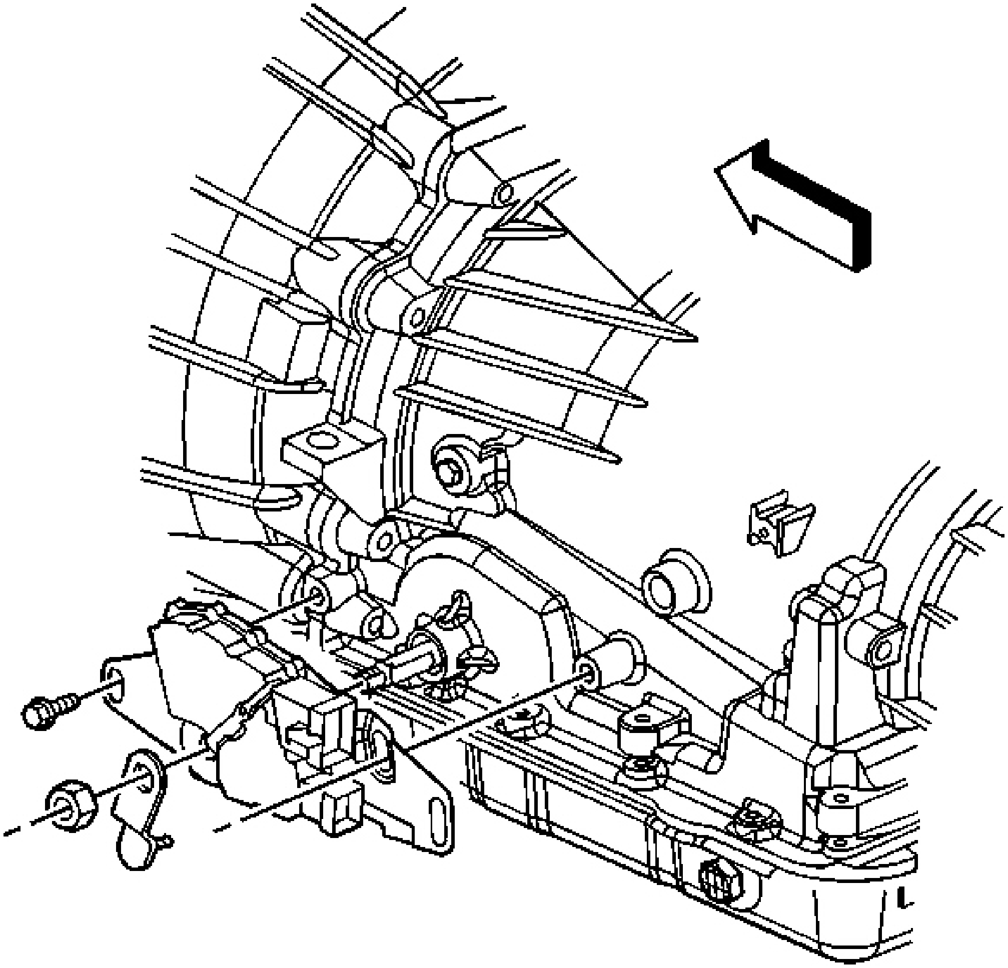


Fig. 44: PNP Switch
Courtesy of GENERAL MOTORS CORP.

1. Install the switch to the transmission manual shaft by aligning the switch hub flats with the manual shaft flats.
2. Slide the switch onto the transmission manual shaft until the switch mounting bracket contacts the

mounting bosses on the transmission.

IMPORTANT: If a new switch is being installed, the switch will come with a positive assurance bracket. The positive assurance bracket aligns the new switch in it proper position for installation and the use of neutral position adjustment tool will not be necessary.

3. Install the switch to the transmission with two bolts finger tight.

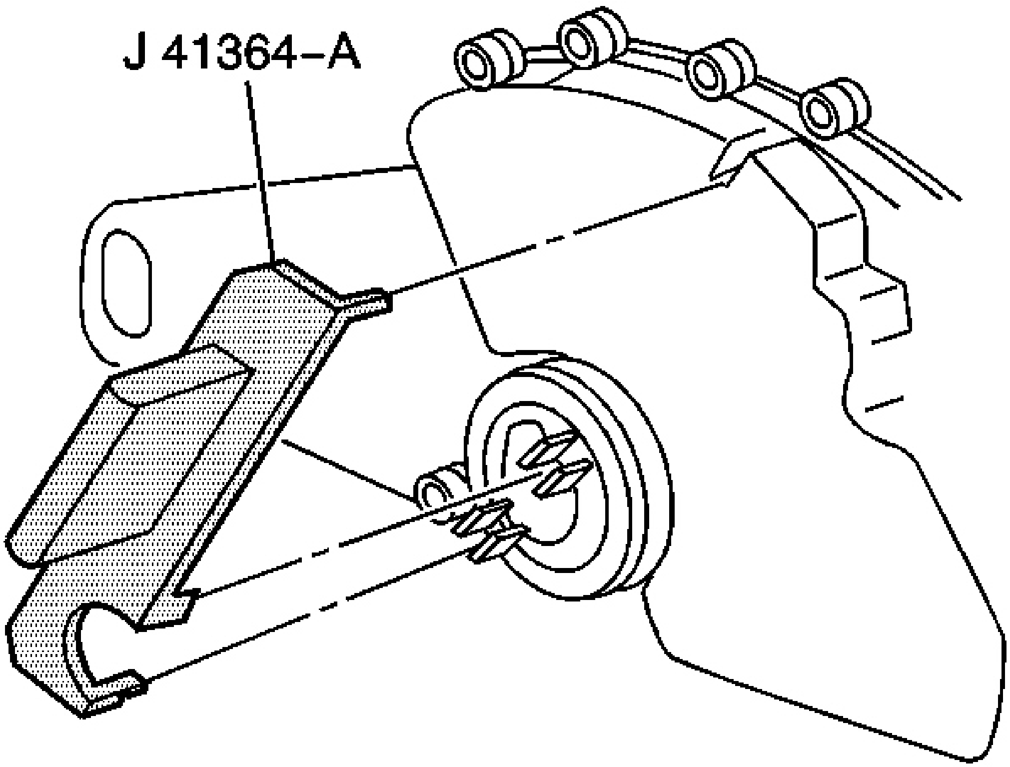


Fig. 45: Installing J 41364-A Onto The PNP Switch
Courtesy of GENERAL MOTORS CORP.

4. Position the tool J 41364-A onto the park/neutral position switch. Ensure that the two slots on the switch where the manual shaft is inserted are lined up with the lower two tabs on the tool.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Rotate the tool until the upper locator pin on the tool is lined up with the slot on the top of the switch.

Tighten: Tighten the bolts securing the switch to 25 N.m (18 lb ft).

6. Remove the J 41364-A from the switch. If installing a new switch, remove the positive assurance bracket at this time.
7. Connect the electrical connectors to the switch.

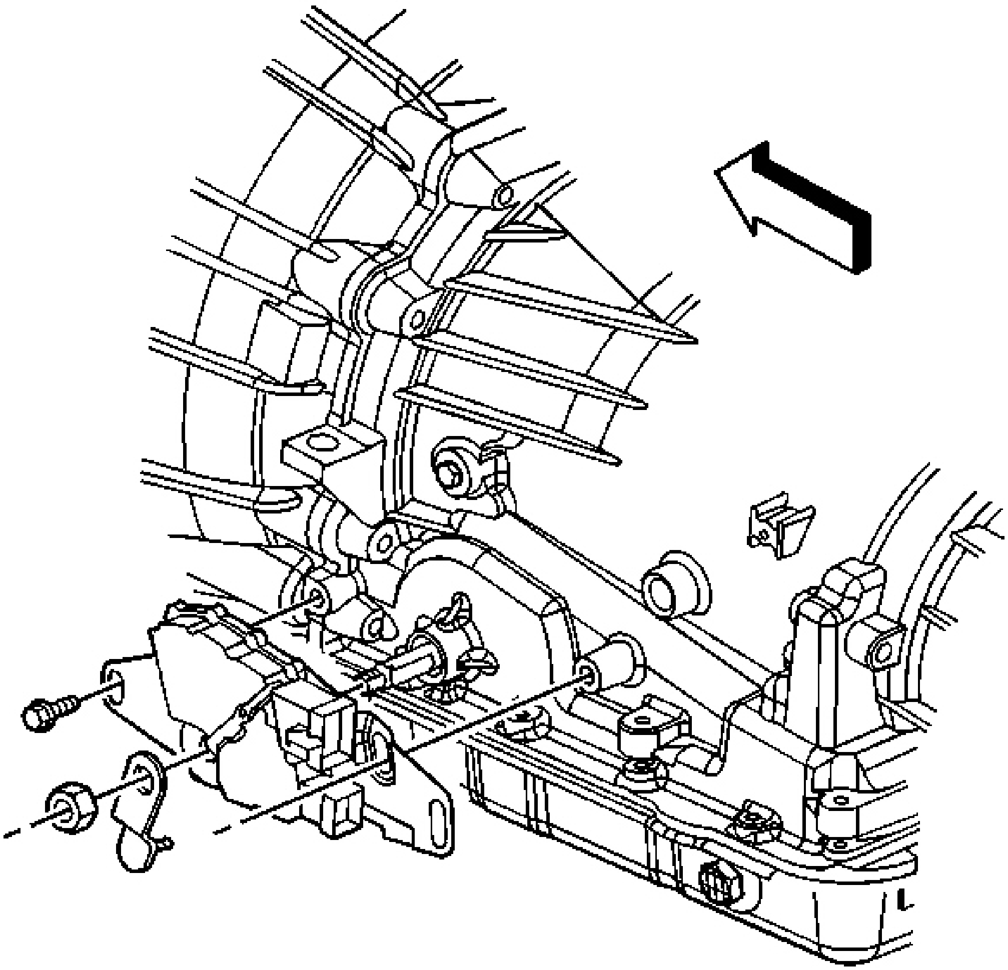


Fig. 46: PNP Switch
Courtesy of GENERAL MOTORS CORP.

8. Install the transmission control lever to the manual shaft with the nut.

Tighten: Tighten the control lever nut to 25 N.m (18 lb ft).

9. Lower the vehicle.
10. Check the switch for proper operation. The engine must start in the P (Park) or N (Neutral) positions only. If proper operation of the switch can not be obtained, replace the switch.

PARK/NEUTRAL POSITION SWITCH ADJUSTMENT

IMPORTANT:

- **The following procedure is for vehicles that have not had the switch removed or replaced. If the switch has been removed or replaced, refer to Park/Neutral Position Switch Replacement for the proper adjustment procedure.**
- **Apply the parking brake.**
- **The engine must start in the P (Park) or N (Neutral) positions only.**
- **Check the switch for proper operation. If adjustment is required, proceed as follows:**

1. Place the transmission range selector in the N (Neutral) position.
2. With an assistant in the drivers seat, raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Loosen the park/neutral position switch mounting bolts.
4. With the vehicle in the N (Neutral) position, rotate the switch while the assistant attempts to start the engine.
5. Following a successful start, turn the engine off.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Tighten the bolts securing the switch to the transmission.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

7. Lower the vehicle.
8. Check the switch for proper operation. The engine must start in the P (Park) or N (Neutral) positions only.
9. Replace the park/neutral position switch if proper operation can not be achieved. Refer to **Park/Neutral Position Switch Replacement** .

TOW/HAUL SWITCH REPLACEMENT

Removal Procedure

1. Remove the instrument panel trim plate bezel. Refer to **Trim Panel Replacement - Instrument Panel (I/P) Center** in Instrument Panel, Gauges, and Console.

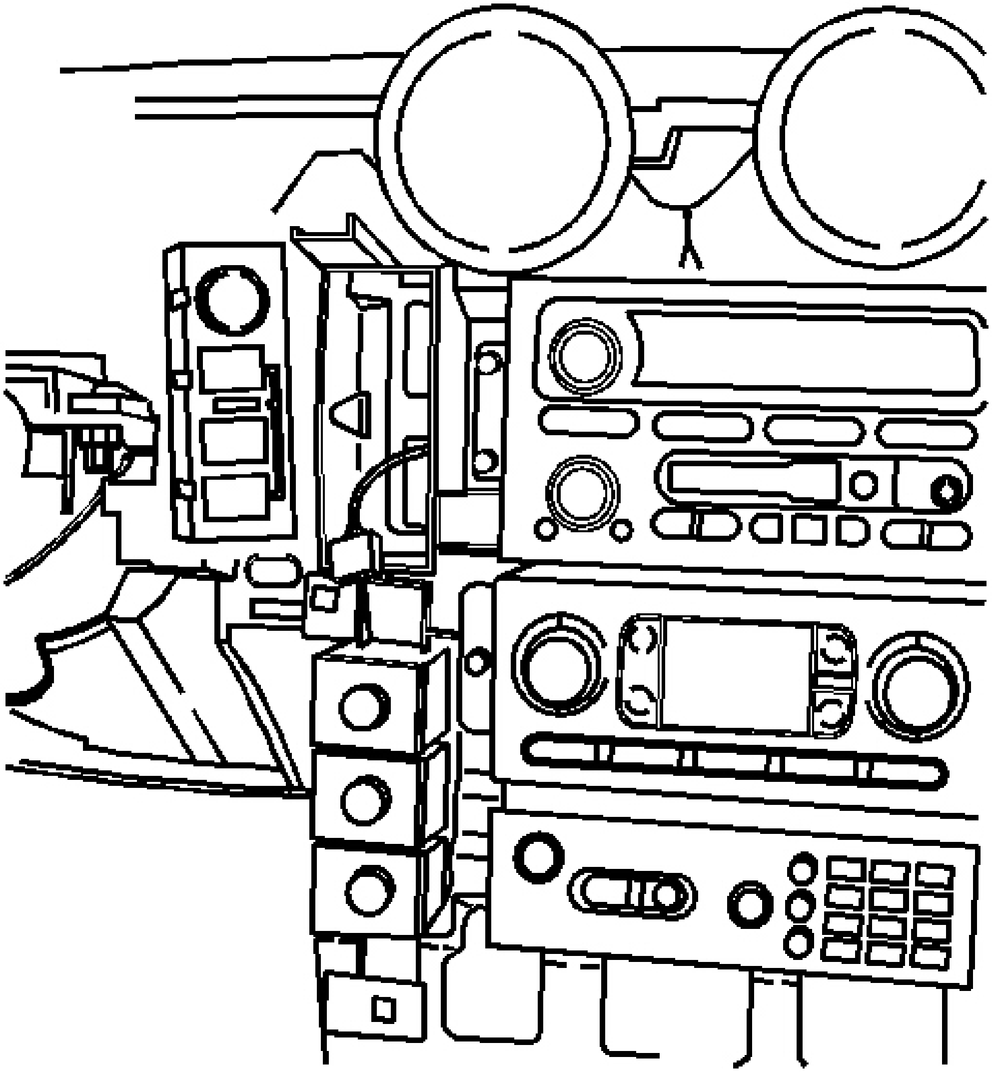


Fig. 47: Switch Recepticle Screws
Courtesy of GENERAL MOTORS CORP.

2. Remove the switch recepticle screws.

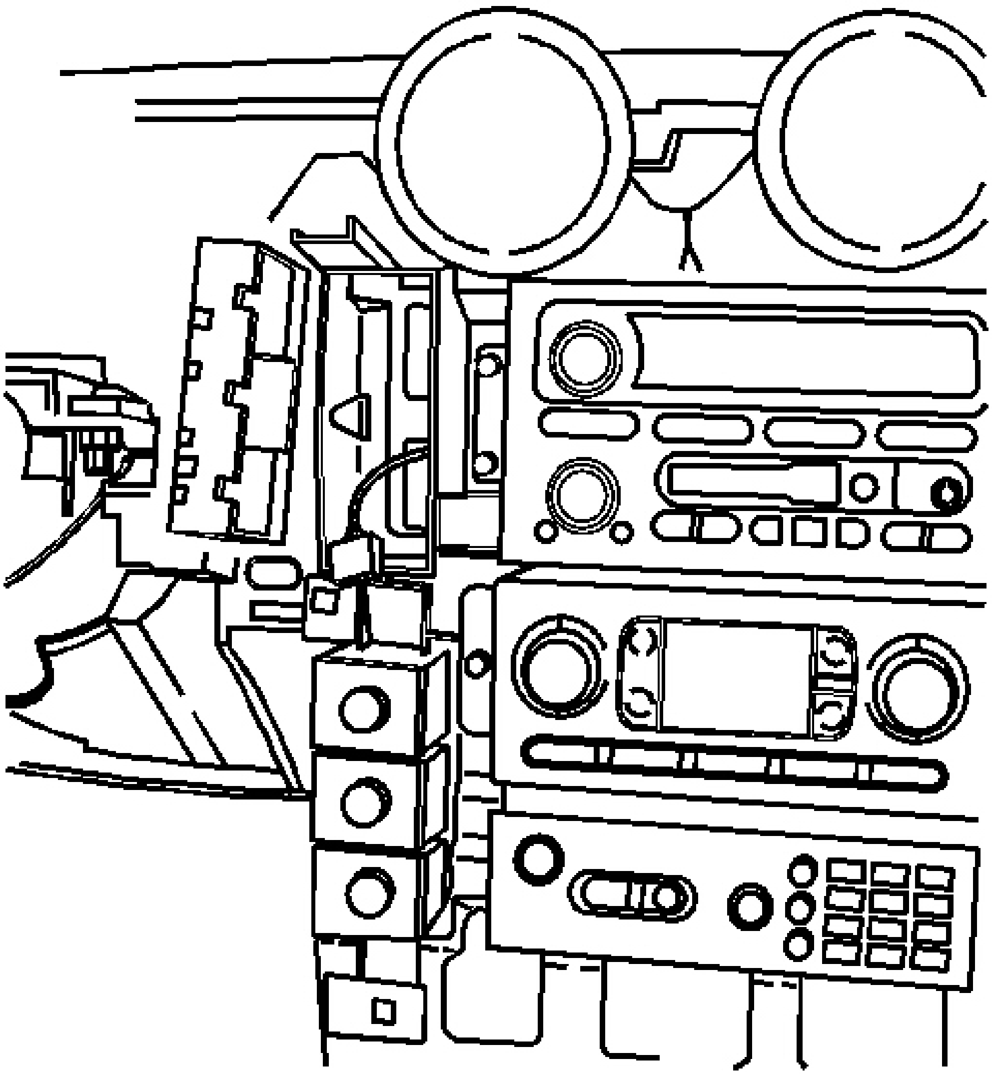


Fig. 48: Switch Recepticle & Instrument Panel
Courtesy of GENERAL MOTORS CORP.

3. Pull the switch recepticle from the instrument panel and disconnect the electrical connectors from the switch.

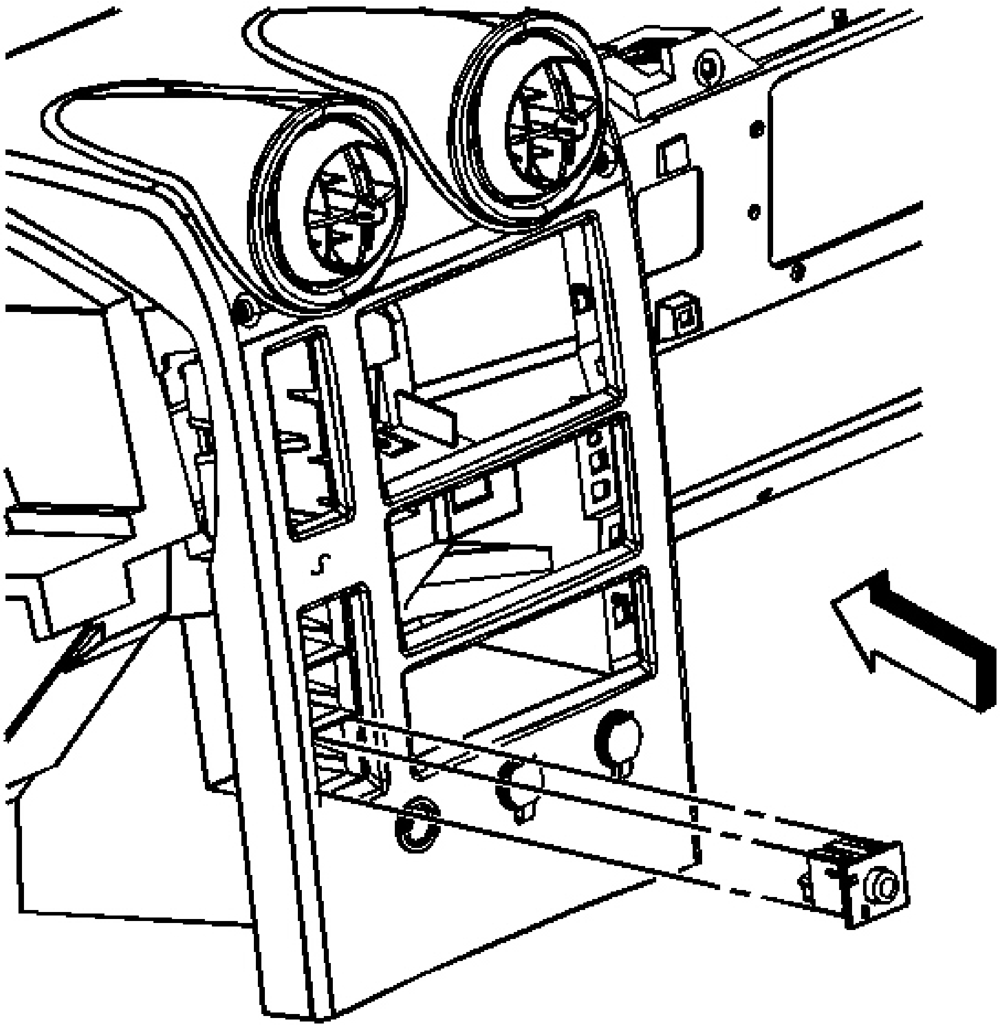


Fig. 49: Tow/Haul Switch
Courtesy of GENERAL MOTORS CORP.

4. Remove the switch from the recepticle.

Installation Procedure

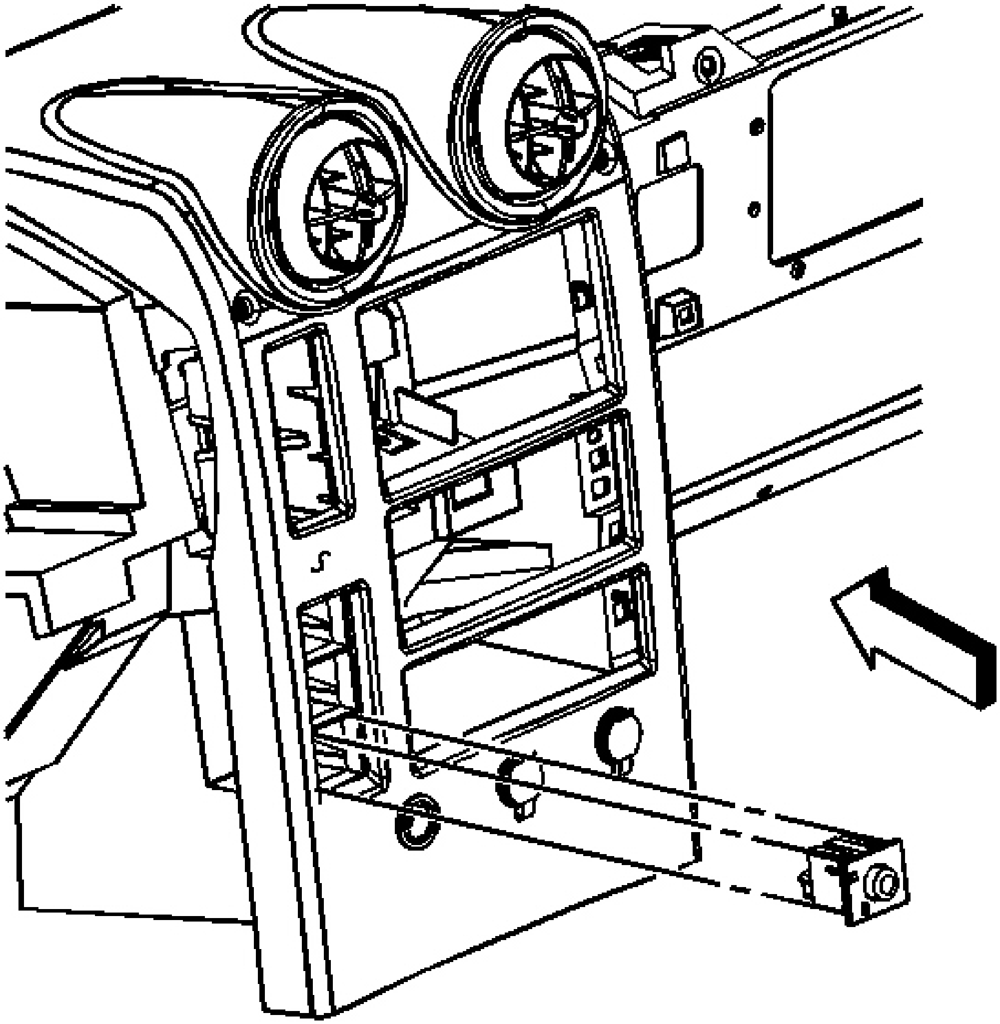
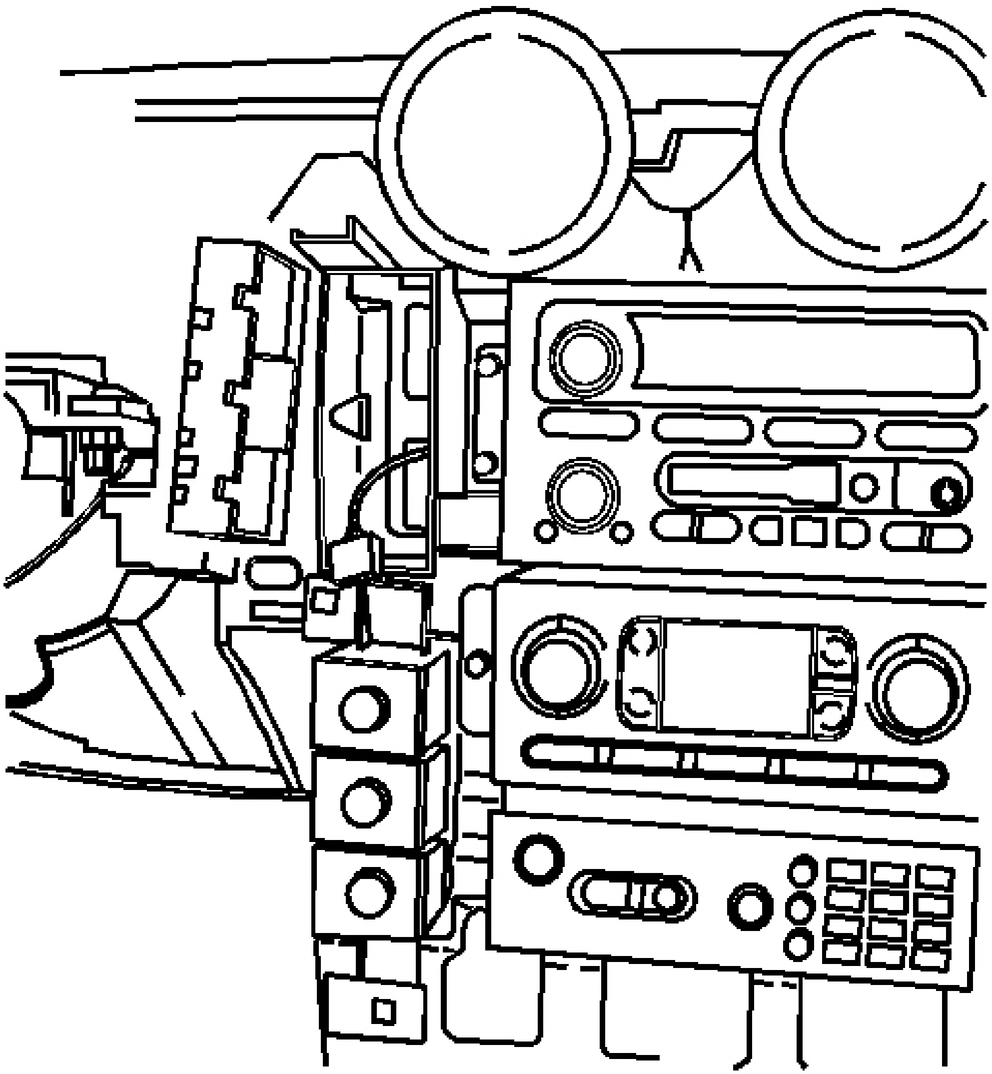


Fig. 50: Tow/Haul Switch
Courtesy of GENERAL MOTORS CORP.

1. Install the switch to the recepticle.



<u>**Fig. 51: Switch Recepticle & Instrument Panel**</u>
Courtesy of GENERAL MOTORS CORP.

2. Connect the electrical connector to the switch. Install the switch recepticle to the instrument panel.

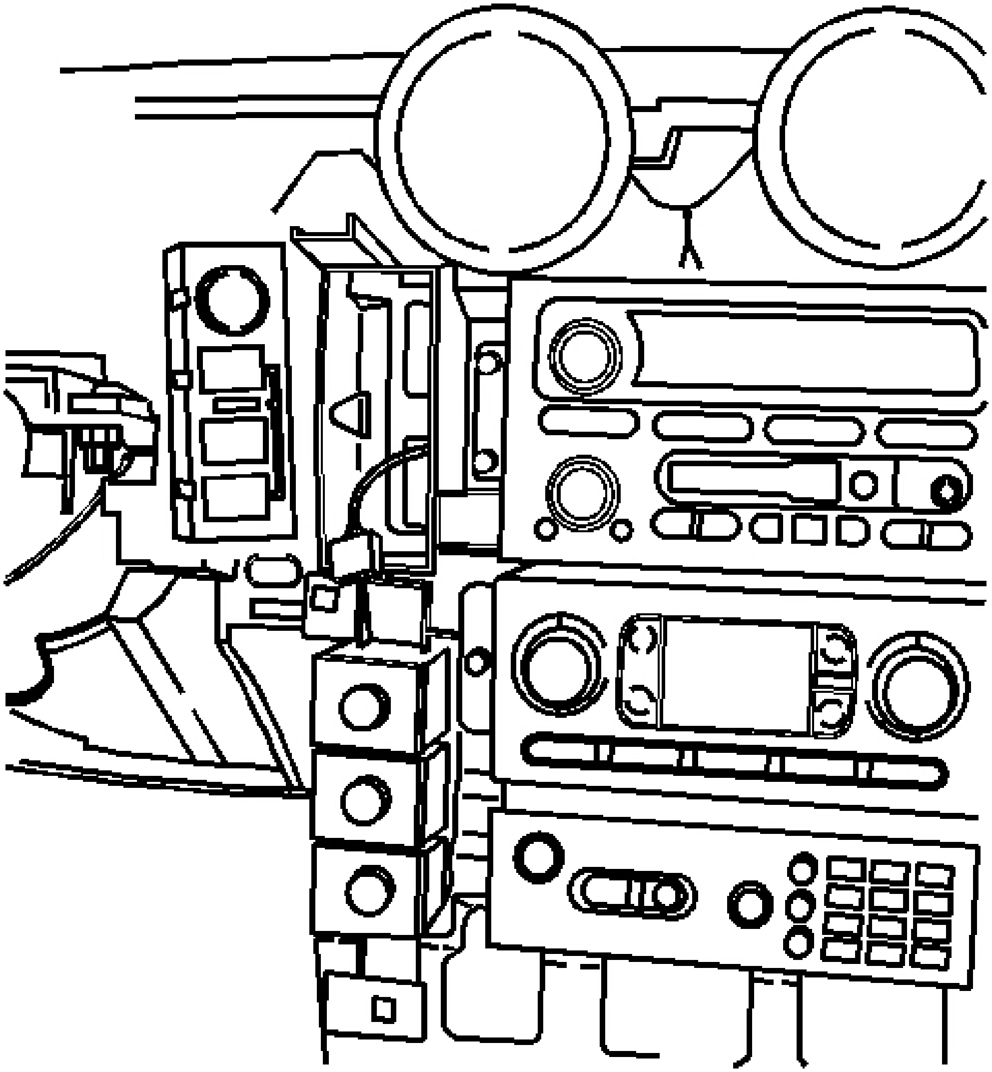


Fig. 52: Switch Recepticle Screws
Courtesy of GENERAL MOTORS CORP.

NOTE: Fastener Notice in Cautions and Notices

3. Install the switch recepticle screws.

Tighten: Tighten the screws to 12 N.m (106 lb in).

4. Install the instrument panel trim plate bezel. Refer to **Trim Panel Replacement - Instrument Panel (I/P) Center** in Instrument Panel, Gauges, and Console.

AUTOMATIC TRANSMISSION FLUID/FILTER REPLACEMENT

Removal Procedure

CAUTION: When the transmission is at operating temperatures, take necessary precautions when removing the drain plug, to avoid being burned by draining fluid.

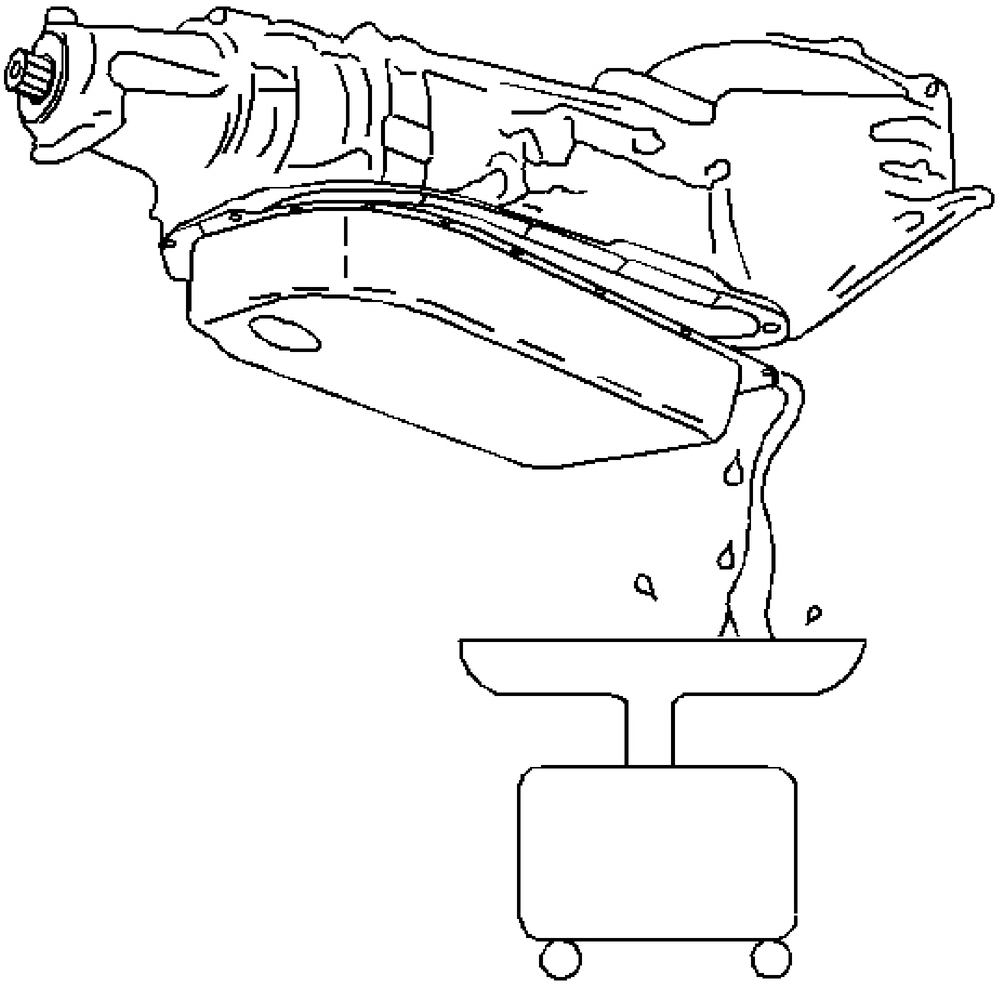


Fig. 53: Draining Transmission
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Place a drain pan under the transmission oil pan.
3. Remove the oil pan drain plug, if equipped.
4. If necessary, remove the bolts and position aside the range selector cable bracket for clearance while lowering the pan. It is not necessary to remove the cable from the lever or bracket.
5. Remove the oil pan bolts from the front and sides of the pan only.
6. Loosen the rear oil pan bolts approximately 4 turns.
7. Lightly tap the oil pan with a rubber mallet in order to loosen the pan to allow the fluid to drain.

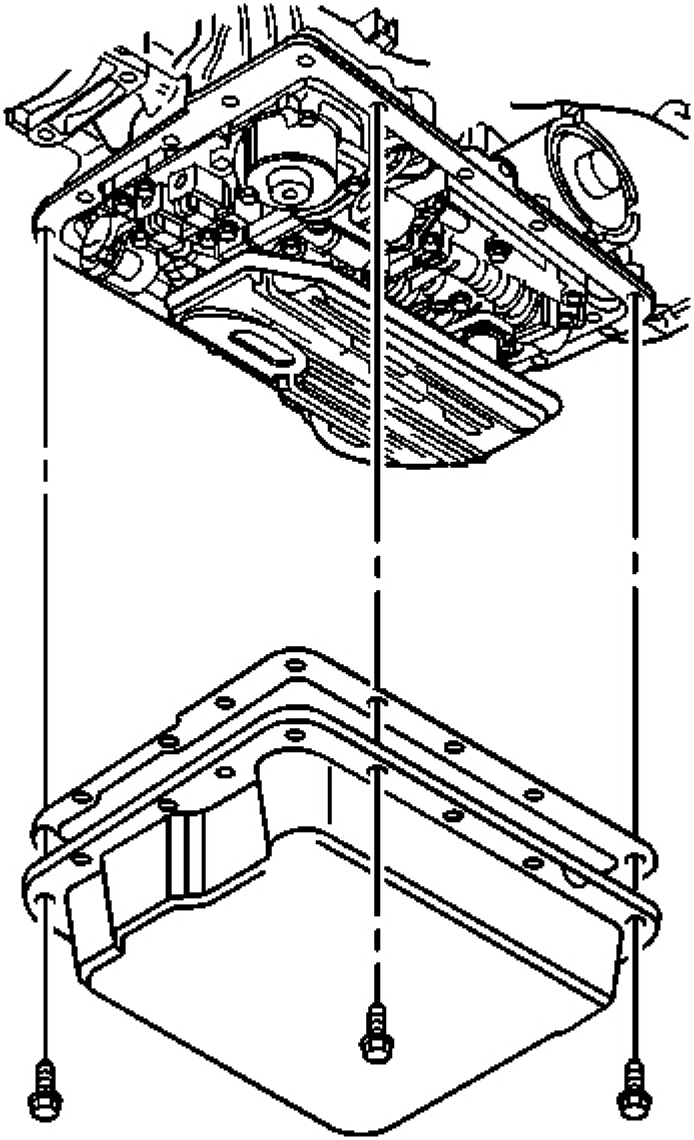


Fig. 54: Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the remaining oil pan bolts.

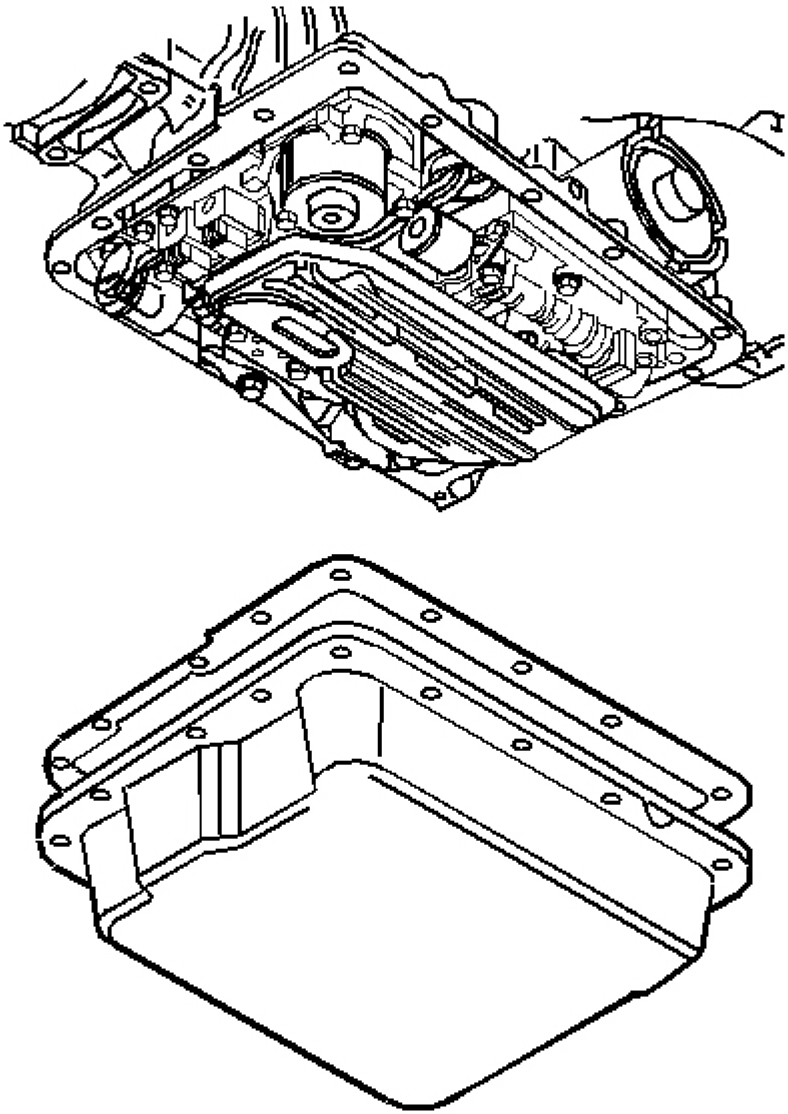


Fig. 55: Oil Pan & Gasket
Courtesy of GENERAL MOTORS CORP.

9. Remove the oil pan and the gasket.

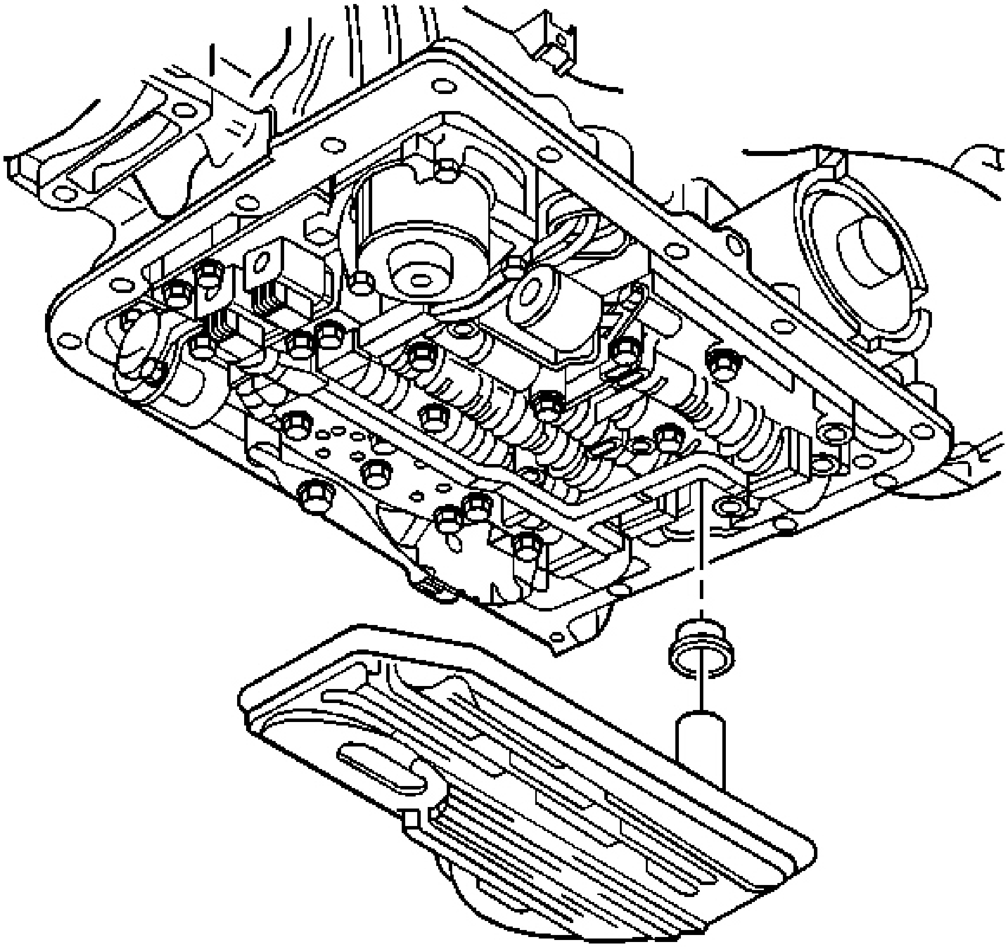


Fig. 56: A/T Filter
Courtesy of GENERAL MOTORS CORP.

10. Grasp firmly while pulling down with a twisting motion in order to remove the filter.

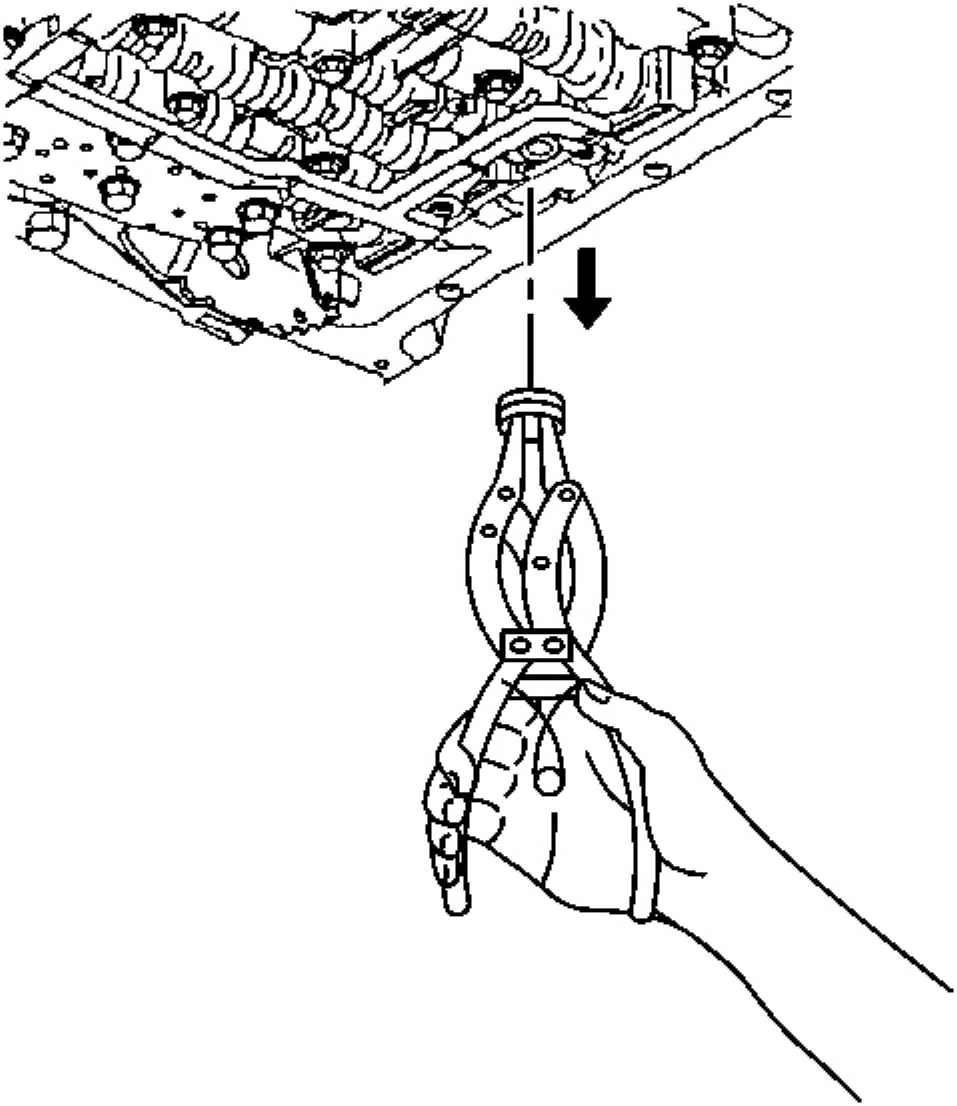


Fig. 57: Removing The Filter Seal
Courtesy of GENERAL MOTORS CORP.

11. Remove the filter seal. The filter seal may be stuck in the pump; if necessary, carefully use pliers or another suitable tool to remove the seal.
12. Discard the seal.
13. Inspect the fluid color.

14. Inspect the filter. Pry the metal crimping away from the top of the filter and pull apart. The filter may contain the following evidence for root cause diagnosis:
    - Clutch material
    - Bronze slivers indicating bushing wear
    - Steel particles
15. Clean the transmission case and the oil pan gasket surfaces with solvent, and air dry. You must remove all traces of the old gasket material.

Installation Procedure

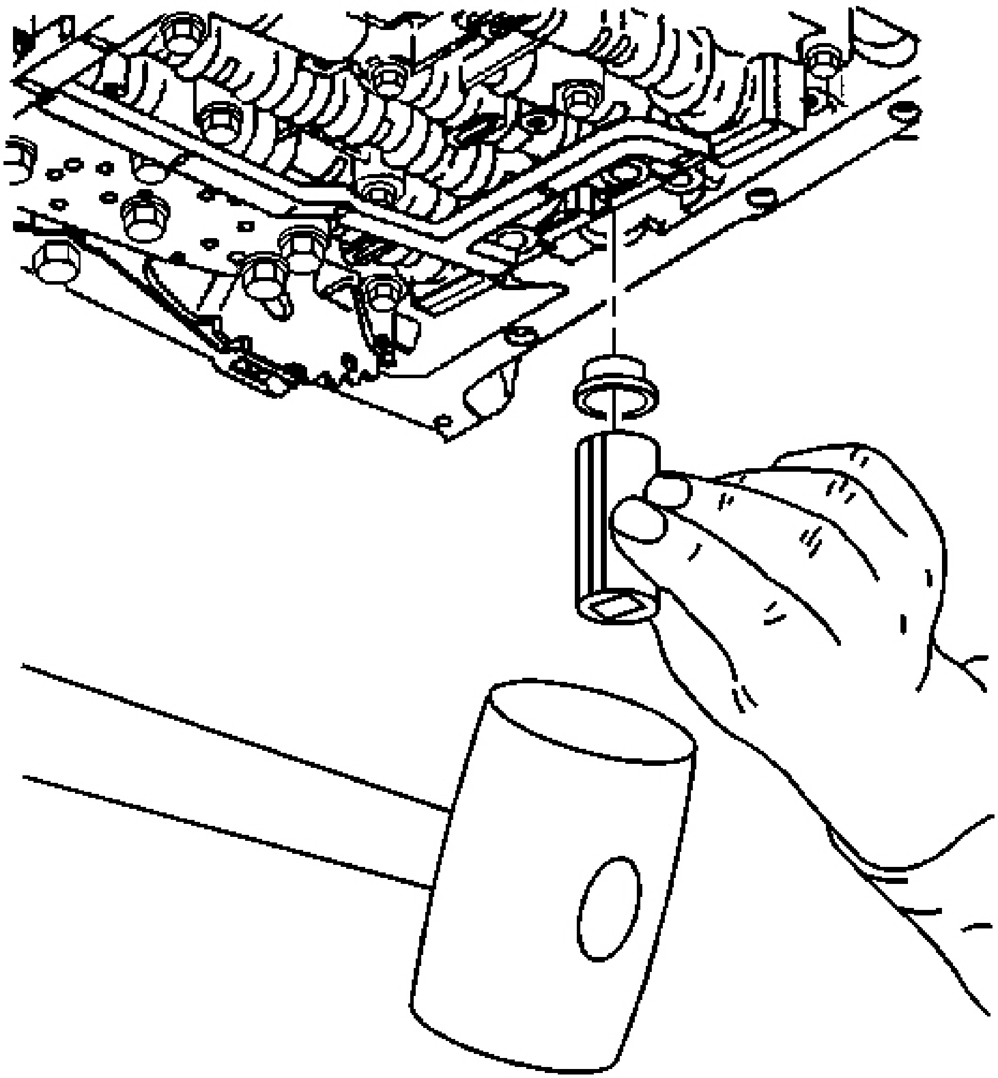


Fig. 58: Installing New Filter Seal Into Transmission Case
Courtesy of GENERAL MOTORS CORP.

1. Coat the new filter seal with automatic transmission fluid.
2. Install the new filter seal into the transmission case. Tap the seal into place using a suitable size socket.
3. Install the new filter into the case.

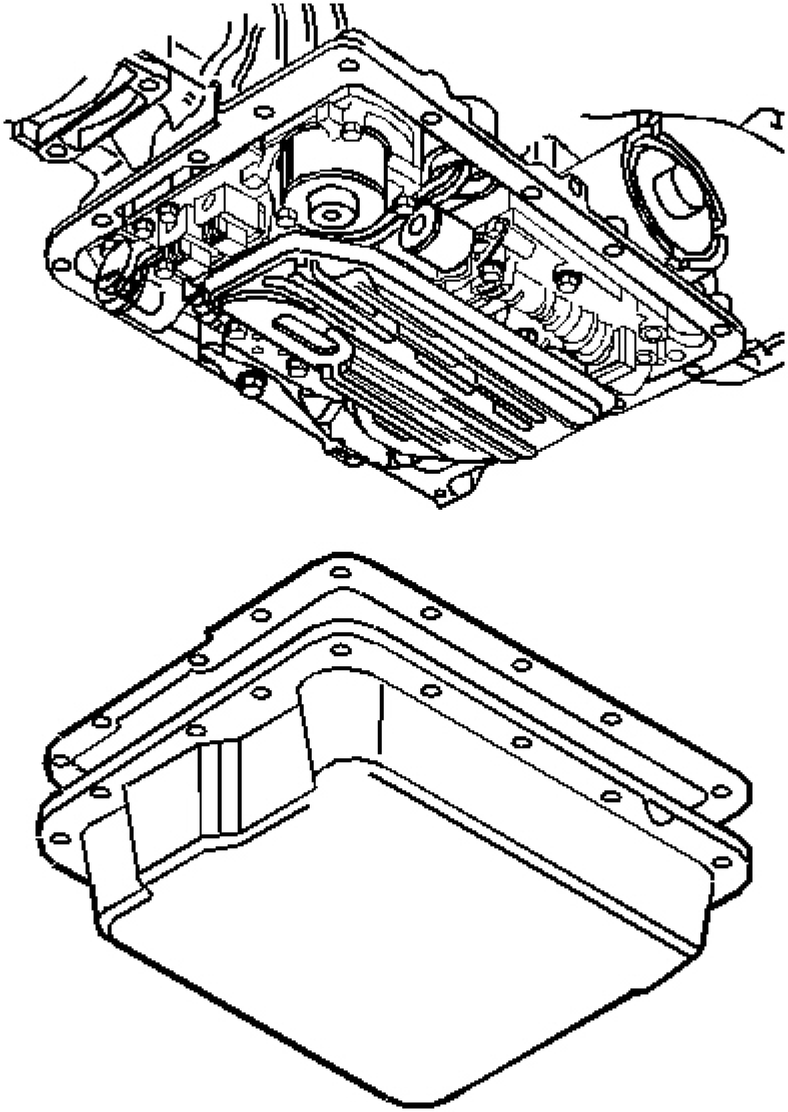


Fig. 59: Oil Pan & Gasket
Courtesy of GENERAL MOTORS CORP.

4. Install the oil pan and a new gasket.

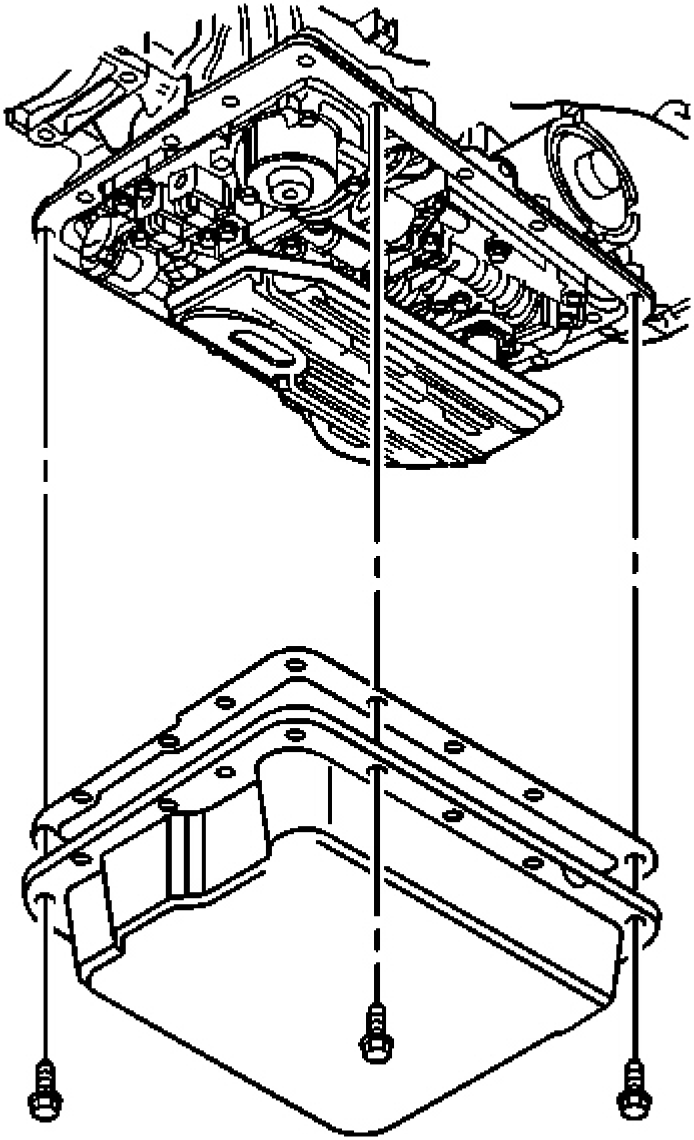


Fig. 60: Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the oil pan bolts.

Tighten: Tighten the oil pan to transmission case bolts alternately and evenly to 11 N.m (97 lb in).

6. If previously removed, install the range selector cable bracket and bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

7. Apply a small amount of sealant GM P/N 12346004, (Canadian P/N 10953480) to the threads of the oil pan drain plug, if equipped.
8. Install the oil pan drain plug, if equipped.

   Tighten: Tighten the oil pan drain plug to 18 N.m (13 lb ft).

9. Lower the vehicle.
10. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** and **Fluid Capacity Specifications** .
11. Check the COLD fluid level reading for initial fill only.
12. Inspect the oil pan gasket for leaks.

TRANSMISSION FLUID COOLER HOSE/PIPE REPLACEMENT

Removal Procedure

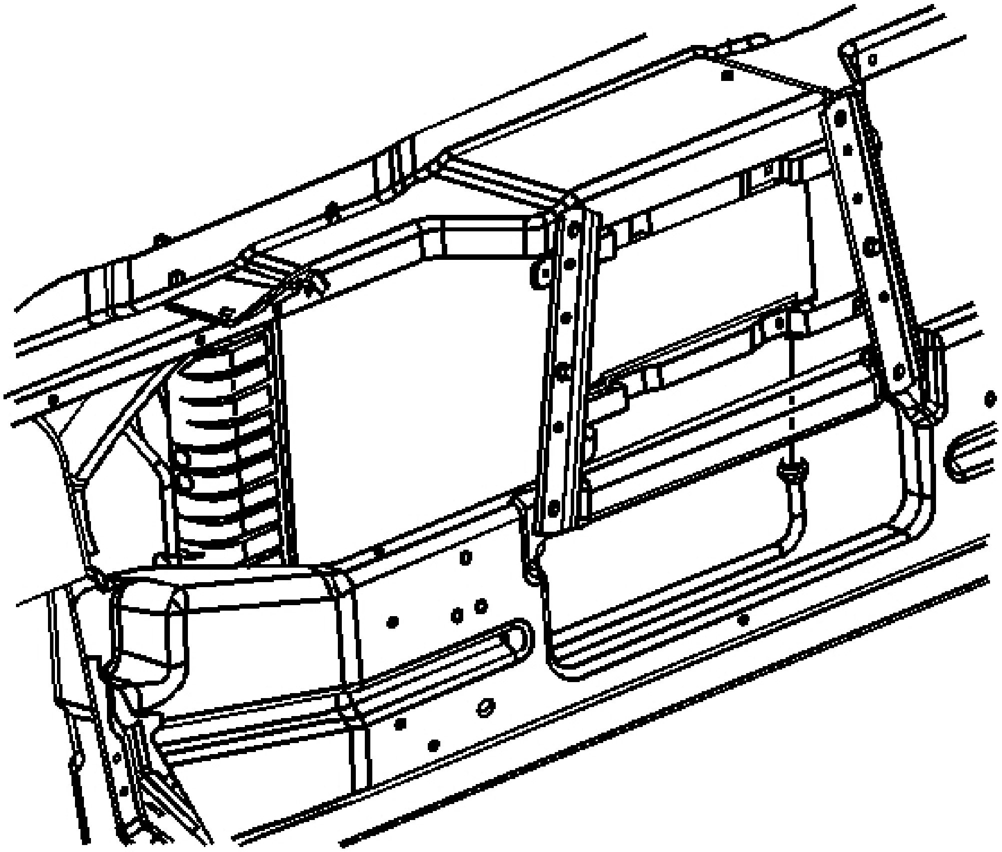


Fig. 61: Air Cleaner Resonator Outlet Duct
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner resonator outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** in Engine Controls - 6.0L.
2. Remove the transmission fluid cooler hoses from the transmission fluid Auxiliary cooler. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

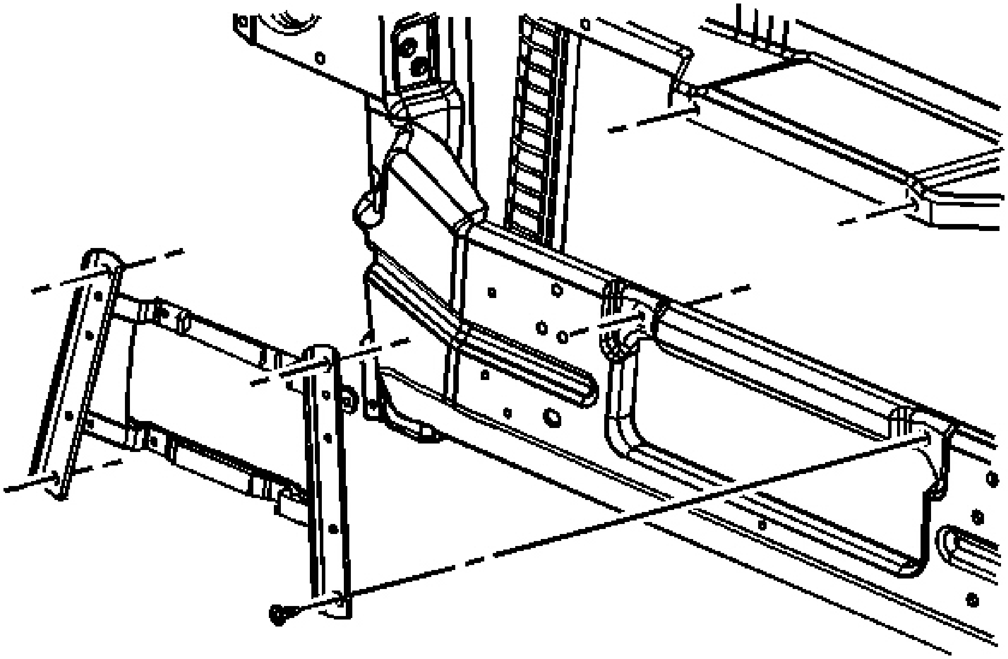


Fig. 62: Auxiliary Oil Cooler
Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts from the auxiliary oil cooler.
4. Remove the auxiliary oil cooler from the vehicle.

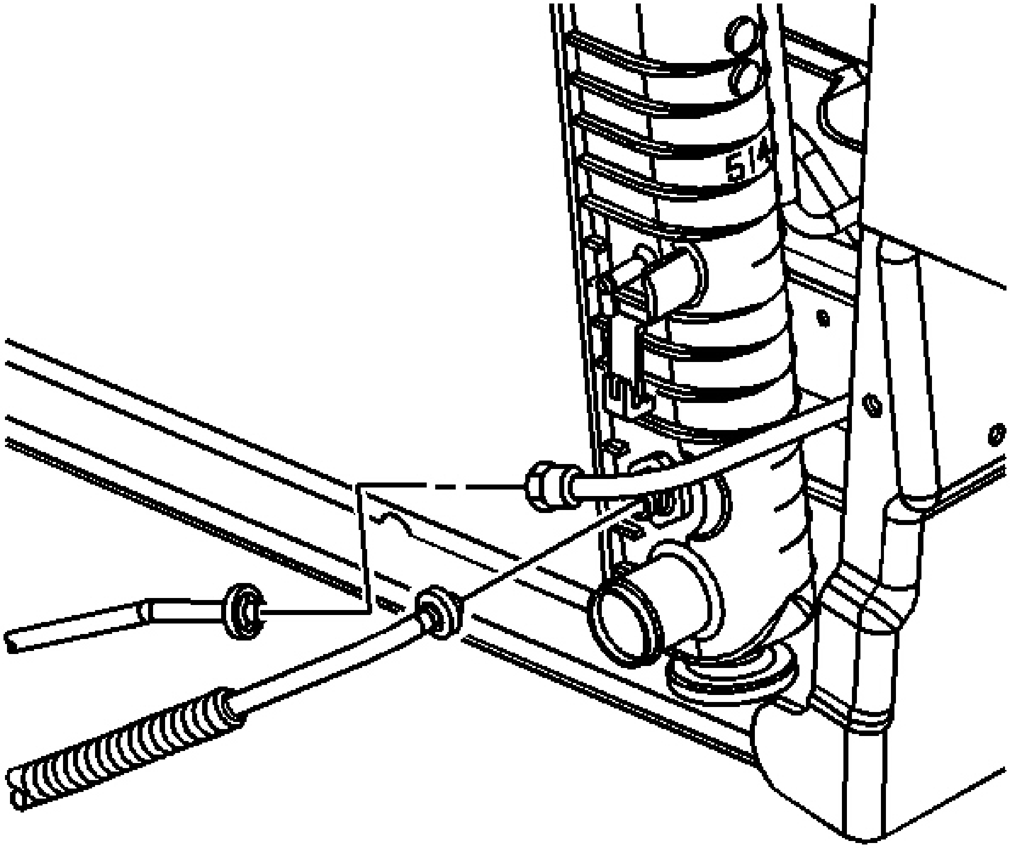


Fig. 63: Transmission Fluid Cooler Hoses & Radiator
Courtesy of GENERAL MOTORS CORP.

5. Remove the transmission fluid cooler hose from the auxiliary transmission fluid cooler. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
6. Remove the transmission fluid cooler hoses from the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

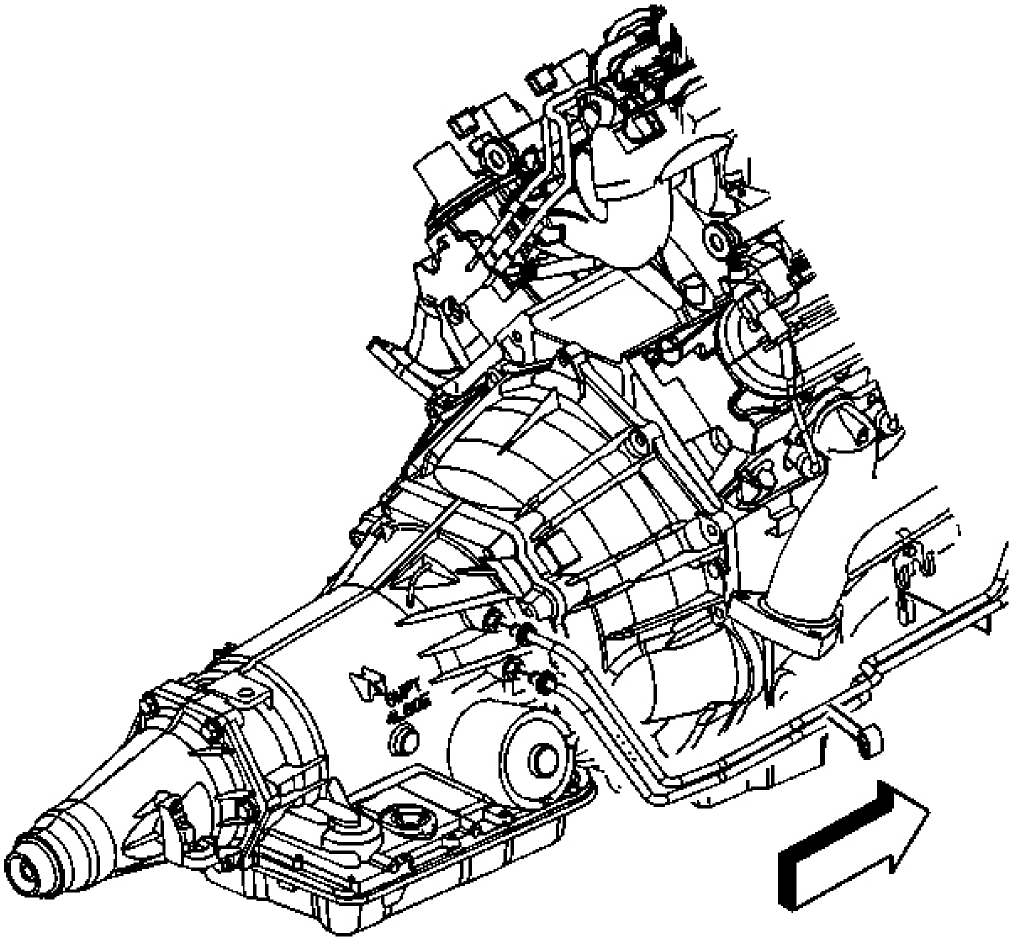


Fig. 64: Transmission Oil Cooler Lines To Transmission
Courtesy of GENERAL MOTORS CORP.

7. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
8. Remove the bolts from the transmission fluid cooler hose insulator.
9. Remove the transmission fluid cooler hose insulator from the transmission.
10. Remove the cooling lines from the clips.
11. Remove the transmission fluid cooler hoses from the transmission. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

Installation Procedure

1. Install the transmission fluid cooler hoses to the transmission. Refer to **Transmission Fluid Cooler Line**

Quick Connect Fitting .

2. Install the cooling lines to the clips.
3. Install the transmission fluid cooler hose insulator to the transmission.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the bolts to the transmission fluid cooler hose insulator.

Tighten: Tighten the bolts to 17 N.m (12 lb ft).

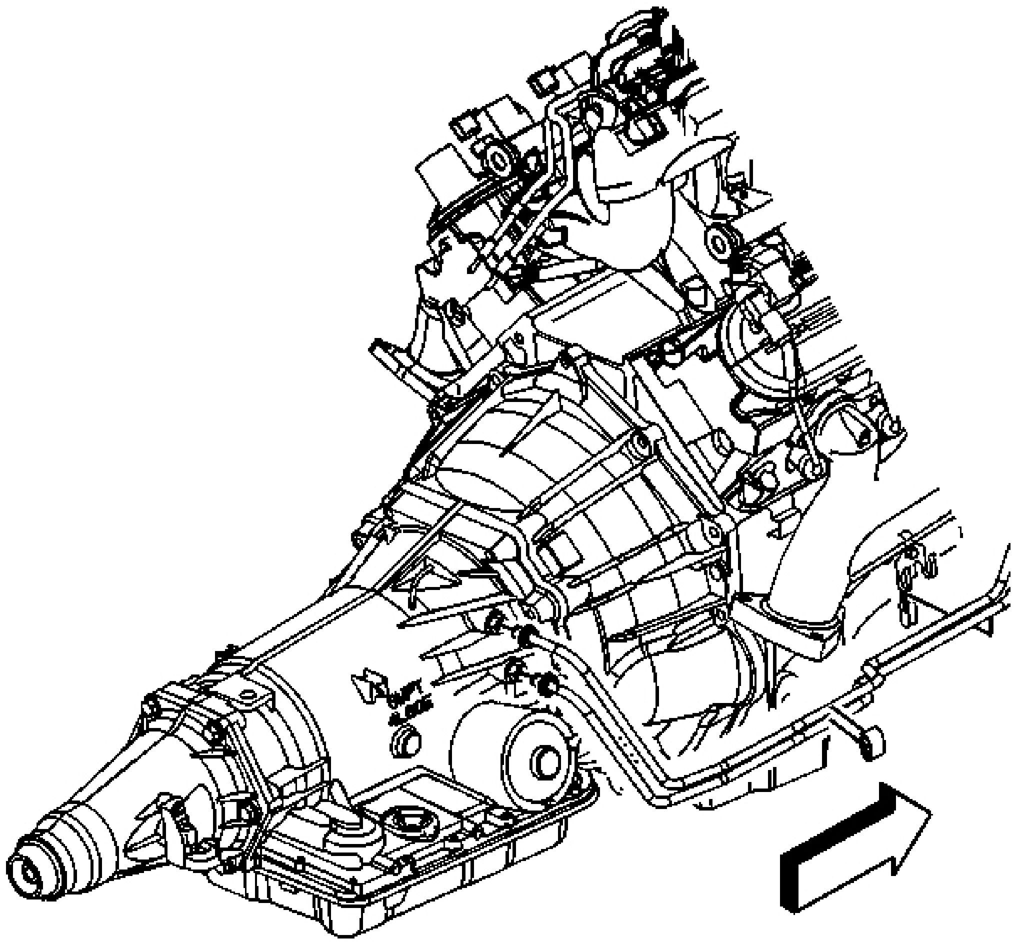


Fig. 65: Transmission Oil Cooler Lines To Transmission
Courtesy of GENERAL MOTORS CORP.

5. Lower the vehicle.

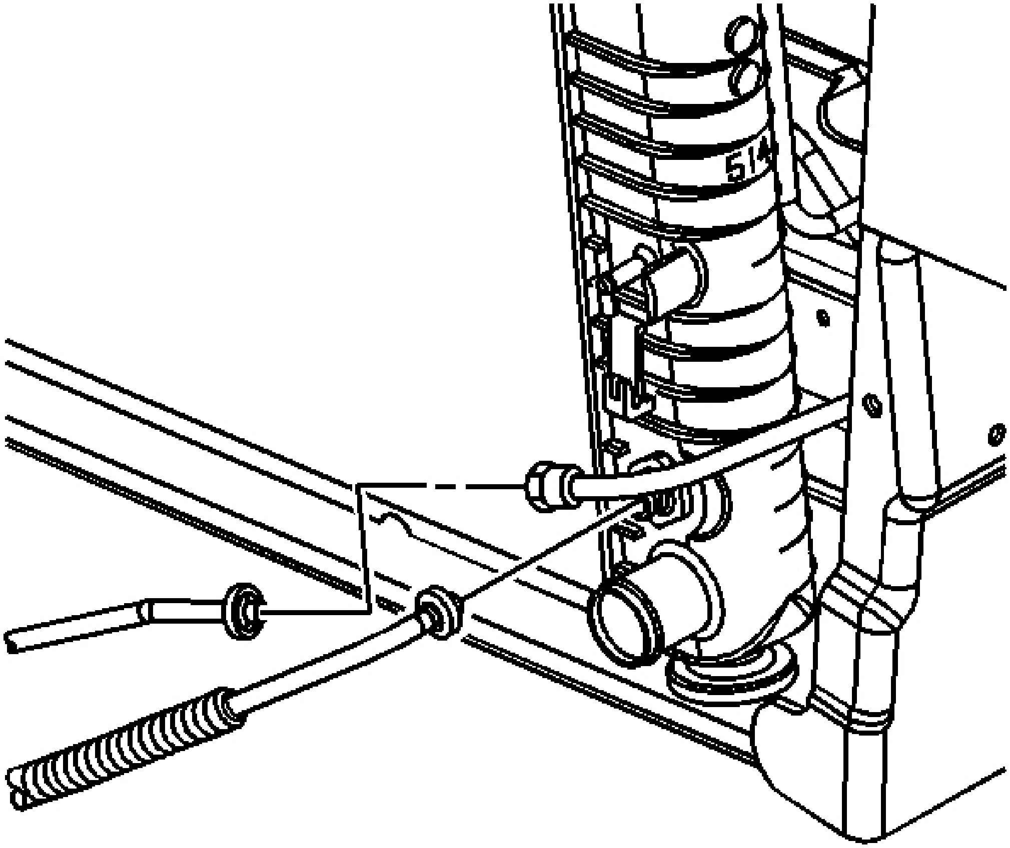


Fig. 66: Transmission Fluid Cooler Hoses & Radiator
Courtesy of GENERAL MOTORS CORP.

6. Install the transmission fluid cooler hoses to the radiator. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
7. Install the transmission fluid cooler hose to the auxiliary transmission fluid cooler. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

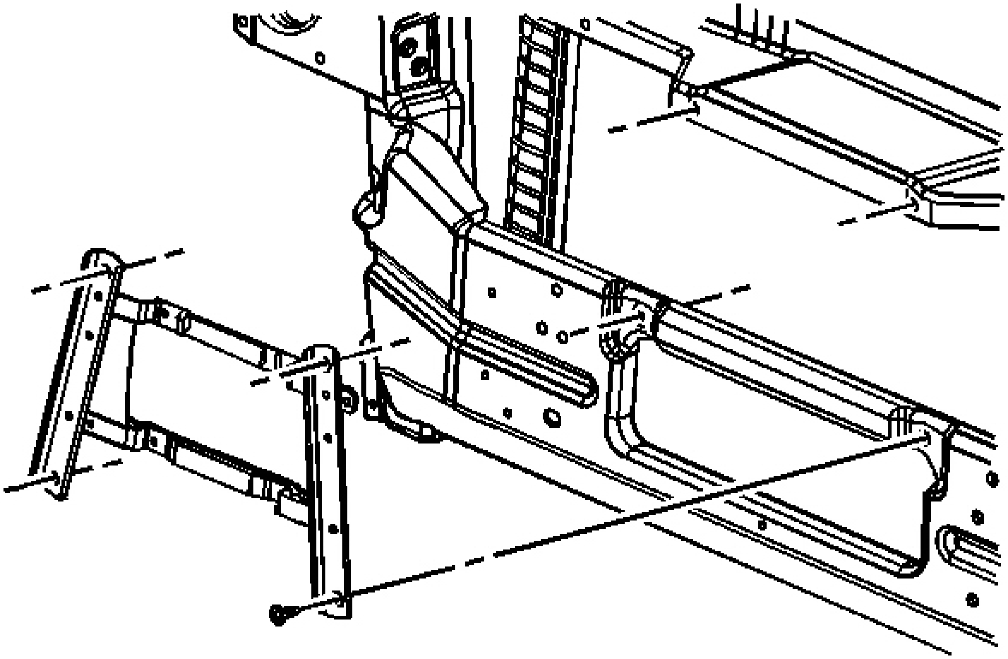


Fig. 67: Auxiliary Oil Cooler
Courtesy of GENERAL MOTORS CORP.

8. Install the auxiliary oil cooler to the vehicle.
9. Install the bolts to the transmission fluid auxiliary cooler.

   Tighten: Tighten the bolts to 17 N.m (12 lb ft).

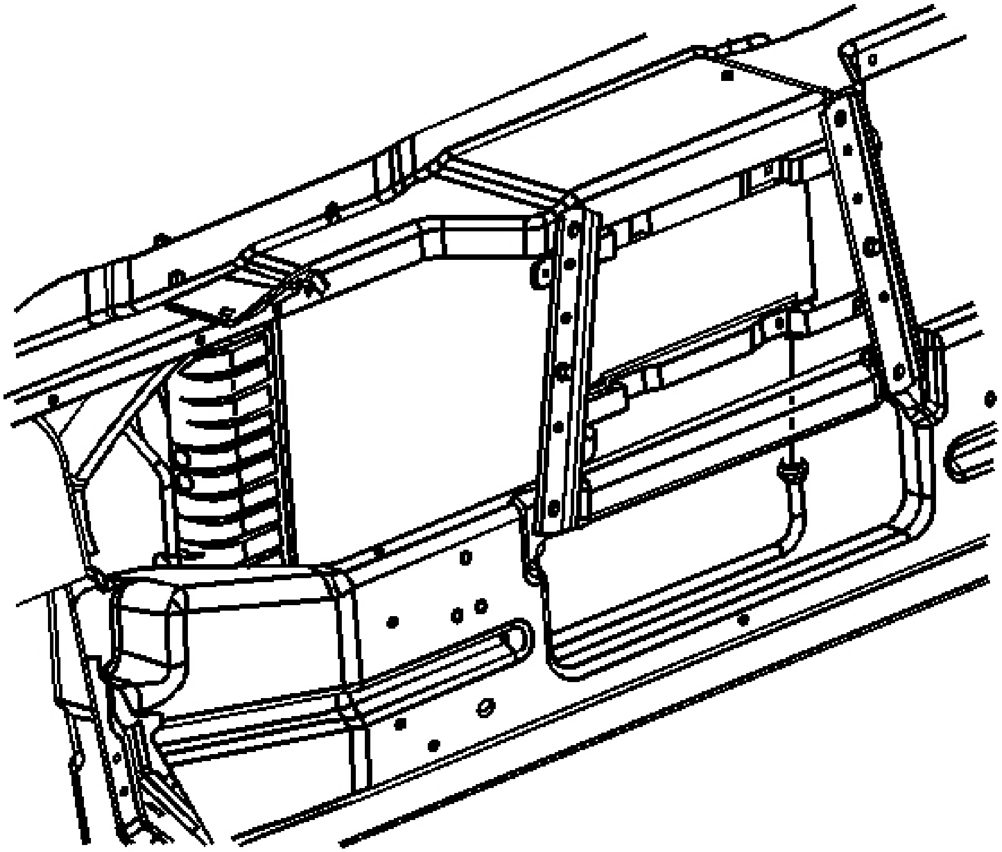


Fig. 68: Air Cleaner Resonator Outlet Duct
Courtesy of GENERAL MOTORS CORP.

10. Install the transmission fluid cooler hoses to the transmission fluid Auxiliary cooler. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
11. Install the air cleaner resonator outlet duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** in Engine Controls - 6.0L.

TRANSMISSION FLUID COOLER LINE QUICK CONNECT FITTING

Removal Procedure

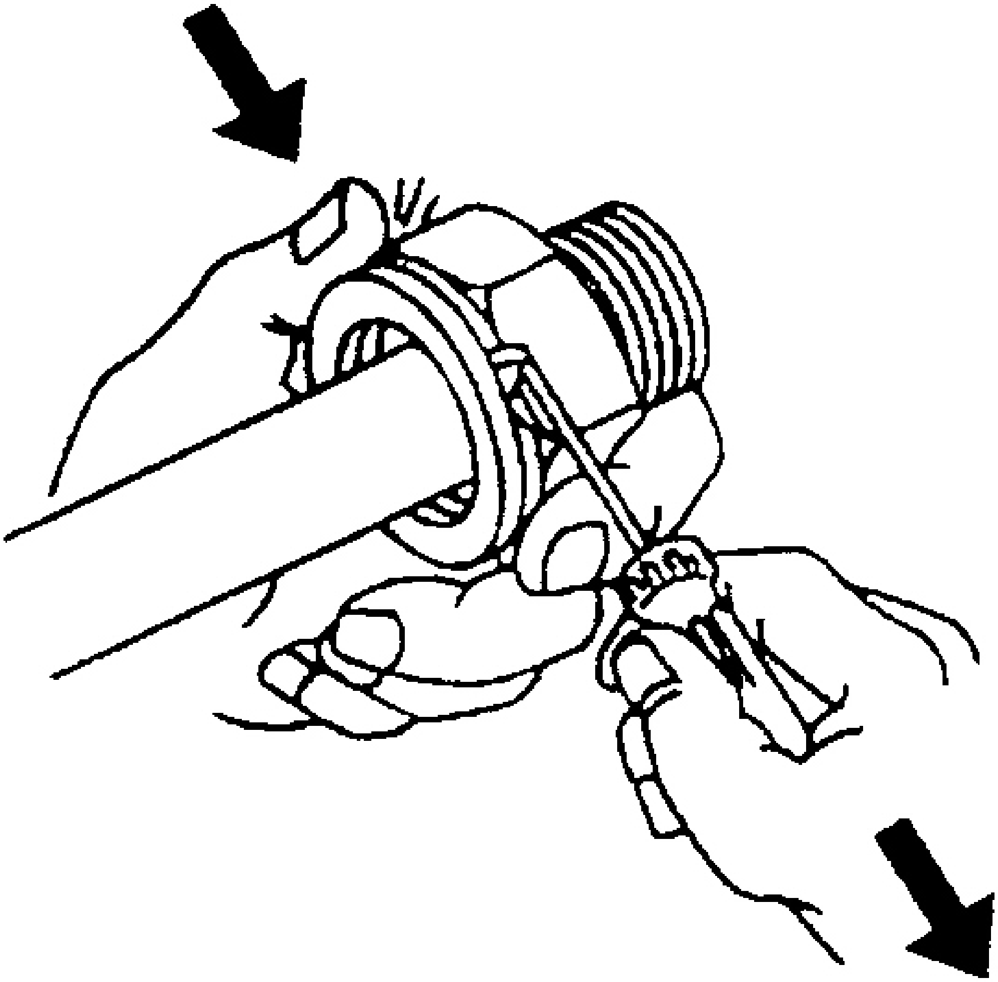


Fig. 69: Removing Retaining Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Perform the following procedure when removing the retaining rings and cooler lines from the quick connect fittings located on the radiator and/or the transmission.

1. Pull the plastic cap back from the quick connect fitting and down along the cooler line about 5 cm (2 in).
2. Using a bent-tip screwdriver, pull on one of the open ends of the retaining ring in order to rotate the retaining ring around the quick connect fitting until the retaining ring is out of position and can be completely removed.

3. Remove the retaining ring from the quick connect fitting.
4. Discard the retaining ring.

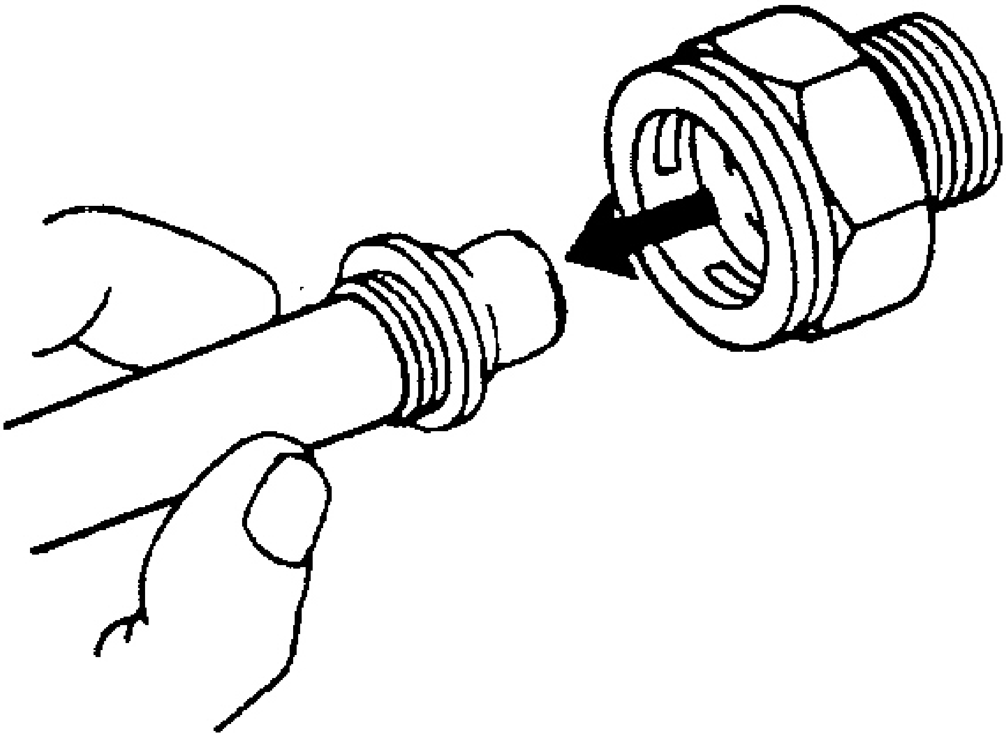


Fig. 70: Removing Cooler Line
Courtesy of GENERAL MOTORS CORP.

5. Pull the cooler line straight out from the quick connect fitting.

Installation Procedure

IMPORTANT:

- **Do not reuse any of the existing oil lines or oil line fittings if there is excessive corrosion.**
- **Do not reuse any of the existing retaining rings that were removed from the existing quick connect fittings. Install new retaining rings.**
- **Ensure the following procedures are performed when installing the new retaining rings onto the fittings.**

1. Install a new retaining ring into the quick connect fitting using the following procedure:

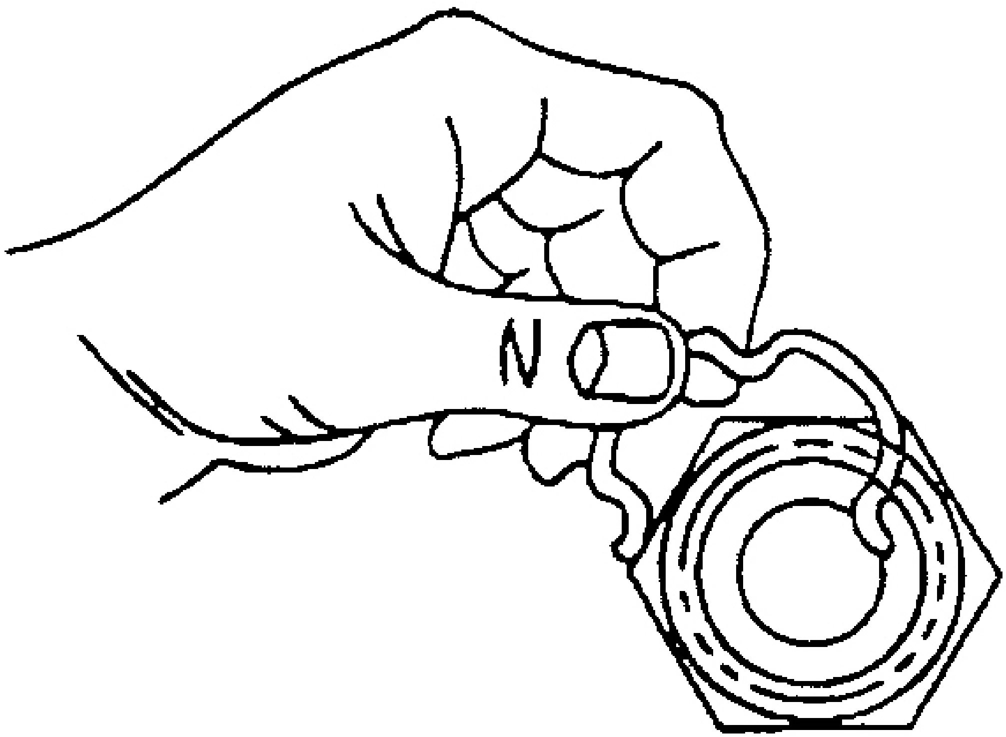


Fig. 71: Hooking Retaining Ring Into Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

2. Hook one of the open ends of the retaining ring in one of the slots in the quick connect fitting.

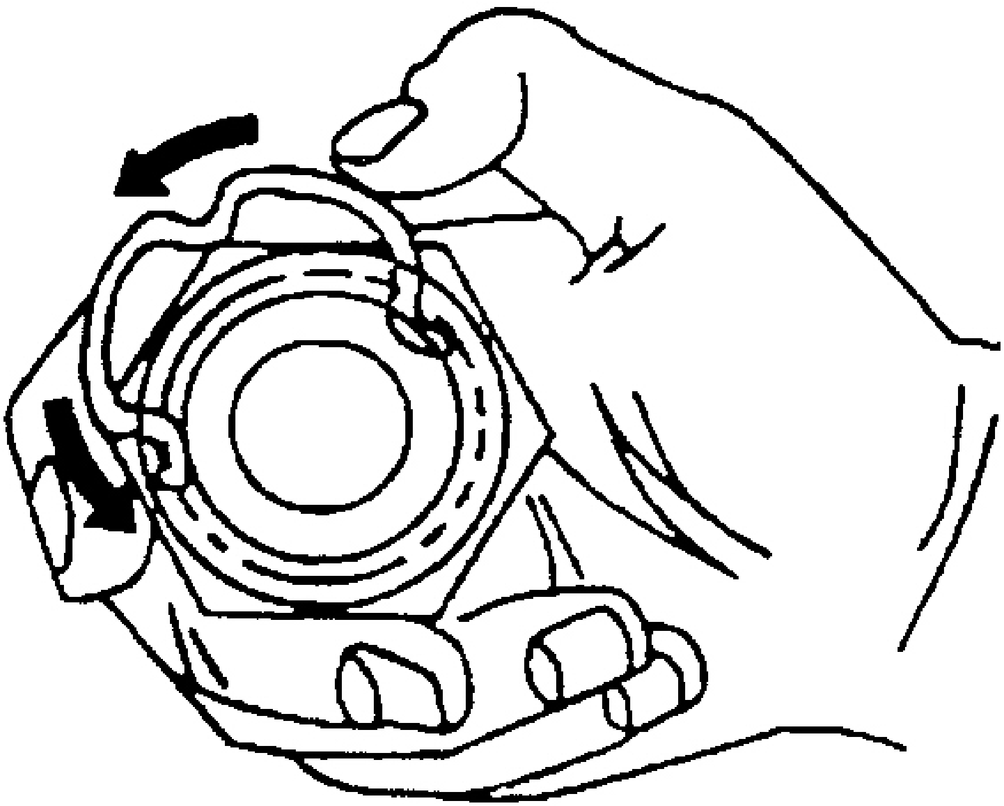


Fig. 72: Rotating Retaining Ring Around Fitting
Courtesy of GENERAL MOTORS CORP.

3. Rotate the retaining ring around the fitting until the retaining ring is positioned with all three ears through the three slots on the fitting.

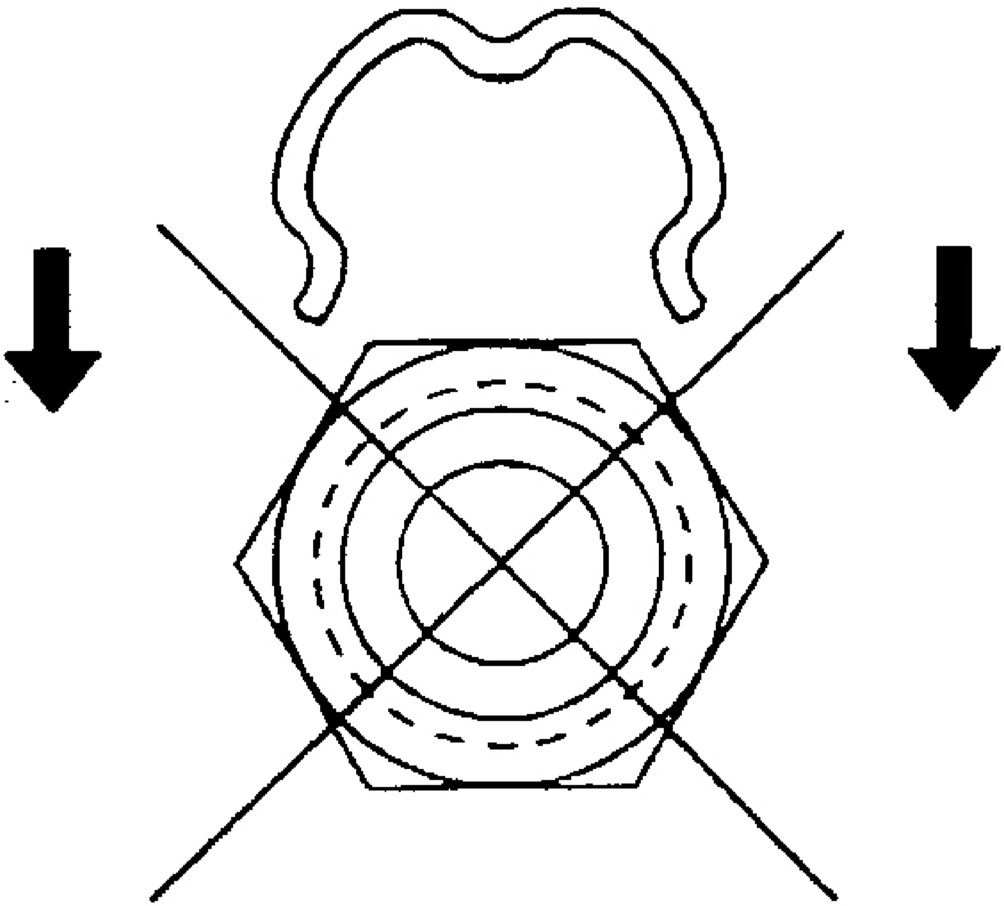


Fig. 73: Improper Retaining Ring Installation
Courtesy of GENERAL MOTORS CORP.

4. Do not install the new retaining ring onto the fitting by pushing the retaining ring.

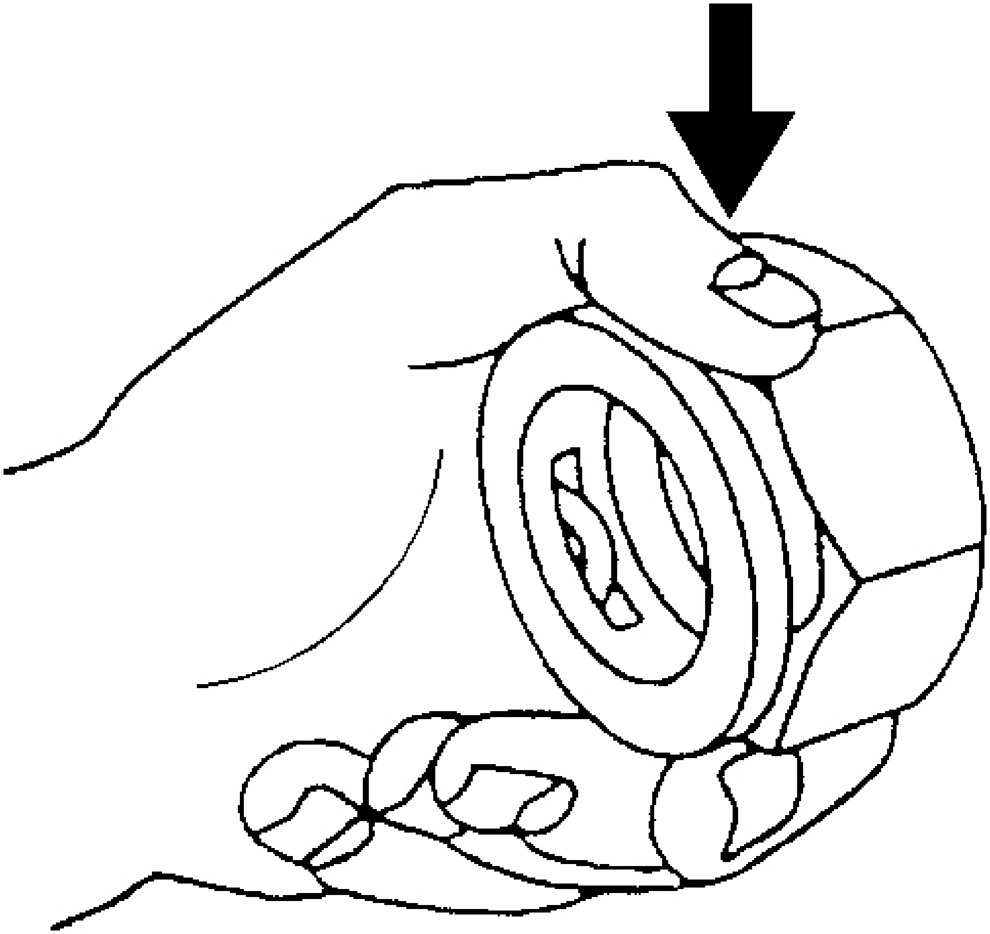


Fig. 74: Ensuring Retaining Ring Is Seated Correctly
Courtesy of GENERAL MOTORS CORP.

5. Ensure that the three retaining ring ears are seen from inside the fitting and that the retaining ring moves freely in the fitting slots.

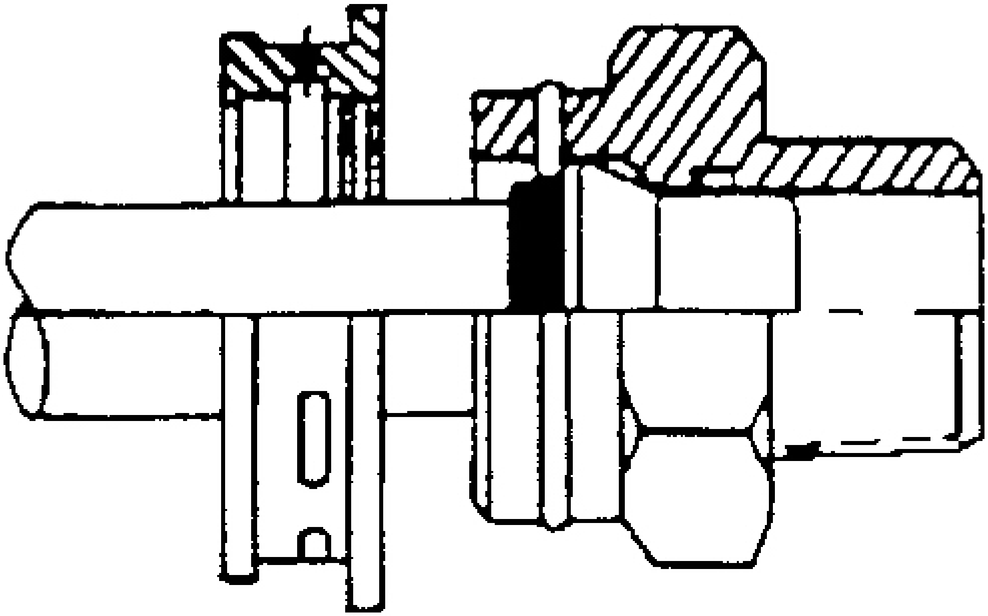


Fig. 75: Installing Cooler Line Into Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

6. Install the cooler line into the quick connect fitting.
7. Insert the cooler line end into the quick connect fitting until a click is either heard or felt.

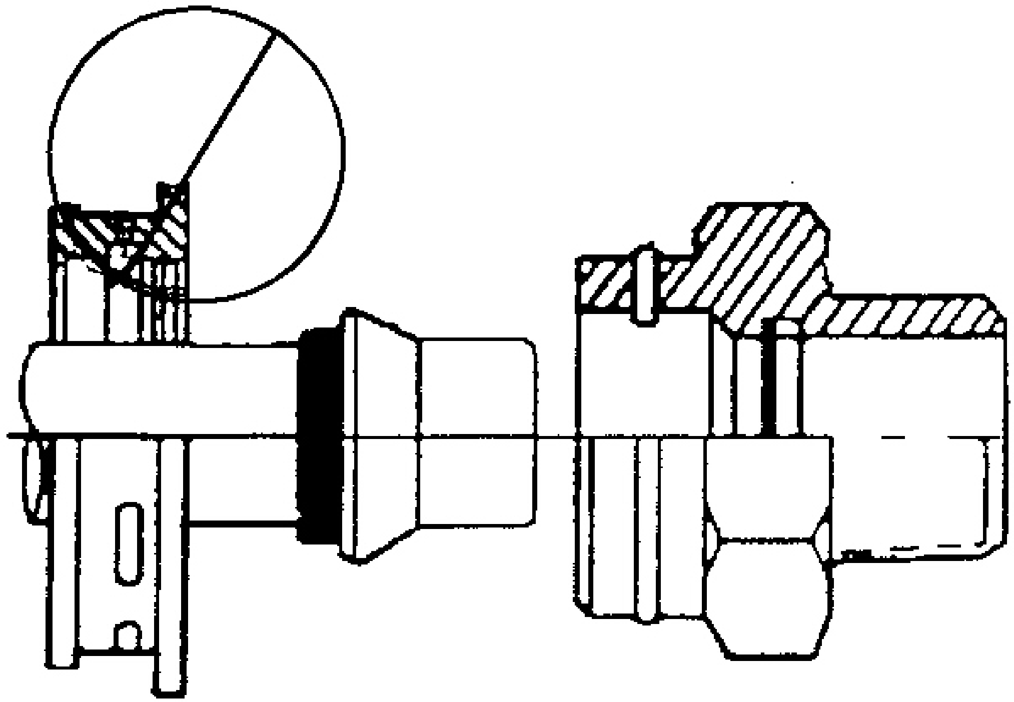


Fig. 76: Improper Cooler Line Installation
Courtesy of GENERAL MOTORS CORP.

8. Do not use the plastic cap on the cooler line in order to install the cooler line into the fitting.
9. Pull back sharply on the cooler line in order to ensure that the cooler line is fastened into the quick connect fitting.

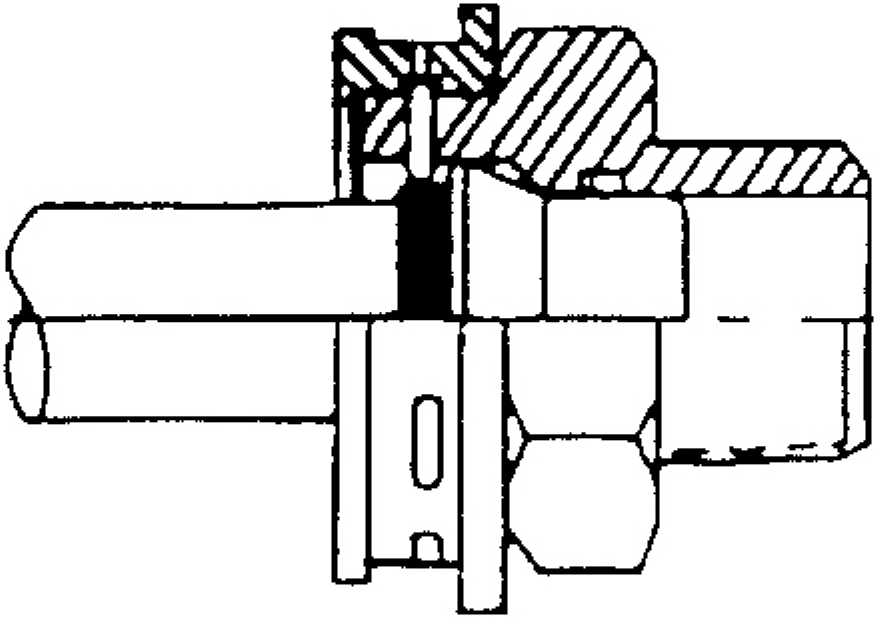


Fig. 77: Inserting Plastic Cap Onto Fitting
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not manually depress the retaining clip when installing the plastic cap.

10. Position (snap) the plastic cap onto the fitting. Do not manually depress the retaining ring when installing the plastic cap onto the quick connect fitting.
11. Ensure that the plastic cap is fully seated against the fitting.

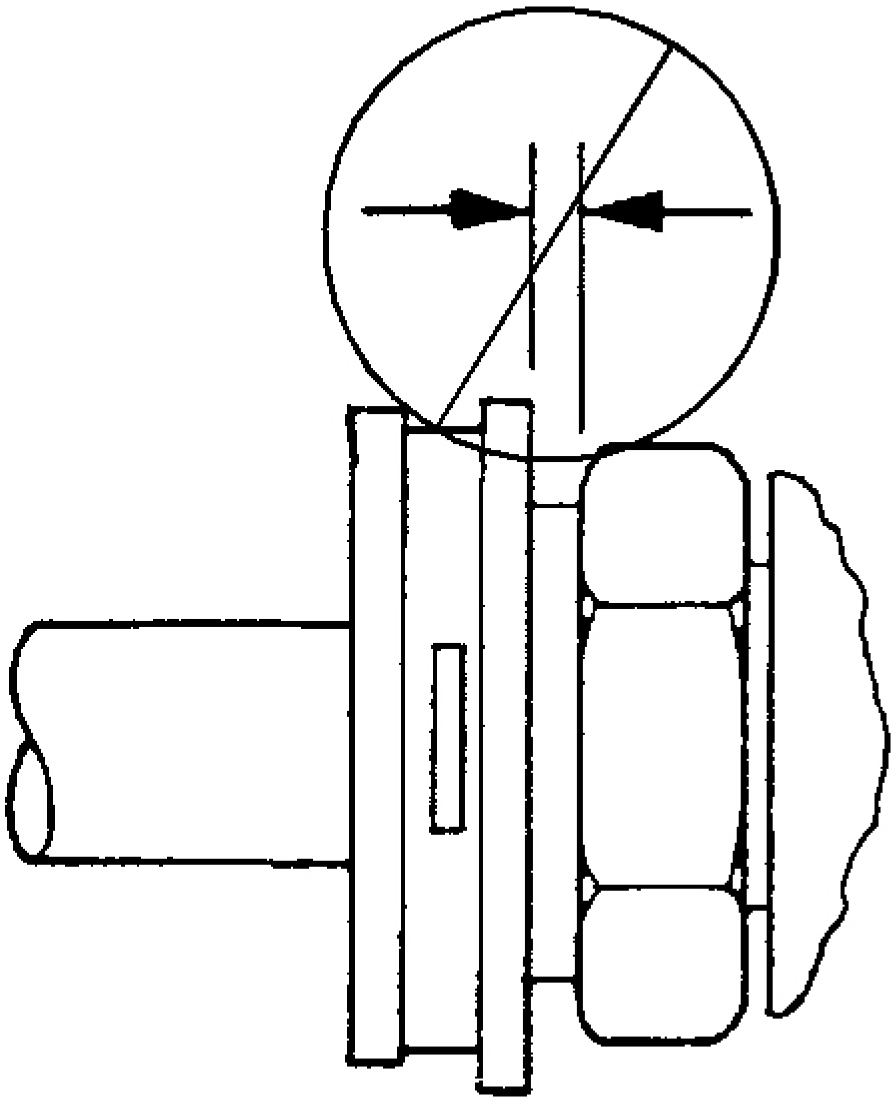


Fig. 78: Ensuring That No Gap Is Present Between Cap & Fitting
Courtesy of GENERAL MOTORS CORP.

12. Ensure that no gap is present between the cap and the fitting.

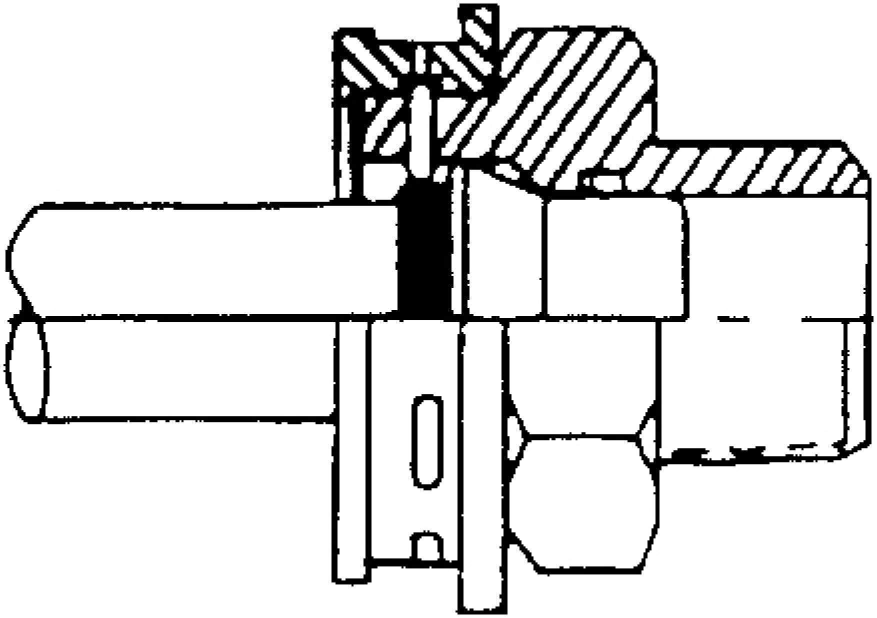


Fig. 79: Inserting Plastic Cap Onto Fitting
Courtesy of GENERAL MOTORS CORP.

13. Ensure that the yellow identification band on the tube is hidden within the quick connect fitting.

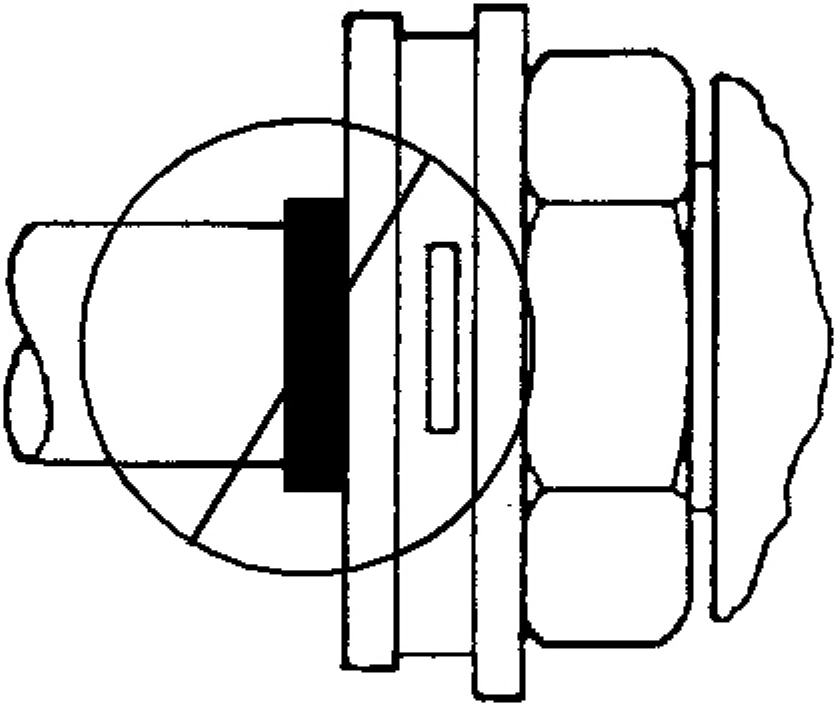


Fig. 80: Improper Joint Seating
Courtesy of GENERAL MOTORS CORP.

14. A hidden yellow identification band indicates proper joint seating.
15. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

TRANSMISSION FLUID AUXILIARY COOLER REPLACEMENT

Removal Procedure

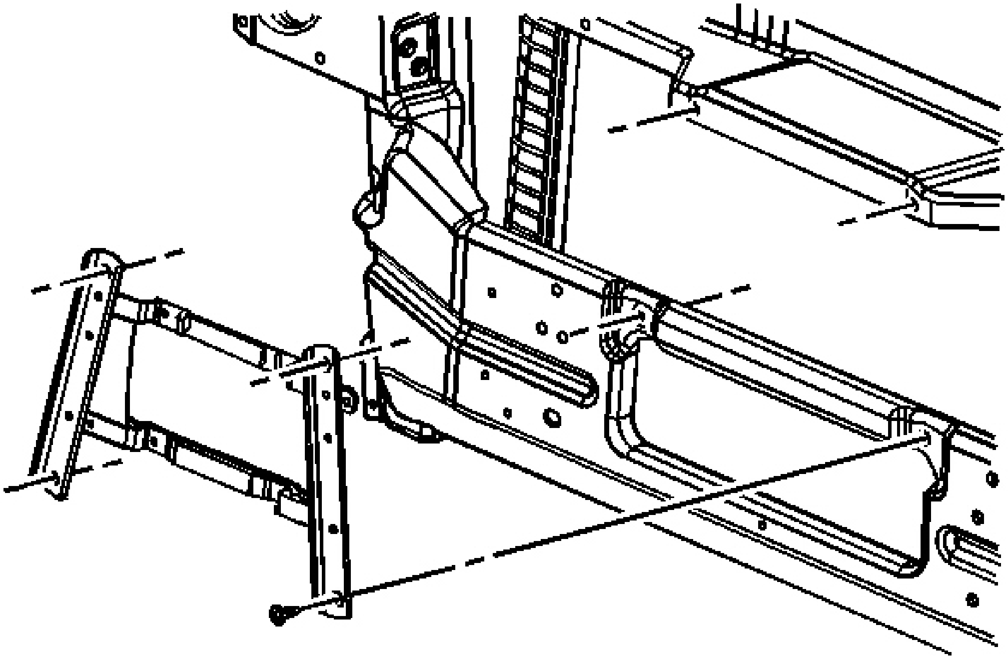


Fig. 81: Auxiliary Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission fluid cooler hoses from the transmission fluid auxiliary cooler. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .
2. Remove the bolts from the auxiliary oil cooler.
3. Remove the auxiliary oil cooler from the vehicle.

Installation Procedure

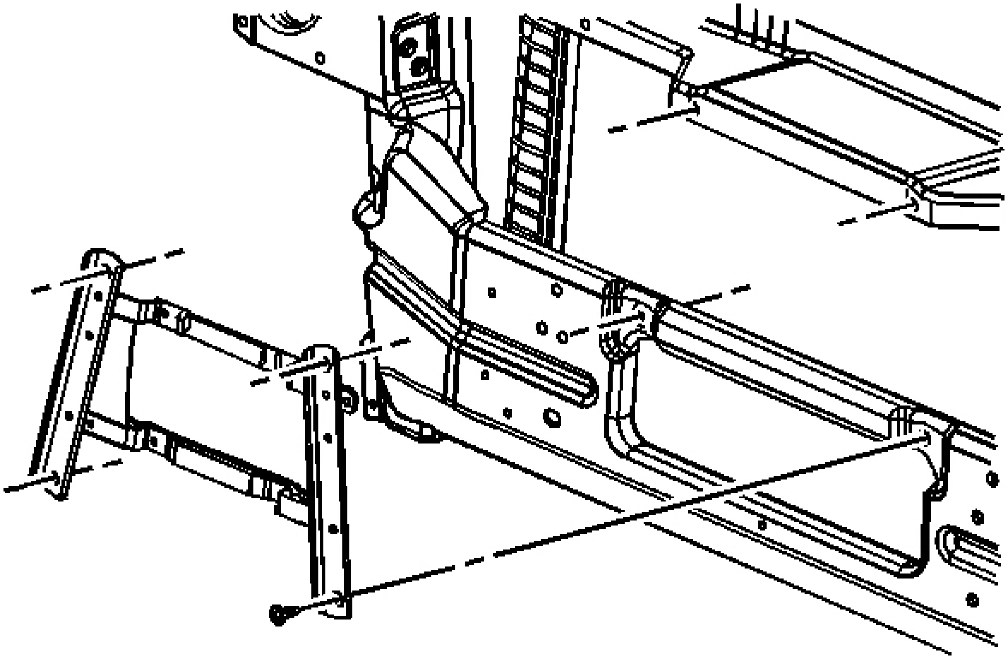


Fig. 82: Auxiliary Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Install the auxiliary oil cooler to the vehicle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the bolts to the transmission fluid auxiliary cooler.

   Tighten: Tighten the bolts to 12 N.m (9 lb ft).

3. Install the transmission fluid cooler hoses to the transmission fluid auxiliary cooler. Refer to **Transmission Fluid Cooler Line Quick Connect Fitting** .

2-4 SERVO

Tools Required

J 29714-A Servo Cover Depressor. See **Special Tools and Equipment** .

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General information.
2. Drain the transmission fluid. Refer to **Transmission Fluid Checking Procedure** in Automatic Transmission - 4L60-E/4L65-E.
3. Remove the right hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.

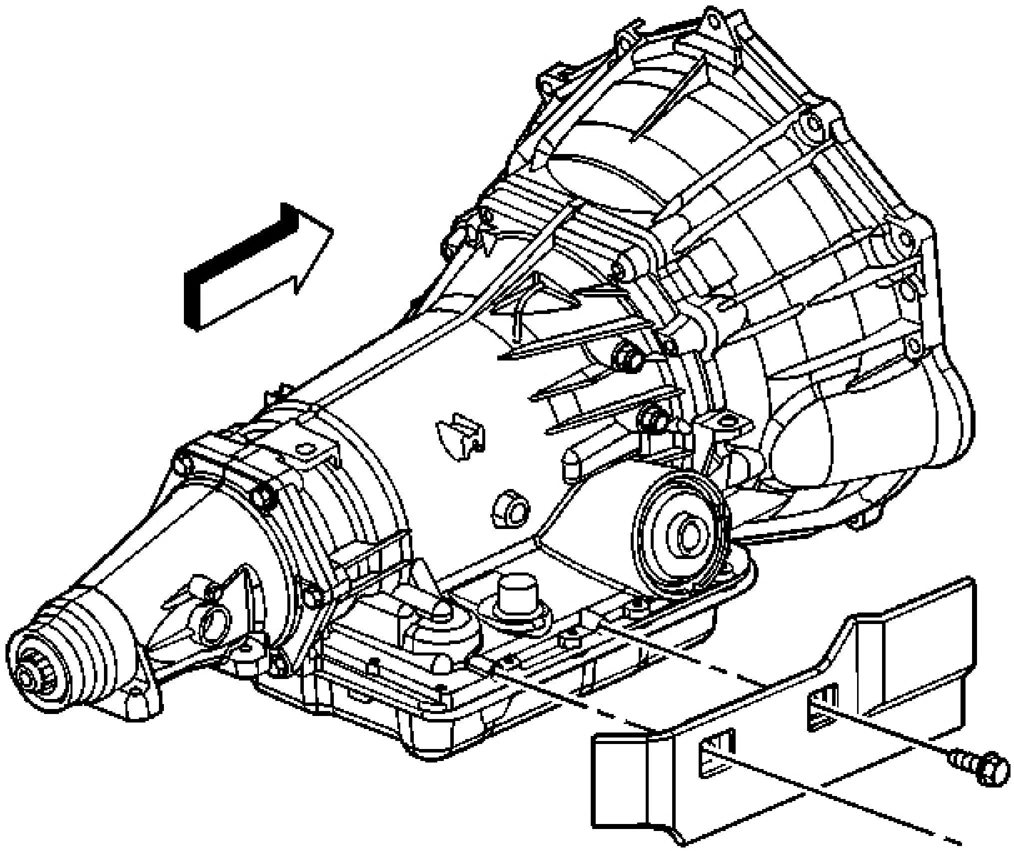


Fig. 83: Transmission Heat Shield Bolts & Heat Shield
Courtesy of GENERAL MOTORS CORP.

4. Remove the heat shield bolts and heat shield from the transmission.

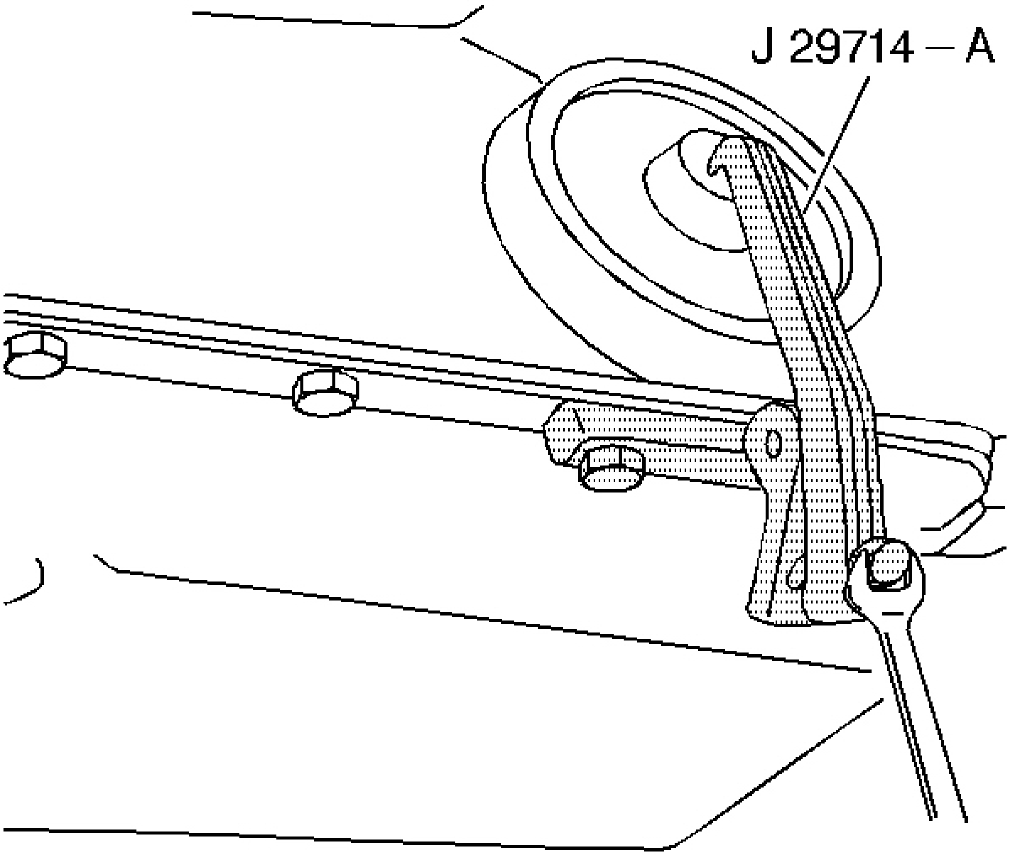


Fig. 84: Servo Using J 29714-A
Courtesy of GENERAL MOTORS CORP.

5. Install the **J 29714-A** . See **Special Tools and Equipment** .
6. Tighten the bolt in order to compress the servo cover.

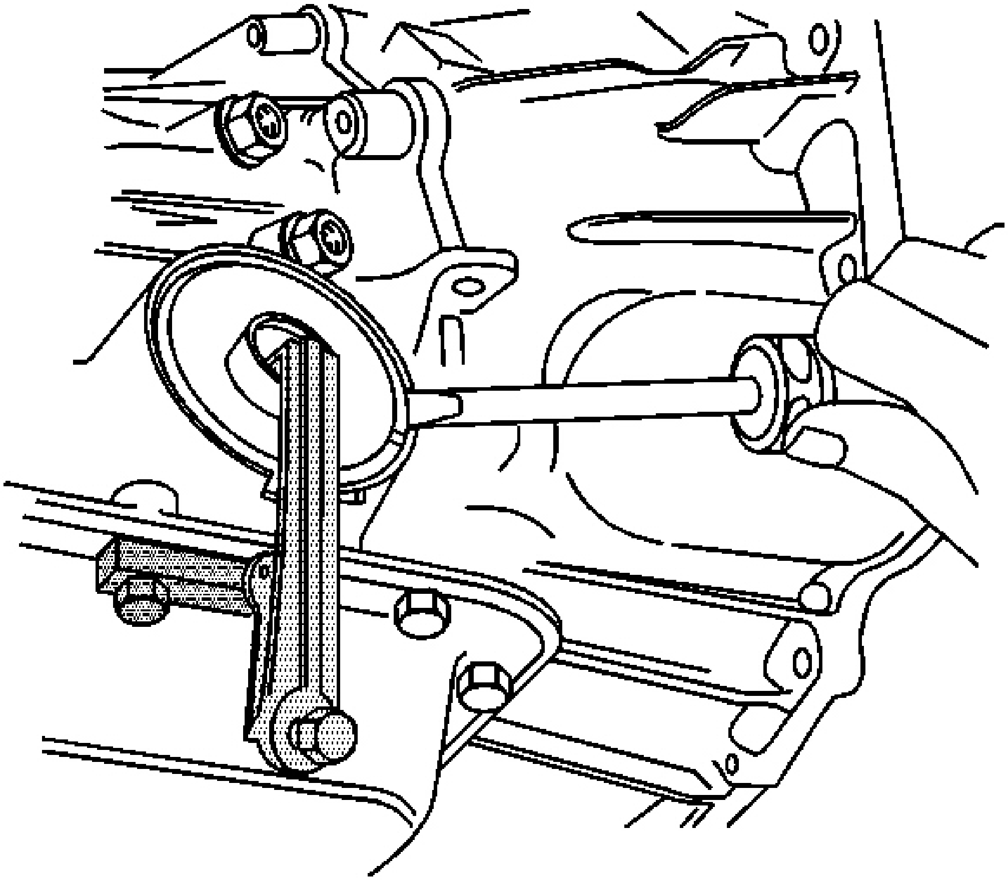


Fig. 85: View Of Servo Cover Ring
Courtesy of GENERAL MOTORS CORP.

7. Remove the servo cover retaining ring.
8. Remove the **J 29714-A** . See **Special Tools and Equipment** .

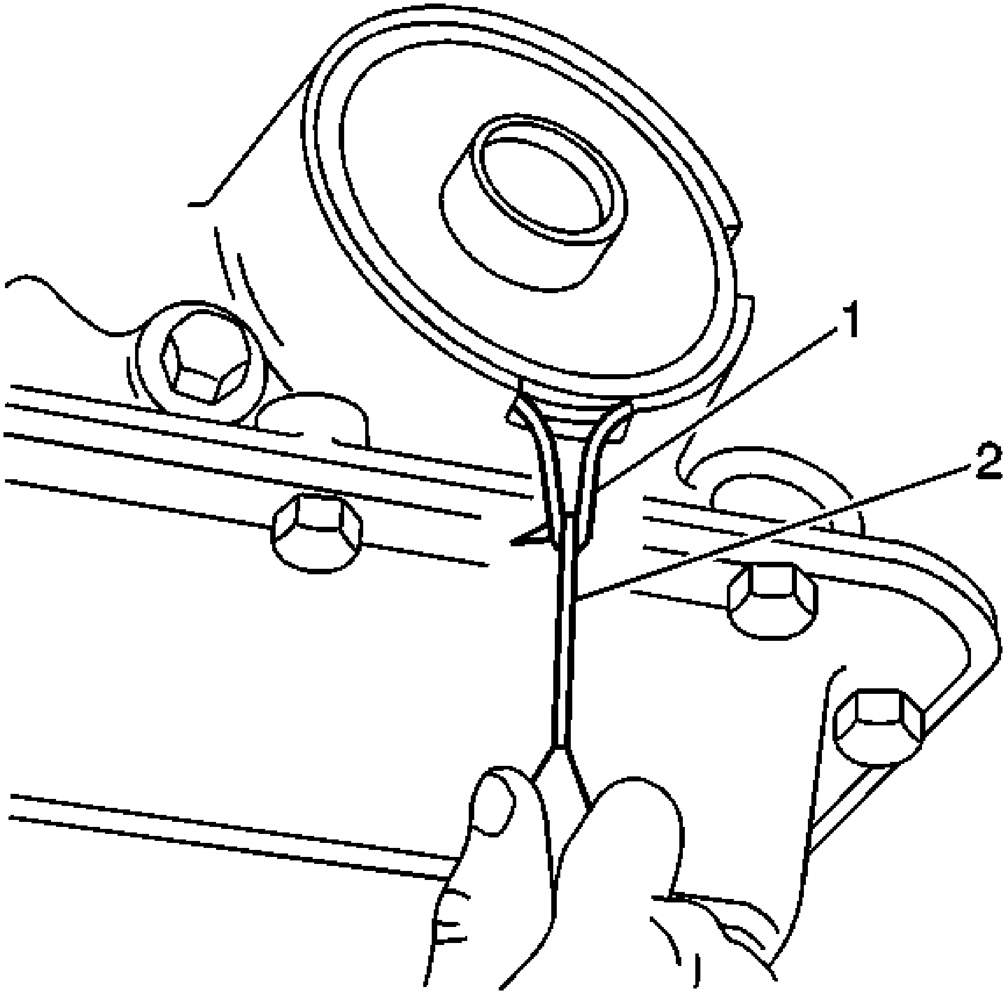


Fig. 86: Servo Cover & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

9. Remove the servo cover and the O-ring seal. If the cover is hung up on the seal, use a pick (2) to pull and stretch the seal (1) out of the groove. Cut and remove the O-ring seal before removing the cover.

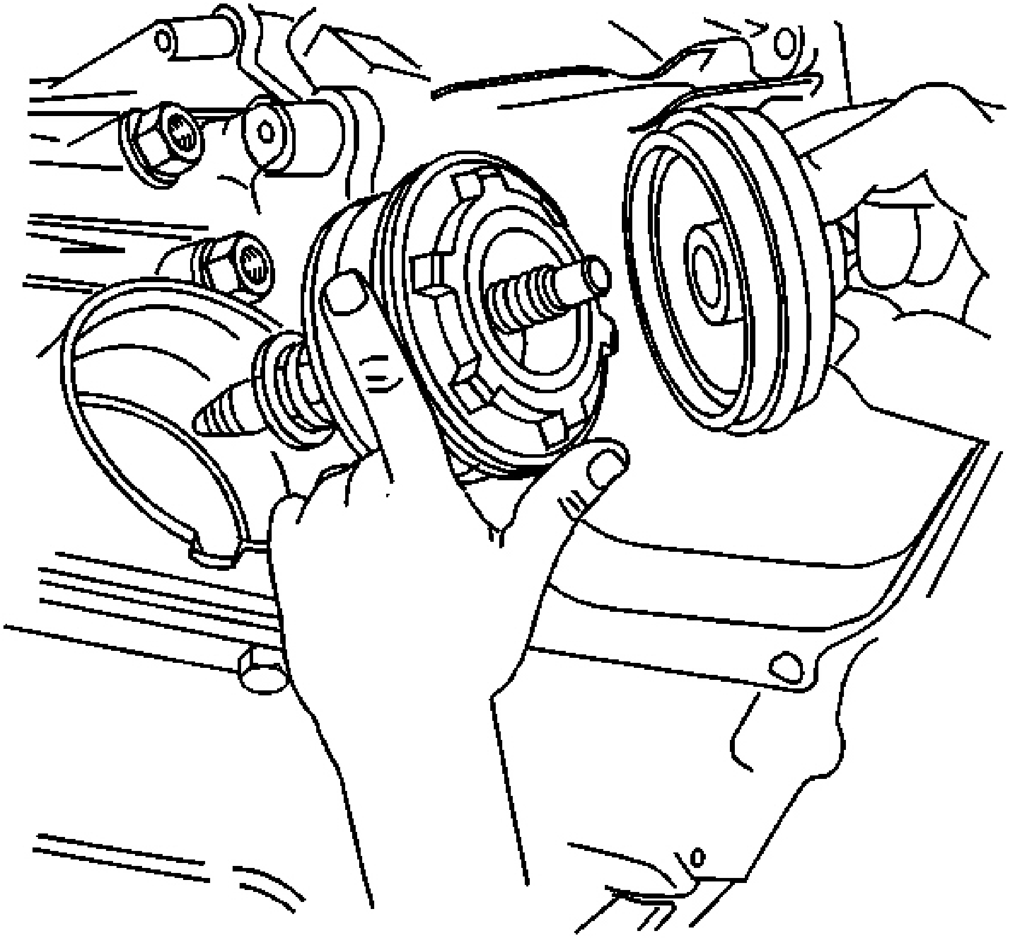


Fig. 87: View Of 2-4 Servo
Courtesy of GENERAL MOTORS CORP.

10. Remove the 2-4 servo from the transmission.
11. Inspect the 4th apply piston, 2-4 servo converter, 2nd apply piston, and the servo piston inner housing for the following defects.
    - Cracks
    - Scoring
    - Burrs and nicks

Installation Procedure

1. Install new seals on the servo pistons and the servo cover.

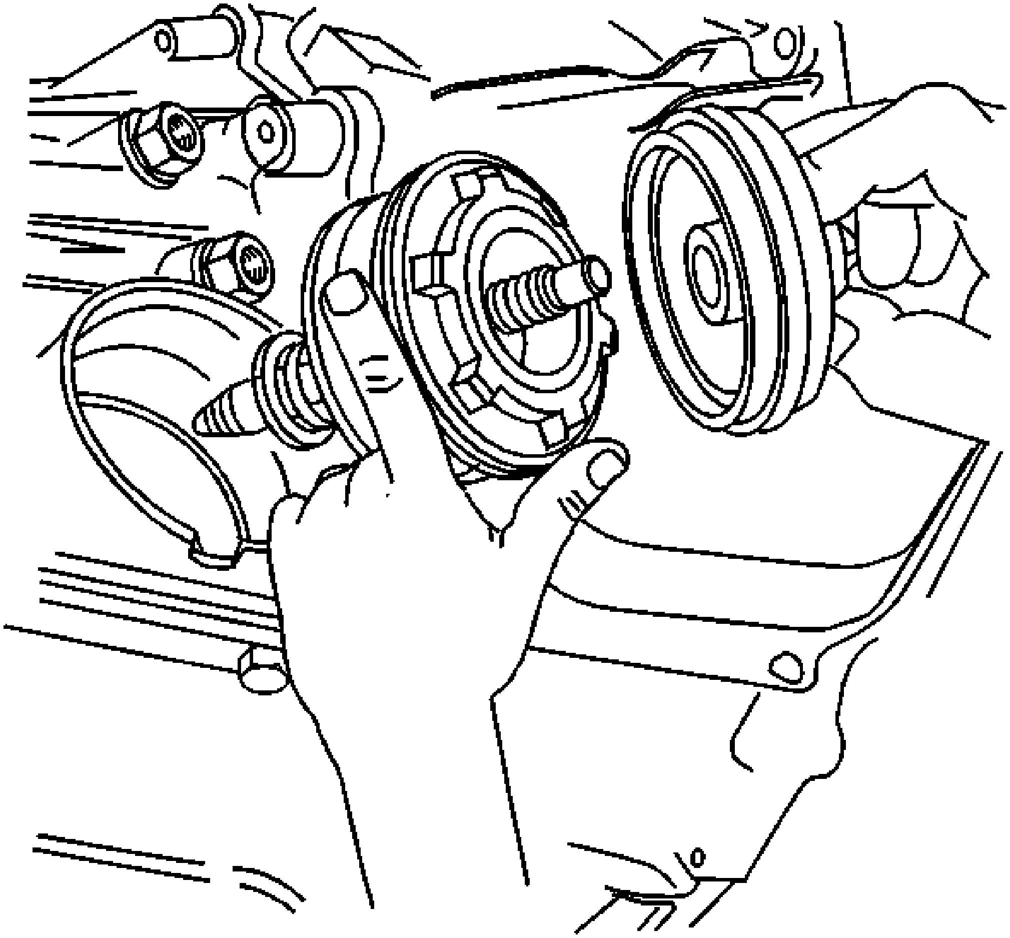


Fig. 88: View Of 2-4 Servo
Courtesy of GENERAL MOTORS CORP.

2. Install the 2-4 servo assembly into the transmission.
3. Install the **J 29714-A** . See **Special Tools and Equipment** .

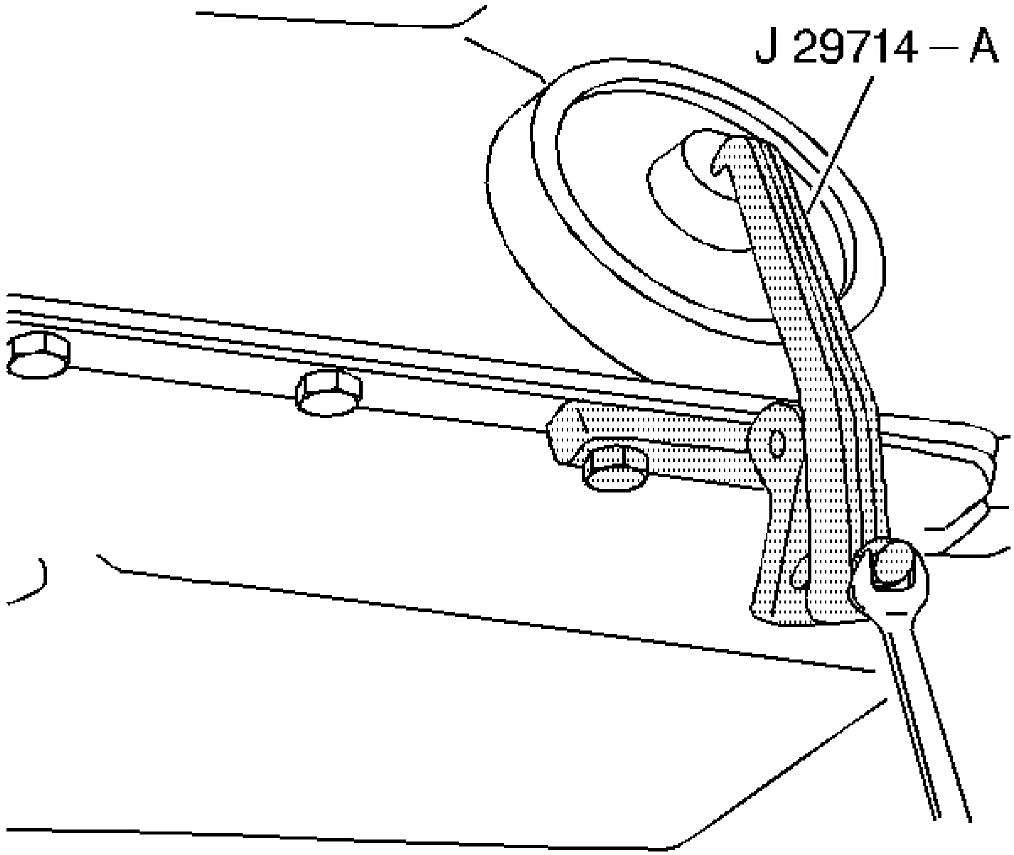


Fig. 89: Servo Using J 29714-A
Courtesy of GENERAL MOTORS CORP.

4. Tighten the bolt in order to compress the servo cover.
5. Install the servo cover retaining ring.
6. Remove the **J 29714-A** from the oil pan flange. See **Special Tools and Equipment** .

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

7. Install the oil pan bolt.

Tighten: Tighten the oil pan bolt to 11 N.m (97 lb in).

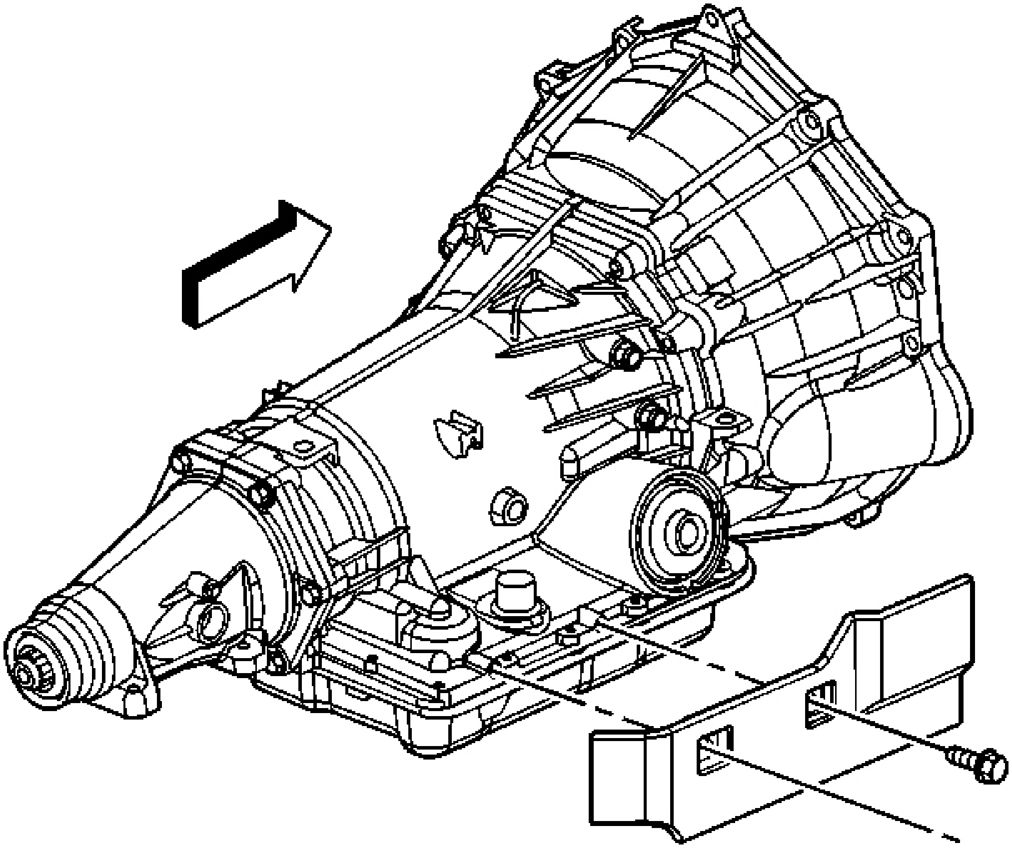


Fig. 90: Transmission Heat Shield Bolts & Heat Shield
Courtesy of GENERAL MOTORS CORP.

8. Install the heat shield.
9. Install the two bolts securing the transmission heat shield to the transmission.

   Tighten: Tighten the bolts to 17 N.m (13 lb ft).

10. Install the right hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
11. Lower the vehicle.
12. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

PRESSURE REGULATOR REPLACEMENT

Removal Procedure

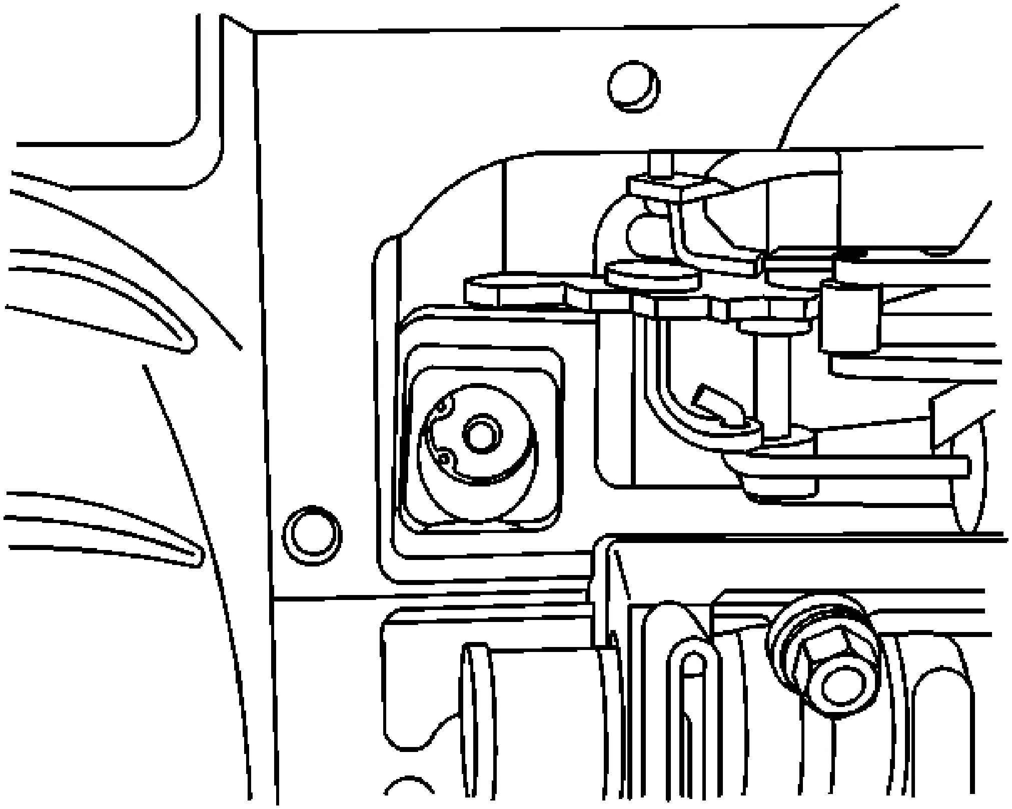


Fig. 91: Locating Reverse Boost Valve
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .
3. Compress the reverse boost valve sleeve into the bore of the oil pump to release tension on the reverse boost valve retaining ring.
4. Remove the reverse boost valve retaining ring, then slowly release tension on the reverse boost valve sleeve.

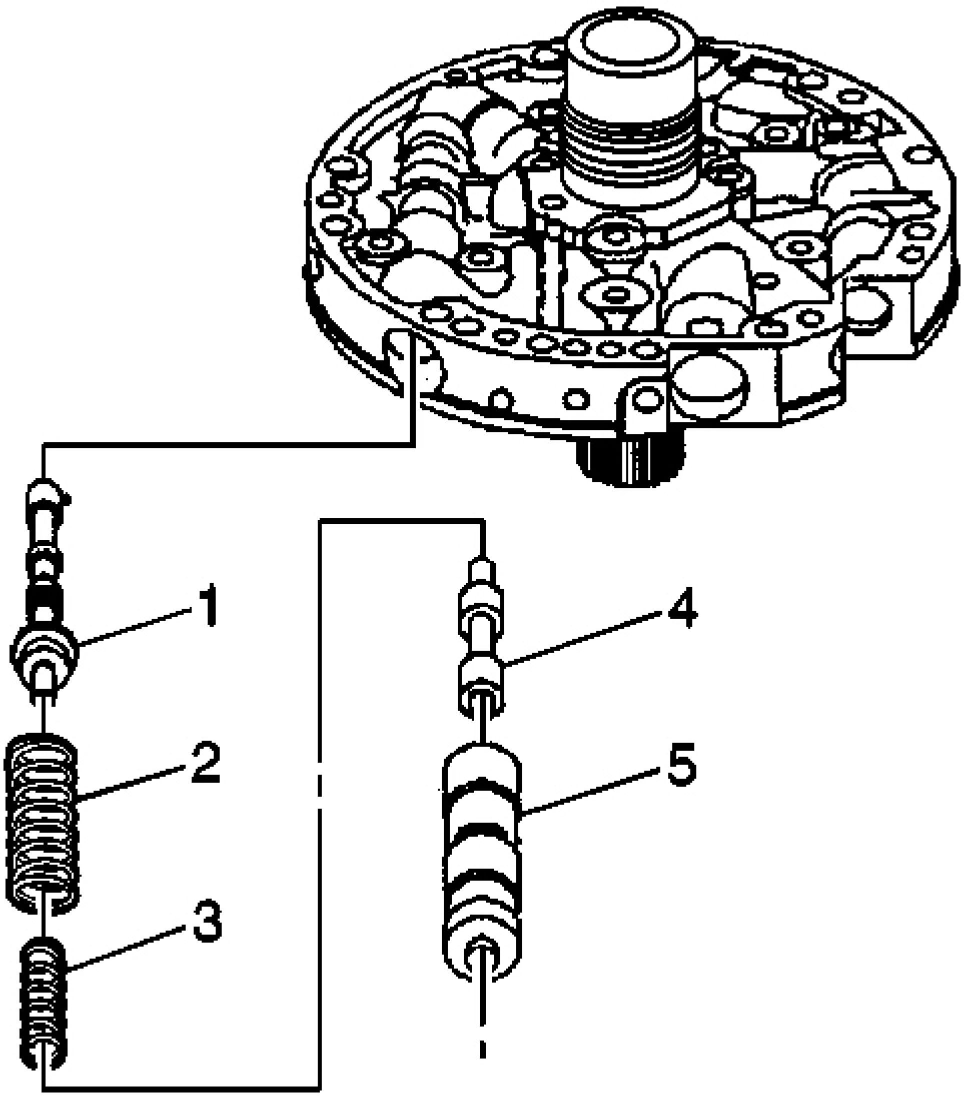


Fig. 92: Identifying Pressure Regulator Valve
Courtesy of GENERAL MOTORS CORP.

5. Remove the reverse boost valve sleeve (5) and the reverse boost valve (4).
6. Remove the pressure regulator isolator spring (3) and the pressure regulator valve spring (2).
7. Remove the pressure regulator valve (1).

Installation Procedure

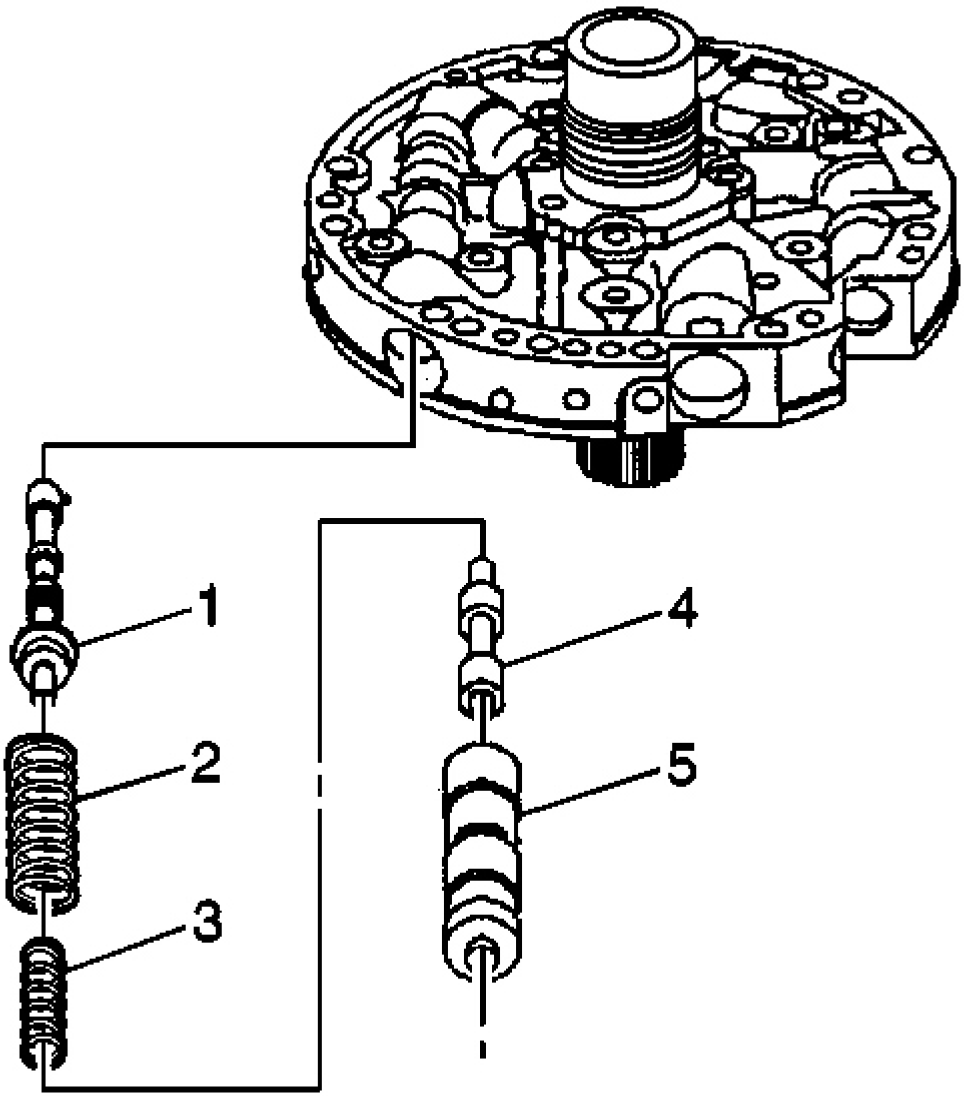


Fig. 93: Identifying Pressure Regulator Valve
Courtesy of GENERAL MOTORS CORP.

1. Install the pressure regulator valve (1).
2. Install the pressure regulator isolator spring (3) and the pressure regulator valve spring (2).
3. Install the reverse boost valve (4) in the reverse boost valve sleeve (5).
4. Install the reverse boost valve (4) and sleeve (5) in the oil pump cover.

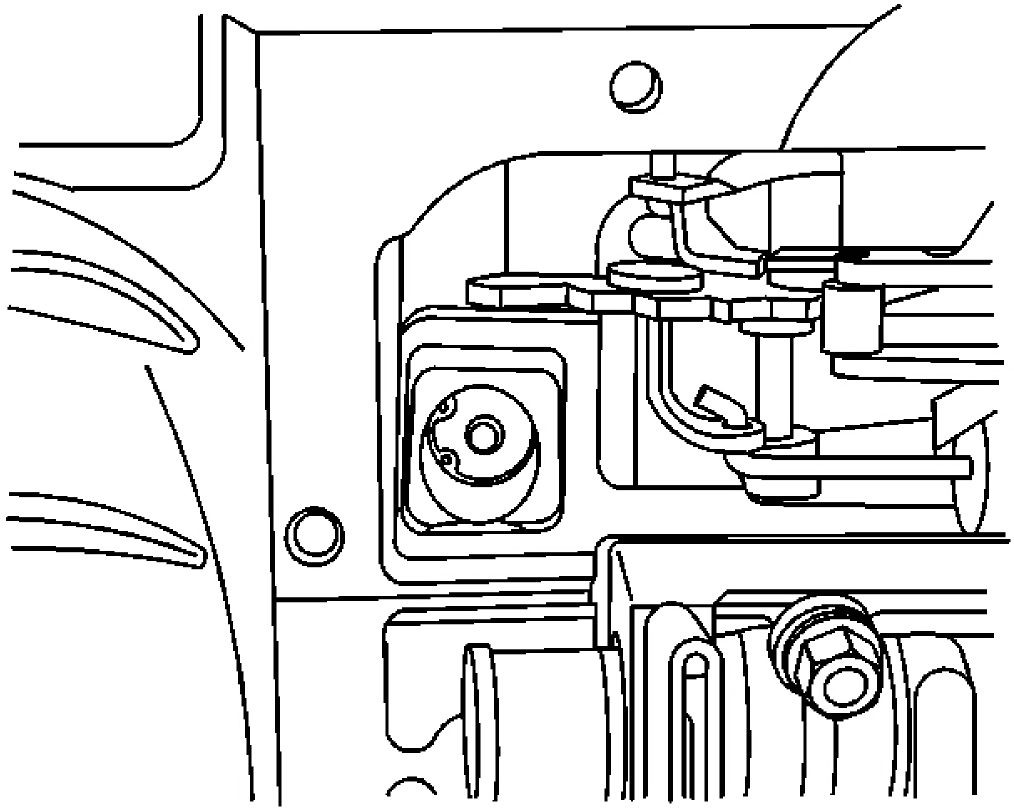


Fig. 94: Locating Reverse Boost Valve
Courtesy of GENERAL MOTORS CORP.

5. Compress the reverse boost valve sleeve into the bore of the oil pump to expose the retaining ring slot.
6. Install the reverse boost valve retaining ring, then slowly release tension on the reverse boost valve sleeve.
7. Install the transmission oil filter and pan. Refer to **Automatic Transmission Fluid/Filter Replacement** .
8. Lower the vehicle.
9. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

FILLER TUBE AND SEAL REPLACEMENT

Removal Procedure

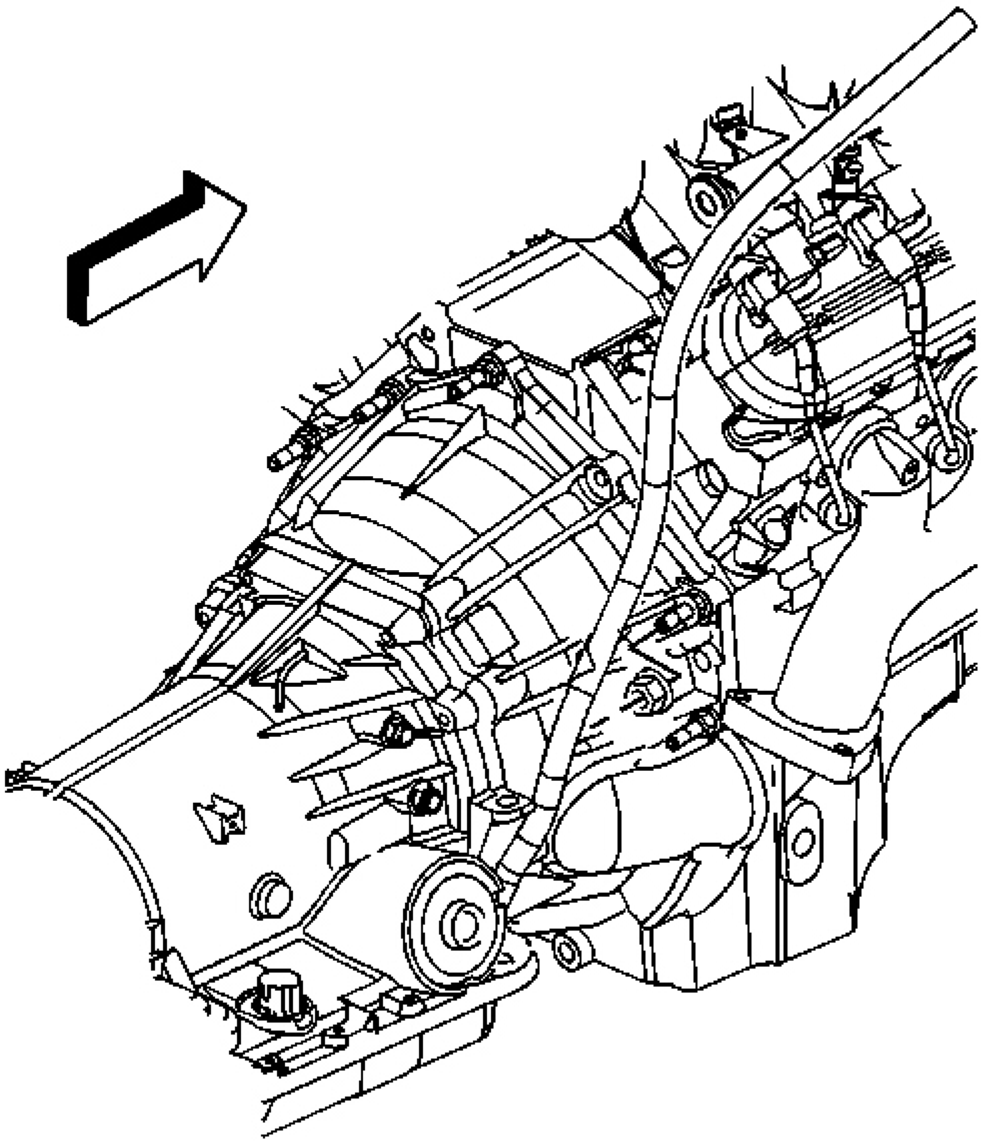


Fig. 95: Indicator Tube Nut
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission oil level indicator.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the right hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in

Engine Exhaust.

4. Remove the transmission heat shield bolt and shield.
5. Remove the nut securing the oil lever indicator tube to the transmission housing.

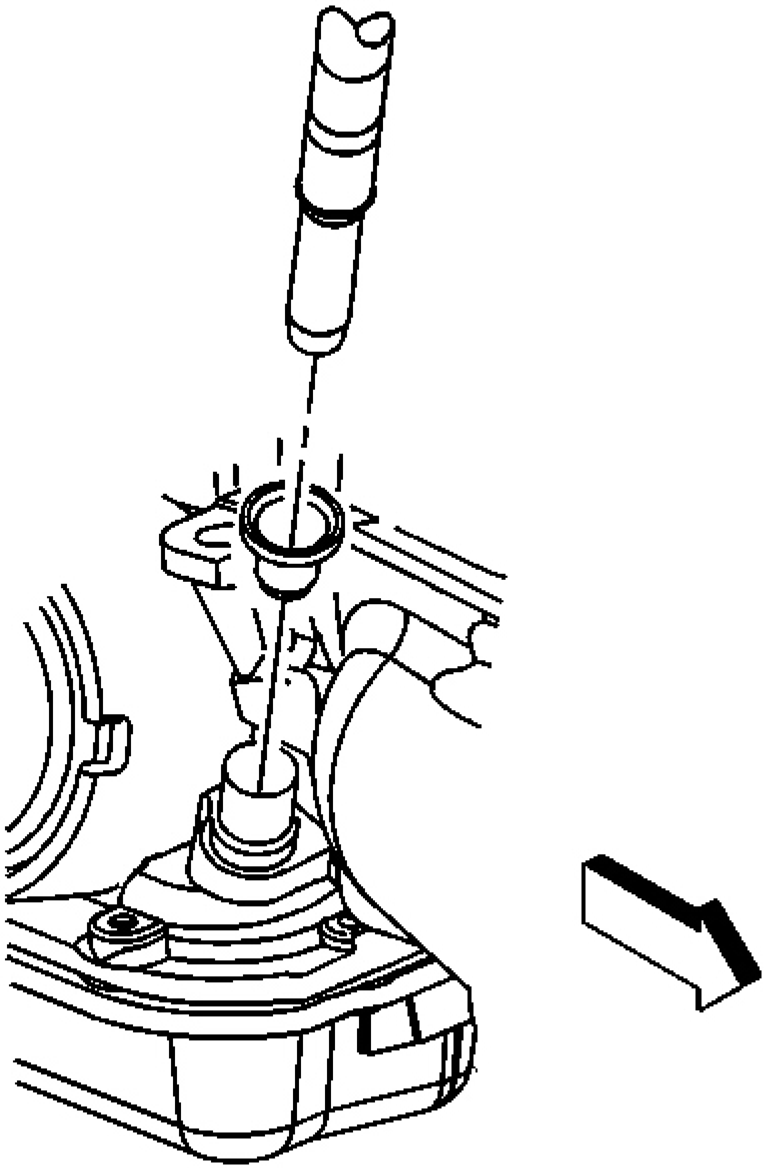


Fig. 96: Identifying Oil Level Indicator Tube (Without RPO HP2)
Courtesy of GENERAL MOTORS CORP.

6. Place a drain pan under the vehicle.
7. Remove the oil level indicator tube from the transmission case and seal.
8. Remove the seal from the transmission case.

Installation Procedure

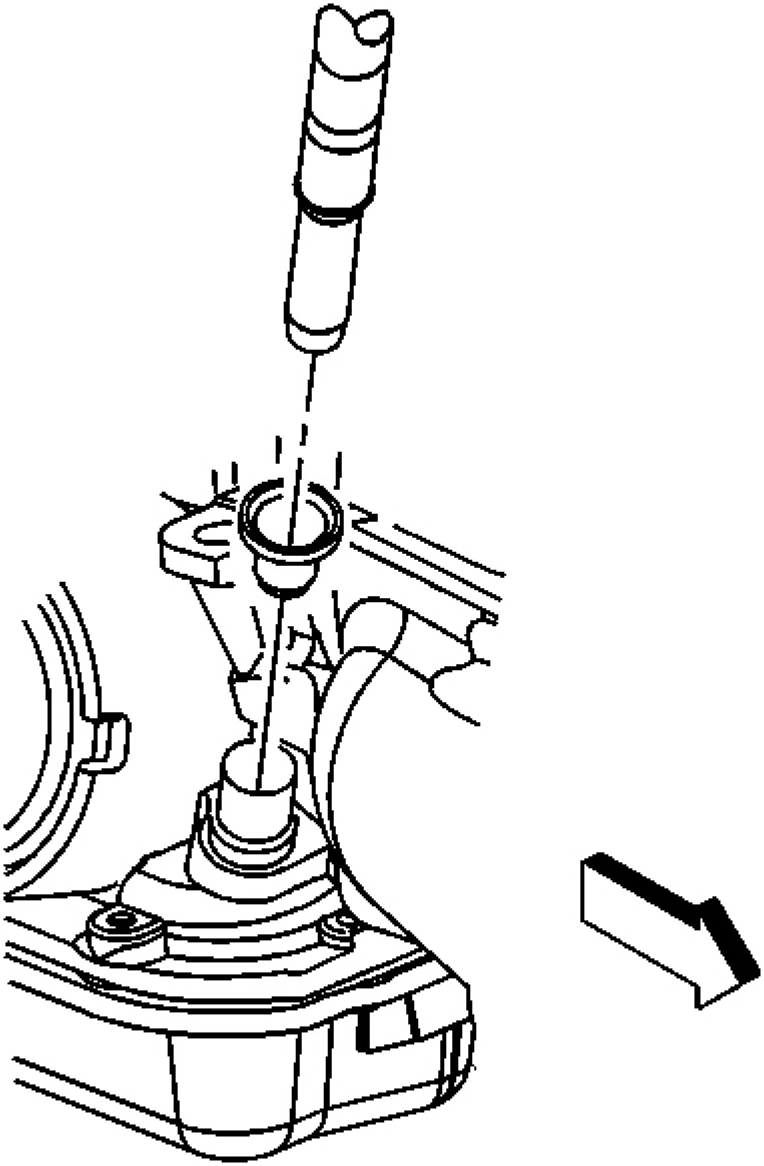


Fig. 97: Identifying Oil Level Indicator Tube (Without RPO HP2)
Courtesy of GENERAL MOTORS CORP.

1. Install a new seal into the transmission case.
2. Install the oil level indicator tube into the seal.

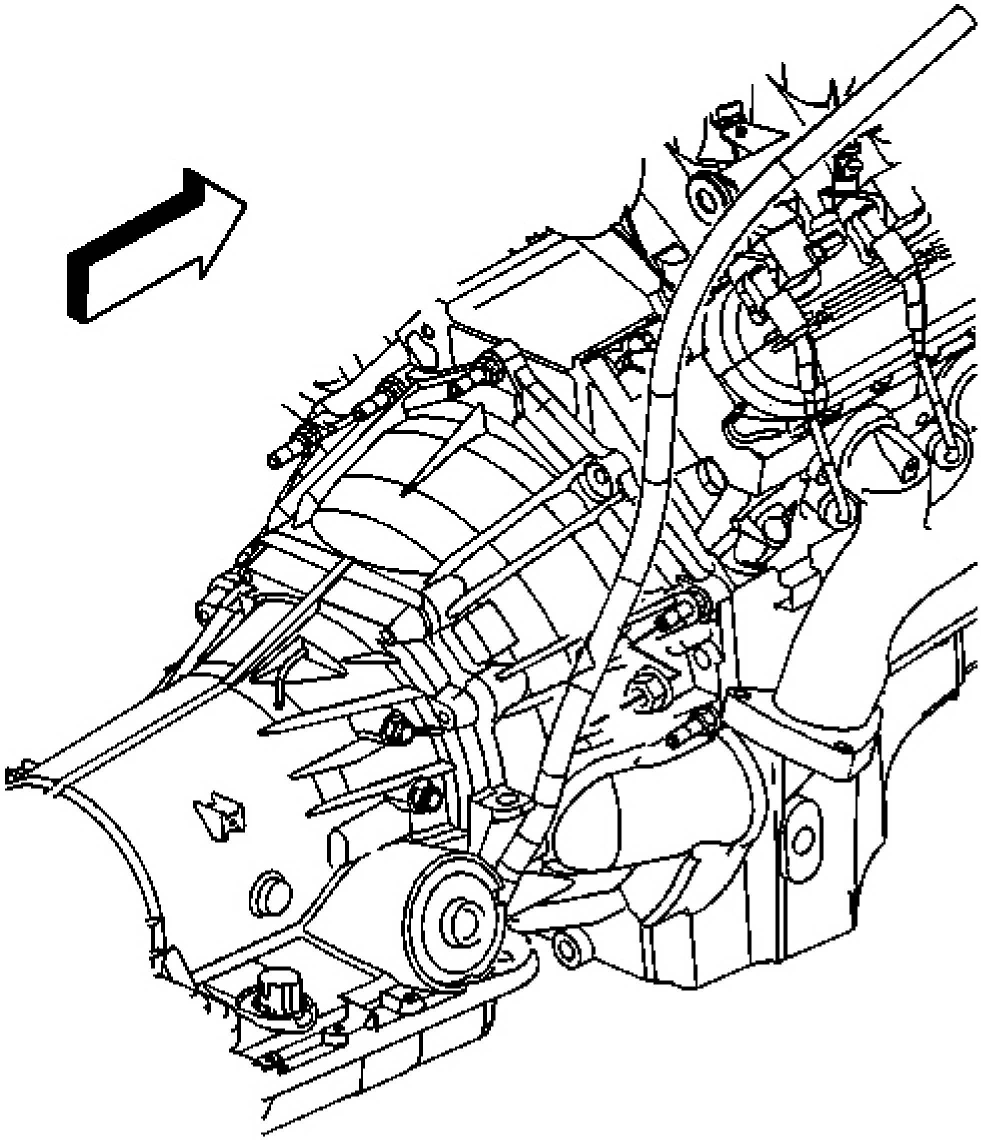


Fig. 98: Indicator Tube Nut

Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

3. Install the nut securing the oil level indicator tube to the transmission stud.

   Tighten: Tighten the nut to 18 N.m (13 lb ft).

4. Install the transmission heat shield.
5. Install the 2 bolts retaining the heat shield.

   Tighten: Tighten the bolts to 17 N.m (13 lb ft).

6. Install the right hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
7. Lower the vehicle.
8. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

MANUAL SHIFT SHAFT SEAL REPLACEMENT

Tools Required

- **J 43911** Selector Shaft Seal Remover. See **Special Tools and Equipment** .
- **J 43909** Selector Shaft Seal Installer. See **Special Tools and Equipment** .

Removal Procedure

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the Park/Neutral Position (PNP) Switch. Refer to **Park/Neutral Position Switch Replacement** .

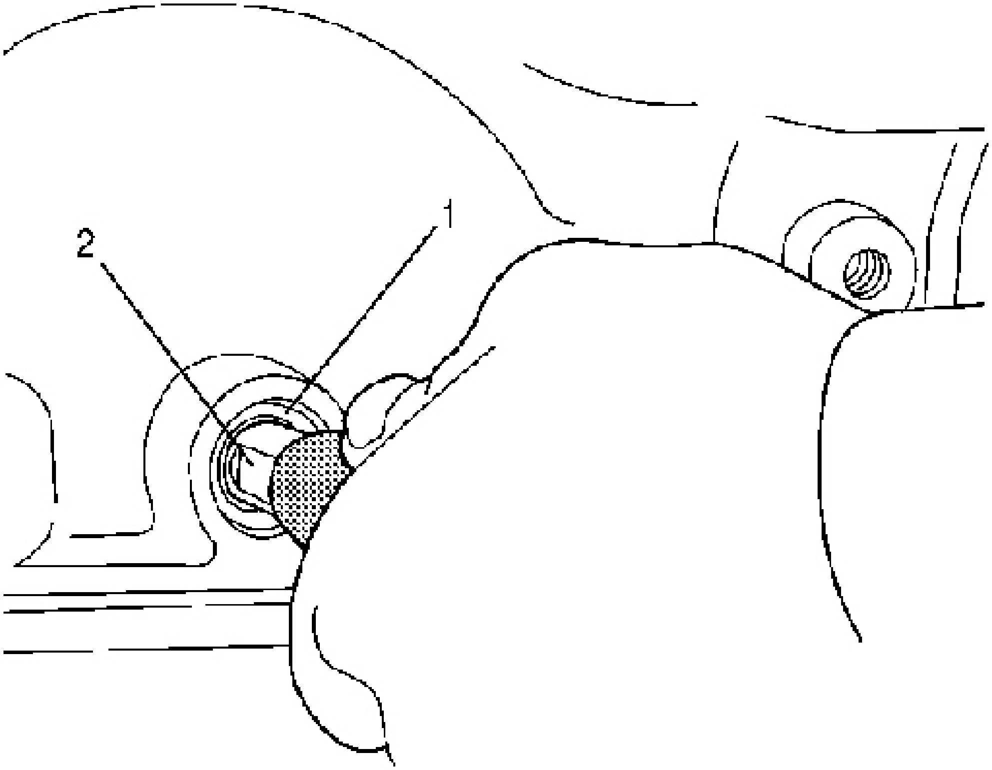


Fig. 99: Sliding Seal Remover Tool Over The Selector Shaft
Courtesy of GENERAL MOTORS CORP.

3. Be sure that the jackscrew for **J 43911** is backed off and will not interfere with installation of the removal tool. Slide the seal remover tool over the selector shaft (2) with the threaded end of the tool towards the seal. See **Special Tools and Equipment** .
4. Rotate the removal tool so that the threads on the end of the tool engage the steel shell (1) of the seal. Use a wrench to be sure that the removal tool is firmly attached to the seal shell.
5. Rotate the jackscrew in the clockwise direction to remove the seal from the bore. Discard the seal that was removed.

Installation Procedure

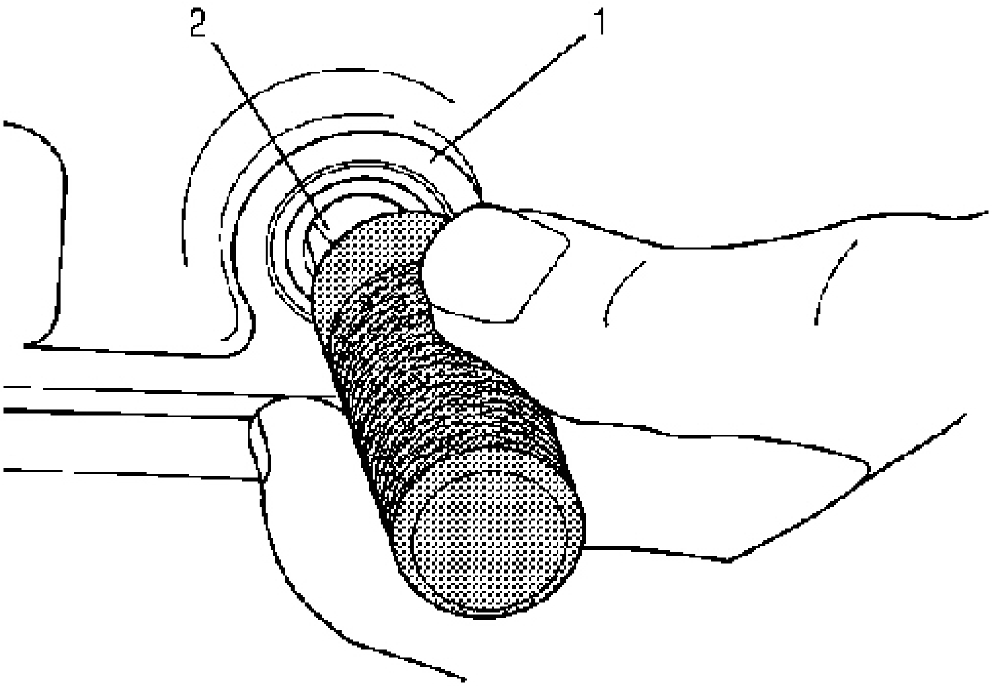


Fig. 100: Sliding New Selector Shaft Seal Over The Selector Shaft
Courtesy of GENERAL MOTORS CORP.

1. Carefully slide a new selector shaft seal (1) over the selector shaft (2) with the wide face of the steel case facing outward. Position the seal so that it is starting to enter the seal bore.
2. Obtain **J 43909** and remove the inner sleeve so that the tool will slide over the selector shaft. See **Special Tools and Equipment** .
3. Slide the **J 43909** into position so that the end of the tool contacts the seal being installed. Use a mallet to strike the **J 43909** and drive the new seal into the seal bore until it is seated at the bottom of the bore. See **Special Tools and Equipment** .
4. Install the PNP Switch. Refer to **Park/Neutral Position Switch Replacement** .
5. Lower the vehicle.
6. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

VALVE BODY AND PRESSURE SWITCH REPLACEMENT

Removal Procedure

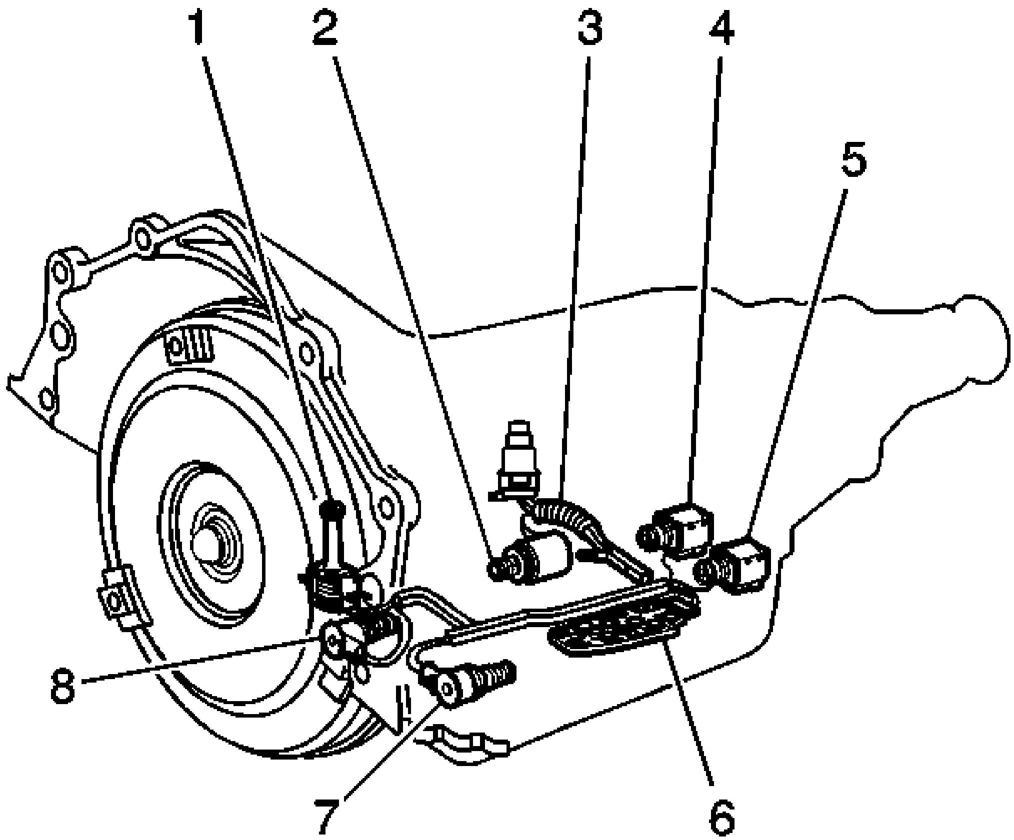


Fig. 101: Valve Body Electrical Components
Courtesy of GENERAL MOTORS CORP.

1. Ensure that removal of the valve body is necessary before proceeding.

IMPORTANT: The following components can be serviced without removing the valve body from the transmission:

- The torque converter clutch solenoid (1)
- The pressure control solenoid (2)
- The internal wiring harness (3)
- The 2-3 shift solenoid (4)
- The 1-2 shift solenoid (5)
- The transmission fluid pressure manual valve position switch (6)
- The 3-2 shift solenoid (7)

- The torque converter clutch pulse width modulation (TCC PWM) solenoid (8)

2. Remove the fluid level indicator.
3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the oil pan, gasket, and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .

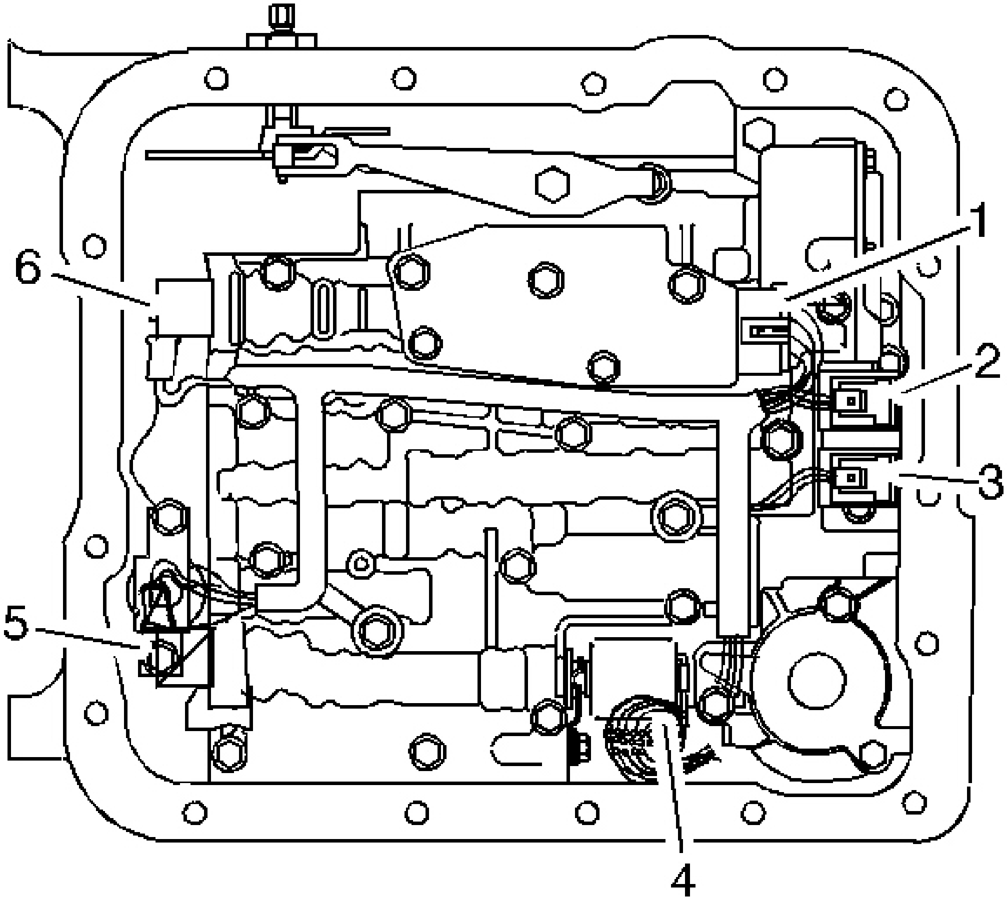


Fig. 102: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the internal wiring harness electrical connectors from the following components:
   - The transmission fluid pressure manual valve position switch (1)
   - The 1-2 shift solenoid (2)
   - The 2-3 shift solenoid (3)

- The pressure control solenoid (4)
- The TCC PWM solenoid (5)
- The 3-2 shift solenoid (6)

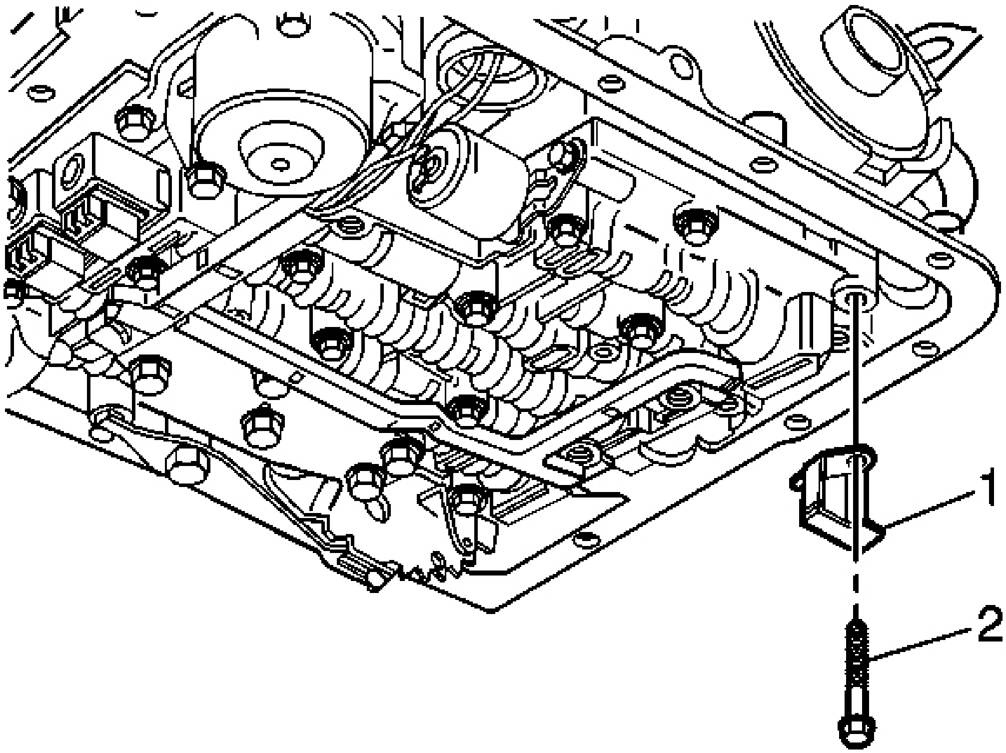


Fig. 103: Transmission Fluid Indicator Stop Bracket
Courtesy of GENERAL MOTORS CORP.

6. Remove the fluid indicator stop bracket bolt (2).
7. Remove the fluid indicator bracket (1).

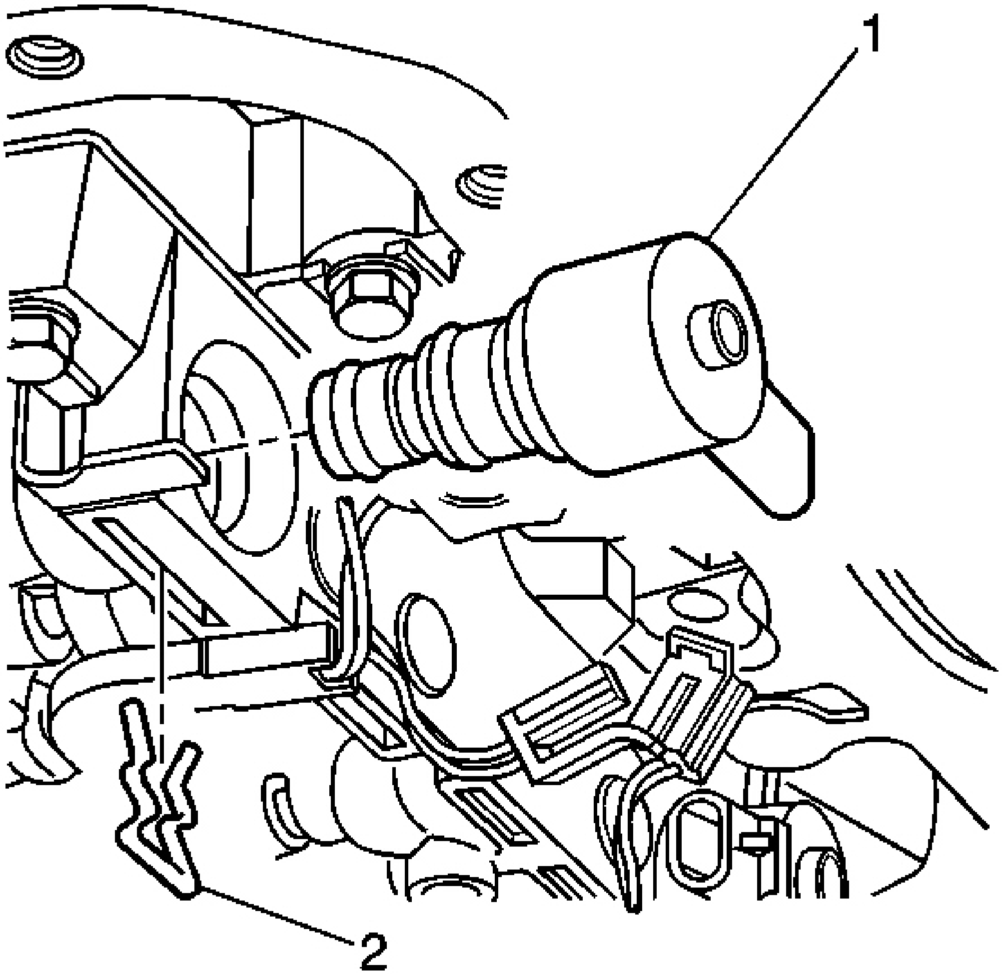


Fig. 104: TCC PWM Solenoid
Courtesy of GENERAL MOTORS CORP.

8. Remove the TCC PWM solenoid retainer (2) with a small screwdriver. Rotate the solenoid (1) in the bore, if necessary, until the flat part of the retainer (2) is visible.
9. Remove the TCC PWM solenoid (1) in order to access the TCC solenoid retaining bolts.

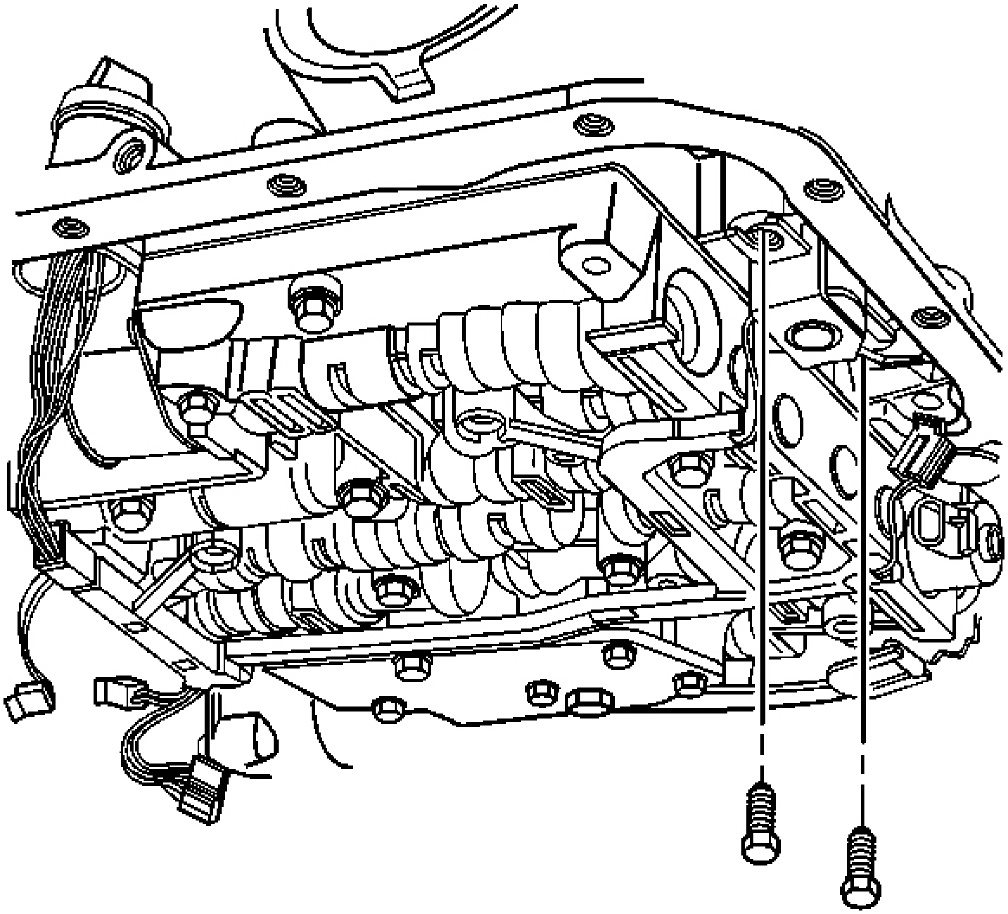


Fig. 105: Identifying TCC Solenoid & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the TCC solenoid retaining bolts.

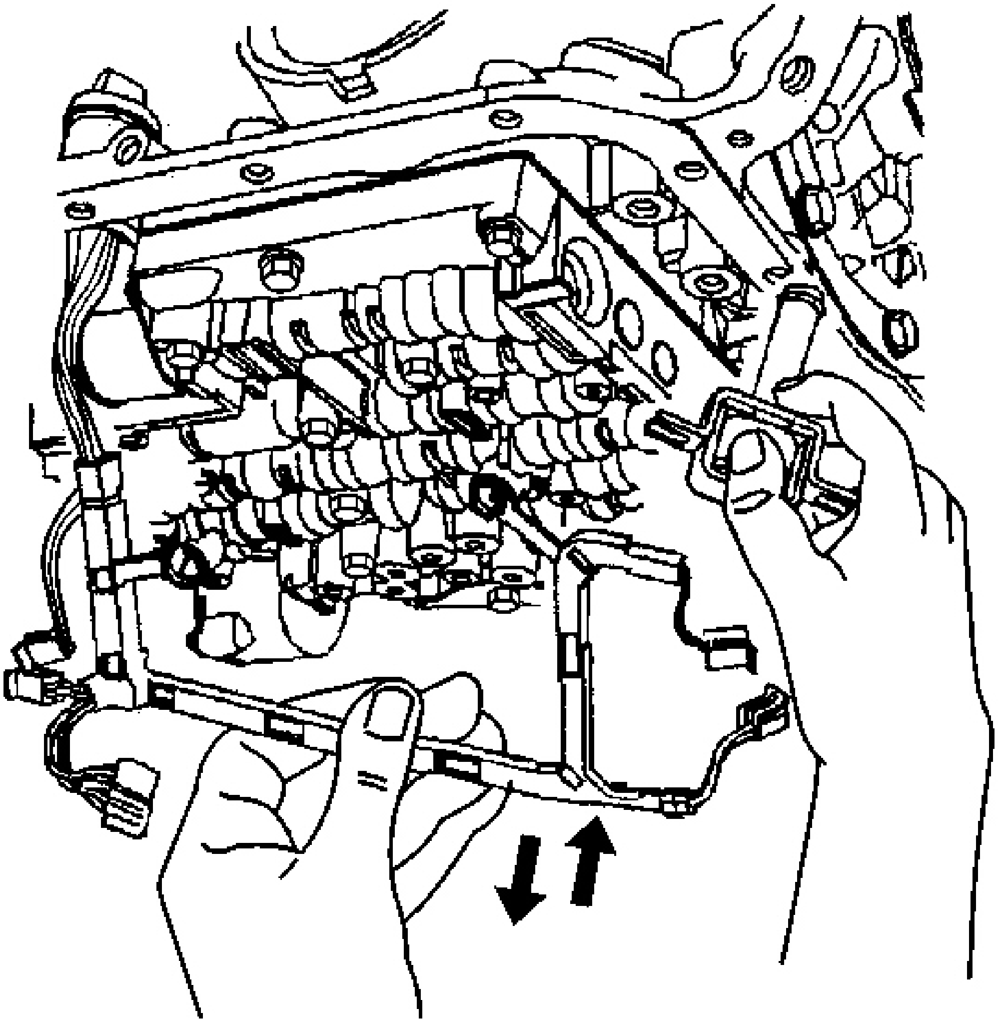


Fig. 106: Identifying TCC Solenoid (With O-Ring Seal) & Wiring Harness
Courtesy of GENERAL MOTORS CORP.

11. Remove the TCC solenoid (with O-ring seal) and wiring harness from the control valve body.
12. Reposition the harness to the side of the transmission case.

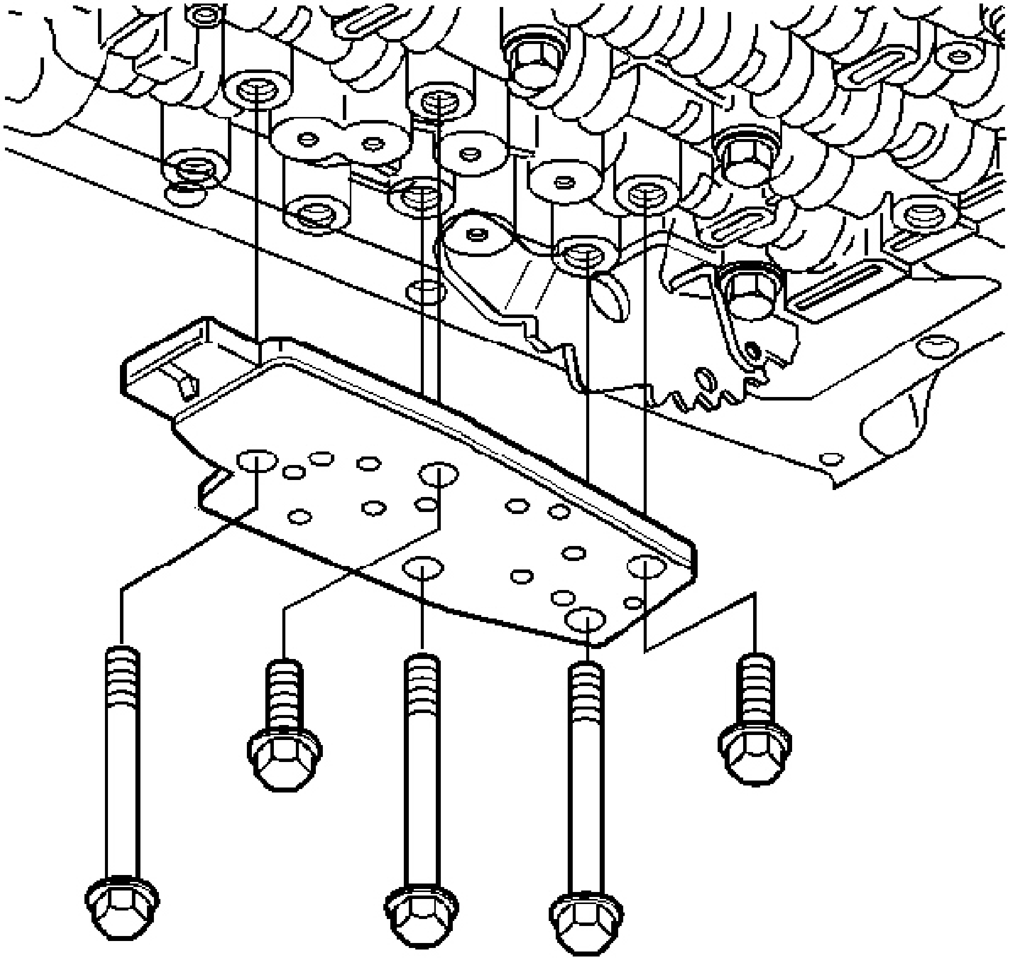


Fig. 107: Identifying Transmission Fluid Pressure Switch
Courtesy of GENERAL MOTORS CORP.

13. Remove the control valve body bolts which retain the transmission fluid pressure switch to the control valve body.
14. Remove the transmission fluid pressure switch.

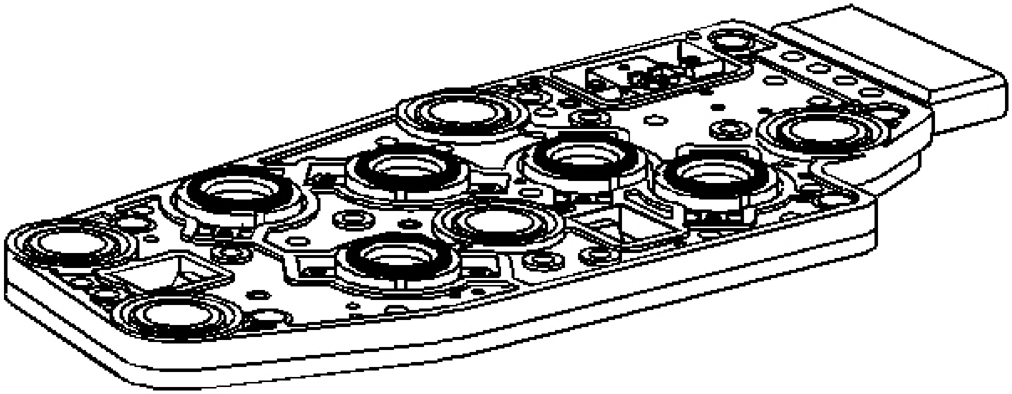


Fig. 108: Inspecting Transmission Fluid Pressure Switch
Courtesy of GENERAL MOTORS CORP.

15. Inspect the transmission fluid pressure switch for damage or debris.

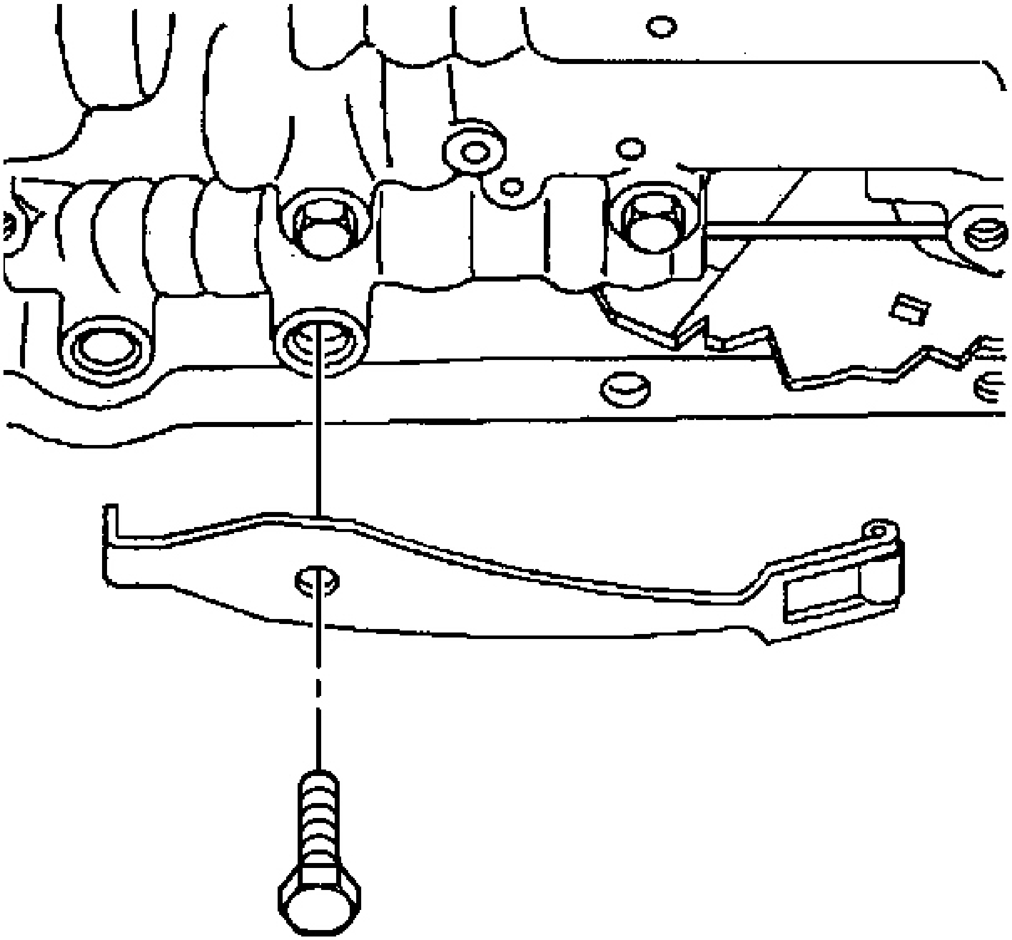


Fig. 109: Identifying Manual Detent Spring
Courtesy of GENERAL MOTORS CORP.

16. Remove the manual detent spring retaining bolt.
17. Remove the manual detent spring.
18. Inspect the manual detent spring for cracks or damage.

IMPORTANT: Keep the control valve body level when lowering it from the vehicle. This will prevent the loss of checkballs located in the control valve body passages.

19. Remove the remaining control valve body bolts.

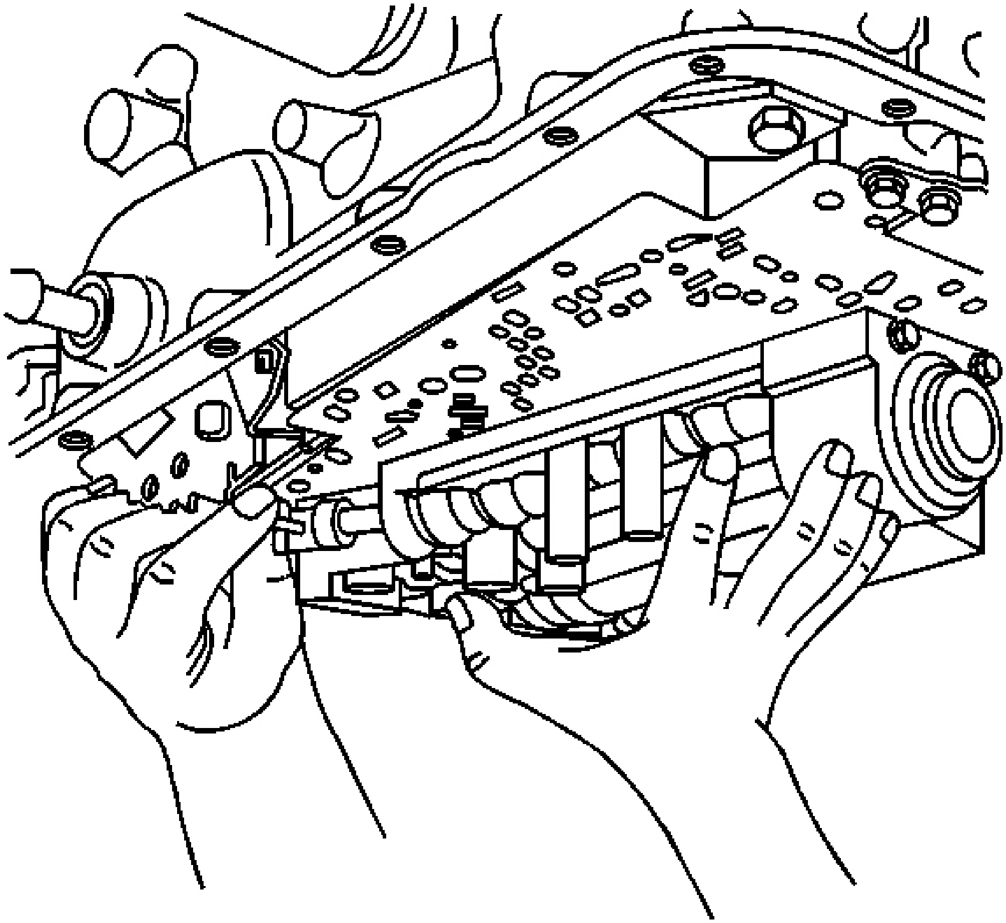


Fig. 110: View Of Valve Body & Transmission Case
Courtesy of GENERAL MOTORS CORP.

20. Carefully begin to lower the control valve body down from the transmission case while simultaneously disconnecting the manual valve link.

Installation Procedure

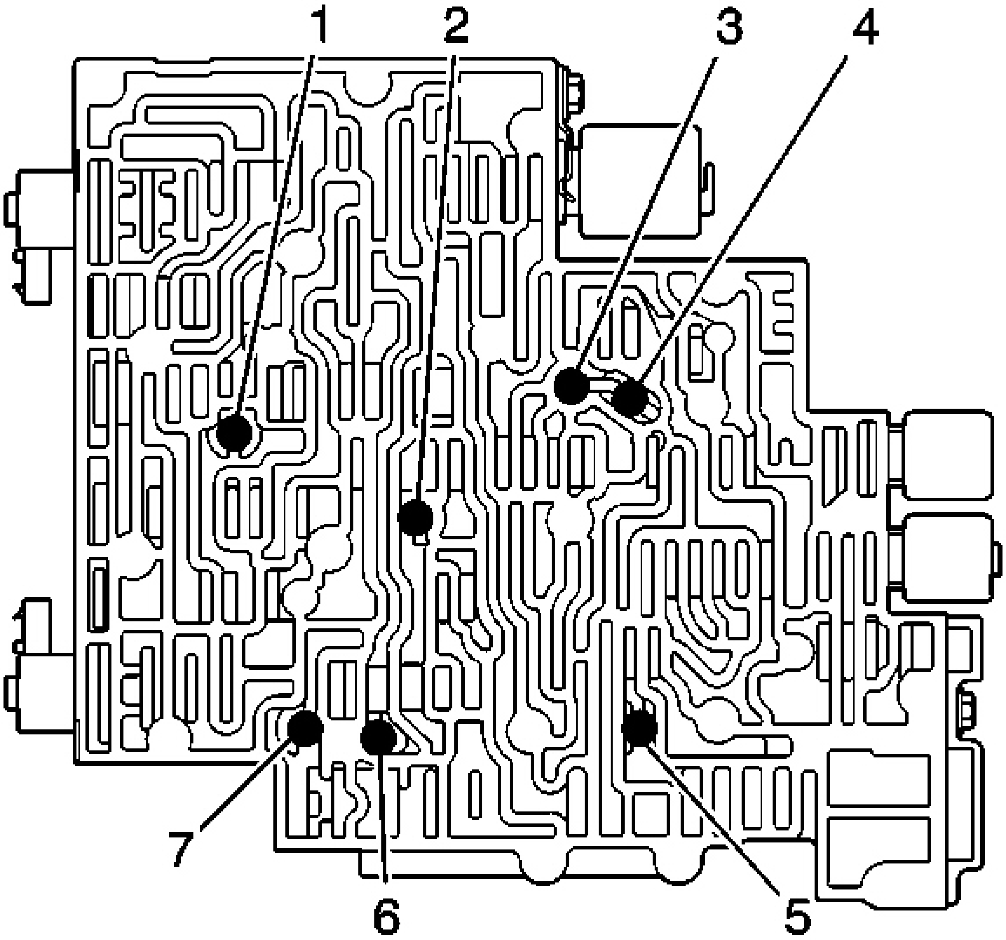


Fig. 111: Locating Seven Valve Body Check Balls
Courtesy of GENERAL MOTORS CORP.

1. Install the checkballs (1-7) in the valve body.

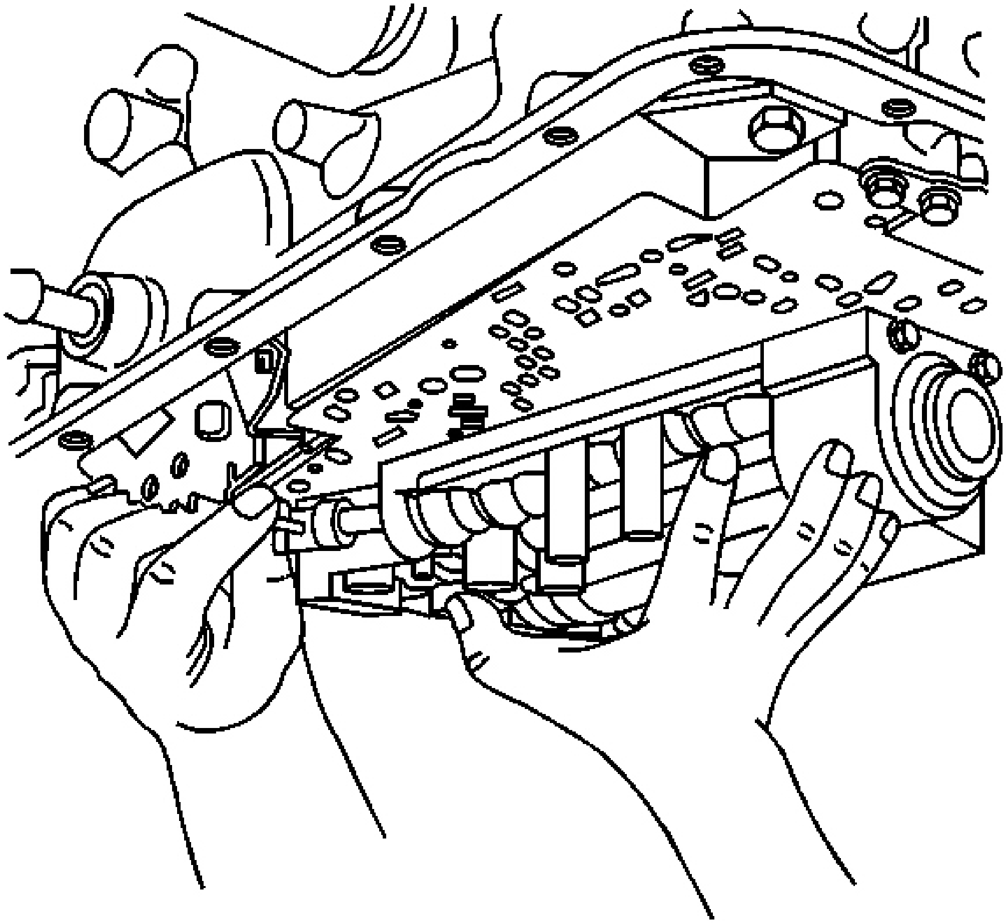


Fig. 112: View Of Valve Body & Transmission Case
Courtesy of GENERAL MOTORS CORP.

2. Install the control valve body to the transmission case while simultaneously connecting the manual valve link to the manual valve.

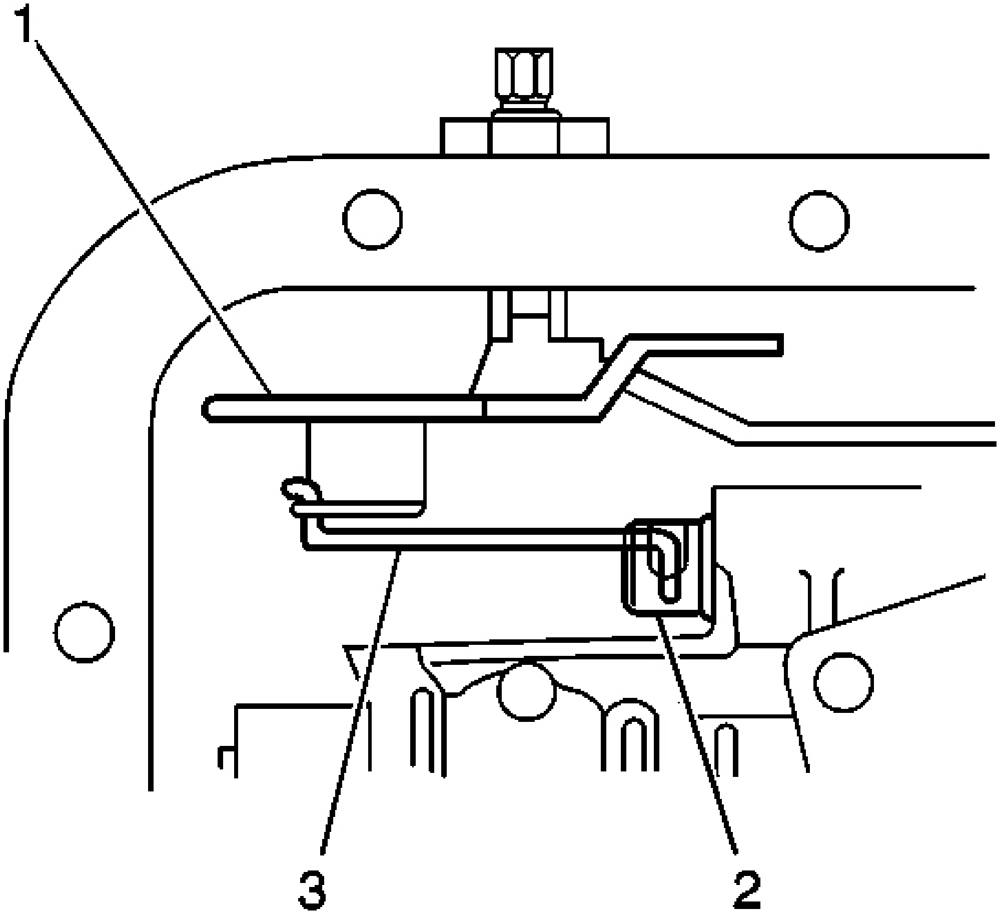


Fig. 113: Verifying Manual Valve Link Is Installed Properly To Inside Detent Lever & Manual Valve
Courtesy of GENERAL MOTORS CORP.

3. Verify that the manual valve link (3) is installed properly to the inside detent lever (1) and the manual valve (2).

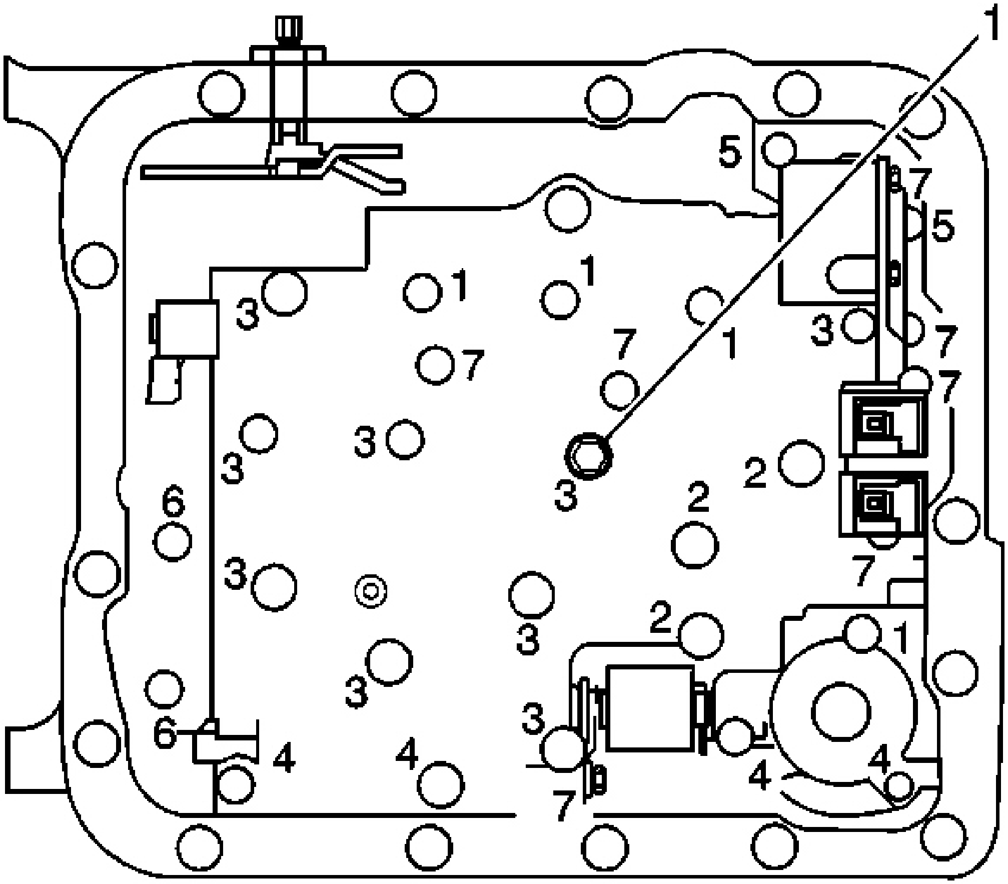


Fig. 114: Installing One Bolt Hand Tight In Center Of Valve Body
Courtesy of GENERAL MOTORS CORP.

4. Install one bolt (M6 X 1.0 X 47.5) hand tight in the center (1) of the valve body to hold it in place.

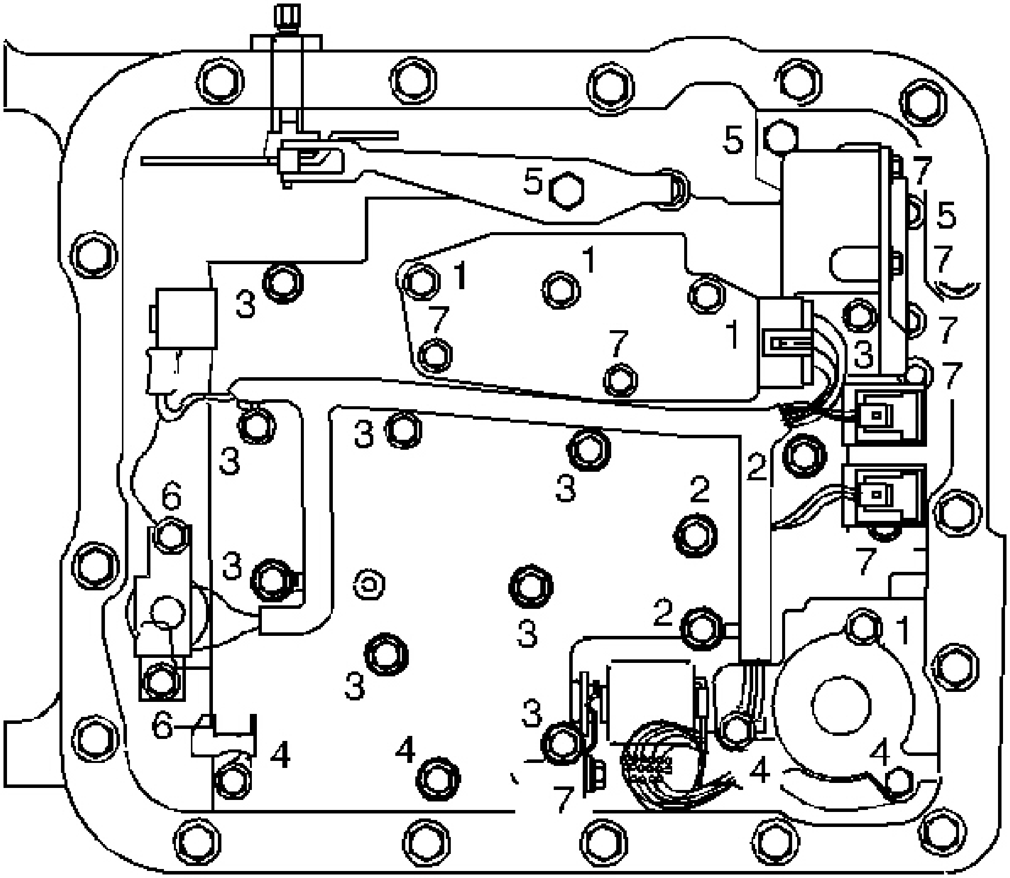


Fig. 115: Installing Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **When installing bolts throughout this procedure, be sure to use the correct bolt size and length in the correct location as specified.**

5. Do not install the transmission fluid indicator stop bracket and bolt at this time.

   Install but do not tighten the control valve body bolts which retain only the valve body directly.

   Each numbered bolt location corresponds to a specific bolt size and length, as indicated by the following:

   - M6 X 1.0 X 65.0 (1)
   - M6 X 1.0 X 54.4 (2)

- M6 X 1.0 X 47.5 (3)
- M6 X 1.0 X 35.0 (4)
- M8 X 1.0 X 20.0 (5)
- M6 X 1.0 X 12.0 (6)
- M6 X 1.0 X 18.0 (7)

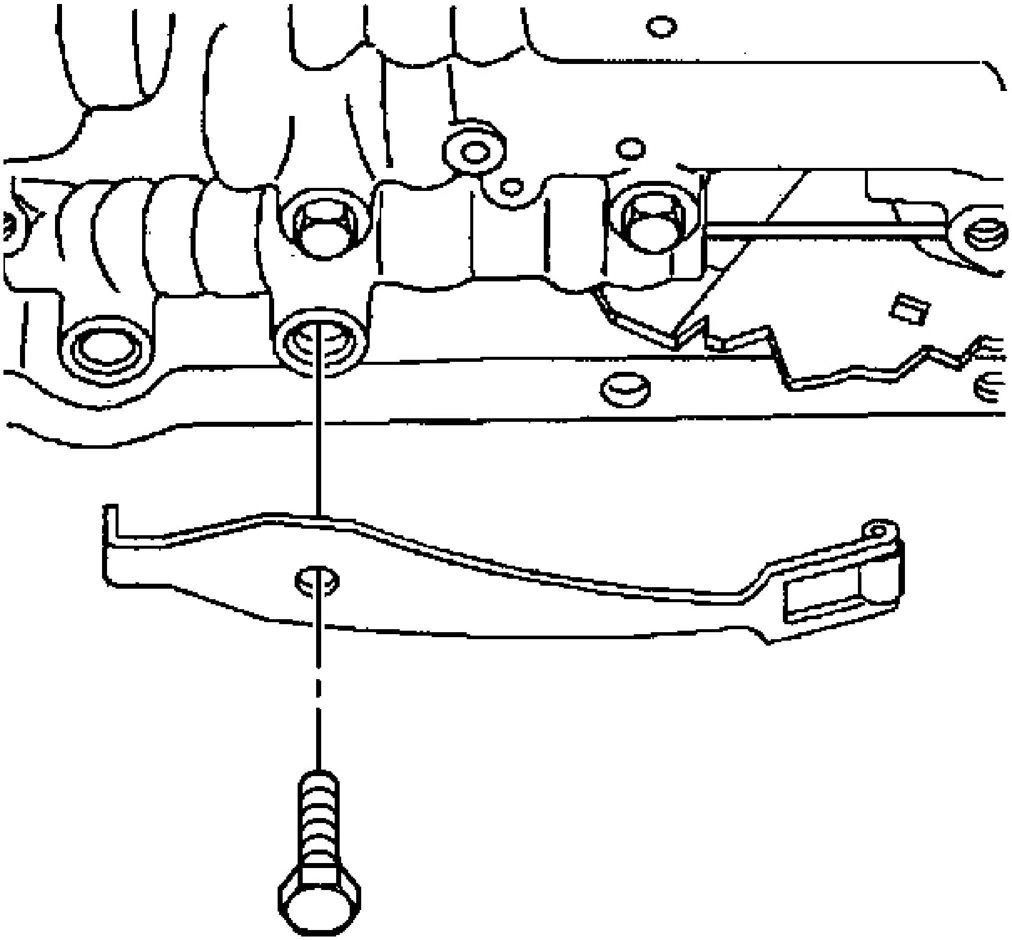


Fig. 116: Identifying Manual Detent Spring
Courtesy of GENERAL MOTORS CORP.

6. Install the manual detent spring.
7. Install but do not tighten the manual detent spring retaining bolt.

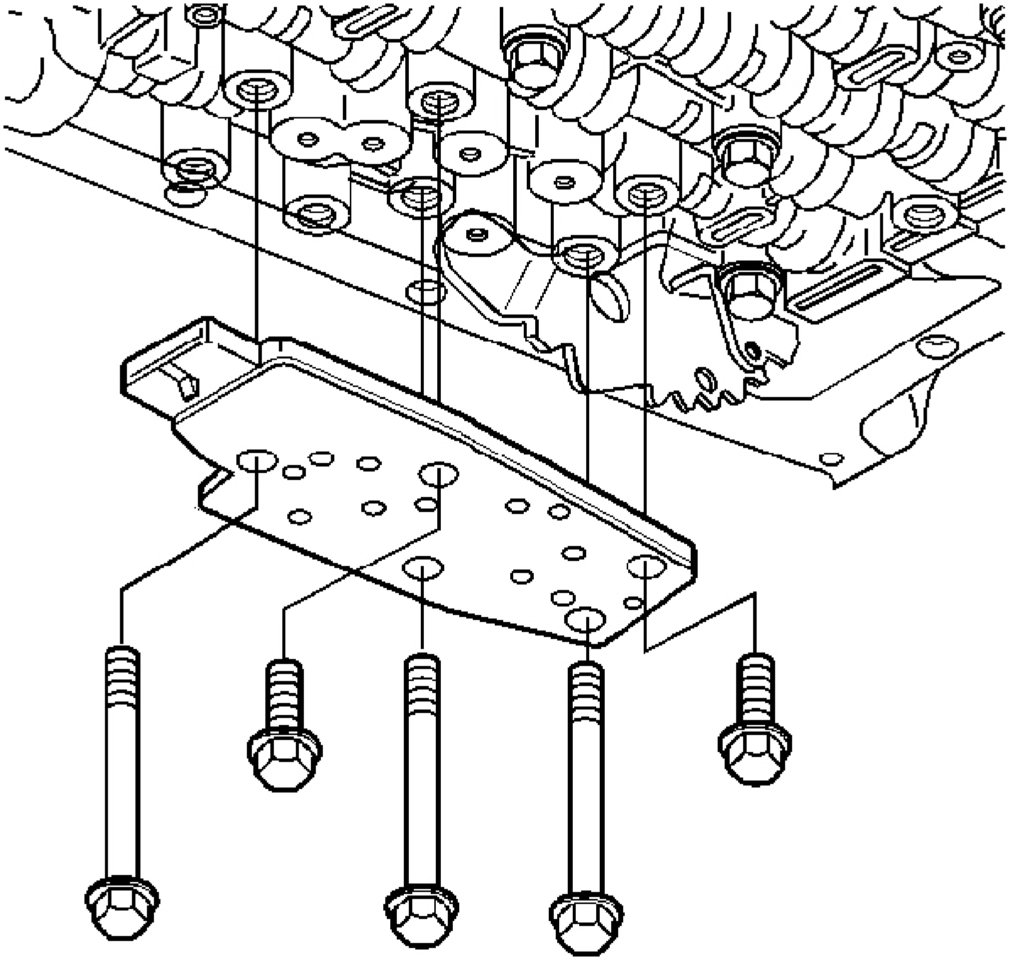


Fig. 117: Identifying Transmission Fluid Pressure Switch
Courtesy of GENERAL MOTORS CORP.

8. Install the transmission fluid pressure switch.
9. Install but do not tighten the control valve body bolts which retain the transmission fluid pressure switch to the control valve body.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

NOTE: **Torque valve body bolts in a spiral pattern starting from the center. If the bolts are torqued at random, valve bores may be distorted and inhibit valve operation.**

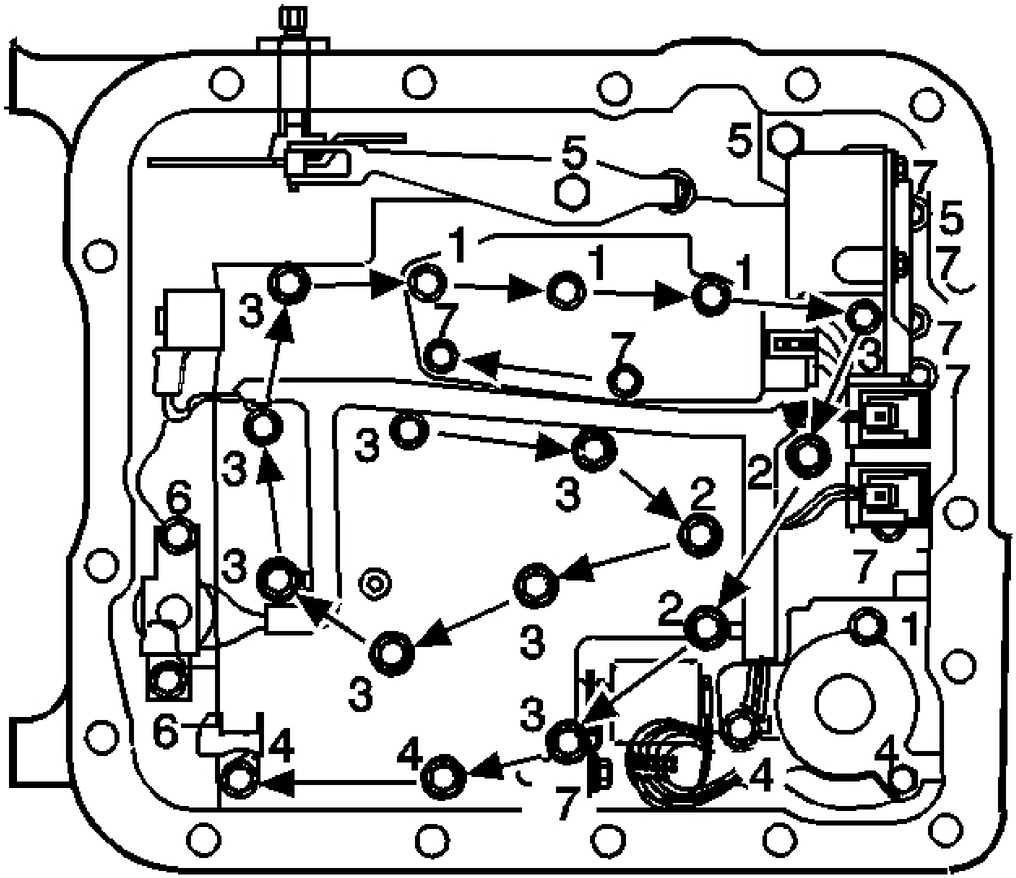


Fig. 118: Valve Body Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

10. Tighten the control valve body bolts in a spiral pattern starting from the center, as indicated by the arrows.

    Tighten: Tighten the control valve body bolts (in sequence) to 11 N.m (97 lb in).

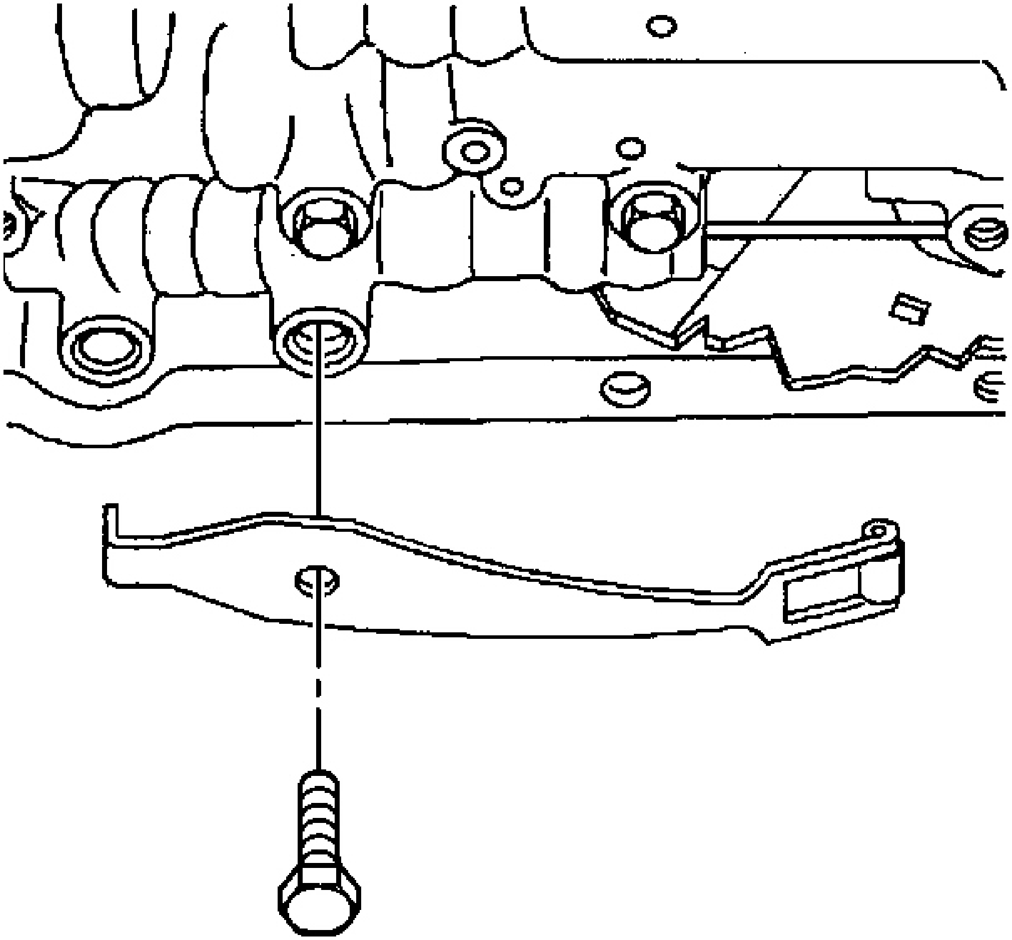


Fig. 119: Identifying Manual Detent Spring
Courtesy of GENERAL MOTORS CORP.

11. Ensure that the manual detent spring is aligned properly with the detent lever.

    Tighten: Tighten the manual detent spring bolt to 11 N.m (97 lb in).

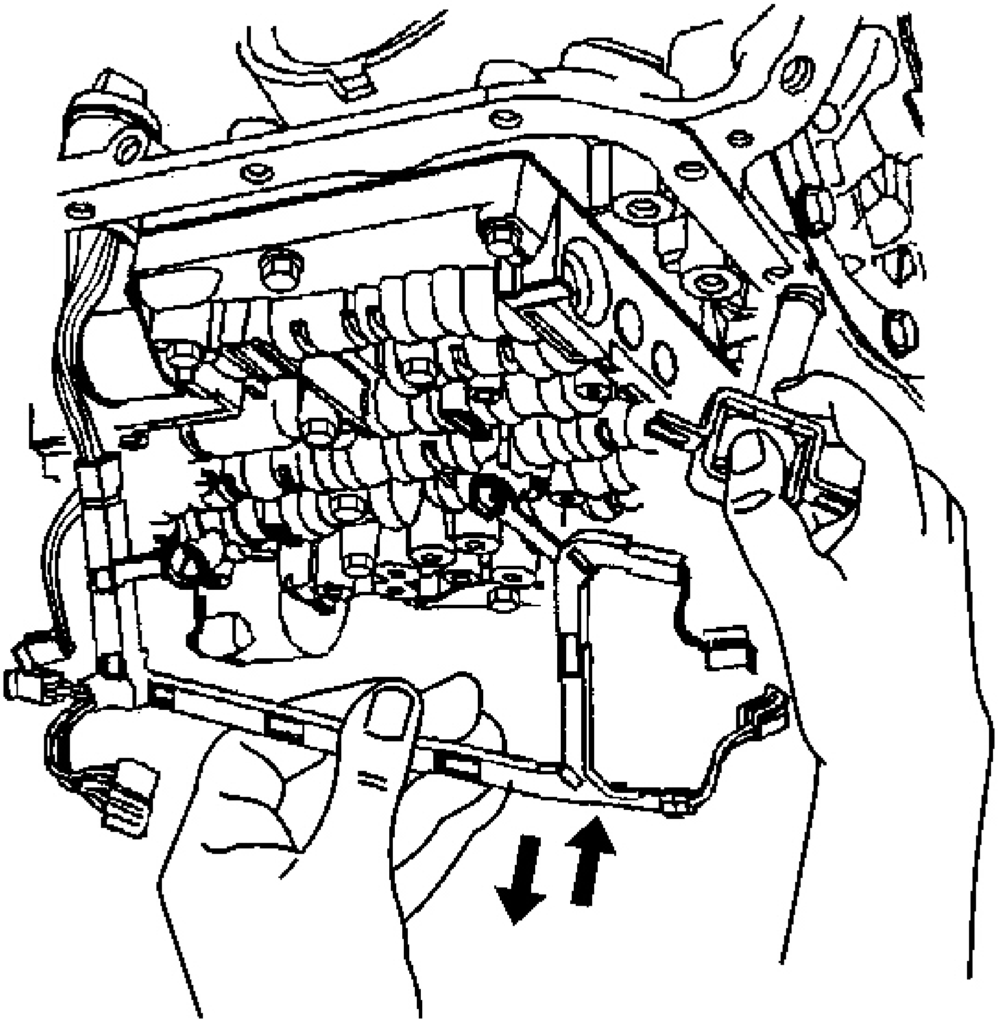


Fig. 120: Identifying TCC Solenoid (With O-Ring Seal) & Wiring Harness
Courtesy of GENERAL MOTORS CORP.

12. Install the TCC solenoid with a new O-ring seal to the valve body.

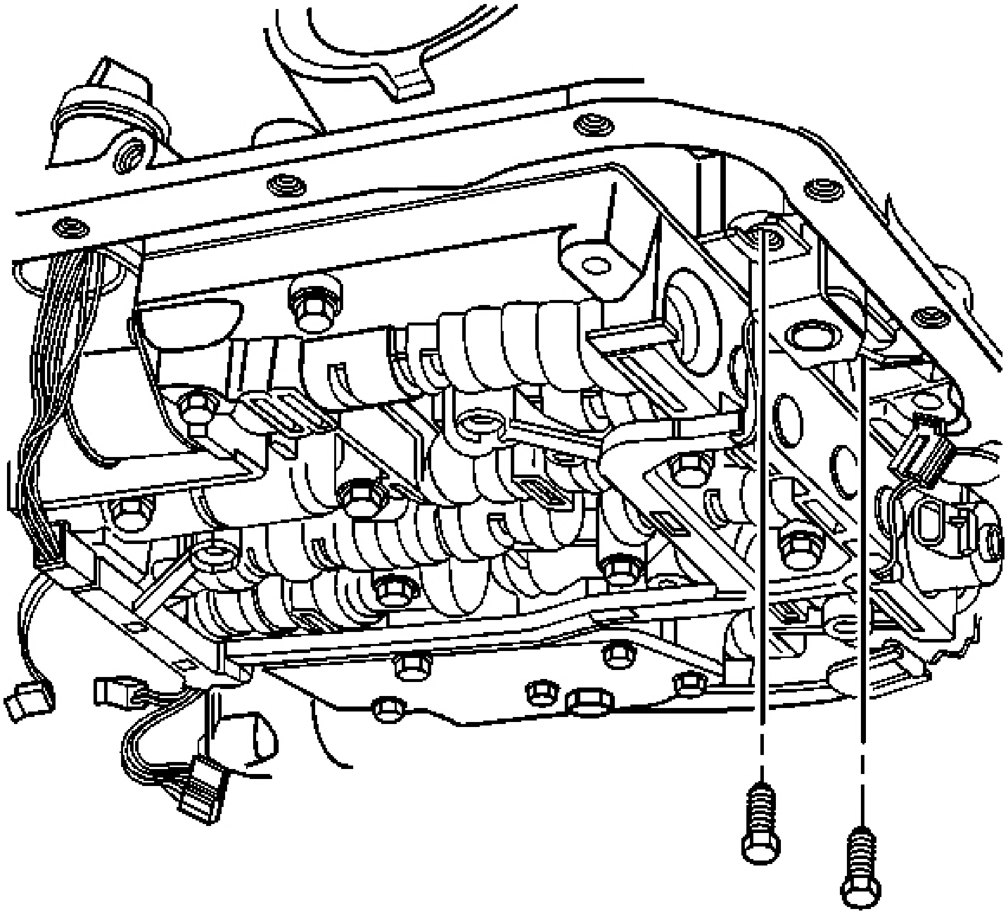


Fig. 121: Identifying TCC Solenoid & Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the TCC solenoid bolts.

    Tighten: Tighten the TCC solenoid retaining bolts to 11 N.m (97 lb in).

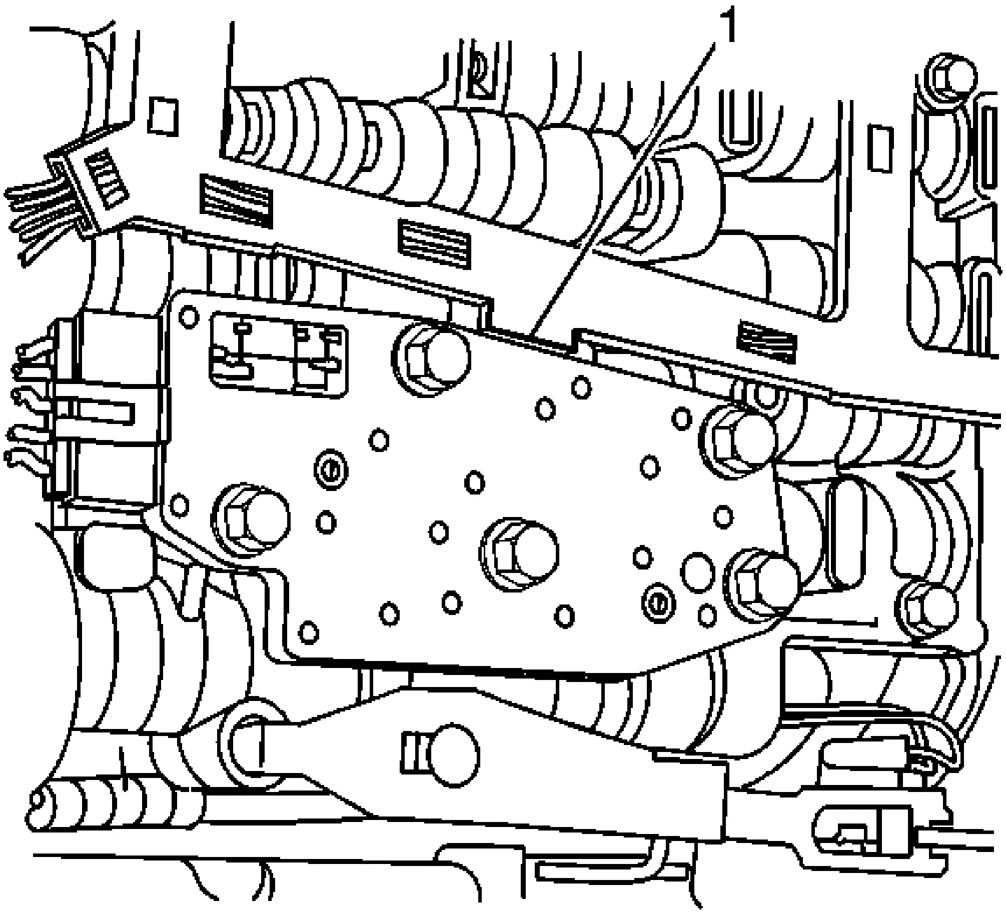


Fig. 122: View Of Internal Wiring Harness & Valve Body
Courtesy of GENERAL MOTORS CORP.

14. Install the internal wiring harness to the valve body. The internal wiring harness has a tab (1) on the edge of the conduit.

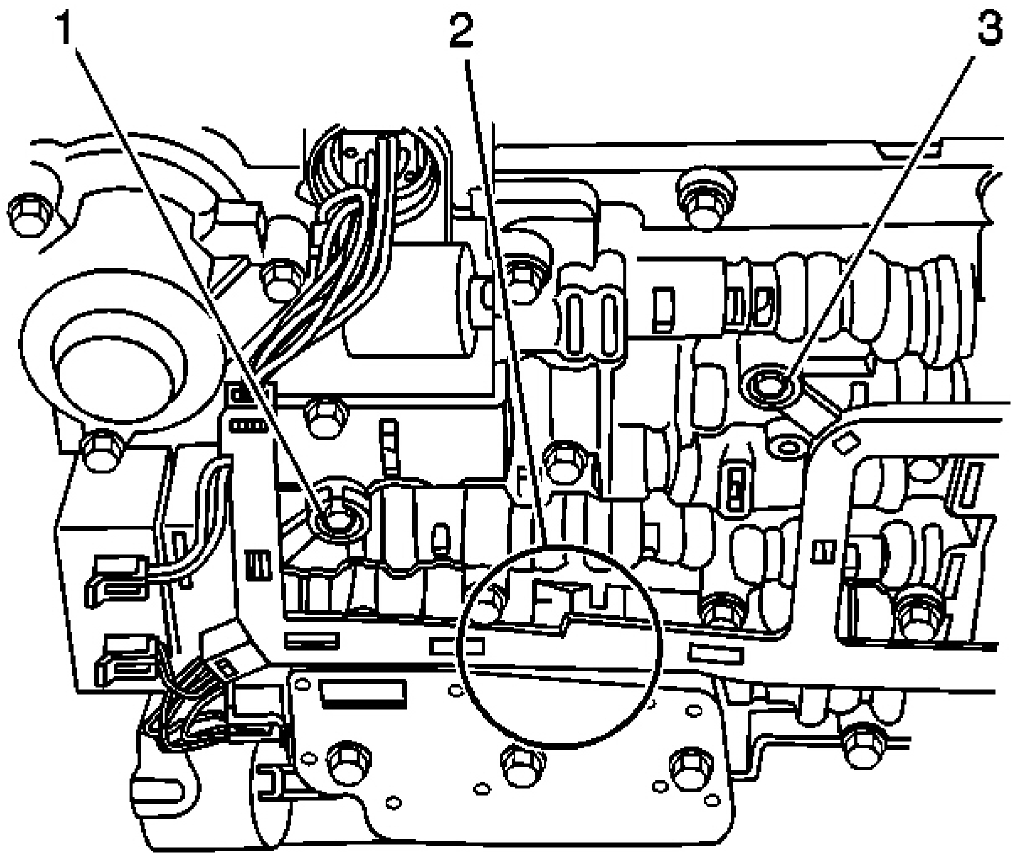


Fig. 123: Placing Tab Between Valve Body Pressure Switch
Courtesy of GENERAL MOTORS CORP.

15. Place the tab between the valve body and the pressure switch in the location shown (2). Press the harness into position on the valve body bolt bosses (1, 3).

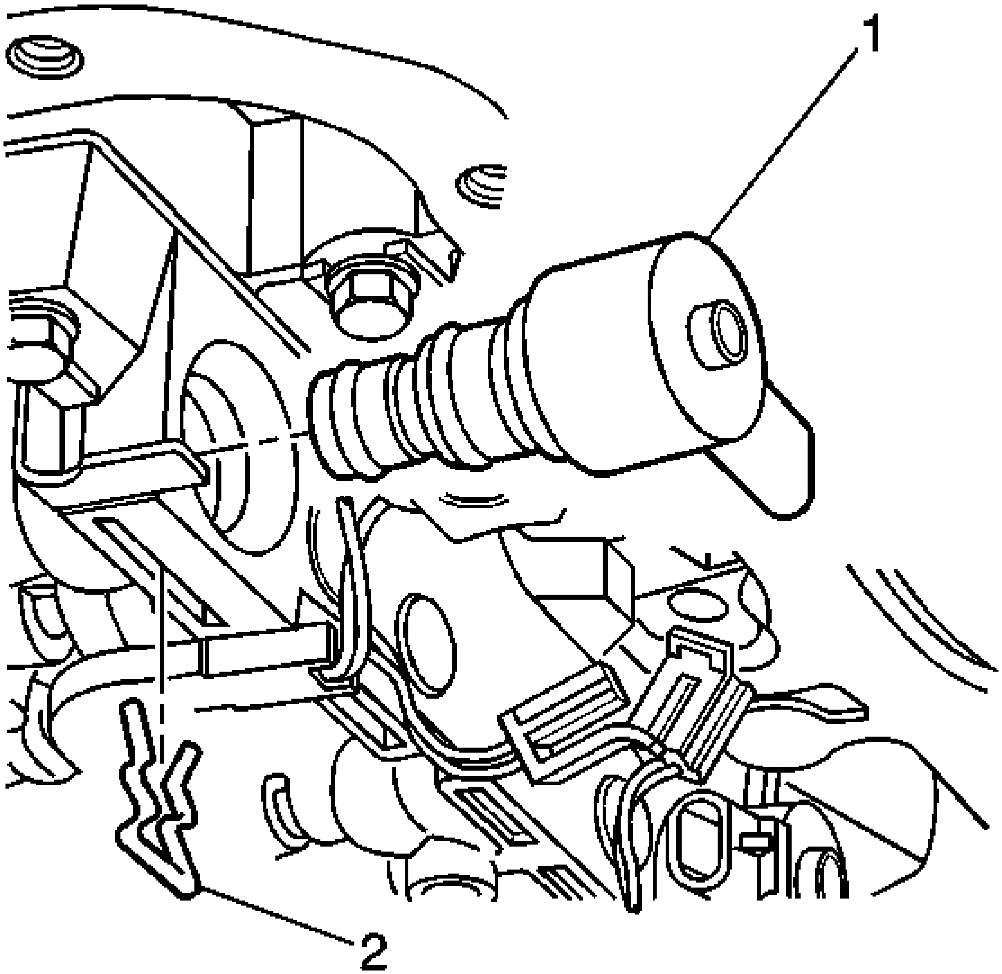


Fig. 124: TCC PWM Solenoid
Courtesy of GENERAL MOTORS CORP.

16. Install the TCC PWM solenoid (1) to the control valve body.
17. Install the TCC PWM solenoid retainer (2).

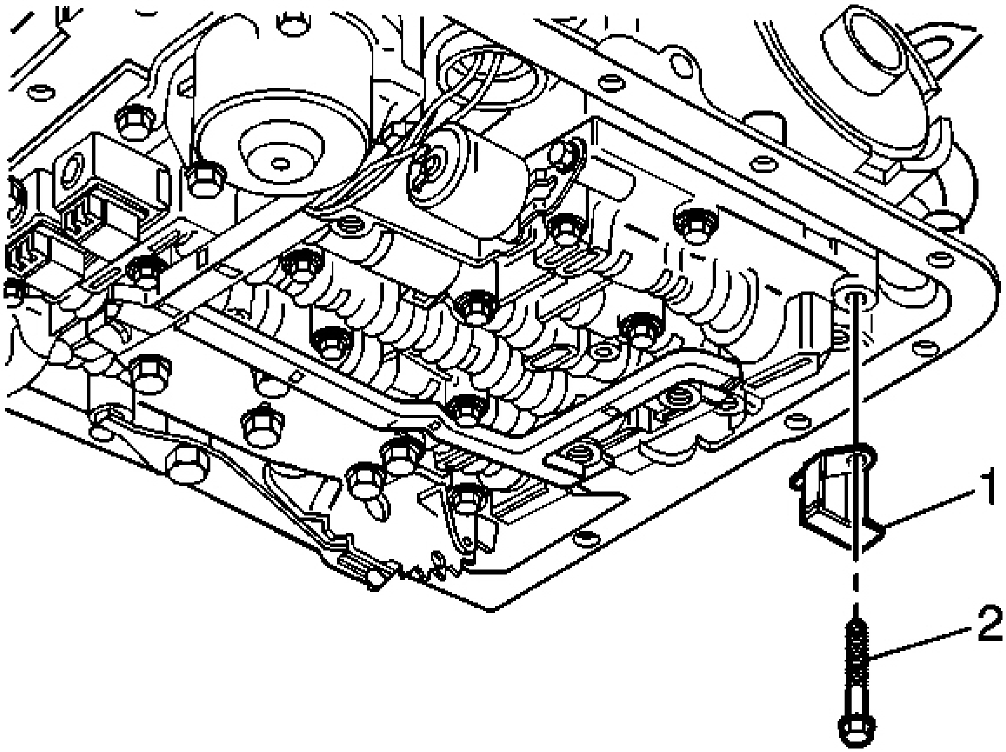


Fig. 125: Transmission Fluid Indicator Stop Bracket
Courtesy of GENERAL MOTORS CORP.

18. Install the transmission fluid indicator stop bracket (1) and bolt (2).

    Tighten: Tighten the transmission fluid indicator stop bracket bolt to 11 N.m (97 lb in).

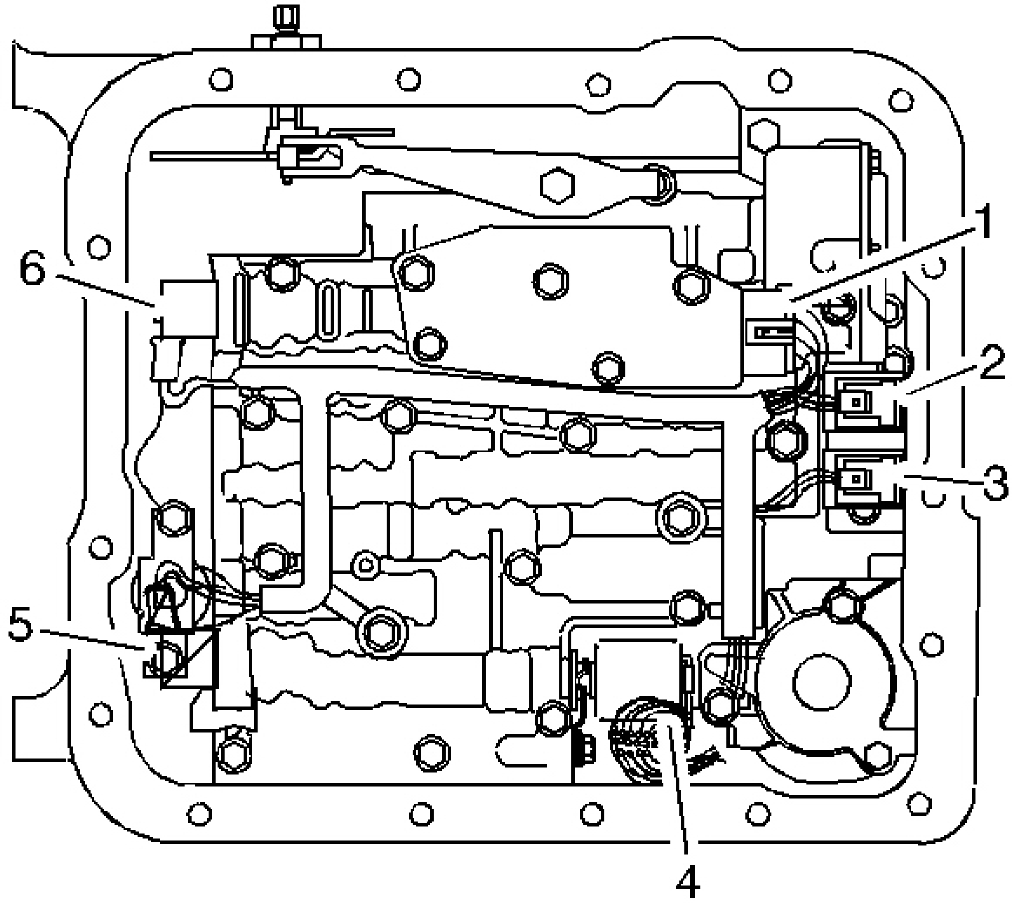


Fig. 126: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

19. Connect the internal wiring harness electrical connectors to the following components:
    - The transmission fluid pressure manual valve position switch (1)
    - The 1-2 shift solenoid (2)
    - The 2-3 shift solenoid (3)
    - The pressure control solenoid (4)
    - The TCC PWM solenoid (5)
    - The 3-2 shift solenoid (6)
20. Install the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .
21. Lower the vehicle.

22. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

CONTROL AND SHIFT SOLENOIDS REPLACEMENT

Removal Procedure

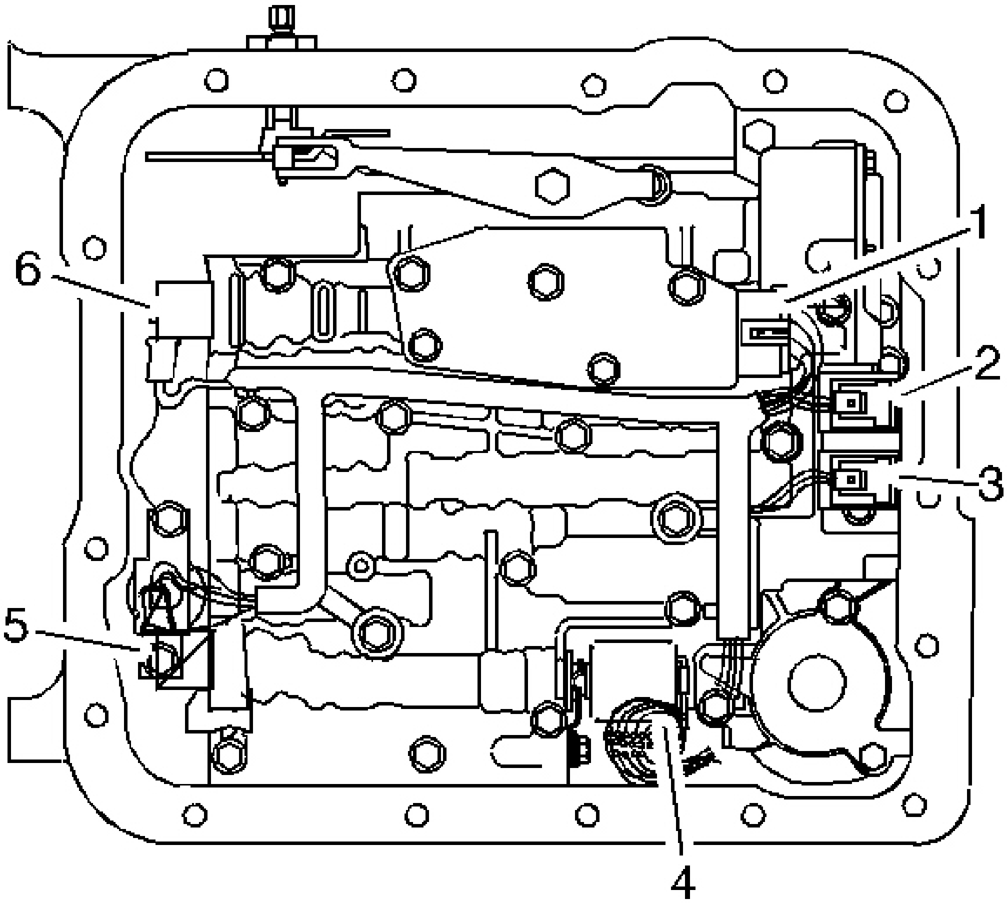


Fig. 127: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .

IMPORTANT: Do not remove the valve body for the following procedures. Removal of

the 1-2 accumulator is necessary only if servicing the pressure control solenoid.

2. Remove the 1-2 accumulator if necessary. Refer to **Accumulator Assembly, Spacer Plate, and Gaskets** .
3. Disconnect the internal wiring harness electrical connectors from the following components:
   - Transmission fluid pressure switch (1)
   - 1-2 shift control solenoid (2)
   - 2-3 shift control solenoid (3)
   - Pressure control solenoid (4)
   - TCC PWM solenoid (5)
   - 3-2 control solenoid (6)

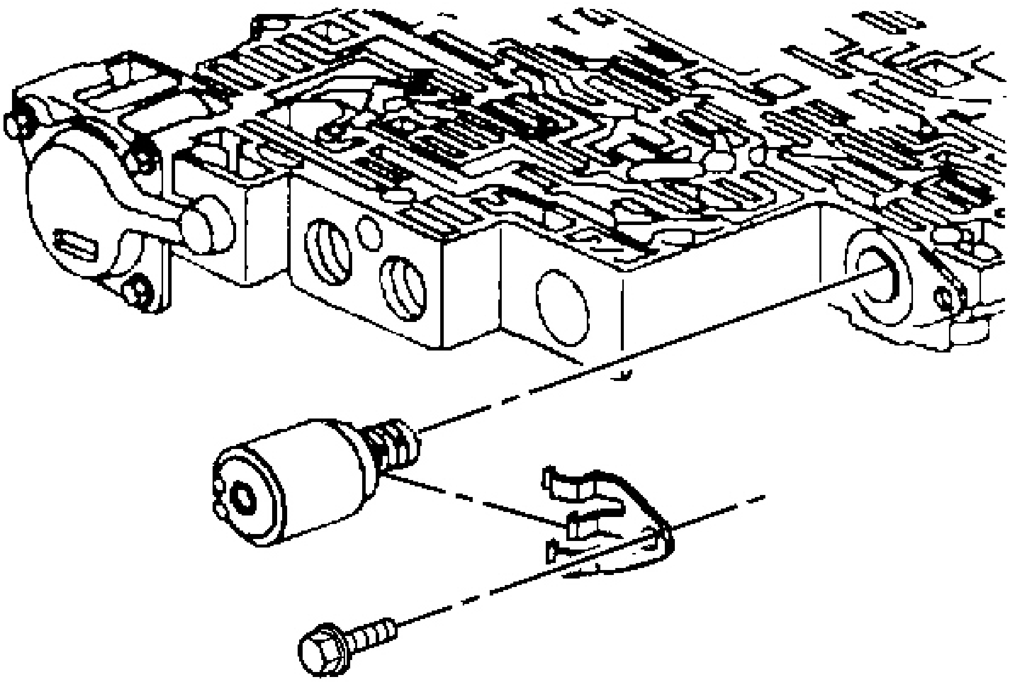


Fig. 128: Locating Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

4. Remove the pressure control solenoid retainer.
5. Remove the pressure control solenoid.

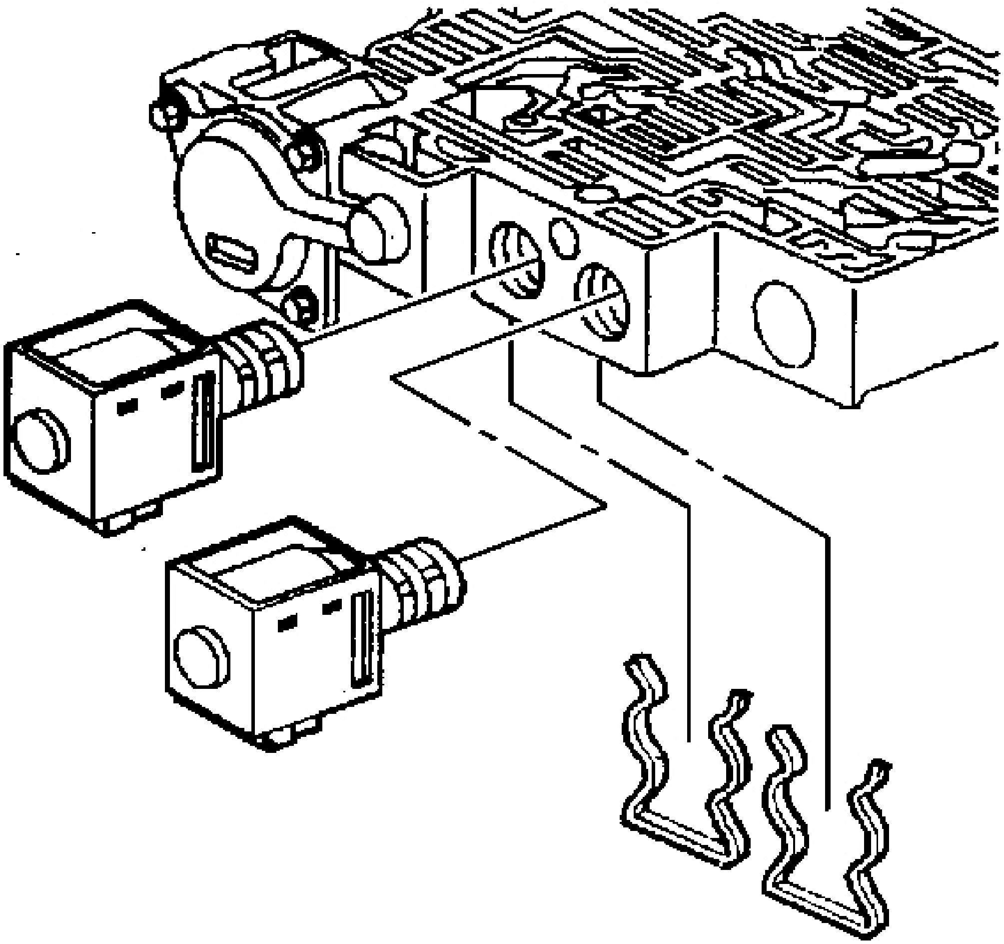


Fig. 129: Shift Solenoids & Retainers (1-2, 2-3)
Courtesy of GENERAL MOTORS CORP.

6. Remove the 1-2 and 2-3 shift solenoid retainers.
7. Remove the 1-2 and 2-3 shift solenoids.

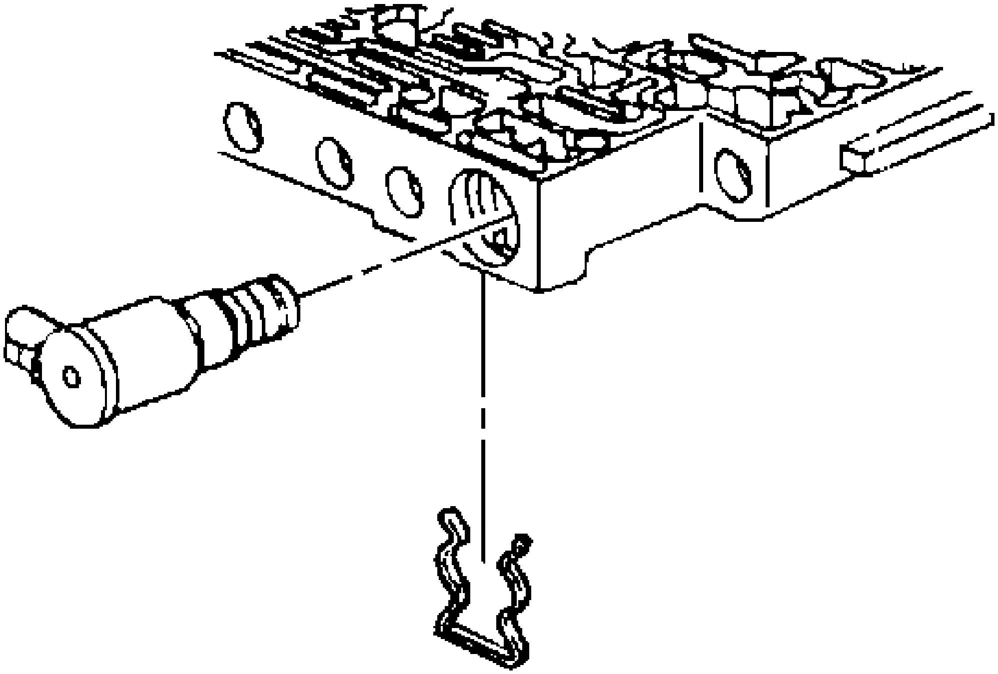


Fig. 130: Control Solenoid & Retainer (3-2)
Courtesy of GENERAL MOTORS CORP.

8. Remove the 3-2 control solenoid retainer.
9. Remove the 3-2 control solenoid.

Installation Procedure

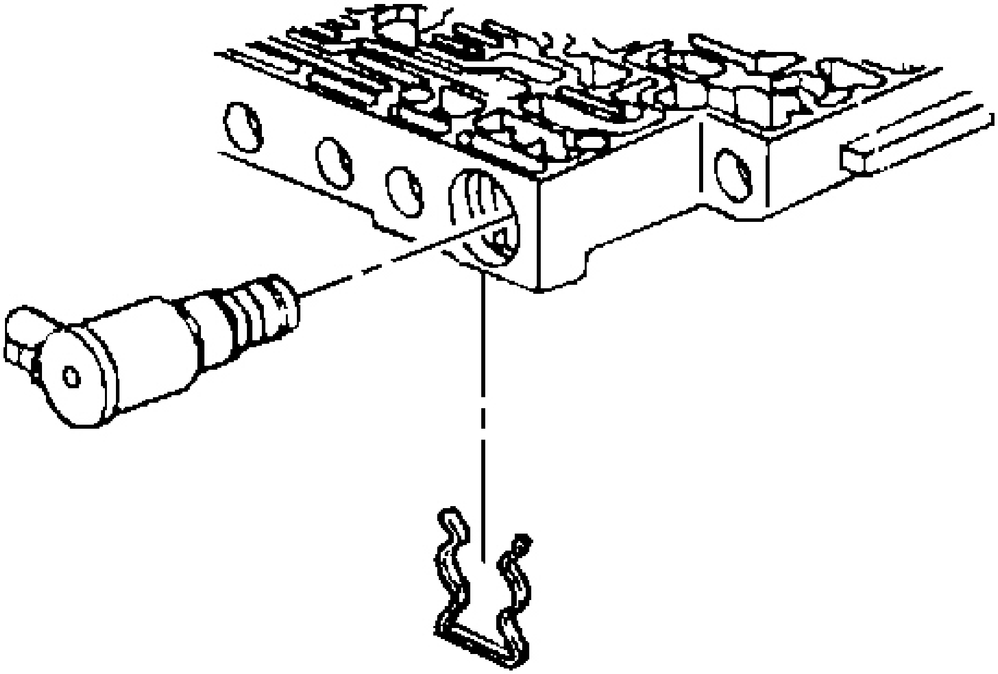


Fig. 131: Control Solenoid & Retainer (3-2)
Courtesy of GENERAL MOTORS CORP.

1. Install the 3-2 control solenoid.
2. Install the 3-2 control solenoid retainer.

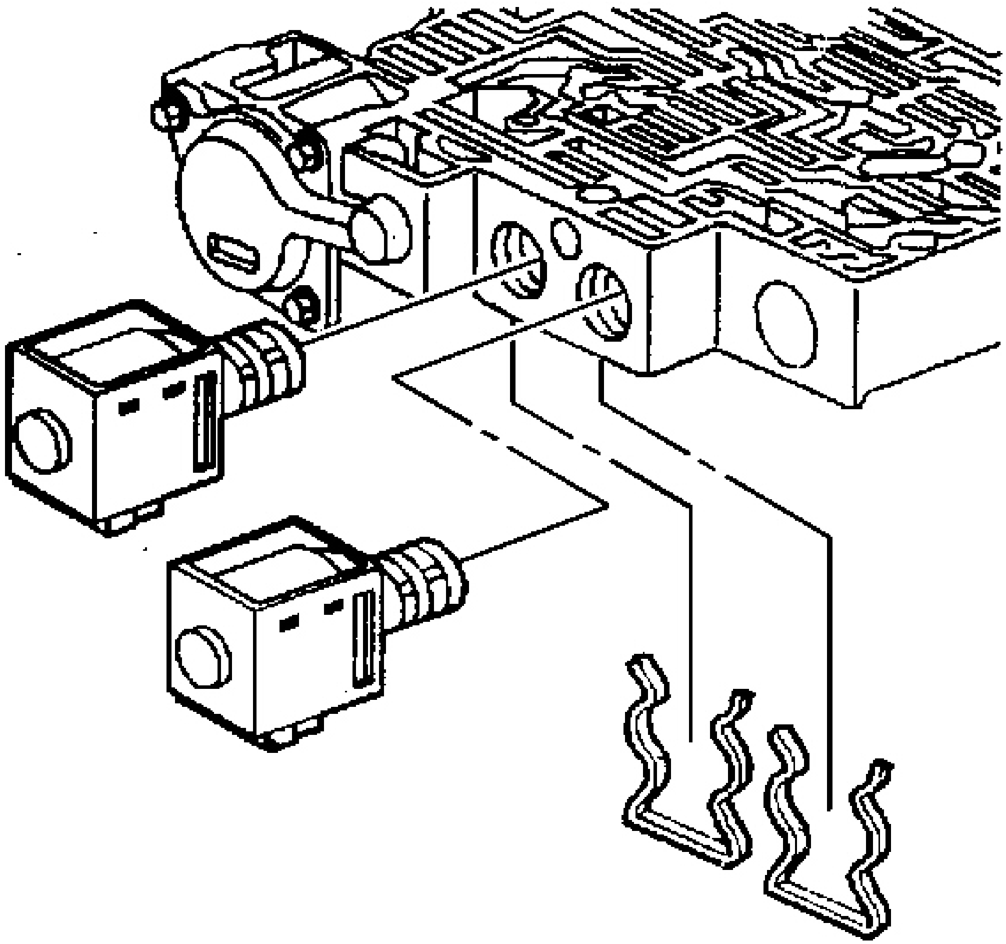


Fig. 132: Shift Solenoids & Retainers (1-2, 2-3)
Courtesy of GENERAL MOTORS CORP.

3. Install the 1-2 and 2-3 shift solenoids.
4. Install the 1-2 and 2-3 shift solenoid retainers.

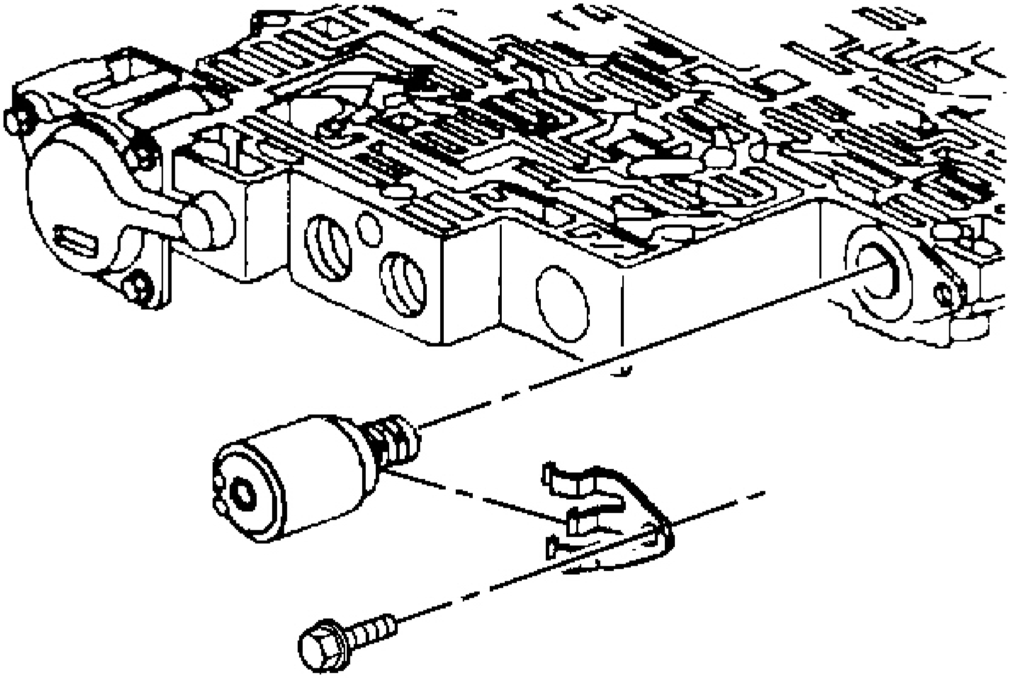


Fig. 133: Locating Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the pressure control solenoid.

   Ensure that the electrical tabs are facing outboard.

6. Install the pressure control solenoid retainer and retaining bolt.

   Tighten: Tighten the pressure control solenoid retaining bolt to 11 N.m (97 lb in).

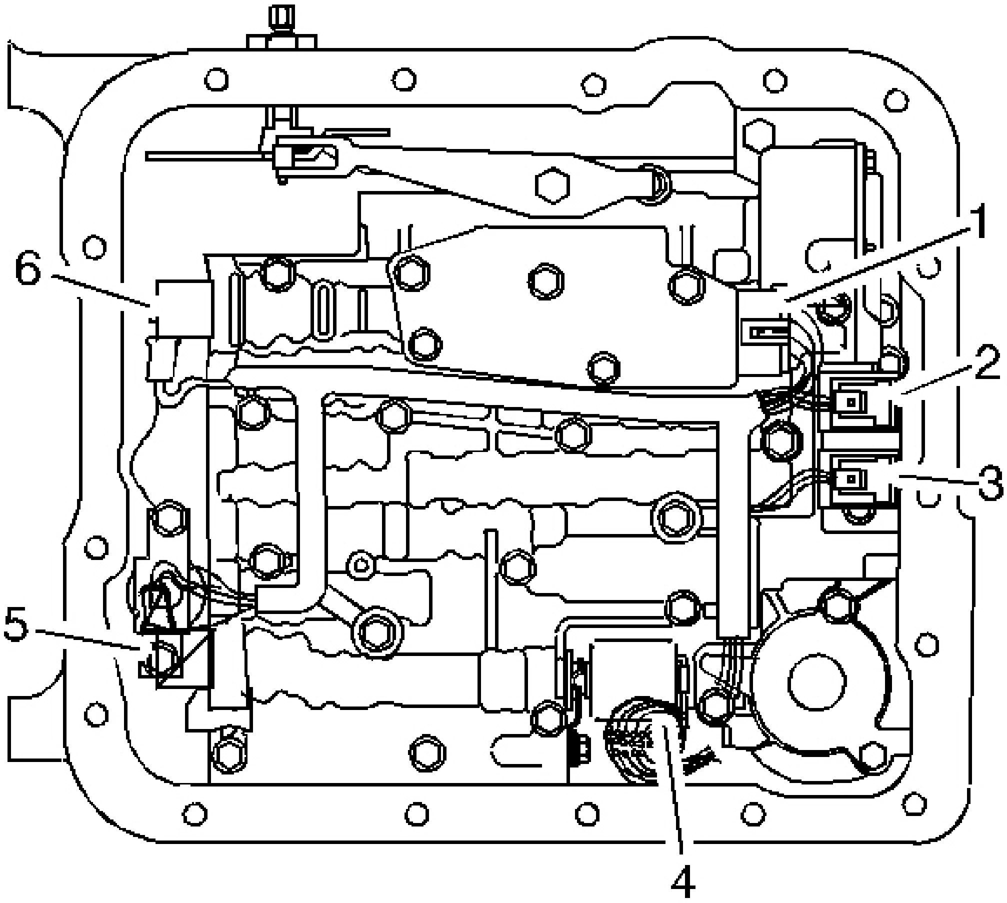


Fig. 134: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

7. Connect the internal wiring harness electrical connectors to the following components:
   - Transmission fluid pressure switch (1)
   - 1-2 shift control solenoid (2)
   - 2-3 shift control solenoid (3)
   - Pressure control solenoid (4)
   - TCC PWM solenoid (5)
   - 3-2 control solenoid (6)
8. Install the 1-2 accumulator. Refer to **Accumulator Assembly, Spacer Plate, and Gaskets** .
9. Install the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .

10. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

TORQUE CONVERTER CLUTCH PULSE WIDTH MODULATION (TCC PWM) SOLENOID, TCC SOLENOID, AND WIRING HARNESS

Tools Required

J 28458 Seal Protector Retainer Installer. See **Special Tools and Equipment** .

Removal Procedure

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the transmission oil pan and the filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .

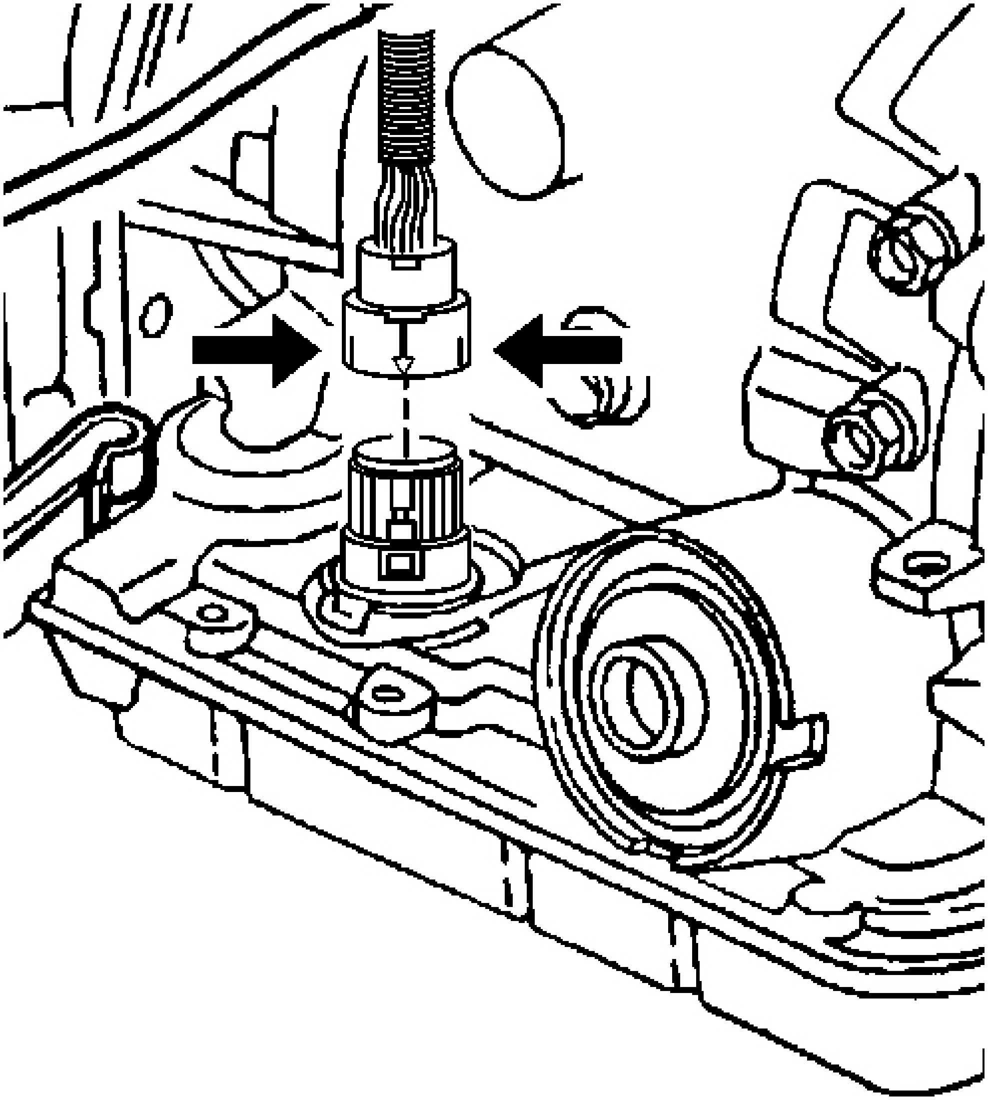


Fig. 135: Depressing Tabs On Transmission Harness 20-Way Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the transmission harness 20-way connector from the transmission internal harness pass-through connector.

   Depress both tabs on the connector and pull straight up; do not pry the connector.

IMPORTANT: Removal of the valve body is not necessary for the following procedure.

4. Remove the 1-2 accumulator assembly. Do not remove the spacer plate. Refer to **Accumulator Assembly, Spacer Plate, and Gaskets** .

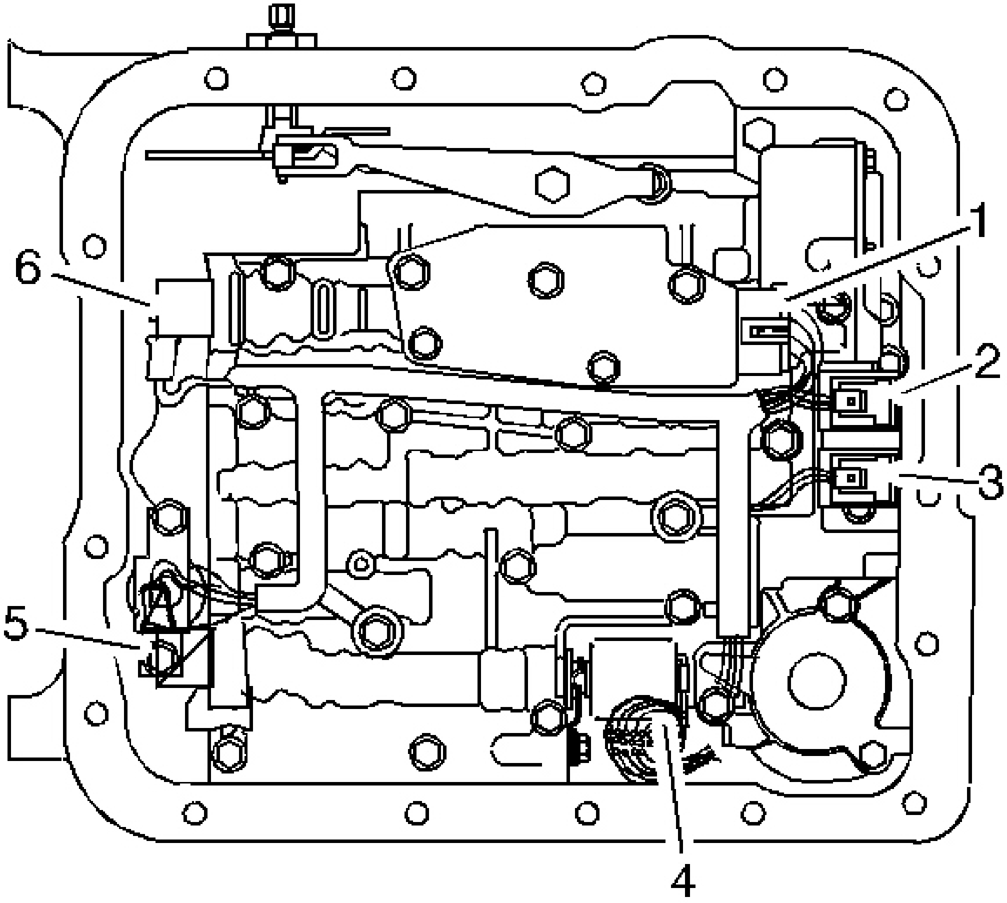


Fig. 136: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the internal wiring harness electrical connectors from the following components:
   - Transmission fluid pressure switch (1)
   - 1-2 shift control solenoid (2)
   - 2-3 shift control solenoid (3)
   - Pressure control solenoid (4)

- TCC PWM solenoid (5)
- 3-2 control solenoid (6)

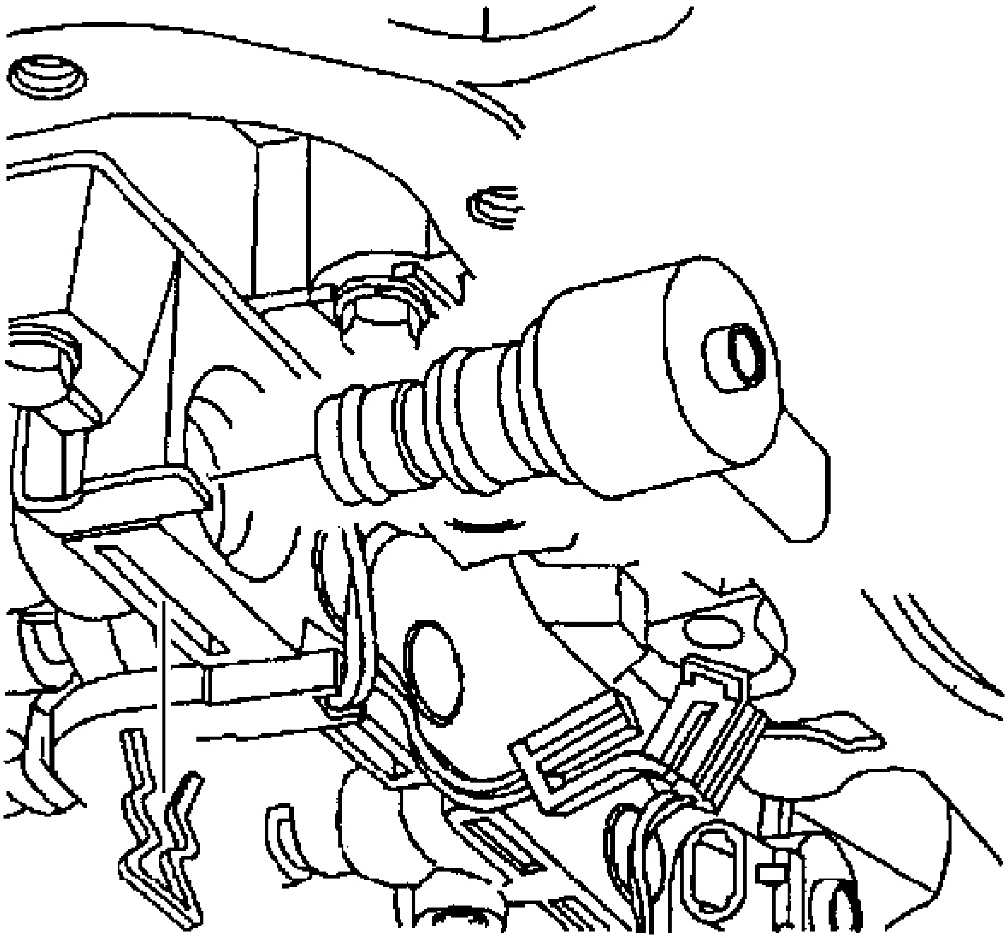


Fig. 137: TCC PWM Solenoid & Control Valve Body
Courtesy of GENERAL MOTORS CORP.

6. Remove the TCC PWM solenoid retainer.
7. Remove the TCC PWM solenoid in order to access one of the TCC solenoid retaining bolts.

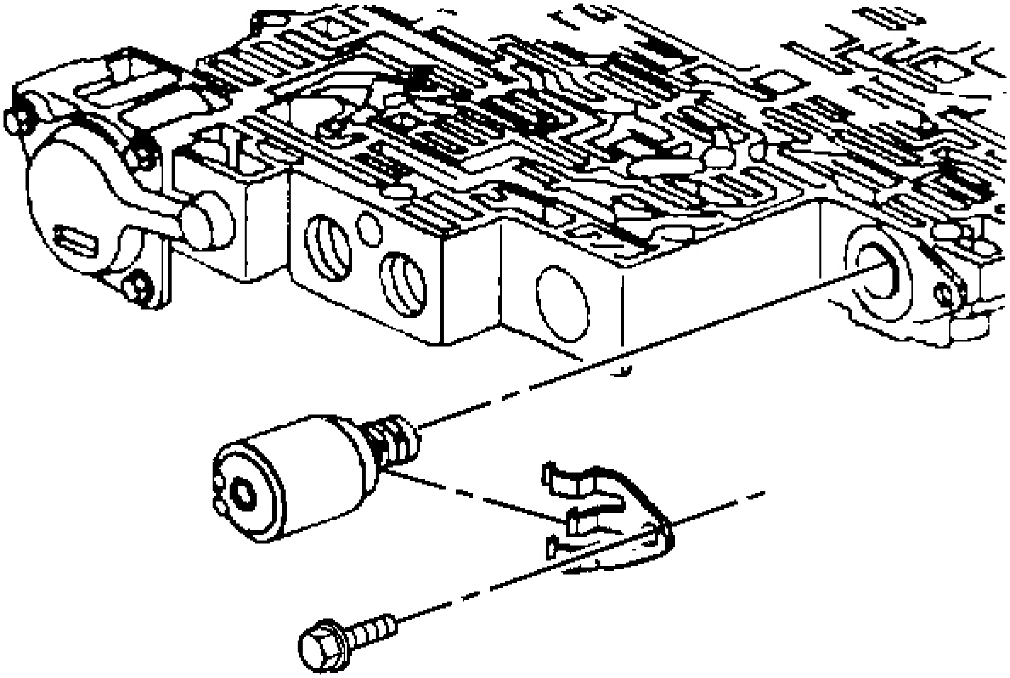


Fig. 138: Locating Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

8. Remove the pressure control solenoid retainer.
9. Remove the pressure control solenoid.

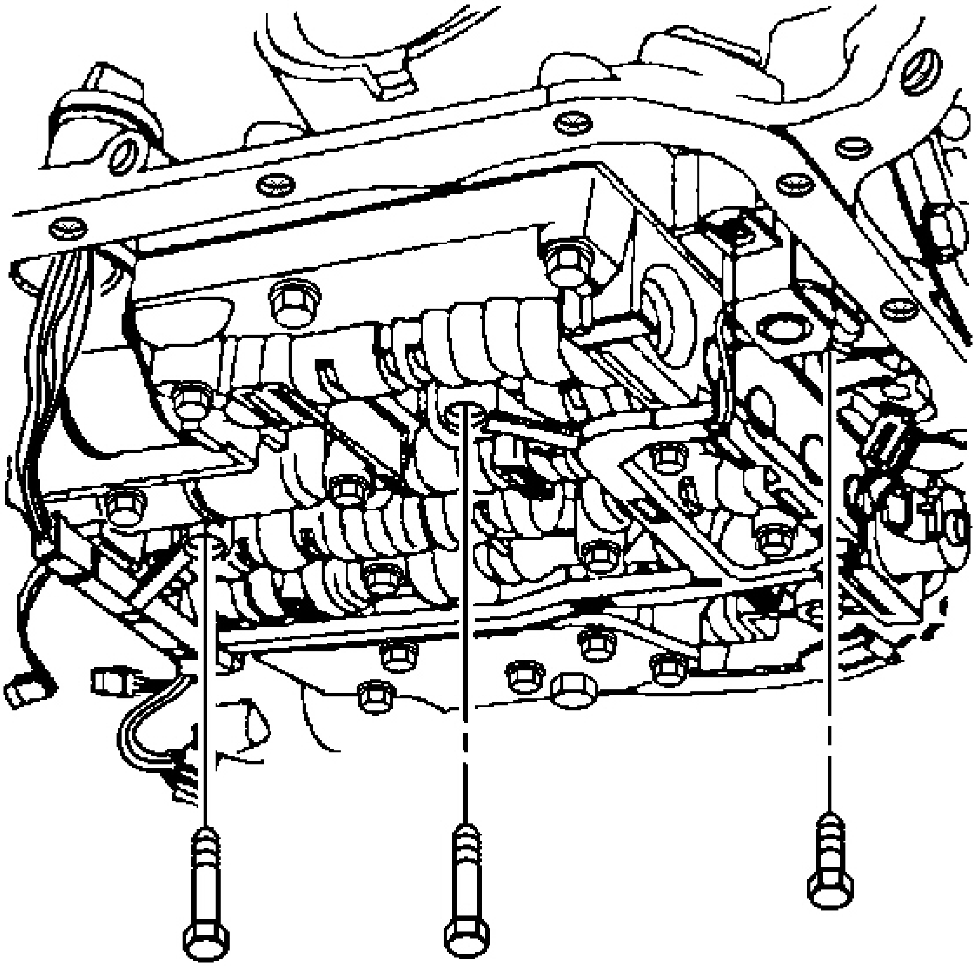


Fig. 139: TCC Solenoid Bolts, Valve Body Bolts & Internal Wiring Harness
Courtesy of GENERAL MOTORS CORP.

10. Remove the TCC solenoid retaining bolts and the valve body bolts which retain the internal wiring harness.

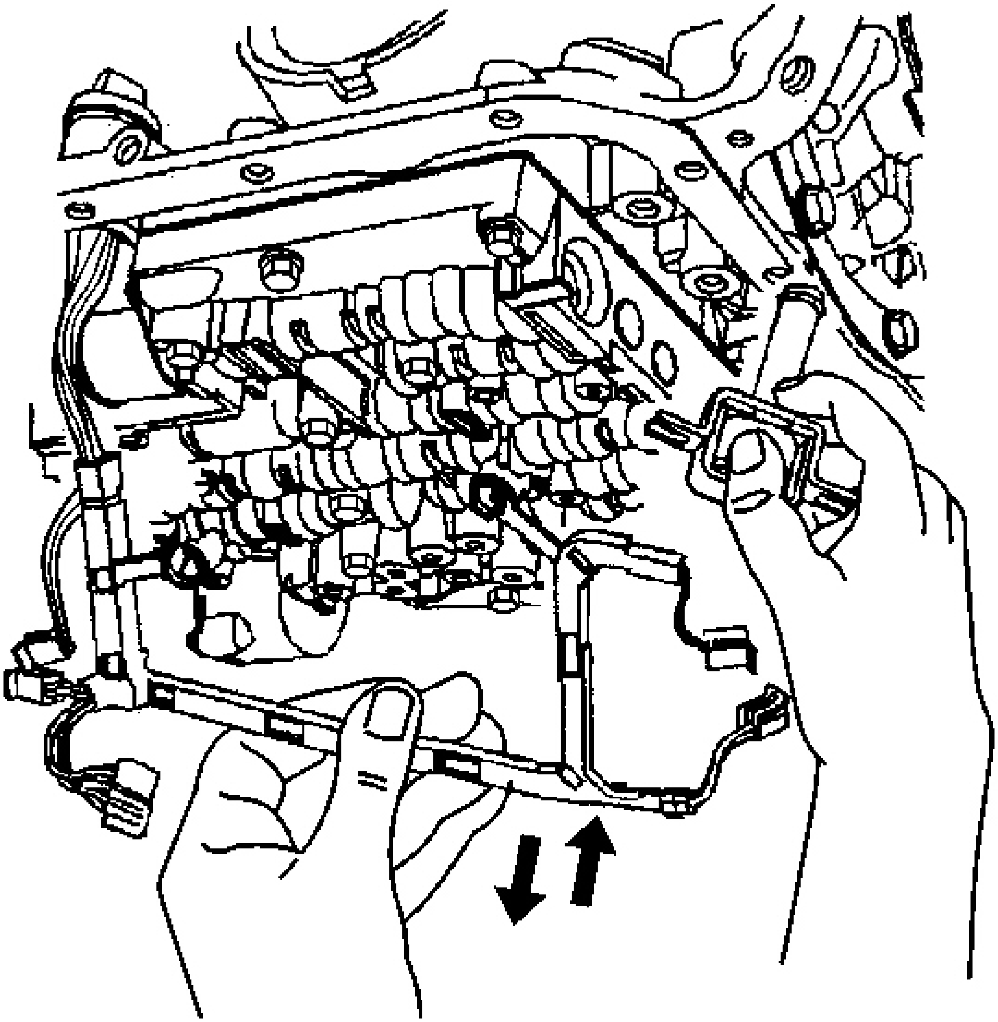


Fig. 140: Identifying TCC Solenoid (With O-Ring Seal) & Wiring Harness
Courtesy of GENERAL MOTORS CORP.

11. Using **J 28458** , release the pass-through electrical connector from the transmission case. See **Special Tools and Equipment** .
    1. Use the small end of the **J 28458** over the top of the connector. See **Special Tools and Equipment** .
    2. Twist in order to release the four tabs retaining the connector.
    3. Pull the harness connector down through the transmission case.
12. Remove the TCC solenoid (with O-ring seal) and wiring harness assembly from the transmission case.

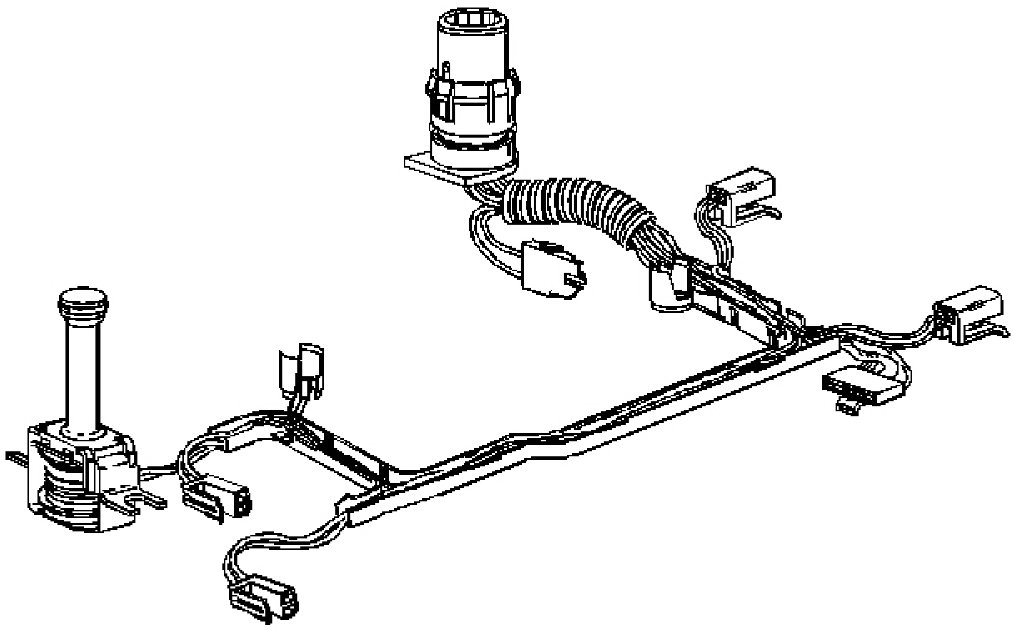


Fig. 141: TCC Wiring Harness
Courtesy of GENERAL MOTORS CORP.

13. Inspect the TCC solenoid and wiring harness assembly for the following defects:
    - Damage
    - Cracked connectors
    - Exposed wires
    - Loose pins

Installation Procedure

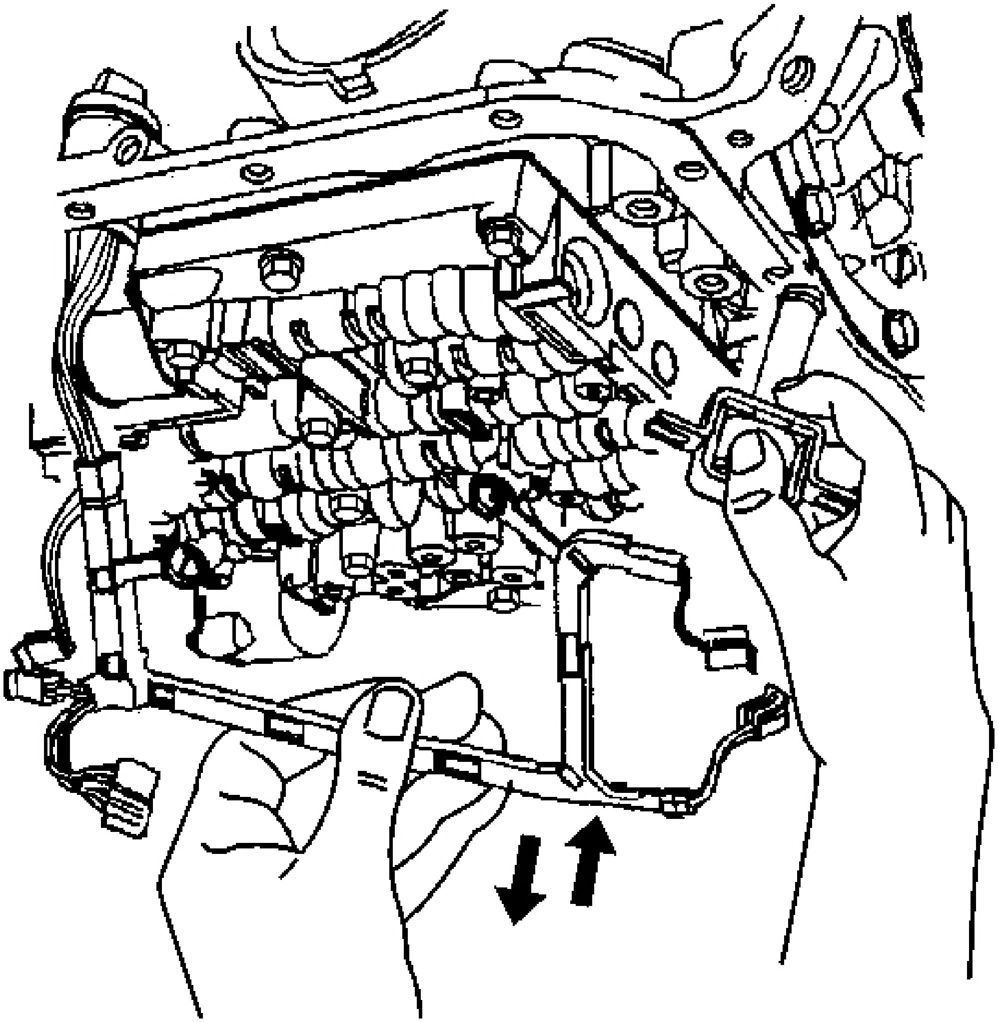


Fig. 142: Identifying TCC Solenoid (With O-Ring Seal) & Wiring Harness
Courtesy of GENERAL MOTORS CORP.

1. Install the wiring harness and TCC solenoid assembly with a new O-ring seal to the transmission.
2. Install the pass-through electrical connector to the transmission case.

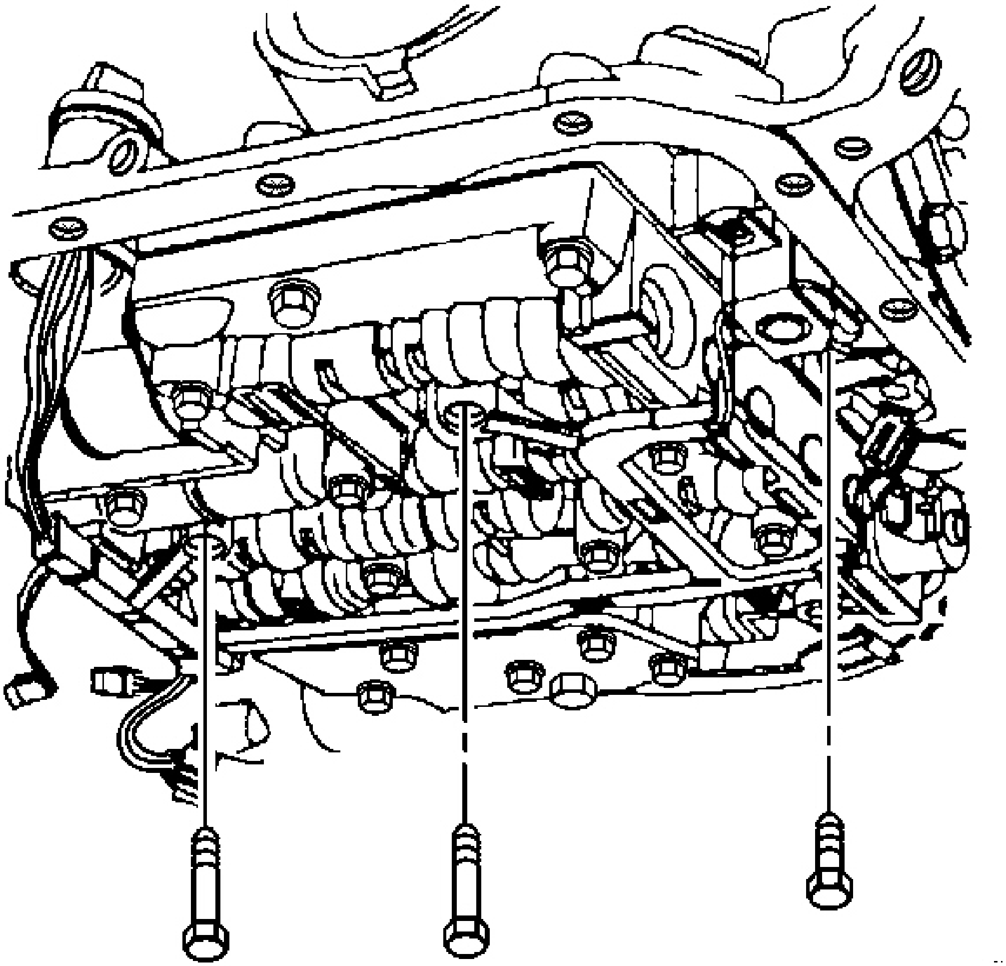


Fig. 143: TCC Solenoid Bolts, Valve Body Bolts & Internal Wiring Harness
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the valve body bolts which retain the internal wiring harness and install the TCC solenoid retaining bolts.

   Tighten:

   - Tighten the control valve body retaining bolts to 11 N.m (97 lb in).
   - Tighten the TCC solenoid retaining bolts to 11 N.m (97 lb in).

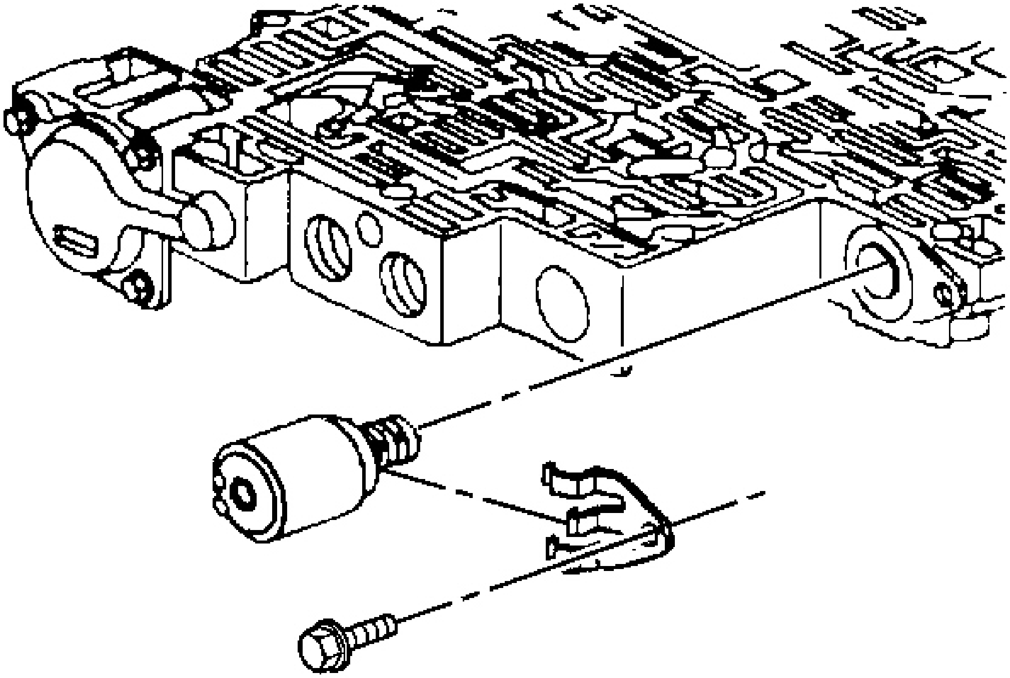


Fig. 144: Locating Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

4. Install the pressure control solenoid.

   Ensure that the electrical tabs are facing outboard.

5. Install the pressure control solenoid retainer and retaining bolt.

   Tighten: Tighten the pressure control solenoid retaining bolt to 11 N.m (97 lb in).

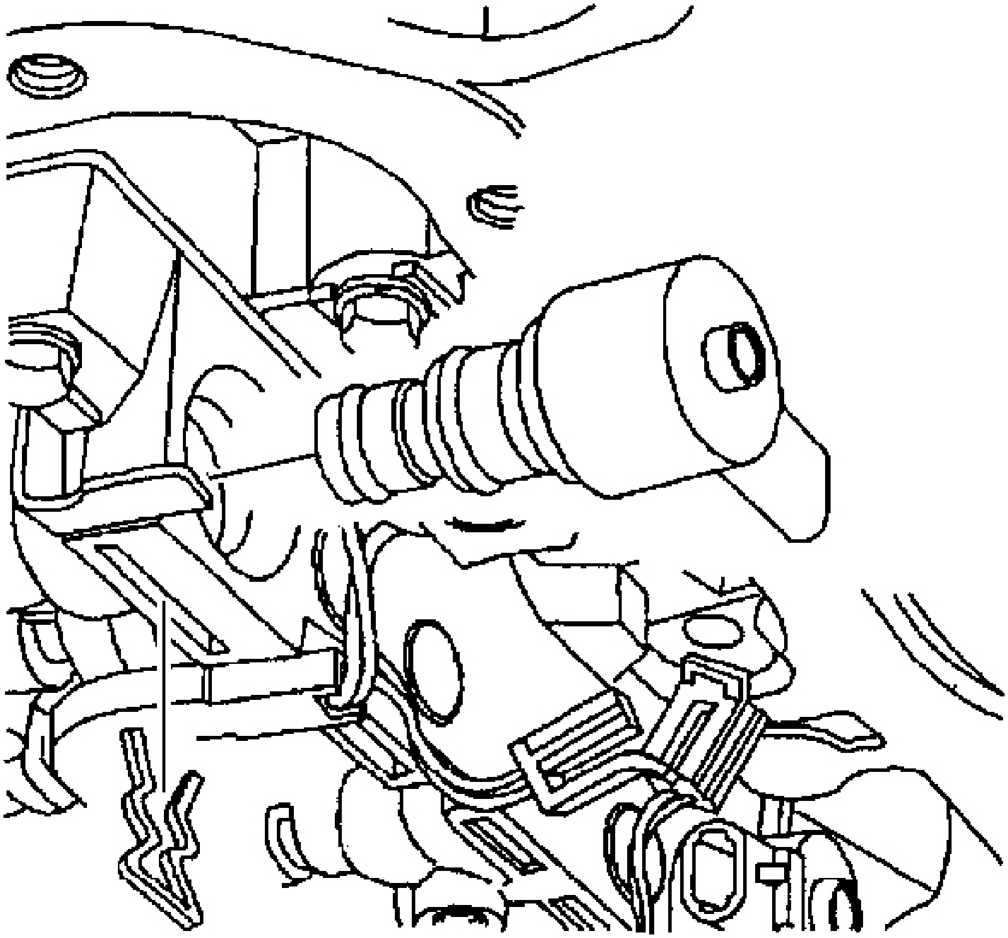


Fig. 145: TCC PWM Solenoid & Control Valve Body
Courtesy of GENERAL MOTORS CORP.

6. Install the TCC PWM solenoid to the control valve body.
7. Install the TCC PWM solenoid retainer.

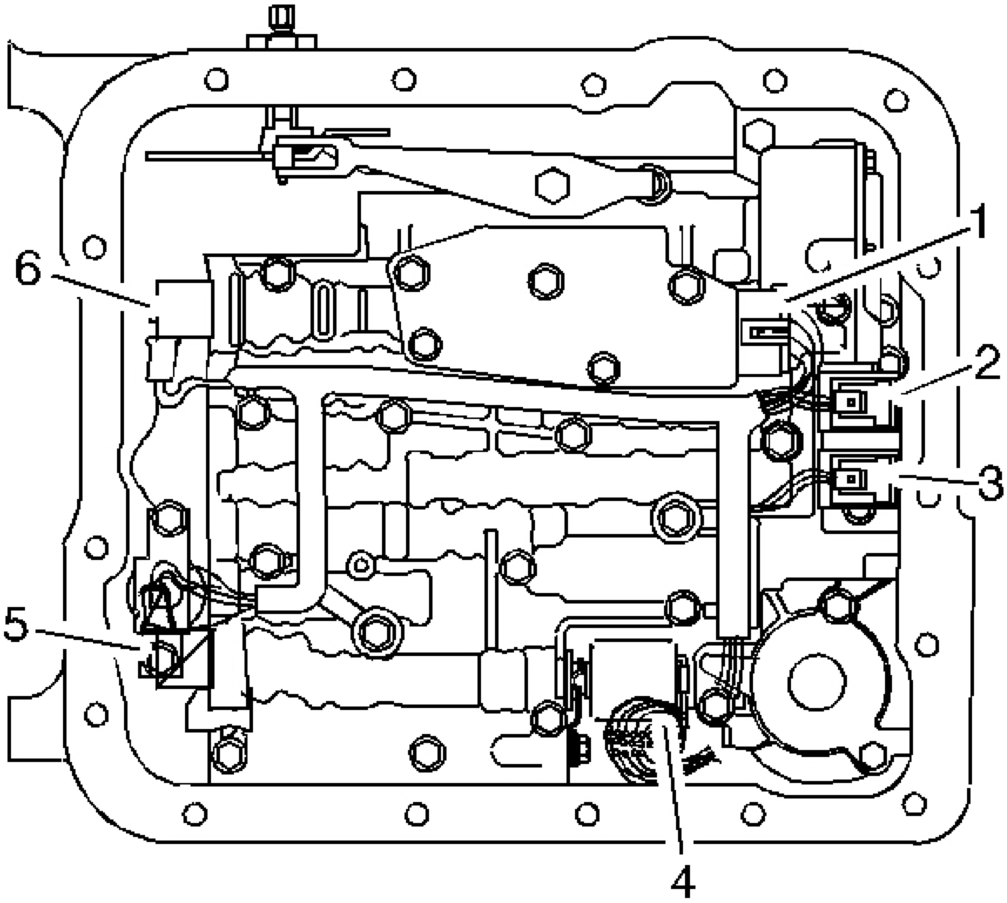


Fig. 146: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

8. Connect the internal wiring harness electrical connectors to the following components:
    - Transmission fluid pressure switch (1)
    - 1-2 shift control solenoid (2)
    - 2-3 shift control solenoid (3)
    - Pressure control solenoid (4)
    - TCC PWM solenoid (5)
    - 3-2 control solenoid (6)
9. Install the 1-2 accumulator. Refer to **Accumulator Assembly, Spacer Plate, and Gaskets** .

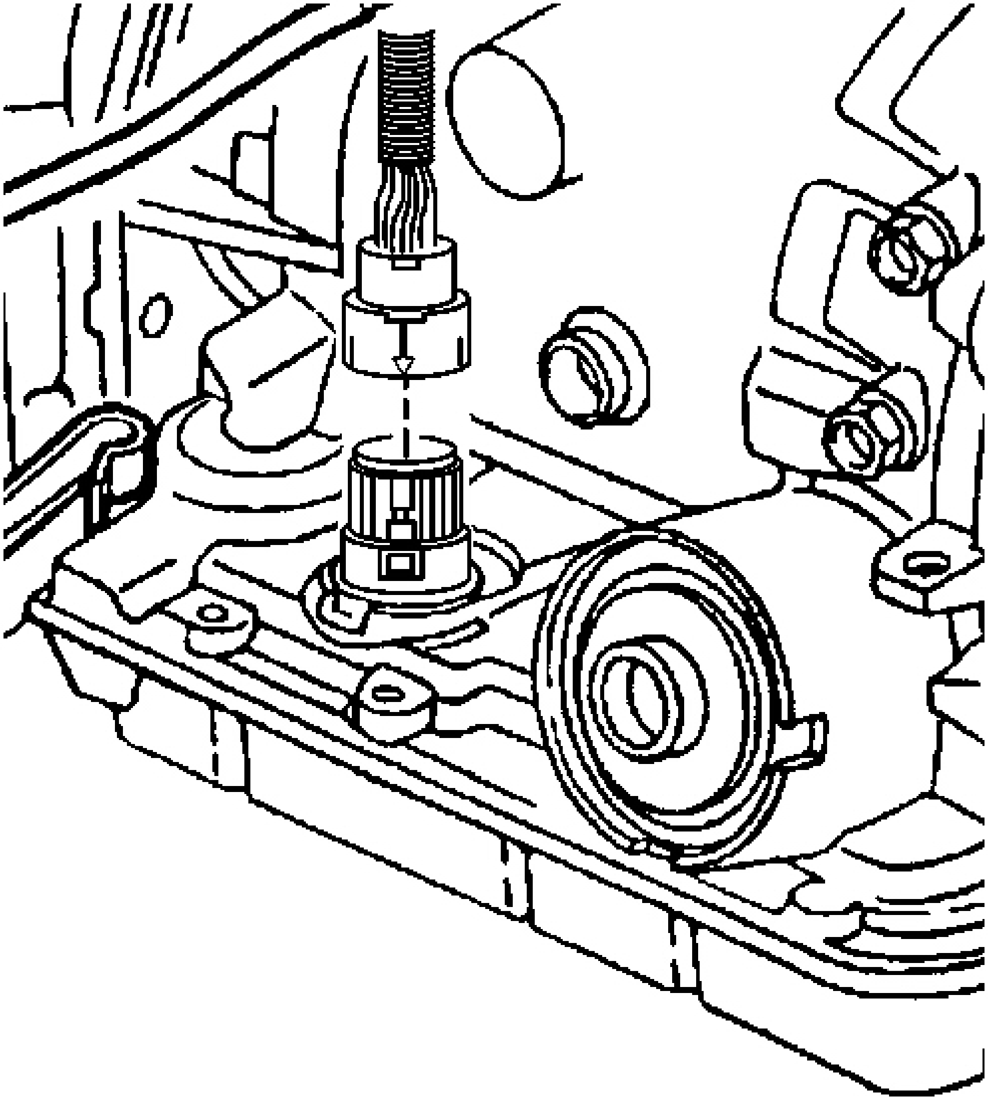


Fig. 147: Aligning Arrows On Each Connector & Inserting Straight Down
Courtesy of GENERAL MOTORS CORP.

10. Connect the transmission harness 20-way connector to the transmission pass-through connector.

    Align the arrows on each half of the connector and insert straight down.

11. Install the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .

12. Lower the vehicle.
13. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

ACCUMULATOR ASSEMBLY, SPACER PLATE, AND GASKETS

Tools Required

- **J 25025-B** Dial Indicator Post and Guide Pin Set. See **Special Tools and Equipment** .
- J 36850 Transjel Lubricant

Removal Procedure

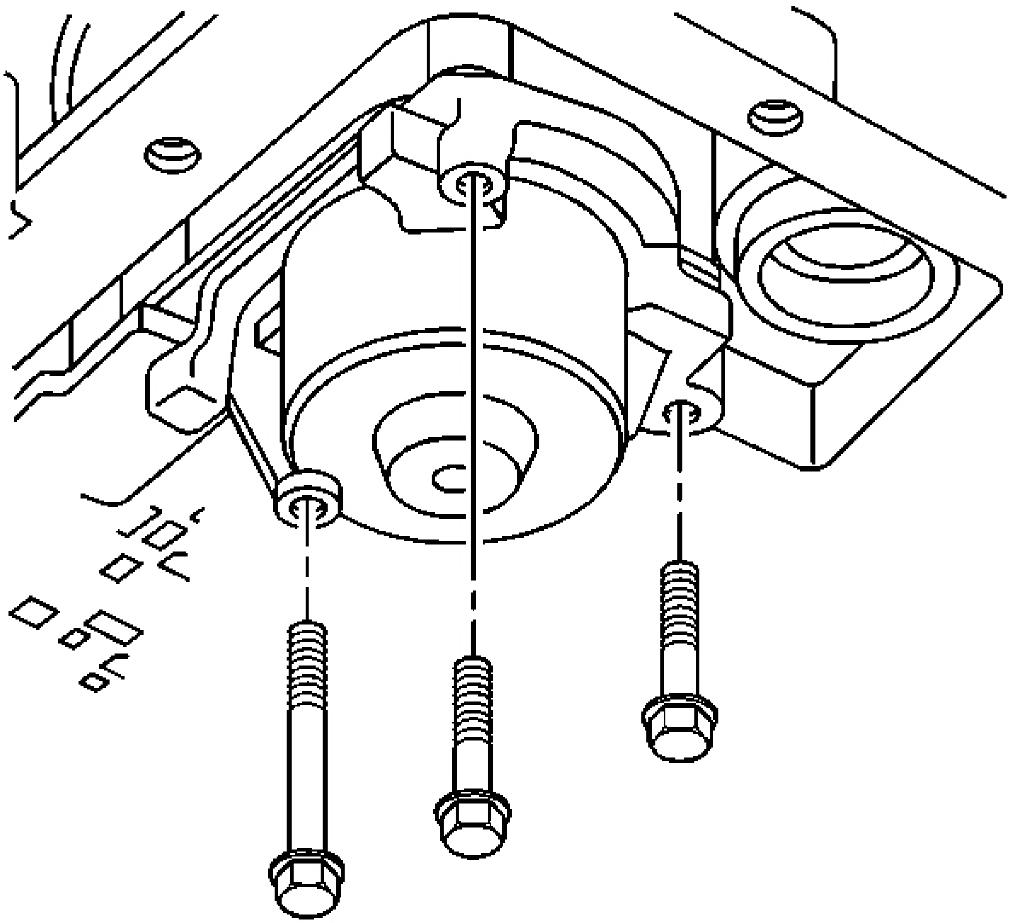


Fig. 148: 1-2 Accumulator Cover
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .

IMPORTANT: The 1-2 accumulator can be removed without removing the control valve assembly.

3. Remove the control valve body. Refer to **Valve Body and Pressure Switch Replacement** .
4. Remove the accumulator cover retaining bolts.
5. Remove the 1-2 accumulator cover assembly.

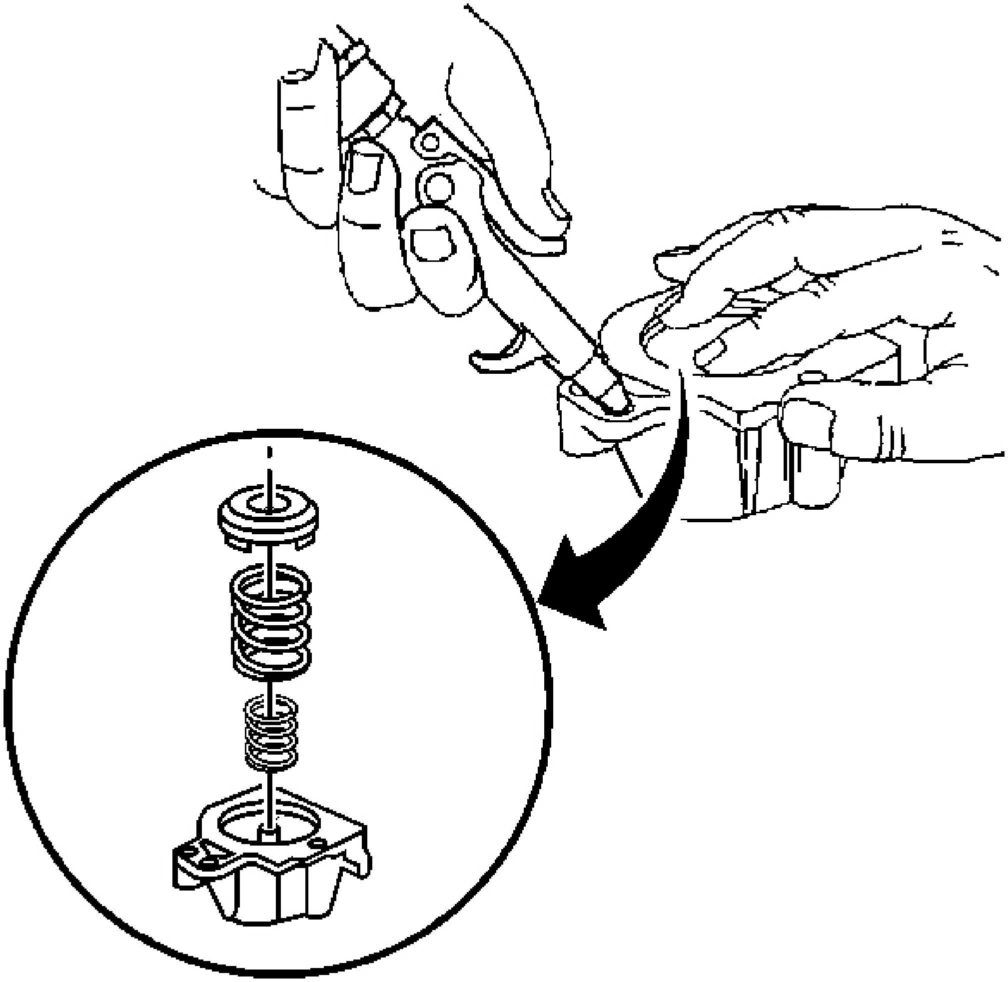


Fig. 149: Disassembling 1-2 Accumulator
Courtesy of GENERAL MOTORS CORP.

6. Disassemble the 1-2 accumulator.
    1. Blow compressed air into the 1-2 accumulator cover, as shown, to remove the 1-2 accumulator piston.
    2. Remove the 1-2 accumulator inner and outer springs.
7. Inspect the 1-2 accumulator inner and outer springs for cracks.

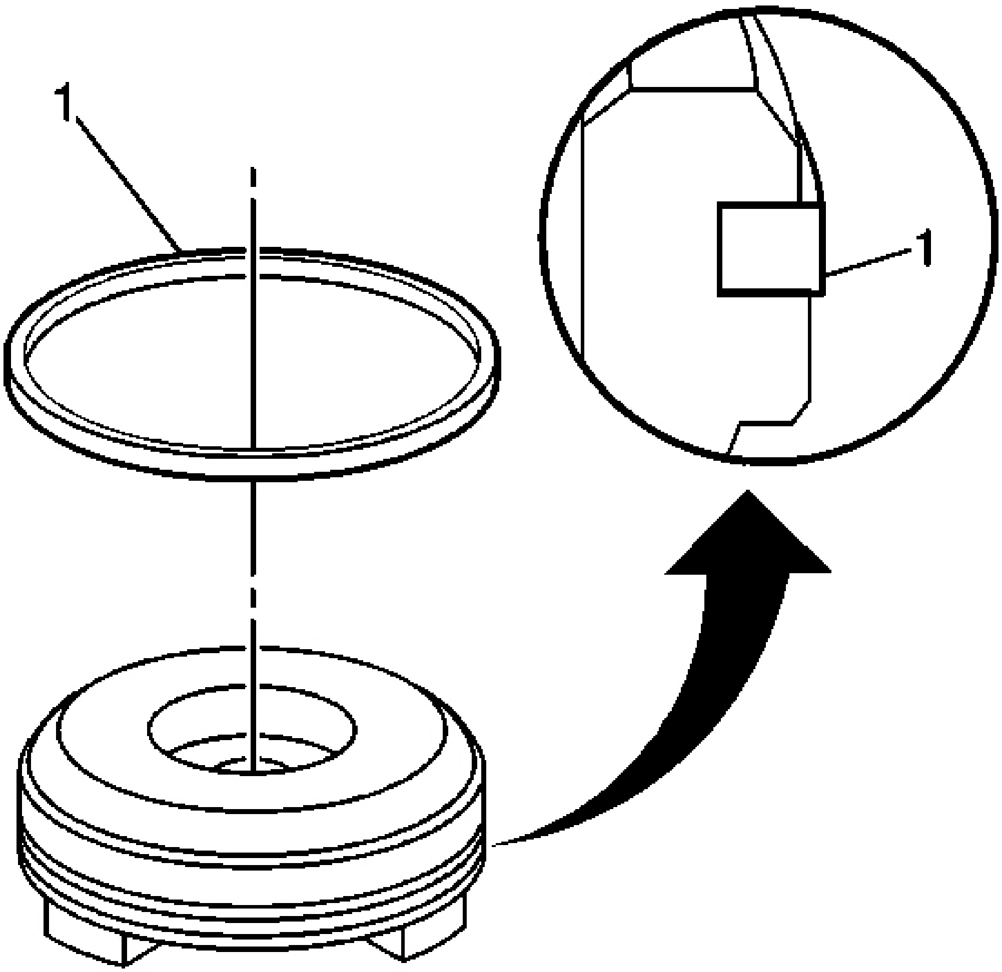


Fig. 150: Identifying Accumulator Piston Seal
Courtesy of GENERAL MOTORS CORP.

8. Remove the 1-2 accumulator piston seal (1) from the 1-2 accumulator piston.
9. Inspect the 1-2 accumulator piston for the following defects:
   - Porosity
   - Cracks
   - Scoring
   - Nicks and scratches

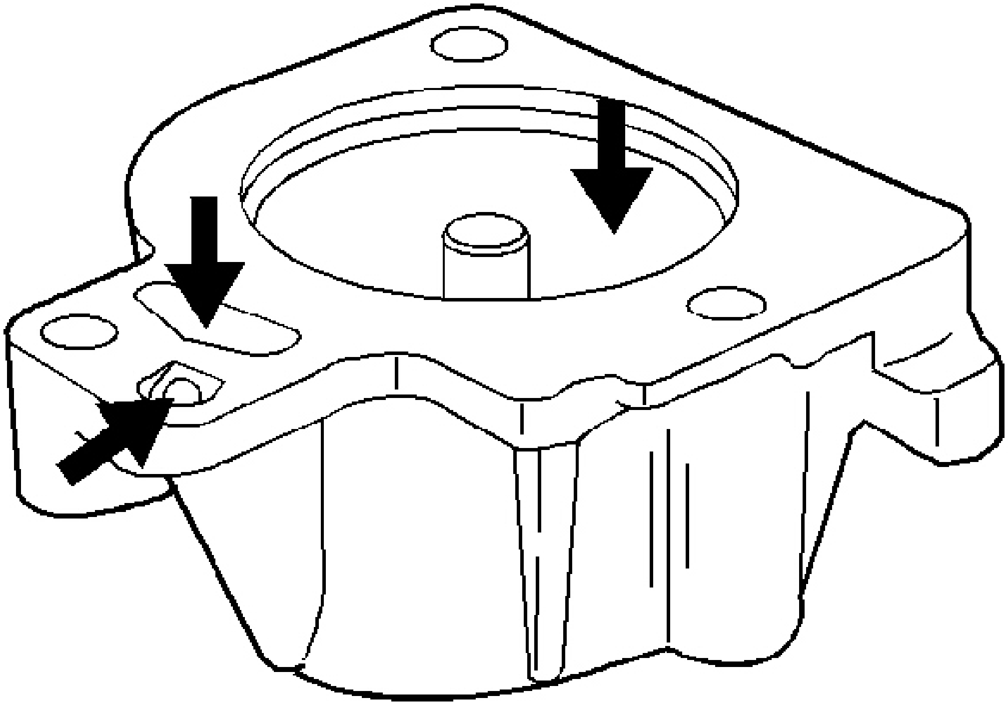


Fig. 151: Inspecting 1-2 Accumulator Cover
Courtesy of GENERAL MOTORS CORP.

10. Inspect the 1-2 accumulator cover for the following defects:
    - Porosity
    - Cracks
    - Scoring
    - Nicks and scratches

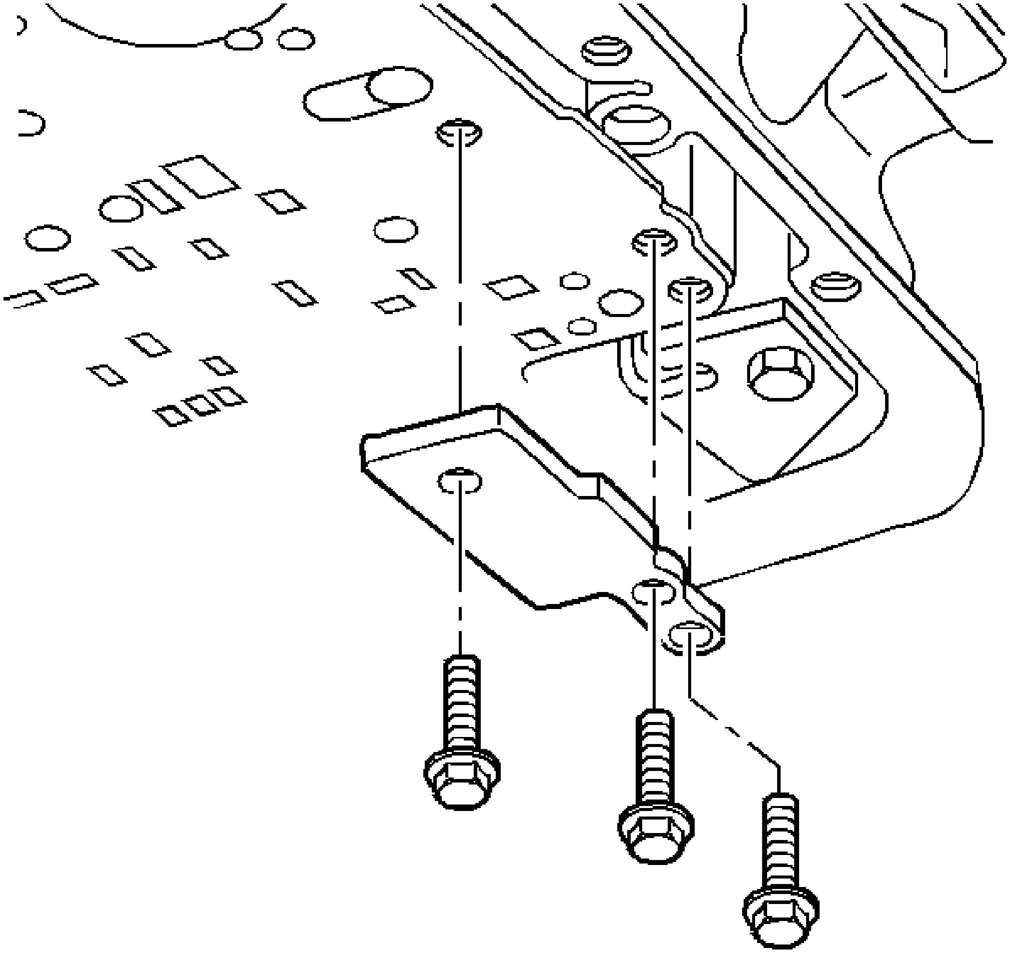


Fig. 152: Identifying Spacer Plate Support Bolts
Courtesy of GENERAL MOTORS CORP.

11. Remove the spacer plate support retaining bolts.

IMPORTANT: Use care not to drop the following items that will be removed along with the spacer plate:

- **The number 1 checkball**
- **The 3-4 accumulator spring**
- **The 3-4 accumulator pin**

12. Remove the spacer plate support.

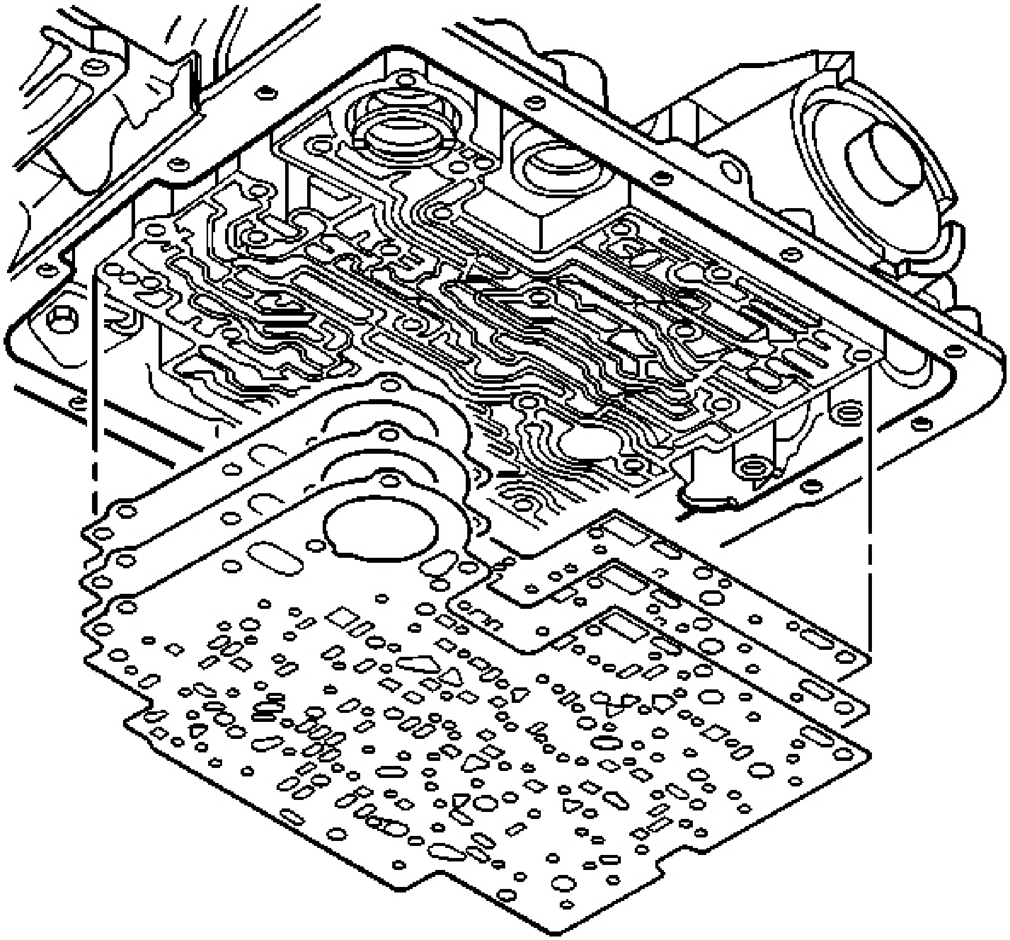


Fig. 153: Identifying Spacer Plate, Valve Body Gasket & Transmission Case Gasket
Courtesy of GENERAL MOTORS CORP.

13. Remove the spacer plate to valve body gasket, the spacer plate and the spacer plate to transmission case gasket.

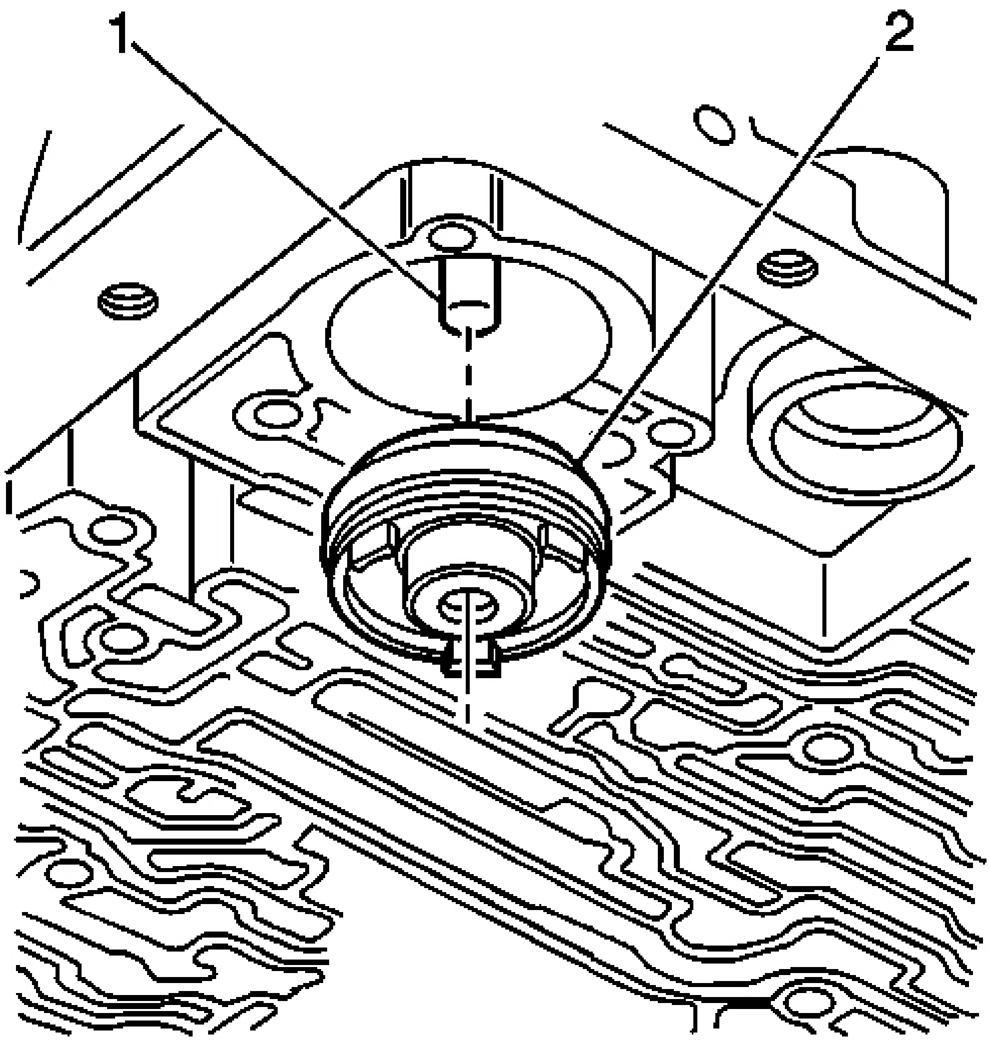


Fig. 154: Identifying 3-4 Accumulator Piston
Courtesy of GENERAL MOTORS CORP.

14. Remove the 3-4 accumulator piston (2).
15. Inspect the 3-4 accumulator spring for cracks.

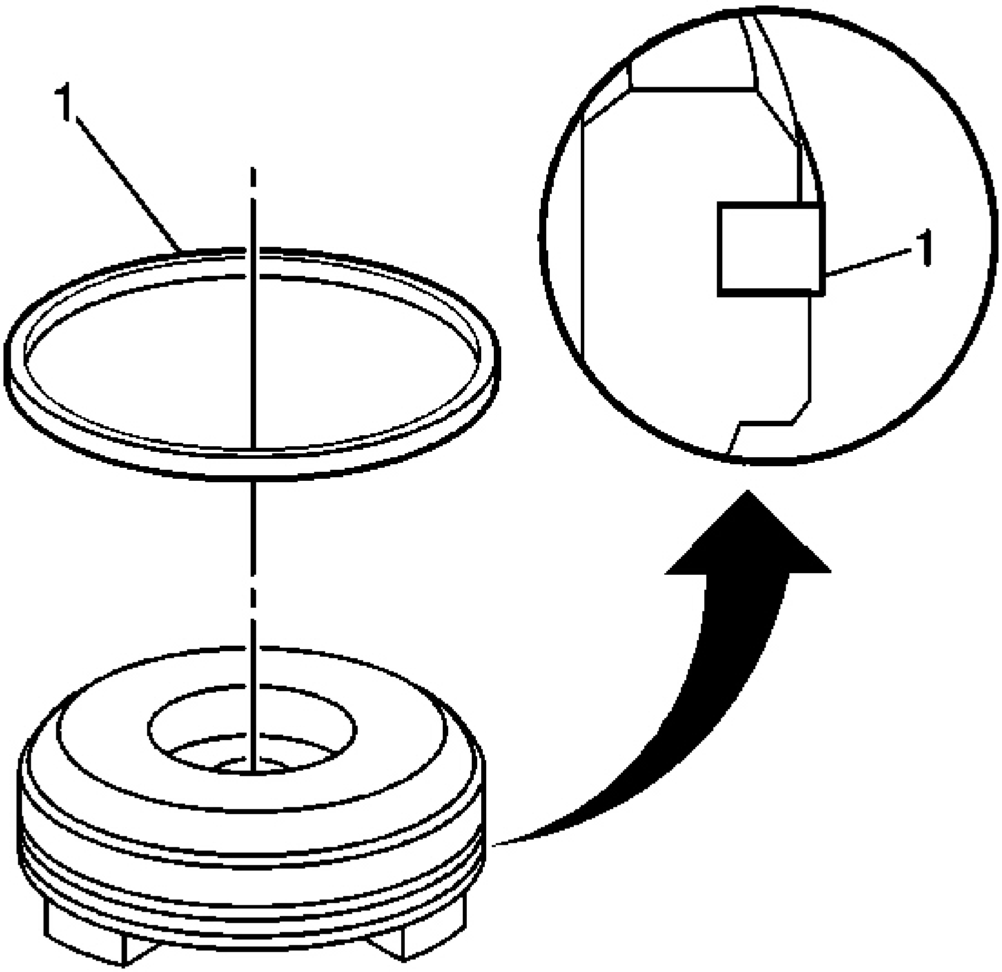


Fig. 155: Identifying Accumulator Piston Seal
Courtesy of GENERAL MOTORS CORP.

16. Remove the 3-4 accumulator piston seal (1) from the 3-4 accumulator piston.
17. Inspect the 3-4 accumulator piston for the following defects:
    - Porosity
    - Cracks
    - Scoring
    - Nicks and scratches

Installation Procedure

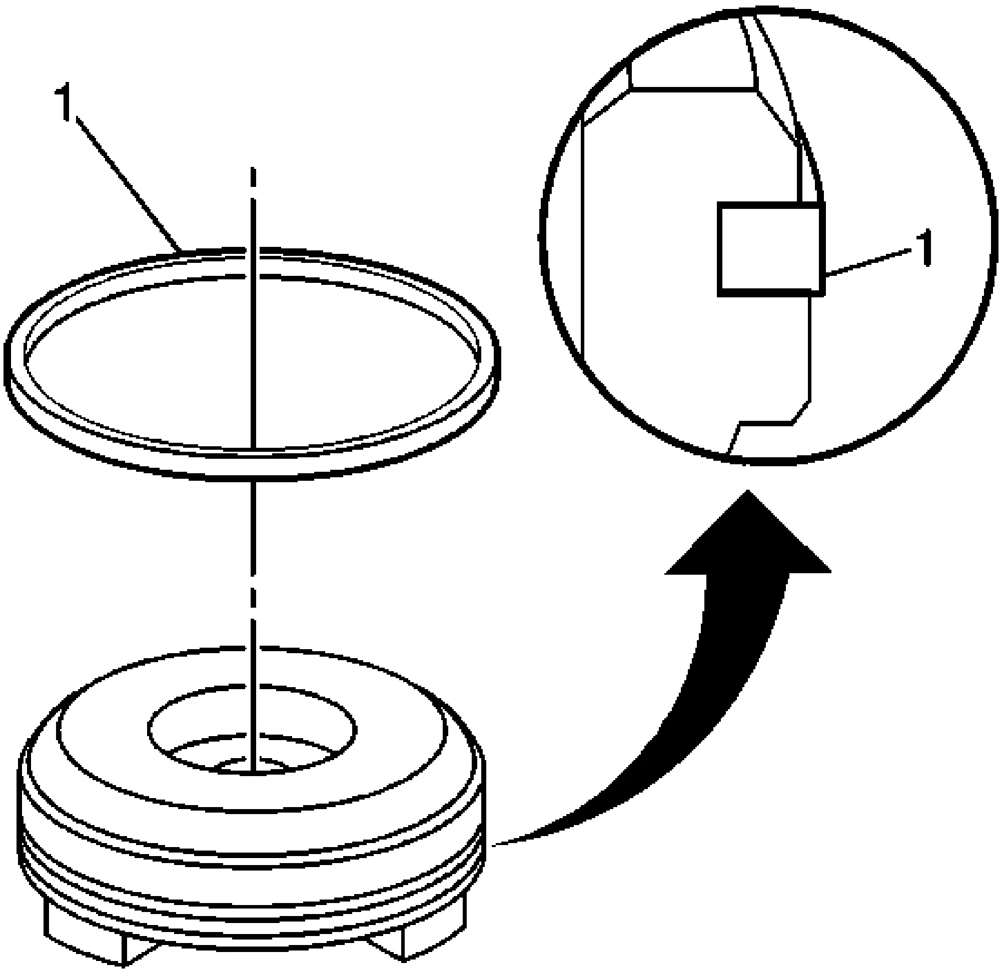


Fig. 156: Identifying Accumulator Piston Seal
Courtesy of GENERAL MOTORS CORP.

1. Install a new 3-4 accumulator piston seal (1) to the 3-4 accumulator piston.

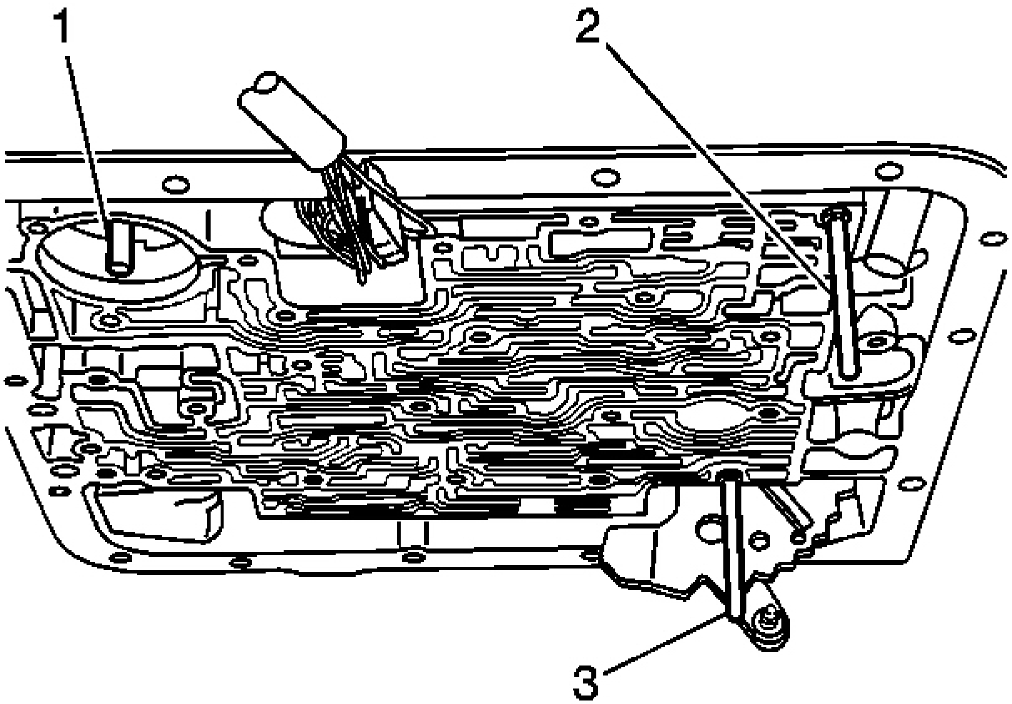
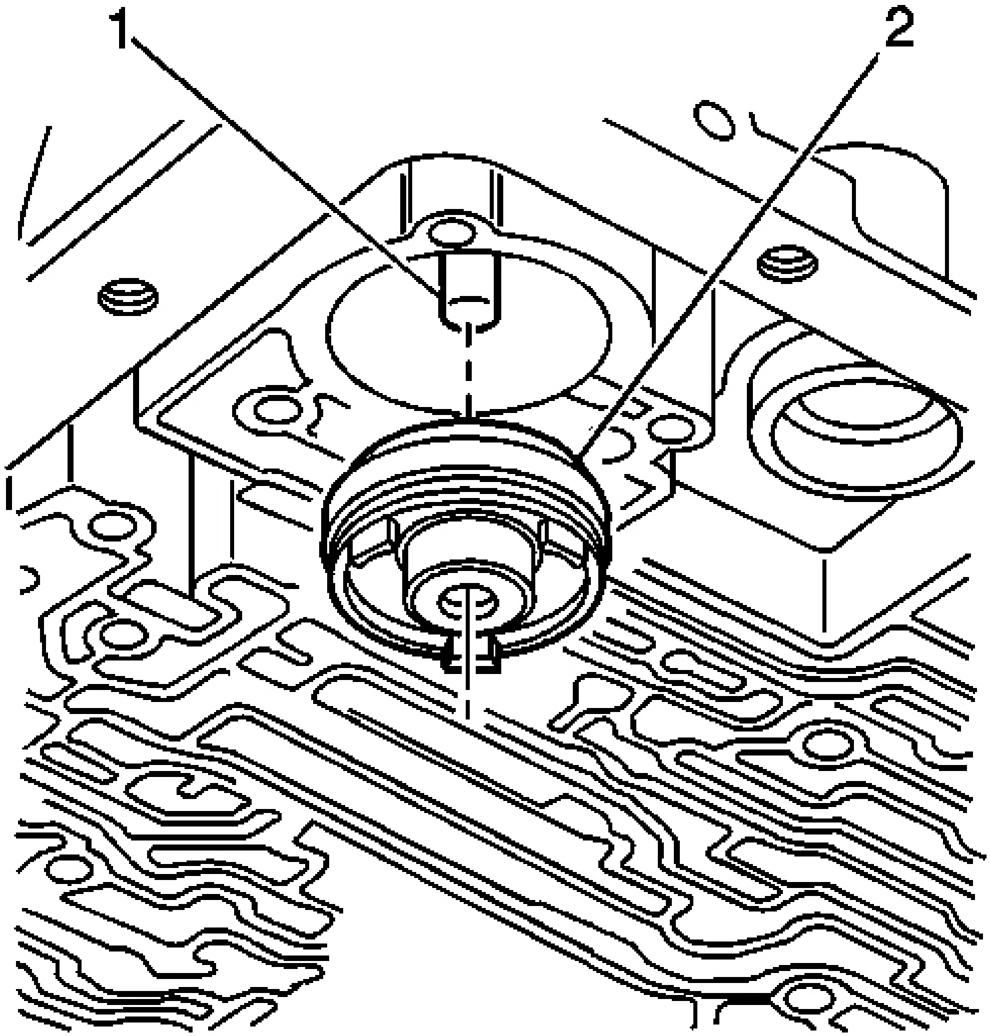


Fig. 157: Installing 3-4 Accumulator Pin Into Transmission Case
Courtesy of GENERAL MOTORS CORP.

2. Install the 3-4 accumulator pin (1) into the transmission case and retain the pin with J 36850 .



<u>Fig. 158: Identifying 3-4 Accumulator Piston</u>
Courtesy of GENERAL MOTORS CORP.

3. Install the 3-4 accumulator piston (2) onto the pin (1) in the transmission case.

   Ensure that the 3-4 accumulator piston legs face away from the transmission case.

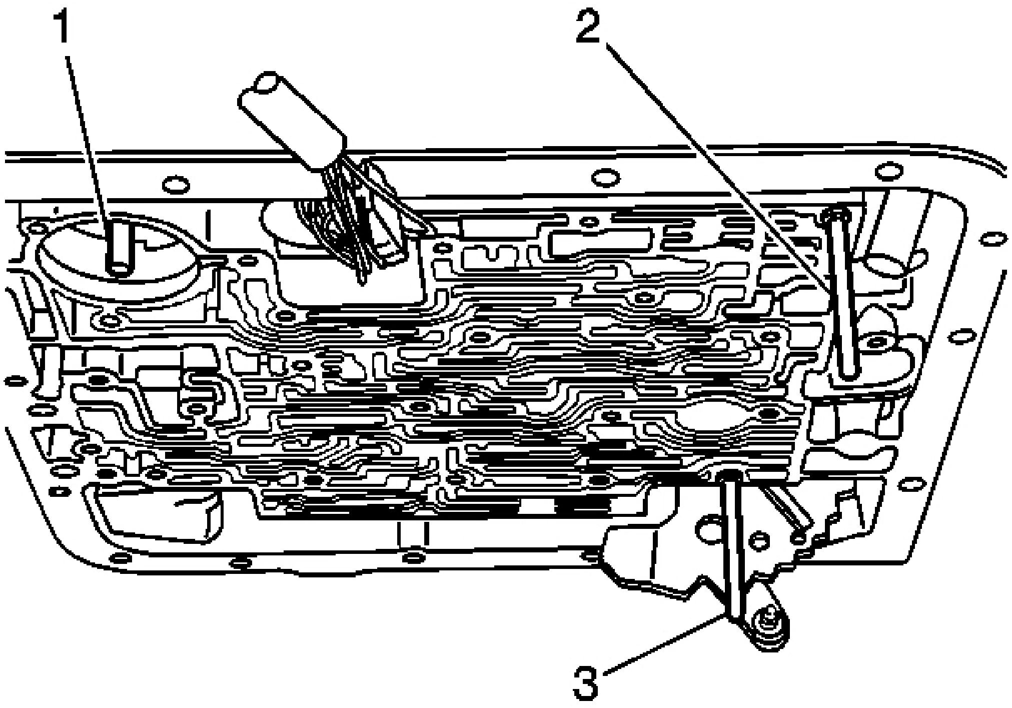


Fig. 159: Installing 3-4 Accumulator Pin Into Transmission Case
Courtesy of GENERAL MOTORS CORP.

4. Install the **J 25025-B** (2, 3) to the transmission case. See **Special Tools and Equipment** .

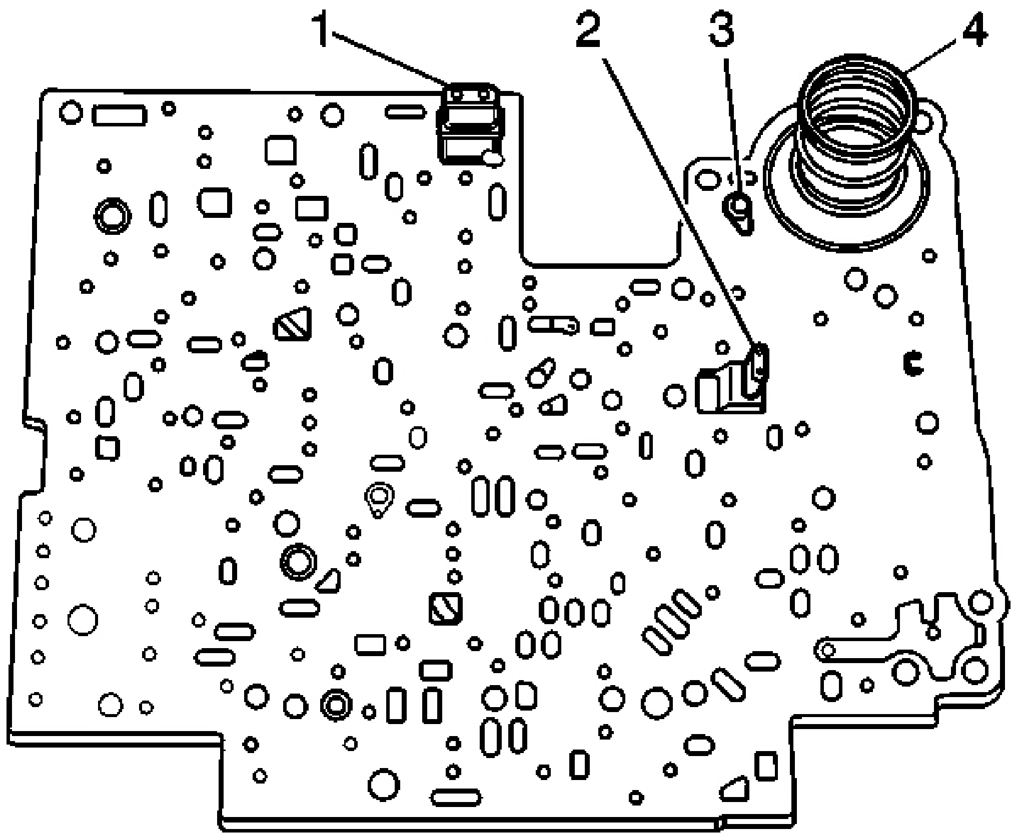


Fig. 160: Installing Spacer Plate Components
Courtesy of GENERAL MOTORS CORP.

5. Install the spacer plate to transmission case gasket and the spacer plate to valve body gasket to the spacer plate; use J 36850 in order to retain the gaskets to the spacer plate.
   - The case gasket is identified by a C.

     Be sure to place the case gasket on the transmission case side of the spacer plate.

   - The valve body gasket is identified by a V.

     Be sure to place the valve body gasket on the valve body side of the spacer plate.

6. Ensure that the solenoid screens (1, 2) are in place on the spacer plate.
7. Place the checkball (3) on the spacer plate in the location shown.
8. Place the 3-4 accumulator spring (4) on the spacer plate.

9. Install the spacer plate and related components to the transmission.

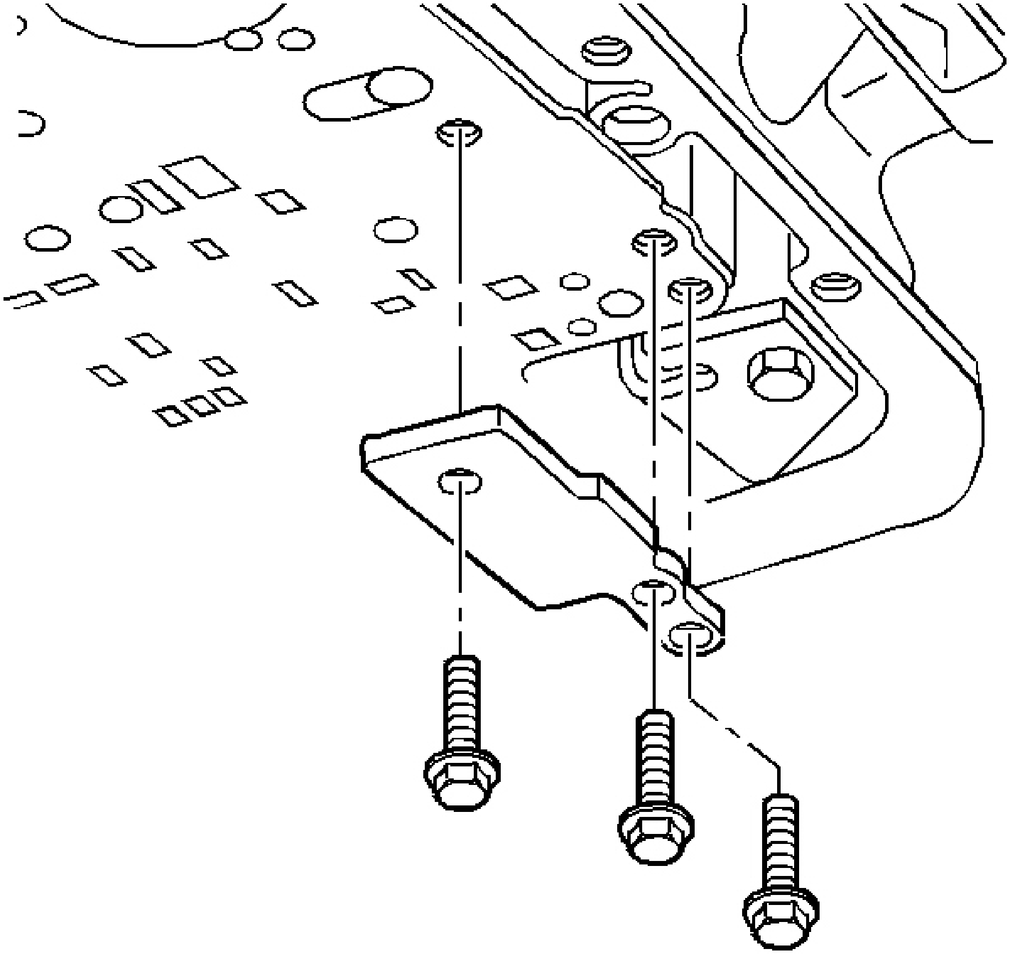


Fig. 161: Identifying Spacer Plate Support Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Install the spacer plate support and the spacer plate support retaining bolts.

Tighten: Tighten the spacer plate support retaining bolts to 11 N.m (97 lb in).

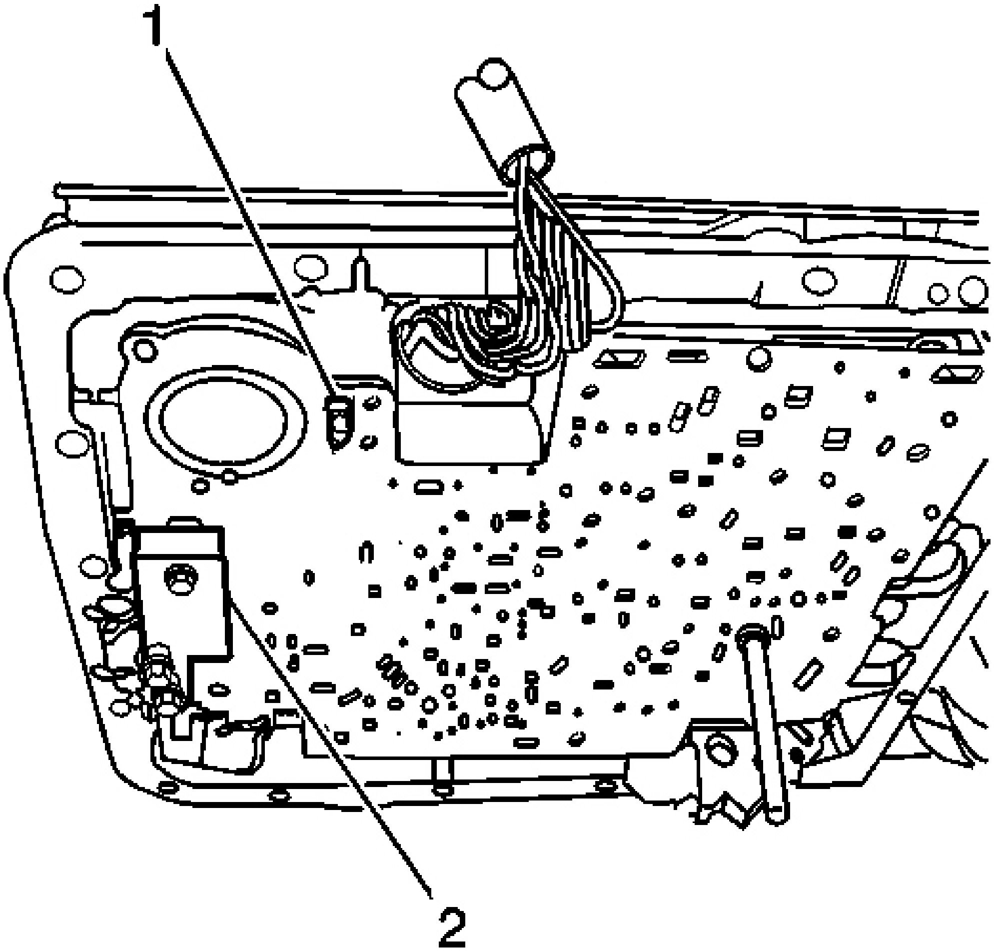


Fig. 162: Ensuring Checkball Has Remained In Proper Location
Courtesy of GENERAL MOTORS CORP.

11. After installing the spacer plate support (2), look through the hole in the spacer plate to ensure that the checkball (1) has remained in the proper location.

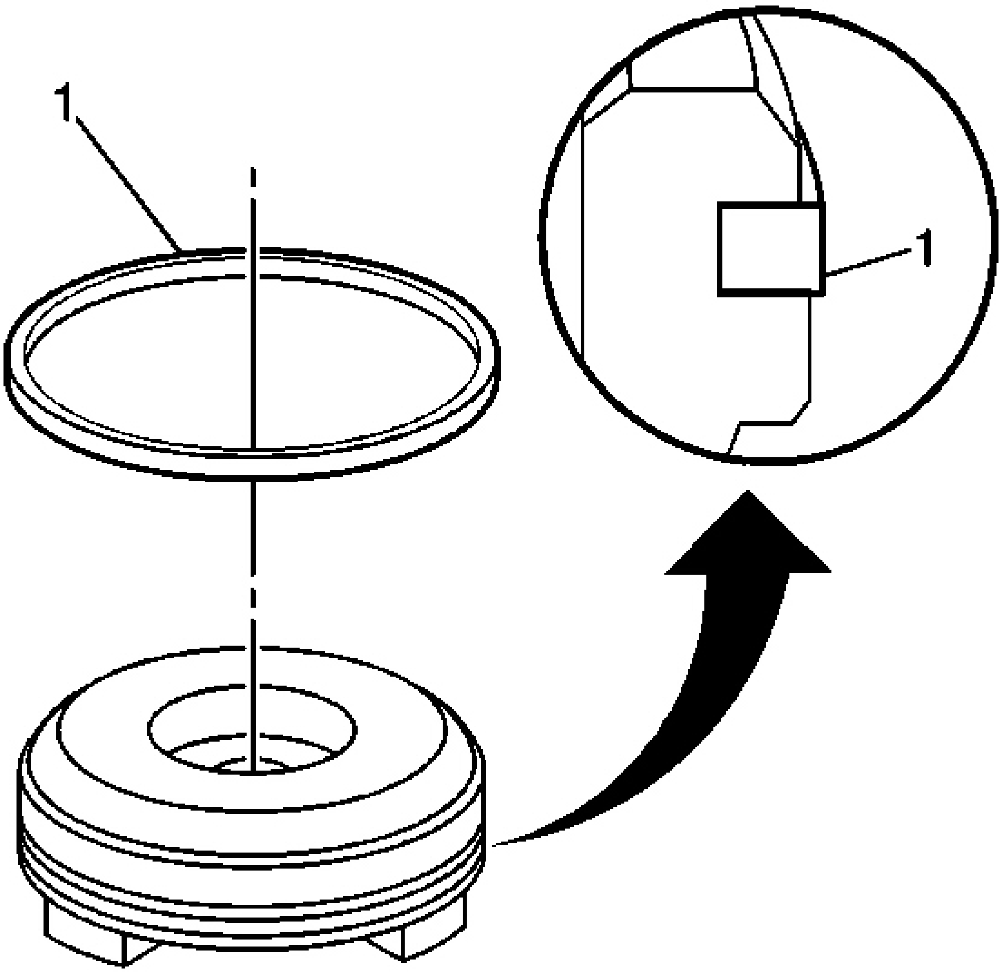


Fig. 163: Identifying Accumulator Piston Seal
Courtesy of GENERAL MOTORS CORP.

12. Install a new 1-2 accumulator piston seal (1) to the 1-2 accumulator piston.

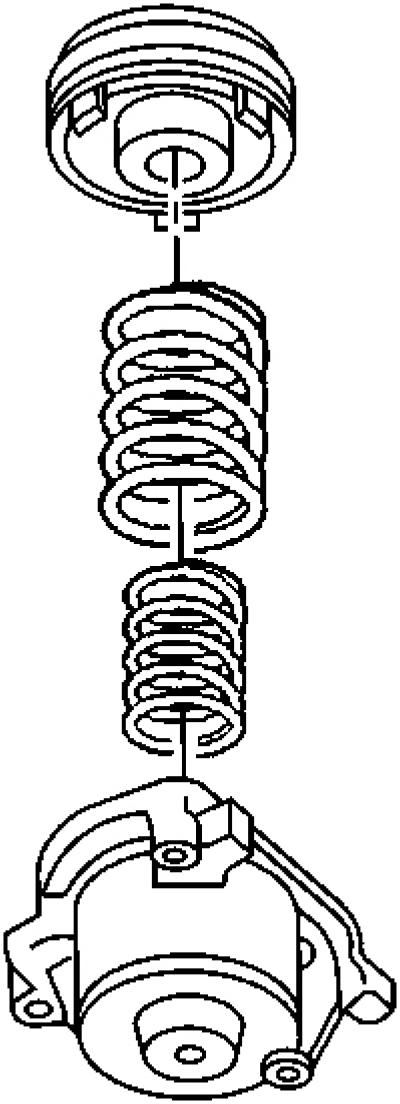


Fig. 164: Installing 1-2 Accumulator Inner & Outer Springs To 1-2 Accumulator Cover
Courtesy of GENERAL MOTORS CORP.

13. Install the 1-2 accumulator inner and outer springs to the 1-2 accumulator cover.
14. Install the 1-2 accumulator piston onto the pin in the 1-2 accumulator cover.

    Ensure that the piston legs face the accumulator cover.

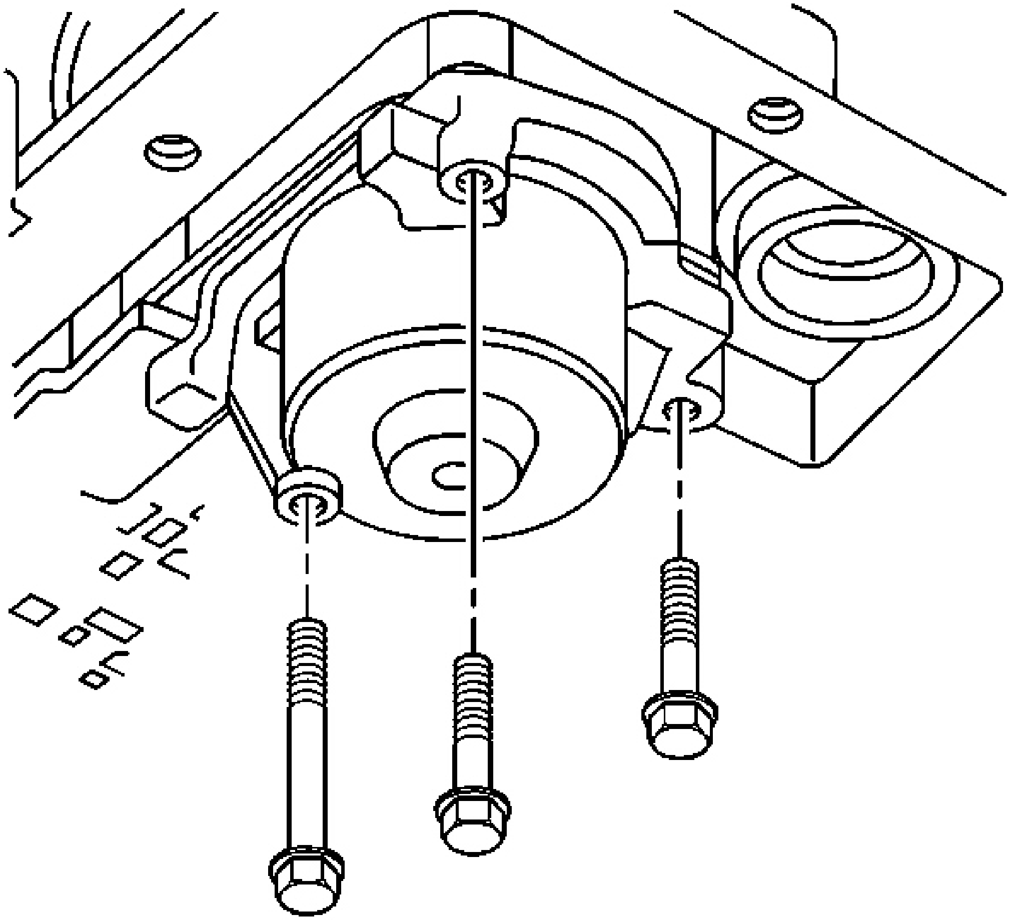


Fig. 165: 1-2 Accumulator Cover
Courtesy of GENERAL MOTORS CORP.

15. Install the 1-2 accumulator cover and the accumulator cover retaining bolts.

    Tighten: Tighten the accumulator cover retaining bolts to 11 N.m (97 lb in).

16. Remove the **J 25025-B** from the transmission case. See **Special Tools and Equipment** .
17. Install the control valve body. Refer to **Valve Body and Pressure Switch Replacement** .
18. Install the transmission oil pan and filter. Refer to **Automatic Transmission Fluid/Filter Replacement** .
19. Lower the vehicle.
20. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

VEHICLE SPEED SENSOR (VSS) REPLACEMENT

Removal Procedure

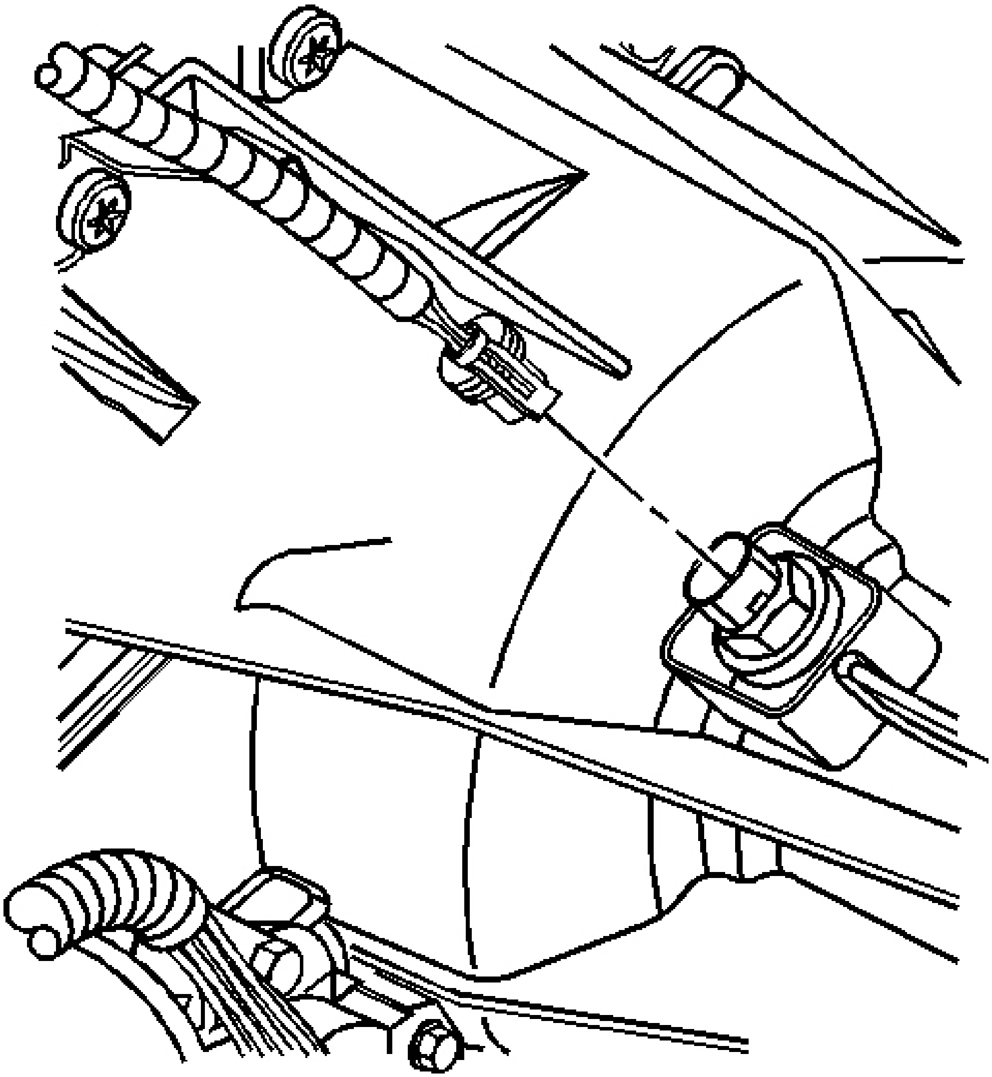


Fig. 166: Electrical Connector & Vehicle Speed Sensor
Courtesy of GENERAL MOTORS CORP.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the electrical connector from the speed sensor.

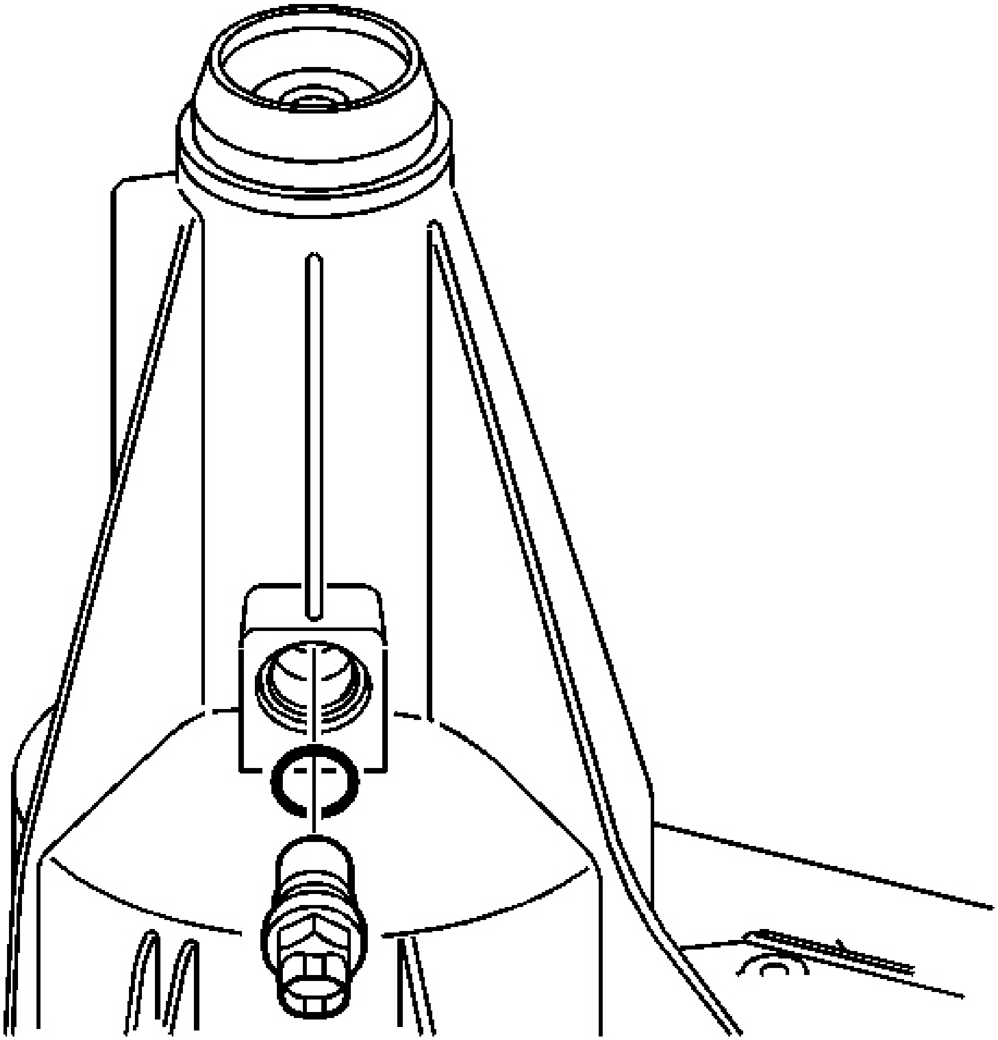


Fig. 167: Vehicle Speed Sensor & O-Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove the speed sensor and the O-ring from the transfer case.

Installation Procedure

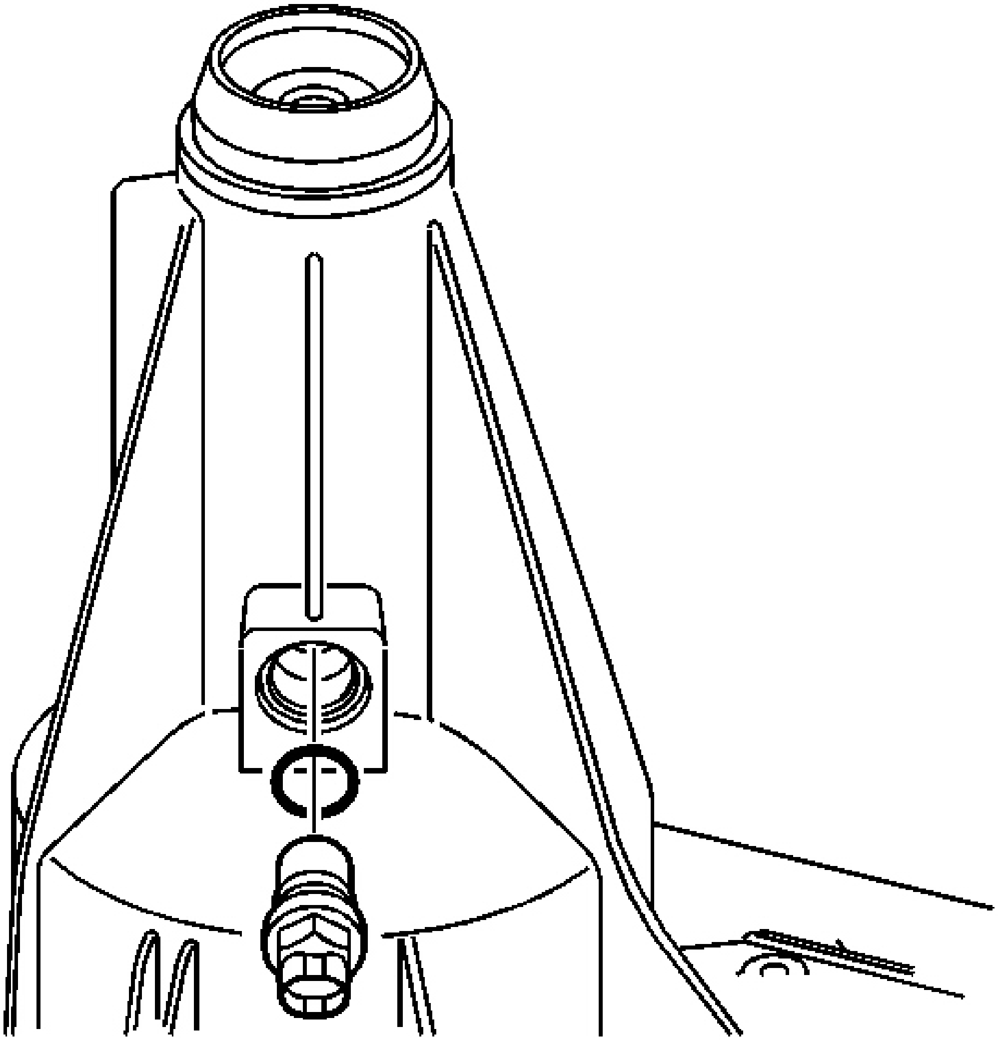


Fig. 168: Vehicle Speed Sensor & O-Ring
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the new rear speed sensor into the transfer case with a new O-ring seal.

   Tighten: Tighten the right rear speed sensor to 17 N.m (13 lb ft).

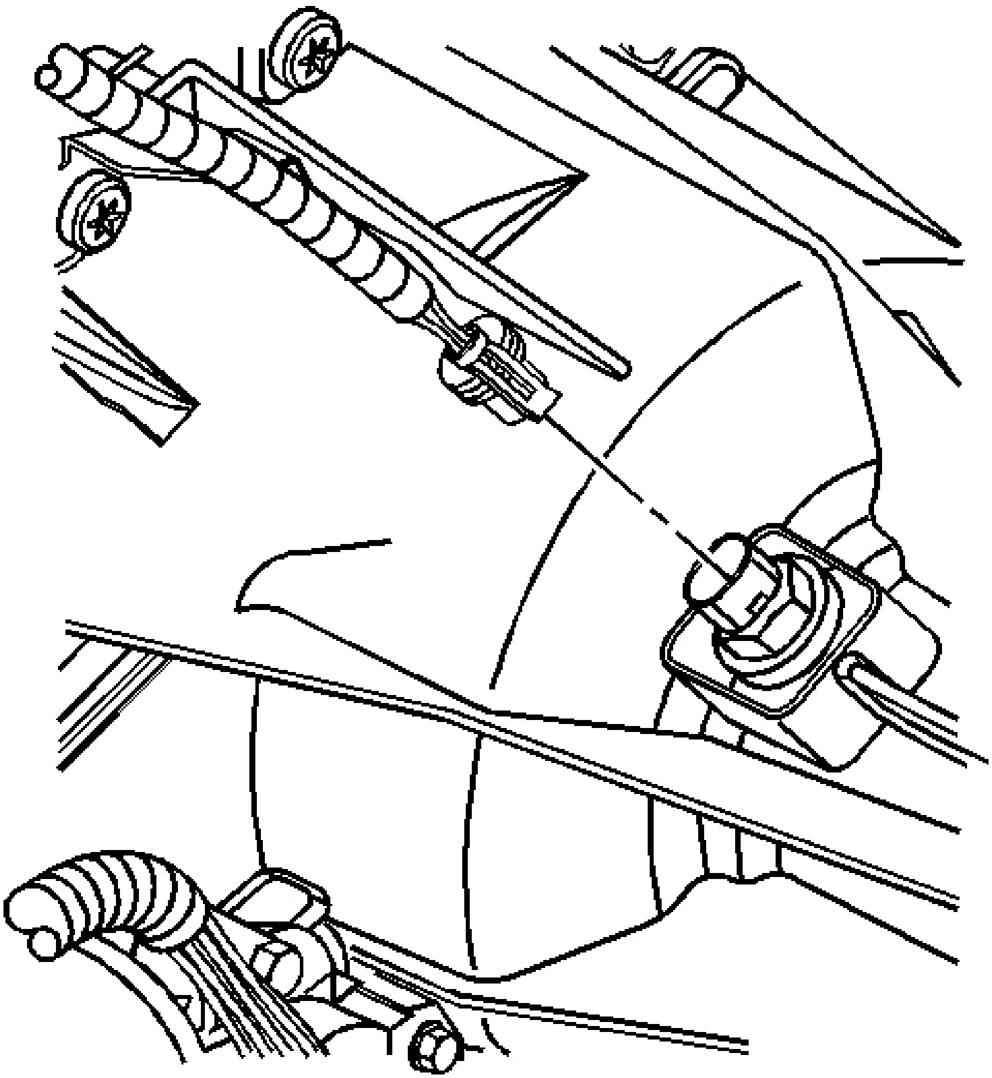


Fig. 169: Electrical Connector & Vehicle Speed Sensor
Courtesy of GENERAL MOTORS CORP.

2. Install the electrical connector to the speed sensor.
3. Lower the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

TRANSMISSION MOUNT REPLACEMENT

Removal Procedure

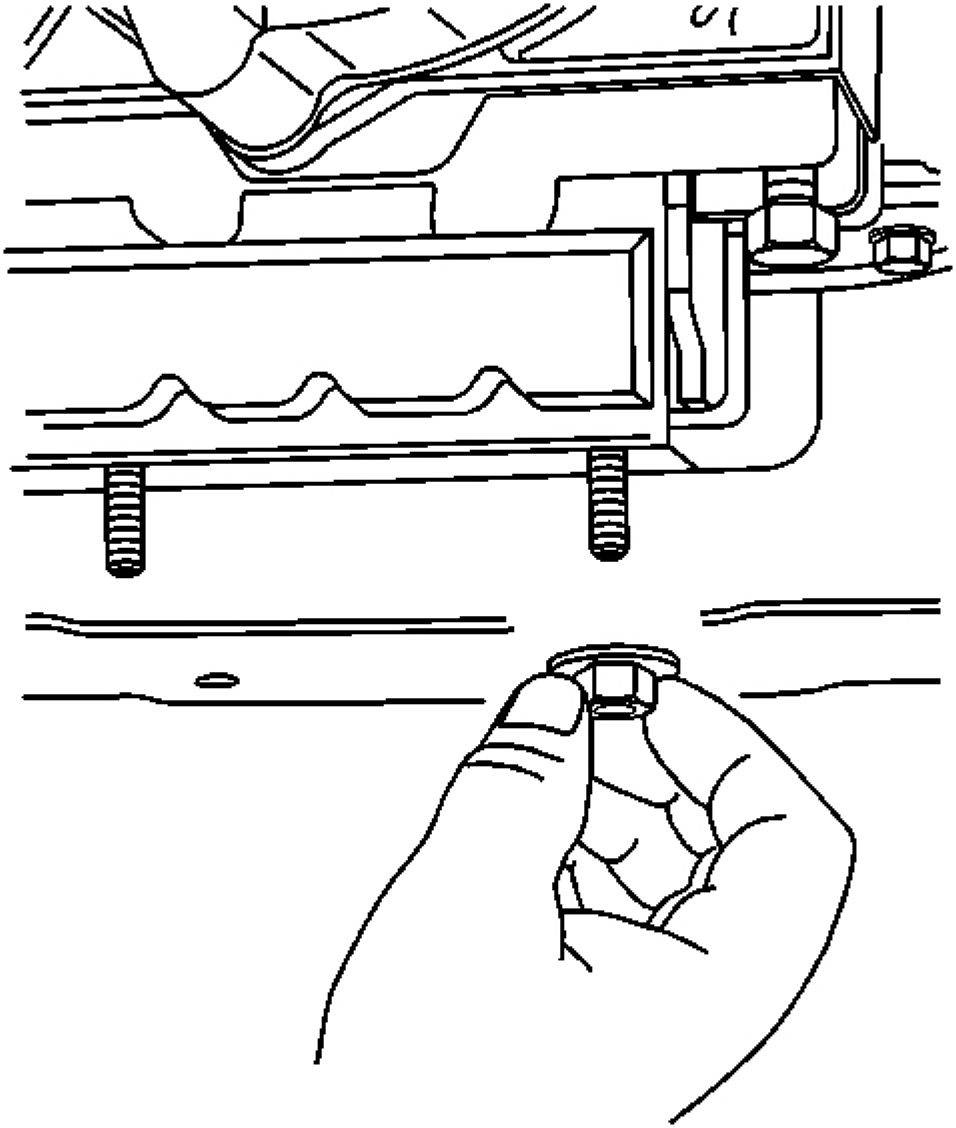


Fig. 170: Identifying Transmission Mount Nuts
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the catalytic converter guard. Refer to **Catalytic Converter Guard Replacement** .
3. Support the transmission with a transmission jack.

4. Remove the two nuts securing the transmission mount to the transmission support.

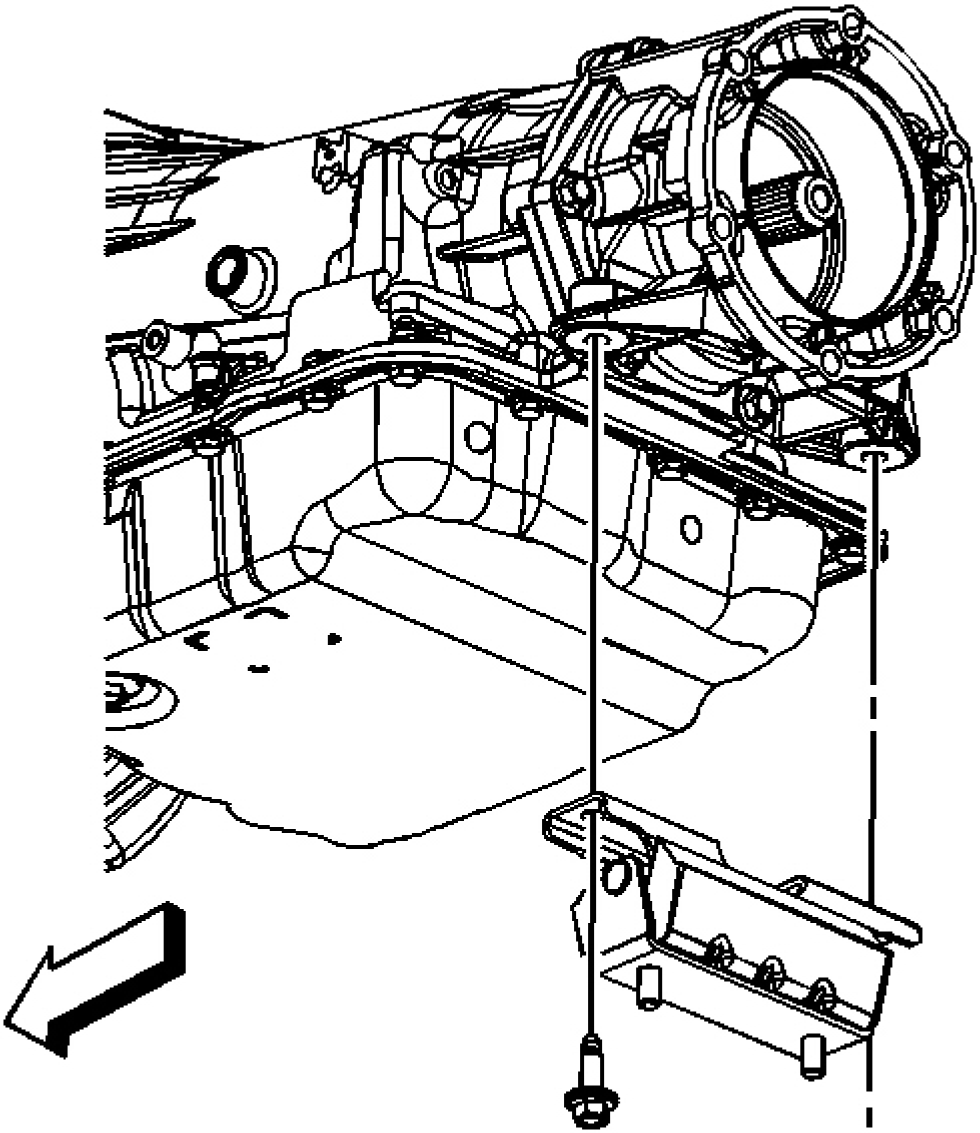


Fig. 171: Transmission Mount
Courtesy of GENERAL MOTORS CORP.

5. Raise the transmission off of the transmission support.
6. Remove the bolts.

Installation Procedure

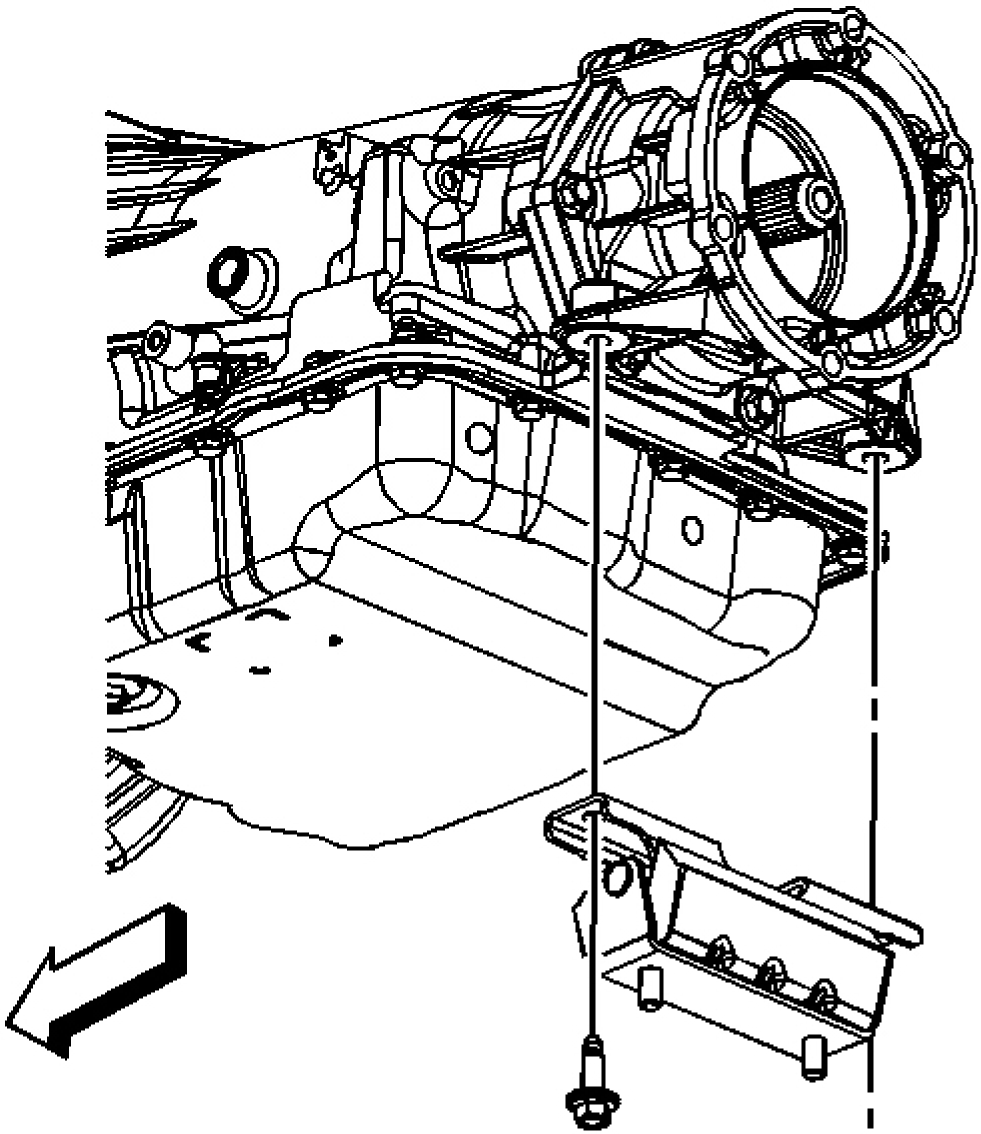


Fig. 172: Transmission Mount
Courtesy of GENERAL MOTORS CORP.

1. Install the transmission mount to the vehicle.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Install the bolts.

   Tighten: Tighten the bolts to 60 N.m (44 lb ft).

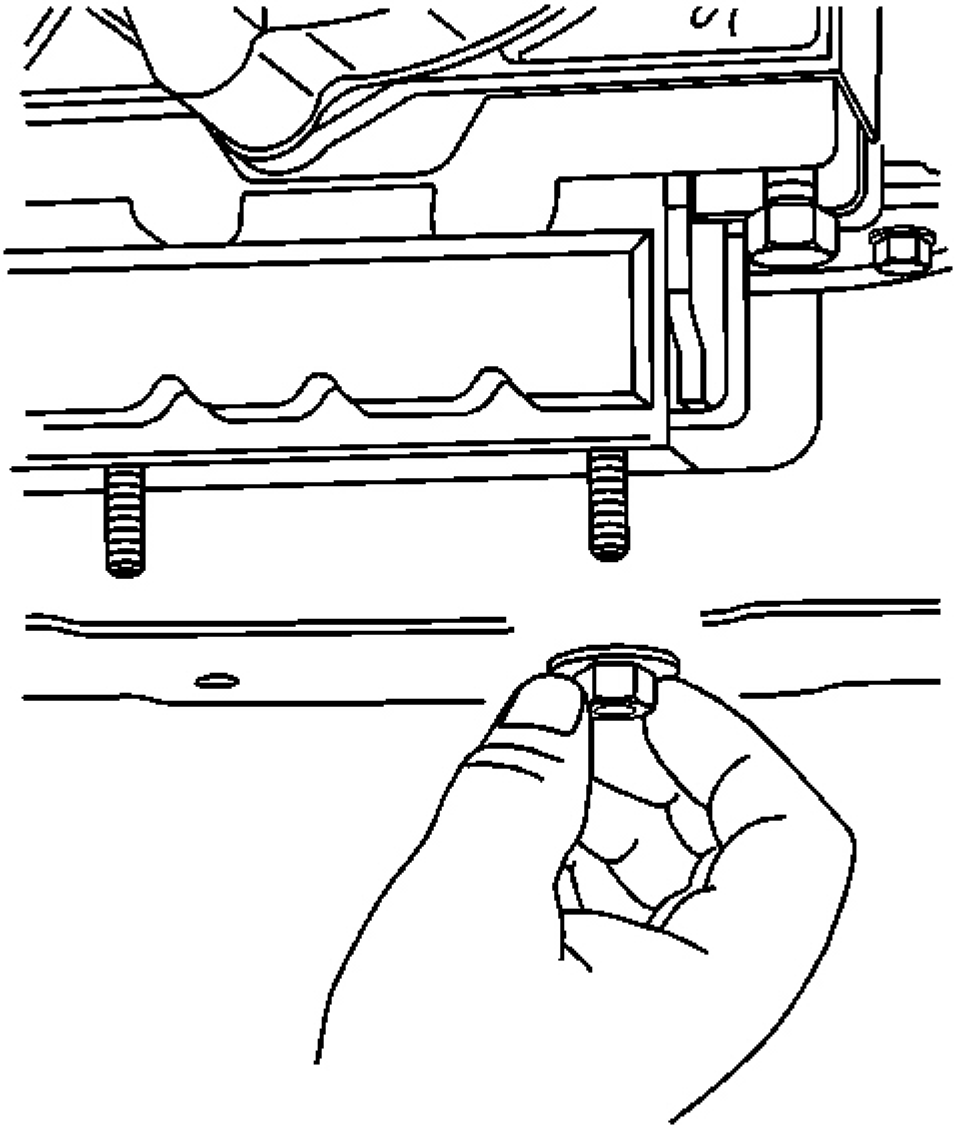


Fig. 173: Identifying Transmission Mount Nuts

Courtesy of GENERAL MOTORS CORP.

3. Lower the transmission and install the two nuts securing the transmission mount to the transmission support.

   Tighten: Tighten the nuts to 40 N.m (30 lb ft).

4. Remove the transmission jack.
5. Install the catalytic converter guard. Refer to **Catalytic Converter Guard Replacement** .
6. Lower the vehicle.

TRANSMISSION REPLACEMENT

Removal Procedure

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the battery.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Support the transmission with a transmission jack.
4. Remove the exhaust pipe assembly. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
5. Remove the starter motor. Refer to **Starter Motor Replacement** in Engine Electrical.
6. Lower the transmission to gain access to the top and sides of the transmission.
7. Remove the transfer case. Refer to **Transfer Case Assembly Replacement** .
8. Remove the shift cable end from the transmission shift lever ball stud and the pan rail bracket. Refer to **Automatic Transmission Range Selector Cable Replacement** .

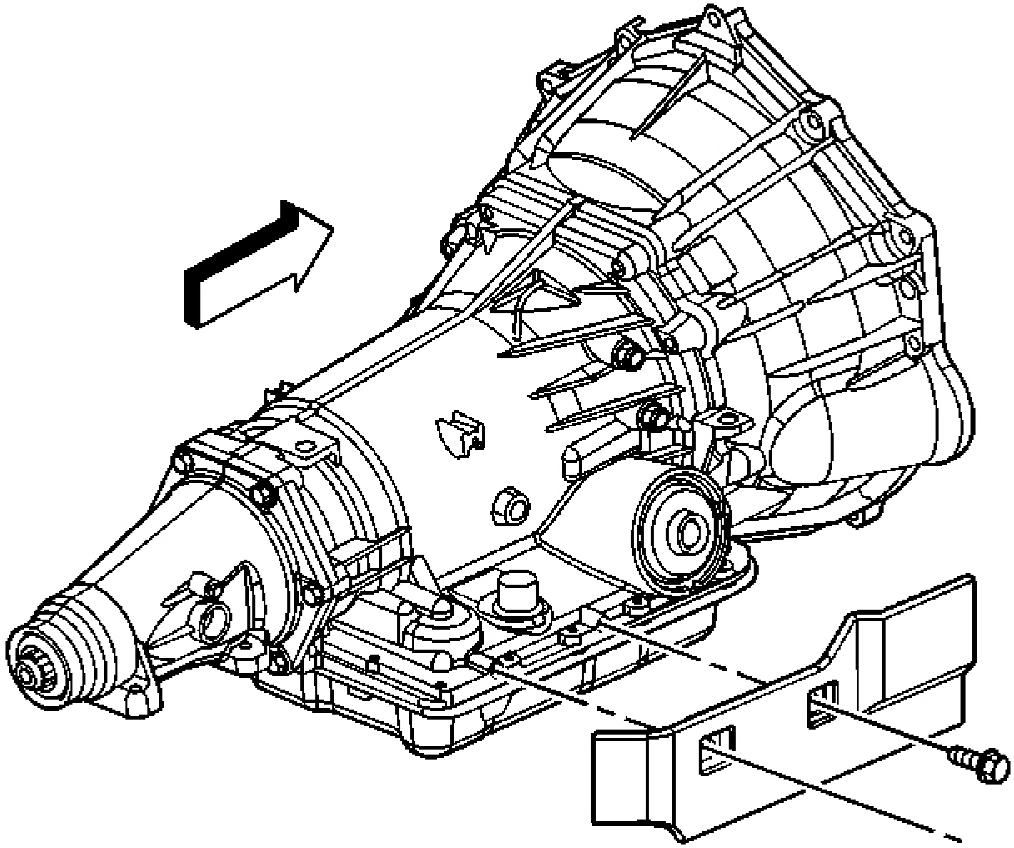


Fig. 174: Transmission Heat Shield Bolts & Heat Shield
Courtesy of GENERAL MOTORS CORP.

9. Remove the transmission heat shield.
10. Disconnect the transmission vent hose, the park/neutral position switch connector, and the main electrical connector from the transmission. Refer to **Park/Neutral Position Switch Replacement** .

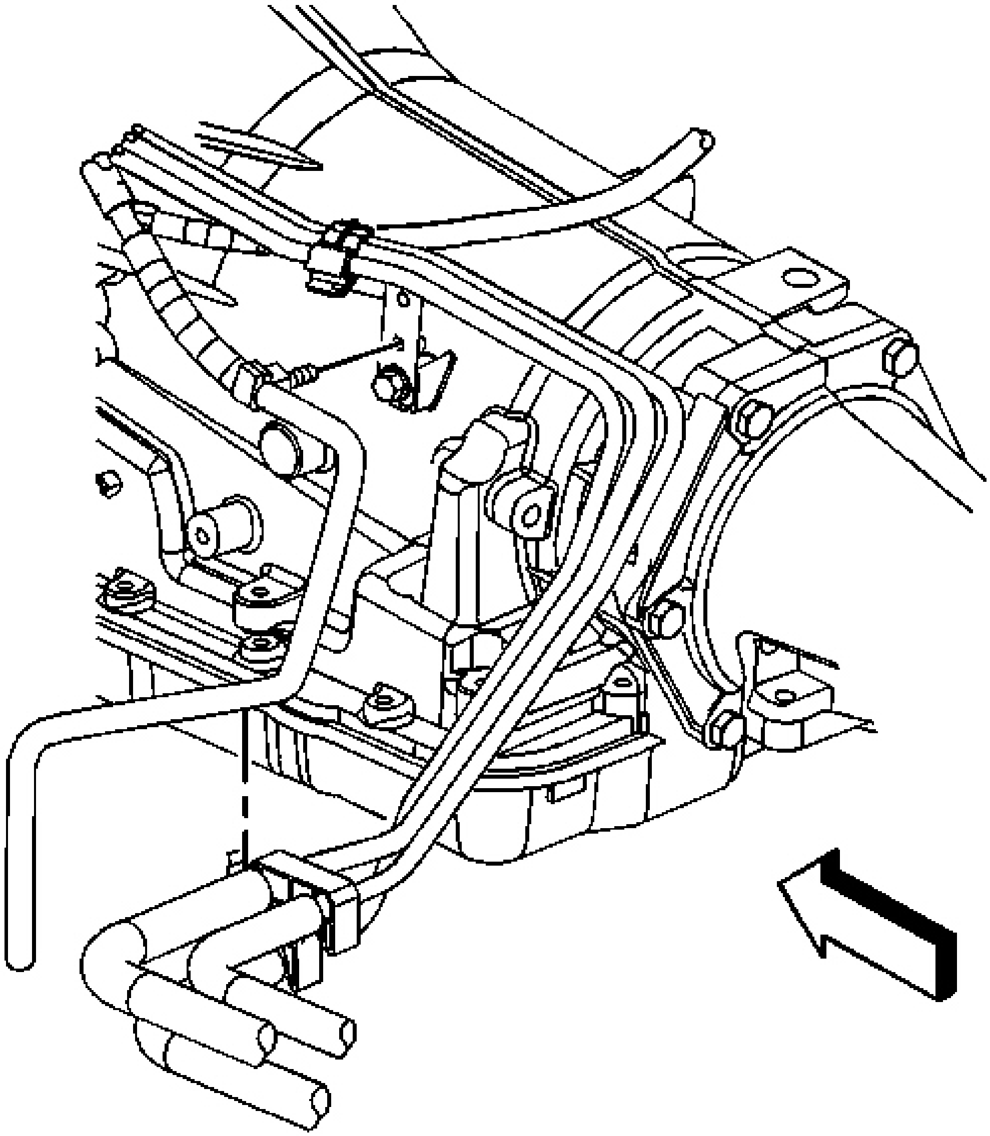


Fig. 175: Locating Bolt That Secures Fuel Line Bracket To Left Side Of Transmission
Courtesy of GENERAL MOTORS CORP.

11. Remove the bolt that secures the fuel line bracket to the left side of the transmission.
12. Remove the torque converter access plug.
13. Remove the flywheel to torque converter bolts.

14. Disconnect the transmission oil cooler lines from the transmission. Refer to **Transmission Fluid Cooler Hose/Pipe Replacement** .
15. Plug the transmission oil cooler line connectors in the transmission case.
16. Remove the transmission fill tube retaining nut from the transmission stud.
17. Remove the engine harness bracket retaining nuts from the transmission studs.
18. Remove the fill tube from the transmission.
19. Remove the engine harness brackets from the transmission studs and position aside.

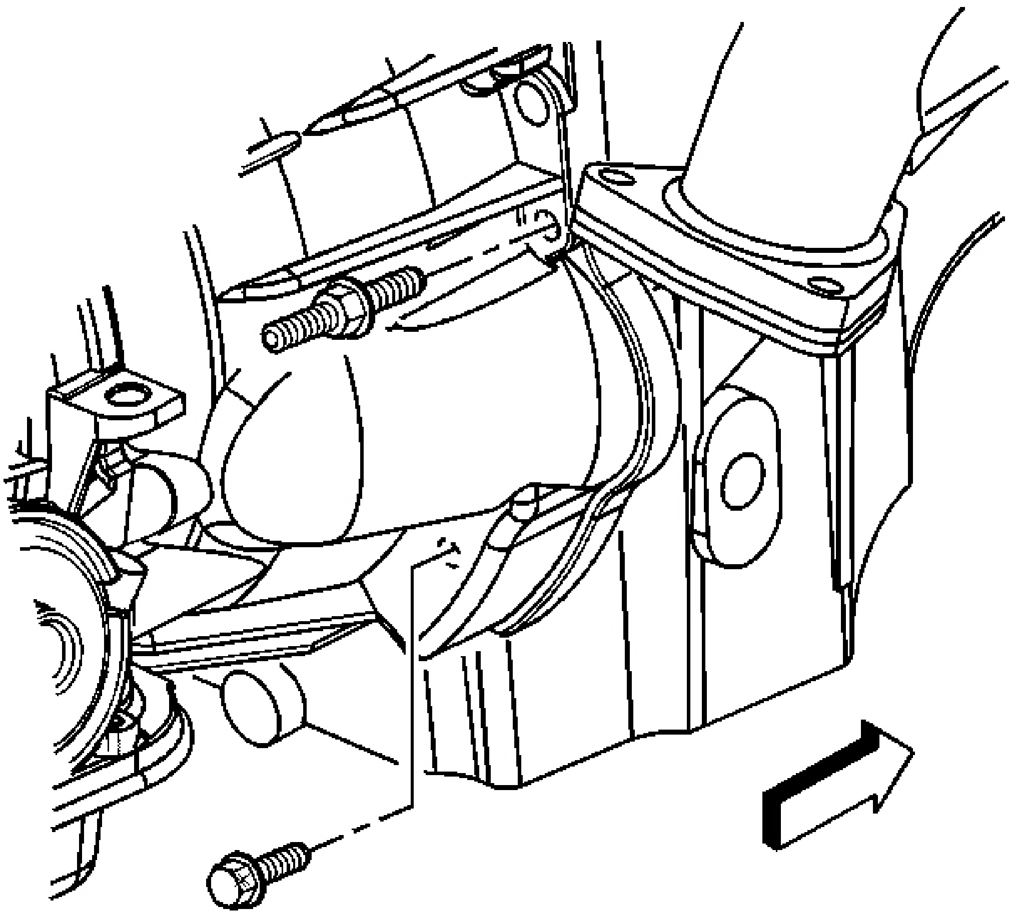


Fig. 176: Identifying Stud & Bolt Securing Transmission To Engine
Courtesy of GENERAL MOTORS CORP.

20. Remove the bolts securing the transmission to the engine oil pan.

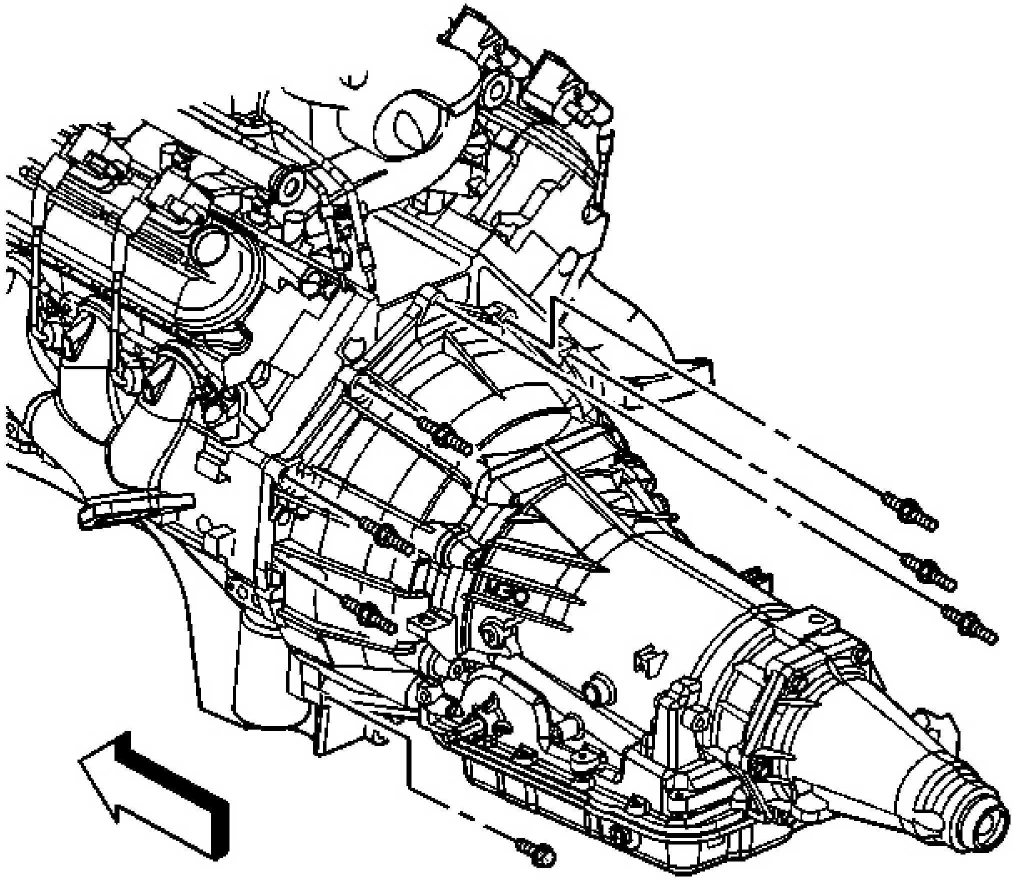


Fig. 177: Identifying The Six Studs & One Bolt Securing Transmission To Engine
Courtesy of GENERAL MOTORS CORP.

21. Remove the six studs and one bolt securing the transmission to the engine.
22. Pull the transmission straight back.
23. Remove the transmission from the vehicle while simultaneously removing the fluid level indicator tube.
24. Perform the automatic transmission oil cooler flushing and flow test. Refer to **Automatic Transmission Oil Cooler Flushing and Flow Test (J 45096)** or **Automatic Transmission Oil Cooler Flushing and Flow Test (J 35944-A)** .

Installation Procedure

1. Support the transmission with a transmission jack.
2. Raise the transmission into place.

3. Slide the transmission straight onto the locating pins while lining up the marks on the flywheel and the torque converter.

   The torque converter must rotate freely by hand.

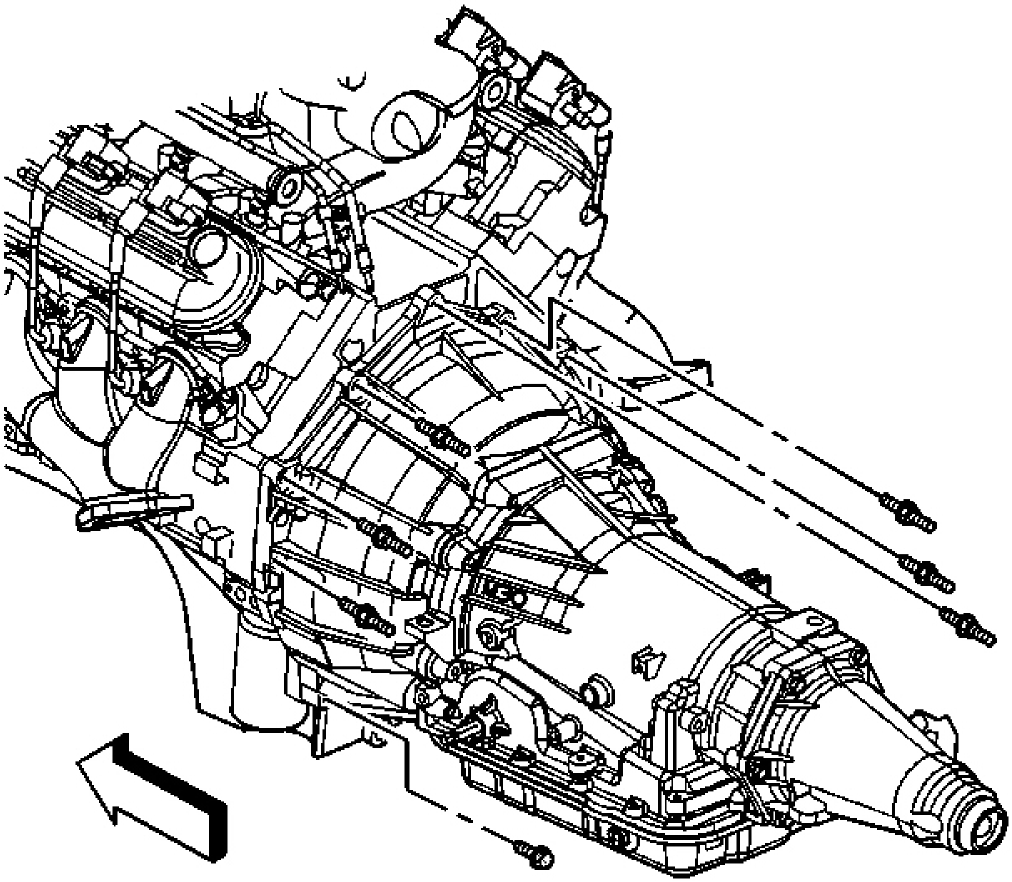


Fig. 178: Identifying The Six Studs & One Bolt Securing Transmission To Engine
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install six studs and one bolt securing the transmission to the engine.

   Tighten: Tighten the studs and the bolt to 50 N.m (37 lb ft).

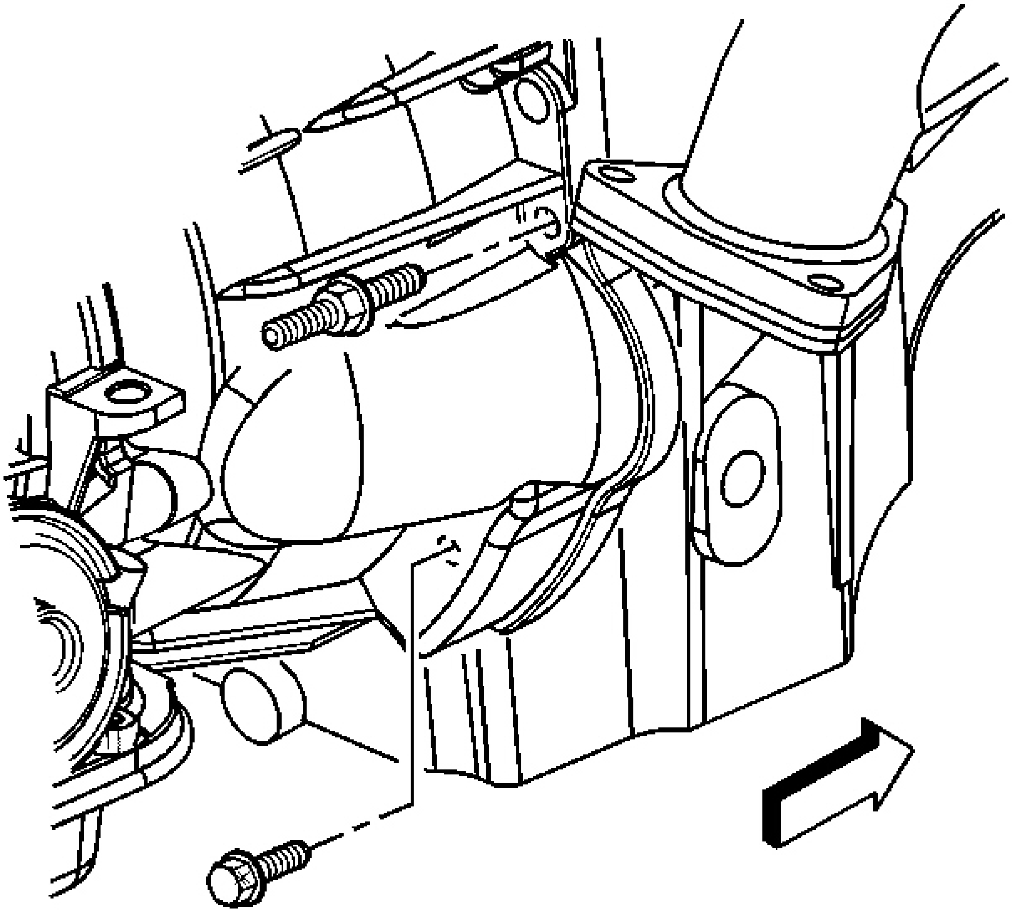


Fig. 179: Identifying Stud & Bolt Securing Transmission To Engine
Courtesy of GENERAL MOTORS CORP.

5. Install the bolts securing the transmission to the engine oil pan.

   Tighten: Tighten the bolts to 50 N.m (37 lb ft).

6. Install the engine harness bracket onto the appropriate transmission studs.
7. Install the fill tube onto the transmission.
8. Instal the engine harness bracket and fill tube nuts onto the transmission studs.

   Tighten: Tighten the nuts to 18 N.m (13 lb ft).

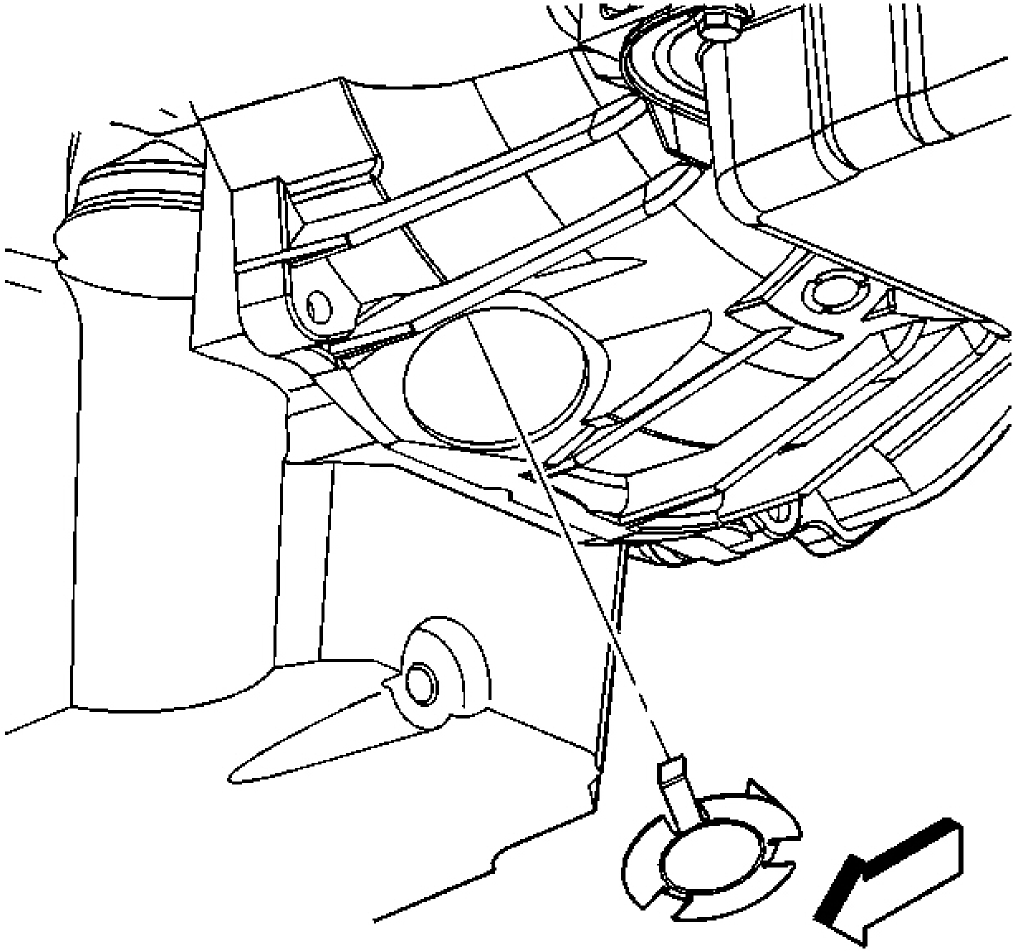
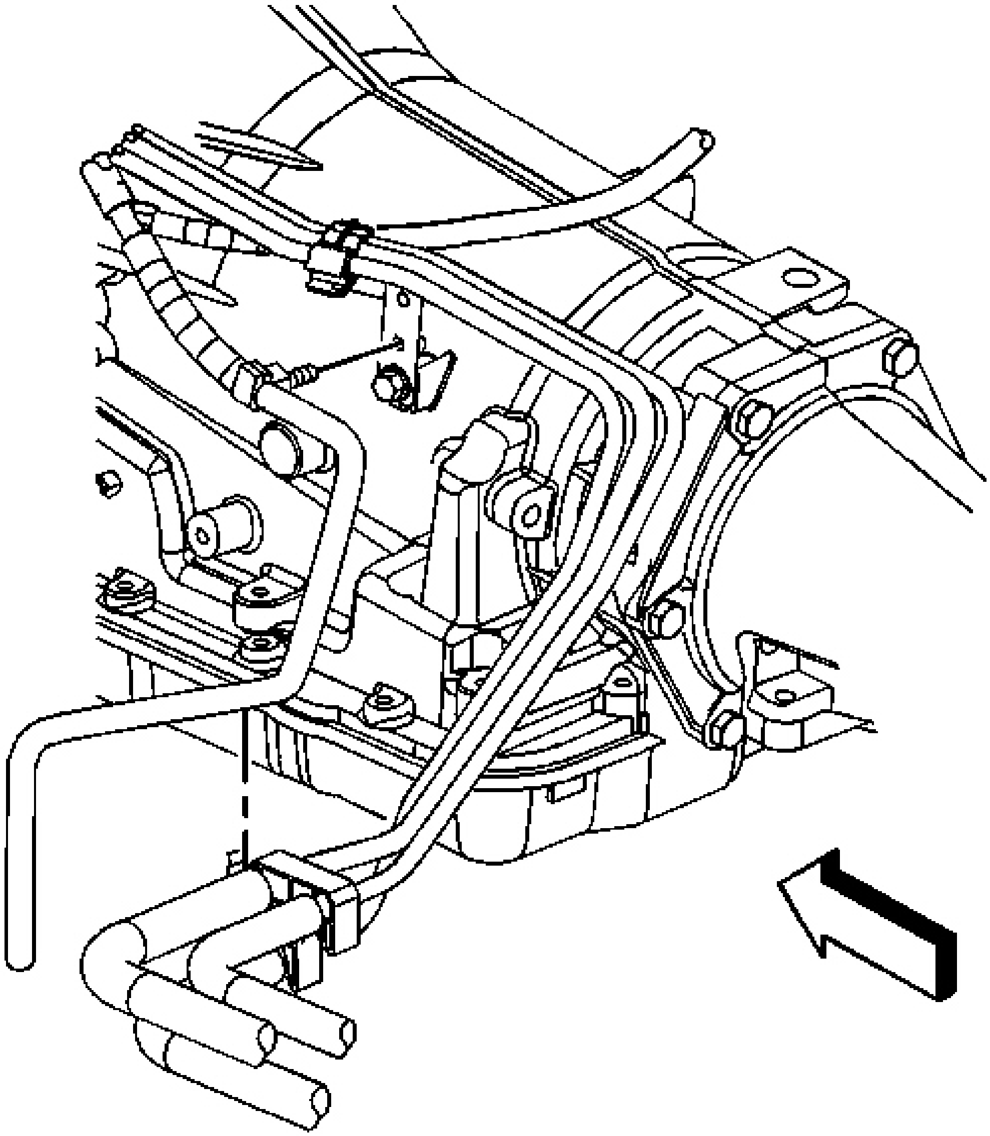


Fig. 180: Installing Torque Converter Access Plug
Courtesy of GENERAL MOTORS CORP.

9. Install the flywheel to torque converter bolts.

   Tighten: Tighten the bolts to 63 N.m (46 lb ft).

10. Install the torque converter access plug.
11. Connect the cooler lines to the transmission. Refer to **Transmission Fluid Cooler Hose/Pipe Replacement** .



<u>Fig. 181: Locating Bolt That Secures Fuel Line Bracket To Left Side Of Transmission</u>
Courtesy of GENERAL MOTORS CORP.

12. Install the transmission vent hose, fuel lines, and the wiring harness connectors to the transmission and park neutral switch.

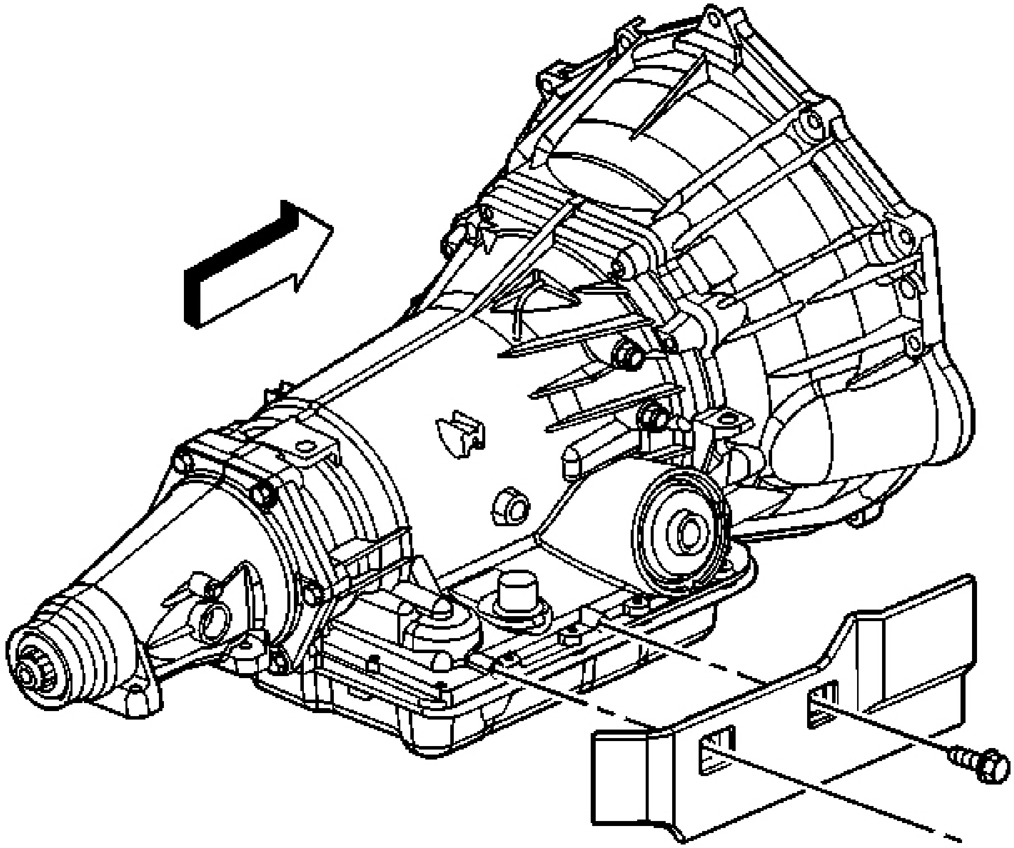


Fig. 182: Transmission Heat Shield Bolts & Heat Shield
Courtesy of GENERAL MOTORS CORP.

13. Install the two bolts securing the heat shield to the transmission.

    Tighten: Tighten the bolt to 17 N.m (13 lb ft).

14. Install the shift cable to the shift lever ball stud and the bracket. Refer to **Automatic Transmission Range Selector Cable Replacement** .
15. Install the transfer case. Refer to **Transfer Case Assembly Replacement** in Transfer Case - BW 4484.
16. Install the starter motor. Refer to **Starter Motor Replacement** in Engine Electrical.
17. Install the exhaust pipe assembly. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
18. Flush the transmission oil cooler and cooling lines if necessary.
19. Lower the vehicle.

CAUTION: Refer to Battery Disconnect Caution in Cautions and Notices.

20. Connect the battery.
21. Fill the transmission to the proper level with DEXRON(R) III transmission fluid. Refer to **Transmission Fluid Checking Procedure** .

HOLDING FIXTURE INSTALLATION

Tools Required

J 8763-02 Holding Fixture and Base

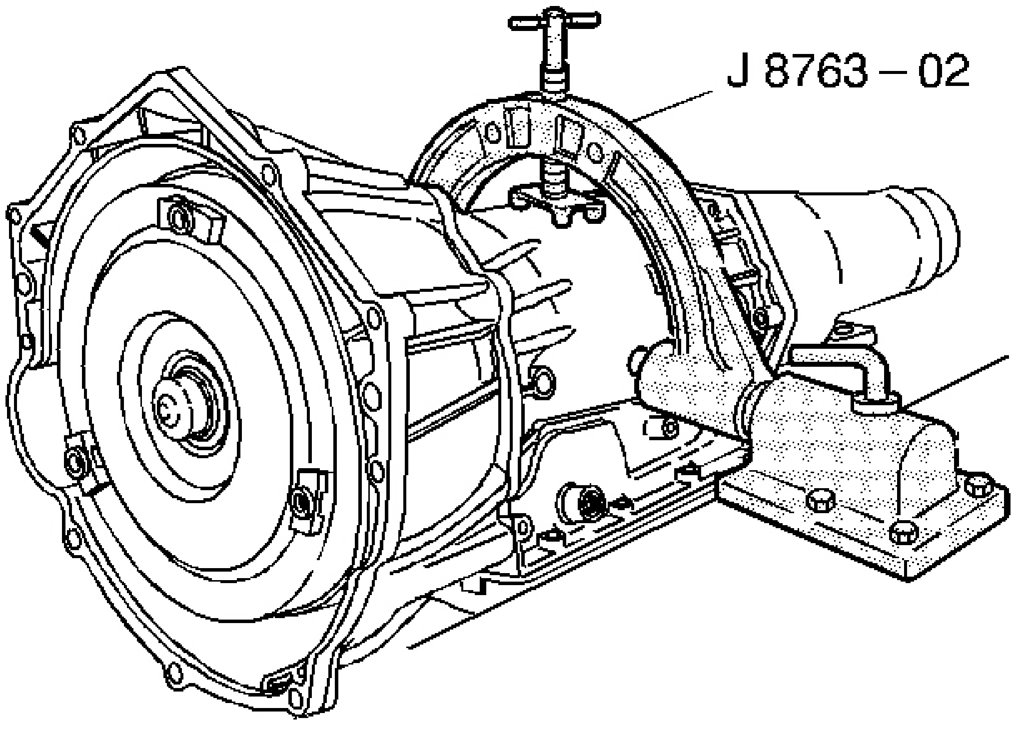


Fig. 183: J 8763-02 & Transmission
Courtesy of GENERAL MOTORS CORP.

1. Install the J 8763-02 onto the transmission.
2. Install the J 8763-02 into the base.

TORQUE CONVERTER ASSEMBLY REMOVAL

CAUTION: The torque converter weighs approximately 65 lbs. Personal injury may result if you lift the torque converter improperly.

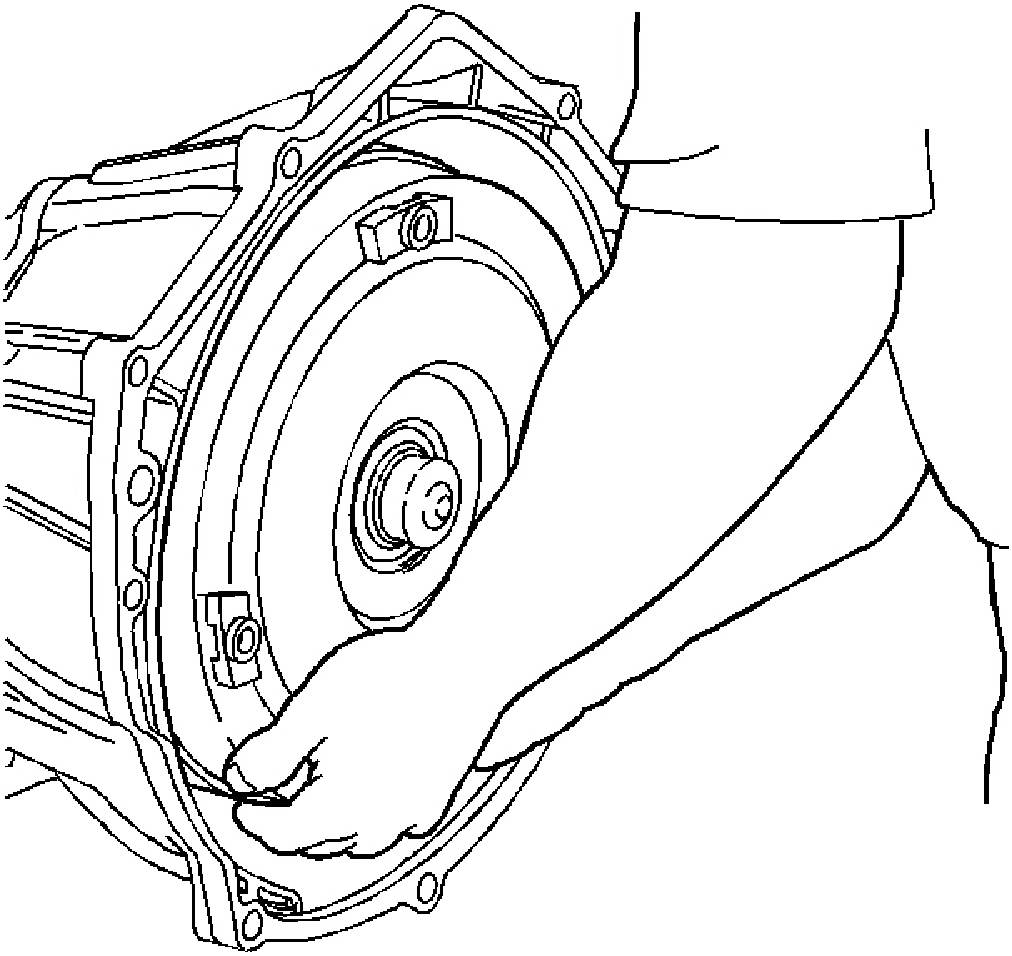


Fig. 184: Removing Torque Converter
Courtesy of GENERAL MOTORS CORP.

Remove the torque converter.

DRAIN OIL

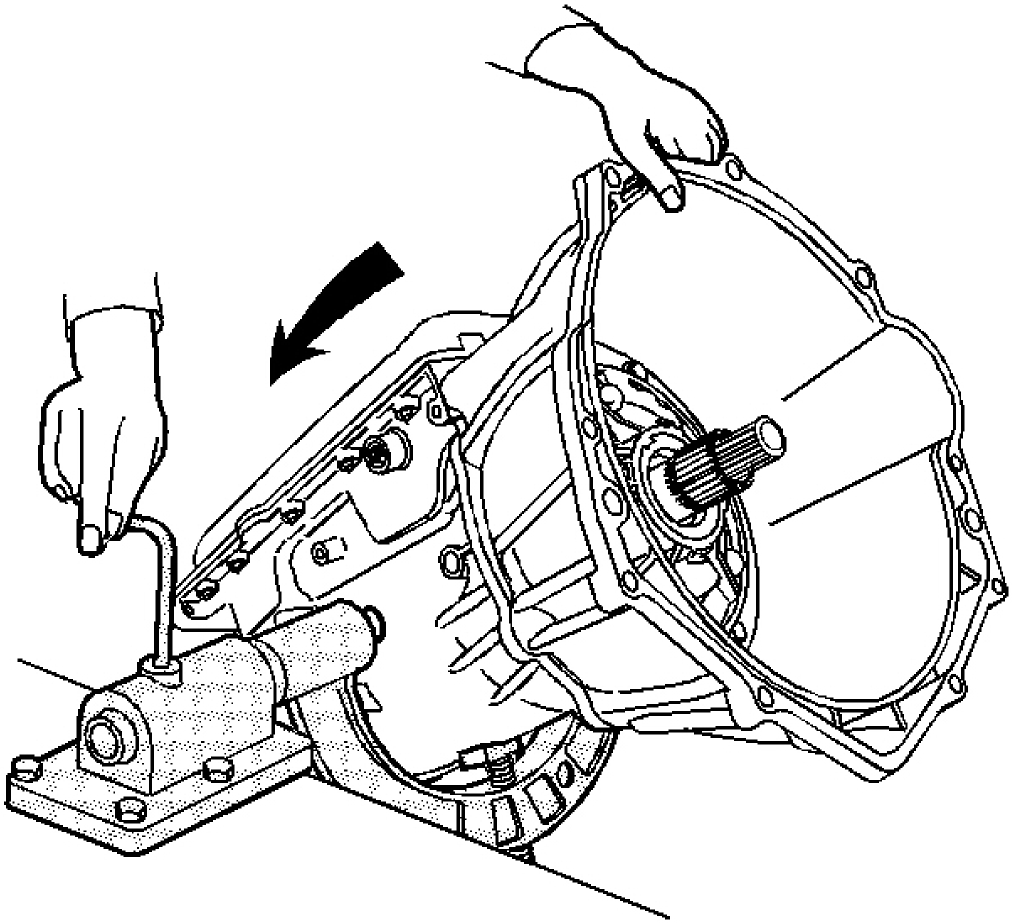


Fig. 185: Rotating Transmission So The Converter Housing Is Up
Courtesy of GENERAL MOTORS CORP.

Rotate the transmission so that the converter housing is up. Allow the transmission fluid to drain from the case extension.

CONVERTER HOUSING REMOVAL

Tools Required

J 41510 T-50 Plus Bit. See **Special Tools and Equipment** .

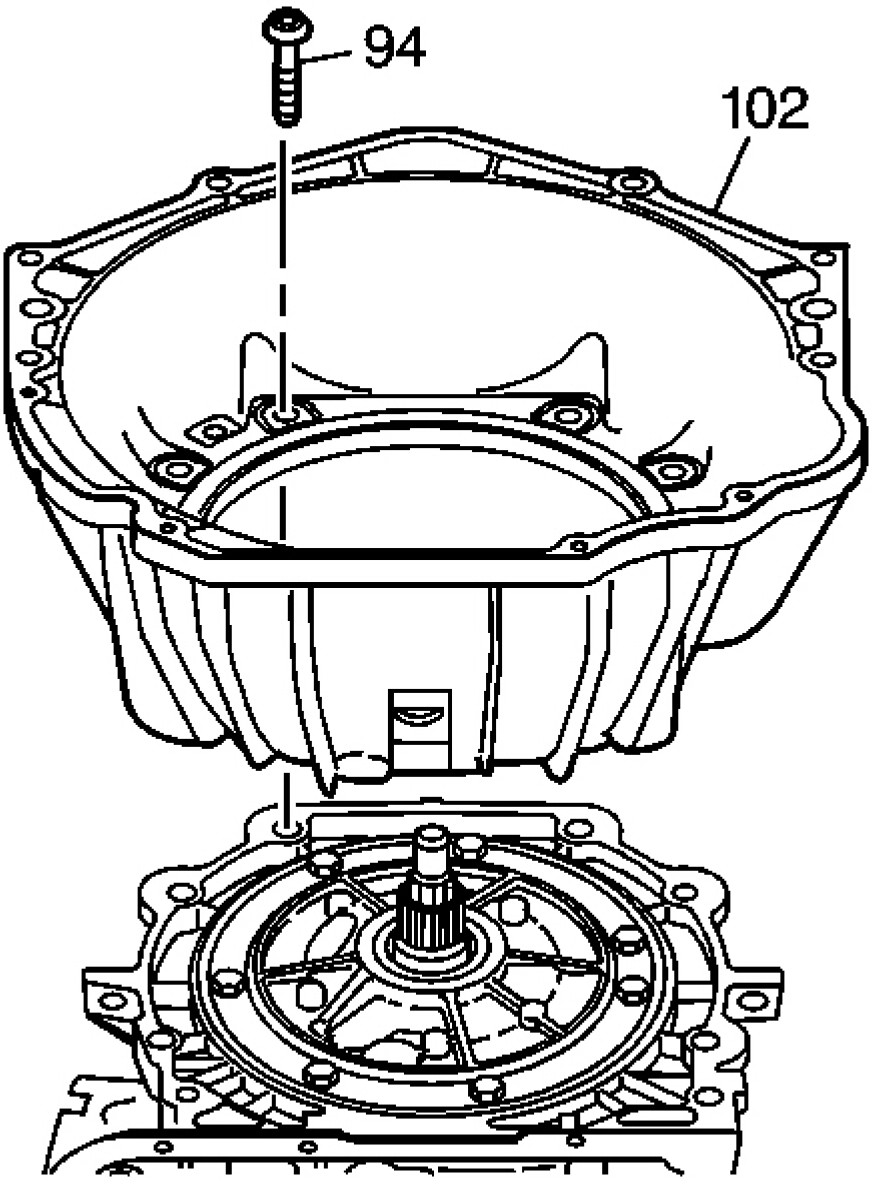


Fig. 186: Removing Converter Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the converter housing bolts (94). Use the **J 41510** . See **Special Tools and Equipment** .
2. Remove the converter housing (102).

2-4 SERVO COVER AND ASSEMBLY REMOVAL

Tools Required

J 29714-A Servo Cover Compressor. See **Special Tools and Equipment** .

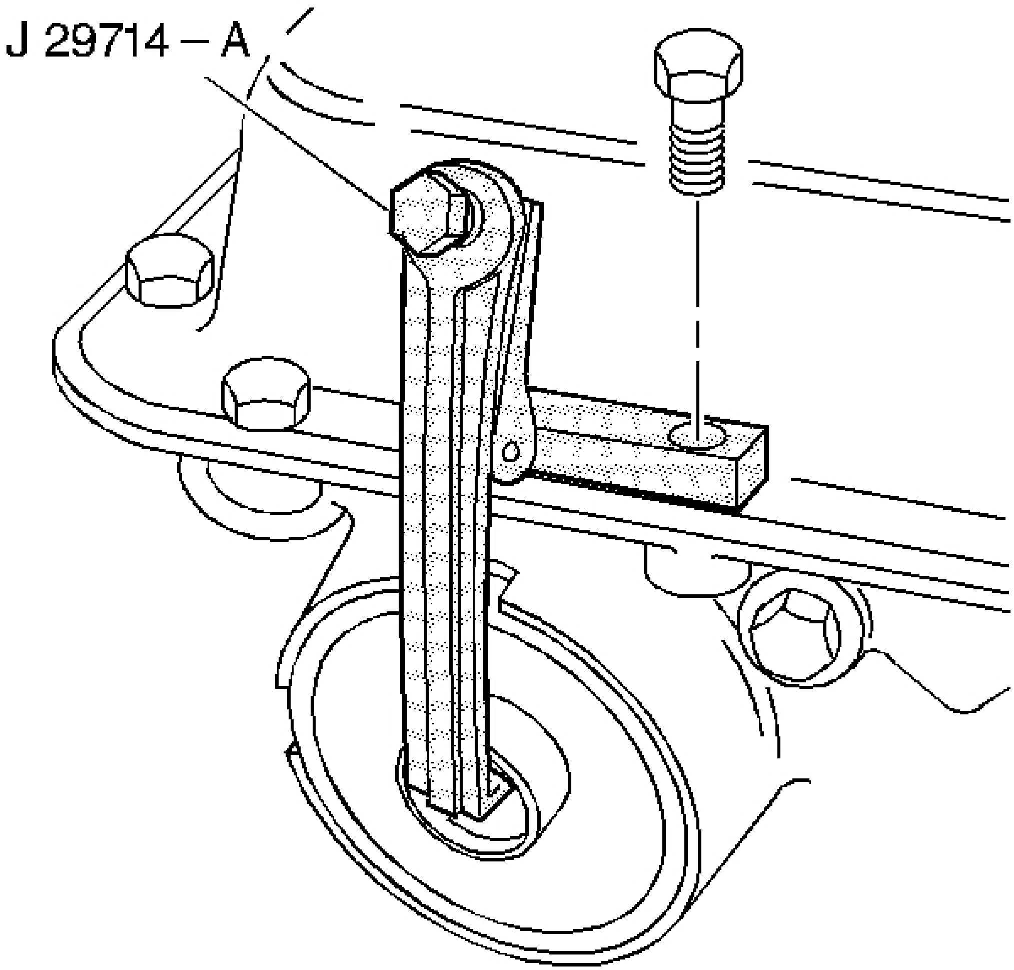


Fig. 187: Installing J 29714-A
Courtesy of GENERAL MOTORS CORP.

1. Install the **J 29714-A** . See **Special Tools and Equipment** .

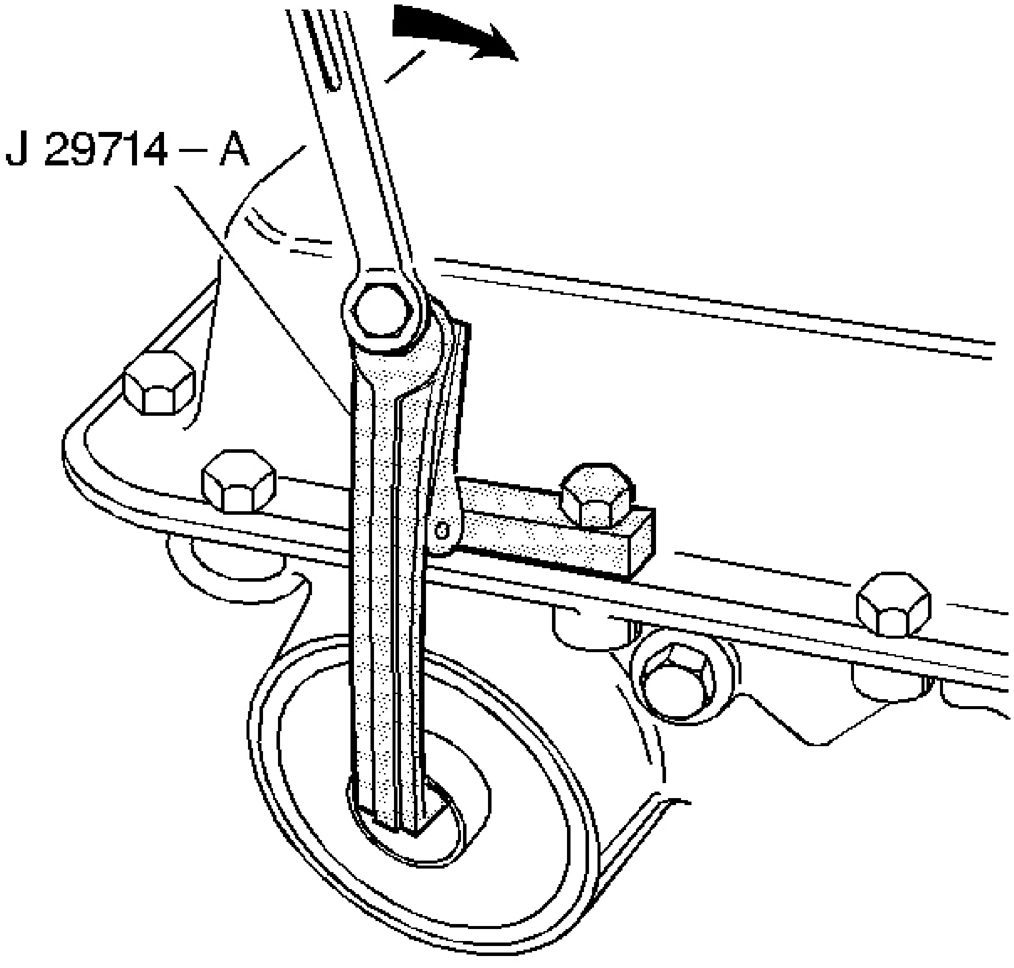


Fig. 188: Tightening J 29714-A Bolt To Compress Servo Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If cover does not move inwards with tool, use a block of wood or suitable material and lightly tap on cover using a hammer to free up cover in bore.

2. Tighten the **J 29714-A** bolt to compress the servo cover. See **Special Tools and Equipment** .

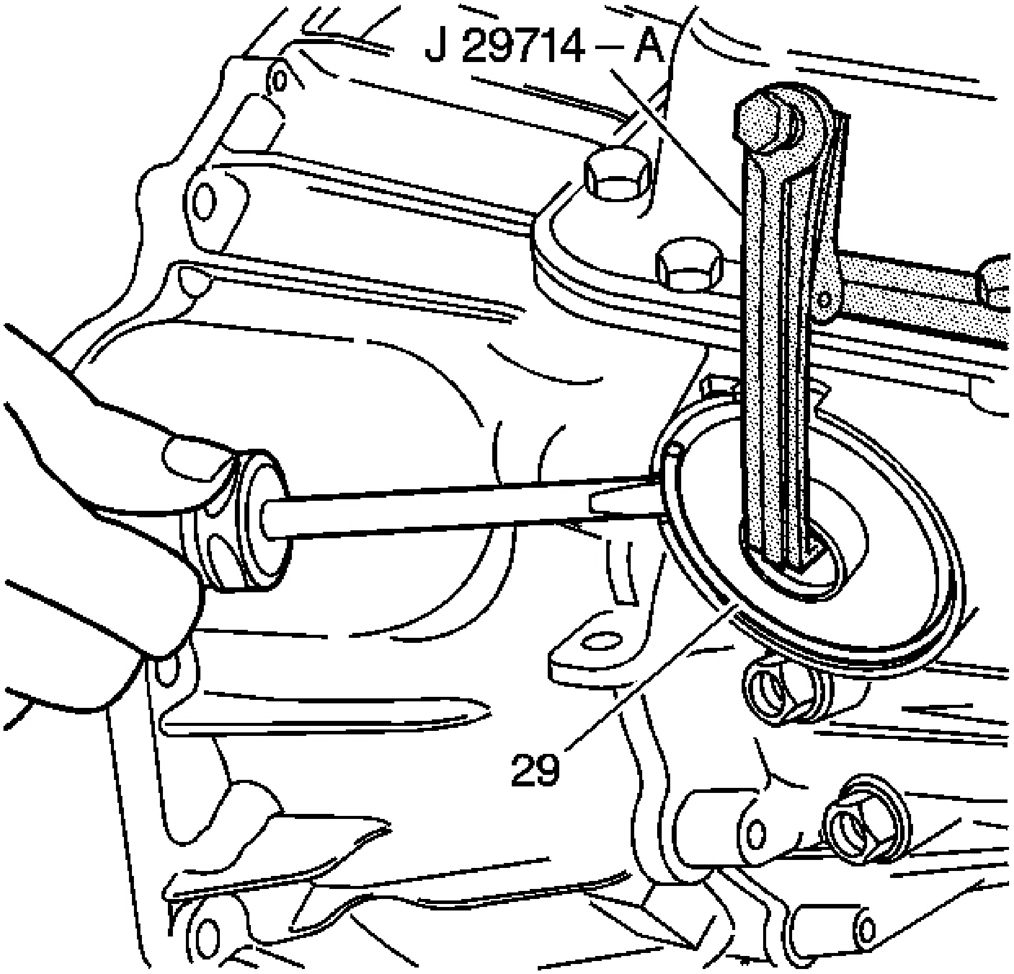


Fig. 189: Servo Cover Retaining Ring & J 29714-A
Courtesy of GENERAL MOTORS CORP.

3. Remove the servo cover retaining ring (29) and the **J 29714-A** . See **Special Tools and Equipment** .

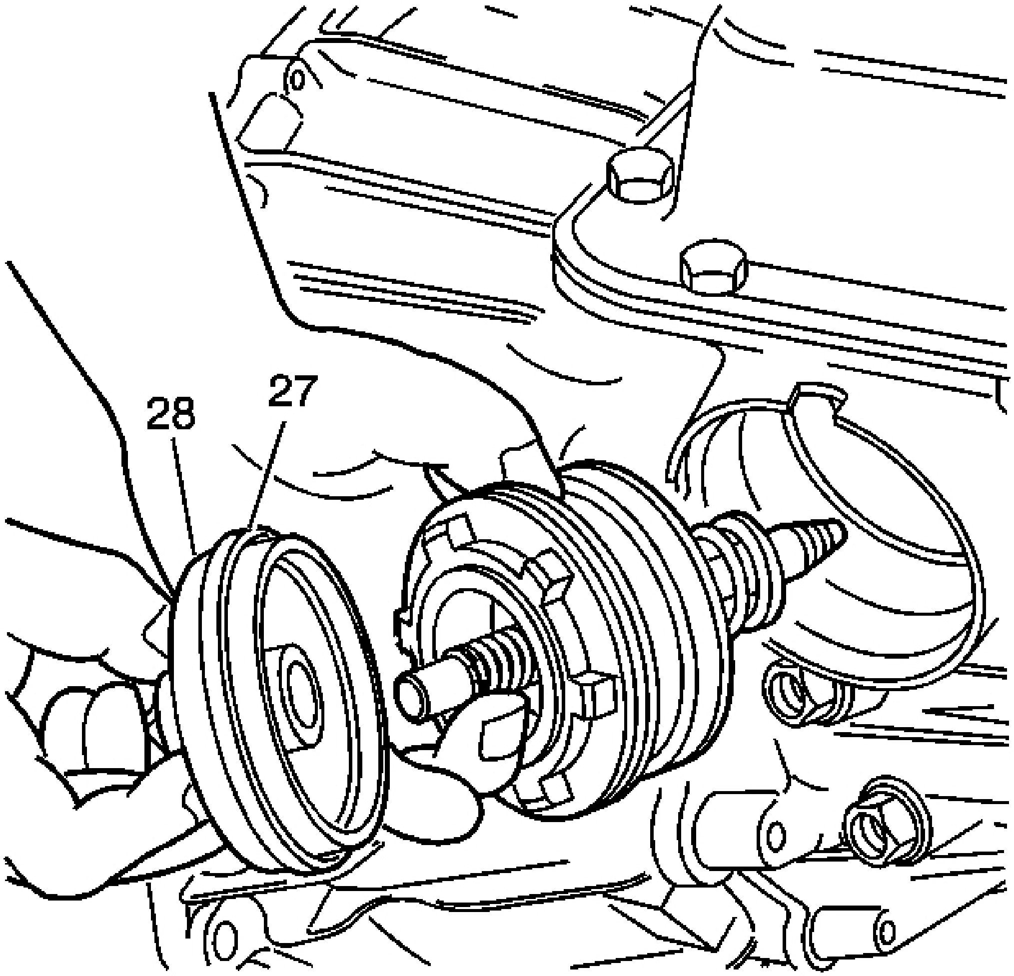


Fig. 190: 2-4 Servo Assembly
Courtesy of GENERAL MOTORS CORP.

4. Remove the servo cover (28) and O-ring seal (27). If the servo cover seems to be hung up on the seal, cut and remove the O-ring seal before removing the cover.
5. Remove the 2-4 servo assembly.

2-4 SERVO DISASSEMBLE

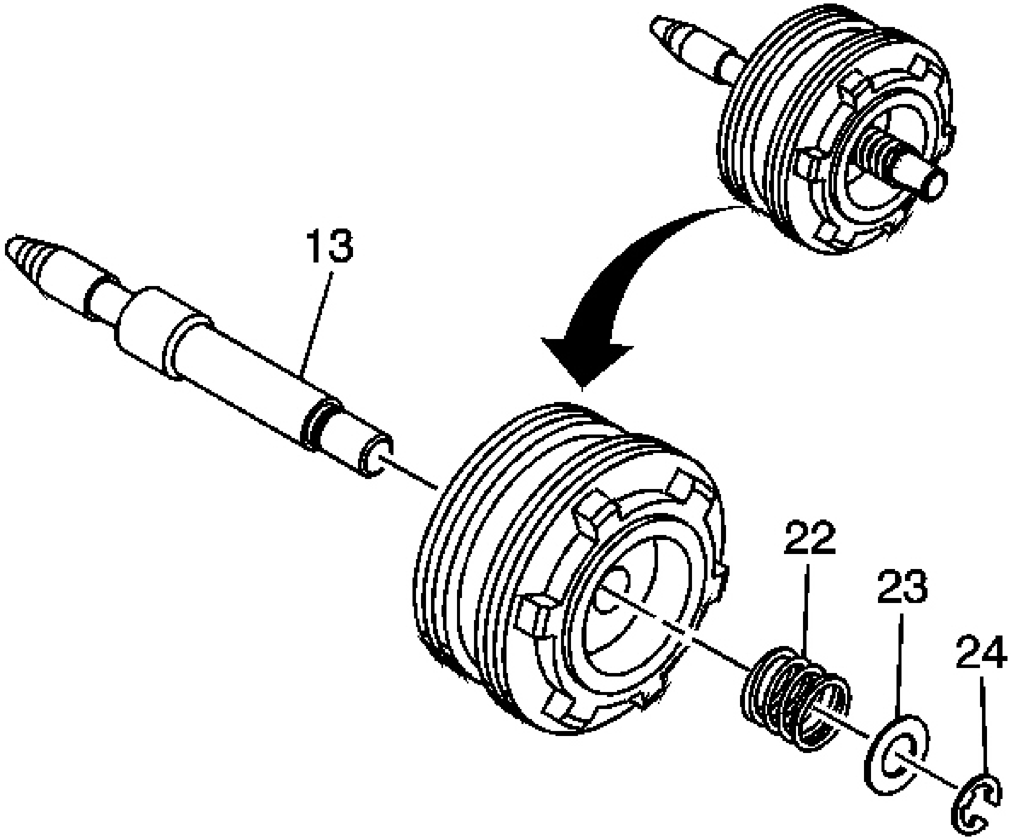


Fig. 191: Disassembling 2-4 Servo Assembly
Courtesy of GENERAL MOTORS CORP.

Disassemble the 2-4 servo assembly.

2-4 SERVO PIN LENGTH CHECK

Tools Required

J 33037 2-4 Intermediate Band Apply Pin Gauge. See **Special Tools and Equipment** .

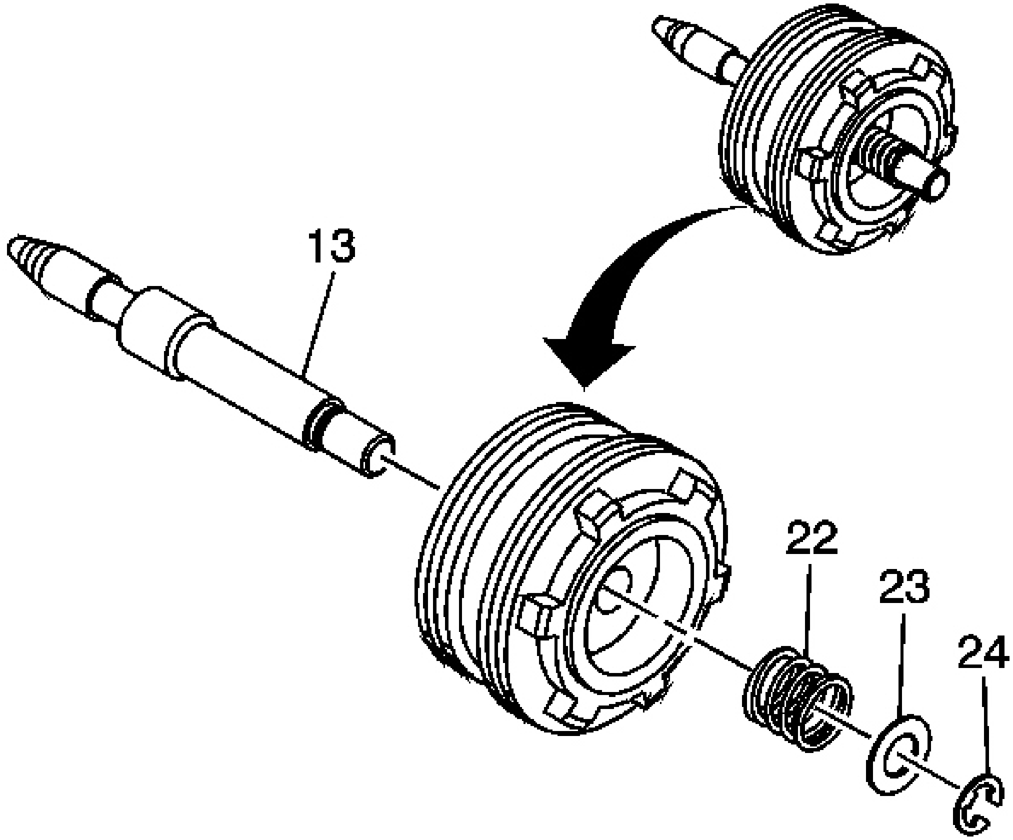


Fig. 192: Disassembling 2-4 Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Disassemble the 2-4 servo assembly. If necessary, refer to **2-4 Servo Disassemble** .

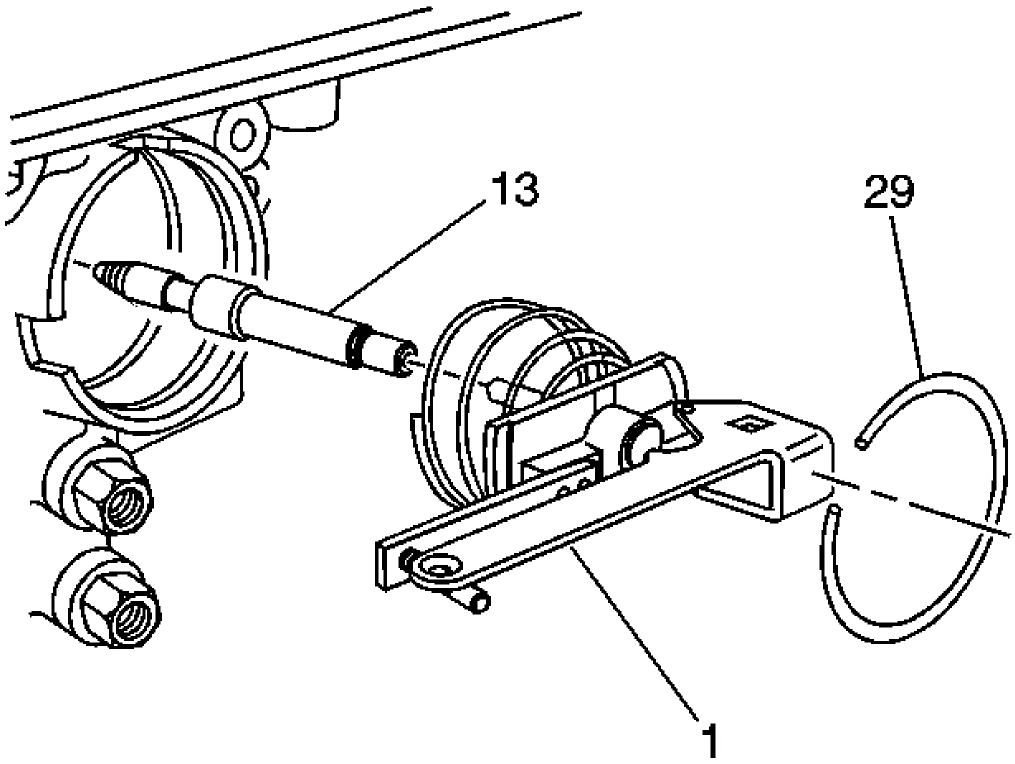


Fig. 193: Installing Band Apply Pin & Servo Cover Retaining Ring
Courtesy of GENERAL MOTORS CORP.

2. Install the band apply pin (13) and the **J 33037** (1). See **Special Tools and Equipment** .
3. Install the servo cover retaining ring (29) to secure the tool.

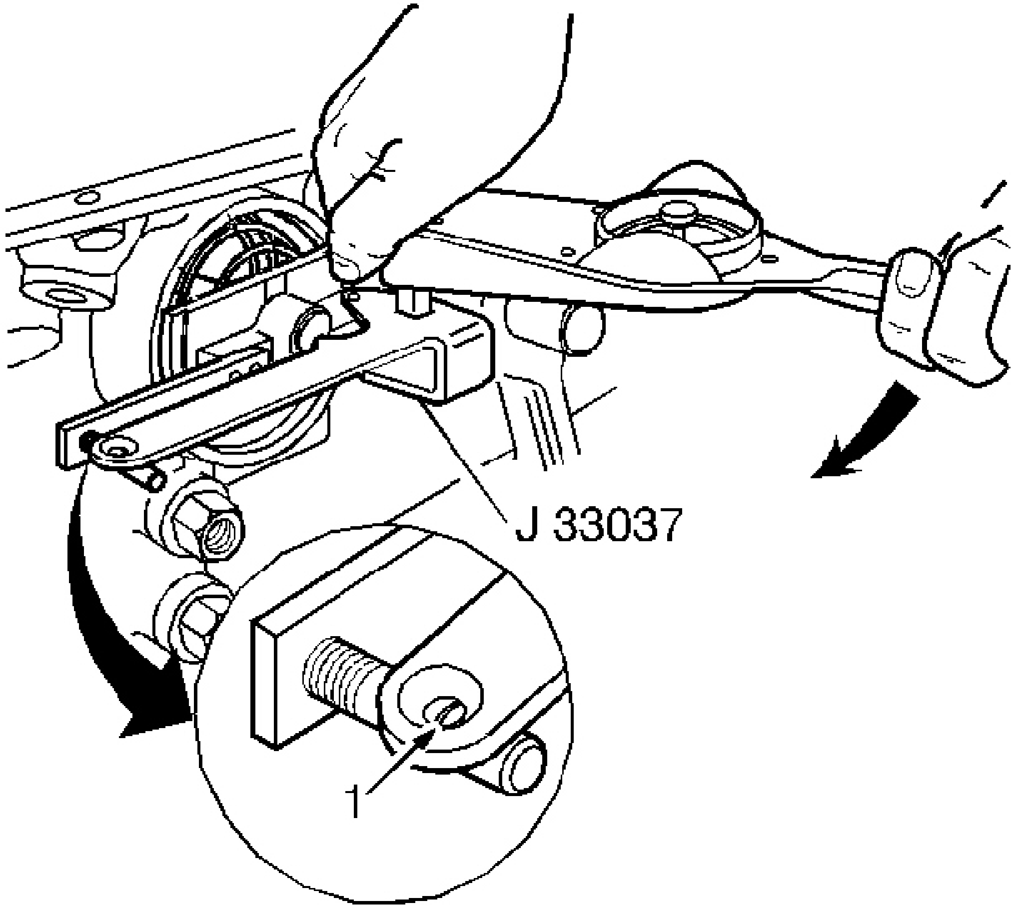


Fig. 194: Applying 11 N.m (98 lb in) Torque
Courtesy of GENERAL MOTORS CORP.

4. Apply 11 N.m (98 lb in) torque. If the white line appears in the gauge slot (1), the pin length is correct.
5. If a new pin is needed, refer to **2-4 Servo Pin Selection** in order to determine correct pin length.

PAN AND FILTER ASSEMBLY REMOVAL

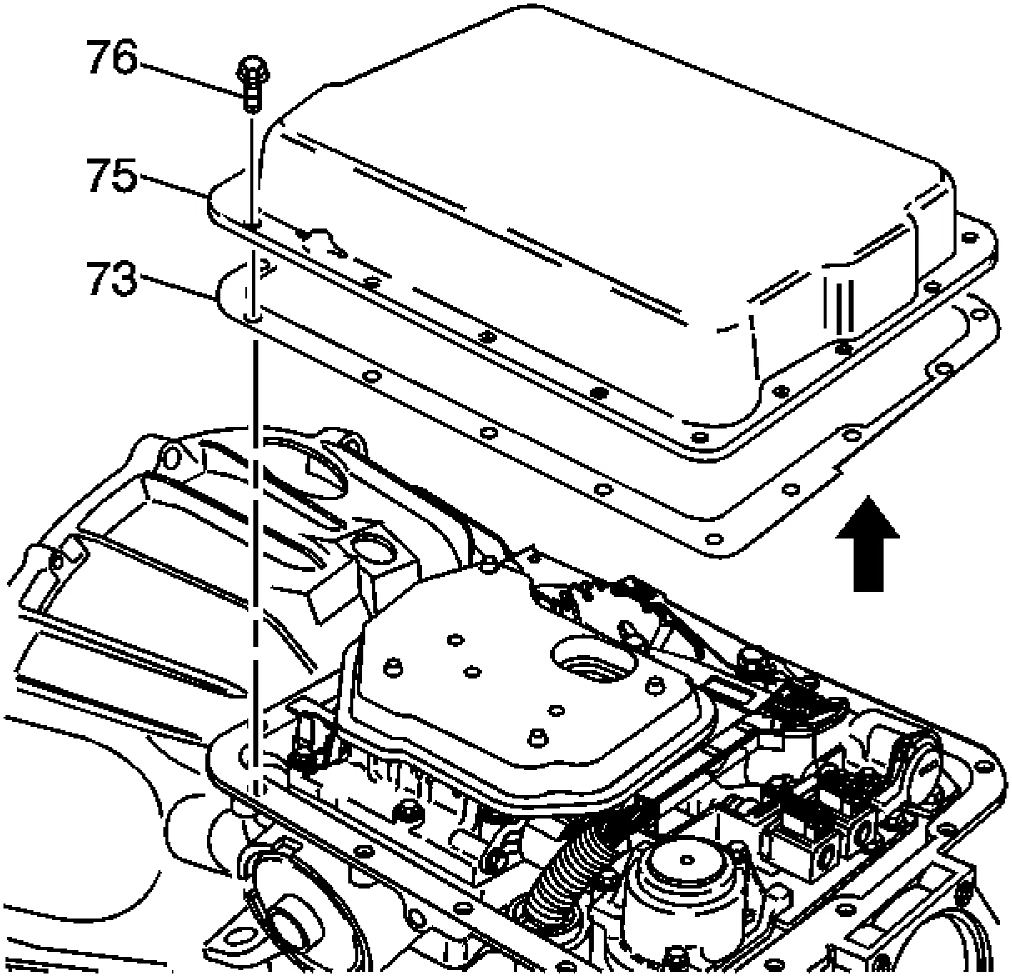


Fig. 195: Transmission Oil Pan, Screws, & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission oil pan screws (76).
2. Remove the transmission oil pan (75) and the transmission oil pan gasket (73).

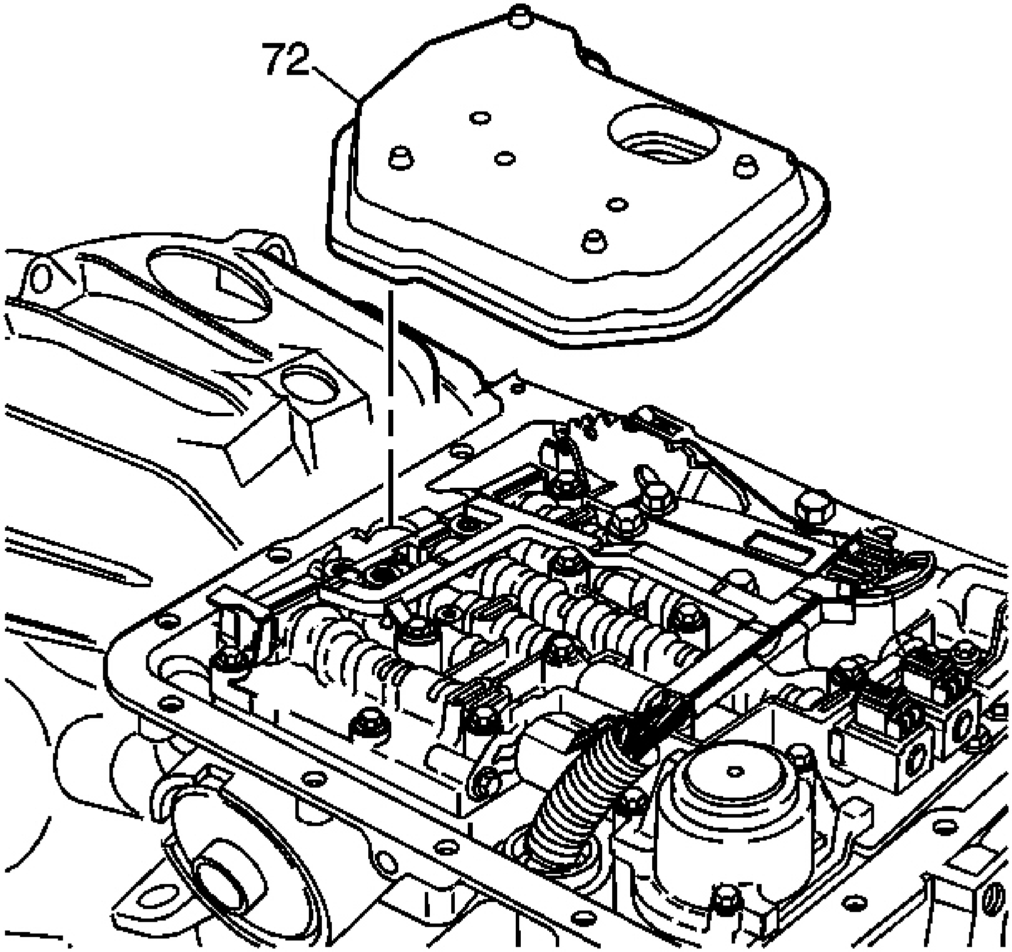


Fig. 196: Removing Transmission Oil Filter Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the transmission oil filter assembly (72).
4. The filter may help in diagnosis. Cut away the top portion of the plastic filter housing and remove. Inspect the filter for the presence of the following items which may indicate wear or corrosion:
   - Clutch material
   - Bronze slivers indicating bushing wear
   - Steel particles

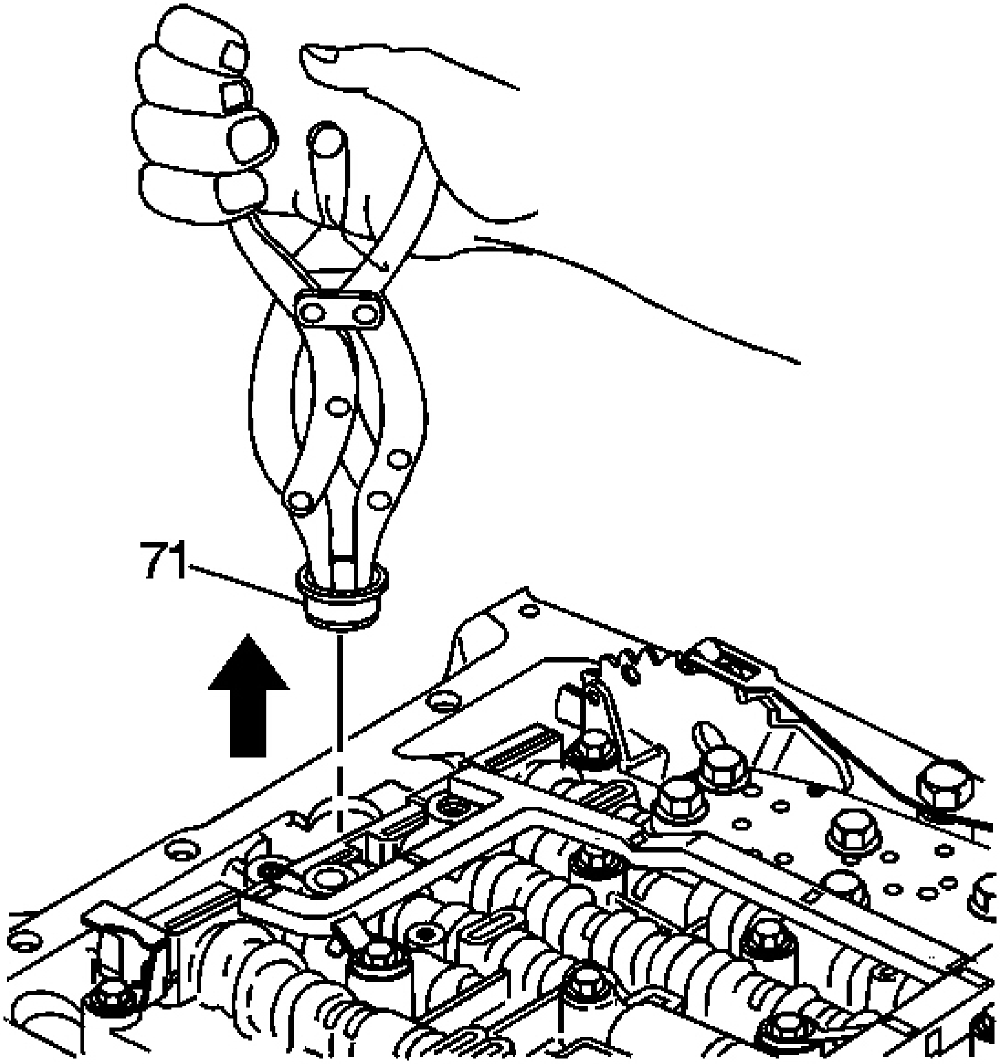


Fig. 197: Removing Oil Filter Seal
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil filter seal (71).

VALVE BODY AND WIRING HARNESS REMOVAL

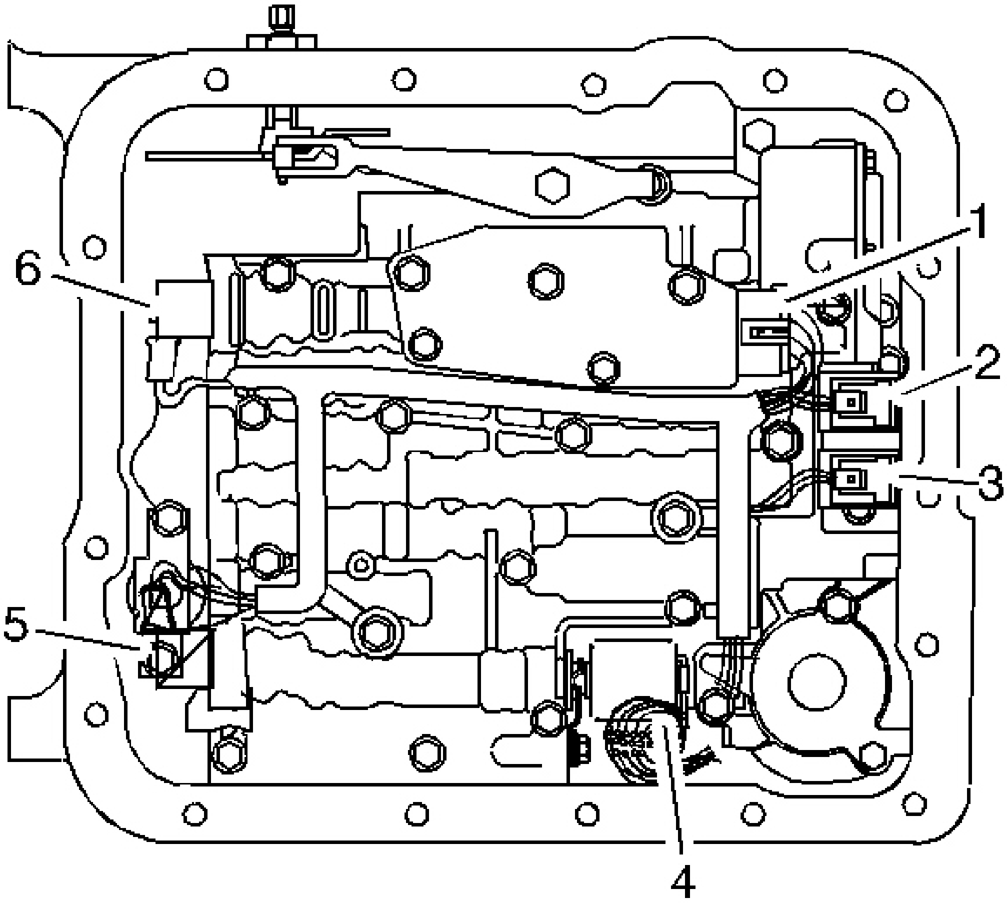


Fig. 198: Valve Body Electrical Connections
Courtesy of GENERAL MOTORS CORP.

1. Remove all electrical connectors (1-6) from the electrical components.

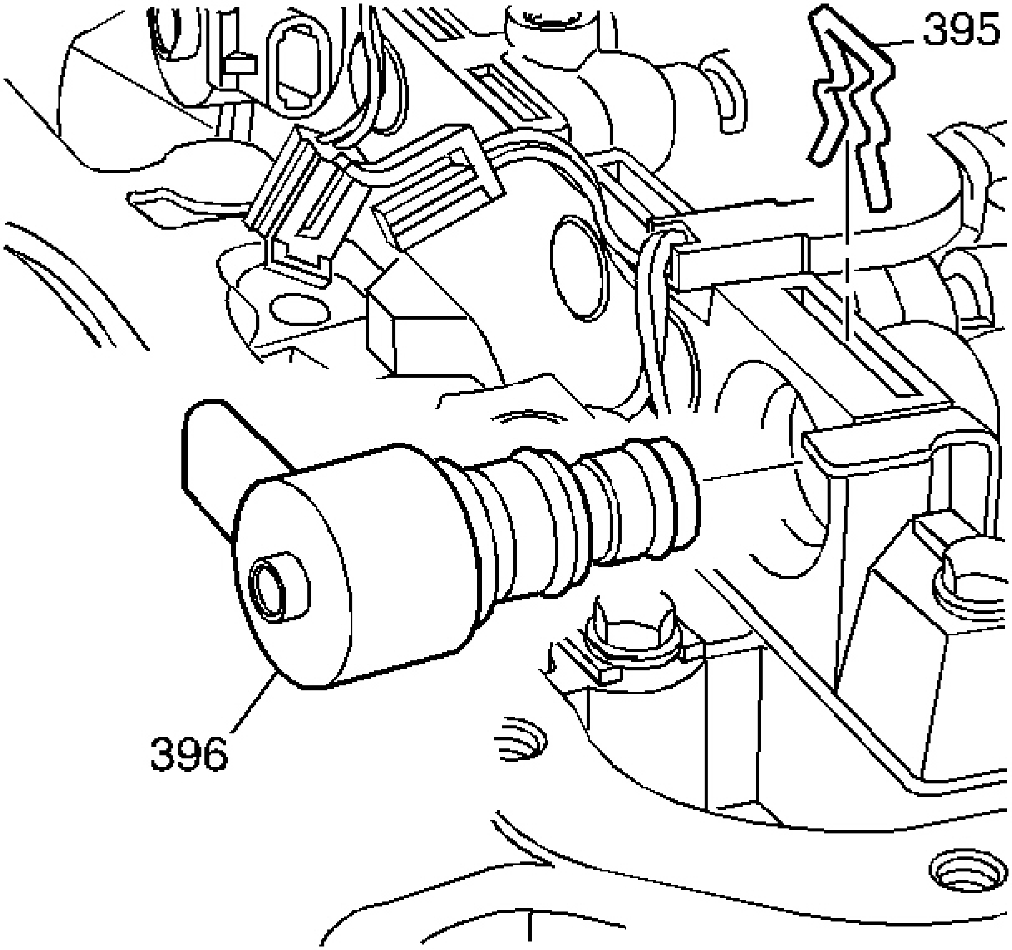


Fig. 199: TCC PWM Solenoid Valve & Solenoid Retainer
Courtesy of GENERAL MOTORS CORP.

2. Remove the TCC PWM retainer clip (395).
3. Remove the TCC PWM solenoid (396).

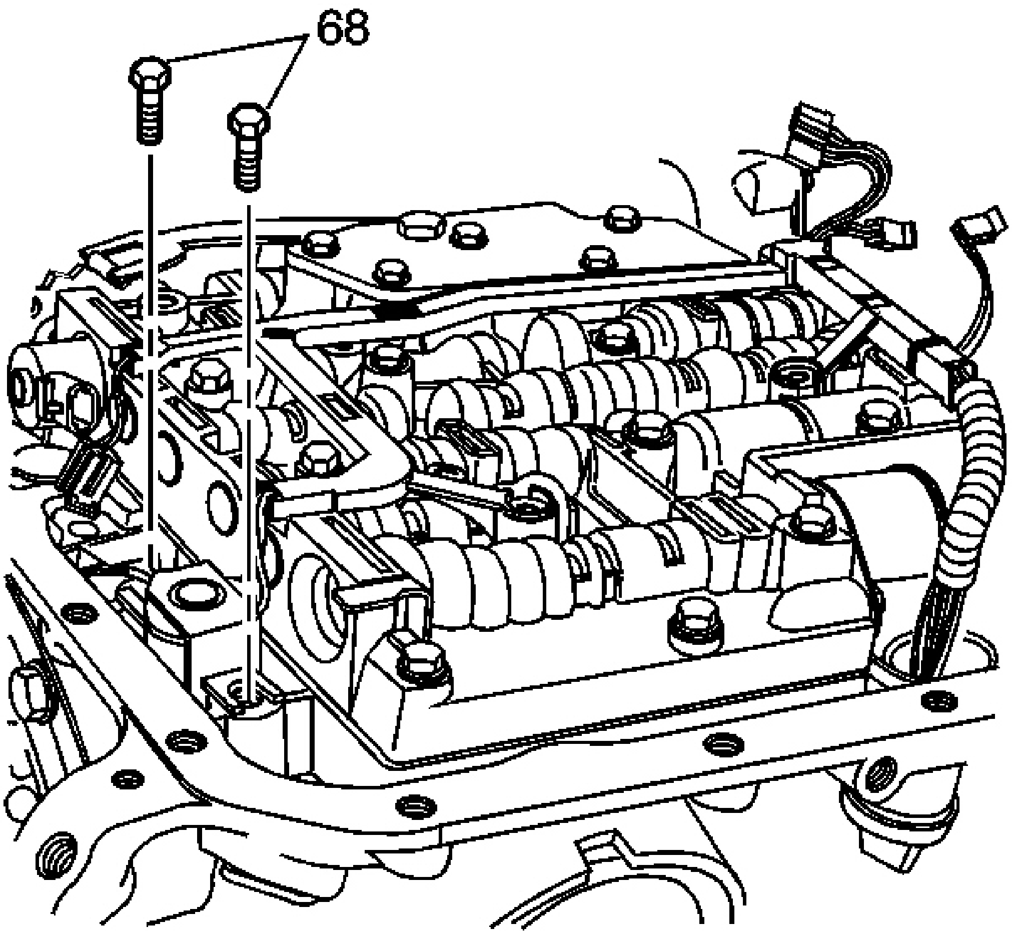


Fig. 200: TCC Solenoid Valves & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the TCC solenoid bolts (68).

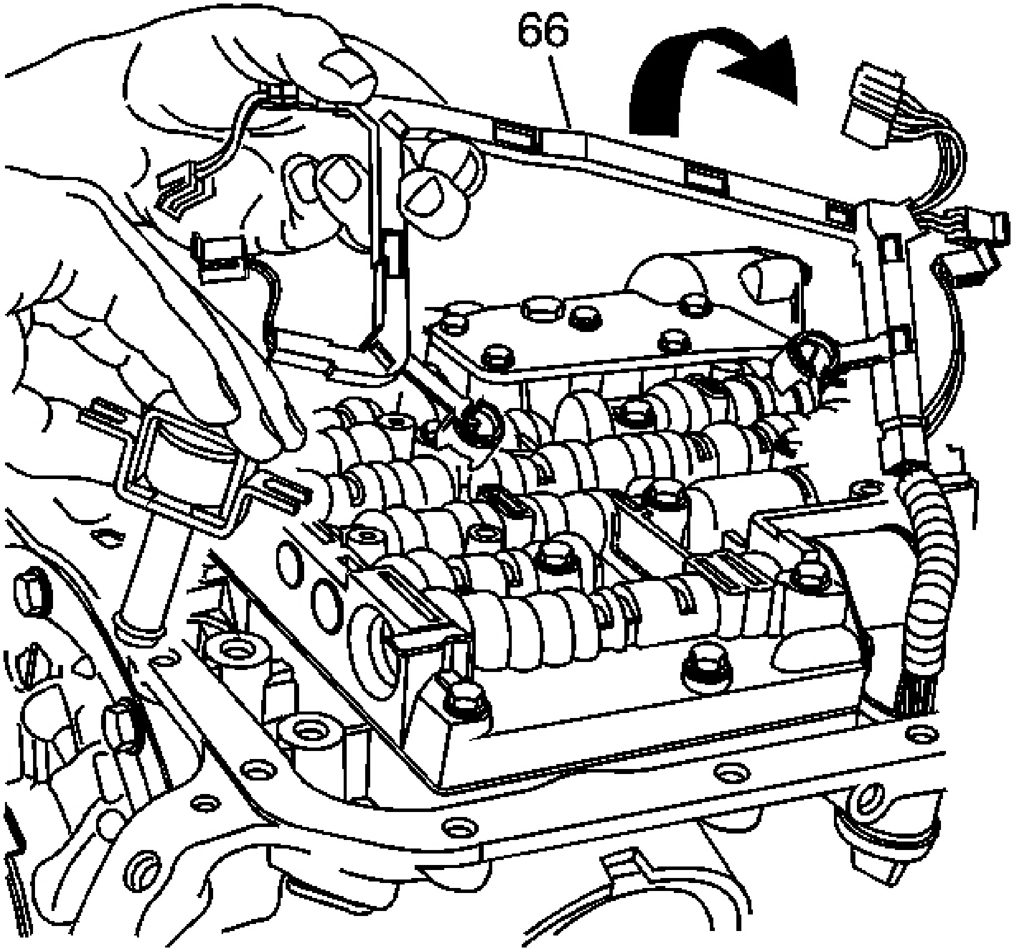


Fig. 201: Removing TCC Solenoid & Wiring Harness
Courtesy of GENERAL MOTORS CORP.

5. Remove the TCC solenoid and wiring harness (66). Turn the wiring harness over so that it hangs over the side of the transmission.

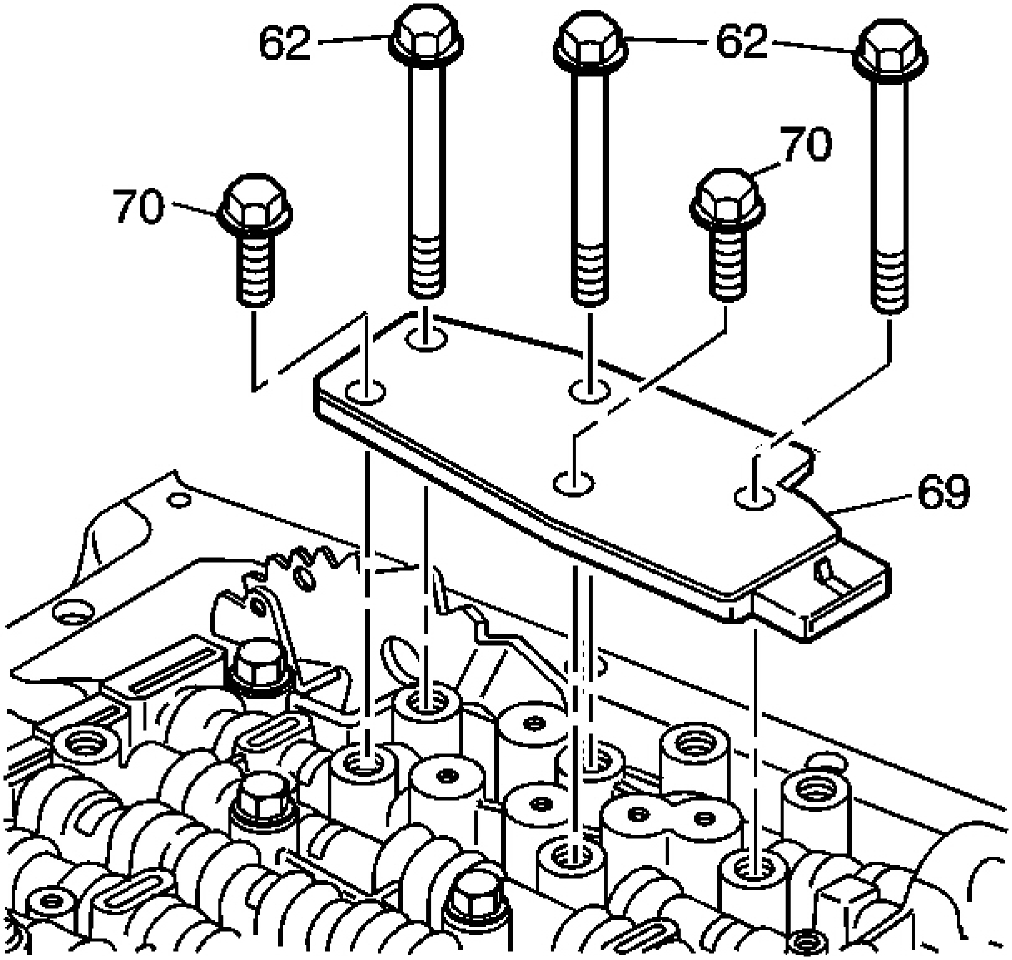


Fig. 202: TFP Manual Valve Position Switch & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the transmission fluid pressure (TFP) manual valve position switch assembly bolts (62, 70).
7. Remove the TFP manual valve position switch (69).

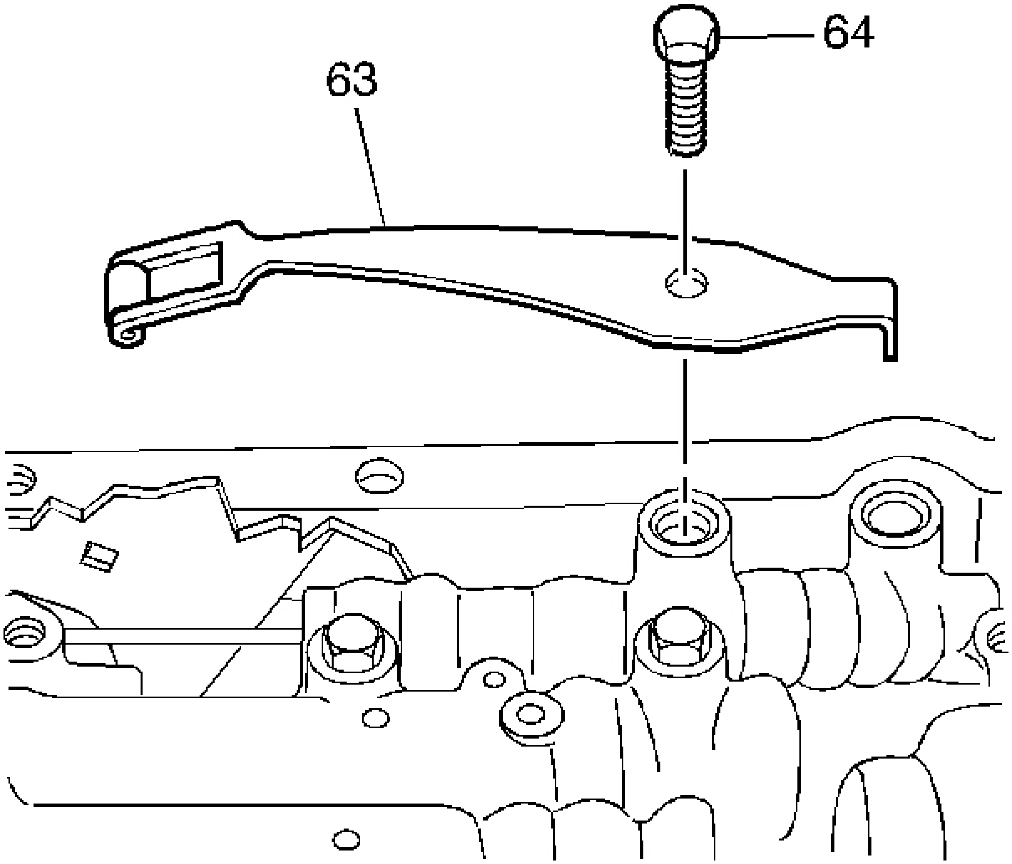


Fig. 203: Manual Detent Spring Bolt & Assembly
Courtesy of GENERAL MOTORS CORP.

8. Remove the manual detent spring bolt (64).
9. Remove the manual detent spring assembly (63).

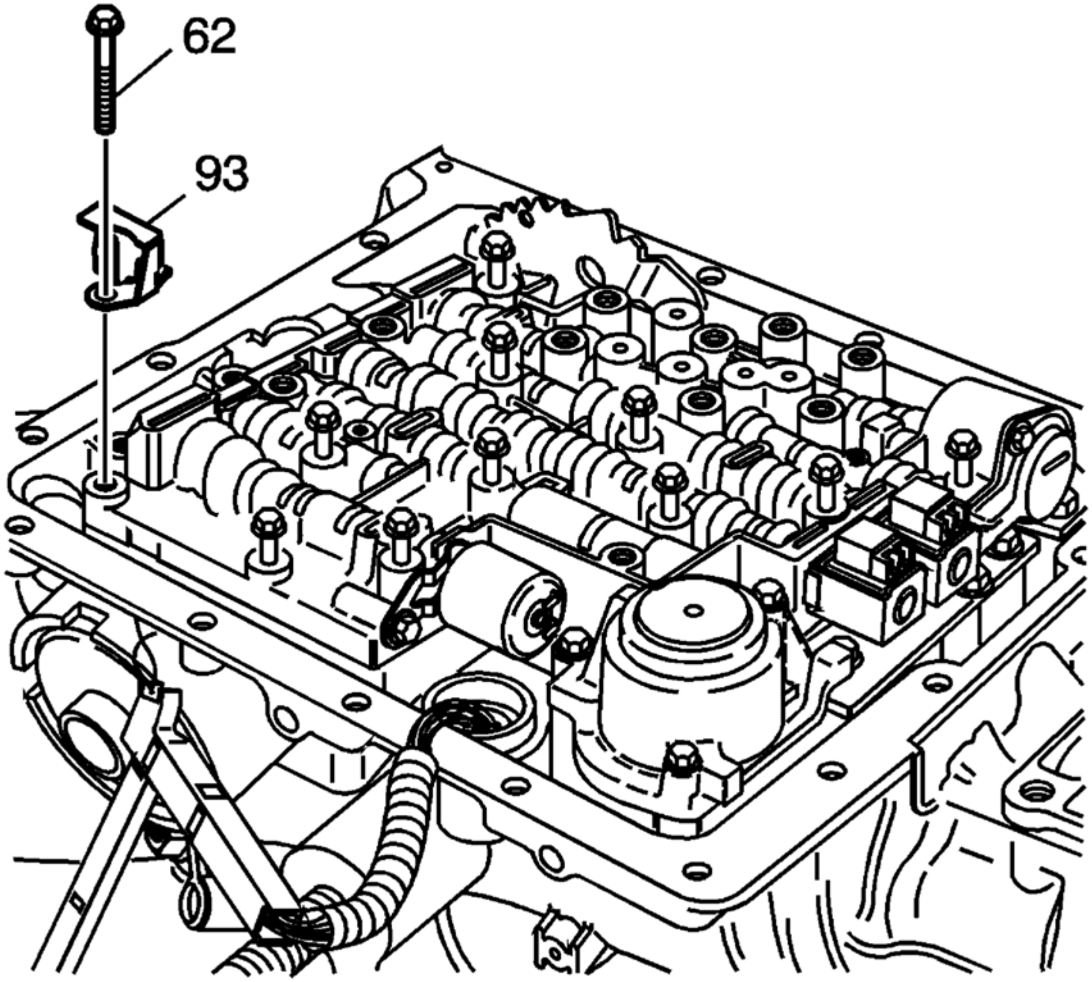


Fig. 204: Fluid Level Indicator Stop Bracket & Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove all valve body bolts (62).
11. Remove the fluid level indicator stop bracket (93).

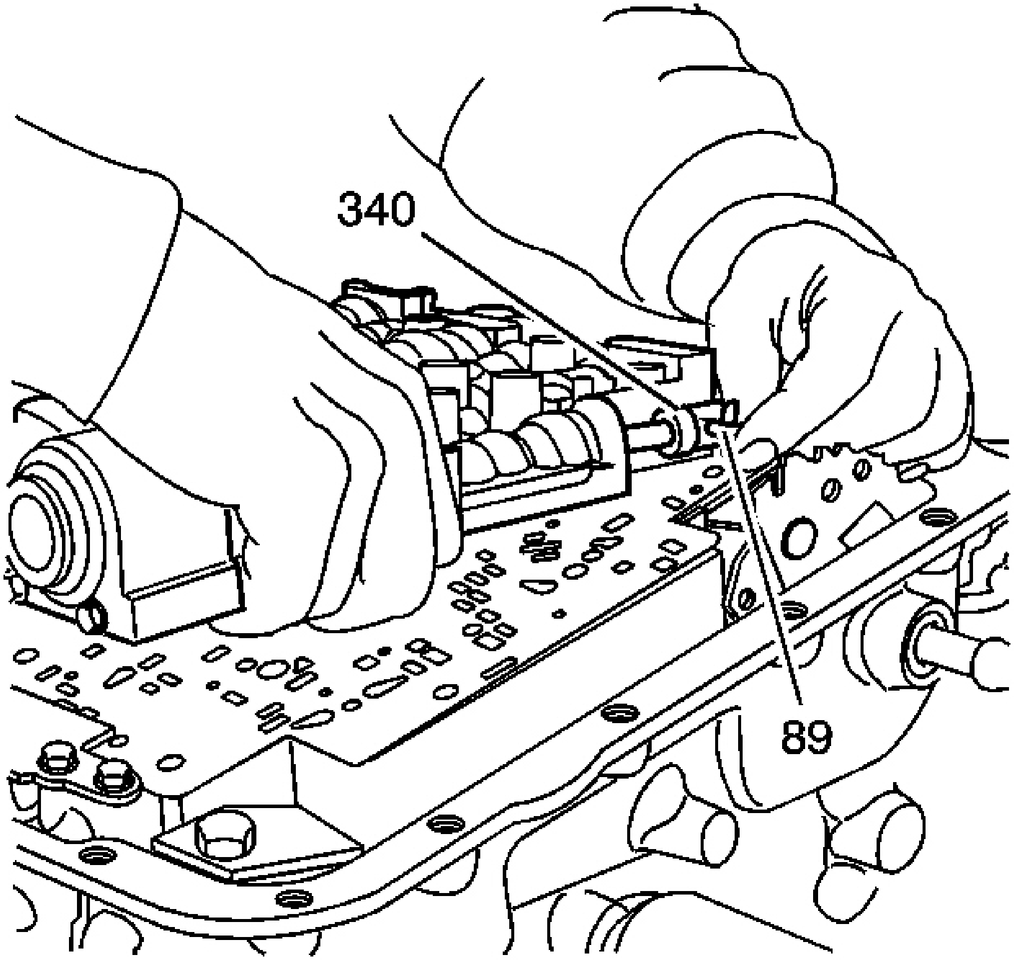


Fig. 205: Manual Valve Link & Manual Valve
Courtesy of GENERAL MOTORS CORP.

12. Lift the valve body carefully so that the checkballs remain on the spacer plate in the correct location. While lifting the valve body, disconnect the manual valve link from the manual valve.

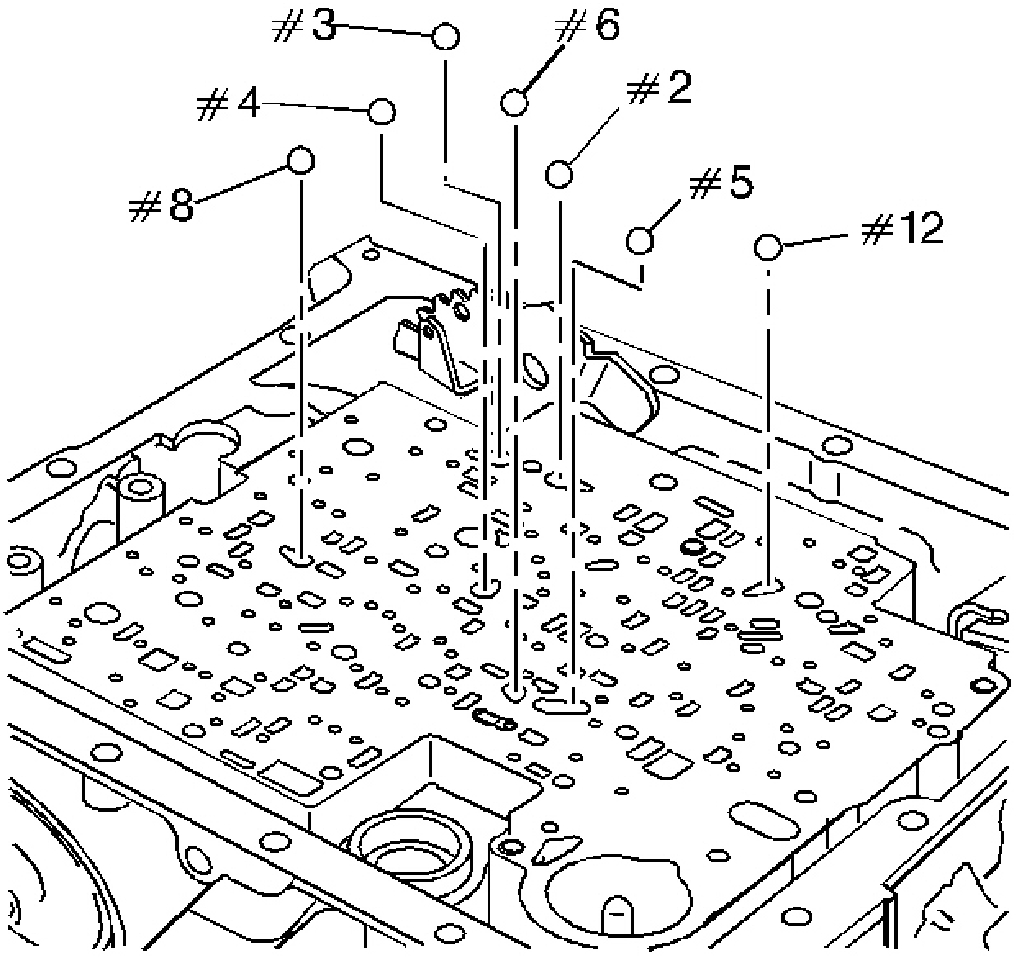


Fig. 206: Removing Seven Valve Body Checkballs (2-6, 8, 12)
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not use a magnet in order to remove the control valve body ball check valves. This may magnetize the control valve body ball check valves, causing metal particles to stick to them.**

13. Remove the seven valve body checkballs (2-6, 8, 12).

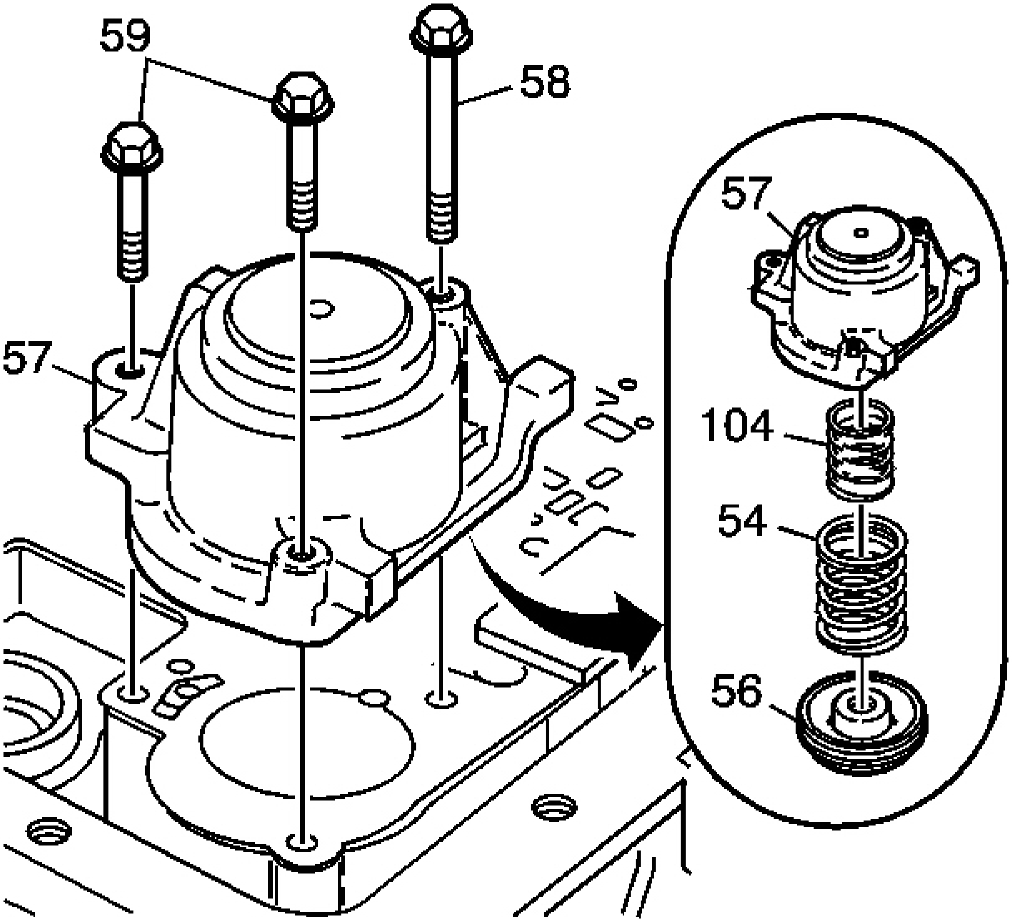


Fig. 207: Removing Accumulator Cover Bolts & Pin Assembly
Courtesy of GENERAL MOTORS CORP.

14. Remove the accumulator cover bolts (58, 59).
15. Remove the 1-2 accumulator cover and pin assembly (57).
16. Disassemble the 1-2 accumulator assembly (54, 56, 57, 104).

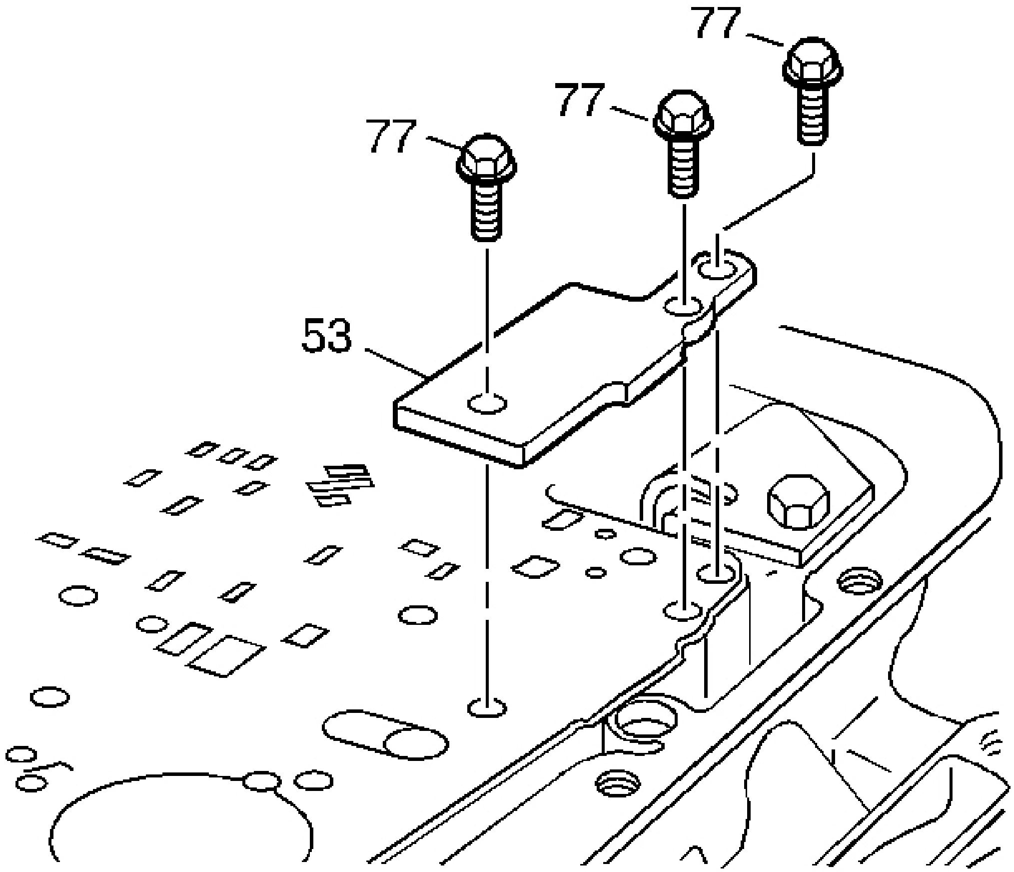


Fig. 208: Spacer Plate Support & Bolts
Courtesy of GENERAL MOTORS CORP.

17. Remove the spacer plate support bolts (77).
18. Remove the spacer plate support (53).

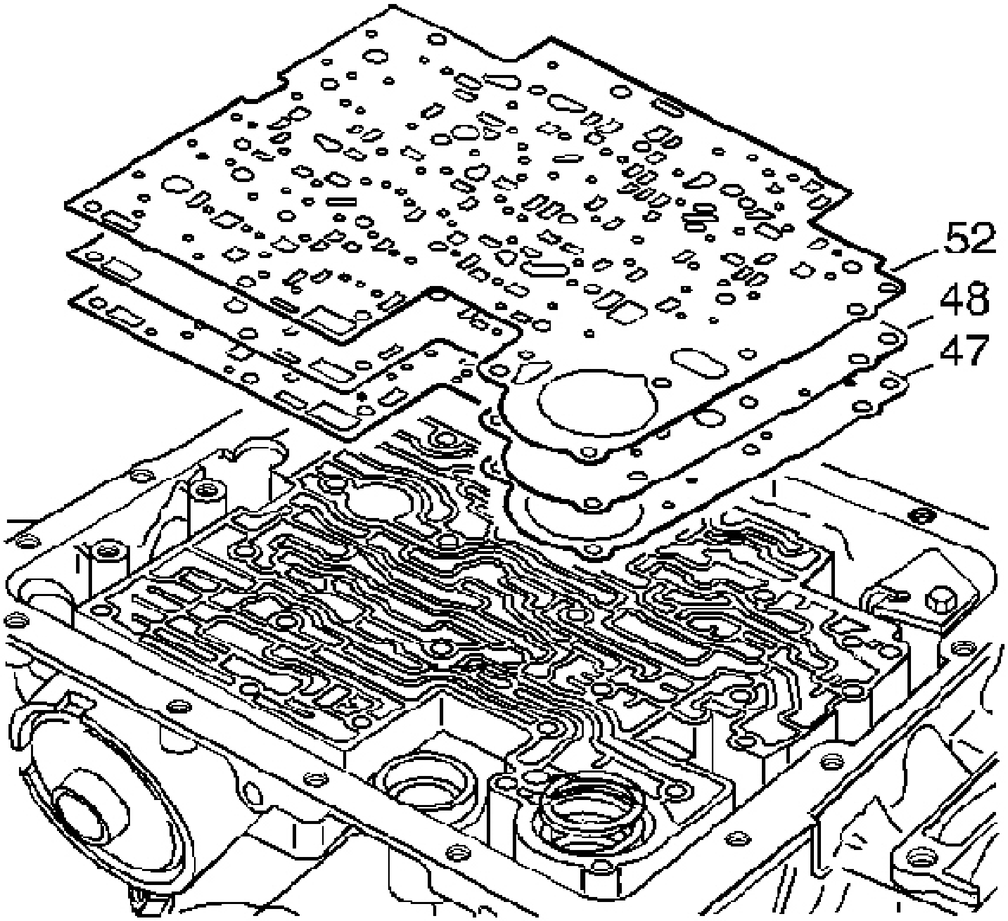


Fig. 209: Valve Body Gasket, Valve Body Spacer Plate & Case Gasket
Courtesy of GENERAL MOTORS CORP.

19. Remove the valve body gasket (52), the valve body spacer plate (48) and the case gasket (47).

    Discard gaskets. Do not reuse.

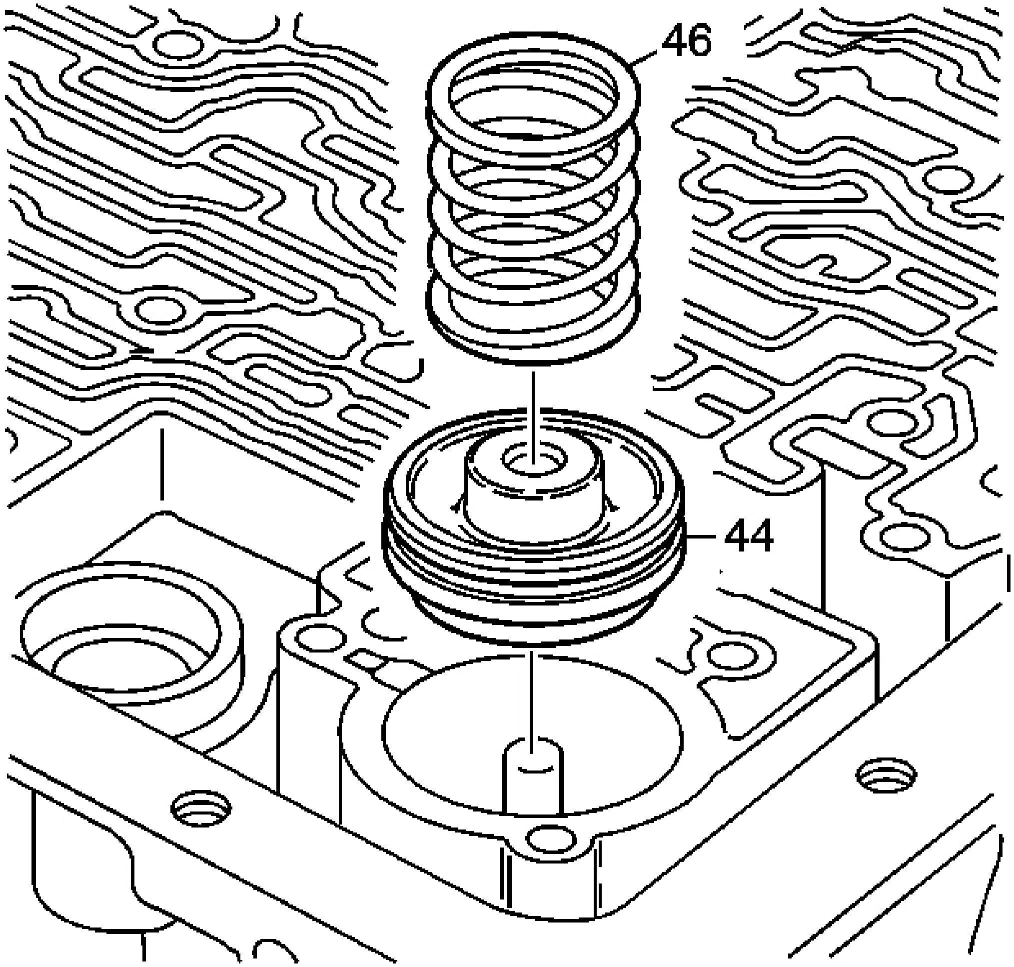


Fig. 210: 3-4 Accumulator Spring & Piston
Courtesy of GENERAL MOTORS CORP.

20. Remove the 3-4 accumulator spring (model dependent) and the 3-4 accumulator piston.

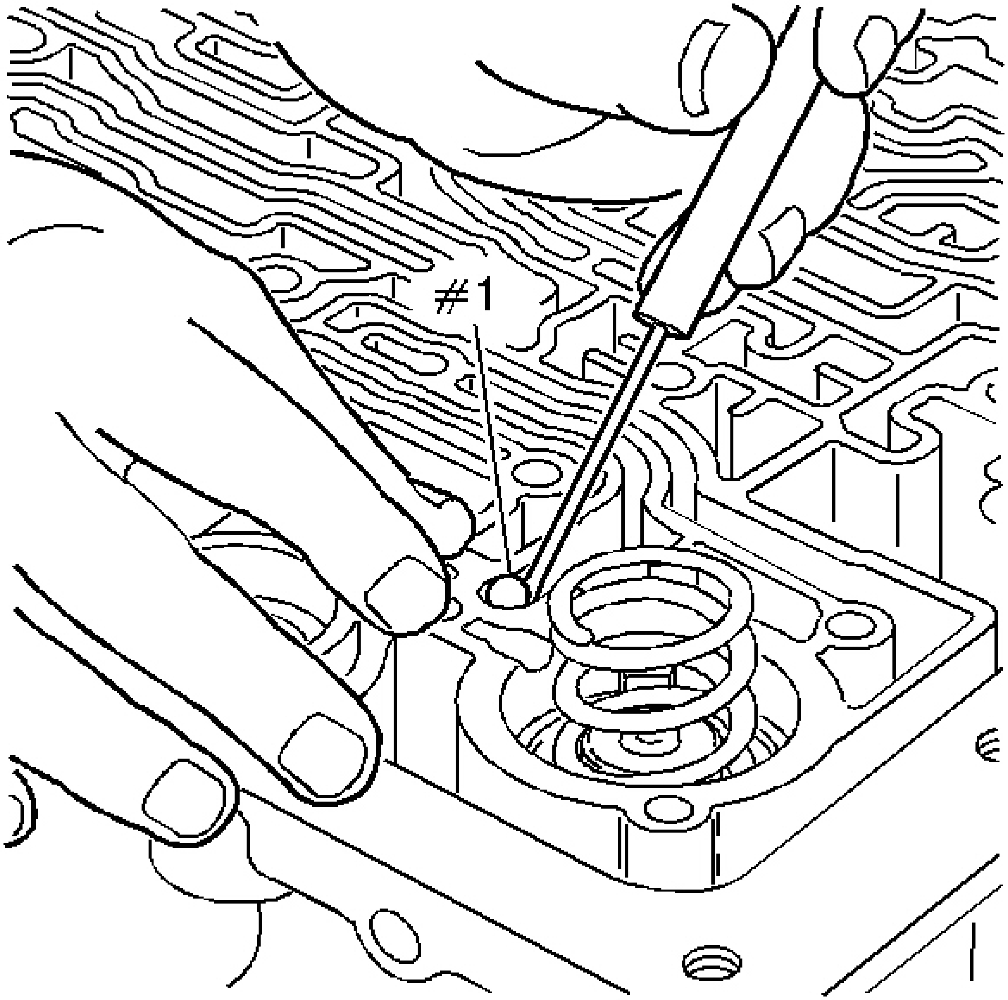


Fig. 211: Identifying Case Checkball
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not use a magnet in order to remove the control valve body ball check valves. This may magnetize the control valve body ball check valves, causing metal particles to stick to them.**

21. Remove the case checkball (#1).

TURBINE SHAFT O-RING REMOVAL

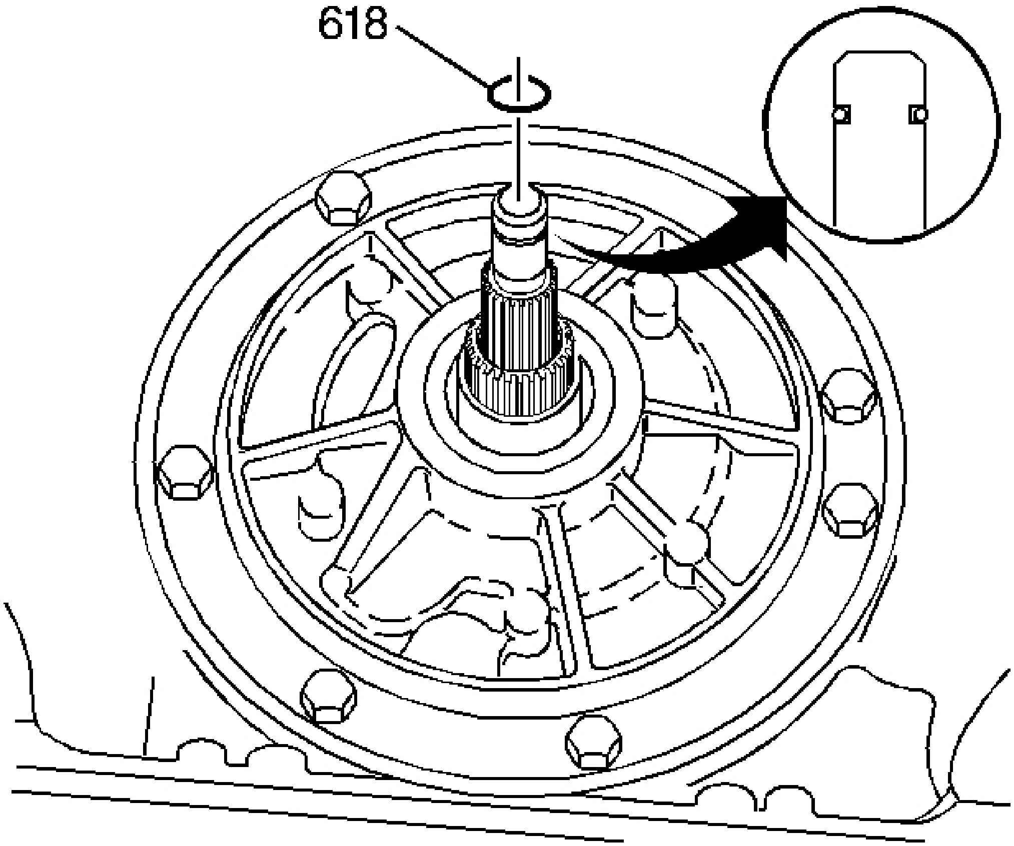


Fig. 212: O-Ring & Turbine Shaft
Courtesy of GENERAL MOTORS CORP.

Remove the O-ring (618) from the turbine shaft. O-Ring location is model dependent.

TRANSMISSION END PLAY CHECK

Tools Required

- **J 25022** End Play Fixture Adapter (245 mm and 258 mm). See **Special Tools and Equipment** .
- **J 34725** End Play Checking Adapter (298 mm). See **Special Tools and Equipment** .
- **J 43205** End Play Fixture Adapter (300 mm). See **Special Tools and Equipment** .
- **J 24773-A** Oil Pump Remover. See **Special Tools and Equipment** .
- J 8001 Dial Indicator Set
- **J 25025-7A** Dial Indicator Mounting Post. See **Special Tools and Equipment** .

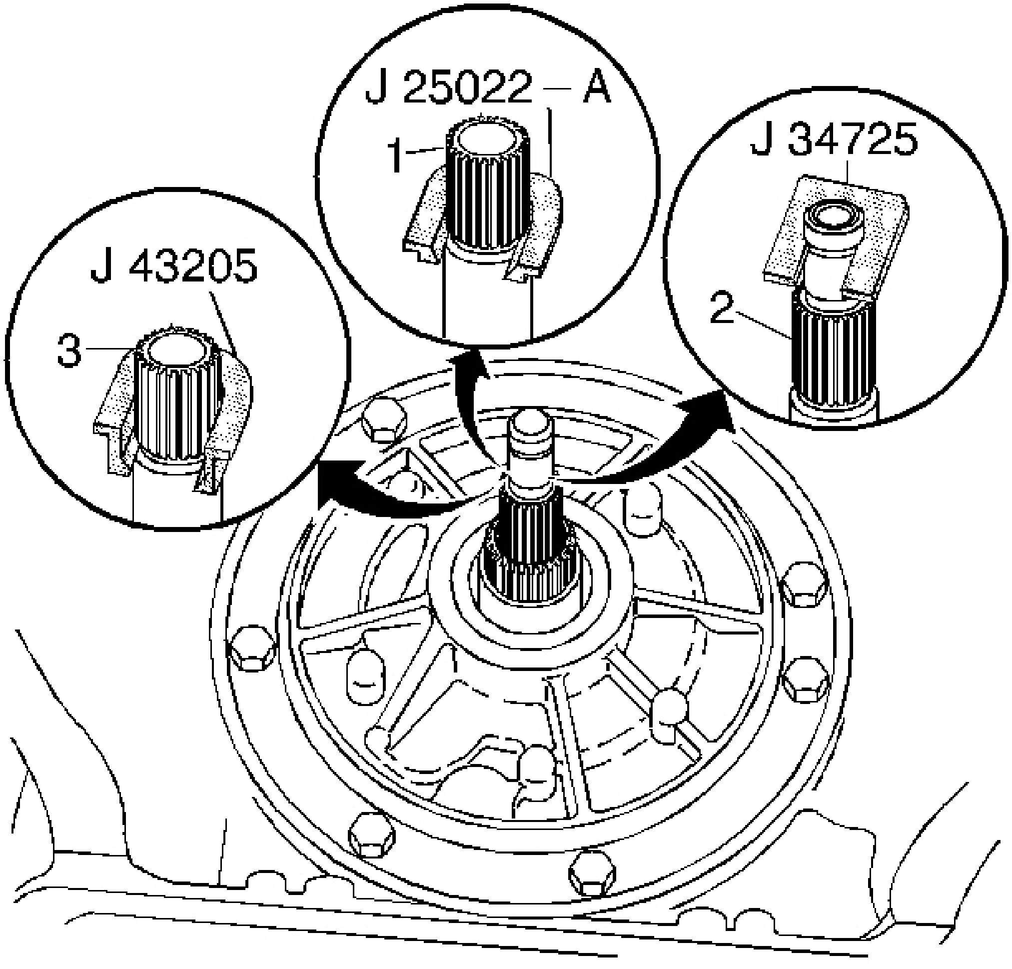


Fig. 213: J 25022, J 34725 & 43205
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Torque converter size is model dependent.

1. Install an end play fixture adapter.
   - Use **J 25022** for a 245 mm and 258 mm turbine shaft (1). See **Special Tools and Equipment** .
   - Use **J 34725** for a 298 mm turbine shaft (2). See **Special Tools and Equipment** .
   - Use **J 43205** for a 300 mm turbine shaft (3). See **Special Tools and Equipment** .

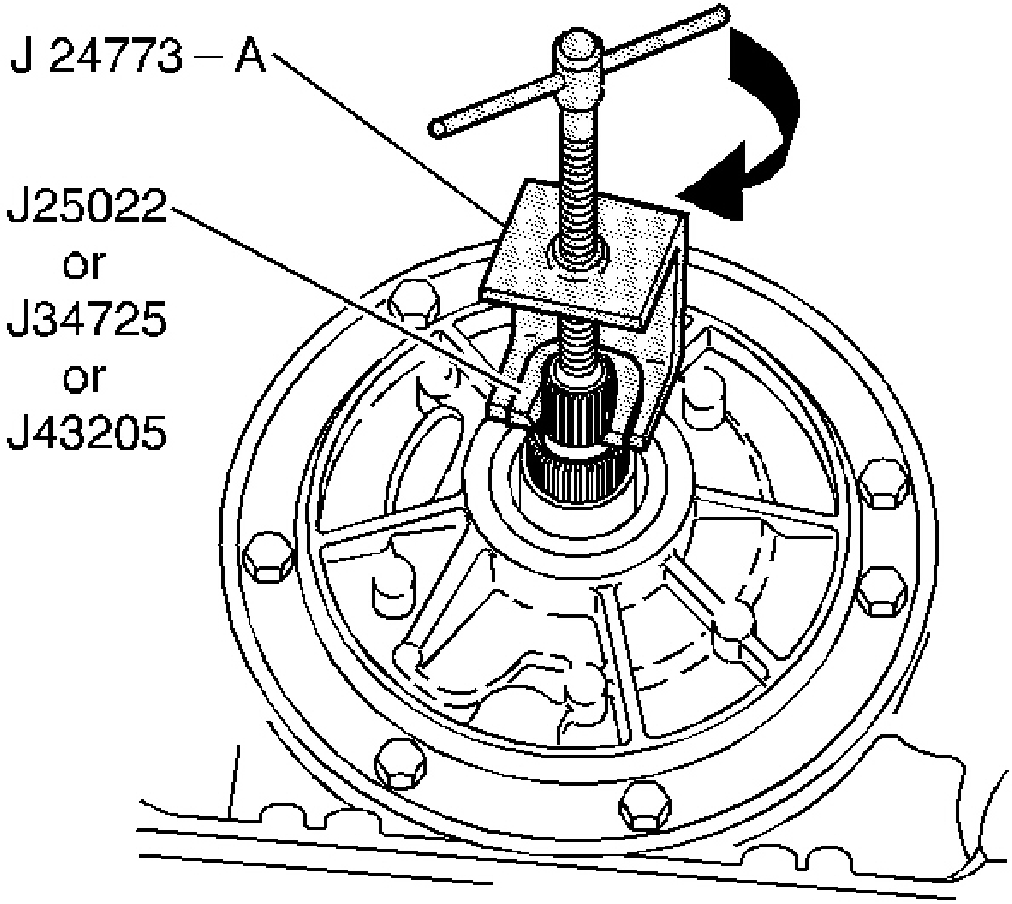


Fig. 214: Installing J 24773-A
Courtesy of GENERAL MOTORS CORP.

2. Install the **J 24773-A** . See **Special Tools and Equipment** .

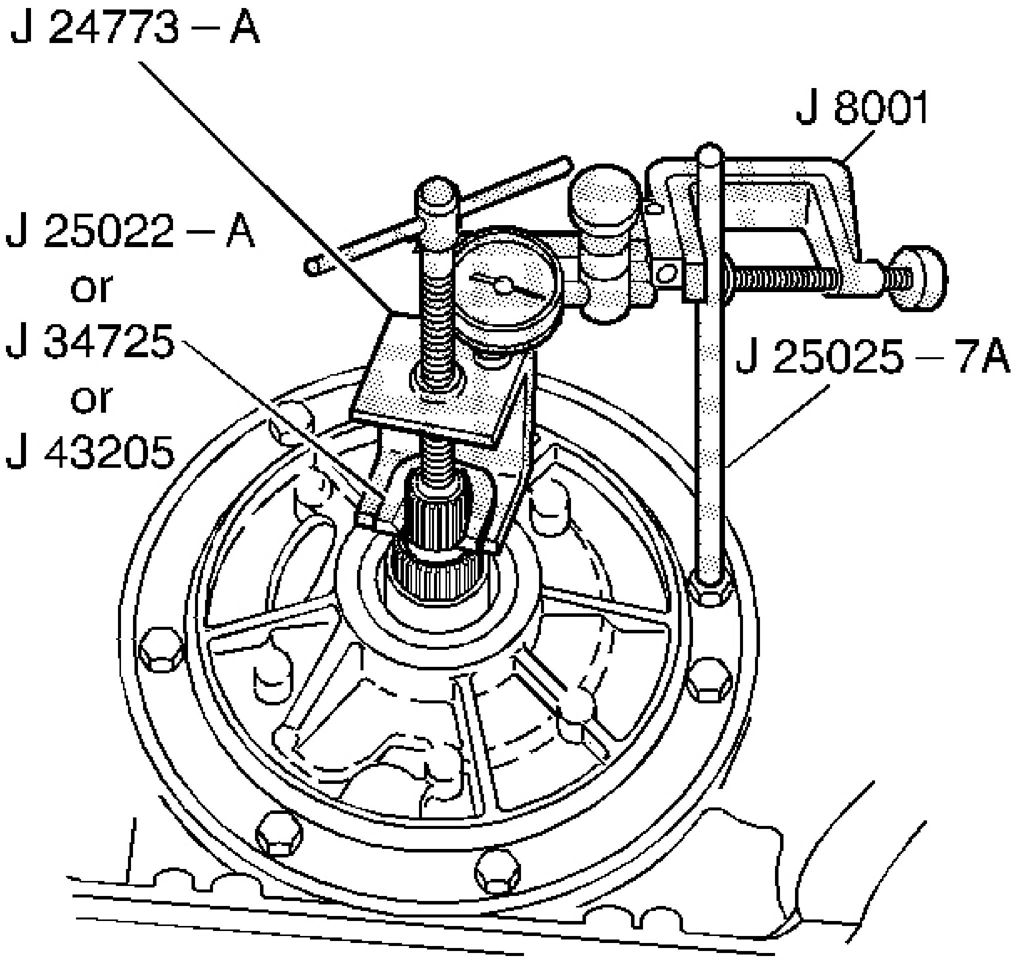


Fig. 215: Identifying J 25025-7A
Courtesy of GENERAL MOTORS CORP.

3. Remove an oil pump bolt.
4. Install **J 25025-7A** (or a 278 mm or 11 in bolt) and lock nut. See **Special Tools and Equipment** .
5. Install J 8001 .

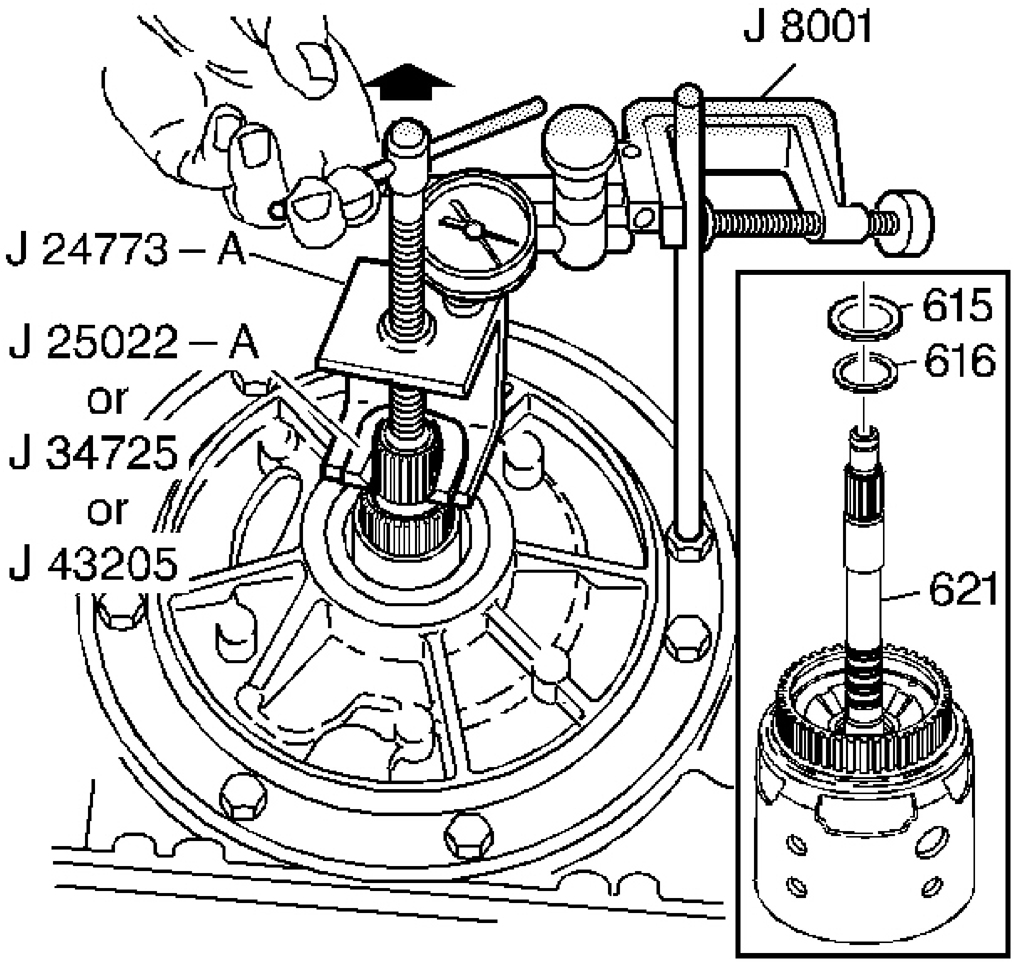


Fig. 216: Setting J 8001 To Zero
Courtesy of GENERAL MOTORS CORP.

6. Set the J 8001 to zero.
7. Pull up on **J 24773-A** . See **Special Tools and Equipment** .

   Proper end play should be 0.13-0.92 mm (0.005-0.036 in).

8. The selective washer (616), which controls the end play, is located between the input housing (621) and the thrust bearing (615) on the oil pump hub.

   If the end play measurement is incorrect, refer to **End Play Specifications** . Choose a new selective washer (616) based on the original selective washer and the information contained in the table.

If the dial indicator shows no end play, the selective washer (616) and thrust bearing (615) may have been misassembled.

9. Correct the end play by changing the selective washer (616).

OIL PUMP REMOVAL

Tools Required

- **J 37789-A** Oil Pump Remover/Installer. See **Special Tools and Equipment** .
- **J 39119** Oil Pump Remover/Installer Adapter. See **Special Tools and Equipment** .

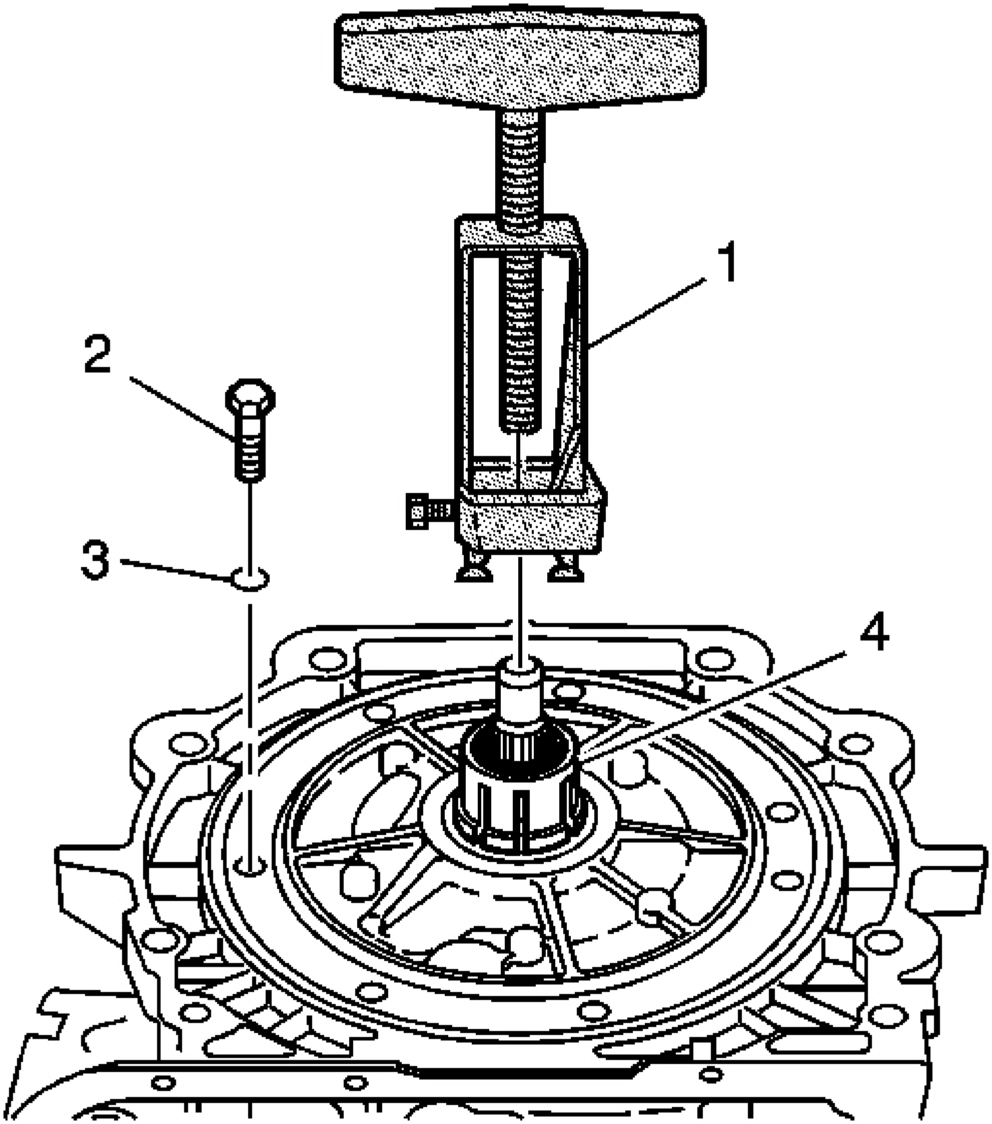


Fig. 217: Installing J 39119 Over Stator Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove all pump bolts (2).
2. Install **J 39119** over stator shaft until it locks under splines. See **Special Tools and Equipment** .
3. Install **J 37789-A** . See **Special Tools and Equipment** .

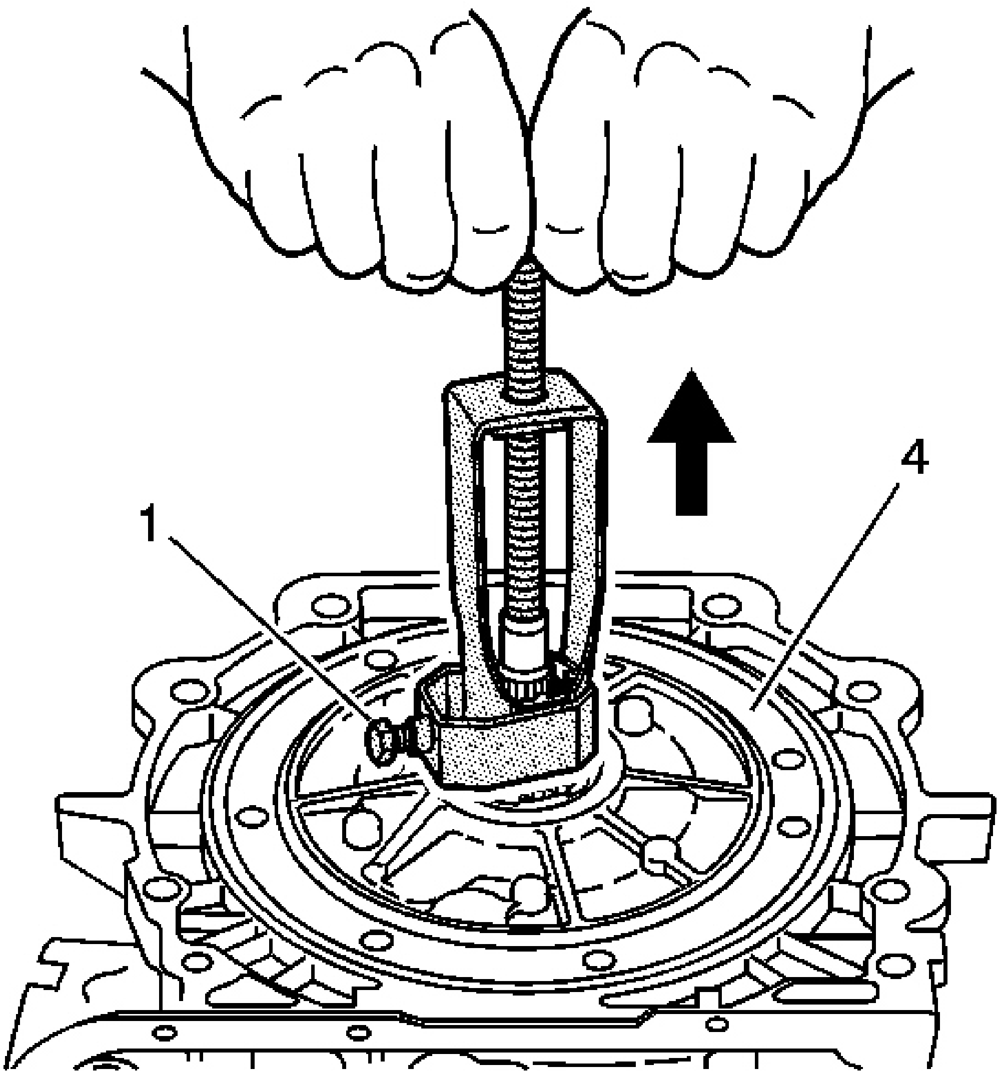


Fig. 218: Secure J 37789-A Around J 39119 By Tightening Bolt With A Wrench
Courtesy of GENERAL MOTORS CORP.

4. To prevent slipping, securely fasten the**J 37789-A** around the **J 39119** by tightening the bolt (1) with a wrench. See **Special Tools and Equipment** .
5. Turn the T-handle on top of **J 37789-A** . See **Special Tools and Equipment** .
6. Lift the pump out of the case.

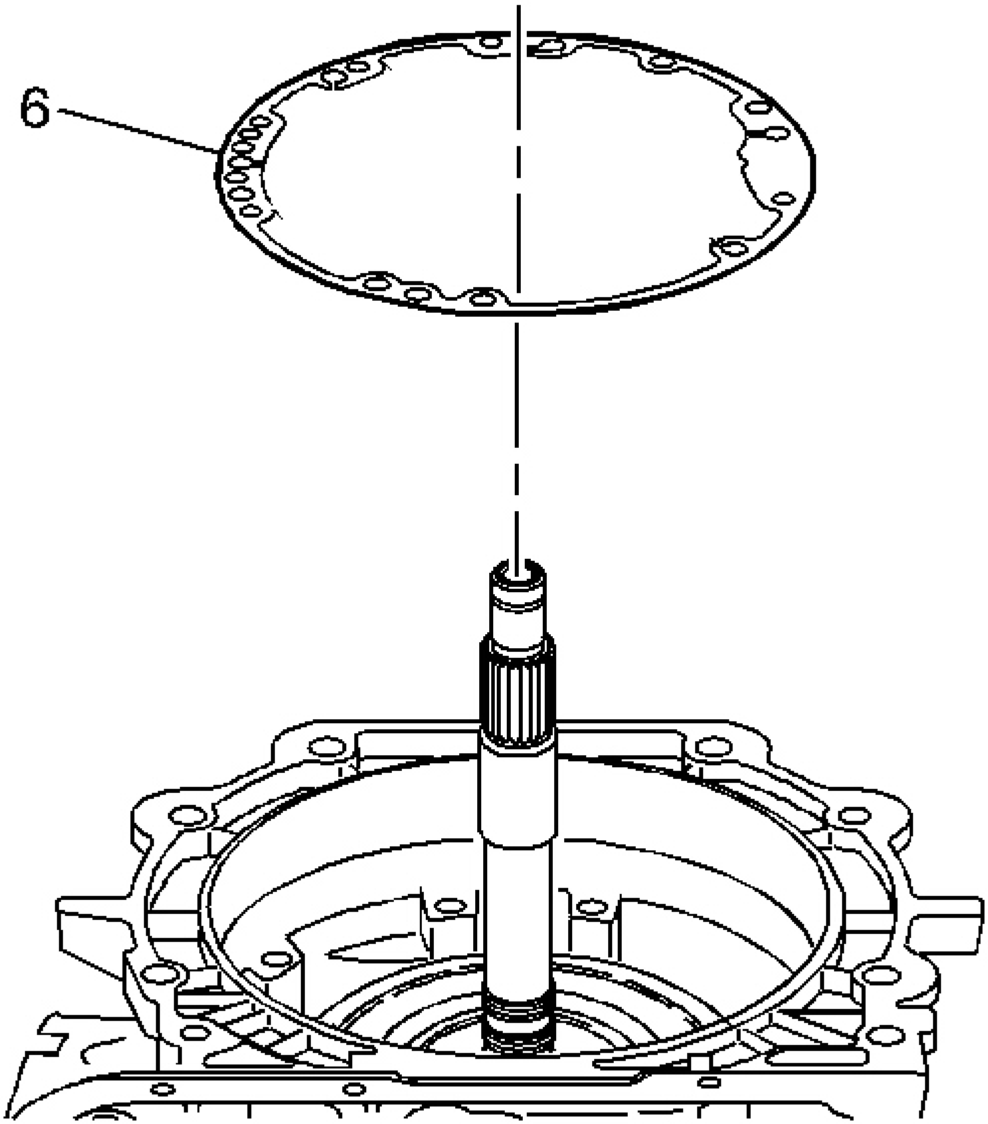


Fig. 219: Pump Cover & Case Gasket
Courtesy of GENERAL MOTORS CORP.

7. Remove the pump cover to case gasket (6).

2-4 BAND, INPUT CLUTCHES, INPUT GEAR SET REMOVAL

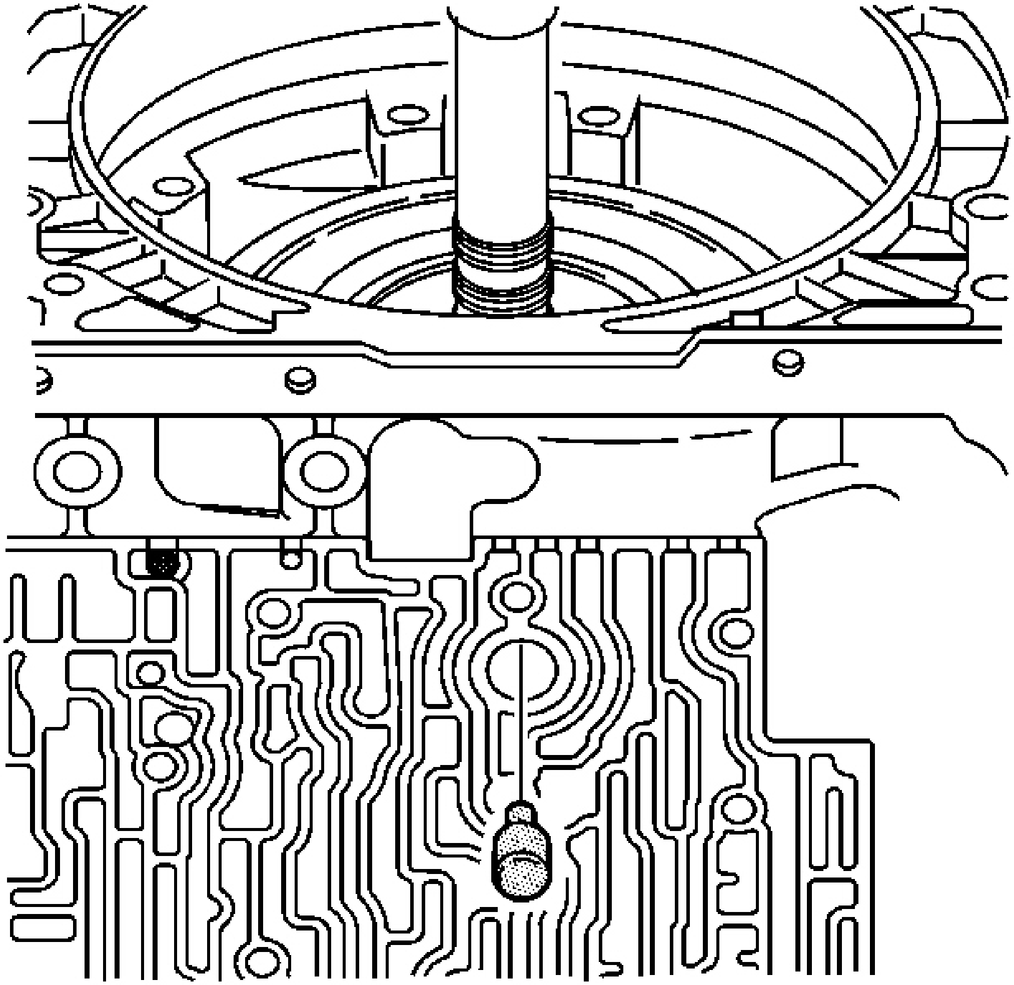


Fig. 220: Band Anchor Pin
Courtesy of GENERAL MOTORS CORP.

1. Remove the band anchor pin.

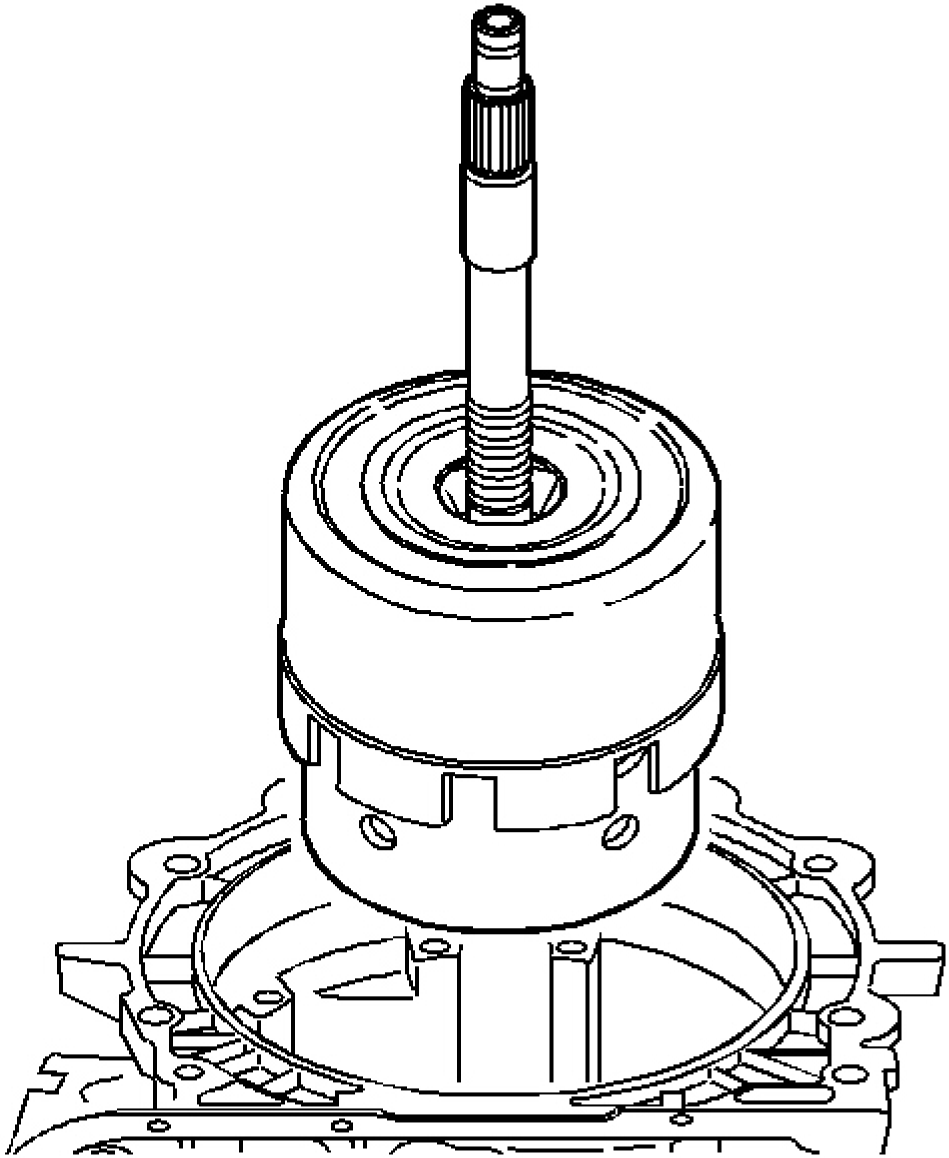


Fig. 221: Reverse Input & Input Clutch Assembly
Courtesy of GENERAL MOTORS CORP.

2. Remove the input housing and shaft assembly and the reverse input clutch housing and drum assembly.

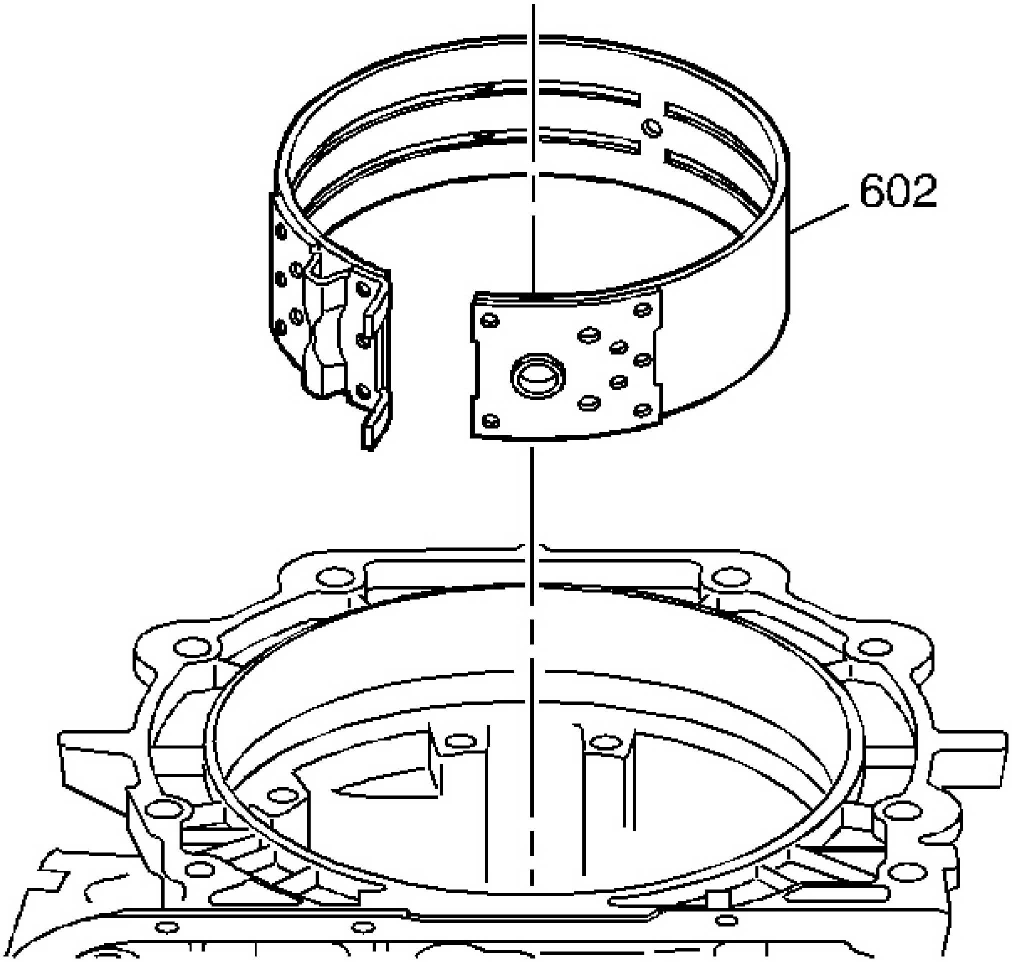


Fig. 222: 2-4 Band Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the 2-4 band assembly (602).

REACTION GEAR SET REMOVAL

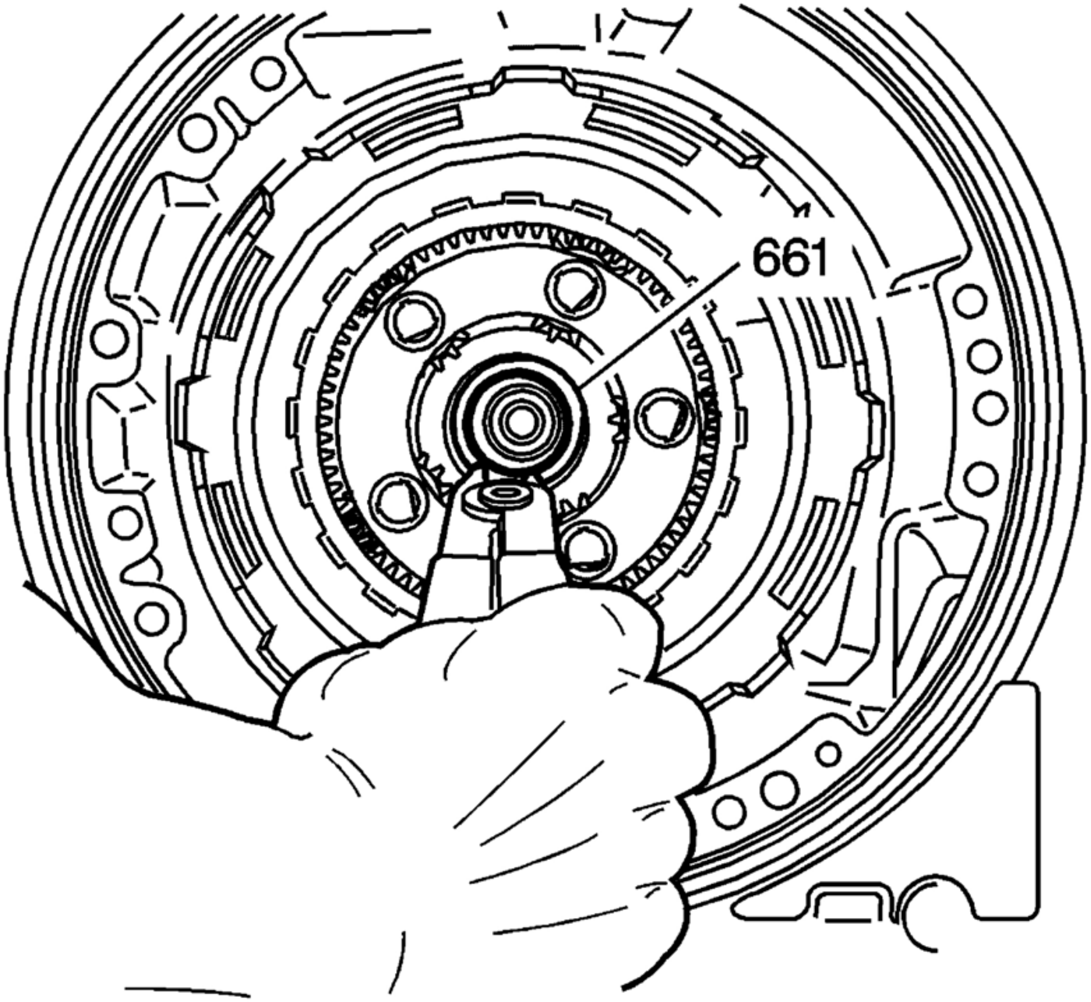


Fig. 223: Removing Output Shaft To Input Carrier Retainer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The retainer must be replaced.

1. Use snap ring pliers remove the output shaft to input carrier retainer (661).

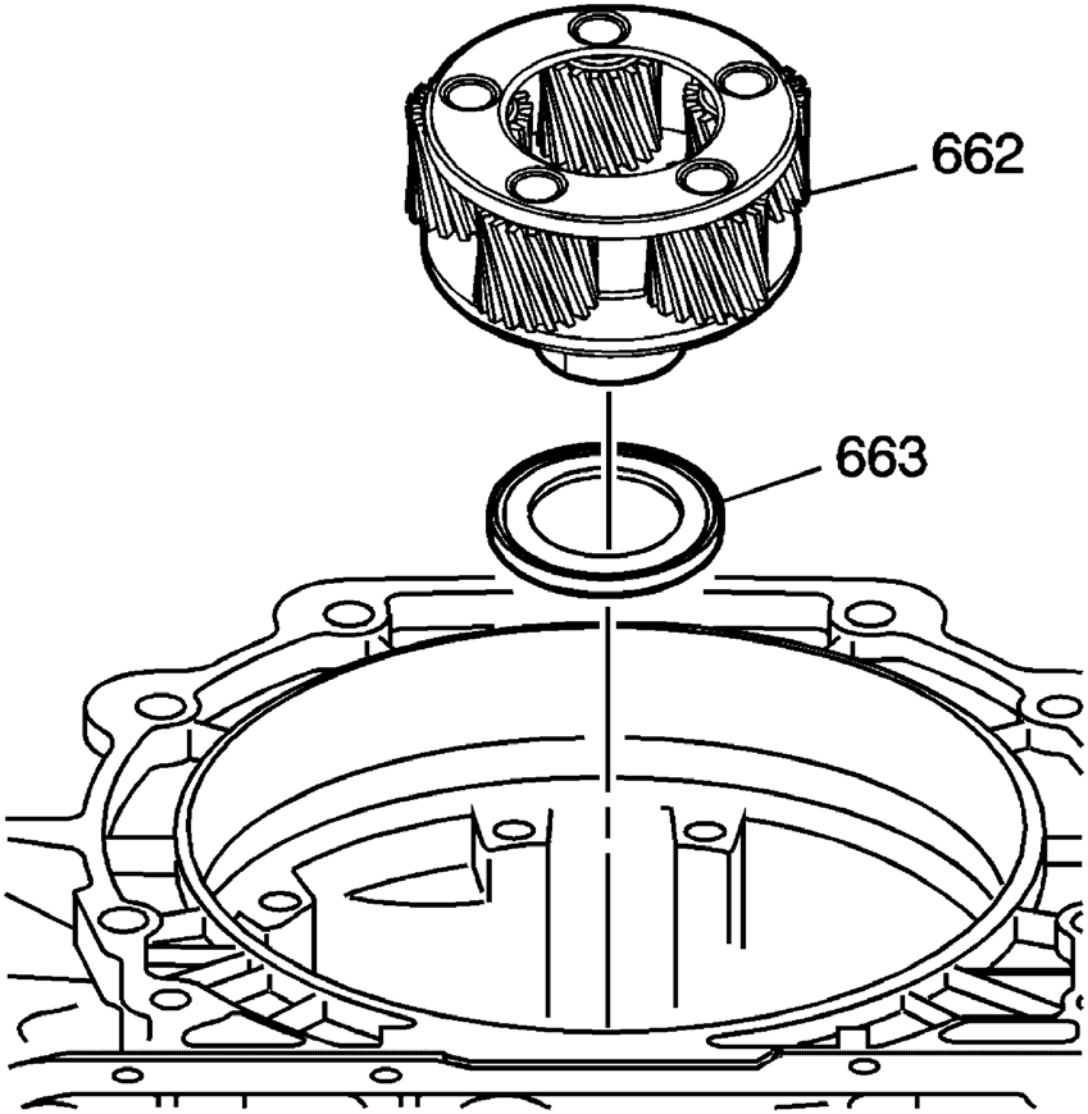


Fig. 224: Input Carrier Assembly & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The carrier assembly can be a 4 or 5 pinion design depending on model.

2. Remove the input carrier assembly (662) and remove the bearing assembly (663).

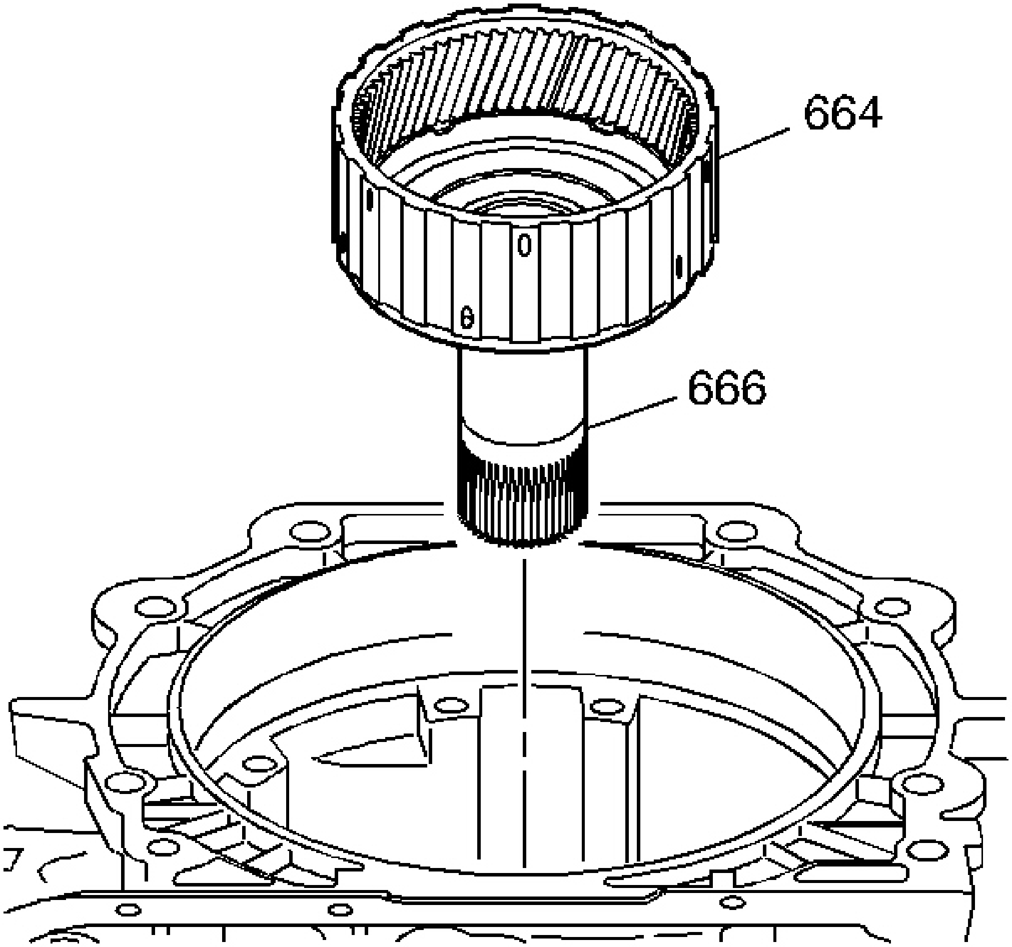


Fig. 225: Input Internal Gear & Reaction Carrier Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the input internal gear (664) and the reaction carrier shaft assembly (666).

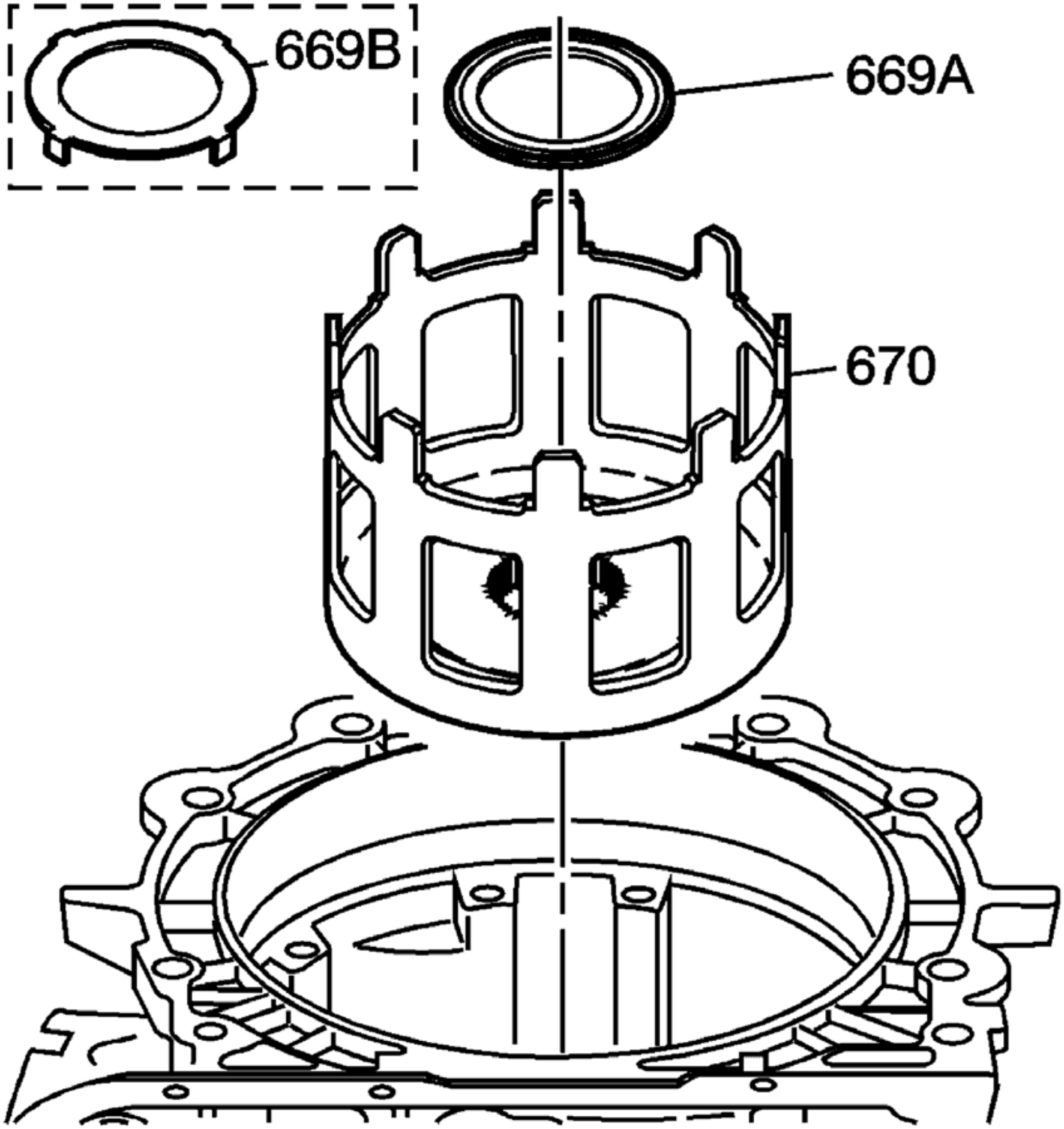


Fig. 226: Thrust Washer & Reaction Sun Shell
Courtesy of GENERAL MOTORS CORP.

4. Remove the thrust washer (669a or 669b) and the reaction sun shell (670).

OUTPUT SHAFT, REACTION GEAR, LOW/REV CLUTCH REMOVAL

Tools Required

J 29837-A Output Shaft Support Fixture. See **Special Tools and Equipment** .

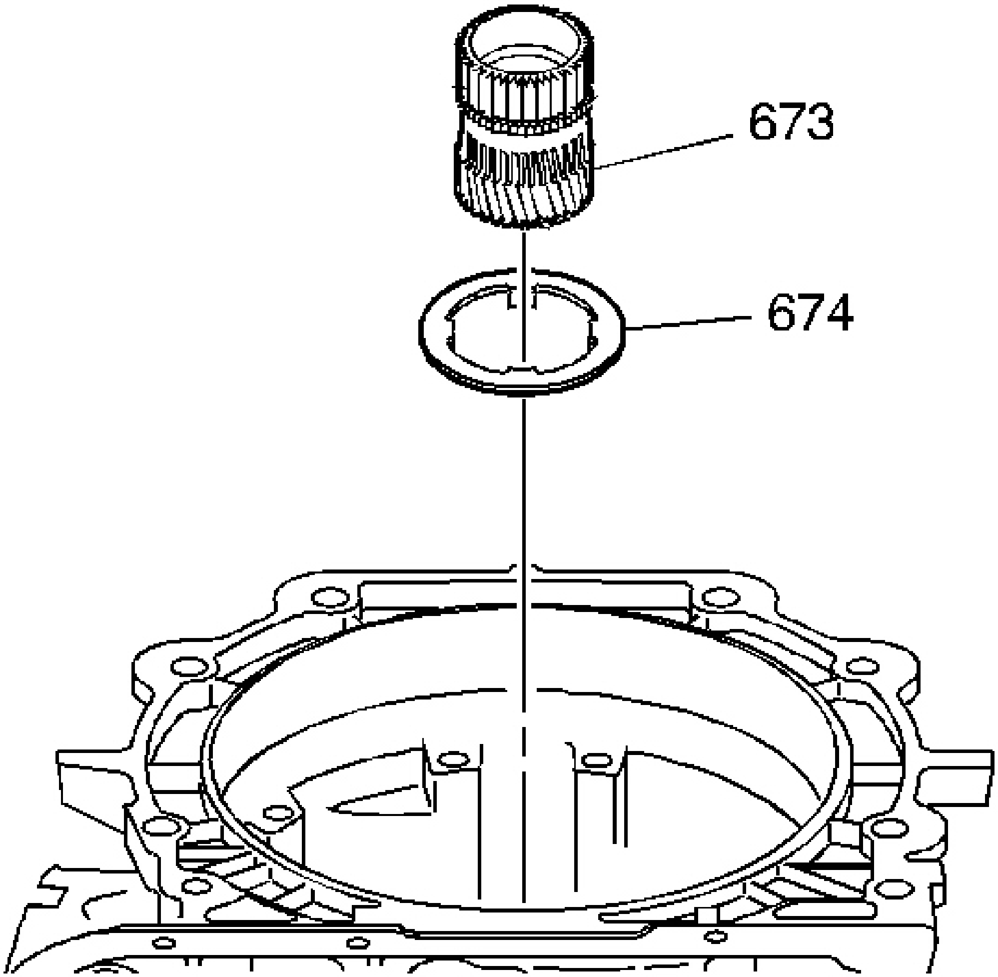


Fig. 227: Reaction Sun Gear & And The Thrust Washer
Courtesy of GENERAL MOTORS CORP.

1. Remove the reaction sun gear (673) and the thrust washer (674).

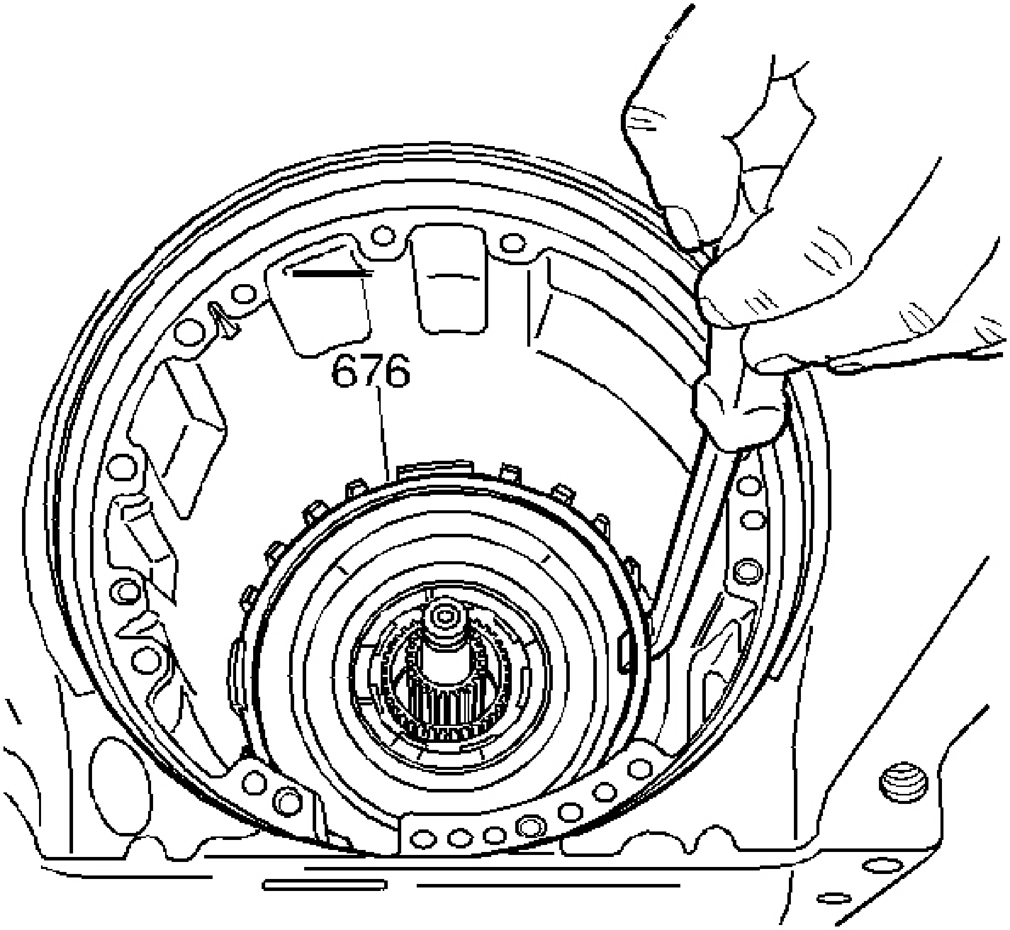


Fig. 228: Low & Reverse Support Retainer Ring
Courtesy of GENERAL MOTORS CORP.

2. Remove the low and reverse support retainer ring (676).

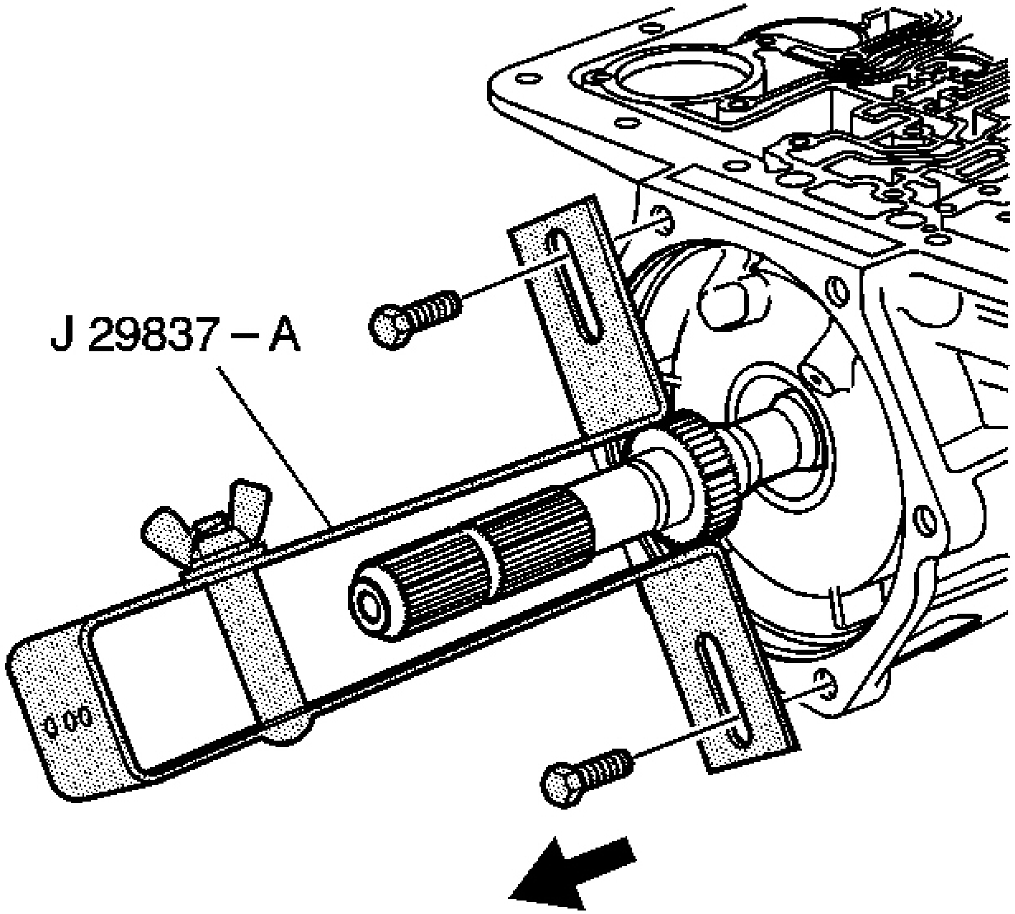


Fig. 229: Removing J 29837-A
Courtesy of GENERAL MOTORS CORP.

3. Remove the **J 29837-A** . See **Special Tools and Equipment** .

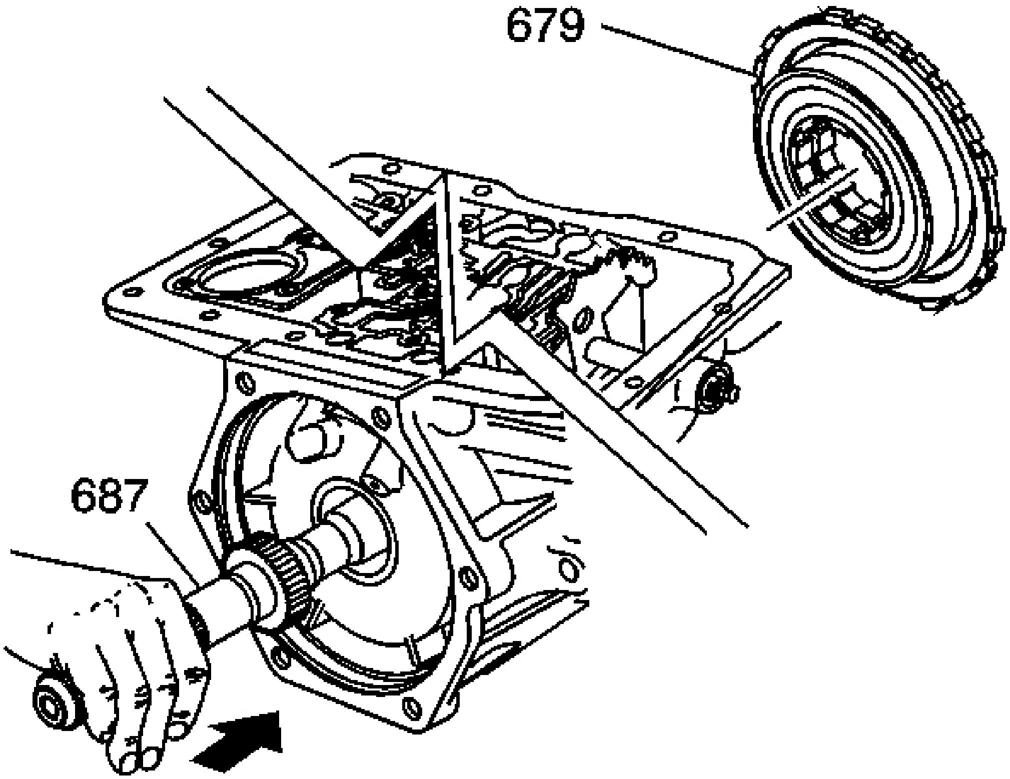


Fig. 230: Low & Reverse Clutch Support
Courtesy of GENERAL MOTORS CORP.

4. Push on the output shaft (687) in order to loosen the low and reverse clutch support (679).
5. Remove the low and reverse clutch support (679).

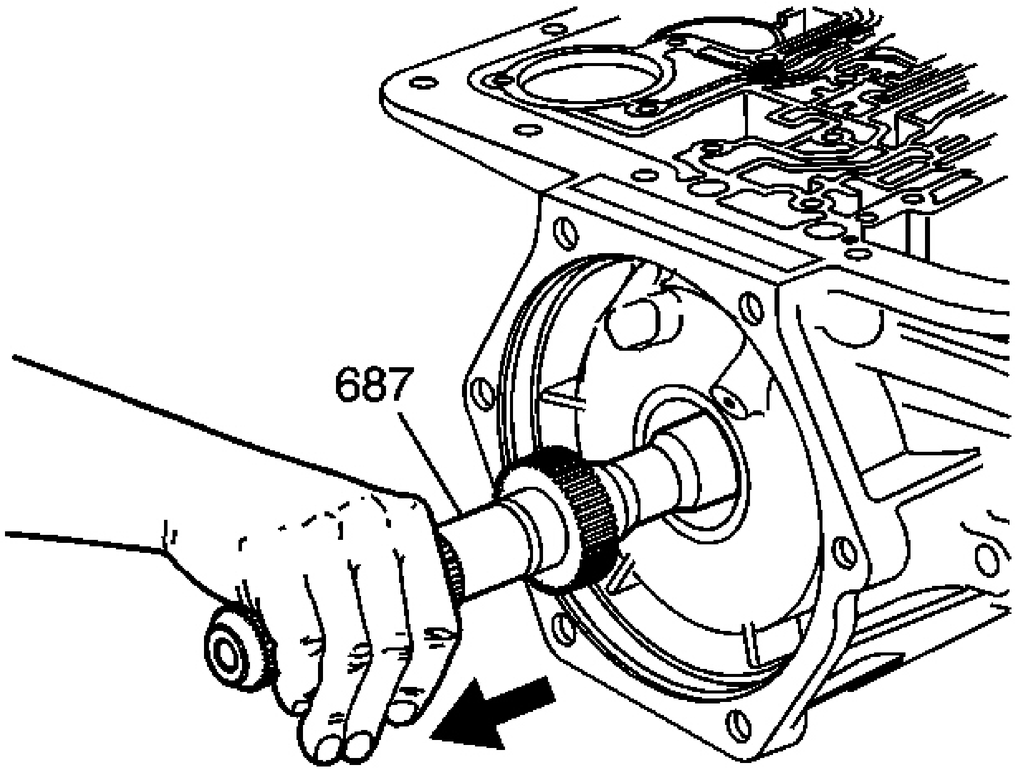


Fig. 231: Removing Output Shaft
Courtesy of GENERAL MOTORS CORP.

6. Remove the output shaft (687).

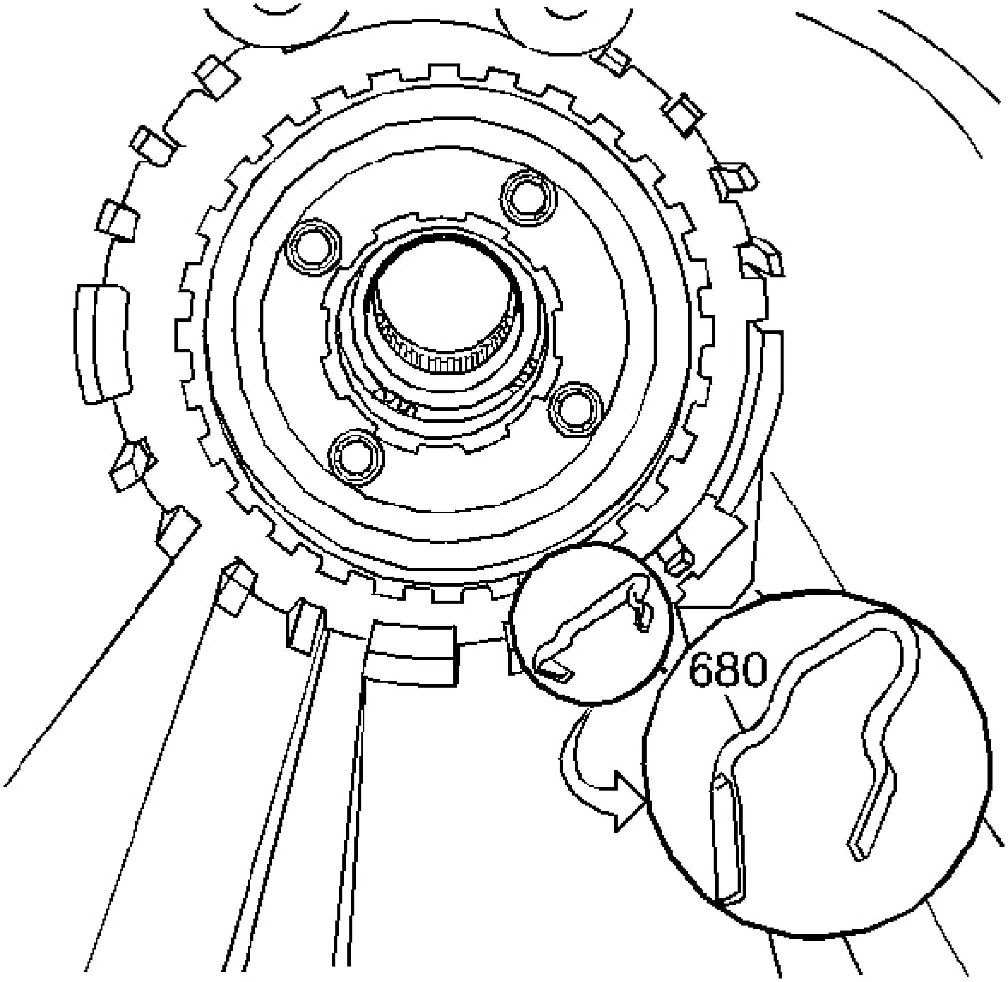


Fig. 232: Low & Reverse Clutch Support Retainer Spring
Courtesy of GENERAL MOTORS CORP.

7. Remove the low and reverse clutch support retainer spring (680).

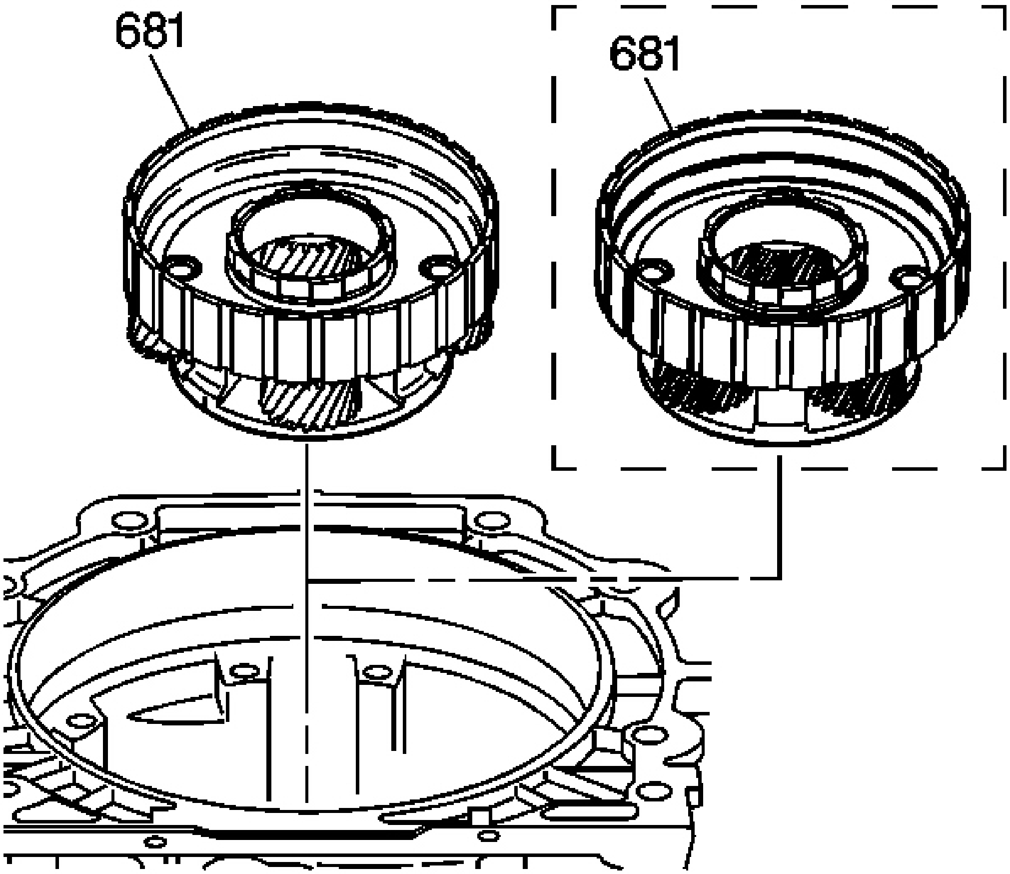


Fig. 233: Reaction Carrier Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The reaction carrier assembly (681) can be a 4 or 5 pinion design depending on the transmission model.

8. Remove the reaction carrier assembly (681).

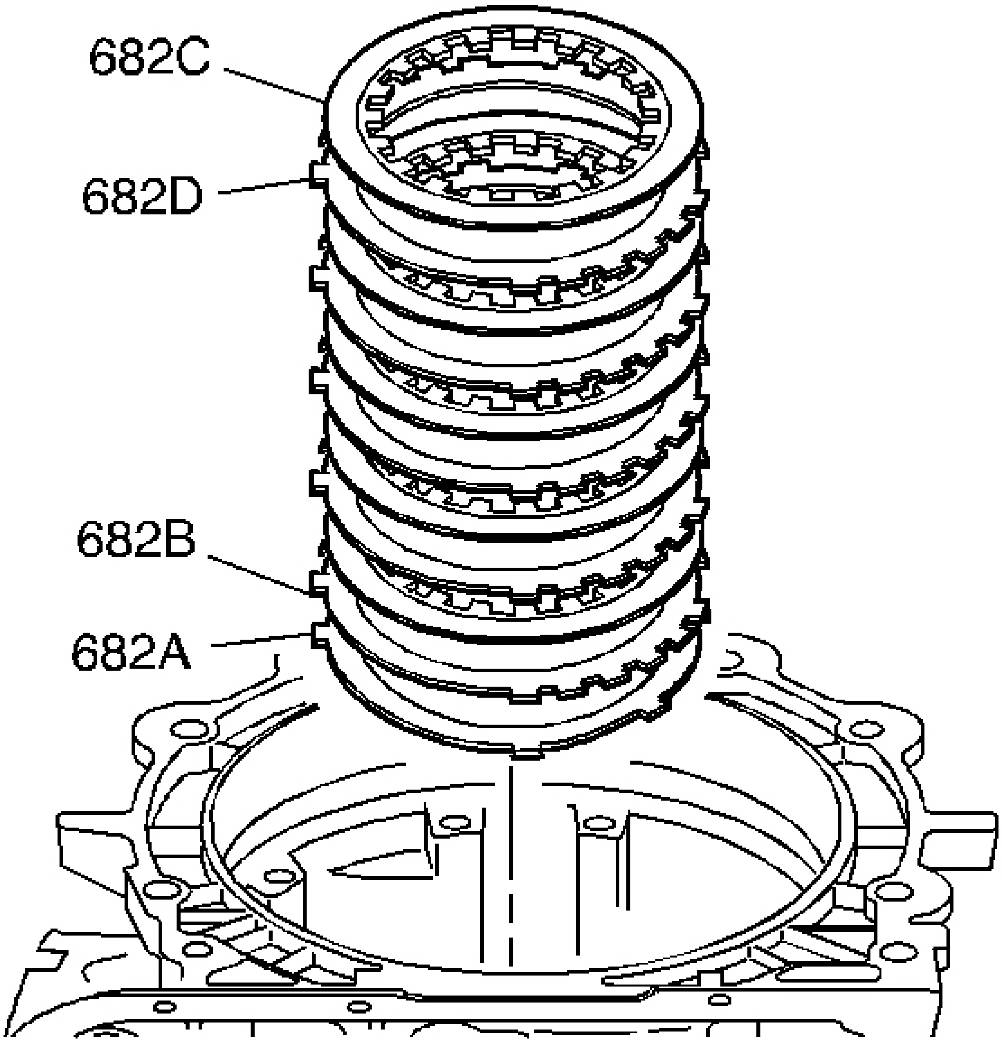


Fig. 234: Low & Reverse Clutch Components
Courtesy of GENERAL MOTORS CORP.

9. Remove the following components:
    1. The low and reverse clutch fiber plate assembly (682C)
    2. The low and reverse clutch steel plates (682D)
    3. The low and reverse clutch selective plate (682B)
    4. The low and reverse clutch waved plate (682A)

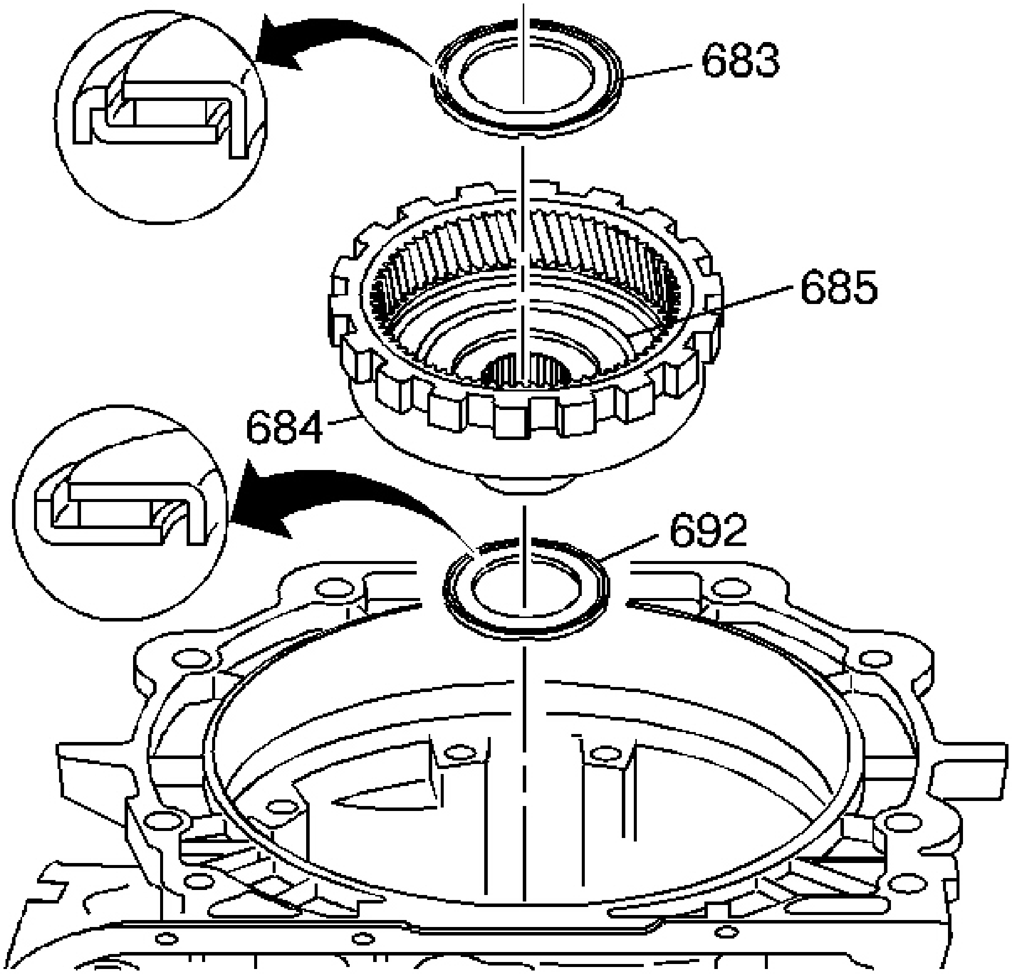


Fig. 235: Reaction Gear Components
Courtesy of GENERAL MOTORS CORP.

10. Remove the following components:
    1. The thrust bearing assembly (reaction carrier support) (683)
    2. The internal reaction gear (684)
    3. The internal reaction gear support (685)
    4. The reaction gear support bearing (692)

INNER MANUAL LINKAGE REMOVAL

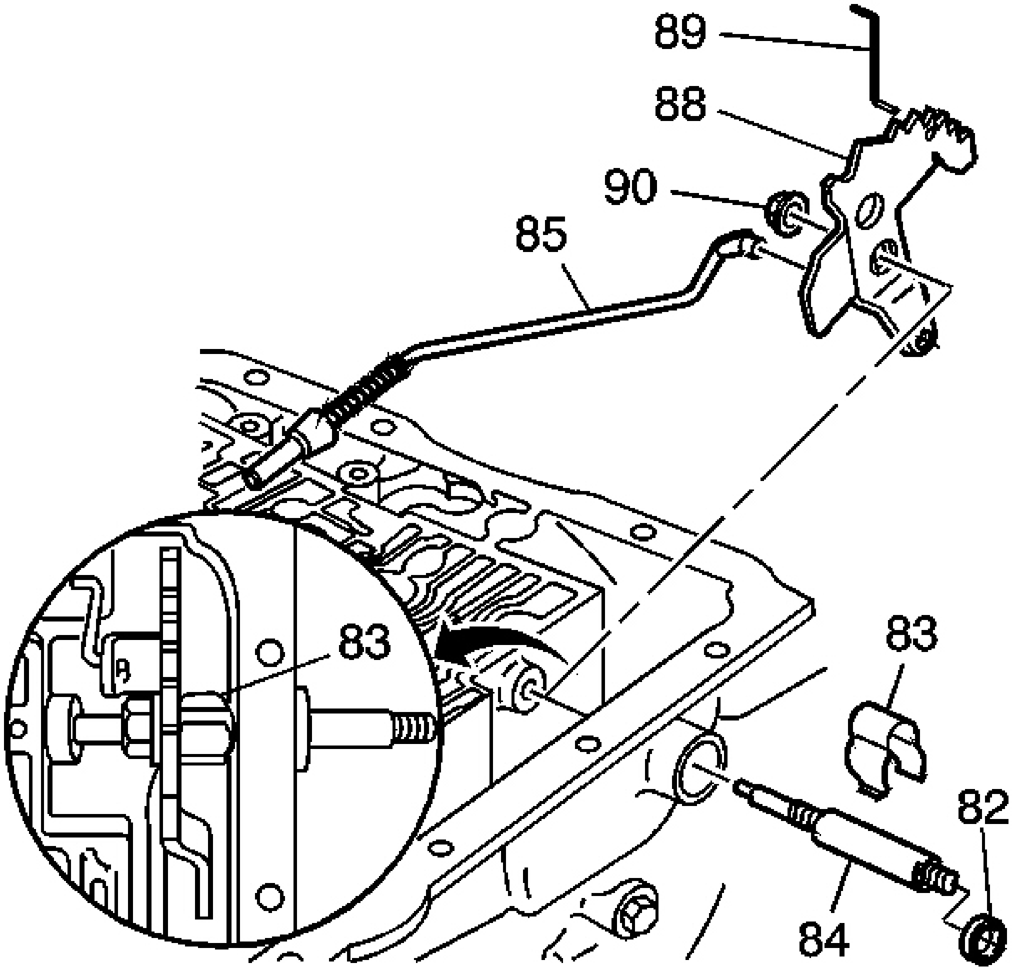


Fig. 236: Inner Manual Linkage Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the following parts:
    1. Hex head nut (90)
    2. Manual valve link (89)
    3. Detent lever (88)
    4. Parking lock actuator assembly (85)
    5. Manual shaft retainer (83)
    6. Manual shaft (84)

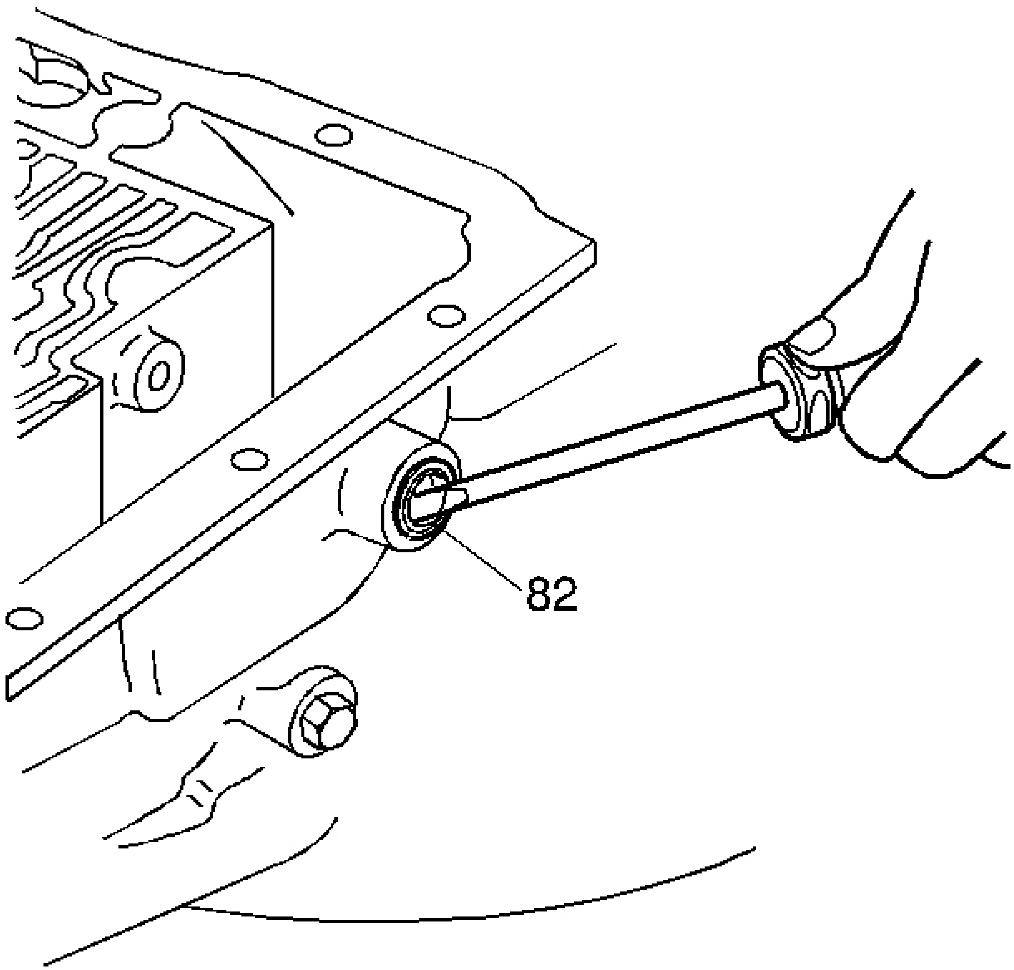


Fig. 237: Manual Shaft Seal
Courtesy of GENERAL MOTORS CORP.

2. Remove the manual shaft seal (82) with a screwdriver.

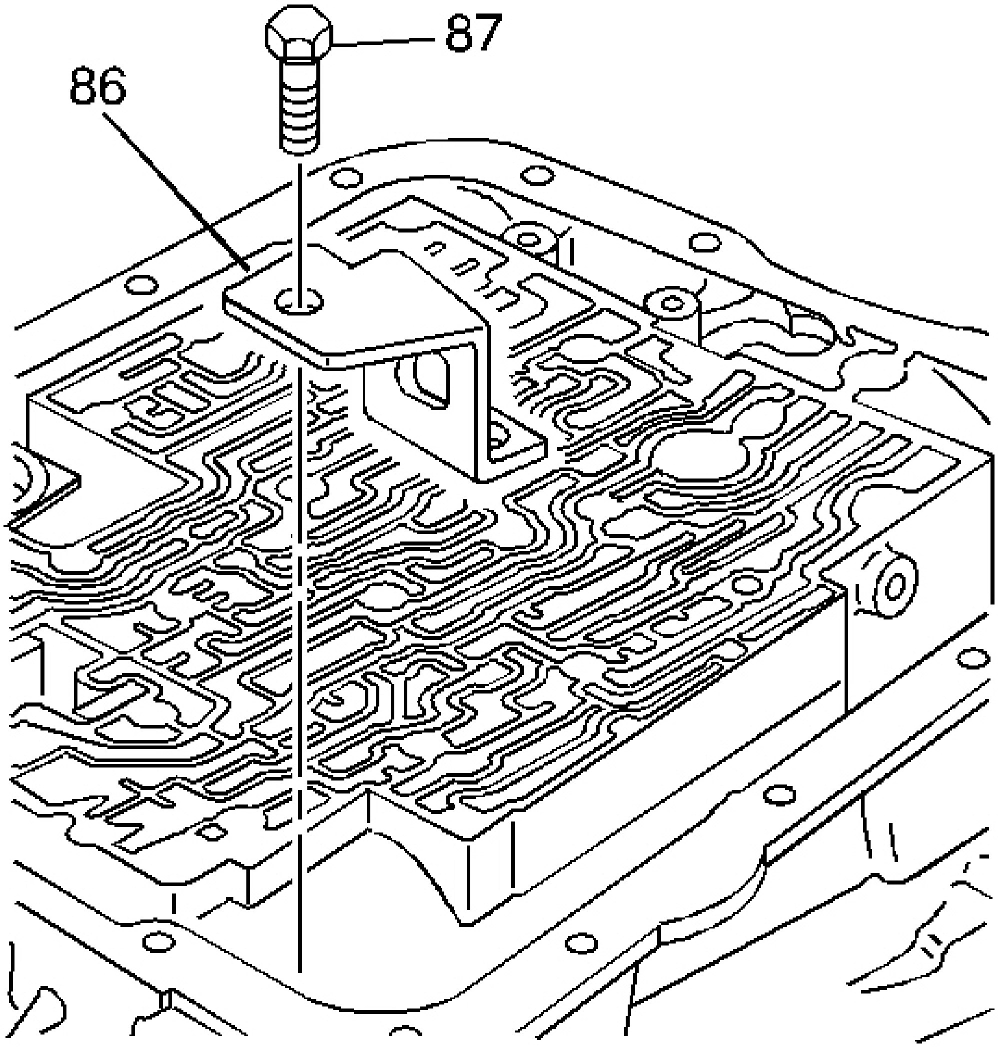


Fig. 238: Parking Lock Bracket & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the following components:
    1. The parking lock bracket bolt (87)
    2. The parking lock bracket (86)

LOW AND REVERSE CLUTCH PISTON REMOVAL

Tools Required

- **J 23327-1** Forward Clutch Spring Compressor (Bridge). See **Special Tools and Equipment** .
- **J 34627** Snap Ring Remover and Installer. See **Special Tools and Equipment** .
- **J 42628** Disc. See **Special Tools and Equipment** .

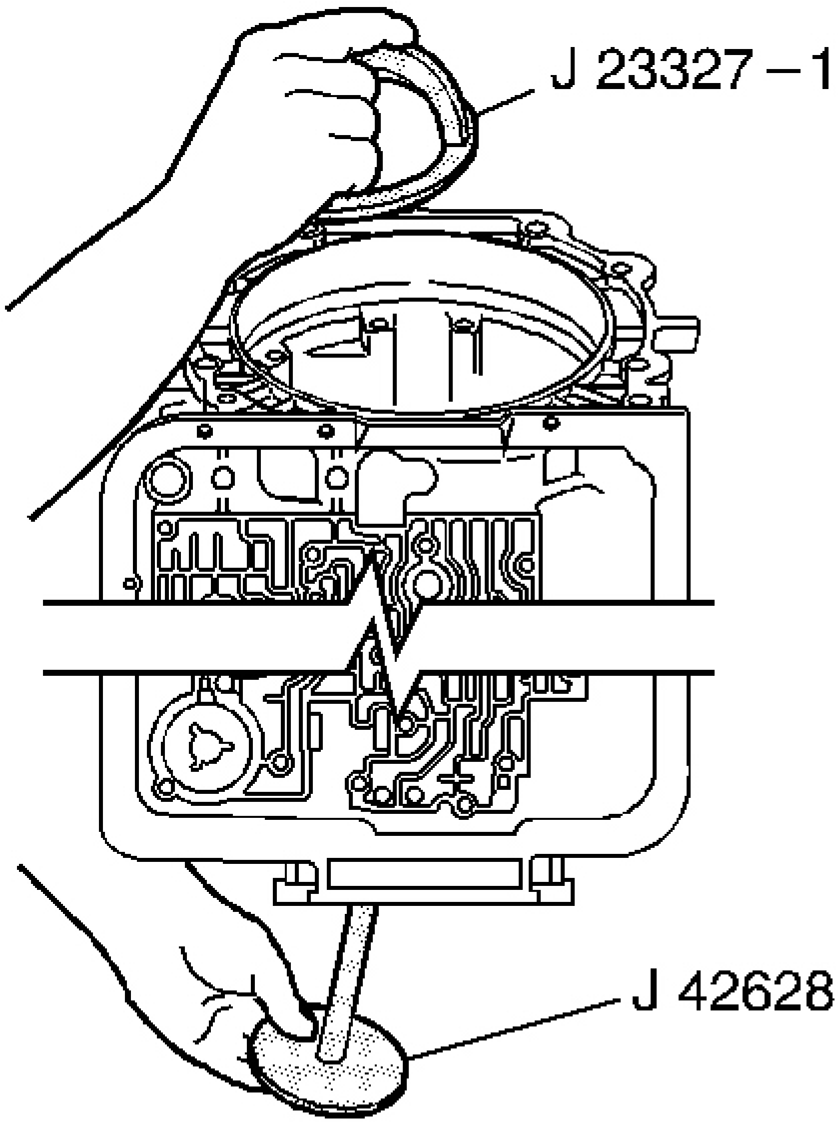
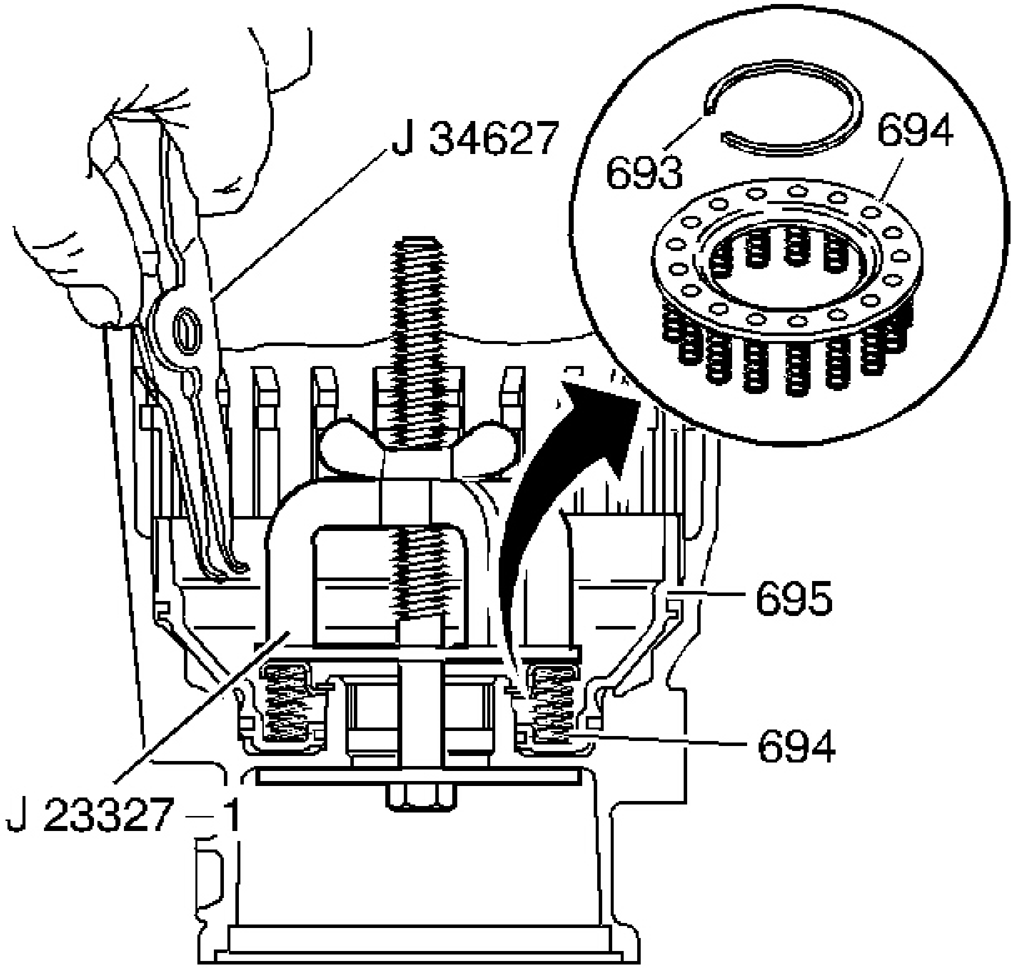


Fig. 239: Installing J 23327-1 & J 42628
Courtesy of GENERAL MOTORS CORP.

1. Install the **J 23327-1** and the **J 42628** . See <u>**Special Tools and Equipment**</u> .



<u>**Fig. 240: Low & Reverse Clutch Spring Assembly**</u>
Courtesy of GENERAL MOTORS CORP.

2. Tighten the **J 23327-1** . See <u>**Special Tools and Equipment**</u> .
3. Remove the low and reverse clutch retainer ring (693) using the**J 34627** . See <u>**Special Tools and Equipment**</u> .
4. Remove the low and reverse clutch spring assembly (694).

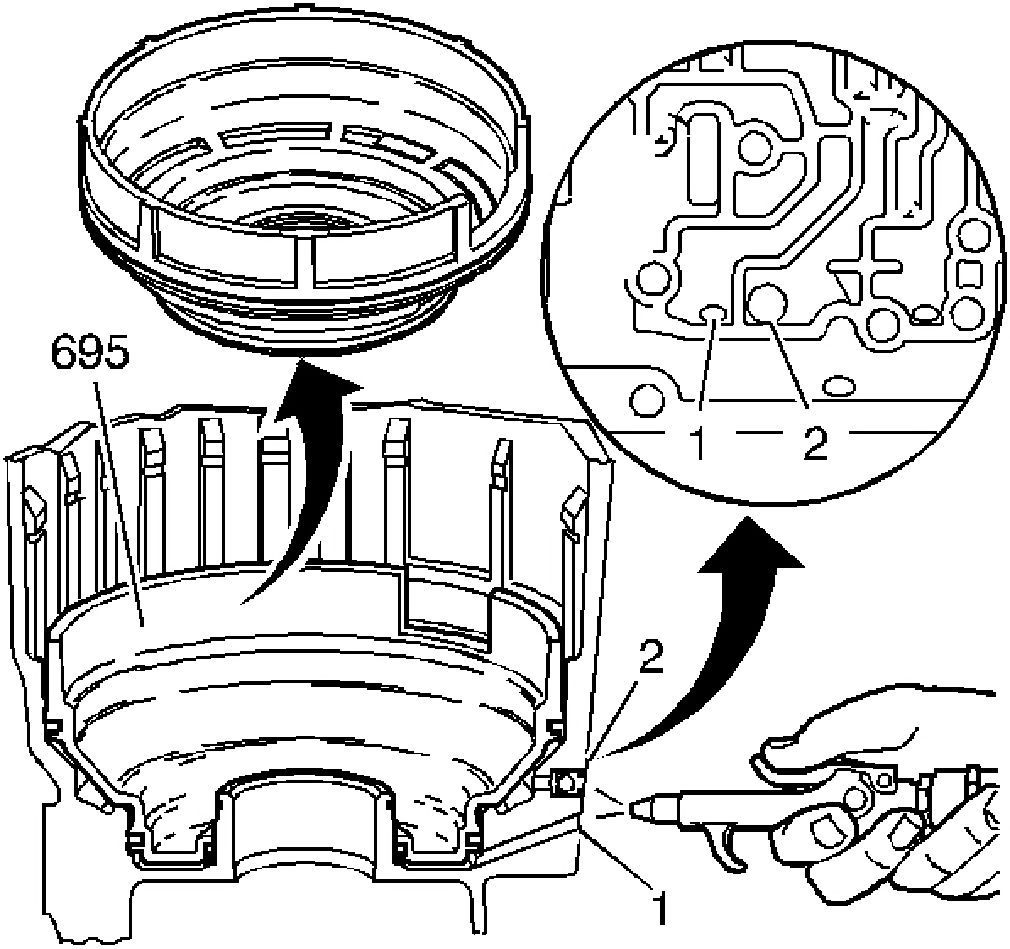


Fig. 241: Blowing Compressed Air Into Case Passage To Remove Low & Reverse Clutch Piston
Courtesy of GENERAL MOTORS CORP.

5. Blow compressed air into the case passage to remove the low and reverse clutch piston (695).
    - (1) LO Feed Passage
    - (2) REV Feed Passage

CASE ASSEMBLY INSPECTION

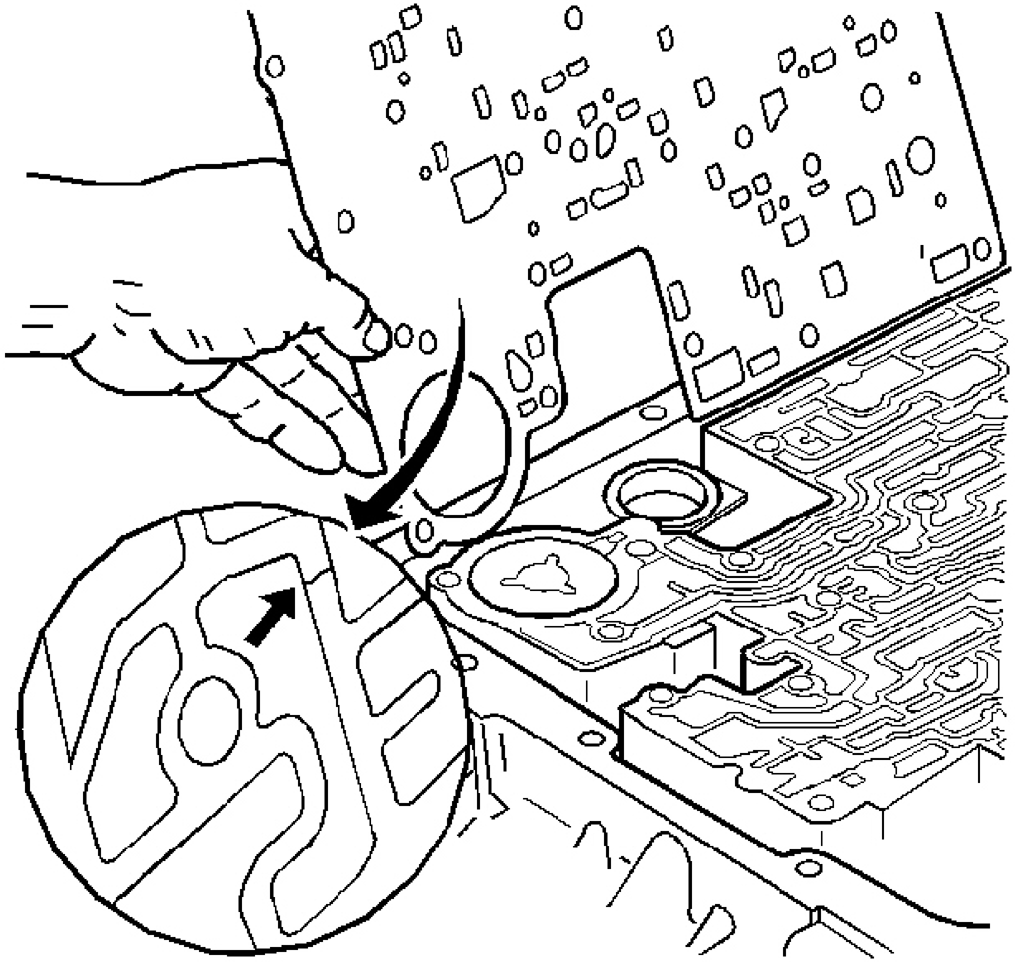


Fig. 242: Inspecting Spacer Plate To Case Gasket
Courtesy of GENERAL MOTORS CORP.

1. Inspect the spacer plate to case gasket for witness marks. The witness marks should be complete. Incomplete witness marks may come from an uneven case surface or from cross channel leaks.

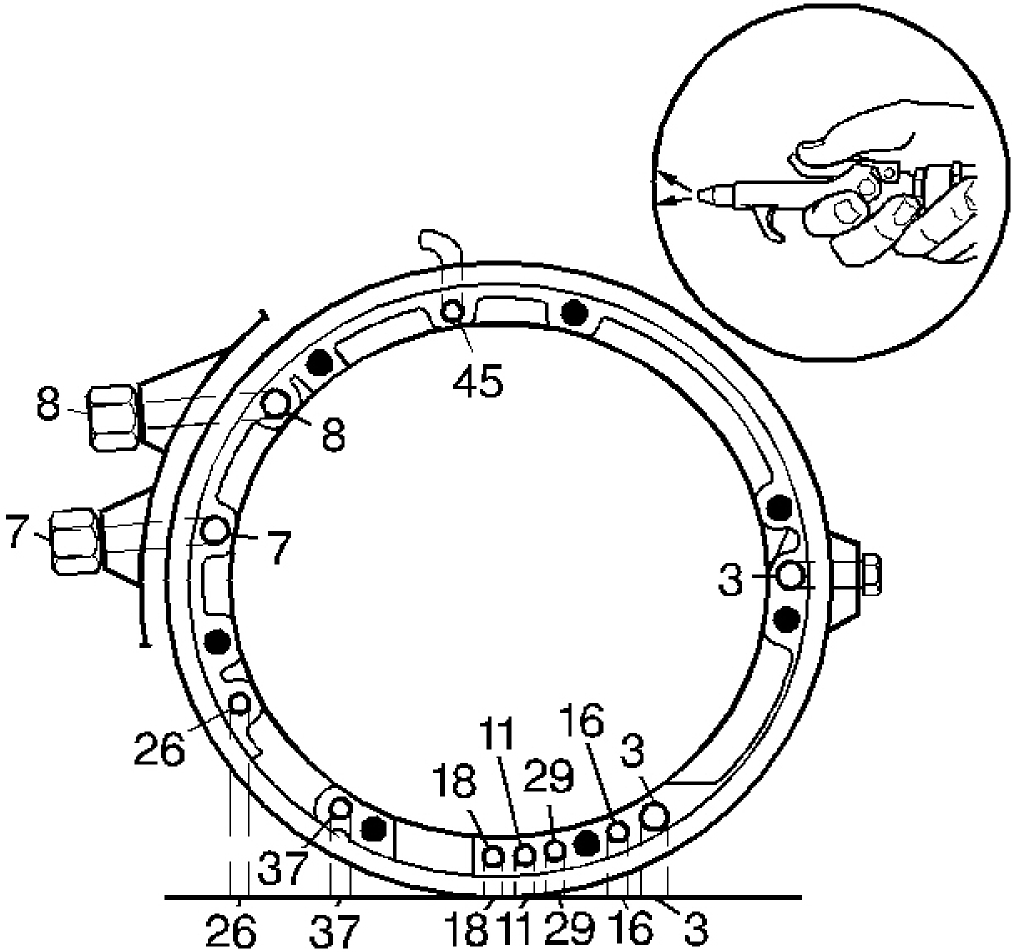


Fig. 243: Use Compressed Air To Blow Into All Of Case Fluid Passages
Courtesy of GENERAL MOTORS CORP.

2. Using compressed air, blow into all of the case fluid passages (3, 7, 8, 11, 16, 18, 26, 29, 37, 45) to ensure that all case fluid passages are clear of any obstruction.

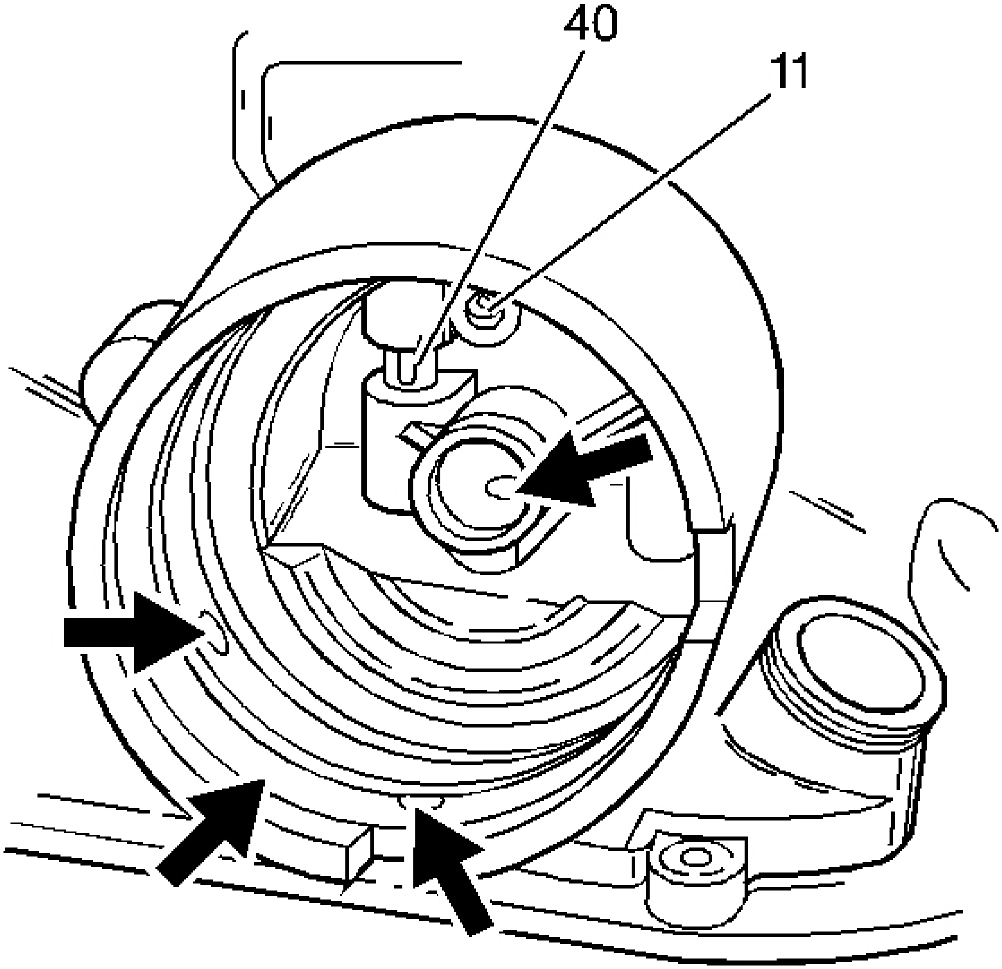


Fig. 244: 2-4 Servo Bore, 3rd Accumulator Retainer & Ball Assembly, Orifice Cup Plug & 2nd Apply Piston Pin Bore
Courtesy of GENERAL MOTORS CORP.

3. Inspect the 2-4 servo bore, the 3rd accumulator retainer and ball assembly (40), the orifice cup plug (11) in the servo bore, and the 2nd apply piston pin bore for any of the following conditions:
   - Porosity
   - Burrs
   - Debris
   - Any other damage

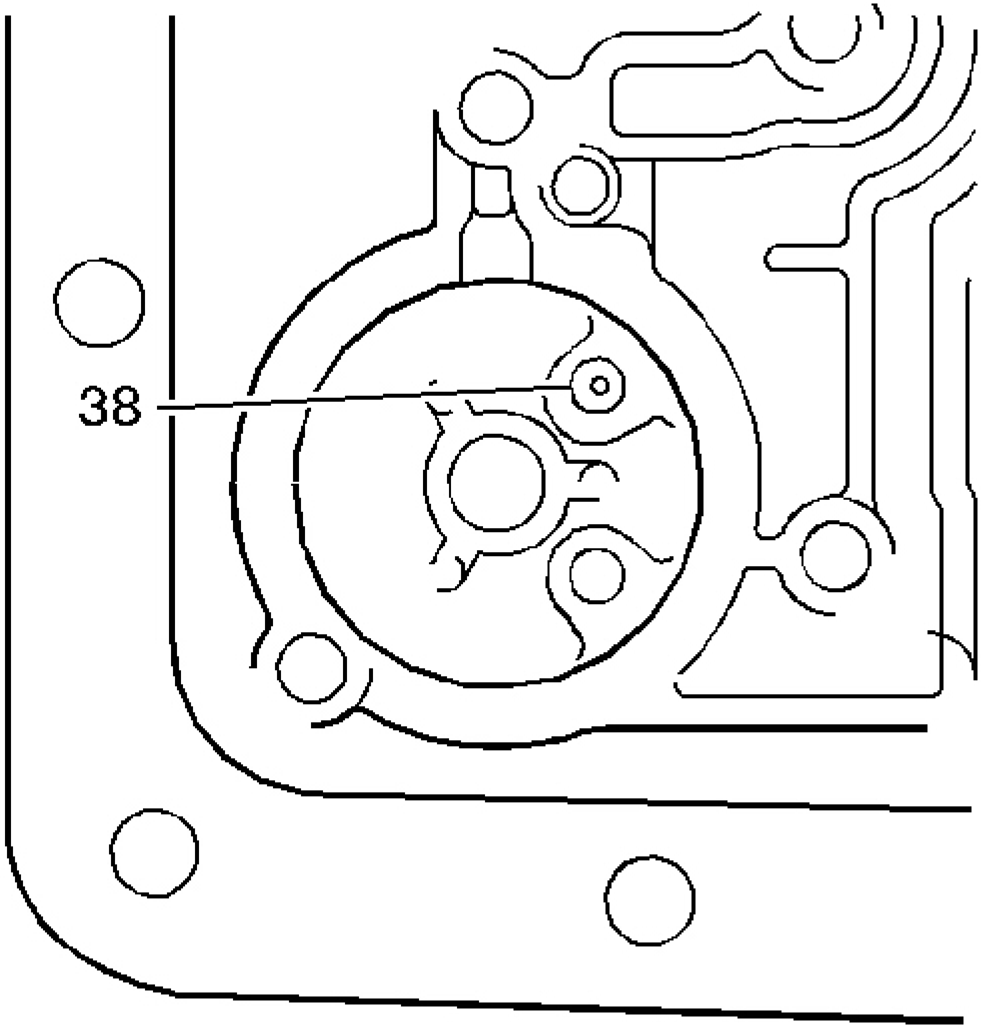


Fig. 245: Inspecting 3-4 Accumulator Bore & Orifice Cup Plug
Courtesy of GENERAL MOTORS CORP.

4. Inspect the 3-4 accumulator bore and the orifice cup plug (38) for any of the following conditions:
   - Porosity
   - Burrs
   - Blockage
   - Any other damage
5. Inspect all bolt holes for thread damage. Use heli-coil to repair damaged threads.

6. Inspect the cooler connectors for damage and proper torque.

   Specification: Cooler connector torque should be 38 N.m (28 lb ft)

RETAINER AND BALL ASSEMBLY LEAK CHECK

Installation Procedure

Tools Required

J 29714-A Servo Cover Compressor. See **Special Tools and Equipment** .

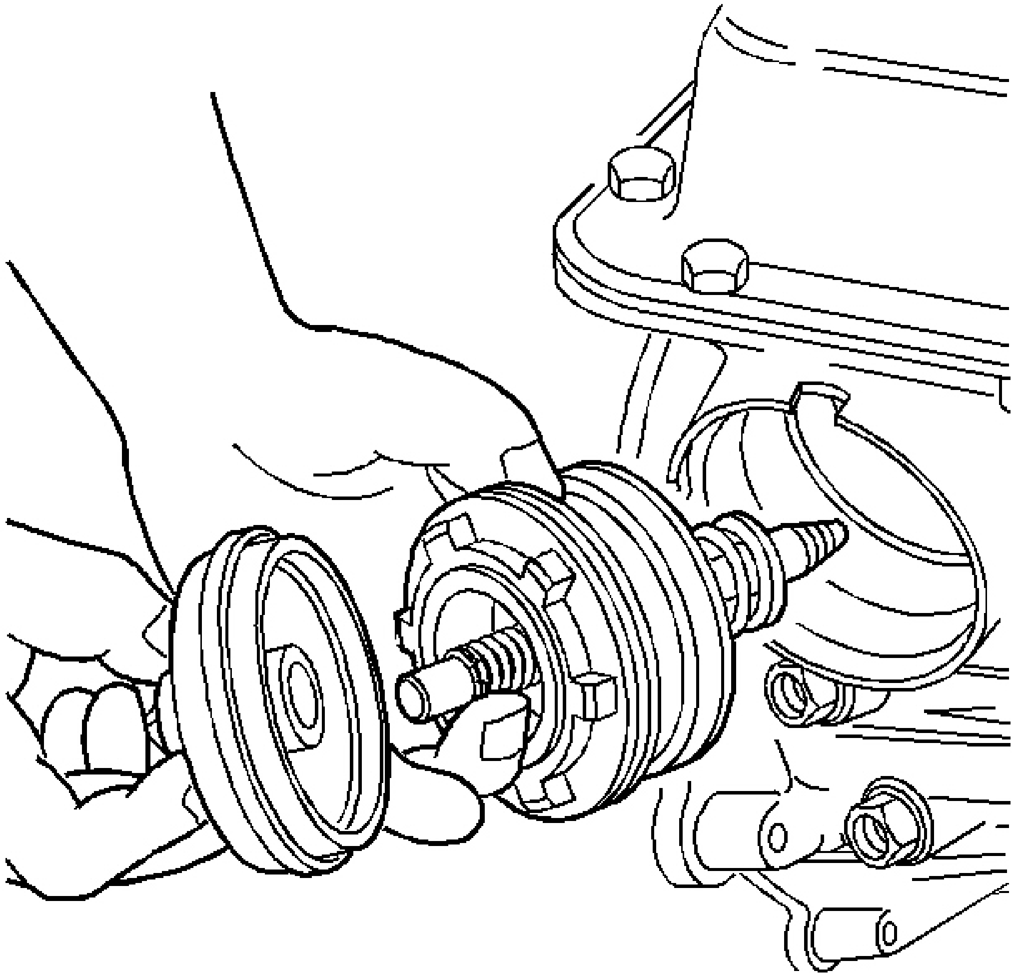


Fig. 246: Installing 2-4 Servo Into Case

Courtesy of GENERAL MOTORS CORP.

1. Install the 2-4 servo into the case.

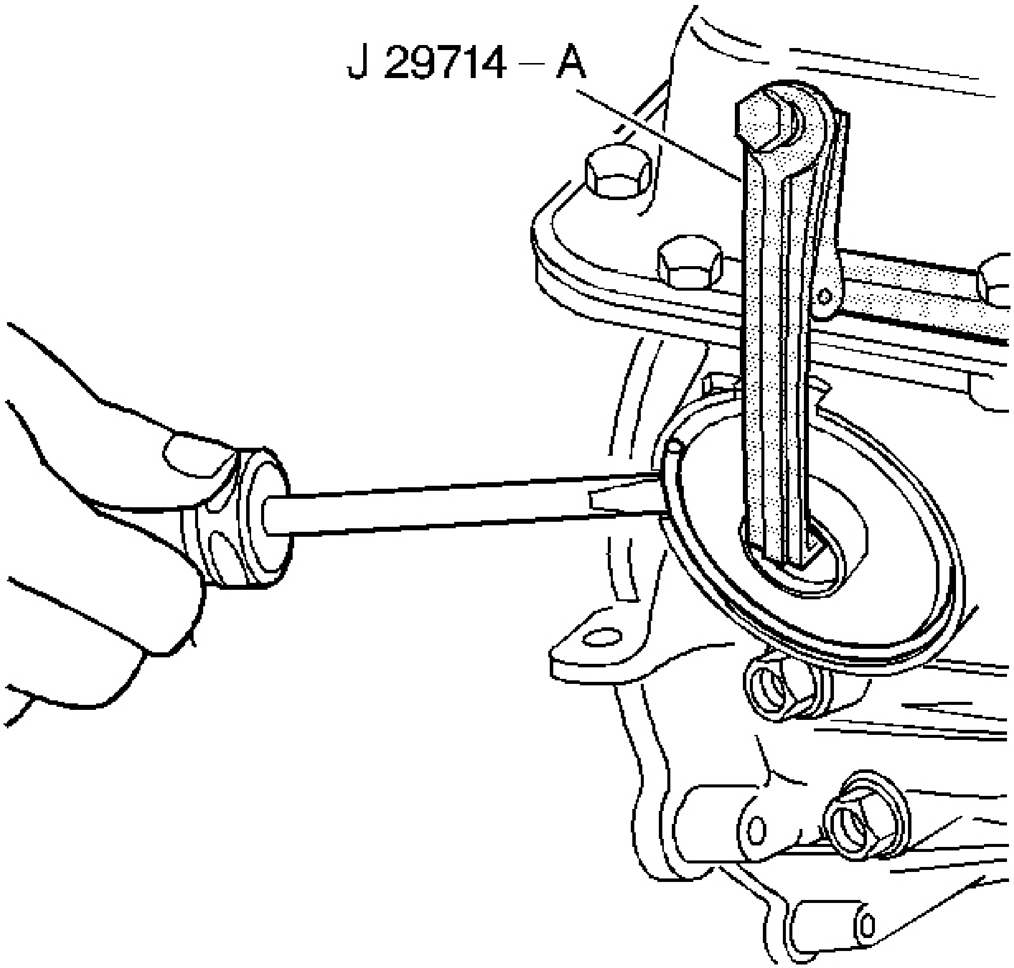
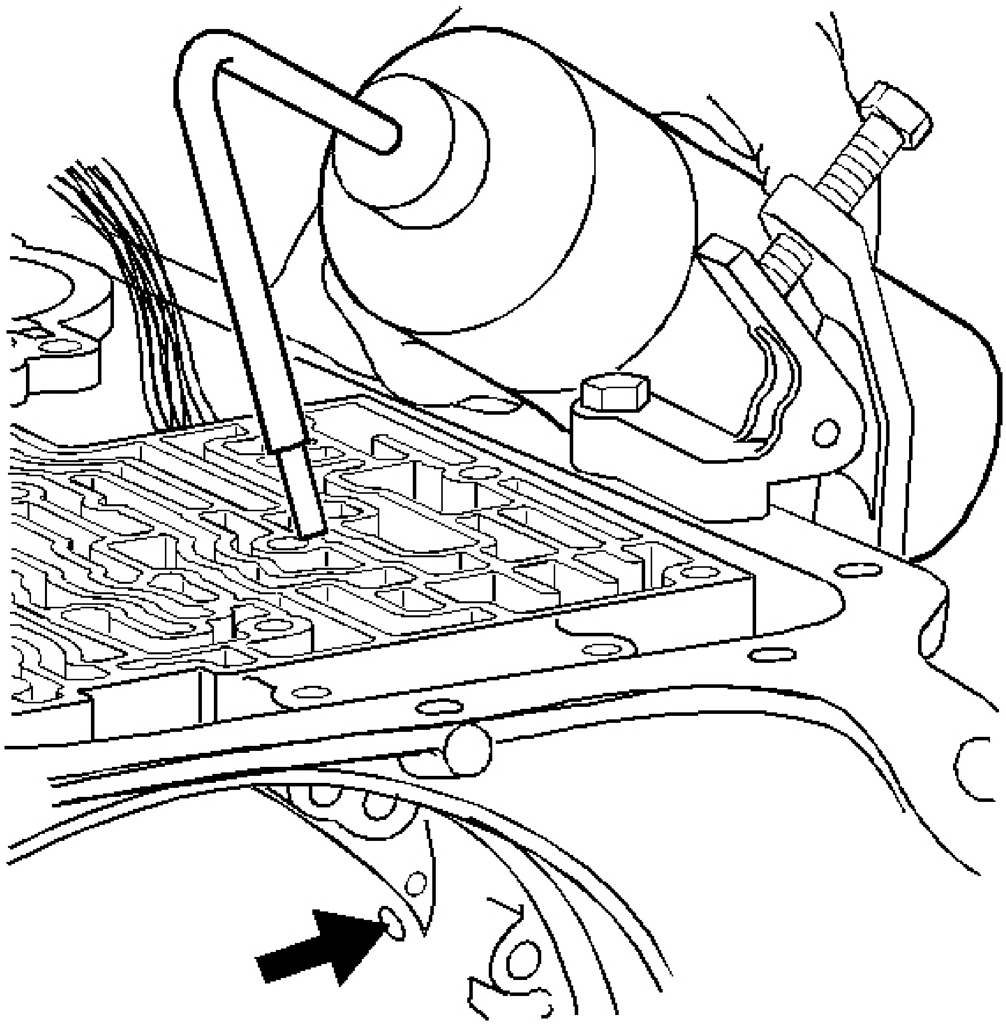


Fig. 247: Using J 29714-A To Compress Servo Cover
Courtesy of GENERAL MOTORS CORP.

2. Install oil pan with only four bolts to align pan to case.
3. Use the **J 29714-A** in order to compress the servo cover. See **Special Tools and Equipment** .
4. Install the servo cover retaining ring.



<u>Fig. 248: Removing Oil Pan</u>
Courtesy of GENERAL MOTORS CORP.

5. Remove oil pan.
6. Pour solvent into the accumulator bore until the channel is filled. Watch for leaks in the case channel.

IMPORTANT: It is normal to see leakage from the small hole next to the larger oval hole.

7. If leakage from the oval shaped hole is observed, replace the third accumulator retainer and ball assembly.

THIRD ACCUMULATOR RETAINER AND BALL REPLACEMENT

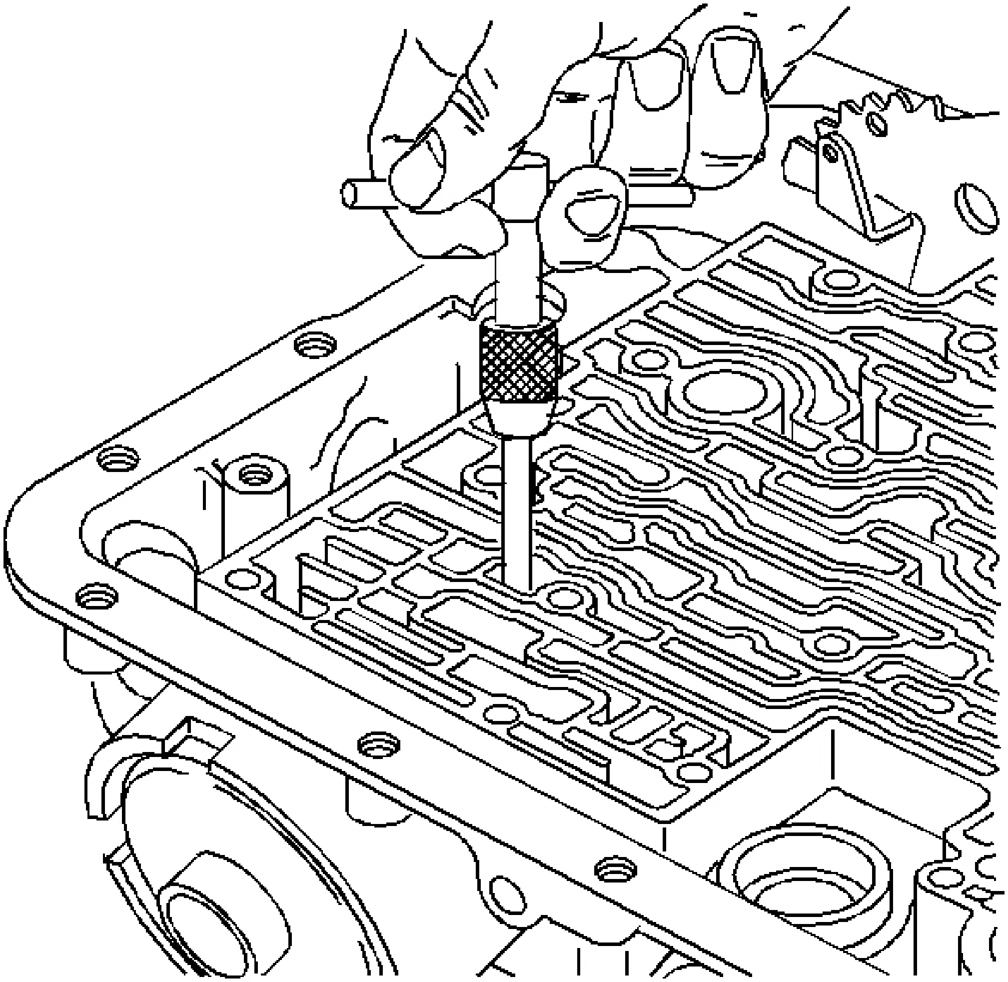


Fig. 249: Third Accumulator Retainer & Ball Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the third accumulator retainer and ball assembly, using a 6.3 mm (0.25 in) #4 screw extractor.

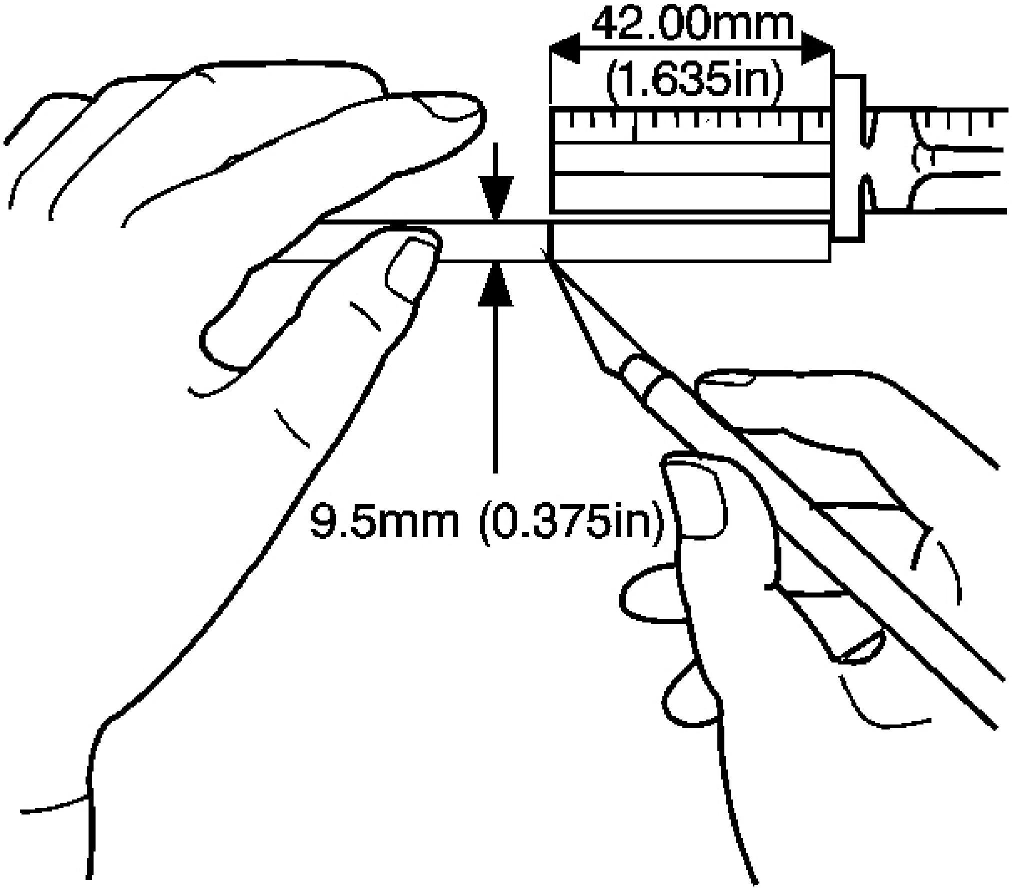


Fig. 250: Scribing Mark On Diameter Metal Rod
Courtesy of GENERAL MOTORS CORP.

2. Scribe a mark at 42 mm (1.653 in) on a 9.5 mm (0.375 in) diameter metal rod. The scribe mark is used to gauge the proper depth of the third accumulator retainer and ball assembly.

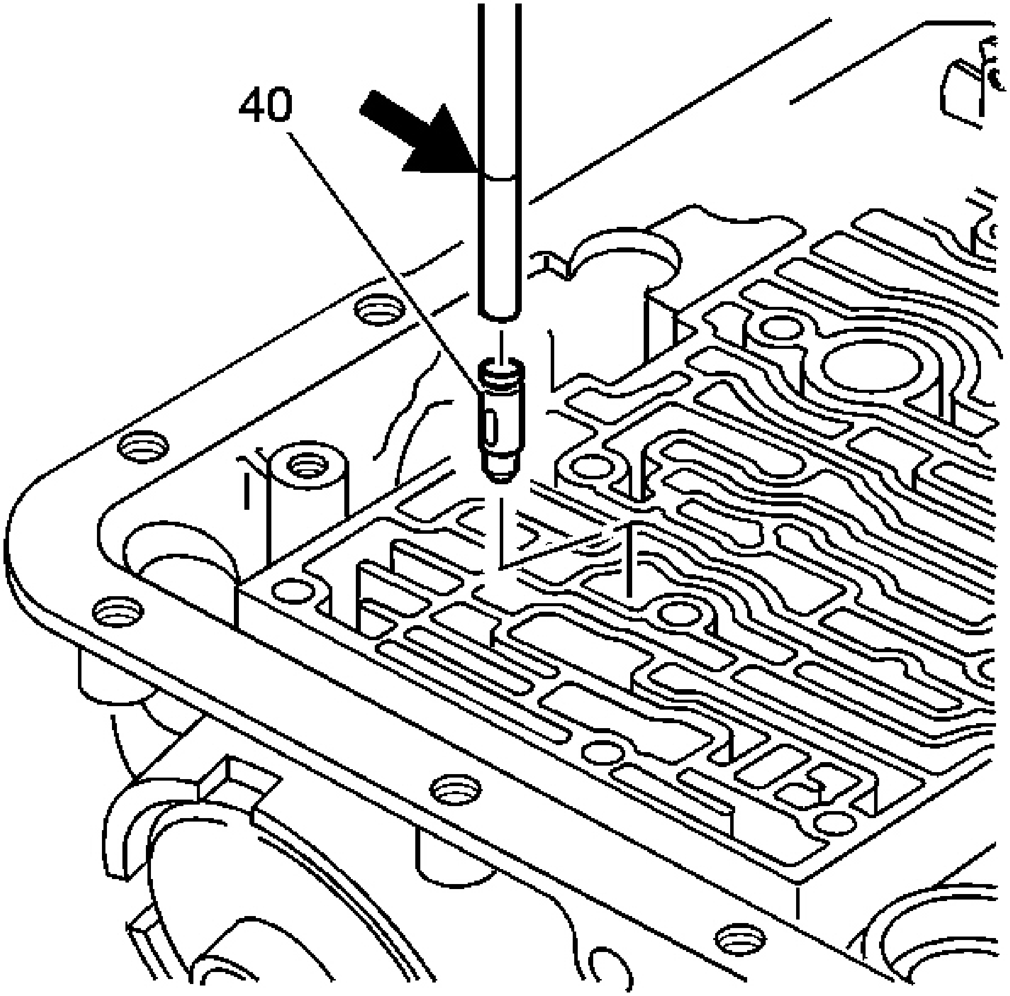


Fig. 251: Lining Up Oil Feed Slots & Installing Third Accumulator Retainer & Ball Assembly
Courtesy of GENERAL MOTORS CORP.

3. Perform the following functions:
    1. Line up the oil feed slots in the third accumulator retainer and ball assembly (40) with the servo bore.
    2. Using the 9.5 mm (0.375 in) diameter metal rod, install the third accumulator retainer and ball assembly.

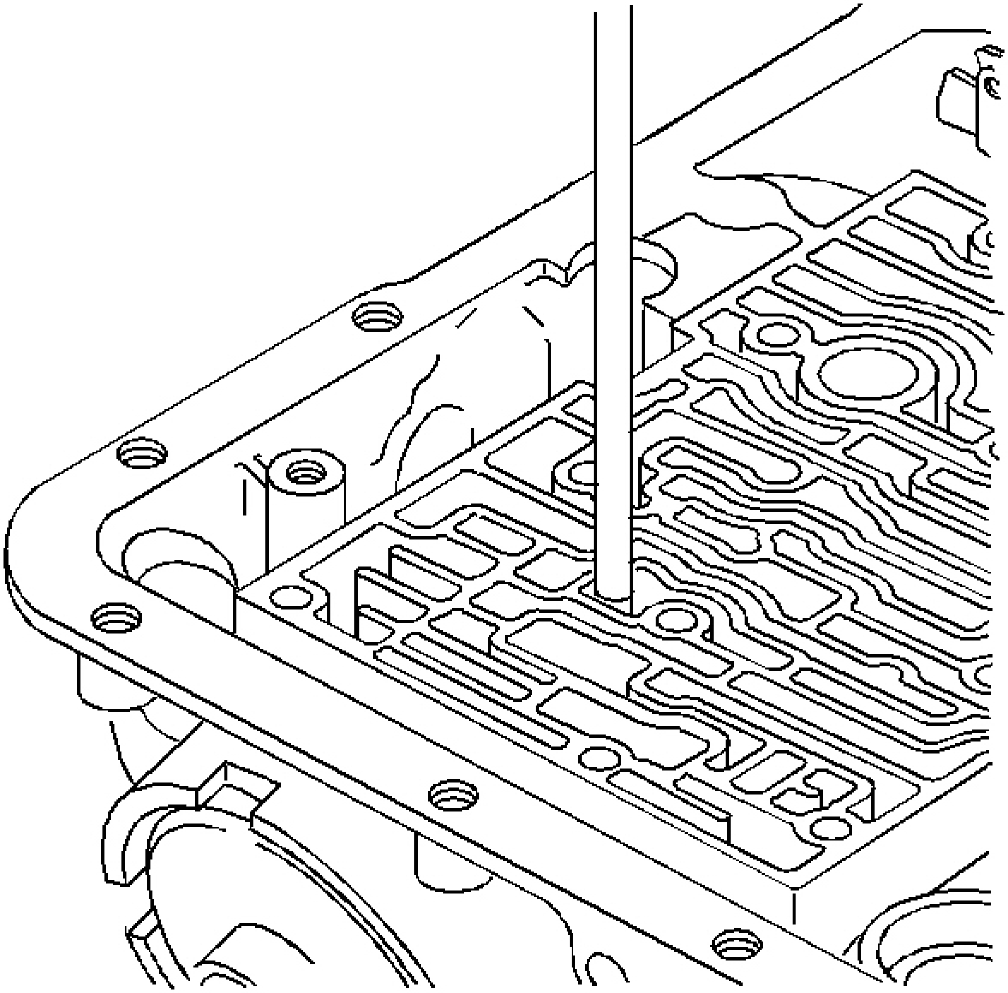


Fig. 252: Third Accumulator Retainer, Ball Assembly & Scribe Mark
Courtesy of GENERAL MOTORS CORP.

4. Ensure that the third accumulator retainer and ball assembly and the scribe mark on the rod are flush with the case surface.

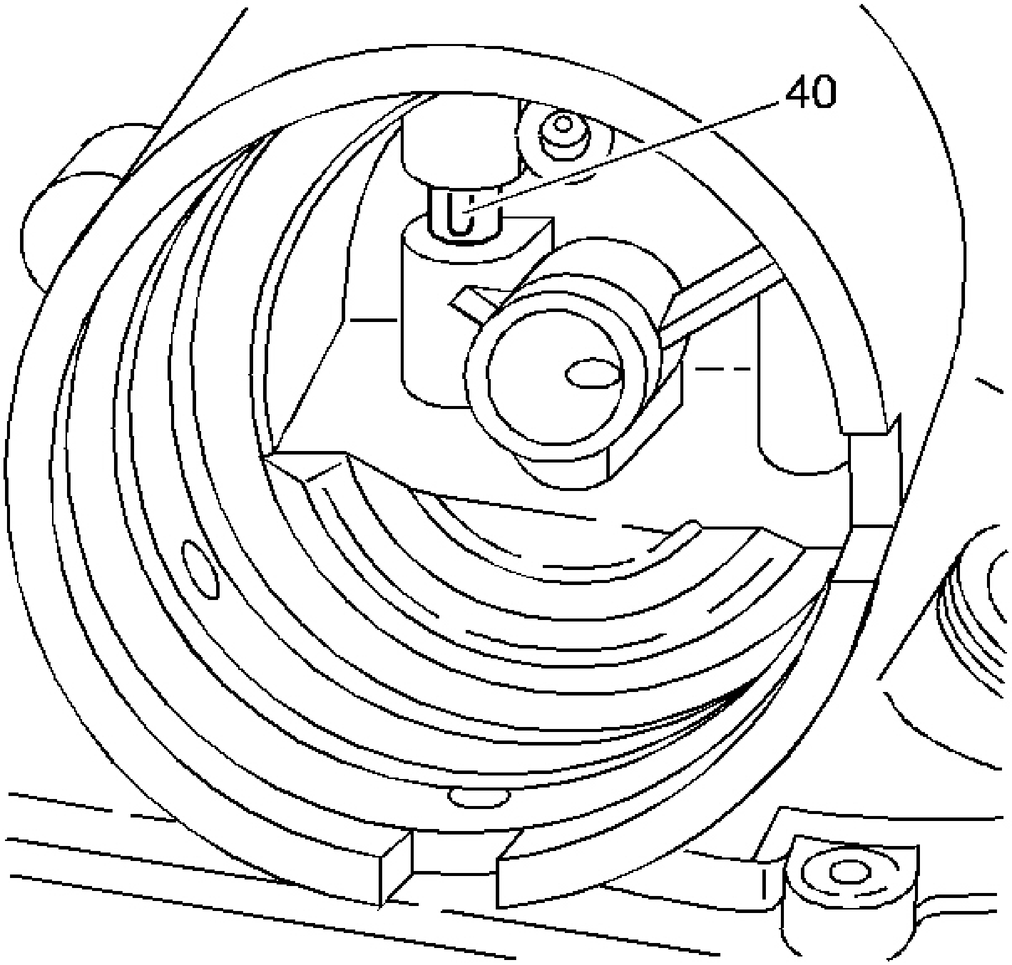


Fig. 253: Checking Third Accumulator Retainer & Ball Assembly For Alignment
Courtesy of GENERAL MOTORS CORP.

5. Check the third accumulator retainer and ball assembly (40) for alignment. The slot in the retainer must be completely open in the servo bore.

MANUAL SHAFT SEAL INSTALLATION

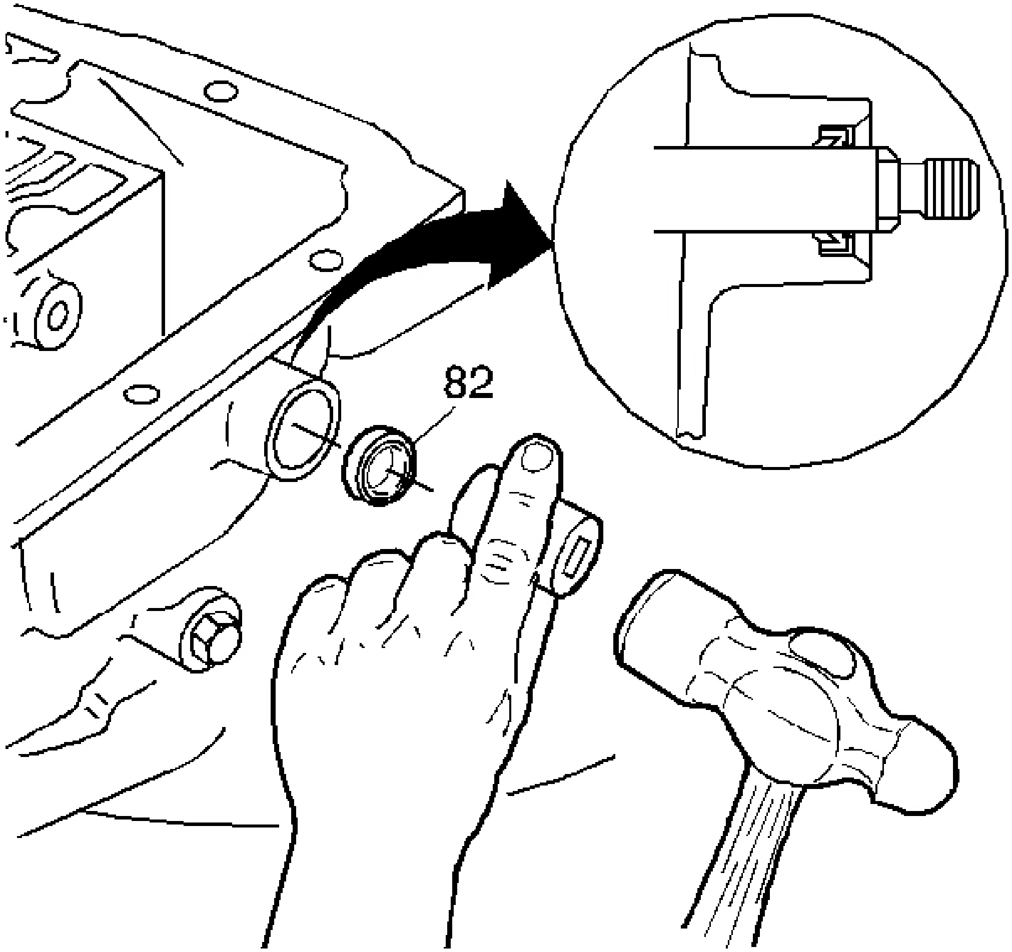


Fig. 254: Installing New Manual Shaft Seal
Courtesy of GENERAL MOTORS CORP.

Install a new manual shaft seal (82).

LOW AND REVERSE CLUTCH PISTON INSTALLATION

Tools Required

- **J 23327-1** Forward Clutch Spring Compressor (Bridge). See **Special Tools and Equipment** .
- **J 34627** Snap Ring Remover and Installer. See **Special Tools and Equipment** .
- J 36850 Transjel Lubricant

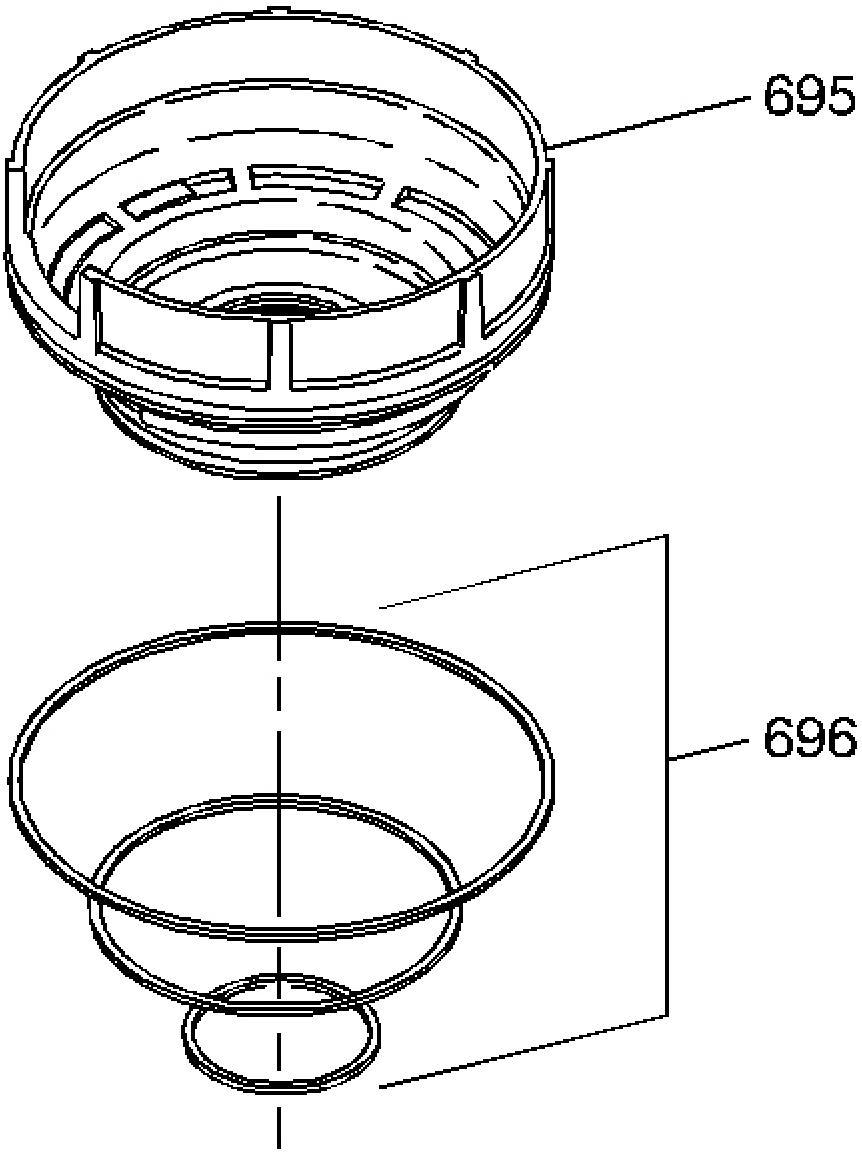


Fig. 255: Installing Transmission Seals
Courtesy of GENERAL MOTORS CORP.

1. Install the transmission (low and reverse clutch outer, center, inner) seals (696) on the low and reverse clutch piston (695).
2. Lubricate the seals with assembly lubricant J 36850 or an equivalent.

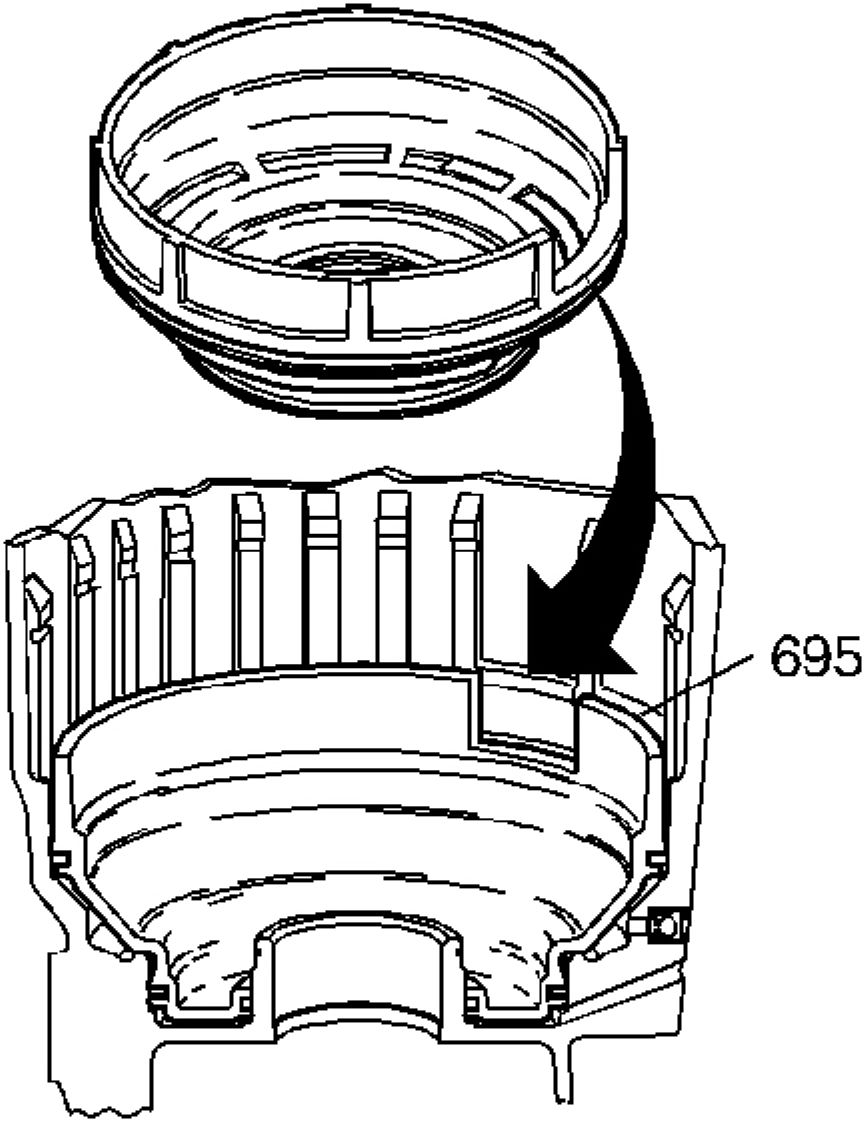


Fig. 256: Installing Low & Reverse Clutch Piston
Courtesy of GENERAL MOTORS CORP.

3. Install the low and reverse clutch piston (695) into the case. The notch in the piston must be aligned with the parking brake pawl window, in the case.

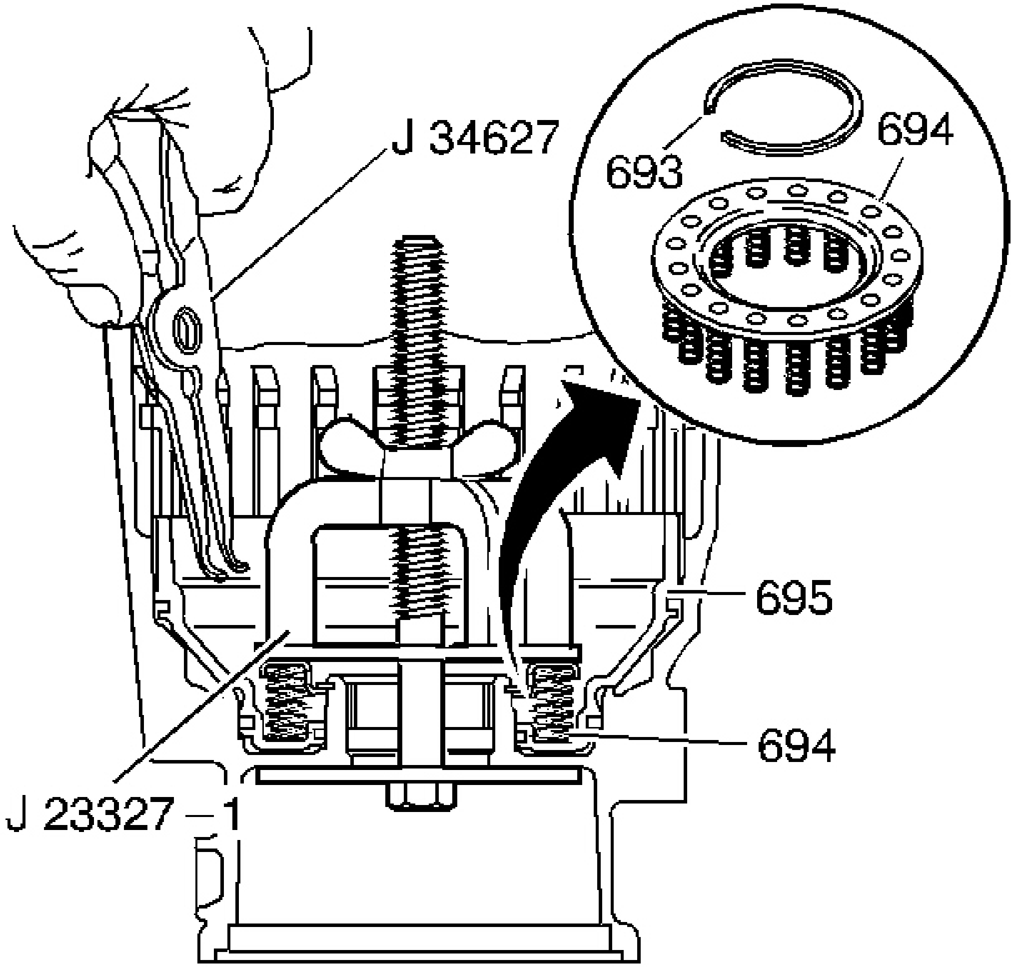


Fig. 257: Low & Reverse Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the low and reverse clutch spring assembly (694).
    1. Using the **J 23327-1** , compress the low and reverse clutch spring assembly (694). See **Special Tools and Equipment** .
    2. Using J 36850 install the low and reverse clutch retainer ring (693).

INNER MANUAL LINKAGE INSTALLATION

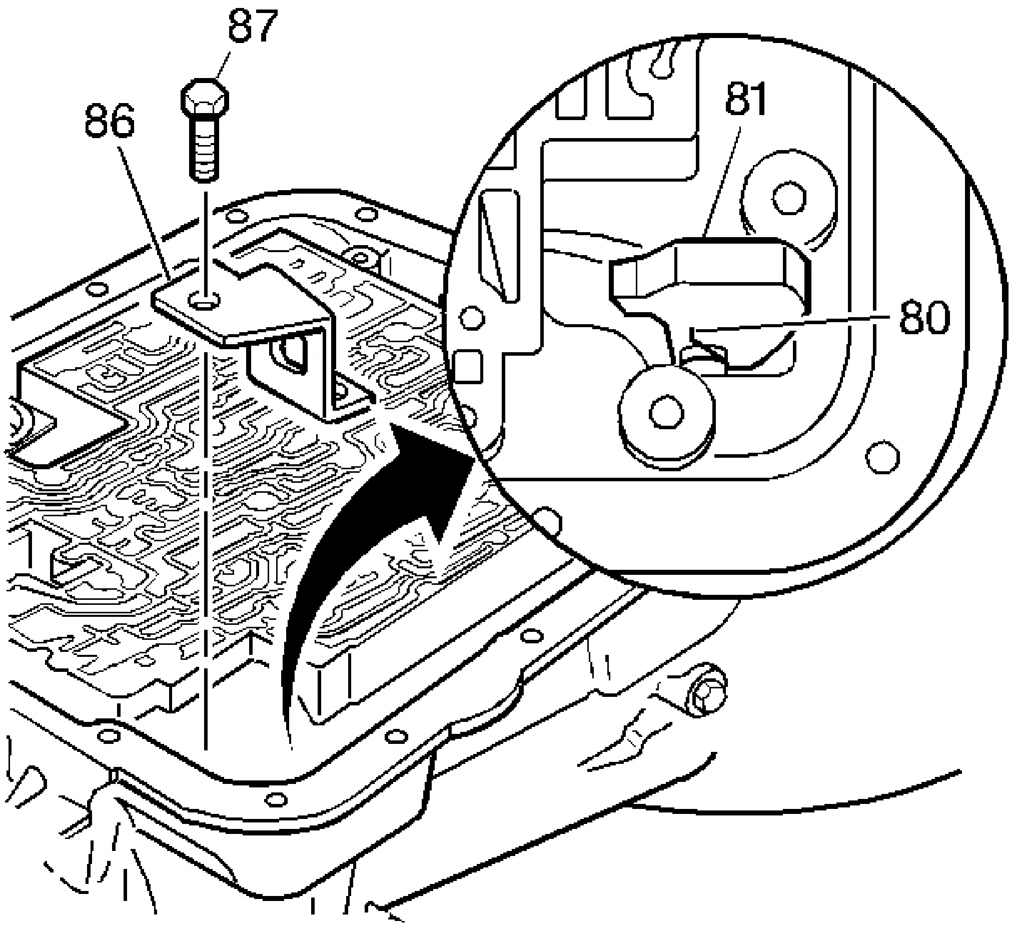


Fig. 258: Installing Parking Lock Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the parking lock bracket (86).

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the parking lock bracket bolt (87).

   Tighten: Tighten the bolt to 31 N.m (23 lb ft).

3. Inspect the following items:
   - The parking brake pawl (81) for damage or cracks

- The parking pawl return spring (80) for being broken or missing

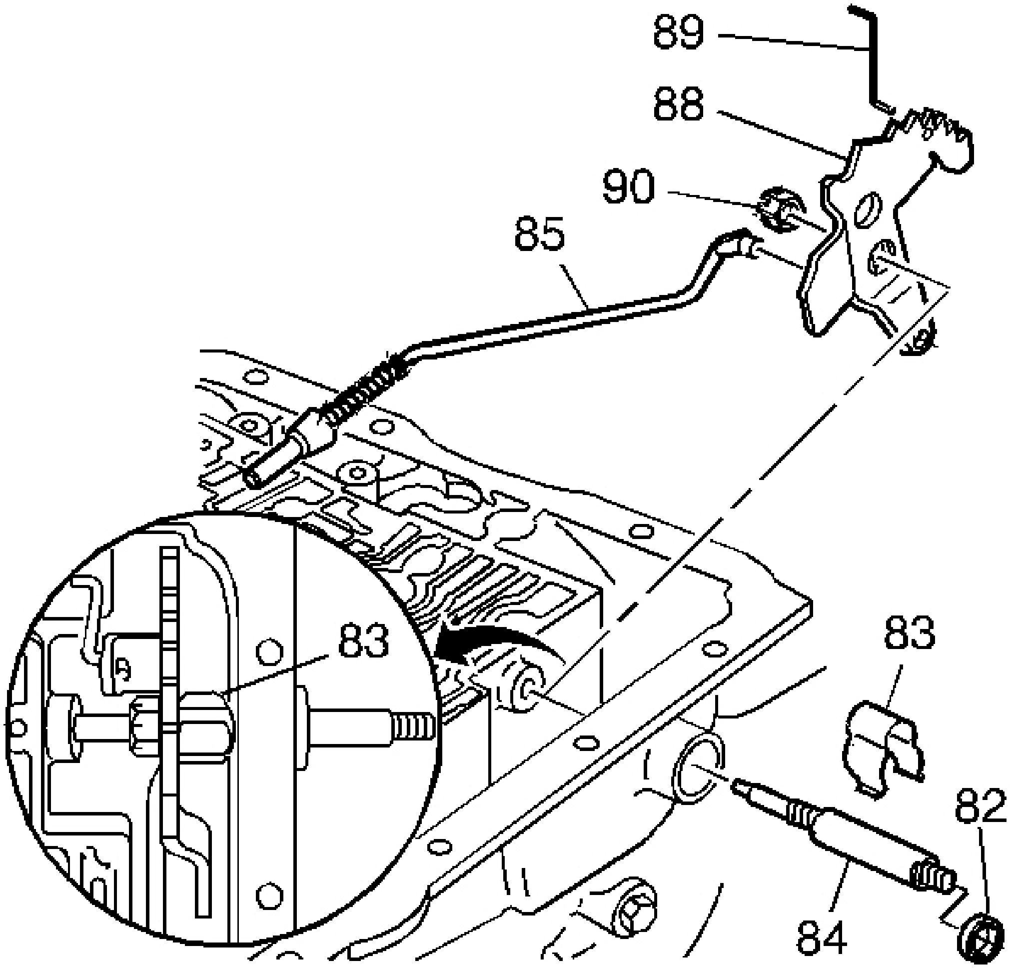


Fig. 259: Inspecting The Following Components
Courtesy of GENERAL MOTORS CORP.

4. Inspect the following items:
    - The manual shaft retainer (83) for damage or cracks
    - The manual shaft (84) for damage or burrs
    - The parking lock actuator assembly (85) for damage
    - The inside detent lever (88) for damage or cracks
    - The manual valve link (89) for damage

- The hex head nut (90) for damage or stripped threads

5. Install the following items:
   - The inside detent lever (88)
   - The parking lock actuator assembly (85)
   - The manual shaft (84) (model dependent)
   - The manual shaft retainer (83)
   - The hex head nut (90)
   - The manual valve link (89)

   Tighten: Tighten the nut to 31 N.m (23 lb ft).

REACTION GEAR AND CARRIER INSPECTION

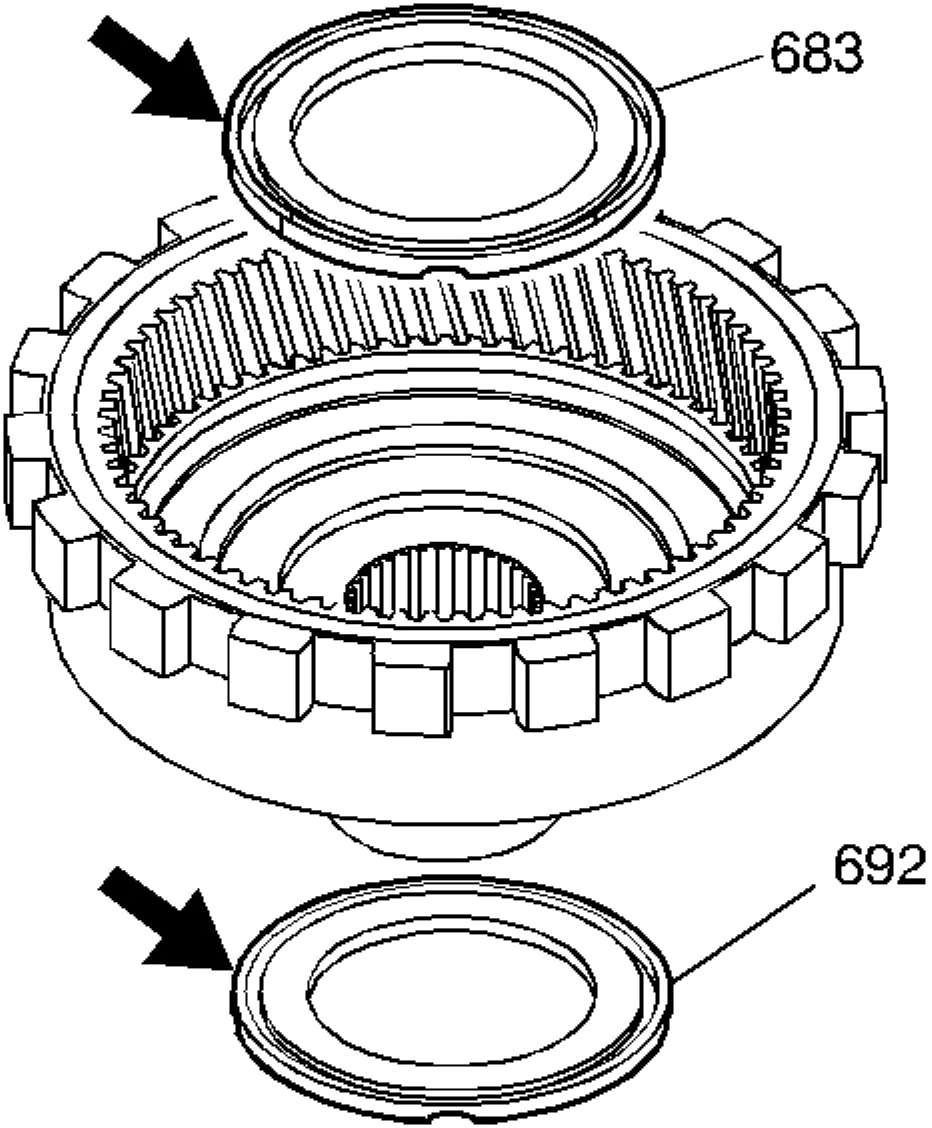


Fig. 260: Reaction Carrier/Support Thrust Bearing Assembly & Reaction Gear Support To Case Bearing
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reaction carrier/support thrust bearing assembly (683) for wear or damage.
2. Inspect the reaction gear support to case bearing (692) for wear or damage.

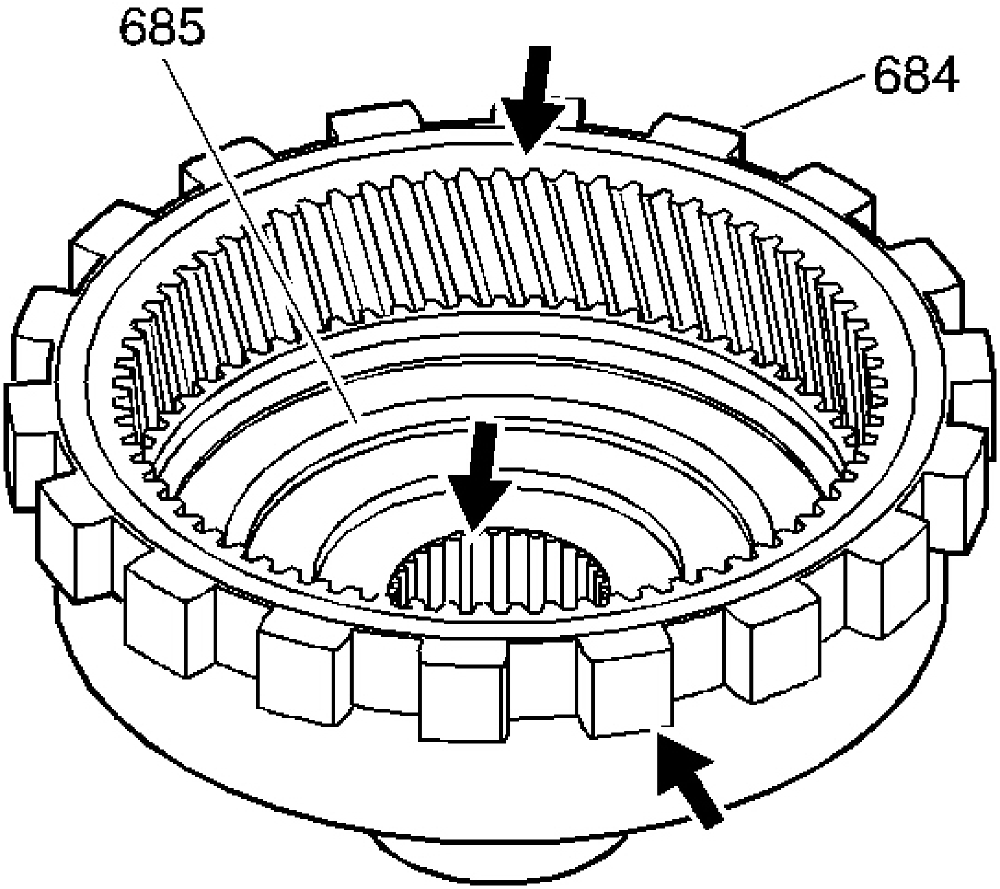


Fig. 261: Internal Reaction Gear & Internal Reaction Gear Support
Courtesy of GENERAL MOTORS CORP.

3. Inspect the internal reaction gear (684) and the internal reaction gear support (685) for proper assembly, stripped splines, cracks, teeth, and lug damage.

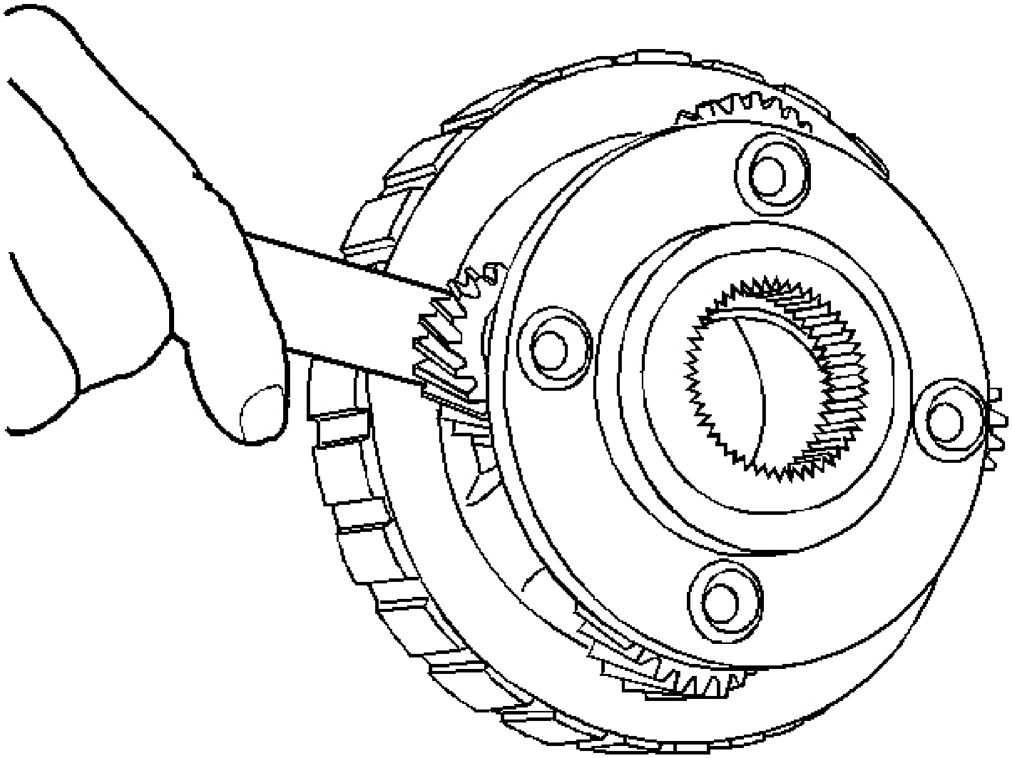


Fig. 262: Reaction Carrier Pinion End Play
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Inspect all pinions, either 4 or 5 depending on model.

4. Check the reaction carrier pinion end play. The end play must not exceed 0.61 mm (0.024 in).

   Inspect the reaction carrier for the following conditions:

   - Pinion gear damage
   - Proper pinion staking
   - Excessive pinion washer wear
   - Keystoned pinion gears
5. Ensure that the pinions turn freely.

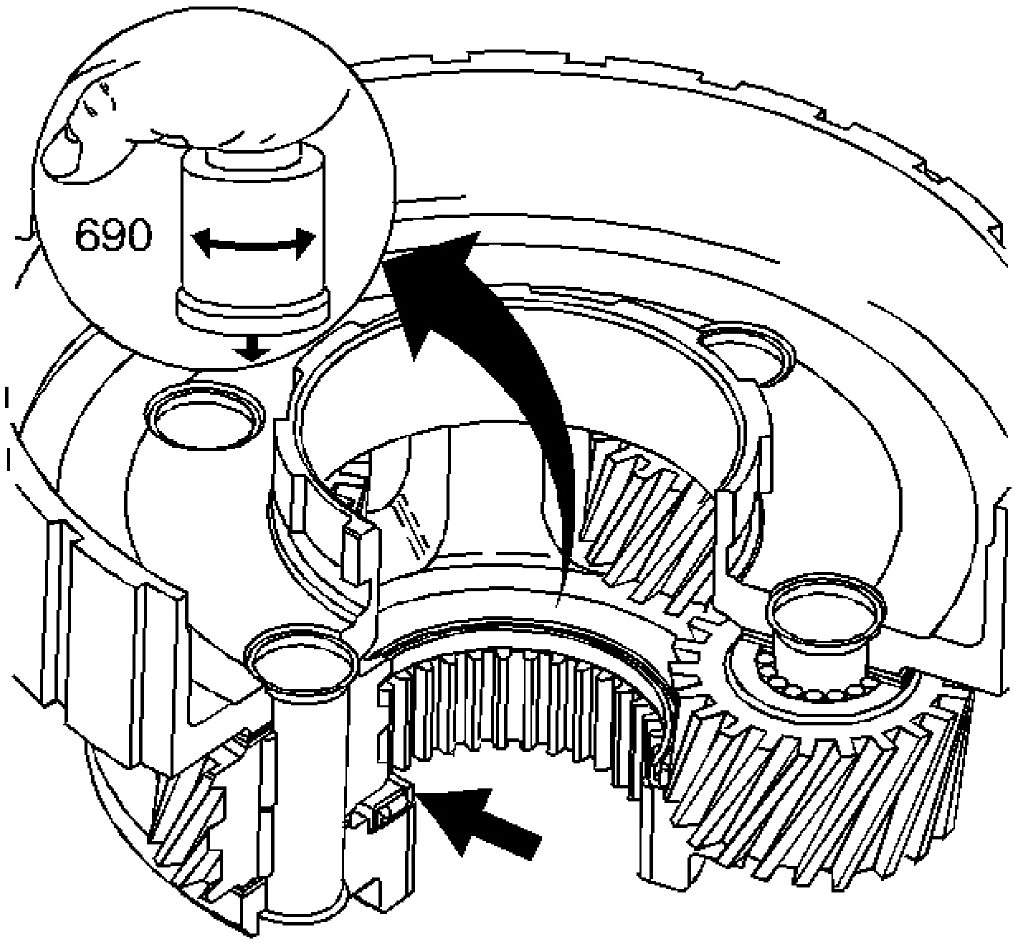


Fig. 263: Reaction Carrier Captive Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

6. Inspect the reaction carrier captive thrust bearing for wear or damage.
    1. Without touching the pinion gears, place a bushing or an output shaft sleeve (690) onto the bearing race, and turn it with the palm of your hand.
    2. Any imperfections will be felt through the bushing.

REACTION GEAR AND CARRIER INSTALLATION

Tools Required

J 36850 Transjel Lubricant

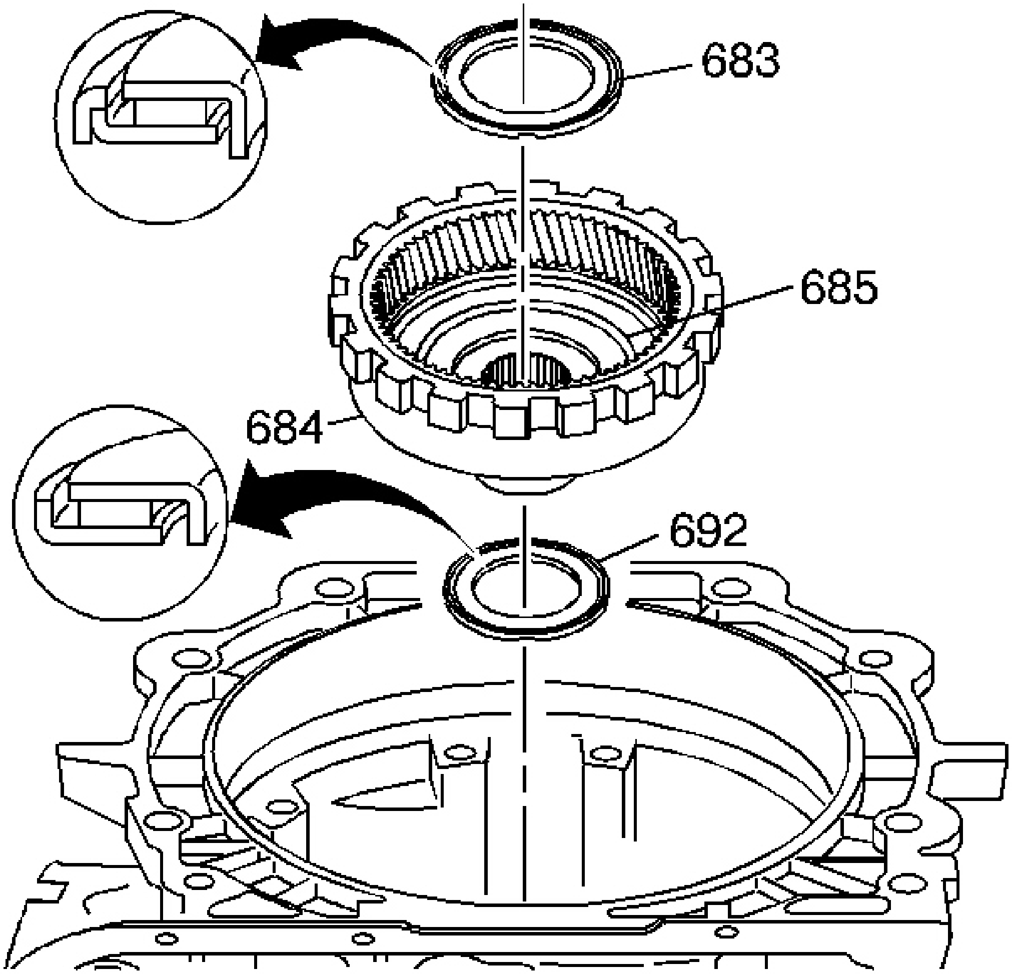


Fig. 264: Reaction Gear Components
Courtesy of GENERAL MOTORS CORP.

1. Install the reaction carrier/support thrust bearing assembly (683) into the internal reaction gear support (685).
2. Install the reaction gear support to case bearing (692) onto the internal reaction gear support (685). Retain the bearing using **J 36850** or equivalent.
3. Install the internal reaction gear (684) and the internal reaction gear support (685) into the case.

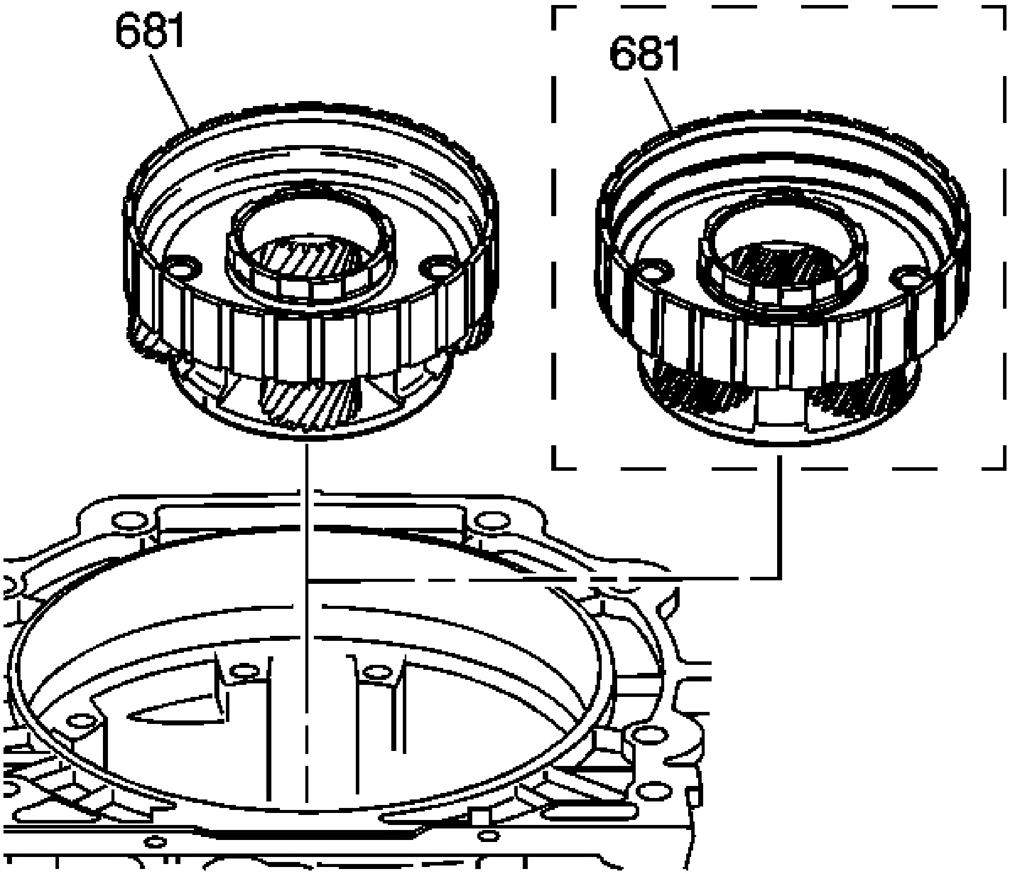


Fig. 265: Reaction Carrier Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the reaction carrier assembly (681) into the internal reaction gear.

LOW AND REVERSE CLUTCH SPACER PLATE SELECTION

Tools Required

- J 8001 Dial Indicator Set
- J 26900-13 Magnetic Indicator Base

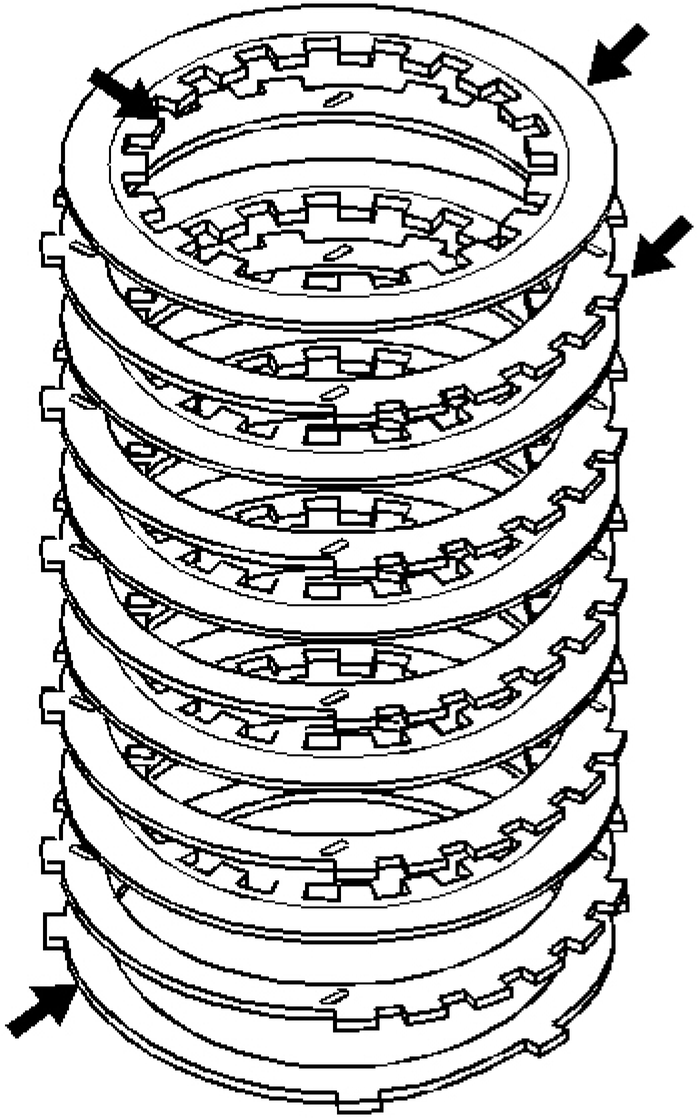


Fig. 266: Low & Reverse Clutch Plates
Courtesy of GENERAL MOTORS CORP.

1. Inspect the low and reverse clutch plates for the following conditions:
   - Composition material wear
   - Composition material heat damage
   - Composition material delamination

- Steel plates heat damage
- Steel plates surface finish damage

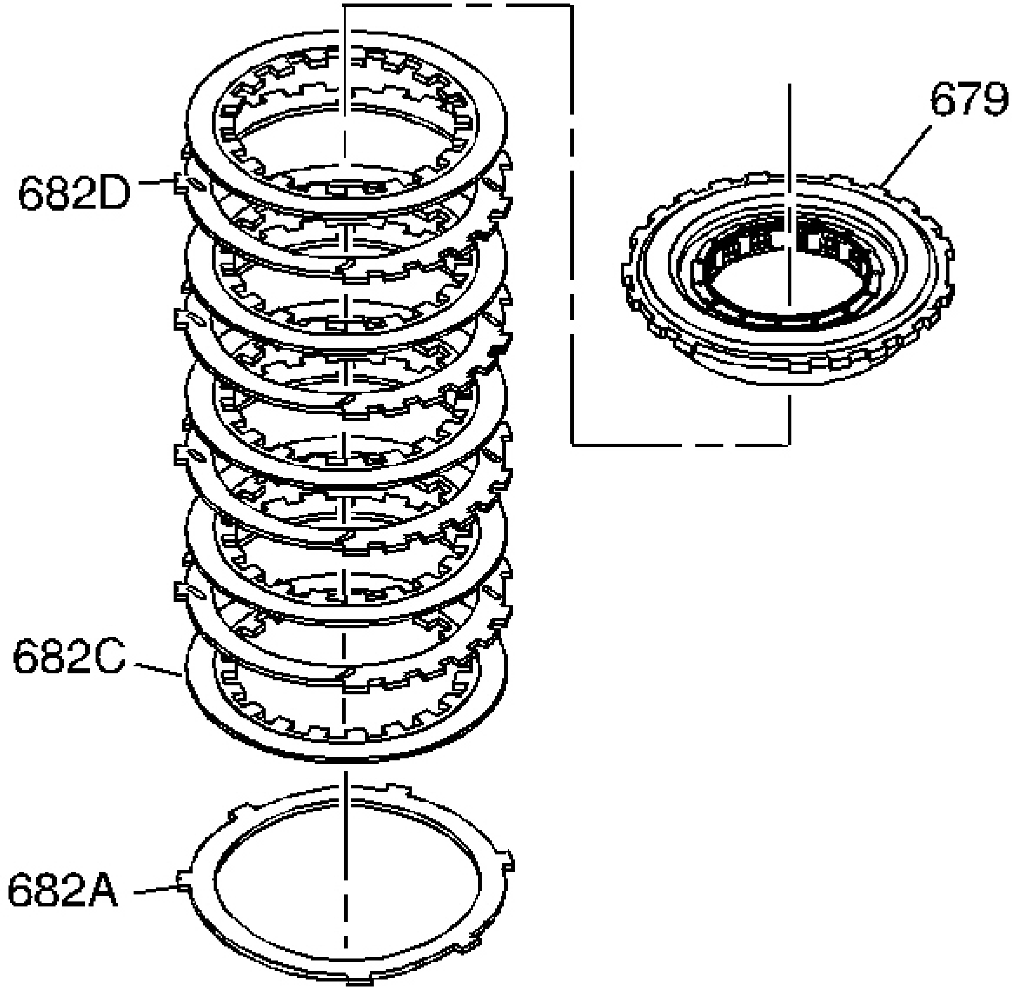


Fig. 267: Low & Reverse Clutch Plate Assembly
Courtesy of GENERAL MOTORS CORP.

2. Stack the low and reverse clutch plate assembly on a flat surface in the following order:
    1. One waved plate (682A)
    2. Five fiber plate assemblies (682C) and four steel plates (682D), starting with one fiber plate assembly and alternating with steel
    3. Low and reverse clutch support (679)

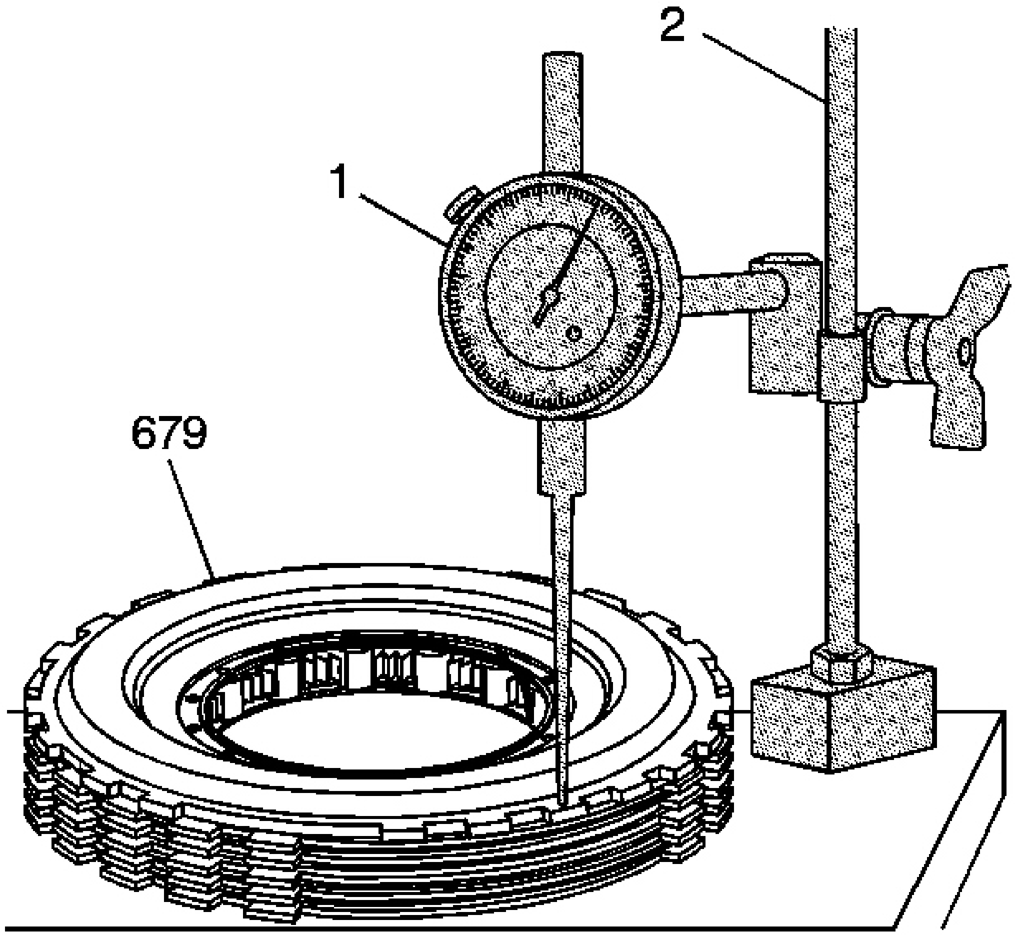


Fig. 268: View Of J 8001 & J 26900-13
Courtesy of GENERAL MOTORS CORP.

3. Using the J 8001 and the J 26900-13 , measure the height of the clutch pack from the work surface to the top of the low and reverse clutch support.
4. Refer to **Low and Reverse Clutch Spacer Plate Selection** in order to select the proper thickness of the low and reverse clutch selective spacer plate (682B).

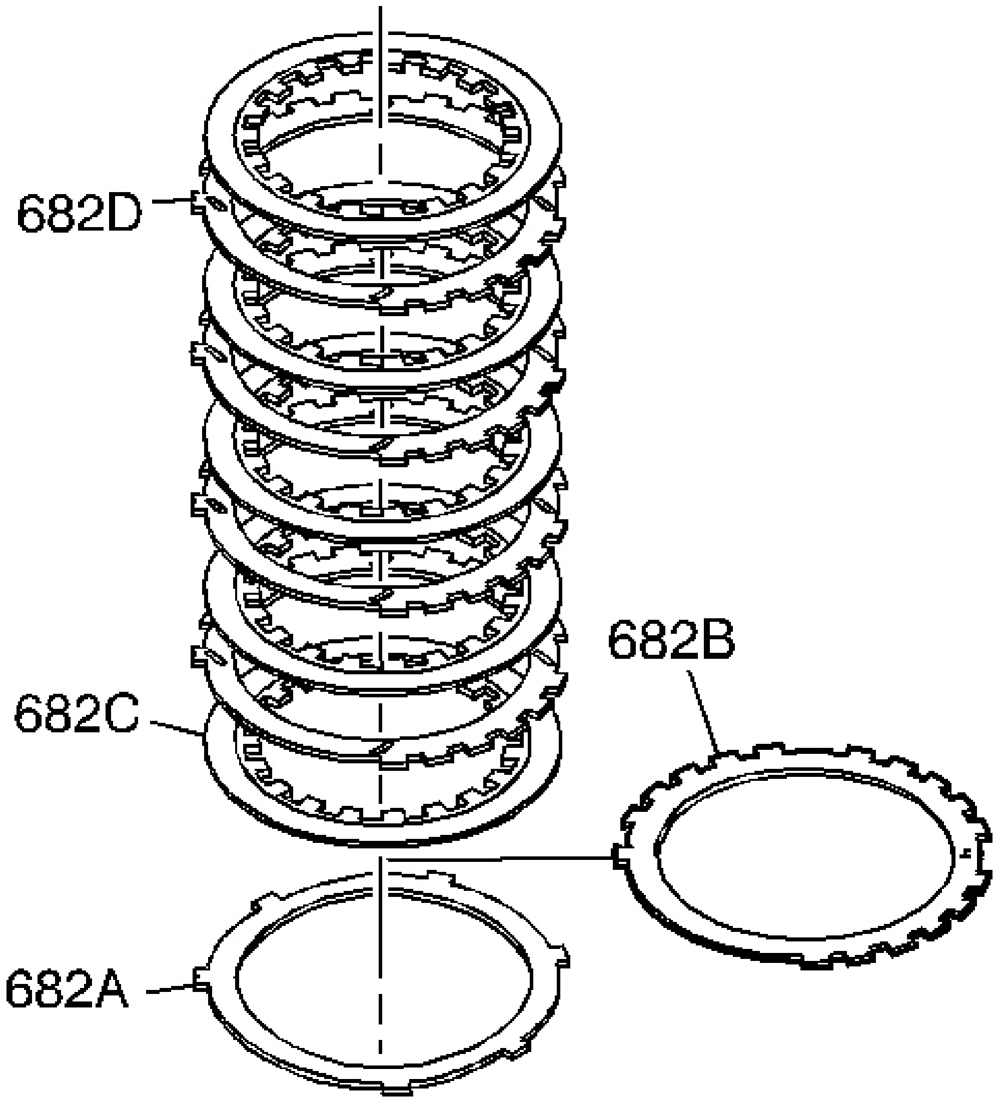


Fig. 269: Proper Selective Spacer Plate
Courtesy of GENERAL MOTORS CORP.

5. Install the proper selective spacer plate (682B) between the wave plate (682A) and the first fiber plate assembly (682C), with the identification side up.

   The overall height for the clutch pack including the selective spacer plate should be 29.22-29.90 mm (1.15-1.18 in).

LOW AND REVERSE CLUTCH PLATES INSTALLATION

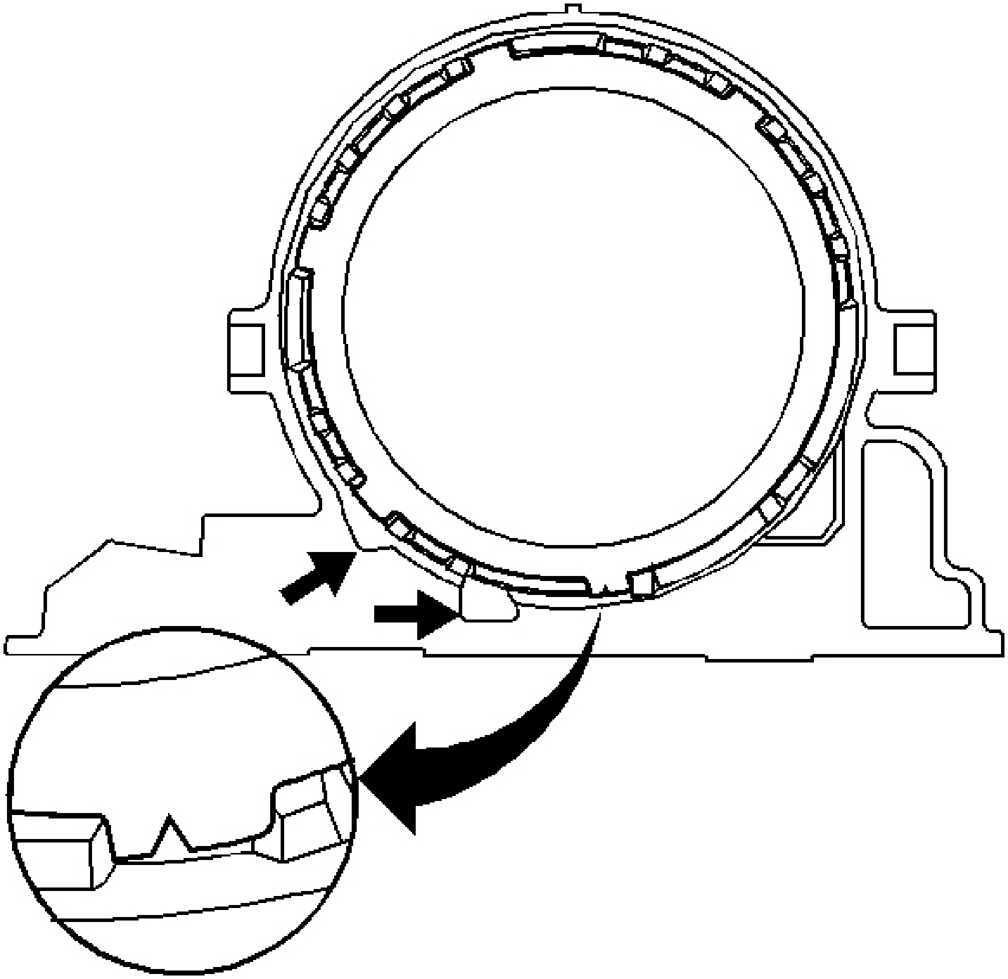


Fig. 270: Indexing Steel Plate Splines
Courtesy of GENERAL MOTORS CORP.

1. Install the waved plate.
2. Install the correct selective spacer plate (from the selection procedure).
3. Install the five fiber plate assemblies and four steel plates, starting with one fiber plate assembly and alternating with steel.
4. Index the steel plate splines in the case as shown.

LOW AND REVERSE CLUTCH SUPPORT DISASSEMBLE

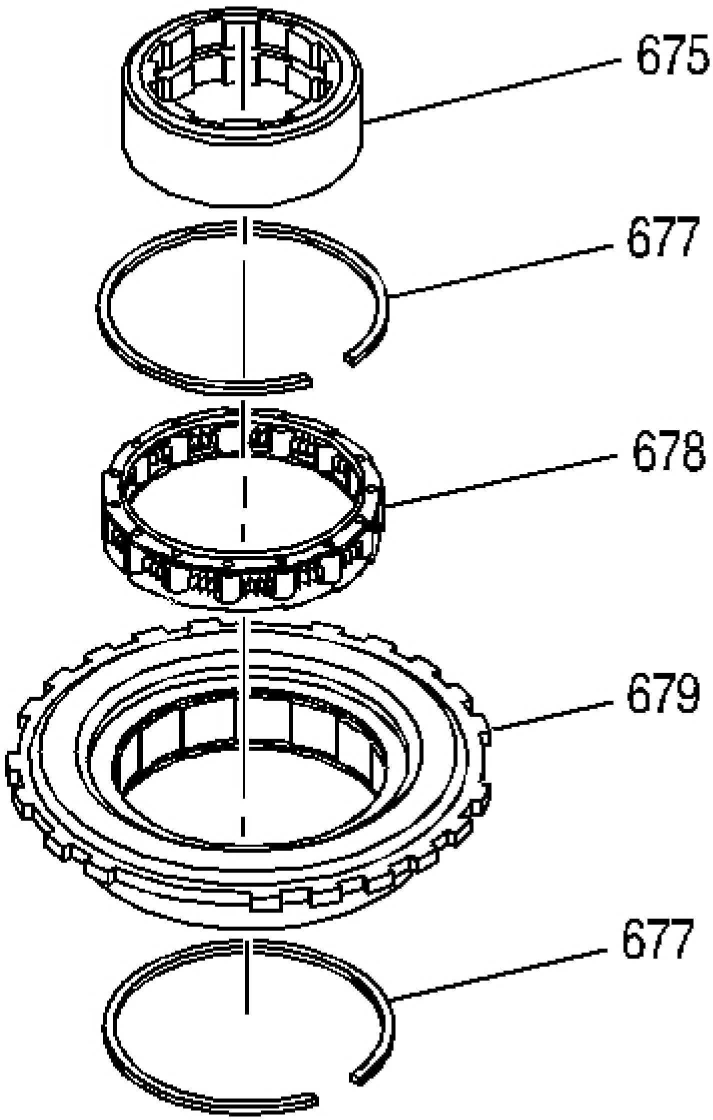


Fig. 271: Removing Low & Reverse Roller Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the low and reverse roller clutch race (675) from the low and reverse clutch support (679). Inspect the race for damage and surface finish.
2. Remove the low and reverse roller retainer ring (677) and the low and reverse roller clutch assembly (678). Inspect the roller clutch assembly for damaged rollers and broken springs.

3. Inspect the low and reverse clutch support (679) for loose cam and cam surface finish. Check the support for cracks and damaged lugs.

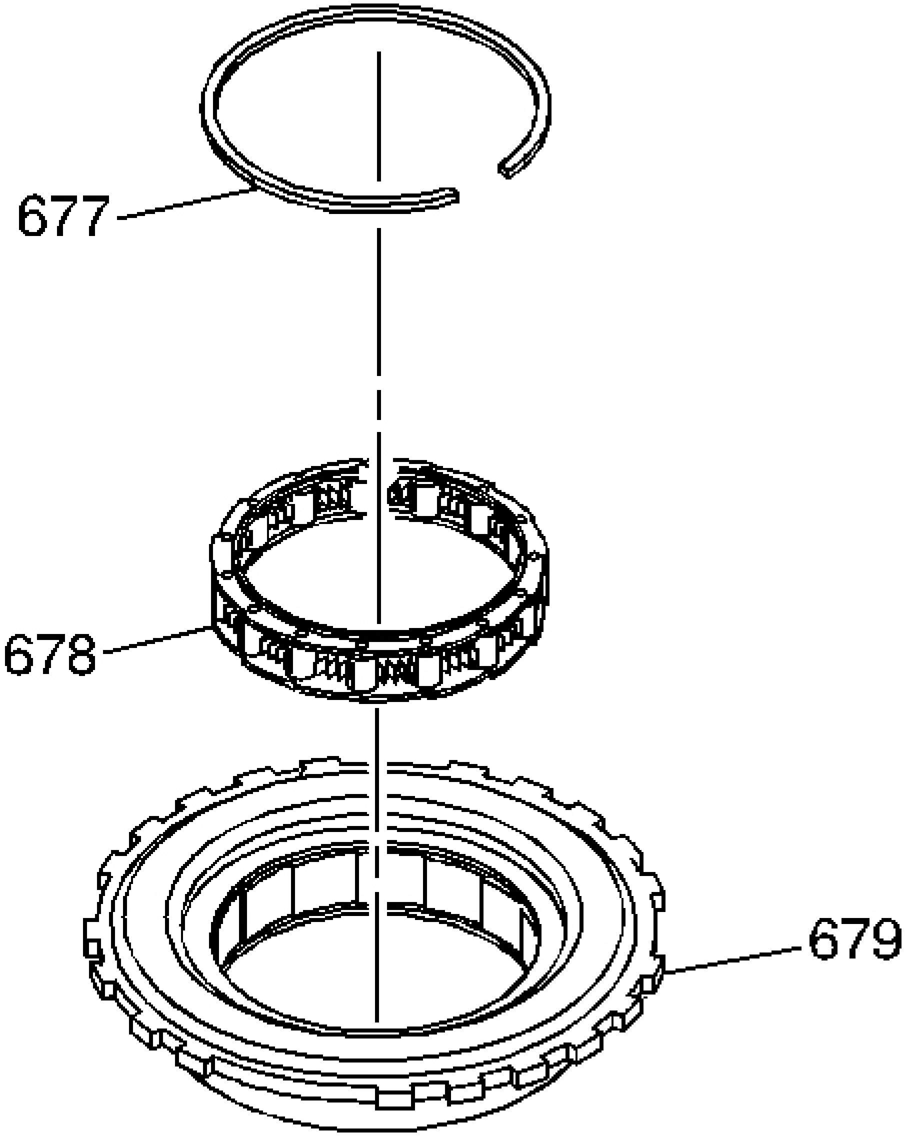


Fig. 272: Low & Reverse Roller Clutch Assembly & Retainer Ring
Courtesy of GENERAL MOTORS CORP.

4. Clean and install the low and reverse roller clutch assembly (678) into the low and reverse clutch support

(679). Install the low and reverse retainer ring (677).

LOW AND REVERSE CLUTCH SUPPORT INSTALLATION

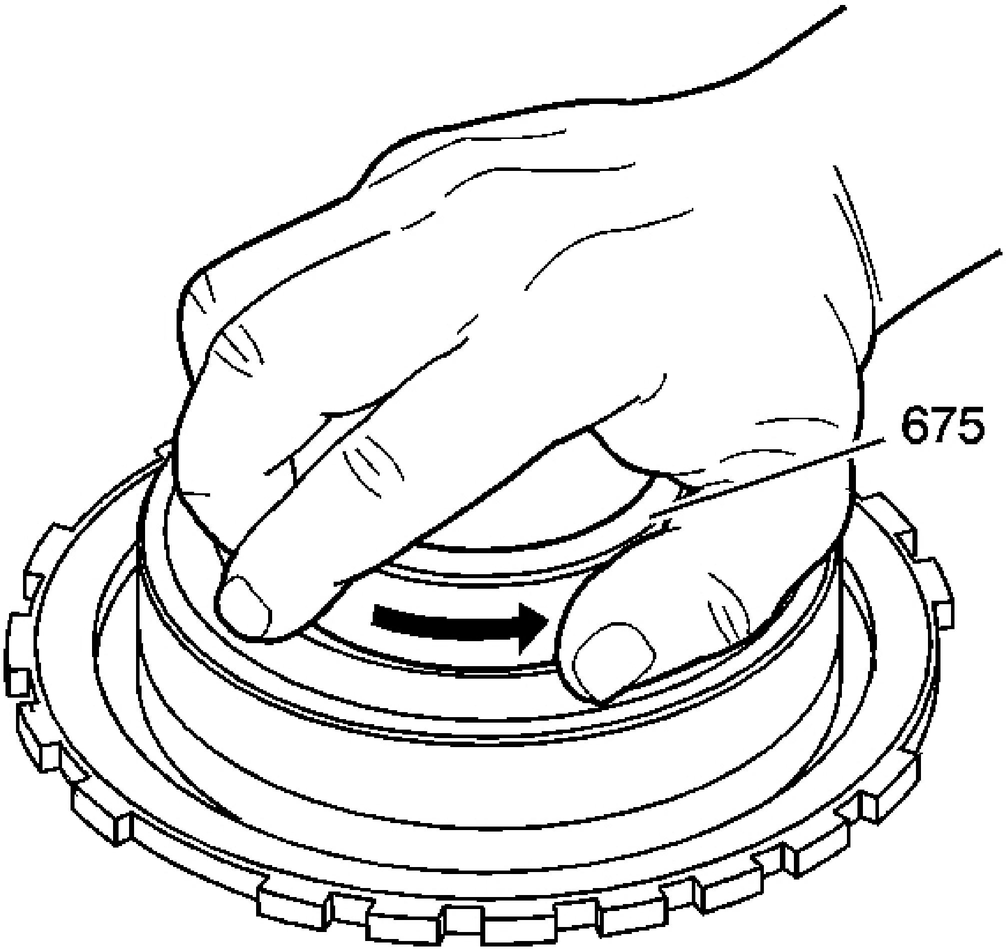


Fig. 273: Low & Reverse Roller Clutch Race
Courtesy of GENERAL MOTORS CORP.

1. Install the low and reverse roller clutch race (675). Simultaneously, turn and insert the race.
2. Rotate the race in order to verify proper operation. The race should only rotate in one direction.

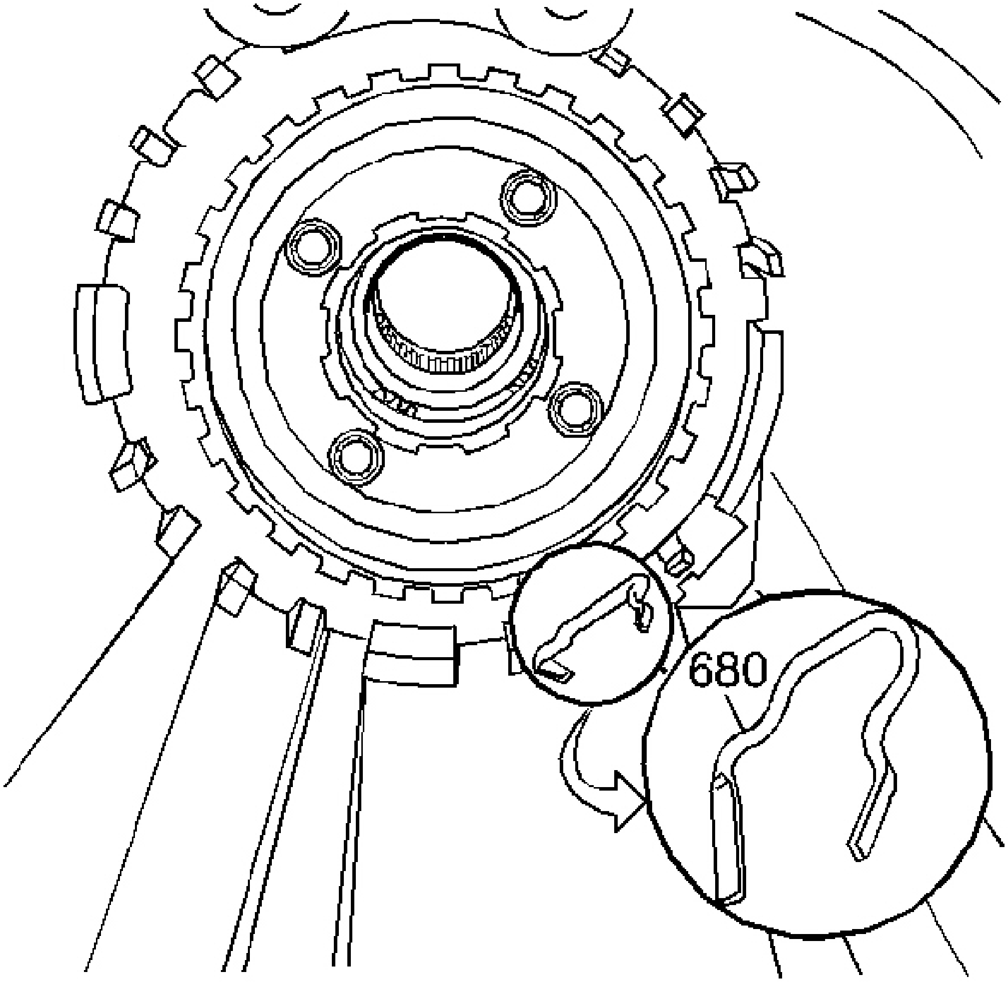


Fig. 274: Low & Reverse Clutch Support Retainer Spring
Courtesy of GENERAL MOTORS CORP.

3. Install the low and reverse clutch support retainer spring (680) into the case.

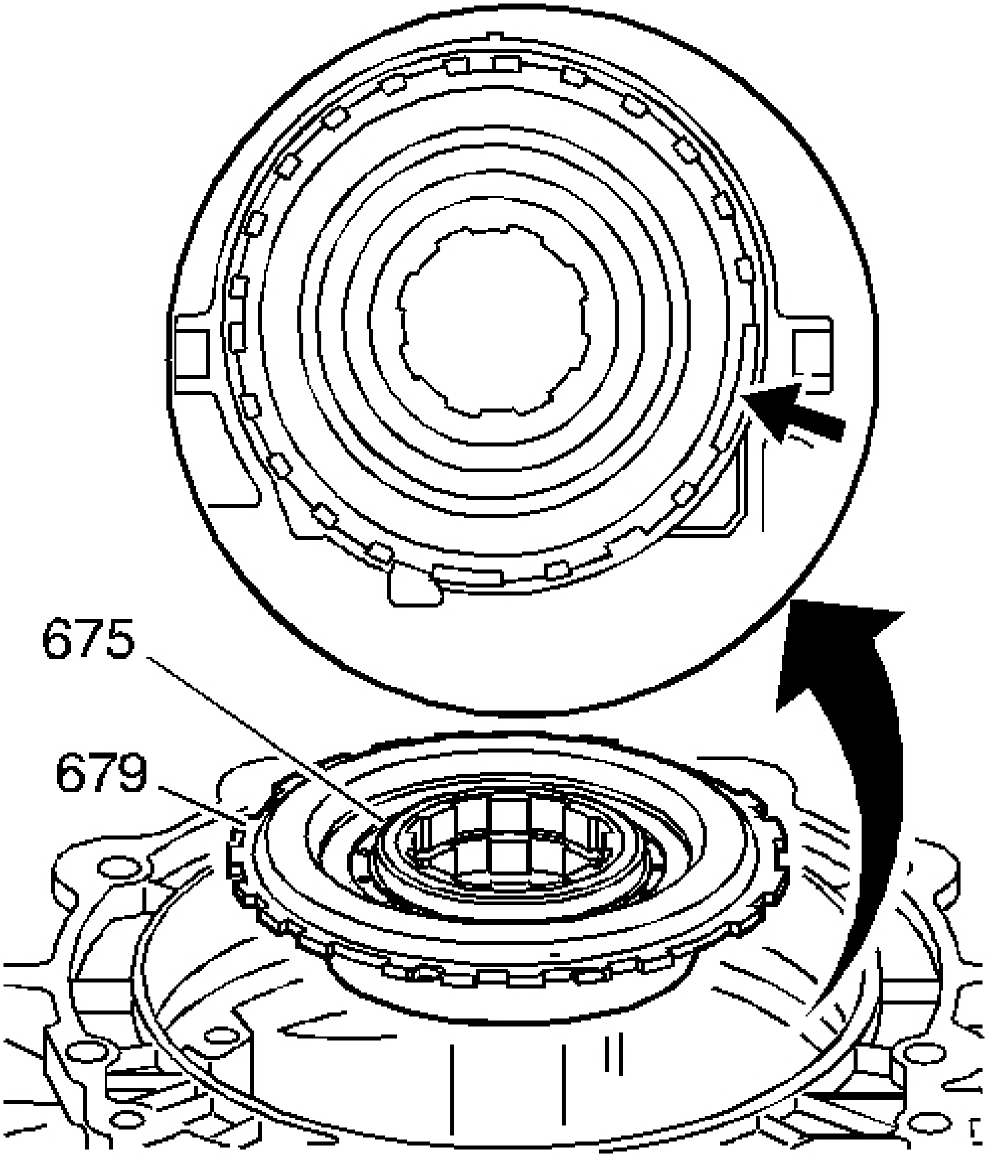


Fig. 275: Low & Reverse Clutch Support & Roller Clutch & Roller Clutch Race Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Align the wide low and reverse clutch support notch with the wide case lug.

4. Install the low and reverse clutch support (679), roller clutch and roller clutch race (675) assembly into the case. Position the hub side down during the installation.

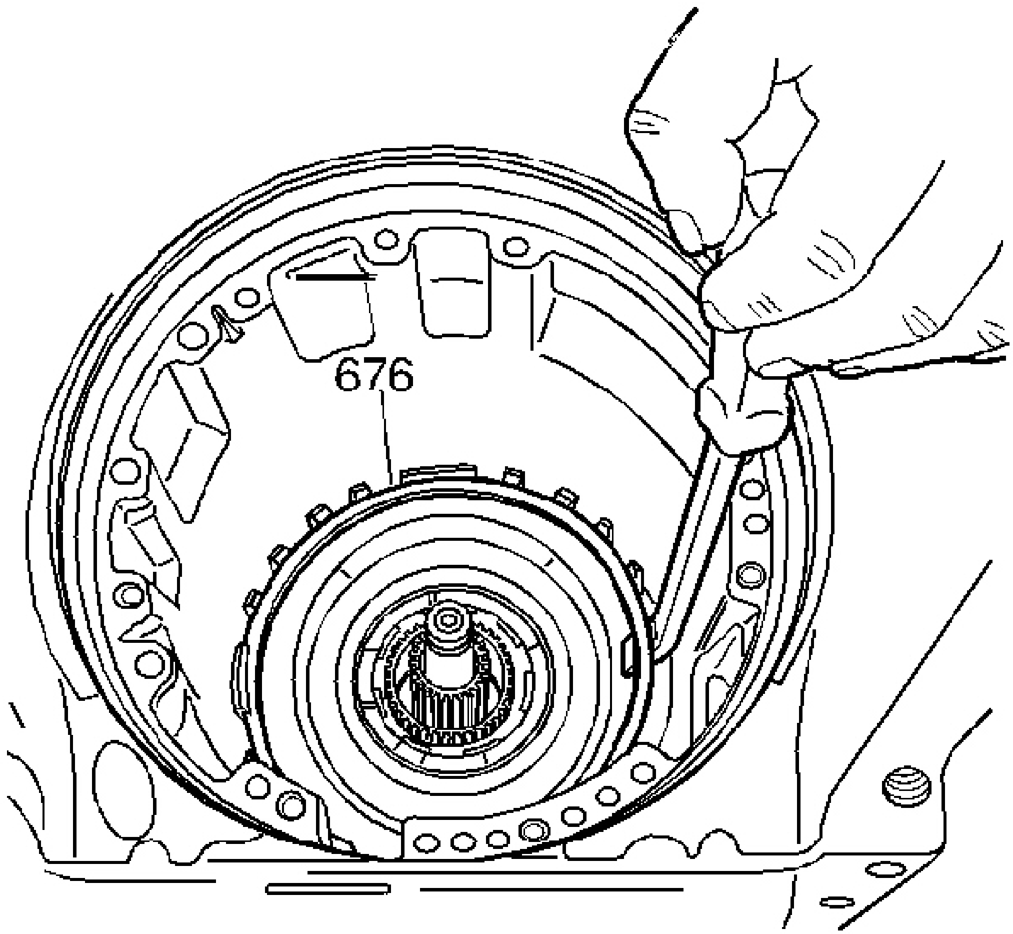


Fig. 276: Low & Reverse Support Retainer Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Align the opening of the low and reverse clutch support retainer ring (676) with the low and reverse clutch support retainer spring (680). It is important that the low and reverse clutch support retainer ring opening is centered around the retainer spring. This will allow the retainer ring to fully seat in all of the transmission case lugs. If the retainer ring lays up against the retainer spring, the retainer ring will not fully seat. Possible damage to the transmission case lugs can occur if the low and reverse

clutch support retainer ring is not fully seated in the transmission case lug.

5. Install the low and reverse support retainer ring (676) into the case.

REACTION SUN GEAR INSTALLATION

Tools Required

- **J 34196-B** Transmission Bushing Service Set. See **Special Tools and Equipment** .
- J 8092 Universal Driver Handle - 3/4 in

IMPORTANT: Do not remove the retaining ring (671), except to replace it.

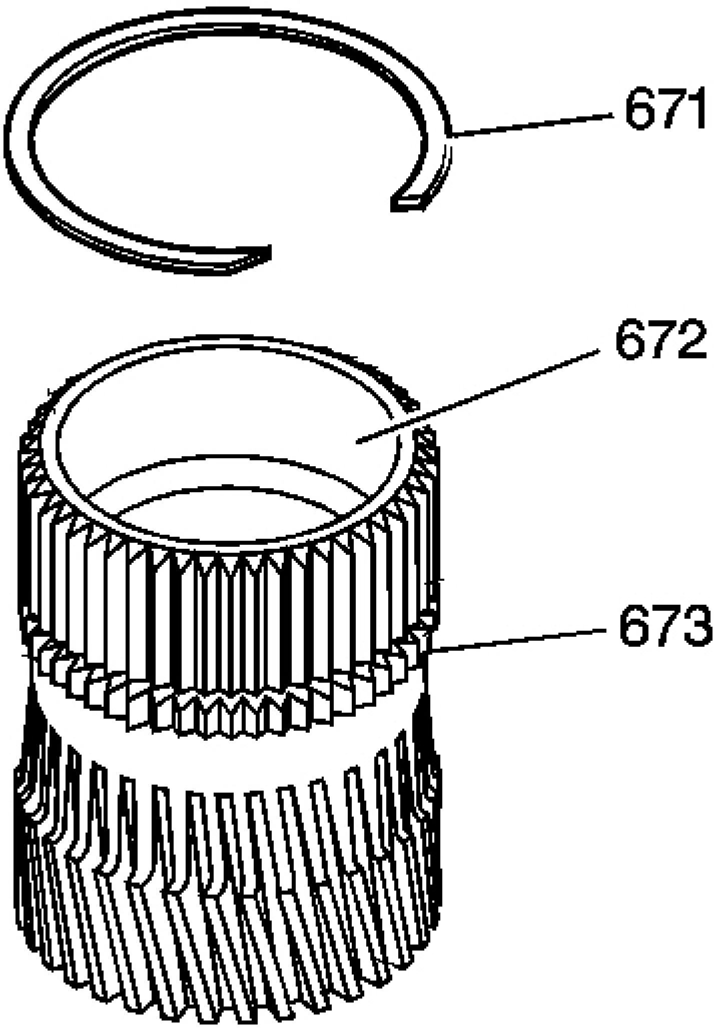


Fig. 277: Inspecting Reaction Sun Gear
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reaction sun gear (673) for the following defects:
   - Nicks
   - Scores
   - Damaged spline or teeth
   - A worn bushing (672)
   - A loose or weak retaining ring (671)

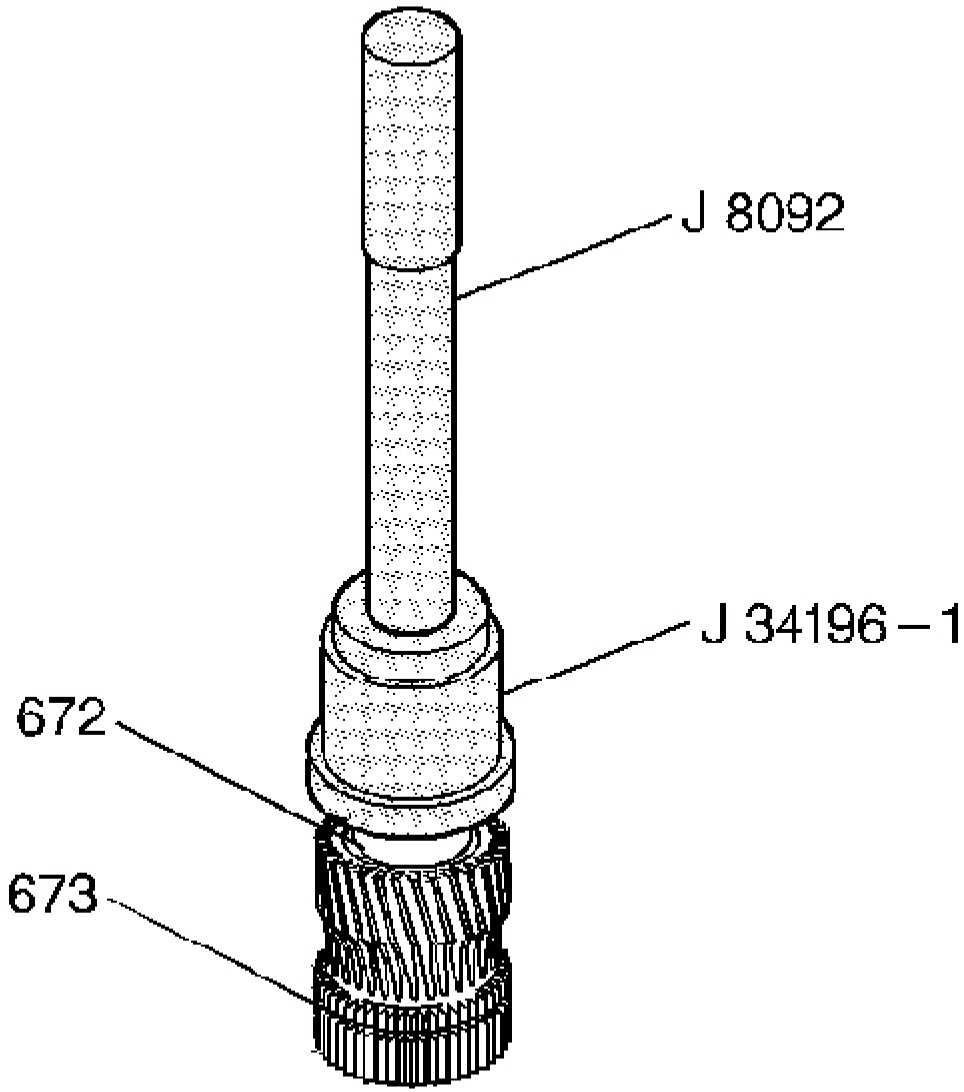


Fig. 278: Removing Reaction Sun Bushing From Reaction Sun Gear
Courtesy of GENERAL MOTORS CORP.

2. If the reaction sun gear bushing (672) needs replacement, use J 34196-1 which is part of kit **J 34196-B** with J 8092 to remove the reaction sun bushing (672) from the reaction sun gear (673). See **Special Tools and Equipment** .

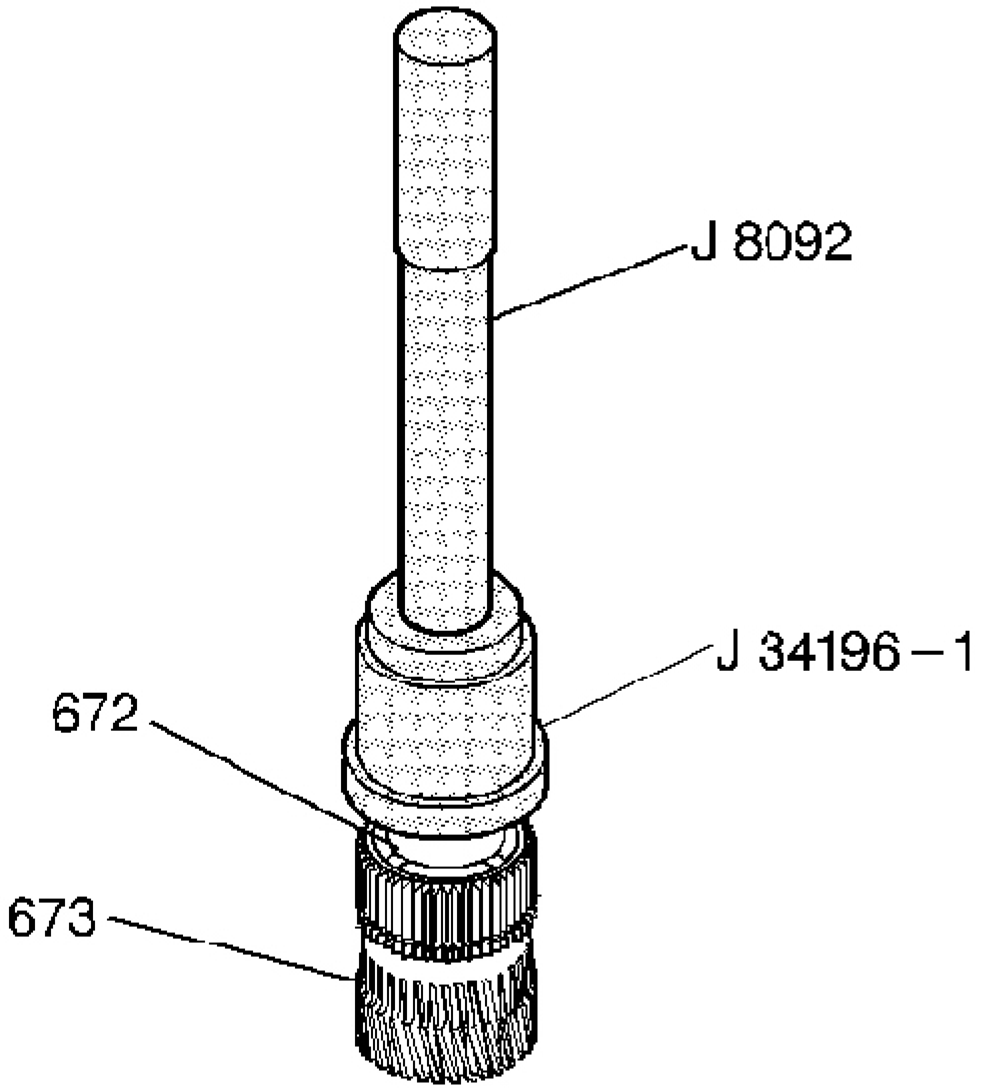


Fig. 279: Installing New Reaction Sun Bushing Into Reaction Sun Gear
Courtesy of GENERAL MOTORS CORP.

3. Using J 34196-1 which is part of kit **J 34196-B** with J 8092 , install a new reaction sun bushing (672) into the reaction sun gear (673). See **Special Tools and Equipment** .

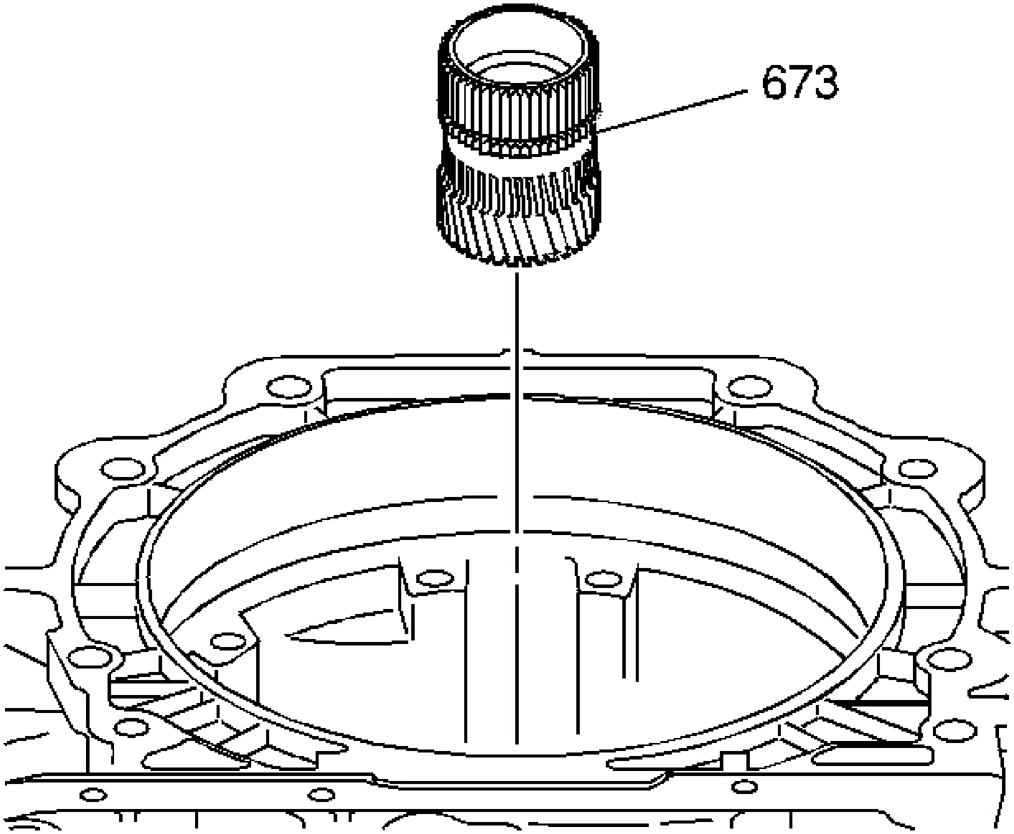


Fig. 280: Installing Reaction Sun Gear Into Reaction Carrier
Courtesy of GENERAL MOTORS CORP.

4. Install the reaction sun gear (673) into the reaction carrier.

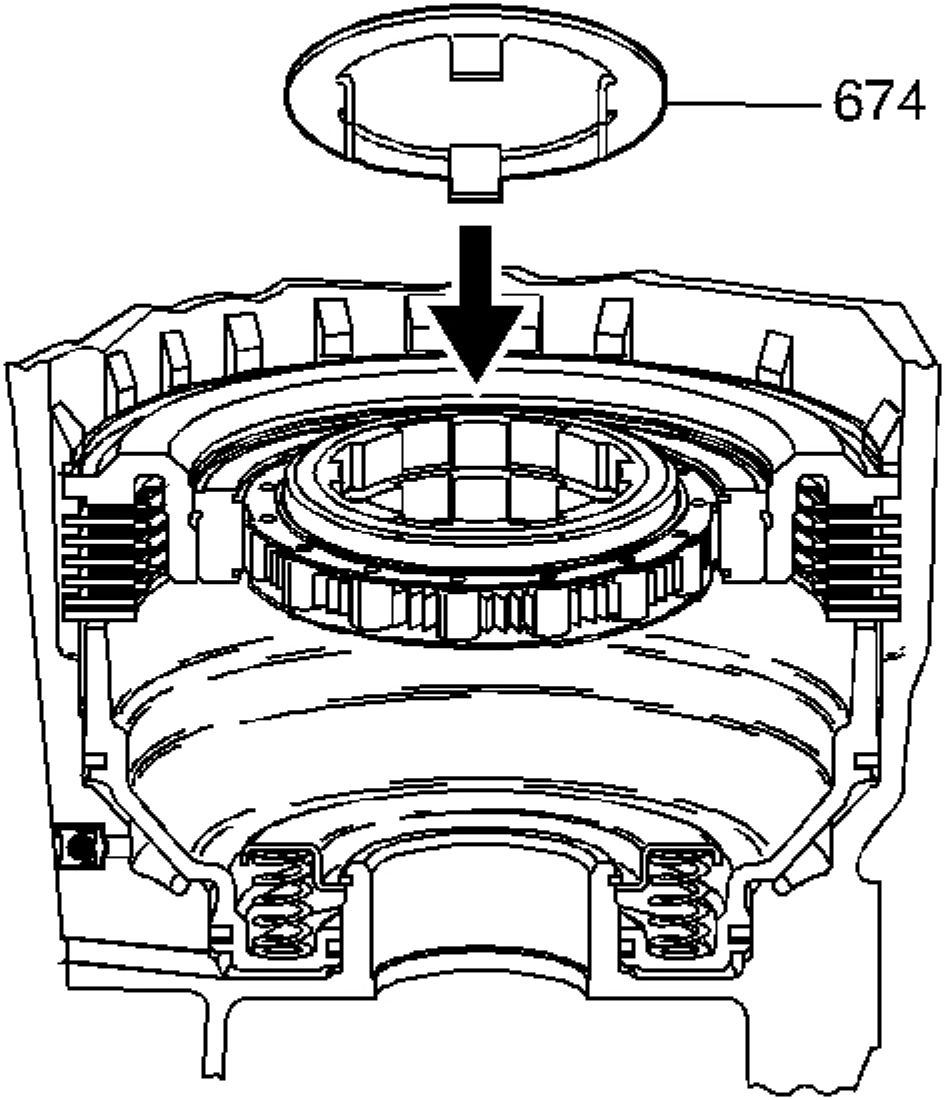


Fig. 281: Installing Thrust Washer
Courtesy of GENERAL MOTORS CORP.

5. Install the thrust washer (674) with the tangs pointing down. Index the tangs of the thrust washer with the splines of the low and reverse roller clutch race.

REACTION CARRIER SHAFT REPLACEMENT

Removal Procedure

Tools Required

- J 8092 Universal Driver Handle - 3/4 in - 10
- **J 7004-A** Universal Remover. See **Special Tools and Equipment** .
- J 23907 Slide Hammer with Bearing Adapter
- **J 25019-14** Stator Pump Bushing Remover. See **Special Tools and Equipment** .
- **J 29369-2** Bushing and Bearing Remover 2-3 in
- **J 34196-B** Transmission Bushing Service Set. See **Special Tools and Equipment** .

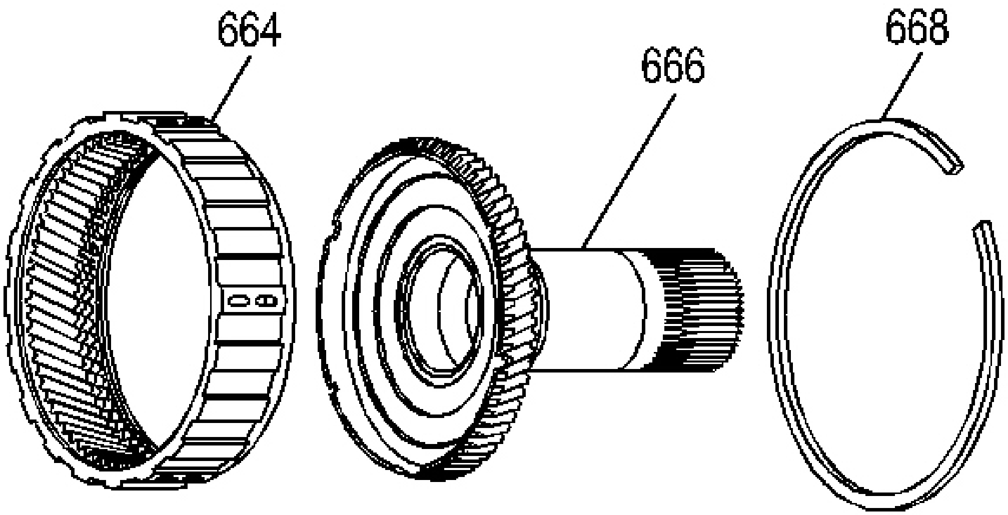


Fig. 282: Removing Reaction Carrier Shaft/Internal Gear Retainer & Reaction Carrier Shaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the reaction carrier shaft/internal gear retainer (668) and the reaction carrier shaft (666) from the input internal gear (664).
2. Inspect the reaction carrier shaft (666) and the input internal gear (664) for the following defects:
   - Scoring
   - Cracking
   - Damaged or worn bushings
   - A cracked shaft
   - A damaged spline

- Damaged gear teeth

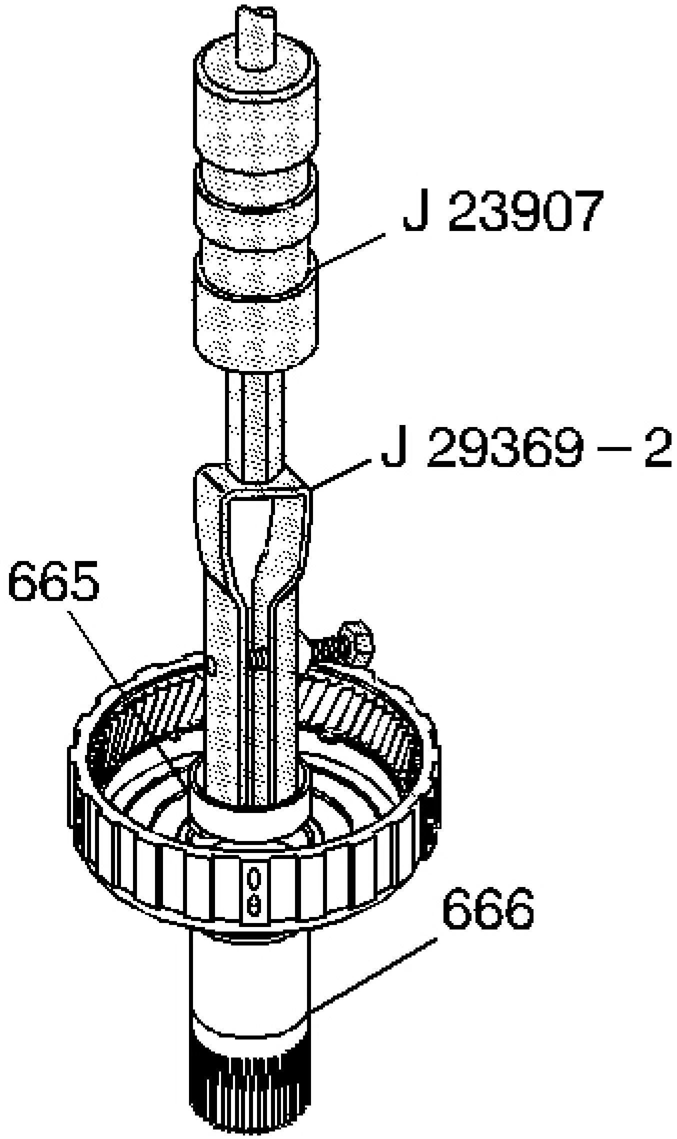


Fig. 283: Removing Reaction Carrier Shaft Front Bushing Using J 29369-2 & J 23907
Courtesy of GENERAL MOTORS CORP.

3. Using**J 29369-2** with J 23907 , remove the reaction carrier shaft front bushing (665).

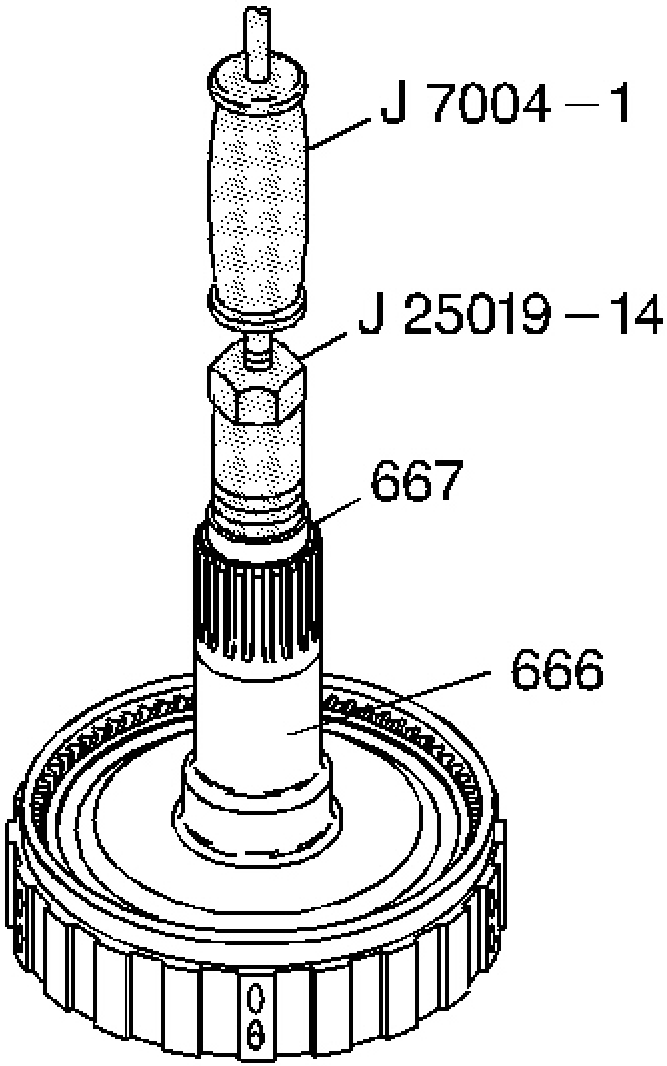


Fig. 284: Removing Reaction Carrier Shaft Rear Bushing Using J 25019-14 & J 7004-A
Courtesy of GENERAL MOTORS CORP.

4. Using**J 25019-14** with **J 7004-A** , remove the reaction carrier shaft rear bushing (667). See **Special Tools and Equipment** .

Installation Procedure

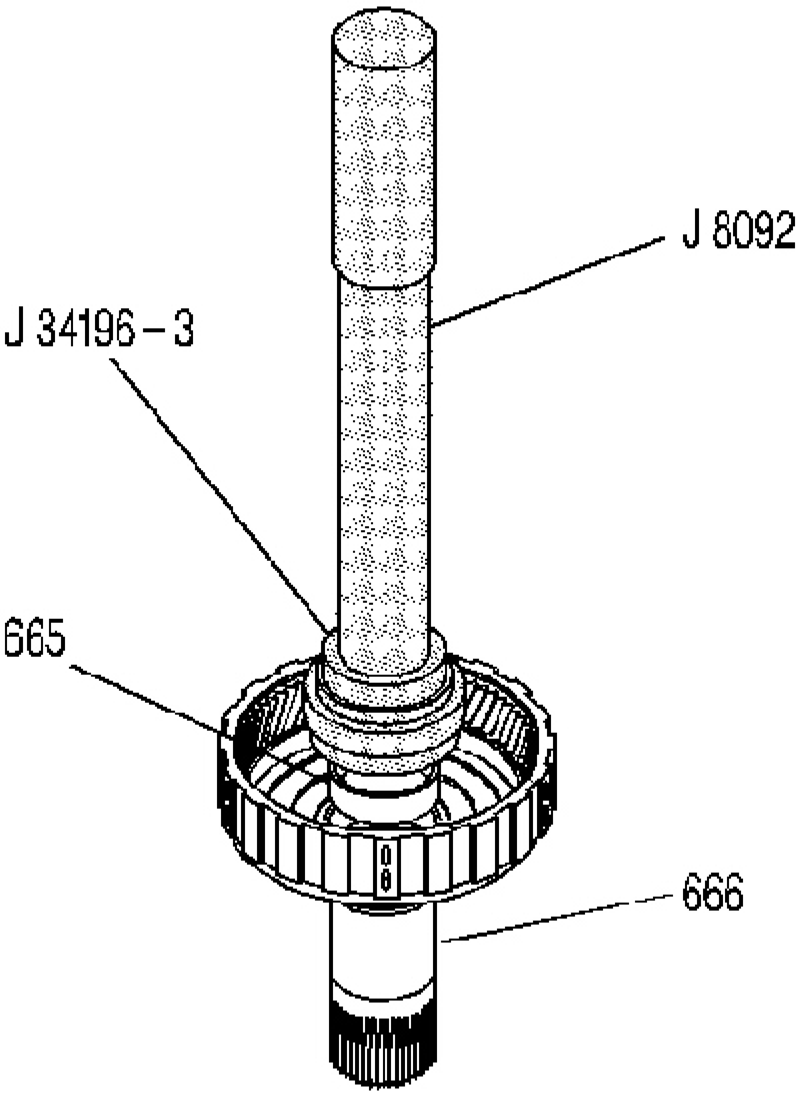


Fig. 285: Installing New Reaction Carrier Shaft Front Bushing Using J 34196-3 & J 8092
Courtesy of GENERAL MOTORS CORP.

1. Using J 34196-3 which is part of kit **J 34196-B** with J 8092 , install a new reaction carrier shaft front bushing (665). See **Special Tools and Equipment** .

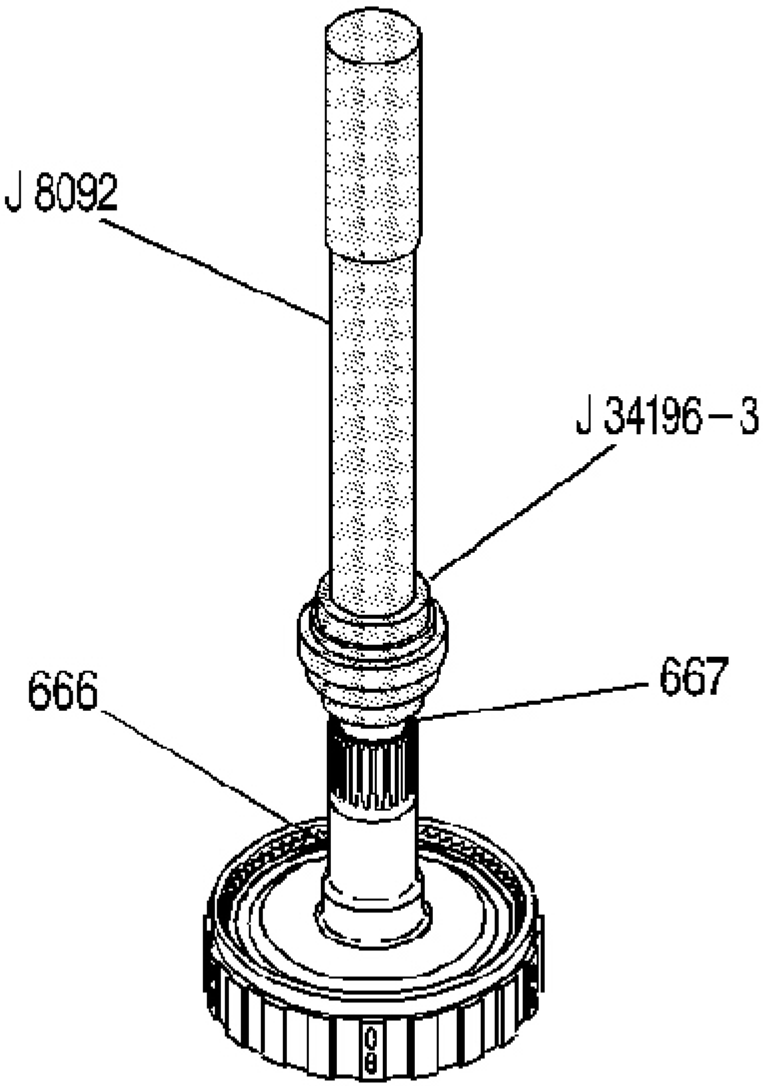


Fig. 286: Installing Reaction Carrier Shaft Rear Bushing Using J 34196-3 & J 8092
Courtesy of GENERAL MOTORS CORP.

2. Using J 34196-3 which is part of kit **J 34196-B** with J 8092 , install a reaction carrier shaft rear bushing (667). See **Special Tools and Equipment** .

INPUT INTERNAL GEAR, REACTION SHAFT AND SHELL INSTALLATION

Tools Required

J 36850 Transjel Lubricant

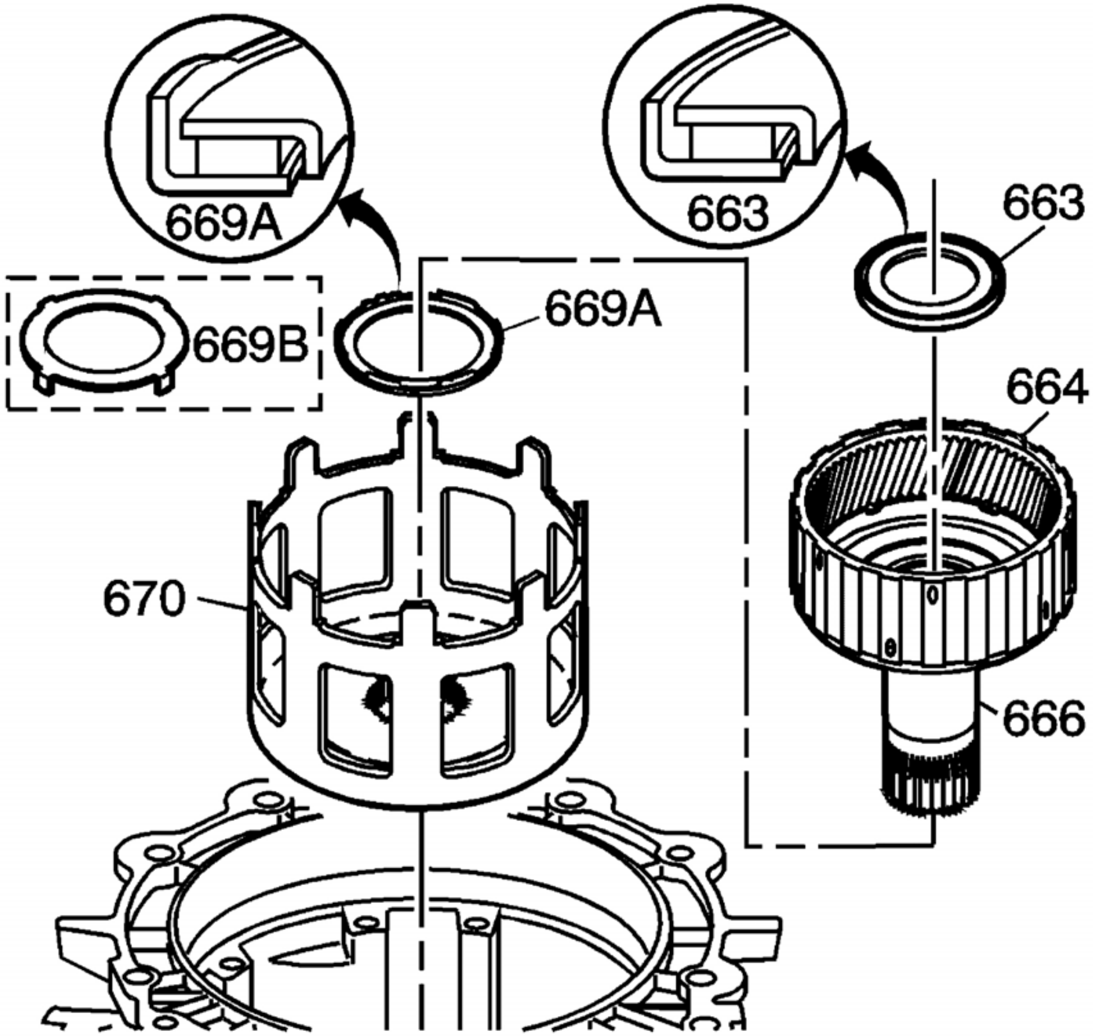


Fig. 287: Reaction Sun Shell & Reaction Sun Gear
Courtesy of GENERAL MOTORS CORP.

1. Install the reaction sun shell (670) into the reaction sun gear.
2. Depending on model, install either a thrust bearing (669A) or thrust washer (669B) as follows:
   - Install thrust washer (669B), tangs down into the holes in the reaction sun shell.
   - Install the thrust bearing (669A) using J 36850 onto the reaction carrier shaft, tangs up, towards the shaft.
3. Install the input internal gear (664) and reaction carrier shaft (666) assembly into the sun gear shell. Index the reaction carrier shaft spline into the reaction carrier.
4. Install the input carrier to reaction shaft thrust bearing assembly (663).

INTERNAL TRANSMISSION SPEED SENSOR ROTOR REPLACEMENT

Removal Procedure

Tools Required

- J 8433 Two Jaw Puller
- **J 21427-A** Speedometer Gear Puller Adapter. See **Special Tools and Equipment** .
- **J 36352** Speed Sensor Rotor Installer Kit. See **Special Tools and Equipment** .

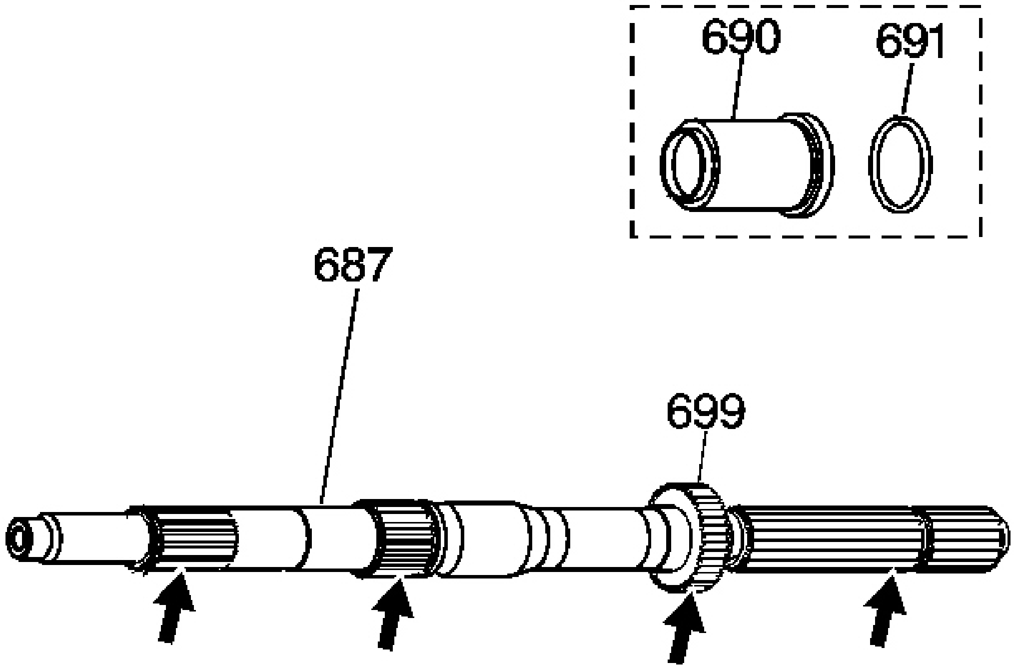


Fig. 288: Output Shaft Seal & Output Shaft Sleeve
Courtesy of GENERAL MOTORS CORP.

1. Inspect the internal transmission speed sensor rotor (699) for cracks or damaged teeth.
2. Inspect all splines on the output shaft (687) for cracks or damaged splines.
3. Remove the output shaft seal (691) and the output shaft sleeve (690) (model dependent) 2WD units only.

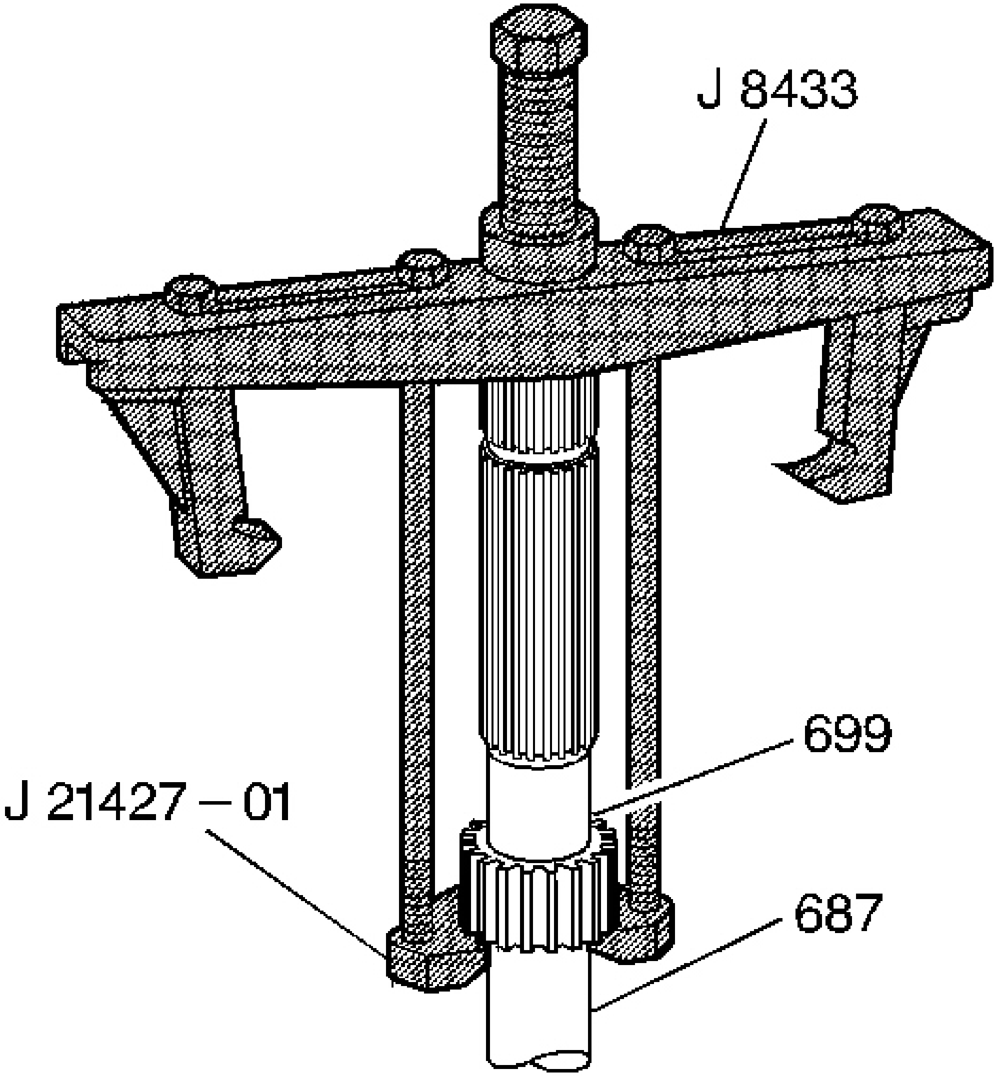


Fig. 289: Internal Speed Sensor Rotor & Output Shaft (Replaced If Damaged)
Courtesy of GENERAL MOTORS CORP.

4. If the internal speed sensor rotor (699) is damaged, replace it.
5. Using J 8433 with J 21427-01 , remove the internal speed sensor rotor (699) from the output shaft (687).

Installation Procedure

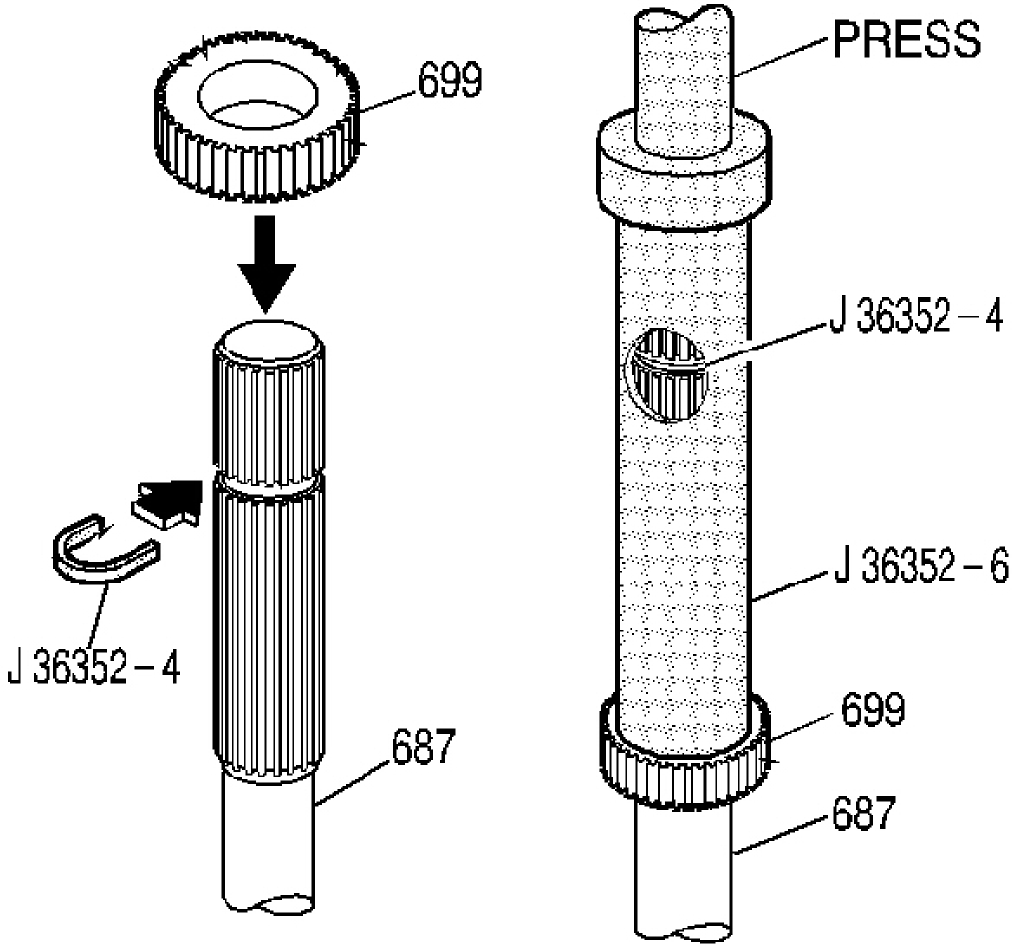


Fig. 290: Internal Speed Sensor Rotor & Output Shaft Splines
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not re-use an internal speed sensor rotor that has been removed.

1. Slip a new internal speed sensor rotor (699) over the output shaft splines.
2. Install the **J 36352-4** in the groove on the output shaft (687). See **Special Tools and Equipment** .
3. Place the **J 36352-6** on the output shaft (687). Press on the **J 36352-6** until it contacts the **J 36352-4** in the window (the **J 36352-4** will be a positive stop for the **J 36352-6**). See **Special Tools and Equipment** .

OUTPUT SHAFT INSTALLATION

Tools Required

J 29837-A Output Shaft Support Fixture. See **Special Tools and Equipment** .

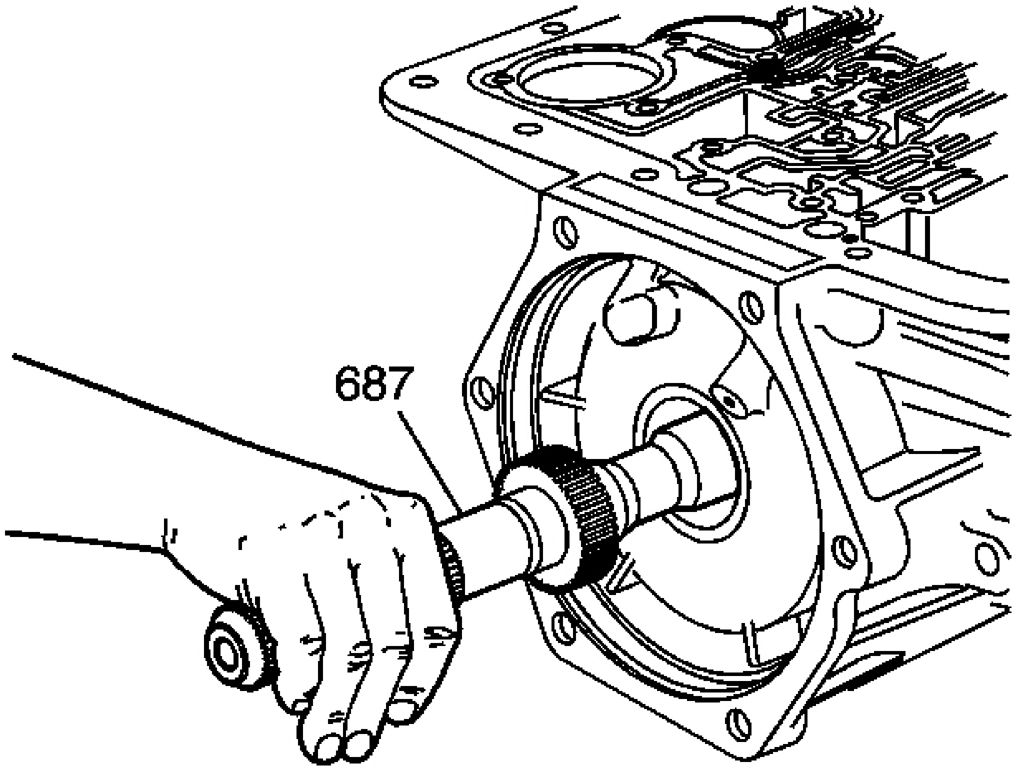


Fig. 291: Installing Output Shaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: It is important to note that the input shaft may need a light tap to fully seat into position. If the input shaft is not completely engaged, the output shaft to input carrier retainer (661) will not seat.

1. Install the output shaft (687).

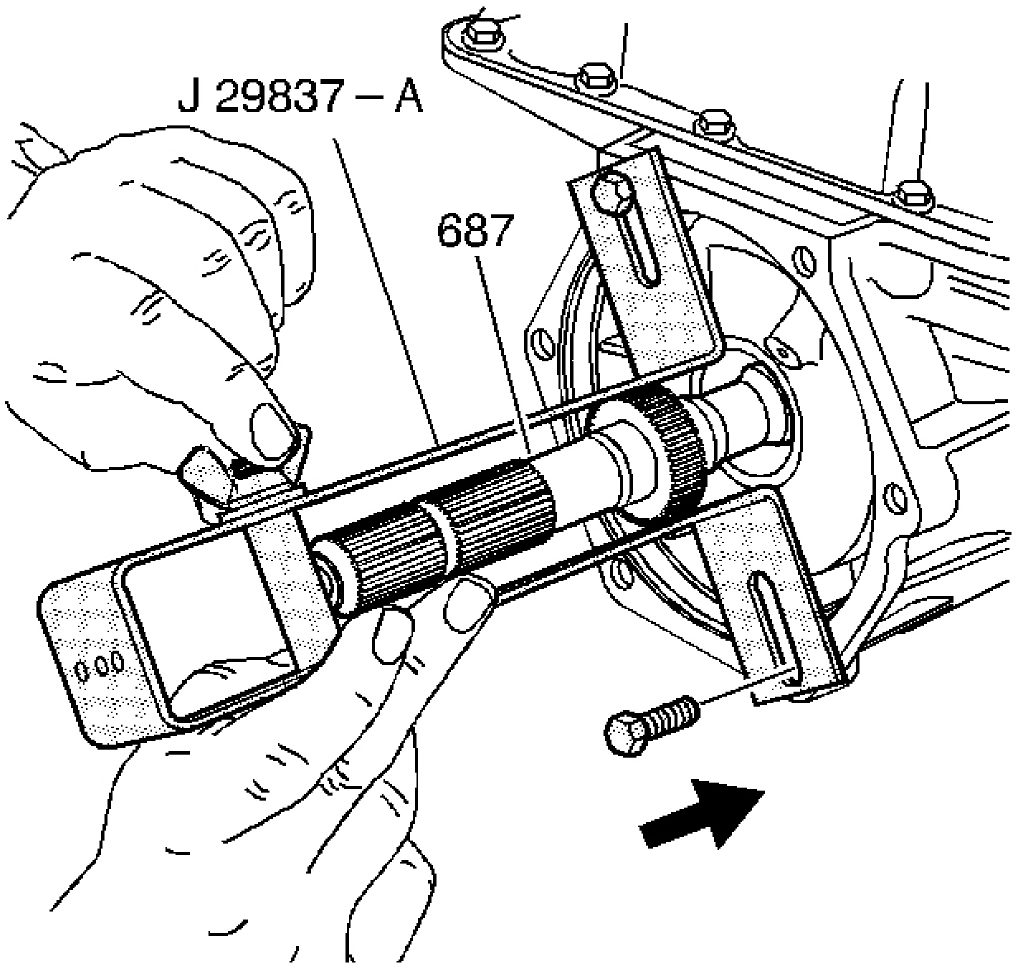


Fig. 292: Installing J 29837-A
Courtesy of GENERAL MOTORS CORP.

2. Install the **J 29837-A** . See **Special Tools and Equipment** .

INPUT CARRIER INSPECTION

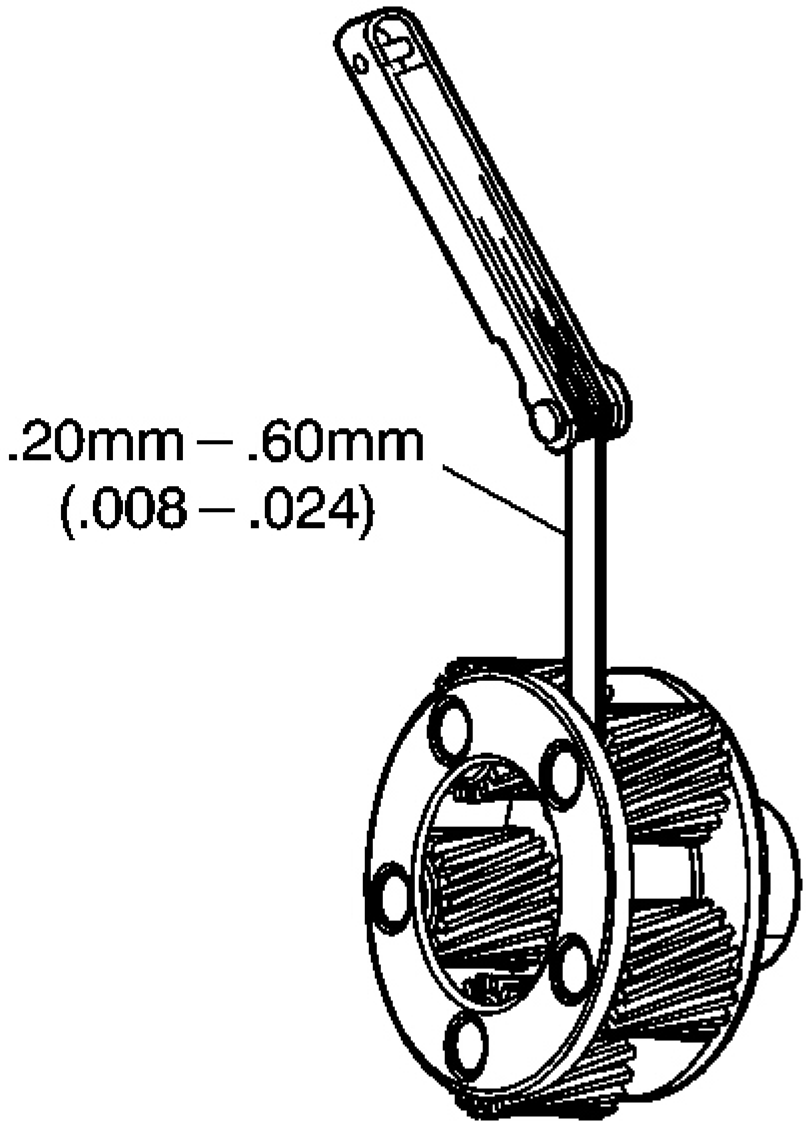


Fig. 293: Input Carrier Pinion End Play
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Check end play on each pinion.

1. Check the input carrier pinion end play. The end play must not exceed 0.61 mm (0.024 in).
2. Inspect the input carrier for pinion gear damage, proper pin stake and keystoned pinion gears. Pinions

must rotate freely.

INPUT SUN GEAR BUSHINGS REPLACEMENT

Removal Procedure

Tools Required

- J 8092 Universal Driver Handle - 3/4 in - 10
- **J 34196-B** Transmission Bushing Service Set. See **Special Tools and Equipment** .

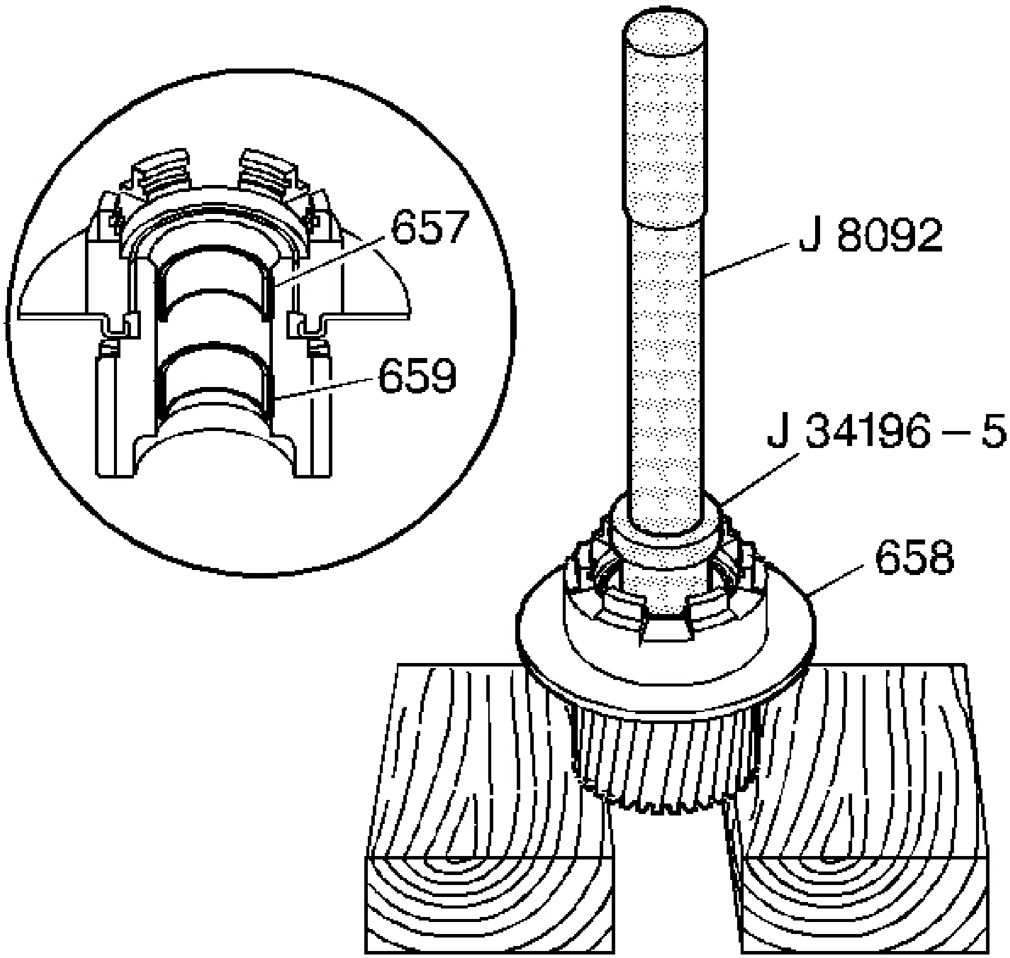


Fig. 294: Input Sun Gear Front Bushing & Rear Bushing
Courtesy of GENERAL MOTORS CORP.

Using J 34196-5 which is part of kit **J 34196-B** with J 8092 , remove the input sun gear front bushing (657) and rear bushing (659). See **Special Tools and Equipment** .

Installation Procedure

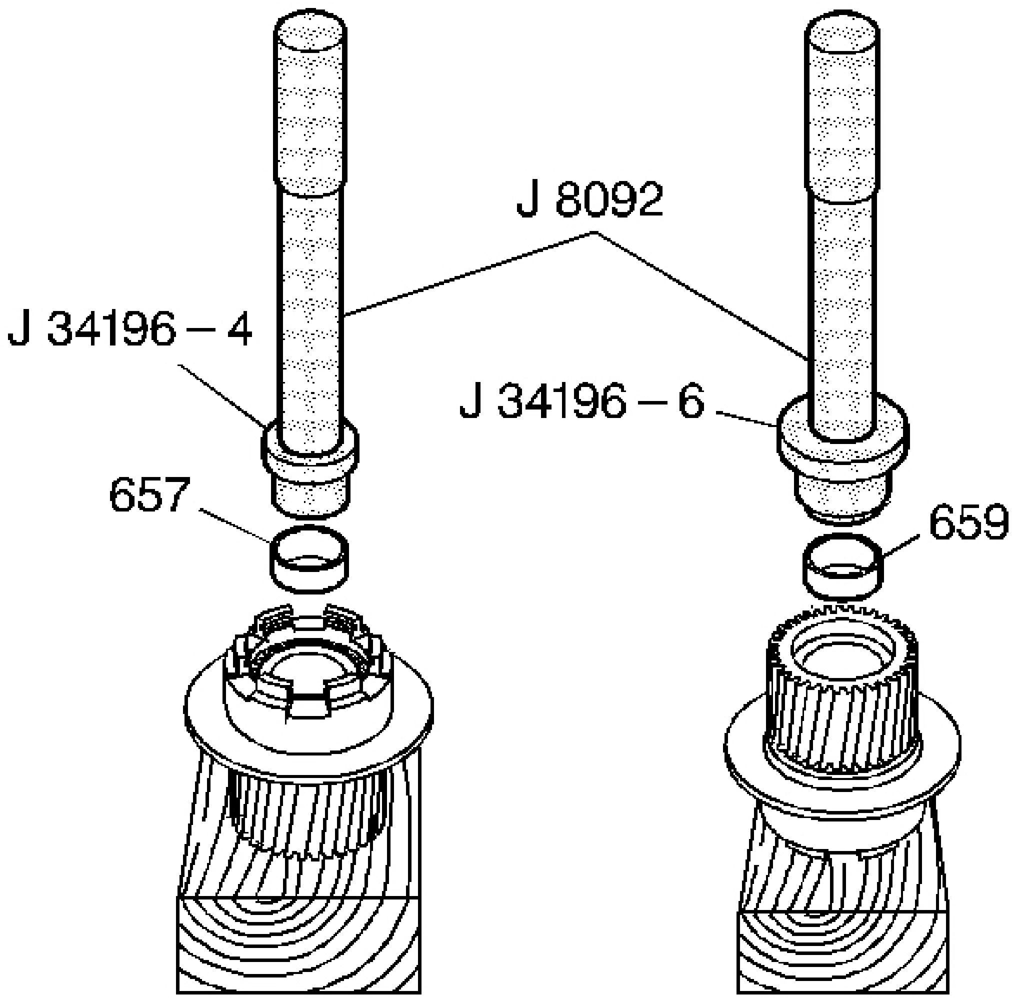


Fig. 295: Input Sun Gear Front Bushing & Rear Bushing
Courtesy of GENERAL MOTORS CORP.

1. Using J 34196-4 which is part of kit **J 34196-B** with J 8092 , install the input sun gear front bushing (657). See **Special Tools and Equipment** .
2. Using J 34196-6 which is part of kit **J 34196-B** with J 8092 , install the input sun gear rear bushing (659). See **Special Tools and Equipment** .

INPUT CARRIER INSPECTION AND INSTALLATION

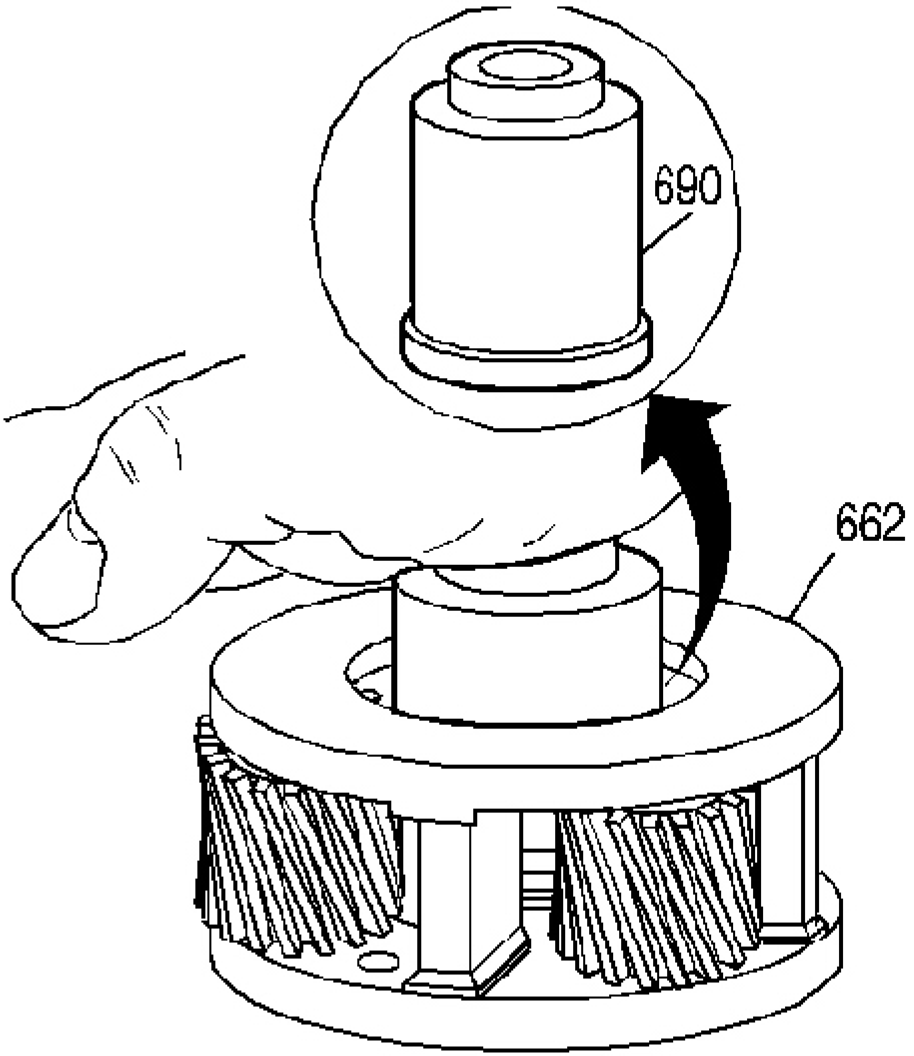


Fig. 296: Inspecting Input Carrier Captive Thrust Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the input carrier captive thrust bearing assembly. To check the captive thrust bearing in the input carrier (662) for wear, place a bushing or an output shaft sleeve (690) onto the bearing race and turn it with the palm of your hand. Do not touch the pinion gears. Any imperfections will be felt through the bushing.

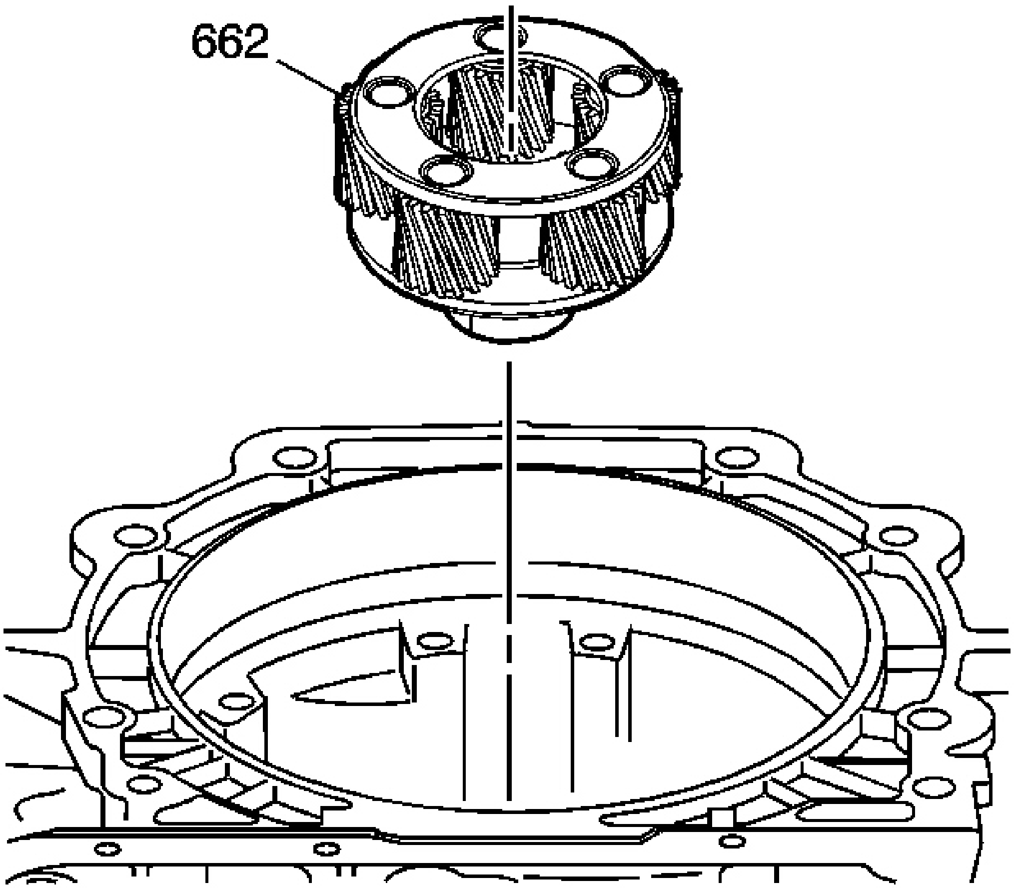


Fig. 297: Input Carrier Assembly & Output Shaft
Courtesy of GENERAL MOTORS CORP.

2. Install the input carrier assembly (662) onto the output shaft.

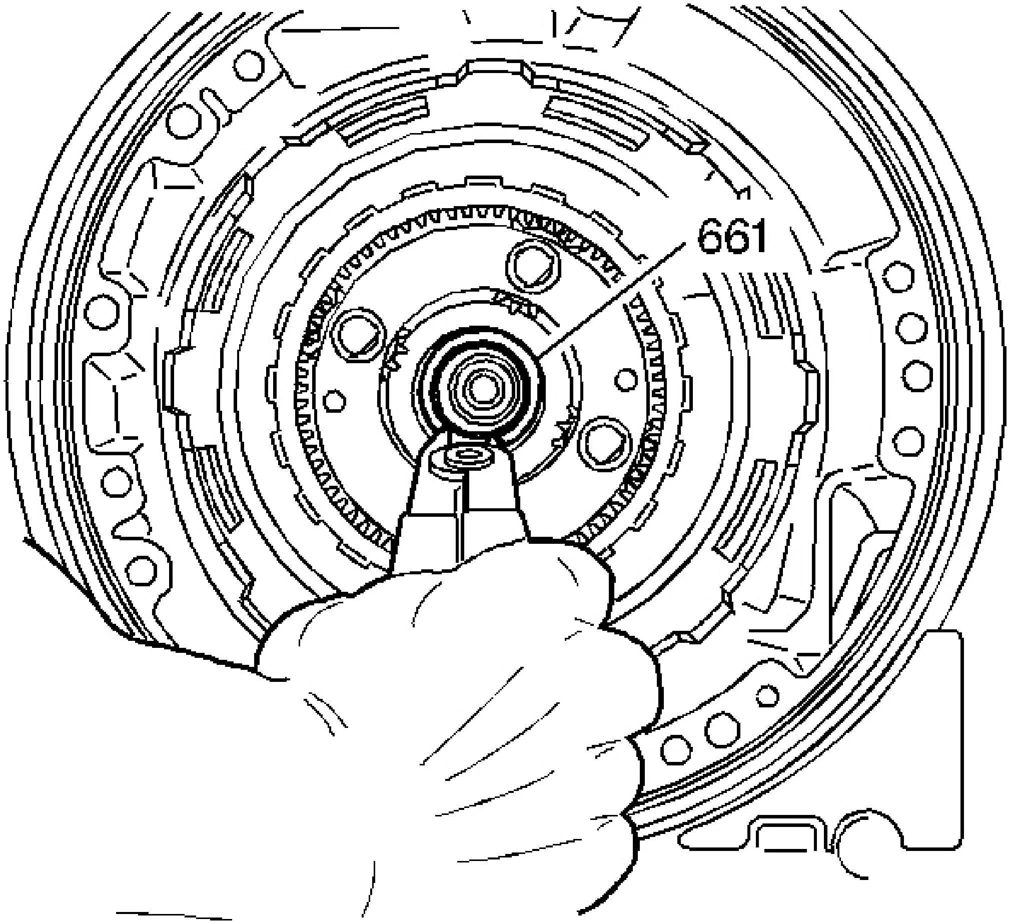


Fig. 298: Output Shaft & Input Carrier Retainer
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:
- **Do not reuse the old output shaft to input carrier retainer (661).**
- **Do not over expand the new output shaft to input carrier retainer during installation.**

3. Install a new output shaft to input carrier retainer (661).

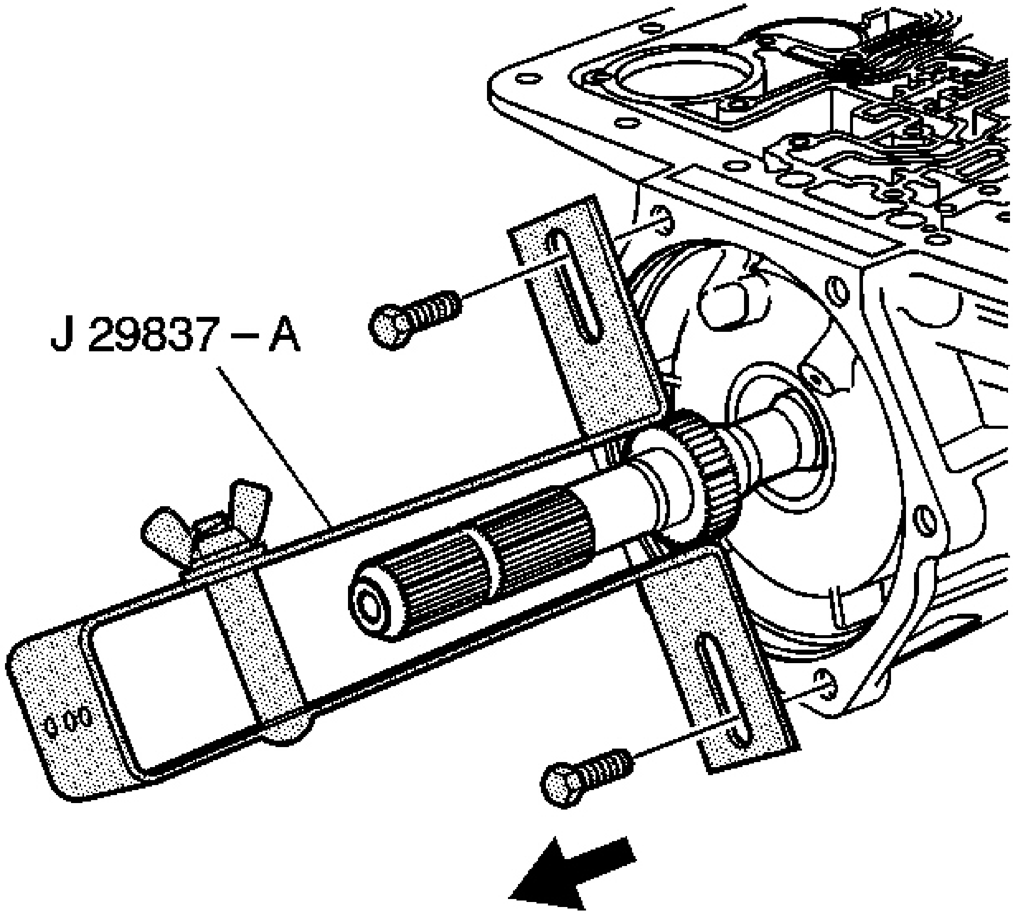


Fig. 299: Removing J 29837-A
Courtesy of GENERAL MOTORS CORP.

4. Remove the **J 29837-A** . See **Special Tools and Equipment** .

INPUT CLUTCH ASSEMBLY DISASSEMBLE

Removal Procedure

Tools Required

- **J 23327-1** Forward Clutch Spring Compressor (Bridge). See **Special Tools and Equipment** .
- **J 23456** Booster and Clutch Pack Compressor. See **Special Tools and Equipment** .
- **J 25018-A** Clutch Spring Compressor Adapter. See **Special Tools and Equipment** .

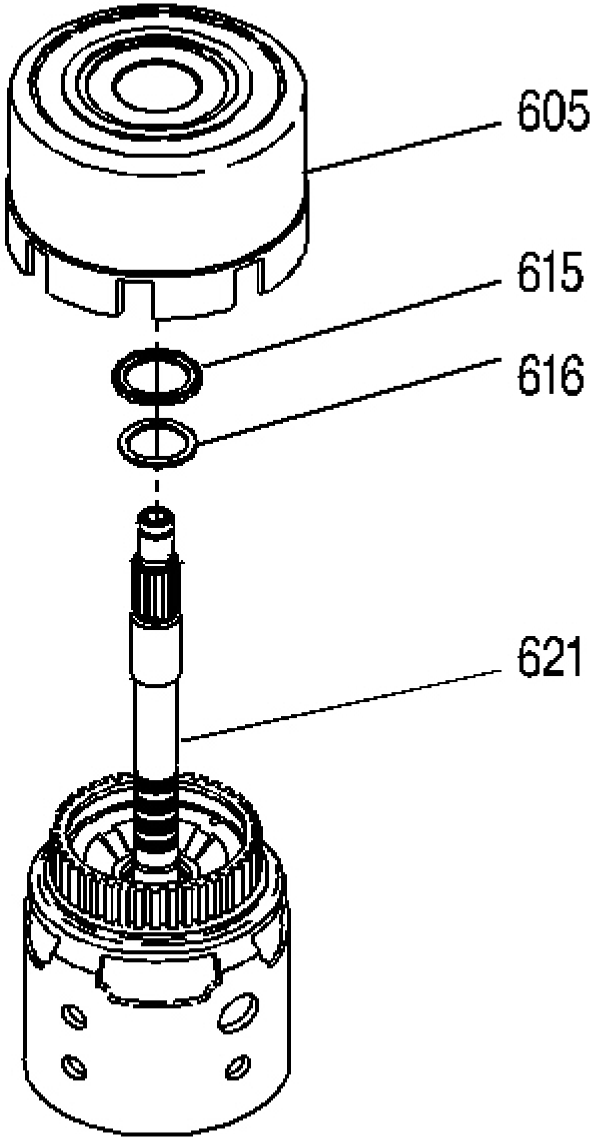


Fig. 300: Reverse Input Clutch Housing & Drum Assembly, Stator Shaft/Selective Washer Bearing Assembly & Selective Thrust Washer
Courtesy of GENERAL MOTORS CORP.

1. Remove the reverse input clutch housing and drum assembly (605) from the input clutch assembly (621).
2. Remove the stator shaft/selective washer bearing assembly (615).

3. Remove the selective thrust washer (616).

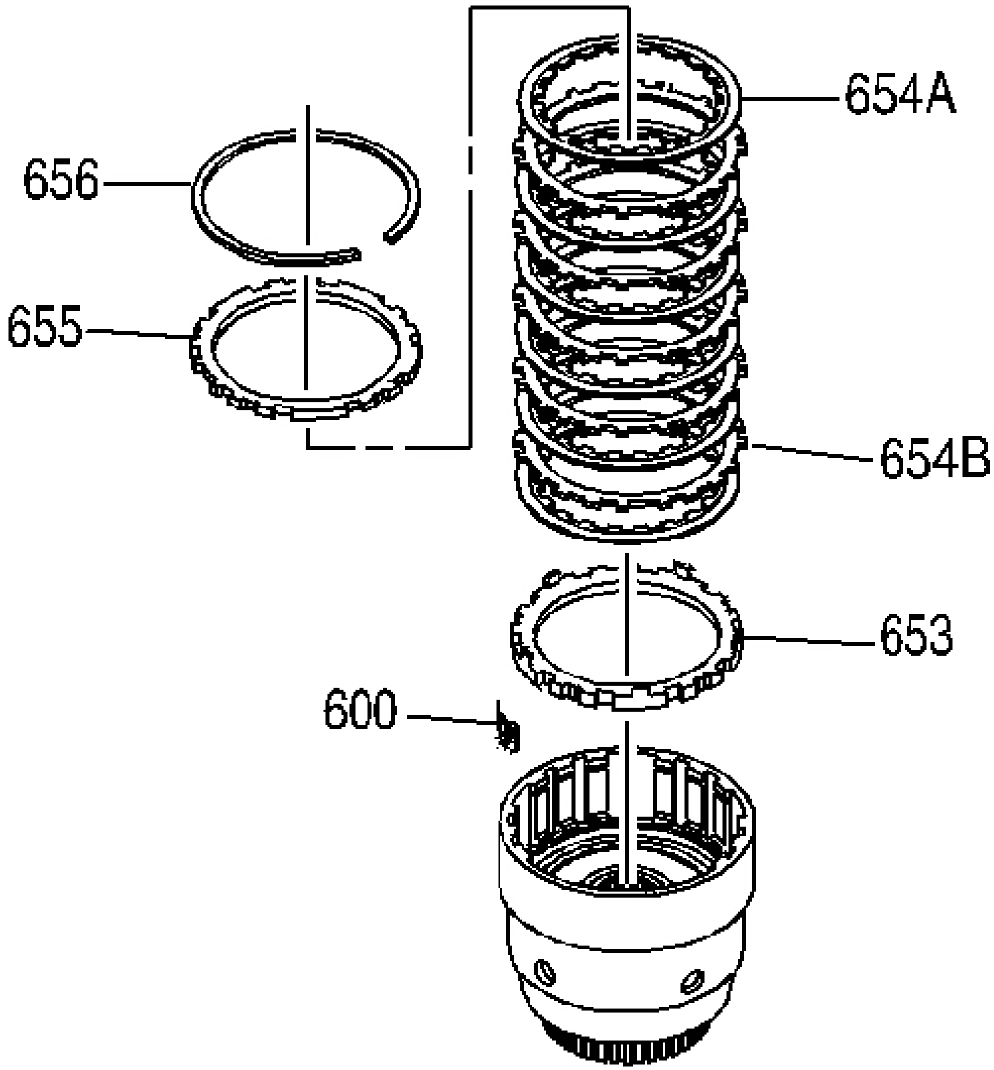


Fig. 301: 3rd & 4th Clutch Backing Plate Retainer Ring
Courtesy of GENERAL MOTORS CORP.

4. Remove the 3rd and 4th clutch backing plate retainer ring (656).

NOTE: **The correct number of fiber plates must be used to avoid damage to the**

transmission. An incorrect stack up height can cause either excessive clutch slippage or insufficient release, resulting in burned clutch plates.

IMPORTANT: The 3rd and 4th clutch plate stack is model specific. Clutch plate stack up could be either 6 or 7 plates.

5. Remove all 3rd and 4th clutch plates (653-655).
6. Remove the 3-4 clutch boost spring assemblies (600).

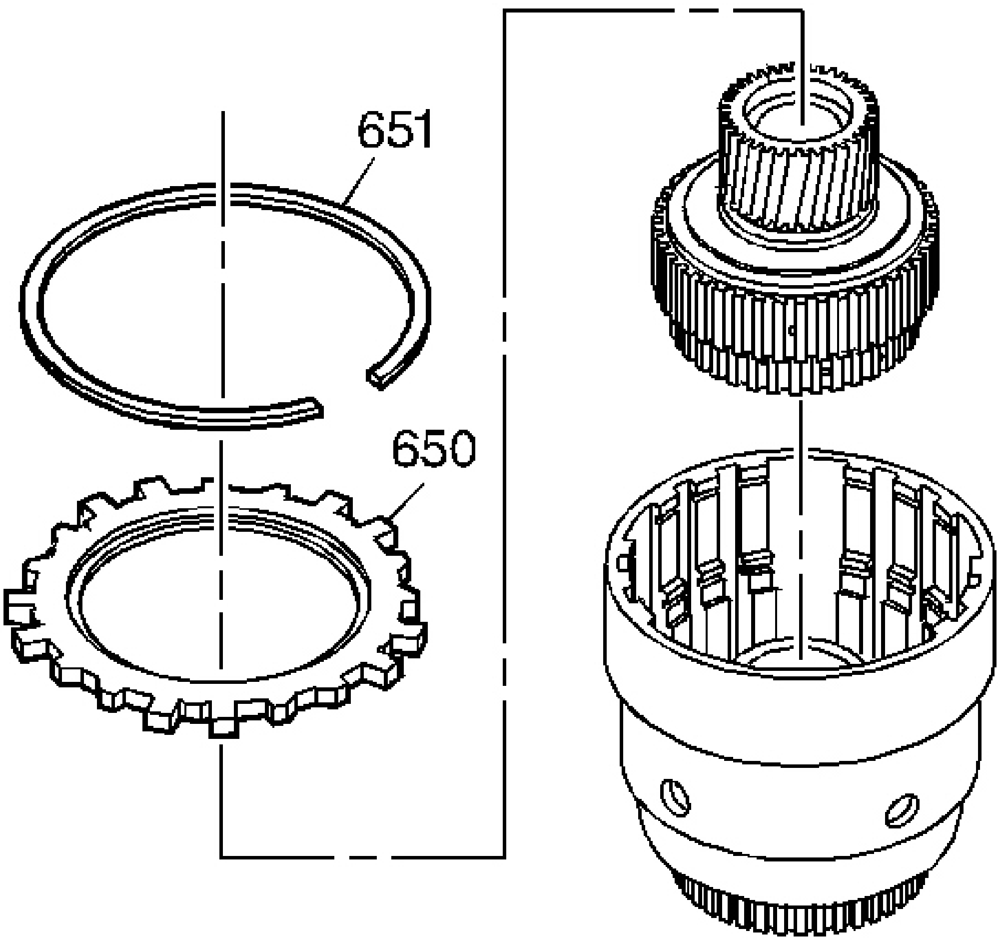


Fig. 302: Forward Clutch Components (1 Of 2)
Courtesy of GENERAL MOTORS CORP.

7. Remove the forward clutch backing plate retainer ring (651).
8. Remove the forward clutch selective backing plate (650).
9. Remove the forward clutch sprag assembly.

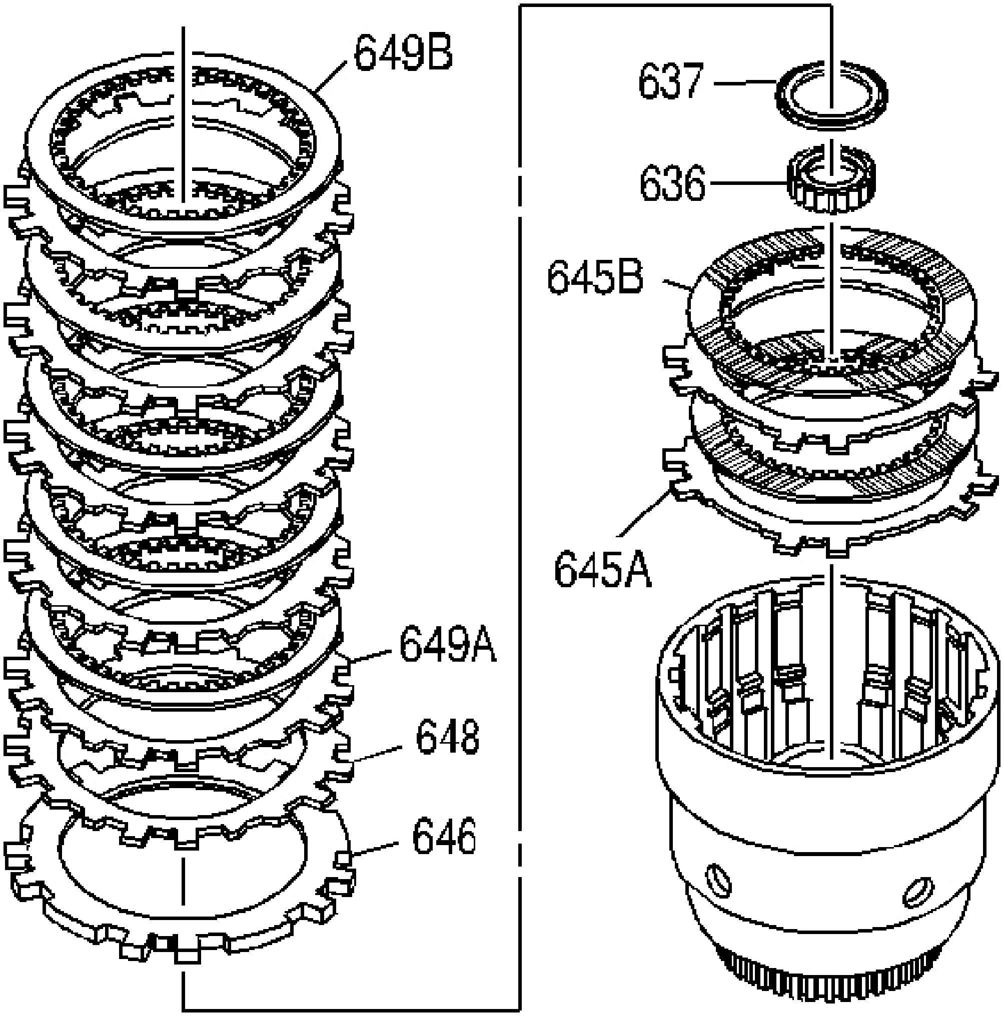


Fig. 303: Forward Clutch Components (2 Of 2)
Courtesy of GENERAL MOTORS CORP.

10. Remove all forward clutch plates (646, 648, 649A, 649B).
11. Remove the input sun gear bearing assembly (637).
12. Remove the input housing to output shaft seal (636).

13. Remove all overrun clutch plates (645A, 645B).

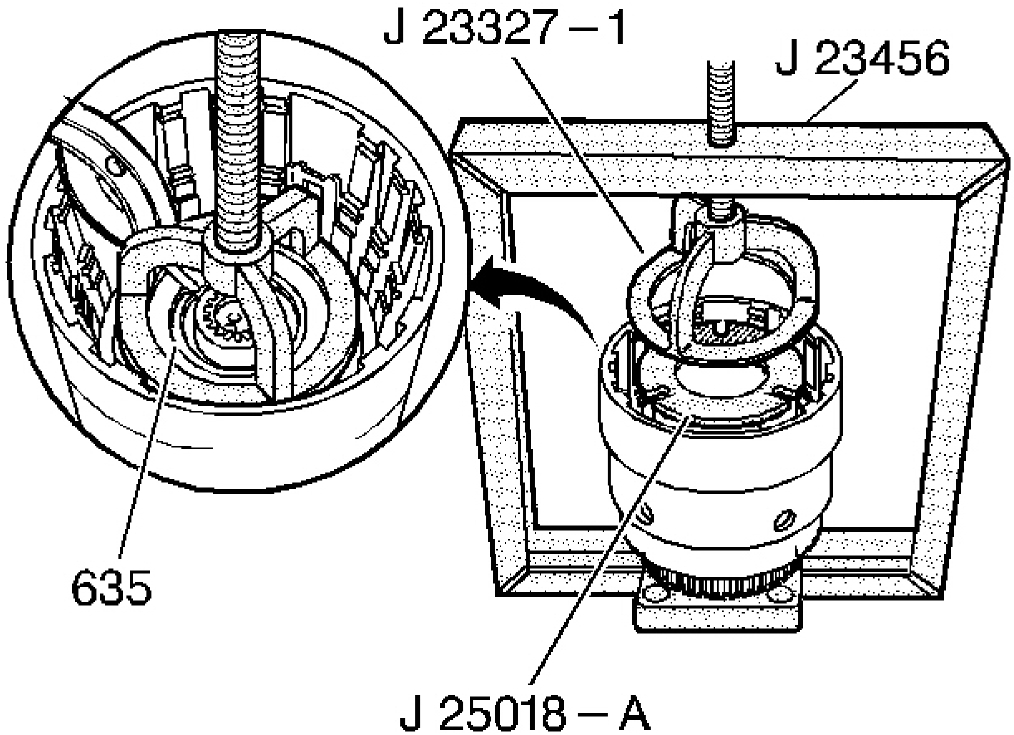


Fig. 304: View Of J 23327-1 & J 25018-A
Courtesy of GENERAL MOTORS CORP.

14. Install the **J 23327-1** and the **J 25018-A** . See **Special Tools and Equipment** .
15. Compress the overrun clutch spring, using the **J 23456** . See **Special Tools and Equipment** .
16. Remove the overrun clutch spring retainer snap ring (635).
17. Remove the **J 23327-1** and the **J 25018-A** . See **Special Tools and Equipment** .

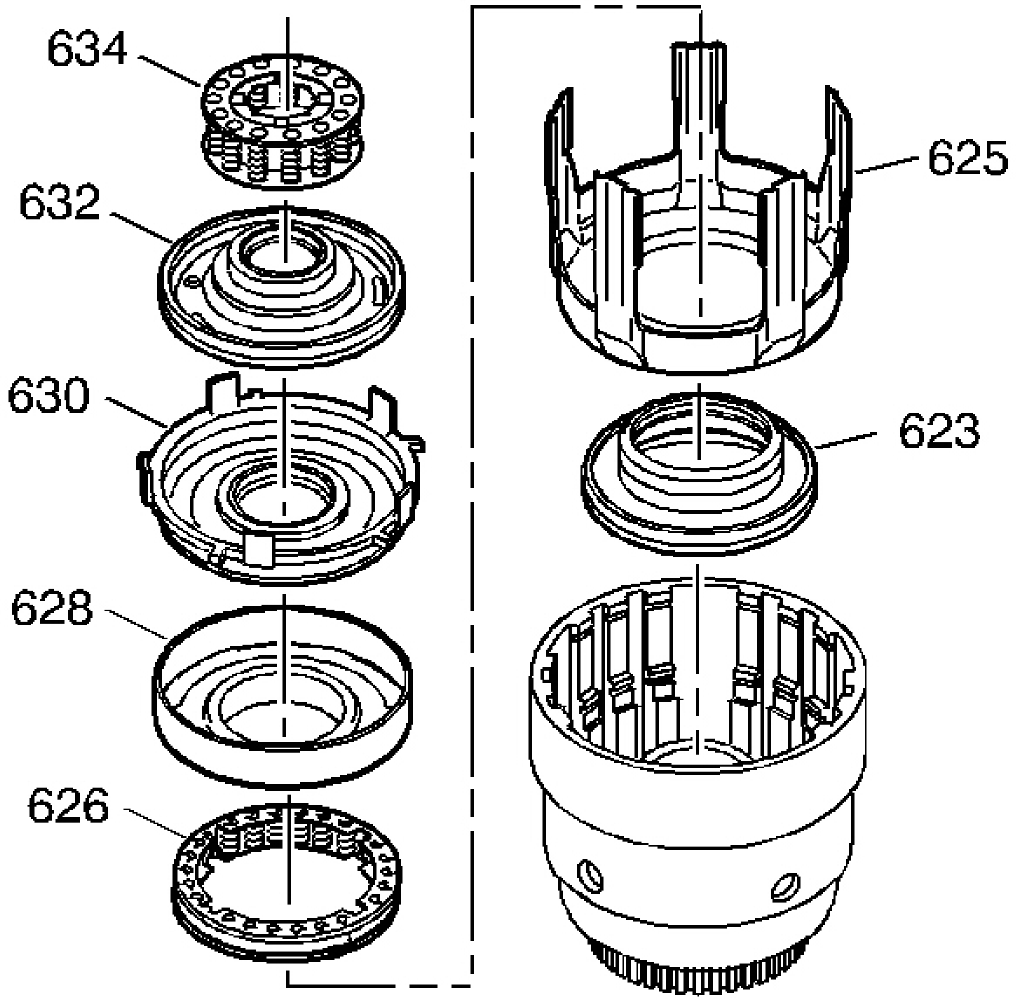


Fig. 305: Overrun Clutch Spring Assembly Components
Courtesy of GENERAL MOTORS CORP.

18. Remove the overrun clutch spring assembly (634).
19. Remove the overrun clutch piston (632).
20. Remove the forward clutch piston (630).
21. Remove the forward clutch housing (628).
22. Remove the 3rd and 4th clutch spring assembly (626).
23. Remove the 3rd and 4th clutch apply ring (625).
24. Remove the 3rd and 4th clutch piston (623).

INPUT HOUSING AND SHAFT ASSEMBLY INSPECTION

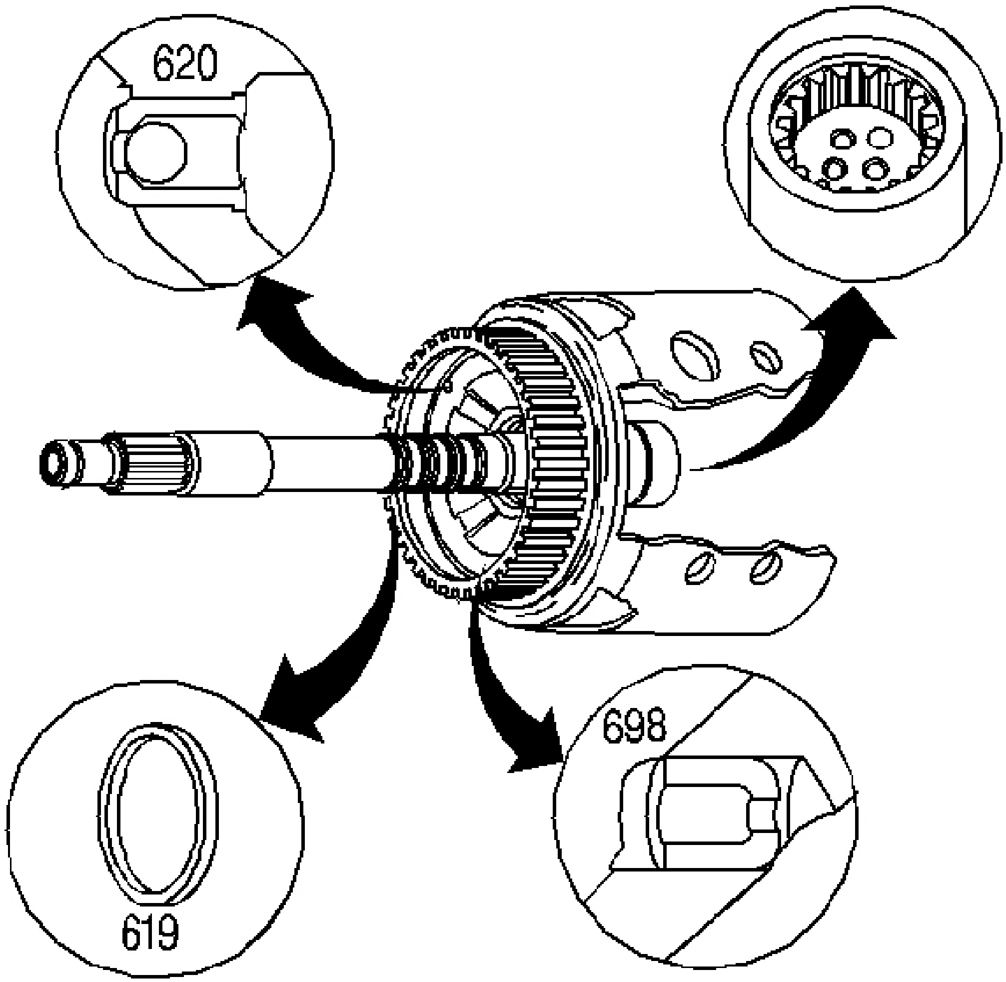


Fig. 306: Inspecting Input Housing & Shaft Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the input housing and shaft assembly for the following items:
    - Porosity
    - Spline wear
    - Three turbine shaft checkballs
    - Retainer and checkball assembly (620)
    - Orificed cup plug (698)

- Lube hole cracks

2. Inspect the turbine shaft oil seal ring grooves for damage or burrs. The oil seal rings (619) must fit loose into the ring grooves.

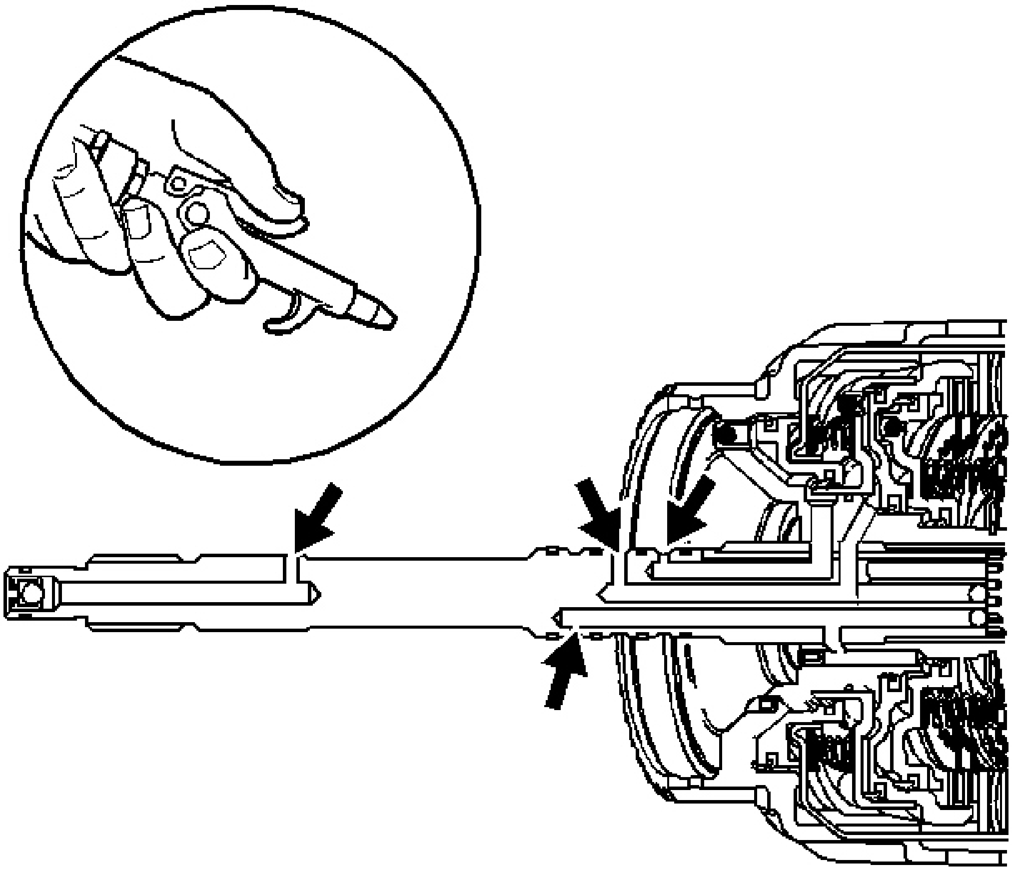


Fig. 307: Inspecting Oil Feed Passages
Courtesy of GENERAL MOTORS CORP.

3. Inspect the oil feed passages for obstructions.
4. Apply compressed air into the passages indicated.

INPUT HOUSING AND SHAFT ASSEMBLY ASSEMBLE

Tools Required

- **J 23327-1** Forward Clutch Spring Compressor (Bridge). See **Special Tools and Equipment** .

- **J 23456** Booster and Clutch Pack Compressor. See **Special Tools and Equipment** .
- **J 25018-A** Clutch Spring Compressor Adapter. See **Special Tools and Equipment** .
- **J 26744-A** Seal Installer. See **Special Tools and Equipment** .
- **J 29882** Overrun Clutch Seal Protector. See **Special Tools and Equipment** .
- **J 29883** Forward Clutch Seal Protector. See **Special Tools and Equipment** .

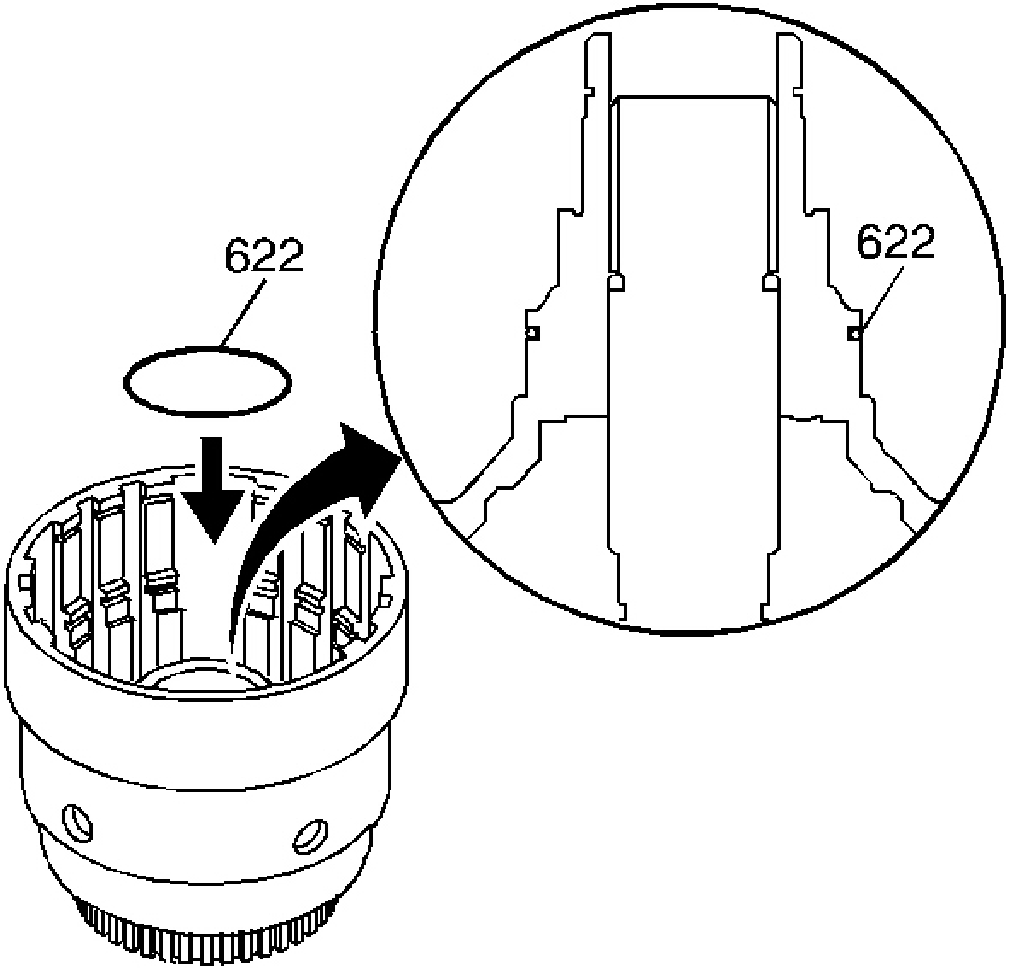


Fig. 308: Input To Forward Clutch Housing O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

1. Install a new input to forward clutch housing O-ring seal (622).

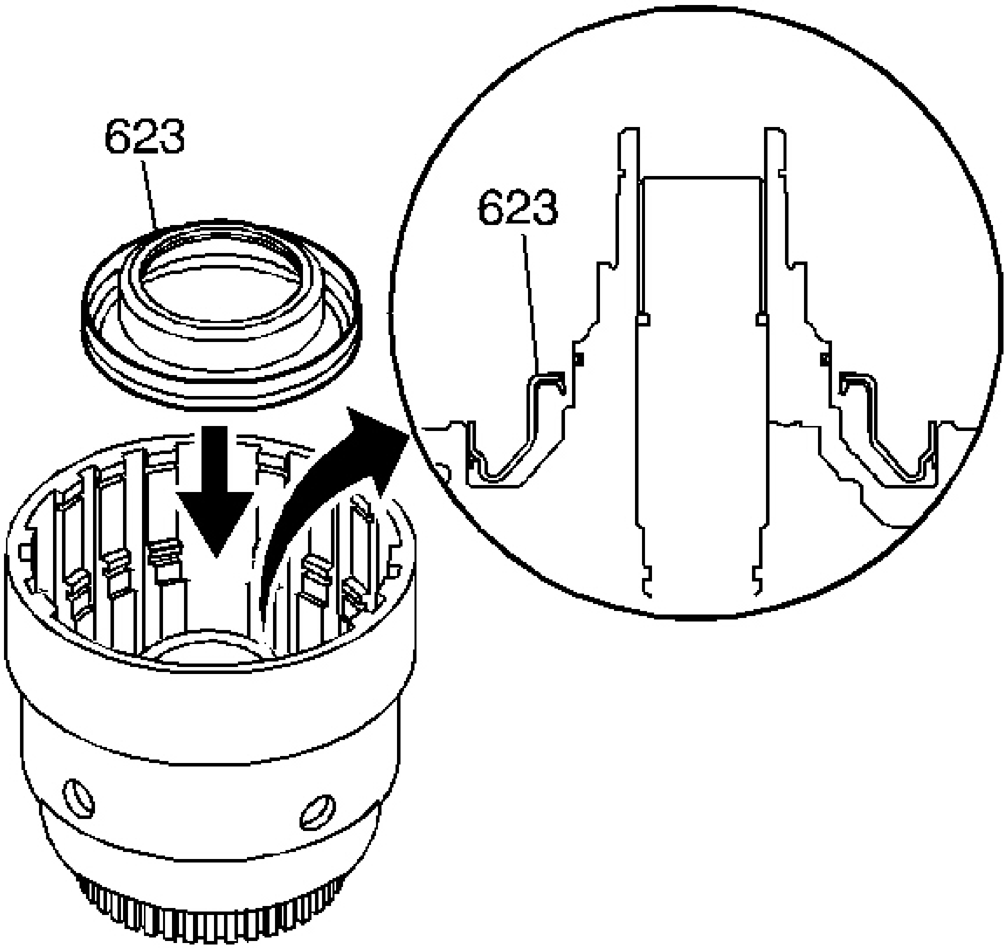


Fig. 309: Inspecting 3rd & 4th Clutch Piston
Courtesy of GENERAL MOTORS CORP.

2. Inspect the 3rd and 4th clutch piston (623) for the following conditions:
   - Porosity or damage
   - Seal damage
3. Install the 3rd and 4th clutch piston (623) into the input housing.

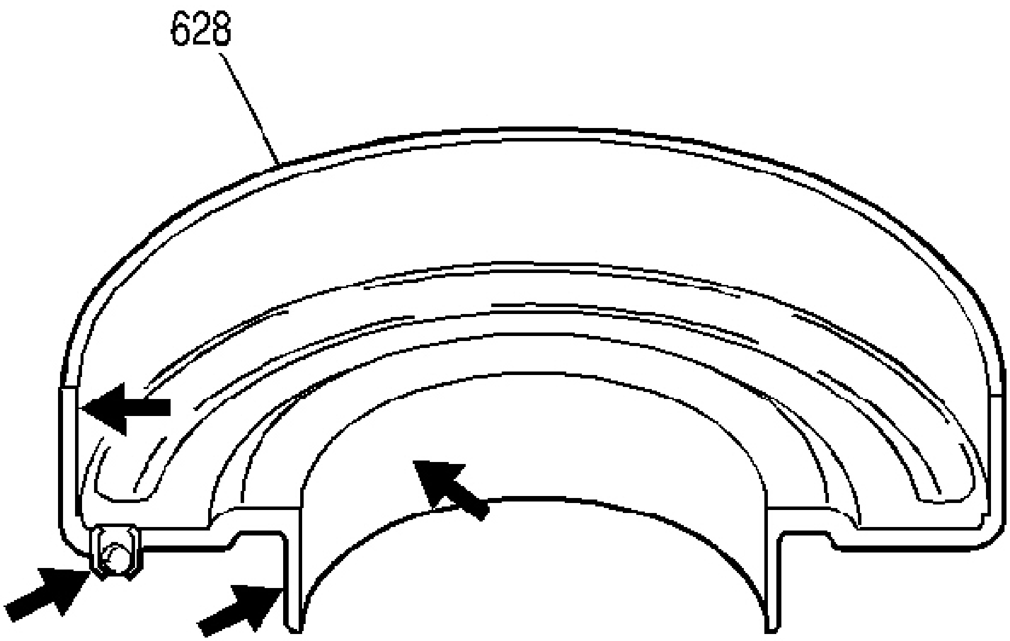


Fig. 310: Inspecting Forward Clutch Housing
Courtesy of GENERAL MOTORS CORP.

4. Inspect the forward clutch housing (628) for the following conditions:
    - Proper check ball operation
    - Damage or distortion
    - Burrs in the seal areas
    - Cracks

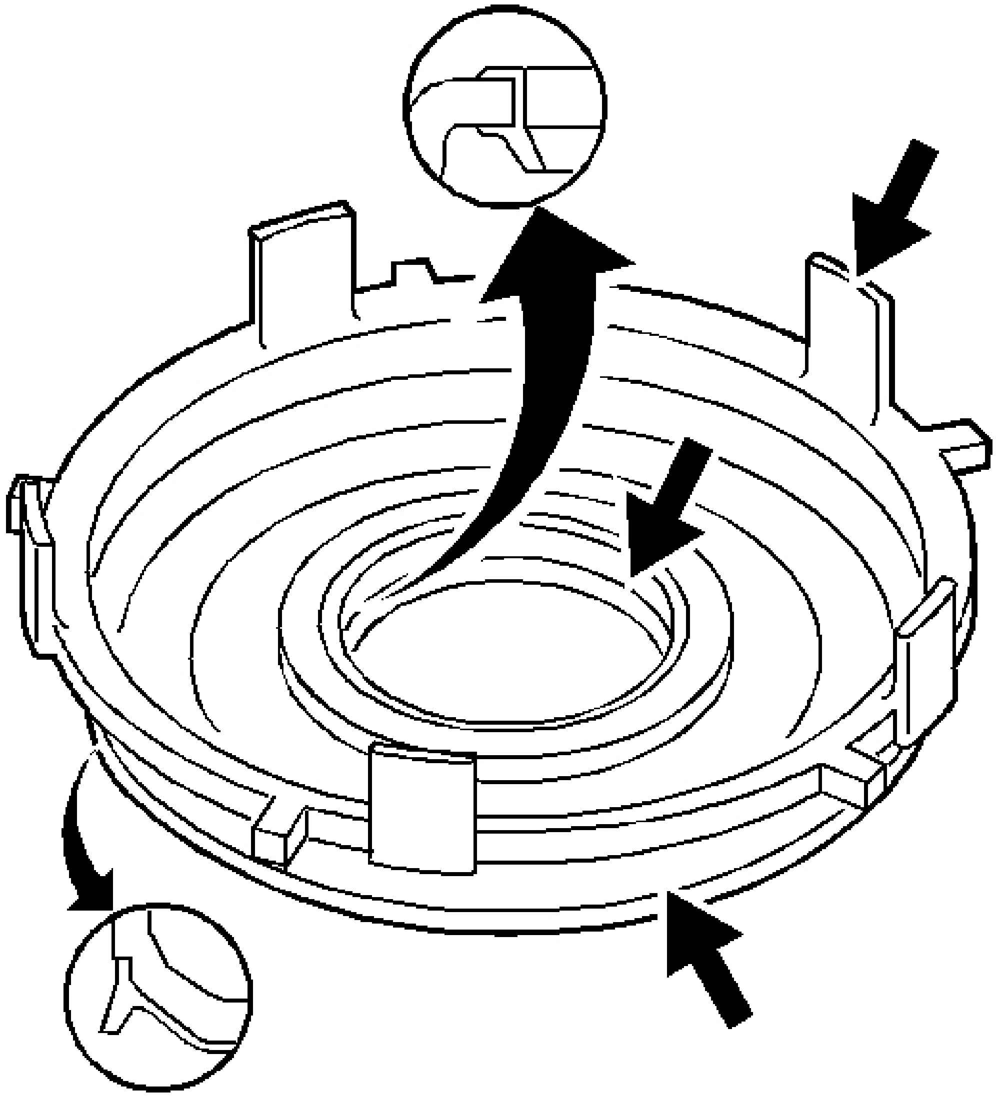


Fig. 311: Inspecting Forward Clutch Piston
Courtesy of GENERAL MOTORS CORP.

5. Inspect the forward clutch piston for the following conditions:
    - Porosity or damage
    - Seal damage
    - Apply leg damage

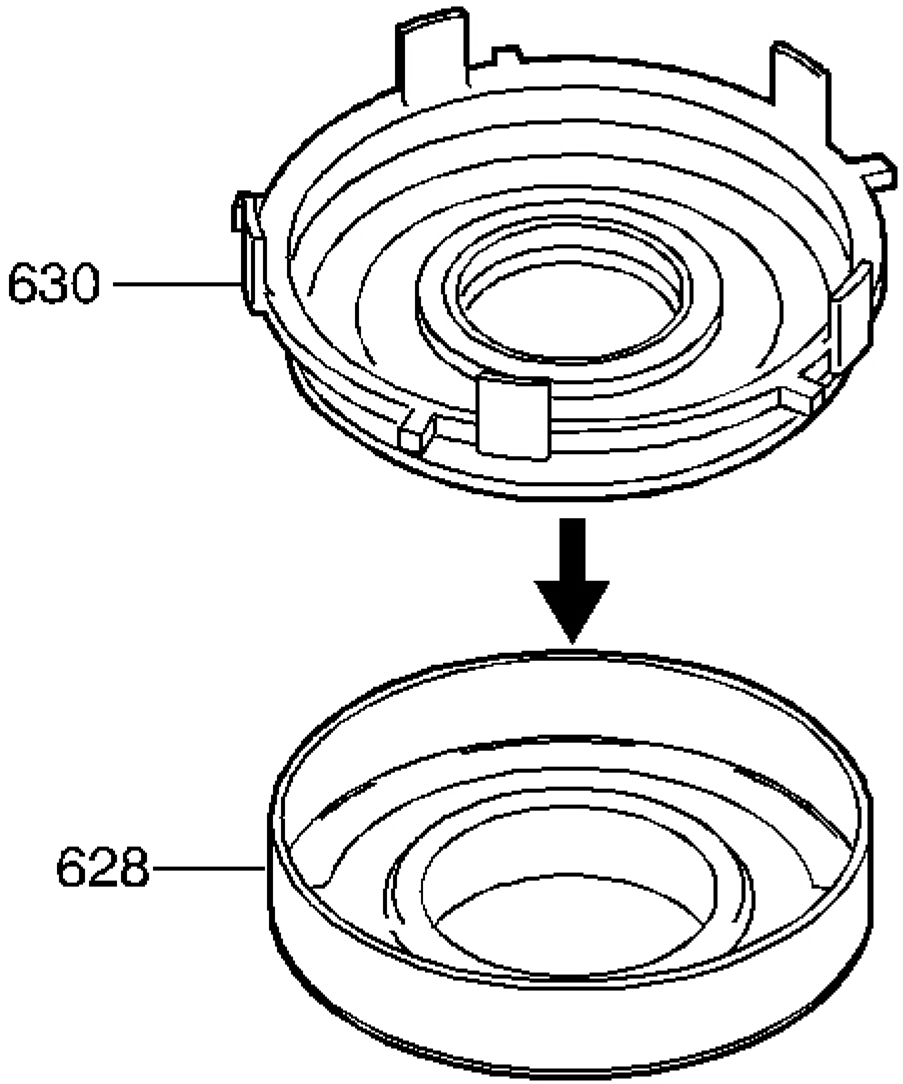


Fig. 312: Forward Clutch Piston & Forward Clutch Housing
Courtesy of GENERAL MOTORS CORP.

6. Install the forward clutch piston (630) into the forward clutch housing (628).

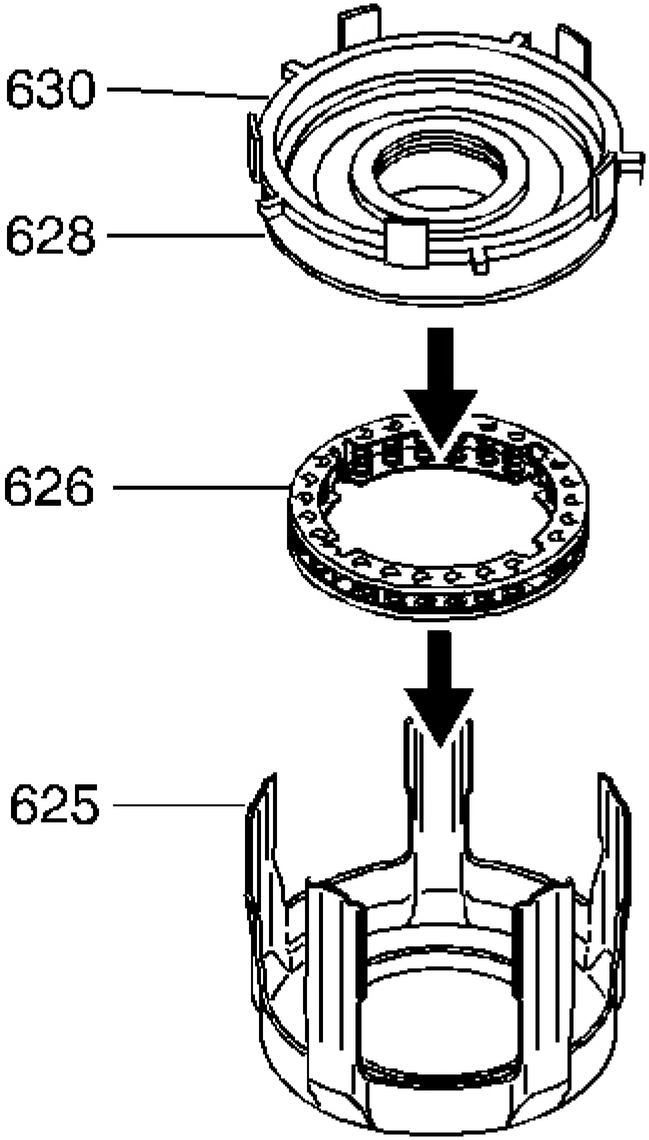


Fig. 313: 3rd & 4th Spring Assembly & Clutch Apply Ring
Courtesy of GENERAL MOTORS CORP.

7. Install the 3rd and 4th spring assembly (626) into the 3rd and 4th clutch apply ring (625).

IMPORTANT: The forward clutch piston (630) apply legs must be indexed with the 3rd and 4th clutch apply ring (625) legs.

8. Install the forward clutch housing (628) and forward clutch piston (630) into the 3rd and 4th apply ring (625).

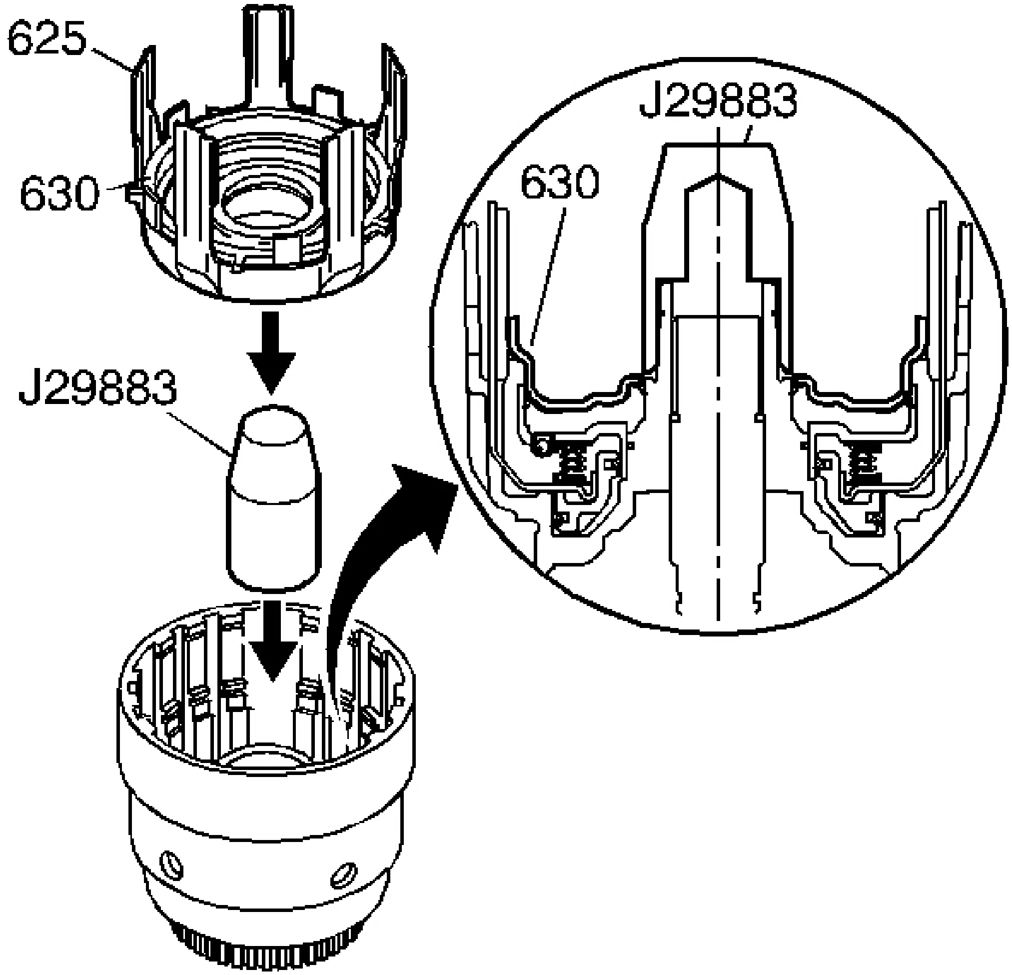


Fig. 314: Installing J 29883 On Input Housing
Courtesy of GENERAL MOTORS CORP.

9. Install the **J 29883** on the input housing. See **Special Tools and Equipment** .
10. Install the 3rd and 4th clutch apply ring and the forward housing and piston assembly using the following procedure:
    - Hold the assembly by the 3rd and 4th clutch apply ring (625) legs during installation.
    - Do not let the forward clutch piston (630) separate from the forward clutch housing.

- Firmly seat the assembly.

11. Remove the **J 29883** from the input housing. See **Special Tools and Equipment** .

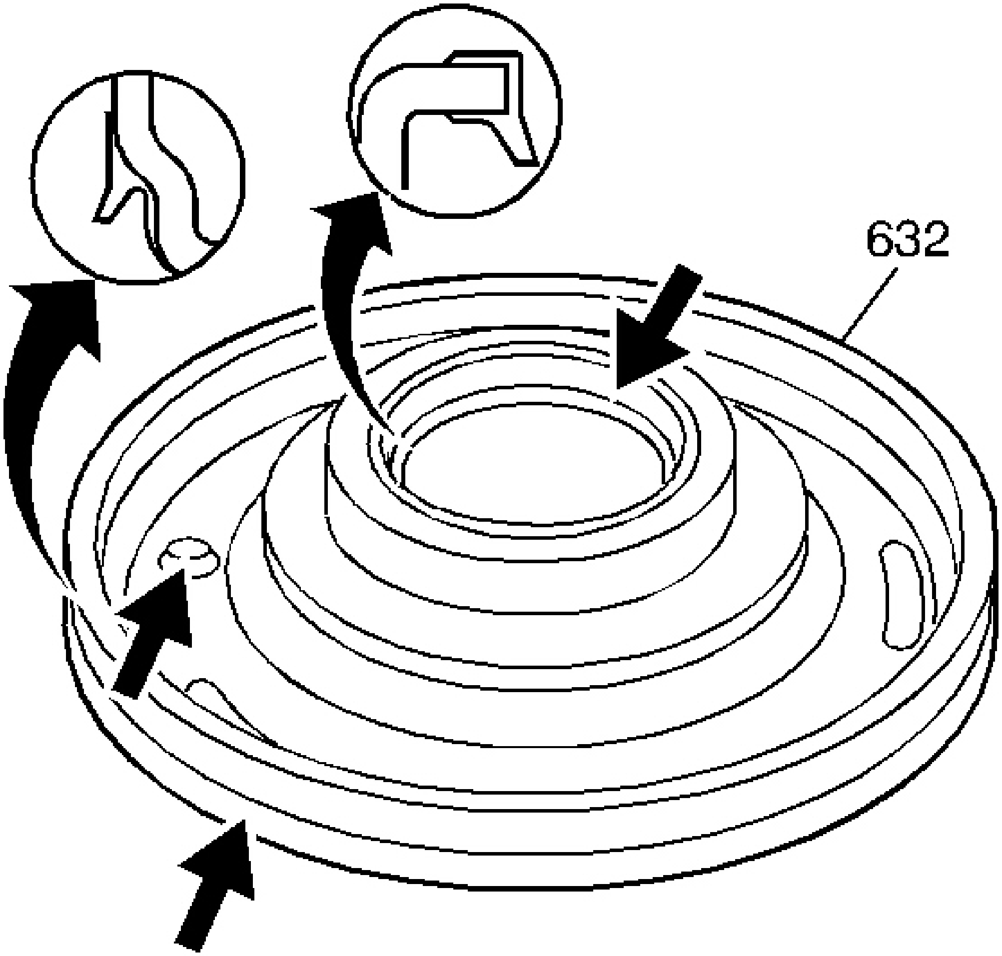


Fig. 315: Inspecting Overrun Clutch Piston
Courtesy of GENERAL MOTORS CORP.

12. Inspect the overrun clutch piston (632) for the following conditions:
    - Porosity or damage
    - Seal damage
    - Overrun clutch ball proper operation

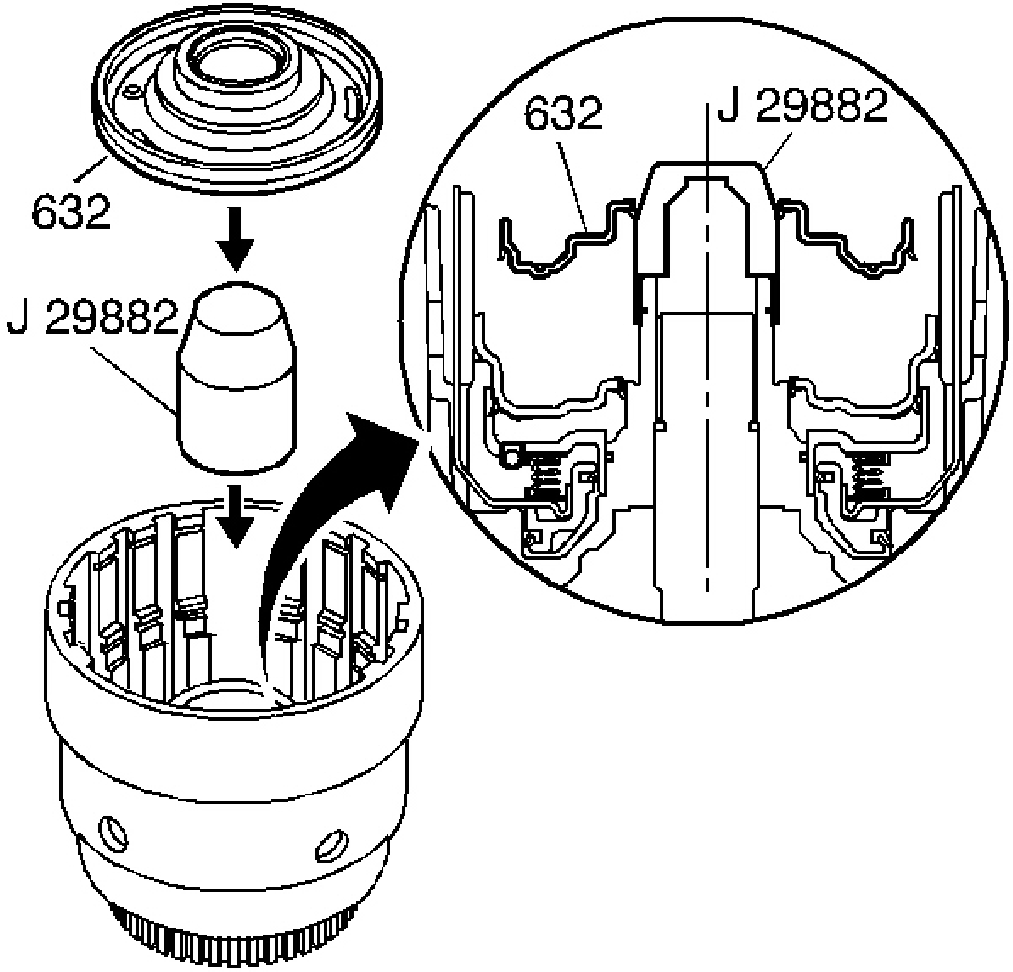


Fig. 316: Installing J 29882 & Overrun Clutch Piston On Input Housing
Courtesy of GENERAL MOTORS CORP.

13. Install the **J 29882** on the input housing. See **Special Tools and Equipment** .
14. Install the overrun clutch piston (632) into the input housing.
15. Remove the **J 29882** from the input housing. See **Special Tools and Equipment** .

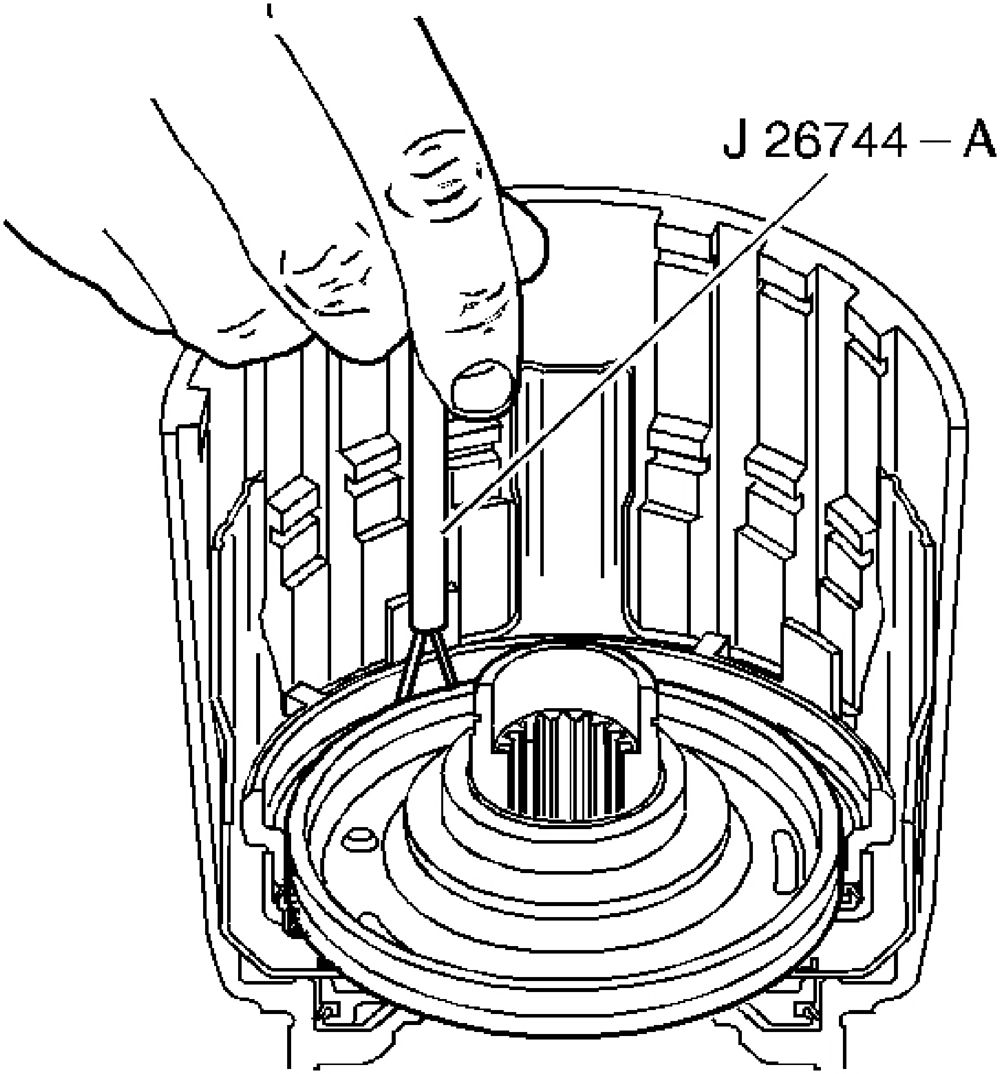


Fig. 317: Installing Overrun Clutch Piston Outer Seal Using J 26744-A
Courtesy of GENERAL MOTORS CORP.

16. Using the **J 26744-A** , carefully install the overrun clutch piston outer seal. See **Special Tools and Equipment** .

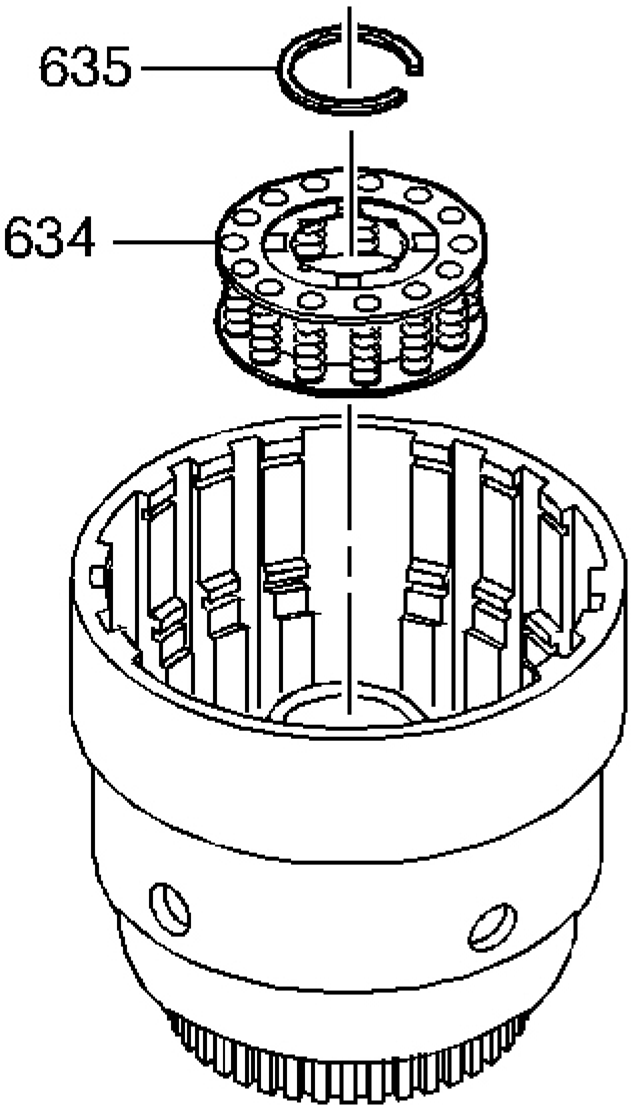


Fig. 318: Overrun Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

17. Install the overrun clutch spring (634) assembly.

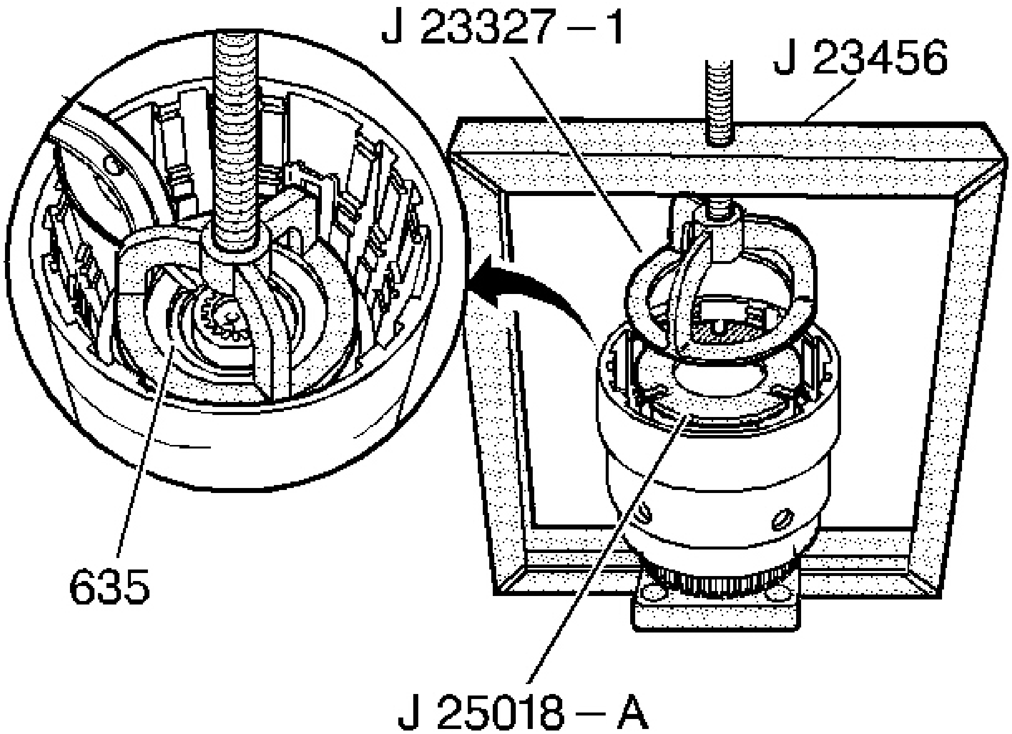


Fig. 319: View Of J 23327-1 & J 25018-A
Courtesy of GENERAL MOTORS CORP.

18. Install the **J 23327-1** and the **J 25018-A** , and compress the overrun clutch spring assembly using **J 23456** . See **Special Tools and Equipment** .
19. Install the overrun clutch spring retainer snap ring (635).
20. Remove the **J 23327-1** and the **J 25018-A** . See **Special Tools and Equipment** .

INPUT HOUSING TO OUTPUT SHAFT SEAL INSTALLATION

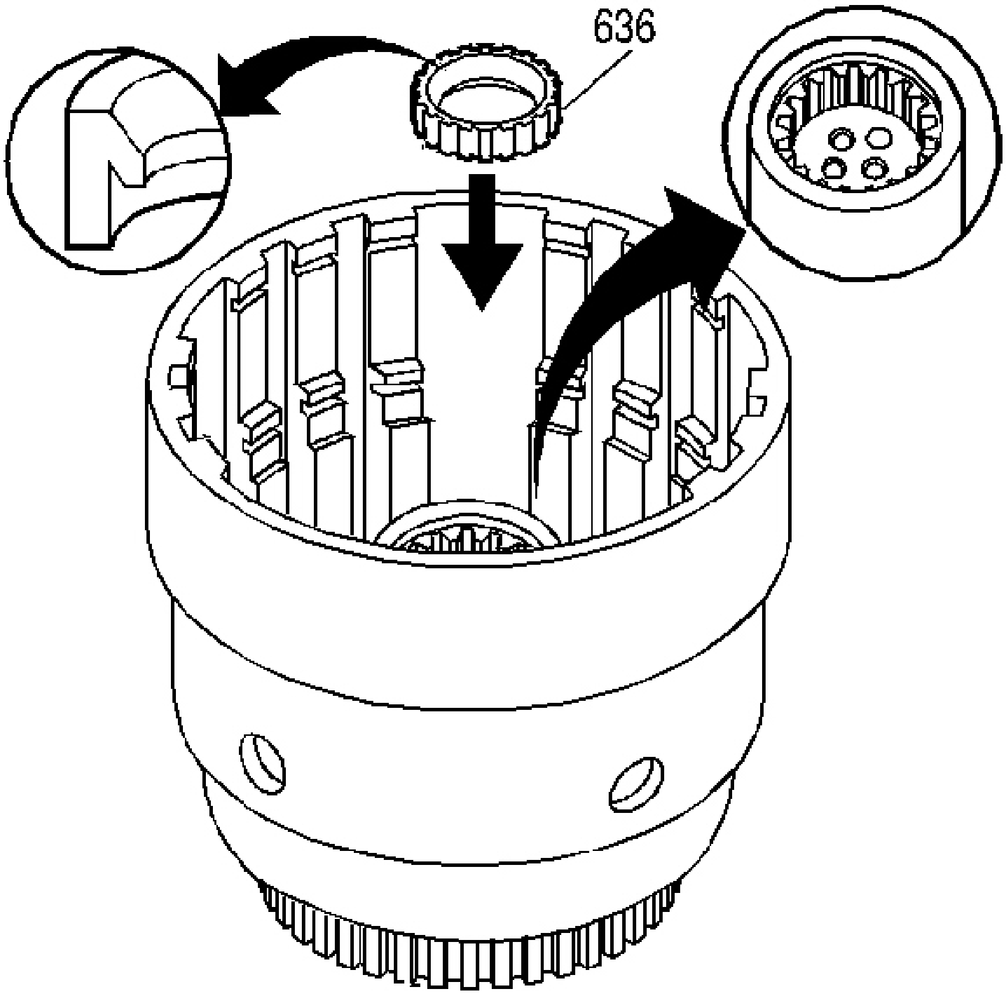


Fig. 320: Input Housing & Output Shaft Seal
Courtesy of GENERAL MOTORS CORP.

Install a new input housing to output shaft seal (636).

OVERRUN CLUTCH INSTALLATION

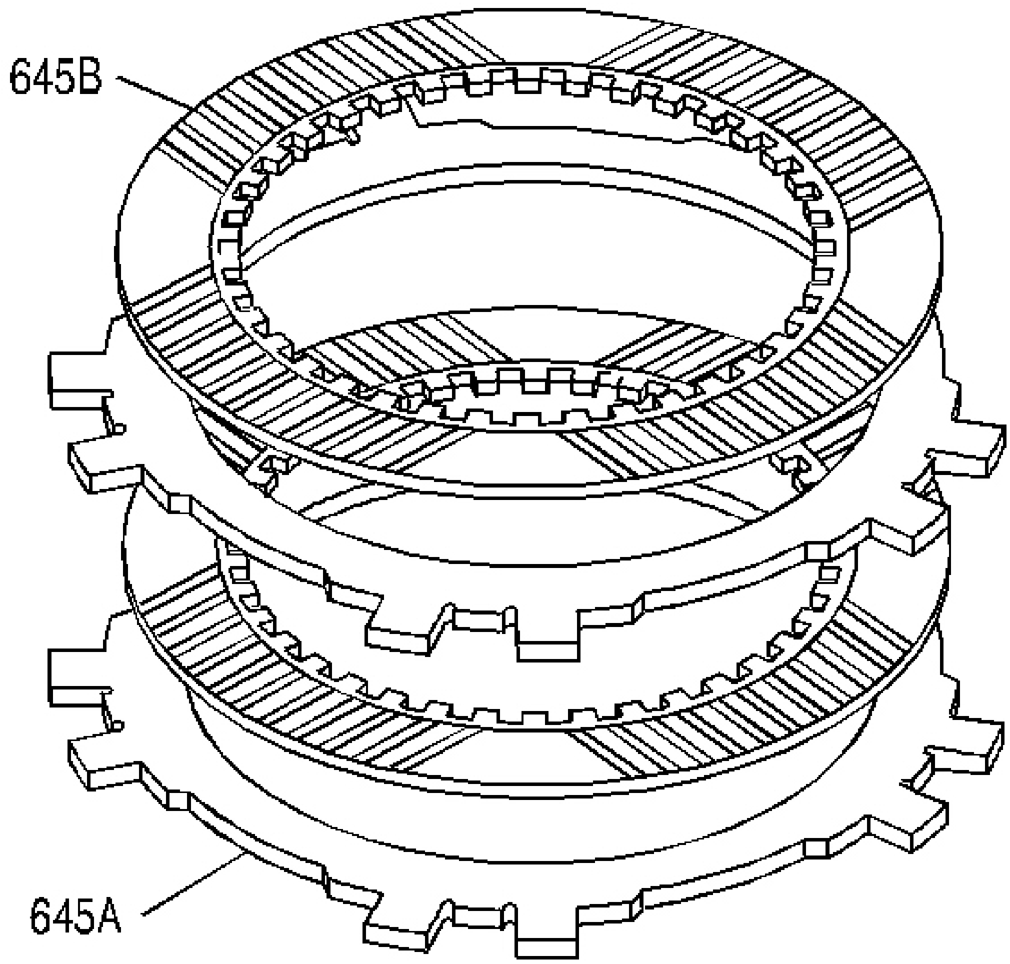


Fig. 321: Inspecting Fiber Plate Assemblies & Steel Plates
Courtesy of GENERAL MOTORS CORP.

1. Inspect the fiber plate assemblies (645B) and the steel plates (645A) for the following defects:
   - Damaged tangs
   - Delamination
   - Excessive wear
   - Wear or heat damage

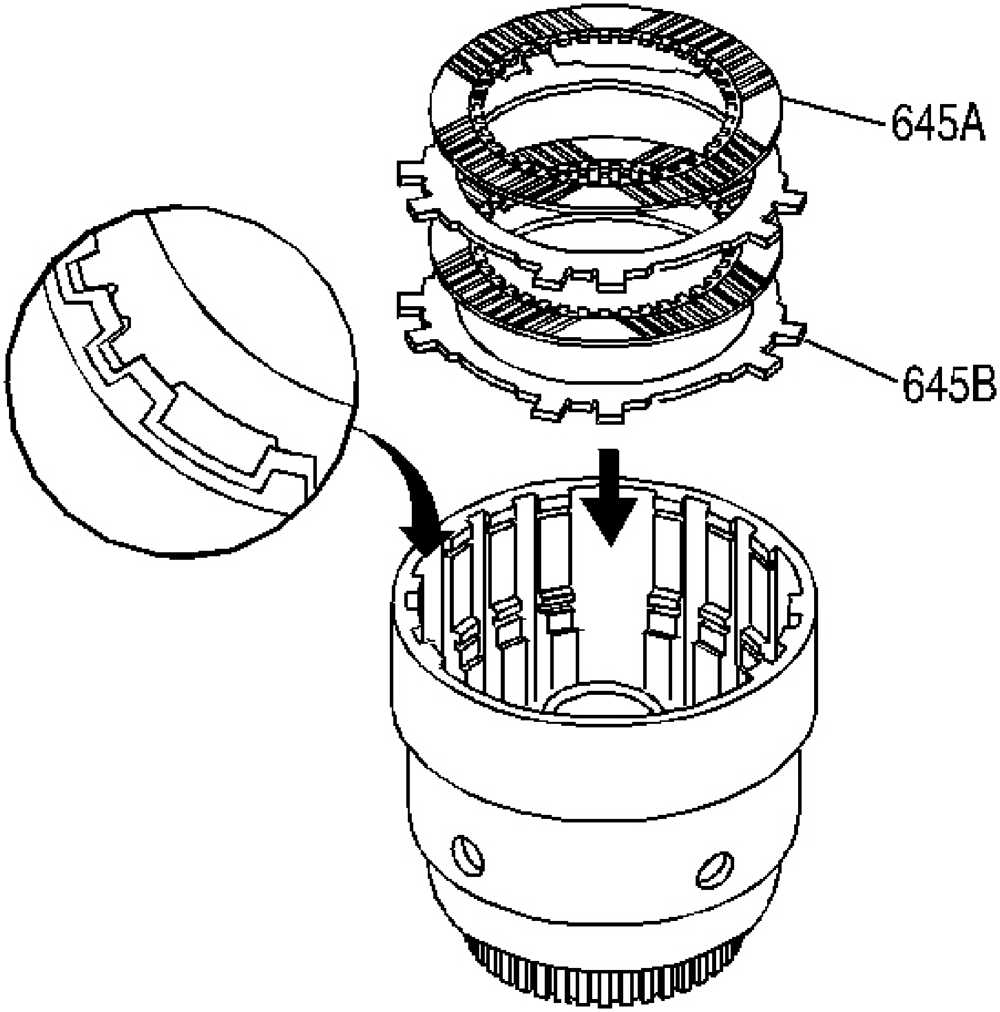


Fig. 322: Overrun Clutch Plates & Input Housing
Courtesy of GENERAL MOTORS CORP.

2. Install the overrun clutch plates into the input housing starting with a steel plate (645B) and alternating with fiber plate assemblies (645A).
3. Index the plates in the input housing with the wide notches remaining open.

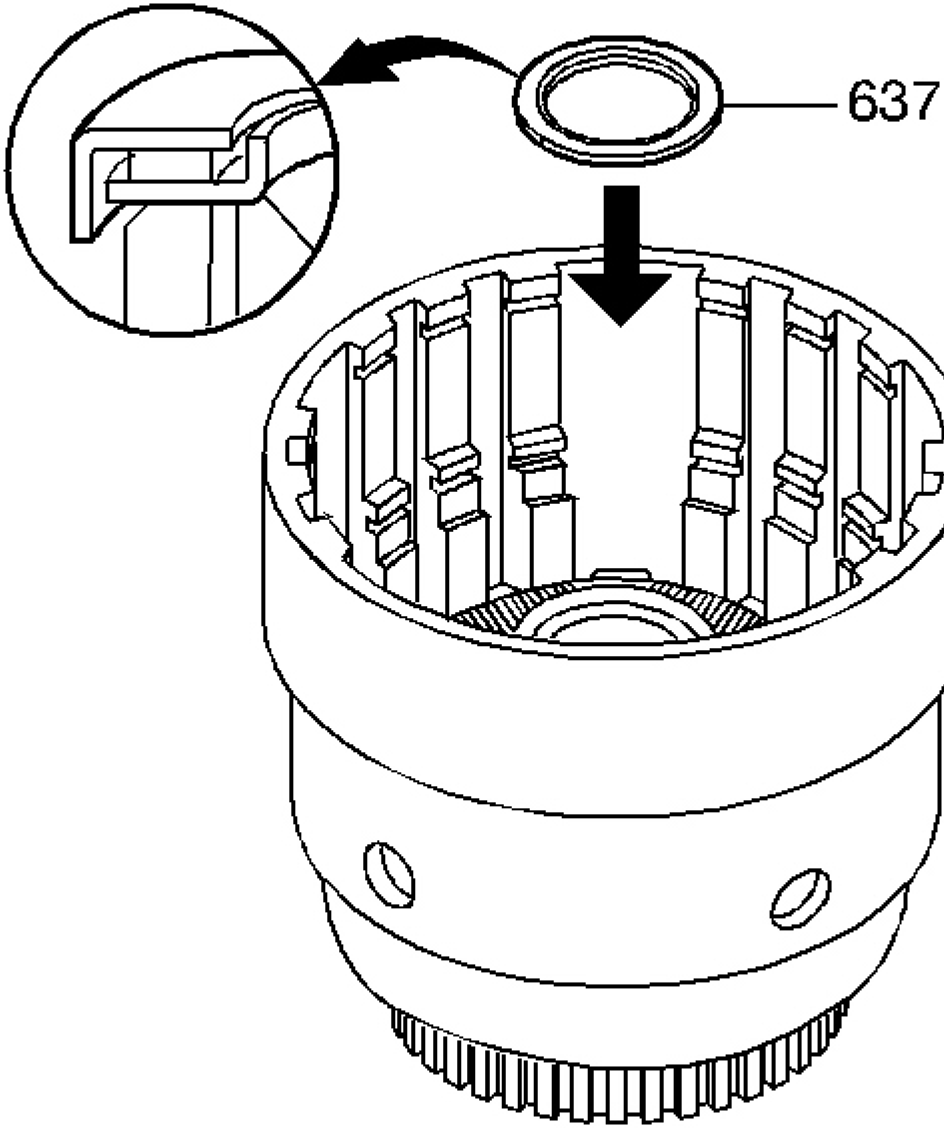
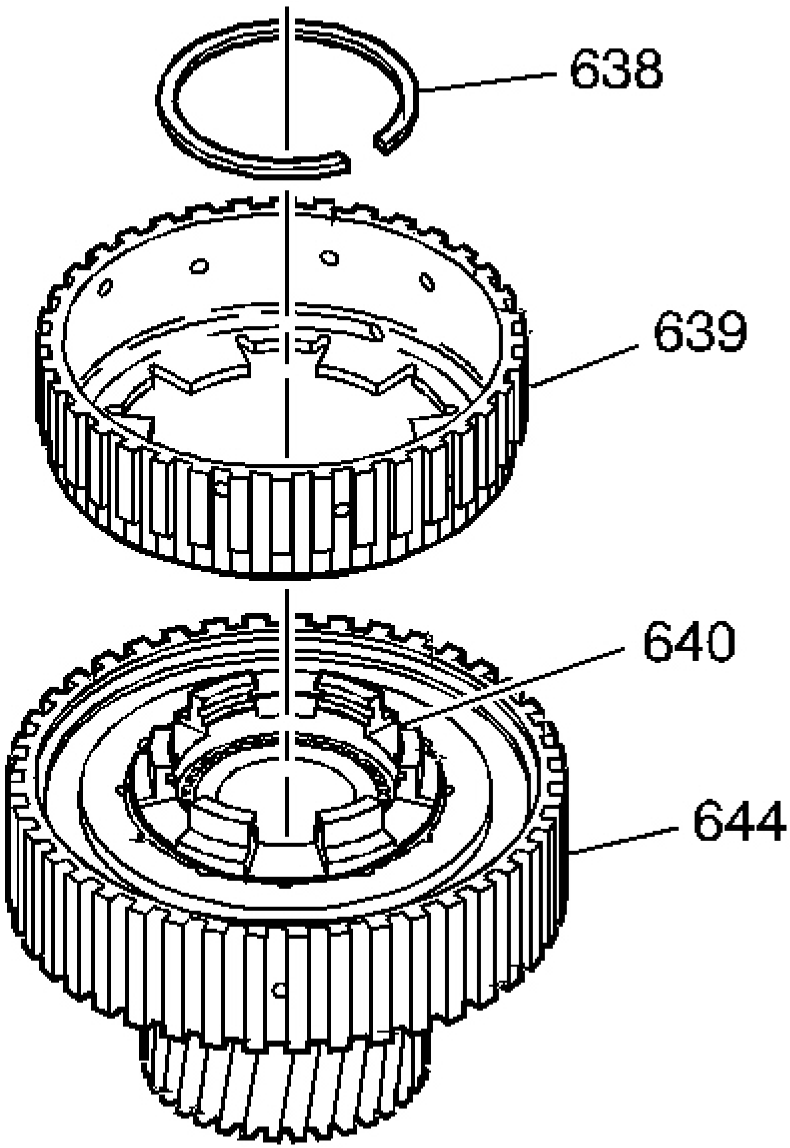


Fig. 323: Input Sun Gear Bearing Assembly & Input Housing
Courtesy of GENERAL MOTORS CORP.

4. Install the input sun gear bearing assembly (637) into the input housing.

FORWARD CLUTCH SPRAG DISASSEMBLE



<u>Fig. 324: Overrun Clutch Hub</u>
Courtesy of GENERAL MOTORS CORP.

1. Remove the overrun clutch hub retaining snap ring (638).
2. Remove the overrun clutch hub (639).
3. Remove the forward sprag clutch inner race and input sun gear assembly (640).

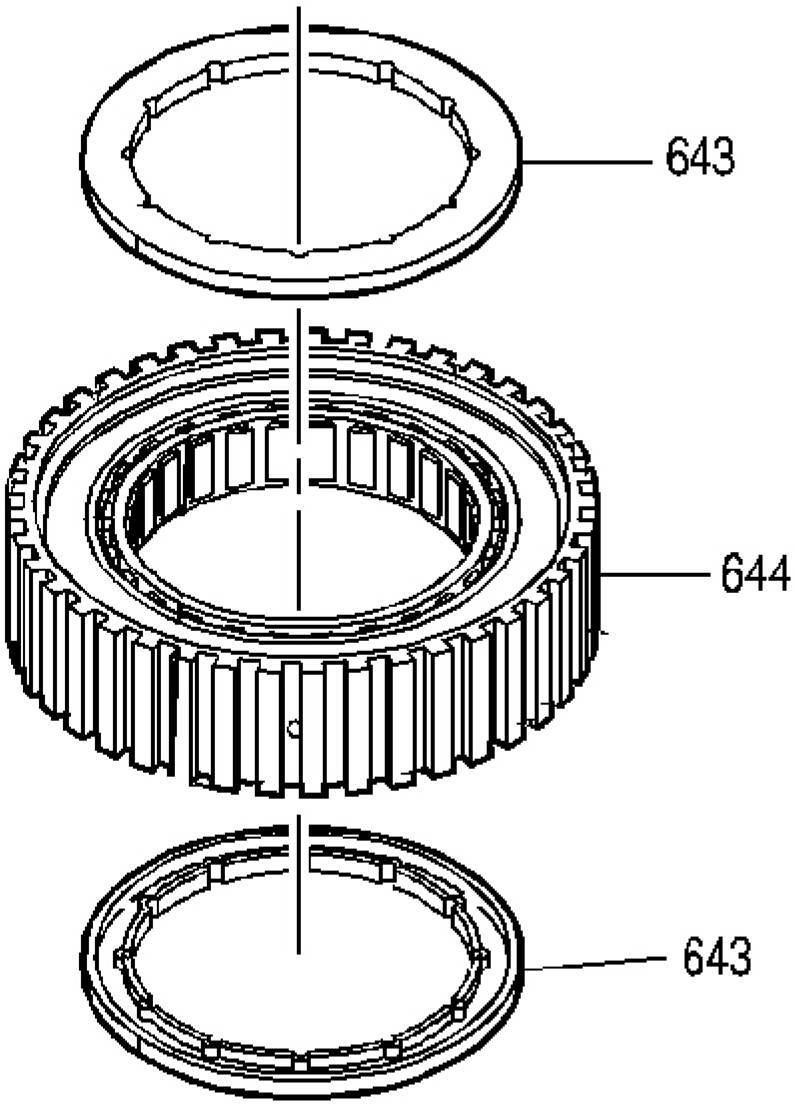


Fig. 325: Sprag Assembly Retainer Rings
Courtesy of GENERAL MOTORS CORP.

4. Remove the sprag assembly retainer rings (643).
5. Remove the forward sprag assembly from the forward clutch outer race (644).

FORWARD CLUTCH SPRAG ASSEMBLE

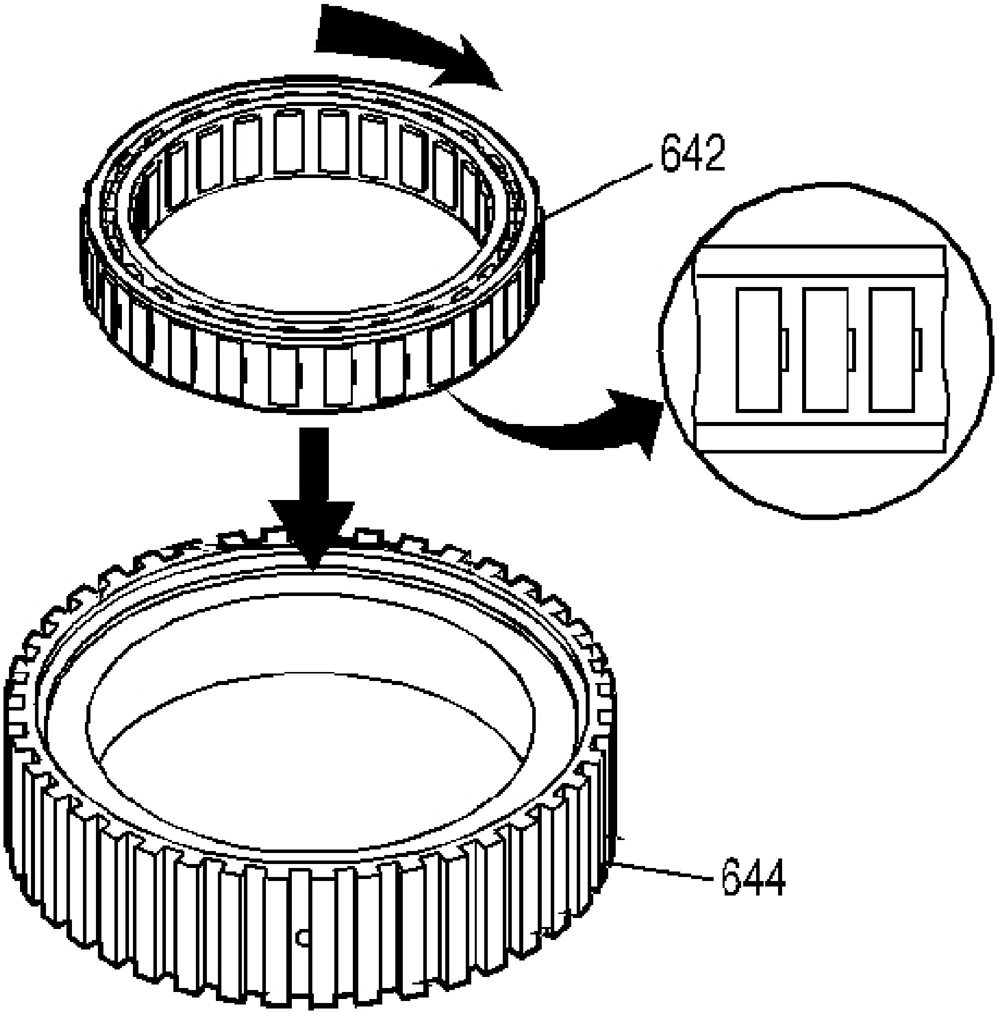


Fig. 326: Inspecting Forward Sprag Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the forward sprag assembly (642) for the following conditions:
   - Wear or damage
   - Weak or broken springs
2. Inspect the forward clutch outer race (644) for the following conditions:
   - Race wear or damage
   - Spline wear

- Surface finish damage

3. Install the forward sprag assembly (642) into the forward clutch outer race (644).

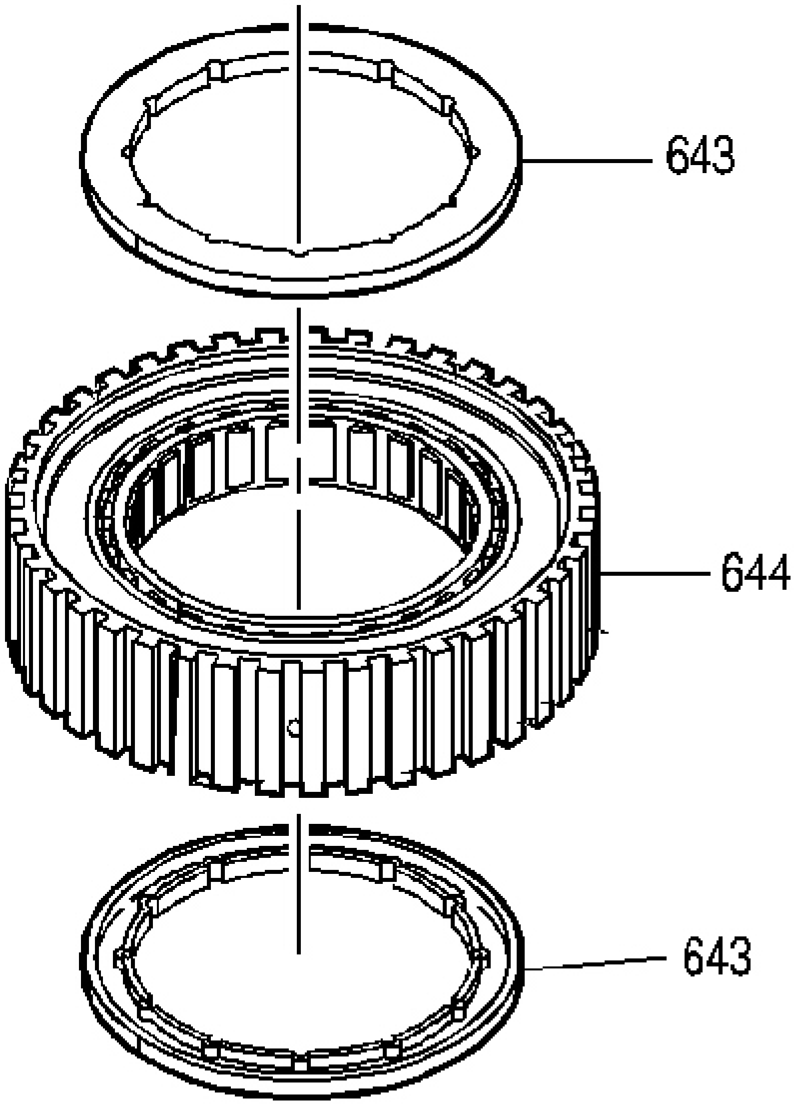


Fig. 327: Sprag Assembly Retainer Rings
Courtesy of GENERAL MOTORS CORP.

4. Inspect the sprag assembly retainer rings (643) for wear or damage.

5. Install the sprag assembly retainer rings (643) into the forward clutch sprag assembly (644).

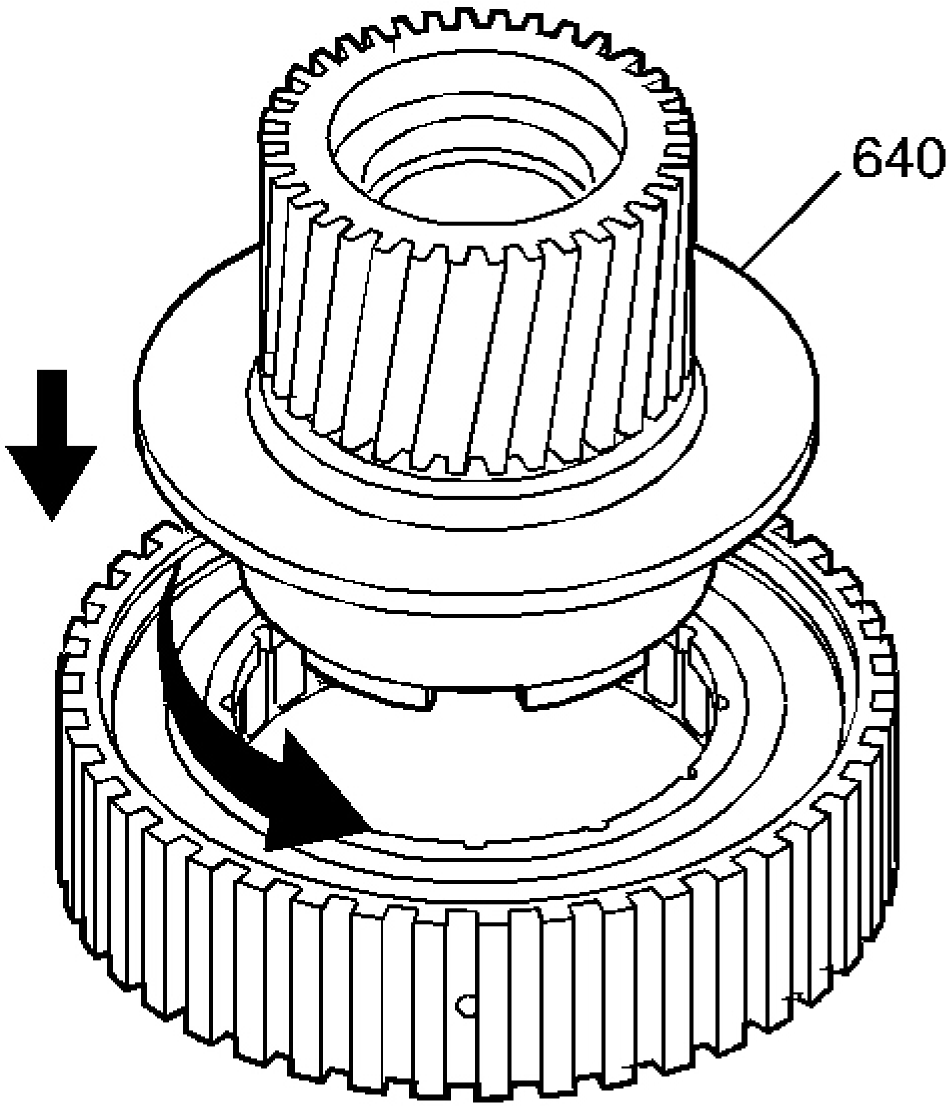


Fig. 328: Inspecting Forward Sprag Clutch Inner Race & Input Sun Gear Assembly
Courtesy of GENERAL MOTORS CORP.

6. Inspect the forward sprag clutch inner race and input sun gear assembly (640) for the following conditions:

- Damaged spline or gear teeth
- Ring groove damage
- Surface finish damage
- Loose retainer
- Wear
- Cracks

7. Install the forward sprag clutch inner race and input sun gear assembly (640) into the forward sprag and outer race assembly.

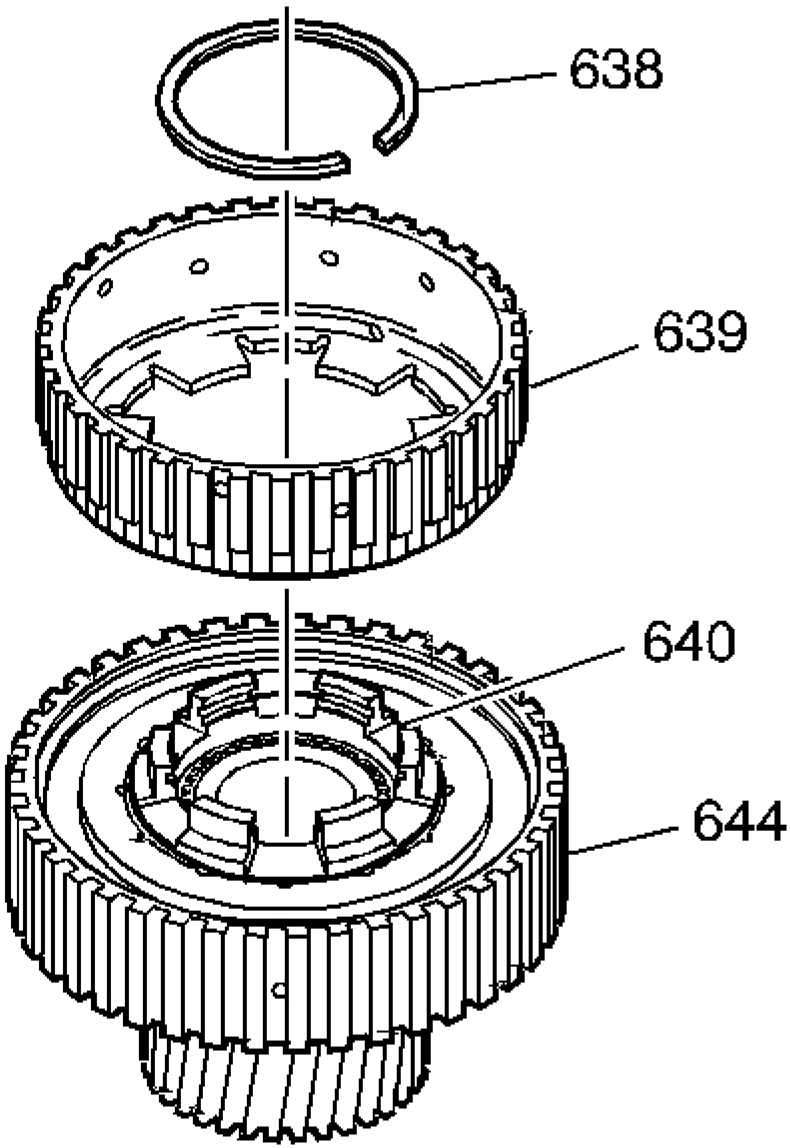


Fig. 329: Overrun Clutch Hub
Courtesy of GENERAL MOTORS CORP.

8. Inspect the overrun clutch hub (639) for the following conditions:
    - Spline damage
    - Plugged lubrication holes

- Damaged tangs
- Cracks

9. Install the overrun clutch hub (639) onto the sprag clutch inner race and input sun gear assembly (640).
10. Install the overrun clutch hub retaining snap ring (638).

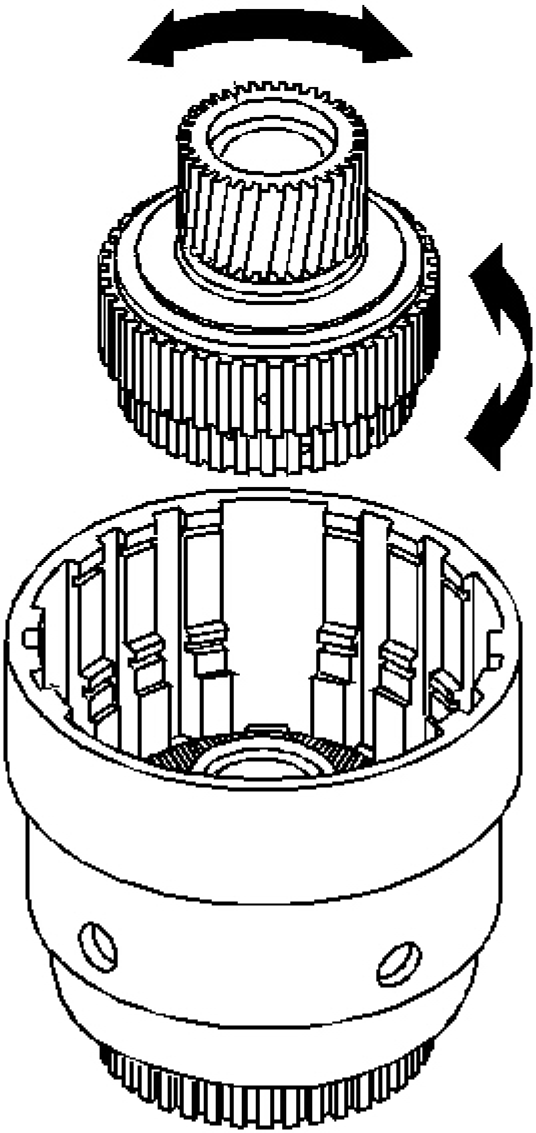


Fig. 330: Reassembling The Sprag

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the forward clutch sprag assembly operates backwards, you have installed the sprag backwards. Reassemble the sprag correctly.

11. Test the forward clutch sprag assembly for proper operation.
    1. Position the forward clutch sprag assembly with the input sun gear facing up.

       IMPORTANT: The sun gear should only rotate in a counterclockwise direction.

    2. Hold the forward sprag clutch outer race with one hand and rotate the input sun gear with the other hand.
12. Install the forward clutch sprag and input sun gear assembly into the input clutch housing.
13. Index the overrun clutch hub into the overrun clutch plates.

FORWARD CLUTCH ASSEMBLY ASSEMBLE

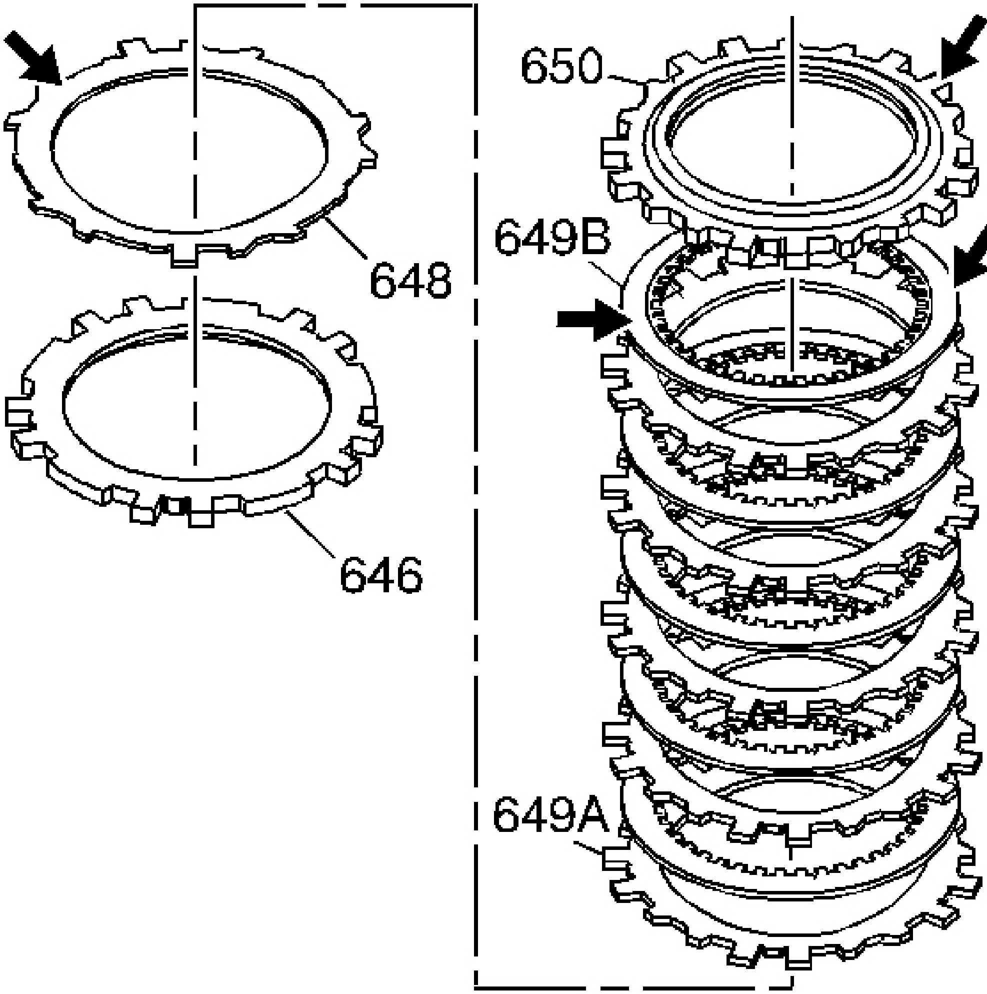


Fig. 331: Inspecting (648), (646), (649B), (649A) & (650)
Courtesy of GENERAL MOTORS CORP.

1. Inspect the forward clutch waved plate (648), the apply plate (646), the fiber plate assemblies (649B), the steel plates (649A) and the selective backing plate (650) for the following conditions:
   - Damaged tangs
   - Delamination
   - Excessive wear
   - Heat damage
   - Flatness

- Surface finish damage
- Burrs and nicks

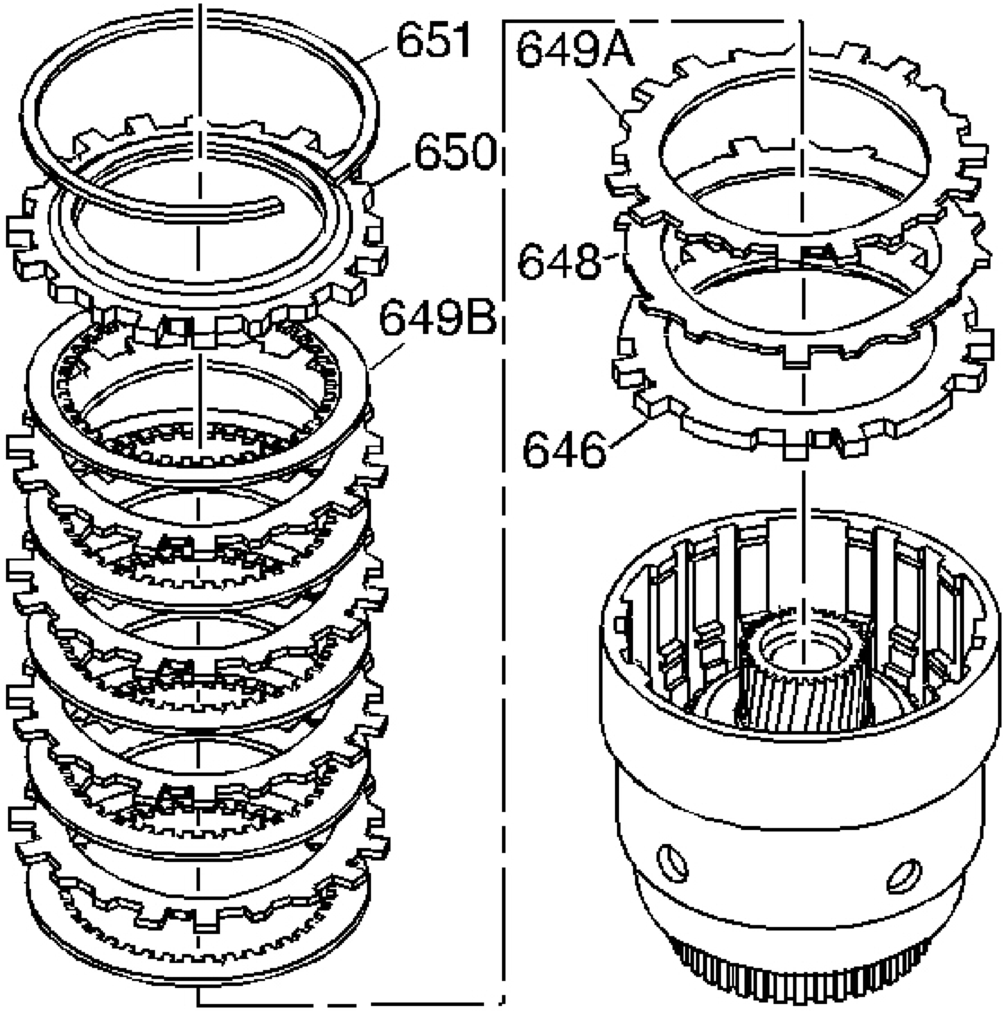


Fig. 332: Installing (646), (648), (649A), (649B), (650), (651)
Courtesy of GENERAL MOTORS CORP.

2. Install the forward clutch apply plate (646).
3. Install the forward clutch waved plate (648).
4. Install the forward clutch steel plates (649A) and alternate with the fiber plate assemblies (649B).
5. Install the forward clutch selective backing plate (650).

6. Install the forward clutch backing plate retainer ring (651).

FORWARD CLUTCH PISTON TRAVEL CHECK

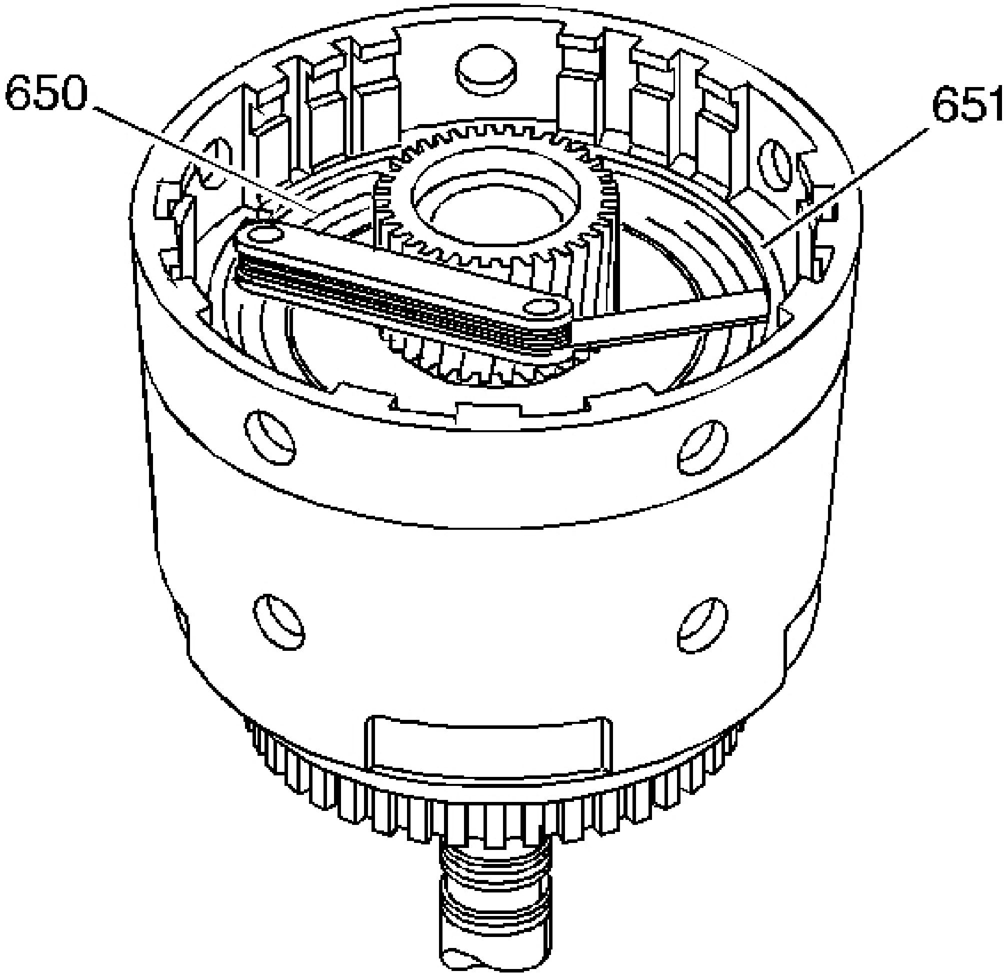


Fig. 333: Forward Clutch Backing Plate Retainer Ring & Forward Clutch Selective Backing Plate
Courtesy of GENERAL MOTORS CORP.

1. Use feeler gauges to check the forward clutch plate travel. Check travel between the forward clutch backing plate retainer ring (651) and the forward clutch selective backing plate (650).

   The forward clutch plate travel should be:

Specification: 298 mm/300 mm Torque Converter- 0.866-1.876 mm (0.034-0.074 in)

2. Select the proper forward clutch selective backing plate (650) to obtain the correct travel. Refer to **Forward Clutch Backing Plate Selection** .

3-4 CLUTCH ASSEMBLE

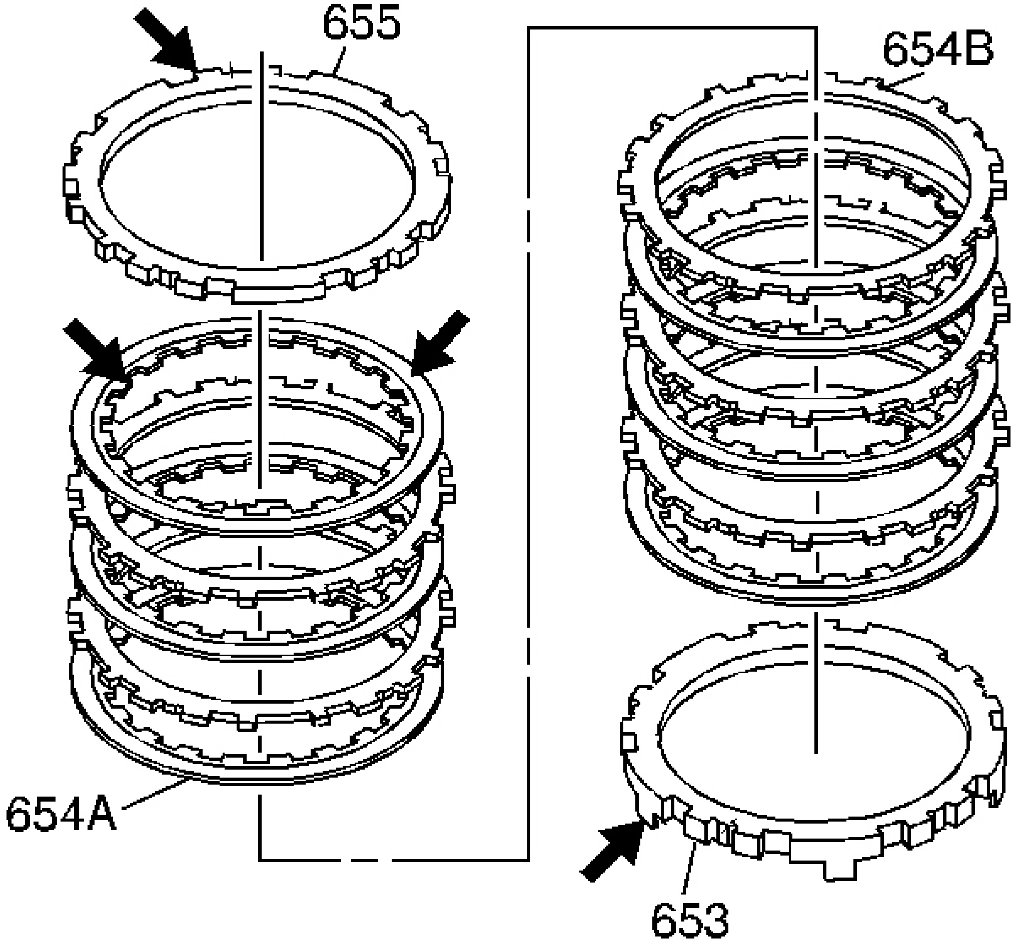


Fig. 334: Inspecting (653), (654A), (654B), & (655)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The part 654A may have 5, 6 or 7 plates.

1. Inspect the 3rd and 4th clutch apply plate (653), the fiber plate assemblies (654A), the steel plates (654B)

and the selective backing plate (655) for the following conditions:

- Damaged tangs
- Delamination
- Excessive wear
- Heat damage or wear
- Surface finish
- Flatness

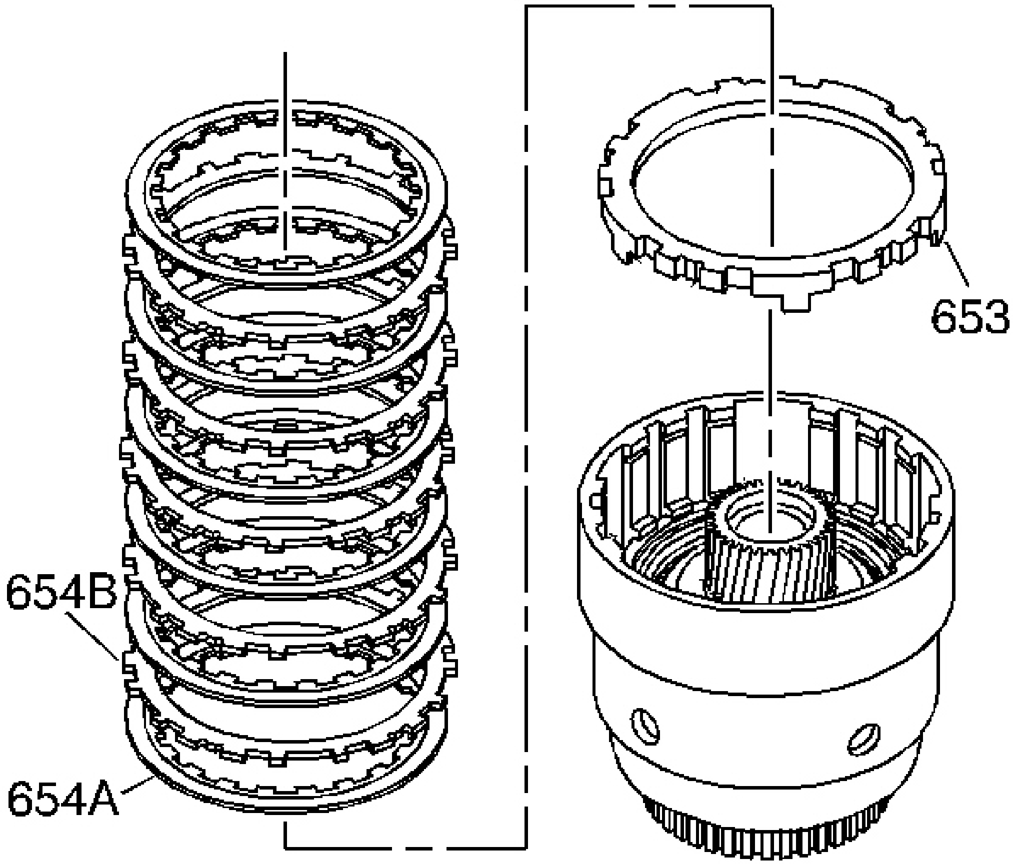


Fig. 335: Installing 3rd & 4th Clutch Apply Plate Into Input Housing
Courtesy of GENERAL MOTORS CORP.

2. Install the 3rd and 4th clutch apply plate (653) into the input housing. Index each leg of the apply plate into the apply ring legs.

IMPORTANT: The first steel plate (654B) has the same spline configuration as the 3rd and 4th clutch apply plate (653).

IMPORTANT: The M30 RPO 3-4 clutch plate stack up is 5 fiber plates, and 6 fiber plates on all other models. The M32 RPO (heavy-duty design) uses 7 fiber plates. These fiber plates are a thinner thickness which can not be used in a M30 stack up. M32 fiber plates must not be used in a M30 design.

NOTE: The correct number of fiber plates must be used to avoid damage to the transmission. An incorrect stack up height can cause either excessive clutch slippage or insufficient release, resulting in burned clutch plates.

3. Install the 3rd and 4th clutch plates starting with a fiber plate assembly (654A) and alternate with a steel plate (654B).

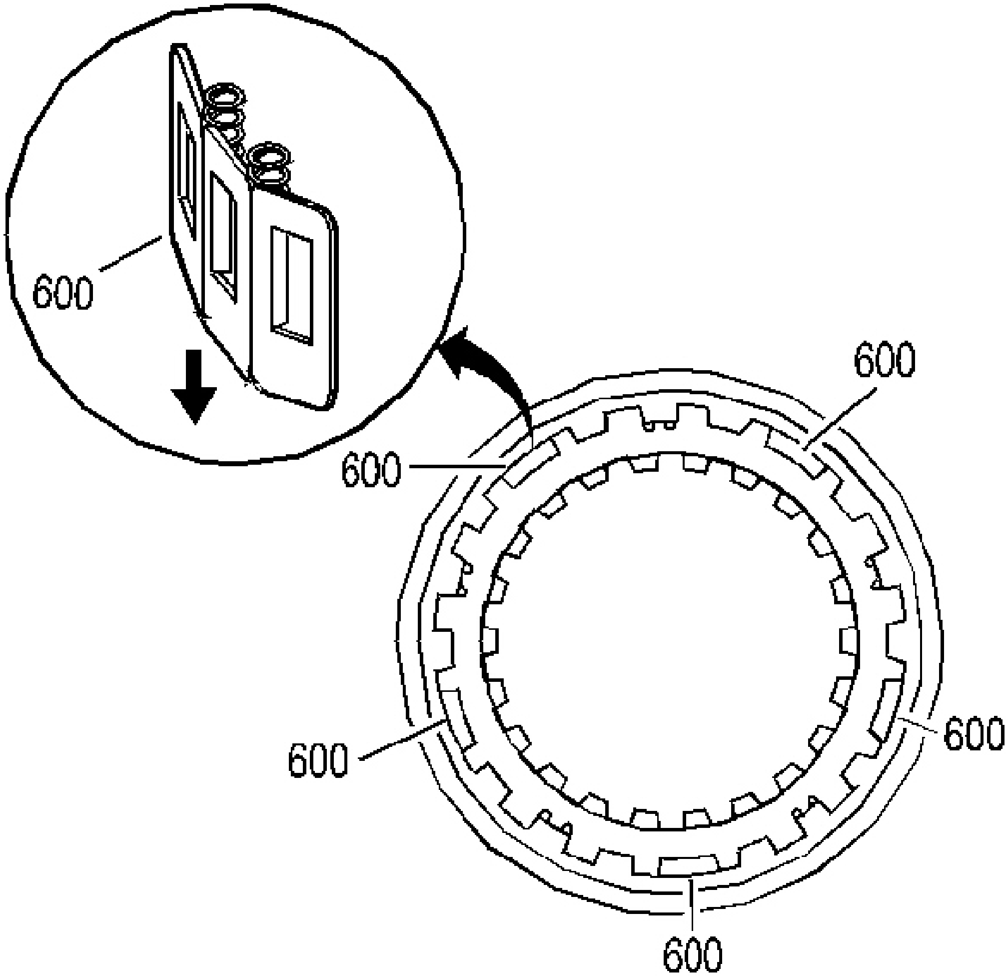


Fig. 336: 3-4 Clutch Boost Spring Assemblies & Input Housing
Courtesy of GENERAL MOTORS CORP.

4. Install the 3-4 clutch boost spring assemblies (600) into the input housing.

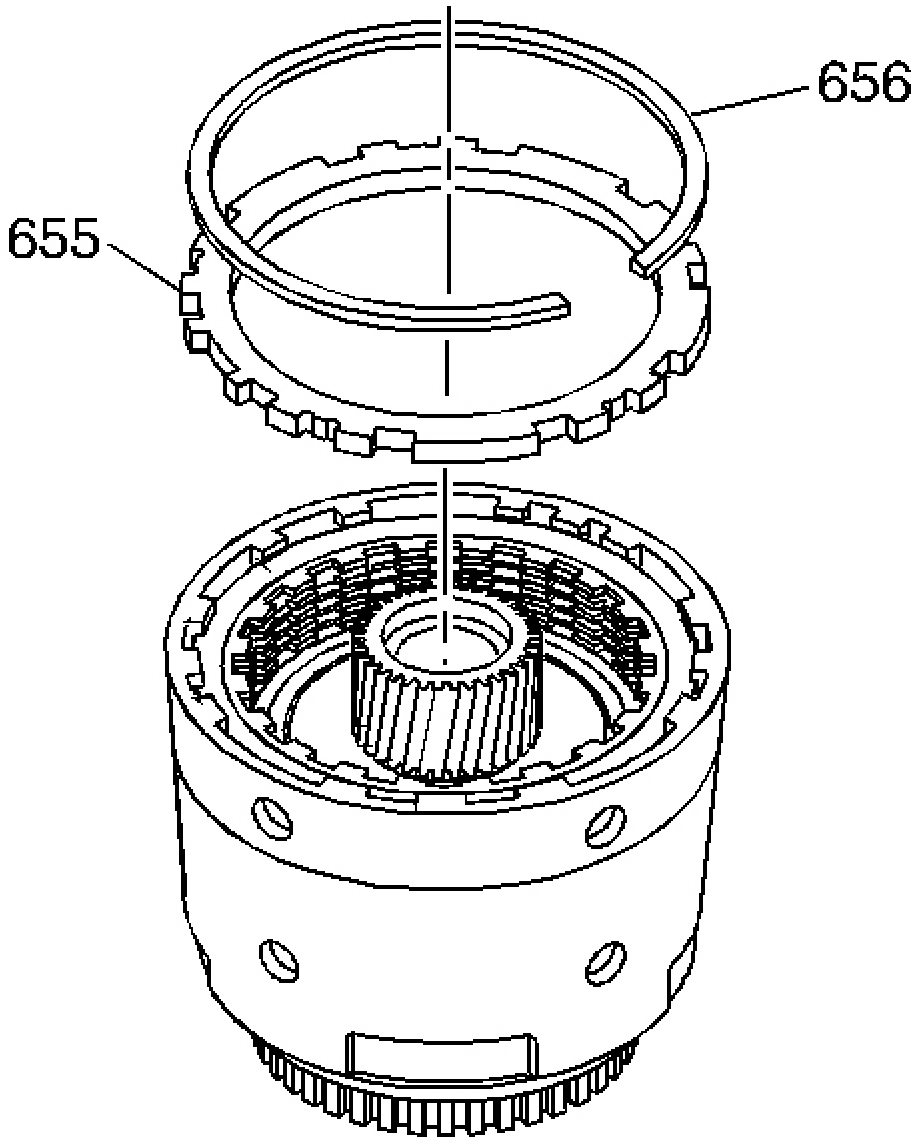


Fig. 337: Installing 3rd & 4th Clutch Selective Backing Plate
Courtesy of GENERAL MOTORS CORP.

5. Install the 3rd and 4th clutch selective backing plate (655). Some models may have a chamfer on one side of the selective backing plate. Install the chamfer side up.
6. Install the 3rd and 4th clutch backing plate retainer ring (656).

3-4 CLUTCH PLATE TRAVEL CHECK

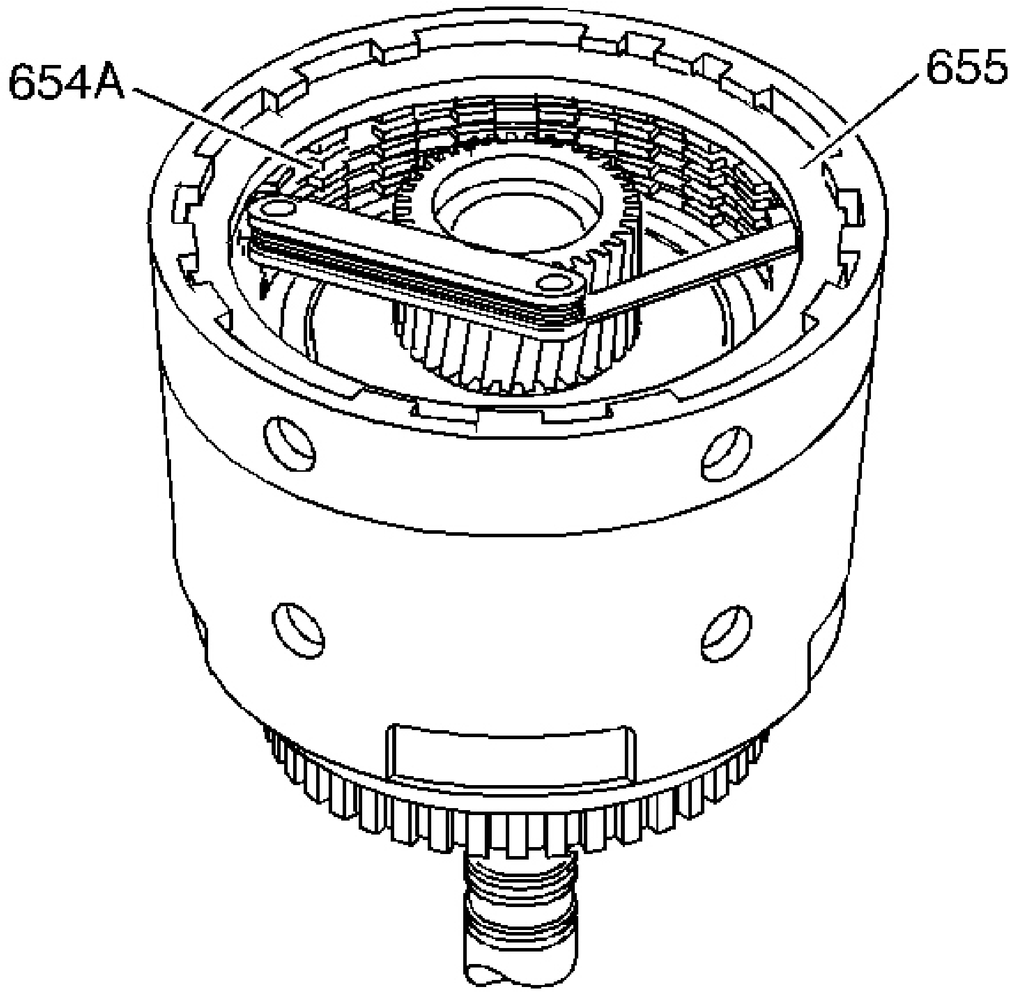


Fig. 338: Selective Backing Plate & First Fiber Plate Assembly
Courtesy of GENERAL MOTORS CORP.

1. Use feeler gauges to check the 3rd and 4th clutch plate travel.
2. Check the travel between the selective backing plate (655) and the first fiber plate assembly (654A).

   The 3rd and 4th clutch plate travel should be 0.90-2.10 mm (0.035-0.083 in).

3. Select the proper 3rd and 4th clutch selective backing plate to obtain the correct travel. Refer to **Third and Fourth Clutch Backing Plate Selection** .

CLUTCH AIR CHECK

Inspection Procedure

IMPORTANT: When the overrun clutch is checked, the air will blow by the forward clutch piston lip seals and exit out of the forward clutch feed hole in the turbine shaft.

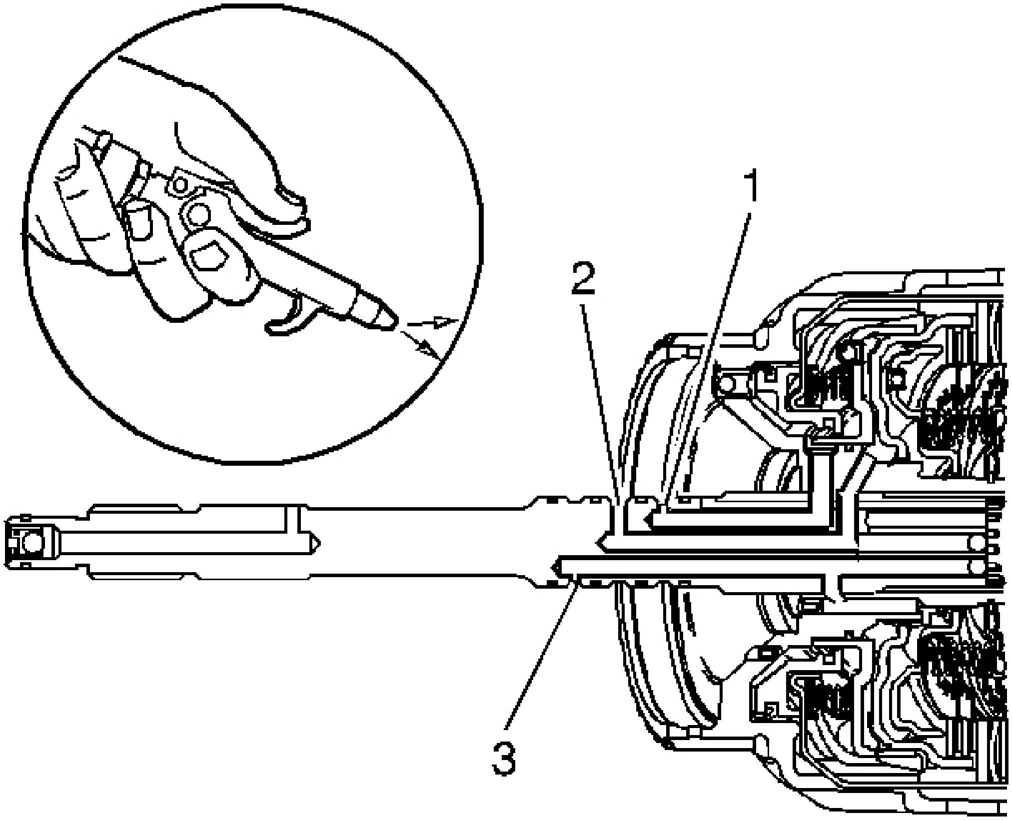


Fig. 339: Applying Air Into Feed Holes In Turbine Shaft
Courtesy of GENERAL MOTORS CORP.

Apply air into the feed holes in the turbine shaft in order to check the following items:

- The 3rd and 4th clutch (1)
- The forward clutch (2)
- The overrun clutch (3)

TURBINE SHAFT SEALS INSTALLATION

Tools Required

- **J 36418-1B** Turbine Shaft Seal Installer. See **Special Tools and Equipment** .
- **J 36418-2A** Turbine Shaft Seal Sizer. See **Special Tools and Equipment** .

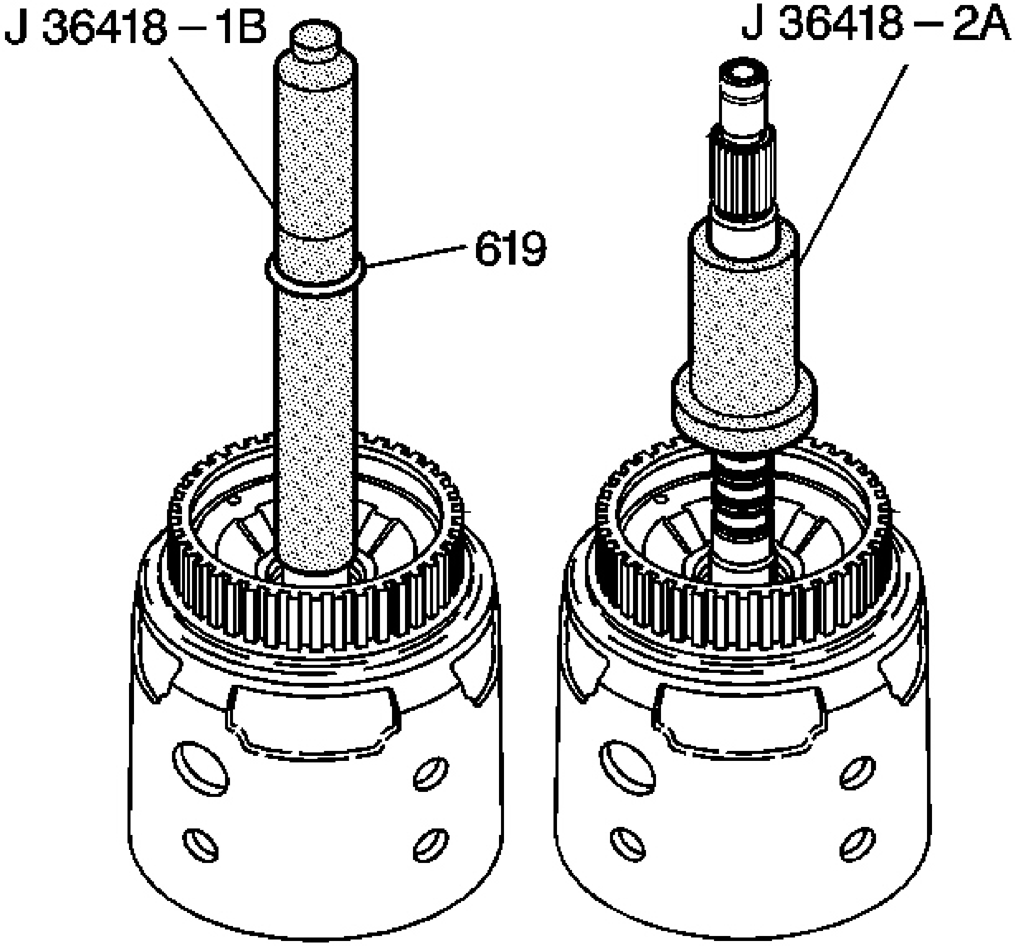


Fig. 340: Installing Four Turbine Shaft Oil Seal Rings
Courtesy of GENERAL MOTORS CORP.

1. Use the **J 36418-1B** in order to install the four turbine shaft oil seal rings (619). See **Special Tools and Equipment** .
2. Place the **J 36418-2A** over the turbine shaft oil seal rings (619). Leave the **J 36418-2A** on the shaft until

the reverse input clutch must be installed on the input clutch. See **Special Tools and Equipment** .

REVERSE INPUT CLUTCH DISASSEMBLE

Tools Required

- **J 23327-1** Forward Clutch Spring Compressor (Bridge). See **Special Tools and Equipment** .
- **J 25018-A** Clutch Spring Compressor Adapter. See **Special Tools and Equipment** .

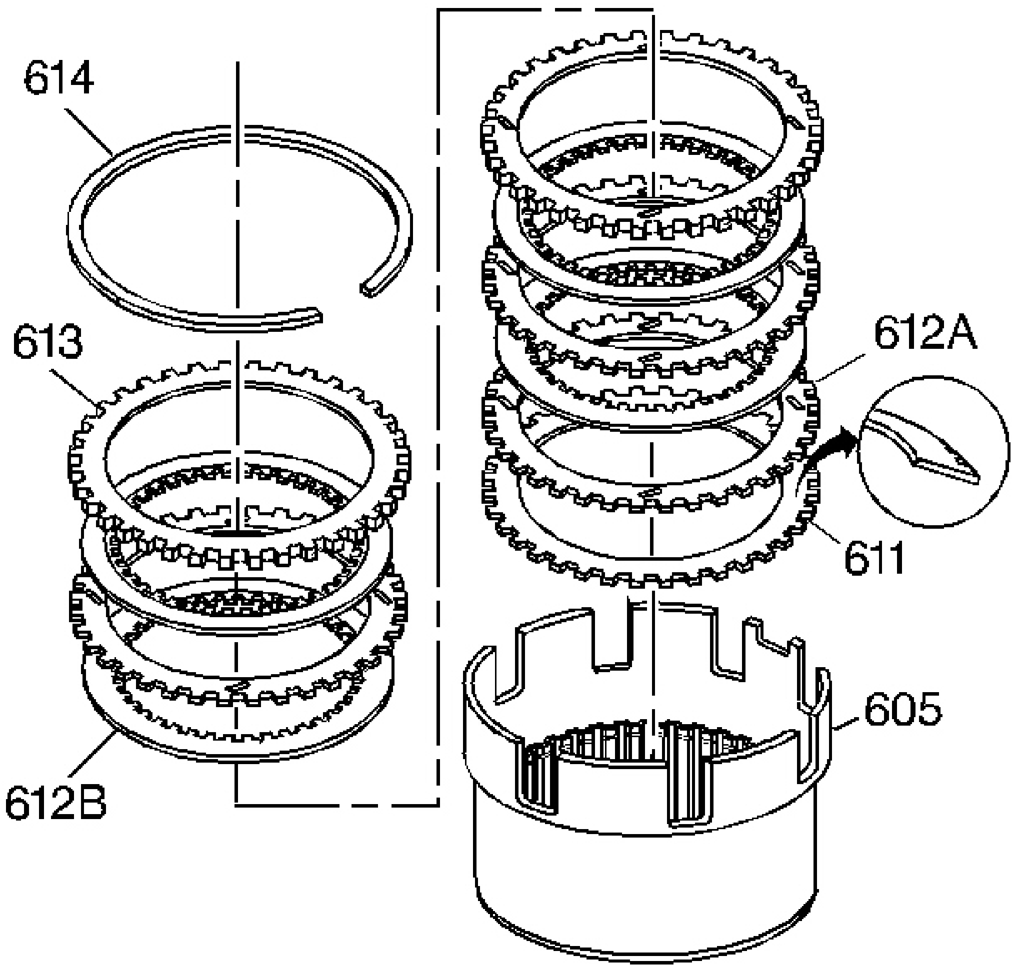


Fig. 341: Reverse Input Clutch Retaining Ring & Reverse Input Clutch Plates
Courtesy of GENERAL MOTORS CORP.

1. Remove the reverse input clutch retaining ring (614).

2. Remove all reverse input clutch plates (611-613).

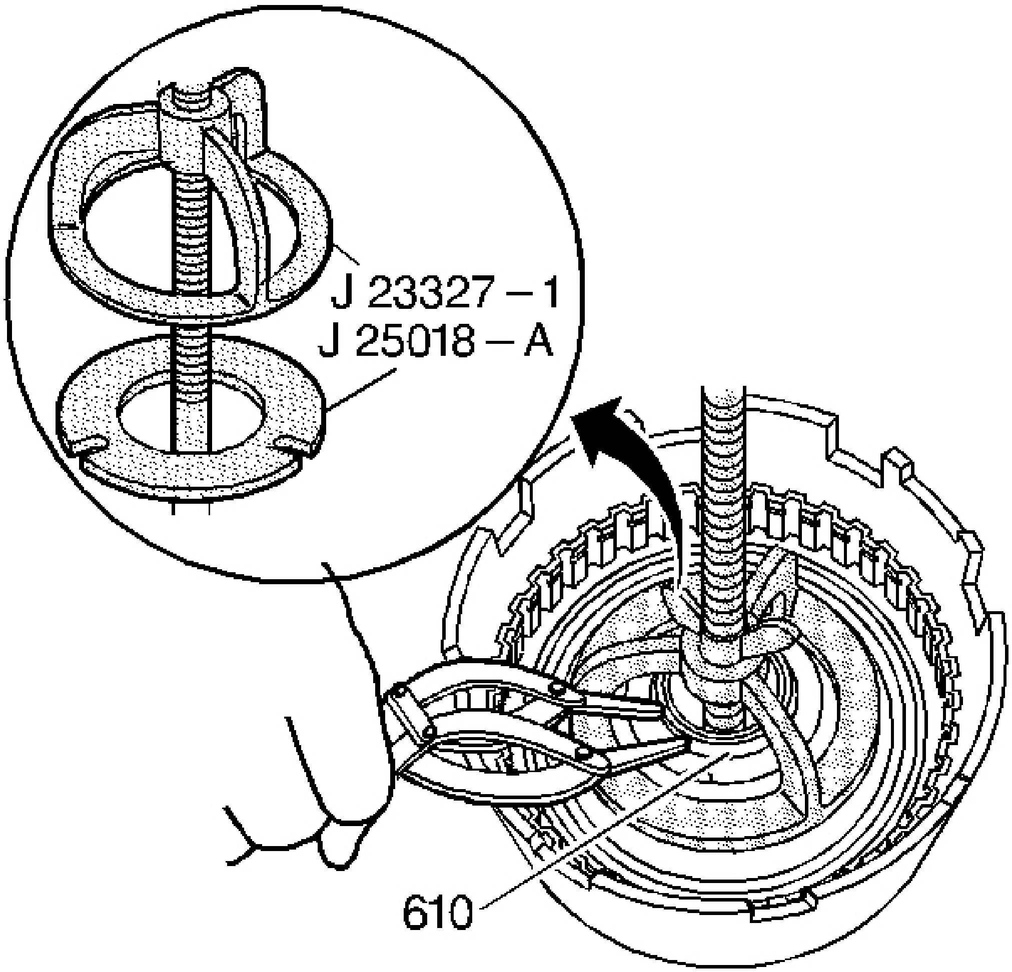


Fig. 342: J 23327-1, J 25018-A & Reverse Input Clutch Spring Retainer Ring
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 23327-1** and the **J 25018-A** . See **Special Tools and Equipment** .
4. Compress the reverse input clutch spring assembly.
5. Remove the reverse input clutch spring retainer ring (610).

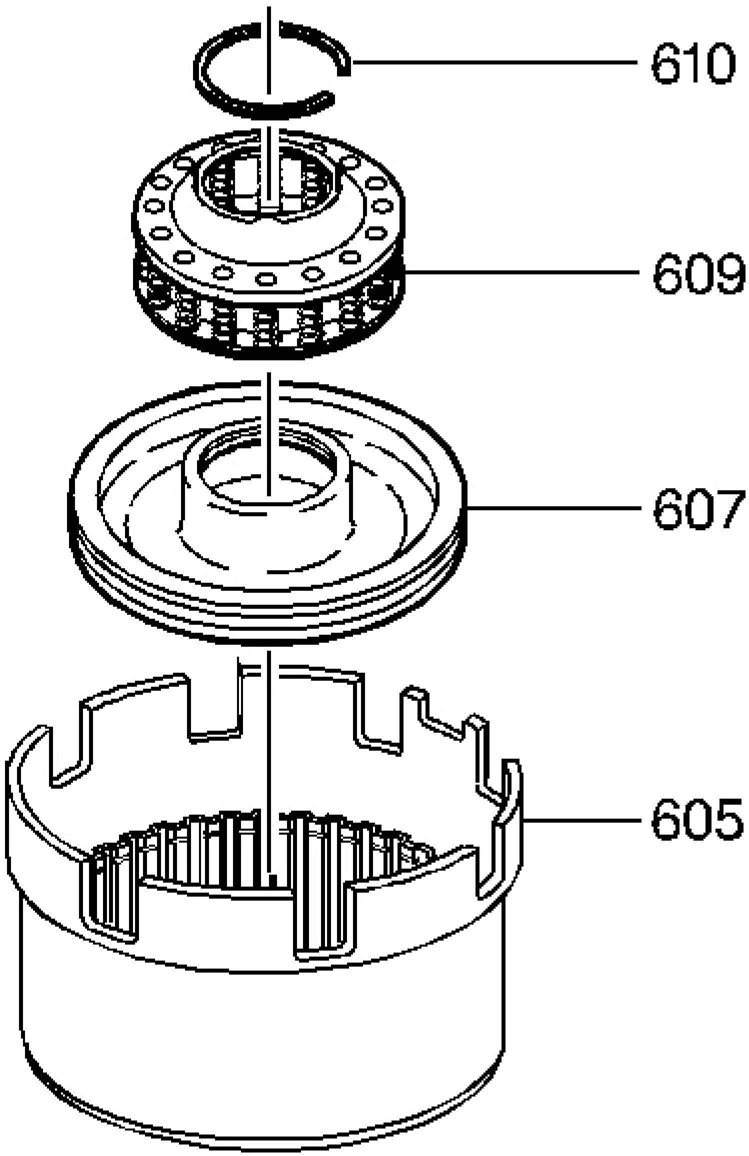


Fig. 343: Reverse Input Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

6. Remove the reverse input clutch spring assembly (609).
7. Remove the reverse input clutch piston assembly (607).

REVERSE INPUT CLUTCH BUSHING REPLACEMENT

Removal Procedure

Tools Required

- **J 25019** Bushing Service Set. See **Special Tools and Equipment** .
- **J 34196-B** Transmission Bushing Service Set. See **Special Tools and Equipment** .
- **J 7004-A** Universal Remover. See **Special Tools and Equipment** .
- J 8092 Universal Driver Handle - 3/4 in - 10

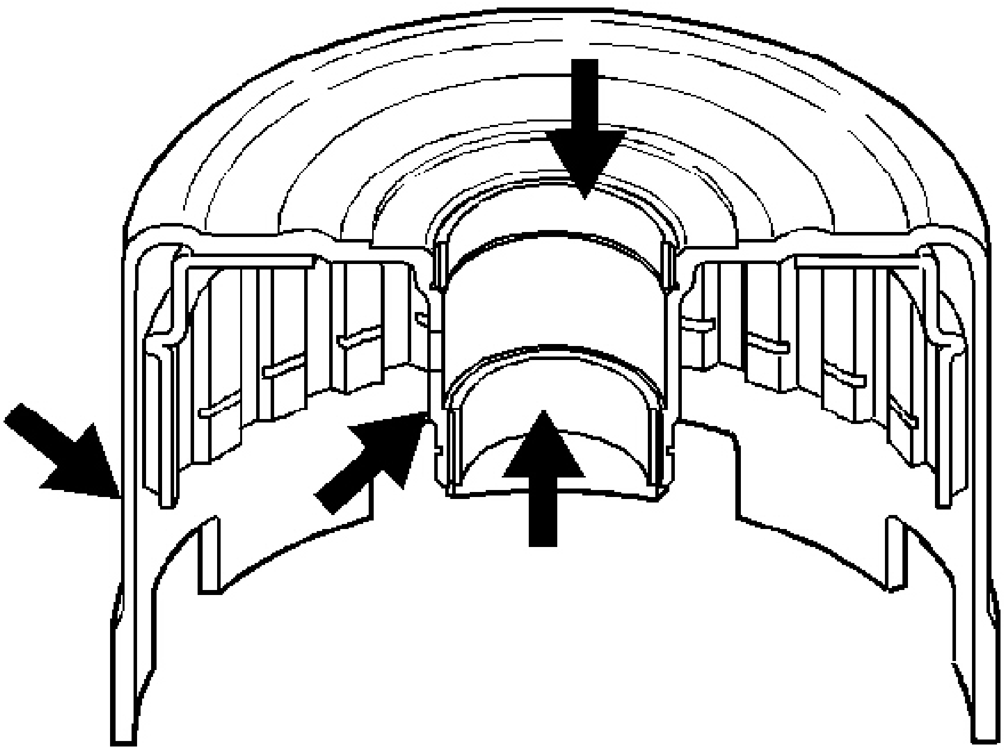


Fig. 344: Inspecting Reverse Input Clutch Housing & Drum Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reverse input clutch housing and drum assembly for the following conditions:
    - Damaged or worn bushings
    - Surface finish on the hub and outer housing - check band surface for flatness

- Leak at the weld
- Heat distortion
- Rolled or distorted retaining ring groove

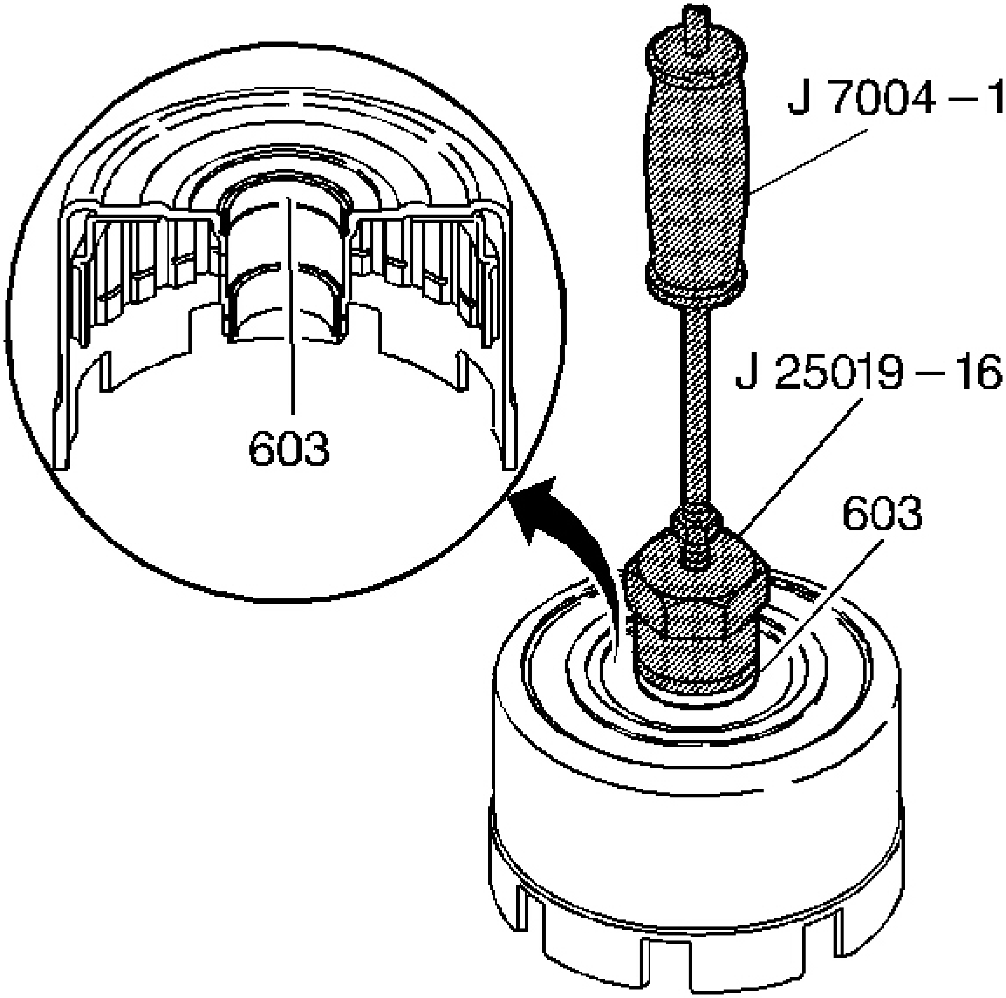


Fig. 345: J 25019-16 & J 7004-A & Reverse Input Clutch Front Bushing
Courtesy of GENERAL MOTORS CORP.

2. Using the J 25019-16 with the **J 7004-A** , remove the reverse input clutch front bushing (603). See **Special Tools and Equipment** .

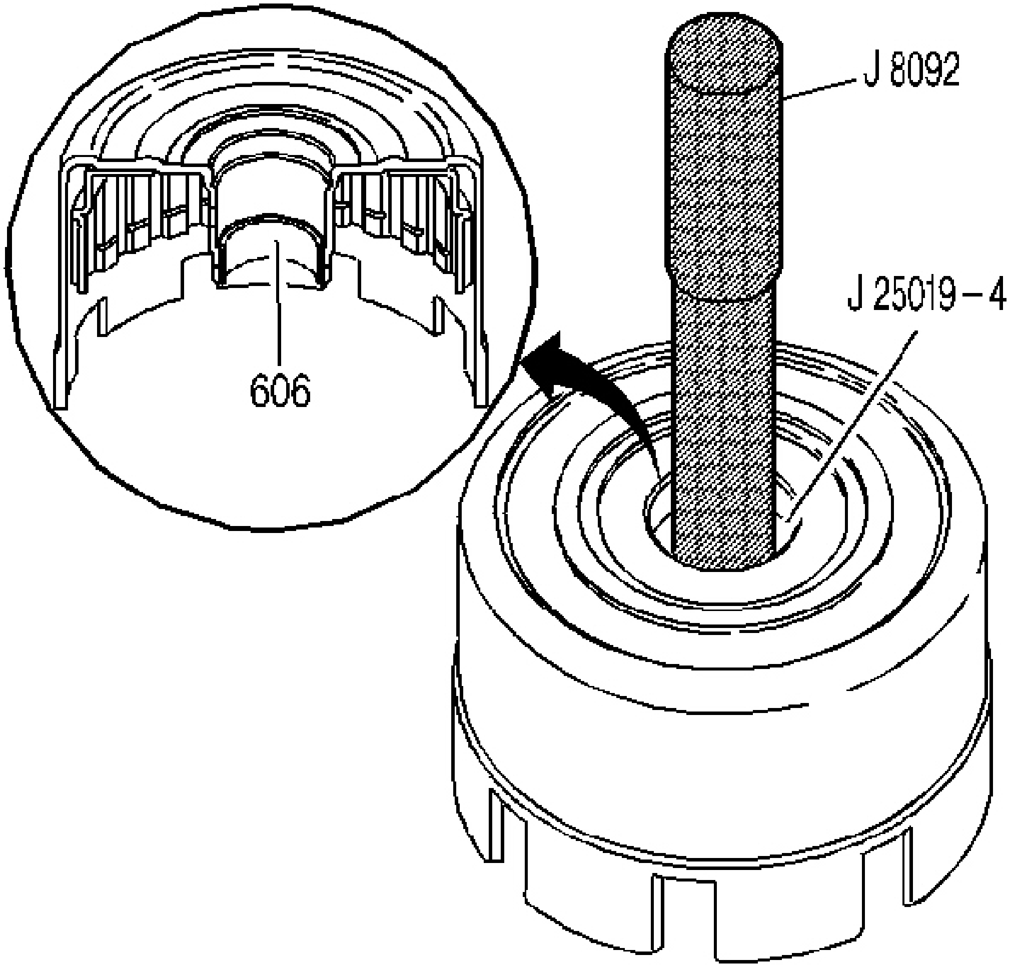


Fig. 346: J 25019-4, J 8092 & Reverse Input Clutch Rear Bushing
Courtesy of GENERAL MOTORS CORP.

3. Using the **J 25019-4** with the J 8092 , remove the reverse input clutch rear bushing (606). See **Special Tools and Equipment** .

Installation Procedure

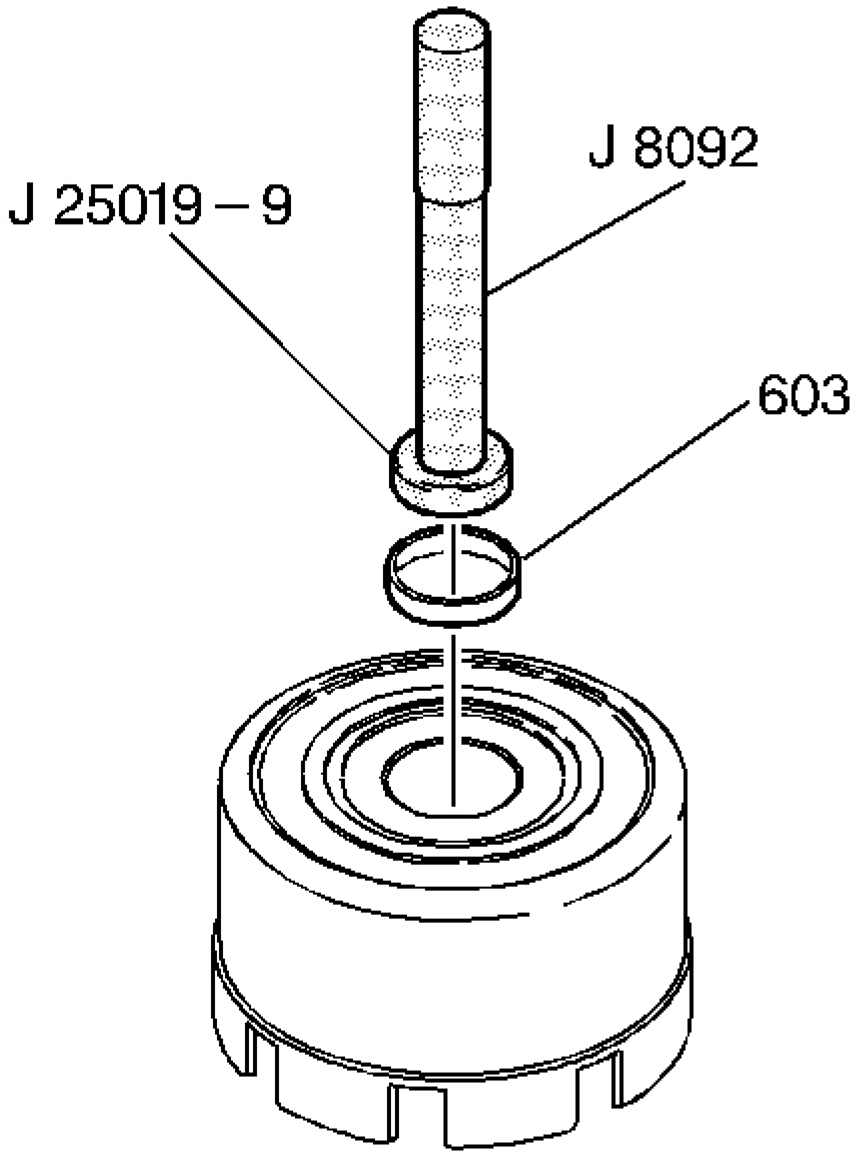


Fig. 347: or
Courtesy of GENERAL MOTORS CORP.

1. Using the **J 25019-9** with the J 8092 , install a reverse input clutch front bushing (603). See **Special Tools and Equipment** .

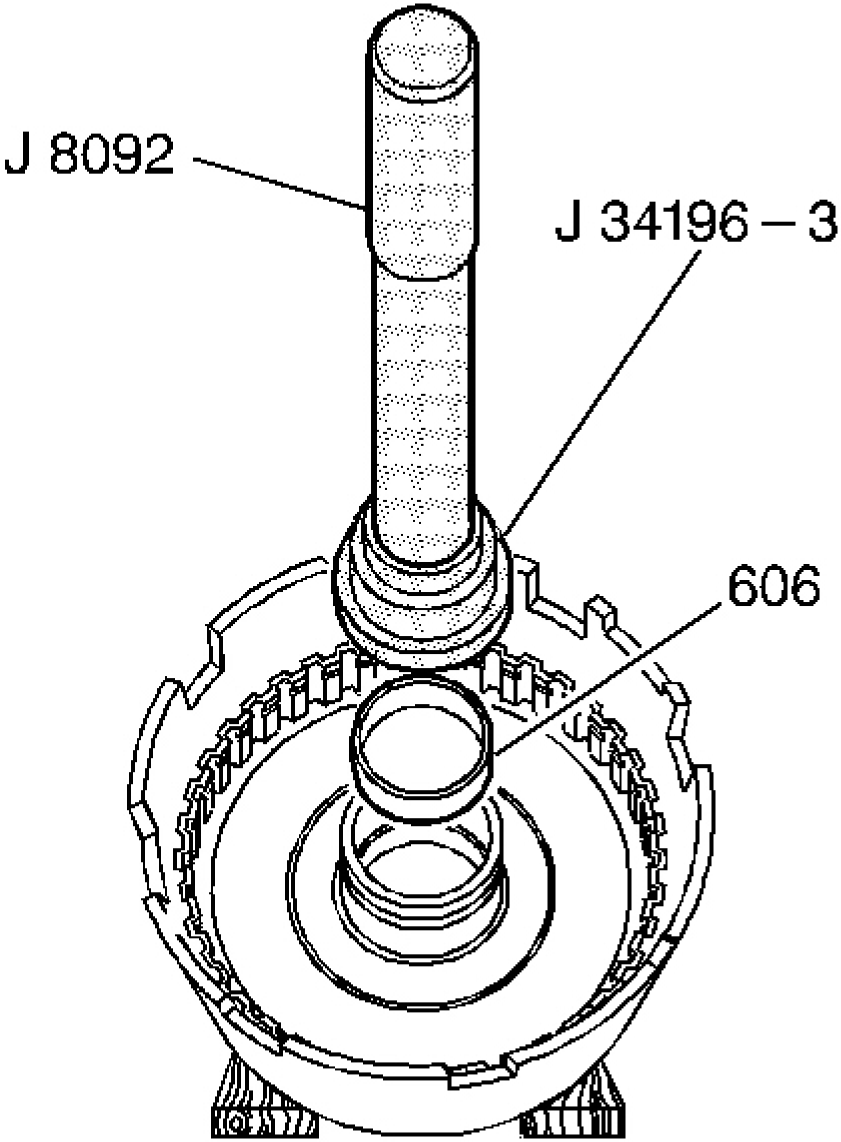


Fig. 348: J 34196-3, J 8092 & Reverse Input Clutch Rear Bushing
Courtesy of GENERAL MOTORS CORP.

2. Using the J 34196-3 which is part of kit **J 34196-B** with the J 8092 , install a reverse input clutch rear bushing (606). See **Special Tools and Equipment** .

REVERSE INPUT CLUTCH ASSEMBLE

Tools Required

- **J 23327-1** Forward Clutch Spring Compressor (Bridge). See **Special Tools and Equipment** .
- **J 25018-A** Clutch Spring Compressor Adapter. See **Special Tools and Equipment** .
- **J 44571-1** Reverse Input Clutch Piston Installer. See **Special Tools and Equipment** .

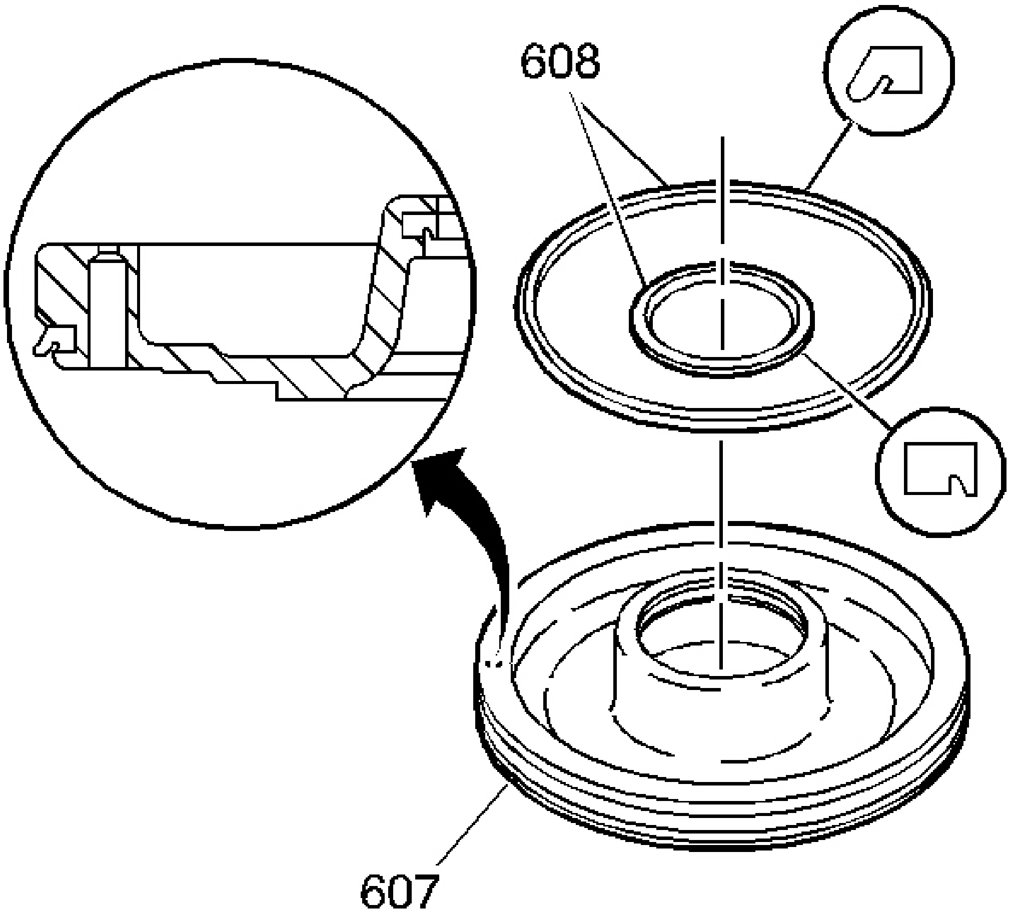


Fig. 349: Inspecting Reverse Input Clutch Piston
Courtesy of GENERAL MOTORS CORP.

1. Inspect the reverse input clutch piston (607) for the following defects:
   - Damaged or porosity
   - Ring groove damage
2. Install the reverse input clutch inner and outer seals (608) on the piston.

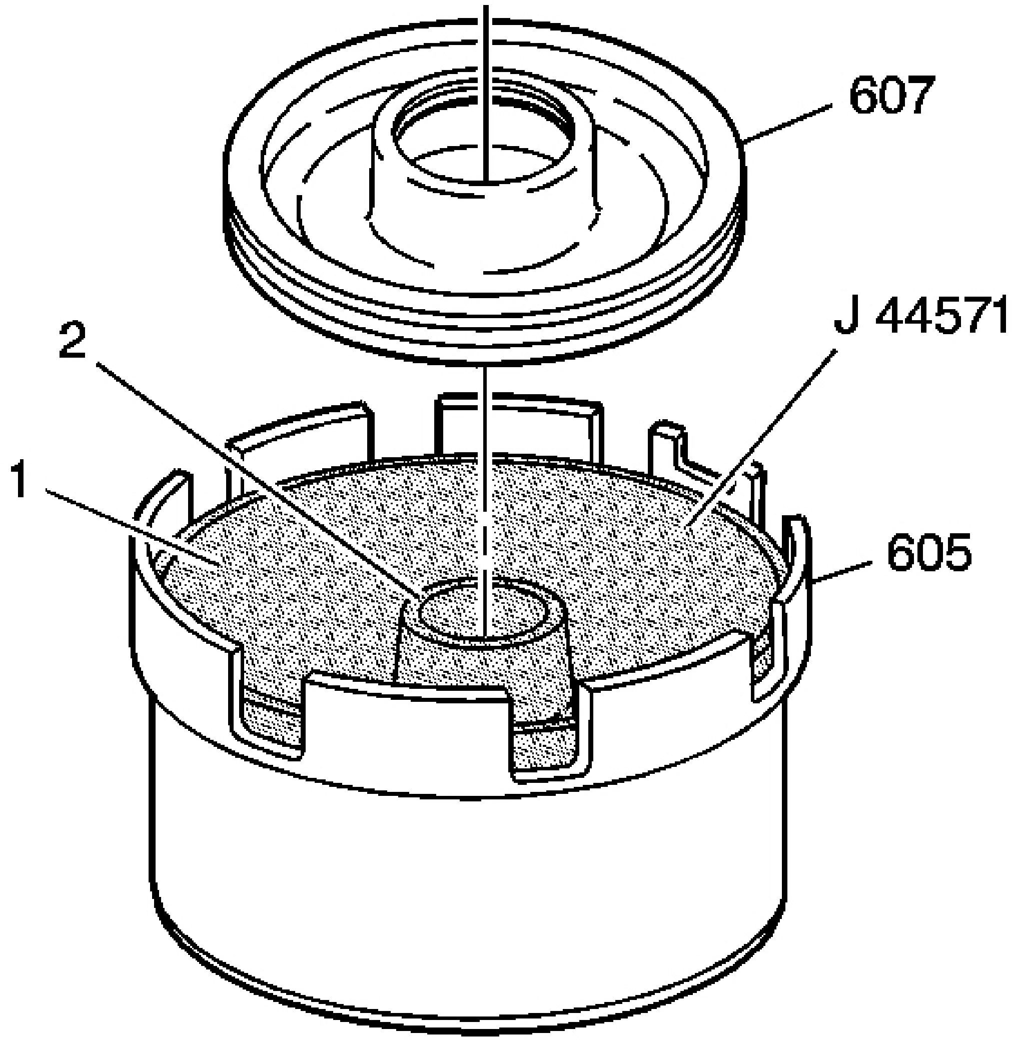


Fig. 350: J 44571-1 Inner & Outer Reverse Input Clutch Piston Installer
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 44571-1** inner (2) and outer (1) reverse input clutch piston installer. See **Special Tools and Equipment** .
4. Install the piston (607) into the housing (605).
5. Remove the **J 44571-1** . See **Special Tools and Equipment** .

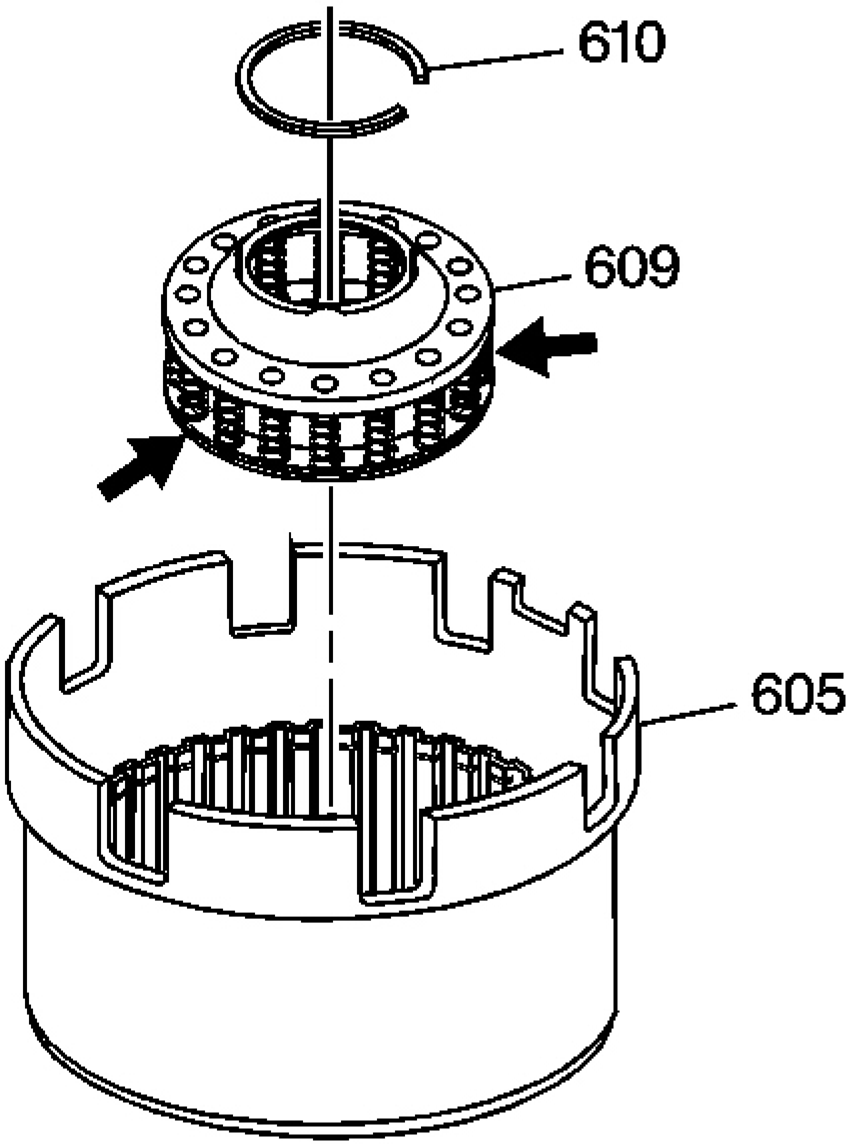


Fig. 351: Reverse Input Clutch Spring Assembly
Courtesy of GENERAL MOTORS CORP.

6. Inspect the reverse input clutch spring assembly (609) for distortion or damage.
7. Install the reverse input clutch spring assembly (609).

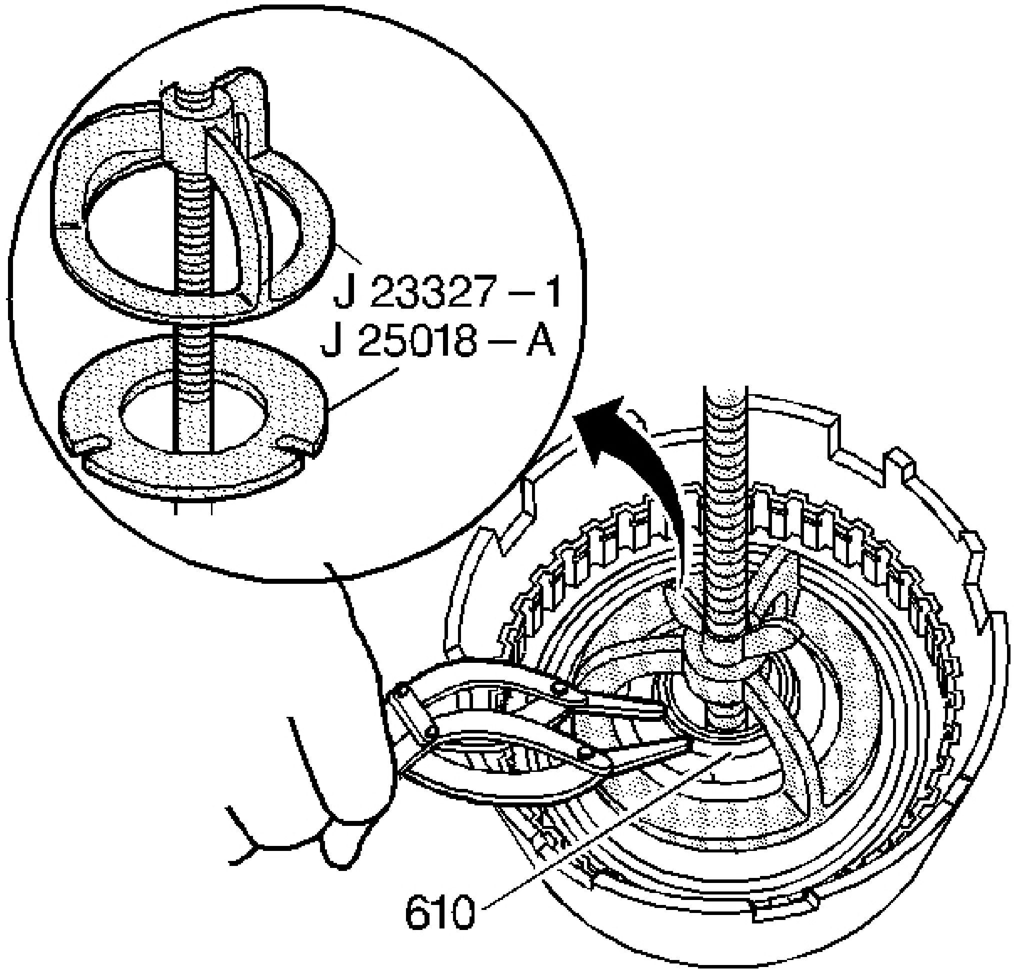


Fig. 352: J 23327-1, J 25018-A & Reverse Input Clutch Spring Retainer Ring
Courtesy of GENERAL MOTORS CORP.

8. Install the **J 23327-1** and the **J 25018-A** . See **Special Tools and Equipment** .
9. Install the reverse input clutch spring retainer ring (610).

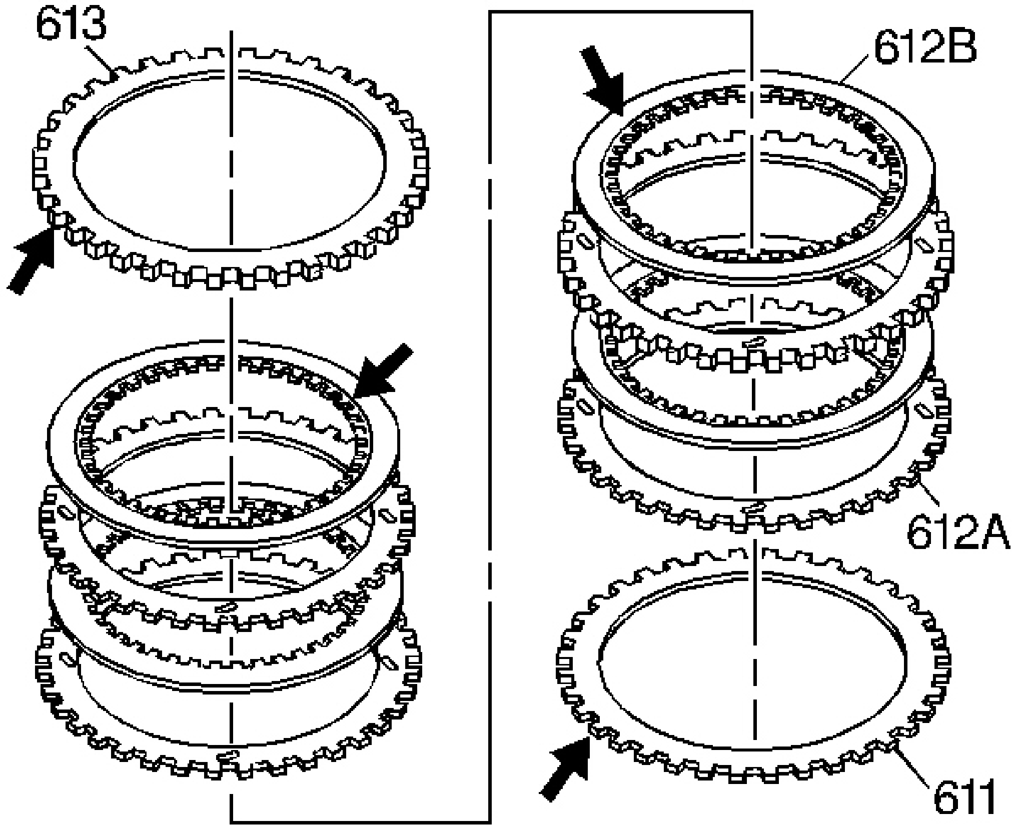


Fig. 353: Inspecting (611), (612B), (612A) & (613)
Courtesy of GENERAL MOTORS CORP.

10. Inspect the belleville plate (611), the fiber plate assemblies (612B), the steel turbulator plates (612A) and the selective backing plate (613) for the following items:
    - Damaged tangs
    - Delamination
    - Excessive wear
    - Heat damage or wear
    - Surface finish
    - Flatness

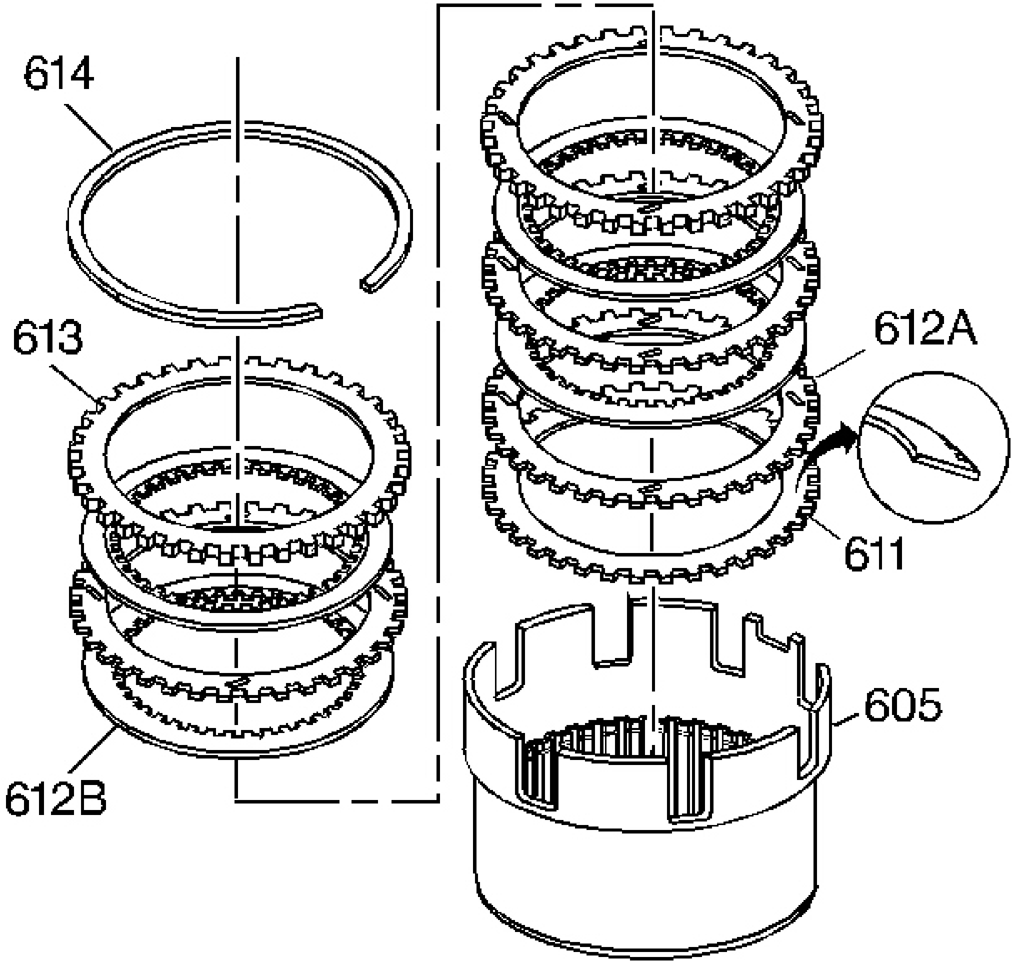


Fig. 354: Reverse Input Clutch Retaining Ring & Reverse Input Clutch Plates
Courtesy of GENERAL MOTORS CORP.

11. Install the reverse input clutch belleville plate (611), with the inner diameter up, into the reverse input clutch housing and drum assembly (605).
12. Install the reverse input clutch plates starting with a steel turbulator plate (612A) and alternate with a fiber plate assembly (612B).
13. Install the reverse input clutch selective backing plate (613).
14. Install the reverse input clutch retaining ring (614).

REVERSE INPUT CLUTCH PLATE TRAVEL CHECK

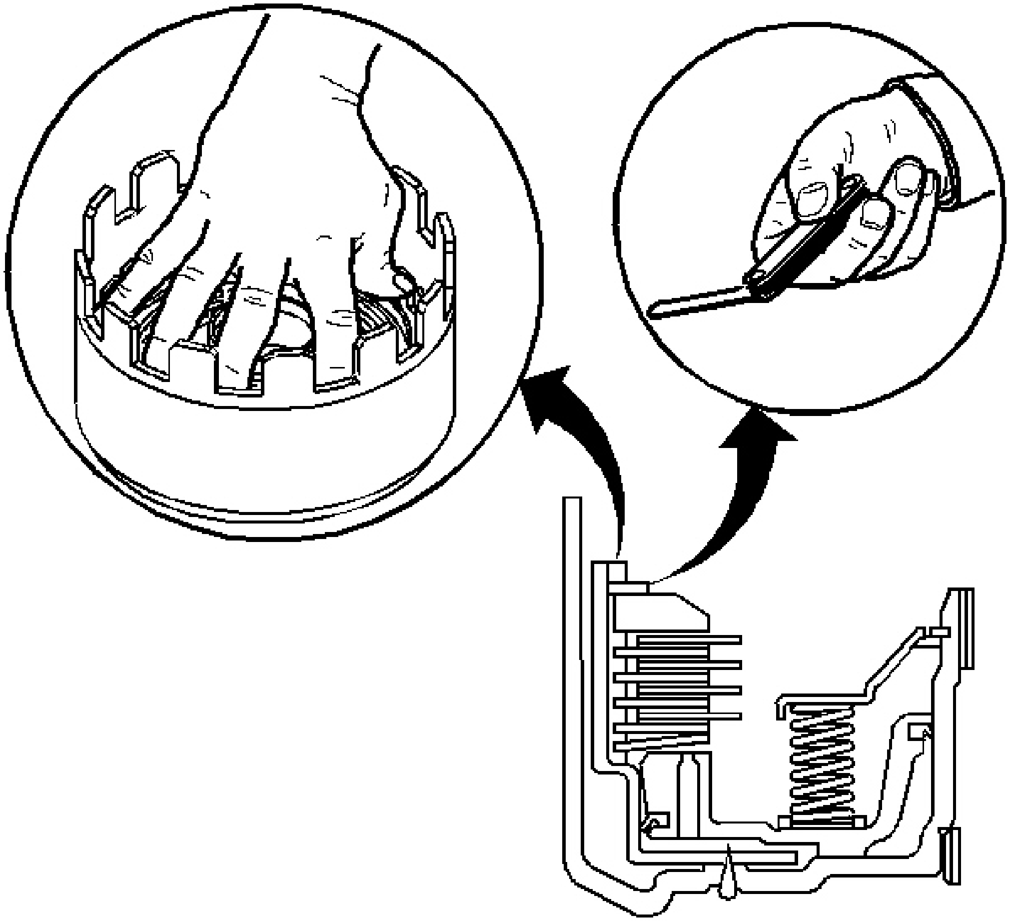


Fig. 355: Applying Load To Clutch Pack
Courtesy of GENERAL MOTORS CORP.

1. Apply an evenly distributed load to the clutch pack.
2. Use feeler gauges to check the reverse input clutch plate travel.
3. Check the travel between the selective backing plate and the reverse input clutch retainer ring.

   Clutch Plate Travel Specifications: The reverse input clutch plate travel should be 1.02-1.94 mm (0.040-0.076 in).

4. Select the proper selective backing plate to obtain the correct travel. Refer to **Reverse Input Clutch Backing Plate Selection** .

REVERSE INPUT AND INPUT CLUTCHES INSTALLATION

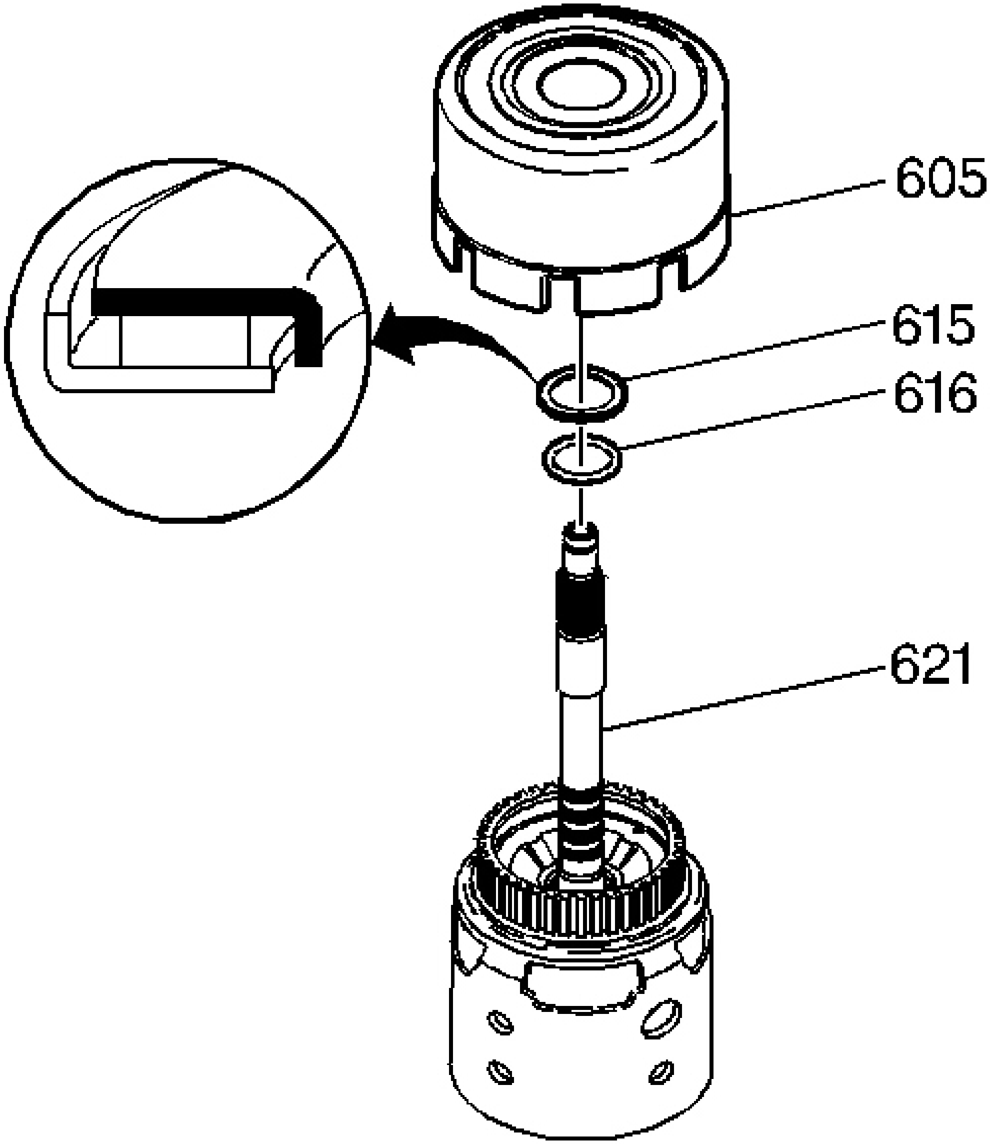


Fig. 356: Selective Thrust Washer, Stator Shaft/Selective Washer Bearing Assembly & Input Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the selective thrust washer (616) on the input housing (621).
2. Install the stator shaft/selective washer bearing assembly (615) on the input housing (621).

The black race on the bearing goes toward the oil pump.

3. Install the reverse input clutch assembly (605) on the input housing (621).
4. Index the reverse input clutch plates with the input clutch hub. Make certain all clutch plates are fully engaged.

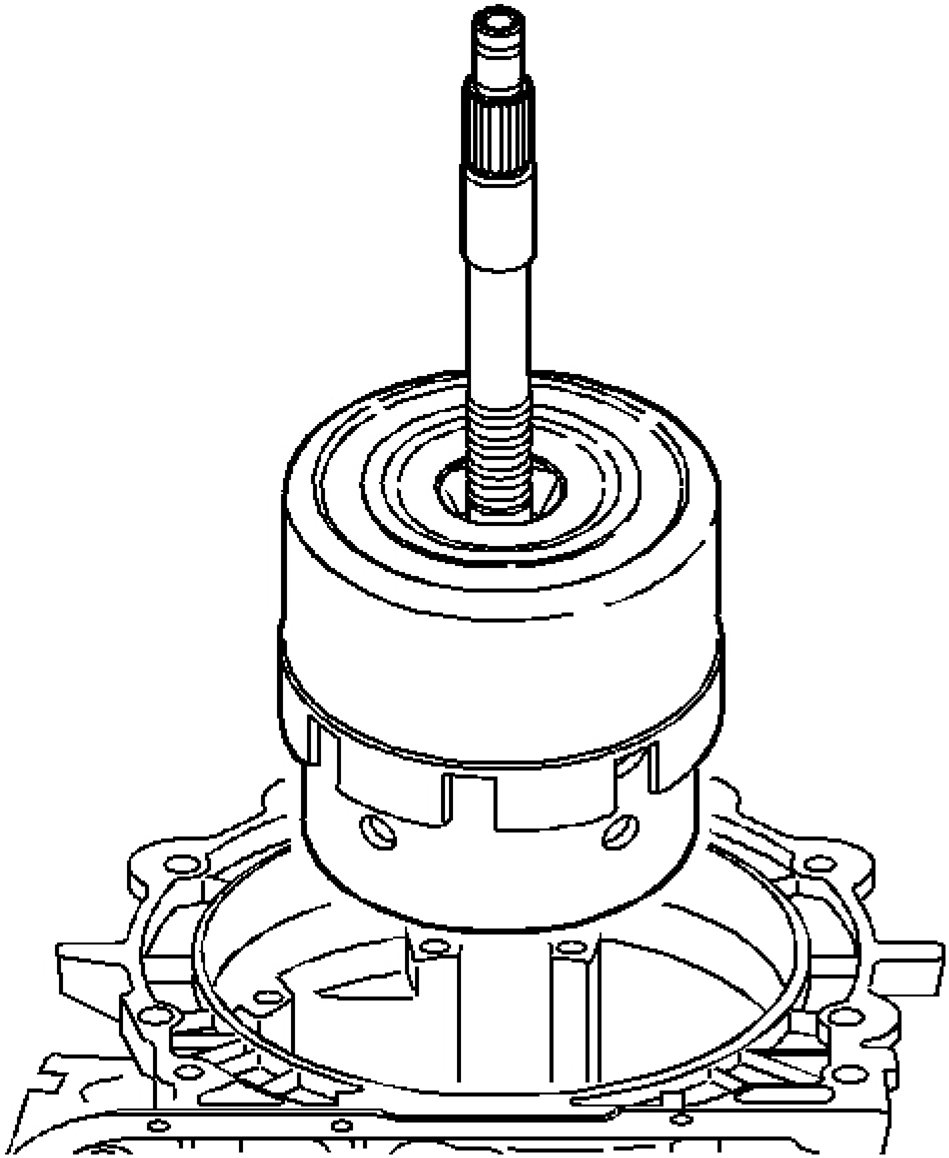


Fig. 357: Reverse Input & Input Clutch Assembly
Courtesy of GENERAL MOTORS CORP.

5. Install the reverse input and the input clutch assembly into the transmission case.
6. Index the 3rd and 4th clutch plates with the input internal gear.
   - Ensure that all clutch plates are fully engaged.
   - When properly assembled, the reverse input clutch housing will be located just below the case oil pump face.

2-4 BAND ASSEMBLY INSTALLATION

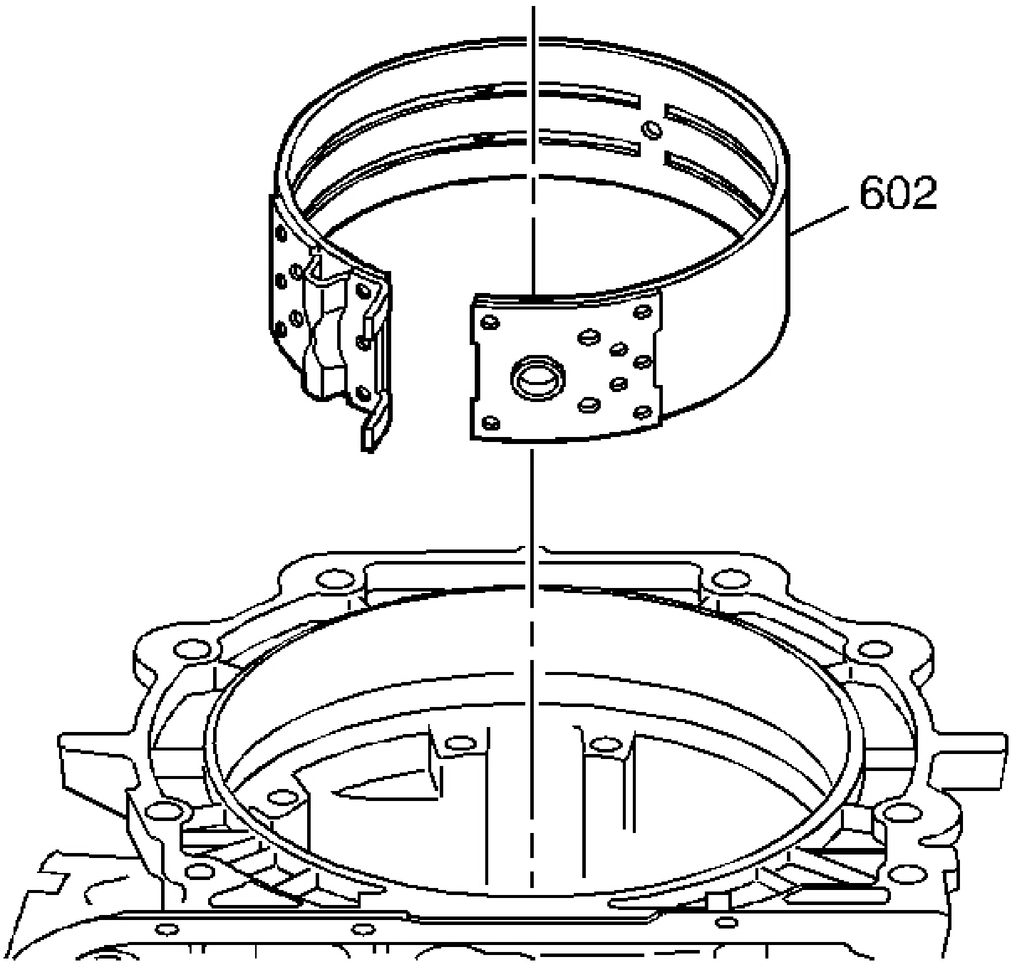


Fig. 358: 2-4 Band Assembly

Courtesy of GENERAL MOTORS CORP.

1. Inspect the 2-4 band assembly (602) for damage or wear.
2. Install the 2-4 band (602) into the case.

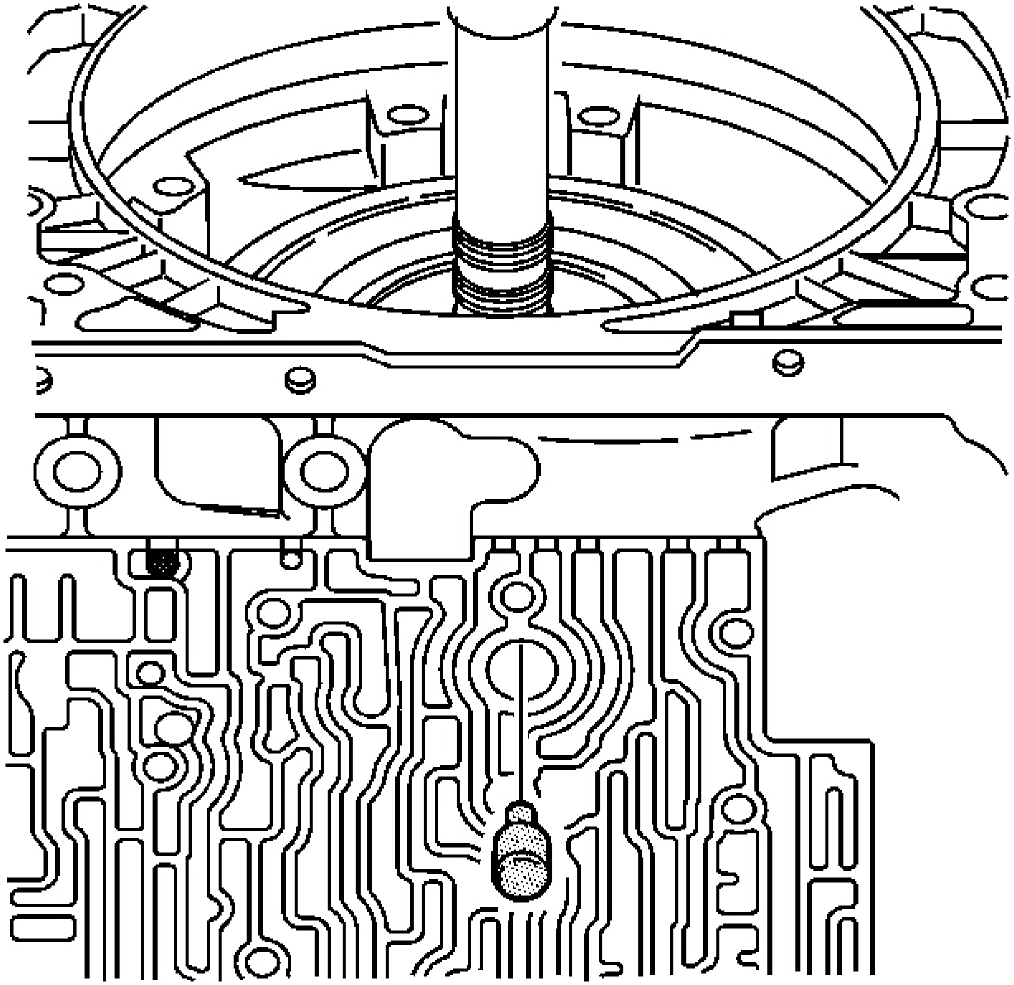


Fig. 359: Band Anchor Pin
Courtesy of GENERAL MOTORS CORP.

3. Install the band anchor pin into the case.
4. Index the band to fit the band anchor pin into the band.

OIL PUMP DISASSEMBLE

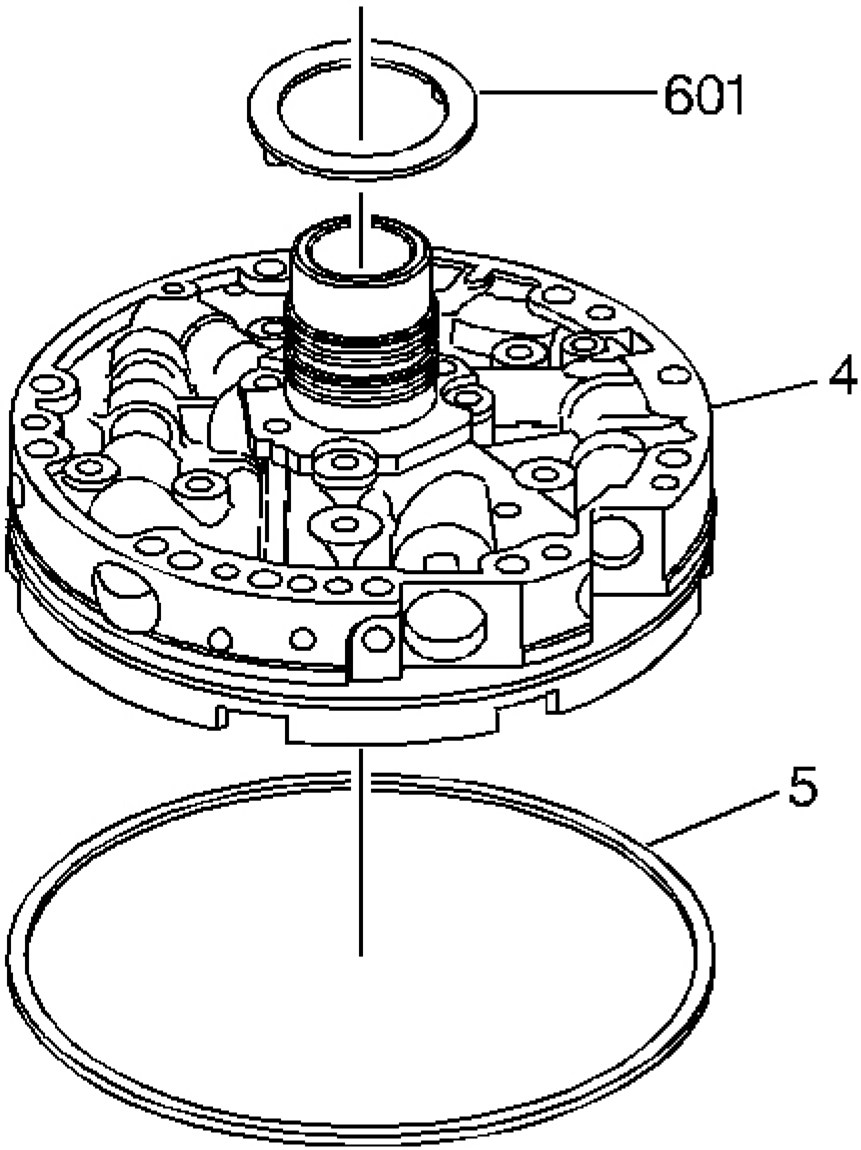


Fig. 360: Thrust (Pump To Drum) Washer & Oil (Pump To Case) Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the thrust (pump to drum) washer (601).
2. Remove the oil (pump to case) seal (5).

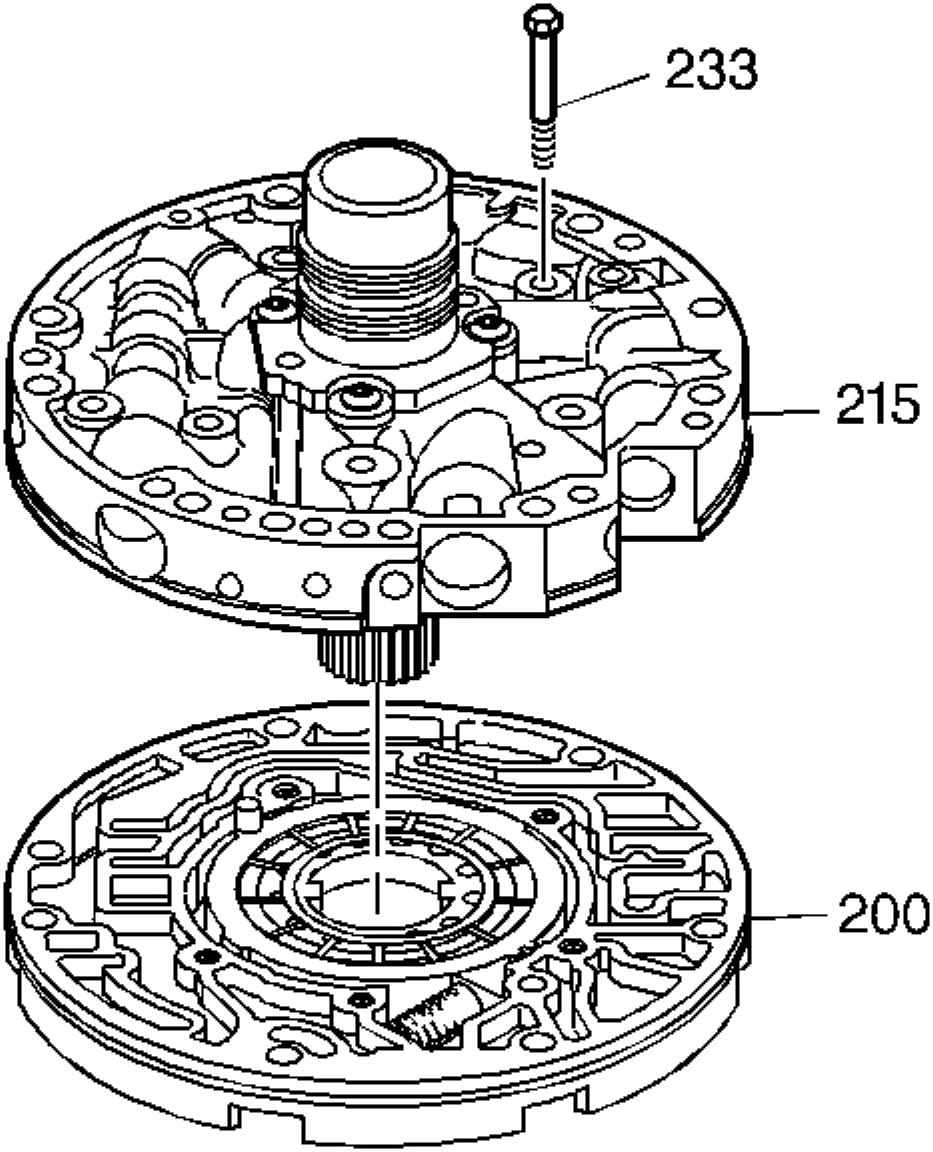


Fig. 361: Pump Cover, Bolts & Body
Courtesy of GENERAL MOTORS CORP.

3. Remove the pump cover bolts (233).
4. Remove the pump cover (215) from the pump body (200).

OIL PUMP BODY DISASSEMBLE

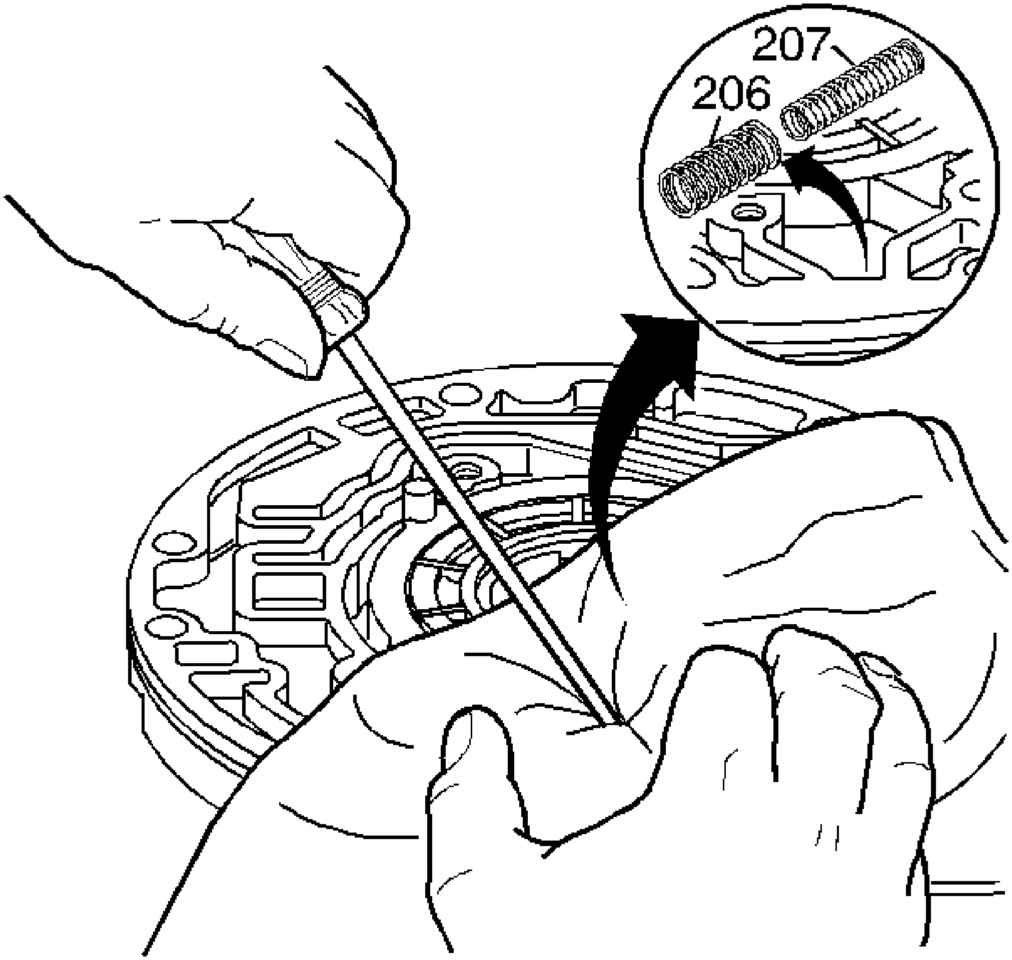


Fig. 362: Pump Slide Inner & Outer Springs
Courtesy of GENERAL MOTORS CORP.

1. Remove the pump slide inner (207) and outer (206) springs.
2. Place a rag over the springs while removing them to prevent the springs from flying out.

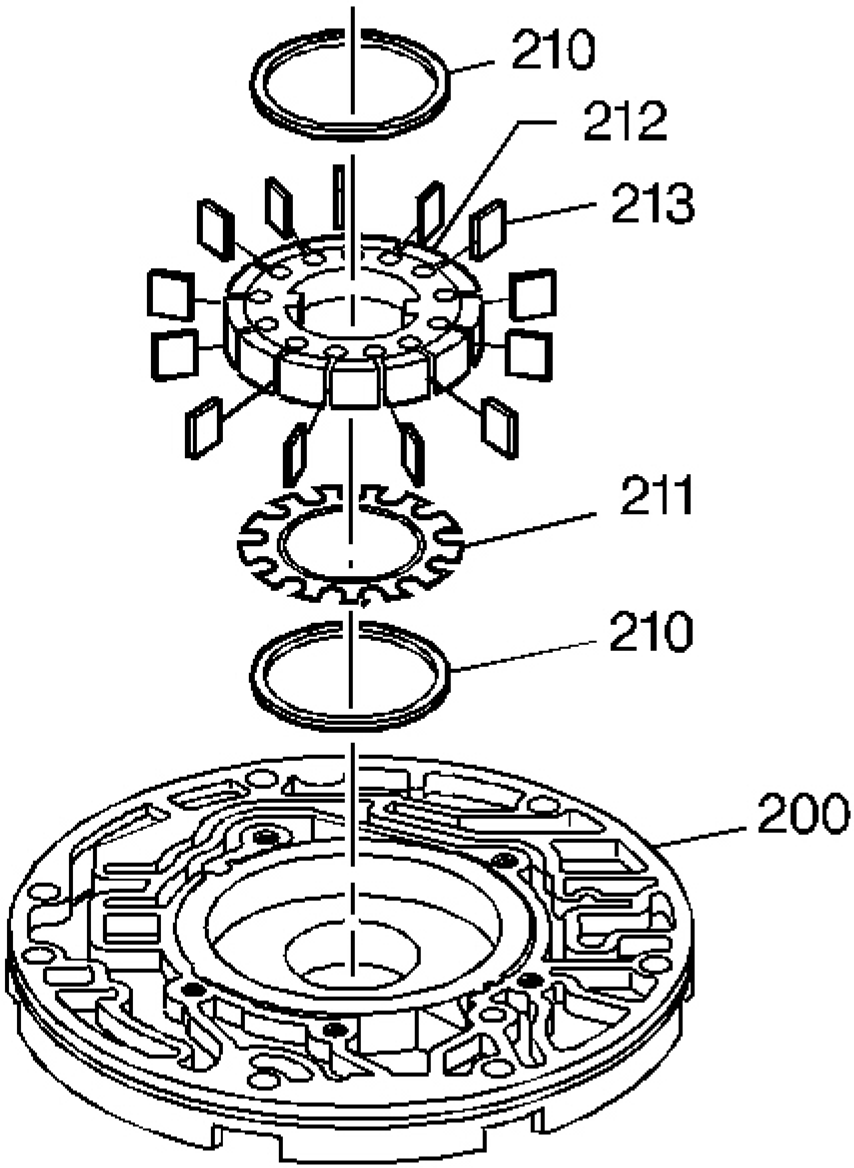


Fig. 363: Oil Pump Rotor, Pump Vane Rings, Pump Vanes & Rotor Guide
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pump rotor (212) and pump vane rings (210).
4. Remove the pump vanes (213).
5. Remove the rotor guide (211).

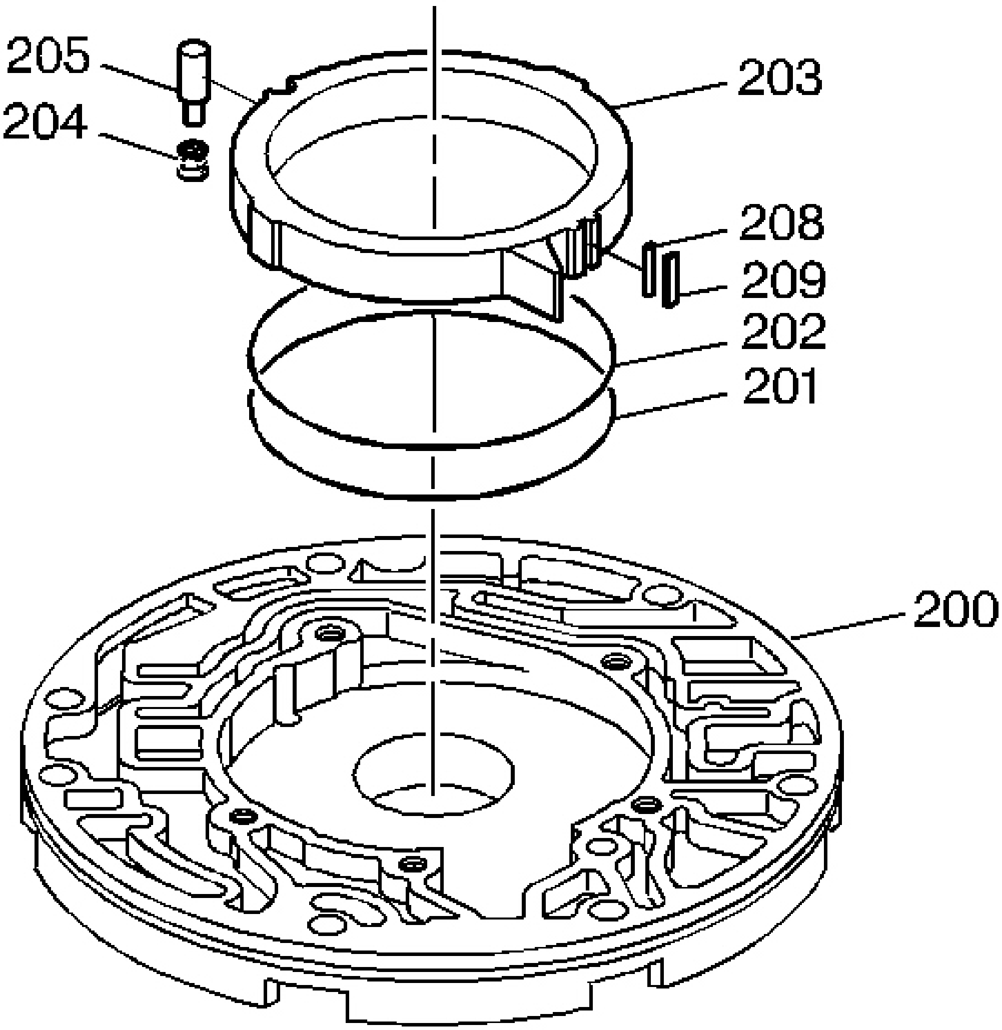


Fig. 364: Removing (203), (208), (209), (202), (201), (205) & (204)
Courtesy of GENERAL MOTORS CORP.

6. Remove the pump slide (203), pump slide support seal (208) and the pump slide seal (209).
7. Remove the slide seal back-up O-ring seal (202) and the oil seal (slide to wear plate) ring (201).
8. Remove the pivot slide pin (205) and the pivot pin spring (204).

OIL PUMP ROTOR AND SLIDE MEASUREMENT

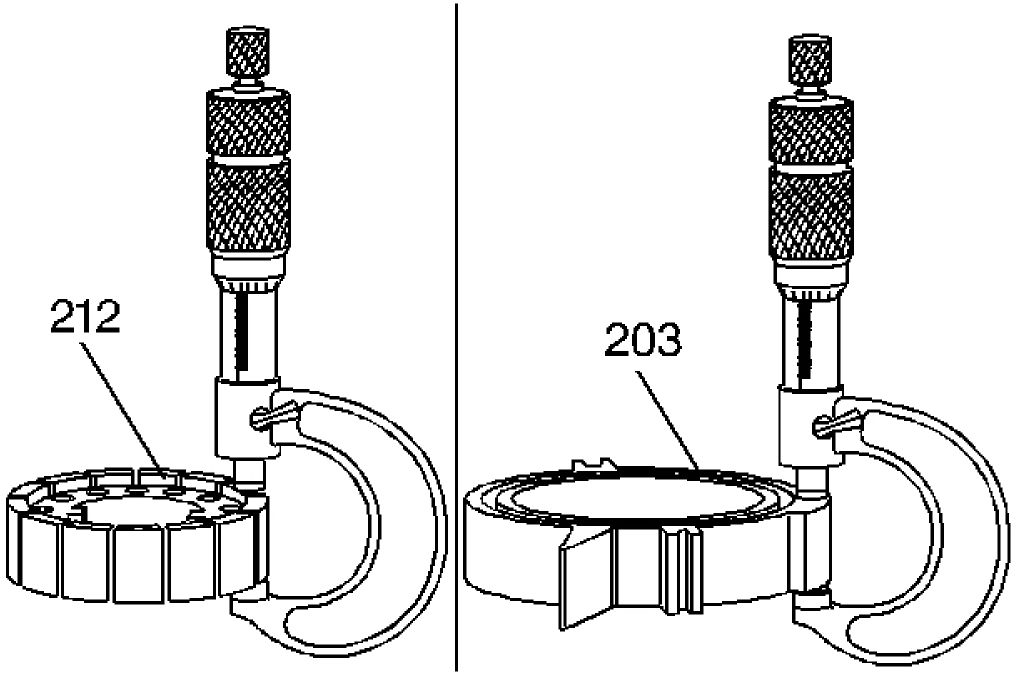


Fig. 365: Measuring Oil Pump Motor & Oil Pump Slide Thickness
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Measure the rotor and slide thickness for surface wear. The rotor and slide measurements must both fall into the same thickness range. If the rotor and slide measurements do not fall into the same thickness range, or are outside of all the ranges, the oil pump must be replaced as an assembly.

- Measure the oil pump rotor (212) thickness.
- Measure the oil pump slide (203) thickness.

OIL PUMP BODY BUSHING REPLACEMENT

Removal Procedure

Tools Required

- **J 41778-1** Pump Body Bushing Installer/Remover. See **Special Tools and Equipment** .
- **J 41778-2** Pump Body Bushing Position Stop. See **Special Tools and Equipment** .

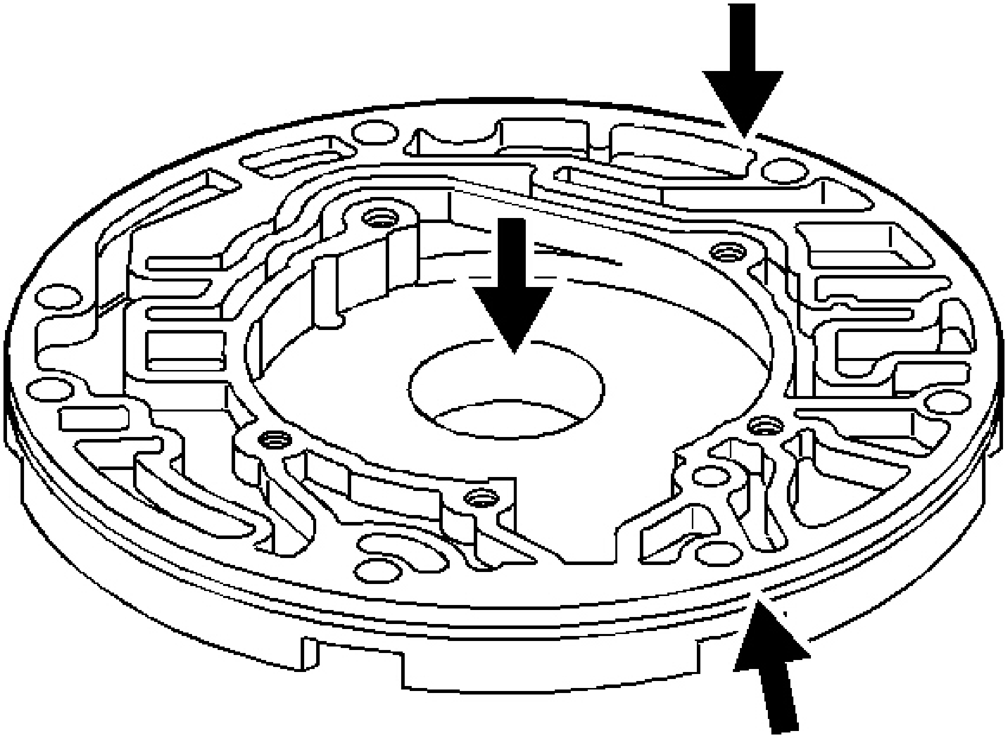


Fig. 366: Inspecting Oil Pump Body
Courtesy of GENERAL MOTORS CORP.

1. Inspect the oil pump body for the following defects:
    - Worn or damaged bushings
    - Foreign material or debris
    - Porosity
    - Scored or irregular mating faces
    - Cross channel leaks
    - Ring groove damage

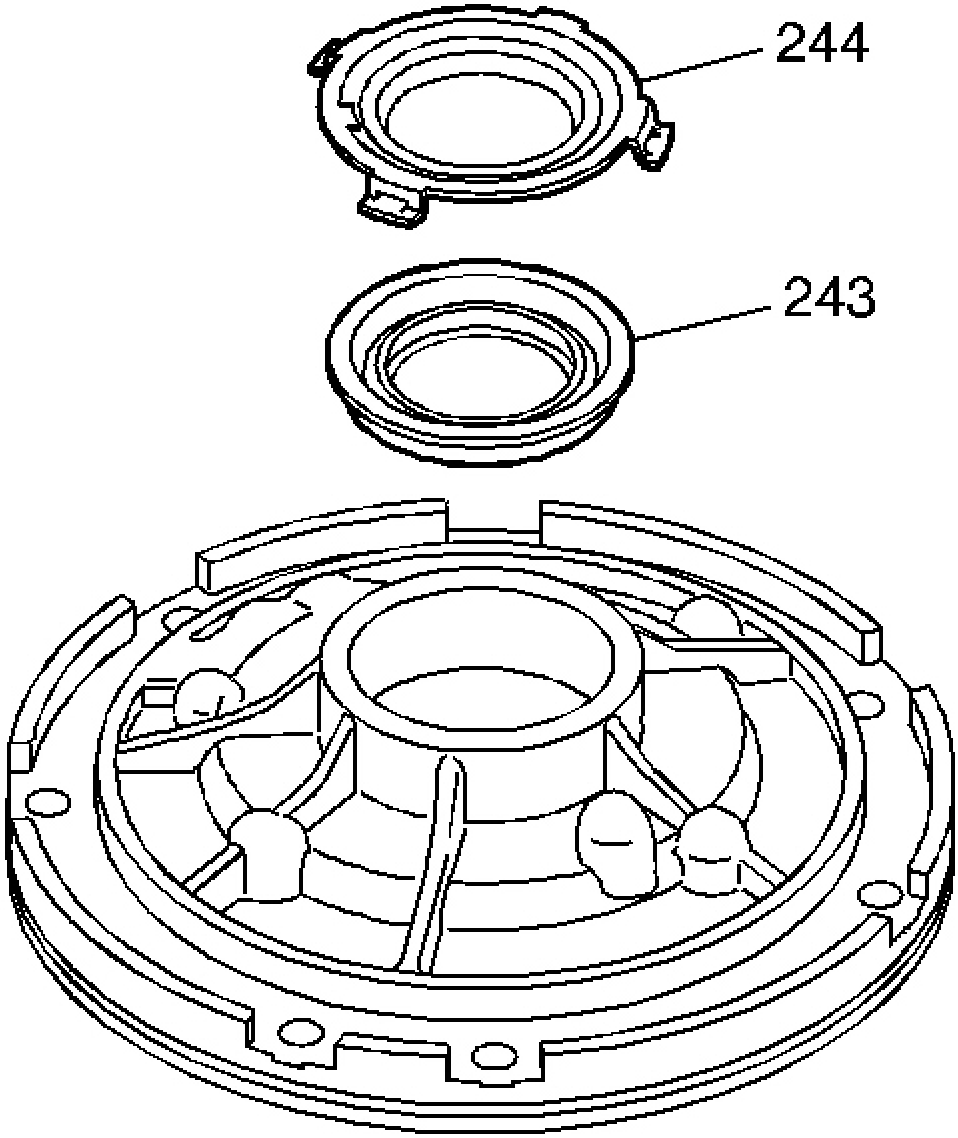


Fig. 367: Front Helix Retainer & Oil Seal Assembly
Courtesy of GENERAL MOTORS CORP.

2. Remove the front helix retainer (244).
3. Remove the oil seal assembly (243).

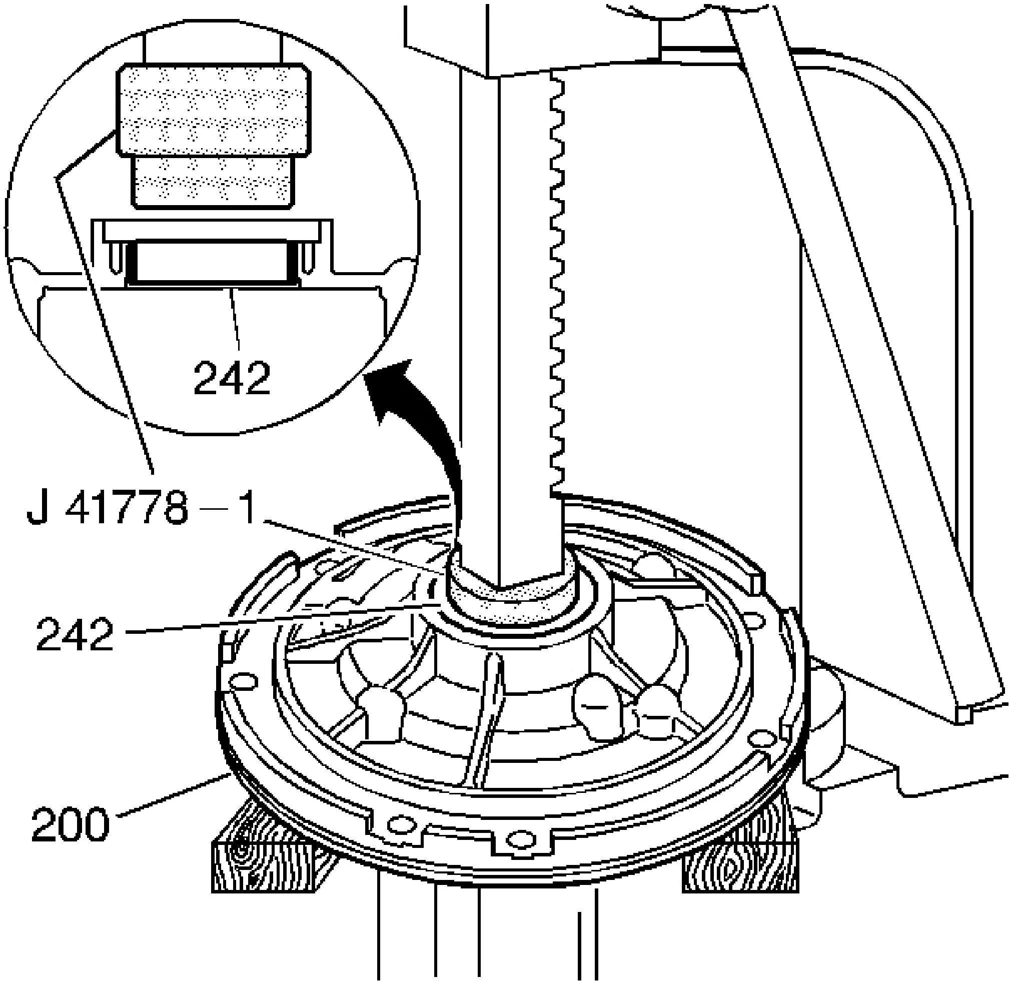


Fig. 368: J 41778-1 & Pump Body Bushing
Courtesy of GENERAL MOTORS CORP.

4. Using the **J 41778-1** with an arbor press, remove the pump body bushing (242). See **Special Tools and Equipment** .

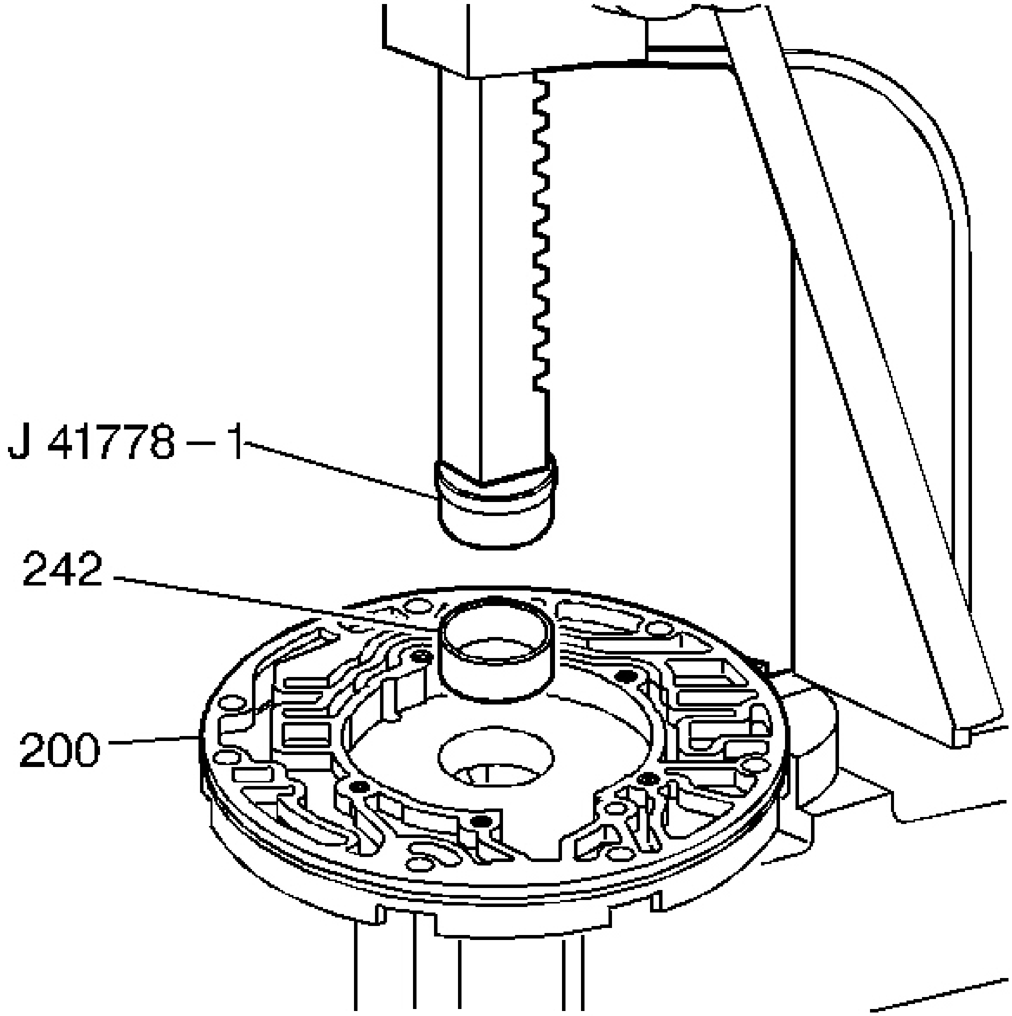


Fig. 369: J 41778-1 & New Pump Body Bushing
Courtesy of GENERAL MOTORS CORP.

5. Using **J 41778-1** with an arbor press, install a new pump body bushing (242). See **Special Tools and Equipment** .

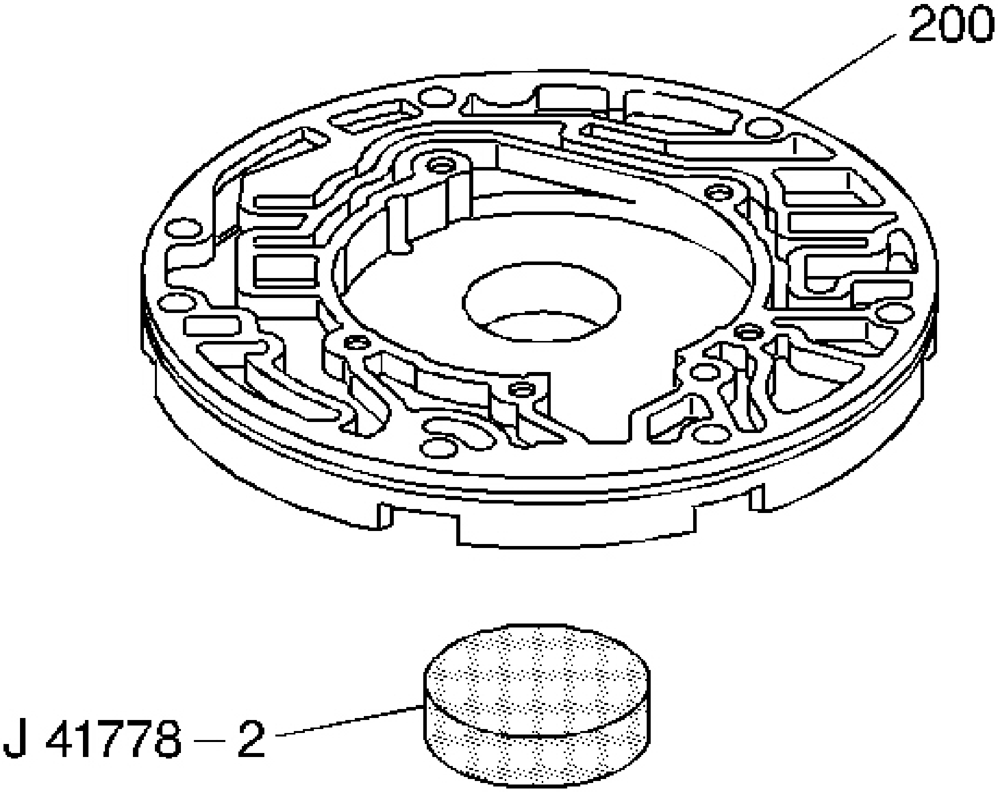


Fig. 370: Using J 41778-2 To Ensure Proper Bushing Depth
Courtesy of GENERAL MOTORS CORP.

6. Use the **J 41778-2** to ensure proper bushing depth. See **Special Tools and Equipment** .

OIL PUMP BODY ASSEMBLE

Tools Required

- **J 25016** Pump Seal and speedometer gear Installer. See **Special Tools and Equipment** .
- J 36850 Transjel Lubricant

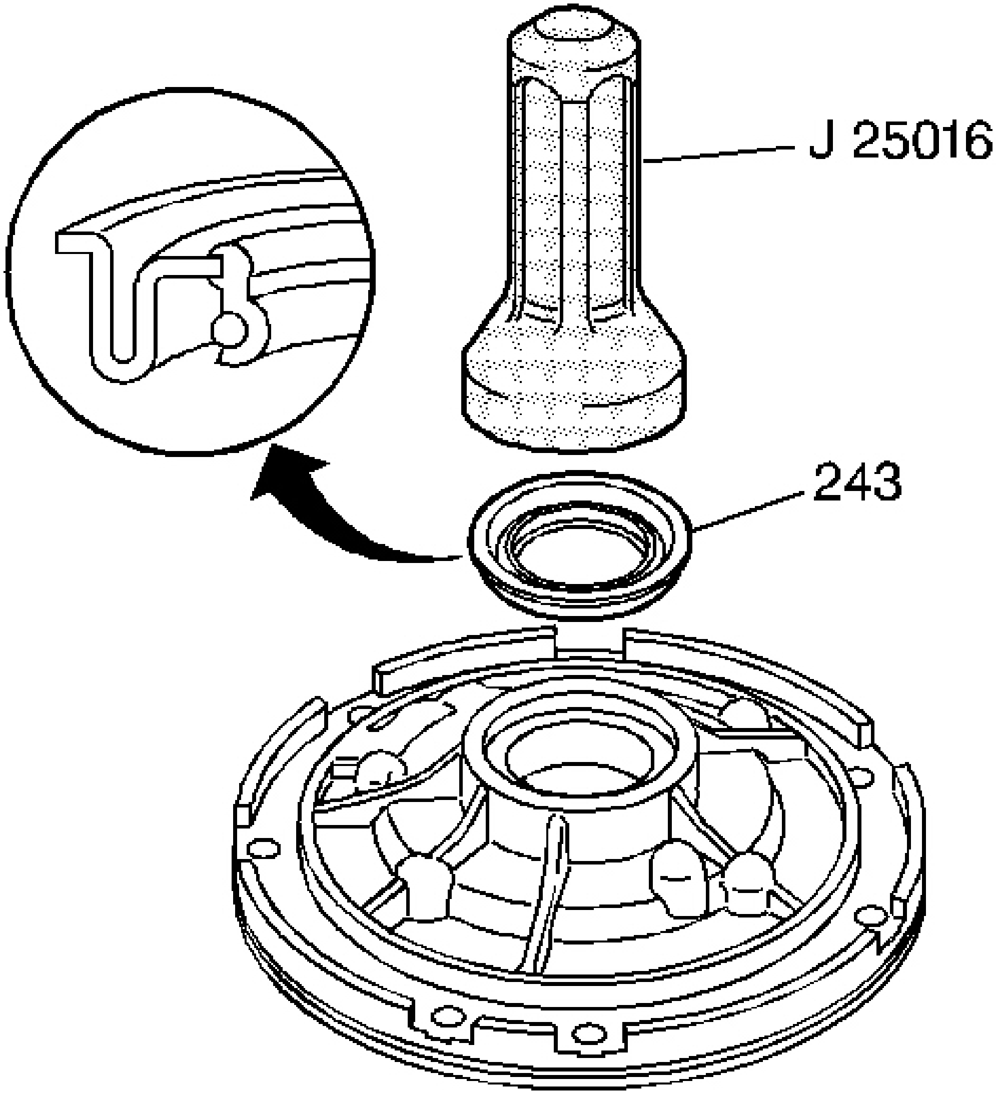


Fig. 371: J 25016 & Oil Seal Assembly
Courtesy of GENERAL MOTORS CORP.

1. Using the **J 25016** , install the oil seal assembly (243). See **Special Tools and Equipment** .

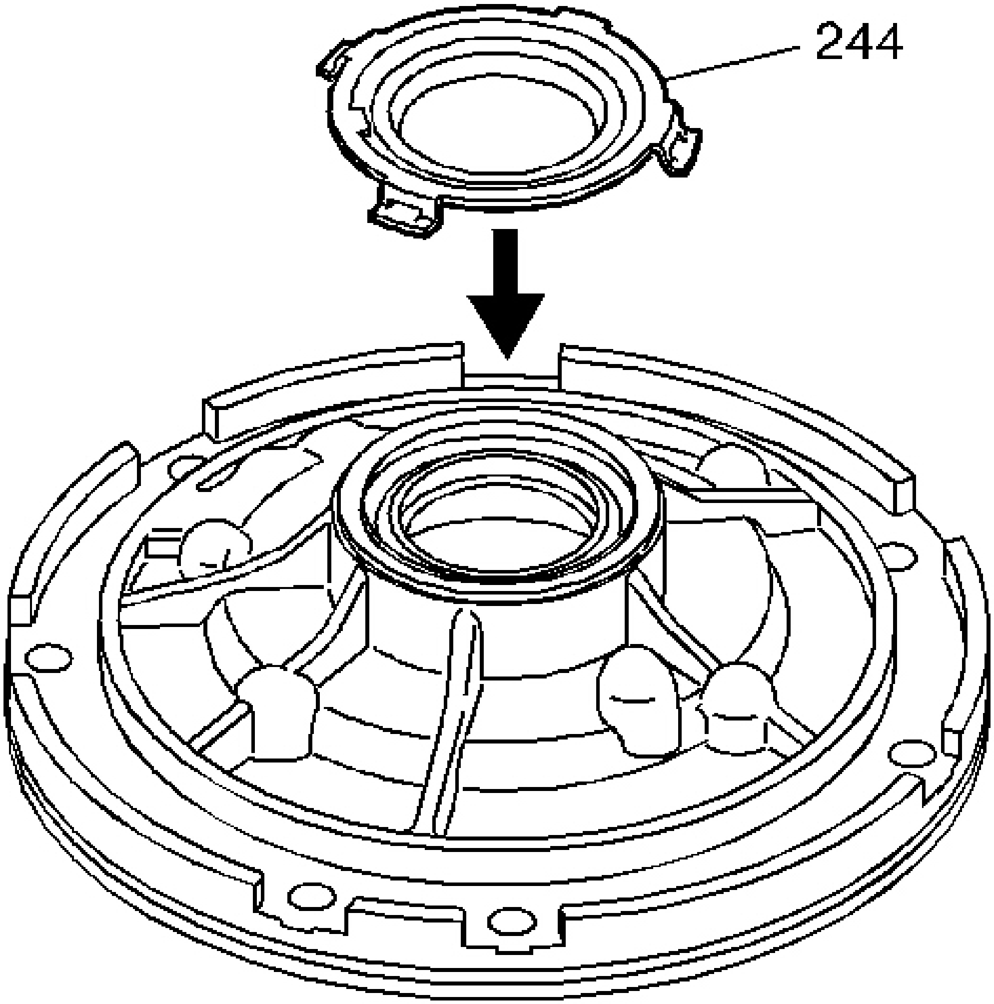


Fig. 372: Front Helix Retainer
Courtesy of GENERAL MOTORS CORP.

2. Install the front helix retainer (244).

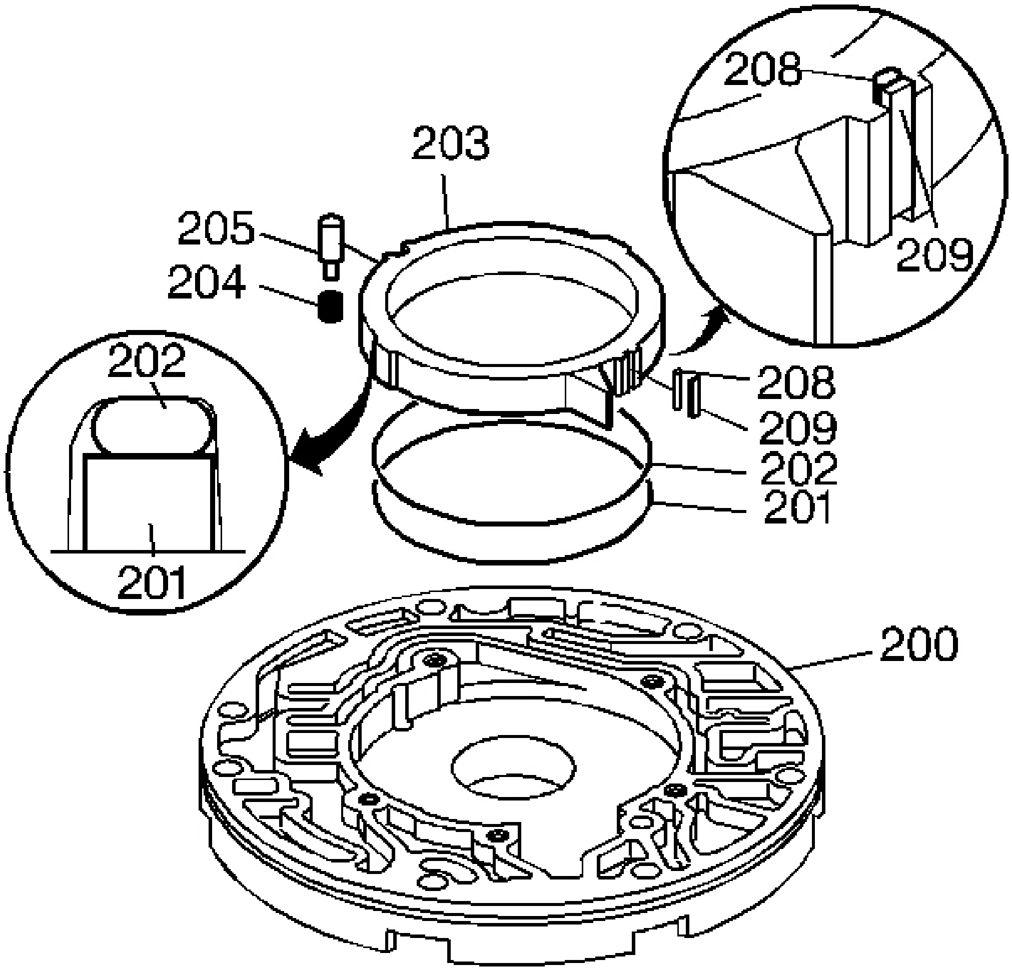


Fig. 373: Installing (202), (201), (204), (205), (208) & (209)
Courtesy of GENERAL MOTORS CORP.

3. Install an O-ring seal (202) and oil seal ring (201) into the groove on the back side of the pump slide (203).
4. Use J 36850 , or an equivalent, to retain the seal and the ring on the slide.
5. Install the pivot pin spring (204) and the pivot pin (205).
6. Install the pump slide (203).
7. Index the slide notch with the pivot pin (205).

   The oil seal ring must face downward into the pump pocket.

8. Install the pump slide seal support (208) and the pump slide seal (209).

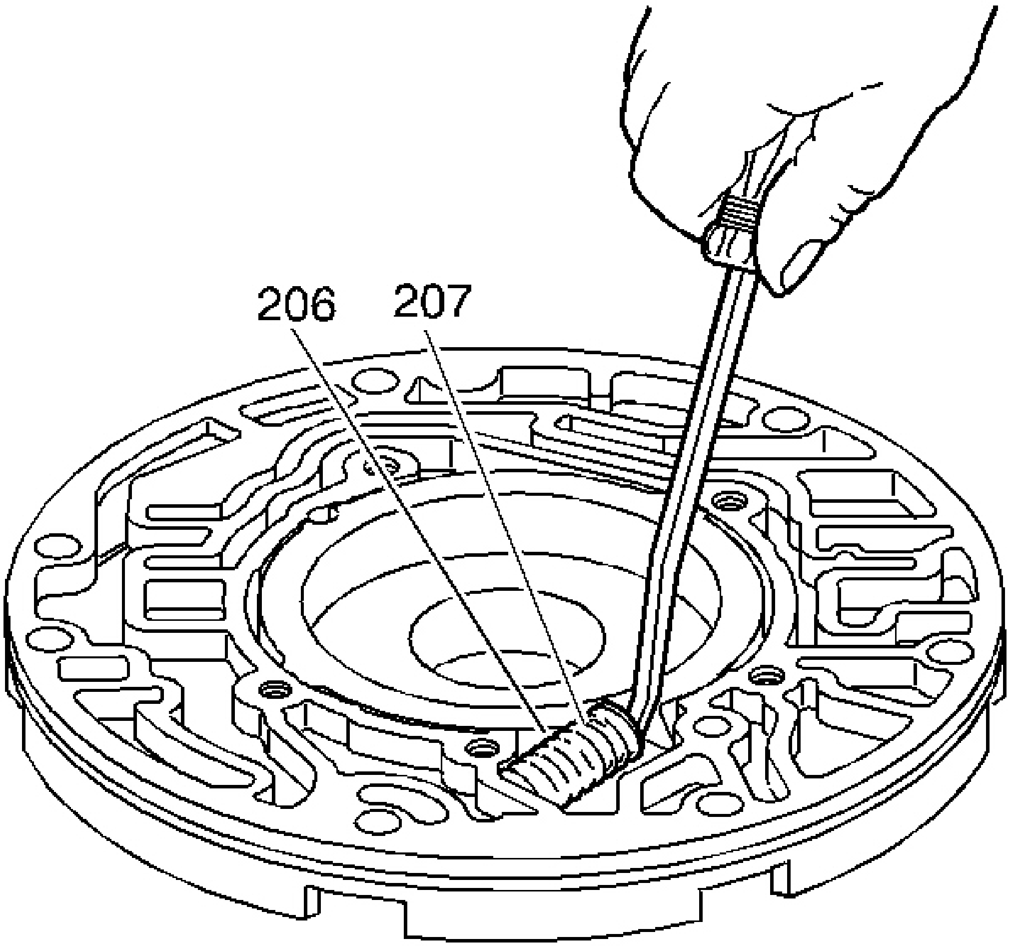


Fig. 374: Pump Slide Inner & Outer Springs
Courtesy of GENERAL MOTORS CORP.

9. Install the pump slide inner (207) and outer (206) springs.

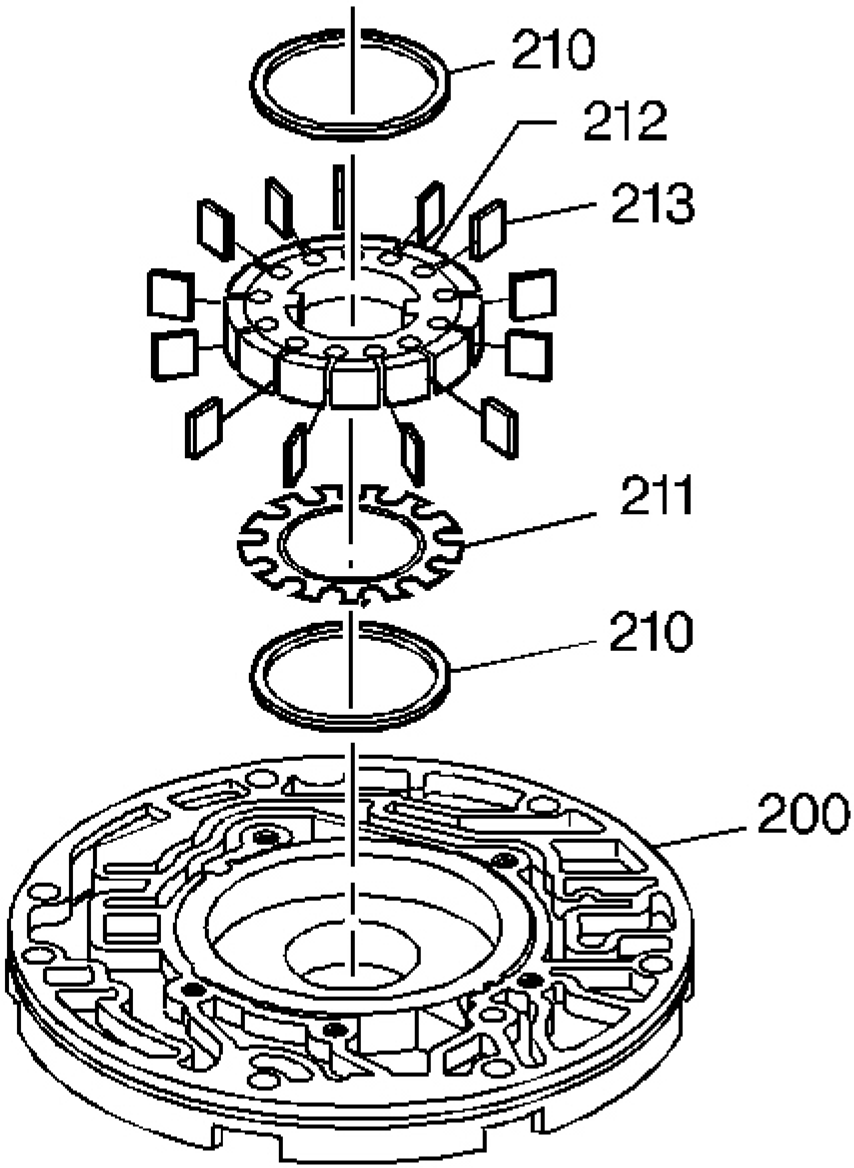


Fig. 375: Oil Pump Rotor, Pump Vane Rings, Pump Vanes & Rotor Guide
Courtesy of GENERAL MOTORS CORP.

10. Install the bottom pump vane ring (210) and the rotor guide (211) into the rotor (212) and retain with J 36850 or an equivalent.
11. Install the rotor (212) with the rotor guide (211) toward the pump pocket.

12. Install the pump vanes (213).
13. Install the top pump vane ring (210).

OIL PUMP COVER DISASSEMBLE

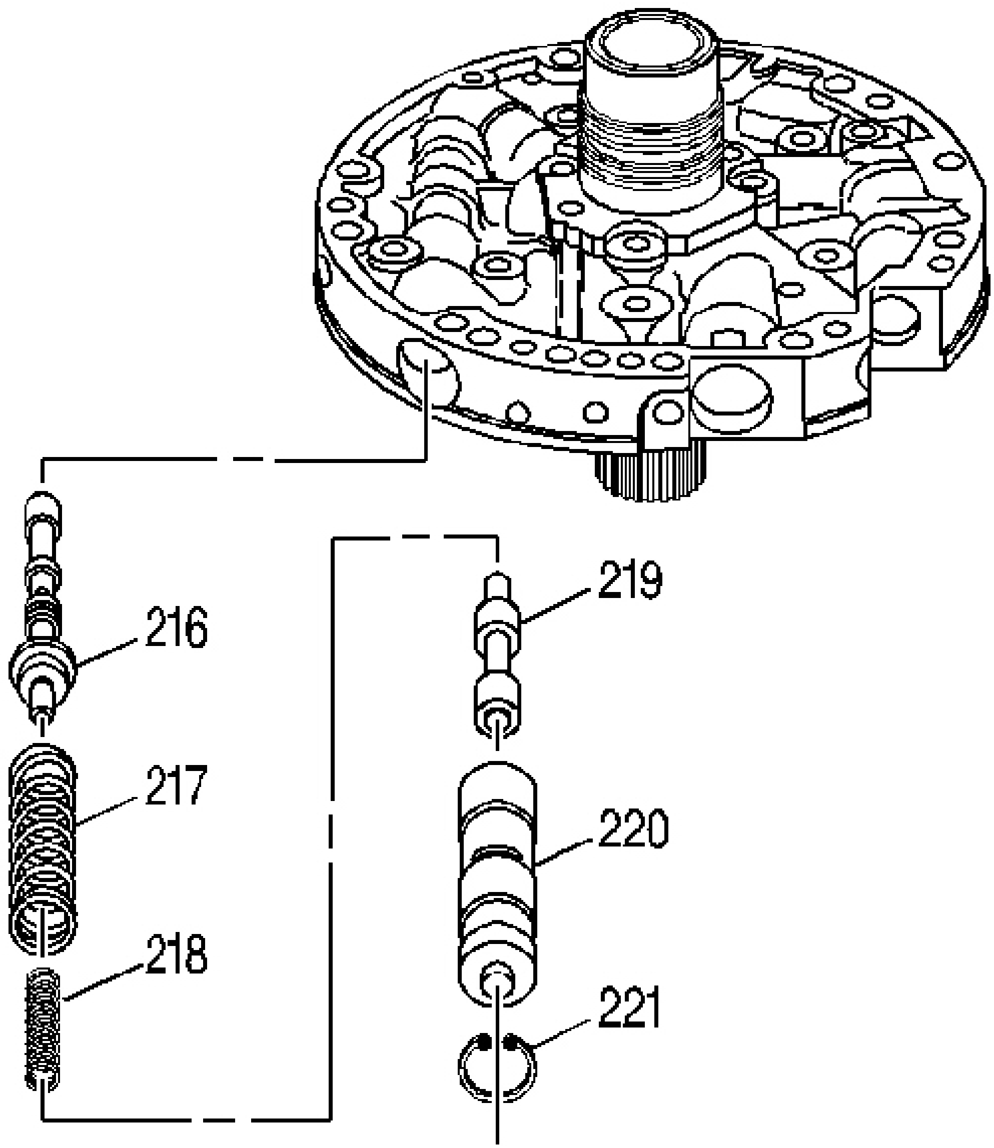


Fig. 376: Removing (221), (220), (219), (218), (217), & (216)

Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump reverse boost valve retaining ring (221).
2. Remove the reverse boost valve sleeve (220) and the reverse boost valve (219).
3. Remove the pressure regulator isolator spring (218) and the pressure regulator valve spring (217).
4. Remove the pressure regulator valve (216).

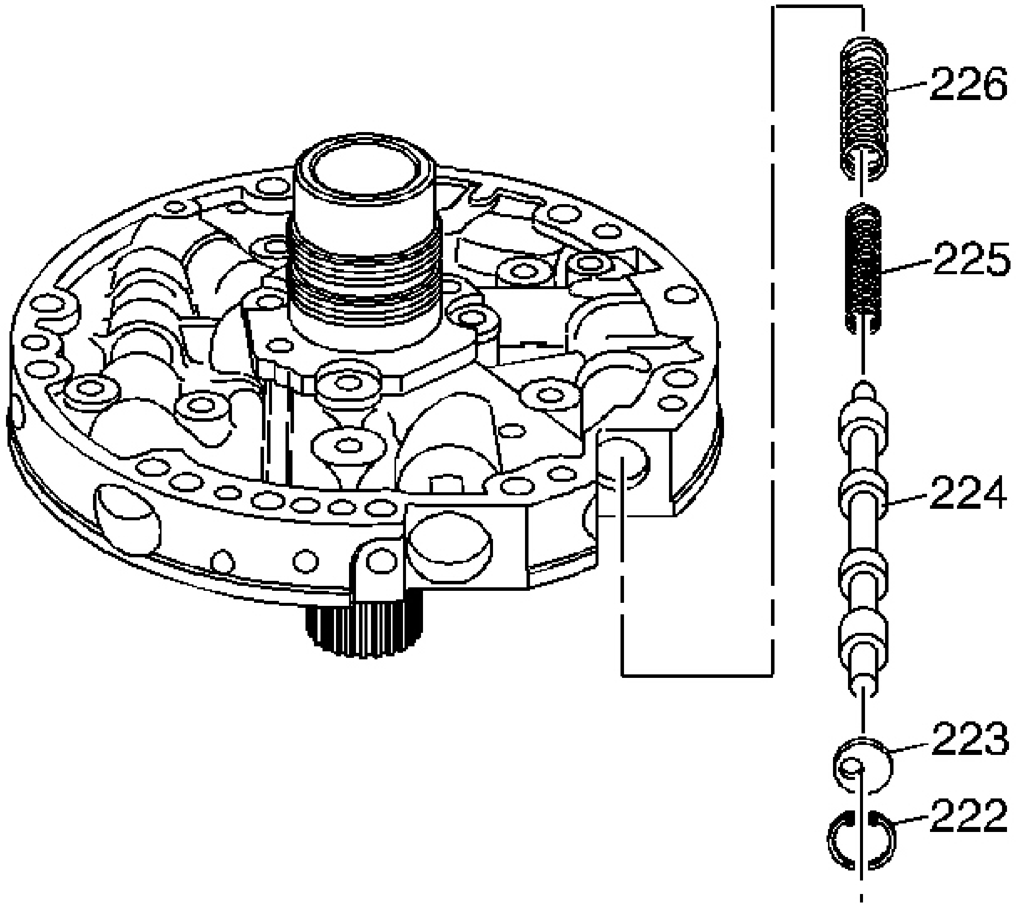


Fig. 377: Oil Pump Converter Clutch Valve Retaining Ring, Stop Valve, Converter Clutch Valve, Converter Clutch Valve Inner & Outer Springs
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pump converter clutch valve retaining ring (222).
6. Remove the stop valve (223) and the converter clutch valve (224).

7. Remove the converter clutch valve inner (225) and outer (226) springs.

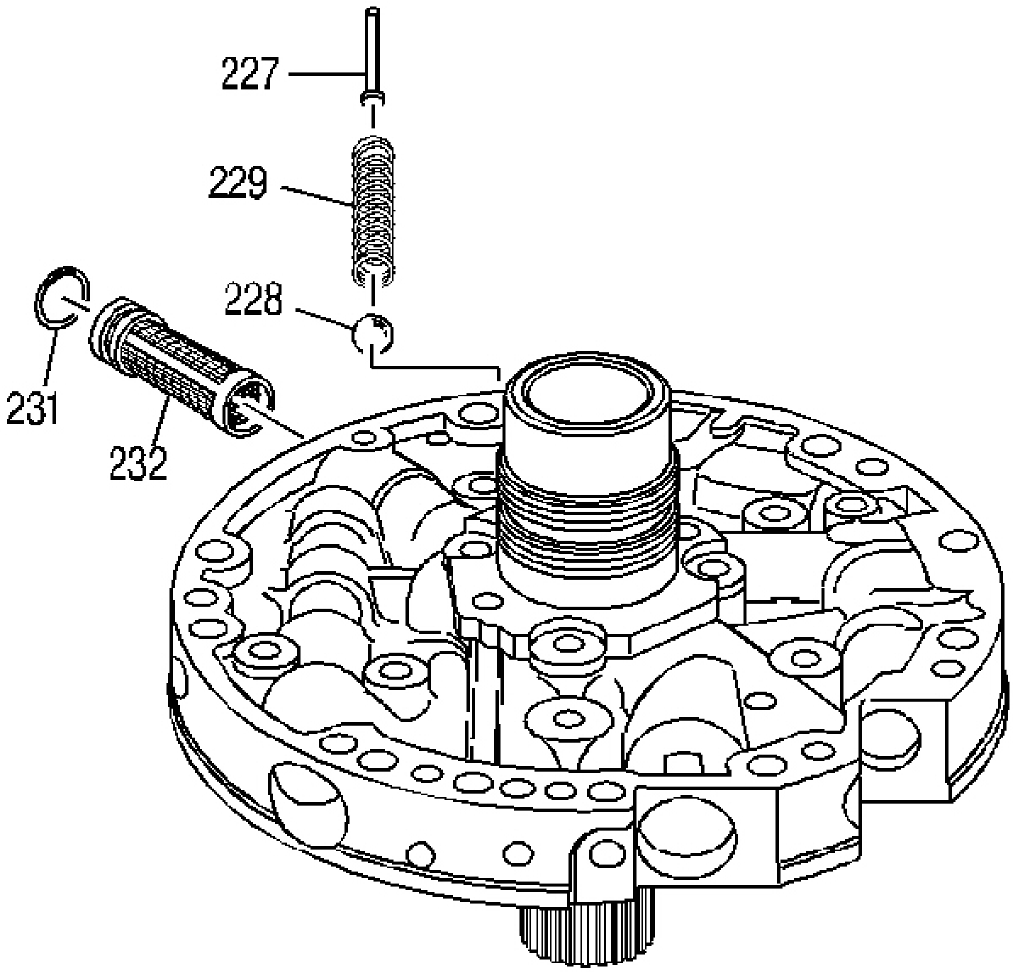


Fig. 378: Pressure Relief Bolt Rivet, Pressure Relief Spring, Pressure Relief Ball, Oil Pump Cover Screen & Oil Pump Cover Screen Seal
Courtesy of GENERAL MOTORS CORP.

8. Remove the pressure relief bolt rivet (227).
9. Remove the pressure relief spring (229) and the pressure relief ball (228).
10. Remove the oil pump cover screen (232) and the oil pump cover screen seal (231).

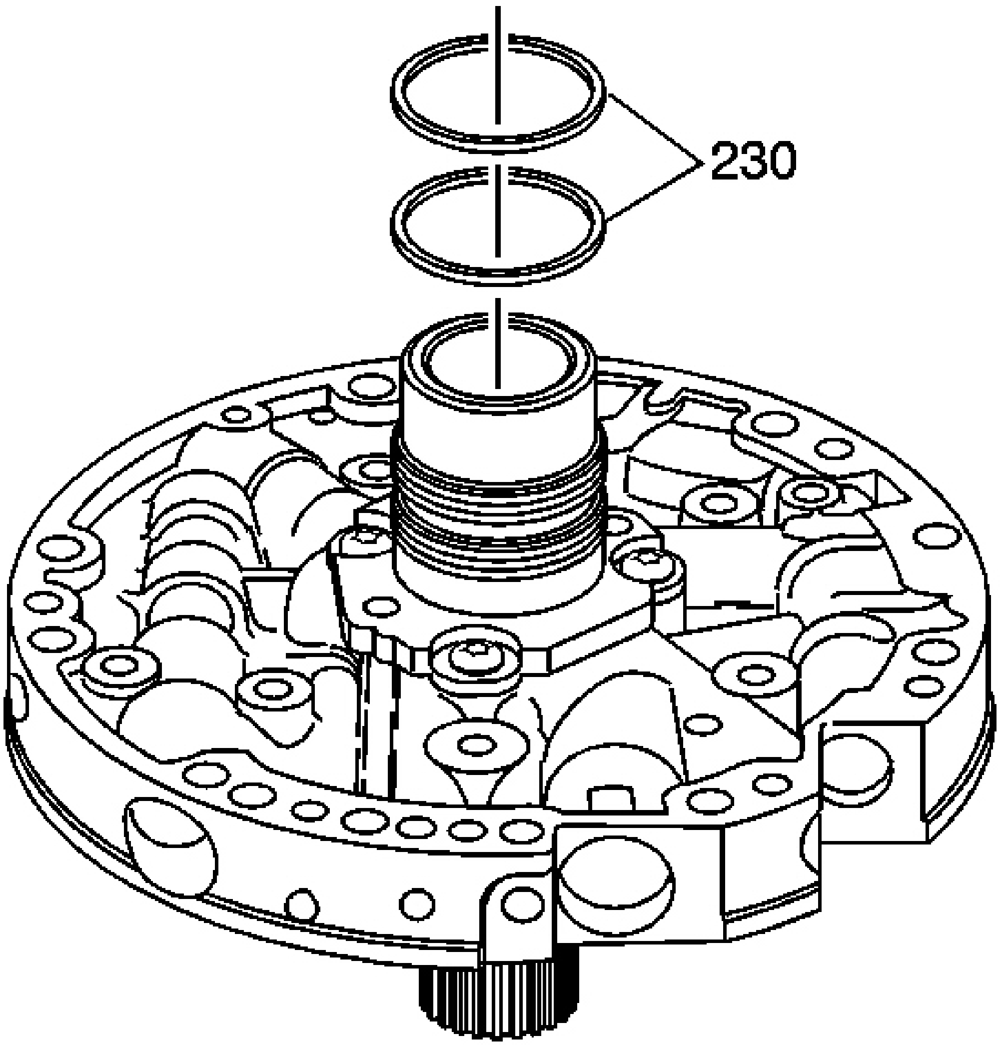


Fig. 379: Stator Shaft Oil Seal Rings
Courtesy of GENERAL MOTORS CORP.

11. Remove the stator shaft oil seal rings (230).

OIL PUMP STATOR SHAFT BUSHING REPLACEMENT

Removal Procedure

Tools Required

- **J 7004-A** Universal Remover. See **Special Tools and Equipment** .
- J 8092 Universal Driver Handle - 3/4 in - 10
- **J 21465-01** Bushing Service Set. See **Special Tools and Equipment** .
- **J 34196-B** Transmission Bushing Service Set. See **Special Tools and Equipment** .

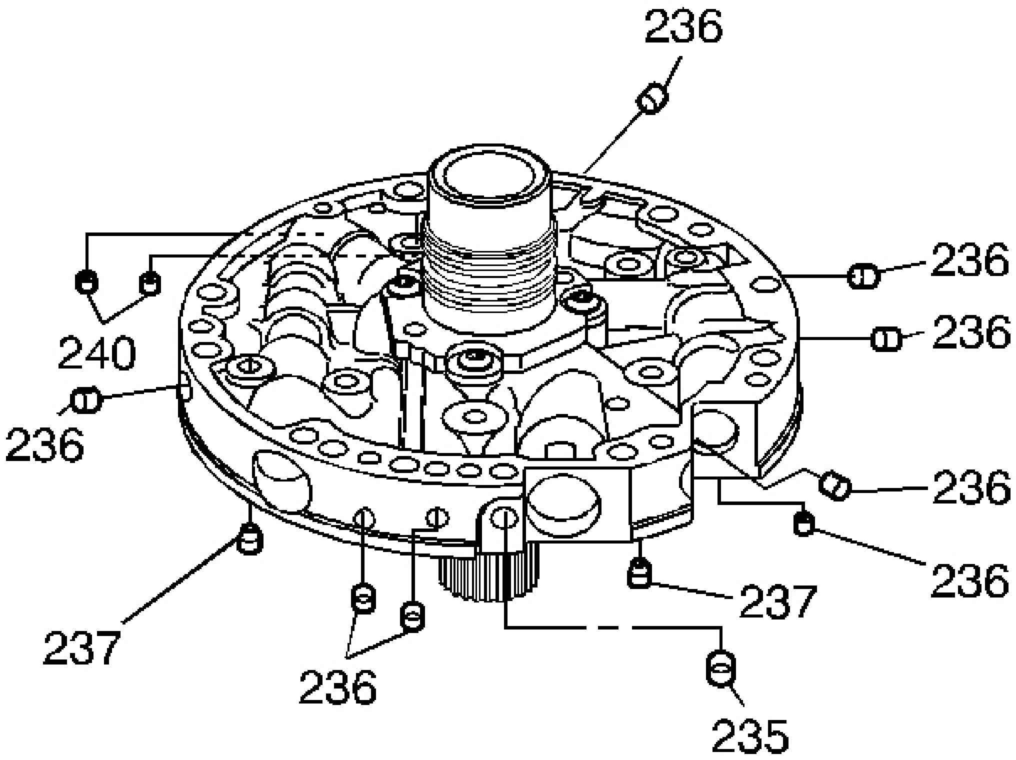


Fig. 380: Pump Cover, Check Valve Retainer, Ball Assemblies, Cup Plugs & Orificed Cup Plugs
Courtesy of GENERAL MOTORS CORP.

1. Inspect the pump cover, all check valve retainer and ball assemblies (237), cup plugs (235, 236) and orificed cup plugs (238, 240).

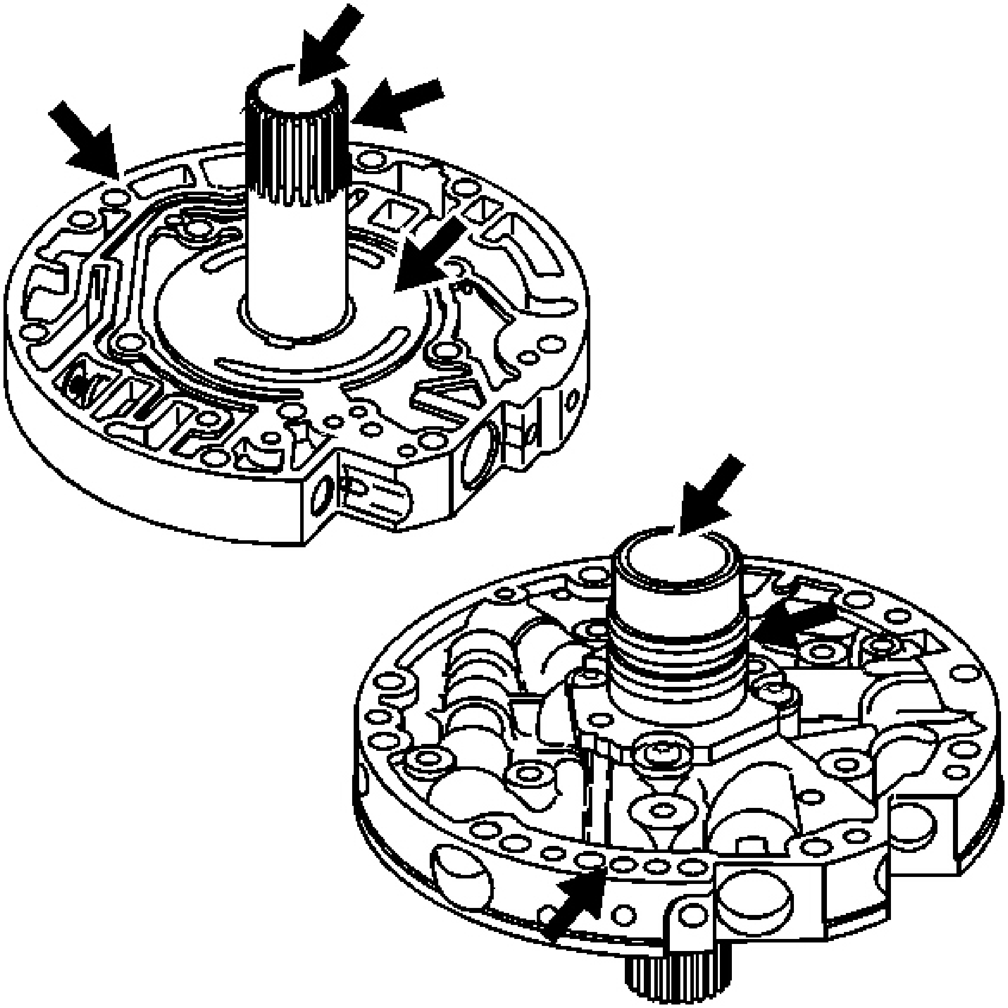


Fig. 381: Inspecting Pump Cover
Courtesy of GENERAL MOTORS CORP.

2. Inspect the pump cover for the following:
   - Worn or damaged bushings
   - Foreign material or debris
   - Porosity
   - Scored or irregular mating faces
   - Cross channel leaks
   - Ring groove damage

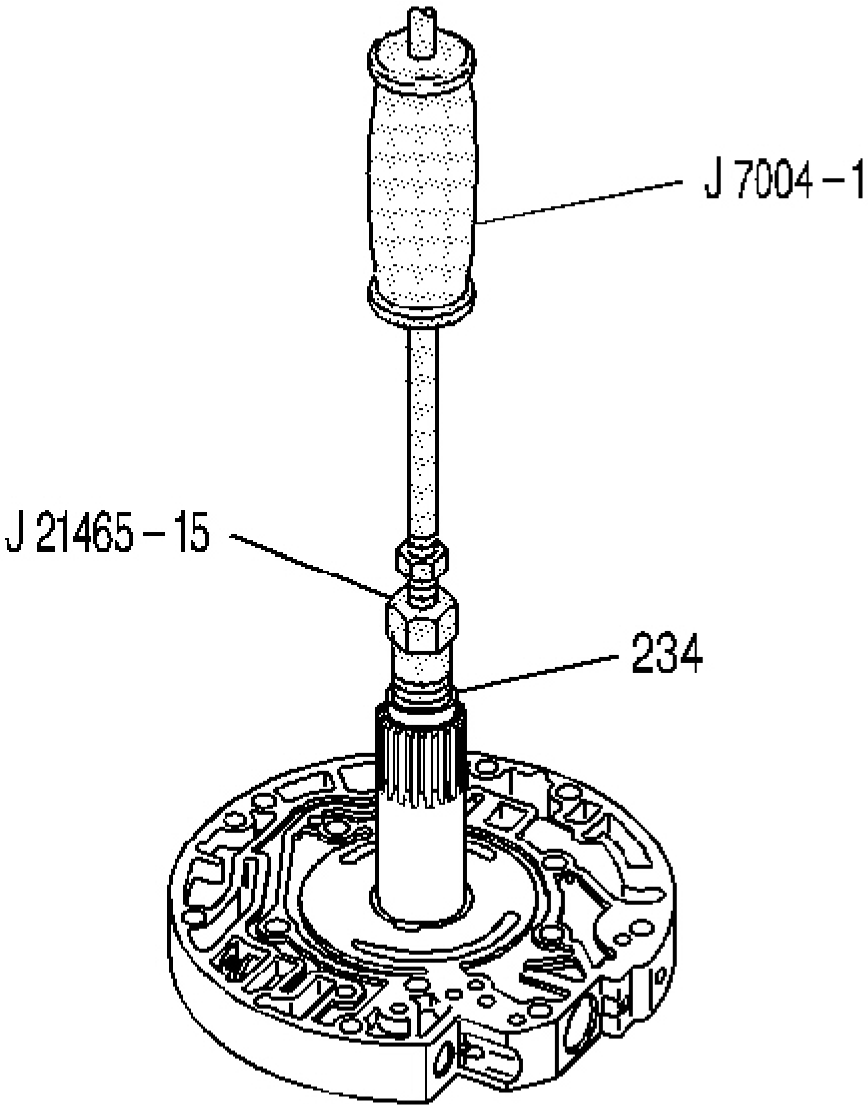


Fig. 382: Removing Stator Shaft Front Bushing
Courtesy of GENERAL MOTORS CORP.

3. Using the **J 21465-15** with the **J 7004-A** , remove the stator shaft front bushing (234). See **Special Tools and Equipment** .

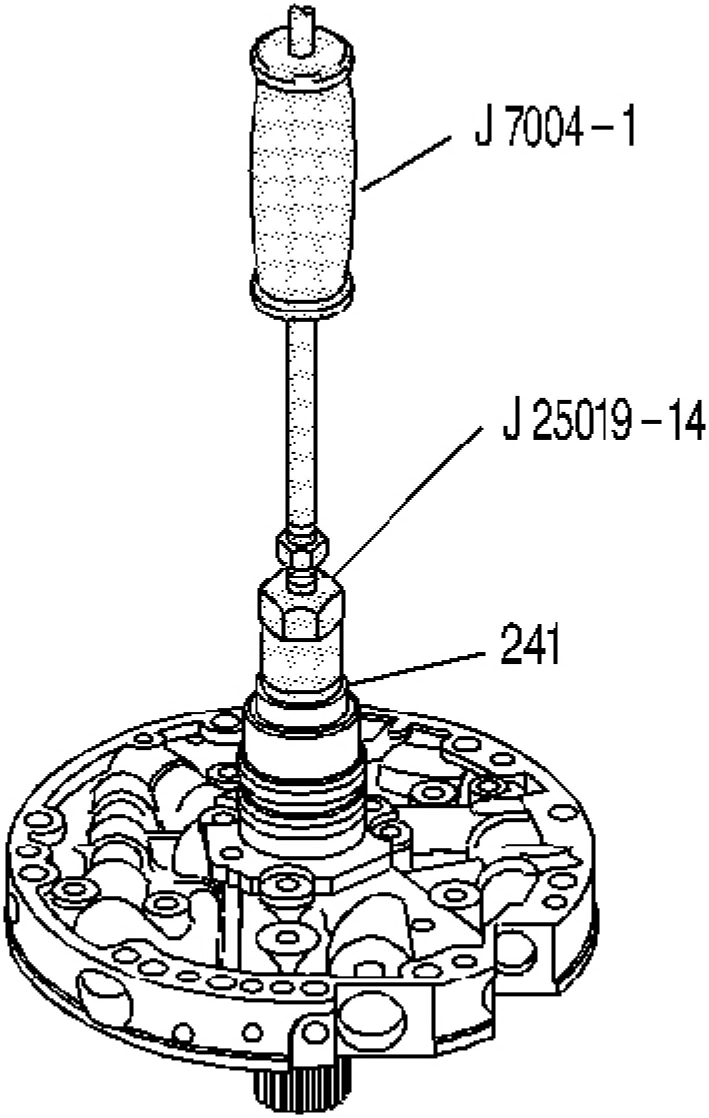


Fig. 383: Removing Stator Shaft Rear Bushing
Courtesy of GENERAL MOTORS CORP.

4. Using the **J 25019-14** with the **J 7004-A** , remove the stator shaft rear bushing (241). See **Special Tools and Equipment** .

Installation Procedure

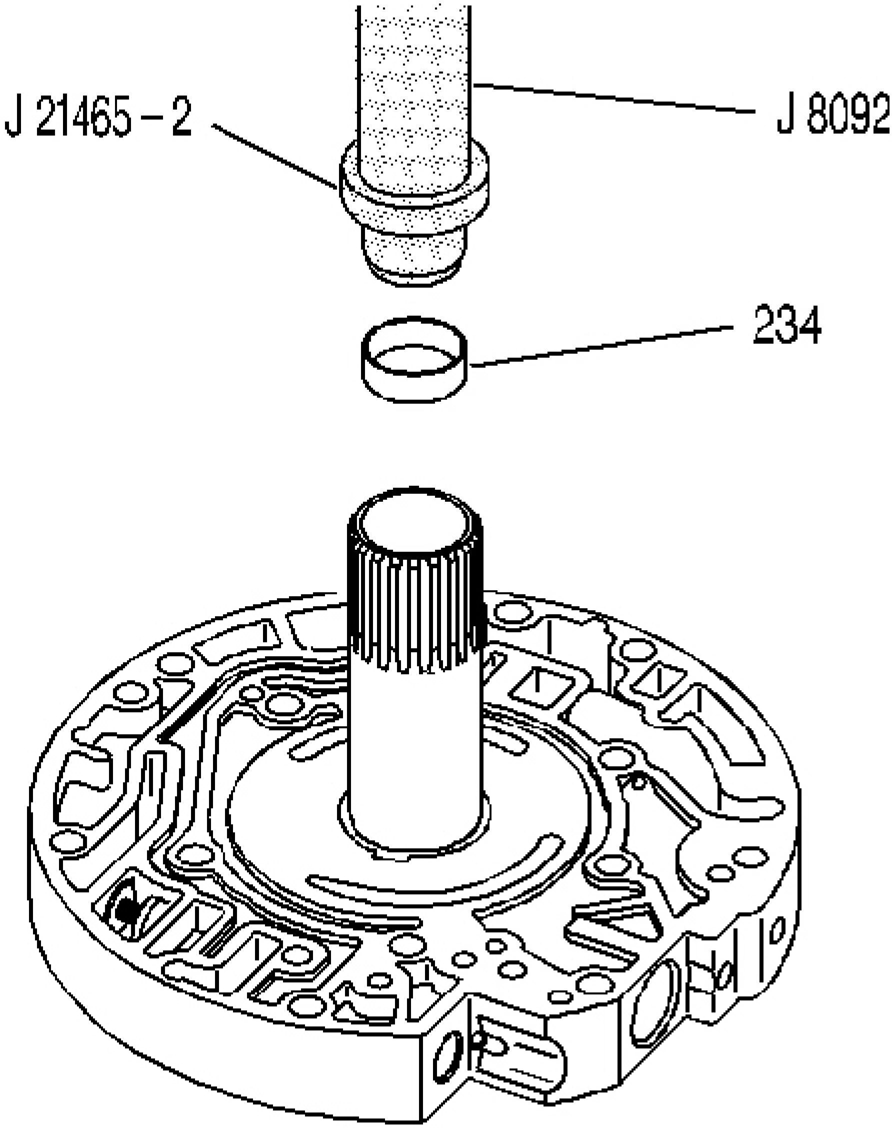


Fig. 384: Installing Stator Shaft Front Bushing
Courtesy of GENERAL MOTORS CORP.

1. Using the **J 21465-2** and the J 8092 , install a new stator shaft front bushing (234).See **Special Tools and Equipment** .

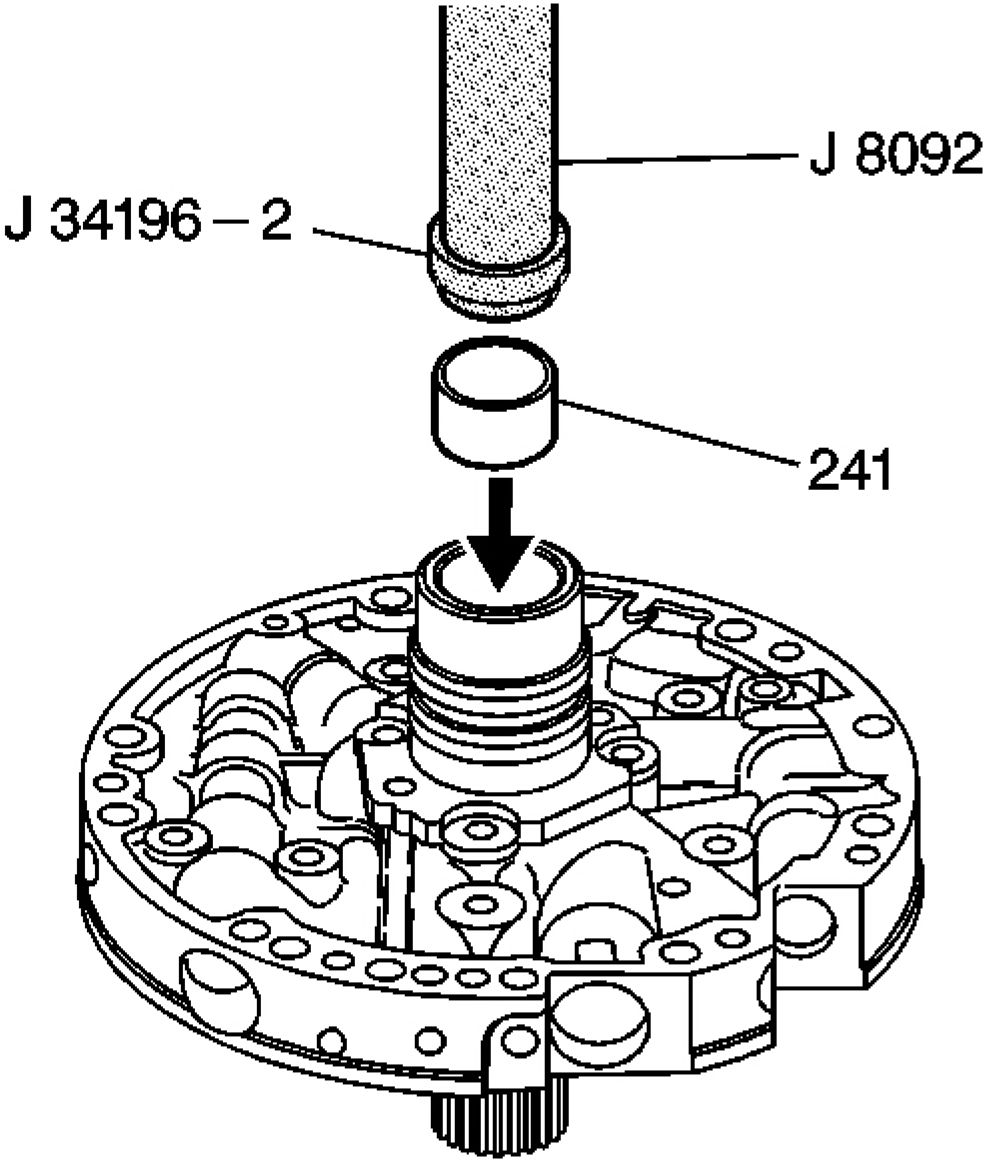


Fig. 385: Installing Stator Shaft Rear Bushing
Courtesy of GENERAL MOTORS CORP.

2. Using the J 34196-2 which is part of kit **J 34196-B** and the J 8092 , install the stator shaft rear bushing (241). See **Special Tools and Equipment** .

OIL PUMP COVER ASSEMBLE

Tools Required

- **J 38735-3** Pusher. See **Special Tools and Equipment** .
- **J 39855** Stator Shaft Seal Installer. See **Special Tools and Equipment** .

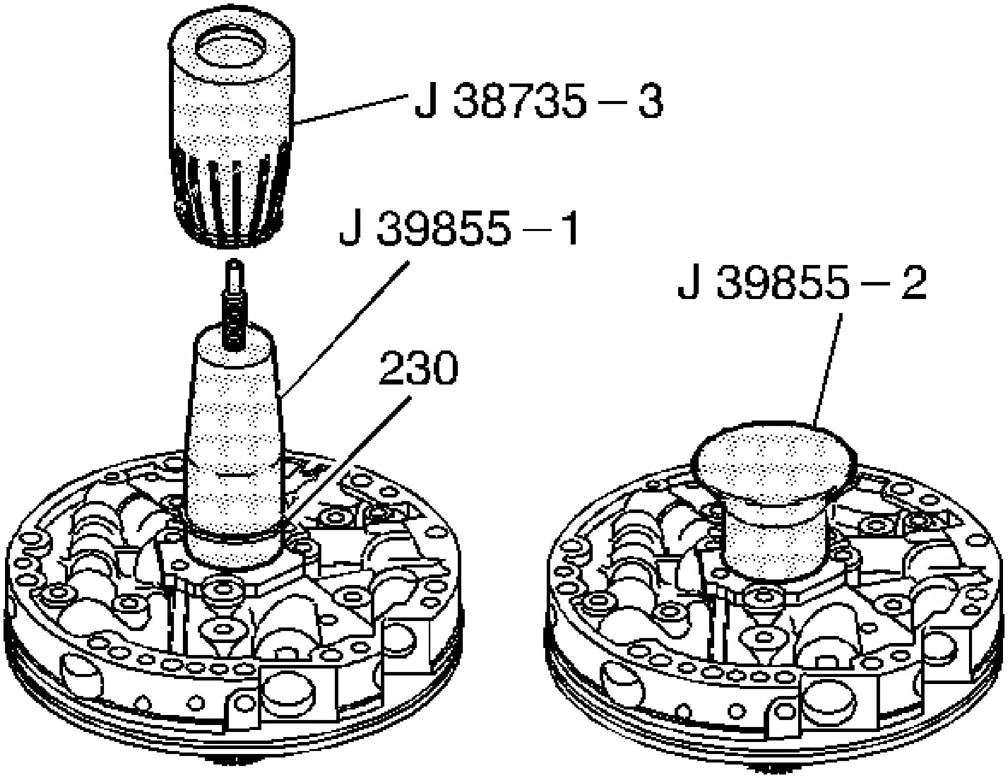


Fig. 386: Installing Stator Shaft Oil Seal Rings
Courtesy of GENERAL MOTORS CORP.

1. Using the J 39855-1 which is part of kit **J 39855** and the **J 38735-3** , install the stator shaft oil seal rings (230). See **Special Tools and Equipment** .
2. Place J 39855-2 which is part of kit **J 39855** over the seals. See **Special Tools and Equipment** .
3. Leave J 39855-2 which is part of kit **J 39855** on the stator shaft until just before the pump is to be installed into the transmission. See **Special Tools and Equipment** .

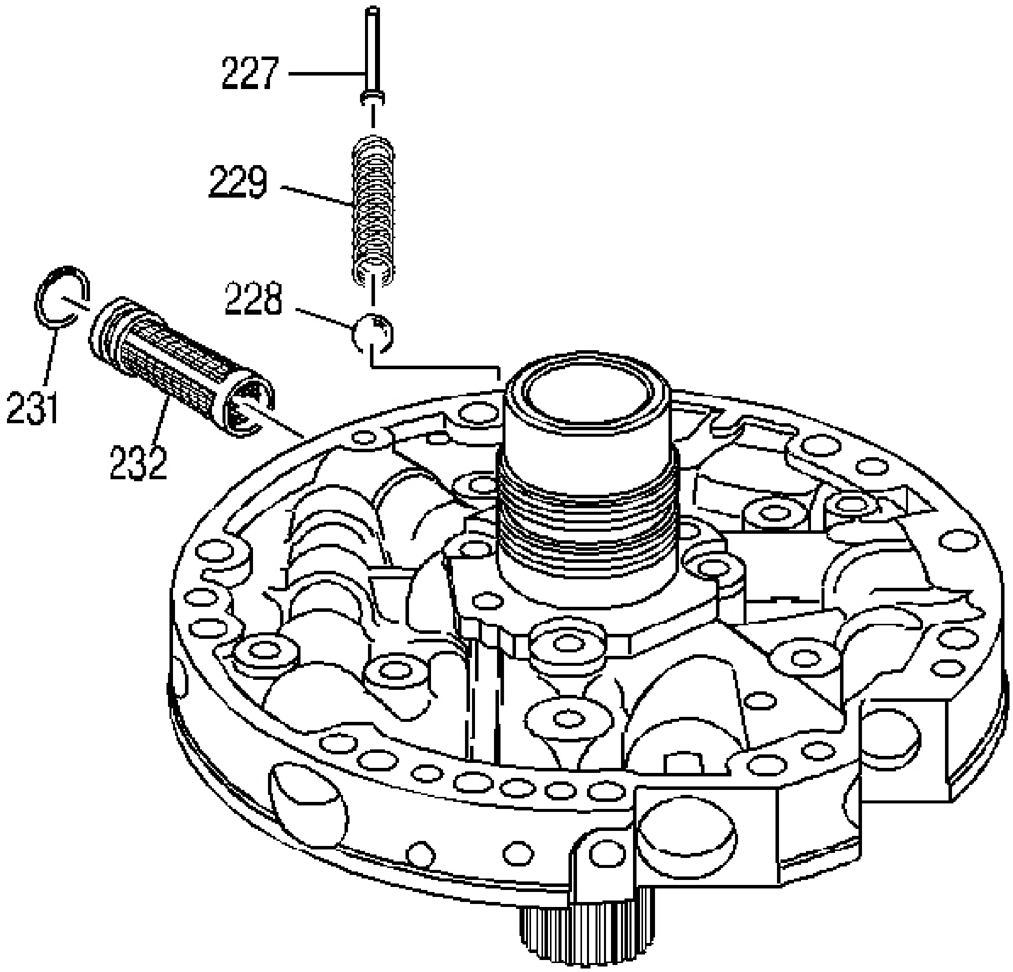


Fig. 387: Pressure Relief Ball, Pressure Relief Spring, Pressure Relief Bolt Rivet, Oil Pump Cover Screen Seal, Oil Pump Cover Screen
Courtesy of GENERAL MOTORS CORP.

4. Install the pressure relief ball (228) and pressure relief spring (229).
5. Install the pressure relief bolt rivet (227).
6. Install the oil pump cover screen seal (231) on the oil pump cover screen (232).
7. Install the oil pump cover screen (232) into the pump cover.

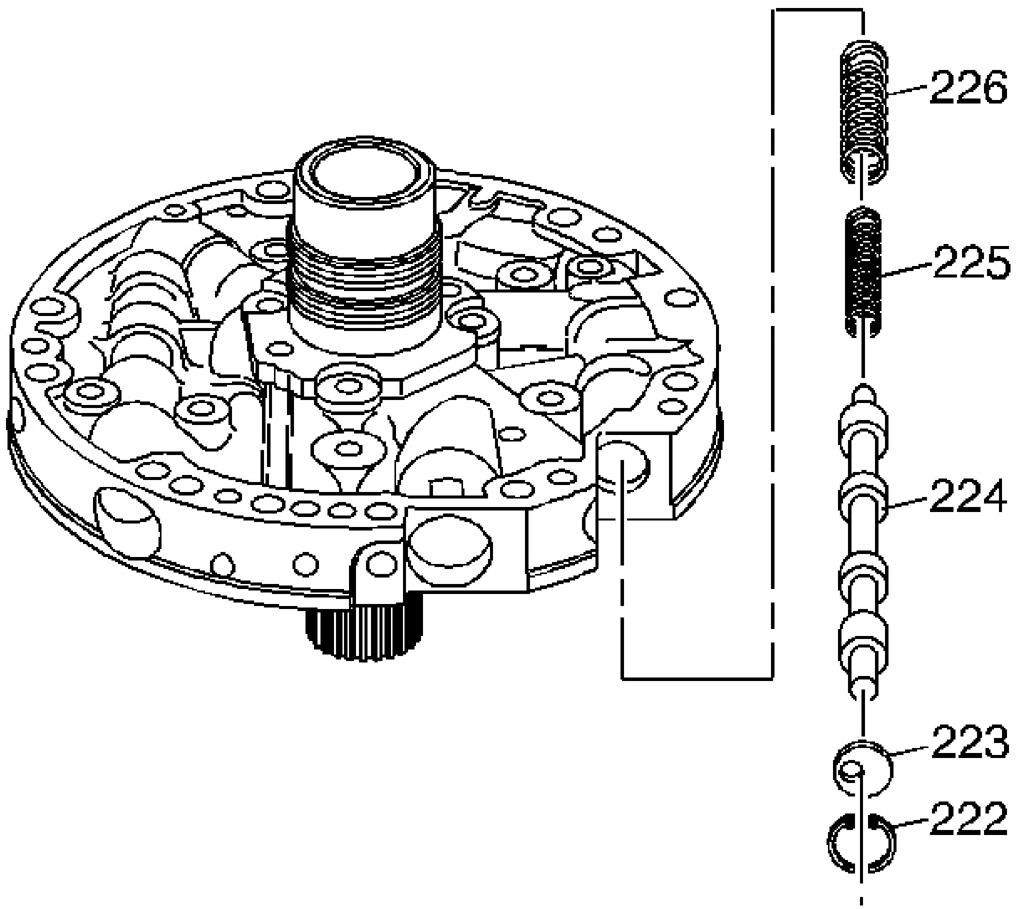


Fig. 388: Oil Pump Converter Clutch Valve Retaining Ring, Stop Valve, Converter Clutch Valve, Converter Clutch Valve Inner & Outer Springs
Courtesy of GENERAL MOTORS CORP.

8. Install the converter clutch valve inner (225) and outer (226) springs.
9. Install the converter clutch valve (224).
10. Install the stop valve (223) and the oil pump converter clutch valve retaining ring (222).

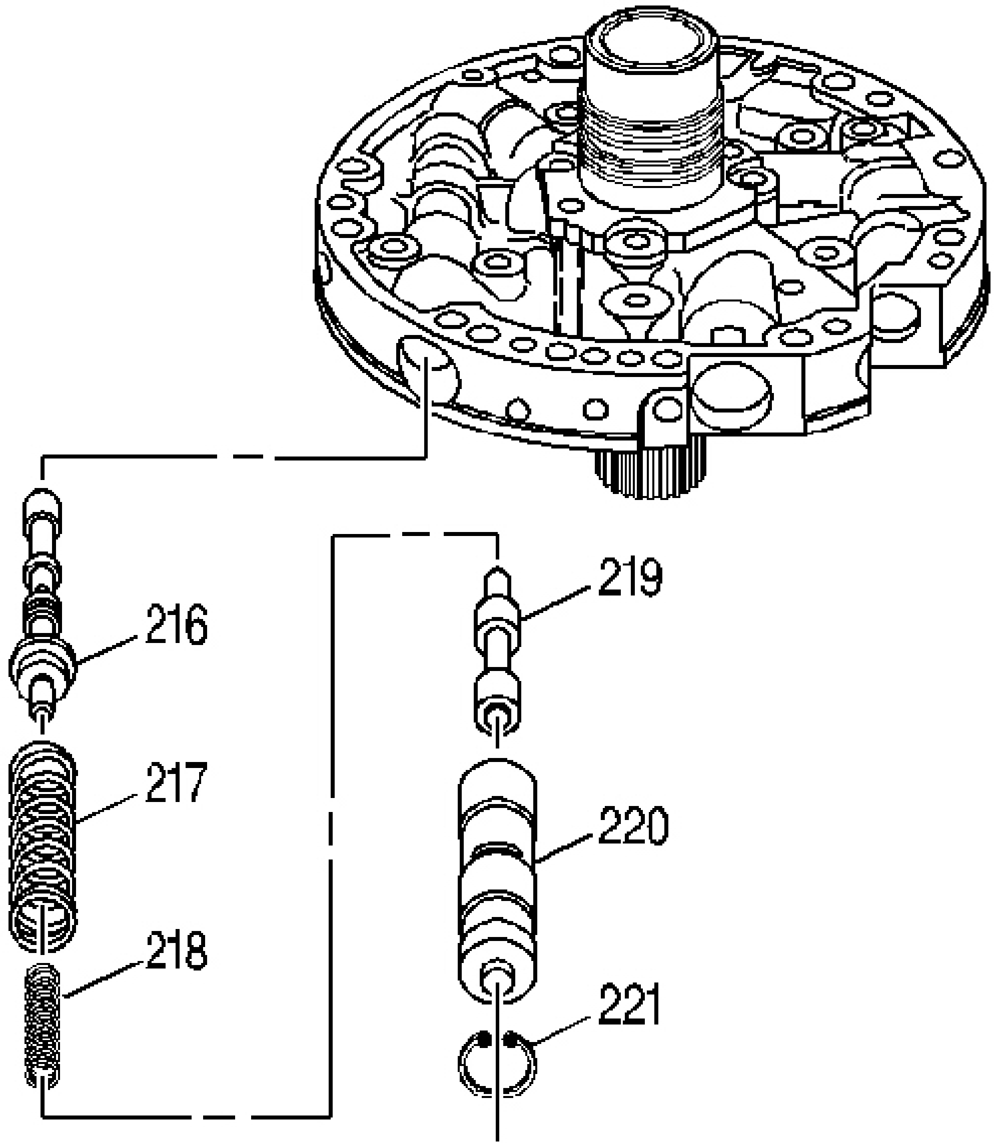


Fig. 389: Pump Cover Components
Courtesy of GENERAL MOTORS CORP.

11. Install the pressure regulator valve (216).
12. Install the pressure regulator isolator spring (218) and the pressure regulator valve spring (217).
13. Install the reverse boost valve (219) in the reverse boost valve sleeve (220).

14. Install the reverse boost valve and sleeve in the pump cover.
15. Install the oil pump reverse boost valve retaining ring (221).

OIL PUMP COVER AND BODY ASSEMBLE

Tools Required

J 21368 Pump Body and Cover Alignment Band. See **Special Tools and Equipment** .

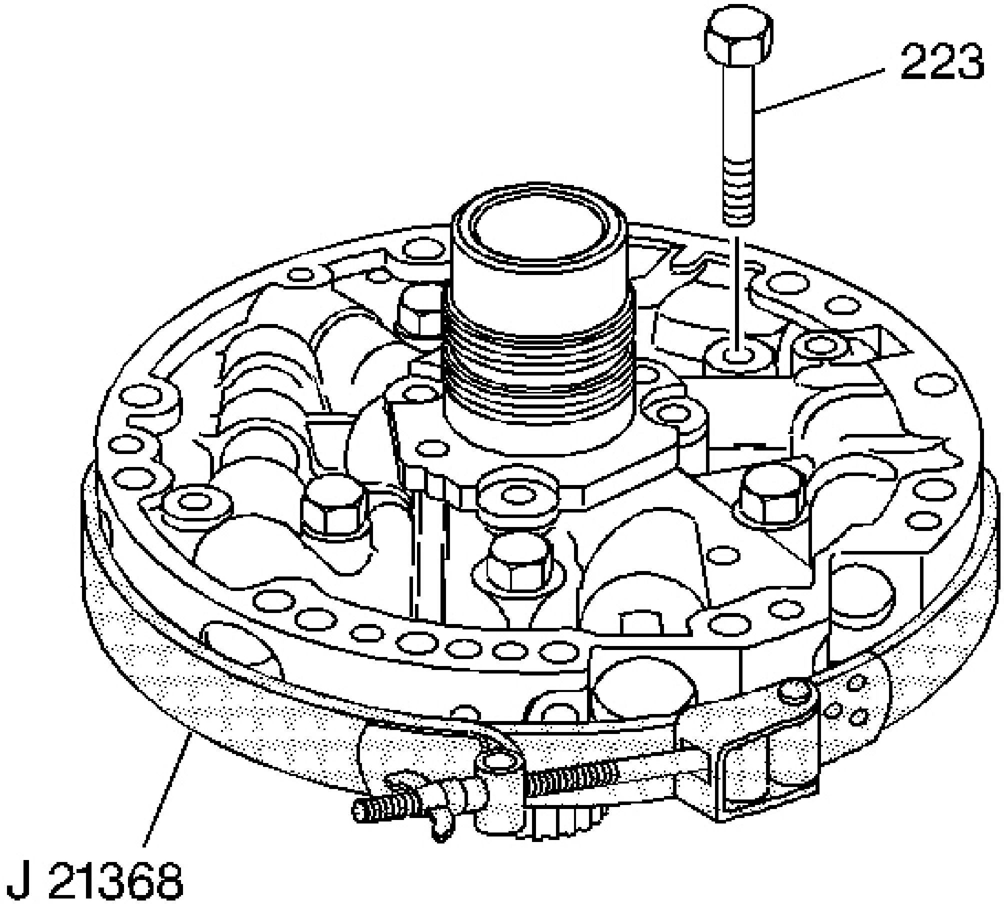


Fig. 390: Installing Pump Cover Bolts & J 21368
Courtesy of GENERAL MOTORS CORP.

1. Place the oil pump cover onto the oil pump body and put stator shaft through a hole in the bench.

2. Install the pump cover bolts (223) finger tight only.
3. Install the **J 21368** . See **Special Tools and Equipment** .

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Tighten the pump cover bolts (223).

   Tighten: Tighten the bolts to 24 N.m (18 lb ft).

5. Remove the **J 21368** . See **Special Tools and Equipment** .

OIL PUMP ASSEMBLY INSTALLATION

Tools Required

- **J 25025-1** Dial Indicator Mounting Post. See **Special Tools and Equipment** .
- **J 39855** Stator Shaft Seal Installer. See **Special Tools and Equipment** .

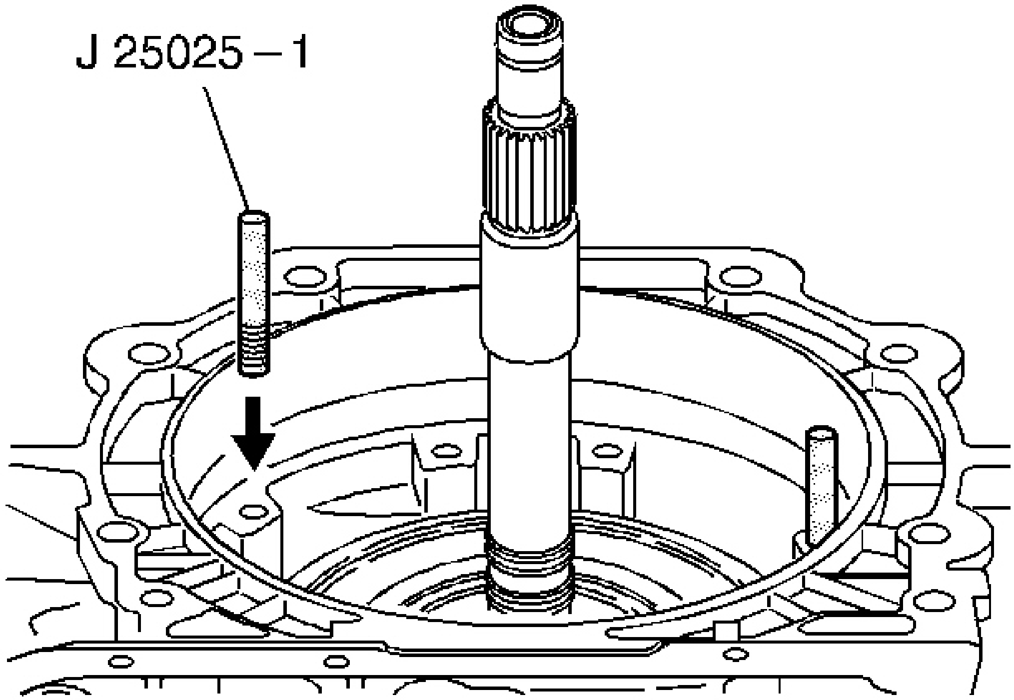


Fig. 391: Installing J 25025-1

Courtesy of GENERAL MOTORS CORP.

1. Install the **J 25025-1** . See **Special Tools and Equipment** .

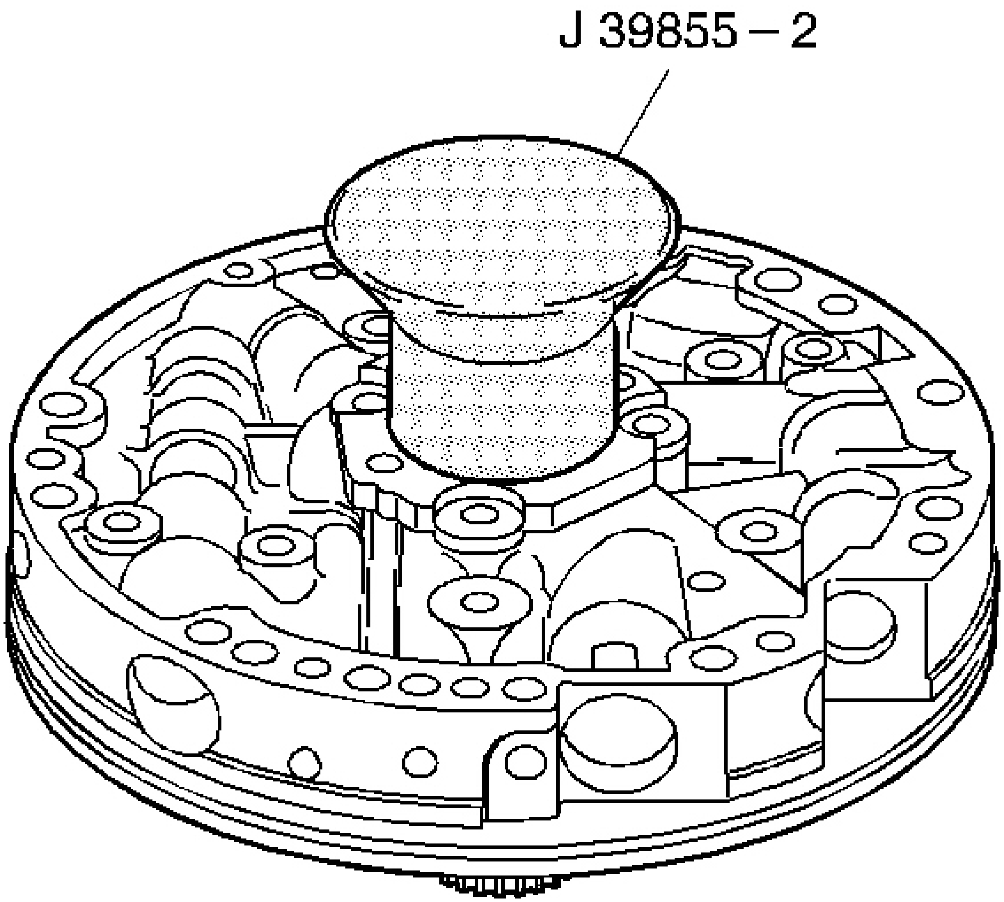


Fig. 392: Removing J 39855-2
Courtesy of GENERAL MOTORS CORP.

2. Remove the J 39855-2 which is part of kit**J 39855** . See **Special Tools and Equipment** .

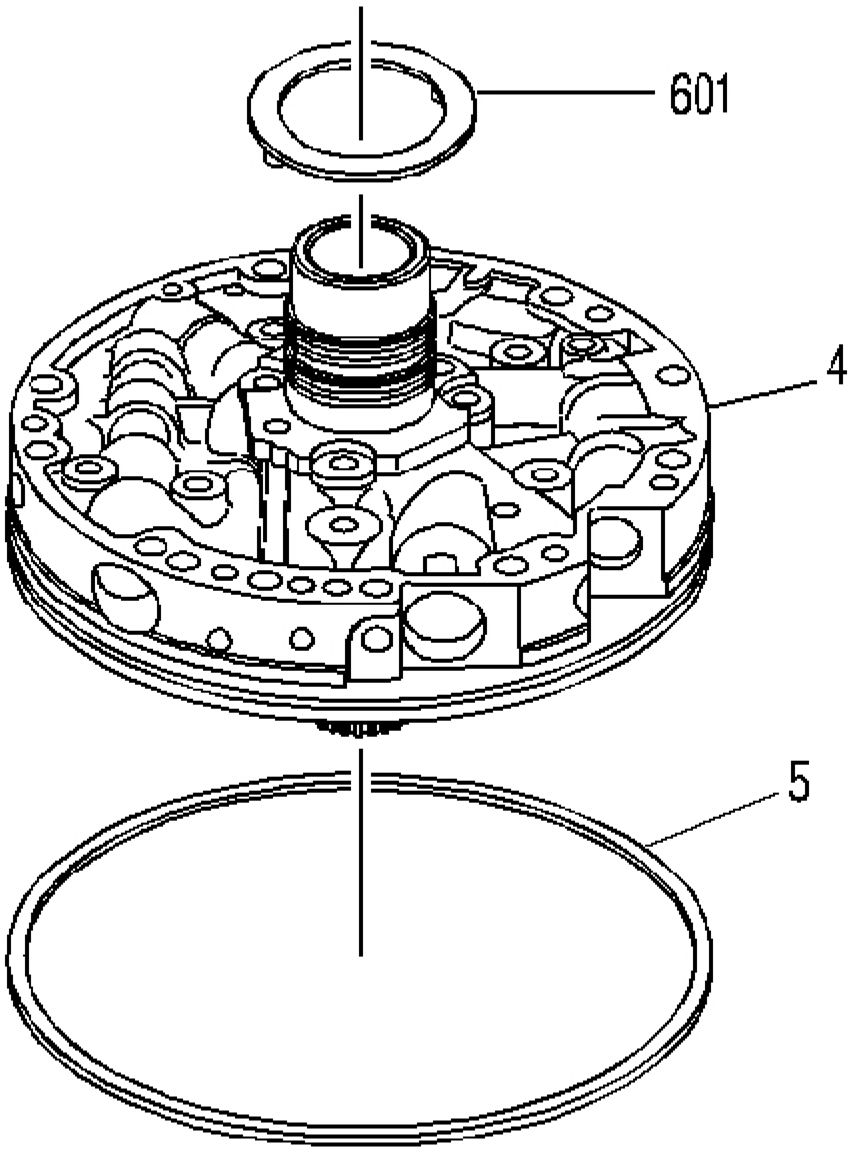


Fig. 393: Installing Pump To Drum Thrust Washer
Courtesy of GENERAL MOTORS CORP.

3. Install the pump to drum thrust washer (601).
4. Use J 36850 or equivalent to retain the washer to the pump.
5. Install the oil pump to case seal (5) on the oil pump assembly (4).

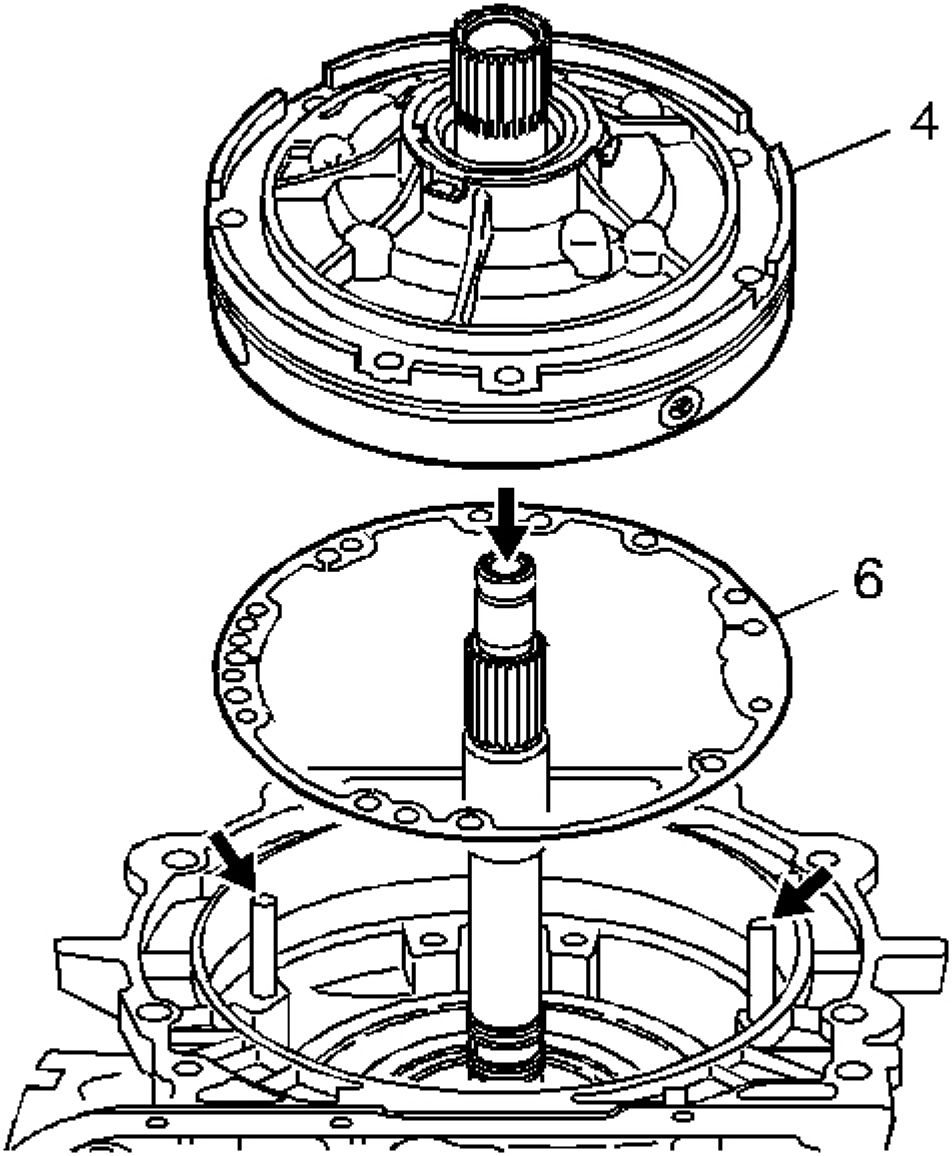


Fig. 394: Installing Cover To Case Gasket & Oil Pump Assembly
Courtesy of GENERAL MOTORS CORP.

6. Install the pump cover to case gasket (6).
7. Install the oil pump assembly (4) into the case and align all holes properly.

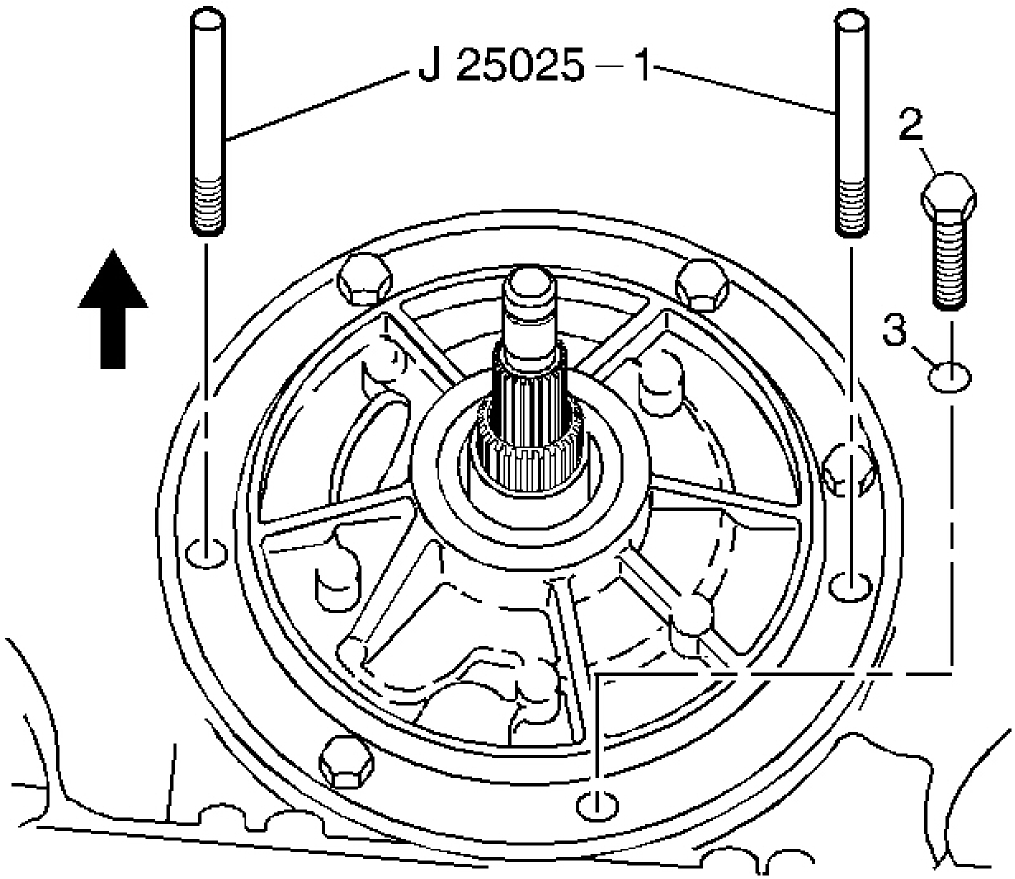


Fig. 395: Installing Pump To Case Bolts & New O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: **The pump to case bolt O-ring seals (3) must be replaced.**

8. Install the pump to case bolts (2) with new O-ring seals (3).

   Tighten: Tighten the bolts to 29 N.m (21 lb ft).

9. Remove the **J 25025-1** . See **Special Tools and Equipment** .

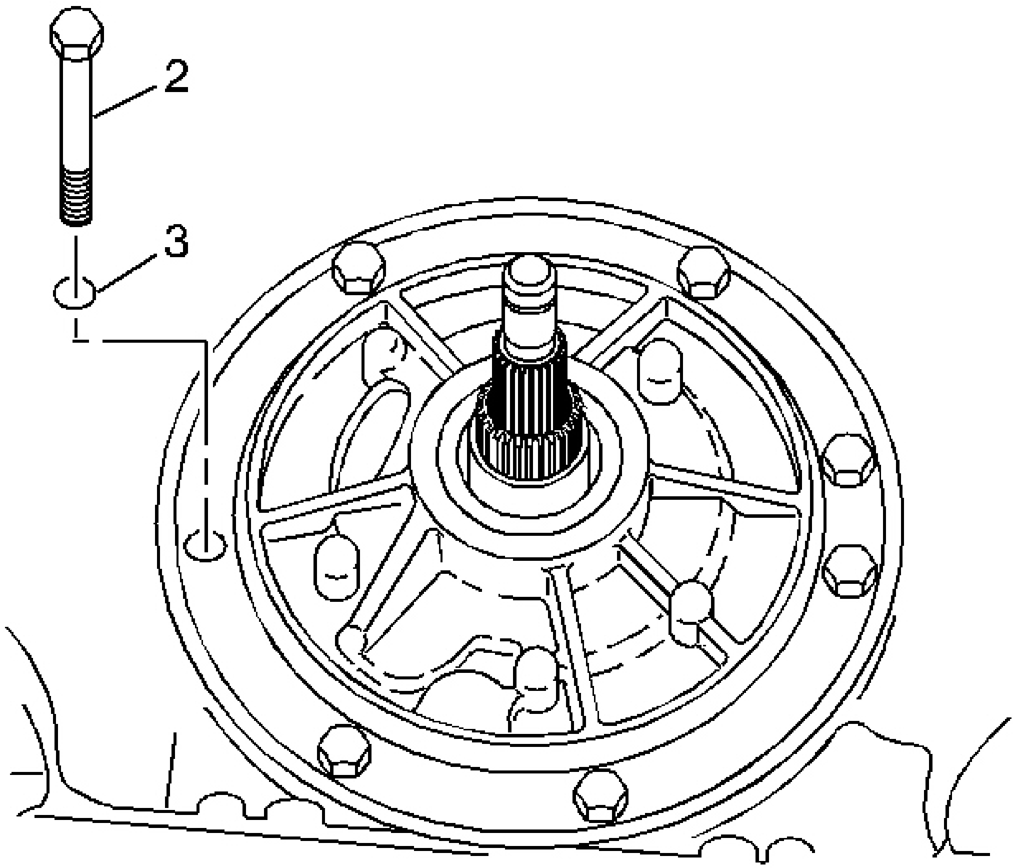


Fig. 396: Install Remaining Pump To Case Bolts & O-Ring Seals
Courtesy of GENERAL MOTORS CORP.

10. Install the remaining pump to case bolts (2) and O-ring seals (3), in the holes where the**J 25025-1** were. See **Special Tools and Equipment** .

    Tighten: Tighten the bolts to 29 N.m (21 lb ft).

TRANSMISSION END PLAY CHECK

Tools Required

- **J 25022** End Play Fixture Adapter. See **Special Tools and Equipment** .
- **J 34725** End Play Checking Adapter. See **Special Tools and Equipment** .
- **J 43205** End Play Fixture Adapter (300 mm). See **Special Tools and Equipment** .

- **J 24773-A** Oil Pump Remover. See **Special Tools and Equipment** .
- J 8001 Dial Indicator Set
- **J 25025-7A** Dial Indicator Post. See **Special Tools and Equipment** .

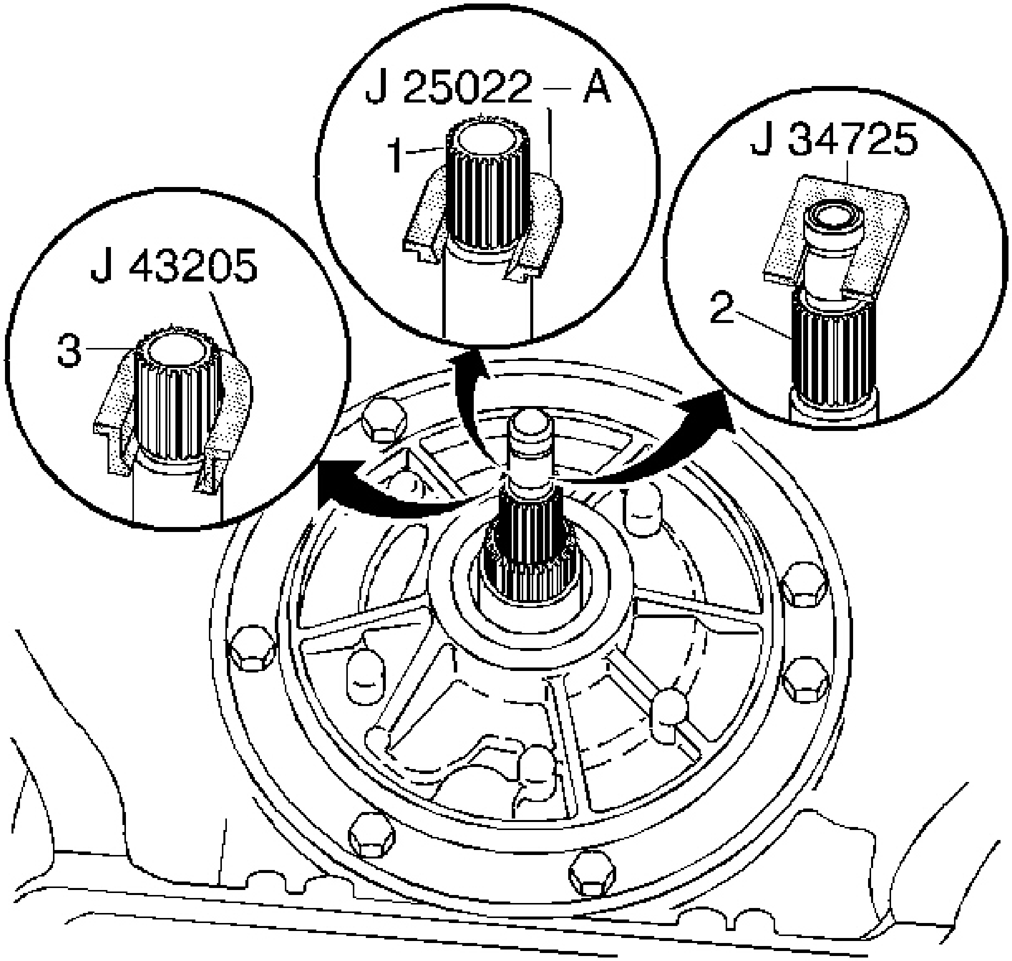


Fig. 397: J 25022, J 34725 & 43205
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Torque converter size is model dependent.

1. Install an end play fixture adapter.
    - Use **J 25022** for a 245 mm and 258 mm turbine shaft (1). See **Special Tools and Equipment** .
    - Use **J 34725** for a 298 mm turbine shaft (2). See **Special Tools and Equipment** .

- Use **J 43205** for a 300 mm turbine shaft (3). See **Special Tools and Equipment** .

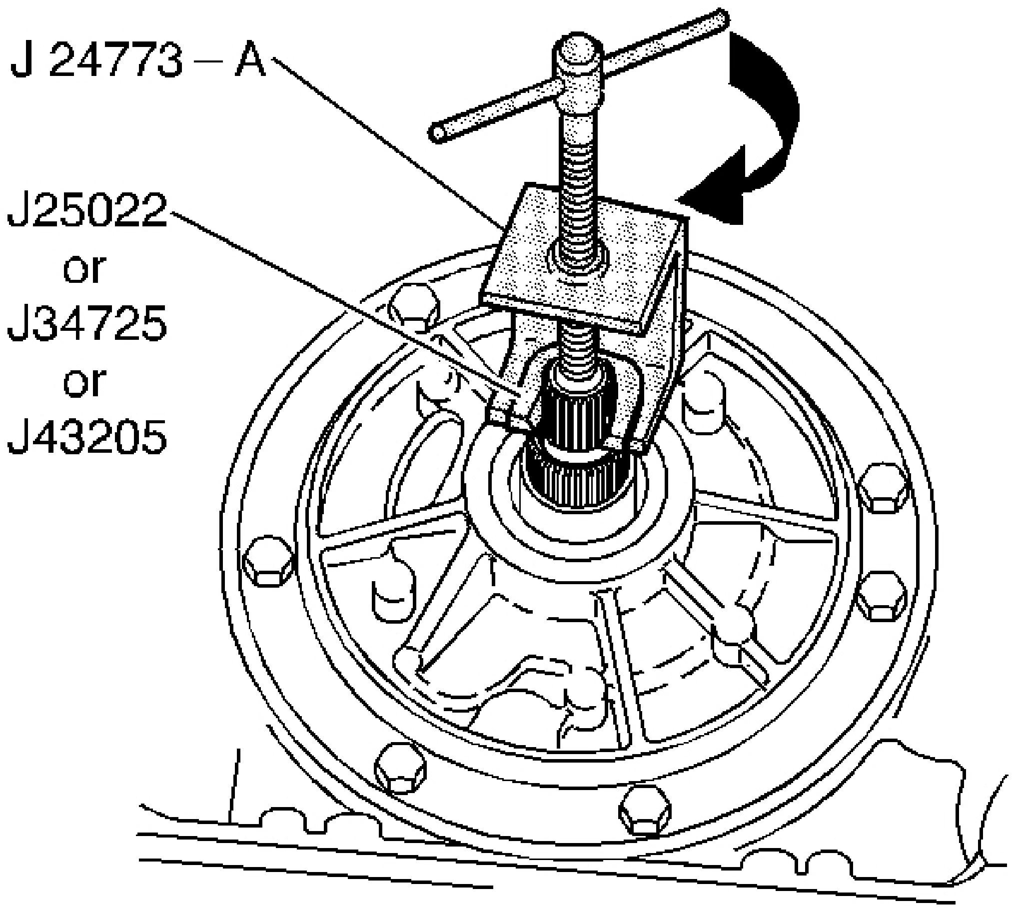


Fig. 398: Installing J 24773-A
Courtesy of GENERAL MOTORS CORP.

2. Install the **J 24773-A** . See **Special Tools and Equipment** .

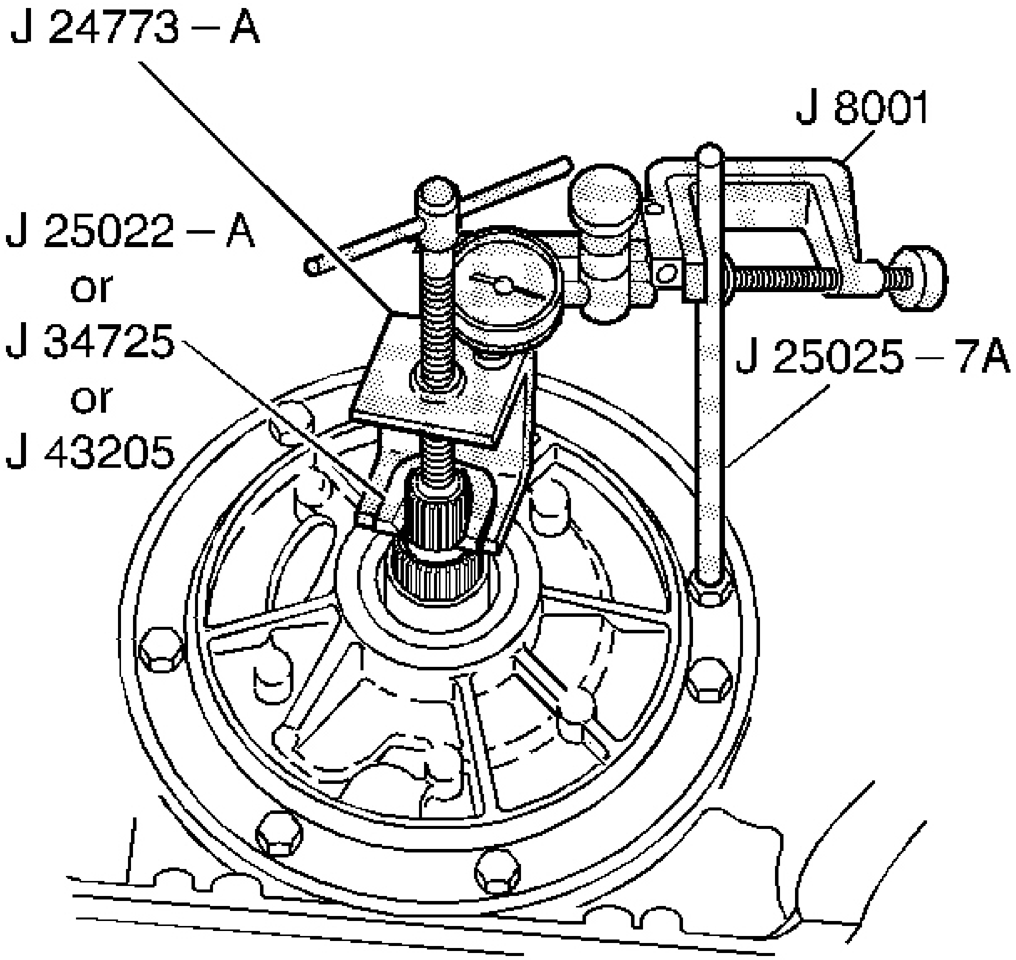


Fig. 399: Identifying J 25025-7A
Courtesy of GENERAL MOTORS CORP.

3. Remove an oil pump bolt.
4. Install **J 25025-7A** (or a 278 mm or 11 in bolt) and lock nut. See **Special Tools and Equipment** .
5. Install J 8001 .

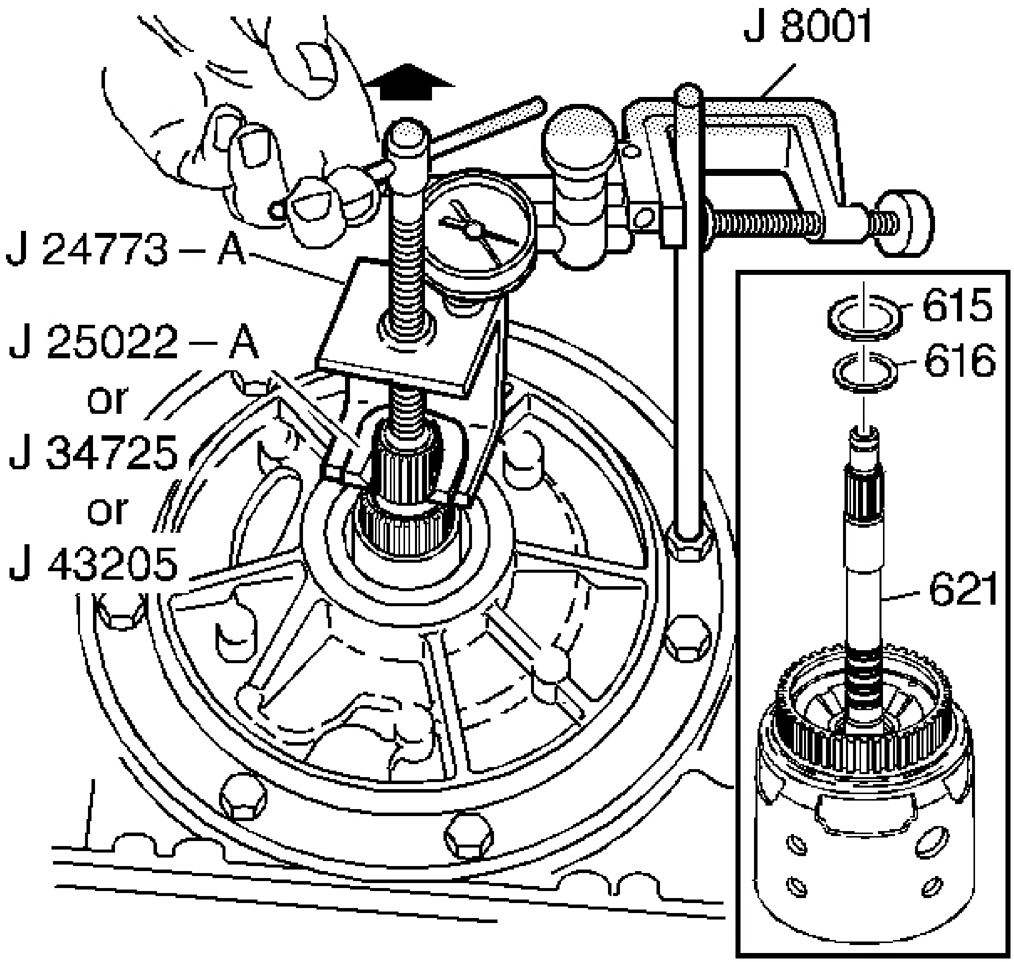


Fig. 400: Setting J 8001 To Zero
Courtesy of GENERAL MOTORS CORP.

6. Set the J 8001 to zero.
7. Pull up on **J 24773-A** . See **Special Tools and Equipment** .

   Proper end play should be 0.13-0.92 mm (0.005-0.036 in).

8. The selective washer (616), which controls the end play, is located between the input housing (621) and the thrust bearing (615) on the oil pump hub.

   If the end play measurement is incorrect, refer to the **End Play Specifications** table. Choose a new selective washer (616) based on the original selective washer and the information contained in the table.

If the dial indicator shows no end play, the selective washer (616) and thrust bearing (615) may have been misassembled.

9. Correct the end play by changing the selective washer (616).

CONVERTER HOUSING INSTALLATION

Tools Required

J 41510 T-50 Plus Bit. See **Special Tools and Equipment** .

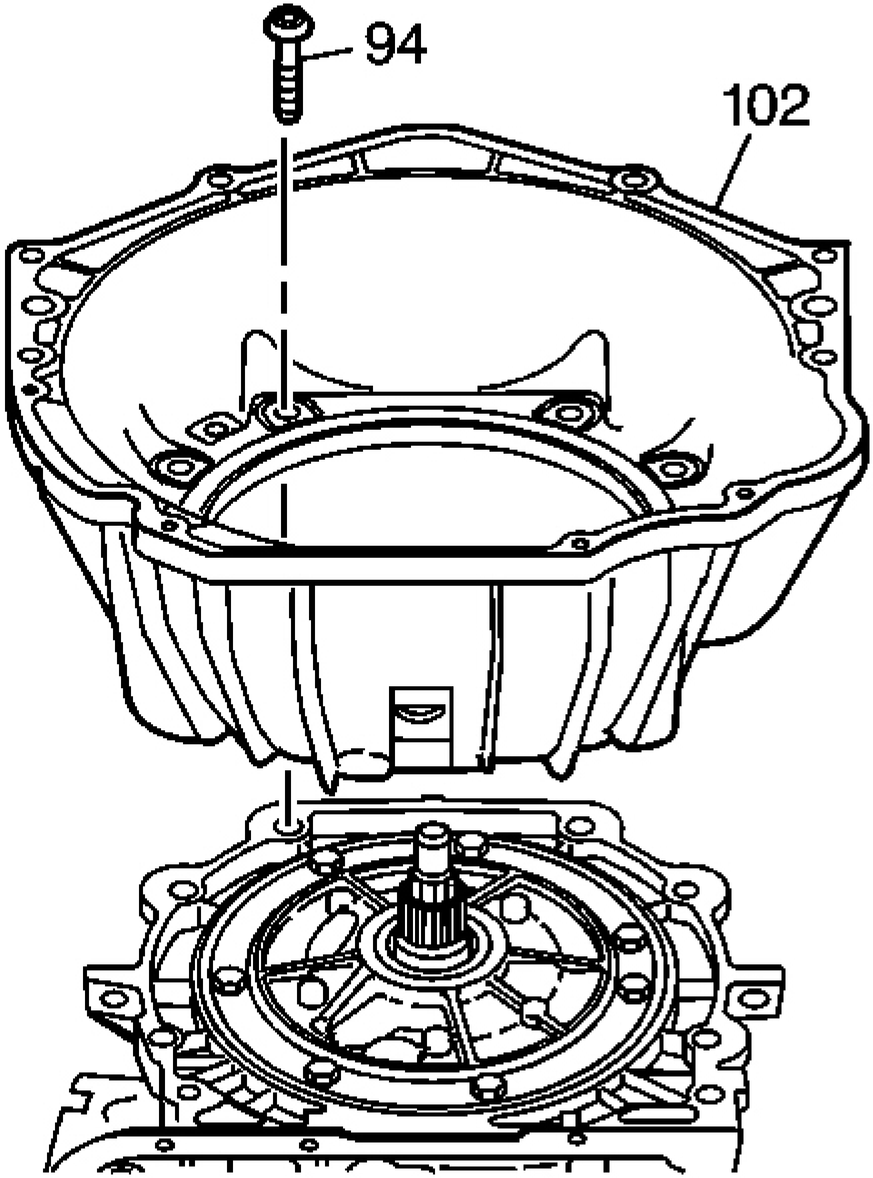


Fig. 401: Converter Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the converter housing (102).

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the converter housing bolts (94) to the transmission case. Use the **J 41510** . See **Special Tools and Equipment** .

   Tighten: Tighten the converter housing bolts (94) to 65-75 N.m (48-55 lb ft).

TURBINE SHAFT O-RING INSTALLATION

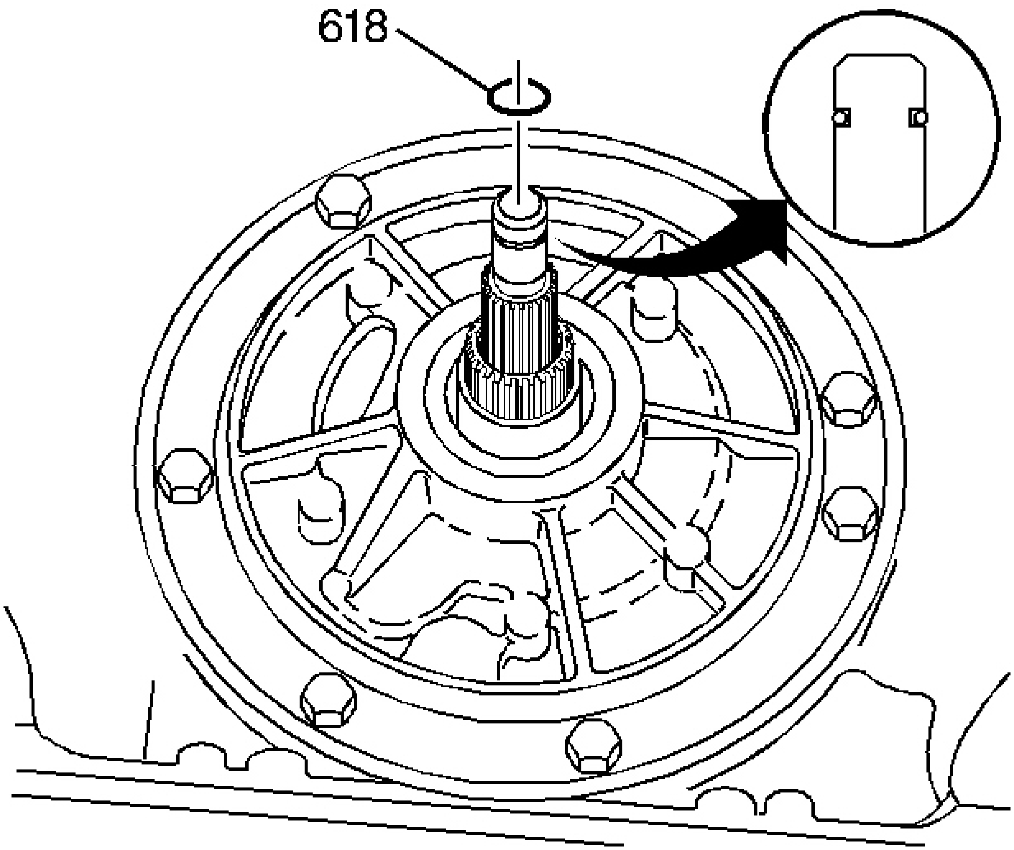


Fig. 402: O-Ring & Turbine Shaft
Courtesy of GENERAL MOTORS CORP.

Install the O-ring (618) on the turbine shaft. O-Ring location is location dependent.

CONTROL VALVE BODY DISASSEMBLE

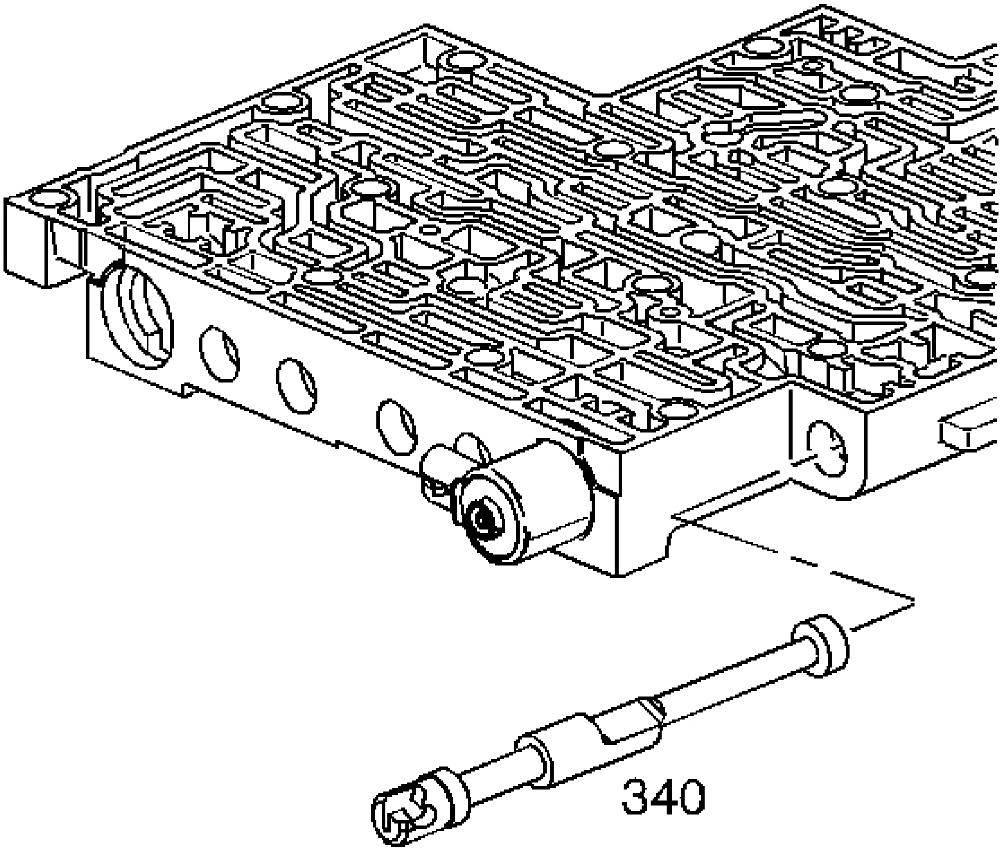


Fig. 403: Identifying Manual Valve
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Valve Springs Can Be Tightly Compressed Caution in Cautions and Notices.

1. Remove the manual valve (340).

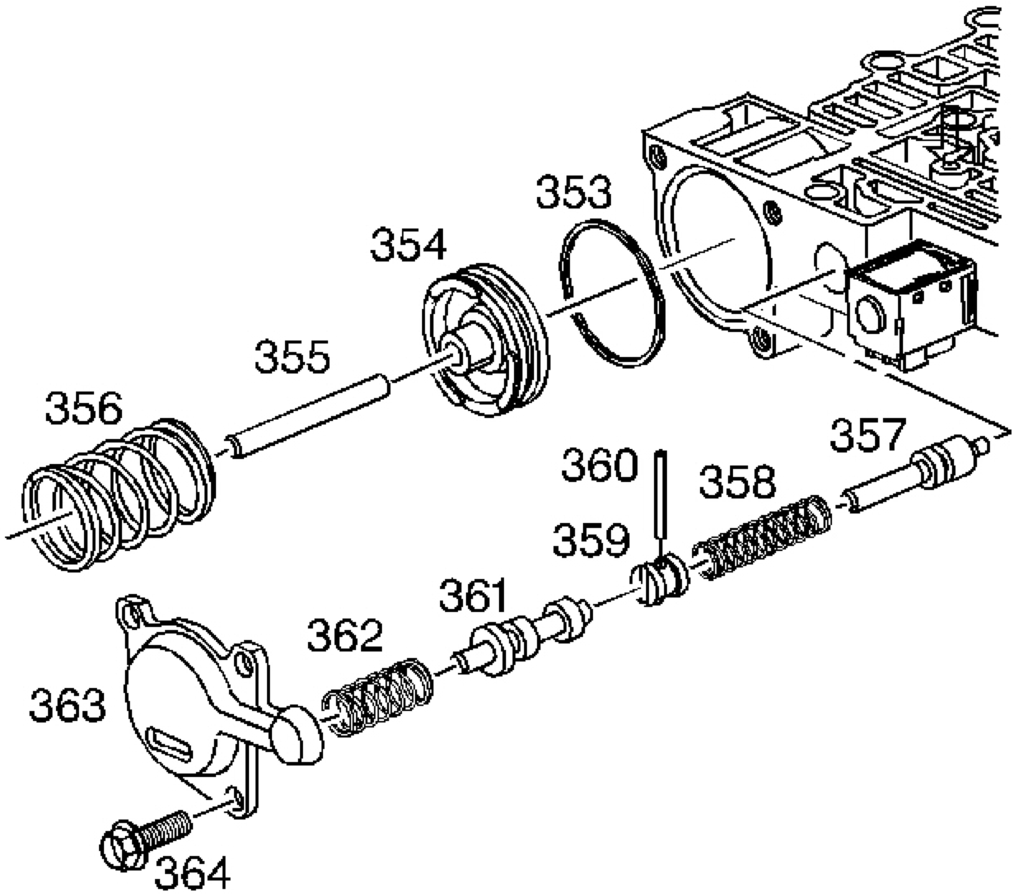


Fig. 404: Identifying (364), (363), (356), (354), (355), (362), (361), (360), (359), (358) & (357)
Courtesy of GENERAL MOTORS CORP.

2. Remove the forward accumulator cover bolts (364) and the forward accumulator cover (363).
3. Remove the forward accumulator spring (356), forward accumulator piston (354), and the forward accumulator pin (355).
4. Remove the low overrun valve spring (362) and the low overrun valve (361).
5. Remove the coiled spring pin (360) and the bore plug (359).
6. Remove the forward abuse valve spring (358) and the forward abuse valve (357).

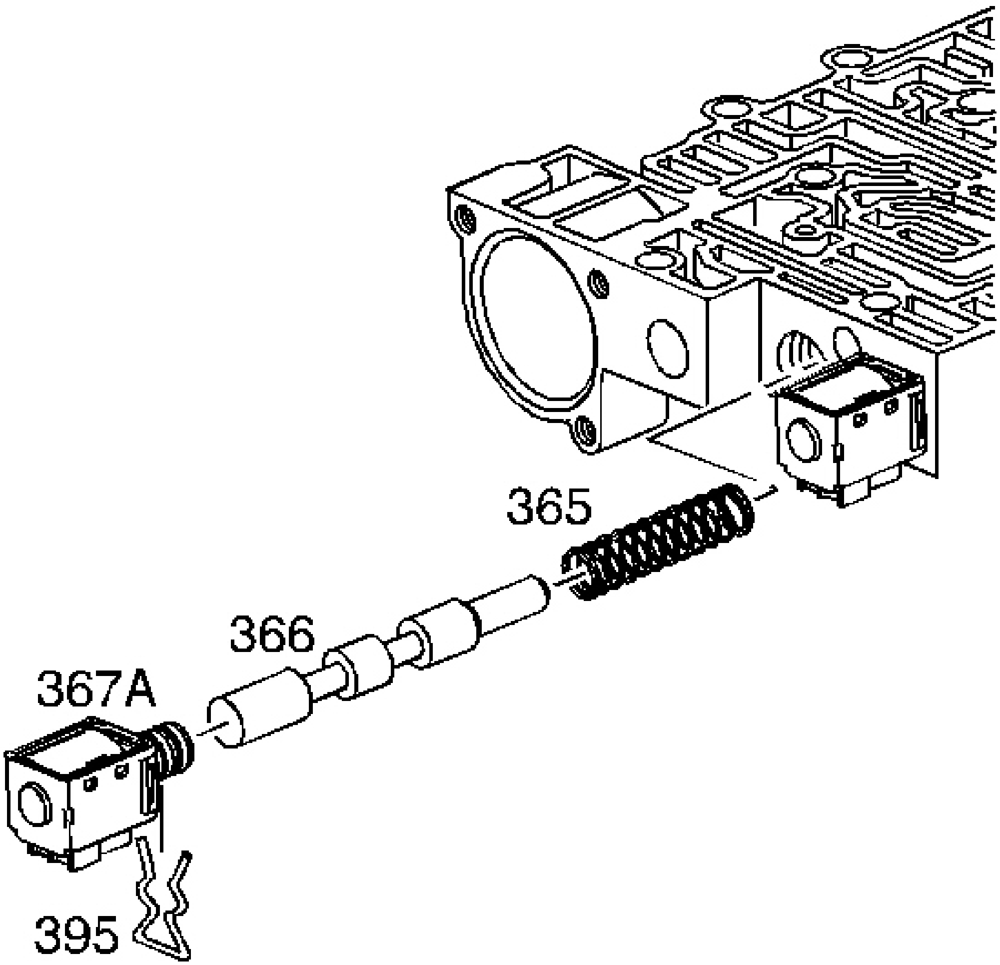


Fig. 405: Solenoid Retainer, 1-2 Shift Solenoid, 1-2 Shift Valve, 1-2 Shift Valve Spring
Courtesy of GENERAL MOTORS CORP.

7. Remove the solenoid retainer (395) and the 1-2 shift solenoid (367A).
8. Remove the 1-2 shift valve (366) and the 1-2 shift valve spring (365).

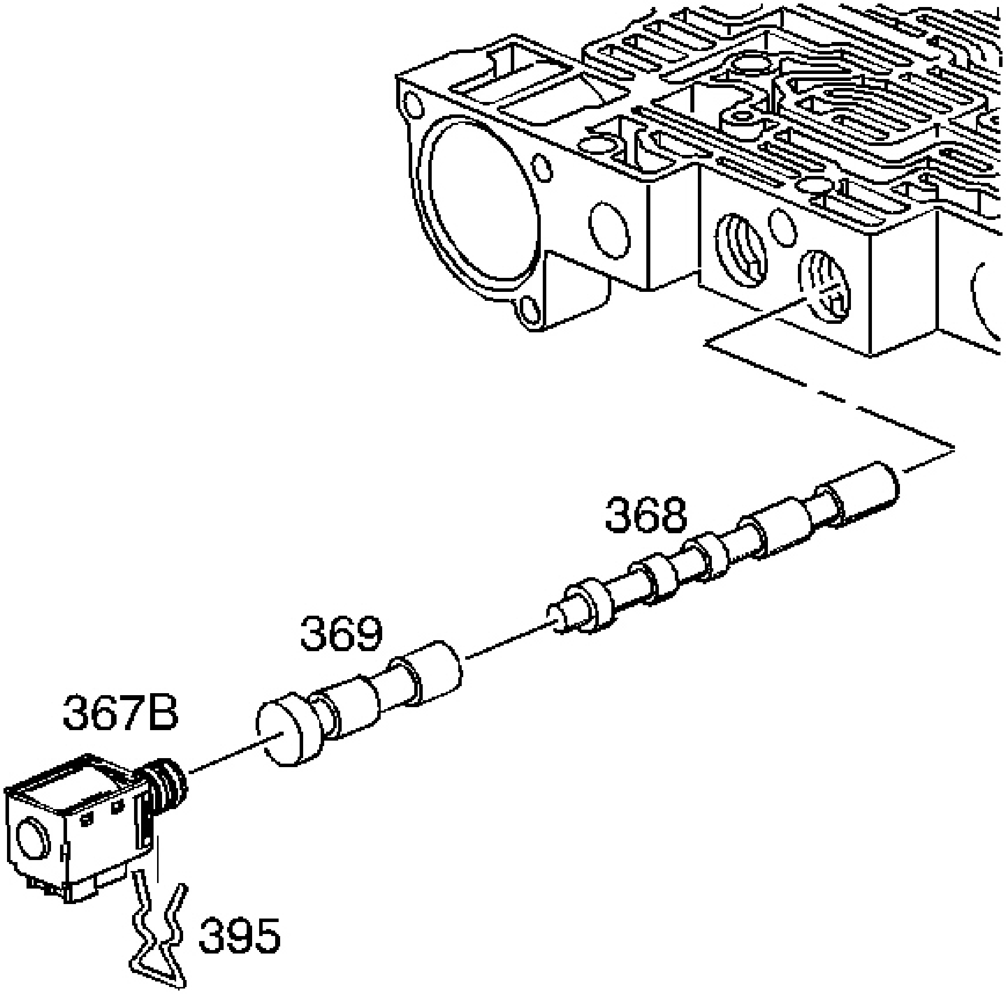


Fig. 406: Solenoid Retainer, 2-3 Shift Solenoid, 2-3 Shuttle Valve & 2-3 Shift Valve
Courtesy of GENERAL MOTORS CORP.

9. Remove the solenoid retainer (395) and the 2-3 shift solenoid (367B).
10. Remove the 2-3 shuttle valve (369) and the 2-3 shift valve (368).

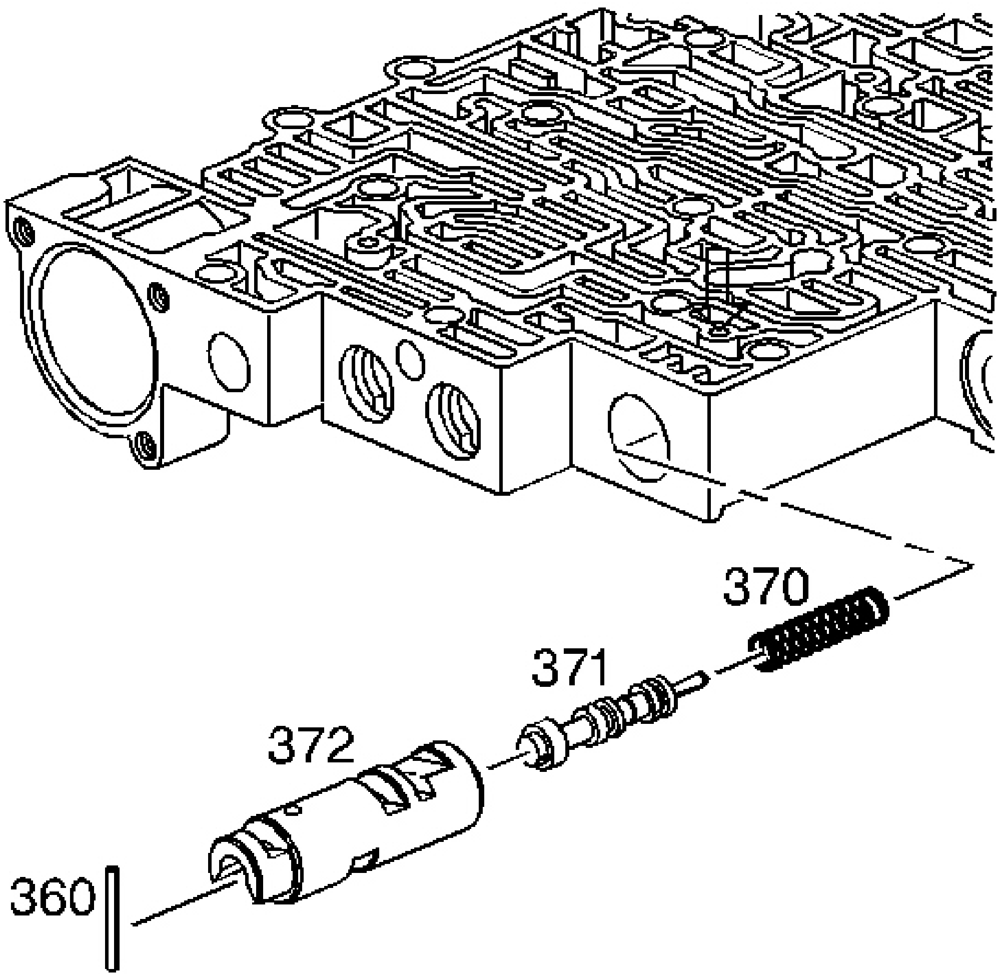


Fig. 407: Coiled Spring Pin, 1-2 Accumulator Valve Sleeve, 1-2 Accumulator Valve & 1-2 Accumulator Valve Spring
Courtesy of GENERAL MOTORS CORP.

11. Remove the coiled spring pin (360).
12. Remove the 1-2 accumulator valve sleeve (372).
13. Remove the 1-2 accumulator valve (371) and the 1-2 accumulator valve spring (370).

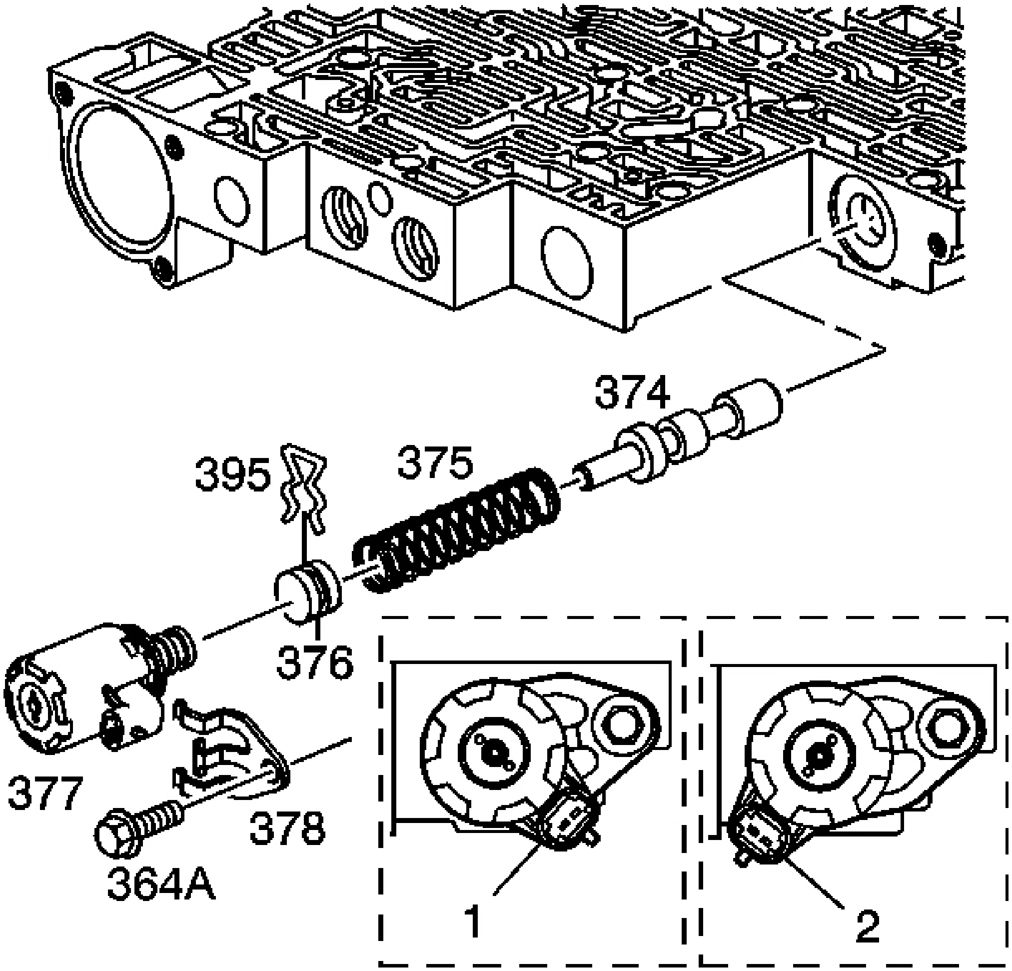


Fig. 408: Pressure Control Solenoid, Bore Plug Retainer, Bore Plug, Actuator Feed Limit Valve Spring & Actuator Feed Limit Valve
Courtesy of GENERAL MOTORS CORP.

14. Remove the solenoid retainer bolt (364A) and the solenoid retainer (378). Remove the pressure control solenoid (377).

CAUTION: Refer to Valve Springs Can Be Tightly Compressed Caution in Cautions and Notices.

15. Compress the actuator feed limit valve spring (375).
16. Remove the bore plug retainer (395) and release the spring slowly.

17. Remove the bore plug (376).
18. Remove the actuator feed limit valve spring (375) and the actuator feed limit valve (374).

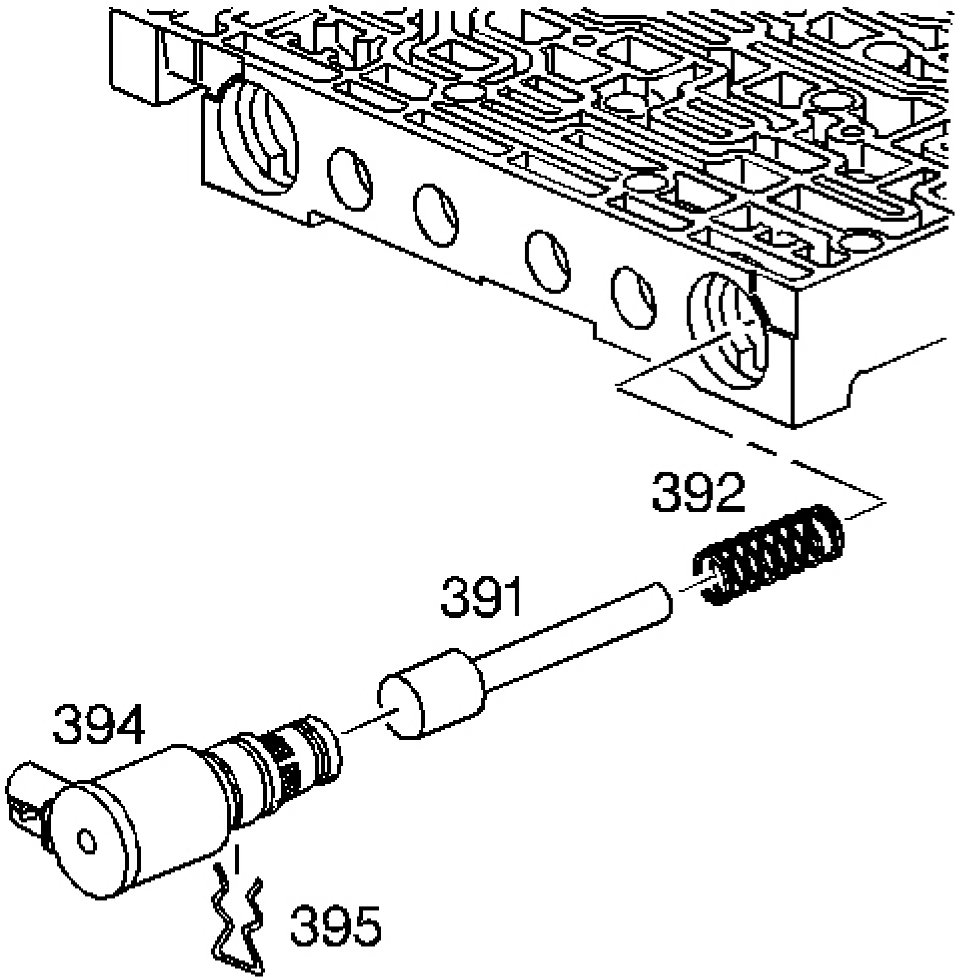


Fig. 409: Solenoid Retainer, 3-2 Control Solenoid, 3-2 Control Valve, 3-2 Control Valve Spring
Courtesy of GENERAL MOTORS CORP.

19. Remove the solenoid retainer (395) and the 3-2 control solenoid (394).
20. Remove the 3-2 control valve (391) and the 3-2 control valve spring (392).

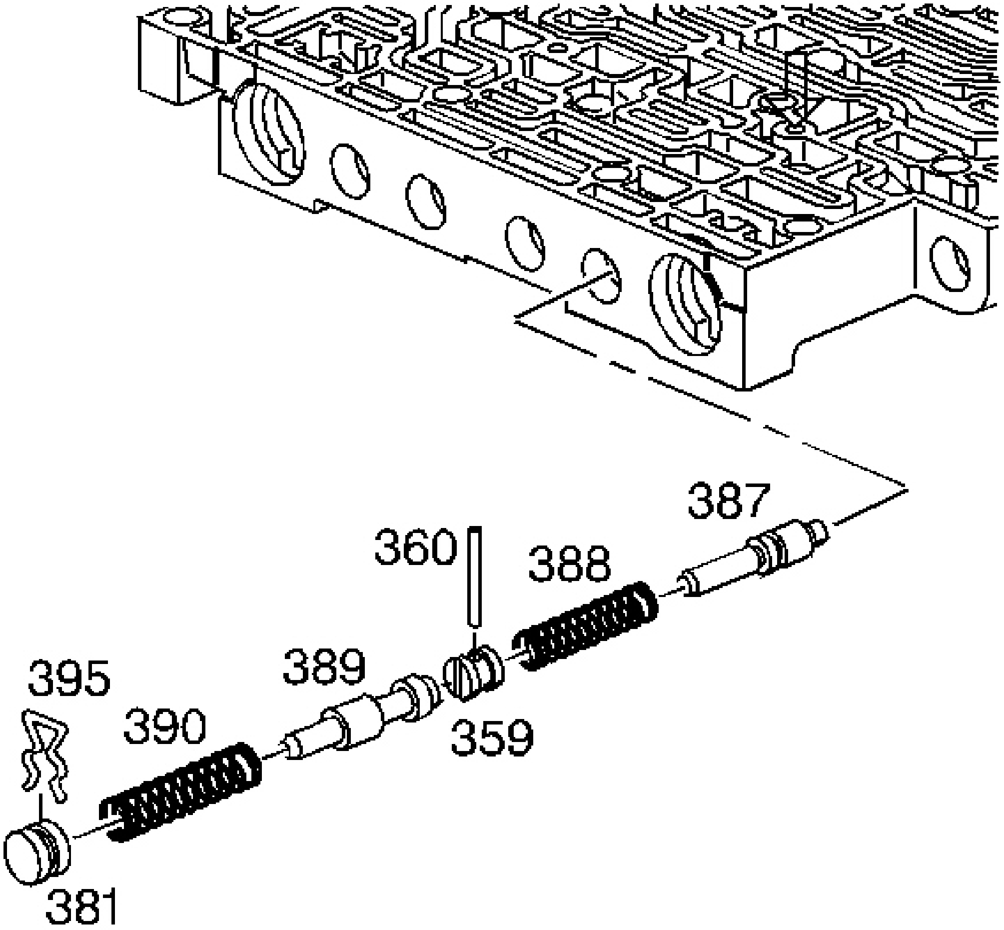


Fig. 410: Identifying (395, 381, 390, 360, 359, 388, & 387)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Valve Springs Can Be Tightly Compressed Caution in Cautions and Notices.

21. Remove the bore plug retainer (395) and the bore plug (381).
22. Remove the 3-2 downshift valve spring (390) and the 3-2 downshift valve (389).
23. Remove the coiled spring pin (360) and the bore plug (359).
24. Remove the reverse abuse valve spring (388) and the reverse abuse valve (387).

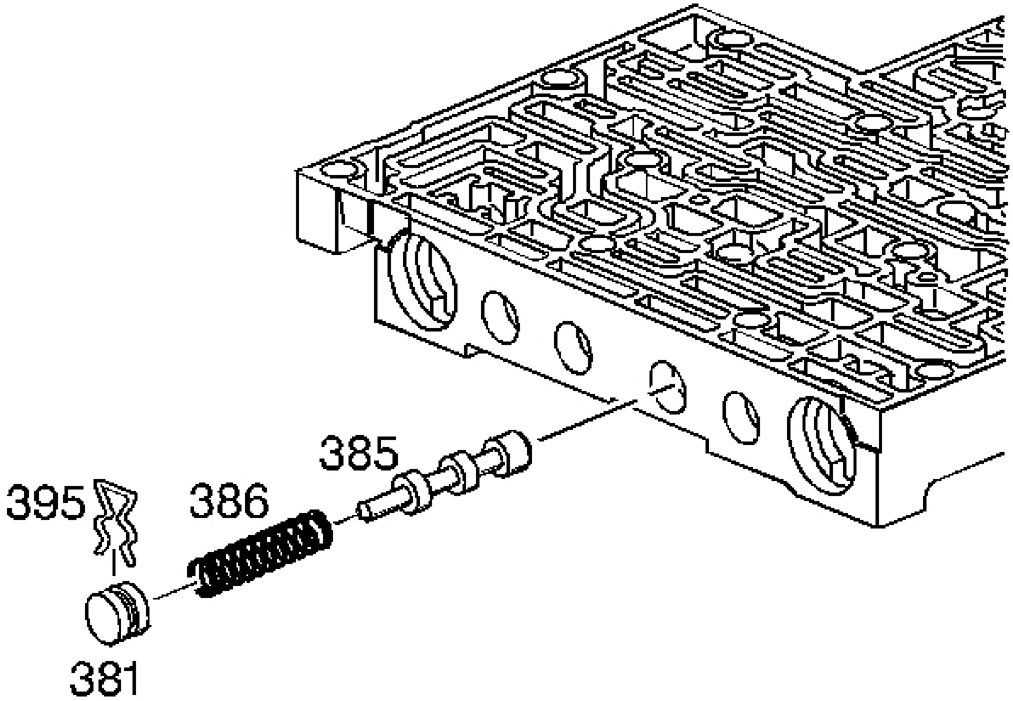


Fig. 411: Bore Plug Retainer, Bore Plug, 3-4 Shift Valve Spring & 3-4 Shift Valve
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Valve Springs Can Be Tightly Compressed Caution in Cautions and Notices.

25. Remove the bore plug retainer (395) and the bore plug (381).
26. Remove the 3-4 shift valve spring (386) and the 3-4 shift valve (385).

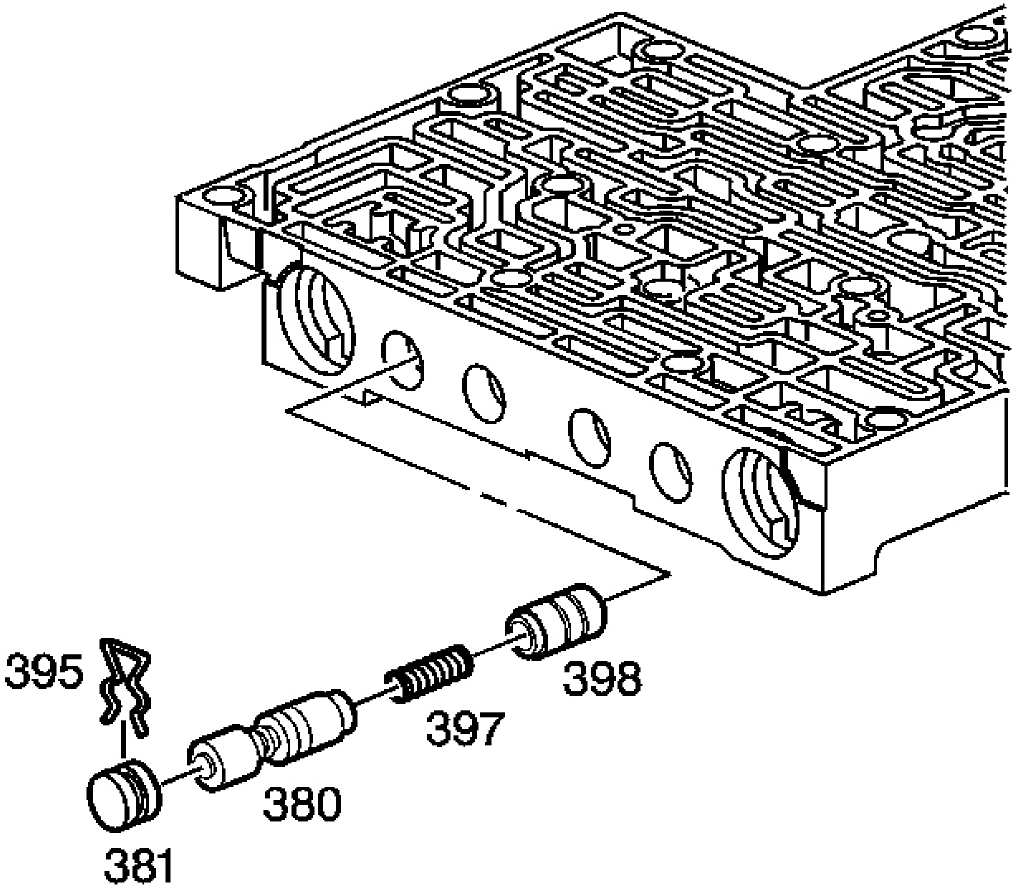


Fig. 412: Bore Plug Retainer, Bore Plug, Regulator Apply Valve, Regulator Apply Spring & Isolator Valve
Courtesy of GENERAL MOTORS CORP.

27. Remove the bore plug retainer (395) and the bore plug (381).
28. Remove the regulator apply valve (380) and the regulator apply spring (397) and the isolator valve (398).

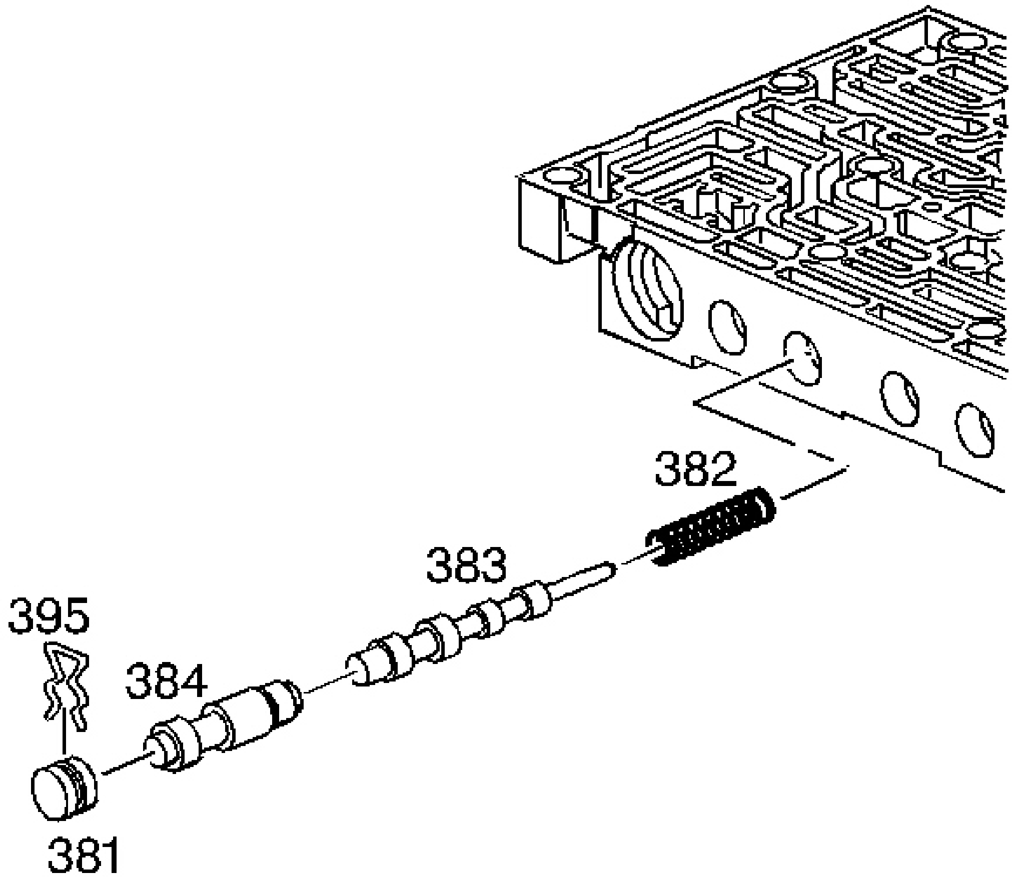


Fig. 413: Bore Plug Retainer, Bore Plug, 3-4 Relay Valve, 4-3 Sequence Valve & 4-3 Sequence Valve Spring
Courtesy of GENERAL MOTORS CORP.

29. Remove the bore plug retainer (395) and the bore plug (381).
30. Remove the 3-4 relay valve (384) and the 4-3 sequence valve (383) and the 4-3 sequence valve spring (382).

CONTROL VALVE BODY ASSEMBLE

Inspection Procedure

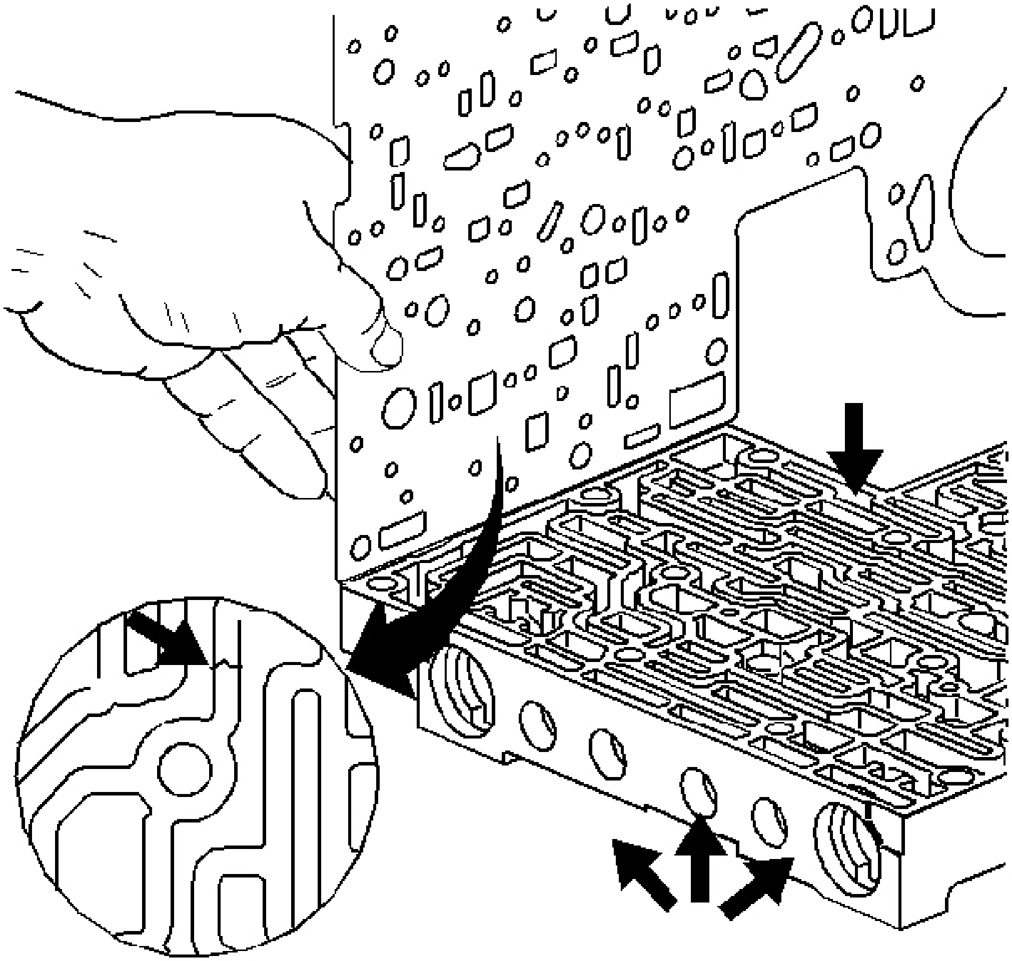


Fig. 414: Inspecting Valve Body Casting
Courtesy of GENERAL MOTORS CORP.

1. Inspect the valve body to spacer plate gasket for valve body channel witness marks. The witness marks should be complete. Incomplete witness marks may be caused by an uneven case surface. Incomplete witness marks may also be caused by cross-channel leaks.
2. Inspect the valve body casting for the following conditions:
   - Porosity
   - Cracks
   - Damaged machined surfaces
   - Chips or debris

Cleaning Procedure

1. Clean all the valves, springs, bushings, and the control valve body in clean solvent.
2. Dry all the parts using compressed air.

Installation Procedure

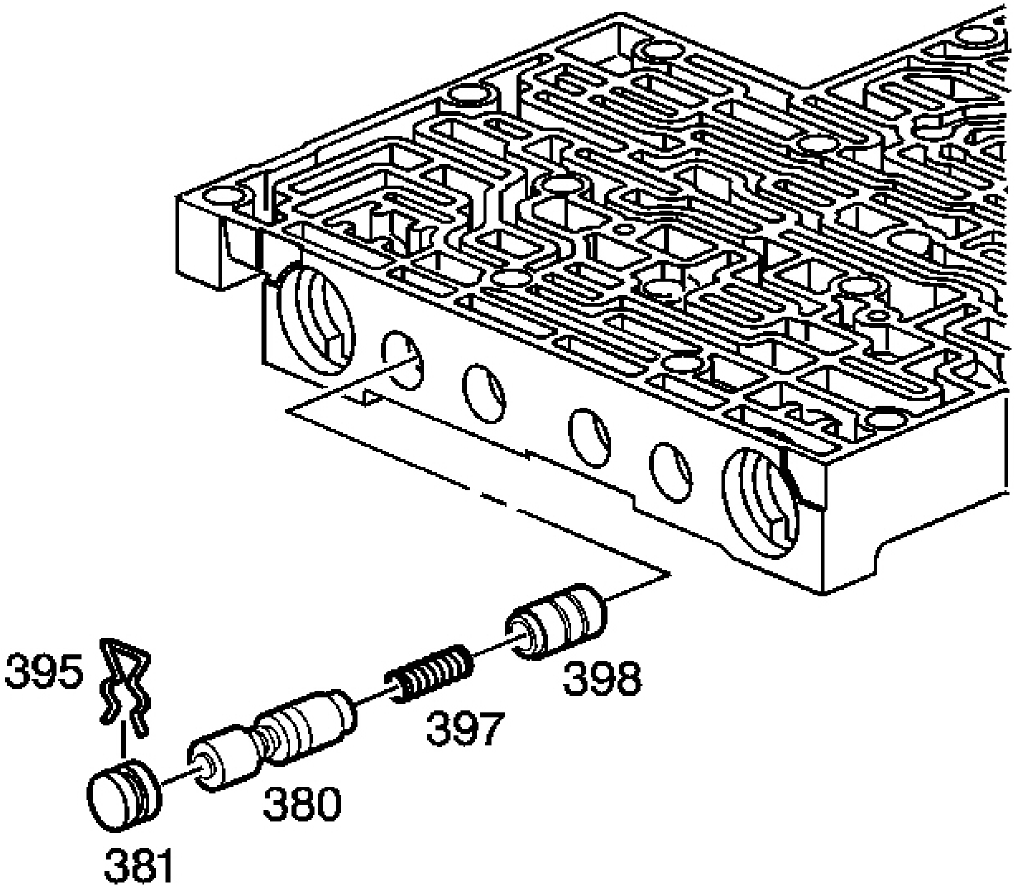


Fig. 415: Bore Plug Retainer, Bore Plug, Regulator Apply Valve, Regulator Apply Spring & Isolator Valve
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Valve Springs Can Be Tightly Compressed Caution in Cautions and Notices.

IMPORTANT: Lubricate all parts with DEXRON(R)III automatic transmission fluid before installation.

1. Install the following items:
    1. The isolator valve (398)
    2. The regulator apply spring (397)
    3. The regulator apply valve (380)
    4. The bore plug (381)
    5. The bore plug retainer (395)

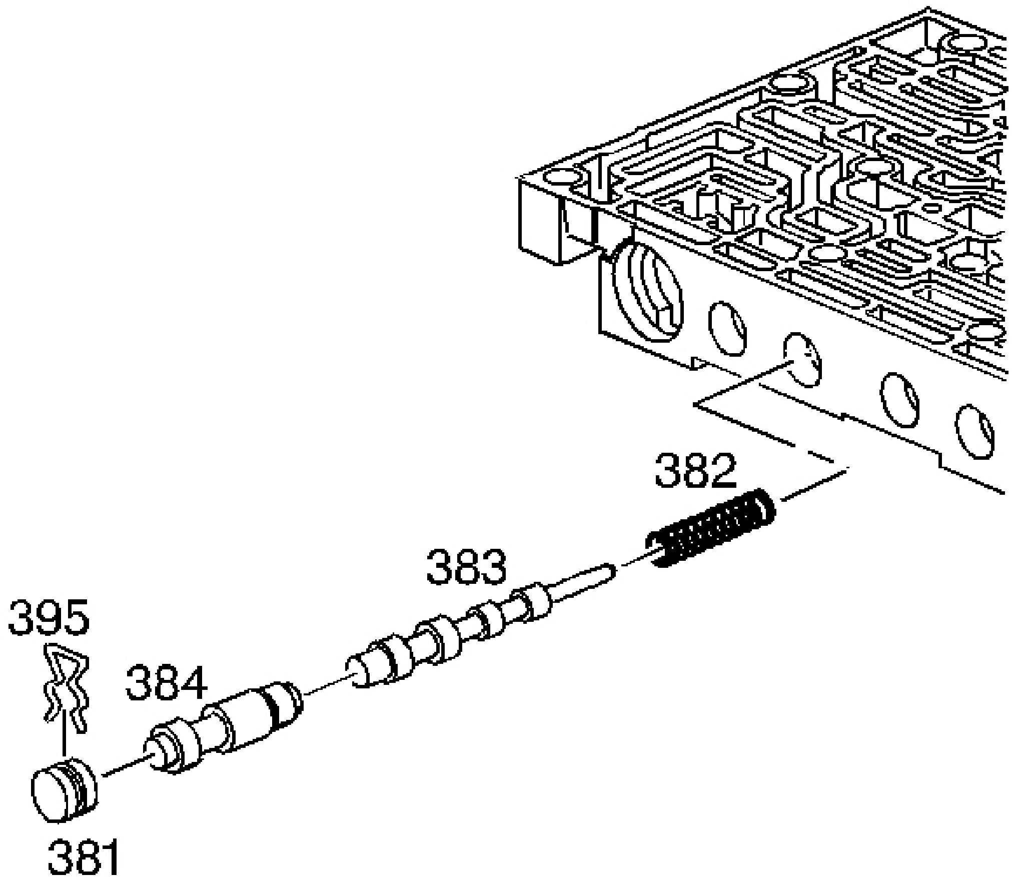


Fig. 416: Bore Plug Retainer, Bore Plug, 3-4 Relay Valve, 4-3 Sequence Valve & 4-3 Sequence Valve Spring
Courtesy of GENERAL MOTORS CORP.

2. Install the following items:
    1. The 4-3 sequence valve spring (382)
    2. The 4-3 sequence valve (383)
    3. The 3-4 relay valve (384)
    4. The bore plug (381)
    5. The bore plug retainer (395)

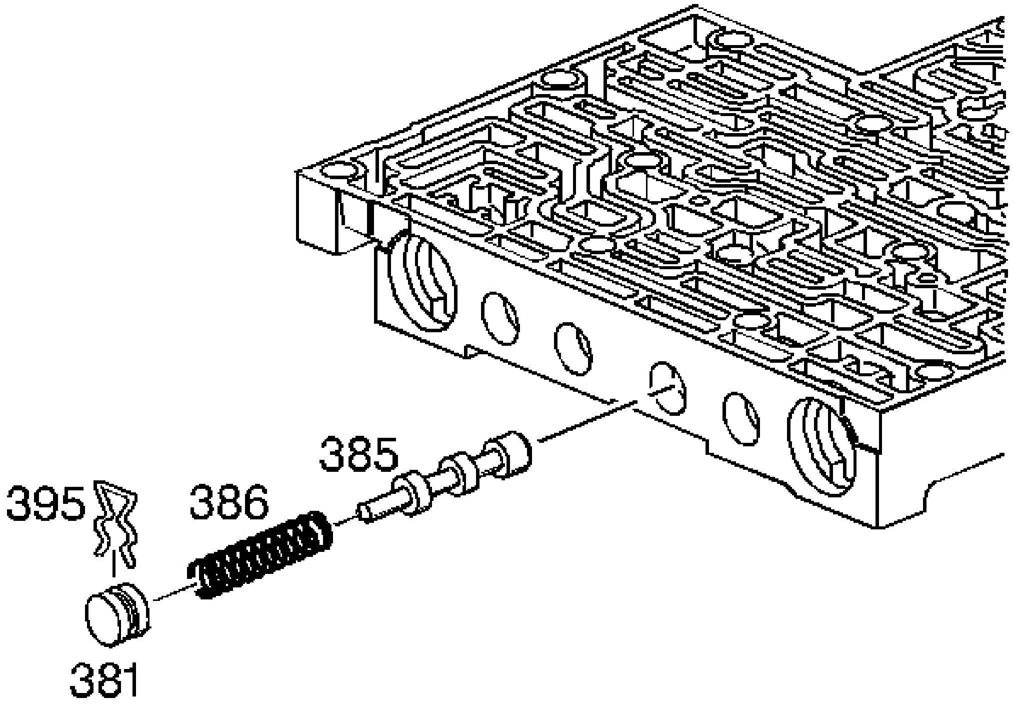


Fig. 417: Bore Plug Retainer, Bore Plug, 3-4 Shift Valve Spring & 3-4 Shift Valve
Courtesy of GENERAL MOTORS CORP.

3. Install the following items:
    1. The 3-4 shift valve (385)
    2. The 3-4 shift valve spring (386)
    3. The bore plug (381)
    4. The bore plug retainer (395)

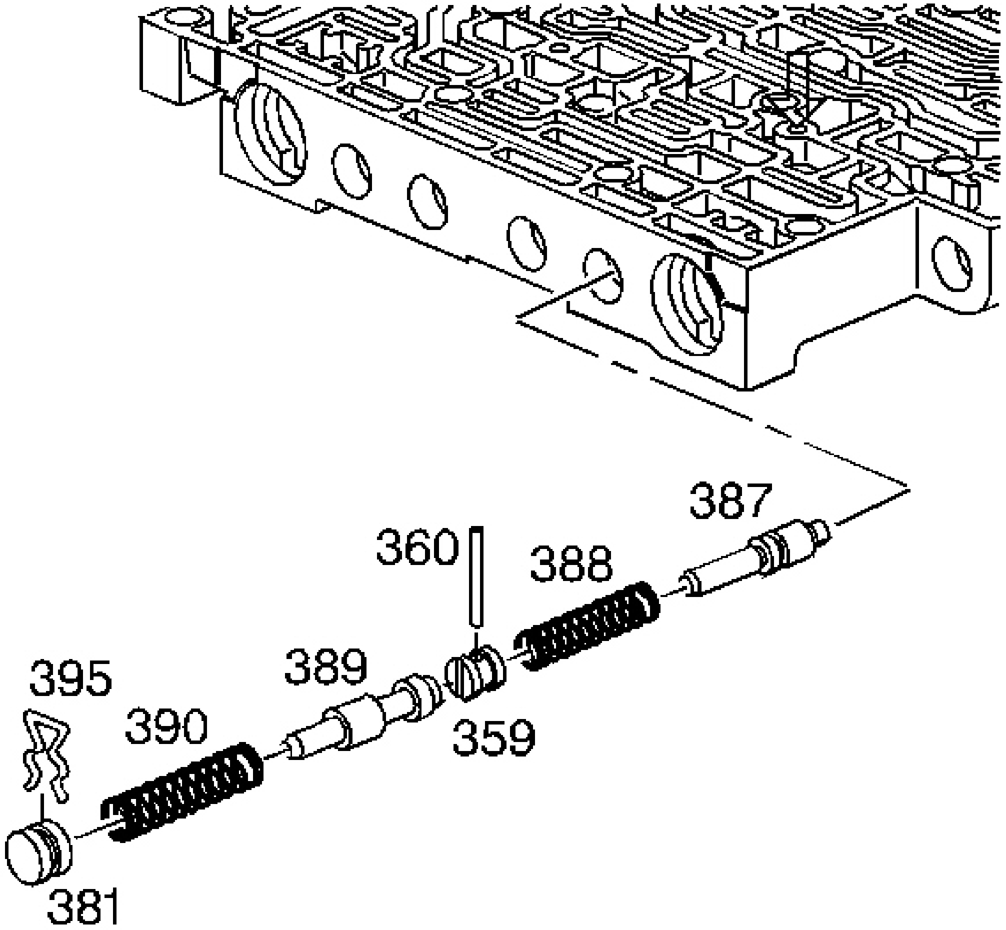


Fig. 418: Identifying (395, 381, 390, 360, 359, 388, & 387)
Courtesy of GENERAL MOTORS CORP.

4. Install the following items:
    1. The reverse abuse valve (387)
    2. The reverse abuse valve spring (388)
    3. The bore plug (359)
    4. The coiled spring pin (360)
    5. The 3-2 downshift valve (389)
    6. The 3-2 downshift valve spring (390)
    7. The bore plug (381)
    8. The bore plug retainer (395)

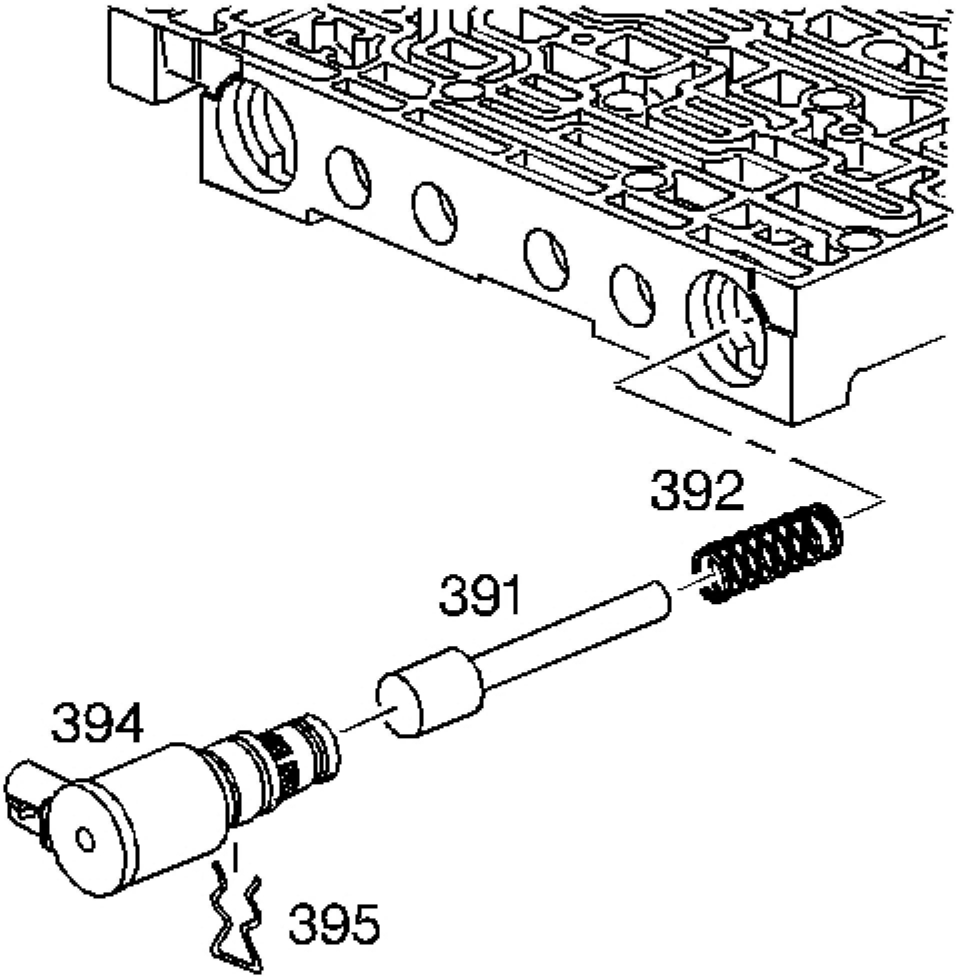


Fig. 419: Solenoid Retainer, 3-2 Control Solenoid, 3-2 Control Valve, 3-2 Control Valve Spring
Courtesy of GENERAL MOTORS CORP.

5. Install the following items:
    1. The 3-2 control valve spring (392)
    2. The 3-2 control valve (391)
    3. The 3-2 control solenoid (394)
    4. The solenoid retainer (395)

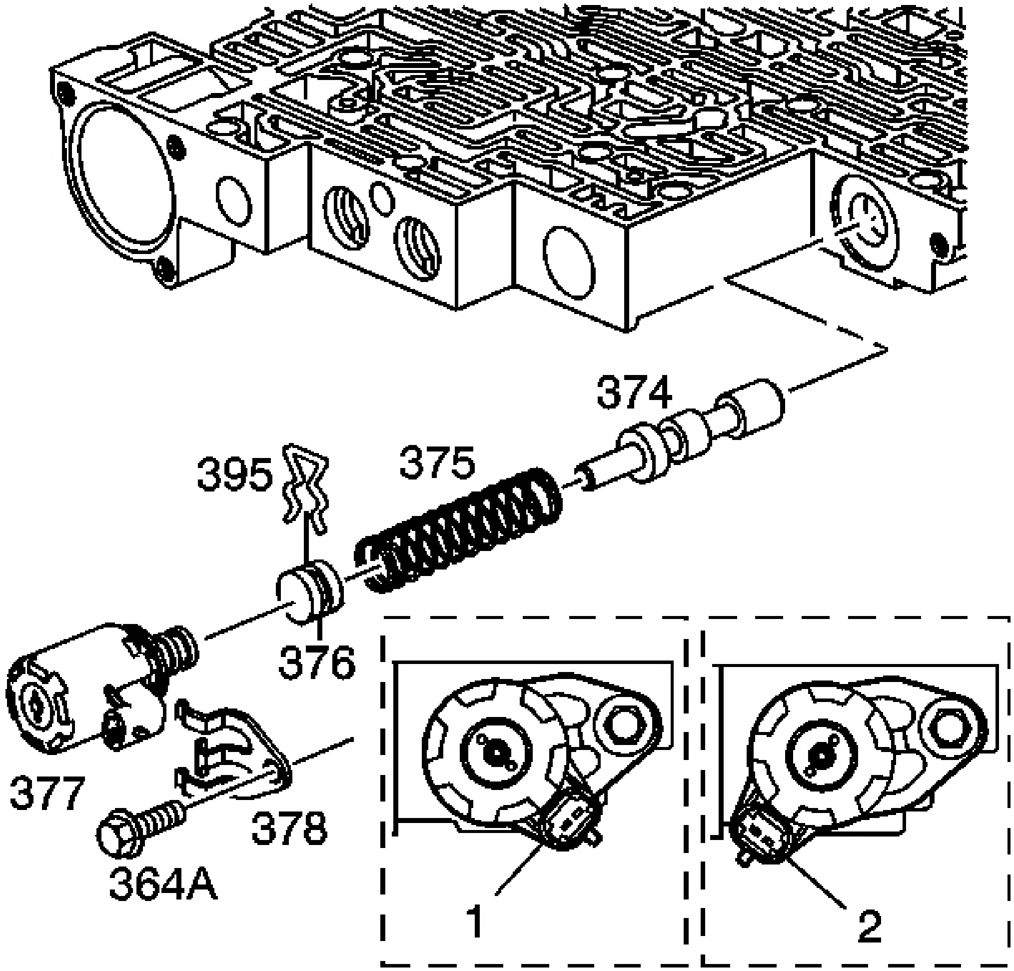


Fig. 420: Pressure Control Solenoid, Bore Plug Retainer, Bore Plug, Actuator Feed Limit Valve Spring & Actuator Feed Limit Valve
Courtesy of GENERAL MOTORS CORP.

6. Install the following items:
   1. The actuator feed limit valve (374)
   2. The actuator feed limit valve spring (375)
   3. The bore plug (376)
   4. The bore plug retainer (395)
   5. The pressure control solenoid (377)
      - 1 - Colorado/Canyon

- 2 - All other models

6. The solenoid retainer (378)

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. The solenoid retainer bolt (364)

Tighten: Tighten the bolt to 8-14 N.m (6-10 lb ft).

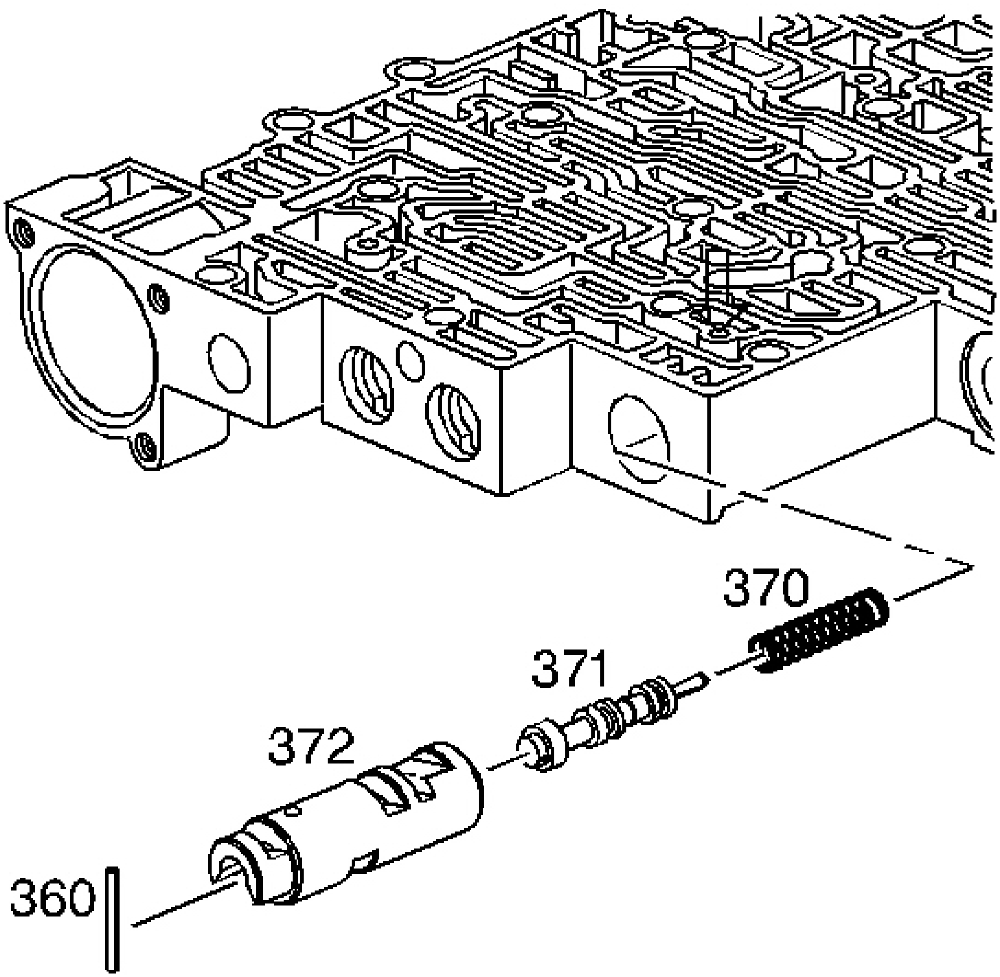


Fig. 421: Coiled Spring Pin, 1-2 Accumulator Valve Sleeve, 1-2 Accumulator Valve & 1-2 Accumulator Valve Spring

Courtesy of GENERAL MOTORS CORP.

7. Install the following items:
    1. The 1-2 accumulator valve spring (370)
    2. The 1-2 accumulator valve (371) in the 1-2 accumulator valve sleeve (372)
    3. The 1-2 accumulator valve and sleeve assembly
    4. The coiled spring pin (360)

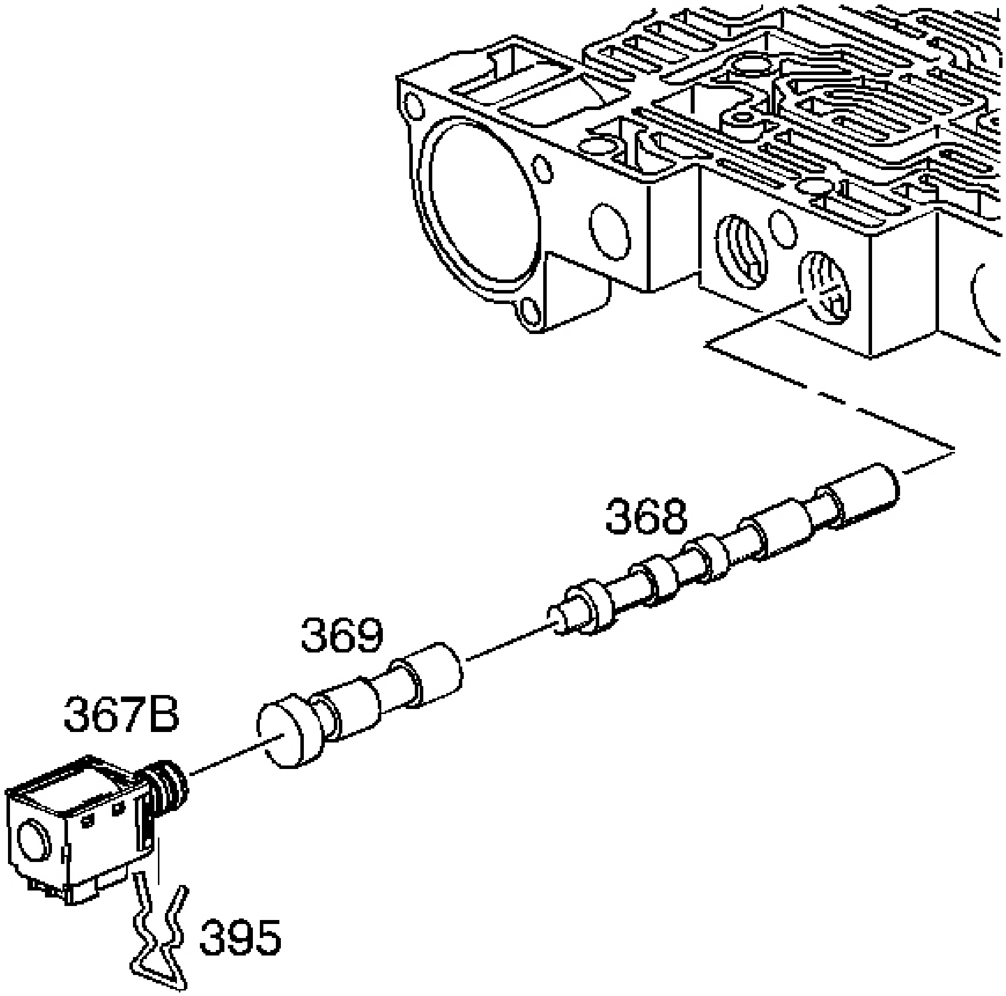


Fig. 422: Solenoid Retainer, 2-3 Shift Solenoid, 2-3 Shuttle Valve & 2-3 Shift Valve
Courtesy of GENERAL MOTORS CORP.

8. Install the following items:
    1. The 2-3 shift valve (368)
    2. The 2-3 shuttle valve (369)
    3. The 2-3 shift solenoid valve (367B)
    4. The solenoid retainer (395)

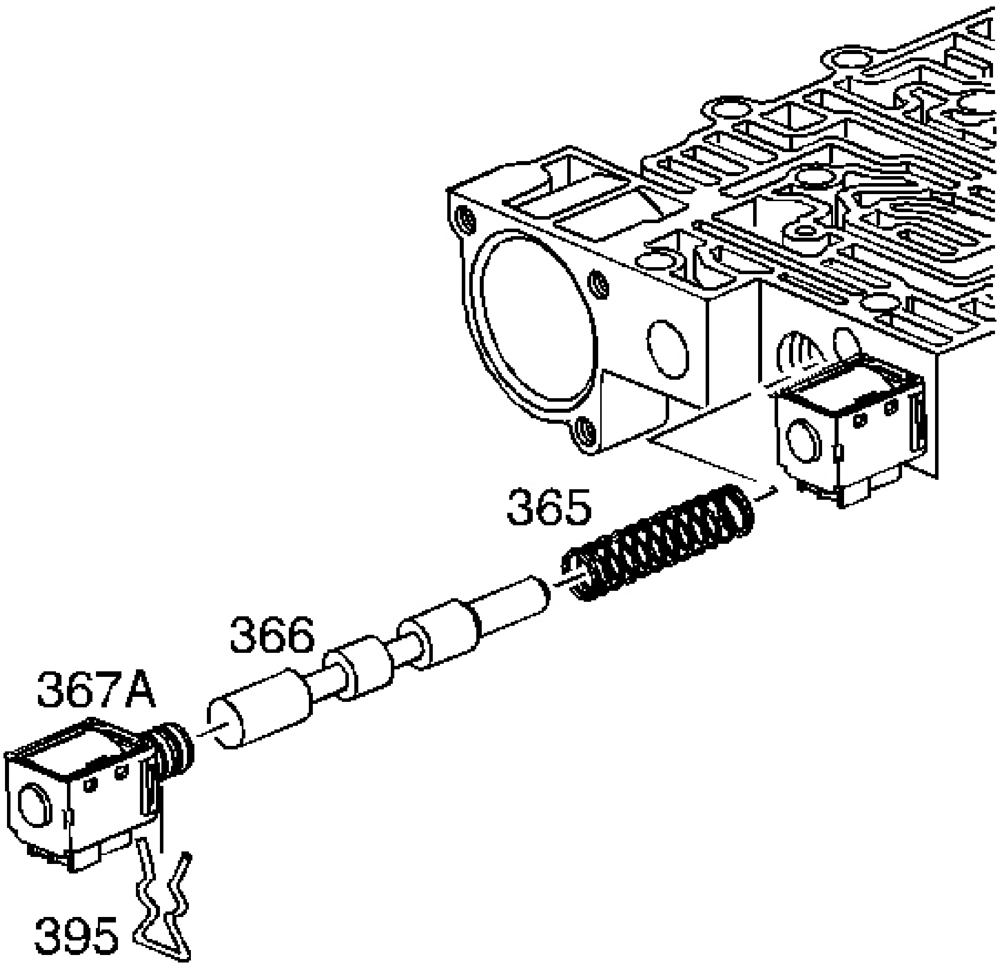


Fig. 423: Solenoid Retainer, 1-2 Shift Solenoid, 1-2 Shift Valve, 1-2 Shift Valve Spring
Courtesy of GENERAL MOTORS CORP.

9. Install the following items:
    1. The 1-2 shift valve spring (365)

2. The 1-2 shift valve (366)
3. The 1-2 shift solenoid valve (367A)
4. The solenoid valve retainer (395)

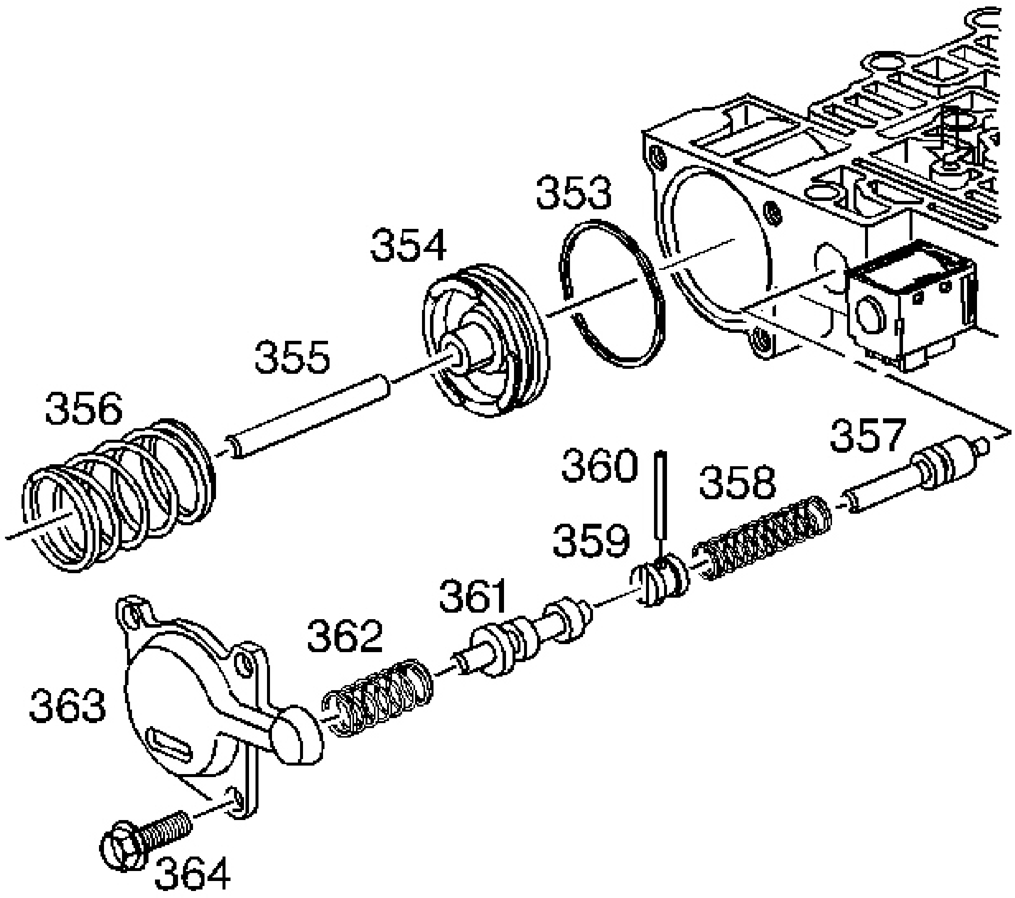


Fig. 424: Identifying (364), (363), (356), (354), (355), (362), (361), (360), (359), (358) & (357)
Courtesy of GENERAL MOTORS CORP.

10. Install the following items:
    1. The forward abuse valve (357)
    2. The forward abuse valve spring (358)
    3. The bore plug (359)
    4. The coiled spring pin (360)
    5. The low overrun valve (361)

6. The low overrun valve spring (362)

11. Install the following items:
    1. The forward accumulator oil seal (353) on the forward accumulator piston (354)
    2. The forward accumulator pin (355)
    3. The forward accumulator piston (354)
    4. The forward accumulator spring (356)
    5. The forward accumulator cover (363)
    6. The forward accumulator cover bolts (364)

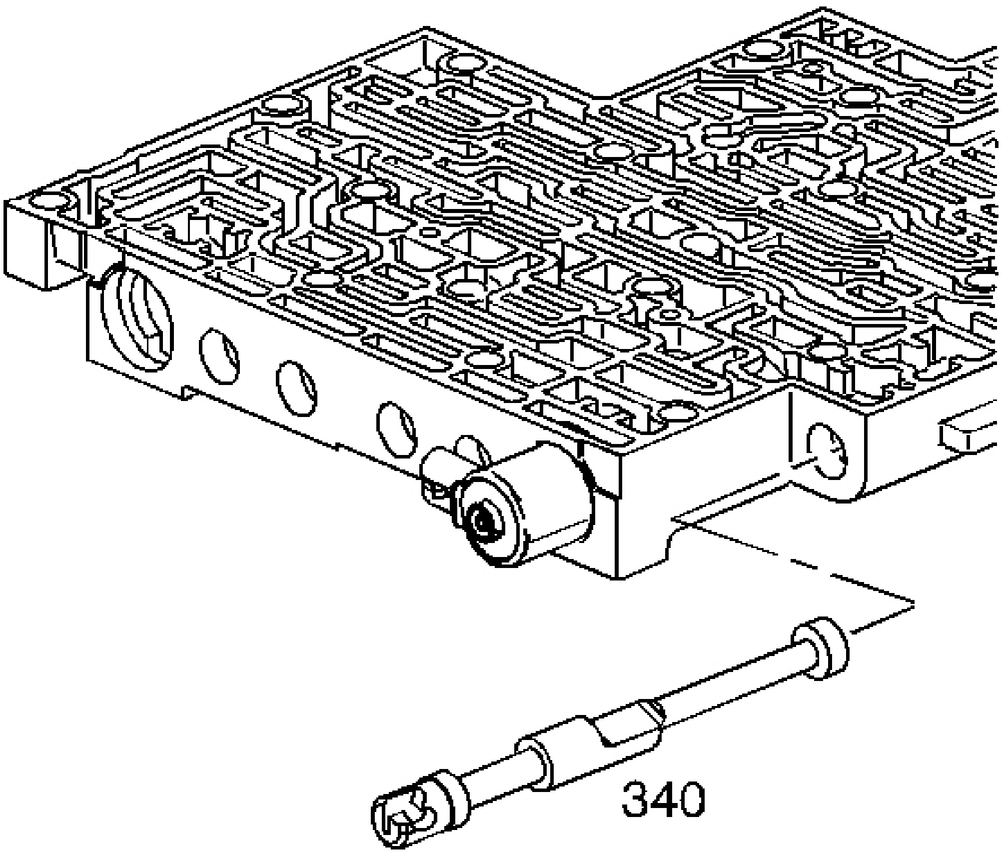


Fig. 425: Identifying Manual Valve
Courtesy of GENERAL MOTORS CORP.

12. Install the manual valve (340).

3-4 ACCUMULATOR INSTALLATION

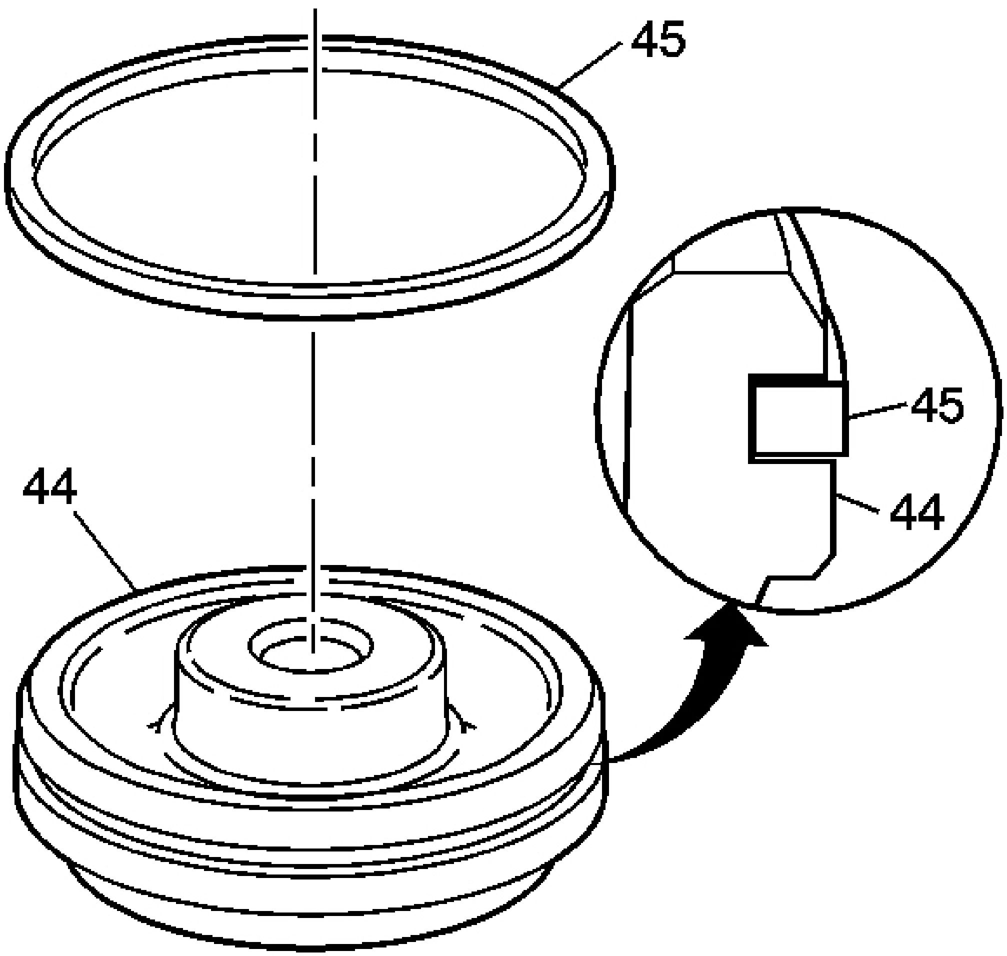


Fig. 426: Inspecting 3-4 Accumulator Piston
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 3-4 accumulator piston (44) for the following conditions:
   - Porosity
   - Cracks
   - Scoring
   - Nicks and scratches
2. Install the 3-4 accumulator piston oil seal ring (45) on the 3-4 accumulator piston (44).

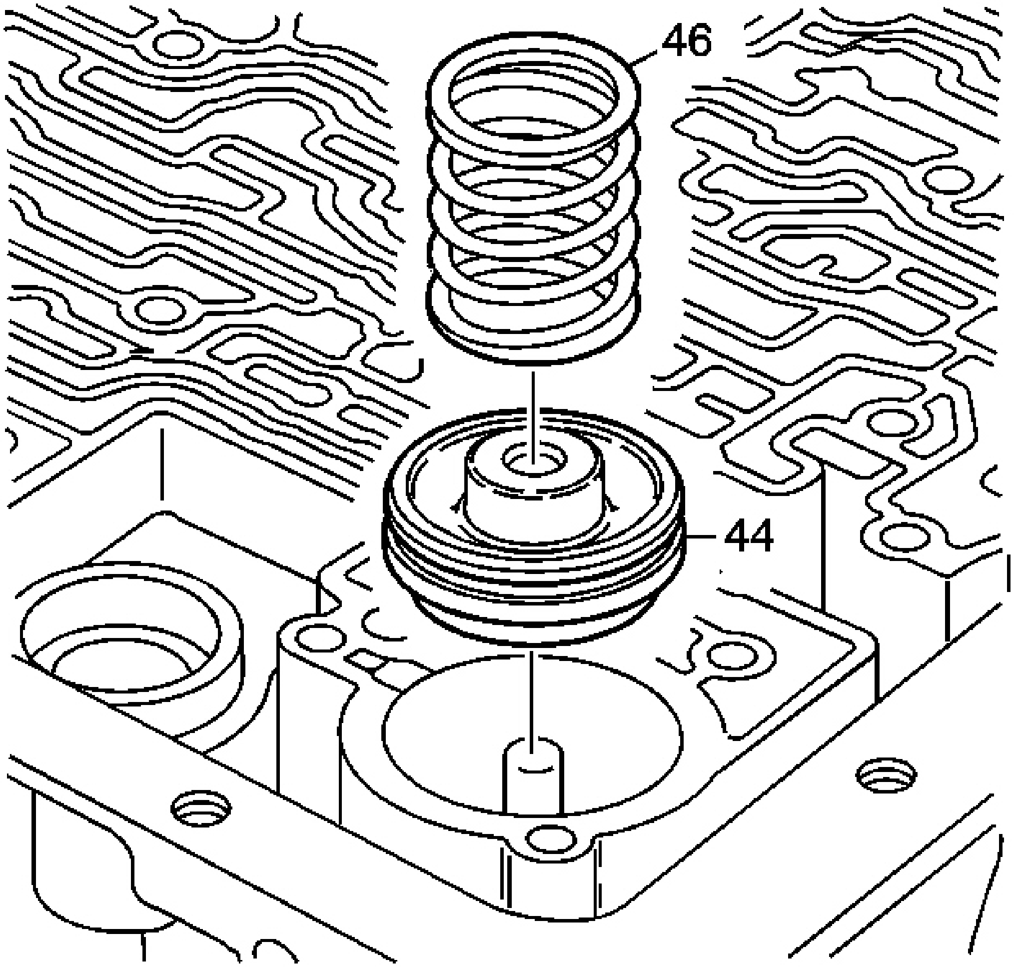


Fig. 427: 3-4 Accumulator Spring & Piston
Courtesy of GENERAL MOTORS CORP.

3. Install the 3-4 accumulator piston (44) and seal assembly into the bore.
4. Inspect the 3-4 accumulator spring (46) for cracks.

IMPORTANT: Some models do not use a 3-4 accumulator spring.

5. Install the 3-4 accumulator spring.

1-2 ACCUMULATOR DISASSEMBLE

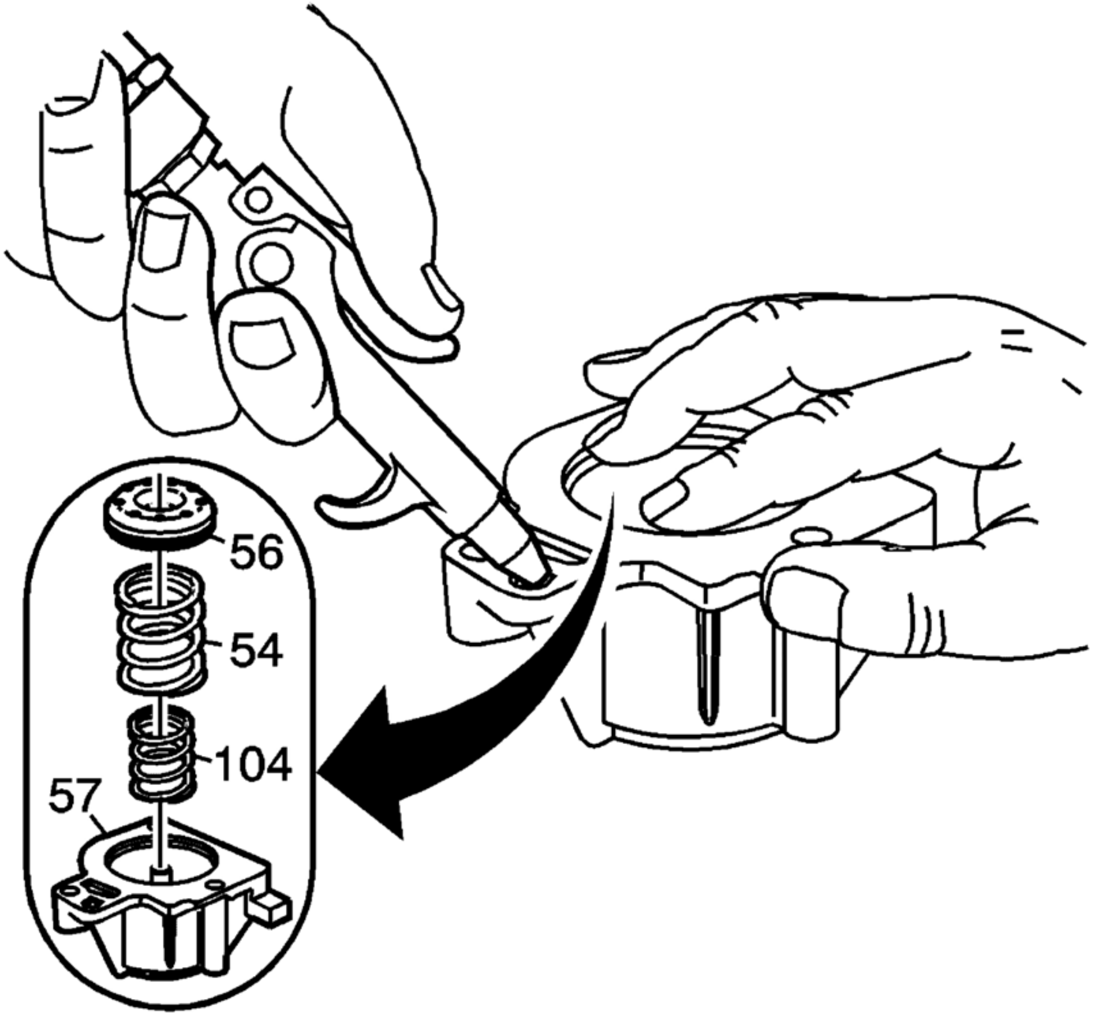


Fig. 428: Identifying Accumulator Housing, Accumulator Piston, 1-2 Inner & Outer Accumulator Springs
Courtesy of GENERAL MOTORS CORP.

1. Blow air into the 1-2 accumulator housing (57) to remove the 1-2 accumulator piston (56).
2. Remove the 1-2 inner (104) and outer (54) accumulator springs.

1-2 ACCUMULATOR ASSEMBLE

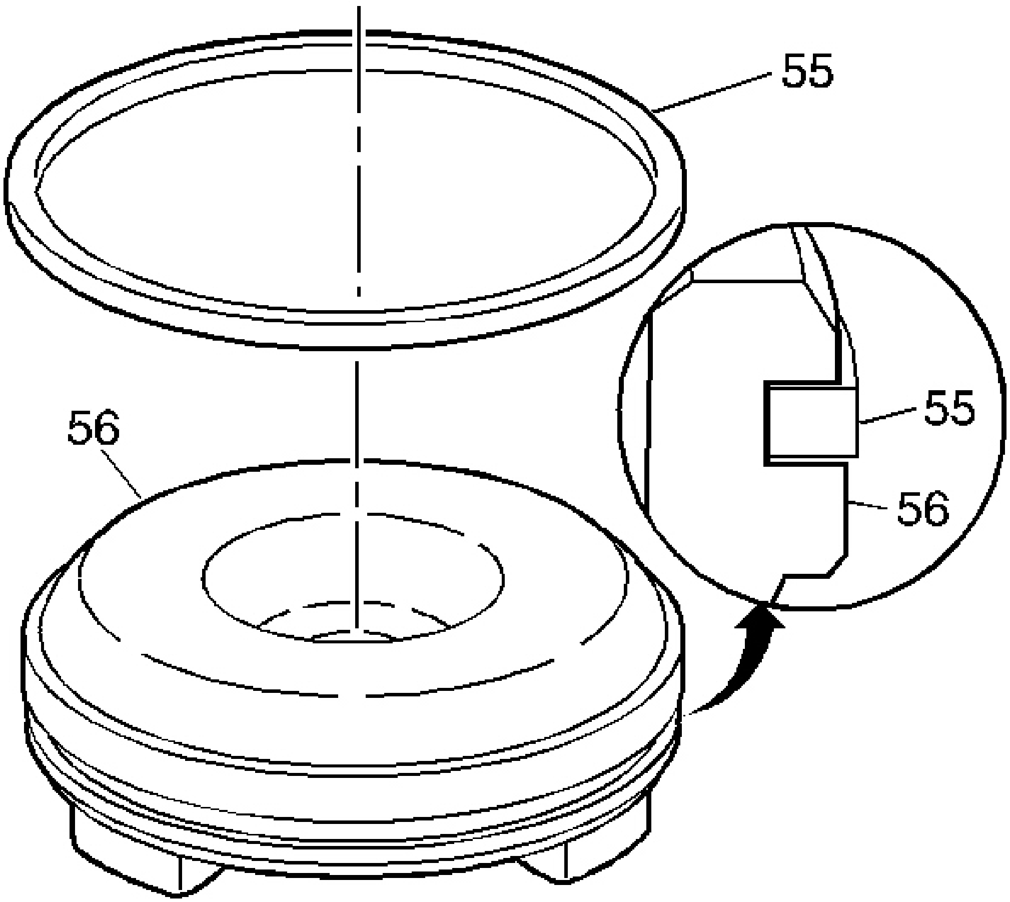


Fig. 429: Inspecting 1-2 Accumulator Piston
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 1-2 accumulator piston (56) for the following conditions:
   - Porosity
   - Cracks
   - Scoring
   - Nicks and Scratches
2. Install a 1-2 accumulator piston oil seal ring (55) on the 1-2 accumulator piston (56).

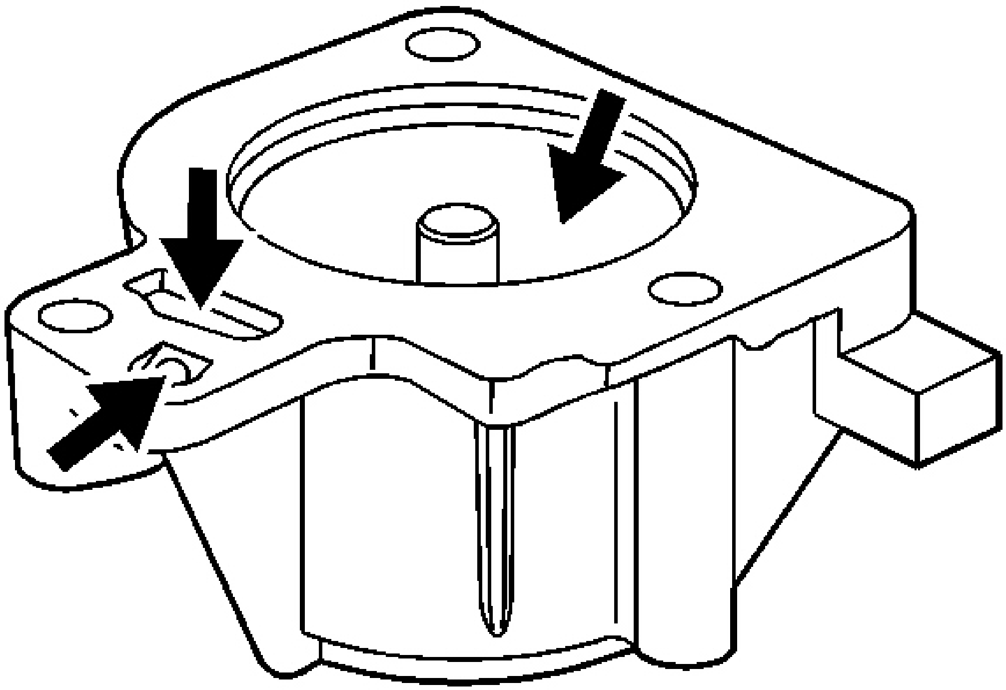


Fig. 430: Inspecting 1-2 Accumulator Housing
Courtesy of GENERAL MOTORS CORP.

3. Inspect the 1-2 accumulator housing for the following conditions:
    - Porosity
    - Cracks
    - Scoring
    - Nicks and Scratches
    - Debris or blocked passages

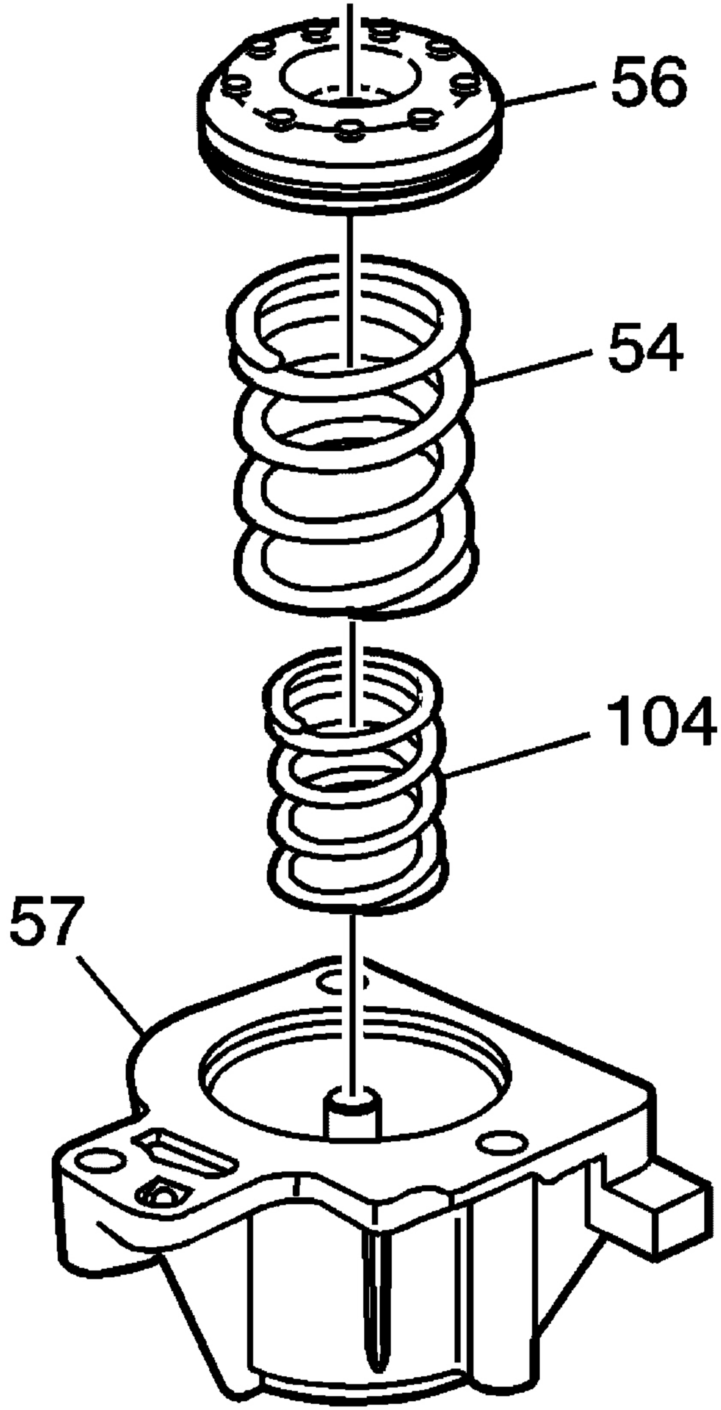


Fig. 431: Installing 1-2 Inner & Outer Accumulator Springs & 1-2 Accumulator Piston
Courtesy of GENERAL MOTORS CORP.

4. Install the 1-2 inner (104) and outer (54) accumulator springs.

5. Install the 1-2 accumulator piston (56).

1-2 ACCUMULATOR INSTALLATION

Tools Required

- **J 25025-5** Dial Indicator Mounting Post - M6. See **Special Tools and Equipment** .
- J 36850 Transjel Lubricant

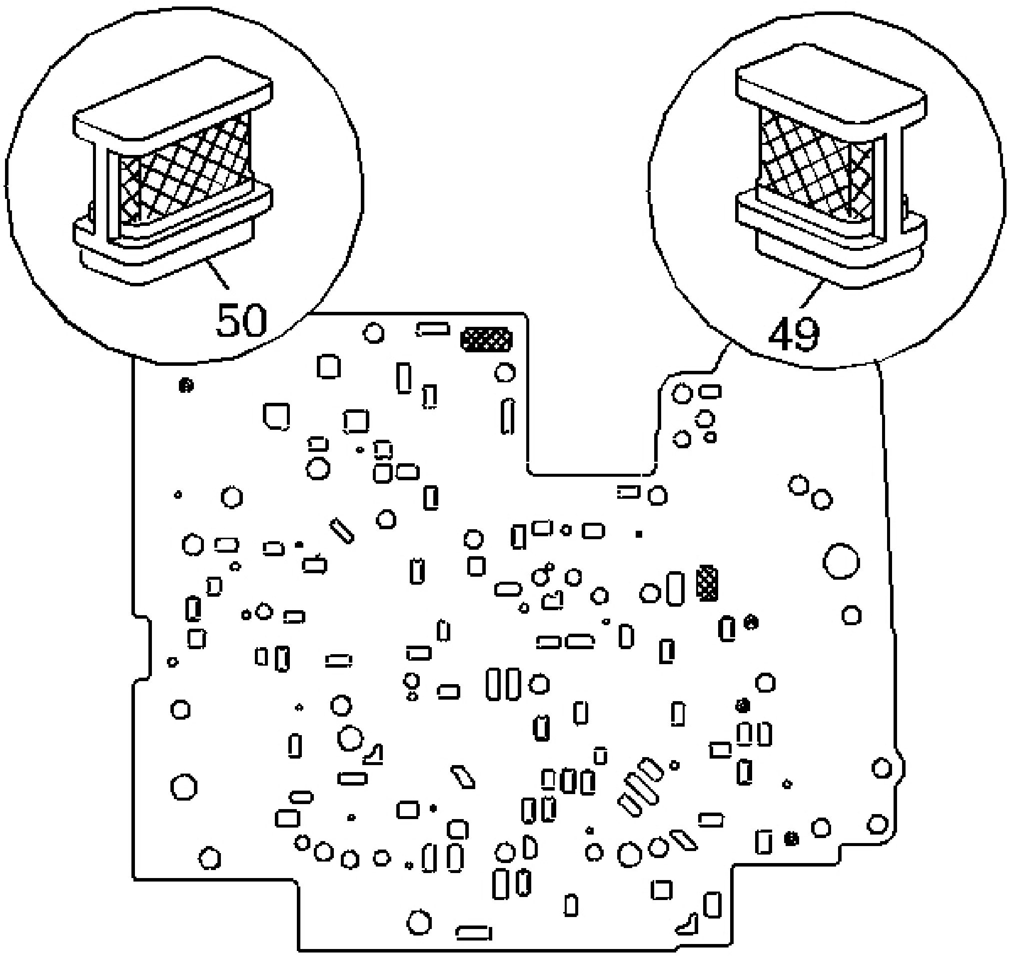


Fig. 432: Inspecting Valve Body Spacer Plate & Solenoid Screens
Courtesy of GENERAL MOTORS CORP.

1. Inspect the valve body spacer plate and the solenoid screens (49, 50) for damage or debris.

Replace the solenoid screens (49, 50) if necessary.

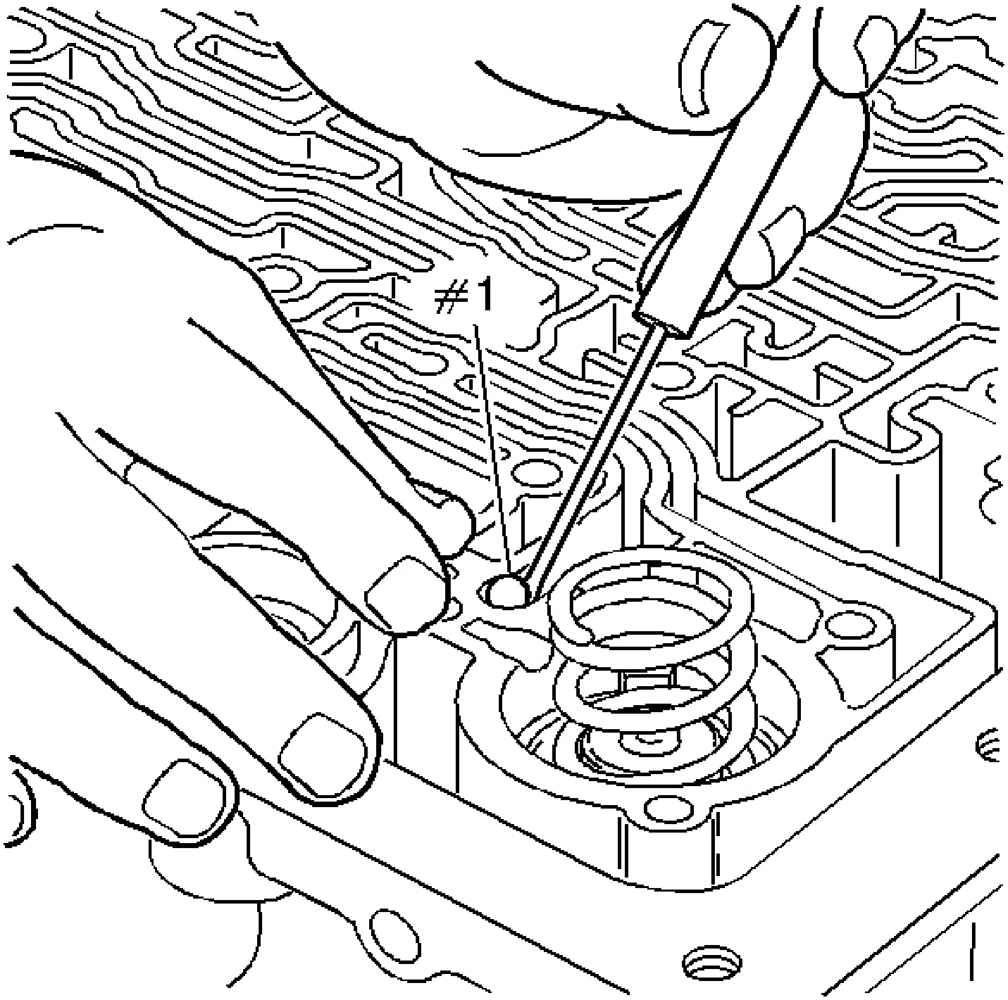


Fig. 433: Identifying Case Checkball
Courtesy of GENERAL MOTORS CORP.

2. Install the #1 checkball into the case.

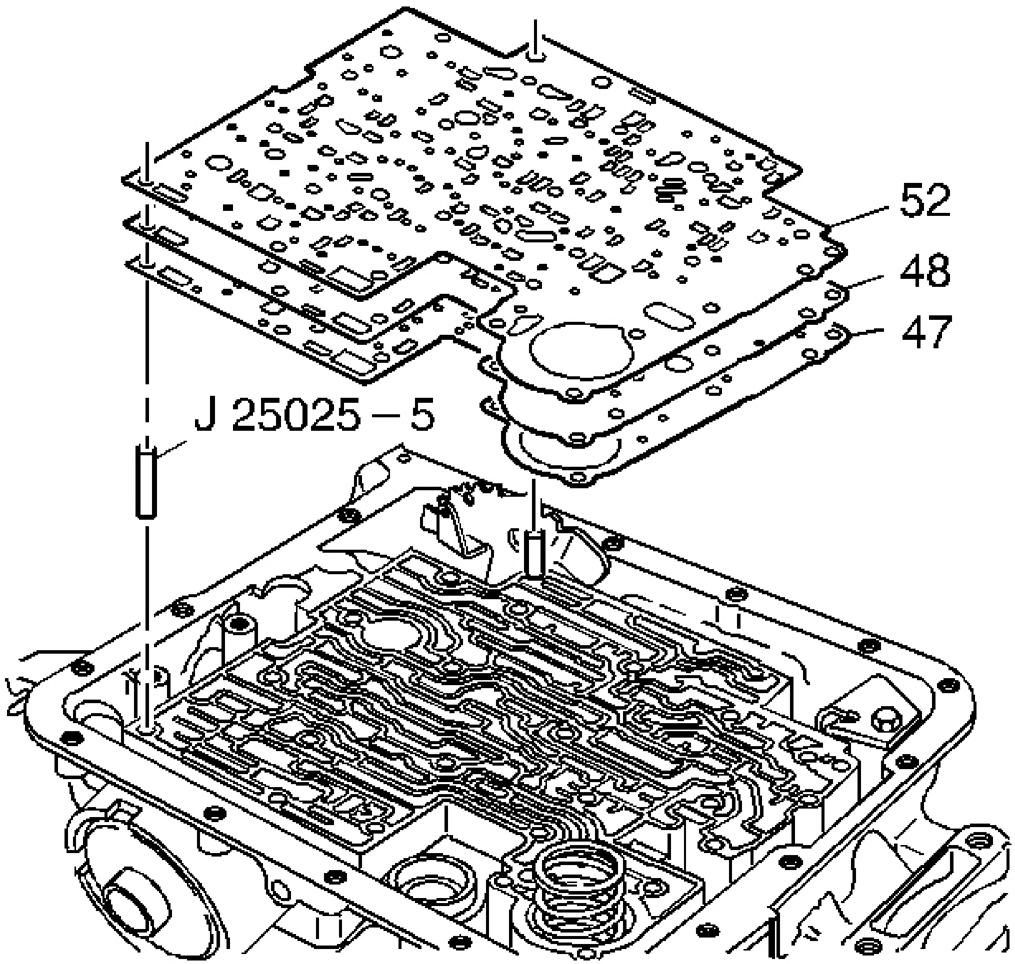


Fig. 434: Spacer Plate To Case Gasket, Spacer Plate To Valve Body Gasket On Spacer Plate
Courtesy of GENERAL MOTORS CORP.

3. Install the **J 25025-5** into the case. See **Special Tools and Equipment** .
4. Place the spacer plate to case gasket (47) (identified by a "C") and the spacer plate to valve body gasket (52) (identified by a "V") on the spacer plate (48). Retain gaskets on the spacer plate with J 36850 or equivalent.
5. Place the spacer and the spacer plate gaskets on the case.

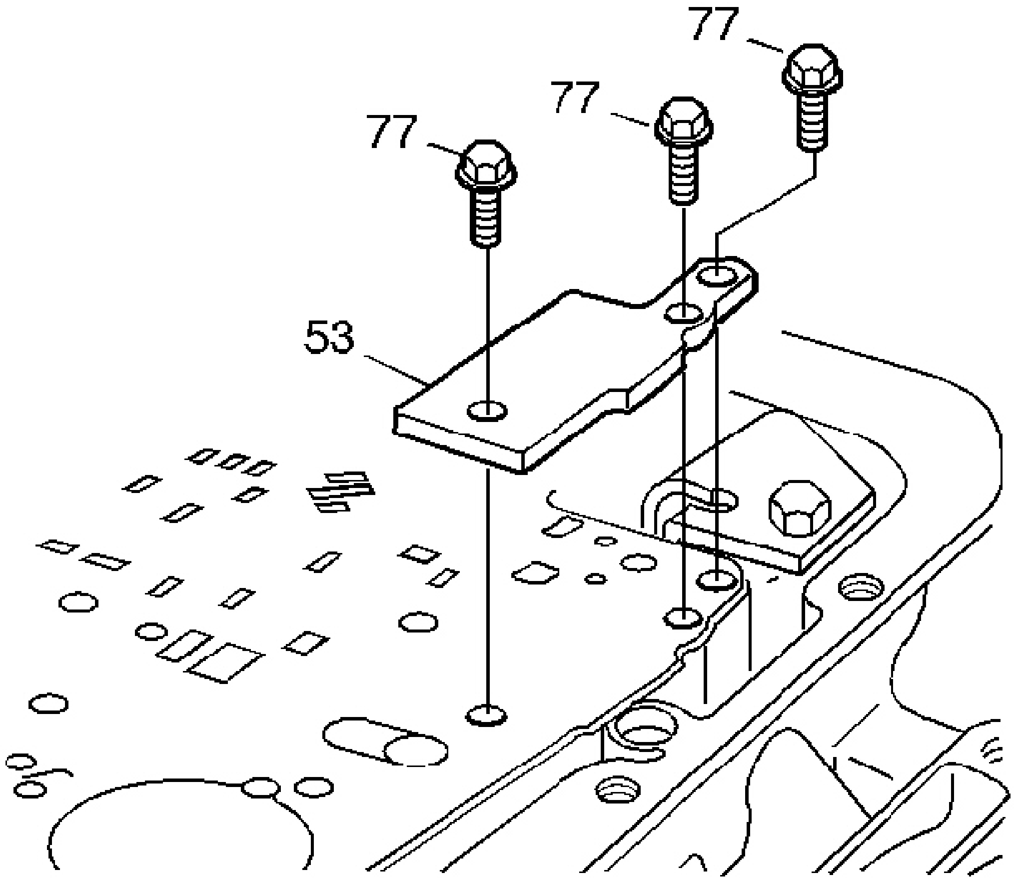


Fig. 435: Installing Spacer Plate Support Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the spacer plate support plate (53).
7. Install the spacer plate support bolts (77).

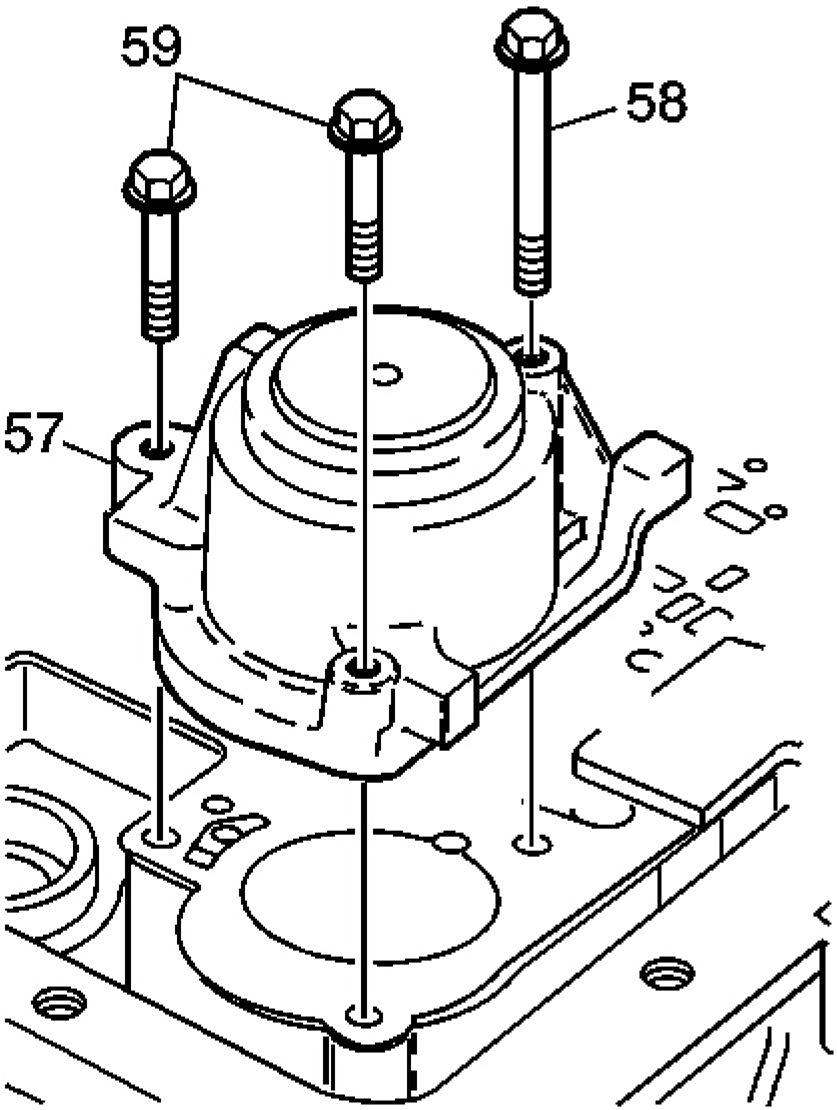


Fig. 436: Installing Accumulator Housing Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the 1-2 accumulator housing assembly (57).

NOTE: Refer to Fastener Notice in Cautions and Notices.

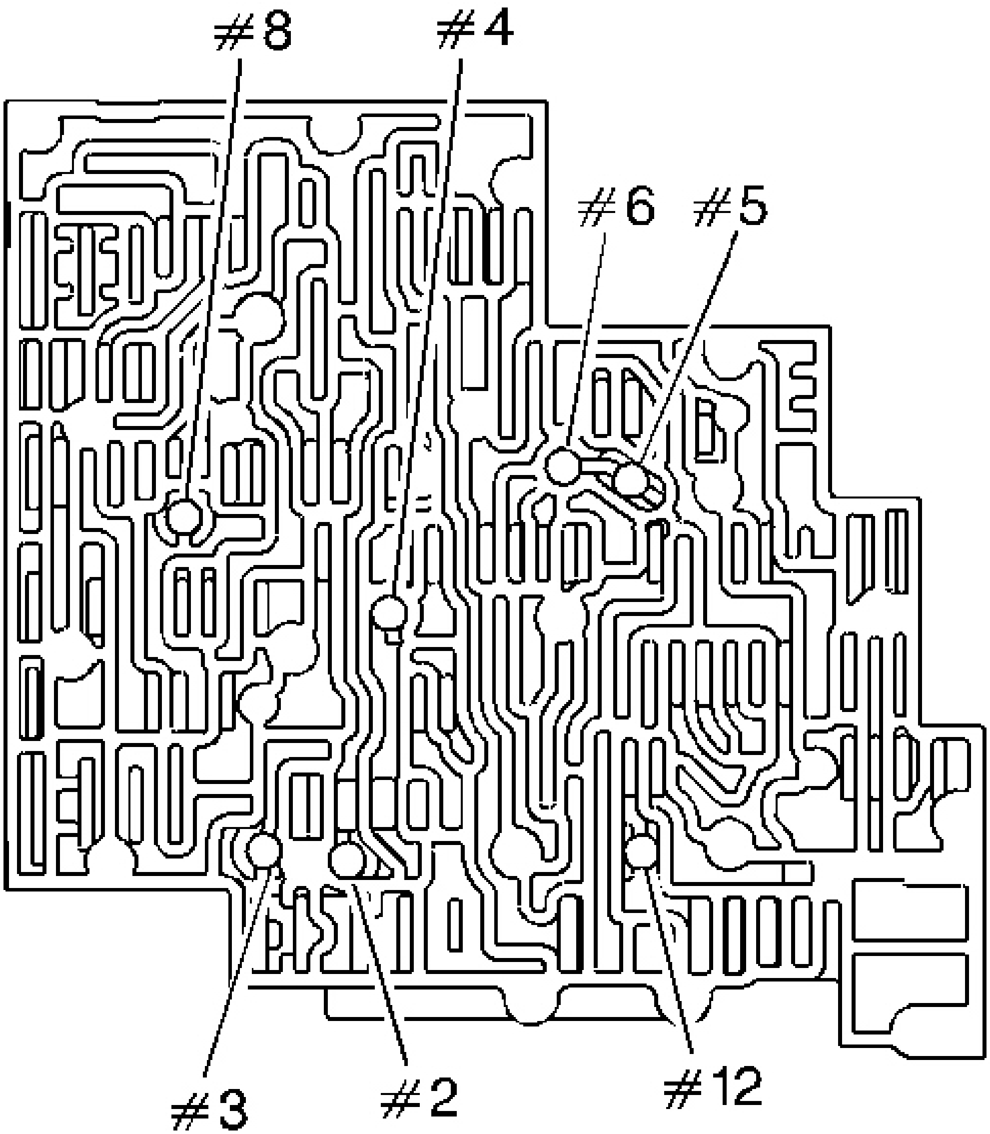
9. Install the 1-2 accumulator housing bolts (58, 59).

   Tighten: Tighten the bolts to 11 N.m (8 lb ft).

CONTROL VALVE BODY INSTALLATION

Tools Required

- **J 25025-5** Dial Indicator Mounting Post M6 x 1. See **Special Tools and Equipment** .00
- J 36850 Transjel Lubricant



<u>Fig. 437: Installing Checkballs (2-6, 8, 12) In Valve Body & Retaining Checkballs</u>
Courtesy of GENERAL MOTORS CORP.

1. Install the checkballs (2-6, 8, 12) in the valve body and retain checkballs with J 36850 or an equivalent.

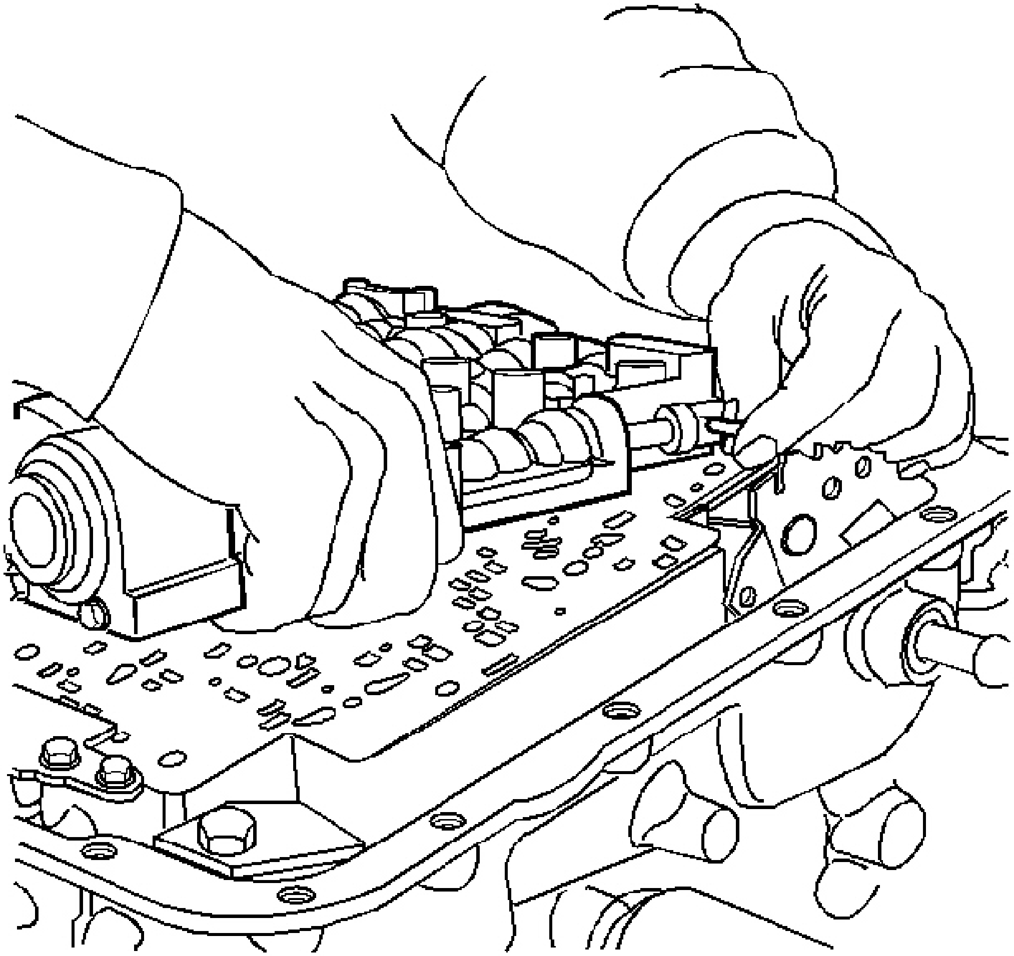


Fig. 438: Installing Valve Body Over J 25025-5
Courtesy of GENERAL MOTORS CORP.

2. Install the valve body over the **J 25025-5** Guide Pins, and connect the manual valve link to the manual valve. See **Special Tools and Equipment** .
3. Install two bolts to hold the valve body in place.
4. Remove the **J 25025-5** . See **Special Tools and Equipment** .

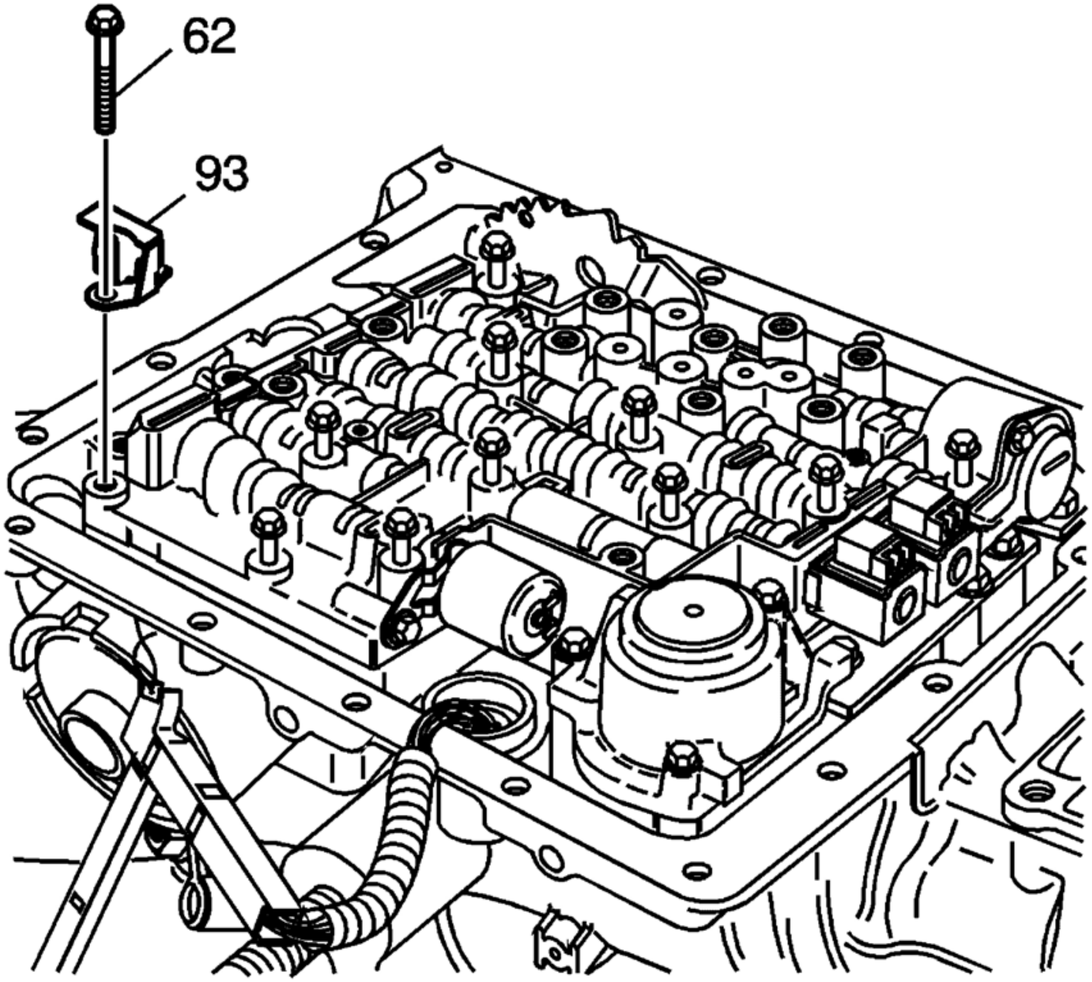


Fig. 439: Fluid Level Indicator Stop Bracket & Valve Body Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the fluid level indicator stop bracket (93) and the valve body bolts (62) that are shown only.
6. Finger tighten the bolts.

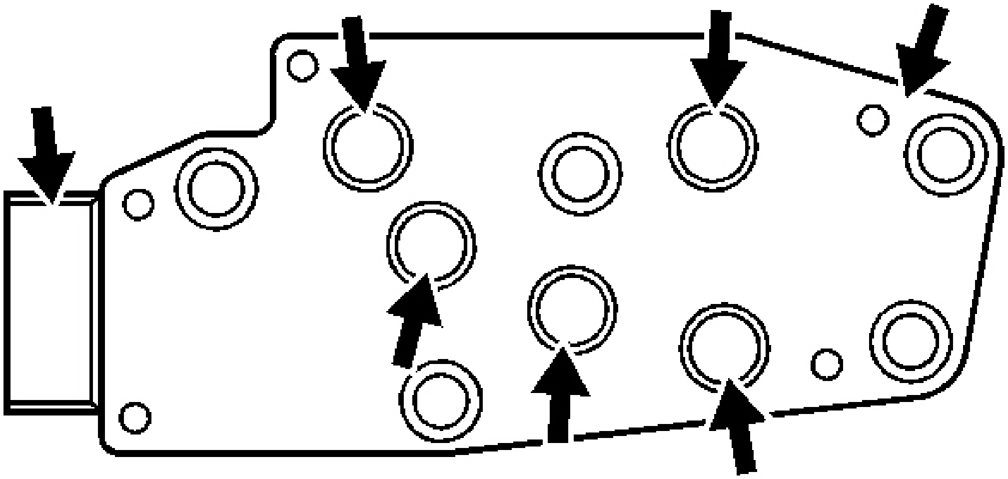


Fig. 440: Inspecting Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly
Courtesy of GENERAL MOTORS CORP.

7. Inspect the Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly for the following conditions:
   - Damage
   - Debris
   - Damaged or missing O-rings
   - Cracked connector
   - Loose pins
   - Poor terminal retension
   - Sediment in switch membrane

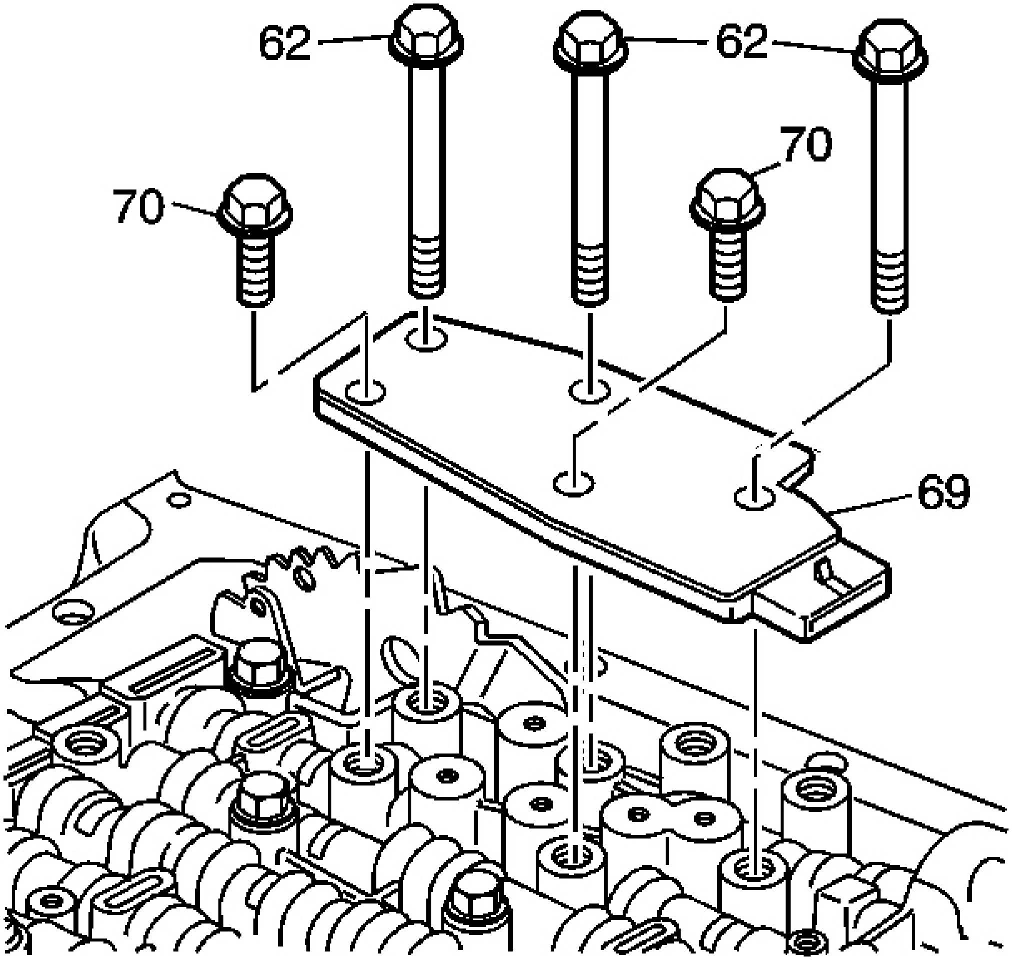


Fig. 441: TFP Manual Valve Position Switch & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the TFP manual valve position switch (69) and bolts (62, 70).

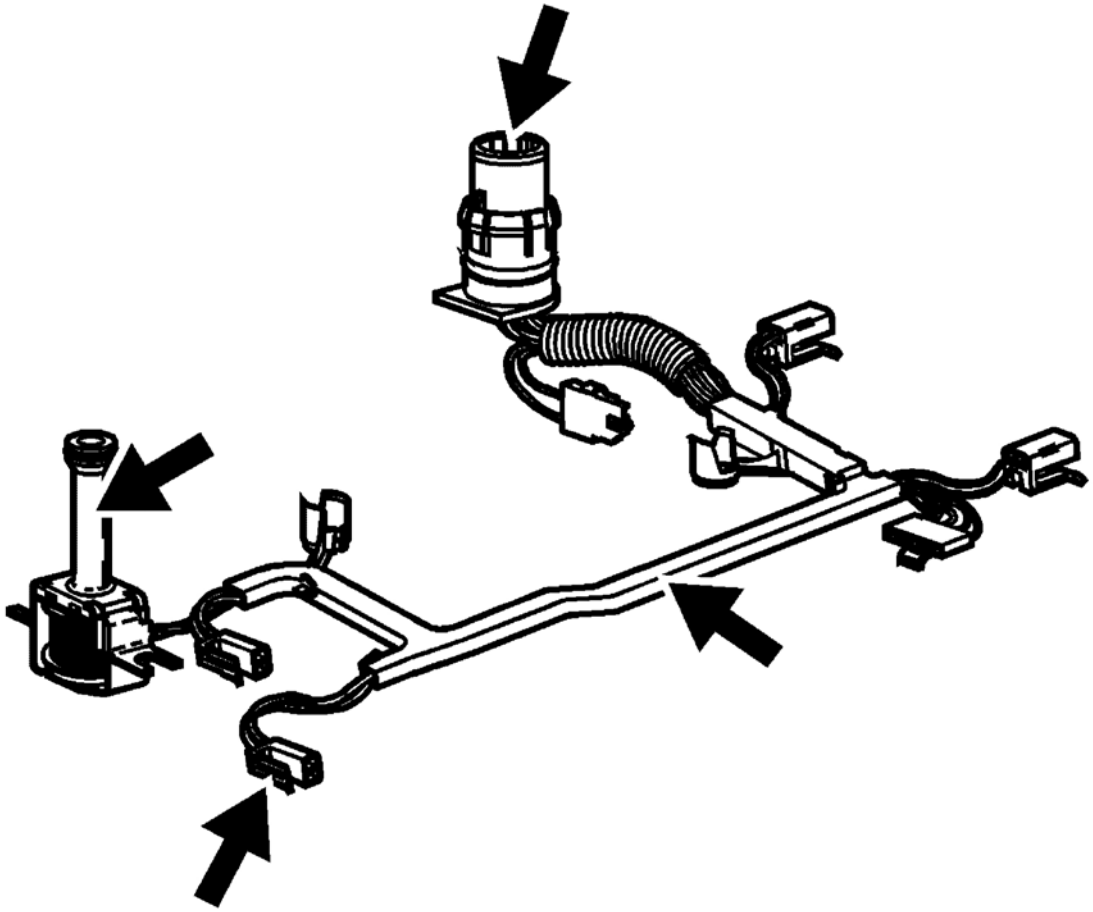


Fig. 442: Inspecting Wiring Harness Solenoid Assembly
Courtesy of GENERAL MOTORS CORP.

9. Inspect the wiring harness solenoid assembly for the following conditions:
    - Damage
    - Cracked connectors
    - Exposed wires
    - Loose pins
    - Poor terminal retension

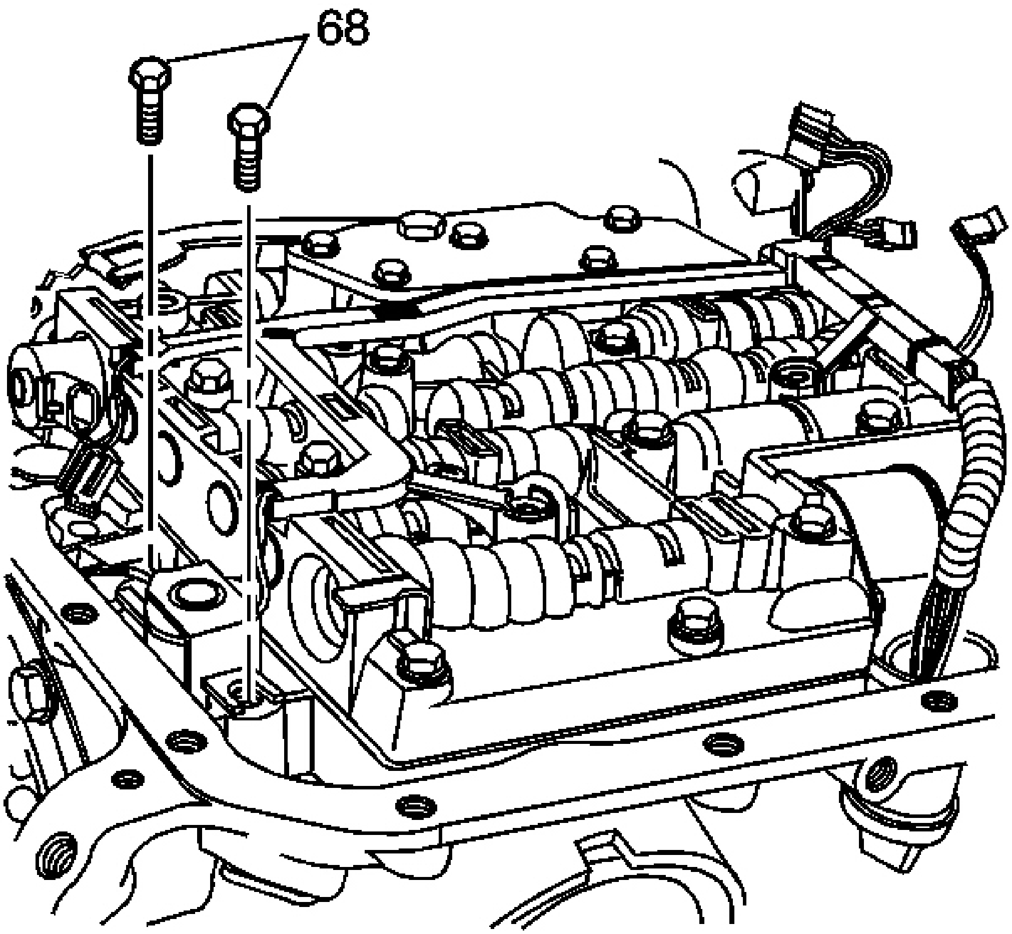


Fig. 443: TCC Solenoid Valves & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Install the transmission wiring harness on the valve body.
11. Install the TCC solenoid valve and bolts (68).

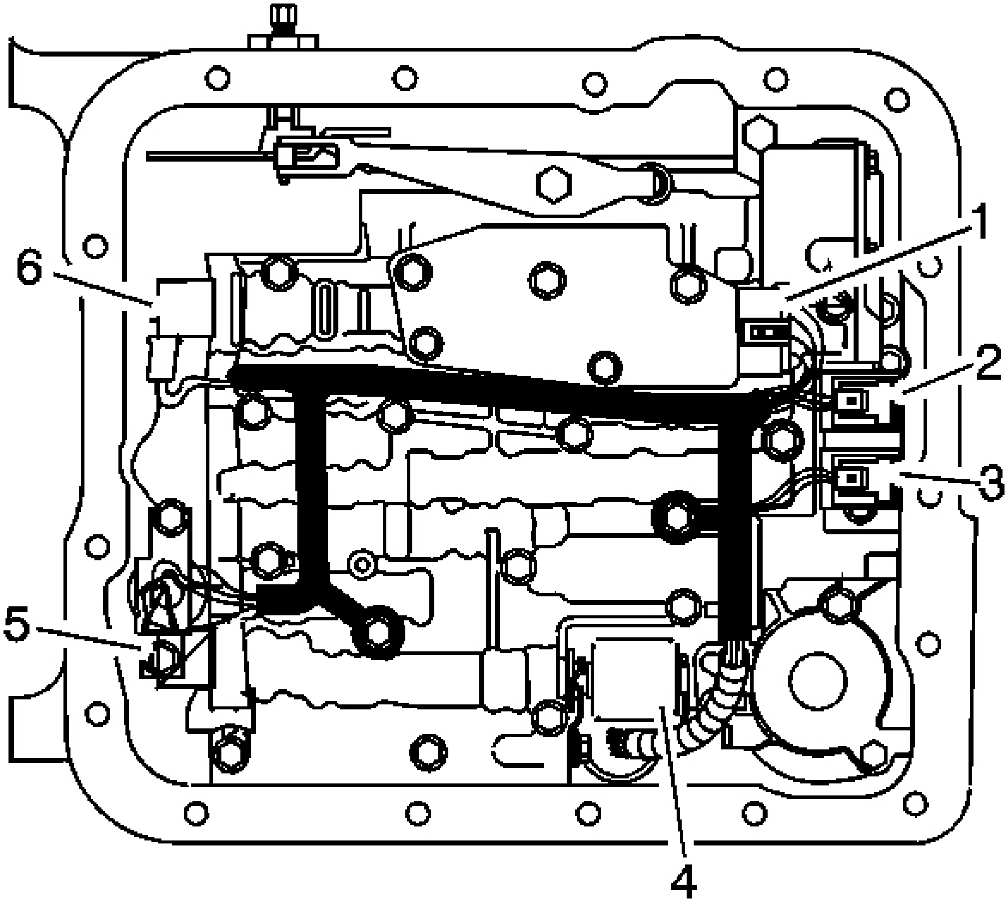


Fig. 444: Electrical Connectors & Electrical Components
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **You must tighten certain bolts in a spiral pattern as indicated. If you tighten these bolts at random you may distort valve bores. This will inhibit valve operation.**

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

12. Tighten the bolts in the order shown.

    Tighten: Tighten the bolts to 11 N.m (8 lb ft).

    Each bolt number refers to a specific bolt size, as indicated by the following list:

- 1 - M6 x 1.0 x 65.0
- 2 - M6 x 1.0 x 54.4
- 3 - M6 x 1.0 x 47.5
- 4 - M6 x 1.0 x 35.0
- 5 - M8 x 1.25 x 20.0
- 6 - M6 x 1.0 x 12.0
- 7 - M6 x 1.0 x 18.0

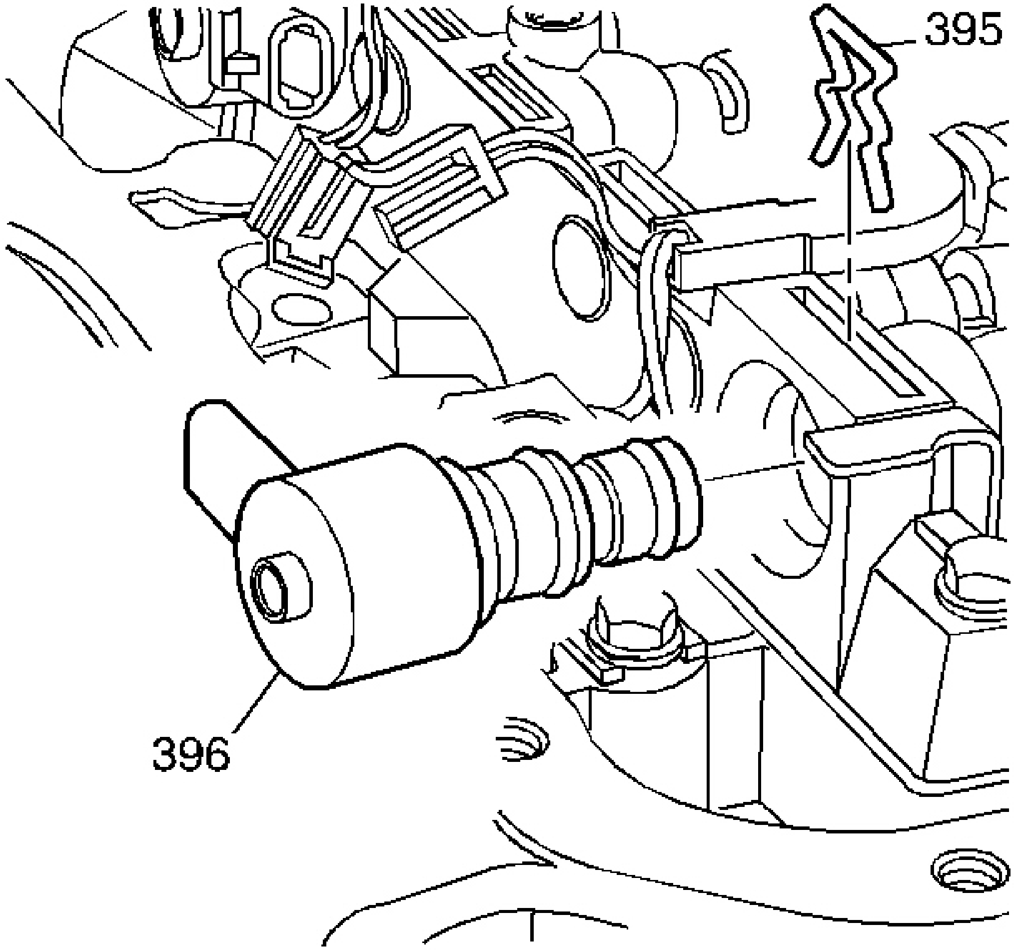


Fig. 445: TCC PWM Solenoid Valve & Solenoid Retainer
Courtesy of GENERAL MOTORS CORP.

13. Install the TCC PWM solenoid valve (396) and the solenoid retainer (395).

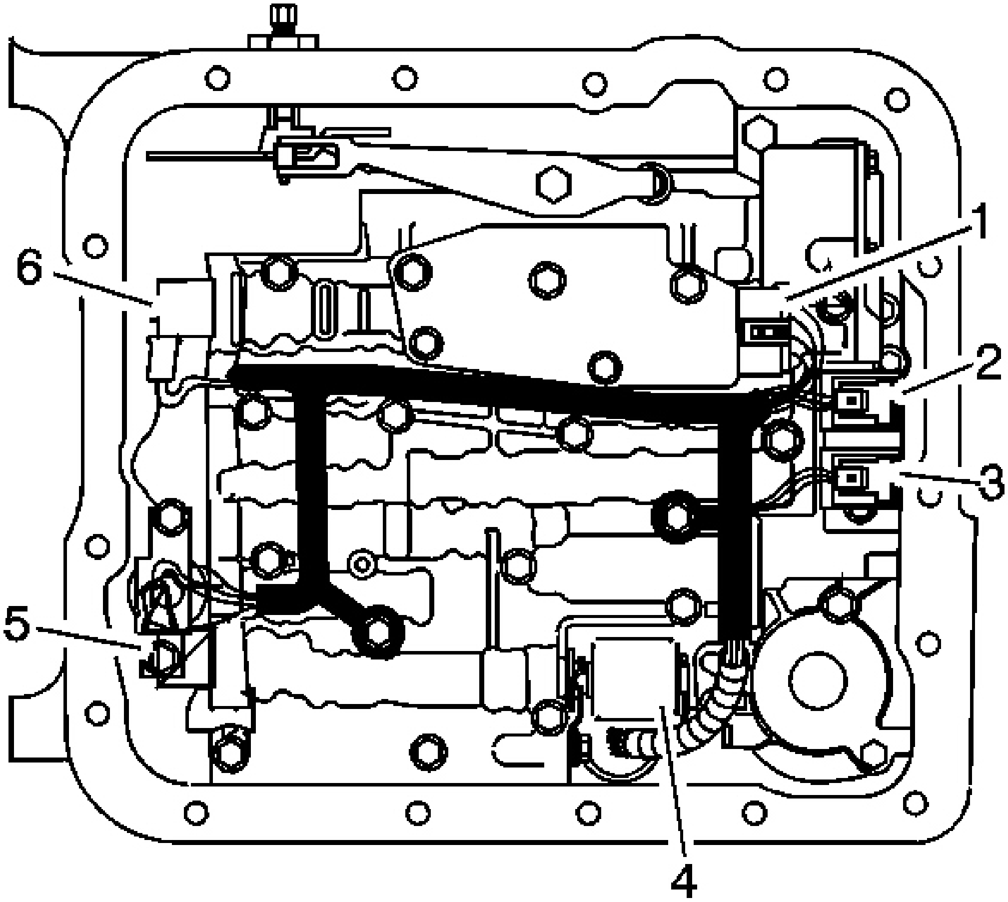


Fig. 446: Electrical Connectors & Electrical Components
Courtesy of GENERAL MOTORS CORP.

14. Connect all electrical connectors (1-6) to the electrical components.

MANUAL DETENT SPRING INSTALLATION

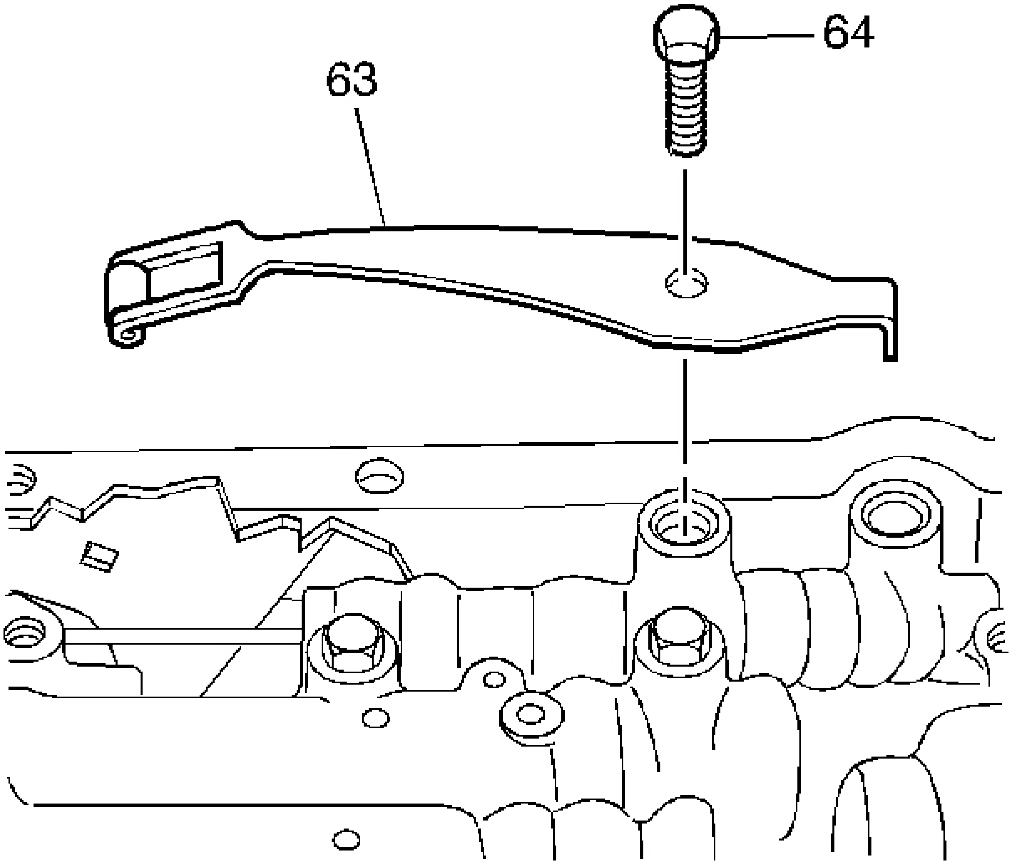


Fig. 447: Manual Detent Spring Bolt & Assembly
Courtesy of GENERAL MOTORS CORP.

1. Inspect the manual detent spring assembly (63) for cracks or damage.
2. Install the manual detent spring assembly (63).

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the manual detent spring bolt (64).

   Tighten: Tighten the bolt to 20-27 N.m (15-20 lb ft).

OIL FILTER ASSEMBLY INSTALLATION

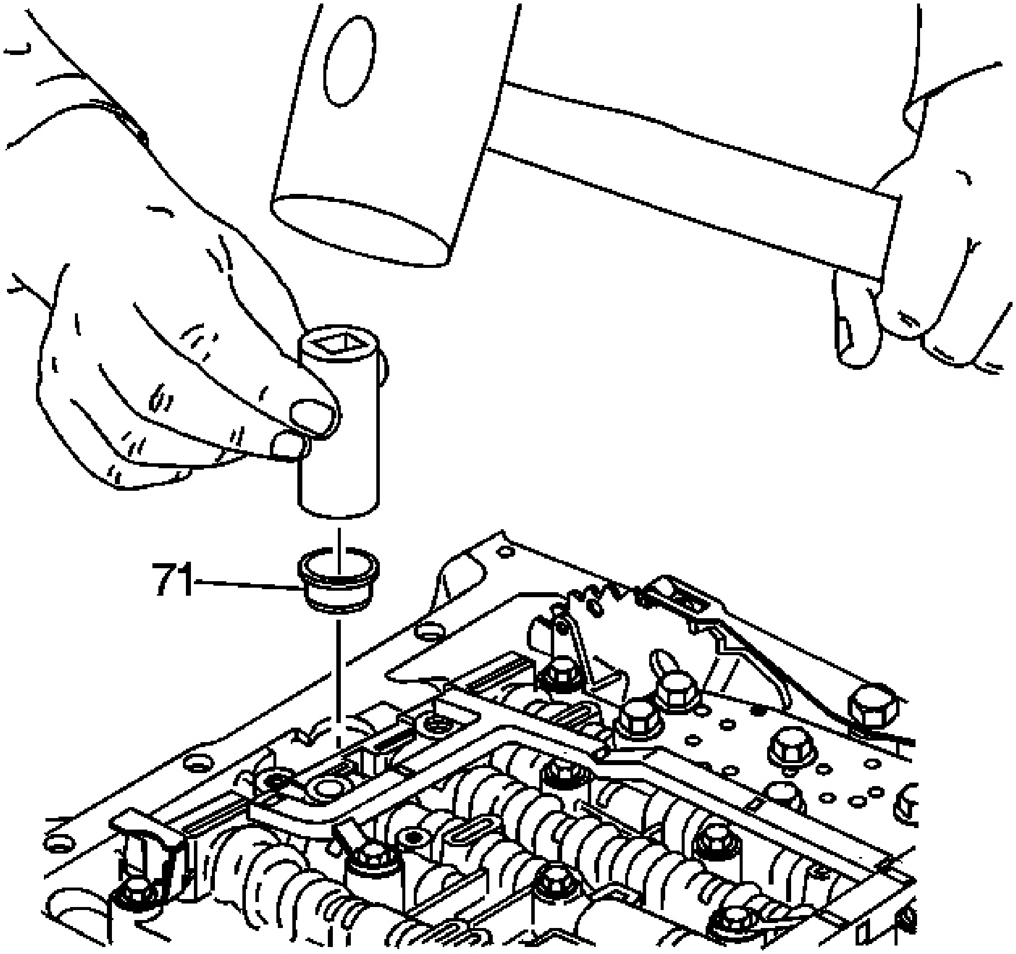


Fig. 448: Installing Filter Seal
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the filter seal (71) with transmission fluid.
2. Use a socket the same size diameter as the filter seal (71) and install the seal.

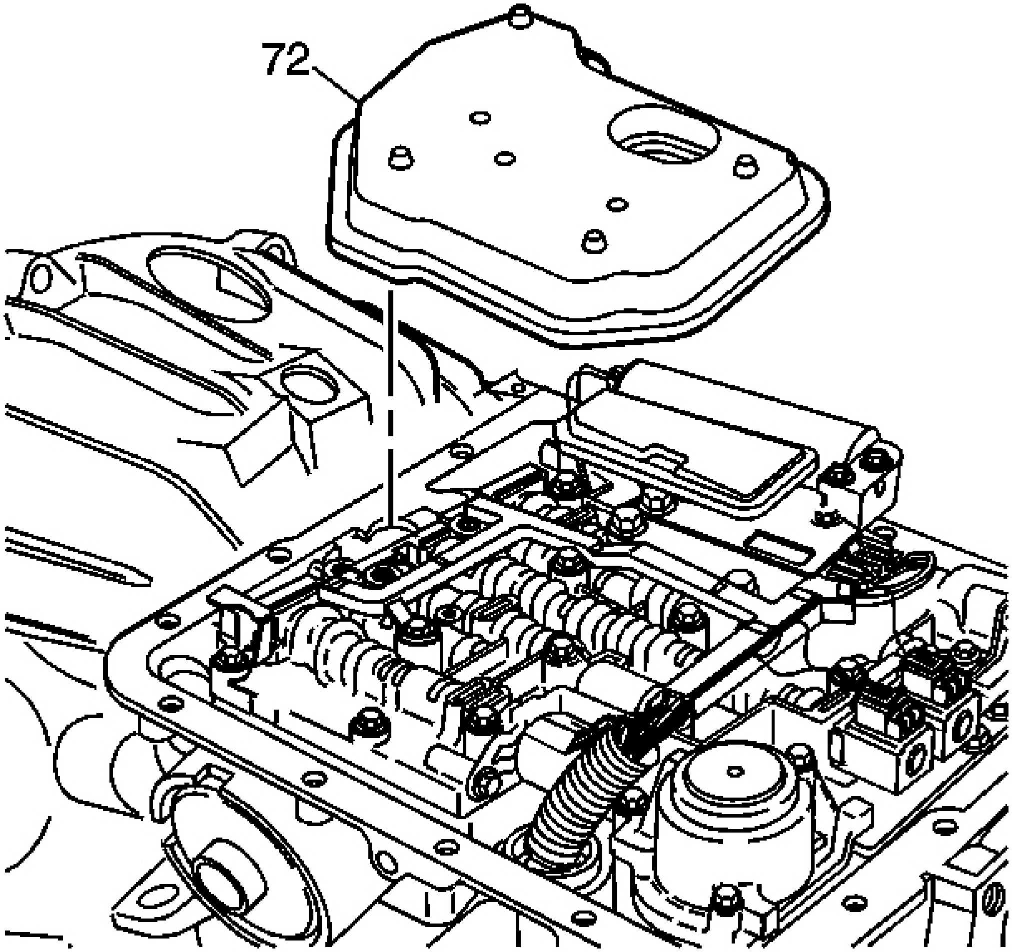


Fig. 449: Installing Transmission Oil Filter Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the transmission oil filter assembly (72).

TRANSMISSION OIL PAN INSTALLATION

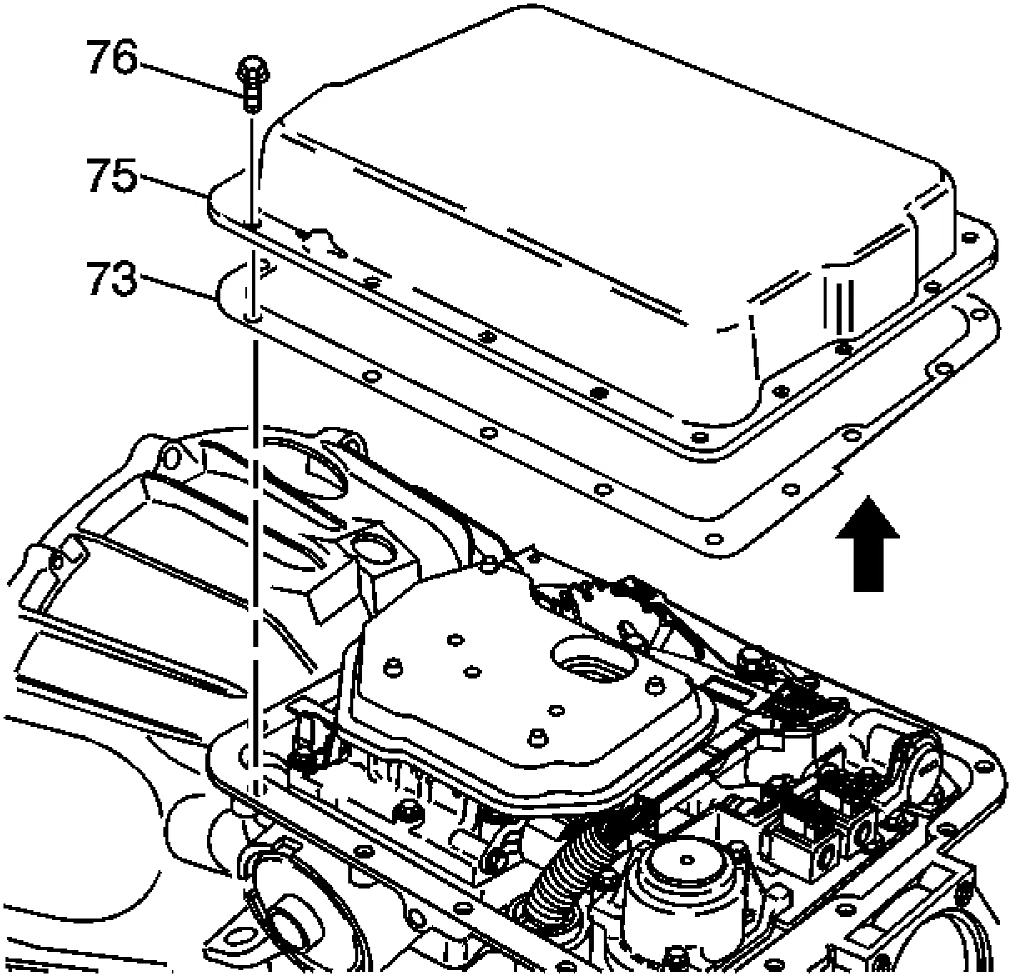


Fig. 450: Transmission Oil Pan, Screws, & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Place the transmission oil pan gasket (73) on the case.
2. Place the transmission oil pan (75) on the case.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install all of the transmission oil pan screws (76).

Tighten: Tighten the screws to 16 N.m (11.8 lb ft).

2-4 SERVO DISASSEMBLE

Tools Required

J 22269-01 Accumulator and Servo Piston Remover. See **Special Tools and Equipment** .

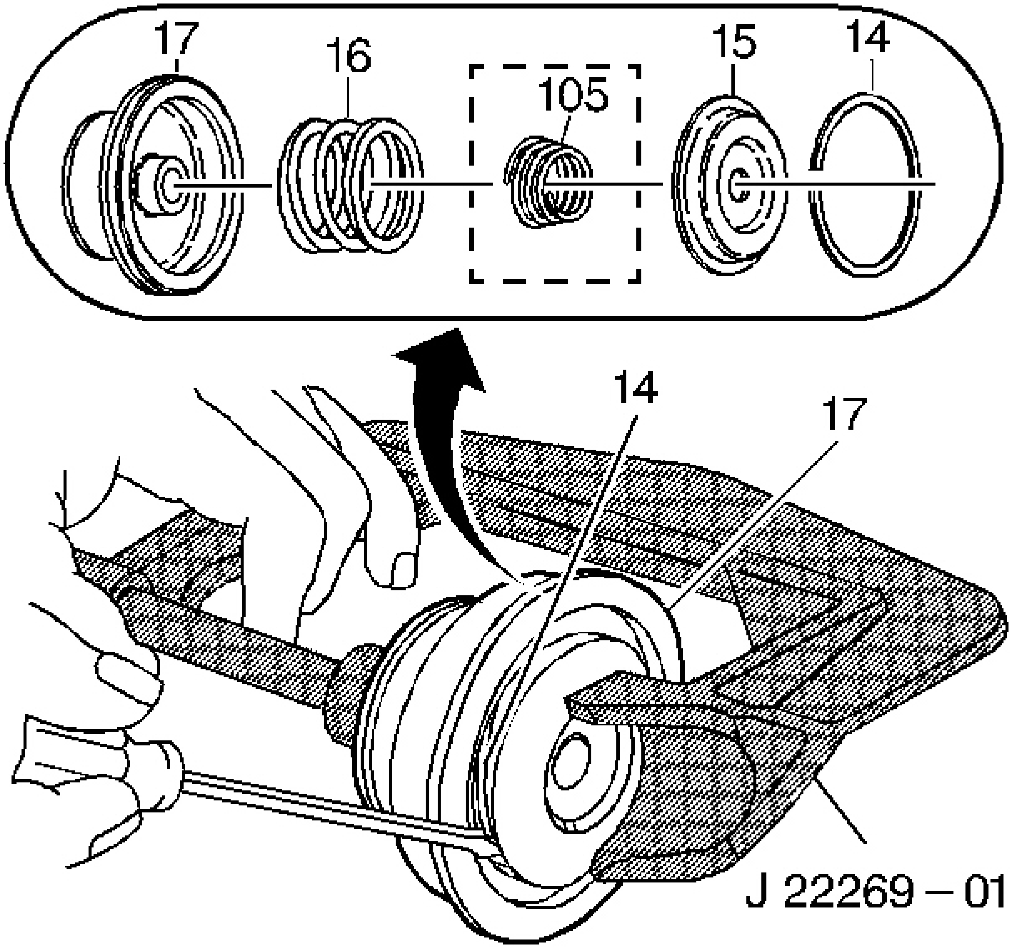


Fig. 451: Using J 22269-01 To Compress Second Apply Piston Assembly
Courtesy of GENERAL MOTORS CORP.

1. Use a **J 22269-01** to compress the second apply piston assembly (17). See **Special Tools and Equipment** .
2. Remove the second apply piston retaining ring (14).
3. Remove the servo cushion spring retainer (15), the servo cushion outer spring (16) and the servo cushion

inner spring (105) (model dependent).

2-4 SERVO PIN LENGTH CHECK

Tools Required

J 33037 2-4 Intermediate Band Apply Pin Gauge. See **Special Tools and Equipment** .

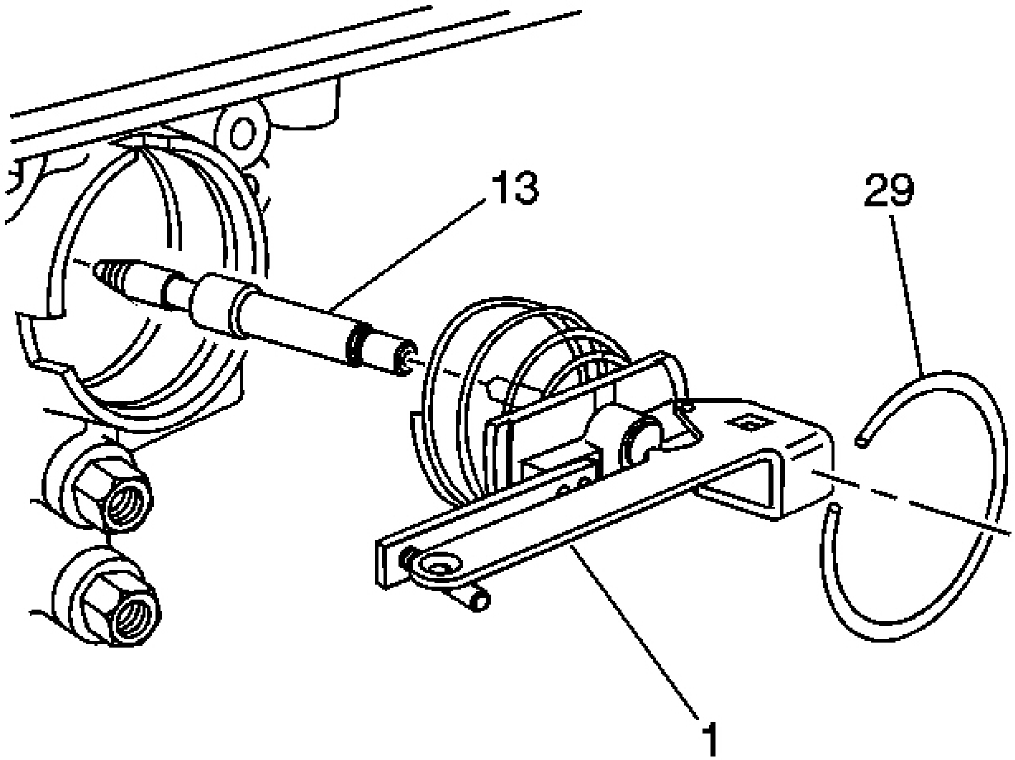


Fig. 452: Installing Band Apply Pin & Servo Cover Retaining Ring
Courtesy of GENERAL MOTORS CORP.

1. Install the band apply pin and the **J 33037** . See **Special Tools and Equipment** .
2. Install the servo cover retaining ring to secure the tool.

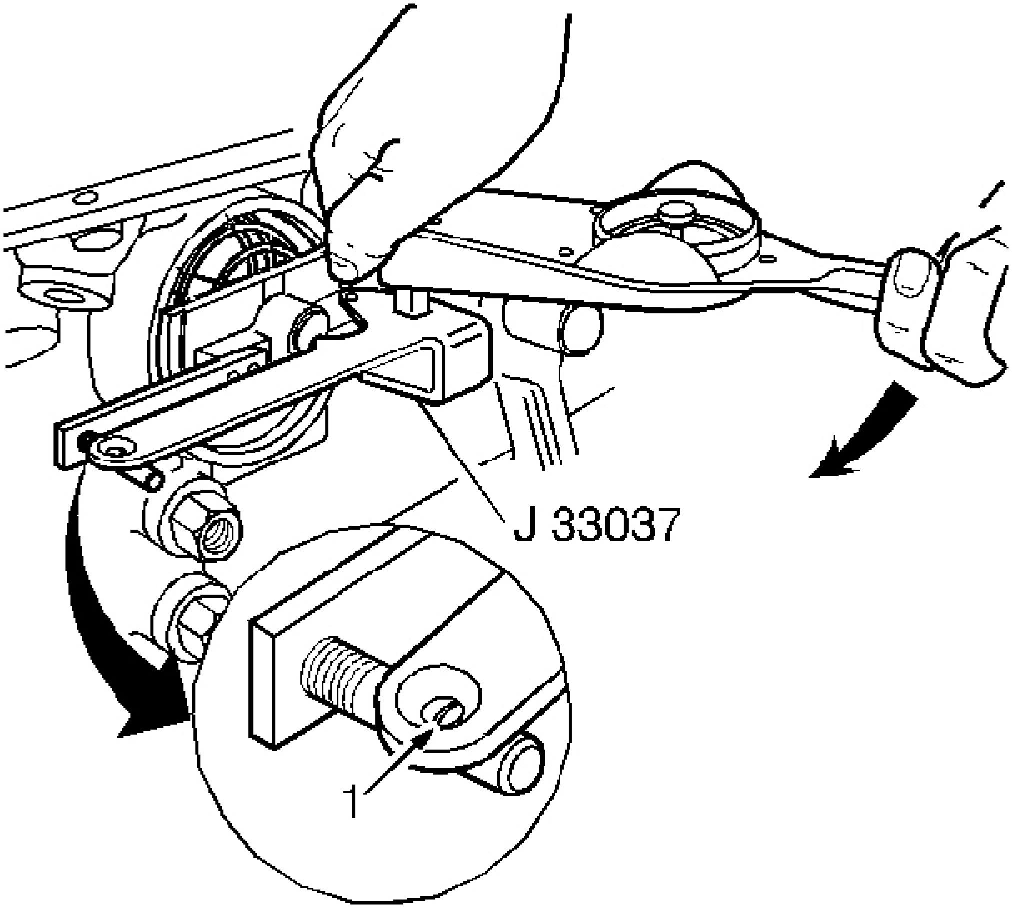


Fig. 453: Applying 11 N.m (98 lb in) Torque
Courtesy of GENERAL MOTORS CORP.

3. Apply 11 N.m (98 lb in) torque. If the white line appears in the gauge slot (1), the pin length is correct.
4. If a new pin is needed, refer to **2-4 Servo Pin Selection** in order to determine the correct pin length.

2-4 SERVO ASSEMBLY INSTALLATION

Tools Required

- **J 22269-01** Accumulator and Servo Piston Remover. See **Special Tools and Equipment** .
- **J 29714-A** Servo Cover Depressor. See **Special Tools and Equipment** .

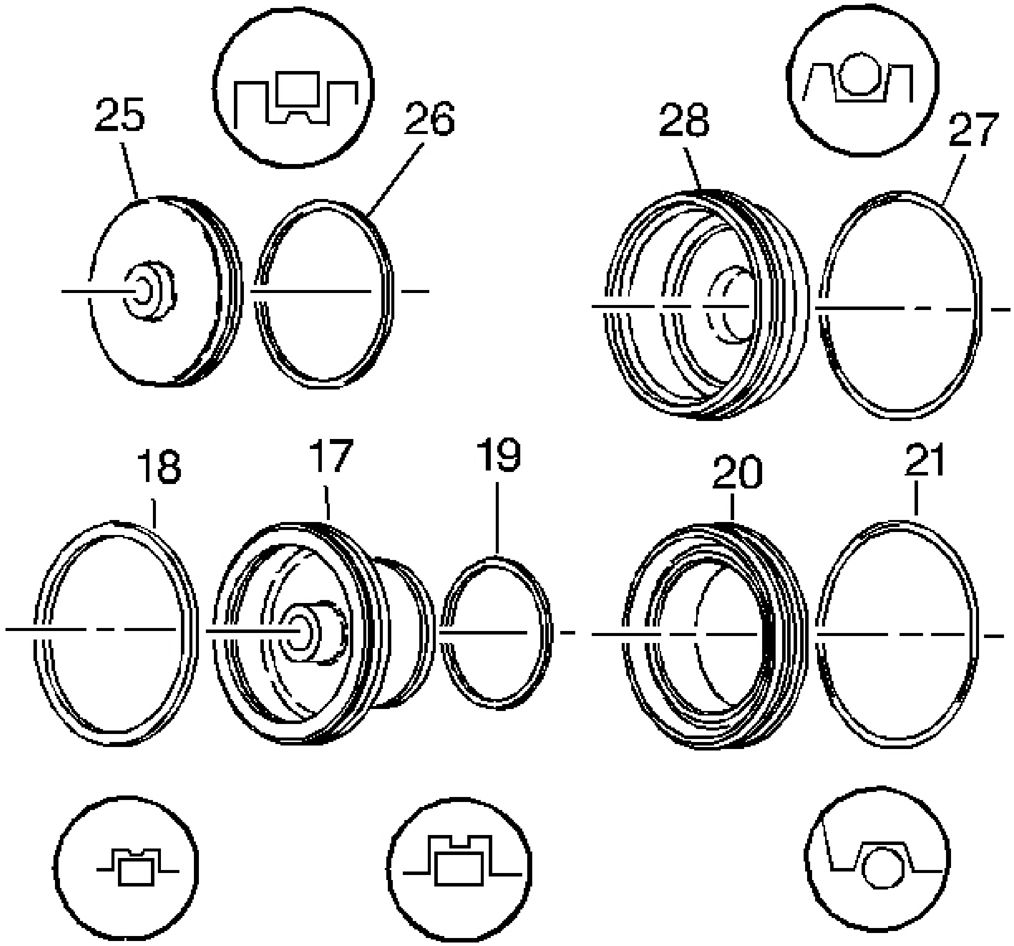


Fig. 454: Inspecting 4th Apply Piston, 2-4 Servo Cover, 2nd Apply Piston, Servo Piston Inner Housing
Courtesy of GENERAL MOTORS CORP.

1. Inspect the 4th apply piston (25), the 2-4 servo cover (28), the 2nd apply piston (17), and the servo piston inner housing (20) for the following conditions:
   - Cracks
   - Scoring
   - Burrs and nicks
2. Install the following seals:
   - The 4th apply piston outer oil seal ring (26) on the 4th apply piston (25).
   - The 2-4 servo cover O-ring seal (27) on the 2-4 servo cover (28).

- The 2nd apply piston outer (18) and inner (19) oil seal rings on the 2nd apply piston (17).
- The O-ring seal (21) on the servo piston inner housing (20).

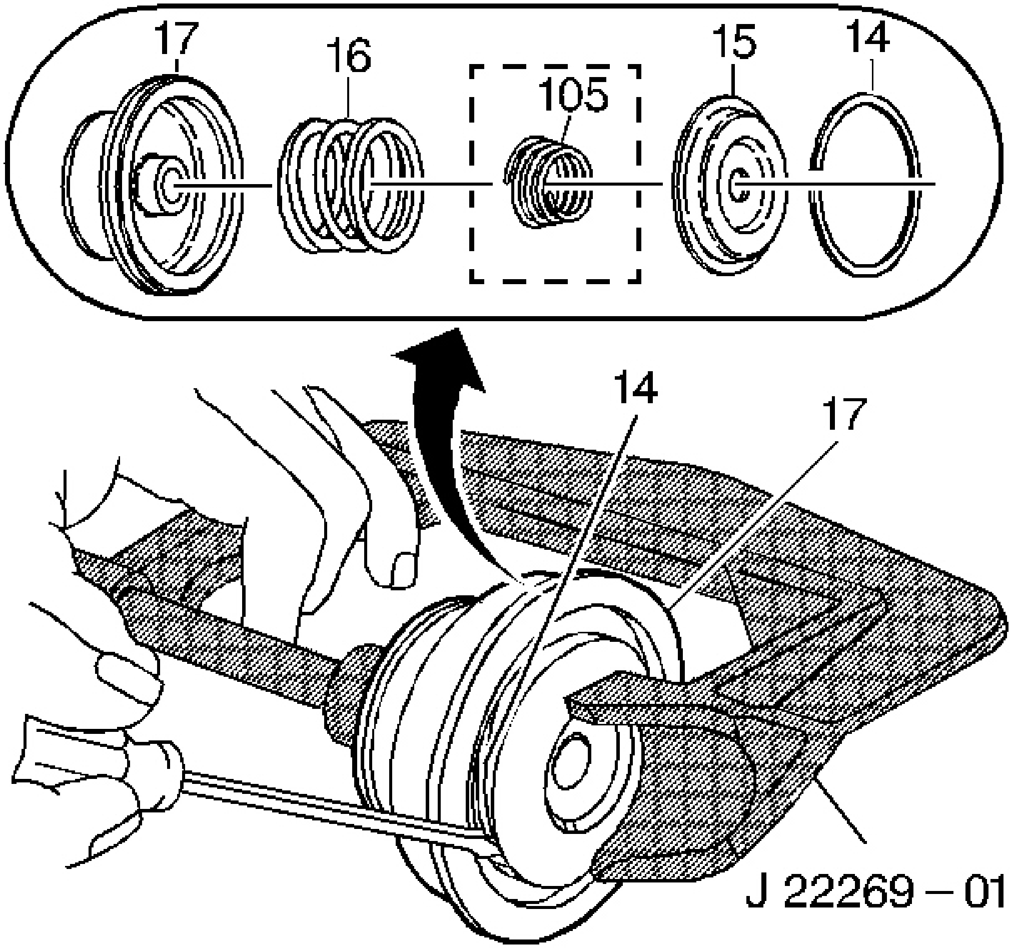


Fig. 455: Using J 22269-01 To Compress Second Apply Piston Assembly
Courtesy of GENERAL MOTORS CORP.

3. Install the servo cushion outer spring (16), the servo cushion inner spring (105) (model dependent) and the cushion spring retainer (15) in the 2nd apply piston (17).
4. Use the **J 22269-01** and compress the second apply piston assembly (17). See **Special Tools and Equipment** .
5. Install the second apply piston retaining ring (14).

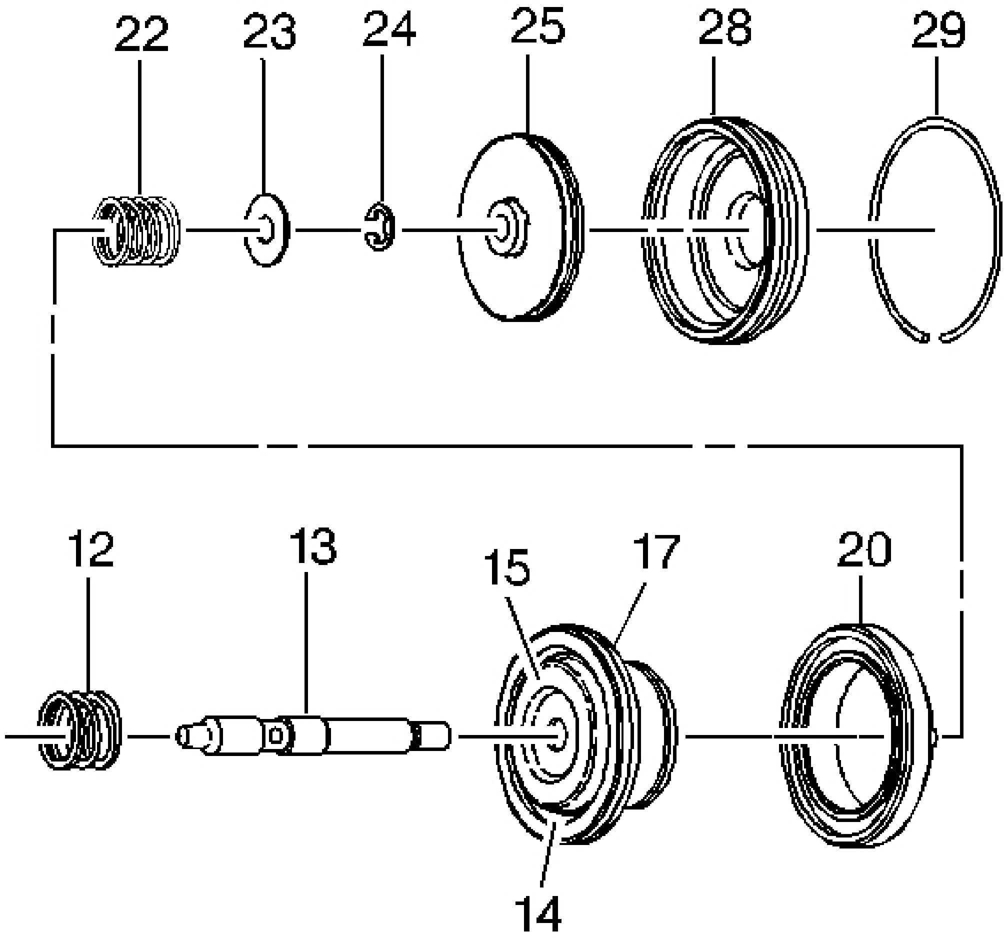


Fig. 456: Assembling 2-4 Servo Components
Courtesy of GENERAL MOTORS CORP.

6. Assemble the 2-4 servo components in the order shown: (12-15, 17, 20, 22-25, 28, 29).

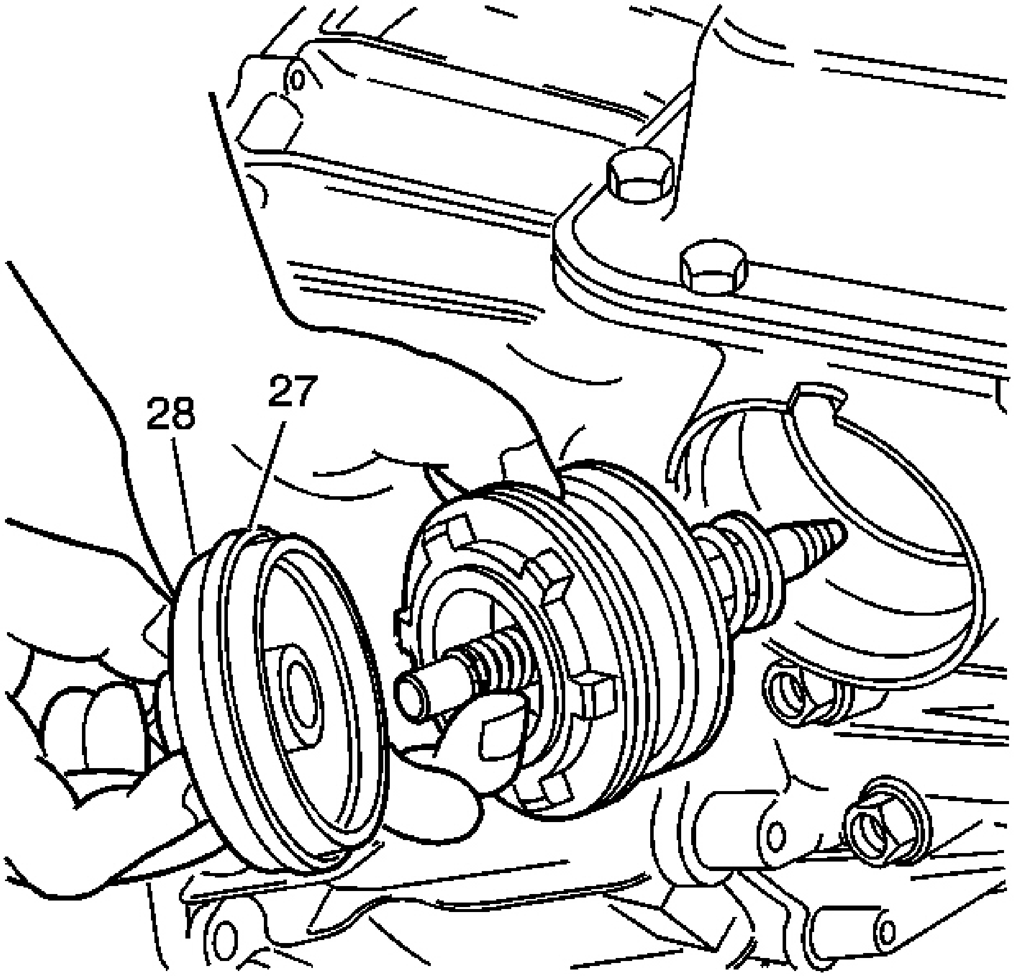


Fig. 457: 2-4 Servo Assembly
Courtesy of GENERAL MOTORS CORP.

7. Install the 2-4 servo assembly into the 2-4 servo bore.

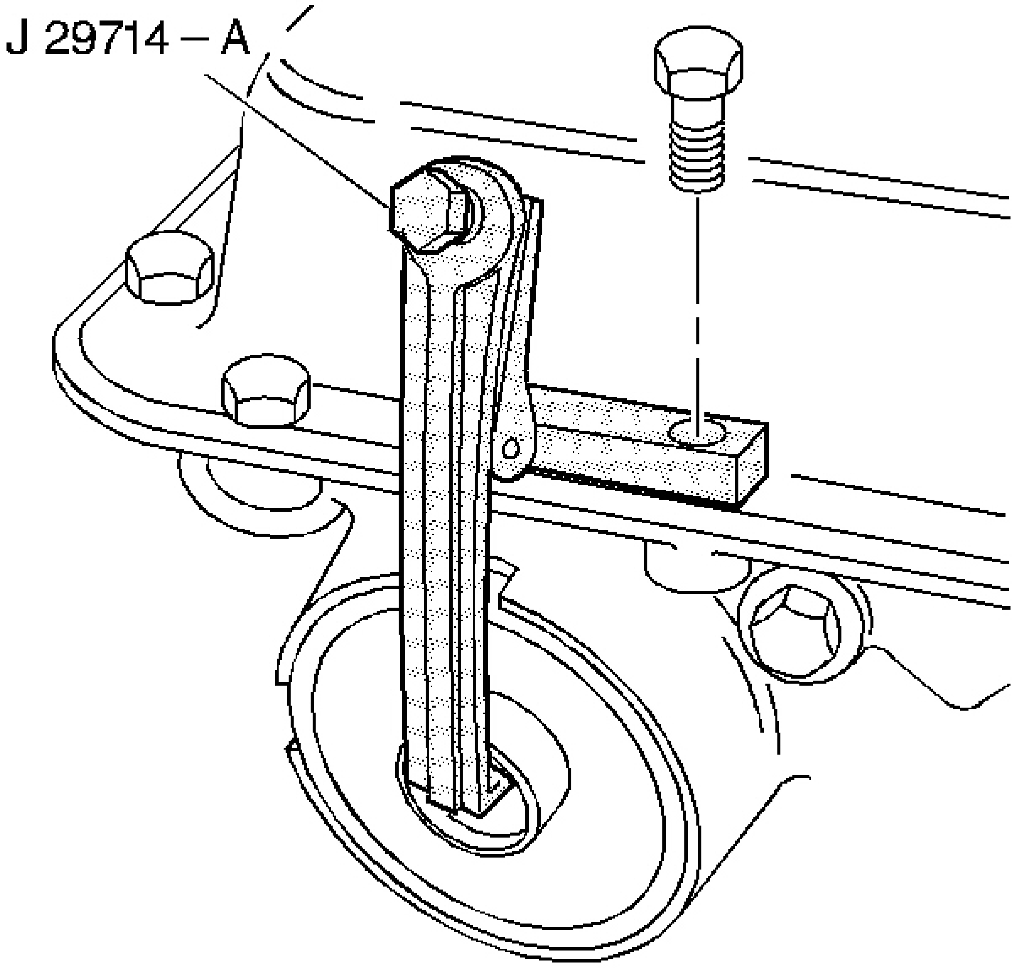


Fig. 458: Installing J 29714-A
Courtesy of GENERAL MOTORS CORP.

8. Install the **J 29714-A** . See **Special Tools and Equipment** .

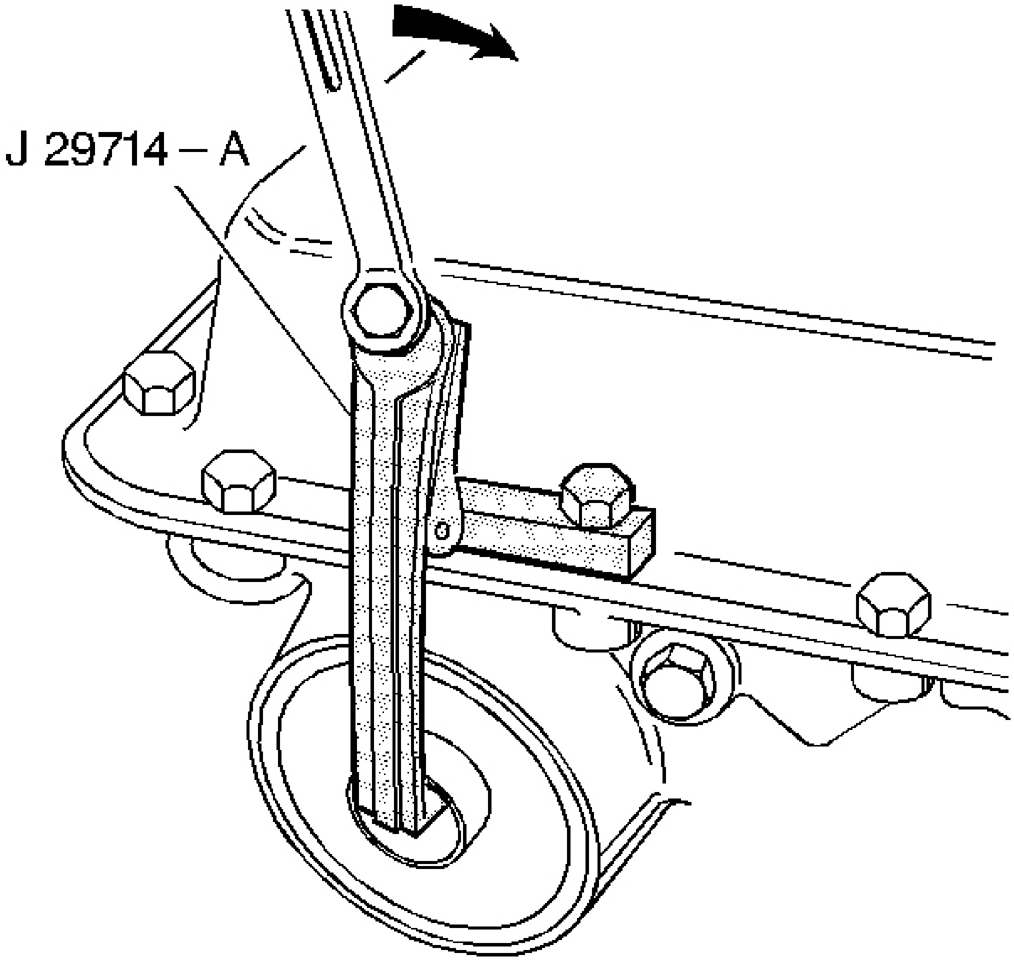


Fig. 459: Tightening J 29714-A Bolt To Compress Servo Cover
Courtesy of GENERAL MOTORS CORP.

9. Tighten the bolt on the **J 29714-A** in order to compress the servo cover. See **Special Tools and Equipment** .

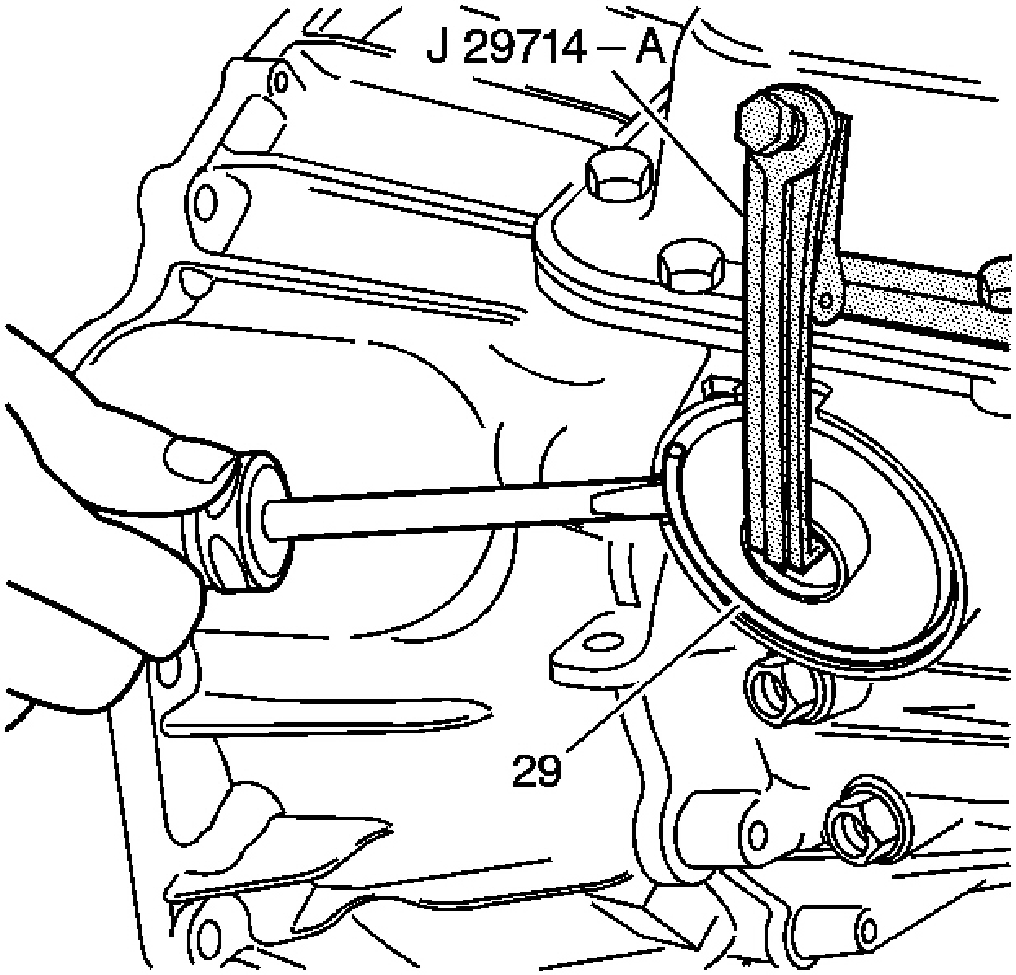


Fig. 460: Servo Cover Retaining Ring & J 29714-A
Courtesy of GENERAL MOTORS CORP.

10. Install the servo cover retaining ring.

TORQUE CONVERTER END PLAY INSPECTION

Tools Required

- J 8001 Dial Indicator Set
- J 26900-13 Magnetic Indicator Base
- **J 35138** Converter End Play Checker. See **Special Tools and Equipment** .

- **J 39195** Converter End Play Check Tool. See **Special Tools and Equipment** .

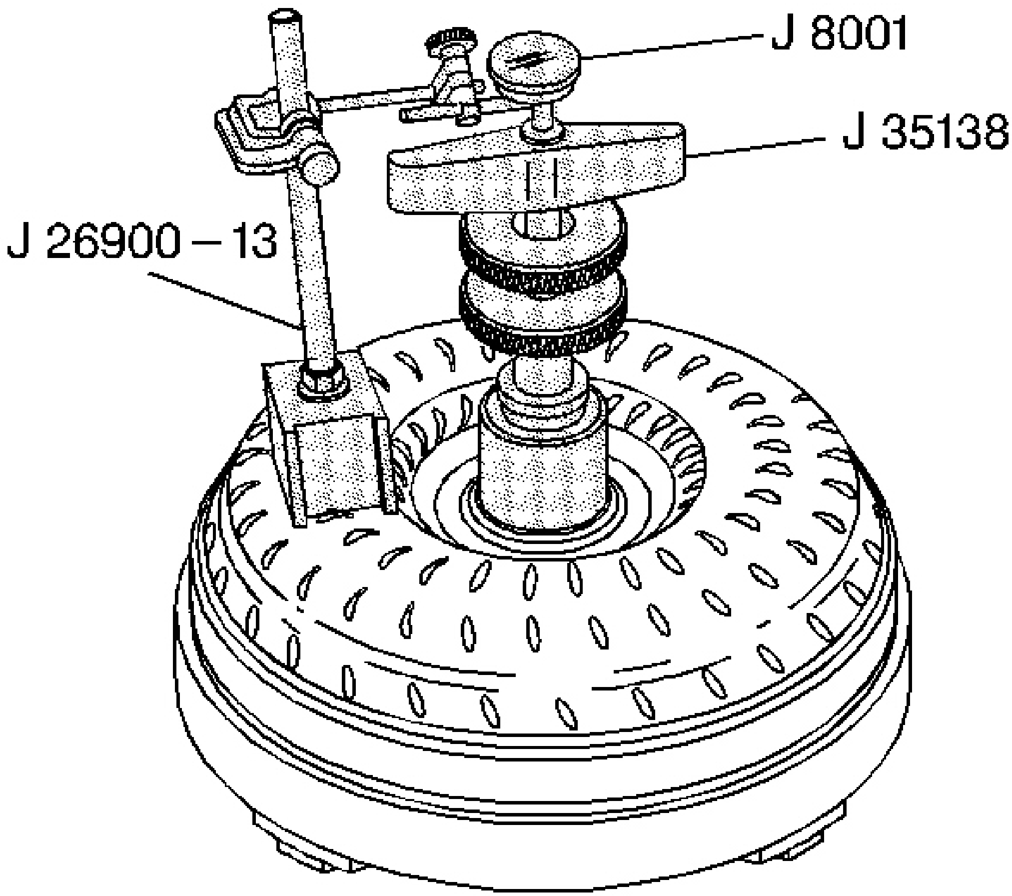


Fig. 461: Inspecting Torque Converter
Courtesy of GENERAL MOTORS CORP.

1. Inspect the torque converter and replace if any of the following conditions exist:
    - Evidence of damage to the pump assembly.
    - Metal particles are found after flushing the cooler and cooler lines.
    - External leaks in the hub area.
    - Converter pilot is broken, damaged or poor fit into the crankshaft.
    - Converter hub is scored or damaged.
    - Internal damage to the stator.
    - Contamination from engine coolant.

- Excessive end play.

IMPORTANT: The torque converter should not be replaced if the fluid has an odor, discoloration or no evidence of metal or clutch plate material. Flushing the torque converter is not recommended.

2. Install the **J 35138** , the. See **Special Tools and Equipment** . J 26900-13 and the J 8001 or **J 39195** to be used with the 300 mm torque converter. See **Special Tools and Equipment** .

   Specification:

   - The end play for a 245 mm torque converter should be 0-0.38 mm (0-0.015 in).
   - The end play for a 298 mm torque converter should be 0.1-0.48 mm (0.004-0.019 in).
   - The end play for a 258 mm and 300 mm torque converter should be 0.1-0.5 mm (0.004-0.020 in).

3. Remove the tools.

TORQUE CONVERTER INSTALLATION

Tools Required

J 21366 Converter Holding Strap

CAUTION: The torque converter weighs approximately 65 lbs. Personal injury may result if you lift the torque converter improperly.

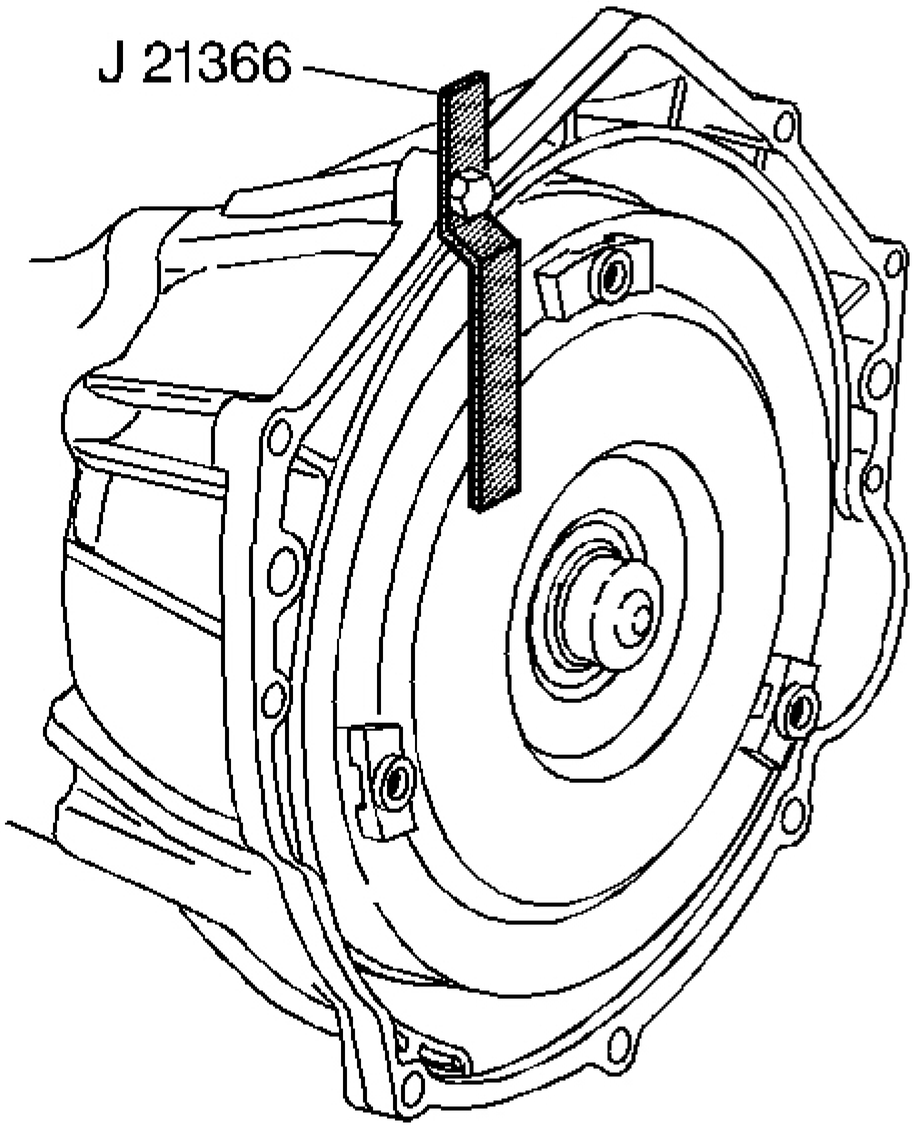


Fig. 462: Installing Torque Converter
Courtesy of GENERAL MOTORS CORP.

1. Install the torque converter.
2. Install the J 21366 .

HOLDING FIXTURE REMOVAL

Tools Required

J 8763-B Holding Fixture and Base. See **Special Tools and Equipment** .

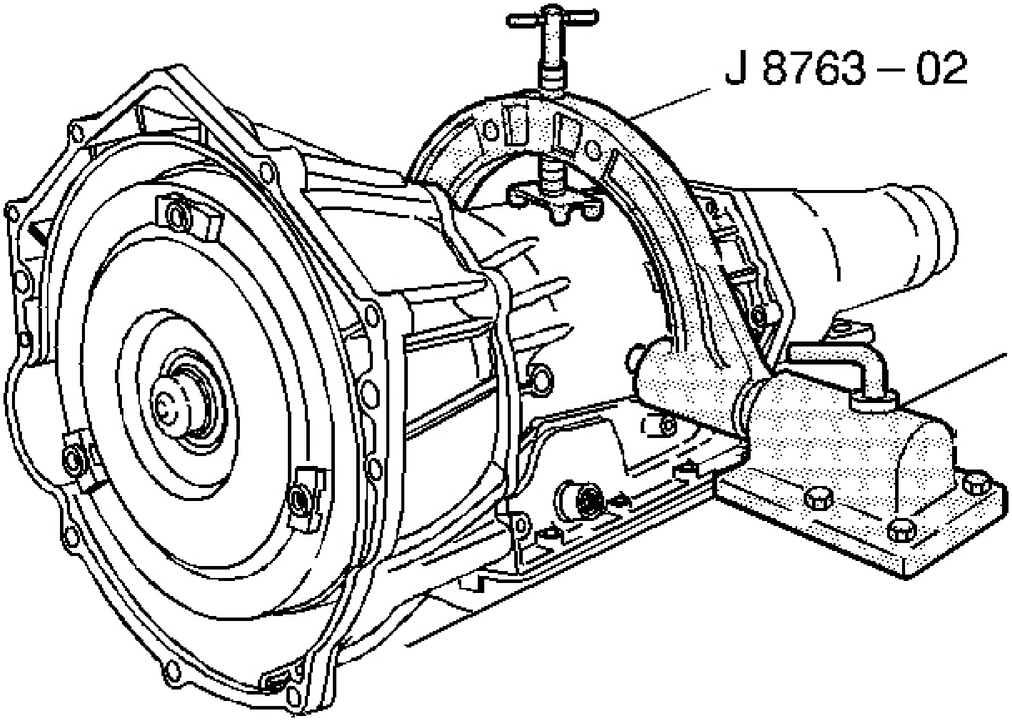


Fig. 463: J 8763-02 & Transmission
Courtesy of GENERAL MOTORS CORP.

Remove the transmission from the **J 8763-B** . See **Special Tools and Equipment** .

DESCRIPTION AND OPERATION

PARK - ENGINE RUNNING

With the gear selector lever in the PARK (P) position and the engine running, the line pressure from the oil pump assembly is directed to various components in the valve body and the oil pump.

Pressure Regulator Valve

The pressure regulator valve regulates the oil pump output (line pressure) in response to the signal fluid pressure, the spring force and the line pressure acting on the end of the valve. The line pressure is routed through the valve and into both the converter feed and the decrease fluid circuits. Regulated line pressure is also directed to the manual valve, the converter clutch valve, the actuator feed limit valve, and the regulated apply valve.

Pressure Relief Valve

Controlled by spring force, this checkball limits the maximum value of the line pressure. When the line pressure reaches this limiting value, fluid is exhausted past the ball and returns to the sump.

Line Pressure Tap

The line pressure tap provides a location to measure the line pressure with a fluid pressure gauge.

Actuator Feed Limit Valve

Biased by spring force and orificed AFL fluid, it limits the maximum value of line pressure entering the AFL fluid circuit. Below this limiting value, the AFL fluid pressure equals the line pressure. The AFL fluid is routed to the pressure control solenoid valve, the 3-2 control solenoid valve, the TCC PWM solenoid valve, the 1-2 and 2-3 shift solenoid valves, and the 2-3 shift valve train.

Pressure Control (PC) Solenoid Valve

Controlled by the powertrain control module (PCM), the PC solenoid valve regulates the filtered AFL fluid into the torque signal fluid pressure. The PCM controls this regulation by varying the current value to the PC solenoid valve in relation to the throttle position and other vehicle operating conditions.

Torque Converter Clutch (TCC)

Torque Converter Clutch PWM Solenoid and Regulator Apply and Isolator Valve

AFL fluid is routed to the TCC PWM solenoid valve, in Park the PCM has the duty cycle turned OFF. This prevents AFL fluid from entering the converter clutch signal fluid circuit. Regulated line pressure is routed to the regulator apply valve, which is open with CC signal circuit empty, and blocks line pressure from entering the regulated apply circuit. Any fluid in the regulated apply circuit will exhaust at the regulated apply valve.

TCC Solenoid Valve

IMPORTANT: TCC converter feed valve assembly (#4), in the converter feed circuit, prevents converter drain down. The orifice is smaller than the exhaust through the TCC solenoid valve. Therefore, fluid pressure does not build up at the end of the converter clutch apply valve.

Under normal operating conditions, the PCM keeps the normally open TCC solenoid valve de-energized (OFF). Converter feed fluid exhausts through the open TCC solenoid valve, and spring force keeps the converter clutch apply valve in the release position.

Converter Clutch Valve

Held in the release position by spring force, it directs converter feed fluid into the release fluid circuit. Also, fluid returning from the converter in the apply fluid circuit is routed through the valve and into the cooler fluid circuit.

Torque Converter

Release fluid pressure unseats the TCC apply checkball (#9), keeps the pressure plate released from the converter cover and fills the converter with fluid. Fluid exits the converter between the converter hub and the stator shaft in the apply fluid circuit.

Cooler and Lubrication System

Cooler fluid from the converter clutch apply valve is routed through the transmission fluid cooler and into the lubrication fluid circuits.

Manual Valve

Controlled by the selector lever and the manual shaft, the manual valve is in the Park (P) position and directs the line pressure into the PR (Park/Reverse) fluid circuit. Line pressure is blocked from entering any other fluid circuit at the manual valve.

Lo and Reverse Clutch Applies

Lo and Reverse Clutch Piston

The PR fluid seats the lo and reverse clutch checkball (#10) and is orificed to the outer area of the piston. Orificing the PR fluid around the #10 checkball helps control the lo and reverse clutch apply. Also, Lo/reverse fluid pressure from the lo overrun valve acts on the inner area of the lo and reverse clutch piston in order to increase the clutch holding capacity.

Lo Overrun Valve

The PR fluid pressure moves the valve against the spring force and fills the Lo/reverse fluid circuit. Lo/reverse fluid is orificed (323) back to the lo overrun valve in order to assist the PR fluid in moving the valve against the spring force. The spring force provides a time delay for the PR fluid filling the Lo/reverse fluid circuit. The Lo/reverse fluid is routed to the inner area of the lo and reverse clutch piston in order to increase the holding capacity of the clutch.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

The TFP manual valve position switch consists of five fluid pressure switches: D2 and D3 are normally closed and D4, Lo and Rev are normally open. All fluid circuits routed to the assembly are empty and the TFP manual valve position switch signals the PCM that the transmission is in either Park or Neutral.

Shift Solenoid Valves (1-2 and 2-3)

Both shift solenoid valves, which are normally open, are energized by the PCM and block fluid from exhausting. This maintains the signal A fluid pressure at the 1-2 shift solenoid valve and signal B fluid pressure at the 2-3 shift solenoid valve.

Shift Valves (1-2, 2-3 and 3-4)

Signal A fluid pressure holds the 1-2 shift valve in the downshift position and the 3-4 valve in the upshift (first and fourth gear) position. The signal B fluid pressure from the 2-3 shift solenoid valve holds the 2-3 shift valve train in the downshift position.

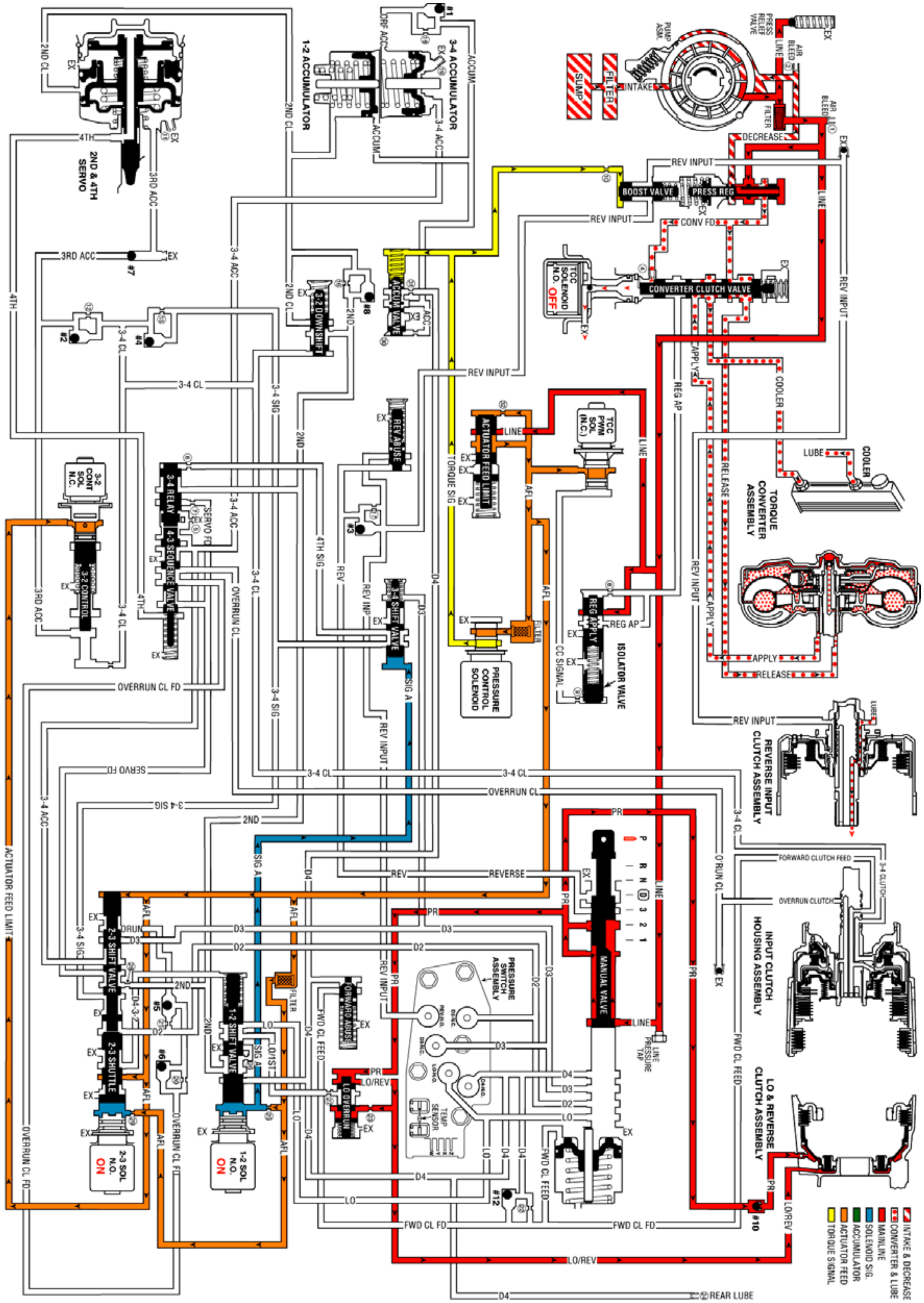


Fig. 464: Park - Engine Running
Courtesy of GENERAL MOTORS CORP.

NEUTRAL - ENGINE RUNNING

When the gear selector lever is moved to the Neutral position (N) from the Reverse position, the following changes occur to the transmission hydraulic and electrical systems.

Manual Valve

In the Neutral position, the manual valve blocks the line pressure from entering any other fluid circuits. Reverse and PR fluids exhaust past the manual valve.

Lo and Reverse Clutch Releases

Lo and Reverse Clutch Piston

PR and Lo/reverse fluids exhaust from the piston, thereby releasing the lo and reverse clutch plates. Exhausting PR fluid unseats the lo and reverse clutch checkball (#10) for a quick exhaust.

Lo Overrun Valve

Spring force closes the valve when the PR fluid pressure exhausts. Lo/reverse fluid exhausts through the valve, into the Lo/1st fluid circuit, past the 1-2 shift valve, into the Lo fluid circuit and through an exhaust port at the manual valve.

Reverse Input Cutch Releases

Reverse Input Clutch Piston

Reverse input fluid pressure exhausts from the piston, through the boost valve, past the #3 checkball and to the manual valve. With the reverse input fluid exhausted, the reverse input clutch plates are released and the transmission is in Neutral.

Reverse Abuse Valve

Reverse fluid pressure exhausts and spring force closes the valve.

Boost Valve

Reverse input fluid pressure exhausts and line pressure returns to the normal operating range as in the Park and Overdrive positions.

Reverse Input Checkball (#3)

Exhausting reverse input fluid unseats the ball for a quick exhaust through the reverse fluid circuit and past the manual valve.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

IMPORTANT: In Park, Reverse and Neutral the shift solenoid valves are shown energized. This is the normal operating state when the vehicle is stationary or at low vehicle speeds. However, the PCM will change the shift solenoid valve states depending on the vehicle speed. For example, if Neutral is selected when the transmission is operating in Second Gear, the shift solenoid valves will remain in a Second Gear state. However, with the manual valve blocking line pressure, the shift solenoid valve states do not affect transmission operation in Park, Reverse and Neutral.

Reverse input fluid exhausts from the TFP manual valve position switch. With no other fluid routed to it, the TFP manual valve position switch signals the PCM that the transmission is operating in either Park or Neutral.

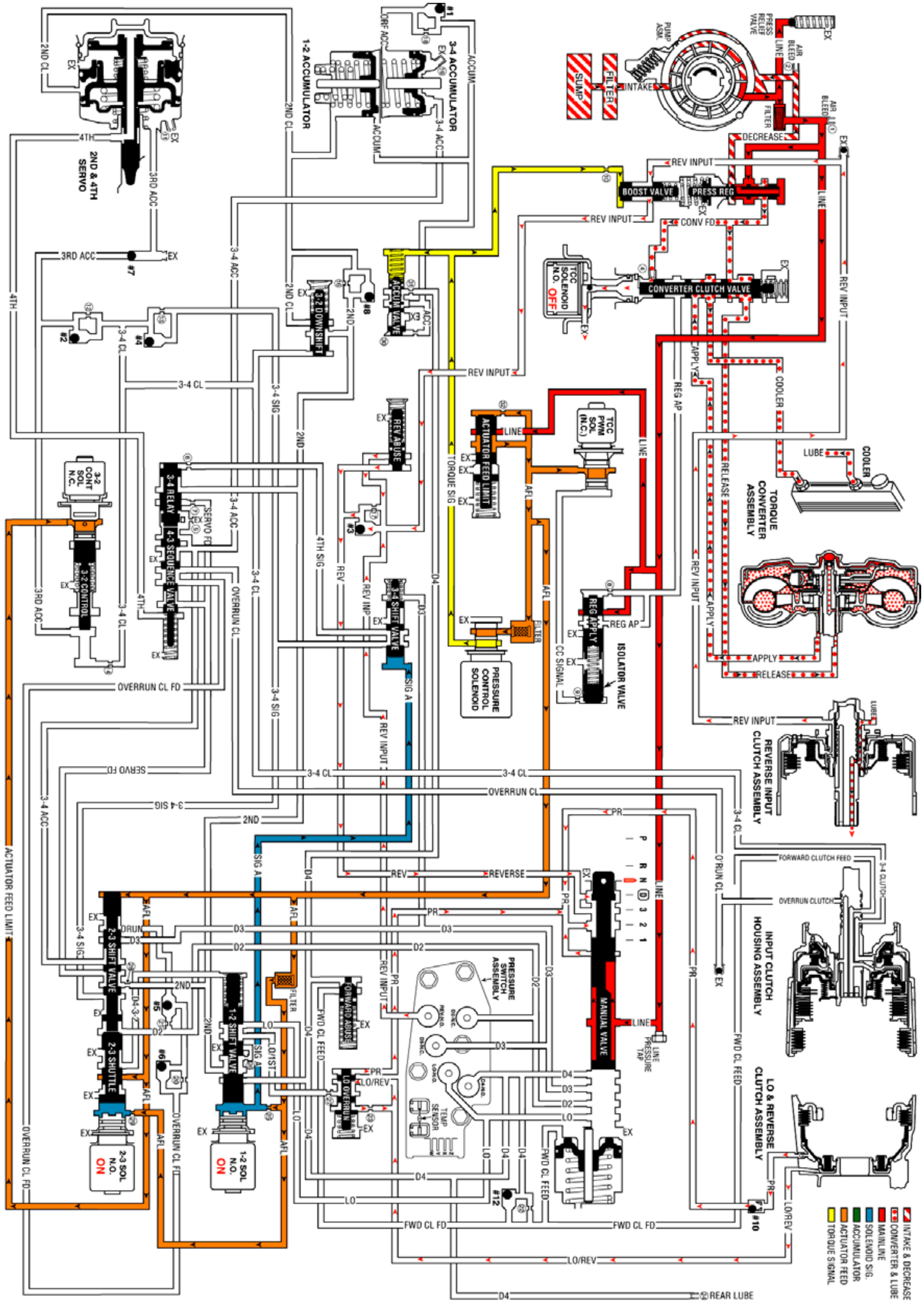


Fig. 465: Neutral - Engine Running
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FIRST GEAR

When the gear selector lever is moved to the Overdrive position, from the neutral position, the following changes occur to the transmission's hydraulic and electrical systems:

Manual Valve

Line pressure flows through the manual valve and fills the D4 fluid circuit. All other fluid circuits remain empty with the manual valve in the Overdrive position.

Forward Clutch Applies

or

Forward Clutch Accumulator Checkball (#12)

D4 fluid pressure seats the checkball and is orificed (#22) into the forward clutch feed fluid circuit. This orifice helps control the forward clutch apply rate.

Forward Clutch Accumulator Piston

Forward clutch feed fluid pressure moves the piston against spring force. This action absorbs some of the initial increase of forward clutch feed fluid pressure to cushion the forward clutch apply.

Forward Clutch Abuse Valve

D4 fluid pressure acts on the valve opposite of spring force. At engine speeds greater than idle, D4 fluid pressure increases and moves the valve against spring force (as shown). D4 fluid can then quickly fill the forward clutch feed fluid circuit, thereby bypassing the control of orifice #22 and providing a faster apply of the forward clutch. Otherwise, with increased throttle opening and engine torque, the clutch may slip during apply.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

D4 fluid pressure is routed to the TFP manual valve position switch and closes the normally open D4 fluid pressure switch. This signals the PCM that the transmission is operating in Overdrive range.

1-2 Shift Solenoid (SS) Valve

Energized (ON) as in Neutral, the normally open solenoid is closed and blocks signal A fluid from exhausting through the solenoid. This maintains pressure in the signal A fluid circuit.

2-3 Shift Solenoid (SS) Valve

Energized (ON) as in Neutral, the normally open solenoid is closed and blocks signal B fluid from exhausting through the solenoid. This maintains signal B fluid pressure at the solenoid end of the 2-3 shift valve.

2-3 Shift Valve Train

Signal B fluid pressure at the solenoid end of the 2-3 shift valve holds the valve train in the downshifted position against AFL fluid pressure acting on the 2-3 shift valve. In this position, the 2-3 shuttle valve blocks AFL fluid from entering the D432 fluid circuit. The D432 fluid circuit is open to an exhaust port past the valve.

1-2 Shift Valve

Signal A fluid pressure holds the valve in the downshifted position against spring force. In the First gear position, the valve blocks D4 fluid from entering the 2nd fluid circuit.

Accumulator Valve

Biased by torque signal fluid pressure, spring force and orificed accumulator fluid pressure at the end of the valve, the accumulator valve regulates D4 fluid into accumulator fluid pressure. Accumulator fluid is routed to both the 1-2 and 3-4 accumulator assemblies in preparation for the 1-2 and 3-4 upshifts respectively.

Rear Lube (All Except Y-Car)

D4 fluid is routed through an orifice cup plug (#24) in the rear of the transmission case to feed the rear lube fluid circuit.

Pressure Control (PC) Solenoid Valve

Remember that the PC solenoid valve continually varies torque signal fluid pressure in relation to throttle position and vehicle operating conditions. This provides a precise control of line pressure.

3-2 Control Solenoid Valve

The PCM keeps the solenoid OFF in First gear and the normally closed solenoid blocks filtered AFL fluid from entering the 3-2 signal fluid circuit.

Torque Converter Clutch PWM Solenoid Valve

In first gear, at approximately 6 mph, the PCM operates the TCC PWM solenoid valve at approximately a 90 percent duty cycle. This opens the AFL fluid circuit, to fill the converter clutch signal fluid circuit through the #9 orifice, and flows to the isolator valve. The CC signal fluid pressure, acting on the isolator valve, will move the regulated apply valve towards the closed position. Regulated line pressure is now routed into the regulated apply circuit, and flows to the closed converter clutch valve, and is blocked from entering the converter clutch apply circuit. Regulated apply fluid is routed through the #8 orifice to the front of the regulated apply valve, and regulates the line pressure entering the regulated apply circuit, in response to the CC signal fluid acting on the isolator valve.

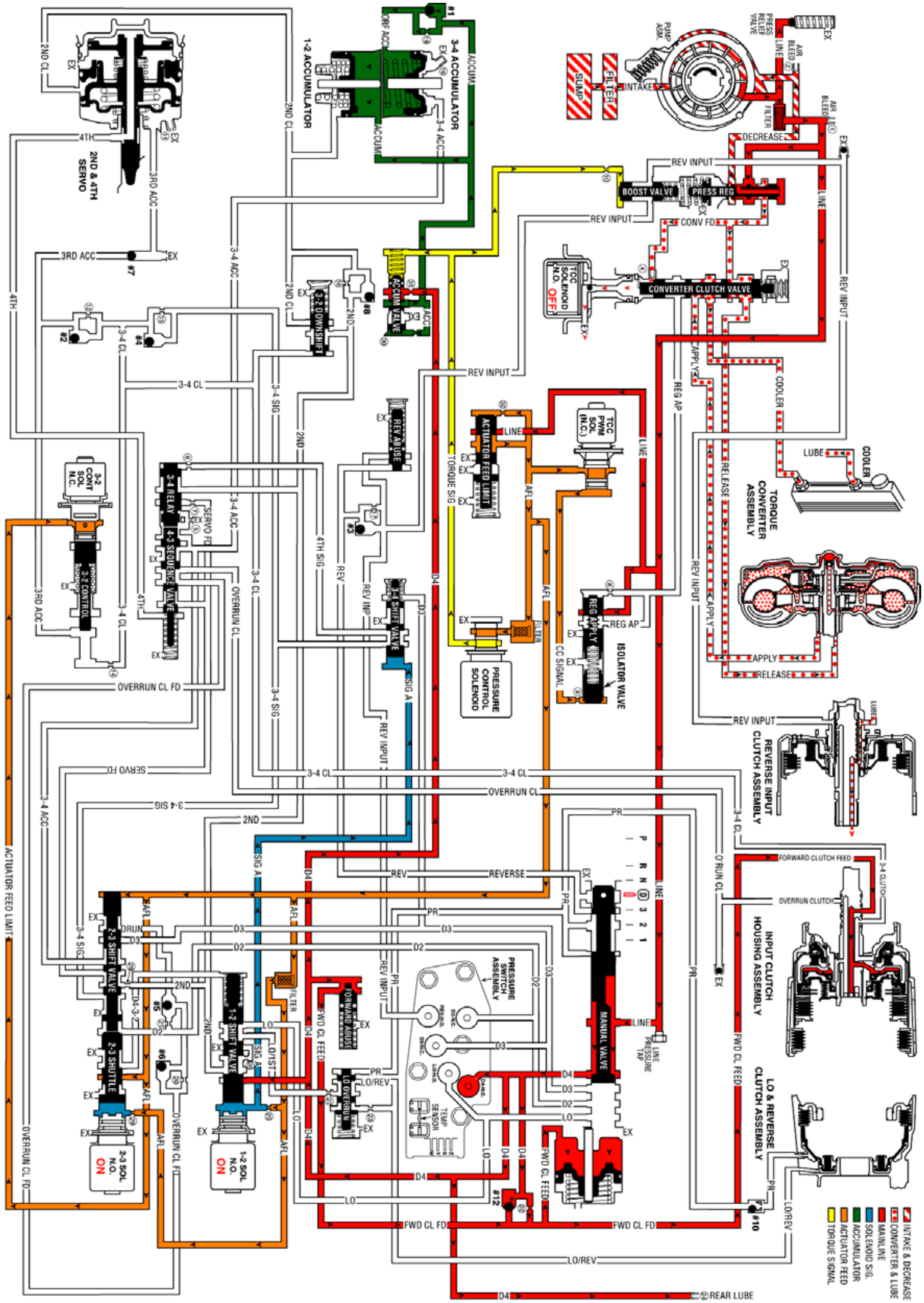


Fig. 466: Overdrive Range, First Gear
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, SECOND GEAR

As vehicle speed increases and other operating conditions are appropriate, the PCM de-energizes the 1-2 shift solenoid valve in order to shift the transmission to second gear.

1-2 Shift Solenoid (SS) Valve

De-energized (turned OFF) by the PCM, the normally open solenoid opens and signal A fluid exhausts through the solenoid.

2-3 Shift Solenoid (SS) Valve

IMPORTANT: The actuator feed limit (AFL) fluid continues to feed the signal A fluid circuit through orifice #25. However, the exhaust port through the solenoid is larger than orifice #25 in order to prevent a pressure buildup in the signal A fluid circuit. Exhausting signal A fluid is represented by the blue arrows.

Energized (ON) as in first gear, the 2-3 shift solenoid valve blocks signal B fluid from exhausting through the solenoid. This maintains signal B fluid pressure at the solenoid end of the 2-3 shift valve.

1-2 Shift Valve

Without signal A fluid pressure, spring force moves the valve into the upshift position. D4 fluid is routed through the valve and fills the 2nd fluid circuit.

1-2 Shift Checkball (#8)

The 2nd fluid pressure seats the #8 checkball, flows through orifice #16, and fills the 2nd clutch fluid circuit. This orifice helps control the 2-4 band apply rate.

2-4 Servo Assembly

The 2nd clutch fluid pressure moves the #8 checkball, flows through orifice #16 and fills the 2nd clutch fluid circuit. This orifice helps to control the 2-4 band apply rate.

1-2 Accumulator

The 2nd clutch fluid pressure also moves the 1-2 accumulator piston against the spring force and the accumulator fluid pressure. This action absorbs the initial 2nd clutch fluid pressure in order to cushion the 2-4 band apply rate. Also, the movement of the 1-2 accumulator piston forces some accumulator fluid out of the accumulator assembly. This accumulator fluid is routed back to the accumulator valve.

Accumulator Valve

The accumulator fluid forced out of the 1-2 accumulator is orificed (#30) to the end of the accumulator valve. This pressure moves the valve against the spring force and the torque signal fluid pressure in order to regulate the exhaust of excess accumulator fluid. This regulation provides additional control for the 2-4 band apply rate.

The fluid circuit shows the exhaust of the accumulator fluid during the shift by the arrow directions in the accumulator fluid circuit.

2-3 Shift Valve Train

The signal B fluid pressure from the 2-3 shift solenoid valve holds the valve train in the downshift position. The 2nd fluid is routed through the 2-3 shuttle valve and fills the servo feed fluid circuit.

3-4 Relay Valve and 4-3 Sequence Valve

Spring force holds these valves in the downshift position (first, second and third gear positions). The 2nd fluid is blocked by the 3-4 relay valve and the servo feed fluid is blocked by both valves in preparation for a 3-4 upshift.

3-2 Downshift Valve

Spring force holds the valve closed, blocking the 2nd fluid and the 2nd clutch fluid. This valve is used in order to help control the 3-2 downshift.

3-2 Control Solenoid Valve

In second gear, the PCM energizes the normally closed solenoid. This opens the AFL fluid circuit to fill the 3-2 signal fluid circuit.

3-2 Control Valve

The 3-2 signal fluid pressure moves the valve against the spring force. This action does not affect the transmission operation in second gear.

3-4 Shift Valve

Signal A fluid pressure exhausts and spring force moves the valve into the downshift position (second and third gear positions).

Torque Converter Clutch

TCC Solenoid Valve

Under normal operating conditions, in Overdrive Range-Second Gear, the PCM keeps the normally open TCC solenoid valve de-energized. Converter feed fluid exhausts through the open solenoid, and spring force keeps the converter clutch apply valve in the release position.

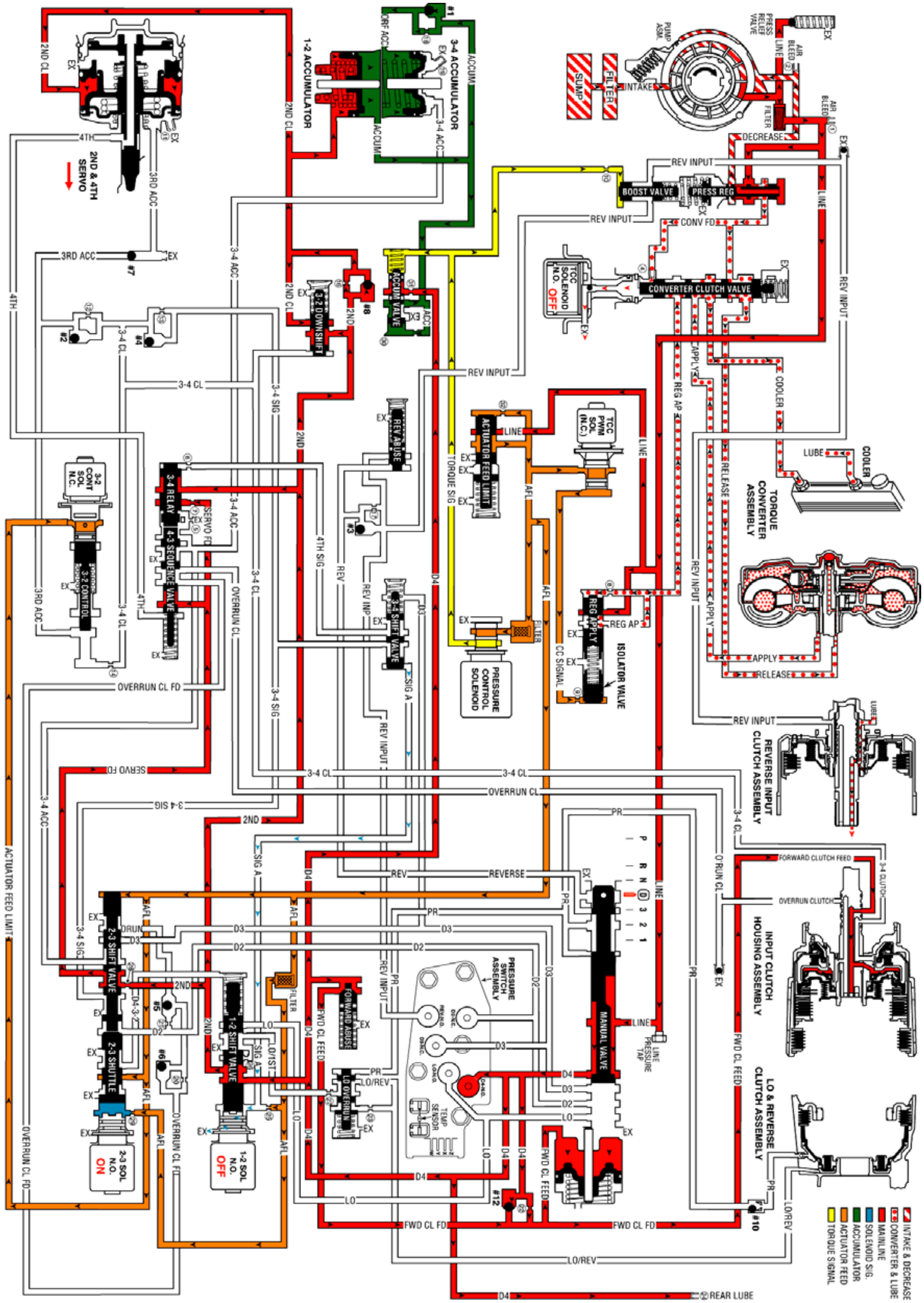


Fig. 467: Overdrive Range, Second Gear
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, THIRD GEAR

As vehicle speed increases further and other vehicle operating conditions are appropriate, the PCM de-energizes the normally open 2-3 shift solenoid valve in order to shift the transmission into Third gear.

2-3 Shift Solenoid (SS) Valve

De-energized (turned OFF) by the PCM, the solenoid opens and actuator feed limit signal B fluid exhausts through the solenoid.

Note: AFL fluid continues to feed signal B fluid to the solenoid through orifice #29. However, the exhaust port through the solenoid is larger than orifice #29 to prevent a buildup of pressure in the signal B fluid circuit at the solenoid end of the 2-3 shift valve. Exhausting signal B fluid is represented by the arrows through the solenoid.

2-3 Shift Valve Train

AFL fluid pressure at the 2-3 shift valve moves the valve train toward the solenoid. In the upshifted position, the following changes occur:

- AFL fluid is routed through the 2-3 shift valve and fills the D432 fluid circuit.
- 2nd fluid is blocked from entering the servo feed fluid circuit and is orificed (#28) into the 3-4 signal fluid circuit. This orifice helps control the 3-4 clutch apply rate.
- Servo feed fluid exhausts past the valve into the 3-4 accumulator fluid circuit and through an exhaust port at the 3-4 relay valve.

3-4 Clutch Exhaust Checkball (#4)

3-4 signal fluid unseats the ball and enters the 3-4 clutch fluid circuit.

3-4 Clutch Piston

3-4 clutch fluid pressure moves the piston to apply the 3-4 clutch plates and obtain 3rd gear. However, the 2-4 band must release as the 3-4 clutch applies.

3rd Accumulator Checkball (#2)

3-4 clutch fluid pressure unseats the ball and fills the 3rd accumulator fluid circuit.

3rd Accumulator Exhaust Checkball (#7)

3rd accumulator fluid seats the ball against the orificed exhaust and is routed to the released side of the 2nd apply piston. Before the #7 checkball seats, air in the 3rd accumulator fluid circuit is exhausted through the orifice.

2-4 Servo Assembly

3rd accumulator fluid pressure acts on the release side of the 2nd apply piston and assists servo return spring force. The surface area on the release side of the piston is greater than the surface area on the apply side. Therefore, 3rd accumulator fluid pressure and servo return spring force move the 2nd apply piston against 2nd clutch fluid pressure. This action serves two functions:

- Move the apply pin to release the 2-4 band.
- Act as an accumulator by absorbing initial 3-4 clutch fluid to cushion the 3-4 clutch apply rate. Remember that the 3rd accumulator fluid circuit is fed by 3-4 clutch fluid.

3-2 Downshift Valve

3-4 clutch fluid pressure moves the valve against spring force. This opens the valve and allows 2nd fluid to feed the 2nd clutch fluid circuit through the valve.

3-2 Control Solenoid Valve and 3-2 Control Valve

The solenoid remains open and routes AFL fluid into the 3-2 signal fluid circuit. 3-2 signal fluid pressure holds the 3-2 control valve against spring force, thereby blocking the 3rd accumulator and 3-4 clutch fluid circuits.

1-2 Shift Solenoid (SS) Valve and 1-2 Shift Valve

The 1-2 SS valve remains de-energized and signal A fluid is exhausted through the solenoid. Also, D432 fluid pressure from the 2-3 shift valve assists spring force to hold the 1-2 shift valve in the upshifted position.

3-4 Shift Valve

Spring force holds the valve in the downshifted position, blocking 3-4 clutch fluid in preparation for a 3-4 upshift.

Torque Converter Clutch

TCC Solenoid Valve

Under normal operating conditions, in Overdrive Range-Third Gear, the PCM keeps the normally open TCC solenoid valve de-energized. Converter feed fluid exhausts through the open solenoid, and spring force keeps the converter clutch apply valve in the release position. However, at speeds above approximately 121 km/h (75 mph), with the transmission still in third gear, the PCM will command TCC apply in third gear. Refer to **Overdrive Range, Fourth Gear - Torque Converter Clutch (TCC) Applied** for more information on TCC apply.

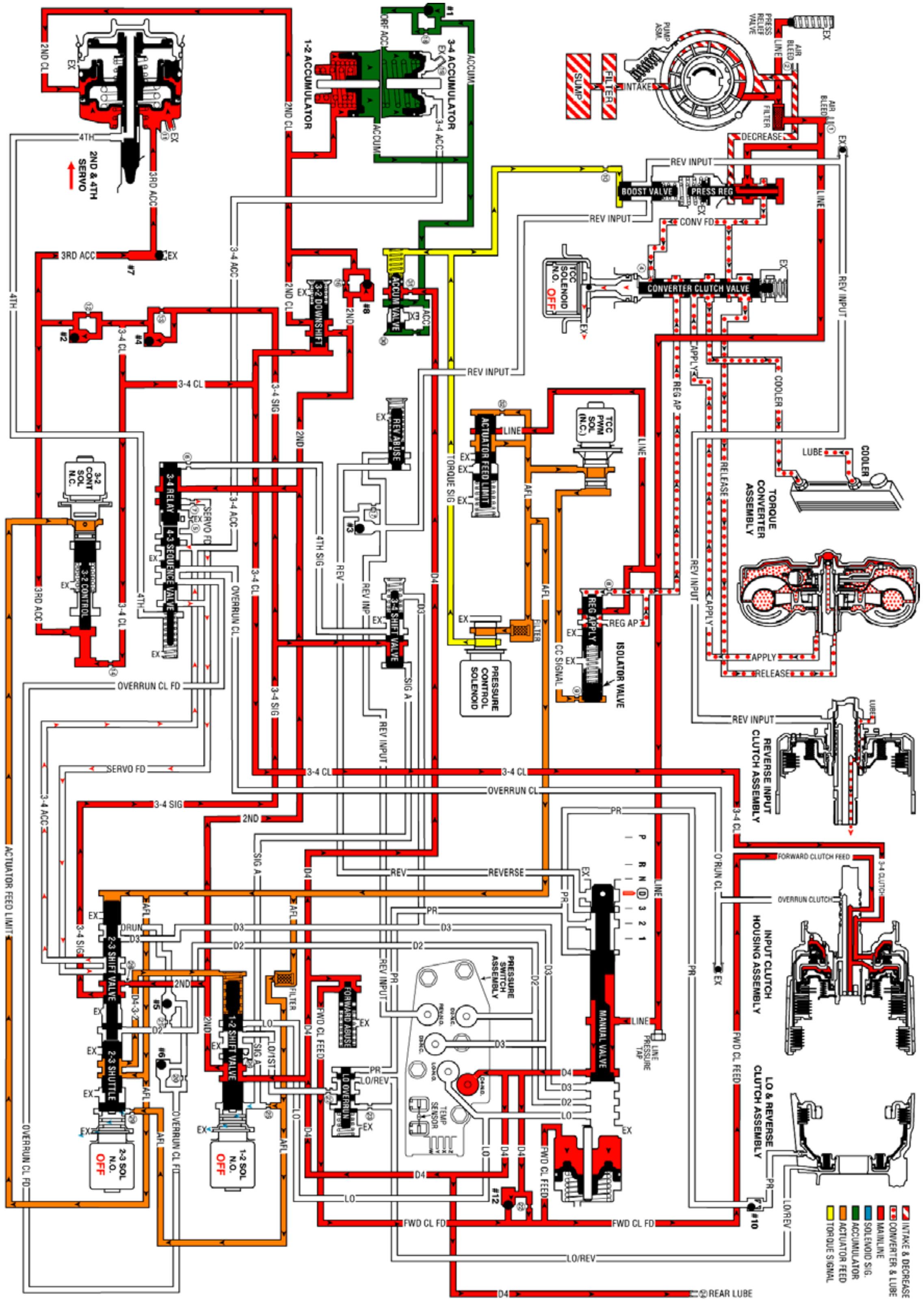


Fig. 468: Overdrive Range, Third Gear
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, FOURTH GEAR - TORQUE CONVERTER CLUTCH (TCC) APPLIED

At higher vehicle speeds, the Hydra-Matic 4L60-E transmission uses an overdrive gear ratio (fourth gear) in order to increase fuel economy and in order to maximize engine performance. When vehicle operating conditions are appropriate, the PCM energizes the 1-2 shift solenoid valve to shift the transmission into fourth gear.

1-2 Shift Solenoid (SS) Valve

Energized (turned ON) by the PCM, the normally open solenoid closes and blocks signal A fluid from exhausting through the solenoid. This creates pressure in the signal A fluid circuit.

2-3 Shift Solenoid (SS) Valve

De-energized (OFF) as in third gear, the 2-3 shift solenoid valve exhausts signal B fluid through the solenoid.

1-2 Shift Valve

D432 fluid pressure from the 2-3 shift valve and spring force hold the valve in the upshift position against signal A fluid pressure.

3-4 Shift Valve

Signal A fluid pressure moves the valve into the upshift position against the spring force. In this position, the valve routes 3-4 signal fluid into the 4th signal fluid circuit.

3-4 Relay Valve and 4-3 Sequence Valve

4th signal fluid pressure moves both valves into the upshift (fourth gear) position against the spring force acting on the 4-3 sequence valve. This causes the following changes:

- Orificed (#7) 2nd fluid is routed through the 3-4 relay valve and into the servo feed fluid circuit.
- Servo feed fluid is routed through the 4-3 sequence valve and into the 4th fluid circuit.
- 3-4 accumulator fluid routed from the 2-3 shuttle valve is blocked by both valves.

2-4 Servo Assembly

4th fluid is routed through the center of the servo apply pin and acts on the apply side of the 4th apply piston. 4th fluid pressure moves the 4th apply piston against the apply pin spring force acting on the release side of the 4th apply piston. This action moves the apply pin and applies the 2-4 band in order to obtain fourth gear.

2-4 Band Apply Accumulation

2-3 Shift Valve Train

The valve train remains in the upshift position with the AFL fluid pressure acting on the 2-3 shift valve. In addition to its operation third gear, the 2-3 shift valve directs servo feed fluid into the 3-4 accumulator fluid circuit.

3-4 Accumulator Assembly

3-4 accumulator fluid pressure moves the 3-4 accumulator piston against spring force and orificed accumulator fluid pressure. This action absorbs initial 4th clutch apply fluid pressure in order to cushion the 2-4 band apply. Remember that both of the 3-4 accumulator and 4th fluid circuits are fed by servo feed fluid. As 3-4 accumulator fluid fills the accumulator, any air in the system will exhaust through office #19. This piston movement forces some orificed accumulator fluid out of the 3-4 accumulator assembly.

3-4 Accumulator Checkball (#1)

The accumulator fluid forced from the accumulator unseats the #1 checkball and enters the accumulator fluid circuit. This fluid is routed to the accumulator valve. This is shown by the arrow directions in the fluid circuit.

Accumulator Valve

Accumulator fluid forced from the 3-4 accumulator is orificed to the end of the accumulator valve. This fluid pressure, in addition to spring force and torque signal fluid pressure, regulates the exhaust of excess accumulator fluid pressure through the middle of the valve. This regulation helps control the 2-4 band apply feel.

3-2 Control Solenoid Valve and 3-2 Control Valve

The solenoid remains open and routes AFL fluid into the 3-2 signal fluid circuit. 3-2 signal fluid pressure holds the 3-2 control valve against spring force, thereby blocking the 3rd accumulator and 3-4 clutch fluid circuits.

Torque Converter Clutch Applies

TCC Solenoid Valve

When operating conditions are appropriate, the PCM energizes the normally open TCC solenoid valve. This closes the solenoid, blocks the converter feed fluid from exhausting, and creates pressure in the converter feed fluid circuit at the converter clutch apply valve and TCC solenoid valve.

Converter Clutch Apply Valve

Converter feed fluid pressure moves the valve against spring force and into the apply position. In this position, release fluid is open to an exhaust port, and regulated apply fluid fills the apply fluid circuit. Converter feed fluid is routed through the converter clutch apply valve to feed the cooler fluid circuit.

Torque Converter

Release fluid from behind the pressure plate exhausts through the end of the turbine shaft. Apply fluid pressure is routed between the converter hub and stator shaft where it enters the torque converter. This fluid applies the converter clutch against the converter cover and keeps the converter filled with fluid.

TCC Apply Checkball (#9)

Release fluid, exhausting from the converter, seats the #9 checkball located in the end of the turbine shaft, and is orificed around the ball. Orificing the exhausting release fluid controls the converter clutch apply rate, along with the TCC PWM solenoid valve.

TCC PWM Solenoid Valve

The torque converter clutch pulse width modulation (TCC PWM) solenoid valve controls the regulated apply valve position. This is done through the use of pulse width modulation (duty cycle operation). The solenoid duty cycle is controlled by the PCM in relation to vehicle operating conditions and regulates actuator feed limit (AFL) fluid into the CC signal circuit, through the #9 orifice, and to the isolator valve. This controls line pressure flow through the regulated apply valve, into the regulated apply circuit, and provides a smooth engagement of the TCC.

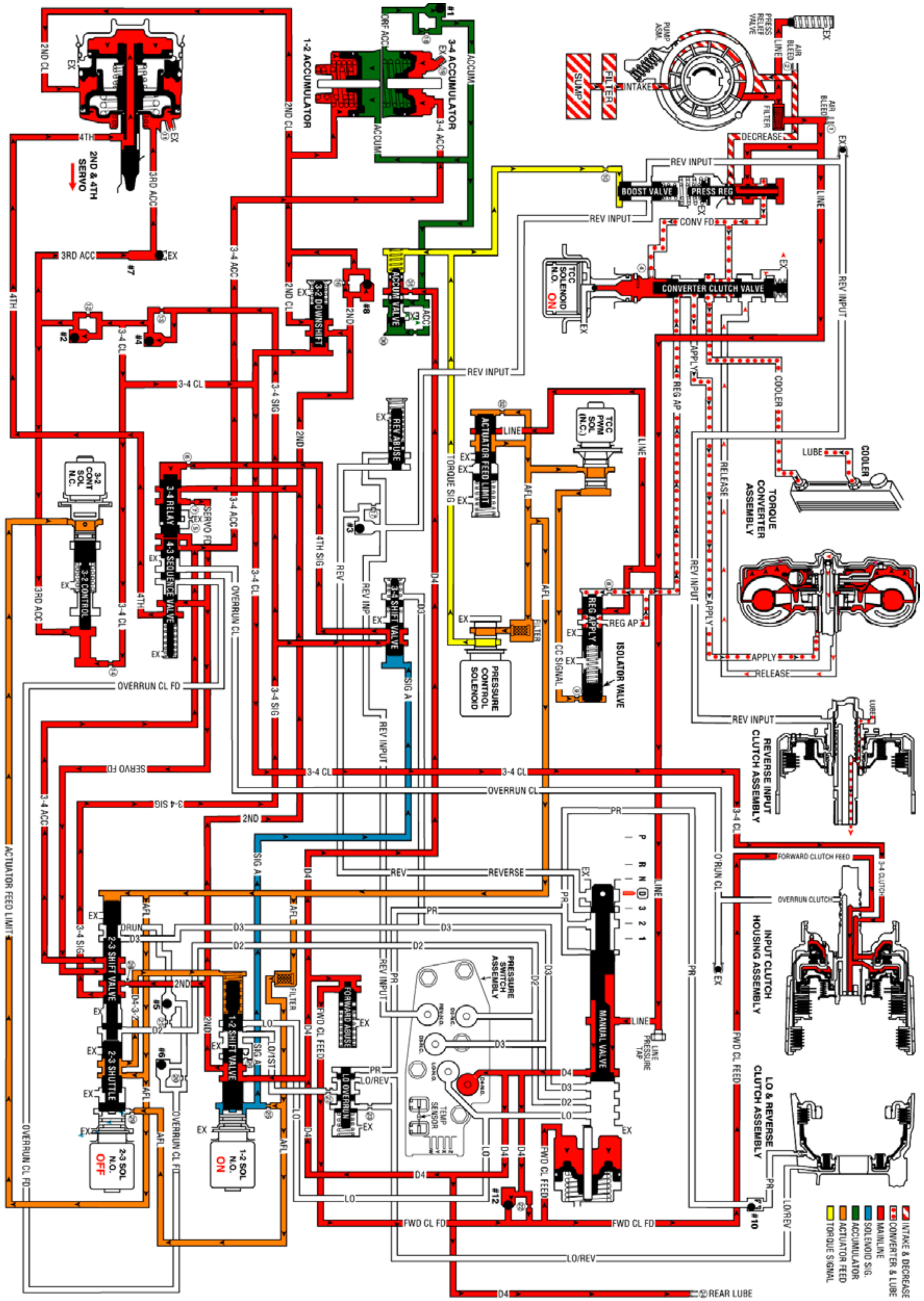


Fig. 469: Overdrive Range, Fourth Gear - TCC Applied

Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, 4-3 DOWNSHIFT

When the transmission is operating in fourth gear, a forced 4-3 downshift occurs if there is a significant increase in throttle position. At minimum throttle, the vehicle speed decreases gradually (coastdown) and the PCM commands a 4-3 downshift. The PCM also initiates a forced 4-3 downshift when the throttle position remains constant but engine load is increased, such as driving up a steep incline. To achieve a 4-3 downshift, the PCM de-energizes the 1-2 shift solenoid valve and the following changes occur to the transmission's electrical and hydraulic systems:

1-2 Shift Solenoid (SS) Valve

De-energized by the PCM, the normally open solenoid opens and signal A fluid exhausts through the solenoid.

1-2 Shift Valve

As in Fourth gear, D432 fluid pressure and spring force hold the valve in the upshift position.

2-4 Band Releases

3-4 Shift Valve

With the signal A fluid pressure exhausted, the spring force moves the valve into the downshift position. In this position, the valve blocks the 3-4 signal fluid and the 4th signal fluid exhausts past the valve.

3-4 Relay Valve and 4-3 Sequence Valve

These valves control the timing of the 2-4 band release. With the 4th signal fluid pressure exhausted, the 3-4 accumulator fluid pressure moves the 3-4 relay valve into the third gear position. This opens the 3-4 accumulator fluid to an orificed exhaust (#5) past the 3-4 relay valve (shown by red arrows). Because the exhaust is orificed, the 3-4 accumulator fluid pressure momentarily holds the 4-3 sequence valve against spring force before completely exhausting.

When the exhausting 3-4 accumulator fluid pressure decreases sufficiently, the spring force moves the 4-3 sequence valve into the third gear position as shown. This opens both the 3-4 accumulator and the 4th fluid circuits to a quick exhaust past the 4-3 sequence valve. In this position the valve blocks the 2nd fluid from entering the servo feed fluid circuit.

2-4 Servo Assembly

The 4th fluid exhausts from the 4th apply piston in the servo assembly. The apply pin spring moves the 4th apply piston and the apply pin in order to release the band from the reverse input drum and shift the transmission into third gear.

3-4 Accumulator Assembly

The 3-4 accumulator fluid exhausts from the 3-4 accumulator piston. The orificed accumulator fluid pressure and the spring force move the piston into a third gear position.

3-4 Accumulator Checkball (#1)

As the accumulator fluid fills the 3-4 accumulator, it seats the #1 checkball and is forced through orifice #18. This orifice controls the rate at which accumulator fluid pressure fills the 3-4 accumulator and the 3-4 accumulator fluid exhausts from the accumulator assembly.

Accumulator Valve

Biased by torque signal fluid pressure and spring force, the accumulator valve regulates the D-4 fluid into the accumulator fluid circuit.

2-3 Shift Solenoid (SS) Valve

This solenoid remains de-energized as in fourth gear and the signal B fluid exhausts through the solenoid.

2-3 Shift Valve Train

The AFL fluid pressure at the 2-3 shift valve holds the valves in the upshift position. This allows the servo feed fluid to exhaust through the valve, into the 3-4 accumulator fluid circuit and past the 4-3 sequence valve.

Torque Converter Clutch Solenoid Valve

TCC PWM Solenoid Valve

The PCM de-energizes the TCC solenoid valve, and operates the duty cycle of the TCC PWM solenoid valve to release the converter clutch for a smooth disengagement, prior to initiating the 4-3 downshift.

Pressure Control (PC) Solenoid Valve

Remember that the PC solenoid valve continually adjusts the torque signal fluid pressure in relation to the various PCM input signals (mainly the throttle position).

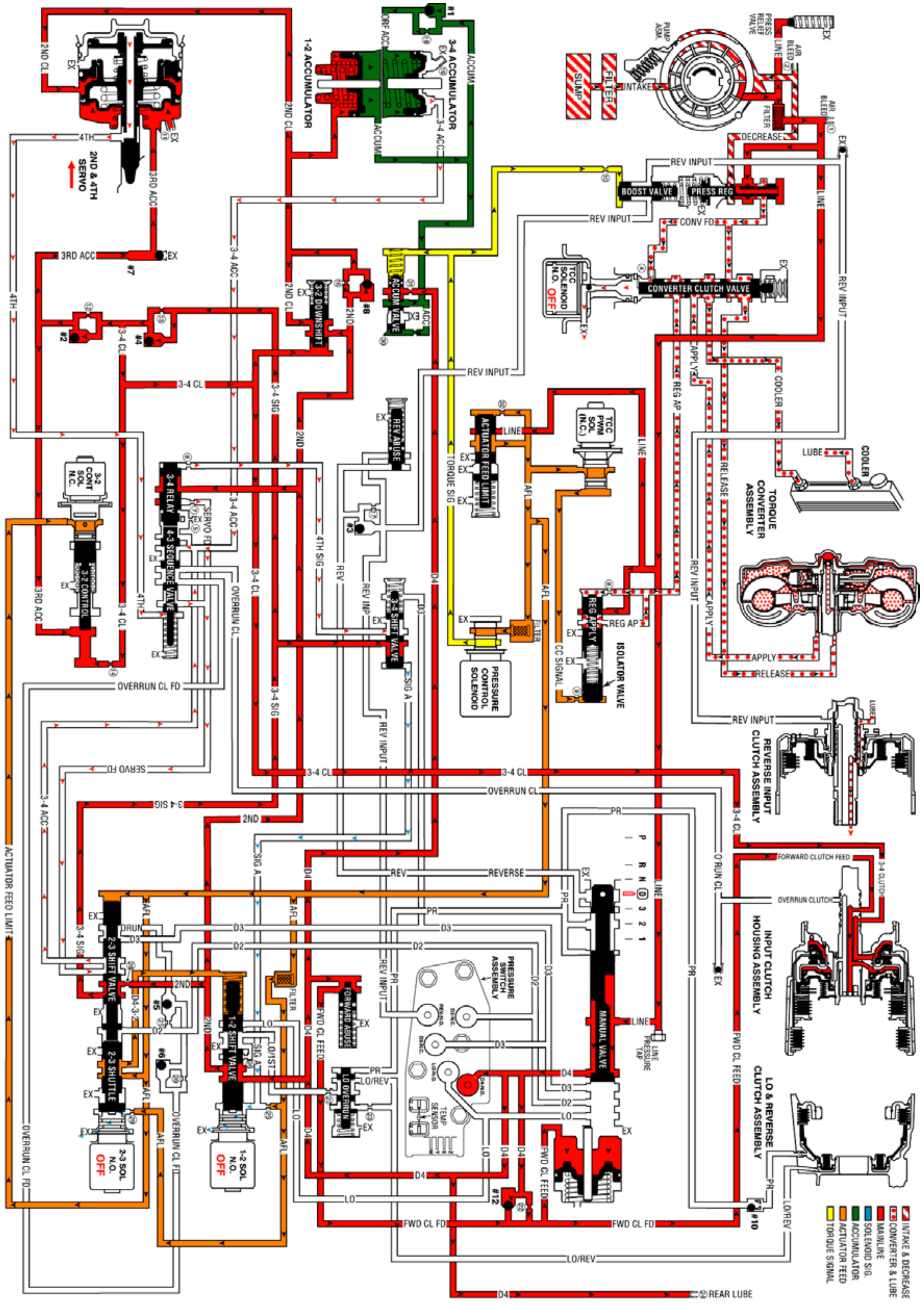


Fig. 470: Overdrive Range, 4-3 Downshift
Courtesy of GENERAL MOTORS CORP.

OVERDRIVE RANGE, 3-2 DOWNSHIFT

Similar to a forced 4-3 downshift, a forced 3-2 downshift can occur because of minimum throttle (coastdown conditions), heavy throttle or increased engine load. In order to achieve a forced 3-2 downshift, the PCM energizes the 2-3 shift solenoid valve and the following changes occur:

Energized by the PCM, the normally open solenoid closes and blocks the signal B fluid from exhausting through the solenoid. This creates pressure in the signal B fluid circuit at the solenoid end of the 2-3 shift valve.

2-3 Shift Valve Train

The signal B fluid pressure from the shift solenoid moves both valves to the downshift position against AFL fluid pressure acting on the 2-3 shift valve. This causes the following changes:

- The AFL fluid is blocked from the D432 fluid circuit and the D432 fluid exhausts past the 2-3 shuttle valve.
- The 2nd fluid is blocked from feeding the 3-4 signal fluid circuit and the 2nd fluid is routed into the servo feed fluid circuit.
- The 3-4 signal fluid is exhausted past the valve. The 3-4 clutch fluid and the 3rd accumulator fluid, which were fed by the 3-4 signal fluid, also exhaust.

3-4 Clutch Releases and 2-4 Band Applies

3-4 Clutch Piston

The 3-4 clutch fluid exhausts from the piston and the 3-4 clutch plates are released.

3-4 Clutch Exhaust Checkball (#4)

Exhausting 3-4 clutch fluid seats the #4 checkball and is forced through orifice #13. This orifice controls the 3-4 clutch fluid exhaust and the 3-4 clutch release rate.

2-4 Servo Assembly

The 3rd accumulator fluid exhausts from the servo assembly. The 2nd clutch fluid pressure moves the 2nd apply piston against the servo return spring force in order to move the apply pin and apply the 2-4 band.

3-2 Downshift Valve and 1-2 Upshift Checkball (#8)

The 3-4 clutch fluid exhausts from the valve and the spring force moves the valve into the second gear position. However, before the spring force overcomes the exhausting 3-4 clutch fluid pressure, the 2nd fluid feeds the 2nd clutch fluid circuit through the valve. This bypasses the control of orifice #16 at the #8 checkball and provides a faster 2-4 band apply. Remember that the #8 checkball and orifice #16 are used to help control the 2-4 band apply during a 1-2 upshift.

Downshift Timing and Control

At higher vehicle speeds, the 2-4 band apply must be delayed to allow the engine speed RPM to increase sufficiently for a smooth transfer of engine load to the 2-4 band. Therefore, exhaust of the 3rd accumulator fluid must be delayed. However, at lower speeds the band must be applied quickly. In order to provide for the varying requirements for the 2-4 band apply rate, the exhausting 3rd accumulator fluid is routed to both the 3rd accumulator checkball (#2) and the 3-2 control valve.

3rd Accumulator Checkball (#2)

The exhausting 3rd accumulator fluid seats the #2 checkball and is forced through orifice #12. This fluid exhausts through the 3-4 clutch and the 3-4 signal fluid circuits and past the 2-3 shift valve. Orifice #12 slows the exhaust of the 3rd accumulator fluid and delays the 2-4 band apply rate.

3-2 Control Solenoid Valve and 3-2 Control Valve

These components are used to increase the exhaust rate of 3rd accumulator fluid, as needed, depending on the vehicle speed.

The 3-2 control solenoid valve is a normally closed On/Off solenoid controlled by the PCM. The PCM controls the solenoid state during a 3-2 downshift according to vehicle speed.

Low Speed

- At lower vehicle speeds, the PCM operates the 3-2 control solenoid valve in the Off position.
- In the Off position the solenoid blocks actuator feed limit fluid pressure from the 3-2 control valve.
- With no actuator feed limit fluid pressure, the 3-2 control valve spring force keeps the valve open to allow a faster exhaust of 3rd accumulator fluid through orifice #14 into the 3-4 clutch fluid circuit.
- A faster exhaust of the 3rd accumulator exhaust fluid provides a faster apply of the 2-4 band, as needed at lower vehicle speeds.

High Speed

- At high vehicle speed, the PCM operates the 3-2 control solenoid valve in the On position allowing actuator feed limit fluid to pass through the solenoid. This pushes the 3-2 control valve into the closed position.
- This action permits a slow apply of the 2-4 band by blocking off 3rd accumulator exhaust fluid from entering the 3-4 clutch fluid circuit through orifice #14.
- This allows the engine speed to easily come up to the necessary RPM before the 2-4 band is applied.

3rd Accumulator Exhaust Checkball (#7)

After the downshift is completed, the #7 checkball unseats and allows the residual fluid in the 3rd accumulator fluid circuit to exhaust.

Pressure Control (PC) Solenoid Valve

Remember that the PC solenoid valve continually adjusts torque signal fluid in relation to the various PCM input signals (mainly the throttle position).

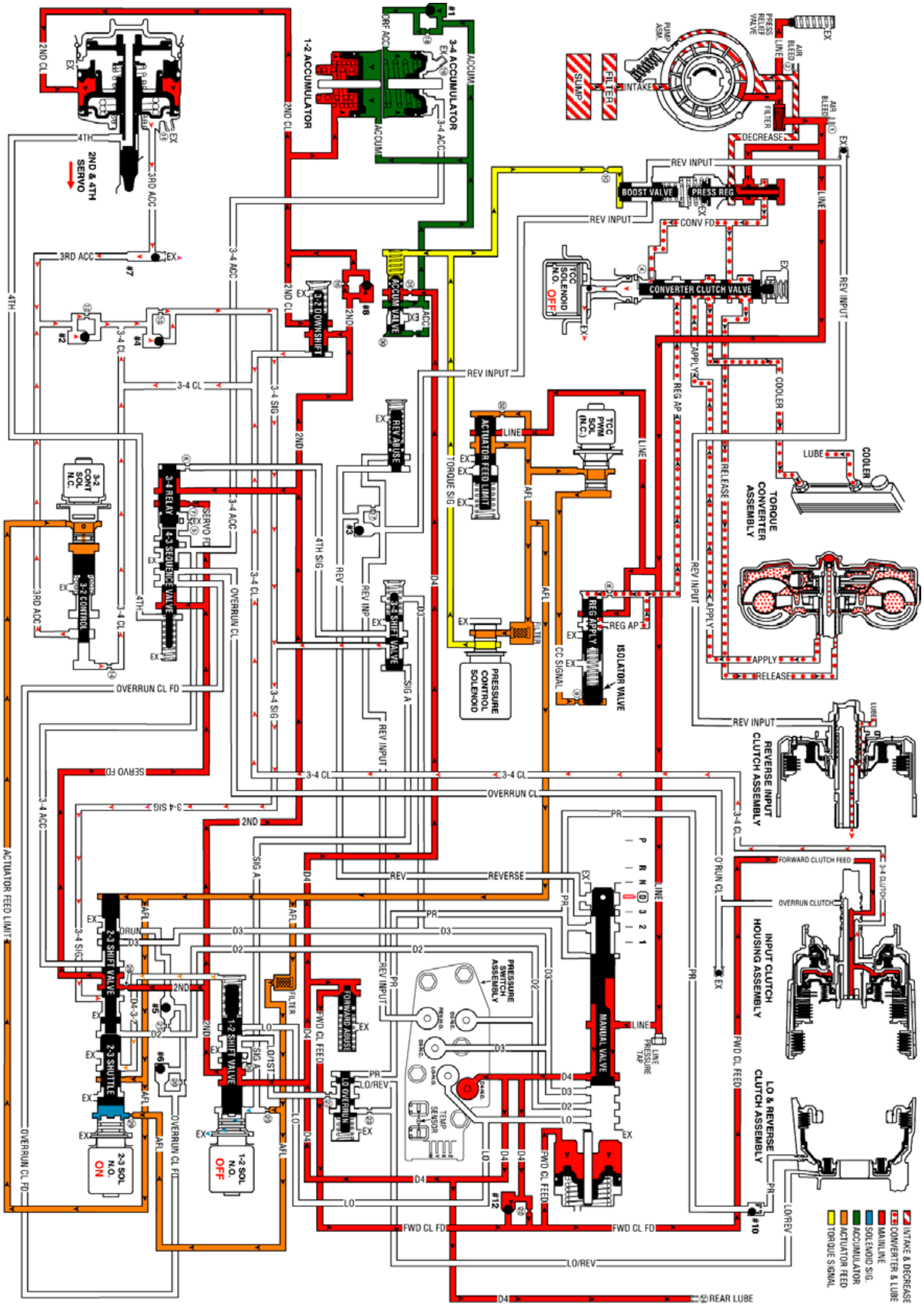


Fig. 471: Overdrive Range, 3-2 Downshift
Courtesy of GENERAL MOTORS CORP.

MANUAL THIRD GEAR

A manual 4-3 downshift is available to increase vehicle performance when the use of only three gear ratios is desired. Manual Third gear range also provides engine braking in Third gear when the throttle is released. A manual 4-3 downshift is accomplished by moving the selector lever into the Manual Third (D) position. This moves the manual valve and immediately downshifts the transmission into Third gear. Refer to **Overdrive Range, 4-3 Downshift** for a complete description of a 4-3 downshift. In Manual Third, the transmission is prevented, both hydraulically and electronically, from shifting into Fourth gear. The following information explains the additional changes during a manual 4-3 downshift as compared to a forced 4-3 downshift.

Manual Valve

The selector lever moves the manual shaft and manual valve into the Manual Third position (D). This allows line pressure to enter the D3 fluid circuit.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

D3 fluid is routed to the TFP manual valve position switch and opens the normally closed D3 fluid pressure switch. The combination of the opened D3 switch and the closed D4 switch signals the PCM that the transmission is operating in Manual Third.

1-2 Shift Solenoid (SS) Valve

When Manual Third is selected, the PCM de-energizes the 1-2 SS valve to immediately downshift the transmission into Third gear. This electronically prevents Fourth gear.

3-4 Shift Valve

D3 fluid pressure assists spring force to keep the valve in the downshifted position against the signal A fluid circuit. In this position, the valve blocks 3-4 signal fluid and the 4th signal fluid circuit is open to an exhaust port past the valve. Therefore, with D3 fluid pressure assisting spring force, Fourth gear is hydraulically prevented.

2-3 Shift Valve Train

With the 2-3 SS valve de-energized and open, actuator feed limit (AFL) fluid acting on the 2-3 shift valve holds both valves in the upshifted position. This allows D3 fluid to feed the overrun fluid circuit through the 2-3 shift valve.

Overrun Clutch Feed Checkball (#5)

Overrun fluid pressure seats the ball against the empty D2 fluid circuit.

Overrun Clutch Control Checkball (#6)

Overrun fluid pressure seats the #6 checkball and is orificed (#20) to fill the overrun clutch feed fluid circuit. This orifice controls the overrun clutch apply rate.

3-4 Relay Valve and 4-3 Sequence Valve

4th signal fluid pressure is exhausted from the end of the 3-4 relay valve. Overrun clutch feed fluid pressure assists spring force and closes both valves. This allows overrun clutch feed fluid to flow through the 4-3 sequence valve and fill the overrun clutch fluid circuit.

Overrun Clutch Piston

Overrun clutch fluid pressure moves the piston to apply the overrun clutch plates. The overrun clutch plates provide engine compression braking in Manual Third - Third Gear.

Overrun Clutch Air Bleed Checkball

This ball and capsule is located in the overrun clutch fluid circuit in the oil pump. It allows air to exhaust from the circuit as fluid pressure increases and also allows air into the circuit to displace the fluid when the clutch releases.

Torque Converter Clutch and Torque Converter Clutch PWM Solenoid Valve

The PCM de-energizes the TCC solenoid valve and operates the duty cycle of the TCC PWM solenoid valve to release the converter clutch prior to downshifting, (assuming the converter clutch is applied in Overdrive Range-Fourth Gear when Manual Third is selected). The PCM will re-apply the converter clutch in Manual Third-Third Gear when proper driving conditions have been met.

Pressure Control (PC) Solenoid Valve

The PC solenoid valve operates in the same manner as Overdrive Range, regulating in response to throttle position and other vehicle operating conditions.

Manual Third - First and Second Gears: Overrun Clutch Released

In Manual Third, the transmission upshifts and downshifts normally between First, Second and Third gears. However, in First and Second gears, the 2-3 SS valve is energized and the 2-3 shift valve train is in the downshifted position. The 2-3 shift valve blocks D3 fluid from entering the overrun fluid circuit and opens the overrun fluid circuit to an exhaust port at the valve. This prevents overrun clutch apply and engine compression braking in Manual Third-First and Second Gears.

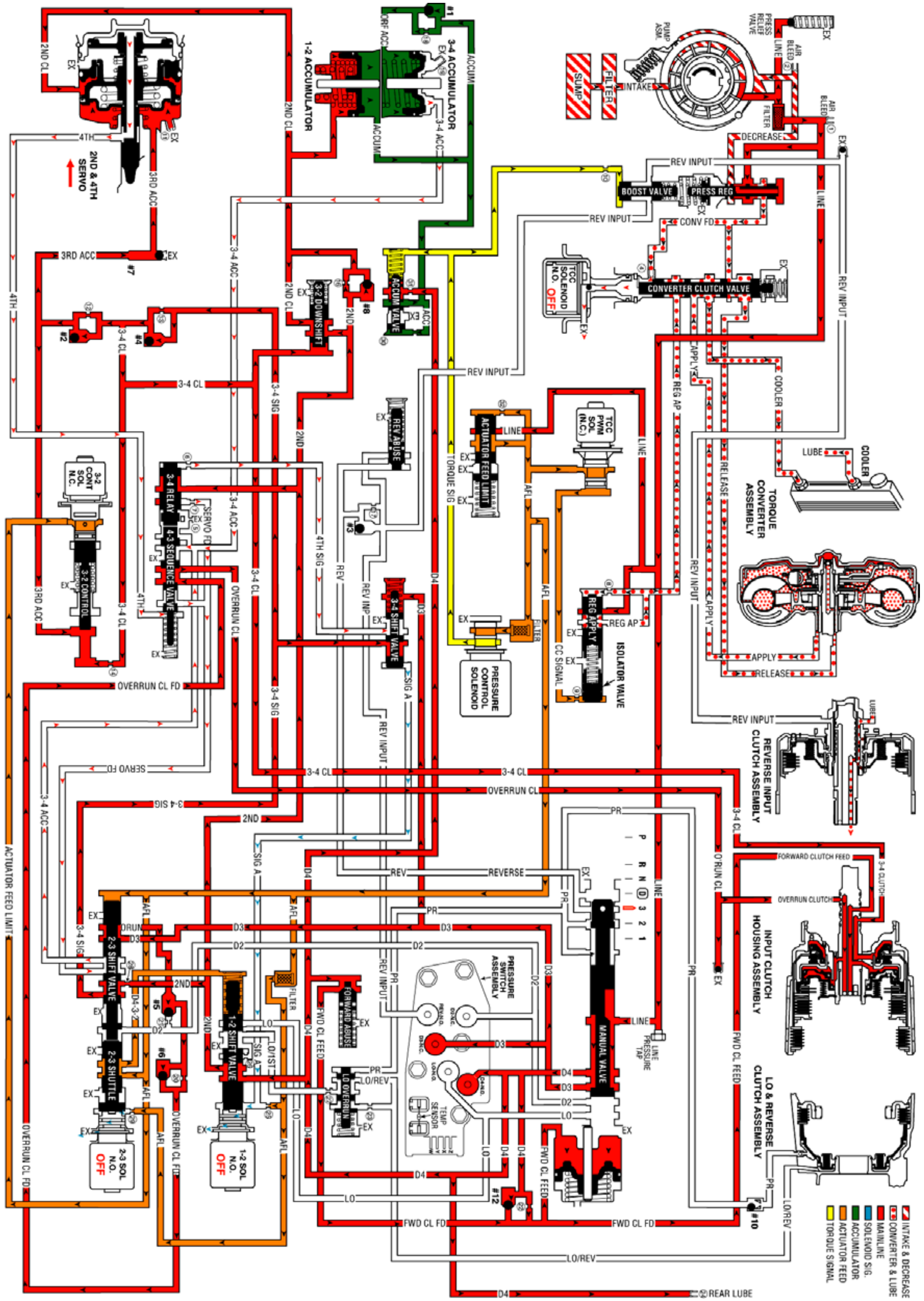


Fig. 472: Manual Third Gear
Courtesy of GENERAL MOTORS CORP.

MANUAL SECOND GEAR

A manual 3-2 downshift can be accomplished by moving the gear selector lever into the Manual Second (2) position when the transmission is operating in third gear. This causes the transmission to shift immediately into second gear regardless of vehicle operating conditions. Also, the transmission is prevented from operating in any other gear, first, third or fourth. The following information explains the additional changes during a manual 3-2 downshift, as compared to a forced 3-2 downshift. Some vehicles in manual second gear will start out in first gear, while other vehicles will have a second gear start. Refer to the owners manual for specific applications.

Manual Valve

The selector lever moves the manual shaft and the manual valve into the manual second (2) position. This allows the line pressure to enter the D2 fluid circuit.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

The D2 fluid is routed to the TFP manual valve position switch where it opens the normally closed D2 fluid pressure switch. With the D2 and the D3 pressure switches closed and the D4 pressure switch open, the TFP manual valve position switch signals the PCM that the transmission is operating in manual second.

Third and Fourth Gears Prevented

2-3 Shift Solenoid (SS) Valve

The PCM energizes the 2-3 SS valve and the AFL fluid pressure holds the 2-3 shift valve in the downshift position. This electronically prevents operation of the third and fourth gears.

2-3 Shift Valve Train

The D2 fluid is routed between the 2-3 shuttle and the 2-3 shift valves and causes the following:

- Regardless of the operating conditions, the D2 fluid pressure holds the 2-3 shift valve in the downshift position against the AFL fluid pressure.
- The 2nd fluid is blocked from entering the 3-4 signal fluid circuit and the 3-4 signal fluid circuit is open to an exhaust port at the valve.
- The 3-4 clutch cannot apply with the 3-4 signal fluid exhausted. Therefore, third and fourth gears are hydraulically prevented.
- The 2nd fluid feeds the servo feed fluid circuit, but the 2nd fluid circuit has no function in manual second.
- The AFL fluid is blocked by the 2-3 shift valve and the D432 fluid circuit is exhausted through the valve.
- The overrun fluid is exhausted through the 2-3 shuttle valve.

1-2 Shift Valve

The 1-2 SS valve is OFF, the signal A fluid exhausts through the solenoid and the spring force holds the valve in the upshifted position.

First Gear Prevented

The prevention of first gear is controlled electronically by the PCM through the 1-2 SS valve. The PCM keeps the 1-2 SS valve de-energized, regardless of the vehicle operating conditions when the TFP manual valve position switch signals manual second gear range. This keeps signal A fluid exhausted and the spring force holds the 1-2 shift valve in the upshift position.

Overrun Clutch Remains Applied

Overrun Clutch Feed Checkball (#5)

Orificed D2 fluid pressure seats the #5 checkball against the empty overrun clutch fluid circuit. This is done simultaneously with the overrun clutch fluid exhausting so that there is a continuous fluid supply to the overrun clutch feed fluid circuit.

Overrun Clutch Piston

A continuous supply of fluid pressure is routed to the piston in order to keep the overrun clutch plates applied.

Torque Converter Clutch

The converter clutch is released prior to downshifting into manual second-second gear. Under normal operating conditions, the TCC will not apply in second gear.

Pressure Control (PC) Solenoid Valve

IMPORTANT: Some vehicles in Manual Second Gear, at a stop, will start out in 1st gear, while others will have a second gear start. Refer to Vehicle Owners Manual.

The PCM output signal to the PC solenoid valve increases the operating range of torque signal fluid pressure in manual second. This provides the increased line pressure for the additional torque requirements during the engine compression braking and increased engine loads.

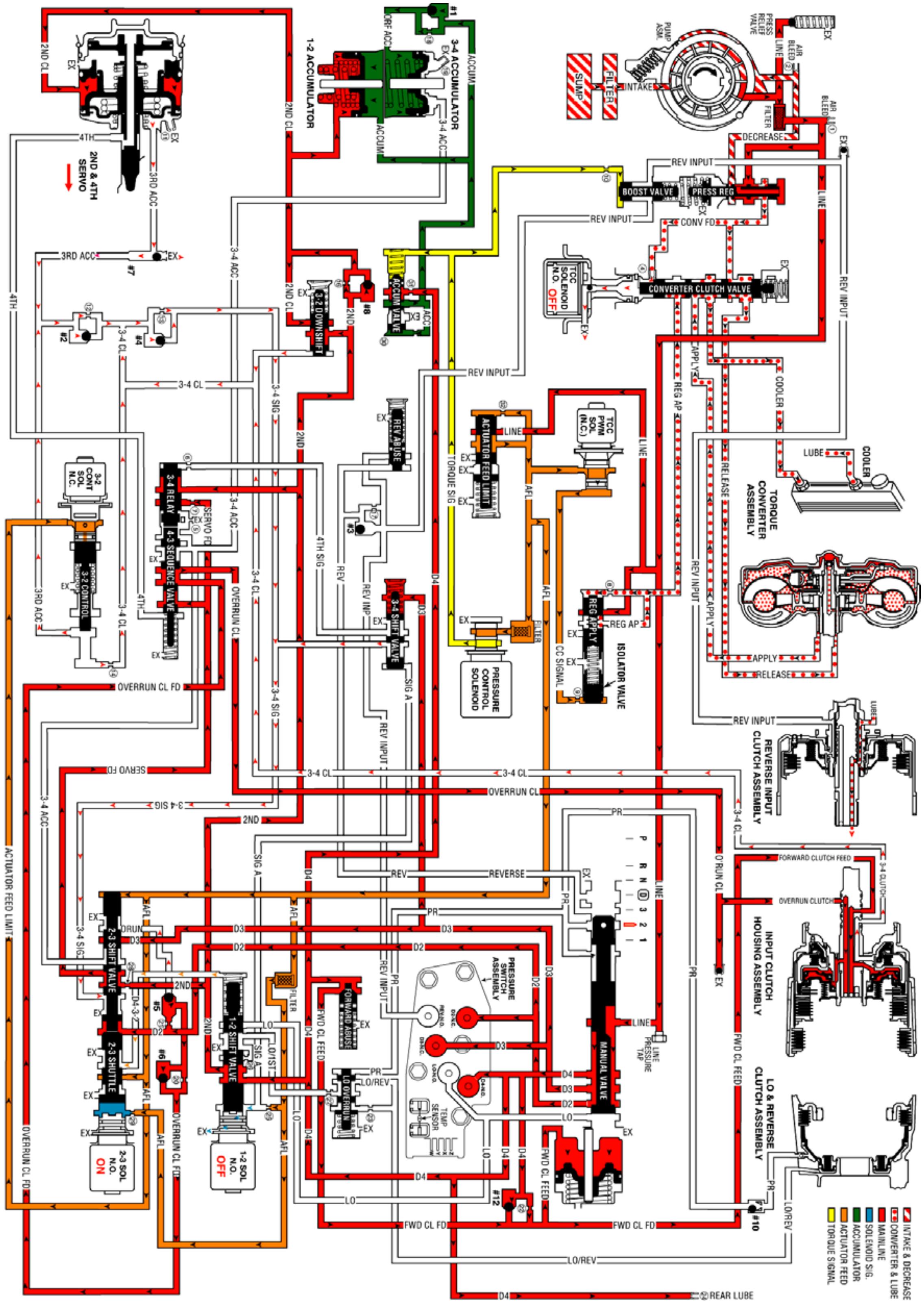


Fig. 473: Manual Second Gear
Courtesy of GENERAL MOTORS CORP.

MANUAL FIRST GEAR

A manual 2-1 downshift can be accomplished by moving the gear selector lever into the manual first (1) position when the transmission is operating in second gear. The downshift to first gear is controlled electronically by the PCM. The PCM will not energize the 1-2 shift solenoid valve to initiate the downshift until the vehicle speed is below approximately 48 to 56 km/h (30 to 35 mph). Above this speed, the transmission operates in a manual first-second gear state. The following text explains the manual 2-1 downshift.

Manual Valve

The selector lever moves the manual shaft and the manual valve into the manual first (1) position. This allows the line pressure to enter the Lo fluid circuit.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

Lo fluid is routed to the TFP manual valve position switch where it closes the normally open lo pressure switch. The addition of the lo pressure switch being closed signals to the PCM that manual first is selected.

2-3 Shift Solenoid (SS) Valve

In both first and second gears, this solenoid is energized and maintains the signal B fluid pressure at the solenoid end of the 2-3 shift valve train.

2-3 Shift Valve Train

Held in the downshift position by the signal B fluid pressure from the solenoid, the valve train blocks the AFL fluid from entering the D432 fluid circuit. The D432 fluid circuit is open to exhaust past the valve.

1-2 Shift Solenoid (SS) Valve

Below approximately 48 to 56 km/h (30 to 35 mph) the PCM energizes the normally open solenoid. This blocks the signal A fluid pressure from exhausting through the solenoid and creates the pressure in the signal A fluid circuit. Above this speed, the PCM keeps the solenoid de-energized and the transmission operates in manual first-second gear.

1-2 Shift Valve

Signal A fluid pressure moves the valve against the spring force and into the downshift position. In this position, Lo fluid from the manual valve is routed into the Lo/1st fluid circuit and D4 fluid is blocked from entering the 2nd fluid circuit. The 2nd fluid exhausts through an orifice and an annulus exhaust port past the valve. This orifice (#26) helps control the 2-4 band release during a 2-1 downshift.

2-4 Band Releases

2-4 Servo Assembly

The 2nd clutch fluid, which was fed by the 2nd fluid, exhausts from the servo. This allows the spring force from the servo cushion and the servo return springs to move the 2nd apply piston and apply the pin to release the 2-4 band. These spring forces help control the 2-4 band release.

1-2 Accumulator Assembly

The 2nd clutch fluid also exhausts from the 1-2 accumulator assembly. The spring force and the accumulator fluid pressure move the accumulator piston to assist the 2nd clutch fluid exhaust.

Accumulator Valve

As the accumulator fluid is filling the 1-2 accumulator assembly, the accumulator valve regulates the D4 fluid into the accumulator fluid circuit. This regulation, biased by torque signal fluid pressure and spring force, helps control the movement of the 1-2 accumulator piston. The 2nd clutch fluid exhaust, and the 2-4 band release.

1-2 Upshift Checkball (#8)

Exhausting the 2nd clutch fluid pressure unseats the ball and is routed through the 2nd fluid circuit.

Lo and Reverse Clutch Applies

Lo Overrun Valve

The Lo/1st fluid is regulated through the lo overrun valve and into the Lo/reverse fluid circuit in order to control the lo and reverse clutch apply.

Lo and Reverse Piston

The Lo/reverse fluid pressure acts on the inner area of the piston in order to move the piston and in order to apply the lo and reverse clutch plates.

Overrun Clutch Applied

The overrun clutch remains applied in manual first in order to provide engine compression braking.

Pressure Control (PC) Solenoid Valve

Similar to manual second, the PCM output signal to the PC solenoid valve increases the operating range of the torque signal fluid pressure. This provides the increased line pressure for the additional torque requirements during the engine compression braking and the increased engine loads.

3-2 Downshift Control Solenoid Valve and the 3-2 Control Valve

In first gear the solenoid is OFF, the AFL fluid is blocked by the solenoid, and the 3-2 signal fluid exhausts through the solenoid and the spring force opens the 3-2 control valve.

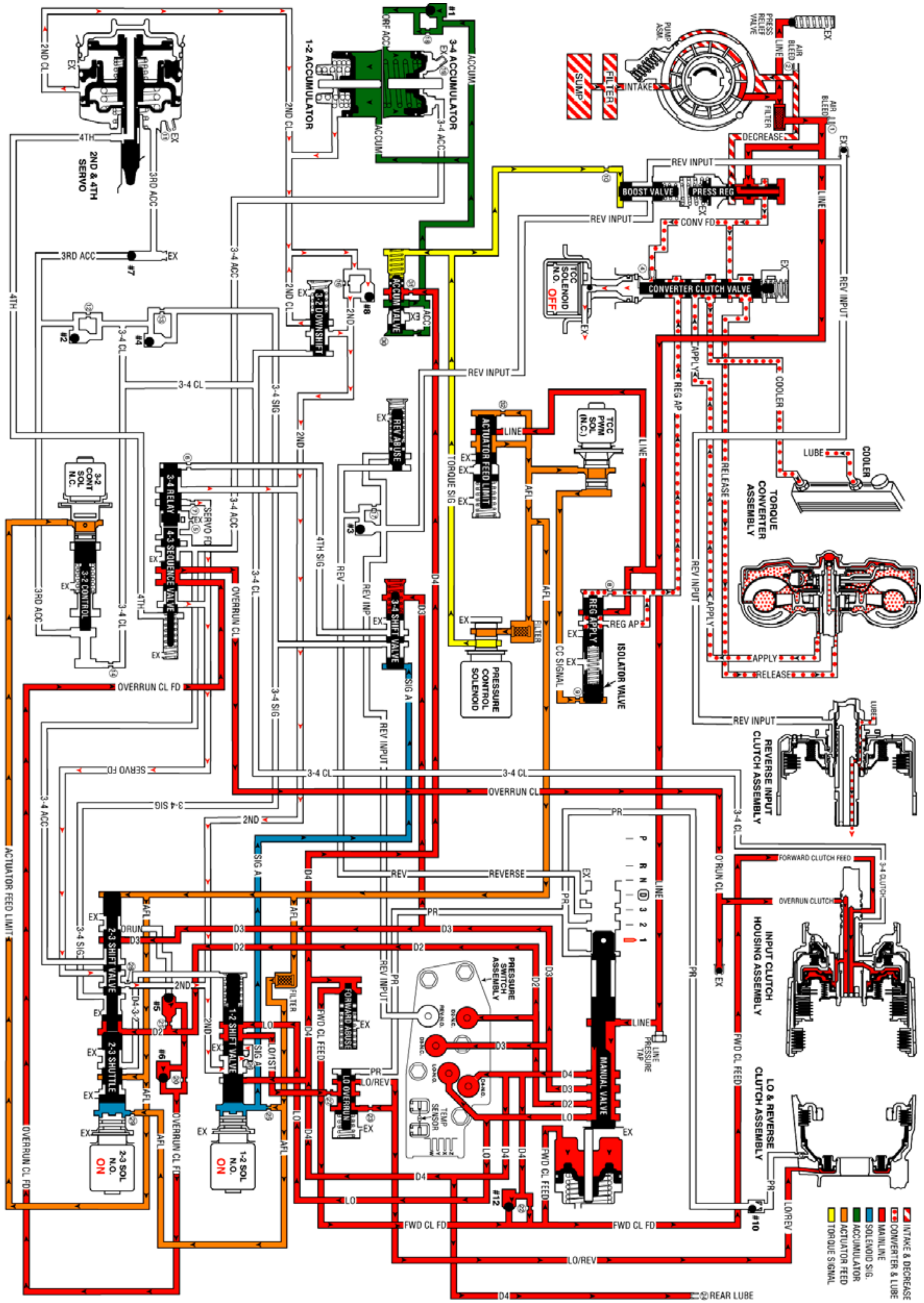


Fig. 474: Manual First Gear
Courtesy of GENERAL MOTORS CORP.

REVERSE

When the gear selector lever is moved to the Reverse (R) position (from the Park position), the following changes occur to the transmissions hydraulic and electrical systems:

Manual Valve

The manual valve moves to the Reverse position and line pressure enters the reverse fluid circuit. As in Park, line pressure also fills the PR (Park/Reverse) fluid circuit. All other fluid circuits are blocked by the manual valve.

Lo and Reverse Clutch

As in Park, PR fluid pressure acts on the outer area of the lo and reverse clutch piston to apply the lo and reverse clutch. Also, Lo/reverse fluid from the lo overrun valve acts on the inner area of the piston to increase the holding capacity of the clutch (see Note below).

Reverse Input Checkball (#3)

Reverse fluid pressure seats the #3 checkball, flows through orifice #17 and fills the reverse input fluid circuit. This orifice helps control the reverse input clutch apply rate when engine speed is at idle.

Reverse Abuse Valve

Reverse fluid pressure acts on the end of the valve opposite of spring force. At engine speeds above idle, reverse fluid pressure, which is fed by line pressure, increases and moves the valve against spring force (as shown). Reverse fluid can then fill the reverse input fluid circuit through the reverse abuse valve. This bypasses the control of orifice #17 and provides a faster clutch apply.

Boost Valve

Reverse input fluid pressure moves the boost valve against the pressure regulator valve spring. The spring acts on the pressure regulator valve to increase the operating range of line pressure in Reverse. Reverse input fluid also flows through the valve and to the reverse input clutch piston. Remember that torque signal fluid pressure continually acts on the boost valve to control line pressure in response to vehicle operating conditions.

Reverse Input Clutch Piston

Reverse input fluid pressure moves the piston to apply the reverse input clutch plates and obtain Reverse.

Reverse Input Air Bleed Checkball

This ball and capsule is located in the reverse input fluid circuit in the oil pump to provide an air escape when the fluid pressure increases. It also allows air into the circuit to displace the fluid when the clutch releases.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Assembly

Reverse input fluid pressure closes the normally open reverse switch in the TFP manual valve position switch This signals the PCM that the manual valve is in the Reverse (R) position.

Shift Solenoid Valves (1-2 and 2-3)

Both shift solenoid valves are energized as in the Park range. Signal A and signal B fluids are blocked from exhausting through the shift solenoid valves to maintain fluid pressure in these circuits at the end of the shift valves.

Shift Valves (1-2, 2-3 and 3-4)

Signal A fluid pressure holds the 1-2 shift valve in the downshifted position and the 3-4 shift valve in the upshifted (First and Fourth gear) position. Signal B fluid pressure from the 2-3 shift solenoid valve holds the 2-3 shift valve train in the downshifted position.

Pressure Control (PC) Solenoid Valve

The PC solenoid valve continues to regulate AFL fluid into torque signal fluid pressure. The PCM varies the current at the solenoid to regulate torque signal fluid pressure in response to throttle position and other PCM input signals. Torque signal fluid pressure is used to control line pressure at the boost and pressure regulator valves.

Note: The explanation in each gear range is, for the most part, limited.

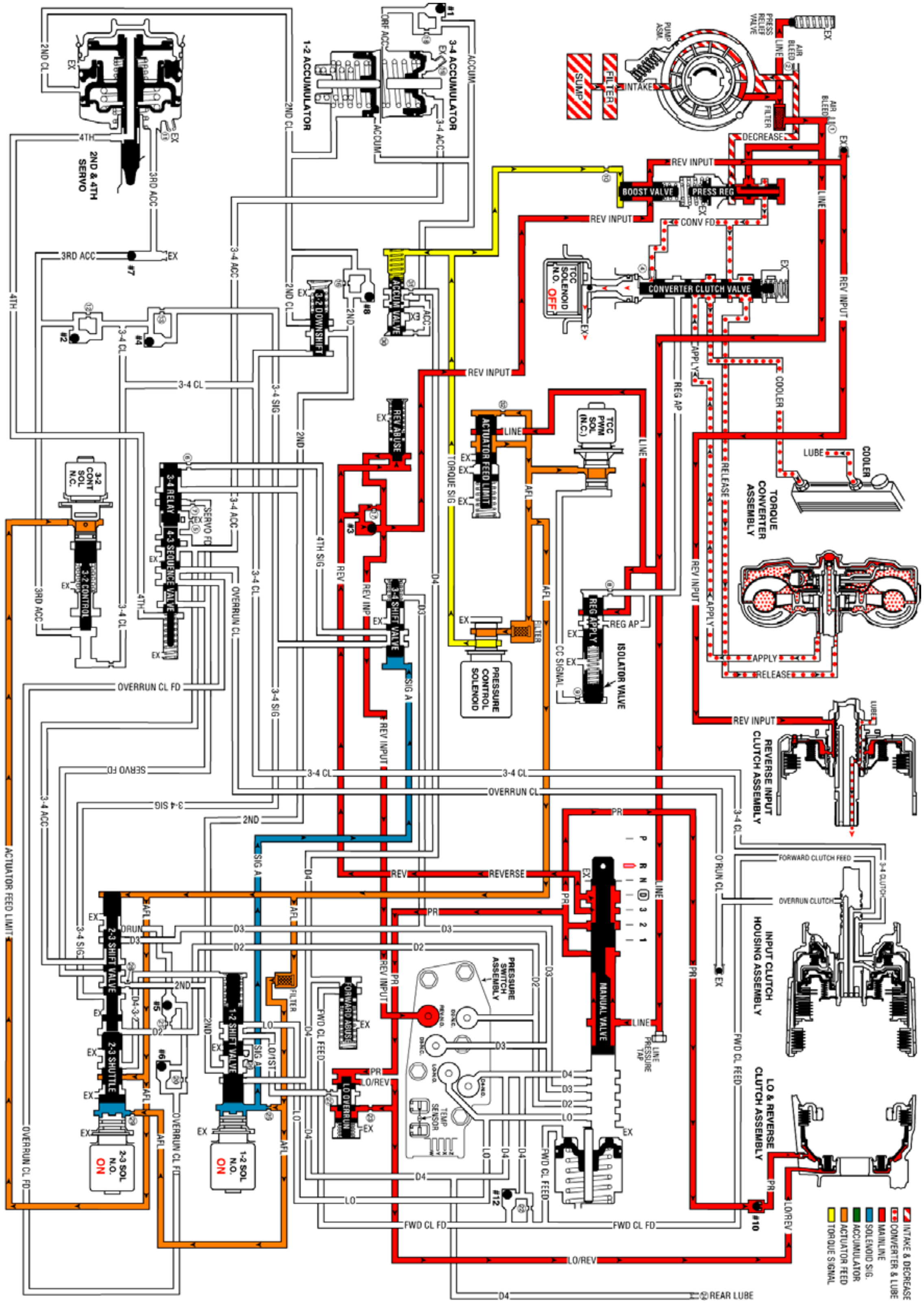


Fig. 475: Reverse
Courtesy of GENERAL MOTORS CORP.

FLUID PASSAGES

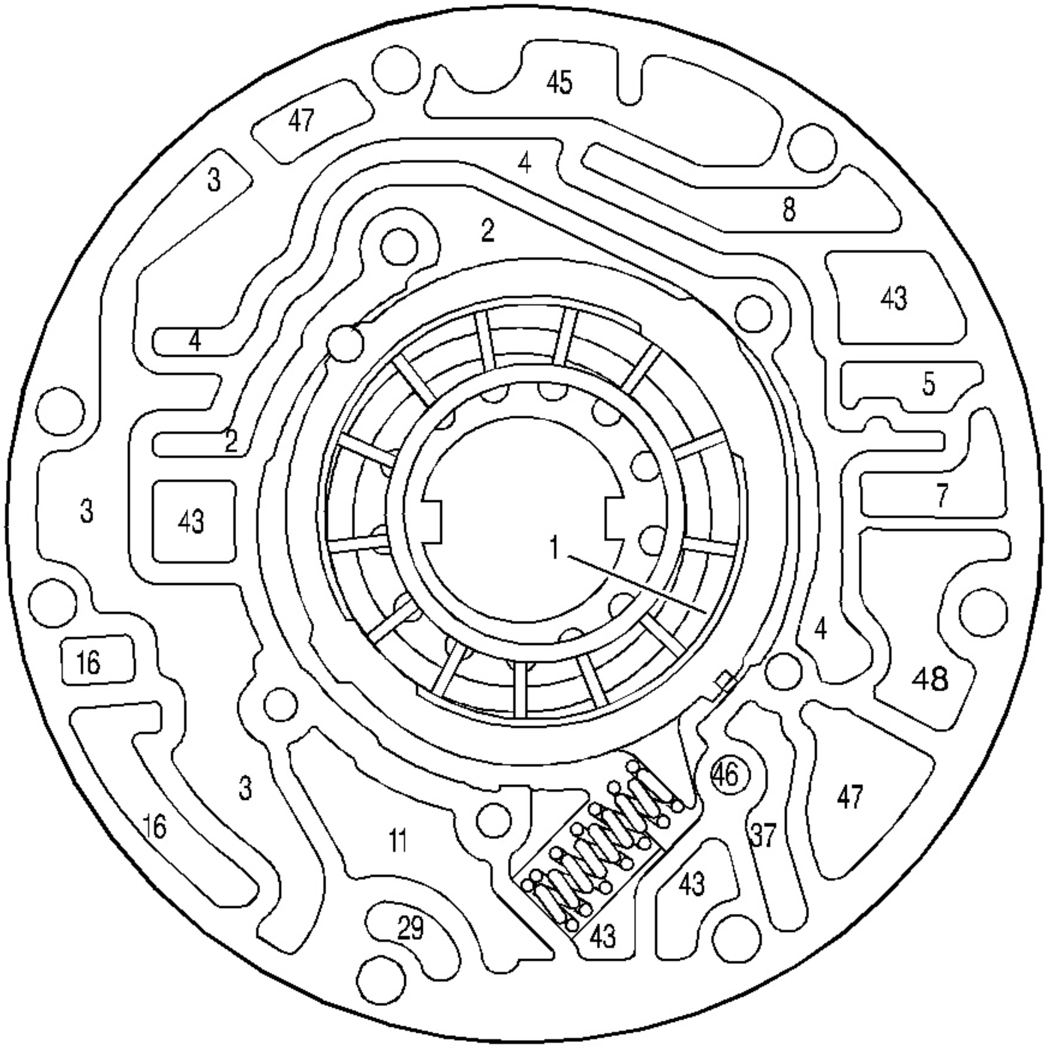
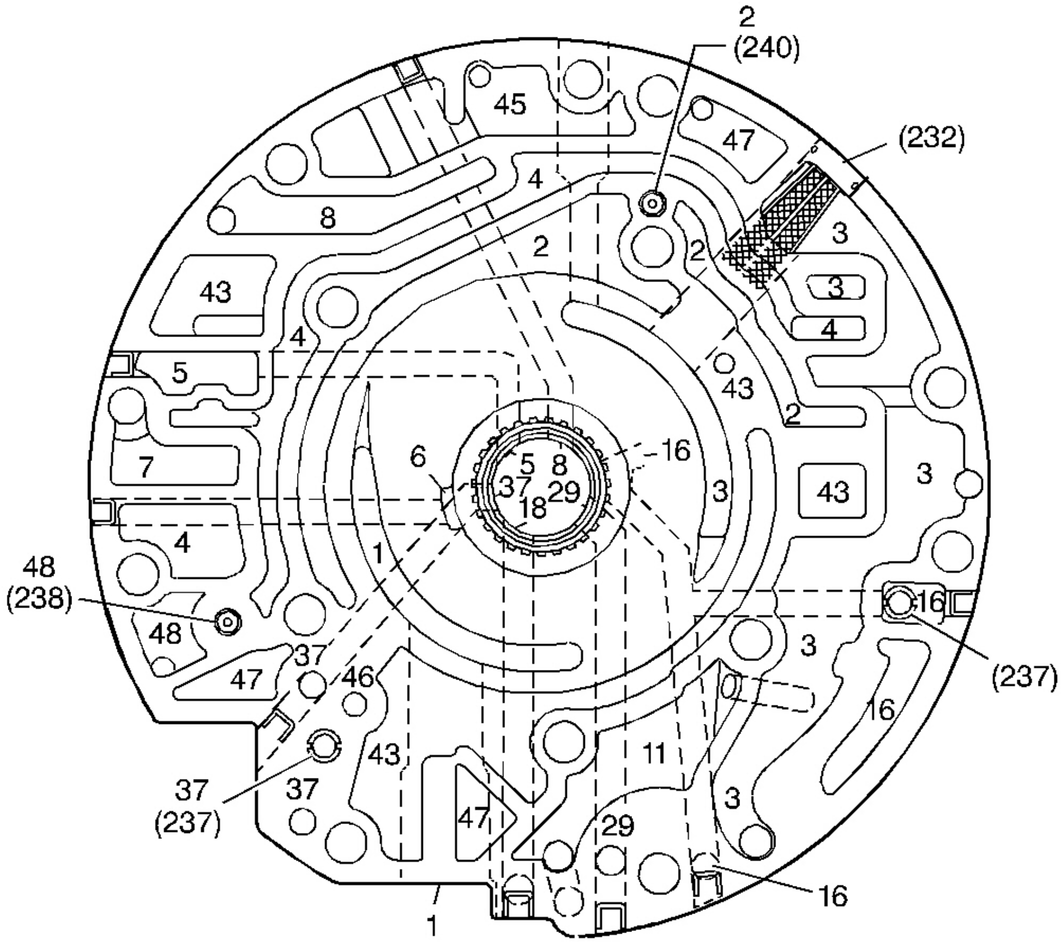


Fig. 476: Pump Body Fluid Passages (Pump Cover Side)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 529

Callout	Component Name
1	Suction (intake)
2	Decrease
2	Decrease
3	Line
3	Line

3	Line
4	Converter Feed
4	Converter Feed
4	Converter Feed
5	Release
7	To Cooler
8	Lube from Cooler
11	Torque Signal
16	Reverse Input
16	Reverse Input
29	3-4 Clutch
37	Overrun Clutch
43	Exhaust
43	Exhaust
43	Exhaust
43	Exhaust
45	Vent
46	Seal Drain
47	Void
47	Void
48	Regulated Apply



<u>**Fig. 477: Pump Cover Fluid Passages (Pump Body Side)**</u>
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 530

Callout	Component Name
1	Suction (intake)
1	Suction (intake)
2	Decrease
2	Decrease
2	Decrease
2	Decrease
3	Line
3	Line
3	Line
3	Line

3	Line
3	Line
4	Converter Feed
4	Converter Feed
4	Converter Feed
4	Converter Feed
5	Release
5	Release
6	Apply
7	To Cooler
8	Lube from Cooler
8	Lube from Cooler
11	Torque Signal
16	Reverse Input
16	Reverse Input
16	Reverse Input
16	Reverse Input
18	Forward Clutch Feed
29	3-4 Clutch
29	3-4 Clutch
37	Overrun Clutch
37	Overrun Clutch
37	Overrun Clutch
37	Overrun Clutch
43	Exhaust
43	Exhaust
43	Exhaust
43	Exhaust
45	Vent
46	Seal Drain
47	Void
47	Void
47	Void
48	Regulated Apply
48	Regulated Apply
232	Oil Pump Cover Screen
237	Check Valve Retainer and Ball Assembly
237	Check Valve Retainer and Ball Assembly
238	Converter Clutch Signal Orificed Cup Plug
240	Orificed Cup Plug

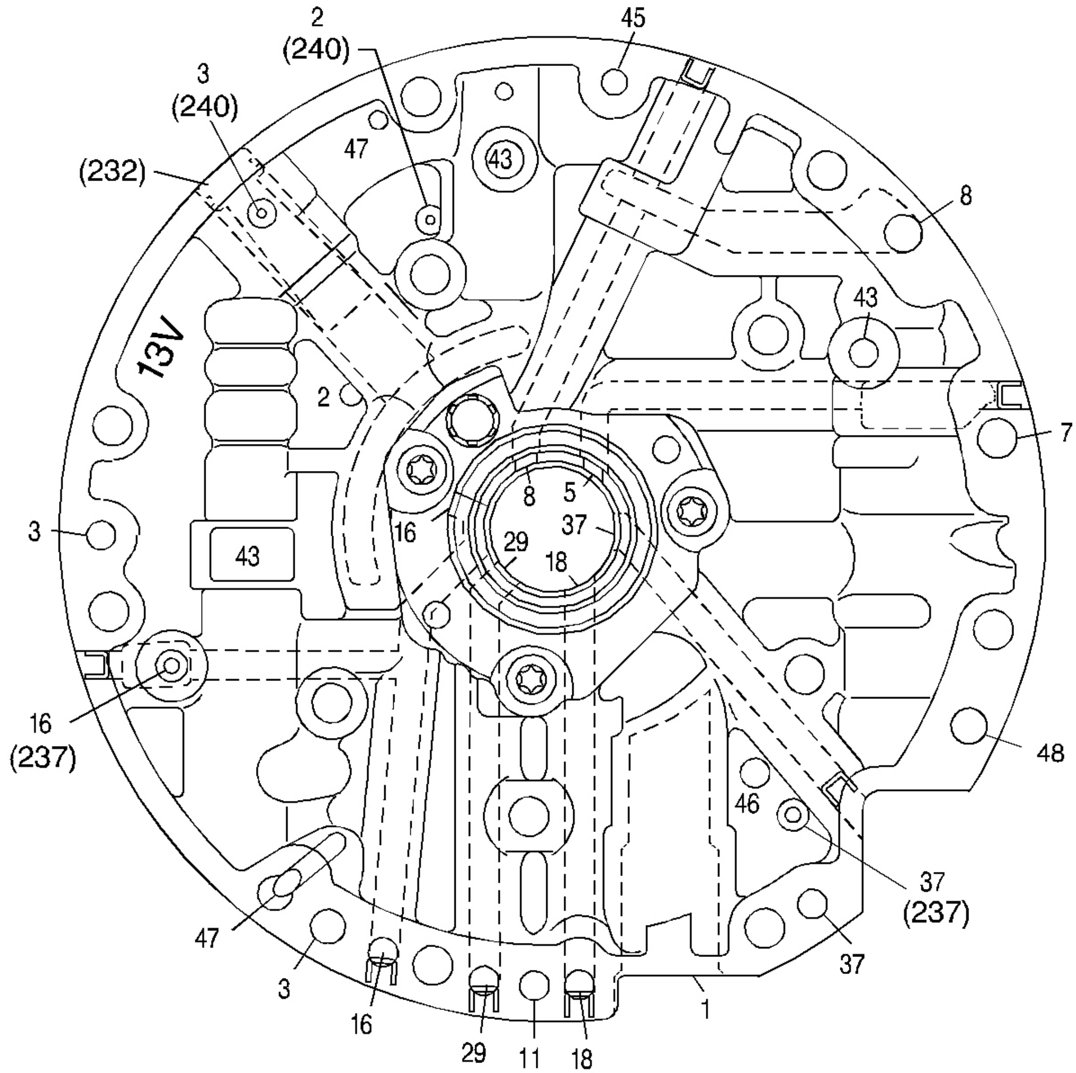


Fig. 478: Pump Cover Fluid Passages (Case Side)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 531

Callout	Component Name
1	Suction (Intake)
2	Decrease
2	Decrease
3	Line
3	Line
3	Line
5	Release

7	To Cooler
8	Lube from Cooler
8	Lube from Cooler
11	Torque Signal
16	Reverse Input (Rev. Clutch
16	Reverse Input (Rev. Clutch
16	Reverse Input (Rev. Clutch
18	Forward Clutch Feed
18	Forward Clutch Feed
29	3-4 Clutch
29	3-4 Clutch
37	Overrun Clutch
37	Overrun Clutch
37	Overrun Clutch
43	Exhaust
43	Exhaust
43	Exhaust
45	Vent
46	Seal Drain
47	Void
47	Void
48	Regulated Apply
232	Oil Pump Cover Screen
237	Check Valve Retainer and Ball Assembly
237	Check Valve Retainer and Ball Assembly
240	Orificed Cup Plug
240	Orificed Cup Plug

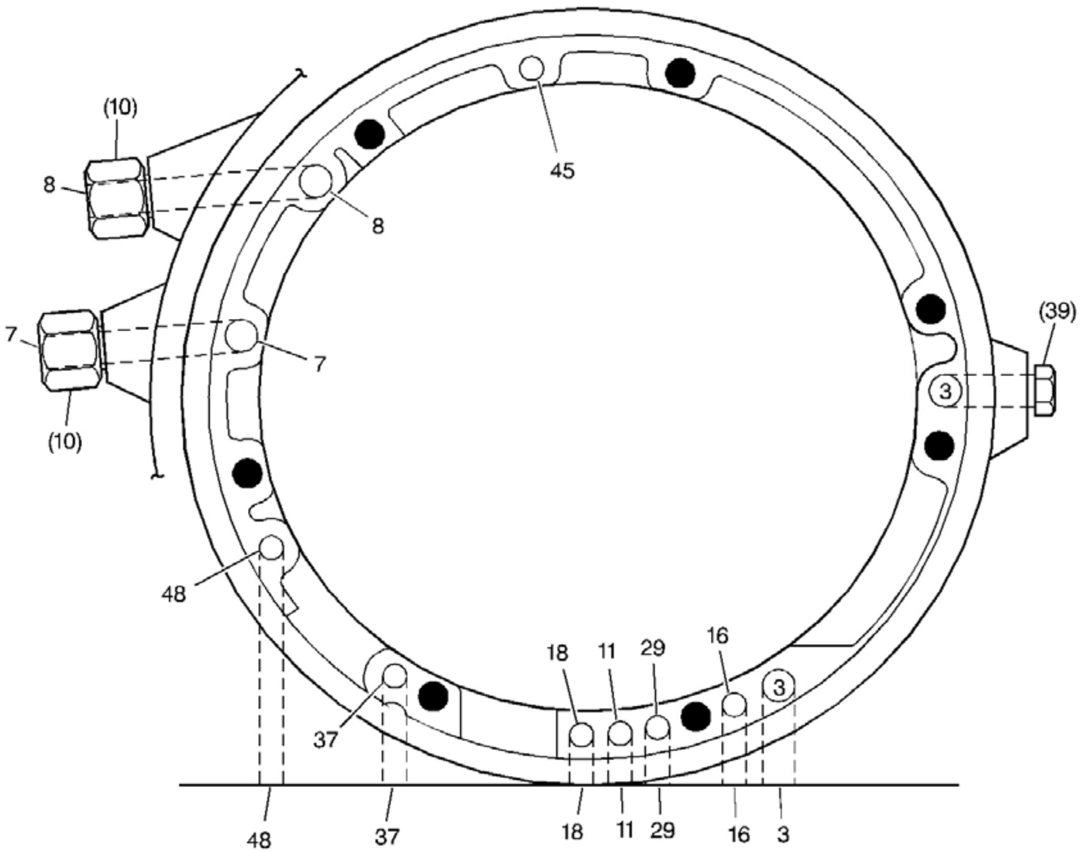


Fig. 479: Case Fluid Passages (Pump Cover Side)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 532

Callout	Component Name
3	Line
3	Line
3	Line
7	To Cooler
7	To Cooler
8	Lube from Cooler
8	Lube from Cooler
10	Oil Cooler Pipe Connector
10	Oil Cooler Pipe Connector
11	Torque Signal
11	Torque Signal
16	Reverse Input
16	Reverse Input

18	Forward Clutch Feed
18	Forward Clutch Feed
29	3-4 Clutch
29	3-4 Clutch
37	Overrun Clutch
37	Overrun Clutch
39	Pressure Plug
45	Vent
48	Regulated Apply
48	Regulated Apply

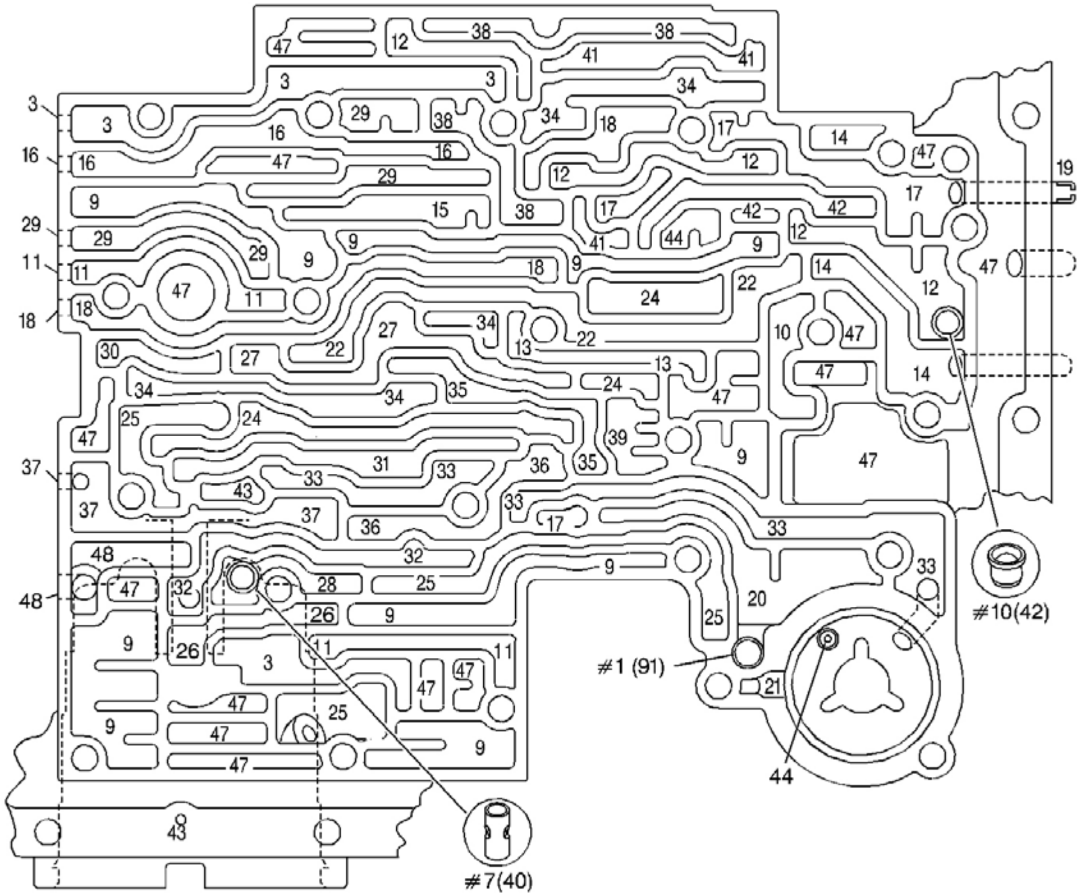


Fig. 480: Case Fluid Passages (Control Valve Body Side)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 533

Callout	Component Name
#1	Checkball (91)

#7	3rd Accumulator Retainer and Ball Assembly (40)
#10	Checkball (42)
3	Line
3	Line
3	Line
3	Line
3	Line
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
10	Filtered Actuator Feed
11	Torque Signal
11	Torque Signal
11	Torque Signal
11	Torque Signal
11	Torque Signal
12	PR
12	PR
12	PR
12	PR
12	PR
13	D4-3-2
13	D4-3-2
14	Lo/Reverse
14	Lo/Reverse
14	Lo/Reverse
15	Reverse
16	Reverse Input (Rev. Clutch
16	Reverse Input (Rev. Clutch
16	Reverse Input (Rev. Clutch
16	Reverse Input (Rev. Clutch
17	D4
17	D4

17	D4
17	D4
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
19	Rear Lube
20	Accumulator
21	Orificed Accumulator
22	Signal A
22	Signal A
22	Signal A
24	2nd
24	2nd
24	2nd
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
26	C.C. Signal
26	C.C. Signal
27	3-4 Signal
27	3-4 Signal
28	3rd Accumulator
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
30	4th Signal
31	Servo Feed
32	4th
32	4th
33	3-4 Accumulator
33	3-4 Accumulator
33	3-4 Accumulator
33	3-4 Accumulator
33	3-4 Accumulator
34	D3
34	D3
34	D3

34	D3
34	D3
35	Overrun
35	Overrun
36	Overrun Clutch Feed
36	Overrun Clutch Feed
37	Overrun Clutch
37	Overrun Clutch
37	Overrun Clutch
38	D2
38	D2
38	D2
38	D2
39	Orificed D2
41	Lo
41	Lo
41	Lo
42	Lo/1st
42	Lo/1st
43	Exhaust
43	Exhaust
44	Orificed Exhaust
44	Orificed Exhaust
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
48	Regulated Apply
48	Regulated Apply

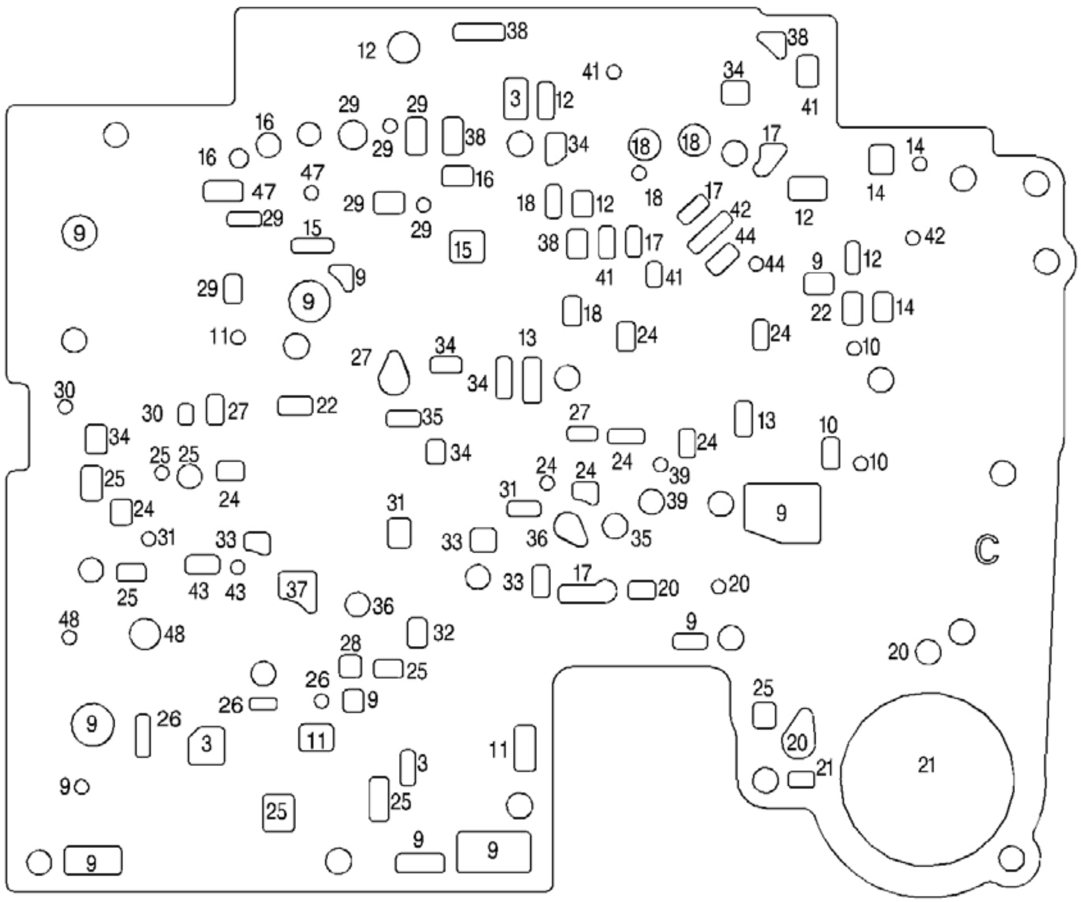


Fig. 481: Spacer Plate To Case Gasket
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 534

Callout	Component Name
3	Line
3	Line
3	Line
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit

9	Actuator Feed Limit
10	Filtered Actuator Feed
10	Filtered Actuator Feed
10	Filtered Actuator Feed
10	Filtered Actuator Feed
10	Filtered Actuator Feed
11	Torque Signal
11	Torque Signal
11	Torque Signal
12	PR
12	PR
12	PR
12	PR
12	PR
13	D4-3-2
13	D4-3-2
14	Lo/Reverse
14	Lo/Reverse
14	Lo/Reverse
15	Reverse
15	Reverse
16	Reverse Input (Rev. Cl.)
16	Reverse Input (Rev. Cl.)
16	Reverse Input (Rev. Cl.)
17	D4
17	D4
17	D4
17	D4
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
20	Accumulator
20	Accumulator
20	Accumulator
20	Accumulator
21	Orificed Accumulator
21	Orificed Accumulator
22	Signal A
22	Signal A

24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
26	C.C. Signal
26	C.C. Signal
26	C.C. Signal
27	3-4 Signal
27	3-4 Signal
27	3-4 Signal
28	3rd Accumulator
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
30	4th Signal
30	4th Signal
31	Servo Feed
31	Servo Feed
31	Servo Feed
32	4th
33	3-4 Accumulator
33	3-4 Accumulator

33	3-4 Accumulator
34	D3
34	D3
34	D3
34	D3
34	D3
34	D3
35	Overrun
35	Overrun
36	Overrun Clutch Feed
36	Overrun Clutch Feed
37	Overrun Clutch
38	D2
38	D2
38	D2
38	D2
39	Orificed D2
39	Orificed D2
41	Lo
41	Lo
41	Lo
41	Lo
42	Lo/1st
42	Lo/1st
43	Exhaust
43	Exhaust
44	Orificed Exhaust
44	Orificed Exhaust
47	Void
47	Void
48	Regulated Apply
48	Regulated Apply

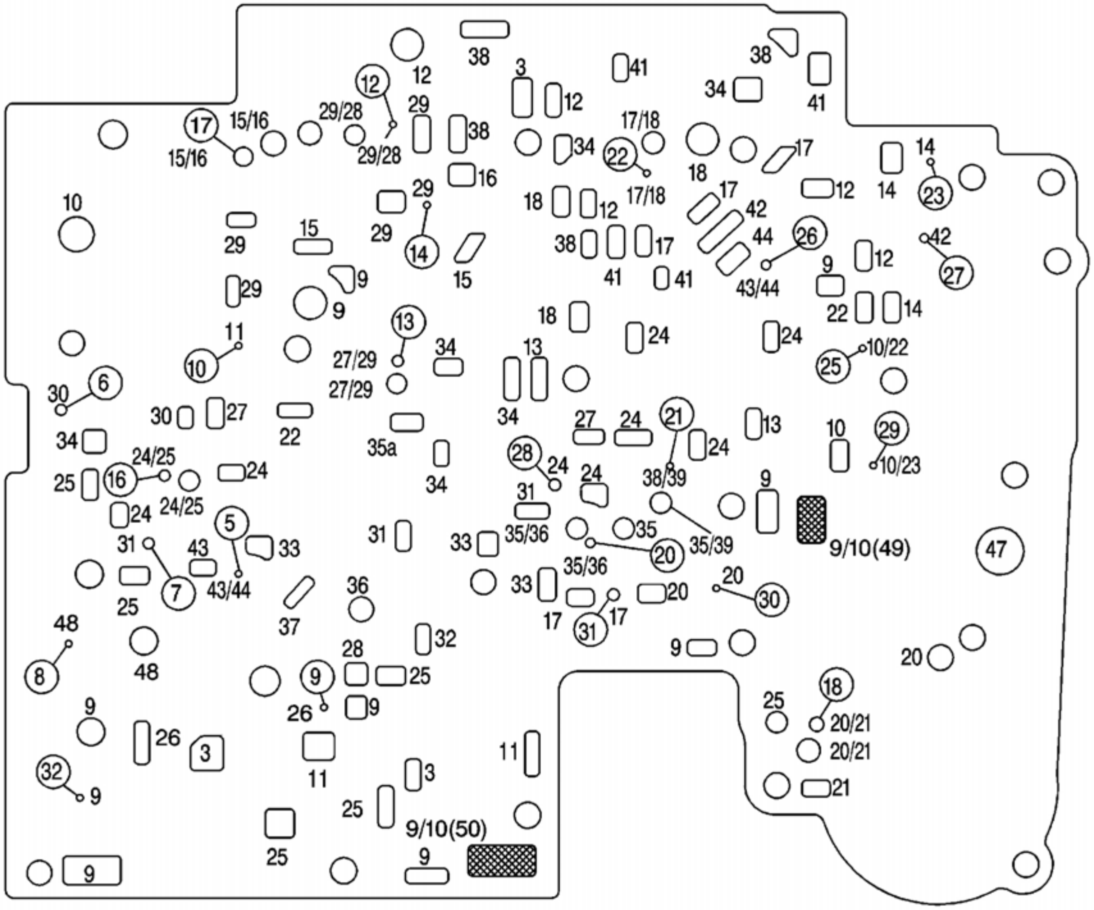


Fig. 482: Spacer Plate Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 535

Callout	Component Name
3	Line
3	Line
3	Line
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit

9	Actuator Feed Limit
9/10	Actuator Feed Limit/Filtered Actuator Feed
9/10	Actuator Feed Limit/Filtered Actuator Feed
10	Filtered Actuator Feed
10	Filtered Actuator Feed
10/22	Filtered Actuator Feed/Signal A
10/23	Filtered Actuator Feed/Signal B
11	Torque Signal
11	Torque Signal
11	Torque Signal
12	PR
12	PR
12	PR
12	PR
12	PR
13	D4-3-2
13	D4-3-2
14	Lo/Reverse
14	Lo/Reverse
14	Lo/Reverse
15	Reverse
15	Reverse
15/16	Reverse/Reverse Input (Rev. Clutch
15/16	Reverse/Reverse Input (Rev. Clutch
16	Reverse Input (Rev. Clutch
17	D4
17	D4
17	D4
17	D4
17	D4
17/18	D4
17/18	D4
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
20	Accumulator
20	Accumulator
20	Accumulator
20/21	Accumulator/Orificed Accumulator
20/21	Accumulator/Orificed Accumulator
21	Orificed Accumulator

22	Signal A
22	Signal A
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24/25	2nd/2nd Clutch
24/25	2nd/2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
26	C.C. Signal
26	C.C. Signal
27	3-4 Signal
27	3-4 Signal
27/29	3-4 Signal
27/29	3-4 Signal
28	3rd Accumulator
29/28	3-4 Clutch/3rd Accumulator
29/28	3-4 Clutch/3rd Accumulator
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
30	4th Signal
30	4th Signal
31	Servo Feed
31	Servo Feed
31	Servo Feed
32	4th
33	3-4 Accumulator
33	3-4 Accumulator
33	3-4 Accumulator

34	D3
34	D3
34	D3
34	D3
34	D3
34	D3
35a	Overrun
35	Overrun
35/36	Overrun/Overrun Clutch Feed
35/36	Overrun/Overrun Clutch Feed
35/39	Overrun/Orificed D2
36	Overrun Clutch Feed
37	Overrun Clutch
38	D2
38	D2
38	D2
38	D2
38/39	D2/Orificed D2
41	Lo
41	Lo
41	Lo
41	Lo
42	Lo/1st
42	Lo/1st
43	Exhaust
43/44	Exhaust/Orificed Exhaust
43/44	Exhaust/Orificed Exhaust
44	Orificed Exhaust
47	Void
48	Regulated Apply
48	Regulated Apply
49	Shift Solenoids Screen
50	Pressure Control Solenoid Screen

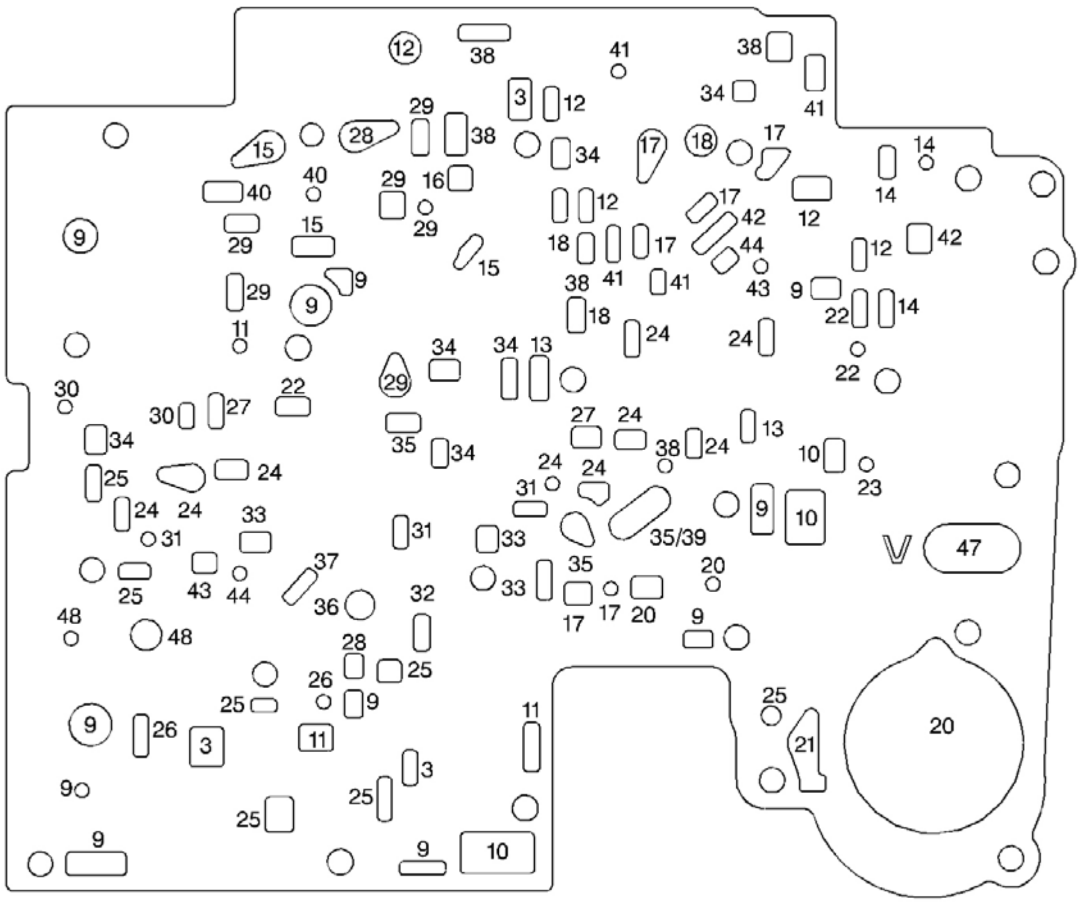


Fig. 483: Spacer Plate To Control Valve Body Gasket
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 536

Callout	Component Name
3	Line
3	Line
3	Line
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit

10	Filtered Actuator Feed
10	Filtered Actuator Feed
10	Filtered Actuator Feed
10	Filtered Actuator Feed
11	Torque Signal
11	Torque Signal
11	Torque Signal
12	PR
12	PR
12	PR
12	PR
12	PR
13	D4-3-2
13	D4-3-2
14	Lo/Reverse
14	Lo/Reverse
14	Lo/Reverse
15	Reverse
15	Reverse
15	Reverse
16	Reverse Input (Rev. Cl.)
17	D4
17	D4
17	D4
17	D4
17	D4
17	D4
18	Forward Clutch Feed
18	Forward Clutch Feed
18	Forward Clutch Feed
20	Accumulator
20	Accumulator
20	Accumulator
21	Orificed Accumulator
22	Signal A
22	Signal A
22	Signal A
23	Signal B
24	2nd
24	2nd
24	2nd

24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
26	C.C. Signal
26	C.C. Signal
27	3-4 Signal
27	3-4 Signal
28	3rd Accumulator
28	3rd Accumulator
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
30	4th Signal
30	4th Signal
31	Servo Feed
31	Servo Feed
31	Servo Feed
32	4th
33	3-4 Accumulator
33	3-4 Accumulator
33	3-4 Accumulator
34	D3
34	D3
34	D3
34	D3
34	D3

34	D3
35	Overrun
35	Overrun
35/39	Overrun/Orificed D2
36	Overrun Clutch Feed
37	Overrun Clutch
38	D2
38	D2
38	D2
38	D2
38	D2
40	3-2 Signal
40	3-2 Signal
41	Lo
41	Lo
41	Lo
41	Lo
42	Lo/1st
42	Lo/1st
43	Exhaust
43	Exhaust
44	Orificed Exhaust
44	Orificed Exhaust
47	Void
48	Regulated Apply
48	Regulated Apply

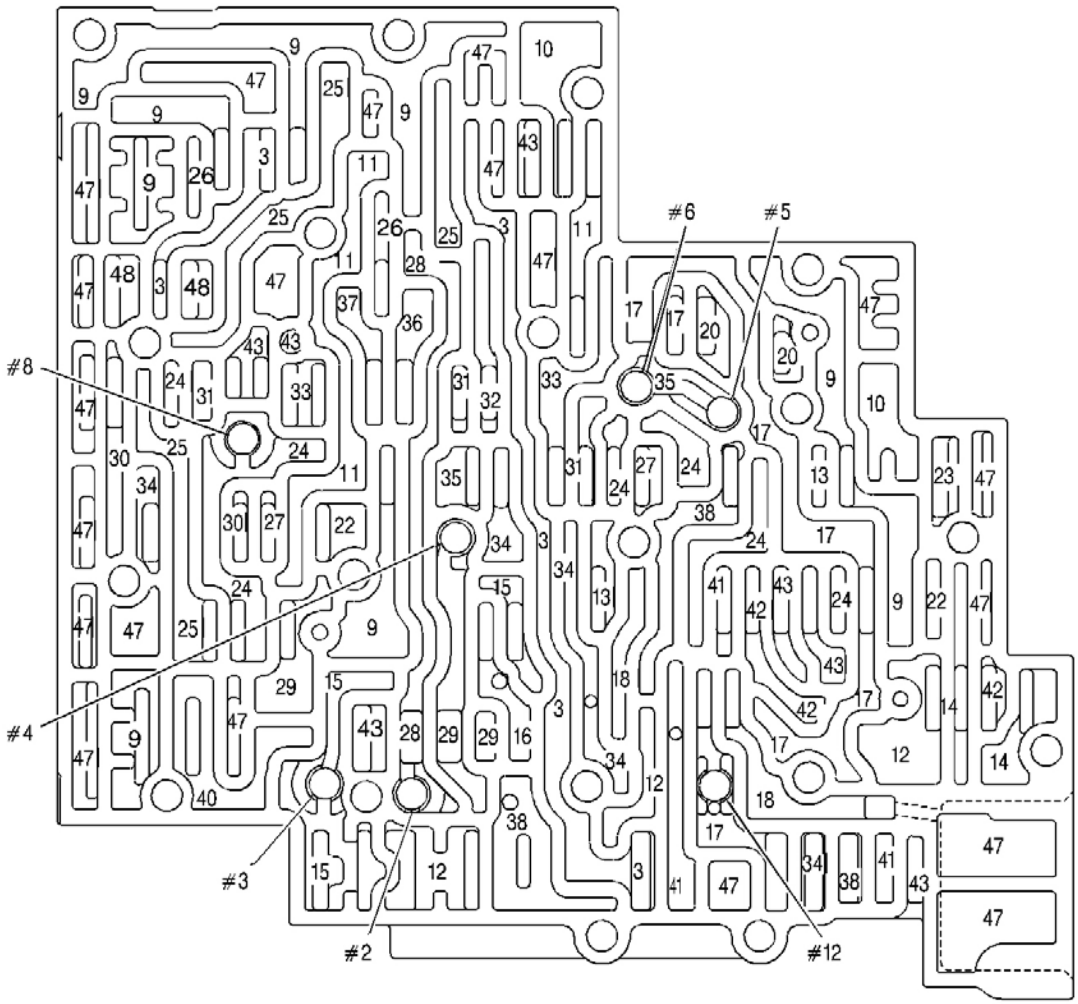


Fig. 484: Control Valve Body Fluid Passages (Case Side)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 537

Callout	Component Name
#2	Checkball (61)
#3	Checkball (61)
#4	Checkball (61)
#5	Checkball (61)
#6	Checkball (61)
#8	Checkball (61)
#12	Checkball (61)
3	Line
3	Line

3	Line
3	Line
3	Line
3	Line
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
9	Actuator Feed Limit
10	Filtered Actuator Feed
10	Filtered Actuator Feed
11	Torque Signal
11	Torque Signal
11	Torque Signal
11	Torque Signal
12	PR
12	PR
12	PR
13	D4-3-2
13	D4-3-2
14	Lo/Reverse
14	Lo/Reverse
15	Reverse
15	Reverse
15	Reverse
16	Reverse Input (Rev. Clutch
17	D4
17	D4
17	D4
17	D4
17	D4
17	D4
17	D4
18	Forward Clutch Feed
18	Forward Clutch Feed
20	Accumulator
20	Accumulator

22	Signal A
22	Signal A
23	Signal B
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
24	2nd
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
26	C.C. Signal
26	C.C. Signal
27	3-4 Signal
27	3-4 Signal
28	3rd Accumulator
28	3rd Accumulator
29	3-4 Clutch
29	3-4 Clutch
29	3-4 Clutch
30	4th Signal
30	4th Signal
31	Servo Feed
31	Servo Feed
31	Servo Feed
32	4th
33	3-4 Accumulator
33	3-4 Accumulator
34	D3
34	D3
34	D3
34	D3
34	D3
35	Overrun
35	Overrun
36	Overrun Clutch Feed

37	Overrun Clutch
38	D2
38	D2
38	D2
40	3-2 Signal
41	Lo
41	Lo
41	Lo
42	Lo/1st
42	Lo/1st
42	Lo/1st
43	Exhaust
43	Exhaust
43	Exhaust
43	Exhaust
43	Exhaust
43	Exhaust
43	Exhaust
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
47	Void
48	Regulated Apply

48	Regulated Apply

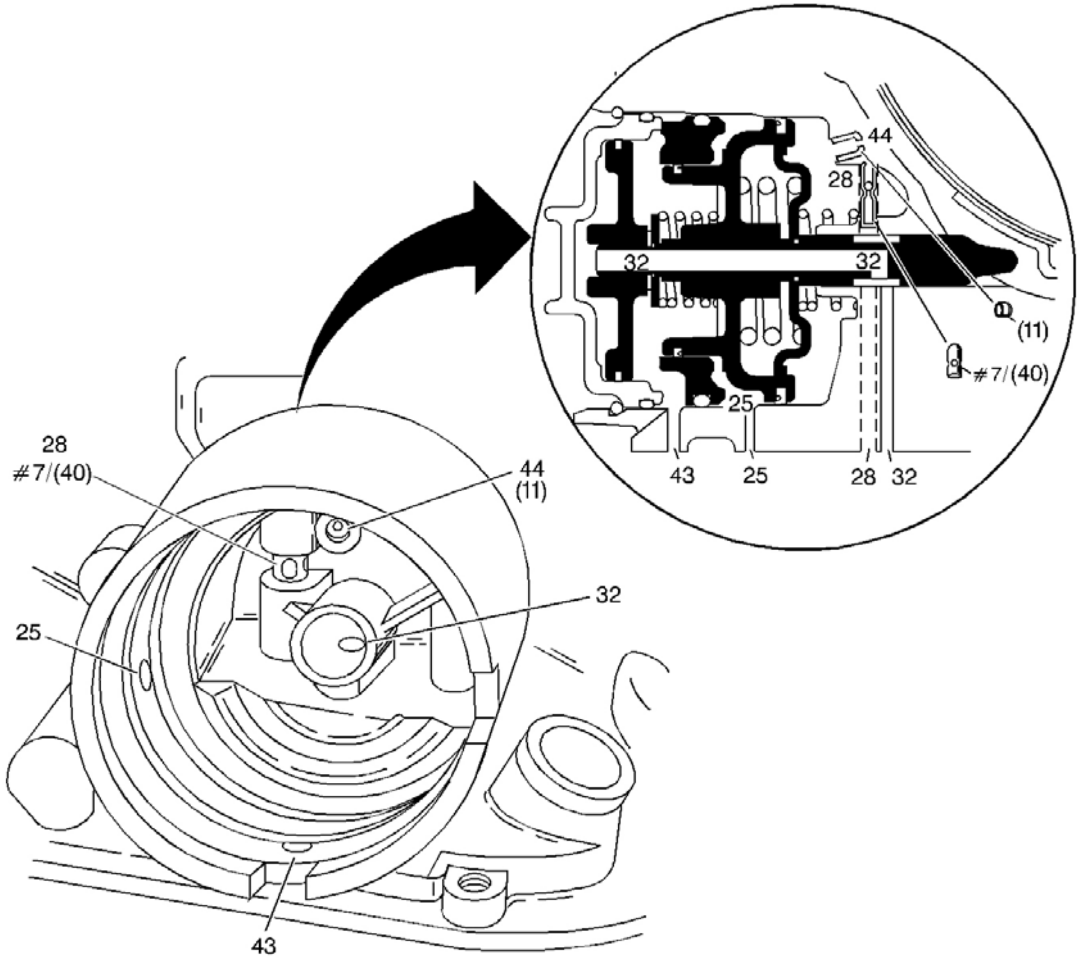


Fig. 485: 2-4 Servo Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 538

Callout	Component Name
#7	3rd Accumulator Retainer and Ball Assembly (40)
#7	3rd Accumulator Retainer and Ball Assembly (40)
11	Case Servo Orificed Plug
11	Case Servo Orificed Plug
25	2nd Clutch
25	2nd Clutch
25	2nd Clutch
28	3rd Accumulator

28	3rd Accumulator
28	3rd Accumulator
32	4th
32	4th
32	4th
32	4th
43	Exhaust
43	Exhaust
44	Orificed Exhaust
44	Orificed Exhaust

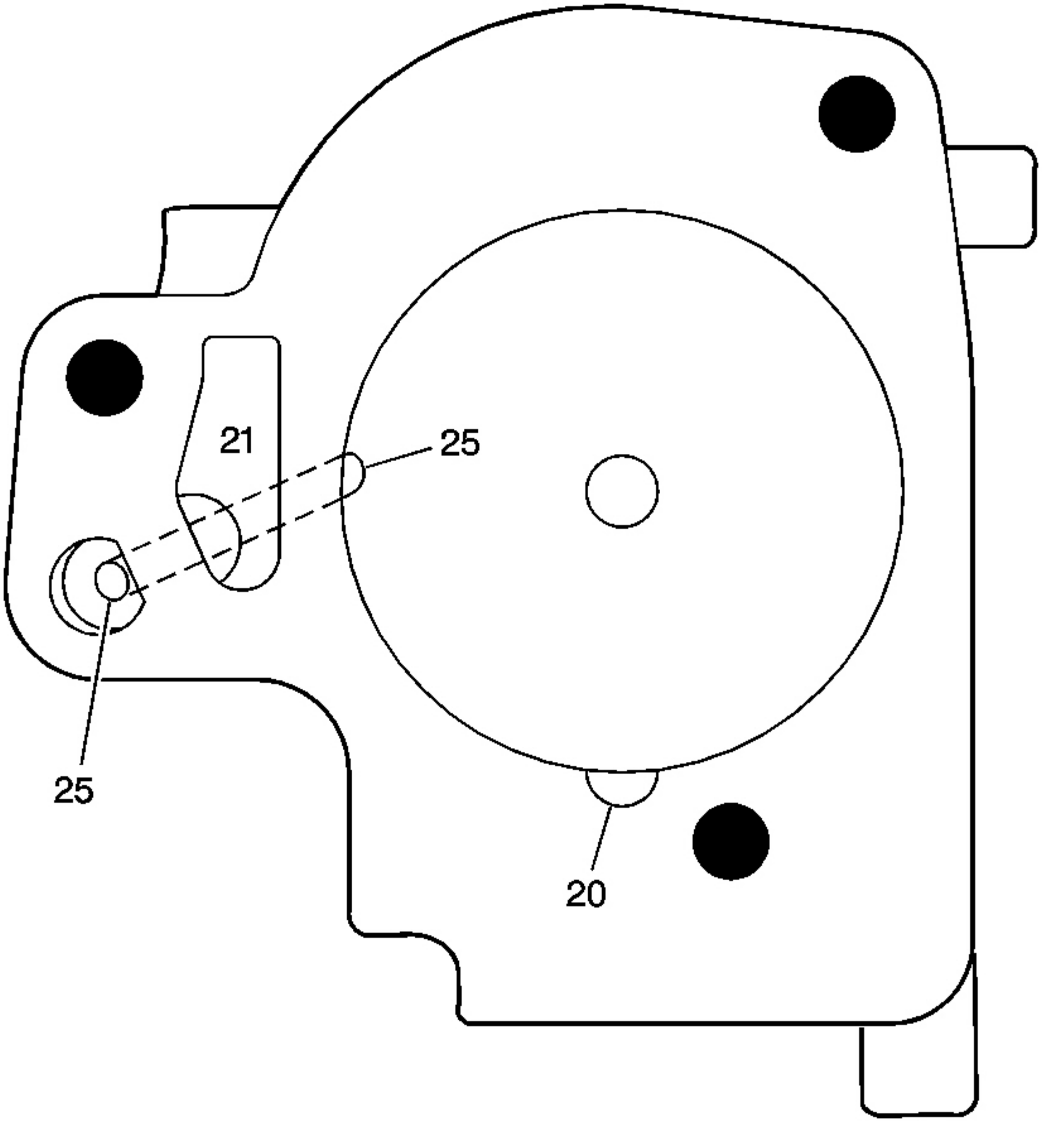


Fig. 486: 1-2 Accumulator Cover Fluid Passages
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 539

Callout	Component Name
20	Accumulator
21	Orificed Accumulator
25	2nd Clutch
25	2nd Clutch

TRANSMISSION GENERAL INFORMATION

How to Use This Section

This section provides the following information:

- General diagnosis information on transmissions
- Procedures for diagnosing the Hydra-Matic transmission

When you diagnose any condition of the Hydra-Matic transmission, begin with A Diagnostic Starting Point. This procedure indicates the proper path of diagnosing the transmission by describing the basic checks. This procedure will then refer you to the locations of specific checks. After you have determined the cause of a condition, refer to Repair Instructions for repair procedures. If the faulty component is not serviceable without removing the transmission from the vehicle, refer to Unit Repair for repair information.

Basic Knowledge

NOTE: **Do not, under any circumstances, attempt to diagnose a powertrain condition without basic knowledge of this powertrain. If you perform diagnostic procedures without this basic knowledge, you may incorrectly diagnose the condition or damage the powertrain components.**

You must be familiar with some basic electronics in order to use this section of the service manual. You should also be able to use the following special tools:

- A digital multimeter (DMM)
- A circuit tester
- Jumper wires or leads
- A line pressure gauge set

Diagnosis

NOTE: **If you probe a wire with a sharp instrument and do not properly seal the wire afterward, the wire corrodes and an open circuit results.**

Diagnostic test probes are now available that allow you to probe individual wires without leaving the wire open to the environment. These probe devices are inexpensive and easy to install, and they permanently seal the wire from corrosion.

DEFINITIONS AND ABBREVIATIONS

Throttle Positions

Engine Braking

A condition where the engine friction is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Full Throttle Detent Downshift

A quick apply of the accelerator pedal to its full travel, forcing a downshift.

Heavy Throttle

Approximately 3/4 of accelerator pedal travel (75 percent throttle position).

Light Throttle

Approximately 1/4 of accelerator pedal travel (25 percent throttle position).

Medium Throttle

Approximately 1/2 of accelerator pedal travel (50 percent throttle position).

Minimum Throttle

The least amount of throttle opening required for an upshift.

Wide Open Throttle (WOT)

Full travel of the accelerator pedal (100 percent throttle position).

Zero Throttle Coastdown

A full release of the accelerator pedal while the vehicle is in motion and in drive range.

Shift Condition Definitions

Bump

A sudden and forceful apply of a clutch or a band.

Chuggle

A bucking or jerking. This condition may be most noticeable when the converter clutch is engaged. It is similar to the feel of towing a trailer.

Delayed

A condition where a shift is expected but does not occur for a period of time. This could be described as a clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator, or during manual downshifting to a lower range. This term is also defined as LATE or EXTENDED.

Double Bump (Double Feel)

Two sudden and forceful applies of a clutch or a band.

Early

A condition where the shift occurs before the car has reached proper speed. This condition tends to labor the engine after the upshift.

End Bump

A firmer feel at the end of a shift than at the start of the shift. This is also defined as END FEEL or SLIP BUMP.

Firm

A noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. This apply should not be confused with HARSH or ROUGH.

Flare

A quick increase in engine RPM along with a momentary loss of torque. This most generally occurs during a shift. This condition is also defined as SLIPPING.

Harsh (Rough)

A more noticeable apply of a clutch or band than FIRM. This condition is considered undesirable at any throttle position.

Hunting

A repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM, such as a 4-3-4 shift pattern. This condition is also defined as BUSYNESS.

Initial Feel

A distinctly firmer feel at the start of a shift than at the finish of the shift.

Late

A shift that occurs when the engine RPM is higher than normal for a given amount of throttle.

Shudder

A repeating jerking condition similar to CHUGGLE but more severe and rapid. This condition may be most noticeable during certain ranges of vehicle speed.

Slipping

A noticeable increase in engine RPM without a vehicle speed increase. A slip usually occurs during or after initial clutch or band apply.

Soft

A slow, almost unnoticeable clutch or band apply with very little shift feel.

Surge

A repeating engine related condition of acceleration and deceleration that is less intense than CHUGGLE.

Tie-Up

A condition where two opposing clutch and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

Drive Link Noise

A whine or growl that increases or fades with vehicle speed, and is most noticeable under a light throttle acceleration. It may also be noticeable in PARK or NEUTRAL operating ranges with the vehicle stationary.

Final Drive Noise

A hum related to vehicle speed which is most noticeable under a light throttle acceleration.

Planetary Gear Noise

A whine related to vehicle speed, which is most noticeable in FIRST gear, SECOND gear, FOURTH gear or REVERSE. The condition may become less noticeable, or go away, after an upshift.

Pump Noise

A high pitched whine that increases in intensity with engine RPM. This condition may also be noticeable in all operating ranges with the vehicle stationary or moving.

Torque Converter Noise

A whine usually noticed when a vehicle is stopped, and the transmission is in DRIVE or REVERSE. The noise will increase with engine RPM.

Transmission Abbreviations

A/C

Air Conditioning

AC

Alternating Current

AT

Automatic Transmission

CCDIC

Climate Control Driver Information Center

DC

Direct Current

DIC

Driver Information Center

DLC

Diagnostic Link Connector

DMM

Digital Multimeter

DTC

Diagnostic Trouble Code

ECT

Engine Coolant Temperature

EMI

Electromagnetic Interference

IAT

Intake Air Temperature

IGN

Ignition

MAP

Manifold Absolute Pressure

MIL

Malfunction Indicator Lamp

NC

Normally Closed

NO

Normally Open

OBD

On Board Diagnostic

OSS

Output (Shaft) Speed Sensor

PC

Pressure Control

PCM

Powertrain Control Module

PWM

Pulse Width Modulation

RPM

Revolutions Per Minute

SS

Shift Solenoid

TAP

Transmission Adaptive Pressure

TCC

Torque Converter Clutch

TFP

Transmission Fluid Pressure

TFT

Transmission Fluid Temperature

TP

Throttle Position

TV

Throttle Valve

VSS

Vehicle Speed Sensor

WOT

Wide Open Throttle

4WD

Four-Wheel Drive

TRANSMISSION IDENTIFICATION INFORMATION

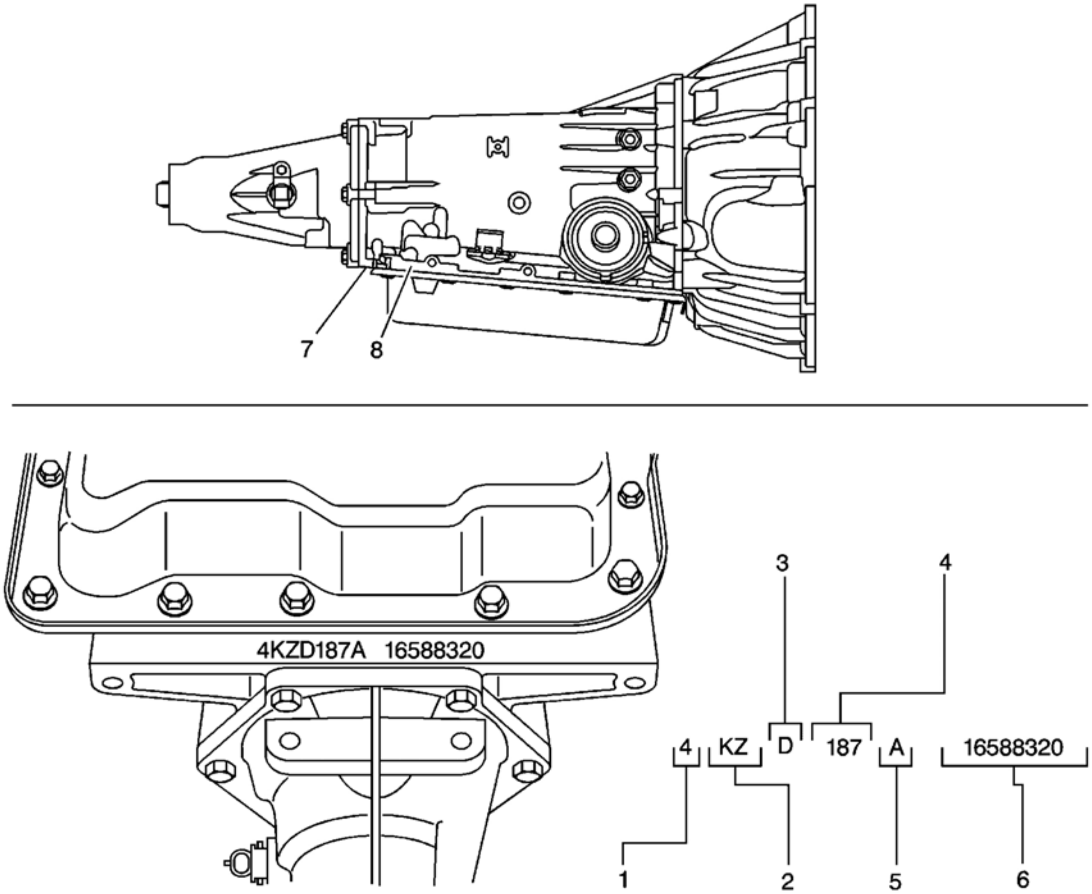


Fig. 487: Transmission Identification
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 540

Callout	Component Name
1	(4 = 2004)
2	Model
3	Hydra-Matic 4L60-E
4	Julian Date (or Day of the Year)
5	Shift Built (A, B, J = First Shift; C, H, W = Second Shift)
6	Serial Number
7	Transmission ID Location
7	Transmission ID Location
8	Optional Transmission ID Location

Plant and Shift Build Chart

Plant	Build Line	1st Shift	2nd Shift	3rd Shift

Toledo, OH	ML1	J	W	X
	ML2	A	C	Not Used
	ML3	B	H	Not Used
	ML4	S	L	V
	ML5	K	E	Z
Romulus, MI	1	A	-	B
Ramos Arizpe, Mexico	1	A	-	-

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of the 4L60-E are as follows:

- A torque converter with an electronically controlled capacity clutch (ECCC)

  This transmission is equipped with an ECCC. The pressure plate does not fully lock to the torque converter cover. Instead, the pressure plate maintains a small amount of slippage, about 20 RPM, in SECOND, THIRD, and FOURTH gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration, or chuggle caused by TCC apply. Typical apply speeds are 49-52 km/h (30-32 mph) in THIRD gear and 65-73 km/h (40-45 mph) in FOURTH gear. Full lockup is available at highway speeds on some applications.

- Torque converter assembly
- Servo assembly and 2-4 band assembly
- Reverse input clutch and housing
- Overrun clutch
- Forward clutch
- 3-4 clutch
- Forward sprag clutch assembly
- Lo and reverse roller clutch assembly
- Lo and reverse clutch assembly
- Two planetary gear sets: Input and Reaction
- Oil pump assembly
- Control valve body assembly

The electrical components of the 4L60-E are as follows:

- 1-2 and 2-3 shift solenoid valves
- 3-2 shift solenoid valve assembly
- Transmission pressure control (PC) solenoid
- Torque converter clutch (TCC) solenoid valve
- TCC pulse width modulation (PWM) solenoid valve

- Automatic transmission fluid pressure (TFP) manual valve position switch
- Automatic transmission fluid temperature (TFT) sensor
- Vehicle speed sensor assembly

For more information, refer to **Electronic Component Description** .

TRANSMISSION ADAPTIVE FUNCTIONS

The 4L60-E transmission utilizes a line pressure control system during upshifts to compensate for the normal wear of transmission components. By adjusting the line pressure, the PCM can maintain acceptable transmission shift times. This process is known as "adaptive learning" or "shift adapts" and is similar to the closed loop fuel control system used for the engine.

In order for the PCM to perform a "shift adapt," it must first identify if an upshift is acceptable to analyze. For example, upshifts that occur during cycling of the A/C compressor or under extreme throttle changes could cause the PCM to incorrectly adjust line pressure. When an upshift is initiated, a number of contingencies, such as throttle position, transmission temperature, and vehicle speed, are checked in order to determine if the actual shift time is valid to compare to a calibrated desired shift time. If all the contingencies are met during the entire shift, then the shift is considered valid and the adapt function may be utilized if necessary.

Once an adaptable shift is identified, the PCM compares the actual shift time to the desired shift time and calculates the difference between them. This difference is known as the shift error. The actual shift time is determined from the time that the PCM commands the shift to the start of the engine RPM drop initiated by the shift. If the actual shift time is longer than the calibrated desired shift time, a soft feel or slow engagement, then the PCM decreases current to the pressure control (PC) solenoid in order to increase line pressure for the next, same, upshift under identical conditions. If the actual shift time is shorter than the calibrated desired shift time, a firm engagement, then the PCM increases current to the PC solenoid in order to decrease line pressure for the next, same, upshift under identical conditions.

The purpose of the adapt function is to automatically compensate the shift quality for the various vehicle shift control systems. It is a continuous process that will help to maintain optimal shift quality throughout the life of the vehicle.

Clearing Transmission Adaptive Pressure (TAP)

Transmission adaptive pressure (TAP) information is displayed and may be reset using a scan tool.

The adapt function is a feature of the PCM that either adds or subtracts line pressure from a calibrated base line pressure in order to compensate for normal transmission wear. The TAP information is divided into 13 units, called cells. The cells are numbered 4 through 16. Each cell represents a given torque range. TAP cell 4 is the lowest adaptable torque range and TAP cell 16 is the highest adaptable torque range. It is normal for TAP cell values to display zero or negative numbers. This indicates that the PCM has adjusted line pressure at or below the calibrated base line pressure.

Updating TAP information is a learning function of the PCM designed to maintain acceptable shift times. It is not recommended that TAP information be reset unless one of the following repairs has been made:

- Transmission overhaul or replacement
- Repair or replacement of an apply or release component, clutch, band, piston, servo
- Repair or replacement of a component or assembly which directly affects line pressure

Resetting the TAP values using a scan tool will erase all learned values in all cells. As a result, the PCM will need to relearn TAP values. Transmission performance may be affected as new TAPs are learned. Learning can only take place when the PCM has determined that an acceptable shift has occurred. The PCM must also relearn TAP values if it is replaced.

ELECTRONIC COMPONENT DESCRIPTION

1-2 and 2-3 Shift Solenoid Valves

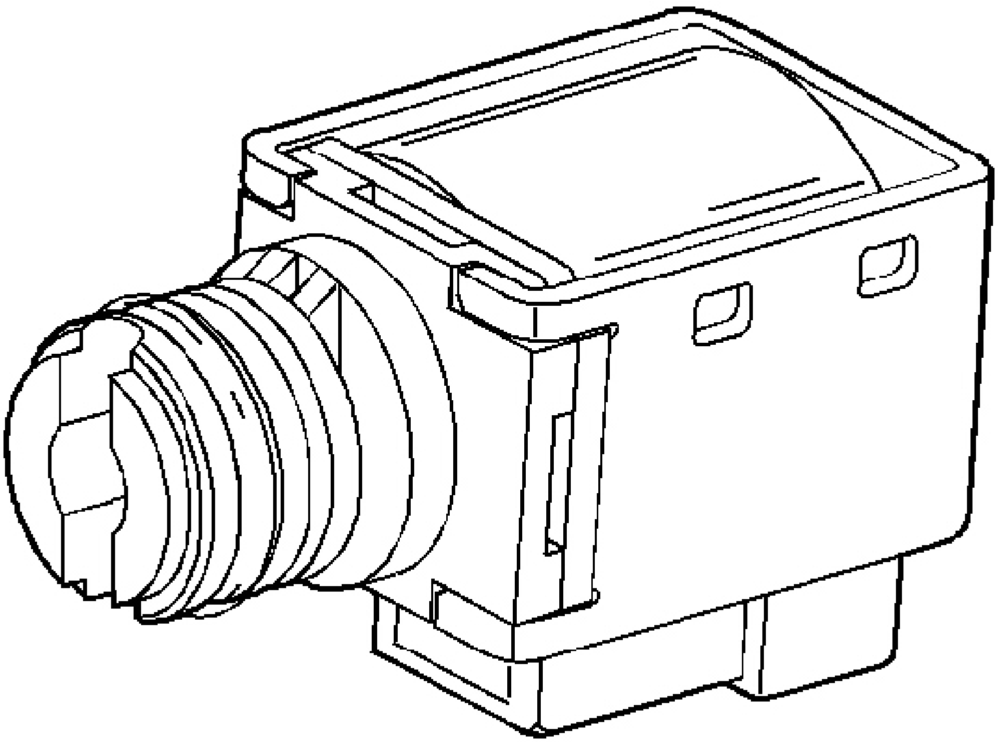


Fig. 488: 1-2 and 2-3 Shift Solenoid Valves
Courtesy of GENERAL MOTORS CORP.

The 1-2 and 2-3 shift solenoid valves (also called A and B solenoids) are identical devices that control the movement of the 1-2 and 2-3 shift valves. The 3-4 shift valve is not directly controlled by a shift solenoid. The solenoids are normally-open exhaust valves that work in 4 combinations to shift the transmission into different gears.

The powertrain control module (PCM) energizes each solenoid by grounding the solenoid through an internal quad driver. This sends current through the coil winding in the solenoid and moves the internal plunger out of the exhaust position. When ON, the solenoid redirects fluid to move a shift valve.

IMPORTANT: The manual valve hydraulically can override the shift solenoids. Only in D4 do the shift solenoid states totally determine what gear the transmission is in. In the other manual valve positions, the transmission shifts hydraulically and the shift solenoid states CATCH UP when the throttle position and the vehicle speed fall into the correct ranges.

The PCM-controlled shift solenoids eliminate the need for TV and governor pressures to control shift valve operation.

3-2 Shift Solenoid Valve Assembly

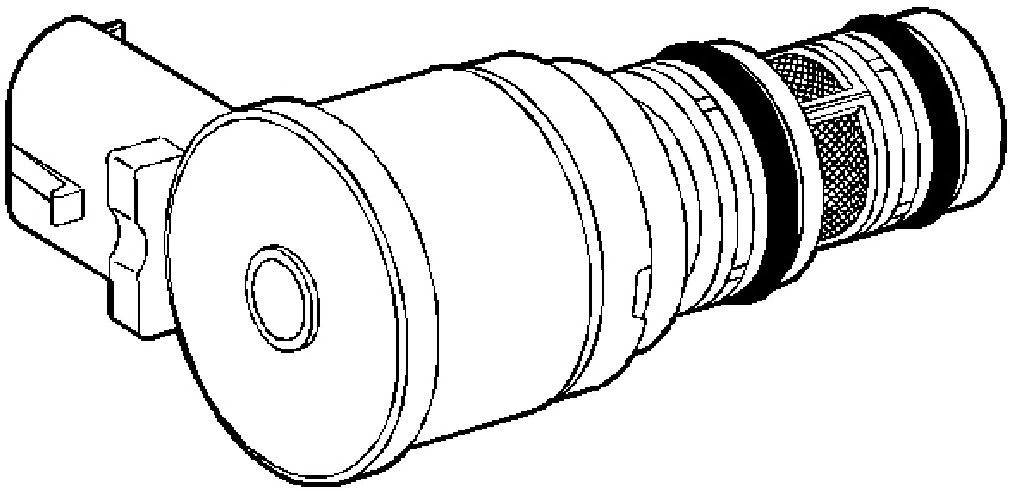


Fig. 489: 3-2 Shift Solenoid Valve Assembly
Courtesy of GENERAL MOTORS CORP.

The 3-2 shift solenoid valve assembly is a normally-closed, 3-port, ON/OFF device that is used in order to improve the 3-2 downshift. The solenoid regulates the release of the 3-4 clutch and the 2-4 band apply.

Transmission Pressure Control Solenoid

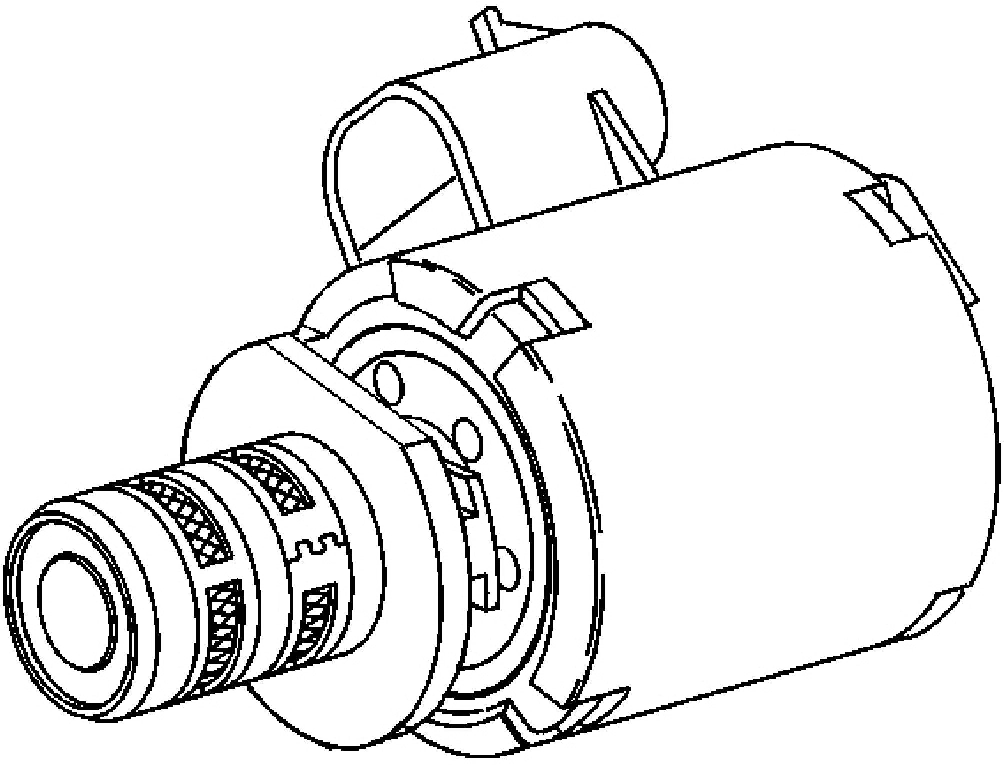


Fig. 490: Transmission Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

The transmission pressure control solenoid is an electronic pressure regulator that controls pressure based on the current flow through its coil winding. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve.

The PCM controls the pressure control solenoid by commanding current between 0.1-1.1 amps. This changes the duty cycle of the solenoid, which can range between 5-95 percent, typically less than 60 percent. High amperage (1.1 amps) corresponds to minimum line pressure, and low amperage (0.1 amp) corresponds to maximum line pressure, if the solenoid loses power, the transmission defaults to maximum line pressure.

The PCM commands the line pressure values, using inputs such as engine speed and throttle position sensor voltage.

The pressure control solenoid takes the place of the throttle valve or the vacuum modulator that was used on past model transmissions.

Torque Converter Clutch Solenoid Valve

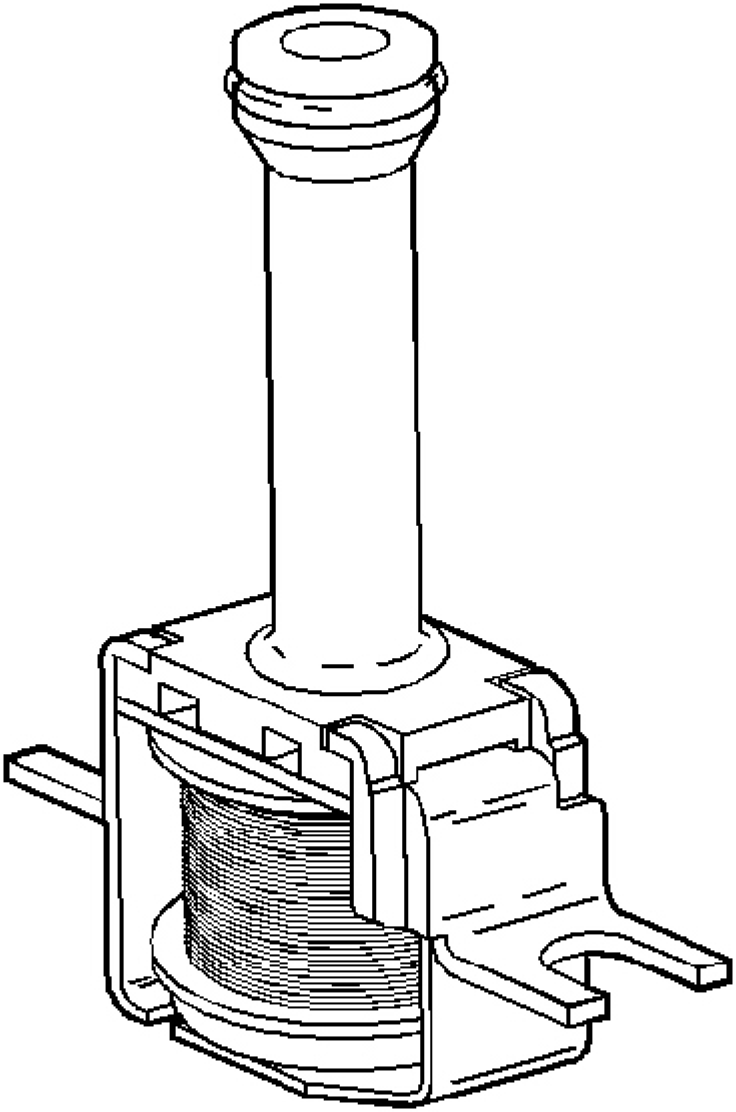


Fig. 491: Torque Converter Clutch Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

The torque converter clutch (TCC) solenoid valve is a normally-open exhaust valve that is used to control torque converter clutch apply and release. When grounded (energized) by the powertrain control module (PCM), the TCC solenoid valve stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and move the TCC solenoid valve into the apply position.

Torque Converter Clutch Pulse Width Modulation Solenoid Valve

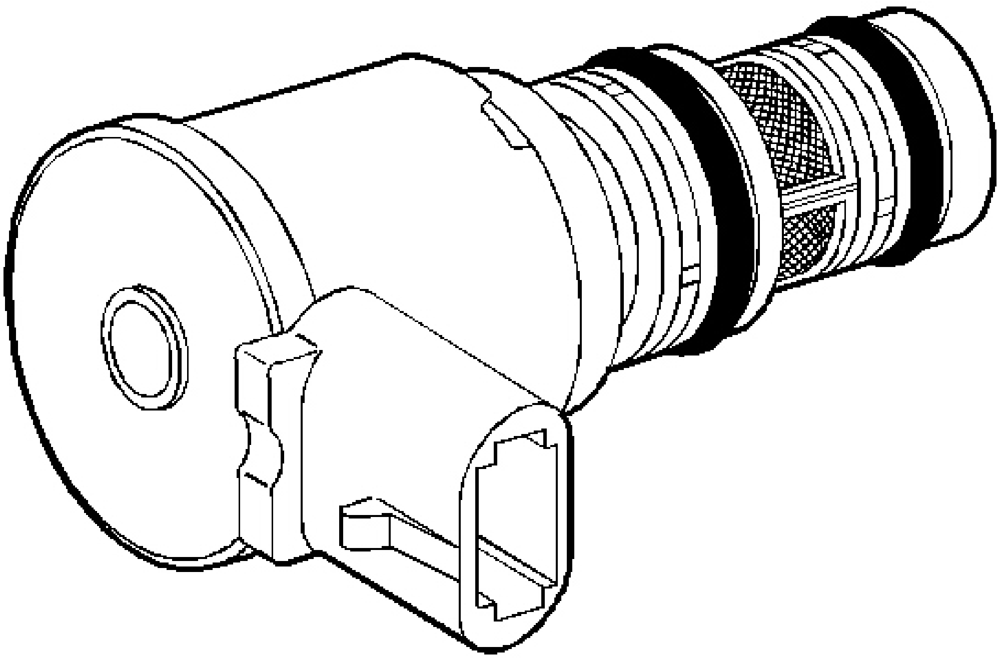


Fig. 492: Torque Converter Clutch Pulse Width Modulation Solenoid Valve (M30/M32)
Courtesy of GENERAL MOTORS CORP.

The torque converter clutch pulse width modulation solenoid valve controls the fluid acting on the converter clutch valve. The converter clutch valve controls the torque converter clutch (TCC) apply and release. This solenoid is attached to the control valve body assembly within the transmission. The TCC PWM solenoid valve provides a smooth engagement of the torque converter clutch by operating during a duty cycle percent of ON time.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch

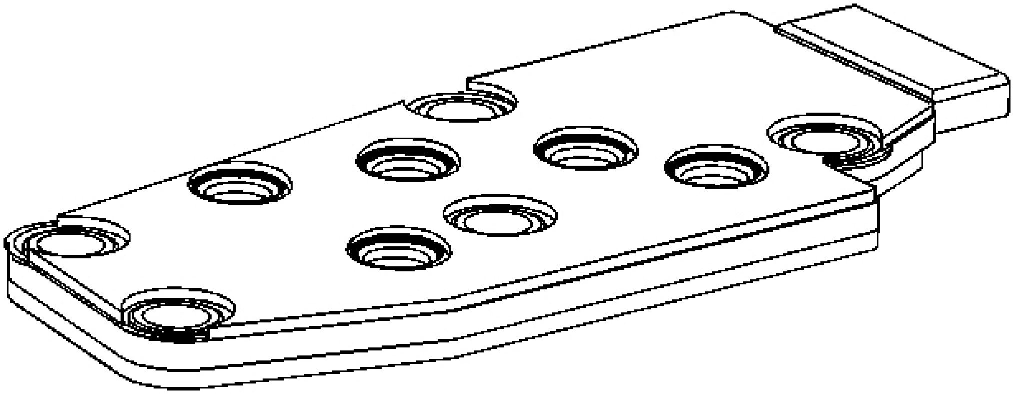


Fig. 493: Transmission Fluid Pressure (TFP) Manual Valve Position Switch (M33 Only)
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Seven valid combinations and two invalid combinations are available from the TFP manual valve position switch. Refer to the Transmission Fluid Pressure (TFP) Manual Valve Position Switch Logic table for valid/invalid combinations for range signal circuits A, B and C.

The transmission fluid pressure (TFP) manual valve position switch consists of five pressure switches (two normally-closed and three normally-open) on the control valve body that sense whether fluid pressure is present in five different valve body passages. The combination of switches that are open and closed is used by the PCM in order to determine the actual manual valve position. The TFP manual valve position switch, however, cannot distinguish between PARK and NEUTRAL because the monitored valve body pressures are identical in both cases.

The switches are wired to provide three signal lines that are monitored by the PCM. These signals are used to help control line pressure, torque converter clutch apply and shift solenoid valve operation. Voltage at each of the signal lines is either zero or twelve volts.

In order to monitor the TFP manual valve position switch operation, the PCM compares the actual voltage combination of the switches to a TFP combination table stored in its memory.

The TFP manual valve position switch signal voltage can be measured from each pin-to-ground and compared to the combination table. On the automatic transmission (AT) wiring harness assembly, pin N is signal A, pin R is signal B, and pin P is signal C. With the AT wiring harness assembly connected and the engine running, a voltage measurement of these three lines will indicate a high reading (near 12 volts) when a circuit is open, and a low reading (zero volts) when the circuit is switched to ground.

The transmission fluid temperature (TFT) sensor is part of the TFP manual valve position switch assembly.

Vehicle Speed Sensor Assembly

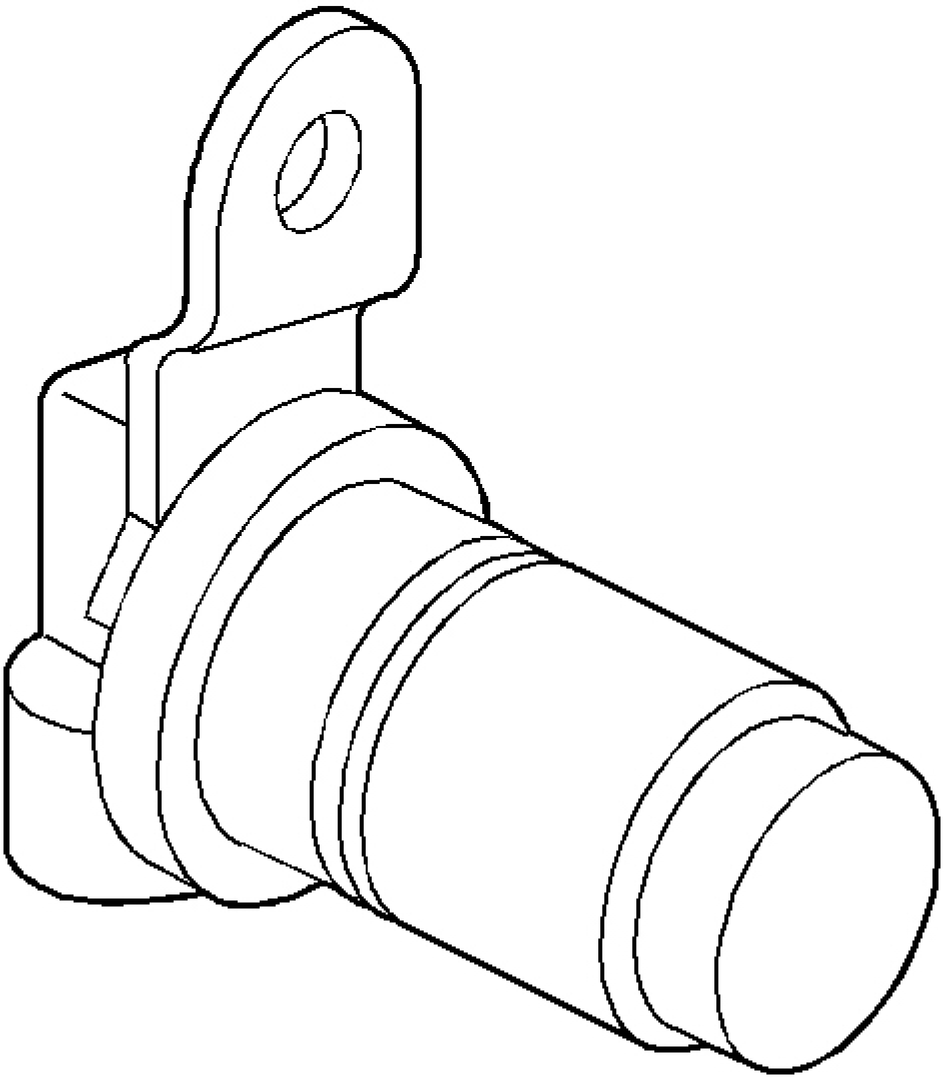


Fig. 494: View Of Vehicle Speed Sensor Assembly
Courtesy of GENERAL MOTORS CORP.

The vehicle speed sensor (VSS) assembly provides vehicle speed information to the PCM. The VSS assembly is a permanent magnet (PM) generator. The PM generator produces a pulsing AC voltage as rotor teeth on the transmission output shaft pass through the sensor's magnetic field. The AC voltage level and the number of pulses increase as the speed of the vehicle increases. Output voltage varies with speed from a minimum of 0.5

volts at 100 RPM to more than 100 volts at 8,000 RPM. The PCM converts the pulsing voltage to vehicle speed. The PCM uses the vehicle speed signal to determine shift timing and TCC scheduling.

Automatic Transmission Fluid Temperature Sensor

The automatic transmission fluid temperature (TFT) sensor is part of the automatic transmission fluid pressure (TFP) manual valve position switch. The TFT sensor is a resistor, or thermistor, which changes value based on temperature. The sensor has a negative-temperature coefficient. This means that as the temperature increases, the resistance decreases and as the temperature decreases, the resistance increases.

The PCM supplies a 5-volt reference signal to the TFT sensor and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high and the PCM detects high signal voltage. As the fluid temperature warms to a normal operating temperature, the resistance becomes less and the signal voltage decreases. Refer to TFT Sensor Specifications for a complete comparison of sensor resistance, temperature and signal voltage.

The PCM uses the TFT sensor information to control shift quality and TCC application.

Transmission Range Switch

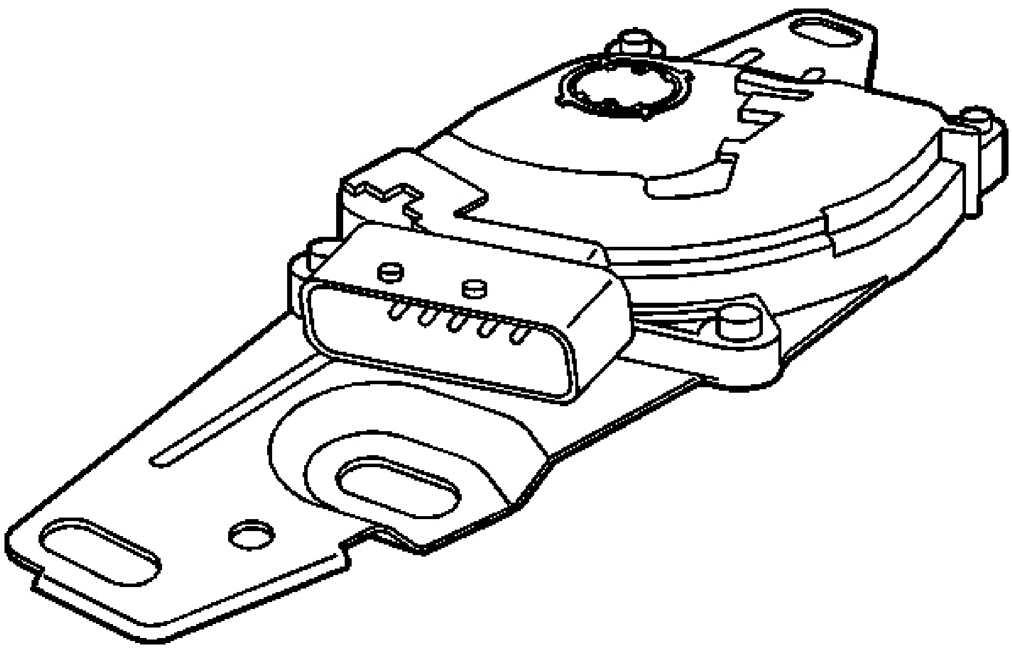


Fig. 495: Transmission Range Switch (M30/M32)
Courtesy of GENERAL MOTORS CORP.

The transmission range (TR) switch is part of the park/neutral position (PNP) and backup lamp switch assembly, which is externally mounted on the transmission manual shaft. The TR switch contains four internal switches that indicate the transmission gear range selector lever position. The powertrain control module (PCM) supplies ignition voltage to each switch circuit. As the gear range selector lever is moved, the state of each switch may change, causing the circuit to open or close. An open circuit or switch indicates a high voltage signal. A closed circuit or switch indicates a low voltage signal. The PCM detects the selected gear range by deciphering the combination of the voltage signals. The PCM compares the actual voltage combination of the switch signals to a TR switch combination chart stored in memory.

Tow/Haul Mode Switch

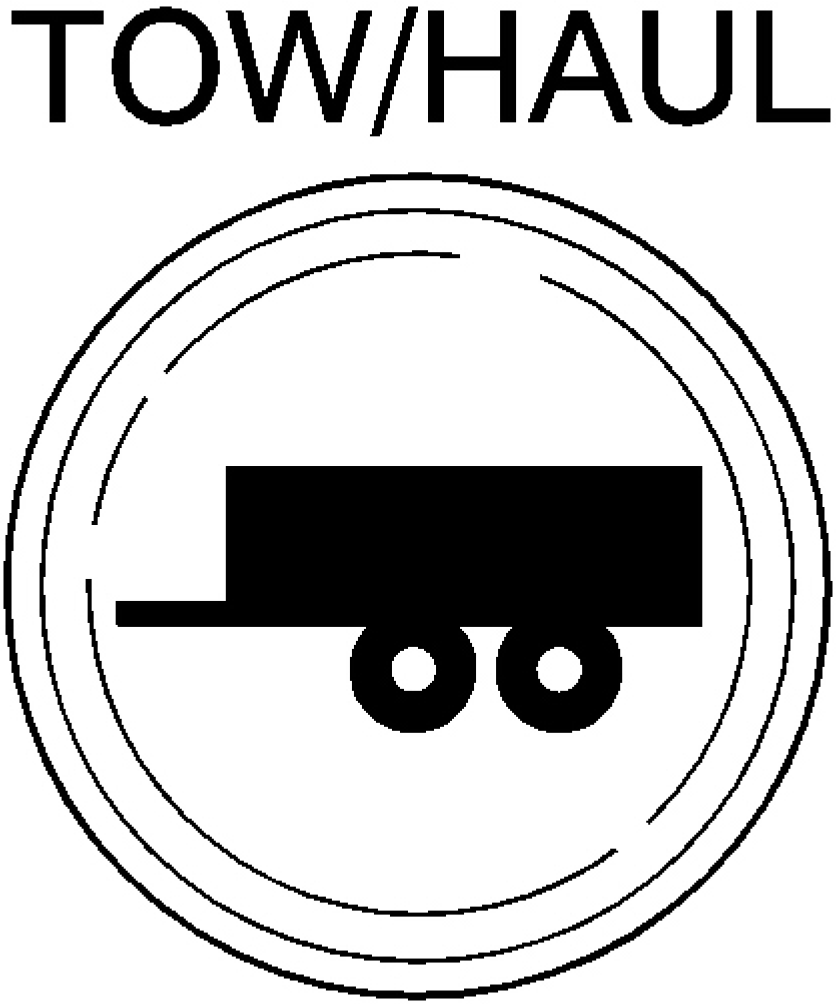


Fig. 496: Tow/Haul Mode Switch
Courtesy of GENERAL MOTORS CORP.

Tow/Haul mode enables the operator to achieve enhanced shift performance when towing or hauling a load. When tow/haul mode is selected, the tow/haul switch input signal to the body control module (BCM) is momentarily toggled to zero volts. This signals the powertrain control module (PCM) to extend the length of time between upshifts and increase transmission line pressure. Cycling the tow/haul switch again disables tow/haul mode and returns the transmission to a normal shift pattern.

AUTOMATIC TRANSMISSION INLINE 20-WAY CONNECTOR DESCRIPTION

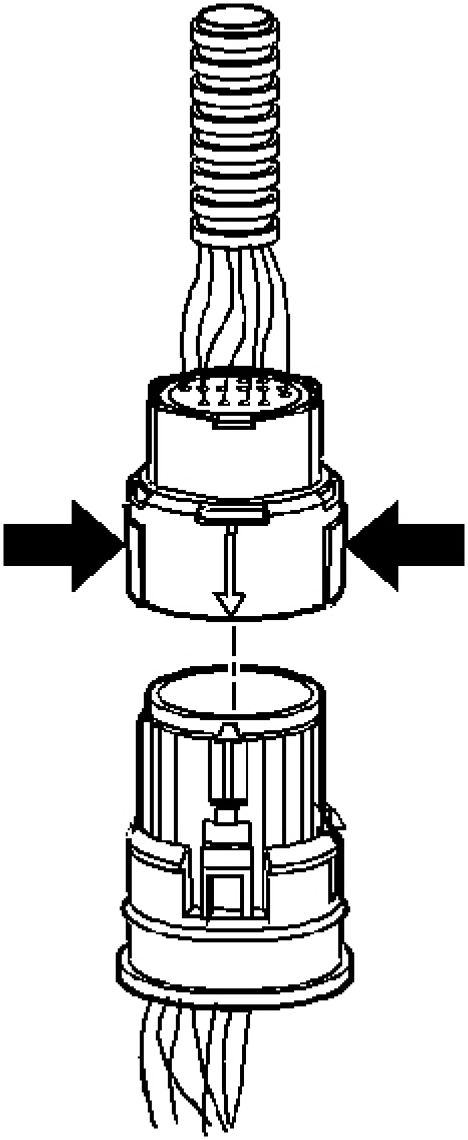


Fig. 497: Automatic Transmission Inline 20-Way Connector
Courtesy of GENERAL MOTORS CORP.

The transmission electrical connector is an important part of the transmission operating system. Any interference with the electrical connection can cause the transmission to set diagnostic trouble codes or affect proper operation.

The following items can affect the electrical connection:

- Bent pins in the connector from rough handling during connection and disconnection
- Wires backing away from the pins or coming uncrimped, in either the internal or the external wiring harness
- Dirt contamination entering the connector when disconnected
- Pins in the internal wiring connector backing out of the connector or pushed out of the connector during reconnection
- Transmission fluid leaking into the connector, wicking up into the external wiring harness and degrading the wire insulation
- Moisture intrusion in the connector
- Low pin retention in the external connector from excessive connection and disconnection of the wiring connector assembly
- Pin corrosion from contamination
- Damaged connector assembly

Remember the following points:

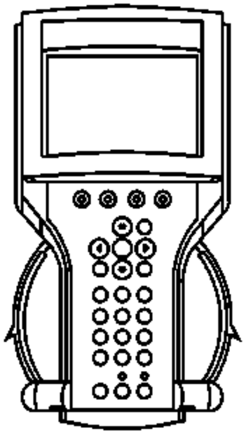
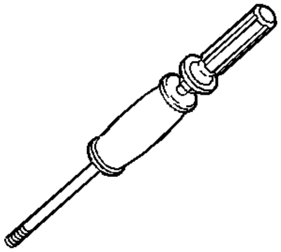
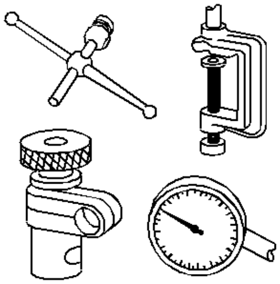
- In order to remove the connector, squeeze the two tabs toward each other and pull straight up without pulling by the wires.
- Limit twisting or wiggling the connector during removal. Bent pins can occur.
- Do not pry the connector off with a screwdriver or other tool.
- Visually inspect the seals to ensure that they are not damaged during handling.
- In order to reinstall the external wiring connector, first orient the pins by lining up the arrows on each half of the connector. Push the connector straight down into the transmission without twisting or angling the mating parts.
- The connector should click into place with a positive feel and/or noise.
- Whenever the transmission external wiring connector is disconnected from the internal harness and the engine is operating, DTCs will set. Clear these DTCs after reconnecting the external connector.

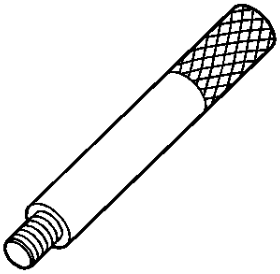
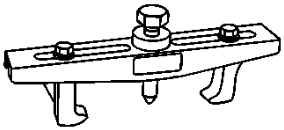
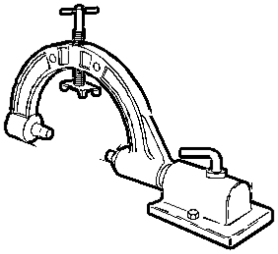
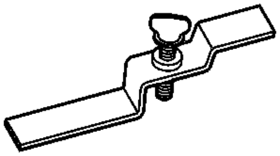
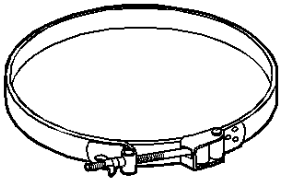
SPECIAL TOOLS AND EQUIPMENT

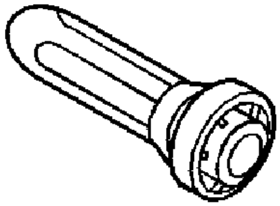
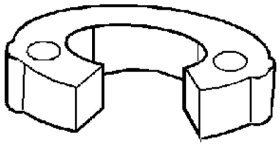
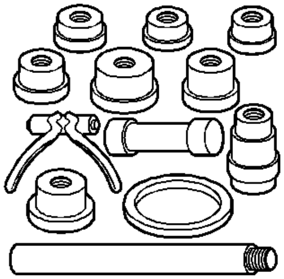
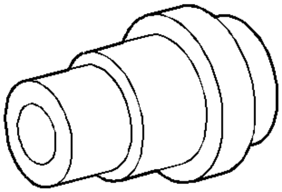
SPECIAL TOOLS

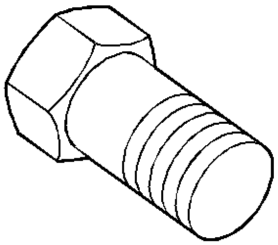
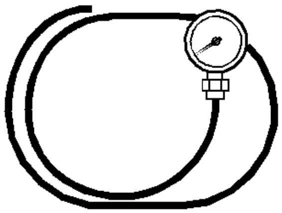
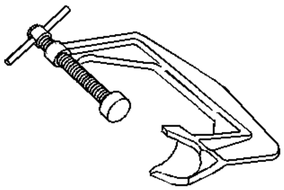
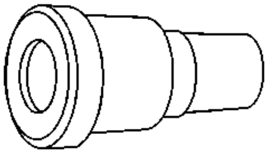
Special Tools

Illustration	Tool Number/Description

	Scan Tool
	J 7004-1 Universal Remover
	J 8001 Dial Indicator Set
	J 8092

	Universal Driver Handle - 3/4 in - 10
	J 8433 Two Jaw Puller
	J 8763-02 Holding Fixture and Base
	J 21366 Converter Holding Strap
	J 21368 Pump Body and Cover Alignment Band

	J 21426 Extension Housing Seal Installer
	J 21427-01 Speedometer Gear Puller Adapter
	J 21465-01 Bushing Service Set
	J 21465-2 Pump Cover Bushing Installer
	J 21465-15 Sun Gear and Stator Shaft Bushing Remover

	
	J 21867 Pressure Gauge
	J 22269-01 Accumulator and Servo Piston Remover
	J 23062-14 Bearing and Bushing Remover
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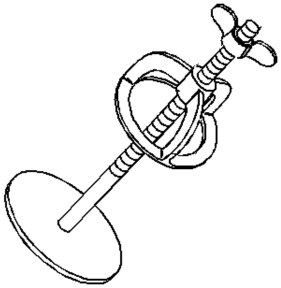
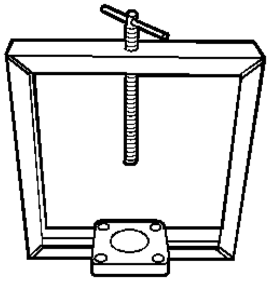
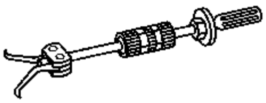
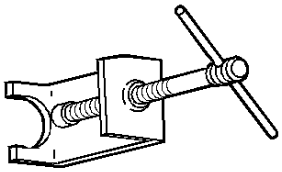
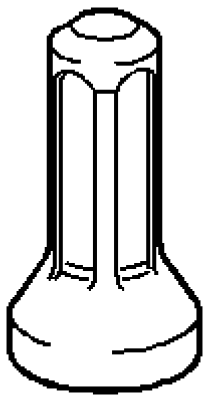
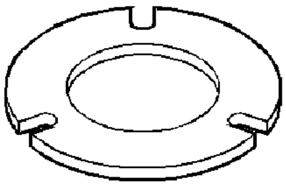
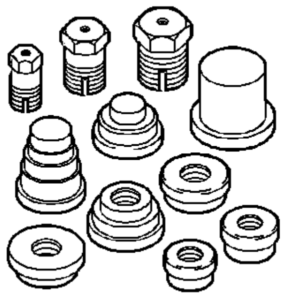
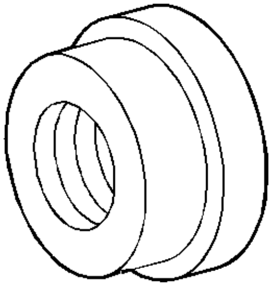
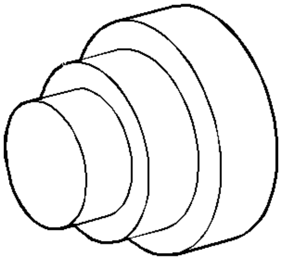
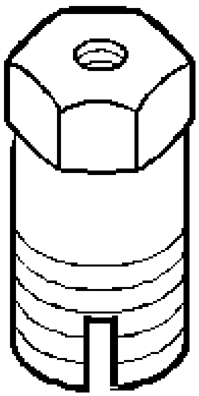
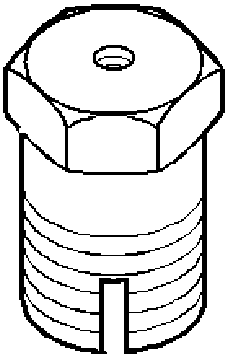
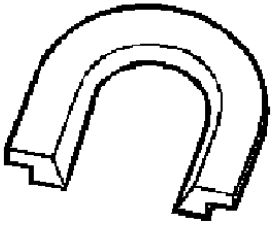
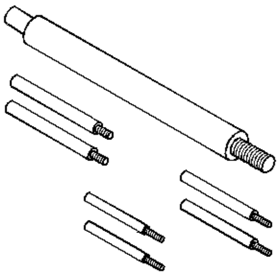
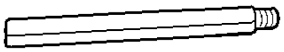
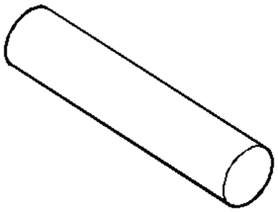
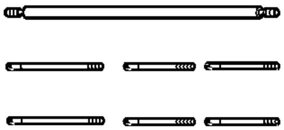
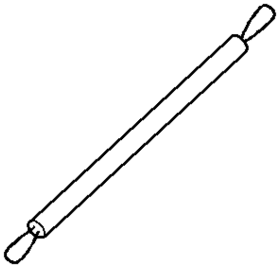
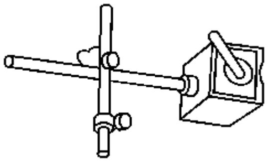
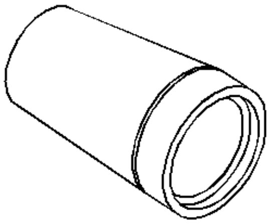
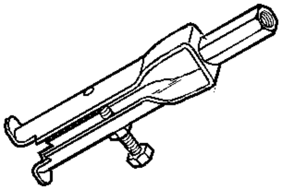
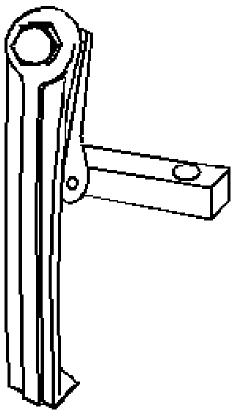
	
	J 23456 Booster and Clutch Pack Compressor
	J 23907 Slide Hammer with Bearing Adapter
	J 24773-A Oil Pump Remover

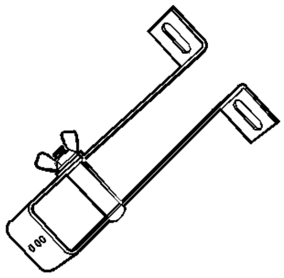
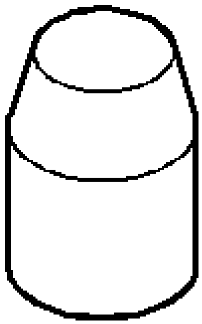
	J 25016 Pump Seal and Speedometer Gear Installer
	J 25018-A Clutch Spring Compressor Adapter
	J 25019 Bushing Service Set
	J 25019-4 Direct Clutch Bushing Remover

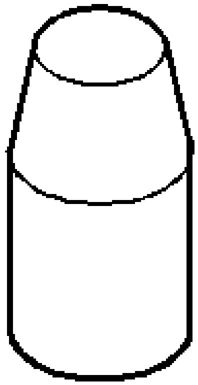
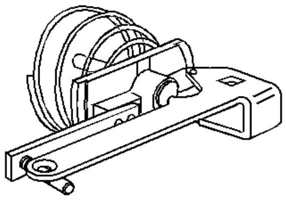
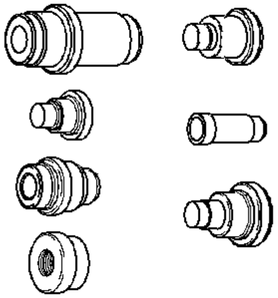
	
	J 25019-9 Bushing Installer
	J 25019-14 Stator Pump Bushing Remover

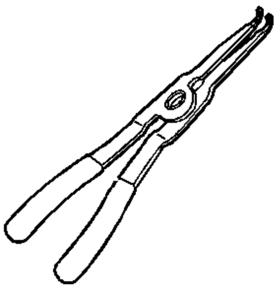
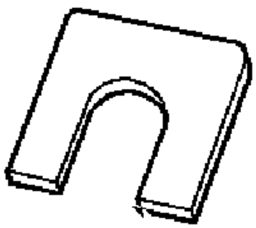
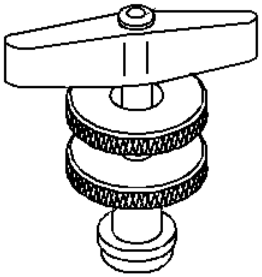
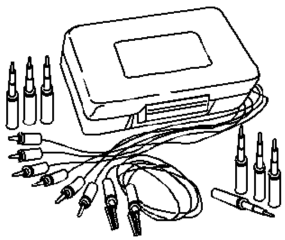
	J 25019-16 Bushing Remover
	J 25022-A End Play Fixture Adapter
	J 25025-B Dial Indicator Post and Guide Pin Set
	J 25025-1 Dial Indicator Mounting Post

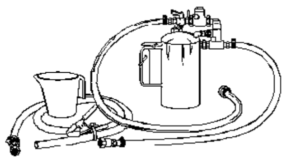
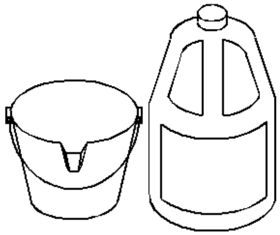
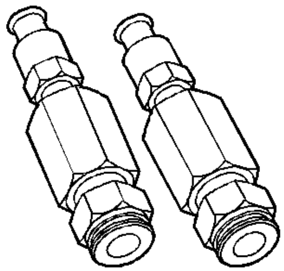
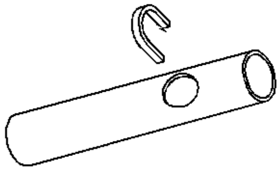
	J 25025-5 Dial Indicator Mounting Post M6 x 1.00
	J 25025-7A Dial Indicator Mounting Post
	J 26744-A Seal Installer
	J 26900-13 Magnetic Indicator Base
	J 28458 Seal Protector Retainer Installer

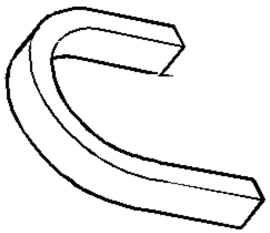
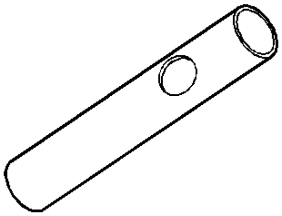
	
	J 29369-2 Bushing and Bearing Remover - 2-3 in
	J 29714-A Servo Cover Depressor
	J 29837-A Output Shaft Support Fixture

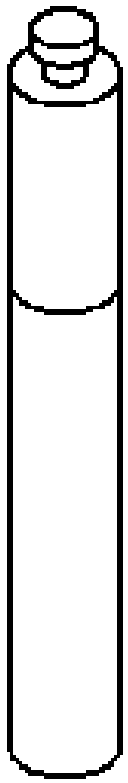
	
	J 29882 Overrun Clutch Seal Protector
	J 29883 Forward Clutch Seal Protector

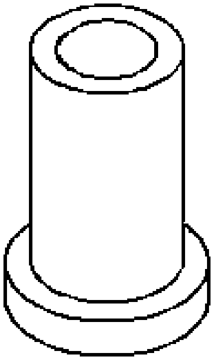
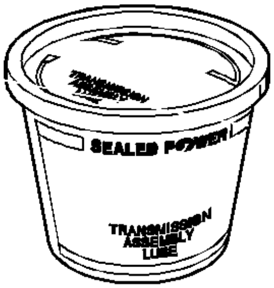
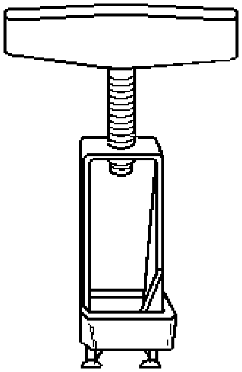
	
	J 33037 2-4 Intermediate Band Apply Pin Gauge
	J 34196-B Transmission Bushing Service Set
	J 34627

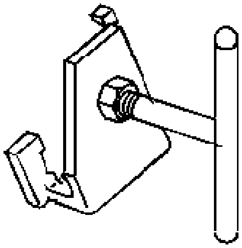
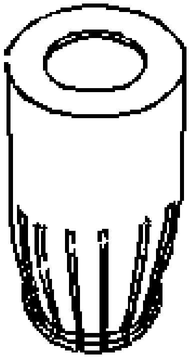
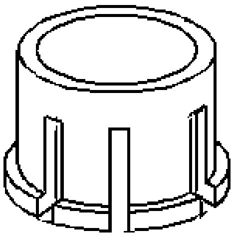
	Snap Ring Remover and Installer
	J 34725 End Play Checking Adapter
	J 35138 Converter End Play Checker
	J 35616-B GM Terminal Test Kit

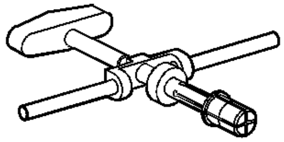
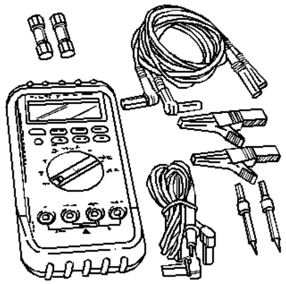
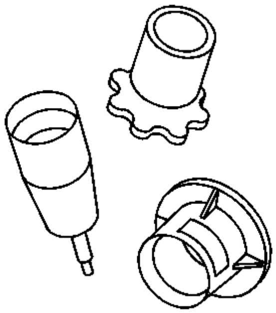
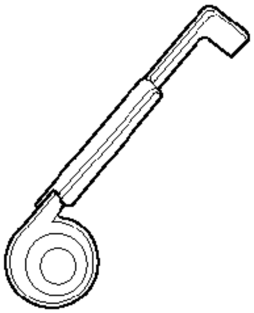
	J 35944-A Transmission Oil Cooler Flusher
	J 35944-22 Transmission Oil Cooler Flushing Fluid
	J 35944-200 Cooler Flushing Adapter
	J 36352 Speed Sensor Rotor Installer Kit
	J 36352-4 Speed Sensor Rotor Installation Depth C Washer

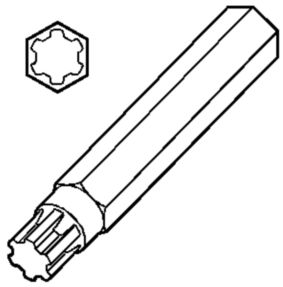
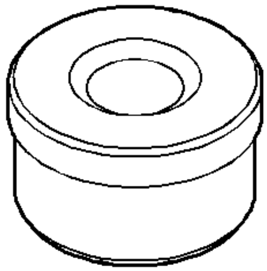
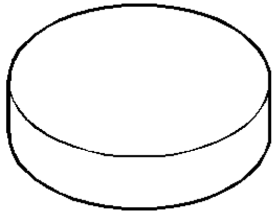
	
	J 36352-6 Speed Sensor Rotor Installation Tube
	J 36418-1B Turbine Shaft Seal Installer

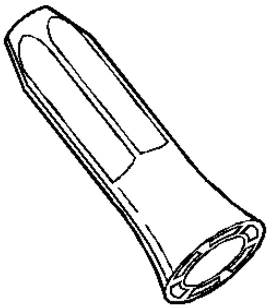
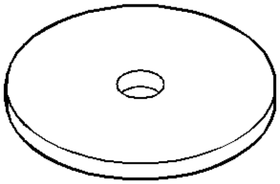
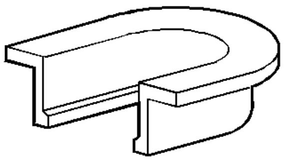
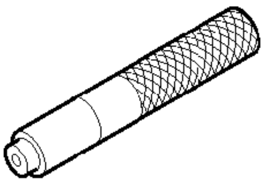
	
	J 36418-2A Turbine Shaft Seal Sizer

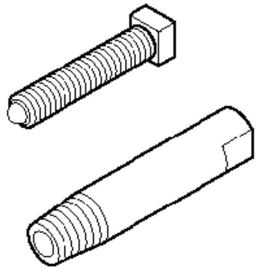
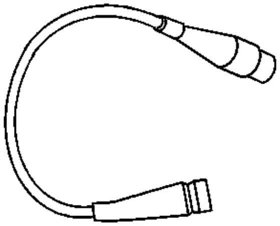
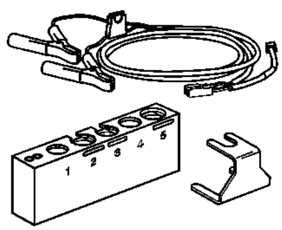
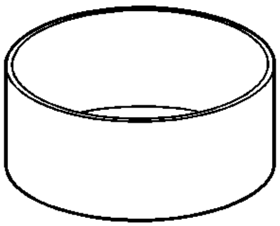
	
	J 36850 Transjel Lubricant
	J 37789-A Oil Pump Remover/Installer

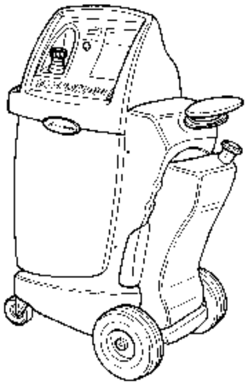
	J 38417 Speed Sensor Remover/Installer
	J 38735-3 Pusher
	J 39119 Oil Pump Remover/Installer Adapter

	J 39195 Converter End Play Check Tool
	J 39200 Digital Multimeter
	J 39855 Stator Shaft Seal Installer
	J 41364-A Park/Neutral Switch Aligner

	J 41510 T-50 Plus Bit
	J 41778-1 Pump Body Bushing Installer/Remover
	J 41778-2 Pump Body Bushing Position Stop
	J 42198 Transmission Rear Seal Installer

	
	J 42628 Disc
	J 43205 End Play Fixture Adapter (300 mm Converter)
	J 43909 Selector Shaft Seal Installer
	J 43911 Selector Shaft Seal Remover

	
	J 44152 Jumper Harness (20 pins)
	J 44246 Solenoid Testing Kit
	J 44571-1 Reverse Input Clutch Piston Installer

	J 45096 Transmission Oil Cooling System Flush and Flow Test Tool

AUTOMATIC TRANSAXLE (DIAGNOSTIC INFORMATION & PROCEDURES)

DIAGNOSTIC STARTING POINT - AUTOMATIC TRANSMISSION

Begin the system diagnosis with **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4). The Diagnostic System Check provides the following information:

- The identification of the control module or modules which commands the system.
- The ability of the control module or modules to communicate through the serial data circuit.
- The identification and status of stored diagnostic trouble codes (DTCs).

The use of the **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4) identifies the correct procedure for diagnosing the system and the procedure location.

Symptoms

When it has been determined through **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4) that no DTCs are present, begin symptom diagnosis by reviewing the **Transmission Component and System Description** . Reviewing the **Transmission Component and System Description** information enables you to understand the operation of the system. This helps you determine if the condition described by the customer is normal or if a malfunction exists. If it is determined that a malfunction exists, identify the concern by referring to the **Symptoms - Automatic Transmission** table. The **Symptoms - Automatic Transmission** table provides common diagnostic categories which relate directly to diagnostic information or procedures.

DIAGNOSTIC SYSTEM CHECK - AUTOMATIC TRANSMISSION

Circuit Description

The Automatic Transmission Diagnostic System Check is an organized approach to identify a problem created by an automatic transmission. The Diagnostic System check is the diagnostic starting point for an automatic transmission complaint. The Diagnostic System Check directs you to the next logical step for diagnosing a transmission concern. Perform this check only if there is a driveability complaint or if you have been directed here from another service information section.

Follow the table to help reduce diagnostic time and help prevent unnecessary replacement of good parts.

Diagnostic Aids

IMPORTANT:	• **Do not clear the DTC unless directed by a diagnostic procedure. Clearing the DTCs will erase all Freeze Frame and Failure Records stored in PCM memory.**

- **Poor engine performance can sometimes be diagnosed as a transmission driveability condition. In order to avoid mis-diagnosis of the automatic transmission, always perform the Diagnostic System Check - Engine Controls in Engine Controls - 6.0L (LQ4).**

- Use a scan tool that is known to function correctly. If necessary, test the scan tool on another vehicle.
- Ensure the scan tool contains the most current file available.
- The scan tool will display a loss of communication error message under the following conditions:
  - PCM power is interrupted
  - The ignition switch is turned OFF
  - The battery voltage level is very low
  - A poor connection at the diagnostic link connector (DLC)

Test Description

The numbers below refer to the step numbers on the diagnostic table.

1: This step determines if the scan tool is receiving power through the DLC connector.

2: The MIL should illuminate whenever the ignition is ON and the engine is not running.

3: This step determines if the PCM is transmitting class 2 serial data to the DLC and that the class 2 data circuit is not open or shorted.

4: This step determines if a DTC is current or stored in history.

Diagnostic System Check - Automatic Transmission

Step	Action	Value (s)	Yes	No
1	1. Install a scan tool. **IMPORTANT:** **Check for applicable service bulletins before proceeding with this test. Perform this test only if there is a driveability complaint or if you have been directed to this table from another section in the service information.** **IMPORTANT:** **Do not turn the ignition OFF when performing this diagnostic procedure. Do not clear the DTCs unless instructed by this diagnostic procedure.**	-		

	2. Turn ON the ignition, with the engine OFF. Does the scan tool turn ON?		Go to **Step 2**	Go to **Diagnostic Starting Point - Data Link Communications** in Data Link Communications
2	Is the MIL ON?	-	Go to **Step 3**	Go to **Malfunction Indicator Lamp (MIL) Inoperative** in Engine Controls - 6.0L (LQ4)
3	Attempt to establish communication with the PCM. Does the scan tool communicate with the PCM?	-	Go to **Step 4**	Go to **Diagnostic Starting Point - Data Link Communications** in Data Link Communications
4	**IMPORTANT:** **Diagnostic Trouble Codes (DTCs), engine performance, and transmission default actions can greatly affect the transmission performance. Ensure that these items are not the cause of a transmission concern.** Use the scan tool Capture Info function in order to save or capture (Store Info) any DTC Information.Are there any DTCs present?	-	Go to **Diagnostic Trouble Code (DTC) List/Type**	Go to **Symptoms - Automatic Transmission**

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selections	Description
		• The PCM commands the 1-2 shift solenoid valve ON and OFF. The scan tool 1-2 Sol. parameter should match the commanded state. The scan tool Commanded Gear parameter should correspond with the shift solenoid combination. Refer to **Shift Solenoid Valve State and Gear Ratio** table. • When the ignition is ON, and the engine is OFF, there are no limits to this control. The solenoid remains ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM. • When the engine is running, the following control limits apply: ○ Only sequential gear changes are allowed. For example, 1st to 3rd is not allowed. If a non-sequential gear change is attempted, the message "Non-sequential gear changes not allowed. Gear changes must be in order" appears on the scan tool display.

<table>
<tr>
<td>1-2 Solenoid</td>
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The vehicle speed must be below a calibrated value. If the vehicle speed is too high, the message "Vehicle speed too high" appears on the scan tool display.
The engine speed must be below a calibrated value. If the engine speed is too high, the message "Engine speed too high" appears on the scan tool display.
Downshifts are allowed only when the vehicle speed is below a calibrated value. If the vehicle speed is too high, the message "Eng. is on and veh. speed too hi for 3-2 or 2-1 downshift" appears on the scan tool display.
The gear requested may not be greater than the current selected transmission range (PRNDL). For example, 3rd gear is not allowed if the transmission range is D2. If the gear requested is greater than the current selected transmission range, the message "Eng. running and gear request is greater than the current TR" appears on the scan tool display.
The solenoid remains ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM.

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<tr>
<td>2-3 Solenoid</td>
<td>-</td>
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The PCM commands the 2-3 shift solenoid valve ON and OFF. The scan tool 2-3 Sol. parameter should match the commanded state. The scan tool Commanded Gear parameter should correspond with the shift solenoid combination. Refer to <u>Shift Solenoid Valve State and Gear Ratio</u> table.
When the ignition is ON, and the engine is OFF, there are no limits to this control. The solenoid will remain ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM.
When the engine is running, the following control limits apply:

Only sequential gear changes are allowed. For example, 1st to 3rd is not allowed. If a non-sequential gear change is attempted, the message "Non-sequential gear changes not allowed. Gear changes must be in order" appears on the scan tool display.
The vehicle speed must be below a calibrated value. If the vehicle speed is too high, the message "Vehicle speed too high" appears on the scan tool display.
The engine speed must be below a calibrated value. If the engine speed is too high, the message "Engine speed too high" appears on the scan tool display.
Downshifts are allowed only when the vehicle speed is below a calibrated value. If the vehicle speed is too high, the message "Eng. is on and veh. speed too hi for 3-2 or 2-1

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downshift" appears on the scan tool display.
The gear requested may not be greater than the current selected transmission range (PRNDL). For example, 3rd gear is not allowed if the transmission range is D2. If the gear requested is greater than the current selected transmission range, the message "Eng. running and gear request is greater than the current TR" appears on the scan tool display.
The solenoid remains ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM.

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<tr><td>3-2 Downshift Solenoid</td><td>-</td><td>

The PCM commands the 3-2 shift solenoid valve ON and OFF. The scan tool 3-2 Downshift Sol. parameter should match the commanded state.
When the ignition is ON, and the engine is OFF, there are no limits to this control. The solenoid remains ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM.
When the engine is running, the following control limits apply:

The transmission range (PRNDL) must be in Park or Neutral. If the transmission range is not in Park or Neutral, the message "Engine running and transmission range is not Park/Neutral" appears on the scan tool display.
The solenoid remains ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM.

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<tr><td>Clear TAP (Transmission Adaptive Pressures)</td><td>-</td><td>

The PCM clears, or resets, the TAP cells to the original base value.
There are no limits to using this output control. It may be performed with the engine running or when the ignition is ON, and the engine is OFF.

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The PCM commands the amperage, current, to the pressure control solenoid in order to control transmission line pressure. As the amperage increases, the line pressure decreases. As the amperage decreases, the line pressure increases. The amperage range is 0.00-1.10 and may be commanded in one-tenth amp increments.
When the ignition is ON, and the engine is OFF, the reference, commanded, amperage may be controlled within calibrated limits. The scan tool parameter "PC Sol. Ref. Current" changes but the parameter "PC Sol. Actual Current" does not change. The reference current remains until commanded otherwise.
When the engine is running, the following control limits apply:

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<tr>
<td>PC Solenoid</td>
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When the transmission range is Park or Neutral, the reference, commanded, amperage may be controlled within calibrated limits. The engine speed must be less than 1,500 RPM. If the engine speed is greater than 1,500 RPM, the message "TR in park/neutral and engine speed over 1,500 RPM" appears on the scan tool display. Both the scan tool parameters "PC Sol. Ref. Current" and "PC Sol. Actual Current" change. Both current readings remain until commanded otherwise.
When the transmission range is not in Park or Neutral, the reference amperage can only be controlled less than the current determined by the PCM. The PCM does not allow a value to be selected that may cause damage to the transmission. If the requested amperage is more than allowed by the PCM, the message "Requested current for the PC Solenoid is too high" appears on the scan tool display.
Transmission range DTCs must not be active. If a transmission range DTC is active, the message "Engine running with transmission DTC present" appears on the scan tool display.

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<tr>
<td>Shift Transmission</td>
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The PCM commands upshifts and downshifts. The scan tool Commanded Gear parameter should correspond with the shift solenoid combination. Refer to Shift Solenoid Valve State and Gear Ratio table.
When the ignition is ON, and the engine is OFF, there are no limits to this control. The scan tool shift solenoid states change to match the Commanded Gear selected.
When the engine is running, the following control limits apply:

The PCM does not allow a shift if it causes the engine RPM to exceed a calibrated limit. If a gear is requested and the engine speed is too high, the message "Engine speed too high" appears on the scan tool display.
The PCM does not allow a 3-2 or 2-1 downshift if the vehicle speed exceeds a calibrated limit. If either downshift is requested and the vehicle speed is too high, the message "Eng. is on and veh. speed too hi for 3-2 or 2-1 downshift" appears on the scan tool display.
The PCM does not allow a 4-3 downshift if the vehicle speed exceeds a calibrated limit. If a 4-3 downshift is requested and the vehicle speed is too high, the message "Vehicle speed too high" appears on the scan tool display.
The PCM does not allow an upshift if the vehicle speed exceeds a calibrated limit. If an upshift is requested and the

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		vehicle speed is too high, the message "Vehicle speed too high" appears on the scan tool display. ◦ The PCM does not allow an upshift that is greater than the current selected transmission range (PRNDL). For example 3rd gear is not allowed if the transmission range is D2. If an upshift is requested that is greater than the current selected transmission range, the message "Eng. running and gear request is greater than the current TR" appears on the scan tool display.
TCC Control Solenoid	-	• The PCM commands the duty cycle of the TCC PWM solenoid. The duty cycle is represented by a percentage of ON, energized, time. Approximately 90-100 percent duty cycle represents an ON, energized, commanded state. Zero percent represents an OFF, non-energized, commanded state. The scan tool TCC Duty Cycle parameter should match the commanded state. • When the ignition is ON, and the engine is OFF, there are no limits to this control. The solenoid remains ON, 90-100 percent duty cycle, until commanded OFF, zero percent duty cycle, and vice versa. When the output control is exited, the solenoid duty cycle is determined by the PCM.
TCC Enable	-	• The PCM commands the TCC enable solenoid valve ON and OFF. The scan tool TCC Enable parameter should match the commanded state. • When the ignition is ON, and the engine is OFF, there are no limits to this control. The solenoid remains ON until commanded OFF, and vice versa. When the output control is exited, the solenoid state is determined by the PCM.

SCAN TOOL DATA LIST

Use the scan tool data list under the following conditions:

- The Diagnostic System Check - Automatic Transmission is complete.
- The on-board diagnostics are functioning properly.
- No DTCs are present.

The values below represent a typical display recorded from a properly functioning system.

IMPORTANT: Do not use a scan tool that displays faulty data. Report the condition to the scan tool manufacturer. The use of a faulty scan tool can result in misdiagnosis and the unnecessary replacement of parts.

Only the parameters listed below are used in this manual for diagnosing. If a scan tool displays other parameters, the values are not recommended by General Motors for use in diagnosis.

Scan tool values below were recorded under the following conditions:

- Engine at idle
- Upper radiator hose hot
- Closed throttle
- Transmission in PARK
- Closed Loop operation
- Accessories OFF
- Brake pedal not applied

Transmission Scan Tool Data List (N Truck)

Scan Tool Parameter	Data List*	Units Displayed	Typical Data Value
1-2 Shift Error	F2, F7/F0	Seconds	Varies
1-2 Shift Time	F0, F2, F7/F0	Seconds	Varies
1-2 Sol.	F0, F2, F3, F4	On/Off	On
1-2 Sol. Open/Short to GND	F2	Yes/No	No
1-2 Sol. Short to Volts	F2	Yes/No	No
1-2 TAP Cell (4-16)	F7/F0	kPa/Psi	Varies
2-3 Shift Error	F3, F7/F1	Seconds	Varies
2-3 Shift Time	F0, F3, F7/F1	Seconds	Varies
2-3 Sol.	F0, F2, F3, F4	On/Off	On
2-3 Sol. Open/Short to GND	F3	Yes/No	No
2-3 Sol. Short to Volts	F3	Yes/No	No
2-3 TAP Cell (4-16)	F7/F1	kPa/Psi	Varies
3-2 Downshift Sol.	F0, F5	On/Off	On
3-2 Sol. Open/Short to GND	F5	Yes/No	No
3-2 Sol. Short to Volts	F5	Yes/No	No
3-4 Shift Error	F4	Seconds	Varies
3-4 Shift Time	F0, F4	Seconds	Varies
4WD	F0	Enabled/Disabled	Disabled
4WD Low	F0	Enabled/Disabled	Disabled
A/C Clutch	F0	On/Off	Off
Commanded Gear	F0, F1, F2, F3, F4, F5, F6	1, 2, 3, 4	1
Cruise	F0	Enabled/Disabled	Disabled
Current TAP Cell	F7/F0, F7/F1	4-16	Varies
ECT	F0, F1	°C (°F)	Varies
Engine Run Time	F0	Hr/Min/Sec	Varies

Engine Speed	F0, F1, F2, F3, F4, F5, F6	RPM	Varies
Engine Torque	F0, F1	N.m (lb ft)	Varies
Estimated Gear Ratio	F0, F1, F2, F3, F4	Ratio	8.00:1
Ignition Voltage	F0	Volts	12-14 Volts
Last Shift Time	F0	Seconds	Varies
PC Sol. Actual Current	F0, F6	Amps	Varies, 0.1-1.1 amps
PC Solenoid Duty Cycle	F0, F6	Percent	Varies
PC Sol. Ref. Current	F0, F6	Amps	Varies, 0.1-1.1 amps
Power Take Off	F0	On/Off	On
Speed Ratio	F0, F1, F2, F3, F4, F5	Ratio	8.00:1
TCC Brake Switch	F0, F1	Open/Closed	Closed
TCC Duty Cycle	F0, F1	Percent	0%
TCC Duty Cycle Open/Short to GND	F1	Yes/No	No
TCC Duty Cycle Short to Volts	F1	Yes/No	No
TCC Enable	F0, F1	Yes/No	No
TCC Enable Open/Short to GND	F1	Yes/No	No
TCC Enable Short to Volts	F1	Yes/No	No
TCC Slip Speed	F0, F1	RPM	+/-50 RPM from Engine Speed
TFP Sw.	F0	Park/Neutral, Reverse, Drive4, Drive3, Drive2, Drive1 or Invalid	Park/Neutral
TFP Sw. A/B/C	F0	HI/LOW	HI/LOW/HI
TFT Sensor	F0, F1, F6	Volts	Varies
Torque Converter Efficiency	F0, F1, F2, F3, F4	Ratio	.00:1
Tow/Haul Mode	F0	Active/Inactive	Inactive
TP Angle Vehicles w/o Traction Control	F0, F1, F2, F3, F4, F5, F6	Percent	0%
TP Indicated Angle Vehicles with Traction Control	F0, F1, F2, F3, F4, F5, F6	Percent	0-10%
TP Sensor Vehicles w/o Traction Control	F0, F1, F2, F3, F4, F5	Volts	0.3-0.9 V

TR Sw.	F0	Park/Neutral, Reverse, Drive4, Drive3, Drive2, Drive1 or Invalid	Park/Neutral
TR Sw. A/B/C/P	F0	HI/LOW	LOW/HI/HI/LOW
Traction Control	F0	Active/Inactive	Inactive
Trans. Fluid Temp.	F0, F1, F5, F6	°C (°F)	Varies
Trans. Slip Counter	F0, F1	0, 1, 2	0
Transfer Case Ratio	F0, F2, F3, F4	Ratio	2.61:1
Transmission Hot Mode	F0, F1	On/Off	Off
Transmission OSS	F0, F1, F2, F3, F4, F5	RPM	0
Vehicle Speed	F0, F1, F2, F3, F4, F5	km/h (mph)	0

***Data List Legend**

- F0: Transmission Data
- F1: TCC Data
- F2: 1-2 Shift Data
- F3: 2-3 Shift Data
- F4: 3-4 Shift Data
- F5: 3-2 Down Shift Data
- F6: PC Solenoid Data
- F7: Transmission Adapts
- F7/F0: 1-2 Adapt. Data
- F7/F1: 2-3 Adapt. Data

SCAN TOOL DATA DEFINITIONS

1-2 Shift Error

This parameter is the difference between the desired 1-2 shift time and the actual 1-2 shift time. A positive number indicates a firm or fast shift, the actual shift time was shorter than the desired shift time. A negative number indicates a soft or slow shift, the actual shift time was longer than the desired shift time. This value is only accurate if the shift was adaptable.

1-2 Shift Time

This parameter is the actual time of the last 1-2 shift. The shift time is based on the engine RPM drop after the commanded 1-2 shift. This value is only accurate if the shift was adaptable.

1-2 Sol.

Displays ON or OFF. This parameter is the commanded state of the 1-2 shift solenoid valve. ON represents a commanded energized state, current is flowing through the solenoid. OFF represents a non-commanded state, current is not flowing through the solenoid.

1-2 Sol. Open/Short to GND

Displays Yes or No. This parameter indicates if an open or short to ground exists in the 1-2 shift solenoid valve feedback signal to the PCM. This parameter is valid only when the 1-2 shift solenoid is commanded OFF.

1-2 Sol. Short to Volts

Displays Yes or No. This parameter indicates if a short to voltage exists in the 1-2 shift solenoid valve feedback signal to the PCM. This parameter is valid only when the 1-2 shift solenoid is commanded ON.

1-2 Tap Cell (4-16)

Displays kPa or psi. This parameter displays the amount of pressure varied from a calibrated base line pressure for shifts. Each TAP Cell is based on a calibrated shift torque value. Each TAP Cell value is calculated from the last shift time. This cell pressure is used in addition to the calibrated base line pressure to adjust the apply of a clutch or band during the next shift.

2-3 Shift Error

This parameter is the difference between the desired 2-3 shift time and the actual 2-3 shift time. A positive number indicates a firm or fast shift, the actual shift time was shorter than the desired shift time. A negative number indicates a soft or slow shift, the actual shift time was longer than the desired shift time. This value is only accurate if the shift was adaptable.

2-3 Shift Time

This parameter is the actual time of the last 2-3 shift. The shift time is based on the engine RPM drop after the commanded 2-3 shift. This value is only accurate if the shift was adaptable.

2-3 Sol.

Displays ON or OFF. This parameter is the commanded state of the 2-3 shift solenoid valve. ON represents a commanded energized state, current is flowing through the solenoid. OFF represents a non-commanded state, current is not flowing through the solenoid.

2-3 Sol. Open/Short to GND

Displays Yes or No. This parameter indicates if an open or short to ground exists in the 2-3 shift solenoid valve feedback signal to the PCM. This parameter is valid only when the 2-3 shift solenoid is commanded OFF.

2-3 Sol. Short to Volts

Displays Yes or No. This parameter indicates if a short to voltage exists in the 2-3 shift solenoid valve feedback signal to the PCM. This parameter is valid only when the 2-3 shift solenoid is commanded ON.

2-3 Tap Cell (4-16)

See 1-2 Tap Cell (4-16)

3-2 Downshift Sol.

Displays On or Off. This parameter indicates if the 3-2 shift solenoid valve assembly is currently commanded On or Off. The solenoid commanded state is based on the transmission temperature. The solenoid will change states during a 3-2 downshift to regulate the appropriate pressure. The commanded state of the solenoid occurs at approximately 30 mph with a throttle increase.

3-2 Downshift Sol. Open/Short to GND

Displays Yes or No. This parameter indicates if an open or short to ground exists in the 3-2 shift solenoid valve assembly feedback signal to the PCM. This parameter is valid only when the 3-2 shift solenoid is commanded OFF.

3-2 Downshift Sol. Short to Volts

Displays Yes or No. This parameter indicates if a short to voltage exists in the 3-2 shift solenoid valve assembly feedback signal to the PCM. This parameter is valid only when the 3-2 shift solenoid is commanded ON.

3-4 Shift Error

This parameter is the difference between the desired 3-4 shift time and the actual 3-4 shift time. A positive number indicates a firm or fast shift, the actual shift time was shorter than the desired shift time. A negative number indicates a soft or slow shift, the actual shift time was longer than the desired shift time. This value is only accurate if the shift was adaptable.

3-4 Shift Time

This parameter is the actual time of the last 3-4 shift. The shift time is based on the engine RPM drop after the commanded 3-4 shift. This value is only accurate if the shift was adaptable.

4WD

Displays Enabled or Disabled. This parameter indicates whether the vehicle is currently in a four-wheel drive mode.

4WD Low

Displays Enabled or Disabled. This parameter is the signal state of the four-wheel drive low circuit. Enabled indicates a 0 voltage signal, 4WD Low requested. Disabled indicates a B+ voltage signal, 4WD Low not requested.

A/C Clutch

Displays On or Off. This parameter indicates the commanded state of the A/C control relay. The clutch should be engaged when On displays.

Commanded Gear

Displays 1, 2, 3 or 4. This parameter indicates the current commanded gear.

Cruise

Displays Enabled or Disabled. This parameter indicates whether the PCM is allowing cruise operation. The PCM has the ability to disable cruise control under certain conditions.

Current TAP Cell

The Current Transmission Adaptive Pressure Cell parameter indicates the current TAP cell in use for transmission line pressure adaptation. The cells are based on engine torque. The higher the engine torque, the higher the current TAP cell. The last cell used will remain displayed until the next adaptable upshift occurs.

ECT

The Engine Coolant Temperature parameter is the input signal of the engine coolant temperature sensor. The engine coolant temperature is high 151°C (304°F) when the signal voltage is low, 0 V, and the engine coolant temperature is low -40°C (-40°F) when the signal voltage is high, 5 V.

Engine Run Time

This parameter measures how long the engine has been operating. When the ignition switch is turned OFF, the value is reset to zero.

Engine Speed

This parameter indicates the rotational speed of the engine expressed as revolutions per minute.

Engine Torque

This parameter indicates the amount of torque that is delivered from the engine.

Estimated Gear Ratio

This parameter indicates the estimated turbine speed divided by the transmission output speed. Estimated turbine speed is calculated from engine speed and engine torque.

Ignition Voltage

This represents the system voltage measured by the PCM at it's ignition feed.

Last Shift Time

This parameter is the actual time of the last upshift. This value is only accurate if the shift was adaptable.

PC Sol. Actual Current

The Pressure Control Solenoid Actual Current parameter is the actual current of the pressure control solenoid circuit at the control module. Zero amp, no current flow, indicates actual higher line pressure. Actual lower line pressure is indicated by 1.1 amps, high current flow.

PC Solenoid Duty Cycle

This parameter is the commanded state of the pressure control solenoid expressed as a percent of energized ON time. Zero percent indicates zero ON time, non-energized, or no current flow. Approximately 60% at idle indicates maximum ON time, energized, or high current flow.

PC Sol. Ref. Current

The Pressure Control Solenoid Reference Current parameter is the commanded current of the pressure control solenoid circuit. Zero amp, no current flow, indicates commanded higher line pressure. Commanded lower line pressure is indicated by 1.1 amps, high current flow.

Power Take-Off

Displays Yes or No. This parameter indicates when the power Take-Off (PTO) is engaged. PTO mode disables all transmission diagnostics.

Speed Ratio

This parameter indicates engine speed divided by transmission output speed. This value is used to estimate transmission gear ratio.

TCC Brake Switch

The Torque Converter Clutch Brake Switch parameter displays Open or Closed. This parameter indicates the state of the brake switch circuit input. Open indicates a zero voltage input, brake switch open, brake pedal applied. Closed indicates a B+ voltage input, brake switch closed, brake pedal released.

TCC Duty Cycle

This parameter is the commanded percentage of ON time of the TCC PWM solenoid. Approximately 90% represents an ON, energized, commanded state. Zero percent represents an OFF, non-energized, commanded state. This commanded state is applied at a vehicle speed between approximately 0-16 km/h (0-10 mph).

TCC Duty Cycle Open/Short to GND

Displays Yes or No. This parameter indicates whether an open or a short to ground exists in the TCC PWM solenoid valve feedback signal to the PCM. This parameter is valid only when the TCC PWM solenoid is commanded OFF, duty cycle is 0%.

TCC Duty Cycle Short to Volts

Displays Yes or No. This parameter indicates whether a short to voltage exists in the TCC PWM solenoid valve feedback signal to the PCM. This parameter is valid only when the TCC PWM solenoid is commanded ON, duty cycle is at maximum.

TCC Enable

Displays On or Off. This parameter is the commanded state of the TCC solenoid. On indicates a commanded energized state, current is flowing through the solenoid. Off indicates a commanded non-energized state, current is not flowing through the solenoid. This commanded state occurs at various vehicle speeds between applications.

TCC Enable Open/Short to GND

Displays Yes or No. This parameter indicates whether an open or a short to ground exists in the TCC solenoid valve feedback signal to the PCM. This parameter is valid only when the TCC solenoid is commanded OFF.

TCC Enable Short to Volts

Displays Yes or No. This parameter indicates whether a short to voltage exists in the TCC solenoid valve feedback signal to the PCM. This parameter is valid only when the TCC solenoid is commanded ON.

TCC Slip Speed

This parameter is the difference between transmission output speed and engine speed. A negative value indicates that the engine speed is less than the output speed, deceleration. A positive value indicates that the engine speed is greater than the output speed, acceleration. A value of zero indicates that the engine speed is equal to the output speed, TCC applied.

TFP Sw.

The Transmission Fluid Pressure Switch parameter displays Park/Neutral, Reverse, Drive4, Drive3, Drive2, Drive1 or Invalid. This parameter is the decoded status of the three A/B/C inputs from the automatic transmission fluid pressure manual valve position switch. Invalid is displayed when the PCM does not recognize a valid combination of inputs.

TFP Sw. A/B/C

Displays HI/LOW, HI/LOW. This parameter indicates the status of the three inputs from the Automatic

Transmission Fluid Pressure Manual Valve Position Switch Assembly to the PCM. LOW represents a zero voltage signal. HI represents an ignition voltage signal.

TFT Sensor

The Transmission Fluid Temperature Sensor parameter displays a voltage related to the transmission fluid temperature. When the transmission fluid is cold, the sensor resistance is high and the PCM will sense high signal voltage. As the transmission fluid temperature warms to a normal operating temperature, the sensor resistance becomes less and the voltage decreases.

Torque Converter Efficiency - Ratio

Displays a ratio of .00:1 to 2:1. The ratio is calculated by multiplying the speed ratio by a value related to the "K factor" of the torque converter. The "K factor" is the looseness or tightness of the torque converter for a given torque. The nearer the torque converter is to full coupling, i.e. 1:1, the closer the torque converter efficiency number will be to 1.

Tow/Haul Mode

Displays Active or Inactive. This parameter indicates when the transmission is operating in a towing or hauling mode. In tow/haul mode, the PCM commands a different shift pattern that increases performance when towing or hauling. Shift quality and TCC scheduling are also affected during tow/haul mode operation.

TP Angle

The Throttle Position Angle is computed by the PCM from the TP Sensor voltage. The TP angle should read 0% at idle and 100% at Wide Open Throttle (WOT).

TP Indicated Angle

This parameter indicates the amount of throttle opening.

TP Sensor

The Throttle Position Sensor is used by the PCM to determine the amount of throttle demanded by the driver. Voltage is below 1 volt at idle and above 4 volts at Wide Open Throttle (WOT).

TR Sw.

The Transmission Range Switch parameter displays Park/Neutral, Reverse, Drive4, Drive3, Drive2, Drive1 or Invalid. This parameter is the decoded status of the four A/B/C/P inputs from the transmission range switch. Invalid is displayed when the PCM does not recognize a valid combination of inputs.

TR Sw. A/B/C/P

Displays HI/LOW, HI/LOW. This parameter indicates the status of the four inputs from the transmission range switch to the PCM. HI indicates an ignition voltage input to the PCM. LOW indicates a zero voltage input to the PCM.

Traction Control

Displays Active or Inactive. When the PCM receives a request for torque reduction from the electronic brake traction control module (EBTCM) Active is displayed.

Trans. Fluid Temp.

This parameter is the input signal of the transmission fluid temperature sensor. Transmission fluid temperature is high 151°C (304°F) when signal voltage is low, 0 V, and transmission fluid temperature is low -40°C (-40°F) when signal voltage is high, 5 V.

Trans. Slip Counter

Displays 0, 1 or 2. This parameter is the number of times the P0894 Diagnostic test has identified a slipping condition. This diagnostic test is required to identify a slipping condition three times in a row in order to set the DTC P0894 Transmission Component Slipping Diagnostic code.

Transfer Case Ratio

This parameter indicates the ratio of the transfer case calculated by engine speed divided by transmission output speed based on transmission commanded gear.

Transmission Hot Mode

Displays On or Off. This parameter monitors transmission temperature. On indicates that the transmission temperature has exceeded 135°C (275°F).

Transmission OSS

The Transmission Output Speed Sensor parameter indicates the rotational speed of the transmission output shaft expressed as revolutions per minute.

Vehicle Speed

This parameter is the input signal from the vehicle speed sensor assembly.

DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

The DTC Type Definitions contain the characteristics for all types of DTCs. Each DTC type may or may not be found in this section. The DTC type is based on the action that the PCM takes when storing DTC information and whether or not the PCM illuminates a service lamp or displays a message on a driver information center (DIC). The DTC descriptions in the Diagnostic Trouble Code List/Type are listed in numeric order and indicate the DTC types for domestic and export vehicle applications. Each DTC is categorized into one of the following types:

Type A

This DTC is emissions related. The PCM stores the DTC in History, Freeze Frame and Failure Records during the first trip in which the conditions for setting the DTC are met. The PCM also illuminates the malfunction indicator lamp (MIL) during the first trip in which the conditions for setting the DTC are met.

Type B

This DTC is emissions related. The PCM stores the DTC in Failure Records during the first trip in which the conditions for setting the DTC are met. The PCM stores the DTC in History and Freeze Frame during the second consecutive trip in which the conditions for setting the DTC are met. The PCM also illuminates the MIL during the second consecutive trip in which the conditions for setting the DTC are met.

Type C

This DTC is non-emissions related. The PCM stores the DTC in History and Failure Records during the first trip in which the conditions for setting the DTC are met. The PCM does not store the DTC in Freeze Frame and does not illuminate the MIL. For some type C DTCs, a message may be displayed on a DIC, if equipped. For other type C DTCs, a separate service lamp, other than the MIL, may be illuminated. Type C DTCs that do not display a message on the DIC or illuminate a separate service lamp were formerly referred to as type D.

Type X

This DTC is available in the PCM software, but has been disabled, or turned off. In this case, the diagnostic does not run, DTCs are not stored, and the MIL does not illuminate. Type X DTCs are used primarily for export vehicles that do not require MIL illumination or DTC storing.

The service information contained in this manual refers to the domestic, federal, calibration package. Domestic calibrations apply to vehicles sold in the United States, Canada and Japan. Export calibrations exist for both leaded and unleaded vehicles. DTC types may change for some export vehicles, and some DTCs may be turned off for leaded export vehicles. Differences between domestic and export calibrations are not reflected on DTC support information pages. DTC types for export calibrations are referenced only in the Diagnostic Trouble Code List/Type.

DIAGNOSTIC TROUBLE CODE (DTC) LIST/TYPE

DTC List

DTC	Domestic	Unleaded Export	Leaded Export
DTC P0218	C	C	C
DTC P0502	B	B	C
DTC P0503	B	B	C
DTC P0706	C	C	C
DTC P0711	C	C	C
DTC P0712	C	C	C
DTC P0713	C	C	C
DTC P0719	C	C	C

DTC P0724	C	C	C
DTC P0740	B	B	C
DTC P0741	B	B	C
DTC P0742	B	B	C
DTC P0748	C	C	C
DTC P0751	B	B	C
DTC P0752	B	B	C
DTC P0753	B	B	C
DTC P0756	A	A	C
DTC P0757	A	A	C
DTC P0758	A	A	C
DTC P0785	B	B	C
DTC P0894	B	B	C
DTC P1810	B	B	C
DTC P2761	B	B	C
DTC P2771	B	B	C

AUTOMATIC TRANSAXLE (TROUBLESHOOTING)

SYMPTOMS - AUTOMATIC TRANSMISSION

Symptom Diagnosis

Diagnostic Category	Diagnostic Information
This table consists of nine diagnostic categories that are located in the left column. Using this column, choose the appropriate category based on the operating conditions of the vehicle or transmission. After selecting a category, use the right column to locate the specific symptom diagnostic information.	
Fluid Diagnosis: This category contains the following topics: • Fluid condition - appearance, contaminants, smell, overheating • Line pressure - high or low • Fluid leaks	• Refer to **Transmission Fluid Checking Procedure** . • Refer to **Oil Pressure High or Low** . • Refer to **Fluid Leak Diagnosis** , procedure. • Refer to **Oil Out the Vent** .
Noise and Vibration Diagnosis: This category contains the following topics: • Ratcheting noise • Noise - drive gear, final drive, whine, growl, rattle, buzz, popping • Vibration	• Refer to **Ratcheting Noise** . • Refer to **Vibration in Reverse and Whining Noise in Park** . • Refer to **Popping Noise** . • Refer to **Whine Noise Varying with RPM or Fluid Pressure** . • Refer to **Buzz Noise or High Frequency Rattle Sound** . • Refer to **Noise in Random Ranges** .
Range Performance Diagnosis: This category contains the following topics: • Drives in Neutral • No Park • No Reverse • No Drive • No engine braking • Shift selector indicator does not match transmission gear range • Lack of Power or Hesitation	• Refer to **Drives in Neutral** . • Refer to **No Park** . • Refer to **No Reverse or Slips in Reverse** . • Refer to **No Drive in All Ranges** . • Refer to **No Drive in Drive Range** . • Refer to **No Overrun Braking - Manual 3-2-1** . • Refer to **Range Selector Displays Incorrect Range** . • Refer to **Lack of Power or Hesitation** .
Shift Quality (Feel) Diagnosis: This category contains the following topics:	• Refer to **Harsh Shifts** .

• Harsh, soft or slipping shifts • Harsh, soft or delayed engagement • Shift shudder, flare or tie-up	• Refer to **Slipping or Harsh 1-2 Shift** . • Refer to **No 2-3 Shift or 2-3 Shift Slips, Rough or Hunting** . • Refer to **No 3-4 Shift, Slips or Rough 3-4 Shift** . • Refer to **Harsh Garage Shift** . • Refer to **Delay in Drive and Reverse** . • Refer to **3-2 Flare or Tie-Up** .
Shift Pattern: This category contains the following topics: • One forward gear only • Two forward gears only • Gear missing or slipping • No upshift or slipping upshift • No downshifts • Non-First gear start	• Refer to **First Gear Range Only - No Upshift** . • Refer to **Third Gear Only** . • Refer to **Second/Third Gear Only or First/Fourth Gears Only** . • Refer to **Slips in First Gear** . • Refer to **Slipping or Harsh 1-2 Shift** . • Refer to **No 2-3 Shift or 2-3 Shift Slips, Rough or Hunting** . • Refer to **No 3-4 Shift, Slips or Rough 3-4 Shift** . • Refer to **No Part Throttle or Delayed Downshifts** . • Refer to **Second Gear Start** .
Shift Speed Diagnosis: This category contains the following topic: Inaccurate or inconsistent shift points	Refer to **Inaccurate Shift Points** .
Torque Converter Diagnosis: This category contains the following topics: • Torque converter diagnosis • TCC does not apply • TCC does not release • TCC apply/release quality	• Refer to **Torque Converter Diagnosis Procedure** . • Refer to **No Torque Converter Clutch (TCC) Apply (300 RPM Slip)** . • Refer to **No Torque Converter Clutch (TCC) Release** . • Refer to **Torque Converter Clutch (TCC) Shudder** .
Indicator On or Message Center Displays Message: This category contains the following topics: • 4WD light does not illuminate • Tow/haul light does not illuminate • Message Center displays "Trans Fluid Hot"	or • Refer to **DTC P2771** . • Refer to **Tow/Haul Switch/Indicator Always On or Inoperative** . • Refer to **Transmission Fluid Checking Procedure** . • Refer to **Transmission Overheats** .

• Message Center displays "Trans Hot...Idle Engine"	
If symptom is not found	• Refer to **Transmission Fluid Checking Procedure** . • Refer to **Road Test Procedure** . • Refer to **Line Pressure Check Procedure** .

RANGE SELECTOR DISPLAYS INCORRECT RANGE

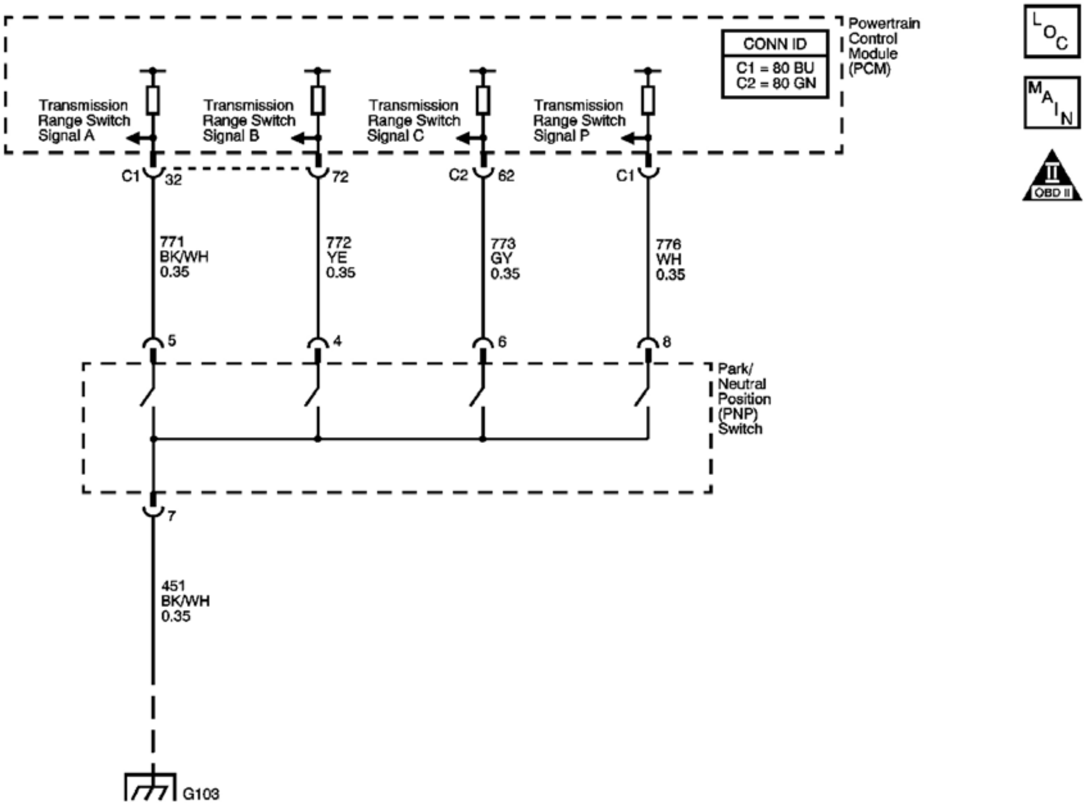


Fig. 1: Transmission Range (TR) Switch Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The transmission range (TR) switch is part of the park/neutral position (PNP) and back-up lamp switch assembly, which is externally mounted on the transmission manual shaft. The TR switch contains four internal switches that indicate the transmission gear range selector lever position. The PCM supplies ignition voltage to each switch circuit. As the gear range selector lever is moved, the state of each switch may change, causing the circuit to open or close. An open circuit or switch indicates a high voltage signal. A closed circuit or switch indicates a low voltage signal. The PCM detects the selected gear range by deciphering the combination of the voltage signals. The PCM compares the actual voltage combination of the switch signals to a TR switch combination chart stored in memory.

Diagnostic Aids

Refer to the **Transmission Range Switch Logic** table for valid combinations of switch signal circuits A, B, C and Parity. On the table, HI indicates an ignition voltage signal. LOW indicates a zero voltage signal.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **4:** By disconnecting the TR switch, the ground path of all TR switch circuits is removed and the PCM should recognize all circuits as open. The scan tool should display HI for all range signal states.
>
> **5:** This step tests the TR switch wiring for an open or the lack of the signal voltage from the PCM.
>
> **6:** This step tests the TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal states should change to LOW.
>
> **7:** This step tests the TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal states should change to LOW.
>
> **8:** This step tests the TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal states should change to LOW.
>
> **9:** This step tests the TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal states should change to LOW.

Range Selector Displays Incorrect Range

Step	Action	Value (s)	Yes	No
1	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Select TR Sw. on the scan tool. 4. With the scan tool, observe the TR Sw. display while selecting each transmission range: P, R, N, D4, D3, D2 and D1. Does each selected transmission range match the scan tool TR Sw. display?	-	Go to **Step 2**	Go to **Step 3**
2	Observe the IPC gear range display while selecting each transmission range: P, R, N, D4, D3, D2, D1. Does each selected transmission range match the IPC display?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 16**
3	With the scan tool, observe the TR Sw. A/B/C/P display. Does the scan tool TR Sw. A/B/C/P parameter indicate HI for all range signal states?	-	Go to **Step 13**	Go to **Step 4**

4	1. Turn OFF the ignition. 2. Disconnect the TR switch connector. 3. Turn ON the ignition, with the engine OFF. Does the scan tool TR Sw. A/B/C/P parameter indicate HI for all range signal states?	-	Go to **Step 5**	Go to **Step 10**
5	1. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the voltage from terminal 8 of the TR switch connector to ground. 2. Measure the voltage from terminal 4 of the TR switch connector to ground. 3. Measure the voltage from terminal 6 of the TR switch connector to ground. 4. Measure the voltage from terminal 5 of the TR switch connector to ground. Does the voltage measure within the specified value at all four terminals?	10-12 V	Go to **Step 6**	Go to **Step 11**
6	Connect a fused jumper wire from terminal 8 of the TR switch connector, signal circuit A, to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When signal circuit A is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 7**
7	Connect a fused jumper wire from terminal 5 of the TR switch connector, signal circuit B, to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When signal circuit B is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 8**
8	Connect a fused jumper wire from terminal 4 of the TR switch connector, signal circuit C, to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When signal circuit C is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 9**
9	Connect a fused jumper wire from terminal 6 of the TR switch connector, signal circuit P, to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When signal circuit P is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 13**
10	Test the signal circuits of the TR switch that did not indicate HI for a short to ground. Refer to **Testing for Short to Ground** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
	Test the signal circuits of the TR switch that did not			

11	indicate proper voltage for an open. Refer to **Testing for Continuity** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
12	Test the affected signal circuits of the TR switch for a shorted together condition. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
13	Test the ground circuit of the TR switch for an open. Refer to **Testing for Continuity** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
14	Replace the TR switch, this switch is part of the park/neutral position switch. Refer to **Park/Neutral Position Switch Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
15	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the IPC. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gauges and Console. Did you complete the replacement?	-	Go to **Step 17**	Go to **Step 2**
17	1. Turn ON the ignition, with the engine OFF. 2. With the scan tool, observe the TR Sw. display while selecting each transmission range: P, R, N, D4, D3, D2 and D1. Does each selected transmission range match the scan tool TR Sw. display?	-	System OK	Go to **Step 2**

TOW/HAUL SWITCH/INDICATOR ALWAYS ON OR INOPERATIVE

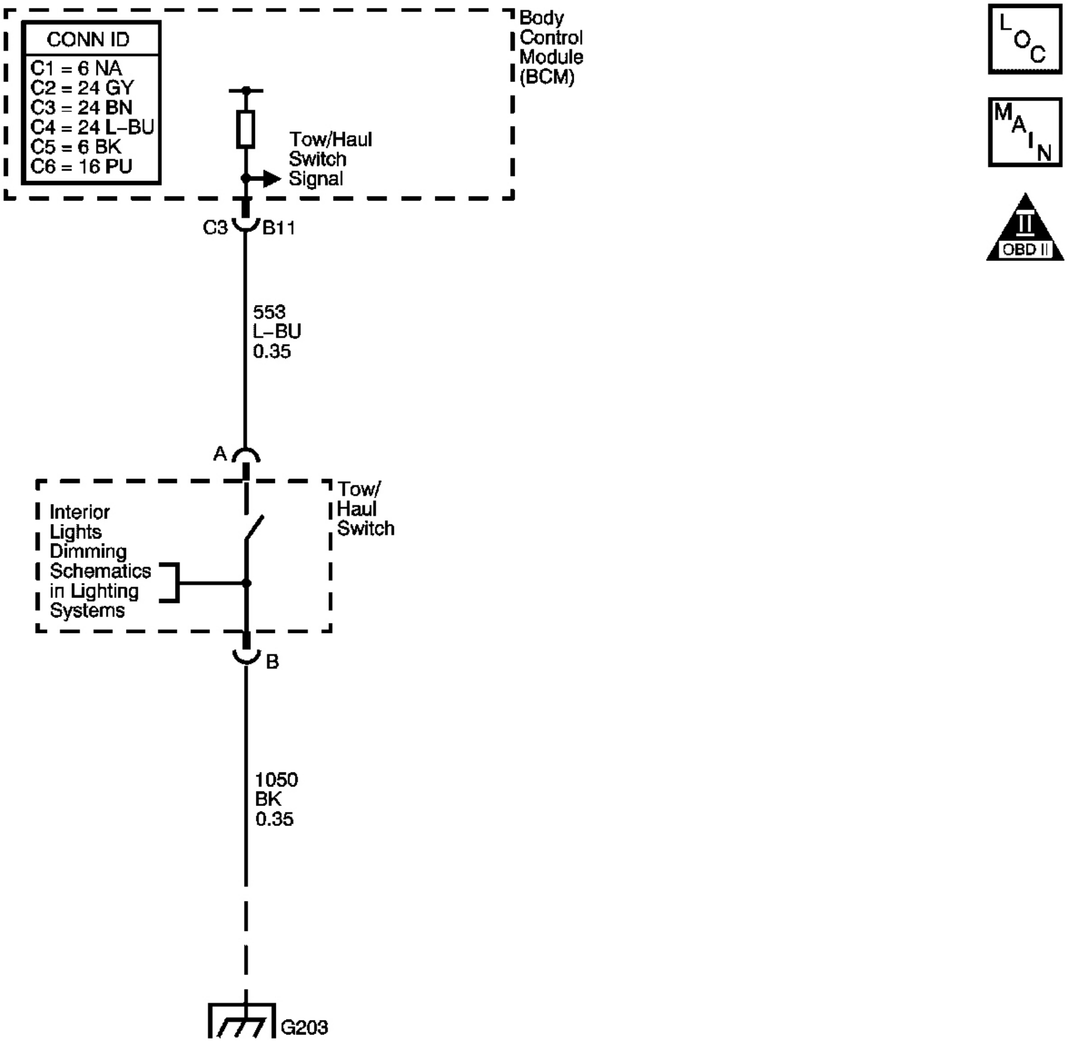


Fig. 2: Tow/Haul Mode Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

Tow/haul mode enables the operator to achieve enhanced shift performance when towing or hauling a load. When tow/haul mode is selected, the tow/haul switch input signal to the body control module (BCM) is momentarily toggled to zero volts. This signals the powertrain control module (PCM) to extend the length of time between upshifts and increase transmission line pressure. Cycling the tow/haul switch again disables tow/haul mode and returns the transmission to a normal shift pattern.

Diagnostic Aids

If the electrical circuit tests are OK and the tow/haul shift pattern is not occurring, there may be a mechanical/hydraulic condition that prevents tow/haul operation. Refer to **Symptoms - Automatic Transmission** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step tests for a faulty tow/haul switch.

3: This step tests for voltage input from the BCM to the tow/haul switch.

6: This step tests for voltage through the body wiring harness junction block.

7: This step tests for ground integrity at the splice pack.

Tow/Haul Switch/Indicator Always On or Inoperative

Step	Action	Value (s)	Yes	No
1	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Cycle the tow/haul switch while observing Tow/Haul Mode on the scan tool. Does the scan tool display Active when the switch is first pressed, and then Inactive when the switch is pressed again?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 2**
2	1. Disconnect the I/P wiring harness connector from the tow/haul switch. 2. Install a fused jumper wire from terminal A to terminal B of the I/P wiring harness connector. Does the scan tool Tow/Haul Mode indicate a status change?	-	Go to **Step 7**	Go to **Step 3**
3	Using the DMM and the **J 35616** GM Terminal Test Kit, measure the voltage at terminal A of the I/P wiring harness connector. Is ignition voltage measured?	-	Go to **Step 6**	Go to **Step 4**
4	Using the DMM and the **J 35616** , measure the voltage at terminal C3-B11 of the body control module (BCM). Is ignition voltage measured?	-	Go to **Step 5**	Go to **Step 8**
	Test the signal circuit of the tow/haul switch for an open or shorted condition.			

5	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
6	Test the ground circuit of the tow/haul switch for an open or shorted condition between terminal B of the I/P wiring harness connector and ground (G203). Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
7	Replace the tow/haul switch. Did you complete the replacement?	-	Go to **Step 9**	-
8	Test the BCM for proper operation. Refer to **Diagnostic Starting Point - Body Control System** in Body Control System. Did you find and correct the condition?	-	Go to **Step 9**	-
9	After the repair is complete, observe Tow/Haul Mode on the scan tool display, while cycling the tow/haul switch. Does the scan tool display Active when the switch is first pressed, and then Inactive when the switch is pressed again?	-	System OK	Go to **Step 1**

TRANSMISSION FLUID CHECKING PROCEDURE

1. Start the engine and operate the vehicle for 15 minutes or until the transmission fluid reaches an operating temperature of 82-93°C (180-200°F).
2. Park the vehicle on a level surface.
3. With your foot on the brake, move the shift lever through each gear range. Pause for about 3 seconds in each range, ending in PARK.
4. Apply the parking brake and let the engine idle for 3 minutes.
5. Remove the transmission fluid level indicator. Wipe the indicator clean. Insert the indicator. Give the indicator a full twist in order to close.
6. Wait 3 seconds and remove the indicator.
7. Read both sides of the indicator. The fluid must be within the hot cross-hatched area using the lowest level reading.

Transmission Fluid Checking Procedure

Step	Action	Yes	No
1	Check the fluid color. Is the fluid red in color?	Go to **Step 5**	Go to **Step 2**
2	Is the fluid a non-transparent pink in color?	Go to **Step 14**	Go to **Step 3**
	IMPORTANT:		

3	**Fluid may turn a dark brown in color from normal use. This does not always indicate an oxidation or a contamination issue.** Is the fluid a light brown in color?	Go to **Step 5**	Go to **Step 4**
4	Is the fluid black in color and or have a "burnt" smell?	Go to **Step 14**	Go to **Step 5**
5	Does the fluid appear as a solid "liquid" and not "foamy" or full of bubbles on level indicator?	Go to **Step 6**	Go to **Step 6**
6	Check the fluid level. Proper level should be in middle of the "X" pattern, on level indicator. Is the level OK?	Go to **Step 19**	Go to **Step 7**
7	Is the fluid level high on indicator?	Go to **Step 12**	Go to **Step 8**
8	Is the fluid level low on indicator?	Go to **Step 9**	Go to **Step 4**
9	Check for any external leak or leaks. Refer to **Fluid Leak Diagnosis** . Did you find an external leak or leaks?	Go to **Step 10**	Go to **Step 11**
10	Correct leak or leaks as needed. Are any leak or leaks still present?	Go to **Step 9**	Go to **Step 11**
11	Add fluid until level is in middle of "X" pattern on the level indicator. Is the level OK?	Go to **Step 19**	Go to **Step 6**
12	Drain fluid until level is in middle of "X" pattern on the level indicator. Is level OK?	Go to **Step 19**	Go to **Step 6**
13	Replace oil cooler and flush lines. Is the replacement complete?	Go to **Step 15**	-
14	**IMPORTANT:** **A small amount of "friction" material in pan bottom is a "normal" condition, but large pieces and or metal particles will require complete transmission overhaul.** Drain fluid and remove oil pan to inspect.Is there sign or signs of internal component damage noted in bottom of transmission oil pan?	Go to **Step 16**	Go to **Step 13**
15	Replace the filter and fluid. Refer to **Automatic Transmission Fluid/Filter Replacement** . Is the replacement complete?	Go to **Step 6**	-
16	Flush oil cooler and lines. Refer to **Automatic Transmission Oil Cooler Flushing and Flow Test (J 45096)** or **Automatic Transmission Oil Cooler Flushing and Flow Test (J 35944-A)** . Is the Automatic Transmission Oil Cooler Flushing and Flow Test complete?	Go to **Step 17**	-
17	Overhaul the transmission. Is the Transmission Overhaul Procedure complete?	Go to **Step 18**	-
18	Add new fluid. Is the procedure complete?	Go to **Step 6**	-
19	Check the fluid level and correct as necessary.	Go to	-

	Is the fluid level satisfactory?	**Step 20**	
20	If equipped, reset the oil life monitor to 100 percent. Are all of the reset procedures complete?	System OK	Go to **Step 1**

LINE PRESSURE CHECK PROCEDURE

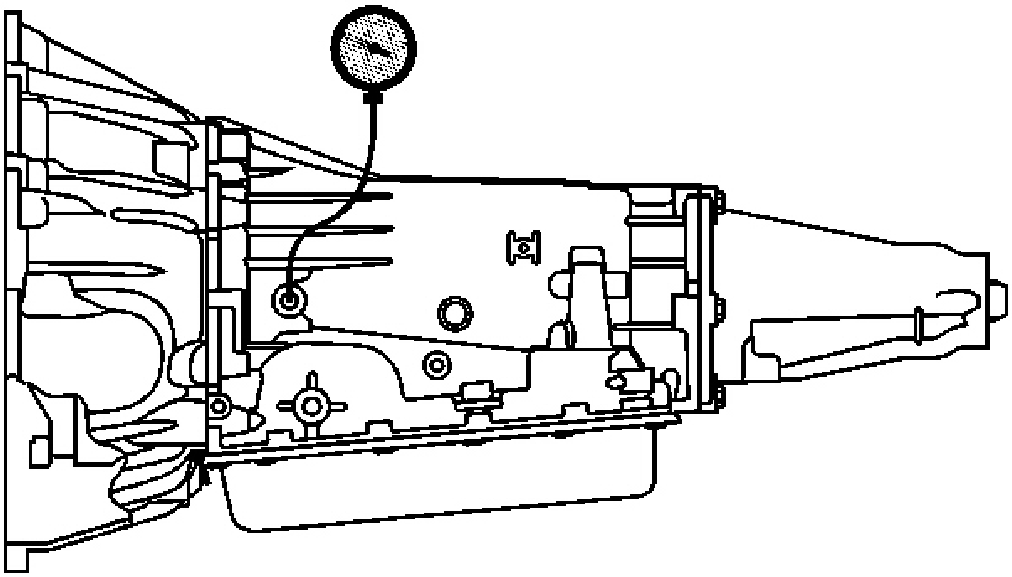


Fig. 3: J 21867 Pressure Gauge
Courtesy of GENERAL MOTORS CORP.

Tools Required

J 21867 Pressure Gauge

CAUTION: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

IMPORTANT: Before performing the line pressure check, verify that the transmission pressure control (PC) solenoid is operating correctly.

1. Install a scan tool.
2. Start the engine.

3. Inspect the transmission for the proper fluid levels. Refer to **Transmission Fluid Checking Procedure** .
4. Use the scan tool to inspect for any active or stored diagnostic trouble codes.
5. Inspect the manual linkage at the transmission for proper function.
6. Turn the engine OFF.

IMPORTANT: It may be necessary to remove or disconnect components in order to gain access to the transmission line pressure test port/plug.

7. Remove the pressure plug.
8. Install the **J 21867** .
9. Access the Scan Tool Output Control for the PC Solenoid.
10. Start the engine.

IMPORTANT: In order to achieve accurate line pressure readings, the following procedure must be performed at least three times in order to gather uniform pressure readings.
The scan tool is only able to control the PC solenoid in PARK and NEUTRAL with engine speeds below 1500 RPM. This protects the clutches from extreme high or low line pressures.

11. Begin commanding PC Solenoid at 1.0 amp and lower the amperage in one-tenth increments (0.01) until maximum line pressure is achieved.
12. Allow the pressure to stabilize between increments.
13. Compare your pressure readings to the Line Pressure table. Refer to **Line Pressure** .
14. If the pressure readings vary greatly from the line pressure table, refer to **Oil Pressure High or Low** .
15. Turn the engine OFF.
16. Remove the **J 21867** .

NOTE: Refer to Fastener Notice in Cautions and Notices.

17. Install the pressure plug.

    Tighten: Tighten the pressure plug to 8-14 N.m (6-10 lb ft).

ROAD TEST PROCEDURE

IMPORTANT: The Road Test Procedure should be performed only as part of the Symptom Diagnosis. Refer to Symptoms - Automatic Transmission .

The following test provides a method of evaluating the condition of the automatic transmission. The test is structured so that most driving conditions would be achieved. The test is divided into the following parts:

- Electrical Function Check
- Upshift Control and Torque Converter Clutch (TCC) Apply
- Part Throttle Detent Downshifts
- Full Throttle Detent Downshifts
- Manual Downshifts
- Coasting Downshifts
- Manual Gear Range Selection
    - REVERSE
    - Manual FIRST
    - Manual SECOND
    - Manual THIRD

IMPORTANT: Complete the test in the sequence given. Incomplete testing cannot guarantee an accurate evaluation.

Before the road test, ensure the following:

- The engine is performing properly.
- Transmission fluid level is correct. Refer to the **Transmission Fluid Checking Procedure** .
- Tire pressure is correct.

During the road test:

- Perform the test only when traffic conditions permit.
- Operate the vehicle in a controlled, safe manner.
- Observe all traffic regulations.
- View the scan tool data while conducting this test.

  Take along qualified help in order to operate the vehicle safely.

- Observe any unusual sounds or smells.

After the road test, check the following:

- Transmission fluid level. Refer to the **Transmission Fluid Checking Procedure** .
- Diagnostic trouble codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Scan tool data for any abnormal readings or data.

Electrical Function Check

Perform this check first, in order to ensure the electronic transmission components are connected and functioning properly. If these components are not checked, a simple electrical condition could be misdiagnosed.

1. Connect the scan tool.
2. Ensure the gear selector is in PARK and set the parking brake.
3. Start the engine.
4. Verify that the following scan tool data can be obtained and is functioning properly.

   Refer to **Scan Tool Data List** for typical data values. Data that is questionable may indicate a concern.

   - Engine speed
   - Transmission output speed
   - Vehicle speed
   - TFP manual valve position switch
   - Transmission range, engine list
   - Commanded gear, current gear
   - PC solenoid reference current
   - PC solenoid actual current
   - PC solenoid duty cycle
   - Brake switch
   - Engine coolant temperature
   - Transmission fluid temperature
   - Throttle angle
   - Ignition voltage
   - 1-2 shift solenoid
   - 2-3 shift solenoid
   - TCC solenoid duty cycle
   - TCC slip speed
5. Monitor the brake switch signal while depressing and releasing the brake pedal. The scan tool should display:
   - Closed when the brake pedal is released.
   - Open when the brake pedal is depressed.
6. Check the garage shifts.
   1. Apply the brake pedal and ensure that the parking brake is set.
   2. Move the gear selector through the following ranges:
      1. PARK to REVERSE
      2. REVERSE to NEUTRAL
      3. NEUTRAL to DRIVE
   3. Pause 2 to 3 seconds in each gear position.
   4. Verify the gear engagements are immediate and not harsh.

IMPORTANT: Harsh engagement may be caused by any of the following conditions:

- **High idle speed. Compare engine idle speed to desired idle speed.**
- **Commanded low PC solenoid current. Compare PC solenoid reference current to PC solenoid actual current.**
- **A default condition caused by certain DTCs that result in maximum line pressure to prevent slippage.**

IMPORTANT: Soft or delayed engagement may be caused by any of the following conditions:

- **Low idle speed. Compare engine idle speed to desired idle speed.**
- **Low fluid level**
- **Commanded high PC solenoid current. Compare PC solenoid reference current to PC solenoid actual current.**
- **Cold transmission fluid. Check for low transmission fluid temperature.**

7. Monitor transmission range on the scan tool, engine list.
    1. Apply the brake pedal and ensure the parking brake is set.
    2. Move the gear selector through all ranges.
    3. Pause 2-3 seconds in each range.
    4. Return gear selector to PARK.
    5. Verify that all selector positions match the scan tool display.
8. Check throttle angle input.
    1. Apply the brake pedal and ensure that the parking brake is set.
    2. Ensure the gear selector is in PARK.
    3. Monitor throttle angle while increasing and decreasing engine speed with the throttle pedal. The scan tool throttle angle should increase and decrease with engine speed.

If any of the above checks do not perform properly, record the result for reference after completion of the road test.

Upshift Control and Torque Converter Clutch (TCC) Apply

The PCM calculates the upshift points based primarily on two inputs: throttle angle and vehicle speed. When the PCM determines that conditions are met for a shift to occur, the PCM commands the shift by closing or opening the ground circuit for the appropriate solenoid.

Perform the following steps:

1. Refer to the **Shift Speed** table in this section and choose a throttle position of 12 percent, 25 percent or 50

percent. All throttle angles shown should be tested to cover the normal driving range.

2. Monitor the following scan tool parameters:
   - Throttle angle
   - Vehicle speed
   - Engine speed
   - Output shaft speed
   - Commanded gear
   - Slip speed
   - Solenoid states
3. Place the gear selector in the OVERDRIVE position.
4. Accelerate the vehicle using the chosen throttle angle. Hold the throttle steady.
5. As the transmission upshifts, note the vehicle speed when the shift occurs for each gear change. There should be a noticeable shift feel or engine speed change within 1-2 seconds of the commanded gear change.
6. Compare the shift speeds to the Shift Speed table. Refer to **Shift Speed** . Shift speeds may vary slightly due to transmission fluid temperature or hydraulic delays in responding to electronic controls.
   - Note any harsh, soft or delayed shifts or slipping.
   - Note any noise or vibration.
7. Repeat steps 1 through 6 to complete all throttle angles.

IMPORTANT: This transmission is equipped with an electronically controlled capacity clutch (ECCC). The pressure plate does not fully lock to the torque converter cover. Instead, the pressure plate maintains a small amount of slippage, about 20 RPM, in SECOND, THIRD and FOURTH gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration or chuggle caused by TCC apply. Typical apply speeds are 49-52 km/h (30-32 mph) in THIRD gear and 65-73 km/h (40-45 mph) in FOURTH gear. Full lockup is available at highway speeds on some applications.

IMPORTANT: The TCC will not engage until the engine is in closed loop operation and the vehicle speed is as shown in the Shift Speed table. Refer to Shift Speed . The vehicle must be in a near-cruise condition, not accelerating or coasting, and on a level road surface.

8. Check for TCC apply in THIRD and FOURTH gear.
   - Note the TCC apply point. When the TCC applies there should be a noticeable drop in engine speed and a drop in slip speed to below 100 RPM. If the TCC apply can not be detected:
     - Check for DTCs.
     - Refer to **Torque Converter Diagnosis Procedure** .
   - Refer to the **Shift Speed** table for the correct apply speeds.

- Lightly tap and release the brake pedal. The TCC will release on most applications.

Part Throttle Detent Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in FOURTH gear.
3. Quickly increase throttle angle to greater than 50 percent.
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to THIRD gear

Full Throttle Detent Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to speeds of 64-88 km/h (40-55 mph) in FOURTH gear.
3. Quickly increase throttle angle to 100 percent wide open throttle (WOT).
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to SECOND gear

Manual Downshifts

The shift solenoid valves do not control the initial downshift for the 4-3 or the 3-2 manual downshifts. The 4-3 and the 3-2 manual downshifts are hydraulic. The 2-1 manual downshift is electronic. The solenoid states should change during or shortly after a manual downshift is selected.

Manual 4-3 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-88 km/h (40-55 mph) in FOURTH gear.
3. Release the throttle while moving the gear selector to THIRD.
4. Verify the following:
    - The TCC releases
    - The transmission downshifts immediately to THIRD gear
    - The engine slows the vehicle

Manual 4-2 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 64-72 km/h (40-45 mph).
3. Release the throttle while moving the gear selector to SECOND.
4. Verify the following:

- The TCC releases
- The transmission downshifts immediately to SECOND gear
- The engine slows the vehicle

Manual 4-1 Downshift

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to 48 km/h (30 mph).
3. Release the throttle while moving the gear selector to FIRST.
4. Verify the following:
   - The TCC releases.
   - The transmission downshifts immediately to FIRST gear.
   - The engine slows the vehicle.

Coasting Downshifts

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to FOURTH gear with the TCC applied.
3. Release the throttle and lightly apply the brakes.
4. Verify the following:
   - The TCC releases
   - Downshifts occur at speeds shown in the Shift Speed table. Refer to **Shift Speed** .

Manual Gear Range Selection

The shift solenoids control the upshifts in the manual gear ranges.

Perform the following tests using 10-15 percent throttle angle.

Reverse

1. With the vehicle stopped, move the gear selector to REVERSE.
2. Slowly accelerate the vehicle.
3. Verify that there is no noticeable slip, noise or vibration.

Manual First

1. With the vehicle stopped, move the gear selector to FIRST.
2. Accelerate the vehicle to 32 km/h (20 mph).
3. Verify the following:
   - No upshifts occur

- The TCC does not apply
- There is no noticeable slip, noise, or vibration

Manual Second

1. With the vehicle stopped, move the gear selector to SECOND.
2. Accelerate the vehicle to 57 km/h (35 mph).
3. Verify the following:
    - The 1-2 shift occurs
    - The 2-3 shift does not occur
    - There is no noticeable slip, noise or vibration

Manual Third

1. With the vehicle stopped, move the gear selector to THIRD.
2. Accelerate the vehicle to 64 km/h (40 mph).
3. Verify the following:
    - The 1-2 shift occurs
    - The 2-3 shift occurs
    - There is no noticeable slip, noise or vibration

TORQUE CONVERTER DIAGNOSIS PROCEDURE

The Torque Converter Clutch (TCC) is applied by fluid pressure, which is controlled by a PWM solenoid valve. This solenoid valve is located inside of the automatic transmission assembly. The solenoid valve is controlled through a combination of computer controlled switches and sensors.

Torque Converter Stator

The torque converter stator roller clutch can have two different malfunctions.

- The stator assembly freewheels in both directions.
- The stator assembly remains locked up at all times.

Poor Acceleration at Low Speed

If the stator is freewheeling at all times, the vehicle tends to have poor acceleration from a standstill. At speeds above 50-55 km/h (30-35 mph), the vehicle may act normally. For poor acceleration, you should first determine that the exhaust system is not blocked, and the transmission is in First gear when starting out.

If the engine freely accelerates to high RPM in NEUTRAL, you can assume that the engine and the exhaust system are normal. Check for poor performance in DRIVE and REVERSE to help determine if the stator is freewheeling at all times.

Poor Acceleration at High Speed

If the stator is locked up at all times, performance is normal when accelerating from a standstill. Engine RPM and vehicle speed are limited or restricted at high speeds. Visual examination of the converter may reveal a blue color from overheating.

If the converter has been removed, you can check the stator roller clutch by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. You should be able to freely turn the inner race clockwise, but you should have difficulty in moving the inner race counterclockwise or you may be unable to move the race at all.

Noise

IMPORTANT: Do not confuse this noise with pump whine noise, which is usually noticeable in PARK, NEUTRAL and all other gear ranges. Pump whine will vary with line pressure.

You may notice a torque converter whine when the vehicle is stopped and the transmission is in DRIVE or REVERSE. This noise will increase as you increase the engine RPM. The noise will stop when the vehicle is moving or when you apply the torque converter clutch, because both halves of the converter are turning at the same speed.

Perform a stall test to make sure the noise is actually coming from the converter:

1. Place your foot on the brake.
2. Put the gear selector in DRIVE.

   NOTE: You may damage the transmission if you depress the accelerator for more than 6 seconds.

3. Depress the accelerator to approximately 1,200 RPM for no more than six seconds.

A torque converter noise will increase under this load.

Torque Converter Clutch Shudder

The key to diagnosing Torque Converter Clutch (TCC) shudder is to note when it happens and under what conditions.

TCC shudder which is caused by the transmission should only occur during the apply or the release of the converter clutch. Shudder should never occur after the TCC plate is fully applied.

If Shudder Occurs During TCC Apply or Release

If the shudder occurs while the TCC is applying, the problem can be within the transmission or the torque converter. Something is causing one of the following conditions to occur:

- Something is not allowing the clutch to become fully engaged.
- Something is not allowing the clutch to release.
- The clutch is releasing and applying at the same time.

One of the following conditions may be causing the problem to occur:

- Leaking turbine shaft seals
- A restricted release orifice
- A distorted clutch or housing surface due to long converter bolts
- Defective friction material on the TCC plate

If Shudder Occurs After TCC has Applied

If shudder occurs after the TCC has applied, most of the time there is nothing wrong with the transmission.

The TCC is not likely to slip after the TCC has been applied. Engine problems may go unnoticed under light throttle and load, but they become noticeable after the TCC apply when going up a hill or accelerating. This is due to the mechanical coupling between the engine and the transmission.

Once TCC is applied, there is no torque converter (fluid coupling) assistance. Engine or driveline vibrations could be unnoticeable before TCC engagement.

Inspect the following components in order to avoid misdiagnosis of TCC shudder. An inspection will also avoid the unnecessary disassembly of a transmission or the unnecessary replacement of a torque converter.

- Spark plugs - Inspect for cracks, high resistance or a broken insulator.
- Plug wires - Look in each end. If there is red dust (ozone) or a black substance (carbon) present, then the wires are bad. Also look for a white discoloration of the wire. This indicates arcing during hard acceleration.
- Coil - Look for a black discoloration on the bottom of the coil. This indicates arcing while the engine is misfiring.
- Fuel injector - The filter may be plugged.
- Vacuum leak - The engine will not get a correct amount of fuel. The mixture may run rich or lean depending on where the leak occurs.
- EGR valve - The valve may let in too much or too little unburnable exhaust gas and could cause the engine to run rich or lean.
- MAP/MAF sensor - Like a vacuum leak, the engine will not get the correct amount of fuel for proper engine operation.
- Carbon on the intake valves - Carbon restricts the proper flow of air/fuel mixture into the cylinders.
- Flat cam - Valves do not open enough to let the proper fuel/air mixture into the cylinders.
- Oxygen sensor - This sensor may command the engine too rich or too lean for too long.
- Fuel pressure - This may be too low.

- Engine mounts - Vibration of the mounts can be multiplied by TCC engagement.
- Axle joints - Check for vibration.
- TP Sensor - The TCC apply and release depends on the TP Sensor in many engines. If the TP Sensor is out of specification, TCC may remain applied during initial engine loading.
- Cylinder balance - Bad piston rings or poorly sealing valves can cause low power in a cylinder.
- Fuel contamination - This causes poor engine performance.

Replace the torque converter if any of the following conditions exist:

- External leaks appear in the hub weld area.
- The converter hub is scored or damaged.
- The converter pilot is broken, damaged, or fits poorly into the crankshaft.
- You discover steel particles after flushing the cooler and the cooler lines.
- The pump is damaged, or you discover steel particles in the converter.
- The vehicle has TCC shudder and/or no TCC apply. Replace the torque converter only after all hydraulic and electrical diagnoses have been made. The converter clutch material may be glazed.
- The converter has an imbalance which cannot be corrected. Refer to **Flexplate/Torque Converter Vibration Test** .
- The converter is contaminated with engine coolant which contains antifreeze or water.
- An internal failure occurs in the stator roller clutch.
- You notice excessive end play.
- Overheating produces heavy debris in the clutch or converter ballooning.
- You discover steel particles or clutch lining material in the fluid filter or on the magnet, when no internal parts in the unit are worn or damaged. This condition indicates that lining material came from the converter.

Do not replace the torque converter if you discover any of the following symptoms:

- The oil has an odor or the oil is discolored, even though metal or clutch facing particles are not present.
- The threads in one or more of the converter bolt holds are damaged. Correct the condition with a new thread inset.
- Transmission failure did not display evidence of damaged or worn internal parts, steel particles or clutch plate lining material in the unit and inside the fluid filter.
- The vehicle has been exposed to high mileage only. An exception may exist where the lining of the torque converter clutch dampener plate has seen excess wear by vehicles operated in heavy and/or constant traffic, such as taxi, delivery, or police use.

FLEXPLATE/TORQUE CONVERTER VIBRATION TEST

Isolating Vibration

NOTE: Some engine/transaxle combinations cannot be balanced in this manner due to

restricted access or limited clearances between the torque converter bolts and the engine. Ensure that the bolts do not bottom out in the lug nuts or the torque converter cover could be dented and cause internal damage.

To isolate and correct a flywheel or torque converter vibration, separate the torque converter from the flywheel to determine if vibration is in the engine or transmission.

1. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration.
2. Turn the engine OFF.
3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
4. Remove the transmission converter cover bolts and the cover.
5. Mark the relationship of the converter to the flywheel.
6. Remove the bolts attaching the converter to the flywheel.
7. Slide the torque converter away from the flywheel.
8. Rotate the flywheel and torque converter to inspect for defects or missing balance weights. Refer to **Engine Flywheel Cleaning and Inspection** in Engine Mechanical - 6.0L (LQ4).
9. Lower the vehicle.
10. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration. Refer to **Diagnostic Starting Point - Vibration Diagnosis and Correction** in Vibration Diagnosis and Correction.
11. Turn the engine OFF.

Indexing Torque Converter

To determine and correct a torque converter vibration, the following procedure may have to be performed several times to achieve the best possible torque converter to flywheel balance.

1. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Rotate the torque converter one bolt position.

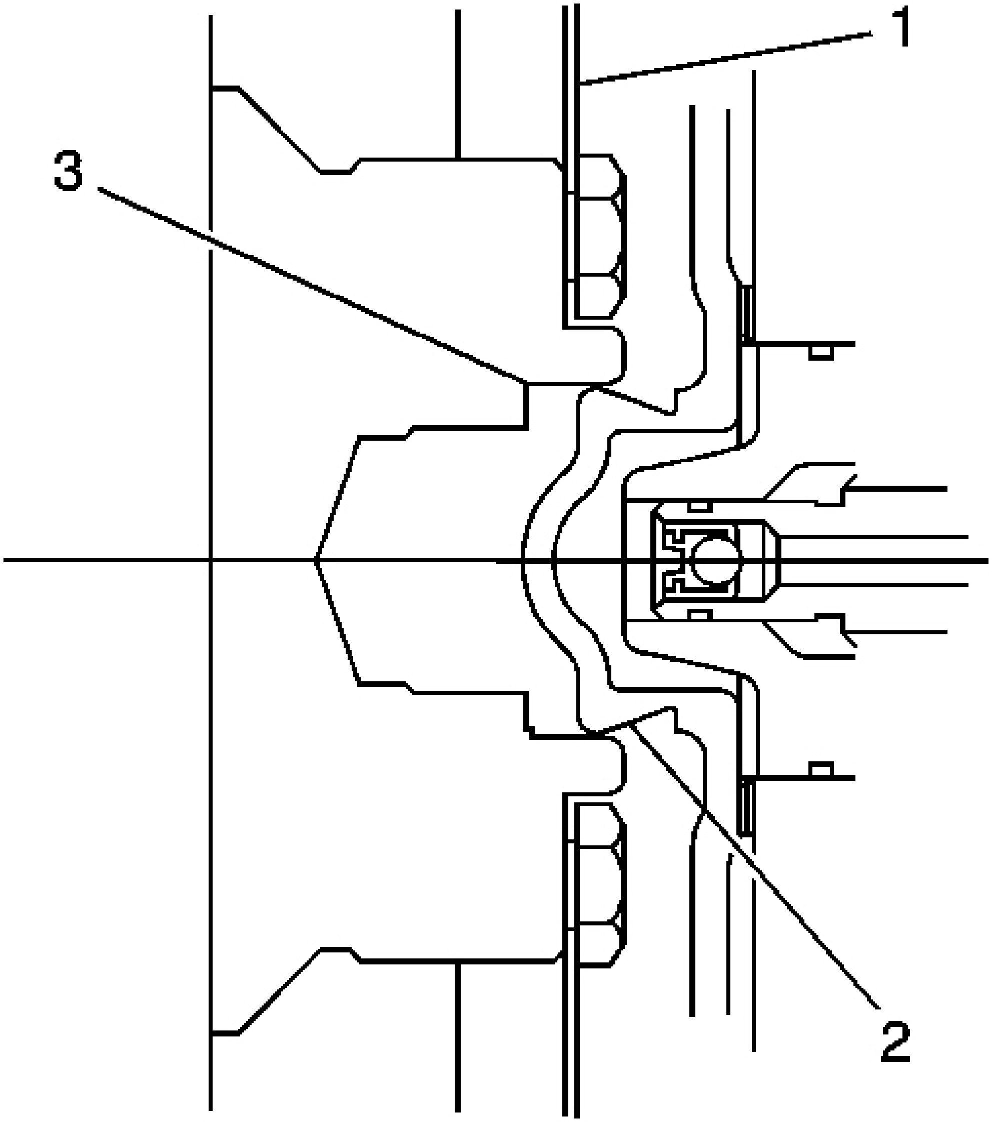


Fig. 4: Aligning Torque Converter Hub In Engine Crankshaft
Courtesy of GENERAL MOTORS CORP.

3. Align the torque converter hub (2) in the engine crankshaft (3) and install the torque converter to flywheel bolts.
4. Lower the vehicle.
5. With the engine at idle speed and the transmission in PARK or NEUTRAL, observe the vibration. Refer

to **Noise and Vibration Analysis** .

Repeat this procedure until you obtain the best possible balance.

6. Install the transmission converter cover bolts and the cover.

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion MAY NOT be the result of the transmission.

If noise or vibration is noticeable in PARK and NEUTRAL with the engine at idle, but is less noticeable as RPM increases, the cause may be from poor engine performance.

- Vibration may also be caused by a small amount of water inside the converter.
- Inspect the tires for the following conditions:
  - Uneven wear
  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
- Inspect the suspension components for the following conditions:
  - Alignment and wear
  - Loose fasteners
  - Driveline damage or wear
- Inspect the engine and transmission mounts for damage and loose bolts.
- Inspect the transmission case mounting holes for the following conditions:
  - Missing bolts, nuts, and studs
  - Stripped threads
  - Cracks
- Inspect the flywheel for the following conditions:
  - Missing or loose bolts
  - Cracks
  - Imbalance
- Inspect the torque converter for the following conditions:
  - Missing or loose bolts or lugs
  - Missing or loose balance weights
  - Imbalance caused by heat distortion or fluid contamination

CLUTCH PLATE DIAGNOSIS

Composition Plates

Dry the plates and inspect the plates for the following conditions:

- Pitting
- Flaking
- Delamination - splitting or separation of bonded clutch material
- Wear
- Glazing
- Cracking
- Charring
- Chips or metal particles embedded in the lining

Replace a composition plate which shows any of these conditions.

Steel Plates

Wipe the plates dry and check the plates for heat discoloration. If the surfaces are smooth, even if color smear is indicated, you can reuse the plate. If the plate is discolored with heat spots or if the surface is scuffed, replace the plate.

Causes of Burned Clutch Plates

The following conditions can result in a burned clutch plate:

- Incorrect usage of clutch or apply plates
- Engine coolant or water in the transmission fluid
- A cracked clutch piston
- Damaged or missing seals
- Low line pressure
- Valve body conditions
  - The valve body face is not flat.
  - Porosity is between channels.
  - The valve bushing clips are improperly installed.
  - The checkballs are misplaced.
- The Teflon(R) seal rings are worn or damaged.

ENGINE COOLANT/WATER IN TRANSMISSION

NOTE:	**The antifreeze or water will deteriorate the seals, gaskets and the glue that bonds the clutch material to the pressure plate. Both conditions may cause damage to the transmission.**

If antifreeze or water has entered the transmission, perform the following:

1. Disassemble the transmission.
2. Replace all of the rubber type seals (the coolant will attack the seal material which will cause leakage).
3. Replace the composition-faced clutch plate assemblies (the facing material may separate from the steel center portion).
4. Replace all of the nylon parts (washers).
5. Replace the torque converter.
6. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

FLUID LEAK DIAGNOSIS

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Park the vehicle over clean paper or cardboard.
5. Shut OFF the engine.
6. Look for fluid spots on the paper.
7. Make the necessary repairs.

Powder Method

1. Thoroughly clean the suspected leak area with solvent.
2. Apply an aerosol type powder, such as foot powder, to the suspected leak area.
3. Operate the vehicle for 24 km (15 mi), or until normal operating temperatures are reached.
4. Shut OFF the engine.
5. Inspect the suspected leak area.
6. Trace the leak path through the powder in order to find the source of the leak.
7. Make the necessary repairs.

Dye and Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

1. Follow the manufacturer's instructions in order to determine the amount of dye to use.
2. Detect the leak with the black light.
3. Make the necessary repairs.

Find the Cause of the Leak

Pinpoint the leak and trace the leak back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions, and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs, or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual or output shaft surface is scratched, nicked, or damaged
- Loose or worn bearing causing excess seal wear

Possible Points of Fluid Leaks

Transmission Oil Pan

- Incorrectly tightened oil pan bolts
- Improperly installed or damaged oil pan gasket
- Damaged oil pan or mounting face
- Incorrect oil pan gasket

Case Leak

- Damaged or missing fill tube seal
- Mislocated fill tube bracket

- Damaged vehicle speed sensor seal
- Damaged manual shaft seal
- Loose or damaged oil cooler connector fittings
- Worn or damaged propeller shaft oil seal
- Loose line pressure pipe plug
- Porous casting warped torque converter housing

Leak at the Torque Converter End

- Converter leak in the weld area
- Converter seal lip cut. Check the converter hub for damage
- Converter seal bushing moved forward and damaged
- Converter seal garter spring missing from the seal
- Porous casting of the transmission case or the oil pump

Leak at the Vent Pipe or the Fluid Fill Tube

- Overfilled system
- Water or coolant in the fluid. The fluid will appear milky
- Transmission case porous
- Incorrect fluid level indicator
- Plugged vent
- Drain-back holes plugged
- Mispositioned oil pump to case gasket, if equipped

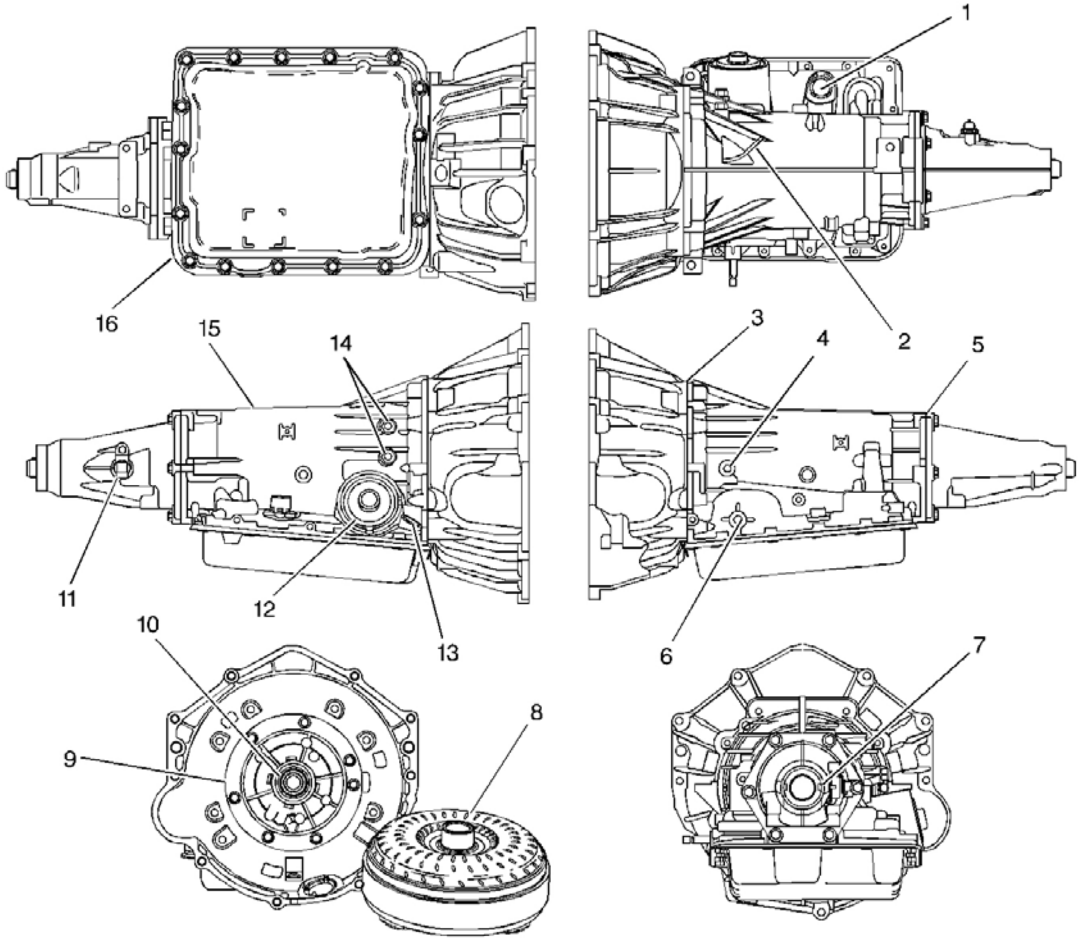


Fig. 5: Leak Inspection Points
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 51

Callout	Component Name
1	Wiring Harness Pass-Through Connector O-ring Seal
2	Transmission Vent Assembly
3	Converter Housing to Case Joint (Pump to Case Oil Seal)
4	Line Pressure Plug
5	Case Extension to Case Seal
6	Manual Shaft Seal
7	Case Extension Oil Seal Assembly
8	Torque Converter Assembly
9	Pump to Case Oil Seal
10	Pump Oil Seal Assembly
11	Internal Transmission Speed Sensor to Case O-ring Seal - Some Models

12	2-4 Servo Cover O-ring Seal
13	Oil Fill Tube Seal
14	Oil Cooler Pipe Connectors
15	Transmission Case
16	Transmission Oil Pan Gasket

CASE POROSITY REPAIR

Some external leaks are caused by case porosity in non-pressurized areas. You can usually repair these leaks with the transmission in the vehicle.

1. Thoroughly clean the area to be repaired with a cleaning solvent. Air dry the area.

CAUTION: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

2. Using instructions from the manufacturer, mix a sufficient amount of an epoxy to make the repair.
3. While the transmission case is still hot, apply the epoxy. You can use a clean, dry soldering acid brush to clean the area and also to apply the epoxy cement. Make certain that the area to be repaired is fully covered.
4. Allow the epoxy cement to cure for three hours before starting the engine.
5. Repeat the fluid leak diagnosis procedures.

SHIFT SOLENOID LEAK TEST

Tools Required

- **J 35616** GM Terminal Test Kit
- **J 44246** Solenoid Testing Kit

Leak Test Procedure

IMPORTANT:

- **This procedure tests On/Off type solenoid valves.**
- **Visually inspect the physical condition of the solenoid before testing. Inspect the O-rings before and after the test to be sure that they are not cut or damaged.**

1. Remove the shift solenoid valve from the control valve body or the torque converter clutch (TCC) solenoid valve from the transmission case. Refer to **Control and Shift Solenoids Replacement** or **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid, TCC Solenoid, and Wiring Harness** .

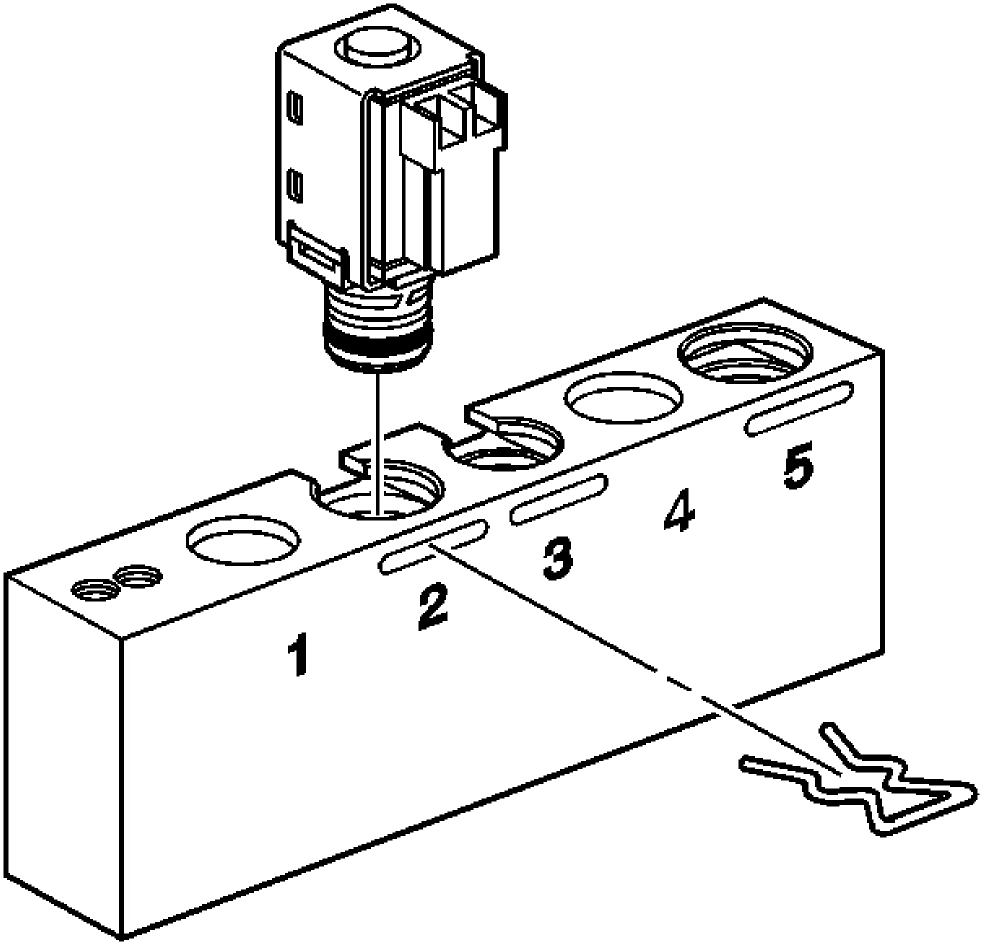


Fig. 6: Installing Valve Into J 44246
Courtesy of GENERAL MOTORS CORP.

2. Install the TCC solenoid valve, the 1-2 shift solenoid valve or the 2-3 shift solenoid valve into bore number 2 of the **J 44246** and install the factory retainer clip to retain the solenoid.

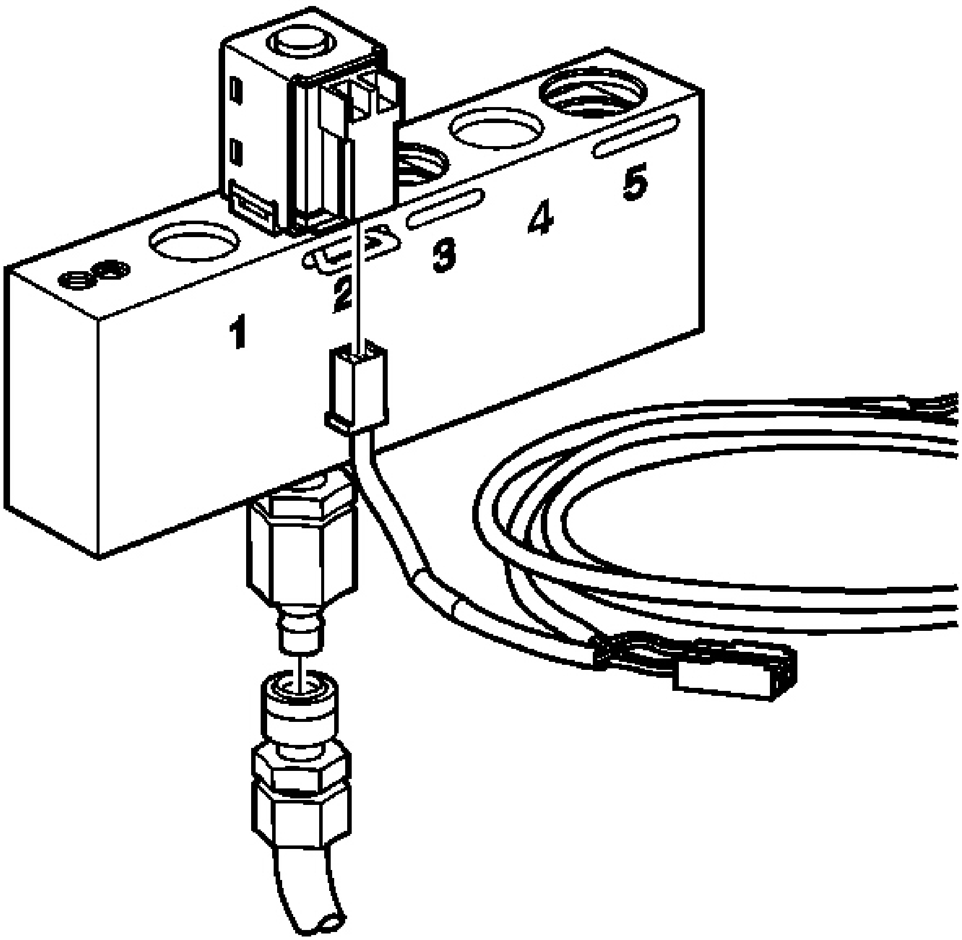


Fig. 7: Connecting The Solenoid Testing Harness To The Solenoid
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The supplied solenoid testing harness will not power the 4L60-E TCC On/Off solenoid. To energize this solenoid, apply battery, 12-volt, positive (+) and negative (-) to the TCC On/Off solenoid wiring harness using connector test adapter kit J 35616 . Use terminal E, Red, Power, and terminal T, Black, Ground. Refer to the Automatic Transmission Inline 20-Way Connector End View .

3. Connect the solenoid testing harness supplied with the **J 44246** to the solenoid.

IMPORTANT: Do not use air pressure in excess of 827.4 kPa (120 psi). Excessive pressure will not allow the solenoid ball check valve to seat properly. Recommended air pressure is 344.75 kPa (50 psi).

4. Apply compressed air to the **J 44246** .
5. Air should flow through the solenoid. If air does not flow through the solenoid, replace the solenoid. Refer to **Control and Shift Solenoids Replacement** .
6. Connect the solenoid testing harness to the 12-volt positive (+) and negative (-) battery terminals.
7. Observe if the solenoid is operating electrically. An audible clicking noise can be heard when connecting or disconnecting power.

IMPORTANT:

- **All solenoids need to be energized to seal.**
- **A small amount of air leakage is normal +/- 21 kPa (+/- 3 psi).**

8. Observe the air flow through the solenoid. The flow will completely or nearly completely stop. Replace the solenoid if there continues to be an obvious air leak when the solenoid is energized.

IMPORTANT: Inspect the O-rings after the test to be sure that they are not cut or damaged.

9. Install the shift solenoid valve into the control valve body or the TCC solenoid valve into the transmission case. Refer to **Control and Shift Solenoids Replacement** or **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid, TCC Solenoid, and Wiring Harness** .

AUTOMATIC TRANSMISSION OIL COOLER FLUSHING AND FLOW TEST (J 45096)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission failure. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

IMPORTANT: Use the J 45096 or equivalent to flush and flow test the transmission oil cooler and the oil cooler pipes after the transaxle is removed for repairs.

Only GM Goodwrench DEXRON(R)III automatic transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing and flow testing are as follows:

Cooler Flow Check and Flushing Steps

1. Machine Set-up
2. Determine Minimum Flow Rate
3. Back Flush
4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

Tools Required

- **J 35944-200** Cooler Flushing Adapter
- **J 45096** Transmission Oil Cooling System Flush and Flow Test Tool
- Shop air supply with water/oil filters, regulator and pressure gauge - minimum 90 psi
- Eye protection
- Rubber gloves

Machine Set-up

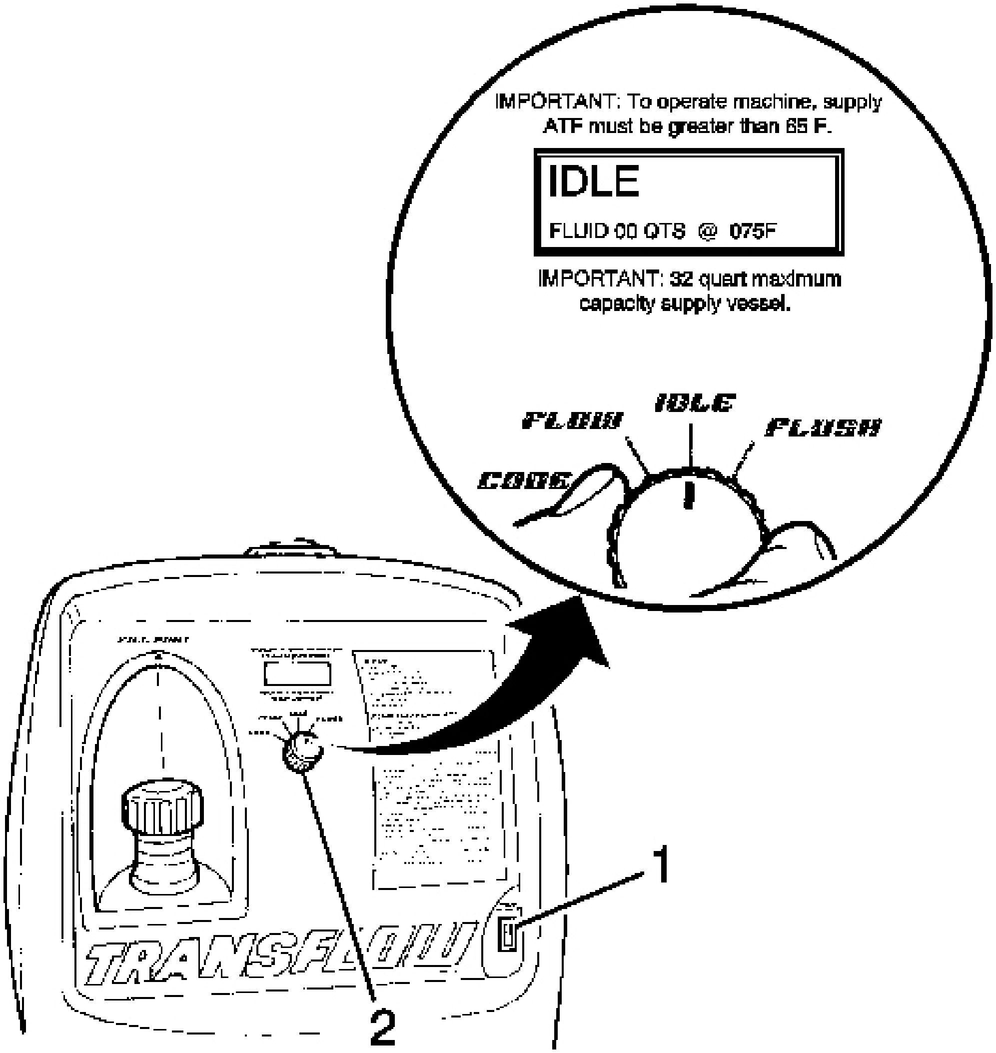


Fig. 8: Turning Main Function Switch To IDLE Position
Courtesy of GENERAL MOTORS CORP.

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

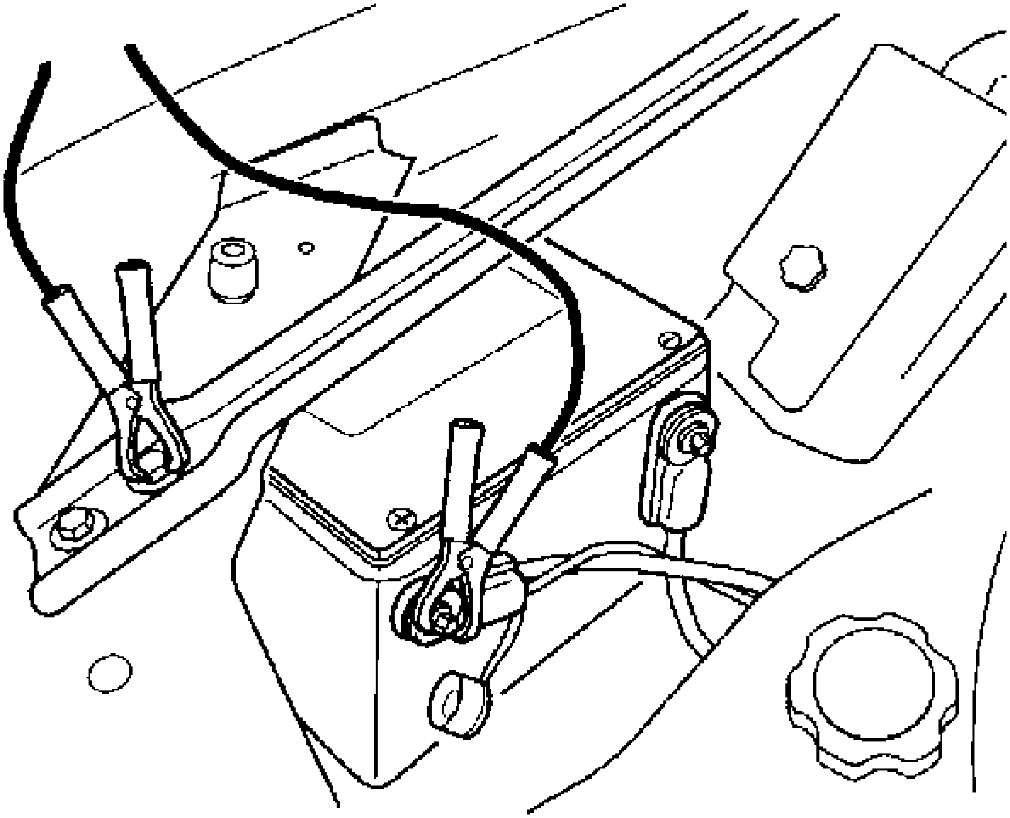
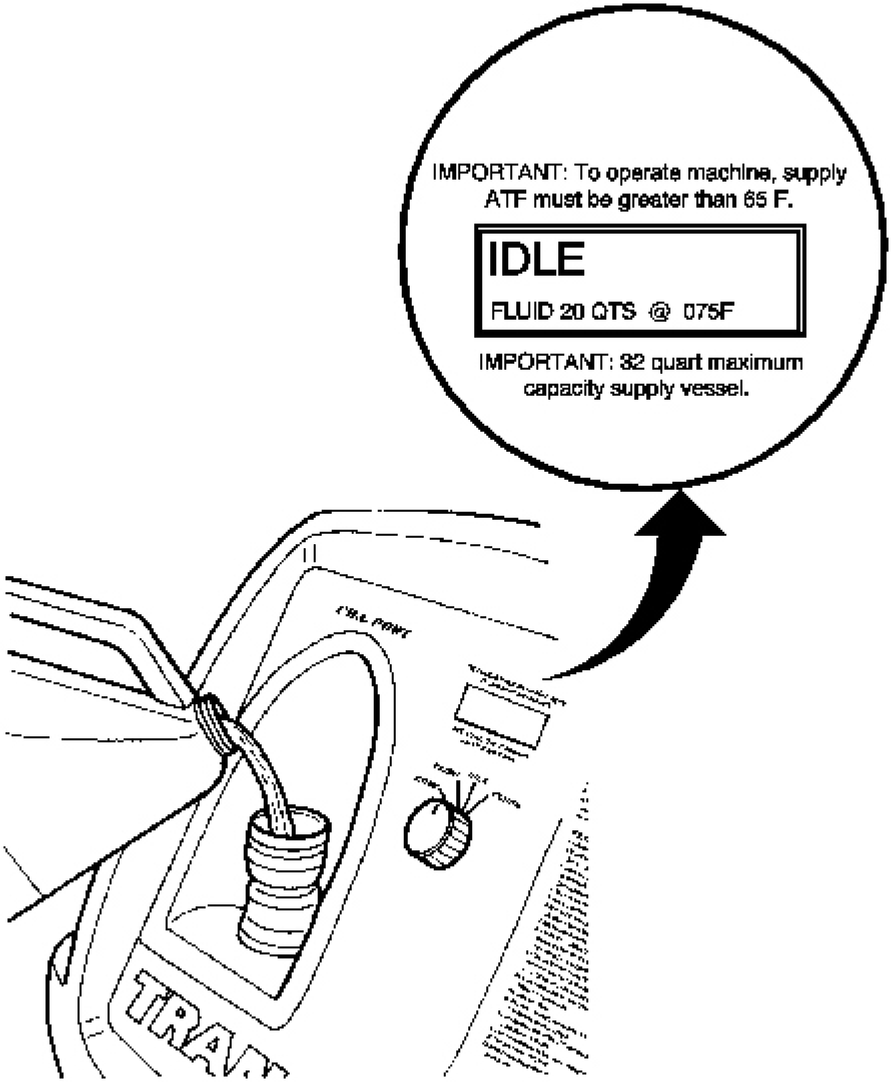


Fig. 9: Connecting J 45096 To Vehicle 12-Volt DC Power Source
Courtesy of GENERAL MOTORS CORP.

3. Connect **J 45096** to the vehicle 12-volt DC power source by connecting the red battery clip to the positive (+) battery post on the vehicle and connect the negative (-) lead to a known good chassis ground.
4. Turn the main power switch to the ON position.



<u>**Fig. 10: Filling Supply Tank With Dexron(R)III/Mercon(R)**</u>
Courtesy of GENERAL MOTORS CORP.

NOTE:	**Do not overfill the supply vessel. Damage to the unit may result. To verify the fluid level, view the LCD screen display while filling the unit, to ensure the fluid level does not exceed 30 L (32 qt).**

5. Fill the supply tank with Dexron(R)III/Mercon(R), or equivalent, through the fill port.

6. Install and tighten the fill cap.

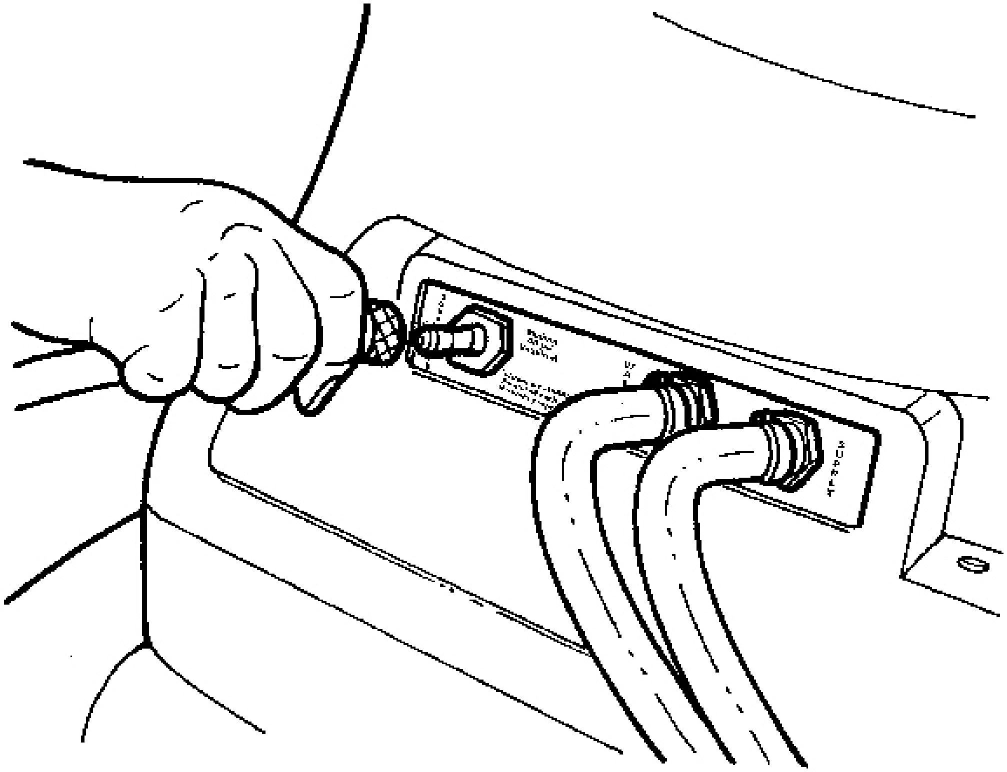


Fig. 11: Connecting A Shop Air Supply Hose To The Quick-Disconnect
Courtesy of GENERAL MOTORS CORP.

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

Determine Minimum Flow Rate

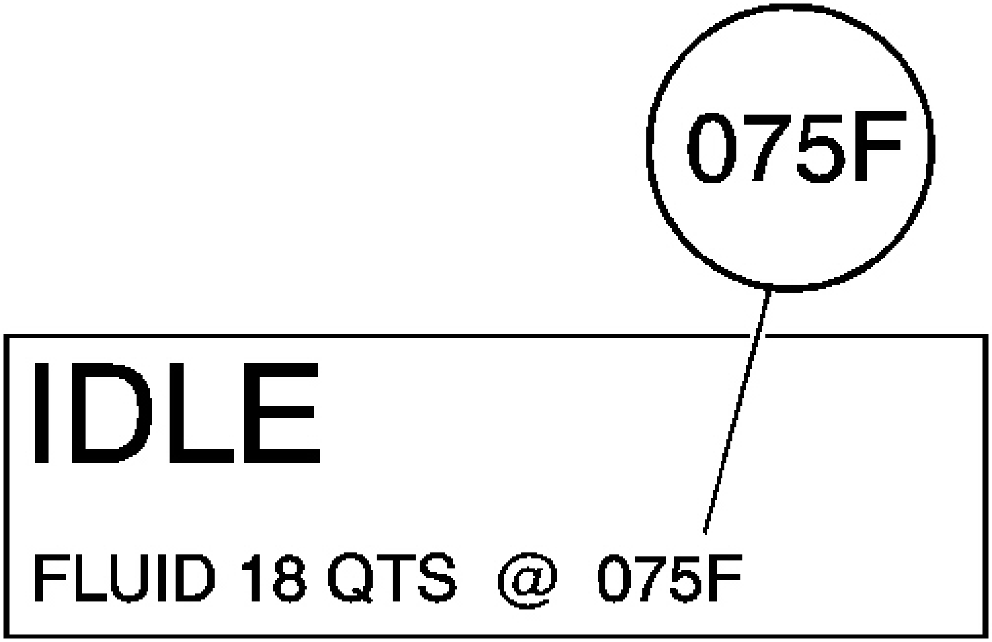


Fig. 12: Identifying Temperature Of Automatic Transmission Fluid
Courtesy of GENERAL MOTORS CORP.

1. From the machine display, identify the temperature of the automatic transmission fluid that is stored in the supply vessel of **J 45096** .

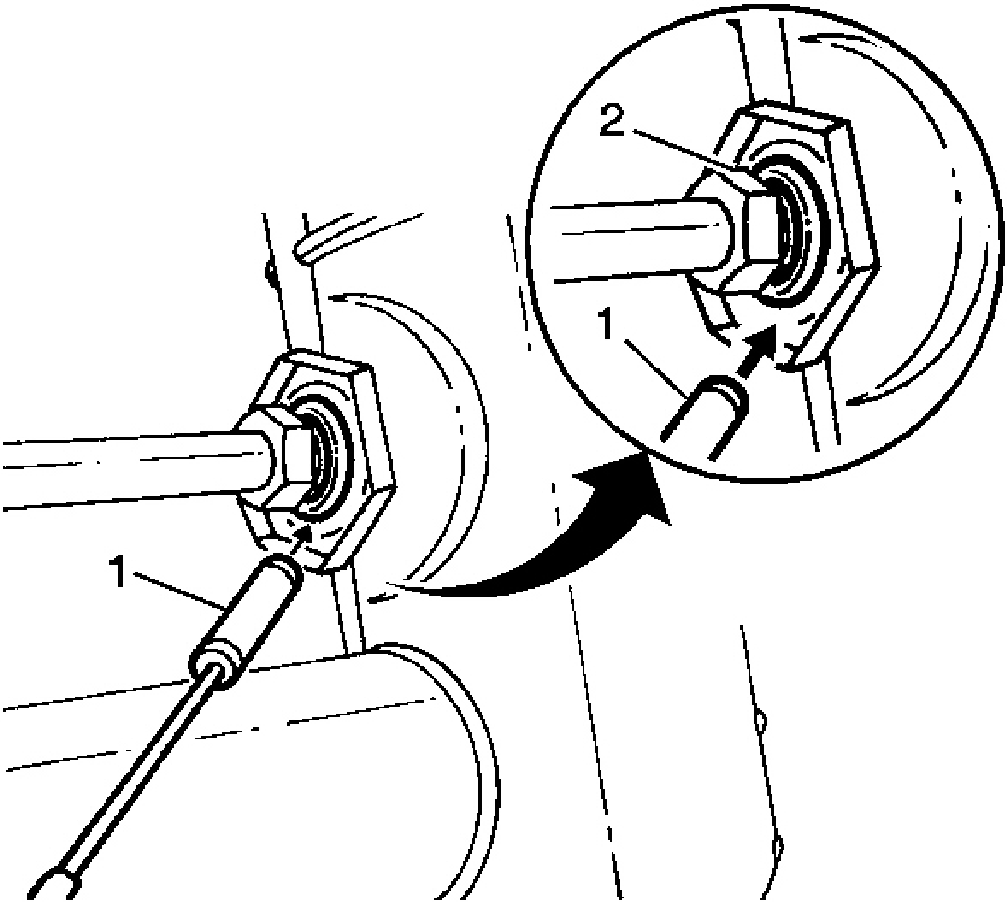


Fig. 13: Determining Whether Transmission Oil Cooler Is Steel Or Aluminum
Courtesy of GENERAL MOTORS CORP.

2. Determine whether the transmission oil cooler is steel or aluminum by using a magnet (1) at the cooler flange (2) at the radiator.
3. Refer to the table below. Using the temperature from step 1, locate on either the Steel MINIMUM Flow Rate table or the Aluminum MINIMUM Flow Rate table the minimum flow rate in gallons per minutes (GPM). Record the minimum flow rate in GPMs and the supply fluid temperature for further reference.

   Example:

   - Fluid temperature: 24°C (75°F)
   - Cooler type: Steel

     The MINIMUM flow rate for this example would be 0.8 GPM.

4. Inspect transmission oil cooler lines for damage or kinks that could cause restricted oil flow. Repair as needed and refer to the appropriate GM service manual procedures.

Minimum Flow Rate in Gallons Per Minute (GPM)

Temperature Range	Steel	Aluminum
65-66°F	0.6 gpm	0.5 gpm
67-70°F	0.7 gpm	0.6 gpm
71-75°F	0.8 gpm	0.7 gpm
76-80°F	0.9 gpm	0.8 gpm
81-84°F	1.0 gpm	0.9 gpm
85-89°F	1.1 gpm	1.0 gpm
90-94°F	1.2 gpm	1.1 gpm
95-98°F	1.3 gpm	1.2 gpm
99-103°F	1.4 gpm	1.3 gpm
104-108°F	1.5 gpm	1.4 gpm
109-112°F	1.6 gpm	1.5 gpm
113-117°F	1.7 gpm	1.6 gpm
118-120°F	1.8 gpm	1.7 gpm

Back Flush Procedure

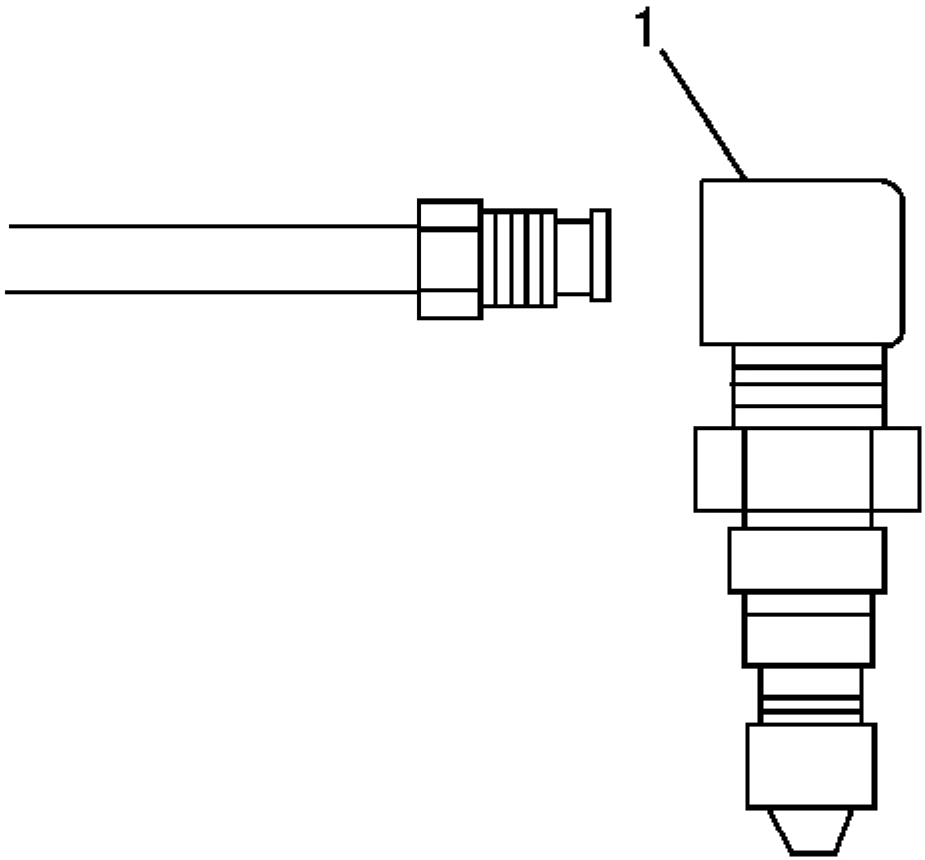


Fig. 14: Connecting J 45096 Adapters To Vehicle's Transmission Oil Cooler Supply & Return Lines
Courtesy of GENERAL MOTORS CORP.

1. Connect the **J 45096** adapters (1) to the vehicle's transmission oil cooler supply and return lines at the transmission, may require **J 35944-200** .

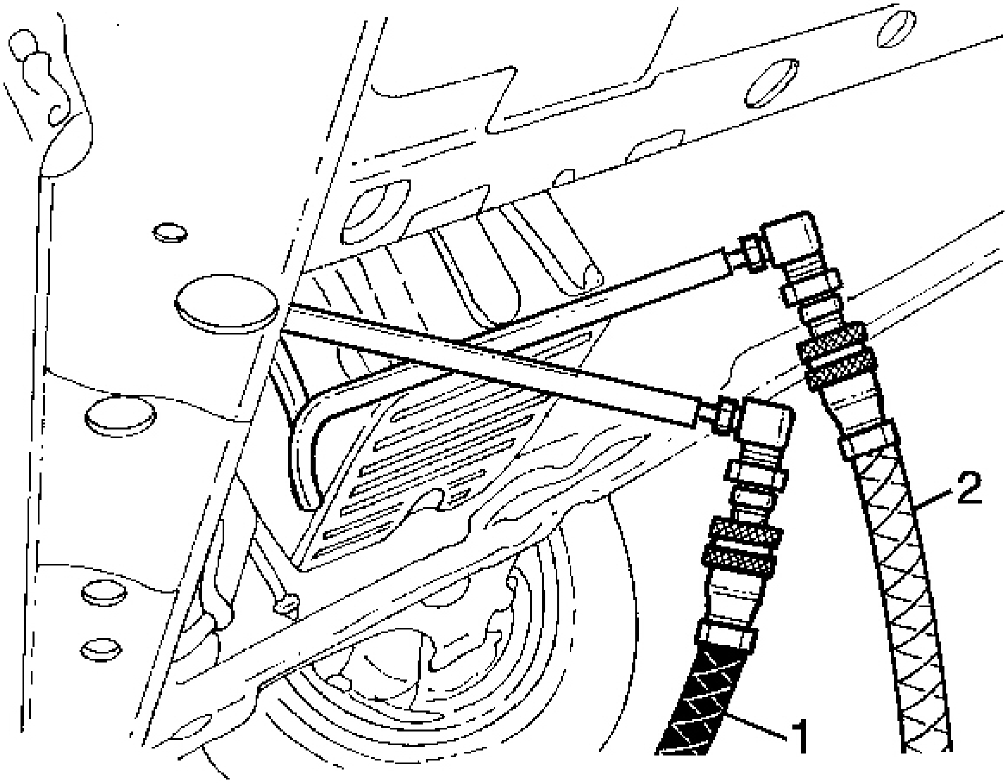


Fig. 15: Connecting Black Supply Hose & Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the black supply hose (1) to the return line, top connector of the transmission, and the clear waste hose (2) to the feed line, bottom connector of the transmission, to the vehicle cooler lines. This is the reverse flow-backflush direction.

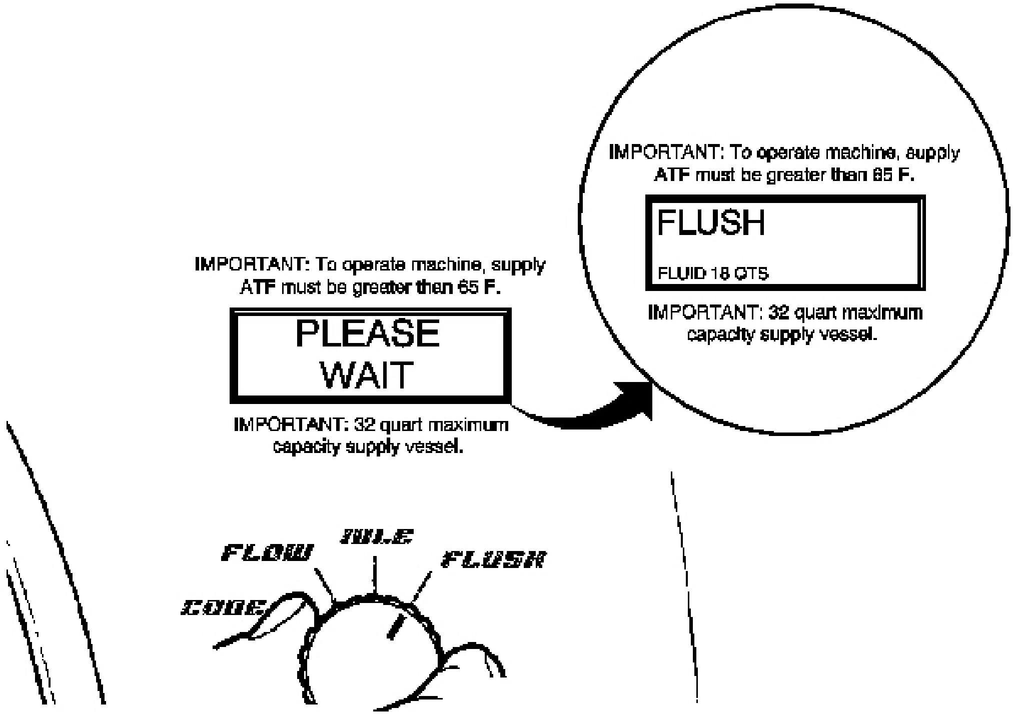


Fig. 16: Turning Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

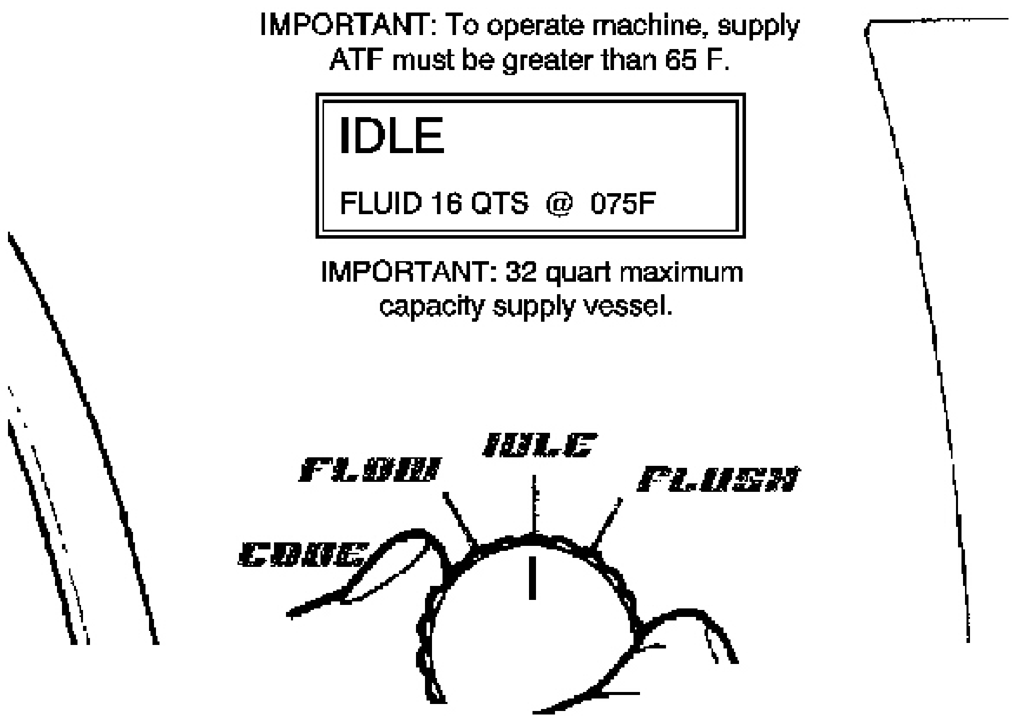


Fig. 17: Turning Main Function Switch To IDLE Position
Courtesy of GENERAL MOTORS CORP.

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

Forward Flush

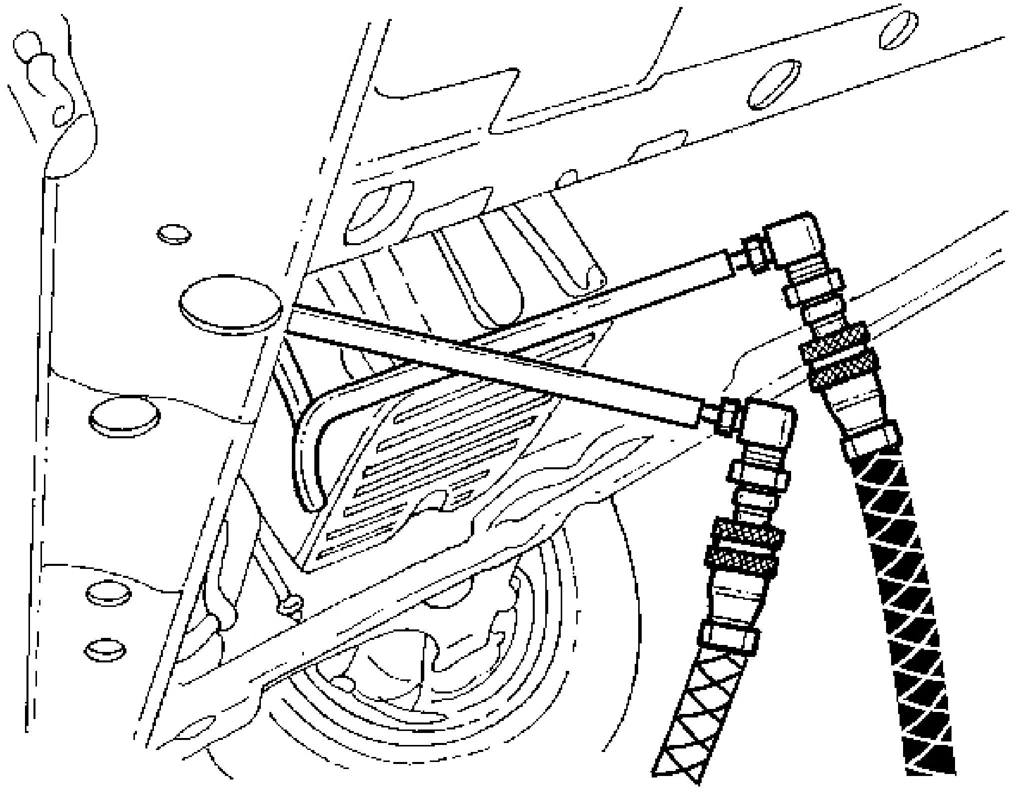


Fig. 18: Disconnecting Supply & Waste Hoses From Vehicle Cooler Lines
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the supply and waste hoses from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

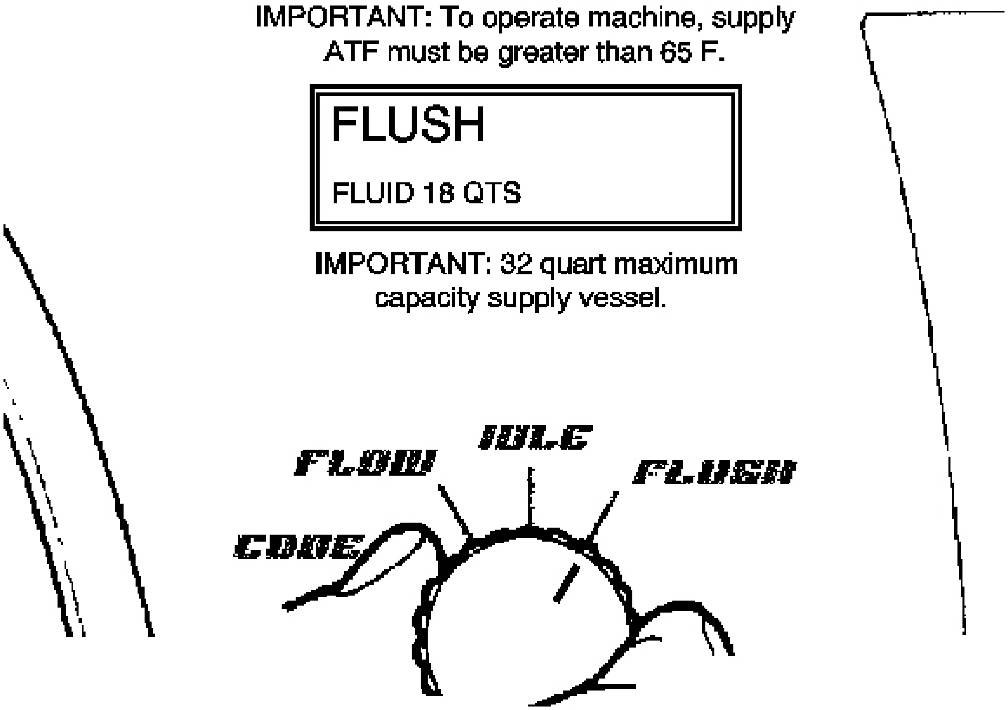


Fig. 19: Turning Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

2. Turn the main function switch to the FLUSH position and allow the machine to operate for 30 seconds.

Flow Test

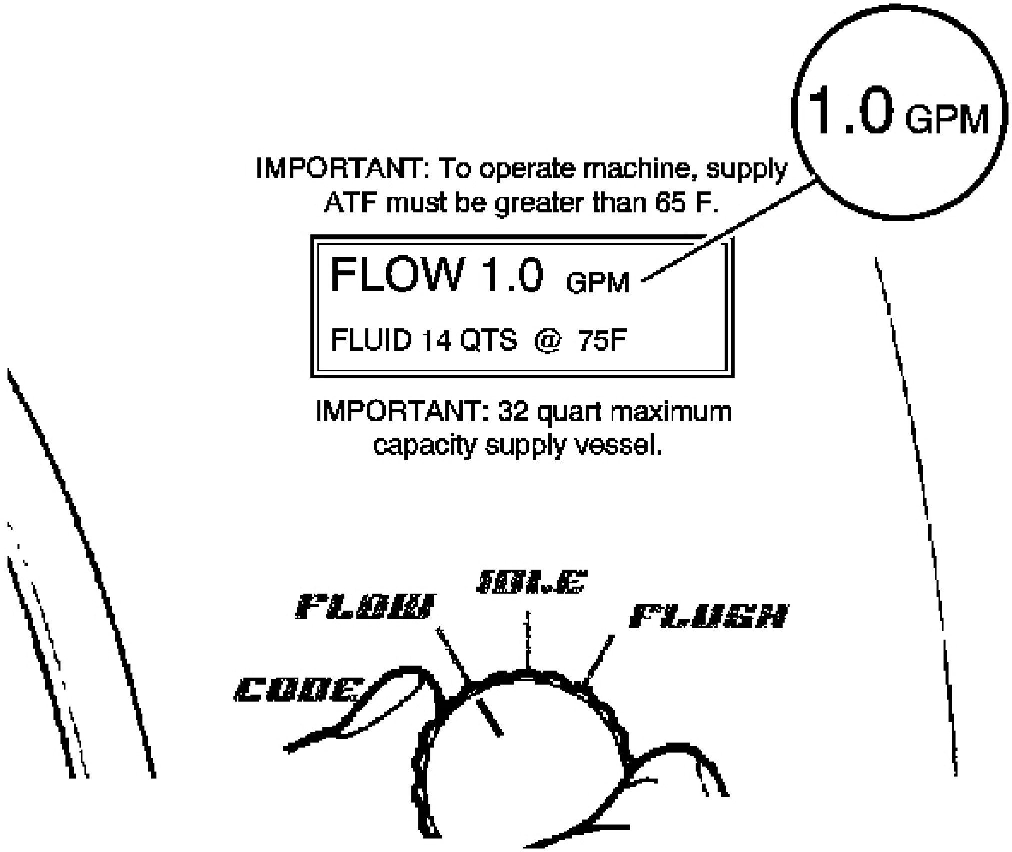


Fig. 20: Turning Main Function Switch To FLOW Position
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: **If the flow rate is less than 0.5 gpm, the LCD displays an error message. Refer to the Troubleshooting section of the operation manual.**

1. Turn the main function switch to the FLOW position and allow the oil to flow for 15 seconds. Observe and note the flow rate. This is the TESTED flow rate.
2. Compare the TESTED flow rate to the MINIMUM flow rate information previously recorded.
   - If the TESTED flow rate is equal to or greater than the MINIMUM flow rate recorded, the oil cooling system is functioning properly. Perform Code Recording Procedure.
   - If the TESTED flow rate is less than the MINIMUM flow rate previously recorded, repeat the back flush and forward flush procedures.
3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform the Code Recording Procedure.

1. Replace the transmission oil cooler.
2. Connect the supply and waste hoses to the cooler lines in the normal flow direction. Perform the Flow Test.
3. Perform the Code Recording Procedure.

Code Recording Procedure

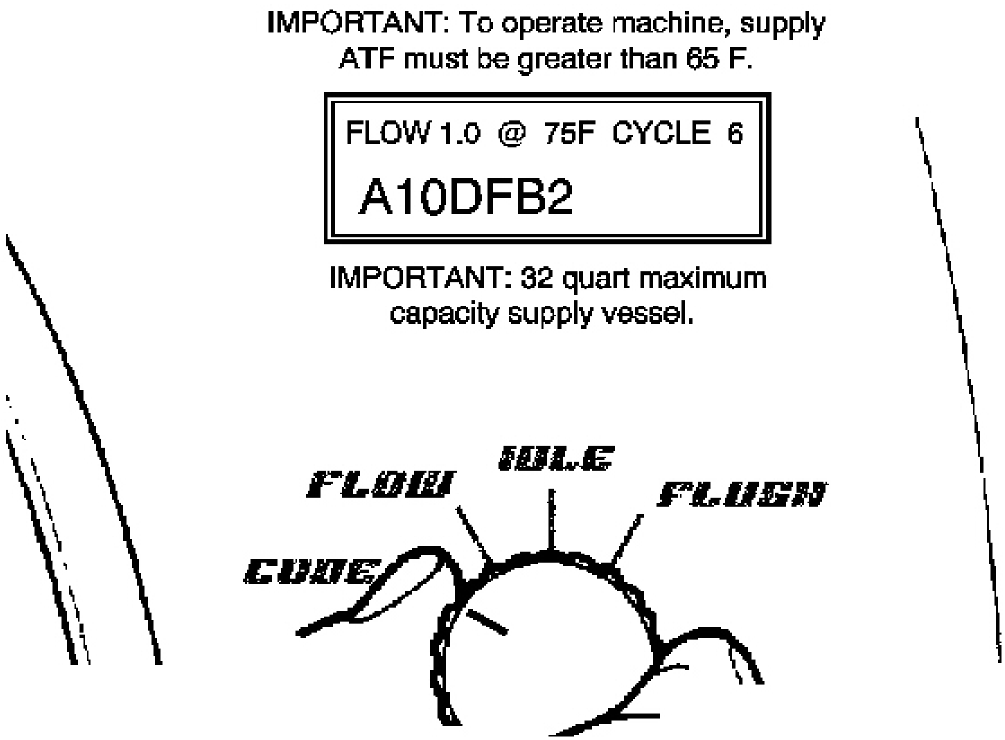


Fig. 21: Turning Main Function Switch To CODE Position
Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch to the CODE position.

IMPORTANT:

- **If power is interrupted prior to the recording of the 7-character code, the code will be lost and the flow rate test will need to be repeated.**
- **The flow test must run for a minimum of 8-10 seconds and be above 0.5 gpm for a code to be generated.**

2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on the repair order.

Clean-Up

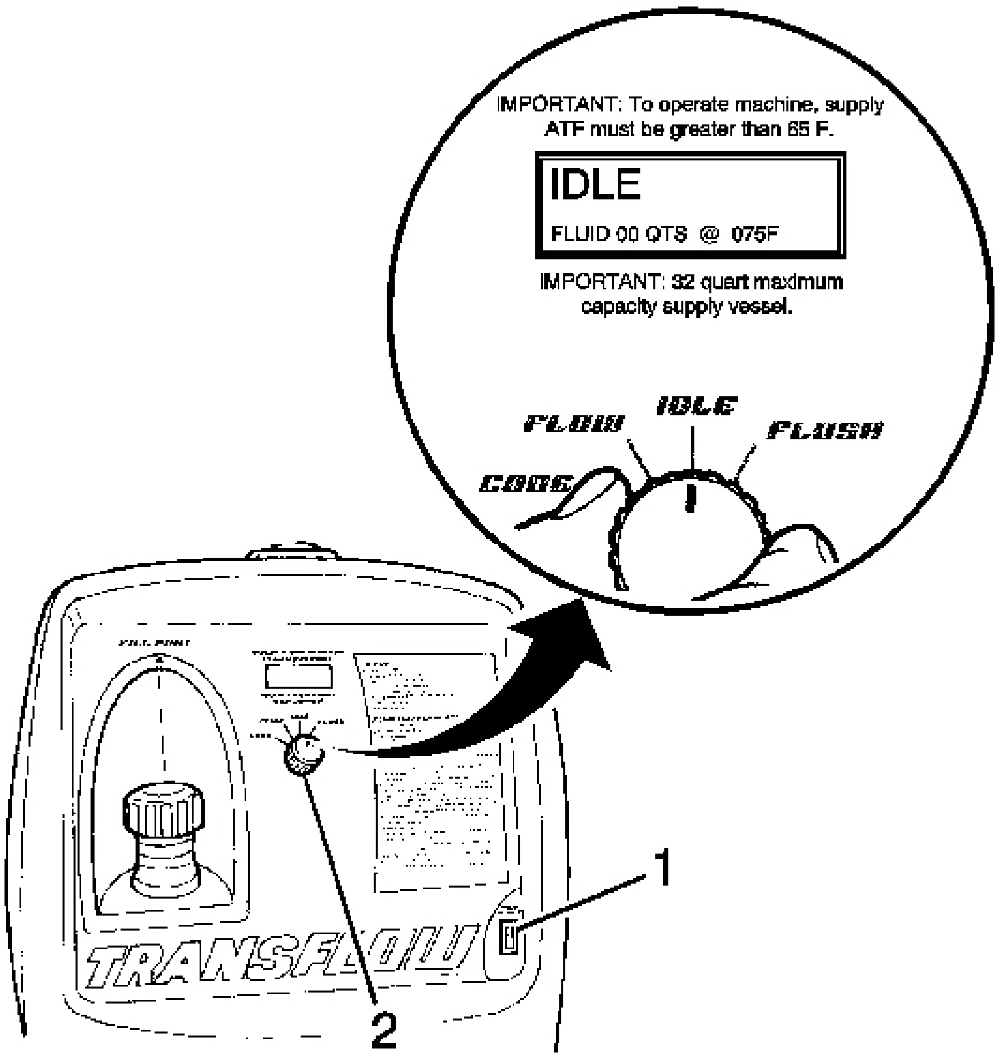


Fig. 22: Turning Main Function Switch To IDLE Position
Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

2. Turn the main power switch to the OFF position.

IMPORTANT: A small amount of water may drain from the bottom of the unit when the air supply is disconnected. This is a normal operation of the built-in water separator.

3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

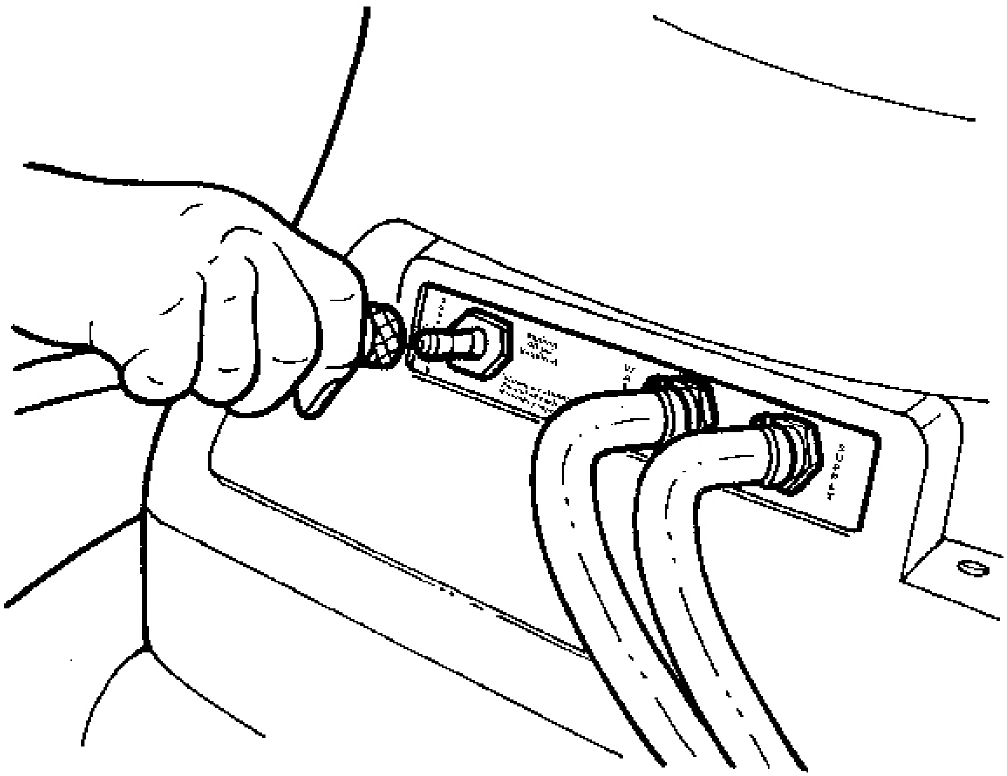


Fig. 23: Connecting A Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the air supply hose from **J 45096** .
5. Dispose of the waste ATF in accordance with all applicable federal, state, and local requirements.

AUTOMATIC TRANSMISSION OIL COOLER FLUSHING AND FLOW TEST (J 35944-A)

GM studies indicate that plugged or restricted transmission oil coolers and pipes cause insufficient transmission lubrication and elevated operating temperatures which can lead to premature transmission wear-out. Many repeat repair cases could have been prevented by following published procedures for transmission oil cooler flushing and flow checking. This procedure includes flow checking and flushing the auxiliary transmission oil cooler, if equipped.

IMPORTANT: Use the J 35944-A or equivalent to flush the transmission oil cooler and the oil cooler pipes whenever the transaxle is removed for the following repairs:

- **Torque converter**
- **Oil pump**
- **Oil pump drive shaft**
- **Drive sprocket support**
- **Transaxle overhaul complete**
- **Transaxle assembly replacement**

IMPORTANT: Use the J 35944-A or equivalent to flush the transmission oil cooler and the oil cooler pipes whenever the transmission is removed for the following repairs:

- **Torque converter**
- **Oil pump**
- **Turbine shaft**
- **Transmission overhaul complete**
- **Transmission assembly replacement**

Only GM Goodwrench DEXRON(R)III automatic transmission fluid should be used when doing a repair on a GM transmission.

Time allowance for performing the cooler flow checking and flushing procedure has been included in the appropriate labor time guide operations since the 1987 model year. The service procedure steps for oil cooler flushing are as follows:

Cooler Flow Check and Flushing Steps

1. Tools Required
2. Preparation
3. Back Flush
4. Forward Flush
5. Flow Check
6. Clean-up

Tools Required

- **J 35944-A** Transmission Oil Cooler Flusher
- **J 35944-22** Transmission Oil Cooler Flushing Fluid
- **J 35944-200** Cooler Flushing Adapter
- Measuring cup
- Funnel
- Water supply, hot water recommended
- Water hose, at least 16 mm (5/8 in) ID
- Shop air supply, with water/oil filters, regulator and pressure gauge
- Air chuck, with clip if available
- Oil drain container
- Pail with lid 19 L (5 gallon)
- Eye protection
- Rubber gloves

Preparation

1. During the installation of the repaired or replacement transmission, do not connect the oil cooler pipes.

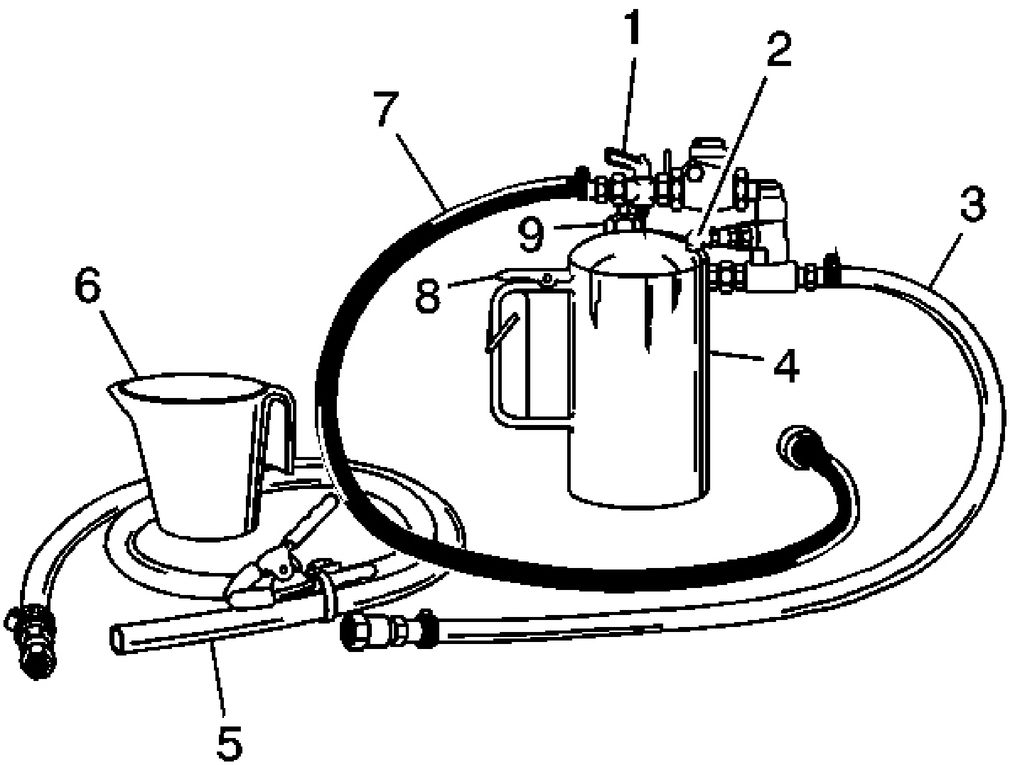


Fig. 24: J 35944 Flusher Tank
Courtesy of GENERAL MOTORS CORP.

NOTE: **Do not use solutions that contain alcohol or glycol. Use of solutions that contain alcohol or glycol may damage the oil cooler line flusher, oil cooler components and/or transmission components.**

IMPORTANT: **The J 35944-22 is environmentally safe, yet powerful enough to cut through transmission fluid to dislodge any contaminants from the cooler. The safety precautions on the label, regarding potential skin and eye irritations associated with prolonged exposure, are typical precautions that apply to many similar cleaning solutions. It should be noted that according to GM, use of other non-approved fluids for cooler flushing can have an adverse reaction to the seals inside the transmission.**

2. Remove the fill cap (9) on the **J 35944-A** and fill the flusher tank (4) with 0.6 L (20-21 oz) of **J 35944-22** , using the measuring cup (6). Do not overfill.
3. Install the fill cap (9) on the **J 35944-A** and pressurize the flusher tank (4) to 550-700 kPa (80-100 psi),

using the shop air supply at the tank air valve (2).

4. With the water supply valve (1) on the **J 35944-A** in the OFF position, connect the water supply hose from the **J 35944-A** to the water supply at the faucet.
5. Turn ON the water supply at the faucet.

Back Flush

1. Inspect the transmission oil cooler pipes for kinks or damage. Repair as necessary.

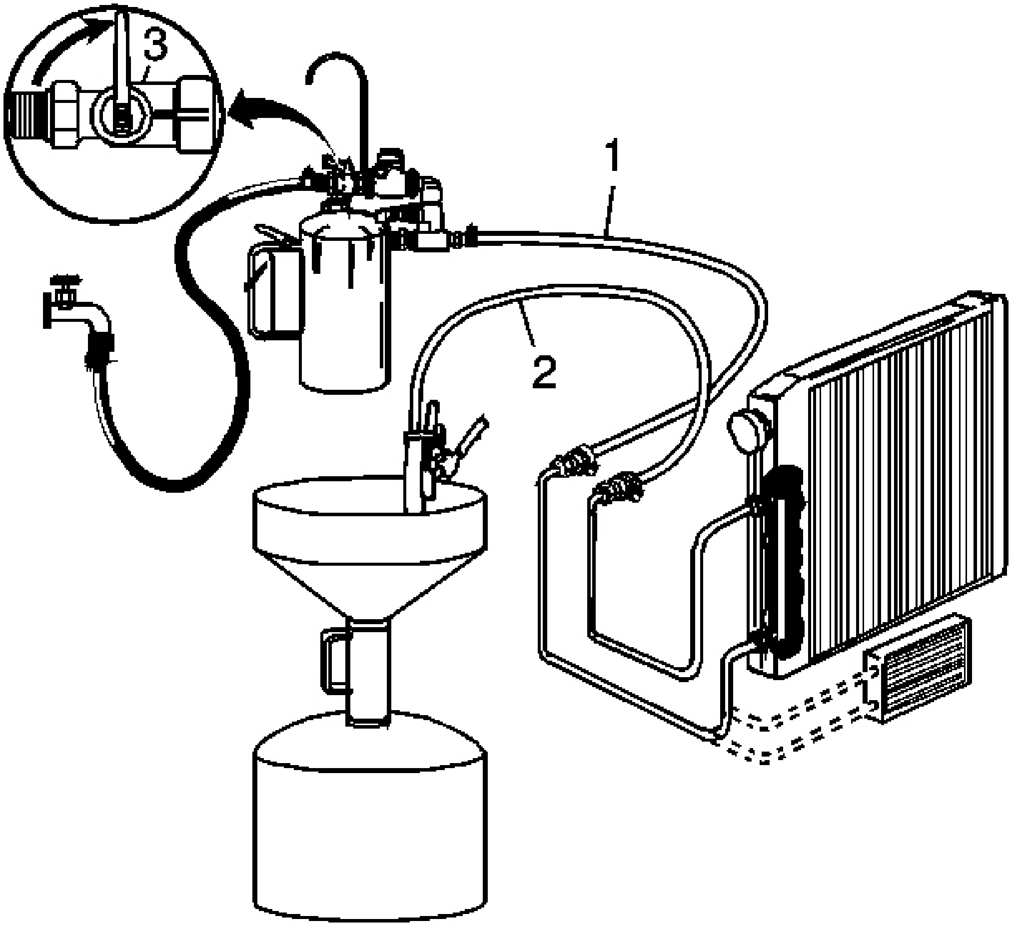


Fig. 25: Flushing Oil Cooler & Lines
Courtesy of GENERAL MOTORS CORP.

2. Connect the **J 35944-A** to the oil cooler feed bottom connector. Use the **J 35944-200** , if required.
3. Clip the discharge hose (2) onto the oil drain container.

4. Attach the **J 35944-A** to the undercarriage of the vehicle with the hook provided and connect the flushing system feed supply hose (1) from the **J 35944-A** to the top connector oil cooler return pipe. Use the **J 35944-200** , if required.
5. Turn the **J 35944-A** water supply valve (3) to the ON position and allow water to flow through the oil cooler and pipes for 10 seconds to remove any remaining transmission fluid. If water does not flow through the oil cooler and pipes, the cause of the blockage must be diagnosed and the plugged component must be repaired or replaced. Continue with the cooler flushing and flow check procedure once the blockage is corrected.
6. Turn the **J 35944-A** water supply valve (3) to the OFF position and clip the discharge hose onto a 19 liter (5 gallon) pail with a lid, to avoid splashback.

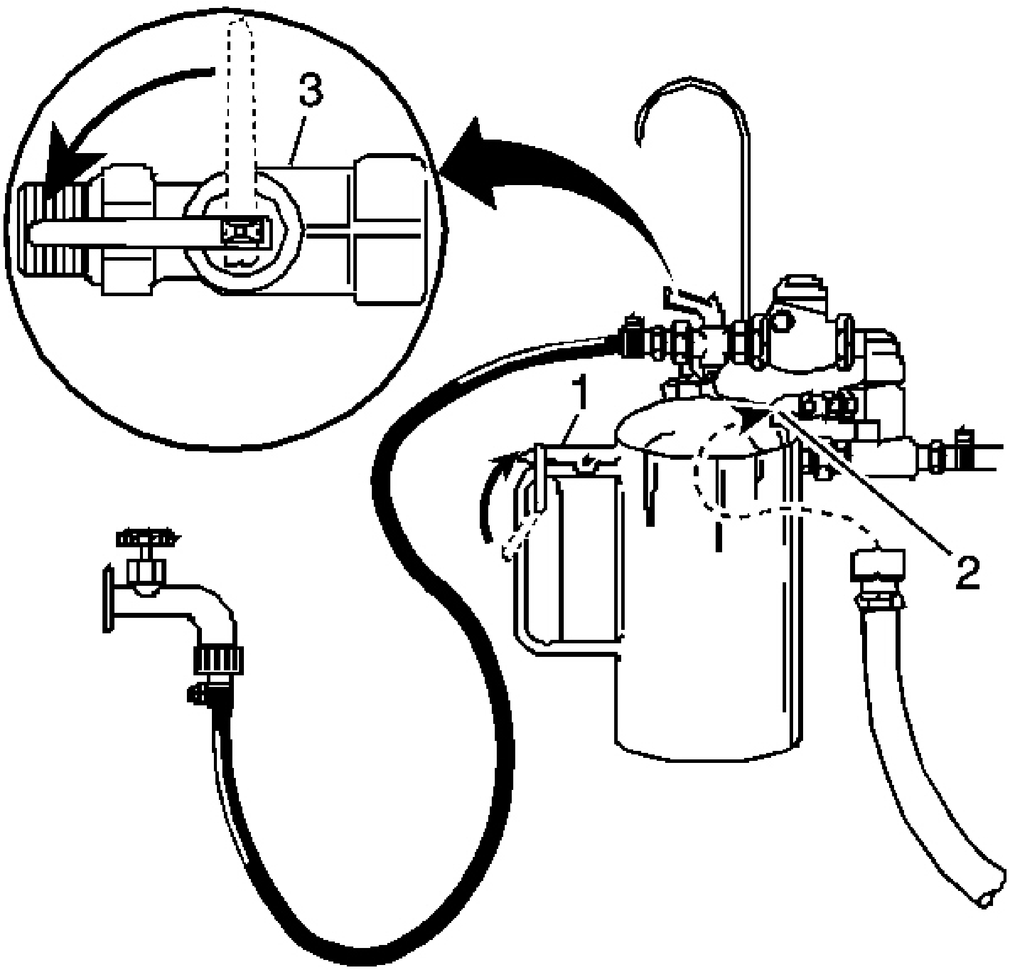


Fig. 26: Turning J 35944-A Water Supply Valve To ON Position

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Flushing for approximately 2 minutes in each cooler line direction will result in a total of about 30-38 L (8-10 gallons) of waste fluid. This mixture of water and flushing fluid is to be captured in a bucket or similar container.

7. Turn the **J 35944-A** water supply valve (3) to the ON position and depress the trigger (1) to mix cooler flushing solution into the water flow. Use the clip provided on the handle to hold the trigger (1) down. The discharge will foam vigorously when the solution is introduced into the water stream.
8. Flush the oil cooler and pipes with water and solution for 2 minutes. During this flush, attach the shop air supply 825 kPa (120 psi) to the flushing system feed air valve (2) located on the **J 35944-A** , for 3-5 seconds at the end of every 15-20 second interval to create a surging action.
9. Release the trigger (1) and turn the **J 35944-A** water supply valve (3) to the OFF position.

Forward Flush

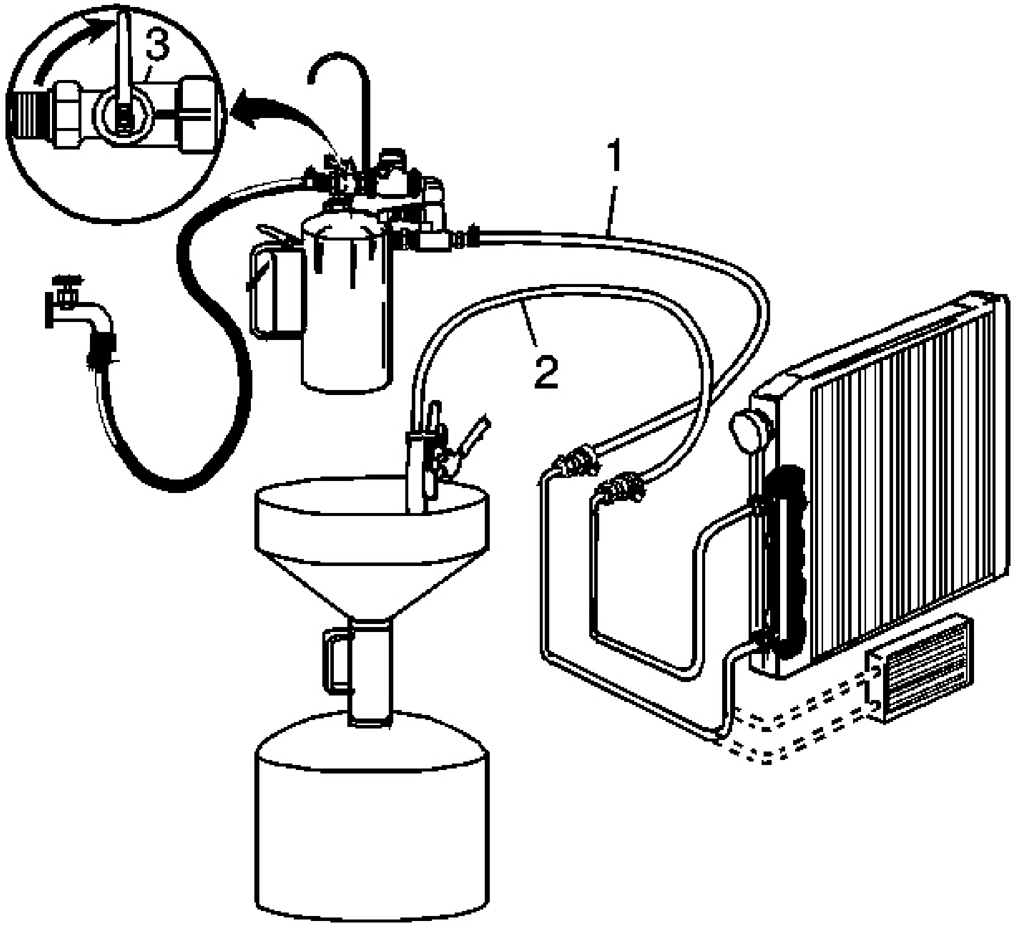


Fig. 27: Flushing Oil Cooler & Lines
Courtesy of GENERAL MOTORS CORP.

1. Disconnect both hoses (1 and 2) from the oil cooler pipes and connect them to the opposite oil cooler pipe. This will allow the oil cooler and pipes to be flushed in the normal flow direction.
2. Repeat Step 6 and 7 of the Back Flush.

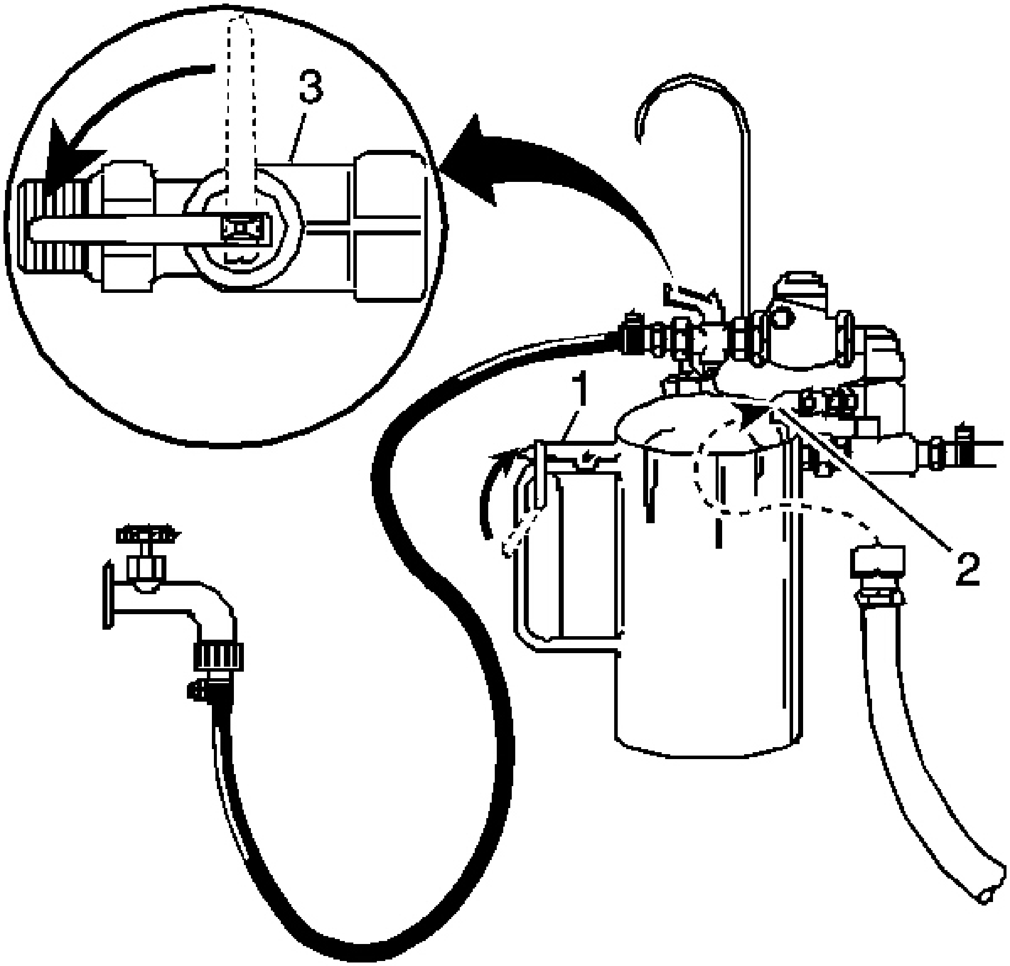


Fig. 28: Turning J 35944-A Water Supply Valve To ON Position
Courtesy of GENERAL MOTORS CORP.

3. Release the trigger (1) of the **J 35944-A** and allow water only to rinse the oil cooler and pipes for 1 minute.
4. Turn the **J 35944-A** water supply valve (3) to the OFF position and turn OFF the water supply at the faucet.
5. Attach the shop air supply to the flushing system feed air valve (2) on the **J 35944-A** and blow out the water from the oil cooler and pipes. Continue, until no water comes out of the discharge hose.

Flow Test

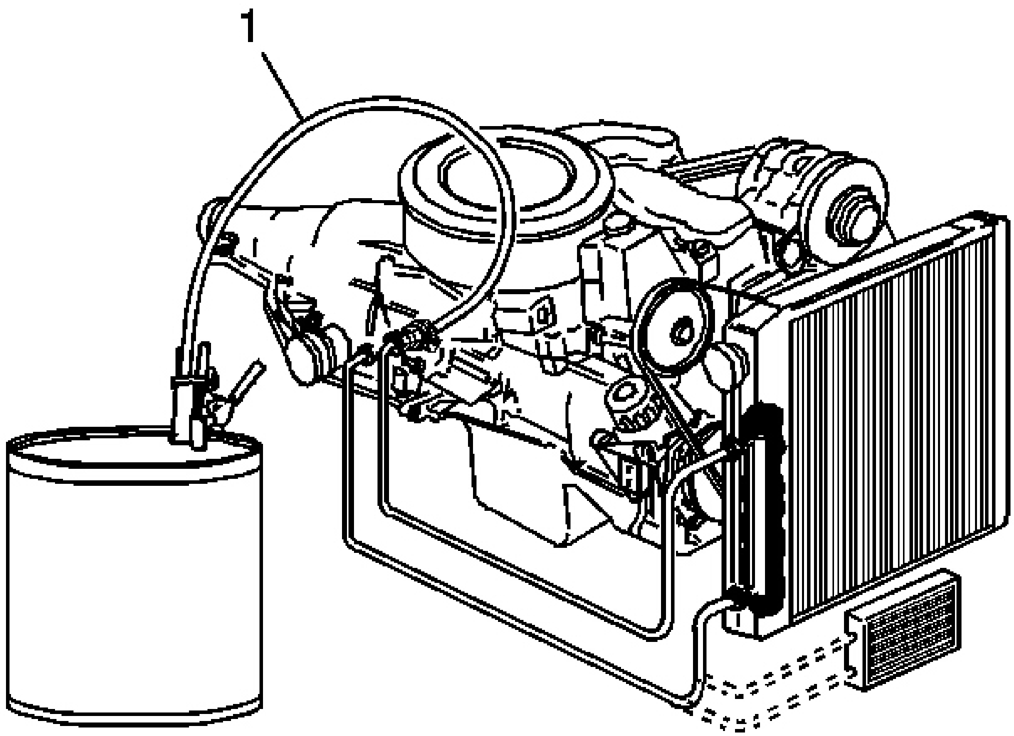


Fig. 29: Clipping Discharge Hose To An Empty Oil Container
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The Flow Test must be performed after the flush to ensure that all flushing solution and water is removed from the oil cooling system.

1. Disconnect the hose from the oil cooler pipe. Connect the oil cooler feed pipe, bottom connector, to the transmission for normal flow.
2. Clip the discharge hose (1) to an empty oil container.
3. Confirm the transmission is filled with automatic transmission fluid. Refer to **Fluid Capacity Specifications** for the correct automatic transmission fluid capacity.
4. Start the engine with the transmission in PARK range and run for 30 seconds after fluid begins to flow from the discharge hose (1). A minimum of 1.9 L (2 qt) must be discharged during this 30 second run time.
5. If the fluid flow meets or exceeds 1.9 L (2 quarts) in 30 seconds, connect the oil cooler feed pipe to the bottom connector on the transmission.
6. If fluid flow is less than 1.9 L (2 qt) in 30 seconds, perform the following diagnosis:
    1. Disconnect the **J 35944-A** discharge hose (1) from the oil cooler return pipe.

2. Disconnect the oil cooler feed pipe at the radiator.
3. Connect the **J 35944-A** discharge hose (1) to the oil cooler feed pipe, radiator end.
4. Clip the discharge hose (1) onto the oil drain container.
5. Start the engine with the transmission in PARK range and run for 30 seconds after fluid begins to flow from the discharge hose (1). A minimum of 1.9 L (2 qt) must be discharged during this 30 second run time.

7. If the amount of transmission fluid flow remains less than 1.9 L (2 qt) in 30 seconds, inspect the oil cooler feed pipe, bottom connector, for restrictions or damage. If no condition is found with the feed pipe, bottom connector, inspect the transmission.

Clean-up

1. Disconnect the water supply hose from the **J 35944-A** and bleed any remaining air pressure from the flusher tank.
2. Remove the fill cap from the **J 35944-A** and return any unused flushing solution to its container. Rinse the **J 35944-A** with water. Do not store the **J 35944-A** with flushing solution in it.
3. After every third use, clean the **J 35944-A** as described in the instructions included with the tool.
4. Dispose of any waste water/solution and transmission fluid in accordance with local regulations.

TRANSMISSION OVERHEATS

Transmission Overheats

Checks	Causes
TCC Circuit	Blockage during apply or release
Pump Cover (215)	Cross channel leakage
Pressure Regulator Valve (216)	The valve is stuck in a high demand position
Oil Cooler	The cooler or the cooler lines are blocked
Oil Pan Gasket (73)	The gasket is damaged
Turbine Shaft O-ring (618)	The O-ring is damaged
Turbine Shaft Seals (619)	The seals are damaged
Stator Shaft Bushings (234/241)	The bushing is worn or damaged
Fluid	The fluid level is low
Radiator	Air flow is restricted or internal blockage

OIL PRESSURE HIGH OR LOW

Oil Pressure High or Low

Checks	Causes
Oil Pump Assembly (4)	• Pressure regulator valve stuck • Pressure regulator valve spring • Rotor guide omitted or misassembled

	• Rotor cracked or broken • Reverse boost valve or sleeve stuck, damaged or incorrectly assembled • Orifice hole in pressure regulator valve plugged • Sticking slide or excessive rotor clearance • Pressure relief ball not seated or damaged • Porosity in pump cover or body • Wrong pump cover • Pump faces not flat • Excessive rotor clearance
Oil Filter (72)	• Intake pipe restricted by casting flash • Cracks in filter body or intake pipe • O-ring seal missing, cut or damaged • Wrong grease used on rebuild
Control Valve Body (60)	• Manual valve scored or damaged • Spacer plate or gaskets incorrect, misassembled or damaged • Face not flat • 2-3 Shift valve stuck • Checkballs omitted or misassembled
Pressure Control Solenoid (377)	Damage to electrical terminals
Transmission Fluid Pressure Manual Valve Position Switch (69)	• Contamination • Damaged seals
Case (103)	Case to control valve body face not flat
System Voltage	• 12 volts not supplied to transmission • Electrical short (pinched solenoid wire) • Solenoid not grounded

HARSH SHIFTS

Harsh Shifts

Checks	Causes
Throttle Position Sensor	Open or shorted circuit
Vehicle Speed Sensor (36)	Open or shorted circuit
Automatic Transmission Fluid Pressure (TFP) (69)	• Contamination • Damaged seals
Trans Fluid Temperature Sensor (Part of 69)	Open or shorted circuit
Engine Coolant Temperature Sensor	Open or shorted circuit

Pressure Control Solenoid (377)	• Damage to electrical terminals • Contamination

INACCURATE SHIFT POINTS

Inaccurate Shift Points

Checks	Causes
Oil Pump Assembly (4)	• Stuck pressure regulator valve • Sticking pump slide
Valve Body Assembly (60)	Spacer plate or gaskets misassembled, damaged or incorrect

Case (103)	• Porous or damaged valve body pad
	• 2-4 Servo Assembly
	    ○ 2-4 accumulator porosity
	    ○ Damaged servo piston seals
	    ○ Apply pin damaged or improper length
	• 2-4 Band Assembly
	    ○ Burned
	    ○ Anchor pin not engaged

Throttle Position Sensor	• Disconnected • Damage
Vehicle Speed Sensor (36)	• Disconnected • Damaged • Bolt not tightened
4WD Low Switch	• Disconnected • Damaged

FIRST GEAR RANGE ONLY - NO UPSHIFT

1st Gear Range Only - No Upshift

Checks	Causes
Control Valve Body (60)	• The 1-2 Shift valve is sticking • The spacer plate or gaskets are mispositioned or damaged
Case (103)	The case to valve body face is damaged or is not flat
Shift Solenoid Valves (366/368)	• Stuck or damaged • Faulty electrical connection
2-4 Servo Assembly (13-28)	• The apply passage case is restricted or blocked • Nicks or burrs on the servo pin or on the pin bore in the case

	• Fourth servo piston is installed backwards
2-4 Band Assembly (602)	• The 2-4 band is worn or damaged • The band anchor pin is not engaged

SLIPS IN FIRST GEAR

Slips in 1st Gear

Checks	Causes
Forward Clutch Assembly (646-651)	• Clutch plates worn • Porosity or damage in forward clutch piston • Forward clutch piston inner and outer seals missing, cut or damaged • Damaged forward clutch housing • Forward clutch housing retainer and ball assembly not sealing or damaged
Forward Clutch Accumulator (353-358)	• Piston seal missing, cut or damaged • Piston out of its bore • Porosity in the piston or valve body • Stuck abuse valve
Input Housing and Shaft Assembly (621)	Turbine shaft seals missing, cut or damaged
Valve Body (60)	• 1-2 Accumulator valve stuck • Face not flat, damaged lands or interconnected passages • Spacer plate or gaskets incorrect, mispositioned or damaged
Low Roller Clutch (678)	• Damage to lugs to inner ramps • Rollers not free moving • Inadequate spring tension • Damage to inner splines • Lube passage plugged
Torque Converter (1)	Stator roller clutch not holding
1-2 Accumulator Assembly (55-57, 104)	• Porosity in piston or 1-2 Accumulator cover and pin assembly • Damaged ring grooves on piston • Piston seal missing, cut or damaged • Valve body to spacer plate gasket at 1-2 Accumulator cover, missing or damaged • Leak between piston and pin • Broken 1-2 Accumulator spring
Line Pressure	Refer to **Oil Pressure High or Low** .

2-4 Servo Assembly (13-28)	4th Servo piston in backward

SLIPPING OR HARSH 1-2 SHIFT

Slipping or Rough 1-2 Shift

Checks	Causes
Valve Body Assembly (60)	• Mislocated valve body to spacer plate checkball or checkballs. • 1-2 Shift valve train stuck due to sediment • Gaskets or spacer plate incorrect, mispositioned or damaged • 1-2 Accumulator valve stuck or damaged • Face not flat • 4-3 sequence valve stuck or damaged • #1 or #8 checkball missing or mis-located • 1-2 accumulator valve bushing rotated 180°
2-4 Servo Assembly (13-28)	• Apply pin too long or too short • 2nd servo apply piston seal missing, cut or damaged • Restricted or missing oil passages • Servo bore in case damaged
2nd Accumulator (55-57, 104)	• Porosity in 1-2 accumulator cover or piston • Piston seal or groove damaged • Nicks or burrs in 1-2 accumulator housing • Missing or restricted oil passage • 1-2 accumulator piston spring not seated • Rough finish in 1-2 accumulator bore in case • A cracked 1-2 accumulator piston - allowing fluid to leak by
2-4 Band (602)	Worn or mispositioned
Oil Pump Assembly (4) or Case (103)	Faces not flat

NO 2-3 SHIFT OR 2-3 SHIFT SLIPS, ROUGH OR HUNTING

No 2-3 Shift or 2-3 Shift slipping, Rough or Hunting

Checks	Causes
Oil Pump (4)	Stator shaft bushings scored or off location
Valve Body Assembly (60)	• 2-3 Shift valve train stuck • Gaskets or spacer plate incorrect, mispositioned or damaged • 2-3 Accumulator valve stuck

	• Face not flat • Chips in servo feed oil, orifice #7 in spacer plate • Mislocated valve body to spacer plate checkball or checkballs
Input Housing Assembly (620-621, 646-655)	• 3-4 clutch or forward clutch plates worn • Excessive clutch plate travel • Cut or damaged 3-4 clutch or forward clutch piston seals • Porosity in input clutch housing or piston • 3-4 clutch piston checkball stuck, damaged or not sealing • Restricted apply passages • Forward clutch piston retainer and ball assembly not seating • Sealing balls loose or missing • Input housing (621) cracked or broken
Case (103)	3rd accumulator retainer and ball assembly not seating
2-4 Servo Assembly (13-28)	2nd apply piston seals missing, cut or damaged

SECOND/THIRD GEAR ONLY OR FIRST/FOURTH GEARS ONLY

Second/Third Gears Only or First/Fourth Gears Only

Checks	Causes
1-2 Shift Solenoid Valve (367A)	• Sediment is in the valves • The electrical connection is faulty • Damaged seal

NO FIRST OR SECOND GEAR/NO THIRD OR FOURTH GEAR

No 1st or 2nd/No 3rd or 4th

Checks	Causes
2-3 Shift Solenoid Valve (367B)	• Sediment is in the valves • The electrical connection is faulty • Damaged seal

NO SECOND GEAR, NO FOURTH GEAR, AND NO REVERSE GEAR

No Second Gear, No Fourth Gear and No Reverse Gear

Checks	Causes
Reaction Sun Shell (670)	Broken spline on reaction sun shell/replace shell.

THIRD GEAR ONLY

Third Gear Only

Checks	Causes
System Voltage	• 12 volts not supplied to transmission • Electrical short (pinched solenoid wire) • Solenoid not grounded

3-2 FLARE OR TIE-UP

3-2 Flare or Tie-Up

Checks	Causes
3-2 Shift Solenoid Valve Assembly (394)	• Shorted or damaged • Contamination • Damaged Seal • Check ball not seating

NO 3-4 SHIFT, SLIPS OR ROUGH 3-4 SHIFT

No 3-4 Shift/Slipping or Rough 3-4 Shift

Checks	Causes
Oil Pump Assembly (4)	• Pump cover retainer and ball assembly omitted or damaged • Faces not flat

Valve Body Assembly (60)	• Valves stuck
	  ○ 2-3 Shift valve train
	  ○ Accumulator valve
	  ○ 1-2 Shift valve train
	  ○ 3-2 Shift solenoid valve assembly
	• Spacer plate or gaskets incorrect, mispositioned or damaged

2-4 Servo Assembly (13-28)	• Incorrect band apply pin • Missing or damaged servo seals • Porosity in piston, cover or case • Damaged piston seal grooves • Plugged or missing orifice cup plug
Case (103)	• 3rd Accumulator retainer and ball assembly leaking • Porosity in 3-4 accumulator piston or bore • 3-4 Accumulator piston seal or seal grooves damaged • Plugged or missing orifice cup plug

	• Restricted oil passage
Input Housing Assembly (621)	Refer to **No 2-3 Shift or 2-3 Shift Slips, Rough or Hunting** .
2-4 Band Assembly (602)	Worn or misassembled

NO REVERSE OR SLIPS IN REVERSE

No Reverse or Slips in Reverse

Checks	Causes
Input Housing Assembly (602)	• 3-4 Apply ring stuck in applied position • Forward clutch not releasing • Turbine shaft seals missing, cut or damaged
Manual Valve Link (89)	Disconnected
Valve Body Assembly (60)	• 2-3 Shift valve stuck • Manual linkage not adjusted • Spacer plate and gaskets incorrect, mispositioned or damaged • Lo overrun valve stuck • Orificed cup plug restricted, missing or damaged
Reverse Input Clutch Assembly (605-614)	• Clutch plate worn • Reverse input housing and drum assembly cracked at weld • Clutch plate retaining ring out of groove • Return spring assembly retaining ring out of groove • Seals cut or damaged • Restricted apply passage • Porosity in piston • Belleville plate installed incorrectly • Excessive clutch plate travel • Oversized housing
Lo and Reverse Clutch (694-696)	• Clutch plates worn • Porosity in piston • Seals damaged • Return spring assembly retaining ring mispositioned • Restricted apply passage
Reaction Sun Shell (670)	Broken spline on reaction sun shell/replace shell

NO PART THROTTLE OR DELAYED DOWNSHIFTS

No Part Throttle or Delayed Downshifts

Checks	Causes
Input Housing Assembly (621)	• 3-4 Apply ring stuck in applied position • Forward clutch not releasing • Turbine shaft seals missing, cut or damaged
Manual Valve Link (89)	Disconnected
Valve Body Assembly (60)	• 2-3 Shift valve stuck • Manual linkage not adjusted • Spacer plate and gaskets incorrect, mispositioned or damaged • Lo overrun valve stuck • Orificed cup plug restricted, missing or damaged
Reverse Input Clutch Assembly (606-614)	• Clutch plate worn • Reverse input housing and drum assembly cracked at weld • Clutch plate retaining ring out of groove • Return spring assembly retaining ring out of groove • Seals cut or damaged • Restricted apply passage • Porosity in piston • Belleville plate installed incorrectly • Excessive clutch plate travel • Oversized housing
Lo and Reverse Clutch (694-696)	• Clutch plates worn • Porosity in piston • Seals damaged • Return spring assembly retaining ring mispositioned • Restricted apply passage

HARSH GARAGE SHIFT

Harsh Garage Shift

Checks	Causes
Valve Body Assembly (60)	• Orifice cup plug missing • Checkball missing

NO OVERRUN BRAKING - MANUAL 3-2-1

No Overrun Braking - Manual 3-2-1

Checks	Causes
External Linkage	Not adjusted properly
Valve Body Assembly (60)	• 4-3 Sequence valve stuck • Checkball mispositioned • Spacer plate and gaskets incorrect, damaged or mispositioned
Overrun and Forward Clutch Assembly (644-651)	• Turbine shaft oil passages plugged or not drilled • Turbine shaft seal rings damaged • Turbine shaft sealing balls loose or missing • Porosity in forward or overrun clutch piston • Overrun piston seals cut or damaged • Overrun piston checkball not sealing

NO TORQUE CONVERTER CLUTCH (TCC) APPLY (300 RPM SLIP)

No Torque Converter Clutch (TCC) Apply

Checks	Causes
Valve Body Assembly (60)	• Regulator apply valve side loading • Stuck converter clutch valve • TCC apply valve stuck closed (debris in bore) • TCC/PWM solenoid broken/cracked • Turbine shaft O-ring omitted • TCC/PWM solenoid leaking
Input Housing and Turbine Shaft Assembly (621)	• Turbine shaft hole not drilled to full depth • Scratched turbine shaft journals • Turbine shaft O-ring omitted/damaged • Turbine shaft retainer and ball assembly restricted or damaged
Electrical	• 12 volts not supplied to transmission • Outside electrical connector damaged • Inside electrical connector damaged • Wire harness damaged • TCC solenoid damaged • Electrical short (pinched wire) • TCC solenoid not grounded
Torque Converter Clutch (1)	Internal damage (blue or distorted)
Oil Pump Assembly (4)	• TCC spring cocked • Orifice cup plug restricted or damaged

	• Pump to case gasket mispositioned • Converter clutch valve retaining ring mispositioned • Converter clutch valve stuck or assembled backward
Transmission Fluid Pressure Manual Valve Position Switch (69)	• Contamination • Damaged seals
Solenoid Screen (367A/367B)	Blocked
TCC Solenoid Valve (Part of 66)	Internal damage
Engine Speed Sensor	Internal damage
Engine Coolant Temperature Sensor	Internal damage
Automatic Transmission Fluid Temperature Sensor (Part of 69)	Internal damage
Brake Switch	Internal damage
PCM	Internal damage
TCC PWM Solenoid (Part of 66)	Internal damage

TORQUE CONVERTER CLUTCH (TCC) SHUDDER

No Torque Converter Clutch Shudder

Checks	Causes
Miscellaneous	• Low oil pressure • Engine not tuned properly • Contaminated transmission oil
Oil Filter (72)	• Crack in filter body • Flash restricting filter neck • O-ring seal (71) cut or damaged
Torque Converter Assembly (1)	• Internal damage • Broken weld or missing weight
Oil Pump Assembly (4)	• Converter clutch valve (224) stuck • Restricted oil passage
Input Housing and Shaft Assembly (621)	• Turbin shaft O-ring (618) cut or damaged • Turbin shaft retainer and ball assembly (617) restricted or damaged

NO TORQUE CONVERTER CLUTCH (TCC) RELEASE

No TCC Release

Checks	Causes

TCC Solenoid Valve (Part of 66)	• External ground • Clogged exhaust orifice
Converter (1)	Internal damage
Valve Body Assembly (60)	The converter clutch apply valve is stuck in the apply position
Oil Pump Assembly (4)	The converter clutch valve is stuck
PCM	External ground

TORQUE CONVERTER CLUTCH (TCC) SLIP - 100 RPM SLIP

TCC Slip (100 RPM)

Checks	Causes
Valve Body Assembly (60)	• TCC/PWM solenoid leaks • Regulator apply valve or converter clutch shift valve sticking or side loading
Oil Pump Assembly (4)	• Stator shaft bushings worn, due to scratched turbine shaft journal (replace bushings and input housing assembly) • TCC apply valve is stuck open • TCC solenoid leaking
Input Housing and Turbine Shaft Assembly (621)	• Scratched journal on turbine shaft • Turbine shaft O-ring cut • Turbine shaft hole not drilled to full depth

TORQUE CONVERTER CLUTCH (TCC) SLIP WITH STALL/STUMBLE

TCC Slip with Stall/Stumble

Checks	Causes
TCC Apply Valve (Part of 66)	Stuck open

TORQUE CONVERTER CLUTCH (TCC) INTERMITTENT - OK COLD/SLIPS HOT

Intermittent TCC OK Cold/Slips Hot

Checks	Causes
TCC PWM Solenoid (396)	Leaks
Regulator Apply Valve (216)	Sticking valve
Converter Clutch Shift Valve (224)	Sticking valve

NO FOURTH GEAR, OR SLIPS IN FOURTH GEAR

No 4th or Slipping 4th

Checks	Causes
Checkball #2, 4,	Valve body checkball in wrong location or an additional checkball is installed. Refer to

8 or 12	**Control Valve Body Installation** in Transmission Unit Repair article - 4L60-E.
Orificed Cup Plug (240)	Not fully pressed into pump cover. Refer to **Oil Pump Stator Shaft Bushing Replacement** in Transmission Unit Repair article - 4L60-E.

SLIP/FLARE IN ANY GEAR

Slip/Flare in any Gear

Checks	Causes
Pump Slide Inner/Outer Spring (206/207)	Omitted

NO THIRD GEAR

No 3rd

Checks	Causes
Orificed Cup Plug (698)	Missing or blown out

DRIVES IN NEUTRAL

Drives in Neutral

Checks	Causes
Forward Clutch (446-451)	The clutch does not release
Manual Valve Link (89)	Disconnected
Case (103)	• The face is not flat • Internal leakage exists

SECOND GEAR START

Second Gear Start

Checks	Causes
Signal Noise on VSS Circuit	Chassis vibrations, incorrect harness routing, owner installed electronic components.
Diagnostic Trouble Code (DTC)	• Electrical or mechanical 1-2 Shift Solenoid Valve (367) malfunction. • Sediment in the valve body may cause improper TFP operation.
Leaking AFL Circuit	Spacer plate (48), spacer plate gaskets (47 or 52), control valve body (60), mispositioned, damaged or poor sealing/mating surface exist.
Blocked or restricted Valve Body Spacer Plate (48) Spacer Plate to Case Gasket (47) or Spacer Plate to Valve Body Gasket (52)	Trapped sediment or metal particles.
Stuck 1-2 Shift Valve (366)	• Trapped sediment or metal particles.

	• Binding shift valve or worn valve body bore.
TFP manual valve position switch (69)	TFP manual valve position switch (69) erratic operation.

NO PARK

No Park

Checks	Causes
Parking Lock Actuator Linkage (85-90)	• Actuator rod assembly bent or damaged • Actuator rod spring binding or improperly crimped • Actuator rod not attached to inside detent lever • Parking lock bracket damaged or not torqued properly • Inside detent lever not torqued properly • Parking pawl binding or damaged

OIL OUT THE VENT

Oil Out the Vent

Checks	Causes
Oil Pump (4)	Chamber in pump body rotor pocket
Miscellaneous	Fluid level-overfilled

VIBRATION IN REVERSE AND WHINING NOISE IN PARK

Vibration in Reverse and Whining Noise in Park

Checks	Causes
Oil Pump (4)	Chamber in pump body rotor pocket
Miscellaneous	Fluid level-overfilled

RATCHETING NOISE

Ratcheting Noise

Checks	Causes
Parking Brake Pawl (50-81)	The parking pawl return spring is weak, damaged, or misassembled

POPPING NOISE

Popping Noise

Checks	Action
DEFINITION: A popping noise, similar to popcorn popping	
Oil Pump	• Check fluid level.

System	• Inspect for pump cavitation, indicated by bubbles in fluid. • Inspect the transmission fluid filter for a leaky seam. • Inspect the transmission fluid filter seal for improper positioning or for a cut seal.

WHINE NOISE VARYING WITH RPM OR FLUID PRESSURE

Whine Noise Varying with RPM or Fluid Pressure

Checks	Action
DEFINITION: In all ranges, a whine which may be sensitive to RPM load, or which ceases when the TCC engages, or which is sensitive to the oil pressure	
Torque Converter (1)	Verify that the noise is internal to the torque converter by placing your left foot on the brake with the gear or selector in Drive. Momentarily stall the engine. Torque Converter noise increases under load.
Oil Pump System	Verify that the noise is internal to the oil pump during a preliminary oil pressure check. An increase in line pressure will vary an oil pump noise.

BUZZ NOISE OR HIGH FREQUENCY RATTLE SOUND

Buzz Noise or High Frequency Rattle Sound

Checks	Action
DEFINITION: A buzz or high frequency rattle	
• Trace Cooler Pipes • Check for binding or contact at the Radiator, other than at the Cooler Pipe connectors	Verify a pressure buzz by watching for a needle vibration of the pressure gauge. A road test may be necessary. Refer to **Road Test Procedure** .

NOISE IN RANDOM RANGES

Noise in Random Ranges

Checks	Action
DEFINITION: Noise only in certain gear ranges	
Refer to **Range Reference** . Determine the power flow and the applicable components that may be causing this noise.	

NO DRIVE IN ALL RANGES

No Drive in All Ranges

Checks	Causes
Low Transmission Fluid Level	Transmission or cooler line leak
Oil Pump (4)	Damaged oil pump rotor (212)
Torque Converter (1)	• Damaged pump drive

	• The converter to flex plate bolts are missing

NO DRIVE IN DRIVE RANGE

No Drive in Drive Range

Checks	Causes
Torque Converter (1)	• The stator roller clutch is not holding • The converter is not bolted to the flex plate

SHIFT LEVER INDICATES WRONG GEAR

Shift Lever Indicates Wrong Gear

Checks	Causes
Manual Valve (340)	Not engaged to detent lever
Detent Roller Pin (63)	Missing or damaged
Detent Roller (63)	Broken or disconnected
Detent Spring (63)	Broken or disconnected
Manual Valve Link (89)	Loose or missing
Manual Shaft (84)	Flats not parallel
Indicator Linkage	Misadjusted

NO GEAR SELECTION

No Gear Selection

Checks	Causes
Detent Lever (63)	Nut loose or missing
Manual Valve (84)	Stuck
Spacer Plate/Gaskets (47, 48, 52)	Blocked holes
Control Valve Body to Case (60/103)	Blocked channels

ENGINE STARTS IN GEAR

Engine Starts in Gear

Checks	Causes
Manual Valve (24)	Not engaged to detent lever
Transmission Range Switch	Not working or mispositioned

DELAY IN DRIVE AND REVERSE

Delay in Drive and Reverse

Checks	Causes
Forward Clutch Piston (630)	Cut or damaged piston seals

Low and Reverse Clutch Piston (695)	Cut or damaged inner, outer or center clutch seals
Reverse Input Clutch Piston Assembly (607)	Cut or damaged inner or outer clutch seals
Pump Cover (215)	Cut or damaged oil seal rings - stator shaft

LACK OF POWER OR HESITATION

Lack of Power or Hesitation

Checks	Causes
Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch (69)	Incorrect TFP signal logic for current gear position. Refer to **Transmission Fluid Pressure (TFP) Manual Valve Position Switch Logic** .

AUTOMATIC TRANSMISSION (DTC P0218 TO DTC P2771)

DTC P0218

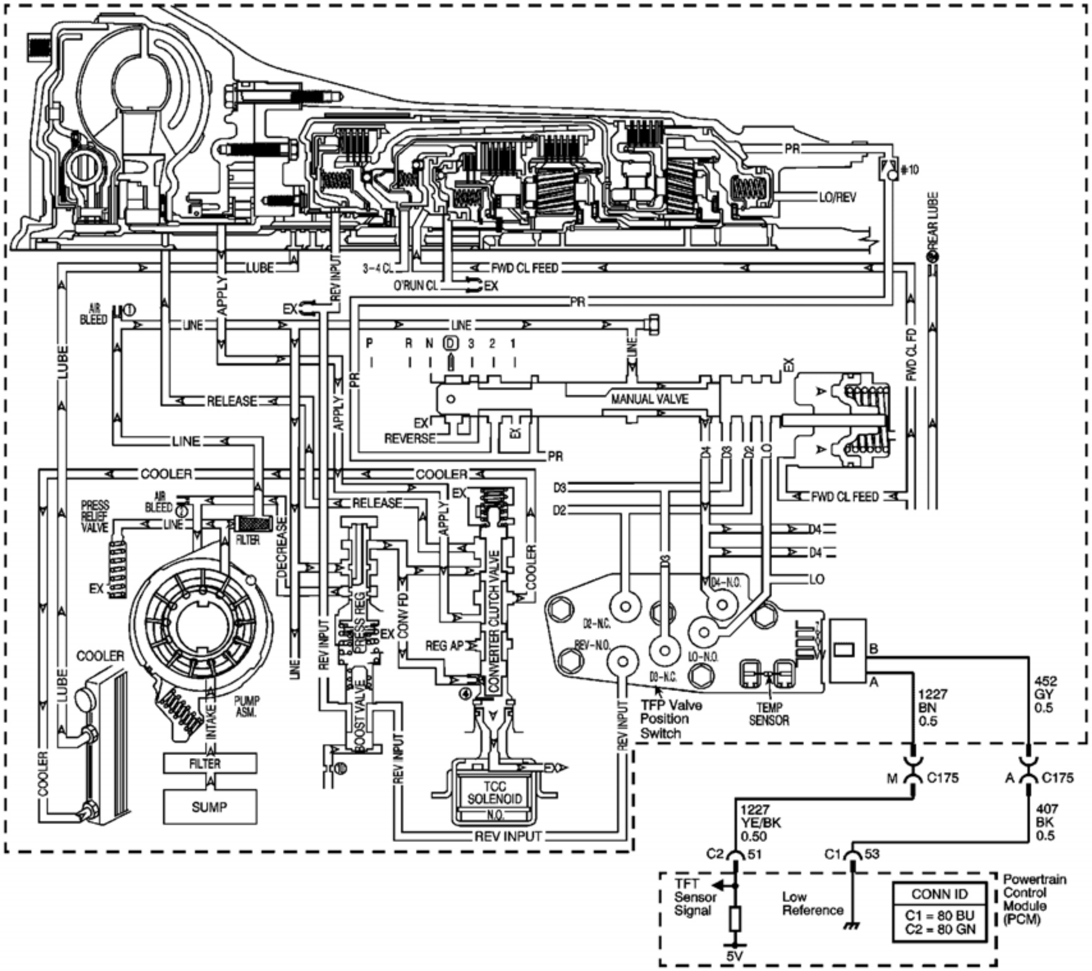


Fig. 1: Filter, Control Valve Body Assembly, Transmission Case & Oil Pump Assembly
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The flow of transmission fluid starts in the bottom pan and is drawn through the filter, control valve body assembly, transmission case and into the oil pump assembly. The oil pump assembly pressurizes the fluid and directs it to the pressure regulator valve where it becomes the main supply of fluid to the various components and hydraulic circuits in the transmission. Hot fluid exiting the torque converter flows through the converter clutch apply valve and into the transmission cooler lines to the oil cooler located in the vehicle radiator, and auxiliary cooler if equipped. From the cooler, fluid returns to cool and lubricate the front of the transmission. In forward drive ranges, D4 fluid from the manual valve is routed through an orificed cup plug in the rear of the transmission case to feed the rear lube fluid circuit.

When the powertrain control module (PCM) detects a high transmission fluid temperature (TFT) for a long period of time, then DTC P0218 sets. DTC P0218 is a type C DTC.

Conditions for Running the DTC

- No TFT sensor DTCs P0711, P0712 or P0713.
- The ignition switch is ON for 5 seconds.

Conditions for Setting the DTC

The TFT is greater than 130°C (266°F) for 600 seconds (10 minutes).

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).
- TRANS HOT...IDLE ENGINE message displays on the driver information center (DIC).
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Failure Records.
- The PCM stores DTC P0218 in PCM history.

Conditions for Clearing the DIC/DTC

- The PCM clears the DIC message when the condition no longer exits.
- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- The scan tool Trans. Fluid Temp. should rise steadily to a normal operating temperature, then stabilize.
- Ask about the customer's driving habits, trailer towing, etc. Trailer towing should occur in D3.

  Refer to **Symptoms - Automatic Transmission** .

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step inspects for air flow restrictions or damage which may result in the transmission overheating.

DTC P0218

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Failure Records. Using the Clear Info function erases the Failure Records from the PCM.** 3. Record the DTC Failure Records. 4. Clear the DTC. 5. Inspect for correct transmission fluid level. Refer to **Transmission Fluid Checking Procedure** . Did you perform the fluid checking procedure?	-	Go to **Step 3**	Go to **Transmission Fluid Checking Procedure**
3	1. Inspect the engine cooling system and transmission cooling system for the following conditions: • Air flow restrictions • Air flow blockage • Debris 2. Inspect the transmission cooling system for damaged cooler lines. 3. Test the oil cooler flow. Refer to **Automatic Transmission Oil Cooler Flushing and Flow Test (J 45096)** or **Automatic**	-		

	Transmission Oil Cooler Flushing and Flow Test (J 35944-A) . Did you find and correct the condition?		Go to **Step 6**	Go to **Step 4**
4	Test for correct line pressure. Refer to **Line Pressure Check Procedure** . Did you find and correct the condition?	-	Go to **Step 6**	Go to **Step 5**
5	Test the torque converter stator. Refer to **Torque Converter Diagnosis Procedure** . Did you find and correct the condition?	-	Go to **Step 6**	Go to Diagnostic Aids
6	Perform the following procedure in order to verify the repair: 1. Install a scan tool. 2. Select DTC. 3. Select Clear Info. 4. Start and idle the engine until it reaches normal operating temperature. 5. Monitor Engine Run Time and Trans. Fluid Temp. on the scan tool. 6. Drive the vehicle for 10 minutes. 7. Ensure that the transmission fluid temperature has stabilized and is less than 129°C (264°F). 8. Select Specific DTC. 9. Enter DTC P0218. Has the test run and passed?	-	Go to **Step 7**	Go to **Step 2**
7	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0502

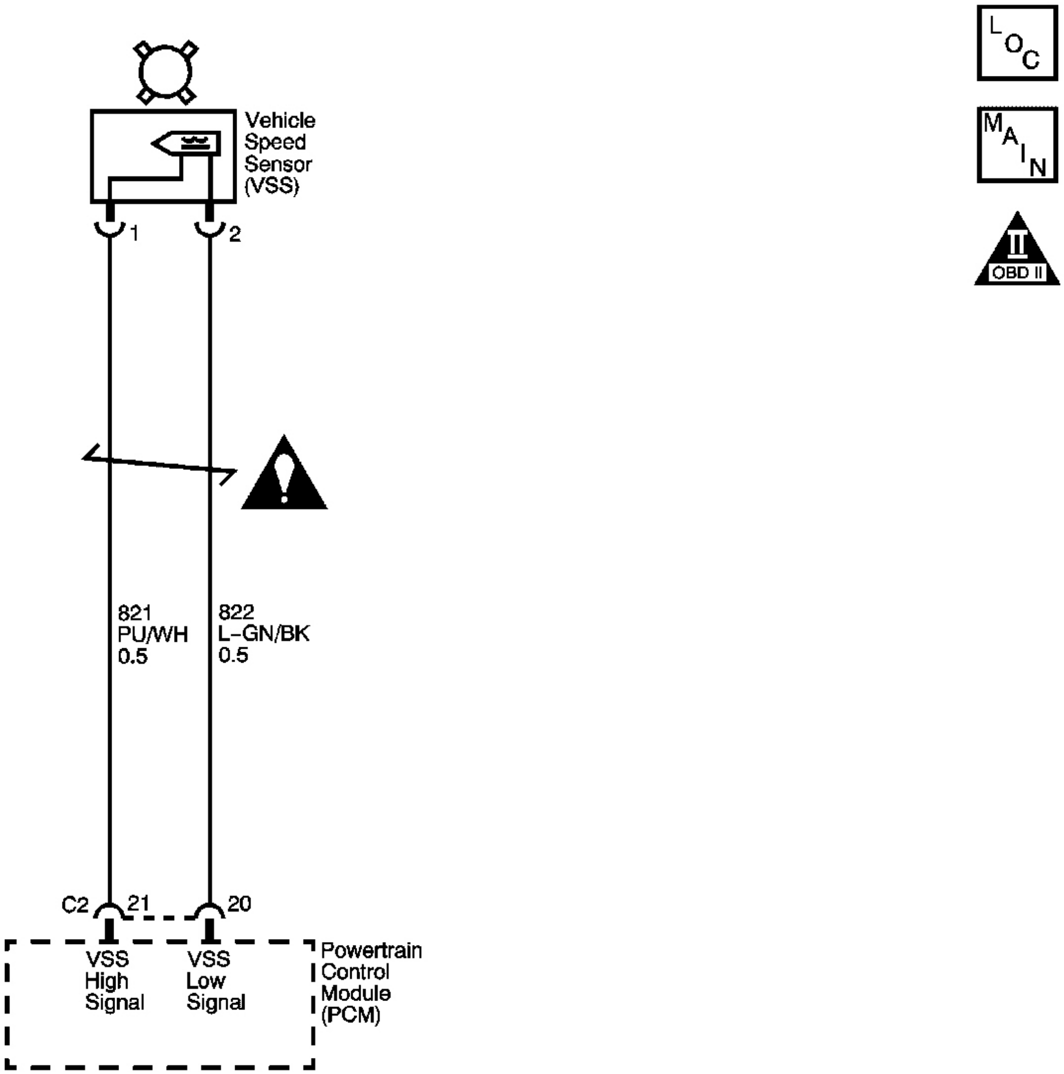


Fig. 2: Vehicle Speed Sensor (VSS) Assembly Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The vehicle speed sensor (VSS) assembly provides vehicle speed information to the powertrain control module (PCM). The VSS assembly is a permanent magnet generator. The VSS produces an AC voltage as rotor teeth on the output shaft of the transfer case pass through the sensor's magnetic field. The AC voltage level and the number of pulses increase as the speed of the vehicle increases. The PCM converts the pulsing voltage to vehicle speed. The PCM uses the vehicle speed signal to determine shift timing and torque converter clutch (TCC) scheduling.

When the PCM detects a low vehicle speed when there is a high engine speed in a drive gear range, then DTC

P0502 sets. DTC P0502 is a type B DTC.

Conditions for Running the DTC

- No MAP sensor DTCs P0107 or P0108.
- No TP sensor DTCs P0122 or P0123.
- No TFP manual valve position switch DTC P1810.
- The engine torque is 54-542 N.m (40-400 lb ft).
- The TP angle is greater than 12 percent.
- The engine speed is greater than 3,000 RPM.
- The transmission is not in PARK or NEUTRAL.

Conditions for Setting the DTC

The transmission output speed is less than 150 RPM for 3 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands second gear only.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0502 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests the VSS assembly circuit.

4: This step tests the integrity of the VSS assembly.

DTC P0502

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Raise and support the rear axle assembly. 6. Start the engine. 7. Place the transmission in any drive range. With the drive wheels rotating, does the scan tool Transmission OSS increase with the drive wheel speed?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the PCM connector C2. 3. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the resistance between harness connector terminals C2-20 and C2-21. Does the resistance measure within the specified range?	976-2354 ohm	Go to **Step 4**	Go to **Step 7**
	1. Place the transmission in NEUTRAL. 2. Select AC volts.			

4	3. Prevent one rear wheel from turning. 4. Rotate the other rear wheel by hand, ensuring that the driveshaft is turning. Does the voltage measure greater than the specified value?	0.5 V	Go to **Step 5**	Go to **Step 12**
5	Measure the resistance from terminal C2-21 to ground. Does the resistance measure greater than the specified value?	50 K ohm	Go to **Step 6**	Go to **Step 9**
6	1. Reconnect the PCM connector C2. 2. Disconnect the engine wiring harness from the VSS assembly. 3. Turn ON the ignition, with the engine OFF. 4. Test the high circuit of the VSS assembly for a short to power. Refer to **Testing for a Short to Voltage** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
7	1. Disconnect the engine wiring harness from the VSS assembly. 2. Measure the resistance of the VSS assembly. Does the resistance measure within the specified range?	976-2354 ohm	Go to **Step 8**	Go to **Step 13**
8	Was the resistance measured in Step 3 greater than the specified value?	2354 ohm	Go to **Step 10**	Go to **Step 11**
9	Test the high circuit of the VSS assembly for a short to ground. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	-
	1. Test the high circuit of the VSS assembly for an open. 2. Test the low circuit of the VSS assembly for an open.			

10	Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	-
11	Test the high circuit and the low circuit of the VSS assembly for a short together. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	-
12	1. Remove the VSS assembly. 2. Inspect the output shaft speed sensor rotor for damage or misalignment. 3. Inspect the case extension bushing for wear. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
13	Replace the VSS assembly. Refer to **Vehicle Speed Sensor (VSS) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 15**	-
15	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Operate the vehicle, so that the transmission output speed is greater than 250 RPM for 2 seconds. 4. Select Specific DTC. 5. Enter DTC P0502. Has the test run and passed?	-	Go to **Step 16**	Go to **Step 2**
16	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls -	

			6.0L (LQ4)	System OK

DTC P0503

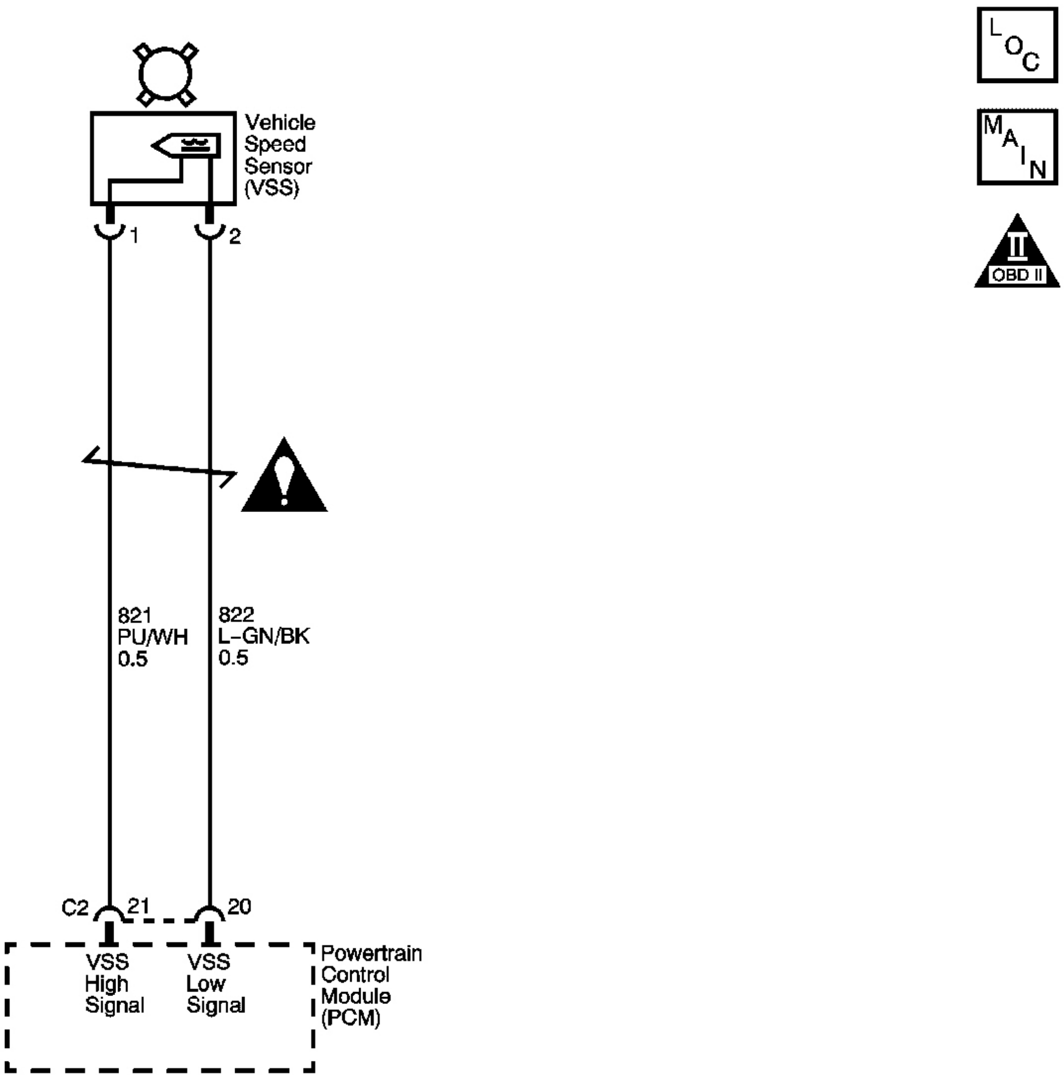


Fig. 3: Vehicle Speed Sensor (VSS) Assembly Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The vehicle speed sensor (VSS) assembly provides vehicle speed information to the powertrain control module (PCM). The VSS assembly is a permanent magnet generator. The VSS produces an AC voltage as rotor teeth on the output shaft of the transfer case pass through the sensor's magnetic field. The AC voltage level and the number of pulses increase as the speed of the vehicle increases. The PCM converts the pulsing voltage to vehicle speed. The PCM uses the vehicle speed signal to determine shift timing and torque converter clutch (TCC) scheduling.

When the PCM detects an unrealistically large drop in vehicle speed, then DTC P0503 sets. DTC P0503 is a type B DTC.

Conditions for Running the DTC

- No TFP manual valve position switch DTC P1810.
- The engine speed is greater than 450 RPM.
- The time since the last gear range change is greater than 6 seconds.
- The time since the last AWD low state change is greater than 6 seconds.
- The transmission output speed rise does not exceed 600 RPM within 2 seconds.

Conditions for Setting the DTC

The transmission output speed drop is greater than 1,300 RPM for 3 seconds when the transmission is not in PARK or NEUTRAL.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands a soft landing to second gear.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM inhibits fourth gear if the transmission is in hot mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0503 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

Inspect for ABS DTCs. A faulty ABS condition may contribute to setting DTC P0503.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests the VSS assembly circuit.
4: This step tests the integrity of the VSS assembly.

DTC P0503

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Raise and support the rear axle assembly. 6. Start the engine. 7. Place the transmission in D3 range. 8. With the drive wheels rotating, slowly accelerate to 2,000 engine RPM and hold. Road test the vehicle if necessary. Does the scan tool Transmission OSS drop or fluctuate more than the specified value?	1,300 RPM	Go to **Step 3**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
3	1. Turn OFF the ignition. 2. Disconnect the PCM connector C2. 3. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the resistance	976-2354		

	between harness connector terminals C2-20 and C2-21. Does the resistance measure within the specified range?	ohm	Go to **Step 4**	Go to **Step 7**
4	1. Place the transmission in NEUTRAL. 2. Select AC volts. 3. Prevent one rear wheel from turning. 4. Rotate the other rear wheel by hand, ensuring that the driveshaft is turning. Does the voltage measure greater than the specified value?	0.5 V	Go to **Step 5**	Go to **Step 12**
5	Measure the resistance from terminal C2-21 to ground. Does the resistance measure greater than the specified value?	50 K ohm	Go to **Step 6**	Go to **Step 9**
6	1. Reconnect the PCM connector C2. 2. Disconnect the engine wiring harness from the VSS assembly. 3. Turn ON the ignition, with the engine OFF. 4. Test the high circuit of the VSS assembly for a short to voltage. Refer to **Testing for a Short to Voltage** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
7	1. Disconnect the engine wiring harness from the VSS assembly. 2. Measure the resistance of the VSS assembly. Does the resistance measure within the specified range?	976-2354 ohm	Go to **Step 8**	Go to **Step 13**
8	Was the resistance measured in Step 3 greater than the specified value?	2354 ohm	Go to **Step 10**	Go to **Step 11**
9	Test the high circuit of the VSS assembly for a short to ground. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring	-		-

	Systems. Did you find and correct the condition?		Go to **Step 15**	
10	1. Test the high circuit of the VSS assembly for an open. 2. Test the low circuit of the VSS assembly for an open. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	-
11	Test the high circuit and the low circuit of the VSS assembly for a short together. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	-
12	1. Remove the VSS assembly. 2. Inspect the output shaft speed sensor rotor for damage or misalignment. 3. Inspect the case extension bushing for wear. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
13	**IMPORTANT:** **For vehicles equipped with an active transfer case, identify the VSS assembly before replacing. There are two transfer case speed sensors located near the VSS assembly. Refer to the wire colors on the schematic to identify the VSS assembly.** Replace the VSS assembly.Refer to **Vehicle Speed Sensor (VSS) Replacement** .Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 15**	-
	Perform the following procedure in order to verify the repair: 1. Select DTC.			

15	2. Select Clear Info. 3. Operate the vehicle, ensuring that the transmission output speed drop is less than 500 RPM for 2 seconds and output speed is greater than 500 RPM for 2 seconds. 4. Select Specific DTC. Enter DTC P0503. Has the test run and passed?	-	Go to **Step 16**	Go to **Step 2**
16	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0706

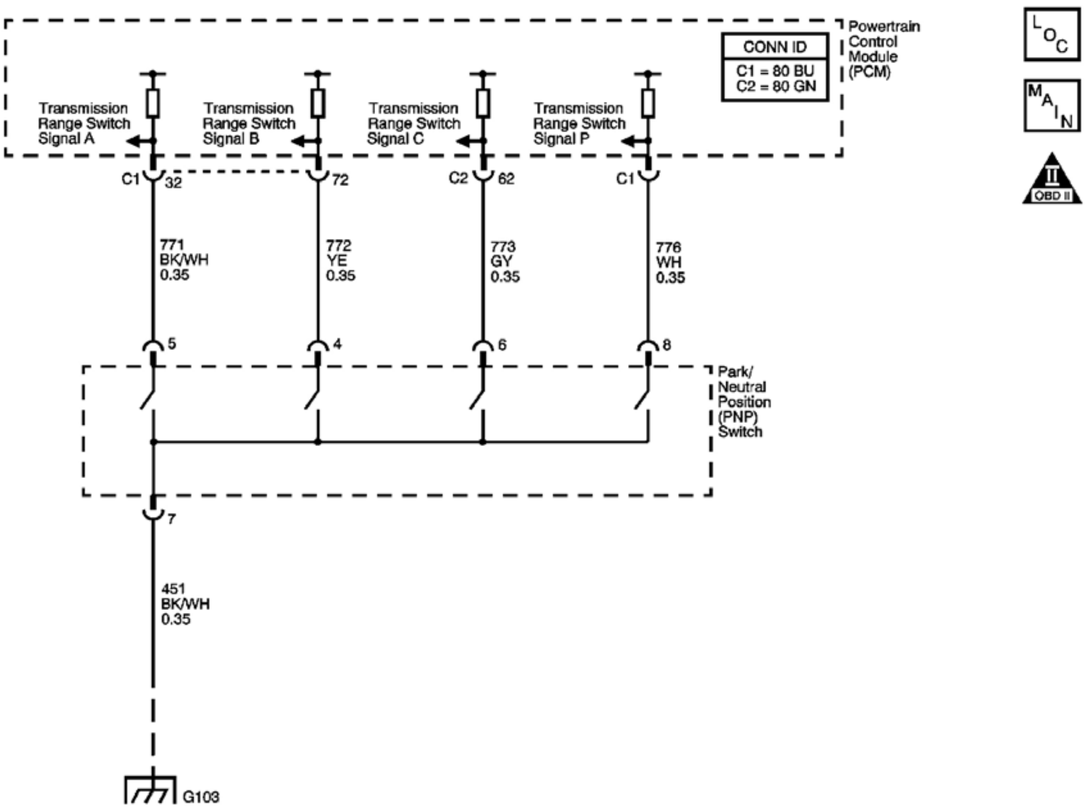


Fig. 4: Transmission Range (TR) Switch Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The transmission range (TR) switch is part of the park/neutral position and back-up lamp switch assembly and is externally mounted on the transmission manual shaft. The TR switch is a multi-signal switch. The PCM supplies ignition voltage to the TR switch on four signal circuits, A, B, C, and P. Each gear selector lever position grounds one or more of the switch circuits. In order to determine the gear range selected by the driver, the PCM compares the voltage combinations on the signal circuits to a look up table stored in the PCM memory. PCM detects the selected gear range by the state change of the switch input. Refer to **Transmission Range Switch Logic** table.

Switch input to the PCM is represented on the scan tool as HI and Low. HI indicates an ignition voltage signal. Low indicates a zero voltage signal. The four parameters represent transmission range switch signal A, B, C and Parity.

DTC P0706 will set if the PCM detects start-up in a drive range or vehicle speed in the PARK or NEUTRAL range. DTC P0706 is a type C DTC.

Conditions for Running the DTC

Transmission is in D4.

Conditions for Setting the DTC

Condition 1

The PCM detects DRIVE or REVERSE at vehicle start-up.

Condition 2

The PCM detects PARK or NEUTRAL and the following conditions occur for 10 seconds:

- TP is 5 percent or greater.
- Engine torque is greater than 68 N.m (50 lb ft).
- VSS is 32 km/h (20 mph) or greater.

Action Taken When the DTC Sets

- The PCM will use TFP Switch to determine gear range.
- The PCM does not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Failure Records.
- The PCM stores DTC P0706 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and the DTC passes.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5: By disconnecting the transmission range switch, the ground path of all TR switch circuits would be removed and the PCM would recognize all circuits as open. The scan tool will display HI for all range signals.

6: This step tests TR switch wiring for an open or the lack of the signal voltage from the PCM.

7: This step tests TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal A should change to LOW.

8: This step tests TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal B should change to LOW.

9: This step tests TR switch wiring and the PCM by providing a ground path through a fused jumper wire. When grounded, the scan tool range signal C should change to LOW.

DTC P0706

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. 3. Select TR Sw. on the scan tool. 4. With the scan tool, observe the TR Sw. display while selecting each transmission range: P, R, N, D3, D2 and D1. Does each selected transmission range match the scan tool TR Sw. display?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 3**
	1. Inspect the PNP switch assembly for the following:			

3	• Damage • Loose or missing mounting hardware • Proper adjustment Refer to **Park/Neutral Position Switch Replacement** . 2. Inspect the shift cable for the following: • Damaged or stretched cable • Proper adjustment Refer to **Automatic Transmission Range Selector Cable Replacement** . Did you find and correct a condition?	-	Go to **Step 16**	Go to **Step 4**
4	With the scan tool, observe the TR Sw. A/B/C/P display. Does the scan tool TR Sw. A/B/C/P parameter indicate HI for all range signal states?	-	Go to **Step 13**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the TR switch connector. 3. Turn ON the ignition, with the engine OFF. Does the scan tool TR Sw. A/B/C/P parameter indicate HI for all range signal states?	-	Go to **Step 6**	Go to **Step 10**
6	1. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the voltage from terminal 8 of the TR switch connector to ground. 2. Measure the voltage from terminal 4 of the TR switch connector to ground. 3. Measure the voltage from terminal 6 of the TR switch connector to ground. 4. Measure the voltage from terminal 5 of the TR switch connector to ground. Does the voltage measure within the specified value at all four terminals?	10-12 V	Go to **Step 7**	Go to **Step 11**
	Connect a fused jumper wire from terminal 5 of the TR switch connector, signal A circuit,			

7	to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When the signal A circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 8**
8	Connect a fused jumper wire from terminal 4 of the TR switch connector, signal B circuit, to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When the signal B circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 9**
9	Connect a fused jumper wire from terminal 6 of the TR switch connector, signal C circuit, to ground while monitoring the scan tool TR Sw. A/B/C/P parameter. When the signal C circuit is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 12**	Go to **Step 14**
10	Test the signal circuit or circuits of the TR switch that did not indicate HI for a short to ground. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
11	Test the signal circuit or circuits of the TR switch that did not indicate proper voltage for an open. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
12	Test the affected signal circuits of the TR switch for a shorted together condition. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
13	Test the ground circuit of the TR switch for an open. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**

14	Replace the TR switch, this switch is part of the park/neutral position (PNP) switch. Refer to **Park/Neutral Position Switch Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 16**	-
16	Perform the following procedures in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle greater than 8 km/h (5 mph) for a short distance, then stop the vehicle. 4. Select each transmission range: P, R, N, D3, D2 and D1. 5. Place the transmission in PARK. 6. Select Specific DTC. Enter DTC P0706. Has the test run and passed?	-	Go to **Step 17**	Go to **Step 2**
17	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0711

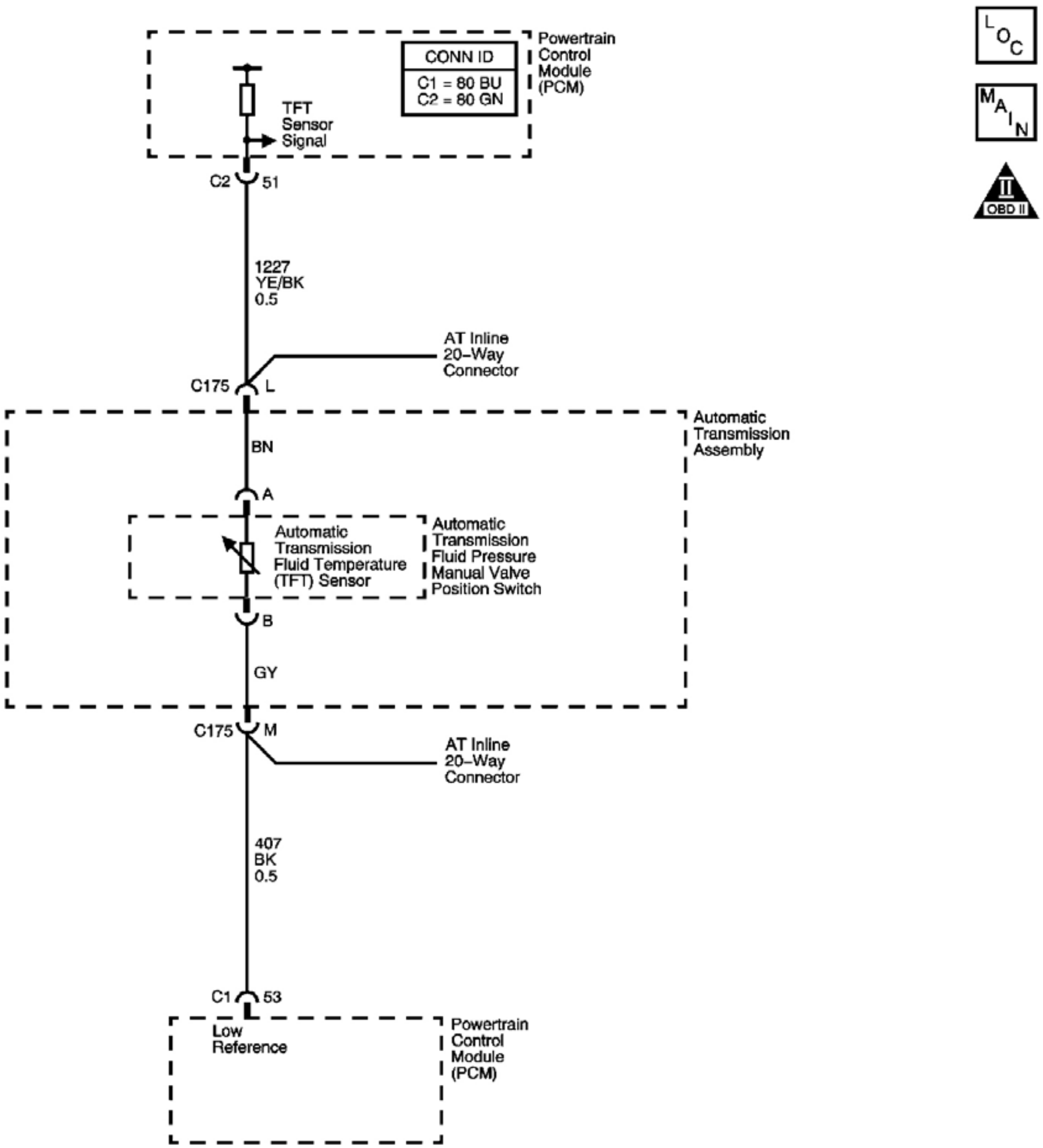


Fig. 5: Automatic Transmission Fluid Temperature (TFT) Sensor
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The automatic transmission fluid temperature (TFT) sensor is part of the automatic transmission fluid pressure (TFP) manual valve position switch. The TFT sensor is a resistor, or thermistor, which changes value based on temperature. The sensor has a negative-temperature coefficient. This means that as the temperature increases, the resistance decreases, and as the temperature decreases, the resistance increases. The powertrain control module (PCM) supplies a 5-volt reference signal to the sensor on the TFT sensor signal circuit and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high and the PCM

detects high signal voltage. As the fluid temperature warms to a normal operating temperature, the resistance becomes less and the signal voltage decreases. The PCM uses this information to control shift quality and torque converter clutch apply.

When the PCM detects one of the following unusual conditions, then DTC P0711 sets.

- An unrealistically large change in transmission temperature
- A transmission temperature which remains constant for a period of time in which a measurable amount of change is expected

DTC P0711 is a type C DTC.

Conditions for Running the DTC

- No VSS assembly DTCs P0502 or P0503.
- No Transmission Component Slipping DTC P0894.
- The engine is running for 409 seconds.
- The engine coolant temperature (ECT) is greater than 84°C (151°F) and the temperature has changed by 54°C (97°F) since startup.
- The vehicle speed is greater than 8 km/h (5 mph) for 409 seconds cumulative during the current ignition cycle.
- The TFT at startup is between -40 and +21°C (-40 and +70°F).
- The TFT is between -38 and +151°C (-36 and +304°F).
- The TCC slip speed is greater than 120 RPM for 409 seconds cumulative during the current ignition cycle.

Conditions for Setting the DTC

DTC P0711 sets if one of the following conditions occurs:

Condition 1

The TFT does not change more than 2.25°C (2.7°F) for 409 seconds since startup.

Condition 2

The TFT changes more than 20°C (36°F) in 200 milliseconds 14 times within 7 seconds.

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).

IMPORTANT: The actions listed below are in order of highest to lowest priority.

- The PCM determines a default TFT using one of the following:

1. If any ECT DTCs P0117 or P0118 are set, then the default TFT is equal to 135°C (275°F).
2. If the ECT is 125°C (257°F) or more, then the default TFT is equal to 135°C (275°F).
3. If the engine run time is less than 300 seconds and:
   - No intake air temperature (IAT) DTCs P0112 or P0113 are set and IAT is available, then the default TFT is equal to IAT.
   - Any IAT DTCs P0112 or P0113 are set or IAT is NOT available, then the default TFT is equal to 90°C (194°F).
4. If the engine run time is greater than 300 seconds and no IAT DTCs P0112 or P0113 are set and IAT is available and ECT is between 40 and 125°C (104 and 257°F) and:
   - IAT at startup is less than 15°C (59°F), then the default TFT is equal to the ECT plus 5°C (8°F).
   - IAT at startup is greater than 35°C (95°F), then the default TFT is equal to the ECT plus 10°C (16°F).
   - IAT at startup is between 15 and 35°C (59 and 95°F), then the default TFT is equal to the ECT.
5. If the engine run time is greater than 300 seconds and any IAT DTCs P0112 or P0113 are set or IAT is NOT available, then the default TFT is equal to the ECT.
6. If the engine run time is greater than 300 seconds and ECT is less than 40°C (104°F) or more, then the default TFT is equal to 60°C (140°F).

- The PCM freezes shift adapts from being updated.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Failure Records.
- The PCM stores DTC P0711 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5: This step tests for an intermittent short or open condition in the engine wiring harness. The test lamp is used as a resistor in the circuit.

6: This step determines if the PCM or the TFT sensor is causing a steady, unchanging TFT reading.

DTC P0711

		Value		

Step	Action	(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	Inspect for correct transmission fluid level. Refer to **Transmission Fluid Checking Procedure** . Did you perform the fluid checking procedure?	-	Go to **Step 3**	Go to **Transmission Fluid Checking Procedure**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Failure Records. Using the Clear Info function erases the Failure Records from the PCM.** 3. Record the DTC Failure Records. 4. Clear the DTC. 5. Select Trans. Fluid Temp. on the scan tool. 6. Drive the vehicle and observe the scan tool for either of the following conditions: • The Trans. Fluid Temp. does not change more than 2.25°C (4°F) in 409 seconds since startup. • The Trans. Fluid Temp. changes more than 20°C (36°F) in 200 milliseconds 14 times within 7 seconds. Did either of the conditions occur?	-	Go to **Step 4**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
4	Did the scan tool display a condition in which the Trans. Fluid Temp. does not change by more than the specified value in 409 seconds since startup?	2.25°C (4°F)	Go to **Step 6**	Go to **Step 5**
	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way connector.			

5	4. Using the **J 35616** GM Terminal Test Kit, connect a test lamp from terminal L to terminal M of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 5. Turn ON the ignition, with the engine OFF. 6. While observing the scan tool display, move or wiggle the engine wiring harness from PCM connectors C1 and C2 to the AT inline 20-way connector. Does the scan tool Trans. Fluid Temp. change by more than the specified value?	20°C (36°F)	Go to **Step 7**	Go to **Step 8**
6	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector. 3. Turn ON the ignition, with the engine OFF. Does the scan tool display the same condition as in Step 4?	-	Go to **Step 11**	Go to **Step 10**
7	1. Test the signal circuit of the TFT sensor for an intermittent open or short condition between the PCM connector C2 and the AT inline 20-way connector. 2. Test the low reference circuit of the TFT sensor for an intermittent open or short condition. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
8	1. Test the signal circuit of the TFT sensor for an intermittent open or short condition between the AT inline 20-way connector and the TFT sensor. 2. Test the low reference circuit of the TFT sensor for an intermittent open or short condition.	-		

	Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems.Did you find an intermittent open or short condition?		Go to **Step 9**	Go to **Step 10**
9	Replace the AT wiring harness assembly. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
10	Replace the TFT sensor, this sensor is part of the TFP manual valve position switch. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 12**	-
12	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle and ensure that the following conditions are met: • The Trans. Fluid Temp. changes by more than 2.25°C (4°F) for 11 seconds since startup • The Trans. Fluid Temp. does not change by more than 20°C (36°F) within 200 milliseconds for a period of at least 11 seconds 4. Select Specific DTC. 5. Enter DTC P0711. Has the test run and passed?	-	Go to **Step 13**	Go to **Step 2**
13	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0712

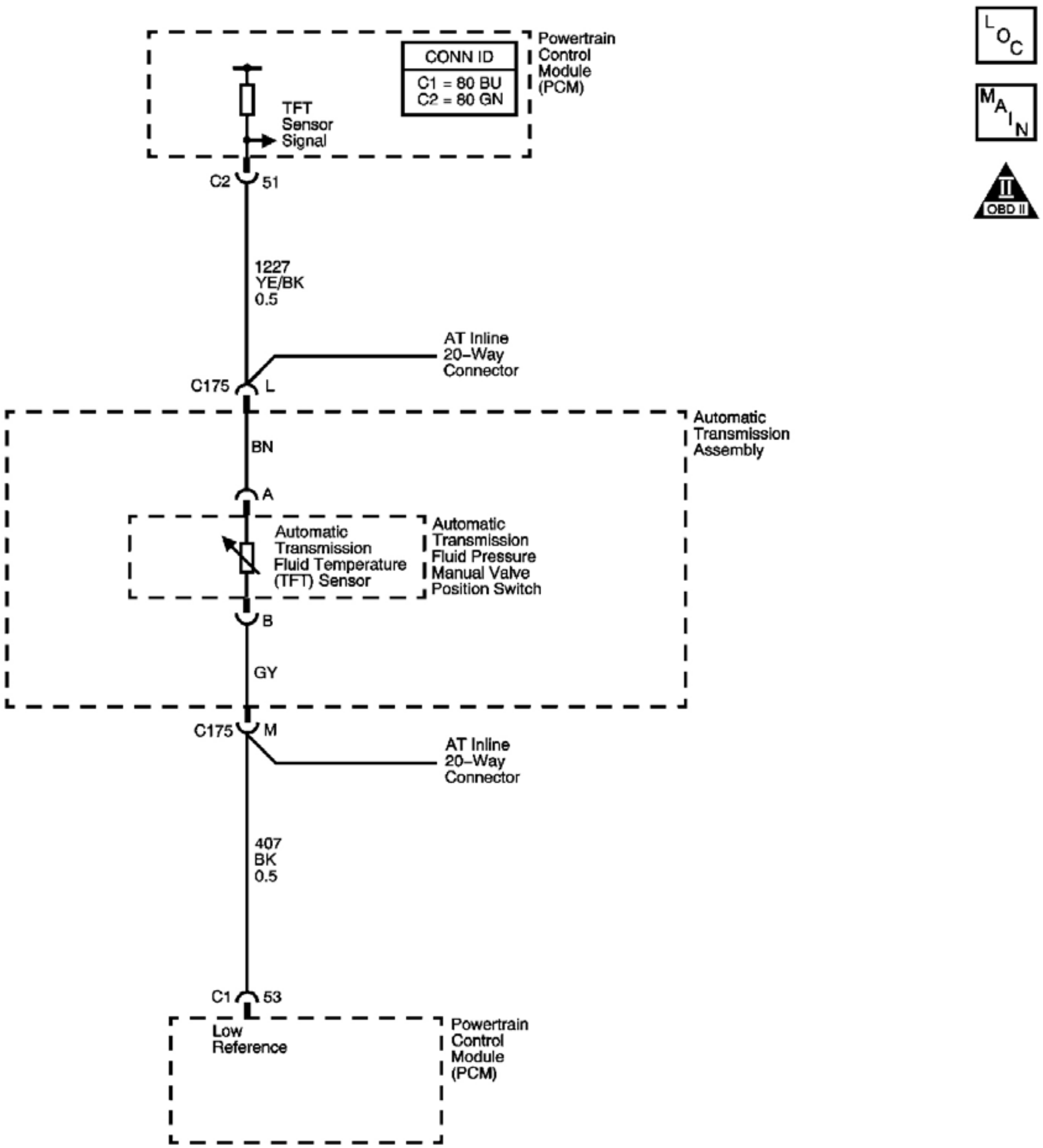


Fig. 6: Automatic Transmission Fluid Temperature (TFT) Sensor
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The automatic transmission fluid temperature (TFT) sensor is part of the automatic transmission fluid pressure (TFP) manual valve position switch. The TFT sensor is a resistor, or thermistor, which changes value based on temperature. The sensor has a negative-temperature coefficient. This means that as the temperature increases, the resistance decreases, and as the temperature decreases, the resistance increases. The powertrain control module (PCM) supplies a 5-volt reference signal to the sensor on the TFT sensor signal circuit and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high and the PCM

detects high signal voltage. As the fluid temperature warms to a normal operating temperature, the resistance becomes less and the signal voltage decreases. The PCM uses this information to control shift quality and torque converter clutch apply.

When the PCM detects a continuous short to ground in the TFT signal circuit or in the TFT sensor, then DTC P0712 sets. DTC P0712 is a type C DTC.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The TFT sensor indicates a signal voltage less than 0.25 volts for 10 seconds.

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).

IMPORTANT: The actions listed below are in order of highest to lowest priority.

- The PCM determines a default TFT using one of the following:
  1. If any ECT DTCs P0117 or P0118 are set, then the default TFT is equal to 135°C (275°F).
  2. If the ECT is 125°C (257°F) or more, then the default TFT is equal to 135°C (275°F).
  3. If the engine run time is less than 300 seconds and:
     - No intake air temperature (IAT) DTCs P0112 or P0113 are set and IAT is available, then the default TFT is equal to IAT.
     - Any IAT DTCs P0112 or P0113 are set or IAT is NOT available, then the default TFT is equal to 90°C (194°F).
  4. If the engine run time is greater than 300 seconds and no IAT DTCs P0112 or P0113 are set and IAT is available and ECT is between 40 and 125°C (104 and 257°F) and:
     - IAT at startup is less than 15°C (59°F), then the default TFT is equal to the ECT plus 5°C (8°F).
     - IAT at startup is greater than 35°C (95°F), then the default TFT is equal to the ECT plus 10°C (16°F).
     - IAT at startup is between 15 and 35°C (59 and 95°F), then the default TFT is equal to the ECT.
  5. If the engine run time is greater than 300 seconds and any IAT DTCs P0112 or P0113 are set or IAT is NOT available, then the default TFT is equal to the ECT.
  6. If the engine run time is greater than 300 seconds and ECT is less than 40°C (104°F) or more, then the default TFT is equal to 60°C (140°F).
- The PCM freezes shift adapts from being updated.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM

stores this information as Failure Records.

- The PCM stores DTC P0712 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- The scan tool displays the transmission fluid temperature in degrees. After the transmission is operating, the fluid temperature should rise steadily to a normal operating temperature, then stabilize.
- Verify the customer's driving habits, trailer towing, etc. Trailer towing should occur in D3.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests for a short to ground condition.

4: This step tests for an internal fault within the transmission by creating an open.

DTC P0712

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	Inspect for correct transmission fluid level. Refer to **Transmission Fluid Checking Procedure** . Did you perform the fluid checking procedure?	-	Go to **Step 3**	Go to **Transmission Fluid Checking Procedure**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Failure Records. Using the Clear Info function erases the Failure**	0.2 V		

	Records from the PCM. 3. Record the DTC Failure Records. 4. Clear the DTC. Does the scan tool displays a TFT Sensor signal voltage greater than the specified value?		Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Turn ON the ignition, with the engine OFF. Does the scan tool displays a TFT Sensor signal voltage greater than the specified value?	4.92 V	Go to **Step 5**	Go to **Step 7**
5	1. Install the **J 44152** Jumper Harness (20 pins) on the transmission side of the AT inline 20-way connector. 2. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the resistance between terminals L and M of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure within the specified range?	3088-3942 ohm at 20°C (68°F) 159-198 ohm at 100°C (212°F)	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 6**
6	Test the signal circuit of the TFT sensor for a short to ground between the AT inline 20-way connector and the TFT sensor. Refer to **Testing for Short to Ground** in Wiring Systems. Did you find a short to ground condition?	-	Go to **Step 9**	Go to **Step 8**
7	Test the signal circuit of the TFT sensor for a short to ground between the PCM connector C2 and the AT inline 20-way connector. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml"	-		

	extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?		Go to **Step 11**	Go to **Step 10**
8	Replace the TFT sensor, this sensor is part of the TFP manual valve position switch. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
9	Replace the AT wiring harness assembly. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 11**	-
10	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 11**	-
11	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Turn ON the ignition, with the engine OFF. 4. Verify that the scan tool indicates a TFT Sensor signal voltage greater than 0.2 volts for 10 seconds. 5. Select Specific DTC. 6. Enter DTC P0712. Has the test run and passed?	-	Go to **Step 12**	Go to **Step 2**
12	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0713

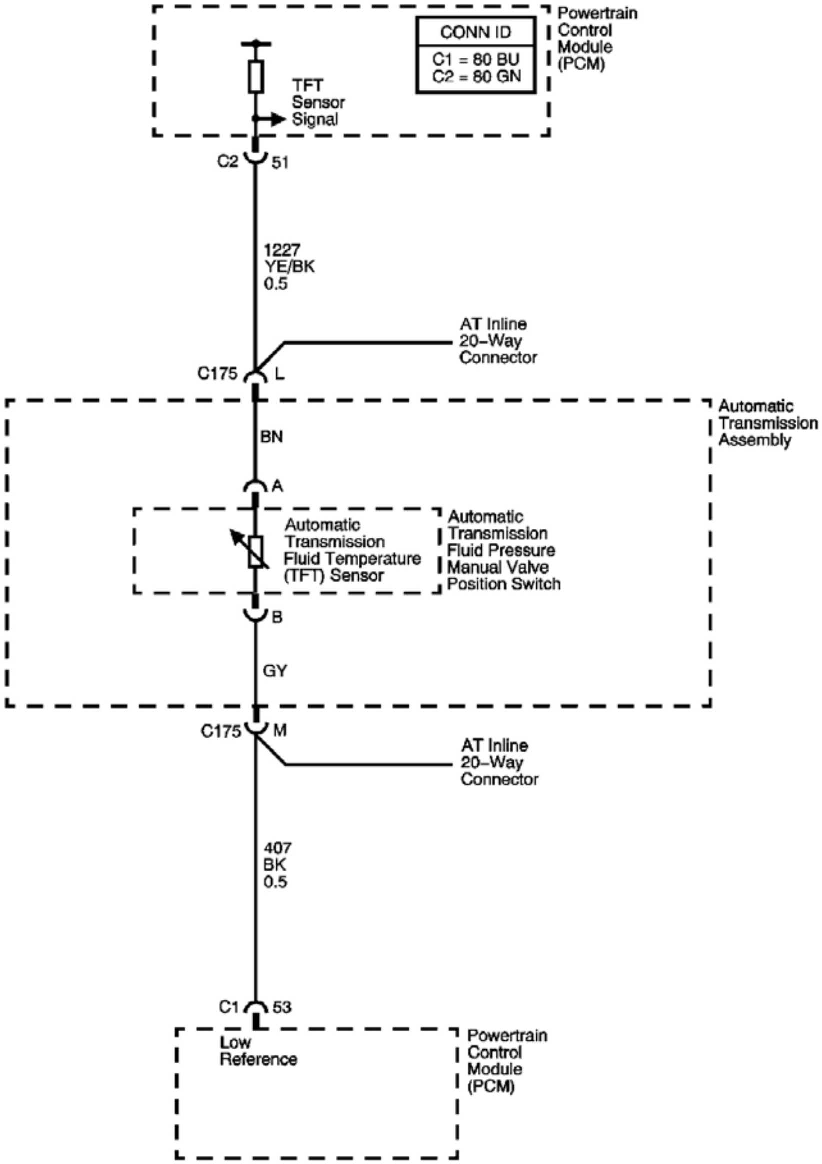


Fig. 7: Automatic Transmission Fluid Temperature (TFT) Sensor
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The automatic transmission fluid temperature (TFT) sensor is part of the automatic transmission fluid pressure (TFP) manual valve position switch. The TFT sensor is a resistor, or thermistor, which changes value based on temperature. The sensor has a negative-temperature coefficient. This means that as the temperature increases, the resistance decreases, and as the temperature decreases, the resistance increases. The powertrain control module (PCM) supplies a 5-volt reference signal to the sensor on the TFT sensor signal circuit and measures the voltage drop in the circuit. When the transmission fluid is cold, the sensor resistance is high and the PCM

detects high signal voltage. As the fluid temperature warms to a normal operating temperature, the resistance becomes less and the signal voltage decreases. The PCM uses this information to control shift quality and torque converter clutch apply.

When the PCM detects a continuous open or short to voltage in the TFT signal circuit or the TFT sensor, then DTC P0713 sets. DTC P0713 is a type C DTC.

Conditions for Running the DTC

The ignition is ON.

Conditions for Setting the DTC

The TFT sensor indicates a signal voltage greater than 4.92 volts for 400 seconds (6.8 minutes).

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).

IMPORTANT: The actions listed below are in order of highest to lowest priority.

- The PCM determines a default TFT using one of the following:
  1. If any ECT DTCs P0117 or P0118 are set, then the default TFT is equal to 135°C (275°F).
  2. If the ECT is 125°C (257°F) or more, then the default TFT is equal to 135°C (275°F).
  3. If the engine run time is less than 300 seconds and:
     - No intake air temperature (IAT) DTCs P0112 or P0113 are set and IAT is available, then the default TFT is equal to IAT.
     - Any IAT DTCs P0112 or P0113 are set or IAT is NOT available, then the default TFT is equal to 90°C (194°F).
  4. If the engine run time is greater than 300 seconds and no IAT DTCs P0112 or P0113 are set and IAT is available and ECT is between 40 and 125°C (104 and 257°F) and:
     - IAT at startup is less than 15°C (59°F), then the default TFT is equal to the ECT plus 5°C (8°F).
     - IAT at startup is greater than 35°C (95°F), then the default TFT is equal to the ECT plus 10°C (16°F).
     - IAT at startup is between 15 and 35°C (59 and 95°F), then the default TFT is equal to the ECT.
  5. If the engine run time is greater than 300 seconds and any IAT DTCs P0112 or P0113 are set or IAT is NOT available, then the default TFT is equal to the ECT.
  6. If the engine run time is greater than 300 seconds and ECT is less than 40°C (104°F) or more, then the default TFT is equal to 60°C (140°F).
- The PCM freezes shift adapts from being updated.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM

stores this information as Failure Records.
- The PCM stores DTC P0713 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

5: This step tests the TFT sensor signal circuit for being shorted to another circuit within the transmission. If the TFT sensor signal circuit shorts to another circuit, which is carrying voltage greater than five volts, the TFT sensor would become open.

6: This step tests the TFT sensor signal circuit for being shorted to voltage, which would be the cause for the open in the TFT sensor.

DTC P0713

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the DTC Failure Records. Using the Clear Info function erases the Failure Records from the PCM.** 3. Record the DTC Failure Records. 4. Clear the DTC. 5. Select Trans. Fluid Temp. on the scan tool.	-39°C (-38° F)		

	Does the scan tool display a Trans. Fluid Temp. less than the specified value?		Go to **Step 3**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
3	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector. Additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the transmission side of the AT inline 20-way connector. 4. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the resistance between terminals L and M of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** .Does the resistance measure less than the specified value?	100 K ohm	Go to **Step 7**	Go to **Step 4**
4	1. Test the signal circuit of the TFT sensor for an open between the AT inline 20-way connector and the TFT sensor. 2. Test the low reference circuit of the TFT sensor for an open between the AT inline 20-way connector and the TFT sensor. Refer to **Testing for Continuity** in Wiring Systems.Did you find an open condition?	-	Go to **Step 8**	Go to **Step 5**
5	Measure the resistance between terminal L and all other terminals of the **J 44152** . Does the resistance measure less than the specified value?	1000 ohm	Go to **Step 10**	Go to **Step 6**
6	Test the signal circuit of the TFT sensor for a short to voltage between the PCM connector and the AT inline 20-way connector. Refer to **Testing for a Short to Voltage** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 9**
	1. Test the signal circuit of the TFT sensor for an open between the PCM connector and the AT inline 20-way connector. 2. Test the low reference circuit of the TFT sensor for an open between the PCM			

7	connector and the AT inline 20-way connector. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct an open condition?	-	Go to **Step 12**	Go to **Step 11**
8	Replace the automatic transmission wiring harness. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
9	Replace the TFT sensor. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
10	1. Replace the automatic transmission wiring harness. 2. Replace the TFT sensor. Refer to **Valve Body and Pressure Switch Replacement** .Did you complete the replacements?	-	Go to **Step 12**	-
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 12**	-
12	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions: • Turn ON the ignition, with the engine OFF. • The Trans. Fluid Temp. must be greater than -40°C (-40°F) for 6 seconds. 4. Select Specific DTC. 5. Enter DTC P0713.	-		

	Has the test run and passed?		Go to **Step 13**	Go to **Step 2**
13	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0719

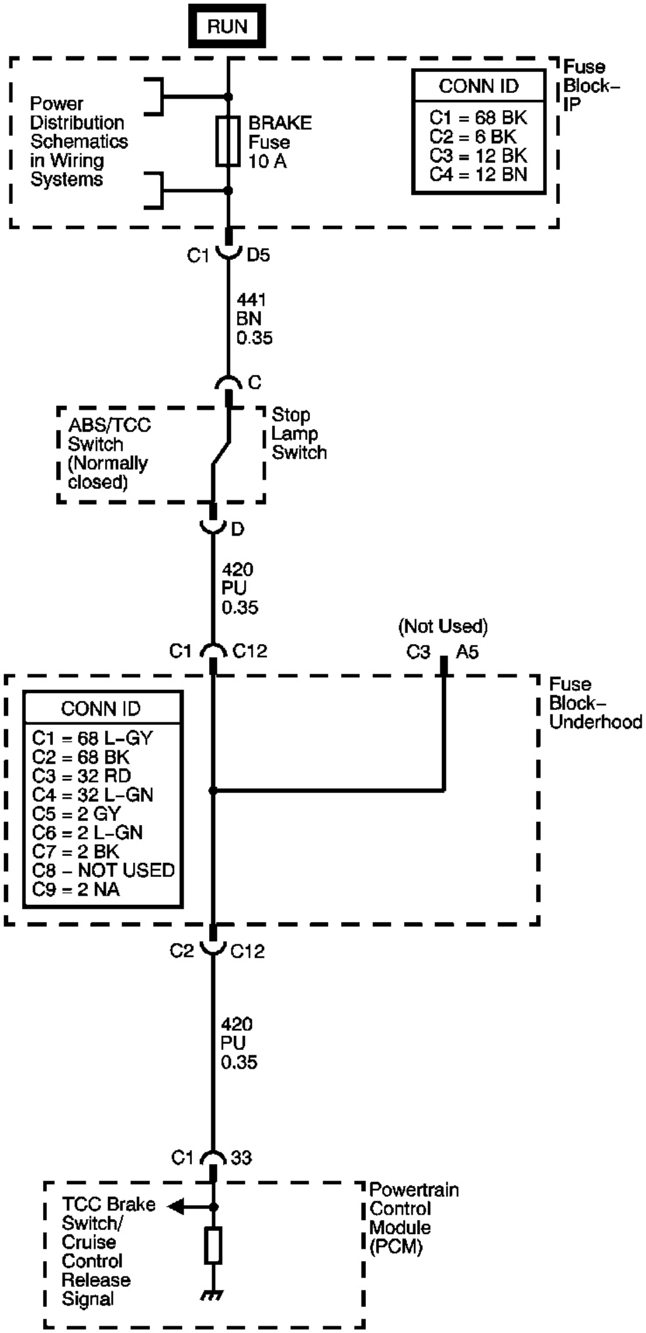


Fig. 8: Brake Switch Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The brake switch indicates brake pedal status to the powertrain control module (PCM). The brake switch is a normally-closed switch that supplies battery voltage on the TCC brake switch signal circuit to the PCM. Applying the brake pedal opens the switch, interrupting voltage to the PCM. When the brake pedal is released, the PCM receives a constant voltage signal. If the PCM receives a zero voltage signal at the brake switch input, and the torque converter clutch (TCC) is engaged, the PCM de-energizes the TCC solenoid valve. The PCM disregards the brake switch input for TCC scheduling if there is a brake switch circuit fault.

When the PCM detects an open brake switch circuit, 0 volts, low input, during accelerations, then DTC P0719 sets. DTC P0719 is a type C DTC.

Conditions for Running the DTC

- No VSS assembly DTCs P0502 or P0503.
- The ignition is ON.
- DTC P0719 has not passed.

Conditions for Setting the DTC

The PCM detects an open brake switch or circuit, 0 volts, for 15 minutes without changing for 2 seconds, and the following events occur eight times:

- The vehicle speed is less than 8 km/h (5 mph);
- then the vehicle speed is 8-32 km/h (5-20 mph) for 4 seconds;
- then the vehicle speed is greater than 32 km/h (20 mph) for 6 seconds.

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).
- The PCM disregards the brake switch input for TCC scheduling.
- The PCM uses throttle position and vehicle speed to determine application and release of the TCC.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Failure Records.
- The PCM stores DTC P0719 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the brake switch for proper mounting and operation.

- Inspect for ABS DTCs. A faulty ABS condition may contribute to setting DTC P0719.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step isolates the brake switch as a source for setting the DTC.

DTC P0719

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Failure Records. Using the Clear Info function erases the Failure Records from the PCM.** 3. Record the DTC Failure Records. 4. Clear the DTC. 5. Select TCC Brake Switch on the scan tool. **CAUTION:** **Refer to SIR Caution in Cautions and Notices.** 6. Disconnect the brake switch connector from the brake switch. 7. Connect a test lamp from terminal C of the brake switch connector to ground. Does the test lamp illuminate?	-	Go to **Step 3**	Go to **Step 4**
3	Connect a fused jumper wire between terminal C and terminal D of the brake switch connector. Did the TCC Brake Switch status on the scan tool change from Open to Closed?	-	Go to **Step 7**	Go to **Step 9**
	Inspect the brake fuse for an open.			

4	Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	-	Go to **Step 5**	Go to **Step 8**
5	Test the ignition 3 voltage circuit of the brake switch for a short to ground. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 6**
6	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the signal circuit of the brake switch for a short to ground.Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
7	Replace the brake switch. Refer to **Stop Lamp Switch Replacement** in Lighting Systems. Did you complete the replacement?	-	Go to **Step 11**	-
8	Test the ignition 3 voltage circuit of the brake switch for an open. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 11**	-
9	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the signal circuit of the brake switch for an open.Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 11**	Go to **Step 10**
10	Replace the PCM. Refer to **Powertrain Control Module (PCM)**	-		-

	Replacement in Engine Controls - 6.0L (LQ4). Did you complete the replacement?		Go to **Step 11**	
11	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Turn ON the ignition, with the engine OFF. 4. Apply and release the brake pedal. 5. Verify that the scan tool TCC Brake Switch status indicates Closed, 12 volts, for 2 seconds. 6. Select Specific DTC. 7. Enter DTC P0719. Has the test run and passed?	-	Go to **Step 12**	Go to **Step 2**
12	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0724

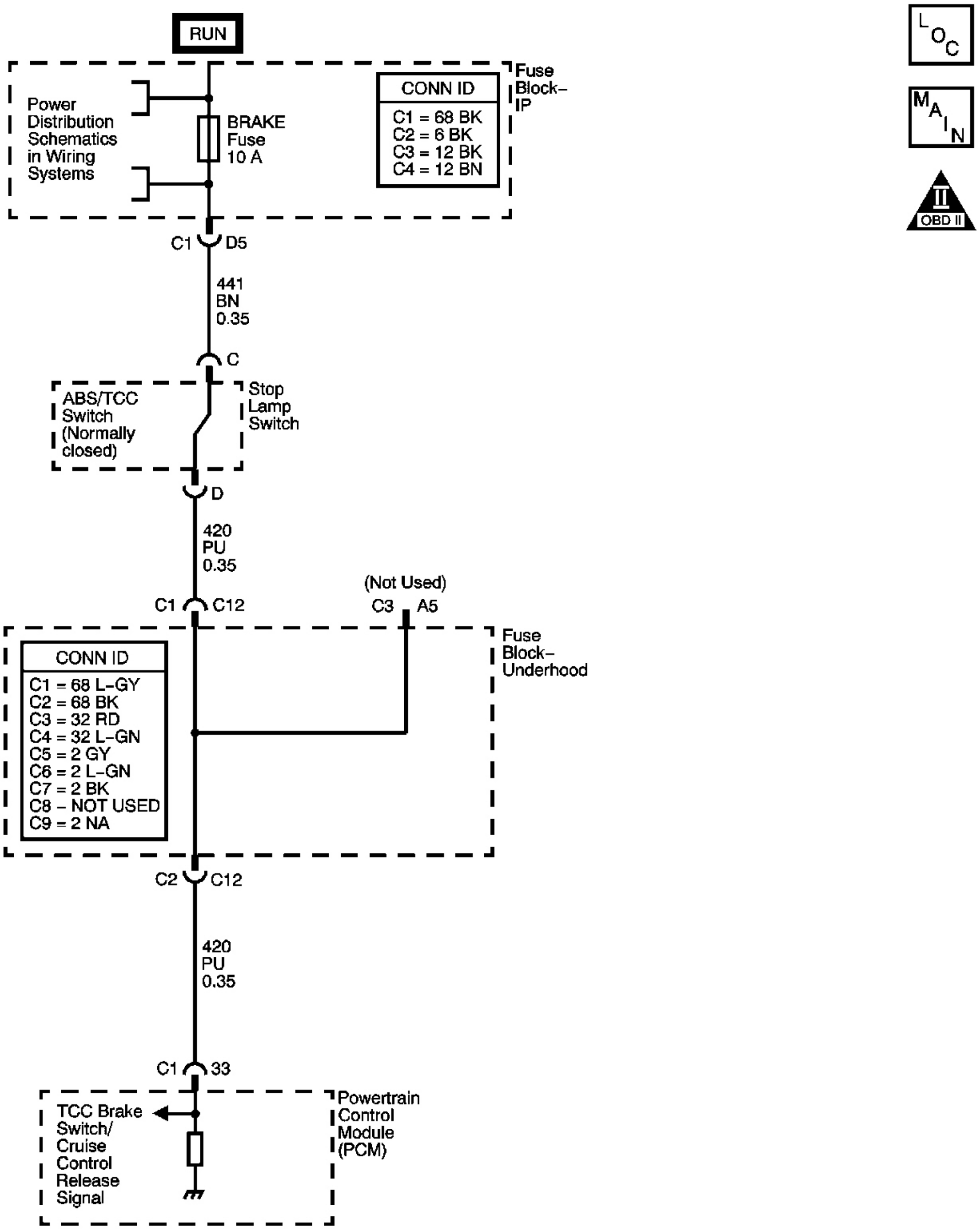


Fig. 9: Brake Switch Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The brake switch indicates brake pedal status to the powertrain control module (PCM). The brake switch is a normally-closed switch that supplies battery voltage on the TCC brake switch signal circuit to the PCM. Applying the brake pedal opens the switch, interrupting voltage to the PCM. When the brake pedal is released, the PCM receives a constant voltage signal. If the PCM receives a zero voltage signal at the brake switch input, and the torque converter clutch (TCC) is engaged, the PCM de-energizes the TCC solenoid valve. The PCM disregards the brake switch input for TCC scheduling if there is a brake switch circuit fault.

When the PCM detects a closed brake switch circuit, 12 volts, high input, during decelerations, then DTC P0724 sets. DTC P0724 is a type C DTC.

Conditions for Running the DTC

- No VSS assembly DTCs P0502 or P0503.
- The ignition is ON.
- DTC P0724 has not passed.

Conditions for Setting the DTC

The PCM detects a closed brake switch circuit, 12 volts, without changing for 2 seconds and the following events occur eight times:

- The vehicle speed is greater than 32 km/h (20 mph) for 6 seconds;
- then the vehicle speed is between 8-32 km/h (5-20 mph) for 4 seconds;
- then the vehicle speed is less than 8 km/h (5 mph).

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Failure Records.
- The PCM stores DTC P0724 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Inspect the brake switch for proper mounting and operation.
- Inspect for ABS DTCs. A faulty ABS condition may contribute to setting DTC P0724.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step isolates the brake switch as a source for setting the DTC.

DTC P0724

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Failure Records. Using the Clear Info function erases the Failure Records from the PCM.** 3. Record the DTC Failure Records. 4. Clear the DTC. 5. Select TCC Brake Switch on the scan tool. **CAUTION:** **Refer to SIR Caution in Cautions and Notices.** 6. Disconnect the brake switch connector from the brake switch. Did the TCC Brake Switch status change from Closed to Open?	-	Go to **Step 3**	Go to **Step 4**
3	Replace the brake switch. Refer to **Stop Lamp Switch Replacement** in Lighting Systems. Did you complete the replacement?	-	Go to **Step 6**	-
4	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the signal circuit of the brake switch for a short	-		

	to power.Refer to **Testing for a Short to Voltage** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?		Go to **Step 6**	Go to **Step 5**
5	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 6**	-
6	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Turn ON the ignition, with the engine OFF. 4. Apply and release the brake pedal. 5. Verify that the scan tool TCC Brake Switch status indicates Open, 0 volts, for 2 seconds. 6. Select Specific DTC. 7. Enter DTC P0724. Has the test run and passed?	-	Go to **Step 7**	Go to **Step 2**
7	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0740

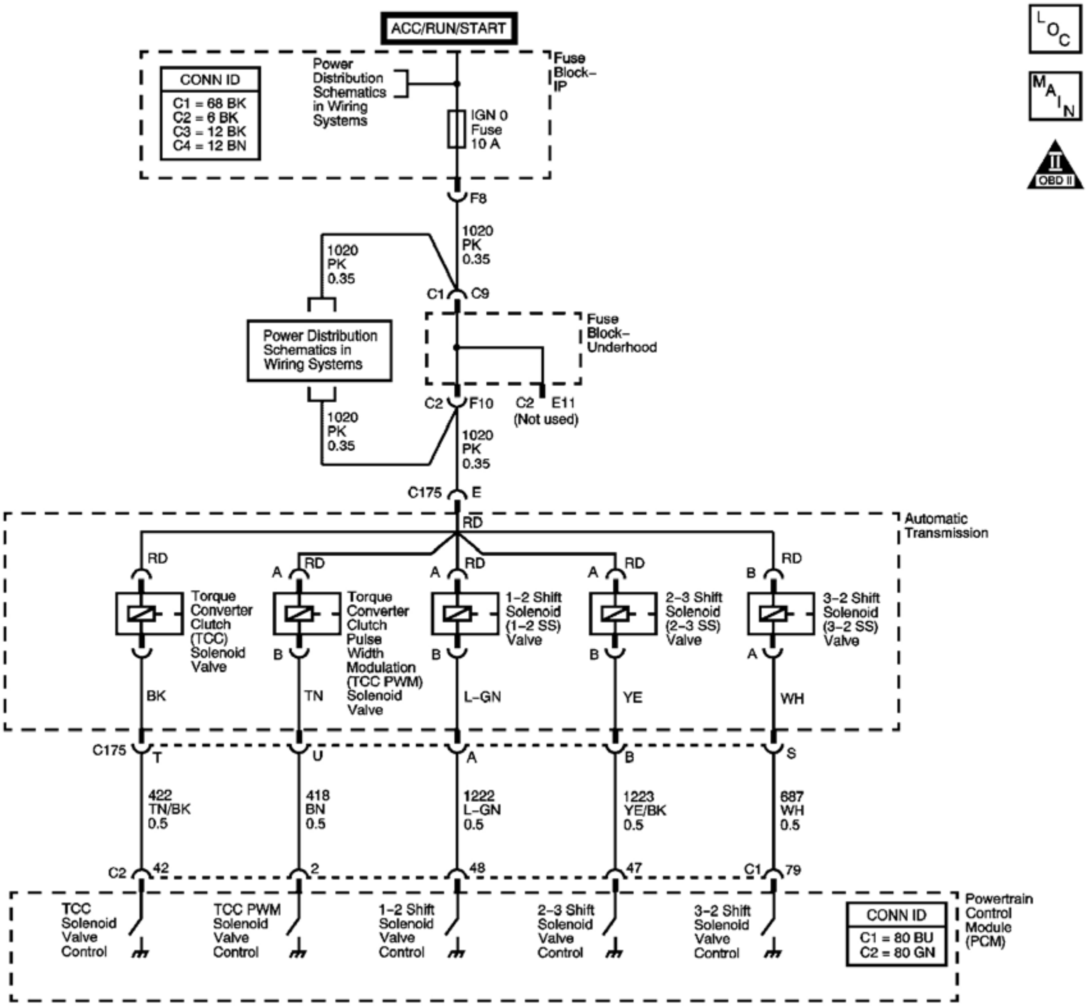


Fig. 10: Torque Converter Clutch (TCC) Solenoid Valve Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The torque converter clutch (TCC) solenoid valve is an electrical device that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve in order to control TCC apply and release. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. The TCC solenoid valve receives ignition voltage through the Ignition 0 voltage circuit. The powertrain control module (PCM) controls the solenoid by providing the ground path on the TCC solenoid valve control circuit. The PCM monitors the throttle position sensor voltage, the vehicle speed, and other inputs in order to determine when to energize the TCC solenoid valve.

When the PCM detects a continuous open, short to ground or short to power in the TCC solenoid valve circuit, then DTC P0740 sets. DTC P0740 is a type B DTC.

Conditions for Running the DTC

- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.

Conditions for Setting the DTC

DTC P0740 sets if one of the following conditions occurs for 5 seconds:

Condition 1

The PCM commands the solenoid ON and the voltage feedback remains high, B+.

Condition 2

The PCM commands the solenoid OFF and the voltage feedback remains low, 0 volt.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear if the transmission is in hot mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0740 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

With the TCC engaged, the TCC slip speed should be -20 to +50 RPM.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step tests for voltage to the solenoid.

5: This step tests the ability of the PCM and wiring to control the ground circuit.

7: This step tests the resistance of the TCC solenoid valve and the automatic transmission (AT) wiring harness assembly.

DTC P0740

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. Are any of the following DTCs also set? • P0753 • P0758 • P0785 • P2761	-	Go to **Step 3**	Go to **Step 4**
3	Inspect the IGN 0 fuse for an open. Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	-	Go to **Step 9**	Go to **Step 4**
	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way			

4	connector. 4. Turn ON the ignition, with the engine OFF. 5. Using the **J 35616** GM Terminal Test Kit, connect a test lamp from terminal E of the **J 44152** to ground. Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the test lamp illuminate?	-	Go to **Step 5**	Go to **Step 12**
5	1. Connect the test lamp from terminal E to terminal T of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 2. Use the scan tool in order to command the TCC solenoid valve ON and OFF three times. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 7**	Go to **Step 6**
6	Is the test lamp always ON?	-	Go to **Step 13**	Go to **Step 14**
7	1. Install the **J 44152** on the transmission side of the AT inline 20-way connector. 2. Using the DMM and the **J 35616** , measure the resistance between terminals T and E of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure within the specified range?	21-33 ohm	Go to **Step 8**	Go to **Step 15**
8	1. Measure the resistance from terminal E of the **J 44152** to ground. 2. Measure the resistance from terminal T of the **J 44152** to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 15**
	IMPORTANT: **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems**			

	for complete circuit distribution.			
9	Test the Ignition 0 voltage circuit of the TCC solenoid valve for a short to ground between the fuse block and the AT inline 20-way connector.Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 10**
10	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the Ignition 1 voltage circuit of the TCC solenoid valve for a short to ground between the AT inline 20-way connector and the TCC solenoid valve.Refer to **Testing for Short to Ground** in Wiring Systems.Did you find a short to ground condition?	-	Go to **Step 15**	Go to **Step 11**
11	1. Test each solenoid for a short to ground. 2. Replace the faulty solenoid as necessary. Did you complete the replacement?	-	Go to **Step 17**	-
12	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the TCC solenoid valve for an open.Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 17**	-
13	Test the control circuit of the TCC solenoid valve for a short to ground between the PCM connector C2 and the AT inline 20-way connector. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
	Test the control circuit of the TCC solenoid valve for			

14	an open or short to power between the PCM connector C2 and the AT inline 20-way connector. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
15	Replace the AT wiring harness assembly, this includes the TCC solenoid valve. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 17**	-
17	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 with the TCC ON and OFF. Ensure that the following conditions are met: • The PCM commands the TCC solenoid valve ON, and the voltage feedback drops to zero. • The PCM commands the TCC solenoid valve OFF, and the voltage feedback increases to B+. • All conditions met for 5 seconds. 4. Select Specific DTC. 5. Enter DTC P0740. Has the test run and passed?	-	Go to **Step 18**	Go to **Step 2**
18	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0741

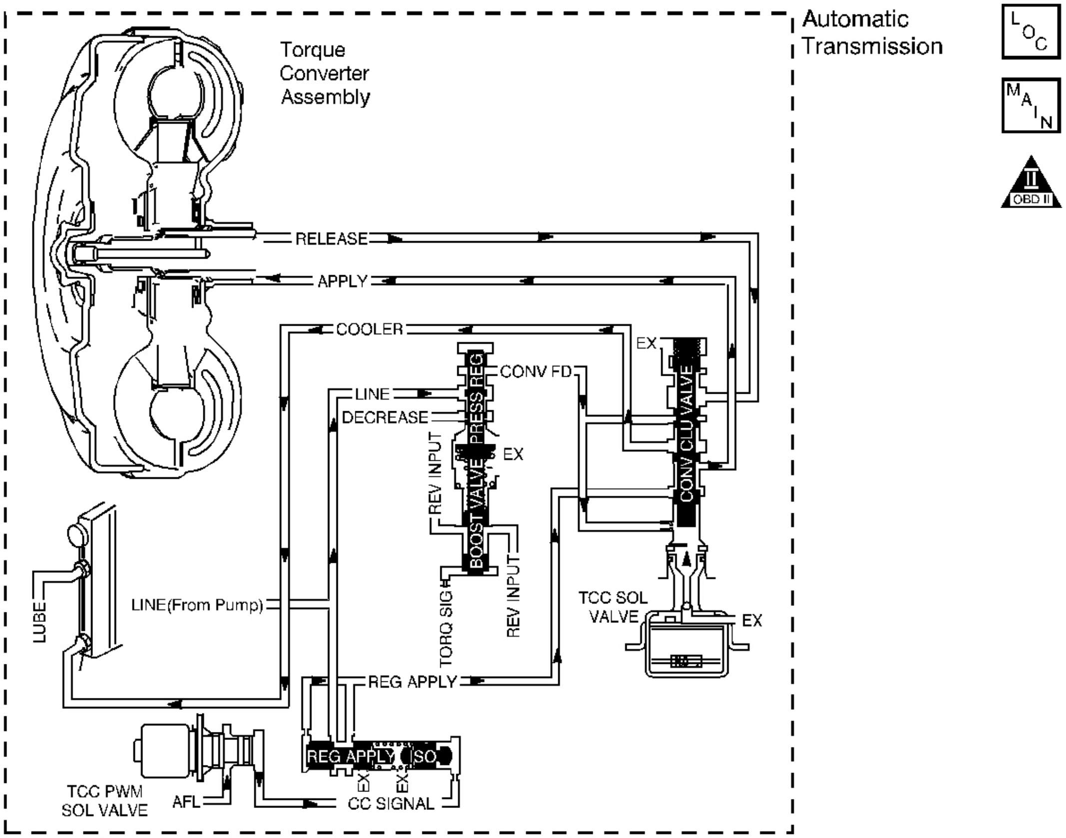


Fig. 11: Torque Converter Clutch (TCC) Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The torque converter clutch (TCC) solenoid valve is a normally-open exhaust valve that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid in order to control fluid acting on the converter clutch apply valve. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. When grounded, energized, by the powertrain control module (PCM), the TCC solenoid valve stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and move the converter clutch apply valve against spring force and into the apply position. In this position, release fluid is open to an exhaust port and converter feed fluid fills the apply circuit. The converter feed fluid applies the TCC. When the PCM no longer provides a ground path, the TCC solenoid valve de-energizes and apply fluid exhausts, releasing the TCC.

When the PCM detects a high TCC slip speed when the PCM commands the TCC ON, then DTC P0741 sets. DTC P0741 is a type B DTC.

Conditions for Running the DTC

- No TCC DTC P0742.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TFP manual valve position switch DTC P1810.
- No TPS high or low DTCs P1120 or P1220.
- The transmission fluid temperature is 20-150°C (68-302°F).
- The TP angle is 20-99 percent.
- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.
- The speed ratio is 0.89-1.02, the speed ratio is engine speed divided by output speed.
- The gear range is D2, D3 or D4.
- The gear range does not change within 6 seconds.
- The TCC is commanded ON for 5 seconds.
- The TCC duty cycle is 75 percent or greater.

Conditions for Setting the DTC

DTC P0741 sets if the following condition occurs three times.

The TCC slip speed is 130 RPM or greater for 20 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM freezes transmission adapt functions.
- The PCM commands maximum line pressure.
- The PCM inhibits 4th gear in Hot Mode.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0741 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the ignition switch is OFF long enough in order to power

down the PCM.

Diagnostic Aids

- Contamination may cause the TCC apply valve to stick in the valve body.
- There may be internal damage in the torque converter causing the no TCC apply.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step inspects for excessive TCC slip when the TCC is commanded ON.
3: This step inspects for possible causes of no TCC apply.

DTC P0741

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Drive the vehicle in the D4 drive range in second, third or fourth gear under steady acceleration, with a TP angle at 20-99%. While the scan tool TCC Enable is Yes, does the scan tool display a TCC Slip Speed greater than the specified range?	130 RPM	Go to **Step 3**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)

3	The TCC is hydraulically or mechanically stuck OFF. Inspect for the following conditions: • Inspect the TCC PWM valve for a damaged exhaust orifice. • Inspect for the converter apply valve being stuck in the OFF, release, position. • Inspect for a misaligned or damaged valve body gasket. • Inspect for a restricted apply valve passage. • Inspect the torque converter clutch for being mechanically stuck OFF. Refer to **Symptoms - Automatic Transmission** NO TCC apply. Was the condition found?	-	Go to **Step 4**	-
4	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 under the following conditions: Hold the throttle at 20-99% and accelerate to 88 km/h (55 mph). Ensure that the scan tool TCC Slip Speed is less than 50 RPM for 5 seconds, with the TCC ON. 4. Select Specific DTC. 5. Enter DTC P0741. Has the test run and passed?	-	Go to **Step 5**	Go to **Step 2**
5	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0742

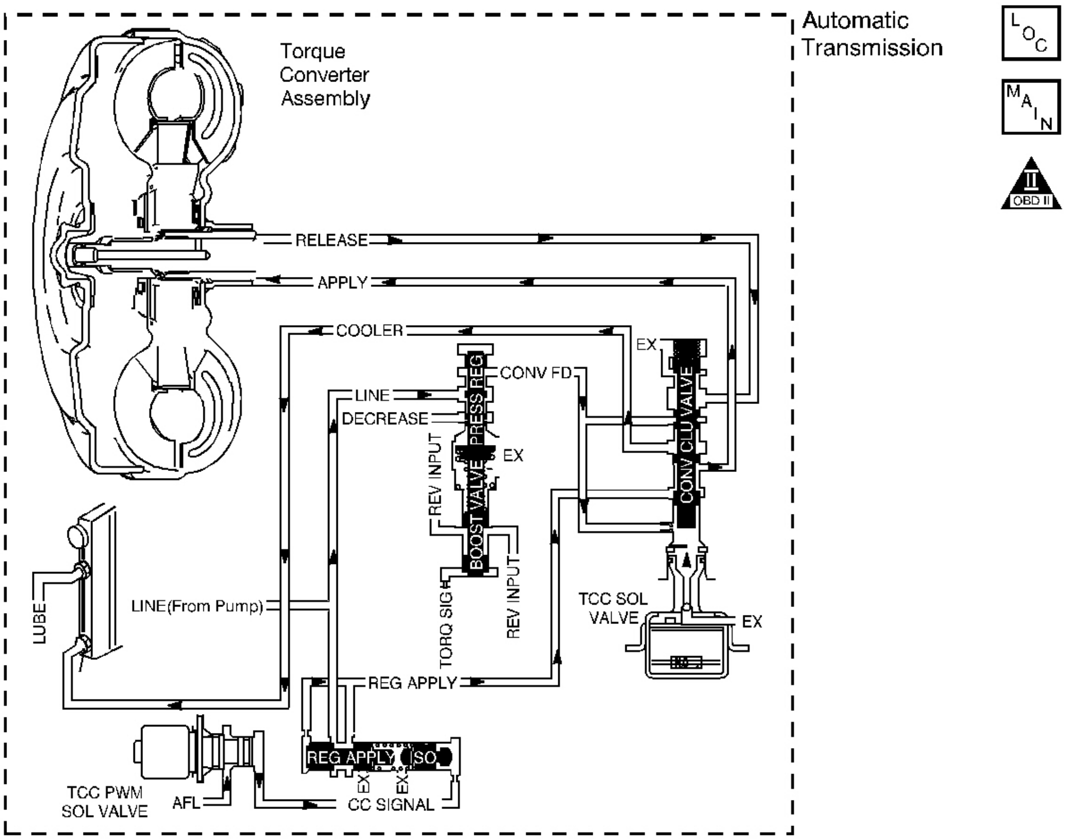


Fig. 12: Torque Converter Clutch (TCC) Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The torque converter clutch (TCC) solenoid valve is a normally-open exhaust valve that is used with the torque converter clutch pulse width modulation (TCC PWM) solenoid valve in order to control fluid acting on the converter clutch apply valve. The TCC solenoid valve attaches to the transmission case assembly extending into the pump cover. When grounded, energized, by the powertrain control module (PCM), the TCC solenoid valve stops converter signal oil from exhausting. This causes converter signal oil pressure to increase and move the converter clutch apply valve against spring force and into the apply position. In this position, release fluid is open to an exhaust port and converter feed fluid fills the apply fluid circuit. The converter feed fluid applies the TCC. When the PCM no longer provides a ground path, the TCC solenoid valve de-energizes and apply fluid exhausts, releasing the TCC.

When the PCM detects low TCC slip speed when the TCC is commanded OFF, then DTC P0742 sets. DTC P0742 is a type B DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122 or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The TP angle is 17-45 percent.
- The engine speed is greater than 450 RPM for 6 seconds.
- The engine is not in fuel cutoff.
- The TFT is between 20-130°C (68-266°F).
- The engine torque is 68-542 N.m (50-400 lb ft).
- The engine speed is 1,000-3,000 RPM.
- The speed ratio is 0.64 to 1.35.
- The vehicle speed is 24-80 km/h (15-50 mph).
- The gear range does not change within 5 seconds.
- The commanded gear is not 1st.
- The gear range is D4.
- The TCC is commanded OFF.

Conditions for Setting the DTC

DTC P0742 sets if the following condition occurs twice.

The TCC slip speed is -20 to +20 RPM for 5 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM inhibits 4th gear in Hot Mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0742 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.

- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

The TCC fluid hydraulically applies the TCC, possibly causing an engine stall, under the following conditions:

- The TCC is hydraulically stuck ON
- The parking brake is applied
- Any gear range is selected

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step tests the hydraulic state of the TCC. When the PCM commands the TCC solenoid valve OFF, the slip speed should increase.

DTC P0742

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Drive the vehicle in the D4 drive range in second, third or fourth gear under	-20 to +20 RPM		

	steady acceleration, with a TP angle at 20%. While the scan tool TCC Enable status is NO, does the scan tool display a TCC Slip Speed within the specified range?		Go to **Step 3**	Go to Diagnostic Aids
3	The TCC is hydraulically stuck ON. Inspect for the following: • Clogged exhaust orifice in the TCC solenoid valve. • Converter clutch apply valve stuck in the apply position. • Misaligned or damaged valve body gasket. • Restricted release passage. • Restricted transmission cooler line. Did you find and correct the condition?	-	Go to **Step 4**	-
4	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 with the TCC OFF and the throttle above 17%. Ensure that the scan tool TCC Slip Speed is 100-2,000 RPM for 5 seconds. 4. Select Specific DTC. 5. Enter DTC P0742. Has the test run and passed?	-	Go to **Step 5**	Go to **Step 2**
5	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0748

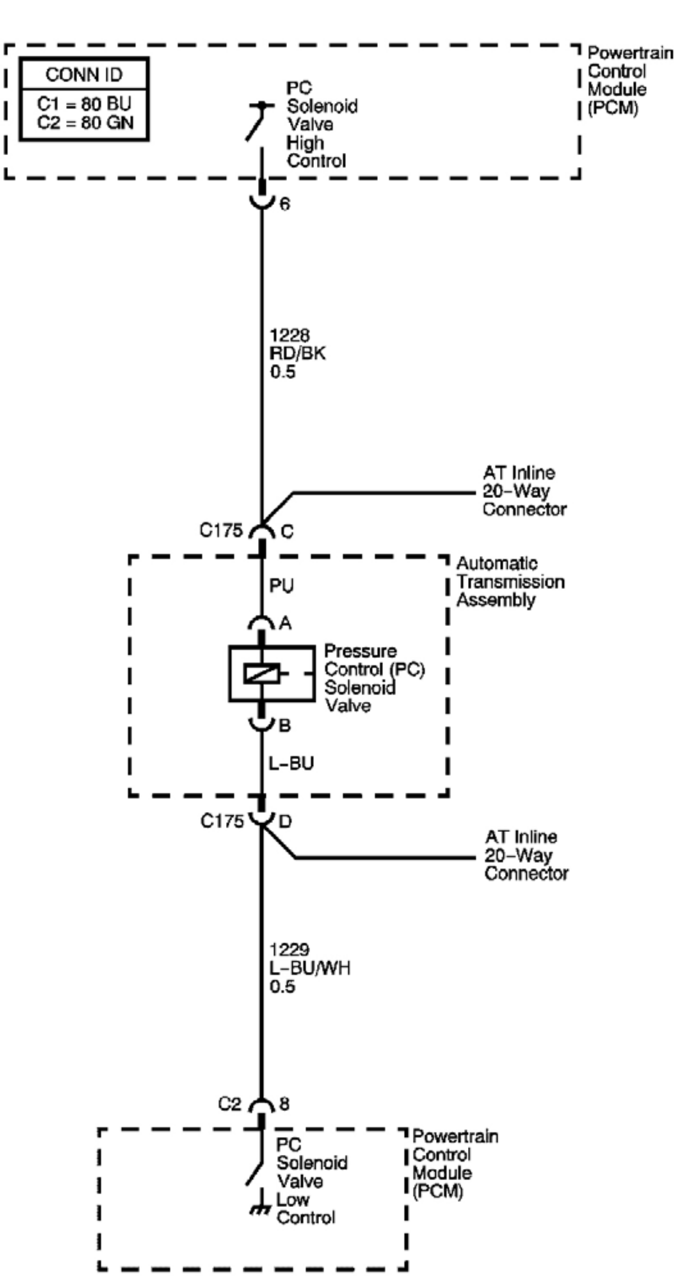


Fig. 13: Pressure Control (PC) Solenoid Valve Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The pressure control (PC) solenoid valve is an electronic device that regulates transmission line pressure based on the current flow through its coil winding. The magnetic field produced by the coil moves the solenoid's internal valve which varies pressure to the pressure regulator valve. The powertrain control module (PCM) controls the PC solenoid valve by applying a varying amount of amperage to the solenoid. The applied amperage can vary from 0.1 to 1.1 amps. Low amperage, 0.1 amp, indicates high line pressure. High amperage, 1.1 amps, indicates low line pressure. The duty cycle of the PC solenoid valve is expressed as a percentage of energized ON time. Zero percent indicates zero ON time, non-energized, or no current flow. Approximately 60 percent at idle indicates maximum ON time, energized, or high current flow. The PCM determines the appropriate line pressure for a given load by comparing the throttle position sensor voltage, the engine speed and other inputs.

When the PCM detects a continuous open or short in the PC solenoid valve circuit, then DTC P0748 sets. DTC P0748 is a type C DTC.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The PC solenoid valve duty cycle reaches its high limit, approximately 95 percent, or low limit, approximately 0 percent.

Action Taken When the DTC Sets

- The PCM does not illuminate the malfunction indicator lamp (MIL).
- The PC solenoid valve is OFF.
- The PCM freezes transmission adaptive functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Failure Records.
- The PCM stores DTC P0748 in PCM history.

Conditions for Clearing the DTC

- A scan tool can clear the DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without a non-emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

DTC P0748 may set under low voltage conditions caused by high electrical system demands.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step tests the ability of the PCM to command the PC solenoid valve.

3: This step tests the PC solenoid valve and automatic transmission wiring harness assembly for incorrect resistance.

DTC P0748

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. With a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Failure Records. Using the Clear Info function erases the Failure Records from the PCM.** 3. Record the DTC Failure Records. 4. Clear the DTC. 5. Start the engine. 6. Use the scan tool in order to command 0.1 amp through 1.0 amp while observing PC Sol. Ref. Current and PC Sol. Actual Current. Is the PC Sol. Actual Current always within the specified value of the PC Sol. Ref. Current?	0.16 amp	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector. 3. Install the **J 44152** Jumper Harness (20 pins) on the transmission side of the AT inline 20-way connector. 4. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the resistance between terminals C and D of the **J 44152** . Refer to **Automatic Transmission**	3-7 ohm		

	Inline 20-Way Connector End View . Does the resistance measure within the specified range?		Go to **Step 5**	Go to **Step 4**
4	Does the resistance measure greater than the specified value?	7 ohm	Go to **Step 9**	Go to **Step 10**
5	Measure the resistance from terminal C of the **J 44152** to the transmission case. Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure greater than the specified value?	250 K ohm	Go to **Step 6**	Go to **Step 11**
6	1. Disconnect the **J 44152** from the transmission side of the AT inline 20-way connector. 2. Reconnect the transmission AT inline 20-way connector. 3. Disconnect the PCM connector C2. 4. Measure the resistance between PCM connector terminal C2-6 and terminal C2-8. Does the resistance measure within the specified range?	3-7 ohm	Go to **Step 8**	Go to **Step 7**
7	Does the resistance measure greater than the specified value?	7 ohm	Go to **Step 12**	Go to **Step 13**
8	Using the DMM and the **J 35616** , measure the resistance from PCM connector terminal C2-6 to ground. Does the resistance measure greater than the specified value?	250 K ohm	Go to **Step 17**	Go to **Step 14**
9	Test the high control circuit and the low control circuit of the PC solenoid valve for an open between the AT inline 20-way connector and the PC solenoid valve. Refer to **Testing for Continuity** in Wiring Systems. Did you find an open condition?	-	Go to **Step 16**	Go to **Step 15**
10	Test the high control circuit and the low control circuit of the PC solenoid valve for a shorted together condition between the AT inline 20-way connector and the PC solenoid valve. Refer to **Circuit Testing** in Wiring Systems. Did you find a shorted together condition?	-	Go to **Step 16**	Go to **Step 15**
	Test the high control circuit and the low control			

11	circuit of the PC solenoid valve for a short to ground between the AT inline 20-way connector and the PC solenoid valve. Refer to **Testing for Short to Ground** in Wiring Systems. Did you find a short to ground condition?	-	Go to **Step 16**	Go to **Step 15**
12	Test the high control circuit and the low control circuit of the PC solenoid valve for an open between the PCM connector C2 and the AT inline 20-way connector. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	-
13	Test the high control circuit and the low control circuit of the PC solenoid valve for a shorted together condition between the PCM connector C2 and the AT inline 20-way connector. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	-
14	Test the high control circuit and the low control circuit of the PC solenoid valve for a short to ground between the PCM connector C2 and the AT inline 20-way connector. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 19**	-
15	Replace the PC solenoid valve. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
16	Replace the AT wiring harness assembly. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 19**	-
17	Test the high control circuit and the low control circuit of the PC solenoid for a short to voltage. Refer to **Testing for a Short to Voltage** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring	-		

	Repairs in Wiring Systems. Did you find and correct the condition?		Go to **Step 19**	Go to **Step 18**
18	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 19**	-
19	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Start the engine and ensure that the following condition is met: The difference between the scan tool PC Sol. Actual Current and the PC Sol. Ref. Current is less than 0.16 amp. 4. Select Specific DTC. 5. Enter DTC P0748. Has the test run and passed?	-	Go to **Step 20**	Go to **Step 2**
20	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0751

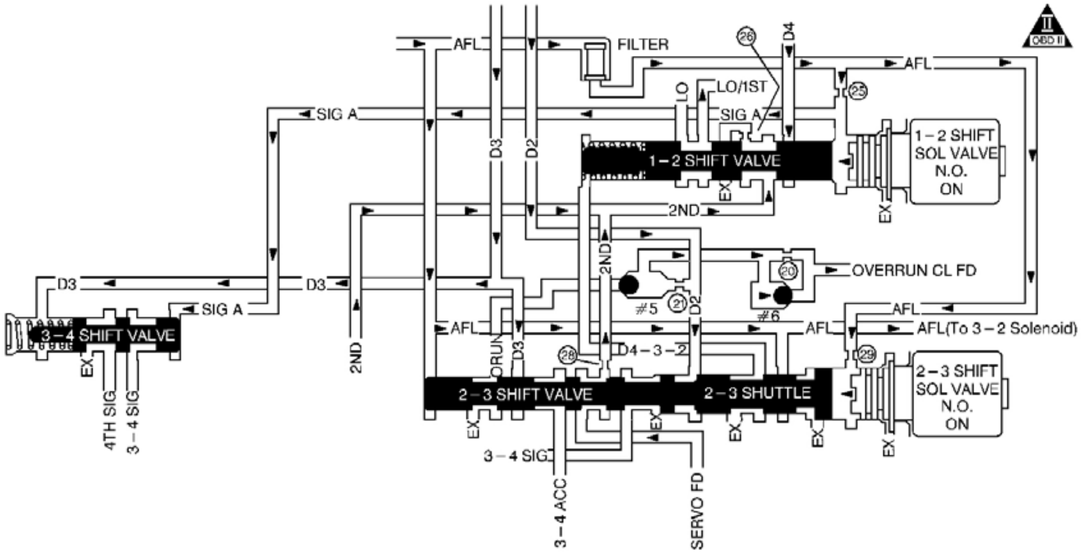


Fig. 14: 1-2 Shift Solenoid (SS) & 2-3 Shift Solenoid (SS) Valve Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The 1-2 SS valve is a normally-open exhaust valve that is used with the 2-3 SS valve, in order to allow four different shifting combinations

When the PCM detects a 2-2-3-3 shift pattern, then DTC P0751 sets. DTC P0751 is a type B DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122 or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TCC stuck ON DTC P0742.
- No 1-2 SS valve DTC P0753.
- No 2-3 SS valve DTC P0758.
- No 3-2 SS valve assembly DTC P0785.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The engine speed is greater than 450 RPM for 5 seconds.

- The engine is not in fuel cutoff.
- The gear range is D4.
- The TP angle is greater than 10 percent.
- The transmission fluid temperature is 20-130°C (68-266°F).
- The engine torque is 68-542 N.m (50-400 lb ft).
- The transmission output speed is 150 RPM or greater.
- The transfer case ratio in 4WD low is 0.9-1.2.
- The transfer case ratio in 4WD high is 2.6-2.85.

Conditions for Setting the DTC

DTC P0751 sets if both of the following conditions occur twice:

Condition 1

- The PCM commands first gear for 2 seconds.
- The estimated gear ratio is 1.2-1.825.
- All conditions are met for 0.5 seconds.

Condition 2

- The PCM commands fourth gear for 1 second.
- The estimated gear ratio is 0.95-1.15.
- All conditions are met for 6 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM inhibits the TCC.
- The PCM inhibits 4th gear in Hot Mode.
- The PCM commands D2 line pressure.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0751 in PCM history.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.

- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Verify that the transmission meets the specifications in the **Shift Speed** table.
- Other internal transmission failures may cause more than one shift to occur.
- Refer to the **Shift Solenoid Valve State and Gear Ratio** table.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step tests that the PCM commanded all shifts, that all shift solenoid valves responded correctly, but that all the shifts did not occur.

DTC P0751

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Drive the vehicle in D4 range under the following conditions: Accelerate the vehicle, ensuring that the	-		

	PCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 2-2-3-3 shift pattern?		Go to **Step 3**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
3	Inspect the shift solenoid/hydraulic circuit for the following conditions: • An internal malfunction. • Damaged seals on the shift solenoid valve. Refer to **Shift Solenoid Leak Test** . Did you find and correct the condition?	-	Go to **Step 4**	-
4	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 range under the following condition, only if traffic and road conditions permit: Hold the throttle at 20% and accelerate to 88 km/h (55 mph). 4. Select Specific DTC. 5. Enter DTC P0751. Has the test run and passed?	-	Go to **Step 5**	Go to **Step 2**
5	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0752

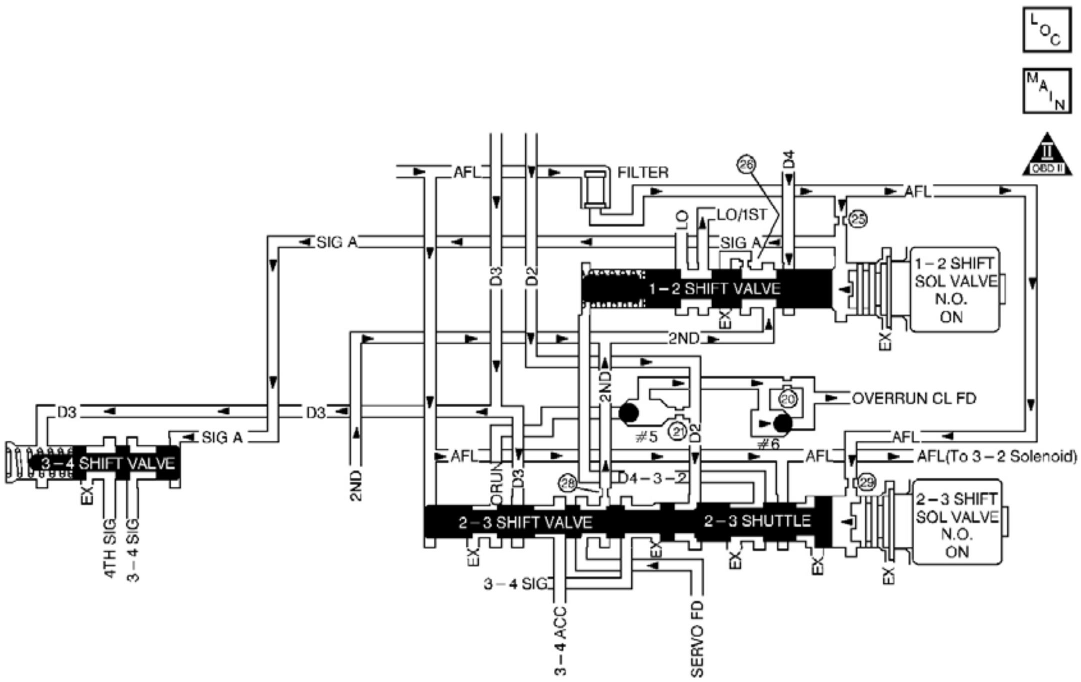


Fig. 15: 1-2 Shift Solenoid (SS) & 2-3 Shift Solenoid (SS) Valve Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The 1-2 SS valve is a normally-open exhaust valve that is used with the 2-3 SS valve, in order to allow four different shifting combinations.

When the PCM detects a 1-1-4-4 shift pattern, then DTC P0752 sets. DTC P0752 is a type B DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122 or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TCC stuck ON DTC P0742.
- No 1-2 SS valve DTC P0753.
- No 2-3 SS valve DTC P0758.
- No 3-2 SS valve assembly DTC P0785.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The engine speed is greater than 450 RPM for 5 seconds.

- The engine is not in fuel cutoff.
- The gear range is D4.
- The TP angle is greater than 10 percent.
- The transmission fluid temperature is 20-130°C (68-266°F).
- The transmission output speed is 150 RPM or greater.
- The transfer case ratio in 4WD low is 0.9-1.2.
- The transfer case ratio in 4WD high is 2.6-2.85.

Conditions for Setting the DTC

DTC P0752 sets if both of the following conditions occur twice:

Condition 1

- The PCM commands second gear for 1 second.
- The estimated gear ratio is 3.0-3.3.
- The engine torque is 34-542 N.m (25-400 lb ft).
- All conditions are met for 2 seconds.

Condition 2

- The PCM commands third gear for 1 second.
- The estimated gear ratio is 0.65-0.9.
- The engine torque is 67-542 N.m (50-400 lb ft).
- All conditions are met for 3 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM inhibits 4th gear in Hot Mode.
- The PCM commands D2 line pressure.
- The PCM inhibits 3-2 downshifts if the vehicle speed is greater than 48 km/h (30 mph) or greater.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0752 in PCM history.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.

- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Verify that the transmission meets the specifications in the **Shift Speed** table.
- Other internal transmission failures may cause more than one shift to occur.
- Refer to the **Shift Solenoid Valve State and Gear Ratio** table.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

2: This step tests that the PCM commanded all shifts, that all shift solenoid valves responded correctly, but that all the shifts did not occur.

DTC P0752

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Drive the vehicle in D4 range under the following conditions:	-		

	Accelerate the vehicle, ensuring that the PCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 1-1-4-4 shift pattern?		Go to **Step 3**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
3	Inspect the shift solenoid/hydraulic circuit for the following conditions: • An internal malfunction. • Damaged seals on the shift solenoid valve. Refer to **Shift Solenoid Leak Test** . Did you find and correct the condition?	-	Go to **Step 4**	-
4	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 range under the following condition, only if traffic and road conditions permit: Hold the throttle at 20% and accelerate to 88 km/h (55 mph). 4. Select Specific DTC. 5. Enter DTC P0752. Has the test run and passed?	-	Go to **Step 5**	Go to **Step 2**
5	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0753

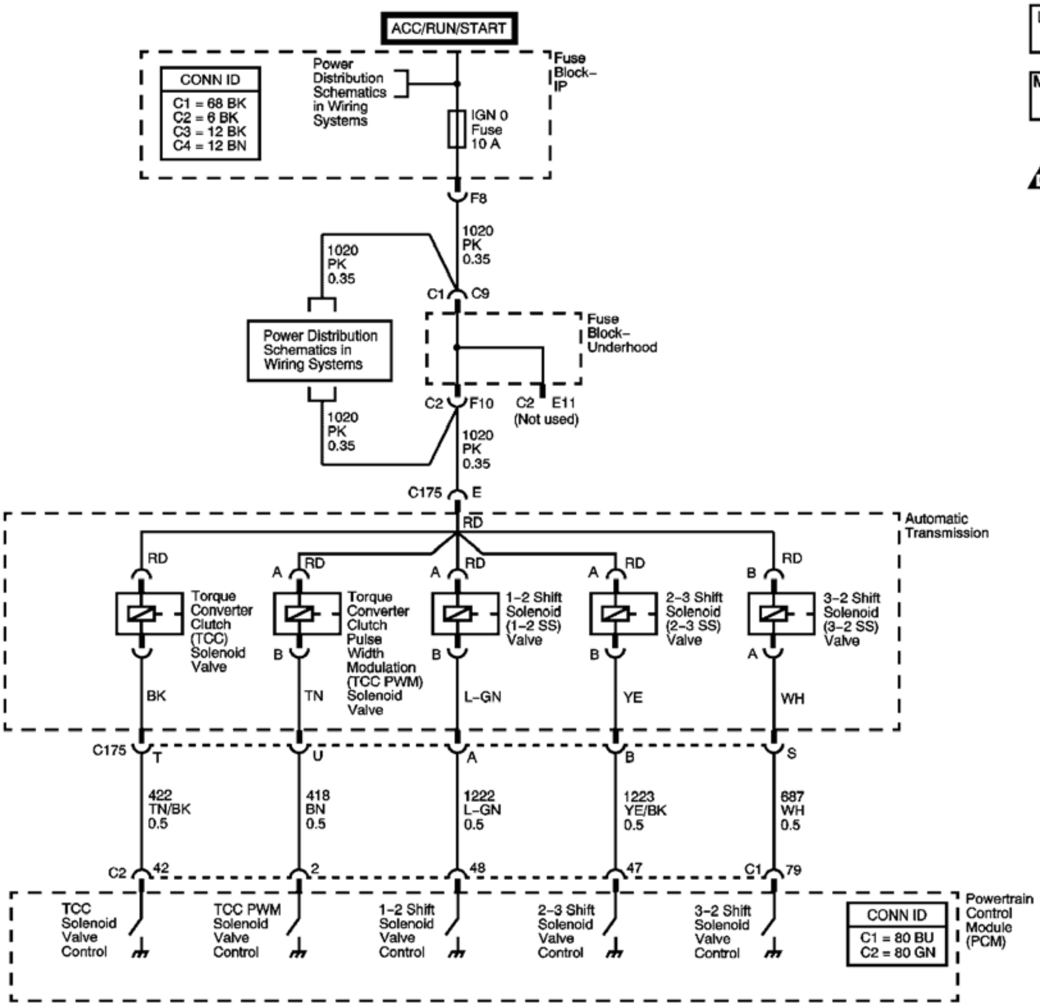


Fig. 16: 1-2 Shift Solenoid (SS) Valve Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 1-2 shift solenoid (SS) valve controls the fluid flow acting on the 1-2 and 3-4 shift valves. The solenoid is a normally-open exhaust valve. With the 2-3 SS valve, the 1-2 SS valve allows four different shifting combinations. The solenoid attaches to the control valve body within the transmission. The 1-2 SS valve receives ignition voltage through the Ignition 0 voltage circuit. The powertrain control module (PCM) controls the solenoid by providing the ground path on the 1-2 SS valve control circuit.

When the PCM detects a continuous open, short to ground or short to power in the 1-2 SS valve circuit, then DTC P0753 sets. DTC P0753 is a type B DTC.

Conditions for Running the DTC

- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.

Conditions for Setting the DTC

DTC P0753 sets if one of the following conditions occurs for 5 seconds:

Condition 1

The PCM commands the solenoid ON and the voltage feedback remains high, B+.

Condition 2

The PCM commands the solenoid OFF and the voltage feedback remains low, 0 volts.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands D2 line pressure.
- The PCM inhibits 3-2 downshifts if the vehicle speed is greater than 48 km/h (30 mph).
- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear in Hot Mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0753 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

Refer to the **Shift Solenoid Valve State and Gear Ratio** table.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step tests the function of the 1-2 SS valve and the automatic transmission (AT) wiring harness assembly.

5: This step tests for power to the 1-2 SS valve from the ignition through the fuse.

6: This step tests the ability of the PCM and of the wiring to control the ground circuit.

8: This step measures the resistance of the AT wiring harness assembly and of the 1-2 SS valve.

DTC P0753

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. Are any of the following DTCs also set? • P0740 • P0758 • P0785 • P2761	-	Go to **Step 3**	Go to **Step 4**
3	Inspect the IGN 0 fuse for an open. Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	-	Go to **Step 12**	Go to **Step 5**
4	Use the scan tool in order to command the 1-2 SS valve ON and OFF three times while listening to the bottom of the transmission pan, a stethoscope may be	-	Go to **Intermittent Conditions** in	

	necessary. Does the solenoid click when commanded?		Engine Controls - 6.0L (LQ4)	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way connector. 4. Turn ON the ignition, with the engine OFF. 5. Using the **J 35616** GM Terminal Test Kit, connect a test lamp from terminal E of the **J 44152** to ground. Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the test lamp illuminate?	-	Go to **Step 6**	Go to **Step 15**
6	1. Connect a test lamp between terminal E and terminal A of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 2. Use the scan tool in order to command the 1-2 SS valve ON and OFF three times. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 8**	Go to **Step 7**
7	Is the test lamp always ON?	-	Go to **Step 16**	Go to **Step 17**
8	1. Install the **J 44152** on the transmission side of the AT inline 20-way connector. 2. Using the DMM and the **J 35616** , measure the resistance between terminal A and terminal E of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure within the specified range?	19-31 ohm	Go to **Step 9**	Go to **Step 10**
9	Measure the resistance from terminal A to ground, and from terminal E to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Intermittent Conditions** in Engine Controls -	

			6.0L (LQ4)	Go to **Step 11**
10	1. Disconnect the AT wiring harness assembly from the 1-2 SS valve. 2. Measure the resistance of the 1-2 SS valve. Does the resistance measure within the specified range?	19-31 ohm	Go to **Step 18**	Go to **Step 19**
11	1. Disconnect the AT wiring harness assembly from the 1-2 SS valve. 2. Measure the resistance from the component's terminals to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Step 18**	Go to **Step 19**
12	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the 1-2 SS valve for a short to ground between the fuse block and the AT inline 20-way connector.Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 13**
13	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the Ignition 1 voltage circuit of the 1-2 SS valve for a short to ground between the AT inline 20-way connector and the 1-2 SS valve.Refer to **Testing for Short to Ground** in Wiring Systems.Did you find a short to ground condition?	-	Go to **Step 18**	Go to **Step 14**
14	1. Test each solenoid for a short to ground. 2. Replace the faulty solenoid as necessary. Did you complete the replacement?	-	Go to **Step 21**	-
	IMPORTANT: **The condition that affects this circuit may exist in**			

	other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.			
15	Test the Ignition 0 voltage circuit of the 1-2 SS valve for an open.Refer to **<u>Testing for Continuity</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	-
16	Test the control circuit of the 1-2 SS valve for a short to ground between the PCM connector C2 and the AT inline 20-way connector. Refer to **<u>Testing for Short to Ground</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
17	Test the control circuit of the 1-2 SS valve for an open or short to power between the PCM connector C2 and the AT inline 20-way connector. Refer to **<u>Circuit Testing</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
18	Replace the AT wiring harness assembly. Refer to **<u>Valve Body and Pressure Switch Replacement</u>** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Replace the 1-2 SS valve. Refer to **<u>Valve Body and Pressure Switch Replacement</u>** . Did you complete the replacement?	-	Go to **Step 21**	-
20	Replace the PCM. Refer to **<u>Powertrain Control Module (PCM) Replacement</u>** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 21**	-
	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 and ensure that the following conditions are met: • The PCM commands the 1-2 SS valve			

21	ON and the voltage feedback drops to zero. • The PCM commands the 1-2 SS valve OFF and the voltage feedback increases to B+. • All conditions are met for 5 seconds. 4. Select Specific DTC. 5. Enter DTC P0753. Has the test run and passed?	-	Go to **Step 22**	Go to **Step 2**
22	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0756

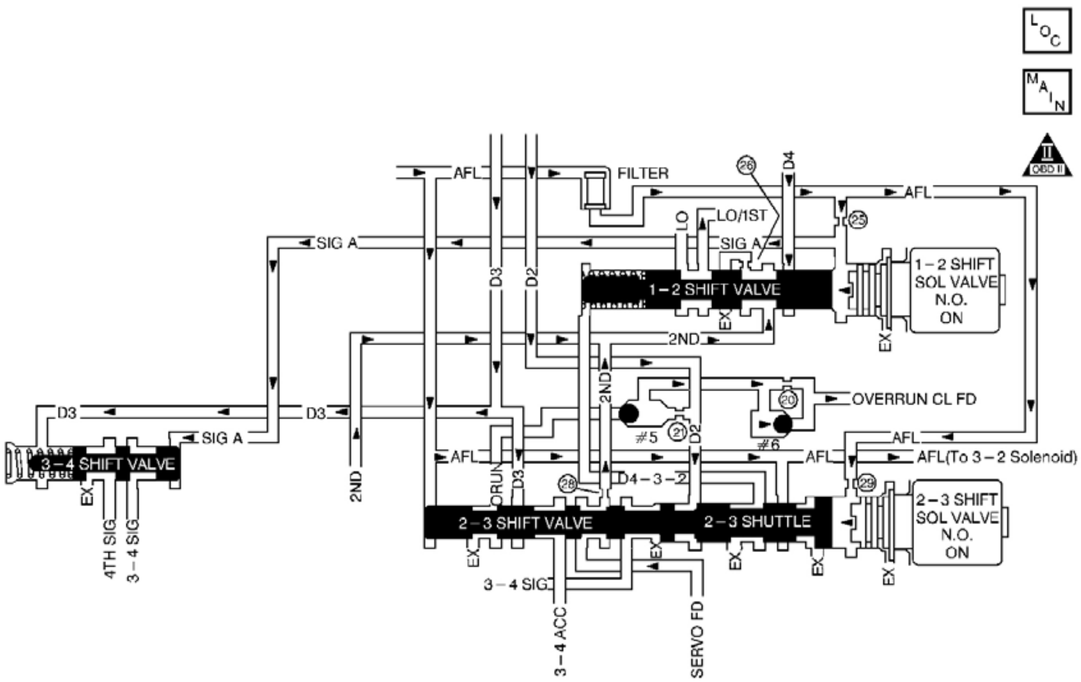


Fig. 17: 1-2 Shift Solenoid (SS) & 2-3 Shift Solenoid (SS) Valve Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The 2-3 SS valve is a normally-open exhaust valve that is used with the 1-2 SS valve, in order to allow four different shifting combinations.

When the PCM detects a 4-3-3-4 shift pattern, then DTC P0756 sets. DTC P0756 is a type A DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122 or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TCC stuck ON DTC P0742.
- No 1-2 SS valve DTC P0753.
- No 2-3 SS valve DTC P0758.
- No 3-2 SS valve assembly DTC P0785.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.
- The gear range is D4.
- The TP angle is greater than 10 percent.
- The transmission fluid temperature is 20-130°C (68-266°F).
- The engine torque is 36-295 N.m (50-400 lb ft).
- The transmission output speed is 150 RPM or greater.
- The transfer case ratio in 4WD low is 0.9-1.2.
- The transfer case ratio in 4WD high is 2.6-2.85.

Conditions for Setting the DTC

DTC P0756 sets if both of the following conditions occur:

Condition 1

- The PCM commands first gear for 2 seconds.
- The estimated gear ratio is 0 to 1.4.
- All conditions are met for 1 second.

Condition 2

- The PCM commands second gear for 1 second.
- The estimated gear ratio is 0.9 to 1.2.

- All conditions are met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM commands third gear only.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0756 in PCM history.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Verify that the transmission meets the specifications in the **Shift Speed** table.
- Other internal transmission failures may cause more than one shift to occur.
- Refer to the **Shift Solenoid Valve State and Gear Ratio** table.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **2:** This step tests that the PCM commanded all shifts, that all shift solenoid valves responded correctly, but that all the shifts did not occur.

DTC P0756

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)

2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Drive the vehicle in D4 range under the following conditions: Accelerate the vehicle, ensuring that the PCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 4-3-3-4 shift pattern?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Inspect the shift solenoid/hydraulic circuit for the following conditions: • Debris or chips in the AFL oil passage. • Debris or chips restricting oil flow in passage #29 of the case or through the spacer plate gasket into the valve body. • A cracked 2-3 shift solenoid. • A 2-3 shift valve which is stuck or hung up in the valve body bore. • A 2-3 shuttle valve which is stuck or hung up in its bore. • Damaged seals on the shift solenoid valves. Refer to **Shift Solenoid Leak Test** . 2. Clean and inspect the related valves, bores and the valve body for debris or contamination.	-		-

	Did you find and correct the condition?		Go to **Step 4**	
4	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 range under the following condition, only if traffic and road conditions permit: Hold the throttle at 40% and accelerate to 64 km/h (40 mph). 4. Select Specific DTC. 5. Enter DTC P0756. Has the test run and passed?	-	Go to **Step 5**	Go to **Step 2**
5	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0757

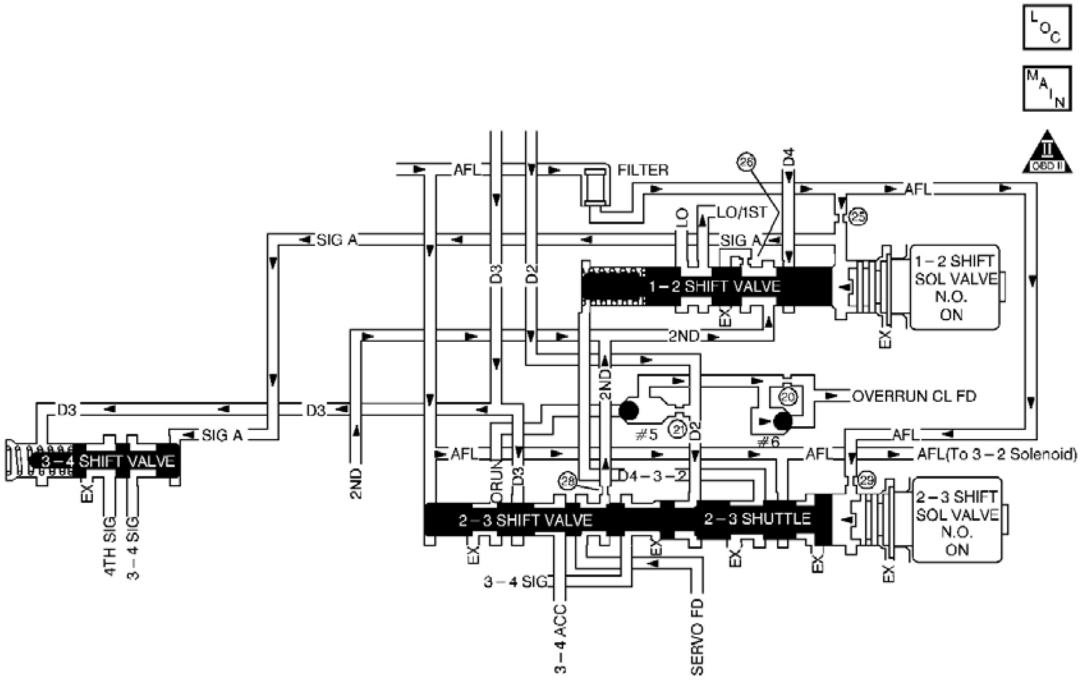


Fig. 18: 1-2 Shift Solenoid (SS) & 2-3 Shift Solenoid (SS) Valve Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The 2-3 SS valve is a normally-open exhaust valve that is used with the 1-2 SS valve in order to allow four different shifting combinations.

When the PCM detects a 1-2-2-1 shift pattern, then DTC P0757 sets. DTC P0757 is a type A DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122 or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TCC stuck ON DTC P0742.
- No 1-2 SS valve DTC P0753.
- No 2-3 SS valve DTC P0758.
- No 3-2 SS valve assembly DTC P0785.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The engine speed is greater than 450 RPM for 5 seconds.

- The engine is not in fuel cutoff.
- The gear range is D4.
- The TP angle is greater than 10 percent.
- The transmission fluid temperature is 20-130°C (68-266°F).
- The transmission output speed is 150 RPM or greater.
- The transfer case ratio in 4WD low is 0.9-1.2.
- The transfer case ratio in 4WD high is 2.6-2.85.

Conditions for Setting the DTC

DTC P0757 sets if both of the following conditions occur:

Condition 1

- The PCM commands third gear for 1 second.
- The estimated gear ratio is 1.6-1.8.
- The engine torque is 36-368 N.m (50-500 lb ft).
- All conditions are met for 2 seconds.

Condition 2

- The PCM commands fourth gear for 1 second.
- The estimated gear ratio is 1.8-3.3.
- The engine torque is 0-295 N.m (50-400 lb ft).
- All conditions are met for 2 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM commands third gear only.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0757 in PCM history.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.

- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Verify that the transmission meets the specifications in the **Shift Speed** table.
- Other internal transmission failures may cause more than one shift to occur.

  Refer to the **Shift Solenoid Valve State and Gear Ratio** table.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

> **2:** This step tests that the PCM commanded all shifts, that all shift solenoid valves responded correctly, but that all the shifts did not occur.

DTC P0757

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Drive the vehicle in D4 range under the following condition:	-		

	Accelerate the vehicle, ensuring that the PCM commands 1st, 2nd, 3rd and 4th gears. Did you detect a 1-2-2-1 shift pattern?		Go to **Step 3**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
3	Inspect the shift solenoid/hydraulic circuit for the following conditions: • An internal malfunction • Damaged seals on the shift solenoid valve Refer to **Shift Solenoid Leak Test** . Did you find and correct the condition?	-	Go to **Step 4**	-
4	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 range under the following condition, only if traffic and road conditions permit: Hold the throttle at 15% and accelerate to 80 km/h (55 mph). 4. Select Specific DTC. 5. Enter DTC P0757. Has the test run and passed?	-	Go to **Step 5**	Go to **Step 2**
5	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0758

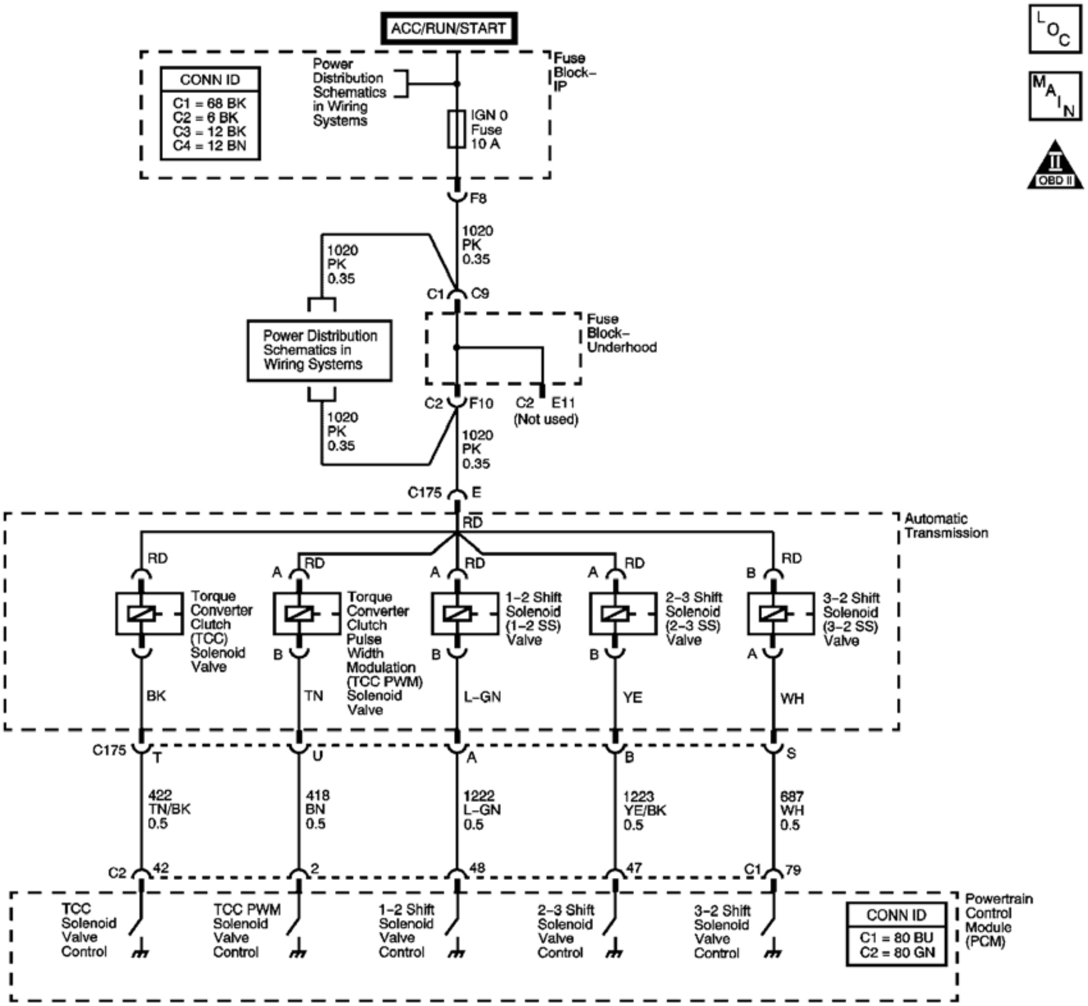


Fig. 19: 2-3 Shift Solenoid (SS) Valve Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 2-3 shift solenoid (SS) valve controls the fluid flow acting on the 2-3 shift valves. The solenoid is a normally-open exhaust valve. With the 1-2 SS valve, the 2-3 SS valve allows four different shifting combinations. The solenoid attaches to the control valve body within the transmission. The 2-3 SS valve receives ignition voltage through the Ignition 0 voltage circuit. The powertrain control module (PCM) controls the solenoid by providing the ground path on the 2-3 SS valve control circuit.

When the PCM detects a continuous open, short to ground or short to power in the 2-3 SS valve circuit, then DTC P0758 sets. DTC P0758 is a type A DTC.

Conditions for Running the DTC

- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.

Conditions for Setting the DTC

DTC P0758 sets if one of the following conditions occurs for 5 seconds:

Condition 1

The PCM commands the solenoid ON and the voltage feedback remains high, B+.

Condition 2

The PCM commands the solenoid OFF and the voltage feedback remains low, 0 volts.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL).
- The PCM commands third gear only.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0758 in PCM history.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

Refer to the **Shift Solenoid Valve State and Gear Ratio** table.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step tests the function of the 2-3 SS valve and the automatic transmission (AT) wiring harness assembly.

5: This step tests for power to the 2-3 SS valve from the ignition through the fuse.

6: This step tests the ability of the PCM and of the wiring to control the ground circuit.

8: This step measures the resistance of the AT wiring harness assembly and of the 2-3 SS valve.

DTC P0758

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. Are any of the following DTCs also set? • P0740 • P0753 • P0785 • P2761	-	Go to **Step 3**	Go to **Step 4**
3	Inspect the IGN 0 fuse for an open. Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	-	Go to **Step 12**	Go to **Step 5**
4	Use the scan tool in order to command the 2-3 SS valve ON and OFF three times while listening to the bottom of the transmission pan, a stethoscope may be necessary. Does the solenoid click when commanded?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 5**

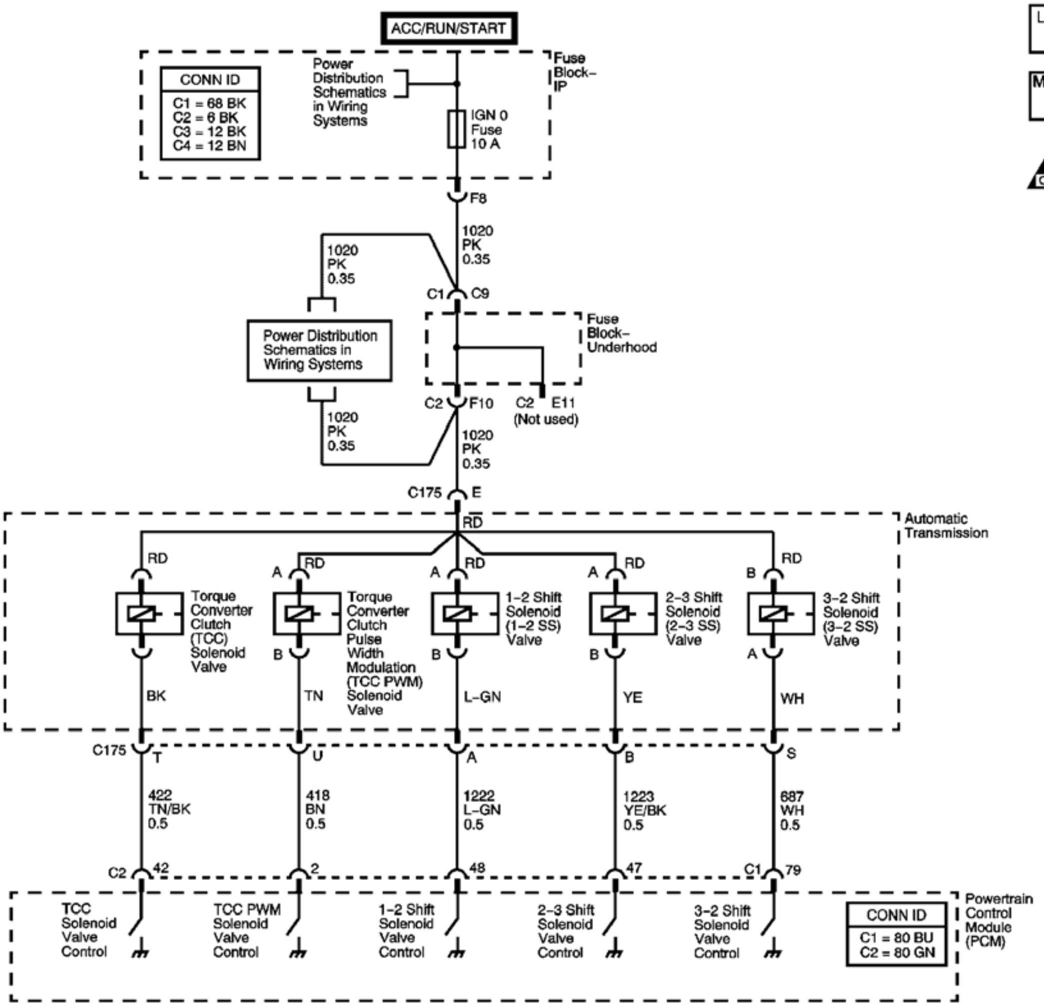
5	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way connector. 4. Turn ON the ignition, with the engine OFF. 5. Using the **J 35616** GM Terminal Test Kit, connect a test lamp from terminal E of the **J 44152** to ground. Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the test lamp illuminate?	-	Go to **Step 6**	Go to **Step 15**
6	1. Connect a test lamp between terminal E and terminal B of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 2. Use the scan tool in order to command the 2-3 SS valve ON and OFF three times. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 8**	Go to **Step 7**
7	Is the test lamp always ON?	-	Go to **Step 16**	Go to **Step 17**
8	1. Install the **J 44152** on the transmission side of the AT inline 20-way connector. 2. Using the DMM and**J 35616** , measure the resistance between terminal B and terminal E of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure within the specified range?	19-31 ohm	Go to **Step 9**	Go to **Step 10**
9	Measure the resistance from terminal B to ground, and from terminal E to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 11**

10	1. Disconnect the AT wiring harness assembly from the 2-3 SS valve. 2. Measure the resistance of the 2-3 SS valve. Does the resistance measure within the specified range?	19-31 ohm	Go to **Step 18**	Go to **Step 19**
11	1. Disconnect the AT wiring harness assembly from the 2-3 SS valve. 2. Measure the resistance from the component's terminals to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Step 18**	Go to **Step 19**
12	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the 2-3 SS valve for a short to ground between the fuse block and the AT inline 20-way connector.Refer to **<u>Testing for Short to Ground</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 13**
13	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.** Test the Ignition 1 voltage circuit of the 2-3 SS valve for a short to ground between the AT inline 20-way connector and the 2-3 SS valve.Refer to **<u>Testing for Short to Ground</u>** in Wiring Systems.Did you find a short to ground condition?	-	Go to **Step 18**	Go to **Step 14**
14	1. Test each solenoid for a short to ground. 2. Replace the faulty solenoid as necessary. Did you complete the replacement?	-	Go to **Step 21**	-
	IMPORTANT: **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to**			

	Power Distribution Schematics in Wiring Systems for complete circuit distribution.			
15	Test the Ignition 0 voltage circuit of the 2-3 SS valve for an open.Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	-
16	Test the control circuit of the 2-3 SS valve for a short to ground between the PCM connector C2 and the AT inline 20-way connector. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
17	Test the control circuit of the 2-3 SS valve for an open or short to power between the PCM connector C2 and the AT inline 20-way connector. Refer to **Testing for a Short to Voltage** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
18	Replace the AT wiring harness assembly. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Replace the 2-3 SS valve. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
20	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 21**	-
	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 and ensure the following conditions are met: • The PCM commands the 2-3 SS valve ON and the voltage feedback drops to			

21	zero. • The PCM commands the 2-3 SS valve OFF and the voltage feedback increases to B+. • All conditions are met for 5 seconds. 4. Select Specific DTC. 5. Enter DTC P0758. Has the test run and passed?	-	Go to **Step 22**	Go to **Step 2**
22	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0785



<u>**Fig. 20: 3-2 Shift Solenoid (SS) Valve Assembly Diagram**</u>
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The 3-2 shift solenoid (SS) valve assembly is a normally-closed, 3-port, on/off device that controls the 3-2 downshift. The solenoid attaches to the control valve body within the transmission. The solenoid receives ignition voltage through the Ignition 0 voltage circuit. The powertrain control module (PCM) controls the solenoid by providing a ground path on the 3-2 shift solenoid valve control circuit. During a 3-2 downshift, the 2-4 band applies as the 3-4 clutch releases. The PCM varies the timing between the 3-4 clutch release and the 2-4 band apply, depending on the vehicle speed and the throttle position.

When the PCM detects a continuous open, short to ground or short to power in the 3-2 SS valve assembly circuit, then DTC P0785 sets. DTC P0785 is a type B DTC.

Conditions for Running the DTC

- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.

Conditions for Setting the DTC

DTC P0785 sets if one of the following conditions occurs for 5 seconds:

Condition 1

The PCM commands the solenoid ON and the voltage feedback remains high, B+.

Condition 2

The PCM commands the solenoid OFF and the voltage feedback remains low, 0 volts.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands a soft landing to third gear.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear if the transmission is in hot mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0785 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Test Description

The item numbers below refer to the step numbers on the diagnostic table.

4: This step tests the ability of the PCM to control the solenoid.

5: This step tests for voltage to the solenoid.

6: This step tests the ability of the PCM and the wiring to control the ground circuit.

8: This step measures the resistance of the automatic transmission wiring harness assembly and the 3-2 SS valve assembly.

DTC P0785

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. Are any of the following DTCs also set? • P0740 • P0753 • P0758 • P2761	-	Go to **Step 3**	Go to **Step 4**
3	Inspect the IGN 0 fuse for an open. Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	-	Go to **Step 12**	Go to **Step 5**
4	Use the scan tool in order to command the 3-2 SS valve assembly ON and OFF three times, while listening to the bottom of the transmission pan, a stethoscope may be necessary. Does the solenoid click when commanded?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 5**

5	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way connector. 4. Turn ON the ignition, with the engine OFF. 5. Using the **J 35616** GM Terminal Test Kit, connect a test lamp from terminal E of the **J 44152** to ground. Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the test lamp illuminate?	-	Go to **Step 6**	Go to **Step 15**
6	1. Connect a test lamp between terminal E and terminal S of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 2. Use the scan tool in order to command the 3-2 SS valve assembly ON and OFF three times. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 8**	Go to **Step 7**
7	Is the test lamp always ON?	-	Go to **Step 16**	Go to **Step 17**
8	1. Install the **J 44152** on the transmission side of the AT inline 20-way connector. 2. Using the DMM and the **J 35616** , measure the resistance between the terminal E and terminal S of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure within the specified range?	20-32 ohm	Go to **Step 9**	Go to **Step 10**
9	1. Measure the resistance from terminal S to ground. 2. Measure the resistance from terminal E to ground.	250 K ohm	Go to **Intermittent Conditions** in	

	Do both readings measure greater than the specified value?		Engine Controls - 6.0L (LQ4)	Go to **Step 11**
10	1. Disconnect the AT wiring harness assembly from the 3-2 SS valve assembly. 2. Measure the resistance of the 3-2 SS valve assembly. Does the resistance measure within the specified range?	20-32 ohm	Go to **Step 18**	Go to **Step 19**
11	1. Disconnect the AT wiring harness assembly from the 3-2 SS valve assembly. 2. Measure the resistance from the component's terminals to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Step 18**	Go to **Step 19**
12	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the 3-2 SS valve assembly for a short to ground between the fuse block and the AT inline 20-way connector.Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 13**
13	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to Power Distribution Schematics in Wiring Systems for complete circuit distribution.** Test the Ignition 1 voltage circuit of the 3-2 SS valve assembly for a short to ground between the AT inline 20-way connector and the 3-2 SS valve assembly.Refer to **Testing for Short to Ground** in Wiring Systems.Did you find a short to ground condition?	-	Go to **Step 18**	Go to **Step 14**
14	1. Test each solenoid for a short to ground. 2. Replace the faulty solenoid as necessary.	-		-

	Did you complete the replacement?		Go to **Step 21**	
15	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the 3-2 SS valve assembly for an open.Refer to **<u>Testing for Continuity</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 21**	-
16	Test the control circuit of the 3-2 SS valve assembly for a short to ground between the PCM connector C1 and the AT inline 20-way connector. Refer to **<u>Testing for Short to Ground</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
17	Test the control circuit of the 3-2 SS valve assembly for an open or short to voltage between the PCM connector C1 and the AT inline 20-way connector. Refer to **<u>Circuit Testing</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
18	Replace the AT wiring harness assembly. Refer to **<u>Valve Body and Pressure Switch Replacement</u>** . Did you complete the replacement?	-	Go to **Step 21**	-
19	Replace the 3-2 SS valve assembly. Refer to **<u>Valve Body and Pressure Switch Replacement</u>** . Did you complete the replacement?	-	Go to **Step 21**	-
20	Replace the PCM. Refer to **<u>Powertrain Control Module (PCM) Replacement</u>** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 21**	-
	Perform the following procedure in order to verify the repair: 1. Select DTC. 2. Select Clear Info.			

21	3. Drive the vehicle in D3 or D4 and perform a 3-2 downshift. Ensure that the following conditions are met: • The PCM commands the 3-2 SS valve assembly ON, and the voltage feedback drops to zero. • The PCM commands the 3-2 SS valve assembly OFF, and the voltage feedback increases to B+. • All conditions are met for 5 seconds. 4. Select Specific DTC. 5. Enter DTC P0785. Has the test run and passed?	-	Go to **Step 22**	Go to **Step 2**
22	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P0894

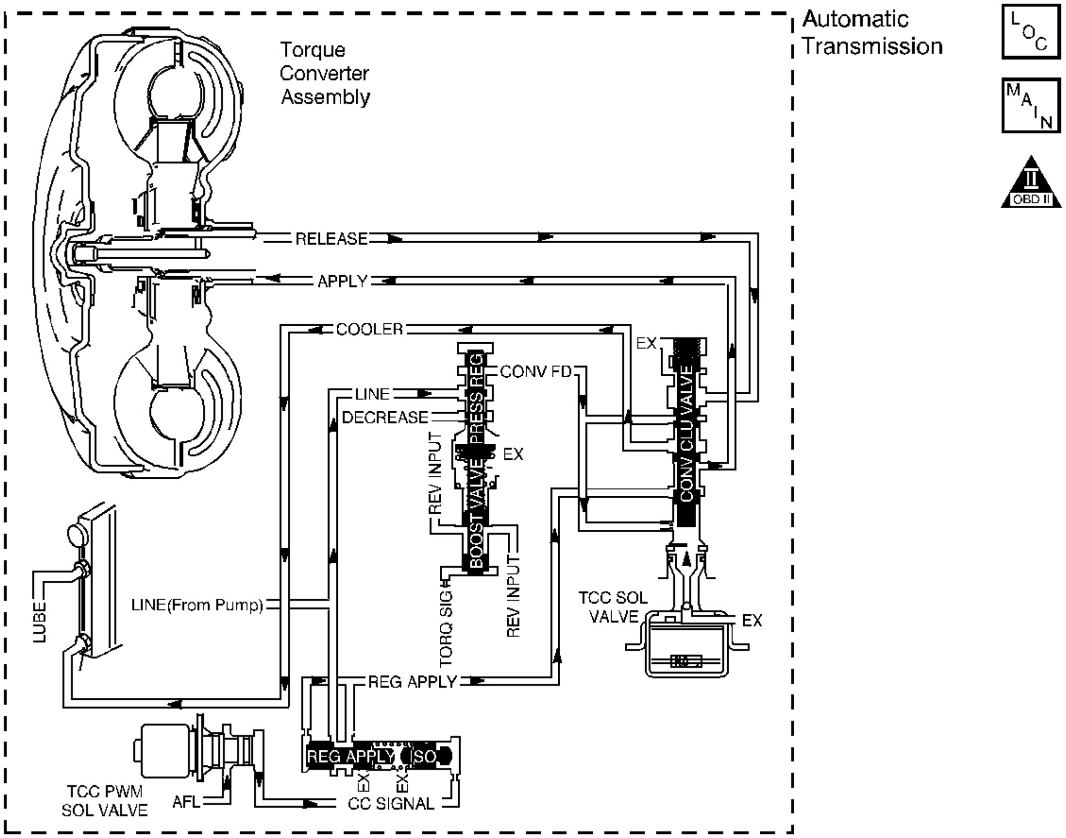


Fig. 21: Torque Converter Clutch (TCC) Fluid Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The powertrain control module (PCM) monitors the difference between engine speed and transmission output speed. In D3 drive range with the TCC engaged, the engine speed should closely match the transmission output speed. In D4 drive range, with the TCC engaged, the TCC slip speed should be -20 to +50 RPM.

When the PCM detects excessive TCC slip when the TCC should be engaged, then DTC P0894 sets. DTC P0894 is a type B DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122 or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No 1-2 SS valve DTC P0753.
- No 2-3 SS valve DTC P0758.

- No 3-2 SS valve assembly DTC P0785.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.
- The engine torque is 68-542 N.m (50-400 lb ft).
- The TP angle is 20-99 percent.
- The vehicle speed is 48-131 km/h (30-82 mph).
- The engine speed is 1,500-3,000 RPM.
- The speed ratio is 0.69-0.88, speed ratio is engine speed divided by the transmission output speed.
- The gear range is D4.
- The commanded gear is not 1st gear.
- The TFT is 20-150°C (68-302°F).
- The shift solenoid performance diagnostic counters are zero.

Conditions for Setting the DTC

DTC P0894 sets if the following conditions occur for three TCC cycles.

- The TCC is commanded ON for 5 seconds.
- The TCC is at 40 percent duty cycle for 5 seconds.
- The TCC slip speed is 130-800 RPM for 7 seconds.

IMPORTANT: The following actions may occur before the DTC sets.

- If the TCC is commanded ON for 5 seconds, the TCC is at 40 percent duty cycle for 5 seconds, the TP angle is 20-99 percent and the transmission slip counter has incremented to either 1 or 2, out of 3 to increment the fail counter for the current ignition cycle, then the following slip conditions and actions may increment the fail counter for the current ignition cycle:

  These conditions must occur sequentially.

Condition 1

If the TCC slip speed is 130-800 RPM for 7 seconds, then the PCM will command maximum line pressure and freeze shift adapts from being updated.

Condition 2

If Condition 1 is met and the TCC slip speed is 130-800 RPM for 7 seconds, then the PCM will command the TCC Off for 1.5 seconds.

Condition 3

If Condition 2 is met and the TCC slip speed is 130-800 RPM for 7 seconds, then the fail counter on the current ignition cycle is incremented.

The above slip conditions and actions may be disregarded if the TCC is commanded OFF at any time as a result of a driving maneuver, sudden acceleration or deceleration.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands maximum line pressure.
- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear if the transmission is in hot mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P0894 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Bronze material found in the transmission oil pan may indicate stator shaft bushing wear. If bushing wear is suspected, inspect the stator shaft and the input, turbine, shaft for damage.
- Refer to **Symptoms - Automatic Transmission** for more information.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests the torque converter for slippage while in a commanded lock-up state.

DTC P0894

Step	Action	Value (s)	Yes	No

1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	Inspect for correct transmission fluid level. Refer to **Transmission Fluid Checking Procedure** . Did you perform the fluid checking procedure?	-	Go to **Step 3**	Go to **Transmission Fluid Checking Procedure**
3	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. **IMPORTANT:** **It may be necessary to allow multiple TCC cycles to occur in order to verify a slipping condition. It may also be necessary to ensure the transmission is warm before performing this step.** 5. Drive the vehicle in 4th gear with the TCC commanded ON. Does the scan tool TCC Slip Speed measure within the specified range for 7 seconds?	130-800 RPM	Go to **Step 4**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
	1. Inspect the torque converter clutch (TCC) solenoid valve for the following conditions: • Internal malfunction, such as sediment or damage • Damaged seals Refer to **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid, TCC Solenoid, and Wiring Harness** .			

4	2. Inspect the torque converter clutch pulse width modulation (TCC PWM) solenoid valve for the following conditions: • Internal malfunction, such as sediment or damage • Damaged seals Refer to **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid, TCC Solenoid, and Wiring Harness** . Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 5**
5	1. Inspect the 1-2 shift solenoid (SS) valve for the following conditions: • Internal malfunction, such as sediment or damage • Damaged seals Refer to **Shift Solenoid Leak Test** . 2. Inspect the 2-3 shift solenoid (SS) valve for the following conditions: • Internal malfunction, such as sediment or damage • Damaged seals Refer to **Shift Solenoid Leak Test** . 3. Inspect the 3-2 shift solenoid valve assembly for the following conditions: • Internal malfunction, such as sediment or damage • Damaged seals Refer to **Shift Solenoid Leak Test** . Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 6**
	Inspect the valve body assembly for the following conditions: • Stuck regulator apply valve • Scored regulator apply valve body			

6	Refer to **Control Valve Body Disassemble** in the 4L60-E section of the Transmission Unit Repair Manual. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 7**
7	Inspect the torque converter assembly for the following conditions: • Front stator shaft bushing for wear • Stator roller clutch not holding • External damage/leaks Refer to **Torque Converter End Play Inspection** . Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 8**
8	Inspect the oil pump assembly for the following conditions: • A stuck converter clutch valve • The converter clutch valve is assembled backwards • A mispositioned converter clutch valve retaining ring • A cocked converter clutch outer valve spring • A mispositioned pump to case gasket • Restricted orifice cup plugs • Damaged orifice cup plugs • Over-tightened, or unevenly tightened pump body to cover bolts Refer to **Oil Pump Cover Disassemble** in the 4L60-E section of the Transmission Unit Repair Manual. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 9**
	Inspect the input housing and shaft assembly for the following conditions: • Cut turbine shaft O-ring seal • Damaged turbine shaft O-ring seal			

9	• Restricted turbine shaft retainer and ball assembly • Damaged turbine shaft retainer and ball assembly Refer to **Input Housing and Shaft Assembly Inspection** in the 4L60-E section of the Transmission Unit Repair Manual. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
10	Inspect the 2-4 band assembly for the following conditions: • Worn 2-4 band/ptxt> • Damaged 2-4 band/ptxt> • Mispositioned 2-4 band/ptxt> • Misassembled 2-4 band • The band anchor pin is not engaged Refer to **2-4 Band Assembly Installation** in the 4L60-E section of the Transmission Unit Repair Manual. Inspect the 2-4 servo assembly for the following conditions: • Restricted apply passages in the 2-4 servo assembly • Blocked apply passages in the 2-4 servo assembly • Nicks or burrs on the 2nd apply piston pin • Damaged 2nd apply piston pin • Incorrect 2nd apply piston pin • Nicks or burrs on the pin bore in the case • Damaged fourth servo piston • Misassembled fourth servo piston • Damaged servo bore in the case • Missing piston seals • Cut piston seals • Damaged piston seals • Porosity in the pistons	-		

	• Porosity in the cover • Porosity in the case • Damaged piston seal grooves • Plugged orifice cup plug • Missing orifice cup plug Refer to **2-4 Servo Disassemble** , **2-4 Servo Pin Length Check** and extxref document="029_Transmission-Transaxle-02" filetype="sgml" extrefid="i191431">2-4 Servo Assembly Installation in the 4L60-E section of the Transmission Unit Repair Manual. Did you find and correct the condition?		Go to **Step 13**	Go to **Step 11**
11	Inspect the forward clutch assembly for the following conditions: • Worn clutch plates • Porosity in the forward clutch piston • Damaged forward clutch piston • Missing forward clutch piston inner and outer seals • Cut forward clutch piston inner and outer seals • Damaged forward clutch piston inner and outer seals • Missing input housing to forward clutch housing O-ring seal • Cut input housing to forward clutch housing O-ring seal • Damaged input housing to forward clutch housing O-ring seal • Damaged forward clutch housing • Damaged forward clutch housing retainer and ball assembly • Forward clutch housing retainer and ball assembly is not sealing Refer to **Forward Clutch Assembly Assemble** in the 4L60-E section of the Transmission Unit Repair Manual.	-		

	Did you find and correct the condition?		Go to **Step 13**	Go to **Step 12**
12	Inspect 3-4 clutch assembly for the following conditions: • Worn clutch plates • Porosity in the 3-4 clutch piston • Damaged 3-4 clutch piston • Missing 3-4 clutch inner and outer seals • Cut 3-4 clutch inner and outer seals • Damaged 3-4 clutch inner and outer seals • Damaged 3-4 clutch spring assembly • Damaged 3-4 clutch apply ring • Damaged piston seal grooves • Plugged orifice cup plug • Missing orifice cup plug Refer to **3-4 Clutch Assemble** and extxref document="029_Transmission-Transaxle-02" filetype="sgml" extrefid="i7905">3-4 Clutch Plate Travel Check in the 4L60-E section of the Transmission Unit Repair Manual. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)
13	1. Change the AT fluid and filter. 2. Inspect for correct transmission fluid level. Refer to **Transmission Fluid Checking Procedure** . 3. Add new AT fluid as necessary. **IMPORTANT:** **The Clear TAPS function will clear all adapt cells. This may affect transmission performance. The PCM will update the transmission adapt cell values as the vehicle is driven.** 4. Using the scan tool, perform the Clear TAPS function. Did you complete the above procedure?	-	Go to **Step 14**	-
	Perform the following procedure in order to verify			

14	the repair: 1. Select DTC. 2. Select Clear Info. 3. Operate the vehicle under the following conditions: • Drive the vehicle in D4, with the TCC ON, and a throttle position of 20-99%. • Ensure that the scan tool TCC Slip Speed is -20 to +50 RPM for at least 7 seconds. 4. Select Specific DTC. 5. Enter DTC P0894. Has the test run and passed?	-	Go to **Step 15**	Go to **Step 2**
15	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P1810

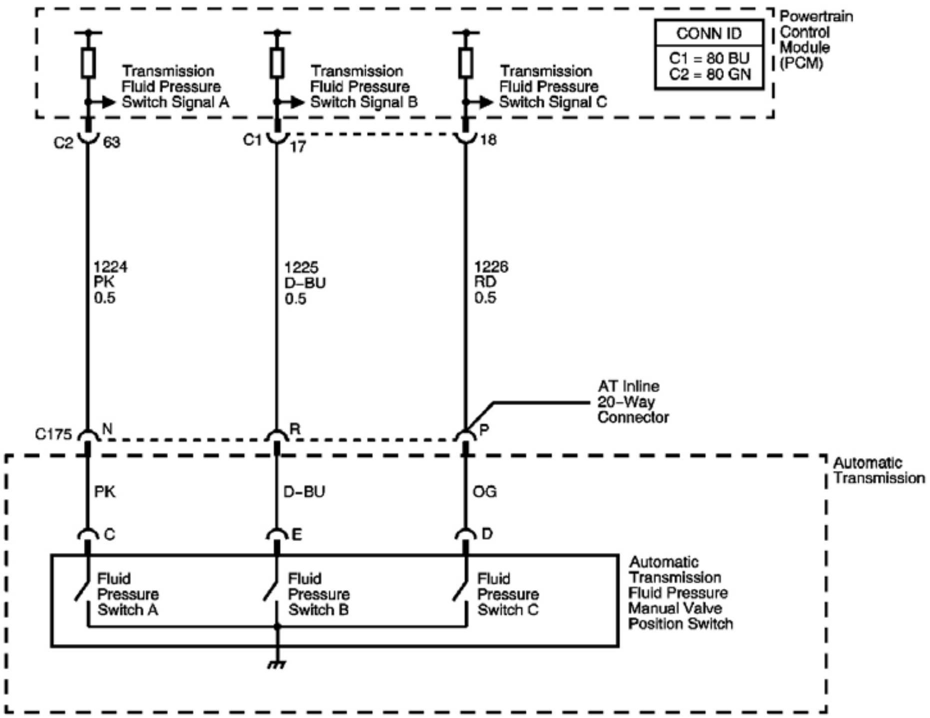


Fig. 22: Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The automatic transmission fluid pressure (TFP) manual valve position switch consists of five pressure switches, two normally-closed and three normally-open, and a transmission fluid temperature (TFT) sensor combined into one unit. The combined unit mounts on the valve body. The powertrain control module (PCM) supplies ignition voltage for each range signal. By grounding one or more of these circuits through various combinations of the pressure switches, the PCM detects which manual valve position you select. The PCM compares the actual voltage combination of the switches to a TFP manual valve position switch combination chart stored in memory.

The TFP manual valve position switch cannot distinguish between PARK and NEUTRAL because the monitored valve body pressures are identical. With the engine OFF and the ignition switch in the ON position, the TFP manual valve position switch indicates PARK/NEUTRAL. Disconnecting the AT inline 20-way connector removes the ground potential for the three range signals to the PCM. In this case, with the engine OFF, and the ignition switch in the ON position, D2 will be indicated.

When the PCM detects an invalid state of the TFP manual valve position switch circuit by deciphering the TFP manual valve position switch inputs, then DTC P1810 sets. DTC P1810 is a type B DTC.

Conditions for Running the DTC

- No VSS assembly DTCs P0502 or P0503.
- The system voltage is 10-18 volts.
- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.
- The engine torque is 54-542 N.m (40-400 lb ft).
- The engine vacuum is 0-105 kPa (0-15 psi).

Conditions for Setting the DTC

DTC P1810 sets if any of the following conditions occurs:

Condition 1

The PCM detects an invalid TFP manual valve position switch state for 60 seconds.

Condition 2

- The engine speed is less than 80 RPM for 0.1 second;

  then the engine speed is 80-550 RPM for 0.07 second;

  then the engine speed is greater than 550 RPM.

- The vehicle speed is less than 3 km/h (2 mph).
- The PCM detects a gear range of D2, D4 or REVERSE during an engine start.
- All conditions met for 5 seconds.

Condition 3

- The TP angle is 10-50 percent.
- The PCM commands fourth gear.
- The TCC is locked ON.
- The speed ratio is 0.6-0.75.
- The PCM detects a gear range of PARK or NEUTRAL when the vehicle is operating in D4.
- All conditions met for 10 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands D2 line pressure.
- The PCM commands a D4 shift pattern.
- The PCM freezes transmission adapt functions.

- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P1810 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Diagnostic Aids

- Refer to the **Transmission Fluid Pressure (TFP) Manual Valve Position Switch Logic** table for the normal range signals and the invalid combinations. On the table, LOW is 0 volts, HI is ignition voltage.
- Sediment in the valve body may cause improper operation of the TFP manual valve position switch. If sediment intrusion is suspected, clean the valve body and replace the TFP manual valve position switch.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step compares the indicated range signal to the selected manual valve position.

5: This step tests for correct voltage from the PCM to the AT inline 20-way connector.

DTC P1810

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	Inspect for correct transmission fluid level. Refer to **Transmission Fluid Checking Procedure** . Did you perform the fluid checking procedure?	-	Go to **Step 3**	Go to **Transmission Fluid Checking Procedure**
	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF.			

3	**IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. 5. Start the engine and idle at normal operating temperature. 6. Apply the brake pedal. 7. Select each transmission range: P, R, N, D4, D3, D2 and D1. Does each selected transmission range match the scan tool TFP Sw. display?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Turn ON the ignition, with the engine OFF. Does the scan tool TFP Sw. A/B/C parameter indicate HI for all range signal states?	-	Go to **Step 5**	Go to **Step 9**
5	1. Turn OFF the ignition. 2. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way connector. 3. Turn ON the ignition, with the engine OFF. 4. Using the DMM and the **J 35616** GM Terminal Test Kit, measure the voltage from terminal N of the **J 44152** to ground. Refer to **Automatic Transmission Inline 20-Way Connector End View** . 5. Measure the voltage from terminal R of the **J 44152** to ground.	10-12 V		

	6. Measure the voltage from terminal P of the **J 44152** to ground. Does the voltage measure within the specified range at all three terminals?		Go to **Step 6**	Go to **Step 10**
6	Connect a fused jumper wire from terminal N of the **J 44152** , signal circuit A, to ground while monitoring the scan tool TFP Sw. A/B/C parameter. When signal circuit A is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 11**	Go to **Step 7**
7	Connect a fused jumper wire from terminal R of the **J 44152** , signal circuit B, to ground while monitoring the scan tool TFP Sw. A/B/C parameter. When signal circuit B is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 11**	Go to **Step 8**
8	Connect a fused jumper wire from terminal P of the **J 44152** , signal circuit C, to ground while monitoring the scan tool TFP Sw. A/B/C parameter. When signal circuit C is grounded, do any other signal circuits indicate LOW?	-	Go to **Step 11**	Go to **Step 12**
9	Test the signal circuits of the TFP manual valve position switch that did not indicate HI for a short to ground between the PCM connector C1 and C2 and the AT inline 20-way connector. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
10	Test the signal circuits of the TFP manual valve position switch that did not indicate ignition voltage for an open between the PCM connector C1 and C2 and the AT inline 20-way connector. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
	Test the affected signal circuits of the TFP manual valve position switch for a shorted together condition between the PCM connector C1 and C2 and the AT inline 20-way			

11	connector. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
12	Test the signal circuits of the TFP manual valve position switch for an open or shorted condition between the TFP manual valve position switch and the AT inline 20-way connector. Refer to **Circuit Testing** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find a condition?	-	Go to **Step 13**	Go to **Step 14**
13	Replace the AT wiring harness assembly. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
14	Replace the TFP manual valve position switch. Refer to **Valve Body and Pressure Switch Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 16**	-

16	Perform the following procedure in order to verify the repair:
	1. Select DTC.
	2. Select Clear Info.
	3. Operate the vehicle under the following conditions:
	   1. Turn ON the ignition, with the engine OFF for at least 2 seconds.
	   2. Start the vehicle and idle for 5 seconds.
	   3. Drive in D4 until the TCC locks for 10 seconds.
	   4. Continue to run the engine for at least 60 seconds from startup.
	4. Select Specific DTC.
		-		

	5. Enter DTC P1810. Has the test run and passed?		Go to **Step 17**	Go to **Step 2**
17	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P2761

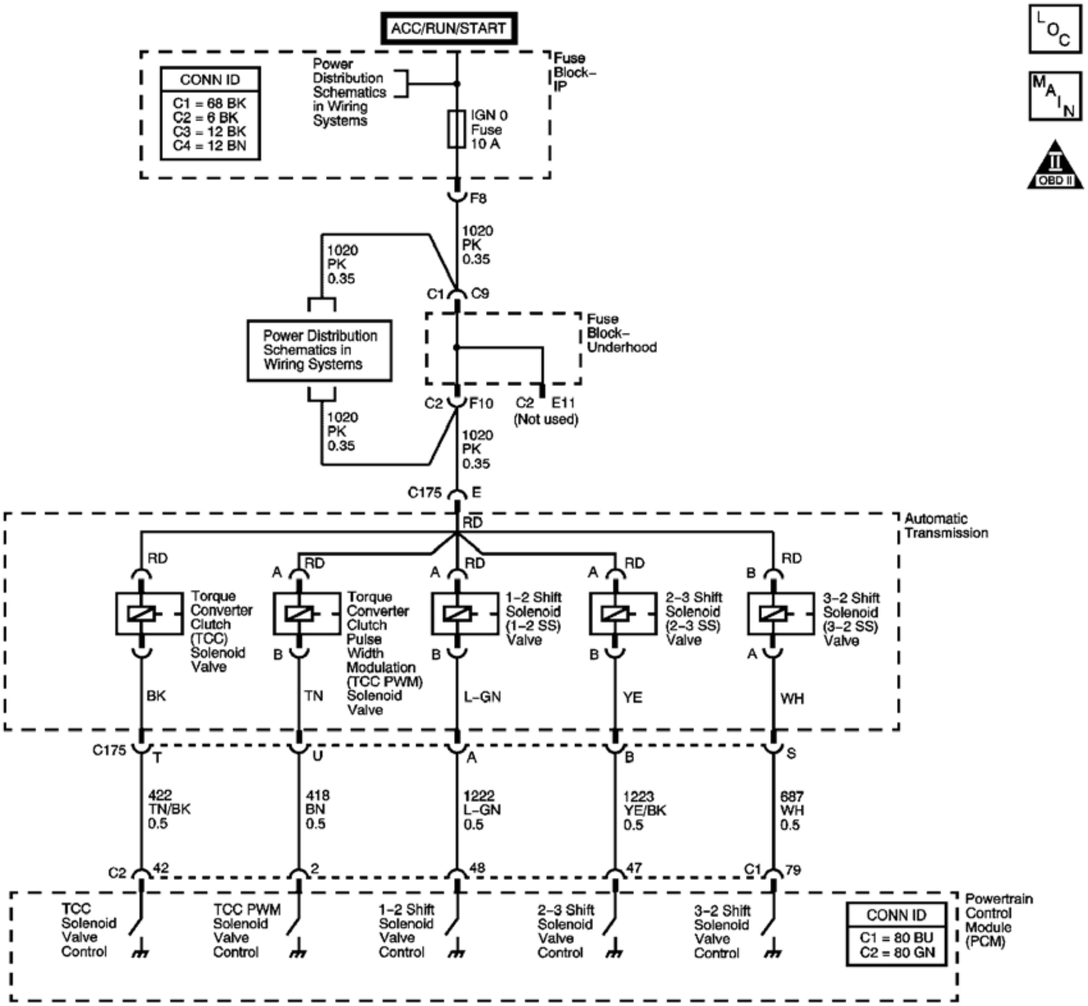


Fig. 23: Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Valve Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The torque converter clutch pulse width modulation (TCC PWM) solenoid valve controls the fluid acting on the converter clutch valve. The converter clutch valve controls the TCC application and release. The solenoid attaches to the control valve body within the transmission. The solenoid receives ignition voltage through the Ignition 0 voltage circuit. The powertrain control module (PCM) controls the solenoid by providing a ground path on the TCC PWM solenoid valve control circuit. Current flows through the solenoid coil according to the duty cycle, percentage of ON and OFF time. The TCC PWM solenoid valve provides a smooth engagement of the TCC by operating during a duty cycle percent of ON time.

When the PCM detects a continuous open, short to ground or short to power in the TCC PWM solenoid valve circuit, then DTC P2761 sets. DTC P2761 is a type B DTC.

Conditions for Running the DTC

- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.
- The PCM commands first gear.
- The TCC duty cycle is less than 10 percent or greater than 90 percent.

Conditions for Setting the DTC

DTC P2761 sets if one of the following conditions occurs for 5 seconds:

Condition 1

The PCM commands the solenoid ON, 90 percent, and the voltage feedback remains high, B+.

Condition 2

The PCM commands the solenoid OFF, 0 percent, and the voltage feedback remains low, 0 volt.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM inhibits TCC engagement.
- The PCM inhibits 4th gear if the transmission is in hot mode.
- The PCM freezes transmission adapt functions.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P2761 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.

- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: This step tests for voltage to the solenoid.

5: This step tests the ability of the PCM and wiring to control the ground circuit.

7: This step tests the resistance of the TCC PWM solenoid valve and the automatic transmission wiring harness assembly.

DTC P2761

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
2	1. Install a scan tool. 2. Turn ON the ignition, with the engine OFF. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure Records. 4. Clear the DTC. Are any of the following DTCs also set? • P0740 • P0753 • P0758	-		

	• P0785		Go to **Step 3**	Go to **Step 4**
3	Inspect the IGN 0 fuse for an open. Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	-	Go to **Step 11**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Disconnect the AT inline 20-way connector, additional DTCs may set. 3. Install the **J 44152** Jumper Harness (20 pins) on the engine side of the AT inline 20-way connector. 4. Turn ON the ignition, with the engine OFF. 5. Using the **J 35616** GM Terminal Test Kit, connect a test lamp from terminal E of the **J 44152** to ground. Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the test lamp illuminate?	-	Go to **Step 5**	Go to **Step 14**
5	1. Connect the test lamp between terminal E and terminal U of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . 2. Use the scan tool in order to command the TCC PWM solenoid valve ON and OFF three times. Does the test lamp turn ON and OFF with each command?	-	Go to **Step 7**	Go to **Step 6**
6	Is the test lamp always ON?	-	Go to **Step 15**	Go to **Step 16**
7	1. Install the **J 44152** on the transmission side of the AT inline 20-way connector. 2. Using the DMM and the **J 35616** , measure the resistance between terminal E and terminal U of the **J 44152** . Refer to **Automatic Transmission Inline 20-Way Connector End View** . Does the resistance measure within the specified range?	10-15 ohm	Go to **Step 8**	Go to **Step 9**

8	Measure the resistance from terminal E to ground, and from terminal U to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **<u>Intermittent Conditions</u>** in Engine Controls - 6.0L (LQ4)	Go to **Step 10**
9	1. Disconnect the AT wiring harness assembly from the TCC PWM solenoid valve. 2. Measure the resistance of the TCC PWM solenoid valve. Does the resistance measure within the specified range?	10-15 ohm	Go to **Step 17**	Go to **Step 18**
10	1. Disconnect the AT wiring harness assembly from the TCC PWM solenoid valve. 2. Measure the resistance from each of the component terminals to ground. Do both readings measure greater than the specified value?	250 K ohm	Go to **Step 17**	Go to **Step 18**
11	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the TCC PWM solenoid valve for a short to ground between the fuse block and the AT inline 20-way connector.Refer to **<u>Testing for Short to Ground</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 12**
12	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.** Test the Ignition 1 voltage circuit of the TCC PWM solenoid valve for a short to ground between the AT inline 20-way connector and the TCC PWM solenoid valve.Refer to **<u>Testing for Short to Ground</u>** in Wiring Systems.Did you find a short to ground condition?	-	Go to **Step 17**	Go to **Step 13**
	1. Test each solenoid for a short to ground.			

13	2. Replace the faulty solenoid as necessary. Did you complete the replacement?	-	Go to **Step 20**	-
14	**IMPORTANT:** **The condition that affects this circuit may exist in other connecting branches of the circuit. Refer to <u>Power Distribution Schematics</u> in Wiring Systems for complete circuit distribution.** Test the Ignition 0 voltage circuit of the TCC PWM solenoid valve for an open.Refer to **<u>Testing for Continuity</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 20**	-
15	Test the control circuit of the TCC PWM solenoid valve for a short to ground between the PCM connector C2 and the AT inline 20-way connector. Refer to **<u>Testing for Short to Ground</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 19**
16	Test the control circuit of the TCC PWM solenoid valve for an open or short to voltage between the PCM connector C2 and the AT inline 20-way connector. Refer to **<u>Circuit Testing</u>** and extxref document="029_body-21" filetype="sgml" extrefid="i162420"> Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 19**
17	Replace the AT wiring harness assembly. Refer to **<u>Valve Body and Pressure Switch Replacement</u>** . Did you complete the replacement?	-	Go to **Step 20**	-
18	Replace the TCC PWM solenoid valve. Refer to **<u>Valve Body and Pressure Switch Replacement</u>** . Did you complete the replacement?	-	Go to **Step 20**	-
19	Replace the PCM. Refer to **<u>Powertrain Control Module (PCM) Replacement</u>** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 20**	-
	Perform the following procedure in order to verify the repair:			

20	1. Select DTC. 2. Select Clear Info. 3. Drive the vehicle in D4 with the TCC On. Ensure that the following conditions are met: • The PCM commands the TCC PWM solenoid valve ON, and the voltage feedback drops to zero. • The PCM commands the TCC PWM solenoid valve OFF, and the voltage feedback increases to B+. • All conditions are met for 5 seconds. 4. Select Specific DTC. 5. Enter DTC P2761. Has the test run and passed?	-	Go to **Step 21**	Go to **Step 2**
21	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK

DTC P2771

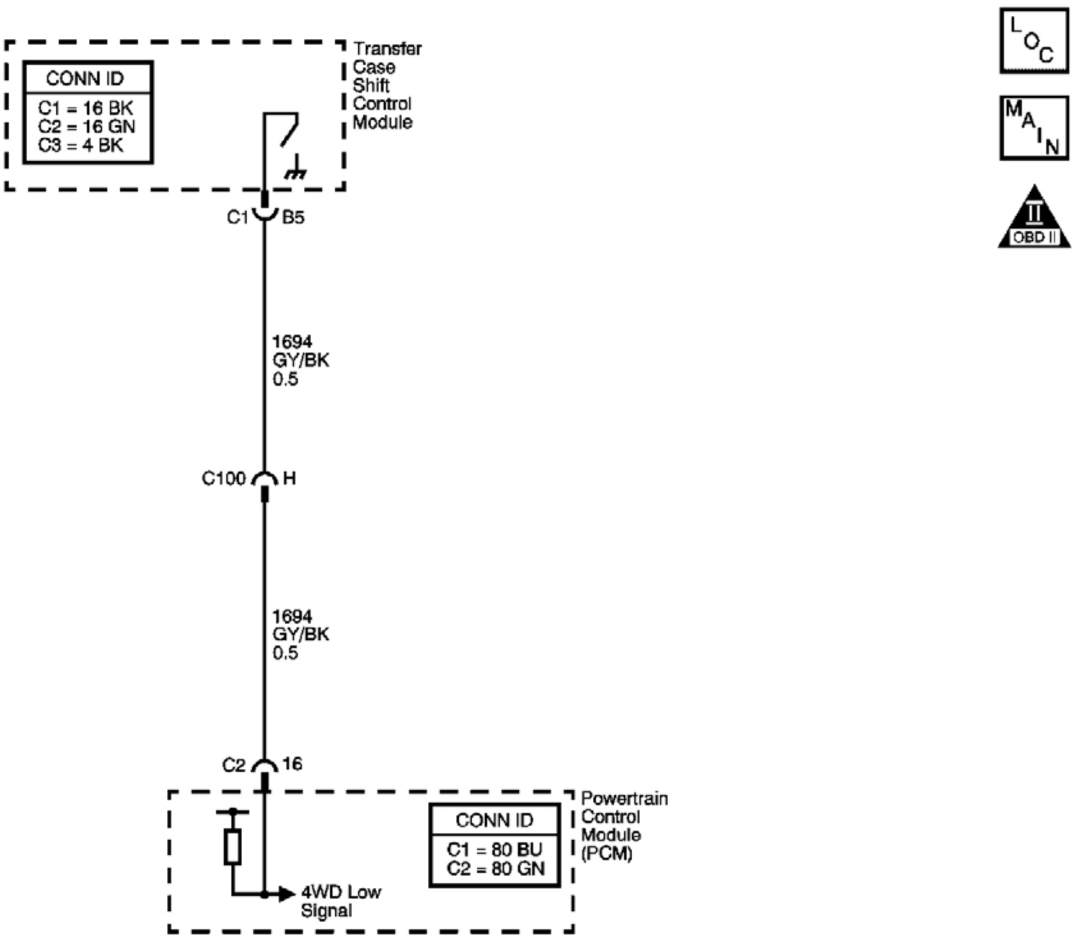


Fig. 24: Four Wheel Drive (4WD) Low Circuit Diagram
Courtesy of GENERAL MOTORS CORP.

Circuit Description

The four wheel drive (4WD) low circuit consists of the powertrain control module (PCM), a transfer case control module and the circuit wiring. The transfer case control module controls the 4WD low signal on the low signal circuit. When the operator selects 4WD low, the transfer case control module grounds the signal circuit, and the 4WD low signal voltage on the circuit changes from ignition voltage to zero volts. The PCM then compensates for transfer case gear reduction in the transmission output shaft speed (OSS) sensor signal. The PCM uses the transmission OSS sensor signal to adjust shift points, line pressure and torque converter clutch (TCC) scheduling.

When the PCM detects a continuous open, short to ground or short to power in the 4WD low circuit, then DTC P2771 sets. DTC P2771 is a type B DTC.

Conditions for Running the DTC

- No TP sensor DTCs P0122, or P0123.
- No VSS assembly DTCs P0502 or P0503.
- No TCC solenoid valve DTC P0740.
- No TCC stuck ON DTC P0742.
- No 1-2 SS valve DTCs P0751 or P0753.
- No 2-3 SS valve DTCs P0756 or P0758.
- No TFP manual valve position switch DTC P1810.
- No TCC PWM solenoid valve DTC P2761.
- The engine speed is greater than 450 RPM for 5 seconds.
- The engine is not in fuel cutoff.
- The vehicle speed is greater than 11 km/h (7 mph).
- The TP angle is 17-50 percent.
- The engine torque is 54-542 N.m (40-400 lb ft).
- The gear range is D4.
- The shift solenoid performance counters are zero.
- The TFT is 20-130°C (68-266°F).

Conditions for Setting the DTC

DTC P2771 sets if one of the following conditions occurs:

Condition 1

- The 4WD low switch is in 4WD low.
- The transfer case is not in 4WD low.
- The TCC slip speed is -3,000 to -50 RPM.
- The transfer case ratio is 0.08-1.2, the transfer case ratio is the engine speed divided by the transfer case output speed.
- All conditions are met for 5 seconds.

Condition 2

- The 4WD low switch is not in 4WD low.
- The transfer case is in 4WD low.
- The TCC is commanded ON.
- The TCC slip speed is 100 to 3,000 RPM.
- The transfer case ratio is 2.5-2.9.
- All conditions are met for 10 seconds.

Action Taken When the DTC Sets

- The PCM illuminates the malfunction indicator lamp (MIL) during the second consecutive trip in which the Conditions for Setting the DTC are met.
- The PCM commands a normal shift pattern, not a 4WD low shift pattern.
- The PCM records the operating conditions when the Conditions for Setting the DTC are met. The PCM stores this information as Freeze Frame and Failure Records.
- The PCM stores DTC P2771 in PCM history during the second consecutive trip in which the Conditions for Setting the DTC are met.

Conditions for Clearing the MIL/DTC

- The PCM turns OFF the MIL during the third consecutive trip in which the diagnostic test runs and passes.
- A scan tool can clear the MIL/DTC.
- The PCM clears the DTC from PCM history if the vehicle completes 40 warm-up cycles without an emission-related diagnostic fault occurring.
- The PCM cancels the DTC default actions when the fault no longer exists and/or the ignition switch is OFF long enough in order to power down the PCM.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

3: This step tests for a short to ground in the 4WD low signal circuit.

4: This step tests for an open in the 4WD low signal circuit or a faulty transfer case control module.

DTC P2771

Step	Action	Value (s)	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls** in Engine Controls - 6.0L (LQ4)
	1. Install a scan tool. 2. Start the engine, parking brake disengaged. **IMPORTANT:** **Before clearing the DTC, use the scan tool in order to record the Freeze Frame and Failure Records. Using the Clear Info function erases the Freeze Frame and Failure Records from the PCM.** 3. Record the DTC Freeze Frame and Failure			

2	Records. 4. Clear the DTC. 5. Place the transmission in NEUTRAL. 6. Select 4HI on the transfer case selector. **IMPORTANT:** **It may be necessary to drive the vehicle slightly forward to engage 4LO on the transfer case.** 7. Select 4LO on the transfer case selector. Does the scan tool 4WD Low display Disabled when you select 4HI, then Enabled when you select 4LO?	-	Go to **Intermittent Conditions** in Engine Controls - 6.0L (LQ4)	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the transfer case control module connector C1. 3. Turn ON the ignition, with the engine OFF. Does the scan tool 4WD Low indicate Enabled?	-	Go to **Step 6**	Go to **Step 4**
4	1. Connect C1-B5 of the transfer case control module connector to ground. 2. Observe the scan tool 4WD Low. Does the scan tool 4WD Low indicate Enabled when the 4WD low signal circuit (1694), is grounded?	-	Go to **Step 5**	Go to **Step 7**
5	Replace the transfer case control module. Refer to **Transfer Case Shift Control Module Replacement** in Transfer Case - BW - 4484. Did you complete the replacement?	-	Go to **Step 9**	-
6	Test the 4WD low signal circuit for a short to ground. Refer to **Testing for Short to Ground** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 9**	Go to **Step 8**
7	Test the 4WD low signal circuit for an open. Refer to **Testing for Continuity** and extxref document="029_body-21" filetype="sgml" extrefid="i162420">Wiring Repairs in Wiring	-		

	Systems. Did you find and correct the condition?		Go to **Step 9**	Go to **Step 8**
8	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** in Engine Controls - 6.0L (LQ4). Did you complete the replacement?	-	Go to **Step 9**	-

9	Perform the following procedure in order to verify the repair:
	1. Select DTC.
	2. Select Clear Info.
	3. Operate the vehicle under the following conditions:
	    1. Select 4LO on the transfer case selector.
	    2. Drive the vehicle in D4.
	    3. Verify that the speed ratio is 2.5-2.9 for 1.5 seconds.
	    4. Select 2HI or 4HI on the transfer case selector.
	    5. Drive the vehicle in D4 with the TCC ON.
	    6. Verify that the speed ratio is 0.8-1.2 for 5 seconds.
	4. Select Specific DTC.
	5. Enter DTC P2771.
	Has the test run and passed?
		-	Go to **Step 10**	Go to **Step 2**

10	With the scan tool, observe the stored information, capture info, and DTC Info. Does the scan tool display any DTCs that you have not diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List** in Engine Controls - 6.0L (LQ4)	System OK