

2006 Chevrolet HHR LT

2006 TRANSMISSION Automatic Transaxle - 4T45-E - HHR

2006 TRANSMISSION

Automatic Transaxle - 4T45-E - HHR

SPECIFICATIONS**TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR SPECIFICATIONS****Transmission Fluid Temperature (TFT) Sensor Specifications**

Temperature	Temperature	Minimum Resistance	Nominal Resistance	Maximum Resistance	Signal
°F	°C	ohms	ohms	ohms	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
Bottom Pan to Case - M6 x 1.0 x 19.0 - Qty 12	12 N.m	106 lb in
Case Cover	24 N.m	18 lb ft
Case Side Cover	20 N.m	15 lb ft

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Channel Plate to Case - M6 x 1.0 x 28.0 - Qty 6	12 N.m	106 lb in
Channel Plate to Case - M6 x 1.0 x 63.0 - Qty 2	12 N.m	106 lb in
Channel Plate to Driven Sprocket Support - M6 x 1.0 x 28.0 - Qty 2	14 N.m	124 lb in
Clip, Wiring Harness - M6 x 1.0 x 15.0 - Qty 1	12 N.m	106 lb in
Converter Shield	10 N.m	89 lb in
Cooler Pipes at Case	8 N.m	71 lb in
Cooler Pipes at Radiator	20-40 N.m	15-30 lb ft
Cover Assembly, Intermediate 4th Servo to Case - M6 x 1.0 x 28.0 - Qty 3	12 N.m	106 lb in
Cover, Lo/Reverse Servo to Case - M6 x 1.0 x 28.0 - Qty 3	12 N.m	106 lb in
Cover, Side to Case - M8 x 1.25 x 28.0 - Qty 10	20 N.m	15 lb ft
Cover, Side to Case (Stud) - M8 x 1.25 x 28.0 - Qty 1	20 N.m	15 lb ft
Flywheel to Torque Converter	62 N.m	46 lb ft
Oil Check Plug	14 N.m	124 lb in
Oil Feed Tube Bolts	14 N.m	124 lb in
Oil Pan to Case	10 N.m	89 lb in
Park/Neutral Position Switch to Case	24 N.m	18 lb ft
Plug, Pipe - 1/8-27 NPTF - Qty 2	12 N.m	106 lb in
Pressure Switch Assembly Bolts	12 N.m	106 lb in
Pump, Valve Body to Channel Plate - M6 x 1.0 x 63.0 - Qty 1	12 N.m	106 lb in
Pump, Valve Body to Channel Plate - M6 x 1.0 x 90.0 - Qty 6	12 N.m	106 lb in
Pump, Valve Body, Channel Plate to Case - M6 x 1.0 x 103.0 - Qty 1	12 N.m	106 lb in
Sensor, Input Speed - M6 x 1.0 x 15.0 (Qty 1)	12 N.m	106 lb in
Sensor, Output Speed Stud - M6 x 1.0 x 15.0 - Qty 1	12 N.m	106 lb in
Shift Lever to Transmission Nut	20 N.m	15 lb ft
Spacer, Channel Plate to Driven Sprocket Support - M6 x 1.0 x 70.0 - Qty 2	14 N.m	124 lb in
Speed Sensor Housing to Case	11 N.m	97 lb in
Spring and Roller Assembly, Detent to Channel Plate - M6 x 1.0 x 19.0 - Qty 1	12 N.m	106 lb in
Support Assembly, Drive Sprocket to Case - M6 x 1.0 x 17.2 - Qty 6	12 N.m	106 lb in
TFP Switch, Valve Body, Channel Plate - M6 x		

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1.0 x 51.0 - Qty 3	12 N.m	106 lb in
TFP Switch, Valve Body, Channel Plate - M6 x 1.0 x 63.0 - Qty 1	12 N.m	106 lb in
TFP Switch, Valve Body, Channel Plate to Case - M6 x 1.0 x 90.0 - Qty 2	12 N.m	106 lb in
Transmission Mount Bracket Bolts	120 N.m	89 lb ft
Transmission Mount - Front	130 N.m	96 lb ft
Transmission Mount - Rear	122 N.m	90 lb ft
Transmission Mount - Side	66 N.m	49 lb ft
Transmission Mount Thrubolt - Front	75 N.m	55 lb ft
Transmission Mount Thrubolt - Rear	120 N.m	89 lb ft
Transmission Mount Thrubolt - Side	55 N.m	41 lb ft
Transmission to Engine Mount Bolts	90 N.m	66 lb ft
Tube Assembly, Transmission Oil to Case - M6 x 1.0 x 19.0 - Qty 2	12 N.m	106 lb in
Tube Assembly, Transmission Oil to Forward Clutch Support - M6 x 1.0 x 19.0 - Qty 1	12 N.m	106 lb in
Tube Assembly, Transmission Oil to Lo/Reverse Servo Cover - M6 x 1.0 x 19.0 - Qty 1	12 N.m	106 lb in
TV Cable to Case	9 N.m	80 lb in
Valve Body, Channel Plate to Case - M6 x 1.0 x 90.0 - Qty 5	12 N.m	106 lb in
Valve Body, Channel Plate to Case - M6 x 1.0 x 103.0 - Qty 2	12 N.m	106 lb in
Valve Body to Channel Plate - M6 x 1.0 x 51.0 - Qty 5	12 N.m	106 lb in

TRANSMISSION GENERAL SPECIFICATIONS**Transmission General Specifications**

Name	Hydra-Matic® 4T45-E
RPO Codes	MN5 - 4T45-E
Production Location	Windsor, Ontario, Canada
Vehicle Platform Engine/Transmission Usage	TA SUV
Transmission Drive	Transverse Mounted Front Wheel Drive
Maximum Engine Torque	290 N.m (215 lb ft)
Maximum Shift Speed	1-2 6,500 RPM 2-3 6,500 RPM

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	3-4 6,500 RPM
1st Gear Ratio	2.960:1
2nd Gear Ratio	1.626:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.681:1
Reverse	2.143:1
Torque Converter Size - Diameter of Torque Converter Turbine	245 mm
Pressure Taps	Line Pressure
Transmission Fluid Type	DEXRON® VI
Transmission Fluid Capacity - Approximate	Bottom Pan Removal: 6.5 L (6.9 qts) Complete Overhaul: 9.0 L (9.5 qts) Dry: 12.2 L (12.9 qts)
Transmission Type: 4	Four Forward Gears
Transmission Type: T	Transverse Mount
Transmission Type: 45	Product Series
Transmission Type: E	Electronic Controls
Position Quadrant	P, R, N, Overdrive (Circle D), 3, 2, 1
Case Material	Die Cast Aluminum
Transmission Weight Dry	75.1 kg (165.6 lb)
Transmission Weight Wet	85.5 kg (188.5 lb)
Maximum Trailer Towing Capacity	487 kg (1,000 lb)
Maximum Gross Vehicle Weight (GVW)	1,826 kg (4,100 lb)
Ratios	
Chain	Final Drive
32/38	3.29
	Effective - Overall
	3.91

FLUID CAPACITY SPECIFICATIONS**Fluid Capacity Specifications (4T45-E)**

Application	Specification	
	Metric	English
Bottom Pan Removal	6.5 liters	6.9 quarts
Complete Overhaul	9.0 liters	9.5 quarts
Dry	12.2 liters	12.9 quarts
Measurements are approximate.		

RANGE REFERENCE**Range Reference**

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Range	Park/ Neutral	Reverse	D				3			2			1	
Gear	N	R	1st	2nd	3rd	4th	1st	2nd	3rd	1st	2nd	3rd**	1st	2nd**
1-2 Shift Solenoid	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
2-3 Shift Solenoid	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
2nd Clutch	-	-	-	A	A*	A*	-	A	A*	-	A	A*	-	A
2nd Roller Clutch	-	-	-	H	O	-	-	H	O	-	H	O	-	H
Int./4th Band	-	-	-	-	-	A	-	-	-	-	A	-	-	A
Reverse Clutch	-	A	-	-	-	-	-	-	-	-	-	-	-	-
Coast Clutch	-	-	-	-	-	-	A	A	A	A	A	A	A	A
Input Sprag	-	-	H	H	H	O	H	H	H	H	H	H	H	H
Direct Clutch	-	-	-	-	A	A	-	-	A	-	-	A	-	-
Forward Clutch	-	-	A	A	A	A*	A	A	A	A	A	A	A	A
Lo/Rev Band	A	A	-	-	-	-	-	-	-	-	-	-	A	-
Lo Roller Clutch	-	-	H	O	O	O	H	O	O	H	O	O	H	O

- A = Applied
- H = Holding
- O = Overrunning
- ON = The solenoid is energized
- OFF = The solenoid is de-energized
- * = Applied with no load
- ** = Manual SECOND-THIRD gear is only available above approximately 100 km/h (62 mph)
- *** = Manual FIRST-SECOND gear is only available above approximately 60 km/h (37 mph)
- Manual FIRST-THIRD gear is also possible at high vehicle speed as a safety feature

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SHIFT SOLENOID VALVE STATE AND GEAR RATIO**Shift Solenoid Valve State and Gear Ratio (4T45-E)**

Gear	1-2 SS Valve	2-3 SS Valve	Gear Ratio
1	ON	OFF	2.96:1
2	OFF	OFF	1.62:1
3	OFF	ON	1.00:1
4	ON	ON	0.68:1
P, R, N	ON	OFF	2.14:1

SHIFT SPEED**Shift Speed**

		1-2 Shift @ +/- 3 mph			2-3 Shift @ +/- 4 mph			3-4 Shift @ +/- 5 mph			Downshifts @ +/- 4 mph			TCC Apply 3rd Gear
% of TPS		12.5	25	50	12.5	25	50	12.5	25	50	4-3 Coast	3-2 Coast	2-1 Coast	10%
Model	Engine RPO													
FWJ	L61	9	12	24	13	23	44	38	38	N/A	31	10	6	27
ELJ	LE5	8	11	23	14	19	39	38	39	63	33	10	6	25

TRANSMISSION FLUID PRESSURE (TFP) MANUAL VALVE POSITION SWITCH LOGIC**Transmission Fluid Pressure (TFP) Manual Valve Position Switch Logic**

Range Signal	B	C
Park/Neutral	HI	HI
Reverse	HI	LOW
Drive	LOW	HI
Invalid	LOW	LOW

LOW = 0 volts
HI = Ignition 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

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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**

Pressure Control Solenoid Current - Amp	Approximate Line Pressure	
	Metric	English
0.00	1041-1138 kPa	151-165 psi
0.10	1027-1123 kPa	149-163 psi
0.20	1000-1096 kPa	145-159 psi
0.30	965-1061 kPa	140-154 psi
0.40	903-1000 kPa	131-145 psi
0.50	827-923 kPa	120-134 psi
0.60	723-820 kPa	105-119 psi
0.70	606-703 kPa	88-102 psi
0.80	475-572 kPa	69-83 psi
0.90	379-475 kPa	55-69 psi
1.00	317-386 kPa	46-56 psi
1.10	289-330 kPa	42-48 psi

COMPONENT RESISTANCE**Component Resistance**

Component	Pass Through Pins	Resistance 20° C (68°F)	Resistance 100°C (212°F)	Resistance to Ground (Case)
1-2 Shift Solenoid Valve	A, E	19-24 ohms	24-31 ohms	Greater than 250 K ohms
2-3 Shift Solenoid Valve	B, E	19-24 ohms	24-31 ohms	Greater than 250 K ohms
Torque Converter Clutch Pulse Width Modulation Solenoid Valve	T, E	10-11 ohms	13-15 ohms	Greater than 250 K ohms
Pressure Control Solenoid Valve	C, D	3-5 ohms	4-7 ohms	Greater than 250 K ohms
*Transmission Fluid				

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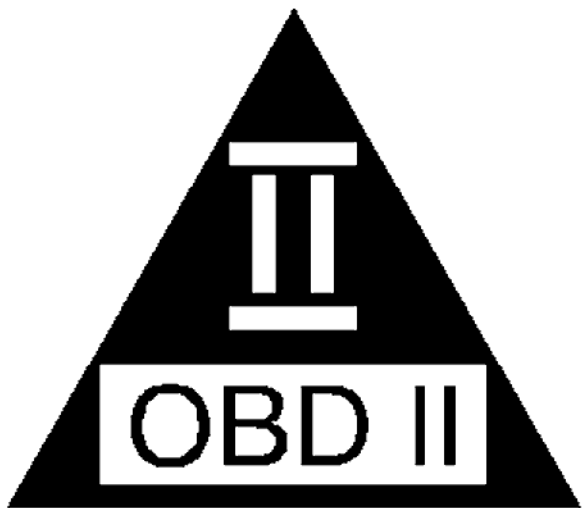
Temperature (TFT) Sensor	L, M	3106-3923 ohms	164-190 ohms	Greater than 20 M ohms
Automatic Transmission Input (Shaft) Speed Sensor	S, V	625-725 ohms	750-835 ohms	Greater than 10 M ohms
Automatic Transmission Output (Shaft) Speed Sensor	A, B	1500-1750 ohms	1750-1900 ohms	Greater than 10 M ohms

***Important:** The resistance of this device is necessarily dependent on the temperature. Therefore the resistance will vary far more than any other device.

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

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"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 9 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

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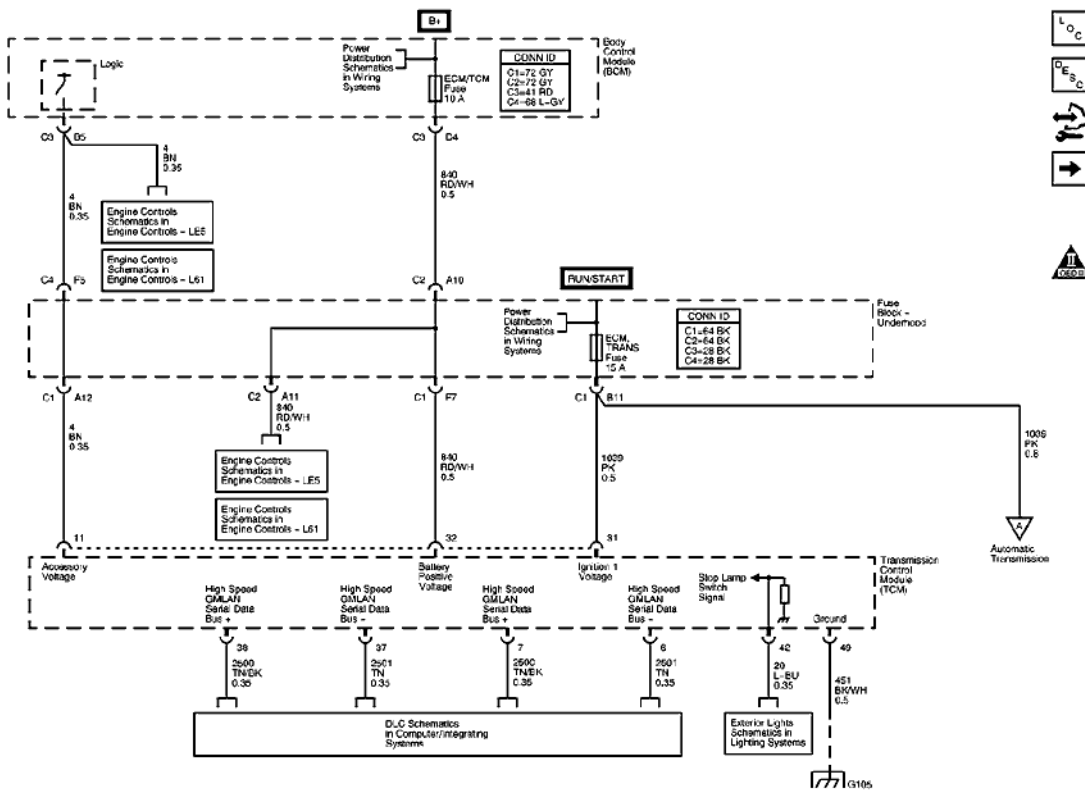


Fig. 1: TCM, Power, and Ground
Courtesy of GENERAL MOTORS CORP.

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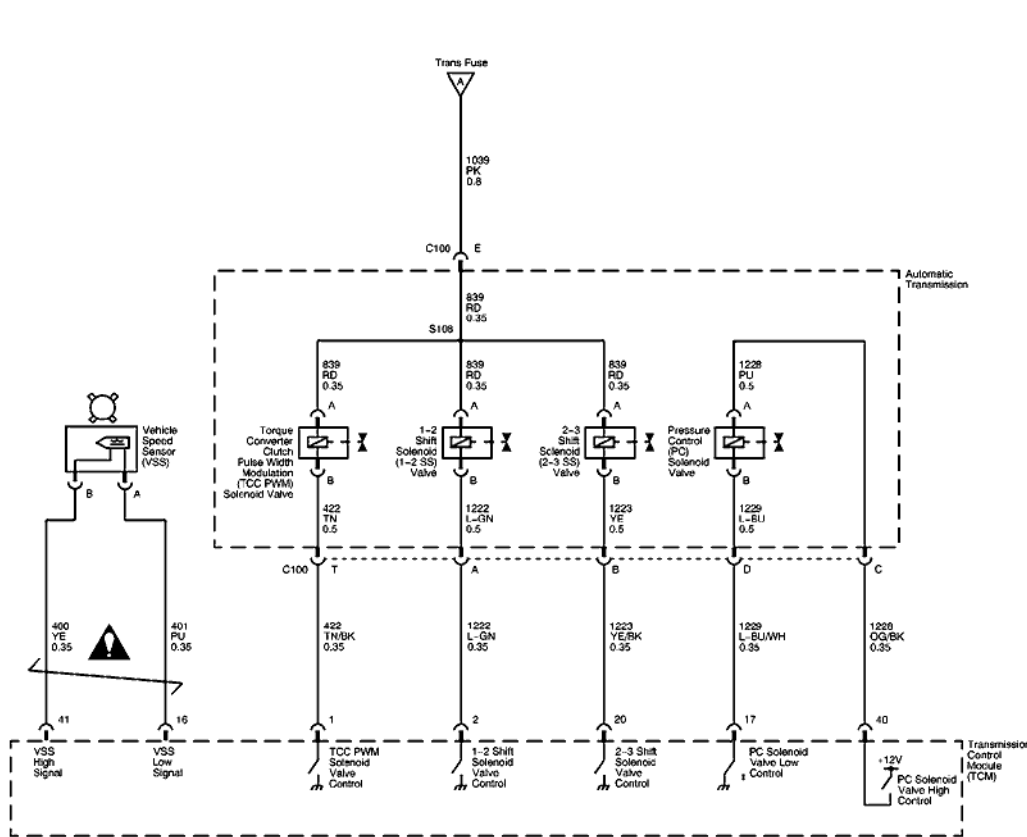


Fig. 2: Transmission Solenoids and VSS
Courtesy of GENERAL MOTORS CORP.

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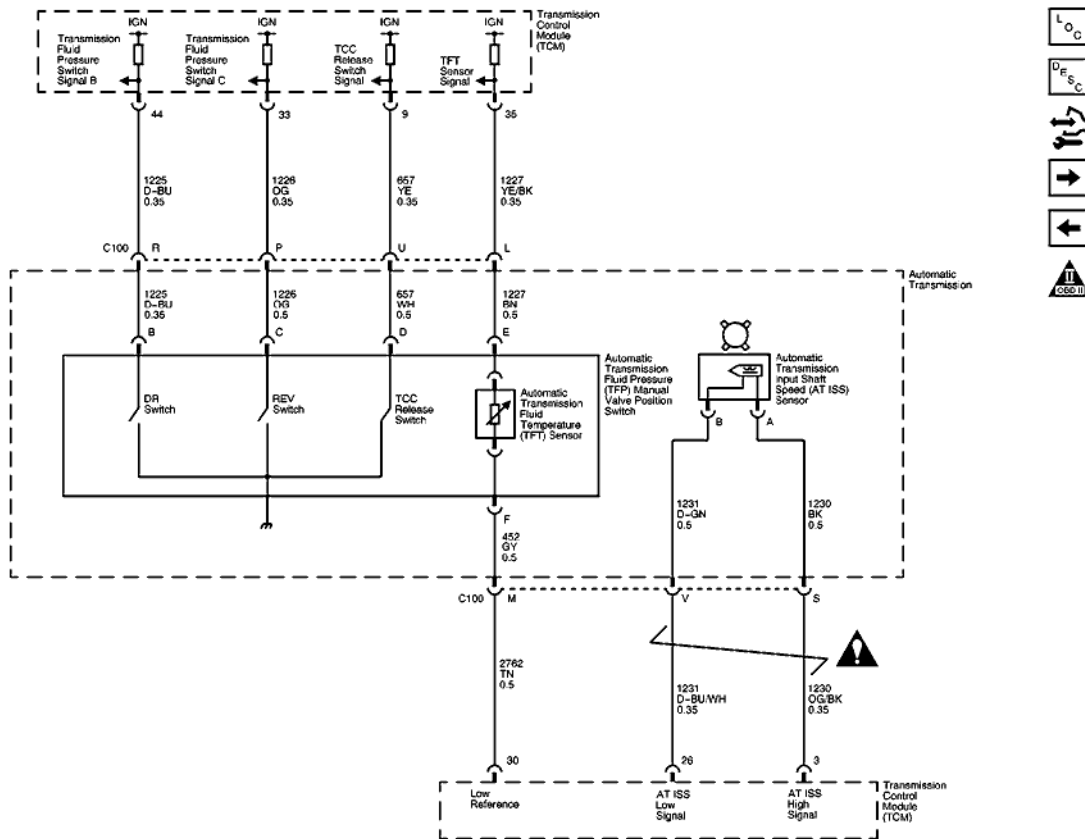


Fig. 3: Transmission Switches, TFT, and A/T ISS Sensors
 Courtesy of GENERAL MOTORS CORP.

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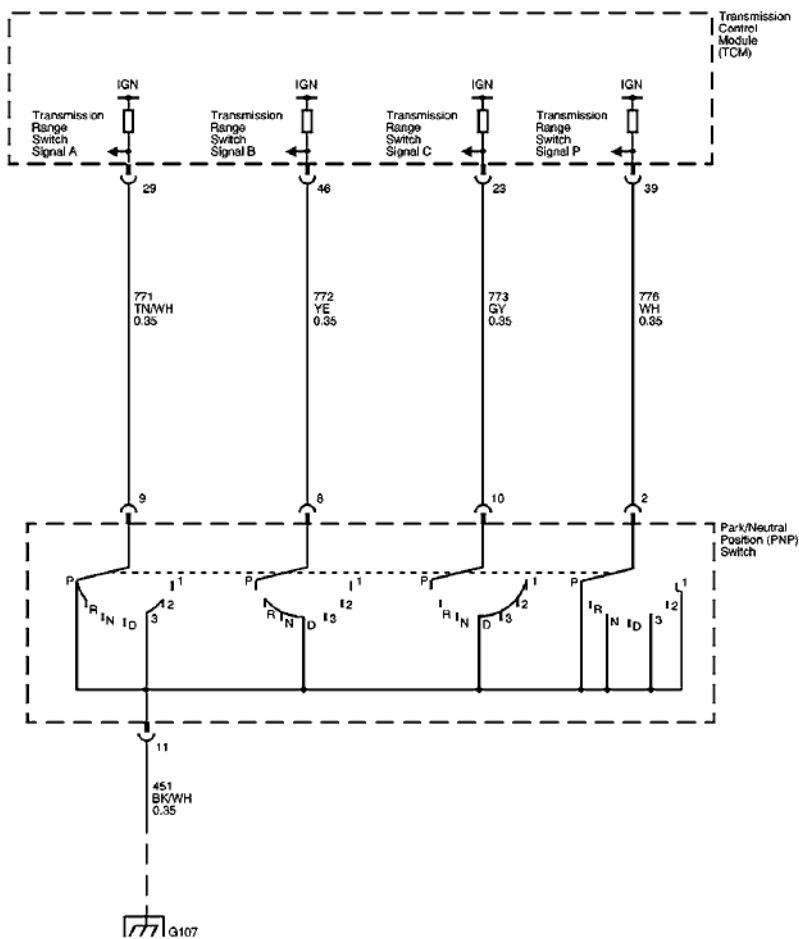


Fig. 4: PNP Switch

Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

AUTOMATIC TRANSMISSION ELECTRONIC COMPONENT VIEWS

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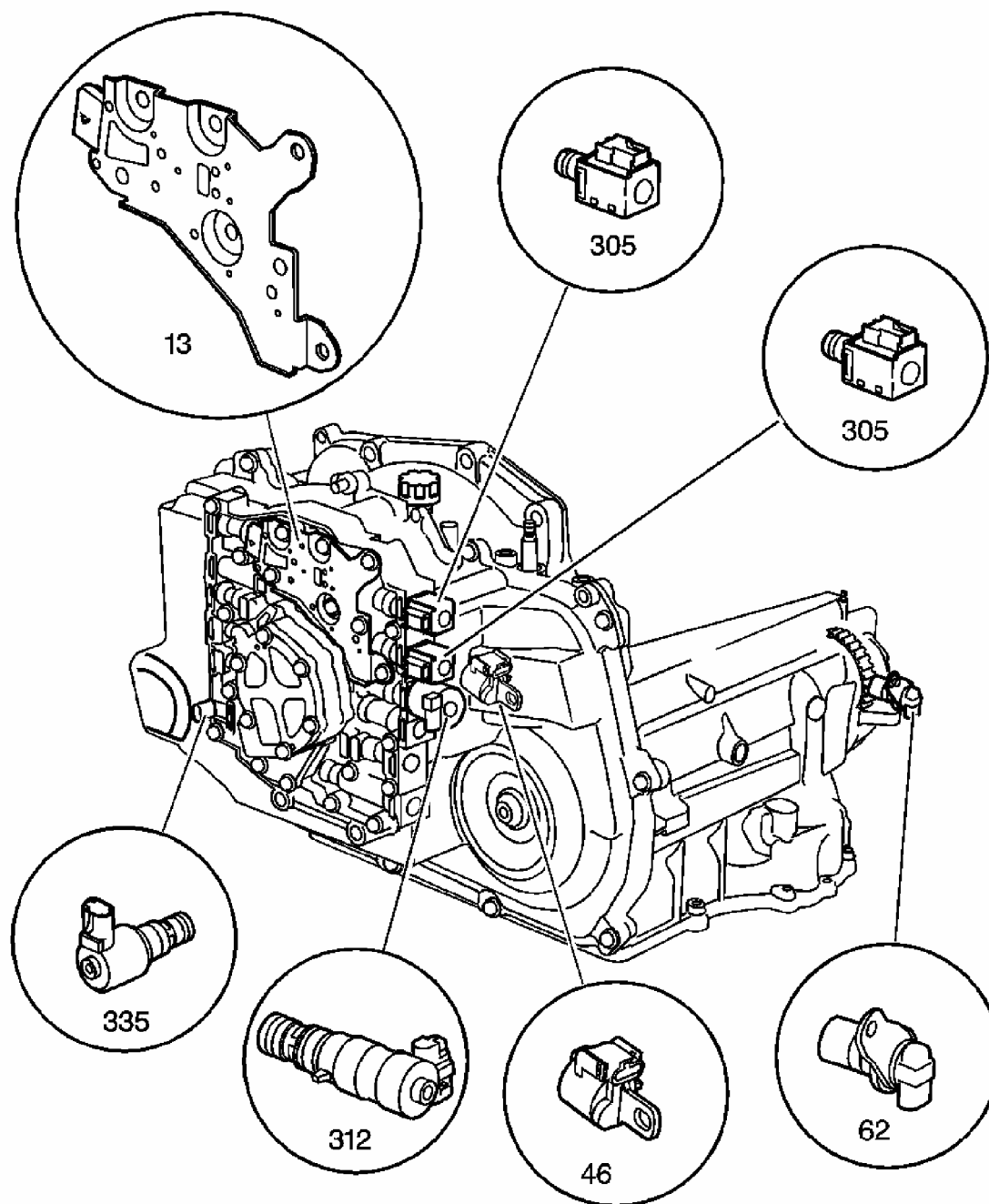


Fig. 5: Electronic Components Component View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 5

Callout	Component Name
13	TFP Manual Valve Position Switch Assembly
46	Input Speed Sensor
62	Output Speed Sensor
305	1-2 and 2-3 Shift Solenoid Valves

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305	1-2 and 2-3 Shift Solenoid Valves
312	Pressure Control Solenoid
335	TCC Control PWM Solenoid

DISASSEMBLED VIEWS

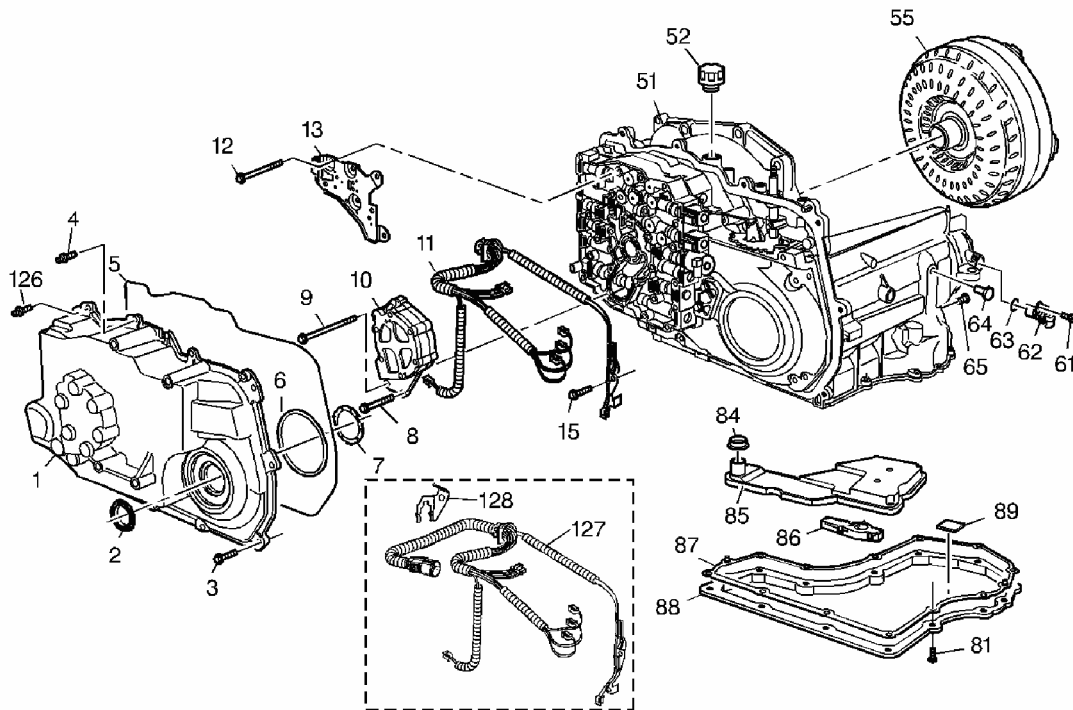


Fig. 6: Case and Associated Parts (1 of 3) Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 6

Callout	Component Name
1	Side Cover (Structural)
2	Axle Oil Seal
3	Side Cover Bolt
4	Side Cover Stud
5	Side Cover Gasket
6	Side Cover Oil Level Control Gasket
7	Thrust Washer (Side Cover to Driven Sprocket)
8	Oil Pump Bolt
9	Oil Pump Bolt
10	Transaxle Oil Pump Assembly
11	Transaxle Wiring Assembly

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12	TFP Manual Valve Position Switch Assembly Bolt
13	TFP Manual Valve Position Switch Assembly
15	Wiring Harness Bracket Bolt/Input Speed Sensor Bolt
51	Transaxle Case
52	Vent Cap
55	Torque Converter Assembly
61	Output Speed Sensor Stud
62	Output Shaft Speed Sensor
63	O-Ring Seal (Output Speed Sensor)
64	Band Anchor Pin (Lo/Reverse)
65	Oil Level Control Plug
81	Tube Assembly Bolt/Bottom Pan Bolt
84	Transaxle Oil Filter Seal
85	Transaxle Oil Filter Assembly
86	Oil Level Control Valve
87	Transaxle Bottom Pan Gasket
88	Transaxle Oil Pan
89	Chip Collector Magnet
126	Side Cover Stud
127	Transmission Wiring Harness Assembly (Some Models)
128	Electrical Connector Retaining Bracket (Some Models)

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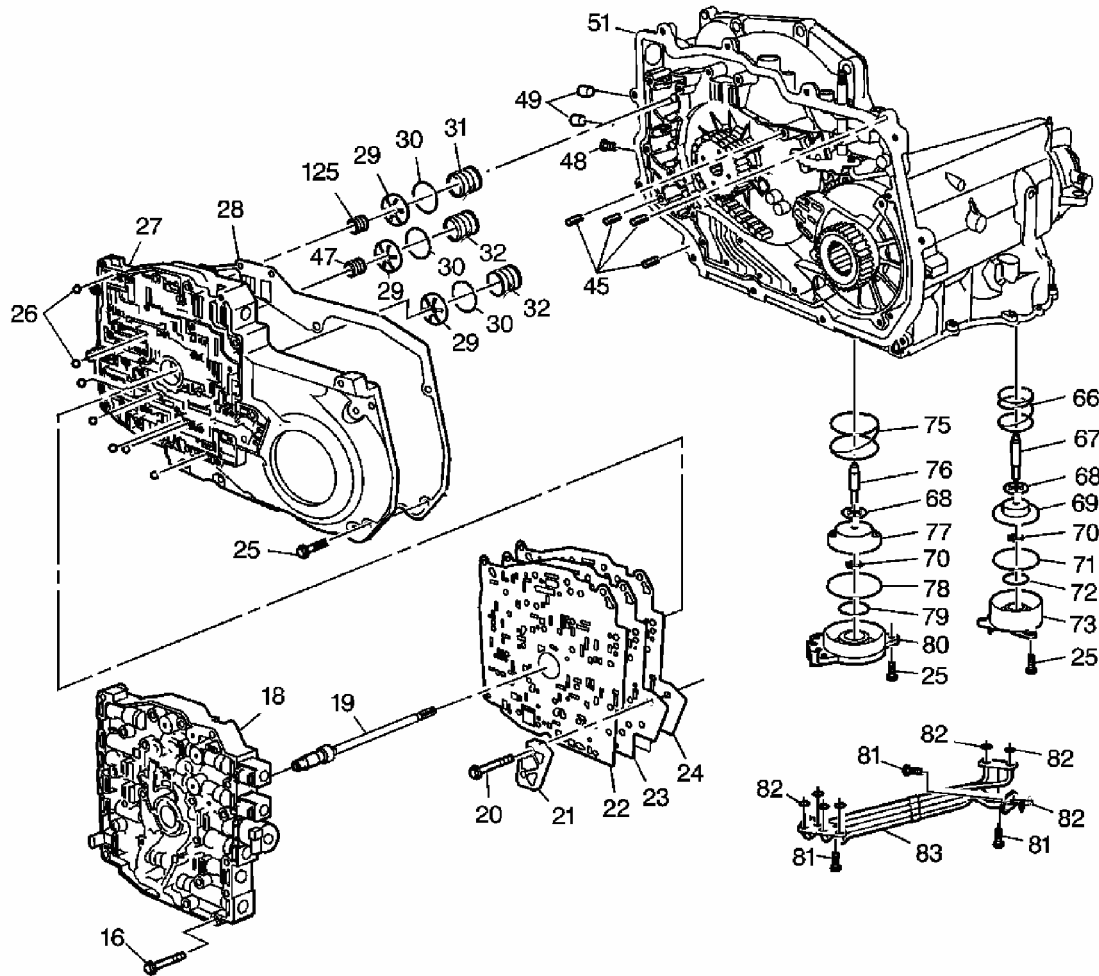


Fig. 7: Case and Associated Parts (2 of 3) Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 7

Callout	Component Name
16	Control Valve Body Bolt
18	Control Valve Body Assembly
19	Oil Pump Drive Shaft
20	Spacer Plate Support Bolt
21	Spacer Plate Support
22	Control Valve Body to Spacer Plate Gasket
23	Control Valve Body Spacer Plate - Model Dependent
24	Spacer Plate to Channel Plate Gasket
25	Channel Plate Bolt/Servo Cover Bolt
25	Channel Plate Bolt/Servo Cover Bolt
25	Channel Plate Bolt/Servo Cover Bolt
26	Checkballs (7)

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27	Channel Plate
28	Case To Channel Plate Gasket
29	Accumulator Piston (1-2, 2-3 and 3-4)
29	Accumulator Piston (1-2, 2-3 and 3-4)
29	Accumulator Piston (1-2, 2-3 and 3-4)
30	Accumulator Piston Seal (1-2, 2-3 and 3-4)
30	Accumulator Piston Seal (1-2, 2-3 and 3-4)
30	Accumulator Piston Seal (1-2, 2-3 and 3-4)
31	1-2 Accumulator Piston Spring
32	2-3 and 3-4 Accumulator Piston Spring
32	2-3 and 3-4 Accumulator Piston Spring
45	Dowel Pin
47	2-3 Accumulator Piston Cushion Spring
48	Line Pressure Tap Plug
49	Cooler Pipe Seal
51	Transaxle Case
66	Servo Return Spring (Lo/Reverse)
67	Servo Apply Pin (Lo/Reverse)
68	Servo Cushion Spring
68	Servo Cushion Spring
69	Servo Piston (Lo/Reverse)
70	Servo Snap Ring
70	Servo Snap Ring
71	Servo Piston Seal (Lo/Reverse)
72	Servo Cover Seal (Lo/Reverse)
73	Servo Cover (Lo/Reverse)
75	Servo Return Spring (Intermediate/4th)
76	Servo Apply Pin (Intermediate/4th)
77	Servo Piston (Intermediate/4th)
78	Servo Piston Seal (Intermediate/4th)
79	Servo Cover Seal (Intermediate/4th)
80	Servo Cover (Intermediate/4th)
81	Tube Assembly Bolt/Bottom Pan Bolt
81	Tube Assembly Bolt/Bottom Pan Bolt
81	Tube Assembly Bolt/Bottom Pan Bolt
82	Oil Feed Tube Assembly Seal
82	Oil Feed Tube Assembly Seal
82	Oil Feed Tube Assembly Seal

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	Oil Feed Tube Assembly Seal
83	Oil Feed Tube Assembly
125	1-2 Accumulator Piston Cushion Spring and Retainer Assembly

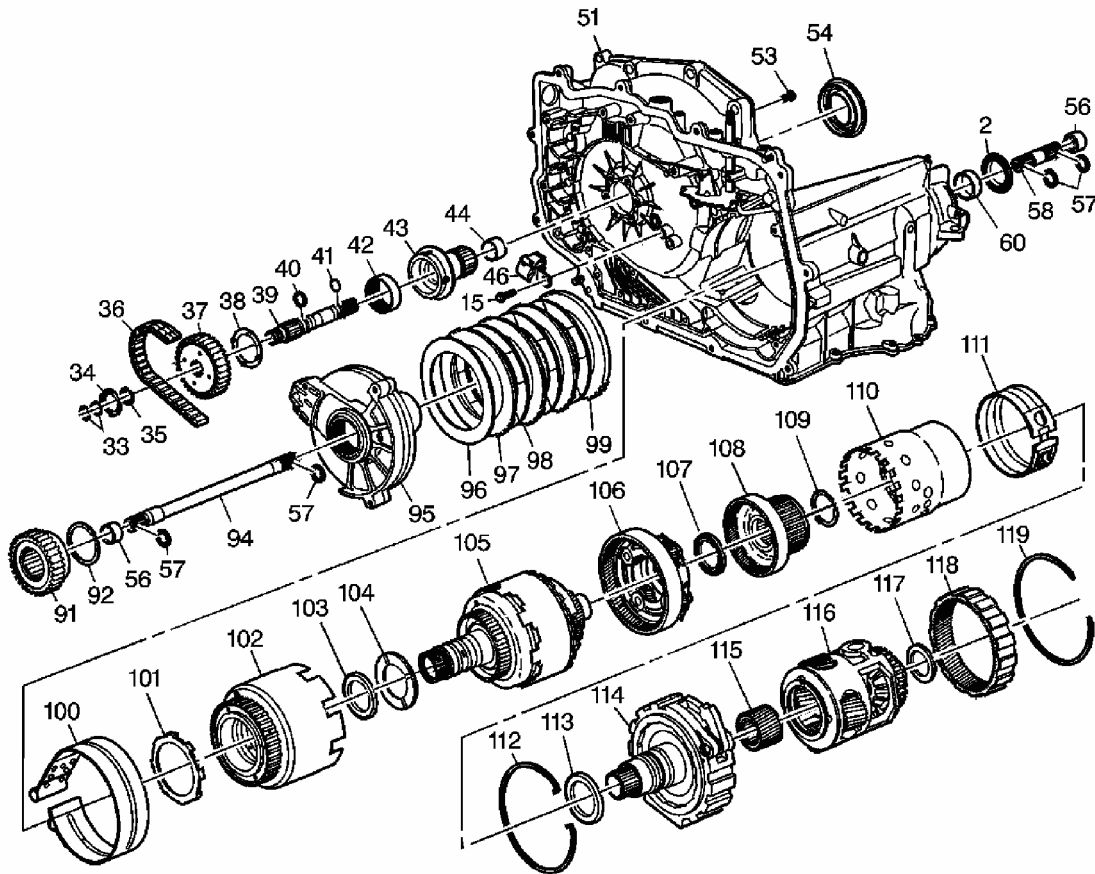


Fig. 8: Case and Associated Parts (3 of 3) Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 8

Callout	Component Name
2	Axle Oil Seal
15	Wiring Harness Bracket Bolt/Input Speed Sensor Bolt
33	Turbine Shaft To Channel Plate Sleeve Seal
34	Thrust Washer (Channel Plate to Drive Sprocket)
35	Snap Ring (Turbine Shaft To Drive Sprocket)
36	Drive Link Assembly
37	Drive Sprocket
38	Thrust Washer (Drive Sprocket to Support)
39	Turbine Shaft
40	Turbine Shaft to Support Seal

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41	O-Ring Seal (Torque Converter)
42	Drive Sprocket Support Bearing
43	Drive Sprocket Support
44	Drive Sprocket Support Bushing
46	Input Speed Sensor
51	Transaxle Case
53	Drive Sprocket Support Screw
54	Converter Seal
56	Output/Stub Shaft Sleeve
56	Output/Stub Shaft Sleeve
57	Output/Stub Shaft Snap Ring
57	Output/Stub Shaft Snap Ring
57	Output/Stub Shaft Snap Ring
58	Output Stub Shaft
60	Case To Final Drive Bushing
91	Driven Sprocket
92	Thrust Washer (Driven Sprocket to Support)
94	Output Shaft
95	Driven Sprocket Support Assembly
96	2nd Clutch Plate (Waved)
97	2nd Clutch Plate (Steel)
98	2nd Clutch Plate (Fiber)
99	2nd Clutch Plate (Backing)
100	Intermediate/4th Band
101	Thrust Washer (Support To Reverse Input Clutch)
102	Reverse Input Clutch Assembly
103	Thrust Bearing
104	Thrust Washer (Selective)
105	Direct and Coast Clutch Assembly
106	Input Carrier Assembly
107	Thrust Bearing
108	Input Flange and Forward Clutch Hub Assembly
109	Thrust Washer
110	Forward Clutch Assembly
111	Lo/Reverse Band
112	Snap Ring (Forward Clutch Support to Case)
113	Thrust Bearing
114	Forward Clutch Support Assembly
115	

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	Final Drive Sun Gear
116	Differential and Final Drive Assembly
117	Thrust Bearing
118	Final Drive Internal Gear
119	Internal Gear to Case Fretting Ring

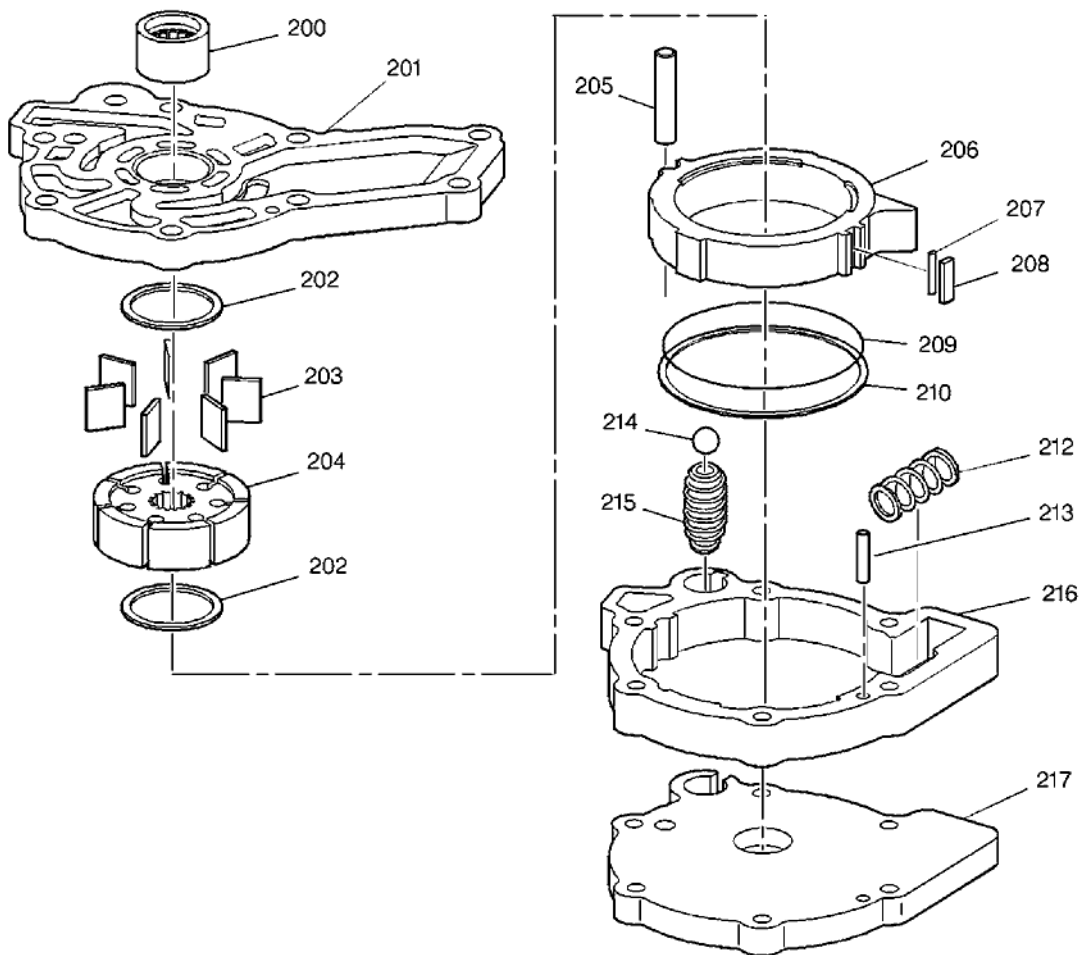


Fig. 9: Oil Pump Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 9

Callout	Component Name
200	Oil Pump Bearing and Seal Assembly
201	Oil Pump Base
202	Oil Pump Vane Ring
202	Oil Pump Vane Ring
203	Oil Pump Vane

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204	Oil Pump Rotor
205	Pivot Pin (Oil Pump Slide)
206	Oil Pump Slide
207	Oil Pump Slide Seal Support
208	Oil Pump Slide Seal
209	O-Ring Seal (Oil Pump Slide)
210	Fluid Seal Ring (Slide to Body)
212	Oil Pump Priming Spring
213	Locating Pin
214	Pressure Relief Ball
215	Pressure Relief Spring
216	Oil Pump Body
217	Pump Cover

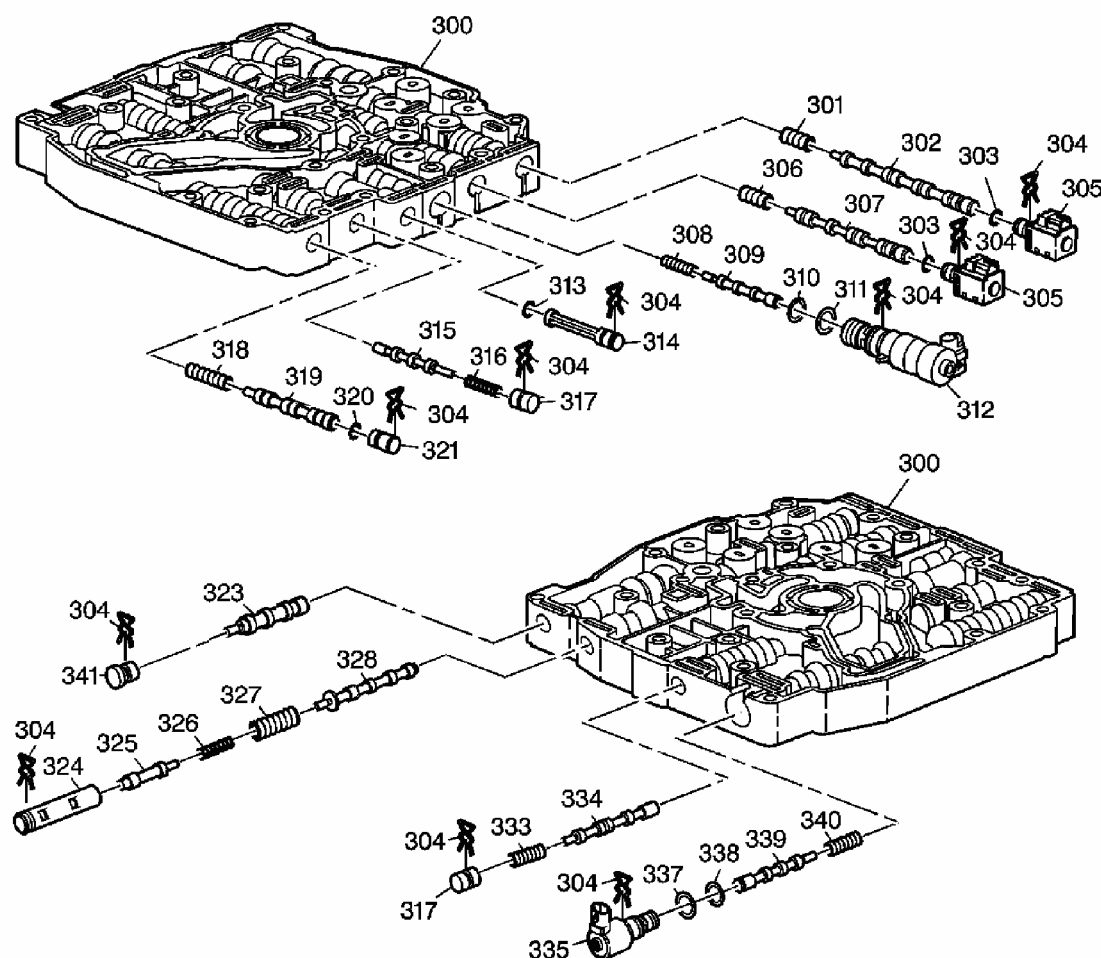


Fig. 10: Control Valve Body Assembly Disassembled View
 Courtesy of GENERAL MOTORS CORP.

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Callouts For Fig. 10

Callout	Component Name
300	Control Valve Body Assembly
300	Control Valve Body Assembly
301	1-2 Shift Valve Spring
302	1-2 Shift Valve
303	Shift Solenoid O-Ring (1-2 and 2-3)
303	Shift Solenoid O-Ring (1-2 and 2-3)
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
304	Retainer Clip
305	Shift Solenoid (1-2 and 2-3)
305	Shift Solenoid (1-2 and 2-3)
306	2-3 Shift Valve Spring
307	2-3 Shift Valve
308	Torque Signal Regulator Valve Spring
309	Torque Signal Regulator Valve
310	Pressure Control Solenoid O-Ring
311	Pressure Control Solenoid O-Ring
312	Pressure Control Solenoid
313	Actuator Oil Filter O-Ring
314	Actuator Oil Filter
315	Actuator Feed Limit Valve
316	Actuator Feed Limit Valve Spring
317	Bore Plug
318	3-4 Shift Valve Spring
319	3-4 Shift Valve
320	3-4 Shift Valve Plug O-Ring
321	Bore Plug
323	1-2/3-4 Accumulator Valve
324	Pressure Regulator Boost Valve Bushing

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325	Pressure Regulator Boost Valve
326	Isolator Spring
327	Pressure Regulator Valve Spring
328	Pressure Regulator Valve
333	TCC Control Valve Spring
334	TCC Control Valve
335	TCC Control PWM Solenoid
337	TCC Control Solenoid O-Ring
338	TCC Control Solenoid O-Ring
339	TCC Regulated Apply Valve
340	TCC Regulated Apply Valve Spring
341	Bore Plug

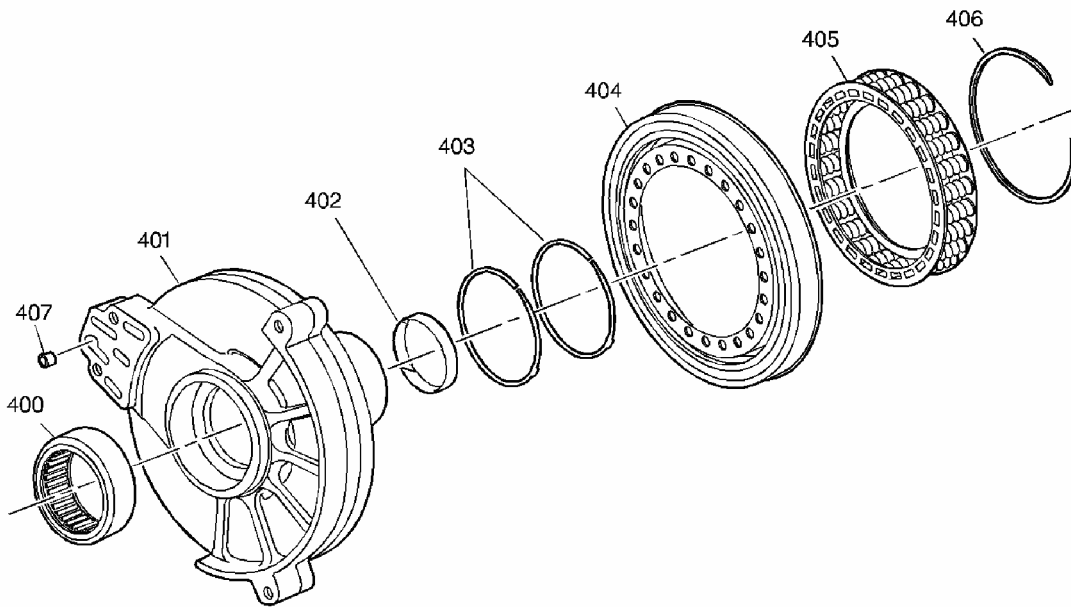


Fig. 11: Driven Sprocket Support Assembly and 2nd Clutch Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 11

Callout	Component Name
400	Driven Sprocket Support Bearing
401	Driven Sprocket Support
402	Driven Sprocket Support Bushing
403	Oil Seal Ring
404	2nd Clutch Piston Assembly
405	2nd Clutch Spring Assembly

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406	2nd Clutch Spring Retaining Ring
407	Reverse Intermediate Clutch Housing Valve Assembly

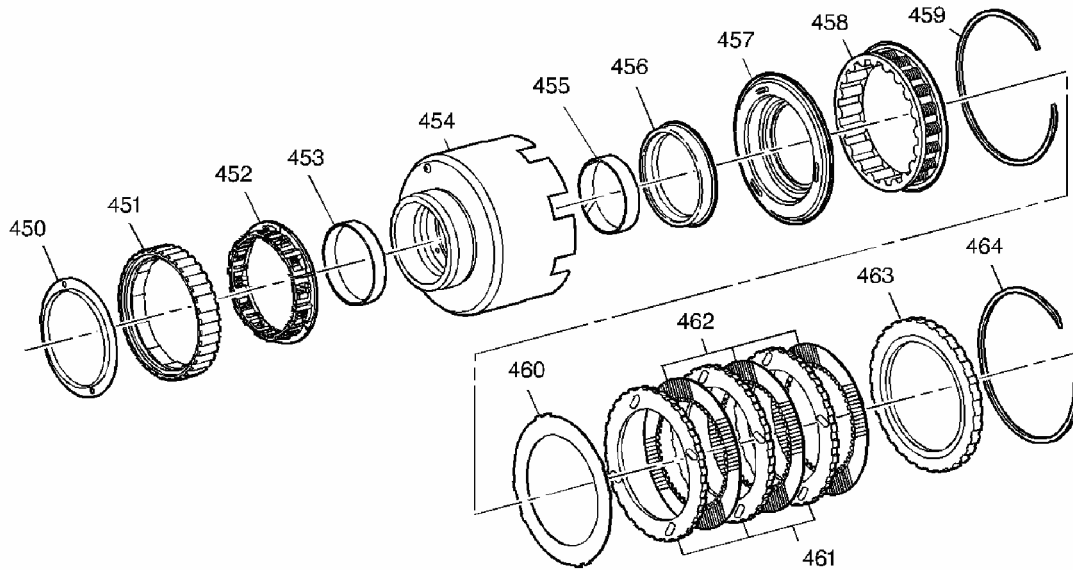


Fig. 12: Reverse Input Clutch Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 12

Callout	Component Name
450	2nd Roller Clutch Retainer
451	2nd Roller Clutch Cam
452	2nd Roller Clutch Assembly
453	Reverse Clutch Bushing
454	Reverse Clutch Housing
455	Reverse Clutch Bushing
456	Reverse Clutch Center Retainer and Seal Assembly
457	Reverse Clutch Piston Assembly
458	Reverse Clutch Spring and Retainer Assembly
459	Snap Ring (Reverse Clutch Spring Retainer)
460	Reverse Clutch Plate (Waved)
461	Reverse Clutch Plate (Steel)
462	Reverse Clutch Plate (Fiber)
463	Reverse Clutch Backing Plate
464	Snap Ring (Reverse Clutch)

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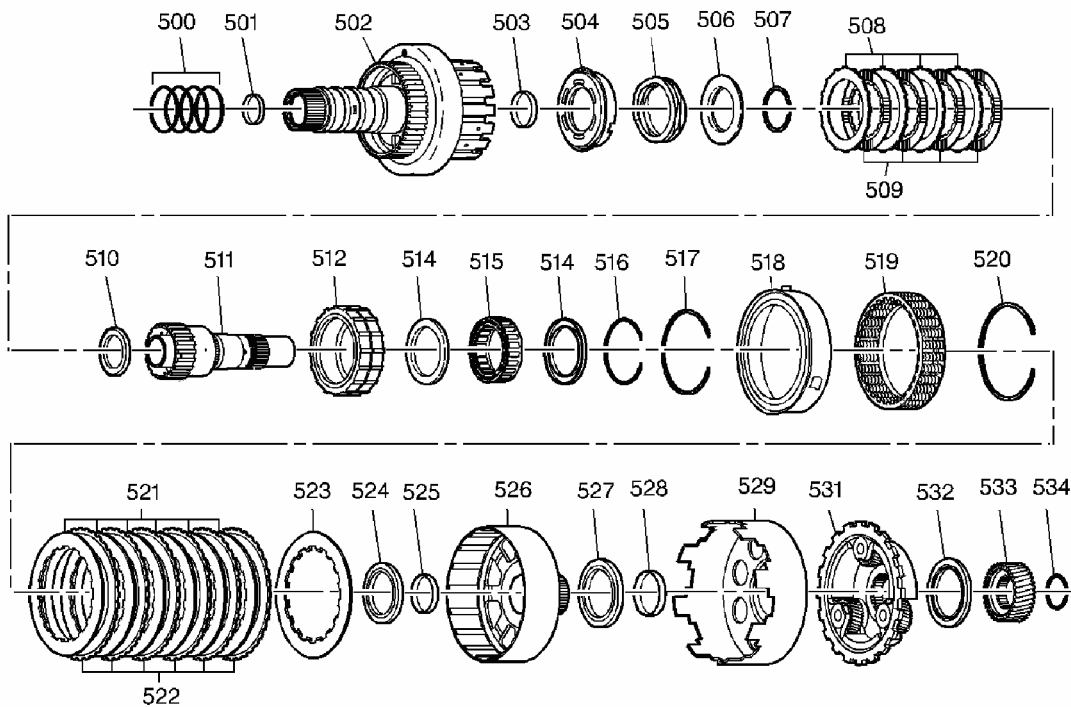


Fig. 13: Direct and Coast Clutch Assemblies Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 13

Callout	Component Name
500	Input Shaft Oil Seal Ring
501	Input Shaft Bushing
502	Direct and Coast Clutch and Input Shaft Housing
503	Direct Clutch Housing to Output Shaft Bushing
504	Coast Clutch Piston Assembly
505	Coast Clutch Release Spring
506	Coast Clutch Spring Retainer
507	Snap Ring (Coast Clutch Spring Retainer)
508	Coast Clutch Plate (Steel)
509	Coast Clutch Plate (Fiber)
510	Thrust Bearing
511	Input Sun Gear Shaft and Inner Race Assembly
512	Outer Race (Input Sprag)
514	Sprag Clutch End Bearings (2)
514	Sprag Clutch End Bearings (2)
515	Input Sprag Assembly
516	Snap Ring (Outer Race to Sprag Assembly)

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517	Snap Ring (Direct/Coast Clutch Retaining)
518	Direct Clutch Piston Assembly
519	Direct Clutch Spring and Retainer Assembly
520	Direct Clutch Spring Retainer Ring
521	Direct Clutch Plate (Steel)
522	Direct Clutch Plate (Fiber)
523	Direct Clutch Plate (Backing)
524	Thrust Bearing
525	Reaction Carrier Shaft Bushing
526	Reaction Carrier Shaft Shell
527	Thrust Bearing (Carrier Shaft to Shell)
528	Reaction Sun Gear Bushing
529	Reaction Sun Shell
531	Reaction Carrier Assembly
532	Thrust Bearing (Reaction Carrier to Sun Gear)
533	Input Sun Gear
534	Snap Ring

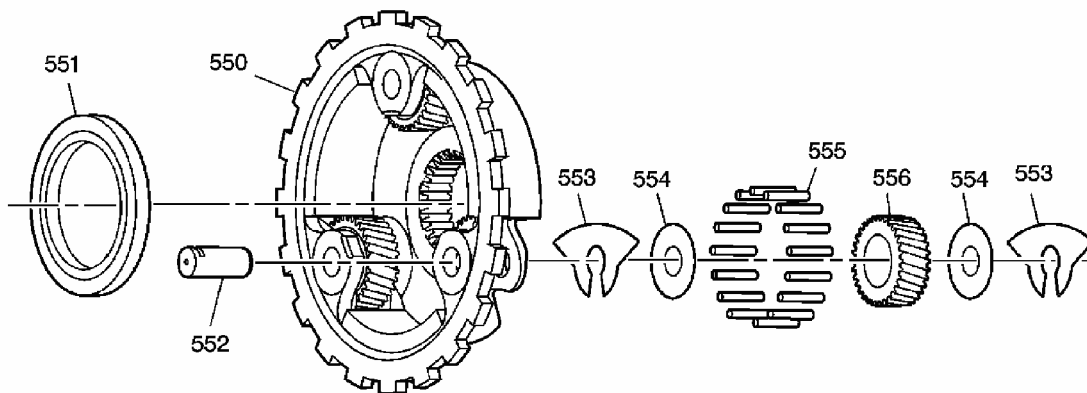


Fig. 14: Reaction Carrier Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 14

Callout	Component Name
550	Reaction Carrier
551	Thrust Bearing
552	Planetary Pinion Gear Pin
553	Pinion Thrust Reaction Washer
553	Pinion Thrust Reaction Washer
554	Pinion Thrust Inner Washer

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554	Pinion Thrust Inner Washer
555	Roller Needle Bearing
556	Reaction Planetary Pinion Gear

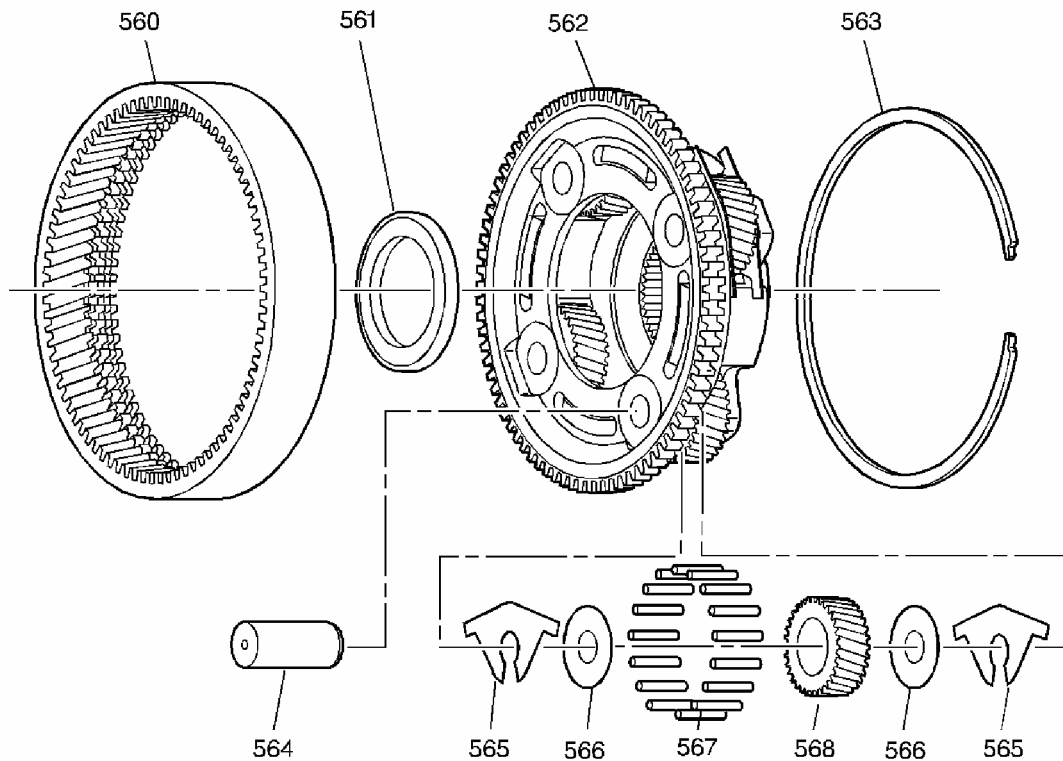


Fig. 15: Input Carrier Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 15

Callout	Component Name
560	Internal Gear (Input and Reaction)
561	Thrust Bearing
562	Input Carrier
563	Snap Ring (Input Carrier to Internal Gear)
564	Planetary Pinion Gear Pin
565	Pinion Thrust Input Washer
565	Pinion Thrust Input Washer
566	Pinion Thrust Inner Washer
566	Pinion Thrust Inner Washer
567	Roller Needle Bearing
568	Input Planetary Pinion Gear

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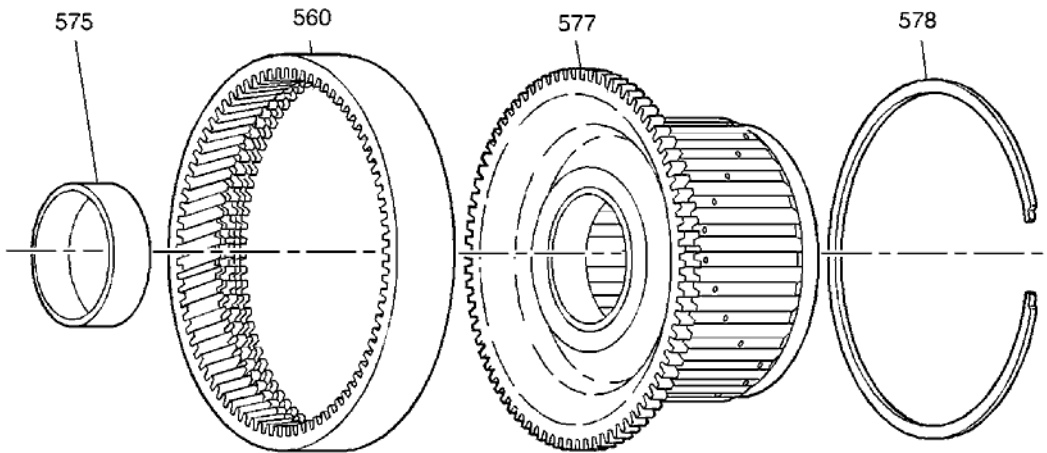


Fig. 16: Input Internal Gear and Forward Clutch Hub Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 16

Callout	Component Name
560	Internal Gear (Input and Reaction)
575	Input Flange Bushing
577	Input Flange and Forward Clutch Hub
578	Snap Ring (Input Internal Gear to Input Flange)

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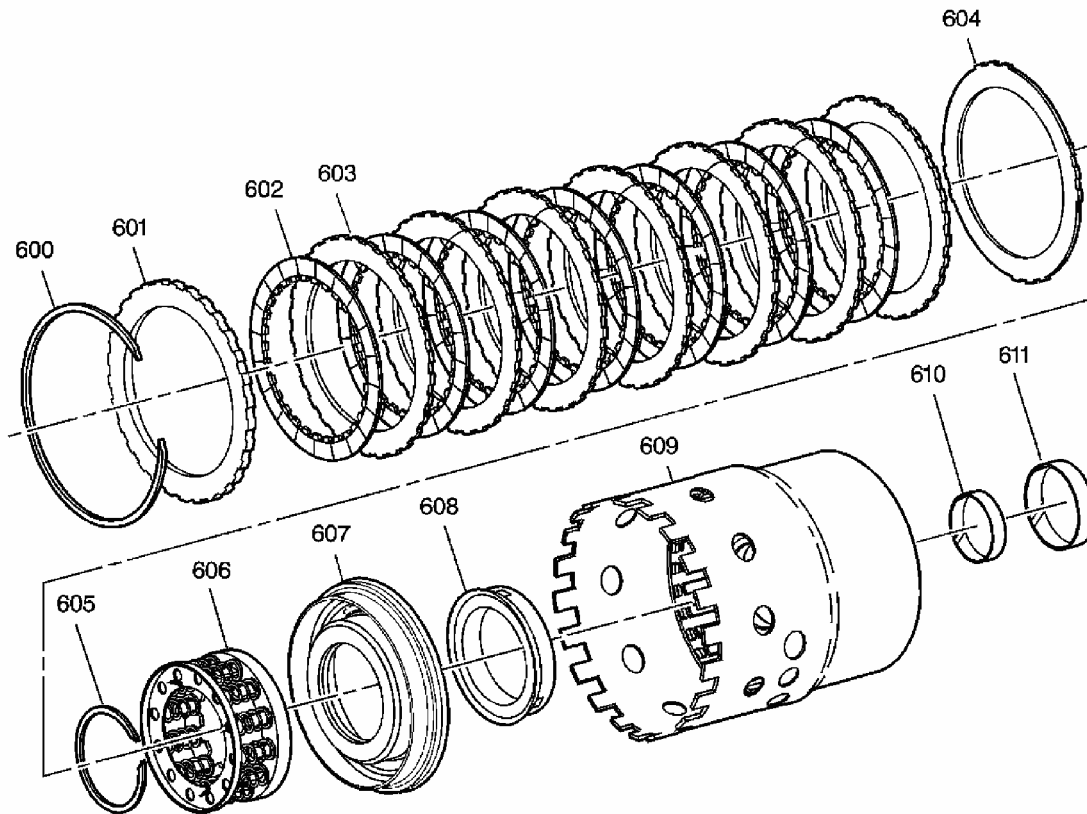


Fig. 17: Forward Clutch Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 17

Callout	Component Name
600	Snap Ring (Forward Clutch)
601	Forward Clutch Plate (Backing)
602	Forward Clutch Plate (Fiber)
603	Forward Clutch Plate (Steel)
604	Forward Clutch Plate (Waved)
605	Snap Ring (Forward Clutch Spring Assembly)
606	Forward Clutch Return Spring Assembly
607	Forward Clutch Piston Assembly
608	Forward Clutch Inner Seal and Sleeve Assembly
609	Forward Clutch Housing
610	Forward Clutch Support Bushing
611	Forward Clutch Support Bushing

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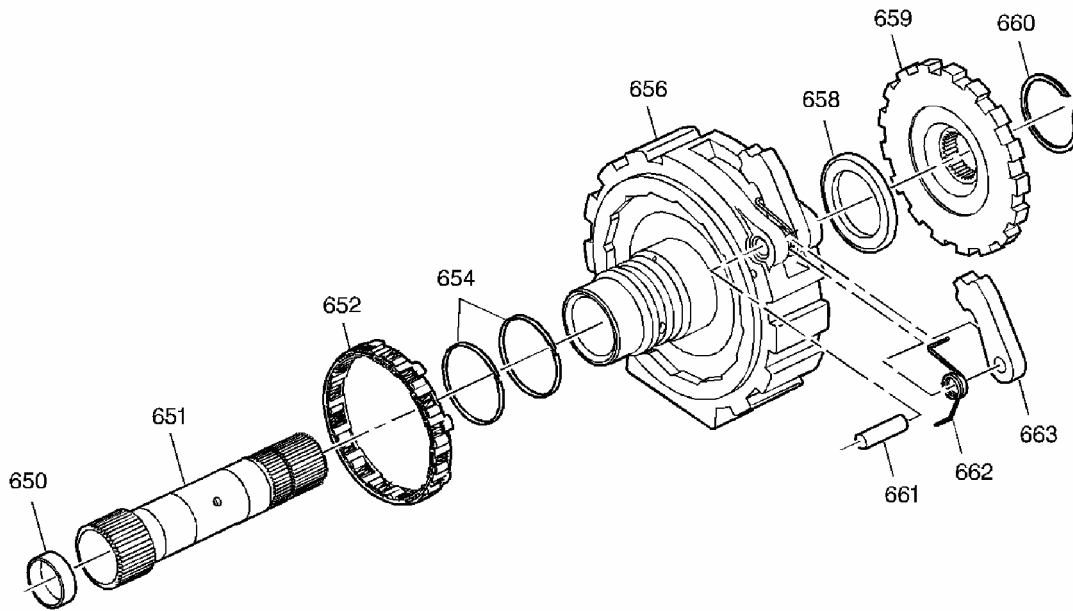


Fig. 18: Forward Clutch Support Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 18

Callout	Component Name
650	Final Drive Sun Shaft Bushing
651	Final Drive Sun Shaft
652	Lo Roller Clutch Assembly
654	Oil Seal Ring (Forward Clutch Support)
656	Forward Clutch Support
658	Thrust Bearing (Forward Support to Park Gear)
659	Park Lock Gear
660	Snap Ring (Final Drive Sun Shaft)
661	Parking Lock Pawl Shaft
662	Parking Lock Pawl Return Spring
663	Parking Lock Pawl

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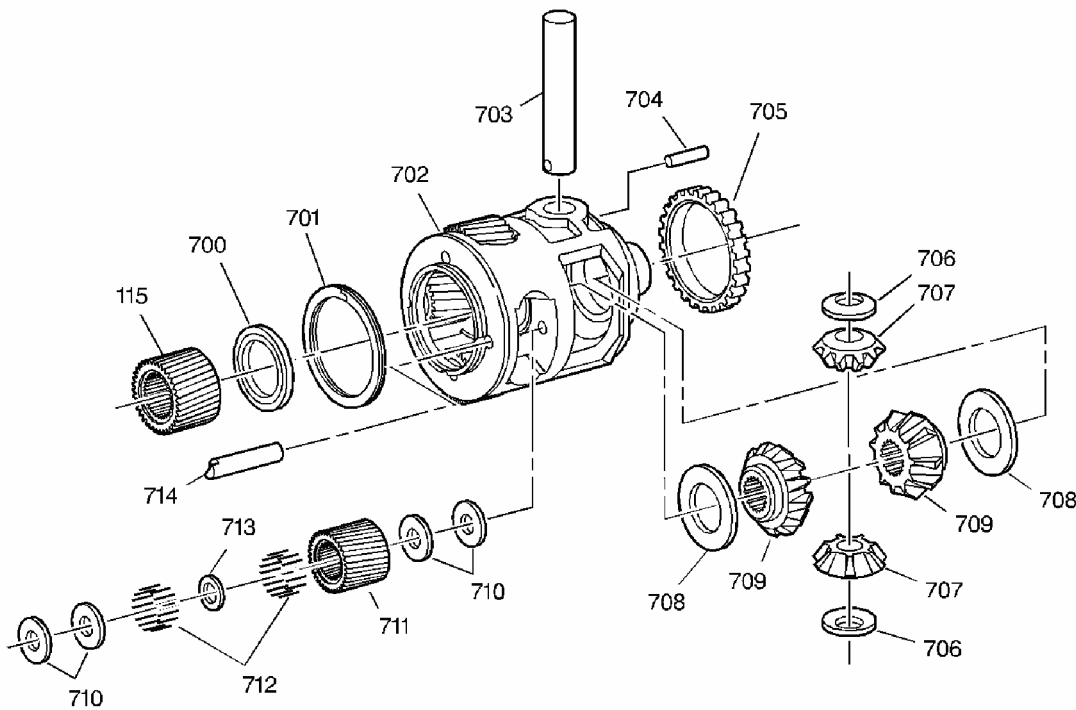


Fig. 19: Final Drive and Differential Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 19

Callout	Component Name
115	Sun Gear (Final Drive)
700	Thrust Bearing
701	Spiral Pin Retaining Ring
702	Differential and Final Drive Carrier
703	Differential Pinion Shaft
704	Differential Pinion Shaft Retaining Pin
705	Speed Sensor Rotor
706	Thrust Washer (Differential Pinion)
706	Thrust Washer (Differential Pinion)
707	Differential Pinion Gear
707	Differential Pinion Gear
708	Thrust Washer (Differential Side Gear)
708	Thrust Washer (Differential Side Gear)
709	Differential Side Gear
709	Differential Side Gear
710	Pinion Thrust Washer

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710	Pinion Thrust Washer
711	Pinion Gear (Final Drive Planetary)
712	Roller Needle Bearing
713	Pinion Needle Bearing Spacer
714	Planetary Pinion Gear Pin

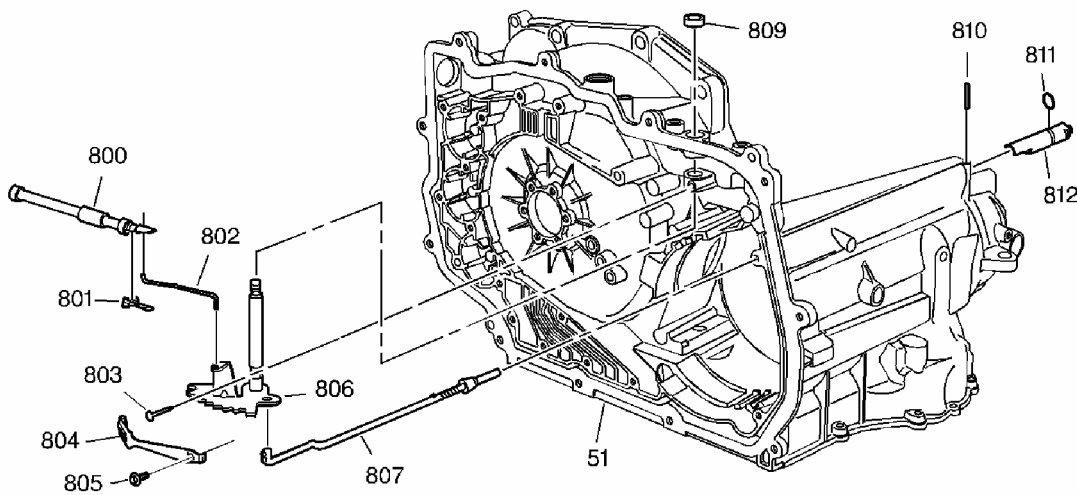


Fig. 20: Manual Shaft, Parking Pawl and Actuator Assembly Disassembled View
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 20

Callout	Component Name
51	Transaxle Case
800	Manual Valve
801	Manual Valve to Link Clip
802	Manual Valve to Detent Lever Link
803	Manual Shaft to Case Pin
804	Manual Detent Spring and Roller Assembly
805	Spring and Roller Assembly to Channel Plate Bolt
806	Manual Shaft and Detent Lever Assembly
807	Parking Lock Actuator Assembly
809	Manual Shaft to Case Seal
810	Actuator Guide Spring Pin
811	Actuator Guide Seal
812	Actuator Guide

COMPONENT LOCATION

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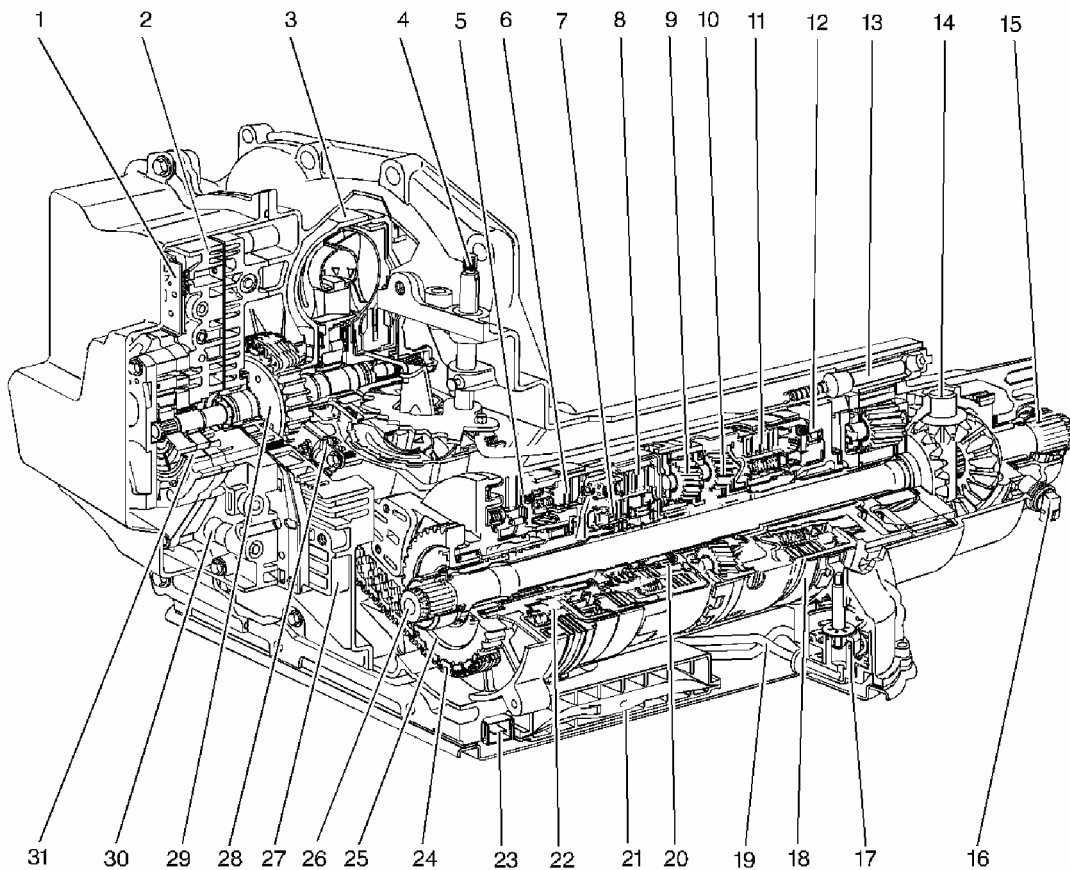


Fig. 21: Transmission Major Components Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 21

Callout	Component Name
1	TFP Manual Valve Position Switch Assembly
2	Control Valve Body Assembly
3	Torque Converter Assembly
4	Manual Shaft and Detent Lever Assembly
5	2nd Clutch
6	Reverse Clutch
7	Coast Clutch
8	Direct Clutch
9	Reaction Planetary Gear Set
10	Input Planetary Gear Set
11	Forward Clutch
12	Lo Roller Clutch
13	Parking Lock Actuator Assembly
14	
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14	Differential and Final Drive Assembly
15	Output Stub Shaft
16	Output Speed Sensor
17	Lo/Reverse Servo Assembly
18	Lo/Reverse Band
19	Oil Feed Tube Assembly
20	Input Sprag Clutch Assembly
21	Oil Filter Assembly
22	2nd Roller Clutch
23	Oil Level Control Valve
24	Drive Link Assembly
25	Driven Sprocket
26	Output Shaft
27	Channel Plate Assembly
28	Input Speed Sensor
29	Drive Sprocket
30	Control Valve Body Assembly
31	Oil Pump Assembly

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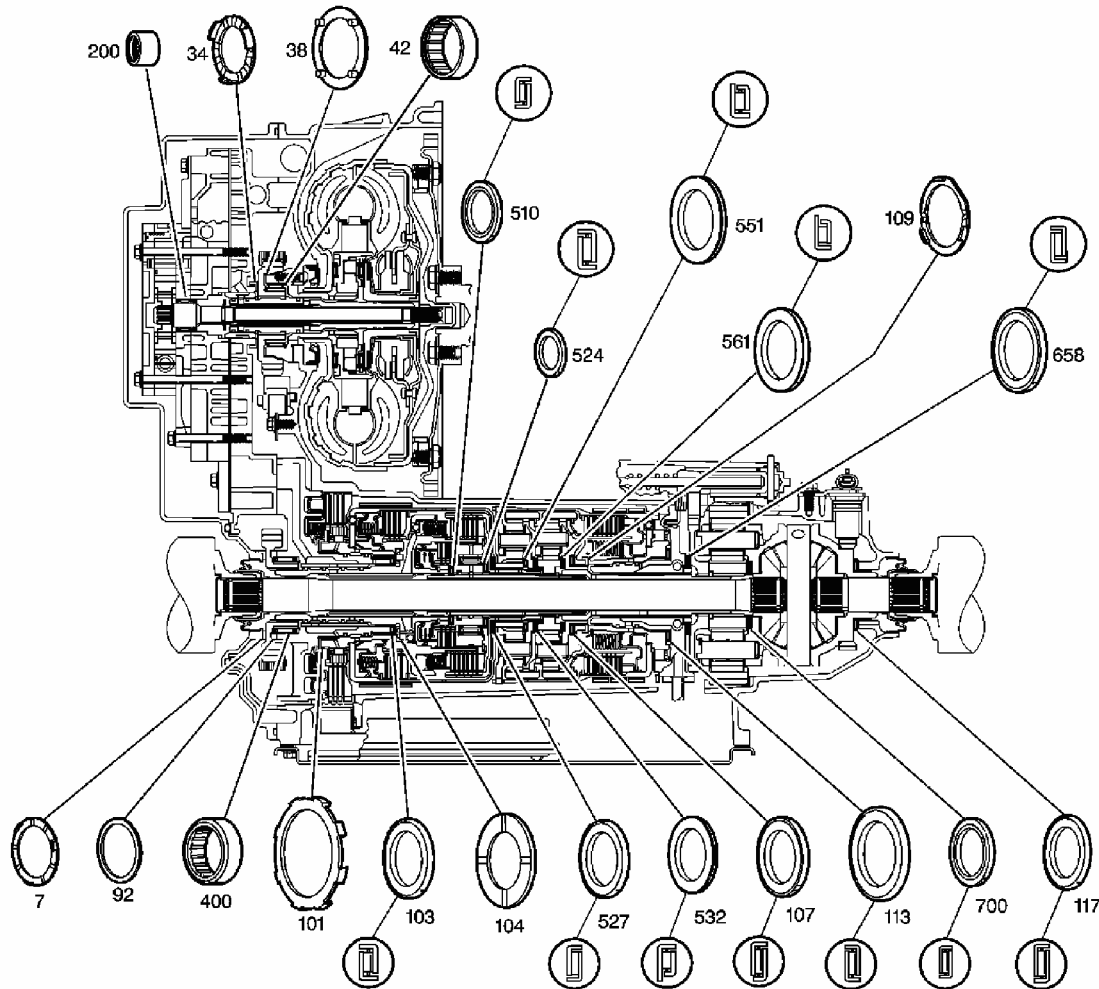


Fig. 22: Bushings, Bearings and Washers Location
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 22

Callout	Component Name
7	Thrust Washer (Side Cover to Driven Sprocket)
34	Thrust Washer (Channel Plate to Drive Sprocket)
38	Thrust Washer (Drive Sprocket to Support)
42	Drive Sprocket Support Bearing
92	Thrust Washer (Driven Sprocket to Support)
101	Thrust Washer (Support to Reverse Input Clutch)
103	Thrust Bearing
104	Selective Thrust Washer
107	Thrust Bearing
109	Thrust Washer
113	Thrust Bearing

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117	Thrust Bearing
200	Oil Pump Bearing and Seal Assembly
400	Driven Sprocket Support Bearing
510	Thrust Bearing
524	Thrust Bearing
527	Thrust Bearing (Carrier Shaft to Shell)
532	Thrust Bearing (Reaction Carrier to Sun Gear)
551	Thrust Bearing
561	Thrust Bearing
658	Thrust Bearing (Forward Support to Park Gear)
700	Thrust Bearing

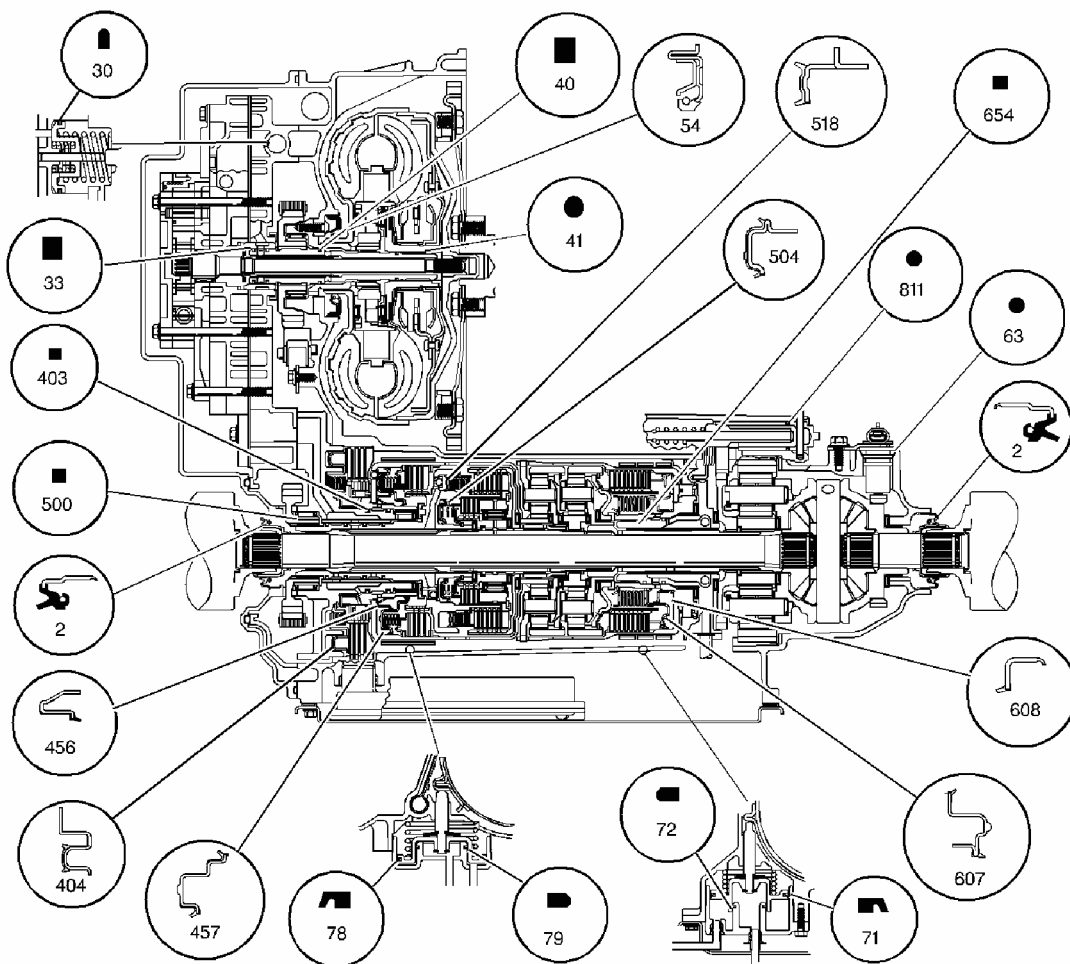


Fig. 23: Seals Location
 Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 23

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Callout	Component Name
2	Axle Oil Seal
2	Axle Oil Seal
30	Accumulator Piston Seal (1-2, 2-3 and 3-4)
33	Seal (Turbine Shaft to Channel Plate Sleeve)
40	O-Ring Seal (Turbine Shaft to Support)
41	O-Ring Seal (Torque Converter)
54	Converter Seal
63	O-Ring Seal (Output Speed Sensor)
71	Servo Piston Seal (Lo/Reverse)
72	Servo Cover Seal (Lo/Reverse)
78	Servo Piston Seal (Intermediate/4th)
79	Servo Cover Seal (Intermediate/4th)
403	Oil Seal Ring
404	2nd Clutch Piston Assembly
456	Reverse Clutch Center Retainer and Seal Assembly
457	Reverse Clutch Piston Assembly
500	Oil Seal Ring- Input Shaft
504	Coast Clutch Piston Assembly
518	Direct Clutch Piston Assembly
607	Forward Clutch Piston Assembly
608	Forward Clutch Inner Seal and Sleeve Assembly
654	Oil Seal Ring (Forward Clutch Support)
811	Actuator Guide Seal

AUTOMATIC TRANSMISSION INLINE 20-WAY CONNECTOR END VIEW

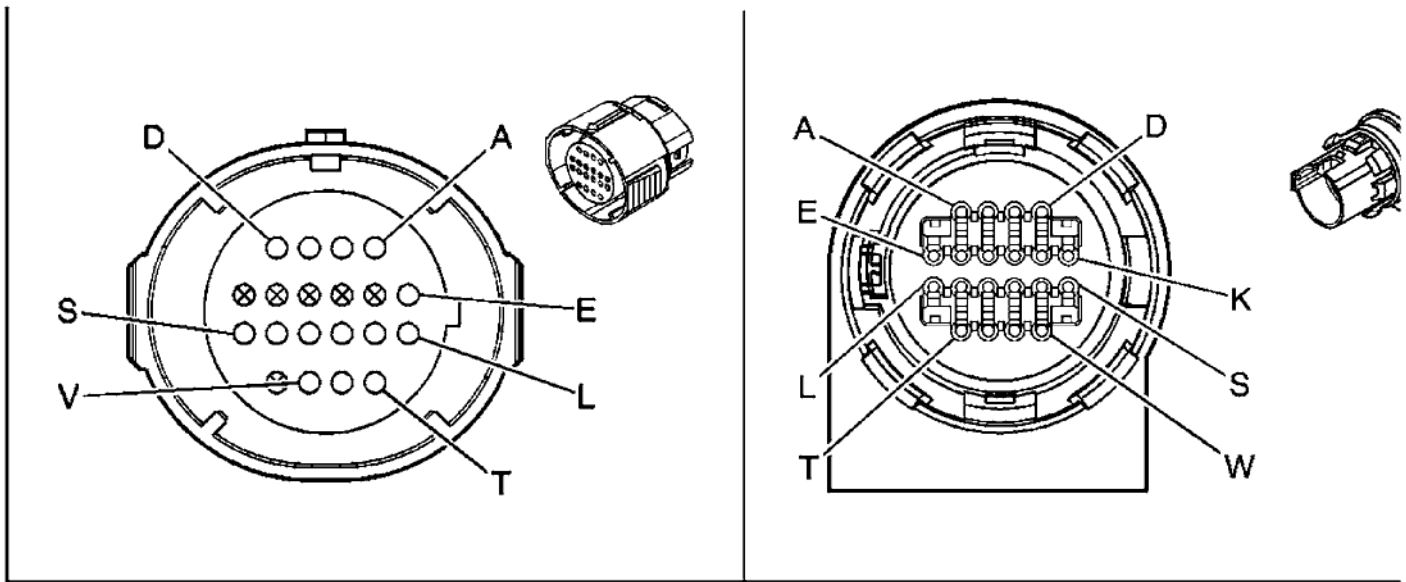
C100 Engine Side to Transmission Side

Automatic Transmission Inline 20-Way Connector End View

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Automatic Transmission Inline 20-Way Connector End View

Connector Part Information

- OEM: 12160493
- Service:
- Description: 20-Way F Micro-Pack 100 Series (GY)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Connector Part Information

- OEM: 12160782
- Service:
- Description: 20-Way M Micro-Pack 100 Series (GY)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

C100 Engine Side to Transmission Side

Pin	Wire Color	Circuit No.	Function	Pin	Wire Color	Circuit No.	Function
A	L-GN	1222	1-2 Shift Solenoid Valve Control	A	L-GN	1222	1-2 Shift Solenoid Valve Control
B	YE/BK	1223	2-3 Shift Solenoid Valve Control	B	YE	1223	2-3 Shift Solenoid Valve Control
C	OG/BK	1228	Pressure Control (PC) Solenoid Valve High Control	C	PU	1228	PC Solenoid Valve High Control
	L-		PC Solenoid				PC Solenoid

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D	BU/WH	1229	Valve Low Control	D	L-BU	1229	Valve Low Control
E	PK	1039	Ignition 1 Voltage	E	RD	839	Ignition 1 Voltage
F-K	-	-	Not Used	F-K	-	-	Not Used
L	YE/BK	1227	Transmission Fluid Temperature (TFT) Sensor Signal	L	BN	1227	TFT Sensor Signal
M	TN	2762	Low Reference	M	GY	452	Low Reference
N	-	-	Not Used	N	-	-	Not Used
P	OG	1226	TFP Switch Signal C	P	OG	1226	TFP Switch Signal C
R	D-BU	1225	TFP Switch Signal B	R	D-BU	1225	TFP Switch Signal B
S	OG/BK	1230	Input Speed Sensor (ISS) High Signal	S	BK	1230	ISS High Signal
T	TN/BK	422	Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid Valve Control	T	TN	418	TCC PWM Solenoid Valve Control
U	YE	657	TCC Release Switch Signal	U	WH	1804	TCC Release Switch Signal
V	D-BU/WH	1231	ISS Low Signal	V	D-GN	1231	ISS Low Signal
W	-	-	Not Used	W	-	-	Not Used

AUTOMATIC TRANSMISSION INTERNAL CONNECTOR END VIEWS

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

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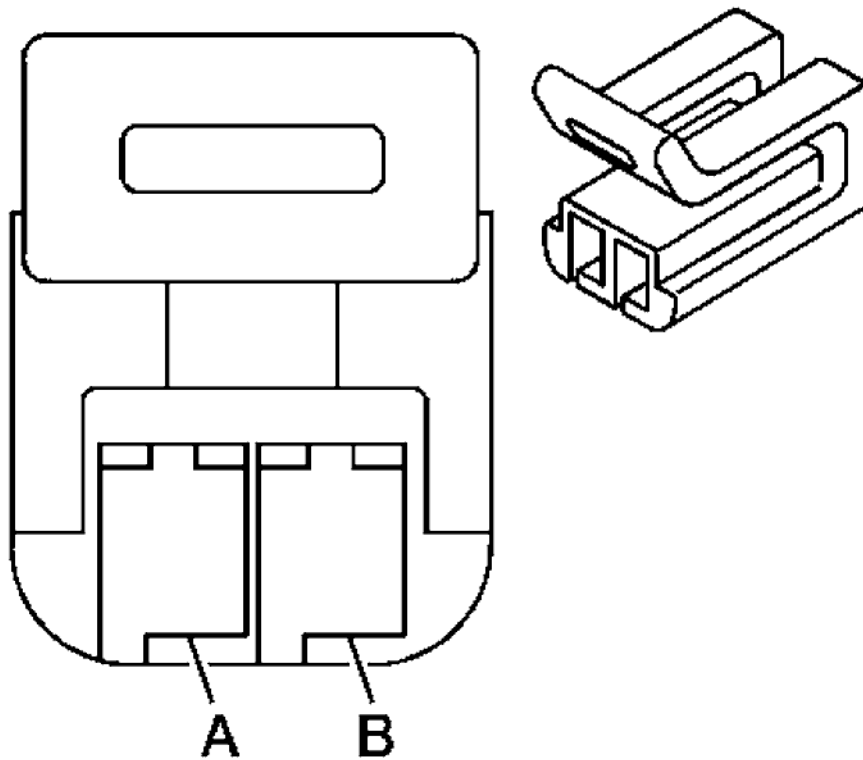


Fig. 24: 1-2 Shift Solenoid (SS) Valve, Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Internal Connector End Views

Connector Part Information

- OEM: 12162201
- Service:
- Description: 2-Way F M/P 150.2 Series P2S (NA)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

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

Pin	Wire Color	Circuit No.	Function

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A	RD	839	Ignition 1 Voltage
B	L-GN	1222	1-2 Shift Solenoid Valve Control

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

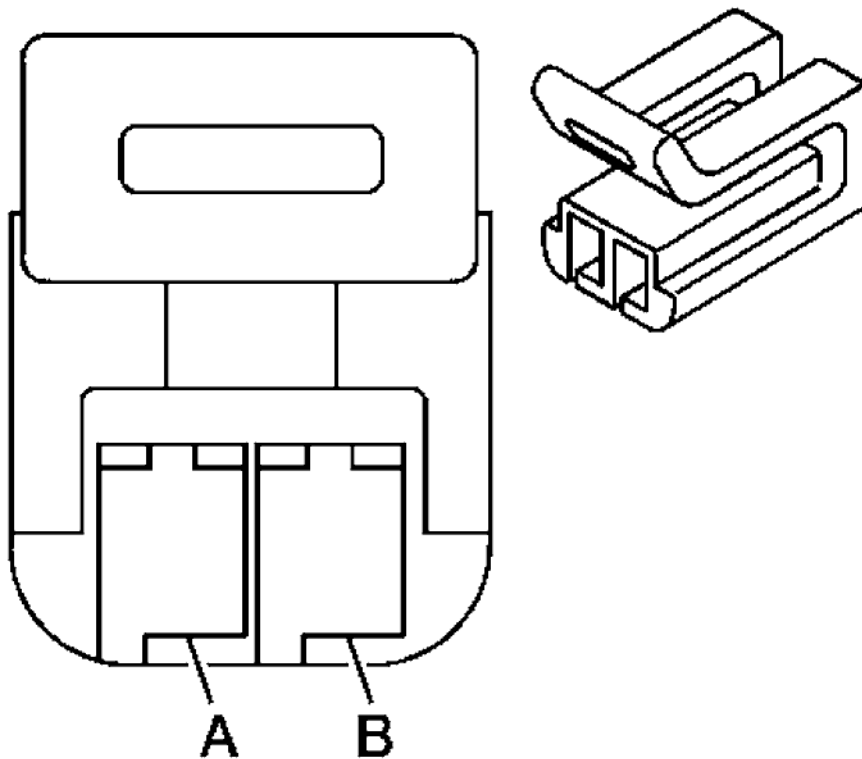


Fig. 25: 2-3 Shift Solenoid (SS) Valve, Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Internal Connector End Views

Connector Part Information

- OEM: 12162201
- Service:
- Description: 2-Way F M/P 150.2 Series P2S (NA)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:

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- Release Tool/Test Probe:

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

Pin	Wire Color	Circuit No.	Function
A	RD	839	Ignition 1 Voltage
B	YE	1223	2-3 Shift Solenoid Valve Control

Automatic Transmission Fluid Pressure Manual Valve Position Switch, Wiring Harness Side

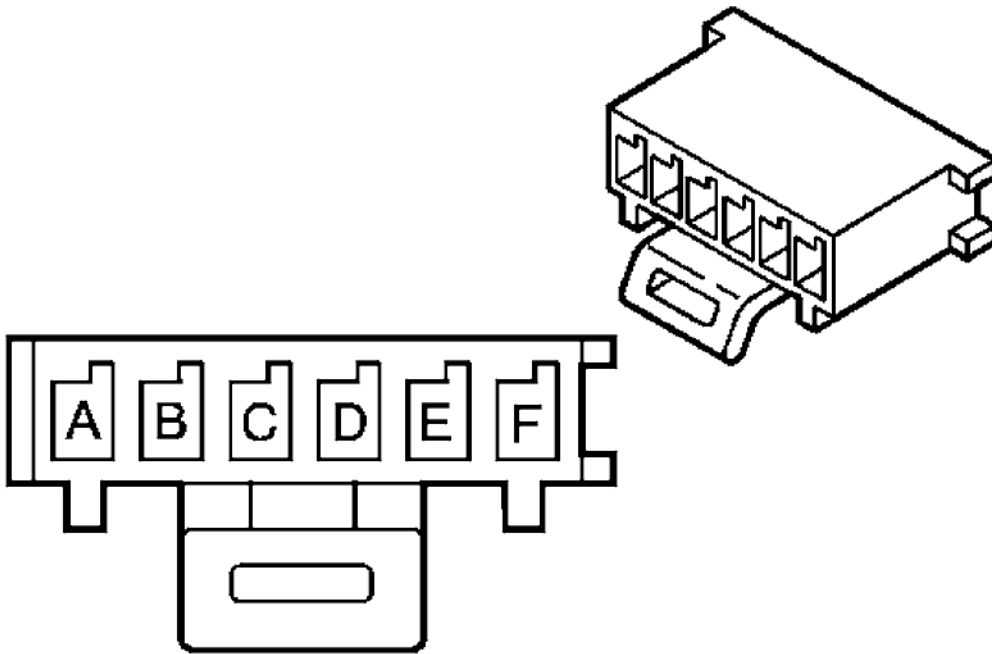


Fig. 26: A/T Fluid Pressure Manual Valve Position Switch, Wiring Harness Side Connector

Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Internal Connector End Views

Connector Part Information

- OEM: 12146095
- Service:
- Description: 6-Way F Metri-Pack 150.2 Series P2S (NA)

Terminal Part Information

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- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Automatic Transmission Fluid Pressure Manual Valve Position Switch, Wiring Harness Side

Pin	Wire Color	Circuit No.	Function
A	-	-	Not Used
B	D-BU	1225	TFP Switch Signal B
C	OG	1226	TFP Switch Signal C
D	WH	1804	Torque Converter Clutch Release Switch Signal
E	BN	1227	Transmission Fluid Temperature (TFT) Sensor Signal
F	GY	452	Low Reference

Input Speed Sensor, Wiring Harness Side

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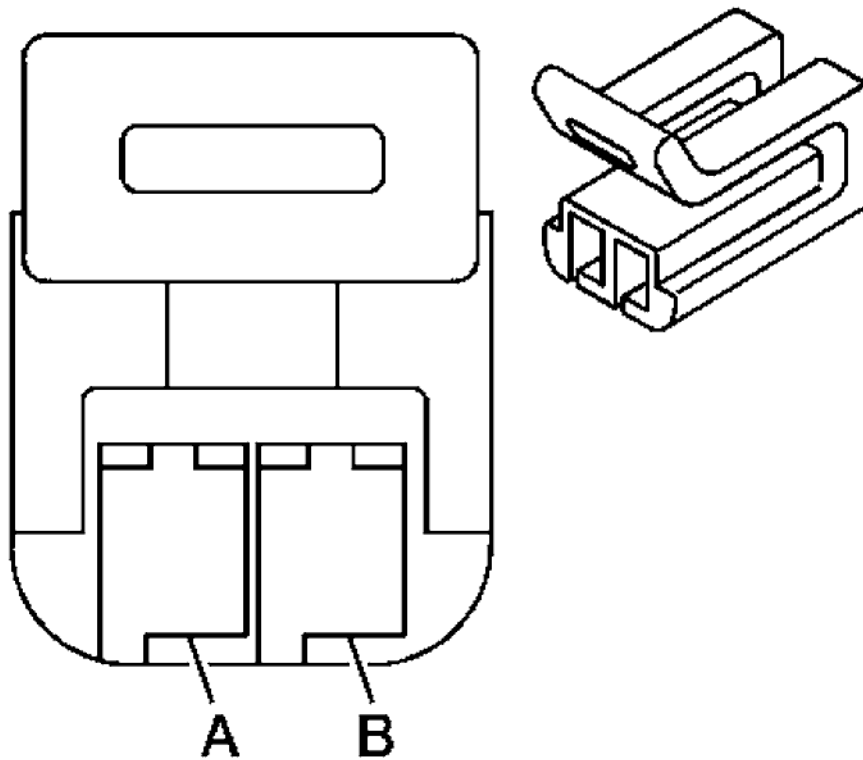


Fig. 27: Input Speed Sensor, Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Internal Connector End Views

Connector Part Information

- OEM: 12162201
- Service:
- Description: 2-Way F Metri-Pack 150.2 Series P2S (NA)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Input Speed Sensor, Wiring Harness Side

Pin	Wire Color	Circuit No.	Function

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A	BK	1230	Input Speed Sensor (ISS) High Signal
B	D-GN	1231	ISS Low Signal

Pressure Control Solenoid Valve, Wiring Harness Side

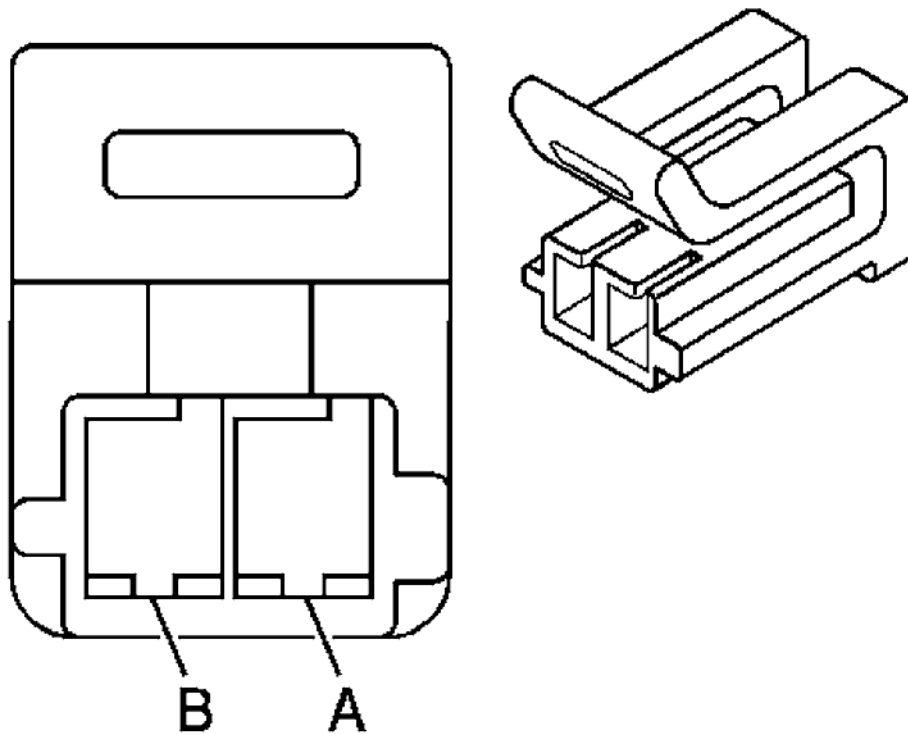


Fig. 28: Pressure Control Solenoid Valve, Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Internal Connector End Views

Connector Part Information

- OEM: 12146094
- Service:
- Description: 2-Way F Metri-Pack 150.2 Series P2S (GY)

Terminal Part Information

- Terminal/Tray:

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- Core/Insulation Crimp:
- Release Tool/Test Probe:

Pressure Control Solenoid Valve, Wiring Harness Side

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 Pulse Width Modulated (TCC PWM) Solenoid Valve, Wiring Harness Side

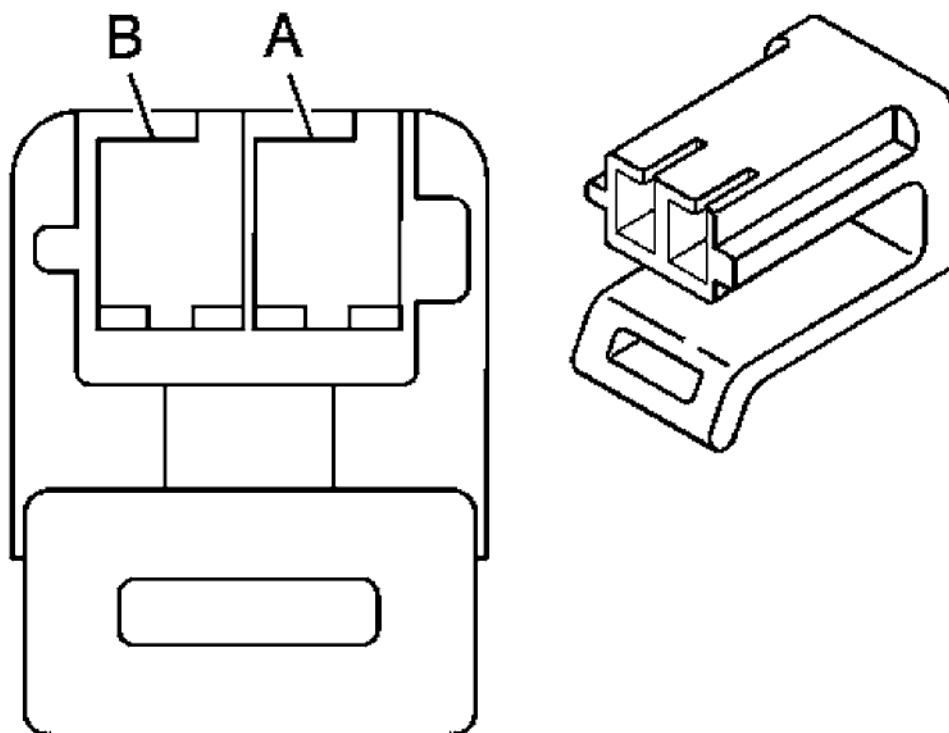


Fig. 29: TCC PWM Solenoid Valve, Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Internal Connector End Views

Connector Part Information

- OEM: 12162202

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- Service:
- Description: 2-Way F M/P 150.2 Series P2S (BU)

Terminal Part Information

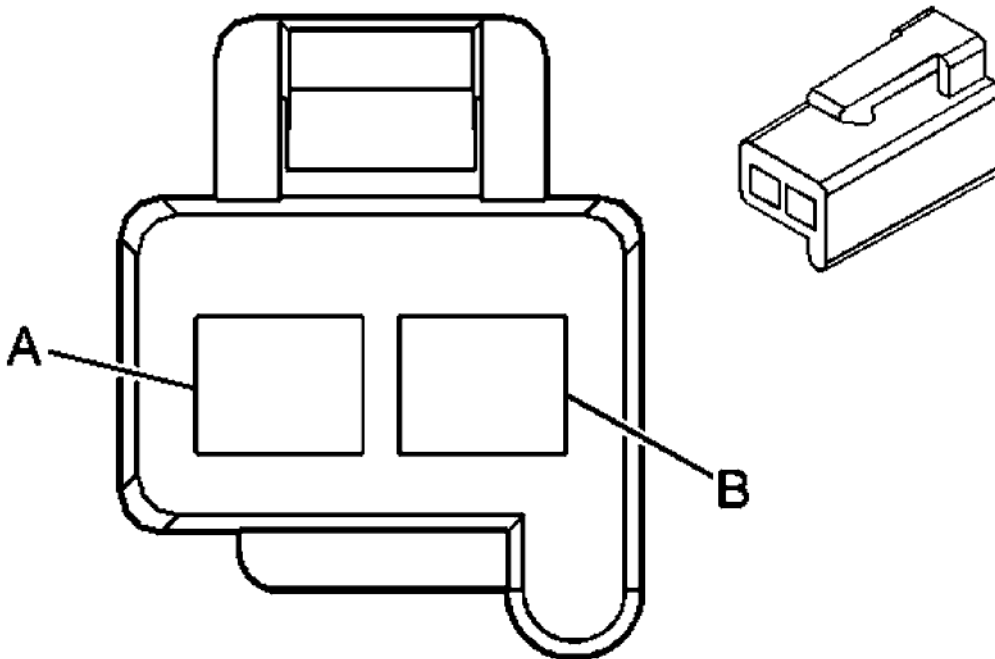
- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

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

Pin	Wire Color	Circuit No.	Function
A	RD	839	Ignition 1 Voltage
B	TN	418	Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid Valve Control

AUTOMATIC TRANSMISSION RELATED CONNECTOR END VIEWS

Cruise Control Brake Switch, Wiring Harness Side



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Fig. 30: Cruise Control Brake Switch, Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Related Connector End Views

Connector Part Information

- OEM: 12041433
- Service:
- Description: 2-Way F M/P 280 Series (BK)

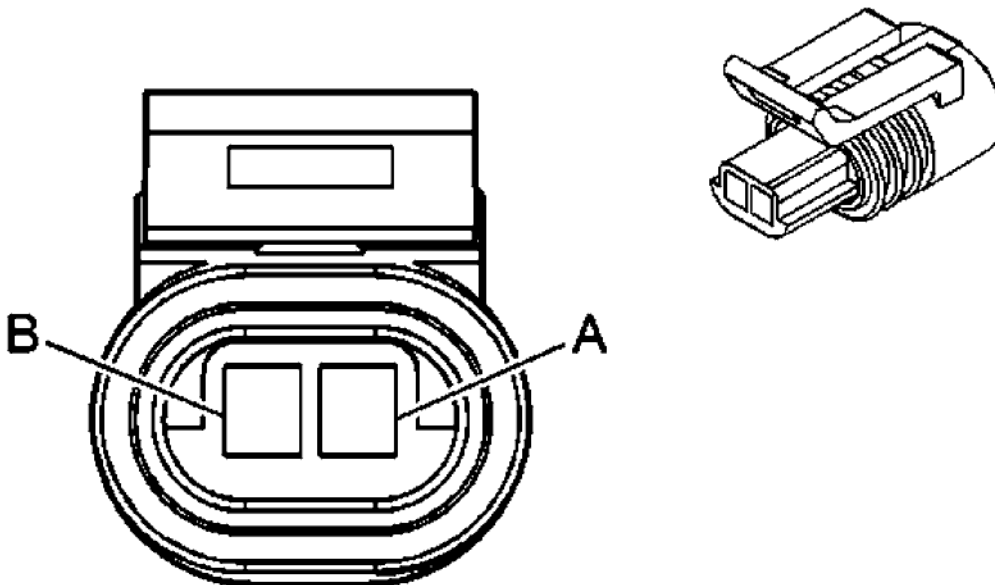
Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Cruise Control Brake Switch, Wiring Harness Side

Pin	Wire Color	Circuit No.	Function
A	BN	341	Ignition 3 Voltage
B	PU	420	TCC Brake Switch Signal

Output Speed Sensor (OSS), Wiring Harness Side



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Fig. 31: Output Speed Sensor (OSS), Wiring Harness Side Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Related Connector End Views

Connector Part Information

- OEM: 12162195
- Service:
- Description: 2-Way F M/P 150.2 Series P2S (BK)

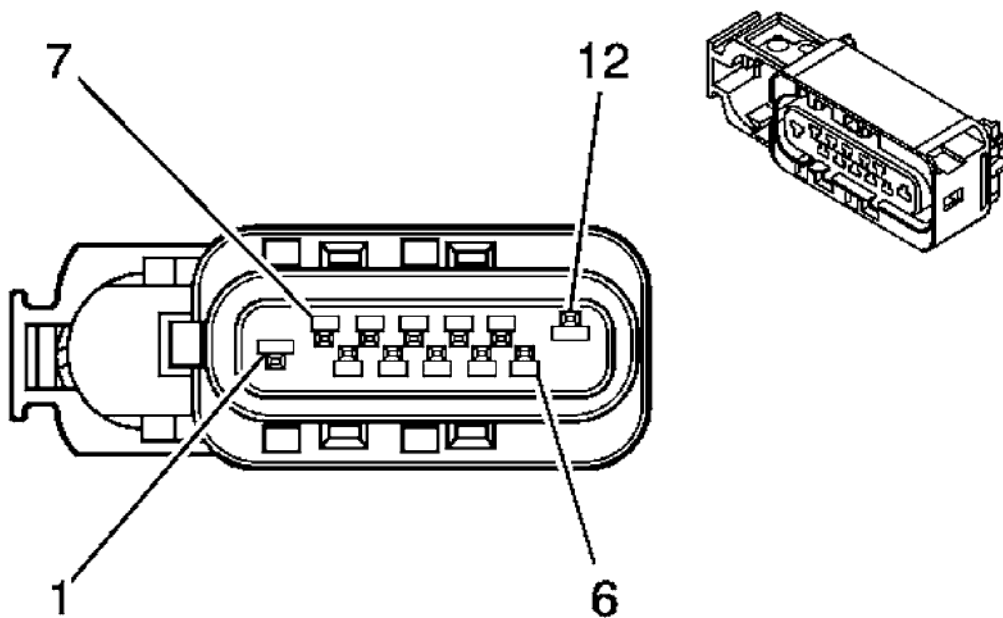
Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Output Speed Sensor (OSS), Wiring Harness Side

Pin	Wire Color	Circuit No.	Function
A	PU	401	OSS Low Signal
B	YE	400	OSS High Signal

Park/Neutral Position Switch



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Fig. 32: Park/Neutral Position Switch Connector
Courtesy of GENERAL MOTORS CORP.

Automatic Transmission Related Connector End Views

Connector Part Information

- OEM: 15416724
- Service:
- Description: 12-Way F Sealed (L-GY)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:
- Release Tool/Test Probe:

Park/Neutral Position Switch

Pin	Wire Color	Circuit No.	Function
1	YE	575	Starter Control
2	WH	776	Transmission Range Switch Signal P
3	-	-	Not Used
4	L-GN	24	Backup Lamp Supply Voltage
5	PK	539	Ignition 1 Voltage
6-7	-	-	Not Used
8	YE	772	Transmission Range Signal B
9	BK/WH	771	Transmission Range Signal A
10	GY	773	Transmission Range Signal C
11	BK/WH	451	Ground
12	PK	539	Ignition 1 Voltage

Transmission Control Module (TCM), Engine Side

Automatic Transmission Related Connector End Views

Connector Part Information

- OEM: 15463921
- Service:
- Description: 49-Way F Micro-64 GT 280 Series Sealed (BK)

Terminal Part Information

- Terminal/Tray:
- Core/Insulation Crimp:

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- Release Tool/Test Probe:

Transmission Control Module (TCM), Engine Side

Pin	Wire Color	Circuit No.	Function
1	TN/BK	422	Torque Converter Clutch Pulse Width Modulated (TCC PWM) Solenoid Valve Control
2	L-GN	1222	1-2 Shift Solenoid (SS) Valve Control
3	OG/BK	1230	Input Speed Sensor (ISS) High Signal
4-5	-	-	Not Used
6	TN	2501	High Speed GMLAN Serial Data Bus - (CAN)
7	TN/BK	2500	High Speed GMLAN Serial Data Bus + (CAN)
8	-	-	Not Used
9	YE	657	TCC Release Switch Signal
10	-	-	Not Used
11	BN	4	Not Used
12-15	-	-	
16	PU	401	Output Speed Sensor (OSS) Low Signal
17	L-BU/WH	1229	Pressure Control (PC) Solenoid Valve Low Control
18-19	-	-	Not Used
20	YE/BK	1223	2-3 SS Valve Control
21-22	-	-	Not Used
23	GY	773	Transmission Range Switch Signal C
24-25	-	-	Not Used
26	D-BU/WH	1231	ISS Low Signal
27-28	-	-	Not Used
29	TN/WH	771	Transmission Range Switch Signal A
30	TN	2762	Transmission Fluid Temperature (TFT) Sensor Low Reference
31	PK	1039	Ignition 1 Voltage
32	RD/WH	840	Battery Positive Voltage
33	OG	1226	Transmission Fluid Pressure (TFP) Switch Signal C
34	-	-	Not Used

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35	YE/BK	1227	TFT Sensor Signal
36	-	-	Not Used
37	TN	2501	High Speed GMLAN Serial Data Bus - (CAN)
38	TN/BK	2500	High Speed GMLAN Serial Data Bus + (CAN)
39	WH	776	Transmission Range Switch Signal P
40	OG/BK	1228	PC Solenoid Valve High Control
41	YE	400	OSS High Signal
42	L-BU/WH	20	Stop Lamp Switch Signal
43	-	-	Not Used
44	D-BU	1225	TFP Switch Signal B
45	-	-	Not Used
46	YE	772	Transmission Range Switch Signal B
47-48	-	-	Not Used
49	BK/WH	451	Ground

DIAGNOSTIC INFORMATION AND PROCEDURES**DIAGNOSTIC CODE INDEX****DIAGNOSTIC CODE INDEX**

DTC	Description
DTC P0218	Transmission Fluid Overtemperature
DTC P0562 or P0563	** MULTIPLE VALUES **
DTC P0601, P0602, P0603, P0604, or P062F	** MULTIPLE VALUES **
DTC P0705	Transmission Range (TR) Switch Circuit
DTC P0711	Transmission Fluid Temperature (TFT) Sensor Performance
DTC P0712 or P0713	** MULTIPLE VALUES **
DTC P0716 or P0717	** MULTIPLE VALUES **
DTC P0719 or P0724	** MULTIPLE VALUES **
DTC P0722 or P0723	** MULTIPLE VALUES **
DTC P0741, P0751, or P0756	** MULTIPLE VALUES **
DTC P0742, P0752, or P0757	** MULTIPLE VALUES **
DTC P0842 or P0843	** MULTIPLE VALUES **
DTC P0961	Line Pressure Control (PC) Solenoid System Performance
DTC P0973, P0976, or	** MULTIPLE VALUES **

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P2764	
DTC P0974, P0977, or P2763	** MULTIPLE VALUES **
DTC P1810, P1816, or P1818	** MULTIPLE VALUES **
DTC P1811	Maximum Adapt and Long Shift
DTC P2534	Ignition 1 Switch Circuit Low Voltage

DIAGNOSTIC STARTING POINT - AUTOMATIC TRANSMISSION

Begin the system diagnosis with the **Diagnostic System Check - Vehicle** in Vehicle DTC Information. The Diagnostic System Check provides the following information:

- The identification of the control modules which commands the system
- The ability of the control modules to communicate through the serial data circuit
- The identification and status of stored diagnostic trouble codes (DTCs)

The use of **Diagnostic System Check - Vehicle** in Vehicle DTC Information identifies the correct procedure for diagnosing the system and the procedure location.

Symptoms

When it has been determined through **Diagnostic System Check - Vehicle** in Vehicle DTC Information 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 **Symptoms - Automatic Transmission**. The **Symptoms - Automatic Transmission** table provides common diagnostic categories which relate directly to diagnostic information or procedures.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection (s)	Description
		• The powertrain control module (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

1-2 Solenoid

-

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.
 - 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

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		"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.
2-3 Solenoid	-	● 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.

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		○ 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.
Reset Transmission Adapts	-	● The PCM clears, 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.
		● 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

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PC Solenoid	-	otherwise. • When the engine is running, the following control limits apply: ◦ 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.
		• The PCM commands upshifts and downshifts. 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

Shift
Transmission

-

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 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

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		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. • When the engine is running, the following control limits apply: ◦ If the transmission range is Park, and the transmission is in hot mode, the TCC control solenoid may not be commanded OFF. If the solenoid is requested OFF, the message "TCC OFF command disabled in Hot Mode" appears on the scan tool display. ◦ The TCC control solenoid may not be commanded OFF for more than a calibrated amount of time. If the solenoid is commanded OFF, for a certain amount of time, the message "TCC OFF time has been exceeded" appears on the scan tool display.

SCAN TOOL DATA LIST

Use the scan tool data values under the following conditions:

- The **Diagnostic System Check - Vehicle** is complete.
- The On-Board Diagnostics are functioning properly.
- There are no diagnostic trouble codes (DTCs) present.

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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

Scan Tool Data List

Scan Tool Parameter	Data List*	Units Displayed	Typical Data Value
1-2 Shift Time	F0, F2, F6/F0	Seconds	Varies
1-2 Sol.	F0, F2, F3, F4	On/Off	On
1-2 Sol. CKT Status	F2	OK, Open/Short to GND, Short to Volts	OK
1-2 TAP Cell 4-16	F6/F0	kPa (psi)	Varies
2-3 Shift Time	F0, F3, F6/F1	Seconds	Varies
2-3 Sol.	F0, F2, F3, F4	On/Off	Off
2-3 Sol. CKT Status	F3	OK, Open/Short to GND, Short to Volts	OK
2-3 TAP Cell 4-16	F6/F1	kPa (psi)	Varies
3-4 Shift Time	F0, F4, F6/F2	Seconds	Varies
3-4 TAP Cell 4-16	F6/F2	kPa (psi)	Varies
Calc. Throttle Position	F0, F1, F2, F3, F4, F5	%	0%
Commanded Gear	F0, F1, F2, F3, F4, F5	1, 2, 3, 4	1
	F6/F0, F6/F1,		

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Current TAP Cell	F6/F2	4-16	Varies
ECT Sensor	F0, F1	°C (°F)	85-105°C (185-220° F)
Engine Speed	F0, F1, F2, F3, F4, F5	RPM	Varies
Engine Torque	F0, F1	N.m (lb ft)	Varies
Gear Ratio	F0, F1, F2, F3, F4	Ratio	3.98:1
Ignition Voltage	F0	Volts	12.6-14.7
Last Shift Time	F0	Seconds	Varies
PC Sol. Actual Current	F0, F5	Amps	Varies
PC Sol. Duty Cycle	F0, F5	%	Varies
PC Sol. Ref. Current	F0, F5	Amps	Varies
Steady State TAP 1GR	F6/F3	kPa (psi)	Varies
Steady State TAP 2GR	F6/F3	kPa (psi)	Varies
Steady State TAP 2GR/TCC	F6/F3	kPa (psi)	Varies
Steady State TAP 3GR	F6/F3	kPa (psi)	Varies
Steady State TAP 3GR/TCC	F6/F3	kPa (psi)	Varies
Steady State TAP 4GR	F6/F3	kPa (psi)	Varies
Steady State TAP 4GR/TCC	F6/F3	kPa (psi)	Varies
Steady State TAP Reverse	F6/F3	kPa (psi)	Varies
TCC Brake Switch	F0, F1	Open/Closed	Closed
TCC Duty Cycle	F0, F1	%	0%
TCC Duty Cycle CKT Status	F1	OK, Open/Short to GND, Short to Volts	OK
TCC Release Pressure	F0, F1	Yes/No	Yes
TCC Slip Speed	F0, F1	RPM	Varies
TFP Sw.	F0	Park/Neutral, Reverse, Drive, or invalid	Park/Neutral
TFP Sw. Sig. B/ Sig.	F0	HI/LOW	HI/HI

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C			
TR Sw.	F0	Park, Reverse, Neutral, Drive 4, Drive 3, Drive 2, Drive 1 or invalid	Park
TR Sw. A/B/C/P	F0	HI/LOW	LOW/HI/HI/LOW
Traction Control Signal	F0	Active/Inactive	Inactive
Trans. Fluid Temp.	F0, F1, F5	°C (°F)	80-90°C (176-194°F)
Transmission Hot Mode	F0, F1	On/Off	Off
Transmission ISS	F0, F1, F2, F3, F4	RPM	Varies
Transmission OSS	F0, F1, F2, F3, F4	RPM	0
Vehicle Speed	F0, F1, F2, F3, F4	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: PC Solenoid Data
- F6/F0: Transmission Adapts/1-2 Adapt. Data
- F6/F1: Transmission Adapts/2-3 Adapt. Data
- F6/F2: Transmission Adapts/3-4 Adapt. Data
- F6/F3: Transmission Adapts/Steady State Data

SCAN TOOL DATA DEFINITIONS**1-2 Shift Time**

This parameter displays the actual time of the last adaptable 1-2 shift. The shift time is based on the gear ratio change after the commanded 1-2 shift.

1-2 Sol.

This parameter displays the commanded state of the 1-2 shift solenoid valve. When the transmission is in FIRST and FOURTH gear, the display should indicate ON, current is flowing through the solenoid. When the transmission is in SECOND and THIRD gear, the display should indicate OFF, current is not flowing through the solenoid.

1-2 Sol. CKT Status

This parameter displays the solenoid valve feedback voltage signal circuit status on the scan tool. If the voltage is low when the solenoid is commanded OFF, the scan tool will display Open/Short to GND. If the voltage is high when the solenoid is commanded ON, the scan tool will display Short to Volts. If no circuit fault is present, the scan tool will display OK.

1-2 TAP Cell (4-16)

This parameter displays the amount of transmission adaptive pressure (TAP), based on 17 N.m (12.5 lb ft) of engine torque increment per cell, added to or subtracted from shift pressure during a 1-2 upshift. A positive number indicates that long shifts have been detected and PC solenoid pressure has been added in order to decrease shift time. A negative number indicates that short shifts have been detected and PC solenoid pressure has been subtracted in order to increase shift time.

2-3 Shift Time

This parameter displays the actual time of the last adaptable 2-3 shift. The shift time is based on the gear ratio change after the commanded 2-3 shift.

2-3 Sol.

This parameter displays the commanded state of the 2-3 shift solenoid valve. When the transmission is in FIRST and SECOND gear, the display should indicate OFF, current is not flowing through the solenoid. When the transmission is in THIRD and FOURTH gear, the display should indicate ON, current is flowing through the solenoid.

2-3 Sol. CKT Status

This parameter displays the solenoid valve feedback voltage signal circuit status on the scan tool. If the voltage is low when the solenoid is commanded OFF, the scan tool will display Open/Short to GND. If the voltage is high when the solenoid is commanded ON, the scan tool will display Short to Volts. If no circuit fault is present, the scan tool will display OK.

2-3 TAP Cell (4-16)

This parameter displays the amount of transmission adaptive pressure (TAP), based on 17 N.m (12.5 lb ft) of engine torque increment per cell, added to or subtracted from shift pressure during a 2-3 upshift. A positive number indicates that long shifts have been detected and PC solenoid pressure has been added in order to decrease shift time. A negative number indicates that short shifts have been detected and PC solenoid pressure has been subtracted in order to increase shift time.

3-4 Shift Time

This parameter displays the actual time of the last adaptable 3-4 shift. The shift time is based on the gear ratio change after the commanded 3-4 shift.

3-4 TAP Cell (4-16)

This parameter displays the amount of transmission adaptive pressure (TAP), based on 17 N.m (12.5 lb ft) of engine torque increment per cell, added to or subtracted from shift pressure during a 3-4 upshift. A positive number indicates that long shifts have been detected and PC solenoid pressure has been added in order to decrease shift time. A negative number indicates that short shifts have been detected and PC solenoid pressure has been subtracted in order to increase shift time.

Calc. Throttle Position

This parameter displays a calculated value, which is determined by the accelerator pedal position and the actual throttle position, used to optimize transmission controls. It represents the driver's intended request for torque or acceleration. The range is 0-100%, where 0% represents an idle or coast request and 100% represents a request for wide open throttle (WOT).

Commanded Gear

This parameter displays the current commanded state of the shift solenoid valves. The scan tool displays 1, 2, 3, 4 or 5.

Current TAP Cell

This parameter displays the current transmission adaptive pressure (TAP) cell in use for transmission line pressure adaptation. The cells are based on 17 N.m (12.5 lb ft) of 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 Sensor

This parameter displays the input signal from the engine coolant temperature (ECT) sensor. ECT is high at 151°C (304°F) when the signal voltage is low, 0 volt. ECT is low at -40°C (-40°F) when the signal voltage is high, 5 volt.

Engine Speed

This parameter displays the rotational speed of the engine expressed as revolutions per minute.

Engine Torque

This parameter displays a calculated value based on engine load, throttle position, mass air flow, and other engine inputs. This parameter is accurate to within 20 N.m (15 ft lb) of actual measured engine torque.

Gear Ratio

This parameter displays the actual transmission gear ratio. The scan tool displays the gear ratio calculated from the automatic transmission input shaft speed sensor (AT ISS) and the automatic transmission output shaft speed sensor (AT OSS) inputs.

Ignition Voltage

This parameter displays the system voltage measured at the ignition feed.

Last Shift Time

This parameter displays the actual time of the last upshift. This value is only accurate if the shift was adaptable.

PC Sol. Actual Current

This parameter displays the actual current flow through the pressure control solenoid circuit, which is measured by the control module. High current flow results in low line pressure. Low current flow results in high line pressure.

PC Sol. Duty Cycle

This parameter displays the commanded state of the pressure control solenoid, expressed as a percentage of energized ON time. A reading of low percent indicates zero ON time, non energized, or no current flow. A high percent at idle indicates maximum ON time, energized, or high current flow.

PC Sol. Ref. Current

This parameter displays the commanded current of the pressure control solenoid circuit. High current results in low line pressure. Low current results in high line pressure.

Steady State TAP 1GR

This parameter displays a pressure modification which is added to the line pressure in 1st gear. The larger the value, the greater the increase to line pressure.

Steady State TAP 2GR

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This parameter displays a pressure modification which is added to the line pressure in 2nd gear. The larger the value, the greater the increase to line pressure.

Steady State TAP 2GR/TCC

This parameter displays a pressure modification which is added to the line pressure in 2nd gear with TCC applied. The larger the value, the greater the increase to line pressure.

Steady State TAP 3GR

This parameter displays a pressure modification which is added to the line pressure in 3rd gear. The larger the value, the greater the increase to line pressure.

Steady State TAP 3GR/TCC

This parameter displays a pressure modification which is added to the line pressure in 3rd gear with TCC applied. The larger the value, the greater the increase to line pressure.

Steady State TAP 4GR

This parameter displays a pressure modification which is added to the line pressure in 4th gear. The larger the value, the greater the increase to line pressure.

Steady State TAP 4GR/TCC

This parameter displays a pressure modification which is added to the line pressure in 4th gear with TCC applied. The larger the value, the greater the increase to line pressure.

Steady State TAP Reverse

This parameter displays a pressure modification which is added to the line pressure in Reverse gear. The larger the value, the greater the increase to line pressure.

TCC Brake Switch

This parameter displays the status of the TCC brake switch circuit input. OPEN indicates a zero voltage input, brake pedal applied. CLOSED indicates a voltage input, brake pedal released. The scan tool displays OPEN or CLOSED.

TCC Duty Cycle

This parameter displays the commanded percentage of ON time for the TCC PWM solenoid. A high percentage represents an ON, energized, commanded state. 0 percent

represents an OFF, non-energized, commanded state.

TCC Duty Cycle CKT Status

This parameter displays the solenoid driver feedback voltage signal and displays the circuit status on the scan tool. If the voltage is low when the solenoid is commanded OFF, the scan tool will display Open/Short to GND. If the voltage is high when the solenoid is commanded ON, the scan tool will display Short to Volts. If no circuit fault is present, the scan tool will display OK.

TCC Release Pressure

This parameter displays the status of the normally closed TCC release switch and displays YES or NO. When TCC release fluid pressure is present, the switch is open, indicating that the TCC is released. When the fluid pressure is not present, the switch is closed, indicating that the TCC is applied.

TCC Slip Speed

This parameter displays the difference between transmission output speed and engine speed. A negative value indicates the engine speed is less than the output speed, deceleration. A positive value indicates the engine speed is greater than the output speed, acceleration. A value of zero indicates the engine speed is equal to the output speed, TCC applied.

TFP Sw.

This 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. If a valid combination of inputs is not detected, invalid will be displayed.

TFP Sw. Sig. A/Sig. C

This parameter displays HI/LOW. The displays are the two inputs from the automatic transmission fluid pressure manual valve position switch. LOW represents a low voltage signal, switch closed. HI represents an ignition voltage signal, switch open. The sequence of open and closed switches is used to determine actual manual valve position.

TR Sw.

This parameter displays the decoded status of the four A/B/C/P inputs from the transmission range switch. The scan tool displays Park, Reverse, Neutral, Drive, Intermediate, Low, and invalid. If a valid combination of inputs is not detected, invalid

will be displayed.

TR Sw. A/B/C/P

This parameter displays the status of the four inputs from the transmission range switch. The scan tool displays HI/LOW. HI indicates an ignition voltage input to the control module. LOW indicates a zero voltage input to the control module.

Traction Control Signal

This parameter 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 displays the input signal of the transmission fluid temperature sensor. Transmission fluid temperature is high, 151°C (304°F), when signal voltage is low, 0 volt. Transmission fluid temperature is low, -40°C (-40°F), when signal voltage is high, 5 volt.

Transmission Hot Mode

This parameter displays the automatic transmission fluid temperature (TFT) and displays On or Off. Off indicates that the TFT has not exceeded 130°C (266°F). On indicates that the TFT has exceeded 130°C (266°F) and has not cooled to 120°C (248°F) for greater than 5 seconds. These numbers are approximate and differ with transmissions.

Transmission ISS

This parameter displays the rotational speed of the transmission input shaft. The scan tool displays input shaft speed as revolutions per minute (RPM).

Transmission OSS

This parameter displays the rotational speed of the transmission output shaft. The scan tool displays output shaft speed as revolutions per minute (RPM).

Vehicle Speed

This parameter displays the speed at which the vehicle is traveling. The scan tool displays vehicle speed as kilometers per hour (km/h), miles per hour (MPH). The vehicle speed is calculated based on the input signal from the automatic transmission output shaft speed sensor.

DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

The diagnostic trouble code (DTC) list below displays all DTCs found in this section. The DTC descriptions are listed in numeric order and indicate the DTC types for domestic and export vehicle applications. 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 below 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

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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**Diagnostic Trouble Code (DTC) List/Type**

DTC	Type
DTC P0218	C
DTC P0562 or P0563	C, C
DTC P0601, P0602, P0603, P0604, or P062F	A, A, A, A, A
DTC P0705	C
DTC P0711	C
DTC P0712 or P0713	C, C
DTC P0716 or P0717	B, B
DTC P0719 or P0724	C, C
DTC P0722 or P0723	B, B
DTC P0741, P0751, or P0756	B, B, A
DTC P0742, P0752, or P0757	B, B, A
DTC P0842 or P0843	B, B
DTC P0961	C
DTC P0973, P0976, or P2764	B, A, B
DTC P0974, P0977, or P2763	B, A, B
DTC P1810, P1816, or P1818	B, B, B
DTC P1811	C
DTC P2534	A
DTC U0073, U0100, U0121, or U0140	B, B, C, C

DTC P0218**DTC Descriptor**

This diagnostic procedure supports the following DTC:

DTC P0218 Transmission Fluid Overtemperature

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

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Transmission fluid is drawn from the bottom pan through the filter, case assembly, channel plate assembly, control valve body assembly and into the oil pump assembly. The pump is mounted on the control valve body assembly. Fluid pressure leaving the pump is controlled by the pressure regulator valve and becomes the main supply of line pressure to the various components and hydraulic circuits. Hot fluid from the torque converter flows through the torque converter clutch (TCC) control valve into the cooler lines to the oil cooler located in the vehicle radiator and auxiliary cooler, if equipped. Cool fluid then returns to lubricate the final drive assembly and other components along the output shaft.

Conditions for Running the DTC

The transmission fluid temperature is between -39 and +149°C (-38 and +300°F) for 5 seconds.

Conditions for Setting the DTC

The transmission fluid temperature is greater than 130°C (266°F) for 10 minutes.

Action Taken When the DTC Sets

- DTC P0218 is a type C DTC.
- The transmission control module (TCM) freezes transmission adaptive functions.

Conditions for Clearing the DTC

DTC P0218 is a type C DTC.

Diagnostic Aids

Ask the customer about possible overloading, exceeding the trailer towing limit, or towing in overdrive.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Testing

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

DTC Type Reference

- Diagnostic Trouble Code (DTC) Type Definitions
- Diagnostic Trouble Code (DTC) List/Type

Circuit/System Verification

Ensure that the transmission fluid level is at the proper level by performing the Transmission Fluid Checking Procedure.

Circuit/System Testing

1. Perform the Transmission Fluid Checking Procedure. If the level is not within specifications, repair as necessary.
2. Inspect for the following conditions:
 - Transmission line pressure low-refer to Line Pressure Check Procedure. If the line pressure is low, refer to High or Low Line Pressure.
 - Transmission fluid flow through cooler and/or auxiliary cooler, if equipped, is restricted due to:
 - Transmission fluid level low
 - A clogged filter
 - A leaking filter or seal-refer to Oil Filter and Seal Replacement.
 - Plugged, kinked or damaged transmission cooler pipes-refer to Automatic Transmission Oil Cooler Flushing and Flow Test (J 45096) or Automatic Transmission Oil Cooler Flushing and Flow Test (J 35944-A).
 - Air flow through transmission fluid cooler and/or auxiliary cooler, if equipped, is restricted due to:
 - Damaged fins
 - Debris
 - Engine overheating due to:
 - Low coolant level-check coolant temperature, coolant level, and hoses

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- Restricted air flow
- Restricted coolant flow-refer to **Engine Overheating**

If any of the conditions listed are found, repair as necessary.

Component Testing

- **Transmission Fluid Checking Procedure**
- **Line Pressure Check Procedure**
- **High or Low Line Pressure**

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

Ensure that the transmission fluid temperature is 129°C (264°F) or less for 5 seconds.

DTC P0562 OR P0563

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0562 System Voltage Low
- DTC P0563 2-3 System Voltage High

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0562 or P0563

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Voltage	P2534	P2534	-	P0562, P0563
Ignition 0 Voltage	-	-	-	P0562, P0563
Battery Positive Voltage	-	-	-	P0562, P0563

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: 12.5-14.5 volts			

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Ignition Voltage	0 volts	0 volts	12.5-14.5 volts
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Circuit/System Description

The transmission control module (TCM) continuously monitors the system voltage on the ignition voltage and the battery voltage circuits. Lower than normal or higher than normal voltage may be inadequate to operate the transmission control solenoids properly. Improper solenoid operation may cause erratic transmission operation and tie-up conditions, which may result in internal damage.

Conditions for Running the DTC

DTC P0562

The engine speed is 1,200 RPM or greater for 5 seconds.

DTC P0563

The ignition is ON.

Conditions for Setting the DTC

DTC P0562

The TCM detects system voltage is 11 volts or less for 10 seconds.

DTC P0563

The TCM detects system voltage is 18 volts or greater for 10 seconds.

Action Taken When the DTC Sets

DTCs P0562 and P0563 are type C DTCs.

Conditions for Clearing the DTC

DTCs P0562 and P0563 are type C DTCs.

Diagnostic Aids

- Observe the driver information center (DIC) messaging that would indicate the electrical system requires service.
- Inspect for loose or damaged terminals at the generator.
- Inspect for loose or worn generator drive belt.
- Use the scan tool in order to inspect all other modules for voltage related DTCs.
- Running the engine with a battery charger attached may cause DTC P0563 to set.
- Inspect the charging circuit for high resistance.

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- Inspect the vehicle battery for open or sulfated cells.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

Circuit/System Verification

Start the engine in PARK and observe the Ignition Voltage parameter on the scan tool. The Ignition Voltage should be between 12-14.5 volts.

Circuit/System Testing

1. Start the engine and observe the Ignition Voltage parameter with a scan tool. The Ignition Voltage parameter should be between 12-14.5 volts. If the voltage is not within the specified range, refer to **Charging System Test**.
2. Increase the engine speed to 1,500 RPM. The Ignition Voltage parameter should remain between 12-14.5 volts. If the voltage is not within the specified range when the engine speed is increased, refer to **Charging System Test**.
3. Turn OFF the ignition. Disconnect the TCM connector. Probe the battery positive voltage and the ignition 1 voltage circuits of the TCM connector with the ground probe of the DMM. Connect the positive lead of the DMM to the battery positive terminal. Turn ON the ignition, with the engine OFF. Measure the voltage drop for each circuit.

The voltage drop should be less than 0.5 volts. If the voltage drop is greater than 0.5 volts, repair the high resistance in the affected circuit.

4. Turn OFF the ignition. Using the positive probe of the DMM, probe the ground circuits of the TCM connector. Connect the negative lead of the DMM to the battery ground terminal. Observe and record the voltage measurements. The voltage drop should be less than 0.2 volts. If the voltage drop is greater than 0.2 volts, repair the open or high resistance in the affected circuit.
5. If all circuits and connections test normal, replace the TCM.

Component Testing

Start the engine and raise the engine speed to 1,500 RPM. Observe the Ignition Voltage parameter on the scan tool. The Ignition Voltage should be between 12-14.5 volts. If the voltage is not within the specified range, perform the **Charging System Test**.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Ensure the battery voltage is between 12-14.5 volts.
- **Control Module References** for TCM replacement, setup, and programming.

DTC P0601, P0602, P0603, P0604, OR P062F

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0601 Transmission Control Module (TCM) Read Only Memory (ROM)
- DTC P0602 Transmission Control Module (TCM) Not Programmed
- DTC P0603 Transmission Control Module (TCM) Long Term Memory Reset
- DTC P0604 Transmission Control Module (TCM) Random Access Memory (RAM)
- DTC P062F Transmission Control Module (TCM) Long Term Memory Performance

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The internal fault detection is handled inside the transmission control module (TCM). No external circuits are involved.

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Conditions for Running the DTC

The TCM runs the program to detect an internal fault when the engine is running. The only requirements are voltage and ground. This program runs even if the voltage is out of the valid operating range.

Conditions for Setting the DTC

The TCM has detected an internal malfunction.

Action Taken When the DTC Sets

- DTCs P0601, P0602, P0603, P0604, and P062F are Type A DTCs.
- The TCM commands maximum line pressure.
- The TCM forces the torque converter clutch (TCC) OFF.
- The TCM inhibits TCC engagement.
- The TCM freezes transmission adaptive functions.

DTCs P0601, P0603, P0604, and P062F

The TCM commands a soft landing to 2nd gear.

DTC P0602

The TCM commands an immediate landing to 2nd gear.

Conditions for Clearing the DTC

DTCs P0601, P0602, P0603, P0604, and P062F are Type A DTCs.

Diagnostic Aids

DTC P0602 indicates the TCM is not programmed.

Circuit/System Verification

1. Verify that DTC P0602 is not set. If DTC P0602 is set, program the TCM.
2. If DTC P0602 is not set, replace the TCM.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

Control Module References for TCM replacement, setup, and programming.

DTC P0705

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DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0705 Transmission Range (TR) Switch Circuit

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0705

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
TR Signal A	P0705	P0705	-	-
TR Signal B	P0705	P0705	-	-
TR Signal C	P0705	P0705	-	-
TR Signal P	P0705	P0705	-	-

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: HI when switch open, LOW when switch grounded.			
TR Sw. A/B/C/P	LOW	HI	-

Circuit/System Description

The transmission range (TR) switch is part of the Park/Neutral Position (PNP) switch and is mounted on the transmission manual shaft. The TR switch is a multi-signal switch. The transmission control module (TCM) supplies ignition voltage to the TR switch on 4 signal circuits, A, B, C, and P. Each gear selector lever position grounds one or more of the signal circuits in a unique pattern. In order to determine the gear range selected by the driver, the TCM compares the voltage combination on the signal circuits to a TR switch combination table stored in memory. Refer to **Transmission Range Switch Logic**.

Conditions for Running the DTC

The engine is running for 5 seconds.

Conditions for Setting the DTC

The combination of TR switch signals is invalid for 60 seconds. Refer to **Transmission Range Switch Logic**.

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Action Taken When the DTC Sets

- DTC P0705 is a type C DTC.
- The TCM commands an alternate coast shift pattern where downshifts occur at higher vehicle speeds while coasting.

Conditions for Clearing the DTC

DTC P0705 is a type C DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

Special Tools Required

- **J 35616** GM Terminal Test Kit. See Special Tools.
- **J 44152** Jumper Harness (20 pins). See Special Tools.

Circuit/System Verification

Start the engine. With the vehicle in Park and at normal operating temperature, observe the TR Sw. A/B/C/P parameter on the scan tool. The TR Sw. A/B/C/P parameter should display LOW/HIGH/HIGH/LOW.

Circuit/System Testing

1. Turn ON the ignition, leaving the engine OFF. Using a scan tool, observe the TR Sw. parameter while selecting each transmission range. The TR Sw. parameter should match each range when selected. If the TR Sw. range on the scan tool matches each selected range, test for intermittent conditions.
2. Inspect the PNP switch assembly and the shift cable for the following conditions. If any of the conditions are found, repair or replace as necessary:
 - Damage
 - Loose or missing mounting hardware
 - Proper adjustment-refer to **Park/Neutral Position (PNP) Switch Replacement**
 - Damaged or stretched cable
 - Proper adjustment
3. Using the scan tool, observe the TR Sw. A/B/C/P parameter. The parameter should display LOW/HIGH/HIGH/LOW. If the scan tool displays HI for all signal states, repair the open or high resistance in the ground circuit for the PNP switch.
4. Turn OFF the ignition. Disconnect the PNP switch connector. Turn ON the ignition, leaving the engine OFF. Observe the TR Sw. A/B/C/P parameter on the scan tool. The scan tool should display HI for all TR Sw. signal circuits. If any of the TR Sw. A/B/C/P signal circuits do not display HI, test the affected circuit for a short to ground.
5. Using the **J 35616** and a DMM, measure the voltage at each TR signal circuit to ground. See **Special Tools**. Each circuit should measure 10-12 volts. If the voltage on any of the circuits is less than the specified value, test the affected circuit for an open or high resistance. If an open or high resistance is not found, replace the TCM.
6. Turn OFF the ignition. Leaving the PNP switch disconnected, disconnect the TCM harness connector. Using the **J 35616**, measure the resistance between each TR signal circuit and all other TR signal circuits. See **Special Tools**. The resistance should be greater than 10K ohms. If the resistance is less than 10K ohms, test for a shorted together condition on the TR signal circuits.
7. If all circuits and connections test normal, test the PNP switch.

Component Testing

Using the **J 35616**, connect a test lamp between battery positive voltage and any of the TR signal circuits at the PNP switch. See **Special Tools**. Referring to **Transmission Range Switch Logic** will ensure that the test lamp illuminates when the TR signal circuit that is being tested is grounded.

If the test lamp does not illuminate when the circuit is grounded, replace the PNP switch.

Repair Instructions

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IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Ensure that the TR. Sw. A/B/C/P parameter on the scan tool displays a valid range for all ranges selected for 5 seconds.
- **Park/Neutral Position (PNP) Switch Replacement**
- **Control Module References** for TCM replacement, setup, and programming.
- **Wiring Harness Replacement**

DTC P0711

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0711 Transmission Fluid Temperature (TFT) Sensor Performance

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0711

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
TFT sensor signal	P0712	P0713	P0713	P0218, P0711
Low reference	-	P0713	-	P0218, P0711

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature			
Parameter Normal Range: Varies near coolant temperature			
Trans. Fluid Temp.	150°C (304°F)	-40°C (-40°F)	-40°C (-40°F)

Circuit/System Description

The automatic transmission fluid temperature (TFT) sensor is a negative coefficient thermistor. When the transmission fluid is cold, the sensor resistance is high. As the transmission fluid warms up, the sensor resistance decreases. This diagnostic monitors the TFT sensor circuit. The circuit may be functional but not in the normal operating range. This diagnostic indicates stuck, erratic, intermittent, or skewed values, resulting in reduced system performance. The TFT sensor range is -40°C to +150°C (-40°F to +304°F).

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Conditions for Running the DTC

- No ECT DTCs P0117 or P0118.
- No ISS DTCs P0716 or P0717.
- No VSS DTCs P0722 or P0723.
- DTC P0711 has not passed this ignition cycle.
- The transmission fluid temperature is -39°C to 149°C (-38°F to 300°F).

Condition 1

- The engine coolant temperature (ECT) is at least 70°C (158°F) and has changed by 55°C (99°F) since start up.
- The vehicle speed is 8 km/h (5 mph) or more for at least 5 minutes cumulative.
- The torque converter clutch (TCC) slip is 120 RPM or more for at least 5 minutes cumulative.

Condition 2

- The engine coolant temperature is at least 70°C (158°F) and has changed by 55°C (99°F) since start up.
- The vehicle speed is 8 km/h (5 mph) or more for at least 5 minutes cumulative.

Condition 3

- The calc. throttle position is between 8 and 90 percent.
- The engine torque is 50 N.m (37 lb ft) or more.
- The vehicle speed is 8 km/h (5 mph) or more.
- The engine speed is greater than 500 RPM.

Conditions for Setting the DTC

Condition 1

The change in transmission fluid temperature is 2°C (4°F) or less when the TFT is -40°C to $+21^{\circ}\text{C}$ (-40°F to $+68^{\circ}\text{F}$) at start up for 80 seconds.

Condition 2

The change in transmission fluid temperature is 2°C (4°F) when the TFT is $129-149^{\circ}\text{C}$ ($264-300^{\circ}\text{F}$) at start up for 80 seconds.

Condition 3

The change in transmission fluid temperature is 20°C (68°F) or less after a predetermined

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time.

Action Taken When the DTC Sets

- DTC P0711 is a Type C DTC.
- The transmission control module (TCM) freezes transmission adaptive functions.
- The TCM calculates a default TFT from the ECT sensor and the intake air temperature (IAT) sensor.

Conditions for Clearing the DTC

DTC P0711 is a type C DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

DTC Type Reference

- Diagnostic Trouble Code (DTC) Type Definitions
- Diagnostic Trouble Code (DTC) List/Type

Special Tools Required

J 44152 Jumper Harness (20 pins). See **Special Tools**.

Circuit/System Verification

Drive the vehicle while observing the Trans. Fluid Temp. parameter on the scan tool. The Trans. Fluid Temp. parameter should rise by 3°C (5°F) or more.

Circuit/System Testing

1. Start the engine and observe the Trans. Fluid Temp. parameter on the scan tool. Drive the vehicle while observing the Trans. Fluid Temp. parameter. The Trans. Fluid Temp. parameter should rise by 3°C (5°F). If the Trans. Fluid Temp. does not rise by 3°C (5°F), turn OFF the ignition.
2. Disconnect the AT 20-way inline connector. Turn ON the ignition with the engine OFF. Observe the Trans. Fluid Temp. parameter on the scan tool. The Trans. Fluid Temp. should display -40°C (-40°F). If the Trans. Fluid Temp. is -40°C (-40°F), replace the TFT sensor.
3. Using a DMM, measure the voltage on the TFT sensor signal circuit on the engine harness side of the AT 20-way inline connector and ground. The voltage should be near 5 volts. If the voltage is not near the specified value, repair the open or high resistance in the TFT sensor signal circuit. If an open or high resistance is not found, test the TCM.
4. Measure the voltage between the TFT sensor signal circuit and the low reference circuit at the AT 20-way inline connector. The voltage should be near 5 volts. If the voltage is not near the specified value, repair the open or high resistance in the low reference circuit.
5. Using the **J 44152**, measure the resistance between the TFT sensor signal circuit and the low reference circuit at the transmission side of the AT 20-way inline connector. See **Special Tools**. Refer to **Temperature vs Resistance** or **Temperature vs Resistance**. The resistance should be between the specified range for the given temperature. If the resistance is not within the specified range for the given temperature, replace the TFT sensor.

Component Testing

1. Disconnect the AT 20-way inline connector and measure the resistance between the TFT sensor signal circuit and the low reference circuit. Refer to **Temperature vs Resistance** or **Temperature vs Resistance** for resistance values.

If the resistance is not within the specified range for the given temperature, replace the TFT sensor.

2. Test the TCM for supplying the 5-volt reference circuit to the TFT sensor.

If the TCM is not supplying a 5-volt reference to the TFT sensor, replace the TCM.

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Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Transmission Fluid Pressure (TFP) Manual Valve Position Switch Replacement
- Control Module References for TCM replacement, setup, and programming
- Wiring Harness Replacement

DTC P0712 OR P0713

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0712 Transmission Fluid Temperature (TFT) Sensor Circuit Low Voltage
- DTC P0713 Transmission Fluid Temperature (TFT) Sensor Circuit High Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0712 or P0713

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
TFT Sensor Signal	P0712	P0713	P0713	P0711
Low Reference	-	P0713	-	P0711

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: -39 to +149°C (-38 to +300°F)			
Trans. Fluid Temp.	Greater than 149°C (300°F)	Less than -39°C (-38°F)	Less than -39°C (-38°F)

Circuit/System Description

The automatic transmission fluid temperature (TFT) sensor is a thermistor. The TFT sensor is part of the automatic transmission fluid pressure (TFP) manual valve position switch. The transmission control module (TCM) supplies a 5-volt reference signal to the sensor. When the transmission fluid is cold, the sensor resistance is high and the TCM senses a high signal voltage. As the transmission fluid warms, the sensor resistance lowers and the TCM senses

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lower voltage. The TCM uses the TFT reading in order to control the torque converter clutch (TCC), line pressure adjustments, and temperature compensated shifts.

Conditions for Running the DTC

DTC P0712

The engine is running for 5 seconds.

DTC P0713

- No ISS DTCs P0716 or P0717.
- No OSS DTCs P0722 or P0723.
- The engine is running for 5 seconds.
- The output speed is 200 RPM or more for 200 seconds cumulatively.
- The TCC slip speed is 120 RPM or more for 200 seconds cumulatively.

Conditions for Setting the DTC

DTC P0712

The TFT sensor is greater than 150°C (302°F) for 12 seconds.

DTC P0713

The TFT is less than -40°C (-40°F) for 1 minute and 20 seconds.

Action Taken When the DTC Sets

- DTCs P0712 and P0713 are Type C DTCs.
- The TCM freezes transmission adaptive functions.
- The TCM calculates a default transmission fluid temperature based on engine coolant temperature, intake manifold air temperature, and engine run time.

Conditions for Clearing the DTC

DTCs P0712 and P0713 are Type C DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View

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- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

Special Tools Required

- **J 35616** GM Terminal Test Kit. See Special Tools.
- **J 44152** Jumper Harness (20 pins). See Special Tools.

Circuit/System Verification

Start the engine. With the vehicle in PARK and at normal operating temperature, observe the Trans. Fluid Temp. parameter on the scan tool. The Trans. Fluid Temp. should display near the ECT sensor parameter.

Circuit/System Testing

1. Disconnect the AT 20-way inline connector. Using a DMM and the **J 35616**, measure the voltage at the TFT sensor signal circuit at the engine side of the connector. See Special Tools. The voltage should be 4.9-5.1 volts.

IMPORTANT: If a short to voltage is found, test the TFT sensor for damage.

2. If the voltage is less than the specified range, test the TFT sensor signal circuit for an open, high resistance, or short to ground. If the voltage is above the specified range, test the TFT sensor signal circuit for a short to voltage.
3. Using the **J 35616**, measure the voltage between the TFT sensor signal circuit and the low reference circuit at the engine side of the AT 20-way inline connector. See Special Tools. The voltage should be 4.9-5.1 volts. If the voltage is less than the specified value, test the low reference circuit for an open, high resistance, or short to ground.

4. Install the **J 44152** Jumper Harness on the transmission side of the AT 20-way inline connector. See **Special Tools**. Using the **J 35616**, measure the resistance between the TFT sensor signal circuit and the low reference circuit. See **Special Tools**. Refer to **Temperature vs Resistance** for the 2.2L engine or **Temperature vs Resistance** for the 2.4L engine for the resistance values.

If the resistance is greater than the specified range for a given temperature, test the TFT sensor signal circuit and the low reference circuit for an open or high resistance. If the resistance is less than the specified range, test the TFT sensor signal circuit and the low reference for a shorted together condition or a faulty TFT sensor. If a shorted together condition is found, replace the transmission wiring harness.

5. Using the **J 35616**, measure the resistance between the TFT sensor signal circuit and the transmission case. See **Special Tools**. The resistance should be greater than 10K ohms. If the resistance is less than 10K ohms, test the TFT sensor signal circuit for a short to the transmission case. If a short to the case is found, replace the transmission wiring harness.
6. Using the **J 35616**, measure the resistance between the low reference circuit and the transmission case. See **Special Tools**. The resistance should be greater than 10K ohms. If the resistance is less than 10K ohms, test the low reference circuit for a short to the transmission case. If a short to the case is found, replace the transmission wiring harness.
7. Using the **J 35616**, measure the resistance between the TFT sensor signal circuit and all other circuits of the **J 44152** jumper harness except the low reference circuit. See **Special Tools**. The resistance should be greater than 10K ohms. If the resistance is less than 10K ohms, replace the transmission wiring harness.
8. If all circuits/connections test normal, test the TFT sensor.

Component Testing

Install the **J 44152** on the transmission side of the AT 20-way inline connector. See **Special Tools**. Using the **J 35616** measure the resistance between the TFT sensor signal circuit and the low reference circuit. See **Special Tools**. Refer to **Temperature vs Resistance** for the 2.2L engine or **Temperature vs Resistance** for the 2.4L engine for the resistance values.

If the resistance is not within the specified range, replace the transmission wiring harness.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Ensure the transmission fluid temperature is between -39 and +149°C (-38 and +300°F) for at least 10 seconds.

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- **Control Module References** for TCM replacement, setup, and programming.
- **Wiring Harness Replacement**

DTC P0716 OR P0717

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0716 Input Speed Sensor Performance
- DTC P0717 Input Speed Sensor Circuit Low Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0716 or P0717

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
ISS High Signal	P0716, P0717	P0716, P0717	P0716, P0717	P0716, P0717
ISS Low Signal	-	P0716, P0717	-	P0716, P0717

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: 450-7,000 RPM			
Transmission ISS	0 RPM	0 RPM	0 RPM

Circuit/System Description

The automatic transmission input speed sensor (ISS) is a permanent magnet with a coil of wire wound around. The ISS mounts in the case cover facing the reluctor wheel of the input shaft. As the reluctor wheel is driven by the turbine shaft, an AC signal is induced in the input speed sensor. Higher vehicle speeds induce a higher frequency and voltage at the sensor. There is a fixed air gap between the sensor and the teeth on the sensor reluctor wheel. The ISS input is used by the transmission control module (TCM) in order to control line pressure, torque converter clutch (TCC) apply and release, and transmission shift patterns. This sensor is also used to calculate the appropriate gear ratios and TCC slippage. This diagnostic indicates stuck, erratic, or intermittent conditions in the system.

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Conditions for Running the DTC

- No ISS DTC P0717.
- No VSS DTC P0722 or P0723.
- The engine speed is greater than 500 RPM for 5 seconds.
- The vehicle speed is 16 km/h (10 mph) or greater.
- The engine torque is greater than 50 N.m (37 lb ft).

DTC P0716

- No TP sensor DTCs P0120 or P0220.
- No 1-2 shift solenoid valve DTCs P0752, P0973, or P0974.
- The ISS is greater than 1050 RPM for at least 2 seconds.
- An increase in ISS is 500 RPM or less for at least 2 seconds.
- The calc. throttle position is 8 percent or more.

Conditions for Setting the DTC

DTC P0716

The input shaft speed changes by 1,000 RPM or more for 3.25 seconds.

DTC P0717

The input shaft speed is less than 100 RPM for 4.5 seconds.

Action Taken When the DTC Sets

- DTCs P0716 and P0717 are type B DTCs.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM calculates input speed based on engine speed and gear ratio.

Conditions for Clearing the DTC

DTCs P0716 and P0717 are type B DTCs.

Diagnostic Aids

Ensure the wiring harness is not stretched too tightly or other components are pressing on the AT inline 20-way connector body. Also inspect for proper clearance to any other components and wiring.

Reference Information

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Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

DTC Type Reference

- Diagnostic Trouble Code (DTC) Type Definitions
- Diagnostic Trouble Code (DTC) List/Type

Special Tools Required

J 44152 Jumper Harness (20 pins). See Special Tools.

Circuit/System Verification

Start the engine in PARK and observe the transmission ISS on the scan tool while varying the engine speed. The transmission ISS should vary with the engine speed and not drop.

Circuit/System Testing

1. Start the engine and ensure the Transmission ISS parameter on the scan tool is greater than 100 RPM. If the value is less than 100 RPM disconnect the AT inline 20-way connector and install the **J 44152** Jumper Harness on the transmission side. See Special Tools.
2. Measure the resistance between the ISS high signal circuit and the ISS low signal

circuit of the **J 44152** . See **Special Tools**. The resistance should be between 820 and 1,428 ohms. If the value is greater than 1,428 ohms, test the ISS high signal circuit and the ISS low signal circuit for an open. If the value is less than 820 ohms, test the ISS high signal and the ISS low signal circuits for a shorted together condition.

3. Measure the resistance of the ISS high signal circuit to the transmission case. The resistance should be greater than 10K ohms. If the value is less than 10 ohms, replace the transmission wiring harness assembly.
4. Measure the resistance between the ISS high signal circuit and all other circuits of the **J 44152** except the ISS low signal circuit. See **Special Tools**. The resistance should be greater than 10K ohms. If the value is less than 10K ohms, replace the transmission wiring harness assembly.
5. Measure the resistance between the ISS low signal circuit and all other circuits of the **J 44152** except the ISS high signal circuit. See **Special Tools**. The resistance should be greater than 10K ohms. If the value is less than 10K ohms replace the transmission wiring harness assembly.
6. Remove the **J 44152** from the transmission side and install on the engine side of the harness. See **Special Tools**. Measure the resistance between the ISS high signal circuit and ground. The resistance should be greater than 10K ohms. If the resistance is less than 10K ohms, test the ISS high signal circuit for a short to ground.
7. Measure the resistance of the ISS high signal circuit between the TCM connector and the AT inline 20-way connector. The resistance should be less than 10 ohms. If the resistance is greater than 10 ohms, test the ISS high signal for an open.
8. Measure the resistance of the ISS low signal circuit between the TCM connector and the AT inline 20-way connector. The resistance should be less than 10 ohms. If the resistance is greater than 10 ohms, test the ISS low signal for an open.
9. Ignition ON, test the ISS high signal circuit for a short to voltage.
10. If all circuit/connections test normal, test or replace the ISS.

Component Testing

Verify the ISS resistance is between 820-1,428 ohms. If the resistance is not within the specified range, replace the ISS.

Repair Instructions

IMPORTANT: Always perform the **Diagnostic Repair Verification** after completing the repair.

- Ensure that the ISS is 500 RPM or greater for 3 seconds and does not change more than 500 RPM or greater for 3 seconds.
- **Input Speed Sensor Removal and Input Speed Sensor Installation**
- **Control Module References** for TCM replacement, setup, and programming

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DTC P0719 OR P0724

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0719 Brake Switch Circuit Low Voltage
- DTC P0724 Brake Switch Circuit High Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0719 or P0724

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stop Lamp Switch Signal	P0719	P0719	P0724	-

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in PARK, normal operating temperature Parameter Normal Range: Closed			
TCC Brake Switch	Closed	Closed	Open

Circuit/System Description

The brake switch indicates brake pedal status to the transmission control module (TCM). The normally-closed brake switch supplies a Closed status to the TCM from the Body Control Module (BCM). Applying the brake pedal opens the switch, interrupts voltage to the BCM. Releasing the brake pedal supplies voltage to the BCM. When the BCM senses 0 volts at the brake switch input, the BCM sends a signal to the TCM to de-energize the torque converter clutch (TCC) solenoid valve.

Conditions for Running the DTC

DTC P0719

- No OSS DTCs P0722 or P0723.
- DTC P0719 has not passed this ignition cycle.

DTC P0724

- No OSS DTCs P0722 or P0723.

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- DTC P0724 has not passed this ignition cycle.

Conditions for Setting the DTC

DTC P0719

DTC P0719 sets if the TCM detects an open brake switch or circuit and the following conditions occur eight times:

- The vehicle speed is greater than 32 km/h (20 mph) for 6 seconds;
- then, the vehicle speed is 8-32 km/h (5-20 mph) for 6 seconds;
- then, the vehicle speed is less than 8 km/h (5 mph) for 2 seconds.

DTC P0724

DTC P0724 sets if the TCM detects a closed brake switch or circuit, 12 volts, for 15 minutes during vehicle acceleration and the following conditions occur eight times:

- The vehicle speed is less than 8 km/h (5 mph) for 1 second;
- then, the vehicle speed is 8-32 km/h (5-20 mph) for 6 seconds;
- then, the vehicle speed is greater than 32 km/h (20 mph) for 6 seconds.

Action Taken When the DTC Sets

DTCs P0719 and P0724 are Type C DTCs.

Conditions for Clearing the DTC

DTCs P0719 and P0724 are Type C DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- Circuit Protection - Fuses
- Circuit Testing

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- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

DTC Type Reference

- Diagnostic Trouble Code (DTC) Type Definitions
- Diagnostic Trouble Code (DTC) List/Type

Special Tools Required

J 35616 GM Terminal Test Kit. See Special Tools.

Circuit/System Verification

Start the engine. With the vehicle in Park and at normal operating temperature, observe the TCC Brake Switch parameter on the scan tool. The TCC Brake Switch parameter should display Closed with the brake pedal released. Apply the brake pedal and the TCC Brake Switch parameter should display Open.

Circuit/System Testing

1. Install a scan tool. Turn ON the ignition, leaving the engine OFF. Observe the TCC Brake Switch parameter. The parameter should display Closed.

If the scan tool displays Open, disconnect the stop lamp switch connector.

2. Observe the TCC Brake Switch parameter on the scan tool with the stop lamp switch connector disconnected. The parameter should display Open.

If the scan tool displays Closed after the stop lamp switch connector disconnected, test the Stop Lamp Switch. If the scan tool displays Open after the stop lamp switch connector is disconnected, test the stop lamp switch signal circuit for a short to voltage.

3. While observing the TCC brake switch parameter on the scan tool, use the **J 35616** GM terminal test kit and install a fused jumper wire between the ignition 1 voltage circuit and the stop lamp switch signal circuit. See Special Tools. The TCC brake switch parameter should change from Closed to Open when the fused jumper wire is installed.

If the TCC brake switch parameter changes, replace the Stop Lamp Switch.

4. Inspect the STOP LPS fuse; refer to **Circuit Protection - Fuses** . The fuse should not be blown.

If the fuse is blown, test the ignition 1 voltage circuit and the stop lamp switch signal circuit for a short to ground.

5. Using a DMM, measure the voltage between the ignition 1 voltage circuit and ground at the stop lamp switch connector. The voltage should be near 12 volts.

If the voltage is not near the specified voltage, test the ignition 1 voltage circuit for an open or high resistance.

6. Using the **J 35616** GM terminal test kit measure the resistance of the stop lamp switch signal circuit between the BCM and the stop lamp switch. See **Special Tools**. The resistance should be less than 10 ohms.

If the resistance is greater than 10 ohms, test the stop lamp switch signal circuit for an open or high resistance.

7. If all circuits and connections test normal, replace the BCM.

Component Testing

Inspect the stop lamp switch for proper adjustment; refer to **Stop Lamp Switch Adjustment** . With the stop lamp switch removed, use a DMM to measure to resistance across the pins for the ignition 1 voltage circuit and the stop lamp switch signal circuit. With the plunger released on the stop lamp switch the resistance should display infinite on the DMM. With the plunger depressed on the stop lamp switch the resistance should display less than 10 ohms.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

Output Speed Sensor Replacement

Control Module References for BCM replacement, setup, and programming

Stop Lamp Switch Adjustment

Stop Lamp Switch Replacement

DTC P0722 OR P0723

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DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0722 Output Speed Sensor Circuit Low Voltage
- DTC P0723 Output Speed Sensor Circuit Intermittent

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0722 or P0723

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS High Signal	P0722, P0723	P0722, P0723	P0722, P0723	P0722, P0723
OSS Low Signal	-	P0722, P0723	-	P0722, P0723

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Drive vehicle, normal operating temperature Parameter Normal Range: 100-7.000 RPM			
Transmission OSS	0 RPM	0 RPM	0 RPM

Circuit/System Description

The output speed sensor (OSS) system is a pulse generator consisting of a speed sensor assembly, located in the case extension, and a toothed vehicle speed sensor reluctor wheel, which is pressed onto the final drive carrier assembly. As the vehicle drives forward, the vehicle speed sensor reluctor wheel rotates. This rotation produces a variable AC signal in the pickup coil that is proportional to vehicle speed. The transmission control module (TCM) uses this signal in order to calculate vehicle speed, shift timing, and gear ratios.

Conditions for Running the DTC

- No ISS DTCs P0716 or P0717.
- The engine speed is greater than 500 RPM for 5 seconds.
- The engine torque is greater than 50 N.m (37 lb ft).
- The transmission range is not PARK or NEUTRAL.

DTC P0722

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- No TP sensor DTCs P0120 or P0220.
- No VSS DTC P0723.
- The calc. throttle position is 8 percent or more.
- The input shaft speed is 1,000-5,000 RPM.
- The TCC slip speed is -20 RPM or more.
- The TFT is -40°C (-40°F) or more.

DTC P0723

- No 1-2 SS electrical DTC P0974.
- The time since the last gear selector range change is 6 seconds or more.
- The output speed is 1,000 RPM or greater for 2 seconds.
- No transmission OSS rise 500 RPM or greater for 2 seconds.
- The ISS changes 500 RPM or less for 2 seconds.

Conditions for Setting the DTC

DTC P0722

The output shaft speed is 200 RPM or less for 4.5 seconds.

DTC P0723

The output shaft speed drops greater than 1,200 RPM for 3.25 seconds.

Action Taken When the DTC Sets

- DTCs P0722 and P0723 are type B DTCs.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.
- The TCM calculates output speed based on ISS, engine speed, and commanded gear.

Conditions for Clearing the DTC

DTCs P0722 and P0723 are type B DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

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- [Automatic Transmission Inline 20-Way Connector End View](#)
- [Automatic Transmission Internal Connector End Views](#)
- [Automatic Transmission Related Connector End Views](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

- [Scan Tool Data List](#)
- [Scan Tool Data Definitions](#)
- [Scan Tool Output Controls](#)

DTC Type Reference

- [Diagnostic Trouble Code \(DTC\) Type Definitions](#)
- [Diagnostic Trouble Code \(DTC\) List/Type](#)

Special Tools Required

J 35616 GM Terminal Test Kit. See [Special Tools](#).

Circuit/System Verification

1. Raise and support the drive wheels.
2. Start and idle the engine.
3. Place the transmission in DRIVE.
4. Monitor Transmission OSS on the scan tool.
5. The Transmission OSS on the scan tool should be greater than 70 RPM.

Circuit/System Testing

1. With the drive wheels supported, the engine running and the transmission in DRIVE ensure the Transmission OSS parameter on the scan tool is greater than 200 RPM.

If the value is less than 200 RPM, disconnect the TCM connector and using the **J 35616** connect the DMM between the OSS high signal and the OSS low signal circuits. See [Special Tools](#).

2. Measure the resistance between the OSS high signal circuit and the OSS low signal circuit. The resistance should be between 1,650-3,180 ohms.

If the value is greater than 3,180 ohms test the OSS high signal circuit and the OSS low signal circuit for an open. If the value is less than 1,650 ohms test the OSS high signal and the OSS low signal circuits for a shorted together condition.

3. Measure the resistance of the OSS high signal circuit to ground. The resistance should be greater than 10K ohms. If the value is less than 10K ohms, repair the short to ground.
4. Measure the resistance between the ISS low signal circuit and ground. The resistance should be greater than 10K ohms. If the value is less than 10K ohms, repair the short to ground.
5. Reconnect the TCM connector. Disconnect the OSS connector. Ignition ON, test the ISS high signal circuit for a short to voltage.
6. If all circuits/connections test normal, test or replace the OSS.

Component Testing

1. Verify the OSS resistance is between 1,650-3,180 ohms.

If the resistance is not within the specified range, replace the OSS.

2. Using the **J 35616** connect the DMM between the OSS high signal and the OSS low signal circuits at the OSS connector. See **Special Tools**. Raise and support the drive wheels. While rotating the drive wheels by hand ensure the AC voltage reading on the DMM is above 0.4 volts.

If the AC voltage is not above 0.4 volts, replace the OSS.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Ensure that the output speed is 500 RPM or greater for 3 seconds and does not change by 500 RPM or greater For 3 seconds.
- **Vehicle Speed Sensor (VSS) Replacement**
- **Control Module References** for TCM replacement, setup, and programming

DTC P0741, P0751, OR P0756

DTC Descriptor

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This diagnostic procedure supports the following DTCs:

- DTC P0741 Torque Converter Clutch (TCC) System - Stuck Off
- DTC P0751 1-2 Shift solenoid (SS) Valve Performance - No First or Fourth Gear
- DTC P0756 2-3 Shift Solenoid (SS) Valve Performance - No First or Second Gear

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0741, P0751, or P0756

Hydraulic Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
1-2 SS Valve	-	-	-	P0751, P0752
2-3 SS Valve	-	-	-	P0756, P0757
TCC PWM Valve	-	-	-	P0741, P0742

Scan Tool Parameter Data

Circuit	Normal	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
1-2 Sol. CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts
2-3 Sol. CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts
TCC Duty Cycle CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts

Circuit/System Description

The transmission control module (TCM) controls the torque converter clutch pulse width modulation (TCC PWM) solenoid valve. The solenoid controls the hydraulic fluid for TCC apply and release. When the TCC is fully applied, the engine is coupled directly to the transmission through the TCC. The TCC used is an electronically controlled capacity clutch (ECCC). The TCM will normally allow a small amount of slip to occur with the ECCC. When the TCC is engaged, TCC slip speed is maintained at approximately 20 to 50 RPM. The 1-2 shift solenoid (SS) valve and the 2-3 SS valve are supplied with fused ignition voltage. The ground path is controlled by the TCM. When the TCM commands the solenoid OFF, a ground path is not provided and the filtered line pressure that is fed to the solenoid is exhausted. When the TCM commands the solenoid ON, a ground path is provided and the exhaust port is blocked, stopping the exhaust of line pressure. The TCM identifies a 1-2 SS

valve or a 2-3 SS valve condition by monitoring the commanded gear versus gear ratio. Refer to **Shift Solenoid Valve State and Gear Ratio**.

Conditions for Running the DTC

- No TP sensor DTCs P0121, P0122, or P0123.
- No ISS DTCs P0716 or P0717.
- No OSS DTCs P0722 or P0723.
- No TCC system stuck ON DTC P0742.
- The engine speed is greater than 500 RPM for 5 seconds.
- The transmission fluid temperature is between 20-130°C (68-266°F).
- The engine torque is greater than 50 N.m (37 lb ft).

DTC P0741

- No TCC release switch DTCs P0842 or P0843.
- The calc. throttle position is between 8-90 percent.
- The TCC PWM solenoid valve is commanded ON.
- The TCC duty cycle is 65 percent or greater for 5 seconds.
- The commanded gear is 2nd, 3rd, or 4th.

DTC P0751

- No 1-2 SS valve electrical DTCs P0973 or P0974.
- No 2-3 SS valve electrical DTCs P0976 or P0977.
- The calc. throttle position is 8 percent or more.
- The transmission ISS is 150 RPM or more.
- The transmission OSS is 200 RPM or more.
- The time since the last gear change is 1 second.

DTC P0756

- No 1-2 SS valve electrical DTCs P0973 or P0974.
- No 2-3 SS valve electrical DTCs P0976 or P0977.
- The calc. throttle position is 8 percent or more.
- The transmission ISS is 150 RPM or more.
- The time since the last gear change is 1.5 seconds.

Conditions for Setting the DTC**DTC P0741**

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The TCC slip speed is 150 RPM or greater for 8 seconds 2 times during the same ignition cycle.

DTC P0751

The following conditions both occur twice in one trip:

Condition 1

The TCM commands 1st gear and the gear ratio indicates 2nd gear, 1.54:1 to 1.71:1, for 2 seconds.

Condition 2

The TCM commands 4th gear and the gear ratio indicates 3rd gear, 0.95:1 to 1.05:1, for 4 seconds.

DTC P0756

The following conditions both occur twice in one trip:

Condition 1

The TCM commands 1st gear with the transmission OSS 200 RPM or more, the TCC slip speed is -20 RPM or more, and the gear ratio indicates 4th gear, 0.65:1 to 1.87:1, for 2 seconds.

Condition 2

The TCM commands 2nd gear and the gear ratio indicates 3rd gear, 0.95:1 to 1.05:1, for 3 seconds.

Action Taken When the DTC Sets

- DTCs P0741 and P0751 are Type B DTCs.
- DTC P0756 is a Type A DTC.
- The TCM freezes transmission adaptive functions.

DTC P0741

- The TCM forces the TCC OFF.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear if the transmission is in Hot Mode.

DTC P0751

The TCM commands maximum line pressure.

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DTC P0756

- The TCM commands maximum line pressure.
- The TCM inhibits 1st gear.

Conditions for Clearing the DTC

- DTCs P0741 and P0751 are Type B DTCs.
- DTC P0756 is a Type A DTC.

Diagnostic Aids

If the DTC is cleared, then will not reset when the vehicle is driven, some of the following conditions may exist:

- Fluid contamination
- Plugged fluid circuits
- Restricted fluid circuits

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [Automatic Transmission Inline 20-Way Connector End View](#)
- [Automatic Transmission Internal Connector End Views](#)
- [Automatic Transmission Related Connector End Views](#)

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

- [Scan Tool Data List](#)
- [Scan Tool Data Definitions](#)
- [Scan Tool Output Controls](#)

DTC Type Reference

- **Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List/Type**

Circuit/System Testing

1. Perform the **Transmission Fluid Checking Procedure**.

Correct the transmission fluid level if the fluid is not at the proper level.

2. Using the scan tool, clear the DTC. If DTC P0741 was set, operate the vehicle above 72 km/h (45 mph) and use the scan tool to command the TCC ON. Observe the TCC Slip Speed parameter on the scan tool. The TCC Slip Speed should be below 175 RPM.

If the TCC Slip Speed is greater than 175 RPM, inspect the following components and repair or replace as necessary:

- The cooling system for plugging-the cooling lines may be pinched. Refer to **Automatic Transmission Oil Cooler Flushing and Flow Test (J 45096)** or **Automatic Transmission Oil Cooler Flushing and Flow Test (J 35944-A)**.
 - The TCC control valve for sticking
 - The TCC regulator valve for sticking
 - The pressure regulator valve
 - The TCC PWM solenoid valve stuck and O-ring seal for leaks-refer to **Control Valve Body Disassemble** in Transmission Overhaul article.
 - The TCC blowoff valve or spring for damage or not seating-refer to **Case Inspection** in Transmission Overhaul article.
 - The TCC signal orifice in the spacer plate plugged
 - The #1 check ball missing or leaking
 - The spacer plate gaskets torn or leaking-refer to **Control Valve Body Assemble** in Transmission Overhaul article.
 - The turbine shaft seals for leaks-refer to **Torque Converter Assembly Removal** in Transmission Overhaul article.
 - The torque converter clutch-refer to **Torque Converter Diagnosis Procedure**.
3. Using the scan tool, clear the DTC. If DTC P0751 or P0756 is set, drive the vehicle and ensure that the TCM commands 1st, 2nd, 3rd, and 4th gears. The ratios should match the commanded gear for all gears. Refer to **Shift Solenoid Valve State and Gear Ratio**.

If the gear ratios do not match the commanded gear, inspect the following and repair or replace as necessary:

DTC P0751

- The 1-2 shift solenoid mechanically stuck OFF
- A stuck or binding 1-2 shift valve
- Damaged seals on the shift solenoid valve

DTC P0756

- The 2-3 shift solenoid mechanically stuck OFF
- A stuck or binding 2-3 shift valve
- Damaged seals on the shift solenoid valve

Component Testing

1. Perform the **Shift Solenoid Leak Test**.

If the solenoid fails the shift solenoid leak test, replace the affected solenoid.

2. Disconnect the wiring harness connector from the affected solenoid. Measure the resistance for the affected solenoid. The resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. The resistance should be between 10-15 ohms for the TCC PWM solenoid.

If the resistance is not within the specified range, replace the affected solenoid.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Allow the transmission to operate through all gears and all the TCC to engage. Ensure that the gear ratios match each commanded gear and the TCC slip speed is less than 55 RPM when the TCC is commanded ON.
- **Shift Solenoid Leak Test**
- **1-2 Shift Solenoid Valve Replacement**
- **2-3 Shift Solenoid Valve Replacement**
- **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Replacement**
- **Control Valve Body Disassemble**
- **Case Side Cover Removal and Side Cover/Gaskets, Disassemble, Assemble, Install in Transmission Overhaul article**

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DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0742 Torque Converter Clutch (TCC) System - Stuck On
- DTC P0752 1-2 Shift solenoid (SS) Valve Performance - No Second or Third Gear
- DTC P0757 2-3 Shift Solenoid (SS) Valve Performance - No Third or Fourth Gear

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0742, P0752, or P0757

Hydraulic Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
1-2 SS Valve	-	-	-	P0751, P0752
2-3 SS Valve	-	-	-	P0756, P0757
TCC PWM Valve	-	-	-	P0741, P0742

Scan Tool Parameter Data

Circuit	Normal	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
1-2 Sol. CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts
2-3 Sol. CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts
TCC Duty Cycle CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts

Circuit/System Description

The transmission control module (TCM) controls the torque converter clutch pulse width modulation (TCC PWM) solenoid valve. The solenoid controls the hydraulic fluid for TCC apply and release. When the TCC is fully applied, the engine is coupled directly to the transmission through the TCC. The TCC used is an electronically controlled capacity clutch (ECCC). The TCM will normally allow a small amount of slip to occur with the ECCC. When the TCC is engaged, TCC slip speed is maintained at approximately 20-50 RPM. The 1-2 shift solenoid (SS) valve and the 2-3 SS valve are supplied with fused ignition voltage. The ground path is controlled by the TCM. When the TCM commands the solenoid OFF, a ground path is not provided and the filtered line pressure that is fed to the solenoid is

exhausted. When the TCM commands the solenoid ON, a ground path is provided and the exhaust port is blocked, stopping the exhaust of line pressure. The TCM identifies a 1-2 SS valve or a 2-3 SS valve condition by monitoring the commanded gear versus gear ratio. Refer to **Shift Solenoid Valve State and Gear Ratio**.

Conditions for Running the DTC

- No TP sensor DTCs P0121, P0122, or P0123.
- No ISS DTCs P0716 or P0717.
- No OSS DTCs P0722 or P0723.
- No TCC system stuck ON DTC P0742.
- The engine speed is greater than 500 RPM for 5 seconds.
- The transmission fluid temperature is between 20-130°C (68-266°F).

DTC P0742

- No TCC system stuck OFF DTC P0741.
- The calc. throttle position is between 8-90 percent.
- The TCC PWM solenoid valve is commanded OFF.
- The gear ratio is between 0.66:1 and 1.68:1.
- The engine torque is greater than 50 N.m (37 lb ft).
- The vehicle speed is 16 km/h (10 mph) or greater.

DTC P0752

- No TCC system stuck ON DTC P0742.
- No 1-2 SS valve electrical DTCs P0973 or P0974.
- No 2-3 SS valve electrical DTCs P0976 or P0977.
- The calc. throttle position is 8 percent or more.
- The transmission ISS is 150 RPM or more.
- The transmission OSS is 200 RPM or more.
- The engine torque is greater than 50 N.m (37 lb ft).
- The time since the last gear change is 1 second.

DTC P0757

- No TCC system stuck ON DTC P0742.
- No 1-2 SS valve electrical DTCs P0973 or P0974.
- No 2-3 SS valve electrical DTCs P0976 or P0977.
- The calc. throttle position is 8 percent or more.

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- The transmission ISS is 150 RPM or more.
- The transmission OSS is 200 RPM or more.
- The engine torque is 40 N.m (29 lb ft) or more when 3rd gear is commanded.
- The time since the last gear change is 1 second.

Conditions for Setting the DTC

DTC P0742

The TCC slip speed is between -20 and 40 RPM for 6 seconds 3 times during the same ignition cycle.

DTC P0752

The following conditions both occur twice in one trip:

Condition 1

The TCM commands 2nd gear and the gear ratio indicates 1st gear, 2.81:1 to 3.11:1 for 2 seconds.

Condition 2

The TCM commands 3rd gear and the gear ratio indicates 4th gear, 0.65:1 to 0.72:1, for 3 seconds.

DTC P0757

The following conditions both occur twice in one trip:

Condition 1

The TCM commands 3rd gear and the gear ratio indicates 2nd gear, 1.54:1 to 1.71:1 for 2 seconds.

Condition 2

The TCM commands 4th gear and the gear ratio indicates 1st gear, 1.54:1 to 3.11:1, for 2 seconds.

Action Taken When the DTC Sets

- DTCs P0742 and P0752 are Type B DTCs.
- DTC P0757 is a Type A DTC.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.

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DTC P0742

The TCM commands the TCC ON at maximum capacity.

DTC P0752

The TCM inhibits 3-2 downshifts when the vehicle speed is greater than 52 km/h (32 mph).

DTC P0757

The TCM inhibits 4th gear.

Conditions for Clearing the DTC

- DTCs P0742 and P0752 are Type B DTCs.
- DTC P0757 is a Type A DTC.

Diagnostic Aids

If the DTC is cleared, then will not reset when the vehicle is driven, some of the following conditions may exist:

- Fluid contamination
- Plugged fluid circuits
- Restricted fluid circuits

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **Automatic Transmission Inline 20-Way Connector End View**
- **Automatic Transmission Internal Connector End Views**
- **Automatic Transmission Related Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**
- **Scan Tool Output Controls**

DTC Type Reference

- **Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List/Type**

Circuit/System Verification

Start and idle the engine. Using the scan tool output controls, command the affected solenoid ON and OFF. Observing the CKT Status parameter on the scan tool for the affected solenoid, ensure that the parameter displays OK.

Circuit/System Testing

1. Perform the **Transmission Fluid Checking Procedure**.

Correct the transmission fluid level if the fluid is not at the proper level.

2. Using the scan tool, clear the DTC. If DTC P0742 was set, operate the vehicle above 72 km/h (45 mph) with the Calc. Throttle Position between 8 and 90 percent and use the scan tool to command the TCC OFF. Observe the TCC slip speed parameter on the scan tool. The TCC slip speed should be greater than 60 RPM.

If the TCC Slip Speed is less than 60 RPM, inspect the following components and repair or replace as necessary:

- The TCC control valve stuck in the apply position
 - The TCC PWM solenoid valve stuck, exhaust restricted or faulty internal O-ring
 - The TCC fluid circuits leaking-refer to **Control Valve Body Disassemble** in Transmission Overhaul article.
 - The TCC blowoff valve or spring for damage or not seating-refer to **Case Inspection** in Transmission Overhaul article.
 - Turbine shaft seals for leaks-refer to **Torque Converter Assembly Removal** in Transmission Overhaul article.
 - Spacer plate gaskets torn or leaking-refer to **Control Valve Body Assemble** in Transmission Overhaul article.
 - Pressure regulator valve stuck-refer to **Control Valve Body Disassemble** in Transmission Overhaul article.
 - Abnormally high or low line pressure-refer to **Line Pressure Check Procedure**.
3. Using the scan tool, clear the DTC. If DTC P0752 or P0757 is set, drive the vehicle and

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ensure that the TCM commands 1st, 2nd, 3rd, and 4th gears. The ratios should match the commanded gear for all gears. Refer to **Shift Solenoid Valve State and Gear Ratio**.

If the gear ratios do not match the commanded gear, inspect the following and repair or replace as necessary:

DTC P0752

- The 1-2 shift solenoid mechanically stuck ON
- A stuck or binding 1-2 shift valve

DTC P0757

- The 2-3 shift solenoid mechanically stuck ON
- A stuck or binding 2-3 shift valve

Component Testing

1. Perform the **Shift Solenoid Leak Test**.

If the solenoid fails the shift solenoid leak test, replace the affected solenoid.

2. Disconnect the wiring harness connector from the affected solenoid. Measure the resistance for the affected solenoid. The resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. The resistance should be between 10-15 ohms for the TCC PWM solenoid.

If the resistance is not within the specified range, replace the affected solenoid.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Allow the transmission to operate through all gears. Ensure that the gear ratios match each commanded gear and the TCC slip speed is 150 RPM or greater when the TCC is commanded OFF.
- **Shift Solenoid Leak Test**
- **1-2 Shift Solenoid Valve Replacement**
- **2-3 Shift Solenoid Valve Replacement**
- **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Replacement**
- **Control Valve Body Disassemble**

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- **Case Side Cover Removal and Side Cover/Gaskets, Disassemble, Assemble, Install** in Transmission Overhaul article

DTC P0842 OR P0843

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0842 Transmission Fluid Pressure (TFP) Sensor Circuit Low Voltage
- DTC P0843 Transmission Fluid Pressure (TFP) Sensor Circuit High Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0842 or P0843

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
TCC Release Switch Signal	P0842	P0843	P0843	-

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: Yes			
TCC Release Pressure	No	Yes	Yes

Circuit/System Description

The torque converter clutch (TCC) release switch is part of the transmission fluid pressure (TFP) manual valve position switch. The TFP manual valve position switch is mounted to the transmission valve body. The TCC release switch is normally closed. The switch signals the transmission control module (TCM) that the TCC is released. This is accomplished by torque converter release fluid pressure acting on the switch contact which opens the circuit. When the circuit voltage is high, the TCM recognizes that the TCC is no longer engaged.

Conditions for Running the DTC

- No ISS DTCs P0716 or P0717.
- No TCC performance DTCs P0741 or P0742.
- No TCC PWM solenoid valve electrical DTCs P2763 or P2764.
- The engine speed is greater than 500 RPM for 5 seconds.

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- The transmission fluid temperature is between 20-130°C (68-266°F).
- The engine torque is 50 N.m (37 lb ft) or more.

DTC P0842

- The TCC is commanded OFF.
- the TCC slip speed is greater than 100 RPM.
- The vehicle speed is 16 km/h (10 mph) or more.

DTC P0843

- The TCC is commanded ON.
- The TCC slip speed is -20 to 60 RPM.

Conditions for Setting the DTC

DTC P0842

The TCC release pressure switch is closed indicating release pressure not present for 8 seconds twice during the same ignition cycle.

DTC P0843

The TCC release pressure switch is open indicating release pressure present for 6 seconds continuous twice during the same ignition cycle.

Action Taken When the DTC Sets

- DTCs P0842 and P0843 are Type B DTCs.
- The TCM freezes transmission adaptive functions.
- The TCM inhibits 4th gear if the transmission is in Hot Mode.

DTC P0842

- The TCM commands maximum line pressure.
- The TCM commands the TCC ON at maximum capacity.

DTC P0843

- The TCM forces the TCC OFF.
- The TCM inhibits TCC engagement.

Conditions for Clearing the DTC

DTCs P0842 and P0843 are Type B DTCs.

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Diagnostic Aids

- Do not replace the torque converter for this condition. Refer to **Torque Converter Diagnosis Procedure** for other concerns.
- Ensure the wiring harness is not stretched too tightly or other components are pressing on the AT inline 20-way connector body. Also inspect for proper clearance to any other components and wiring. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **Automatic Transmission Inline 20-Way Connector End View**
- **Automatic Transmission Internal Connector End Views**
- **Automatic Transmission Related Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**
- **Scan Tool Output Controls**

DTC Type Reference

- **Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List/Type**

Special Tools Required

- **J 35616** GM Terminal Test Kit. See **Special Tools**.
- **J 44152** Jumper Harness (20 pins). See **Special Tools**.

Circuit/System Verification

Start the engine in PARK and observe the TCC Release Pressure parameter on the scan tool. The TCC Release Pressure should display Yes. Drive the vehicle in D4 until the transmission shifts into 4th gear and the TCC is commanded ON. Observe the TCC Release Pressure parameter on the scan tool. The TCC Release Pressure should display No.

Circuit/System Testing

1. Drive the vehicle in D4 until the transmission shifts into 4th gear and the TCC is commanded ON. Observe the TCC Release Pressure parameter on the scan tool. The TCC Release Pressure should display No.

If the TCC Release Pressure displays Yes, turn OFF the engine and disconnect the AT 20-way inline connector. Using the **J 35616**, jumper the TCC release switch circuit at the engine harness side to ground. See **Special Tools**. Turn ON the ignition with the engine OFF. If the TCC Release switch parameter displays Yes, test the TCC release switch circuit for an open between the TCM and the AT 20-way inline connector. If the parameter displays NO, test the TCC release switch signal circuit for an open between the AT 20-way inline connector and the TFP manual valve position switch.

2. Reconnect the AT 20-way inline connector. Start the engine and observe the TCC Release Pressure parameter on the scan tool. The TCC Release Pressure should indicate Yes.

If the TCC Release Pressure displays No, disconnect the AT 20-way inline connector.

3. With the AT 20-way inline connector disconnected, observe the TCC Release Pressure parameter on the scan tool. The parameter should display Yes.

If the parameter displays Yes, test the TCC release switch signal circuit for a short to ground between the AT 20-way inline connector and the TFP manual valve position switch. If the parameter displays No, test the TCC release switch signal circuit for a short to ground between the TCM and the AT 20-way inline connector.

4. Inspect for the following conditions that would cause TCC release pressure to be present when the TCC is applied:
 - The turbine shaft O-ring seal leaking
 - The turbine shaft oil seal rings missing or damaged-refer to **Torque Converter Assembly Removal** in Transmission Overhaul article.
 - The TCC control valve damaged-refer to **Control Valve Body Disassemble** in Transmission Overhaul article.
 - The #1 checkball damaged
 - The spacer plate release exhaust blocked with debris-refer to **Control Valve Body**

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Assemble in Transmission Overhaul article.

- The case cover or spacer plate gaskets improperly installed-refer to **Case Side Cover Removal** in Transmission Overhaul article.

If any of the conditions are found, repair as necessary.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Transmission Fluid Pressure (TFP) Manual Valve Position Switch Replacement
- Wiring Harness Replacement
- Control Module References for TCM replacement, setup, and reprogramming.
- Operate the vehicle with the TCC commanded OFF and commanded ON. Ensure that the TCC slip speed is 150 RPM or greater when the TCC is commanded OFF and the TCC release switch is open for 5 seconds. Ensure that the TCC slip speed is between -20 and +60 RPM with the TCC commanded ON and the TCC release switch is closed for 5 seconds.

DTC P0961

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P0961 Line Pressure Control (PC) Solenoid System Performance

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0961

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
PC Solenoid High Control	P0961	P0961	P0961	P0961
PC Solenoid Low Control	P0961	P0961	P0961	P0961

Scan Tool Parameter Data

Circuit	Normal	Short to Ground	Open/High Resistance	Short to Voltage
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Operating Conditions: Engine running in Park, normal operating temperature

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Parameter Normal Range: 0.02-1.10 amps

PC Sol. Actual Current	0.02-1.10 amps	Less than 0.02 amps	Less than 0.02 amps	Less than 0.02 amps
PC Sol. Ref. Current	0.02-1.10 amps	Less than 0.02 amps	Less than 0.02 amps	Less than 0.02 amps

Circuit/System Description

The pressure control (PC) solenoid valve is located in the valve body. The PC solenoid valve controls transmission line pressure based on current flow through the windings. The transmission control module (TCM) determines desired line pressure based on throttle position and other inputs. The TCM then varies the duty cycle on the high side of the PC solenoid valve to control current flow to the solenoid. Current is controlled from about 0.02 amps for maximum line pressure to 1.1 amps for minimum line pressure. The TCM monitors the actual current to the solenoid.

Conditions for Running the DTC

The PC solenoid valve is enabled.

Conditions for Setting the DTC

The PC solenoid duty cycle is outside the range of 0.5-95 percent for 4 seconds.

Action Taken When the DTC Sets

DTC P0961 is a Type C DTC.

Conditions for Clearing the DTC

DTC P0961 is a Type C DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views
- Automatic Transmission Related Connector End Views

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**
- **Scan Tool Output Controls**

Special Tools Required

- **J 35616** GM Terminal Test Kit. See **Special Tools**.
- **J 44152** Jumper Harness (20 pins). See **Special Tools**.

Circuit/System Verification

Start and idle the engine. Using the scan tool, select PC Solenoid under the Transmission Output Controls. With the scan tool, command several values of solenoid reference current from 0.1 amp through 1.1 amp and observe the PC Sol. Actual Current and the PC Sol. Ref. Current. The PC Sol. Actual Current should not vary from the PC Sol. Ref. Current by more than 0.16 amps.

Circuit/System Testing

1. Disconnect the AT inline 20-way connector. Install the **J 44152** on the transmission side on the connector. See **Special Tools**. Using the **J 35616**, measure the resistance between the PC solenoid high control circuit and the PC solenoid low control circuit. See **Special Tools**. The resistance should be between 3-7 ohms.

If the resistance is greater than 7 ohms, test the PC solenoid high control circuit or the PC solenoid low control circuit for an open or a faulty PC solenoid valve. If the resistance is less than 3 ohms, test for the PC solenoid high control circuit and the PC solenoid low control circuit shorted together of a faulty PC solenoid valve.

2. Measure the resistance between the PC solenoid high control circuit and the transmission case. Measure the resistance between the PC solenoid low control circuit and the transmission case. The resistance should be greater than 10K ohms.

If the resistance is less than 10K ohms, replace the automatic transmission wiring harness assembly.

3. Measure the resistance between the PC solenoid high control circuit and all other

circuits of the **J 44152** except the PC solenoid low control circuit. See **Special Tools**. Measure the resistance between the PC solenoid low control circuit and all other circuits of the **J 44152** except the PC solenoid high control circuit. See **Special Tools**. The resistance should be greater than 10K ohms.

If the resistance is less than 10K ohms, replace the automatic transmission wiring harness assembly.

4. Remove the **J 44152** from the transmission side and install on the engine side of the harness. See **Special Tools**. Disconnect the TCM connector. Using the **J 35616**, measure the resistance of the PC solenoid high control circuit between the TCM connector and the AT inline 20-way connector. See **Special Tools**. Measure the resistance of the PC solenoid low control circuit between the TCM connector and the AT inline 20-way connector. The resistance should be less than 10 ohms for each circuit.

If the value is greater than 10 ohms, repair the open in the affected circuit.

5. Measure the resistance between the PC solenoid high control circuit and ground. Measure the resistance between the PC solenoid low control circuit and ground. The resistance for each circuit should be greater than 10K ohms.

If the value is less than 10K ohms, repair the short to ground in the affected circuit.

6. Reconnect the TCM connector. Turn ON the ignition with the engine OFF. Test the PC solenoid high control circuit and the PC solenoid low control circuit for a short to voltage.

If a short to voltage condition is found, repair as necessary.

7. If all circuits/connections test normal, test or replace the PC solenoid valve.

Component Testing

Verify the PC solenoid valve resistance is between 3-7 ohms.

If the resistance is not within the specified range, replace the PC solenoid valve.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- Pressure Control Solenoid (PCS) Replacement
- Wiring Harness Replacement

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- **Control Module References** for TCM replacement, setup, and programming.

DTC P0973, P0976, OR P2764

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0973 1-2 Shift Solenoid (SS) Control Circuit Low Voltage
- DTC P0976 2-3 Shift Solenoid (SS) Control Circuit Low Voltage
- DTC P2764 Torque Converter Clutch (TCC) Pressure Control (PC) Solenoid Control Circuit Low Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0973, P0976, or P2764

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Ignition 1 Voltage	P0973, P0976, P2764	P0973, P0976, P2764	-
1-2 SS Valve control	P0973	P0973	P0974
2-3 SS Valve Control	P0976	P0976	P0977
TCC PWM Valve Control	P2764	P2764	P2763

Scan Tool Parameter Data

Circuit	Normal	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK				
1-2 Sol. CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts
2-3 Sol. CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts
TCC Duty Cycle CKT Status	OK	Open/Short to GND	Open/Short to GND	Short to Volts

Circuit/System Description

The 1-2 shift solenoid (SS) valve and the 2-3 SS valves control transmission fluid pressure acting on the shift valves to position the valves for the appropriate gear. The 1-2 SS and the

2-3 SS valves are normally-open exhaust valves located on the control valve body. A fused circuit supplies ignition voltage to the 1-2 SS valve and the 2-3 SS valve. The transmission control module (TCM) commands the solenoid ON or OFF by switching the ground path. When the 1-2 SS valve or the 2-3 SS valve is commanded ON, the TCM senses low voltage. When the 1-2 SS valve or the 2-3 SS valve is commanded OFF, the TCM senses high voltage. The torque converter clutch pulse width modulated (TCC PWM) solenoid valve is a normally closed solenoid used to control the apply and release of the converter clutch. The TCM operates the solenoid with a negative duty cycle. When vehicle operating conditions are appropriate to apply the TCC, the TCM immediately increases the duty cycle to approximately 42 percent. The TCM then ramps the duty cycle to approximately 90 percent to achieve full TCC apply pressure. When the solenoid is commanded OFF, the TCM senses high voltage. When the solenoid is commanded ON, the TCM senses low voltage.

Conditions for Running the DTC

The engine speed is greater than 500 RPM for 5 seconds.

Conditions for Setting the DTC**DTC P0973**

The TCM detects an open or short to ground on the 1-2 SS valve control circuit for 4.4 seconds.

DTC P0976

The TCM detects an open or short to ground on the 2-3 SS valve control circuit for 4.4 seconds.

DTC P2764

The TCM detects an open or short to ground on the TCC PWM solenoid valve control circuit for 4.4 seconds.

Action Taken When the DTC Sets

- DTCs P0973 and P2764 are Type B DTCs.
- DTC P0976 is a Type A DTC.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.

DTC P0973

The TCM inhibits 3-2 downshifts when the vehicle speed is greater than 52 km/h (32 mph).

DTC P0976

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The TCM commands a soft landing to 2nd gear.

DTC P2764

- The TCM forces the TCC solenoid OFF.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear when in HOT mode.

Conditions for Clearing the DTC

- DTCs P0973 and P2764 are Type B DTCs.
- DTC P0976 is a Type A DTC.

Reference Information

Schematic Reference

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Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

DTC Type Reference

- Diagnostic Trouble Code (DTC) Type Definitions
- Diagnostic Trouble Code (DTC) List/Type

Special Tools Required

- **J 35616** GM Terminal Test Kit. See **Special Tools**.
- **J 44152** Jumper Harness (20 pins). See **Special Tools**.

Circuit/System Verification

Start and idle the engine. Using the scan tool output controls command the 1-2 SS ON and OFF. Observing the 1-2 Sol. CKT Status parameter on the scan tool, ensure that the parameter shows OK.

Circuit/System Testing

1. Inspect the TRANS fuse for an open.

If the fuse is open, test the ignition 1 voltage circuit and the affected control circuit for a short to ground between the Fuse Block-Underhood and the AT inline 20-way connector.

2. Disconnect the AT inline 20-way connector. Connect the **J 44152** to the engine side of the connector. See **Special Tools**. Using the **J 35616**, connect a test lamp between the ignition 1 voltage circuit and the affected control circuit. See **Special Tools**. Turn On the ignition with the engine OFF. Using the scan tool output controls command the affected solenoid ON and OFF. The test lamp should blink ON and OFF as commanded.

If the test lamp is always OFF, test the circuits for an open.

3. Connect the **J 44152** to the transmission side of the connector. See **Special Tools**. Using the **J 35616**, measure the resistance between the ignition 1 voltage circuit and the affected control circuit. See **Special Tools**. Resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. Resistance should be between 10-15 ohms for the TCC PWM solenoid valve.

If resistance is greater than the specified range, test the circuits for an open. If the resistance is less than the specified range, test for a faulty solenoid or a shorted together condition.

4. Measure the resistance between the ignition 1 voltage circuit and the transmission case. The resistance should be greater than 10K ohms.

If the resistance is less than 10K ohms, test the ignition 1 voltage circuit for a short to ground.

5. Measure the resistance between the affected control circuit and ground. The resistance should be greater than 10K ohms.

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If the resistance is greater than 10K ohms, test the affected control circuit for a short to ground.

Component Testing

1. Using the **J 44152** and the **J 35616**, measure the resistance between the ignition 1 voltage circuit and the affected control circuit. See **Special Tools**. The resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. The resistance should be between 10-15 ohms for the TCC PWM solenoid.

If the resistance is not within the specified range, remove the case side cover.

2. Disconnect the wiring harness connector from the affected solenoid. Measure the resistance of the affected control circuit. The resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. The resistance should be between 10-15 ohms for the TCC PWM solenoid.

If the resistance is not within the specified range, replace the affected solenoid.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- **1-2 Shift Solenoid Valve Replacement**
- **2-3 Shift Solenoid Valve Replacement**
- **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Replacement**
- **Case Side Cover Removal and Side Cover/Gaskets, Disassemble, Assemble, Install** in Transmission Overhaul article
- **Control Module References** for TCM replacement, setup, and reprogramming.

DTC P0974, P0977, OR P2763

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P0974 1-2 Shift Solenoid (SS) Control Circuit High Voltage
- DTC P0977 2-3 Shift Solenoid (SS) Control Circuit High Voltage
- DTC P2763 Torque Converter Clutch (TCC) Pressure Control (PC) Solenoid Control Circuit High Voltage

Diagnostic Fault Information

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IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P0974, P0977, or P2763

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Ignition 1 Voltage	P0973, P0976, P2764	P0973, P0976, P2764	-
1-2 SS Valve control	P0973	P0973	P0974
2-3 SS Valve Control	P0976	P0976	P0977
TCC PWM Valve Control	P2764	P2764	P2763

Scan Tool Parameter Data

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature Parameter Normal Range: OK			
1-2 Sol. CKT Status	Open/Short to GND	Open/Short to GND	Short to Volts
2-3 Sol. CKT Status	Open/Short to GND	Open/Short to GND	Short to Volts
TCC Duty Cycle CKT Status	Open/Short to GND	Open/Short to GND	Short to Volts

Circuit/System Description

The 1-2 shift solenoid (SS) valve and the 2-3 SS valves control transmission fluid pressure acting on the shift valves to position the valves for the appropriate gear. The 1-2 SS and the 2-3 SS valves are normally-open exhaust valves located on the control valve body. A fused circuit supplies ignition voltage to the 1-2 SS valve and the 2-3 SS valve. The transmission control module (TCM) commands the solenoid ON or OFF by switching the ground path. When the 1-2 SS valve or the 2-3 SS valve is commanded ON, the TCM senses low voltage. When the 1-2 SS valve or the 2-3 SS valve is commanded OFF, the TCM senses high voltage. The torque converter clutch pulse width modulated (TCC PWM) solenoid valve is a normally closed solenoid used to control the apply and release of the converter clutch. The TCM operates the solenoid with a negative duty cycle. When vehicle operating conditions are appropriate to apply the TCC, the TCM immediately increases the duty cycle to approximately 42 percent. The TCM then ramps the duty cycle to approximately 90 percent to achieve full TCC apply pressure. When the solenoid is commanded OFF, the TCM senses high voltage. When the solenoid is commanded ON, the TCM senses low voltage.

Conditions for Running the DTC

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The engine speed is greater than 500 RPM for 5 seconds.

DTC P2763

The TCC is commanded ON.

Conditions for Setting the DTC

DTC P0974

The TCM detects a short to voltage on the 1-2 SS valve control circuit for 4.4 seconds.

DTC P0977

The TCM detects a short to voltage on the 2-3 SS valve control circuit for 4.4 seconds.

DTC P2763

The TCM detects a short to voltage on the TCC PWM solenoid valve control circuit for 4.4 seconds.

Action Taken When the DTC Sets

- DTCs P0974 and P2763 are Type B DTCs.
- DTC P0977 is a Type A DTC.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.

DTC P0977

The TCM inhibits 4th gear.

DTC P2763

- The TCM forces the TCC solenoid OFF.
- The TCM inhibits TCC engagement.
- The TCM inhibits 4th gear when in HOT mode.

Conditions for Clearing the DTC

- DTCs P0974 and P2763 are Type B DTCs.
- DTC P0977 is a Type A DTC.

Reference Information

Schematic Reference

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Scan Tool Reference

- Scan Tool Data List
- Scan Tool Data Definitions
- Scan Tool Output Controls

DTC Type Reference

- Diagnostic Trouble Code (DTC) Type Definitions
- Diagnostic Trouble Code (DTC) List/Type

Special Tools Required

- **J 35616** GM Terminal Test Kit. See Special Tools.
- **J 44152** Jumper Harness (20 pins). See Special Tools.

Circuit/System Verification

Start and idle the engine. Using the scan tool output controls, command the affected solenoid ON and OFF. Observing the CKT Status parameter on the scan tool for the affected solenoid, ensure that the parameter displays OK.

Circuit/System Testing

1. Disconnect the AT inline 20-way connector. Install the **J 44152** on the engine side of the AT inline 20-way connector. See Special Tools. Using the **J 35616**, connect a test lamp between the affected control circuit and ground. See Special Tools. Turn ON the ignition with the engine OFF. The test lamp should be OFF.

If the test lamp is ON, test the affected control circuit for a short to voltage between the Fuse Block-Underhood and the AT inline 20-way connector.

2. Disconnect the **J 44152** from the engine harness. See **Special Tools**. Connect the **J 44152** to the transmission side of the AT inline 20-way connector. See **Special Tools**. Using the **J 35616**, measure the resistance between the affected control circuit and the ignition 1 voltage circuit. See **Special Tools**. Resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. Resistance should be between 10-15 ohms for the TCC PWM solenoid valve.

If the resistance is less than the specified value, test for a short to the ignition 1 voltage circuit or a faulty solenoid.

3. Using the **J 35616**, measure the resistance between the affected control circuit and all other circuits in the **J 44152** except the ignition 1 voltage circuit and the other control circuits. See **Special Tools**. Resistance should be greater than 10 ohms.

If resistance is less than 10 ohms, test the control circuit for a short to another circuit.

Component Testing

1. Using the **J 44152** and the **J 35616** measure the resistance between the ignition 1 voltage circuit and the affected control circuit. See **Special Tools**. The resistance should be between 19-31 ohms for the 1-2 SS and the 2-3 SS. The resistance should be between 10-15 ohms for the TCC PWM solenoid.

If the resistance is not within the specified range, remove the case side cover.

2. Disconnect the wiring harness connector from the affected solenoid. Measure the resistance of the affected control circuit. The resistance should be between 19 and 31 ohms for the 1-2 SS and the 2-3 SS. The resistance should be between 10 and 15 ohms for the TCC PWM solenoid.

If the resistance is not within the specified range, replace the affected solenoid.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

- **1-2 Shift Solenoid Valve Replacement**
- **2-3 Shift Solenoid Valve Replacement**
- **Torque Converter Clutch Pulse Width Modulation (TCC PWM) Solenoid Replacement**
- **Case Side Cover Removal and Side Cover/Gaskets, Disassemble, Assemble, Install**

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in Transmission Overhaul article

- **Control Module References** for TCM replacement, setup, and reprogramming.

DTC P1810, P1816, OR P1818

DTC Descriptor

This diagnostic procedure supports the following DTCs:

- DTC P1810 Transmission Fluid Pressure (TFP) Position Switch Circuit
- DTC P1816 Transmission Fluid Pressure (TFP) Valve Position Switch Indicates Park/Neutral (P/N) with Drive Ratio
- DTC P1818 Transmission Fluid Pressure (TFP) Valve Position Switch Indicates Drive without Drive Ratio

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P1810, P1816, or P1818

Circuit	Short to Ground	Open/High Resistance	Short to Voltage
TFP Switch Signal B	P1810, P1816, P1818	P1816	-
TFP Switch Signal C	P1810, P1816, P1818	P1810, P1816, P1818	-

Scan Tool Parameter Data

Circuits	Normal	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature				
Parameter Normal Range: HI/HI				
TFP Sig B.	HI/HI	LOW/HI	HI/HI	HI/HI
TFP Sig C.	HI/HI	HI/LOW	HI/HI	HI/HI

Circuit/System Description

The automatic transmission fluid pressure (TFP) manual valve position switch consists of three pressure switches. Two of the switches are normally-open, and determine gear range selection. The third switch is normally-closed, and detects torque converter clutch (TCC) release fluid pressure. The TFP manual valve position switch also contains the automatic transmission fluid temperature (TFT) sensor. These components are combined into one unit, attached to the control valve body. The transmission control module (TCM) provides battery

voltage on the two range signal circuits. By grounding one or more of the switches with fluid pressure from the manual shift valve, the TCM detects the selected gear range. When you disconnect the transmission electrical connector and the ignition is ON, the ground potential for the range signals from the TCM will be removed, and an invalid gear range will be indicated. Refer to **Transmission Fluid Pressure (TFP) Manual Valve Position Switch Logic**.

Conditions for Running the DTC**DTC P1810**

The engine is running for 5 seconds.

DTC P1816

- No TP DTCs P0120 or P0220.
- No ISS DTCs P0716 or P0717.
- No OSS DTCs P0722 or P0723.
- No SS valve performance DTCs P0751, P0752, P0756, or P0757.
- No SS valve electrical DTCs P0973 or P0974, P0976, or P0977.
- The engine is running for 5 seconds.
- The Calc. Throttle Position is between 8 percent and 90 percent.
- The engine torque is greater than 50 N.m (37 lb ft).
- The output speed is 250 RPM or more.

DTC P1818

- No MAP DTCs P0107 or P0108.
- No TP DTCs P0120 or P0220.
- No ISS DTCs P0716 or P0717.
- No OSS DTCs P0722 or P0723.
- No SS valve performance DTCs P0751, P0752, P0756, or P0757.
- No SS valve electrical DTCs P0973 or P0974, P0976, or P0977.
- The engine is running for 5 seconds.
- The Calc. Throttle Position is 3 percent or more.
- The engine torque is greater than 20 N.m (15 lb ft).
- The output speed is 153 RPM or more.
- The transmission fluid temperature is greater than 0°C (32°F).

Conditions for Setting the DTC**DTC P1810**

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The TCM detects an invalid gear range for 60 seconds. Refer to **Transmission Fluid Pressure (TFP) Manual Valve Position Switch Logic**.

DTC P1816

The TCM detects P/N with a drive ratio for 6 seconds.

DTC P1818

The TCM detects a PARK, NEUTRAL, or a drive range with a REVERSE ratio for 3 seconds.

Action Taken When the DTC Sets

- DTCs P1810, P1816, and P1818 are Type B DTCs.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.

Conditions for Clearing the DTC

DTCs P1810, P1816, and P1818 are Type B DTCs.

Reference Information

Schematic Reference

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Connector End View Reference

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Scan Tool Reference

- **Scan Tool Data List**
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- **Scan Tool Output Controls**

DTC Type Reference

- **Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List/Type**

Special Tools Required

- **J 35616** GM Terminal Test Kit. See **Special Tools**.
- **J 44152** Jumper Harness (20 pins). See **Special Tools**.

Circuit/System Verification

Start and idle the engine. Using the scan tool, observe the TFP Sig. B/Sig. C parameter. The scan tool should display HI/HI. Move the gear selector through all ranges and ensure that the TFP Switch parameter matches the gear selector for each selected range.

Circuit/System Testing

1. Perform the Transmission Fluid Checking Procedure.

If the fluid level is at an incorrect level, repair any leaks found and add fluid to the proper level.

2. Disconnect the AT inline 20-way connector. Turn On the ignition with the engine OFF. Observe the TFP Sig. B/Sig. C parameter on the scan tool. The parameter should display HI/HI.

If the TFP sig. B/Sig. C parameter does not display HI/HI, repair the short to ground in the TFP signal circuit that displayed LOW.

3. Using a DMM, measure the voltage at the engine side of the AT 20-way connector between the TFP signal B circuit and ground and the TFP signal C circuit and ground. The voltage should be near 12 volts for each circuit.

If the voltage is less than the specified range, test the affected circuit for an open.

4. Turn OFF the ignition. Measure the resistance at the transmission side of the AT 20-way connector between the TFP signal B circuit and the transmission case. The resistance should be greater than 10K ohms.

If the resistance is less than 10K ohms, test the TFP signal B circuit for a short to ground.

5. Measure the resistance at the transmission side of the AT 20-way connector between the TFP signal C circuit and the transmission case. The resistance should be greater than 10K ohms.

If the resistance is less than 10K ohms, test the TFP signal C circuit for a short to ground.

6. Measure the resistance of the TFP signal B circuit between the transmission side of the AT 20-way connector and the TFP switch. The resistance should be less than 10 ohms.

If the resistance is greater than 10 ohms repair the open in the TFP signal B circuit.

7. Measure the resistance of the TFP signal C circuit between the transmission side of the AT 20-way connector and the TFP switch. The resistance should be less than 10 ohms.

If the resistance is greater than 10 ohms repair the open in the TFP signal C circuit.

8. If all circuits/connections test normal, replace the TCM.

Component Testing

1. Disconnect the AT 20-way connector. Using the **J 44152** and the **J 35616** measure the resistance between the TFP signal B circuit and the TFP signal C circuit at the transmission side of the AT 20-way connector and ground. See **Special Tools**. The resistance should be greater than 10K ohms.

If the resistance is not greater than the specified range, test the affected circuit for a short to ground. If a short to ground is not found, replace the TFP switch.

2. Start the engine. Measure the resistance between the TFP signal B circuit and the TFP signal C circuit at the transmission side of the AT 20-way connector and ground. The resistance should be less than 10 ohms. If the resistance is greater than 10 ohms, test the affected circuit for an open. If an open circuit is not found, replace the TFP switch.

Repair Instructions

IMPORTANT: Always perform the **Diagnostic Repair Verification** after completing the repair.

Transmission Fluid Pressure (TFP) Manual Valve Position Switch Replacement

Transmission Control Module Replacement. Refer to **Control Module References** for replacement, setup, and programming

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DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P1811 Maximum Adapt and Long Shift

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

Circuit/System Description

The transmission pressure is modified by an adaptive modifier which controls the shift execution time. This diagnostic tests the time required to accomplish the shift. If the shift takes longer than 0.65 seconds and the adaptive modifier cannot shorten this time, then a counter increases by one.

Conditions for Running the DTC

- The shift is adaptable.
- The 1-2, 2-3, or 3-4 shift adapt cell has reached the limit.

Conditions for Setting the DTC

The 1-2, 2-3, or 3-4 shift is longer than 0.65 seconds, twice in one trip.

Action Taken When the DTC Sets

- DTC P1811 is a Type C DTC.
- The TCM commands maximum line pressure.
- The TCM freezes transmission adaptive functions.

Conditions for Clearing the DTC

DTC P1811 is a Type C DTC.

Reference Information

Schematic Reference

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- **Scan Tool Output Controls**

DTC Type Reference

- **Diagnostic Trouble Code (DTC) Type Definitions**
- **Diagnostic Trouble Code (DTC) List/Type**

Circuit/System Verification

Ensure that the transmission fluid level is at the proper level by performing the **Transmission Fluid Checking Procedure**. Ensure that the line pressure is within specification by performing the **Line Pressure Check Procedure**.

Circuit/System Testing

1. Perform the **Transmission Fluid Checking Procedure**.

If the level is not within specifications, repair as necessary.

2. Perform the **Line Pressure Check Procedure**.

If the pressures are not within specifications, inspect and repair the following components:

- Oil filter and seal missing, plugged, or damaged-refer to **Oil Filter and Seal Replacement**.
- Spacer plate and gasket damage or misassembled-refer to **Control Valve Body Assemble** in Transmission Overhaul article.
- PC solenoid valve damaged or contaminated
- Pressure regulator valve line-up binding or damaged

- Torque signal valve line-up binding or damaged-refer to **Control Valve Body Disassemble** in Transmission Overhaul article.
 - Oil pump assembly damaged or missing components-refer to **Oil Pump Cleaning and Inspection** in Transmission Overhaul article.
3. Using the scan tool observe the shift times for the 1-2 upshift. The 1-2 shift time should be less than 0.65 seconds.

If the shift time is above 0.65 seconds, inspect and repair the following components:

- Leaking 1-2 accumulator piston seals
- Rolled 1-2 accumulator piston seals
- Cut 1-2 accumulator piston seals

Refer to **Channel Plate Assembly Disassemble** in Unit Repair.

- Leaking 2nd clutch piston seals
- Rolled 2nd clutch piston seals
- Cut 2nd clutch piston seals
- Burned 2nd clutch plates
- Damaged 2nd clutch plates
- Broken 2nd clutch springs
- Out-of-position 2nd clutch springs
- Damaged 2nd clutch piston
- Cracked or damaged driven sprocket support
- Leaking driven sprocket support seals
- Damaged driven sprocket support seals

Refer to **Driven Sprocket Support Assembly Disassemble** in Unit Repair.

- Internal fluid passage leaks
- Casting porosity or damage

Refer to **Case Inspection** in Unit Repair.

- Damaged gasket or spacer plate
- Out-of-position gasket or spacer plate

Refer to **Control Valve Body Disassemble** in Unit Repair.

- Slipping forward clutch
- Damaged sprag clutch, not holding

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Refer to **Direct/Coast Clutch, Reaction Carrier Disassemble** in Unit Repair.

- 2nd roller clutch damaged, not holding

Refer to **Reverse Input and Second Roller Clutch Disassemble** in Unit Repair.

4. Using the scan tool observe the shift times for the 2-3 upshift. The 2-3 shift time should be less than 0.65 seconds.

If the 2-3 shift time is above 0.65 seconds, inspect and repair the following components:

- Leaking 2-3 accumulator piston seals
- Rolled 2-3 accumulator piston seals
- Cut 2-3 accumulator piston seals

Refer to **Channel Plate Assembly Disassemble** in Unit Repair.

- Leaking direct clutch piston seals
- Rolled direct clutch piston seals
- Cut direct clutch piston seals
- Burned direct clutch plates
- Damaged direct clutch plates
- Broken direct clutch springs
- Out-of-position direct clutch springs
- Damaged direct clutch pistons
- Damaged, or not holding, sprag clutch

Refer to **Direct/Coast Clutch, Reaction Carrier Disassemble** in Unit Repair.

- Leaking driven sprocket support seals
- Damaged driven sprocket support seals
- Damaged driven sprocket support

Refer to **Driven Sprocket Support Assembly Disassemble** in Unit Repair.

- Internal fluid passage leaks
- Casting porosity or damage

Refer to **Case Inspection** in Unit Repair.

- Damaged gasket or spacer plate

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- Out-of-position gasket or spacer plate

Refer to **Control Valve Body Disassemble** in Unit Repair.

5. Using the scan tool observe the shift times for the 3-4 upshift. The 3-4 shift time should be less than 0.65 seconds.

If the 3-4 shift time is above 0.65 seconds, inspect and repair the following components:

- Leaking 3-4 accumulator piston seals
- Rolled 3-4 accumulator piston seals
- Cut 3-4 accumulator piston seals

Refer to **Channel Plate Assembly Disassemble** in Unit Repair.

- Leaking intermediate/4th servo piston seals
- Rolled intermediate/4th servo piston seals
- Cut intermediate/4th servo piston seals
- Damaged intermediate/4th servo pin
- Seized intermediate/4th servo pin
- Damaged intermediate/4th servo piston
- Cracked intermediate/4th servo cover
- Leaking intermediate/4th servo cover

Refer to **Intermediate/Fourth Servo Disassemble** in Unit Repair.

- Burned intermediate/4th band
- Out-of-position intermediate/4th band
- Damaged intermediate/4th band
- Slipping intermediate/4th band

Refer to **Intermediate Fourth Band Removal** in Unit Repair.

- Internal fluid passage leaks
- Casting porosity or damage

Refer to **Case Inspection** in Unit Repair.

- Damaged gasket or spacer plate
- Out-of-position gasket or spacer plate

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Refer to **Control Valve Body Disassemble** in Unit Repair.

- Slipping direct clutch

Refer to **Direct/Coast Clutch, Reaction Carrier Disassemble** in Unit Repair.

6. Change the AT fluid and filter. Add new AT fluid, refer to **Transmission Fluid Checking Procedure**.

If the fluid is not at the proper level, add as necessary.

IMPORTANT: The Reset Transmission Adapts function will clear all adapt cells. This may affect transmission performance. The TCM will update the transmission adapt cell values as the vehicle is driven

7. Perform the Transmission Adapts function.

Component Testing

- **Transmission Fluid Checking Procedure**
- **Line Pressure Check Procedure**
- **High or Low Line Pressure**

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

DTC P2534

DTC Descriptor

This diagnostic procedure supports the following DTC:

DTC P2534 Ignition 1 Switch Circuit Low Voltage

Diagnostic Fault Information

IMPORTANT: Always perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

DTC P2534

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

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Ignition 1 Voltage	P2534	P2534	-	P0562, P0563
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Scan Tool Parameter Data

Circuit	Normal	Short to Ground	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running in Park, normal operating temperature Parameter Normal Range: 12.0-14.5 volts				
Ignition Voltage	12.0-14.5 volts	0 volts	0 volts	12.0-14.5 volts

Circuit/System Description

The transmission control module (TCM) samples the system voltage on the Ignition 1 voltage circuit every 0.1 seconds. Lower than normal voltage may be inadequate to operate the transmission control solenoids properly. Improper solenoid operation may cause erratic transmission operation, which may result in internal damage.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The TCM detects an open or short to ground on the Ignition 1 voltage circuit.

Action Taken When the DTC Sets

- DTC P2534 is a Type A DTC.
- The TCM commands maximum line pressure.
- The TCM commands an immediate landing to 2nd gear.
- The TCM freezes transmission adaptive functions.

Conditions for Clearing the DTC

DTC P2534 is a Type A DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- Automatic Transmission Inline 20-Way Connector End View
- Automatic Transmission Internal Connector End Views

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- **Automatic Transmission Related Connector End Views**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

- **Scan Tool Data List**
- **Scan Tool Data Definitions**
- **Scan Tool Output Controls**

Special Tools Required

- **J 35616** GM terminal test kit. See **Special Tools**.
- **J 44152** Jumper Harness (20 pins). See **Special Tools**.

Circuit/System Verification

Start and idle the engine. Using the scan tool, select the Ignition Voltage parameter on the scan tool. The Ignition Voltage parameter should be between 12-14.5 volts.

Circuit/System Testing

1. Remove the TRANS fuse. Inspect the fuse for an open.

If the fuse is open, test the ignition 1 voltage circuit for a short to ground.

2. Disconnect the TCM connector. Turn ON the ignition leaving the engine OFF. Using the **J 35616** GM Terminal Test Kit, measure the voltage at the ignition 1 voltage circuit. See **Special Tools**. The voltage should be near battery voltage.

If the voltage is below the specified value, test the ignition 1 voltage circuit for an open or high resistance.

3. If all circuits and connections test normal, replace the TCM.

Component Testing

Verify that there is near battery voltage on the ignition 1 voltage circuit at the TCM.

If the voltage is not near the specified value, repair the short to ground, open or high

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resistance in the ignition 1 voltage circuit.

Repair Instructions

IMPORTANT: Always perform the Diagnostic Repair Verification after completing the repair.

Control Module References for TCM replacement, setup, and programming.

SYMPTOMS - AUTOMATIC TRANSMISSION

Symptoms - Automatic Transmission

Diagnostic Category	Diagnostic Information
The following table consists of seven diagnostic categories that are located in the left-hand 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-hand 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 <u>Transmission Fluid Checking Procedure</u>. • Refer to <u>Fluid Foaming</u>. • Refer to <u>High or Low Line Pressure</u>. • Refer to <u>Fluid Leak Diagnosis</u>. • Refer to <u>Automatic Transmission Fluid Leaks</u>.
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 <u>Ratcheting Noise</u>. • Refer to <u>Whine Noise Varying with RPM</u>. • Refer to <u>High Pitch Whine Noise</u>. • Refer to <u>Popping Noise</u>. • Refer to <u>Buzz Noise or High Frequency Rattle Sound</u>. • Refer to <u>Whine/Growl Noise That Changes with Vehicle Speed</u>. • Refer to <u>Final Drive Noise or Hum Noise</u>. • Refer to <u>Noise in Random Ranges</u>. • Refer to <u>Noise in First, Second, Third, or Fourth</u>. • Refer to <u>Flexplate/Torque</u>

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Converter Vibration Test.

- Refer to Noise and Vibration Analysis.
- Refer to Vibration.

Range Performance Diagnosis:

This category contains the following topics:

- Drives in Neutral
- No Park
- No Reverse
- No Drive
- Loss of power
- No engine braking
- Shift indicator indicating wrong gear
- No gear selection

- Refer to Drives in Neutral.
- Refer to No Park.
- Refer to No Reverse or Slips in Reverse.
- Refer to Loss of Drive.
- Refer to Loss of Power.
- Refer to Engine Stall.
- Refer to No Engine Braking; All Manual Ranges.
- Refer to No Engine Braking; Manual First - First Gear.
- Refer to No Engine Braking; Manual Second - Second Gear.
- Refer to Shift Indicator Indicates Wrong Gear Selection.
- Refer to No Gear Selection.

Shift Quality - Feel - Diagnosis:

This category contains the following topic:
Harsh shifts

Refer to Harsh Shifts.

Shift Pattern:

This category contains the following topics:

- One forward gear only
- Specific forward gears only
- Slipping

- Refer to Second Gear Only.
- Refer to First and Second Gears Only.
- Refer to First and Fourth Gears Only.
- Refer to Second and Third Gears Only.
- Refer to Third and Fourth Gears Only.
- Refer to No First Gear, Slips in First Gear.
- Refer to No Second Gear, Slips in Second Gear.
- Refer to No Third Gear, Slips in Third Gear.

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	• Refer to No Fourth Gear, or Slips in Fourth Gear.
Shift Speed Diagnosis: This category contains the following topic: Inaccurate or inconsistent shift points	Refer to Inaccurate/Inconsistent Shift Points.
Torque Converter Diagnosis: This category contains the following topics: • Torque converter diagnosis • TCC remains engaged • TCC application while engine is cold • TCC shudder • Engine stalling	• Refer to Torque Converter Diagnosis Procedure. • Refer to No Torque Converter Clutch (TCC) Release. • Refer to Torque Converter Clutch (TCC) Apply with Cold Engine. • Refer to Torque Converter Clutch (TCC) Shudder. • Refer to Engine Stall.
If no symptoms are found:	• Refer to Transmission Fluid Checking Procedure. • Refer to Road Test Procedure. • Refer to Line Pressure Check Procedure.

TRANSMISSION FLUID CHECKING PROCEDURE

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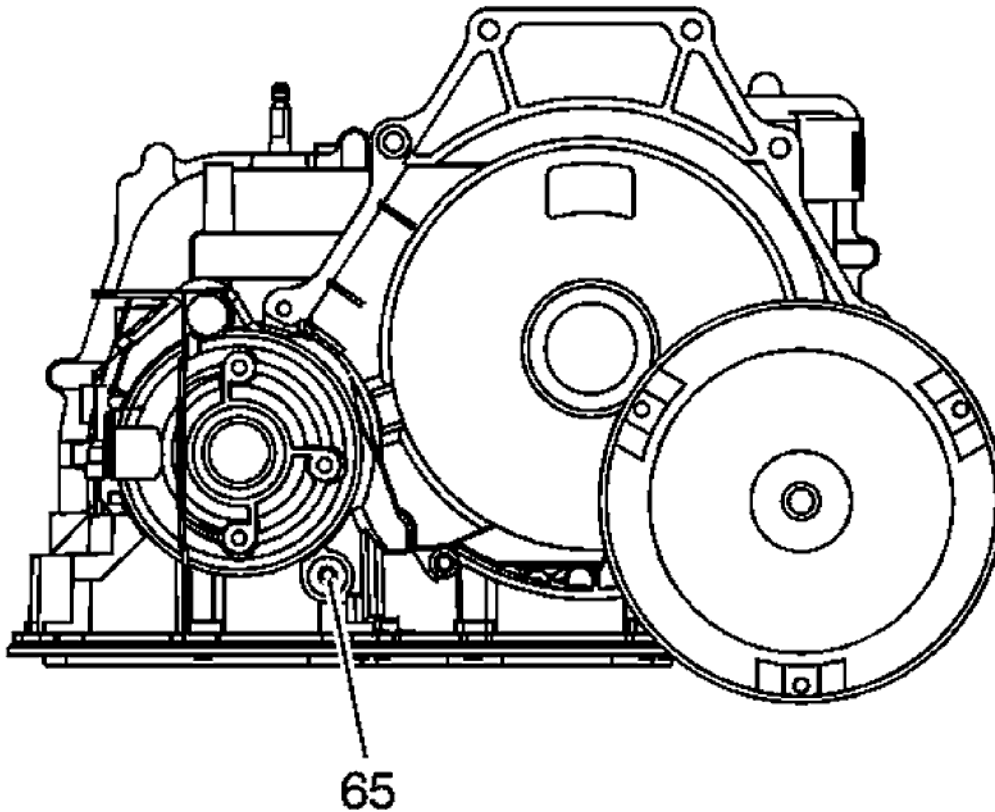


Fig. 33: Locating Oil Level Control Plug
Courtesy of GENERAL MOTORS CORP.

The oil level control plug (65) is located on the torque converter side of the transmission.

Transmission Fluid Checking Procedure

Step	Action	Value(s)	Yes	No
	1. Start the engine and allow the engine to idle until the transmission fluid temperature has reached the value specified. 2. Depress the brake pedal and move the shift lever through the gear ranges, pausing a few seconds in each range. Return the shift lever to the PARK range.			

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1	NOTE: Refer to <u>Transmission Fluid Vent Cap Removal Notice</u> in Cautions and Notices. 3. Remove the fluid vent cap. 4. Raise the vehicle on a hoist. The vehicle must be level, with the engine running and the shift lever in the PARK range. Refer to <u>Lifting and Jacking the Vehicle</u> in General Information. CAUTION: Refer to <u>Checking Hot Transmission Fluid Through Drain Plug Hole Caution</u> in Cautions and Notices. 5. Remove the transmission oil level control plug (65). See drawing above. IMPORTANT: The transmission fluid may darken with normal use and does not always indicate contamination or oxidation. 6. Check the fluid color. If necessary, use a small screwdriver as a dipstick.	At least 40° C (104°F)		
	Is the fluid color clear red or light brown with no burnt odor?			
2	Does the fluid have a burnt odor or a dark brown color?	-	Go to Step 8	Go to Step 3
3	Does the fluid have a cloudy or milky appearance?	-	Go to Step 7	Go to Step 8
4	Check the fluid level. The fluid level should be even with the bottom of the threaded plug hole. Is the fluid level low?	-	Go to Step 5	Go to Step 11
5	Add DEXRON®VI automatic transmission fluid in increments of 0.5 L (0.5 qt) until the fluid drains from the plug hole.	-		

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	Did you add more than 1.5 L (1.6 qt) to the transmission?		Go to Step 6	Go to Step 11
6	The transmission may have a leak. Refer to Fluid Leak Diagnosis . Was a transmission fluid leak found?	-	Go to Step 9	Go to Step 11
7	The transmission fluid is contaminated with engine coolant. Repair or replace the transmission cooler in the radiator. Is the transmission cooler repair complete?	-	Go to Step 9	-
8	1. Drain the fluid by removing the bottom pan. IMPORTANT: A very small amount of material in the bottom of the bottom pan is a normal condition. 2. Check the bottom pan for any excessive debris. Was excessive debris found?	-	Go to Step 9	Go to Step 10
	1. Repair the transmission if required. In some cases, overhaul may be required. 2. Flush the transmission oil cooler and pipes and check 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). NOTE: Refer to Transmission Fluid Vent Cap Removal Notice in Cautions and Notices. 3. Remove the fluid vent cap. 4. Add enough DEXRON®VI automatic transmission fluid to bring the fluid level to the bottom of the threaded plug hole.			

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5. Start the engine and allow the engine to idle until the transmission fluid temperature has reached the value specified.
6. Depress the brake pedal and move the shift lever through the gear ranges, pausing a few seconds in each range. Return the shift lever to the PARK range.
7. Raise the vehicle on a hoist. The vehicle must be level, with the engine running and the shift lever in the PARK range. Refer to **Lifting and Jacking the Vehicle** in General Information.

CAUTION:

Refer to **Checking Hot Transmission Fluid Through Drain Plug Hole Caution** in Cautions and Notices.

9

8. Remove the transmission plug.
9. If needed, add DEXRON®VI automatic transmission fluid in increments of 0.5 L (0.5 qt) until the fluid drains from the threaded plug hole.

NOTE:

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

IMPORTANT:

Before installing the fill plug, apply GM P/N 12345382 (Canadian P/N 10953489) to the thread of the line pressure plug.

10. Allow fluid to finish draining out of the plug hole. Install the plug and tighten to specified value.
11. Wipe any excess fluid from the transmission with a rag or shop towel.

At least 40°
C (104°F)
12 N.m (9
lb ft)

-

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	12. Install the fluid vent cap.			
	Is the repair complete?		System OK	
10	1. Change the fluid and the fluid filter. Refer to <u>Oil Filter and Seal Replacement</u>. 2. Start the engine and allow the engine to idle until the transmission fluid temperature has reached the value specified. 3. Depress the brake pedal and move the shift lever through the gear ranges, pausing a few seconds in each range. Return the shift lever to the PARK range. 4. Raise the vehicle on a hoist. The vehicle must be level with the engine running and the shift lever in the PARK range. Refer to <u>Lifting and Jacking the Vehicle</u> in General Information. NOTE: Refer to <u>Transmission Fluid Vent Cap Removal Notice in Cautions and Notices</u>. 5. Remove the fluid vent cap. CAUTION: Refer to <u>Checking Hot Transmission Fluid Through Drain Plug Hole Caution in Cautions and Notices</u>. 6. Remove the transmission plug. 7. If needed, add DEXRON®VI automatic transmission fluid in increments of 0.5 L (0.5 qt) until the fluid drains from the threaded plug hole. NOTE: Refer to <u>Fastener Notice in Cautions and Notices</u>.	At least 40° C (104°F) 12 N.m (9 lb ft)		-

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	IMPORTANT: Before installing the fill plug, apply GM P/N 12345382 (Canadian P/N 10953489) to the thread of the line pressure plug. 8. Allow fluid to finish draining out of the plug hole. Install the plug and tighten to specified value. 9. Wipe any excess fluid from the transmission with a rag or shop towel. 10. Install the fluid vent cap. Is the repair complete?			
11	NOTE: Refer to <u>Fastener Notice</u> in Cautions and Notices. IMPORTANT: Before installing the fill plug, apply GM P/N 12345382 (Canadian P/N 10953489) to the thread of the line pressure plug. 1. Allow fluid to finish draining out of the plug hole. Install the plug and tighten to specified value. 2. Wipe any excess fluid from the transmission with a rag or shop towel. 3. Install the fluid vent cap. Is the repair complete?	12 N.m (9 lb ft)	System OK	-

LINE PRESSURE CHECK PROCEDURE

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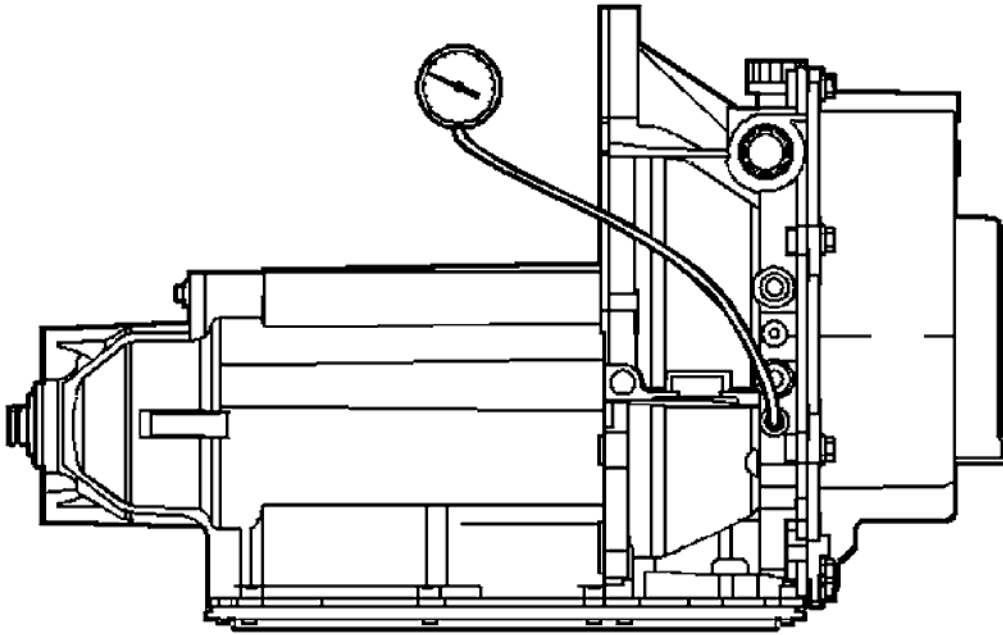


Fig. 34: View Of Installed Scan Tool
Courtesy of GENERAL MOTORS CORP.

CAUTION: Keep the brakes applied at all times in order to prevent unexpected vehicle motion. Personal injury may result if the vehicle moves unexpectedly.

NOTE: The total test running time should not be longer than 2 minutes. Running the test longer than 2 minutes may damage the transaxle.

Line pressures are calibrated for two sets of gear ranges - DRIVE-PARK-NEUTRAL, and REVERSE. This allows the transaxle line pressure to be appropriate for different pressure needs in different gear ranges.

Before performing a line pressure check, verify that the pressure control solenoid for the transaxle is receiving the correct electrical signal from the PCM.

IMPORTANT: Some conditions may be intermittent, therefore this test should be performed at least 3 times.

1. Install the scan tool.

2. Start the engine and set the parking brake.
3. Check for diagnostic trouble codes, including the diagnostic code for a stored pressure control solenoid.
4. Repair the vehicle if necessary. Include the following areas:
 - Inspect the fluid level
 - Inspect the manual linkage at the transaxle
 - Install or connect the scan tool.
 - Install or connect the oil pressure gage at the line pressure tap.
5. Put the gear selector in PARK and set the parking brake.
6. Start the engine and allow the engine to warm up at idle.
7. Access the PCS Control test on the scan tool.
8. Increase DESIRED PCS in 0.1 amp increments. Read the corresponding line pressure on the pressure gage. Allow the pressure to stabilize for 5 seconds after each current charge.

IMPORTANT: Before installing the line pressure plug, apply GM P/N 12345382 (Canadian P/N 10953489) to the thread of the line pressure plug.

9. Remove oil pressure gage and install line pressure plug.

If your pressure readings differ greatly from the line pressure table, refer to the Diagnosis Tables contained in this section.

The scan tool is only able to control the pressure control solenoid in PARK and NEUTRAL with the vehicle stopped. This protects the clutches from extremely high or low pressures in DRIVE or REVERSE ranges.

Refer to **Line Pressure**.

The pressures in the table assume a temperature of 70°C (158°F). The pressure will vary with a change in temperature.

ROAD TEST PROCEDURE

IMPORTANT: 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

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- 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 **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:

- 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 input speed, turbine
 - Transmission output speed
 - Vehicle speed
 - TFP manual valve position switch
 - Transmission range
 - 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 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.
 1. Apply the brake pedal and ensure the parking brake is set.
 2. Move the gear selector through all ranges.
 3. Pause 2 to 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 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 **Shift Speed** table in this section and choose a throttle position of 10%, 25% or 50%. 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
 - 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 to 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, approximately 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%.
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% (WOT).
4. Verify the following:
 - The TCC releases
 - The transmission downshifts immediately to SECOND gear

Manual Downshifts

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The shift solenoid valves do not control the 4-3 manual downshift. The 4-3 manual downshift is hydraulic. The 3-2 and 2-1 manual downshifts are electronic. The solenoid states will change during, or shortly after a 4-3 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 64 km/h (40 mph).
3. Release the throttle while moving the gear selector to FIRST.
4. Verify the following:
 - The TCC releases
 - The transmission immediately downshifts to SECOND Gear.
 - The engine slows the vehicle.
 - The transmission downshifts to FIRST gear at the calibrated speed, typically 48-64 km/h (30-40 mph).

Coasting Downshifts

1. Place the gear selector in the OVERDRIVE position.
2. Accelerate the vehicle to FOURTH gear with the TCC applied.

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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 chart. 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 pulse width modulated (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 car tends to have poor acceleration from a standstill. At speeds above 50-55 km/h (30-35 mph), the car 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 car 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 6 seconds.

A torque converter noise will increase under this load.

Torque Converter Clutch Shudder

The key to diagnosing 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 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!

As mentioned above, 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 sensor

Like a vacuum leak, the engine will not get the correct amount of fuel for proper engine operation.

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- 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.

Torque Converter Evaluation and Diagnosis

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.
- An internal failure occurs in the stator roller clutch.
- You notice excessive end play.
- Overheating produces heavy debris in the clutch.
- 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 which could dent 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.

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2. Turn the engine OFF.
3. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
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** for the 2.2L (L61) engine or **Engine Flywheel Cleaning and Inspection** for the 2.4L engine.
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** .
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** .
2. Rotate the torque converter one bolt position.

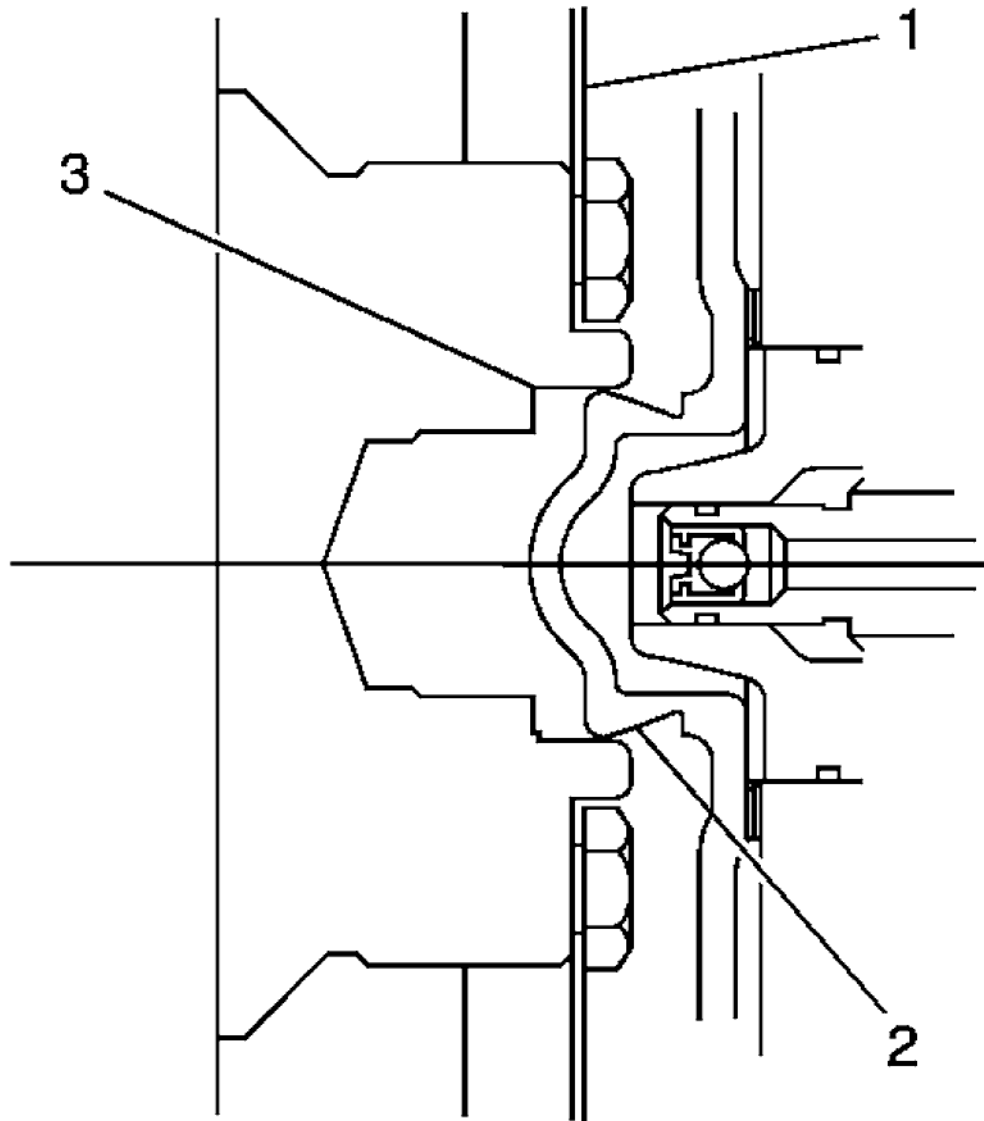


Fig. 35: View Of Torque Converter Hub In Engine Crankshaft
Courtesy of GENERAL MOTORS CORP.

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**.

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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.

- Inspect the tire for the following:
 - Uneven wear
 - Imbalance
 - Mixed sizes
 - Mixed radial and bias ply
- Inspect the suspension components for the following:
 - Alignment and wear
 - Loose fasteners
- Inspect the engine and transmission mounts for damage and loose bolts.
- Inspect the transmission case mounting holes for the following:
 - Missing bolts, nuts, and studs
 - Stripped threads
 - Cracks
- Inspect the flywheel for the following:
 - Missing or loose bolts
 - Cracks
 - Imbalance
- Inspect the torque converter for the following:
 - Missing or loose bolts or lugs
 - Missing or loose balance weights
 - Imbalance

CLUTCH PLATE DIAGNOSIS

Composition Plates

Dry the plates and inspect the plates for the following conditions:

- Pitting

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- 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® 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.

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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.

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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

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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
- Warped
- Distorted torque converter housing
- Porous casting

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

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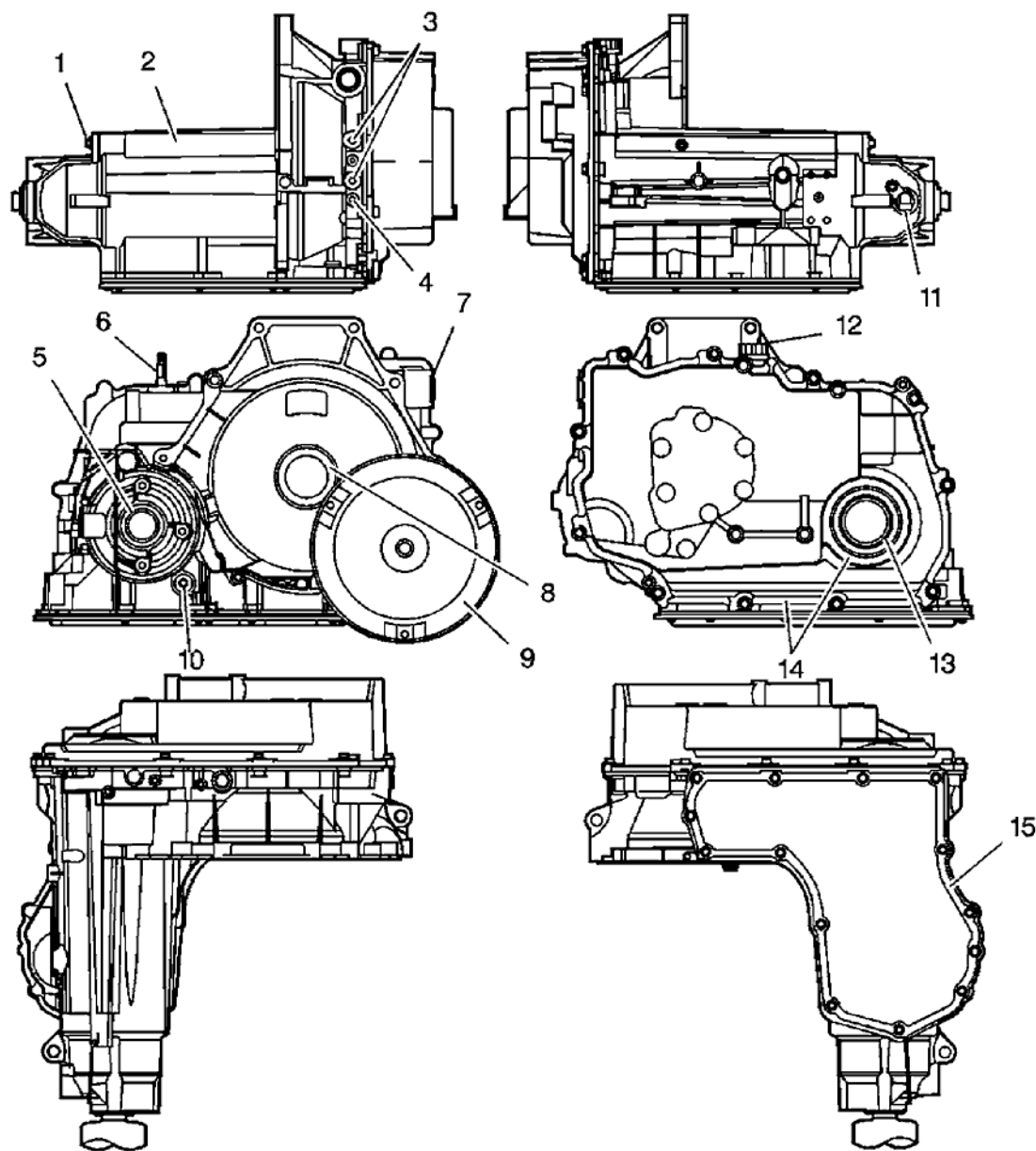


Fig. 36: Leak Inspection Points
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 36

Callout	Component Name
1	Actuator Guide Seal
2	Case
3	Cooler Pipe Seals
4	Line Pressure Tap Plug
5	Axle Oil Seal (Case) and Stub Shaft Sleeve
6	Manual Shaft Seal

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7	Pass-Thru Connector Seal
8	Converter Seal
9	Torque Converter Assembly
10	Oil Level Control Plug
11	Output Speed Sensor O-Ring Seal
12	Fill and Vent Cap Seal
13	Axle Oil Seal (Side Cover) and Output Shaft Sleeve
14	Side Cover Gaskets
15	Bottom 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 44246 Solenoid Testing Kit. See Special Tools.

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 solenoid from the control valve body. Refer to 1-2 Shift Solenoid Valve

Replacement or 2-3 Shift Solenoid Valve Replacement.

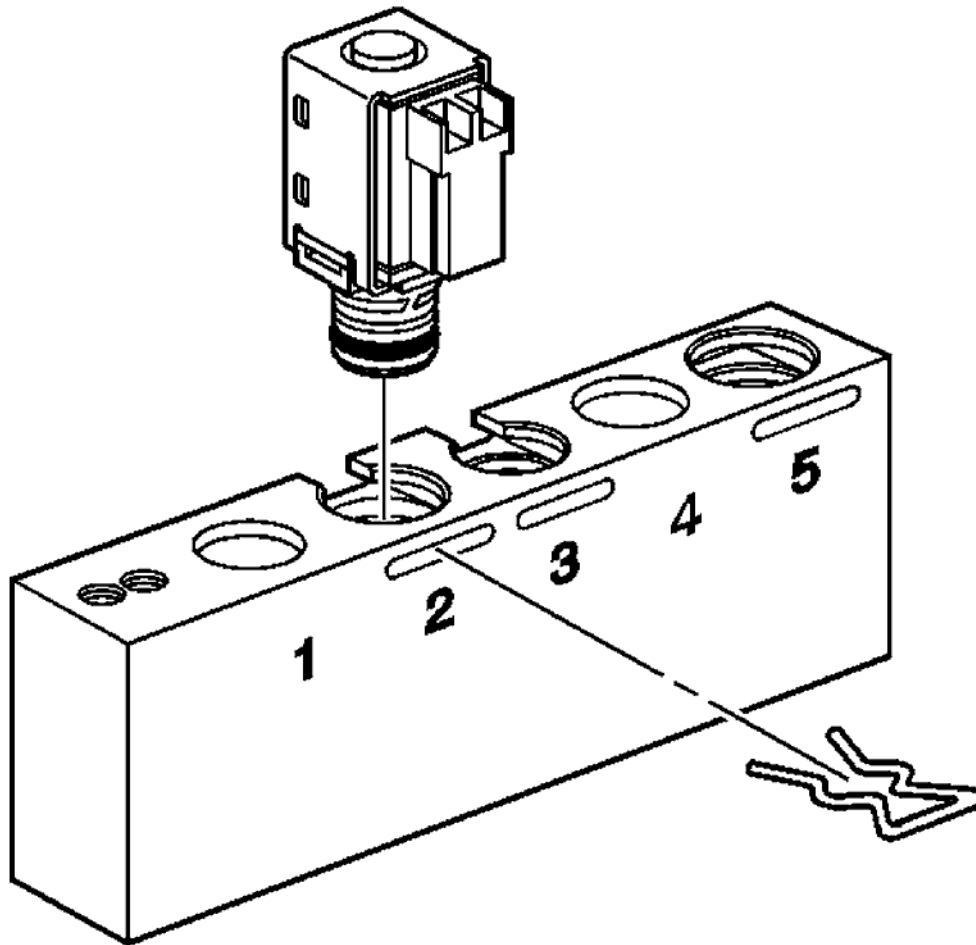


Fig. 37: Installing Valve Into Bore No. 2 Of J 44246
Courtesy of GENERAL MOTORS CORP.

2. Install 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. See **Special Tools**.

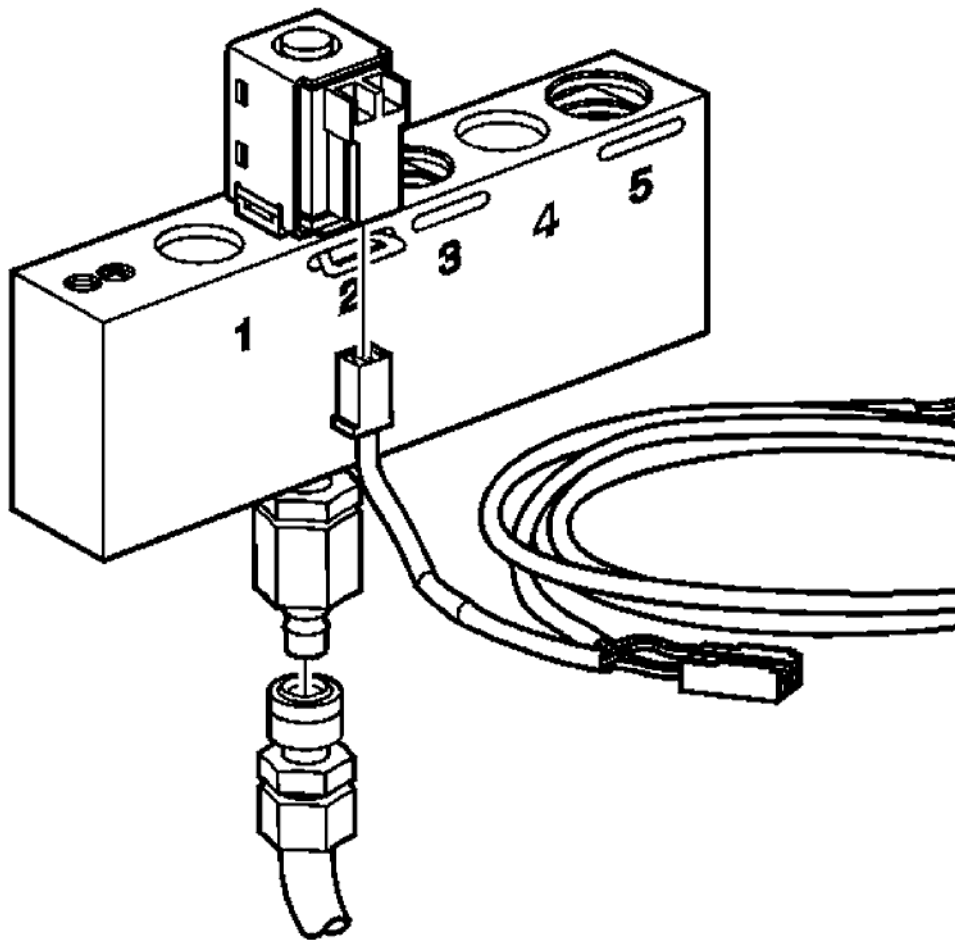


Fig. 38: Connecting Solenoid Testing Harness To Solenoid
Courtesy of GENERAL MOTORS CORP.

3. Connect the solenoid testing harness supplied with the **J 44246** to the solenoid. See **Special Tools**.

IMPORTANT: Do not use air pressure in excess of 120 psi. Excessive pressure will not allow the solenoid ball check valve to seat properly. Recommended air pressure is 50 psi.

4. Apply compressed air to the **J 44246** . See **Special Tools**.
5. Air should flow through the solenoid. If air does not flow through the solenoid, replace the solenoid. Refer to **Control Valve Body 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 solenoid into the control valve body. Refer to 1-2 Shift Solenoid Valve Replacement or 2-3 Shift Solenoid Valve Replacement.

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. See Special Tools.

Only GM Goodwrench DEXRON®VI 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

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4. Forward Flush
5. Flow Test
6. Code Recording Procedure
7. Clean-up

Tools Required

- **J 45096** Transmission Oil Cooling System Flush and Flow Test Tool. See **Special Tools**.
- **J 35944-440** Cooler Flushing Adapter. See **Special Tools**.
- Shop air supply with water/oil filters, regulator and pressure gage - minimum 90 psi
- Eye protection
- Rubber gloves

Machine Set-up

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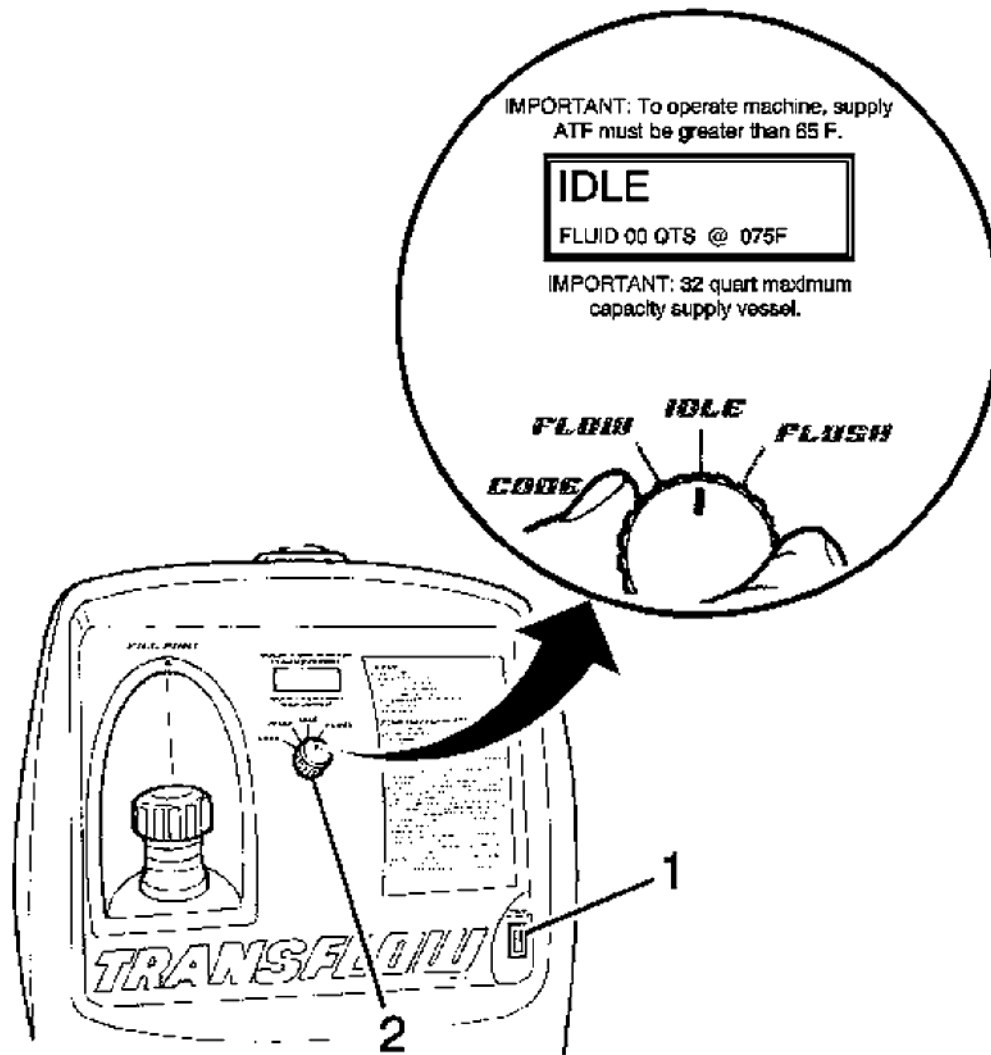


Fig. 39: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS CORP.

1. Verify that the main power switch (1) is in the OFF position.
2. Place the main function switch (2) in the IDLE position.

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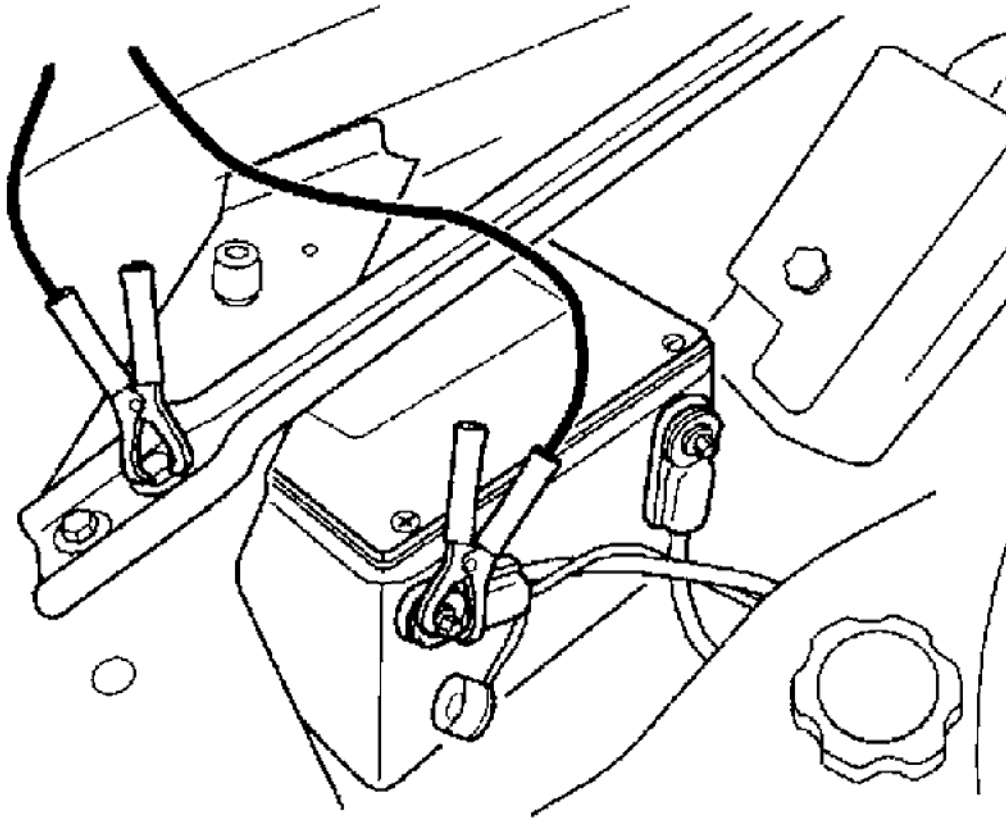


Fig. 40: Connecting To 12V DC Power Source
Courtesy of GENERAL MOTORS CORP.

3. Connect **J 45096** to the vehicle 12V 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. See **Special Tools**.
4. Turn the main power switch to the ON position.

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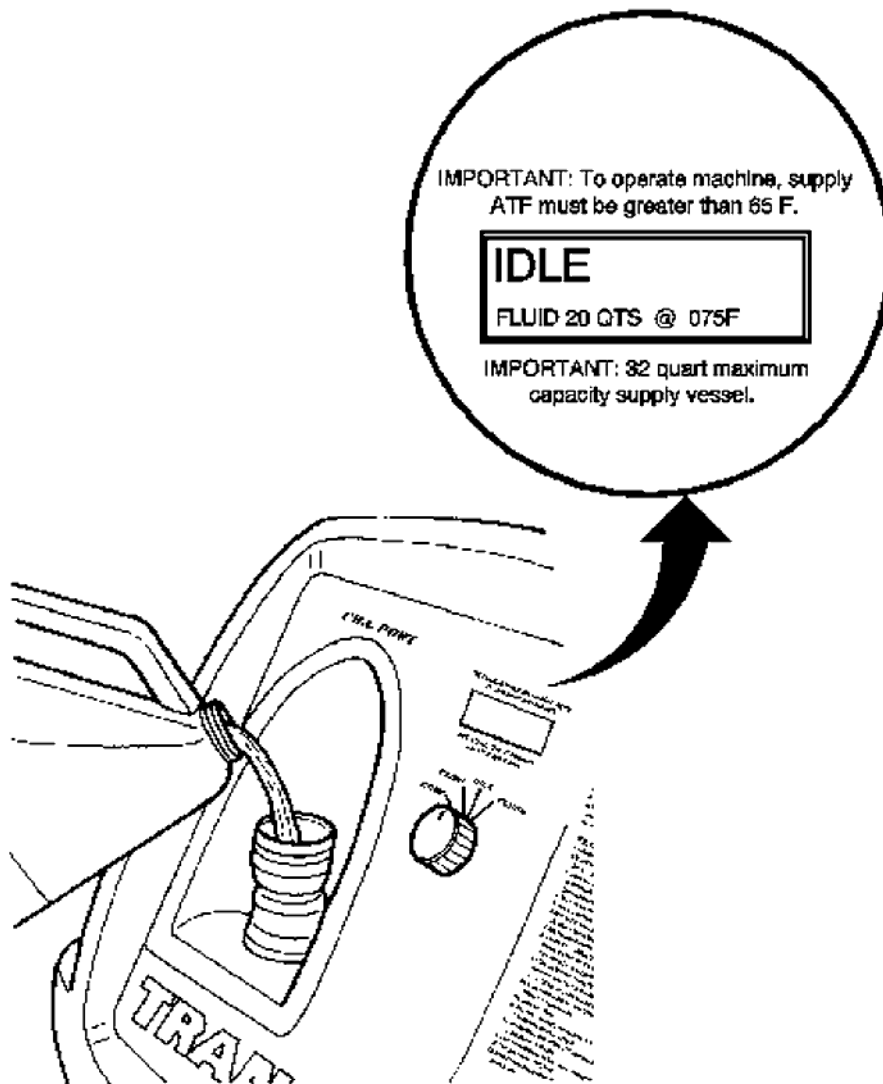


Fig. 41: Filling Supply Tank With Transmission Fluid
Courtesy of GENERAL MOTORS CORP.

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®VI/Mercon®, or equivalent, through the fill port.
6. Reinstall and tighten the fill cap.

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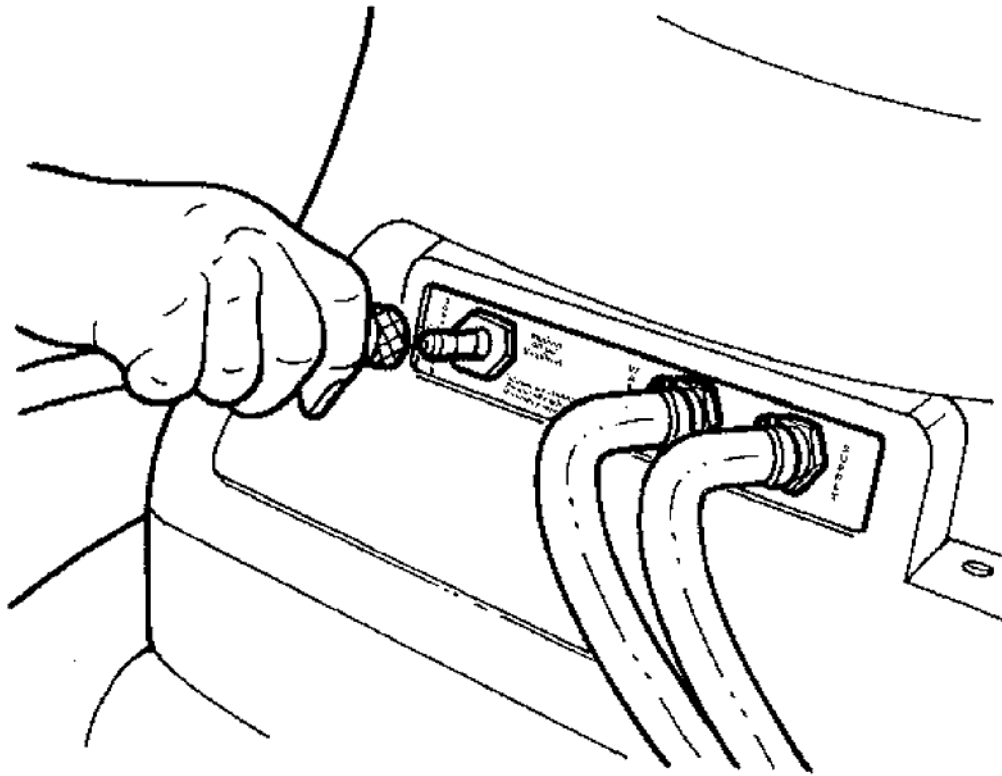


Fig. 42: Applying Shop Air Supply Hose To Quick-Disconnect
Courtesy of GENERAL MOTORS CORP.

7. Connect a shop air supply hose to the quick-disconnect on the rear panel marked SUPPLY AIR.

Determine Minimum Flow Rate

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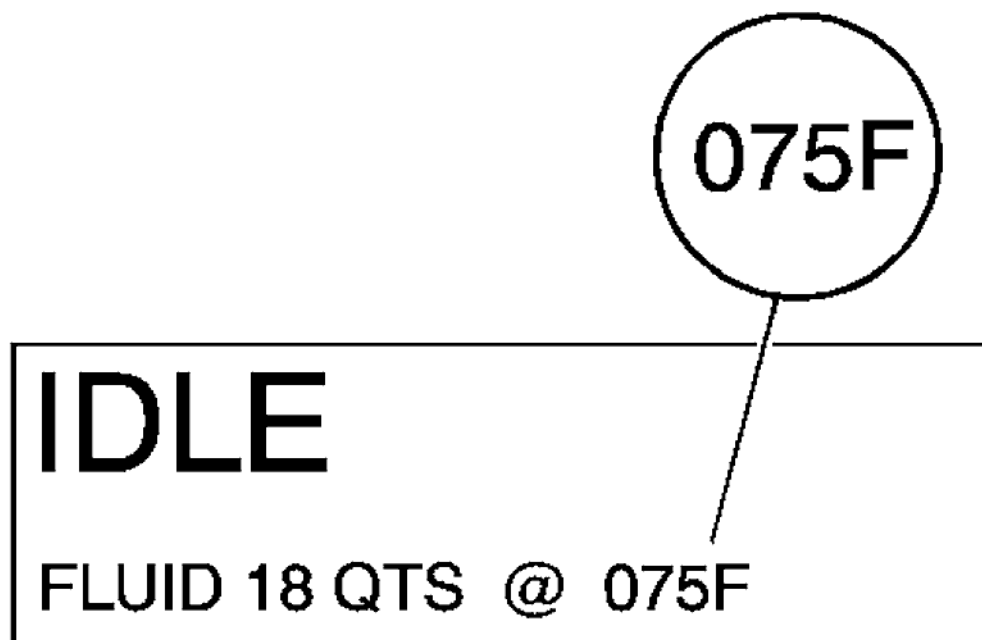


Fig. 43: Identifying Machine Display Of Automatic Transmission Fluid Temperature

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** . See **Special Tools**.

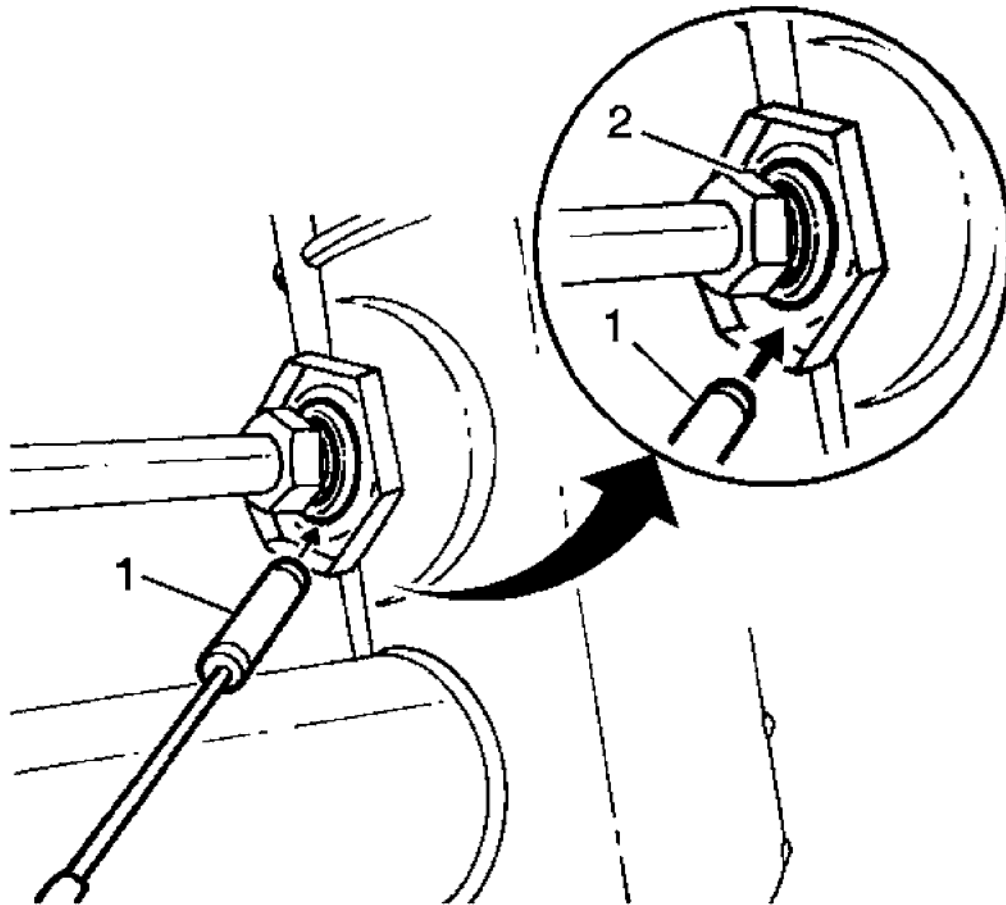


Fig. 44: Identifying Transmission Oil Cooler Metal Composition
Courtesy of GENERAL MOTORS CORP.

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: 75°F
- Cooler type: Steel

The MINIMUM flow rate for this example would be 0.8 GPM.

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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

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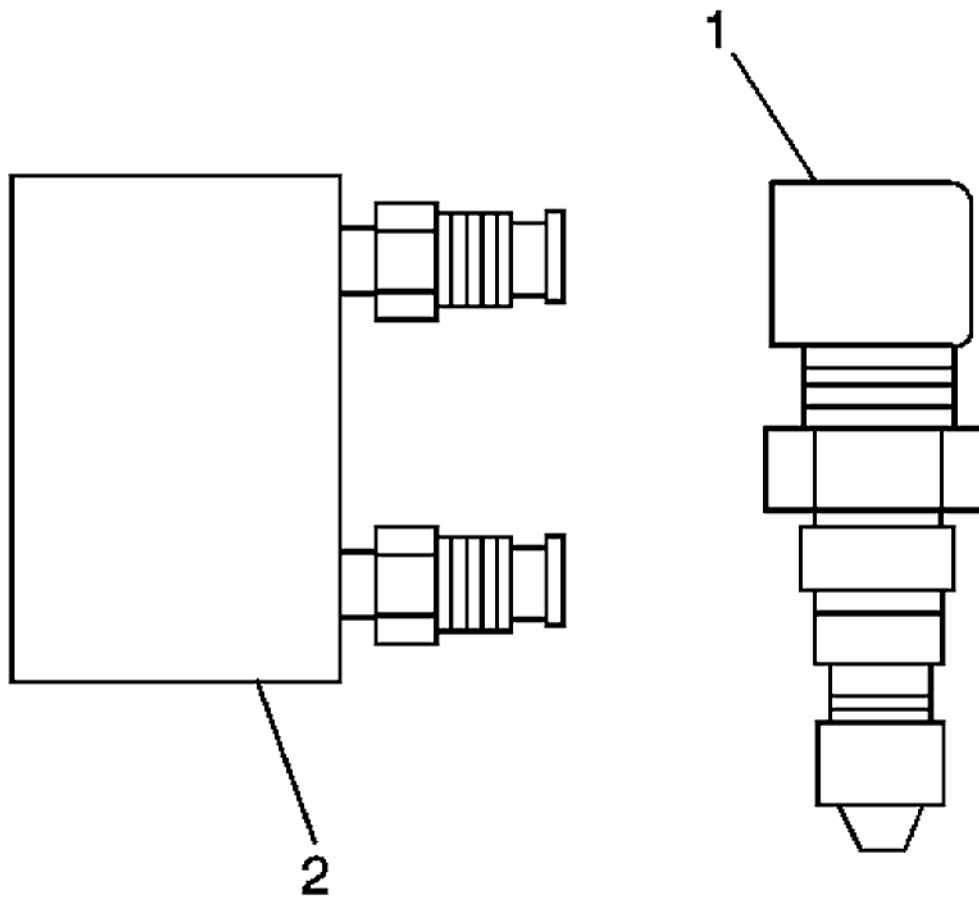


Fig. 45: View Of J 45096 & J 35944-440
Courtesy of GENERAL MOTORS CORP.

1. Connect the **J 45096** adapters (1) to the vehicle's transmission oil cooler supply and return lines at the transmission, using **J 35944-440** . See **Special Tools**.

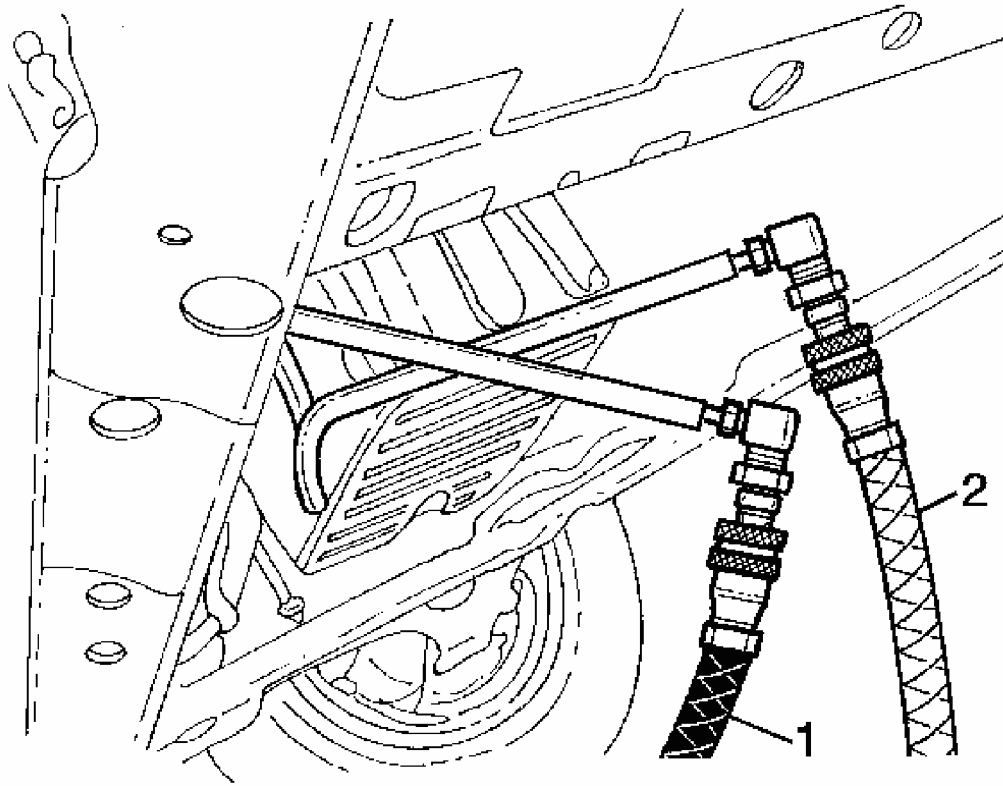


Fig. 46: Identifying Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

2. Connect the black supply hose (1) to the return line, bottom connector of the transmission, and the clear waste hose (2) to the feed line, top connector of the transmission, to the vehicle cooler lines. This is the reverse flow - backflush direction.

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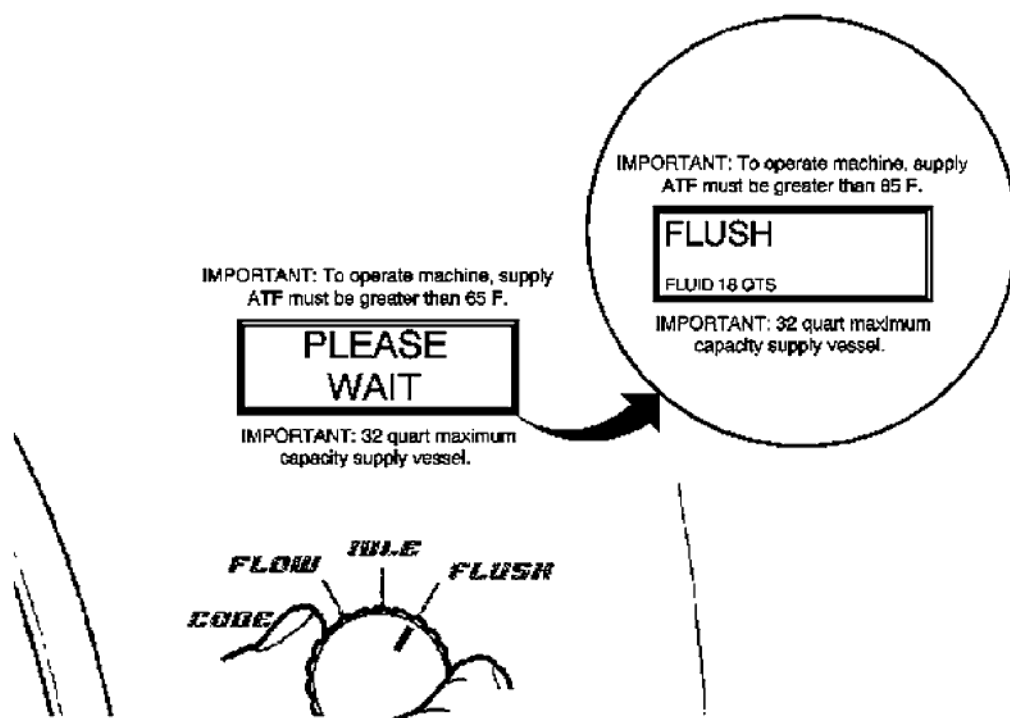


Fig. 47: Setting Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

3. Turn the main function switch to the FLUSH position. Allow the machine to operate for 30 seconds.

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IMPORTANT: To operate machine, supply ATF must be greater than 65 F.

IDLE

FLUID 16 QTS @ 075F

IMPORTANT: 32 quart maximum capacity supply vessel.

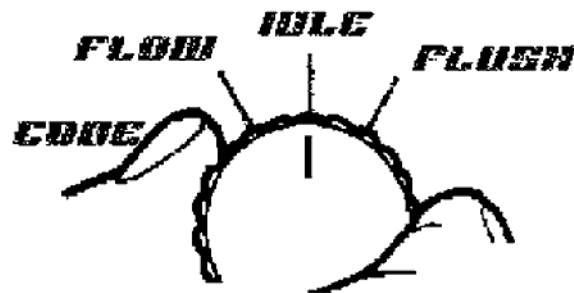


Fig. 48: Setting Main Function Switch To IDLE Position
Courtesy of GENERAL MOTORS CORP.

4. Turn the main function switch to the IDLE position and allow the supply vessel pressure to dissipate.

Forward Flush

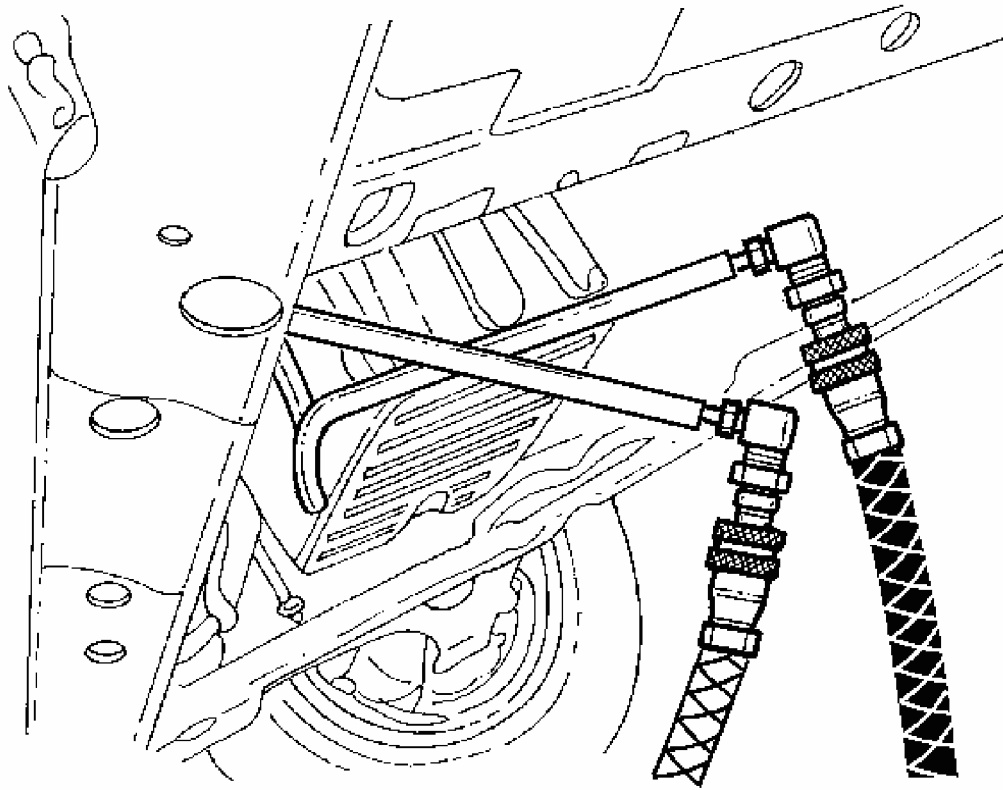


Fig. 49: Identifying Black Supply Hose And Clear Waste Hose
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the supply and waste hoses from the vehicle cooler lines. Reverse the supply and waste hoses to provide a normal flow direction.

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IMPORTANT: To operate machine, supply
ATF must be greater than 65 F.

FLUSH

FLUID 18 QTS

IMPORTANT: 32 quart maximum
capacity supply vessel.



Fig. 50: Setting Main Function Switch To FLUSH Position
Courtesy of GENERAL MOTORS CORP.

2. Turn the main function switch to the FLUSH position and allow machine to operate for 30 seconds.

Flow Test

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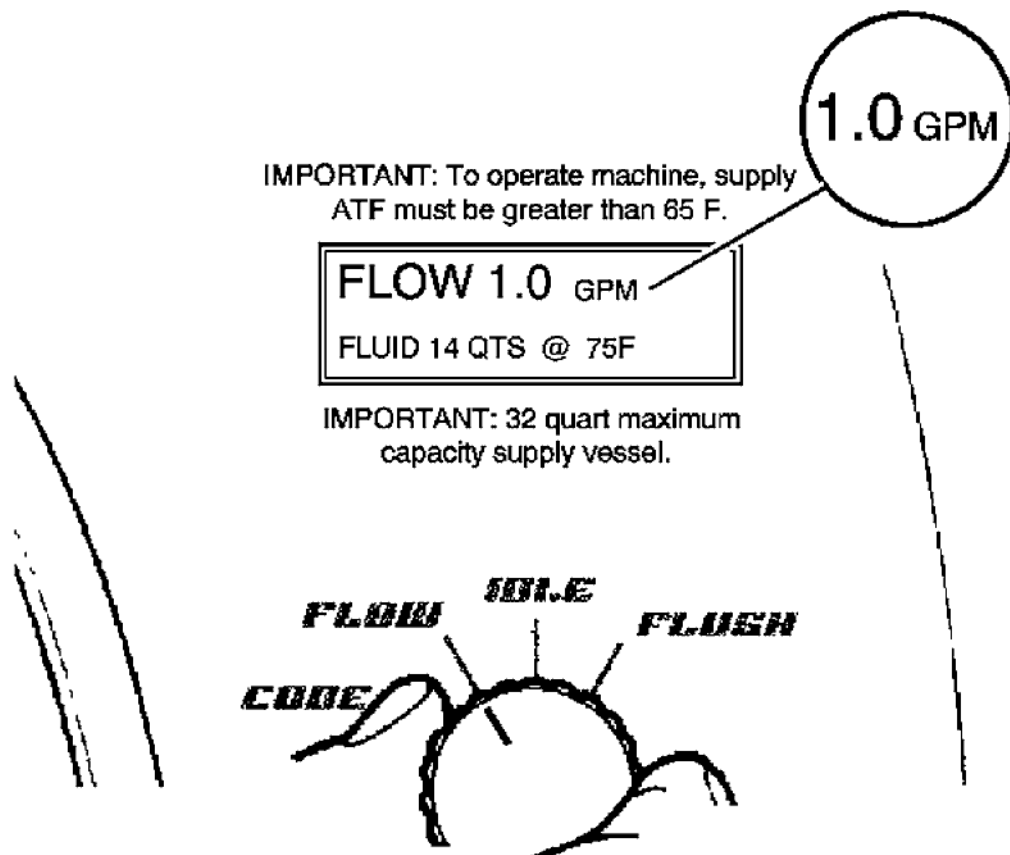


Fig. 51: Setting Main Function Switch To FLOW Position

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.

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3. If the TESTED flow rate is less than the MINIMUM flow rate after the second test, perform Code Recording Procedure.
 1. Replace the transmission oil cooler.
 2. Reconnect supply and waste hoses to the cooler lines in the normal flow direction. Perform Flow Test.
 3. Perform Code Recording Procedure.

Code Recording Procedure

IMPORTANT: To operate machine, supply ATF must be greater than 65 F.

FLOW 1.0 @ 75F CYCLE 6

A10DFB2

IMPORTANT: 32 quart maximum capacity supply vessel.



Fig. 52: Setting 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 seven-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.

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2. Record TESTED flow rate, temperature, cycle and seven-character flow code information on repair order.

Clean-up

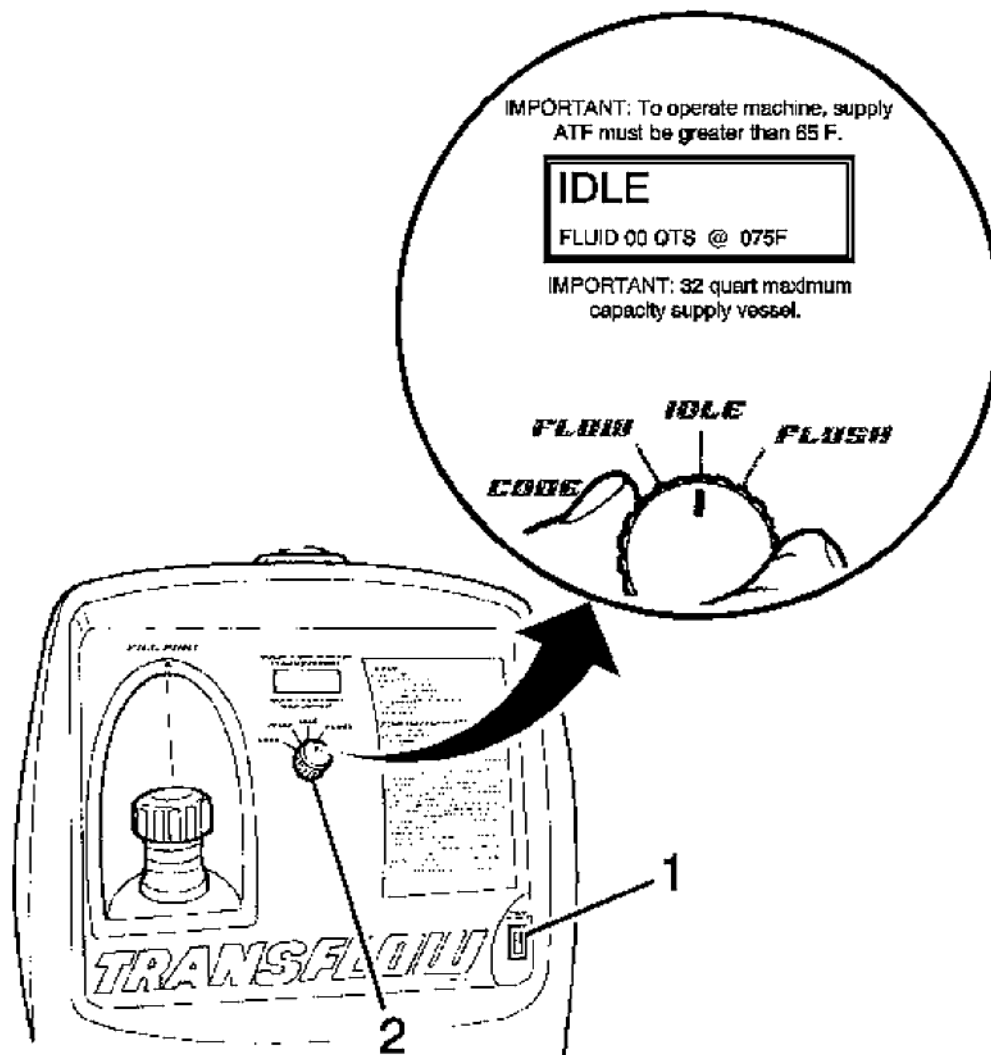


Fig. 53: View Of Main Power Switch & Main Function Switch
Courtesy of GENERAL MOTORS CORP.

1. Turn the main function switch (2) to the IDLE position and allow the supply vessel pressure to dissipate.
2. Turn the main power switch (1) to the OFF position.
3. Disconnect the supply and waste hoses and the 12-volt power source from the vehicle.

4. Disconnect the air supply hose from **J 45096** . See **Special Tools**.
5. Dispose of the waste ATF in accordance with all applicable federal, state, and local requirements.

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.

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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. See Special Tools.

- 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. See Special Tools.

- Torque converter
- Oil pump
- Turbine shaft
- Transmission overhaul complete
- Transmission assembly replacement

Only GM Goodwrench DEXRON®VI 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 and Line Flusher. See Special Tools.
- **J 35944-22** Transmission Oil Cooler Flushing Fluid. See Special Tools.

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- **J 35944-440** Cooler Flushing Adapter. See **Special Tools**.
- 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 gage
- 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.

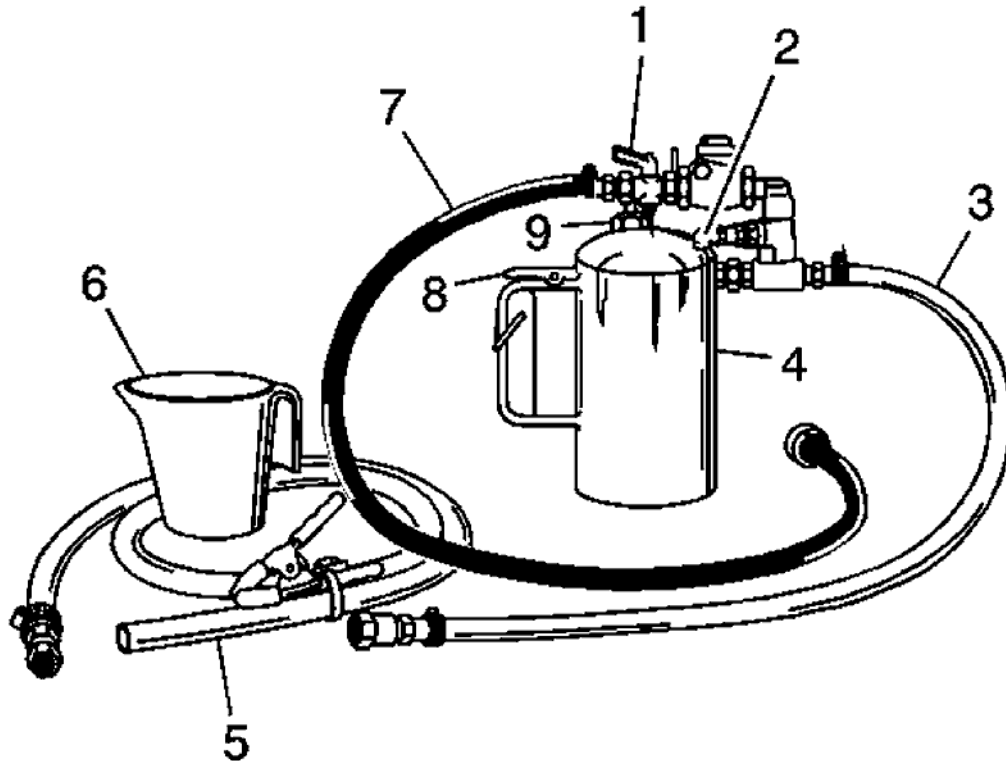


Fig. 55: Identifying Flusher Tank & Components
Courtesy of GENERAL MOTORS CORP.

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. See Special Tools. 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. See Special Tools. 6 L (20-21 oz) of **J 35944-22**, using the measuring cup (6). See Special Tools. 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). See Special Tools.
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. See Special Tools.
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.

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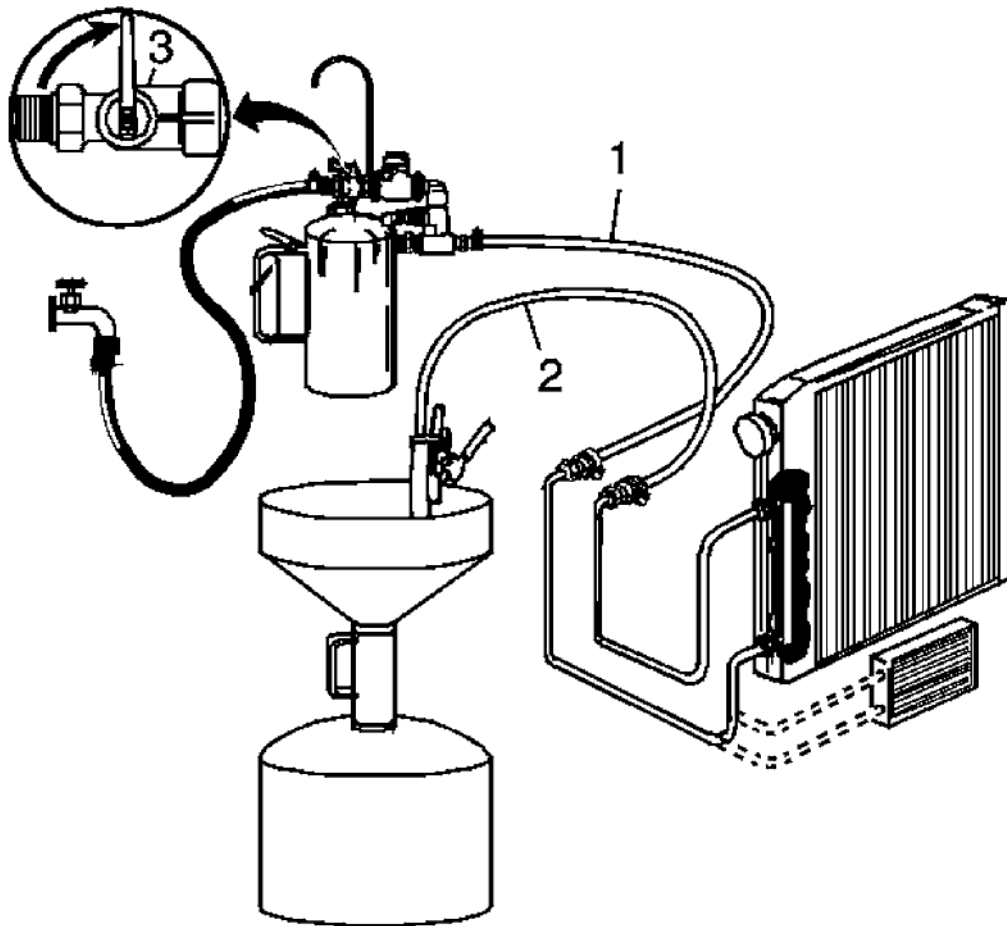


Fig. 56: Connecting J 35944 To Oil Cooler
Courtesy of GENERAL MOTORS CORP.

2. Connect the **J 35944-A** to the oil cooler feed top connector. See **Special Tools**. Use the **J 35944-440**. See **Special Tools**.
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 bottom connector oil cooler return pipe. See **Special Tools**. Use the **J 35944-440**. See **Special Tools**.
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. See **Special Tools**. 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

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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. See **Special Tools**.

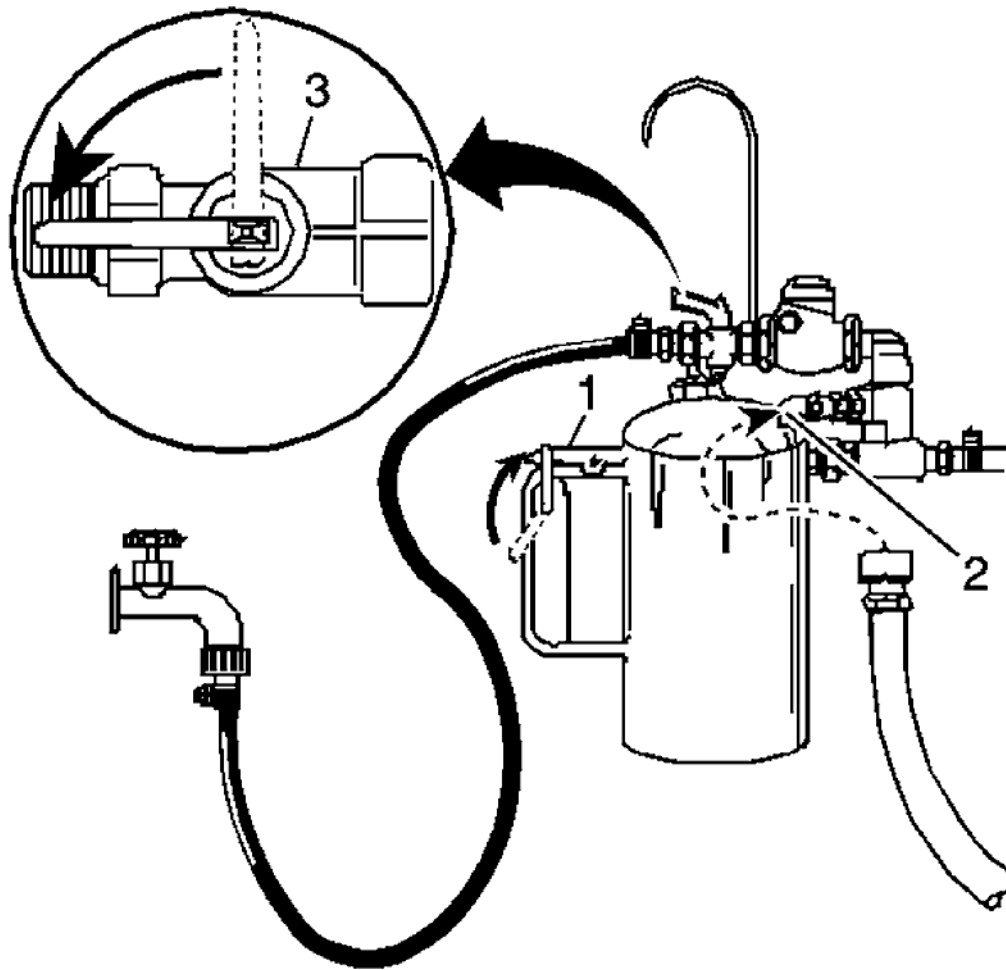


Fig. 57: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Flushing for approximately 2 minutes in each cooler line direction will result in a total of about 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. See **Special Tools**. Use the clip

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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. See **Special Tools**.
9. Release the trigger (1) and turn the **J 35944-A** water supply valve (3) to the OFF position. See **Special Tools**.

Forward Flush

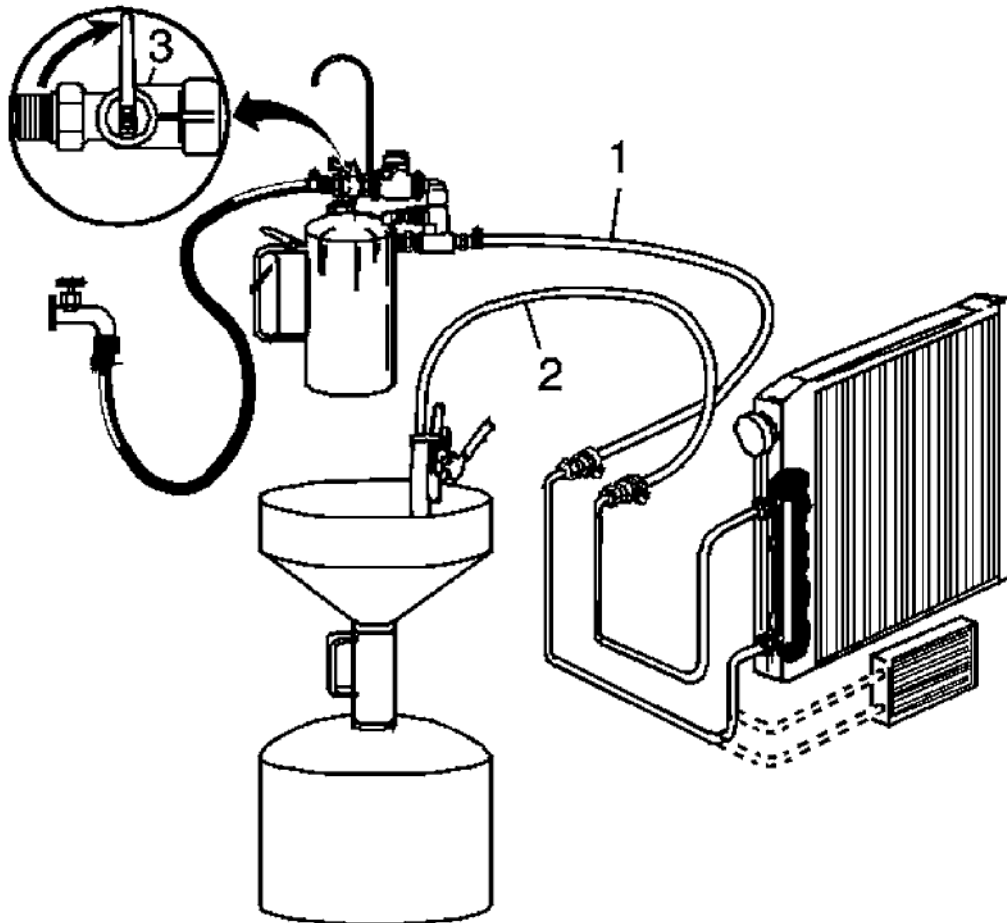


Fig. 58: Connecting J 35944 To Oil Cooler
Courtesy of GENERAL MOTORS CORP.

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.

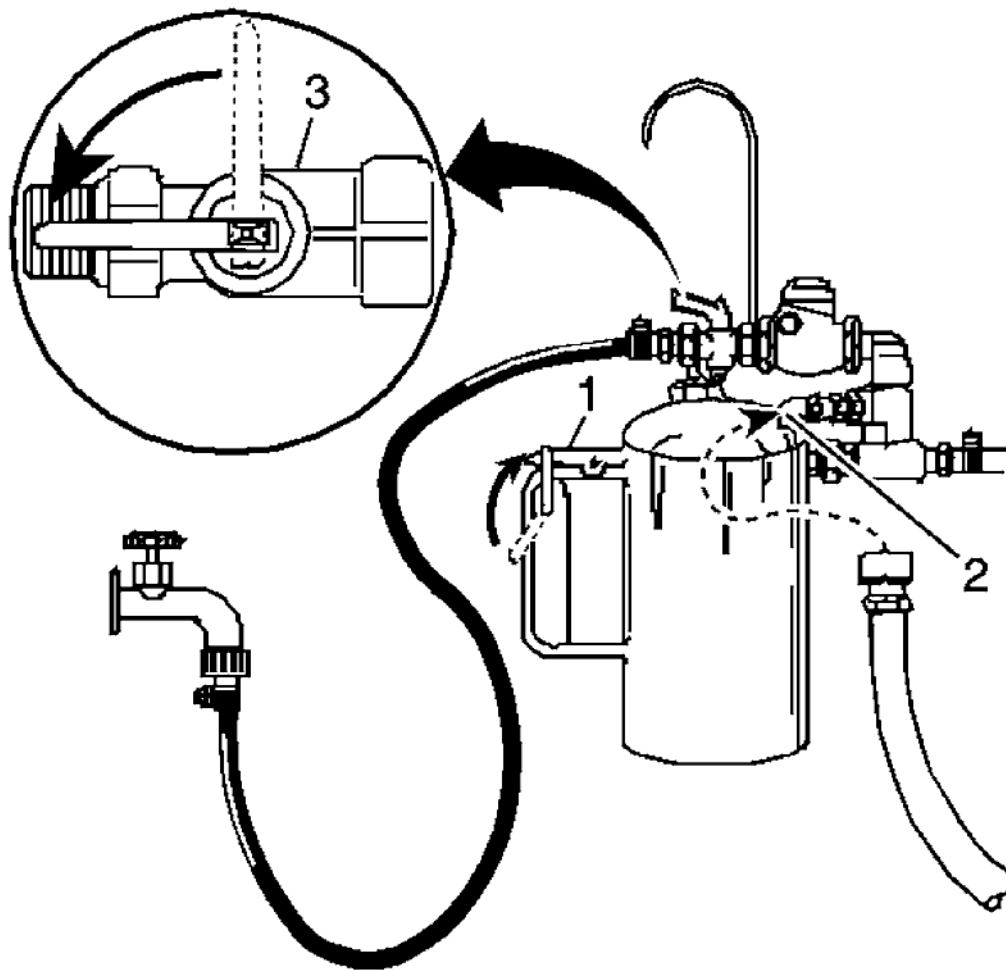


Fig. 59: J 35944-A Water Supply Valve ON/OFF Positions
Courtesy of GENERAL MOTORS CORP.

3. Release the trigger (1) of the **J 35944-A** and allow water only to rinse the oil cooler and pipes for 1 minute. See **Special Tools**.
4. Turn the **J 35944-A** water supply valve (3) to the OFF position and turn OFF the water supply at the faucet. See **Special Tools**.
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. See **Special Tools**. Continue, until no water comes out of the discharge hose.

Flow Test

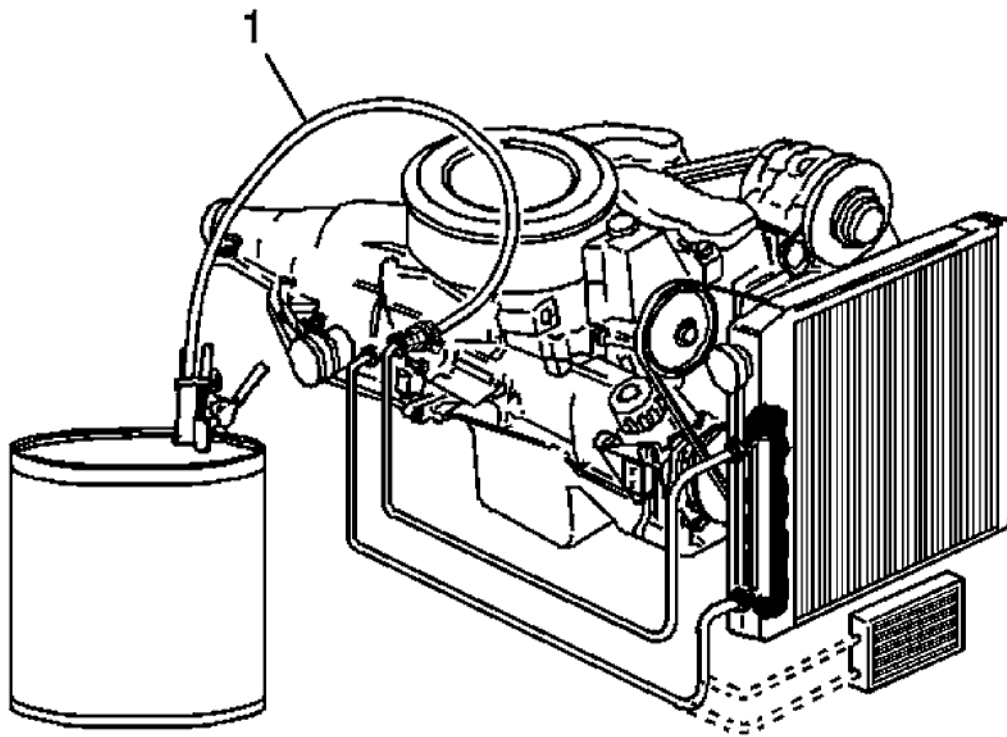


Fig. 60: Clipping The Discharge Hose To An Empty Oil Container
Courtesy of GENERAL MOTORS CORP.

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, top 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 quarts) 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 front 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. See **Special Tools**.
 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. See **Special Tools**.
 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, top connector, for restrictions or damage. If no condition is found with the feed pipe, 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. See **Special Tools**.
2. Remove the fill cap from the **J 35944-A** and return any unused flushing solution to its container. See **Special Tools**. Rinse the **J 35944-A** with water. See **Special Tools**. Do not store the **J 35944-A** with flushing solution in it. See **Special Tools**.
3. After every third use, clean the **J 35944-A** as described in the instructions included with the tool. See **Special Tools**.
4. Dispose of any waste water/solution and transmission fluid in accordance with local regulations.

AUTOMATIC TRANSMISSION FLUID LEAKS

Fluid Leaks

Checks	Action
Refer to Fluid Leak Diagnosis .	

HIGH OR LOW LINE PRESSURE

High or Low Line Pressure

Checks	Causes
Oil Level	High or Low; correct as required
• Pressure Regulator Valve (328) • Springs (326, 327) • Boost Valve (325)	Stuck

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Pressure Control Solenoid (312)	• Leak, damaged O-rings • Loose connector, damaged pins • Contaminated
Torque Signal Regulator Valve (309)	Stuck
Transmission Wiring Harness (11)	• Loose connector at the vehicle harness • Short
Pressure Switch Assembly	• Loose connector • Damaged or missing O-ring
Throttle Position Sensor	• Damaged, sticking, disconnected • An intermittent open or a shorted circuit
Oil Filter (85)	Clogged, broken, or loose
Oil Filter Seal (84)	Leaking
Cooler Lines	Clogged or restricted
Cooler Line Seals (49)	Leaking
Oil Pump (10)	Damaged, sticking, porous, or leaking
Oil Pump Drive Shaft (19)	Damaged
Pressure Relief Valve (214)	Damaged spring or missing ball
• Transmission Case (1) • Valve Body (18) • Channel Plate (27)	• Porosity, leaking circuits • Flatness of machined surfaces

INACCURATE/INCONSISTENT SHIFT POINTS**Inaccurate/Inconsistent Shift Points**

Checks	Causes
Shift Solenoids (305)	• Contamination • An intermittent open or a shorted circuit
Throttle Position Sensor	• Damaged, disconnected • An intermittent open or a shorted circuit
Vehicle (62) and Input Speed Sensors (46)	• Damaged, disconnected or loose • An intermittent open or a shorted circuit

HARSH SHIFTS**Harsh Shifts**

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Checks	Causes
Line Pressure	High Refer to High or Low Line Pressure .
Checkballs (26)	Missing; no orificed apply
Accumulators	• Springs or piston binding; no accumulation • Accumulator valve is stuck
Clutch Housing Retainer and Ball Assemblies	Plugged

NO REVERSE OR SLIPS IN REVERSE**No Reverse, Slips in Reverse**

Checks	Causes
Reverse Clutch	No apply or slipping
Piston and Seal Assembly (457)	Binding, cracked, or leaking
Inner Seal (456)	Plugged orifice
Clutch Plates (460-463)	Worn friction or broken splines
Snap Ring (459, 464)	Out of position
Housing (454)	Cracked, plugged feed holes, or broken tangs
Housing Retainer and Ball Assembly	Missing or out of position
Springs (458)	Binding
Reverse Clutch Fluid Routing	Fluid leak or restriction
Driven Sprocket Support (95)	• Leaking seal rings • Porosity, damage, misalignment
Channel Plate and Gasket, and Valve Body, Gaskets, and Channel Plate	Porosity, fluid leak across the channels, misalignment, damage, or fluid restriction
Low and Reverse Band and Servo	No apply or slipping
Servo Piston (69)	Broken or binding
Servo Piston Seals (71, 72)	Leaking
Servo Pin (67) and Springs (66, 68)	Binding
Servo Cover (73)	Broken, loose, or leaking
Low and Reverse Band (111)	Broken, worn, or out of position
Anchor Pin (64)	Broken
Fluid Feed Tubes (83)	• Broken, bent, or plugged

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	• Missing or leaking seal rings
Transmission Case (1)	Porosity, fluid leak, or restriction
Shift Linkage	Disconnected or misaligned
Manual Valve (800) and Link (802)	Disconnected or misaligned
#1 Checkball	Missing, no low band fluid
Fluid Level	Low
Fluid Pressure	Low Refer to High or Low Line Pressure .

NO FIRST GEAR, SLIPS IN FIRST GEAR**No First Gear, Slips in First Gear**

Checks	Causes
Forward Clutch	No apply or slipping
Piston and Seal Assembly (607)	Binding, cracked, or leaking
Inner Seal (608)	Plugged orifice
Clutch Plates (601-604)	Worn friction, or broken splines
Snap Ring (600, 605)	Out of position
Housing (609)	Cracked, or plugged feed holes
Housing Retainer and Ball Assembly	Missing or out of position
Springs (606)	Binding
Input Sprag (515)	Damaged or not holding
Lo Roller Clutch (652)	Damaged or not holding
Forward Clutch Fluid Routing	Fluid leak or restriction
Oil Feed Tubes (83)	• Bent, broken, or plugged • Leaking seal rings
Forward Clutch Support (114)	• Porosity • Leaking or damaged seal rings • Plugged feed holes
Channel Plate (27) and Gasket (28)	• Porosity • Misalignment • Fluid leaking across the channels • Restriction
PSA (13)	Leaking drive switch O-ring
1-2 Shift Solenoid Valve	• Failed OFF

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(305)	Leaking
1-2 Shift Valve (302)	Stuck in upshifted position
2-3 Shift Solenoid Valve (305)	- Failed ON - Plugged exhaust
- Manual Valve (800) - Shift Linkage	Misalignment
Torque Converter (55)	Stator roller clutch is not holding
Line Pressure	Low Pressure Refer to High or Low Line Pressure .

NO SECOND GEAR, SLIPS IN SECOND GEAR**No Second Gear, Slips in Second Gear**

Checks	Causes
Second Clutch	No apply or slipping
Piston and Seal Assembly (404)	Binding, cracked, or leaking
Clutch Plates (96-99)	Worn friction or broken splines
Snap Ring (406)	Out of position
Spring (405)	Binding
Driven Sprocket Support (95)	Damaged, leaking, porous
Second Clutch Fluid Routing	Fluid leak or restriction
- Valve Body - Gaskets and Spacer Plate - Channel Plate and Gasket - Driven Sprocket Support	- Porosity - Misalignment - Loose or restricted - Fluid leak across the channels
Second Roller Clutch (452)	Damaged, not holding
1-2 Shift Solenoid Valve (305)	- Stuck ON - Plugged
Forward Clutch	Low capacity shows up in Second Gear
Line Pressure	Low pressure Refer to High or Low Line Pressure .
1-2 Accumulator (29-31)	- Leak at the piston seal - Channel plate or case porosity
1-2 Accumulator Valve (323)	Stuck
2-3 Shift Valve (306)	Stuck in an upshifted position
PSA	Electrical or hydraulic malfunction

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NO THIRD GEAR, SLIPS IN THIRD GEAR**No Third Gear, Slips in Third Gear**

Checks	Causes
Direct Clutch	No apply or slipping
Piston and Seal Assembly (518)	Binding, cracked, or leaking
Clutch Plates	Worn friction or broken splines
Snap Ring (520)	Out of position
Springs (519)	Binding
Direct & Coasting Housing and Input Shaft (520)	• Damaged or cracked • Restricted feed holes
Housing Retaining and Ball Assembly	Missing or loose
Direct Clutch Fluid Routing	Fluid leak or restriction
• Valve Body • Gaskets & Spacer Plate • Channel Plate & Gasket • Driven Sprocket Support	• Porosity • Misalignment • Looseness • Fluid Restriction • Fluid leak across the channels
Driven Sprocket support Seals	Leaking
Input Shaft	• Leaking seals • Damaged or misaligned sleeve
2-3 Shift Solenoid Valve (305)	• Stuck OFF • Leaking
2-3 Accumulator	• A leak at a piston seal • Channel plate or case porosity
2-3 Accumulator Valve (330)	Stuck
Line Pressure	Low pressure Refer to High or Low Line Pressure .
3-4 Shift Valve (319)	Stuck in upshifted position
PSA (13)	Electrical or hydraulic malfunction

SECOND GEAR ONLY**Second Gear Only**

Checks	Causes
1-2 Shift Valve (302)	Stuck in the down shifted position

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NO FOURTH GEAR, OR SLIPS IN FOURTH GEAR**No Fourth Gear, Slips in Fourth Gear**

Checks	Causes
Intermediate/Fourth Band & Servo	No apply or slipping
Servo Piston (77)	Broken or binding
Servo Piston Seals (78, 79)	Leaking
Servo Pin (76) and Springs (78, 79)	Binding
Servo Cover (80)	Broken, loose, or leaking
Band (100)	Broken, worn, or out of position
Case (1)	Cracked at the band seat
Band Apply Fluid Routing	Fluid leak and fluid restricting
• Valve Body • Gaskets & Spacer Plate • Channel Plate • Case	• Porosity • Misalignment • Fluid leak across the channels
1-2 Shift Solenoid Valve (305)	• Stuck OFF • Leaking
3-4 Shift Valve (319)	Stuck in the downshifted position
Manual Valve (800)	Misaligned in Manual Third gear
3-4 Accumulator	• A leak at the piston seal • Channel plate or case porosity
3-4 Accumulator Valve (323)	Stuck
Line Pressure	Low pressure Refer to High or Low Line Pressure .
Direct Clutch	A low capacity will cause a failure in the Fourth gear
PSA	Hydraulic or electrical malfunction

LOSS OF DRIVE**Loss of Drive**

Checks	Causes
Torque Converter (55)	• Broken lugs or a failed lug weld • Sheared lug bolts • Worn turbine shaft splines • An internal failure

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	• A cracked cover at the weld
Wheel Drive Shafts	• Damaged • Worn or loose splines
Turbine Shaft (39)	Stripped splines
Oil Pump (10)	Seized or broken pump gears
Oil Pump Shaft (19)	Broken or stripped splines
Filter and Filter Seal (84, 85)	Plugged or missing
Fluid Level	Low
Shift Linkage	Disconnected
Drive/Driven Sprockets and Drive Chain (36, 37, 91)	Broken
Planetary Gears	Failure or lack of lube
Final drive	Gear failure or lack of lube
Channel Plate and Gasket (28)	Damaged, leaking, or misaligned
Valve Body, Gaskets, and Spacer Plate	Damaged, leaking, or misaligned
• Forward Sprag Clutch • Forward Clutch • Low Roller Clutch	Damaged or not holding Refer to No First Gear, Slips in First Gear.
Hydraulic System	• Tie up • Fluid circuit leaks

LOSS OF POWER**Loss of Power**

Checks	Causes
Fluid Level	Low
Shift Solenoids (305)	• Second gear start failed OFF • 2-3 Shift solenoid Valve failed ON
TCC System	The TCC is stuck ON or is dragging
Torque Converter (55)	Contaminated or damaged

ENGINE STALL**Engine Stall**

Checks	Causes
TCC System	The TCC is stuck ON or is dragging
TCC Solenoid Valve (335)	• Stuck ON

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	• Solenoid exhaust is plugged
TCC Regulated Apply Valve (339)	Stuck in the apply position

FIRST AND SECOND GEARS ONLY**First and Second Gears Only**

Checks	Causes
2-3 Shift Solenoid Valve (305)	• Stuck in OFF • Leaking solenoid • Electrical malfunction
2-3 Shift Valve (307)	Stuck in downshifted position
Direct Clutch	Failed clutch (released)
Pressure Control Solenoid (312)	Actual line pressure is lower than desired line pressure.

THIRD AND FOURTH GEARS ONLY**Third and Fourth Gears Only**

Checks	Causes
2-3 Shift Solenoid Valve(305)	• Stuck ON • Solenoid is plugged • Electrical malfunction
1-2 and 2-3 Shift Valves	Both are stuck in an upshifted position

FIRST AND FOURTH GEARS ONLY**First and Fourth Gears Only**

Checks	Causes
1-2 Shift Solenoid Valve (305)	• Stuck ON • The solenoid is plugged • Electrical malfunction

SECOND AND THIRD GEARS ONLY**Second and Third Gears Only**

Checks	Causes
1-2 Shift Solenoid Valve (305)	• Stuck OFF • The solenoid is leaking

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- Electrical malfunction

NO PARK**No Park**

Checks	Causes
Parking Lock Actuator Assembly (807)	• Bent or damaged rod • Binding or broken spring • The rod is not attached to the detent lever
Detent Roller and Spring (804)	• The bolt is not torqued, or loose • Bent or damaged
Detent Lever (806)	• Damaged or loose • A manual shaft pin is missing
Manual Valve (800)	• Misaligned • The manual valve to detent lever link is bent
Parking Lock Pawl (663)	• Damaged • Broken tooth
Park Lock Gear (659)	• Damaged teeth • Damaged splines
Park Pawl Spring (662)	Broken or missing
Shift Linkage	Misadjusted

RATCHETING NOISE**Ratcheting Noise**

Checks	Causes
Parking Pawl (663)	The return spring is damaged, weak, or misassembled

NO ENGINE BRAKING; ALL MANUAL RANGES**No Engine Braking; All Manual Ranges**

Checks	Causes
Coast Clutch	No apply or slipping
Piston and Seal Assembly (504)	Binding, cracked, or leaking
Clutch Plates (508, 509)	Worn friction or broken splines
Springs (505)	Binding
Direct & Coast Clutch	• Damaged or cracked

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Housing and Input Shaft (502)	• Fluid feed holes are restricted
Housing Retainer and Ball Assembly	Missing or loose
Coast Clutch Fluid Routing	Fluid leak or restriction
• Valve Body Gaskets and Spacer Plate • Channel Plate and Gasket • Driven Sprocket Support	• Porosity • Misalignment • Looseness • Fluid restriction • Fluid leak across the channels
Driven Sprocket Support Seals	Leaking
Input Shaft (502)	• Leaking seals • Damaged or misaligned sleeve
Oil Level or Line Pressure	Low Pressure Refer to High or Low Line Pressure .
3-4 Shift Valve (319)	Stuck in Fourth gear position, No coast clutch apply
Manual Valve or Shift Linkage (800)	Misaligned

NO ENGINE BRAKING; MANUAL SECOND - SECOND GEAR**No Engine Braking; Manual Second - Second Gear**

Checks	Causes
Coast Clutch	No apply Refer to No Engine Braking; All Manual Ranges .
Intermediate or Fourth Band (100)	No apply Refer to No Fourth Gear, or Slips in Fourth Gear .
Pressure Switch Assembly (13)	Leaking or inoperative
Vehicle Speed Sensor (62)	Reads 0 km/h (0 mph)

NO ENGINE BRAKING; MANUAL FIRST - FIRST GEAR**No Engine Braking; Manual First - First Gear**

Checks	Causes
Coast Clutch	No apply Refer to No Engine Braking; All Manual Ranges .
Lo and Reverse Servo	No apply Refer to No Reverse or Slips in Reverse .
Pressure Switch Assembly	Leaking or inoperative

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(13)	
#1 Checkball	Missing

DRIVES IN NEUTRAL

Drives in Neutral

Checks	Causes
Forward Clutch Drives Forward	Not releasing
Reverse Clutch and Lo & Reverse Servo Drives in Reverse	Both are not releasing
Manual Valve and Linkage (800)	Misaligned

NO GEAR SELECTION

No Gear Selections

Checks	Causes
Manual Valve to Detent Lever Link (802)	• Broken or missing • Disconnected from the manual valve
Manual Valve to Link Clip (801)	Disconnected
Manual Valve (800)	Stuck
Shift Linkage	Disconnected
Valve Body, Channel Plate and Case	Blocked fluid channels

SHIFT INDICATOR INDICATES WRONG GEAR SELECTION

Shift Indicator Indicates Wrong Gear Selection

Checks	Causes
Indicator Linkage	Misadjusted
Detent Spring and Roller Assembly (804)	• Broken or missing • Loose bolt
Manual Valve (800)	Not connected to the detent lever

FLUID FOAMING

Fluid Foaming

Checks	Causes

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Fluid	• Degraded fluid • Contaminated antifreeze • The transmission is overfilled
Cooler Lines	Plugged
Transmission Oil Filter (85)	Clogged or cracked
Filter Seal (84)	Leaking
Side Cover Seal (6)	Damaged
Engine	Overheated
Vehicle	Overloaded
Oil Level Control Valve (86)	Damaged or loose

VIBRATION**Vibration**

Checks	Causes
Torque Converter (55)	• Out of balance • Internal Failure
Transmission or Engine	Misaligned
Output (94) or Stub Shafts (58)	• Out of balance • Worn or damaged bushings
Turbine Shaft (39)	• Out of balance • Worn bushings

WHINE NOISE VARYING WITH RPM**Whine Noise Varying with RPM**

Checks	Action
DEFINITION: In all ranges, a whine which may be sensitive to RPM load or which ceases when the torque converter clutch (TCC) engages.	
Torque Converter (55)	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.

HIGH PITCH WHINE NOISE**High Pitch Whine Noise**

Checks	Action
DEFINITION: A high pitch whine which will intensify with engine RPM or which is sensitive to the oil pressure.	

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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.

POPPING NOISE

Popping Noise

Checks	Action
DEFINITION: A popping noise, similar to popcorn popping.	
Oil Pump 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.

BUZZ NOISE OR HIGH FREQUENCY RATTLE SOUND

Buzz Noise or High Frequency Rattle Sound

Checks	Action
• Trace Cooler Pipes • Inspect 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 gage. A road test may be necessary. Refer to Road Test Procedure .

WHINE/GROWL NOISE THAT CHANGES WITH VEHICLE SPEED

Whine/Growl Noise that Changes with Vehicle Speed

Checks	Causes
DEFINITION: A whine or growl that increases and fades with vehicle speed and is most noticeable under light acceleration.	
Drive Link Assembly System	Verify that the noise comes from the sprockets, the chain, or the drive link assembly by placing your left foot on the brake and by moving the gear selector from Park or Reverse. If the noise stops, check the following items: • Drive Chain • Drive Sprocket • Driven Sprocket

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	• Drive Sprocket Support • Driven Sprocket Support
Drive Chain (36)	Stretched
Drive Sprocket (37) and Driven Sprocket (91)	• Broken or sheared teeth • Nicked or scored bearing surfaces • The bearing race or roller bearing surfaces on the gear support inner bearing are rough or pitted • A damaged bearing
Drive Sprocket Support (43) and Driven Sprocket Support (95)	The bearing outer race support is rough or nicked.

FINAL DRIVE NOISE OR HUM NOISE

Final Drive Noise or Hum Noise

Checks	Causes
DEFINITION: A final drive noise or hum is most noticeable under light throttle acceleration or turns.	
• Final Drive Gear Set (116) • Final Drive Internal Gear (118)	• Worn planet pinions • Worn washers • Worn or damaged teeth
• Differential Carrier (116) • Differential Side Gears (709)	• Worn or pitted gears • A damaged thrust washer

NOISE IN RANDOM RANGES

Noise in Random Ranges

Checks	Action
DEFINITION: Noise is only present in certain gear ranges.	
Refer to Range Reference . Determine the power flow and the applicable components that may be causing this noise.	

NOISE IN FIRST, SECOND, THIRD, OR FOURTH

Noise in First, Second, Third, or Fourth

Checks	Causes
• Final Drive Sun Gear (115)	Worn or damaged gears

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- Final Drive Pinions (707)

NO TORQUE CONVERTER CLUTCH (TCC) RELEASE

No TCC Release

Checks	Causes
TCC Solenoid (335)	• Internal failure • A plugged fluid exhaust • An external ground
Torque Converter (55)	Internal failure
TCC Regulated Apply Valve (339) and TCC Control Valve (344)	Stuck in the TCC apply position

TORQUE CONVERTER CLUTCH (TCC) APPLY WITH COLD ENGINE

TCC Apply with Cold Engine

Checks	Causes
Engine Coolant Temp Sensor	Malfunction

TORQUE CONVERTER CLUTCH (TCC) SHUDDER

TCC Shudder

Checks	Action
Refer to the TCC Shudder Diagnosis portion of <u>Torque Converter Diagnosis Procedure</u> .	

REPAIR INSTRUCTIONS

TRANSMISSION CONTROL MODULE (TCM) REPLACEMENT

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical.
2. Remove the ECM. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 2.2L (L61).

IMPORTANT: Use care not to damage connector retaining levers.

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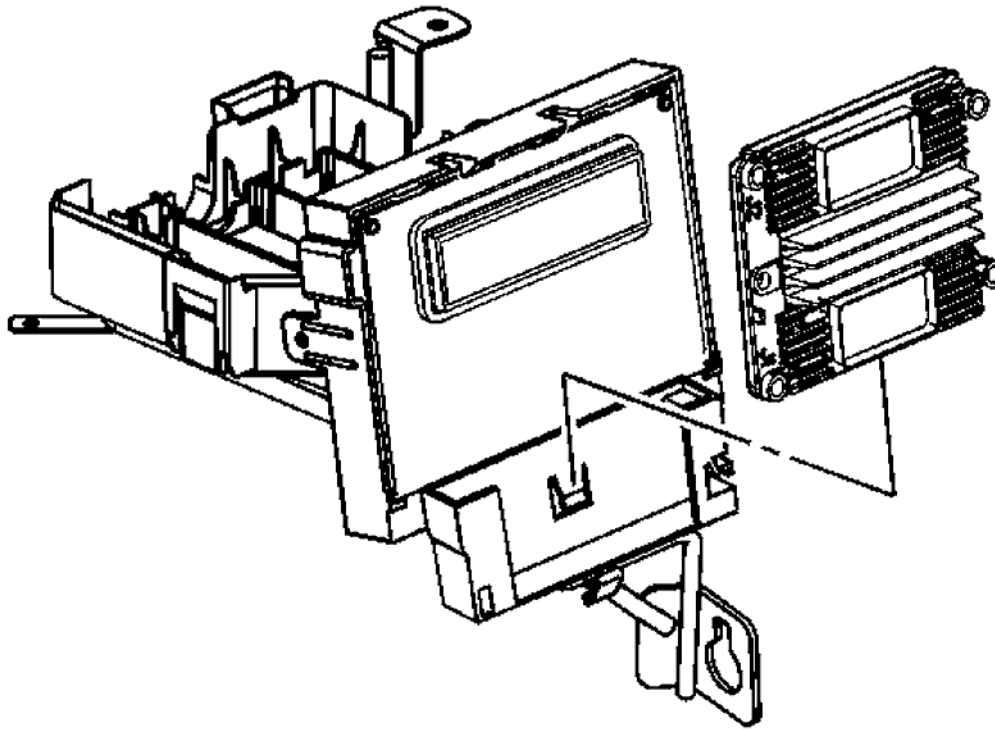


Fig. 61: View Of TCM

Courtesy of GENERAL MOTORS CORP.

3. Remove the TCM connectors from the TCM, noting proper connection points for installation.

NOTE: Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables or when charging the vehicles battery.

4. Use the retaining tab in order to release the TCM from the under hood junction block bracket.
5. Lift the TCM halfway, then rotate the TCM clockwise to remove.

Installation Procedure

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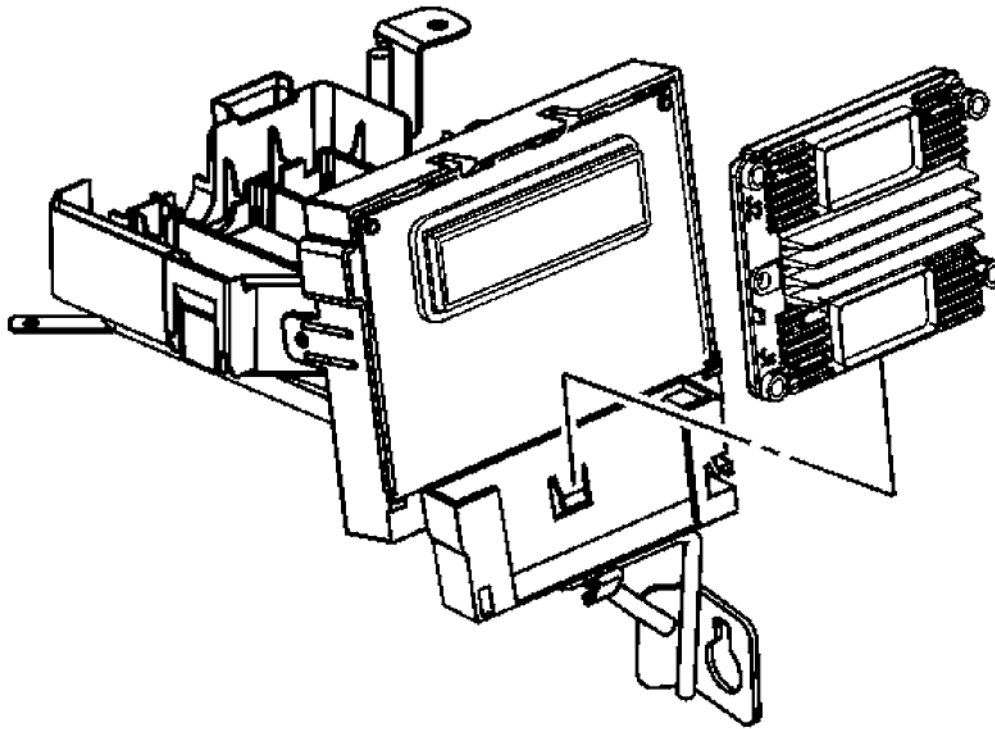


Fig. 62: View Of TCM
Courtesy of GENERAL MOTORS CORP.

1. Place the lower right corner of the TCM into the under hood junction block bracket.
2. Rotate the TCM counter clockwise, then press the TCM downward until fully seated.
3. Install the TCM harness connectors to the TCM, as noted during removal.
4. Install the ECM. Refer to **Engine Control Module (ECM) Replacement** in Engine Controls - 2.2L (L61).
5. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** in Engine Electrical.
6. Program the TCM. Refer to **Transmission Control Module Programming and Setup** .

FLOOR SHIFT CONTROL KNOB REPLACEMENT

Removal Procedure

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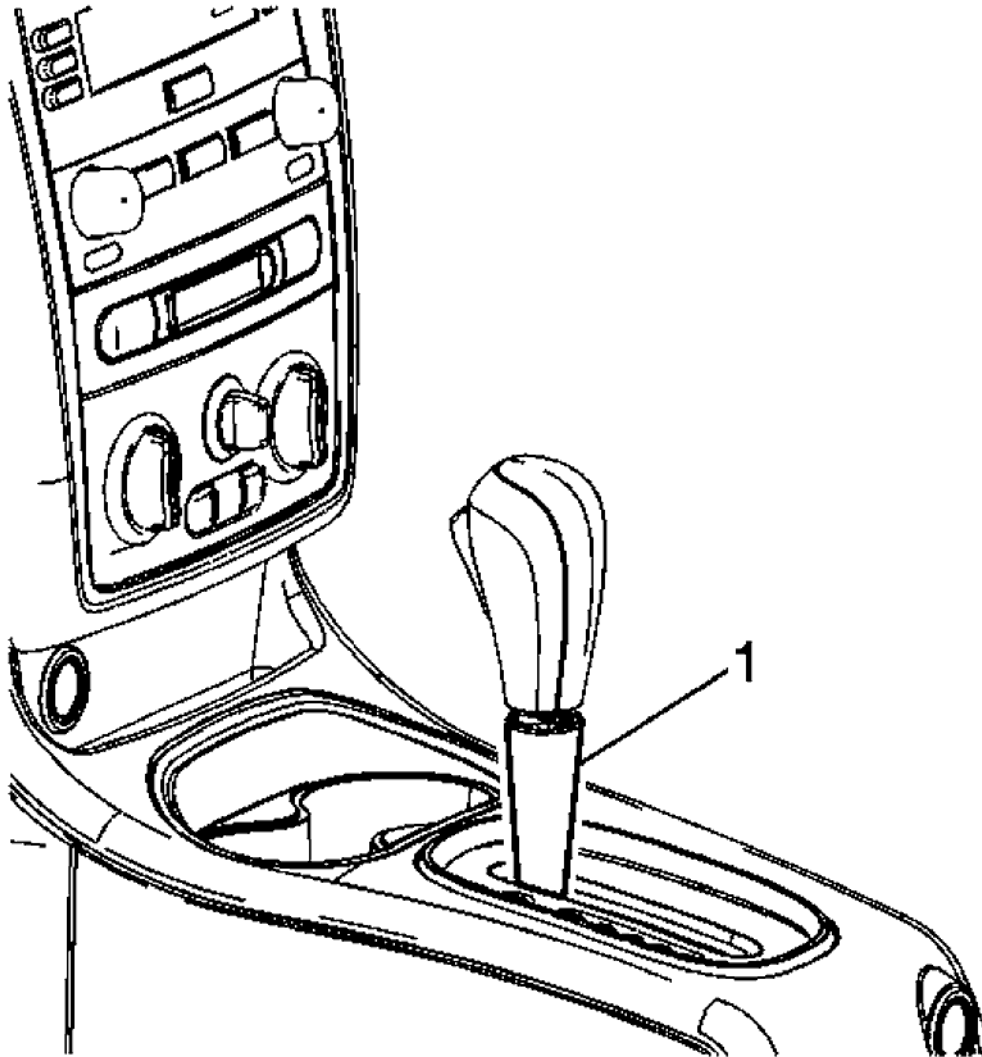


Fig. 63: Shift Knob Bezel

Courtesy of GENERAL MOTORS CORP.

1. Pull the shift knob bezel (1) down to expose the shift knob retaining screw.

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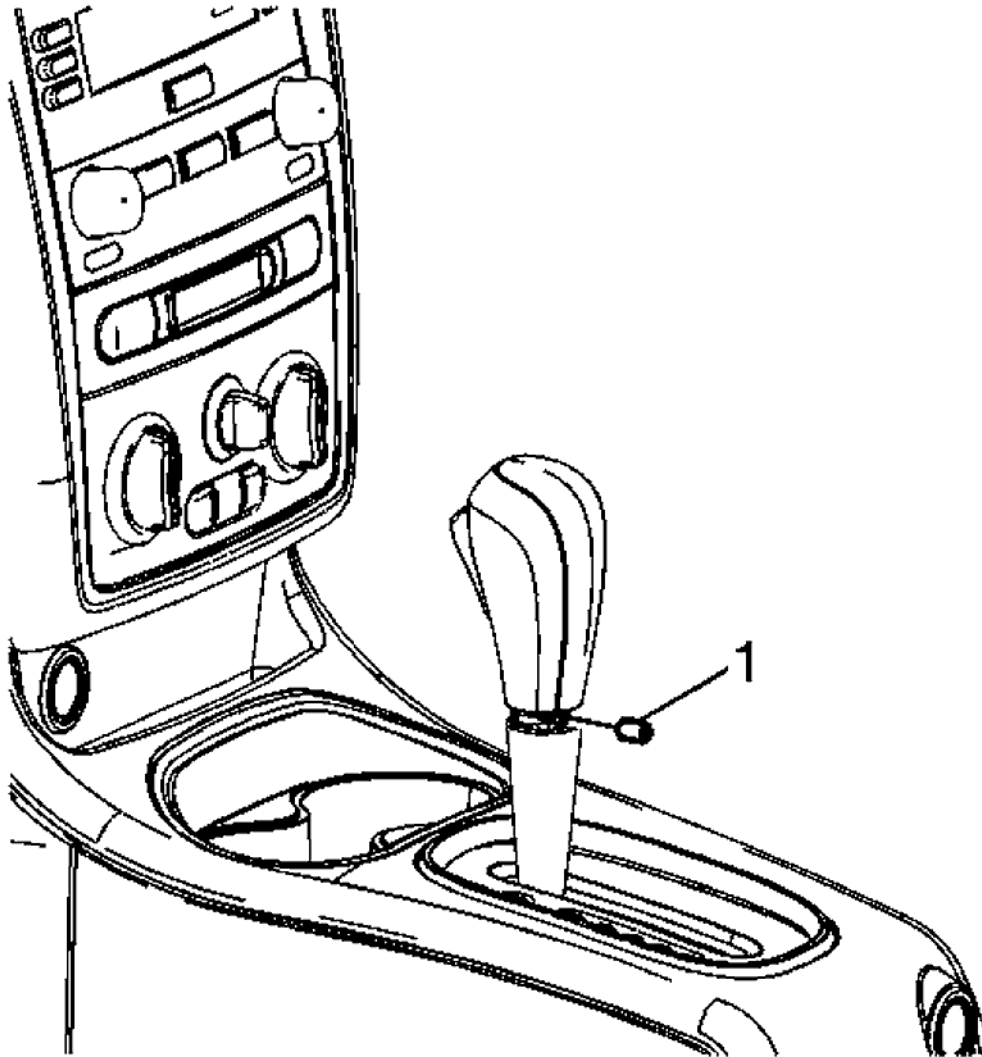


Fig. 64: Shift Knob Retaining Screw
Courtesy of GENERAL MOTORS CORP.

2. Remove the shift knob retaining screw (1).

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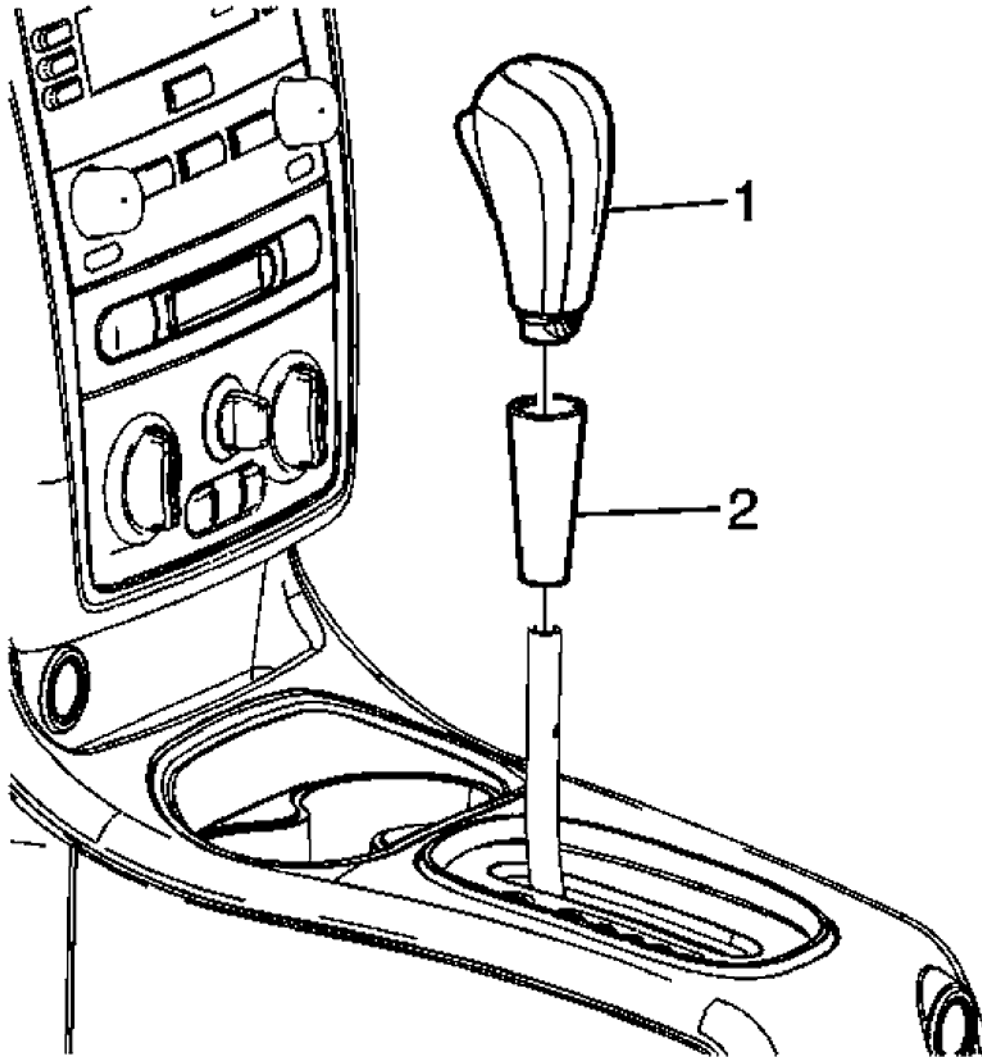


Fig. 65: Shift Knob & Bezel
Courtesy of GENERAL MOTORS CORP.

3. Remove the shift knob (1) and bezel (2) from the shift control lever.

Installation Procedure

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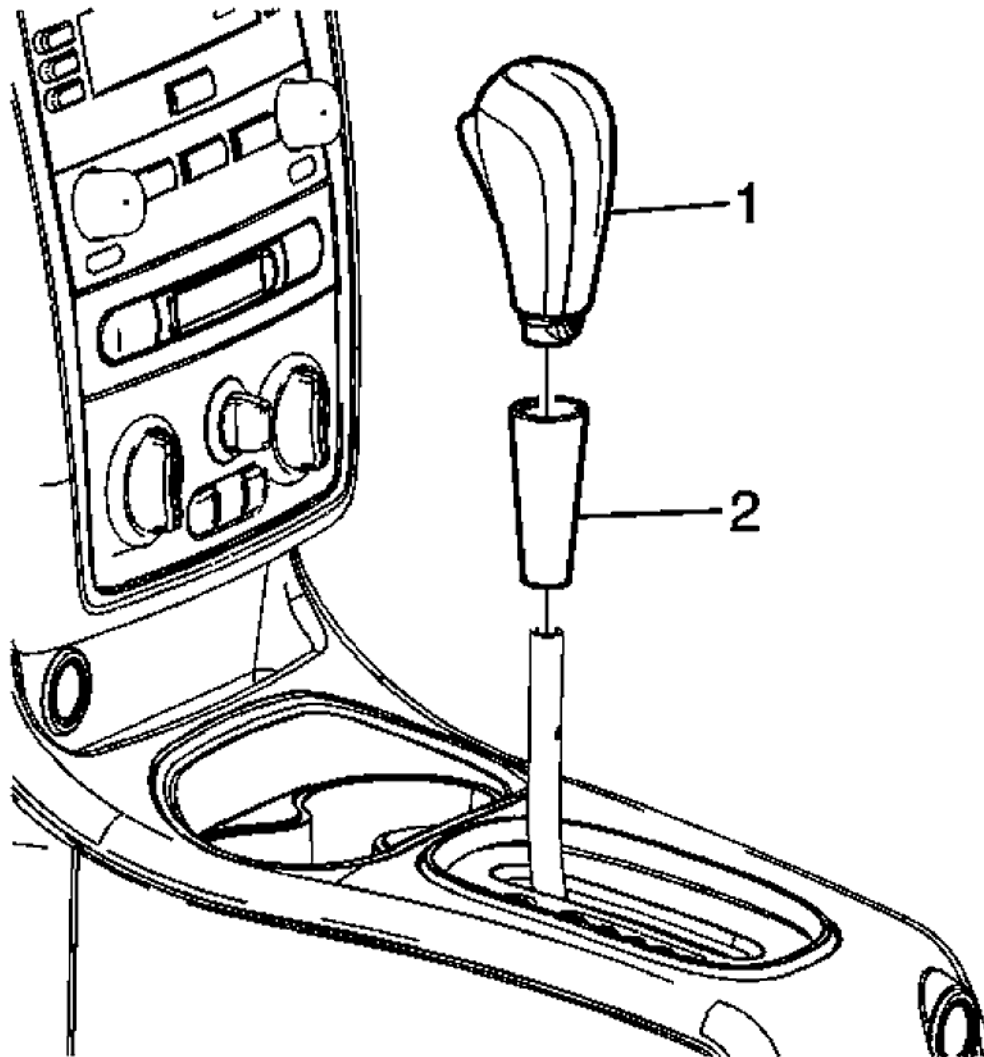


Fig. 66: Shift Knob & Bezel

Courtesy of GENERAL MOTORS CORP.

1. Install the bezel (2) and shift knob (1) to the shift control lever.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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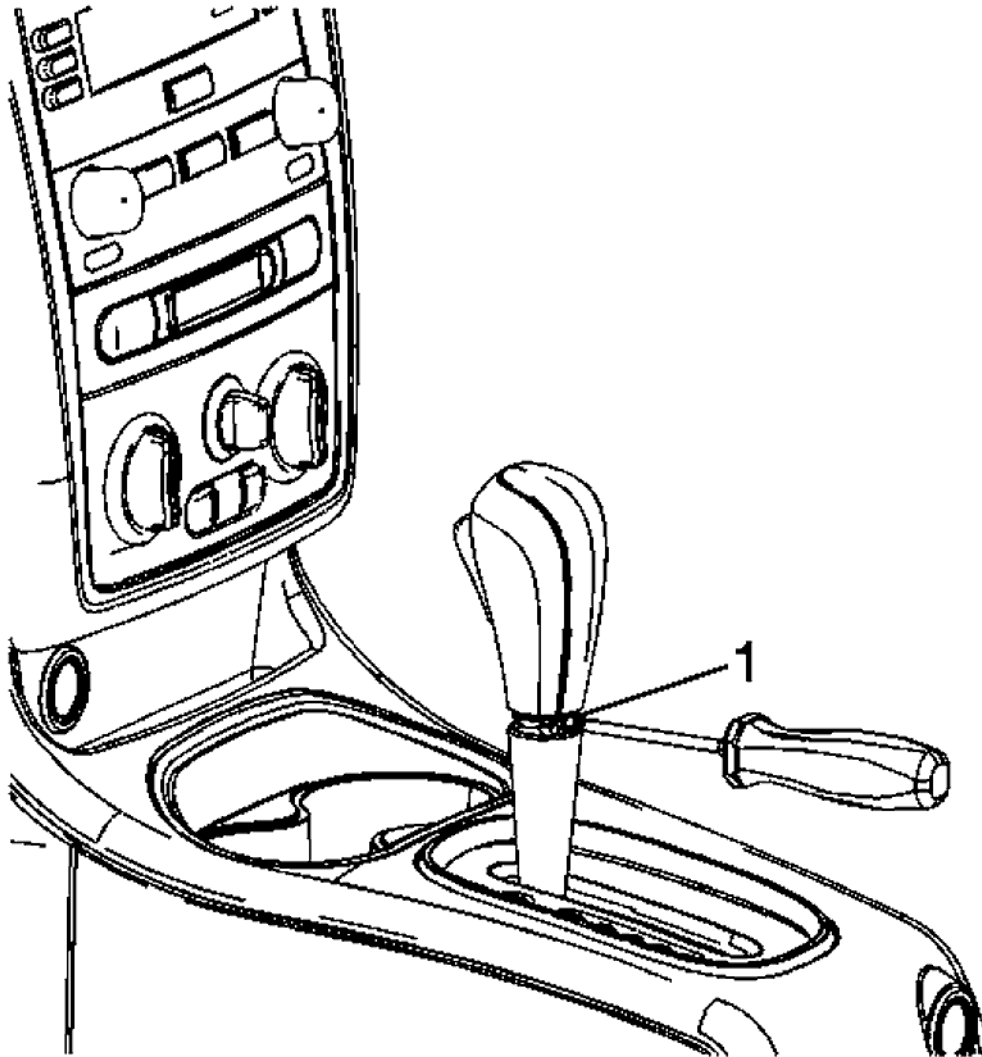


Fig. 67: Shift Knob Retaining Screw
Courtesy of GENERAL MOTORS CORP.

2. Install the shift knob retaining screw (1).

Tighten: Tighten the screw to 2 N.m (18 lb in).

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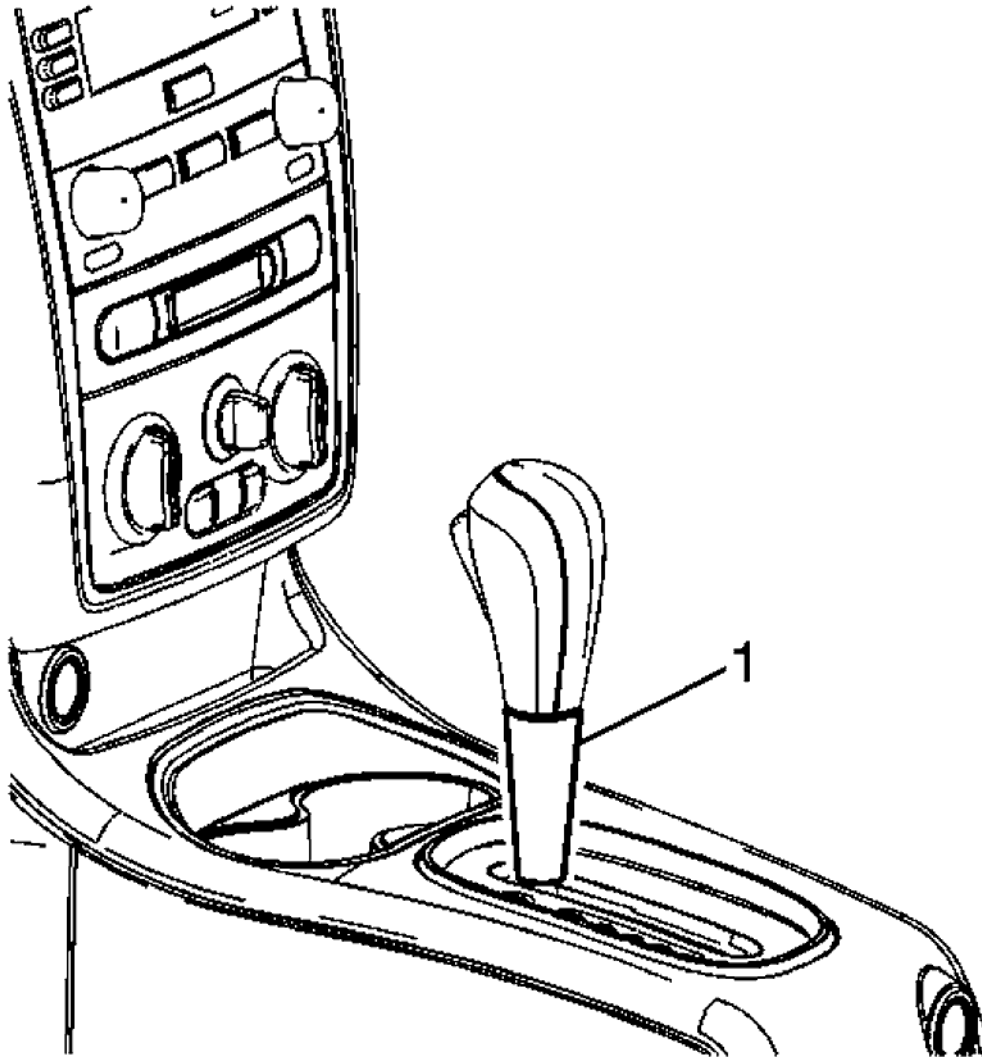


Fig. 68: Shift Knob Bezel

Courtesy of GENERAL MOTORS CORP.

3. Secure the shift knob bezel (1) to the shift knob.

FLOOR SHIFT CONTROL REPLACEMENT

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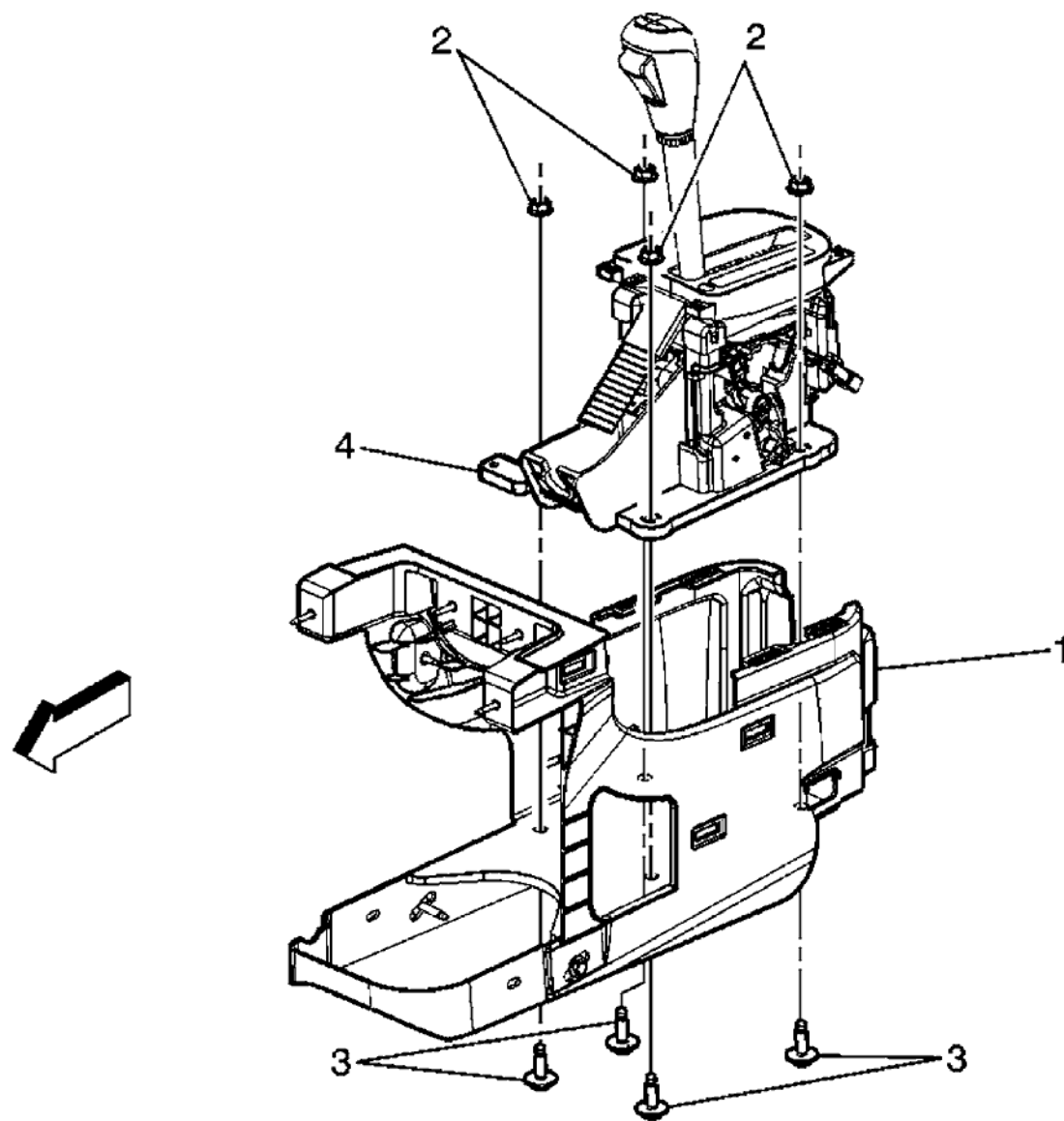


Fig. 69: Floor Shift Control Replacement
Courtesy of GENERAL MOTORS CORP.

Floor Shift Control Replacement

Callout	Component Name
NOTE: Refer to <u>Fastener Notice</u> in Cautions and Notices. Fastener Tightening Specifications: Refer to <u>Fastener Tightening Specifications</u>. Preliminary Procedures 1. Disconnect the shift cables from the shift control. Refer to Shift Control Cable	

Replacement - Floor Shift.

2. Disconnect the shift lock solenoid electrical connector.

1	Instrument Panel Center Support Bracket. Refer to Bracket Replacement - Instrument Panel (I/P) Center Support
2	Shift Control Nut (Qty: 4) Tighten: 10 N.m (89 lb in)
3	Shift Control Bolt (Qty: 4)
4	Shift Control

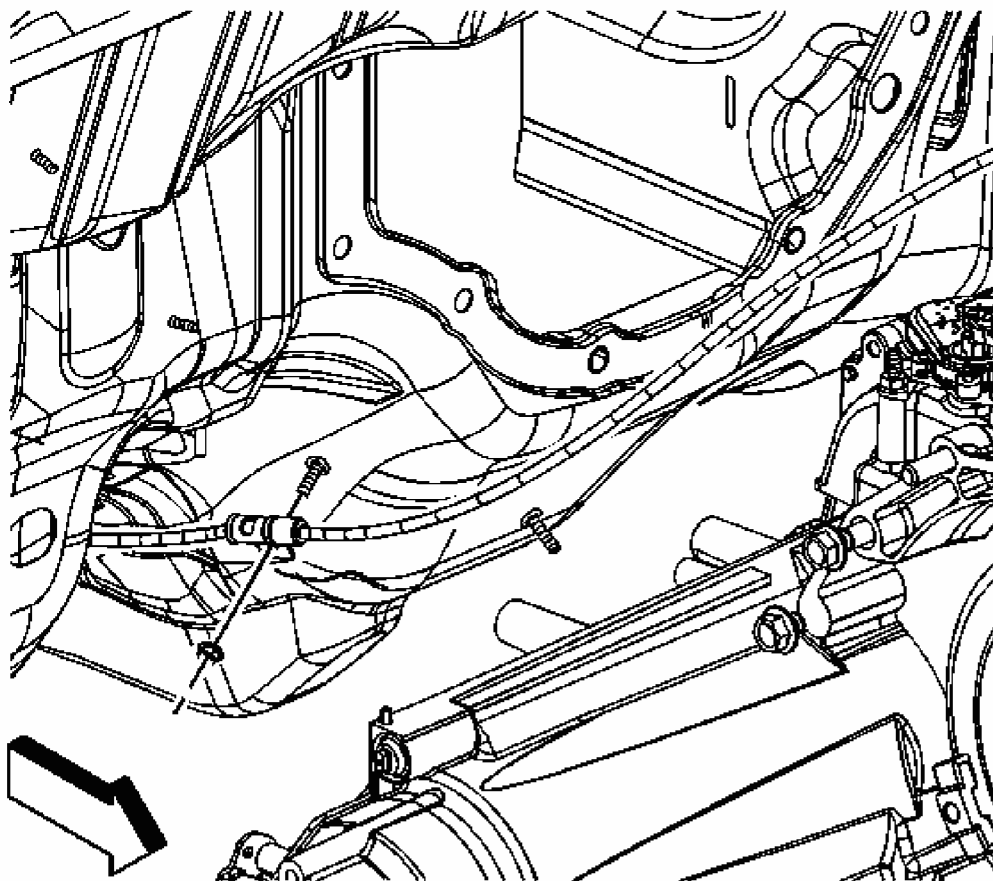
SHIFT CONTROL CABLE REPLACEMENT - FLOOR SHIFT**Removal Procedure**

Fig. 70: Identifying Shift Cable Retaining Nut
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the shift cable retaining nut near the exhaust heat shield.

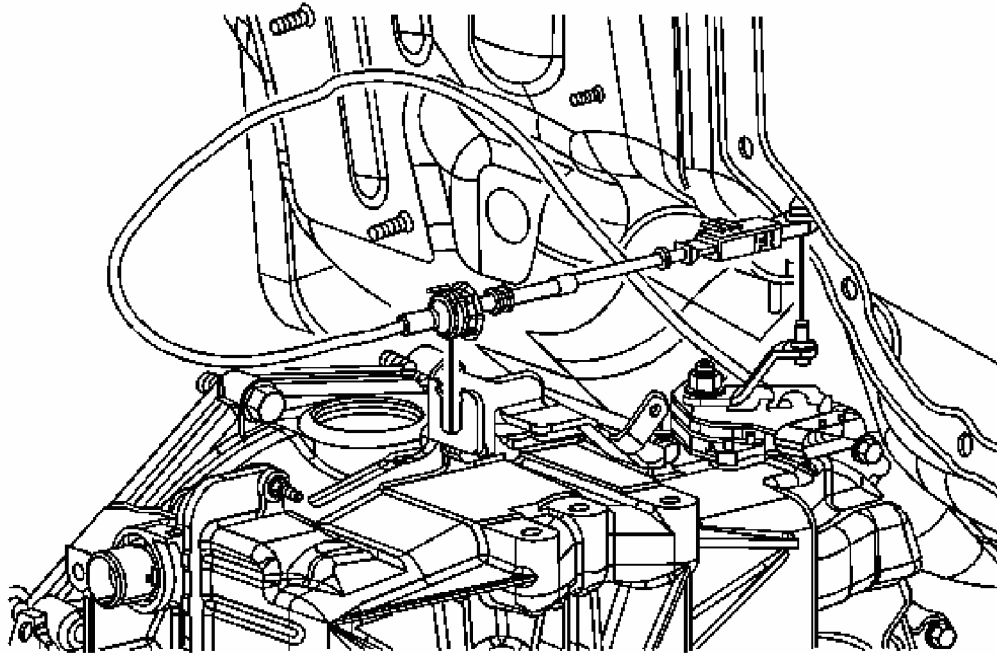


Fig. 71: Identifying Shift Cable
Courtesy of GENERAL MOTORS CORP.

3. Remove the shift cable from the transmission cable bracket.
4. Disconnect the shift cable from the park/neutral position switch.
5. Lower the vehicle.
6. Remove the console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.

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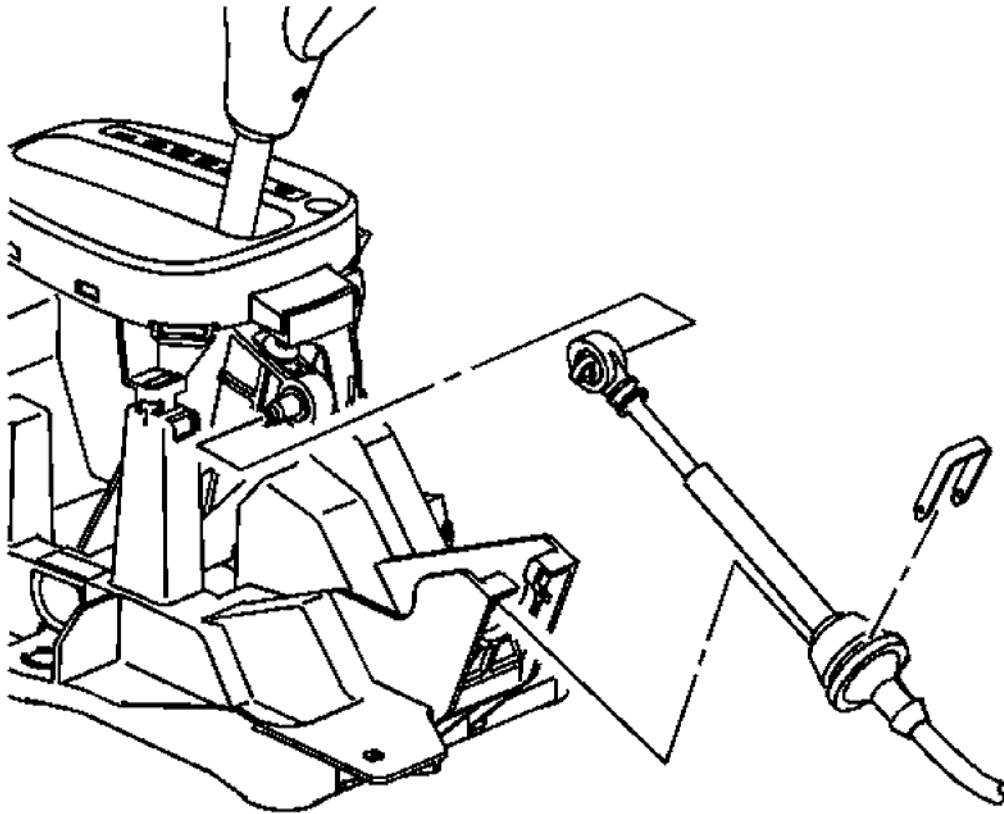


Fig. 72: View Of Shift Control
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the shift cable from the shift control assembly.
8. Position the driver's side front carpet aside.

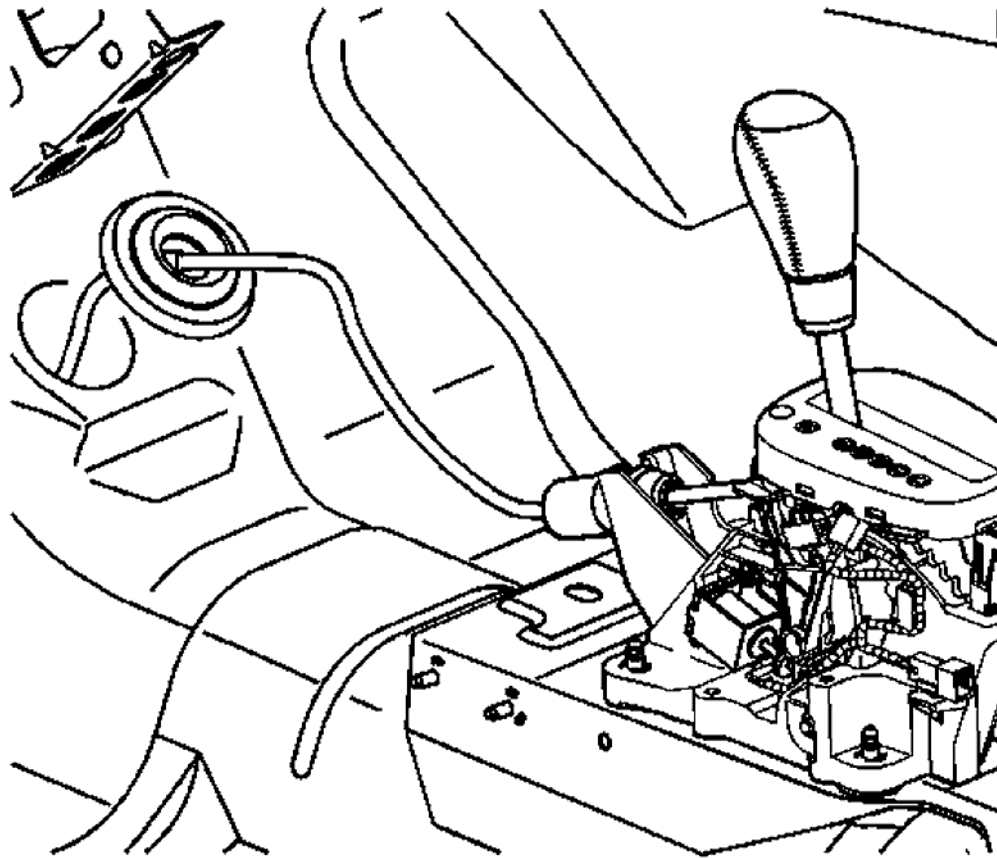


Fig. 73: View Of Floor Pan Grommet
Courtesy of GENERAL MOTORS CORP.

9. Separate the grommet from the floor pan.
10. Remove the cable from the vehicle by pulling the cable through the driver's floor opening.

Installation Procedure

1. Insert the cable through the driver's floor opening.

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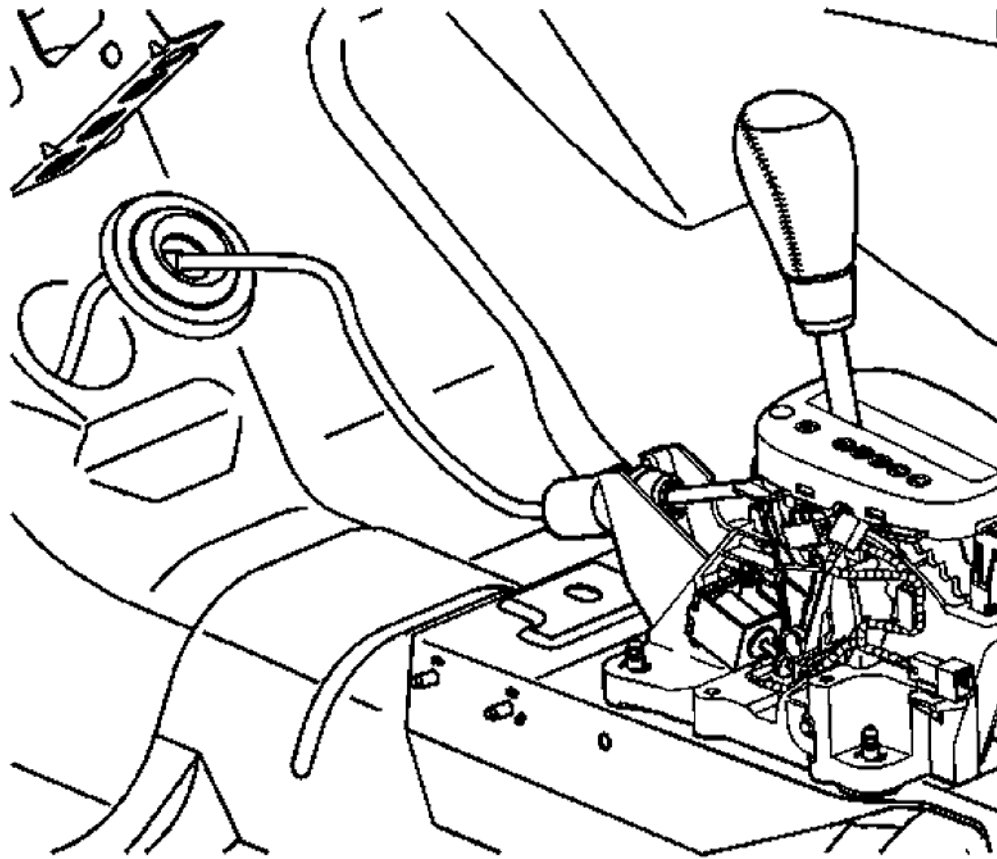


Fig. 74: View Of Floor Pan Grommet
Courtesy of GENERAL MOTORS CORP.

2. Install the grommet flush with the floor opening.
3. Install the driver's side front carpet.

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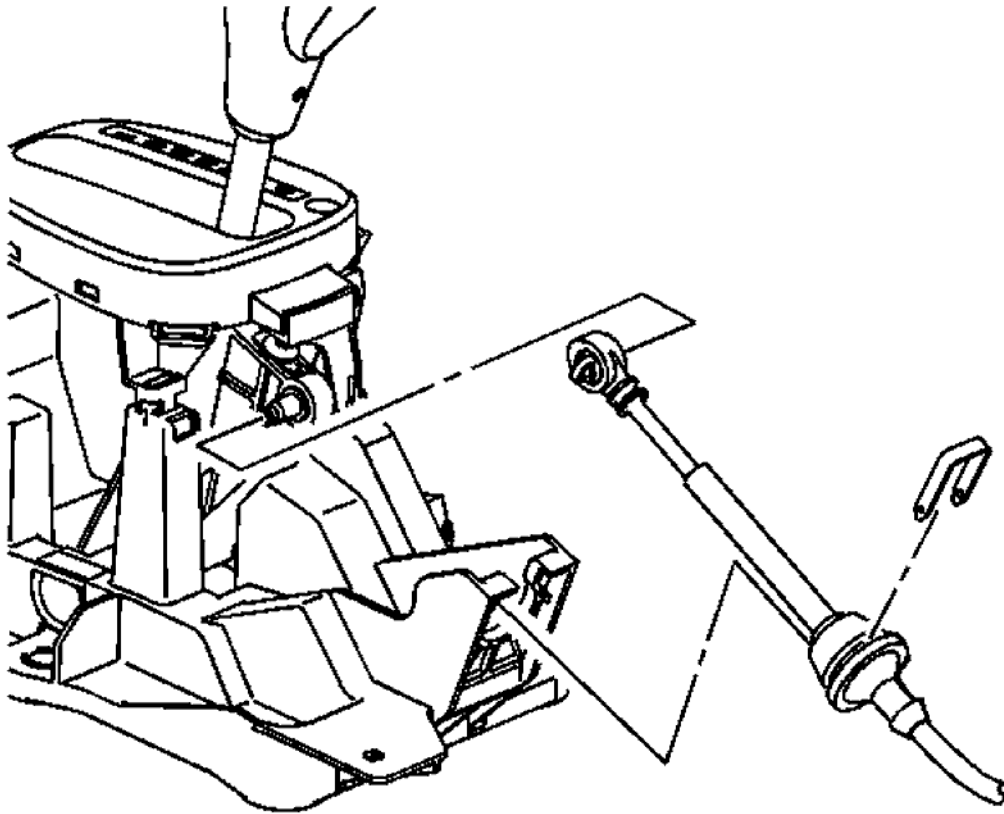


Fig. 75: View Of Shift Control
Courtesy of GENERAL MOTORS CORP.

4. Connect the shift cable to the shift control assembly.
5. Install the console. Refer to **Console Replacement - Front Floor** in Instrument Panel, Gages, and Console.
6. Raise the vehicle.

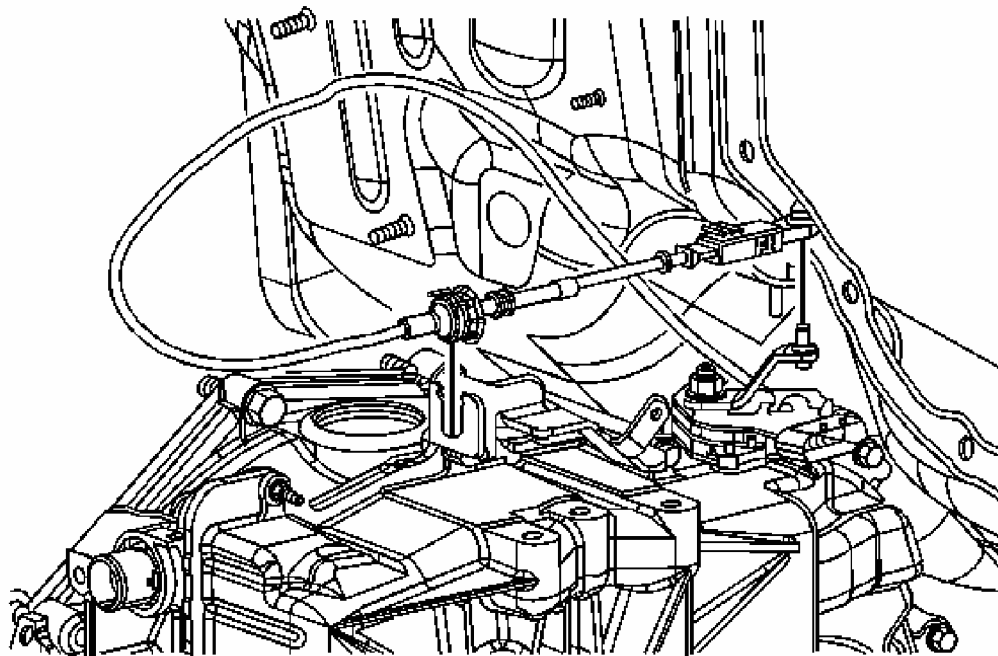


Fig. 76: Identifying Shift Cable
Courtesy of GENERAL MOTORS CORP.

7. Connect the shift cable to the park/neutral position switch.
8. Connect the shift cable to the transmission cable bracket.

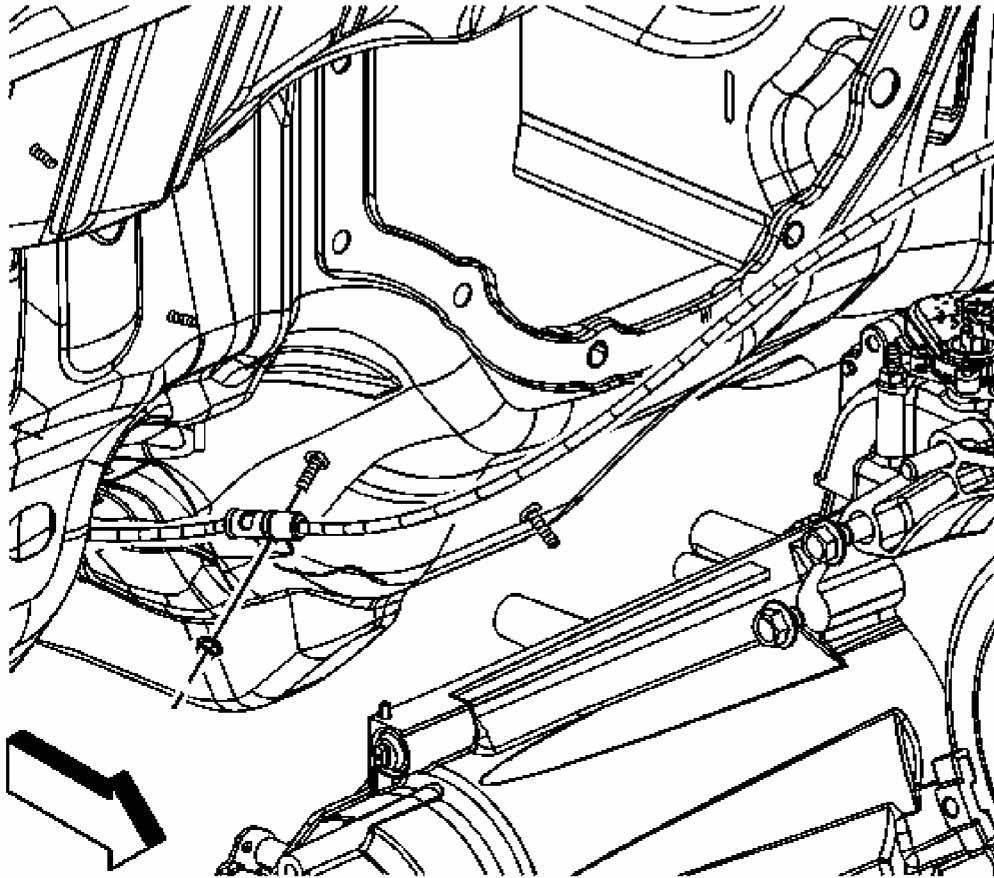


Fig. 77: Identifying Shift Cable Retaining Nut
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

9. Install the shift cable retaining nut near the exhaust heat shield.

Tighten: Tighten the nut to 10 N.m (89 lb in).

10. Lower the vehicle.

SHIFT CONTROL CABLE ADJUSTMENT

1. Place the shift control lever in the PARK position.

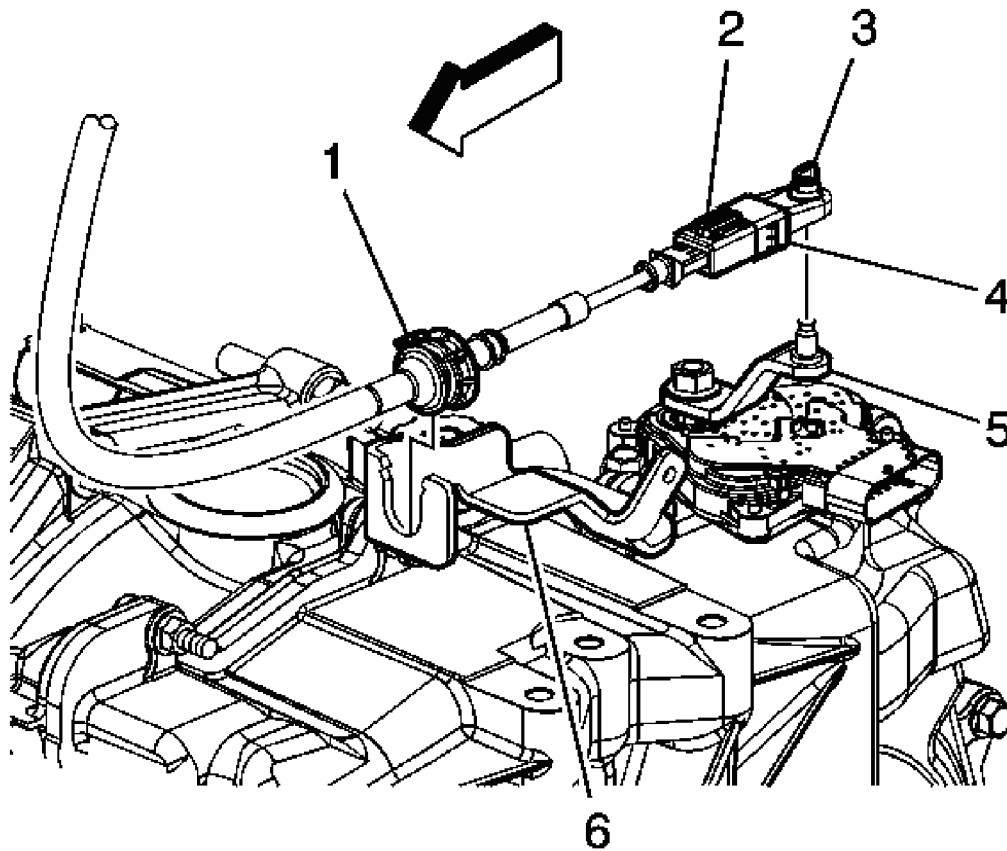


Fig. 78: Shift Control Cable

Courtesy of GENERAL MOTORS CORP.

2. Carefully remove the shift cable end (3) from the transmission range select lever (5).
3. Release the shift cable retainer (3) from the shift cable bracket (6).
4. On the underside of the cable adjustment lock protective sleeve (4), release the retaining tab using a flat bladed tool.
5. Slide the cable adjustment lock protective sleeve (4) toward the end of the cable (3) to expose the cable adjustment lock (2).
6. Release the cable adjustment lock (2) to allow freedom of movement of the cable end (3).
7. Secure the shift cable retainer (3) to the shift cable bracket (6).
8. Secure the shift cable end (3) to the transmission range select lever (5).
9. Insure both the shift control lever and the transmission range select lever (5) are in the park position.
10. Depress the cable adjustment lock (2) to secure the adjustment of the shift cable end

(3).

11. Slide the cable adjustment lock protective sleeve (4) over the cable adjustment lock (2).
12. Test the shift control lever in all positions for proper gear range selection.

PARK/NEUTRAL POSITION (PNP) SWITCH REPLACEMENT

Tools Required

J 41545 Park/Neutral Switch Aligner. See Special Tools.

Removal Procedure

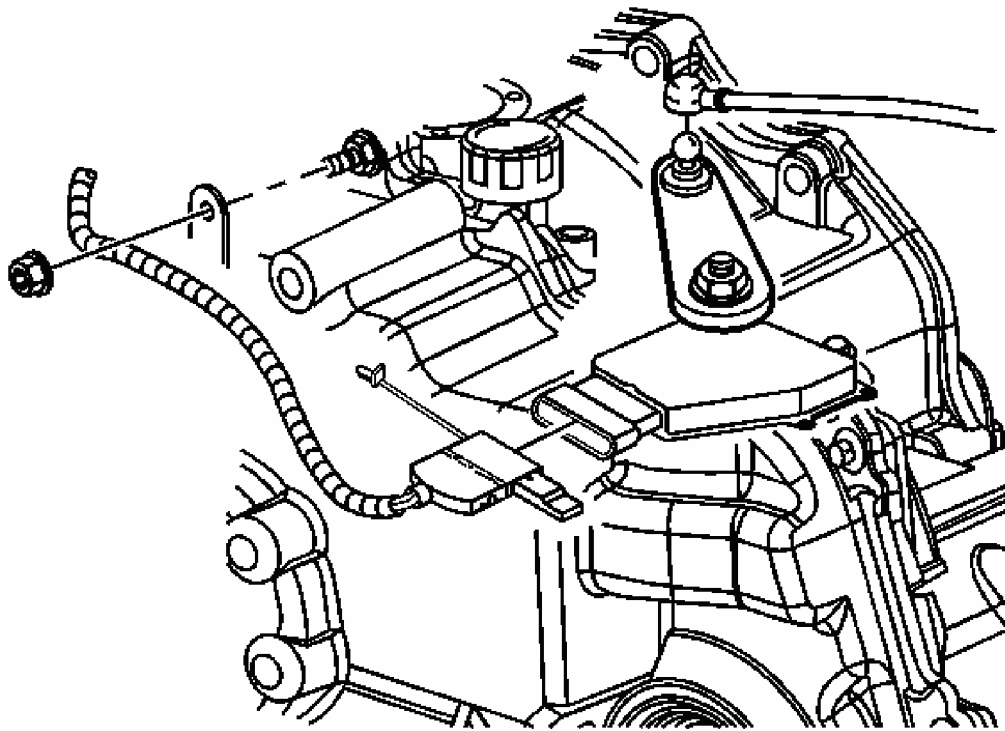


Fig. 79: Identifying Shift Control Cable, Lever & Electrical Connector At Transaxle Range (TR) Switch

Courtesy of GENERAL MOTORS CORP.

1. Apply the parking brake and place the control assembly in Neutral. The transaxle manual shaft must be in the Neutral position prior to installing the range switch.
2. Remove the shift control cable from the transaxle range switch lever.
3. Disconnect the electrical connectors from the transaxle range switch.

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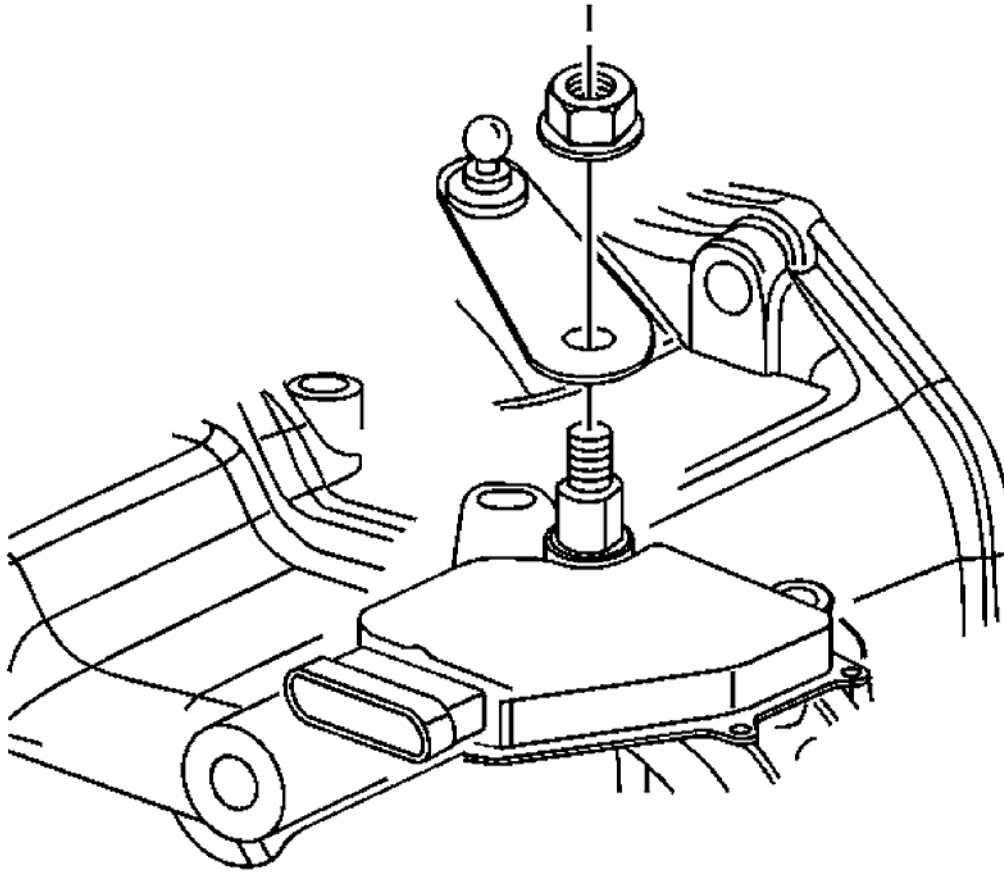


Fig. 80: Identifying Transaxle Range (PNP) Switch Lever
Courtesy of GENERAL MOTORS CORP.

4. Remove the transaxle range switch lever nut and lever.

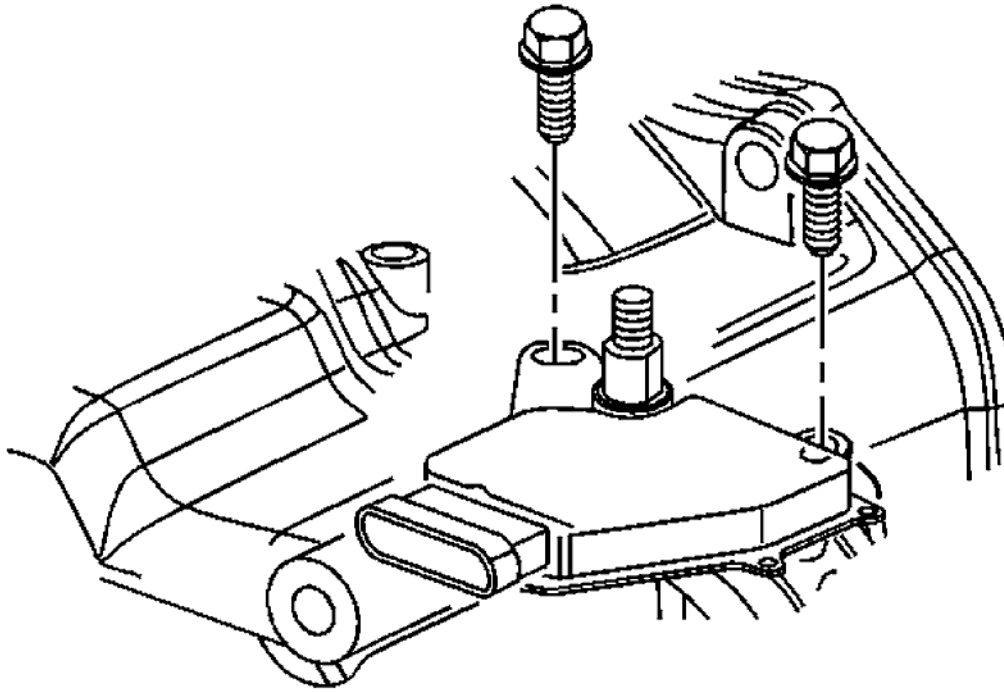


Fig. 81: Identifying Transaxle Range Switch And Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the transaxle range switch bolts and remove the switch.

Installation Procedure (Old Switch)

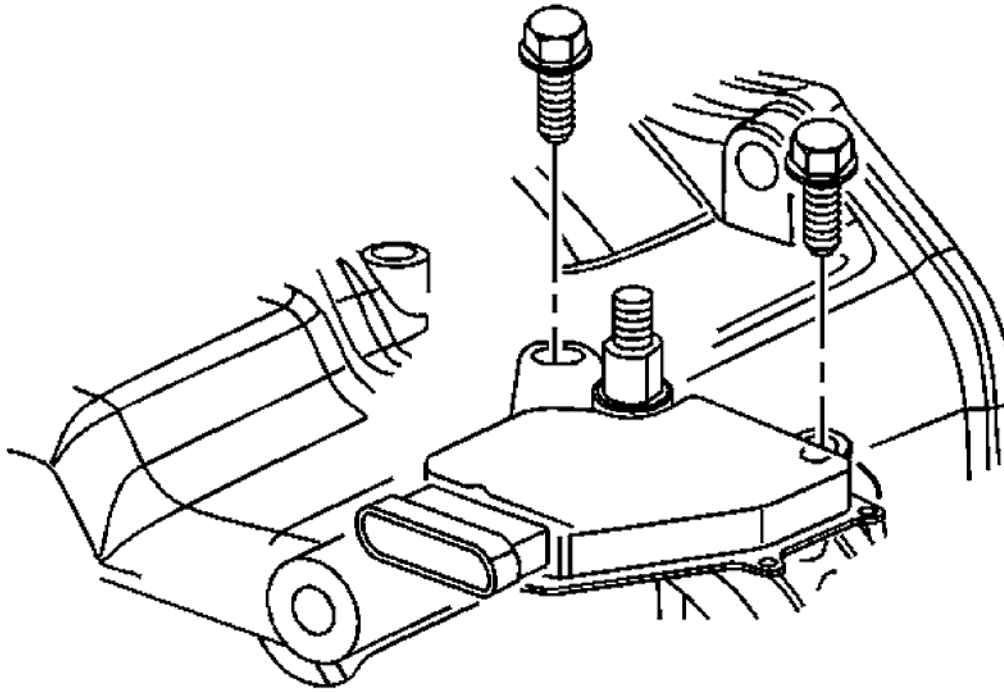


Fig. 82: Identifying Transaxle Range Switch And Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

1. Make sure the transaxle manual shaft is in the Neutral position.
2. Align the flats on the transaxle shift shaft with the flats on the transaxle range switch and install the switch.
3. Loosely install the transaxle range switch bolts.

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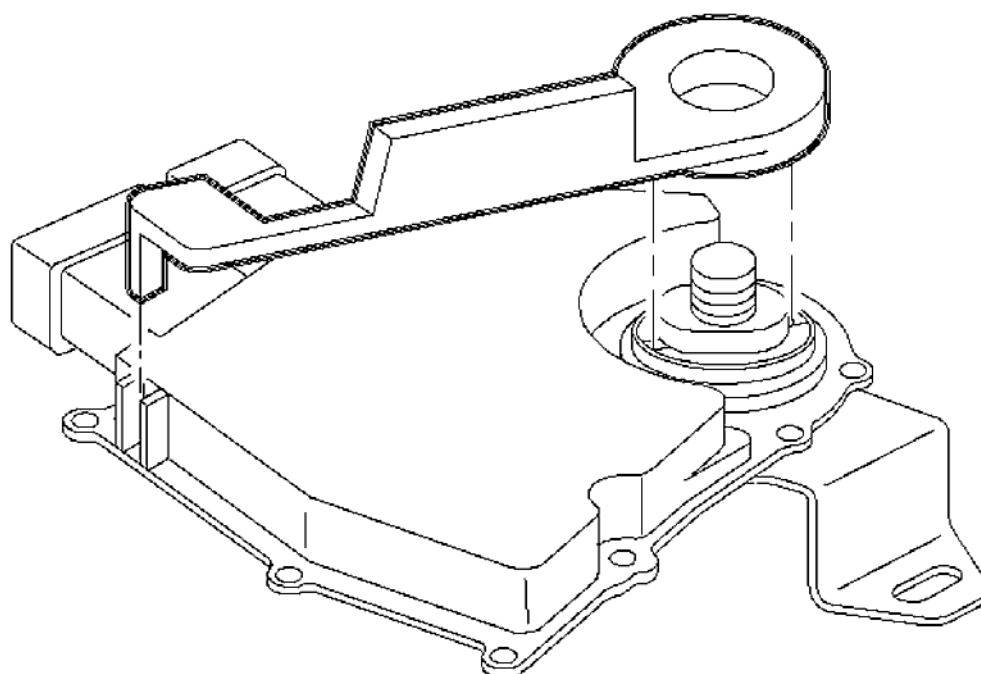


Fig. 83: Identifying J 41545
Courtesy of GENERAL MOTORS CORP.

4. Insert the **J 41545** as shown and rotate the switch until the tool drops onto position. See Special Tools.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Tighten the transaxle range switch bolts.

Tighten: Tighten the range switch bolts to 20 N.m (15 lb ft).

6. Remove the alignment tool.

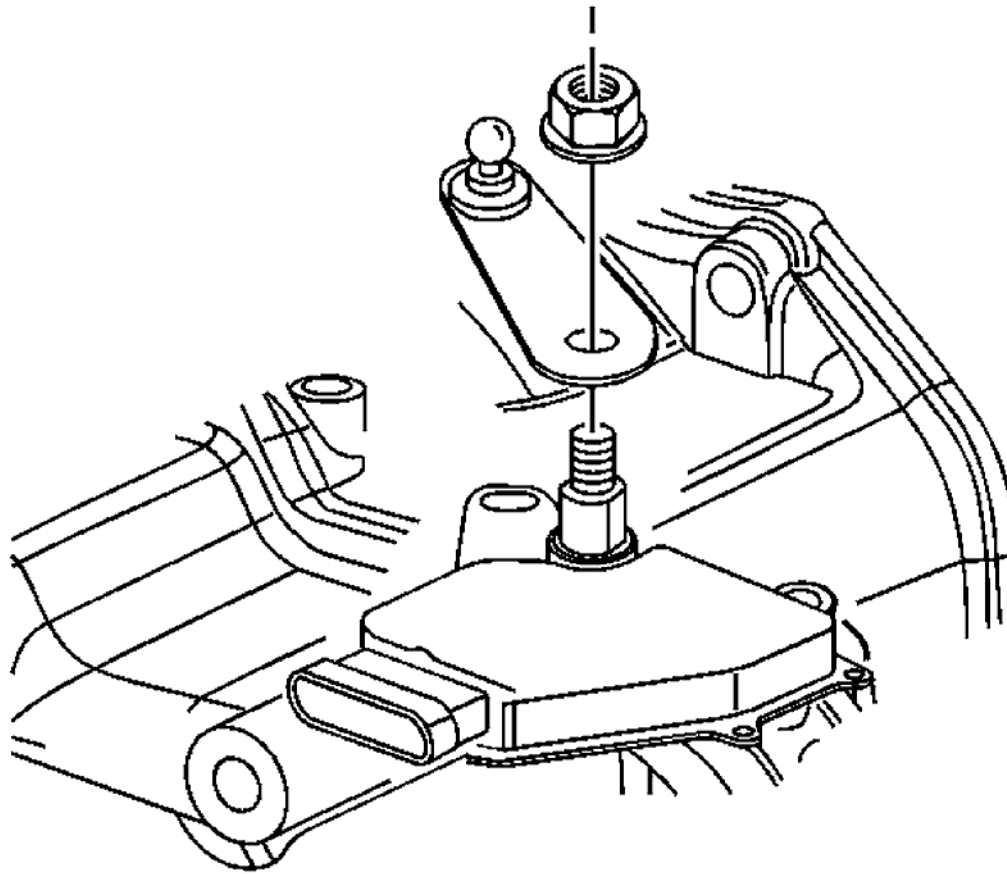


Fig. 84: Identifying Transaxle Range (PNP) Switch Lever
Courtesy of GENERAL MOTORS CORP.

7. Install the transaxle range switch lever and nut

Tighten: Tighten the transaxle range switch lever retaining nut to 35 N.m (26 lb ft).

IMPORTANT: After adjusting the switch, verify the engine only starts in Park or Neutral. If the engine starts in any other position, adjust the switch.

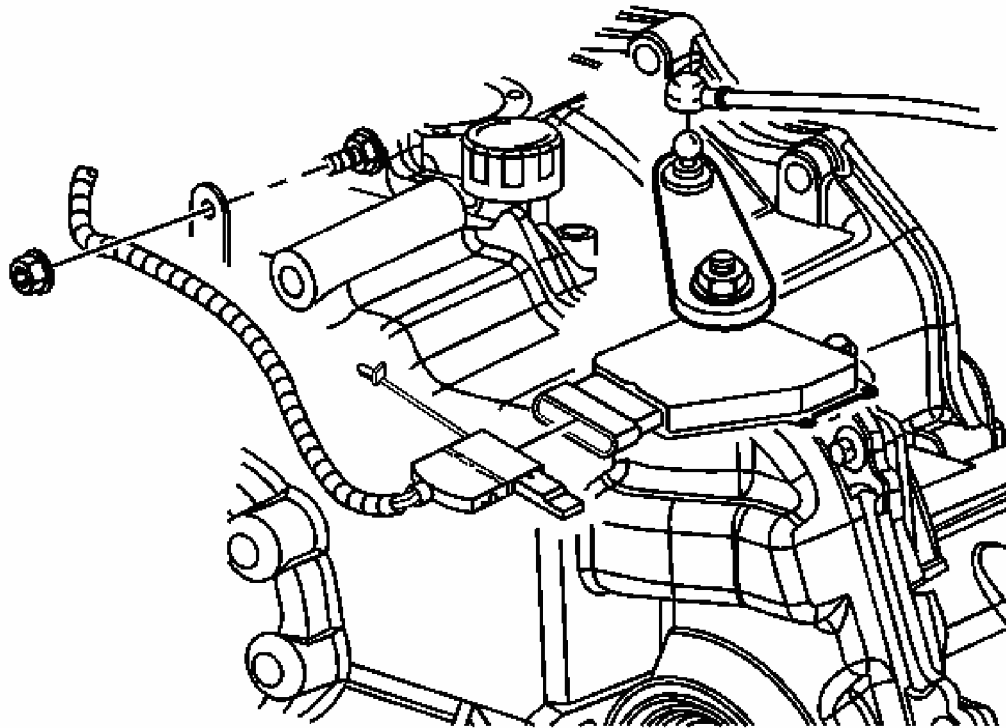


Fig. 85: Identifying Shift Control Cable, Lever & Electrical Connector At Transaxle Range (TR) Switch
Courtesy of GENERAL MOTORS CORP.

8. Connect the transaxle range switch electrical connectors.
9. Install the shift control cable to transaxle range switch lever and verify proper operation.
10. Install the shift control cable to transaxle range switch lever and verify proper operation.

Installation Procedure (New Switch)

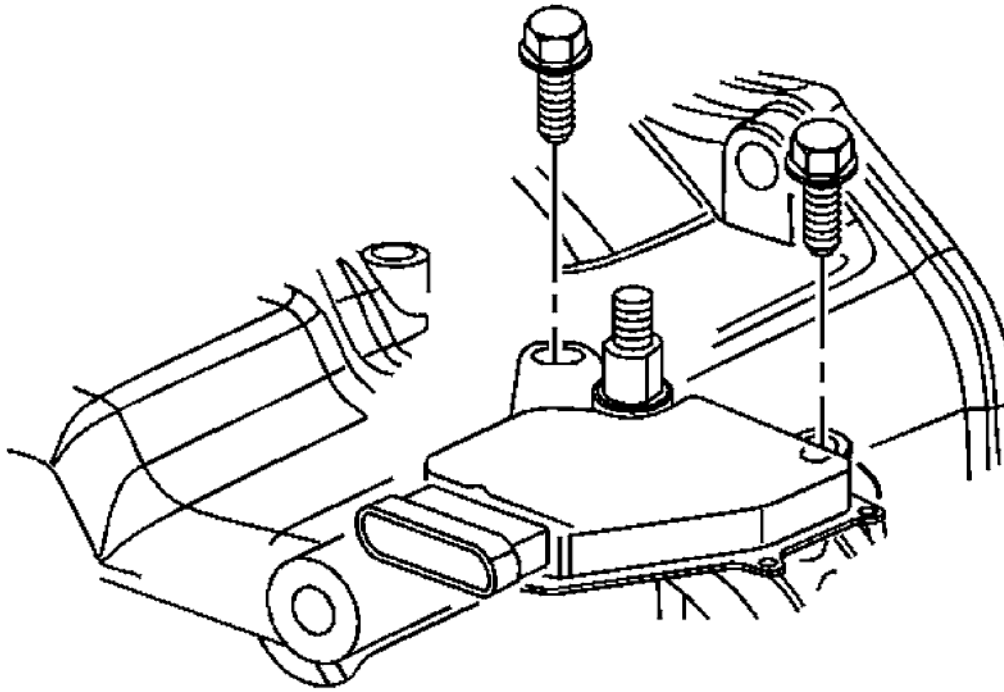


Fig. 86: Identifying Transaxle Range Switch And Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

1. Make sure the transaxle manual shaft is in the Neutral position.
2. Align the flats on the transaxle shift shaft with the flats on the transaxle range switch and install the switch.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Tighten the transaxle range switch bolts.

Tighten: Tighten the range switch bolts to 20 N.m (15 lb ft).

4. Install the transaxle range switch lever and nut.

Tighten: Tighten the transaxle range switch lever retaining nut to 35 N.m (26 lb ft).

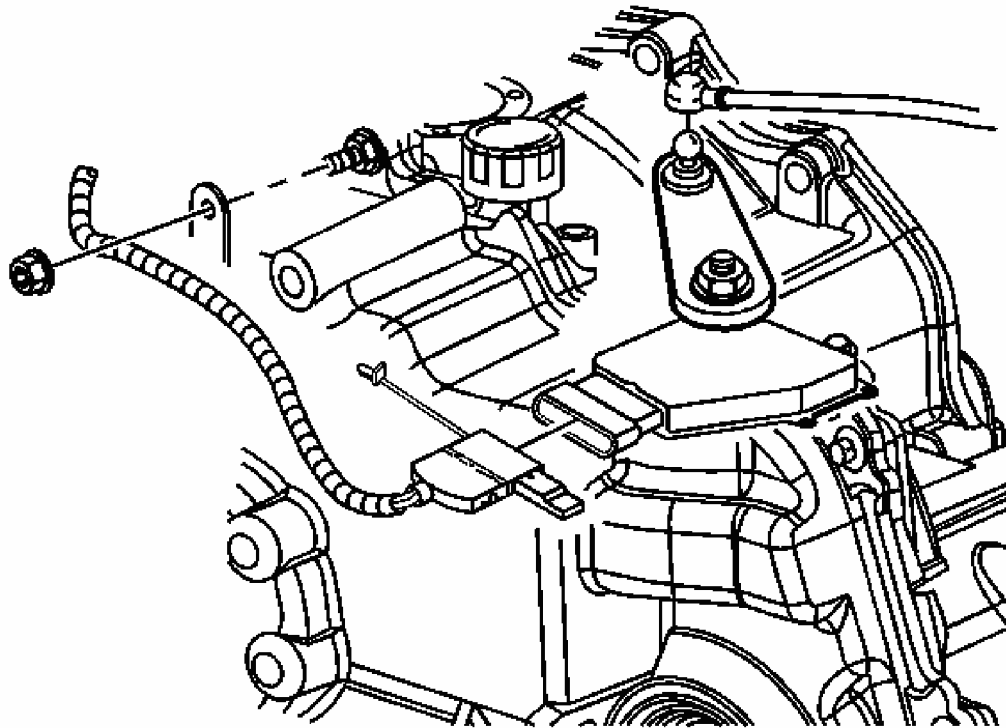


Fig. 87: Identifying Shift Control Cable, Lever & Electrical Connector At Transaxle Range (TR) Switch
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: After adjusting the switch, verify the engine only starts in Park or Neutral. If the engine starts in any other position, adjust the switch.

5. Install the shift control cable to transaxle range switch lever and verify proper operation.

OIL PAN REPLACEMENT

Removal Procedure

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

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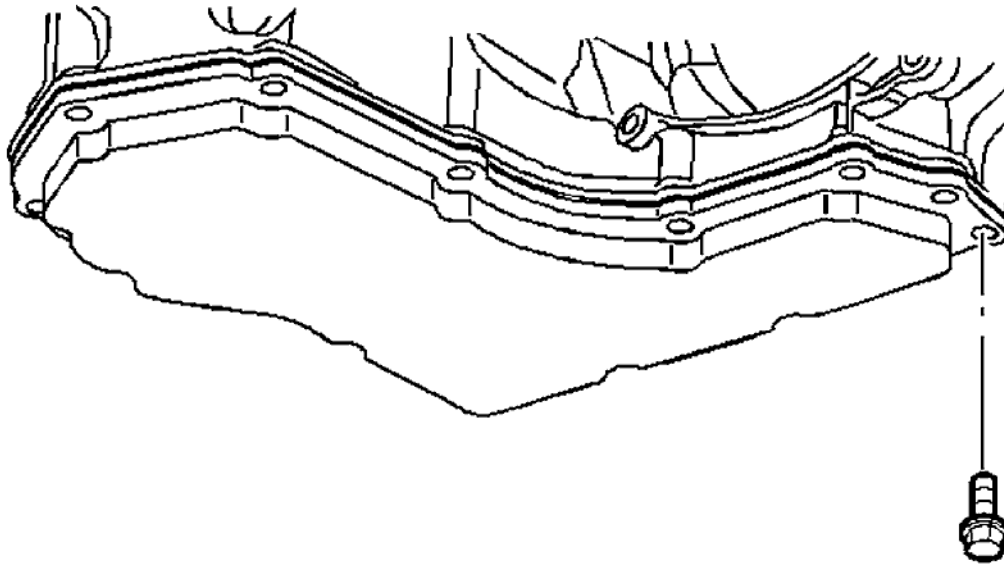


Fig. 88: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

2. Loosen the oil pan bolts.
3. Drain the oil. Use a suitable container to catch the transmission fluid.
4. Remove the oil pan attaching bolts.

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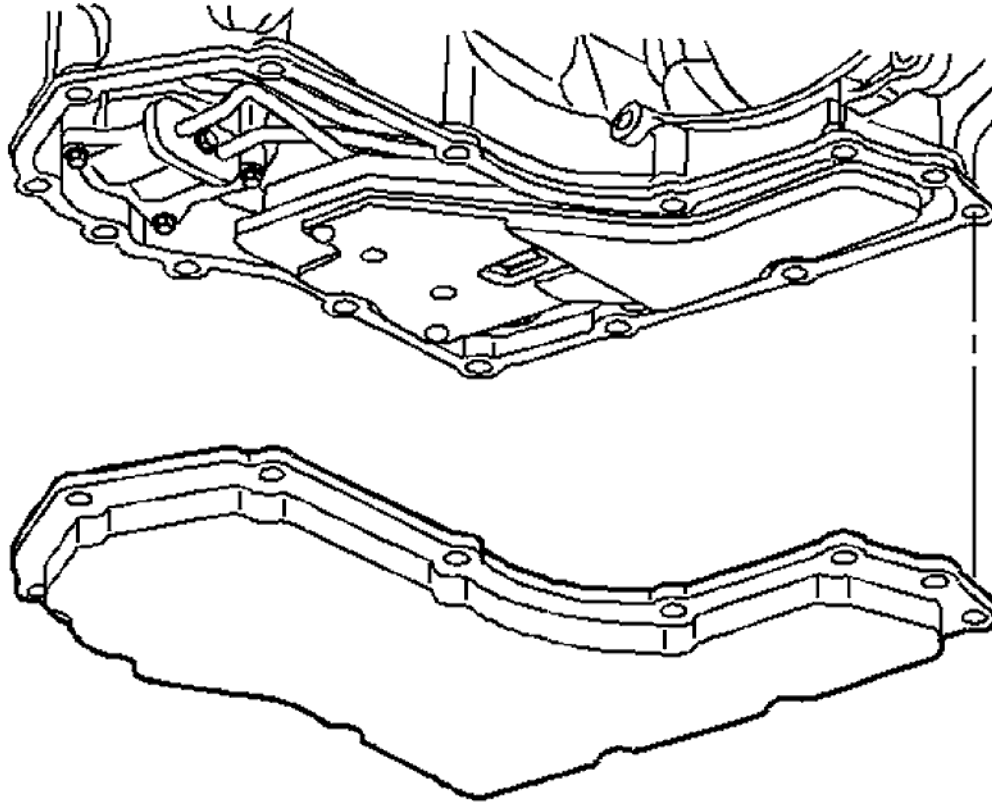


Fig. 89: View of Oil Pan

Courtesy of GENERAL MOTORS CORP.

5. Remove the oil pan.

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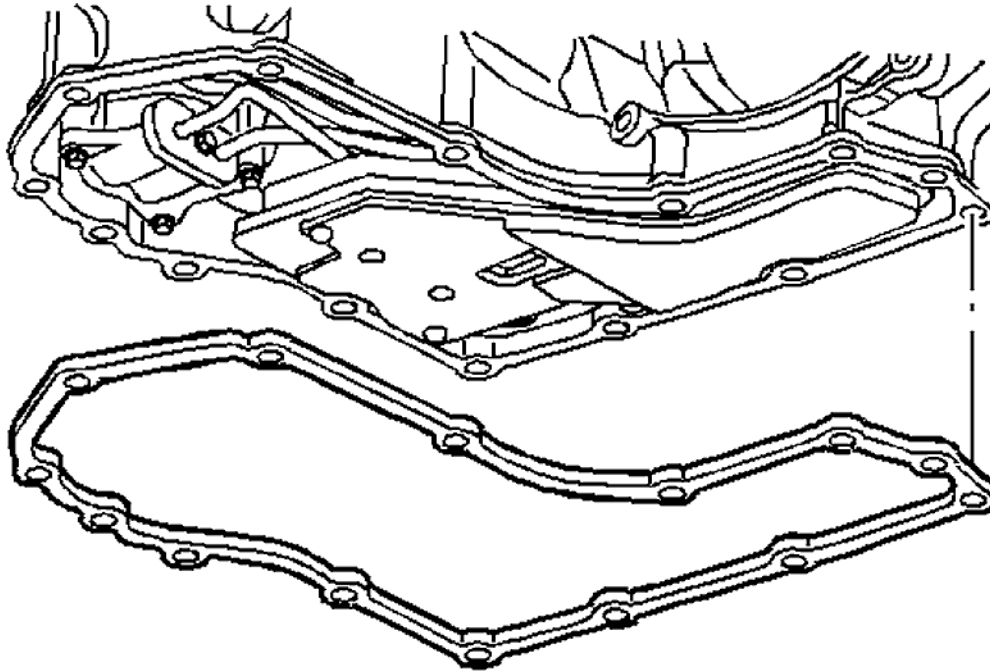


Fig. 90: Locating Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

6. Remove the oil pan gasket.

Installation Procedure

1. Clean and inspect the oil pan for dents or damage. Dry the oil pan before installation.

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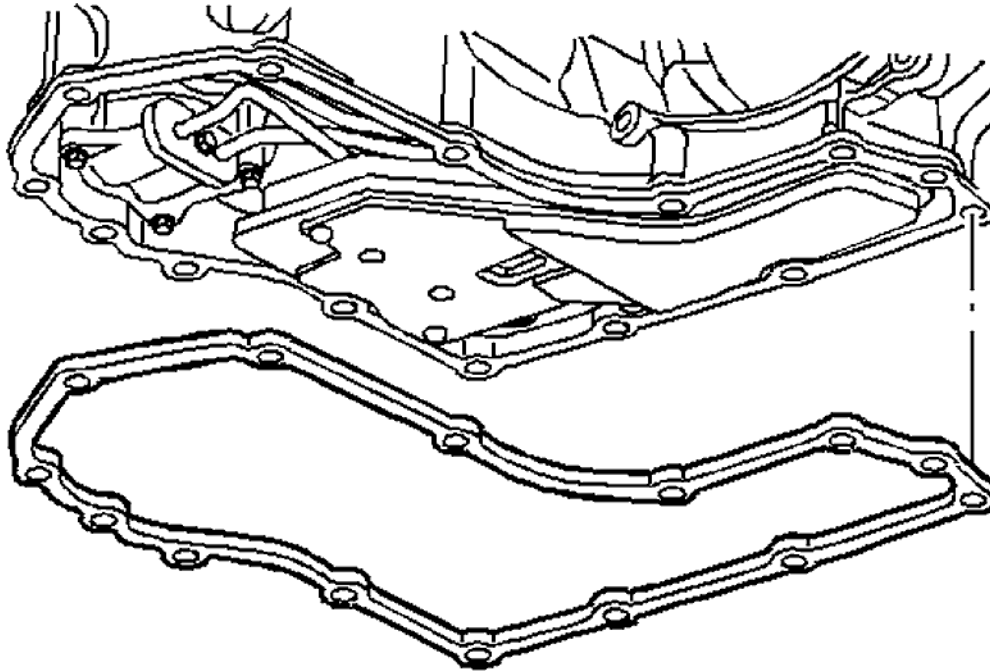


Fig. 91: Locating Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install the oil pan gasket. Use a new gasket if the sealing ribs are damaged.

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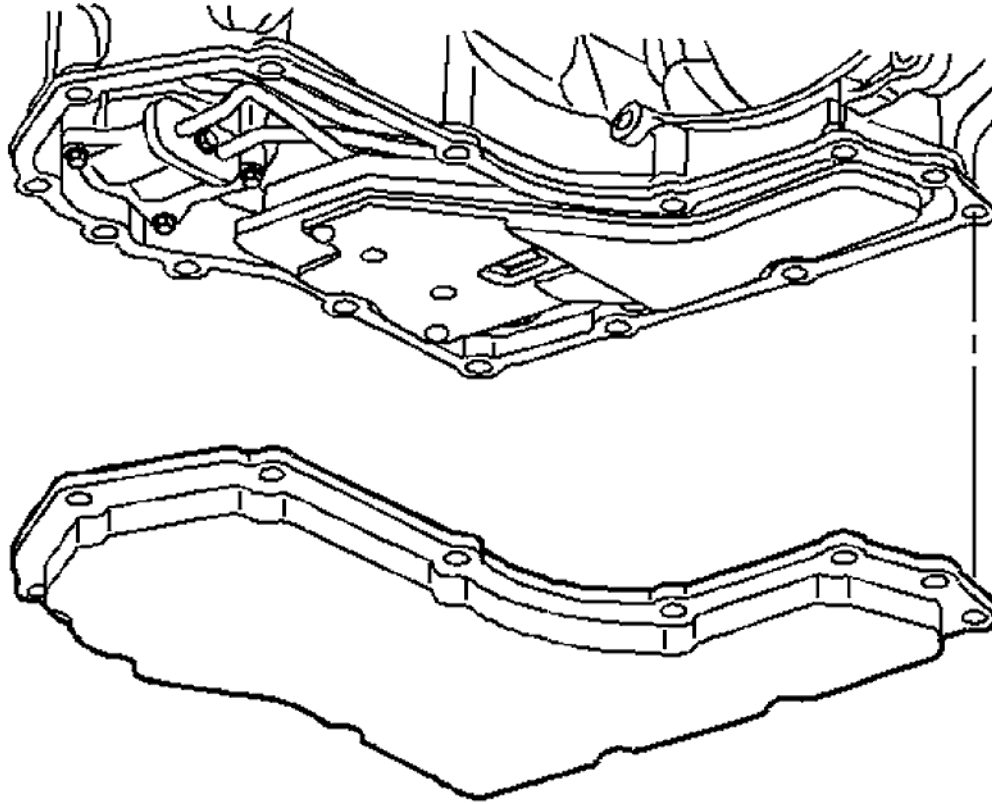


Fig. 92: View of Oil Pan

Courtesy of GENERAL MOTORS CORP.

3. Install the oil pan. Replace the bottom pan if damaged.

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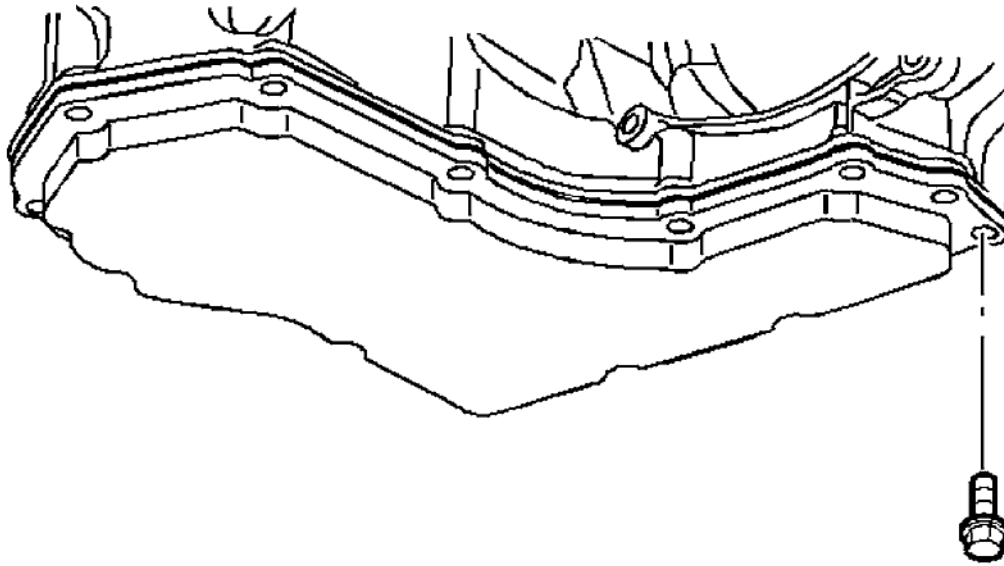


Fig. 93: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the oil pan attaching bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

5. Lower the vehicle.
6. Check the pan for leaks. Refill the transmission to the proper level with DEXRON®-III. Refer to **Fluid Capacity Specifications**.
7. Recheck the fluid level. Refer to Transmission Fluid Checking Procedure.
8. Inspect the oil pan gasket for leaks.

OIL FILTER AND SEAL REPLACEMENT

Tools Required:

- J 6125-1B Slide Hammer
- J 23129 Axle Boot Remover. See Special Tools.

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in Cautions and Notices.

1. Raise and support the vehicle.
2. Place the drain pan under the transaxle oil pan.

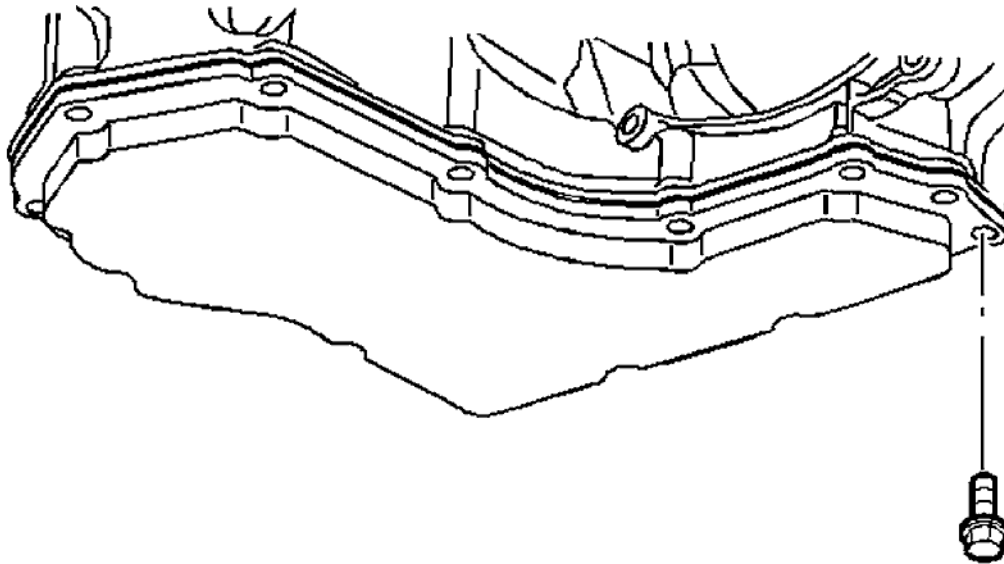


Fig. 94: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: When removing the oil pan bolts, be careful not to damage the oil pan sealing surfaces. Such damage may result in oil leaks in this area.

3. Remove the oil pan bolts from only the front and the sides.
4. Loosen the rear oil pan bolts about 4 turns.
5. Lightly tap the oil pan with a rubber mallet or pry in order to allow the fluid to drain.
6. Inspect the fluid color.
7. Remove the remaining oil pan bolts.

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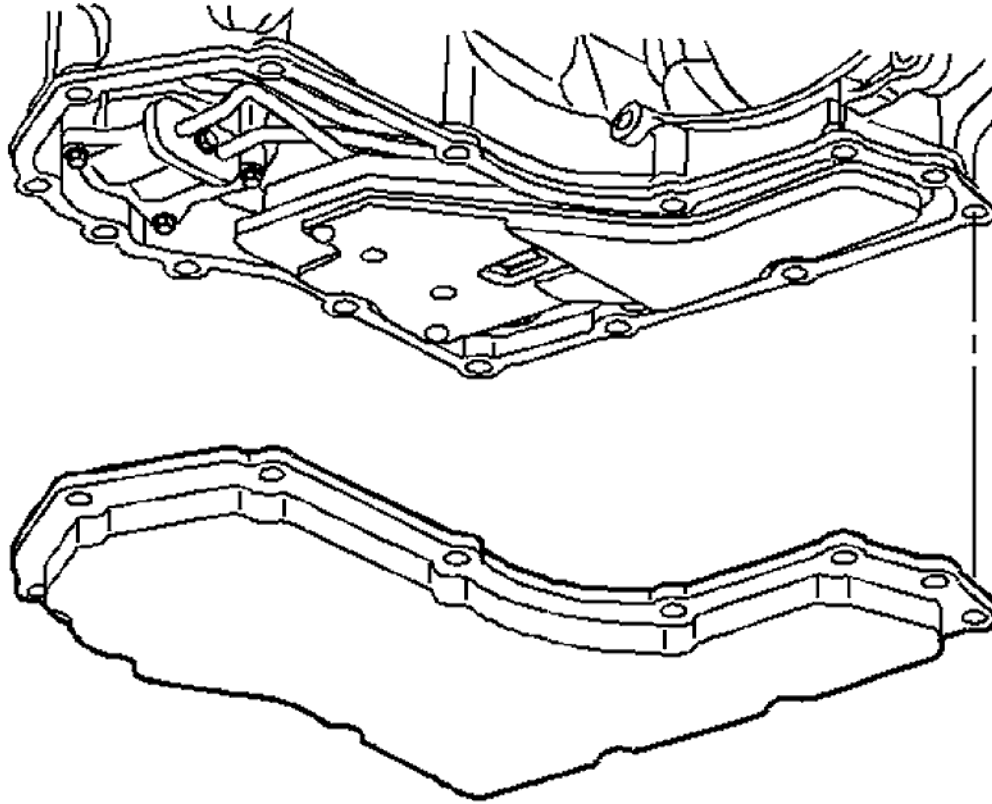


Fig. 95: View of Oil Pan

Courtesy of GENERAL MOTORS CORP.

8. Remove the oil pan.

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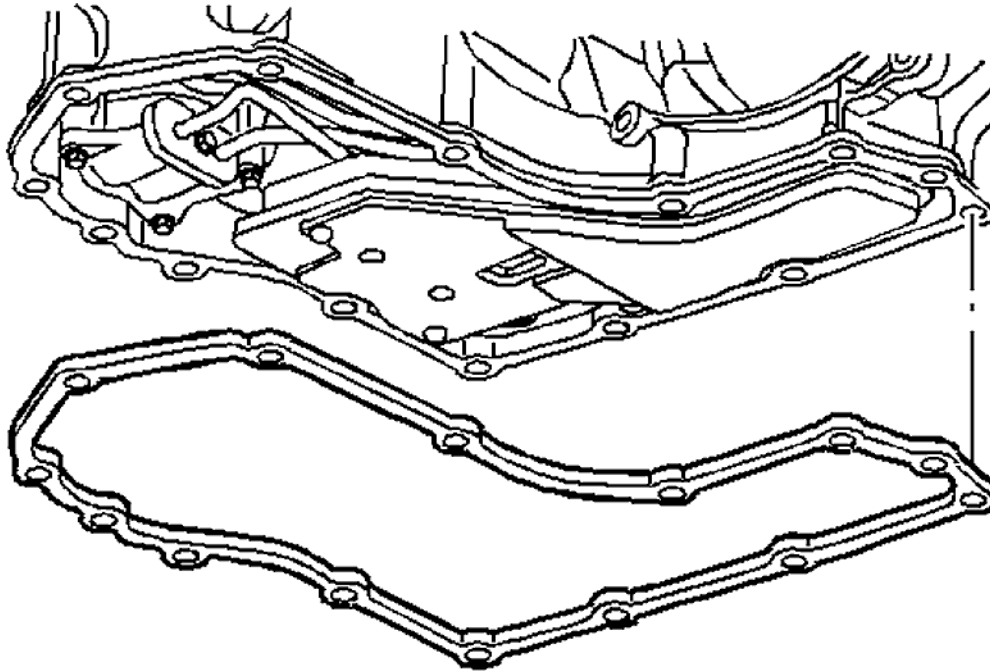


Fig. 96: Locating Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

9. Remove the oil pan gasket.

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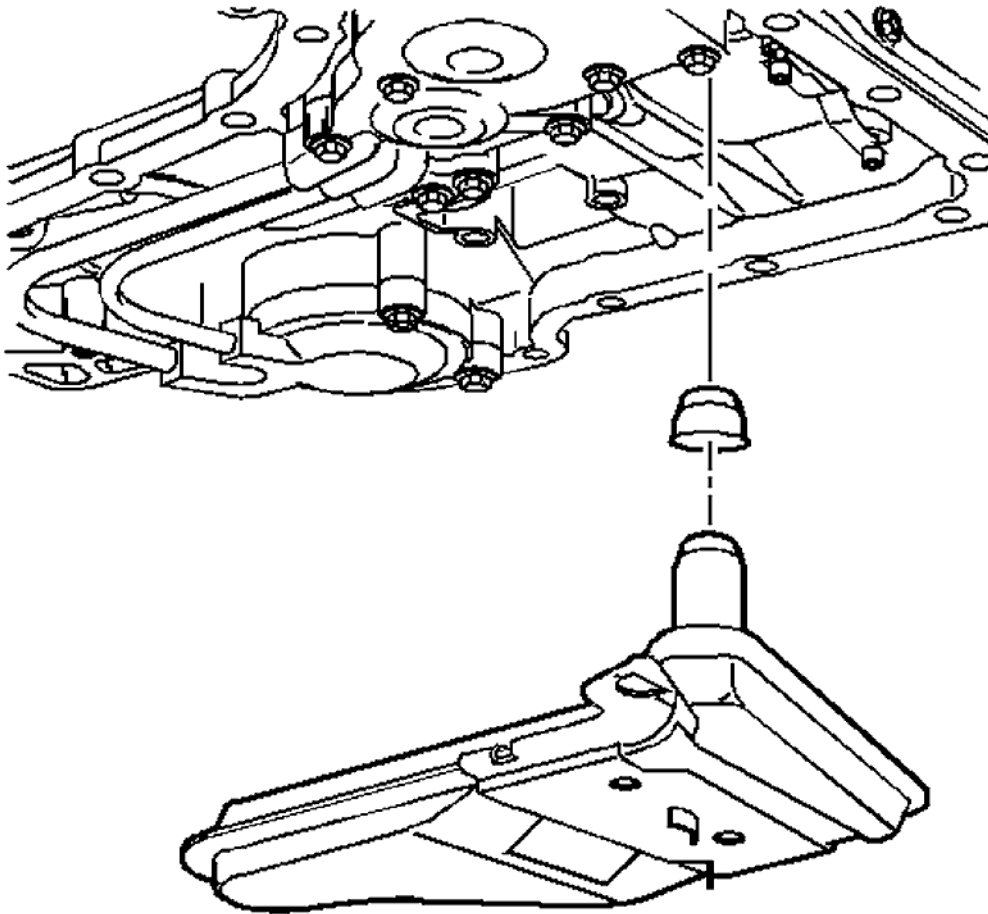


Fig. 97: Removing/Installing Transaxle Oil Pan & Seal
Courtesy of GENERAL MOTORS CORP.

10. Remove the oil filter. Use a long screwdriver in order to pry the oil filter neck out of the seal.
11. Check the oil filter seal for damage or wear.
12. As needed, remove the seal using the **J 6125-1B** and the **J 23129** . See **Special Tools**.

Installation Procedure

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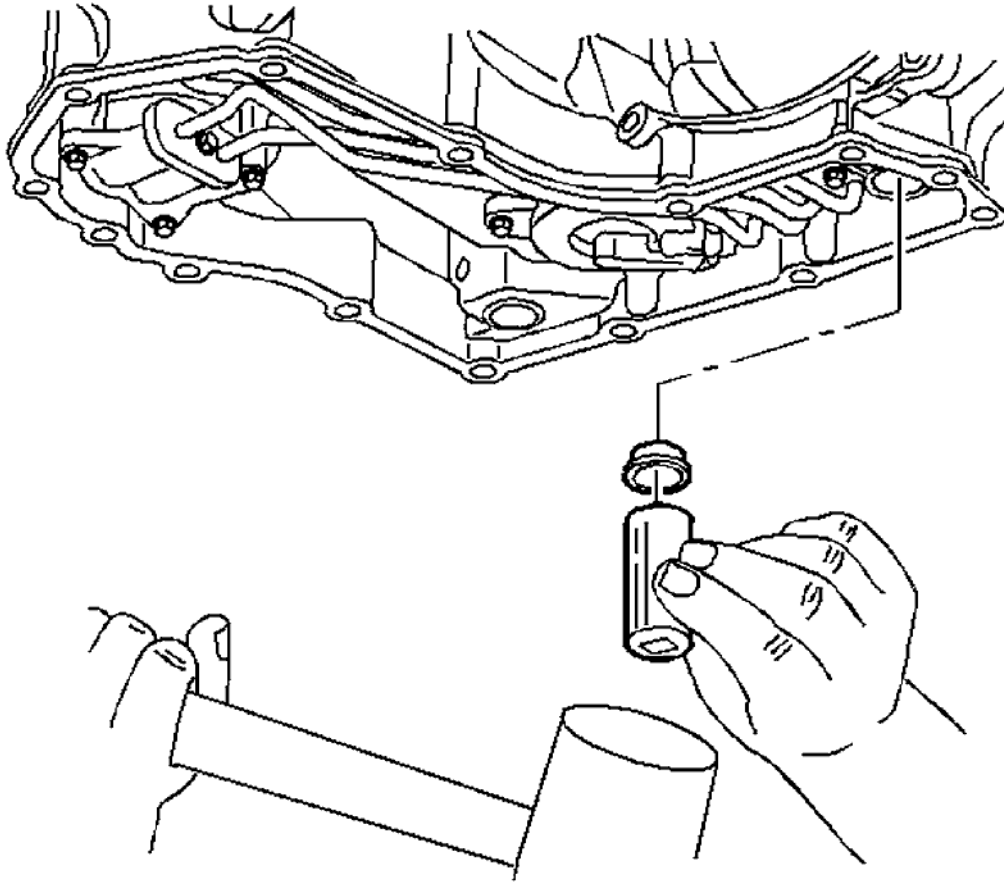


Fig. 98: Identifying Oil Filter Seal
Courtesy of GENERAL MOTORS CORP.

1. Install a new seal, as needed. Before installing, coat the new seal with a small amount of **J 36850** or petroleum jelly.
2. Install a new filter into the case.

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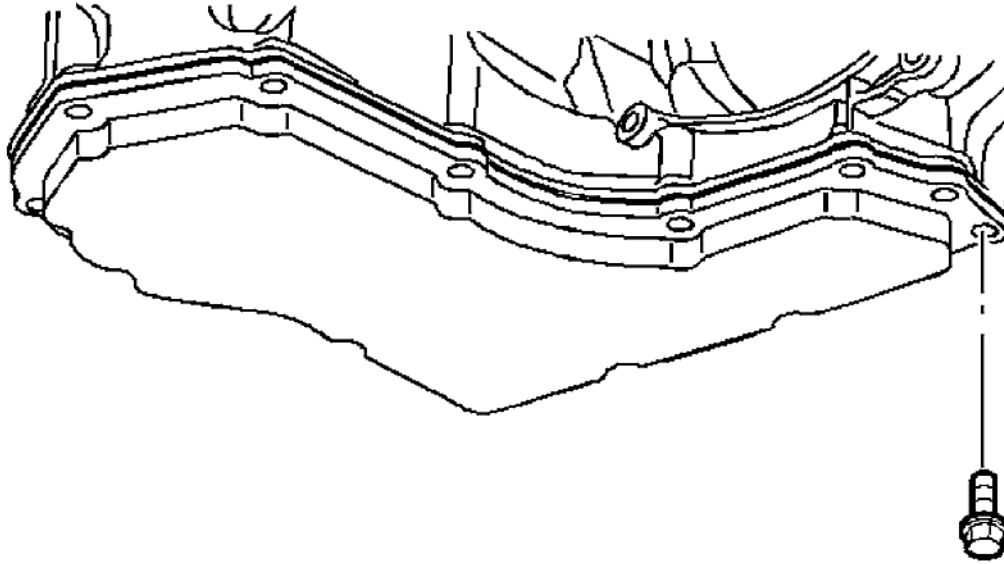


Fig. 99: Identifying Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the oil pan gasket. Use a new gasket if the sealing ribs are damaged.
4. Clean and dry the oil pan. Inspect the pan for damage and replace the pan if necessary.
5. Install the oil pan.
6. Clean and dry the oil pan. Inspect the pan for damage and replace the pan if necessary.
7. Install the oil pan.

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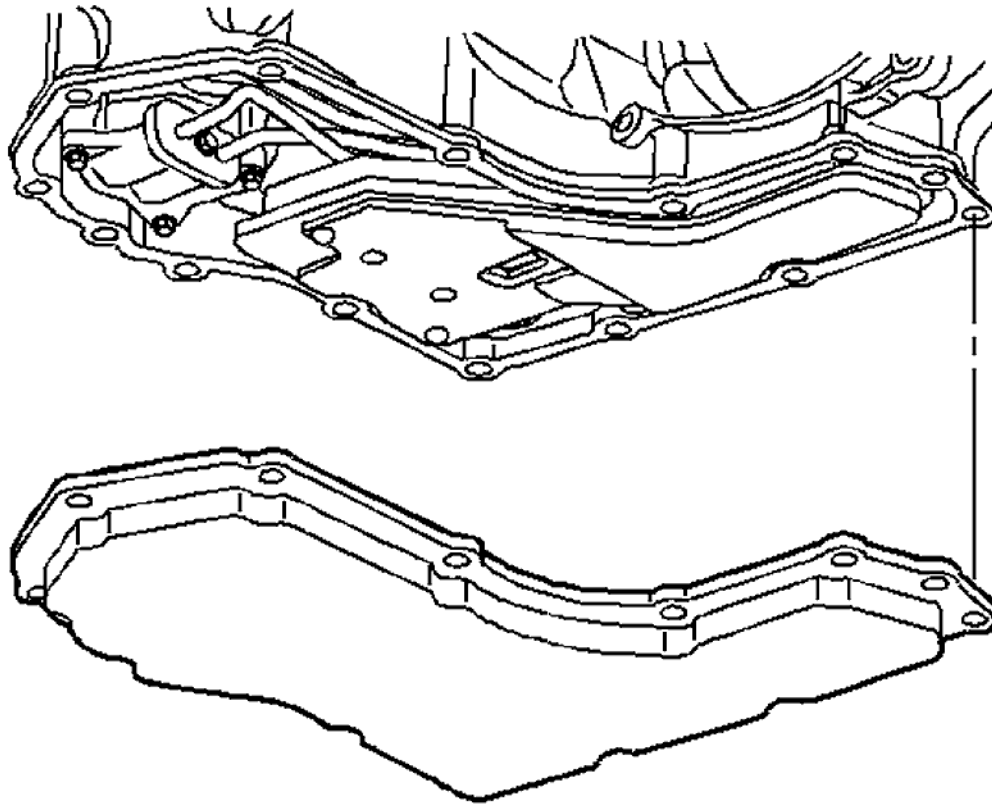


Fig. 100: View of Oil Pan

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the oil pan bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

9. Lower the vehicle.
10. Fill the transaxle to the proper level with DEXRON® III fluid or the equivalent. Refer to Fluid Capacity Specifications.
11. Inspect the pan for leaks. Recheck the transmission fluid level. Refer to Transmission Fluid Checking Procedure.

Removal Procedure

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

1. Disconnect the negative battery cable from the battery negative terminal.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the electrical connector at the vehicle speed sensor.

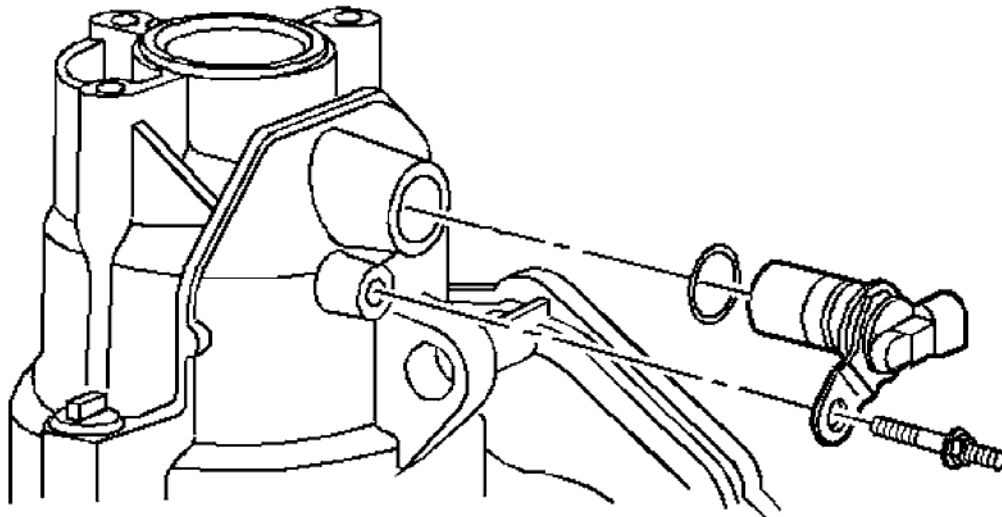


Fig. 101: Vehicle Speed Sensor (VSS) & Retaining Stud
Courtesy of GENERAL MOTORS CORP.

4. Remove the retaining stud and the sensor. Pull straight out in order to avoid damage to the case.

Installation Procedure

1. Clean and dry the vehicle speed sensor.

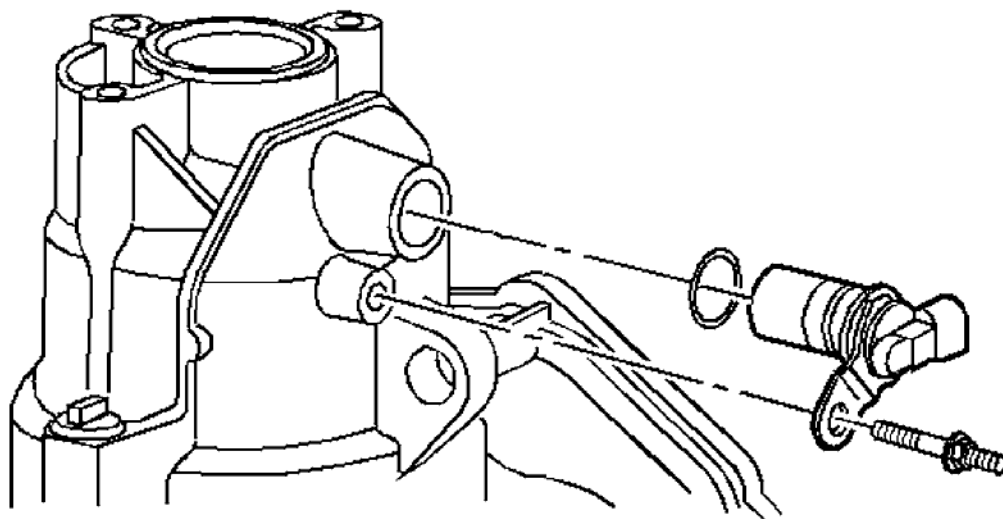


Fig. 102: Vehicle Speed Sensor (VSS) & Retaining Stud
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the vehicle speed sensor and the retaining bolt.

Tighten: Tighten the stud to 12 N.m (97 lb in).

3. Install the electrical connector at the sensor.
4. Remove the safety stands.
5. Lower the vehicle.
6. Connect the negative battery cable.

Tighten: Tighten the terminal bolt to 15 N.m (11 lb ft).

LOW/REVERSE SERVO ASSEMBLY REPLACEMENT

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in Cautions and Notices.

1. Raise the vehicle. Support the vehicle.

2. Remove the oil pan and filter. Refer to **Oil Filter and Seal Replacement**.
3. Remove the oil feed pipes. Refer to **Oil Feed Pipes Replacement**.

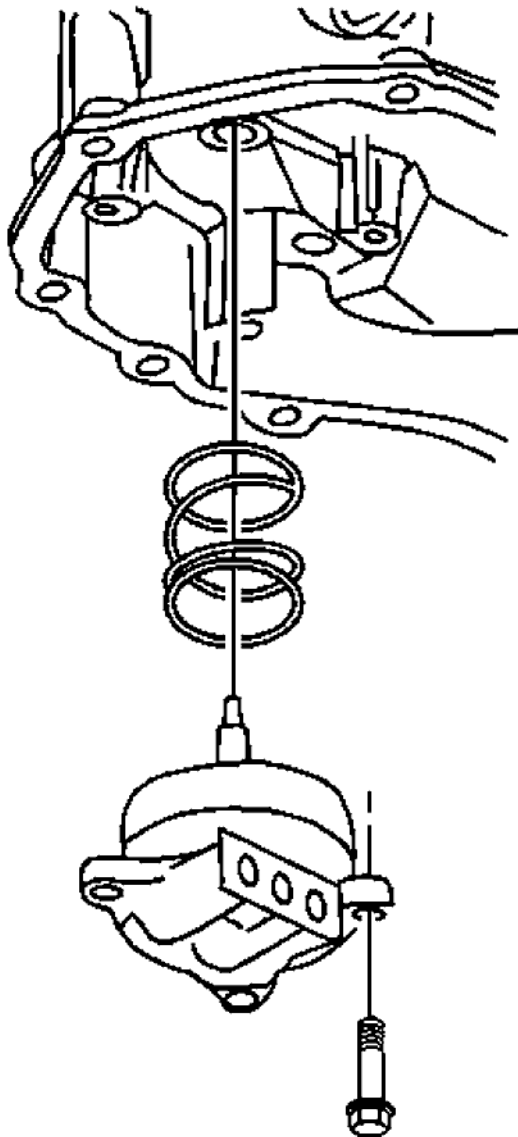


Fig. 103: View Of Low/Reverse Servo Assembly
Courtesy of GENERAL MOTORS CORP.

4. Remove the three low/reverse band servo cover bolts, the servo and the spring.
5. Disassemble, clean and inspect the low/reverse servo assembly. Refer to **Low and Reverse Servo Disassemble** in Automatic Transmission Transaxle Unit Repair

Manual.

Installation Procedure

1. Assemble the low/reverse servo. Refer to **Low and Reverse Servo Assemble and Installation** in Automatic Transmission Transaxle Unit Repair Manual.

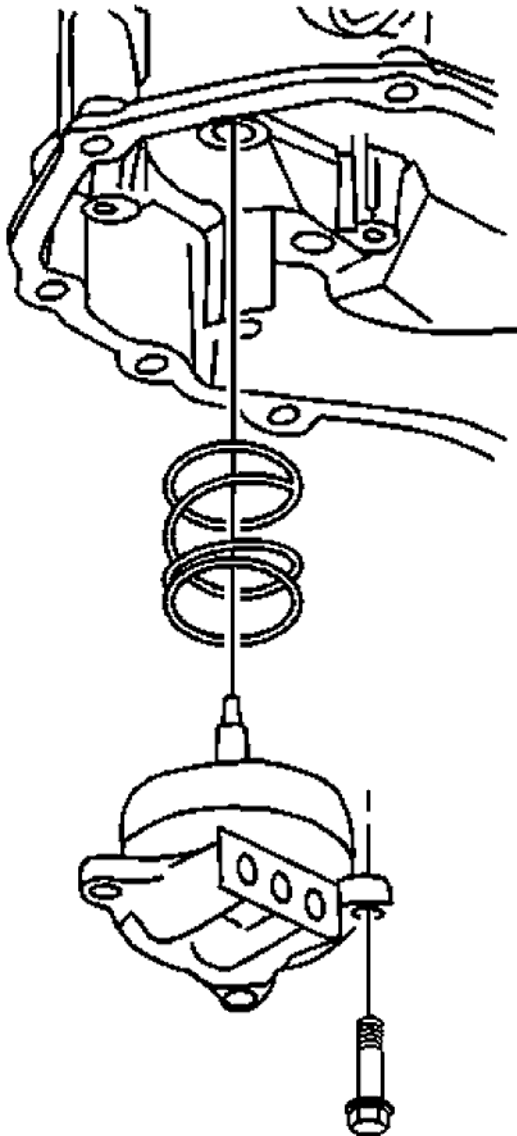


Fig. 104: View Of Low/Reverse Servo Assembly
Courtesy of GENERAL MOTORS CORP.

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NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the low/reverse band servo cover bolts.

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

3. Install the oil feed pipe. Refer to Oil Feed Pipes Replacement.
4. Install the oil filter and pan. Refer to Oil Filter and Seal Replacement.
5. Lower the vehicle.
6. Connect the negative battery cable.
7. Fill the transmission. Refer to Fluid Capacity Specifications.
8. Inspect the transmission fluid level. Refer to Transmission Fluid Checking Procedure.

INTERMEDIATE/FOURTH SERVO ASSEMBLY REPLACEMENT

Removal Procedure

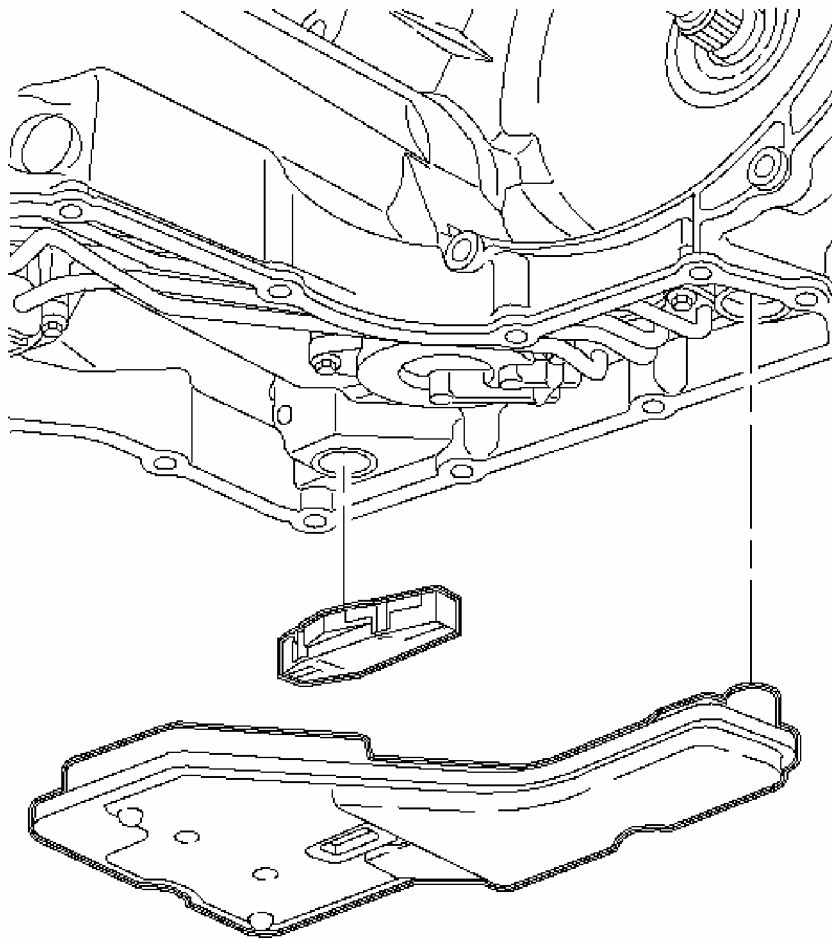


Fig. 105: View Of Oil Filter, O-Ring Seal & Oil Level Control Valve
Courtesy of GENERAL MOTORS CORP.

CAUTION: Ensure that the vehicle is properly supported and squarely positioned. To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which the components are being removed.

1. Position the vehicle on a hoist and raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Remove the oil pan. Refer to **Oil Pan Replacement**.
3. Remove the oil level control valve. Pull the valve straight down. Do not pry on the valve.

4. Remove the oil filter and oil filter O-ring seal. The seal may stay in the case when the filter is removed.

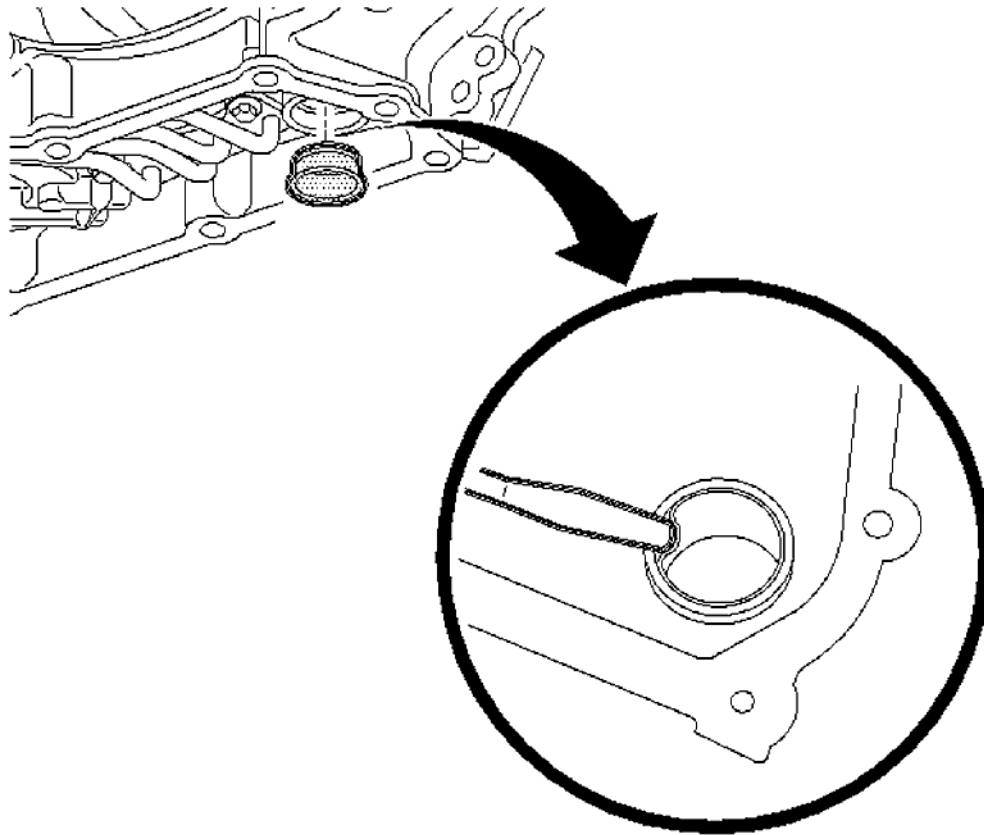


Fig. 106: Removing Oil Filter Neck Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not score or damage the transaxle case when removing the filter neck seal.

5. Using a chisel, indent the top of the filter neck seal to relax the press fit.
6. Remove the filter neck seal from the transaxle case and discard.

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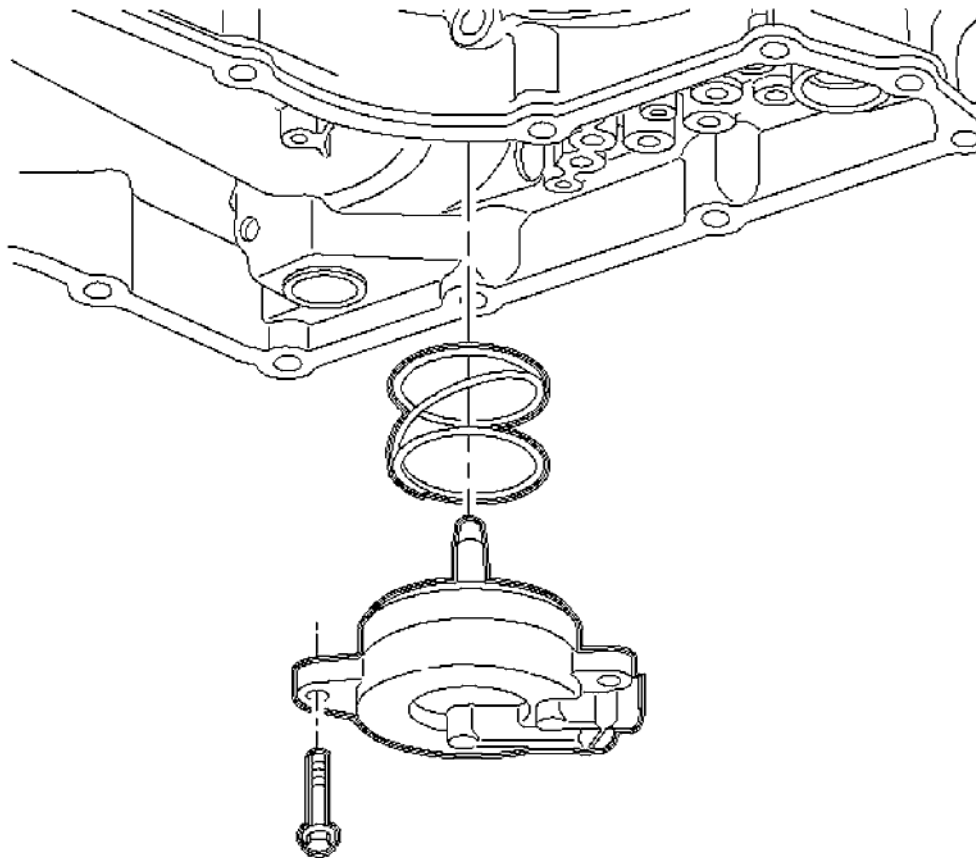


Fig. 107: Removing & Installing Intermediate/Fourth Servo Assembly
Courtesy of GENERAL MOTORS CORP.

7. Remove the intermediate/4th servo assembly bolts.
8. Remove the intermediate/4th servo assembly.

Disassembly Procedure

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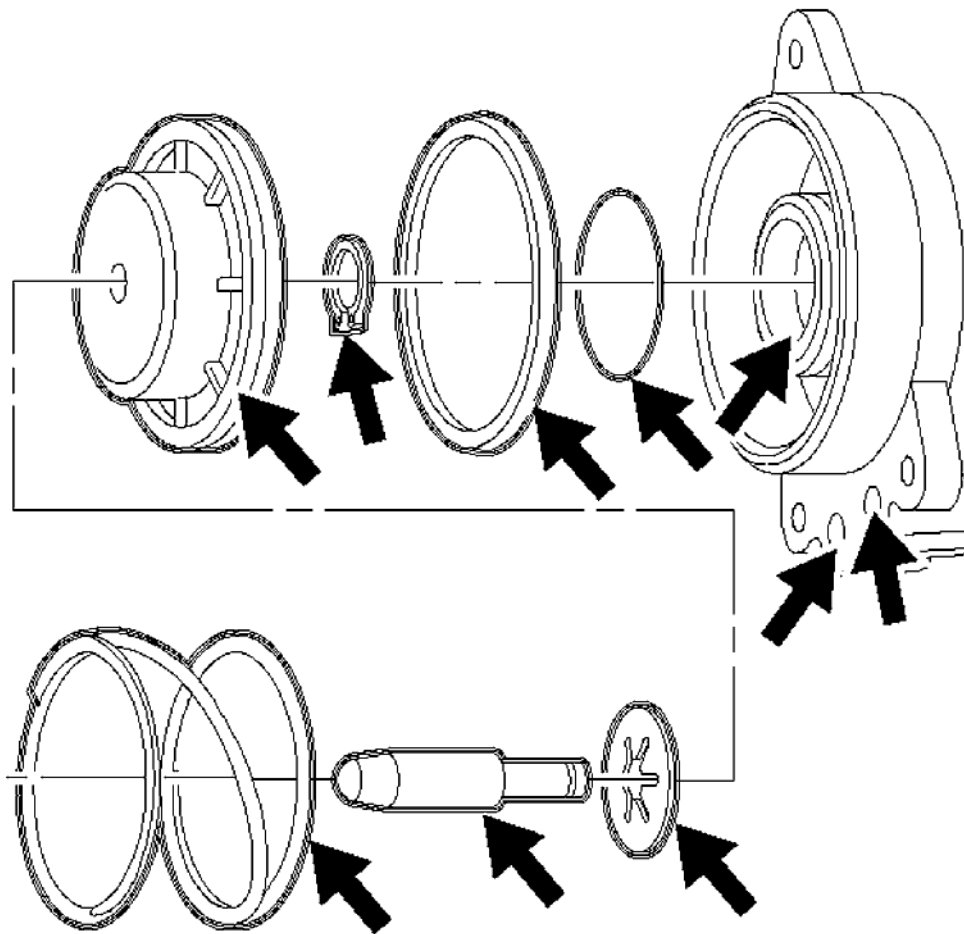


Fig. 108: Exploded View Of Intermediate/Fourth Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the piston and pin assembly from the servo cover.
2. Remove the snap ring from the servo pin.
3. Remove the piston and the servo cushion springs from the servo pin.
4. Remove the servo piston seals from the servo cover.
5. Discard the servo piston seals. Do not reuse the servo piston seals.
6. Inspect all components for damage.
7. Inspect the fluid feed holes for obstructions.
8. Inspect the bolt hole threads for debris and stripping.
9. Inspect the seal grooves for damage.
10. Clean and dry each component.

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Assembly Procedure

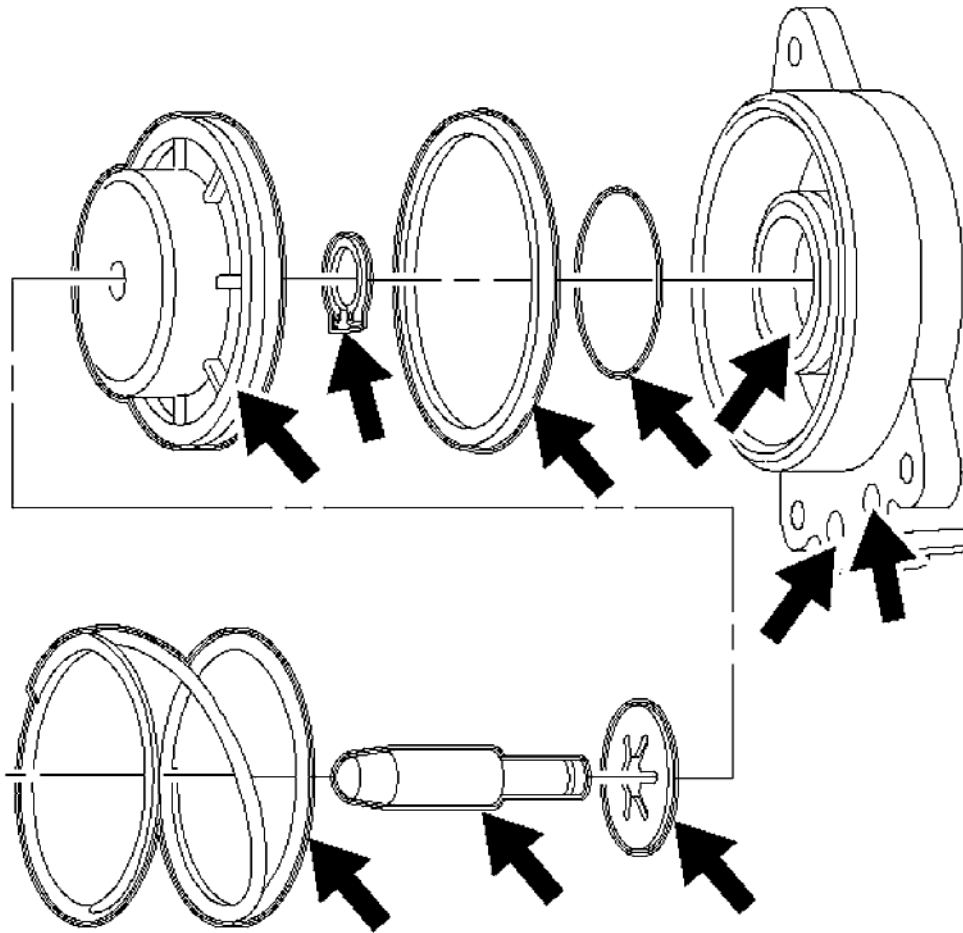


Fig. 109: Exploded View Of Intermediate/Fourth Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the servo cushion springs and the servo piston onto the servo pin.
2. Install the snap ring onto the servo pin in order to retain the springs and piston.
3. Install the new seals onto the servo piston and the servo cover.
4. Install the servo piston assembly into the servo cover. Lubricate the piston seals with transaxle fluid in order to aid in assembly.

Installation Procedure

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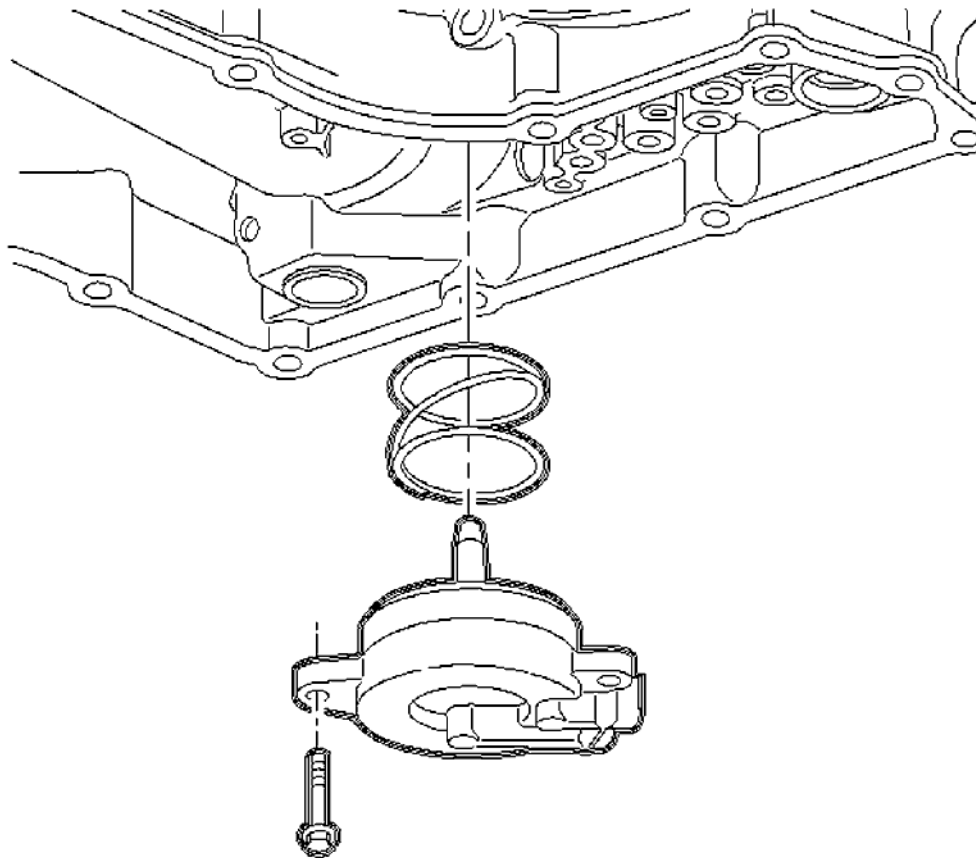


Fig. 110: Removing & Installing Intermediate/Fourth Servo Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the servo return spring into the transaxle case.
2. Install the servo return spring into the transaxle case.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Hand start and tighten servo cover bolts evenly to prevent damage to servo cover bore.

3. Hand start and install the servo cover bolts.

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

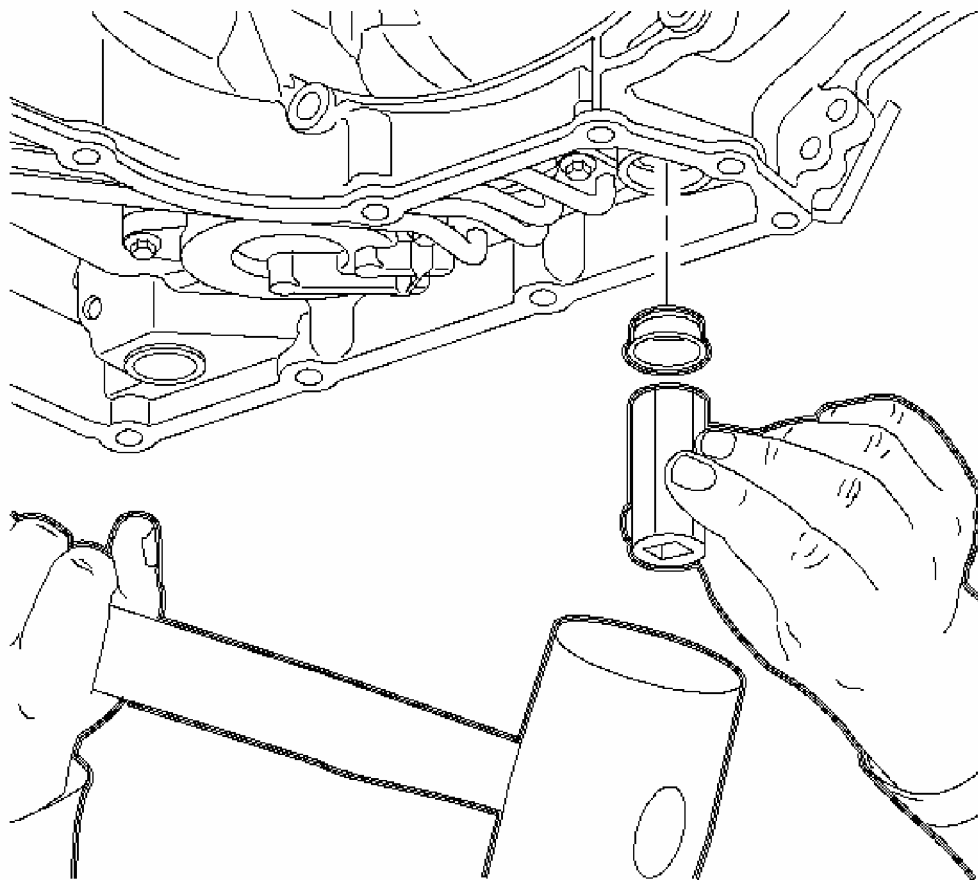


Fig. 111: Installing NEW Oil Filter Neck Seal
Courtesy of GENERAL MOTORS CORP.

4. Install the new filter neck seal into the transaxle case. A large socket can be used as an installation tool. Two mallets can be used as well.

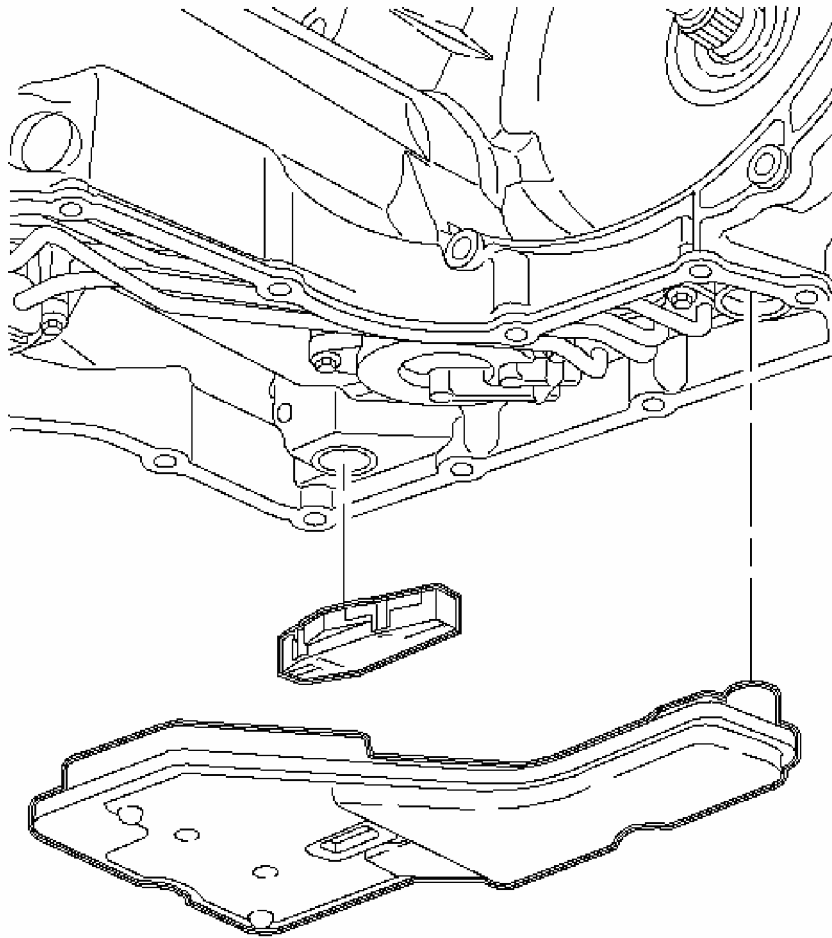


Fig. 112: View Of Oil Filter, O-Ring Seal & Oil Level Control Valve
Courtesy of GENERAL MOTORS CORP.

5. Coat the filter O-ring with a small amount of petroleum jelly, and install the filter into the case.

NOTE: **Push straight down on the center of the oil level control valve in order to prevent damage to the case bore.**

6. Install the oil level control valve.
7. Install the oil pan. Refer to **Oil Pan Replacement**.
8. Lower the vehicle.
9. Remove the AIR. Refer to **Transmission Fluid Checking Procedure**.
10. Add DEXRON® III P/N 21019223 transaxle fluid or equivalent to the specified refill

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capacity.

Specification:

- The bottom pan removal capacity is approximately 6.5 L (6.9 qt).
- The complete overhaul capacity is approximately 9 L (9.5 qt).
- The dry capacity is approximately 12.2 L (12.9 qt).

11. Start the engine, warm up the transaxle, and check for leaks.
12. Inspect the fluid level. Refer to **Transmission Fluid Checking Procedure**.

TRANSMISSION FLUID COOLER LINE QUICK CONNECT FITTING

Removal Procedure

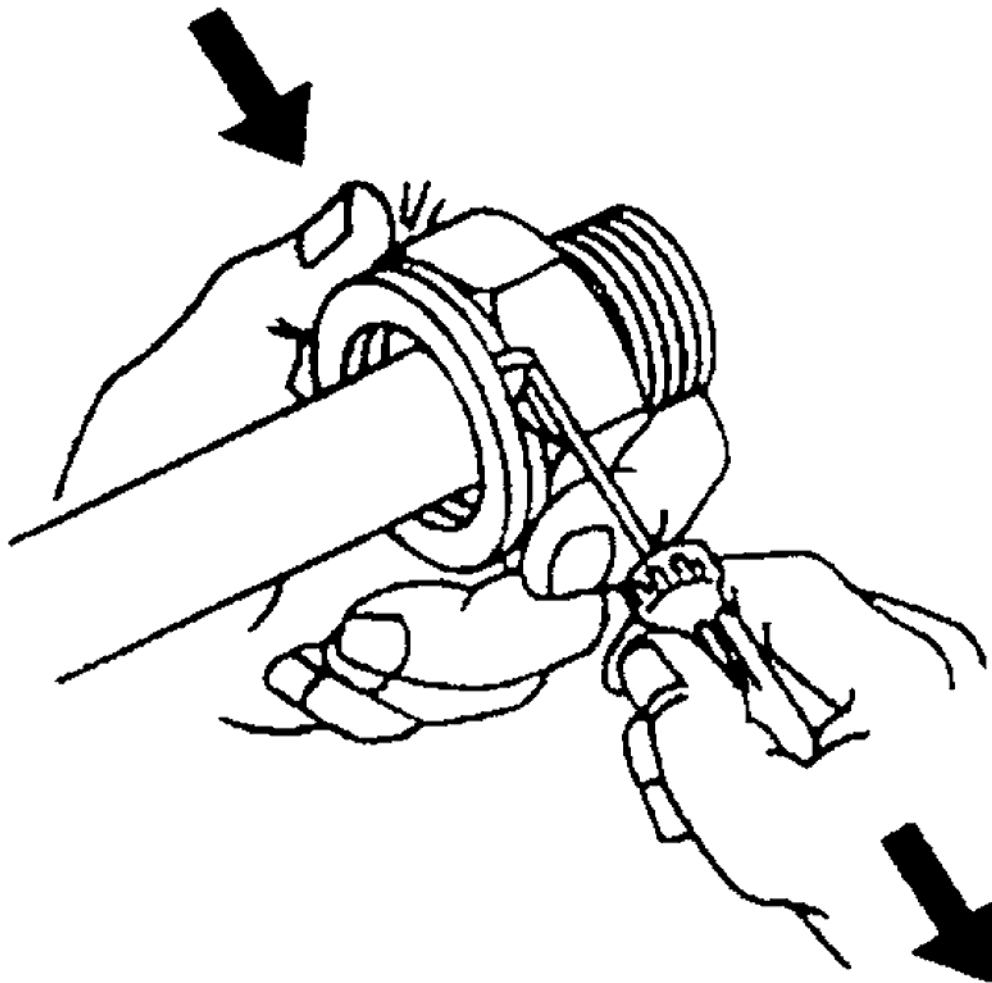


Fig. 113: Removing Retaining Ring For The Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

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.

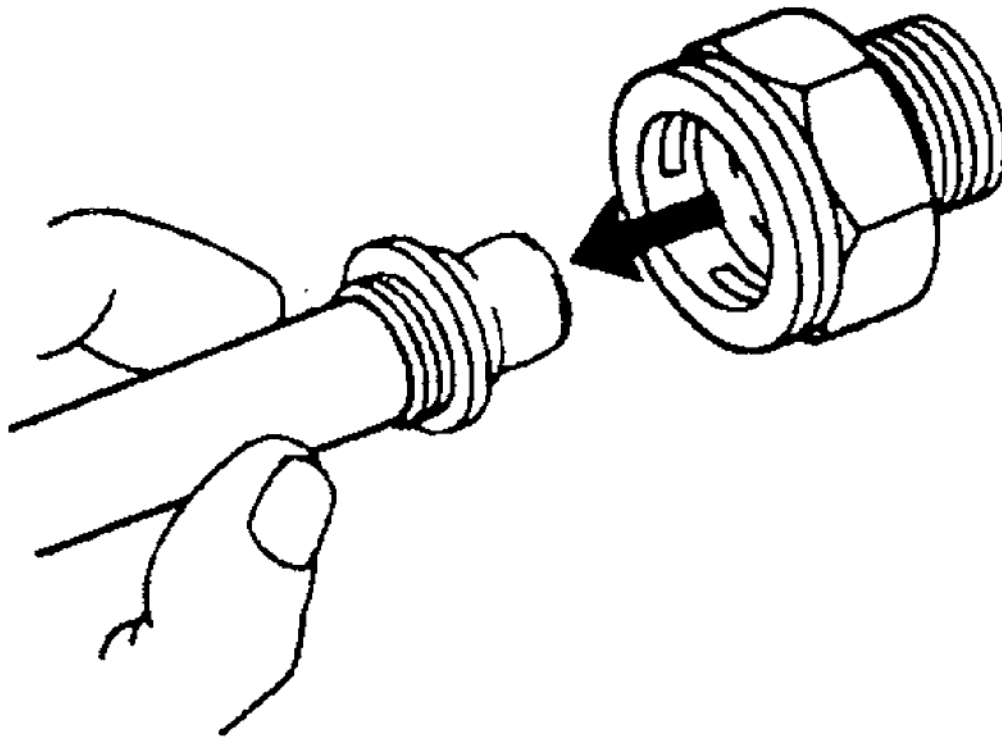


Fig. 114: Cooler Line & Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

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:

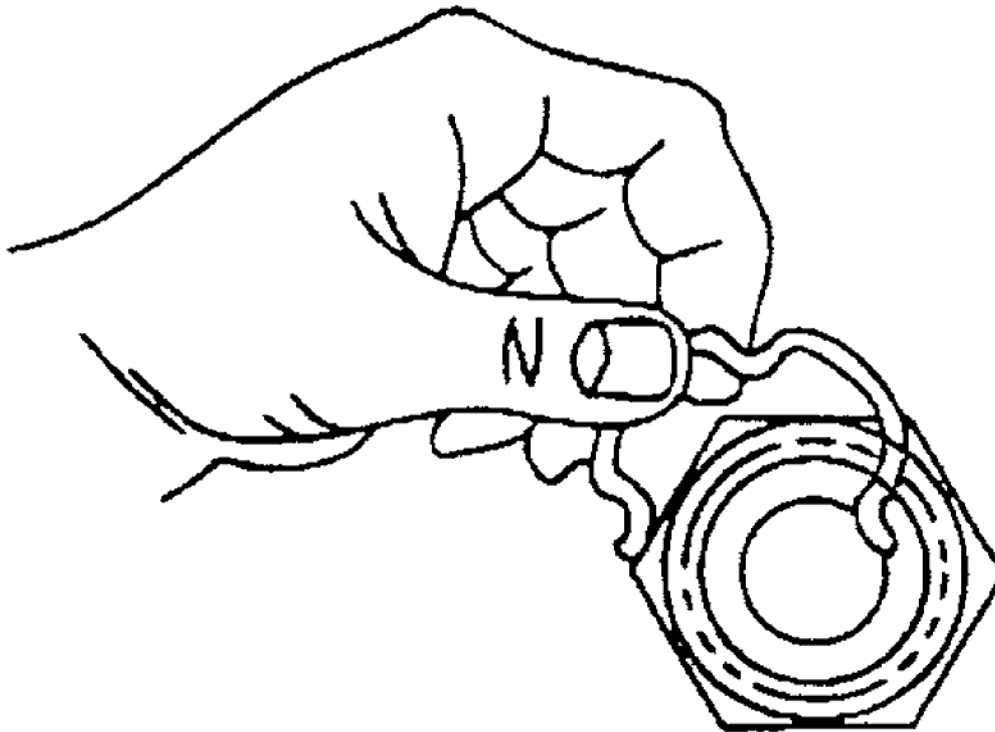


Fig. 115: Hooking Retaining Ring Into Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

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

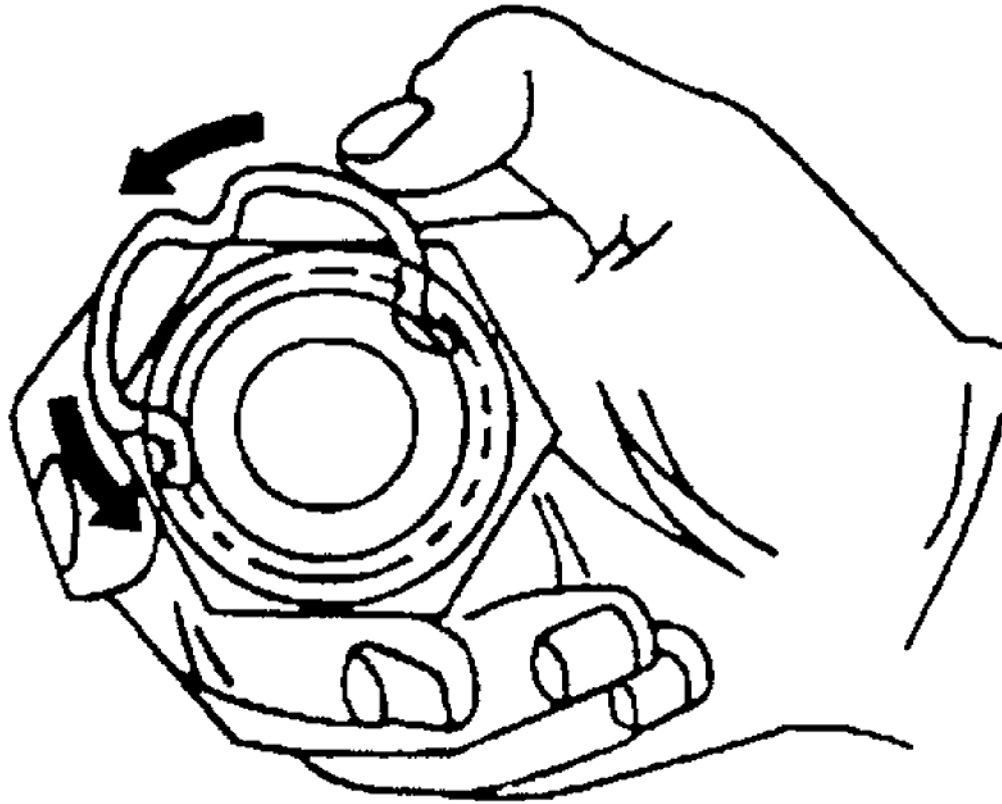


Fig. 116: Rotating Retaining Ring Around Fitting
Courtesy of GENERAL MOTORS CORP.

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.

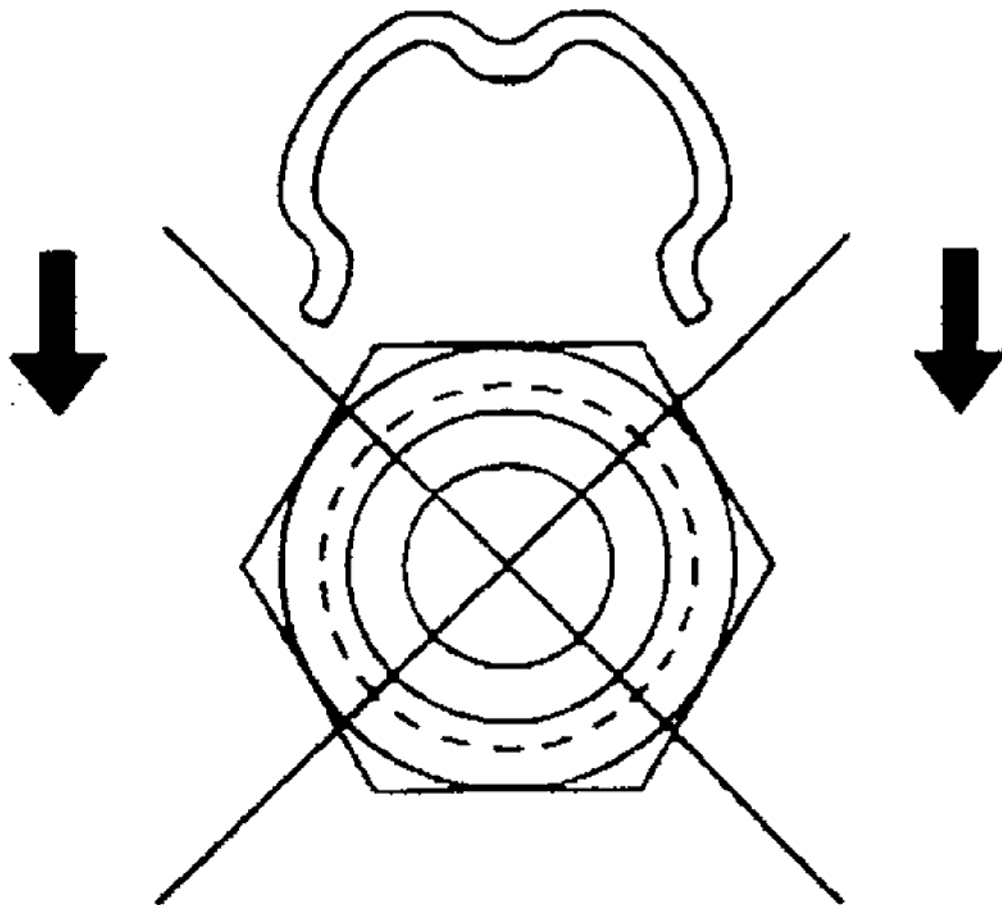


Fig. 117: Identifying Improper Engine Oil Cooler Hose/Pipe Retaining Ring Installation

Courtesy of GENERAL MOTORS CORP.

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

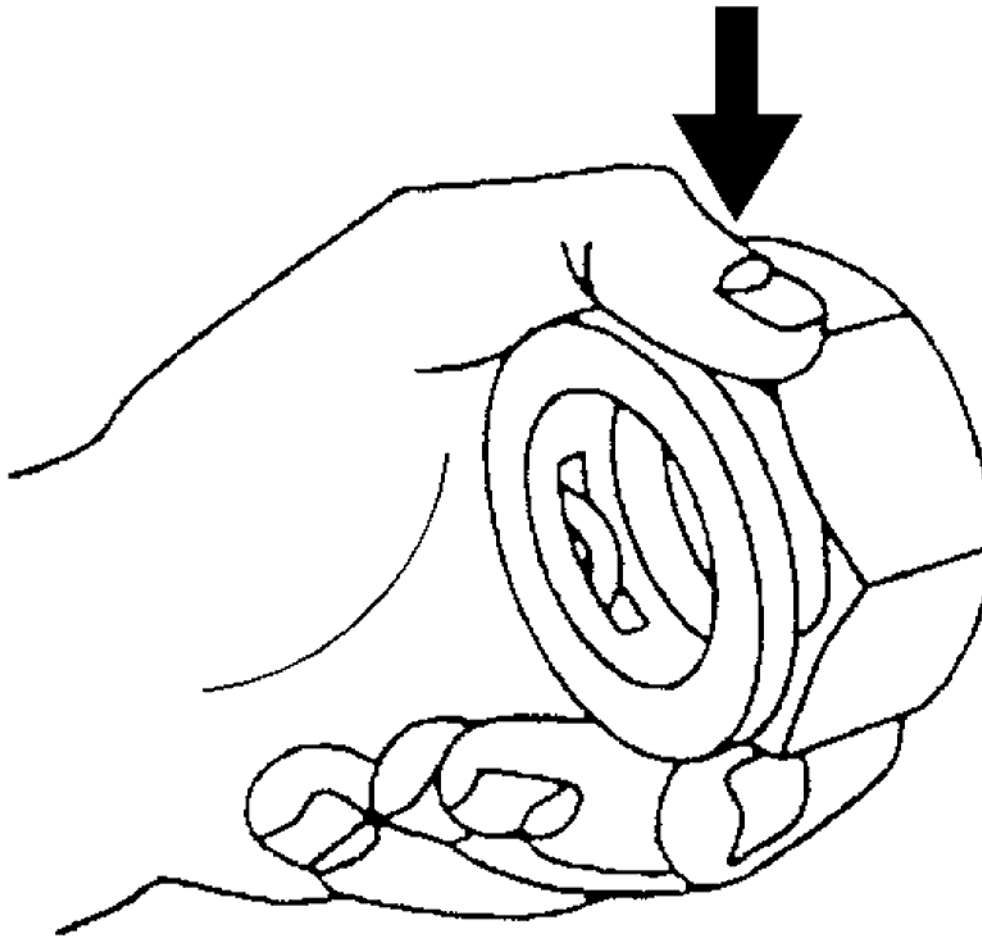


Fig. 118: Ensuring Retaining Ring Is Seated Correctly
Courtesy of GENERAL MOTORS CORP.

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.

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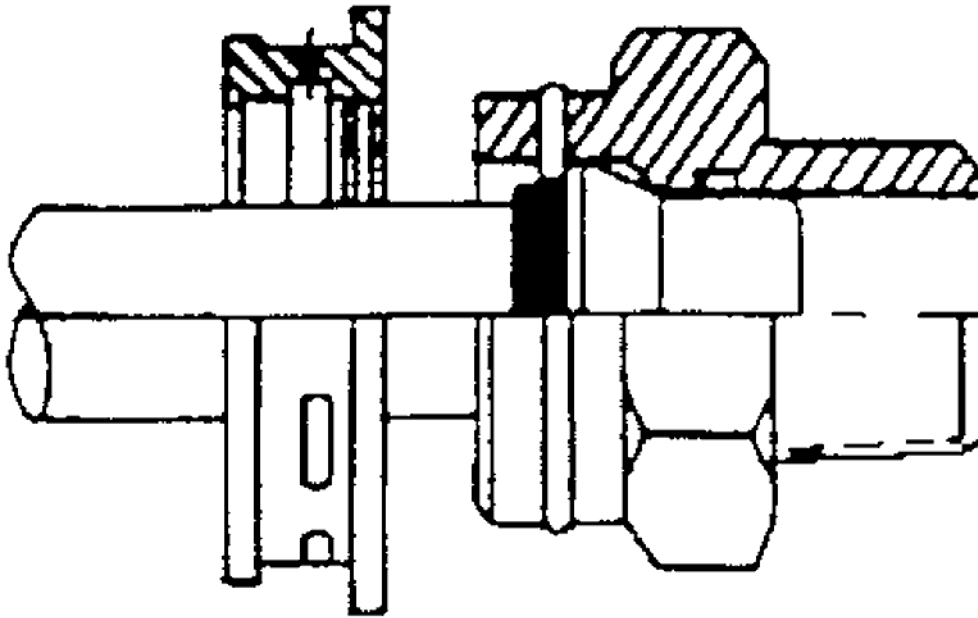


Fig. 119: View Of Cooler Line Quick Connect Fitting
Courtesy of GENERAL MOTORS CORP.

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.

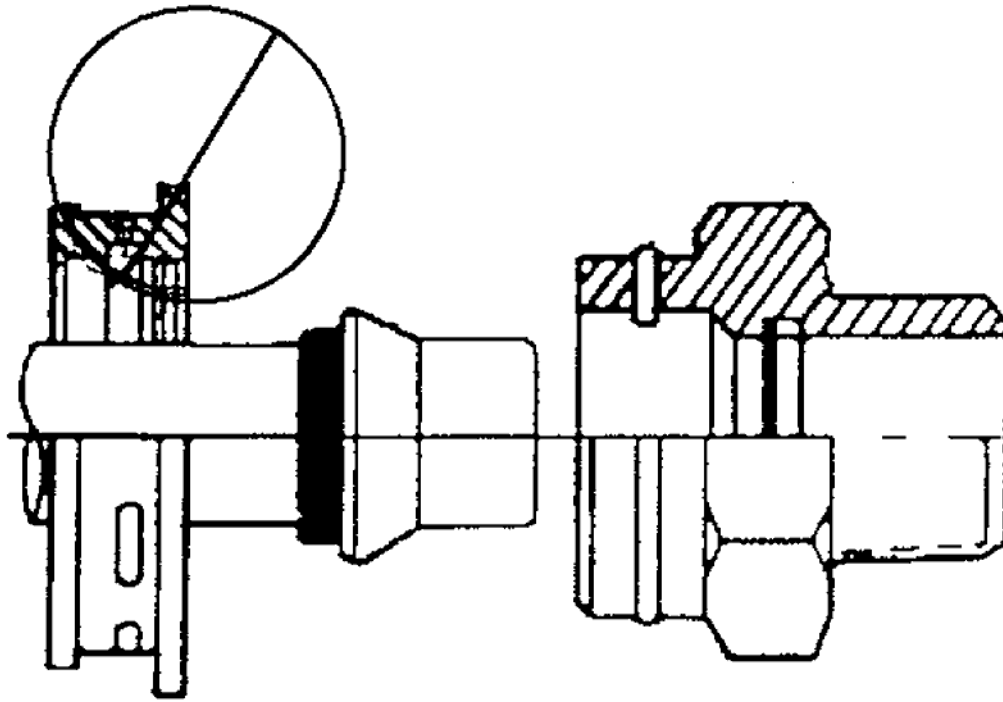


Fig. 120: Do Not Use Plastic Cap On Cooler Line In Order To Install Cooler Line Into The Fitting
Courtesy of GENERAL MOTORS CORP.

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.

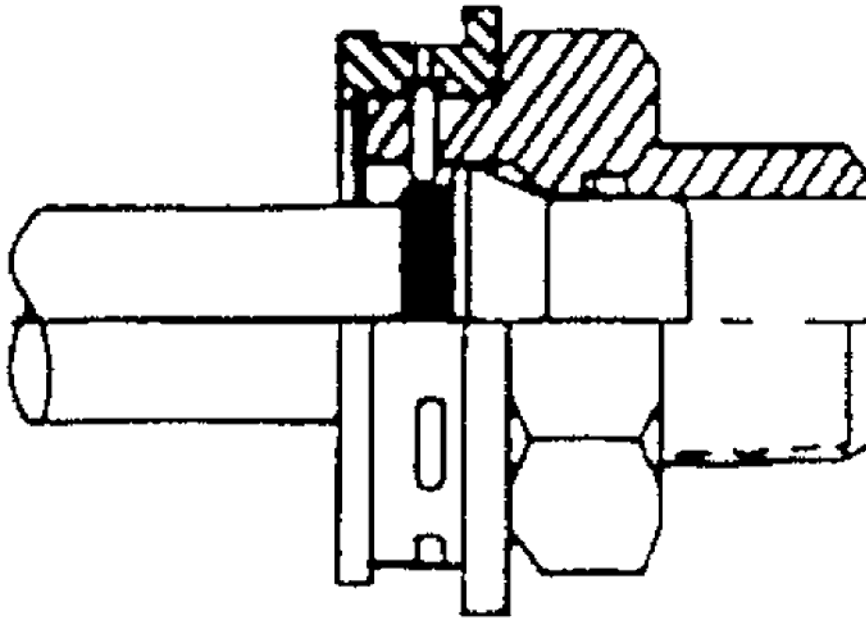


Fig. 121: View Of Cooler Line & Plastic Cap
Courtesy of GENERAL MOTORS CORP.

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.

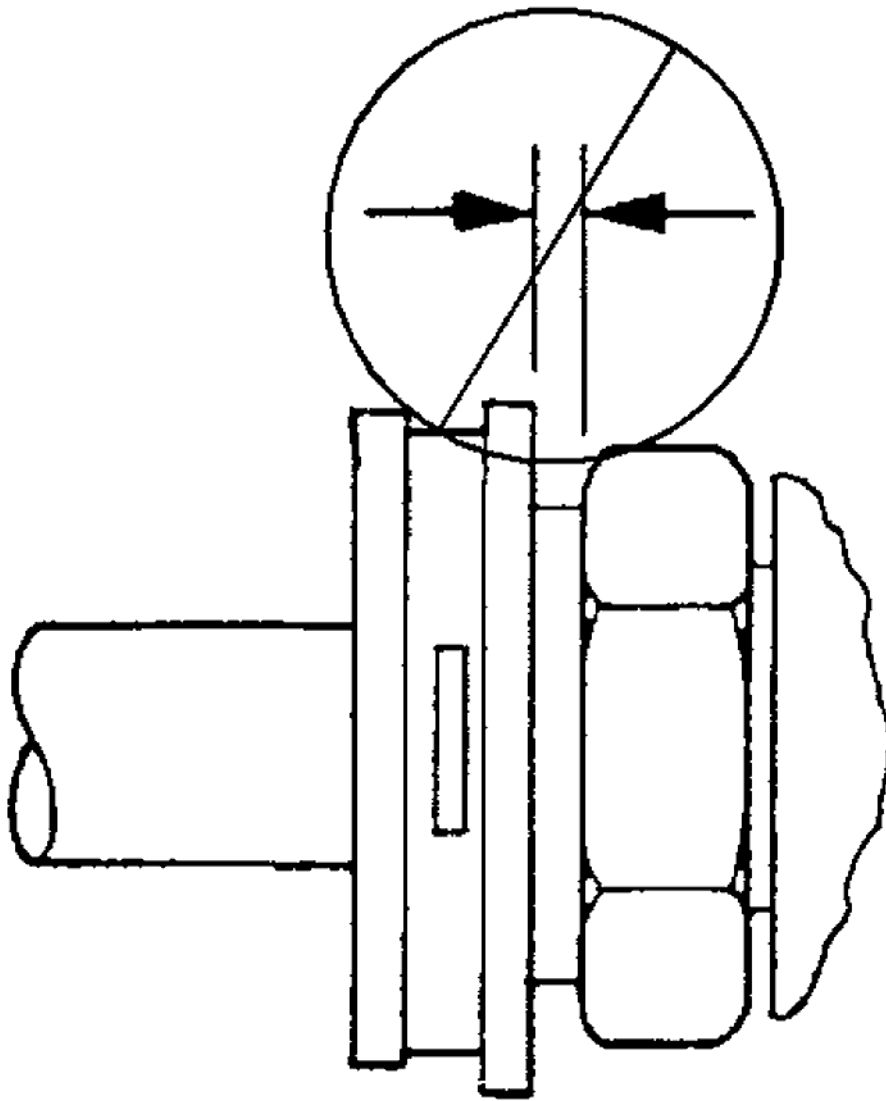


Fig. 122: Checking For Gap Between Cap & Fitting
Courtesy of GENERAL MOTORS CORP.

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

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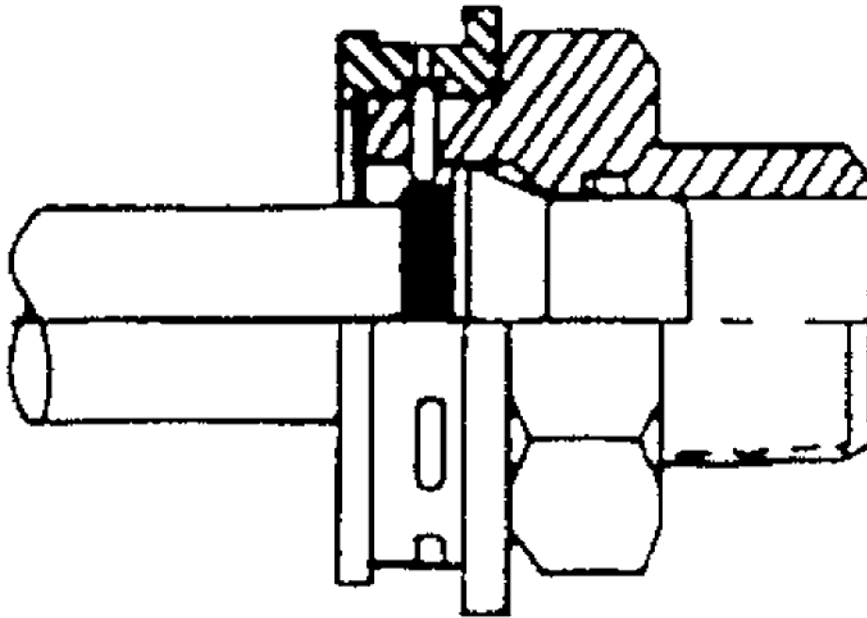


Fig. 123: View Of Cooler Line & Plastic Cap
Courtesy of GENERAL MOTORS CORP.

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

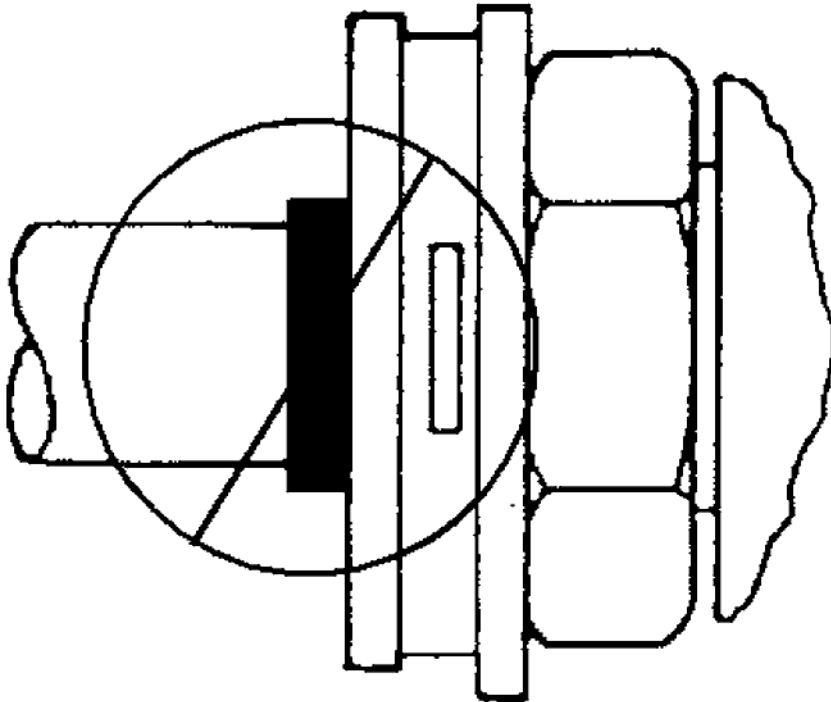


Fig. 124: Identifying Improper Joint Seating
Courtesy of GENERAL MOTORS CORP.

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

AUTOMATIC TRANSMISSION OIL COOLER PIPES REPLACEMENT

Removal Procedure

NOTE: Allow sufficient clearance around the transaxle oil cooler pipes and around the hoses to prevent damage or wear which may cause fluid loss.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Position a drain pan under the transaxle cooler pipes.

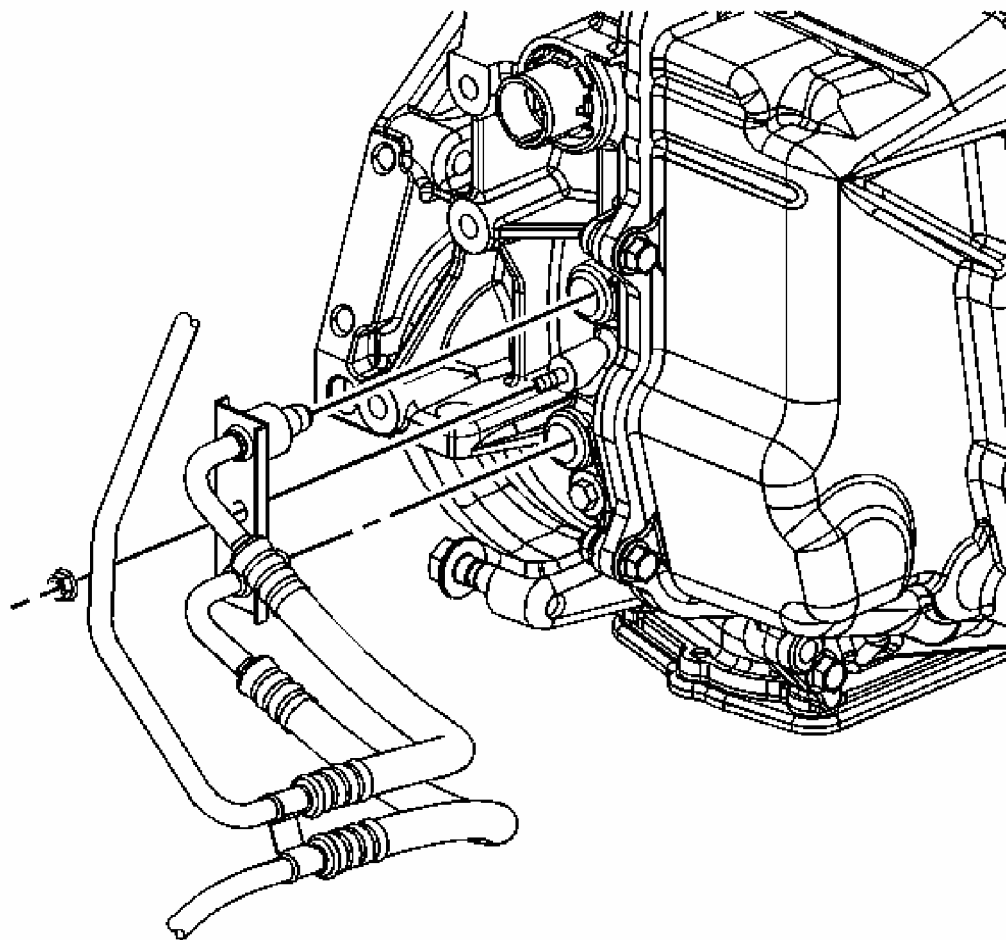


Fig. 125: View Of Transaxle Oil Cooler Pipes
Courtesy of GENERAL MOTORS CORP.

3. Remove the transaxle oil cooler pipes retaining nut from the transaxle.
4. Remove the transaxle oil cooler pipes from the transaxle.

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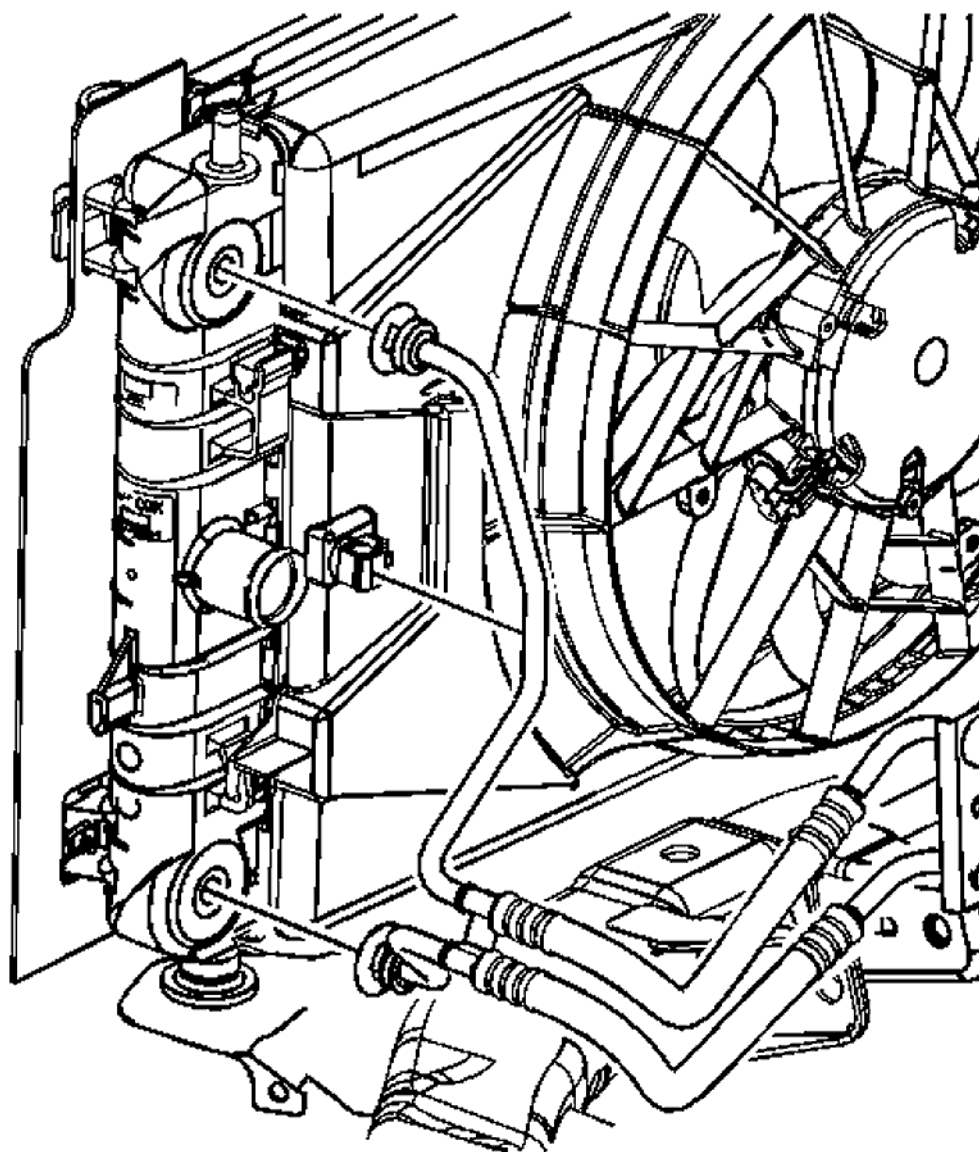


Fig. 126: Identifying Transaxle Oil Cooler Pipe
Courtesy of GENERAL MOTORS CORP.

5. Using **J 41623-B** remove the transaxle oil cooler pipes from the fittings at the radiator. See **Special Tools**.
6. Remove the transaxle oil cooler pipe from the retaining clip at the radiator.
7. Remove the transaxle oil cooler pipes from the vehicle.

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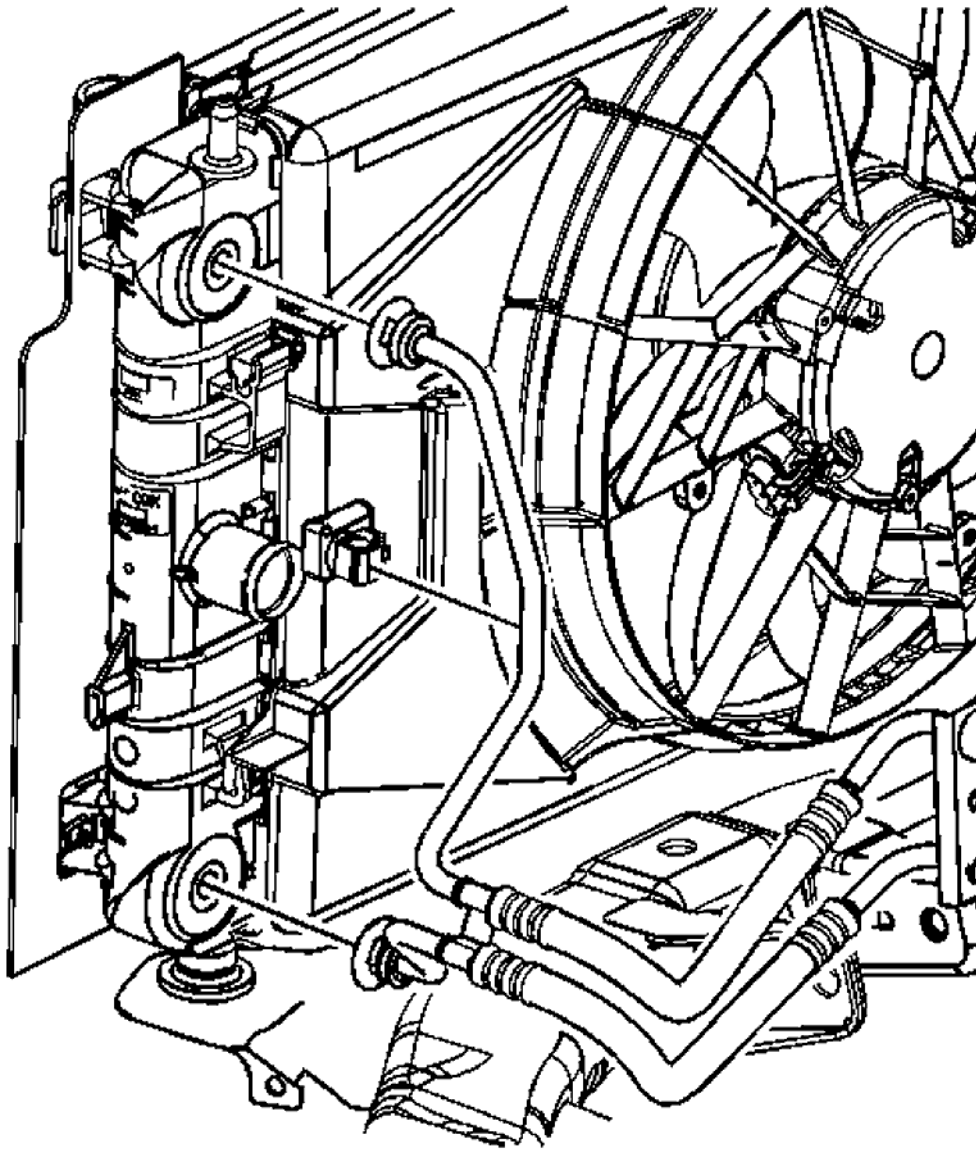


Fig. 127: Identifying Transaxle Oil Cooler Pipe
Courtesy of GENERAL MOTORS CORP.

1. Install the transaxle oil cooler pipes to the vehicle.
2. Install the transaxle oil cooler pipes to the fittings at the radiator.
3. Install the transaxle oil cooler pipe to the retaining clip at the radiator.

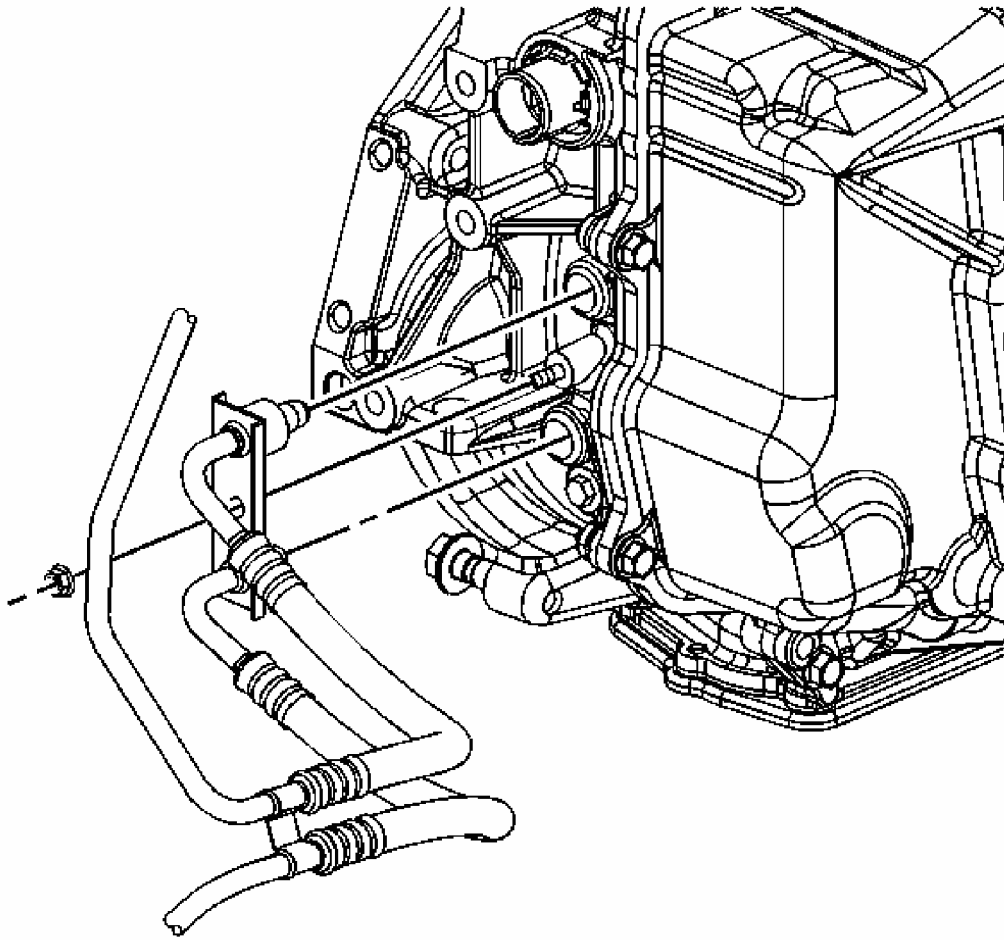


Fig. 128: View Of Transaxle Oil Cooler Pipes
Courtesy of GENERAL MOTORS CORP.

4. Install the transaxle oil cooler pipes to the transaxle.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the transaxle oil cooler pipe retaining nut.

Tighten: Tighten the nut to 7 N.m (62 lb in).

6. Remove the drain pan.
7. Lower the vehicle.

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NOTE: Do NOT overfill the transaxle. The overfilling of the transaxle causes foaming, loss of fluid, shift complaints, and possible damage to the transaxle.

8. Adjust the transmission fluid level. Refer to Transmission Fluid Checking Procedure.
9. Inspect for fluid leaks.

TORQUE CONVERTER, TURBINE SHAFT SEAL REPLACEMENT

Removal Procedure

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

1. Disconnect the negative battery cable.
2. Remove the transmission assembly from the vehicle. Refer to Transmission Replacement.

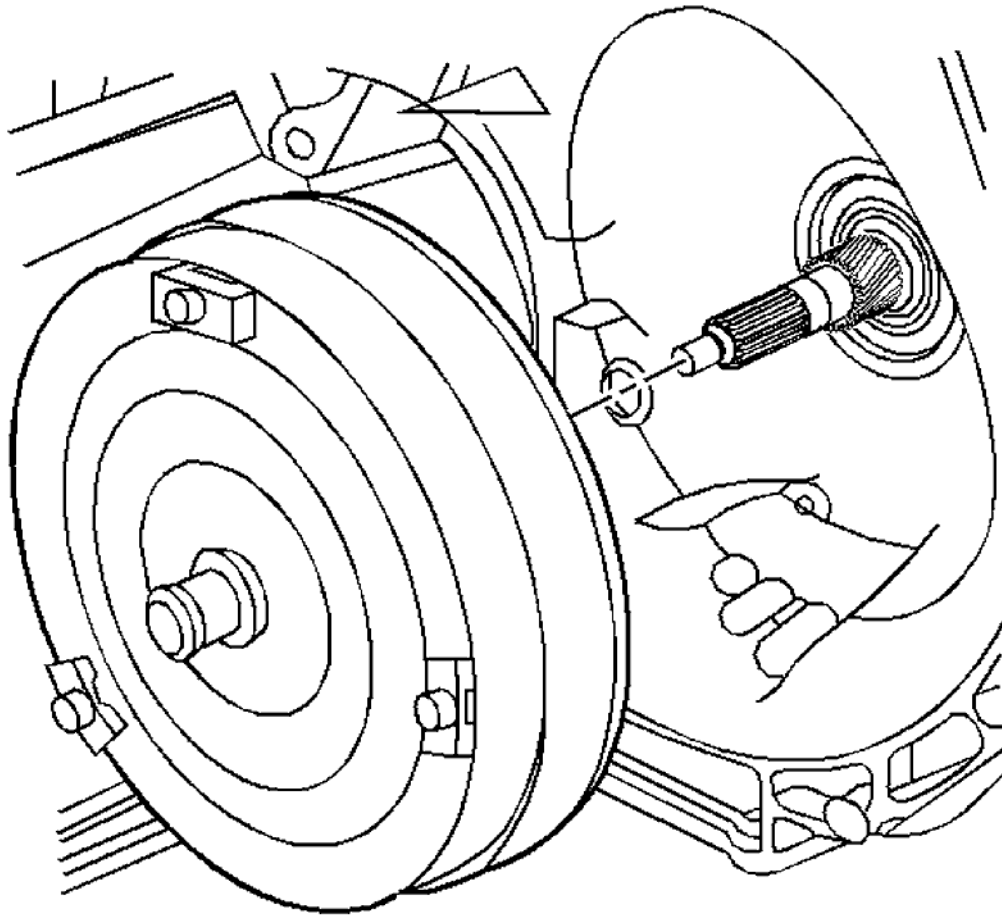


Fig. 129: View Of Torque Converter Assembly & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

3. Remove the torque convertor assembly from the transmission.
4. Remove the torque convertor O-ring seal from the end of the turbine shaft. Use a screwdriver.

Installation Procedure

1. Install a new torque convertor O-ring seal on the end of the turbine shaft.

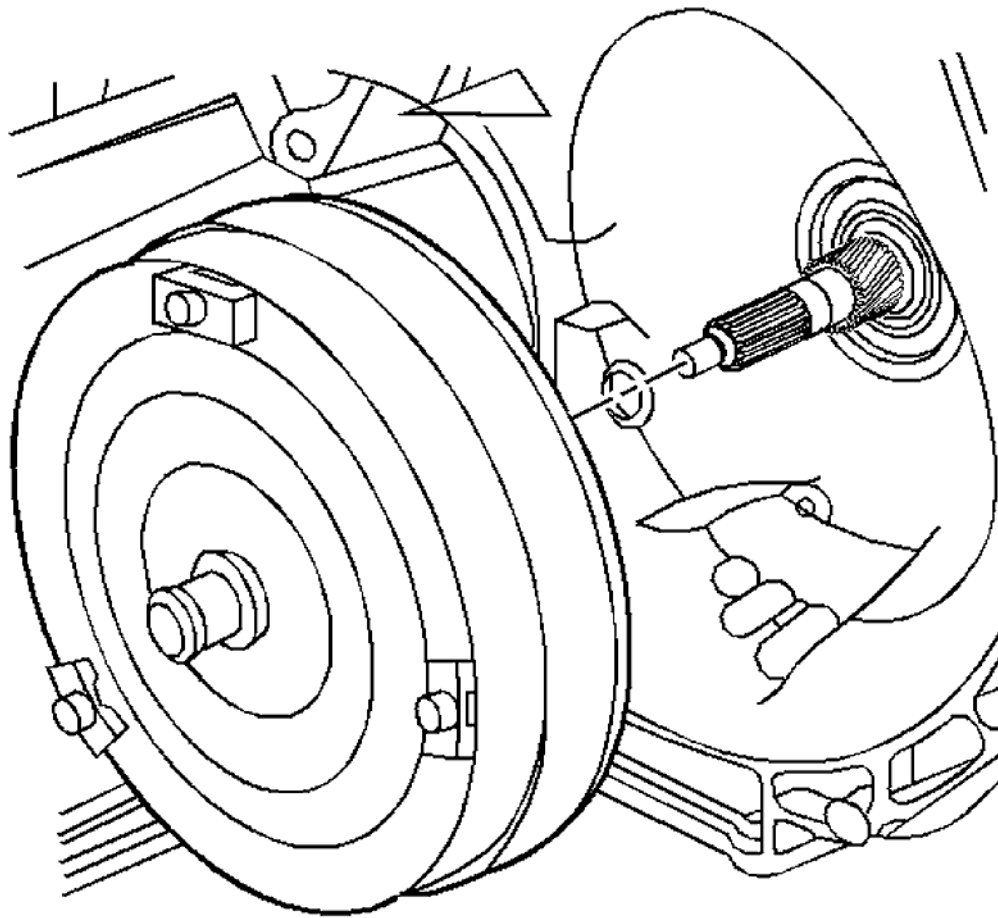


Fig. 130: View Of Torque Converter Assembly & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

2. Install the torque convertor onto the transmission.
3. Install the transmission into the vehicle. Refer to Transmission Replacement.
4. Connect the negative battery cable.
5. Adjust the transmission oil level. Refer to Transmission Fluid Checking Procedure.

OIL FEED PIPES REPLACEMENT

Removal Procedure

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

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1. Disconnect the negative battery cable.
2. Raise the vehicle. Support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the transmission oil pan. Refer to **Oil Pan Replacement**.
4. Remove the transmission oil filter assembly. Refer to **Oil Filter and Seal Replacement**.

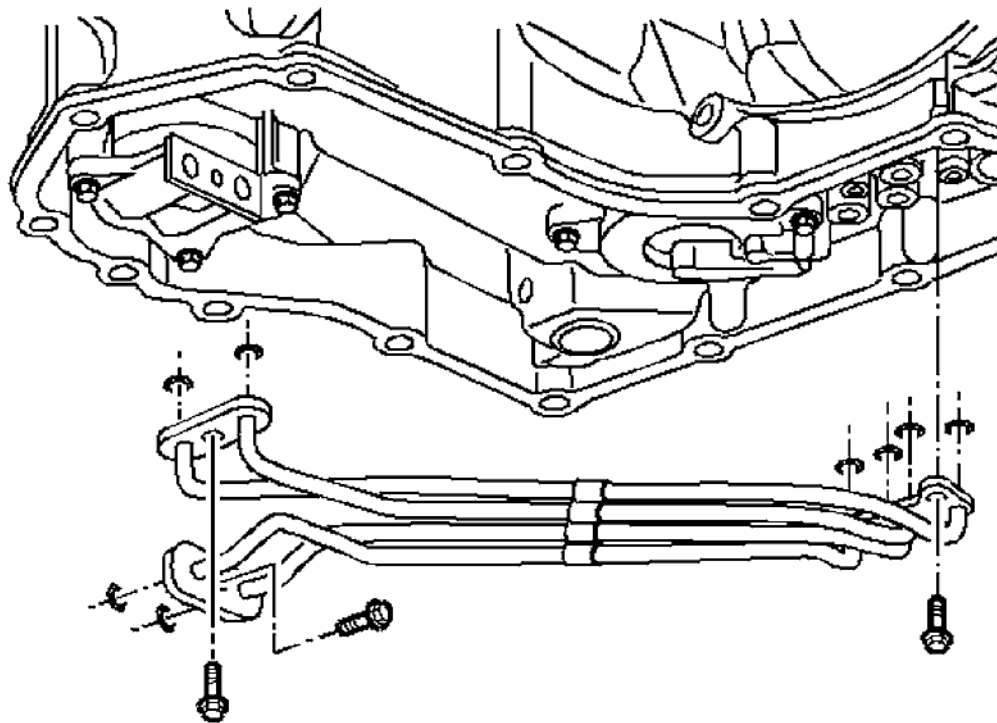


Fig. 131: View Of Oil Feed Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the oil feed pipe bolts.
6. Inspect the eight oil feed pipe seal rings.
7. Replace the seal rings only if the seal rings are cut, swollen or damaged.

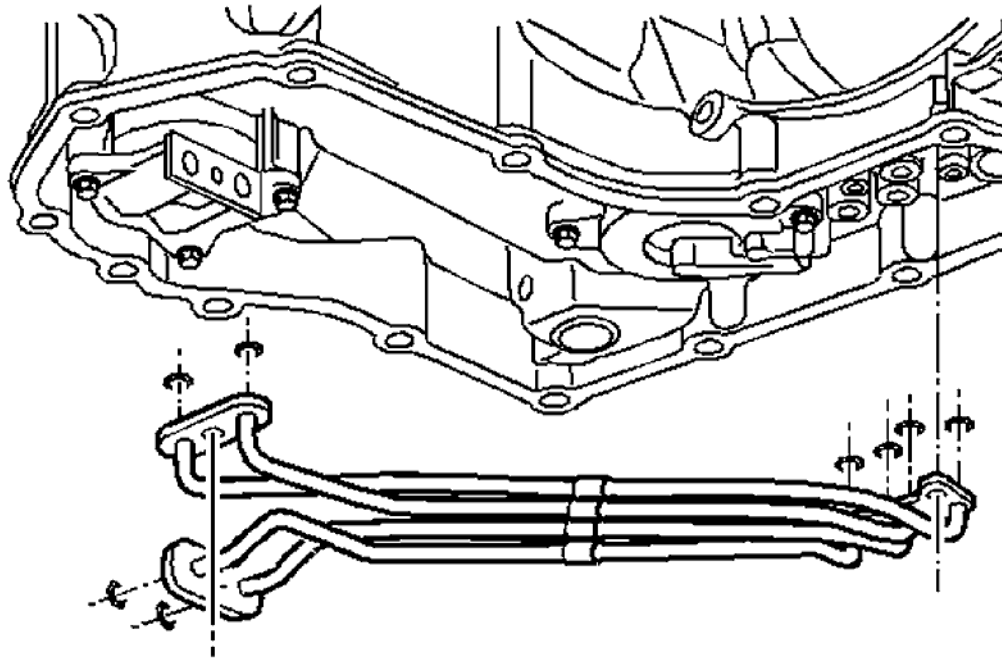


Fig. 132: Identifying Lo & Reverse Band Oil Pipe Assembly Seals
Courtesy of GENERAL MOTORS CORP.

8. Remove the low/reverse band oil pipe assembly.
9. Remove the eight low/reverse band oil pipe assembly seals.
10. Inspect the oil feed pipes for plugged passages, bent pipes, or cracks.
11. Inspect the oil feed pipe seal rings. Verify the proper location of the seal rings. Replace the seal rings if these are cut, swelled or damaged.

Installation Procedure

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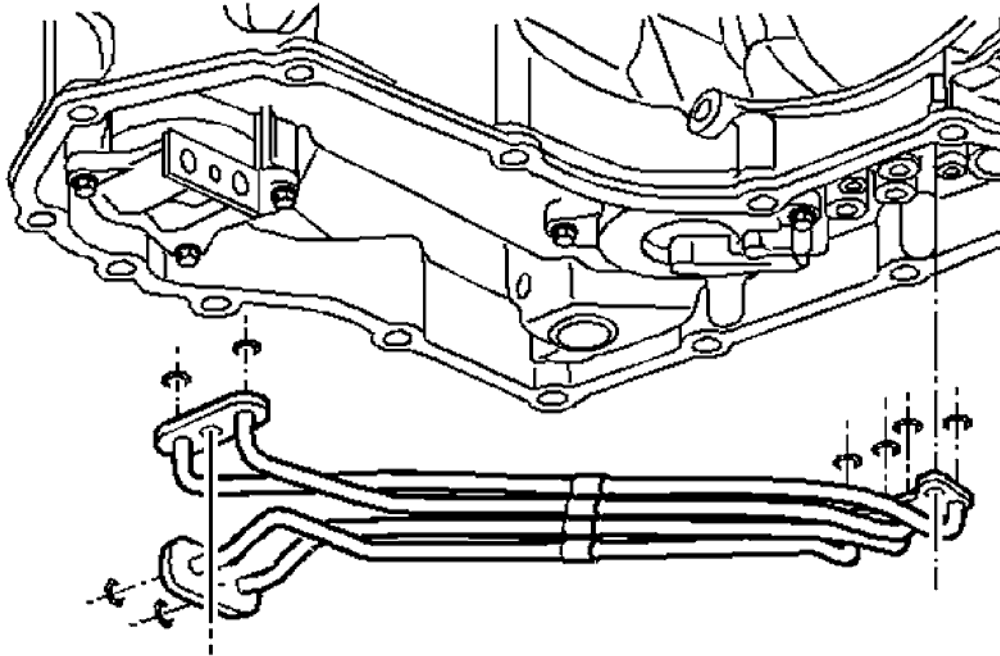


Fig. 133: Identifying Lo & Reverse Band Oil Pipe Assembly Seals
Courtesy of GENERAL MOTORS CORP.

1. Install the eight low/reverse band oil pipe assembly seals.
2. Install the low/reverse band oil feed pipe assembly onto the transmission.

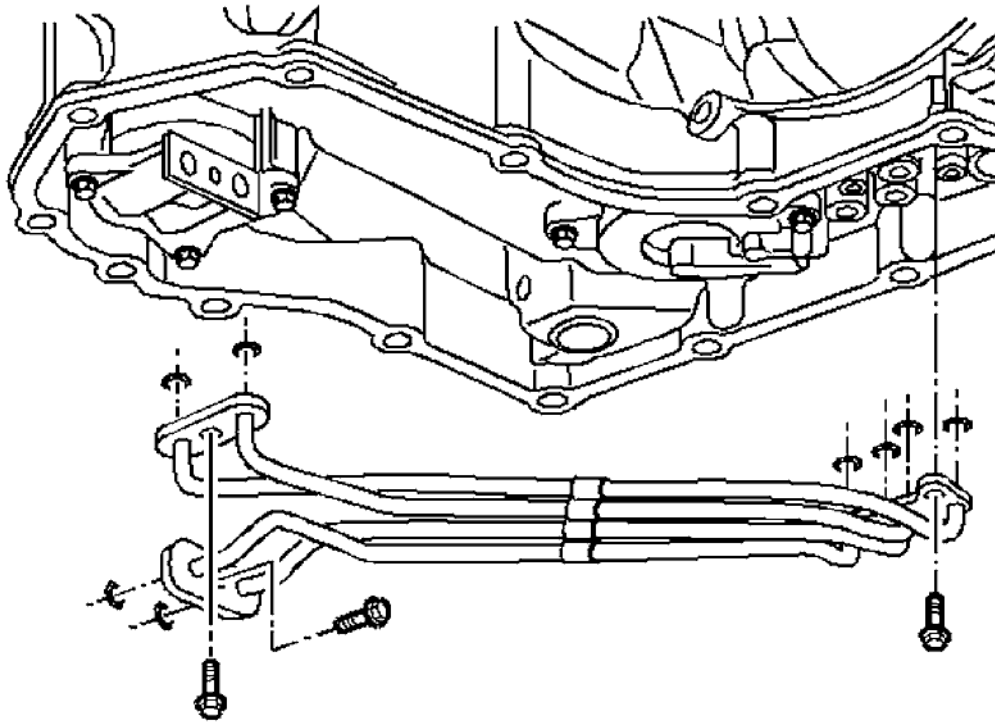


Fig. 134: View Of Oil Feed Pipe Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Hand start the bolts that attach the oil feed pipe assembly to the transmission.

Tighten: Tighten the bolts to 14 N.m (124 lb in).

4. Install the transmission oil filter assembly. Refer to Oil Filter and Seal Replacement.
5. Install the transmission oil pan and gasket. Refer to Oil Filter and Seal Replacement.
6. Lower the vehicle.
7. Refill the transmission to the proper level.
8. Inspect the transmission oil level. Refer to Transmission Fluid Checking Procedure.

CASE SIDE COVER REPLACEMENT

Removal Procedure

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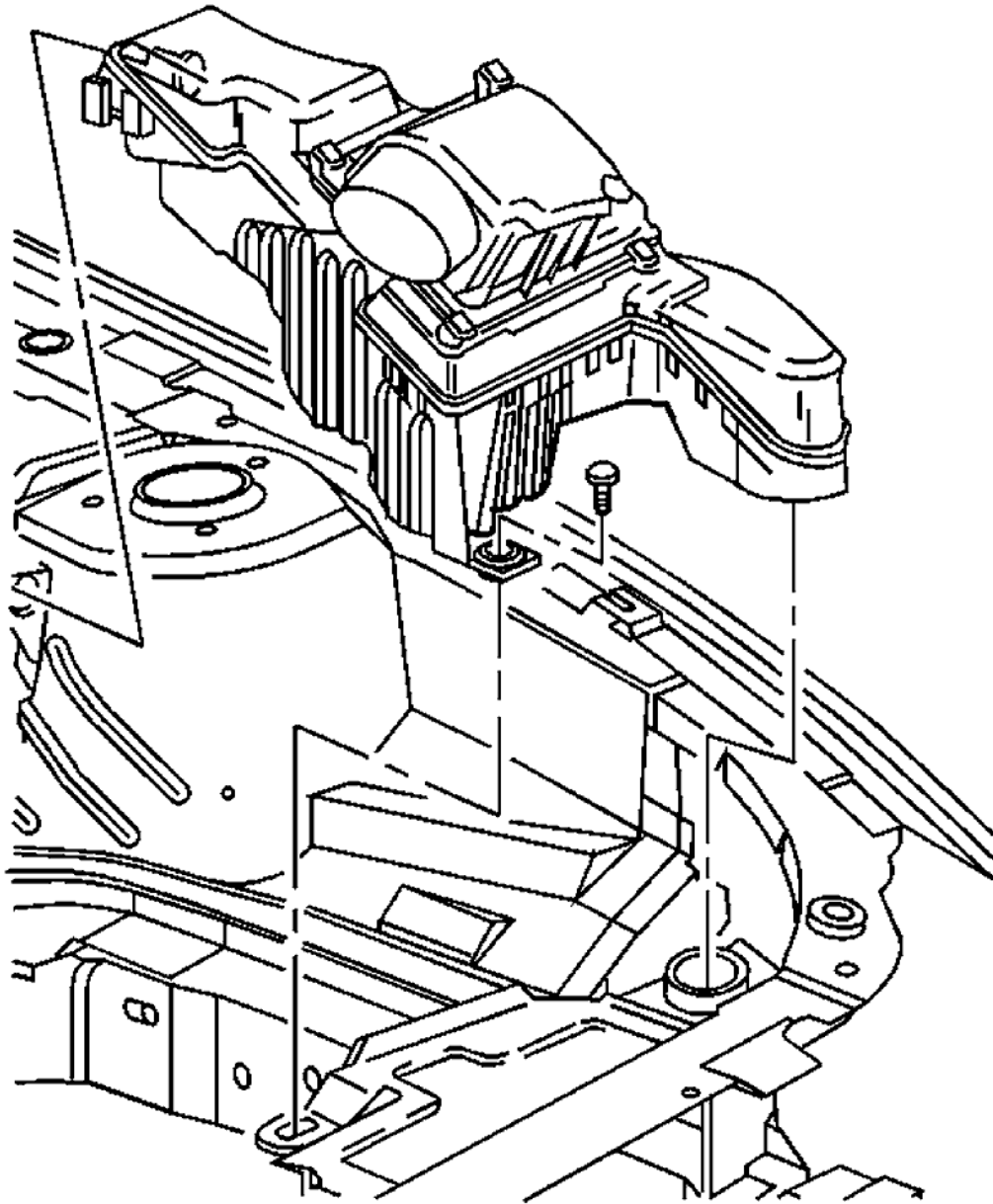


Fig. 135: Identifying Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the air cleaner housing assembly. Refer to **Air Cleaner Assembly Replacement** .

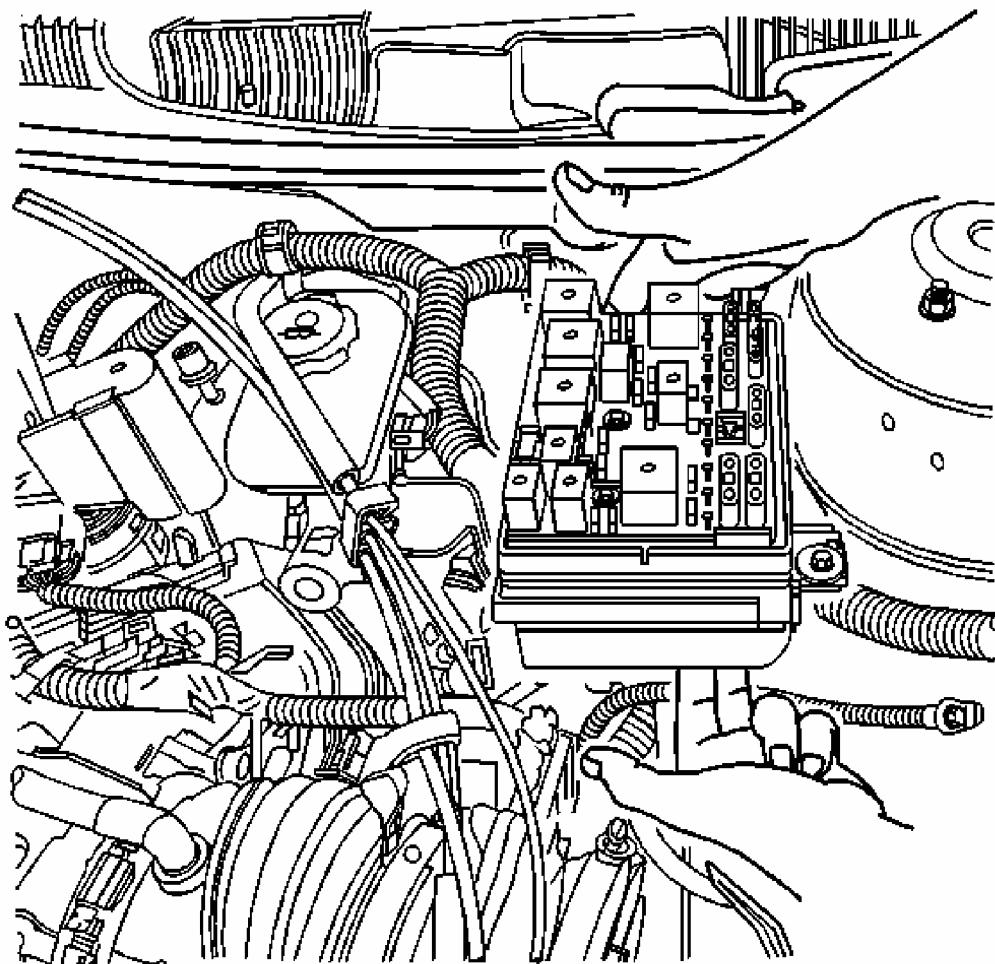


Fig. 136: View Of Junction Block
Courtesy of GENERAL MOTORS CORP.

2. Remove the underhood electrical center from the bracket.
3. Remove the underhood electrical center bracket.

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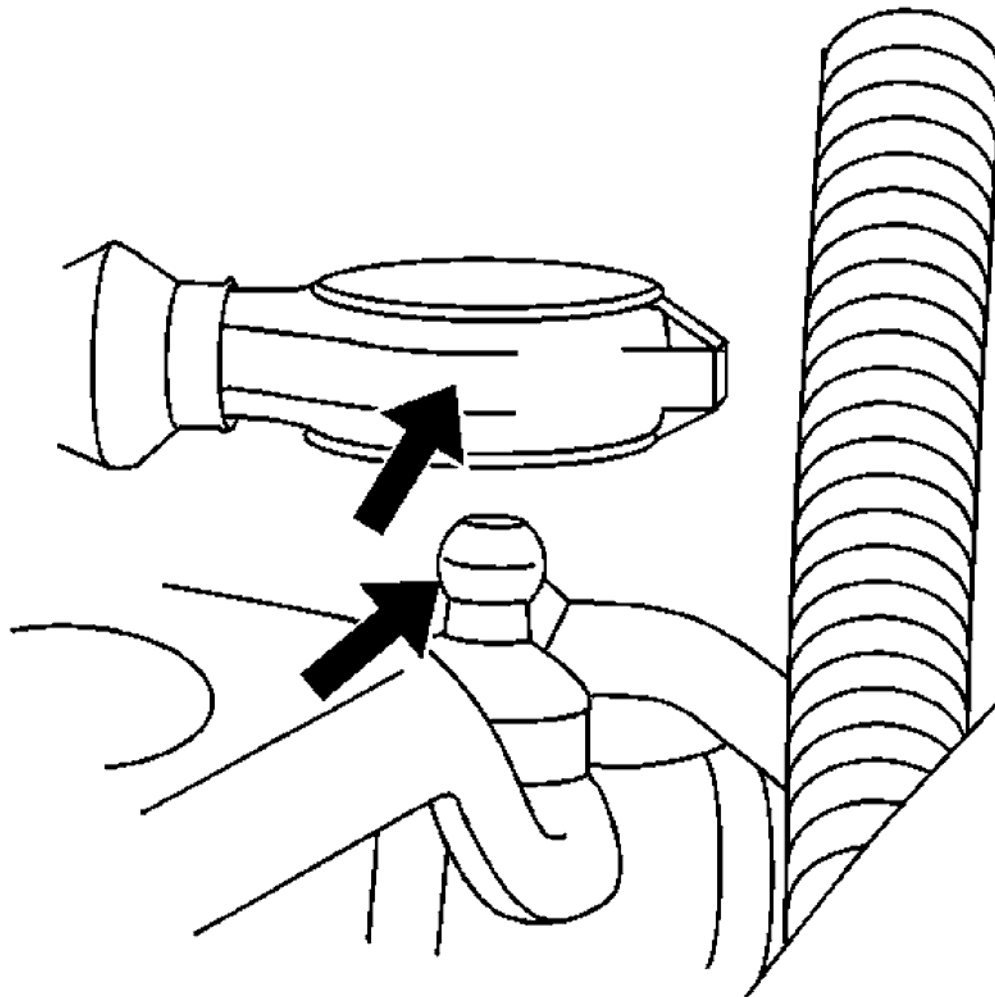


Fig. 137: View Of Shift Cable & Shift Linkage
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the shift cable from the PNP switch.
5. Remove the shift cable bracket.

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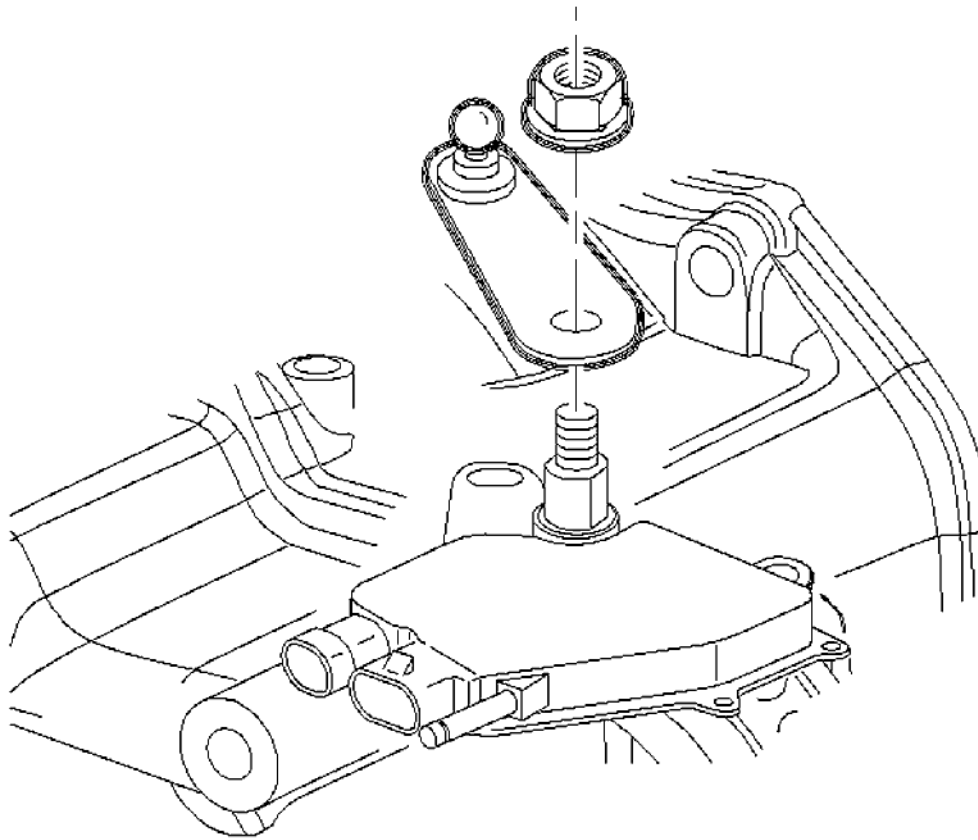


Fig. 138: Removing/Installing Transaxle Range Switch Lever & Nut
Courtesy of GENERAL MOTORS CORP.

6. Remove the PNP switch lever nut and lever.

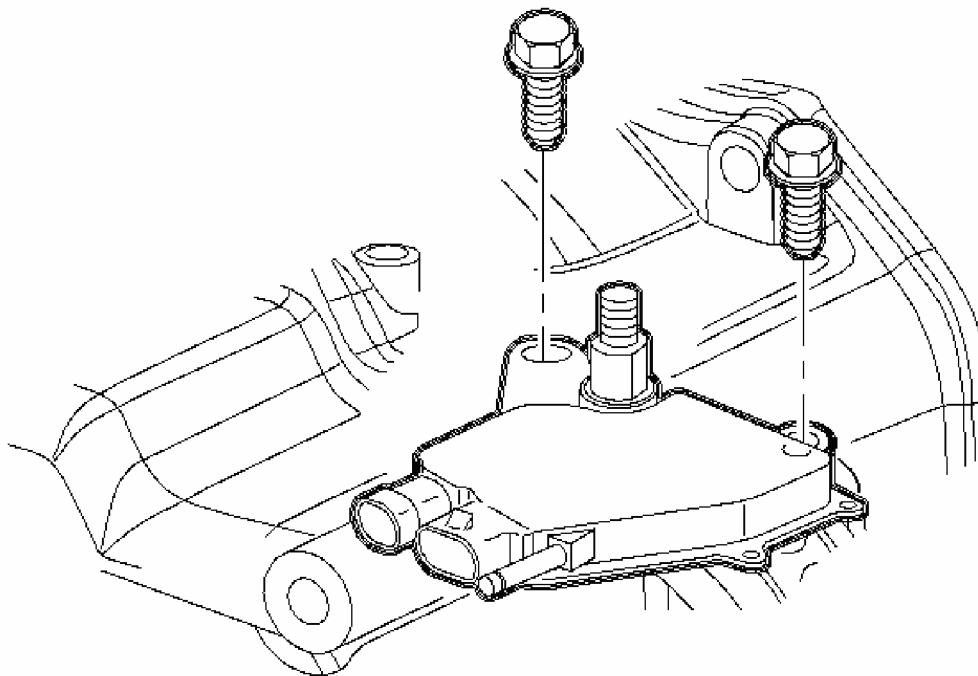


Fig. 139: Locating Transaxle Range Switch Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the PNP switch. Refer to **Park/Neutral Position (PNP) Switch Replacement**.
8. Remove the transmission upper side cover bolts.
9. Install the engine support fixture. Refer to **Engine Support Fixture**.
10. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle**.
11. Remove the left front tire and wheel. Refer to **Tire and Wheel Removal and Installation**.
12. Remove the left inner fender liner. Refer to **Wheelhouse Liner Replacement - Front**.
13. Remove the wheel drive shaft from the transmission. Refer to **Wheel Drive Shaft Replacement**.
14. Remove the power steering gear mounting bolts. Refer to **Power Steering Gear**

Replacement .

15. Remove the frame. Refer to **Frame Replacement .**

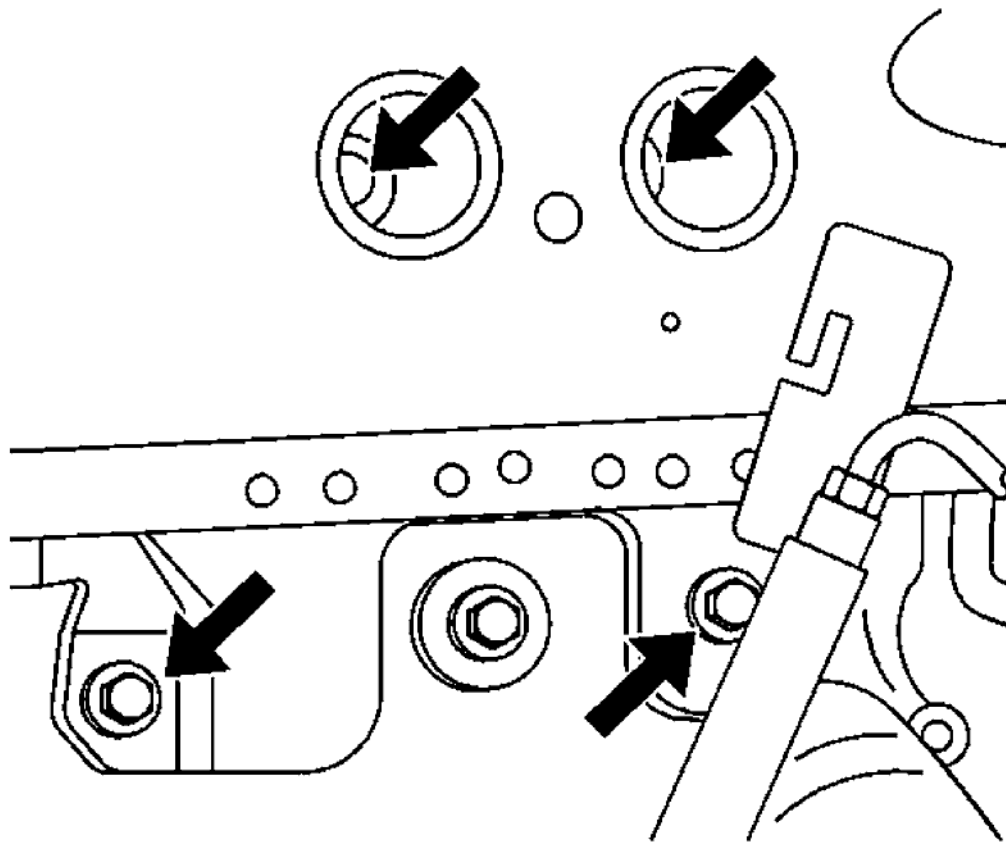


Fig. 140: Identifying Transmission Side Cover Bolts
Courtesy of GENERAL MOTORS CORP.

16. Remove the transmission mount. Refer to **Transmission Mount Replacement - Front** or **Transmission Mount Replacement - Rear.**
17. Lower the vehicle.
18. Lower the engine with the engine support fixture.
19. Raise the vehicle.
20. Remove the transmission side cover lower bolts.
21. Remove the transmission side cover.

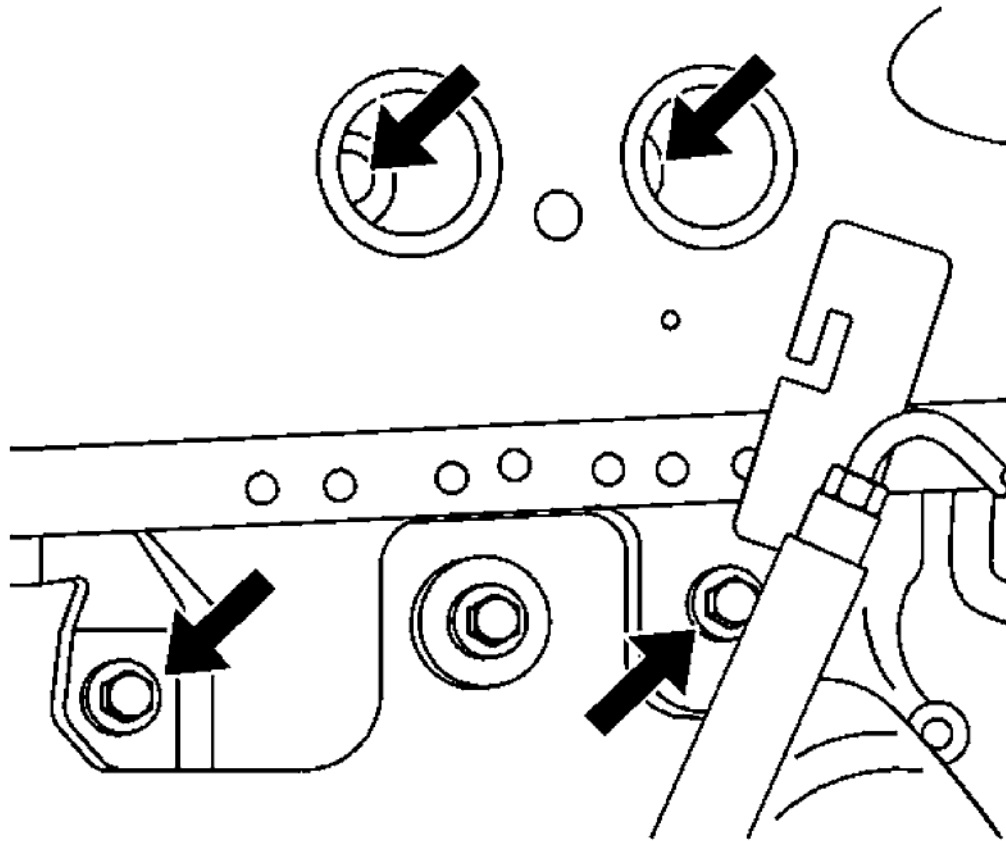


Fig. 141: Identifying Transmission Side Cover Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the transmission side cover.

NOTE: Refer to Fastener Notice .

2. Hand start the transmission side cover lower bolts.

Tighten: Tighten the side cover bolts and stud to 20 N.m (15 lb ft).

3. Lower the vehicle.
4. Raise the engine with the engine support fixture.
5. Raise the vehicle.
6. Install the transmission mount. Refer to Transmission Mount Replacement - Front or Transmission Mount Replacement - Rear.

7. Install the frame. Refer to **Frame Replacement** .
8. Install the power steering gear mounting bolts. Refer to **Power Steering Gear Replacement** .
9. Install the wheel drive shaft to the transmission. Refer to **Wheel Drive Shaft Replacement** .
10. Connect the left ball joint to the steering knuckle. Refer to **Lower Ball Joint Replacement** .
11. Install the left inner fender liner. Refer to **Wheelhouse Liner Replacement - Front** .
12. Install the left front tire and wheel. Refer to **Tire and Wheel Removal and Installation** .
13. Lower the vehicle.
14. Remove the engine support fixture. Refer to **Engine Support Fixture** .

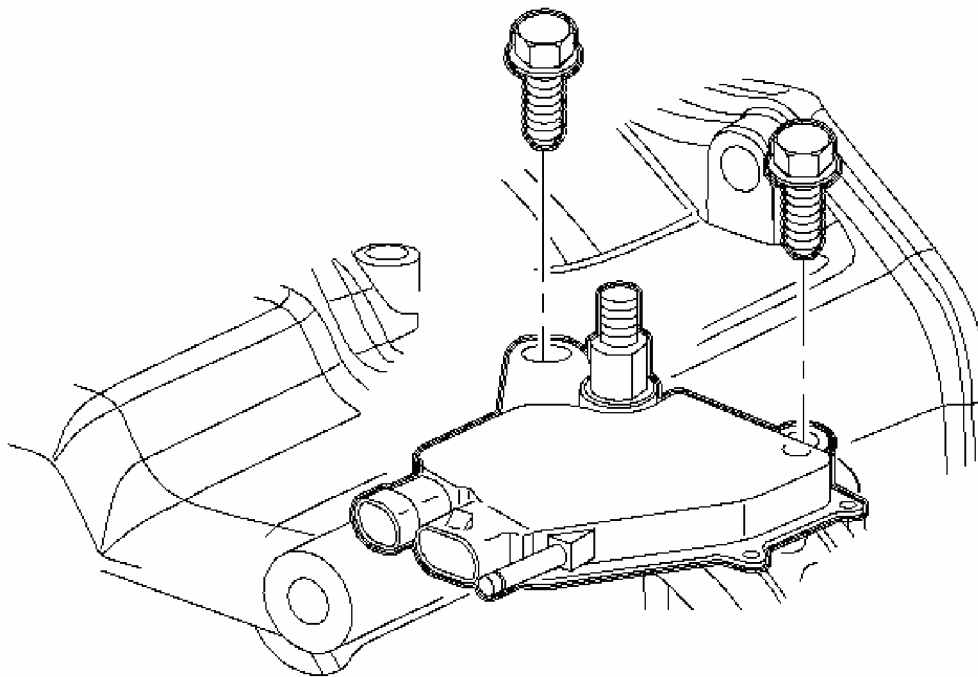


Fig. 142: Locating Transaxle Range Switch Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the PNP switch. Refer to **Park/Neutral Position (PNP) Switch Replacement**.

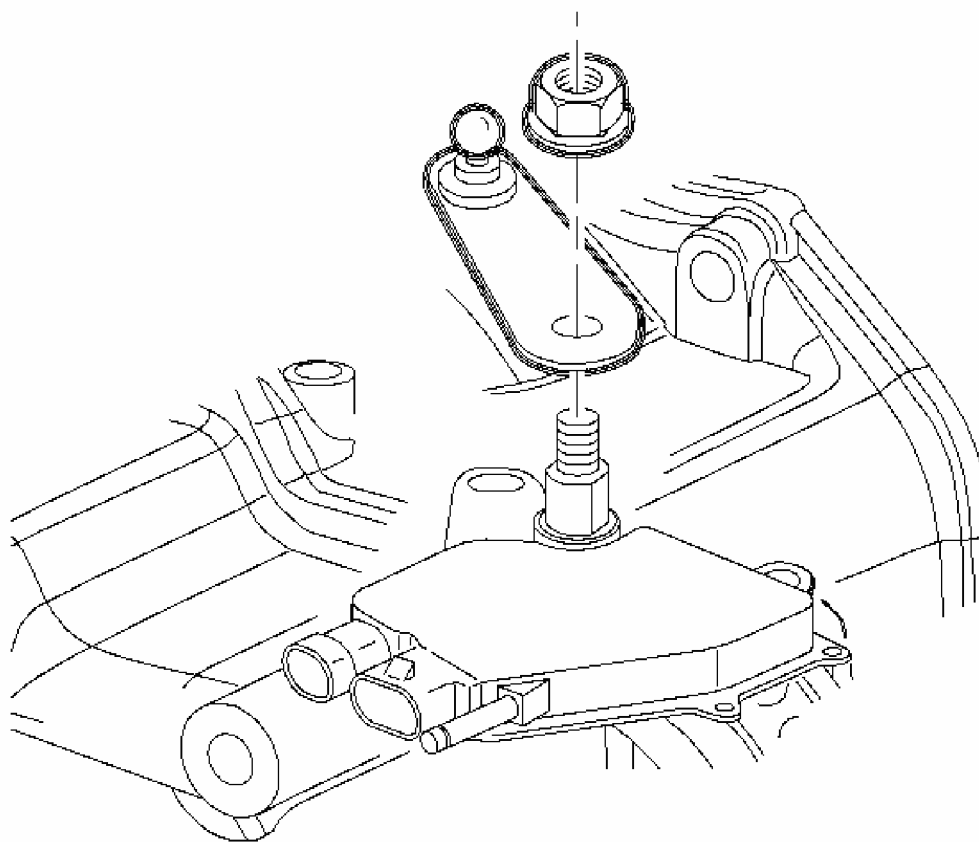


Fig. 143: Removing/Installing Transaxle Range Switch Lever & Nut
Courtesy of GENERAL MOTORS CORP.

16. Install the PNP switch lever and nut.

Tighten: Tighten the nut to 35 N.m (26 lb ft).

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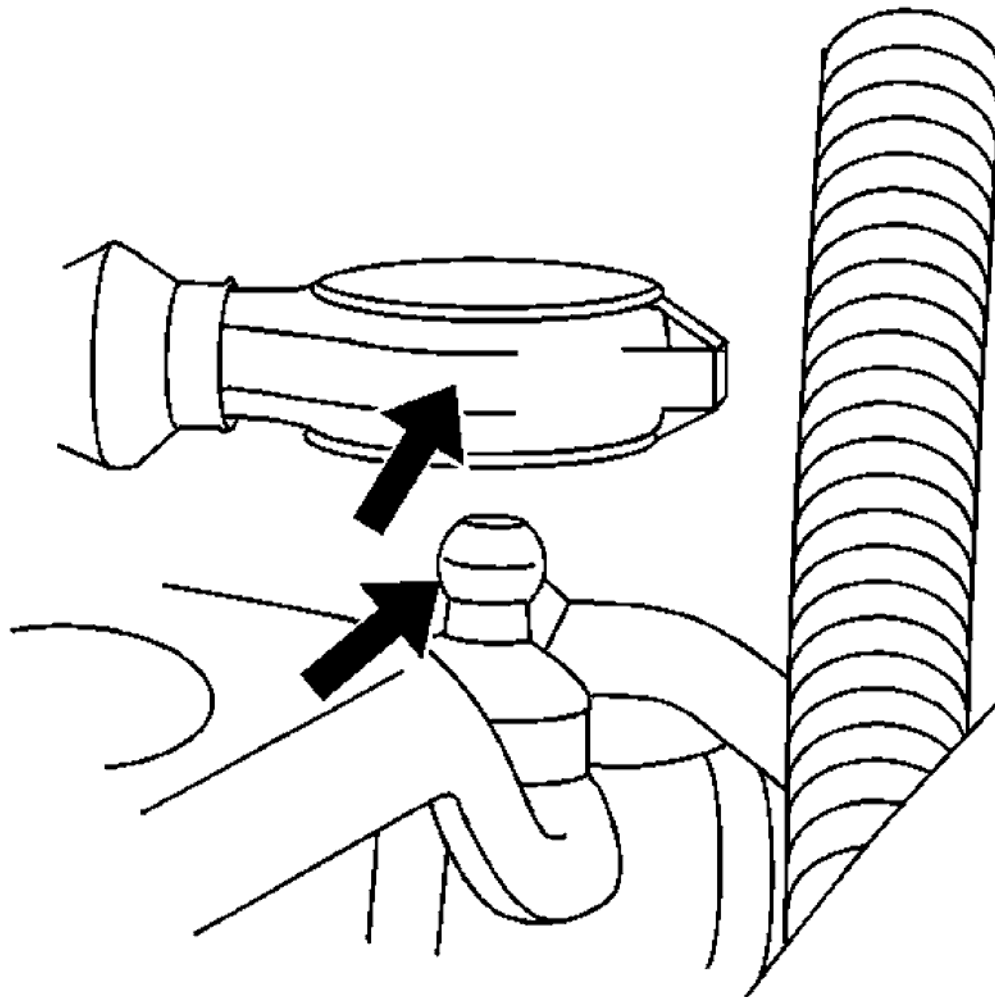


Fig. 144: View Of Shift Cable & Shift Linkage
Courtesy of GENERAL MOTORS CORP.

17. Install the shift cable bracket.
18. Connect the shift cable from the PNP switch.

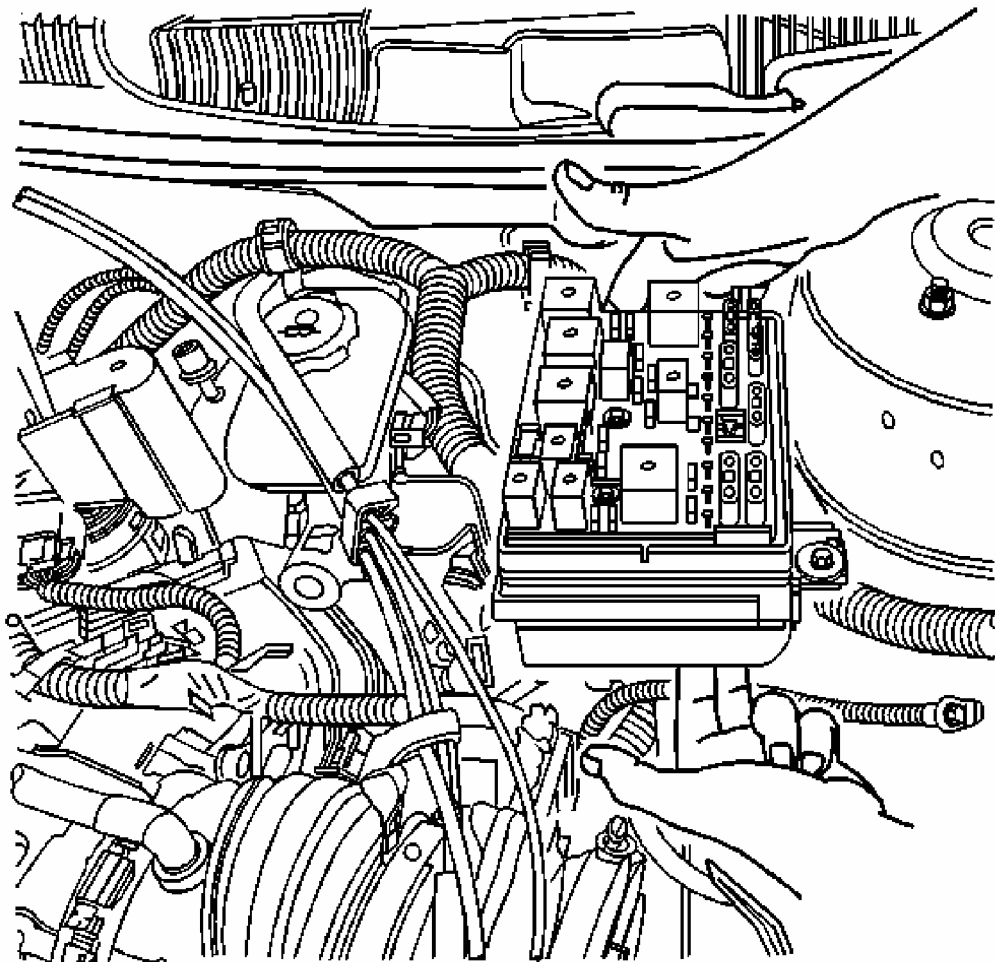


Fig. 145: View Of Junction Block
Courtesy of GENERAL MOTORS CORP.

19. Install the underhood electrical center bracket.
20. Install the underhood electrical center to the bracket.

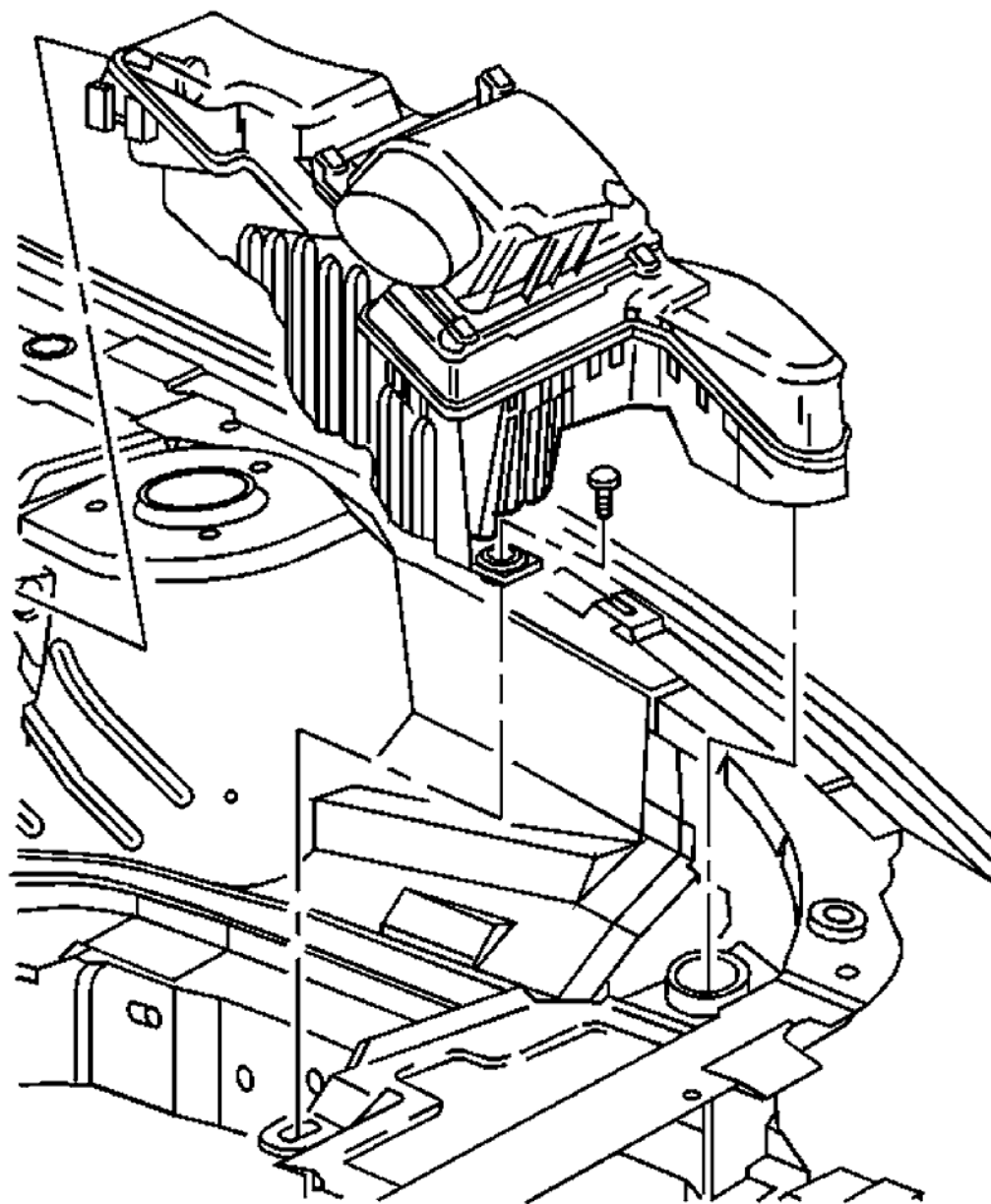


Fig. 146: Identifying Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

21. Install the air cleaner housing assembly. Refer to **Air Cleaner Assembly Replacement** .
22. Fill the transmission. Refer to **Capacities - Approximate Fluid** .

CASE SIDE COVER SEAL REPLACEMENT

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Tools Required

- **J 41227** Output Shaft Sleeve Remover. See Special Tools.
- **J 41228** Output Shaft Seal Installer. See Special Tools.
- **J 41102** Axle Seal Installer. See Special Tools.

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in **Cautions and Notices**.

1. Raise the vehicle.
2. Remove the drive axle assembly. Refer to Wheel Drive Shaft Replacement in **Wheel Drive Shafts**.

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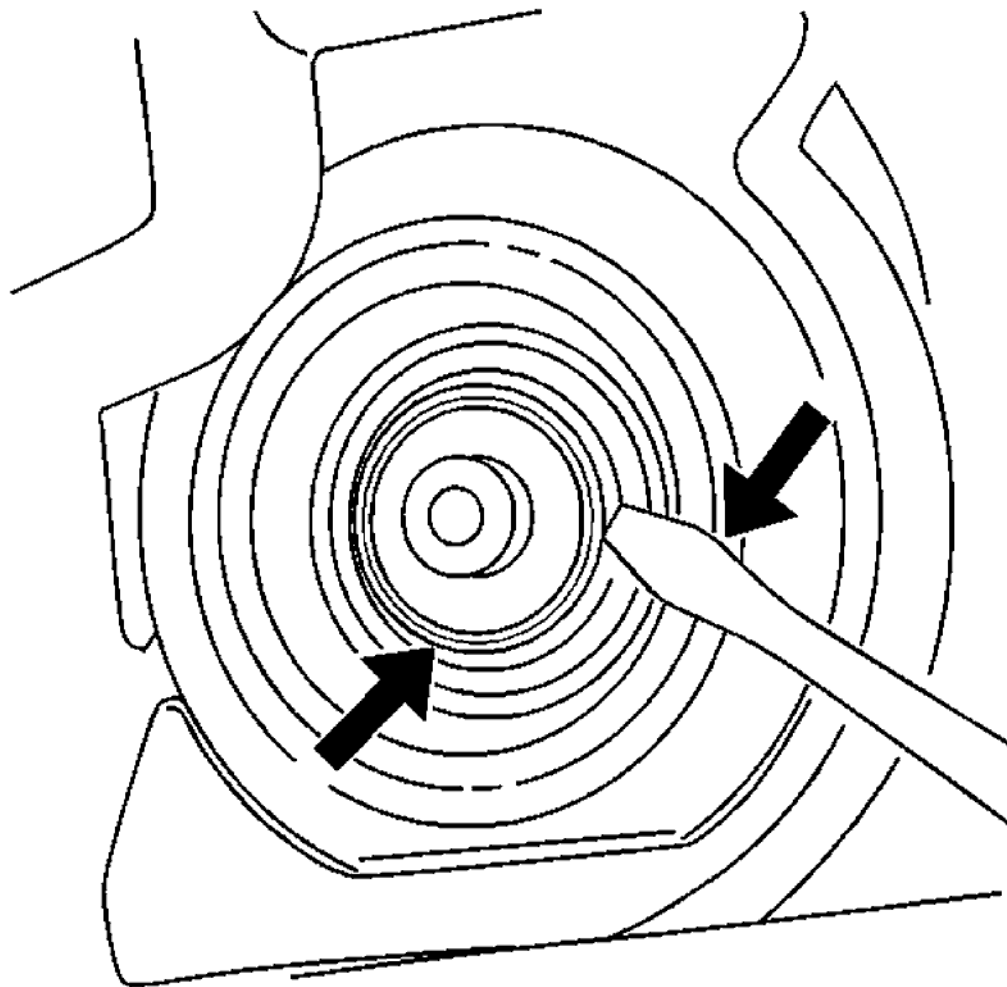


Fig. 147: View Of Case Cover Seal
Courtesy of GENERAL MOTORS CORP.

3. Use a medium screwdriver and a mallet in order to remove the case cover seal.

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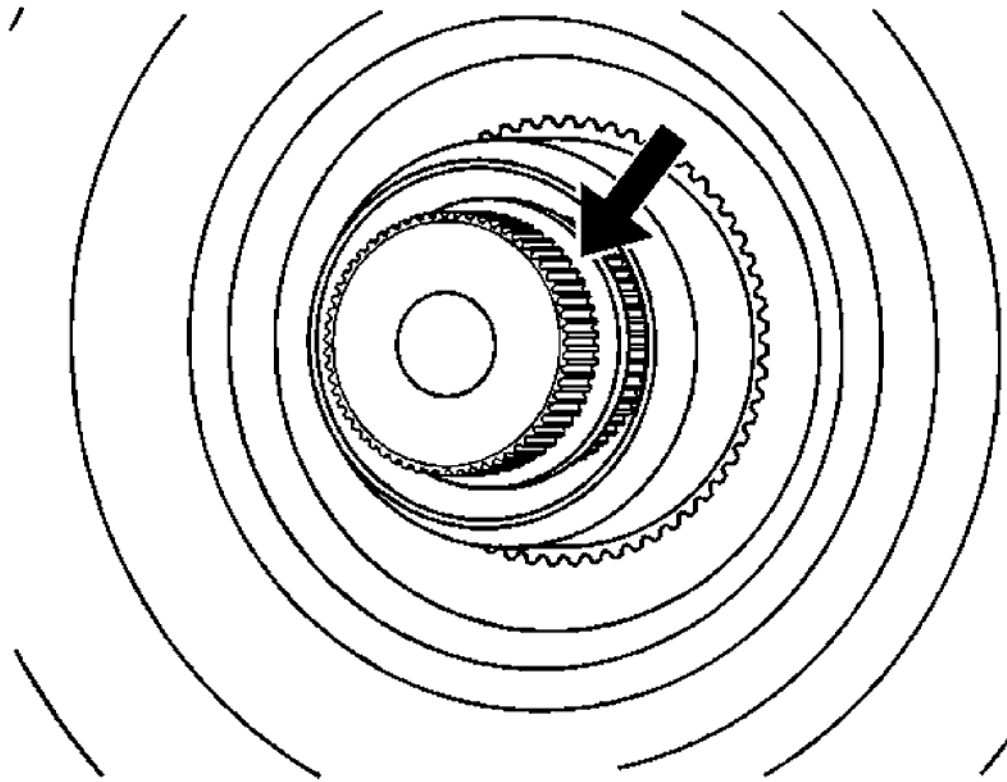


Fig. 148: Locating Drive Axle Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Remove the drive axle retaining clip from the output axle.

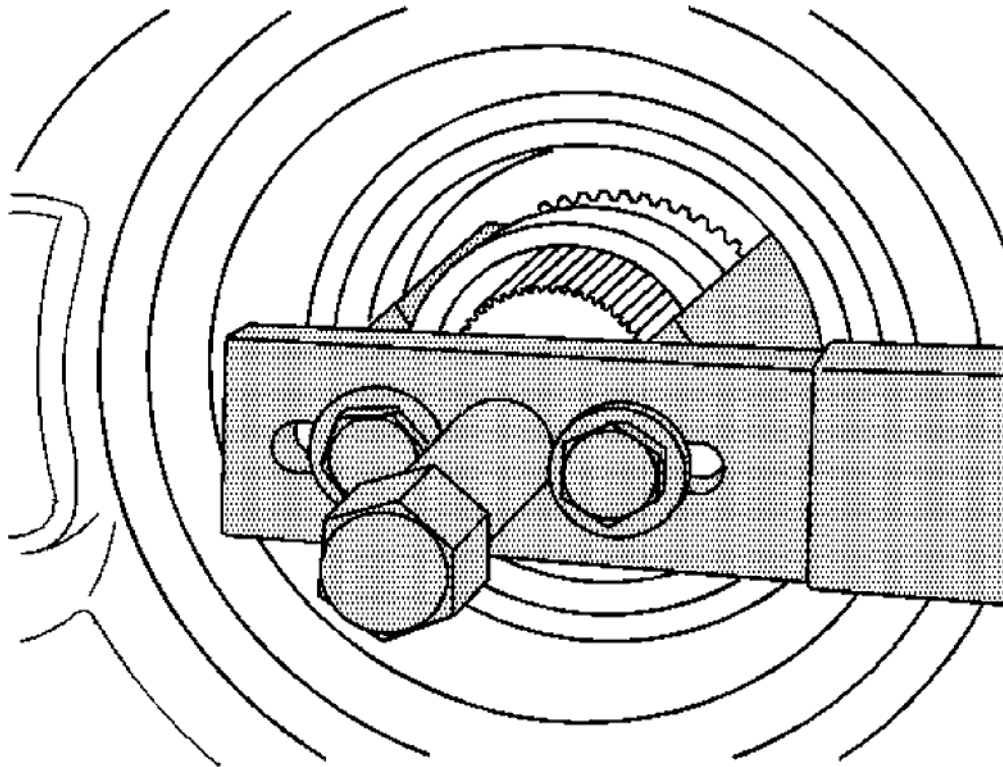


Fig. 149: Using Special Tool To Remove Sleeve From Output Axle Shaft
Courtesy of GENERAL MOTORS CORP.

5. Use the **J 41227** in order to remove the sleeve from the output axle shaft. See **Special Tools**.
6. Clean and inspect the seal bore.
7. Use fine sand paper in order to remove any burrs or nicks. Clean the entire area after any sanding.

Installation Procedure

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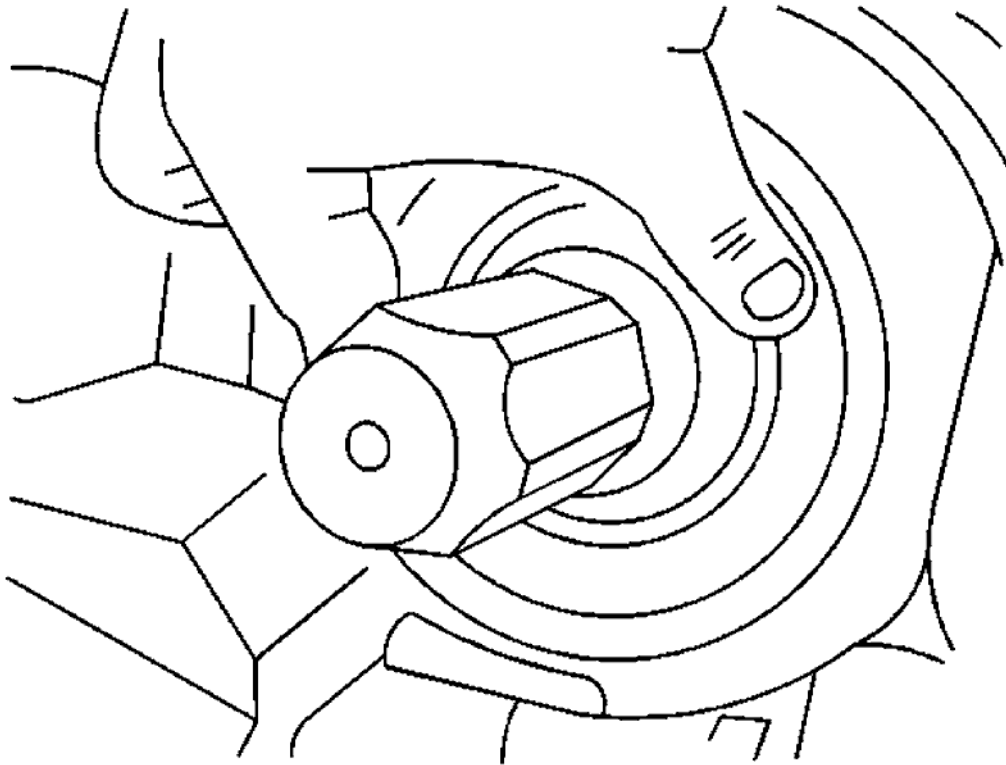


Fig. 150: Identifying J 41102

Courtesy of GENERAL MOTORS CORP.

1. Use the **J 41102** and a mallet in order to install the new case cover seal. See **Special Tools**.

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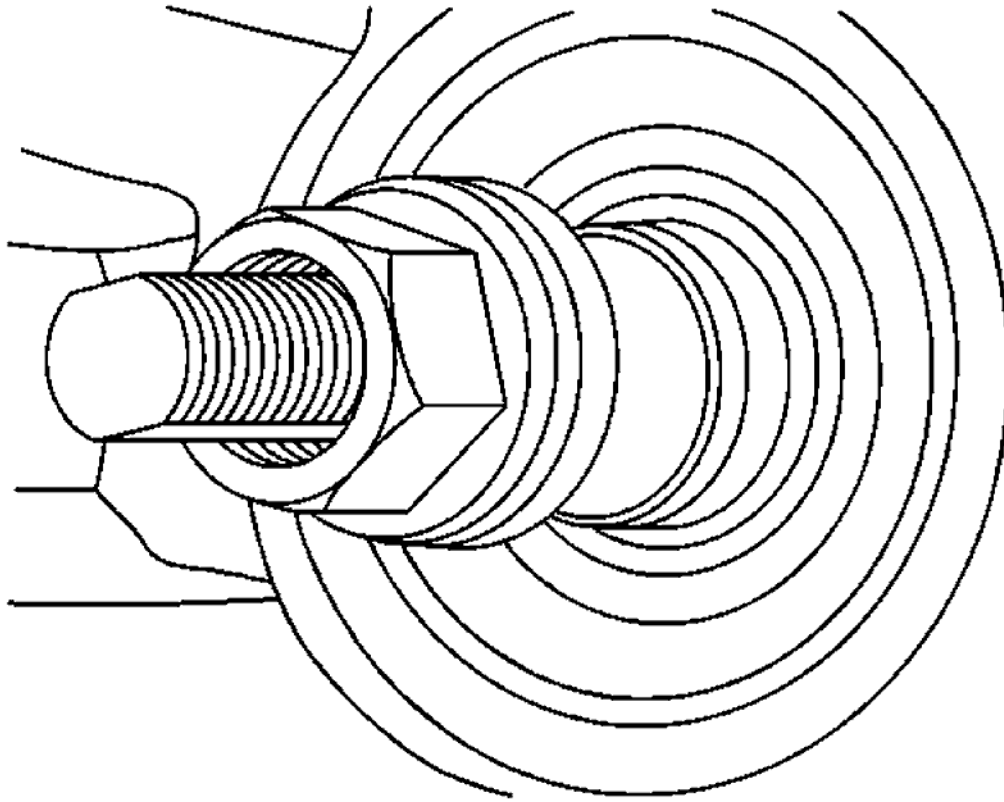


Fig. 151: View Of J 41228

Courtesy of GENERAL MOTORS CORP.

2. Use the **J 41228** in order to install a new sleeve on the output axle. See **Special Tools**. Install the **J 41228** so that the collar is in the snap ring groove. See **Special Tools**.

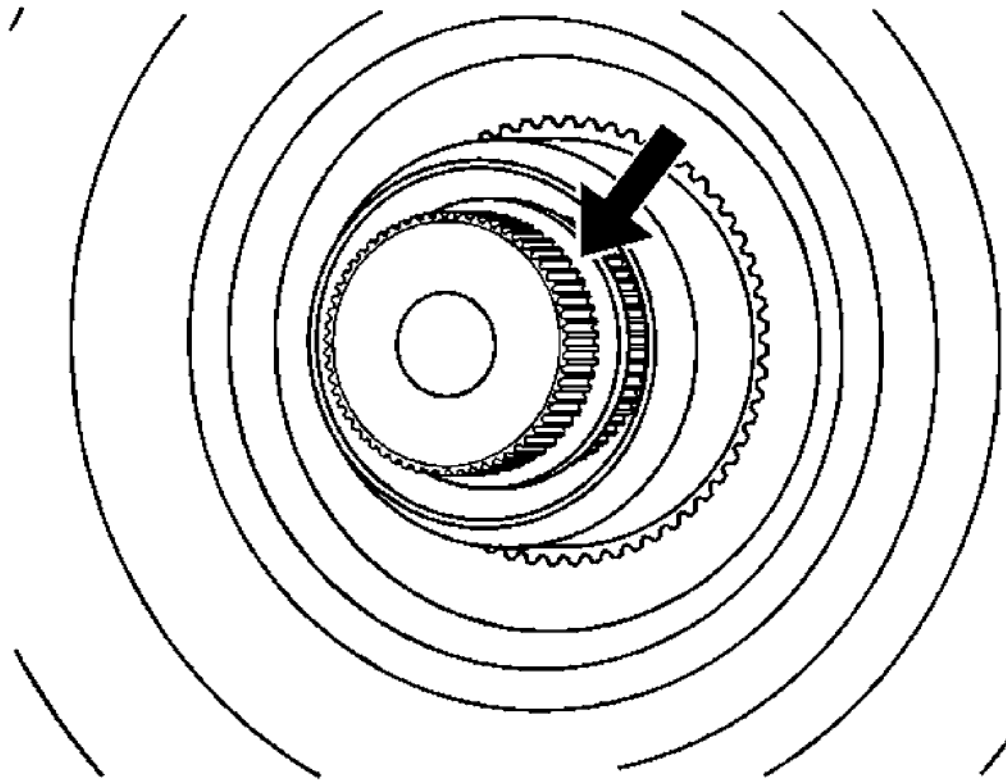


Fig. 152: Locating Drive Axle Retaining Clip
Courtesy of GENERAL MOTORS CORP.

3. Install the axle shaft retaining clip onto the output axle.
4. Install the drive axle assembly. Refer to **Wheel Drive Shaft Replacement** in Wheel Drive Shafts.
5. Lower the vehicle.
6. Inspect the shaft sleeve for leaks.
7. Inspect the transmission oil level. Refer to **Transmission Fluid Checking Procedure**.

WIRING HARNESS REPLACEMENT

Tools Required

J 41101 Pass-Through Connector Remover. See **Special Tools**.

Removal Procedure

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**.

2. Remove the control valve body. Refer to **Control Valve Body Replacement**.

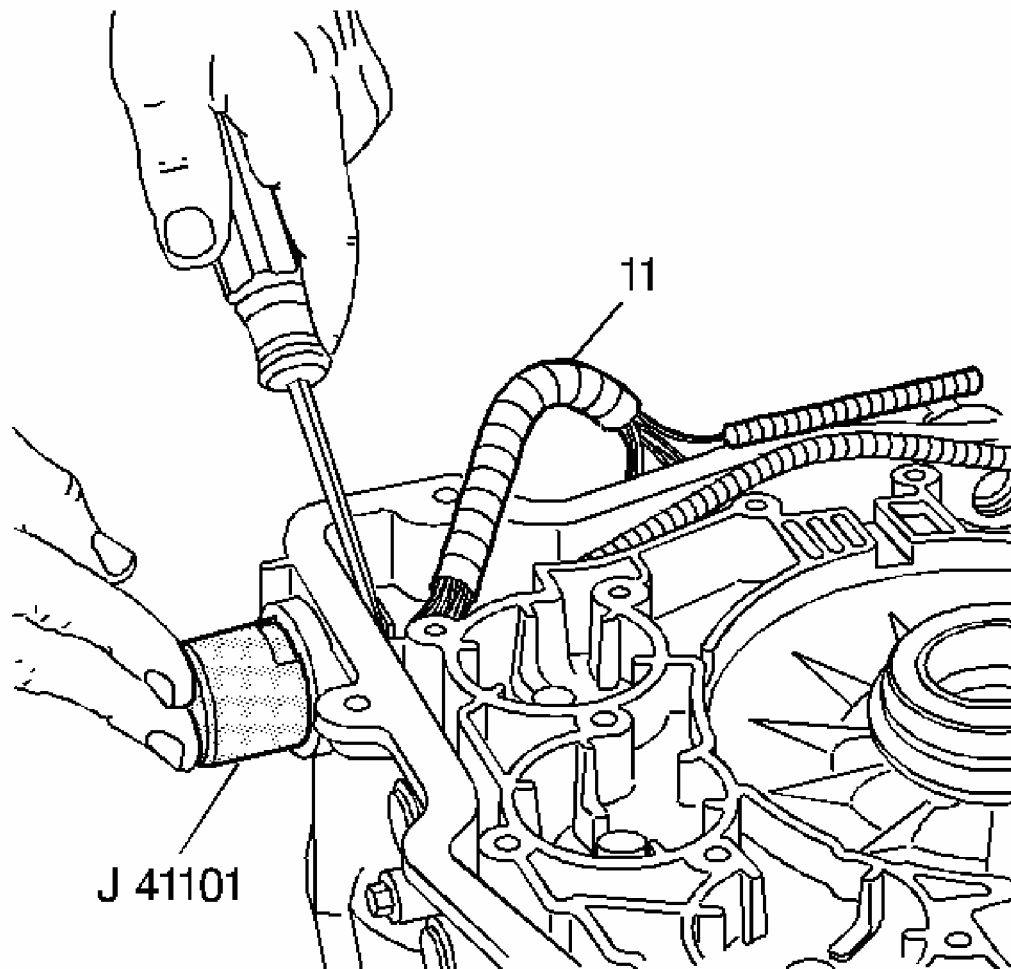


Fig. 153: View Of Transmission Wiring Harness
Courtesy of GENERAL MOTORS CORP.

3. Push the **J 41101** onto the pass-through connector from the outside of the transmission case in order to compress the pass-through connector's retaining tabs. See **Special Tools**.
4. With the retaining tabs compressed, use a screwdriver in order to remove the pass-through connector through the inside of the transmission case.
5. Remove the wiring harness (11).

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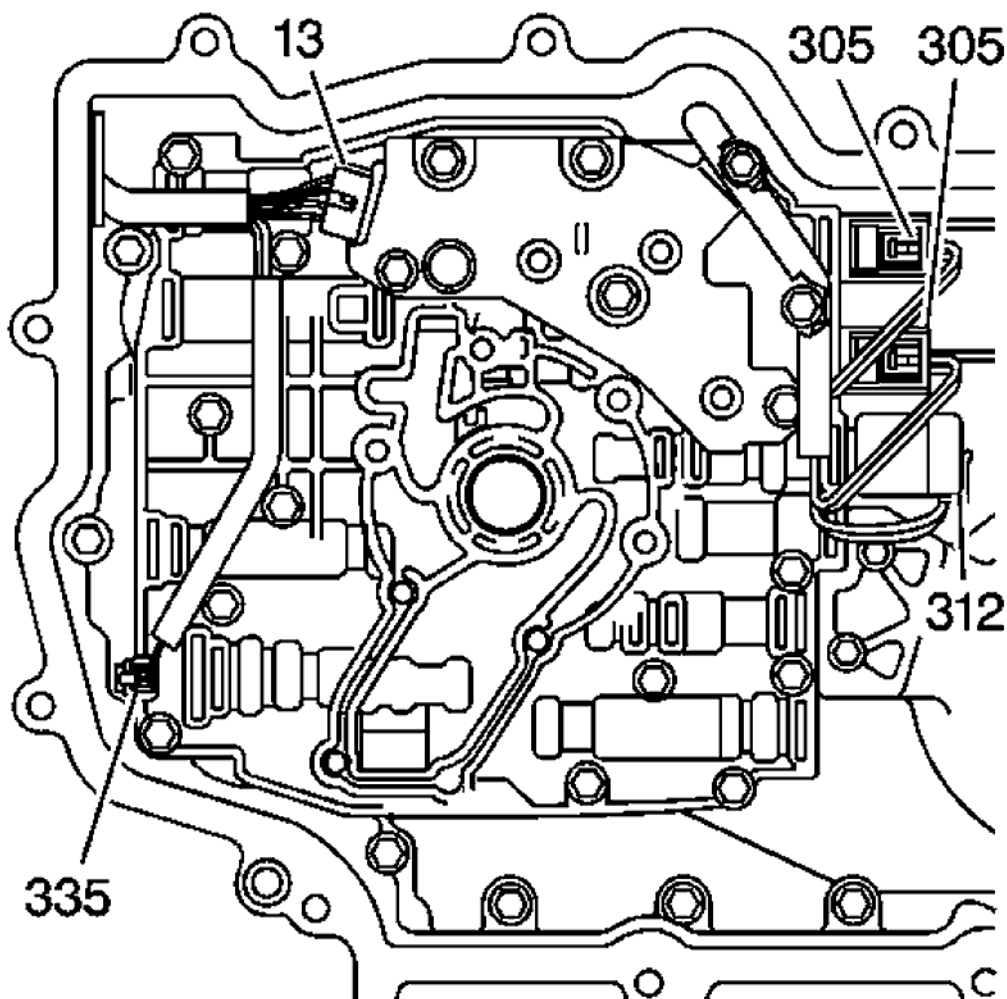


Fig. 154: Identifying Wiring Harness Assembly
Courtesy of GENERAL MOTORS CORP.

Connect the wiring harness assembly to the following components:

- The TFP switch assembly (13)
- The pressure control solenoid (312) (red connector)

IMPORTANT: The 1-2 shift solenoids wires are red and light green. The 2-3 shift solenoid wires are red and yellow.

- The 1-2 shift solenoid (305) (white connector)
- The 2-3 shift solenoids (305) (white connectors)

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- The TCC solenoid (335)
- Install the control valve body. Refer to **Control Valve Body Replacement**.
- Install the transmission side cover. Refer to **Case Side Cover Replacement**.

TORQUE CONVERTER CLUTCH PULSE WIDTH MODULATION (TCC PWM) SOLENOID REPLACEMENT

Replacement Procedure

IMPORTANT: Retainer clips hold in each of the valve line-ups. Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips and valves. Before removing the valve line-ups, inspect each valve line-up for freedom of movement.

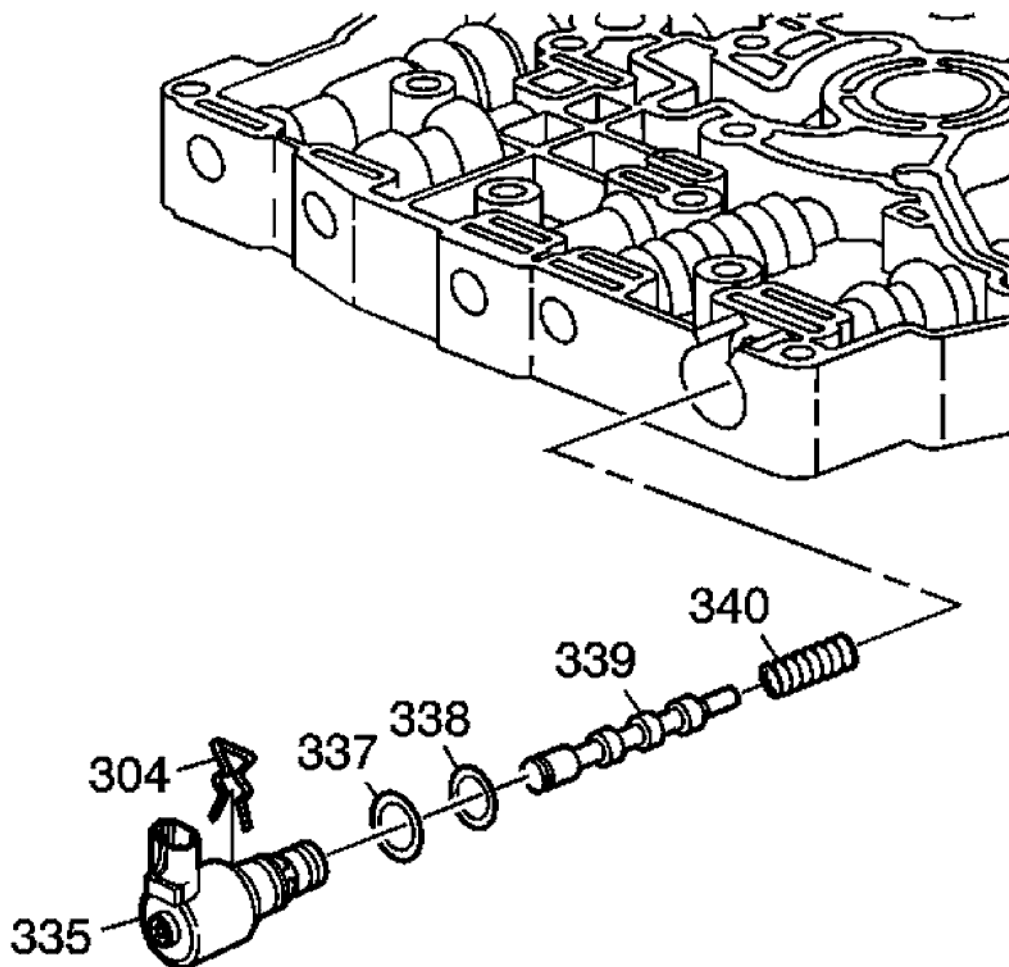


Fig. 155: Exploded View Of TCC Solenoid
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**
2. Remove the TCC solenoid retainer clip (304), the TCC solenoid (335), with two O-rings (337, 338), and screen, the TCC regulated apply valve (339) and the spring (340).

Installation Procedure

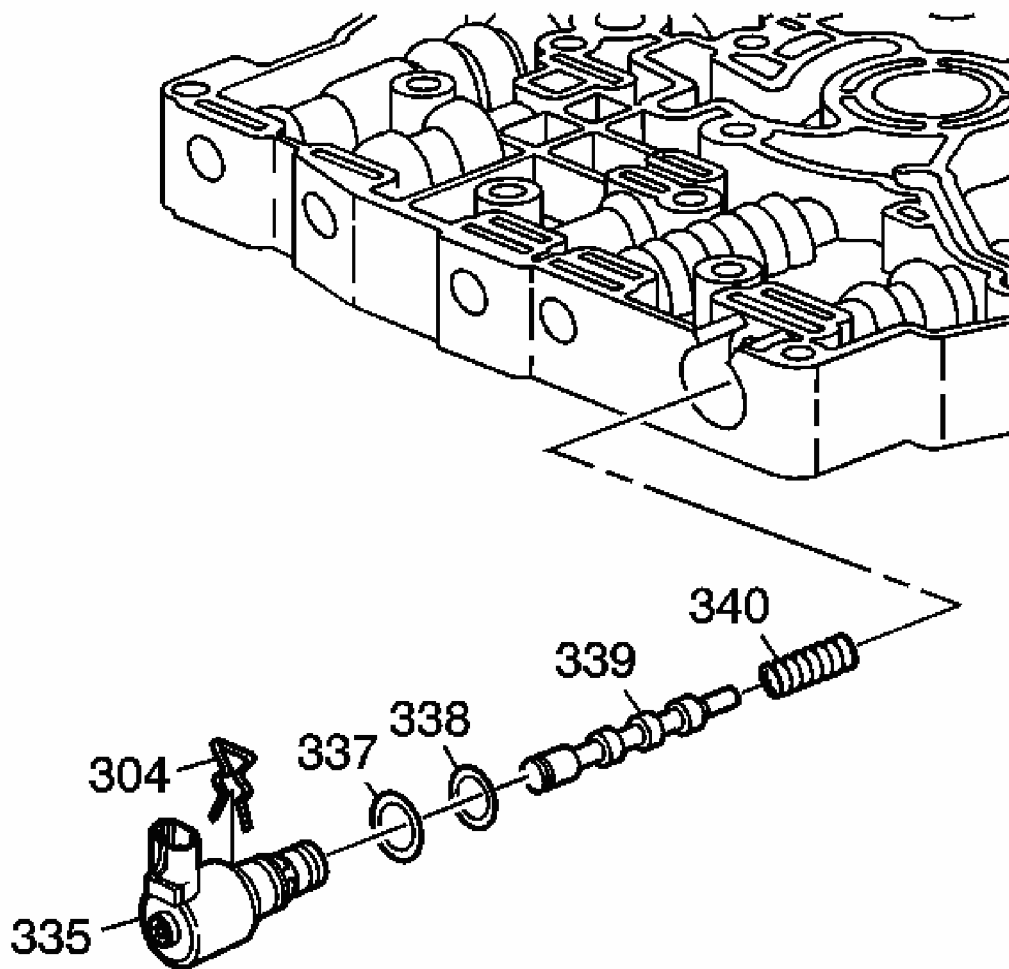


Fig. 156: Exploded View Of TCC Solenoid
Courtesy of GENERAL MOTORS CORP.

1. Install the spring (340), the TCC regulated apply valve (339), the TCC solenoid (335) with two O-rings (337 and 338) and screen, and the TCC solenoid retainer clip (304).
2. Install the transmission side cover. Refer to **Case Side Cover Replacement**

1-2 SHIFT SOLENOID VALVE REPLACEMENT

Removal Procedure

IMPORTANT: Retainer clips hold in each of the valve line-ups. Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips and valves. Before removing the valve line-ups, inspect each valve line-up for freedom of movement.

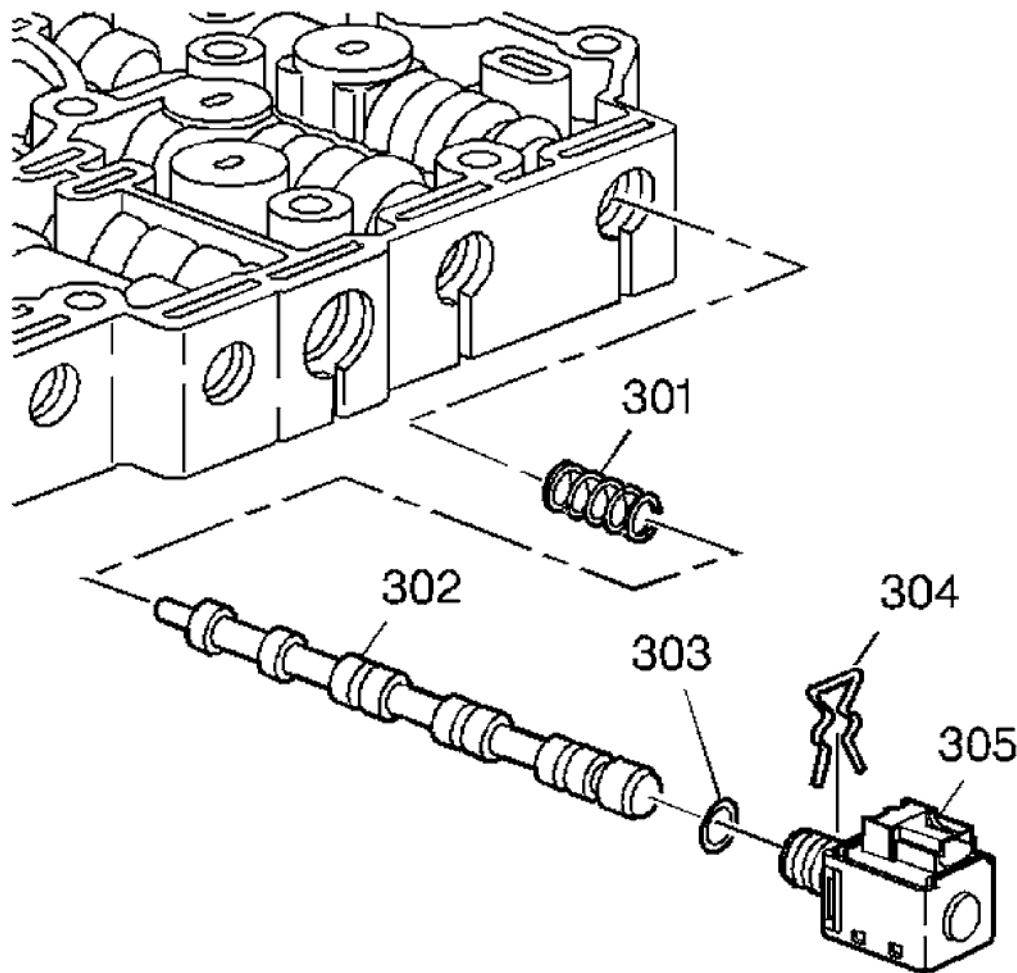


Fig. 157: View Of 1-2 Shift Solenoid
 Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**.
2. Remove the 1-2 shift solenoid retainer clip (304), the 1-2 shift solenoid (305) with O-

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ring (303), the 1-2 shift valve (302), and the 1-2 shift valve spring (301).

Installation Procedure

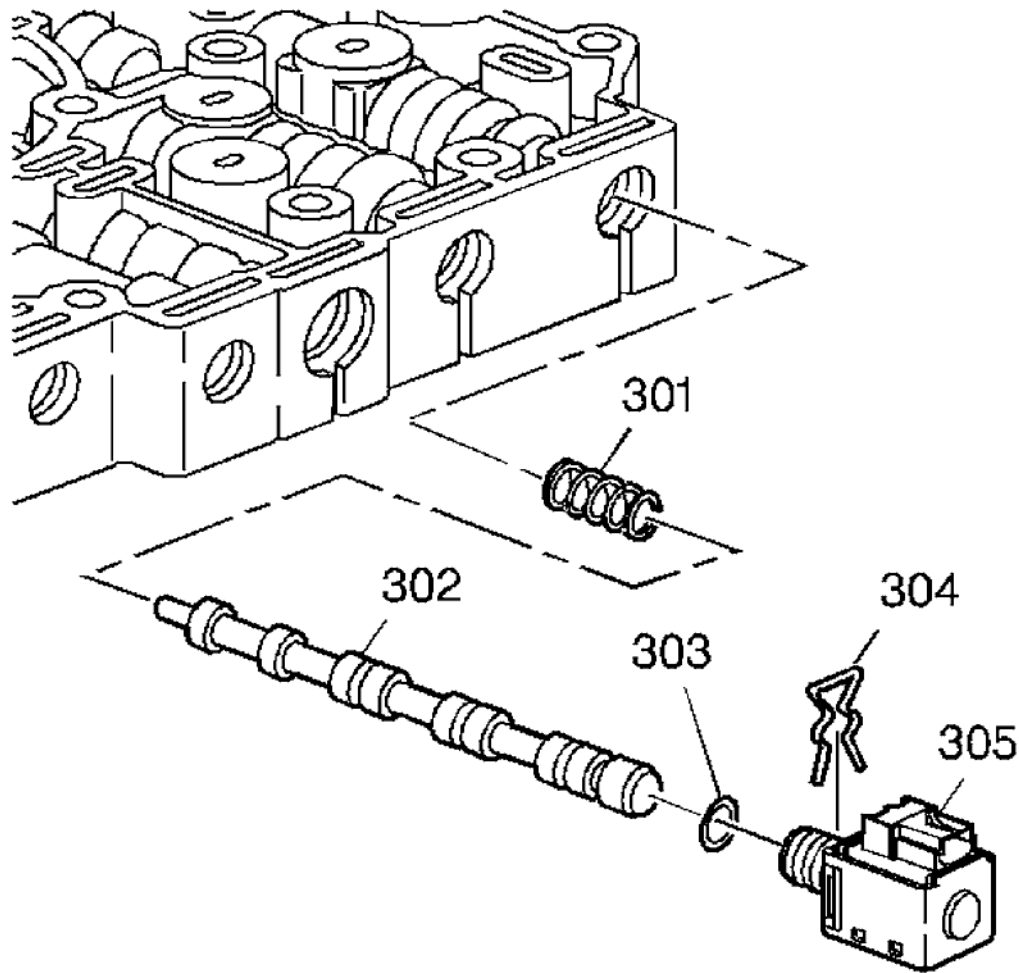


Fig. 158: View Of 1-2 Shift Solenoid
Courtesy of GENERAL MOTORS CORP.

1. Install the 1-2 shift valve spring (301), the 1-2 shift valve (302), the 1-2 shift solenoid (305) with O-ring (303) and the 1-2 shift solenoid retainer clip (304).
2. Install the transmission side cover. Refer to **Case Side Cover Replacement**.

2-3 SHIFT SOLENOID VALVE REPLACEMENT

Removal Procedure

IMPORTANT: Retainer clips hold in each of the valve line-ups. Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips and valves. Before removing the valve line-ups, inspect each valve line-up for freedom of movement.

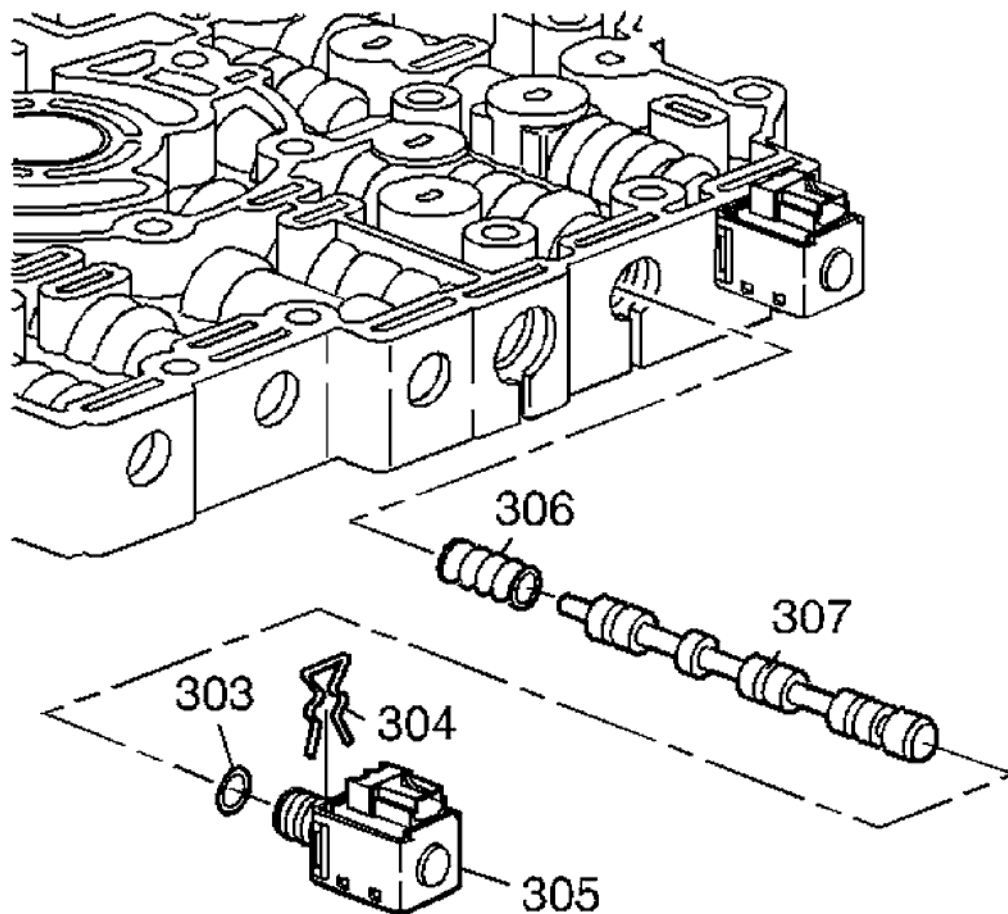


Fig. 159: Identifying 2-3 Shift Solenoid Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**.
2. Remove the 2-3 shift solenoid retainer clip (304), the 2-3 shift solenoid (305) with O-ring (303), the 2-3 shift valve (307), and the 2-3 shift valve spring (306).

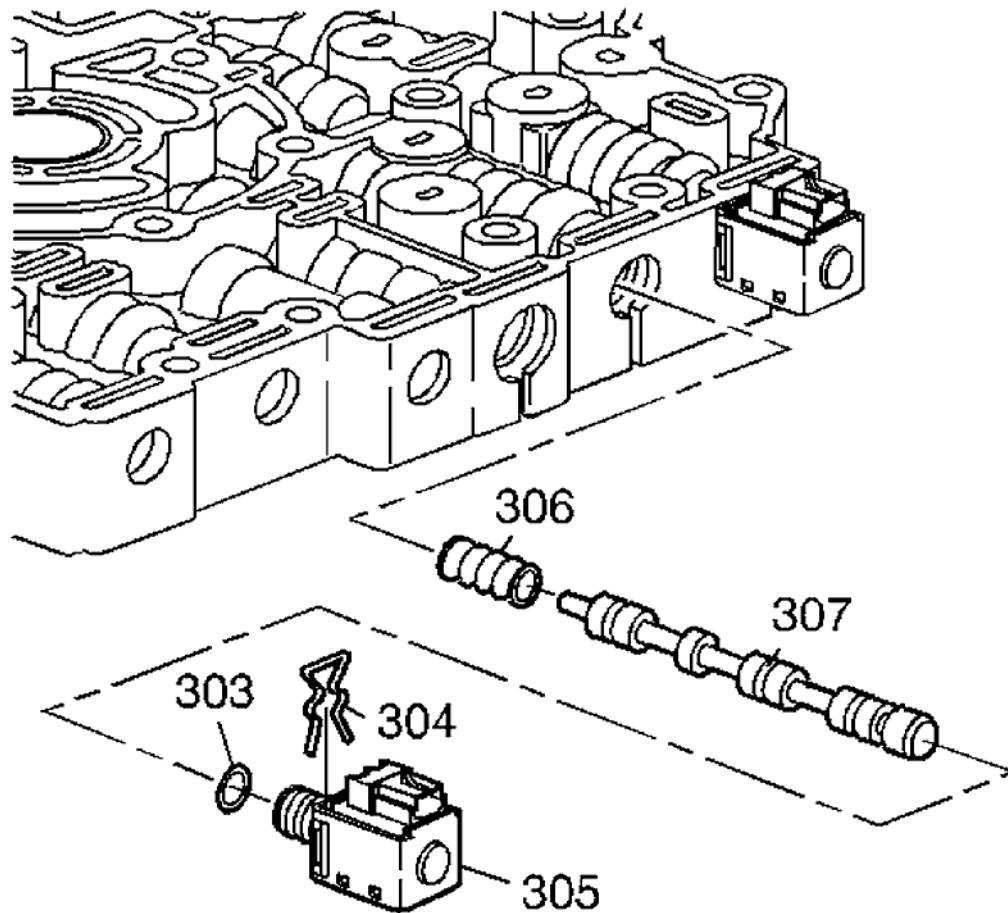


Fig. 160: Identifying 2-3 Shift Solenoid Components
Courtesy of GENERAL MOTORS CORP.

1. Install the 2-3 shift valve spring (306), the 2-3 shift valve (307), the 2-3 shift solenoid (305) with O-ring (303) and the 2-3 shift solenoid retainer clip (304).
2. Install the transmission side cover. Refer to **Case Side Cover Replacement**.

PRESSURE CONTROL SOLENOID (PCS) REPLACEMENT

Removal Procedure

IMPORTANT: Retainer clips hold in each of the valve line-ups. Use a small screwdriver in order to remove the retainer clips. Be careful not to score the valve body when removing the retainer clips and valves. Before removing the valve line-ups, inspect each valve line-up for freedom of movement.

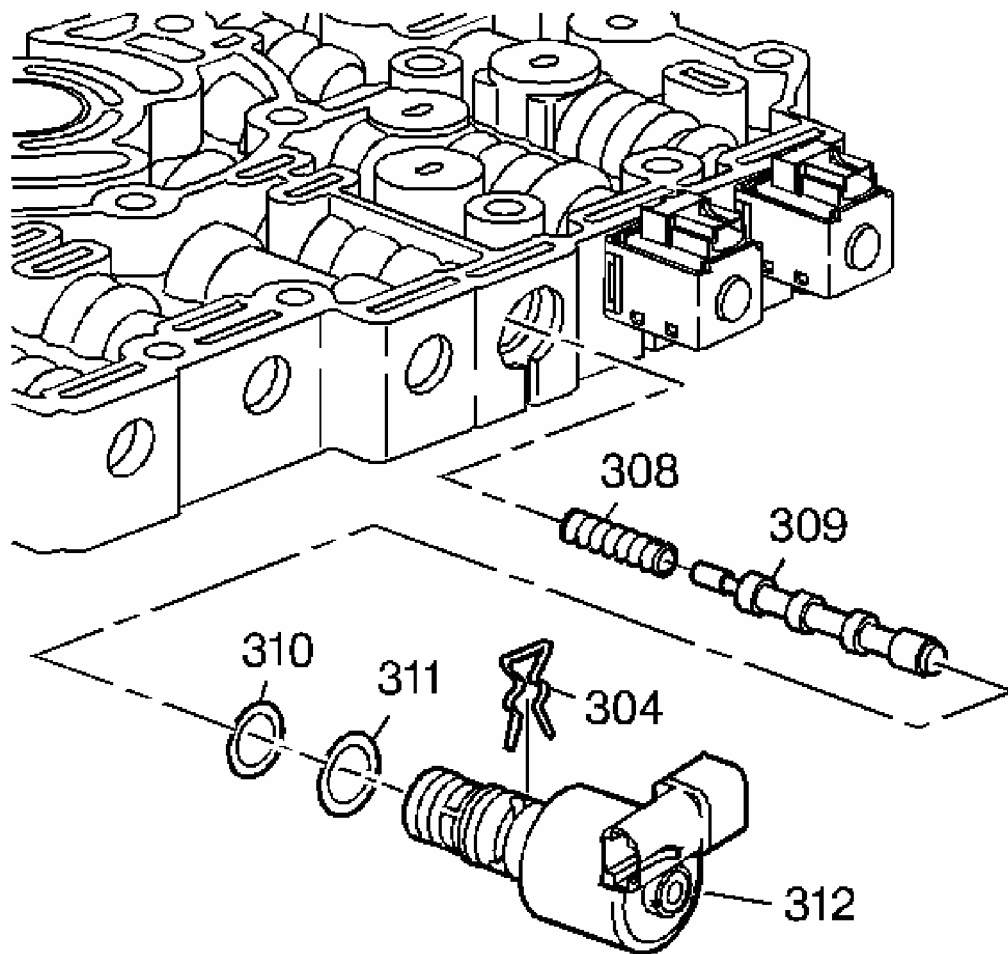


Fig. 161: Exploded View Of Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**
2. Remove the Pressure Control Solenoid (PCS) retainer clip (304), the PCS with two O-rings and screen (312, 309, 310), the torque signal regulator valve (309), and the torque signal regulator spring (308).

Installation Procedure

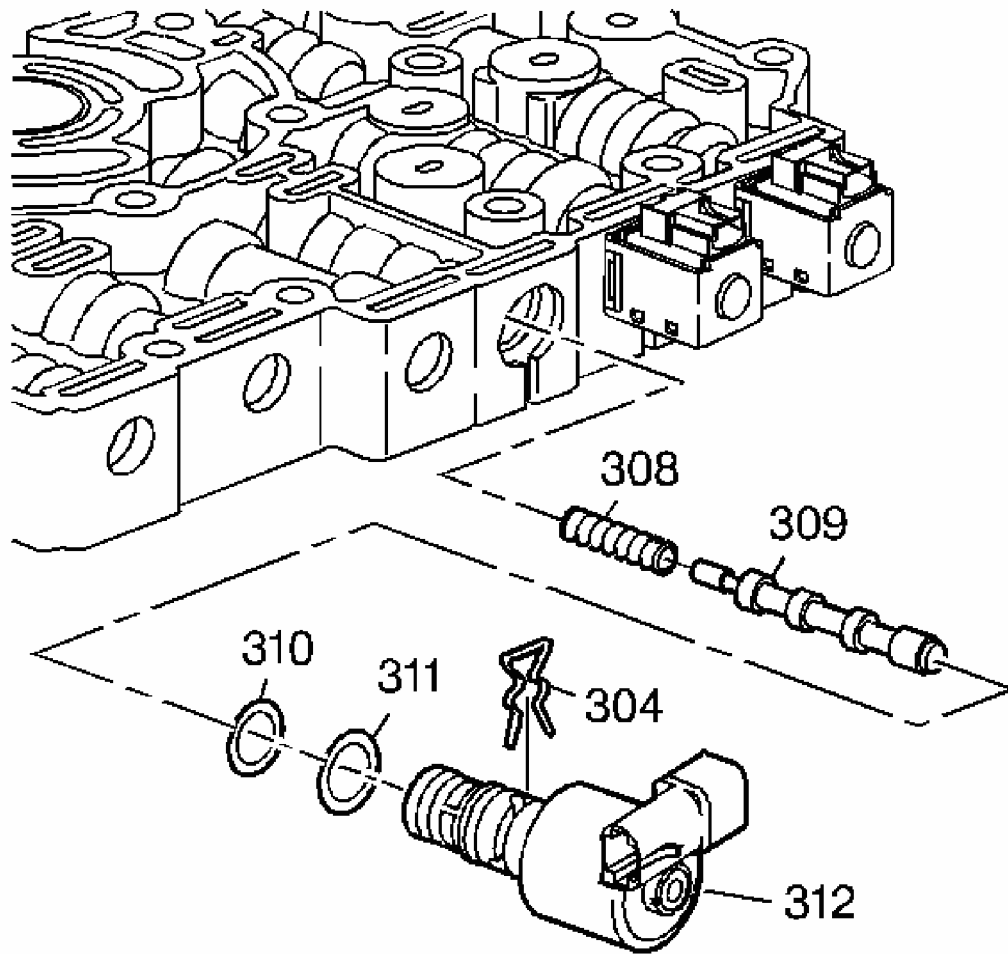


Fig. 162: Exploded View Of Pressure Control Solenoid
Courtesy of GENERAL MOTORS CORP.

1. Install the torque signal regulator spring (308), the torque signal regulator valve (309), the Pressure Control Solenoid (PCS) with two O-rings and screen (312, 309, 310) and the PCS retainer clip (304).
2. Install the transmission side cover. Refer to **Case Side Cover Replacement**.

TRANSMISSION FLUID PRESSURE (TFP) MANUAL VALVE POSITION SWITCH REPLACEMENT

Removal Procedure

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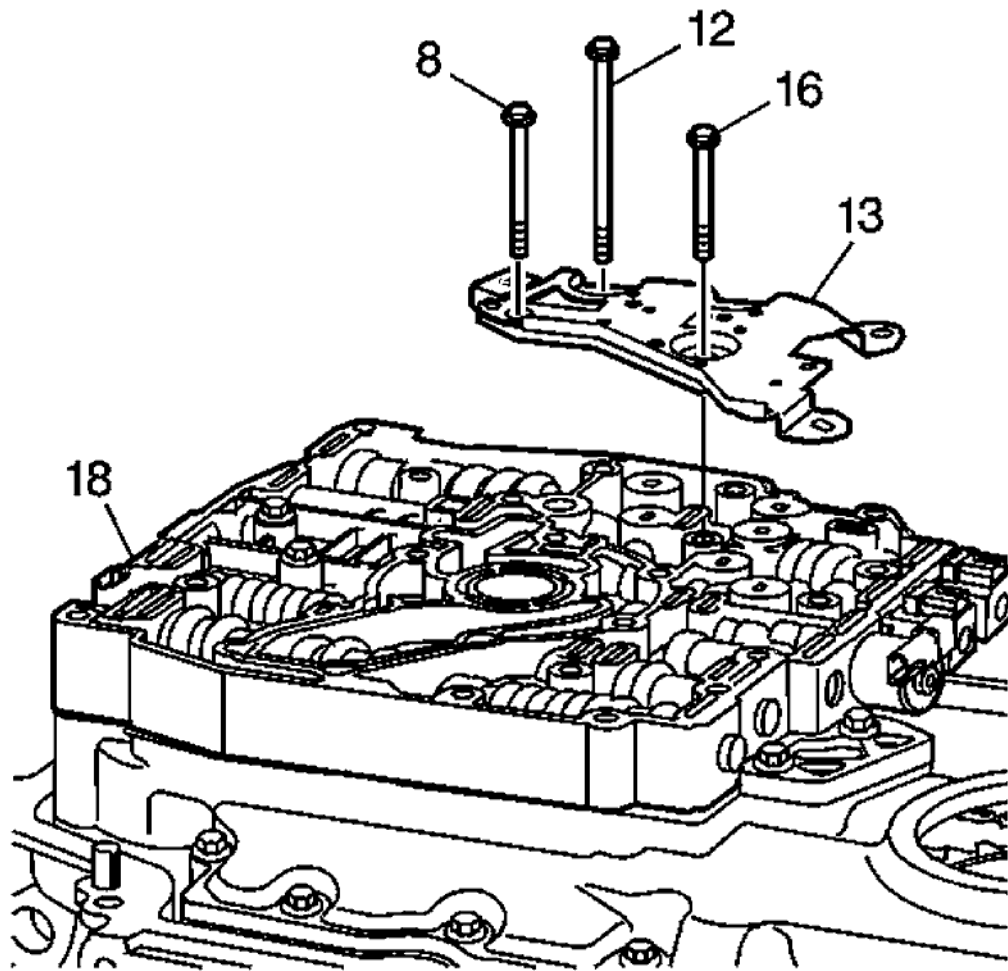


Fig. 163: Locating TFP Switch Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**.
2. Remove the six bolts from the TFP switch assembly.
3. Remove the TFP switch assembly from the control valve body assembly. The 4 pressure switch O-rings are reusable and should remain with the TFP switch assembly.

Installation Procedure

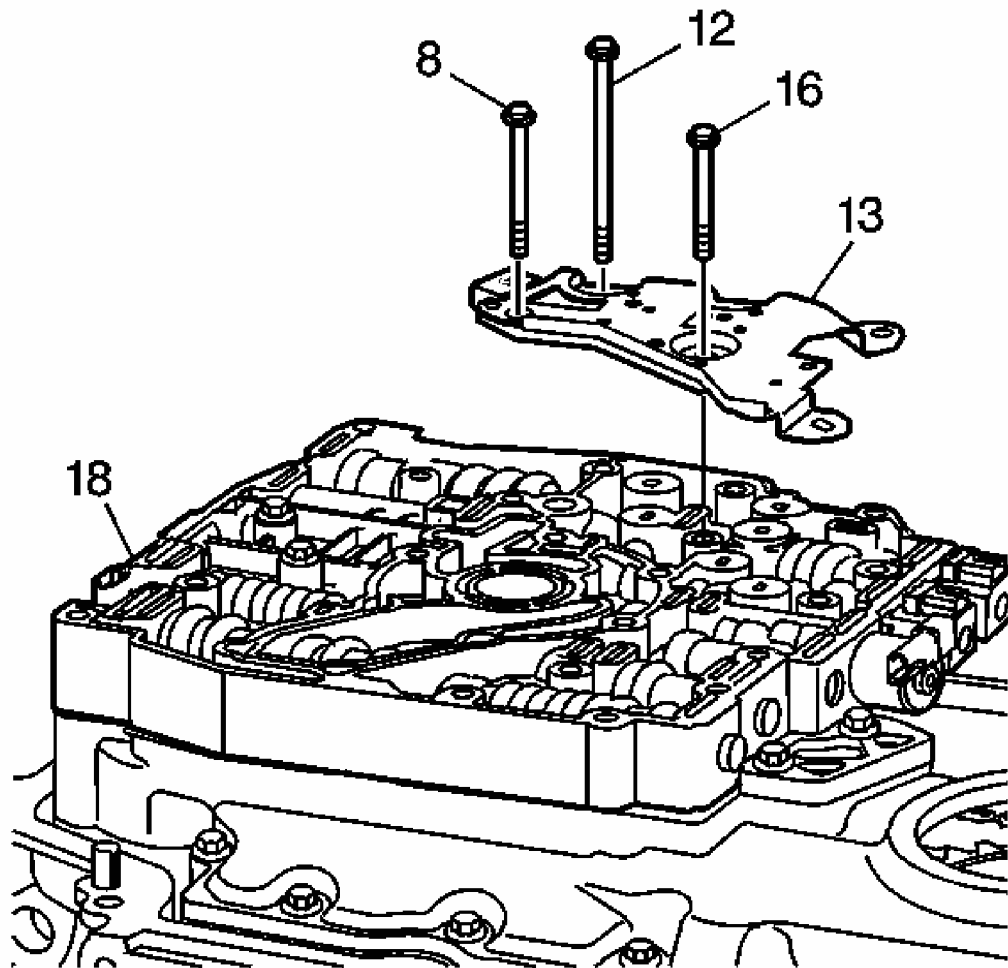


Fig. 164: Locating TFP Switch Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the TFP switch assembly to the control valve body assembly. The 4 pressure switch O-rings are reusable and should remain with the TFP switch assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the six bolts to the TFP switch assembly.

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

3. Install the transmission side cover. Refer to Case Side Cover Replacement.

CONTROL VALVE BODY REPLACEMENT

Removal Procedure

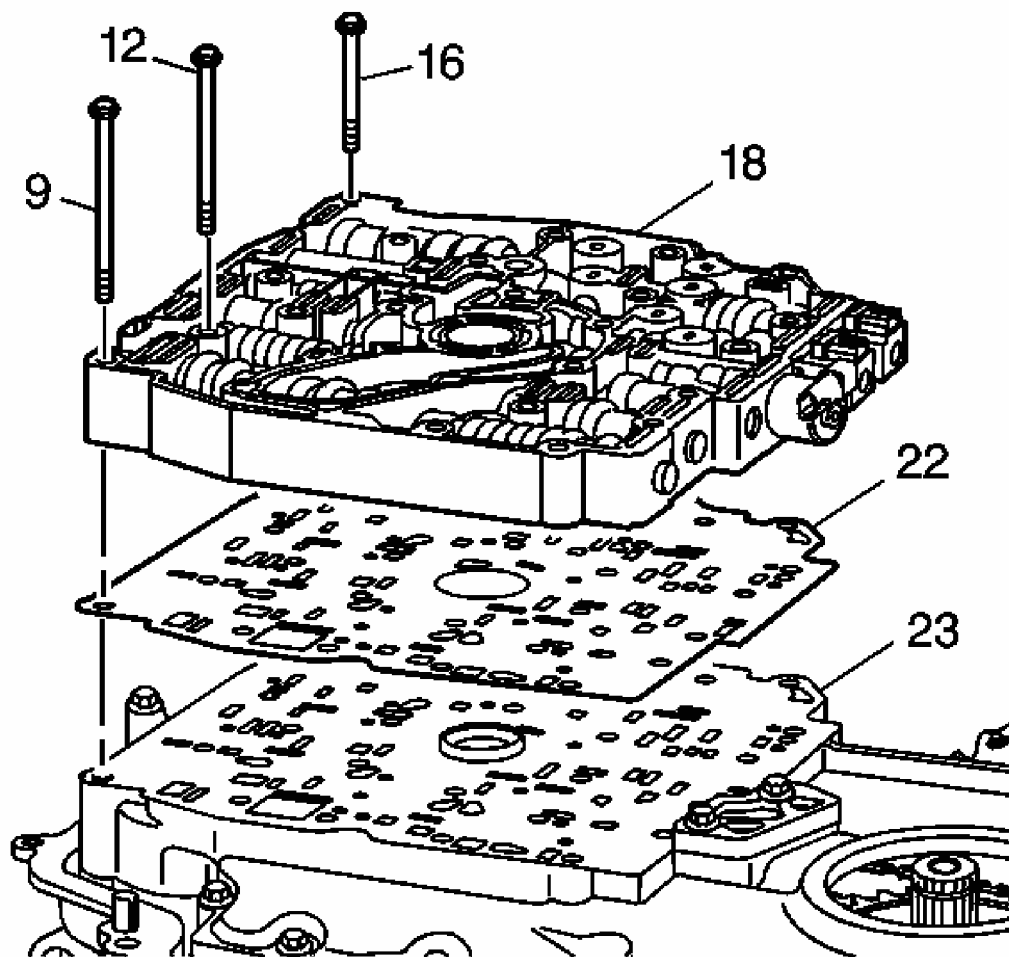


Fig. 165: View Of Control Valve Body & Spacer Plate Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the transmission side cover. Refer to **Case Side Cover Replacement**.
2. Remove the bolts (9, 12 and 16) from the control valve body assembly (18).
3. Remove the control valve body assembly (18).
4. Remove and discard the valve body to spacer plate gasket (22).

Installation Procedure

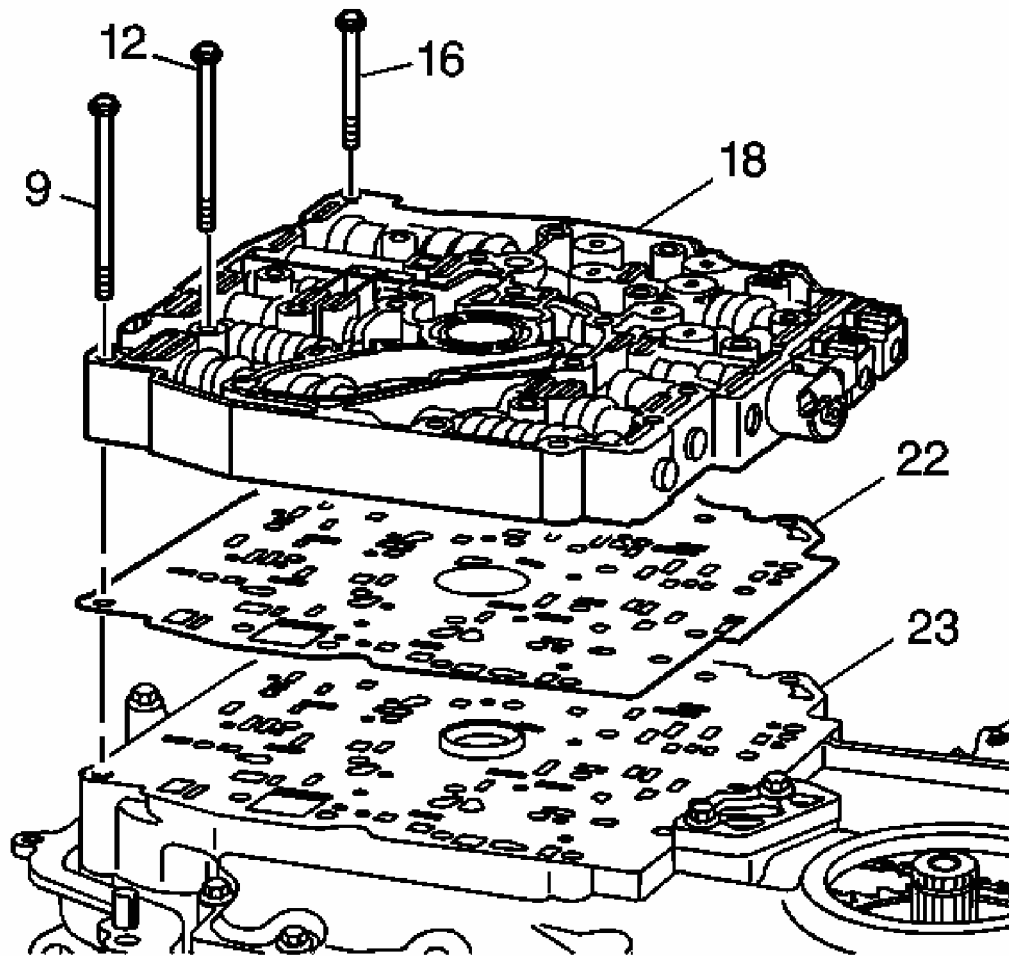


Fig. 166: View Of Control Valve Body & Spacer Plate Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the control valve body to spacer plate gasket (22) onto the spacer plate (23).
2. Install the control valve body assembly (18) onto the gasket (22).

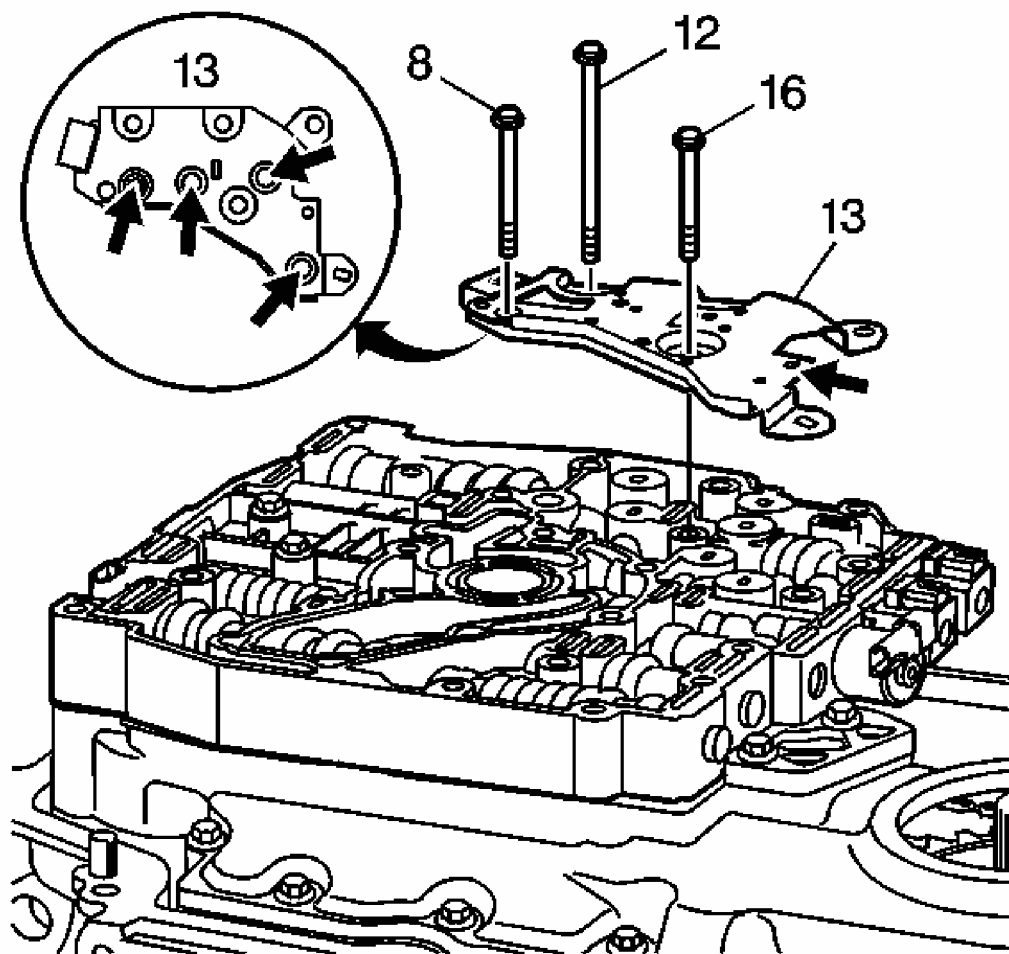


Fig. 167: Identifying 4 Pressure Switch O-Rings
Courtesy of GENERAL MOTORS CORP.

3. Inspect the TFP switch assembly (13) in order to verify the condition and correct location of the 4 pressure switch O-rings.
4. If necessary replace the pressure switch O-rings.

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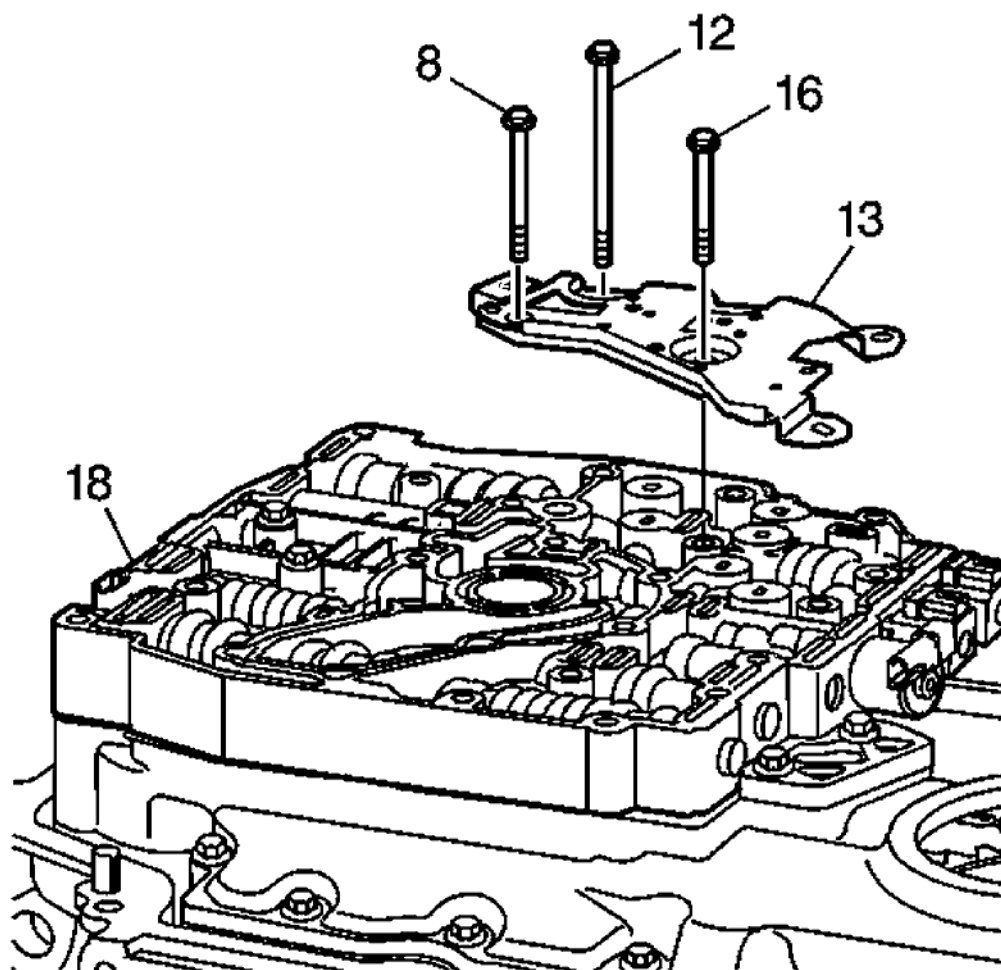


Fig. 168: Locating TFP Switch Assembly
Courtesy of GENERAL MOTORS CORP.

5. Install the TFP switch assembly (13) onto the control valve body assembly.

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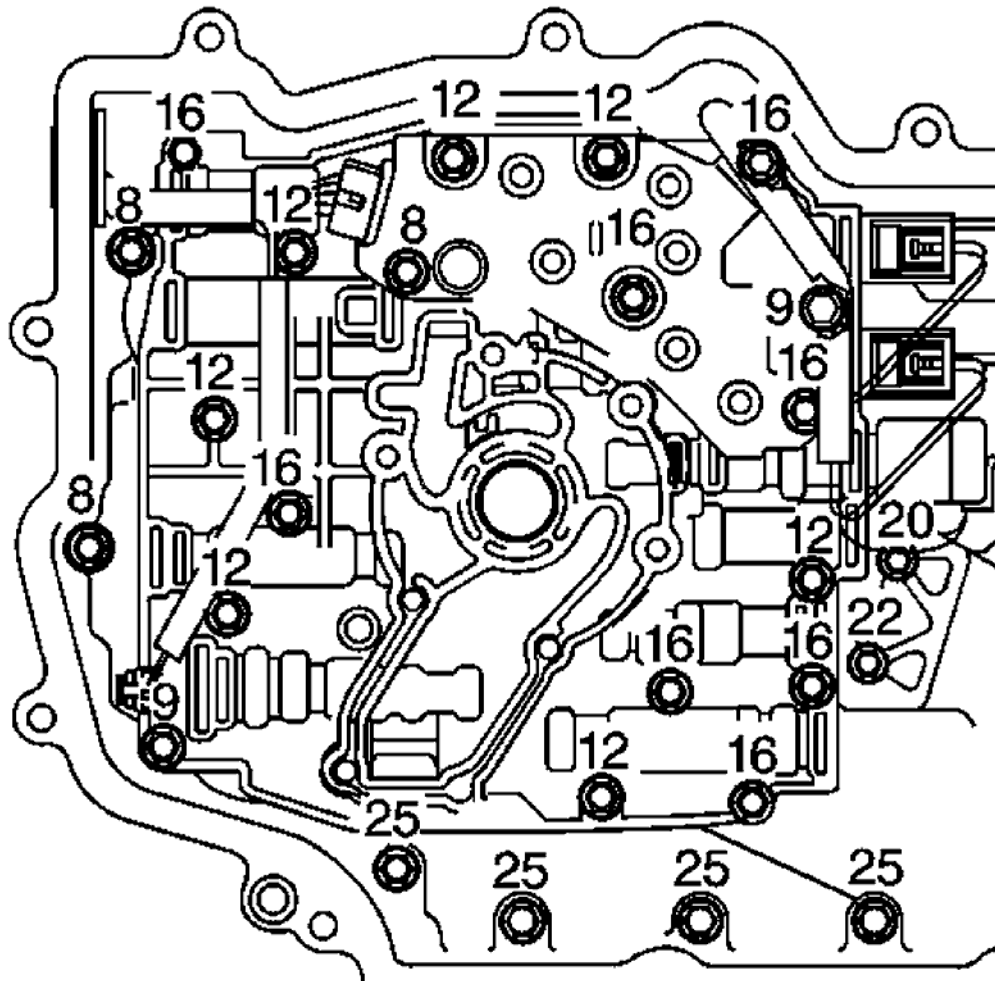


Fig. 169: Installing Control Valve Body Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the eighteen control valve body assembly bolts.

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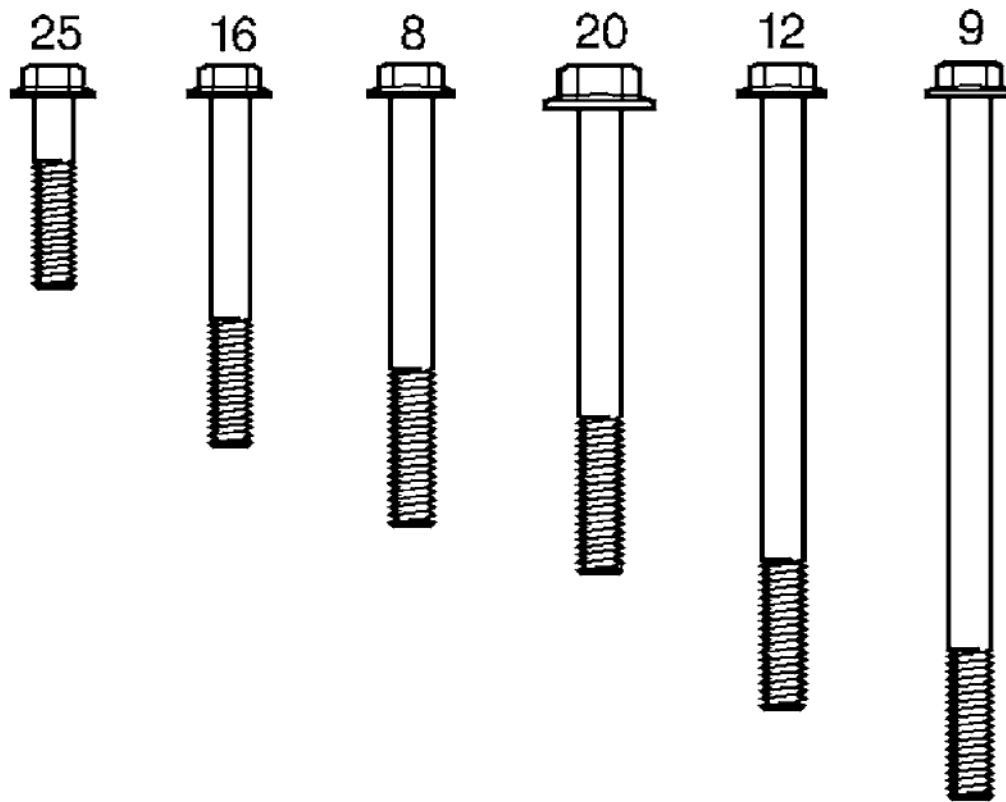


Fig. 170: View Of Control Valve Body Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

7. Hand start the bolts.

Tighten: Tighten the bolts to 14 N.m (124 lb in).

8. Install the transmission side cover. Refer to Case Side Cover Replacement.

STUB AXLE SHAFT SLEEVE AND SEAL REPLACEMENT

Tools Required

- J 38868 Shaft Removal Tool
- J 6125-1B Slide Hammer
- J 23129 Universal Seal Remover. See **Special Tools**.

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- **J 41102** Axle Seal Installer. See Special Tools.

Removal Procedure

IMPORTANT: Do not damage the seal bore or the sleeve assembly. Fluid leaks may result.

1. Raise and support the vehicle. Refer to Battery Negative Cable Disconnect/Connect Procedure in Engine Electrical.
2. Remove the drive axle assembly. Refer to Wheel Drive Shaft Replacement in Wheel Drive Shafts.

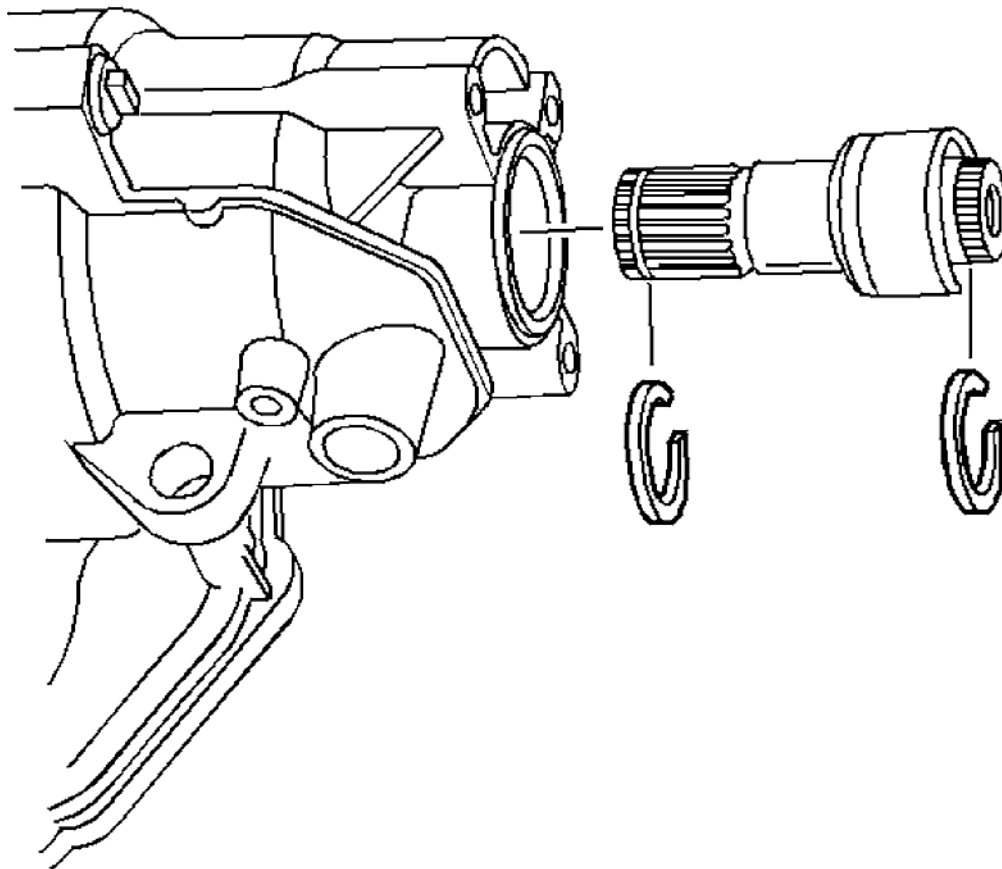


Fig. 171: Identifying Stub Axle Shaft Snap Ring
Courtesy of GENERAL MOTORS CORP.

3. Remove the snap ring from the stub axle shaft. Discard the snap ring. Do not reuse.

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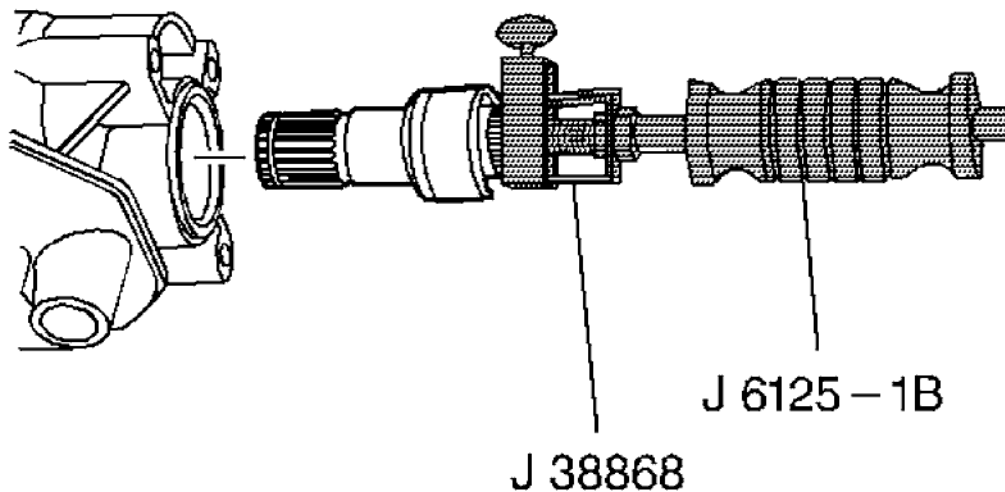


Fig. 172: View Of J 6125-1B & J 38868
Courtesy of GENERAL MOTORS CORP.

4. Remove the stub shaft from the transmission. Use the **J 6125-1B** and the **J 38868** .
5. Pull lightly on the shaft. Rotate the shaft until the stub shaft snap ring at the differential seats in the taper on the differential side gear.
6. Remove inner snap ring.
7. Remove the right hand axle seal from the transmission. Use the **J 23129** and the **J 6125-1B** . See Special Tools.

Installation Procedure

IMPORTANT: The stub axle shaft sleeve and seal must be replaced together. DO NOT replace the sleeve or seal separately.

1. Install the new seal. Use the **J 41102** . See Special Tools. Lubricate the seal lip with a light wipe of transmission oil.

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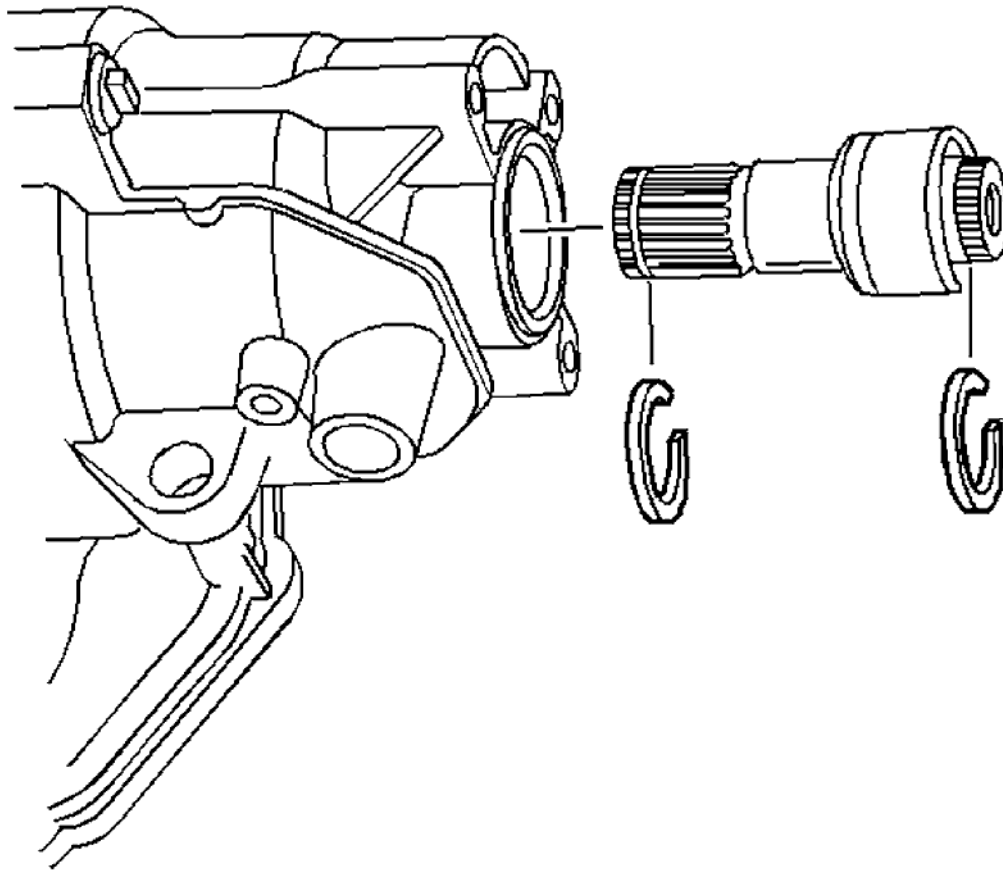


Fig. 173: Identifying Stub Axle Shaft Snap Ring
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Carefully guide the axle shaft past the lip seal. Do not allow the shaft splines to contact any portion of the seal lip surface, otherwise damage to the seal will occur.

2. Install the two new snap rings on the stub shaft.

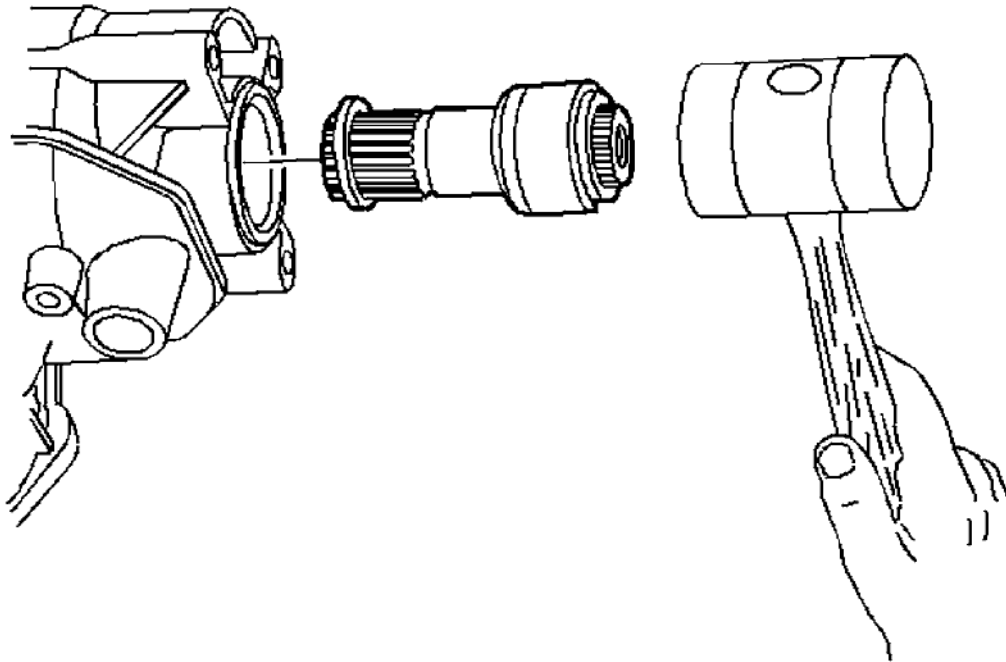


Fig. 174: View Of Stub Shaft
Courtesy of GENERAL MOTORS CORP.

3. Install the stub shaft into the transmission. Use a mallet.
4. Install the drive axle assembly. Refer to **Wheel Drive Shaft Replacement** in Wheel Drive Shafts.
5. Lower the vehicle.
6. Inspect the oil level. Refer to **Transmission Fluid Checking Procedure**.
7. Inspect the shaft and the seal for leaks.

OUTPUT AXLE SHAFT SLEEVE AND SEAL REPLACEMENT

Tools Required

- **J 41227** Output Shaft Sleeve Remover
- **J 41228** Output Shaft Sleeve Installer

Removal Procedure

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

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2. Remove the drive axle assembly. Refer to **Wheel Drive Shaft Replacement** in Wheel Drive Shafts.

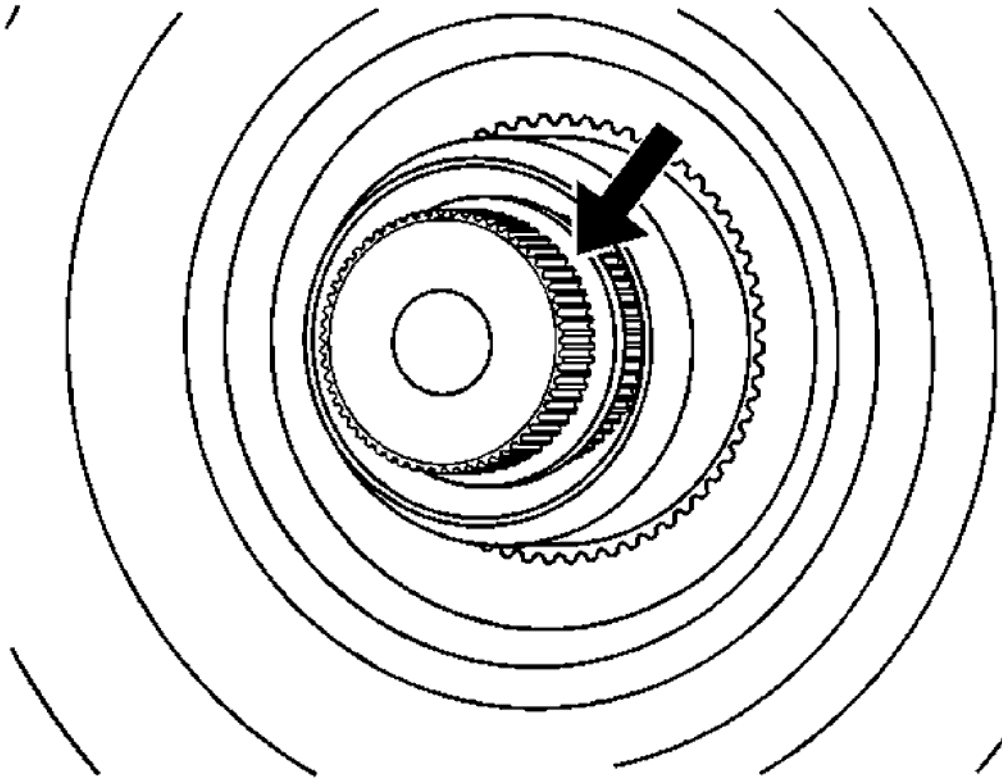


Fig. 175: Locating Drive Axle Retaining Clip
Courtesy of GENERAL MOTORS CORP.

3. Remove the snap ring from axle.

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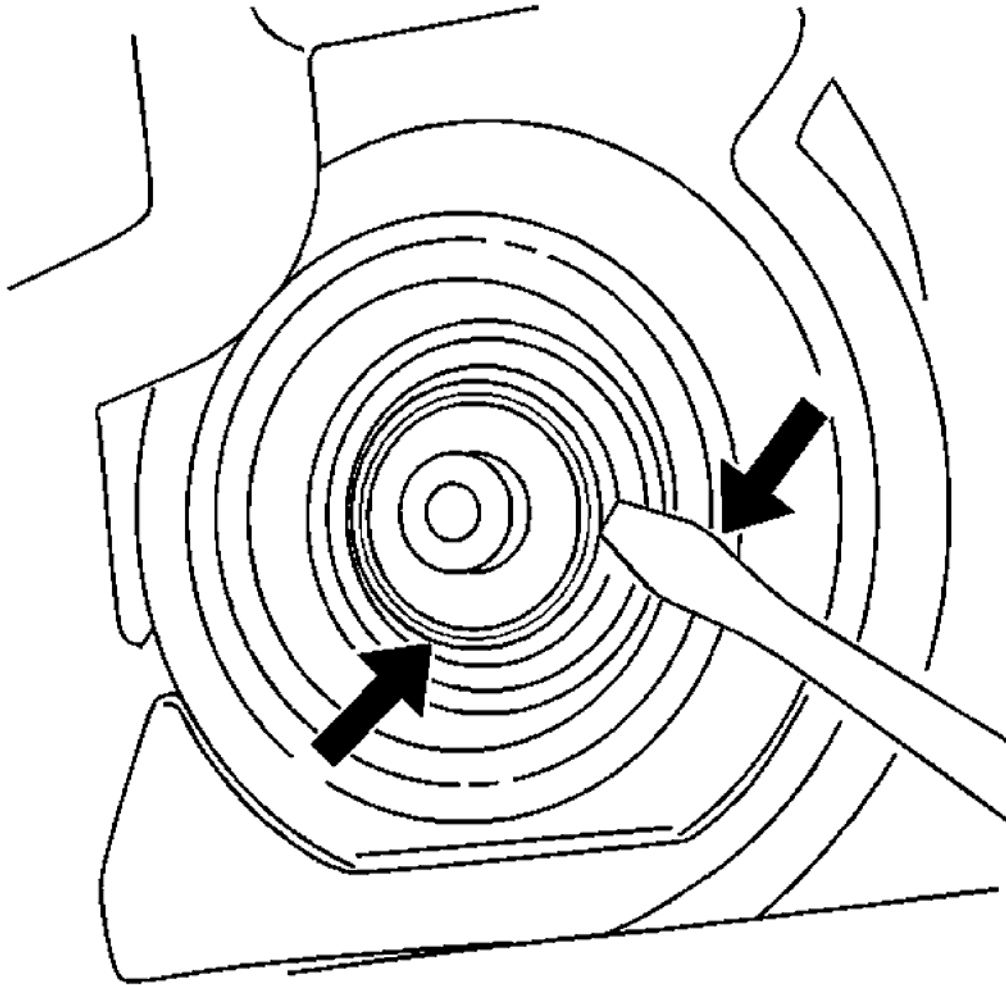


Fig. 176: View Of Case Cover Seal
Courtesy of GENERAL MOTORS CORP.

4. Remove the output axle seal.

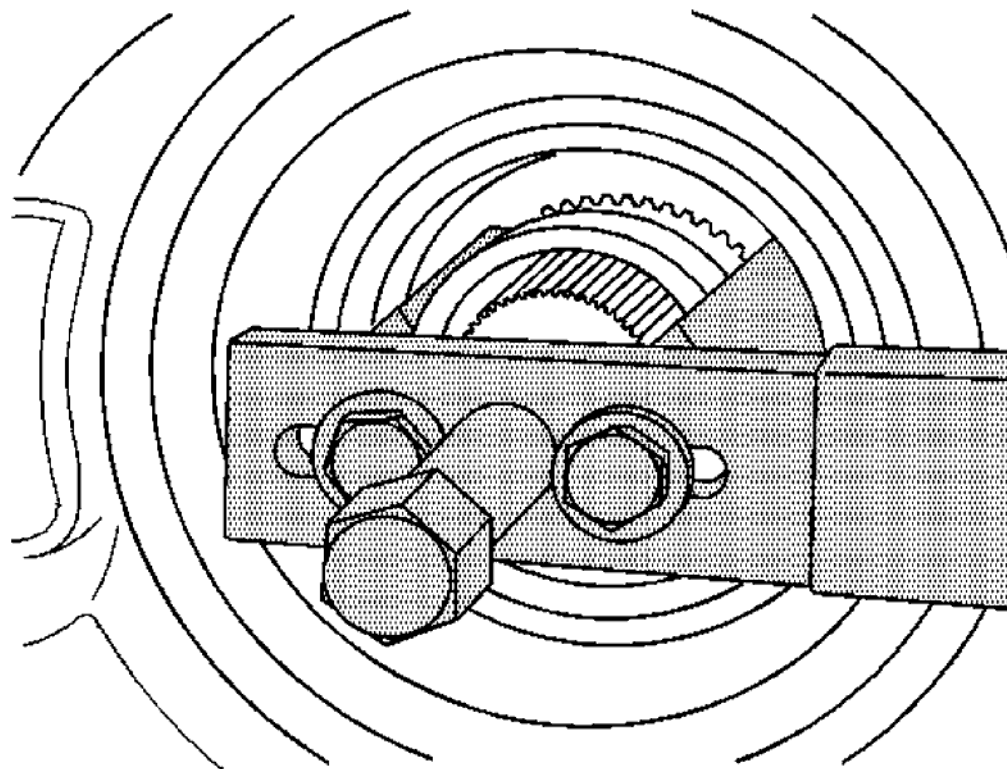


Fig. 177: Using Special Tool To Remove Sleeve From Output Axle Shaft
Courtesy of GENERAL MOTORS CORP.

5. Use the **J 41227** to remove the sleeve from the output axle.

Installation Procedure

IMPORTANT: The output axle shaft sleeve and seal must be replaced together. DO NOT replace the sleeve or seal separately.

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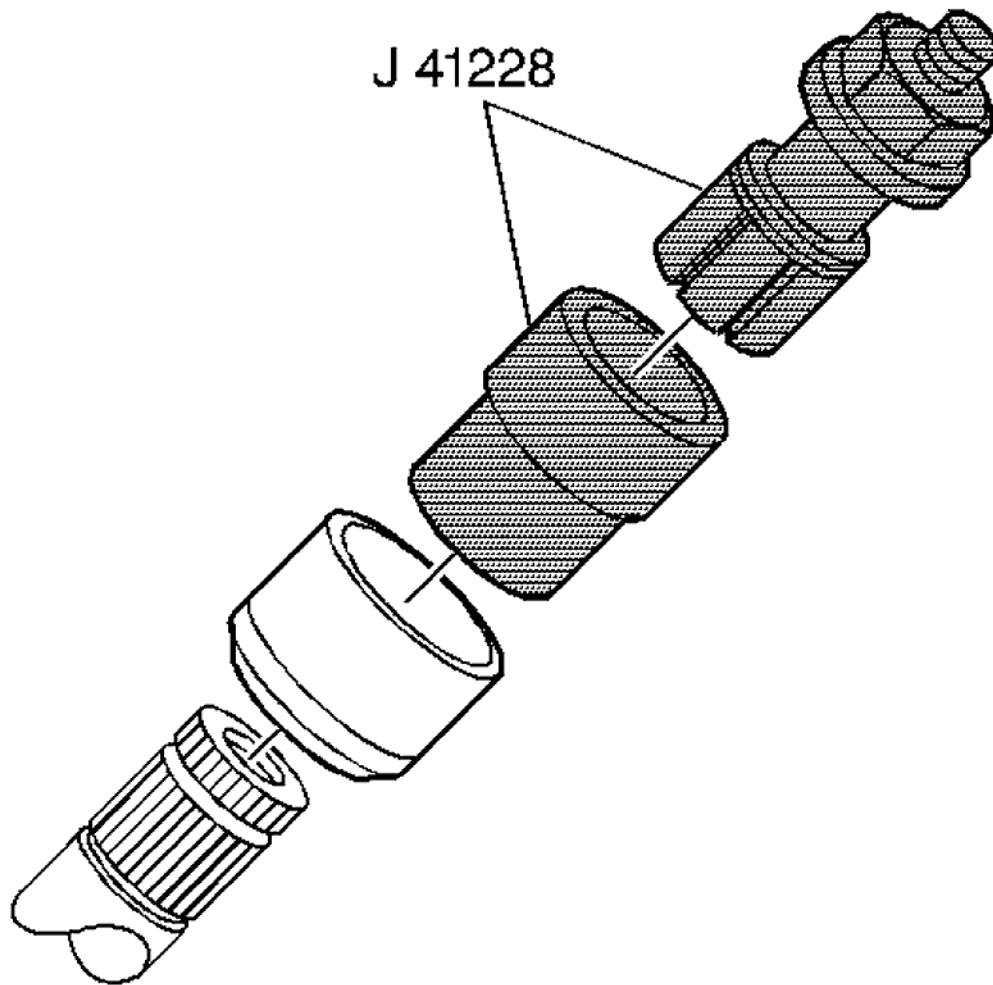


Fig. 178: View Of J 41228

Courtesy of GENERAL MOTORS CORP.

1. Use the **J 41228** to install a new sleeve on the output axle shaft. Ensure that the collet is located in the snap ring groove when installing.

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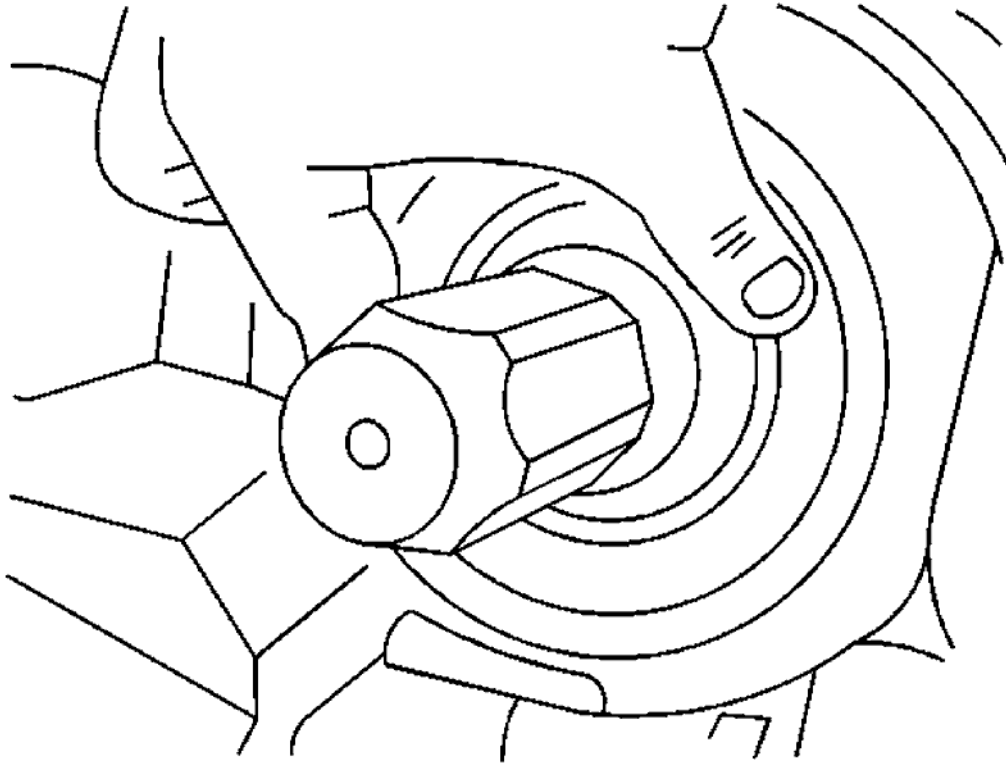


Fig. 179: Identifying J 41102
Courtesy of GENERAL MOTORS CORP.

2. Install the new output axle seal.

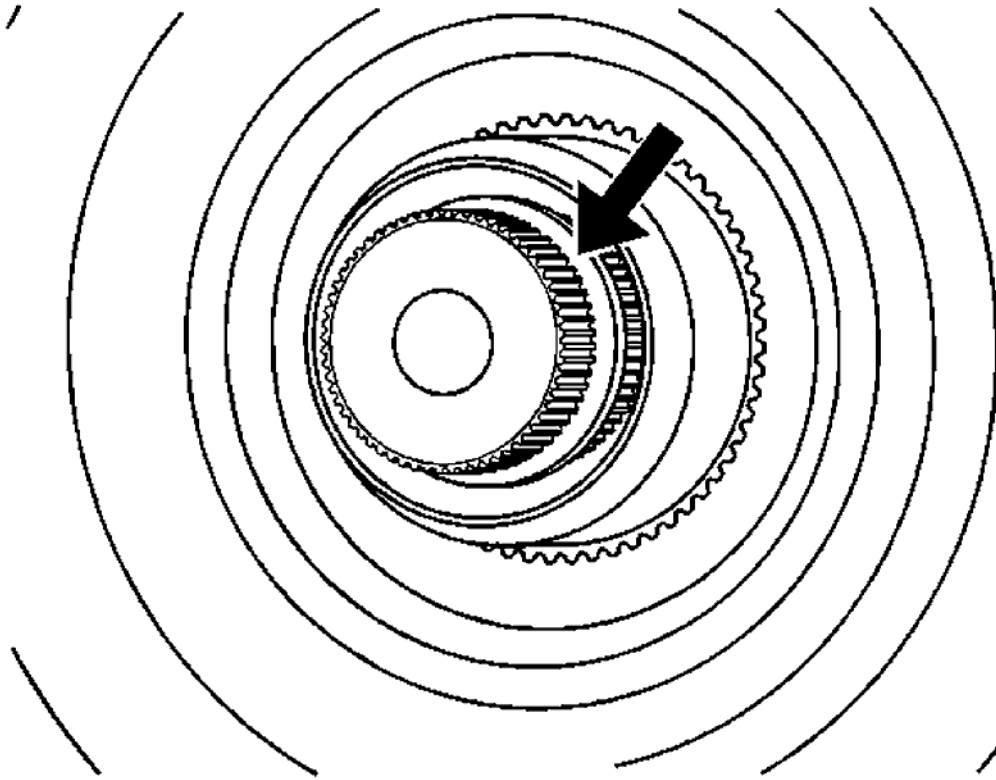


Fig. 180: Locating Drive Axle Retaining Clip
Courtesy of GENERAL MOTORS CORP.

3. Install one new snap ring on the output shaft.
4. Install the drive axle assembly. Refer to **Wheel Drive Shaft Replacement** in Wheel Drive Shafts.
5. Lower the vehicle.
6. Inspect the output axle shaft sleeve for leaks.
7. Inspect the oil level. Refer to **Transmission Fluid Checking Procedure**.

TRANSMISSION MOUNT INSPECTION

NOTE: In order to avoid oil pan damage and possible engine failure, insert a block of wood that spans the width of the oil pan bottom between the oil pan and the jack support.

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

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2. Place a jack stand under the transmission/transaxle.
3. Place a block of wood between the jack stand and the transaxle in order to protect the transmission/transaxle pan.

IMPORTANT: Before replacing any transmission/transaxle mount due to suspected fluid loss, verify that the source of the fluid is the transmission/transaxle mount, not the engine, transmission/transaxle or accessories.

4. Raise the transmission/transaxle in order to remove the weight from the transmission/transaxle mount and create slight tension in the rubber.
5. Observe the transmission/transaxle mount while raising the transmission/transaxle. Replace the transmission/transaxle mount if the transmission/transaxle mount exhibits any of the following conditions:
 - The hard rubber surface is covered with heat check cracks.
 - The rubber is separated from the metal plate of the transmission/transaxle mount.
 - The rubber is split through the center of the transmission/transaxle mount.
6. If there is movement between the metal plate of the transmission/transaxle mount and its attaching points, lower the transmission/transaxle on the transmission/transaxle mount. Tighten the bolts or nuts attaching the transmission/transaxle mount to the frame or transmission/transaxle mount bracket.
7. Remove the Jack stand and block of wood from under the vehicle.
8. Lower the vehicle.

TRANSMISSION MOUNT REPLACEMENT - FRONT

Removal Procedure

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

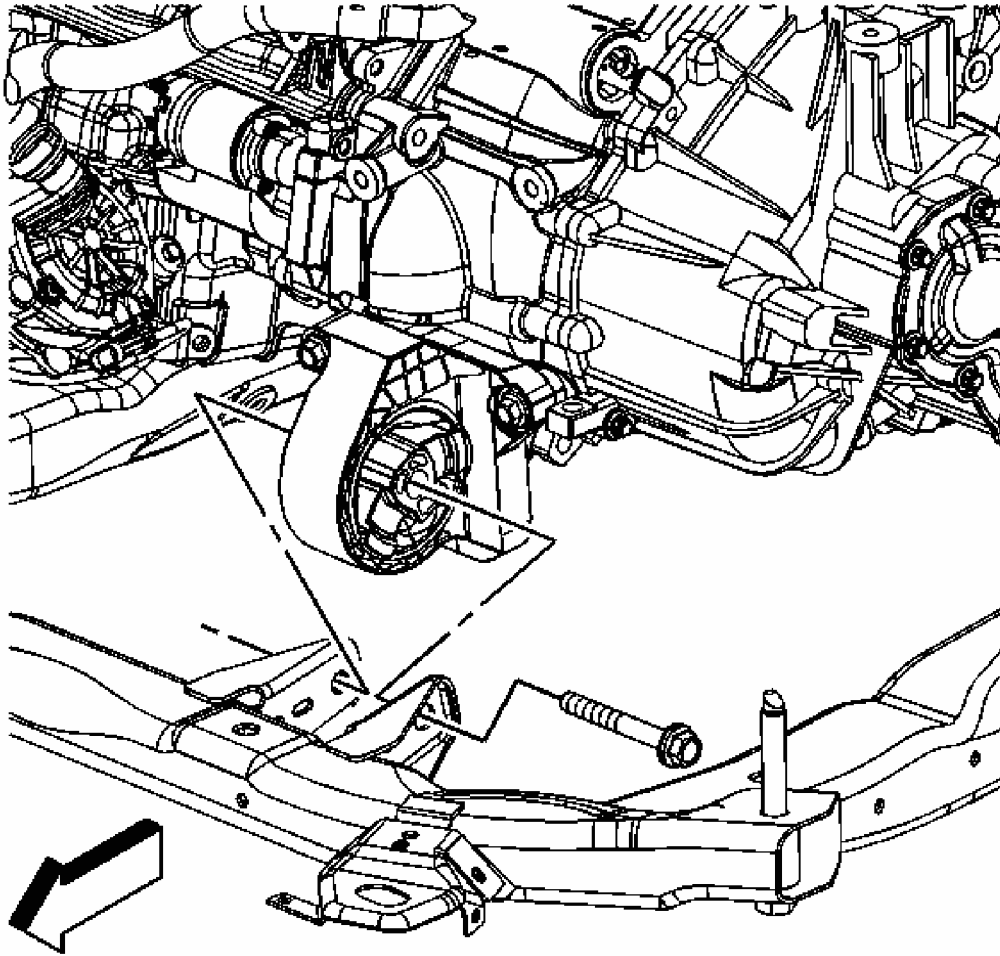


Fig. 181: View Of Front Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the front transaxle mount thru bolt.

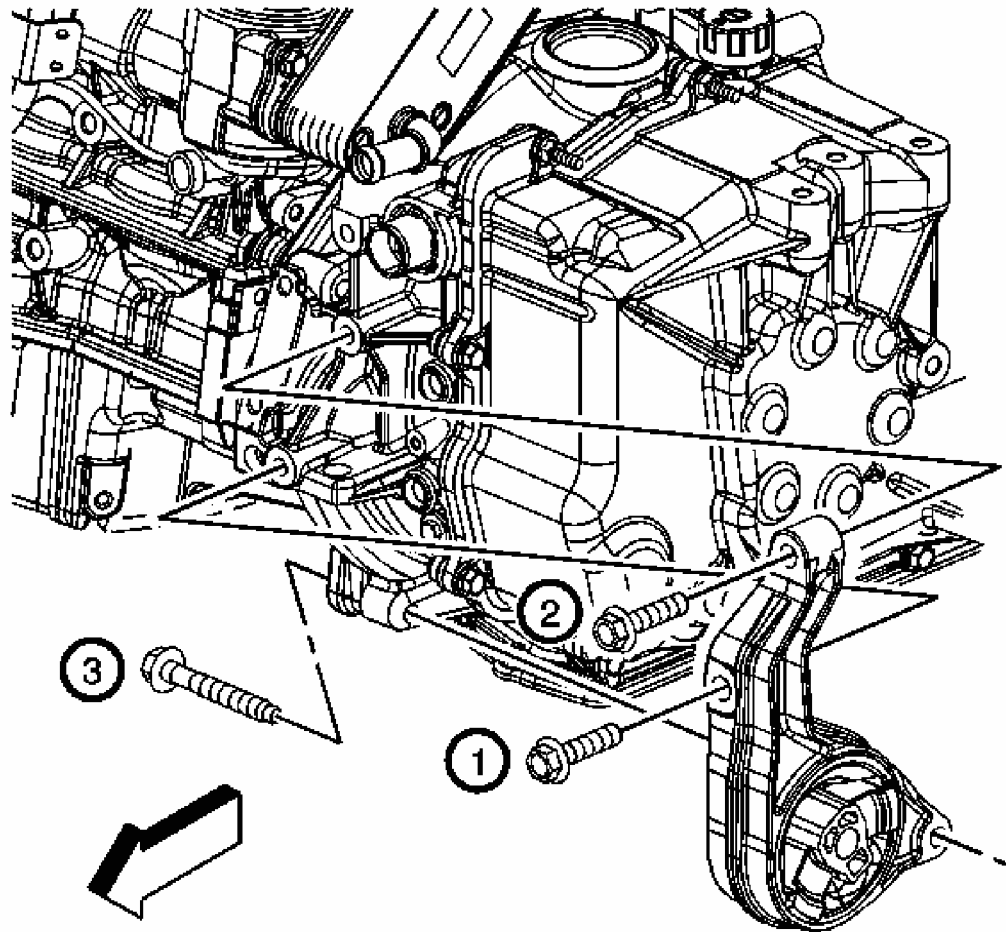


Fig. 182: View Of Front Transaxle Mount
Courtesy of GENERAL MOTORS CORP.

3. Remove the front transaxle mount to transaxle bolts.
4. Remove the front transaxle mount from the vehicle.

Installation Procedure

IMPORTANT: The transaxle bolts must be torqued in a mandatory sequence as shown.

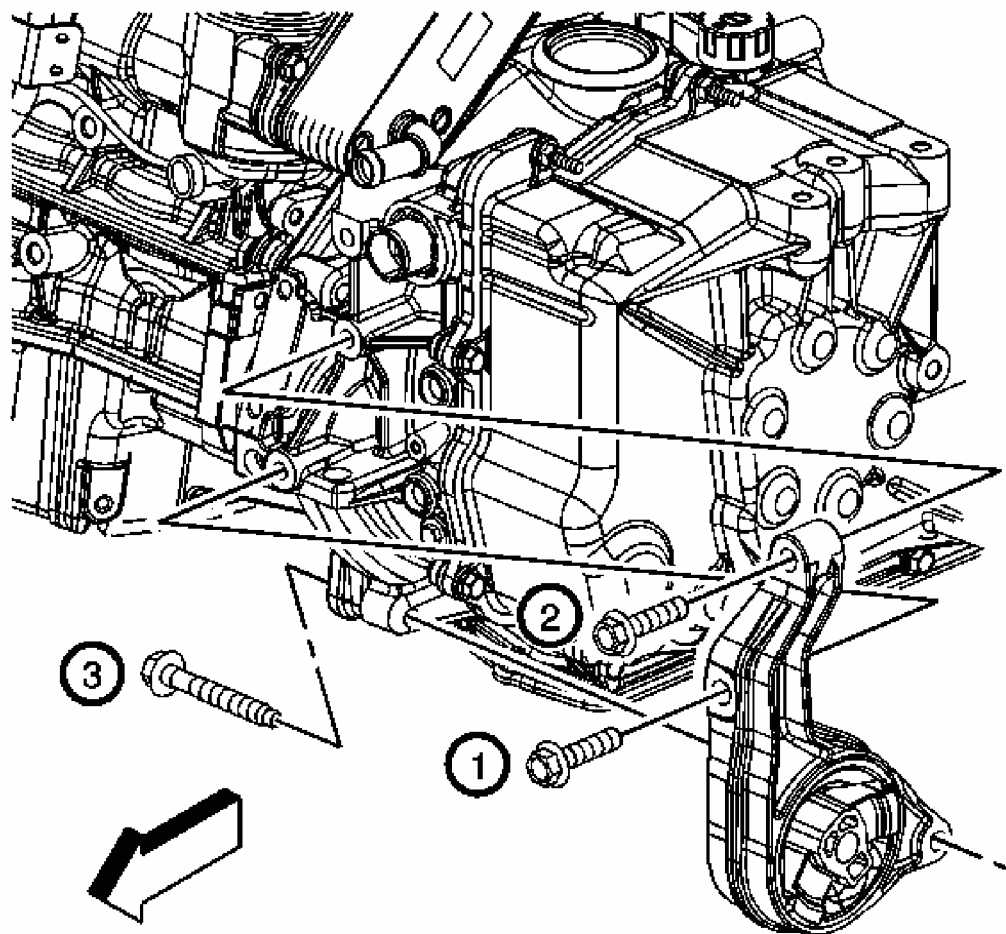


Fig. 183: View Of Front Transaxle Mount
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the front transaxle mount and transaxle bolts.

Tighten: Tighten the bolts to 90 N.m (66 lb ft).

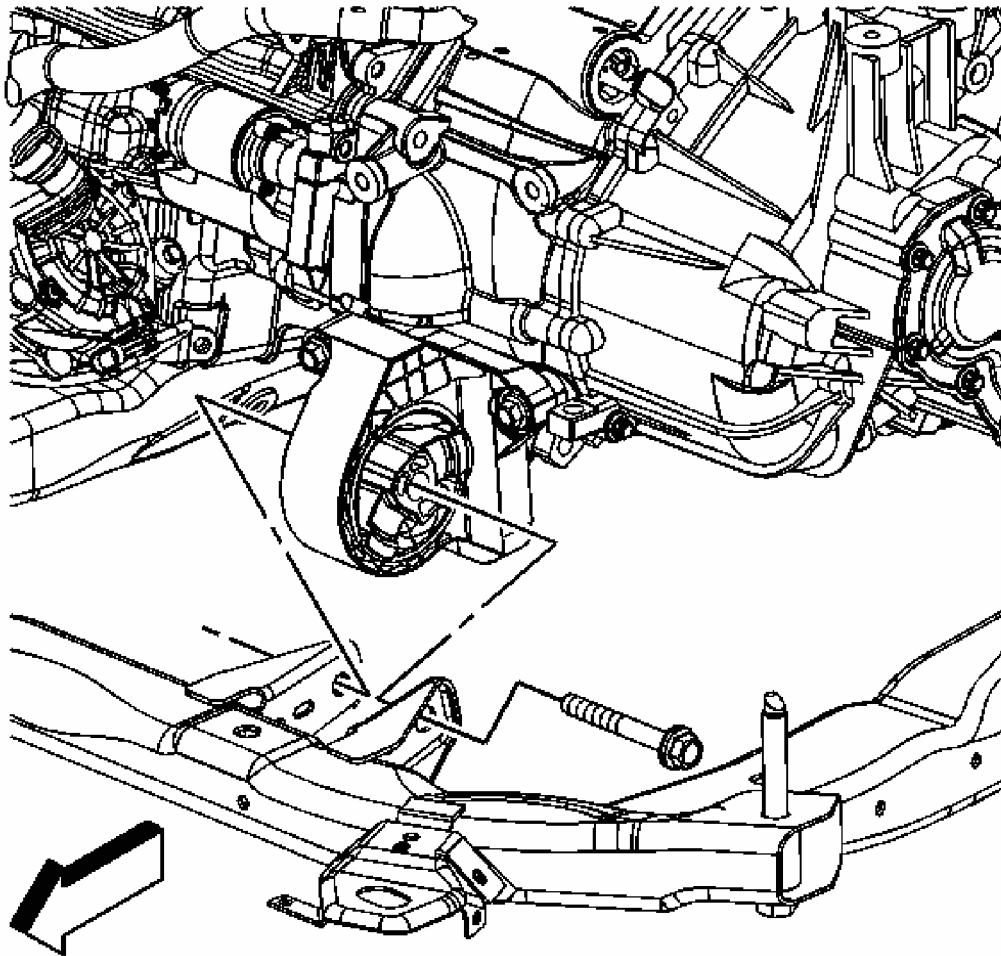


Fig. 184: View Of Front Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

2. Hand tighten the front transaxle mount thru bolt.

IMPORTANT: The front and rear transmission mounts must be allowed to settle with the thru bolts loosened.

3. Loosen the rear trans mount thru bolt.
4. Tighten the transmission mount thru bolts in the following order.

Tighten:

1. Tighten the rear bolt to 100 N.m (74 lb ft).
2. Tighten the front bolt to 100 N.m (74 lb ft).

5. Lower the vehicle.

TRANSMISSION MOUNT REPLACEMENT - REAR

Removal Procedure

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

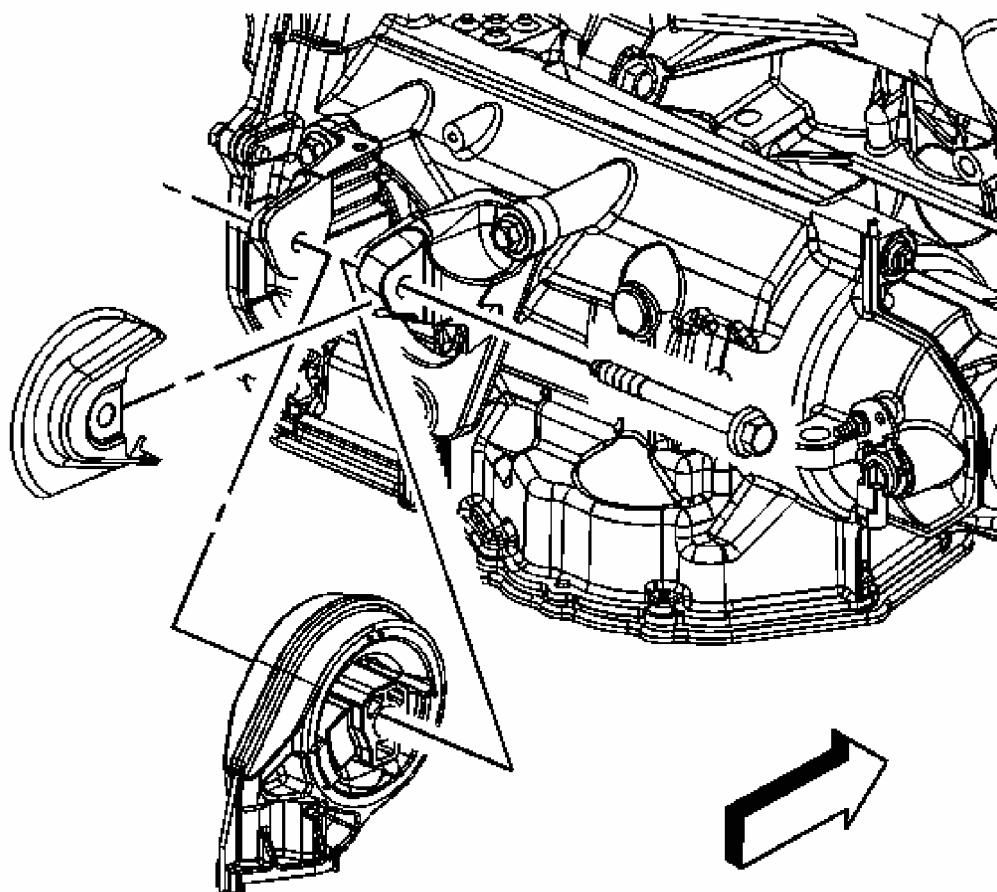


Fig. 185: Rear Transaxle Mount
Courtesy of GENERAL MOTORS CORP.

2. Remove the rear transaxle mount thru bolt and heat shield.

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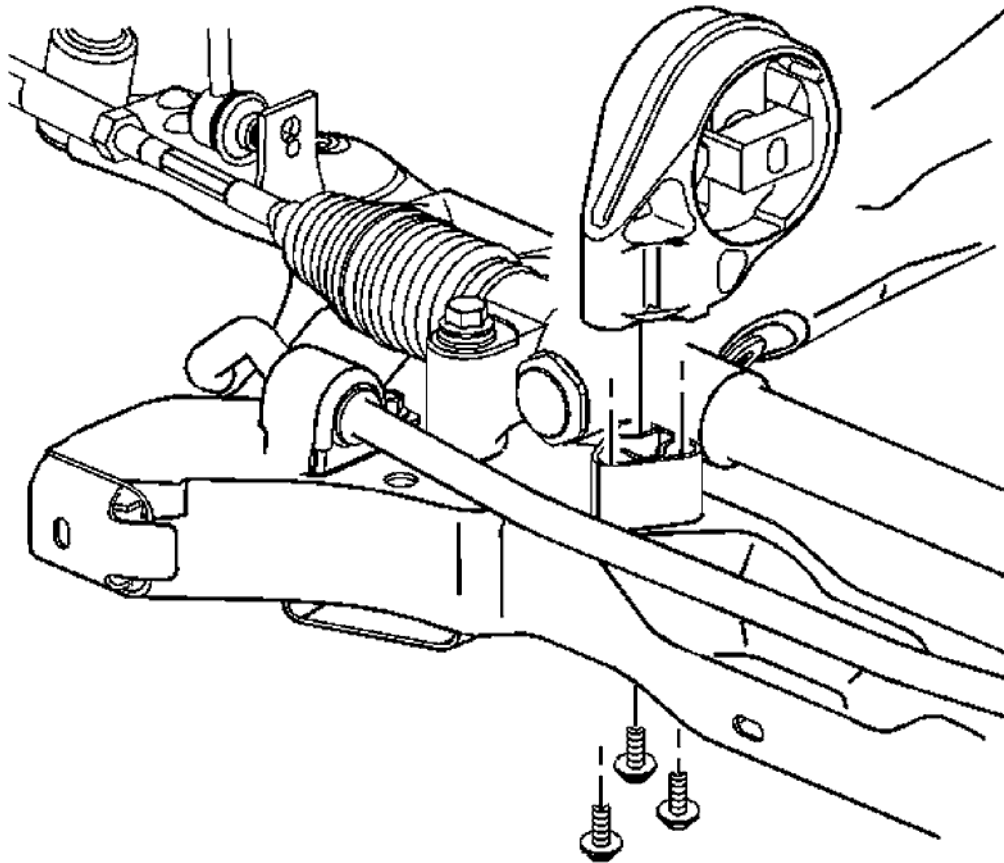


Fig. 186: View Of Rear Transaxle Mount To Frame Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the rear transaxle mount to frame bolts.
4. Remove the rear transaxle mount.

Installation Procedure

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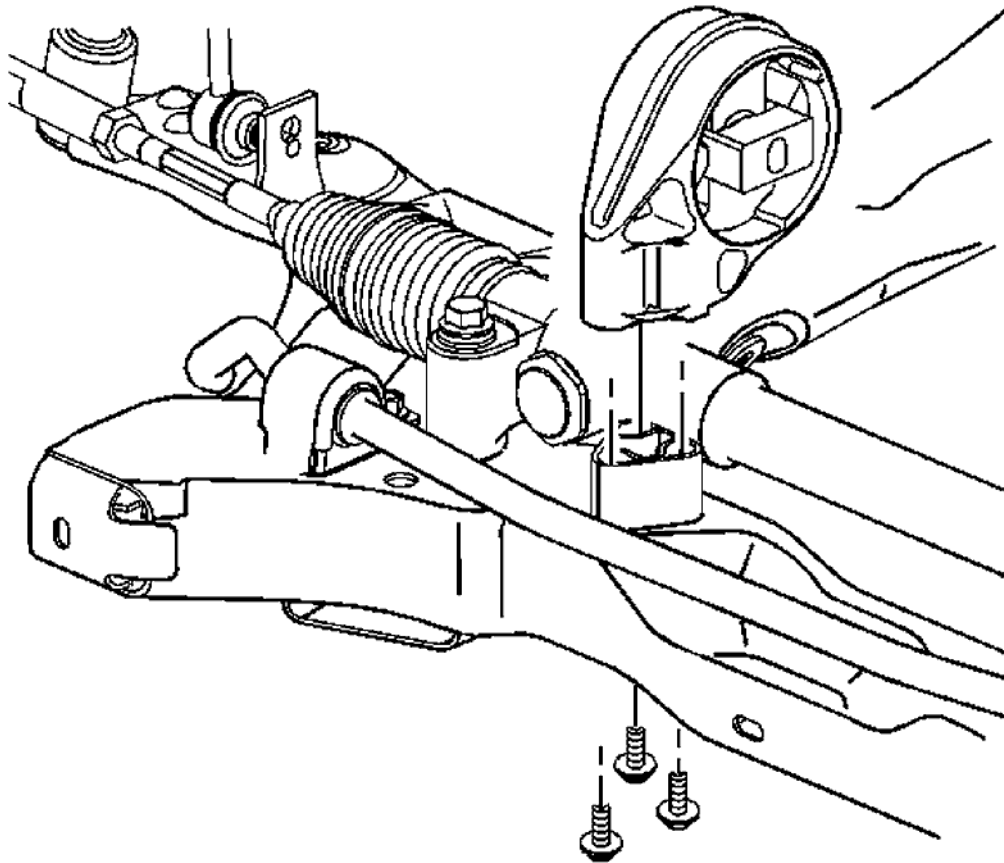


Fig. 187: View Of Rear Transaxle Mount To Frame Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the rear transaxle mount to frame bolts. Hand tighten the bolts.

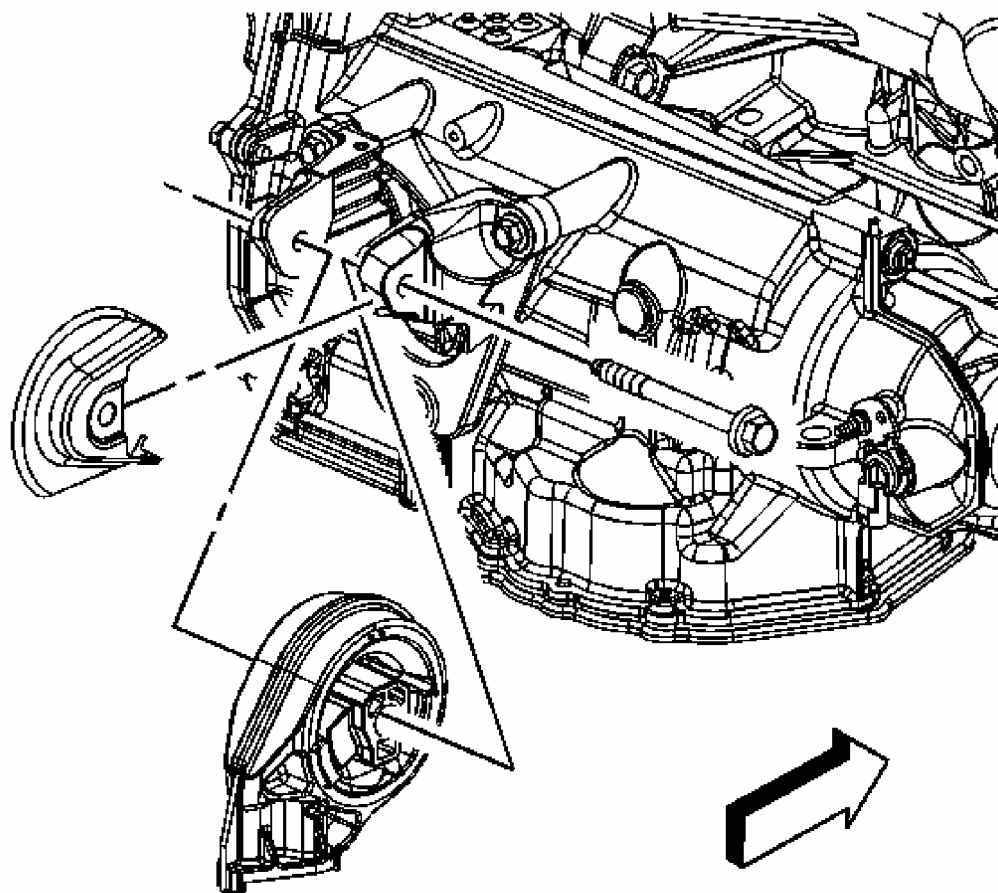


Fig. 188: Rear Transaxle Mount
Courtesy of GENERAL MOTORS CORP.

2. Install the rear transaxle mount, heat shield and the thru bolt to the transmission bracket. Hand tighten the bolt.

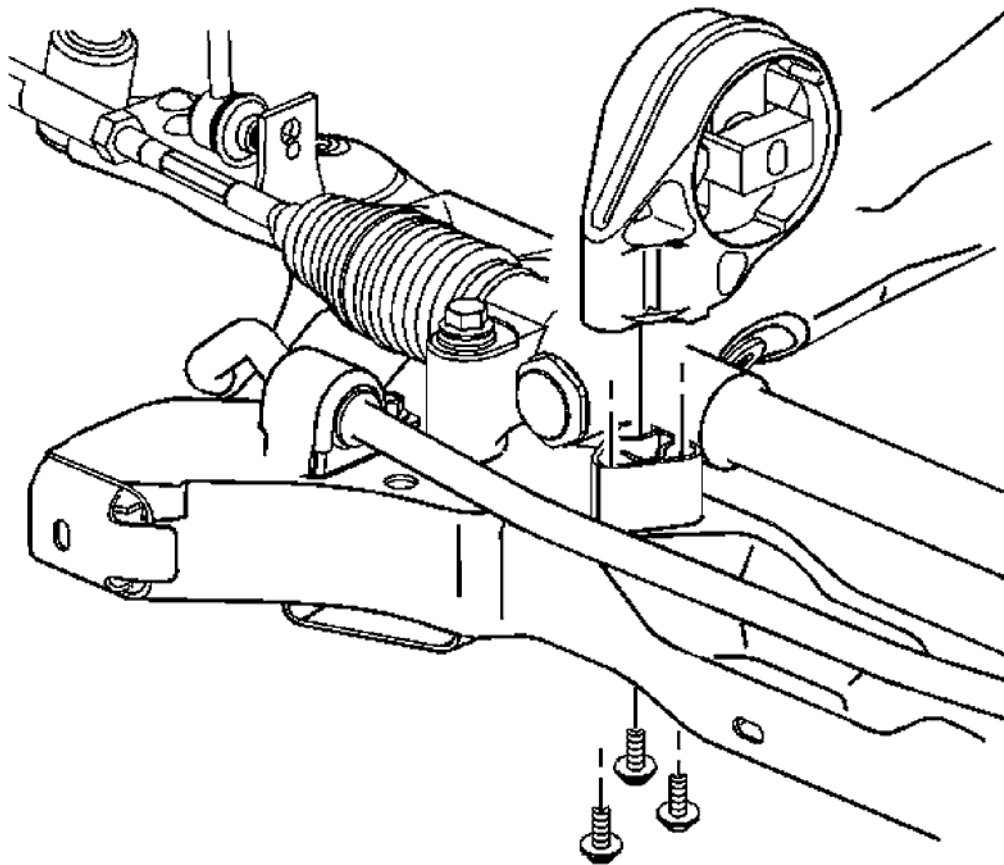


Fig. 189: View Of Rear Transaxle Mount To Frame Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Tighten the rear transaxle mount to frame bolts.

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

IMPORTANT: Rotate the rear transaxle mount heat shield clockwise until the tab is seated on the mount bracket.

IMPORTANT: The front and rear transmission mounts must be allowed to settle with the thru bolts loosened.

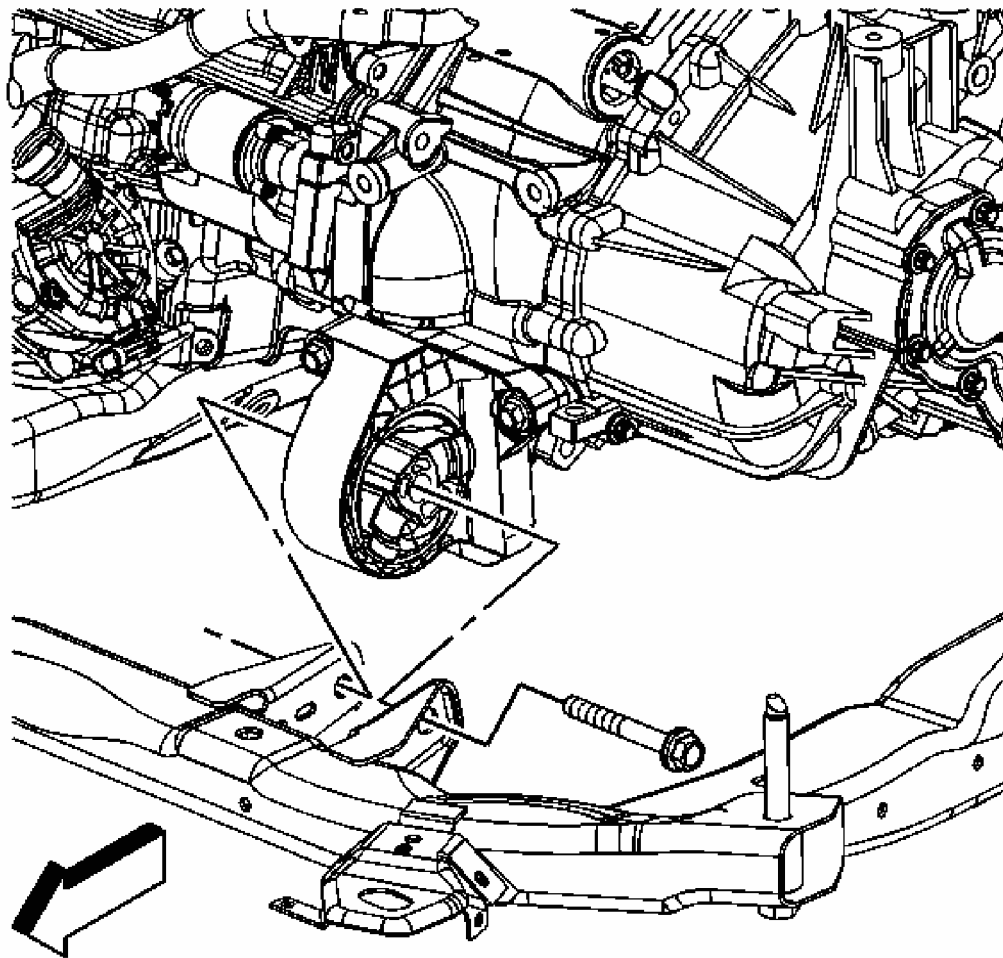


Fig. 190: View Of Front Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

4. Loosen the front transaxle mount thru bolt but do not remove the bolt.

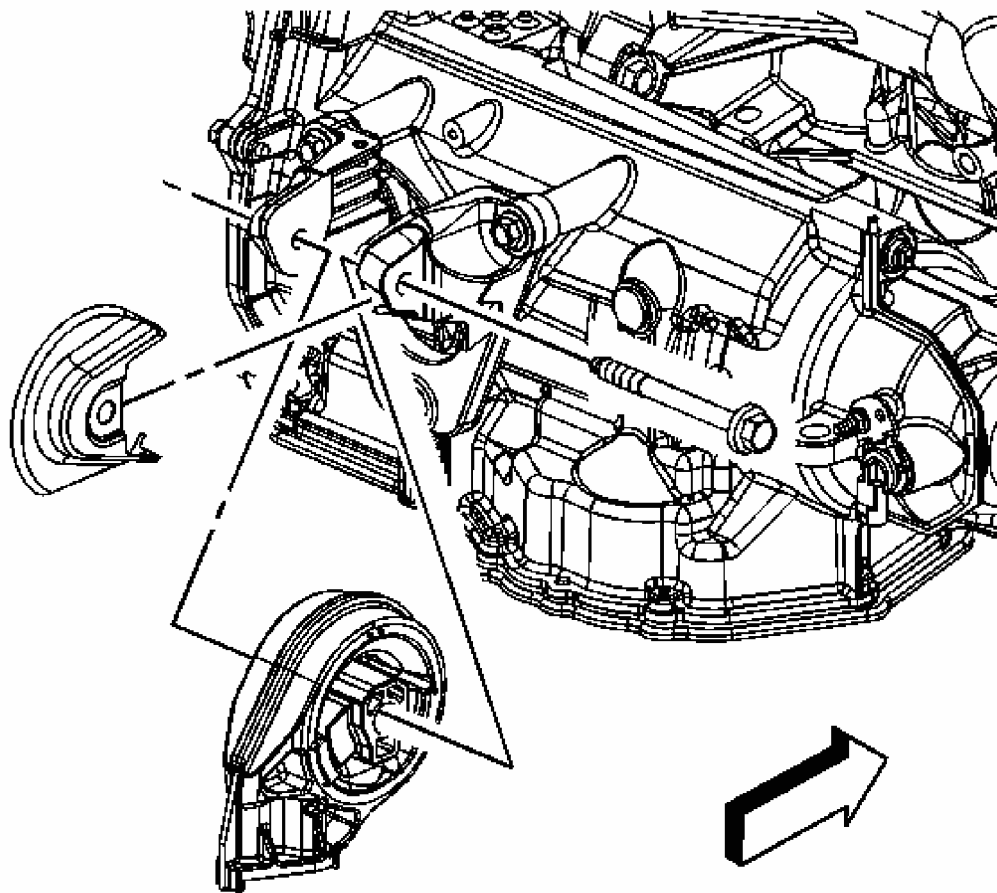


Fig. 191: Rear Transaxle Mount
Courtesy of GENERAL MOTORS CORP.

5. Tighten the rear transmission mount thru bolt.

Tighten: Tighten the thru bolt to 100 N.m (74 lb ft).

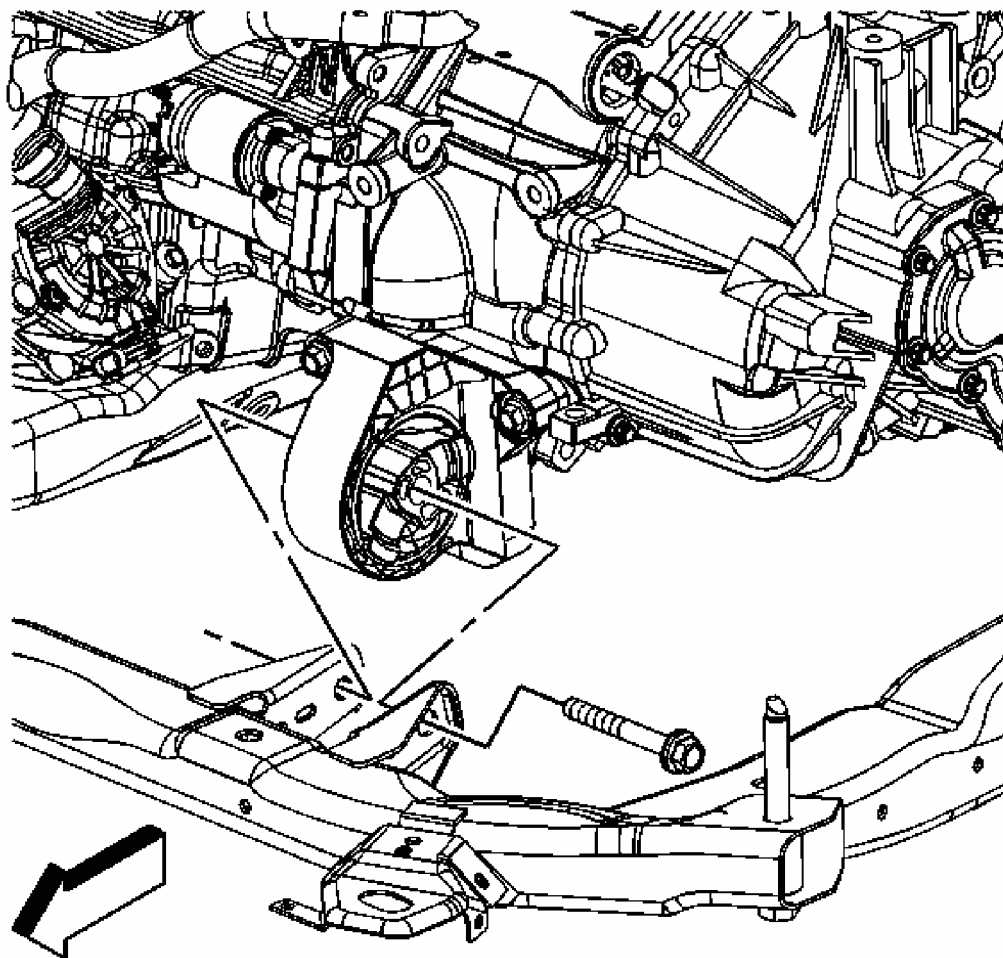


Fig. 192: View Of Front Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

6. Tighten the front transmission mount thru bolt.

Tighten: Tighten the thru bolt to 100 N.m (74 lb ft).

7. Lower the vehicle.

TRANSMISSION MOUNT REPLACEMENT - LEFT

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.

2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

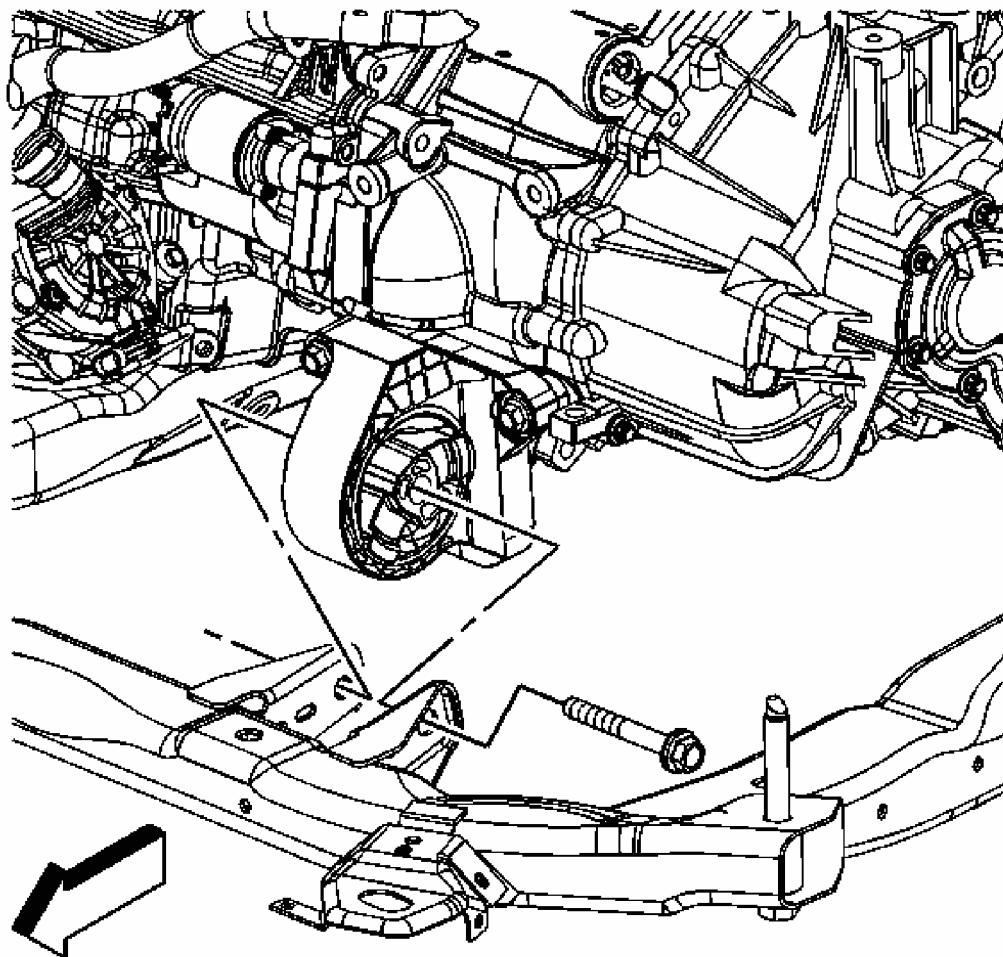


Fig. 193: View Of Front Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the front transmission mount thru bolt.

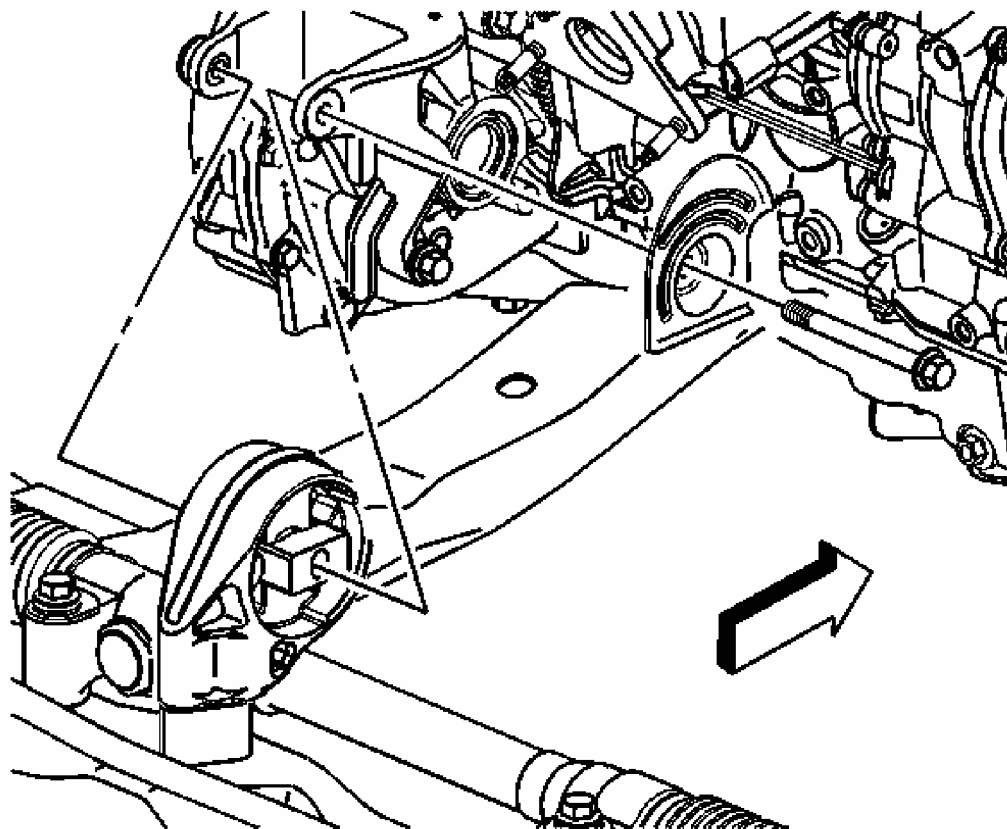


Fig. 194: View Of Rear Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

4. Remove the rear transmission mount thru bolt.
5. Lower the vehicle.
6. Remove the under hood electrical center cover.

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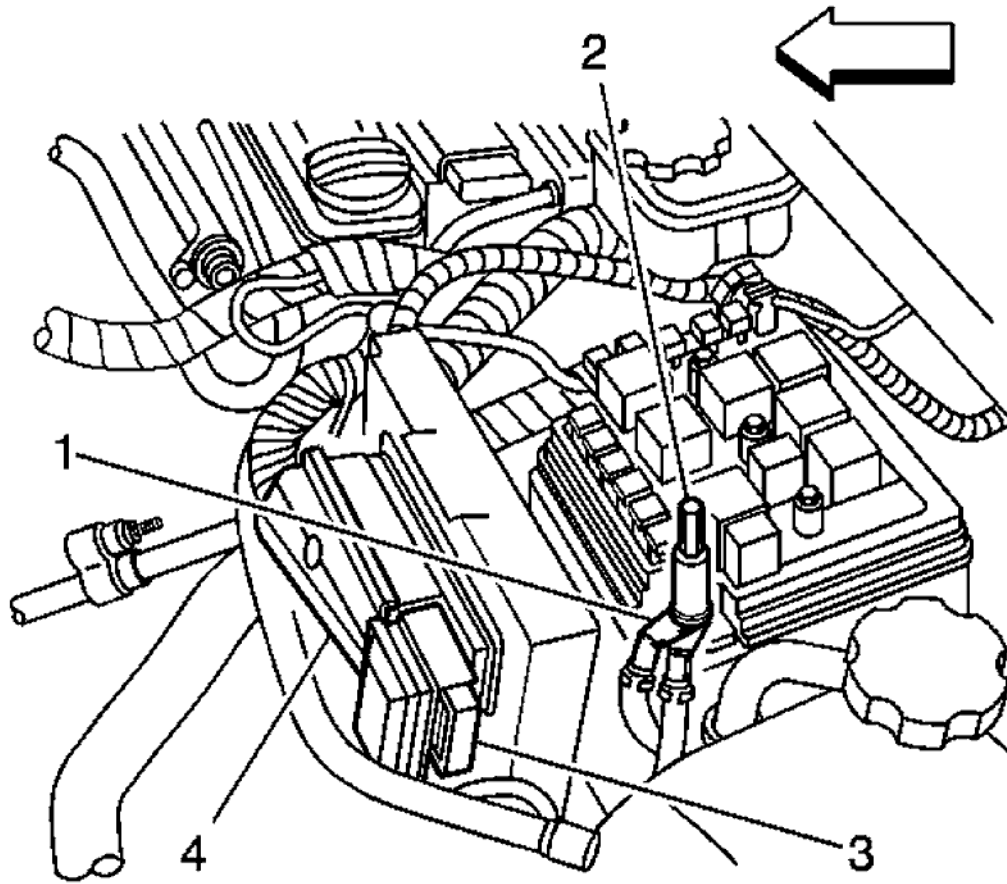


Fig. 195: View Of Engine Electrical Center
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the engine control module harness connector (3,4).
8. Disconnect the positive battery cables (1) from the under hood electrical center.

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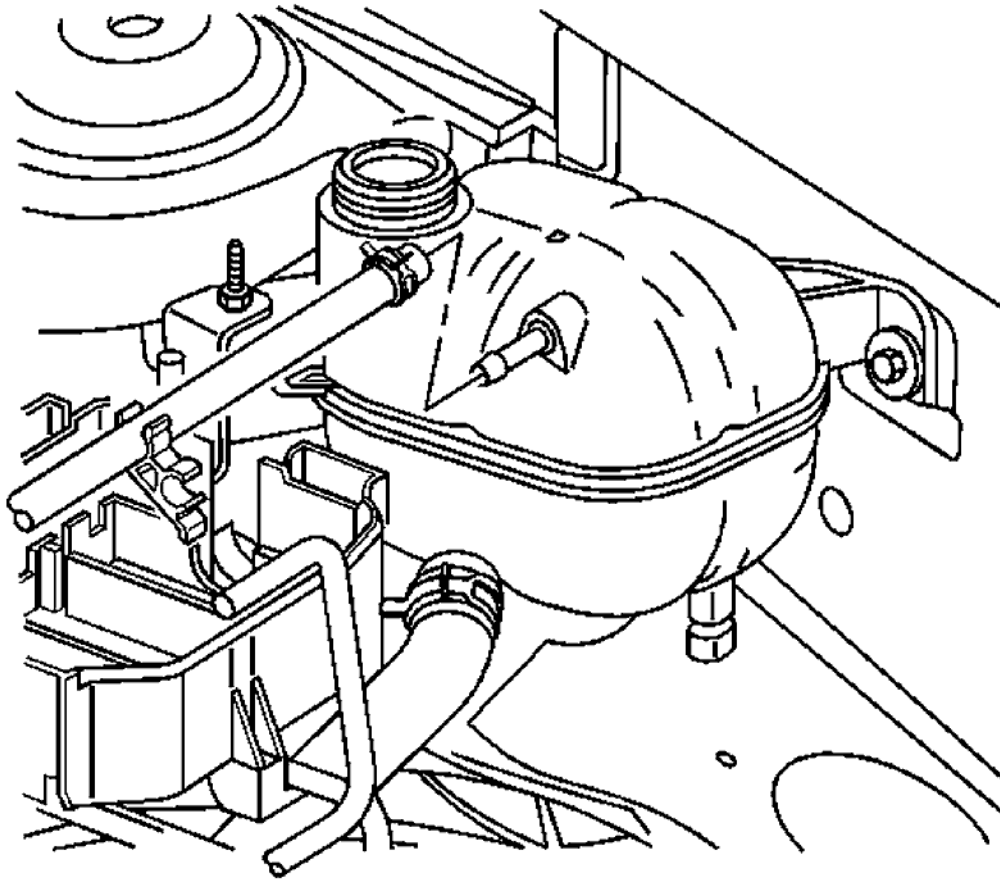


Fig. 196: View Of Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the surge tank inlet hose from the surge tank.

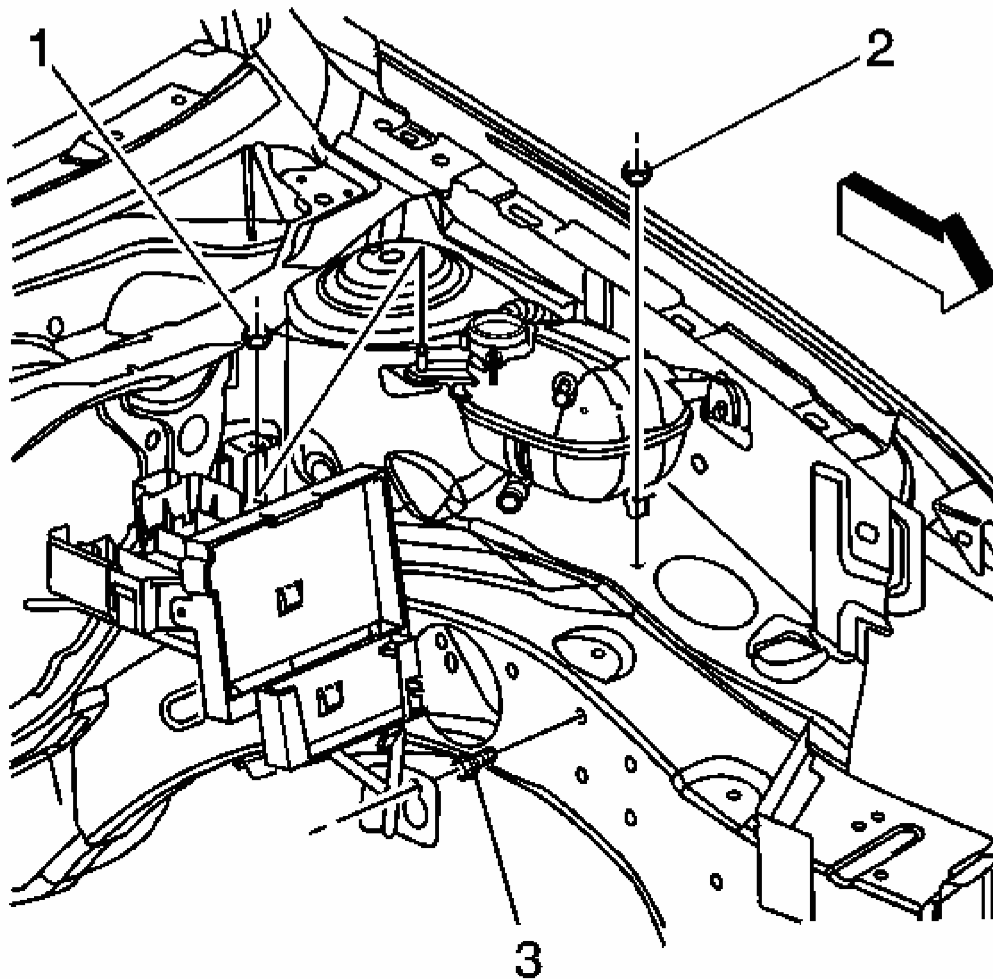


Fig. 197: View Of Engine Compartment Component Locations
Courtesy of GENERAL MOTORS CORP.

10. Remove the under hood electrical center tray bracket nuts (1,2) and bolt (3).
11. Disconnect the wiring harness retainer from the tray bracket.

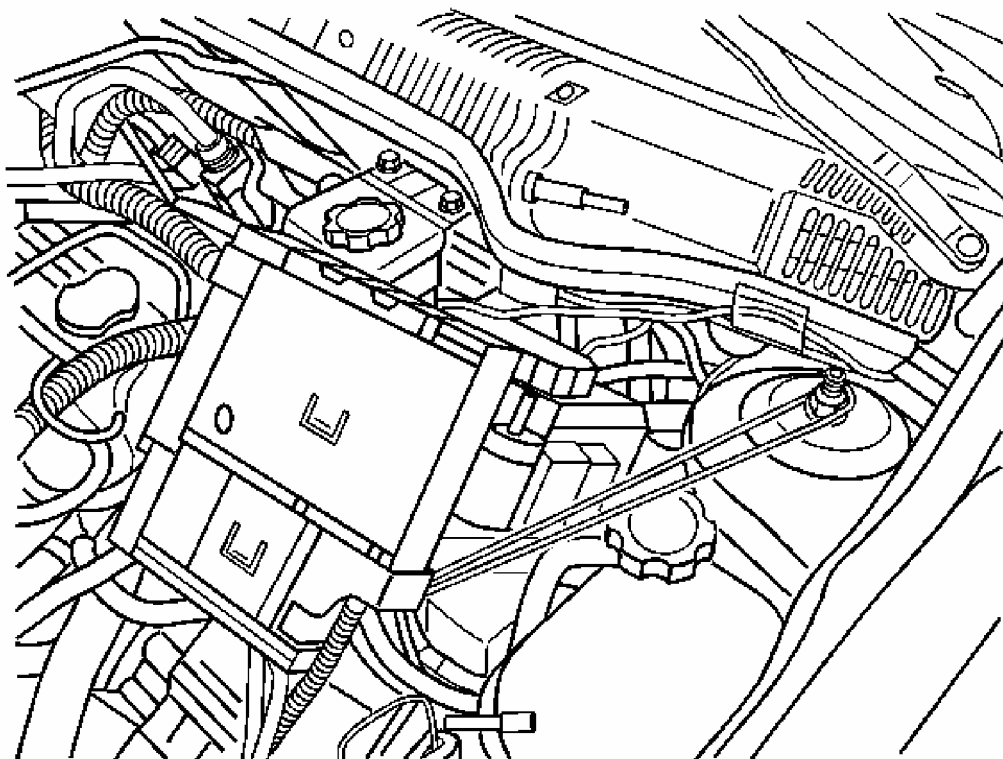


Fig. 198: View Of Underhood Junction Block
Courtesy of GENERAL MOTORS CORP.

12. Lift the electrical center up and swing it back and out of the way.

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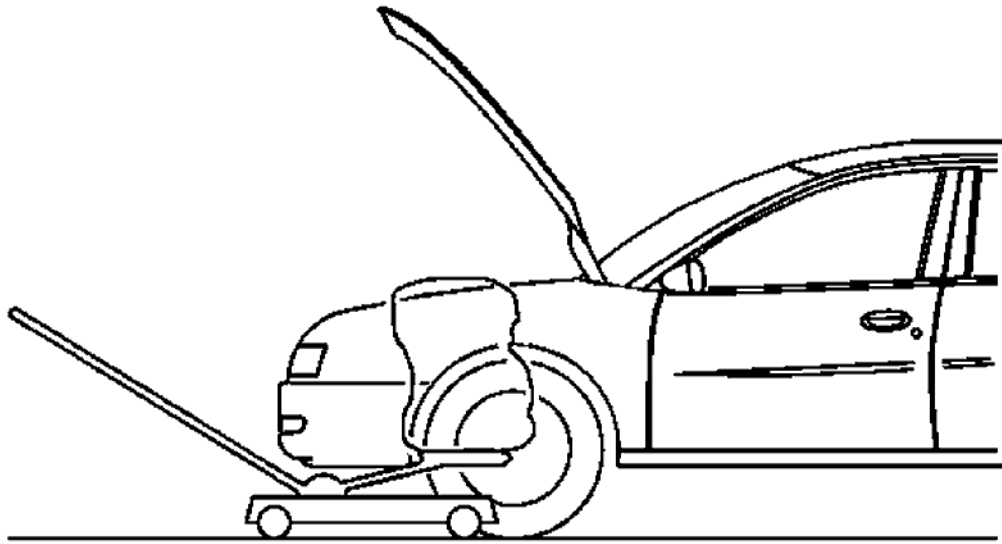


Fig. 199: Supporting Engine/Transmission With Hydraulic Floor Jack
Courtesy of GENERAL MOTORS CORP.

13. Support the transmission with an hydraulic floor jack. Use a block of wood between the jack and the transmission.

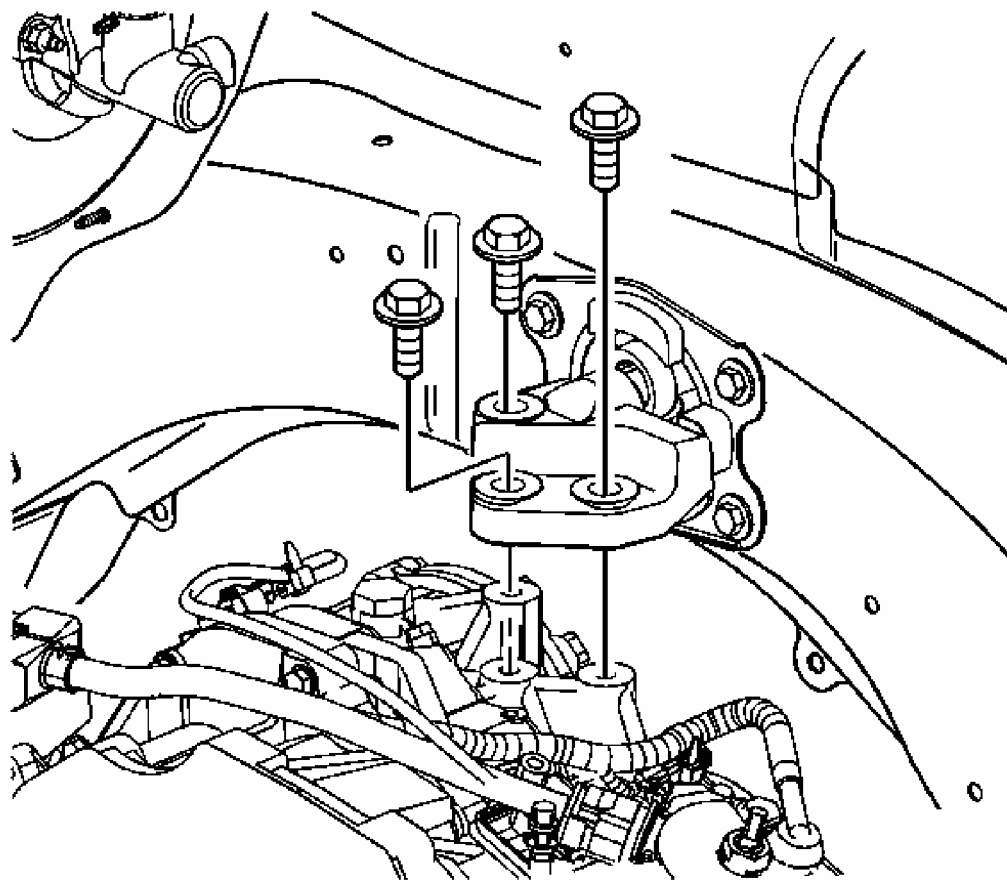


Fig. 200: View Of Transmission Mount-To-Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

14. Remove the transmission mount to transmission bolts.

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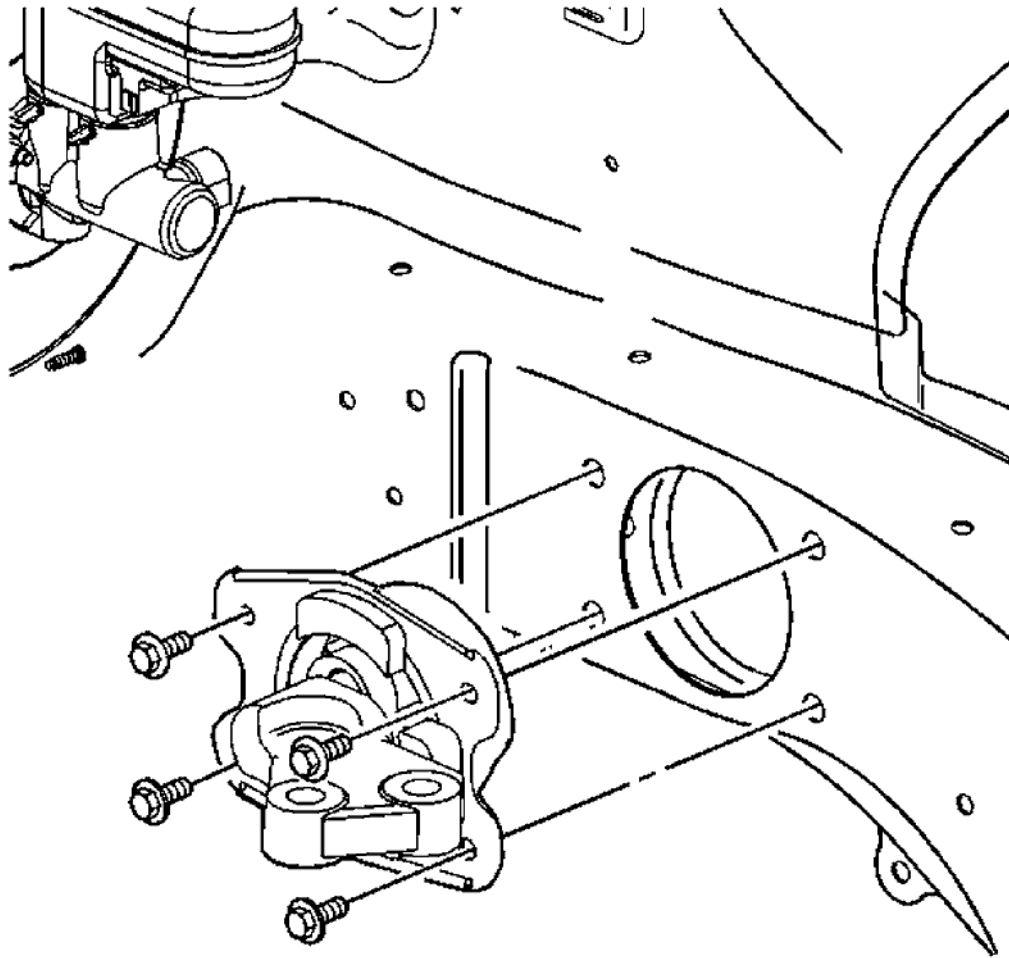


Fig. 201: View Of Transmission Mount-To-Mid-rail Bolts
Courtesy of GENERAL MOTORS CORP.

15. Remove the transmission mount to mid-rail bolts.

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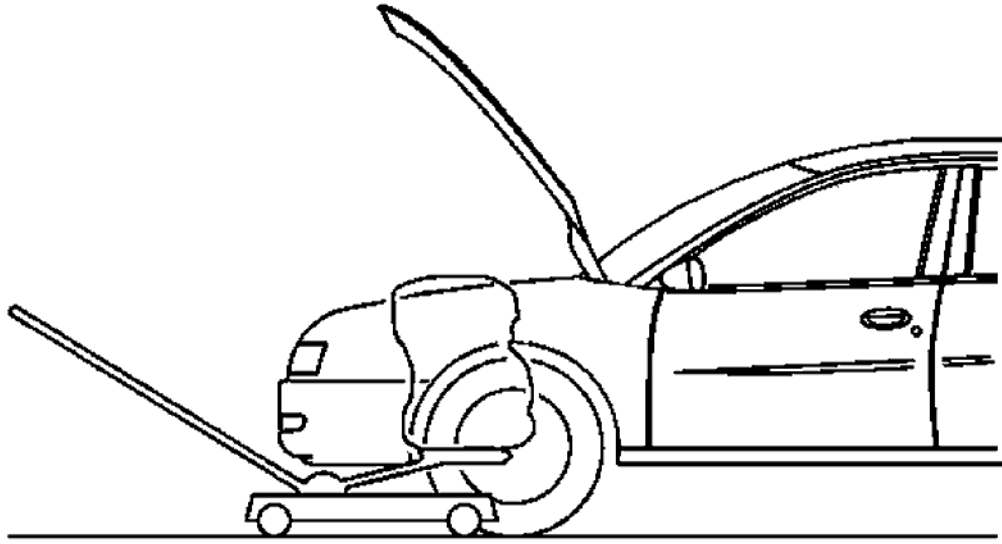


Fig. 202: Supporting Engine/Transmission With Hydraulic Floor Jack
Courtesy of GENERAL MOTORS CORP.

16. Using the floor jack, slowly lower the transmission just enough to remove the transmission mount from the vehicle.

Installation Procedure

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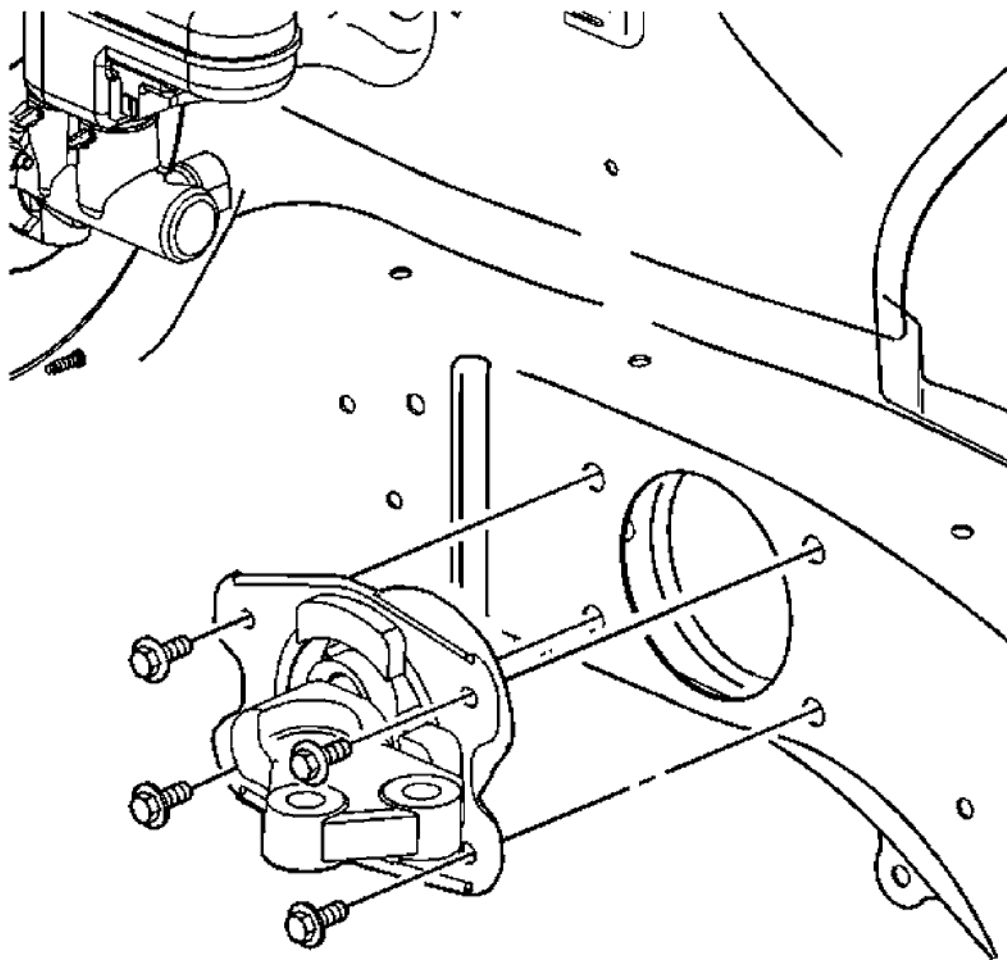


Fig. 203: View Of Transmission Mount-To-Mid-rail Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the transmission mount to the mid-rail.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Hand start the transmission mount to mid-rail bolts.

Tighten: Tighten the bolts to 34 N.m (25 lb ft).

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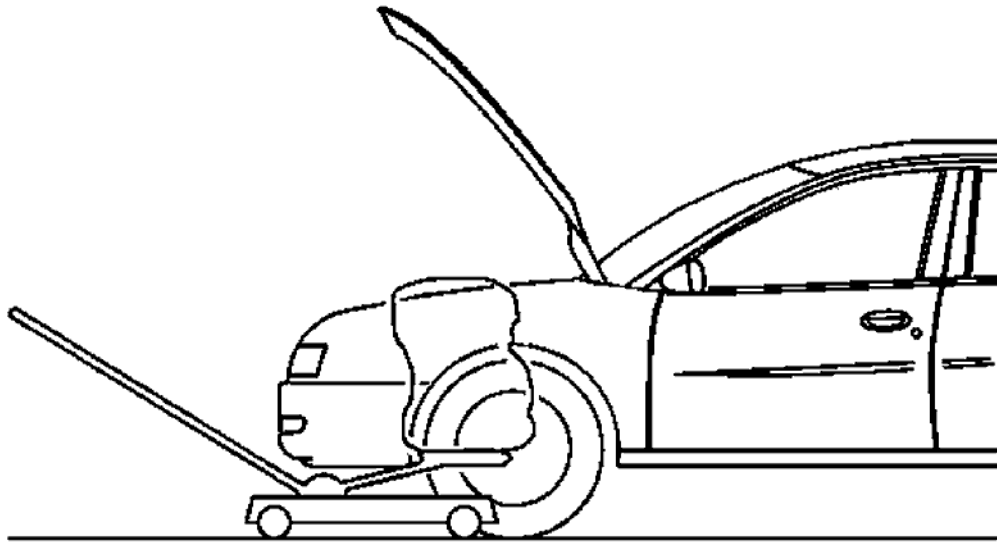


Fig. 204: Supporting Engine/Transmission With Hydraulic Floor Jack
Courtesy of GENERAL MOTORS CORP.

3. Using a hydraulic jack, raise the transmission until it contacts the transmission mount.

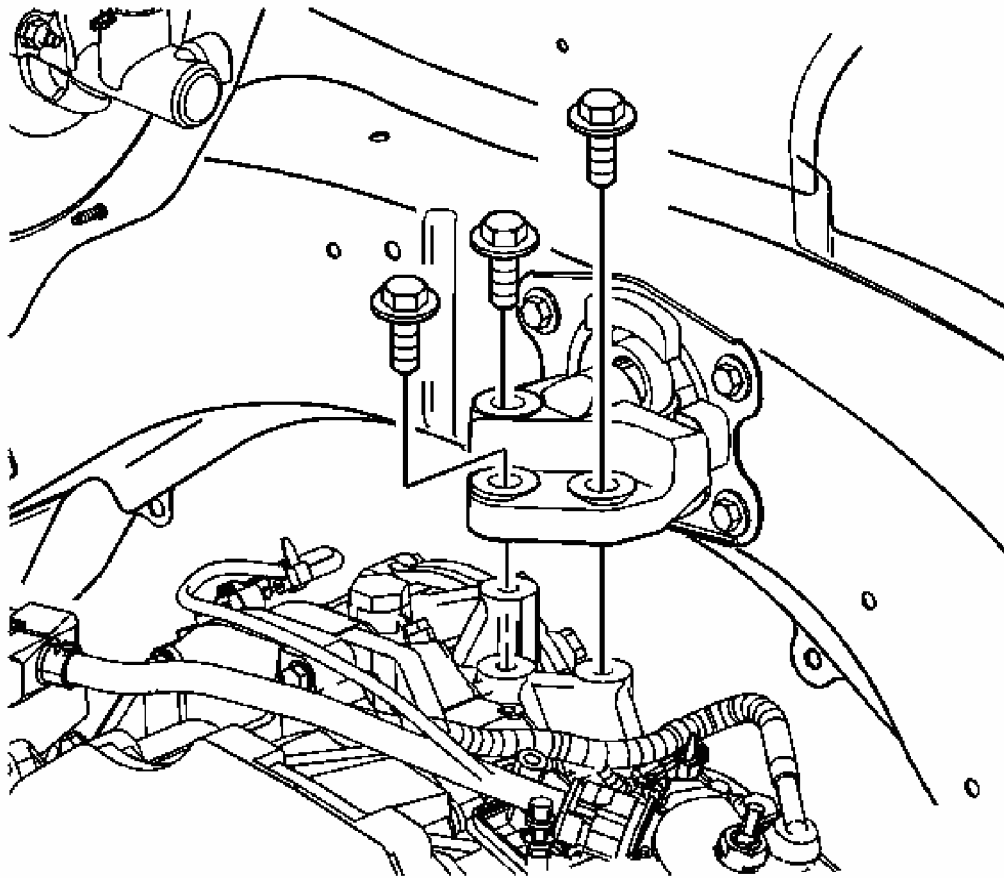


Fig. 205: View Of Transmission Mount-To-Transmission Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The transmission mount to transmission bolts must be hand started. Do not pry the transmission or mount to align the holes.

4. Hand start the transmission mount to transmission bolts using the following sequence:
 1. Rear Bolt
 2. Middle Bolt
 3. Front Bolt
5. Using the previous sequence, tighten the transmission mount bolts.

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

6. Reposition the under hood electrical center.

7. Connect the wiring harness retainer to the tray bracket.

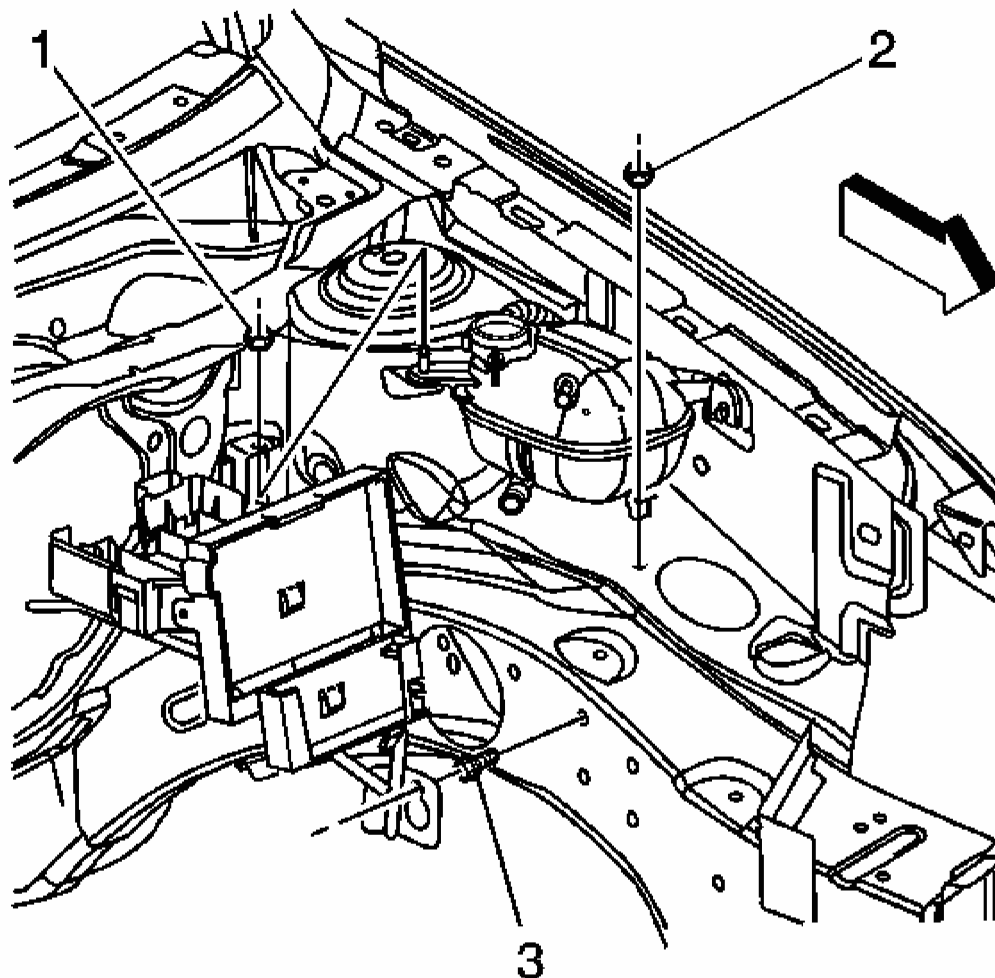


Fig. 206: View Of Engine Compartment Component Locations
Courtesy of GENERAL MOTORS CORP.

8. Install the electrical center nuts (1,2) and bolts (3).

Tighten:

- Tighten the nut to 10 N.m (89 lb in).
- Tighten the bolt to 25 N.m (18 lb ft).

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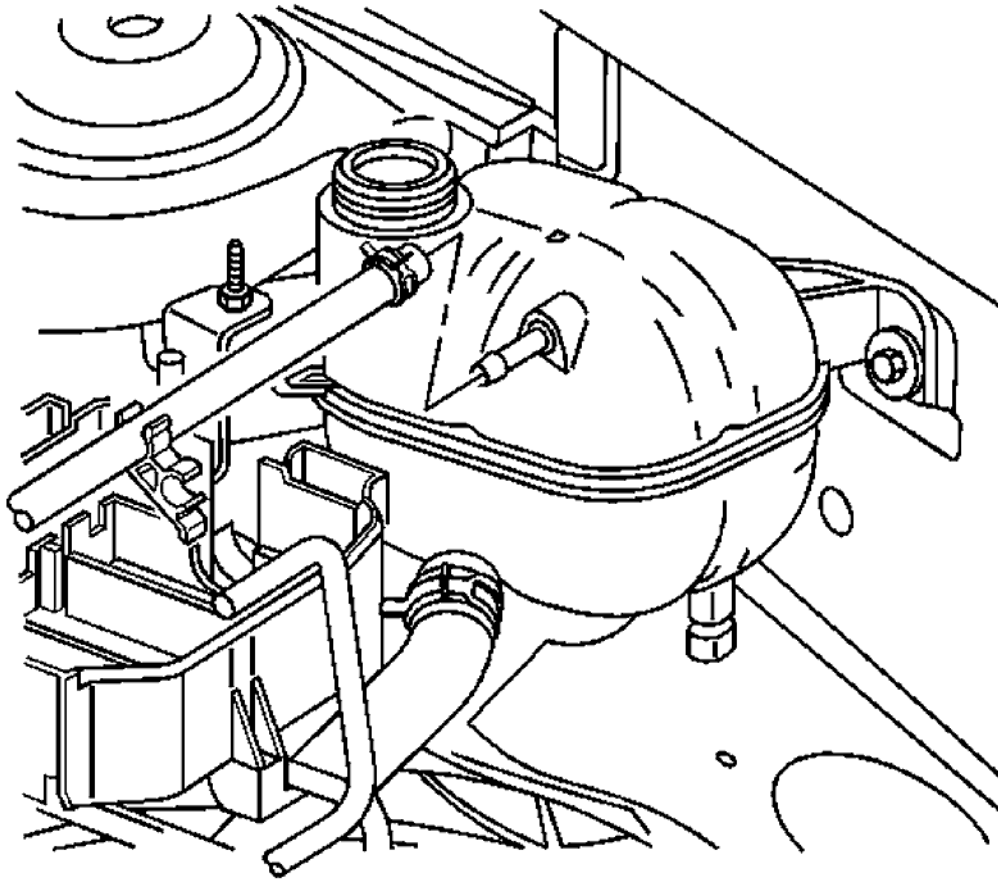


Fig. 207: View Of Surge Tank Inlet Hose
Courtesy of GENERAL MOTORS CORP.

9. Connect the surge tank inlet hose to the surge tank.

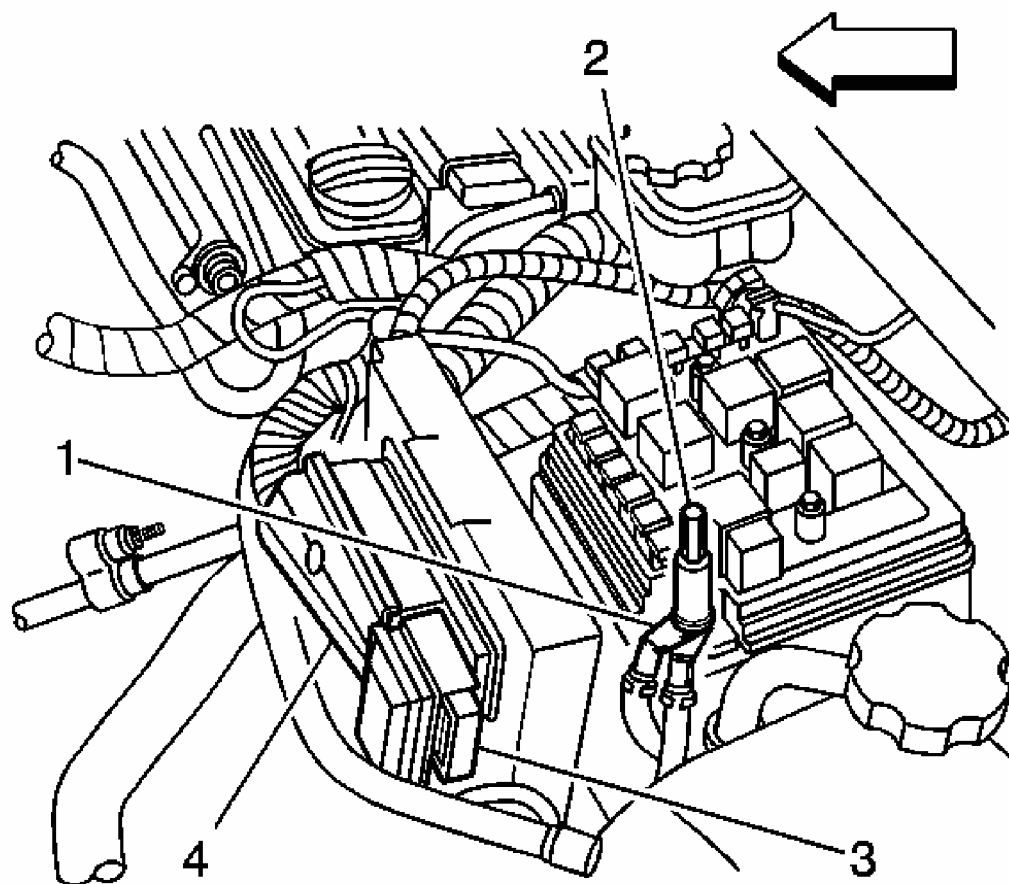


Fig. 208: View Of Engine Electrical Center
Courtesy of GENERAL MOTORS CORP.

10. Install the positive battery cables (1) to the under hood electrical center.

Tighten: Tighten the positive cable nut to 15 N.m (11 lb ft).

11. Connect the engine control module harness connectors (3,4).
12. Install the under hood electrical center cover.
13. Raise the vehicle.

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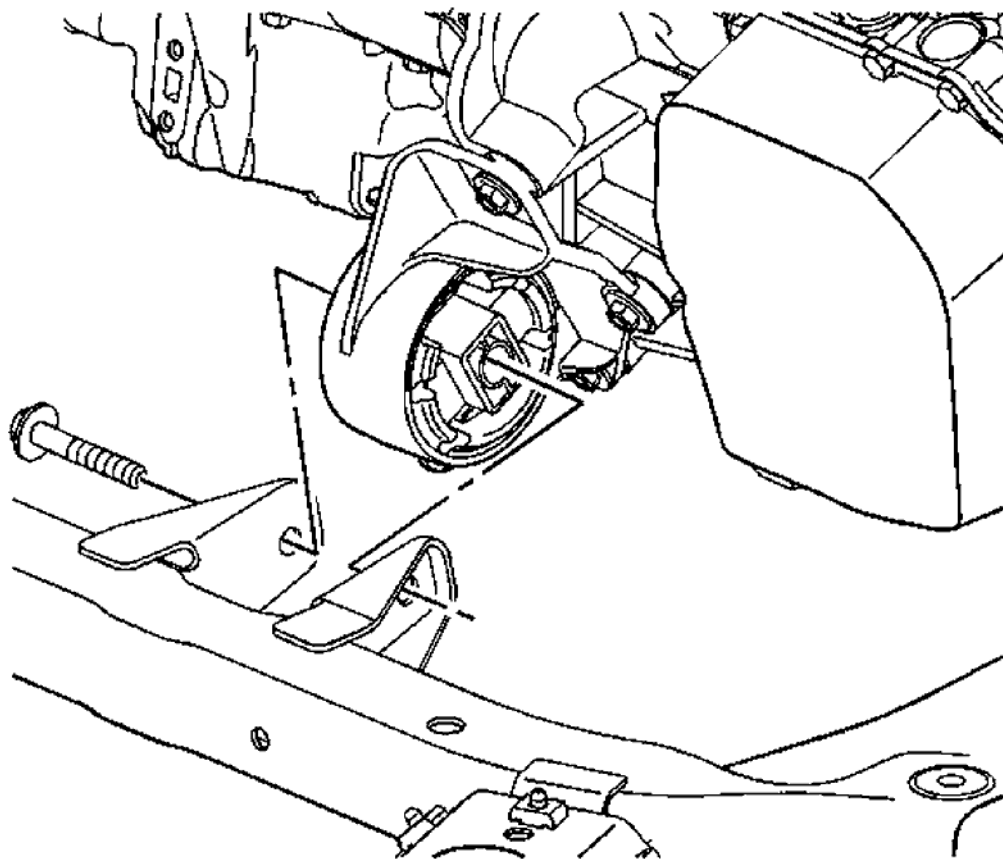


Fig. 209: View Of Front Transmission Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

14. Hand tighten the front transmission mount thru bolt
15. Hand tighten the rear transmission mount thru bolt.
16. Tighten the front transmission mount thru bolt.

Tighten: Tighten the bolt to 100 N.m (74 lb ft).

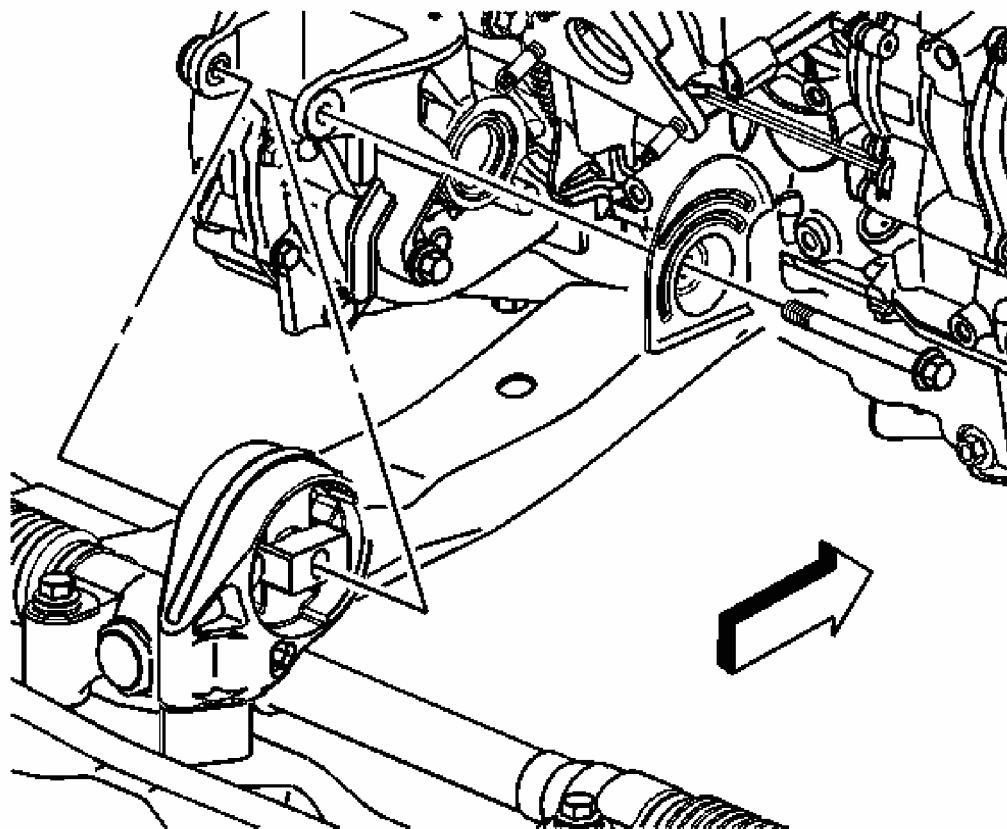


Fig. 210: View Of Rear Transaxle Mount Through Bolt
Courtesy of GENERAL MOTORS CORP.

17. Tighten the rear transmission mount thru bolt.

Tighten: Tighten the bolt to 100 N.m (74 lb ft).

18. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure** .

TRANSMISSION MOUNT BRACKET REPLACEMENT - REAR

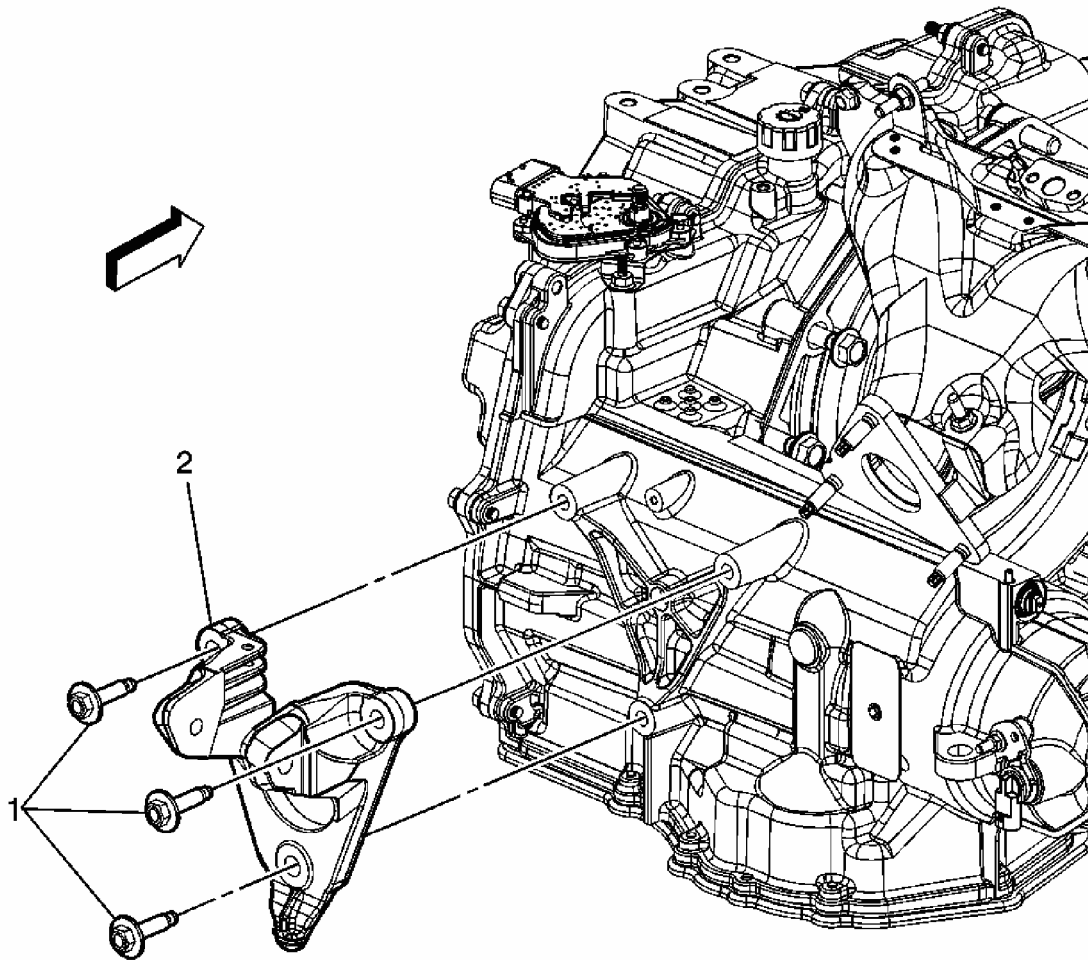


Fig. 211: Transmission Mount Bracket
 Courtesy of GENERAL MOTORS CORP.

Transmission Mount Bracket Replacement - Rear

Callout	Component Name
NOTE: Refer to Fastener Notice in Cautions and Notices.	
Fastener Tightening Specifications: Refer to Fastener Tightening Specifications . Preliminary Procedure: Remove the rear transmission mount. Refer to Transmission Mount Replacement - Rear .	
1	Bolt, transaxle mount bracket (Qty 3) Tighten: 50 N.m (37 lb ft). Tip: Tighten bolts in specified sequence.
2	Bracket, transaxle

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TRANSMISSION REPLACEMENT

Tools Required

J 43653 Flywheel Holding Tool. See **Special Tools**.

Removal Procedure

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
2. Disconnect the air inlet duct hose from the intake plenum.

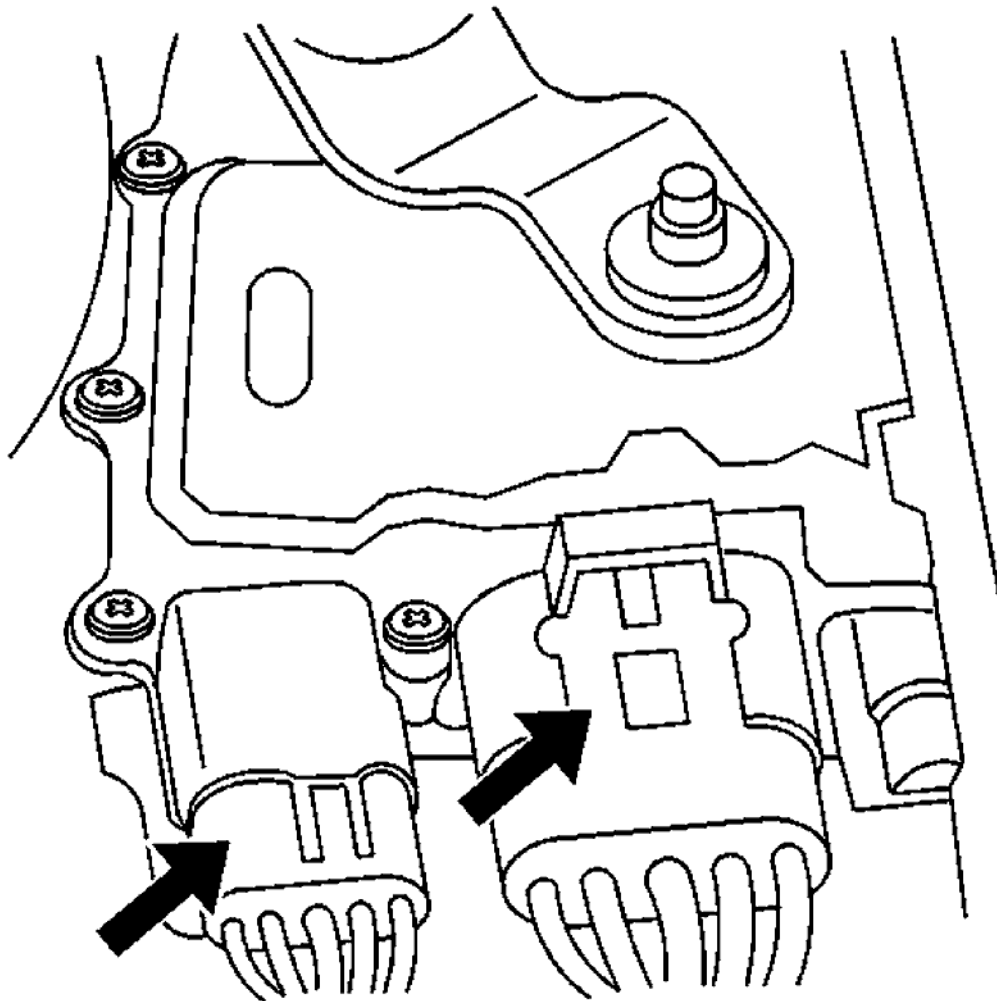


Fig. 212: Locating Transaxle & PNP Switch Connectors
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the transaxle wiring harness from the transaxle and the PNP switch.

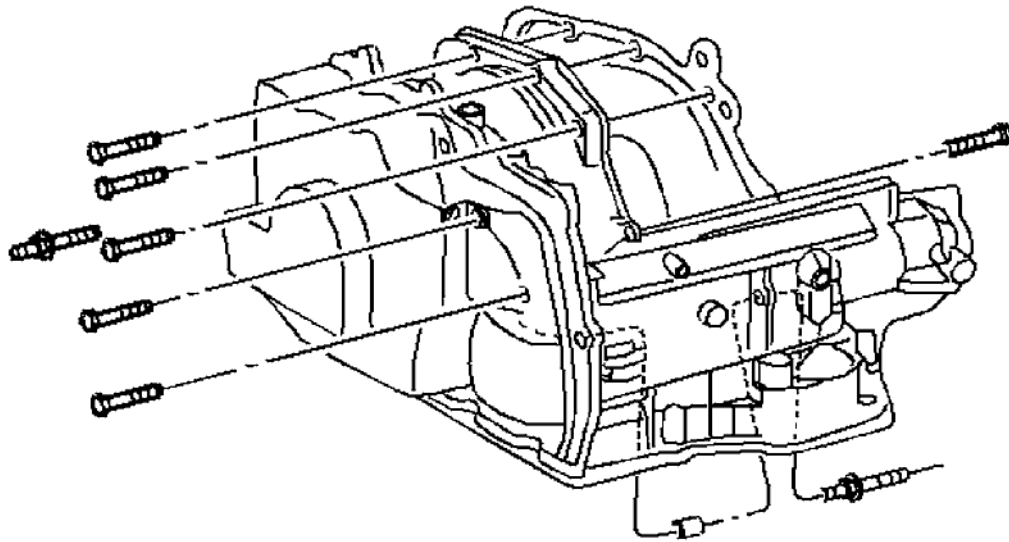


Fig. 213: Identifying Lower Transmission To Engine Bolts And Stud
Courtesy of GENERAL MOTORS CORP.

4. Remove the upper transmission to engine bolts and stud.
5. Install the engine support fixture. Refer to **Engine Support Fixture** for the 2.2L (L61) engine.
6. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle**.
7. Remove the front wheel and tire assemblies. Refer to **Tire and Wheel Removal and Installation**.
8. Remove the both front fender liners. Refer to **Wheelhouse Liner Replacement - Front**.
9. Remove the steering gear mounting bolts and secure the steering gear with mechanics wire.
10. Disconnect the wheel speed sensor wires from the both front wheels and unclip from the frame.
11. Separate the ball joints from the steering knuckles. Refer to **Lower Ball Joint Replacement**.
12. Remove the frame. Refer to **Frame Replacement**.

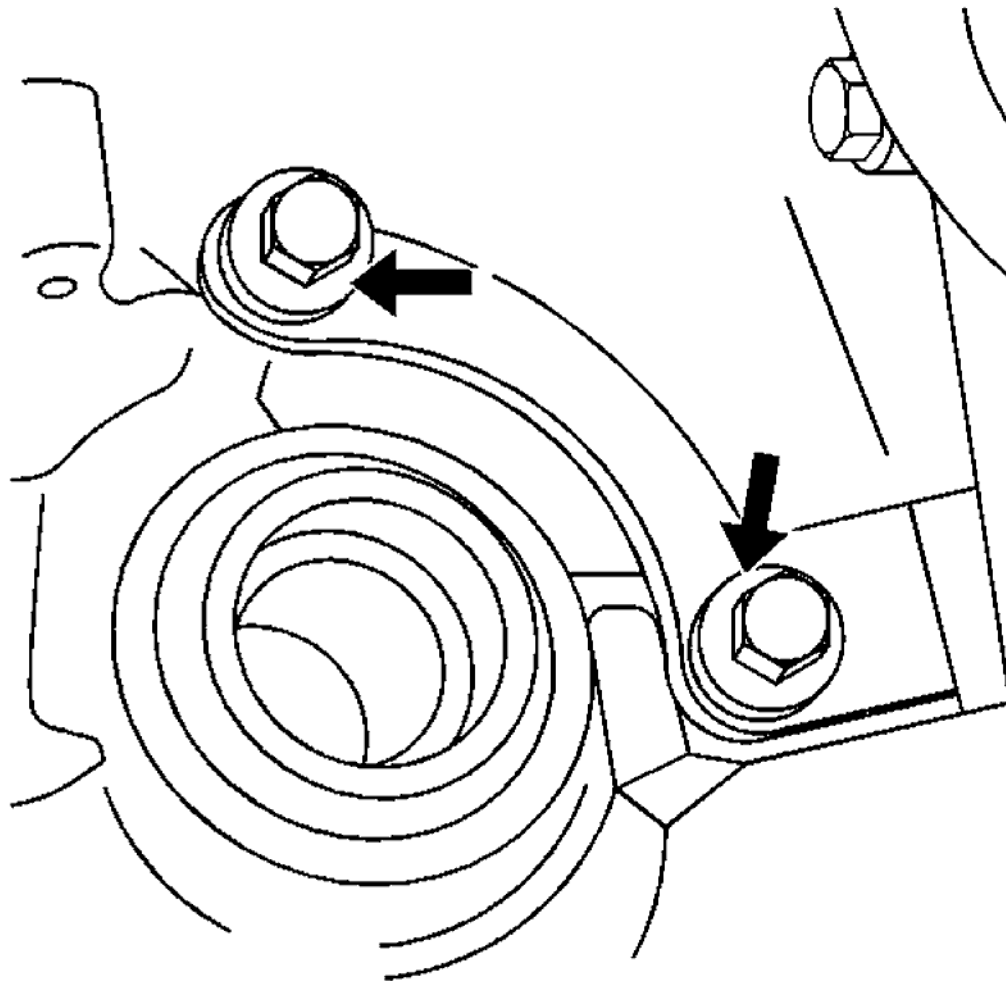


Fig. 214: Identifying Transmission-To-Engine Brace Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the 2 bolts from the transmission brace.

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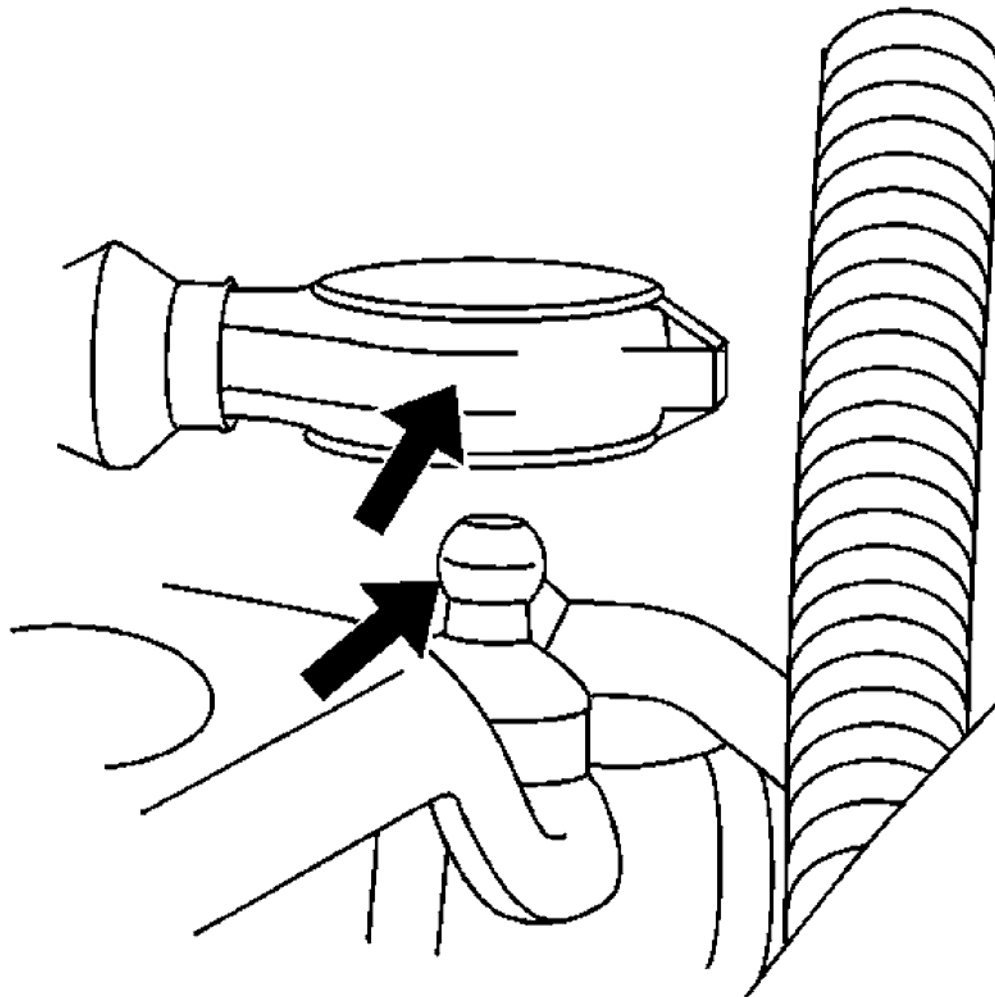


Fig. 215: View Of Shift Cable & Shift Linkage
Courtesy of GENERAL MOTORS CORP.

14. Disconnect the shift cable from the shift linkage.
15. Disconnect the cable from the bracket.

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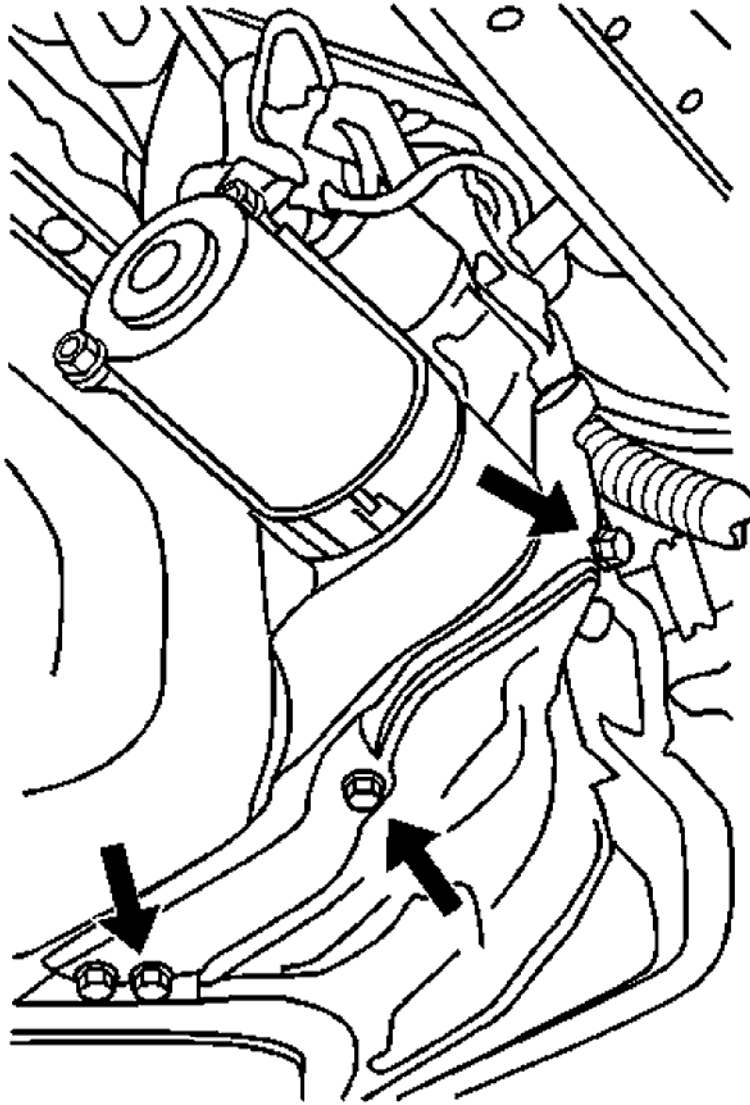


Fig. 216: View Of Flywheel Inspection Cover Bolts
Courtesy of GENERAL MOTORS CORP.

16. Remove the flywheel inspection cover.
17. Remove the starter. Refer to **Starter Motor Replacement**.
18. Mark the relationship of the flywheel to the torque converter for reassembly.
19. Use the **J 43653** to prevent the crankshaft from rotating. See **Special Tools**.

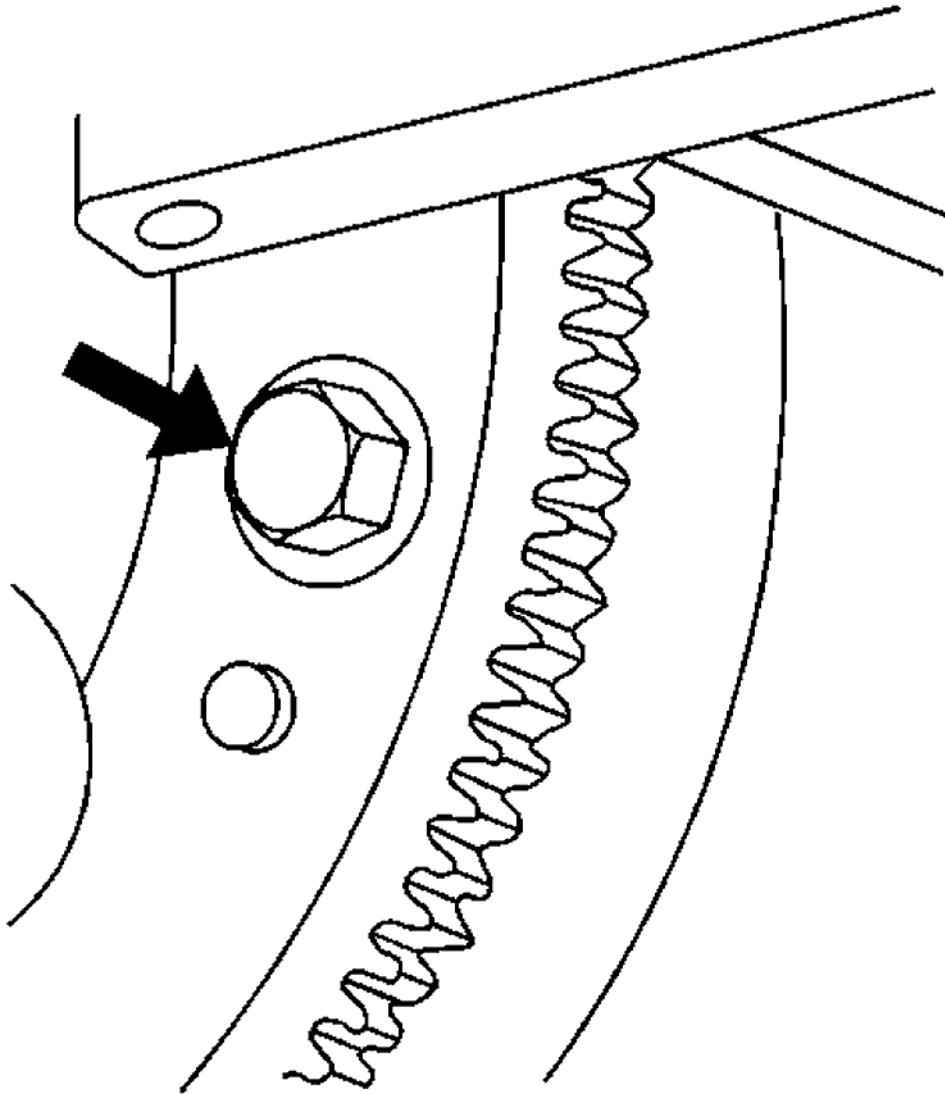


Fig. 217: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

20. Use **J 43653** to remove the torque converter to flywheel bolts. See **Special Tools**.
21. Remove the transmission cooler lines by removing the nut holding the bracket to the transaxle case.

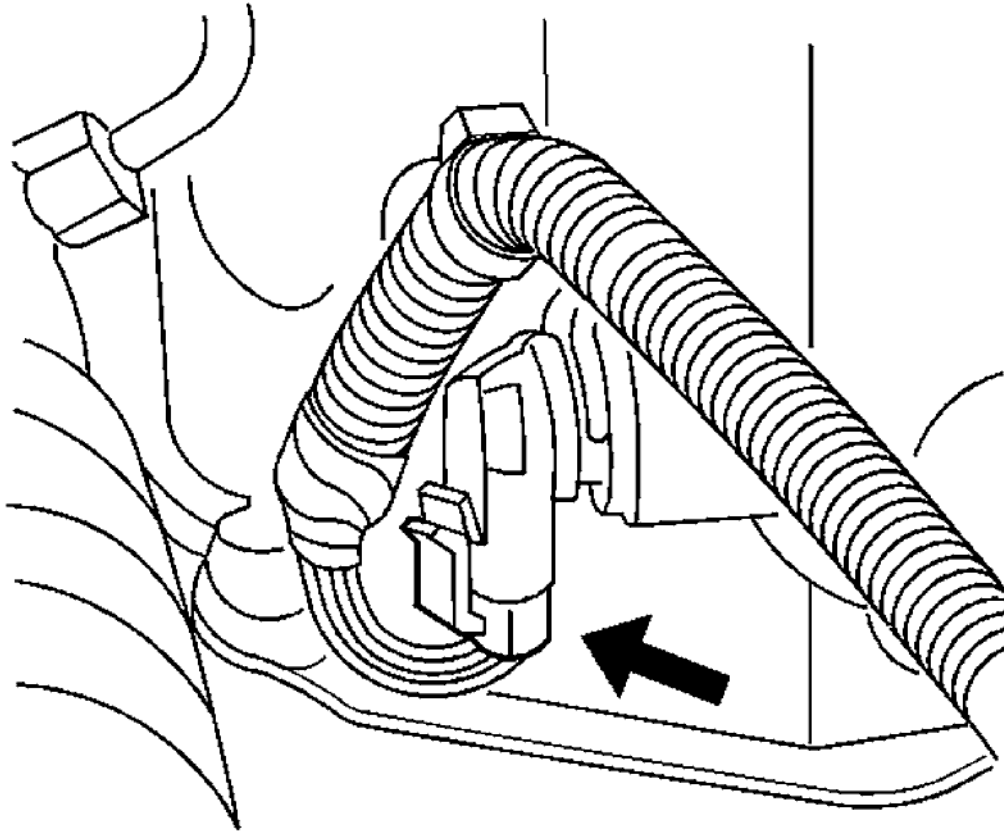


Fig. 218: View Of VSS Wiring Harness
Courtesy of GENERAL MOTORS CORP.

22. Disconnect the VSS wiring harness from the sensor.
23. Disconnect the wheel drive shafts from the transaxle. Refer to **Wheel Drive Shaft Replacement** .
24. Lower the vehicle.
25. Remove the body to transmission mount bolts.
26. Lower the transmission with the engine support fixture enough to remove the transmission.
27. Raise the vehicle.
28. Remove the oil pan to drain the transmission. Refer to **Oil Pan Replacement**.
29. Install the oil pan. Refer to **Oil Pan Replacement**.
30. Support the transmission with a suitable jack.

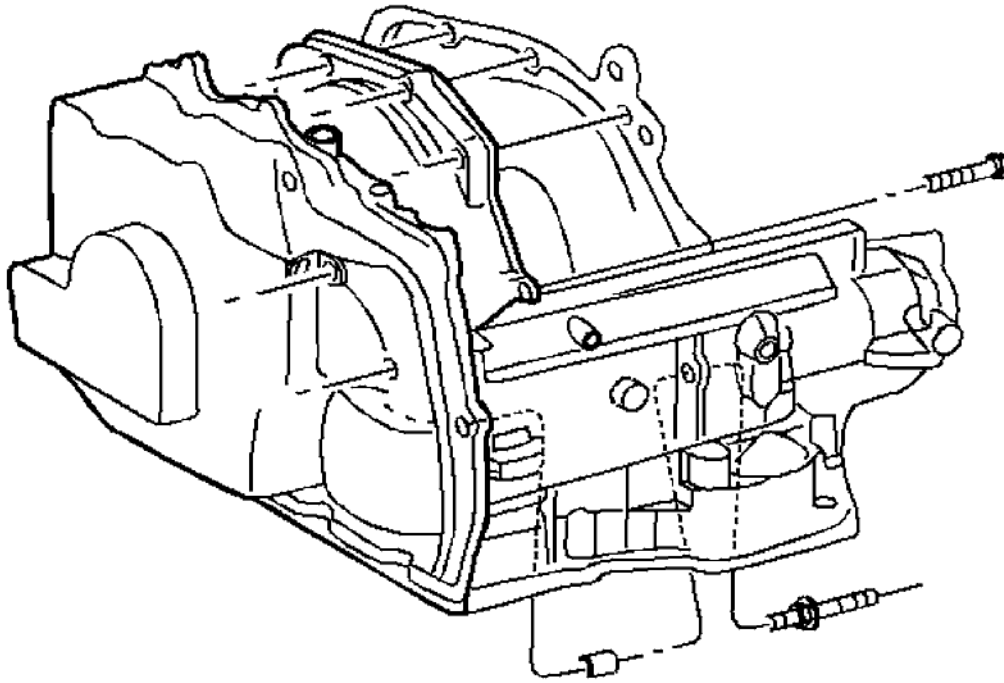


Fig. 219: View Of Lower Transmission To Engine Stud
Courtesy of GENERAL MOTORS CORP.

31. Remove the transaxle to engine nut.
32. Separate the engine and the transaxle.
33. Remove the transaxle from the vehicle.
34. Remove the PNP switch.
35. Remove the shifter cable bracket.
36. Remove the lower transmission to engine stud.
37. Remove the transmission mount.
38. Flush the transmission 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)**.

Installation Procedure

1. Install the PNP switch.
2. Install the shifter cable bracket.
3. Install the lower transmission to engine stud.
4. Install the transmission mount.

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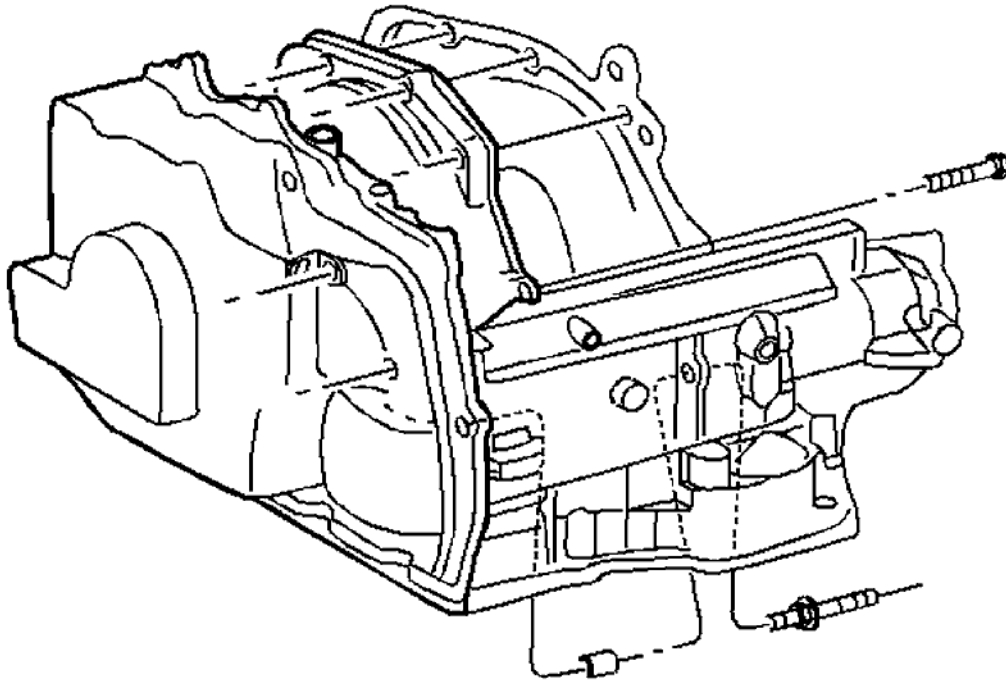


Fig. 220: View Of Lower Transmission To Engine Stud
Courtesy of GENERAL MOTORS CORP.

5. Position the transaxle in the vehicle.

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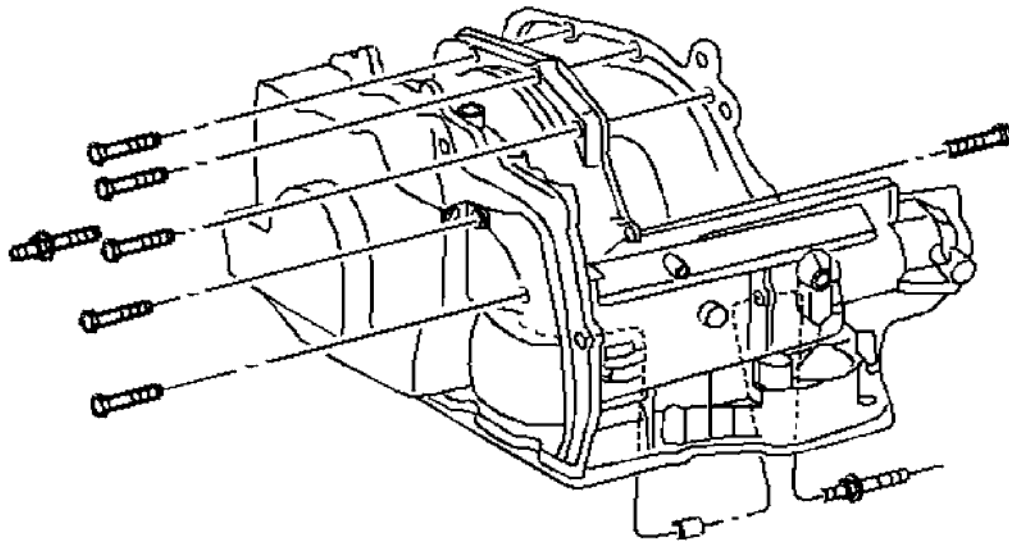


Fig. 221: Identifying Lower Transmission To Engine Bolts And Stud
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

6. Install the lower transmission to engine bolts and nuts.

Tighten: Tighten the bolts and nuts to 90 N.m (66 lb ft).

7. Connect the transaxle cooler pipes to the transaxle.

Tighten: Tighten the cooler pipes to 8 N.m (71 lb in).

8. Use the **J 43653** to prevent the crankshaft from rotating. See Special Tools.

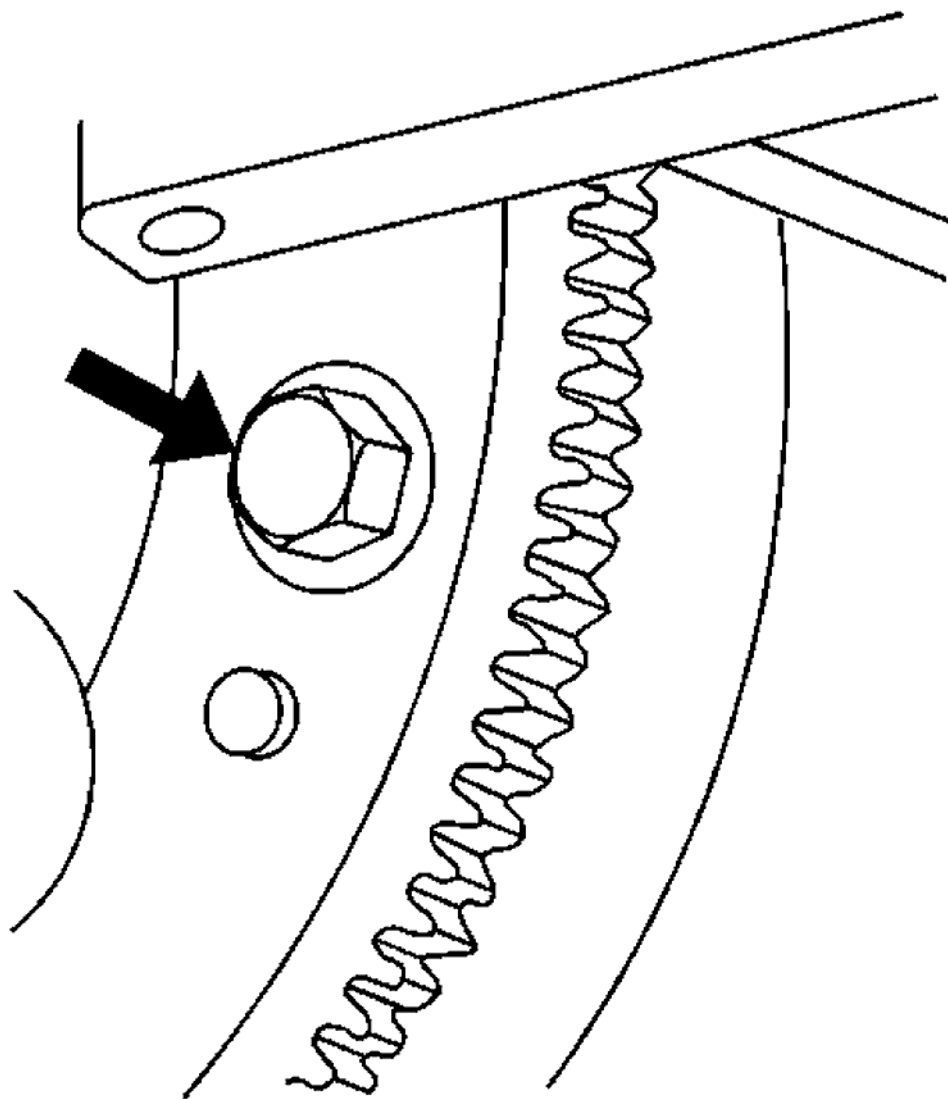


Fig. 222: View Of Flywheel To Torque Converter Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the torque converter to flywheel bolts.

Tighten: Tighten the torque converter bolts to 62 N.m (46 lb ft).

10. Install the wheel drive shafts to the transaxle. Refer to **Wheel Drive Shaft Replacement** .

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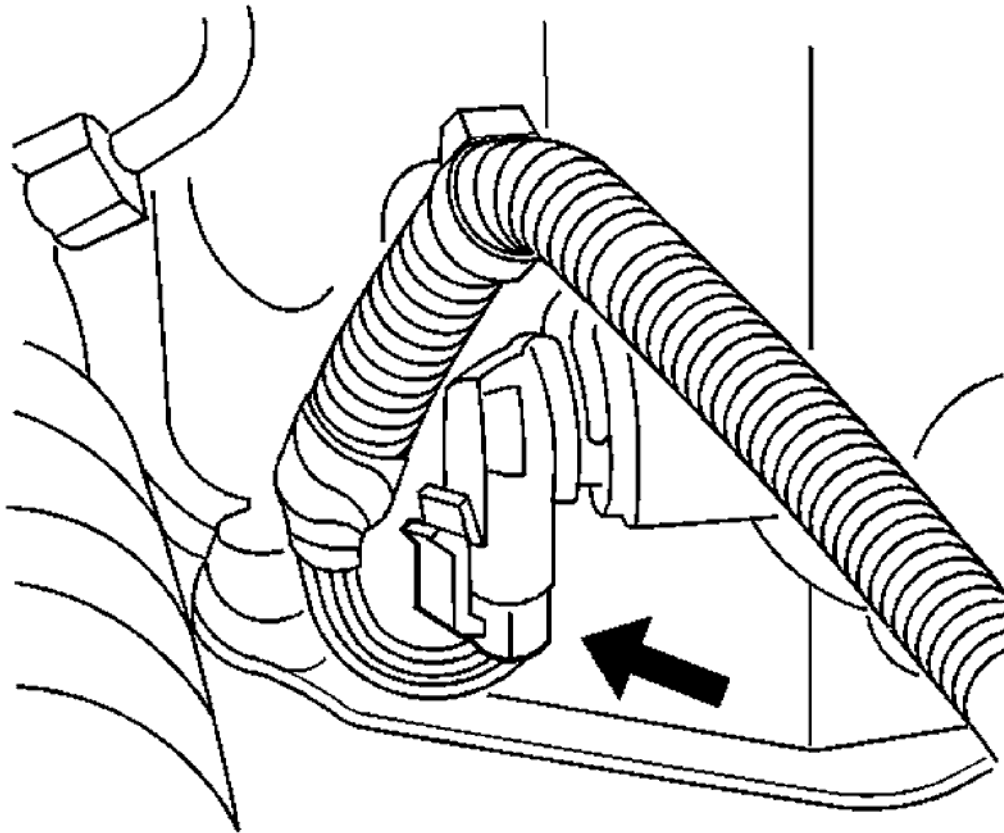


Fig. 223: View Of VSS Wiring Harness
Courtesy of GENERAL MOTORS CORP.

11. Connect the wiring harness to the VSS.

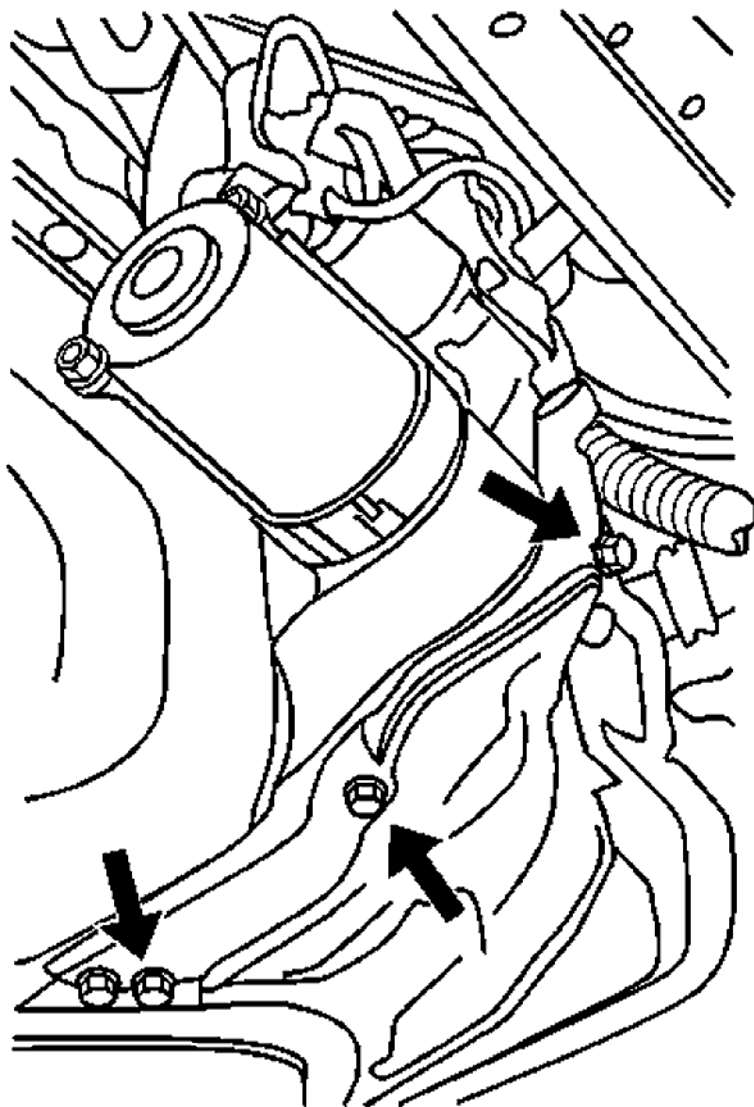


Fig. 224: View Of Flywheel Inspection Cover Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the starter. Refer to **Starter Motor Replacement** .
13. Install the flywheel inspection cover bolts.

Tighten: Tighten the bolts to 10 N.m (89 lb in).

14. Lower the vehicle.
15. Use the engine support fixture to raise the engine and transmission assembly.

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16. Install the transaxle mount to body bolts.

Tighten: Tighten the bolts to 90 N.m (66 lb ft).

17. Raise the vehicle.

18. Install the frame. Refer to **Frame Replacement**.

19. Connect the ball joints to the steering knuckles. Refer to **Lower Ball Joint Replacement**.

20. Route and clip the wheel speed sensor wiring into the proper position on both sides.

21. Install the steering gear to the front suspension crossmember.

22. Install the steering gear bolts to the front suspension crossmember.

Tighten: Tighten the bolts to 110 N.m (81 lb ft).

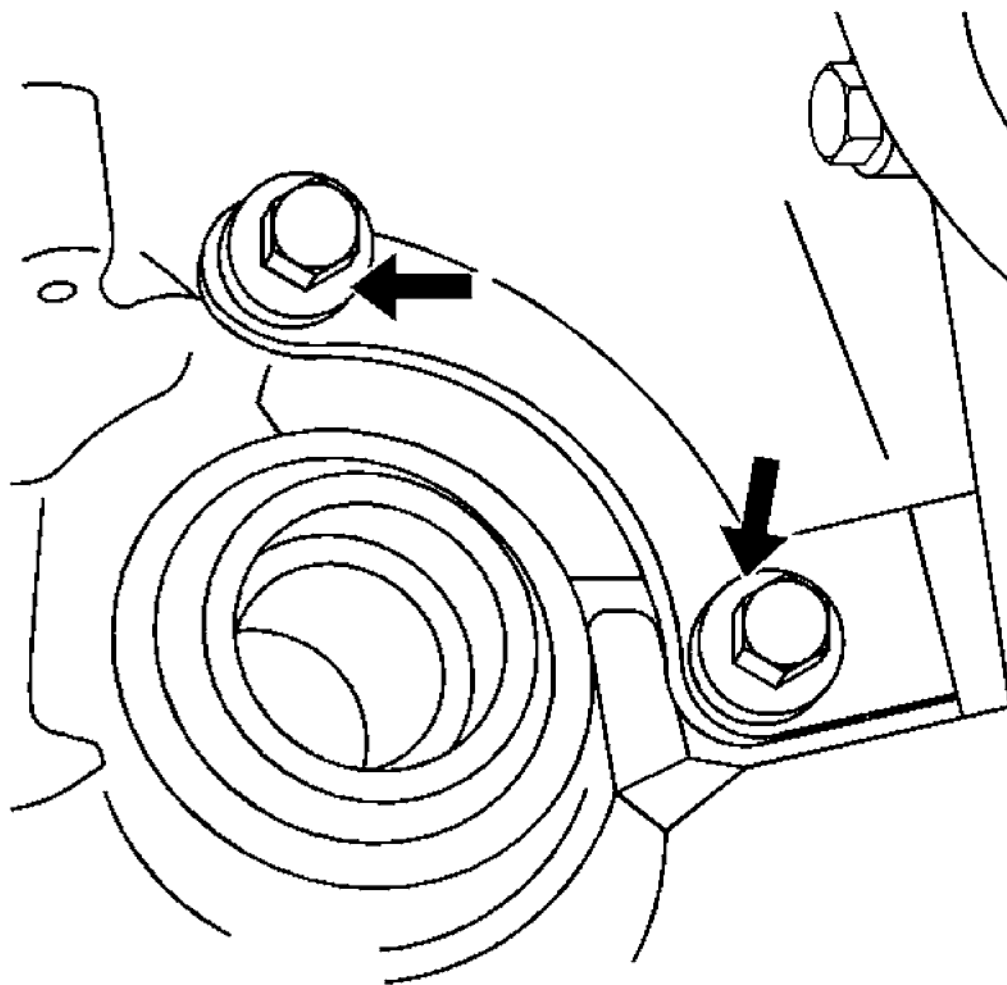


Fig. 225: Identifying Transmission-To-Engine Brace Bolts
Courtesy of GENERAL MOTORS CORP.

23. Install the transmission to engine brace bolts.

Tighten: Tighten the bolts to 72 N.m (53 lb ft).

24. Install the both front fender liners. Refer to **Wheelhouse Liner Replacement - Front**.
25. Install the front wheel and tire assemblies. Refer to **Tire and Wheel Removal and Installation**.
26. Lower the vehicle.

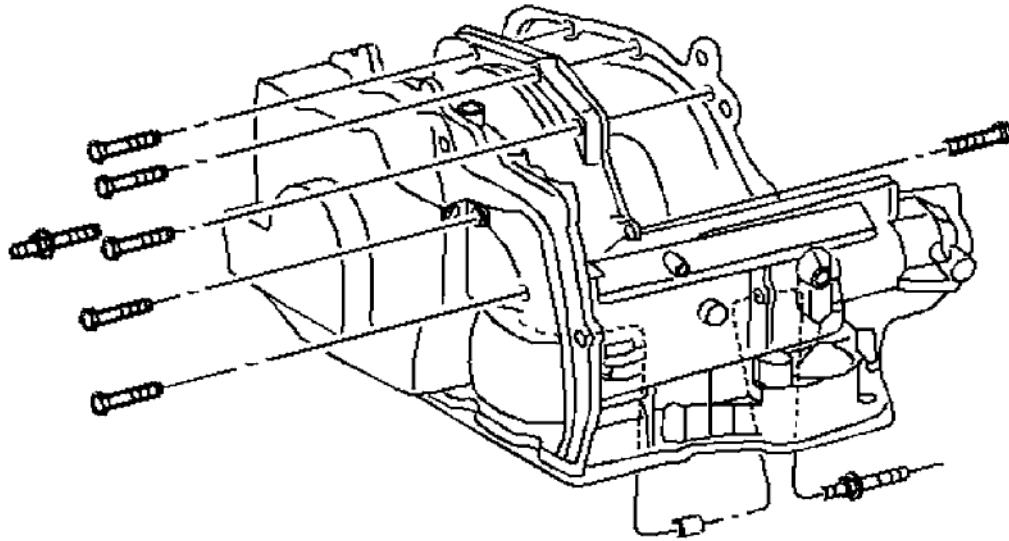


Fig. 226: Identifying Lower Transmission To Engine Bolts And Stud
Courtesy of GENERAL MOTORS CORP.

27. Install the upper transmission to engine bolts and stud.

Tighten: Tighten all of the bolts to 90 N.m (66 lb ft).

28. Install the engine wiring harness grounds to the transaxle to engine mount stud and nut.

Tighten: Tighten the nut to 8 N.m (71 lb in).

29. Remove the engine support fixture. Refer to **Engine Support Fixture** for the 2.2 L (L61) engine.

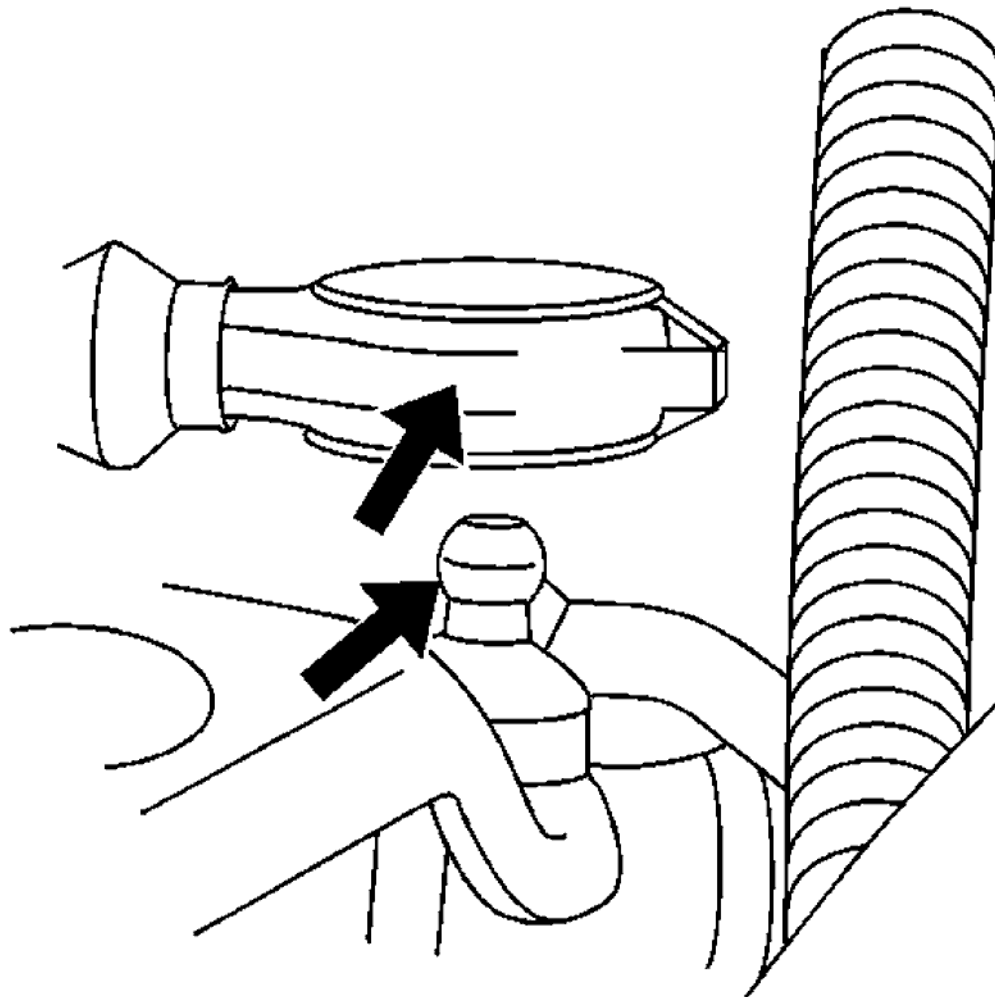


Fig. 227: View Of Shift Cable & Shift Linkage
Courtesy of GENERAL MOTORS CORP.

30. Install the shift linkage to the transmission.

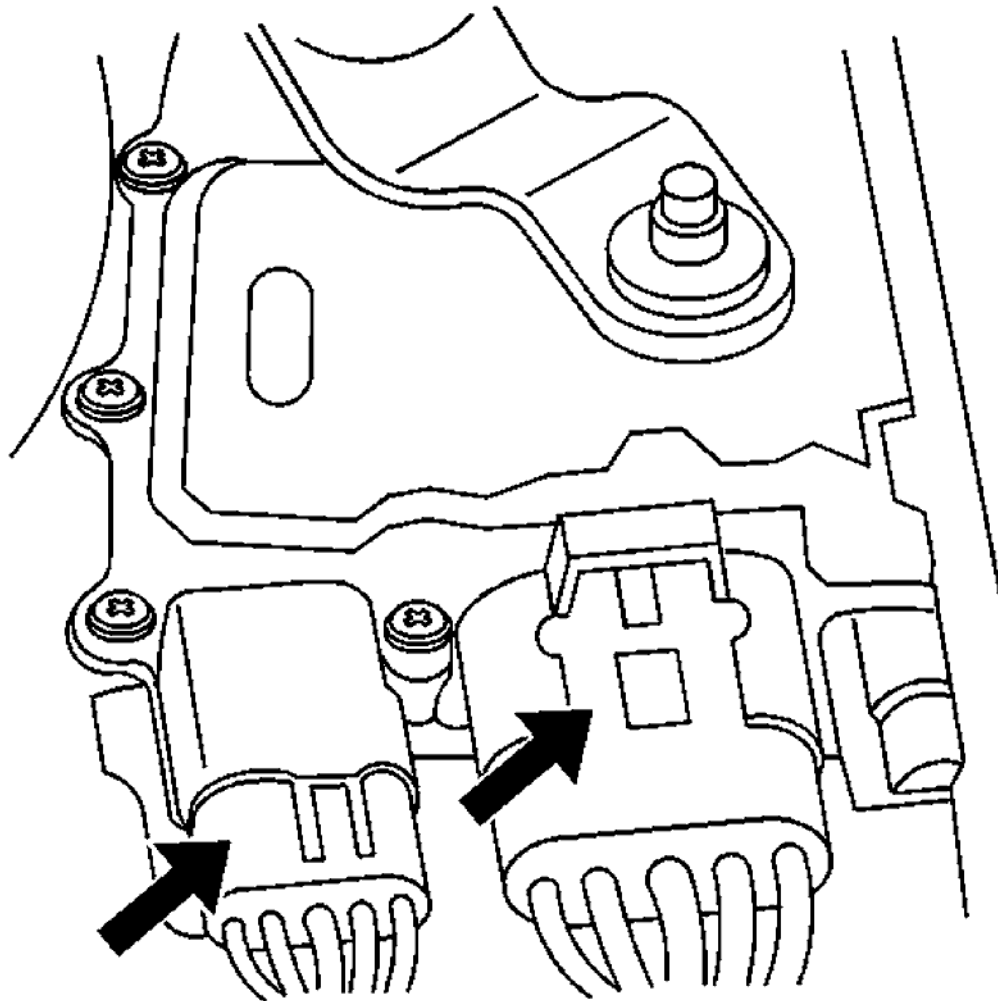


Fig. 228: Locating Transaxle & PNP Switch Connectors
Courtesy of GENERAL MOTORS CORP.

31. Connect the electrical connectors to the PNP switch and transaxle.
32. Connect the air duct hose to the intake plenum.
33. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure**.
34. Inspect the transmission fluid level.

DESCRIPTION AND OPERATION

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 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 the Transmission Unit Repair Manual (TURM) 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 gage 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

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Engine Braking

A condition where the engine 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.

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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

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Diagnostic Trouble Code

EBTCM

Electronic Brake/Traction Control Module

ECCC

Electronically-Controlled Capacity Clutch

ECT

Engine Coolant Temperature

EMI

Electromagnetic Interference

IAT

Intake Air Temperature

IGN

Ignition

ISS

Input Speed Sensor

MAP

Manifold Absolute Pressure

MIL

Malfunction Indicator Lamp

NC

Normally Closed

NO

Normally Open

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OBD

On Board Diagnostic

OSS

Output 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

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Throttle Position

VSS

Vehicle Speed Sensor

WOT

Wide Open Throttle

TRANSMISSION IDENTIFICATION INFORMATION

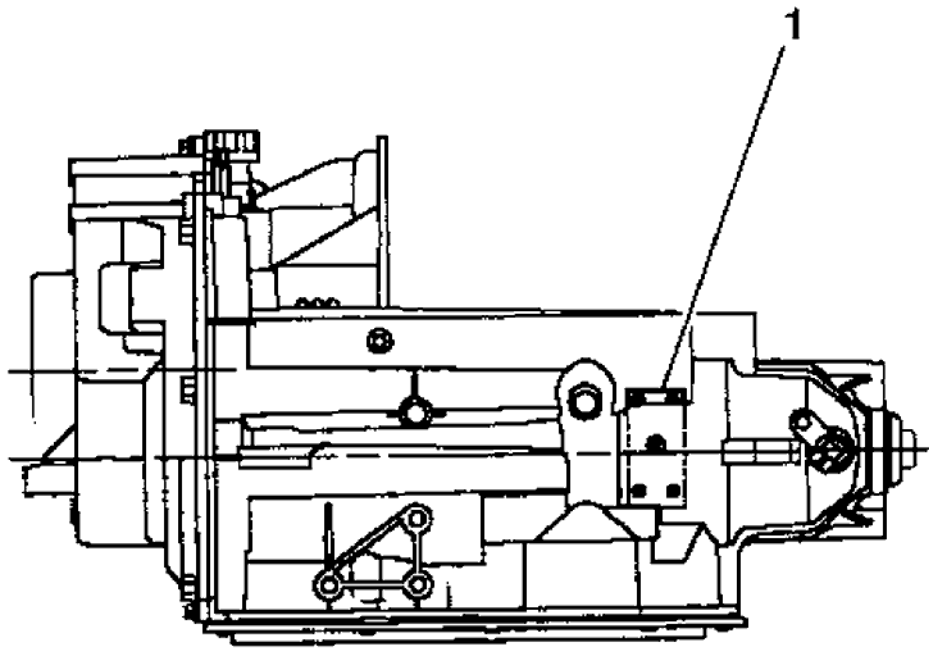


Fig. 229: Locating Transmission Metal Identification (ID) Nameplate
Courtesy of GENERAL MOTORS CORP.

All automatic transmissions have a metal identification (ID) nameplate (1) attached to the case exterior.

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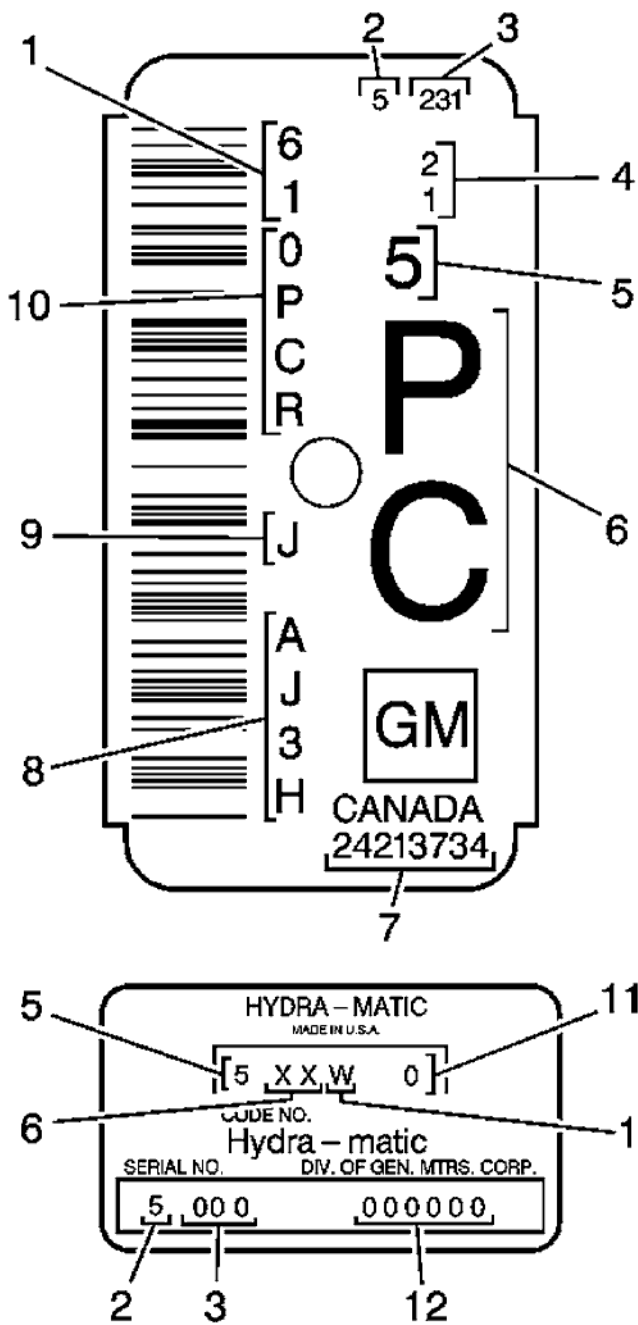


Fig. 230: A/T Metal Identification (ID) Plate
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 230

Callout	Component Name
1	Transaxle

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1	Transaxle
2	Calendar Year
2	Calendar Year
3	Julian Date or Day of the Year
3	Julian Date or Day of the Year
4	Shift and Line Number
5	Model Year
5	Model Year
6	Model
6	Model
7	Part Number
8	Serial Number in Base Code 34
9	Plant
10	Broadcast Code
11	Control Number
12	Serial Number

The Hydra-Matic 4T40-E transmission has a metal identification nameplate (1) attached to the case exterior.

The information on the nameplate assists the technician in servicing the transmission and ordering replacement parts from a GM Parts Catalog.

Additional transmission identification information is provided on the Service Parts Identification label. This label shows the Regular Production Options (RPO) as well as the standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant.

TRANSMISSION GENERAL DESCRIPTION

The 4T40-E is a fully automatic front wheel drive electronically controlled transmission. The 4T40-E provides four forward ranges including overdrive and one reverse gear range. The PCM controls shift points by means of two shift solenoids. A vane type pump supplies the oil pressure. The PCM regulates oil pressure by means of the Pressure Control Solenoid (PCS).

You can operate the transmission in any one of the following seven modes:

- P - Park position prevents the vehicle from rolling either forward or backward. For safety reasons, use the parking brake in addition to the park position.
- R - Reverse allows the vehicle to be operated in a rearward direction.
- N - Neutral allows the engine to be started and operated while driving the vehicle. If

necessary, you may select this position in order to restart the engine with the vehicle moving.

- D - Overdrive is used for all normal driving conditions. Overdrive provides four gear ratios plus a converter clutch operation. Depress the accelerator in order to downshift for safe passing.
- 3 - Drive position is used for city traffic, hilly terrain, and trailer towing. Drive provides three gear ranges and prevents the transmission from operating in fourth gear. Depress the accelerator in order to downshift.
- 2 - Manual Second provides two gear ratios under most operating conditions. Manual Second provides acceleration and engine braking. You may select this range at any vehicle speed, but you cannot downshift the transmission into Second gear until the vehicle speed drops below approximately 100 km/h (62 mph).
- 1 - Manual Lo provides maximum engine braking. You may select this range at any vehicle speed, but you cannot downshift the transmission into First gear until the vehicle speed drops below approximately 60 km/h (37 mph).

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of this unit 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 chugle 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.

- A drive link assembly
- Intermediate/4th and Lo/Reverse friction band assemblies
- Forward, Coast, 2nd, Reverse, and Direct multiple disc clutch assemblies
- Two planetary gear sets: Input and Reaction
- Two roller clutches - Lo and 2nd
- One sprag clutch
- One vane type oil pump
- One control valve assembly
- A final drive and differential assembly

The electrical components of this unit are as follows:

- Two shift solenoid valves, 1-2 and 2-3
- A torque converter clutch pulse width modulated (TCC PWM) solenoid valve
- A transmission pressure control (PC) solenoid valve
- An automatic transmission fluid temperature (TFT) sensor
- Two speed sensors: input and output speed sensor
- An automatic transmission fluid pressure (TFP) manual valve position switch assembly
- An automatic transmission wiring harness assembly
- A park/neutral position (PNP) switch

For more information refer to **Electronic Component Description**.

TRANSMISSION ADAPTIVE FUNCTIONS

The 4T40 automatic transmission uses a line pressure control system, which has the ability to continuously adapt the system line pressure. This compensates for normal wear of the following parts:

- The clutch fiber plates
- The seals
- The springs

The powertrain control module (PCM) maintains the Upshift Adapt parameters for the transmission. The PCM monitors the input speed sensor (ISS) and the output speed sensor (OSS) during commanded shifts in order to determine if a shift is occurring too fast or too slow. The PCM adjusts the signal from the transmission pressure control (PC) solenoid in order to maintain a set shift feel.

Transmission adapts must be set again when the transmission is overhauled or replaced. In order to set the transmission adapts again, select the following:

1. Scan Tool
2. Transmission/Transaxle
3. Special Functions
4. Reset Transmission Adapts

ELECTRONIC COMPONENT DESCRIPTION

Transmission Control Module

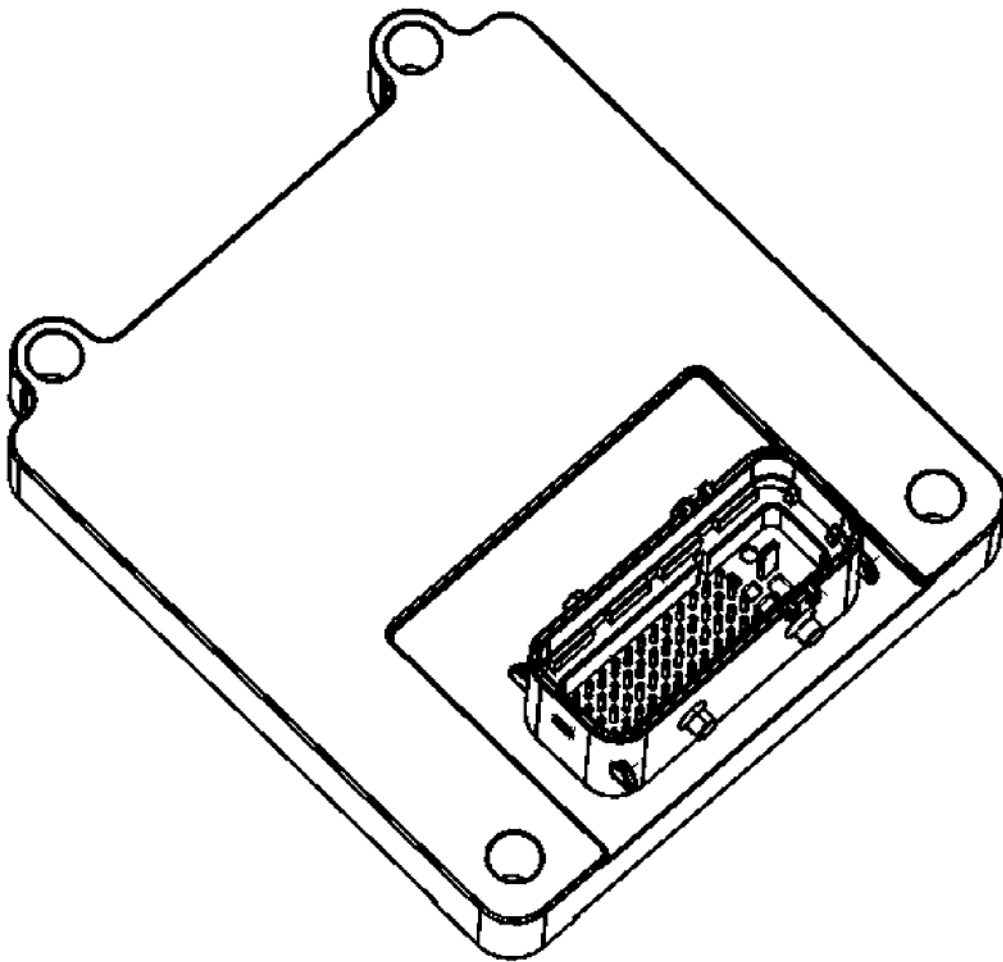


Fig. 231: Transmission Control Module (TCM)
Courtesy of GENERAL MOTORS CORP.

The transmission control module (TCM) is mounted in the engine compartment and connects directly to the engine wiring harness. A single 49-way connector is used to make the connection between the vehicle wiring and the TCM. The TCM is an electronic control module that receives input or provides output in order to control the operation of the 4T45-E automatic transmission.

The TCM receives the following inputs from the engine control module (ECM):

- Engine speed and torque values
- Engine intake air temperature (IAT), accelerator pedal position (APP) information
- Engine coolant temperature (ECT)

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- Kick-down request
- Traction control status
- Air-conditioning (A/C) status
- Cruise control status

The ECM provides this data to the TCM through the controller area network (CAN). The CAN is a 2-wire communication connection between the 2 controllers.

Other TCM inputs are the following:

- Battery and ignition voltage
- Brake switch status
- Transmission manual range switch
- Transmission fluid temperature (TFT)
- Transmission input speed sensor (ISS)
- Transmission output speed sensor (OSS)

The TCM provides the following outputs in order to control the automatic transmission:

- Shift solenoids to control transmission shifting
- TCC PWM solenoid operation to control the apply and release of the torque converter clutch ASM
- Pressure control solenoid (PCS) to regulate transmission line pressure

Other TCM outputs provided to the ECM are the following:

- MIL illumination request
- Vehicle speed
- Transmission input speed
- Transmission fluid temperature
- Commanded gear status
- TCC status
- Torque reduction requests

Torque Converter Clutch Pulse Width Modulated Solenoid Valve

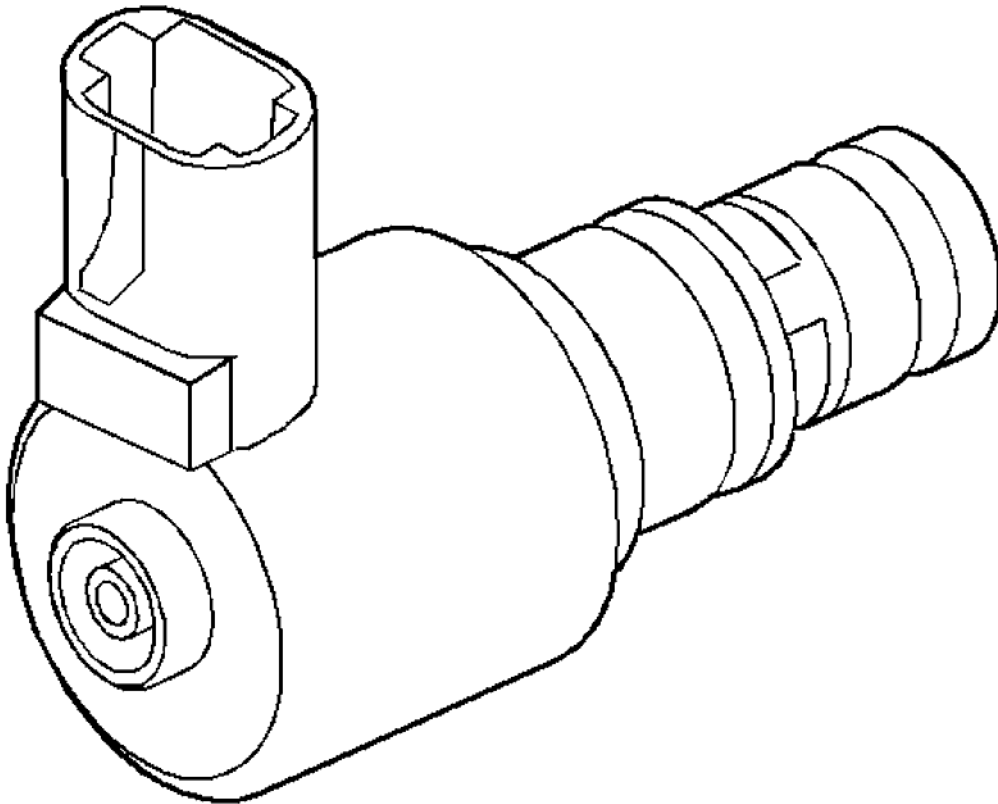


Fig. 232: Torque Converter Clutch Pulse Width Modulated Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

The torque converter clutch (TCC) solenoid valve is a normally closed, pulse width modulated (PWM) solenoid used to control the apply and release of the converter clutch. The powertrain control module (PCM) operates the solenoid with a negative duty cycle at a fixed frequency of 42 Hz to control the rate of TCC apply/release. The solenoid's ability to ramp the TCC apply and release pressures results in smoother TCC operation.

When vehicle operating conditions are appropriate to apply the TCC, the PCM immediately increases the duty cycle to approximately 42 percent. The PCM then ramps the duty cycle up to approximately 90 percent to achieve full TCC apply pressure. The rate at which the PCM increases the duty cycle controls the TCC apply. Similarly, the PCM also ramps down the TCC solenoid duty cycle to control the TCC release.

Some operating conditions prevent or enable the TCC apply under various conditions. Also if the PCM receives a high voltage signal from the brake switch, indicating that the brake pedal is depressed, the PCM immediately releases the TCC.

Note that the duty cycles in the graph are for example only. Actual duty cycles vary depending on the vehicle application and the vehicle operating conditions.

The TCC solenoid valve resistance should measure between 10-11 ohms when measured at 20°C (68°F). The resistance would measure approximately 16 ohms at 150°C (300°F).

Automatic Transmission Pressure Control Solenoid Valve

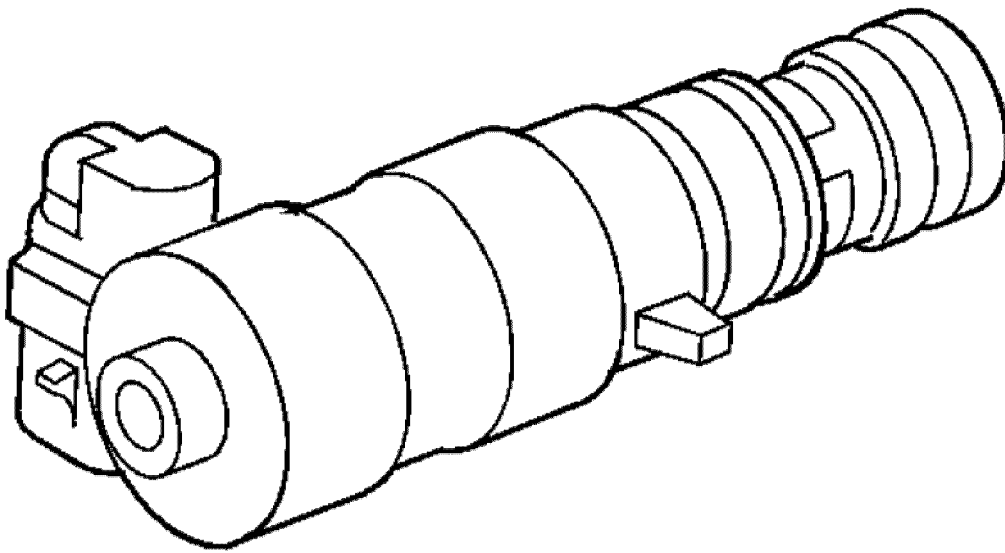


Fig. 233: View Of Pressure Control Solenoid Valve
Courtesy of GENERAL MOTORS CORP.

The pressure control (PC) solenoid valve is a precision electronic pressure regulator that controls the transmission line pressure. This control is based on the flow of current through the coil windings of the valve. As the flow of current is increased, the magnetic field which is produced by the coil moves the solenoid's plunger further away from the exhaust port. Opening the exhaust port decreases the output fluid pressure regulated by the PC solenoid valve, which ultimately decreases line pressure.

The powertrain control module (PCM) controls the PC solenoid valve based on various inputs, including throttle position, fluid temperature, manifold absolute pressure (MAP) sensor, and gear state.

The PCM controls the PC solenoid valve on a positive duty cycle at a fixed frequency of 614 Hz. Duty cycle is defined as the percent of time current is flowing through the solenoid coil during each cycle. A higher duty cycle provides a greater current flow through the solenoid.

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The high, positive, side of the PC solenoid valve electrical circuit at the PCM controls the PC solenoid valve operation. The PCM provides a ground path for the circuit, monitors average current and continuously varies the PC solenoid valve duty cycle to maintain the correct average current flowing through the PC solenoid valve.

Electronic Component Description

Duty Cycle	Current	Line Pressure
+5%	0.02 amps	Maximum
+40%	1.1 amps	Minimum

The resistance on the PC solenoid valve should measure between 3-5 ohms at 20°C (68°F).

Shift Solenoid Valves: 1-2 and 2-3

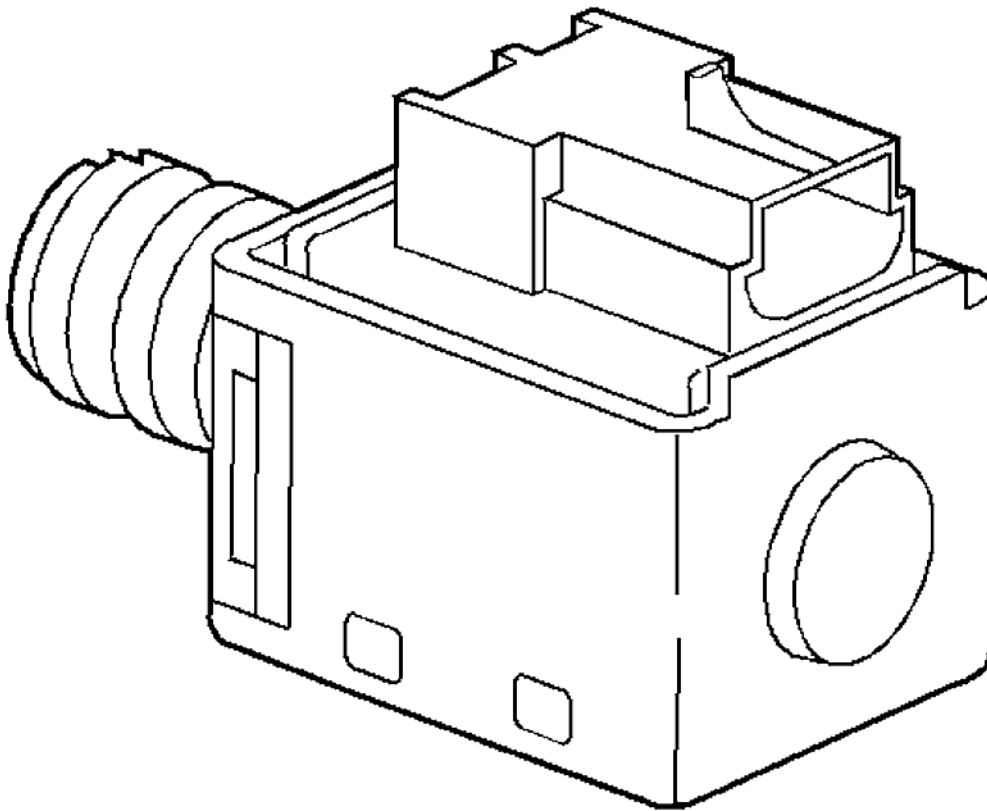


Fig. 234: Shift Solenoid Valves
Courtesy of GENERAL MOTORS CORP.

The shift solenoid valves are two identical, electronic exhaust valves that control upshifts

and downshifts in all forward gear ranges. These valves are normally open. These shift solenoid valves work together in a combination of ON and OFF sequences in order to control the positions of the 1-2, 2-3, and 3-4 shift valve trains. The powertrain control module (PCM) monitors numerous inputs to determine the appropriate solenoid state combination and transmission gear for the vehicle operating conditions.

Electronic Component Description

Gear	Solenoid 1-2	Solenoid 2-3
PARK, REVERSE, NEUTRAL*	ON	OFF
FIRST	ON	OFF
SECOND	OFF	OFF
THIRD	OFF	ON
FOURTH	ON	ON

IMPORTANT: The solenoid states are normally ON (1-2) and OFF (2-3) in the P, R, and N gears. However, these may change based on the vehicle speed and the throttle position.

The PCM energizes the shift solenoid valves by providing a ground to the solenoid's electrical circuit. This sends current through the coil winding of the solenoid, thereby creating a magnetic field. The magnetic field repels the plunger inside the solenoid. This seats the solenoid metering ball against the fluid inlet port. This action prevents the exhaust of fluid through the solenoid. It then provides an increase in fluid pressure at the end of the shift valves. This fluid pressure initiates an upshift by moving the shift valves. Refer to the oil flow diagrams in Unit Repair for a complete description of the hydraulic control of the shift valves for each gear range.

The resistance on the shift solenoid valves should measure between 19-24 ohms when measured at 20°C (68°F) and between 24-31 ohms when measured at 88°C (190°F).

The shift solenoid valves should energize when the voltage is greater than 7.5 volts. The shift solenoid valves should de-energize when the voltage is less than one volt.

Automatic Transmission Fluid Pressure Manual Valve Position Switch Assembly

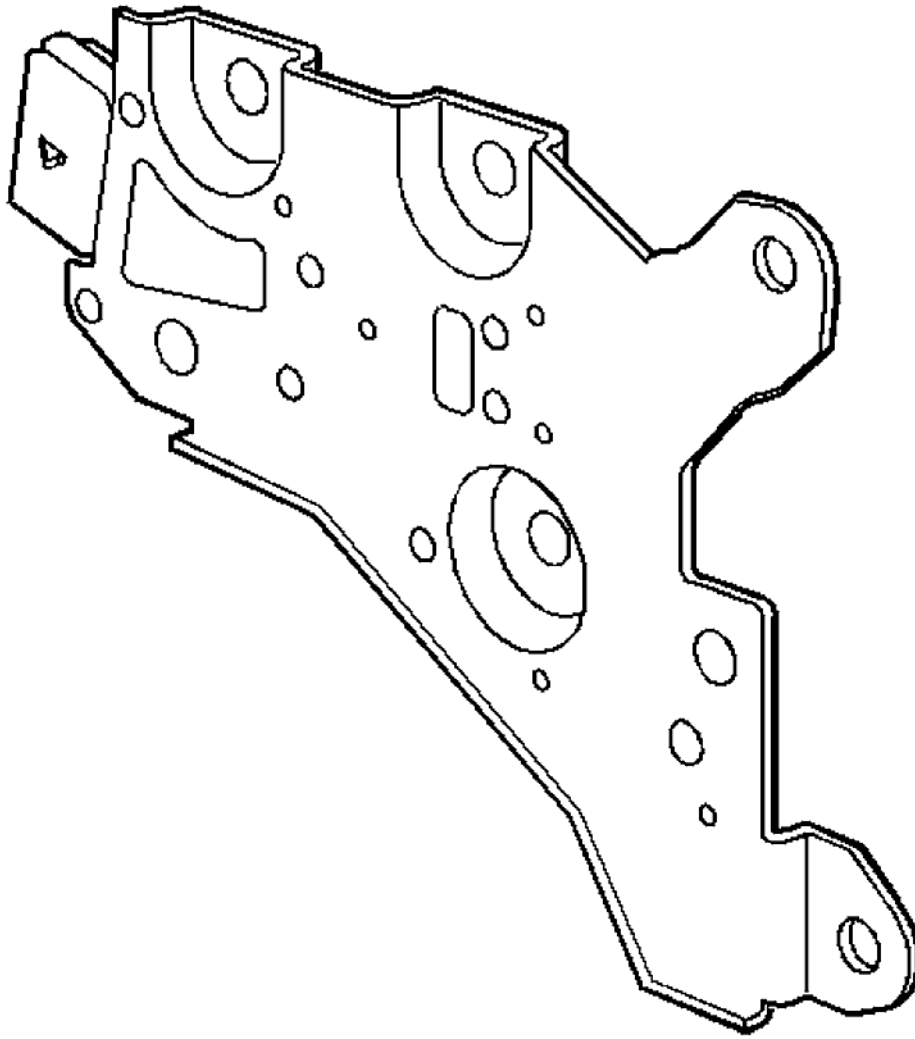


Fig. 235: Automatic Transmission Fluid Pressure Manual Valve Position Switch Assembly

Courtesy of GENERAL MOTORS CORP.

The automatic transmission fluid pressure (TFP) manual valve position switch assembly is attached to the control valve body. This assembly contains three fluid pressure switches and the automatic transmission fluid temperature sensor.

2 of the fluid pressure switches are normally-open. These are used to indicate the position of the manual valve. The powertrain control module (PCM) uses this information to control line pressure, torque converter clutch (TCC) apply and release and shift solenoid operation.

The release pressure switch is used as a diagnostic tool to confirm that the TCC is actually OFF when it has been commanded OFF by the PCM. This switch is normally-closed.

Each fluid pressure switch produces either an open or a ground to the PCM depending on the presence of fluid pressure at the switches. The sequence of open and closed switches produces a combination of voltage readings. The PCM monitors these readings.

The PCM measures TFP manual valve position switch signal voltage from each pin to ground and compares the voltage to a TFP manual valve position switch combination table stored in the PCM memory. If the PCM does not recognize the switch sequence, a diagnostic code will be set as a result. A diagnostic code may also set if the TFP manual valve position switch sequence indicates a gear range selection that conflicts with other sensory inputs to the PCM.

Fluid Pressure and Circuit Combination

Range Indicator	Fluid Pressure		Circuit	
	REV	DR	B	C
PARK/NEUTRAL	1	1	HI	HI
REVERSE	1	0	HI	LOW
OVERDRIVE	0	1	LOW	HI
Manual THIRD	0	1	LOW	HI
Manual SECOND	0	1	LOW	HI
Manual FIRST	0	1	LOW	HI
• 1 = Pressurized • 0 = Exhausted • LOW = 0 volts • HI = Ignition voltage				

Valid combinations for circuits B and C are shown in the table. LOW means that the switch is grounded with a resistance less than 50 ohms at 0 volts; HI means that the switch is open with a resistance greater than 50 K ohms at 12 volts.

Note that resistance should be measured with the engine running. When the transmission's pass through connector is disconnected from the vehicle harness while the engine is running, multiple diagnostic codes will set. Clear these codes when you are finished with this procedure.

Output Speed Sensor (OSS)

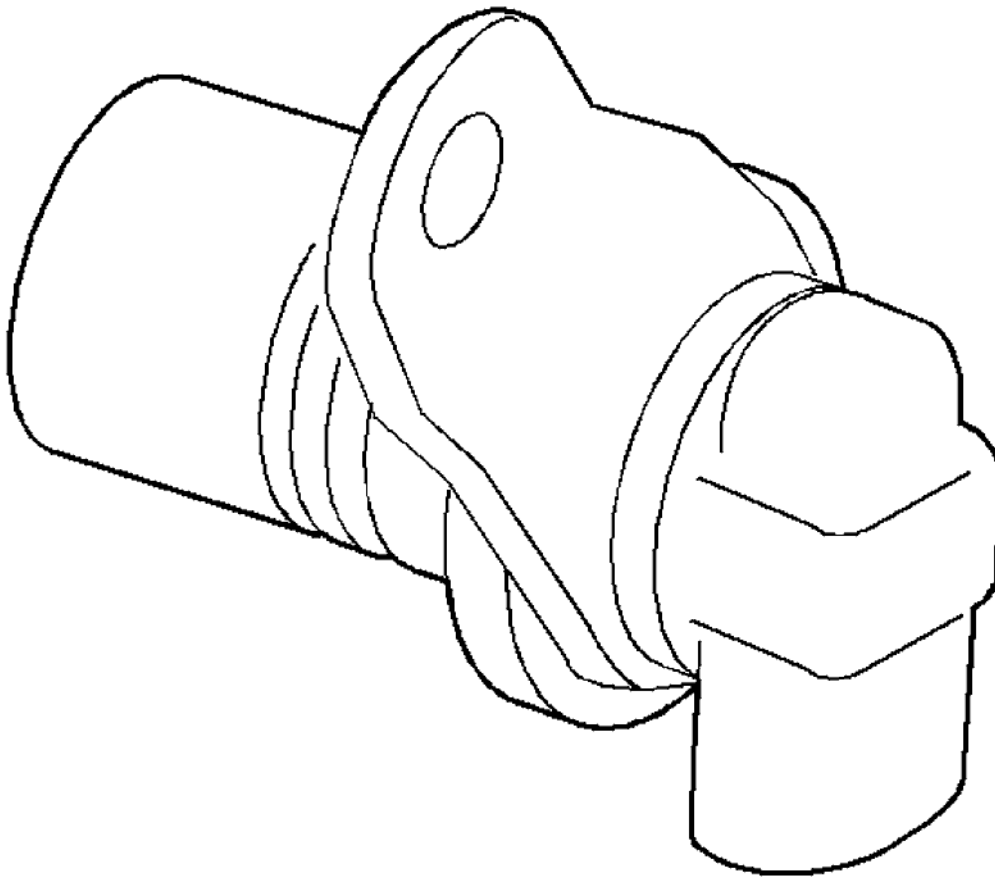


Fig. 236: Output Speed Sensor (OSS)
Courtesy of GENERAL MOTORS CORP.

The automatic transmission output speed sensor (OSS) is a magnetic inductive pickup that relays information relative to vehicle speed to the powertrain control module (PCM). Vehicle speed information is used by the PCM to control shift timing, line pressure, and torque converter clutch (TCC) apply and release.

The OSS mounts in the case at the speed sensor rotor which is pressed onto the differential. An air gap of 0.27-1.57 mm (0.011-0.062 in) is maintained between the sensor and the teeth on the speed sensor rotor. The sensor consists of a permanent magnet surrounded by a coil of wire. As the differential rotates, an AC signal is induced in the OSS. Higher vehicle speeds induce a higher frequency and voltage measurement at the sensor.

Sensor resistance should be 1500-1750 ohms when measured at 20°C (68°F). Output voltage will vary with speed from a minimum of 0.5 volts AC at 25 RPM to 200 volts AC at 1728 RPM.

Input Speed Sensor (ISS)

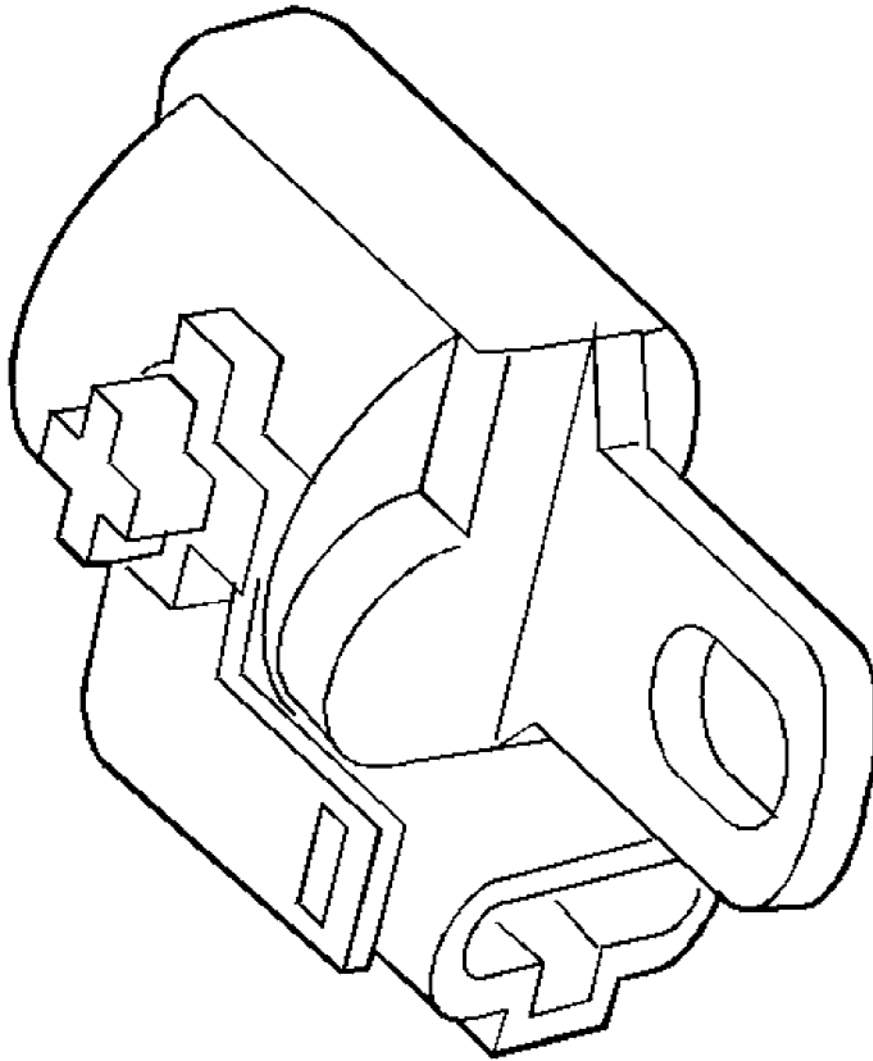


Fig. 237: Input Speed Sensor (ISS)
Courtesy of GENERAL MOTORS CORP.

The automatic transmission input speed sensor (ISS) is a magnetic inductive pickup that relays information about the transmission input speed to the powertrain control module (PCM). The PCM uses this information to control the line pressure, torque converter clutch (TCC) apply and release, and the transmission shift patterns. This information is also used to calculate the appropriate operating gear ratios and TCC slippage.

The ISS mounts on the transmission case under the channel plate next to the drive sprocket.

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An air gap of 0.26-2.90 mm (0.010-0.114 in) is maintained between the sensor and the teeth of the drive sprocket. The sensor consists of a permanent magnet surrounded by a coil of wire. As the drive sprocket is driven by the turbine shaft, an AC signal is induced in the ISS. Higher engine speeds induce a higher frequency and voltage measurement at the sensor.

Sensor resistance should be 625-725 ohms when measured at 20°C (68°F). Output voltage will vary with speed from a minimum of 0.5 volts AC at 550 RPM, to 200 volts AC at 7000 RPM.

Automatic Transmission Fluid Temperature Sensor

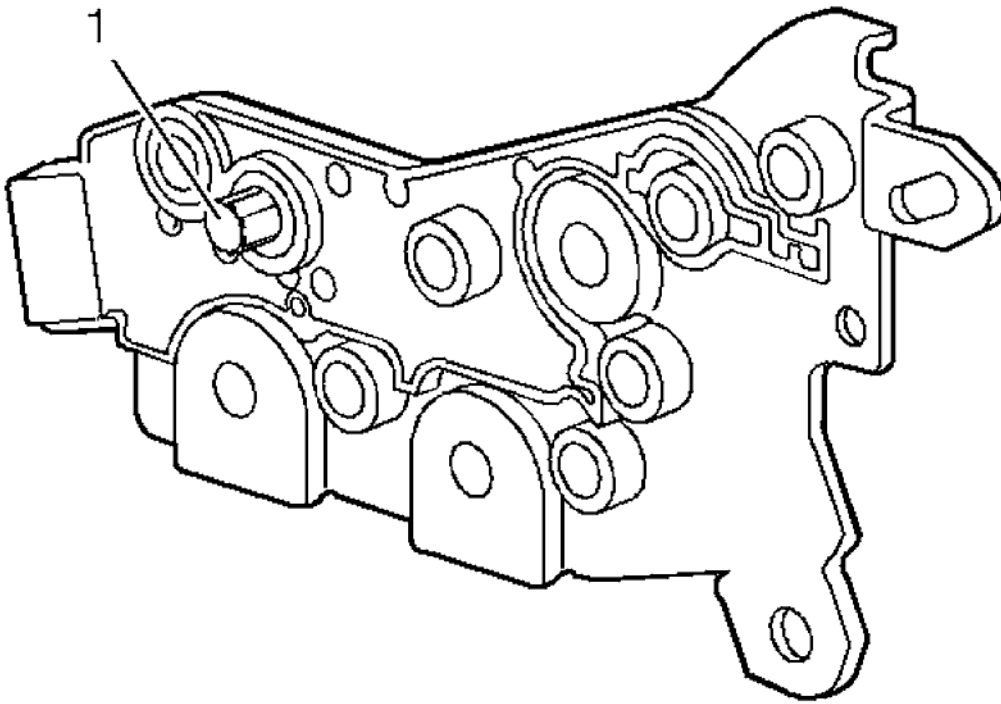


Fig. 238: Automatic Transmission Fluid Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

The automatic transmission fluid temperature (TFT) sensor is a negative temperature coefficient thermistor that provides information to the powertrain control module (PCM) regarding the temperature of the transmission fluid. The TFT sensor (1) is integrated in the automatic transmission fluid pressure (TFP) manual valve position switch assembly which is bolted to the control valve body. The sensor monitors main line pressure from the inside of the control valve body in order to determine the operating temperature of the transmission fluid. The sensor uses an O-ring seal to maintain fluid pressure in the control valve body.

The internal electrical resistance of the sensor varies in relation to the operating temperature of the transmission fluid. The PCM sends a 5-volt reference signal to the sensor. This measures the voltage drop in the electrical circuit. A lower fluid temperature creates a higher resistance in the TFT sensor, thereby measuring a higher voltage signal.

The PCM measures this voltage as another input to help control line pressure, shift schedules and torque converter clutch (TCC) apply. When the TFT reaches 140°C (284°F), the PCM enters hot mode. Above this temperature the PCM modifies the transmission shift schedules and TCC apply in an attempt to reduce fluid temperature by reducing the amount of heat generated by the transmission. During hot mode the PCM applies TCC at all times in Third and Fourth gears. Also, the PCM performs the 2-3 and the 3-4 shifts earlier in order to help reduce the generation of fluid heat. Refer to **Transmission Fluid Temperature (TFT) Sensor Specifications**.

Park/Neutral Position Switch

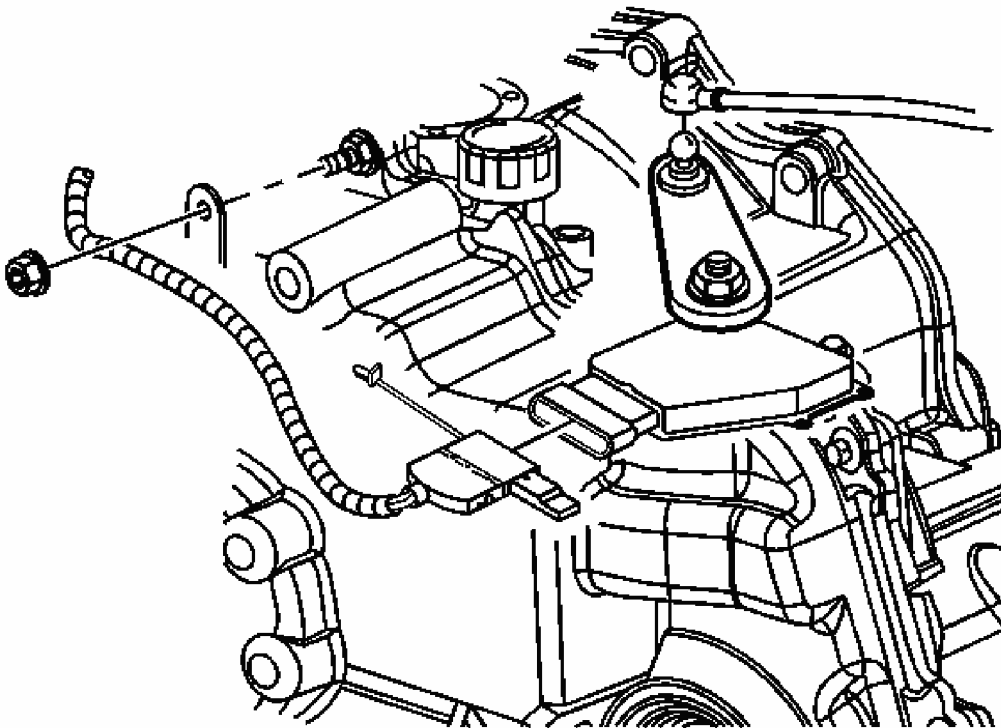


Fig. 239: Identifying Shift Control Cable, Lever & Electrical Connector At Transaxle Range (TR) Switch
Courtesy of GENERAL MOTORS CORP.

The transmission range (TR) switch is part of the park/neutral position (PNP) and back-up

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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. By grounding one or more of the switch circuits, the PCM detects the selected gear range by the state change of the switch input. Refer to **Transmission Range Switch Logic**. 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.

AUTOMATIC TRANSMISSION INLINE 20-WAY CONNECTOR DESCRIPTION

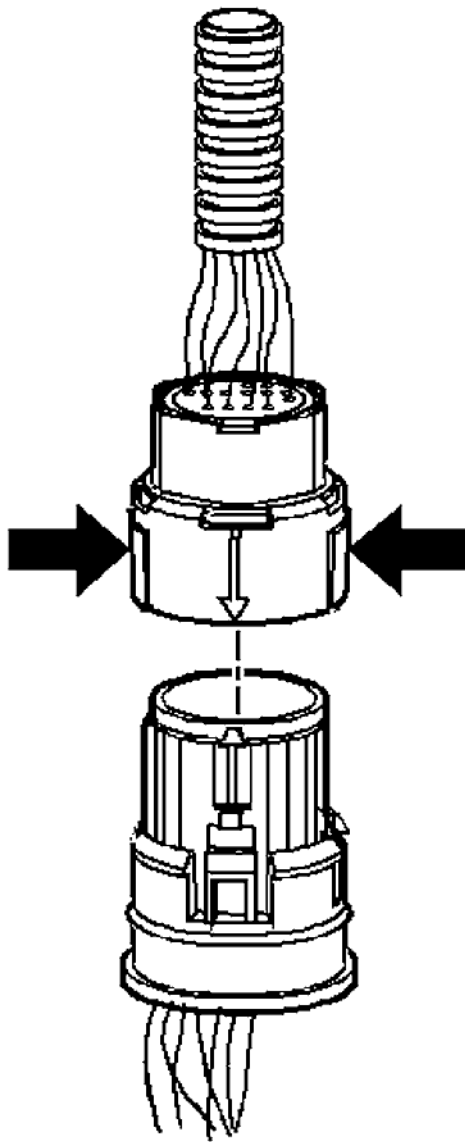


Fig. 240: Identifying Automatic Transmission In-Line 20-Way Connector
Courtesy of GENERAL MOTORS CORP.

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

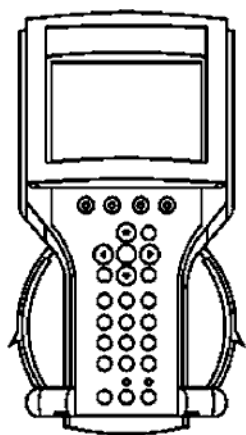
SPECIAL TOOLS

Special Tools

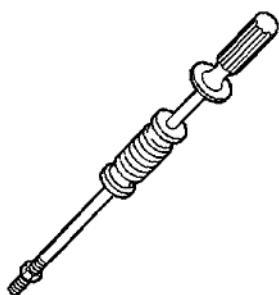
Illustration	Tool Number/Description

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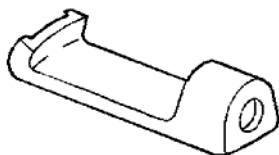
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Scan Tool



J 6125-1B
Slide Hammer



J 23129
Universal Seal Remover

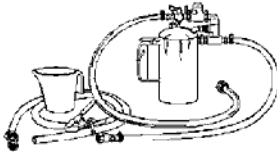


J 35616
GM-Approved Terminal Test Kit

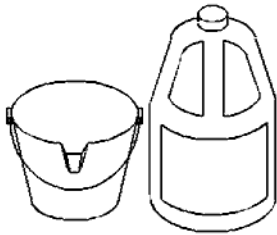
J 35944-A

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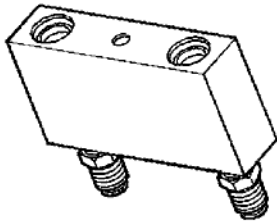
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Transmission Oil Cooler and Line Flusher



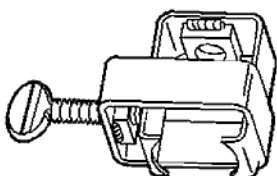
J 35944-22
Transmission Oil Cooler Flushing Fluid



J 35944-440
Cooler Flushing Adapter



J 36850
Transjel Lubricant



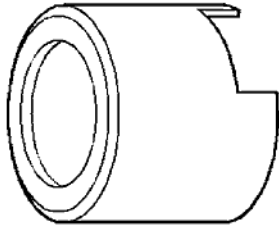
J 38868
Output Shaft Assembly Remover and
Installer

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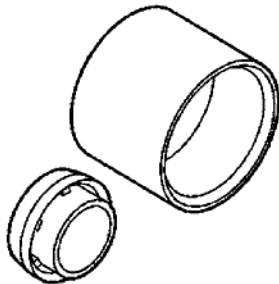
2006 TRANSMISSION Automatic Transaxle - 4T45-E - HHR



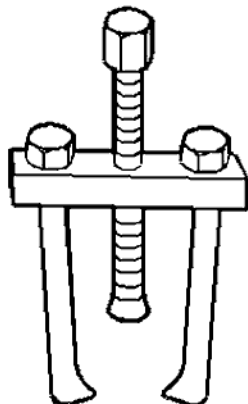
J 39200
Digital Multimeter (DMM)



J 41101
Transaxle Connector Remover



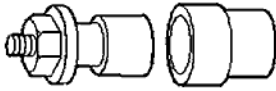
J 41102
Axle Seal Installer



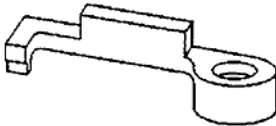
J 41227
Output Shaft Sleeve Remover

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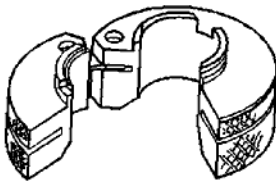
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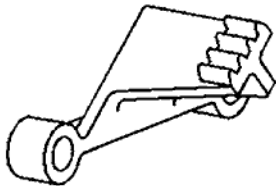
J 41228
Output Shaft Sleeve Installer



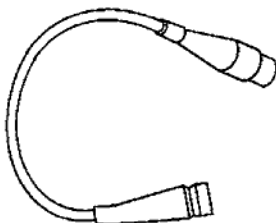
J 41545
Park/Neutral Switch Aligner



J 41623-B
Cooler Quick Connect Tool



J 43653
Flywheel Holding Tool

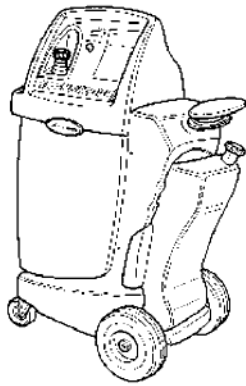
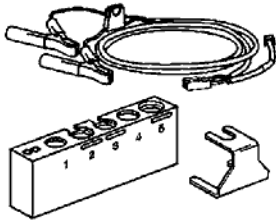


J 44152
Jumper Harness (20 pins)

J 44246
Solenoid Testing Kit

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J 45096
Transmission Oil Cooling System Flush
and Flow Test Tool