

2017 TRANSMISSION

Automatic Transmission - 4EL70 (MRD) - Component Locator - CT6

COMPONENT LOCATOR

DISASSEMBLED VIEWS

Case and Associated Parts

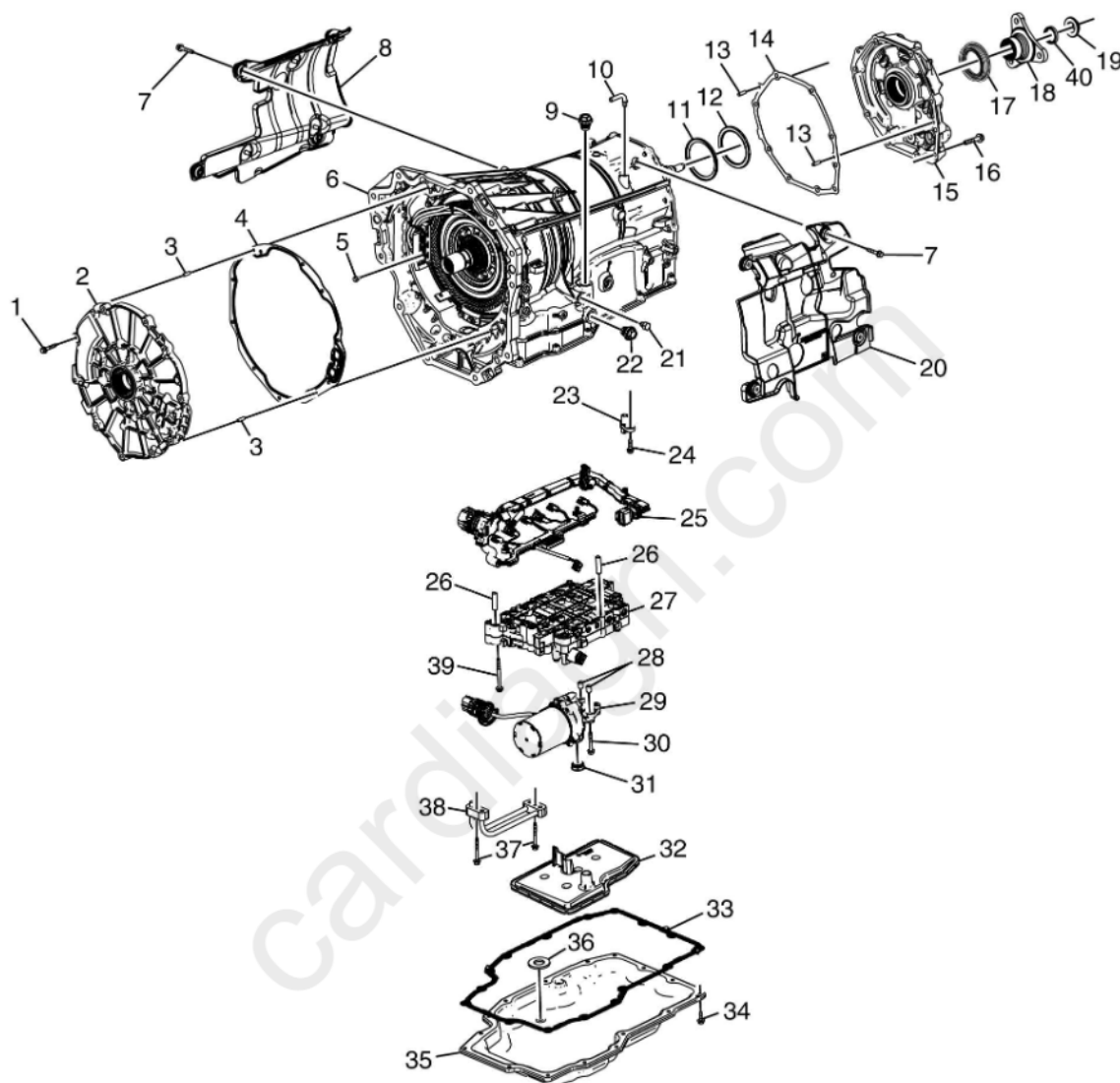


Fig. 1: Case And Associated Parts

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Bolt [10x]
2	Automatic Transmission Torque Damper Housing
3	Transmission Case Locating Pin
4	Automatic Transmission Torque Damper Housing Gasket
5	Wiring Harness Connector Bolt [6x]
6	Automatic Transmission Case
7	Automatic Transmission Case Bolt [8x]
8	Transmission Housing Sound Insulator
9	Transmission Fluid Filler Plug
10	Automatic Transmission Vent Pipe
11	Output Shaft Thrust Washer

Callout	Component Name
12	Output Shaft Bearing
13	Transmission Case Locating Pin
14	Automatic Transmission Case Extension Gasket
15	Automatic Transmission Case Extension
16	Automatic Transmission Case Extension Bolt [9x]
17	Propeller Shaft Front Slip Yoke Oil Seal
18	Propeller Shaft Flange
19	Front Propeller Shaft Flange Nut
20	Transmission Housing Sound Insulator
21	Automatic Transmission Fluid Pressure Test Hole Plug
22	Transmission Fluid Filler Plug
23	Automatic Transmission Output Speed Sensor
24	Automatic Transmission Output Speed Sensor Bolt
25	Automatic Transmission Control Wiring Harness
26	Valve Body Locating Pin
27	Control Valve
28	Automatic Transmission Fluid Pump Locating Pin
29	Automatic Transmission Fluid Pump
30	Automatic Transmission Fluid Pump Bolt [4x]
31	Automatic Transmission Fluid Filter Seal
32	Automatic Transmission Fluid Filter
33	Automatic Transmission Fluid Pan Gasket
34	Automatic Transmission Fluid Pan Bolt [16x]
35	Automatic Transmission Fluid Pan
36	Automatic Transmission Fluid Pan Magnet
37	Valve Body Bolt [2x]
38	Control Valve Body Fluid Manifold
39	Automatic Transmission Control Bolt [4x]
40	Propeller Shaft Transmission Flange Seal

Drive Motor - 1st Position

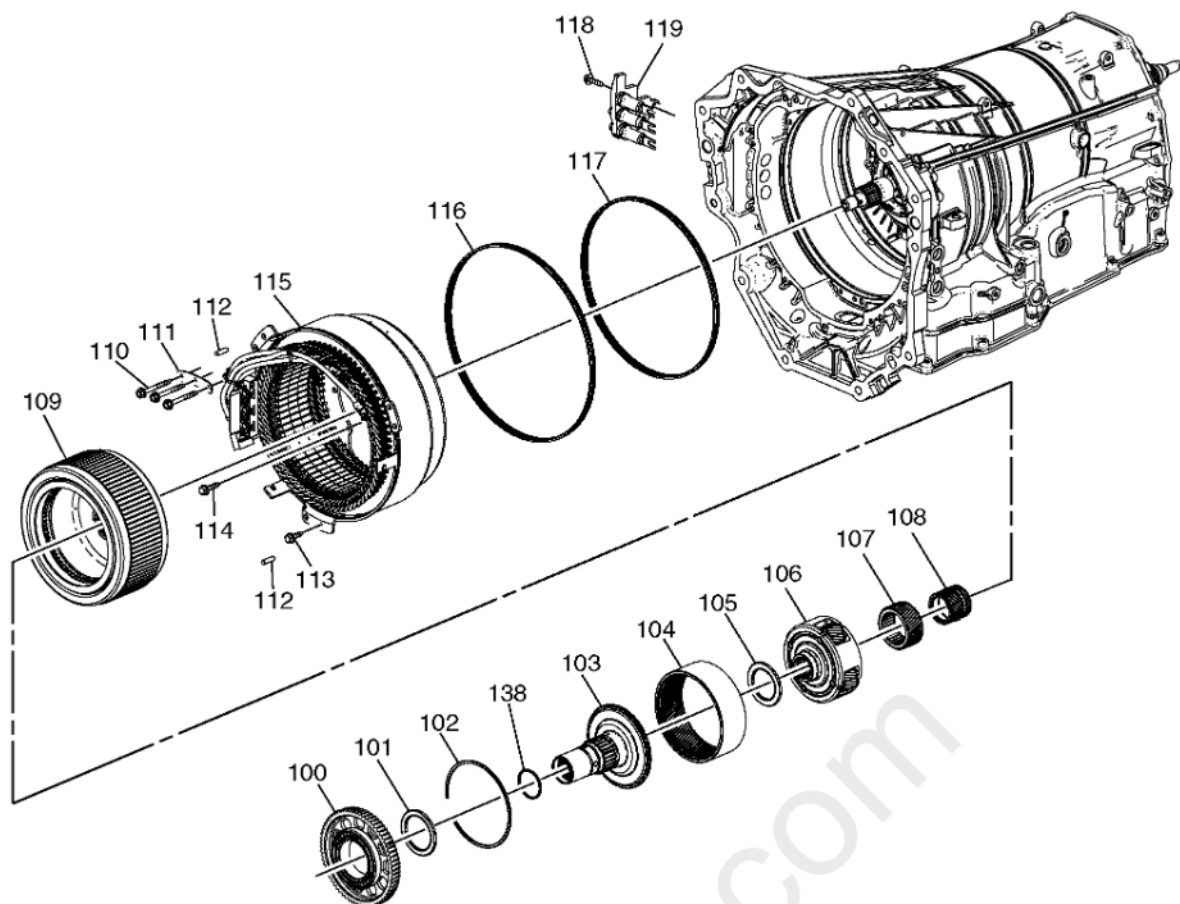


Fig. 2: Drive Motor - 1st Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
100	Drive Motor Rotor Bearing
101	Input Shaft Thrust Bearing
102	Input Shaft Retaining Ring - Position 1
103	Input Shaft
104	Internal Gear - Position 1
105	Sun Gear Carrier Thrust Bearing
106	Sun Gear Carrier - Position 1
107	Sun Gear- Position 1
108	Sun Gear Shaft - Position 1
109	Drive Motor Rotor
110	Automatic Transmission Case Bolt [3x]
111	Automatic Transmission Case Fluid Passage Cover
112	Drive Motor Locating Pin
113	Automatic Transmission Case Bolt [6x]
114	Variable 1-4 and 1-3 Clutch Bolt [8x]
115	Drive Motor Stator - Position 1
116	Drive Motor Stator Housing Front Seal - Position 1
117	Drive Motor Stator Housing Rear Seal - Position 1
118	Wiring Harness Connector Bolt
119	Wiring Harness Connector
138	Input Shaft Fluid Seal Ring

Drive Motor - 2nd Position

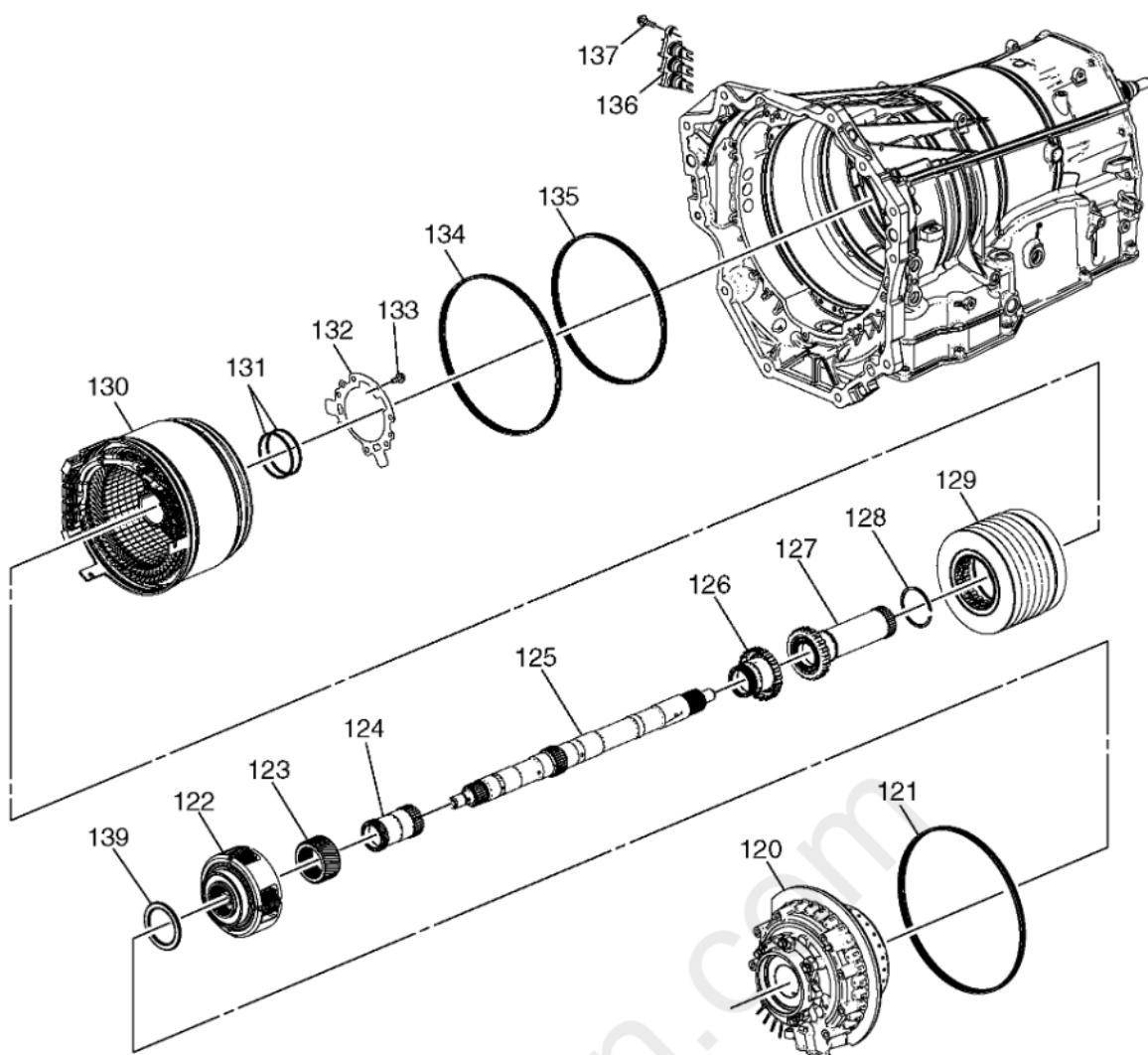


Fig. 3: Drive Motor - 2nd Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
120	Variable 1-2-3-4 and 1-2-3 Clutch
121	Clutch Housing Seal
122	Sun Gear Carrier- Position 2
123	Sun Gear- Position 2
124	Variable 2-3 and 1-2-3 Clutch Shaft
125	Main Shaft
126	Sun Gear Shaft
127	Variable 3-4 and 2-3 Clutch Shaft
128	Drive Motor Generator Rotor Bearing Retaining Ring
129	Drive Motor Rotor- Position 2
130	Drive Motor- Position 2
131	Variable 3-4 and 2-3 Clutch Housing Fluid Seal Ring [2x]
132	Variable 3-4 and 2-3 Clutch Housing Fluid Passage Hub Gasket
133	Automatic Transmission Case Bolt [7x]
134	Drive Motor Stator Housing Front Seal - Position 2
135	Drive Motor Stator Housing Rear Seal - Position 2
136	Wiring Harness Connector
137	Wiring Harness Connector Bolt
139	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing

Internal Components

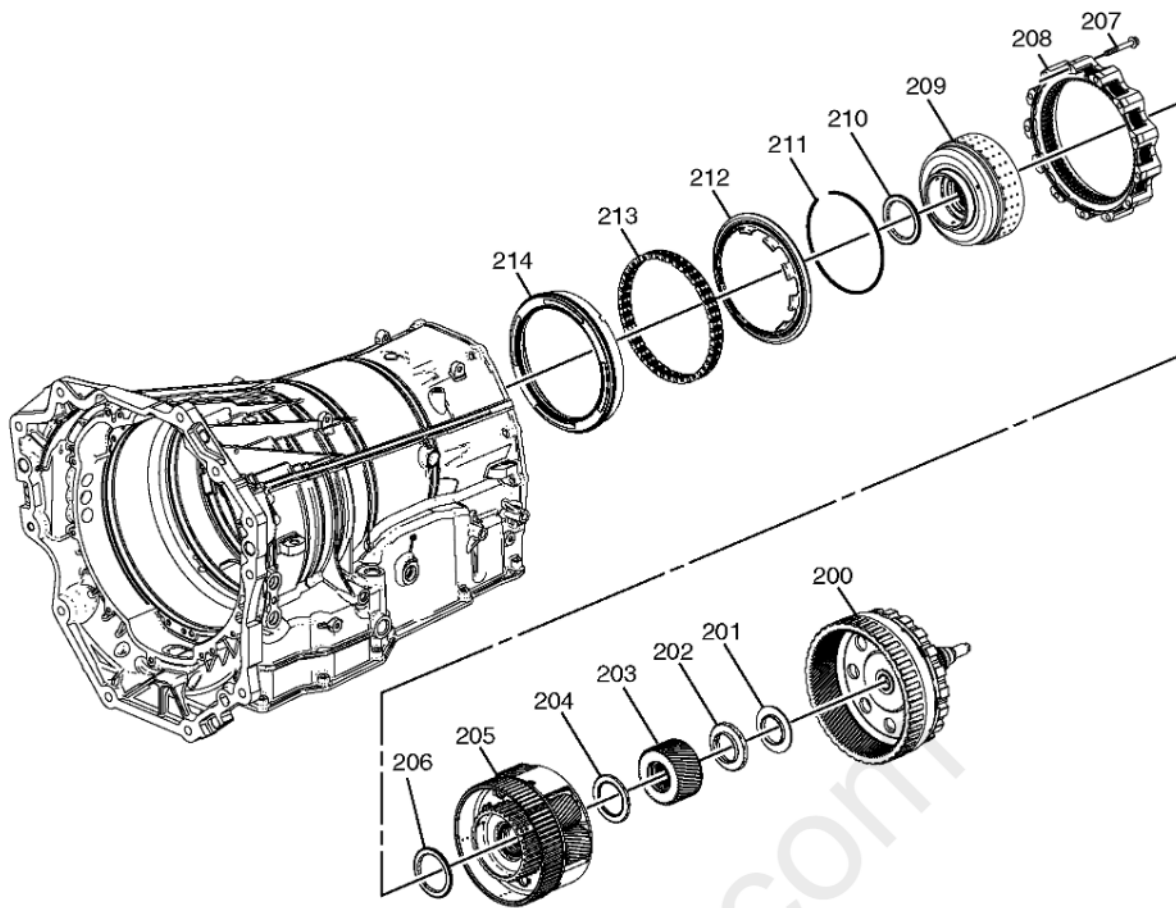


Fig. 4: Internal Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
200	Output Shaft
201	Sun Gear Thrust Washer
202	Sun Gear Thrust Bearing - Position 3
203	Sun Gear - Position 3
204	Sun Gear Carrier Thrust Bearing - Position 3
205	Sun Gear Carrier - Position 3
206	Variable 3-4 and 2-3 Clutch Hub Thrust Bearing
207	Automatic Transmission Case Bolt [13x]
208	Variable 1-2 and 1-2 Clutch Housing
209	Variable 3-4 and 2-3 Clutch Housing
210	Variable 3-4 and 2-3 Clutch Housing Thrust Bearing
211	Variable 1-2 and 1-2 Clutch Piston Return Spring Retaining Ring
212	Variable 1-2 and 1-2 Clutch Piston Return Spring Plate
213	Variable 1-2 and 1-2 Clutch Piston Return Spring
214	Variable 1-2 and 1-2 Clutch Piston

Automatic Transmission Torque Dampener Housing

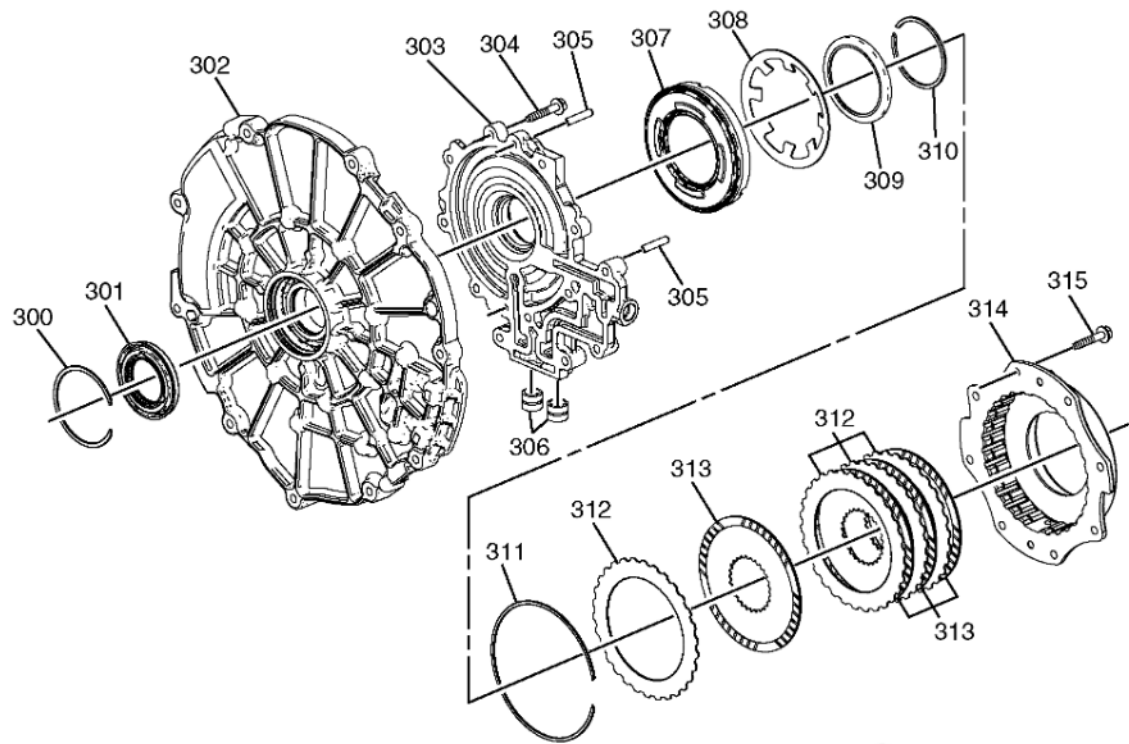


Fig. 5: Automatic Transmission Torque Dampener Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
300	Automatic Transmission Torque Dampener Fluid Seal Retaining Ring
301	Automatic Transmission Torque Dampener Seal
302	Automatic Transmission Torque Dampener Housing
303	Variable 1-2-3-4 Clutch Housing
304	Automatic Transmission Torque Dampener Housing Bolt [4x]
305	Automatic Transmission Torque Dampener Pin
306	1-2-3-4 Clutch Piston Housing Seal
307	Variable 1-2-3-4 Clutch Piston
308	Variable 1-2-3-4 Clutch Piston Return Spring
309	Variable 1-2-3-4 Clutch Piston Return Spring Plate
310	Variable 1-2-3-4 Clutch Housing Ring
311	Variable 1-2-3-4 Clutch Backing Plate Retaining Ring
312	Variable 1-2-3-4 Clutch Plate [4x]
313	Variable 1-2-3-4 Clutch Friction Plate [4x]
314	Variable 1-2-3-4 Clutch Backing Plate
315	Automatic Transmission Torque Dampener Housing Bolt [8x]

Control Valve Assembly

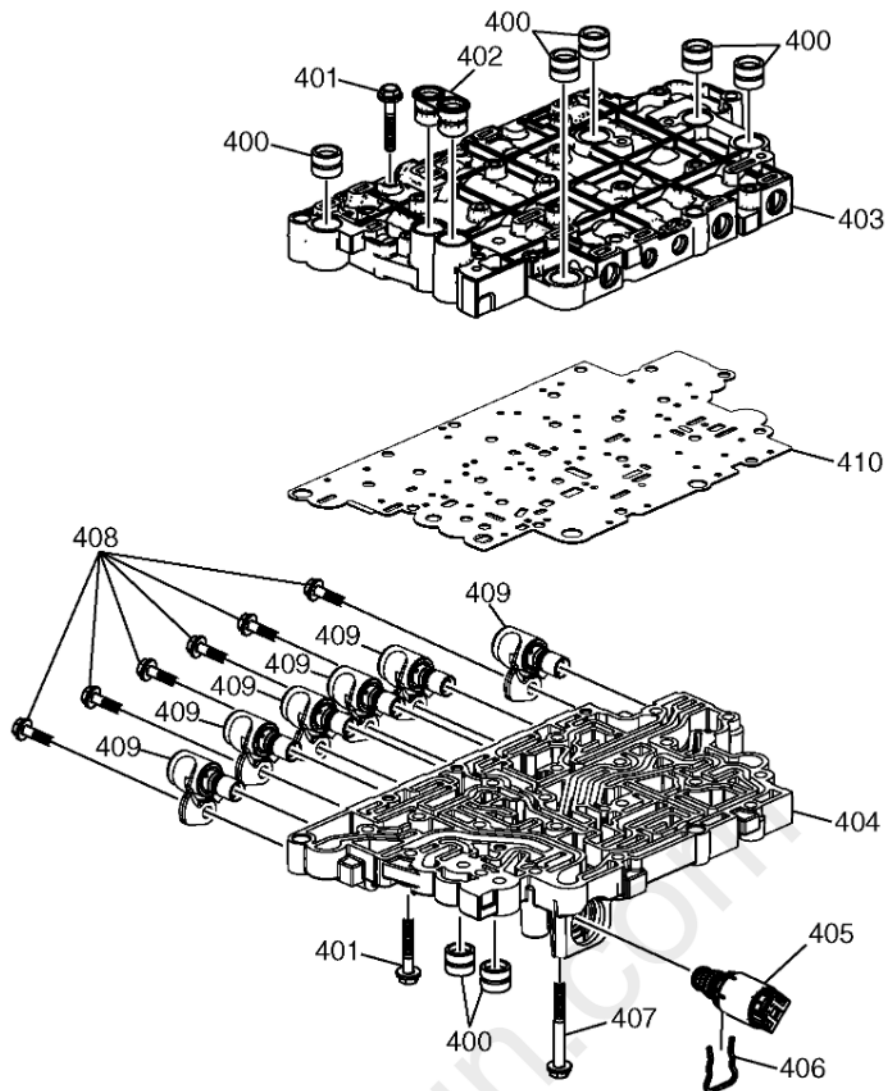


Fig. 6: Control Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
400	Automatic Transmission Hybrid Direct 2-3-4 Clutch Regulator Valve Seal [7x]
401	Valve Body Bolt [18x]
402	Automatic Transmission Hybrid Direct 2-3-4 Clutch Regulator Valve Seal
403	Control Valve Upper Body
404	Control Valve Solenoid Body
405	Clutch Pressure Control Solenoid Valve
406	Control Solenoid Valve Retainer
407	Control Valve Body Bolt [3x]
408	Shift Solenoid Valve Bolt [6x]
409	Shift Solenoid Valve [6x]
410	Control Valve Body Spacer Plate

Control Valve Upper Body Assembly

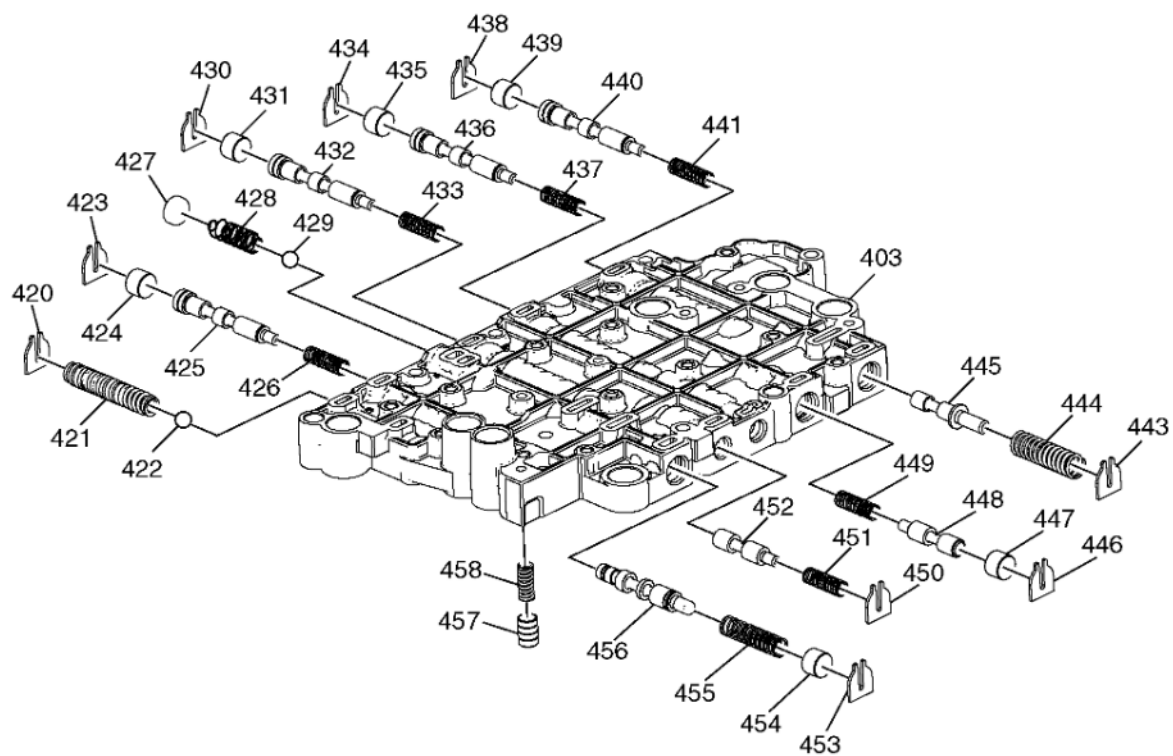


Fig. 7: Control Valve Upper Body Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
403	Control Valve Upper Body
420	Pressure Relief Ball Valve Spring Retainer
421	Pressure Relief Ball Valve Spring
422	Pressure Relief Ball Valve
423	Body Valve Bore Plug Retainer
424	Body Valve Bore Plug
425	Variable 1-4 and 1-3 Clutch Valve
426	Valve Spring
427	Pressure Relief Ball Valve Spring Retainer
428	Pressure Relief Ball Valve Spring
429	Pressure Relief Ball Valve
430	Body Valve Bore Plug Retainer
431	Body Valve Bore Plug
432	Variable 2-3 and 1-2-3 Clutch Valve
433	Valve Spring
434	Body Valve Bore Plug Retainer
435	Body Valve Bore Plug
436	Variable 3-4 and 2-3 Clutch Valve
437	Valve Spring
438	Body Valve Bore Plug Retainer
439	Body Valve Bore Plug
440	Variable 1-2 and 1-2 Clutch Valve
441	Valve Spring
443	Actuator Feed Limit Valve Spring Retainer
444	Actuator Feed Limit Valve Spring
445	Actuator Feed Limit Valve
446	Body Valve Bore Plug Retainer
447	Body Valve Bore Plug
448	Variable 1-2-3-4 Clutch Valve

Callout	Component Name
449	Valve Spring
450	Stator Valve Retainer
451	Stator Valve Spring
452	Stator Valve
453	Pressure Regulator Valve Bore Plug Retainer
454	Pressure Regulator Valve Plug
455	Pressure Regulator Valve Spring
456	Pressure Regulator Valve
457	Signal Accumulator Piston
458	Signal Accumulator Piston Spring

1-2-3-4 and 1-2-3 Clutch Housing

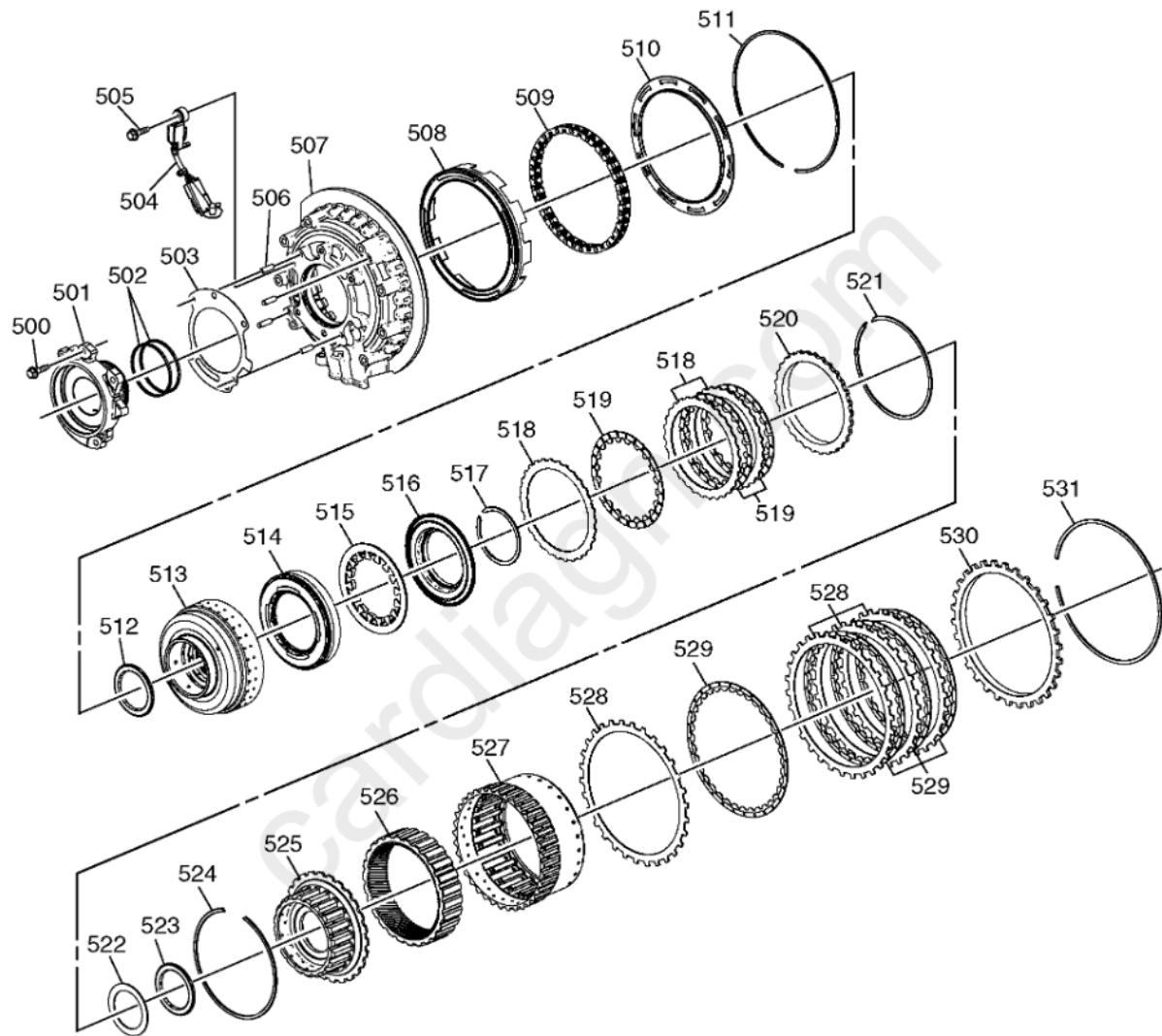


Fig. 8: 1-2-3-4 and 1-2-3 Clutch Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
500	Variable 1-4 and 1-3 Clutch Bolt [4x]
501	Variable 2-3 and 1-2-3 Clutch Housing Fluid Passage Hub
502	Variable 2-3 and 1-2-3 Clutch Housing Fluid Seal Ring [2x]
503	Variable 1-4 and 1-3 Clutch Housing Fluid Passage Hub Gasket
504	Drive Motor Speed and Direction Sensor
505	Automatic Transmission Speed Sensor Bolt
506	Variable 1-4 and 1-3 Clutch Housing Fluid Passage Hub Locating Pin
507	Variable 1-4 and 1-3 Clutch Housing
508	Variable 1-4 and 1-3 Clutch Piston

Callout	Component Name
509	Variable 1-4 and 1-3 Clutch Return Spring
510	Variable 1-4 and 1-3 Clutch Piston Return Spring Plate
511	Variable 1-4 and 1-3 Clutch Return Spring Ring
512	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
513	Variable 2-3 and 1-2-3 Clutch Housing
514	Variable 2-3 and 1-2-3 Clutch Piston
515	Variable 2-3 and 1-2-3 Clutch Return Spring
516	Variable 2-3 and 1-2-3 Clutch Piston Dam
517	Variable 2-3 and 1-2-3 Clutch Piston Dam Retaining Ring
518	Variable 2-3 and 1-2-3 Clutch Plate
519	Variable 2-3 and 1-2-3 Clutch Friction Plate
520	Variable 2-3 and 1-2-3 Clutch Backing Plate
521	Variable 2-3 and 1-2-3 Clutch Backing Retaining Ring
522	2-3 and 1-2-3 Clutch Housing Thrust Washer
523	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
524	Variable 1-2-3-4 and 1-2-3 Clutch Hub Retaining Ring
525	Variable 2-3 and 1-2-3 Clutch Hub
526	Internal Gear - Position 2
527	Clutch Housing To Internal Gear Drum - Position 2
528	Variable 1-4 and 1-3 Clutch Plate
529	Variable 1-4 and 1-3 Clutch Friction Plate
530	Variable 1-4 and 1-3 Clutch Backing Plate
531	Variable 1-4 and 1-3 Clutch Backing Plate Retaining Ring

3-4 and 2-3 Clutch Housing

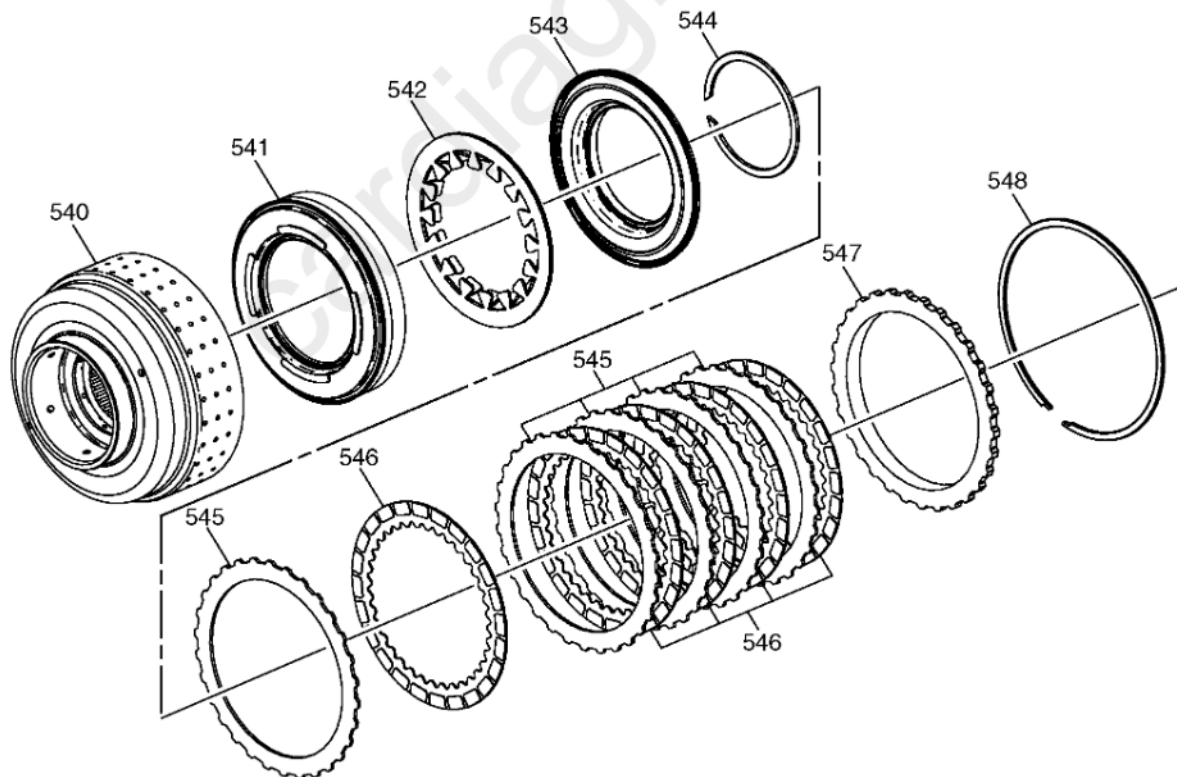


Fig. 9: 3-4 and 2-3 Clutch Housing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
540	Variable 3-4 and 2-3 Clutch Housing
541	Variable 3-4 and 2-3 Clutch Piston
542	Variable 3-4 and 2-3 Clutch Piston Return Spring

Callout	Component Name
543	Variable 3-4 and 2-3 Clutch Piston Dam
544	Variable 3-4 and 2-3 Clutch Piston Dam Retaining Ring
545	Variable 3-4 and 2-3 Clutch Plate
546	Variable 3-4 and 2-3 Clutch Friction Plate
547	Variable 3-4 and 2-3 Clutch Backing Plate
548	Variable 3-4 and 2-3 Clutch Backing Plate Retaining Ring

1-2 and 1-2 Clutch Housing

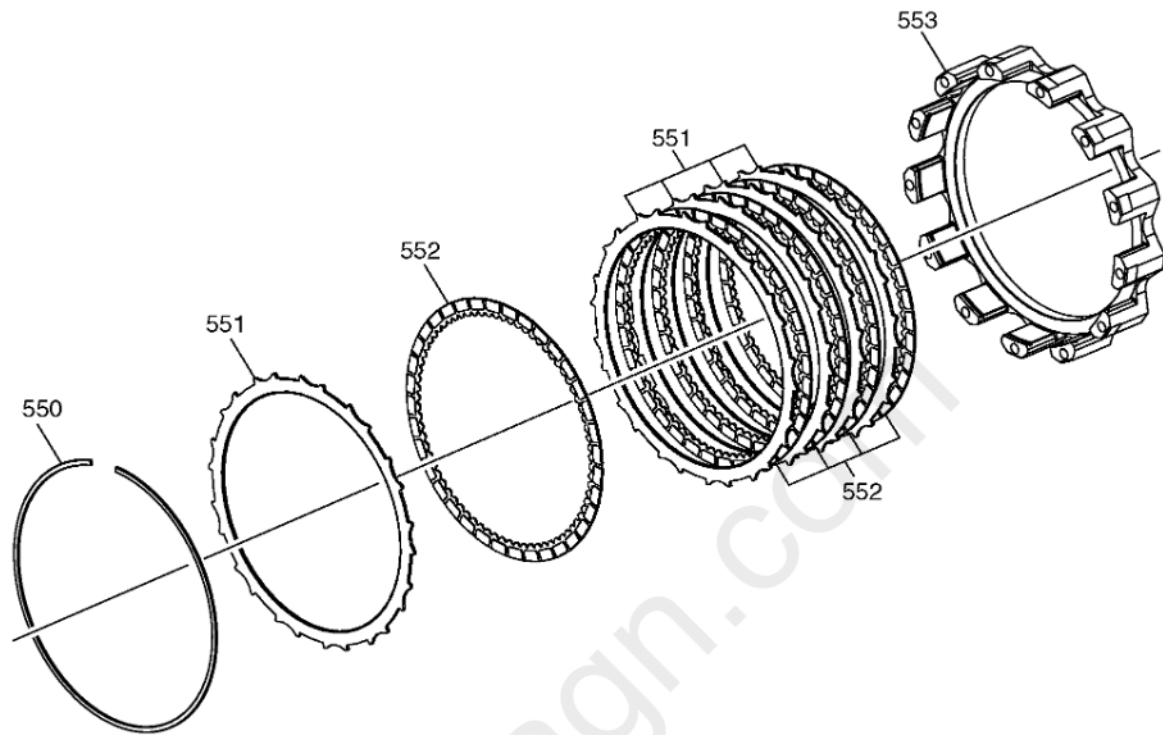


Fig. 10: 1-2 and 1-2 Clutch Housing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
550	Variable 1-2 and 1-2 Clutch Backing Plate Retaining Ring
551	Variable 1-2 and 1-2 Clutch Plate [5x]
552	Variable 1-2 and 1-2 Clutch Friction Plate [5x]
553	Variable 1-2 and 1-2 Clutch Housing

Park System Components

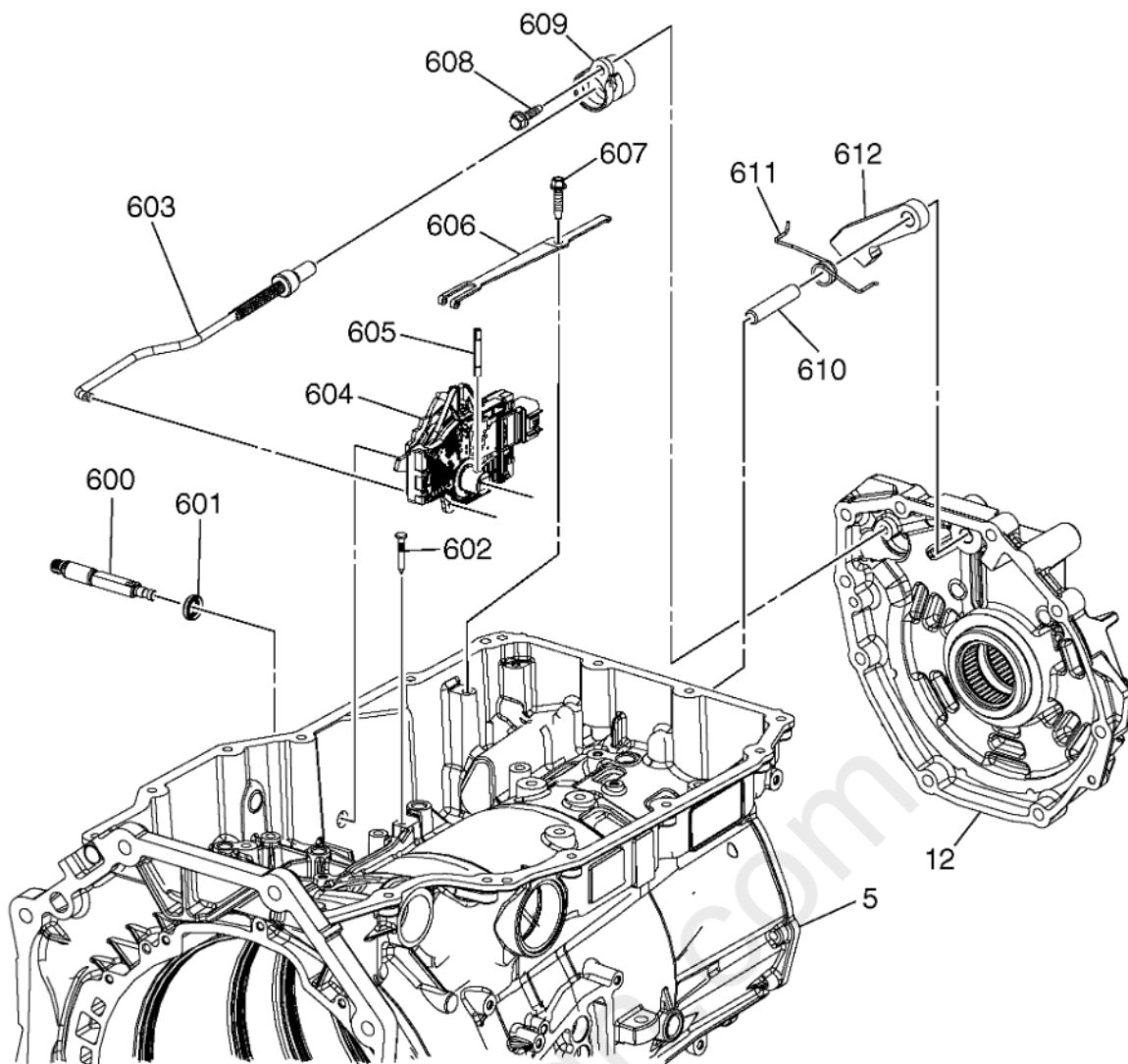


Fig. 11: Park System Components

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
5	Automatic Transmission Case
12	Automatic Transmission Case Extension
600	Manual Shift Shaft
601	Manual Shift Shaft Seal
602	Manual Shift Shaft Pin
603	Park Pawl Actuator
604	Manual Shift Shaft Position Switch Assembly
605	Manual Shift Detent Lever Hub Pin
606	Manual Shift Detent Lever Spring
607	Manual Shift Detent Spring Bolt
608	Park Pawl Actuator Guide Bolt
609	Park Pawl Actuator Guide
610	Park Pawl Shaft
611	Park Pawl Spring
612	Park Pawl

COMPONENT LOCATION

Component Location

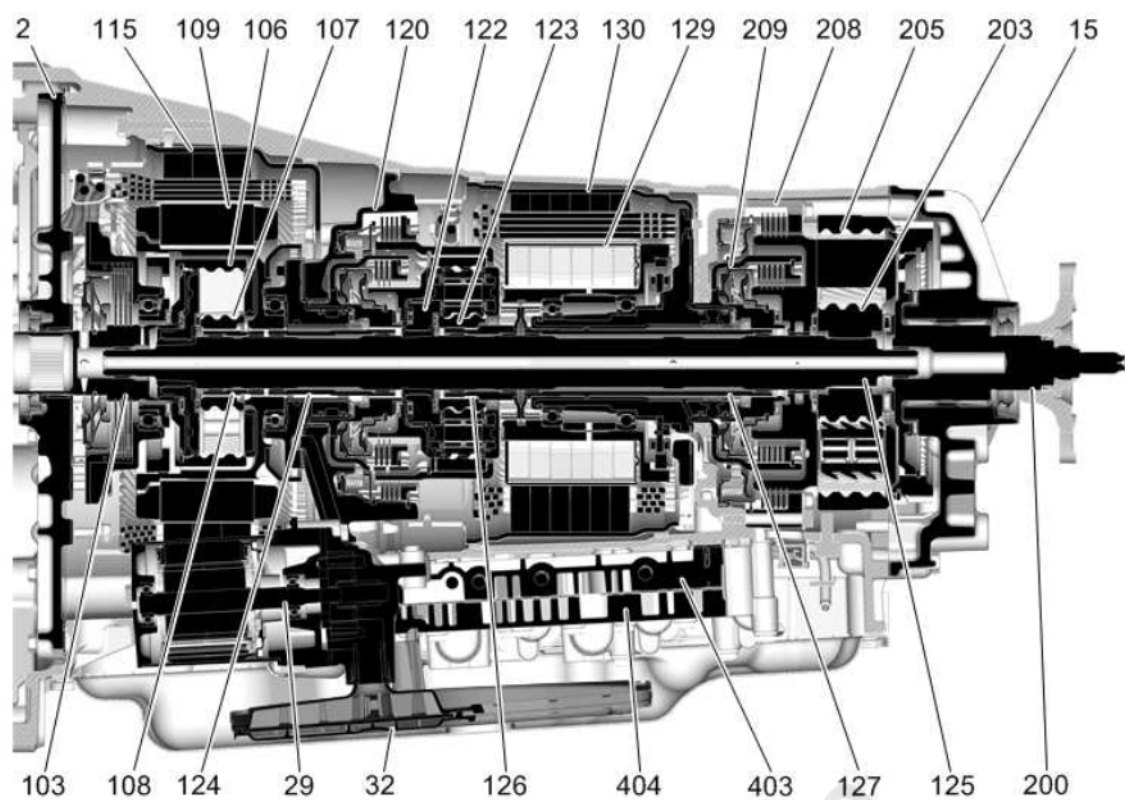


Fig. 12: Component Location

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Automatic Transmission Torque Dampener Housing
15	Automatic Transmission Case Extension
29	Automatic Transmission Fluid Pump
32	Automatic Transmission Fluid Filter
103	Input Shaft
106	Sun Gear Carrier - Position 1
107	Sun Gear - Position 1
108	Sun Gear Shaft - Position 1
109	Drive Motor Rotor - Position 1
115	Drive Motor Stator - Position 1
120	Variable 1-2-3-4 and 1-2-3 Clutch
122	Sun Gear Carrier - Position 2
123	Sun Gear- Position 2
124	Variable 2-3 and 1-2-3 Clutch Shaft
125	Main Shaft
126	Sun Gear Shaft - Position 2
127	Variable 3-4 and 2-3 Clutch Shaft
129	Drive Motor Rotor - Position 2
130	Drive Motor Stator - Position 2
200	Output Shaft
203	Sun Gear - Position 3
205	Sun Gear Carrier - Position 3
208	Variable 1-2 and 1-2 Clutch Housing
209	Variable 3-4 and 2-3 Clutch Housing
403	Control Valve Upper Body
404	Control Valve Solenoid Body

BUSHING, BEARING AND WASHER LOCATIONS

Bushing, Bearing and Washer Locations

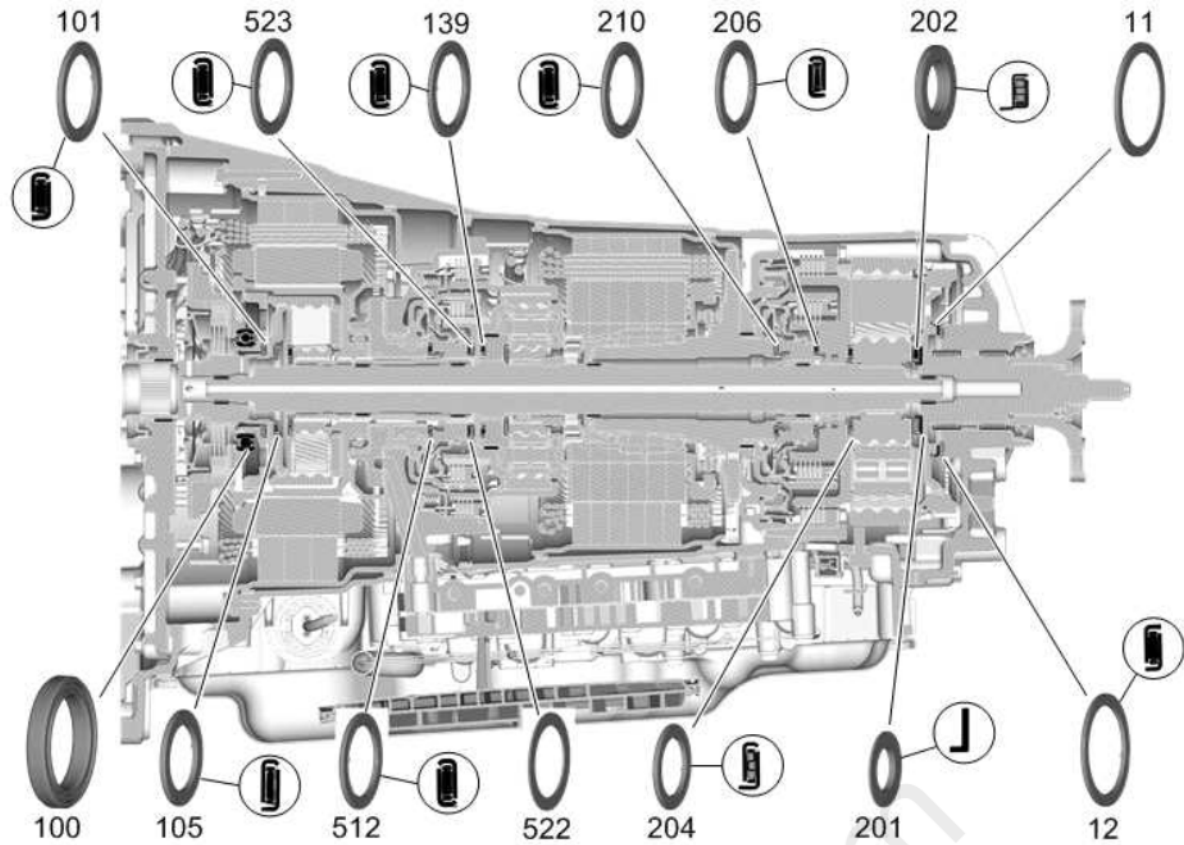


Fig. 13: Bushing, Bearing and Washer Locations
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
11	Output Shaft Thrust Washer
12	Output Shaft Bearing
100	Drive Motor Rotor Bearing
101	Input Shaft Thrust Bearing
105	Sun Gear Carrier Thrust Bearing
201	Sun Gear Thrust Washer
202	Sun Gear Thrust Bearing
204	Sun Gear Carrier Thrust Bearing
206	Variable 3-4 and 2-3 Clutch Hub Thrust Bearing
210	Variable 3-4 and 2-3 Clutch Housing Thrust Bearing
512	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
522	2-3 and 1-2-3 Clutch Housing Thrust Washer
523	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing

SEAL LOCATIONS

Seal Locations

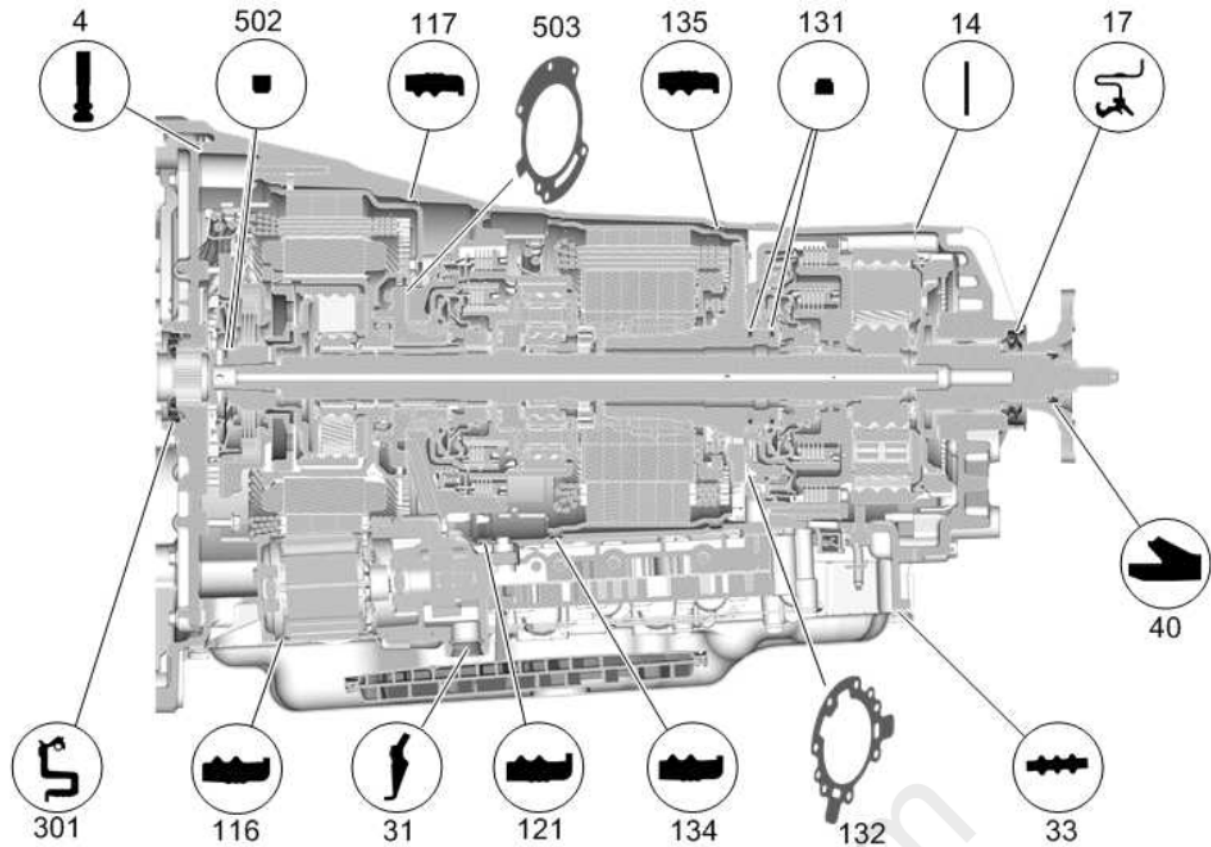


Fig. 14: Seal Locations

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
4	Automatic Transmission Torque Dampener Housing Gasket
14	Automatic Transmission Case Extension Gasket
17	Propeller Shaft Front Slip Yoke Oil Seal
31	Automatic Transmission Fluid Filter Seal
33	Automatic Transmission Fluid Pan Gasket
40	Propeller Shaft Transmission Flange Seal
116	Drive Motor Stator Housing Front Seal
117	Drive Motor Stator Housing Rear Seal
121	Clutch Housing Seal
131	Variable 3-4 and 2-3 Clutch Housing Fluid Seal Ring [2x]
132	Variable 3-4 and 2-3 Clutch Housing Fluid Passage Hub Gasket
134	Drive Motor Stator Housing Front Seal
135	Drive Motor Stator Housing Rear Seal
301	Automatic Transmission Torque Dampener Seal
502	Variable 2-3 and 1-2-3 Clutch Housing Fluid Seal Ring [2x]
503	Variable 1-4 and 1-3 Clutch Housing Fluid Passage Hub Gasket

2017 TRANSMISSION

Automatic Transmission - 4EL70 (MRD) - Description and Operation - CT6

DESCRIPTION AND OPERATION

DEFINITIONS AND ABBREVIATIONS

Throttle Positions

Engine Braking

A condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Full Throttle Downshift

A quick apply of the accelerator pedal to its full travel, forcing a downshift.

Heavy Throttle

Approximately 3/4 of accelerator pedal travel, 75 percent throttle position.

Light Throttle

Approximately 1/4 of accelerator pedal travel, 25 percent throttle position.

Medium Throttle

Approximately 1/2 of accelerator pedal travel, 50 percent throttle position.

Minimum Throttle

The least amount of throttle opening required for an upshift.

Wide Open Throttle (WOT)

Full travel of the accelerator pedal, 100 percent throttle position.

Zero Throttle Coastdown

A full release of the accelerator pedal while the vehicle is in motion and in drive range.

Shift Condition Definitions

Bump

A sudden and forceful apply of a clutch or a band.

Chuggle

A bucking or jerking. This condition may be most noticeable when the converter clutch is engaged. It is similar to the feel of towing a trailer.

Delayed

A condition where a shift is expected but does not occur for a period of time. This could be described as a clutch or band engagement that does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator or during manual downshifting to a lower range. This term is also defined as LATE or EXTENDED.

Double Bump - Double Feel

Two sudden and forceful applies of a clutch or a band.

Early

A condition where the shift occurs before the car has reached proper speed. This condition tends to labor the engine after the upshift.

End Bump

A firmer feel at the end of a shift than at the start of the shift. This is also defined as END FEEL or SLIP BUMP.

Firm

A noticeably quick apply of a clutch or band that is considered normal with a medium to heavy throttle. This apply should not be confused with HARSH or ROUGH.

Flare

A quick increase in engine RPM along with a momentary loss of torque. This most generally occurs during a shift. This condition is also defined as SLIPPING.

Harsh - Rough

A more noticeable apply of a clutch or band than FIRM. This condition is considered undesirable at any throttle position.

Hunting

A repeating quick series of upshifts and downshifts that causes a noticeable change in engine RPM, such as a 4-3-4 shift pattern. This condition is also defined as BUSYNESS.

Initial Feel

A distinctly firmer feel at the start of a shift than at the finish of the shift.

Late

A shift that occurs when the engine RPM is higher than normal for a given amount of throttle.

Shudder

A repeating jerking condition similar to CHUGGLE but more severe and rapid. This condition may be most noticeable during certain ranges of vehicle speed.

Slipping

A noticeable increase in engine RPM without a vehicle speed increase. A slip usually occurs during or after initial clutch or band apply.

Soft

A slow, almost unnoticeable clutch or band apply with very little shift feel.

Surge

A repeating engine related condition of acceleration and deceleration that is less intense than CHUGGLE.

Tie-Up

A condition where two opposing clutch and/or bands are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine RPM.

Noise Conditions

Drive Link Noise

A whine or growl that increases or fades with vehicle speed and is most noticeable under a light throttle acceleration. It may also be noticeable in PARK or NEUTRAL operating ranges with the vehicle stationary.

Final Drive Noise

A hum related to vehicle speed which is most noticeable under a light throttle acceleration.

Planetary Gear Noise

A whine related to vehicle speed, which is most noticeable in FIRST gear, SECOND gear, FOURTH gear or REVERSE. The condition may become less noticeable or go away, after an upshift.

Pump Noise

A high pitched whine that increases in intensity with engine RPM. This condition may also be noticeable in all operating ranges with the vehicle stationary or moving.

Driver Shift Control

Driver shift control (DSC) allows the driver to change gears similar to a manual transmission. Refer to the vehicle owner's manual for specific DSC operating instructions.

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

Data Link Connector

DMM

Digital Multimeter

DSC

Driver Shift Control

DTC

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

IMS

Internal Mode Switch

MAP

Manifold Absolute Pressure

MIL

Malfunction Indicator Lamp

NC

Normally Closed

NO

Normally Open

OBD

On Board Diagnostic

OSS

Output Speed Sensor

PC

Pressure Control

PCM

Powertrain Control Module

PCS

Pressure Control Solenoid

PS

Pressure Switch

PWM

Pulse Width Modulation

RPM

Revolutions Per Minute

SS

Shift Solenoid

TAP

Transmission Adaptive Pressure

TFP

Transmission Fluid Pressure

TFT

Transmission Fluid Temperature

TP

Throttle Position

VSS

Vehicle Speed Sensor

WOT

Wide Open Throttle

TRANSMISSION IDENTIFICATION INFORMATION

NOTE: The transmission identification label is located beneath the transmission housing sound insulator.

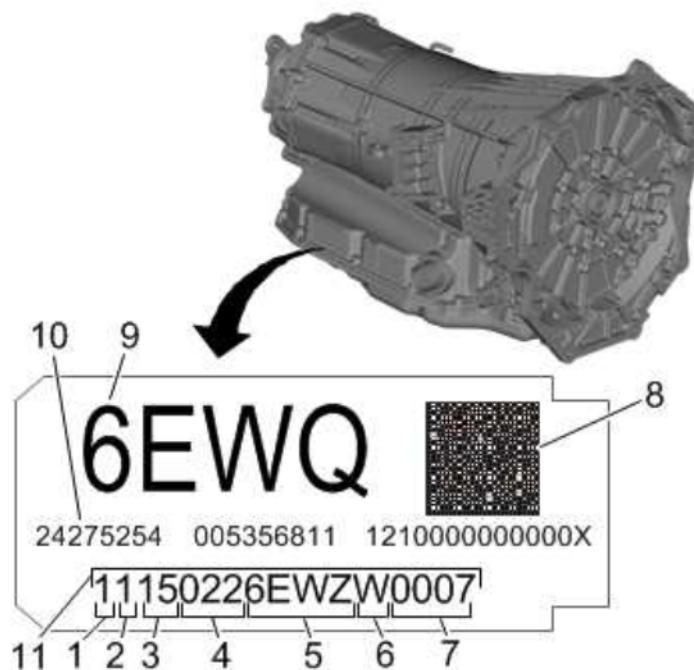


Fig. 1: Transmission Identification Label
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Line ID
2	Shift ID
3	Build Year
4	Julian Date
5	Broadcast Code
6	Reserved Use
7	Sequence Number
8	Machine Readable Matrix
9	Broadcast Code
10	GM Part Number
11	Transmission Unique Number (TUN)

TRANSMISSION GENERAL DESCRIPTION

The 4EL70 is a fully automatic, rear wheel drive transmission containing an electronically-controlled continuously-variable electric transmission. It includes an input shaft, three stationary and two rotating friction clutch assemblies, a hydraulic pressurization and control system, an electric fluid pump, three planetary gear sets and two electric drive motors.

The torque dampener is external to the transmission, bolted to the engine crankshaft and splined to the transmission input shaft. The torque dampener acts as a spring coupling to smoothly transmit shaft power from the engine to the input planetary gear set in the transmission and as a direct mechanical coupling from the transmission to the engine.

The hydraulic system includes a high pressure electric fluid pump driven by an electric motor supplied with high-voltage current from the power inverter module, shift solenoid valves, a variable line pressure control solenoid valve and control wiring harness. The electric pump maintains working pressure and control of the clutches when the engine is on and when the engine is off.

The three planetary gear sets, electric motor-generators and other clutches together provide all-electric propulsion, continuously-variable hybrid transmission ratios and fixed mechanical transmission ratios.

The transmission may be operated in any of the following gear ranges:

P (PARK)

This position locks the wheels and prevents the vehicle from rolling either forward or backward.

R (REVERSE)

This position allows the vehicle to be operated in a rearward direction. There is no separate reverse clutch or gearing in the transmission. All of the torque for reverse comes from drive motor - position 2.

N (NEUTRAL)

In this position, the propulsion system does not provide power to the wheels.

D (DRIVE)

Drive range should be used for all normal driving conditions for maximum efficiency and fuel economy. Drive position allows the transmission to operate all-electrically using one or both motor-generators when sufficient battery power and energy are available or using the engine when the battery is not sufficient.

L (Low)

This position is used for the "feel" of engine braking and can be used for the slowing of the vehicle once the throttle is lifted. While in the position the vehicle will slow quicker and use the drive motor - position 2 to more aggressively collect energy during a regenerative braking event.

TRANSMISSION COMPONENT AND SYSTEM DESCRIPTION

The mechanical components of the hybrid 4EL70 Transmission are as follows:

- Control Valve Assembly
- Propeller Shaft Flange
- Automatic Transmission Case Extension
- Output Shaft
- Input Shaft Assembly
- Sun Gear Carrier
- Sun Gear and Sun Gear Shaft
- Automatic Transmission Torque Dampener Housing
- Drive Motor- Position 1
- Variable 1-2-3-4 and 1-2-3 Clutch
- Drive Motor- Position 2
- Variable 1-2 and 1-2 Clutch Housing
- Variable 3-4 and 2-3 Clutch Housing

The electrical components of the 4EL70 are as follows:

- Automatic Transmission Control Wiring Harness
- Automatic Transmission Fluid Pump
- Automatic Transmission Output Speed Sensor
- Drive Motor - Position 1
- Drive Motor - Position 2
- Manual Shift Shaft Position Switch Assembly

For more information, refer to [Electronic Component Description](#).

TRANSMISSION INDICATORS AND MESSAGES

Transmission Shift Lever Position Indicator

The Transmission Shift Lever Position Indicator, if equipped, is located on the center console instrument panel cluster and indicates the current transmission shift lever position. The Transmission Shift Lever Position Indicator receives power and ground and is controlled by the Body Control Module (BCM) via serial data. The Transmission Control Module determines transmission shift lever position based on signals from the Transmission Internal Mode Switch and sends the shift lever position information to the BCM via serial data.

No transmission-related messages are displayed on the instrument panel cluster (IPC). For a complete listing and description of all vehicle indicators and messages, refer to [Indicator/Warning Message Description and Operation](#).

ELECTRONIC COMPONENT DESCRIPTION

Transmission Control Module

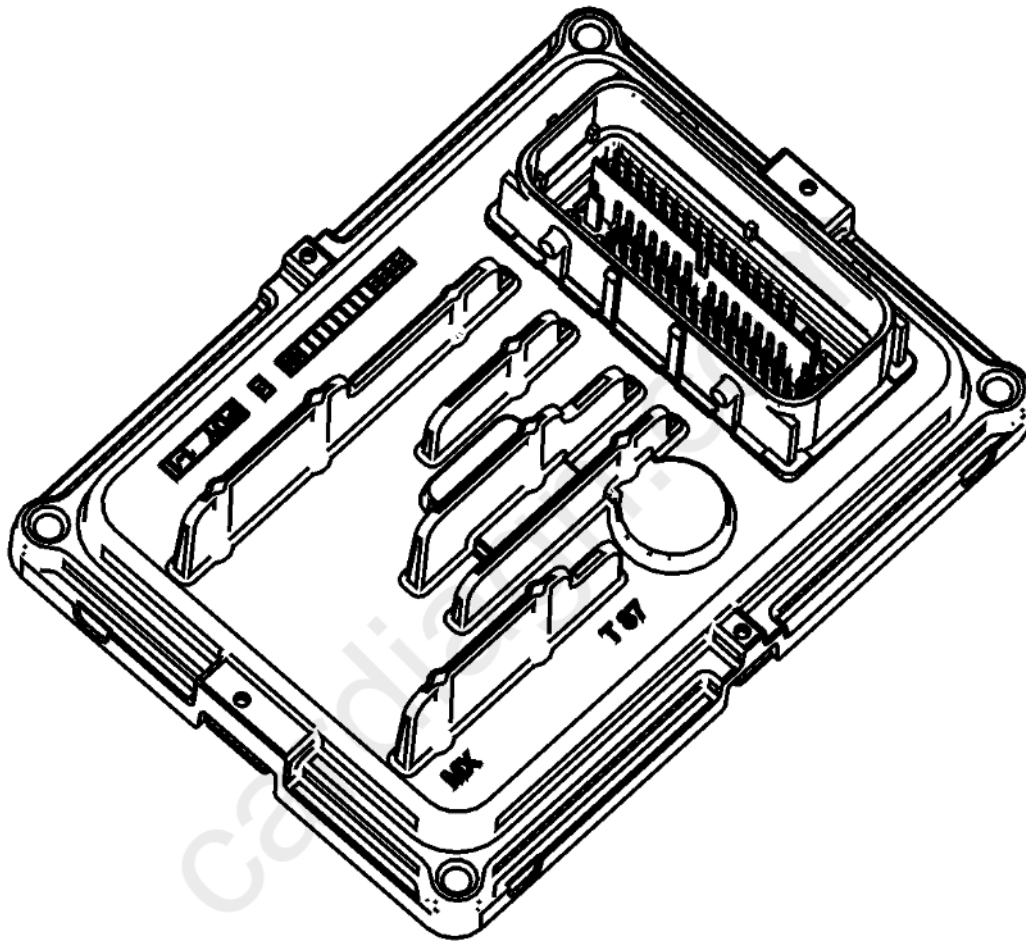


Fig. 2: Transmission Control Module
Courtesy of GENERAL MOTORS COMPANY

The Transmission Control Module (TCM) for this transmission is a standalone controller mounted to the vehicle. The TCM has one 66 way connector to interface with vehicle electrical system, transmission assembly and other vehicle control modules. The TCM sends and receives various input and output signals from a number of switches and sensors internal and external to the transmission. In addition, the TCM is part of a network of other control modules on the vehicle. The network of control modules will share information with each other, over a common serial data communications line. Based upon the calibrations and input information the TCM receives, it will always have final authority of when to allow an upshift or downshift whether in manual mode operation or in drive position for automatic shifting.

Transmission Solenoid Valves

The 4EL70 transmission contains a total of seven individual solenoids installed in various bore locations on the lower control valve body assembly. The seven solenoid valves are used to control pressure

regulation and direction of transmission fluid.

There are two variations of the pressure regulating solenoid valves used on this transmission. They are; high pressure normally low, high pressure normally high and low pressure normally high, variable force solenoid valves.

- Normally Low On/Off = When no current is applied to the solenoid valve coil the variable restriction is closed, resulting in no or low pressure.
- Variable Force Solenoid Valve = This solenoid is used to control transmission fluid line pressure by increasing or decreasing the amount of current applied to solenoid valve coil.

Pressure Regulating Solenoid Valves

High Pressure Normally High, Variable Force Solenoid Valve

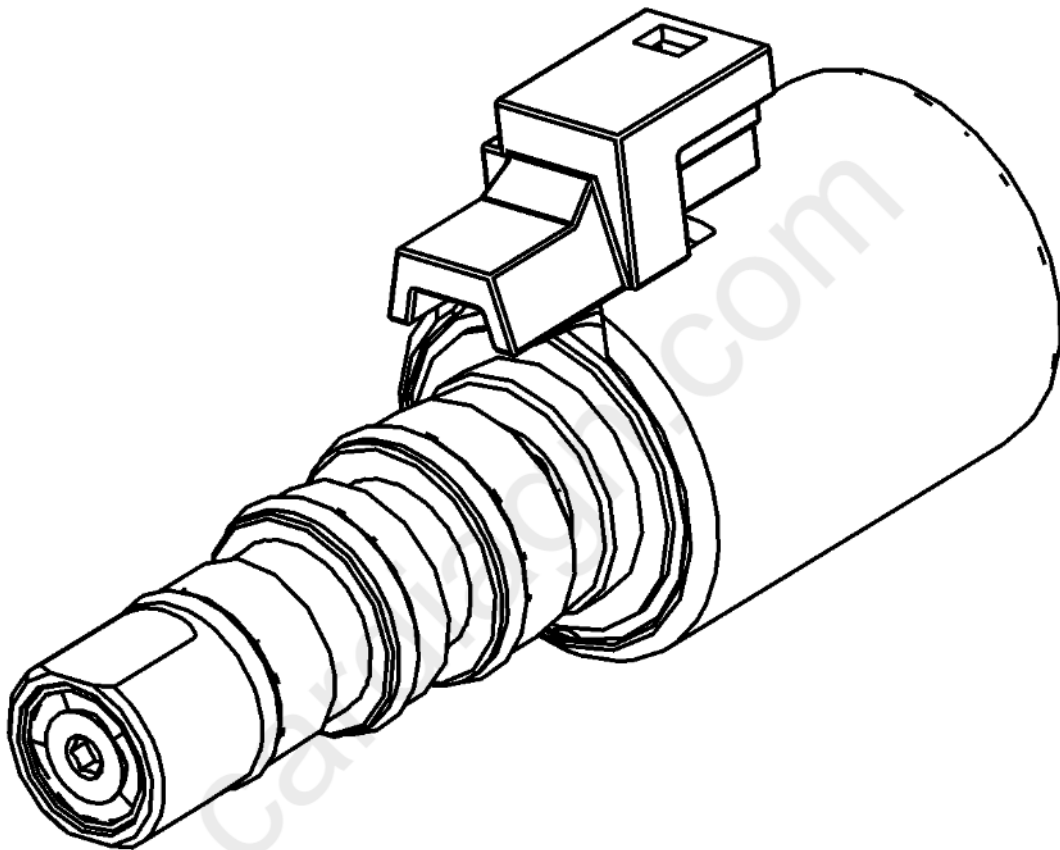


Fig. 3: Transmission Control Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

The Transmission Control Solenoid Valve 1 is a high pressure, normally high, variable force solenoid valve, which controls transmission line pressure. This type of solenoid valve regulates hydraulic fluid pressure based on current flow through the solenoid valve coil windings. The solenoid receives 12 V from a high side driver internal to the TCM. This solenoid has a control circuit to an individual low side driver internal to the TCM, which turns ON and OFF to control the amount of current. As an increasing current is applied to the coil windings, the force imparted to the armature overcomes the high fluid pressure acting on the solenoid valve armature resulting in a decrease in fluid pressure to the controlled element. The normal operating current range for this solenoid is between 0-1.2 A. If the TCM detects an electrical circuit malfunction or excessive current flow, the TCM turns off the high side driver to that solenoid and sets a DTC. The high side driver will reset when the circuit fault is corrected and the ignition switch is cycled.

ON/OFF Solenoid Valves

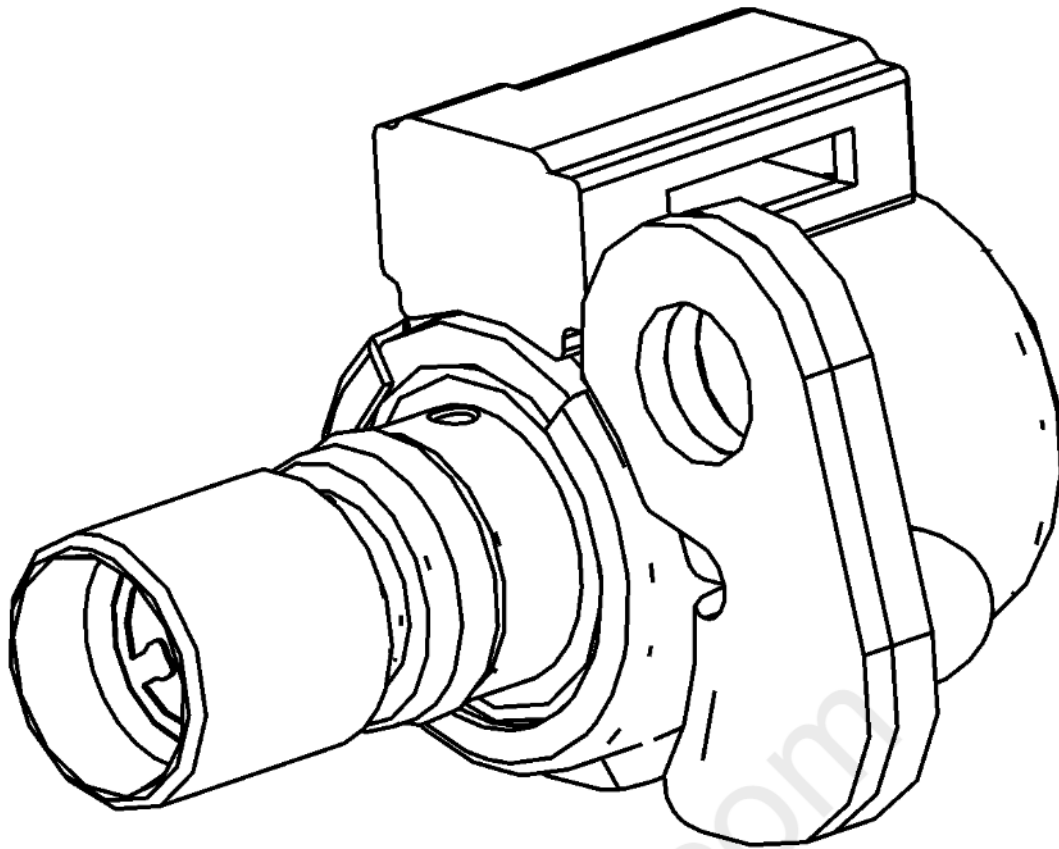


Fig. 4: Transmission Control Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

Transmission Control Solenoid Valves are normally low, ON/OFF solenoids. These solenoids only direct hydraulic fluid pressure when commanded ON. Each solenoid receives 12 V from a high side driver internal to the TCM. Each solenoid valve has a control circuit to an individual low side driver internal to the TCM. The normal operating current range for these solenoids is between 0-1 A. If the TCM detects an electrical circuit malfunction or excessive current flow, the TCM turns off the high side driver to that solenoid and sets a DTC. The high side driver will reset when the circuit fault is corrected and the ignition switch is cycled.

Speed Sensor

Output Speed Sensor

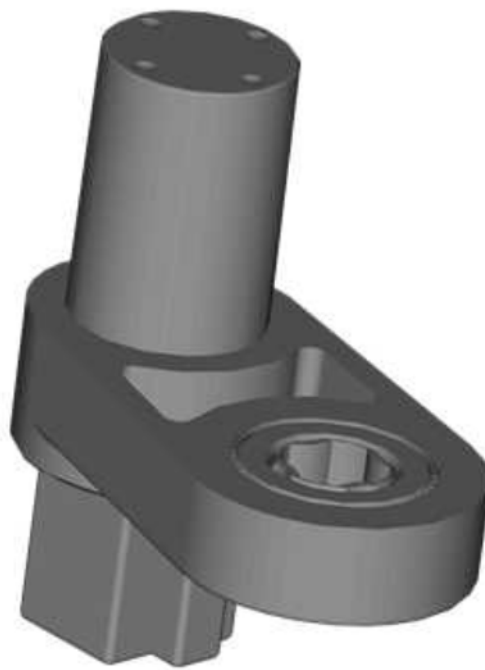


Fig. 5: Output Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

The output speed sensor assembly is a two wire hall-effect type sensor. The TCM supplies a 9 V signal circuit and a low reference circuit to the output speed sensor. The output speed sensor produces a square wave signal by toggling the 9 V signal circuit low and high based on the leading and trailing edges on the outside diameter of the output carrier assembly. As the rotational speed of the output carrier assembly increases, the frequency of the output speed sensor signal increases. The TCM uses the output speed sensor signal along with the input and intermediate speed sensor signals to determine transmission line pressure, shift patterns and the correct gear ratio.

Transmission Fluid Temperature Sensor



Fig. 6: Transmission Fluid Temperature Sensor

Courtesy of GENERAL MOTORS COMPANY

The transmission fluid temperature sensor is a 2 wire negative temperature coefficient thermistor. The TCM supplies a 5 V signal circuit and a low reference circuit to the transmission fluid temperature sensor. The transmission fluid temperature sensor measures the temperature of the fluid in the transmission fluid pan. As the temperature of the fluid increases, the resistance of the sensor decreases, varying the voltage on the signal circuit. The transmission fluid temperature sensor is part of the transmission internal wire harness assembly and has no serviceable parts. If the transmission fluid

temperature sensor is faulty, then replace the internal transmission wire harness assembly that has the temp sensor attached to it.

Transmission Internal Mode Switch

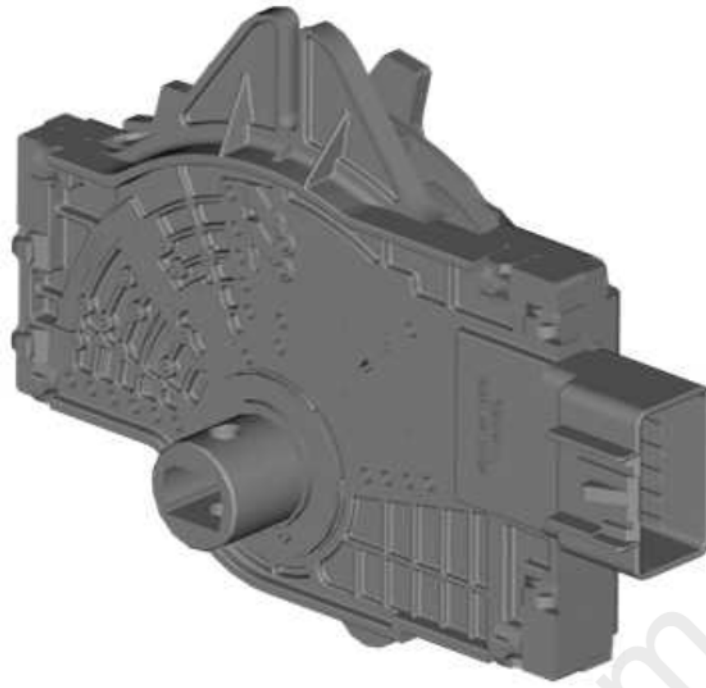


Fig. 7: Transmission Internal Mode Switch
Courtesy of GENERAL MOTORS COMPANY

Transmission Internal Mode Switch

The Transmission Internal Mode Switch contains 9 separate switches in one assembly. The other 4 electronic switches are called the transmission range switches and are used to indicate the gear position the vehicle operator has selected. The Transmission Internal Mode Switch is mounted on the interior left side of the transmission case. The internal mode switch assembly is a dual sliding Hall Effect switch. The nine outputs from the switch indicate which position is selected by the transmission manual shaft. Four outputs (A, B, C, P) are range selection inputs to the transmission control module (TCM). Five outputs (R1, R2, D1, D2 and S) are direction selection inputs to the Hybrid/EV Powertrain Control Module 1, through the transmission X175 connector. The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as IMS Range and IMS Direction. The IMS Range input parameters represented are transmission range signal A, signal B, signal C and signal P. The IMS Direction input parameters represented are transmission direction signal R1, signal R2, signal D1, signal D2 and signal Start. The Transmission Internal Mode Switch indicates to the TCM which Range position the vehicle operator has selected. The Transmission Internal Mode Switch consists of 9 separate Hall Effect switches. Each Hall Effect switch is supplied a 9 V signal circuit from the TCM. Each signal circuit for each gear selector position will have either a voltage reading of 0.70-0.96 V indicating ON or 1.68-2.38 V indicating OFF. The voltage values on each Transmission Internal Mode Switch circuit will change and are dependent on the position of the gear selector. The state of each Transmission Internal Mode Switch A/B/C/P/S circuit is displayed on the scan tool.

Electric Drive Motors

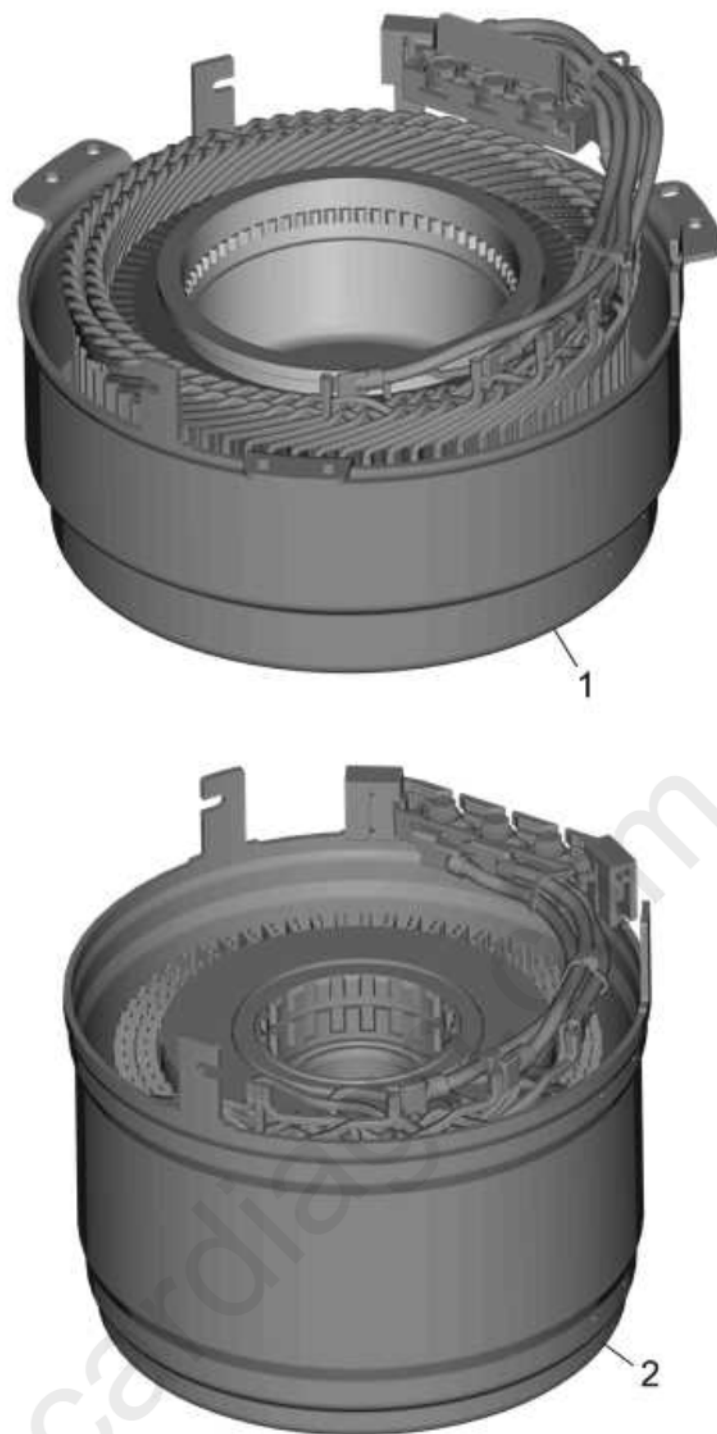


Fig. 8: Drive Motor 1 and Drive Motor 2
Courtesy of GENERAL MOTORS COMPANY

Drive Motor 1 and Drive Motor 2

Drive Motor 1, also called Drive Motor - 1st Position (1), is a 93.6 kW peak power induction motor mounted inside the transmission and Drive Motor 2, also called Drive Motor - 2nd Position (2), is a 61 kW peak power permanent magnet electric motor mounted inside the transmission. These electric drive motors enable engine cranking, transmission reverse and two EV modes of operation. Both are actively cooled via transmission fluid and are encased in steel housings to facilitate transmission assembly. The front motor is used to start the engine and also react torque from the rear motor. During engine crank, the Drive Motor 1 will crank the engine from 0 RPM to over 1400 RPM in under 0.5 seconds. The rear motor propels the vehicle when operating in full-electric mode with the engine off or in reverse. Motor speeds are controlled and monitored by position sensors internal to the motor housings. The drive motor generator position sensor is monitored by the motor control module. The motor control module monitors the angular position, speed and direction of the drive motor generator based upon the signals of the position sensors. The Drive Motor 1 position sensor contains a tone ring mounted to the Drive Motor 1 Rotor and a hall effect sensor assembly mounted to the Drive Motor 1 stator housing. The hall effect sensor assembly contains two sensors in one molded assembly staggered exactly 50 percent offset. The rotor speed and direction can be determined based on the two hall effect sensors.

The Drive Motor 2 position sensor or resolver, contains a drive coil, two driven coils and an irregular shaped metallic rotor. The metallic rotor is mechanically attached to the shaft of the drive motor generator. At ignition ON, the motor control module outputs a 7V ac, 10 kHz excitation signal to the drive coil. The drive coil excitation signal creates a magnetic field surrounding the two driven coils and the irregular shaped rotor. The motor control module then monitors the two driven coil circuits for a return signal. The position of the irregular shaped metallic rotor causes the magnetically-induced return signals of the driven coils to vary in size and shape. A comparison of the two driven coils signals allows the motor control module to determine the exact angle, speed and direction of the drive motor generator. For more information on the drive motor function and system interaction, refer to [Drive Motor Power Inverter Module Description and Operation](#) and [Hybrid Modes of Operation Description](#) .

Electric/Auxiliary Transmission Fluid Pump



Fig. 9: Automatic Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

Automatic Transmission Fluid Pump

The automatic transmission fluid pump is called the Auxiliary Transmission Fluid Pump on the scan tool, is a high voltage AC motor controlled by the Hybrid/EV Powertrain Control Module 1. The purpose of the Electric/Auxiliary Transmission Fluid Pump is to supply oil to the transmission for lube, cooling and clutch. The Electric/Auxiliary Transmission Fluid Pump is commanded on when propulsion is active.

PARK/NEUTRAL - FULL

Park/Neutral State during 1). Pump failed off remedial action. 2). Prior to key-crank request and 3). After/during shutdown.

Park/Neutral - Full

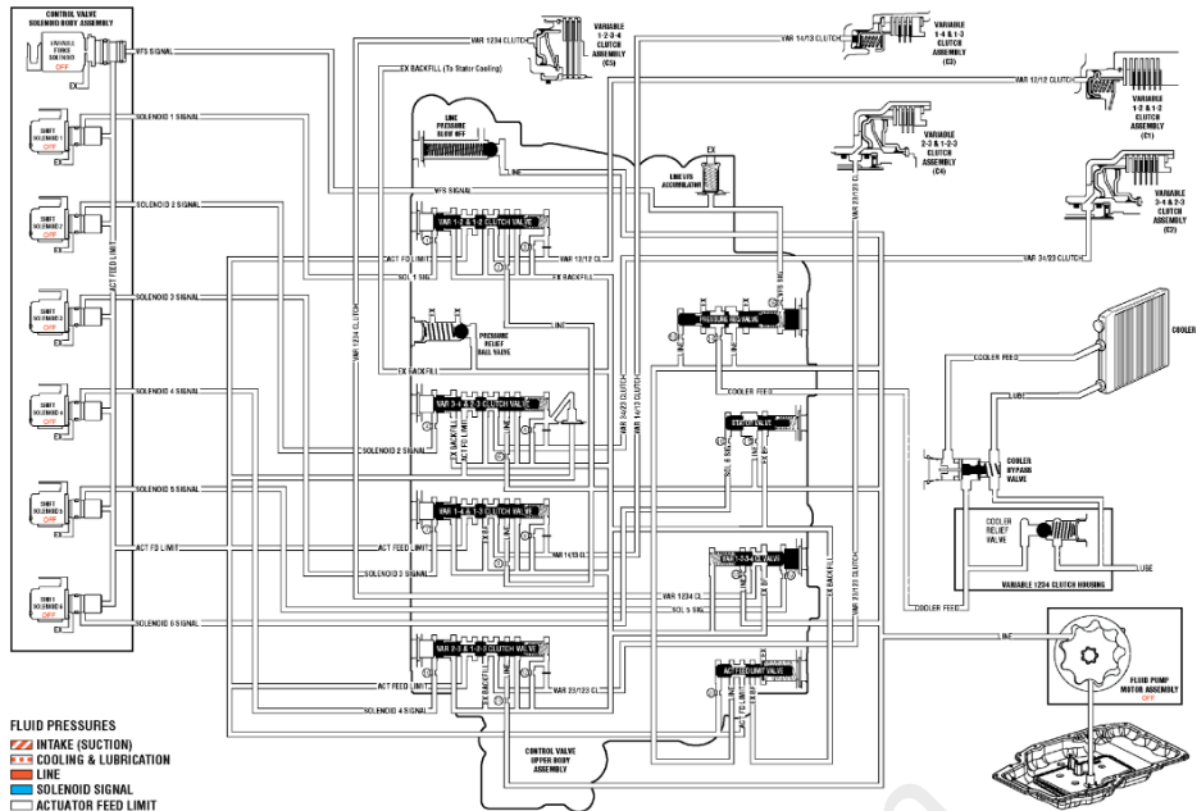


Fig. 10: Park Neutral - Full Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

PARK/NEUTRAL - C3

Primary state for driver selected Neutral/Park at a stop, very low speeds (i.e. carwash) or M4 speeds with engine running.

Fluid Pressure Directed in Preparation for a Shift

Line Fluid Circuit

Line fluid from the automatic transmission fluid pump supplies constant fluid pressure to various components such as the Actuator Feed Limit Valve, Variable 1-2-3-4 Clutch Valve, Stator Valve, Pressure Regulator Valve, Line Pressure Blow Off, Variable 1-2 & 1-2 Clutch Valve, Variable 3-4 & 2-3 Clutch Valve, Variable 1-4 amp; 1-3 Clutch Valve, Variable 2-3 & 1-2-3 Clutch Valve.

Variable Force Solenoid (VFS)

The variable force solenoid is energized ON, allowing fluid to enter the VFS signal circuit. VFS signal fluid is then routed to the pressure regulator valve.

Shift Solenoid 6

When shift solenoid 6 is energized ON, it allows fluid to enter the solenoid 6 signal circuit. Solenoid 6 signal fluid is then routed to the stator valve. Solenoid 6 is actively controlled on and off depending on the need to actively cool the motor stators as calculated real-time by the control system.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

Shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Park/Neutral - C3

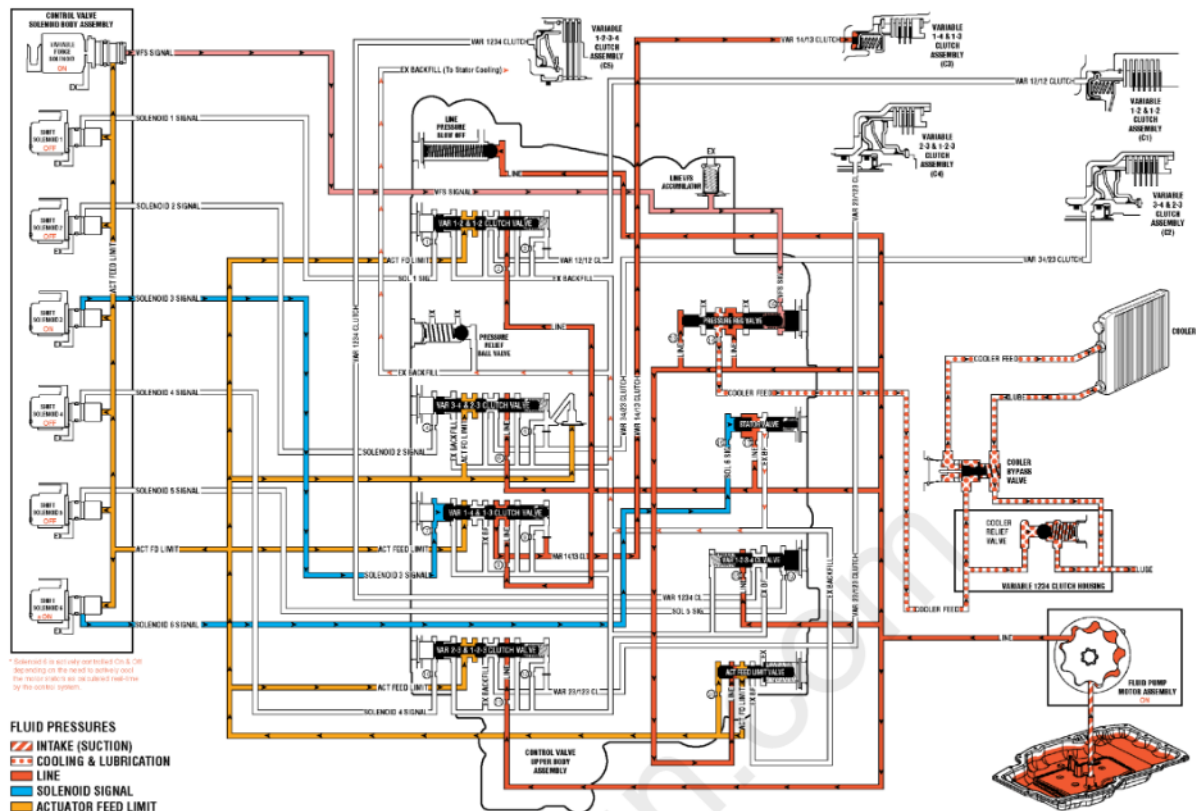


Fig. 11: Park/Neutral - C3 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

PARK/NEUTRAL - C34

Used when the Hybrid Battery has low power/state of charge during cold temperature key-cranks in Park/Neutral, After Key Crank C4 will be disengaged and vehicle slows to Neutral C3.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

Shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

Shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Park/Neutral - C34

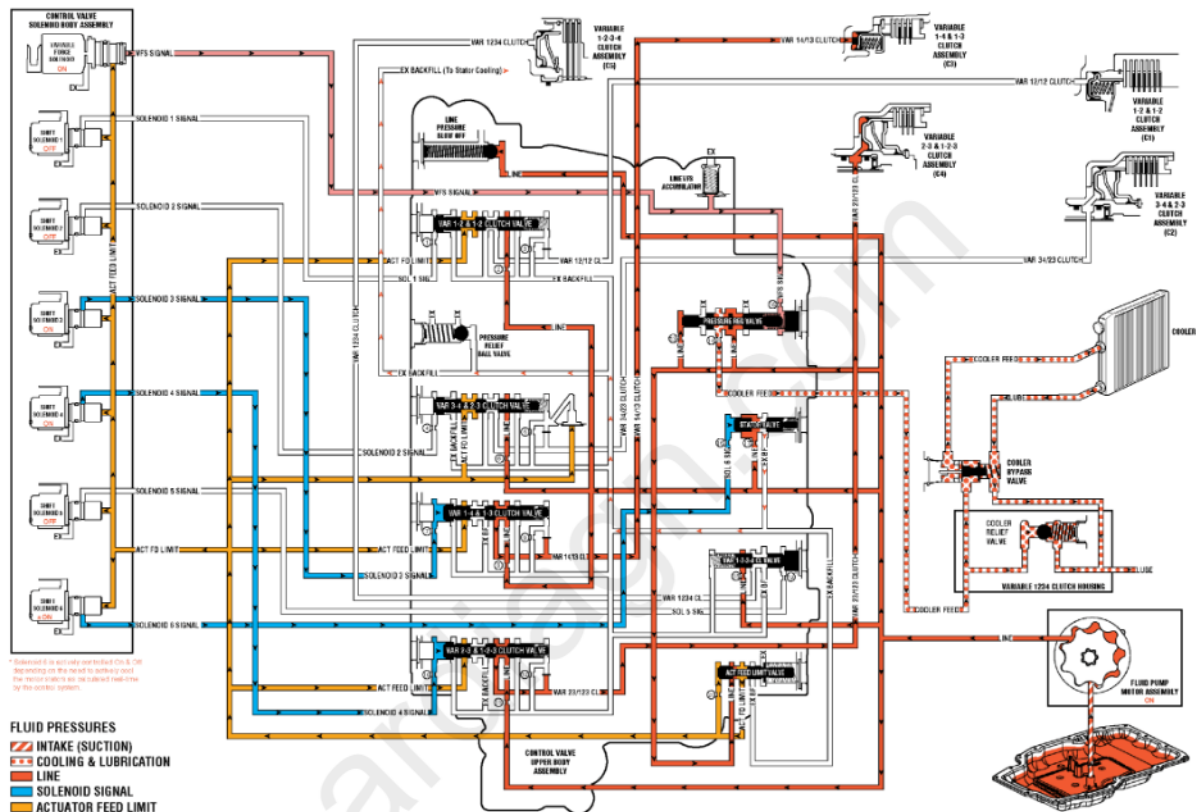


Fig. 12: Park/Neutral - C34 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

PARK/NEUTRAL - C35

Primary state for driver selected neutral/park at a stop, very low speeds (i.e. carwash) or M4 speeds with engine off.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice # 7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Neutral - C4

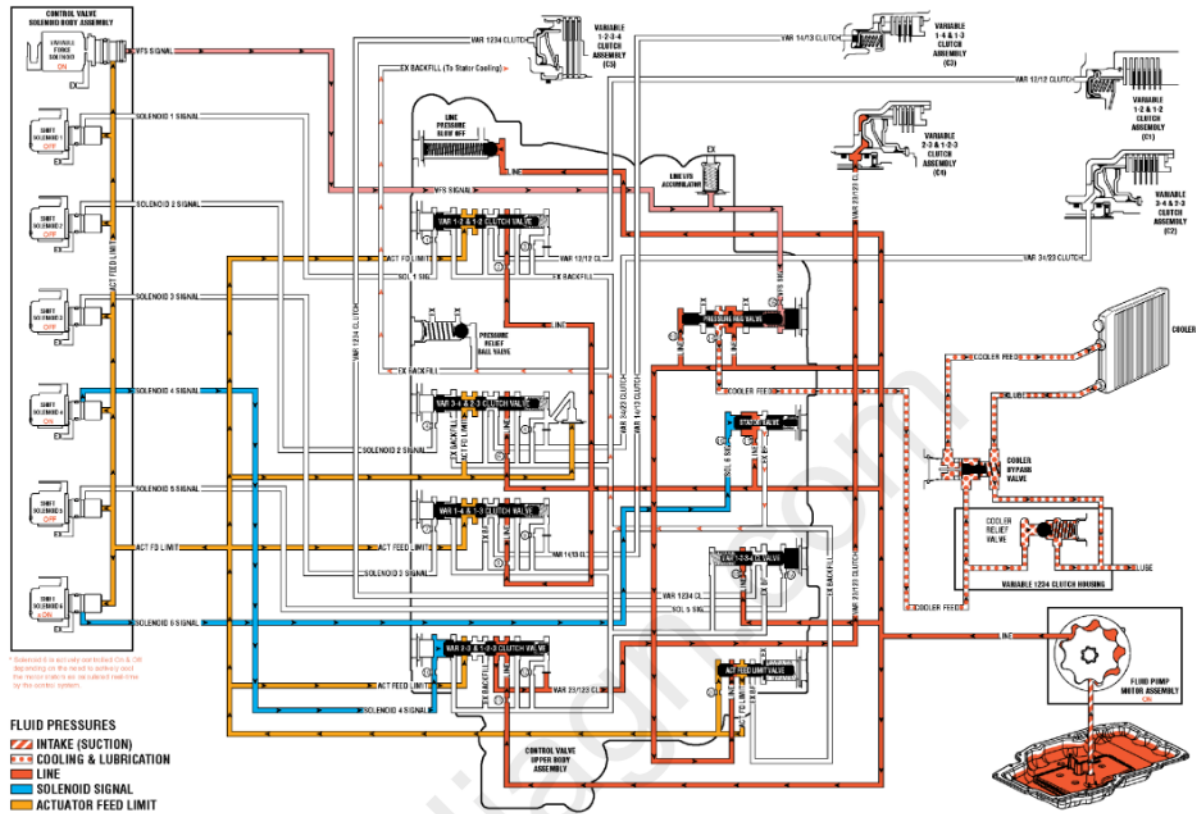


Fig. 14: Neutral - C4 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

NEUTRAL - C45

State for driver selected neutral at M2/M3 output speeds with the engine off when vehicle is in motion.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

The shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Variable 1-2-3-4 Clutch Applies

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the variable 1-2-3-4 clutch valve.

Variable 1-2-3-4 Clutch Valve

Solenoid 5 signal fluid is directed thru orifice #19 to the variable 1-2-3-4 clutch valve. Fluid applies pressure against the variable 1-2-3-4 clutch valve spring force to regulate line pressure into the variable 1234 clutch circuit.

Variable 1-2-3-4 Clutch Assembly (C5)

Variable 1234 clutch fluid is routed to the variable 1-2-3-4 clutch. Variable 1234 clutch fluid applies pressure against the variable 1-2-3-4 clutch piston which applies holding pressure to the variable 1-2-3-4 clutch plates.

Neutral - C45

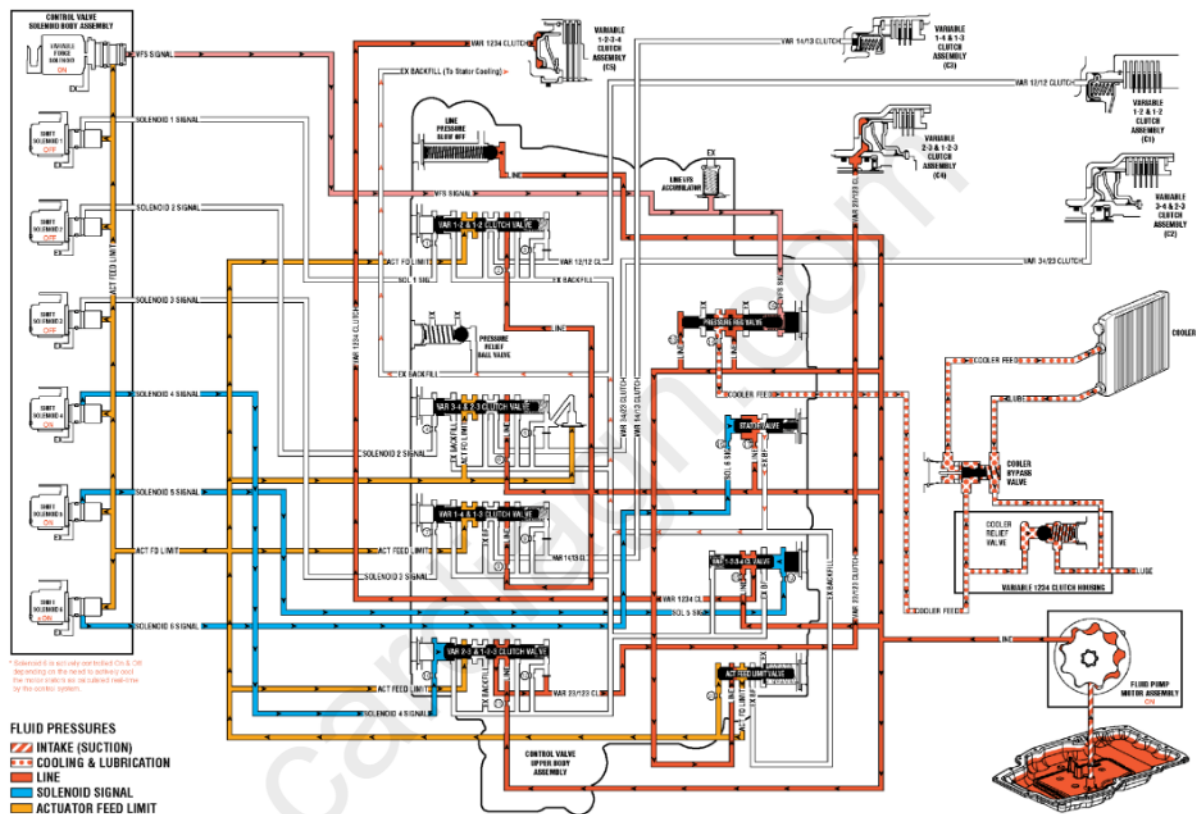


Fig. 15: Neutral - C45 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

DRIVE MODE 1

Primary launch mode with engine ON both in Drive & Reverse.

Variable 1-2 & 1-2 Clutch Applies

Shift Solenoid 1

The shift solenoid 1 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 1 signal circuit. Solenoid 1 signal fluid is then routed to the variable 1-2 & 1-2 clutch valve.

Variable 1-2 & 1-2 Clutch Valve

Solenoid 1 signal fluid is directed thru orifice # 1 to the variable 1-2 & 1-2 clutch valve. Fluid applies pressure against the variable 1-2 & 1-2 clutch valve spring force to regulate line pressure into the variable 12/12 clutch fluid circuit.

Variable 1-2 & 1-2 Clutch Assembly (C1)

Variable 12/12 clutch fluid is routed to the variable 1-2 & 1-2 clutch. Variable 12/12 clutch fluid applies pressure against the variable 1-2 & 1-2 clutch piston which applies holding pressure to the variable 1-2 & 1-2 clutch plates.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Drive Mode 1

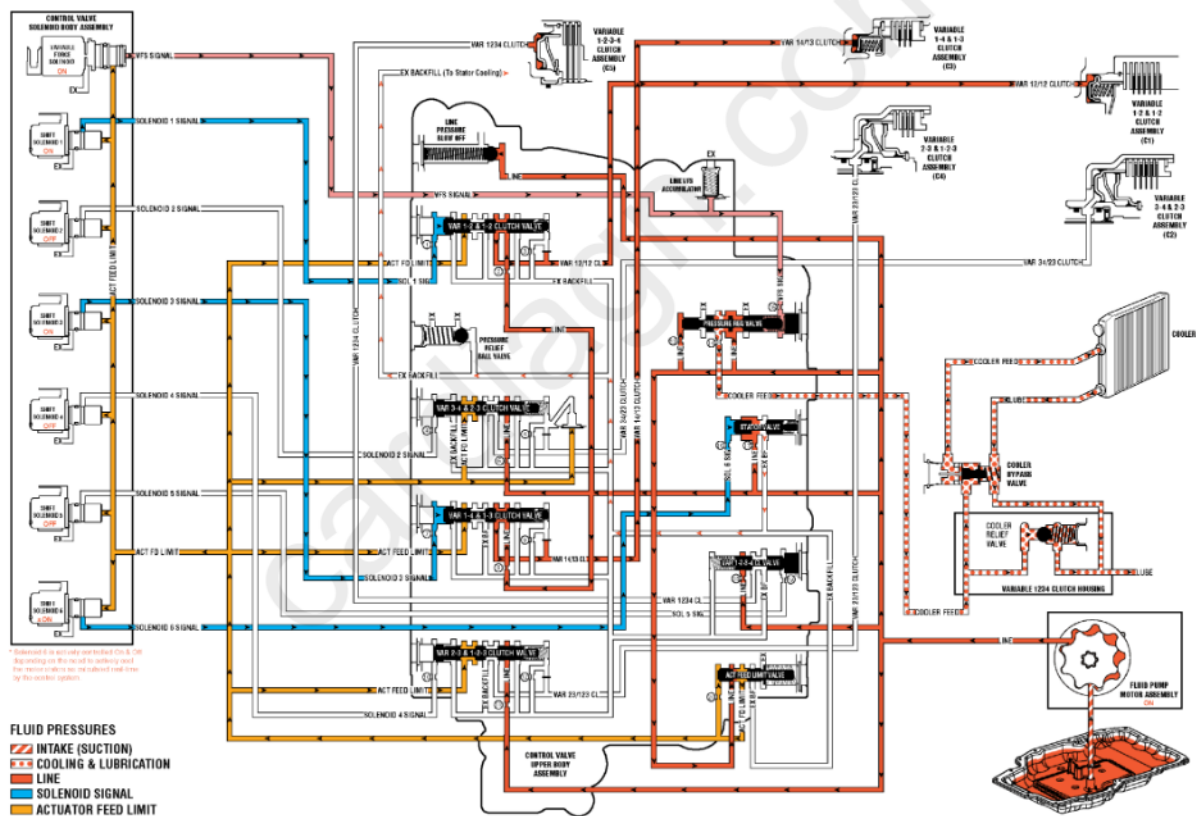


Fig. 16: Drive Mode 1 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

DRIVE MODE 2

Forward Drive state after launch with engine ON.

Variable 1-2 & 1-2 Clutch Applies

Shift Solenoid 1

The shift solenoid 1 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 1 signal circuit. Solenoid 1 signal fluid is then routed to the variable 1-2 & 1-2 clutch valve.

Variable 1-2 & 1-2 Clutch Valve

Variable 3-4 & 2-3 Clutch Applies

Shift Solenoid 2

The shift solenoid 2 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 2 signal circuit. Solenoid 2 signal fluid is then routed to the variable 3-4 & 2-3 clutch valve.

Variable 3-4 & 2-3 Clutch Valve

Solenoid 2 signal fluid is directed thru orifice #4 to the variable 3-4 & 2-3 clutch valve. Fluid applies pressure against the variable 3-4 & 2-3 clutch valve spring force to regulate line pressure into the variable 34/23 clutch fluid circuit.

Variable 3-4 & 2-3 Clutch Assembly (C2)

Variable 34/23 clutch fluid is routed to the variable 3-4 & 2-3 clutch. Variable 34/23 clutch fluid applies pressure against the variable 3-4 & 2-3 clutch piston which applies holding pressure to the variable 3-4 & 2-3 clutch plates.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

The shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Drive Mode 3

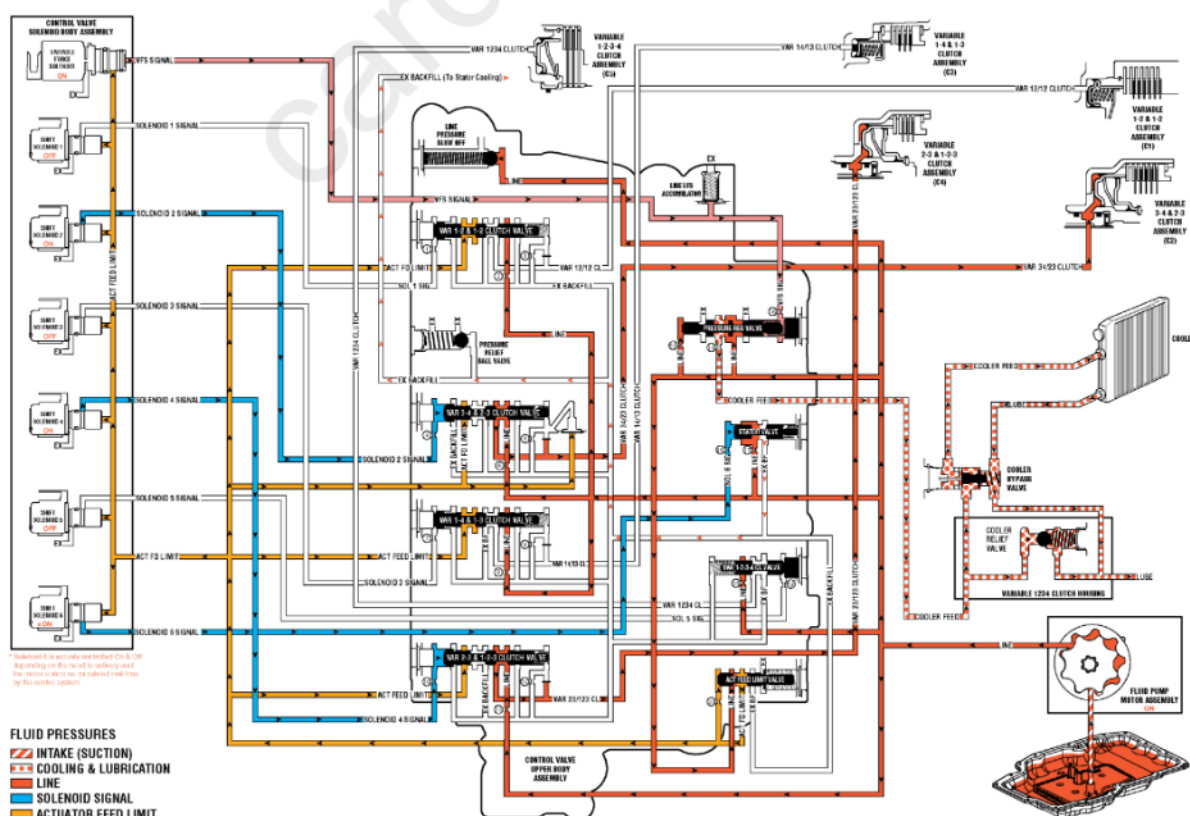


Fig. 18: Drive Mode 3 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

DRIVE MODE 4

Forward Drive state after launch with engine ON.

Variable 3-4 & 2-3 Clutch Applies

Shift Solenoid 2

The shift solenoid 2 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 2 signal circuit. Solenoid 2 signal fluid is then routed to the variable 3-4 & 2-3 clutch valve.

Variable 3-4 & 2-3 Clutch Valve

Solenoid 2 signal fluid is directed thru orifice #4 to the variable 3-4 & 2-3 clutch valve. Fluid applies pressure against the variable 3-4 & 2-3 clutch valve spring force to regulate line pressure into the variable 34/23 clutch fluid circuit.

Variable 3-4 & 2-3 Clutch Assembly (C2)

Variable 34/23 clutch fluid is routed to the variable 3-4 & 2-3 clutch. Variable 34/23 clutch fluid applies pressure against the variable 3-4 & 2-3 clutch piston which applies holding pressure to the variable 3-4 & 2-3 clutch plates.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Drive Mode 4

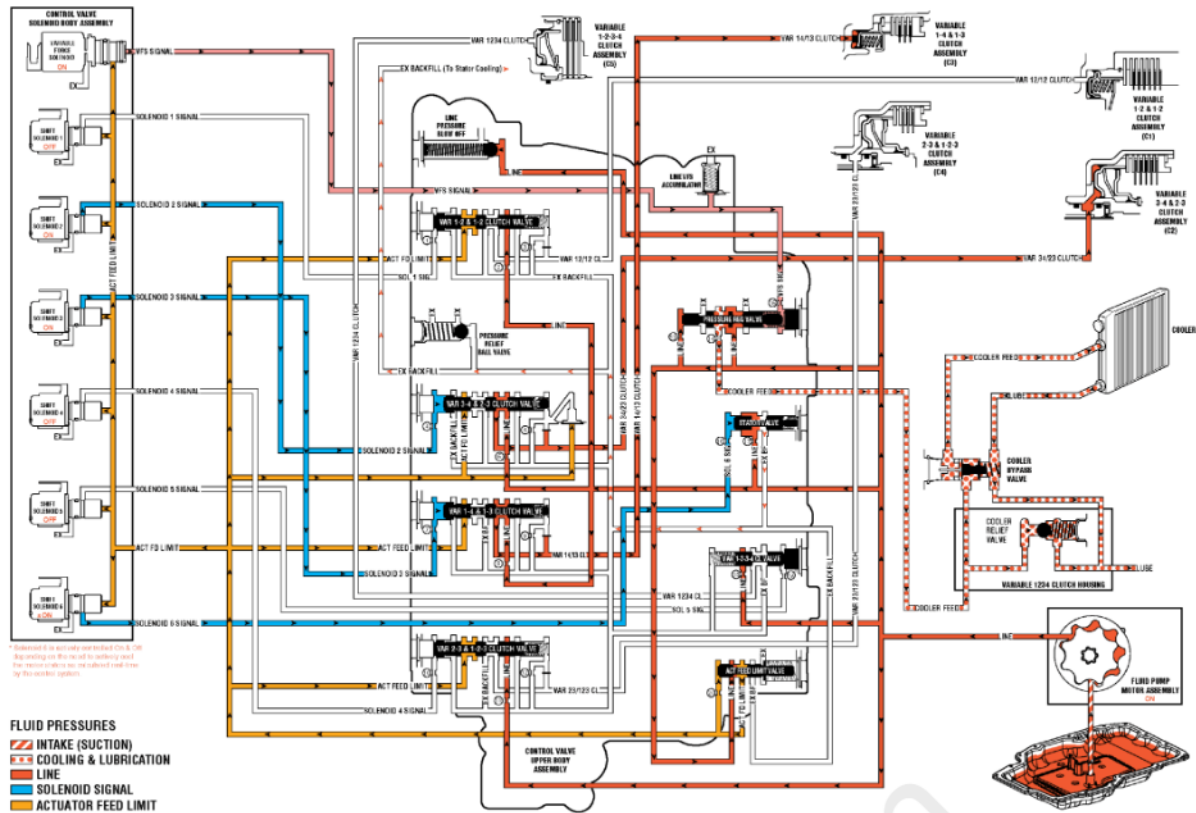


Fig. 19: Drive Mode 4 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

DRIVE RANGE, FIRST GEAR

Fixed Forward Gear 1 with Engine running.

Variable 1-2 & 1-2 Clutch Applies

Shift Solenoid 1

The shift solenoid 1 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 1 signal circuit. Solenoid 1 signal fluid is then routed to the variable 1-2 & 1-2 clutch valve.

Variable 1-2 & 1-2 Clutch Valve

Solenoid 1 signal fluid is directed thru orifice #1 to the variable 1-2 & 1-2 clutch valve. Fluid applies pressure against the variable 1-2 & 1-2 clutch valve spring force to regulate line pressure into the variable 12/12 clutch fluid circuit.

Variable 1-2 & 1-2 Clutch Assembly (C1)

Variable 12/12 clutch fluid is routed to the variable 1-2 & 1-2 clutch. Variable 12/12 clutch fluid applies pressure against the variable 1-2 & 1-2 clutch piston which applies holding pressure to the variable 1-2 & 1-2 clutch plates.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

The shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Drive Range - First Gear

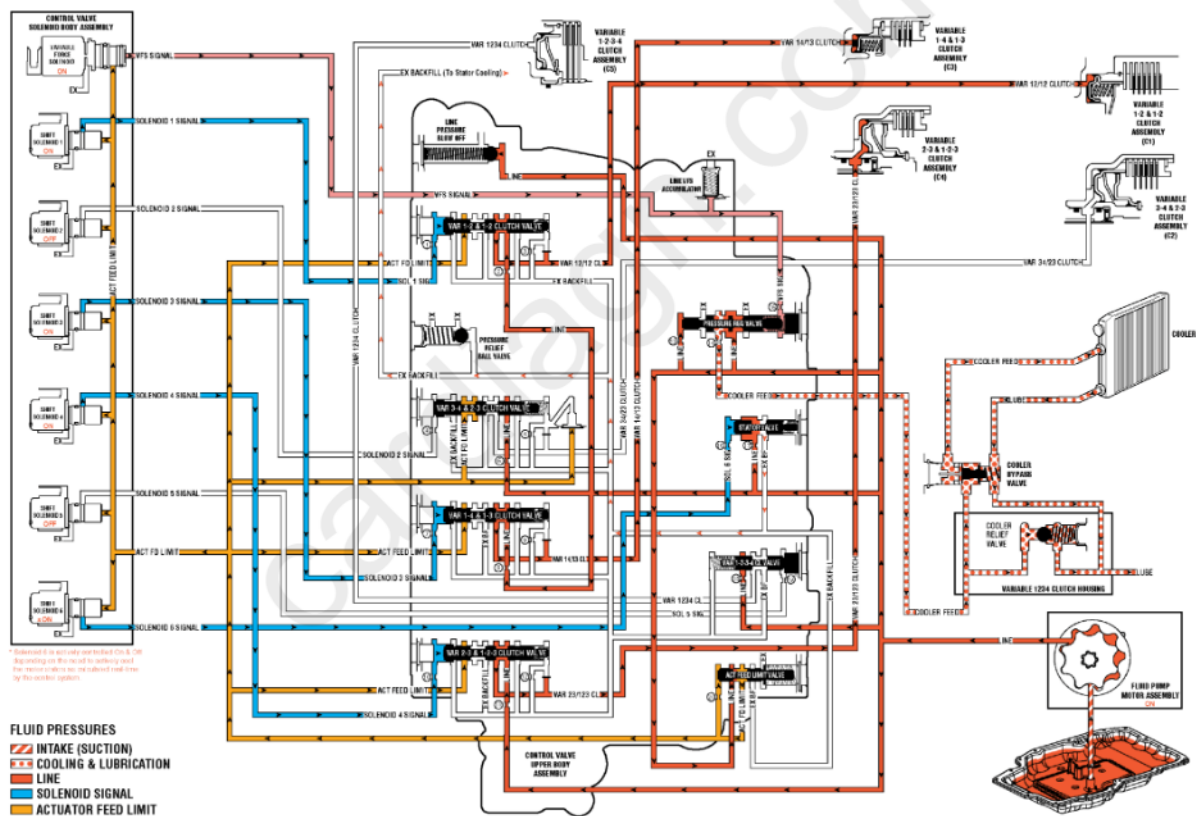


Fig. 20: Drive Range - First Gear Hydraulic Diagram

Courtesy of GENERAL MOTORS COMPANY

DRIVE RANGE, SECOND GEAR

Fixed Forward Gear 2 with Engine running.

Variable 1-2 & 1-2 Clutch Applies

Shift Solenoid 1

The shift solenoid 1 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 1 signal circuit. Solenoid 1 signal fluid is then routed to the variable 1-2 & 1-2 clutch valve.

Variable 1-2 & 1-2 Clutch Valve

Solenoid 1 signal fluid is directed thru orifice #1 to the variable 1-2 & 1-2 clutch valve. Fluid applies pressure against the variable 1-2 & 1-2 clutch valve spring force to regulate line pressure into the variable 12/12 clutch fluid circuit.

Variable 1-2 & 1-2 Clutch Assembly (C1)

Variable 12/12 clutch fluid is routed to the variable 1-2 & 1-2 clutch. Variable 12/12 clutch fluid applies pressure against the variable 1-2 & 1-2 clutch piston which applies holding pressure to the variable 1-2 & 1-2 clutch plates.

Variable 3-4 & 2-3 Clutch Applies

Shift Solenoid 2

The shift solenoid 2 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 2 signal circuit. Solenoid 2 signal fluid is then routed to the variable 3-4 & 2-3 clutch valve.

Variable 3-4 & 2-3 Clutch Valve

Solenoid 2 signal fluid is directed thru orifice #4 to the variable 3-4 & 2-3 clutch valve. Fluid applies pressure against the variable 3-4 & 2-3 clutch valve spring force to regulate line pressure into the variable 34/23 clutch fluid circuit.

Variable 3-4 & 2-3 Clutch Assembly (C2)

Variable 34/23 clutch fluid is routed to the variable 3-4 & 2-3 clutch. Variable 34/23 clutch fluid applies pressure against the variable 3-4 & 2-3 clutch piston which applies holding pressure to the variable 3-4 & 2-3 clutch plates.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

The shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Drive Range - Second Gear

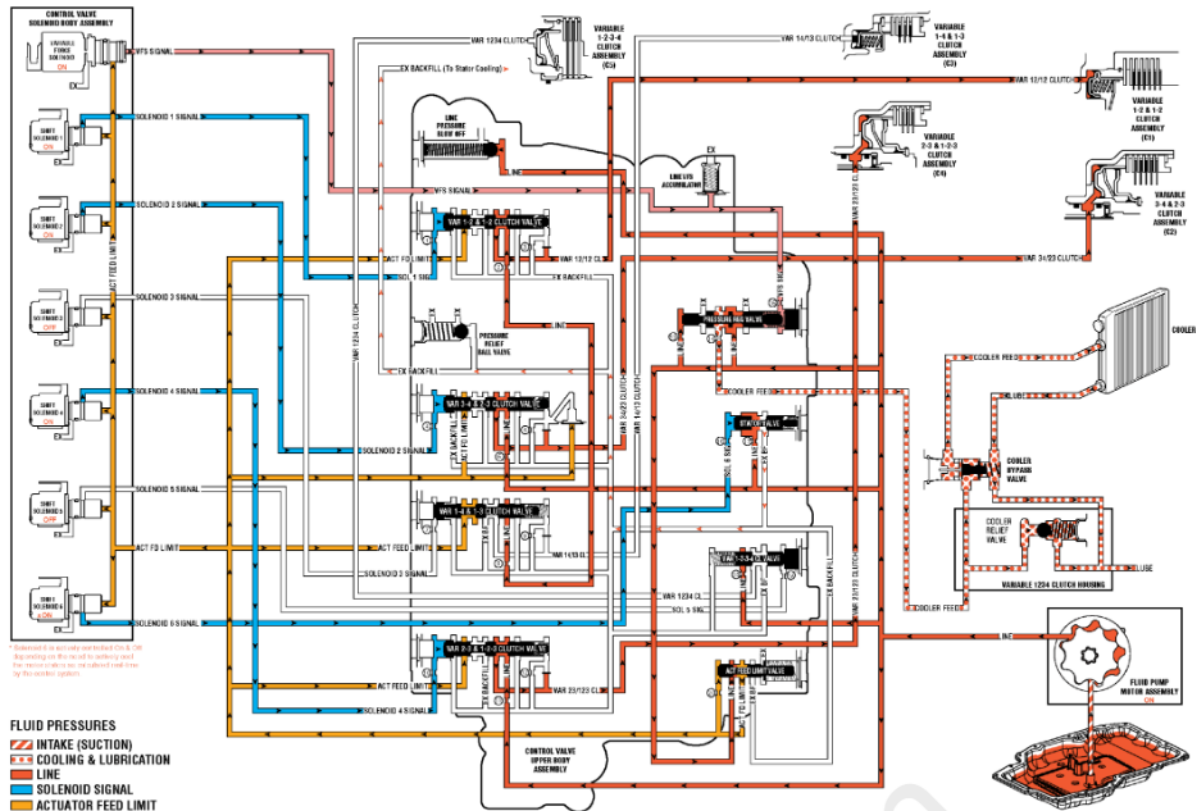


Fig. 21: Drive Range - Second Gear Hydraulic Diagram

Courtesy of GENERAL MOTORS COMPANY

DRIVE RANGE, THIRD GEAR

Fixed Forward Gear 3 with Engine running.

Variable 3-4 & 2-3 Clutch Applies

Shift Solenoid 2

The shift solenoid 2 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 2 signal circuit. Solenoid 2 signal fluid is then routed to the variable 3-4 & 2-3 clutch valve.

Variable 3-4 & 2-3 Clutch Valve

Solenoid 2 signal fluid is directed thru orifice #4 to the variable 3-4 & 2-3 clutch valve. Fluid applies pressure against the variable 3-4 & 2-3 clutch valve spring force to regulate line pressure into the variable 34/23 clutch fluid circuit.

Variable 3-4 & 2-3 Clutch Assembly (C2)

Variable 34/23 clutch fluid is routed to the variable 3-4 & 2-3 clutch. Variable 34/23 clutch fluid applies pressure against the variable 3-4 & 2-3 clutch piston which applies holding pressure to the variable 3-4 & 2-3 clutch plates.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

The shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 23/123 clutch fluid is routed to the variable 2-3 & 1-2-3 clutch. Variable 23/123 clutch fluid applies pressure against the variable 2-3 & 1-2-3 clutch piston which applies holding pressure to the variable 2-3 & 1-2-3 clutch plates.

Drive Range - Third Gear

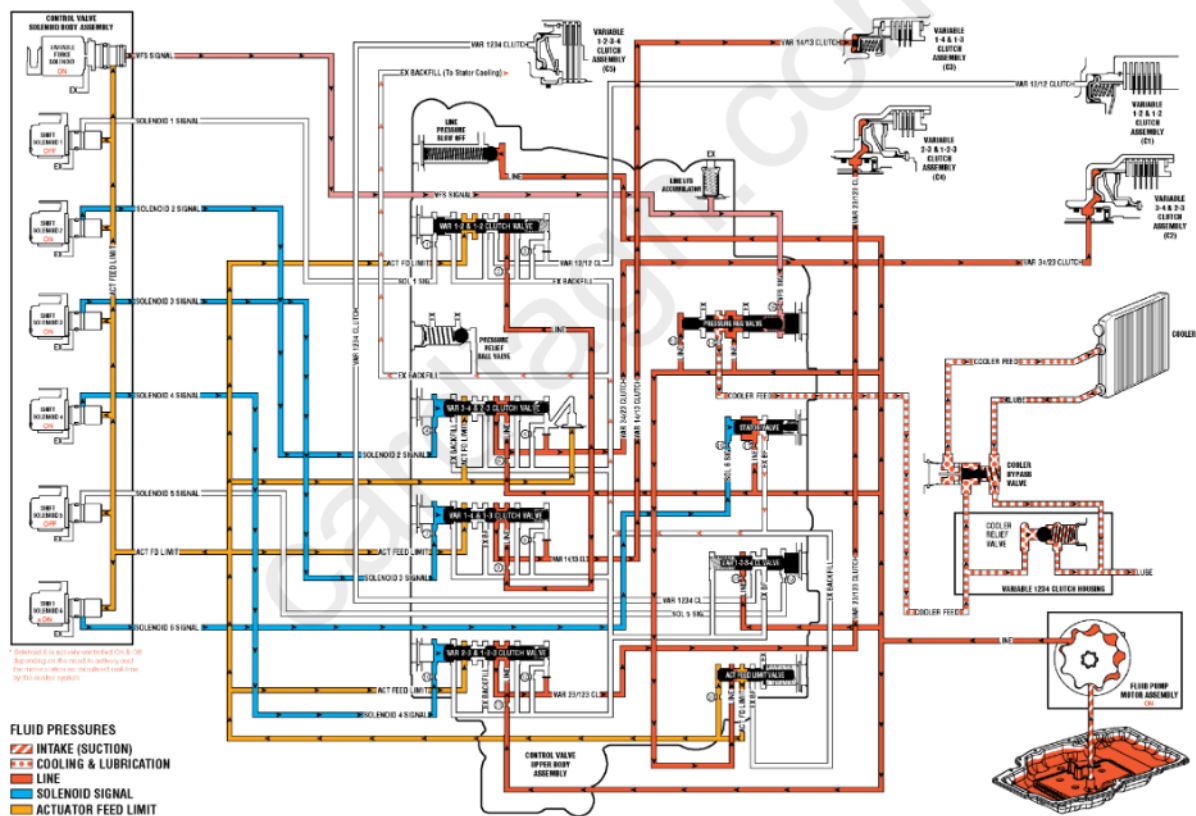


Fig. 22: Drive Range - Third Gear Hydraulic Diagram

Courtesy of GENERAL MOTORS COMPANY

ELECTRIC VEHICLE MODE 1

Electric Vehicle Mode 1 with Engine OFF in Drive or Reverse.

Variable 1-2 & 1-2 Clutch Applies

Shift Solenoid 1

The shift solenoid 1 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 1 signal circuit. Solenoid 1 signal fluid is then routed to the variable 1-2 & 1-2 clutch valve.

Variable 1-2 & 1-2 Clutch Valve

Solenoid 1 signal fluid is directed thru orifice # 1 to the variable 1-2 & 1-2 clutch valve. Fluid applies pressure against the variable 1-2 & 1-2 clutch valve spring force to regulate line pressure into the variable 12/12 clutch fluid circuit.

Variable 1-2 & 1-2 Clutch Assembly (C1)

Variable 12/12 clutch fluid is routed to the variable 1-2 & 1-2 clutch. Variable 12/12 clutch fluid applies pressure against the variable 1-2 & 1-2 clutch piston which applies holding pressure to the variable 1-2 & 1-2 clutch plates.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Variable 1-2-3-4 Clutch Applies

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the variable 1-2-3-4 clutch valve.

Variable 1-2-3-4 Clutch Valve

Solenoid 5 signal fluid is directed thru orifice #19 to the variable 1-2-3-4 clutch valve. Fluid applies pressure against the variable 1-2-3-4 clutch valve spring force to regulate line pressure into the variable 1234 clutch circuit.

Variable 1-2-3-4 Clutch Assembly (C5)

Variable 1234 clutch fluid is routed to the variable 1-2-3-4 clutch. Variable 1234 clutch fluid applies pressure against the variable 1-2-3-4 clutch piston which applies holding pressure to the variable 1-2-3-4 clutch plates.

Electric Vehicle Mode 1

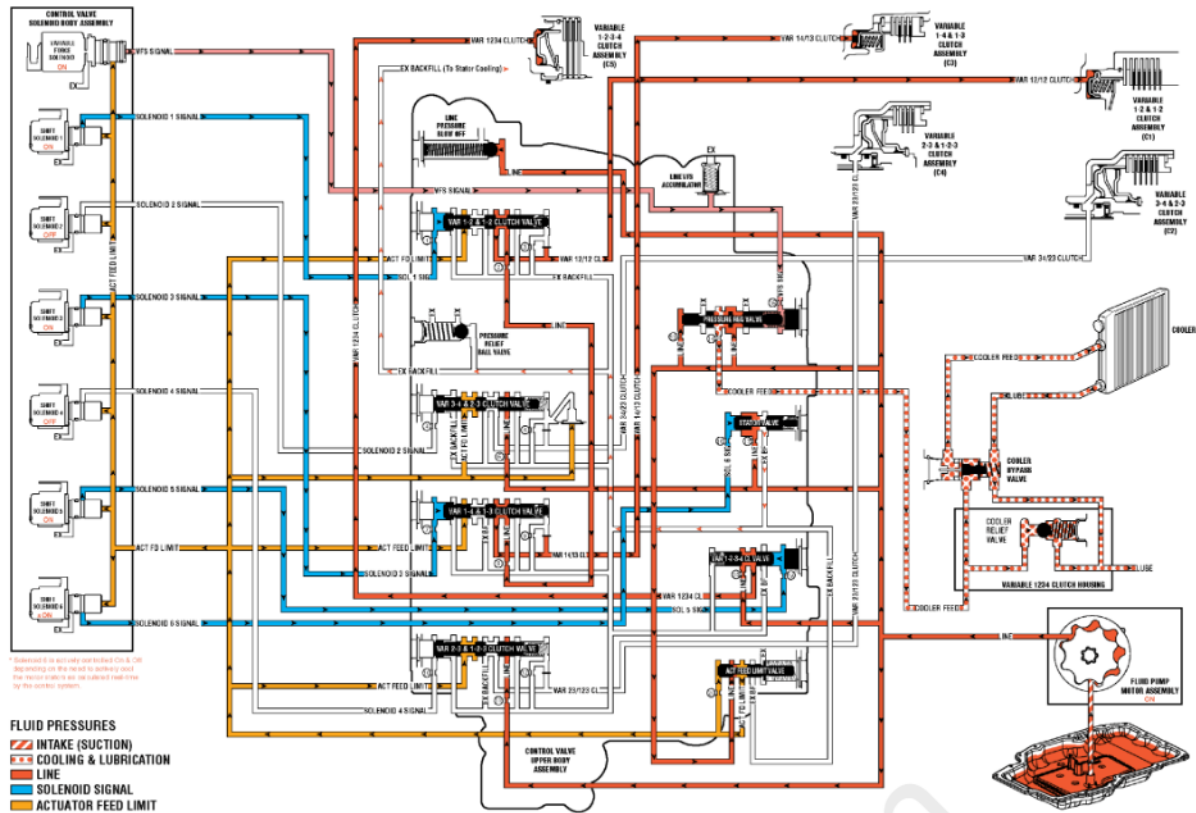


Fig. 23: Electric Vehicle Mode 1 Hydraulic Diagram
Courtesy of GENERAL MOTORS COMPANY

ELECTRIC VEHICLE MODE 3

Electric Vehicle Mode 3 with Engine OFF in Drive.

Variable 3-4 & 2-3 Clutch Applies

Shift Solenoid 2

The shift solenoid 2 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 2 signal circuit. Solenoid 2 signal fluid is then routed to the variable 3-4 & 2-3 clutch valve.

Variable 3-4 & 2-3 Clutch Valve

Solenoid 2 signal fluid is directed thru orifice # 4 to the variable 3-4 & 2-3 clutch valve. Fluid applies pressure against the variable 3-4 & 2-3 clutch valve spring force to regulate line pressure into the variable 34/23 clutch fluid circuit.

Variable 3-4 & 2-3 Clutch Assembly (C2)

Variable 34/23 clutch fluid is routed to the variable 3-4 & 2-3 clutch. Variable 34/23 clutch fluid applies pressure against the variable 3-4 & 2-3 clutch piston which applies holding pressure to the variable 3-4 & 2-3 clutch plates.

Variable 2-3 & 1-2-3 Clutch Applied

Shift Solenoid 4

The shift solenoid 4 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 4 signal circuit. Solenoid 4 signal fluid is then routed to the variable 2-3 & 1-2-3 clutch valve.

Variable 2-3 & 1-2-3 Clutch Valve

Solenoid 4 signal fluid is directed thru orifice #10 to the variable 2-3 & 1-2-3 clutch valve. Fluid applies pressure against the variable 2-3 & 1-2-3 clutch valve spring force to regulate line pressure into the variable 23/123 clutch circuit.

Variable 2-3 & 1-2-3 Clutch Assembly (C4)

Variable 3-4 & 2-3 Clutch Valve

Solenoid 2 signal fluid is directed thru orifice # 4 to the variable 3-4 & 2-3 clutch valve. Fluid applies pressure against the variable 3-4 & 2-3 clutch valve spring force to regulate line pressure into the variable 34/23 clutch fluid circuit.

Variable 3-4 & 2-3 Clutch Assembly (C2)

Variable 34/23 clutch fluid is routed to the variable 3-4 & 2-3 clutch. Variable 34/23 clutch fluid applies pressure against the variable 3-4 & 2-3 clutch piston which applies holding pressure to the variable 3-4 & 2-3 clutch plates.

Variable 1-4 & 1-3 Clutch Applies

Shift Solenoid 3

The shift solenoid 3 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 3 signal circuit. Solenoid 3 signal fluid is then routed to the variable 1-4 & 1-3 clutch valve.

Variable 1-4 & 1-3 Clutch Valve

Solenoid 3 signal fluid is directed thru orifice #7 to the variable 1-4 & 1-3 clutch valve. Fluid applies pressure against the variable 1-4 & 1-3 clutch valve spring force to regulate line pressure into the variable 14/13 clutch fluid circuit.

Variable 1-4 & 1-3 Clutch Assembly (C3)

Variable 14/13 clutch fluid is routed to the variable 1-4 & 1-3 clutch. Variable 14/13 clutch fluid applies pressure against the variable 1-4 & 1-3 clutch piston which applies holding pressure to the variable 1-4 & 1-3 clutch plates.

Variable 1-2-3-4 Clutch Applies

Shift Solenoid 5

The shift solenoid 5 is energized ON, allowing actuator feed limit fluid to enter the Solenoid 5 signal circuit. Solenoid 5 signal fluid is then routed to the variable 1-2-3-4 clutch valve.

Variable 1-2-3-4 Clutch Valve

Solenoid 5 signal fluid is directed thru orifice #19 to the variable 1-2-3-4 clutch valve. Fluid applies pressure against the variable 1-2-3-4 clutch valve spring force to regulate line pressure into the variable 1234 clutch circuit.

Variable 1-2-3-4 Clutch Assembly (C5)

Variable 1234 clutch fluid is routed to the variable 1-2-3-4 clutch. Variable 1234 clutch fluid applies pressure against the variable 1-2-3-4 clutch piston which applies holding pressure to the variable 1-2-3-4 clutch plates.

Electric Vehicle Mode 4

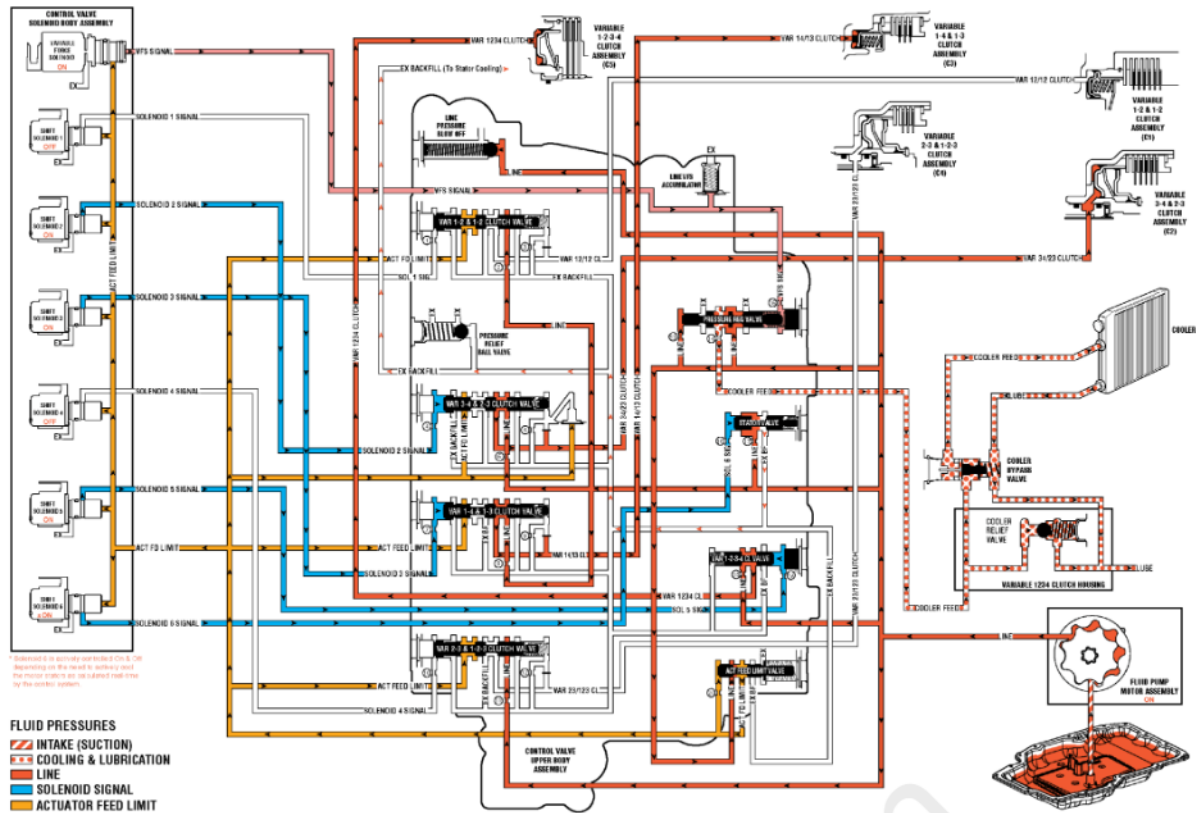


Fig. 25: Electric Vehicle Mode 4 Hydraulic Diagram
 Courtesy of GENERAL MOTORS COMPANY

FLUID PASSAGES

Case Assembly - Case Extension Side

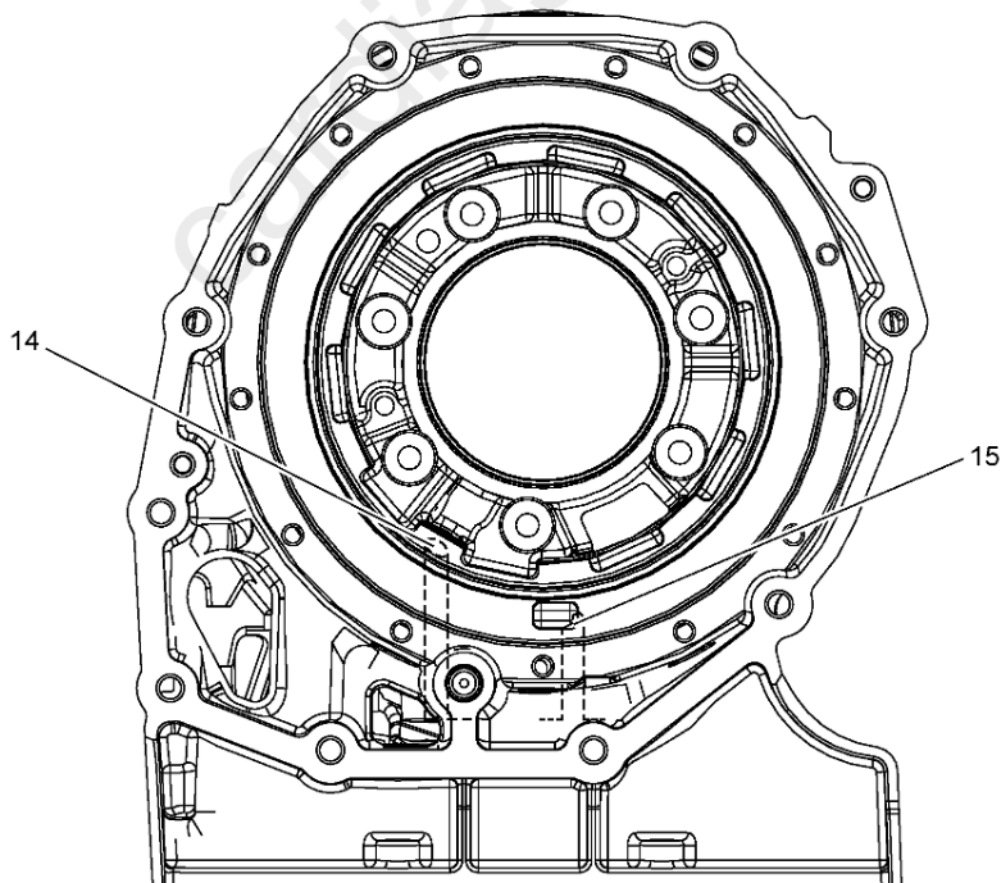


Fig. 26: Case Assembly - Case Extension Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
14	Variable 14/13 Clutch
15	Variable 23/123 Clutch

Case Assembly - Torque Dampener Side

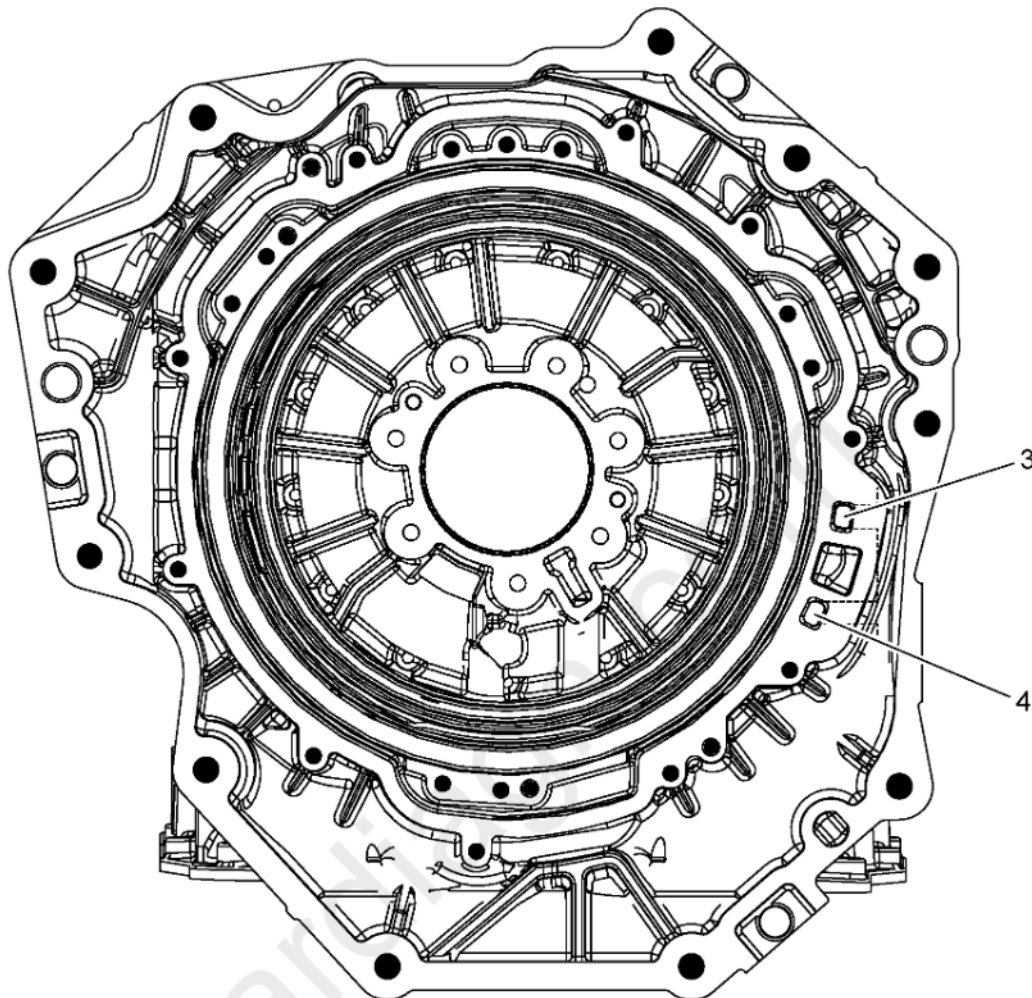


Fig. 27: Case Assembly - Torque Dampener Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
3	Lube
4	Cooler Feed

Case Assembly - Control Valve Upper Body Side

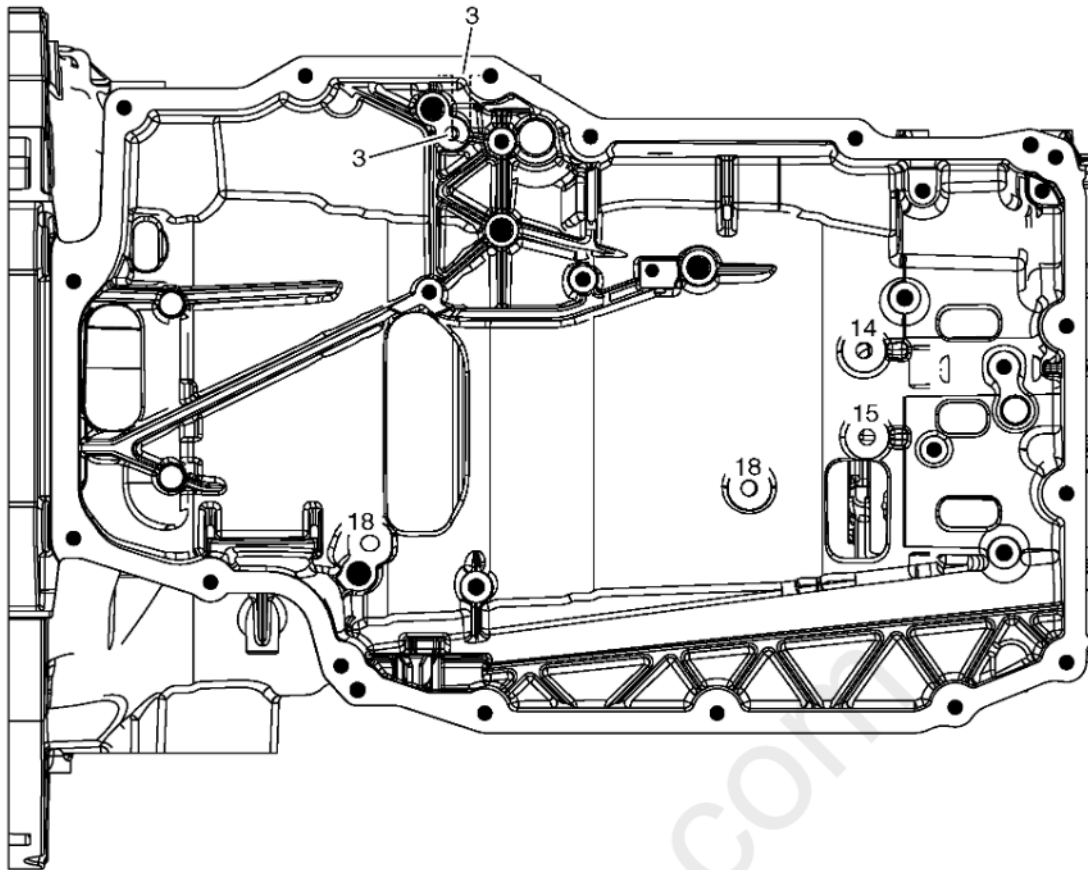


Fig. 28: Case Assembly - Control Valve Upper Body Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
3	Lube
14	Variable 14/13 Clutch
15	Variable 23/123 Clutch
18	Exhaust Backfill

Control Valve Solenoid Body - Fluid Pan Side

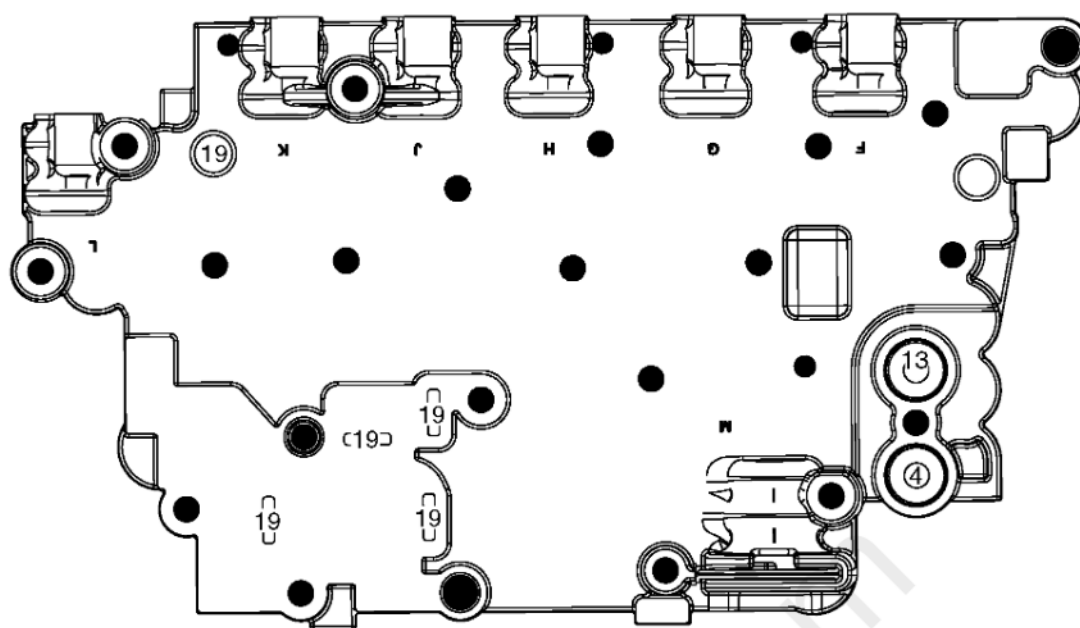


Fig. 29: Control Valve Solenoid Body - Fluid Pan Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
4	Cooler Feed
13	Variable 1234 Clutch
19	Exhaust

Control Valve Solenoid Body - Spacer Plate Side

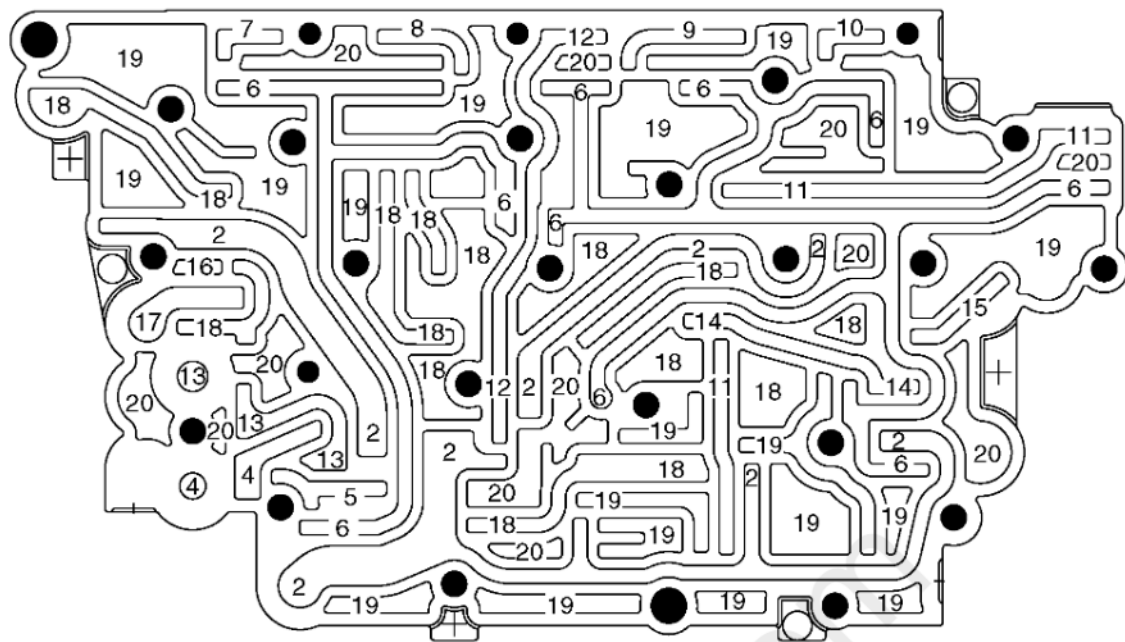


Fig. 30: Control Valve Solenoid Body - Spacer Plate Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
4	Cooler Feed
5	Variable Force Solenoid Valve Signal
6	Actuator Feed Limit
7	Solenoid Valve 1 Signal
8	Solenoid Valve 2 Signal
9	Solenoid Valve 3 Signal
10	Solenoid Valve 4 Signal
11	Solenoid Valve 5 Signal
12	Solenoid Valve 6 Signal
13	Variable 1234 Clutch
14	Variable 14/13 Clutch
15	Variable 23/123 Clutch
16	Variable 12/12 Clutch
17	Variable 34/23 Clutch
18	Exhaust Backfill
19	Exhaust

Control Valve Upper Body Assembly - Spacer Plate Side

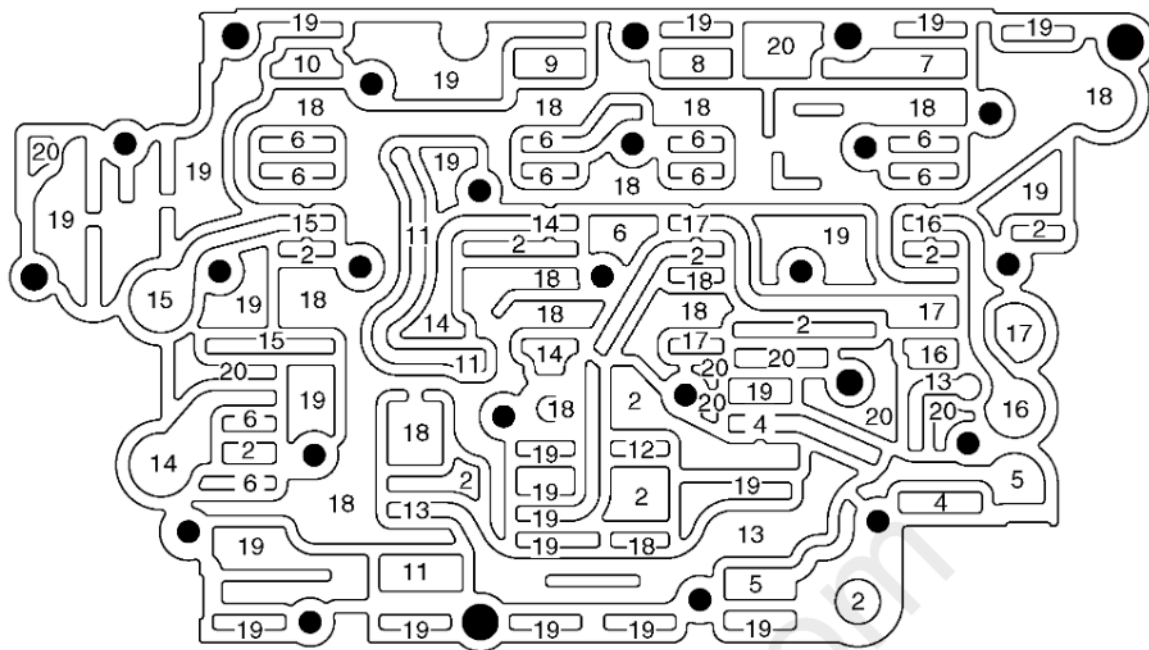


Fig. 31: Control Valve Upper Body Assembly - Spacer Plate Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
4	Cooler Feed
5	Variable Force Solenoid Valve Signal
6	Actuator Feed Limit
7	Solenoid Valve 1 Signal
8	Solenoid Valve 2 Signal
9	Solenoid Valve 3 Signal
10	Solenoid Valve 4 Signal
11	Solenoid Valve 5 Signal
12	Solenoid Valve 6 Signal
13	Variable 1234 Clutch
14	Variable 14/13 Clutch
15	Variable 23/123 Clutch
16	Variable 12/12 Clutch
17	Variable 34/23 Clutch
18	Exhaust Backfill
19	Exhaust

Control Valve Upper Body Assembly - Case Assembly Side

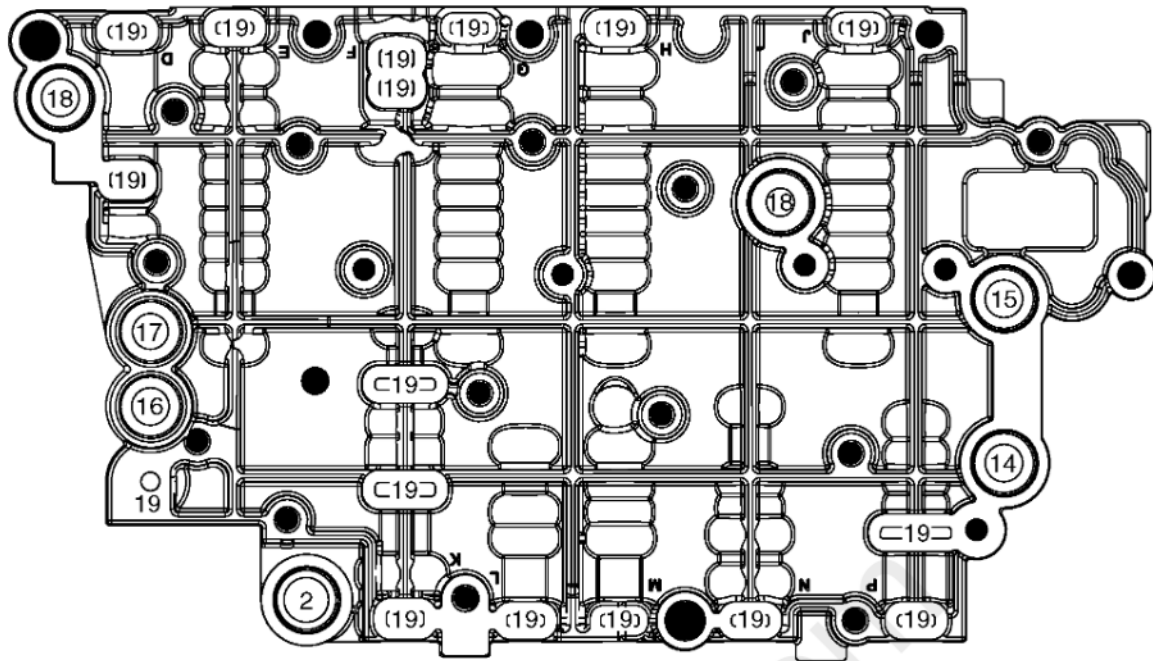


Fig. 32: Control Valve Upper Body Assembly - Case Assembly Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
14	Variable 14/13 Clutch
15	Variable 23/123 Clutch
16	Variable 12/12 Clutch
17	Variable 34/23 Clutch
18	Exhaust Backfill
19	Exhaust

Spacer Plate Assembly - Control Valve Solenoid Body Side

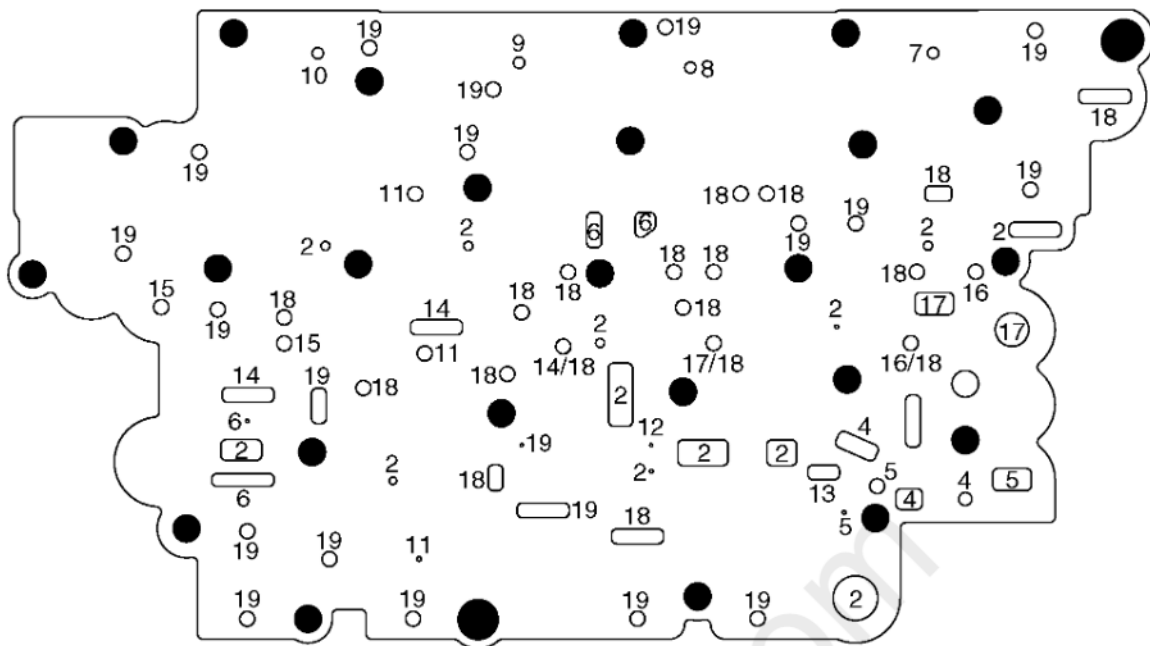


Fig. 33: Spacer Plate Assembly - Control Valve Solenoid Body Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
2	Line
4	Cooler Feed
5	Variable Force Solenoid Valve Signal
6	Actuator Feed Limit
7	Solenoid Valve 1 Signal
8	Solenoid Valve 2 Signal
9	Solenoid Valve 3 Signal
10	Solenoid Valve 4 Signal
11	Solenoid Valve 5 Signal
12	Solenoid Valve 6 Signal
13	Variable 1234 Clutch
14	Variable 14/13 Clutch
15	Variable 23/123 Clutch
16	Variable 12/12 Clutch
17	Variable 34/23 Clutch
18	Exhaust Backfill
19	Exhaust

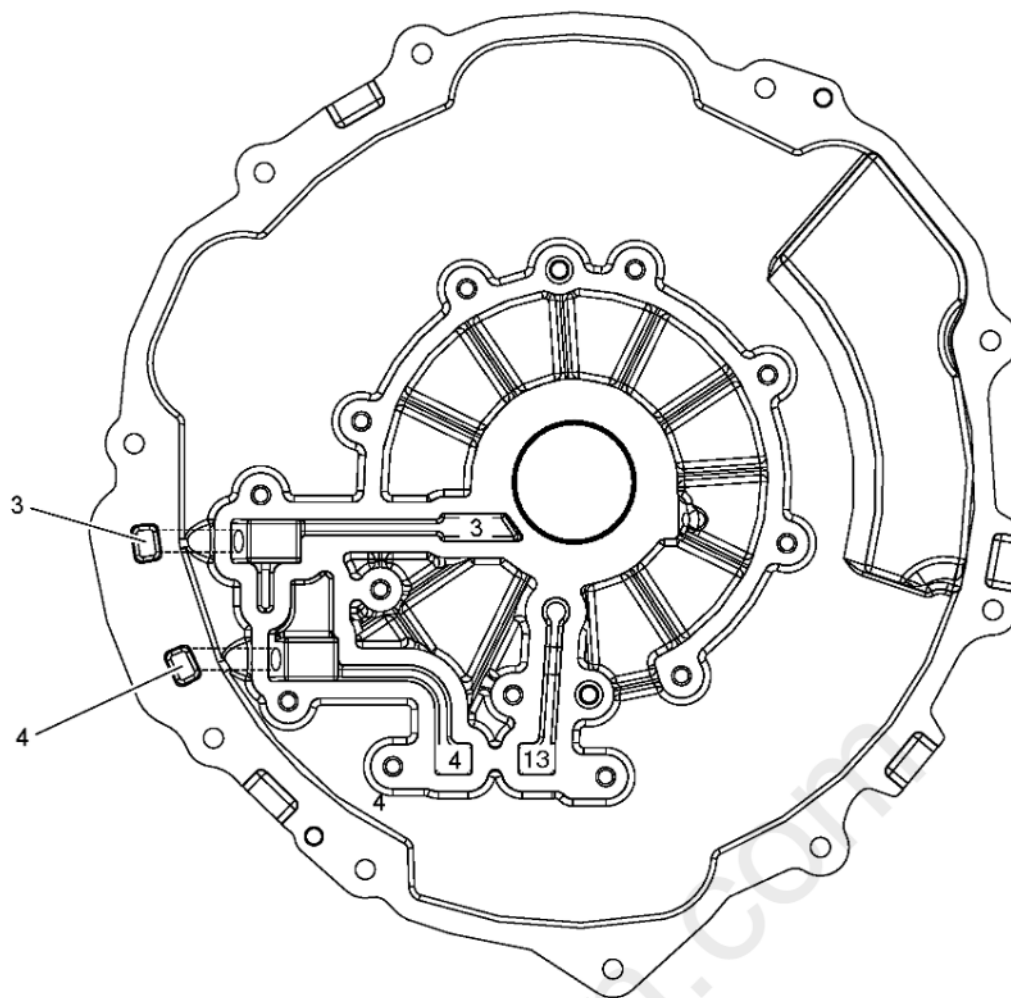


Fig. 34: Torque Dampener - Case Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
3	Lube
4	Cooler Feed
13	Variable 1234 Clutch

Torque Dampener Gasket - Case Side

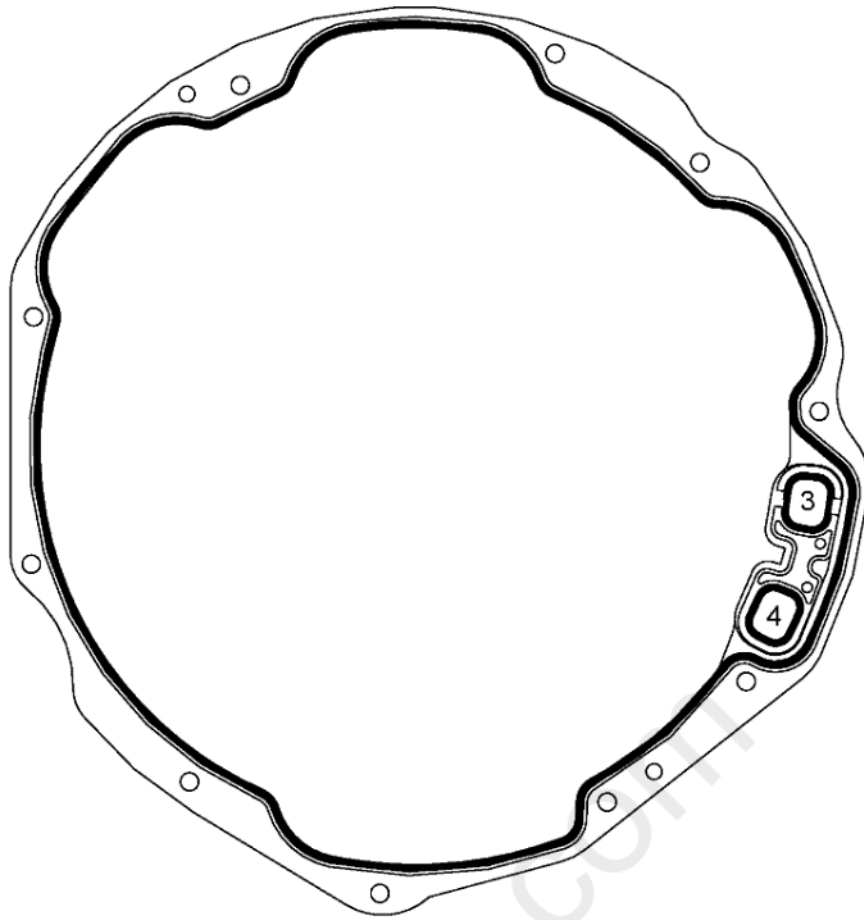


Fig. 35: Torque Dampener Gasket - Case Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
3	Lube
4	Cooler Feed

Variable 1-2-3-4 Clutch Housing - Torque Dampener Side

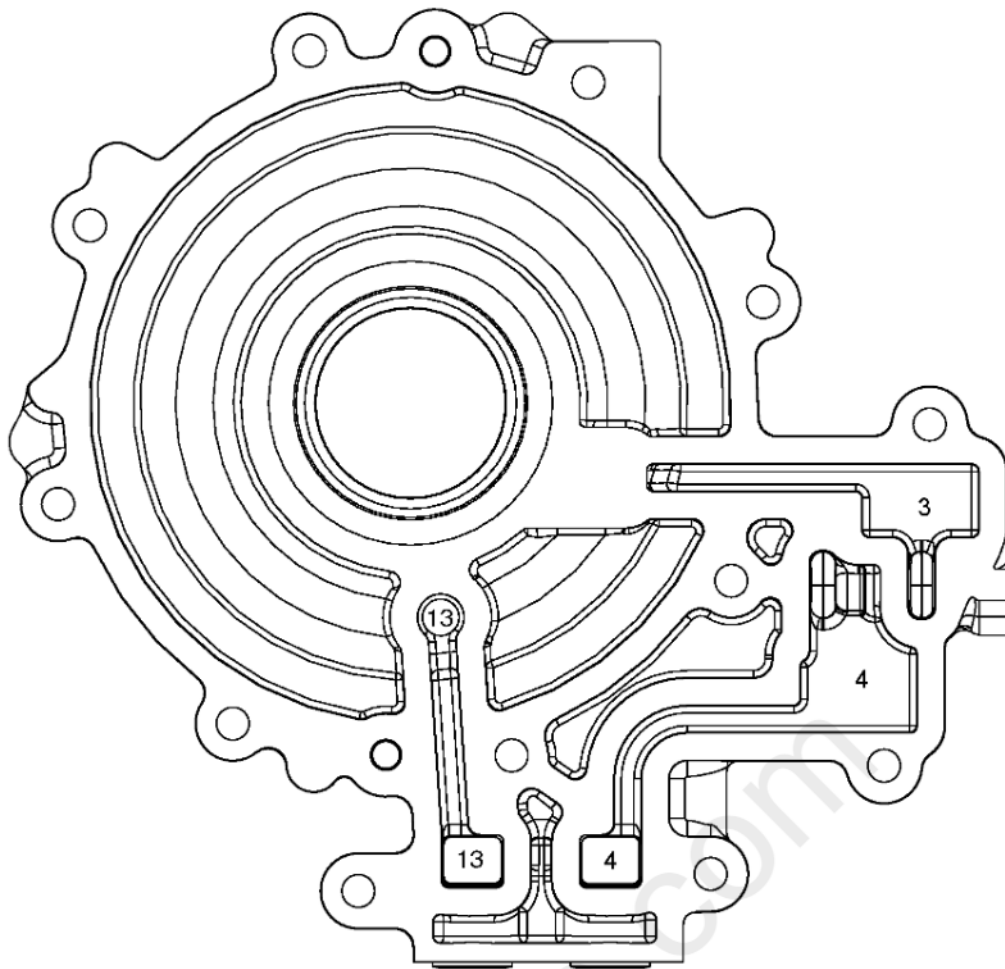


Fig. 36: Variable 1-2-3-4 Clutch Housing - Torque Dampener Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
3	Lube
4	Cooler Feed
13	Variable 1234 Clutch

Variable 1-4/1-3 Clutch Housing - Variable 2-3/1-2-3 Clutch Housing Fluid Passage Side

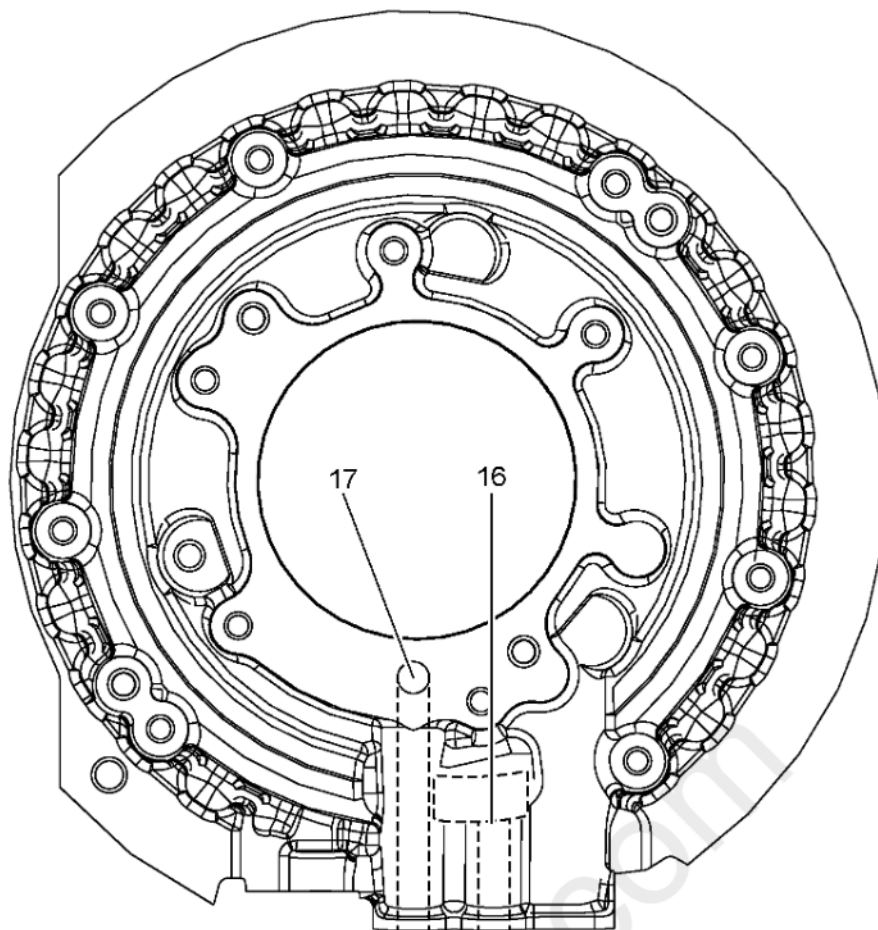


Fig. 37: Variable 1-4/1-3 Clutch Housing - Variable 2-3/1-2-3 Clutch Housing Fluid Passage Side
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
16	Variable 12/12 Clutch
17	Variable 34/23 Clutch

Variable 2-3/1-2-3 Clutch Housing Fluid Passage Hub Gasket - Variable 1-4/1-3 Clutch Housing Side

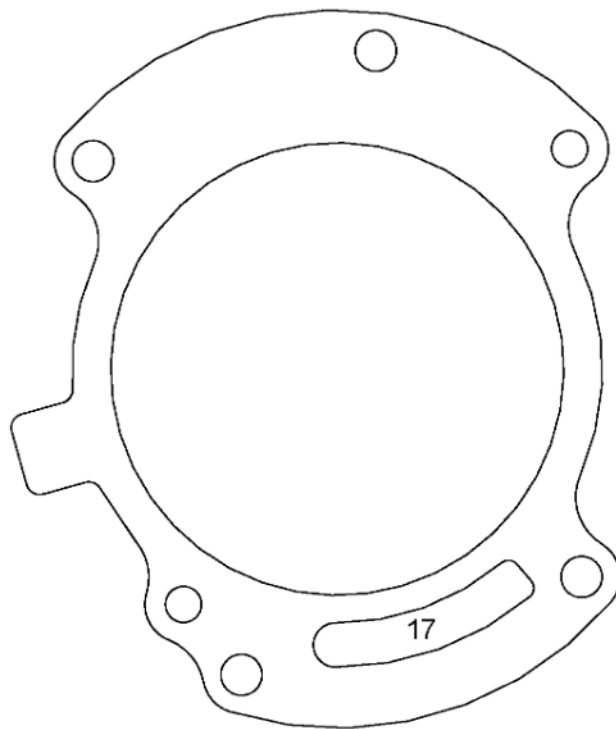


Fig. 38: Variable 2-3/1-2-3 Clutch Housing Fluid Passage Hub Gasket - Variable 1-4/1-3 Clutch Housing Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
17	Variable 34/23 Clutch

Variable 2-3/1-2-3 Clutch Housing Fluid Passage Hub - Variable 2-3/1-2-3 Clutch Housing Fluid Passage Hub Gasket Side

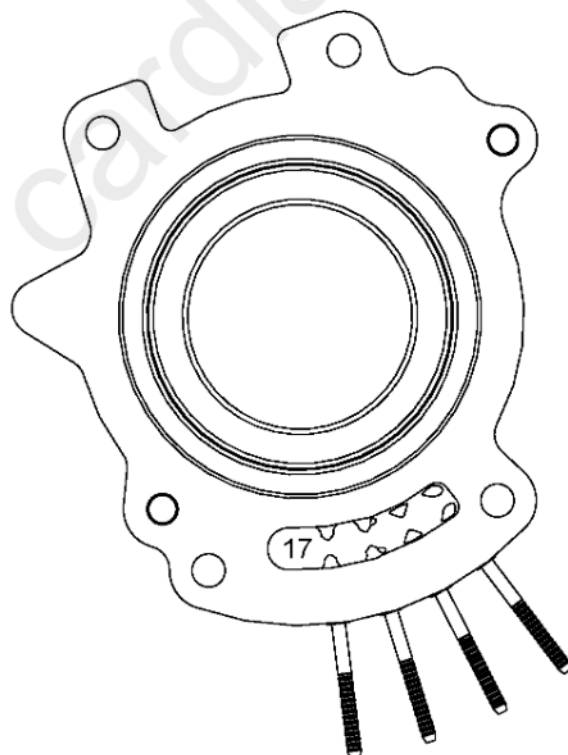


Fig. 39: Variable 2-3/1-2-3 Clutch Housing Fluid Passage Hub - Variable 2-3/1-2-3 Clutch Housing Fluid Passage Hub Gasket Side

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
---------	----------------

Callout	Component Name
17	Variable 34/23 Clutch

Variable 3-4/2-3 Clutch Housing Fluid Passage Hub Gasket - Variable 1-2/1-2 Clutch Assembly Side

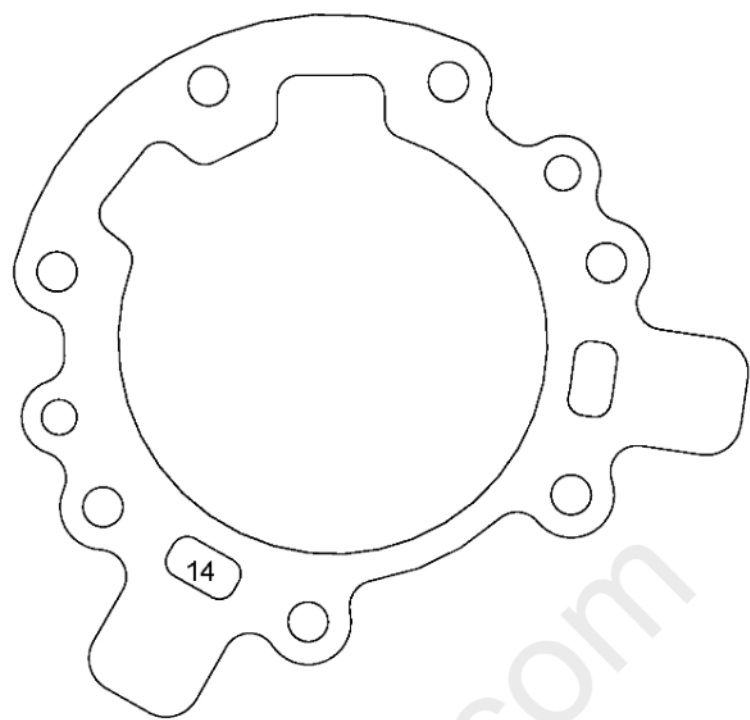


Fig. 40: Variable 3-4/2-3 Clutch Housing Fluid Passage Hub Gasket - Variable 1-2/1-2 Clutch Assembly Side
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
14	Variable 14/13 Clutch

2017 TRANSMISSION

Automatic Transmission - 4EL70 (MRD) - Diagnostic Information and Procedures - CT6

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P0601-P0604, P0606, P062F, P16E9, P16F0, P16F3, P16F7 OR P16F8: CONTROL MODULE MEMORY

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0601

Control Module Read Only Memory Performance

DTC P0602

Control Module Not Programmed

DTC P0603

Control Module Long Term Memory Reset

DTC P0604

Control Module Random Access Memory Performance

DTC P0606

Control Module Processor Performance

DTC P062F

Control Module Long Term Memory Performance

DTC P16E9

Control Module Serial Peripheral Interface Bus 2

DTC P16F0

Control Module Serial Peripheral Interface Bus 1

DTC P16F3

Control Module Redundant Memory Performance

DTC P16F7

Control Module Pressure Control Solenoid Command Incorrect

DTC P16F8

Control Module Clutch Command Incorrect

Circuit/System Description

This is an internal fault detection of the transmission control module (TCM). This fault is handled inside the TCM and no external circuits are involved.

Conditions for Running the DTC

- P0601, P0602, P0603, P0604, P0606, P062F, P16E9, P16F3, P16F0, P16F7 or P16F8 is not set.
- Vehicle On.

Conditions for Setting the DTC

The TCM detects an internal failure or incomplete programming during TCM initialization.

Action Taken When the DTC Sets

- P0601, P0602, P0603, P0604, P0606, P16E9, P16F0, P16F3, P16F7 and P16F8 are Type A DTCs.
- P062F is a Type B DTC.

Conditions for Clearing the DTC

- P0601, P0602, P0603, P0604, P0606, P16E9, P16F0, P16F3, P16F7 and P16F8 are Type A DTCs.
- P062F is a Type B DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify DTC P0602 is not set.
 - **If the DTC is set**
 1. Program the K71 Control Module.

2. Verify the DTC does not set.

- If the DTC sets, replace the K71 Transmission Control Module.
- If the DTC does not set

3. All OK.

- **If the DTC is not set**

3. Verify DTC P0601, P0603, P0604, P0606, P062F, P16E9, P16F0, P16F7 or P16F8 is not set.

- **If DTC P0601, P0603, P0604, P0606, P062F, P16E9, P16F0, P16F7 or P16F8 is set**

Replace the K71 Transmission Control Module.

- **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P0658 OR P0659: ACTUATOR HIGH CONTROL CIRCUIT GROUP 1

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0658

Actuator High Control Circuit Group 1 Low Voltage

DTC P0659

Actuator High Control Circuit Group 1 High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
High Side Driver 1	P0658	P0659	P0659	-

Typical Scan Tool Data

High Side Driver 1

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: On			
High Side Driver 1	Off	On	Off

Circuit/System Description

The high side driver 1 is internal to the transmission control module (TCM). With the vehicle On, the high side driver 1 provides 12 V to the transmission control solenoid valve 2 and 4. If excessive current flow is detected in high side driver 1 circuit, the high side driver 1 will turn Off. When the circuit fault is corrected, the high side driver 1 will reset.

Conditions for Running the DTC

P0658

- Vehicle is On.
- High side driver 1 is On.

P0659

Vehicle is On.

Conditions for Setting the DTC

P0658

TCM has detected a short to ground on the high side driver 1 circuit during TCM initialization.

P0659

TCM has detected an open or short to voltage on the high side driver 1 circuit during TCM initialization.

Action Taken When the DTC Sets

P0658 and P0659 are Type A DTCs.

P0658

TCM turns Off the high side driver 1.

Conditions for Clearing the DTC

P0658 and P0659 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **[COMPONENT CONNECTOR END VIEWS - INDEX](#)**
- **[INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)**

Description and Operation

- **[Electronic Component Description](#)**
- **[Transmission Component and System Description](#)**
- **[Transmission General Description](#)**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify the scan tool High Side Driver 1 Command parameter displays On.
 - **If On is not displayed**

Refer to Circuit/System Testing.
 - **If On is displayed**
3. Verify the parameters listed below do not display Malfunction when commanding the high side driver 1, On and Off with a scan tool.
 - High Side Driver 1 Circuit Low Voltage Test Status
 - High Side Driver 1 Circuit Open Test Status
 - High Side Driver 1 Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down. Vehicle On.
2. Command the high side driver 1 Off.
3. Connect a test lamp between the High Side Driver 1 circuit terminal 18 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module. Vehicle On.
 3. Verify a test lamp does not illuminate between the High Side Driver 1 circuit terminal 18 and ground.
 - **If the test lamp illuminates**

Repair the short to voltage in the High Side Driver 1 circuit.
 - **If the test lamp does not illuminate**

Replace the K71 Transmission Control Module.
 - **If the test lamp does not illuminate**
5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 1 On and Off with a scan tool.
 - **If the test lamp is always Off**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the High Side Driver 1 circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance
3. Test for less than 2 Ω in the High Side Driver 1 circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If the test lamp turns On and Off**
7. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the following solenoids listed below:
 - Q77B Transmission Control Solenoid Valve 2
 - Q77D Transmission Control Solenoid Valve 4
6. Vehicle On.
7. Command the high side driver 1 Off.
8. Connect a test lamp between terminal 2 and ground on each solenoid harness connector for the following solenoids listed below:
 - Q77B Transmission Control Solenoid Valve 2
 - Q77D Transmission Control Solenoid Valve 4
9. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**

Replace the transmission control wiring harness.

- **If the test lamp does not illuminate**
10. Connect a test lamp between terminal 2 and ground on each solenoid harness connector for the following solenoids listed below:
 - Q77B Transmission Control Solenoid Valve 2
 - Q77D Transmission Control Solenoid Valve 4
 11. Verify the test lamp turns On and Off when commanding the high side driver 1 On and Off with a scan tool for each of the following solenoids listed below:
 - Q77B Transmission Control Solenoid Valve 2
 - Q77D Transmission Control Solenoid Valve 4
 - **If the test lamp is always Off**

Replace the transmission control wiring harness.

 - **If the test lamp turns On and Off**
 12. Disconnect the test lamp.
 13. Test for 4.5-5.5 Ω between the High Side Driver 1 terminal 1 and the control terminal 2 on the following solenoids:
 - Q77B Transmission Control Solenoid Valve 2
 - Q77D Transmission Control Solenoid Valve 4
 - **If not between 4.5-5.5 Ω**

Replace the solenoid that is not between 4.5-5.5 Ω .

 - **If between 4.5-5.5 Ω**
 14. Test for infinite resistance between each ignition terminal 1 and ground and then each control terminal 2 and ground on the following solenoids:
 - Q77B Transmission Control Solenoid Valve 2
 - Q77D Transmission Control Solenoid Valve 4
 - **If not infinite resistance**

Replace the solenoid that has continuity to ground.

 - **If infinite resistance**
 15. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Control Valve Solenoid Body Replacement](#) for solenoid replacement.
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P0711-P0713: TRANSMISSION FLUID TEMPERATURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0711

Transmission Fluid Temperature Sensor Performance

DTC P0712

Transmission Fluid Temperature Sensor Circuit Low Voltage

DTC P0713

Transmission Fluid Temperature Sensor Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Signal	P0712	P0713	P0713	P0711
Low Reference	P0712	P0713	P0713	P0711

Typical Scan Tool Data

Transmission Fluid Temperature Sensor

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: Transmission Fluid Temperature -40Â° to +130Â°C (-40Â° to +266Â°F)			
Signal	130Â°C (266Â°F)	-40Â° (-40Â°F)	-40Â° (-40Â°F)
Low Reference	130Â°C (266Â°F)	-40Â° (-40Â°F)	-40Â° (-40Â°F)

Circuit/System Description

The transmission fluid temperature sensor is a 2 wire negative temperature coefficient thermistor. The transmission control module (TCM) supplies a 5 V signal circuit and a low reference circuit to the transmission fluid temperature sensor. The transmission fluid temperature sensor measures the temperature of the oil in the transmission fluid pan. As the temperature of the fluid increases, the resistance of the sensor decreases, varying the voltage on the signal circuit. The transmission fluid temperature sensor is part of the transmission internal wire harness assembly and has no serviceable parts.

Conditions for Running the DTC

P0711

- DTC P0712, P0713, U179A or U0293 is not set.
- Engine speed is 0.00 to 8, 000 RPM for 0.00 s.
- Vehicle speed is less than 185.79 MPH for 0.00 s.
- Transmission fluid cold soak average temperature is greater than or equal to -40Â°C (-40Â°F).
- Transmission fluid temperature is between -40Â°C to +130Â°C (-40Â° to +266Â°F).

P0712 or P0713

- Battery voltage is greater than 9 V for 0.01 s.
- Ignition voltage is greater than 9 V for 0.01 s.

Conditions for Setting the DTC

P0711 - Condition 1

Transmission fluid temperature rate of change is 15Â°C (59Â°F) for 60 s.

P0711 - Condition 2

- Transmission fluid temperature rate of change is 10Â°C (50Â°F) or greater for 8 s.
- Transmission fluid temperature change is 0Â°C (32Â°F) or less for 300 s.

P0712

Transmission fluid temperature sensor resistance is 68.60 Ω or less for 2 s in a 3 s window.

P0713

Transmission fluid temperature sensor resistance is 83641 Ω or greater for 2 s in a 3 s window.

Action Taken When the DTC Sets

P0711, P0712 or P0713 are Type A DTCs.

Conditions for Clearing the DTC

P0711, P0712 or P0713 are Type A DTCs.

Diagnostic Aids

During a road test, the transmission fluid temperature should steadily increase to a normal operating and then stabilize.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

Electronic Component Description

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify the transmission fluid level and condition is correct. Refer to **Transmission Fluid Level and Condition Check**.
 - **If the transmission fluid level and condition is not correct**
Repair as necessary.
 - **If the transmission fluid level and condition is correct**
2. Vehicle On at operating temperature.
3. Verify the scan tool Transmission Fluid Temperature parameter is between -40 $^{\circ}$ C to +130 $^{\circ}$ C (-40 $^{\circ}$ F to +266 $^{\circ}$ F).

- **If not between -40Â°C to +130Â°C (-40Â° to +266Â°F)**

Refer to Circuit/System Testing.

- **If between -40Â°C to +130Â°C (-40Â° to +266Â°F)**

4. Verify the Transmission Fluid Temperature parameter increases greater than 1Â°C (33.8Â°F) after operating the vehicle at 64 km/h (40 mph) for 5 min.

- **If the temperature does not increase greater than 1Â°C (33.8Â°F)**

Refer to Circuit/System Testing.

- **If the temperature does increase greater than 1Â°C (33.8Â°F)**

5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.

6. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min. for all vehicle systems to power down.

2. Test for less than 10 Ω between the low reference circuit terminal 6 on the X175 harness connector and ground.

- **If 10 Ω or greater**

1. Ignition Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for less than 2 Ω in the low reference circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω, replace the K71 Transmission Control Module.

- **If less than 10 Ω**

3. Vehicle On.

4. Test for 4.8-5.2 V between the signal circuit terminal 7 and ground.

- **If not between 4.8-5.2 V**

1. Ignition Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the signal circuit terminal 7 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 1 Ω in the signal circuit end to end.

- If 1 Ω or greater, repair the open/high resistance in the circuit.
- If less than 1 Ω, replace the K71 Transmission Control Module.

- **If between 4.8-5.2 V**

5. Replace the B13 Transmission Fluid Temperature Sensor.

NOTE: The B13 Transmission Fluid Temperature Sensor is part of the transmission control wiring harness assembly.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- [Automatic Transmission Control Wiring Harness Replacement](#) for B13 Transmission Fluid Temperature Sensor replacement.
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P0721 OR P077B-P077D: OUTPUT SPEED SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0721

Output Speed Sensor Performance

DTC P077B

Output Speed Sensor Circuit Direction Incorrect

DTC P077C

Output Speed Sensor Circuit Low Voltage

DTC P077D

Output Speed Sensor Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
9 V Reference	P077C	P077D	P077D	P0721/P077B
Signal	P077C	P077D	P077D	P0721/P077B

Typical Scan Tool Data

Transmission Output Speed

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running, drive range drive wheels rotating Parameter Normal Range: 0-7500 RPM			
Transmission Output Speed	0 RPM	0 RPM	-

Circuit/System Description

The A/Trans Output Speed Sensor Assembly has 3 internal hall-effect type sensors and two signal-processing channels and is capable of sensing both speed and direction. The output speed sensor is internal to the transmission and mounts to the A/Trans case assembly and is connected to the transmission control module through the transmission internal harness. The A/Trans Output Speed Sensor Assembly faces the park gear machined teeth surface. The sensor receives 9V on the OSS supply voltage circuit from the transmission control module. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft.

- When the vehicle is moving in a forward direction, channel A detects a particular tooth before channel B.
- When the vehicle is moving in a reverse direction, channel B detects a particular tooth before channel A.

The electronics in the sensor combine the two channels and send a signal with a different pulse width. This signal is interpreted by the transmission control module (TCM) for speed and direction and is transmitted through the serial data circuits to the hybrid/EV powertrain control module 1. The TCM and hybrid/EV powertrain control module 1 compare the output speed sensor signal with the antilock brake system (ABS) wheel speed sensor signal. The hybrid/EV powertrain control module 1 is part of the T6 power inverter module and is not serviced separately.

Conditions for Running the DTC

P0721

Vehicle is On for 3.5 s.

P077B

- P0721, P077C, P077D or P215C is not set.
- Vehicle is On.
- Drive motor speed is valid.
- The difference between drive motor 2 speed and transmission output speed signal is less than 50 RPM.
- Estimated transmission output speed sensor signal is 50 RPM or greater.

P077C

- P077D is not set.
- Battery voltage is greater than 9 V.
- Ignition voltage is 6 V or greater.

P077D

- P077C is not set.
- Vehicle is On for 1.5 s.
- Battery voltage is greater than 9 V.
- Ignition voltage is 6 V or greater.

Conditions for Setting the DTC

P0721

TCM has detected the transmission output speed sensor signal direction is incorrect for 3.5 s in a 5 s window.

P077B

TCM has detected the transmission output speed sensor signal is incorrect compared to the drive motor 2 speed signal for 0.35 s in a 5 s window.

P077C

TCM has detected a low transmission output speed sensor signal voltage of less than 0.35 V for 25 ms.

P077D

TCM has detected a high transmission output speed sensor signal voltage of greater than 4.25 V for 25 ms.

Action Taken When the DTC Sets

- P0721, P077B, P077C or P077D are Type A DTCs.
- P0721 and P077B, the TCM calculates direction from the wheel speed sensors and drive motor 2.

Conditions for Clearing the DTC

P0721, P077B, P077C or P077D are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522 Variable Signal Generator

For equivalent regional tools, refer to **Special Tools** .

Circuit/System Verification

1. Vehicle On.
2. Verify the scan tool 9 V Reference 1 Circuit Status parameter does not display Malfunction.
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Verify the ISS/OSS supply voltage parameter does not display Out of Range.
 - **If Out of Range is displayed**
Refer to Circuit/System Testing.
 - **If Out of Range is not displayed**
4. Road test the vehicle.
5. Verify the scan tool transmission output speed parameter increases with wheel speed and does not drop out.
 - **If the transmission output speed does not increase with wheel speed or drops out**
Refer to Circuit/System Testing.

- **If the transmission output speed does increase with wheel speed and does not drop out**

6. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.

7. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

8. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.

2. Test for 8.3-9.8 V between the 9 V reference 1 circuit terminal 16 and ground.

- **If less than 8.3 V**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the 9 V reference 1 circuit terminal 16 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 1 Ω in the 9 V reference 1 circuit end to end.

- If 1 Ω or greater, repair the open/high resistance in the circuit.
- If less than 1 Ω , replace the K71 Transmission Control Module.

- **If greater than 9.8 V**

1. Vehicle Off.

2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.

3. Test for less than 1 V between the 9 V reference 1 circuit terminal 16 and ground.

- If greater than the specified value, repair the short to voltage on the circuit.
- If less than the specified value, replace the K71 Transmission Control Module.

- **If between 8.3-9.8 V**

3. Vehicle Off.

4. Connect the red lead of the **J-38522** generator to the signal circuit terminal 15 and connect the black lead of the **J-38522** generator to ground.

5. Set the **J-38522** generator to the specifications listed below:

- Signal switch to 5 V
- Frequency switch to 300 Hz
- Duty cycle switch to the 50% or the Normal position

6. Vehicle On.

7. Verify the scan tool Transmission Output Speed parameter is between 250-280 RPM.

- **If not between 250-280 RPM**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the signal circuit terminal 15 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 1 Ω in the signal circuit end to end.

- If 1 Ω or greater, repair the open/high resistance in the circuit.
- If less than 1 Ω , replace the K71 Transmission Control Module.

- **If between 250-280 RPM**

8. Perform the Component Testing.

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission Assembly. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect B14A Transmission Output Shaft Speed Sensor harness connector, Vehicle On.
6. Test for 8.3-9.8 V between the 9 V reference 1 circuit terminal 1 and ground.

- **If not between 8.3-9.8 V**

Replace the automatic transmission wiring harness, electrical connector passage sleeve.

- **If between 8.3-9.8 V**

7. Connect the red lead of the **J-38522** generator to the signal circuit terminal 2 and connect the black lead of the **J-38522** generator to ground.
8. Set the **J-38522** generator to the specifications listed below:
 - Signal switch to 5 V
 - Frequency switch to 300 Hz
 - Duty cycle switch to the 50% or the Normal position

9. Verify the scan tool transmission input speed parameter is between 250-280 RPM.

- **If not between 250-280 RPM**

Replace the automatic transmission wiring harness, electrical connector passage sleeve.

- **If between 250-280 RPM**

10. Remove the B14A Transmission Output Shaft Speed Sensor from the T12 Automatic Transmission Assembly.

11. Verify there is no damage or misalignment with the machine slots on the outside diameter of the output carrier and the B14A Transmission Output Shaft Speed Sensor.

- **If damage or misalignment**

Repair or replace the necessary components.

- **If no damage or misalignment**

12. Replace the B14A Transmission Output Shaft Speed Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement**
- **Automatic Transmission Control Wiring Harness Replacement**
- **Automatic Transmission Output Speed Sensor Replacement**
- **Control Module References** for K71 Transmission Control Module replacement, programming and setup.

DTC P079A: TRANSMISSION CLUTCH 1 SLIP DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P079A

Transmission Clutch 1 Slip Detected

Typical Scan Tool Data

Variable 1-2 and 1-2 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 1 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 1 Status	Applied	Released	Applied
Clutch 1 Energy	Varies	0	Greater than or equal to 12, 416 Joules

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 1 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-2 and 1-2 Clutch is tied to Clutch 1 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-2 and 1-2 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 1 slip by comparing the slip speed across the clutch to a slip threshold or comparing the calculated slip energy to an energy threshold.

Conditions for Running the DTC

- Transmission line pressure is greater than or equal to 350 kPa (51 PSI).
- Clutch 1 estimated torque is greater than 60 N.m (44 lb ft).
- Clutch 1 is commanded On.
- No drive motor speed DTCs are set.

- Wheel slip is 0 RPM.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 1 slip speed is greater than or equal to 150 RPM for 0.70 s in a 0.88 s window for 2 counts.

Condition 2

Clutch 1 slip speed transient is greater than or equal to 185 RPM for 0.70 s in a 0.88 s window for 2 counts.

Condition 3

Clutch 1 energy is greater than or equal to 12, 416 joules for 2 counts.

Action Taken When the DTC Sets

- P079A is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 1.
- The hybrid/EV powertrain control module 1 inhibits mode 2.
- The hybrid/EV powertrain control module 1 inhibits gear 1.

Conditions for Clearing the DTC

P079A is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 1 Slip Speed parameters listed below on the scan tool when the Clutch 1 Status parameter reading is Applied:
 - Clutch 1 Slip Speed should be less than 150 RPM.
 - Clutch 1 Slip Speed should be less than 185 RPM during a shift.
 - Clutch 1 Energy should be less than or equal to 12, 416 joules.
 - **If clutch 1 parameters are not within the specified range**

Refer to Component Testing.

- If clutch 1 parameters are within the specified range

4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Variable 1-2 and 1-2 Clutch valve
- Variable 1-4 and 1-3 Clutch valve
- If you found a concern in the valve body

Repair or replace the valve or valve body.

- If no concern is found

3. Inspect the variable 1-2 and 1-2 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- If you found a Variable 1-2 and 1-2 clutch assembly concern

Repair or replace the Variable 1-2 and 1-2 clutch assembly as necessary.

- If no concern is found

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Variable 1-2 and 1-2 Clutch Housing Removal](#) and [Variable 1-2 and 1-2 Clutch Housing Installation](#) for Variable 1-2 and 1-2 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P079B: TRANSMISSION CLUTCH 2 SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P079B

Transmission Clutch 2 Slip Detected

Typical Scan Tool Data

Variable 3-4 and 2-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 2 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 2 Status	Applied	Released	Applied
Clutch 2 Energy	Varies	0	Greater than or equal to 8, 569 Joules

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 2 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 3-4 and 2-3 Clutch is tied to Clutch 2 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 3-4 and 2-3 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 2 slip by comparing the slip speed across the clutch to a slip threshold or comparing the calculated slip energy to an energy threshold.

Conditions for Running the DTC

- Transmission line pressure is greater than or equal to 350 kPa (51 PSI).
- Clutch 2 estimated torque is greater than 50 N.m (36.8 lb ft).
- Clutch 2 is commanded On.
- No drive motor speed DTCs are set.
- Wheel slip is 0 RPM.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 2 slip speed is greater than or equal to 150 RPM for 0.80 s in a 1.00 s window for 2 counts.

Condition 2

Clutch 2 slip speed transient is greater than or equal to 215 RPM for 0.80 s in a 1.00 s window for 2 counts.

Condition 3

Clutch 2 energy is greater than or equal to 8, 569 joules for 2 counts.

Action Taken When the DTC Sets

- P079B is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 3.
- The hybrid/EV powertrain control module 1 inhibits mode 4.
- The hybrid/EV powertrain control module 1 inhibits gear 2.

Conditions for Clearing the DTC

P079B is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 2 Slip Speed parameters listed below on the scan tool when the Clutch 2 Status parameter reading is Applied:
 - Clutch 2 Slip Speed should be less than 150 RPM.
 - Clutch 2 Slip Speed should be less than 215 RPM during a shift.
 - Clutch 2 Energy should be less than or equal to 8, 569 joules.
 - **If clutch 2 parameters are not within the specified range**

Refer to Component Testing.

- **If clutch 2 parameters are within the specified range**

4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to **Control Valve Body Diagnostic Inspection**:

- Control valve body spacer plate
- Variable 3-4 and 2-3 Clutch valve
- Variable 2-3 and 1-2-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 3-4 and 2-3 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 3-4 and 2-3 clutch assembly concern**

Repair or replace the Variable 3-4 and 2-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Replacement** for control valve body replacement.
- **Variable 3-4 and 2-3 Clutch Housing Removal** and **Variable 3-4 and 2-3 Clutch Housing Installation** for Variable 3-4 and 2-3 Clutch Assembly replacement
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P079C: TRANSMISSION CLUTCH 3 SLIP DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P079C

Transmission Clutch 3 Slip Detected

Typical Scan Tool Data

Variable 1-4 and 1-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 3 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 3 Status	Applied	Released	Applied
Clutch 3 Energy	Varies	0	Greater than or equal to 8, 000 Joules

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 3 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-4 and 1-3 Clutch is tied to Clutch 3 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-4 and 1-3 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 3 slip by comparing the slip speed across the clutch to a slip threshold or comparing the calculated slip energy to an energy threshold.

Conditions for Running the DTC

- Transmission line pressure is greater than or equal to 350 kPa (51 PSI).
- Clutch 3 estimated torque is greater than 55 N.m (40.5 lb ft).
- Clutch 3 is commanded On.
- No drive motor speed DTCs are set.
- Wheel slip is 0 RPM.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 3 slip speed is greater than or equal to 110 RPM for 0.80 s in a 1.00 s window for 2 counts.

Condition 2

Clutch 3 slip speed transient is greater than or equal to 195 RPM for 0.80 s in a 1.00 s window for 2 counts.

Condition 3

Clutch 3 energy is greater than or equal to 8, 000 joules for 2 counts.

Action Taken When the DTC Sets

- P079C is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 1.
- The hybrid/EV powertrain control module 1 inhibits mode 4.
- The hybrid/EV powertrain control module 1 inhibits gear 1.

Conditions for Clearing the DTC

P079C is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 3 Slip Speed parameters listed below on the scan tool when the Clutch 3 Status parameter reading is Applied:
 - Clutch 3 Slip Speed should be less than 110 RPM.
 - Clutch 3 Slip Speed should be less than 195 RPM during a shift.
 - Clutch 3 Energy should be less than or equal to 8, 000 joules.
 - **If clutch 3 parameters are not within the specified range**

Refer to Component Testing.
 - **If clutch 3 parameters are within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to **Control Valve Body Diagnostic Inspection**:

- Control valve body spacer plate
- Pressure Control Solenoid 5
- Variable 2-3 and 1-2-3 Clutch valve
- Variable 1-4 and 1-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 1-4 and 1-3 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 1-4 and 1-3 clutch assembly concern**

Repair or replace the Variable 1-4 and 1-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Replacement** for control valve body replacement.
- **Drive Motor Removal - 1st Position** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Disassemble** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Assemble** and **Drive Motor Installation - 1st Position** for Variable 1-4 and 1-3 Clutch Assembly replacement.
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P079D: TRANSMISSION CLUTCH 4 SLIP DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P079D

Transmission Clutch 4 Slip Detected

Typical Scan Tool Data

Variable 2-3 and 1-2-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Clutch 4 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 4 Status	Applied	Released	Applied
Clutch 4 Energy	Varies	0	Greater than or equal to 5, 141 Joules

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 4 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 2-3 and 1-2-3 Clutch is tied to Clutch 4 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 2-3 and 1-2-3 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 4 slip by comparing the slip speed across the clutch to a slip threshold or comparing the calculated slip energy to an energy threshold.

Conditions for Running the DTC

- Transmission line pressure is greater than or equal to 350 kPa (51 PSI).
- Clutch 4 estimated torque is greater than 50 N.m (36.8 lb ft).
- Clutch 4 is commanded On.
- No drive motor speed DTCs are set.
- Wheel slip is 0 RPM.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 4 slip speed is greater than or equal to 110 RPM for 0.80 s in a 1.00 s window for 2 counts.

Condition 2

Clutch 4 slip speed transient is greater than or equal to 205 RPM for 0.80 s in a 1.00 s window for 2 counts.

Condition 3

Clutch 4 energy is greater than or equal to 5, 141 joules for 2 counts.

Action Taken When the DTC Sets

- P079D is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 2.
- The hybrid/EV powertrain control module 1 inhibits mode 3.
- The hybrid/EV powertrain control module 1 inhibits gear 1.
- The hybrid/EV powertrain control module 1 inhibits gear 2.

Conditions for Clearing the DTC

P079D is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 4 Slip Speed parameters listed below on the scan tool when the Clutch 4 Status parameter reading is Applied:
 - Clutch 4 Slip Speed should be less than 110 RPM.
 - Clutch 4 Slip Speed should be less than 205 RPM during a shift.
 - Clutch 4 Energy should be less than or equal to 5, 141 joules.
 - **If clutch 4 parameters are not within the specified range**

Refer to Component Testing.
 - **If clutch 4 parameters are within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to **Control Valve Body Diagnostic Inspection**:
 - Control valve body spacer plate
 - Pressure Control Solenoid 4
 - Variable 2-3 and 1-2-3 Clutch valve
 - Variable 1-4 and 1-3 Clutch valve
 - **If you found a concern in the valve body**

Repair or replace the valve or valve body.
 - **If no concern is found**
3. Inspect the variable 2-3 and 1-2-3 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.
 - **If you found a Variable 2-3 and 1-2-3 clutch assembly concern**

Repair or replace the Variable 2-3 and 1-2-3 clutch assembly as necessary.
 - **If no concern is found**
4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Replacement** for control valve body replacement.
- **Drive Motor Removal - 1st Position** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Disassemble** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Assemble** and **Drive Motor Installation - 1st Position** for Variable 2-3 and 1-2-3 Clutch Assembly replacement
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P079E: TRANSMISSION CLUTCH 5 SLIP DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P079E

Transmission Clutch 5 Slip Detected

Typical Scan Tool Data

Variable 1-2-3-4 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 5 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 5 Status	Applied	Released	Applied
Clutch 5 Energy	Varies	0	Greater than or equal to 6, 848 Joules

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 5 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-2-3-4 Clutch is tied to Clutch 5 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-2-3-4 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 5 slip by comparing the slip speed across the clutch to a slip threshold or comparing the calculated slip energy to an energy threshold.

Conditions for Running the DTC

- Transmission line pressure is greater than or equal to 350 kPa (51 PSI).
- Clutch 5 estimated torque is greater than 50 N.m (36.8 lb ft).
- Clutch 5 is commanded On.
- No drive motor speed DTCs are set.
- Wheel slip is 0 RPM.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 5 slip speed is greater than or equal to 50 RPM for 0.80 s in a 0.80 s window for 1 count.

Condition 2

Clutch 5 slip speed transient is greater than or equal to 50 RPM for 0.80 s in a 1.00 s window for 1 count.

Condition 3

Clutch 5 energy is greater than or equal to 6, 848 joules for 1 count.

Action Taken When the DTC Sets

- P079E is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits Autostop.

Conditions for Clearing the DTC

P079E is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 5 Slip Speed parameters listed below on the scan tool when the Clutch 5 Status parameter reading is Applied:
 - Clutch 5 Slip Speed should be less than 50 RPM.
 - Clutch 5 Slip Speed should be less than 50 RPM during a shift.
 - Clutch 5 Energy should be less than or equal to 6, 848 joules.
 - **If clutch 5 parameters are not within the specified range**

Refer to Component Testing.
 - **If clutch 5 parameters are within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to [Control Valve Body Diagnostic Inspection](#):
 - Control valve body spacer plate
 - Pressure Control Solenoid 5
 - Variable 1-2-3-4 Clutch valve
 - Variable 2-3 and 1-2-3 Clutch valve
 - **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 1-2-3-4 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 1-2-3-4 clutch assembly concern**

Repair or replace the Variable 1-2-3-4 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Torque Dampener Housing Removal](#) , [Torque Dampener Housing Disassemble](#) , [Torque Dampener Housing Assemble](#) and [Torque Dampener Housing Installation](#) for Variable 1-2-3-4 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A3: TRANSMISSION CLUTCH 1 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P07A3

Transmission Clutch 1 Stuck On

Typical Scan Tool Data

Variable 1-2 and 1-2 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			
Clutch 1 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 1 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 1 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-2 and 1-2 Clutch is tied to Clutch 1 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-2 and 1-2 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 1 slip by comparing the slip speed across the clutch to a slip threshold when slip is expected.

Conditions for Running the DTC

- Clutch 1 is commanded Off.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 1 slip speed is less than or equal to 30 RPM for 2 s in a 2.68 s window for 2 counts.

Condition 2

Clutch 1 slip speed profile is greater than or equal to 350 RPM for 2 s in a 2.68 s window for 2 counts.

Action Taken When the DTC Sets

- P07A3 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 3.
- The hybrid/EV powertrain control module 1 inhibits mode 4.

Conditions for Clearing the DTC

P07A3 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 1 Slip Speed on the scan tool when the Clutch 1 Status parameter reading is Released. Clutch 1 Slip Speed should be greater than 30 RPM.
 - **If clutch 1 parameter is not within the specified range**
Refer to Component Testing.
 - **If clutch 1 parameter is within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.

- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a stuck valve or stuck on condition, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Variable 1-2 and 1-2 Clutch valve
- Variable 1-4 and 1-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 1-2 and 1-2 clutch assembly snap ring, piston, clutch discs and housing for a stuck on or welded condition.

- **If you found a Variable 1-2 and 1-2 clutch assembly concern**

Repair or replace the Variable 1-2 and 1-2 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Variable 1-2 and 1-2 Clutch Housing Removal](#) and [Variable 1-2 and 1-2 Clutch Housing Installation](#) for Variable 1-2 and 1-2 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A5: TRANSMISSION CLUTCH 2 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P07A5

Transmission Clutch 2 Stuck On

Variable 3-4 and 2-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 2 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 2 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 2 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 3-4 and 2-3 Clutch is tied to Clutch 2 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 3-4 and 2-3 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 2 slip by comparing the slip speed across the clutch to a slip threshold when slip is expected.

Conditions for Running the DTC

- Clutch 2 is commanded Off.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC**Condition 1**

Clutch 2 slip speed is less than or equal to 30 RPM for 2 s in a 2.68 s window for 2 counts.

Condition 2

Clutch 2 slip speed profile is greater than or equal to 350 RPM for 2 s in a 2.68 s window for 2 counts.

Action Taken When the DTC Sets

- P07A5 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 1.
- The hybrid/EV powertrain control module 1 inhibits mode 2.

Conditions for Clearing the DTC

P07A5 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 2 Slip Speed on the scan tool when the Clutch 2 Status parameter reading is Released. Clutch 2 Slip Speed should be greater than 30 RPM.
 - **If clutch 2 parameter is not within the specified range**

Refer to Component Testing.
 - **If clutch 2 parameter is within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a stuck valve or stuck on condition, refer to [Control Valve Body Diagnostic Inspection](#):
 - Control valve body spacer plate
 - Pressure Control Solenoid 2
 - Variable 3-4 and 2-3 Clutch valve
 - Variable 2-3 and 1-2-3 Clutch valve
 - **If you found a concern in the valve body**

Repair or replace the valve or valve body.
 - **If no concern is found**

3. Inspect the variable 3-4 and 2-3 clutch assembly snap ring, piston, clutch discs and housing for a stuck on or welded condition.

- **If you found a Variable 3-4 and 2-3 clutch assembly concern**

Repair or replace the Variable 3-4 and 2-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Variable 3-4 and 2-3 Clutch Housing Removal](#) and [Variable 3-4 and 2-3 Clutch Housing Installation](#) for Variable 3-4 and 2-3 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A7: TRANSMISSION CLUTCH 3 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P07A7

Transmission Clutch 3 Stuck On

Typical Scan Tool Data

Variable 1-4 and 1-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			
Clutch 3 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 3 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 3 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-4 and 1-3 Clutch is tied to Clutch 3 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-4 and 1-3 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 3 slip by comparing the slip speed across the clutch to a slip threshold when slip is expected.

Conditions for Running the DTC

- Clutch 3 is commanded Off.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC

Condition 1

Clutch 3 slip speed is less than or equal to 30 RPM for 2 s in a 2.68 s window for 2 counts.

Condition 2

Clutch 3 slip speed profile is greater than or equal to 450 RPM for 2 s in a 2.68 s window for 2 counts.

Action Taken When the DTC Sets

- P07A7 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 2.
- The hybrid/EV powertrain control module 1 inhibits mode 3.

Conditions for Clearing the DTC

P07A7 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 3 Slip Speed on the scan tool when the Clutch 3 Status parameter reading is Released. Clutch 3 Slip Speed should be greater than 30 RPM.
 - **If clutch 3 parameter is not within the specified range**
Refer to Component Testing.
 - **If clutch 3 parameter is within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper

procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a stuck valve or stuck on condition, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Pressure Control Solenoid 3
- Variable 1-4 and 1-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 1-4 and 1-3 clutch assembly snap ring, piston, clutch discs and housing for a stuck on or welded condition.

- **If you found a Variable 1-4 and 1-3 clutch assembly concern**

Repair or replace the Variable 1-4 and 1-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Drive Motor Removal - 1st Position](#) , [Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Disassemble](#) , [Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Assemble](#) and [Drive Motor Installation - 1st Position](#) for Variable 1-4 and 1-3 Clutch Assembly replacement.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P07A9: TRANSMISSION CLUTCH 4 STUCK ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P07A9

Transmission Clutch 4 Stuck On

Variable 2-3 and 1-2-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 4 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 4 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 4 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 2-3 and 1-2-3 Clutch is tied to Clutch 4 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 2-3 and 1-2-3 Clutch is applied. The hybrid/EV powertrain control module 1 monitors the Clutch 4 slip by comparing the slip speed across the clutch to a slip threshold when slip is expected.

Conditions for Running the DTC

- Clutch 4 is commanded Off.
- No drive motor speed DTCs are set.
- The hybrid/EV powertrain control module 1 is not requesting the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Setting the DTC**Condition 1**

Clutch 4 slip speed is less than or equal to 30 RPM for 1 s in a 1.25 s window for 2 counts.

Condition 2

Clutch 4 slip speed profile is greater than or equal to 350 RPM for 1 s in a 1.25 s window for 2 counts.

Action Taken When the DTC Sets

- P07A9 is a Type A DTC.
- The hybrid/EV powertrain control module 1 inhibits mode 1.

Conditions for Clearing the DTC

P07A9 is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions**Circuit/System Verification**

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 4 Slip Speed on the scan tool when the Clutch 4 Status parameter reading is Released. Clutch 3 Slip Speed should be greater than 30 RPM.
 - **If clutch 4 parameter is not within the specified range**

Refer to Component Testing.
 - **If clutch 4 parameter is within the specified range**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a stuck valve or stuck on condition, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Pressure Control Solenoid 4
- Variable 2-3 and 1-2-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 2-3 and 1-2-3 clutch assembly snap ring, piston, clutch discs and housing for a stuck on or welded condition.

- **If you found a Variable 2-3 and 1-2-3 clutch assembly concern**

Repair or replace the Variable 2-3 and 1-2-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Replacement** for control valve body replacement.
- **Drive Motor Removal - 1st Position** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Disassemble** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Assemble** and **Drive Motor Installation - 1st Position** for Variable 2-3 and 1-2-3 Clutch Assembly replacement
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P07AB: TRANSMISSION CLUTCH 5 STUCK ON

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC P07AB

Transmission Clutch 5 Stuck On

Typical Scan Tool Data

Clutch 5 Reference

Parameter	Commanded ON	Commanded OFF	Stuck when Commanded OFF
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 300 RPM			
Clutch 5 Slip Speed	0 RPM	0-6, 300 RPM	0-6, 300 RPM
Clutch 5 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 continuously monitors the Clutch Slip 5 Speed. The hybrid/EV powertrain control module 1 is part of the drive motor generator power inverter module and is not serviced separately. Clutch 5 in the vehicle software and on the scan tool, is tied to the Variable 1-2-3-4 Clutch in the transmission. The purpose of Variable 1-2-3-4 Clutch is to allow drive motor 1 to provide torque through the transmission to the rear wheels and prevent the internal combustion engine from rotating backwards. The Variable 1-2-3-4 Clutch is grounded to the transmission case. Therefore, a Variable 1-2-3-4 Clutch stuck On condition could appear to be a seized internal combustion engine. Conversely, a stuck On pressure control solenoid 5, stuck or seized Variable 1-2-3-4 Clutch Valve, stuck On or seized Variable 1-2-3-4 Clutch or a seized internal combustion engine may appear to be a Stuck On Variable 1-2-3-4 Clutch Assembly (C5).

Conditions for Running the DTC

Clutch 5 command is Off.

Conditions for Setting the DTC

Condition 1

Clutch 5 slip speed is less than or equal to 30 RPM for 2 s in a 2.68 s window for 1 count.

Condition 2

Clutch 5 slip speed profile is greater than or equal to 550 RPM for 2 s in a 2.68 s window for 1 count.

Action Taken When the DTC Sets

P07AB is a Type A DTC.

The hybrid/EV Powertrain Control Module 1 inhibits the following mode and gears:

- Mode 2
- Gear 1
- Gear 2
- Gear 3

Then

The hybrid/EV powertrain control module 1 requests the hybrid/EV powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

P07AB is a Type A DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first. The Variable 1-2-3-4 Clutch is grounded to the transmission case and splined to the input shaft. Therefore DTC P07AB could be set by the following conditions:

- A mechanically stuck On pressure control solenoid 5.
- A seized internal combustion engine (ICE).
- Stuck On Variable 1-2-3-4 Clutch.
- A seized Drive Motor 1.
- A seized Drive Motor 1 Bearing.

Reference Information

Mechanical Reference

- [Disassembled Views](#) for Automatic Transmission Torque Dampener Housing
- [Disassembled Views](#) for Drive Motor - 1st Position
- [Range Reference](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Open the hood, vehicle On, depress the accelerator for at least 5 s.
2. Verify that the internal combustion engine (ICE) starts and stays running.
 - **If the ICE does not start verify the ICE is not seized**

refer to [Engine Will Not Crank - Crankshaft Will Not Rotate](#) .

- If the ICE does not start and is not seized

Inspect the transmission for the following conditions, refer to [Component Testing](#)

- Pressure Control Solenoid 6 is not mechanically stuck On.
- Variable 1-2-3-4 Clutch for a Stuck On or seized condition.
- Drive Motor 1 seized condition.
- If the ICE starts and stays running

3. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Remove the transmission oil pan, refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#). Inspect pressure control solenoid 5 for a stuck On condition.
3. Remove the transmission, refer to [Transmission Replacement](#).
4. Inspect the Variable 1-2-3-4 Clutch for a broken or seized condition. The clutch 5 should rotate freely.
5. If the Variable 1-2-3-4 Clutch tests OK, inspect drive motor 1 or drive motor 1 bearing, for a seized condition. Refer to [Drive Motor Removal - 1st Position](#).

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#) for transmission fluid pan removal.
- [Control Valve Solenoid Body Replacement](#) for pressure control solenoid 5 replacement.
- [Transmission Replacement](#) for Transmission removal.

- [Torque Dampener Housing Removal](#) for Variable 1-2-3-4 Clutch removal procedure.
- [Drive Motor Removal - 1st Position](#) for drive motor 1 removal.
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P0815, P0816 OR P0826: UPSHIFT/DOWNSHIFT SWITCH CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0815

Upshift Switch Circuit

DTC P0816

Downshift Switch Circuit

DTC P0826

Up and Down Shift Switch Circuit

Diagnostic Fault Information

Regenerative Braking On Demand

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Normal Range = None				
Tap Up/Tap Down Switch Signal Circuit	0 V	0 V	5-12 V	-

Typical Scan Tool Data

Regenerative Braking On Demand

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running, In Drive Range, Manual Mode selected			
Parameter Normal Range: Active/Inactive			
Signal	Active	Inactive	-
Ground	-	Inactive	Active

Regenerative Braking On Demand Switch

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running, In Drive Range, Manual Mode selected			
Parameter Normal Range: Active/Inactive, None, Invalid			
Signal	Active	Inactive	None
Ground	Inactive	Inactive	Active

Circuit/System Description

The transmission manual mode shift switches consists of 2 separate switches mounted on the forward facing side of the steering wheel. The 2 switches consist of voltage dropping resistors that are in series - parallel to each other. A 12 V signal circuit is provided by the body control module (BCM). Both the right and left switches are connected to a common chassis ground. The BCM is constantly monitoring the signal circuit for a change in voltage. When either the upshift or downshift switch is momentarily depressed, the voltage will change on the signal circuit. Depending on which switch is depressed, this will indicate either an upshift or downshift to the BCM. A signal is then sent out on the serial data line to the ECM and TCM to perform the desired upshift or downshift.

Conditions for Running the DTC

P0815

- P0836 or P1761 is not set.
- The vehicle is On.

P0816

- P0836 or P1761 is not set.
- The vehicle is On.

P0826

- P1761 is not set.
- The vehicle is On.

Conditions for Setting the DTC

P0815 - Condition 1

The BCM detects a stuck On Tap Up switch for 3 s in Drive.

P0815 - Condition 2

The BCM detects a stuck On Tap Up switch for 655 s.

P0816 - Condition 1

The BCM detects a stuck On Tap Down switch for 1 s in Drive.

P0816 - Condition 2

The BCM detects a stuck On Tap Down switch for 655 s.

P0826

The BCM detects an invalid voltage on the tap up/down signal circuit for 8 s.

Action Taken When the DTC Sets

- P0815, P0816 and P0826 are Type C DTCs.
- The TCM disables tap shift operation.

Conditions for Clearing the DTC

P0815, P0816 and P0826 are Type C DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle On, place the transmission shift lever into manual mode position.
2. Verify the scan tool driver shift control mode parameter displays Active.
 - **If the parameter does not display Active**
Refer to Circuit/System Testing.
 - **If the parameter does display Active**
3. Verify the scan tool, Up and Down Shift Switch parameter displays Upshift, when pushing rearward on the S2R Transmission Manual Shift Switch - Right.
 - **If the parameter does not display Upshift**
Refer to Circuit/System Testing.
 - **If the parameter does display Upshift**
4. Verify the scan tool, Up and Down Shift Switch parameter displays Downshift, when pushing rearward on the S2L Transmission Manual Shift Switch - Left.
 - **If the parameter does not display Downshift**
Refer to Circuit/System Testing.
 - **If the parameter does display Downshift**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
7. All OK.

[Circuit/System Testing](#)

1. Vehicle Off and all vehicle systems Off. Disconnect the harness connector at the S2R Transmission Manual Shift - Right. It may take up to 2 min. for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle Off.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the wire circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

3. Vehicle On.

4. Test for 11.6-12.4 V between the signal circuit terminal 1 and ground.

- **If not between 11.6-12.4 V**

1. Vehicle Off. Disconnect the X3 connector at the K9 Body Control Module.

2. Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground in the signal circuit.
- If infinite resistance

3. Test for less than 2 Ω in the signal circuit end to end.

- If greater than 2 Ω , repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K9 Body Control Module.

- **If between 11.6-12.4 V**

5. Vehicle Off.

6. Disconnect the harness connector at the S2L Transmission Manual Shift Switch - Left.

7. Test for less than 2 Ω between terminal 2 on the S2L Transmission Manual Shift Switch - Left harness connector and terminal 3 on the S2R Transmission Manual Shift Switch - Right harness connector.

- **If 2 Ω or greater**

Repair the open/high resistance in the signal circuit between the S2L Transmission Manual Shift Switch - Left and the S2R Transmission Manual Shift Switch - Right.

- **If less than 2 Ω**

8. Test for less than 5 Ω between the ground circuit terminal 1 and ground on the S2L Transmission Manual Shift Switch - Left.

- **If 5 Ω or greater**

1. Vehicle Off.

2. Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the wire circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.

- **If less than 5 Ω**

9. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.

2. Test for infinite resistance between terminal 1 and terminal 2 on S2R Transmission Manual Shift Switch - Right.

- **If not infinite resistance**

Replace the S2R Transmission Manual Shift Switch - Right.

- **If infinite resistance**

3. Test for 500-750 Ω between terminal 1 and terminal 2 on the S2R Transmission Manual Shift Switch - Right, while depressing the switch.

- **If not within the specified range**

Replace the S2R Transmission Manual Shift Switch - Right.

- **If within the specified range**

4. Test for 5400-5800 Ω between terminal 1 and terminal 2 on the S2L Transmission Manual Shift Switch - Left.

- **If not within the specified range**

Replace the S2L Transmission Manual Shift Switch - Left.

- **If within the specified range**

5. Test for 1200-1500 Ω between terminal 1 and terminal 2 on the S2L Transmission Manual Switch
- Left with the switch depressed.

- **If not within the specified range**

Replace the S2L Transmission Manual Shift Switch - Left.

- **If within the specified range**

6. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Steering Wheel Replacement](#) for S2R Transmission Manual Shift Switch - Right or S2L Transmission Manual Switch - Left replacement.
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P0960, P0962 OR P0963: TRANSMISSION CONTROL SOLENOID VALVE 1 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0960

Transmission Control Solenoid Valve 1 Control Circuit Open

DTC P0962

Transmission Control Solenoid Valve 1 Control Circuit Low Voltage

DTC P0963

Transmission Control Solenoid Valve 1 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2760	P2761	P2761	-
Control	P0962	P0960	P0963	-

Typical Scan Tool Data

Transmission Control Solenoid Valve 1 Control Circuit Open Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Transmission Control Solenoid Valve 1 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Transmission Control Solenoid Valve 1 Control Circuit High Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 1 is a low pressure, normally high, variable force solenoid valve that controls transmission fluid line pressure. The transmission control module (TCM) high side driver 2 supplies 12 V to the transmission control solenoid valve 1. A low side driver circuit in the TCM is pulse width modulated to vary the current to the solenoid.

Conditions for Running the DTC

- Vehicle On.
- Ignition Voltage is greater than 9 V.
- Battery voltage is between 11-32 V for 1 s or greater.
- Engine speed is less than or equal to 8, 000 RPM.
- Vehicle speed is less than or equal to 250 MPH (402 km/h).

Conditions for Setting the DTC

P0960

TCM detects an open/high resistance in the transmission control solenoid valve 1 control circuit, for 0.3 s in a 0.4 s window.

P0962

TCM detects a short to ground in the transmission control solenoid valve 1 control circuit, for 0.3 s in a 0.4 s window.

P0963

TCM detects a short to voltage in the transmission control solenoid valve 1 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

- P0960, P0962 or P0963 are Type A DTCs.
- The TCM shuts off the high side driver, resulting in maximum line pressure.

Conditions for Clearing the DTC

P0960, P0962 or P0963 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Transmission Control Solenoid Valve 1 On and Off with a scan tool.
 - Transmission Control Solenoid Valve 1 Control Circuit Open Voltage Test Status
 - Transmission Control Solenoid Valve 1 Control Circuit Low Voltage Test Status
 - Transmission Control Solenoid Valve 1 Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

[Circuit/System Testing](#)

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down. Vehicle On.
2. Command the high side driver 2 Off.
3. Connect a test lamp between the ignition circuit terminal 19 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.

3. Verify a test lamp does not illuminate between the ignition circuit terminal 19 and ground.
 - If the test lamp illuminates, repair the short to voltage in the ignition circuit.
 - If the test lamp does not illuminate, replace the K71 Transmission Control Module.
- **If the test lamp does not illuminate**
5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 2 On and Off with a scan tool.
 - **If the test lamp is always Off**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If the test lamp turns On and Off**
7. Remove the test lamp.
8. Test for 1.8-2.2 V between the transmission control solenoid valve 1 control circuit terminal 4 and ground.
 - **If less than 1.8 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If greater than 2.2 V**
9. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
10. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K71 Transmission Control Module.
 - **If between 1.8-2.2 V**
11. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [**High Voltage Disabling**](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper

procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q23 Line Pressure Control Solenoid Valve.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.
8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.
 - If the test lamp is always Off
Replace the automatic transmission control wiring harness.
 - If the test lamp turns On and Off
9. Replace the Q77A Transmission Control Solenoid Valve 1.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Solenoid Body Replacement](#) for Q77A Transmission Control Solenoid Valve 1 replacement.
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Transmission Fluid Pan and Filter Assembly Removal](#)
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P0964, P0966 OR P0967: TRANSMISSION CONTROL SOLENOID VALVE 2 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0964

Transmission Control Solenoid Valve 2 Control Circuit Open

DTC P0966

DTC P0967

Transmission Control Solenoid Valve 2 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2670	P2671	P2671	-
Control	P0966	P0964	P0967	-

Typical Scan Tool Data**Transmission Control Solenoid Valve 2 Control Circuit Open Test Status**

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Transmission Control Solenoid Valve 2 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Transmission Control Solenoid Valve 2 Control Circuit High Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 2 is a normally Off, On/Off solenoid valve. The transmission control module (TCM) high side driver 2, supplies 12 V to the transmission control solenoid valve 2. A low side driver circuit in the TCM is pulse width modulated to vary the current to the solenoid.

Conditions for Running the DTC**P0964**

- Battery voltage is between 11-32 V.
- Ignition voltage is between 11-16 V.
- Engine is between 0 and 7500 rpm for 5 s.
- Vehicle speed is less than or equal to 200 mph (322 km/h).
- Propulsion system is active.

P0966 and P0967

- Battery voltage is between 11-32 V.
- Ignition voltage is greater than or equal to 9 V.
- Engine is between 0 and 8000 rpm.
- Vehicle speed is less than or equal to 250 mph (402 km/h).
- Propulsion system is active.

Conditions for Setting the DTC

P0964

TCM detects an open/high resistance in the transmission control solenoid valve 2 control circuit, for 0.3 s in a 0.4 s window.

P0966

TCM detects a short to ground in the transmission control solenoid valve 2 control circuit, for 0.081 s in a 0.100 s window.

P0967

TCM detects a short to power in the transmission control solenoid valve 2 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

P0964, P0966 and P0967 are Type A DTCs.

P0966

- TCM disables high side driver 2.
- TCM inhibits mode 1.
- TCM inhibits mode 2.
- TCM inhibits mode 4.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 3.
- TCM inhibits gear 4.

P0967

- TCM inhibits mode 1.
- TCM inhibits mode 2.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 4.

Conditions for Clearing the DTC

P0964, P0966 and P0967 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Transmission Control Solenoid Valve 2 On and Off with a scan tool.
 - Transmission Control Solenoid Valve 2 Control Circuit Open Voltage Test Status
 - Transmission Control Solenoid Valve 2 Control Circuit Low Voltage Test Status
 - Transmission Control Solenoid Valve 2 Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

[Circuit/System Testing](#)

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.
2. Command the high side driver 1 Off.
3. Connect a test lamp between the ignition circuit terminal 18 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 3. Verify a test lamp does not illuminate between the ignition circuit terminal 18 and ground.
 - If the test lamp illuminates, repair the short to voltage in the ignition circuit.
 - If the test lamp does not illuminate, replace the K71 Transmission Control Module.
 - **If the test lamp does not illuminate**
5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 1 On and Off with a scan tool.
 - **If the test lamp is always Off**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
- **If the test lamp turns On and Off**
7. Remove the test lamp.
8. Test for 1.8-2.2 V between the transmission control solenoid valve 2 control circuit terminal 1 and ground.
 - **If less than 1.8 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If greater than 2.2 V**
9. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
10. Test for less than 1 V between the control circuit terminal 1 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K71 Transmission Control Module.
 - **If between 1.8-2.2 V**
11. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [**High Voltage Disabling**](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.

- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q77B Transmission Control Solenoid Valve 2.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.
8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.

- **If the test lamp is always Off**

Replace the automatic transmission control wiring harness.

- **If the test lamp turns On and Off**

9. Replace the Q77B Transmission Control Solenoid Valve 2.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Solenoid Body Replacement](#) for Q77B Transmission Control Solenoid Valve 2 replacement
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Transmission Fluid Pan and Filter Assembly Removal](#)
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P0968, P0970 OR P0971: TRANSMISSION CONTROL SOLENOID VALVE 3 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0968

Transmission Control Solenoid Valve 3 Control Circuit Open

DTC P0970

Transmission Control Solenoid Valve 3 Control Circuit Low Voltage

DTC P0971

Transmission Control Solenoid Valve 3 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2670	P2671	P2671	-

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Control	P0970	P0968	P0971	-

Typical Scan Tool Data

Transmission Control Solenoid Valve 3 Control Circuit Open Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Transmission Control Solenoid Valve 3 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Transmission Control Solenoid Valve 3 Control Circuit High Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 3 is a normally Off, On/Off solenoid valve. The transmission control module (TCM) high side driver 2 supplies 12 V to the transmission control solenoid valve 3. A low side driver circuit in the TCM is pulse width modulated to vary the current to the solenoid.

Conditions for Running the DTC

- Battery voltage is between 11-32 V.
- Ignition voltage is greater than or equal to 9 V.
- Engine is between 0 and 8000 rpm.
- Vehicle speed is less than or equal to 250 mph (402 km/h).
- Propulsion system is active.

Conditions for Setting the DTC

P0968

TCM detects an open/high resistance in the transmission control solenoid valve 2 control circuit, for 0.3 s in a 0.4 s window.

P0970

TCM detects a short to ground in the transmission control solenoid valve 2 control circuit, for 0.07 s in a 0.09 s window.

P0971

TCM detects a short to voltage in the transmission control solenoid valve 2 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

P0968, P0970, P0971 are Type A DTCs.

P0970

- TCM disables high side driver 1.
- TCM inhibits mode 2.
- TCM inhibits mode 3.
- TCM inhibits mode 4.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 3.
- TCM inhibits gear 4.

P0971

- TCM inhibits mode 2.
- TCM inhibits mode 3.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 3.
- TCM inhibits gear 4.

Conditions for Clearing the DTC

P0968, P0970, P0971 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Transmission Control Solenoid Valve 3 On and Off with a scan tool.
 - Transmission Control Solenoid Valve 3 Control Circuit Open Voltage Test Status
 - Transmission Control Solenoid Valve 3 Control Circuit Low Voltage Test Status
 - Transmission Control Solenoid Valve 3 Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**

Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**

Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.
2. Command the high side driver 1 Off.
3. Connect a test lamp between the ignition circuit terminal 19 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 3. Verify a test lamp does not illuminate between the ignition circuit terminal 19 and ground.
 - If the test lamp illuminates, repair the short to voltage on the ignition circuit.
 - If the test lamp does not illuminate, replace the K71 Transmission Control Module.
 - **If the test lamp does not illuminate**
5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 1 On and Off with a scan tool.
 - **If the test lamp is always Off**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If the test lamp turns On and Off**
7. Remove the test lamp.
8. Test for 1.8-2.2 V between the transmission control solenoid valve 3 control circuit terminal 1 and ground.
 - **If less than 1.8 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the control circuit terminal 5 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If greater than 2.2 V**
9. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
10. Test for less than 1 V between the control circuit terminal 5 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K71 Transmission Control Module.
 - **If between 1.8-2.2 V**
11. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q77C Transmission Control Solenoid Valve 3.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.

8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.

- **If the test lamp is always Off**

Replace the automatic transmission control wiring harness.

- **If the test lamp turns On and Off**

9. Replace the Q77C Transmission Control Solenoid Valve 3.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Solenoid Body Replacement** for Q77C Transmission Control Solenoid Valve 3 replacement
- **Automatic Transmission Control Wiring Harness Replacement**
- **Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement**
- **Control Module References** for K71 Transmission Control Module replacement, programming and setup.

DTC P0973 OR P0974: SHIFT SOLENOID VALVE 1 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P0973

Shift Solenoid Valve 1 Control Circuit Low Voltage

DTC P0974

Shift Solenoid Valve 1 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2670	P2671	P2671	-
Control	P0973	P0974	P0974	-

Typical Scan Tool Data

Shift Solenoid Valve 1 Control Circuit Open Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Shift Solenoid Valve 1 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Shift Solenoid Valve 1 Control Circuit High Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 1 is a normally Off, On/Off solenoid valve. The transmission control module (TCM) high side driver 2, supplies 12 V to the transmission control solenoid valve 1.

Conditions for Running the DTC

- Battery voltage is between 11-32 V.
- Ignition voltage is greater than or equal to 9 V.
- Engine is between 0 and 8000 rpm.
- Vehicle speed is less than or equal to 250 mph (402 km/h).
- Propulsion system is active.

Conditions for Setting the DTC**P0973**

TCM detects a short to ground in the Shift Solenoid Valve 1 control circuit, for 0.07 s in a 0.09 s window.

P0974

TCM detects an open or short to voltage in the Shift Solenoid Valve 1 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

P0973 and P0974 are Type A DTCs.

P0973

- TCM disables high side driver 1.
- TCM reports clutch 2 stuck Off.
- TCM reports clutch 4 stuck Off.

P0974

TCM inhibits drive motor cooling.

Conditions for Clearing the DTC

P0973 and P0974 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **[COMPONENT CONNECTOR END VIEWS - INDEX](#)**
- **[INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)**

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Shift Solenoid Valve 1 On and Off with a scan tool.
 - Shift Solenoid Valve 1 Control Circuit Open Voltage Test Status
 - Shift Solenoid Valve 1 Control Circuit Low Voltage Test Status
 - Shift Solenoid Valve 1 Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.
2. Command the high side driver 2 Off.
3. Connect a test lamp between the ignition circuit terminal 19 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 3. Verify a test lamp does not illuminate between the ignition circuit terminal 18 and ground.
 - If the test lamp illuminates, repair the short to voltage in the ignition circuit.
 - If the test lamp does not illuminate, replace the K71 Transmission Control Module.
 - **If the test lamp does not illuminate**

5. Vehicle On.

6. Verify the test lamp turns On and Off when commanding the high side driver 2 On and Off with a scan tool.

- **If the test lamp is always Off**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K71 Transmission Control Module.

- **If the test lamp turns On and Off**

7. Connect a test lamp between the Shift Solenoid Valve 1 control circuit terminal 3 and terminal 19.

8. Command the Shift Solenoid Valve 1 On and Off with the scan tool.

- **If the test lamp is always Off**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the control circuit terminal 3 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , replace the K71 Transmission Control Module.

- **If the test lamp turns On and Off**

9. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.

2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#)

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q32A Shift Solenoid Valve 1.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.
8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.
 - **If the test lamp is always Off**

Replace the automatic transmission control wiring harness.

- **If the test lamp turns On and Off**
9. Replace the Q32A Shift Solenoid Valve 1.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Solenoid Body Replacement](#) for Q32A Shift Solenoid Valve 1 replacement
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Transmission Fluid Pan and Filter Assembly Removal](#)
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P1761: UP AND DOWN SHIFT SWITCH SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1761

Up and Down Shift Switch Signal Message Counter Incorrect

Circuit/System Description

The Regenerative braking feature takes some of the energy from the moving vehicle and turns it back into electrical energy. This energy is then stored back into the high voltage battery system, contributing to increased energy efficiency. The Regenerative braking feature is activated when the gear selector is in the manual position. The Regenerative braking feature is deactivated in all other range positions. When Regenerative braking is requested, a signal is sent to the Body Control Module (BCM) and also to the Transmission Control Module (TCM). Each time a signal is sent, an internal counter in the BCM and TCM increments. Both counters must have the same count value.

Conditions for Running the DTC

Vehicle is On.

Conditions for Setting the DTC

The TCM detects an error in the rolling count value that does not match with the rolling count value sent by the BCM.

Action Taken When the DTC Sets

P1761 is a Type C DTC.

Conditions for Clearing the DTC

P1761 is a Type C DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify with a scan tool, there are no other K71 Transmission Control Module or K9 Body Control Module DTCs set.

NOTE:

- **P1761 is an informational DTC.**
- **Diagnose all other K71 Transmission Control Module and K9 Body Control Module DTCs prior to DTC P1761.**

- **If a DTC is set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If a DTC is not set**

2. Complete the diagnosis by looking for a serial data fault. Refer to **Scan Tool Does Not Communicate with Low Speed GMLAN Device** .

- **If a serial data circuit fault is found**

Repair as necessary.

- **If a serial data circuit fault is not found**

3. Replace the K71 TCM.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P179B: TRANSMISSION RANGE STATE COMMAND SIGNAL MESSAGE COUNTER INCORRECT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P179B

Transmission Range State Command Signal Message Counter Incorrect

Circuit/System Description

The transmission control module (TCM) checks for corruption of the hybrid range state command over the serial data circuits. This fault is handled inside the TCM and no external circuits are involved.

Conditions for Running the DTC

- Vehicle On for greater than or equal to 0.50 s.
- Run/crank voltage is greater than 9.5V

Conditions for Setting the DTC

The TCM detects an Alive Rolling Count error of the hybrid range state for 137.5 ms in a 200 ms window.

Action Taken When the DTC Sets

P179B is a Type A DTC.

Conditions for Clearing the DTC

P179B is a Type A DTC.

Reference Information

Schematic Reference

[Automatic Transmission Controls Schematics](#)

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle On.
2. Verify DTC P179B is not set.
 - **If the DTC is set**
 1. Program the K71 Transmission Control Module.
 2. Verify the DTC does not set.
 - If the DTC sets, replace the K71 Transmission Control Module.
 - If the DTC does not set
 3. All OK.
 - **If the DTC is not set**
3. All OK.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

Refer to [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P179C: TRANSMISSION CLUTCH 1 MINOR SLIP DETECTED

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

[DTC Descriptor](#)

DTC P179C

Transmission Clutch 1 Minor Slip Detected

[Typical Scan Tool Data](#)

Variable 1-2 and 1-2 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			
Clutch 1 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 1 Status	Applied	Released	Applied

[Circuit/System Description](#)

The hybrid/EV powertrain control module 1 monitors the Clutch 1 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-2 and 1-2 Clutch is tied to Clutch 1 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-2 and 1-2 Clutch is applied. When a small amount of clutch slip is detected the system can intervene to prevent the slip. This diagnostic detects either an excessive amount of clutch slip adapt from slip intervention once the maximum clutch capacity reserve adapt has been reached or if there are multiple slip intervention requests without the adapt changing.

Conditions for Running the DTC

The vehicle is On.

Conditions for Setting the DTC

Condition 1

Maximum clutch 1 capacity reserve adapt is detected for 100 cycles.

Condition 2

Clutch 1 Slip intervention requested without changing the adapt is detected for 100 cycles.

Action Taken When the DTC Sets

P179C is a Type B DTC.

Conditions for Clearing the DTC

P179C is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 1 Slip Speed parameter on the scan tool. The Clutch 1 Slip Speed parameter display should be less than 100 RPM when the Clutch 1 Status parameter reading is Applied.

- **If clutch slip speed is greater than 100 RPM**

Refer to Component Testing.

- **If clutch slip speed is less than 100 RPM**

4. All OK

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Variable 1-2 and 1-2 Clutch valve
- Variable 1-4 and 1-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the Variable 1-2 and 1-2 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 1-2 and 1-2 clutch assembly concern**

Repair or replace the Variable 1-2 and 1-2 clutch assembly as necessary.

- **If no concern is found**

4. All OK

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Variable 1-2 and 1-2 Clutch Housing Removal](#) and [Variable 1-2 and 1-2 Clutch Housing Installation](#) for Variable 1-2 and 1-2 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P179D: TRANSMISSION CLUTCH 2 MINOR SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P179D

Transmission Clutch 2 Minor Slip Detected

Typical Scan Tool Data

Variable 3-4 and 2-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph) Parameter Normal Range: 0-6, 000 RPM			
Clutch 2 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 2 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 2 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 3-4 and 2-3 Clutch is tied to Clutch 2 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 3-4 and 2-3 Clutch is applied. When a small amount of clutch slip is detected the system can intervene to prevent the slip. This diagnostic detects either an excessive amount of clutch slip adapt from slip intervention once the maximum clutch capacity reserve adapt has been reached or if there are multiple slip intervention requests without the adapt changing.

Conditions for Running the DTC

The vehicle is On.

Conditions for Setting the DTC

Condition 1

Maximum Clutch 2 capacity reserve adapt is detected for 100 cycles.

Condition 2

Clutch 2 slip intervention requested without changing the adapt is detected for 100 cycles.

Action Taken When the DTC Sets

P179D is a Type B DTC.

Conditions for Clearing the DTC

P179D is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

[Circuit/System Verification](#)

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 2 Slip Speed parameter on the scan tool. The Clutch 2 Slip Speed parameter display should be less than 100 RPM when the Clutch 2 Status parameter reading is Applied.
 - **If clutch 2 parameter is greater than 80 RPM**
Refer to Component Testing.
 - **If clutch 2 parameter is less than 80 RPM**
4. All OK.

[Component Testing](#)

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Variable 3-4 and 2-3 Clutch valve
- Variable 2-3 and 1-2-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 3-4 and 2-3 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 3-4 and 2-3 clutch assembly concern**

Repair or replace the Variable 3-4 and 2-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Variable 3-4 and 2-3 Clutch Housing Removal](#) and [Variable 3-4 and 2-3 Clutch Housing Installation](#) for Variable 3-4 and 2-3 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P179E: TRANSMISSION CLUTCH 3 MINOR SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P179E

Transmission Clutch 3 Minor Slip Detected

Typical Scan Tool Data

Variable 1-4 and 1-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			
Clutch 3 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 3 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 3 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-4 and 1-3 Clutch is tied to Clutch 3 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-4 and 1-3 Clutch is applied. When a small amount of clutch slip is detected the system can intervene to prevent the slip. This diagnostic detects either an excessive amount of clutch slip adapt from slip intervention once the maximum clutch capacity reserve adapt has been reached or if there are multiple slip intervention requests without the adapt changing.

Conditions for Running the DTC

The vehicle is On.

Conditions for Setting the DTC

Condition 1

Maximum Clutch 3 capacity reserve adapt is detected for 100 cycles.

Condition 2

Clutch 3 Slip intervention requested without changing the adapt is detected for 100 cycles.

Action Taken When the DTC Sets

P179E is a Type B DTC.

Conditions for Clearing the DTC

P179E is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 3 Slip Speed parameter on the scan tool. The Clutch 3 Slip Speed parameter display should be less than 100 RPM when the Clutch 3 Status parameter reading is Applied.
 - **If clutch slip speed is greater than 100 RPM**
Refer to Component Testing.
 - **If clutch slip speed is less than 100 RPM**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to **Control Valve Body Diagnostic Inspection**:

- Control valve body spacer plate
- Variable 2-3 and 1-2-3 Clutch valve
- Variable 1-4 and 1-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 1-4 and 1-3 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 1-4 and 1-3 clutch assembly concern**

Repair or replace the Variable 1-4 and 1-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Replacement** for control valve body replacement.
- **Drive Motor Removal - 1st Position** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Disassemble** , **Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Assemble** and **Drive Motor Installation - 1st Position** for Variable 1-4 and 1-3 Clutch Assembly replacement.
- Perform the **Reset Transmission Adapts** following all transmission related repairs.

DTC P179F: TRANSMISSION CLUTCH 4 MINOR SLIP DETECTED

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P179F

Transmission Clutch 4 Minor Slip Detected

Typical Scan Tool Data

Variable 2-3 and 1-2-3 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			
Clutch 4 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 4 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 4 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 2-3 and 1-2-3 Clutch is tied to Clutch 4 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 2-3 and 1-2-3 Clutch is applied. When a small amount of clutch slip is detected the system can intervene to prevent the slip. This diagnostic detects either an excessive amount of clutch slip adapt from slip intervention once the maximum clutch capacity reserve adapt has been reached or if there are multiple slip intervention requests without the adapt changing.

Conditions for Running the DTC

The vehicle is On.

Conditions for Setting the DTC

Condition 1

Maximum clutch 4 capacity reserve adapt is detected for 100 cycles.

Condition 2

Clutch 4 Slip intervention requested without changing the adapt is detected for 100 cycles.

Action Taken When the DTC Sets

P179F is a Type B DTC.

Conditions for Clearing the DTC

P179F is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the Transmission Fluid Level and Condition Check to verify correct fluid level and condition.
2. Perform the Line Pressure Check to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 4 Slip Speed parameter on the scan tool. The Clutch 4 Slip Speed parameter display should be less than 80 RPM when the Clutch 4 Status parameter reading is Applied.
 - **If clutch slip speed is greater than 80 RPM**
Refer to Component Testing.
 - **If clutch slip speed is less than 80 RPM**
4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to High Voltage Disabling.

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to Control Valve Body Diagnostic Inspection:
 - Control valve body spacer plate
 - Variable 2-3 and 1-2-3 Clutch valve
 - **If you found a concern in the valve body**
Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 2-3 and 1-2-3 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 2-3 and 1-2-3 clutch assembly concern**

Repair or replace the Variable 2-3 and 1-2-3 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Drive Motor Removal - 1st Position](#) , [Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Disassemble](#) , [Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch Assemble](#) and [Drive Motor Installation - 1st Position](#) for Variable 2-3 and 1-2-3 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P17A0: TRANSMISSION CLUTCH 5 MINOR SLIP DETECTED

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P17A0

Transmission Clutch 5 Minor Slip Detected

Typical Scan Tool Data

Variable 1-2-3-4 Clutch Reference

Parameter	Commanded ON	Commanded OFF	Slipping when Commanded ON
Operating Conditions: Vehicle speed 0-161 km/h (0-100 mph)			
Parameter Normal Range: 0-6, 000 RPM			
Clutch 5 Slip Speed	0 RPM	0-6, 000 RPM	0-6, 000 RPM
Clutch 5 Status	Applied	Released	Applied

Circuit/System Description

The hybrid/EV powertrain control module 1 monitors the Clutch 5 Slip Speed for each Hybrid Transmission Mode Commanded state. The Variable 1-2-3-4 Clutch is tied to Clutch 5 on the scan tool. The hybrid/EV powertrain control module 1 monitors clutch slip when the Variable 1-2-3-4 Clutch is applied. When a small amount of clutch slip is detected the system can intervene to prevent the slip. This diagnostic detects either an excessive amount of clutch slip adapt from slip intervention once the maximum clutch capacity reserve adapt has been reached or if there are multiple slip intervention requests without the adapt changing.

Conditions for Running the DTC

The vehicle is On.

Conditions for Setting the DTC

Condition 1

Maximum clutch 5 capacity reserve adapt is detected for 100 cycles.

Condition 2

Clutch 5 Slip intervention requested without changing the adapt is detected for 100 cycles.

Action Taken When the DTC Sets

P17A0 is a Type B DTC.

Conditions for Clearing the DTC

P17A0 is a Type B DTC.

Diagnostic Aids

When attempting to set transmission performance DTCs, observe the Freeze Frame and Failure Records to assist in duplicating the failure conditions. Ensure the transmission fluid level is correct and there are no leaks. If there are any other transmission DTCs set, diagnose those first.

Reference Information

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Perform the [Transmission Fluid Level and Condition Check](#) to verify correct fluid level and condition.
2. Perform the [Line Pressure Check](#) to verify correct oil pressure.
3. Operate the vehicle in drive and monitor Clutch 5 Slip Speed parameter on the scan tool. The Clutch 5 Slip Speed parameter display should be less than 80 RPM when the Clutch 5 Status parameter reading is Applied.

- **If clutch slip speed is greater than 80 RPM**

Refer to Component Testing.

- **If clutch slip speed is less than 80 RPM**

4. All OK.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission Assembly. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper

procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Inspect the valve body components and hydraulic circuits listed below for a leak or a stuck valve, refer to [Control Valve Body Diagnostic Inspection](#):

- Control valve body spacer plate
- Variable 2-3 and 1-2-3 Clutch valve
- **If you found a concern in the valve body**

Repair or replace the valve or valve body.

- **If no concern is found**

3. Inspect the variable 1-2-3-4 clutch assembly snap ring, piston, clutch discs and housing for a slipping or damaged condition.

- **If you found a Variable 1-2-3-4 clutch assembly concern**

Repair or replace the Variable 1-2-3-4 clutch assembly as necessary.

- **If no concern is found**

4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Replacement](#) for control valve body replacement.
- [Torque Dampener Housing Removal](#) , [Torque Dampener Housing Disassemble](#) , [Torque Dampener Housing Assemble](#) and [Torque Dampener Housing Installation](#) for Variable 1-2-3-4 Clutch Assembly replacement
- Perform the [Reset Transmission Adapts](#) following all transmission related repairs.

DTC P1824, P182A-P182F, P1838 OR P1839: INTERNAL MODE SWITCH CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P1824

Internal Mode Switch P Circuit High Voltage

DTC P182A

Internal Mode Switch A Circuit Low Voltage

DTC P182B

Internal Mode Switch B Circuit Low Voltage

DTC P182C

Internal Mode Switch B Circuit High Voltage

DTC P182D

Internal Mode Switch P Circuit Low Voltage

DTC P182E

Internal Mode Switch Indicates Invalid Range

DTC P182F

Internal Mode Switch C Circuit High Voltage

DTC P1838

Internal Mode Switch A Circuit High Voltage

DTC P1839

Internal Mode Switch C Circuit Low Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Transmission Range Signal A	P182A	P1838	P1838	P182E
Transmission Range Signal B	P182B	P182C	P182C	P182E
Transmission Range Signal C	P1839	P182F	P182F, P18BC	P182E
Transmission Range Signal P	P182D	P1824	P1824	P182E

Typical Scan Tool Data

Internal Mode Switch A/B/C/P

Circuit	Normal Range	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle ON, range selector in Park				
Internal Mode Switch A	1.62V-2.49V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch B	0.66V-1.02V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch C	1.62V-2.49V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Internal Mode Switch P	0.66V-1.02V	Less than 0.66V	Greater than 2.49V	Greater than 2.49V
Valid High = Switch open = 1.62V-2.49V Valid Low = Switch Closed = 0.66V-1.02V				

Transmission Internal Mode Switch Logic

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Gear Selector Position	Signal A	Signal B	Signal C	Signal P
Park (P)	Low	High	High	Low
Reverse (R)	Low	Low	High	High
Neutral (N)	High	Low	High	Low
Drive (D)	High	Low	Low	High
Low (L)	High	High	Low	Low

Circuit/System Description

The transmission internal mode switch, often referred to as the automatic transmission manual shift shaft position switch, is a hall-effect switch attached to the transmission case within the transmission. The 4 outputs from the switch indicate which position is selected by the transmission manual shift. The 4 outputs (A, B, C, P) are range selection inputs to the transmission control module (TCM). The input voltage at the modules is high when the switch is open and low when the switch is closed to ground. The state of each input is displayed on the scan tool as Internal Mode Switch A/B/C/P. The Internal Mode Switch Range input parameters represented are transmission range signal A, signal B, signal C and signal P.

Conditions for Running the DTC

The system voltage is greater than 9 V.

Conditions for Setting the DTC

Any one or more of the following conditions:

- The Internal Mode Switch signal circuit A, B or P are Low in Park for greater than 8 s.
- The Internal Mode Switch signal circuit A is Low in D for 8 s.
- The Internal Mode Switch signal circuit C is High in D for 8 s.
- The hybrid/EV powertrain control module 1 detects an invalid range from the Internal Mode Switch for 3.25 s.
- The Internal Mode Switch signal circuit C is high in D for greater than 8 s.
- Park/Neutral Switch equals P/N and the Internal Mode Switch state is not Park or Neutral or the Park/Neutral switch is not Park or Neutral and the Internal Mode Switch state equals Park or Neutral for 4 s.
- Or the transmission internal mode switch indicates a transitional state for 8 s.

Action Taken When the DTC Sets

- DTCs P1824, P182A-P182F, P1838 and P1839 are Type B DTCs.
- The PRNDL position indicator on the instrument cluster will be blank.
- The hybrid/EV powertrain control module 1 may command neutral if multiple circuit faults exist.

Conditions for Clearing the DTC

DTCs P1824, P182A-P182F, P1838 and P1839 are Type B DTCs.

Diagnostic Aids

The transmission internal mode switch connects electrically to the control solenoid valve assembly. Inspect the transmission internal mode switch, harness, connector and control solenoid assembly pins for metallic debris. Use a terminal test kit for any test that requires probing the control solenoid assembly harness connector or a component harness connector. The transmission internal mode switch can be damaged by currents exceeding 2 mA. Test the transmission internal mode switch for an open condition whenever a short to voltage condition is observed.

Reference Information

Schematic Reference

Connector End View Reference

[COMPONENT CONNECTOR END VIEWS - INDEX](#)

Electrical Information Reference

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle ON, observe the scan tool Internal Mode Switch A/B/C/P parameter while moving the gear shift lever from Park, through all gear selector positions and back to Park. The parameter should match each gear range that is selected. Refer to [Transmission Internal Mode Switch Logic](#).
2. Verify all the Internal Mode Switch Status parameters display Valid while moving the gear shift lever from Park, through all gear selector positions and back to Park.
 - **If any of the parameters display Invalid**
Refer to Circuit/System Testing.
 - **If all the parameters display valid**
3. Verify all the Internal Mode Switch parameters display 1.62V-2.49V when High and 0.66V-1.02V when Low.
 - **If any of the parameters display outside of the specified range**
Refer to Circuit/System Testing.
 - **If all the parameters display within the specified range**
4. Perform the [Range Selector Lever Cable Adjustment](#) procedure to verify proper adjustment.
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records data.
6. Verify [DTC P1824, P182A-P182F, P1838 or P1839](#) is not set.
 - **If any of the DTCs are set**
Refer to Circuit/System Testing.
 - **If none of the DTCs are set**
7. All OK

[Circuit/System Testing](#)

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground terminal 33 and ground.
 - **If greater than 10 Ω**
 1. Disconnect the harness connector at the K71 TCM.

2. Test less than 2 Ω in the ground circuit end to end.
 - If greater than 2 Ω , repair the open/high resistance on the circuit.
 - If infinite resistance, replace the K71 TCM.
 - **If less than 10 Ω**
3. Vehicle ON.
4. Test for 12 V between the signal and ground circuits listed below:
 - Switch Signal A: terminal 32 and terminal 33
 - Switch Signal B: terminal 25 and terminal 33
 - Switch Signal C: terminal 24 and terminal 33
 - Switch Signal P: terminal 26 and terminal 33
 - If less than 12 V
 - If 12 V, perform the Component Testing.
5. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
6. Test for infinite resistance between the 12 V signal circuits listed below and ground:
 - Switch Signal A: terminal 32 and terminal 33
 - Switch Signal B: terminal 25 and terminal 33
 - Switch Signal C: terminal 24 and terminal 33
 - Switch Signal P: terminal 26 and terminal 33
 - **If less than infinite resistance**

Repair the short to ground on the circuit.
 - **If infinite resistance**
7. Test for less than 1 Ω in the 12 V signal circuits listed below end to end:
 - Switch Signal A: terminal 32
 - Switch Signal B: terminal 25
 - Switch Signal C: terminal 24
 - Switch Signal P: terminal 26
 - **If 1 Ω or greater**

Repair the open/high resistance in the circuit.
 - **If less than 1 Ω**
8. Replace the K71 Transmission Control Module.

Component Testing

1. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Connect the X175 harness connector at the T12 Automatic Transmission Assembly.
3. Vehicle OFF, remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
4. Disconnect the harness connector at the B15 Transmission Internal Mode Switch.
5. Vehicle in service mode.
6. Test for 12 V between both 9 V reference circuits terminal 1, terminal 8 and ground.
 - **If not within the specified range**
Test the voltage circuits for an open/high resistance end to end.
 - If 2 Ω or greater, replace the A/Trans Wiring Extension Harness Assembly.
 - If 2 Ω or less, replace the K71 TCM.
 - **If within the specified range**
7. Vehicle On.
8. Install a 3 A fused jumper wire between each signal circuit listed:
 - Switch Signal A: terminal L and terminal G
 - Switch Signal B: terminal K and terminal G
 - Switch Signal C: terminal J and terminal G
 - Switch Signal P: terminal H and terminal G
9. Verify each scan tool Internal Mode Switch A/B/C/P/S parameter displays Low when jumped.
 - **If any parameter displays High when jumped**
Test the signal circuit and ground for an open/short to voltage or short together end to end.
 - If an open/short to voltage or short together is found, replace the Automatic Transmission Wiring Harness - Shift Shaft Position Switch.
 - If an open/short to voltage or short together is not found, replace the K71 Transmission Control Module.
 - **If each signal circuit parameter displays Low when jumped**
10. Replace the B15 Transmission Internal Mode Switch.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Automatic Transmission Manual Shift Shaft Position Switch Replacement](#) for B15 Transmission Internal Mode Switch, often referred to as the manual shift shaft position switch, replacement.
- [Automatic Transmission Control Wiring Harness Replacement](#) for Automatic Transmission Wiring Harness - Shift Shaft Position Switch replacement.
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P215B: VEHICLE SPEED - OUTPUT SHAFT SPEED NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P215B

Vehicle Speed - Output Shaft Speed Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Supply Voltage	P215C	P0721, P215C	P0721, P215C	P077B, P0721, P215C
OSS Signal	P215C	P0721, P215C	P0721, P215C	P077B, P0721, P215C

Typical Scan Tool Data

Transmission OSS

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature			
OSS Signal	0-7, 000 RPM	0 RPM	0 RPM
OSS Supply Voltage	-	0 RPM	0 RPM

ISS/OSS Supply Voltage

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Key ON, Engine OFF or Engine running, normal operating temperature			
OSS Signal	OK	OK	OK
OSS Supply Voltage	OK	Out of Range	Out of Range
8.3-9.3 Volts = OK, Any other voltage = Out of range			

Circuit/System Description

The A/Trans Output Speed Sensor Assembly has 3 internal hall-effect type sensors and two signal-processing channels and is capable of sensing both speed and direction. The output speed sensor is internal to the transmission and mounts to the A/Trans case assembly and is connected to the transmission control module (TCM) through the transmission internal harness. The A/Trans Output Speed Sensor Assembly faces the park gear machined teeth surface. The sensor receives 9 V on the OSS supply voltage circuit from the TCM. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft.

- When the vehicle is moving in a forward direction, channel A detects a particular tooth before channel B.
- When the vehicle is moving in a reverse direction, channel B detects a particular tooth before channel A.

The electronics in the sensor combine the two channels and send a signal with a different pulse width. This signal is interpreted by the TCM for speed and direction and is transmitted through the serial data circuits to the hybrid/EV powertrain control module 1. The TCM and hybrid/EV powertrain control module 1 compare the output speed sensor signal with the anti-lock brake system (ABS) wheel speed sensor signal. The hybrid/EV powertrain control module 1 is part of the T6 power inverter module and is not serviced separately.

Conditions for Running the DTC

- The ABS, TCM and hybrid/EV powertrain control module 1 are reporting vehicle speed for 0.15 s.
- No active ABS DTCs.
- The hybrid/EV powertrain control module 1 is performing a vehicle speed rationality check for 0.15 s.

Conditions for Setting the DTC

Two of the three ABS, TCM or hybrid/EV powertrain control module 1 wheel speed signals do not match for 0.20 s.

Action Taken When the DTC Sets

- P215B is a Type A DTC.
- The power inverter module requests the hybrid powertrain control module 2 to open the high voltage contactor relays.

Conditions for Clearing the DTC

P215B is a Type A DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Component Description

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

EL-38522 Variable Signal Generator

Equivalent regional tools: **Special Tools**

Circuit/System Verification

Operate the vehicle while observing the Transmission OSS and ABS wheel parameters on the scan tool.

- The Transmission OSS and ABS wheel speed signal parameters should not vary by greater than 20 km/h (12.42 mph).

Circuit/System Testing

1. Verify ABS DTCs are not set in the electronic brake control module.

- If a DTC is set

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

2. Perform the [Output Shaft Speed Input Test](#).

- If the DTC does not set

3. Replace the T6 Power Inverter Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for T6 Power Inverter Module replacement, programming and set up.

DTC P215C: OUTPUT SHAFT SPEED - WHEEL SPEED NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P215C

Output Shaft Speed - Wheel Speed Not Plausible

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
OSS Supply Voltage	P215C	P0721, P215C	P0721, P215C	P077B, P0721, P215C
OSS Signal	P215C	P0721, P215C	P0721, P215C	P077B, P0721, P215C

Typical Scan Tool Data

Transmission OSS

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Engine running, normal operating temperature			
OSS Signal	0-7, 000 RPM	0 RPM	0 RPM
OSS Supply Voltage	-	0 RPM	0 RPM

ISS/OSS Supply Voltage

Circuit	Normal Range	Open/High Resistance	Short to Voltage
Operating Conditions: Key ON, Engine OFF or Engine running, normal operating temperature			
OSS Signal	OK	OK	OK
OSS Supply Voltage	OK	Out of Range	Out of Range
8.3-9.3 Volts = OK, Any other voltage = Out of range			

Circuit/System Description

The A/Trans Output Speed Sensor Assembly has 3 internal hall-effect type sensors and two signal-processing channels and is capable of sensing both speed and direction. The output speed sensor is internal to the transmission and mounts to the A/Trans case assembly and is connected to the transmission control module (TCM) through the transmission internal harness. The A/Trans Output Speed Sensor Assembly faces the park gear machined teeth surface. The sensor receives 9 V on the OSS

supply voltage circuit from the TCM. As the output shaft rotates, the sensor produces a signal frequency based on the machined surface of the output shaft.

- When the vehicle is moving in a forward direction, channel A detects a particular tooth before channel B.
- When the vehicle is moving in a reverse direction, channel B detects a particular tooth before channel A.

The electronics in the sensor combine the two channels and send a signal with a different pulse width. This signal is interpreted by the TCM for speed and direction and is transmitted through the serial data circuits to the hybrid/EV powertrain control module 1. The TCM and hybrid/EV powertrain control module 1 compare the output speed sensor signal with the anti-lock brake system (ABS) wheel speed sensor signal. The hybrid/EV powertrain control module 1 is part of the T6 power inverter module and is not serviced separately.

Conditions for Running the DTC

- The ABS wheel speed sensors are reporting vehicle speed.
- No active ABS DTCs.
- The propulsion system is active.
- ABS calculated wheel speed is greater than or equal to 150 RPM.
- Drive motor calculated output speed sensor speed is greater than or equal to 150 RPM.

Conditions for Setting the DTC

Condition 1

The difference between transmission output speed and the calculated average of output speed from the drive motors and ABS wheel speed sensors is greater than 140 RPM for 0.20 s.

Condition 2

The difference between transmission output speed and the calculated average of output speed from the drive motors and ABS wheel speed sensors pass criteria is less than or equal to 50 RPM for 0.50 s.

Action Taken When the DTC Sets

- P215C is a Type B DTC.
- The TCM calculates output speed based drive motor 2 speed if ABS wheel speed is not available.

Conditions for Clearing the DTC

P215C is a Type B DTC.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electronic Component Description

Electrical Information Reference

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

- [Wiring Repairs](#)

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Special Tools

EL-38522 Variable Signal Generator

Equivalent regional tools: [Special Tools](#)

[Circuit/System Verification](#)

Operate the vehicle while observing the Transmission OSS and ABS wheel parameters on the scan tool.

- The Transmission OSS and ABS wheel speed signal parameters should not vary by greater than 20 km/h (12.42 mph).

[Circuit/System Testing](#)

1. Verify ABS DTCs are not set in the electronic brake control module.

- **If a DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#).

2. Perform the [Output Shaft Speed Input Test](#).

- **If the DTC does not set**

3. Replace the K71 Transmission Control Module.

[Repair Instructions](#)

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for K71 Transmission Control Module replacement, programming and set up.

DTC P2670 OR P2671: ACTUATOR HIGH CONTROL CIRCUIT GROUP 2

[Diagnostic Instructions](#)

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

[DTC Descriptors](#)

DTC P2670

Actuator High Control Circuit Group 2 Low Voltage

DTC P2671

Actuator High Control Circuit Group 2 High Voltage

[Diagnostic Fault Information](#)

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2670	P2671	P2671	-

High Side Driver 2

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: On			
High Side Driver 2	Off	On	Off

Circuit/System Description

The high side driver 2 is internal to the transmission control module (TCM). With the vehicle On, the high side driver 1 provides 12 V to the transmission line 3, 5, 6 and 7 pressure control solenoids. If excessive current flow is detected in high side driver 2 circuit, the high side driver 2 will turn Off. When the circuit fault is corrected, the high side driver 2 will reset.

Conditions for Running the DTC**P2670**

- Vehicle is On.
- High side driver 2 is On.

P2671

Vehicle is On.

Conditions for Setting the DTC**P2670**

TCM has detected a short to ground on the high side driver 2 circuit for 0.0375 s out of a 15 s window.

P2671

TCM has detected an open or short to voltage on the high side driver 2 circuit for 0.00625 s.

Action Taken When the DTC Sets

P2670 and P2671 are Type A DTCs.

P2670

- TCM turns Off high side driver 2.
- TCM reports clutches 1, 3 and 5 as stuck Off.

P2671

TCM reports clutches 1, 3 and 5 as stuck Off.

Conditions for Clearing the DTC

P2670 and P2671 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **[COMPONENT CONNECTOR END VIEWS - INDEX](#)**
- **[INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)**

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify the scan tool High Side Driver 2 Command parameter displays On.
 - **If On is not displayed**
Refer to Circuit/System Testing.
 - **If On is displayed**
3. Verify the parameters listed below do not display Malfunction when commanding the high side driver 2 On and Off with a scan tool.
 - High Side Driver 2 Circuit Low Voltage Test Status
 - High Side Driver 2 Circuit Open Test Status
 - High Side Driver 2 Circuit High Voltage Test Status
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
5. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
6. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down. Vehicle On.
2. Command the high side driver 2 Off.
3. Connect a test lamp between the ignition circuit terminal 19 and ground.
4. Verify the test lamp does not illuminate.

- **If the test lamp illuminates**

1. Vehicle Off.
2. Disconnect the harness connector at the K71 Transmission Control Module. Vehicle On.
3. Verify a test lamp does not illuminate between the ignition circuit terminal 19 and ground.

- **If the test lamp illuminates**

Repair the short to B+ in the ignition circuit.

- **If the test lamp does not illuminate**

Replace the K71 Transmission Control Module.

- **If the test lamp does not illuminate**

5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 2 On and Off with a scan tool.

- **If the test lamp is always Off**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.

- **If the test lamp turns On and Off**

7. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the following solenoids listed below.
 - Q77A Transmission Control Solenoid Valve 1
 - Q77C Transmission Control Solenoid Valve 3
 - Q77E Transmission Control Solenoid Valve 5
 - Q77F Transmission Control Solenoid Valve 6
 - Q32A Shift Solenoid Valve 1
6. Vehicle On.
7. Command the high side driver 2 Off.
8. Connect a test lamp between terminal 2 and ground on each solenoid harness connector for the following solenoids listed below:
 - Q77A Transmission Control Solenoid Valve 1
 - Q77C Transmission Control Solenoid Valve 3
 - Q77E Transmission Control Solenoid Valve 5
 - Q77F Transmission Control Solenoid Valve 6
 - Q32A Shift Solenoid Valve 1
9. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
Replace the transmission control wiring harness.
 - **If the test lamp does not illuminate**
10. Connect a test lamp between terminal 2 and ground on each solenoid harness connector for the following solenoids listed below:
 - Q77A Transmission Control Solenoid Valve 1
 - Q77C Transmission Control Solenoid Valve 3
 - Q77E Transmission Control Solenoid Valve 5
 - Q77F Transmission Control Solenoid Valve 6
 - Q32A Shift Solenoid Valve 1
11. Verify the test lamp turns On and Off when commanding the high side driver 2 On and Off with a scan tool for each of the following solenoids listed below:
 - Q77A Transmission Control Solenoid Valve 1
 - Q77C Transmission Control Solenoid Valve 3
 - Q77E Transmission Control Solenoid Valve 5
 - Q77F Transmission Control Solenoid Valve 6
 - Q32A Shift Solenoid Valve 1
 - **If the test lamp is always Off**
Replace the transmission control wiring harness.
 - **If the test lamp turns On and Off**
12. Disconnect the test lamp.
13. Test for 4.5-5.5 Ω between the ignition terminal 2 and the control terminal 1 on the following solenoids:
 - Q77A Transmission Control Solenoid Valve 1
 - Q77C Transmission Control Solenoid Valve 3
 - Q77E Transmission Control Solenoid Valve 5

- Q77F Transmission Control Solenoid Valve 6
- Q32A Shift Solenoid Valve 1
- **If not between 4.5-5.5 Ω**

Replace the solenoid that is not between 4.5-5.5 Ω .

- **If between 4.5-5.5 Ω**

14. Test for infinite resistance between each ignition terminal 1 and ground and then each control terminal 2 and ground on the following solenoids:

- Q77A Transmission Control Solenoid Valve 1
- Q77C Transmission Control Solenoid Valve 3
- Q77E Transmission Control Solenoid Valve 5
- Q77F Transmission Control Solenoid Valve 6
- Q32A Shift Solenoid Valve 1
- **If not infinite resistance**

Replace the solenoid that has continuity to ground.

- **If infinite resistance**

15. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Control Valve Solenoid Body Replacement](#) for solenoid replacement.
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P2718, P2720 OR P2721: TRANSMISSION CONTROL SOLENOID VALVE 4 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2718

Transmission Control Solenoid Valve 4 Control Circuit Open

DTC P2720

Transmission Control Solenoid Valve 4 Control Circuit Low Voltage

DTC P2721

Transmission Control Solenoid Valve 4 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0658	P0659	P0659	-
Control	P2720	P2718	P2721	-

Transmission Control Solenoid Valve 4 Control Circuit Open Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Transmission Control Solenoid Valve 4 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Transmission Control Solenoid Valve 4 Control Circuit High Voltage Test Status

Circuit	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On			
Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 4 is a normally Off, On/Off solenoid valve. The transmission control module (TCM) high side driver 1, supplies 12 V to the transmission control solenoid valve 4. A low side driver circuit in the TCM is pulse width modulated to vary the current to the solenoid.

Conditions for Running the DTC

- Battery voltage is between 11-32 V.
- Ignition voltage is greater than or equal to 9 V.
- Engine is between 0 and 8000 rpm.
- Vehicle speed is less than or equal to 250 mph (402 km/h).
- Propulsion system is active.

Conditions for Setting the DTC**P2718**

TCM detects an open/high resistance in the transmission control solenoid valve 4 control circuit, for 0.3 s in a 0.4 s window.

P2720

TCM detects a short to ground in the transmission control solenoid valve 4 control circuit, for 0.6 s in a 0.7 s window.

P2721

TCM detects a short to power in the transmission control solenoid valve 4 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

P2718, P2720 and P2721 are Type A DTCs.

P2720

- TCM disables high side driver 2.

- TCM inhibits mode 1.
- TCM inhibits mode 2.
- TCM inhibits mode 4.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 3.
- TCM inhibits gear 4.

P2721

- TCM inhibits mode 1.
- TCM inhibits mode 4.
- TCM inhibits gear 1.
- TCM inhibits gear 3.

Conditions for Clearing the DTC

P2718, P2720 and P2721 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Transmission Control Solenoid Valve 4 On and Off with a scan tool.
 - Transmission Control Solenoid Valve 4 Control Circuit Open Test Status
 - Transmission Control Solenoid Valve 4 Control Circuit Low Voltage Test Status
 - Transmission Control Solenoid Valve 4 Control Circuit High Voltage Test Status

- **If Malfunction is displayed**

Refer to Circuit/System Testing.

- **If Malfunction is not displayed**

3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.

4. Verify the DTC does not set.

- **If the DTC sets**

Refer to Circuit/System Testing.

- **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.

2. Command the high side driver 1 Off.

3. Connect a test lamp between the ignition circuit terminal 18 and ground.

4. Verify the test lamp does not illuminate.

- **If the test lamp illuminates**

1. Vehicle Off.

2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.

3. Verify a test lamp does not illuminate between the ignition circuit terminal 18 and ground.

- If the test lamp illuminates, repair the short to voltage in the ignition circuit.

- If the test lamp does not illuminate, replace the K71 Transmission Control Module.

- **If the test lamp does not illuminate**

5. Vehicle On.

6. Verify the test lamp turns On and Off when commanding the high side driver 1 On and Off with a scan tool.

- **If the test lamp is always Off**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the ignition circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the ignition circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K71 Transmission Control Module.

- **If the test lamp turns On and Off**

7. Remove the test lamp.

8. Test for 1.8-2.2 V between the transmission control solenoid valve 3 control circuit terminal 1 and ground.

- **If less than 1.8 V**

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the control circuit terminal 2 and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance

3. Test for less than 2 Ω in the control circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , replace the K71 Transmission Control Module.

- If greater than 2.2 V

1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
2. Test for less than 1 V between the control circuit terminal 2 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K71 Transmission Control Module.

- If between 1.8-2.2 V

9. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q77D Transmission Control Solenoid Valve 4.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.
8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.
 - If the test lamp is always Off

Replace the automatic transmission control wiring harness.

- If the test lamp turns On and Off

9. Replace the Q77D Transmission Control Solenoid Valve 4.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Control Valve Solenoid Body Replacement** for Q77D Transmission Control Solenoid Valve 4 replacement
- **Automatic Transmission Control Wiring Harness Replacement**
- **Transmission Fluid Pan and Filter Assembly Removal**
- **Control Module References** for K71 Transmission Control Module replacement, programming and setup.

DTC P2727, P2729 OR P2730: TRANSMISSION CONTROL SOLENOID VALVE 5 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P2727

Transmission Control Solenoid Valve 5 Control Circuit Open

DTC P2729

Transmission Control Solenoid Valve 5 Control Circuit Low Voltage

DTC P2730

Transmission Control Solenoid Valve 5 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P0658	P0659	P0659	-
Control	P2729	P2727	P2730	-

Typical Scan Tool Data

Transmission Control Solenoid Valve 5 Control Circuit Open Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Transmission Control Solenoid Valve 5 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Transmission Control Solenoid Valve 5 Control Circuit High Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 5 is a low pressure, normally Off, On/Off solenoid valve. The transmission control module (TCM) high side driver 2 supplies 12 V to the transmission control solenoid valve 5. A low side driver circuit in the TCM is pulse width modulated to vary the current to the solenoid.

Conditions for Running the DTC

- Battery voltage is between 11-32 V.
- Ignition voltage is greater than or equal to 9 V.
- Engine is between 0 and 8000 rpm.
- Vehicle speed is less than or equal to 250 mph (402 km/h).
- Propulsion system is active.

Conditions for Setting the DTC

P2727

TCM detects an open/high resistance in the transmission control solenoid valve 5 control circuit, for 0.3 s in a 0.4 s window.

P2729

TCM detects a short to ground in the transmission control solenoid valve 5 control circuit, for 0.07 s in a 0.09 s window.

P2730

TCM detects a short to power in the transmission control solenoid valve 5 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

P2727, P2729 and P2730 are Type A DTCs.

P2729

- TCM disables high side driver 1.
- TCM inhibits mode 2.
- TCM inhibits mode 3.
- TCM inhibits mode 4.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 3.
- TCM inhibits gear 4.

P2730

- TCM inhibits mode 2.
- TCM inhibits mode 3.
- TCM inhibits gear 1.
- TCM inhibits gear 2.

- TCM inhibits gear 3.
- TCM inhibits gear 4.

Conditions for Clearing the DTC

P2727, P2729 and P2730 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Verification

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Transmission Control Solenoid Valve 5 On and Off with a scan tool.
 - Transmission Control Solenoid Valve 5 Control Circuit Open Test Status
 - Transmission Control Solenoid Valve 5 Control Circuit Low Voltage Test Status
 - Transmission Control Solenoid Valve 5 Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**

5. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.
2. Command the high side driver 2 Off.
3. Connect a test lamp between the ignition circuit terminal 19 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 3. Verify a test lamp does not illuminate between the ignition circuit terminal 19 and ground.
 - If the test lamp illuminates, repair the short to voltage in the ignition circuit.
 - If the test lamp does not illuminate, replace the K71 Transmission Control Module.
 - **If the test lamp does not illuminate**
5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 2 On and Off with a scan tool.
 - **If the test lamp is always Off**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If the test lamp turns On and Off**
7. Remove the test lamp.
8. Test for 1.8-2.2 V between the transmission control solenoid valve 5 control circuit terminal 4 and ground.
 - **If less than 1.8 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit terminal 4 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If greater than 2.2 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 2. Test for less than 1 V between the control circuit terminal 4 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K71 Transmission Control Module.
 - **If between 1.8-2.2 V**
9. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.

2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q77E Transmission Control Solenoid Valve 5.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.
8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.

- **If the test lamp is always Off**

Replace the automatic transmission control wiring harness.

- **If the test lamp turns On and Off**

9. Replace the Q77E Transmission Control Solenoid Valve 5.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Solenoid Body Replacement](#) for Q77E Transmission Control Solenoid Valve 5 replacement.
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Transmission Fluid Pan and Filter Assembly Removal](#)
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

DTC P2736, P2738 OR P2739: TRANSMISSION CONTROL SOLENOID VALVE 6 CONTROL CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P2736

Transmission Control Solenoid Valve 6 Control Circuit Open

DTC P2738

Transmission Control Solenoid Valve 6 Control Circuit Low Voltage

DTC P2739

Transmission Control Solenoid Valve 6 Control Circuit High Voltage

Diagnostic Fault Information

Circuits	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition	P2760	P2761	P2761	-
Control	P2738	P2736	P2739	-

Typical Scan Tool Data

Transmission Control Solenoid Valve 6 Control Circuit Open Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	Malfunction	-

Transmission Control Solenoid Valve 6 Control Circuit Low Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	Malfunction	-	-

Transmission Control Solenoid Valve 6 Control Circuit High Voltage Test Status

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Vehicle On Parameter Normal Range: OK or Not Run			
Ignition	Malfunction	Malfunction	Malfunction
Control	-	-	Malfunction

Circuit/System Description

The transmission control solenoid valve 6 is a low pressure, normally Off, On/Off solenoid valve. This solenoid is also referred to as the line pressure solenoid. The transmission control module (TCM) high side driver 2, supplies 12 V to the transmission control solenoid valve 6. A low side driver circuit in the TCM is pulse width modulated to vary the current to the solenoid.

Conditions for Running the DTC

- Battery voltage is between 11-32 V.
- Ignition voltage is greater than or equal to 9 V.

- Engine is between 0 and 8000 rpm.
- Vehicle speed is less than or equal to 250 mph (402 km/h).
- Propulsion system is active.

Conditions for Setting the DTC

P2736

TCM detects an open/high resistance in the transmission control solenoid valve 6 control circuit, for 0.3 s in a 0.4 s window.

P2738

TCM detects a short to ground in the transmission control solenoid valve 6 control circuit, for 0.06 s in a 0.07 s window.

P2739

TCM detects a short to power in the transmission control solenoid valve 6 control circuit, for 0.3 s in a 0.4 s window.

Action Taken When the DTC Sets

P2736, P2738 and P2739 are Type A DTCs.

P2738

- TCM disables high side driver 2.
- TCM inhibits mode 1.
- TCM inhibits mode 2.
- TCM inhibits mode 4.
- TCM inhibits gear 1.
- TCM inhibits gear 2.
- TCM inhibits gear 3.
- TCM inhibits gear 4.

P2739

TCM inhibits Autostop.

Conditions for Clearing the DTC

P2736, P2738 and P2739 are Type A DTCs.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- [COMPONENT CONNECTOR END VIEWS - INDEX](#)
- [INLINE HARNESS CONNECTOR END VIEWS - INDEX](#)

Description and Operation

- [Electronic Component Description](#)
- [Transmission Component and System Description](#)
- [Transmission General Description](#)

Electrical Information Reference

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

DTC Type Reference

[Powertrain Diagnostic Trouble Code \(DTC\) Type Definitions](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

[Circuit/System Verification](#)

1. Vehicle On.
2. Verify the parameters listed below do not display Malfunction when commanding the Transmission Control Solenoid Valve 6 On and Off with a scan tool.
 - Transmission Control Solenoid Valve 6 Control Circuit Open Test Status
 - Transmission Control Solenoid Valve 6 Control Circuit Low Voltage Test Status
 - Transmission Control Solenoid Valve 6 Control Circuit High Voltage Test Status
 - **If Malfunction is displayed**
Refer to Circuit/System Testing.
 - **If Malfunction is not displayed**
3. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
4. Verify the DTC does not set.
 - **If the DTC sets**
Refer to Circuit/System Testing.
 - **If the DTC does not set**
5. All OK.

[Circuit/System Testing](#)

1. Vehicle Off and all vehicle systems Off. Disconnect the X175 harness connector at the T12 Automatic Transmission Assembly. It may take up to 2 min for all vehicle systems to power down, Vehicle On.
2. Command the high side driver 2 Off.
3. Connect a test lamp between the ignition circuit terminal 19 and ground.
4. Verify the test lamp does not illuminate.
 - **If the test lamp illuminates**
 1. Vehicle Off.
 2. Disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 3. Verify a test lamp does not illuminate between the ignition circuit terminal 19 and ground.
 - If the test lamp illuminates, repair the short to voltage in the ignition circuit.
 - If the test lamp does not illuminate, replace the K71 Transmission Control Module.
 - **If the test lamp does not illuminate**
5. Vehicle On.
6. Verify the test lamp turns On and Off when commanding the high side driver 2 On and Off with a scan tool.
 - **If the test lamp is always Off**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.

2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
- **If the test lamp turns On and Off**
7. Remove the test lamp.
8. Test for 1.8-2.2 V between the transmission control solenoid valve 6 control circuit terminal 8 and ground.
 - **If less than 1.8 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module.
 2. Test for infinite resistance between the control circuit terminal 8 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K71 Transmission Control Module.
 - **If greater than 2.2 V**
 1. Vehicle Off, disconnect the harness connector at the K71 Transmission Control Module, Vehicle On.
 2. Test for less than 1 V between the control circuit terminal 8 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K71 Transmission Control Module.
 - **If between 1.8-2.2 V**
9. Perform the Component Testing

Component Testing

1. Perform the Circuit/System Testing first.
2. Vehicle OFF, disable the high voltage at the T12 Automatic Transmission. Refer to [High Voltage Disabling](#).

WARNING:

Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.

- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

3. Vehicle Off, connect the X175 harness connector.
4. Remove the fluid pan from the T12 Automatic Transmission. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
5. Disconnect the harness connector at the Q77F Transmission Control Solenoid Valve 6.
6. Connect a test lamp between terminal 1 and terminal 2.
7. Vehicle in service mode.
8. Verify the test lamp turns On and Off when commanding the line pressure control solenoid On and Off with a scan tool.
 - **If the test lamp is always Off**
Replace the automatic transmission control wiring harness.
 - **If the test lamp turns On and Off**
9. Replace the Q77F Transmission Control Solenoid Valve 6.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Control Valve Solenoid Body Replacement](#) for Q77F Transmission Control Solenoid Valve 6 replacement.
- [Automatic Transmission Control Wiring Harness Replacement](#)
- [Transmission Fluid Pan and Filter Assembly Removal](#)
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

SYMPTOMS - AUTOMATIC TRANSMISSION

NOTE: Use the symptom tables only if the following conditions are met:

- Refer to [Diagnostic Starting Point - Vehicle](#).
- There are no DTCs set.
- The control modules can communicate via the serial data link.
- Review the system operation in order to familiarize yourself with the system functions. Refer to [Transmission General Description](#) and [Transmission Component and System Description](#).

Visual/Physical Inspection

Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#).

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Fluid Diagnosis

- [Transmission Fluid Level and Condition Check](#)
- [Automatic Transmission Fluid Pump Pressure High or Low](#)
- [Automatic Transmission Fluid Leaks](#)
- [Fluid Leak Diagnosis](#)
- Noise and Vibration Diagnosis
 - [Whine/Growl Noise That Changes with Vehicle Speed](#)
 - [Vibration](#)
 - [Noise in Drive or Reverse Gear](#)
 - [Noise and Vibration Analysis](#)
- Symptom Not Found or No Symptom Detected
 - [Transmission Fluid Level and Condition Check](#)
 - [Road Test](#)

REGENERATIVE BRAKING ON DEMAND MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Fault Information

Regenerative Braking On Demand

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Normal Range = None				
Tap Up/Tap Down Switch Signal Circuit	0 V	0 V	5-12 V	-

Typical Scan Tool Data

Regenerative Braking On Demand

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running, In Drive Range, Manual Mode selected			
Parameter Normal Range: Active/Inactive			
Signal	Active	Inactive	-
Ground	-	Inactive	Active

Regenerative Braking On Demand Switch

Circuits	Short to Ground	Open	Short to Voltage
Operating Conditions: Engine running, In Drive Range, Manual Mode selected			
Parameter Normal Range: Active/Inactive, None, Invalid			
Signal	Active	Inactive	None
Ground	Inactive	Inactive	Active

Circuit/System Description

The transmission manual mode shift switches consists of 2 separate switches mounted on the forward facing side of the steering wheel. The 2 switches consist of voltage dropping resistors that are in series - parallel to each other. A 12 V signal circuit is provided by the body control module (BCM). Both the right and left switches are connected to a common chassis ground. The BCM is constantly monitoring the signal circuit for a change in voltage. When either the upshift or downshift switch is momentarily depressed, the voltage will change on the signal circuit. Depending on which switch is depressed, this will indicate either an upshift or downshift to the BCM. A signal is then sent out on the serial data line to the ECM and TCM to perform the desired upshift or downshift.

Reference Information

Schematic Reference

Automatic Transmission Controls Schematics

Connector End View Reference

- **COMPONENT CONNECTOR END VIEWS - INDEX**
- **INLINE HARNESS CONNECTOR END VIEWS - INDEX**

Description and Operation

- **Electronic Component Description**
- **Transmission Component and System Description**
- **Transmission General Description**

Electrical Information Reference

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

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle On, place the transmission shift lever into manual mode position.
2. Verify the scan tool driver shift control mode parameter displays Active.
 - **If the parameter does not display Active**
Refer to Circuit/System Testing.
 - **If the parameter does display Active**
3. Verify the scan tool, Up and Down Shift Switch parameter displays Upshift, when pushing rearward on the S2R Transmission Manual Shift Switch - Right.
 - **If the parameter does not display Upshift**
Refer to Circuit/System Testing.
 - **If the parameter does display Upshift**
4. Verify the scan tool, Up and Down Shift Switch parameter displays Downshift, when pushing rearward on the S2L Transmission Manual Shift Switch - Left.
 - **If the parameter does not display Downshift**
Refer to Circuit/System Testing.
 - **If the parameter does display Downshift**
5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observe from the Freeze Frame/Failure Records data.
6. Verify the DTC does not set.
 - **If the DTC sets**

- **If the DTC does not set**

7. All OK.

Circuit/System Testing

1. Vehicle Off and all vehicle systems Off. Disconnect the harness connector at the S2R Transmission Manual Shift - Right. It may take up to 2 min. for all vehicle systems to power down.
2. Test for less than 5 Ω between the ground circuit terminal 2 and ground.
 - **If 5 Ω or greater**
 1. Vehicle Off.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the wire circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
3. Vehicle On.
4. Test for 11.6-12.4 V between the signal circuit terminal 1 and ground.
 - **If not between 11.6-12.4 V**
 1. Vehicle Off. Disconnect the X3 connector at the K9 Body Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground in the signal circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If greater than 2 Ω , repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K9 Body Control Module.
 - **If between 11.6-12.4 V**
5. Vehicle Off.
6. Disconnect the harness connector at the S2L Transmission Manual Shift Switch - Left.
7. Test for less than 2 Ω between terminal 2 on the S2L Transmission Manual Shift Switch - Left harness connector and terminal 3 on the S2R Transmission Manual Shift Switch - Right harness connector.
 - **If 2 Ω or greater**

Repair the open/high resistance in the signal circuit between the S2L Transmission Manual Shift Switch - Left and the S2R Transmission Manual Shift Switch - Right.
 - **If less than 2 Ω**
8. Test for less than 5 Ω between the ground circuit terminal 1 and ground on the S2L Transmission Manual Shift Switch - Left.
 - **If 5 Ω or greater**
 1. Vehicle Off.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the wire circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 5 Ω**
9. Perform the Component Testing.

Component Testing

1. Perform the Circuit/System Testing first.
2. Test for infinite resistance between terminal 1 and terminal 2 on S2R Transmission Manual Shift Switch - Right.

- **If not infinite resistance**

Replace the S2R Transmission Manual Shift Switch - Right.

- **If infinite resistance**

3. Test for 500-750 Ω between terminal 1 and terminal 2 on the S2R Transmission Manual Shift Switch - Right, while depressing the switch.

- **If not within the specified range**

Replace the S2R Transmission Manual Shift Switch - Right.

- **If within the specified range**

4. Test for 5400-5800 Ω between terminal 1 and terminal 2 on the S2L Transmission Manual Shift Switch - Left.

- **If not within the specified range**

Replace the S2L Transmission Manual Shift Switch - Left.

- **If within the specified range**

5. Test for 1200-1500 Ω between terminal 1 and terminal 2 on the S2L Transmission Manual Switch - Left with the switch depressed.

- **If not within the specified range**

Replace the S2L Transmission Manual Shift Switch - Left.

- **If within the specified range**

6. Replace the K9 Body Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [Steering Wheel Replacement](#) for S2R Transmission Manual Shift Switch - Right or S2L Transmission Manual Switch - Left replacement.
- [Control Module References](#) for K71 Transmission Control Module replacement, programming and setup.

OUTPUT SHAFT SPEED INPUT TEST

Special Tools

EL 38522 Variable Signal Generator

For equivalent regional tools, refer to [Special Tools](#).

The purpose of this test is to provide a simulated output speed sensor signal to the K71 Transmission Control Module Output Shaft Speed Sensor input circuits in order to verify the K71 Transmission Control Module is able to process the output speed sensor signal.

1. Vehicle OFF, remove the Automatic Transmission Fluid, Fluid Pan. Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#).
2. Vehicle OFF, disconnect the Automatic Transmission Wiring from the Output Shaft Speed Sensor wiring harness.
3. Vehicle in Service Mode, test for 8.3-9.3 volts between terminals 1 and 2.

- **If not within the specified range**

Test the Automatic Transmission Wiring Harness for an open, short to ground or short to voltage. If the harness tests OK, replace the K71 Transmission Control Module.

- **If within the specified range**

4. Vehicle OFF, using the **EL 35616** terminal test kit, connect the **EL 38522** variable signal generator red lead to the Output Shaft Speed Sensor signal circuit terminal 2 on the Automatic Transmission Wiring Harness.
5. Connect the black lead from the **EL 38522** variable signal generator to ground.
6. Set the **EL 38522** variable signal generator to 8 volts, the frequency to 120 Hz and the percent duty cycle to 50 or the normal position.
7. Vehicle in Service Mode, verify with a scan tool the Output Shaft Speed Sensor parameter is between 375-400 RPM.
 - **If not within the specified range**

Replace the K71 Transmission Control Module.
 - **If within the specified range**
8. Test the Automatic Transmission Wiring Harness for an open, short to ground or short to voltage.
 - **If the Automatic Transmission Wiring Harness is shorted or open**

Replace the Automatic Transmission Wiring Harness.
 - **If all circuits test normal**
9. Test or replace the B14A Transmission Output Shaft Speed Sensor.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Automatic Transmission Control Wiring Harness Replacement** for Automatic Transmission Control Wiring Harness Replacement.
- **Automatic Transmission Output Speed Sensor Replacement** for B14A Transmission Output Shaft Speed Sensor replacement.
- **Control Module References** for K71 Transmission Control Module replacement, programming and setup.

RESET TRANSMISSION ADAPTS

Reset Transmission Adapts is a procedure for automatic transmissions in which a series of tests are run to allow the transmission control module (TCM) to learn individual clutch characteristics. Once the clutch data is learned, Reset Transmission Adapts translates it into the adaptive data cells, which the TCM uses for clutch control during shifts. The scan tool provides initiation of the Reset Transmission Adapts procedure. This procedure is to be used following transmission repair.

The Reset Transmission Adapts procedure must be performed when one of the following repairs have been made to the vehicle. Failure to perform the procedure after one of the following repairs may result in poor transmission performance, as well as transmission DTCs being set:

- Transmission internal service/overhaul
- Valve body repair or replacement
- Control solenoid valve assembly replacement
- TCM software/calibration update
- Any service in response to a shift quality concern

NOTE: Ensure the following conditions are met before performing the Reset Transmission Adapts procedure:

- Drive wheels are blocked
- Parking brake is applied
- Service brake is applied
- Zero percent throttle and no external engine RPM control
- Transmission fluid temperature is between 70-115°C (158-239°F)

- Transmission gear selector has been cycled from Park to Reverse 3 times in order to purge air from the clutches.

1. Use the scan tool to perform the Reset Transmission Adapts procedure. As the procedure is being performed, the scan tool data display will provide operator instructions. Follow the scan tool instructions as required.

NOTE: If at any time during the procedure, required conditions are not met, Reset Transmission Adapts may abort and the process may need to be started again from the beginning. If this occurs, the transmission will be left in a neutral state until the controller is shut down, vehicle OFF and remove the scan tool and wait for more than 30 seconds prior to re-try procedure. If the procedure repeatedly fails, a limit that engineering set is being exceeded and there is possibly a transmission hardware issue.

2. Once the procedure is complete, vehicle OFF and power down the TCM. You will lose communication to the scan tool.

Ensure you exit back to the main screen in the scan tool, shut the scan tool OFF and unplug it from the DLC or the TCM may not shut down leaving the vehicle in a neutral state.

3. Vehicle ON. This will complete the Reset Transmission Adapts procedure.

NOTE: When the Reset Transmission Adapts procedure is completed, the transmission will remain in a neutral state until the controller shuts down. If after 1-2 minutes of sitting, with the vehicle OFF and scan tool removed, the vehicle remains in a neutral state, disconnect the battery and wait 5-10 minutes and then connect the battery. Reverse and drive should return.

4. Perform the [Road Test](#).

Troubleshooting

If the Reset Transmission Adapts will not run and the above stated conditions have been met, ensure the following:

- Transmission Fluid Temperature parameter is between 40-60°C (104-140°F).
- Brakes and brake switch are functioning properly.
- No active DTCs.
- Park/Neutral position switch is properly adjusted and functioning.
- Line pressure control is able to provide 1000 kPa and is within specifications.
- Vehicle is not moving or vibrating excessively.
- Clutches are properly assembled.

CONTROL VALVE BODY DIAGNOSTIC INSPECTION

The purpose of this inspection procedure is to determine if the control valve body assembly is the cause of a transmission DTC or symptom concern. The table will assist you in identifying which component within the control valve body is associated with a particular DTC or symptom. The components within the control valve body are not serviced separately.

Component Testing

1. Remove the control valve body assembly. Refer to [Control Valve Replacement](#).

WARNING: Valve springs can be tightly compressed. Use care when removing retainers and plugs. Personal injury could result.

CAUTION: After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure.

CAUTION: Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component.

2. Clean and inspect all control valve body assembly components for the following conditions listed below:

- Stuck or scored control valve
- Scored or damaged control valve body bore
- Broken, weak or damaged control valve return spring
- Missing, damaged or stuck check ball
- Missing, restricted or out of position modulated fluid pressure orifice
- Missing or damaged control valve retainer
- Debris or sediment

- **If a condition is found and cannot be repaired by cleaning**

Replace the control valve body assembly.

- **If a condition is not found**

3. All OK

Control Valve Upper Body Assembly

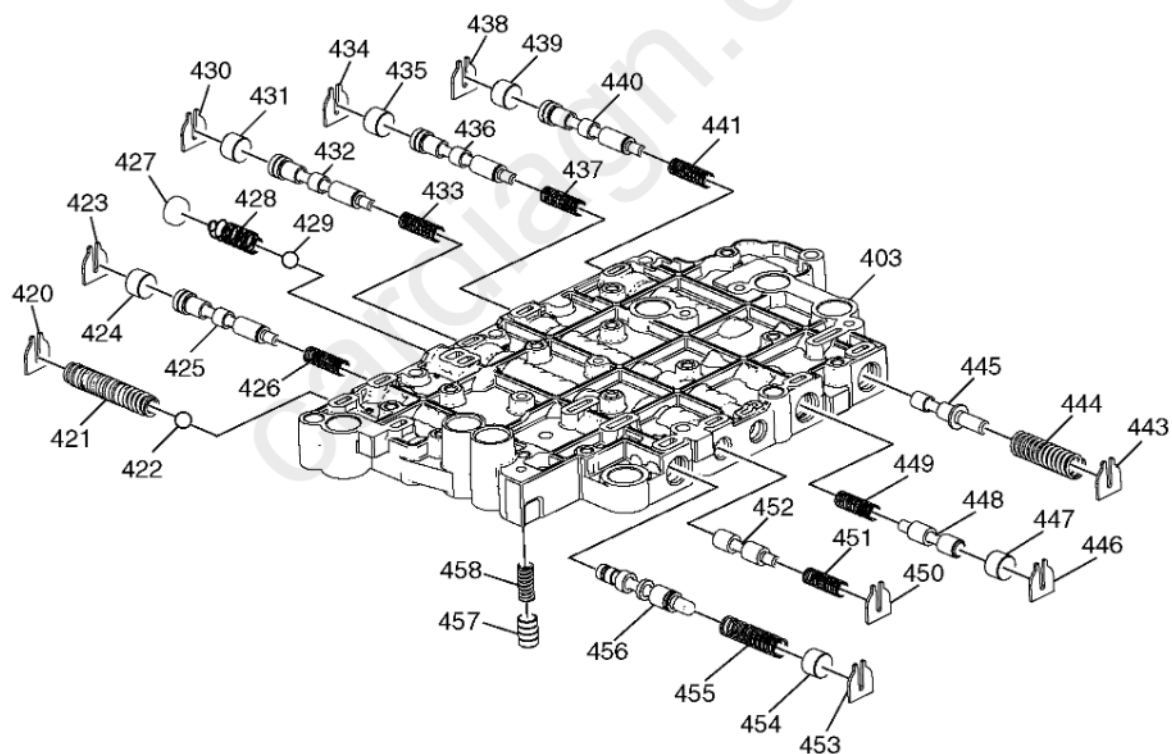


Fig. 1: Control Valve Upper Body Assembly
Courtesy of GENERAL MOTORS COMPANY

Control Valve Body Diagnostic Inspection

Callout	Component Name	DTC/Symptom Associated with Component
422	Pressure Relief Ball Valve	High or low line pressure, P079A, P079B, P079C, P079D, P079E, P179A, P179B, P179C, P179D, P179E, P17A0
425	Variable 1-4 and 1-3 Clutch Valve	P079A, P07A3, P179C

Callout	Component Name	DTC/Symptom Associated with Component
429	Pressure Relief Ball Valve	High or low line pressure
432	Variable 2-3 and 1-2-3 Clutch Valve	P079D, P07A9, P179F
436	Variable 3-4 and 2-3 Clutch Valve	P079B, P07A5, P179D
440	Variable 1-2 and 1-2 Clutch Valve	P079A, P07A3, P179C
445	Actuator Feed Limit Valve	Harsh Shifts
448	Variable 1-2-3-4 Clutch Valve	P079E, P07AB, P17A0
452	Stator Valve	Drive Motor Over Temperature
456	Pressure Regulator Valve	High or low line pressure

TRANSMISSION FLUID LEVEL AND CONDITION CHECK

This procedure checks both the transmission fluid level, as well as the condition of the fluid itself. Since the transmission on this vehicle is not equipped with a fill tube and dipstick, the transmission fluid filler plug in the case is used to set the fluid level.

WARNING: The transmission fluid level must be checked when the transmission fluid temperature (TFT) is between 35-45Â°C (95-113Â°F). If the TFT is not within this range, either idle or brake torque the vehicle to raise the fluid temperature or shut off the vehicle to allow the fluid to cool as required. Setting the fluid level with a TFT outside this range will result in either an under or over-filled transmission. TFT>45Â°C=under-filled, TFT<35Â°C=over-filled. An under-filled transmission will cause premature component wear or damage. An over-filled transmission will cause fluid to discharge out the vent tube, possibly causing a fire that may result in serious bodily injury or severe vehicle damage, fluid foaming or pump cavitation.

NOTE: The transmission fluid level should be checked only after the TFT has reached or exceeded an operating temperature of 90Â°C (194Â°F). Once the TFT has reached or exceeded 90Â°C (194Â°F), then turn OFF the vehicle and allow the TFT to cool back down to 35-45Â°C (95-113Â°F) before checking the fluid level as required. Reaching or exceeding an operating temperature of 90Â°C (194Â°F) opens the bypass valve and allows the cooler to fill up with fluid, which will result in a more accurate fluid level check.

1. Observe the TFT using the driver information center (DIC) or a scan tool.
2. Propulsion System Active, vehicle parked on a level surface with unnecessary electrical loads turned off.
3. Maintain condition for a minimum of 5 minutes with TFT between 35-45Â°C (95-113Â°F).
4. Open the hood to turn off the engine. The automatic transmission fluid pump will remain running.
5. Raise the vehicle on a hoist. The vehicle must be level, with the hood open and the shift lever in the PARK range.
6. Clean around the transmission fluid filler plug (1).

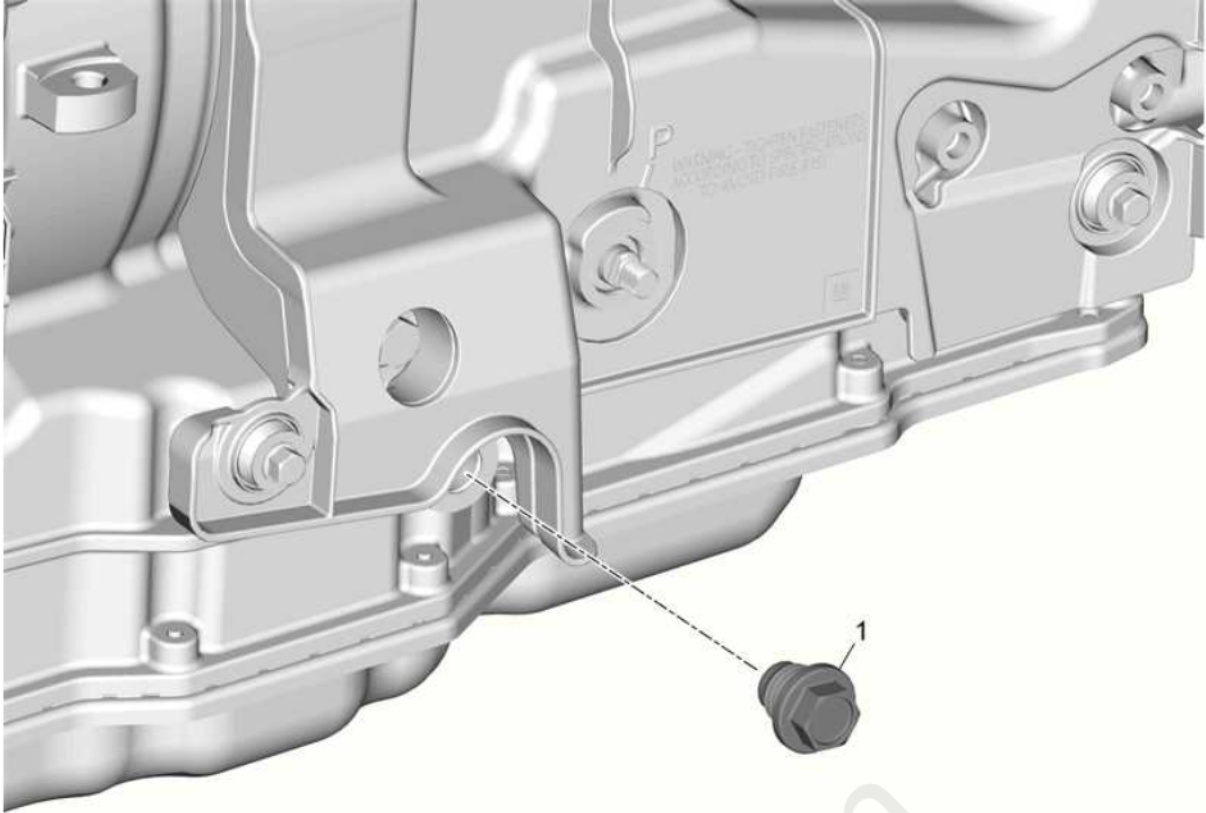


Fig. 2: Transmission Fluid Filler Plug

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The automatic transmission fluid pump **MUST BE RUNNING** when the transmission fluid filler plug is removed or excessive fluid loss will occur, resulting in an under-filled condition. An under-filled transmission will cause premature component wear or damage.

NOTE: Continue to monitor the TFT. If the TFT is not within the specified values, reinstall the transmission fluid filler plug and repeat the previous steps.

7. Remove the transmission fluid filler plug (1) from the transmission case and discard. Allow any fluid to drain.

- If the fluid is flowing as a steady stream, wait until the fluid begins to drip.
- If no fluid comes out, add fluid until fluid drips out. Refer to [Transmission Fluid Fill Procedure](#).

8. Inspect the fluid color. The fluid should be red or dark brown.

NOTE: The transmission fluid may turn dark after mileage is accrued on the vehicle. If the transmission fluid appears dark, do not assume that the transmission is damaged internally. **DO NOT** replace the transmission, transmission cooler or perform a transmission or transmission cooler flush procedure based only on the appearance of the transmission fluid.

- If the fluid color is very dark or black and has a burnt odor, inspect the fluid and inside of the bottom pan for excessive metal particles or other debris. A small amount of "friction" material in the bottom pan is a "normal" condition. If large pieces and/or metal particles are noted in the fluid or bottom pan, flush the oil cooler and cooler lines and overhaul the transmission. If there are no signs of transmission internal damage noted, replace the fluid filter assembly, repair the oil cooler and flush the cooler lines.
- Fluid that is cloudy or milky or appears to be contaminated with water indicates engine coolant or water contamination. Refer to [Engine Coolant/Water in Transmission](#).

9. Install a NEW transmission fluid filler plug and tighten to 21 N.m (15 lb ft).

CAUTION: Refer to [Fastener Caution](#) .

10. Inspect for external leaks. Refer to [Fluid Leak Diagnosis](#).

TRANSMISSION FLUID FILL PROCEDURE

Special Tools

- DT-45096 Transmission Oil Cooling System Flush and Flow Test Tool
- DT-45096-40 Transflow Oil Fill Adapter

For equivalent regional tools, refer to [Special Tools](#) .

CAUTION: Use Dexron® HP transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

CAUTION: Check the transmission fluid level immediately after adding fluid and before vehicle operation. Do not overfill the transmission. An overfilled transmission may result in foaming or fluid to be expelled out the vent tube when the vehicle is operated. Overfilling will result in possible damage to the transmission.

Check the transmission fluid level, refer to [Transmission Fluid Level and Condition Check](#).

1. Ensure the transmission fluid filler plug (1) has been removed from the transmission case and no fluid is still draining from the transmission fluid filler plug port.

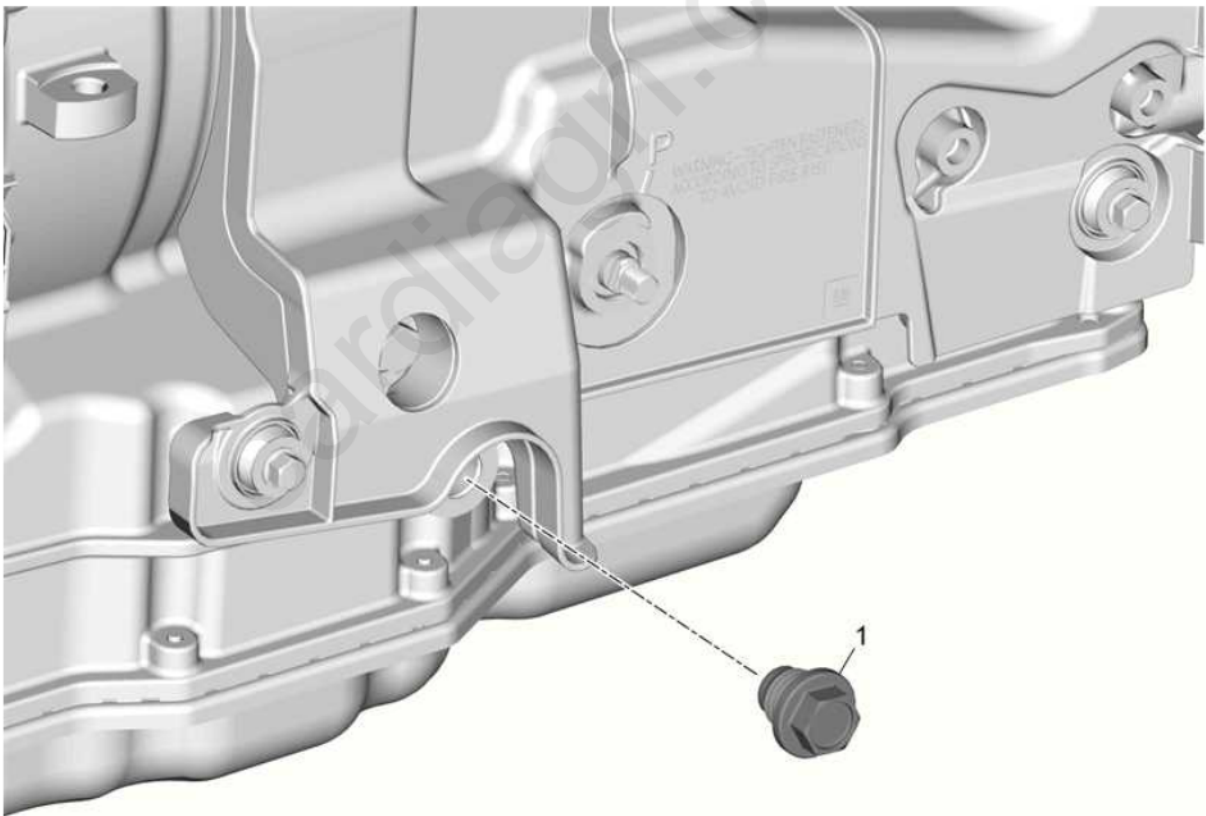


Fig. 3: Transmission Fluid Filler Plug

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Use Dexron® HP transmission fluid only. Failure to use the proper fluid may result in transmission internal damage.

NOTE: Ensure the area around the transmission fluid filler plug is clean.

2. Determine the approximate amount of fluid needed to fill the transmission, based on the repair performed. Refer to [Approximate Fluid Capacities](#) . To avoid an under-fill condition, slightly

overfill the transmission and then allow the extra fluid to drain out through the transmission fluid filler plug port.

- Using the **DT-45096-40** transflow oil fill adapter (1) and the **DT-45096** flush and flow test tool (2) or a suitable hand pump, add transmission fluid through the transmission filler plug opening. Refer to [Transmission Fluid Cooler Flow Test and Flushing \(4EL70\)](#) for complete **DT-45096** flush and flow test tool operating instructions. Use the FLOW position on the main function switch to pump the fluid.

NOTE: The **DT-45096** flush and flow test tool is being utilized as a convenient method to pump the fluid into the bottom pan. A suitable hand pump may also be used instead. When using the **DT-45096** flush and flow test tool, monitor the display panel to determine the amount of fluid being pumped from the tool supply tank into the transmission.

- Check the fluid level and complete the fluid level and condition check procedure. Refer to [Transmission Fluid Level and Condition Check](#).

CAUTION: Check the transmission fluid level immediately after adding fluid and before vehicle operation. Do not overfill the transmission. An overfilled transmission may result in foaming or fluid to be expelled out the vent tube when the vehicle is operated. Overfilling will result in possible damage to the transmission.

ROAD TEST

NOTE: The Road Test Procedure should be performed only as part of the Symptom Diagnosis. Refer to [Symptoms - Automatic Transmission](#).

The following test provides a method of evaluating the condition of the automatic transmission. The test is divided into the following parts:

- Low Voltage Electrical Function Check
- Hydraulic Control Function Check
- High Voltage Electric Machine Control Function Check

NOTE: Complete the test in the sequence given.

Before the road test, ensure the following:

- The engine is performing properly.
- Transmission fluid level is correct. Refer to [Transmission Fluid Level and Condition Check](#).
- Tire pressure is correct.
- The high voltage battery is above 30% state of charge.

During the road test:

- Perform the test only when traffic conditions permit.
- Operate the vehicle in a controlled, safe manner.
- Observe all traffic regulations.
- To view the scan tool data while conducting this test, take along qualified help in order to operate the vehicle safely or review the data after the drive audit.
- Observe any unusual sounds or smells.

After the road test, check the following:

- Inspect for proper transmission fluid level. Refer to [Transmission Fluid Level and Condition Check](#).

- Inspect for any diagnostic trouble codes (DTCs) that may have set during the testing. Refer to the applicable DTC.
- Monitor the scan tool data for any abnormal readings or data.
- Inspect for fluid leaks. Refer to [Fluid Leak Diagnosis](#).

Low Voltage Electrical Function Check

Perform this procedure first in order to ensure the electronic transmission components are 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 vehicle. To ensure the engine starts, open the hood. Depress the accelerator pedal to 100% for 5 seconds with the hood open.
4. With a scan tool, monitor the transmission data parameters and compare them to typical scan tool data definitions.

Refer to [Hybrid Powertrain Control Module Scan Tool Information](#) for typical data values. Data that is questionable may indicate a concern.

5. Monitor transmission range on the scan tool data list.
 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.
6. Check accelerator position sensor input.
 1. Apply the brake pedal and ensure the parking brake is set while monitoring accelerator pedal data.
 2. Ensure the gear selector is in PARK.
 3. Monitor the scan tool Accelerator Pedal Position while increasing and decreasing engine speed with the accelerator pedal. The scan tool Accelerator Pedal Position percentage 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.

Hydraulic and Electric Machine Control Function Checks

Charge vehicle to greater than 25% state of charge to enter EV only mode, if not already done. Perform the following steps while monitoring data:

1. Drive vehicle at 35 mph (57 km/h) at steady state.
2. Accelerate safely with 100% accelerator pedal to 55 mph (89 km/h), then drive at or above 55 mph (89 km/h).
3. Monitor for any excessive clutch slip speed during acceleration.
4. Slow vehicle by shifting to LOW or engage regenerative braking.
5. Drive vehicle below 35 mph (57 km/h) with stop-and-go city driving.
 1. The engine will stop and start as needed.
 2. Ensure smooth operation free of excessive vibrations.
6. Accelerate safely with 100% accelerator pedal to 55 mph (89 km/h), then drive at or above 55 mph (89 km/h).
 1. Monitor for any excessive clutch slip speed during acceleration.
 2. Monitor for any excessive clutch slip during 55 mph (89 km/h) steady state driving.
7. Slow vehicle by shifting to LOW or engage regenerative braking.
8. Ensure smooth deceleration as clutches engage and disengage at lower vehicle speeds.

Reverse

Perform the following test safely:

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.
4. This test ensures the control system is properly applying torque in the reverse direction.

This procedure checks general functionality of the transmission. For diagnosing intermittent problems, try to duplicate the conditions of the original complaint. Refer to freeze frame records if a DTC set to determine the conditions.

CLUTCH PLATE DIAGNOSIS

Composition Plates

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

- Pitting
- Flaking
- Delamination - splitting or separation of bonded clutch material
- Wear
- Glazing
- Cracking
- Charring
- Chips or metal particles embedded in the lining

Replace a composition plate which shows any of these conditions.

Steel Plates

Wipe the plates dry and check the plates for heat discoloration. If the surfaces are smooth, even if color smear is indicated, you can reuse the plate. If the plate is discolored with heat spots or if the surface is scuffed, replace the plate.

Causes of Burned Clutch Plates

The following conditions can result in a burned clutch plate:

- Incorrect usage of clutch or apply plates
- Engine coolant or water in the transmission fluid
- A cracked clutch piston
- Damaged or missing seals
- Low line pressure
- Valve body conditions
 - The valve body face is not flat.
 - Porosity is between channels.
 - The valve bushing clips are improperly installed.
 - The checkballs are misplaced.
- The Teflon® seal rings are worn or damaged.

ENGINE COOLANT/WATER IN TRANSMISSION

CAUTION: The antifreeze or water will deteriorate the seals, gaskets and the glue that bonds the clutch material to the pressure plate. Both conditions may cause damage to the transmission.

If antifreeze or water has entered the transmission, perform the following:

1. Disassemble the transmission.
2. Replace all of the rubber type seals. The coolant will attack the seal material which will cause leakage.
3. Replace the composition-faced clutch plate assemblies. The facing material may separate from the steel center portion.
4. Replace all of the nylon parts - washers.
5. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
6. Replace the transmission fluid cooler thermal bypass valve. Refer to [Transmission Fluid Cooler Thermal Bypass Valve Replacement](#).
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

LINE PRESSURE CHECK

Special Tools

GE-21867-A Pressure Gauge

For equivalent regional tools refer to [Special Tools](#)

Main Line Pressure Check

1. Install a scan tool.

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

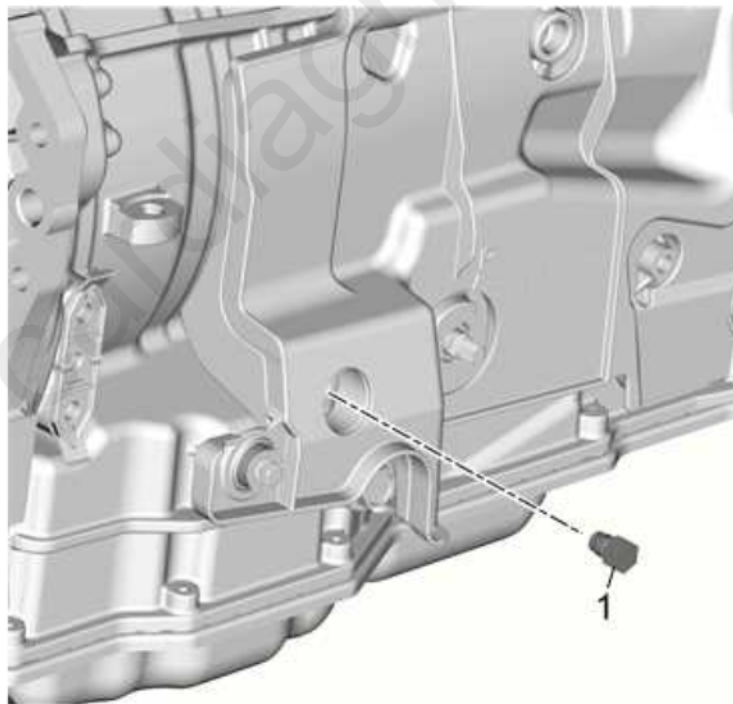


Fig. 4: Automatic Transmission Fluid Pressure Test Hole Plug
Courtesy of GENERAL MOTORS COMPANY

2. Start the vehicle.

NOTE: Depending on the hybrid/EV battery state of charge the engine may not start.

3. Inspect the transmission for the proper fluid level. Refer to [Transmission Fluid Level and Condition Check](#).
4. Inspect the manual linkage at the transmission for proper function.

5. Turn the vehicle OFF.

6. Remove the automatic transmission fluid pressure test hole plug (1).

WARNING: While the transmission is at operating temperatures, always wear protective gloves when removing the automatic transmission fluid pressure test hole plug. This precaution will help prevent getting burned by the catalytic converter which is in very close proximity to the test hole plug.

NOTE: You may need to remove or disconnect components in order to gain access to the fluid pressure test hole plug.

7. Install the **GE-21867-A** pressure gauge.

8. Access the Scan Tool Transmission Control Module Control Function for Line Pressure Control Solenoid Valve.

9. Vehicle ON.

NOTE: The engine does not need to be running and depending on state of charge, may not start with vehicle on.

10. Use the scan tool to increase and decrease the Line Pressure in increments of approximately 100 KPa (15 psi). The scan tool commands the increment values automatically.

NOTE: In order to achieve accurate line pressure readings, the following procedure must be performed at least 3 times in order to gather uniform pressure readings.

The scan tool is only able to control the line Pressure Control solenoid in PARK and NEUTRAL with engine speeds below 1500 RPM. This protects the clutches from extreme high or low line pressures.

11. Allow the pressure to stabilize between increments.

12. Compare your pressure readings on the scan tool to those indicated on the **GE-21867-A** pressure gauge.

13. If the pressure readings vary greatly, refer to [Automatic Transmission Fluid Pump Pressure High or Low](#)

14. Install the automatic transmission fluid pressure test hole plug. Tighten the pressure plug to 10.5 N.m (93 lb in).

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.

2. Using instructions from the manufacturer, mix a sufficient amount of an epoxy to make the repair.

WARNING: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.

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.

BUSHING AND MATING SHAFT INSPECTION

NOTE:

Proper bushing and corresponding mating shaft inspection should be performed before replacing the bushing, shaft and in some cases, the component which houses the bushing. Thoroughly clean and dry the bushing and shaft surfaces before inspecting for damage.

Any of the following bushing conditions require replacement of the bushing and/or housing:

- Discoloration due to heat distress
- Misalignment or displacement of bushing as a result of spinning in housing
- Medium to heavy scoring that can be easily detected with fingernail. Light scoring is a normal condition.
- Debris embedded into the bushing lining material
- Obvious damage, including excessive and uneven wear
- Excessive polishing. Minor polishing of the bushing is an indication of normal wear and does not require replacement.

Any of the following conditions require replacement of the bushing's mating shaft:

- Discoloration due to heat distress
- Rough surface finish that can be easily detected with finger
- Obvious shaft abnormalities, including warping or uneven surfaces
- Obvious damage or cracking

AUTOMATIC TRANSMISSION FLUID PUMP PRESSURE HIGH OR LOW

Checks	Causes
Automatic Transmission Fluid Pump Motor	• Faulty fluid pump motor assembly • Faulty fluid pump motor wiring • Low fluid level • Inspect for leaking or damaged fluid pump outlet seal and fluid filter seal • Inspect for improperly installed or damaged fluid filter
Control Valve Assembly	• Inspect for leaking or damaged control solenoid valve seals • Inoperable control solenoid valve • Inspect for damaged control solenoid electrical connector or wiring • Inspect for leaking or damaged control valve body spacer plate • Inspect for damaged or stuck open pressure relief ball valve • Inspect for a sticky or stuck line pressure regulator valve • Inspect for other sticky or stuck valves within the control valve body • Inspect for leaking or damaged valve body manifold • Inspect for other leak paths within the line pressure hydraulic circuit or control valve solenoid hydraulic circuitry

AUTOMATIC TRANSMISSION FLUID LEAKS

--

Checks	Causes
Torque Dampener Housing Assembly	• Inspect for damage • Inspect for damaged Input Shaft Seal • Inspect for porosity
Case Assembly and Extension Housing	• Inspect for porosity or damage on the sealing surfaces • Inspect for loose oil cooler line bolts or damaged oil cooler line seals • Inspect for damaged manual shift shaft seal • Inspect for damaged or worn propeller shaft oil seal on the output shaft flange • Inspect for loose fluid pressure test hole plug and transmission fluid filler plugs • Inspect for damaged wiring harness sealing rings
Automatic Transmission Fluid Pan	• Inspect for damaged or warped fluid pan • Inspect for loose fluid pan bolts

FLUID LEAK DIAGNOSIS

General Method

1. Verify that the leak is transmission fluid.
2. Thoroughly clean the suspected leak area using a rag.

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

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 using a rag.

CAUTION: Do not clean using brake cleaner or other reactive solvents as these solvents can damage rubber gaskets, seals and bushings.

2. Apply an aerosol type leak tracing 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. Operate the vehicle for 24 km (15 mi) or until normal operating temperatures are reached.

3. Detect the leak with the black light.

4. Make the necessary repairs.

Find the Cause of the Leak

Pinpoint the leak and trace the leak back to the source. You must determine the cause of the leak in order to repair the leak properly. For example, if you replace a gasket, but the sealing flange is bent, the new gasket will not repair the leak. You must also repair the bent flange. Before you attempt to repair a leak, check for the following conditions and make repairs as necessary:

Gaskets

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Improperly tightened fasteners
- Dirty or damaged threads
- Warped flanges or sealing surface
- Scratches, burrs or other damage to the sealing surface
- Damaged or worn gasket
- Cracking or porosity of the component
- Improper sealant used, where applicable
- Incorrect gasket

Seals

- Fluid level/pressure is too high
- Plugged vent or drain-back holes
- Damaged seal bore
- Damaged or worn seal
- Improper installation
- Cracks in component
- Manual shaft or output shaft surface is scratched, nicked or damaged
- Loose or worn bearing causing excess seal wear

Possible Points of Fluid Leaks

Control Valve Body Cover

- Incorrectly tightened bolts
- Improperly installed or damaged gasket/seal
- Damaged mounting face
- Incorrect gasket seal

Case Leak

- Damaged manual shift shaft seal
- Loose or damaged oil cooler lines/seals
- Worn or damaged drive shaft oil seal
- Loose line pressure plug or fluid level hole plug
- Porous casting
- Warped torque dampener and differential housing
- Damaged torque dampener and differential housing gasket

Torque Dampener and Differential Housing

- Damaged torque dampener and differential housing gasket.
- Worn or damaged drive shaft oil seal

- Porous casting of the torque dampener and differential housing

Leak at the Vent

- Overfilled system
- Water or coolant in the fluid; The fluid will appear milky
- Transmission case porous
- Incorrect fluid level indicator causing an overfilled system
- Plugged vent

WHINE/GROWL NOISE THAT CHANGES WITH VEHICLE SPEED

Checks	Causes
Propeller Shaft Flange (18) to Output Shaft	Inspect for loose flange nut (19).
Torque Dampener, when engine is ON.	Inspect for wear or damage.
Planetary Gear Sets (106, 122, 205)	Inspect for damaged gears and bearings.
Drive Motor - Position 1 Rotor (109) and Drive Motor - Position 2 Rotor (129)	Inspect rotor bearings for wear or damage.
Thrust Bearings	Inspect for wear or damage.
Automatic Transmission Fluid Filter (32)	• Inspect for damaged or restricted fluid filter assembly • Inspect for damaged fluid filter seal assembly or improper sealing interface - leaks, fluid aeration.

NOISE IN DRIVE OR REVERSE GEAR

Checks	Causes
Propeller Shaft Flange (18) to Output Shaft	Inspect for loose flange nut (19).
Torque Dampener, when engine is ON.	Inspect for wear or damage.
Planetary Gear Sets (106, 122, 205)	Inspect for damaged gears and bearings.
Drive Motor - Position 1 Rotor (109) and Drive Motor - Position 2 Rotor (129)	Inspect rotor bearings for wear or damage.
Thrust Bearings	Inspect for wear or damage.

VIBRATION

Checks	Causes
Propeller Shaft Flange (18) to Output Shaft	Inspect for loose flange nut (19).
Engine to Transmission Mounts and Mount Bolts	Inspect for damage or loose bolts.
Torque Dampener, when engine is ON.	Inspect for wear or damage.
Planetary Gear Sets (106, 122, 205)	Inspect for damaged gears and bearings.
Drive Motor - Position 1 Rotor (109) and Drive Motor - Position 2 Rotor (129)	Inspect rotor bearings for wear or damage.

It is necessary to monitor scan tool data to isolate which component could be contributing to noise and vibration. Components could include the engine/input shaft, drive motor - position 1, drive motor - position 2 or output shaft.

If noise only occurs when engine is OFF and vehicle is stationary, inspect the transmission fluid level and pump for proper operation.

A noise or vibration that is noticeable when the vehicle is in motion MAY NOT be the result of the transmission.

- Inspect the tires for the following conditions:
 - Uneven wear
 - Imbalance
 - Mixed sizes
 - Mixed tread types
 - Inspect the suspension components for the following conditions:
 - Alignment wear or damage
 - Loose fasteners
 - Driveline damage or wear
 - Inspect the engine and transmission mounts for damage and loose bolts.
 - Inspect the propeller shaft center carrier bearing for damage and loose bolts.
 - Inspect the transmission case mounting holes for the following conditions:
 - Missing bolts, nuts and studs
 - Stripped threads
 - Cracks
 - Inspect the flywheel for the following conditions:
 - Missing or loose bolts
 - Cracks
 - Imbalance
 - Inspect the input drive flange for the following conditions:
 - Missing or loose bolts or lugs
 - Missing or loose balance weights
 - Imbalance caused by heat distortion or fluid contamination
-

2017 TRANSMISSION

(Automatic Transmission - 4EL70 (MRD) - Repair Instructions - Off Vehicle

REPAIR INSTRUCTIONS - OFF VEHICLE

TRANSMISSION HOUSING SOUND INSULATOR REMOVAL

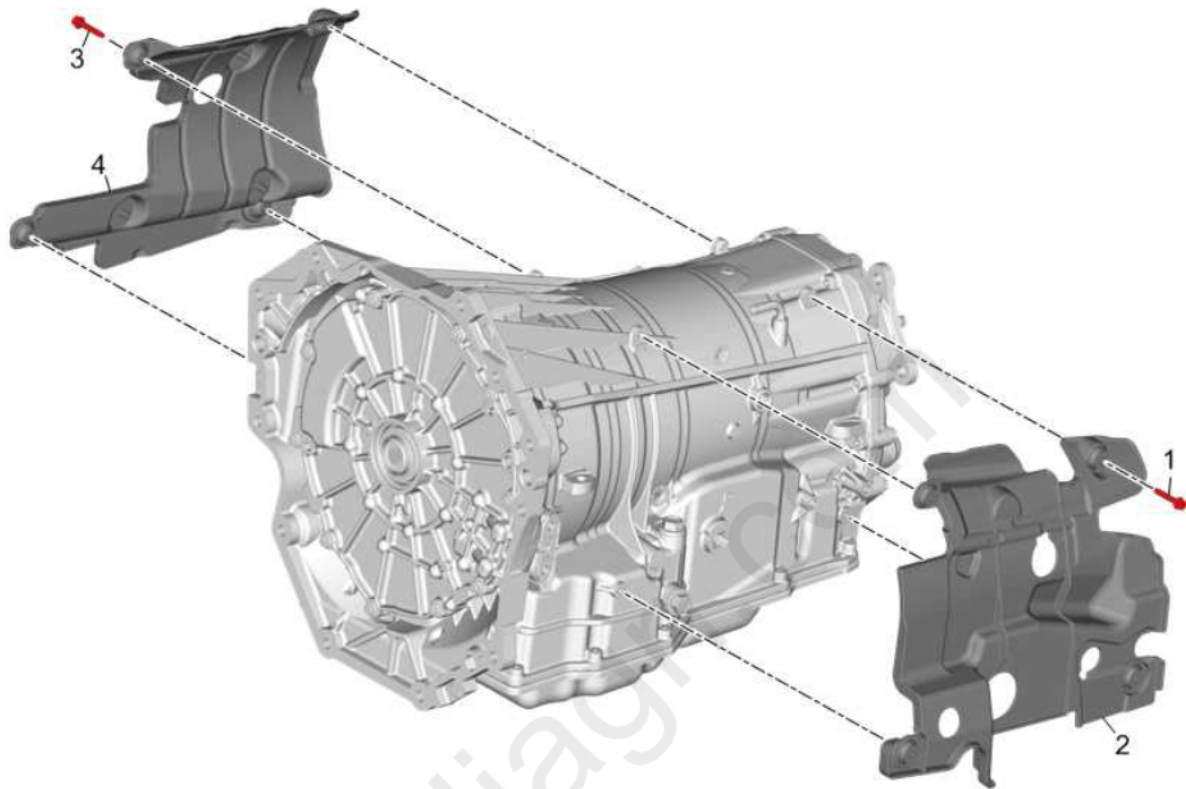


Fig. 1: Transmission Housing Sound Insulator
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Bolt [4x]
2	Transmission Housing Sound Insulator
3	Automatic Transmission Case Bolt [4x]
4	Transmission Housing Sound Insulator

HOLDING FIXTURE INSTALLATION

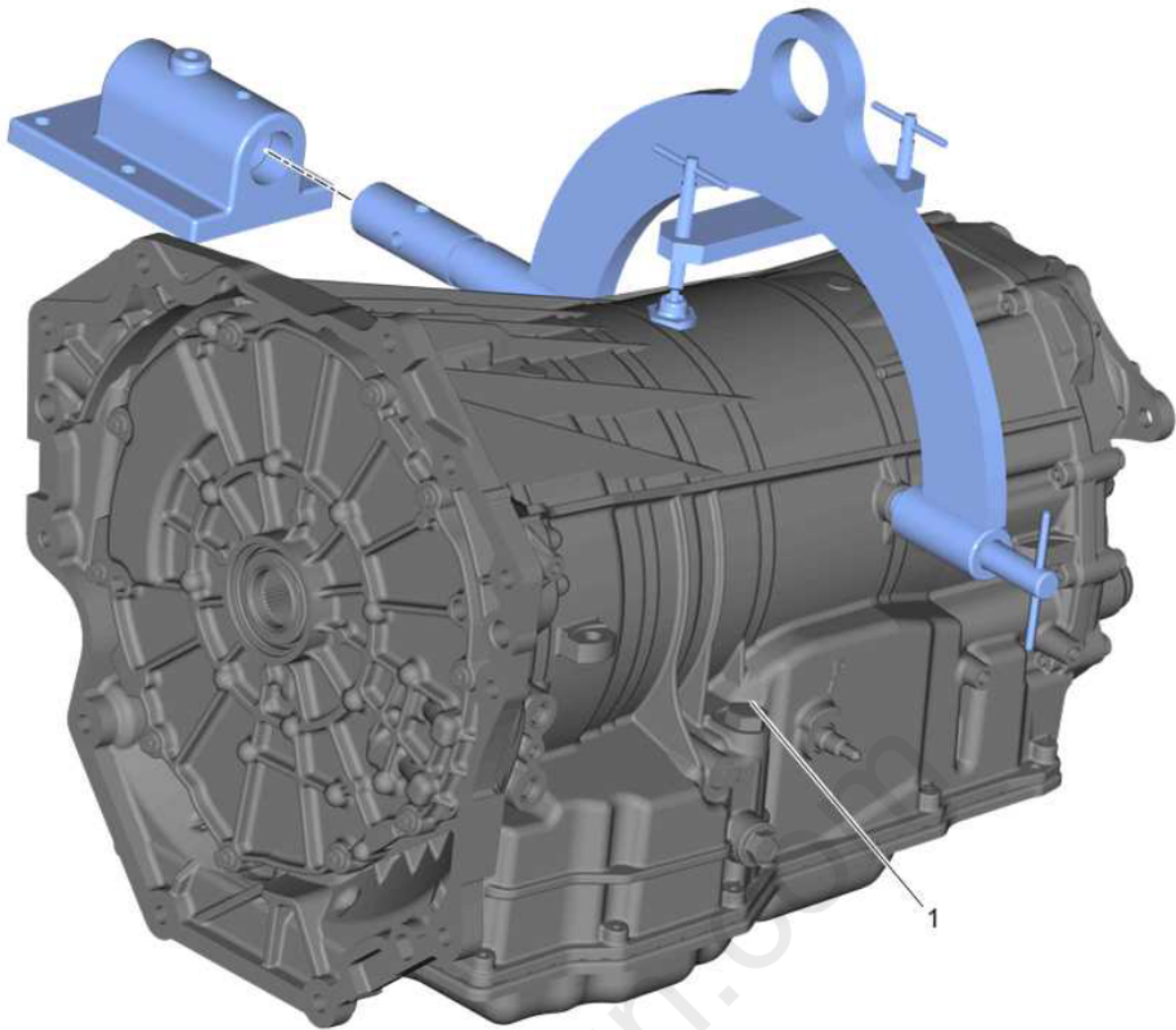


Fig. 2: Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case WARNING: Handle with care, the transmission assembly weighs over 83 Kg (183 lbs). Bodily injury could occur if not handled properly. Procedure 1. Install the fixture to the transmission case securely. 2. Install the transmission case and fixture to the holding fixture base and secure with pin. Special Tools • DT-03289-20 Holding Fixture Base Assembly • DT-48989 Holding Fixture Equivalent regional tools: Special Tools

TRANSMISSION FLUID PAN AND FILTER ASSEMBLY REMOVAL

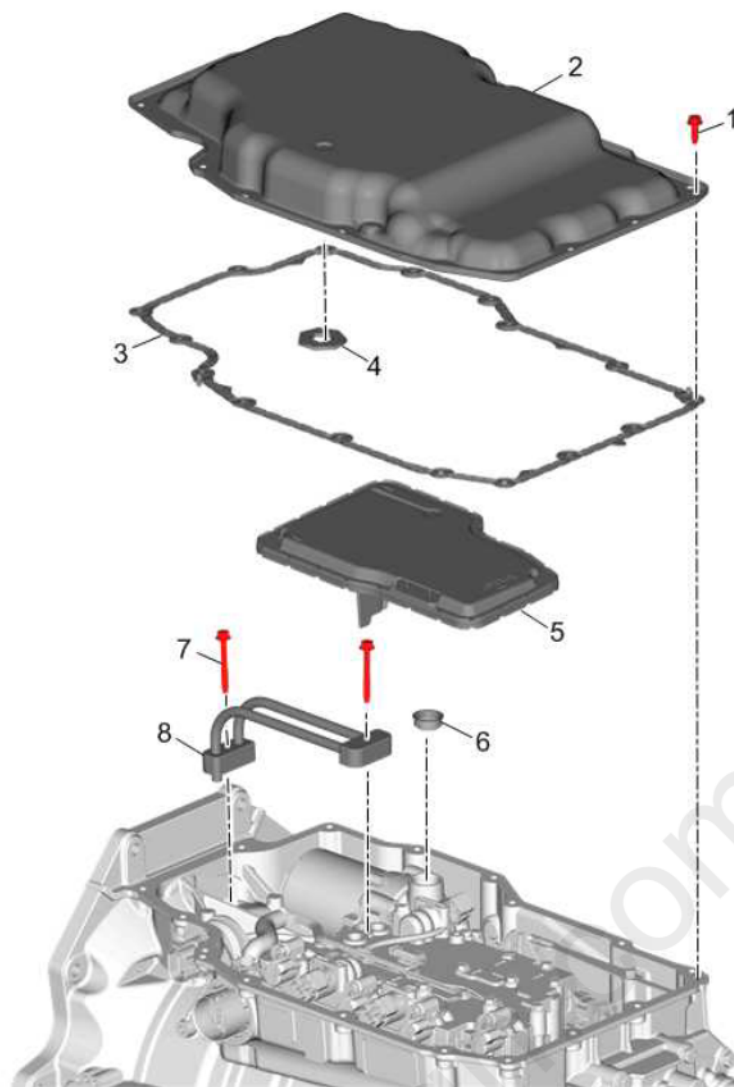


Fig. 3: Transmission Fluid Pan and Filter Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pan Bolt [16x]
2	Automatic Transmission Fluid Pan
3	Automatic Transmission Fluid Pan Gasket
4	Automatic Transmission Fluid Pan Magnet
5	Automatic Transmission Fluid Filter
6	Automatic Transmission Fluid Filter Seal
7	Valve Body Bolt [2x]
8	Control Valve Body Fluid Manifold

CONTROL VALVE ASSEMBLY REMOVAL

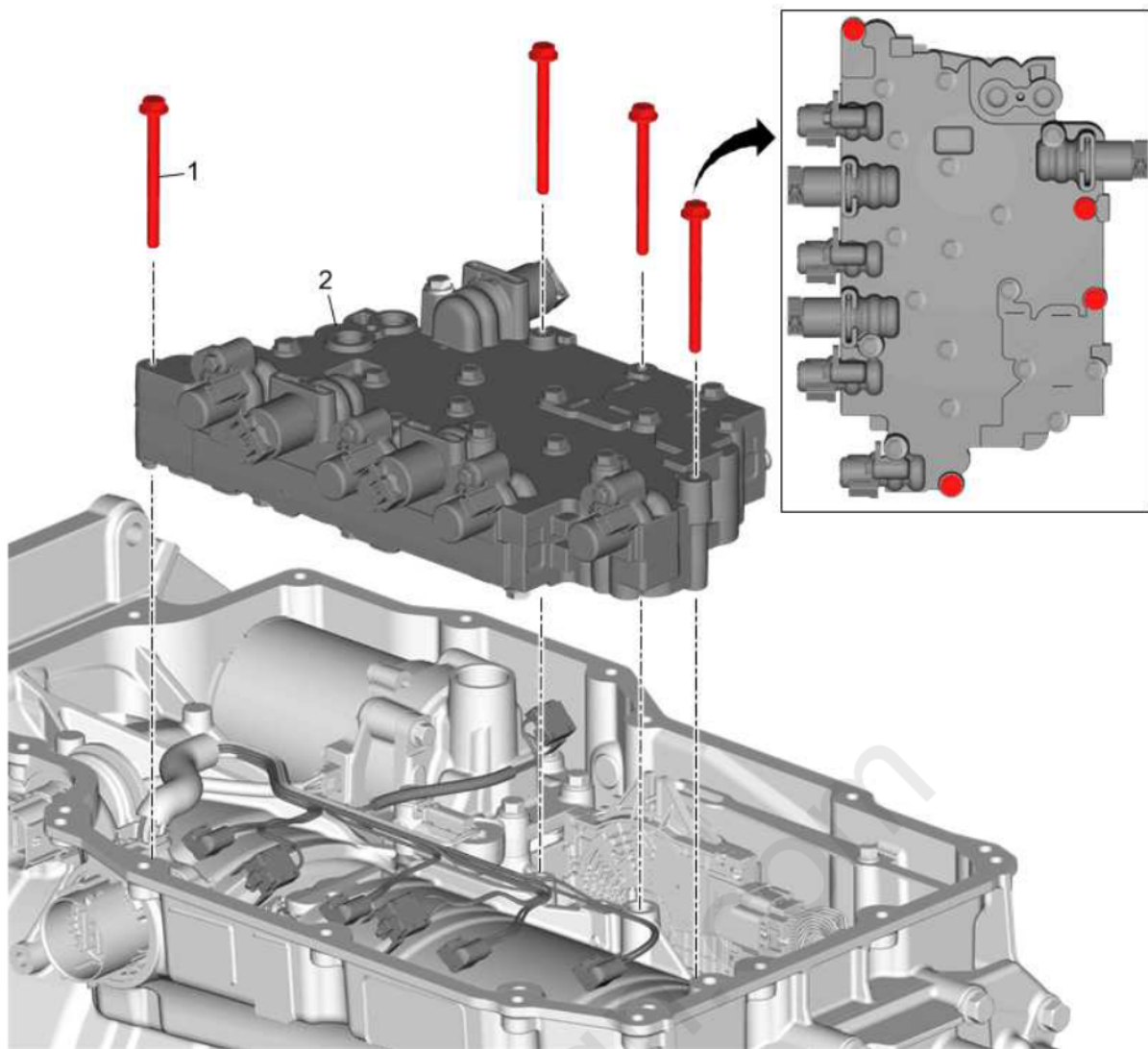


Fig. 4: Control Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Disconnect the wiring harness connectors from the control valve.	
1	Automatic Transmission Control Bolt [4x]
2	Control Valve

TRANSMISSION CONTROL WIRING HARNESS REMOVAL

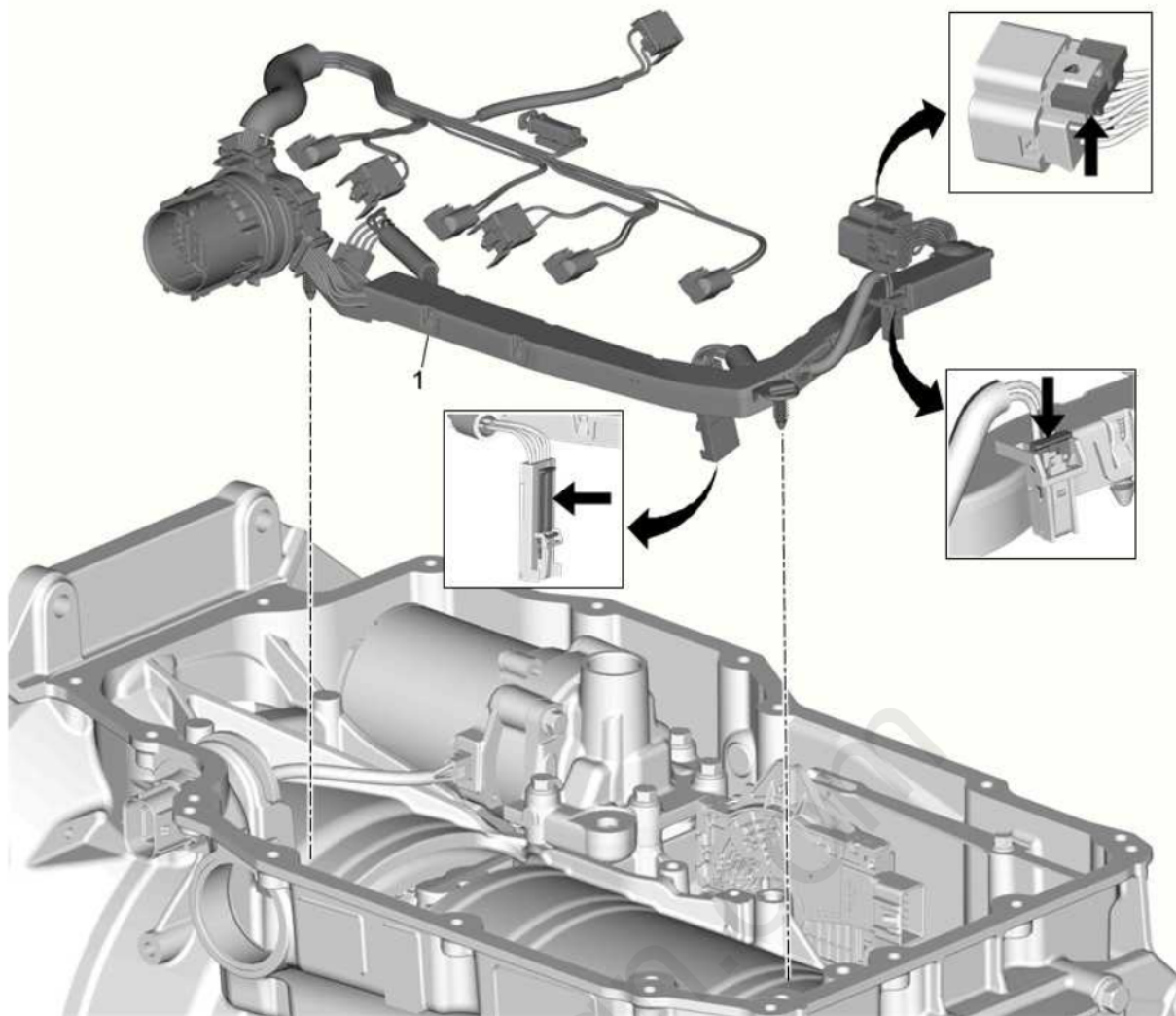


Fig. 5: Transmission Control Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure • Locate connectors on the wiring harness that have connector position assurance (CPA) tabs. Ensure the CPA tabs are disengaged before disconnecting the connector. • Remove the wiring harness only if it is being replaced.	
1	Automatic Transmission Control Wiring Harness Procedure 1. Disengage all CPA tabs. 2. Disconnect all connectors. 3. Disengage the main wiring harness connector from the transmission case. NOTE: Use care when servicing the main wiring harness connector. Depress the retainers and carefully rock the connector out of the transmission case. 4. Remove the wiring harness.

TRANSMISSION FLUID PUMP REMOVAL

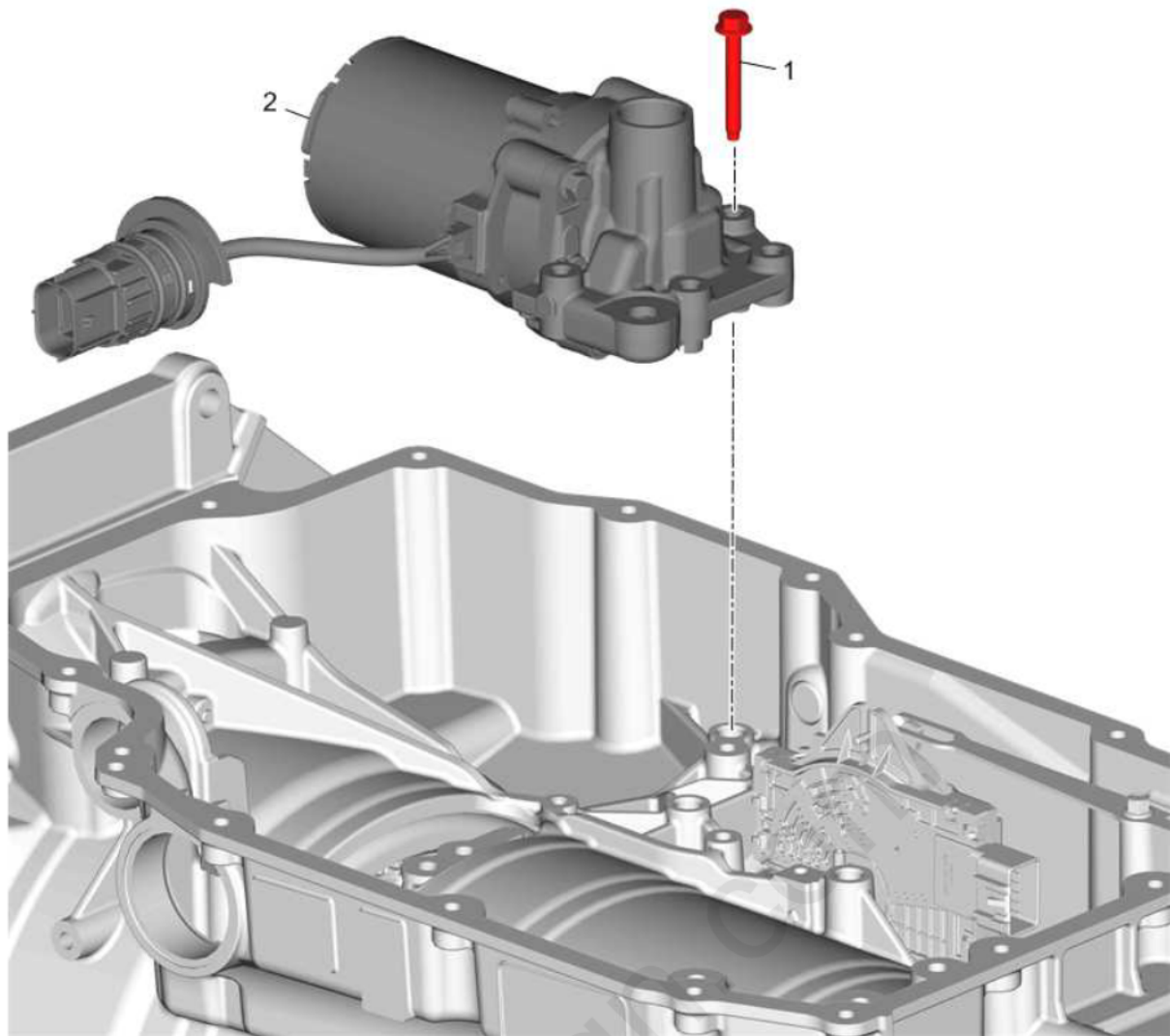


Fig. 6: Transmission Fluid Pump

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure NOTE: Use care when servicing the main wiring harness connector. Depress the retainers and carefully rock the connector out of the transmission case. Disengage the main fluid pump connector from the transmission case.	
1	Automatic Transmission Fluid Pump Bolt [4x]
2	Automatic Transmission Fluid Pump

PROPELLER SHAFT TRANSMISSION FLANGE REMOVAL

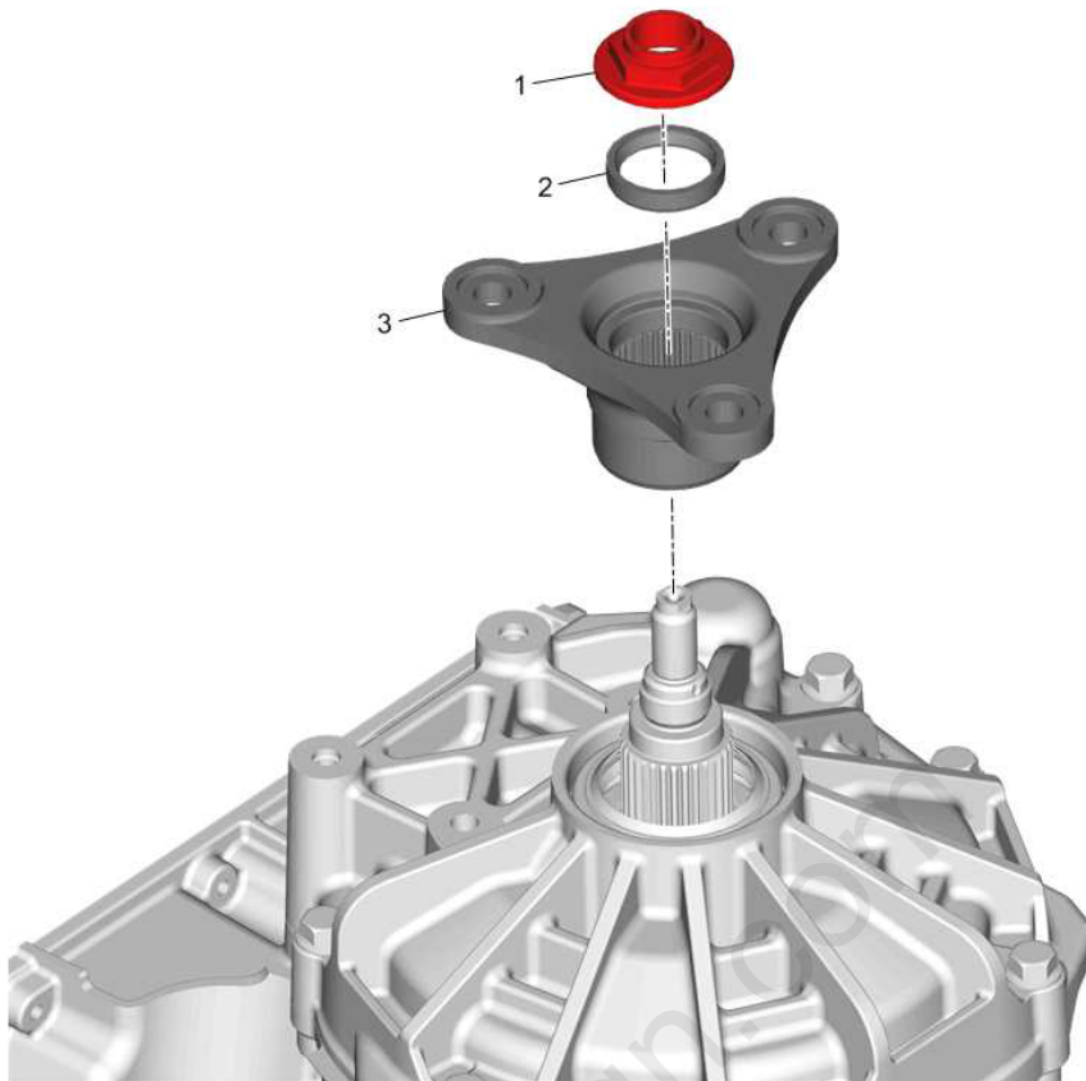


Fig. 7: Propeller Shaft Transmission Flange
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Front Propeller Shaft Flange Nut Procedure Remove and discard the nut.
2	Propeller Shaft Transmission Flange Seal Procedure When necessary, remove and discard the seal.
3	Propeller Shaft Flange

OUTPUT SPEED SENSOR REMOVAL

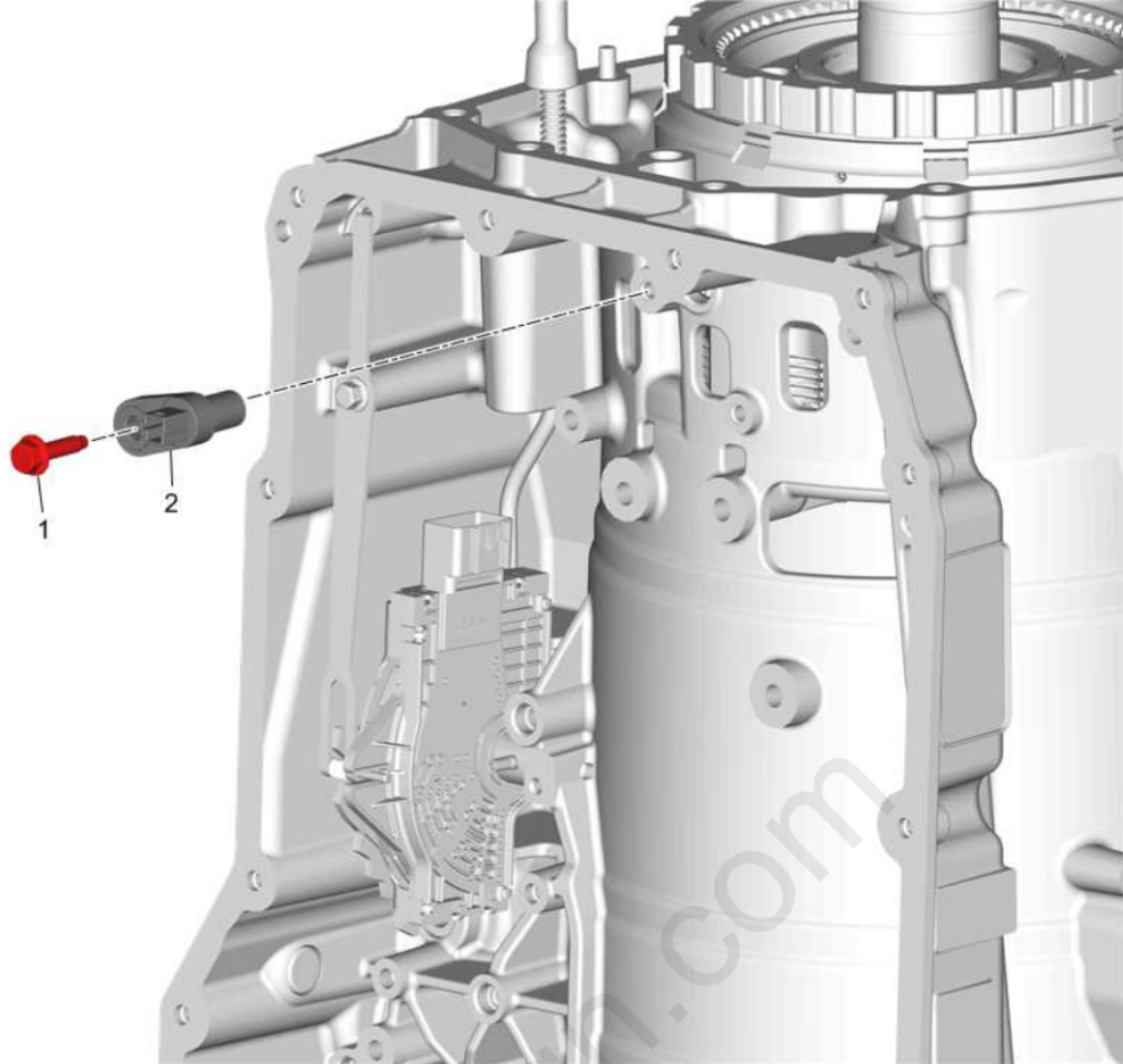


Fig. 8: Output Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Output Speed Sensor Bolt
2	Automatic Transmission Output Speed Sensor

CASE EXTENSION ASSEMBLY REMOVAL

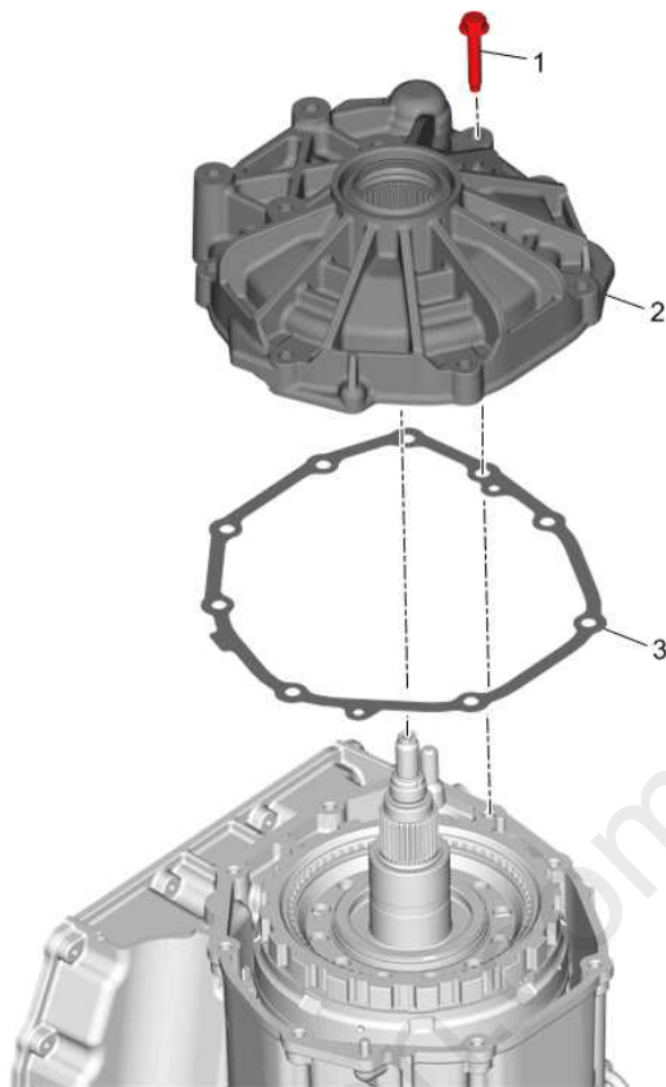


Fig. 9: Case Extension Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Extension Bolt [9x]
2	Automatic Transmission Case Extension
3	Automatic Transmission Case Extension Gasket

OUTPUT SHAFT REMOVAL

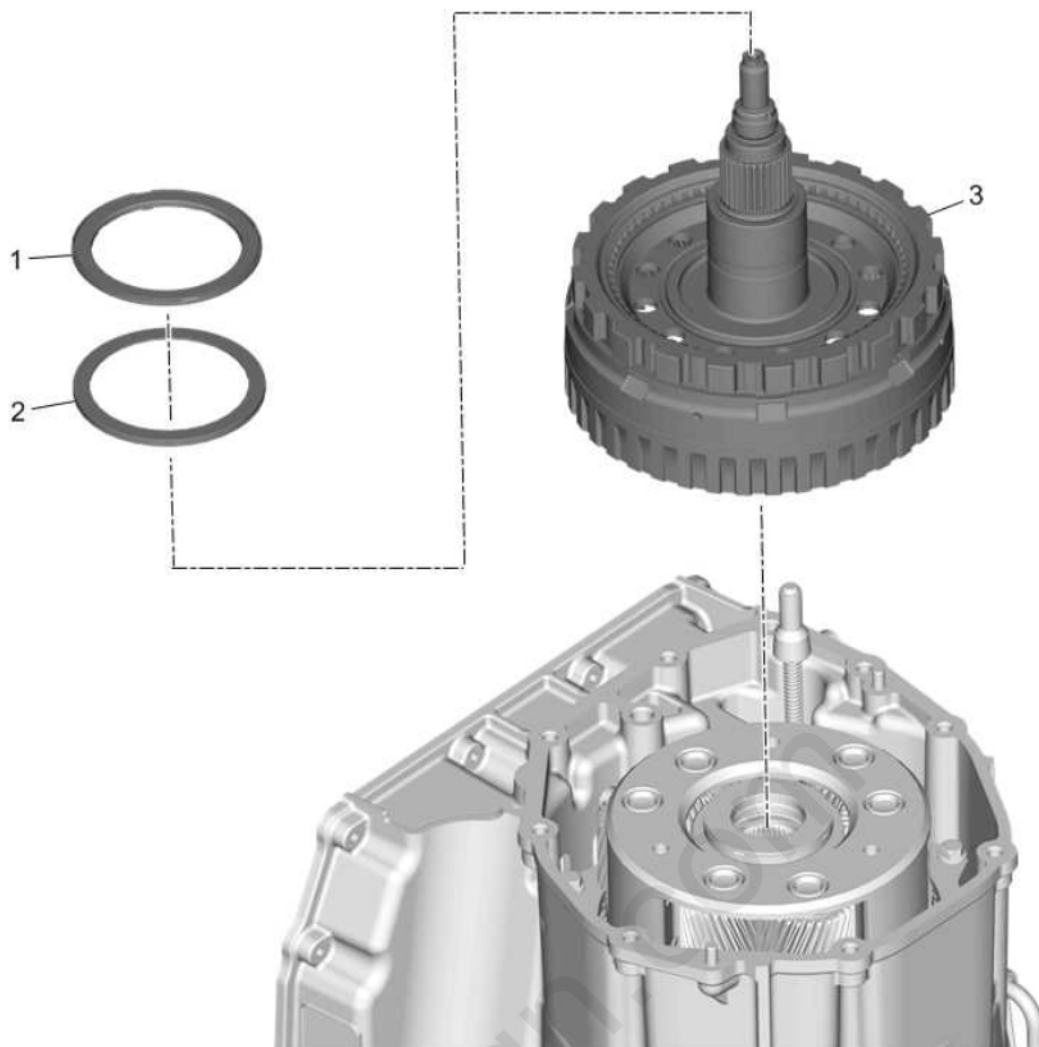


Fig. 10: Output Shaft

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Shaft Bearing
2	Output Shaft Thrust Washer
3	Output Shaft

SUN GEAR AND SUN GEAR CARRIER REMOVAL - 3RD POSITION

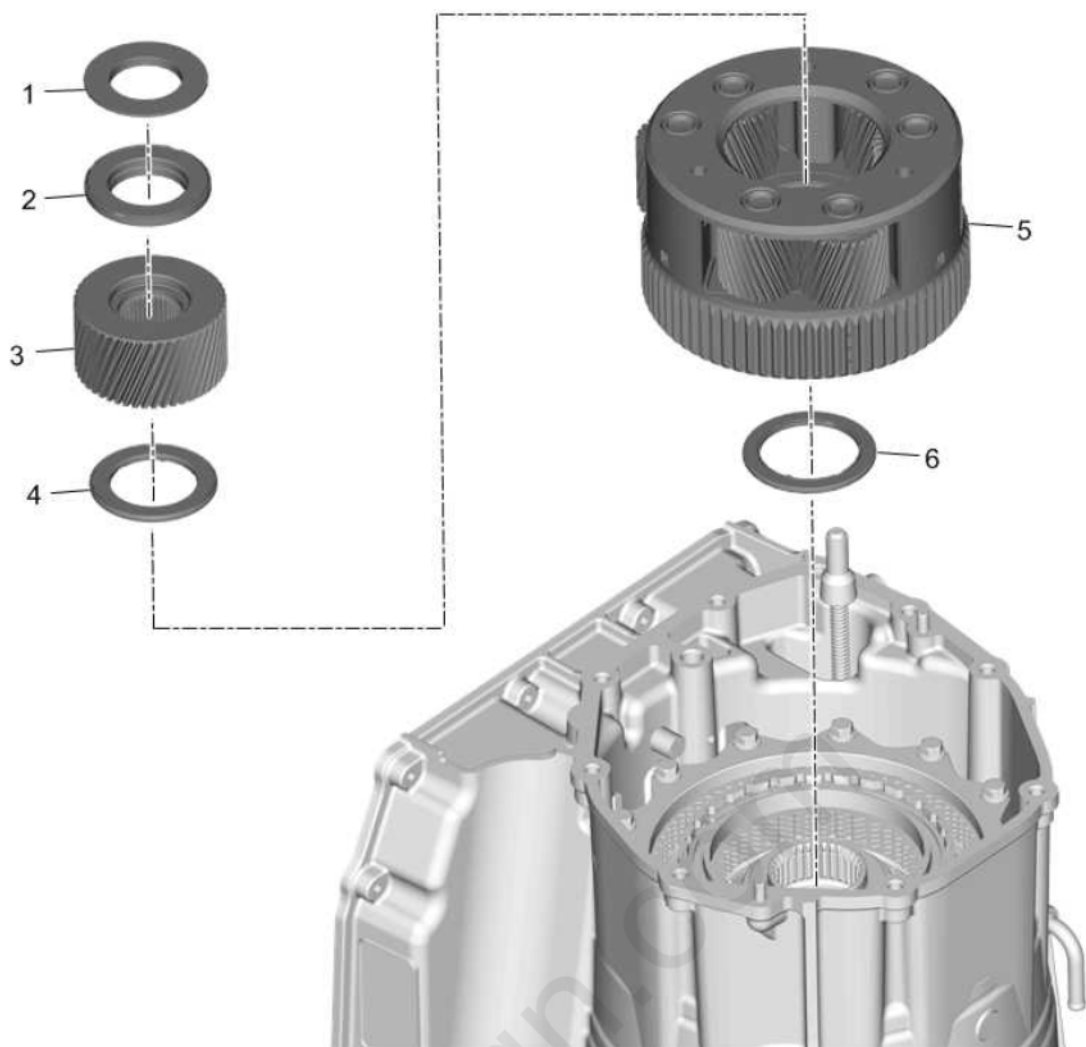


Fig. 11: Sun Gear and Sun Gear Carrier - 3rd Position
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Sun Gear Thrust Washer
2	Sun Gear Thrust Bearing- Position 3
3	Sun Gear- Position 3
4	Sun Gear Carrier Thrust Bearing- Position 3
5	Sun Gear Carrier- Position 3
6	Variable 3-4 and 2-3 Clutch Hub Thrust Bearing

VARIABLE 1-2 AND 1-2 CLUTCH HOUSING REMOVAL

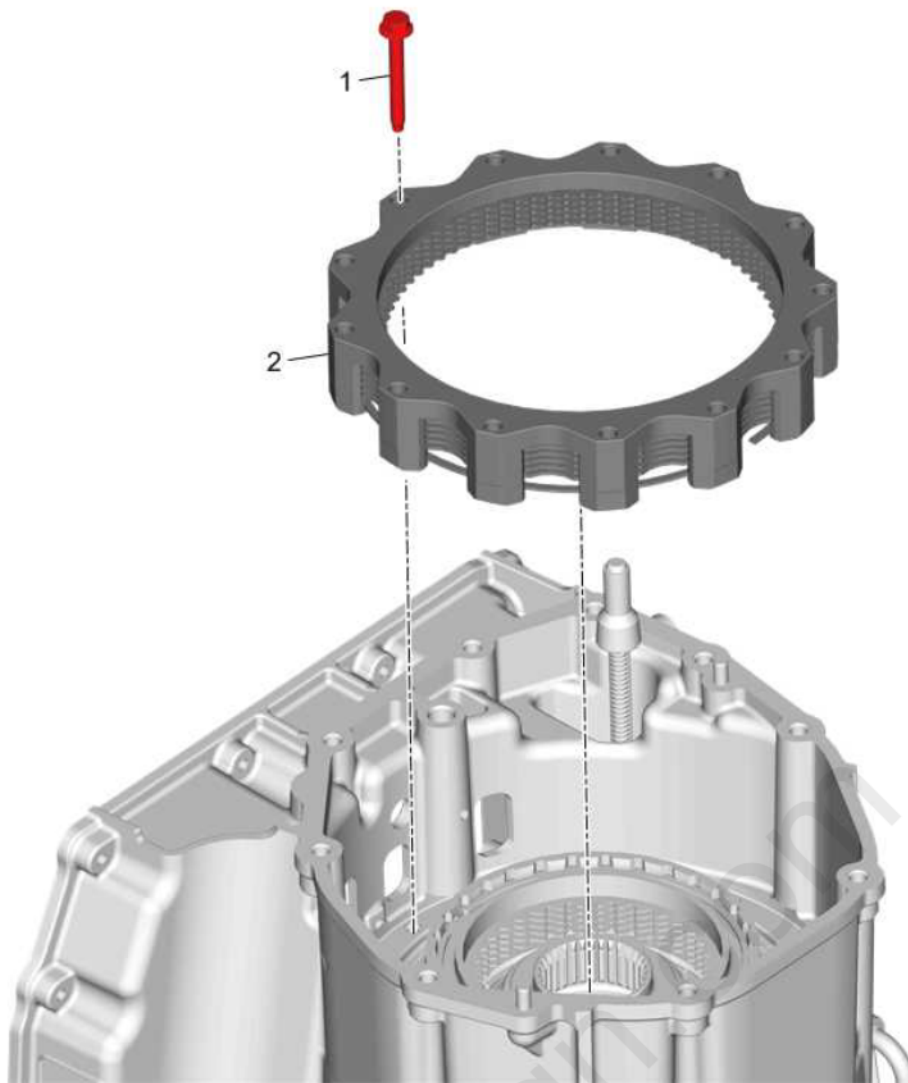


Fig. 12: Variable 1-2 and 1-2 Clutch Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Bolt [13x]
2	Variable 1-2 and 1-2 Clutch Housing

VARIABLE 3-4 AND 2-3 CLUTCH HOUSING REMOVAL

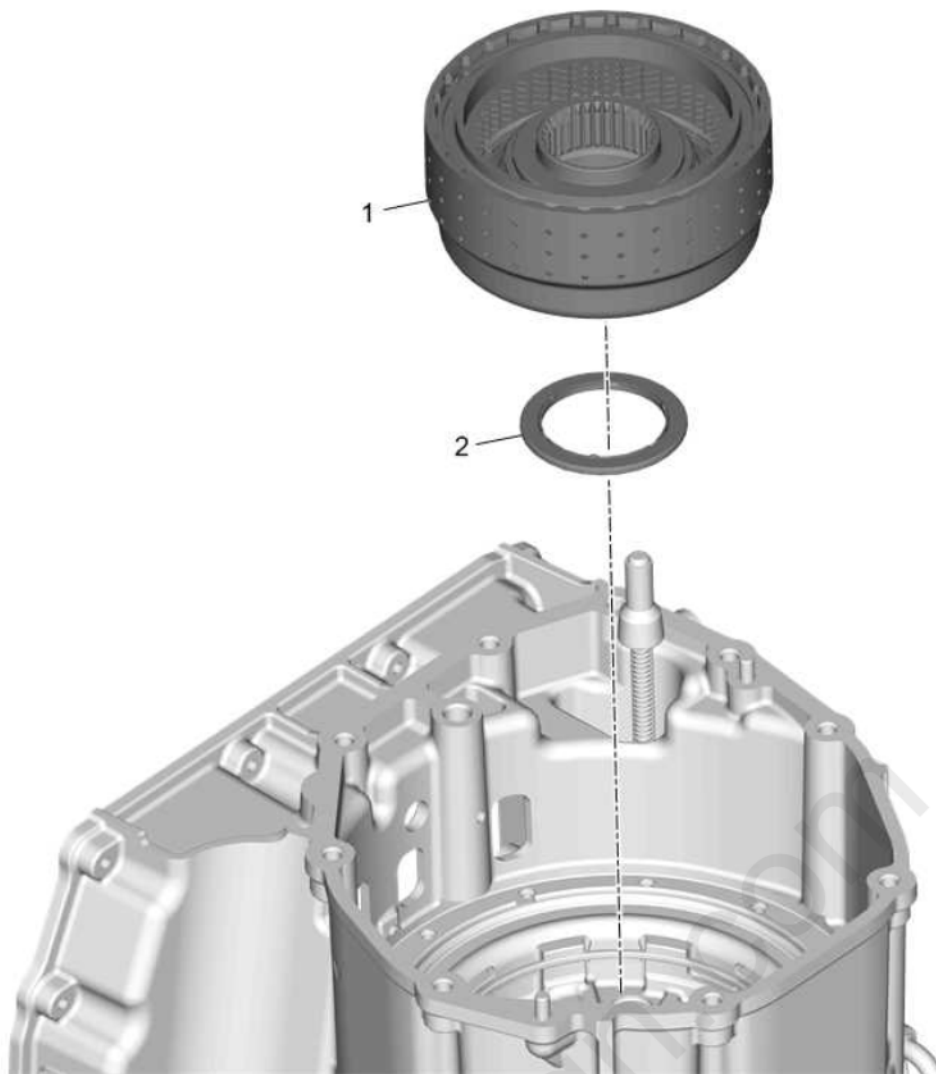


Fig. 13: Variable 3-4 and 2-3 Clutch Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 3-4 and 2-3 Clutch Housing
2	Variable 3-4 and 2-3 Clutch Housing Thrust Bearing

VARIABLE 1-2 AND 1-2 CLUTCH PISTON REMOVAL

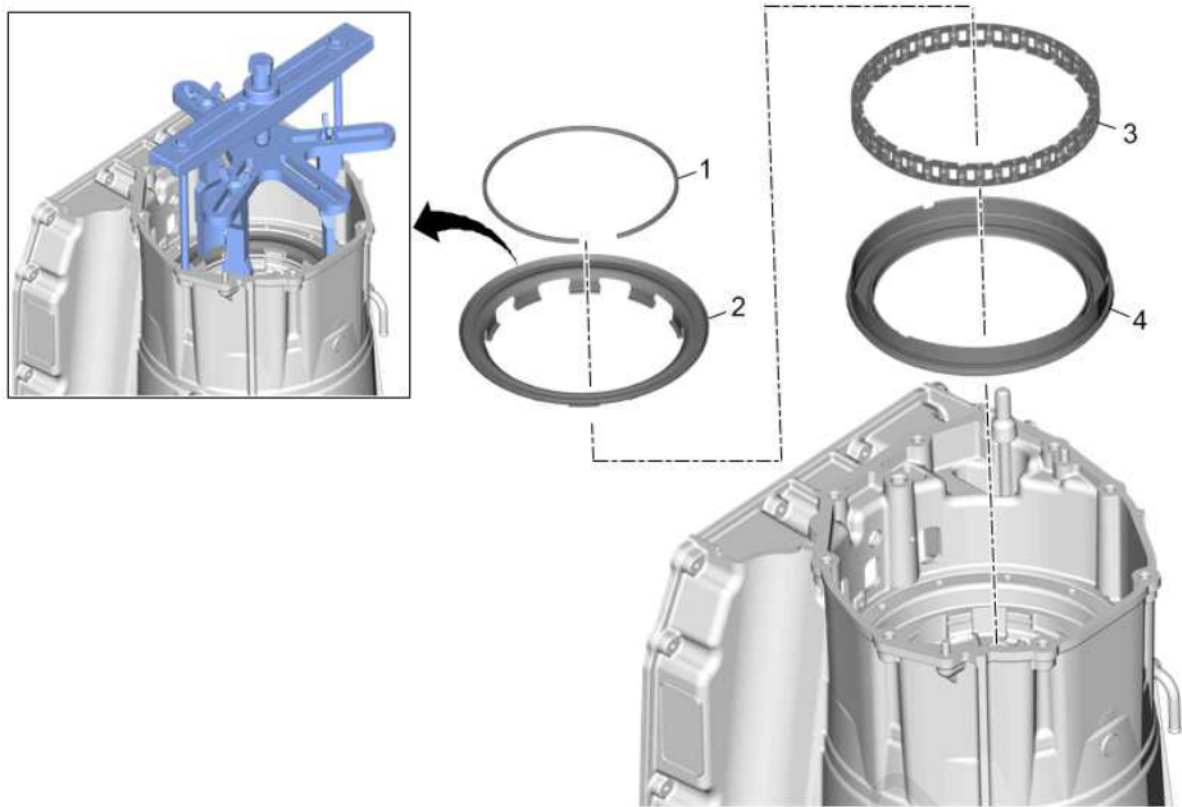


Fig. 14: Variable 1-2 and 1-2 Clutch Piston
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 1-2 and 1-2 Clutch Piston Return Spring Retaining Ring Special Tools • GE-8433-1 Puller Bar • DT-51889 Bolt Set • DT-51892 Bridge Kit Equivalent regional tools: Special Tools
2	Variable 1-2 and 1-2 Clutch Piston Return Spring Plate
3	Variable 1-2 and 1-2 Clutch Piston Return Spring
4	Variable 1-2 and 1-2 Clutch Piston

TORQUE DAMPENER HOUSING REMOVAL

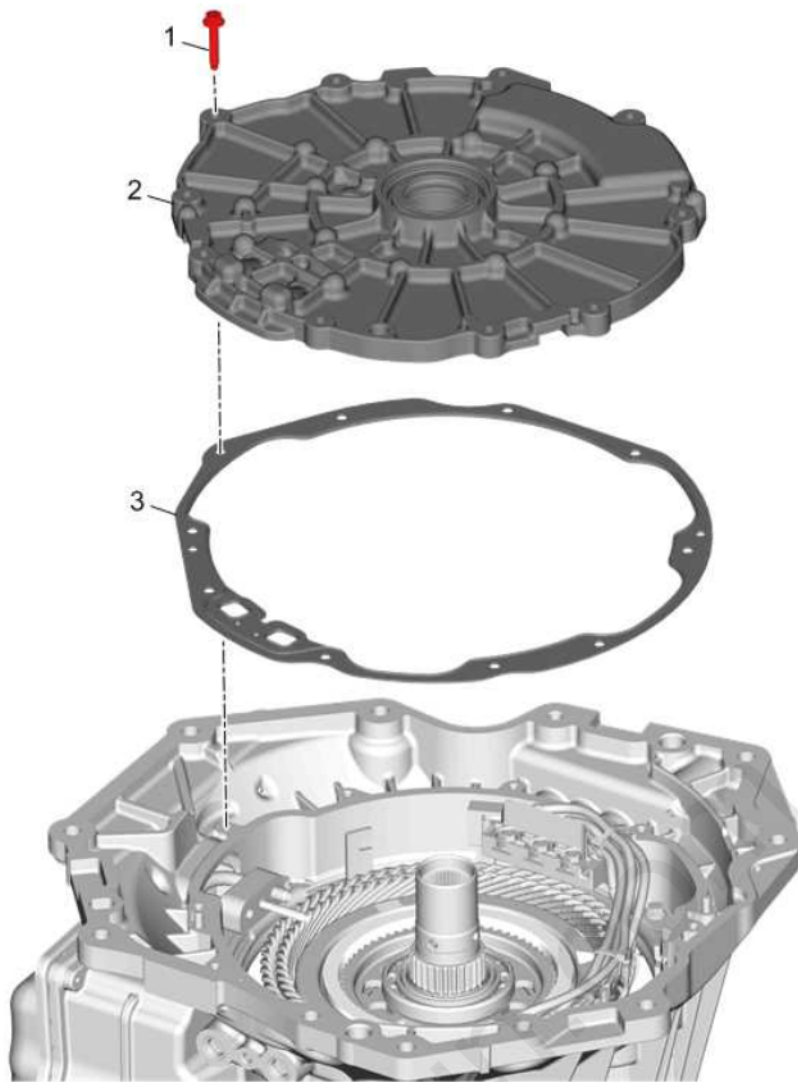


Fig. 15: Torque Dampener Housing

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Bolt [10x]
2	Automatic Transmission Torque Dampener Housing
3	Automatic Transmission Torque Dampener Housing Gasket

DRIVE MOTOR ROTOR BEARING AND INPUT SHAFT THRUST BEARING REMOVAL

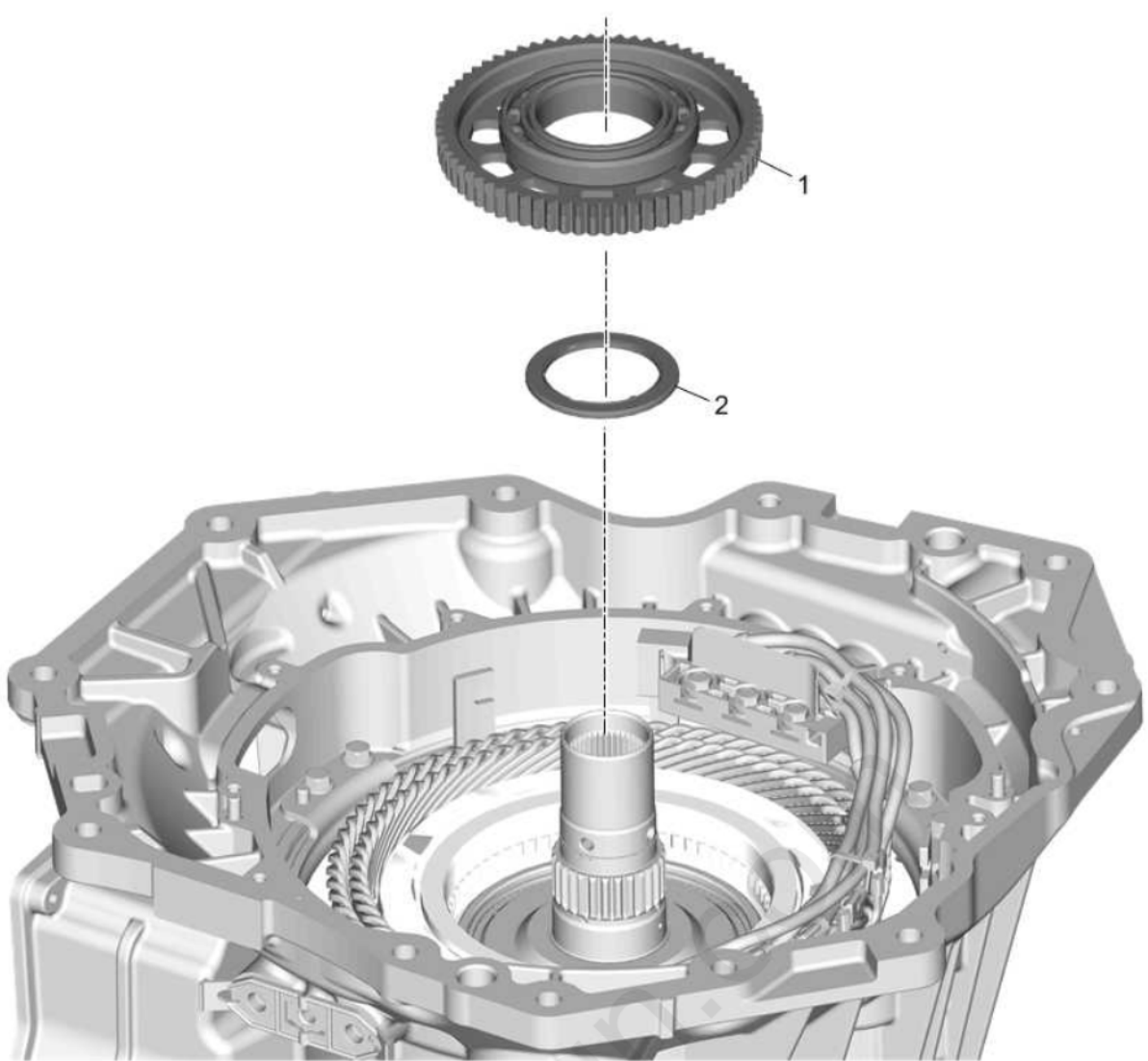


Fig. 16: Drive Motor Rotor Bearing and Input Shaft Thrust Bearing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Rotor Bearing
2	Input Shaft Thrust Bearing

INPUT SHAFT, SUN GEAR CARRIER, SUN GEAR AND SUN GEAR SHAFT REMOVAL - 1ST POSITION

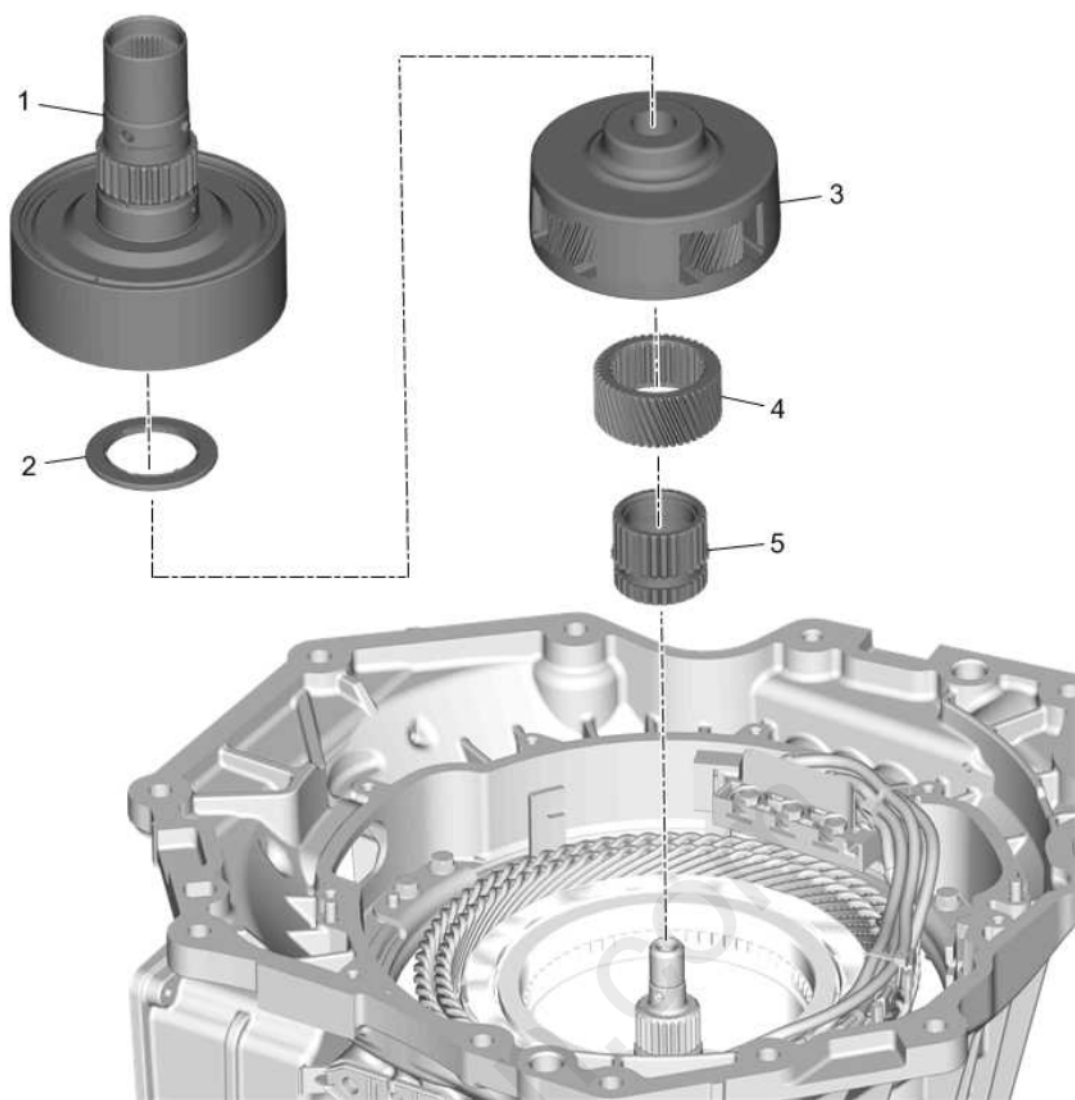


Fig. 17: Input Shaft, Sun Gear Carrier, Sun Gear and Sun Gear Shaft - 1st Position
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft
2	Sun Gear Carrier Thrust Bearing - Position 1
3	Sun Gear Carrier - Position 1
4	Sun Gear - Position 1
5	Sun Gear Shaft - Position 1

DRIVE MOTOR ROTOR REMOVAL - 1ST POSITION

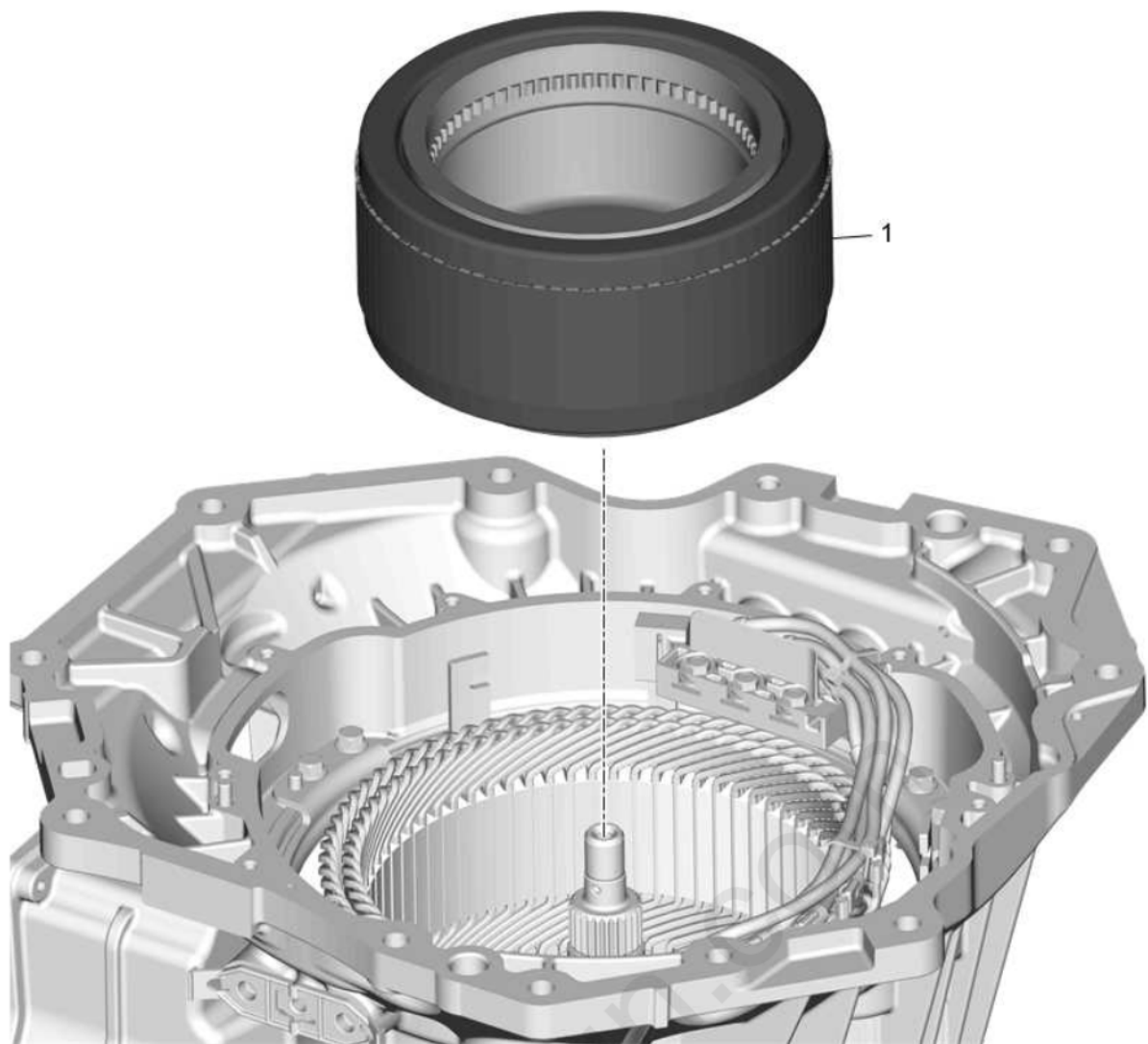


Fig. 18: Drive Motor Rotor - 1st Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Install DT-51887 stator protector sheets between the stator and rotor before rotor removal.	
Special Tools DT-51887 Stator Protector Equivalent regional tools: Special Tools	
1	Drive Motor Rotor

MAIN SHAFT AND VARIABLE 2-3 AND 1-2-3 CLUTCH SHAFT REMOVAL

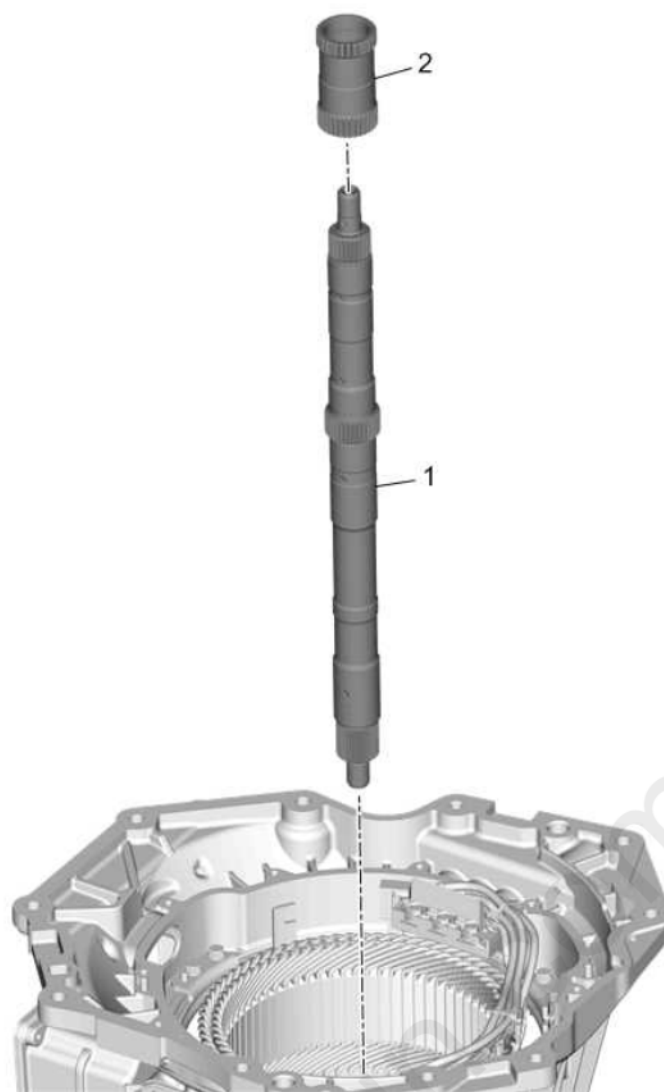


Fig. 19: Main Shaft and Variable 2-3 and 1-2-3 Clutch Shaft

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Main Shaft
2	Variable 2-3 and 1-2-3 Clutch Shaft Procedure Remove the variable 2-3 and 1-2-3 clutch shaft from the main shaft after the main shaft is removed.

DRIVE MOTOR REMOVAL - 1ST POSITION

Wiring Harness Connector and Automatic Transmission Case Bolt Removal

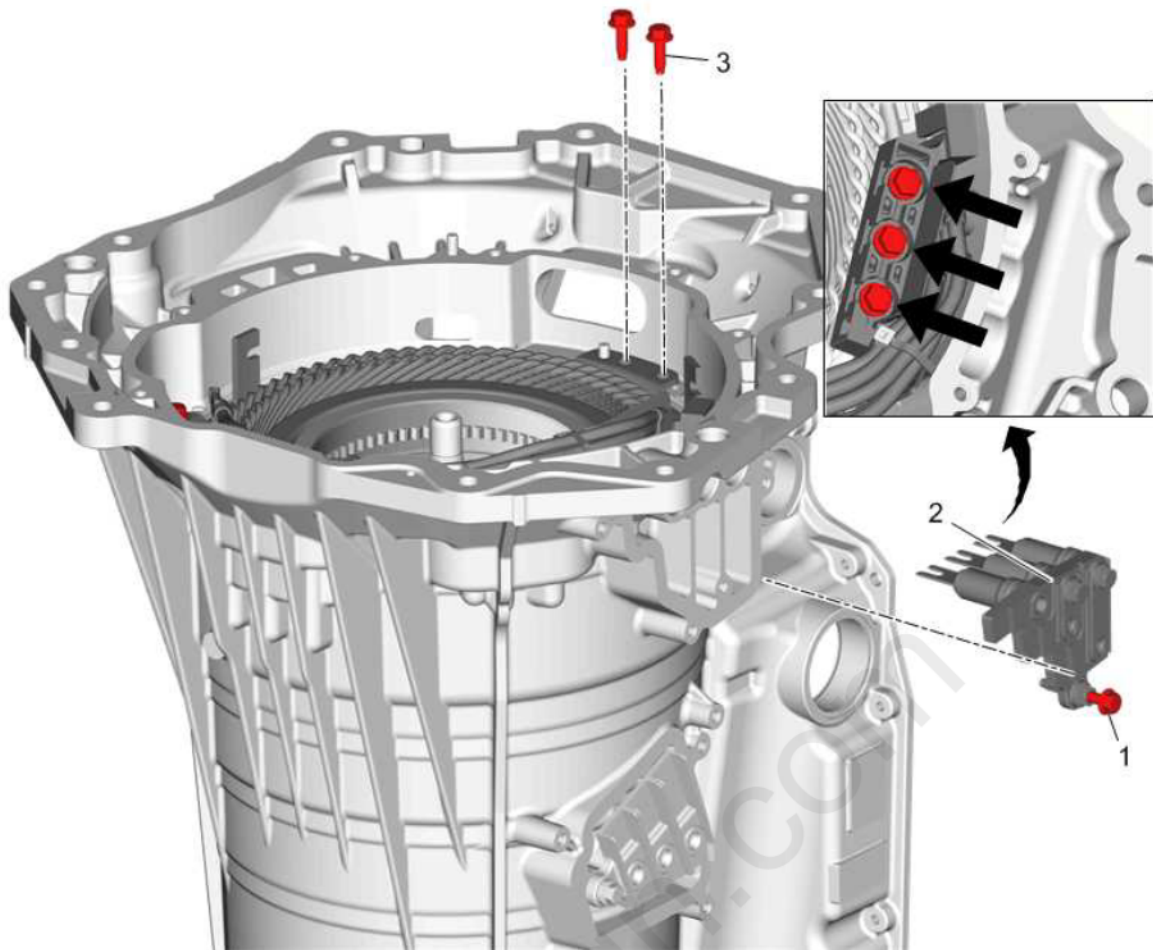


Fig. 20: Wiring Harness Connector And Automatic Transmission Case Bolts
 Courtesy of GENERAL MOTORS COMPANY

Wiring Harness Connector and Automatic Transmission Case Bolt Removal

Callout	Component Name
1	Wiring Harness Connector Bolt
2	Wiring Harness Connector Procedure 1. Loosen the 3 connector terminal bolts inside the transmission case. 2. Install 2 M6 bolts loosely into the connector header cover bolt locations. NOTE: Do not pry on the connector to remove it from the transmission case. 3. Use the bolts to rock the connector loose from the transmission case.
3	Automatic Transmission Case Bolt [6x]

Drive Motor Removal

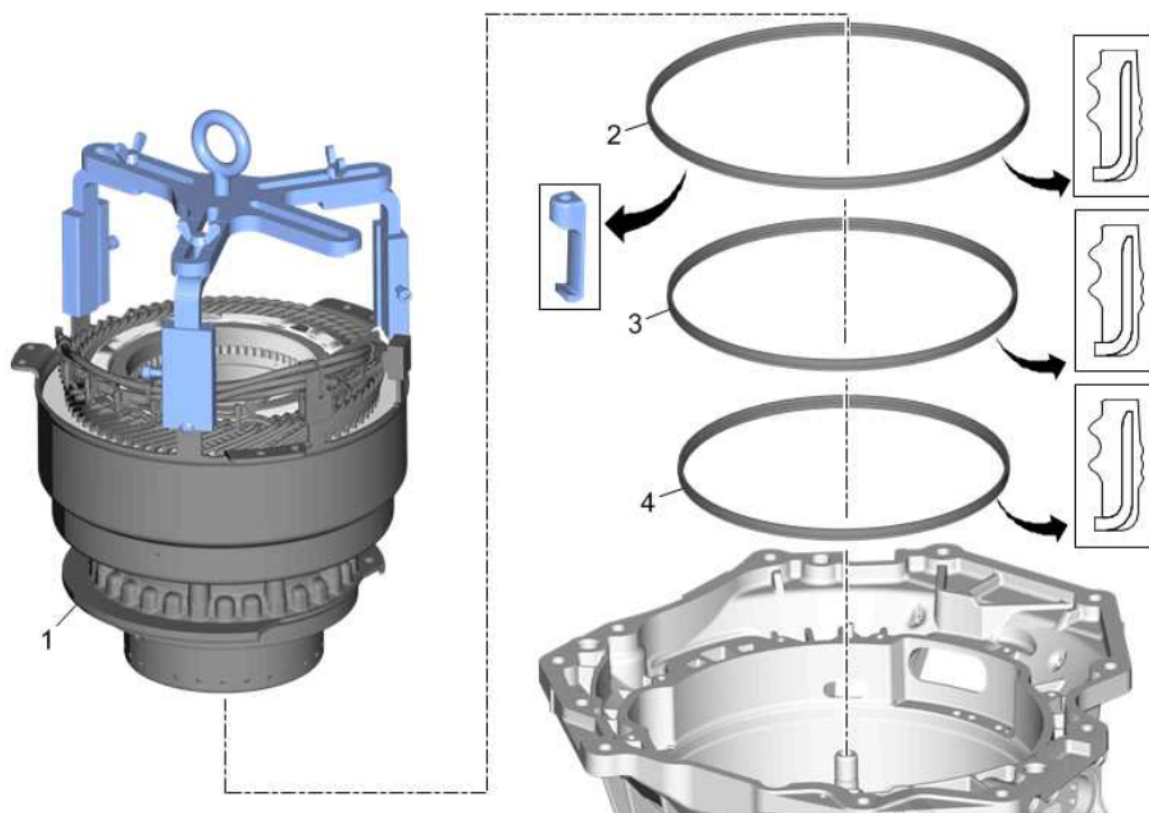


Fig. 21: Drive Motor

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Removal

Callout	Component Name
1	Drive Motor Stator - Position 1, Drive Motor Rotor - Position 1 and Variable 1-2-3-4 and 1-2-3 Clutch Procedure 1. Install 3 DT-51884 supports to the drive motor. 2. Install DT-51892 bridge to DT-51884 supports. 3. Install DT-51884 ring to the DT-51892 bridge. 4. Install a shop hoist to the ring to assist in the drive motor removal. Special Tools • DT-51884 Motor A and B Lift Assist • DT-51892 Bridge Kit Equivalent regional tools: Special Tools
2	Drive Motor Stator Housing Front Seal - Position 1 Special Tools • GE-6125-1B Slide Hammer • DT-23129 Universal Seal Remover Equivalent regional tools: Special Tools

Callout	Component Name
3	Drive Motor Stator Housing Rear Seal - Position 1 Special Tools • GE-6125-1B Slide Hammer • DT-23129 Universal Seal Remover Equivalent regional tools: Special Tools
4	Clutch Housing Seal Special Tools • GE-6125-1B Slide Hammer • DT-23129 Universal Seal Remover Equivalent regional tools: Special Tools

SUN GEAR CARRIER, SUN GEAR AND SUN GEAR SHAFT REMOVAL - 2ND POSITION

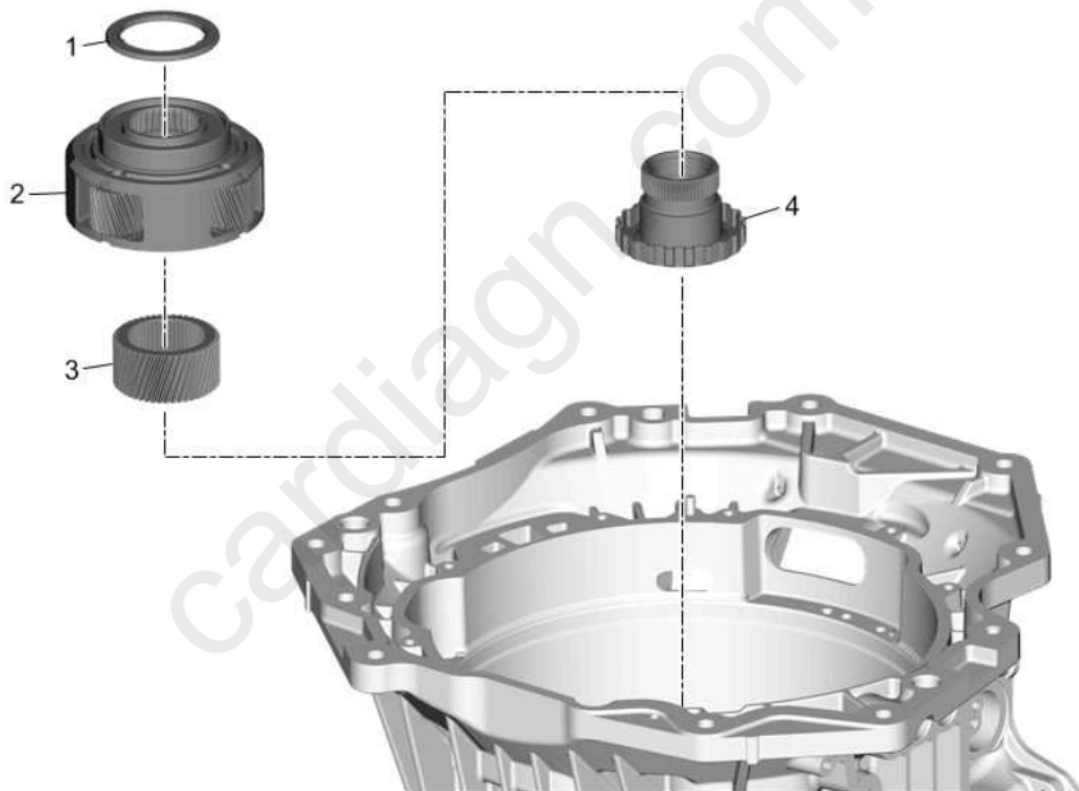


Fig. 22: Sun Gear Carrier, Sun Gear and Sun Gear Shaft - 2nd Position
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
2	Sun Gear Carrier - Position 2
3	Sun Gear - Position 2
4	Sun Gear Shaft - Position 2

VARIABLE 3-4 AND 2-3 CLUTCH SHAFT REMOVAL

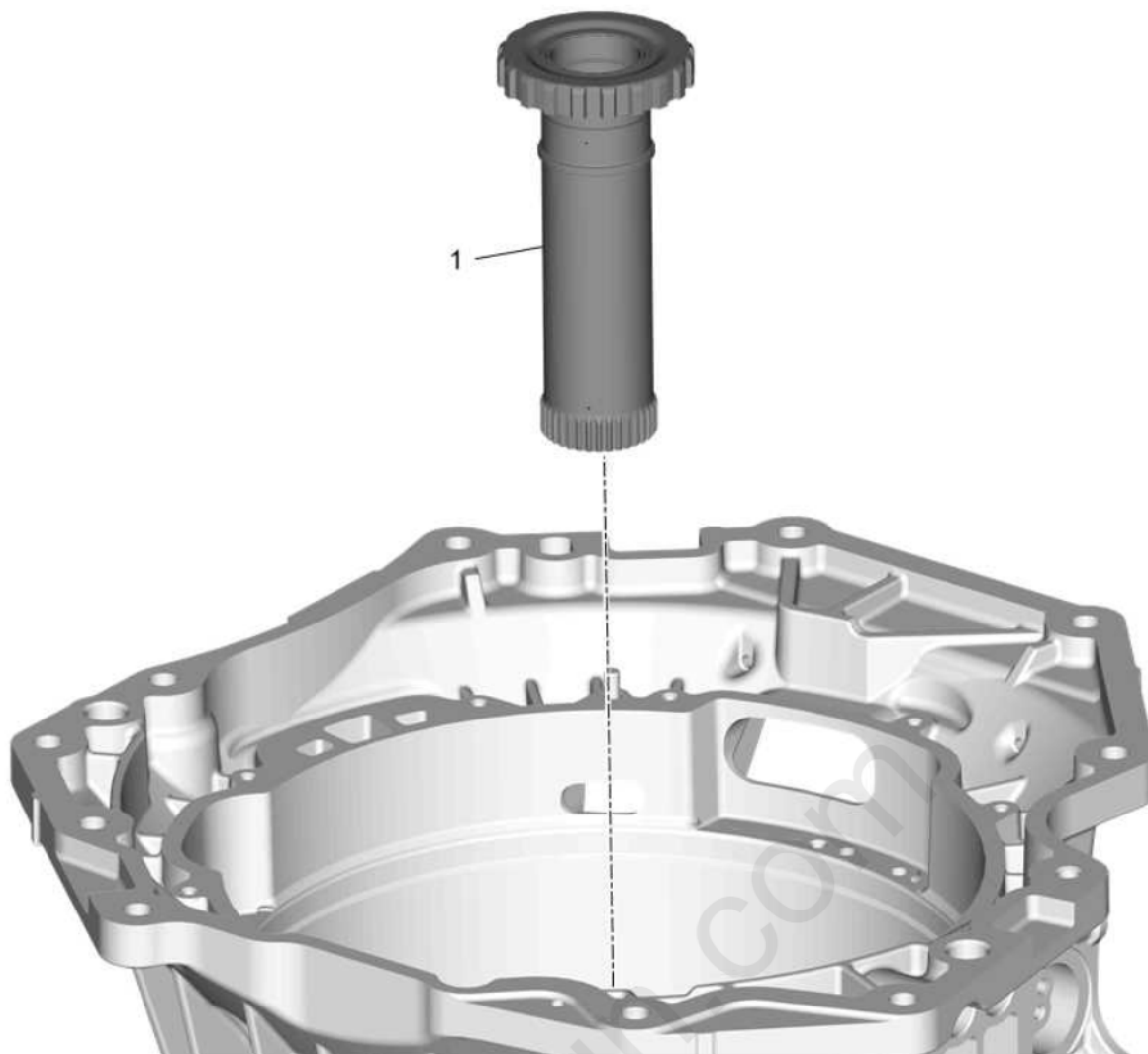


Fig. 23: Variable 3-4 and 2-3 Clutch Shaft
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 3-4 and 2-3 Clutch Shaft

DRIVE MOTOR REMOVAL - 2ND POSITION

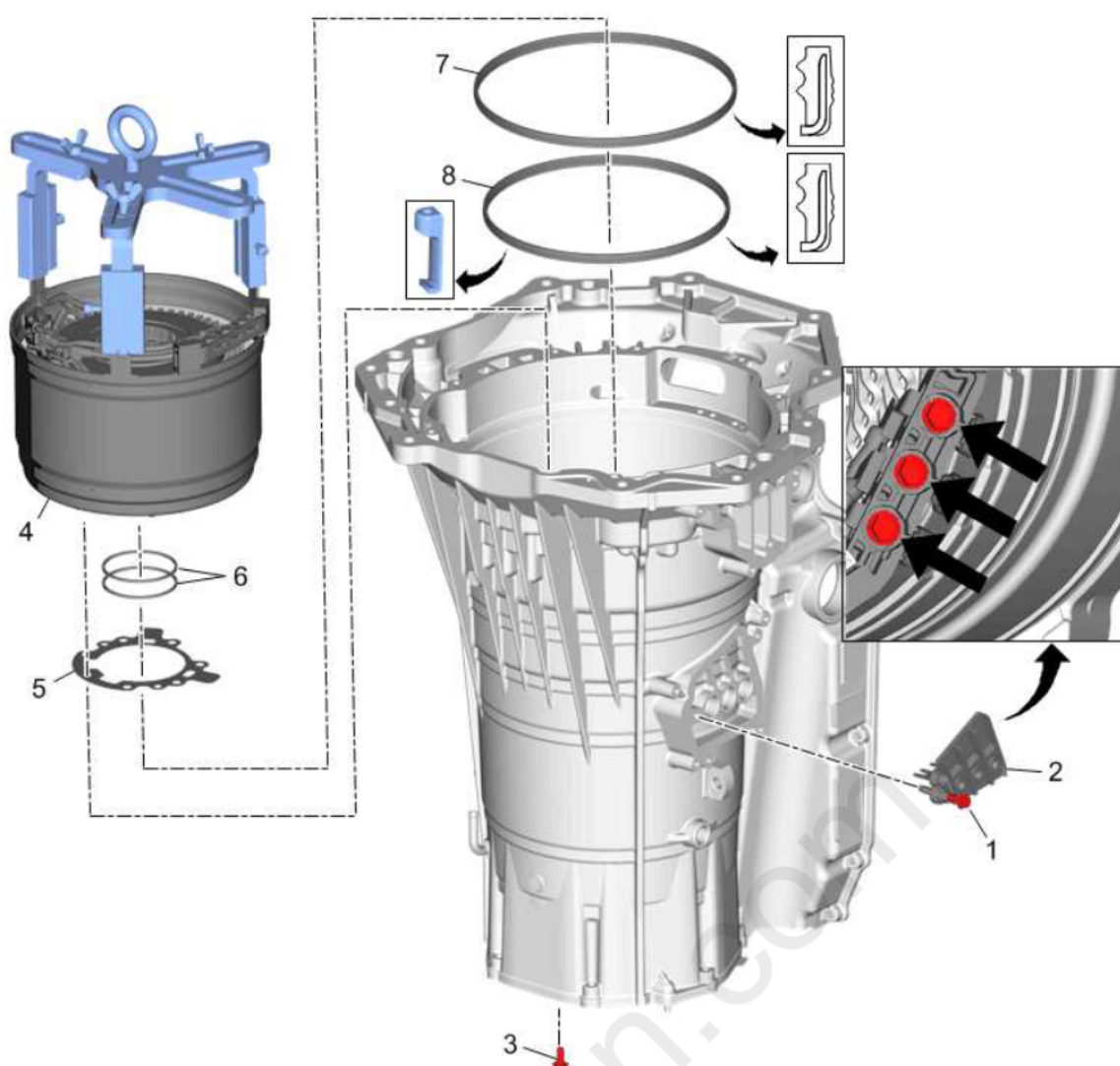


Fig. 24: Drive Motor - 2nd Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Wiring Harness Connector Bolt
2	Wiring Harness Connector Procedure 1. Loosen the 3 connector terminal bolts inside the transmission case. 2. Install 2 M6 bolts loosely into the connector header cover bolt locations. NOTE: Do not pry on the connector to remove it from the transmission case. 3. Use the bolts to rock the connector loose from the transmission case.
3	Automatic Transmission Case Bolt [7x] NOTE: These 7 bolts hold the drive motor to the transmission case. Ensure the transmission case is secured vertically with the engine mating surface down before removing these bolts.

Callout	Component Name
4	Drive Motor - Position 2 Procedure 1. Install 3 DT-51884 supports to the drive motor. 2. Install DT-51892 bridge to DT-51884 supports. 3. Install DT-51884 ring to the DT-51892 bridge. 4. Install a shop hoist to the ring to assist in the drive motor removal. Special Tools • DT-51884 Motor A and B Lift Assist • DT-51892 Bridge Kit Equivalent regional tools: Special Tools
5	Variable 3-4 and 2-3 Clutch Housing Fluid Passage Hub Gasket
6	Variable 3-4 and 2-3 Clutch Housing Fluid Seal Ring [2x]
7	Drive Motor Stator Housing Front Seal - Position 2 Special Tools • GE-6125-1B Slide Hammer • DT-23129 Universal Seal Remover Equivalent regional tools: Special Tools
8	Drive Motor Stator Housing Rear Seal - Position 2 Special Tools • GE-6125-1B Slide Hammer • DT-23129 Universal Seal Remover Equivalent regional tools: Special Tools

MANUAL SHIFT DETENT LEVER WITH SHAFT POSITION SWITCH ASSEMBLY AND PARK PAWL ACTUATOR REMOVAL

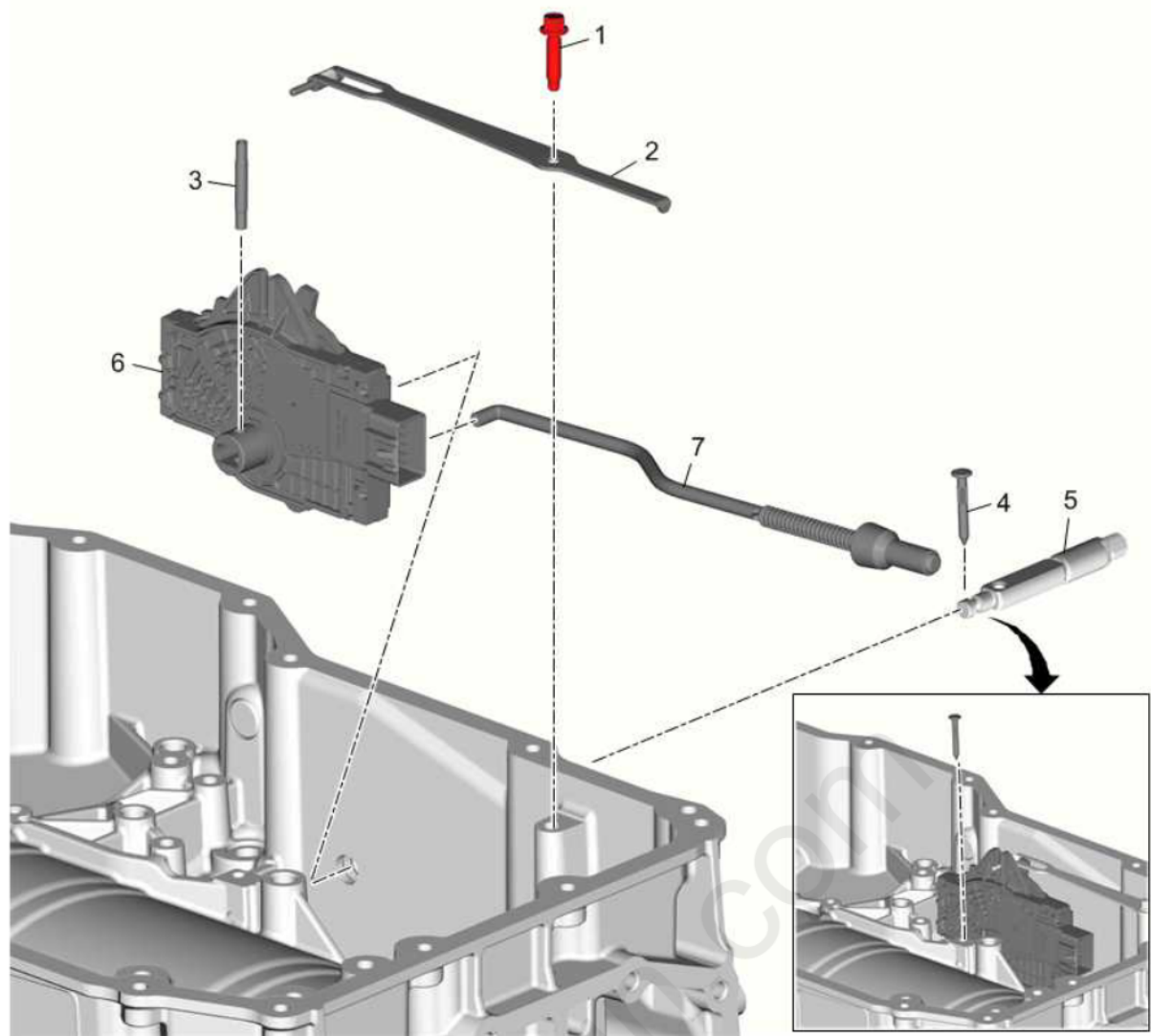


Fig. 25: Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Detent Spring Bolt
2	Manual Shift Detent Lever Spring
3	Manual Shift Detent Lever Hub Pin Procedure Remove and discard the pin.
4	Manual Shift Shaft Pin Procedure Remove and discard the pin.
5	Manual Shift Shaft
6	Manual Shift Shaft Position Switch Assembly
7	Park Pawl Actuator

MANUAL SHIFT SHAFT SEAL REMOVAL

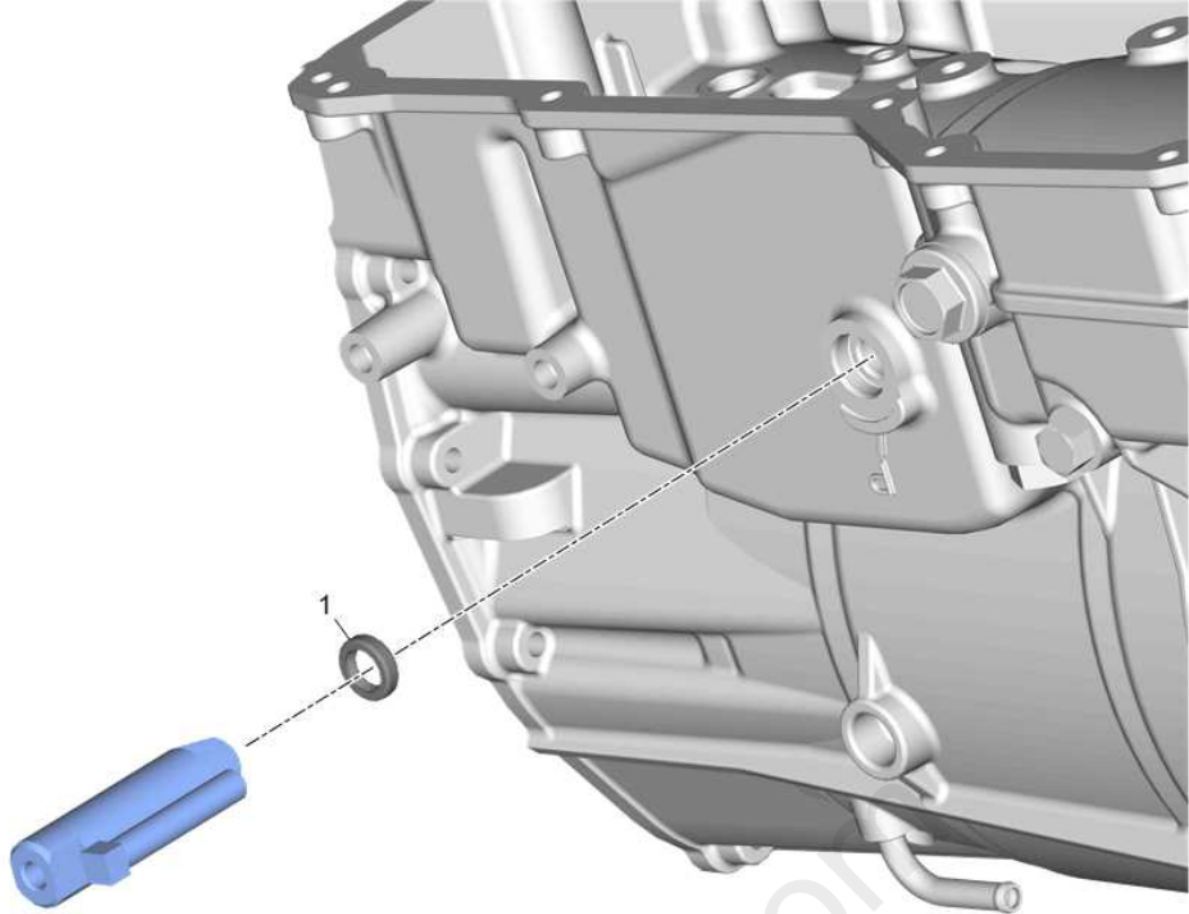


Fig. 26: Manual Shift Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manual Shift Shaft Seal Procedure Remove and discard the seal. Special Tools DT-43911 Selector Shaft Seal Remover Equivalent regional tools: Special Tools

TRANSMISSION CASE CLEANING AND INSPECTION

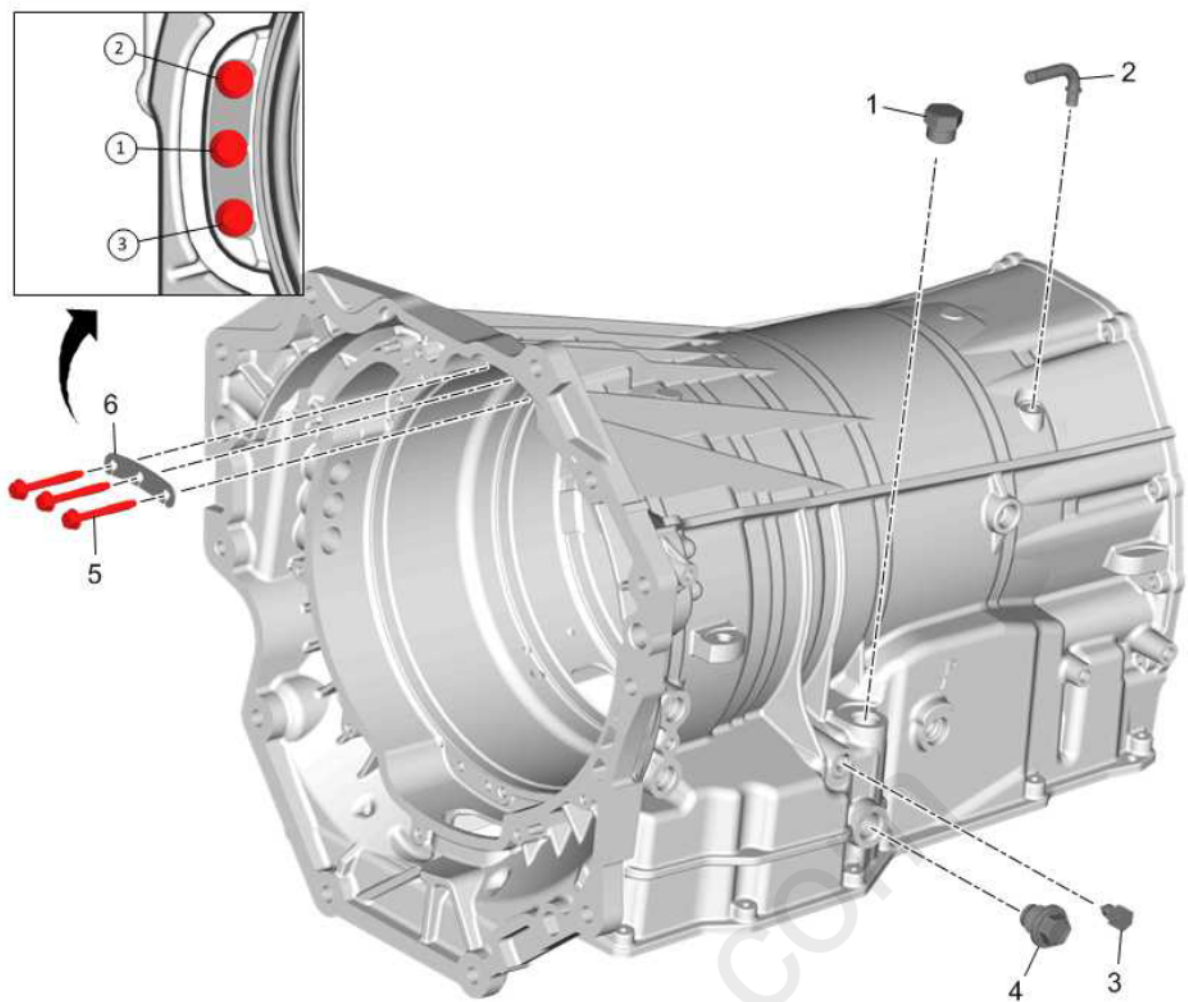


Fig. 27: Transmission Case Cleaning and Inspection
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
CAUTION: After cleaning the transmission components, allow to air dry. Do not use cloth or paper towels in order to dry any transmission components. Lint from the towels can cause component failure. CAUTION: Do not reuse cleaning solvents. Previously used solvents may deposit sediment which may damage the component. Preliminary Procedures 1. Thoroughly clean the transmission case assembly, including case threads, with clean solvent. 2. Clean gasket sealing surfaces. Remove all residual gasket material. 3. Inspect all threaded holes. If necessary, repair any thread damage.	

Callout	Component Name
1	Transmission Fluid Filler Plug CAUTION: Refer to Component Fastener Tightening Caution . NOTE: Discard and replace the plug when removed. Tighten 21 N.m (15 lb ft)
2	Automatic Transmission Vent Pipe
3	Automatic Transmission Fluid Pressure Test Hole Plug NOTE: Discard and replace the plug when removed. Tighten 10.5 N.m (93 lb in)
4	Transmission Fluid Filler Plug NOTE: Discard and replace the plug when removed. Tighten 21 N.m (15 lb ft)
5	Automatic Transmission Case Bolt [3x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)
6	Automatic Transmission Case Fluid Passage Cover

MANUAL SHIFT DETENT LEVER WITH SHAFT POSITION SWITCH ASSEMBLY AND PARK PAWL ACTUATOR INSTALLATION

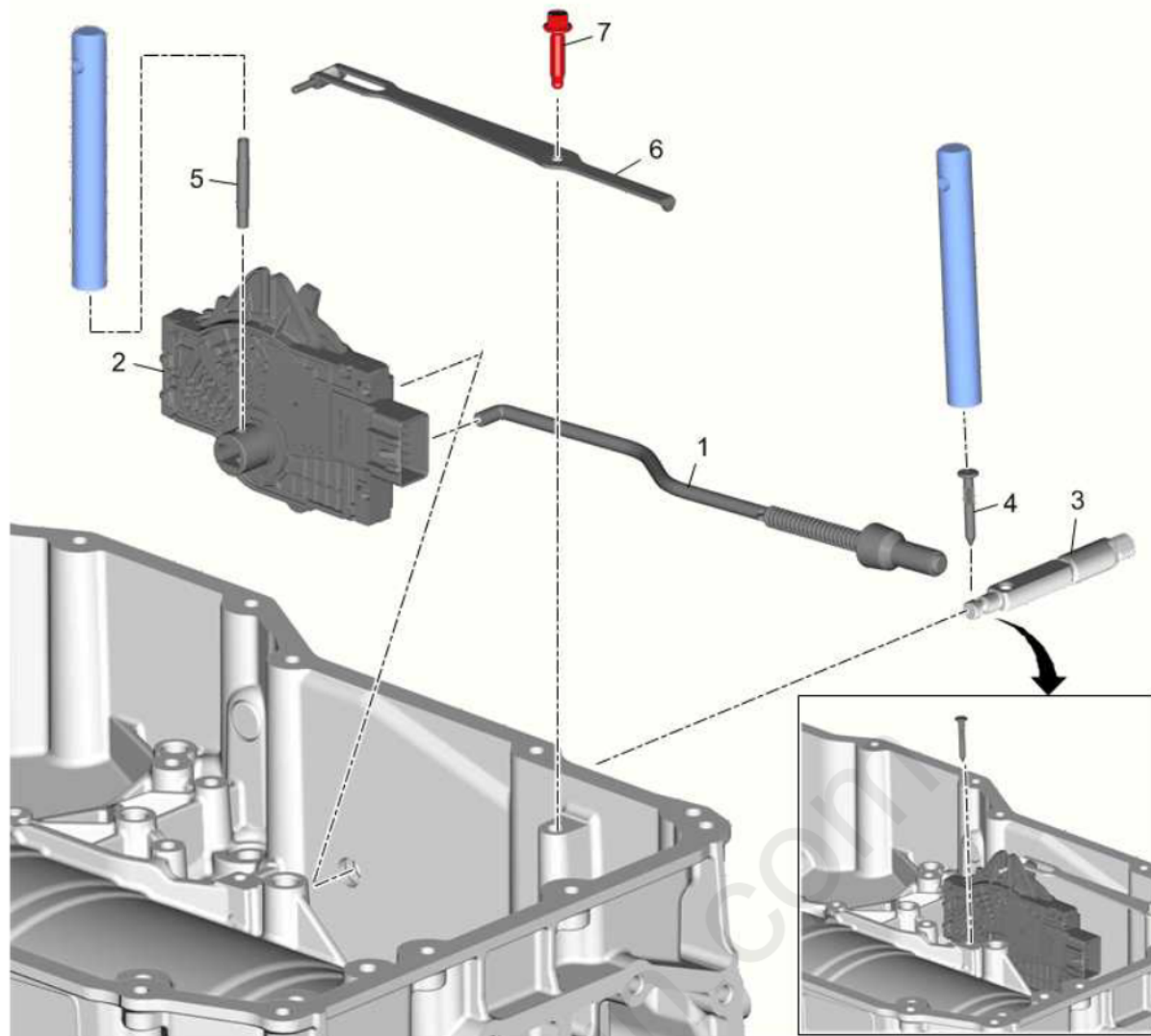


Fig. 28: Manual Shift Detent Lever with Shaft Position Switch Assembly and Park Pawl Actuator
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Park Pawl Actuator
2	Manual Shift Shaft Position Switch Assembly
3	Manual Shift Shaft
4	Manual Shift Shaft Pin CAUTION: Refer to Torque-to-Yield Fastener Caution . NOTE: Always use a NEW pin. Special Tools DT-51893 Shift Shaft Retainer and Roll Pin Installer Equivalent regional tools: Special Tools

Callout	Component Name
5	Manual Shift Detent Lever Hub Pin CAUTION: Refer to Torque-to-Yield Fastener Caution . NOTE: Always use a NEW pin. Special Tools DT-51893 Shift Shaft Retainer and Roll Pin Installer Equivalent regional tools: Special Tools
6	Manual Shift Detent Lever Spring
7	Manual Shift Detent Spring Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

MANUAL SHIFT SHAFT SEAL INSTALLATION

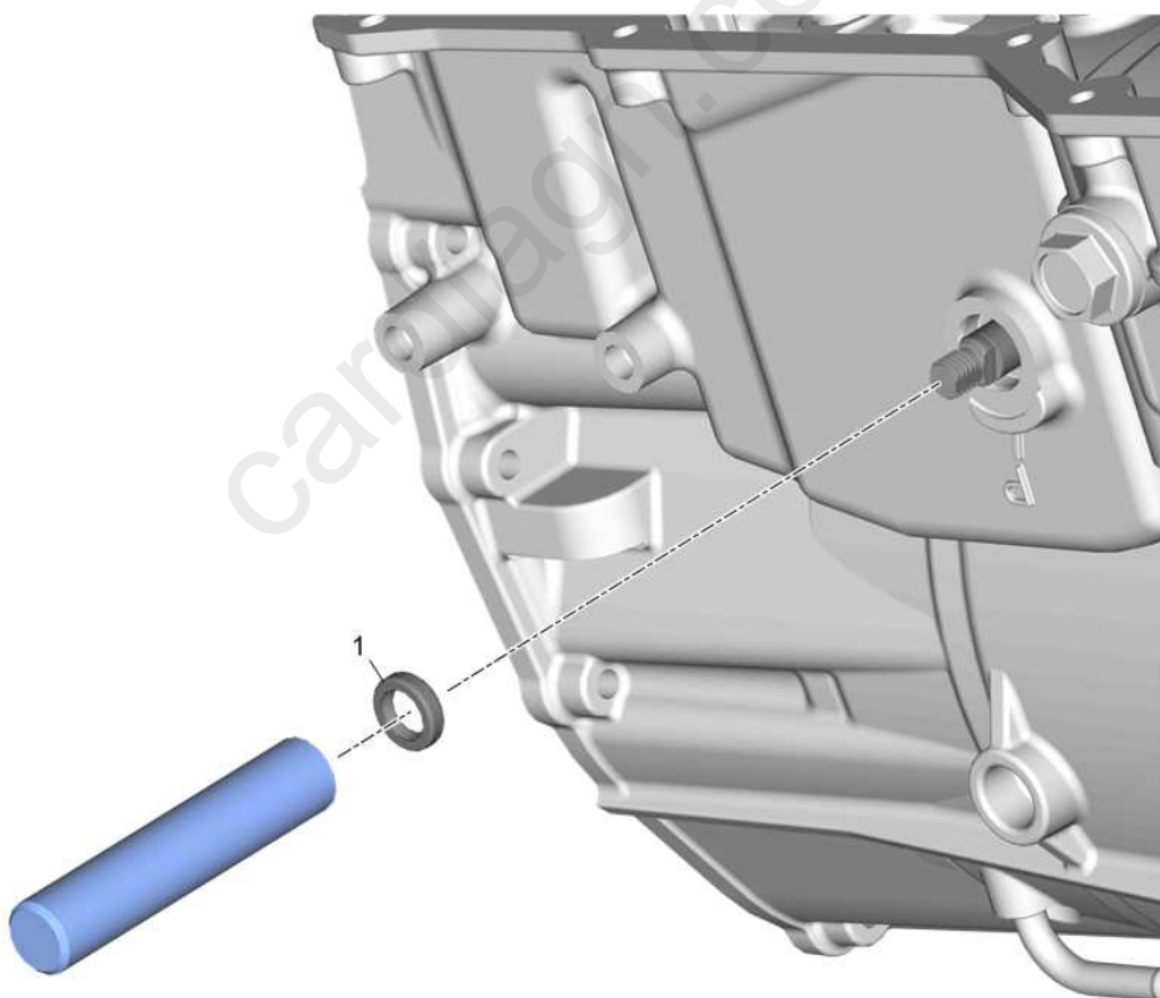


Fig. 29: Manual Shift Shaft Seal

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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Callout	Component Name
1	Manual Shift Shaft Seal NOTE: Use a NEW seal. Special Tools DT-49101 Seal Installer Equivalent regional tools: Special Tools

DRIVE MOTOR DISASSEMBLE - 2ND POSITION

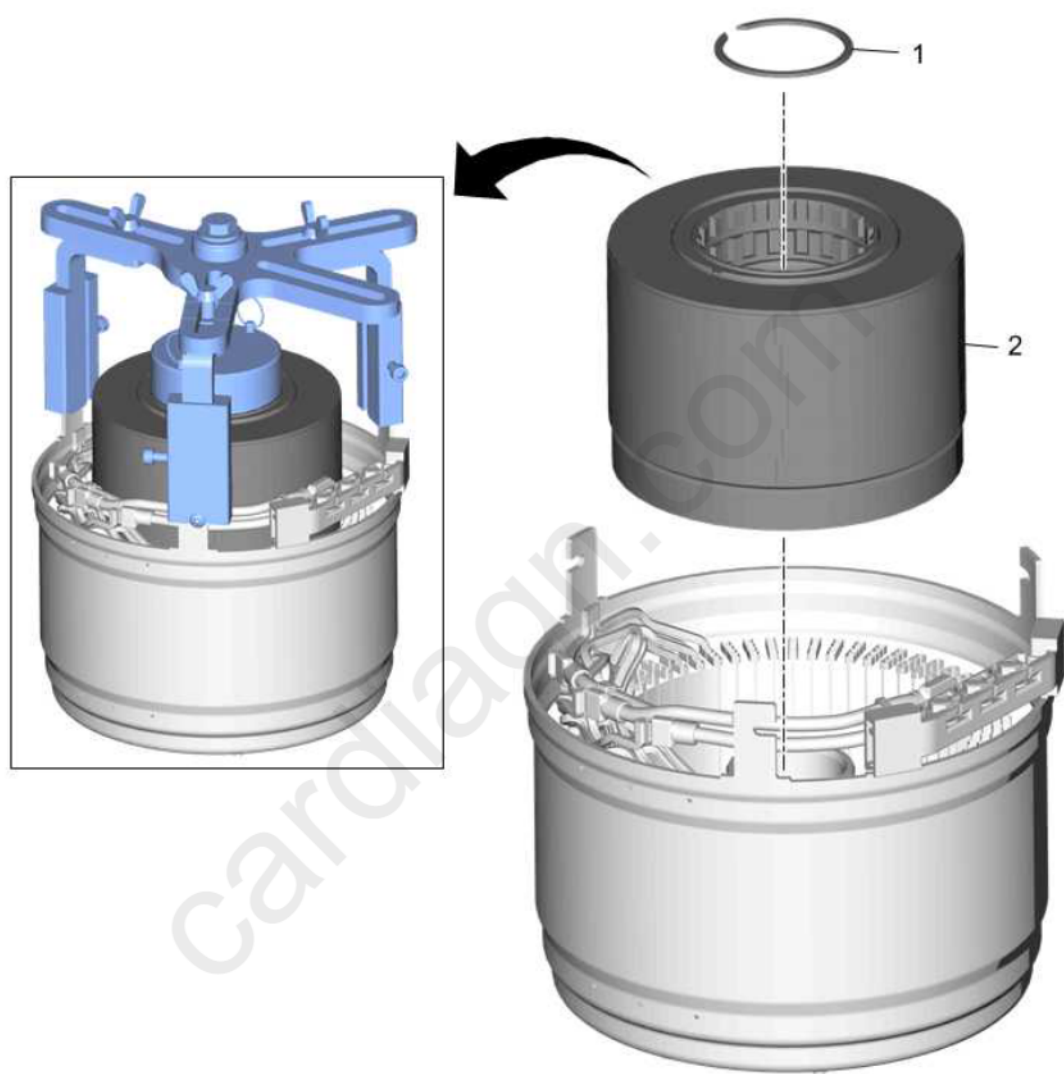


Fig. 30: Drive Motor - 2nd Position
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Generator Rotor Bearing Retaining Ring

Callout	Component Name
2	Drive Motor Rotor - Position 2 Procedure 1. Install 2 DT-51887 stator protector sheets between the stator and the rotor. 2. Install DT-51884 rotor remover into the rotor. Rotate the tool 10-15 degrees in order to seat the locking pins. NOTE: The pins will lock the remover to the rotor when the special tool is correctly installed. 3. Install 3 DT-51884 supports onto the stator. 4. Install DT-51892 bridge, bolt, washer and bearing to DT-51884 rotor remover. 5. Rotate the DT-51892 bolt to remove the rotor. Special Tools • DT-51884 Motor A and B Lift Assist • DT-51887 Stator Protector • DT-51892 Bridge Kit Equivalent regional tools: Special Tools

DRIVE MOTOR ASSEMBLE - 2ND POSITION

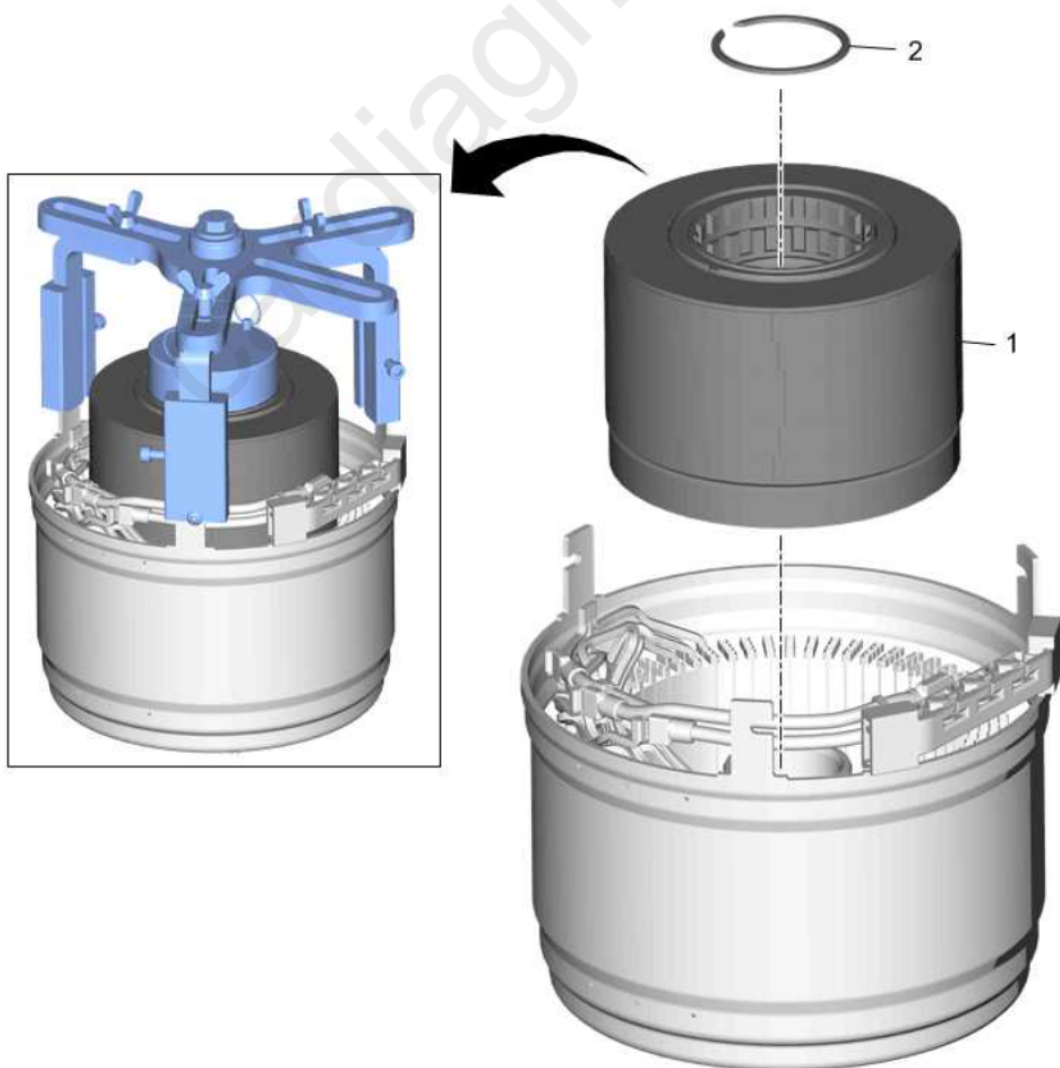


Fig. 31: Drive Motor - 2nd Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Rotor- Position 2 Procedure 1. Install 3 DT-51884 supports onto the stator. 2. Install DT-51884 rotor installer into the rotor. The pins will lock the remover to the rotor. 3. Install DT-51892 bridge, bolt, washer and bearing to DT-51884 rotor installer. Rotate the bolt until the rotor is raised to the bridge. 4. Place the rotor and special tools onto the 3 DT-51884 supports on the stator. Secure the assembly with the wing bolts. 5. Install 2 DT-51887 stator protector sheets between the stator and the rotor. 6. Rotate the DT-51892 bolt to install the rotor. 7. Remove the special tools and ensure the rotor has fully seated into the stator. Special Tools • DT-51884 Motor A and B Lift Assist • DT-51887 Stator Protector • DT-51892 Bridge Kit Equivalent regional tools: Special Tools
2	Drive Motor Generator Rotor Bearing Retaining Ring

DRIVE MOTOR INSTALLATION - 2ND POSITION

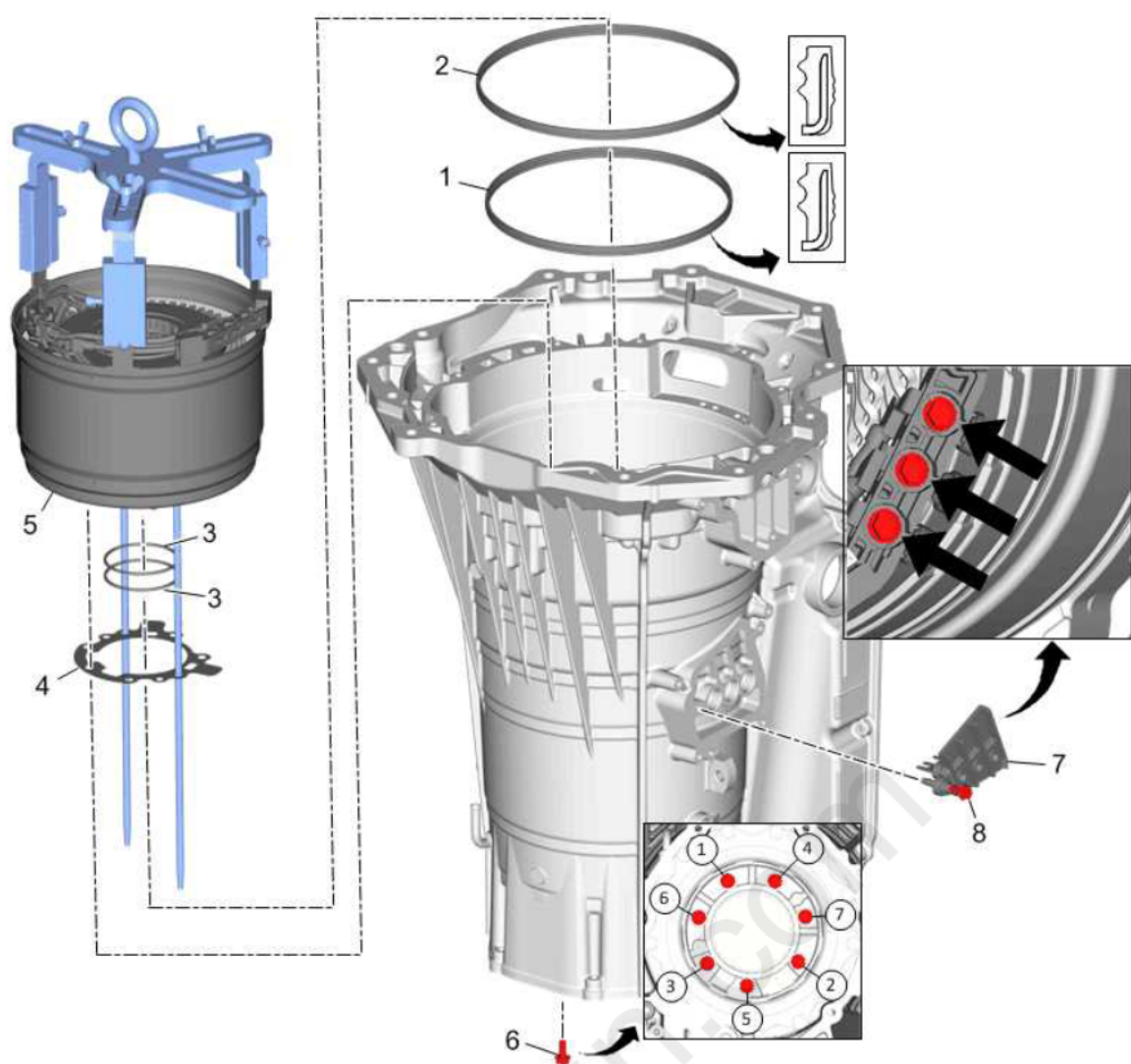


Fig. 32: Drive Motor - 2nd Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Drive Motor Stator Housing Rear Seal - Position 2 Procedure Lubricate and install the seal by hand. Refer to Adhesives, Fluids, Lubricants and Sealers .
2	Drive Motor Stator Housing Front Seal - Position 2 Procedure Lubricate and install the seal by hand. Refer to Adhesives, Fluids, Lubricants and Sealers .
3	Variable 3-4 and 2-3 Clutch Housing Fluid Seal Ring [2x]
4	Variable 3-4 and 2-3 Clutch Housing Fluid Passage Hub Gasket Procedure Apply trans jell on the gasket prior to installation. Refer to Adhesives, Fluids, Lubricants and Sealers .

Callout	Component Name
5	Drive Motor- Position 2 Procedure 1. Install 3 DT-51884 supports to the drive motor. 2. Install DT-51892 bridge to DT-51884 supports and secure with the wing bolts. 3. Install DT-51884 ring to the DT-51892 bridge. 4. Install a shop hoist to the ring to assist in the drive motor installation. Raise the drive motor to install the DT-51891 pins. 5. Install the DT-51891 pins into the bolt locations at the bottom of the drive motor, offset to the drive motor alignment pins. NOTE: Offsetting the DT-51891 pins with the drive motor alignment pins will help determine which bolt hole to align the DT-51891 pins with. 6. Ensure the drive motor electrical connector is aligned with the connector location on the transmission case. 7. Using the hoist, install the drive motor. NOTE: Ensure the DT-51891 pins do not scratch the transmission case during installation. NOTE: Ensure the transmission case remains secured in a vertical position with the engine mating surface down until the bolts securing the motor are installed. Special Tools • DT-51884 Motor A and B Lift Assist • DT-51891 Stator Alignment Pins • DT-51892 Bridge Kit Equivalent regional tools: Special Tools
6	Automatic Transmission Case Bolt [7x] CAUTION: Refer to Fastener Caution . NOTE: These 7 bolts mount the drive motor to the transmission case. Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

Callout	Component Name
7	Wiring Harness Connector Procedure 1. Visually inspect each terminal seal and ensure there are no cracks, nicks or swelling of the seal. Reinstall each seal if suitable for use. Replace the wiring harness connector if these conditions are present. NOTE: The terminal seals may have been retained in the case when the connector is removed. 2. Install the connector and ensure the connector header is fully seated in the transmission case and the 3 connector terminals are fully seated in the connector header. 3. Tighten the 3 connector terminal bolts inside the transmission case a first pass to 9 N.m (80 lb in). 4. Tighten the 3 bolts a final pass to 9 N.m (80 lb in) to ensure all fasteners are correctly tightened.
8	Wiring Harness Connector Bolt Tighten 9 N.m (80 lb in)

VARIABLE 3-4 AND 2-3 CLUTCH SHAFT INSTALLATION

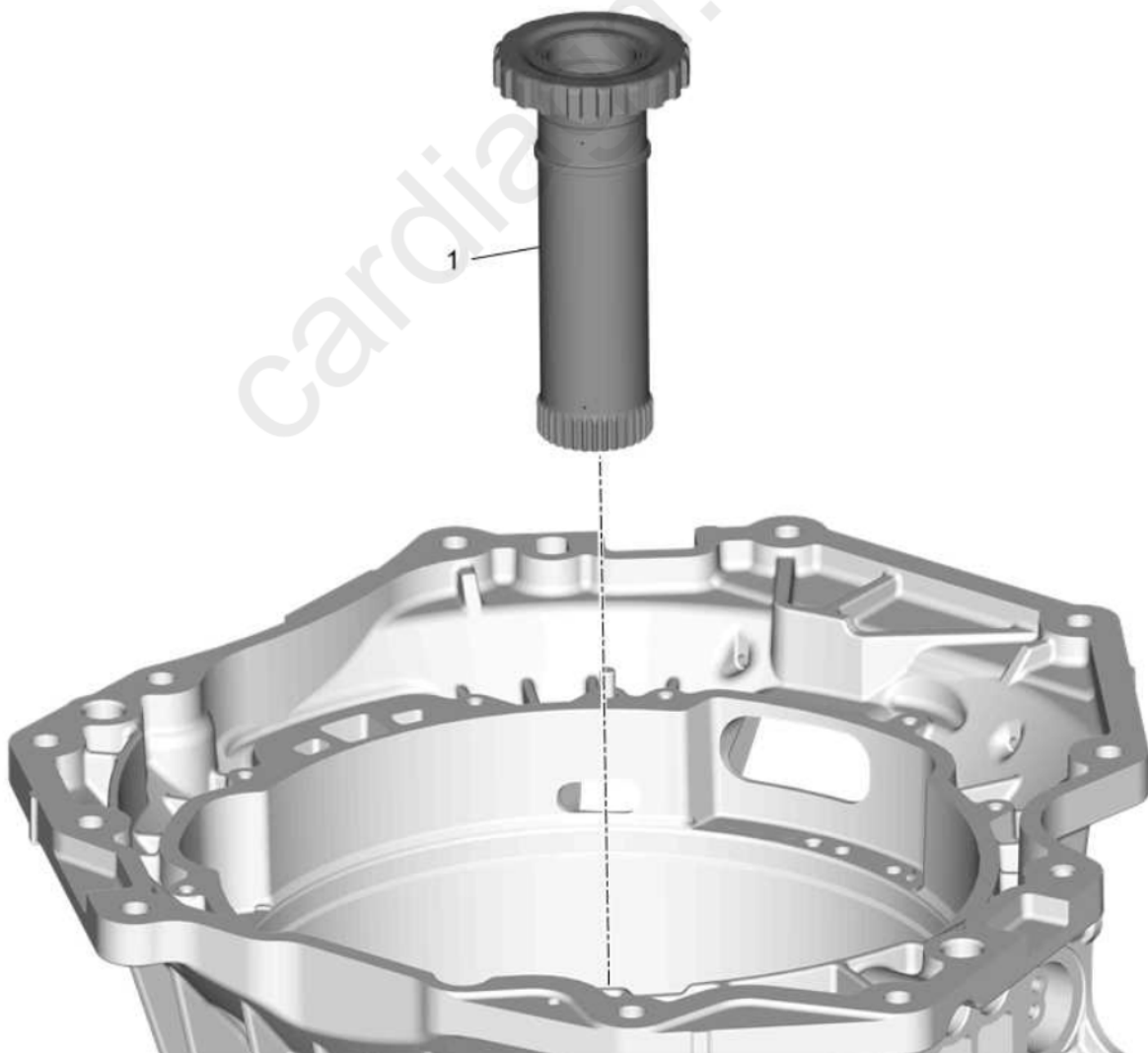


Fig. 33: Variable 3-4 and 2-3 Clutch Shaft
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 3-4 and 2-3 Clutch Shaft

SUN GEAR CARRIER, SUN GEAR AND SUN GEAR SHAFT INSTALLATION - 2ND POSITION

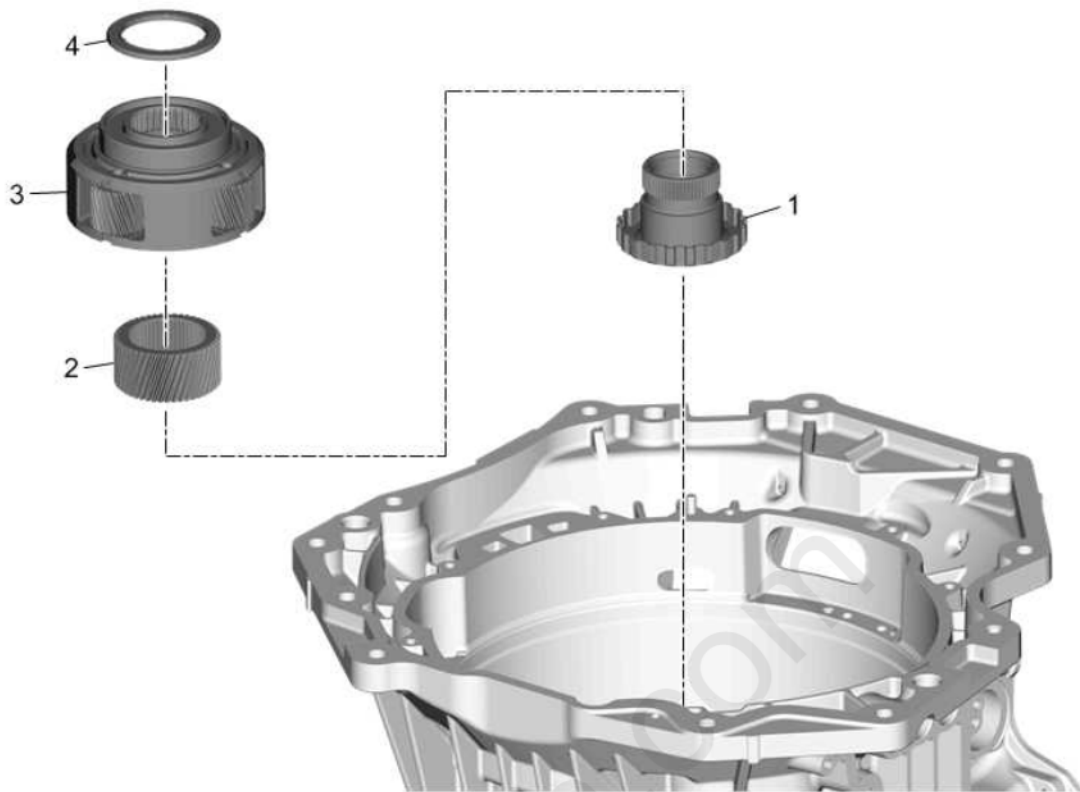


Fig. 34: Sun Gear Carrier, Sun Gear and Sun Gear Shaft - 2nd Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Sun Gear Shaft - Position 2
2	Sun Gear - Position 2
3	Sun Gear Carrier - Position 2

DRIVE MOTOR - 1ST POSITION AND VARIABLE 1-2-3-4 AND 1-2-3 CLUTCH DISASSEMBLE

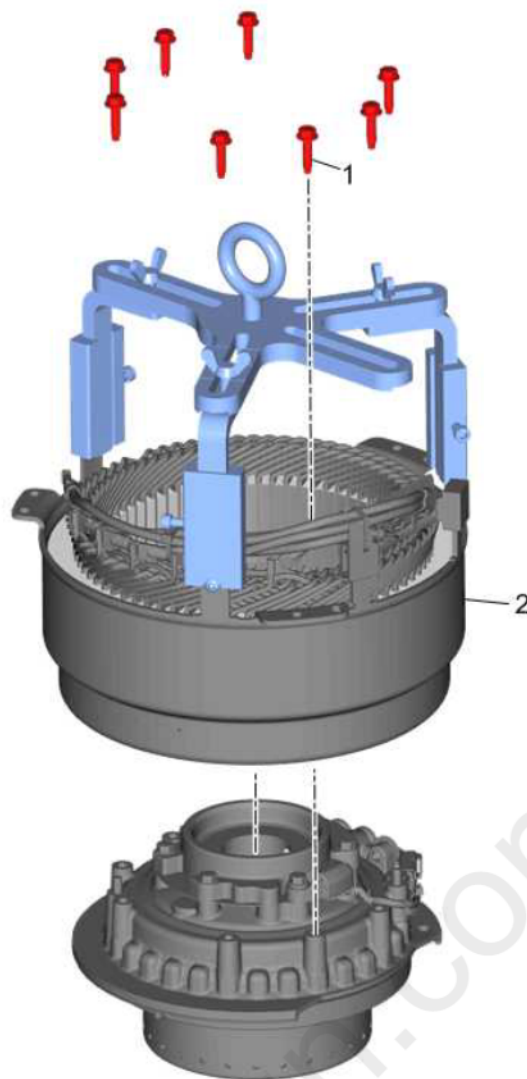


Fig. 35: Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Install 3 DT-51884 supports to the drive motor. 2. Install DT-51892 bridge to DT-51884 supports. 3. Install DT-51884 ring to the DT-51892 bridge. 4. Install a shop hoist to the ring to assist in the drive motor stator removal.	
Special Tools • DT-51884 Motor A and B Lift Assist • DT-51892 Bridge Kit	
Equivalent regional tools: Special Tools	
1	Variable 1-4 and 1-3 Clutch Bolt [8x]
2	Drive Motor Stator- Position 1

VARIABLE 1-2-3-4 AND 1-2-3 CLUTCH DISASSEMBLE

Clutch Disassemble 1

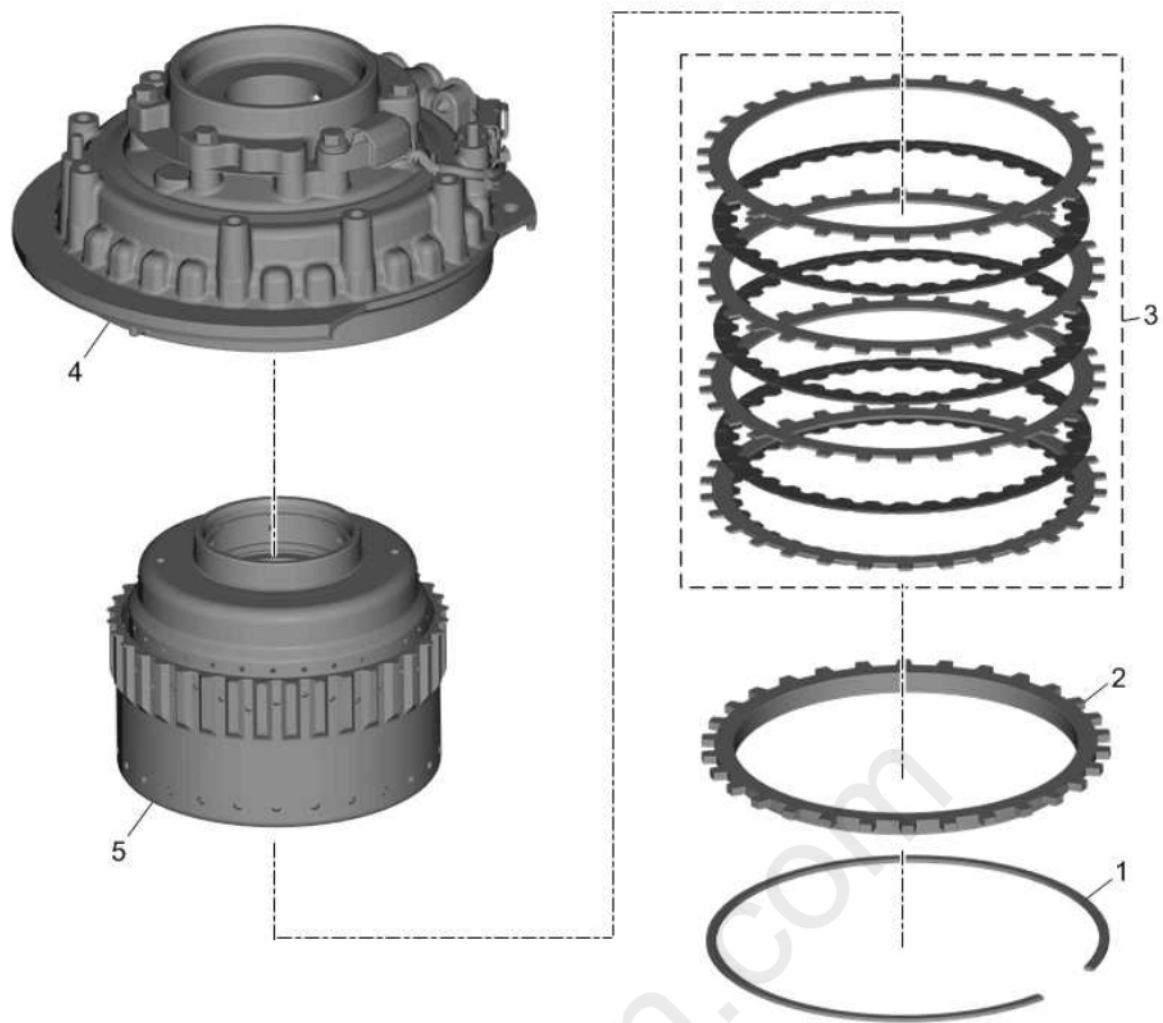


Fig. 36: Clutch Disassemble (1 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Disassemble 1

Callout	Component Name
1	Variable 1-4 and 1-3 Clutch Backing Plate Retaining Ring
2	Variable 1-4 and 1-3 Clutch Backing Plate
3	Variable 1-4 and 1-3 Clutch Plate • Variable 1-4 and 1-3 Clutch Plate • Variable 1-4 and 1-3 Clutch Friction Plate
4	Variable 1-4 and 1-3 Clutch Housing
5	Variable 2-3 and 1-2-3 Clutch Housing

Clutch Disassemble 2

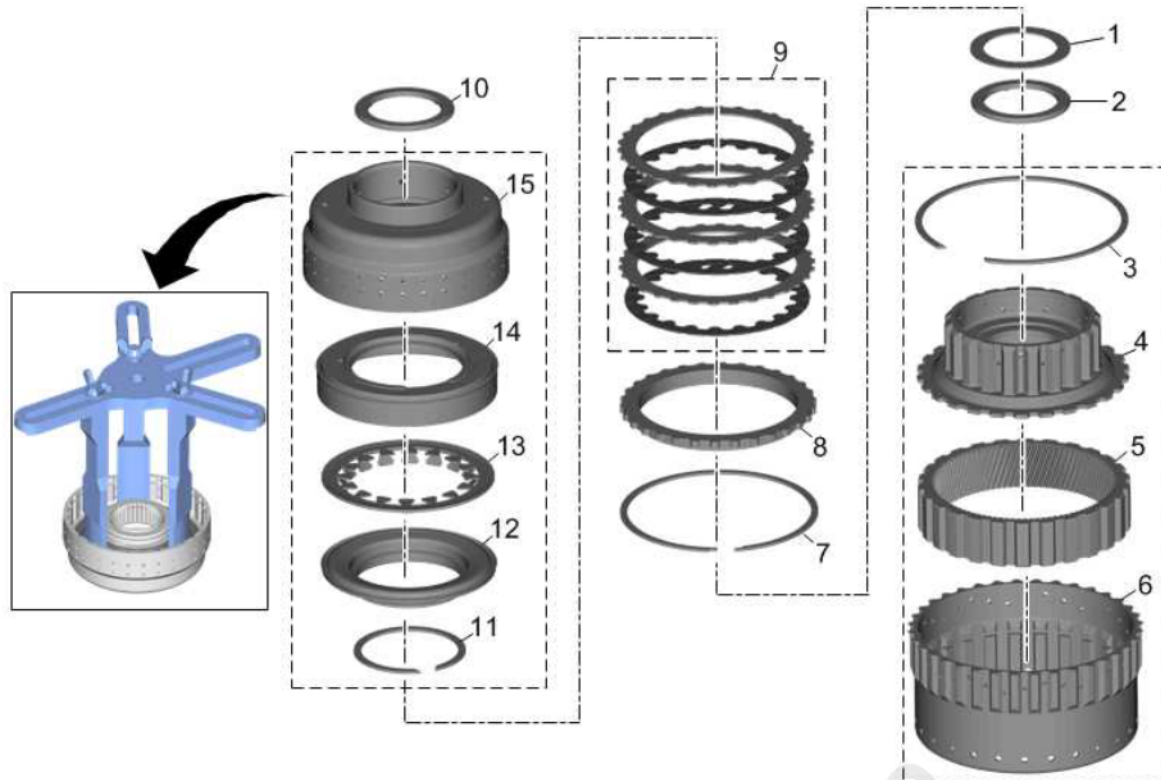


Fig. 37: Clutch Disassemble (2 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Disassemble 2

Callout	Component Name
1	2-3 and 1-2-3 Clutch Housing Thrust Washer
2	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
3	Variable 1-2-3-4 and 1-2-3 Clutch Hub Retaining Ring
4	Variable 2-3 and 1-2-3 Clutch Hub
5	Internal Gear- Position 2
6	Clutch Housing To Internal Gear Drum- Position 2
7	Variable 2-3 and 1-2-3 Clutch Backing Retaining Ring
8	Variable 2-3 and 1-2-3 Clutch Backing Plate
9	Variable 2-3 and 1-2-3 Clutch Plate - Variable 2-3 and 1-2-3 Clutch Plate - Variable 2-3 and 1-2-3 Clutch Friction Plate
10	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
11	Variable 2-3 and 1-2-3 Clutch Piston Dam Retaining Ring Special Tools DT-51892 Bridge Kit Equivalent regional tools: Special Tools
12	Variable 2-3 and 1-2-3 Clutch Piston Dam
13	Variable 2-3 and 1-2-3 Clutch Return Spring
14	Variable 2-3 and 1-2-3 Clutch Piston
15	Variable 2-3 and 1-2-3 Clutch Housing

Clutch Disassemble 3

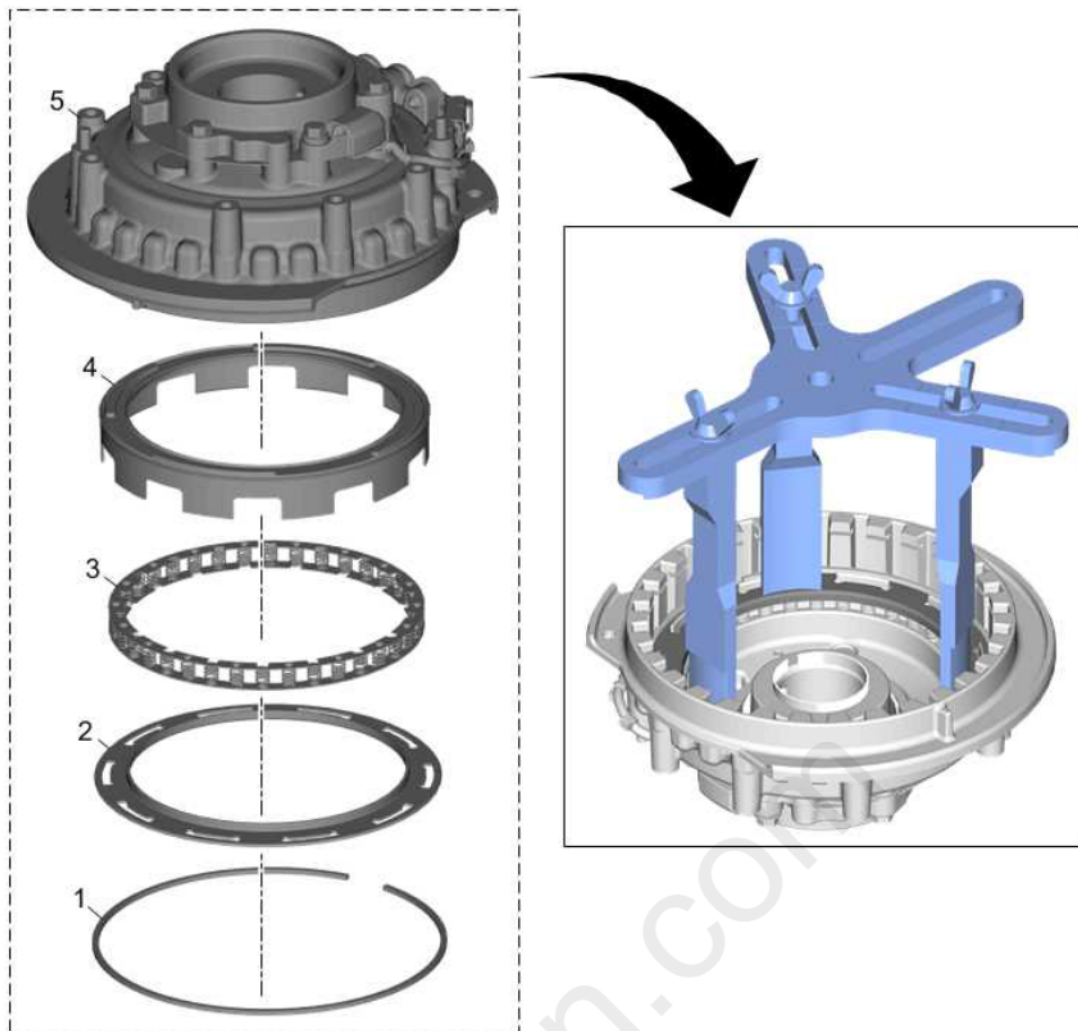


Fig. 38: Clutch Disassemble (3 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Disassemble 3

Callout	Component Name
1	Variable 1-4 and 1-3 Clutch Return Spring Ring Special Tools DT-51892 Bridge Kit Equivalent regional tools: Special Tools
2	Variable 1-4 and 1-3 Clutch Piston Return Spring Plate
3	Variable 1-4 and 1-3 Clutch Return Spring
4	Variable 1-4 and 1-3 Clutch Piston

Clutch Disassemble 4

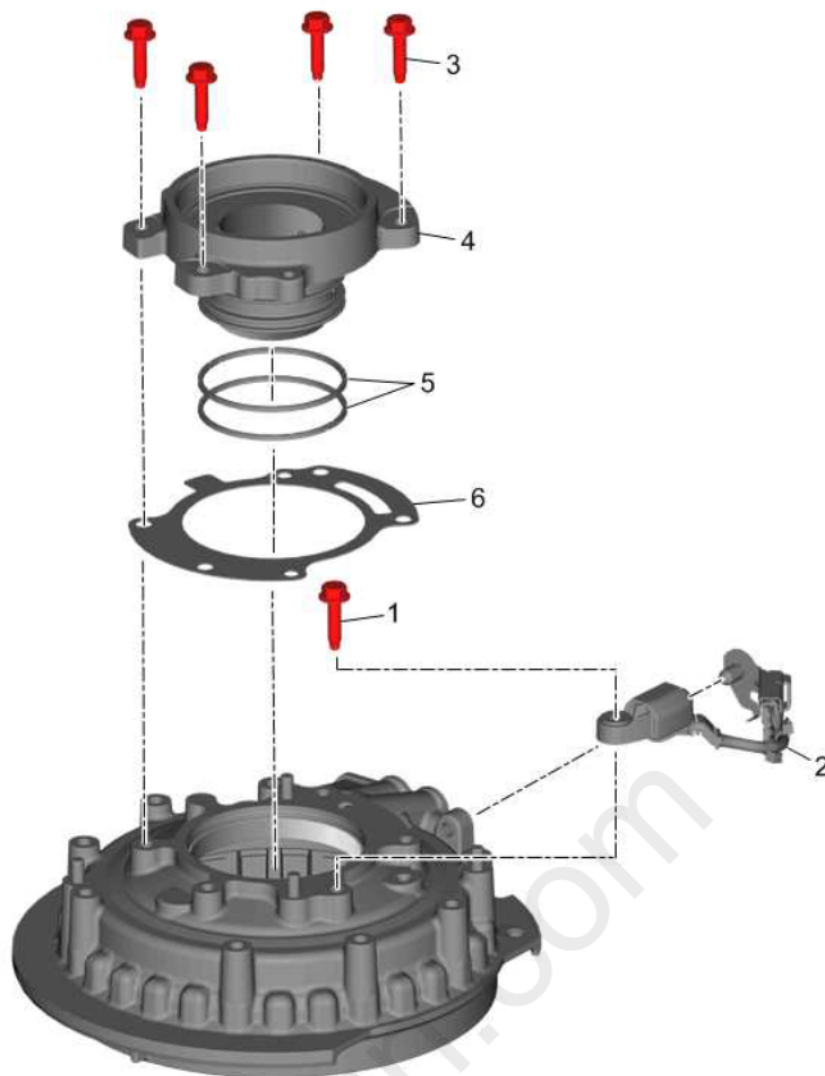


Fig. 39: Clutch Disassemble (4 Of 4)
 Courtesy of GENERAL MOTORS COMPANY

Clutch Disassemble 4

Callout	Component Name
1	Automatic Transmission Speed Sensor Bolt
2	Drive Motor Speed and Direction Sensor
3	Variable 1-4 and 1-3 Clutch Bolt [4x]
4	Variable 2-3 and 1-2-3 Clutch Housing Fluid Passage Hub
5	Variable 2-3 and 1-2-3 Clutch Housing Fluid Seal Ring [2x]
6	Variable 1-4 and 1-3 Clutch Housing Fluid Passage Hub Gasket

VARIABLE 1-2-3-4 AND 1-2-3 CLUTCH ASSEMBLE

Clutch Assemble 1

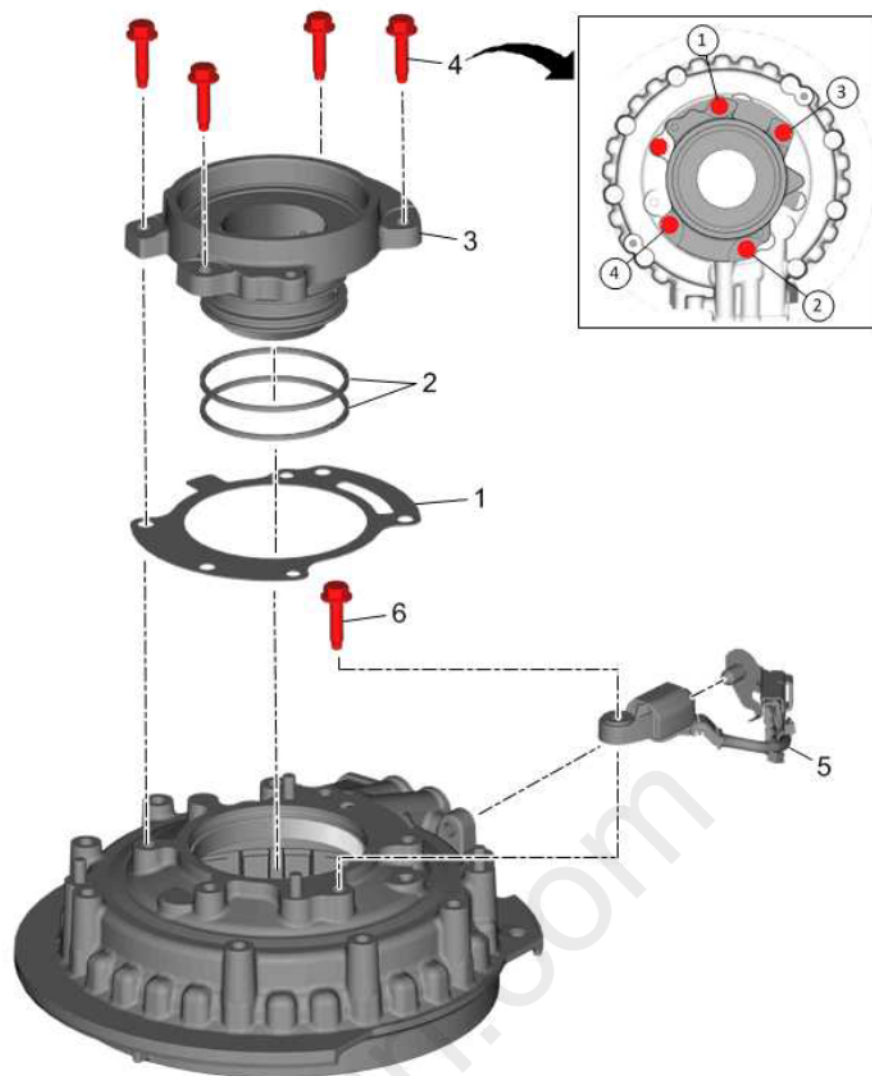


Fig. 40: Clutch Assembly (1 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Assemble 1

Callout	Component Name
1	Variable 1-4 and 1-3 Clutch Housing Fluid Passage Hub Gasket
2	Variable 2-3 and 1-2-3 Clutch Housing Fluid Seal Ring [2x]
3	Variable 2-3 and 1-2-3 Clutch Housing Fluid Passage Hub
4	Variable 1-4 and 1-3 Clutch Bolt [4x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)
5	Drive Motor Speed and Direction Sensor
6	Automatic Transmission Speed Sensor Bolt Tighten 9 N.m (80 lb in)

Clutch Assemble 2

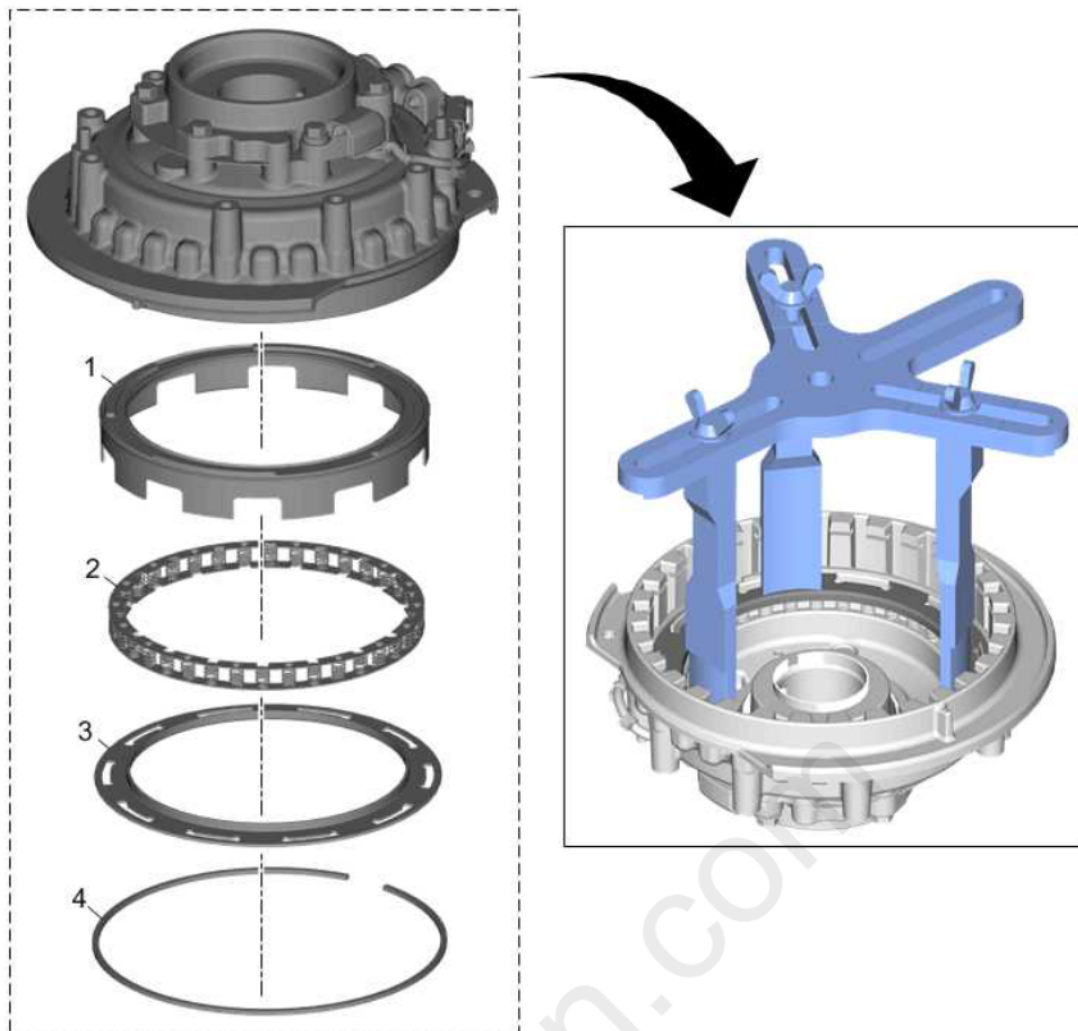


Fig. 41: Clutch Assemble (2 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Assemble 2

Callout	Component Name
1	Variable 1-4 and 1-3 Clutch Piston
2	Variable 1-4 and 1-3 Clutch Return Spring
3	Variable 1-4 and 1-3 Clutch Piston Return Spring Plate
4	Variable 1-4 and 1-3 Clutch Return Spring Ring Special Tools DT-51892 Bridge Kit Equivalent regional tools: Special Tools

Clutch Assemble 3

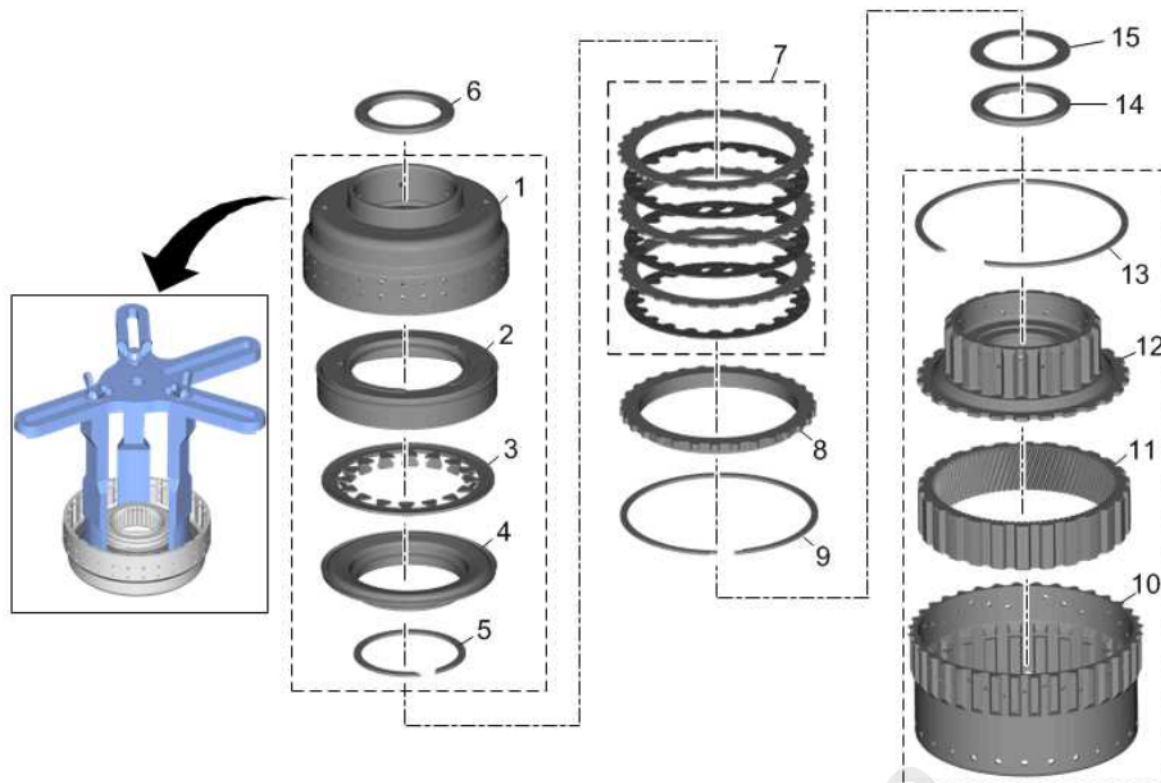


Fig. 42: Clutch Assemble (3 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Assemble 3

Callout	Component Name
1	Variable 2-3 and 1-2-3 Clutch Housing
2	Variable 2-3 and 1-2-3 Clutch Piston
3	Variable 2-3 and 1-2-3 Clutch Return Spring
4	Variable 2-3 and 1-2-3 Clutch Piston Dam
5	Variable 2-3 and 1-2-3 Clutch Piston Dam Retaining Ring Special Tools DT-51892 Bridge Kit Equivalent regional tools: Special Tools
6	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
7	Variable 2-3 and 1-2-3 Clutch Plate - Variable 2-3 and 1-2-3 Clutch Plate - Variable 2-3 and 1-2-3 Clutch Friction Plate
8	Variable 2-3 and 1-2-3 Clutch Backing Plate
9	Variable 2-3 and 1-2-3 Clutch Backing Retaining Ring
10	Clutch Housing To Internal Gear Drum - Position 2
11	Internal Gear - Position 2
12	Variable 2-3 and 1-2-3 Clutch Hub
13	Variable 1-2-3-4 and 1-2-3 Clutch Hub Retaining Ring
14	Variable 2-3 and 1-2-3 Clutch Hub Thrust Bearing
15	2-3 and 1-2-3 Clutch Housing Thrust Washer

Clutch Assemble 4

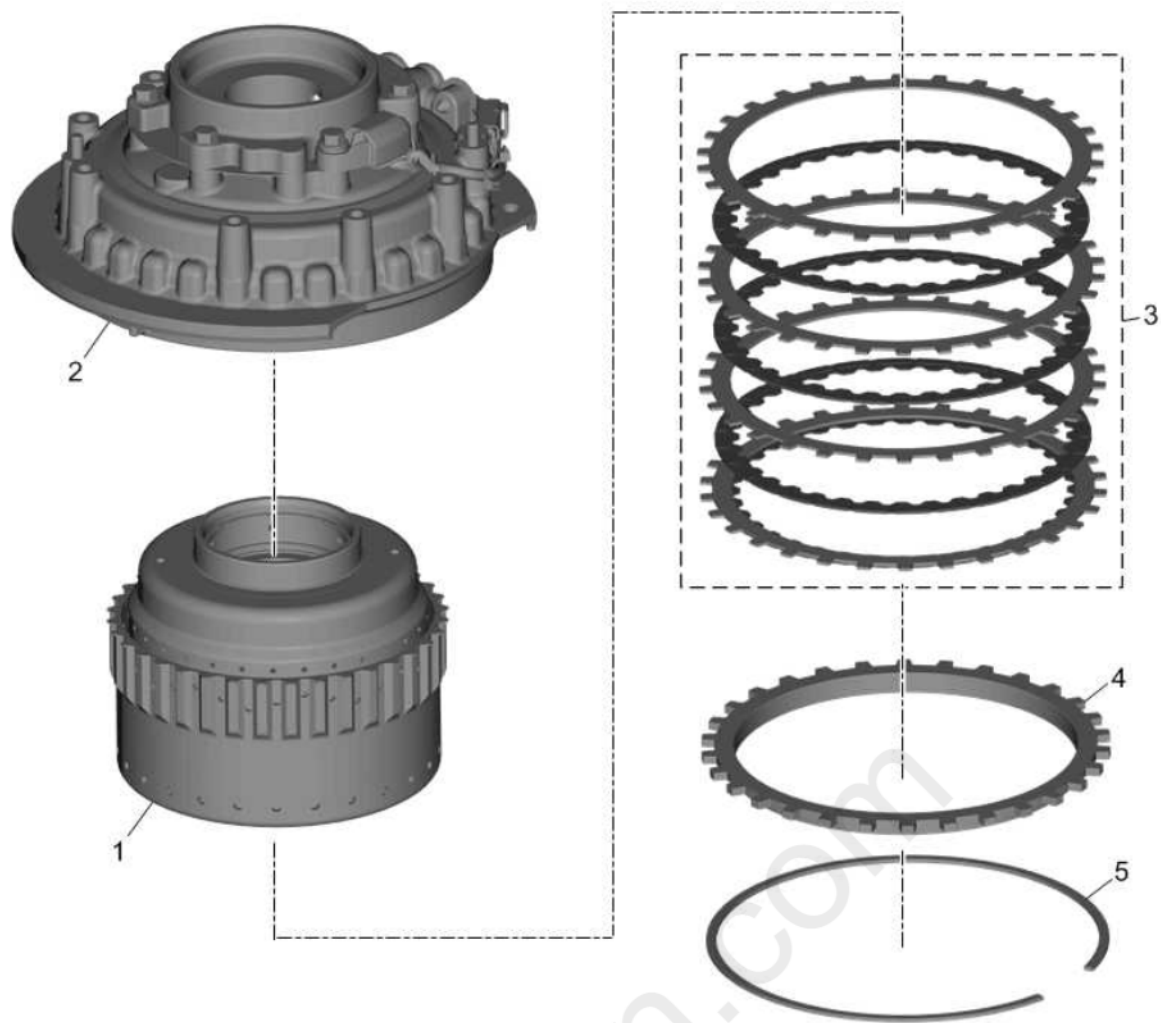


Fig. 43: Clutch Assemble (4 Of 4)

Courtesy of GENERAL MOTORS COMPANY

Clutch Assemble 4

Callout	Component Name
1	Variable 2-3 and 1-2-3 Clutch Housing
2	Variable 1-4 and 1-3 Clutch Housing
3	Variable 1-4 and 1-3 Clutch Plate • Variable 1-4 and 1-3 Clutch Plate • Variable 1-4 and 1-3 Clutch Friction Plate
4	Variable 1-4 and 1-3 Clutch Backing Plate
5	Variable 1-4 and 1-3 Clutch Backing Plate Retaining Ring

DRIVE MOTOR - 1ST POSITION AND VARIABLE 1-2-3-4 AND 1-2-3 CLUTCH ASSEMBLE

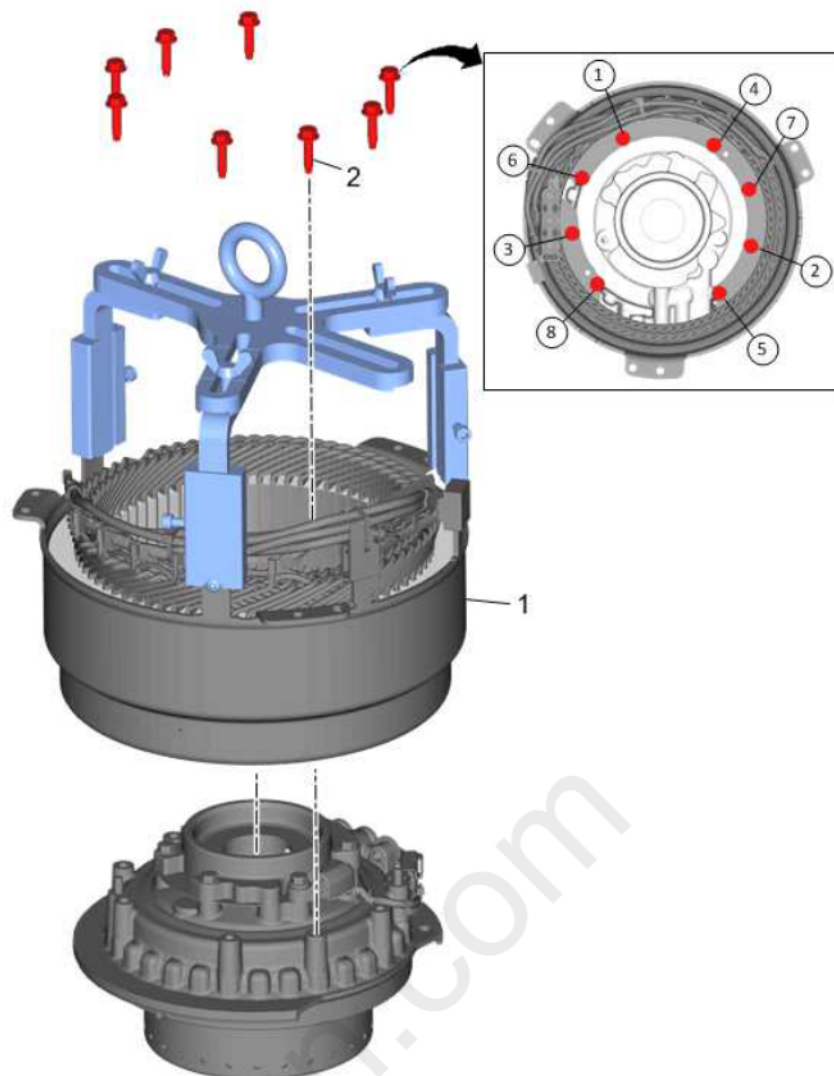


Fig. 44: Drive Motor - 1st Position and Variable 1-2-3-4 and 1-2-3 Clutch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Install 3 DT-51884 supports to the drive motor. 2. Install DT-51892 bridge to DT-51884 supports. 3. Install DT-51884 ring to the DT-51892 bridge. 4. Install a shop hoist to the ring to assist in the drive motor stator installation.	
Special Tools • DT-51884 Motor A and B Lift Assist • DT-51892 Bridge Kit	
Equivalent regional tools: Special Tools	
1	Drive Motor Stator - Position 1
2	Variable 1-4 and 1-3 Clutch Bolt [8x] CAUTION: Refer to <u>Fastener Caution</u> . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

Drive Motor Installation

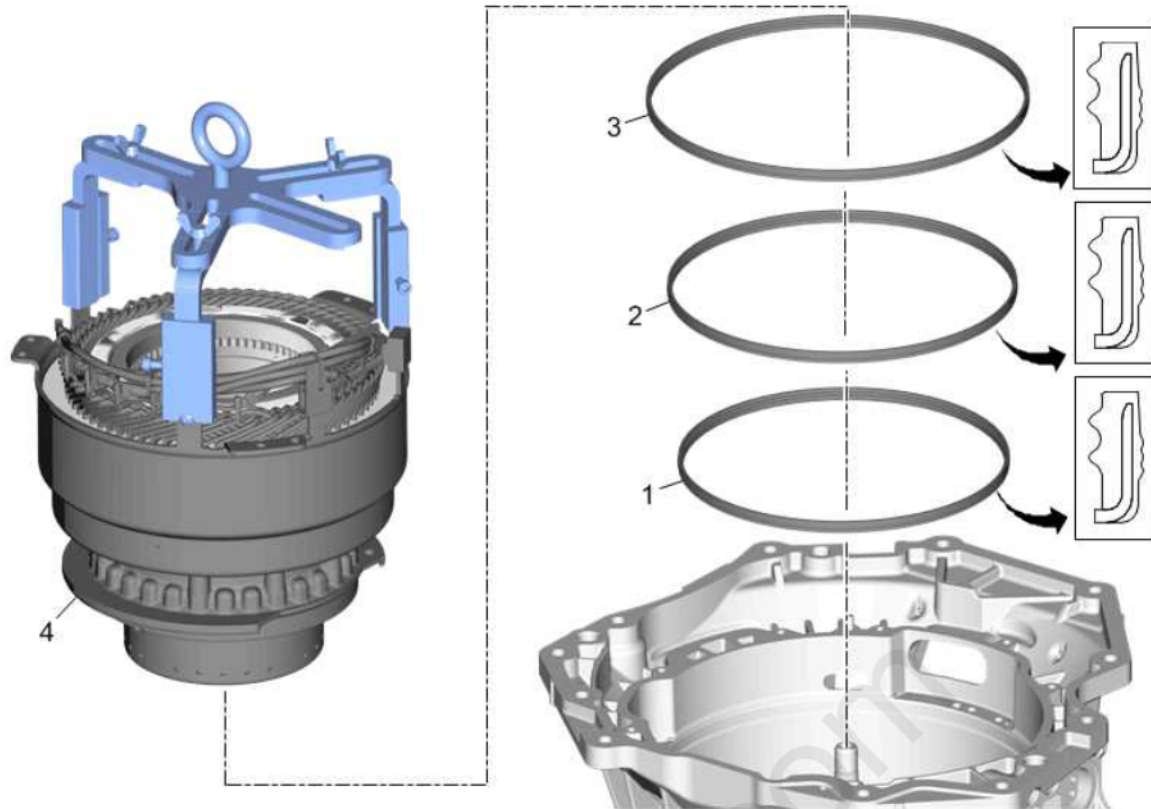


Fig. 45: Drive Motor

Courtesy of GENERAL MOTORS COMPANY

Drive Motor Installation

Callout	Component Name
1	Clutch Housing Seal Procedure Lubricate and install the seal by hand. Refer to Adhesives, Fluids, Lubricants and Sealers .
2	Drive Motor Stator Housing Rear Seal - Position 1 Procedure Lubricate and install the seal by hand. Refer to Adhesives, Fluids, Lubricants and Sealers .
3	Drive Motor Stator Housing Front Seal - Position 1 Procedure Lubricate and install the seal by hand. Refer to Adhesives, Fluids, Lubricants and Sealers .

Callout	Component Name
4	Drive Motor Stator - Position 1, Drive Motor Rotor - Position 1 and Variable 1-2-3-4 and 1-2-3 Clutch Procedure 1. Install 3 DT-51884 supports to the drive motor. 2. Install DT-51892 bridge to DT-51884 supports. 3. Install DT-51884 ring to the DT-51892 bridge. 4. Install a shop hoist to the ring to assist in the drive motor installation. Special Tools • DT-51884 Motor A and B Lift Assist • DT-51892 Bridge Kit Equivalent regional tools: Special Tools

Wiring Harness Connector and Automatic Transmission Case Bolt Installation

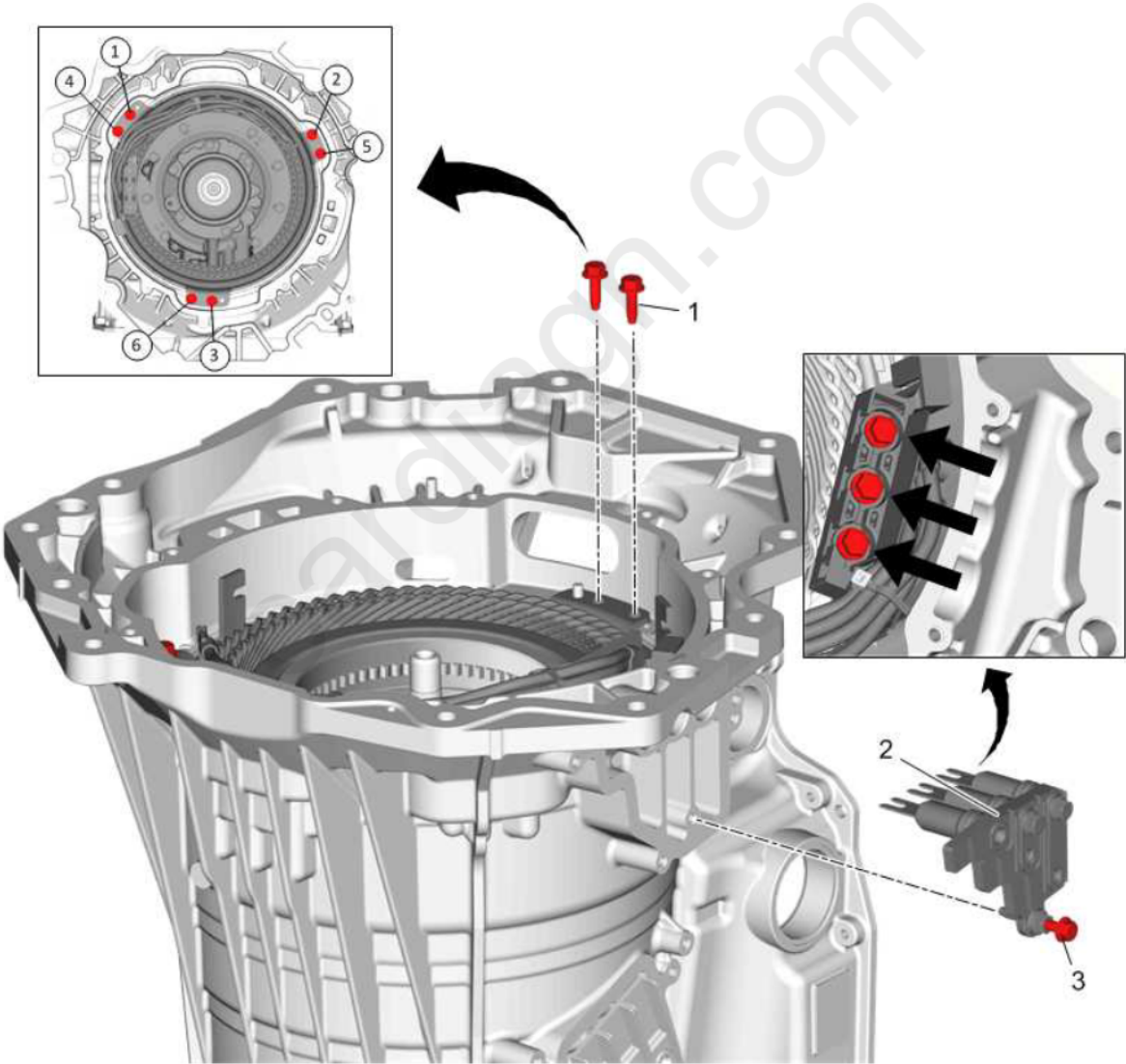


Fig. 46: Wiring Harness Connector and Automatic Transmission Case Bolt
 Courtesy of GENERAL MOTORS COMPANY

Wiring Harness Connector and Automatic Transmission Case Bolt Installation

Callout	Component Name

Callout	Component Name
1	Automatic Transmission Case Bolt [6x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)
2	Wiring Harness Connector Procedure 1. Visually inspect each terminal seal and ensure there are no cracks, nicks or swelling of the seal. Reinstall each seal if suitable for use. Replace the wiring harness connector if these conditions are present. NOTE: The terminal seals may have been retained in the case when the connector is removed. 2. Install the connector and ensure the connector header is fully seated in the transmission case and the 3 connector terminals are fully seated in the connector header. 3. Tighten the 3 connector terminal bolts inside the transmission case a first pass to 9 N.m (80 lb in). 4. Tighten the 3 bolts a final pass to 9 N.m (80 lb in) to ensure all fasteners are correctly tightened.
3	Wiring Harness Connector Bolt Tighten 9 N.m (80 lb in)

MAIN SHAFT AND VARIABLE 2-3 AND 1-2-3 CLUTCH SHAFT INSTALLATION

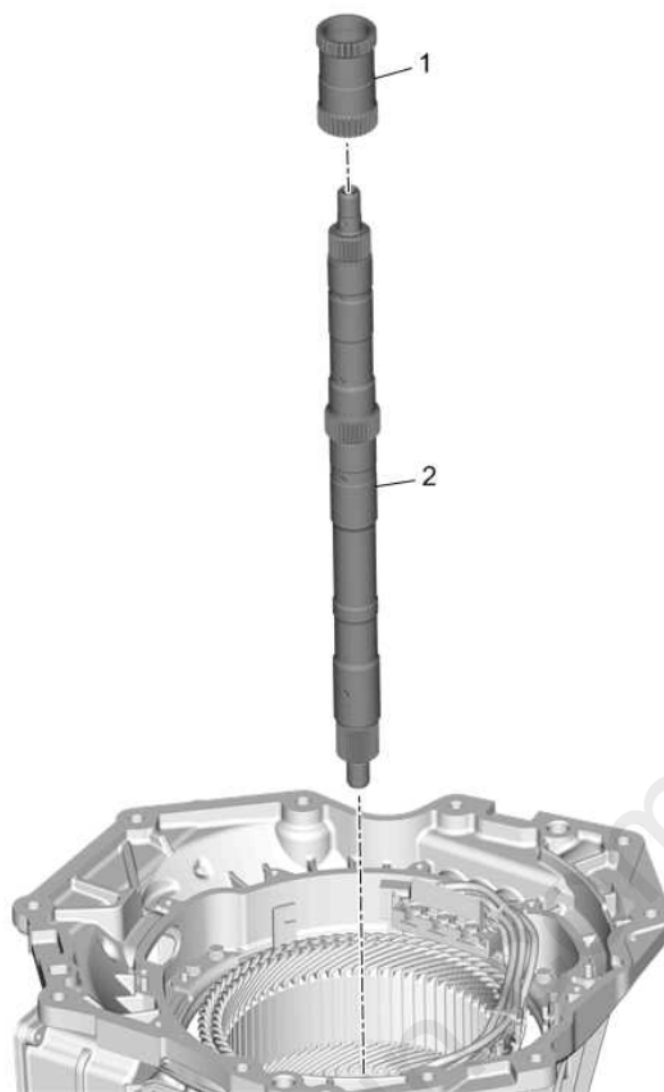


Fig. 47: Main Shaft and Variable 2-3 and 1-2-3 Clutch Shaft

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 2-3 and 1-2-3 Clutch Shaft Procedure Install the variable 2-3 and 1-2-3 clutch shaft on the main shaft.
2	Main Shaft

DRIVE MOTOR ROTOR INSTALLATION - 1ST POSITION

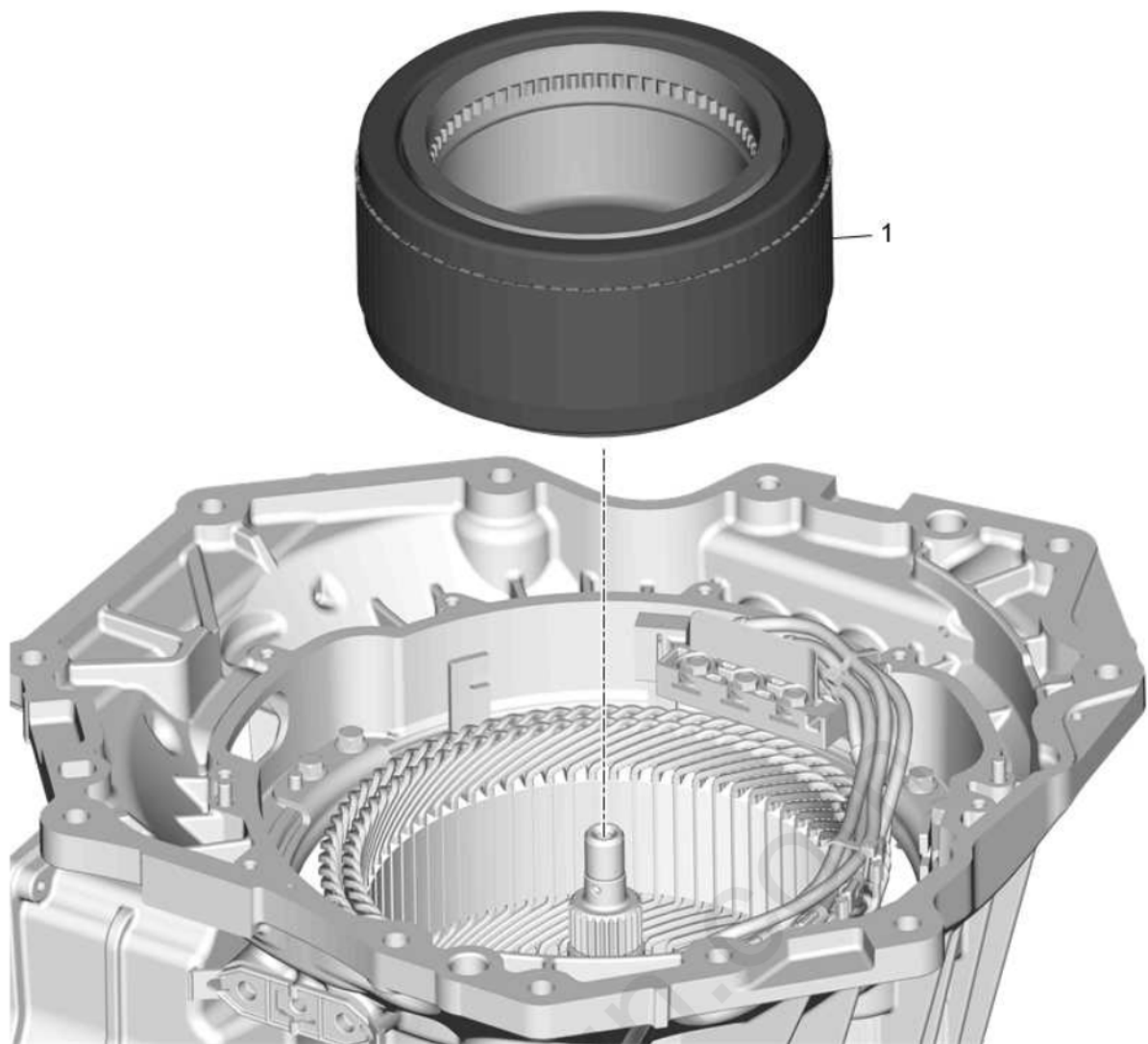


Fig. 48: Drive Motor Rotor - 1st Position

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Install DT-51887 stator protector sheets between the stator and rotor before rotor installation.	
Special Tools DT-51887 Stator Protector Equivalent regional tools: Special Tools	
1	Drive Motor Rotor

INPUT SHAFT, SUN GEAR CARRIER, SUN GEAR AND SUN GEAR SHAFT INSTALLATION - 1ST POSITION

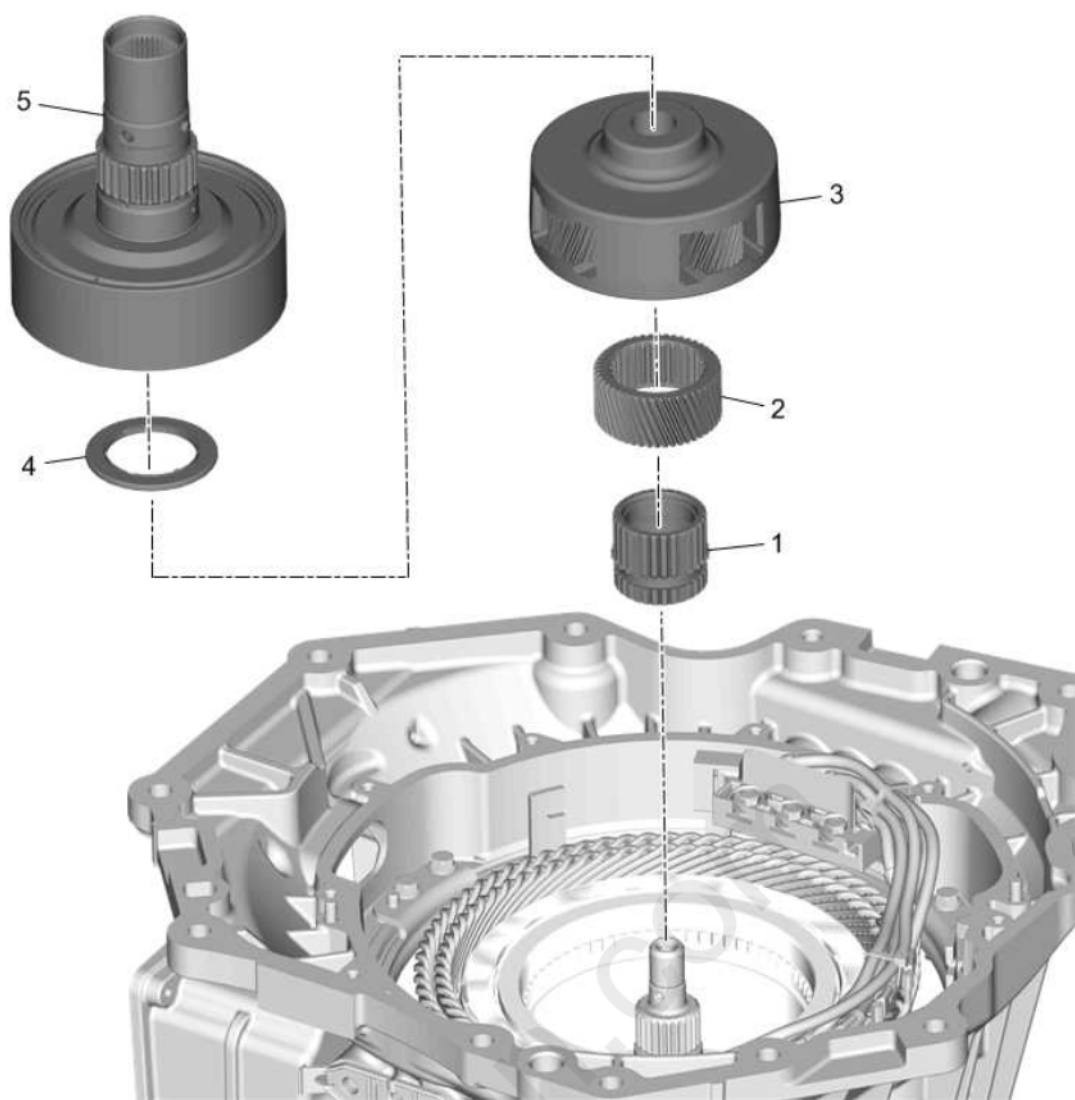


Fig. 49: Input Shaft, Sun Gear Carrier, Sun Gear and Sun Gear Shaft - 1st Position
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Sun Gear Shaft- Position 1
2	Sun Gear- Position 1
3	Sun Gear Carrier- Position 1
4	Sun Gear Carrier Thrust Bearing- Position 1
5	Input Shaft

DRIVE MOTOR ROTOR BEARING AND INPUT SHAFT THRUST BEARING INSTALLATION

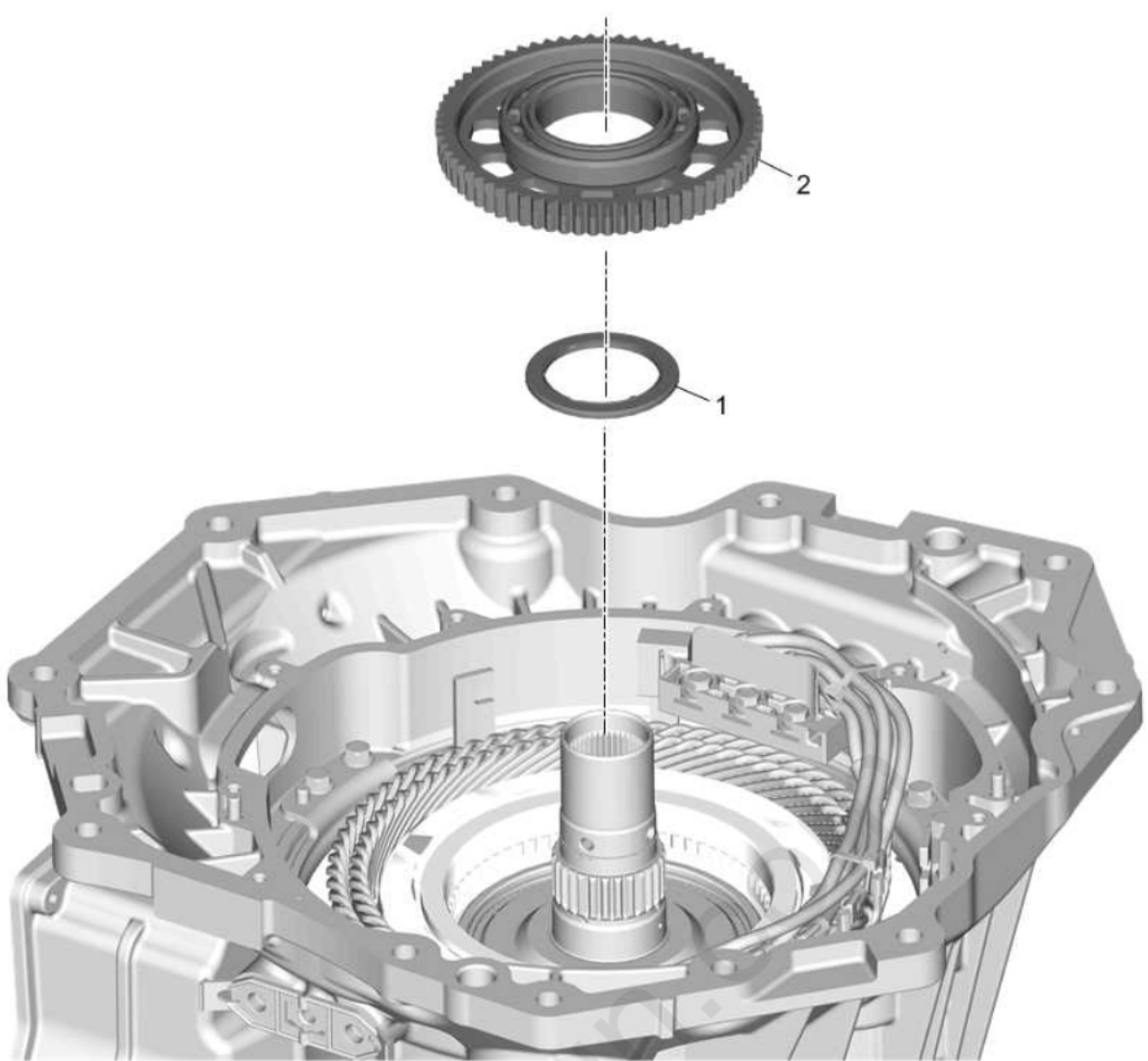


Fig. 50: Drive Motor Rotor Bearing and Input Shaft Thrust Bearing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Input Shaft Thrust Bearing
2	Drive Motor Rotor Bearing

TORQUE DAMPENER HOUSING DISASSEMBLE

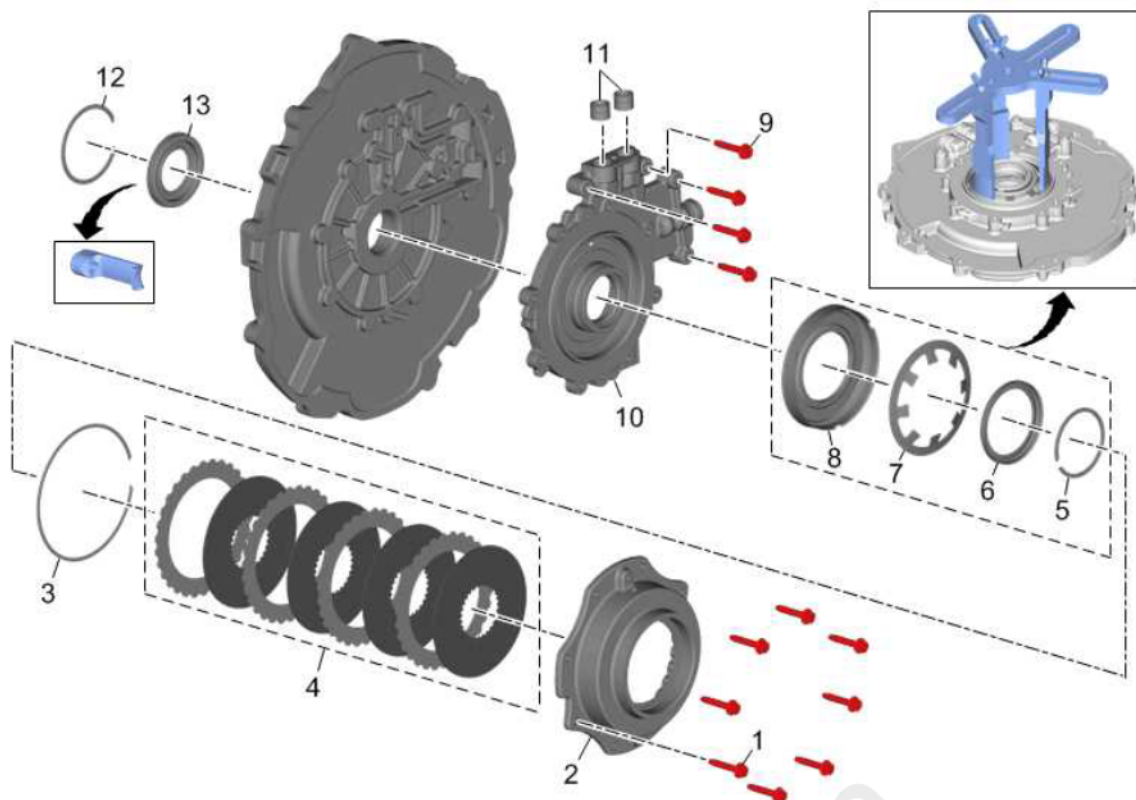


Fig. 51: Torque Dampener Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Torque Dampener Housing Bolt [8x]
2	Variable 1-2-3-4 Clutch Backing Plate
3	Variable 1-2-3-4 Clutch Backing Plate Retaining Ring
4	Variable 1-2-3-4 Clutch Plate - Variable 1-2-3-4 Clutch Plate - Variable 1-2-3-4 Clutch Friction Plate
5	Variable 1-2-3-4 Clutch Housing Ring Special Tools DT-51892 Bridge Kit Equivalent regional tools: Special Tools
6	Variable 1-2-3-4 Clutch Piston Return Spring Plate
7	Variable 1-2-3-4 Clutch Piston Return Spring
8	Variable 1-2-3-4 Clutch Piston
9	Automatic Transmission Torque Dampener Housing Bolt [4x]
10	Variable 1-2-3-4 Clutch Housing
11	1-2-3-4 Clutch Piston Housing Seal
12	Automatic Transmission Torque Dampener Fluid Seal Retaining Ring
13	Automatic Transmission Torque Dampener Seal Special Tools GE-6125-1B Slide Hammer DT-23129 Universal Seal Remover Equivalent regional tools: Special Tools

TORQUE DAMPENER HOUSING ASSEMBLE

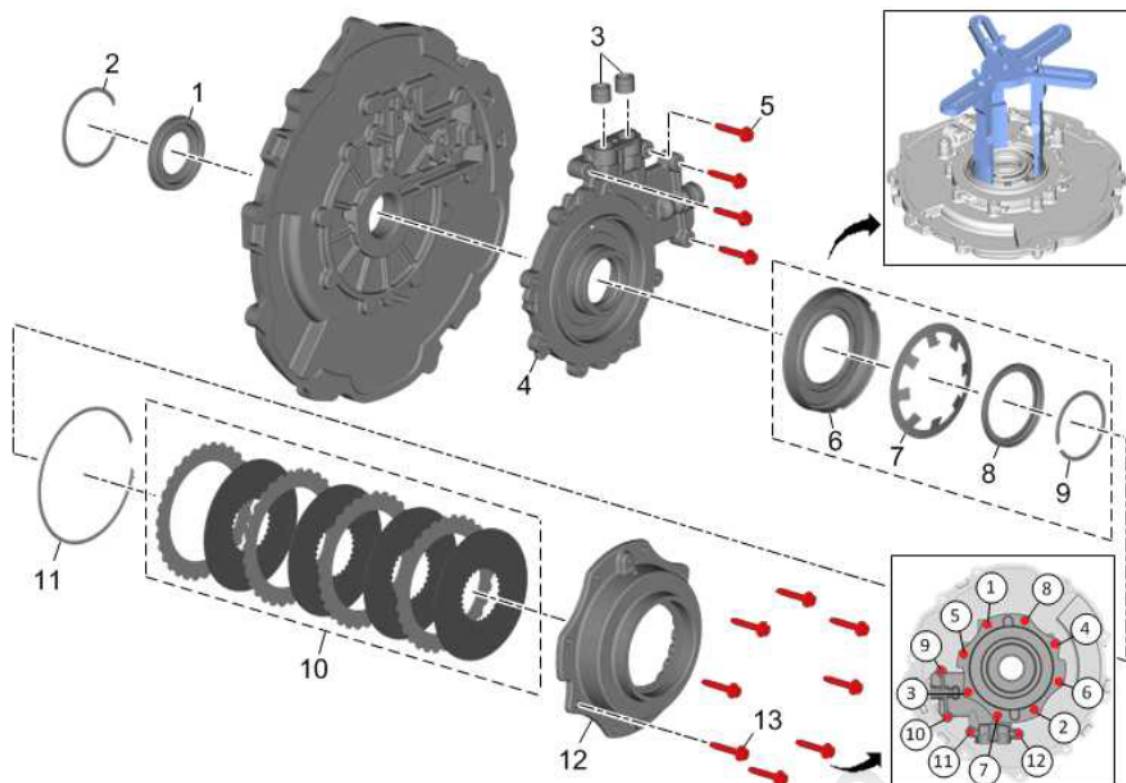


Fig. 52: Torque Dampener Housing
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Torque Dampener Seal
2	Automatic Transmission Torque Dampener Fluid Seal Retaining Ring
3	1-2-3-4 Clutch Piston Housing Seal
4	Variable 1-2-3-4 Clutch Housing
5	Automatic Transmission Torque Dampener Housing Bolt [4x] NOTE: Install the bolts by hand. Tighten all 12 torque dampener housing bolts in sequence when all components are assembled.
6	Variable 1-2-3-4 Clutch Piston
7	Variable 1-2-3-4 Clutch Piston Return Spring
8	Variable 1-2-3-4 Clutch Piston Return Spring Plate
9	Variable 1-2-3-4 Clutch Housing Ring Special Tools DT-51892 Bridge Kit Equivalent regional tools: Special Tools
10	Variable 1-2-3-4 Clutch Plate - Variable 1-2-3-4 Clutch Plate - Variable 1-2-3-4 Clutch Friction Plate
11	Variable 1-2-3-4 Clutch Backing Plate Retaining Ring
12	Variable 1-2-3-4 Clutch Backing Plate

Callout	Component Name
13	Automatic Transmission Torque Dampener Housing Bolt [8x] CAUTION: Refer to Fastener Caution . NOTE: Tighten all 12 torque dampener housing bolts in sequence. Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

TORQUE DAMPENER HOUSING INSTALLATION

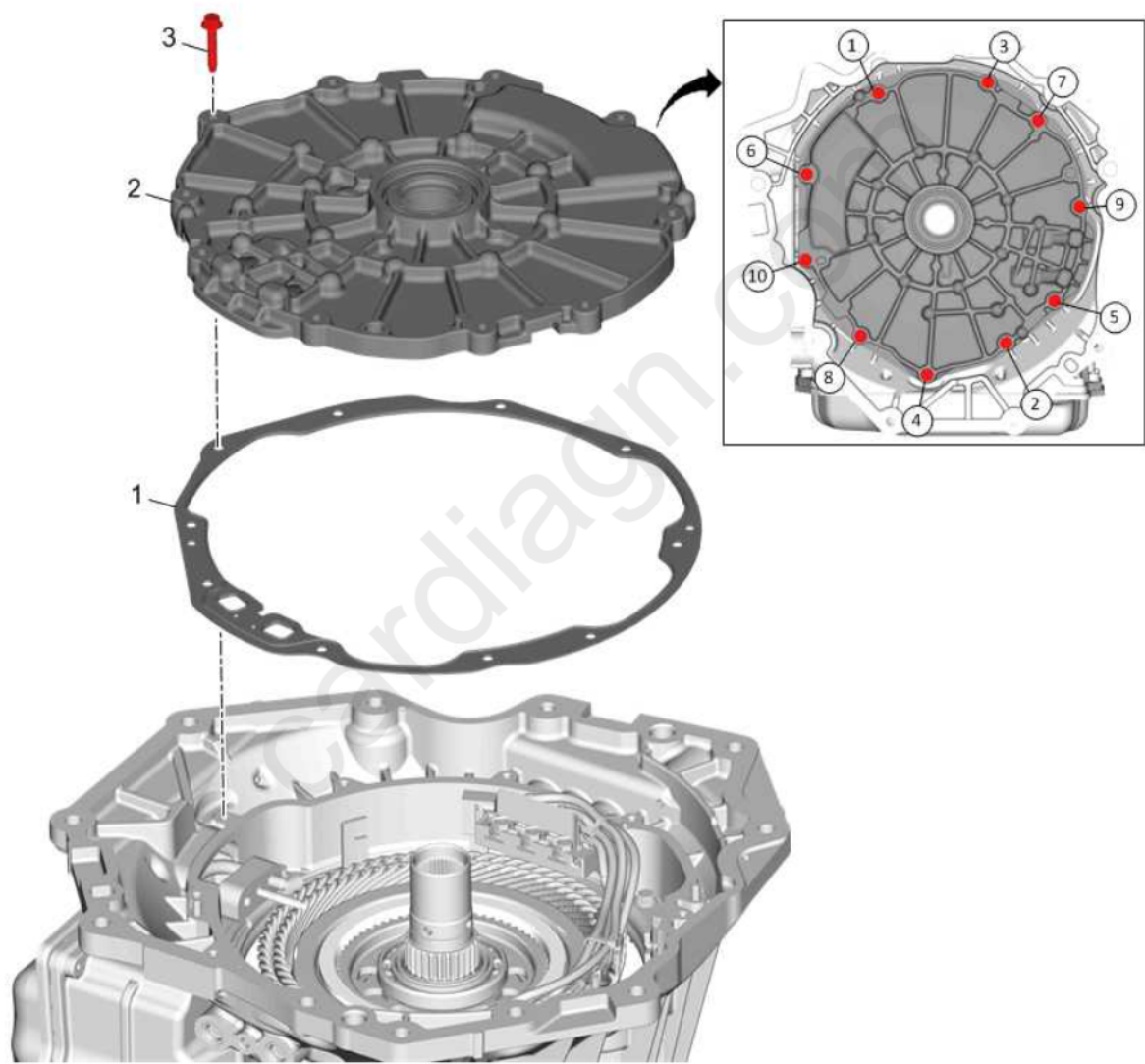


Fig. 53: Torque Dampener Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Torque Dampener Housing Gasket
2	Automatic Transmission Torque Dampener Housing
	NOTE: It may be necessary to rotate the input shaft to fully seat the housing.

Callout	Component Name
3	Automatic Transmission Case Bolt [10x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

VARIABLE 1-2 AND 1-2 CLUTCH PISTON INSTALLATION

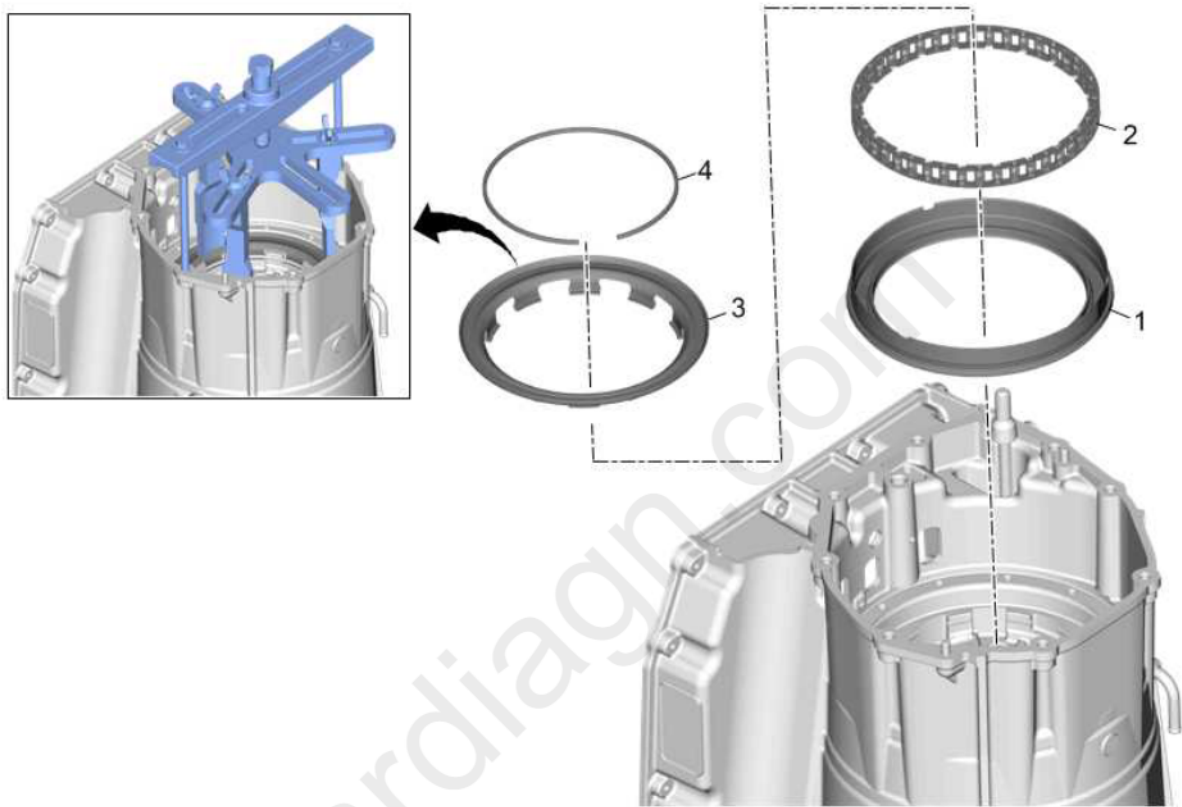


Fig. 54: Variable 1-2 and 1-2 Clutch Piston
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 1-2 and 1-2 Clutch Piston
2	Variable 1-2 and 1-2 Clutch Piston Return Spring
3	Variable 1-2 and 1-2 Clutch Piston Return Spring Plate
4	Variable 1-2 and 1-2 Clutch Piston Return Spring Retaining Ring Special Tools • GE-8433-1 Puller Bar • DT-51889 Bolt Set • DT-51892 Bridge Kit Equivalent regional tools: Special Tools

VARIABLE 3-4 AND 2-3 CLUTCH HOUSING CLEANING AND INSPECTION

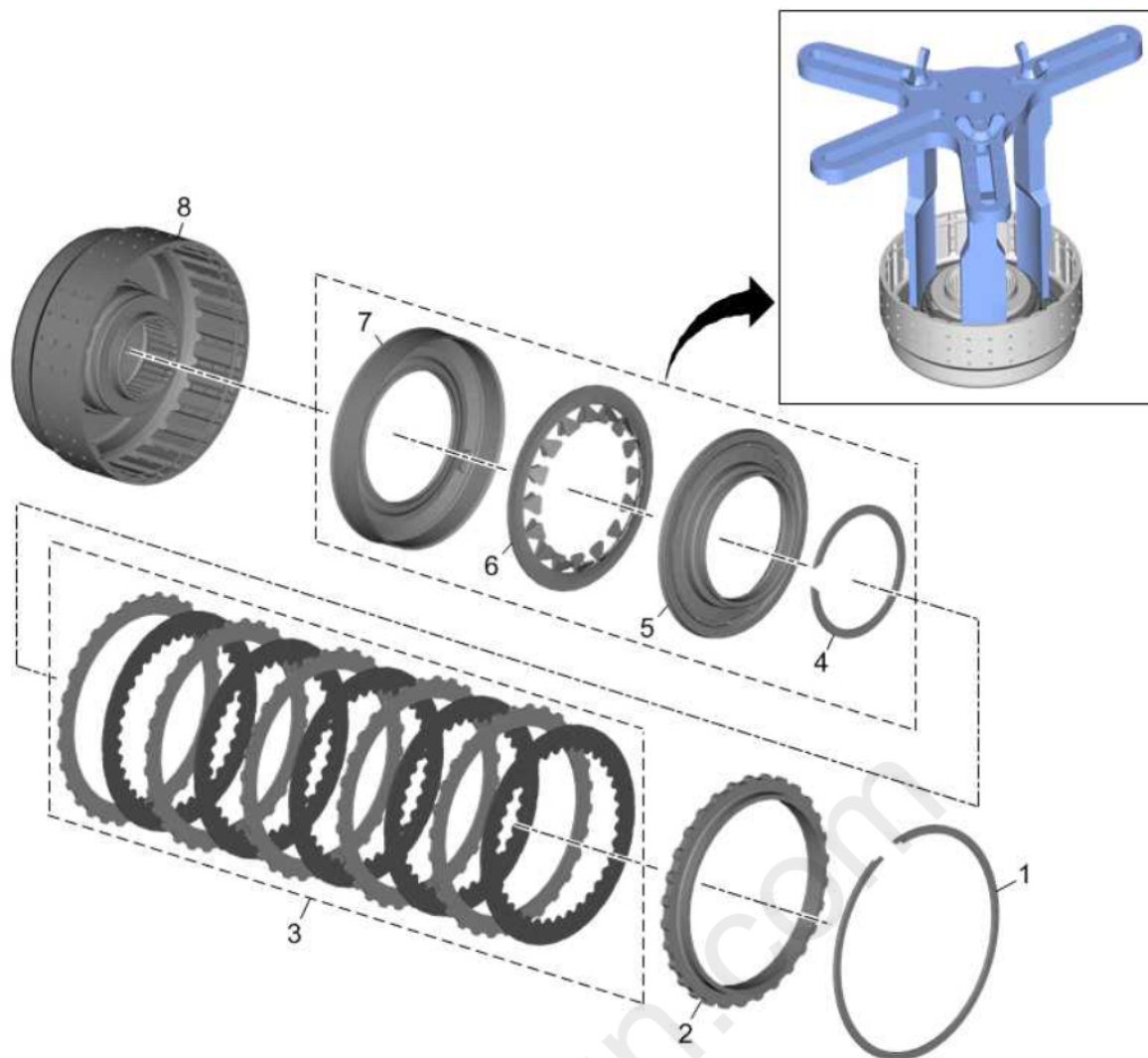


Fig. 55: Variable 3-4 and 2-3 Clutch Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Disassemble and inspect each component. Replace the entire assembly if unsuitable for use.	
1	Variable 3-4 and 2-3 Clutch Backing Plate Retaining Ring
2	Variable 3-4 and 2-3 Clutch Backing Plate
3	Variable 3-4 and 2-3 Clutch Plate • Variable 3-4 and 2-3 Clutch Plate [5x] • Variable 3-4 and 2-3 Clutch Friction Plate [5x]
4	Variable 3-4 and 2-3 Clutch Piston Dam Retaining Ring
Special Tools	
DT-51892 Bridge Kit	
Equivalent regional tools: Special Tools	
5	Variable 3-4 and 2-3 Clutch Piston Dam
6	Variable 3-4 and 2-3 Clutch Piston Return Spring
7	Variable 3-4 and 2-3 Clutch Piston
8	Variable 3-4 and 2-3 Clutch Housing

VARIABLE 3-4 AND 2-3 CLUTCH HOUSING INSTALLATION

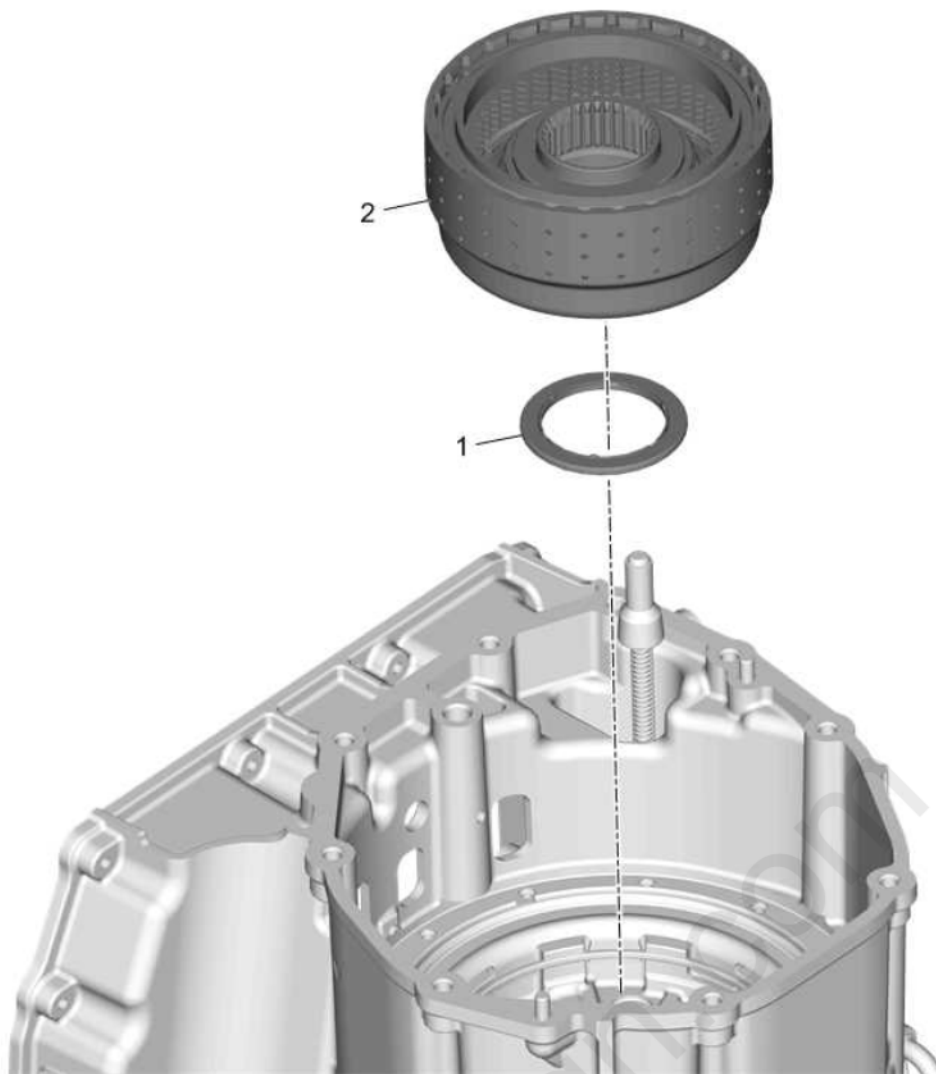


Fig. 56: Variable 3-4 and 2-3 Clutch Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 3-4 and 2-3 Clutch Housing Thrust Bearing
2	Variable 3-4 and 2-3 Clutch Housing

VARIABLE 1-2 AND 1-2 CLUTCH HOUSING CLEANING AND INSPECTION

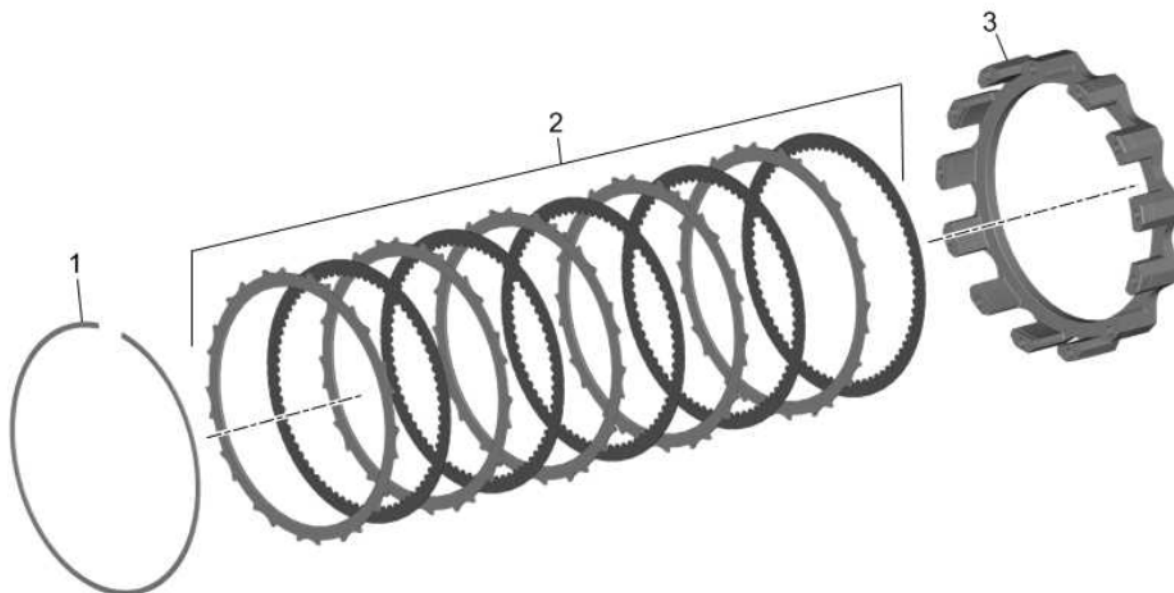


Fig. 57: Variable 1-2 and 1-2 Clutch Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Disassemble and inspect each component. Replace the entire assembly if unsuitable for use.	
1	Variable 1-2 and 1-2 Clutch Backing Plate Retaining Ring
2	Variable 1-2 and 1-2 Clutch Plate • Variable 1-2 and 1-2 Clutch Plate [5x] • Variable 1-2 and 1-2 Clutch Friction Plate [5x]
3	Variable 1-2 and 1-2 Clutch Housing

VARIABLE 1-2 AND 1-2 CLUTCH HOUSING INSTALLATION

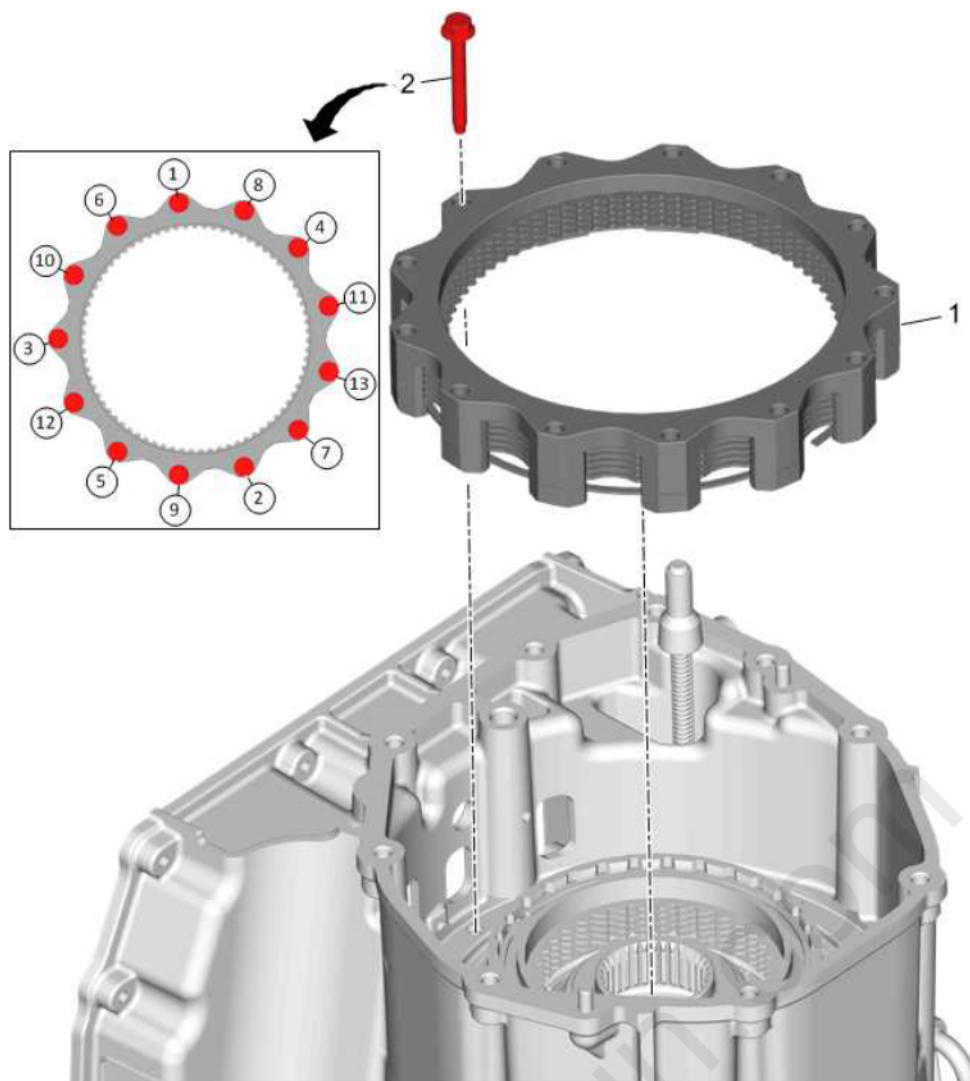


Fig. 58: Variable 1-2 and 1-2 Clutch Housing
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 1-2 and 1-2 Clutch Housing
2	Automatic Transmission Case Bolt [13x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

SUN GEAR AND SUN GEAR CARRIER INSTALLATION - 3RD POSITION

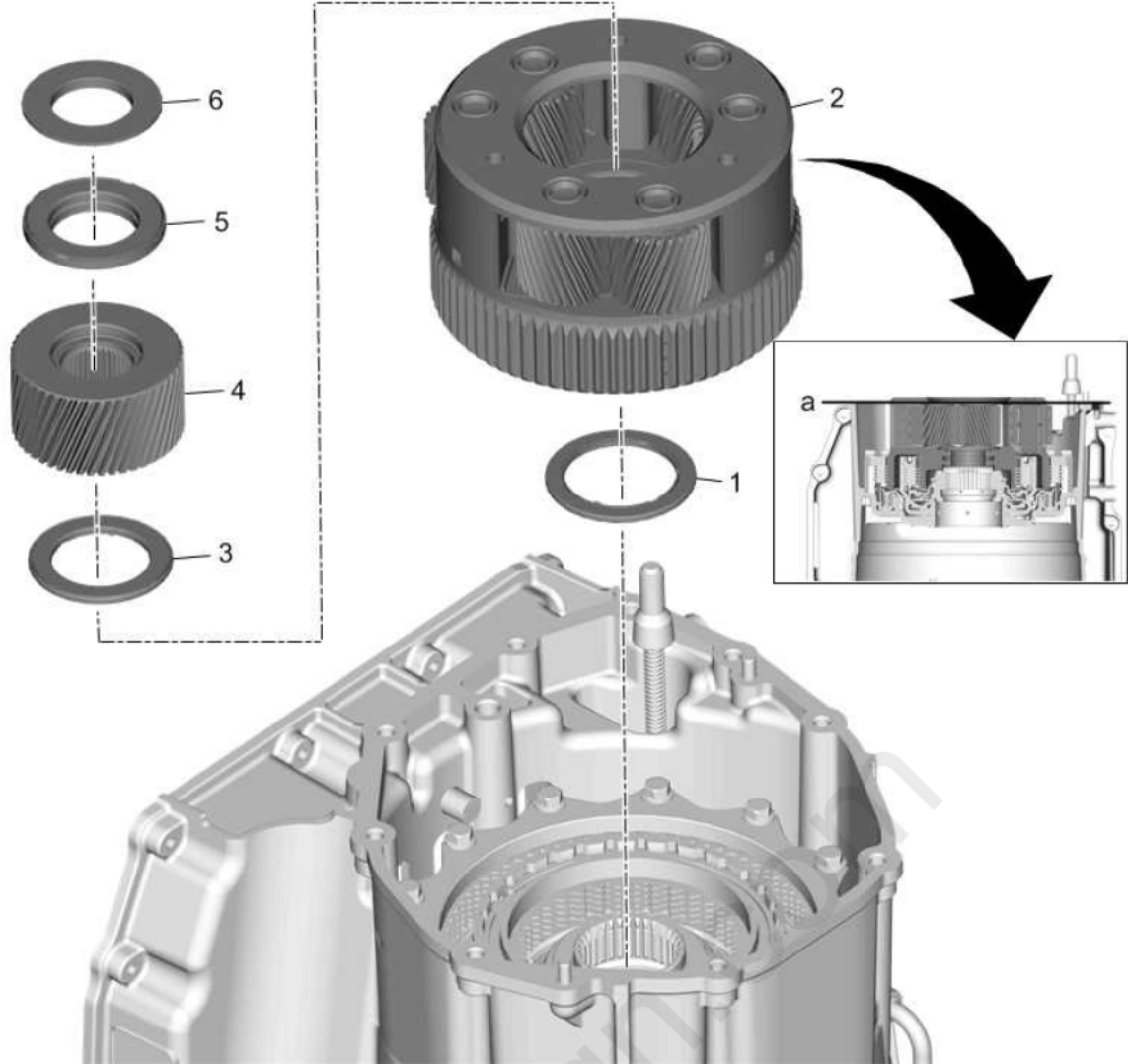


Fig. 59: Sun Gear and Sun Gear Carrier - 3rd Position
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Variable 3-4 and 2-3 Clutch Hub Thrust Bearing
2	Sun Gear Carrier - Position 3 Procedure Ensure that the installed position of the carrier is correct, the lower edge of the chamfer should be level to the transmission case mounting surface (a).
3	Sun Gear Carrier Thrust Bearing - Position 3
4	Sun Gear - Position 3
5	Sun Gear Thrust Bearing - Position 3
6	Sun Gear Thrust Washer

OUTPUT SHAFT INSTALLATION

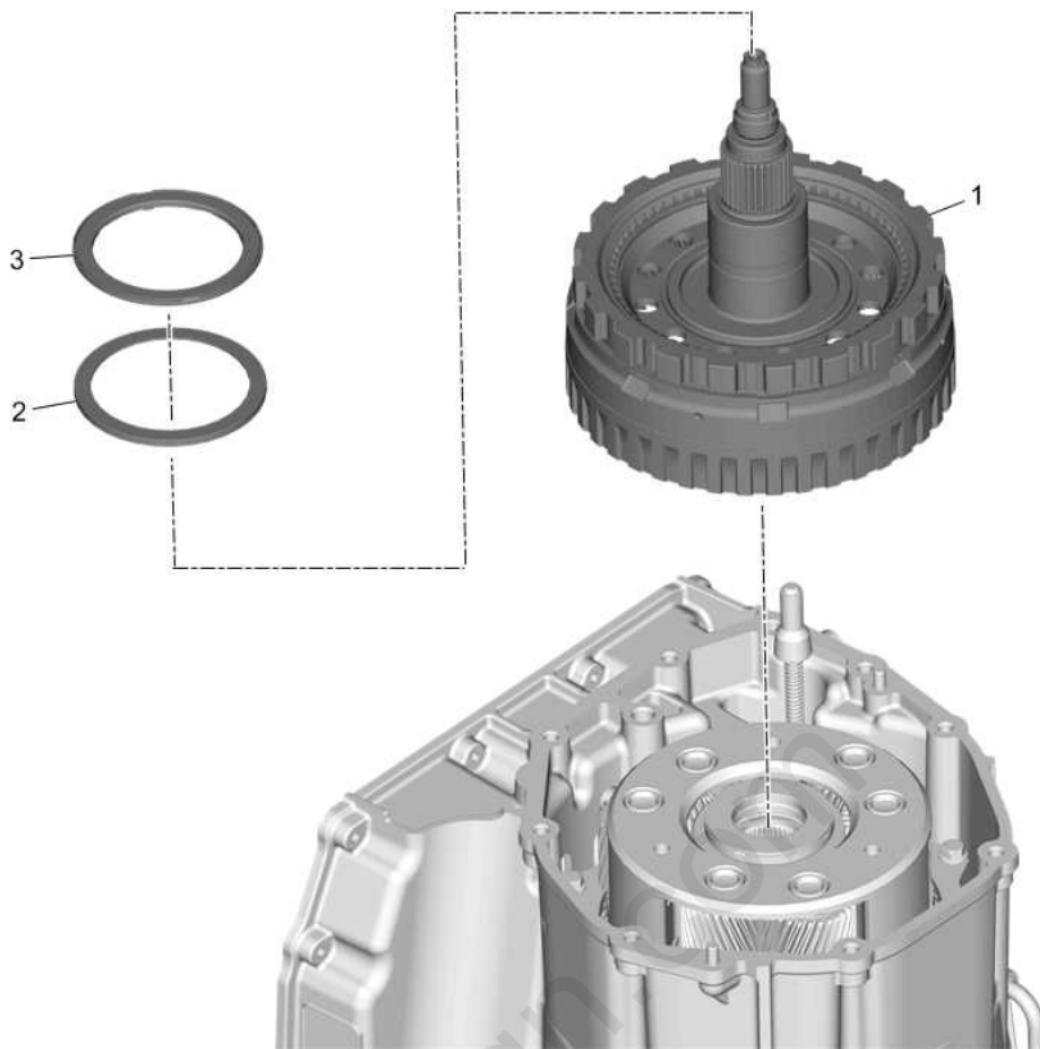


Fig. 60: Output Shaft

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Output Shaft
2	Output Shaft Thrust Washer
3	Output Shaft Bearing

CASE EXTENSION DISASSEMBLE

Park Pawl Components Removal

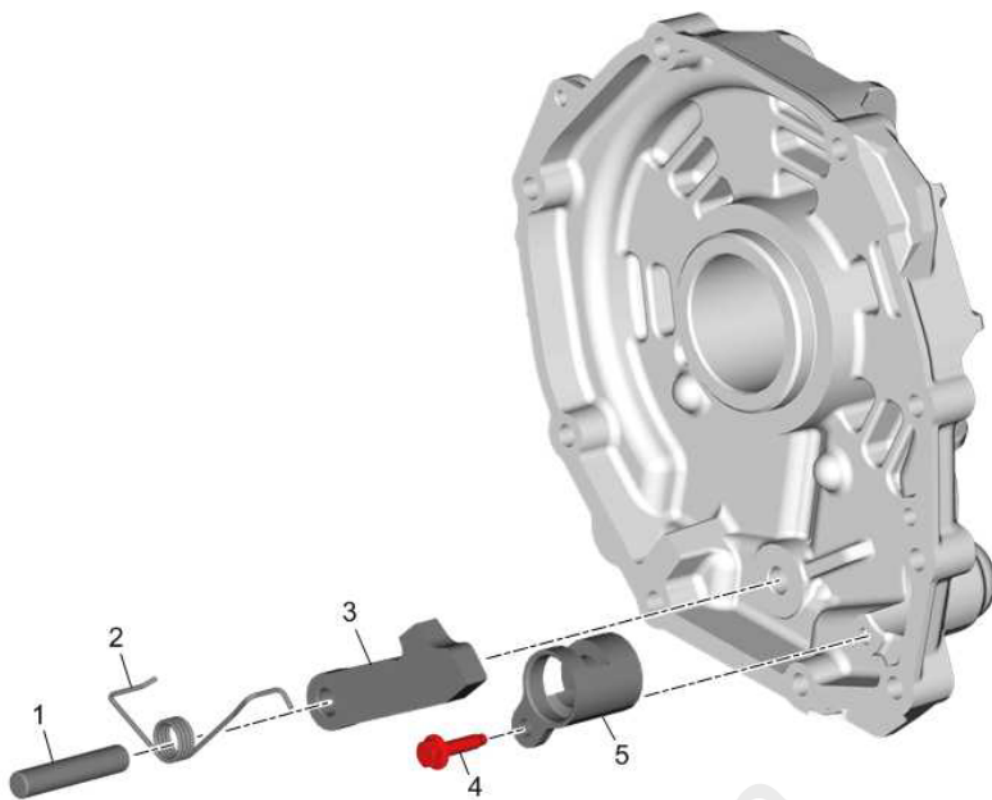


Fig. 61: Park Pawl Components

Courtesy of GENERAL MOTORS COMPANY

Park Pawl Components Removal

Callout	Component Name
1	Park Pawl Shaft
2	Park Pawl Spring
3	Park Pawl
4	Park Pawl Actuator Guide Bolt
5	Park Pawl Actuator Guide

Propeller Shaft Front Slip Yoke Oil Seal Removal

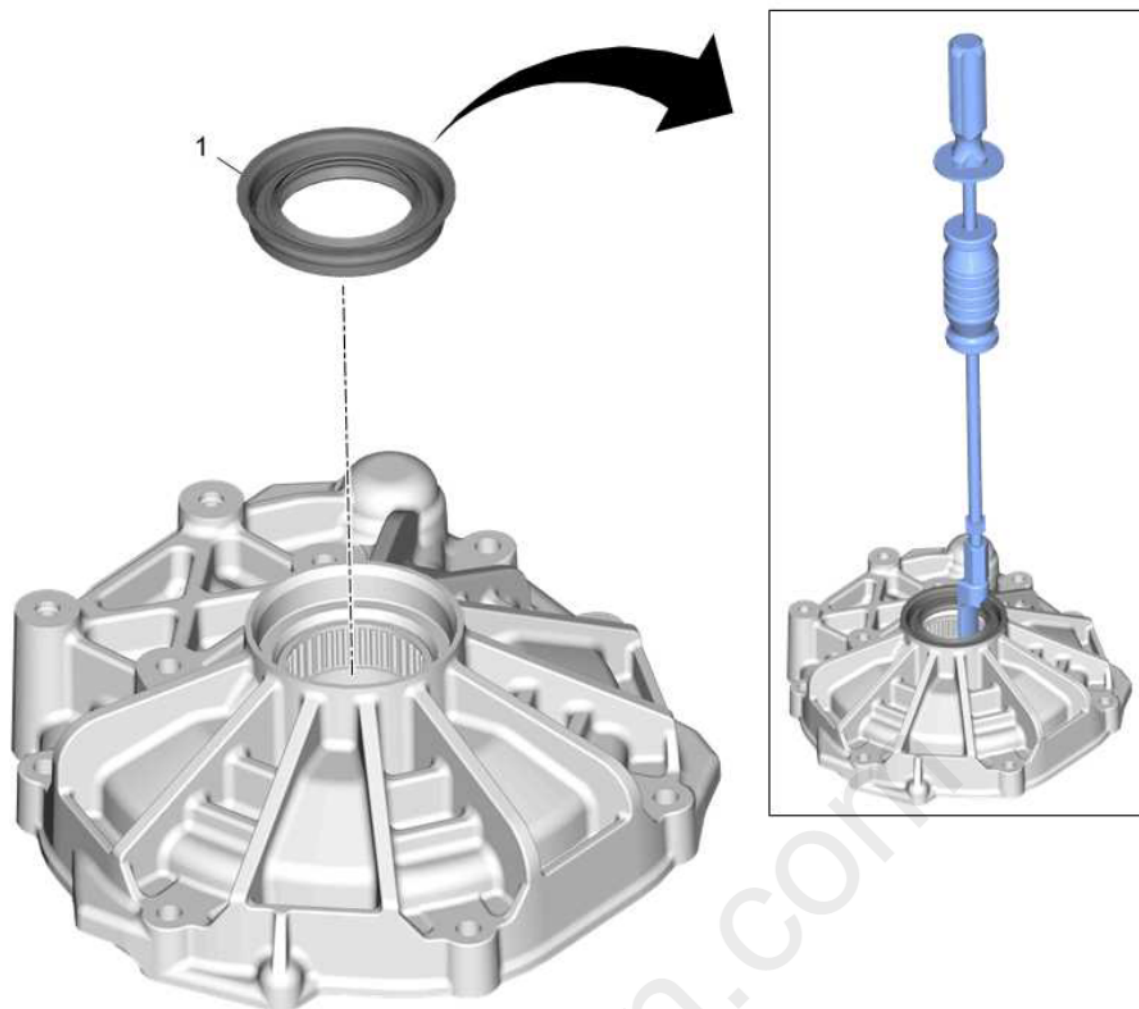


Fig. 62: Propeller Shaft Front Slip Yoke Oil Seal
Courtesy of GENERAL MOTORS COMPANY

Propeller Shaft Front Slip Yoke Oil Seal Removal

Callout	Component Name
1	Propeller Shaft Front Slip Yoke Oil Seal Special Tools • J-6125-1B Slide Hammer • J-23129 Universal Seal Remover Equivalent regional tools: Special Tools

CASE EXTENSION ASSEMBLE

Propeller Shaft Front Slip Yoke Oil Seal Installation

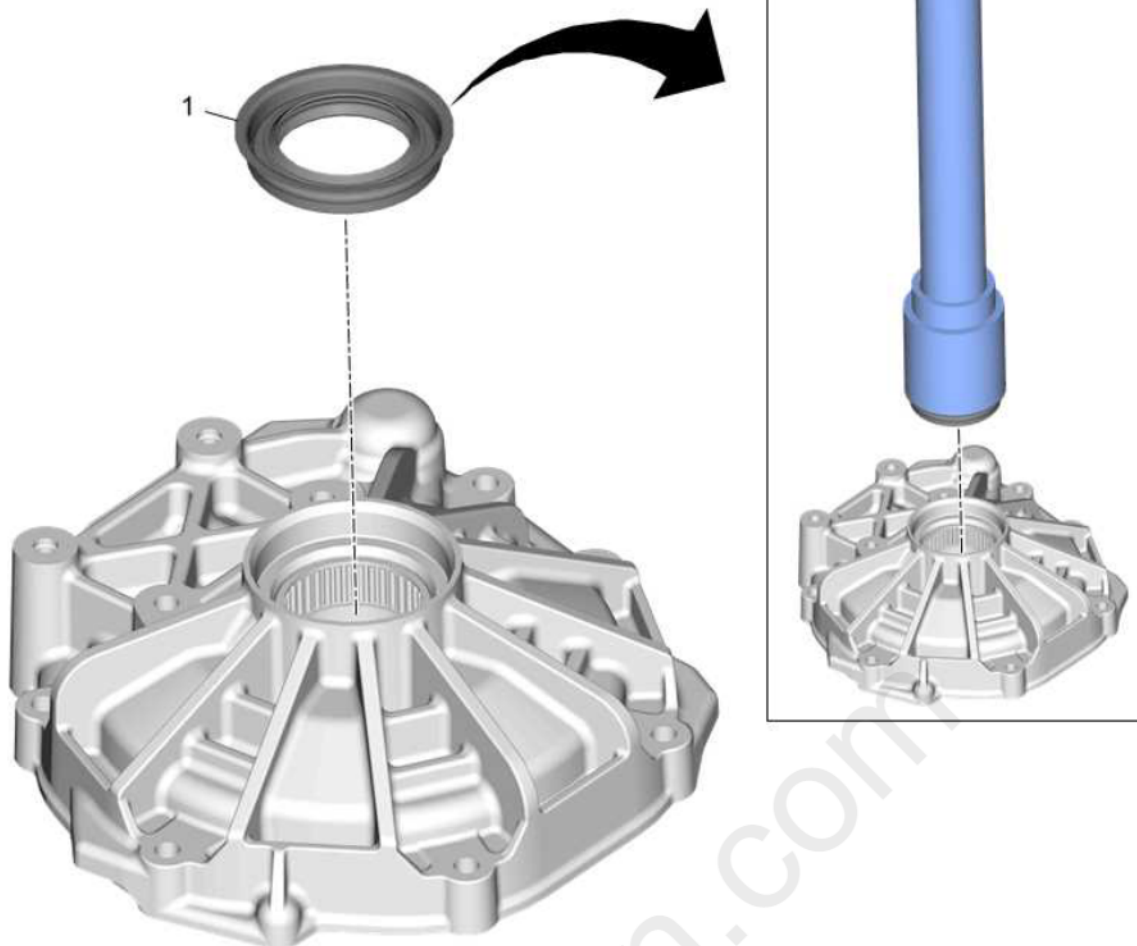


Fig. 63: Propeller Shaft Front Slip Yoke Oil Seal
 Courtesy of GENERAL MOTORS COMPANY

Propeller Shaft Front Slip Yoke Oil Seal Installation

Callout	Component Name
1	Propeller Shaft Front Slip Yoke Oil Seal Special Tools • DT-50896 Seal Installer • DT-22828 Input and Countershaft Race Installer Equivalent regional tools: Special Tools

Park Pawl Components Installation

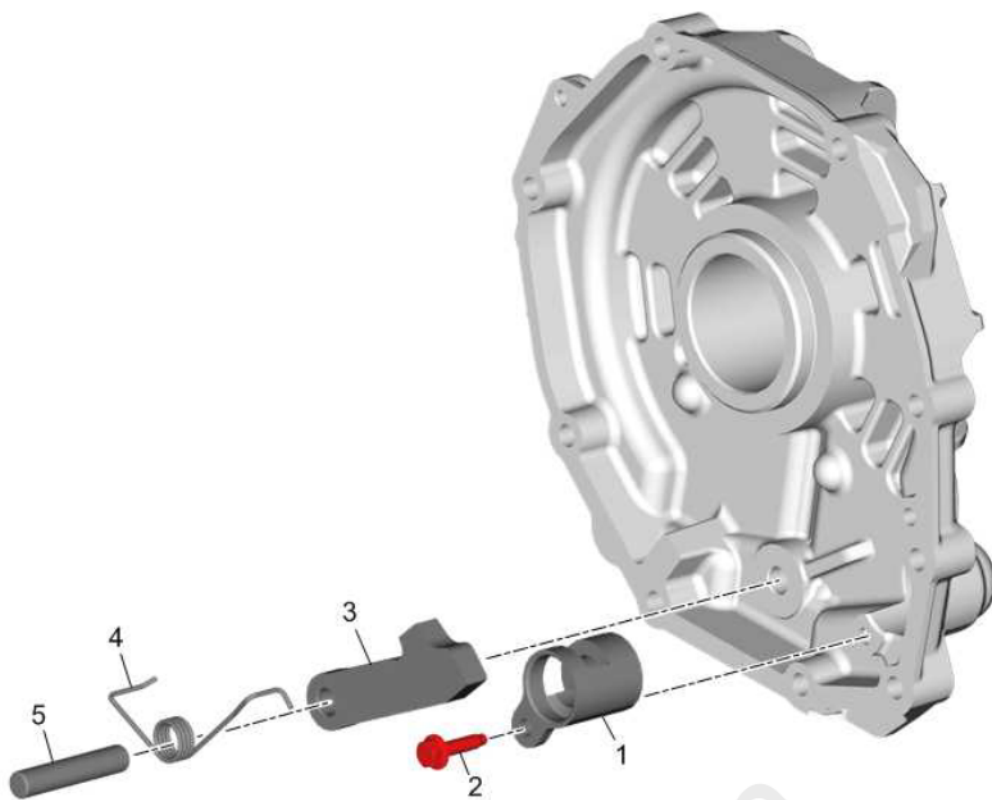


Fig. 64: Park Pawl Components

Courtesy of GENERAL MOTORS COMPANY

Park Pawl Components Installation

Callout	Component Name
1	Park Pawl Actuator Guide
2	Park Pawl Actuator Guide Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Park Pawl
4	Park Pawl Spring
5	Park Pawl Shaft

CASE EXTENSION ASSEMBLY INSTALLATION

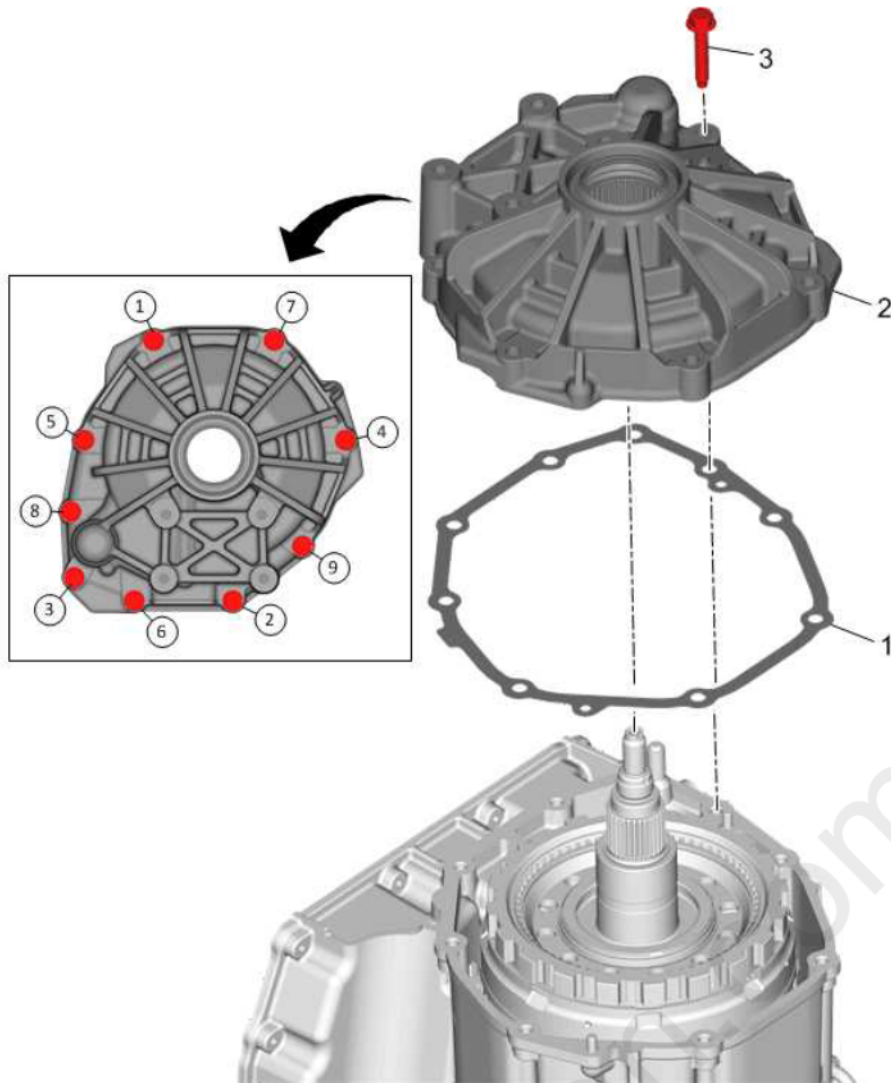


Fig. 65: Case Extension Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case Extension Gasket
2	Automatic Transmission Case Extension
3	Automatic Transmission Case Extension Bolt [9x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 22 N.m (16 lb ft)

OUTPUT SPEED SENSOR INSTALLATION

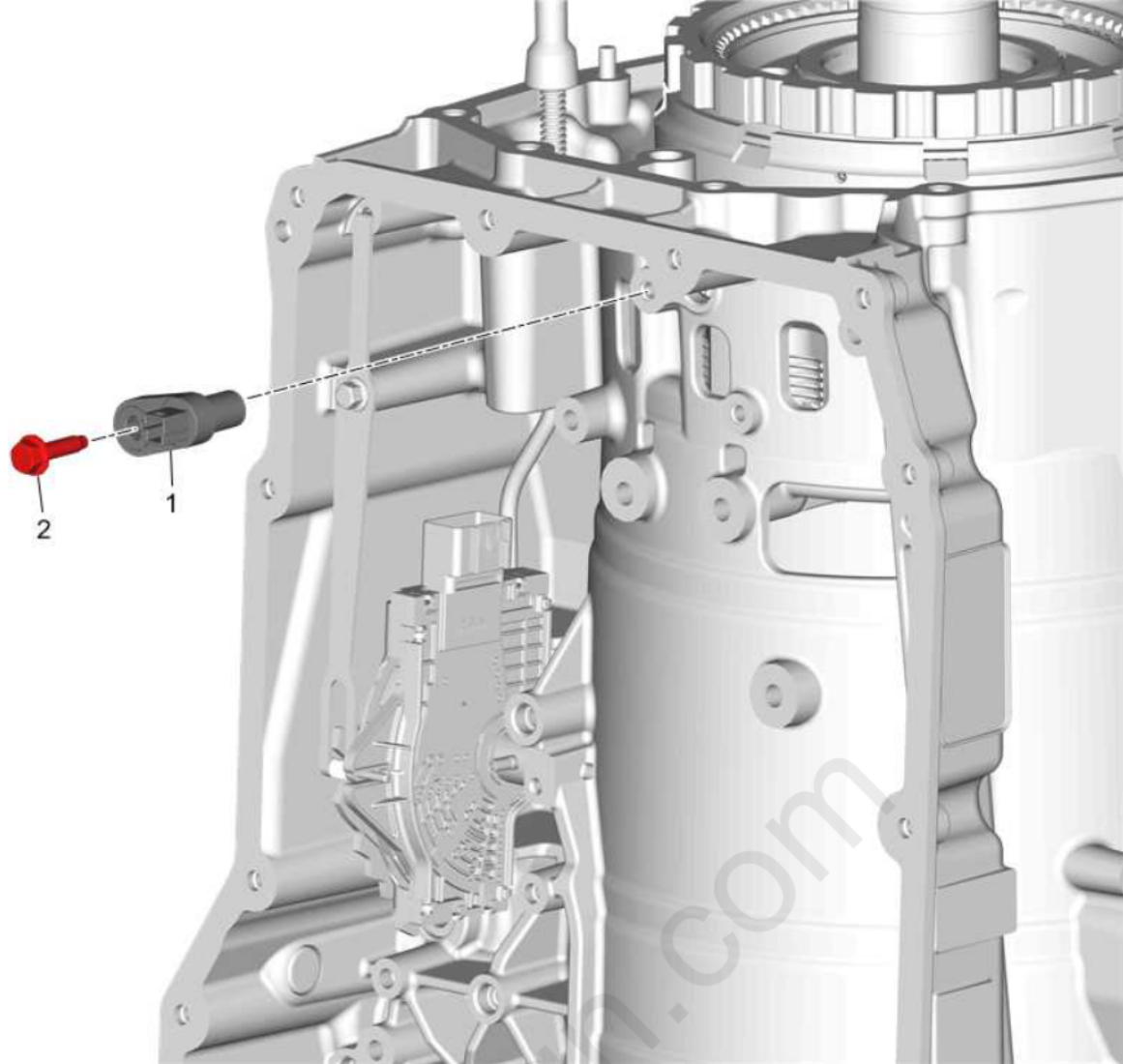


Fig. 66: Output Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Output Speed Sensor
2	Automatic Transmission Output Speed Sensor Bolt
	CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

PROPELLER SHAFT TRANSMISSION FLANGE INSTALLATION

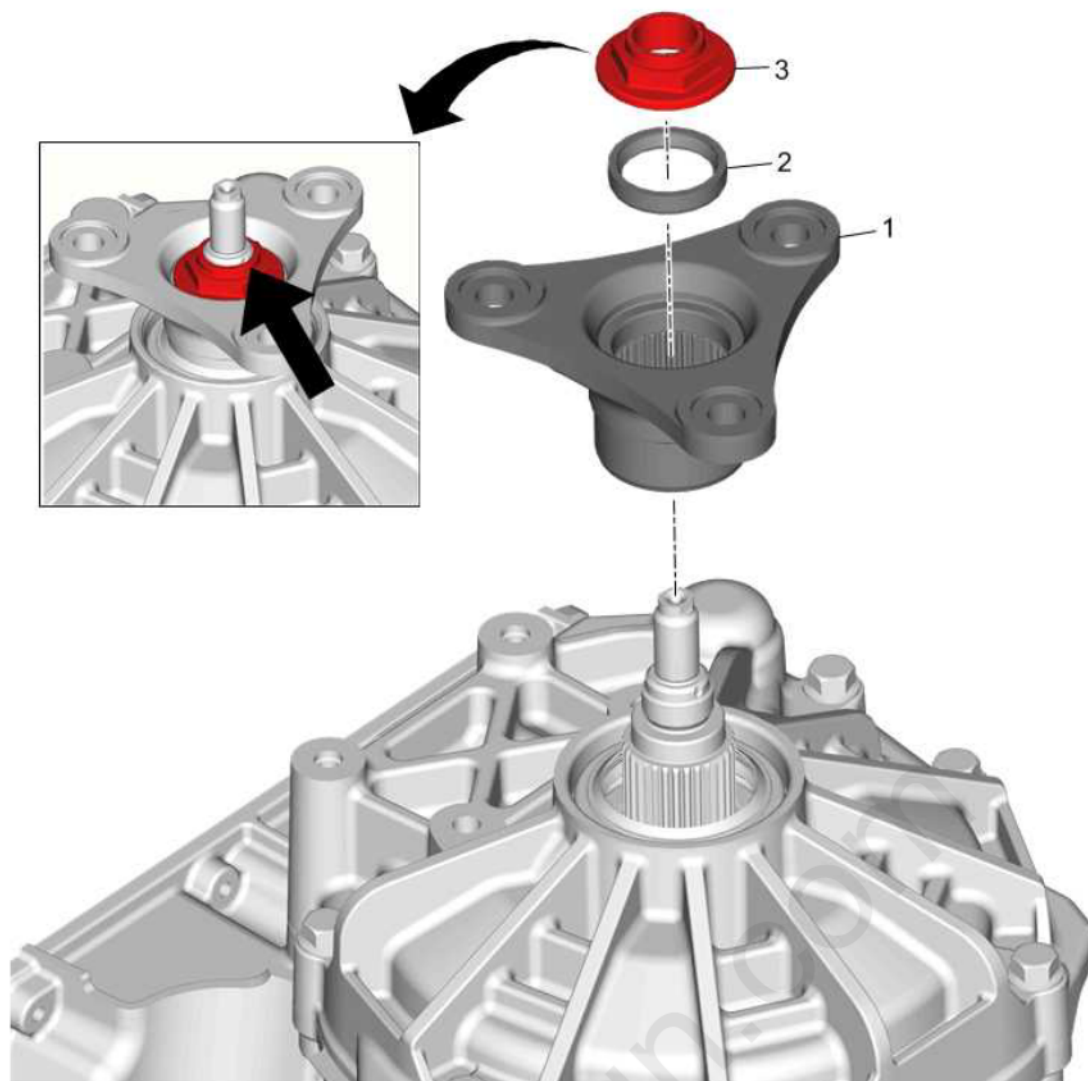


Fig. 67: Propeller Shaft Transmission Flange
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Propeller Shaft Flange
2	Propeller Shaft Transmission Flange Seal Procedure Use a NEW seal. Fit the seal in the propeller shaft flange bore. The propeller shaft flange nut will seat the seal when tightened.
3	Front Propeller Shaft Flange Nut CAUTION: Refer to Fastener Caution . CAUTION: Refer to Torque-to-Yield Fastener Caution . Procedure Use a NEW nut. Use a 6 oz hammer and a round, blunt tip punch to stake the nut in place once final torque is achieved. Tighten 105 N.m (77 lb ft)

AUTOMATIC TRANSMISSION FLUID PUMP INSTALLATION

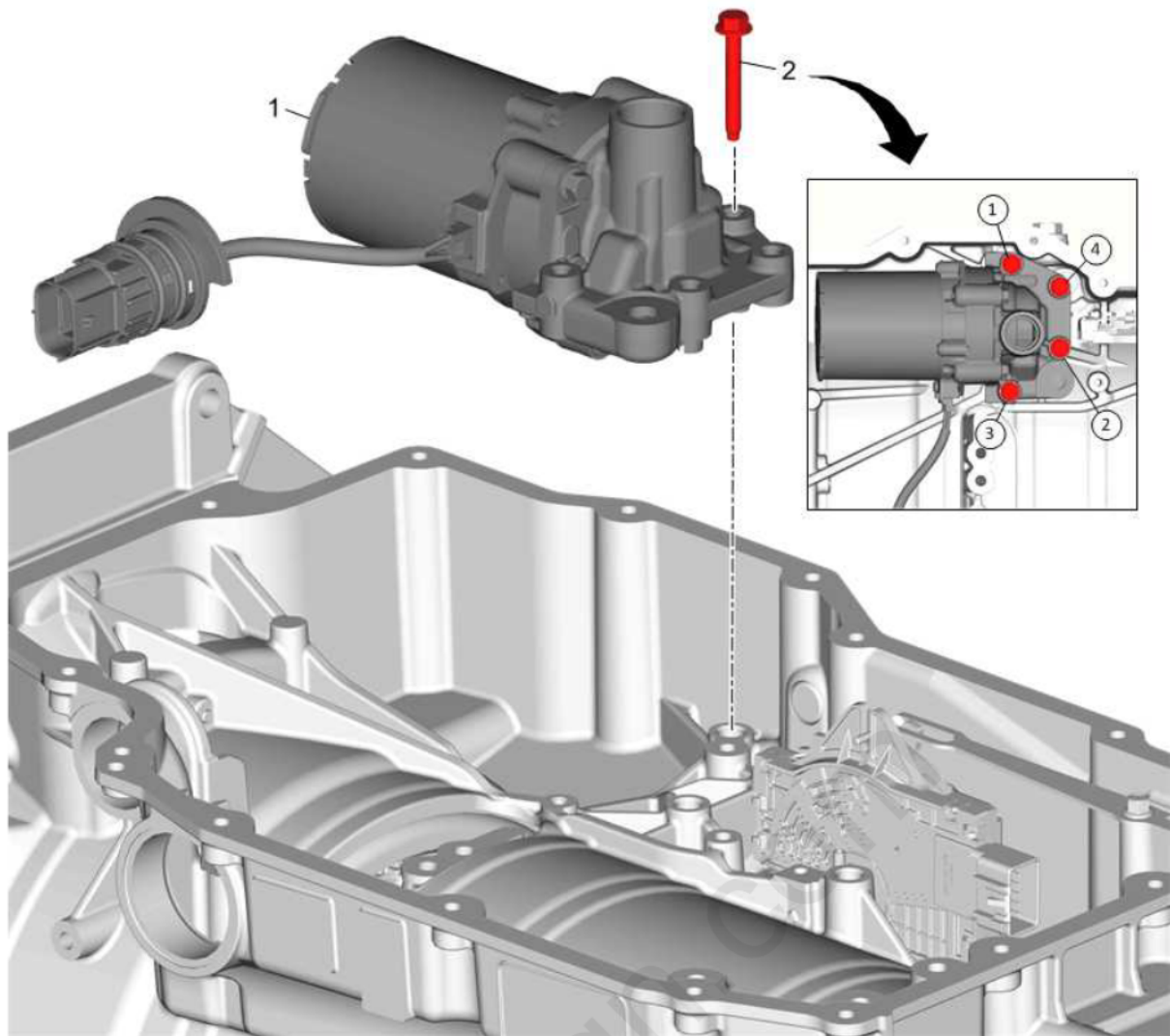


Fig. 68: Automatic Transmission Fluid Pump
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Fluid Pump
2	Automatic Transmission Fluid Pump Bolt [4x]
	CAUTION: Refer to Fastener Caution . Procedure 1. Tighten the bolts in the sequence shown. 2. Install the fluid pump connector into the transmission case after the pump is installed. NOTE: Ensure the fluid pump connector is fully installed and the retaining tabs have locked into the transmission case. Tighten 9 N.m (80 lb in)

TRANSMISSION CONTROL WIRING HARNESS INSTALLATION

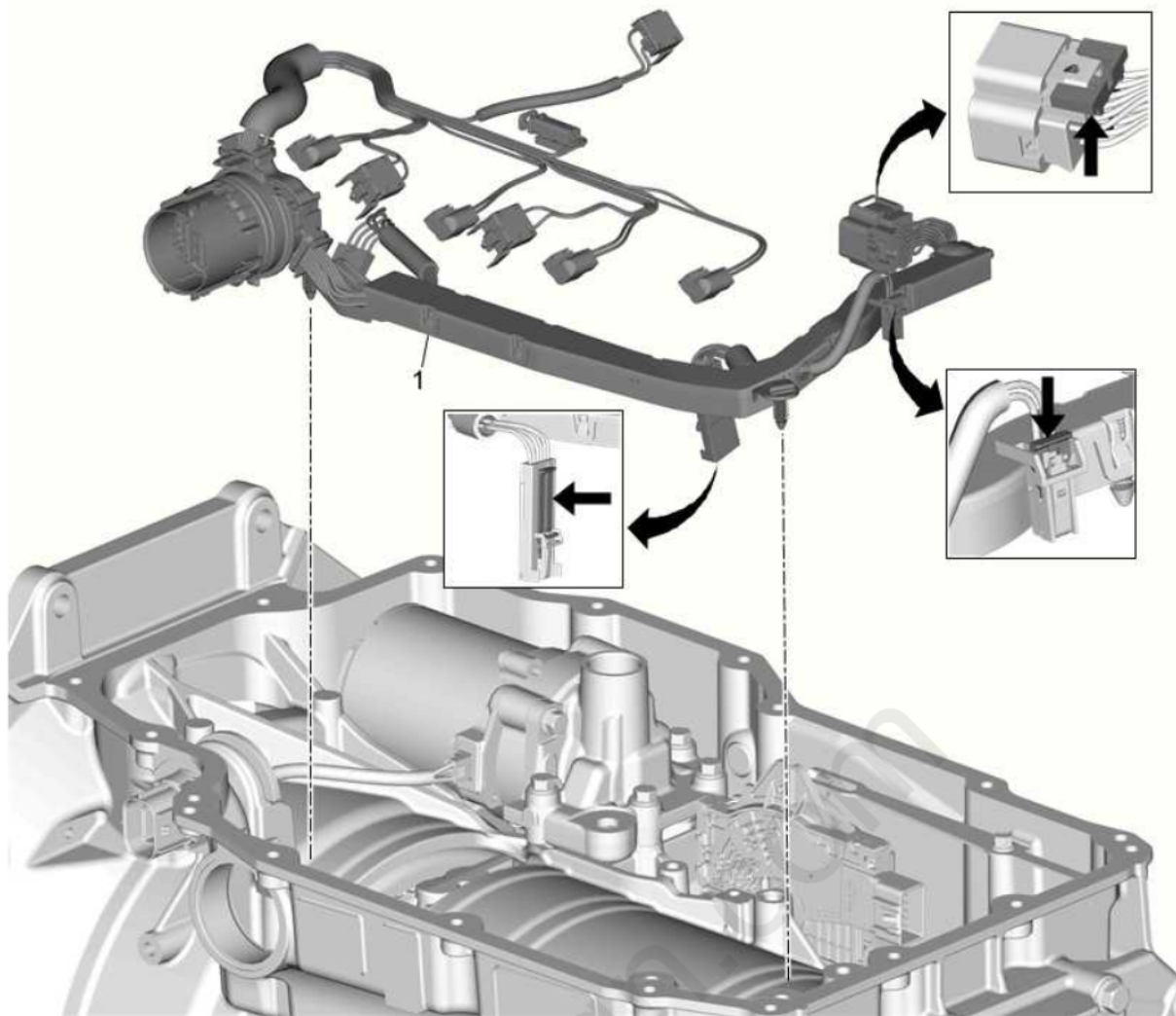


Fig. 69: Transmission Control Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Locate connectors on the wiring harness that have connector position assurance (CPA) tabs. Ensure the CPA tabs are locked after the wiring harness is installed.	
1	Automatic Transmission Control Wiring Harness Procedure 1. Install the wiring harness. 2. Install the main wiring harness connector in the transmission case. NOTE: Ensure the main wiring harness connector is fully installed and the retaining tabs have locked into the transmission case. 3. Connect the speed sensor and motor position sensor connectors. 4. Lock the CPA tabs.

CONTROL VALVE ASSEMBLY DISASSEMBLE

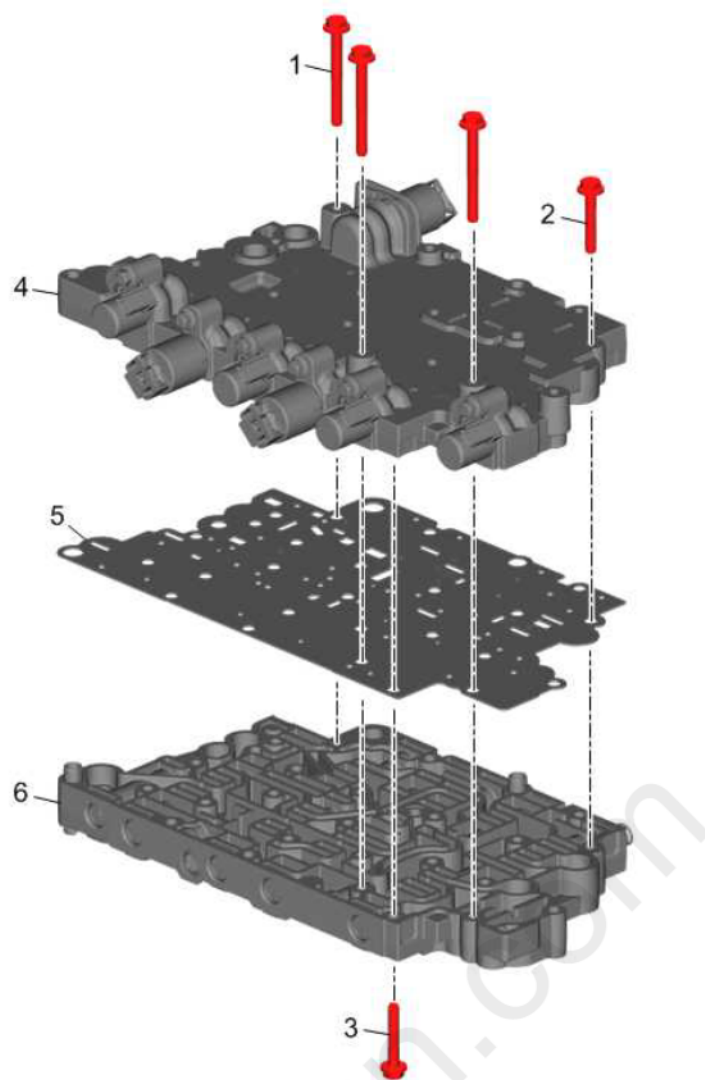


Fig. 70: Control Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Control Valve Body Bolt - Lower [3x]
2	Valve Body Bolt [14x]
3	Valve Body Bolt [4x]
4	Control Valve Solenoid Body
5	Control Valve Channel Plate Spacer Plate Gasket
6	Control Valve Upper Body

CONTROL VALVE ASSEMBLY CLEANING AND INSPECTION

Control Valve Solenoid Body

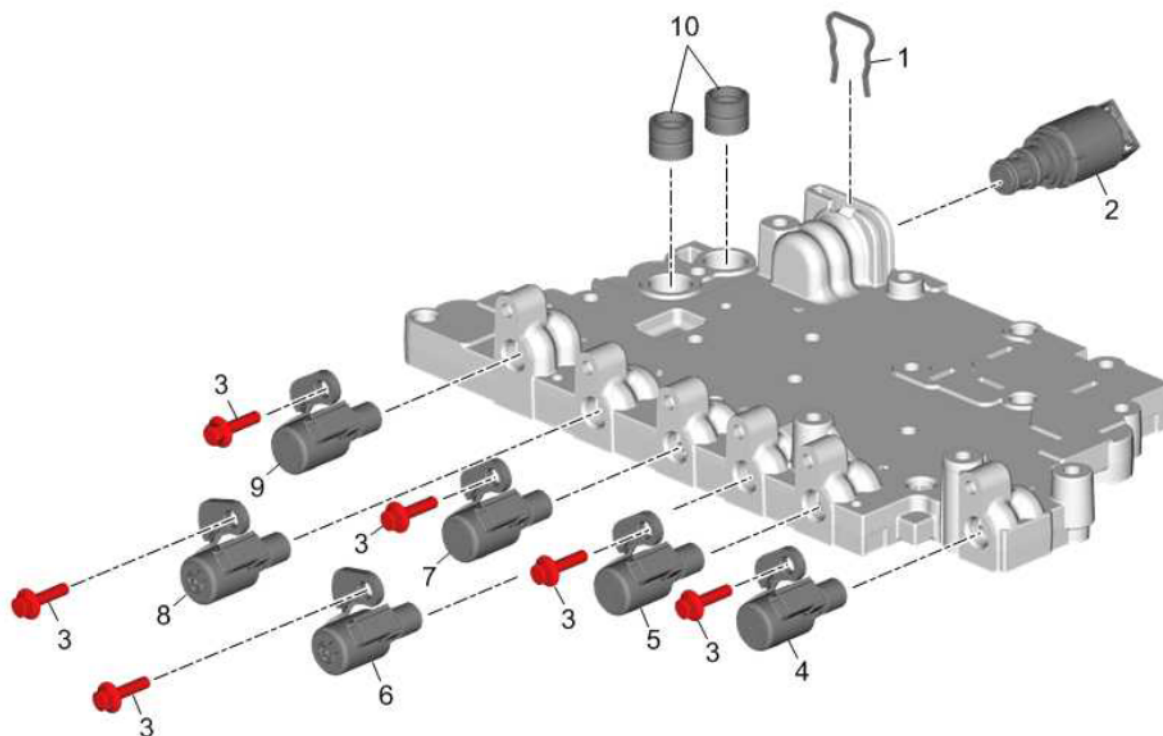


Fig. 71: Control Valve Solenoid Body
 Courtesy of GENERAL MOTORS COMPANY

Control Valve Solenoid Body

Callout	Component Name
1	Control Solenoid Valve Retainer
2	Clutch Pressure Control Solenoid Valve
3	Shift Solenoid Valve Bolt [6x] CAUTION: Refer to Fastener Caution . Tighten 4.7 N.m (42 lb in)
4	Shift Solenoid Valve
5	Shift Solenoid Valve
6	Shift Solenoid Valve
7	Shift Solenoid Valve
8	Shift Solenoid Valve
9	Shift Solenoid Valve
10	Automatic Transmission Hybrid Direct 2-3-4 Clutch Regulator Valve Seal [2x]

Control Valve Upper Body Valves

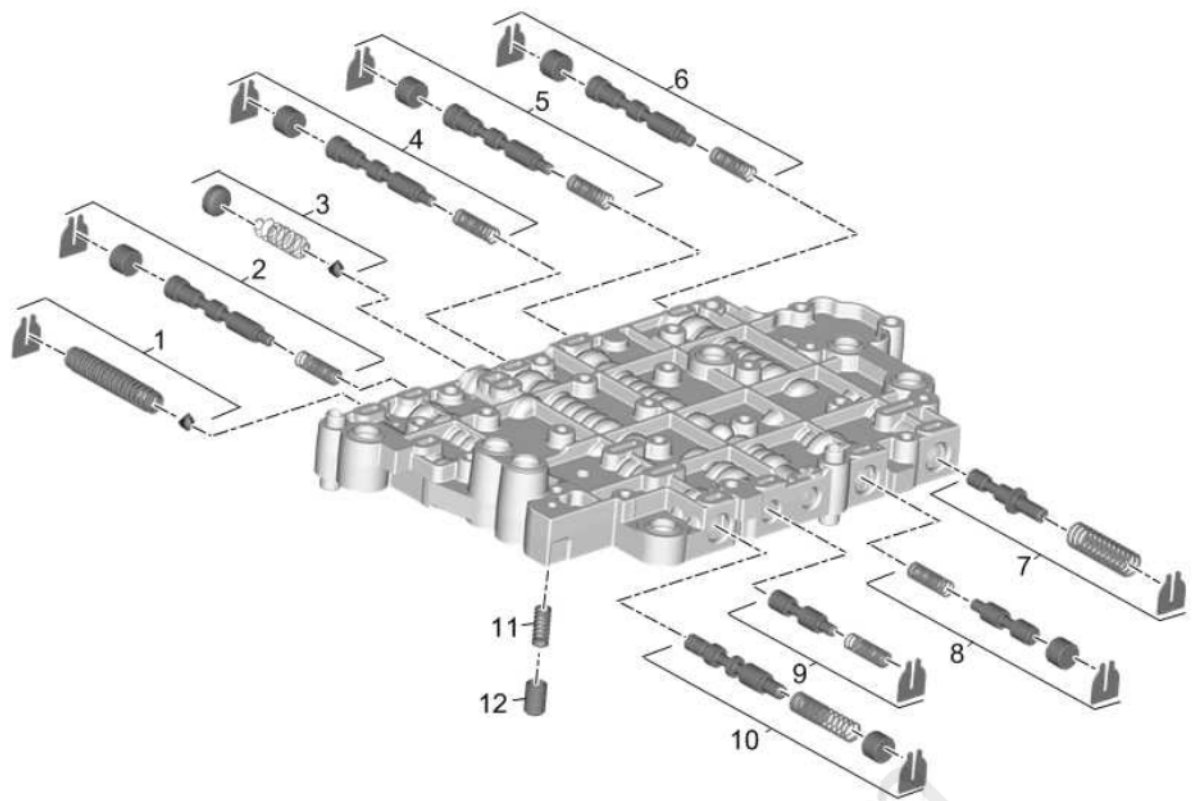


Fig. 72: Control Valve Upper Body Valves
 Courtesy of GENERAL MOTORS COMPANY

Control Valve Upper Body Valves

Callout	Component Name
1	Pressure Relief Ball Valve
2	Variable 1-4 and 1-3 Clutch Valve
3	Pressure Relief Ball Valve
4	Variable 2-3 and 1-2-3 Clutch Valve
5	Variable 3-4 and 2-3 Clutch Valve
6	Variable 1-2 and 1-2 Clutch Valve
7	Actuator Feed Limit Valve
8	Variable 1-2-3-4 Clutch Valve
9	Stator Valve
10	Pressure Regulator Valve Train
11	Signal Accumulator Piston Spring
12	Signal Accumulator Piston

Control Valve Upper Body Seals

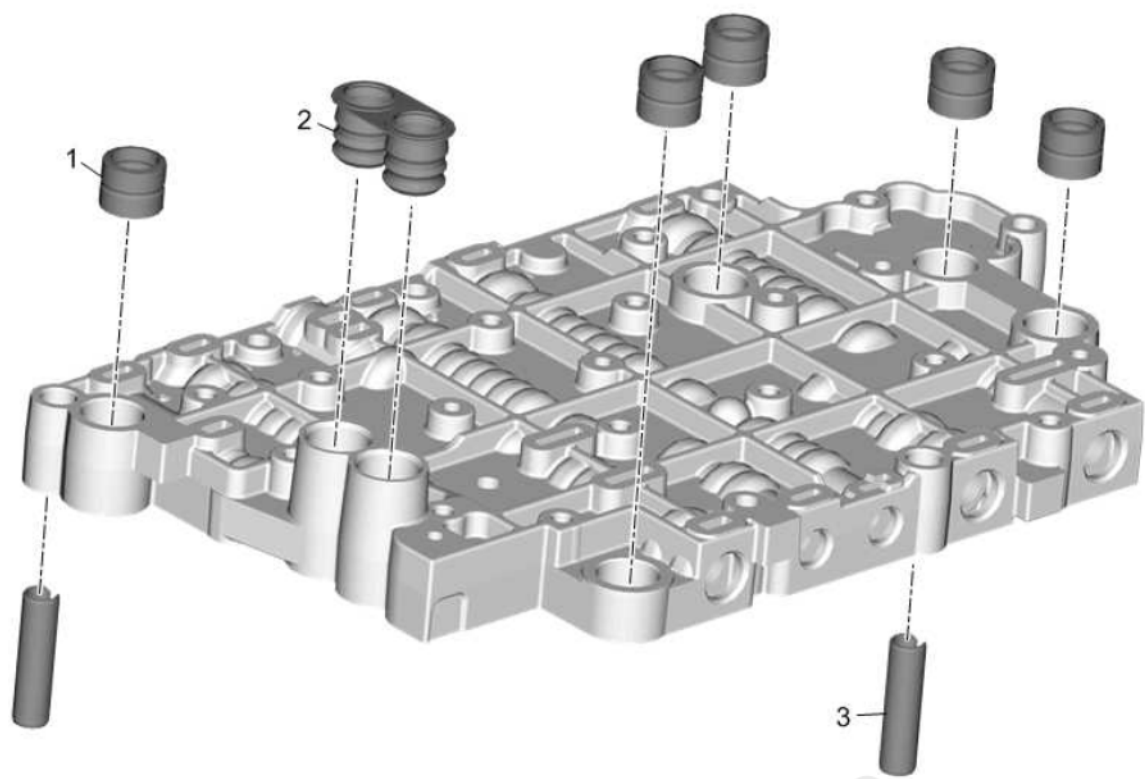


Fig. 73: Control Valve Upper Body Seals
 Courtesy of GENERAL MOTORS COMPANY

Control Valve Upper Body Seals

Callout	Component Name
1	Automatic Transmission Hybrid Direct 2-3-4 Clutch Regulator Valve Seal [5x]
2	Automatic Transmission Hybrid Direct 2-3-4 Clutch Regulator Valve Seal
3	Control Valve Body Locating Pin [2x]

CONTROL VALVE ASSEMBLY ASSEMBLE

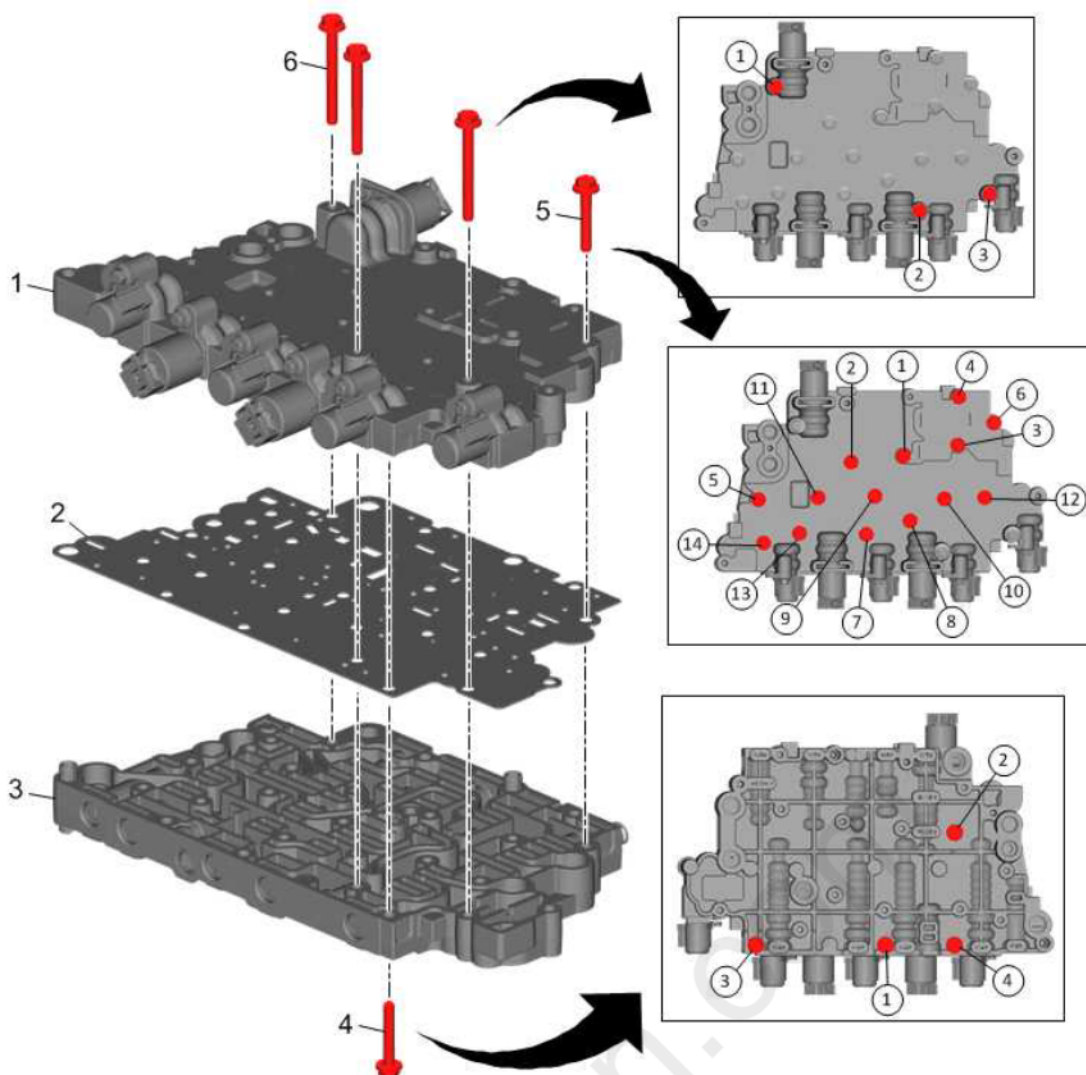


Fig. 74: Control Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Control Valve Upper Body
2	Control Valve Channel Plate Spacer Plate Gasket
3	Control Valve Solenoid Body
4	Valve Body Bolt [4x] CAUTION: Refer to Fastener Caution . Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)
5	Valve Body Bolt [14x] Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)
6	Control Valve Body Bolt - Lower [3x] Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

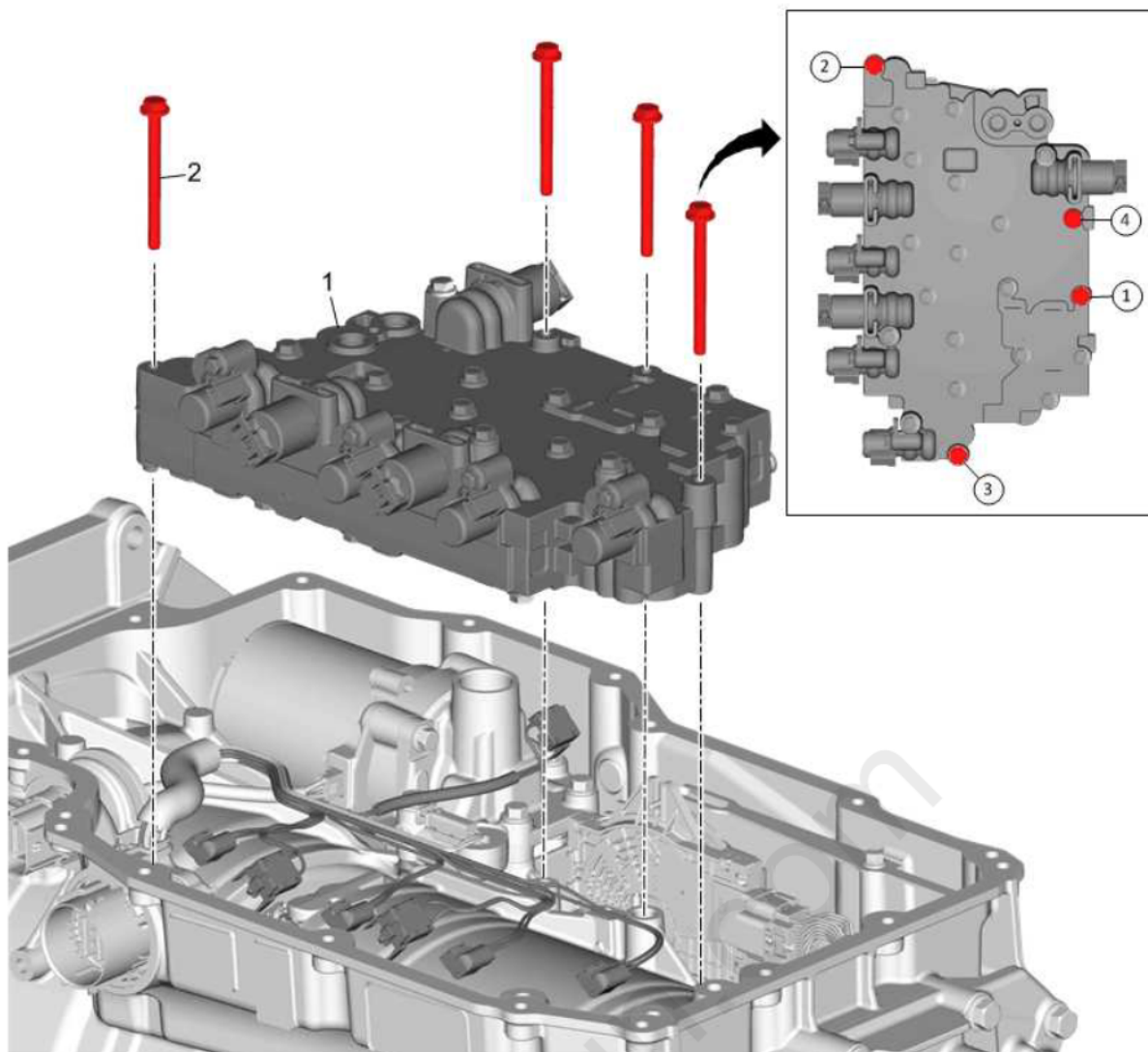


Fig. 75: Control Valve Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Control Valve
2	Automatic Transmission Control Bolt [4x] CAUTION: Refer to Fastener Caution . Procedure 1. Tighten the bolts in the sequence shown. 1. Tighten the bolts a first pass in sequence to 9 N.m (80 lb in). 2. Tighten the bolts a final pass in sequence to 9 N.m (80 lb in), to ensure all bolts are correctly tightened. 2. Connect the wiring harness connectors to the control valve.

TRANSMISSION FLUID PAN AND FILTER ASSEMBLY INSTALLATION

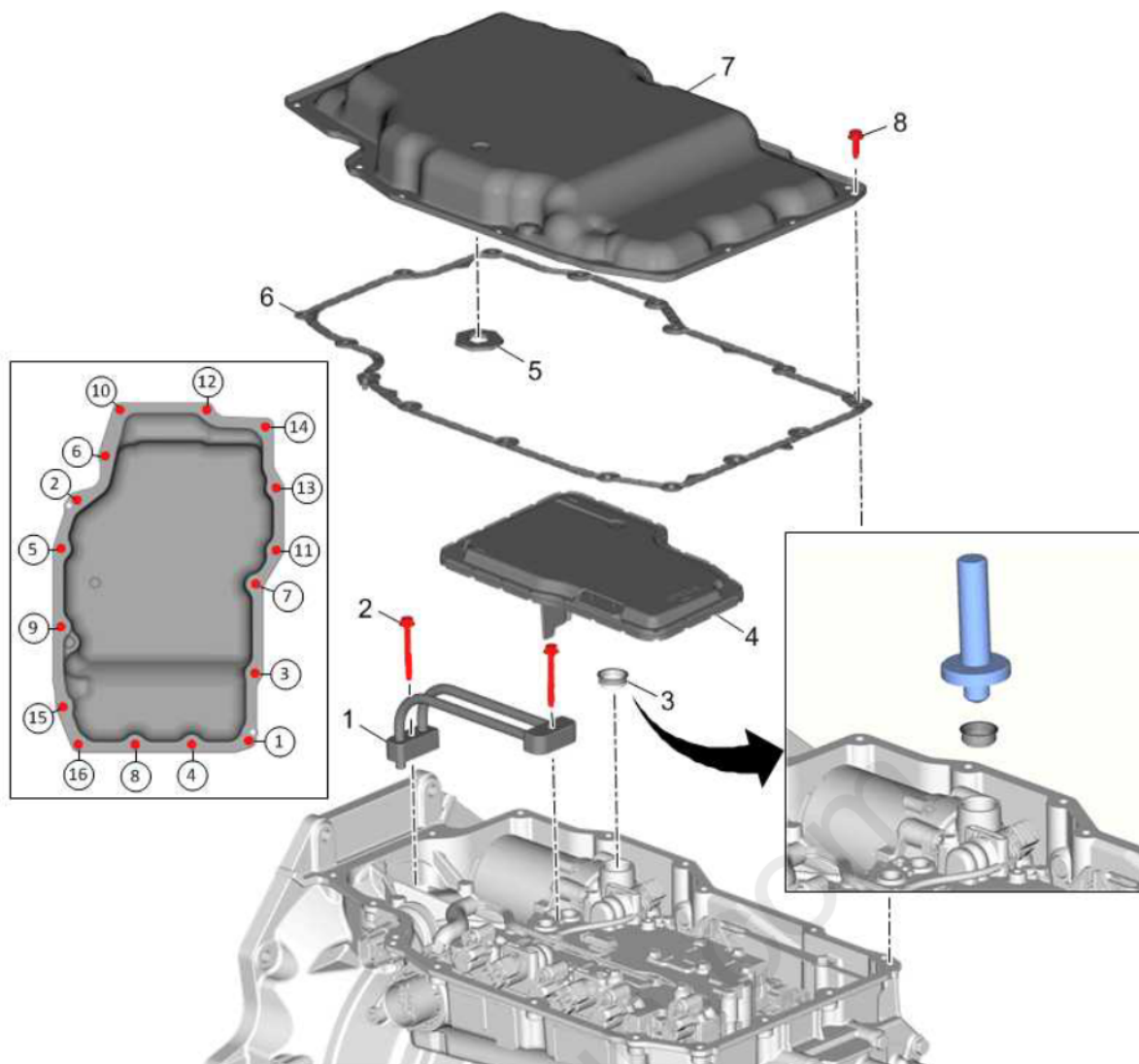


Fig. 76: Transmission Fluid Pan and Filter Assembly
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Control Valve Body Fluid Manifold
2	Valve Body Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Automatic Transmission Fluid Filter Seal Special Tools • J-42737 Sector Bearing Installer • DT-46626 Seal Installer Equivalent regional tools: Special Tools
4	Automatic Transmission Fluid Filter
5	Automatic Transmission Fluid Pan Magnet
6	Automatic Transmission Fluid Pan Gasket
7	Automatic Transmission Fluid Pan

Callout	Component Name
8	Automatic Transmission Fluid Pan Bolt [16x] Procedure Tighten the bolts in the sequence shown. Tighten 9 N.m (80 lb in)

HOLDING FIXTURE REMOVAL

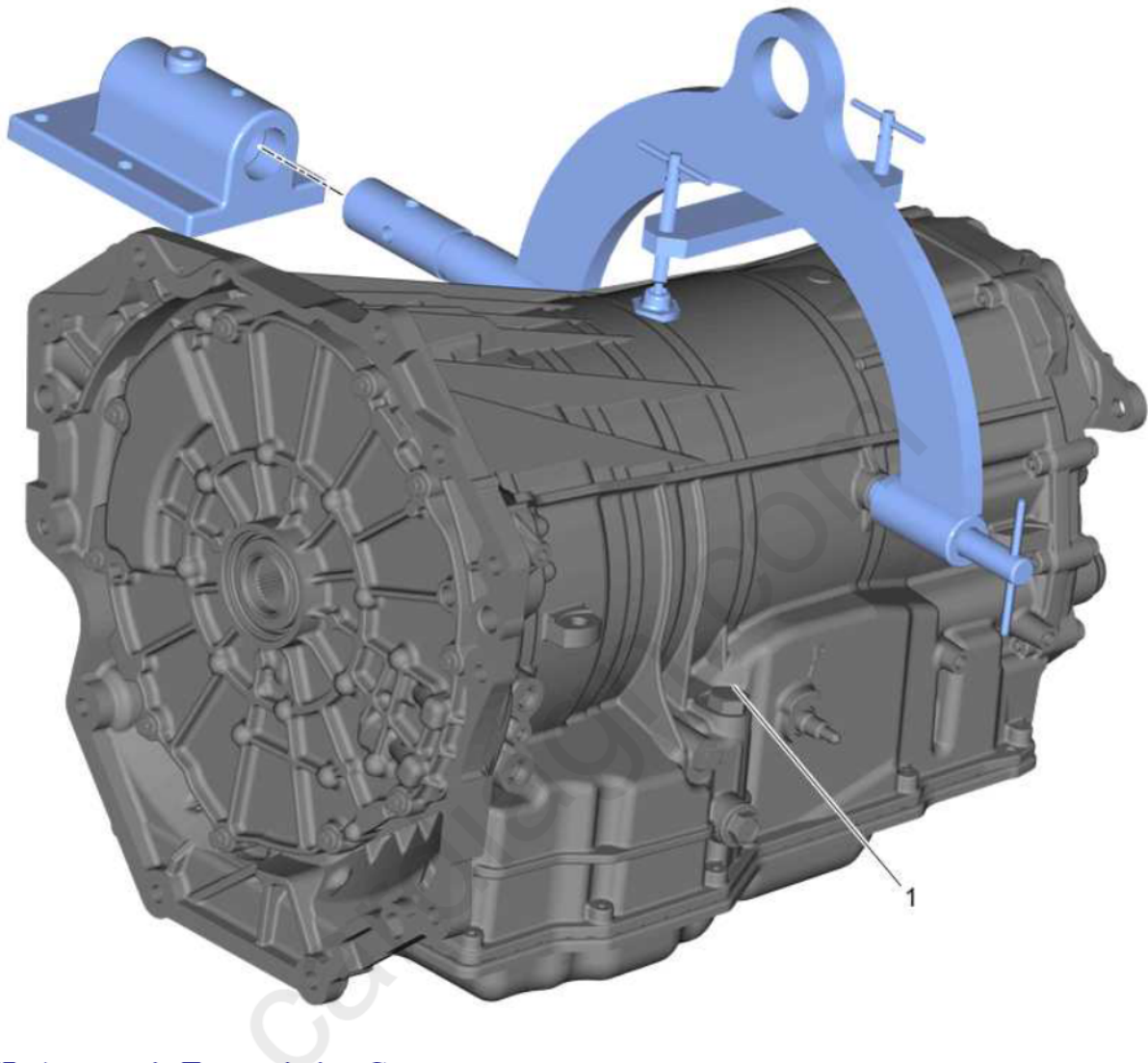


Fig. 77: Automatic Transmission Case
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Automatic Transmission Case WARNING: Handle with care, the transmission assembly weighs over 83 Kg (183 lbs). Bodily injury could occur if not handled properly. Special Tools • DT-03289-20 Holding Fixture Base Assembly • DT-48989 Holding Fixture Equivalent regional tools: Special Tools

TRANSMISSION HOUSING SOUND INSULATOR INSTALLATION

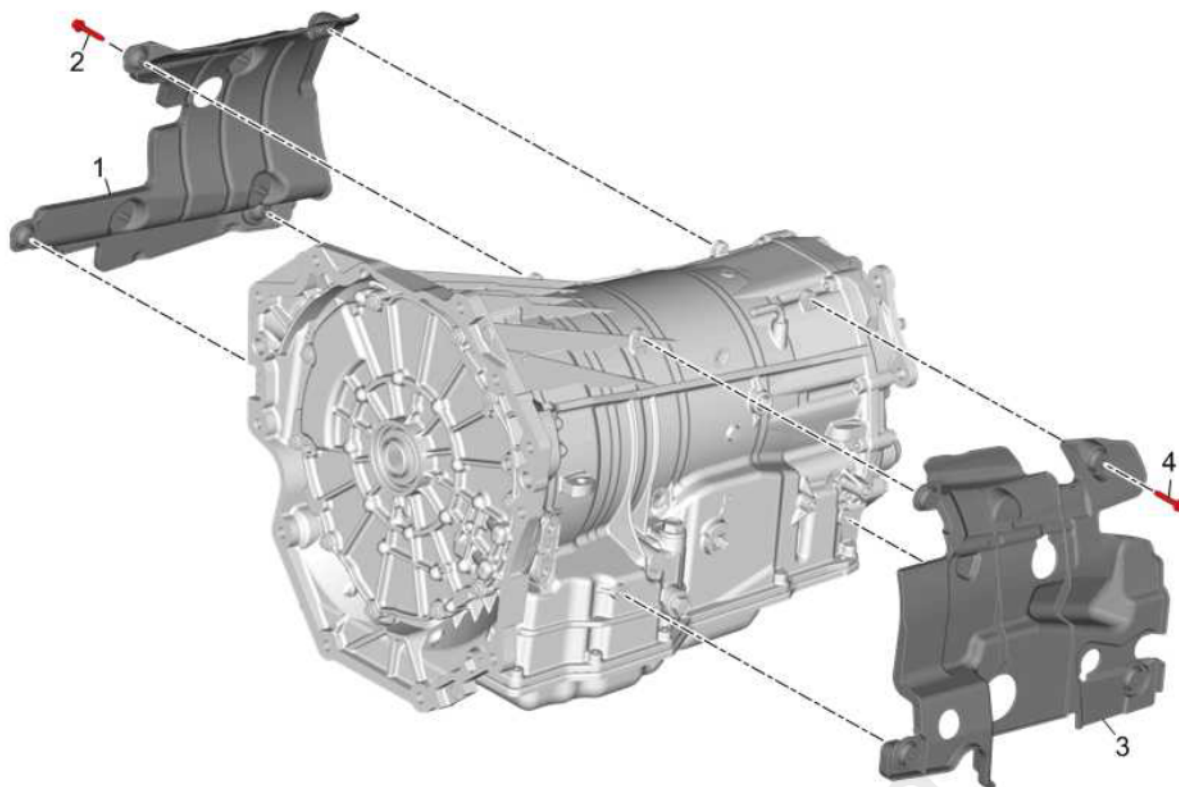


Fig. 78: Transmission Housing Sound Insulator
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Transmission Housing Sound Insulator
2	Automatic Transmission Case Bolt [4x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Transmission Housing Sound Insulator
4	Automatic Transmission Case Bolt [4x] Tighten 9 N.m (80 lb in)

2017 TRANSMISSION

Automatic Transmission - 4EL70 (MRD) - Repair Instructions - On Vehicle - CT6

REPAIR INSTRUCTIONS - ON VEHICLE

CONNECTOR RECONNECTION - AUTOMATIC TRANSMISSION

Special Tools

EL-35616 Terminal Test Probe Kit

For equivalent regional tools, refer to [Special Tools](#).

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Loose, corroded or painted terminal stud/fastener
- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- A terminal not seated all the way into the connector body
- Poor terminal to wire connection - Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to [Testing for Electrical Intermittents](#) for test procedures to detect intermittent open, high resistance, short to ground and short to voltage conditions.
- Refer to [Scan Tool Snapshot Procedure](#) for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add dielectric grease/lubricant (Nyogel 760G or equivalent, meeting GM specification 9986087) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the **EL-35616** kit when probing connectors. Other causes of terminal deformation are improperly joining the connector halves or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use the **EL-35616** kit to test for proper terminal contact. Failure to use the **EL-35616** kit can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals and connector body.
3. Using an equivalent male terminal/terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire Connectors

There are no serviceable parts for flat wire connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter into the flat wire harness connector in order to test the circuit in question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors,

fuses and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) and [Power Distribution Schematics](#).

- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) and [Ground Distribution Schematics](#).

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to [Inducing Intermittent Fault Conditions](#) in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A mis-routed harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. - These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay or a control module driven solenoid or switch - These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. - These accessories may create interference in other circuits while operating and the interference would disappear when the accessory is not operating. Refer to [Checking Aftermarket Accessories](#).
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.

- Revised software/calibration files have been released for this vehicle.
- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to [Control Module References](#) for replacement, setup and programming.

NOTE: DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.

TRANSMISSION CONTROL MODULE REPLACEMENT

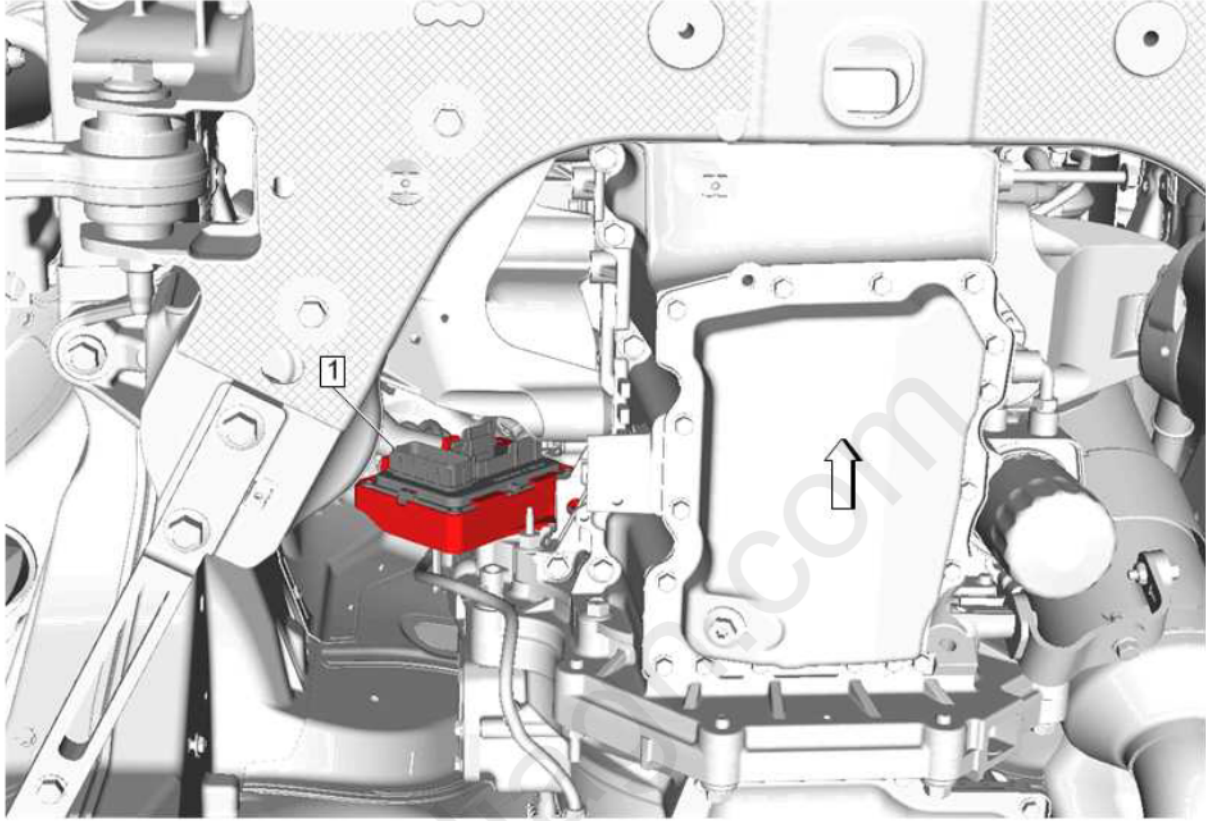


Fig. 1: Transmission Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Drivetrain and Front Suspension Cradle Plate Replacement	
1	Transmission Control Module Procedure 1. Disconnect the electrical connector. 2. Remove the module from the module bracket by releasing the retaining tabs. 3. Program the transmission control module, if replaced. Control Module References

TRANSMISSION CONTROL MODULE BRACKET REPLACEMENT

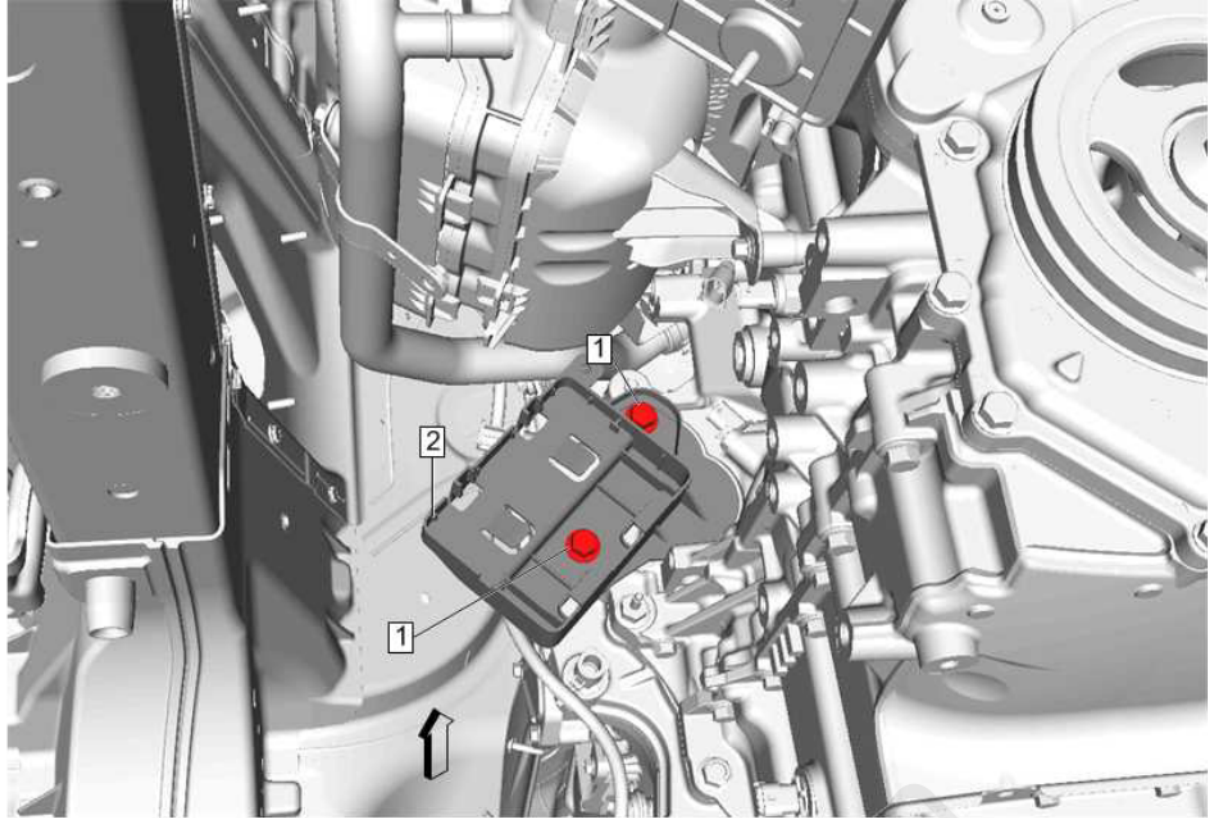


Fig. 2: Transmission Control Module Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Transmission Control Module Replacement	
1	Transmission Control Module Bracket Fastener [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Transmission Control Module Bracket

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER CABLE BRACKET REPLACEMENT

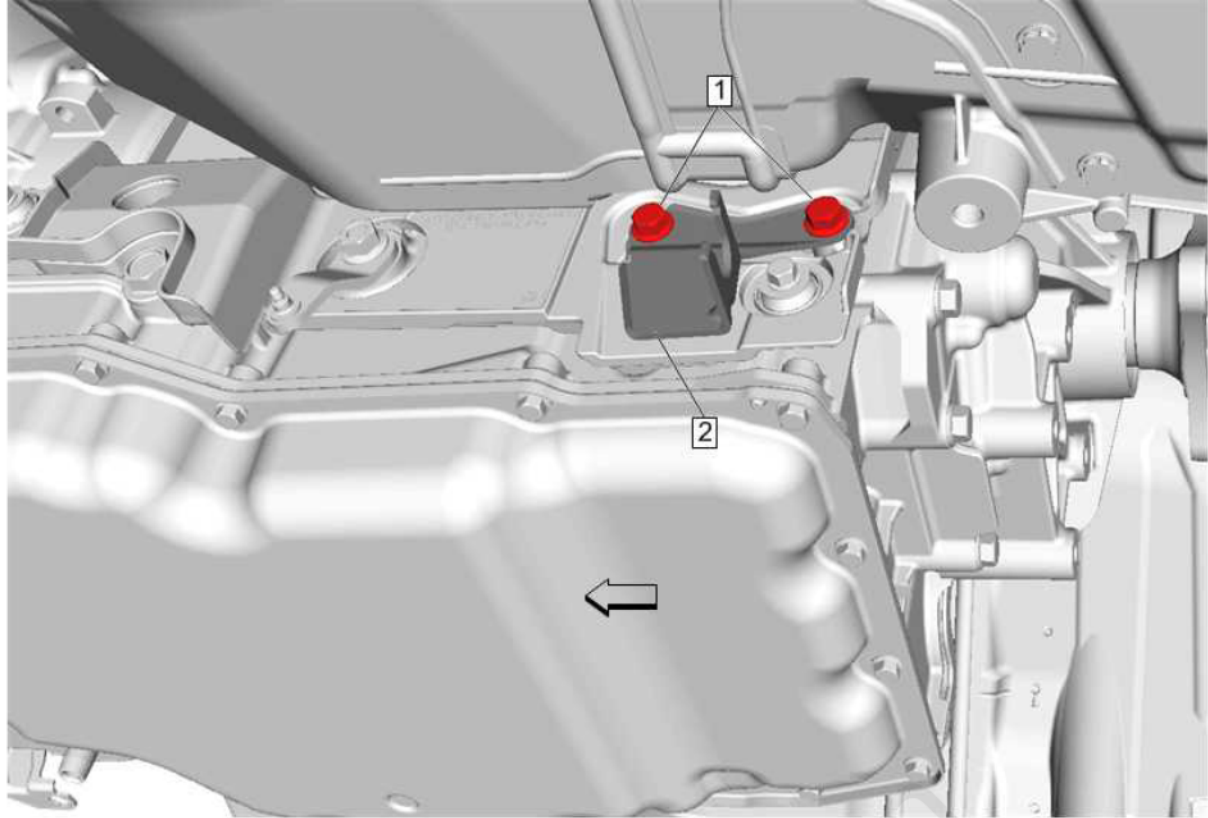


Fig. 3: Automatic Transmission Range Selector Lever Cable Bracket
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Apply the park brake. 2. Shift the transmission into neutral. 3. <u>Lifting and Jacking the Vehicle</u> . 4. <u>Automatic Transmission Range Selector Lever Cable Replacement</u>.	
1	Transmission Range Selector Cable Bracket Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Transmission Range Selector Cable Bracket

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER CABLE REPLACEMENT

Removal Procedure

1. Set the park brake.
2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
3. Disconnect the transmission range selector lever cable terminal (1) from the transmission manual shift lever pin (6).

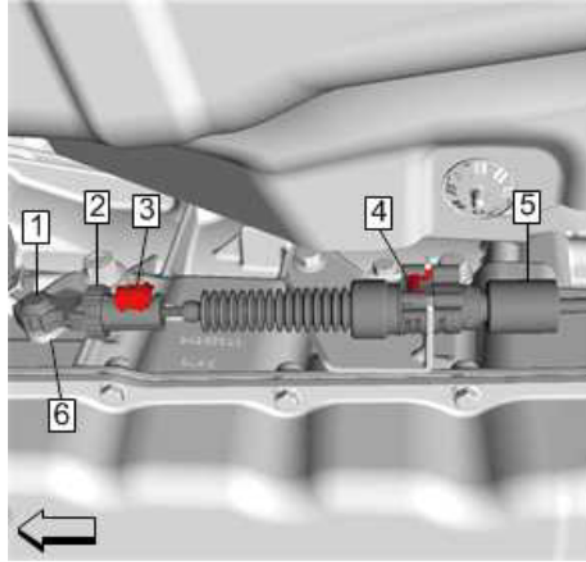


Fig. 4: Transmission Range Selector Lever Cable Terminal
 Courtesy of GENERAL MOTORS COMPANY

4. Slide the retainer (4) rearward to release the transmission range selector lever cable from the bracket.
5. Lower the vehicle.
6. **Front Floor Lower Console Replacement (Left Side)** Â» Left Side Remove
7. Slide the transmission range selector lever cable retainer rearward (2) and remove the transmission range selector cable from the transmission control base.

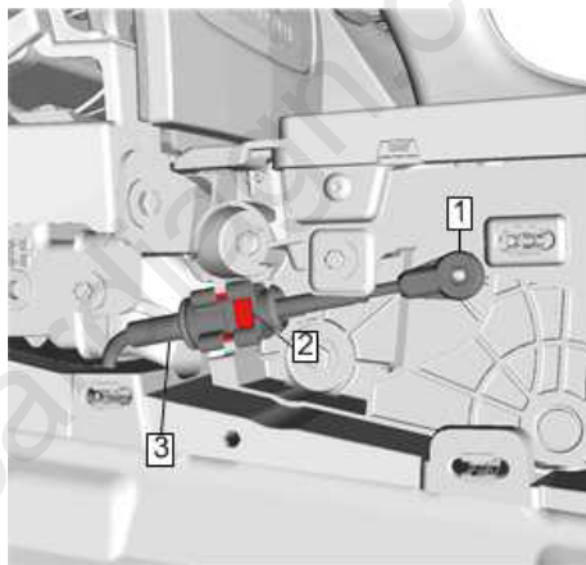


Fig. 5: Transmission Range Selector Lever Cable Retainer Rearward
 Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the transmission range selector lever cable terminal (1) from the shift lever pin.
9. **Front Floor Console Replacement** Â» Remove
10. Remove the two fasteners (1) then remove grommet and cable assembly (2) from the floor panel.

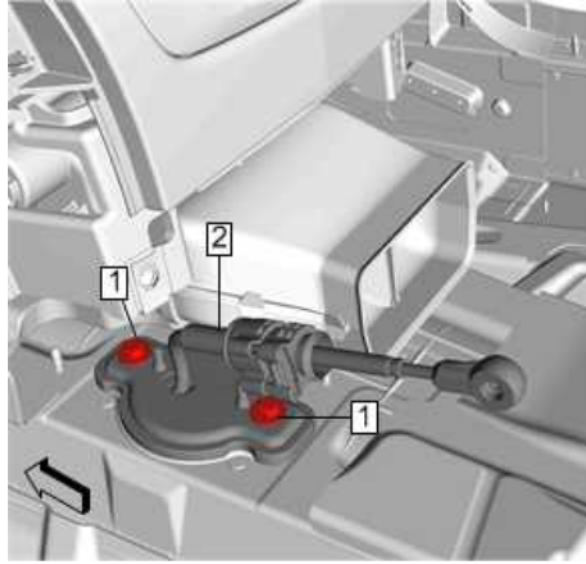


Fig. 6: Fasteners And Cable Assembly
 Courtesy of GENERAL MOTORS COMPANY

11. Remove the transmission range selector lever cable from the vehicle.

Installation Procedure

1. Install the grommet and cable assembly (2) in the vehicle.

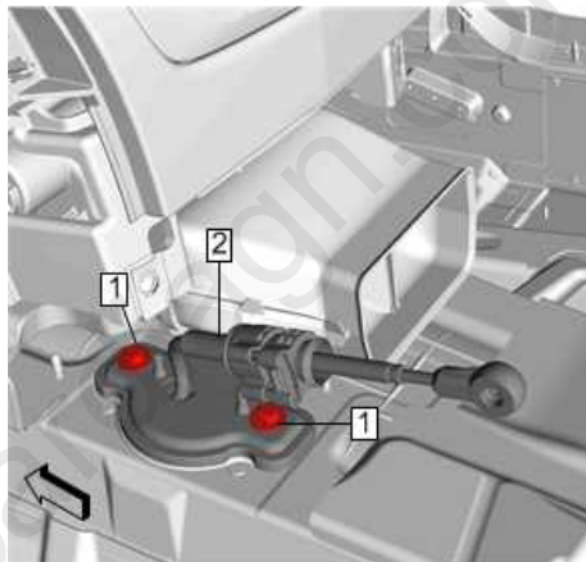


Fig. 7: Fasteners And Cable Assembly
 Courtesy of GENERAL MOTORS COMPANY

2. Install the two fasteners (1) and tighten to 9 N.m (80 lb in).

CAUTION: Refer to **Fastener Caution** .

3. **Front Floor Console Replacement** » Install
4. Connect the transmission range selector lever cable terminal (1) to the shift lever pin.

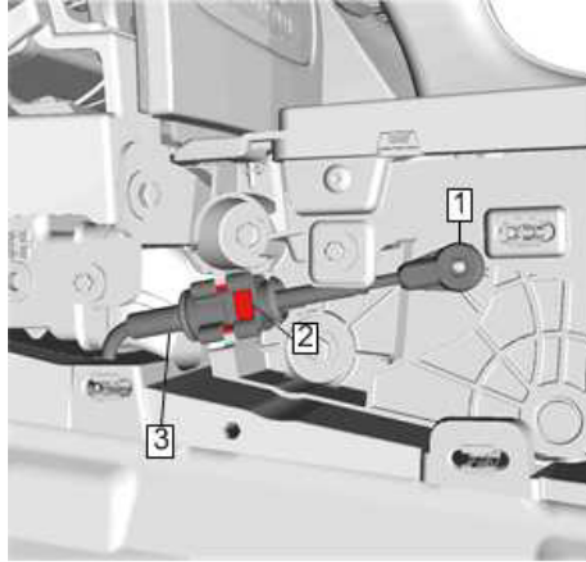


Fig. 8: Transmission Range Selector Lever Cable Retainer Rearward
Courtesy of GENERAL MOTORS COMPANY

WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

5. Install the transmission range selector cable to the transmission control base by pressing down until it seats into place.
6. Slide the transmission range selector lever cable retainer forward (2) to lock the transmission range selector cable to the transmission control base.
7. **Front Floor Lower Console Replacement (Left Side)** Â» Left Side Install
8. Raise the vehicle.
9. Connect the transmission range selector lever cable terminal (1) to the transmission manual shift lever pin (6).

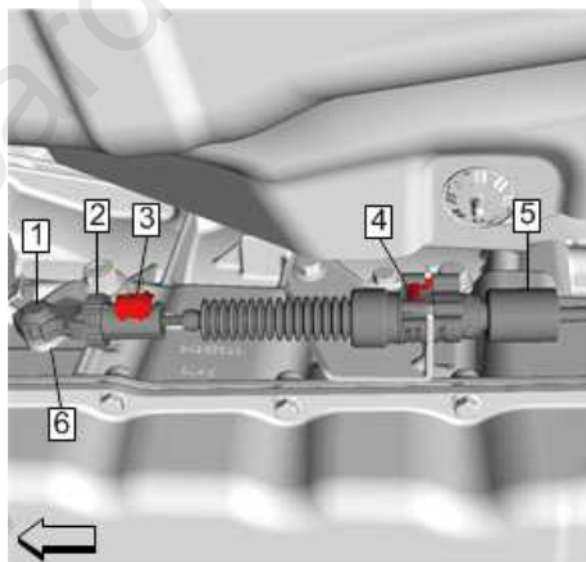


Fig. 9: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

10. Install the cable (5) into the bracket and ensure cable is fully seated.
11. Slide the transmission range selector lever cable retainer rearward (4) to lock the transmission range selector cable to the bracket.
12. Adjust the cable. **Range Selector Lever Cable Adjustment** .

AUTOMATIC TRANSMISSION RANGE SELECTOR LEVER CABLE LEVER REPLACEMENT

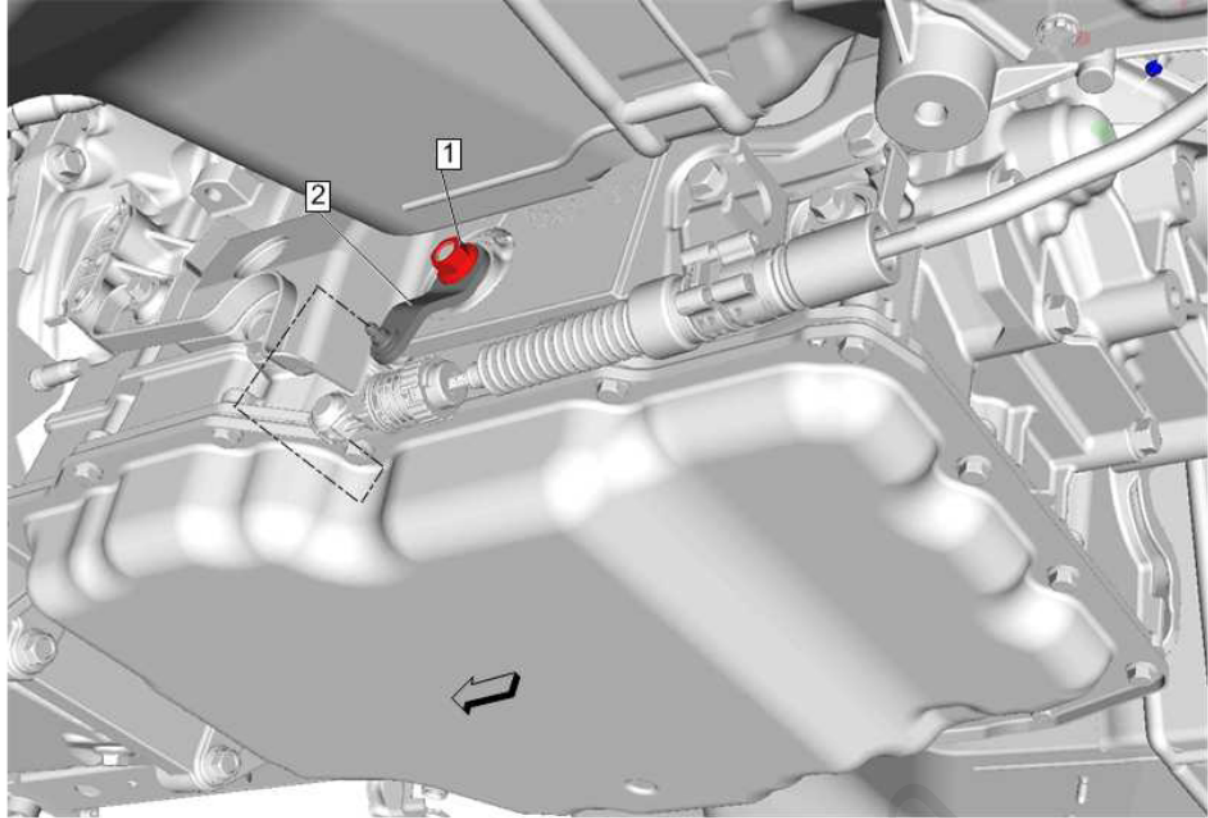


Fig. 10: Automatic Transmission Range Selector Lever Cable Lever

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Apply the park brake. 2. Shift the transmission into neutral. 3. Disconnect the transmission range selector cable from the range selector cable lever ball stud. WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.	
1	Transmission Range Selector Cable Lever Nut WARNING: Hold the transmission range selector lever while removing or installing the lever retaining nut. Failure to hold the lever can cause damage to the transmission internal park system components which could allow the vehicle to roll when placed in the park position. CAUTION: Refer to Fastener Caution . Tighten 25 N.m (18 lb ft)
2	Transmission Range Selector Cable Lever

RANGE SELECTOR LEVER CABLE ADJUSTMENT

1. Set the park brake and chock the wheels.

NOTE: Adjust the automatic transmission range selector cable while the transmission and the gear selector are in the Park position only. Failure to do so may cause mis-adjustment.

2. Verify the transmission range select lever is in the park position.
3. Verify the transmission manual shift lever is in the park position.
4. If installing a new cable, skip this step and go to the next step. Pull the retaining collar (2) forward, then release the range select cable adjuster clip (3) by pushing in on the adjuster clip from the backside.

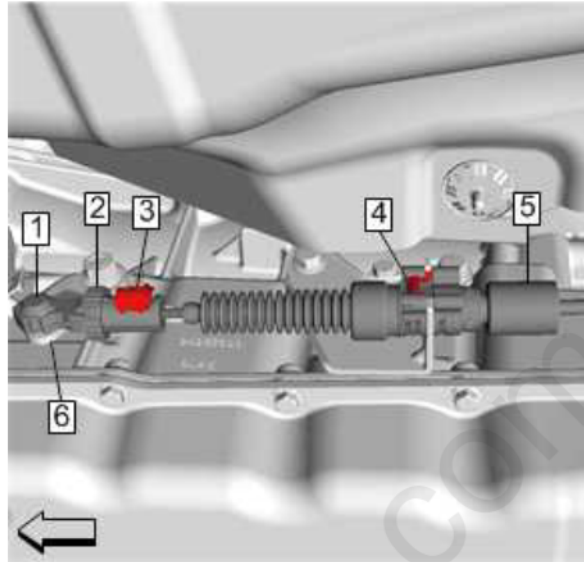


Fig. 11: Transmission Range Selector Lever Cable Terminal
Courtesy of GENERAL MOTORS COMPANY

WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

5. Depress the adjuster clip (3) inboard, locking the adjuster clip completely.
6. Ensure that the cable adjuster clip (3) is secured with retaining collar (2) covering the adjuster clip.
7. Check the transmission range select lever in all gear selections for proper operation.

AUTOMATIC TRANSMISSION FLUID PRESSURE TEST HOLE PLUG REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).
2. Clean the surrounding area of the automatic transmission fluid pressure test hole plug.

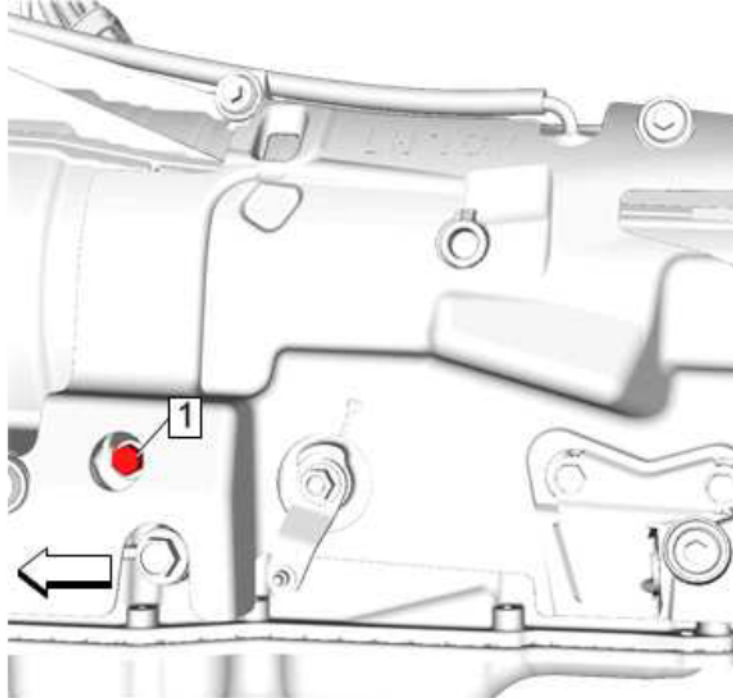


Fig. 12: Automatic Transmission Fluid Pressure Test Hole Plug
Courtesy of GENERAL MOTORS COMPANY

3. Remove the automatic transmission fluid pressure test hole plug (1).

Installation Procedure

1. Install the automatic transmission fluid pressure test hole plug (1) and tighten to 10.5 N.m (93 lb in).

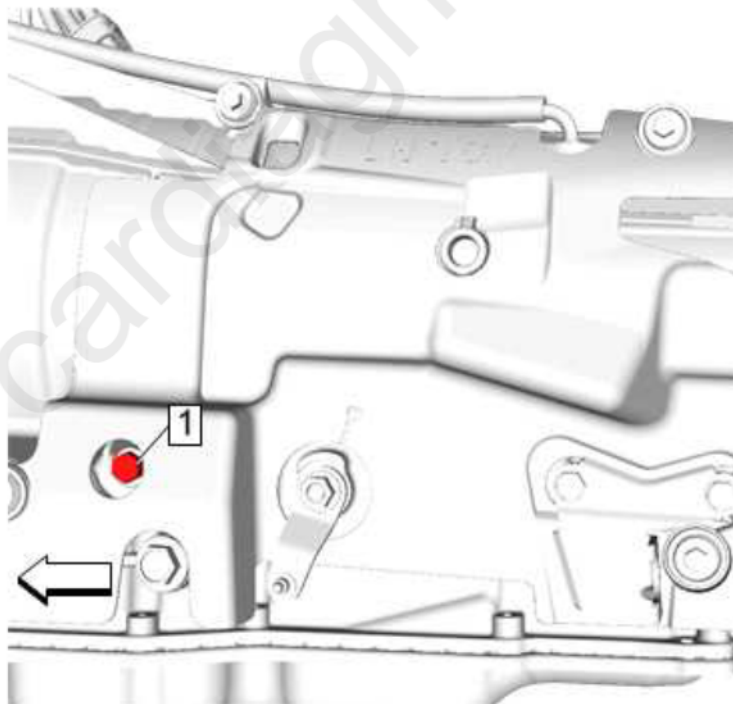


Fig. 13: Automatic Transmission Fluid Pressure Test Hole Plug
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Component Fastener Tightening Caution** .

2. Check the transmission fluid level (fill if necessary). Refer to **Transmission Fluid Level and Condition Check** .
3. Lower the vehicle.

TRANSMISSION FLUID FILLER PLUG REPLACEMENT

Removal Procedure

1. Remove the transmission from the vehicle. Refer to [Transmission Replacement](#).
2. Remove the transmission housing sound insulator bolts (1).

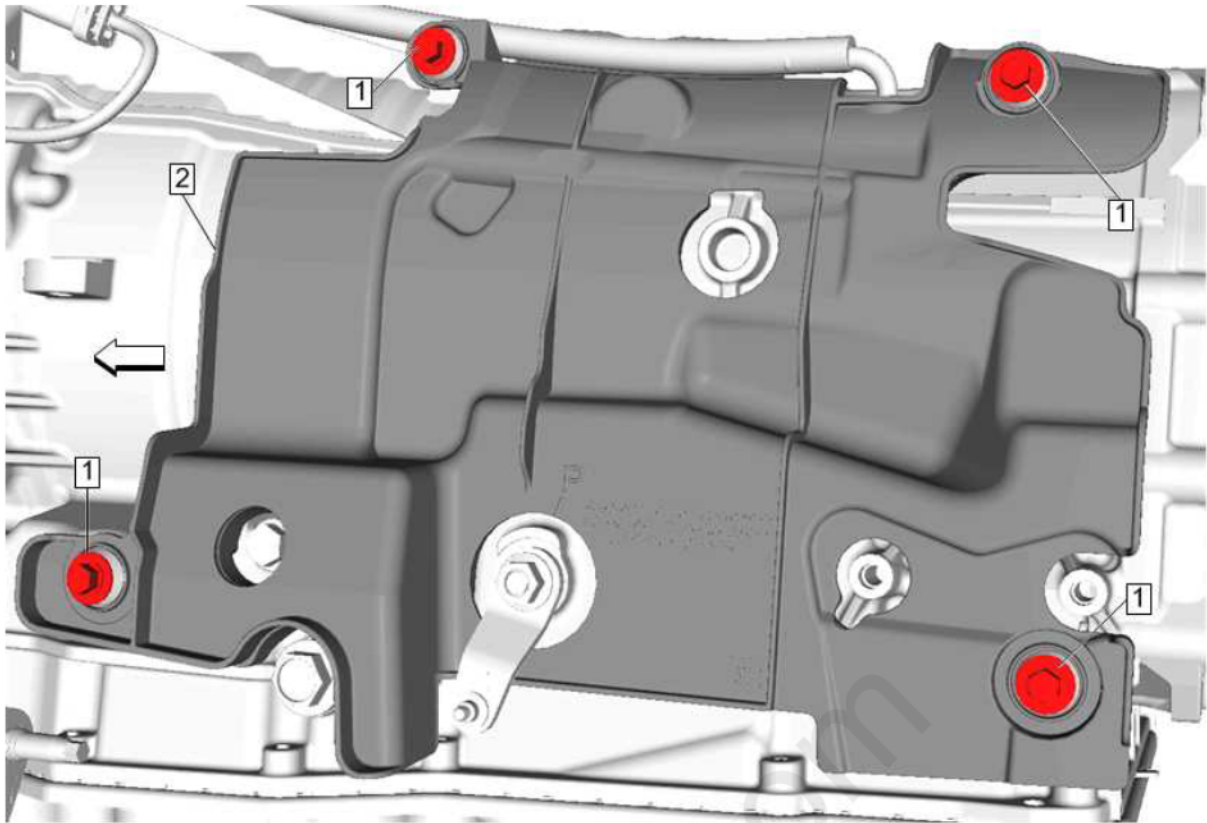


Fig. 14: Transmission Housing Sound Insulator Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD the fill plug (2).

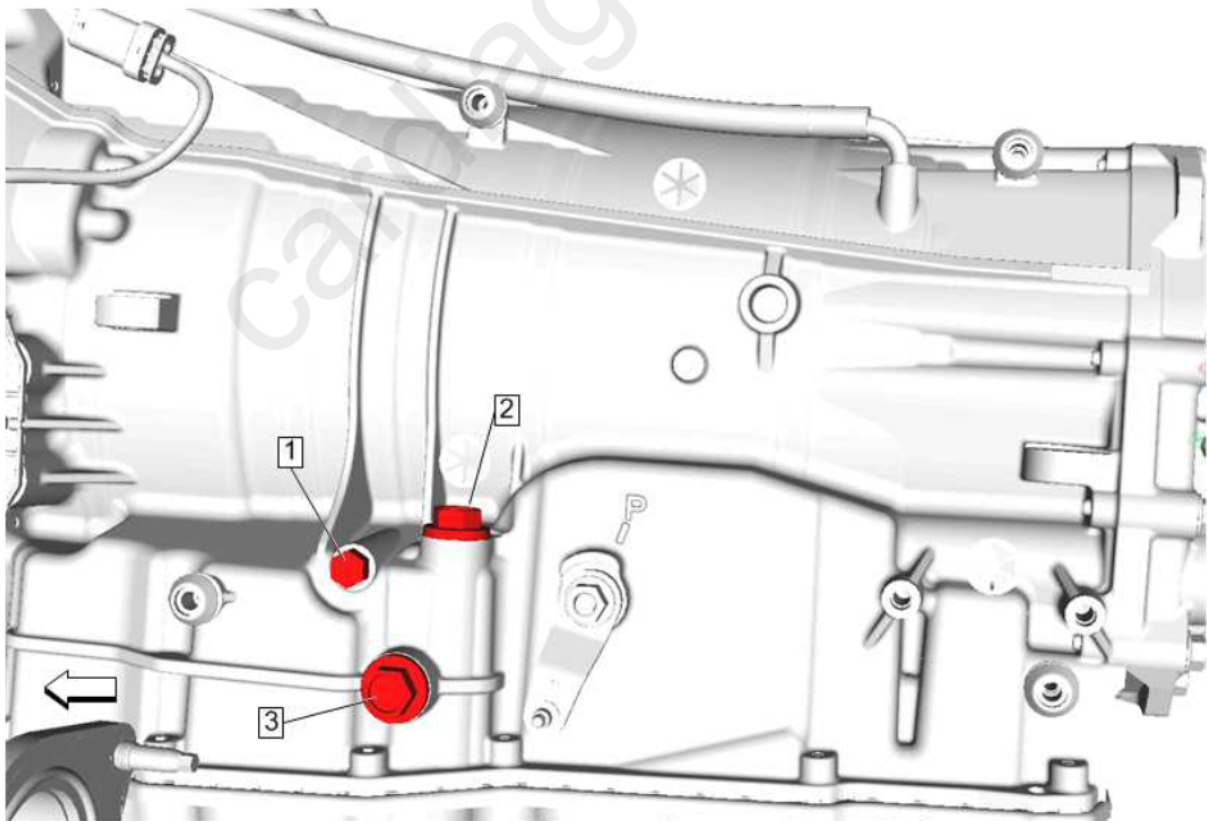


Fig. 15: Fill Plug
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Install the NEW fill plug (2) and tighten to 21 N.m (15 lb ft).

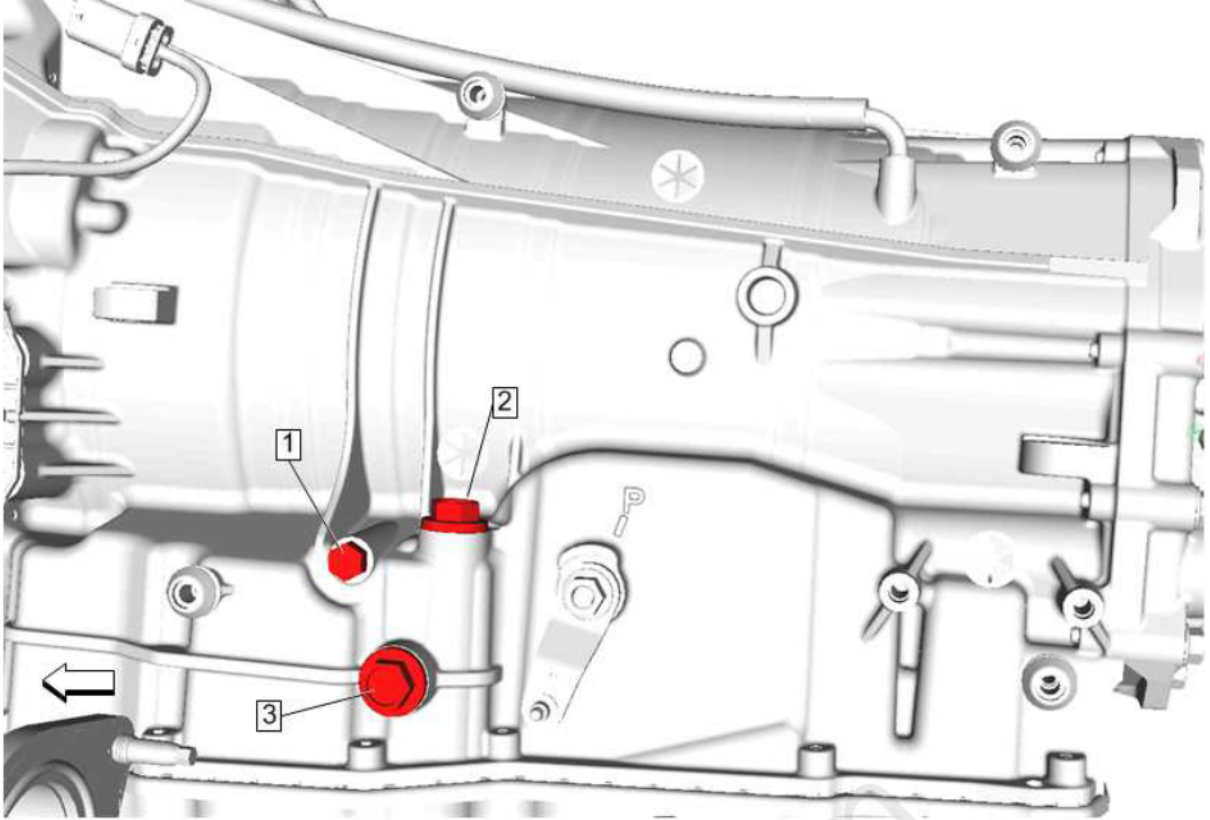


Fig. 16: Fill Plug

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#)

2. Position the noise shield (2) to the transmission.

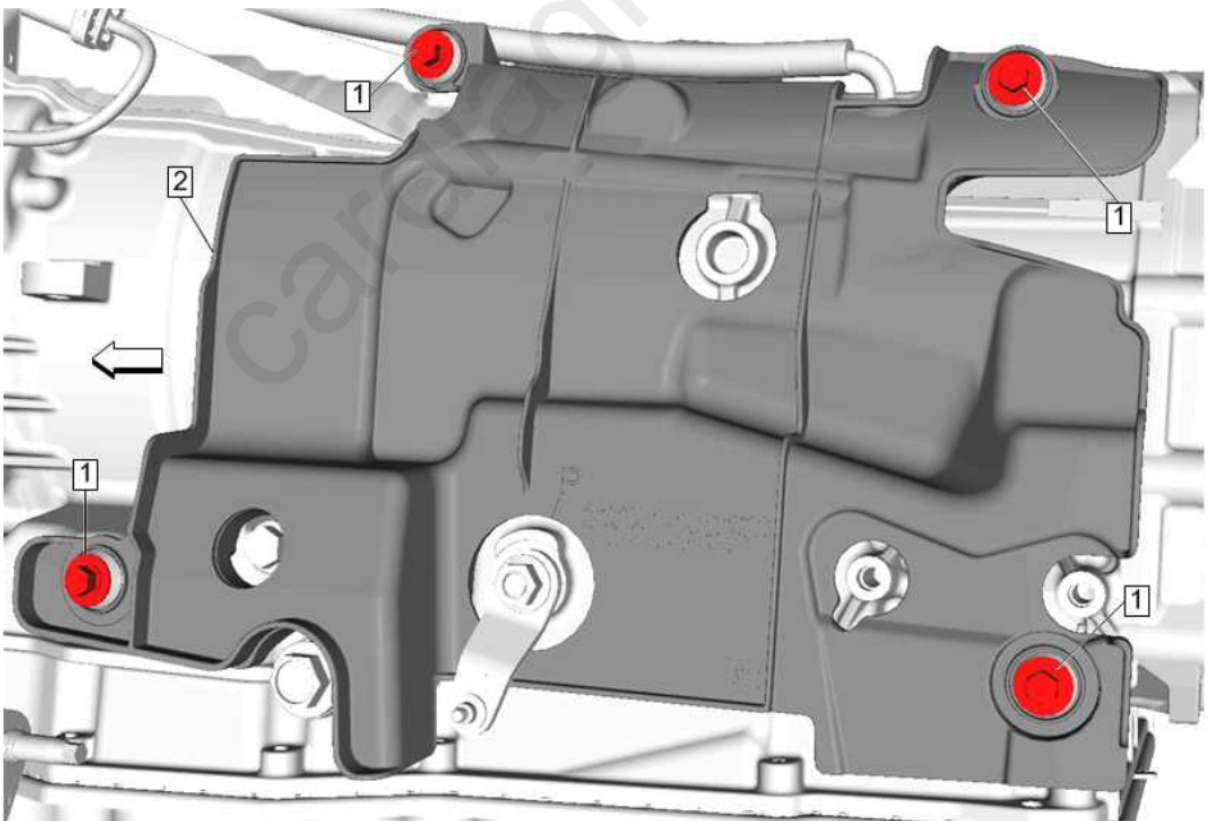


Fig. 17: Transmission Housing Sound Insulator Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install the transmission housing sound insulator bolts (1) and tighten to 10 N.m (89 lb in).

CAUTION: Refer to [Fastener Caution](#)

4. Install the transmission to the vehicle. Refer to [Transmission Replacement](#).

TRANSMISSION MOUNT INSPECTION

CAUTION: To prevent transmission oil pan damage and possible transmission failure, insert a block of wood that completely covers the bottom of the transmission oil pan surface, between the transmission oil pan and the jack support. If the inserted block of wood does not completely cover the bottom of the transmission oil pan, this may result in damage to the transmission oil pan and possible transmission failure.

1. Raise the transmission in order to remove the weight from the transmission mount and create slight tension in the rubber.
2. Observe the transmission mount while raising the transmission. Replace the transmission/transaxle mount if the transmission mount exhibits any of the following conditions:
 - The hard rubber surface is covered with heat check cracks.

NOTE: Black paint on the rubber will crack with time, this does not constitute a failure.

- The rubber is separated from the metal plate of the transmission mount.
 - The rubber is split through the center of the transmission mount.
3. If there is movement between the metal plate of the transmission mount and its attaching points, lower the transmission on the transmission mount. Tighten the bolts or nuts attaching the transmission mount to the frame or transmission mount bracket.

TRANSMISSION MOUNT REPLACEMENT

The transmission mount and transmission support are to be replaced as an assembly. To replace the transmission mount and the transmission support, refer to [Transmission Support Crossmember Replacement \(LTG\)](#).

TRANSMISSION ADAPTER REPLACEMENT

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Remove the transmission from the vehicle. Refer to [Transmission Replacement](#)
3. Remove the oil pump control valve heat shield (4) from the engine assembly. Refer to [Oil Pump Flow Control Valve Heat Shield Replacement](#)

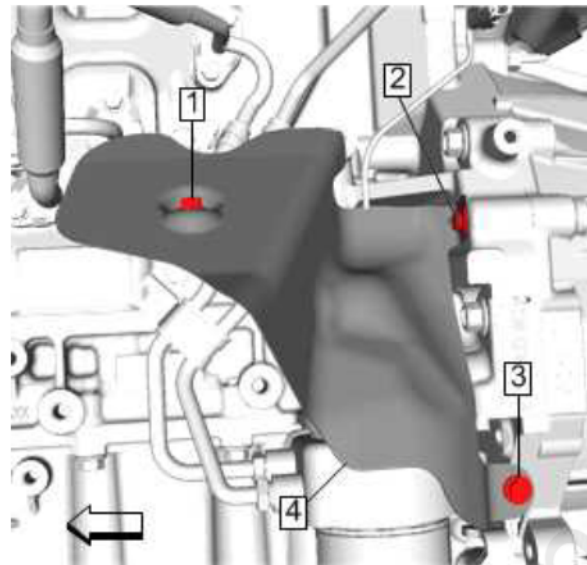


Fig. 18: Catalytic Converter Shield

Courtesy of GENERAL MOTORS COMPANY

4. Remove the middle left transmission to engine bolts (1, 2).

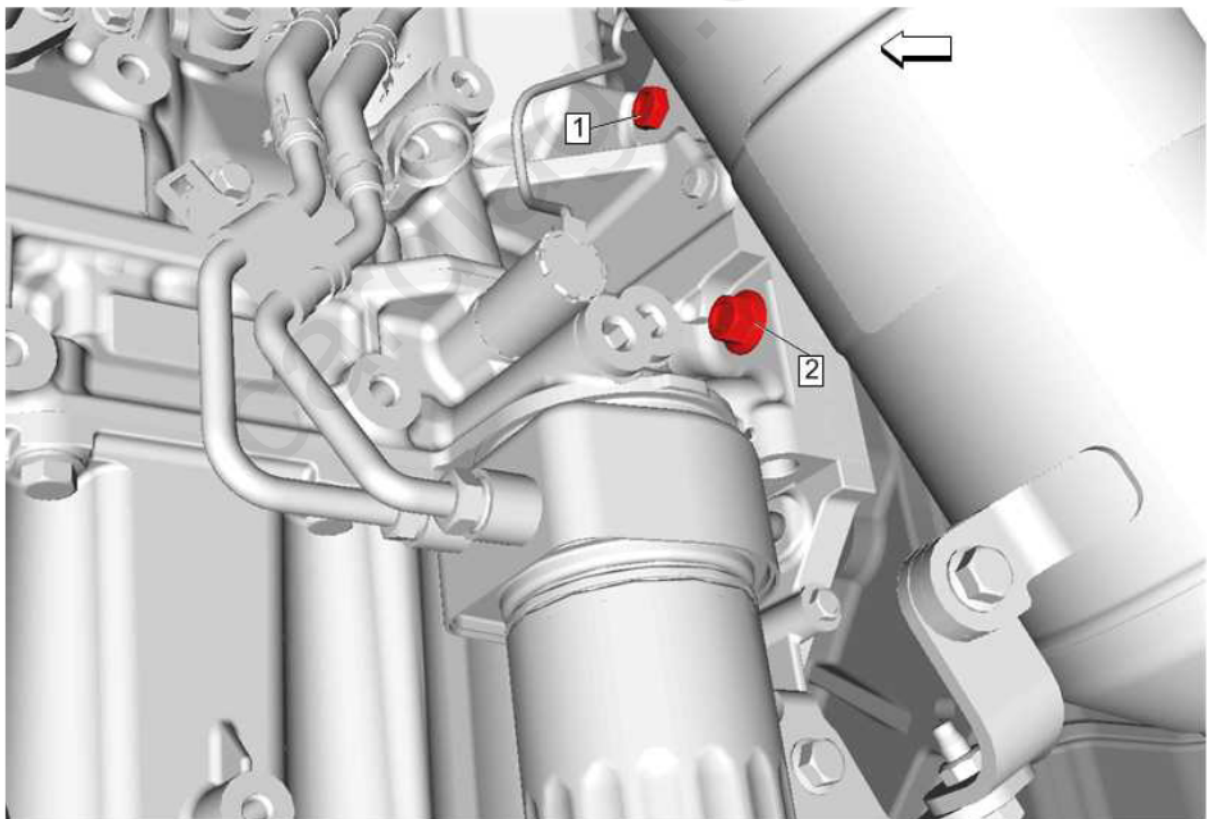


Fig. 19: Middle Left Transmission To Engine Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the right engine to transmission bolts (1, 2).

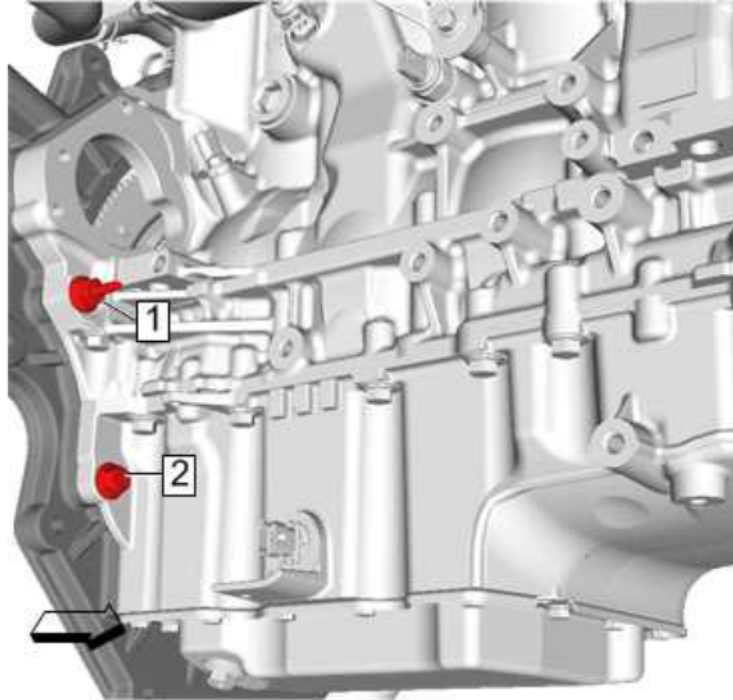


Fig. 20: Right Engine To Transmission Bolts
 Courtesy of GENERAL MOTORS COMPANY

6. Remove the transmission adapter plate bolts (1, 2, 3, 4, 5).

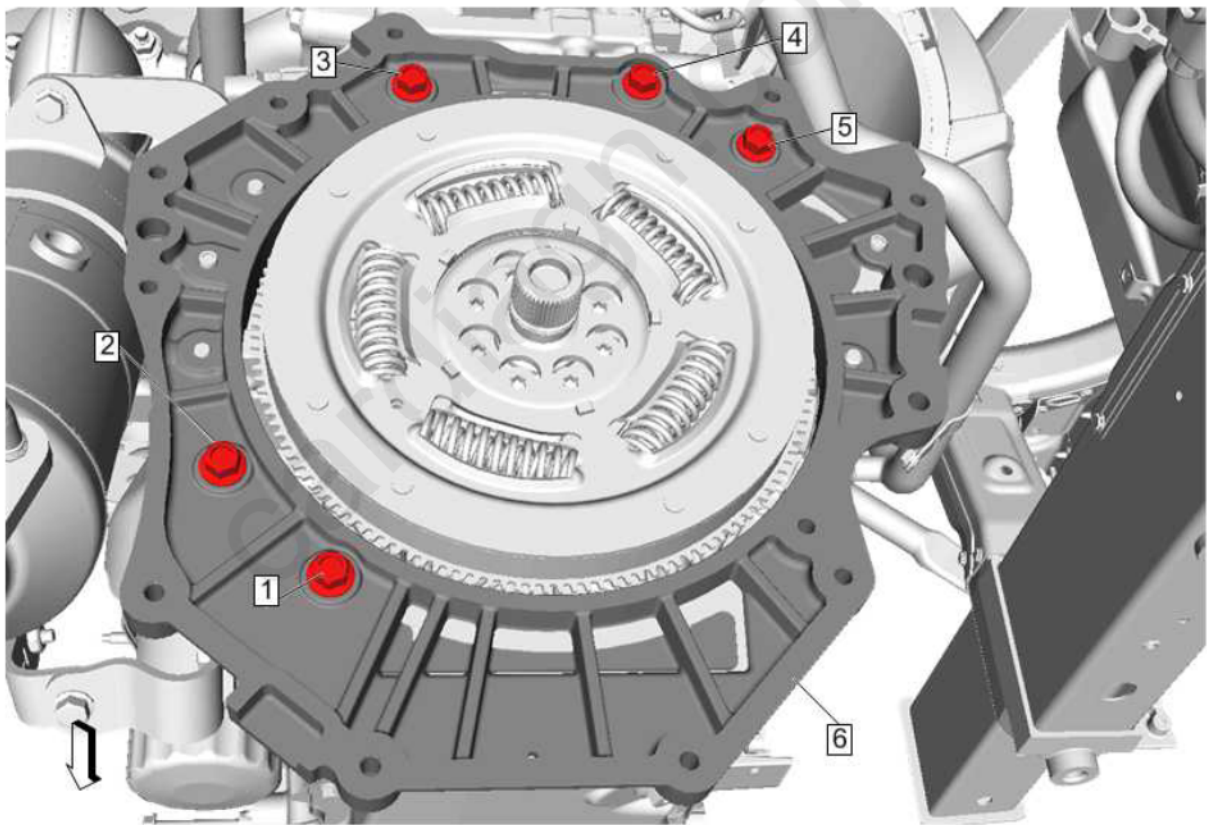


Fig. 21: Transmission Adapter Plate Bolts
 Courtesy of GENERAL MOTORS COMPANY

7. Remove the transmission adapter plate (6) from the engine assembly.

Installation Procedure

1. Position the transmission adapter plate (6) to the engine assembly.

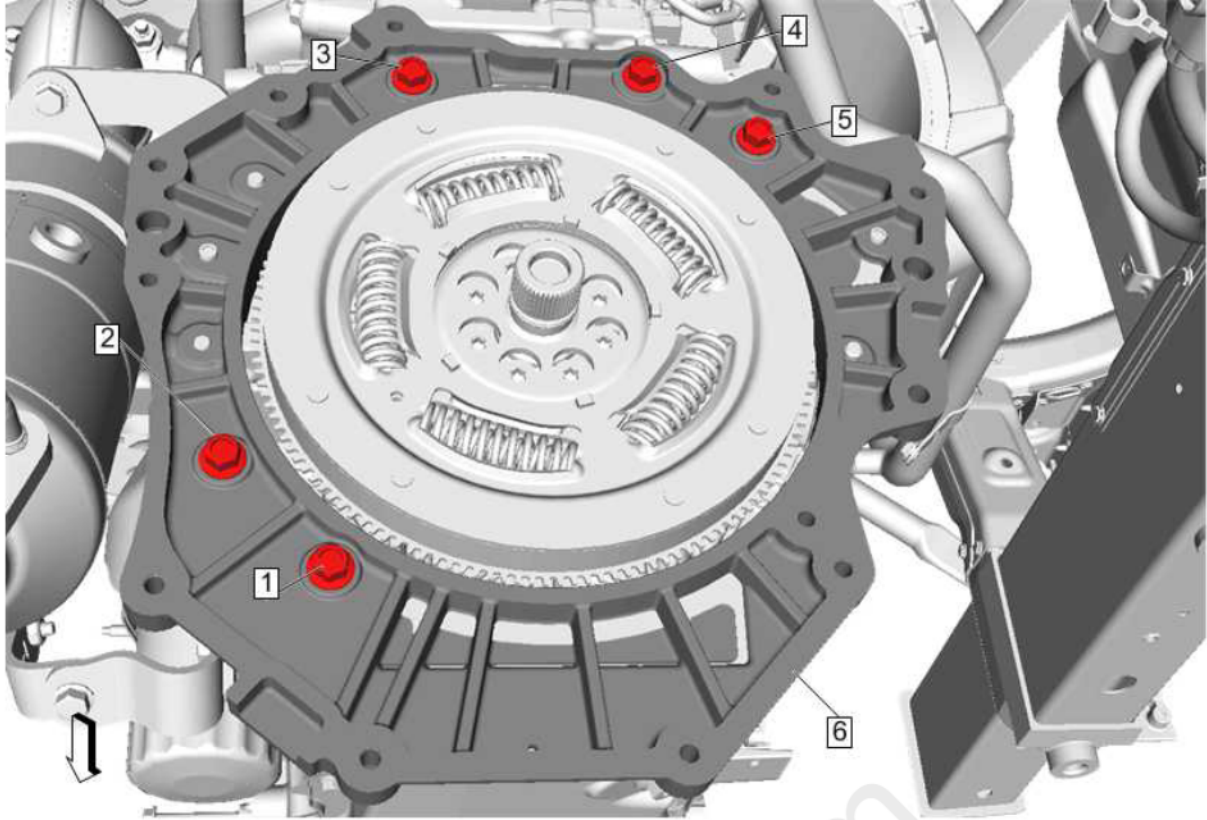


Fig. 22: Transmission Adapter Plate Bolts
 Courtesy of GENERAL MOTORS COMPANY

2. Install the transmission adapter plate bolts (1, 2, 3, 4, 5) and tighten to 58 N.m (43 lb ft).

CAUTION: Refer to **Fastener Caution**.

3. Install the right engine to transmission bolts (1, 2) and tighten to 58 N.m (43 lb ft).

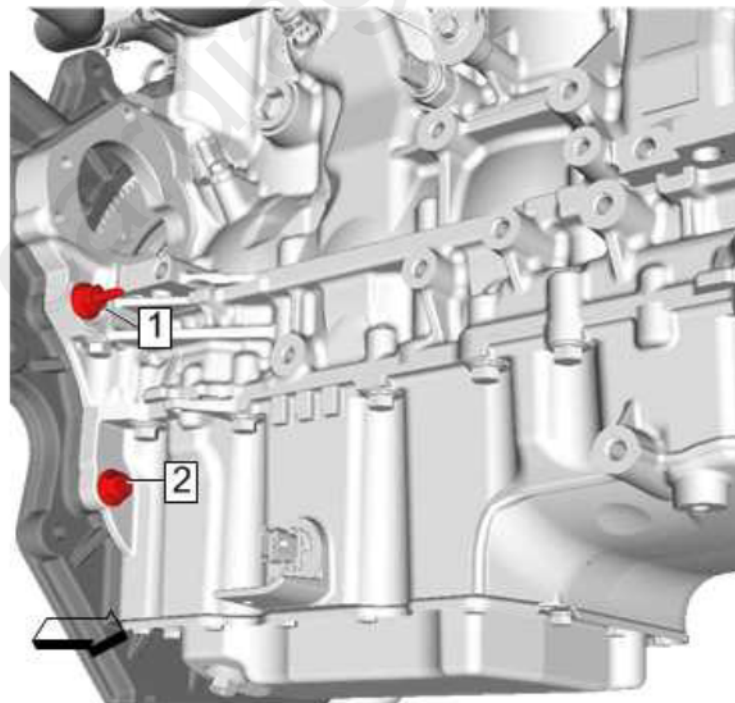


Fig. 23: Right Engine To Transmission Bolts
 Courtesy of GENERAL MOTORS COMPANY

4. Install the middle left transmission to engine bolts (1, 2) and tighten to 58 N.m (43 lb ft).

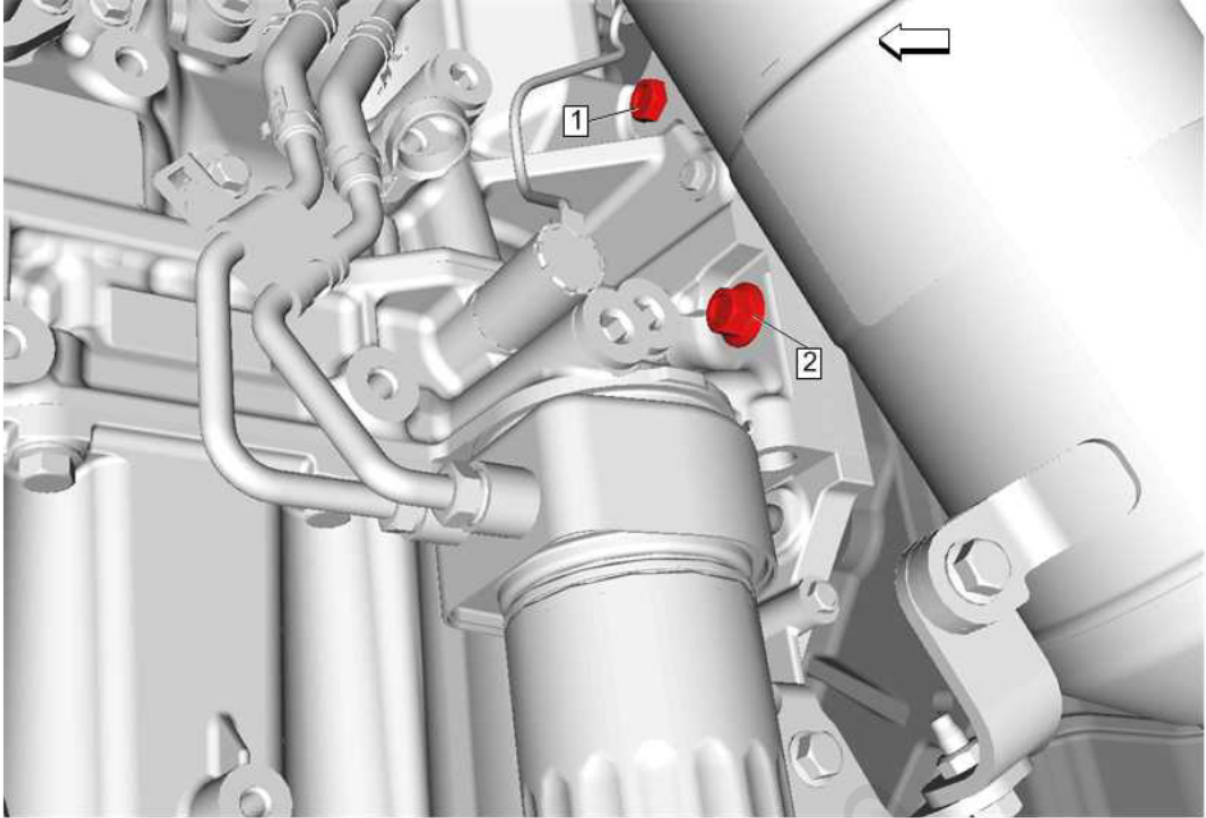


Fig. 24: Middle Left Transmission To Engine Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install the oil pump control valve heat shield to the engine assembly. Refer to [Oil Pump Flow Control Valve Heat Shield Replacement](#)

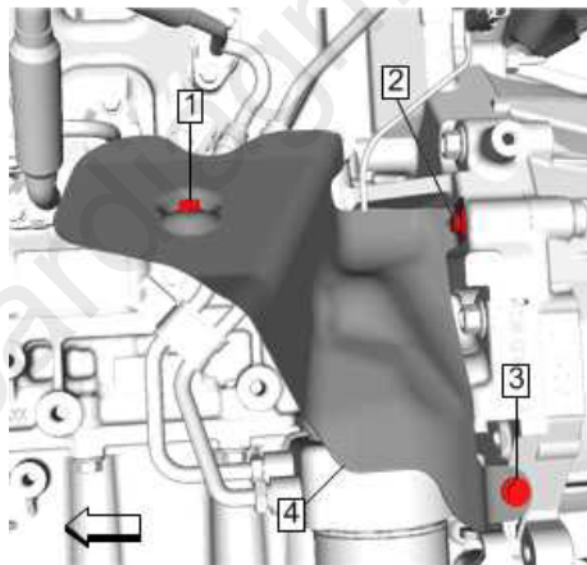


Fig. 25: Catalytic Converter Shield

Courtesy of GENERAL MOTORS COMPANY

6. Install the transmission to the vehicle. Refer to [Transmission Replacement](#)
7. Enable the high voltage system. Refer to [High Voltage Enabling](#)

AUTOMATIC TRANSMISSION CONTROL LEVER KNOB REPLACEMENT

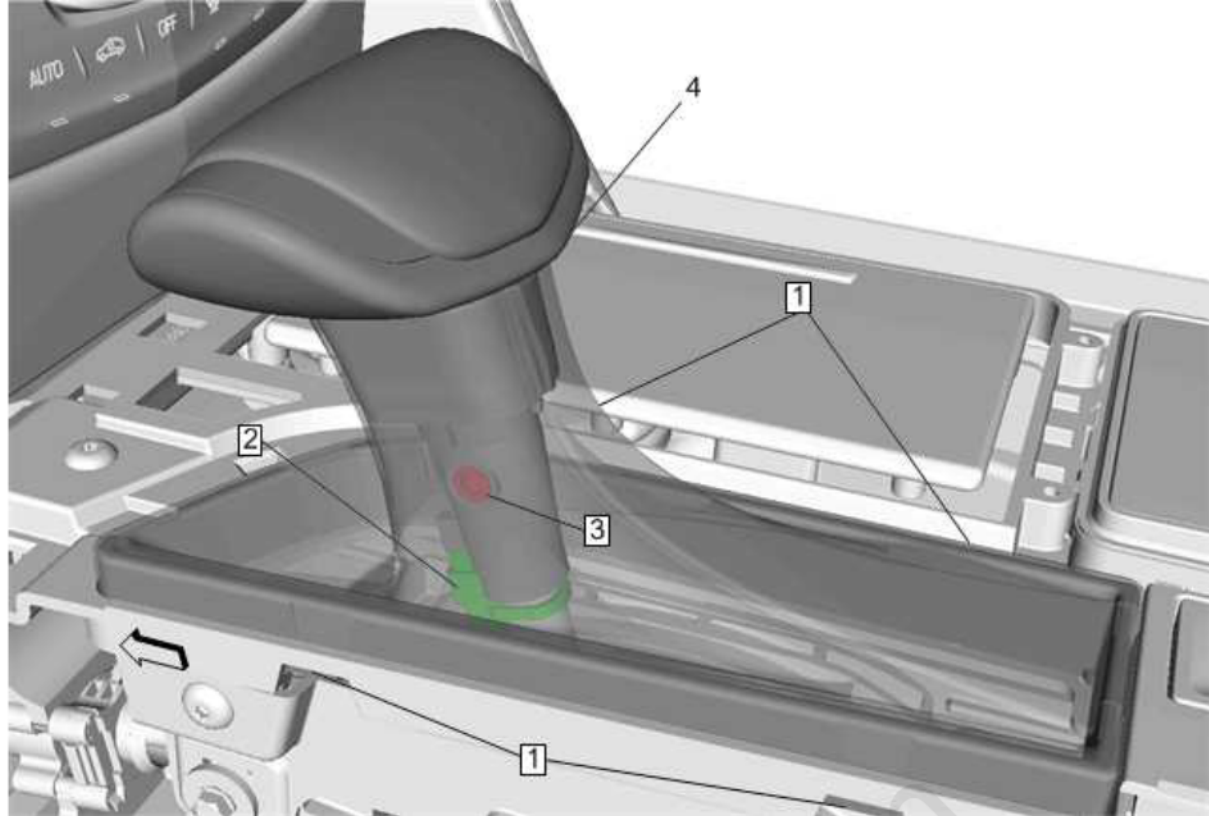


Fig. 26: Transmission Control Lever Knob
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Front Floor Console Extension Panel Replacement - Left Side	
1	Transmission Control Lever Knob Retaining Tabs (Qty: 6) Procedure Using a flat-bladed plastic trim tool, release the retainer securing the control lever boot.
2	Electrical Dock Lock Connector NOTE: Shift boot shown semi-transparent for clarity. NOTE: Do Not twist the transmission control lever knob. Procedure Lift the transmission control lever knob straight up to disconnect the electrical connector.
3	Retaining Screw Procedure Lift the shift boot to access the retaining screw.
4	Transmission Control Lever Knob NOTE: • The control lever boot and knob are replaced as an assembly. • DO NOT TWIST the knob to remove, pull upward ONLY.

AUTOMATIC TRANSMISSION CONTROL REPLACEMENT

Removal Procedure

1. Set the park brake.
2. Remove the left side front floor console extension panel. Refer to [Front Floor Console Extension Panel Replacement - Left Side](#).
3. Remove the transmission control lever knob. Refer to [Transmission Control Lever Knob Replacement](#)
4. Remove the front floor console trim plate. Refer to [Front Floor Console Trim Plate Replacement](#)
5. Remove the upper transmission control retaining bolt (1).

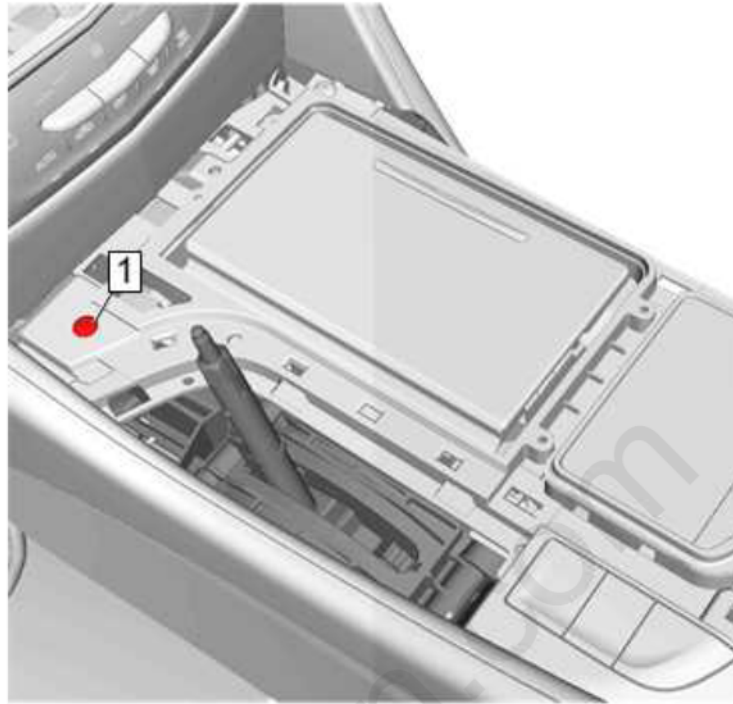


Fig. 27: Upper Transmission Control Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Slide the transmission range selector lever cable retainer rearward (2) and remove the transmission range selector cable from the transmission control base.

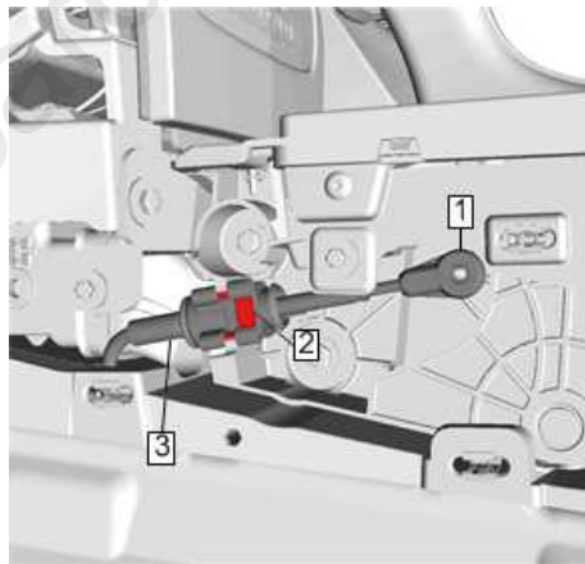


Fig. 28: Transmission Range Selector Lever Cable Retainer Rearward
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the transmission range selector lever cable terminal (1) from the shift lever pin.
8. Remove the five fasteners (1, 2) then remove the shift cover (3) from the front floor console.

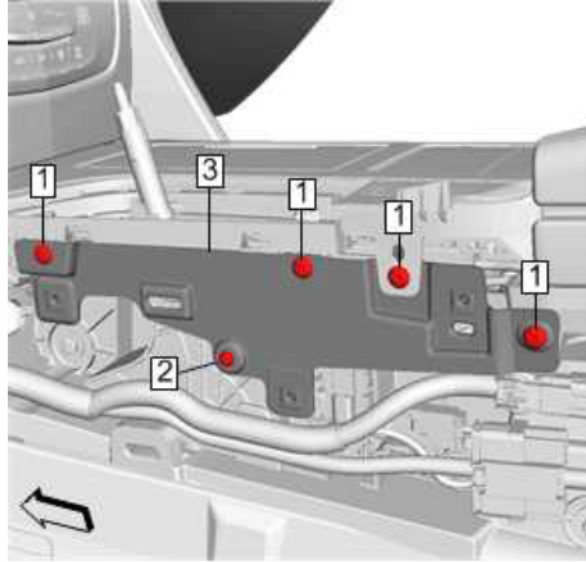


Fig. 29: Fasteners And Shift Cover

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect the electrical connector (2) from the transmission control assembly.

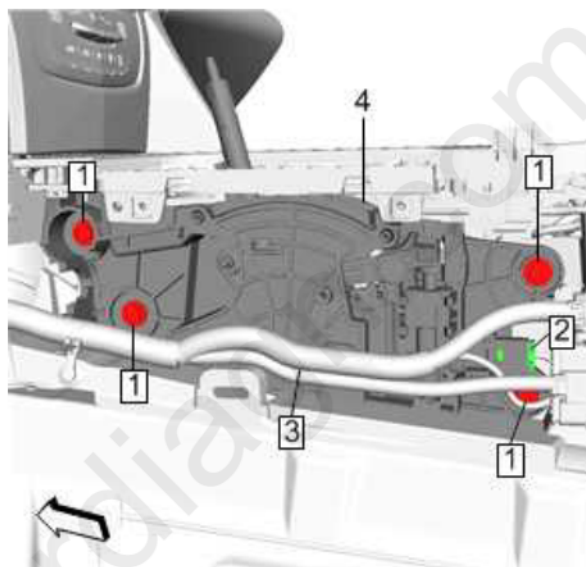


Fig. 30: Electrical Connector And Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

10. Remove the four transmission control fasteners (1).
11. Reposition the wiring harness (3) out of the way.
12. Remove the transmission control (4) from the front floor console.

Installation Procedure

1. Position the transmission control (4) to the front floor console.

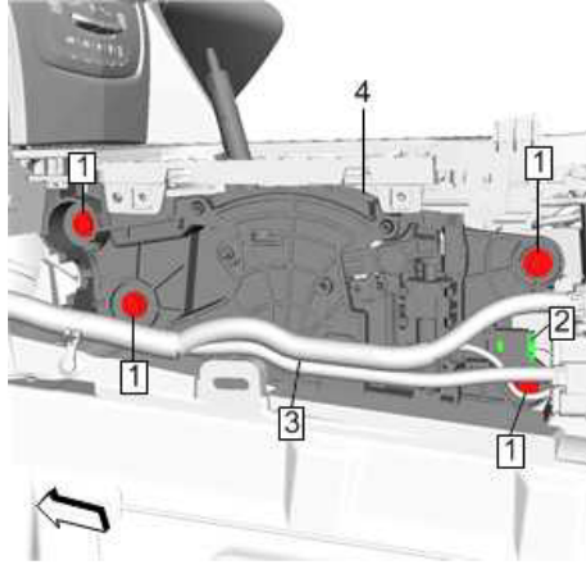


Fig. 31: Electrical Connector And Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

2. Connect the electrical connector (2) to the transmission control assembly.
3. Install the four fasteners (1) and tighten to 9 N.m (80 lb in).

CAUTION: Refer to **Fastener Caution** .

4. Reposition the wiring harness (3) to the front floor console.
5. Install the shift cover (3) to the front floor console, then install the five fasteners (1, 2).

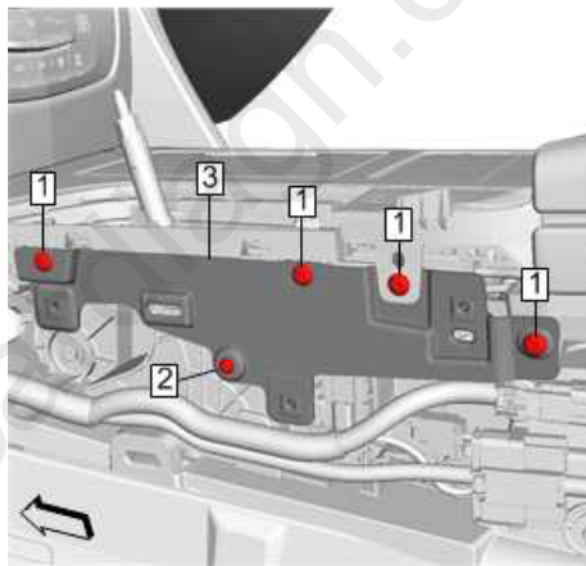


Fig. 32: Fasteners And Shift Cover

Courtesy of GENERAL MOTORS COMPANY

6. Connect the transmission range selector lever cable terminal (1) to the shift lever pin.

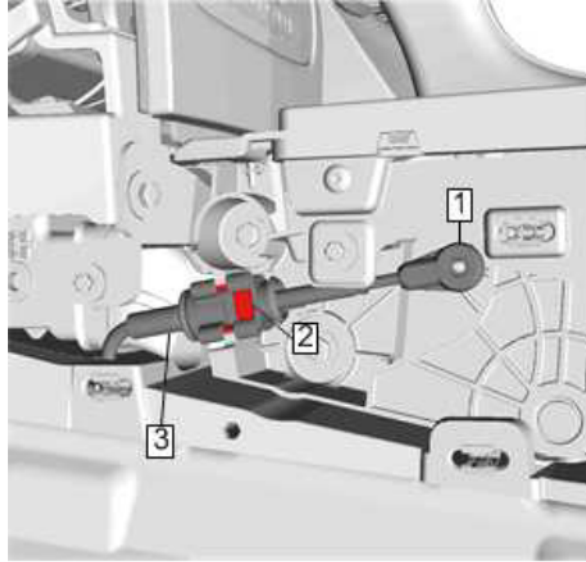


Fig. 33: Transmission Range Selector Lever Cable Retainer Rearward
Courtesy of GENERAL MOTORS COMPANY

WARNING: After installing the transmission range selector shift cable, pull up and push down on ALL connections to verify that the connections are fully seated and properly engaged. Failure to perform this task can result in the vehicle not being able to shift into PARK causing potential vehicle damage and bodily injury.

7. Install the transmission range selector cable to the transmission control base by pressing down until it seats into place.
8. Slide the transmission range selector lever cable retainer forward (2) to lock the transmission range selector cable to the transmission control base.
9. Install the upper transmission control retaining bolt (1) and tighten to 2.5 N.m (22 lb in).

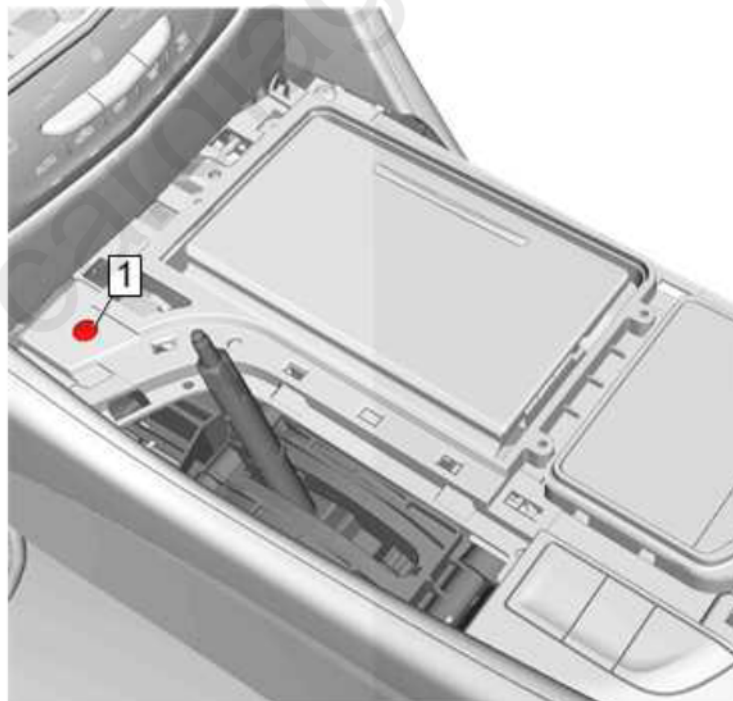


Fig. 34: Upper Transmission Control Retaining Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Install the front floor console trim plate. Refer to [Front Floor Console Trim Plate Replacement](#)
11. Install the transmission control lever knob. Refer to [Transmission Control Lever Knob Replacement](#)
12. Install the left side front floor console extension panel. Refer to [Front Floor Console Extension Panel Replacement - Left Side](#).

Special Tools

- **J-42737** Sector Bearing Installer
- **J-46626** Seal Installer
- For equivalent regional tools, refer to [Special Tools](#) .

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Place a suitable drain pan under the automatic transmission.
3. Clean the surrounding area of the automatic transmission fluid pan.

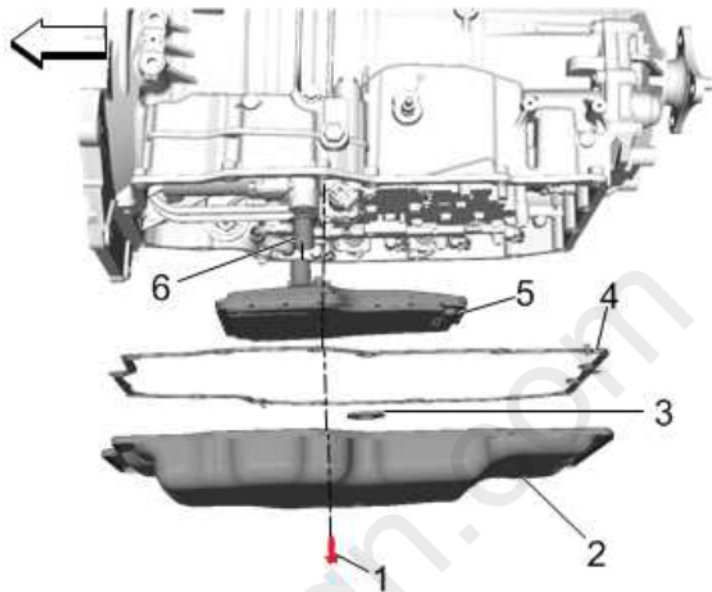


Fig. 35: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
Courtesy of GENERAL MOTORS COMPANY

4. Remove the automatic transmission fluid pan bolts (1).
5. Remove the automatic transmission fluid pan (2).
6. Remove the automatic transmission fluid pan gasket (4).
7. Remove the automatic transmission fluid filter (5).
8. Remove the automatic transmission fluid filter seal (6).

Installation Procedure

1. Install the **J-42737** Sector Bearing Installer to the **J-46626** Seal Installer and install the automatic transmission fluid filter seal (6).

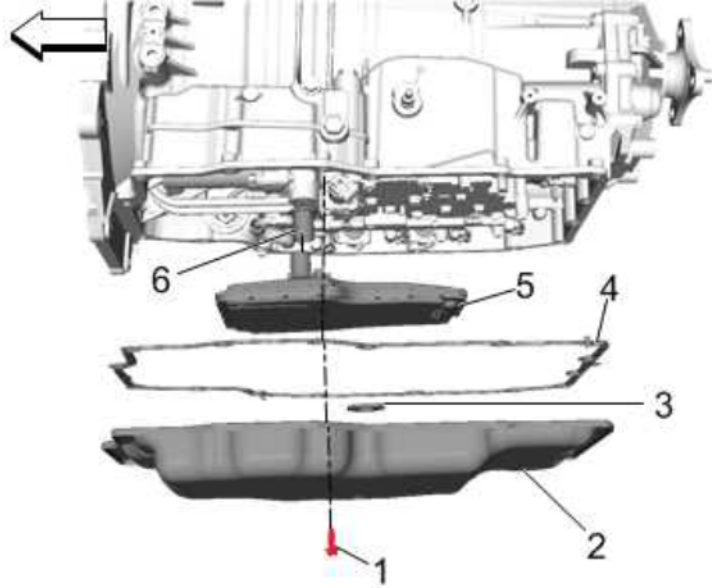


Fig. 36: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
Courtesy of GENERAL MOTORS COMPANY

2. Install the automatic transmission fluid filter (5).
3. Clean the automatic transmission fluid pan magnet (3), then re-install to the fluid pan.
4. Install the automatic transmission fluid pan gasket (4) to the fluid pan.
5. Install the automatic transmission fluid pan (2) to the transmission.
6. Install the automatic transmission fluid pan bolts (1) and tighten in the sequence shown to 9 N.m (80 lb in).

CAUTION: Refer to **Fastener Caution** .

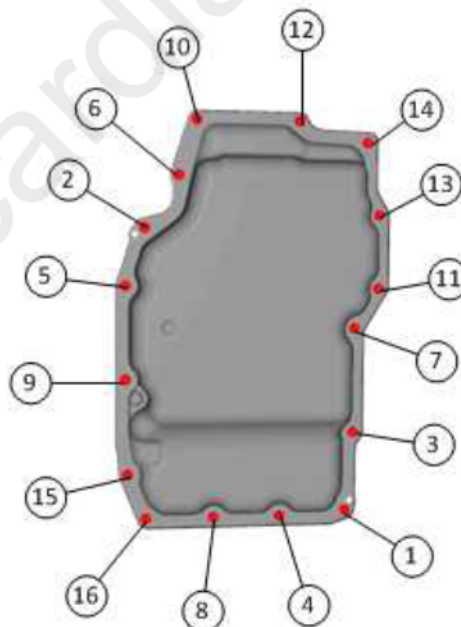


Fig. 37: Automatic Transmission Fluid Pan Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

7. Fill the transmission. Refer to **Transmission Fluid Level and Condition Check**
8. Lower the vehicle.

PROPELLER SHAFT TRANSMISSION FLANGE SEAL REPLACEMENT

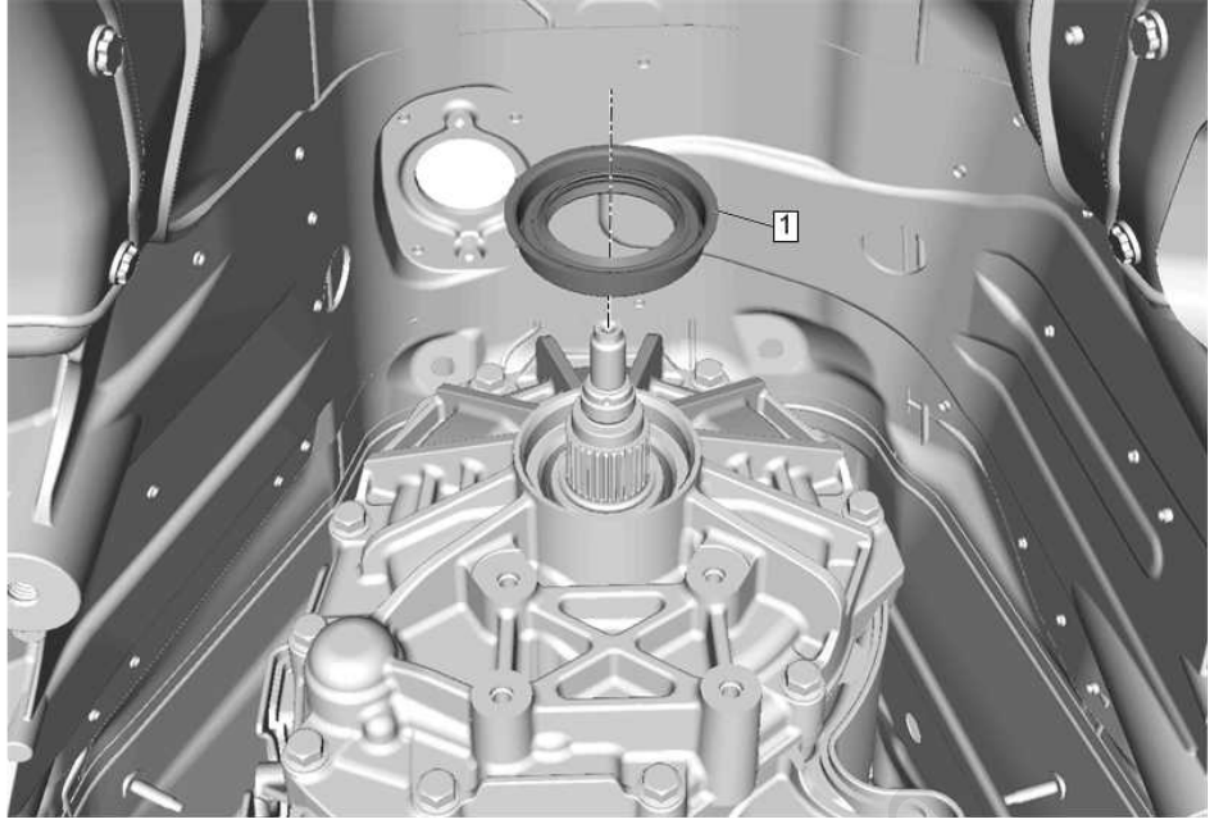


Fig. 38: Propeller Shaft Transmission Flange Seal
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Transmission Propeller Shaft Flange Replacement	
1	Propeller Shaft Transmission Flange Seal Procedure 1. Using J-6125-1B Slide Hammer and J-23129 Universal Seal Remover, Remove and DISCARD the propeller shaft transmission flange seal. 2. Using DT-50896 Seal Installer and DT-22828 Input and Countershaft Race Installer, install the NEW propeller shaft transmission flange seal. NOTE: Do not scrape or gouge the case extension housing while removing the output shaft seal. Special Tools DT-22828 Input and Countershaft Race Installer DT-50896 Seal Installer J-23129 Universal Seal Remover J-6125-1B Slide Hammer Equivalent regional tools: Special Tools .

TRANSMISSION PROPELLER SHAFT FLANGE REPLACEMENT

Special Tools

- EN-38416-B Harmonic Balancer Remover
- DT-45012 Holding Fixture
- For equivalent regional tools, refer to **Special Tools** .

Removal Procedure

1. Remove the propeller shaft. Refer to [Propeller Shaft Replacement](#).
2. Install the **DT-45012** Holding Fixture (3) to the propeller shaft transmission flange (2).

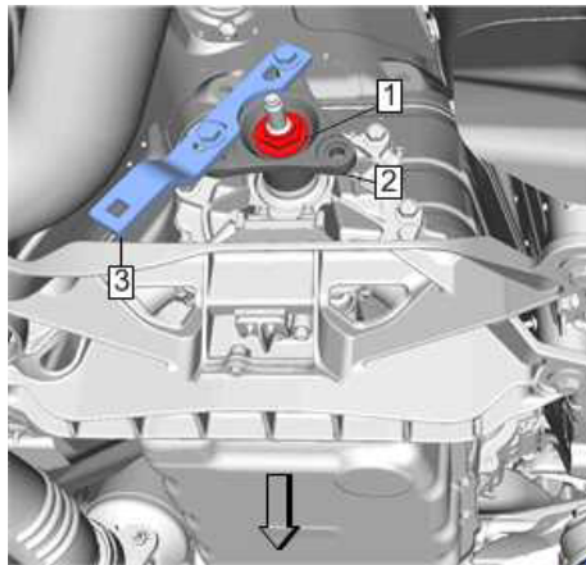


Fig. 39: Holding Fixture And Propeller Shaft Transmission Flange
Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD the propeller shaft transmission flange nut (1).

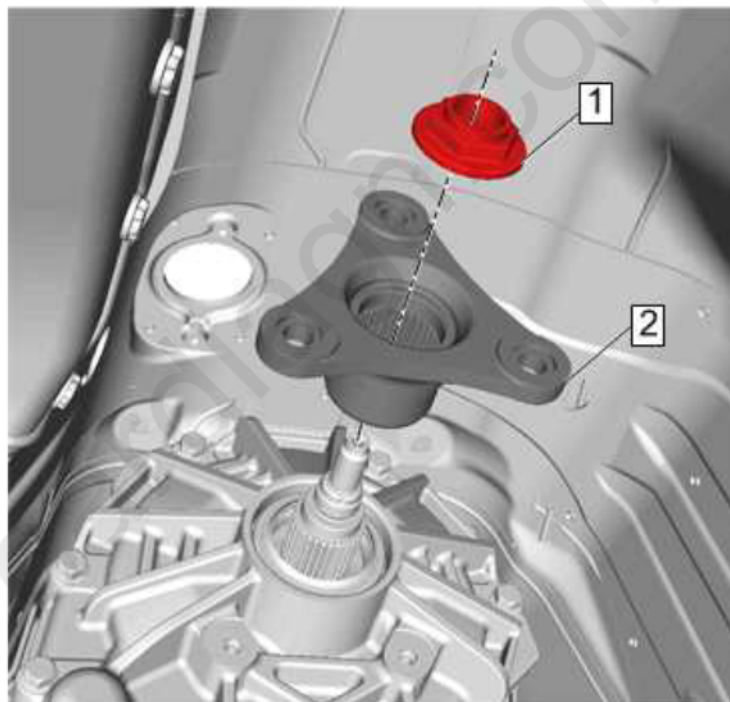


Fig. 40: Propeller Shaft Transmission Flange Nut
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not reuse the flange nut. Reusing the flange nut may cause damage to the transmission.

4. Remove the propeller shaft transmission flange (2) from the output shaft.

NOTE: If the propeller shaft transmission flange is not easily removed with DT-45012 Holding Fixture use EN-38416 B Harmonic Balancer Remover to remove the flange.

Installation Procedure

1. Install the propeller shaft transmission flange (2) to the output shaft.

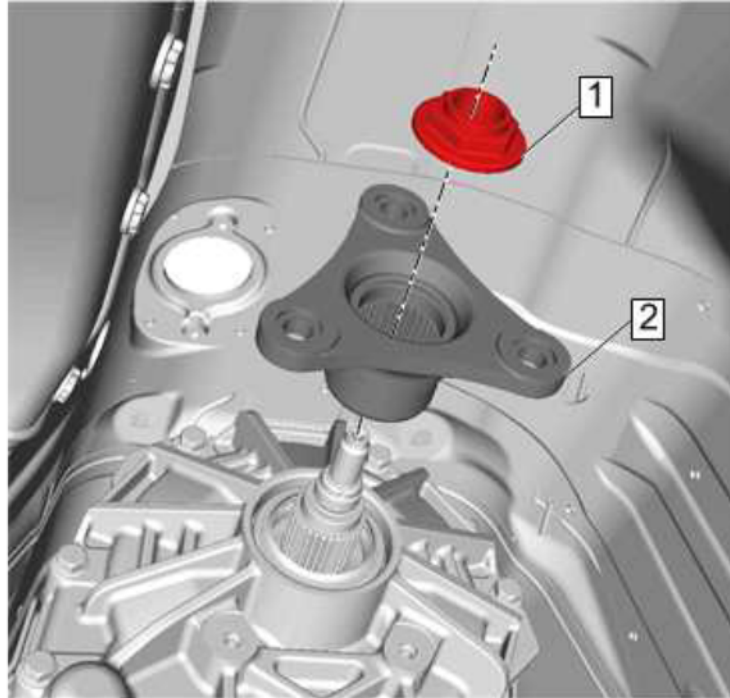


Fig. 41: Propeller Shaft Transmission Flange Nut
Courtesy of GENERAL MOTORS COMPANY

2. Install the NEW propeller shaft transmission flange nut (1) and tighten to 105 N.m (77 lb ft).

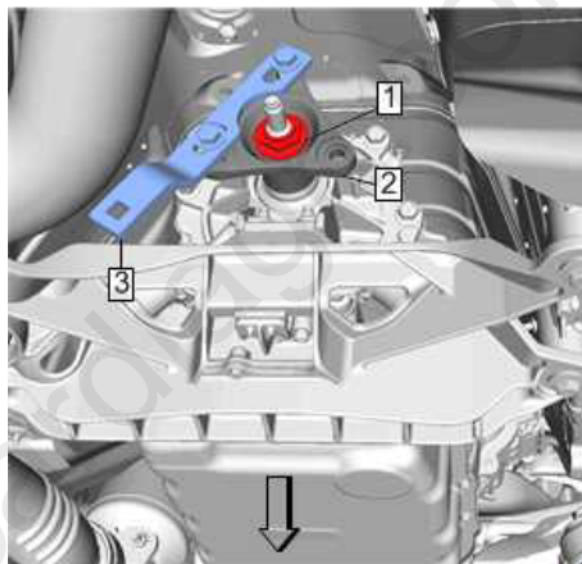


Fig. 42: Holding Fixture And Propeller Shaft Transmission Flange
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Remove the **DT-45012** Holding Fixture (3) from the propeller shaft transmission flange (2).
4. Stake the propeller shaft transmission flange nut (1).

CAUTION: Stake the flange nut onto the output shaft. Use the two staking grooves on the shaft to locate the staking points. Failure to stake the flange nut may result in damage to the transmission.

5. Install the propeller shaft. Refer to [Propeller Shaft Replacement](#) .

MANUAL SHIFT SHAFT REPLACEMENT

Special Tools

- **DT-51893** Shift Shaft Retainer and Roll Pin Installer
- For equivalent regional tools, refer to [Special Tools](#) .

Removal Procedure

1. Remove the automatic transmission range selector lever cable lever. Refer to [Automatic Transmission Range Selector Lever Cable Lever Replacement](#)
2. Remove the control valve assembly from the transmission. Refer to [Control Valve Replacement](#)
3. Remove the manual shift detent spring bolt (1).

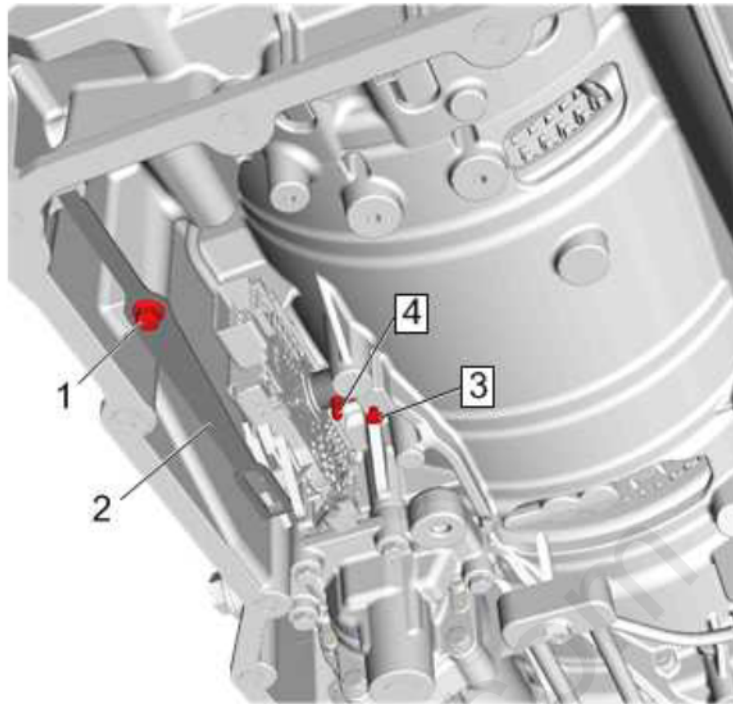


Fig. 43: Manual Shift Detent Spring Bolt, Spring, Shaft Pin, Detent Lever Hub Pin
Courtesy of GENERAL MOTORS COMPANY

4. Remove the manual shift detent spring (2).
5. Remove and DISCARD the manual shift detent lever hub pin (4).
6. Remove and DISCARD the manual shift shaft pin (3).
7. Remove the manual shift shaft (1).

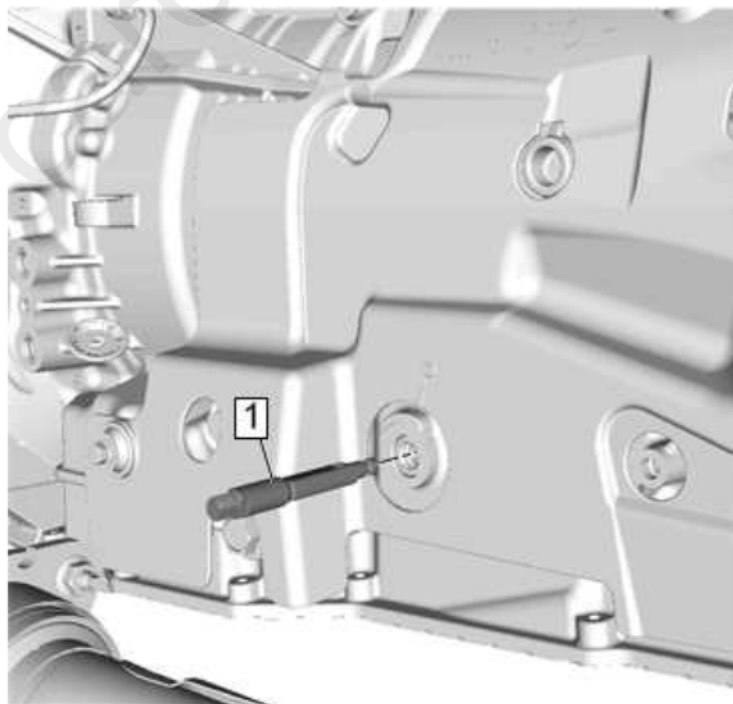


Fig. 44: Manual Shift Shaft
Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Position the manual shift shaft (1) into the transmission.

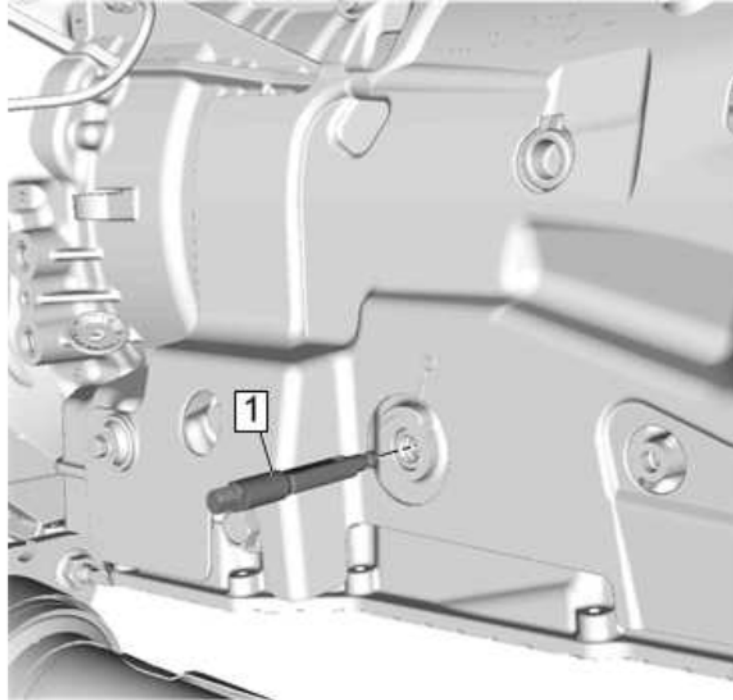


Fig. 45: Manual Shift Shaft

Courtesy of GENERAL MOTORS COMPANY

2. Install the NEW manual shift detent lever hub pin (4).

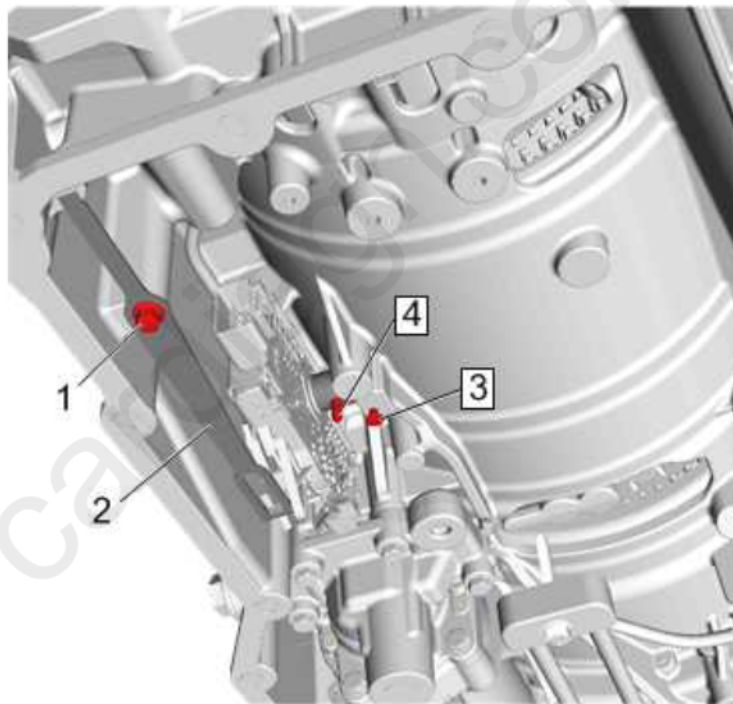


Fig. 46: Manual Shift Detent Spring Bolt, Spring, Shaft Pin, Detent Lever Hub Pin

Courtesy of GENERAL MOTORS COMPANY

3. Install the NEW manual shift shaft pin (3), using **DT-51893** Shift Shaft Retainer and Roll Pin Installer.

NOTE: Always install a NEW pin.

4. Install the manual shift detent spring (2).
5. Install the manual shift detent spring bolt (1) and tighten to 9 N.m (80 lb in).

CAUTION: Refer to **Fastener Caution** .

6. Install the control valve assembly to the transmission. Refer to **Control Valve Replacement**
7. Install the automatic transmission range selector lever cable lever. Refer to **Automatic Transmission Range Selector Lever Cable Lever Replacement**

Special Tools

- **J-43911** Selector Shaft Seal Remover 3/8" - 16
- **J-49101** Seal Installer
- For equivalent regional tools, refer to [Special Tools](#).

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Remove the automatic transmission range selector lever cable lever from the transmission. Refer to [Automatic Transmission Range Selector Lever Cable Lever Replacement](#)
3. Using a suitable jack, support the transmission.
4. Remove the transmission mount. Refer to [Transmission Mount Replacement](#)
5. Lower the transmission to gain access to the seal.
6. Remove and DISCARD the manual shift shaft seal, using **J-43911** Selector Shaft Seal Remover 3/8" - 16 (1).

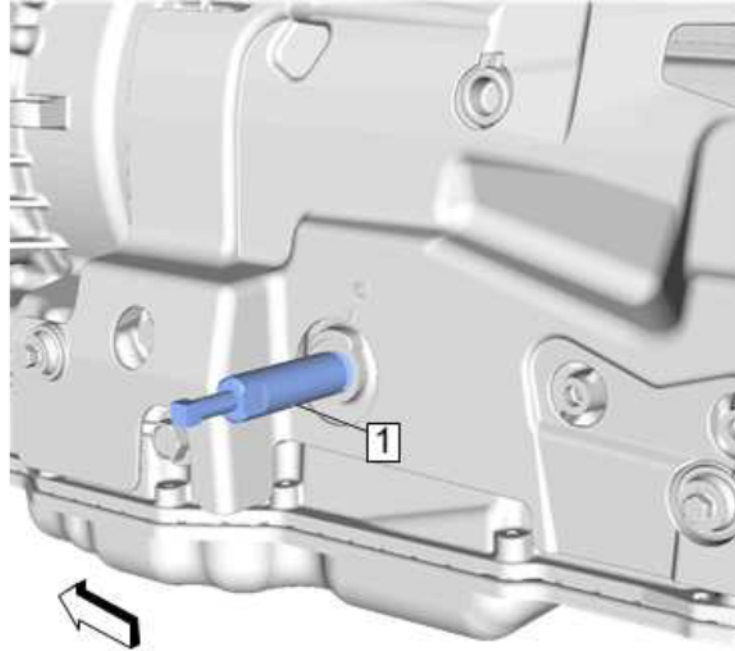


Fig. 47: Selector Shaft Seal Remover

Courtesy of GENERAL MOTORS COMPANY

Installation Procedure

1. Install the NEW manual shift shaft seal, using **J-49101** Seal Installer (1).

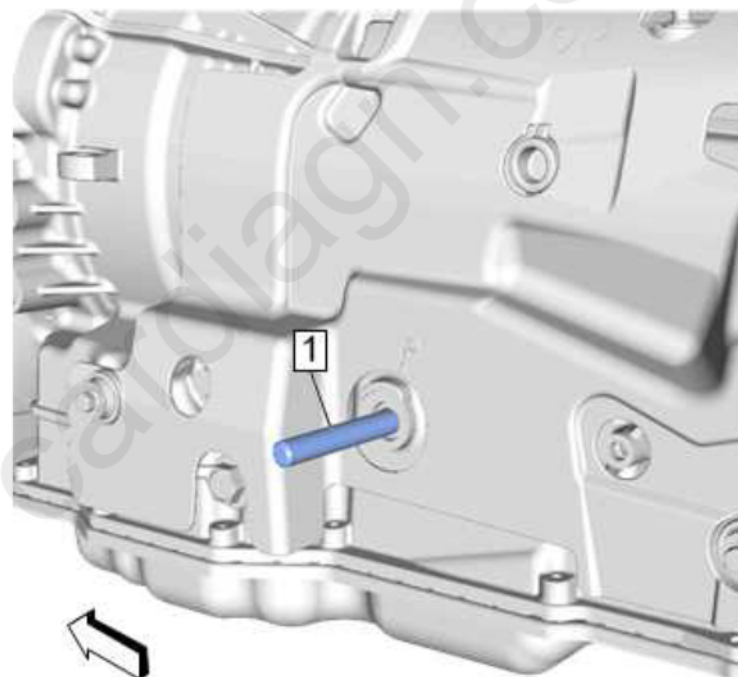


Fig. 48: Seal Installer

Courtesy of GENERAL MOTORS COMPANY

2. Raise the transmission.
3. Install the transmission mount. Refer to [Transmission Mount Replacement](#)
4. Install the automatic transmission range selector lever cable lever to the transmission. Refer to [Automatic Transmission Range Selector Lever Cable Lever Replacement](#)
5. Enable the high voltage system. Refer to [High Voltage Enabling](#)

AUTOMATIC TRANSMISSION MANUAL SHIFT SHAFT POSITION SWITCH REPLACEMENT

Removal Procedure

1. Remove the control valve assembly from the transmission. Refer to [Control Valve Replacement](#)
2. Remove the manual shift shaft from the transmission. Refer to [Manual Shift Shaft Replacement](#)
3. Disconnect the electrical connector from the automatic transmission manual shift shaft position switch (1).

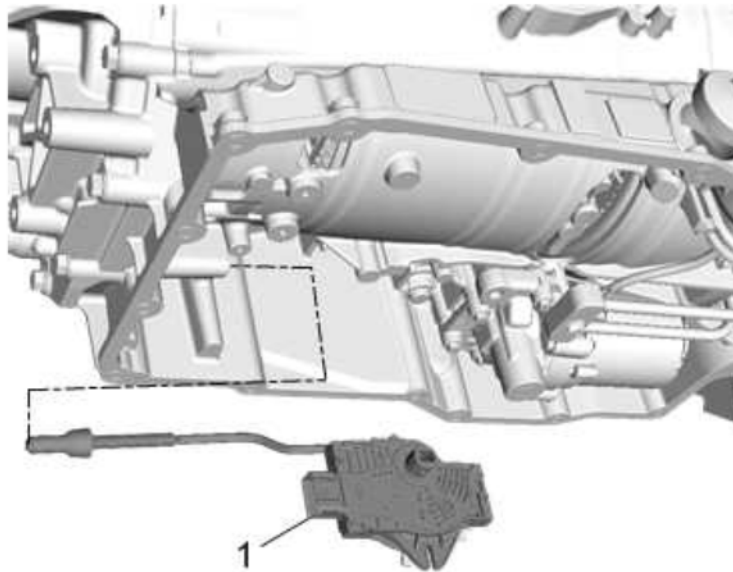


Fig. 49: Automatic Transmission Manual Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

4. Remove the automatic transmission manual shift shaft position switch (1) from the transmission.

Installation Procedure

1. Position the automatic transmission manual shift shaft position switch (1) to the transmission.

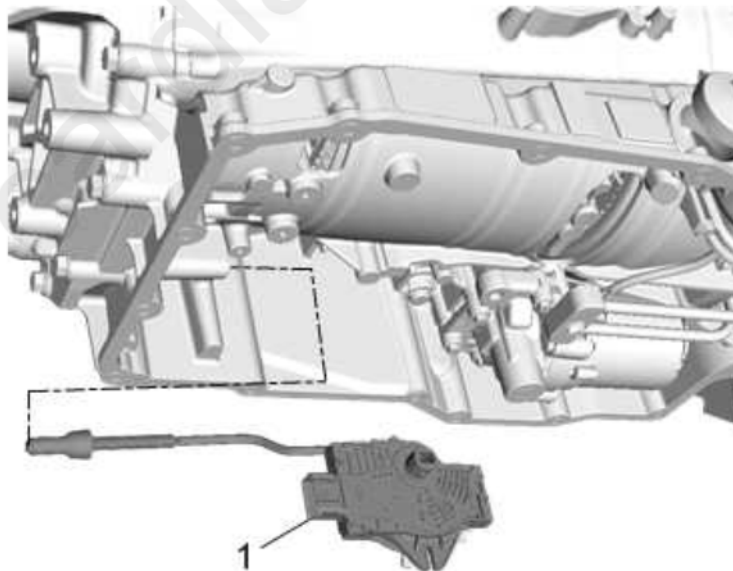


Fig. 50: Automatic Transmission Manual Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

2. Install the manual shift shaft to the transmission. Refer to [Manual Shift Shaft Replacement](#)
3. Connect the electrical connector to the automatic transmission manual shift shaft position switch (1).
4. Install the control valve assembly to the transmission. Refer to [Control Valve Replacement](#)

Removal Procedure

1. Remove the transmission fluid pan (2). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

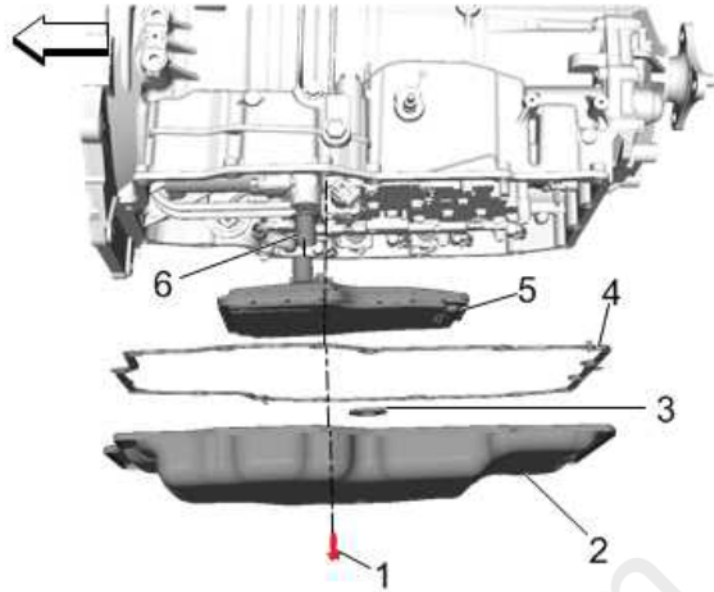


Fig. 51: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the electrical connector (1) from the output speed sensor (3).

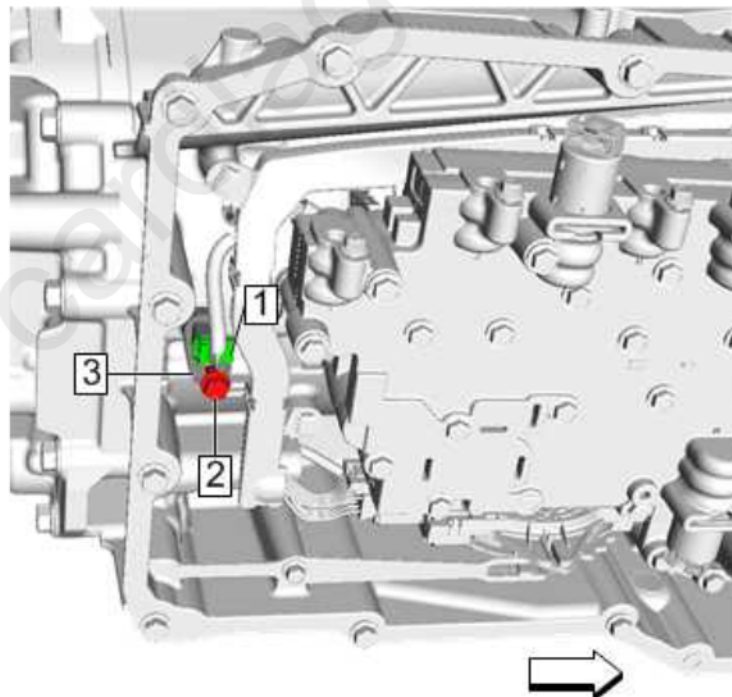


Fig. 52: Output Speed Sensor
Courtesy of GENERAL MOTORS COMPANY

3. Remove the output speed sensor bolt (2).
4. Remove the output speed sensor (3).

Installation Procedure

1. Install the output speed sensor (3).

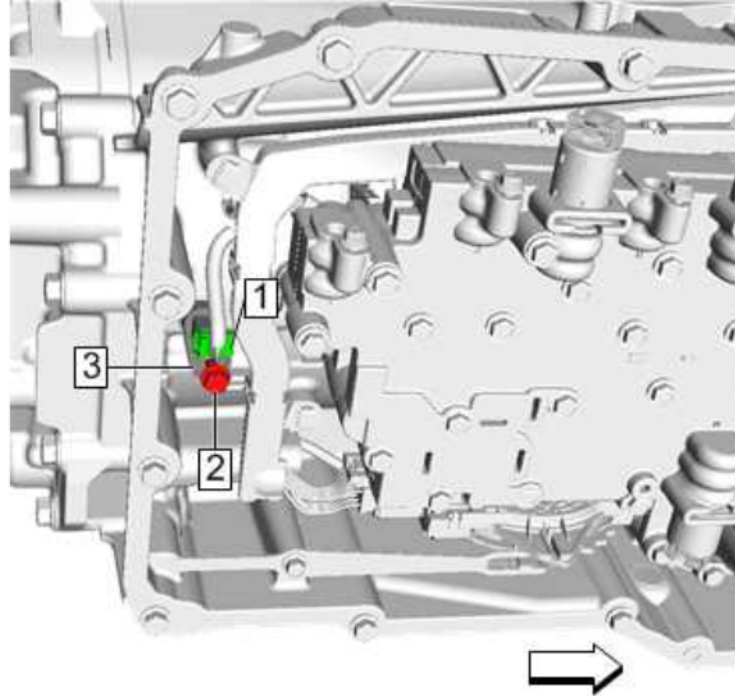


Fig. 53: Output Speed Sensor

Courtesy of GENERAL MOTORS COMPANY

2. Install the output speed sensor bolt (2) and tighten to 9 N.m (80 lb in).

CAUTION: Refer to [Fastener Caution](#) .

3. Connect the electrical connector (1) to the output speed sensor (3).
4. Install the transmission fluid pan (2). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

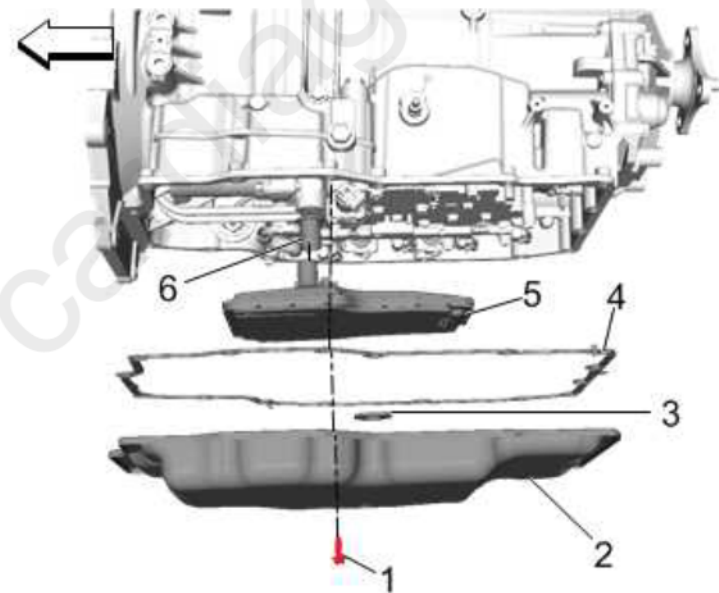


Fig. 54: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal

Courtesy of GENERAL MOTORS COMPANY

AUTOMATIC TRANSMISSION CONTROL WIRING HARNESS REPLACEMENT

Removal Procedure

1. Remove the control valve assembly from the transmission. Refer to [Control Valve Replacement](#)

NOTE: Remove the wiring harness only if it is being replaced.

2. Disconnect the engine wiring harness connector from the transmission wiring harness.
3. Disconnect the wiring harness (3) electrical connectors from the transmission.

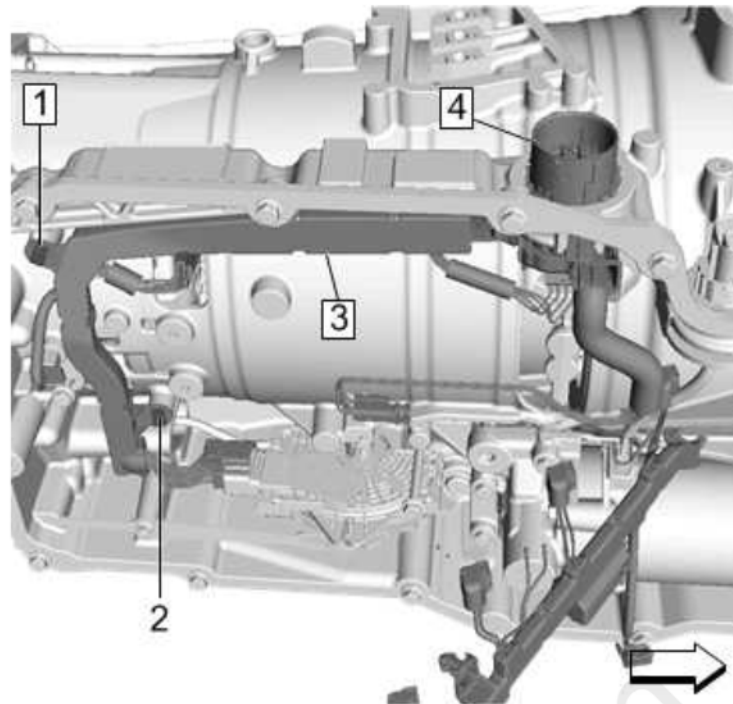


Fig. 55: Wiring Harness And Retainers

Courtesy of GENERAL MOTORS COMPANY

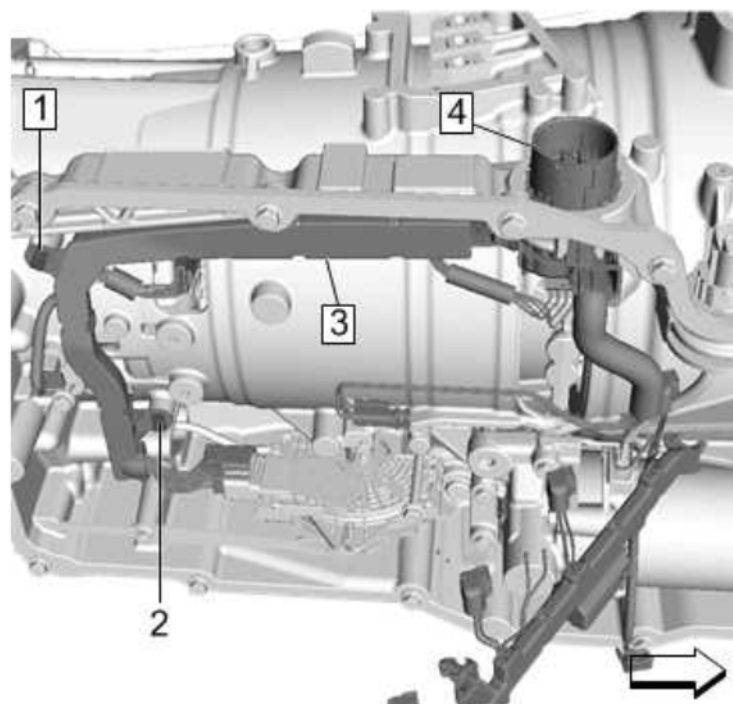
NOTE: Locate connectors on the wiring harness that have connector position assurance (CPA) tabs. Ensure the CPA tabs are disengaged before disconnecting the connector.

4. Disconnect the wiring harness retainers (1, 2) from the transmission.
5. Disengage the main wiring harness connector (4) from the transmission case.

NOTE: Use care when servicing the main wiring harness connector. Depress the retainers and carefully rock the connector out of the transmission case.

Installation Procedure

1. Install the main wiring harness connector (4) in the transmission case.



NOTE: Ensure the main wiring harness connector is fully installed and the retaining tabs have locked into the transmission case.

2. Connect the wiring harness retainers (1, 2) to the transmission.
3. Connect the speed sensor and motor position sensor connectors.
4. Connect the remaining wiring harness (3) electrical connectors to the transmission.

NOTE: Locate connectors on the wiring harness that have connector position assurance (CPA) tabs. Ensure the CPA tabs are locked after the wiring harness is installed.

5. Install the control valve assembly to the transmission. Refer to [Control Valve Replacement](#)
6. Connect the engine wiring harness connector to the transmission wiring harness.

TRANSMISSION FLUID PUMP REPLACEMENT

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 N.m (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.
 - Visually and functionally inspect the gloves before use.
 - Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Remove the transmission fluid pan (2). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

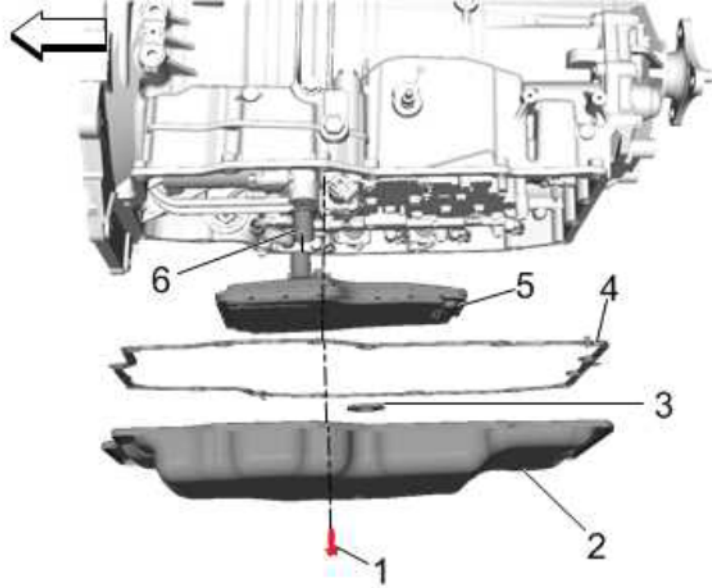


Fig. 57: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the high voltage electrical connector (2) from the transmission.

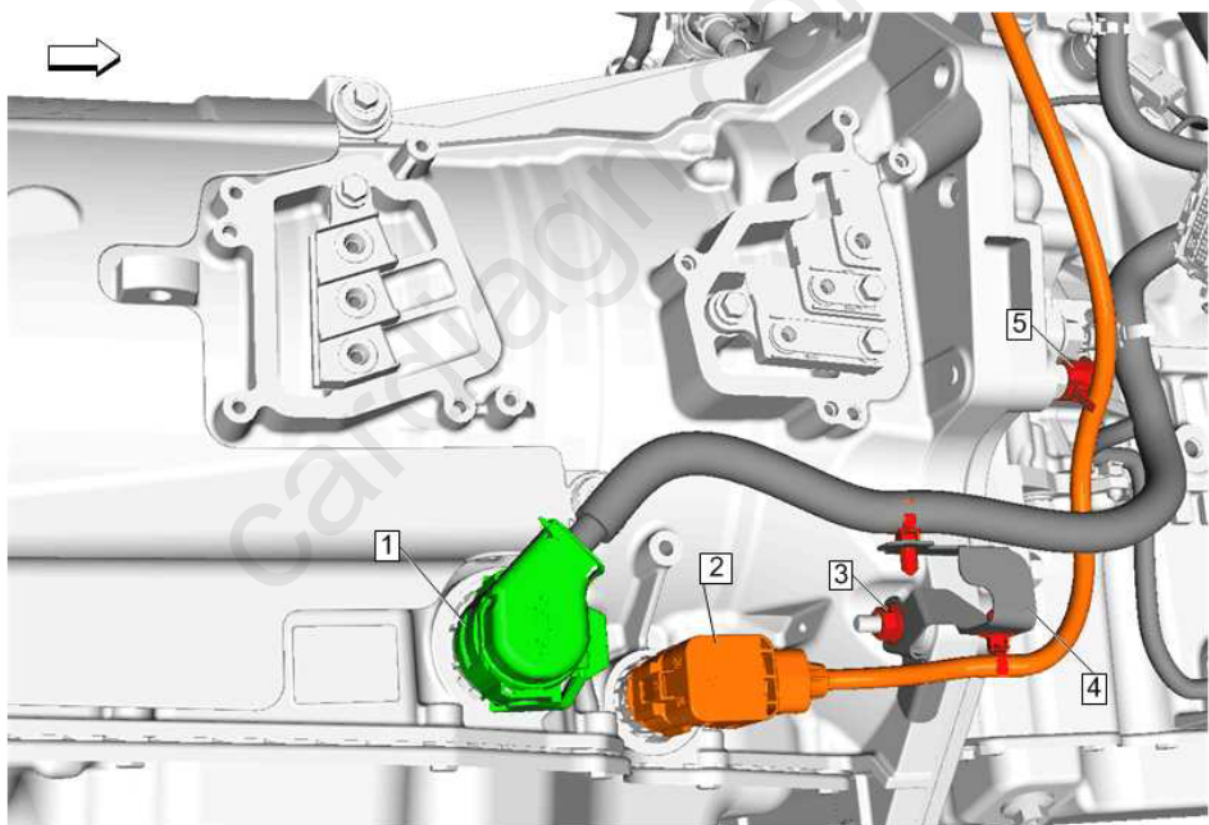


Fig. 58: High Voltage Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

4. Disengage the main fluid pump connector (5) from the transmission case.

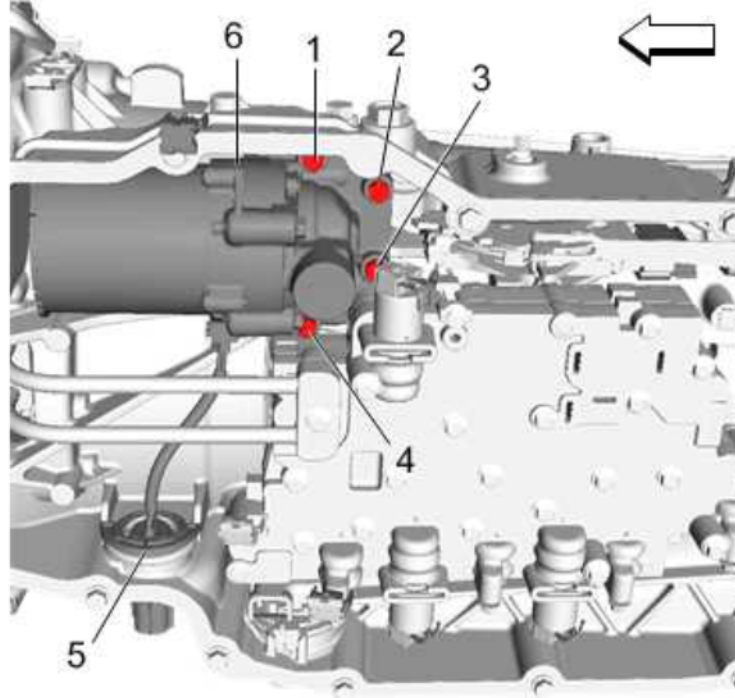


Fig. 59: Transmission Fluid Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: Use care when servicing the main wiring harness connector. Depress the retainers and carefully rock the connector out of the transmission case.

5. Remove the transmission fluid pump bolts (1, 2, 3, 4).
6. Remove the transmission fluid pump (6) from the transmission.

Installation Procedure

1. Position the transmission fluid pump (6) to the transmission.

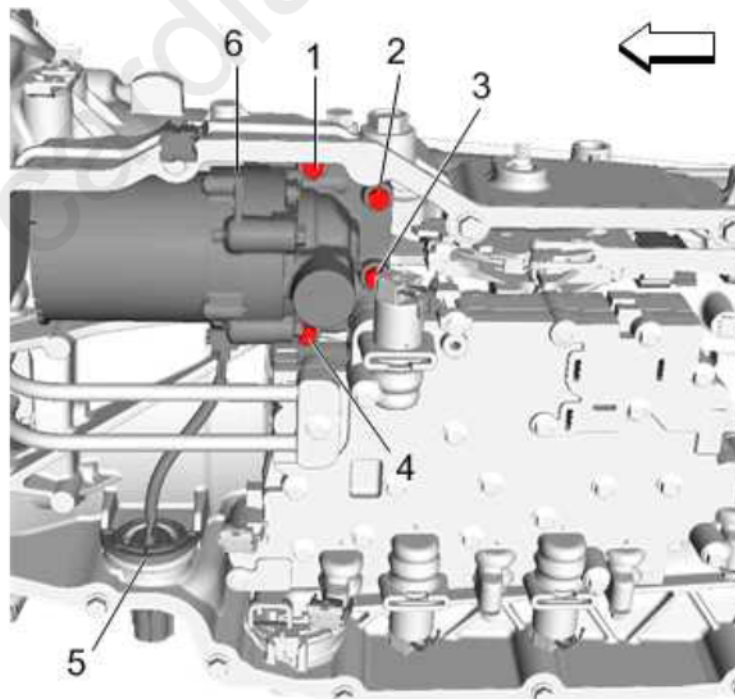


Fig. 60: Transmission Fluid Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Tighten the bolts in the following sequence: 1, 3, 4, 2 to 9 N.m (80 lb in).

CAUTION: Refer to **Fastener Caution** .

3. Install the fluid pump connector (5) into the transmission case.

NOTE: Ensure the fluid pump connector is fully installed and the retaining tabs have locked into the transmission case.

4. Connect the high voltage electrical connector (2) to the transmission.

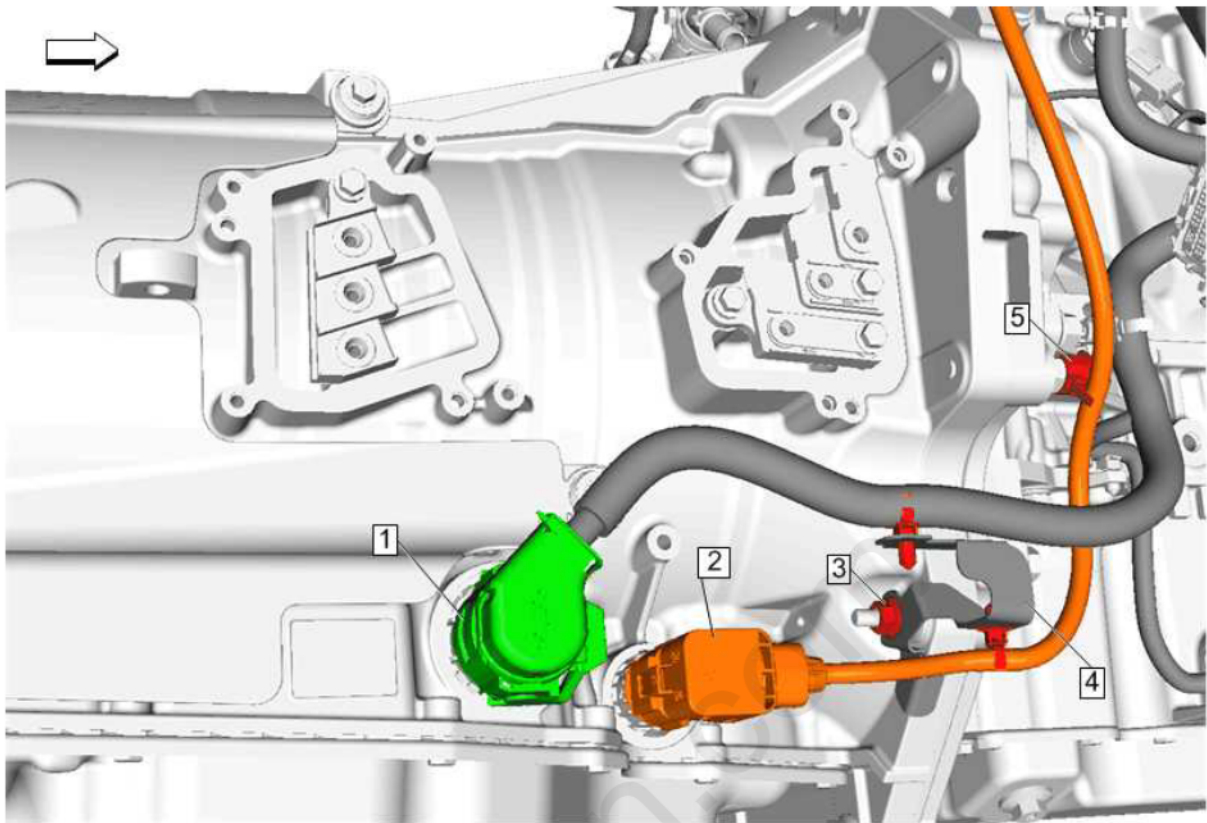


Fig. 61: High Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Install the transmission fluid pan (2). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

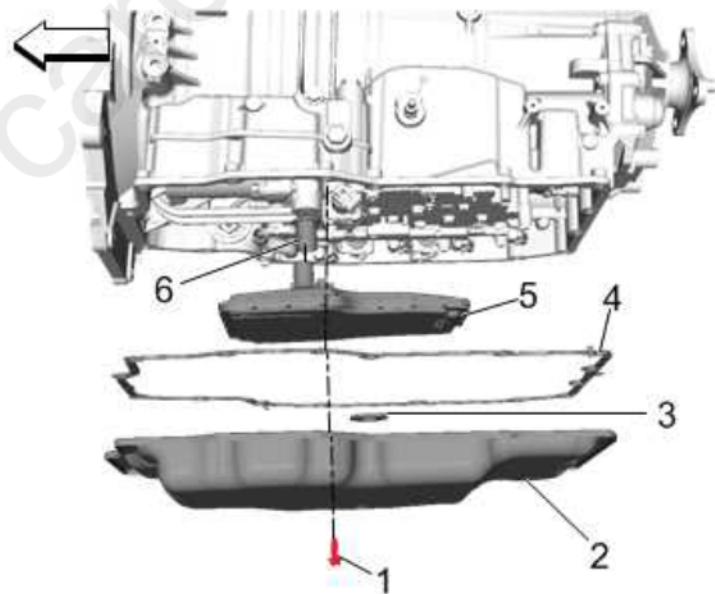


Fig. 62: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
Courtesy of GENERAL MOTORS COMPANY

6. Enable the high voltage system. Refer to [High Voltage Enabling](#)

CONTROL VALVE REPLACEMENT

Removal Procedure

1. Remove the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

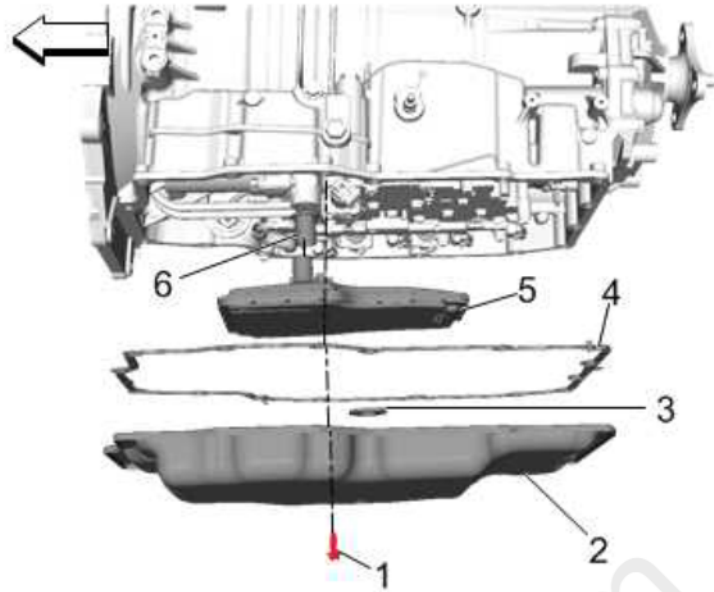


Fig. 63: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the electrical connectors (1) from the control valve assembly (3).

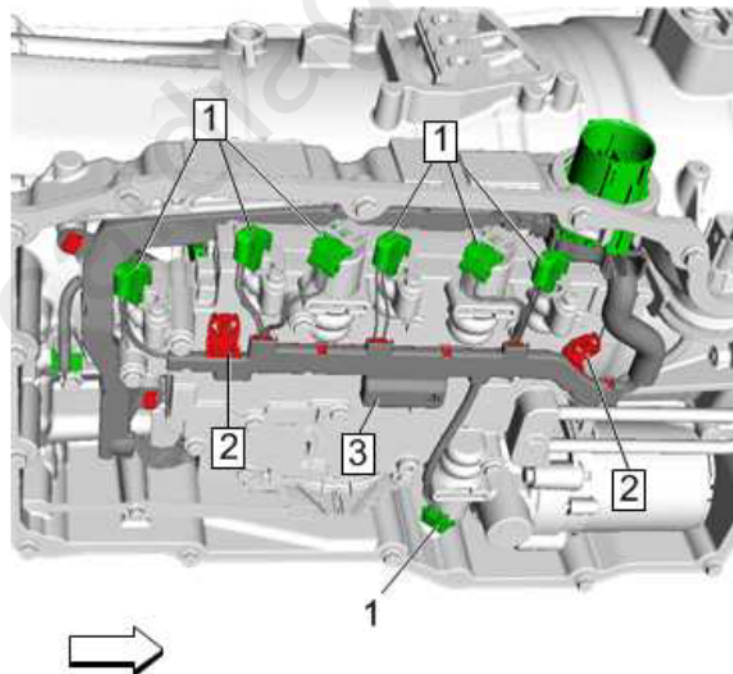


Fig. 64: Control Valve Assembly, Wiring Harness Retainers And Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the wiring harness retainers (2) from the control valve assembly.
4. Remove the control valve body fluid manifold bolts (1, 2).

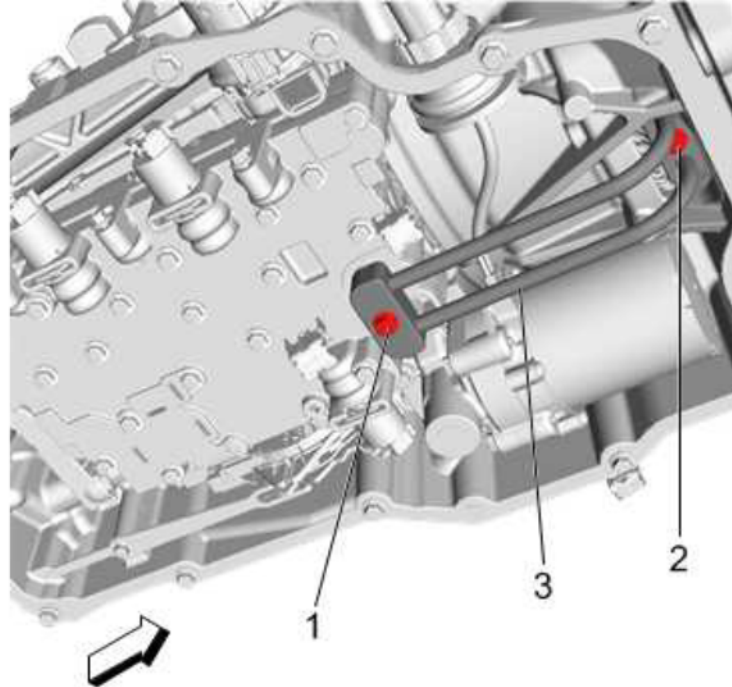


Fig. 65: Control Valve Body Fluid Manifold And Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Remove the control valve body fluid manifold (3).
6. Remove the control valve body bolts (1, 2, 3, 4).

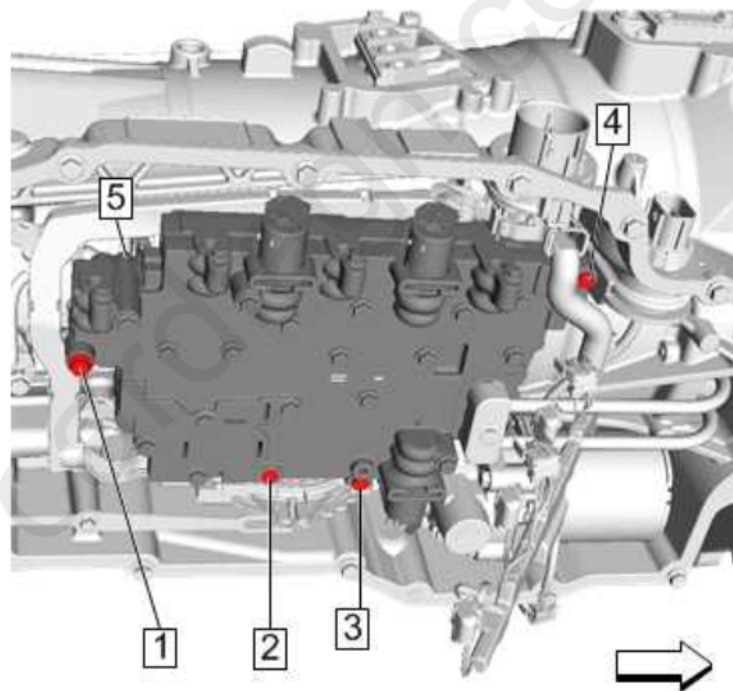


Fig. 66: Control Valve Body And Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Remove the control valve body (5) from the transmission.

Installation Procedure

1. Position the control valve body (5) to the transmission.

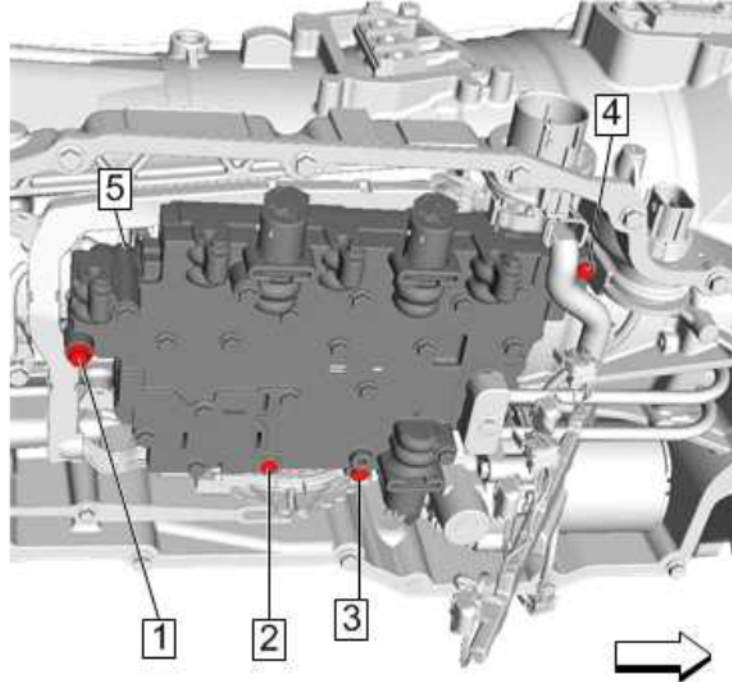


Fig. 67: Control Valve Body And Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Loosely install the control valve body bolts (1, 2, 3, 4).
3. Install the bolts and tighten in the sequence: bolt 2, then bolt 4, then bolt 1, then bolt 3 to 9 N.m (80 lb in).

CAUTION: Refer to [Fastener Caution](#) .

4. Tighten the bolts again in the same sequence: bolt 2, then bolt 4, then bolt 1, then bolt 3 to 9 N.m (80 lb in) to ensure all bolts are correctly tightened to 9 N.m (80 lb in).
5. Position the control valve body fluid manifold (3) in the transmission.

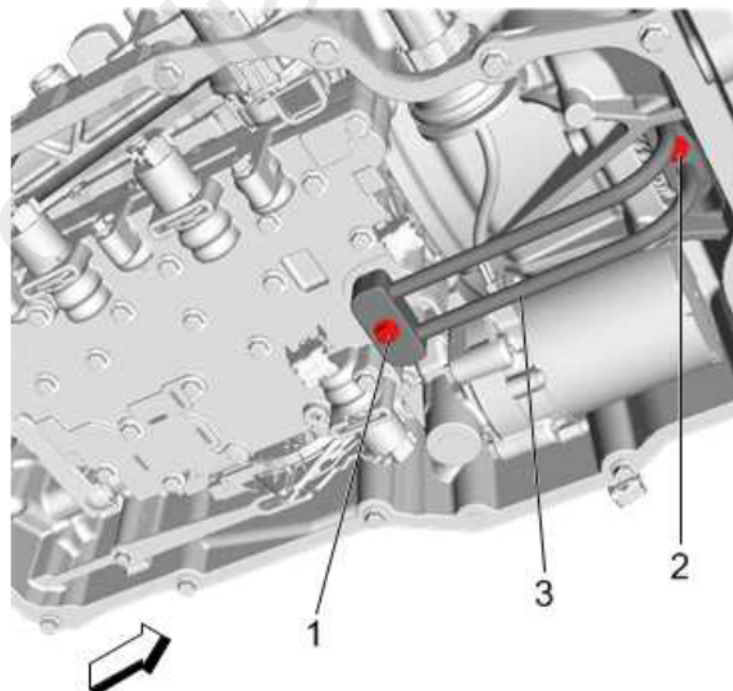


Fig. 68: Control Valve Body Fluid Manifold And Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Install the control valve body fluid manifold bolts (1, 2) and tighten to 9 N.m (80 lb in).
7. Connect the electrical connectors (1) to the control valve assembly (3).

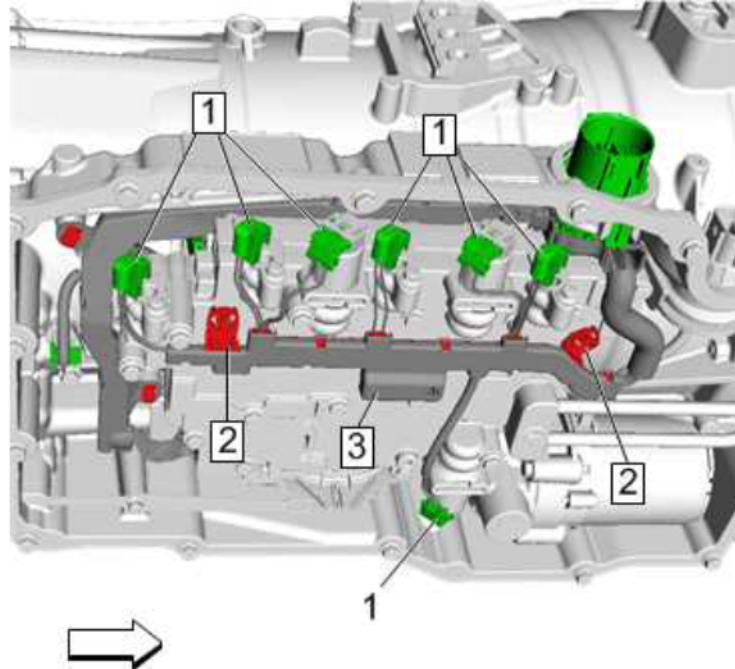


Fig. 69: Control Valve Assembly, Wiring Harness Retainers And Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

8. Connect the wiring harness retainers (2) to the control valve assembly.
9. Install the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

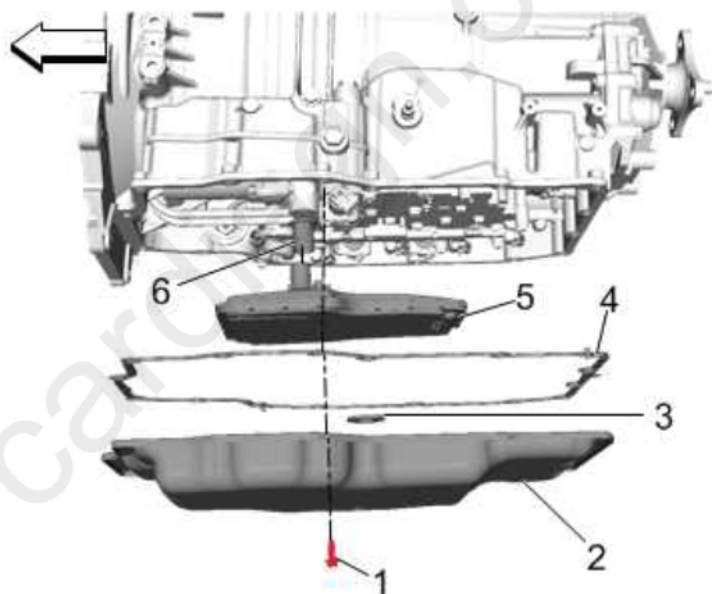


Fig. 70: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
 Courtesy of GENERAL MOTORS COMPANY

CONTROL VALVE UPPER BODY REPLACEMENT

Removal Procedure

1. Remove the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

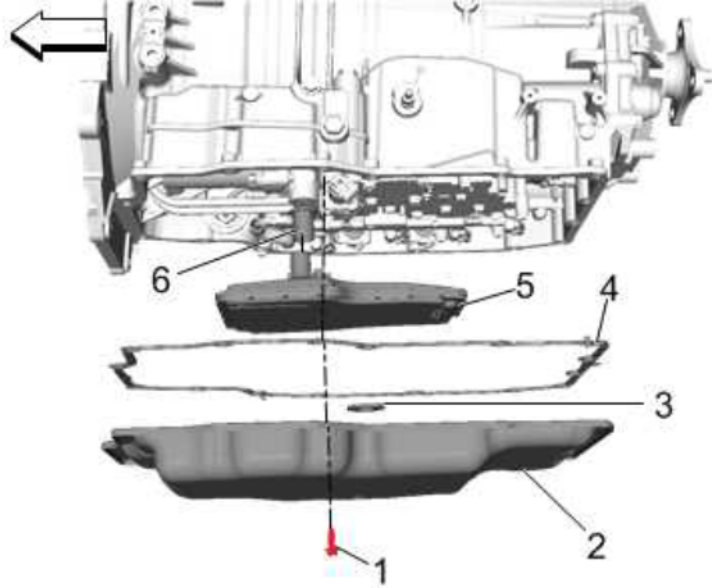


Fig. 71: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the electrical connectors (1) from the control valve assembly (3).

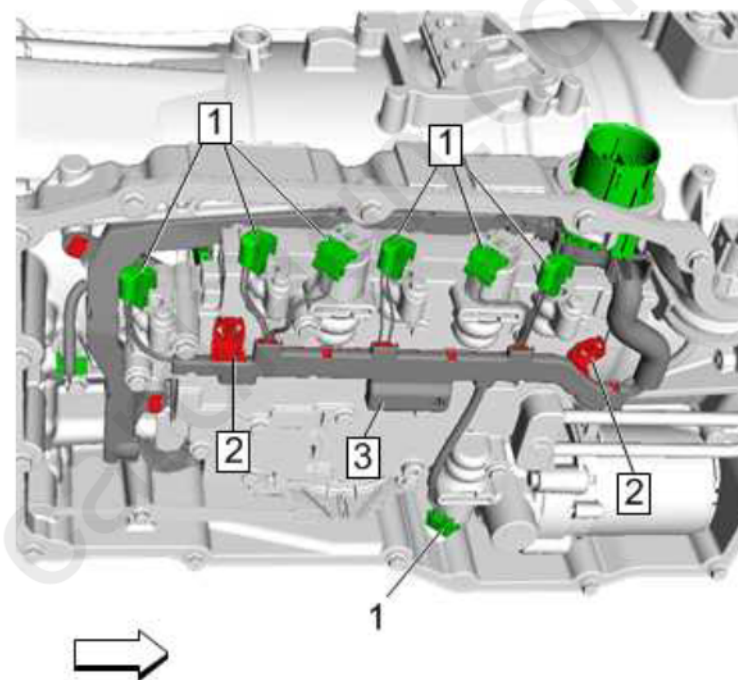


Fig. 72: Control Valve Assembly, Wiring Harness Retainers And Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the wiring harness retainers (2) from the control valve assembly.
4. Remove the control valve body fluid manifold bolts (1, 2).

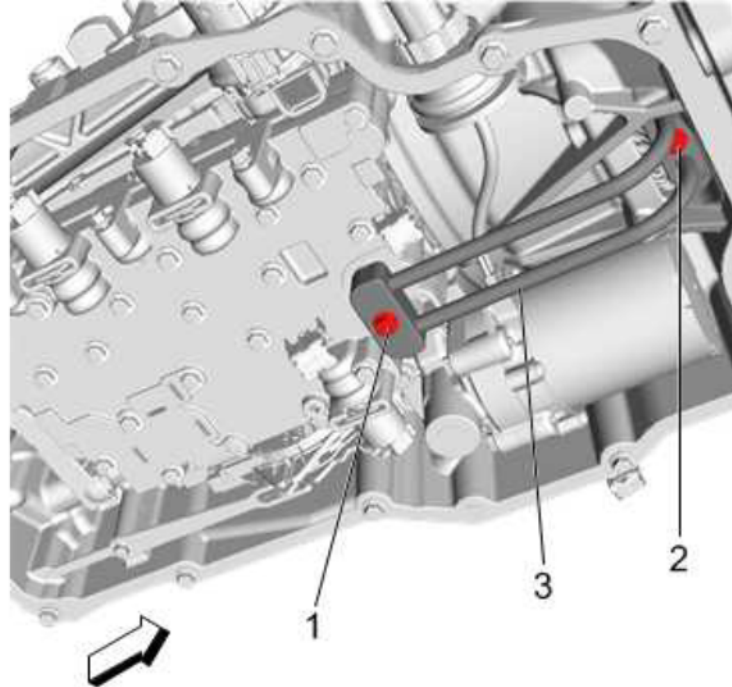


Fig. 73: Control Valve Body Fluid Manifold And Bolts
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the control valve body fluid manifold (3).
6. Remove the control valve body bolts (1, 2, 3, 4).

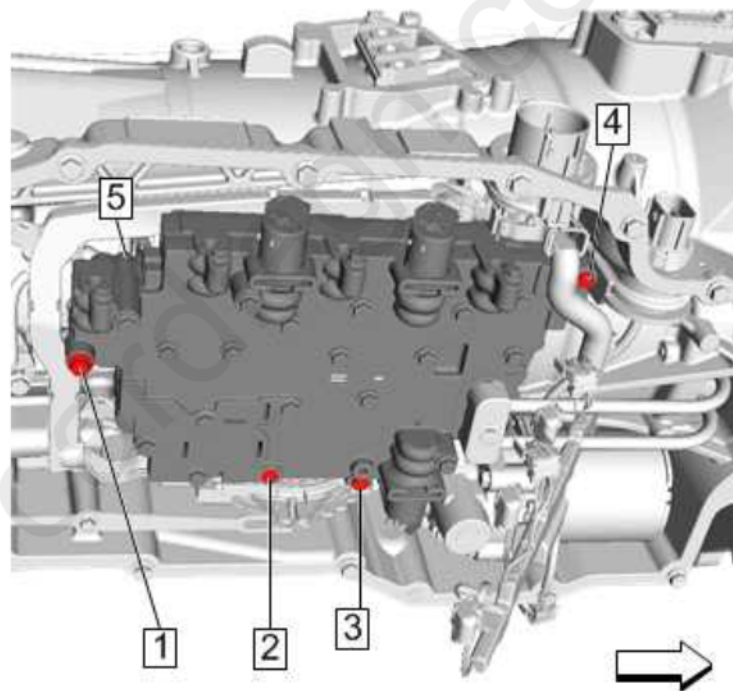


Fig. 74: Control Valve Body And Bolts
 Courtesy of GENERAL MOTORS COMPANY

7. Remove the control valve body (5) from the transmission.
8. Disassemble the control valve body. Refer to [Control Valve Assembly Disassemble](#)
9. Clean and inspect the control valve body. Refer to [Control Valve Assembly Cleaning and Inspection](#)
10. Assemble the control valve body. Refer to [Control Valve Assembly Assemble](#)

Installation Procedure

1. Position the control valve body (5) to the transmission.

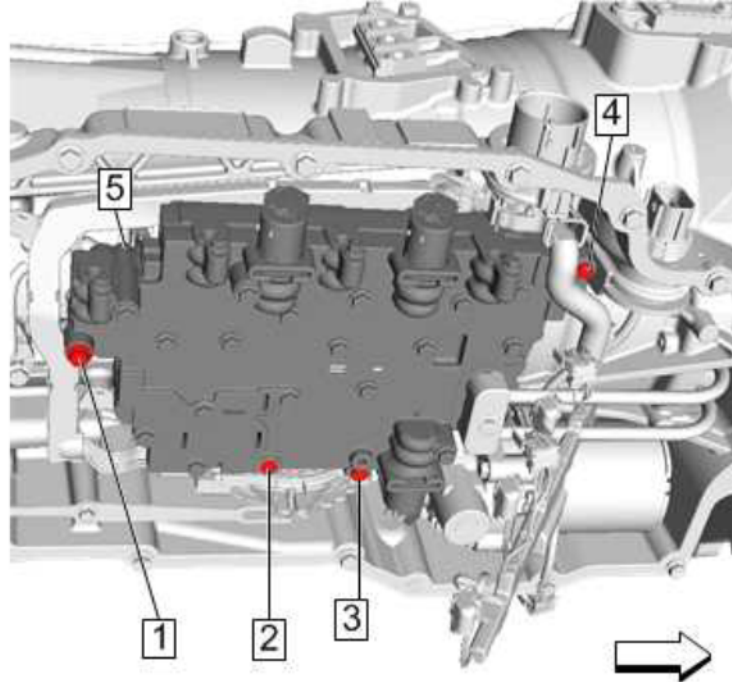


Fig. 75: Control Valve Body And Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Loosely install the control valve body bolts (1, 2, 3, 4).
3. Tighten to bolts in the following sequence: bolt 2, then bolt 4, then bolt 1, then bolt 3 to 9 N.m (80 lb in).

CAUTION: Refer to [Fastener Caution](#) .

4. Tighten the bolts again in the same sequence: bolt 2, then bolt 4, then bolt 1, then bolt 3 to 9 N.m (80 lb in) to ensure all bolts are correctly tightened to 9 N.m (80 lb in).
5. Position the control valve body fluid manifold (3) in the transmission.

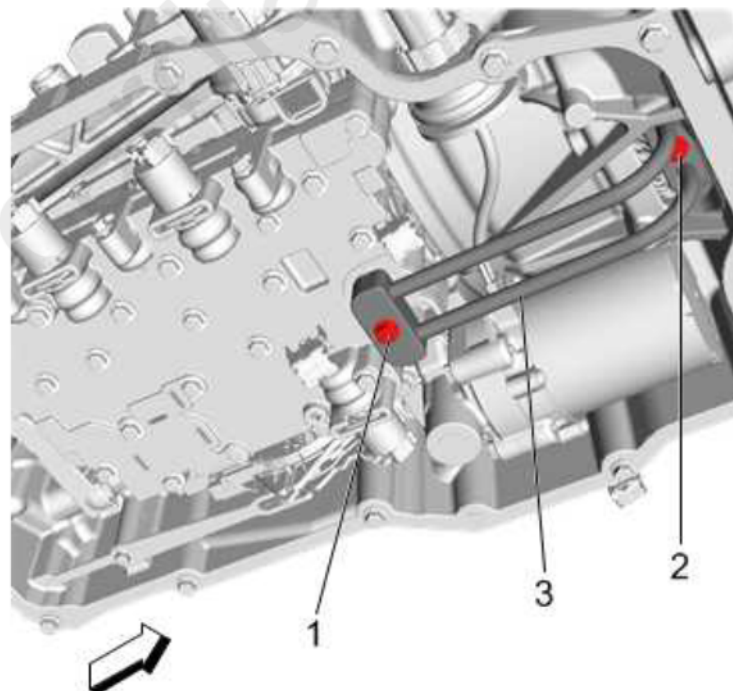


Fig. 76: Control Valve Body Fluid Manifold And Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Install the control valve body fluid manifold bolts (1, 2) and tighten to 9 N.m (80 lb in).
7. Connect the electrical connectors (1) to the control valve assembly (3).

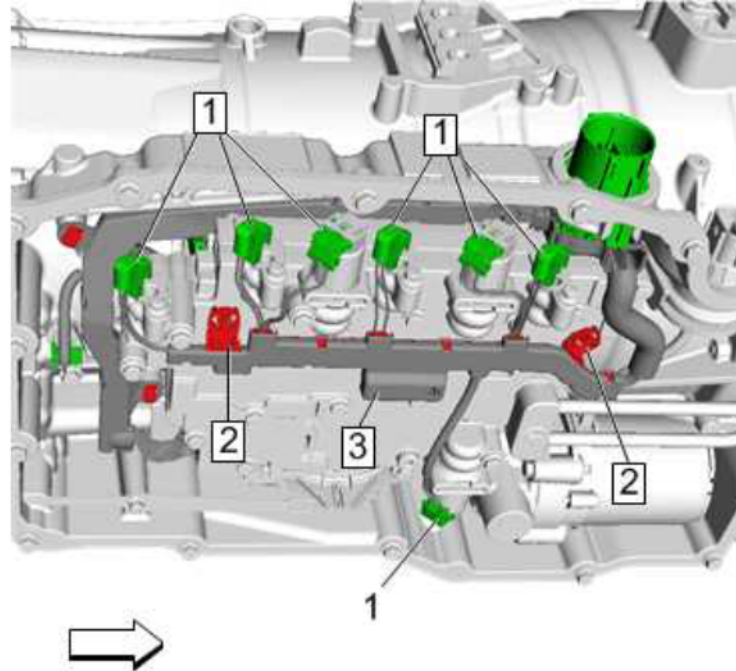


Fig. 77: Control Valve Assembly, Wiring Harness Retainers And Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

8. Connect the wiring harness retainers (2) to the control valve assembly.
9. Install the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

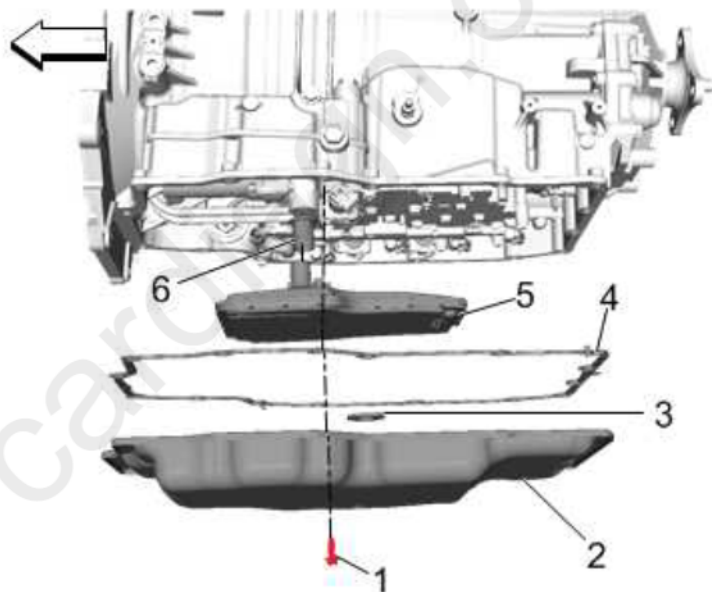


Fig. 78: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
 Courtesy of GENERAL MOTORS COMPANY

CONTROL VALVE SOLENOID BODY REPLACEMENT

Removal Procedure

1. Remove the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

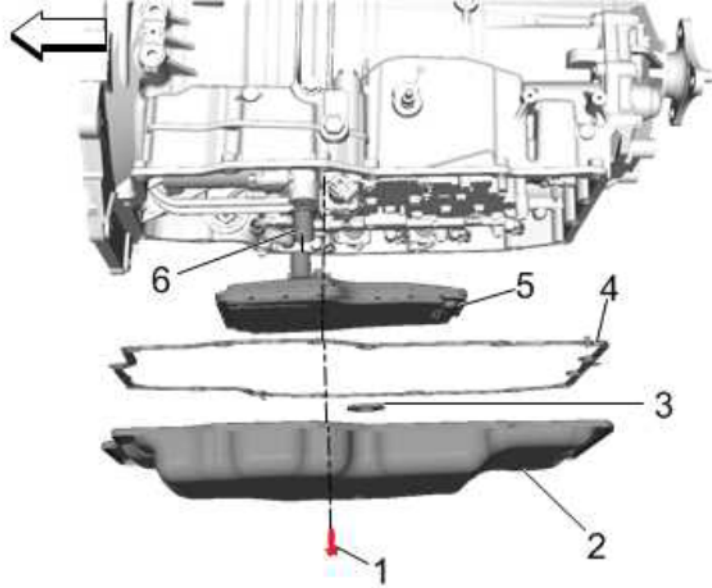


Fig. 79: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the electrical connectors (1) from the control valve assembly (3).

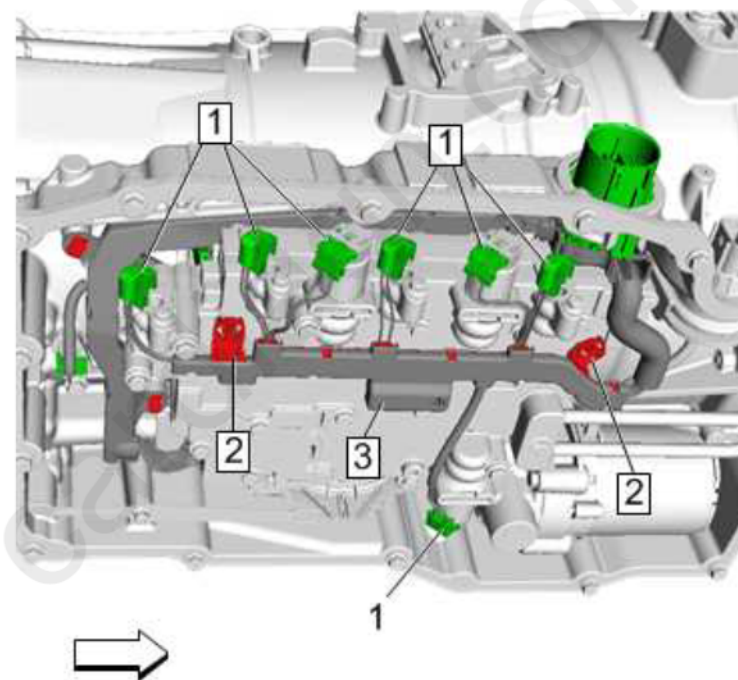


Fig. 80: Control Valve Assembly, Wiring Harness Retainers And Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the wiring harness retainers (2) from the control valve assembly.
4. Remove the control valve body fluid manifold bolts (1, 2).

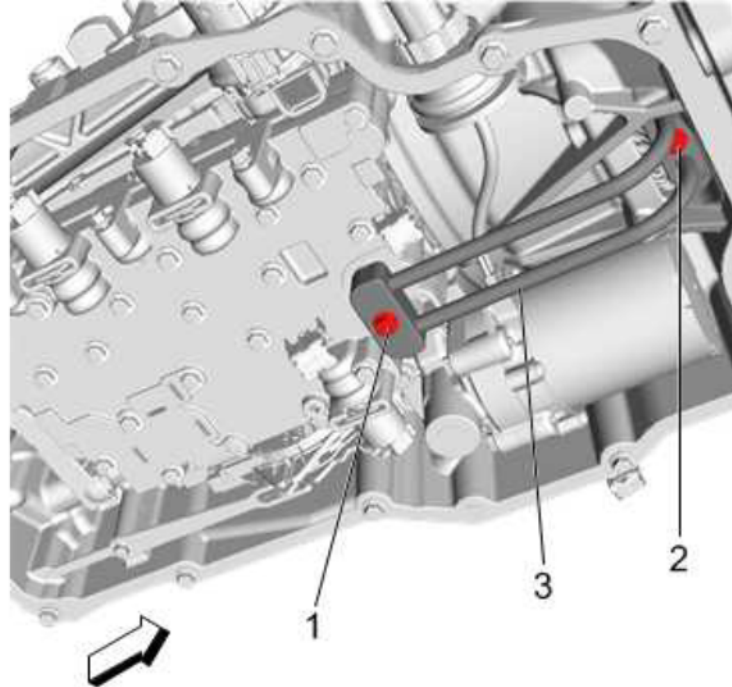


Fig. 81: Control Valve Body Fluid Manifold And Bolts
 Courtesy of GENERAL MOTORS COMPANY

5. Remove the control valve body fluid manifold (3).
6. Remove the control valve body bolts (1, 2, 3, 4).

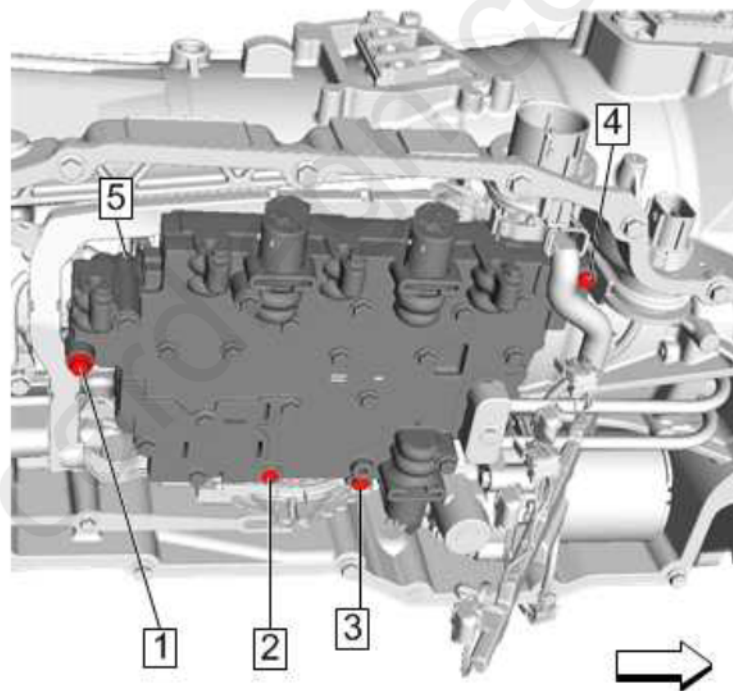


Fig. 82: Control Valve Body And Bolts
 Courtesy of GENERAL MOTORS COMPANY

7. Remove the control valve body (5) from the transmission.
8. Disassemble the control valve body. Refer to [Control Valve Assembly Disassemble](#)
9. Clean and inspect the control valve body. Refer to [Control Valve Assembly Cleaning and Inspection](#)
10. Assemble the control valve body. Refer to [Control Valve Assembly Assemble](#)

Installation Procedure

1. Position the control valve body (5) to the transmission.

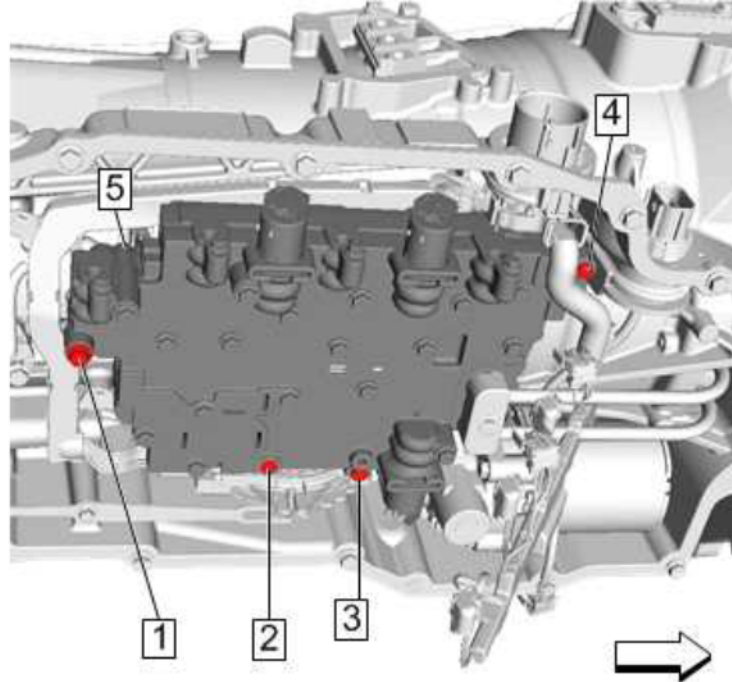


Fig. 83: Control Valve Body And Bolts

Courtesy of GENERAL MOTORS COMPANY

2. Loosely install the control valve body bolts (1, 2, 3, 4).
3. Tighten to bolts in the following sequence: bolt 2, then bolt 4, then bolt 1, then bolt 3 to 9 N.m (80 lb in).

CAUTION: Refer to [Fastener Caution](#) .

4. Tighten the bolts again in the same sequence: bolt 2, then bolt 4, then bolt 1, then bolt 3 to 9 N.m (80 lb in) to ensure all bolts are correctly tightened to 9 N.m (80 lb in).
5. Position the control valve body fluid manifold (3) in the transmission.

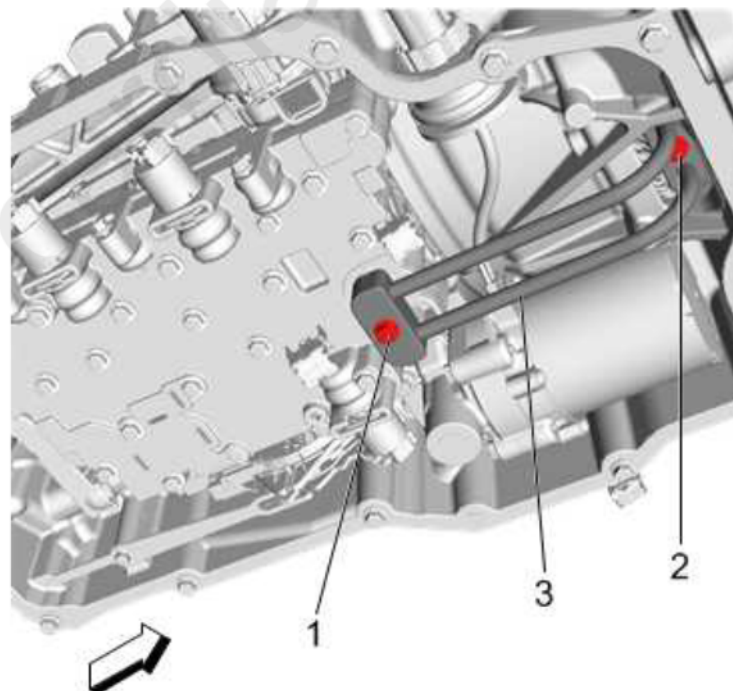


Fig. 84: Control Valve Body Fluid Manifold And Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Install the control valve body fluid manifold bolts (1, 2) and tighten to 9 N.m (80 lb in).
7. Connect the electrical connectors (1) to the control valve assembly (3).

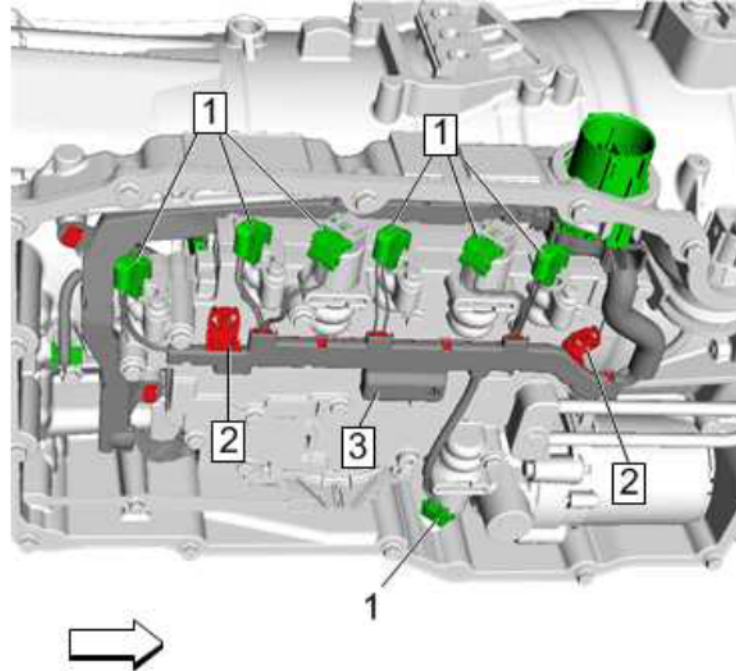


Fig. 85: Control Valve Assembly, Wiring Harness Retainers And Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

8. Connect the wiring harness retainers (2) to the control valve assembly.
9. Install the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

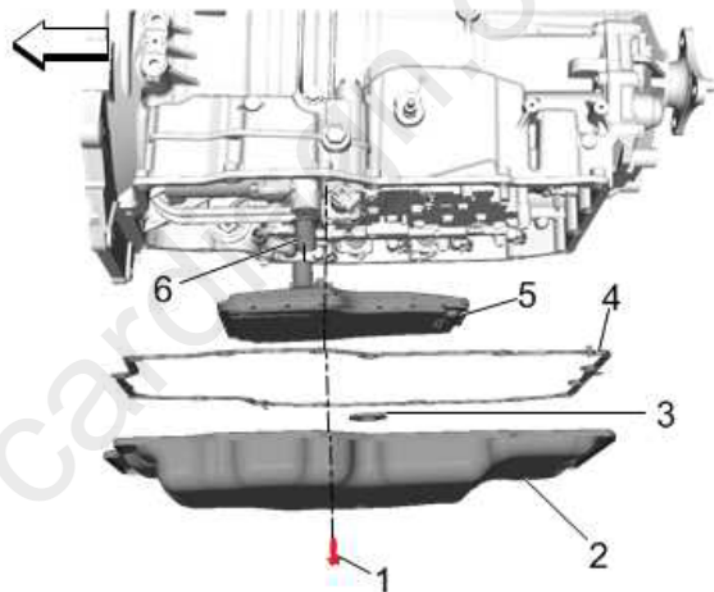


Fig. 86: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
 Courtesy of GENERAL MOTORS COMPANY

CONTROL VALVE BODY FLUID MANIFOLD REPLACEMENT

Removal Procedure

1. Remove the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

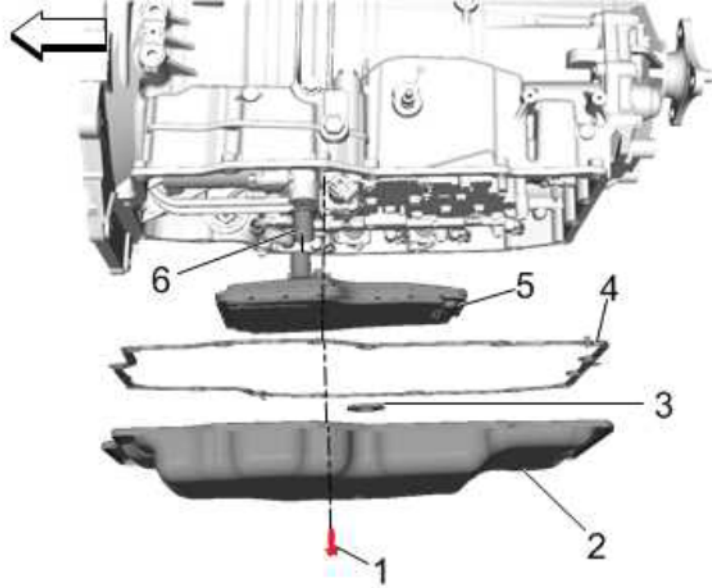


Fig. 87: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal
Courtesy of GENERAL MOTORS COMPANY

2. Remove the control valve body fluid manifold bolts (1, 2).

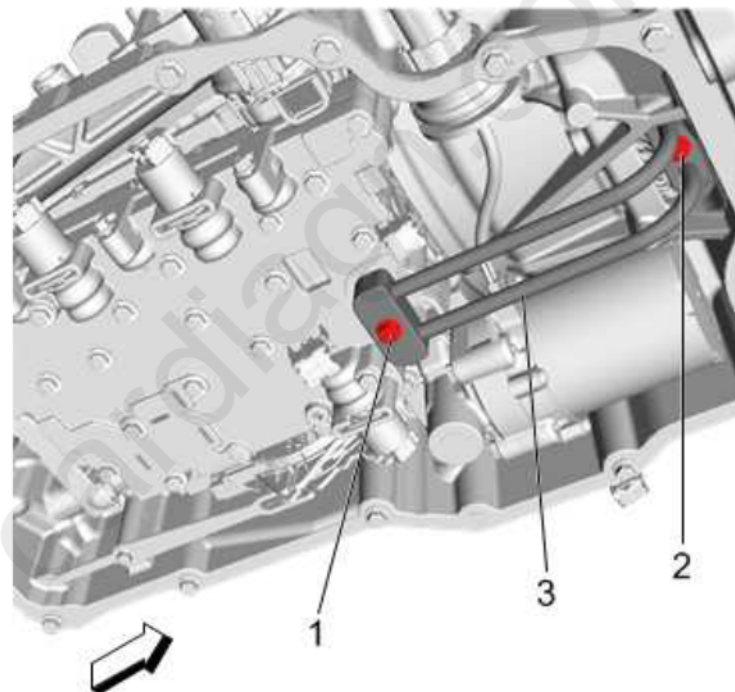


Fig. 88: Control Valve Body Fluid Manifold And Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove the control valve body fluid manifold (3).
4. Inspect seals from the torque dampener housing to the control valve body fluid manifold for damage. Replace as necessary.

Installation Procedure

1. Inspect seals from the control valve body to the control valve body fluid manifold for damage. Install new seals as necessary.
2. Position the control valve body fluid manifold (3) in the transmission.

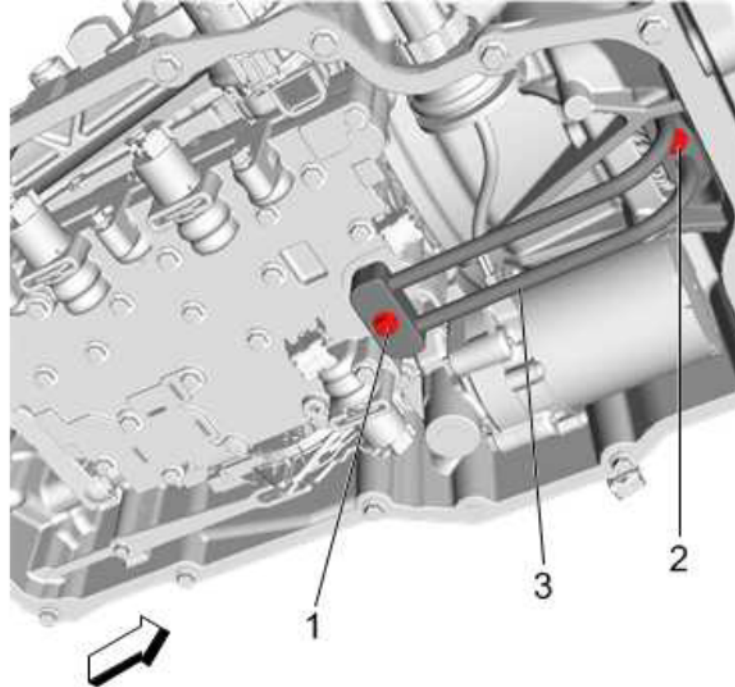


Fig. 89: Control Valve Body Fluid Manifold And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install the control valve body fluid manifold bolts (1, 2) and tighten to 9 N.m (80 lb in).

CAUTION: Refer to [Fastener Caution](#) .

4. Install the transmission fluid filter (5). Refer to [Automatic Transmission Fluid, Fluid Pan and/or Filter Replacement](#)

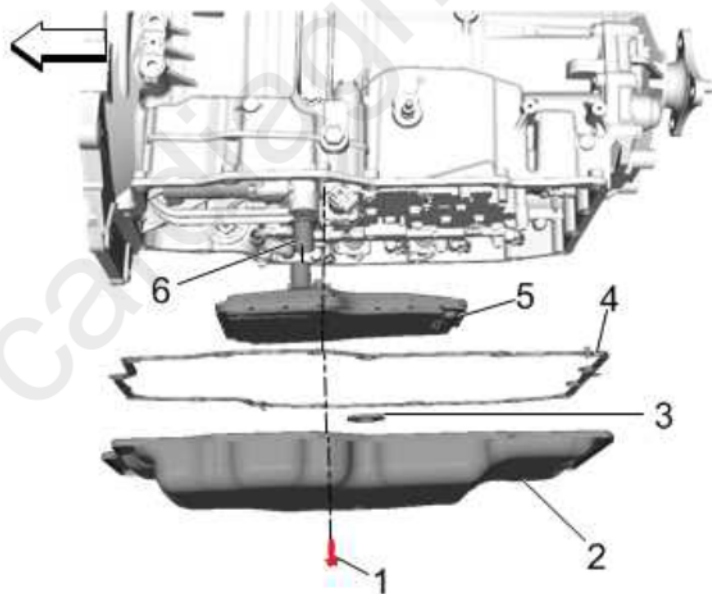


Fig. 90: Automatic Transmission Fluid Pan Bolts, Pan, Pan Gasket, Filter And Filter Seal

Courtesy of GENERAL MOTORS COMPANY

PARK PAWL ACTUATOR REPLACEMENT

Removal Procedure

1. Remove the propeller shaft flange from the transmission. Refer to [Transmission Propeller Shaft Flange Replacement](#)
2. Remove the transmission support crossmember. Refer to [Transmission Support Crossmember Replacement \(LTG\)](#)

3. Remove the automatic transmission manual shift shaft position switch (1). Refer to [Automatic Transmission Manual Shift Shaft Position Switch Replacement](#)

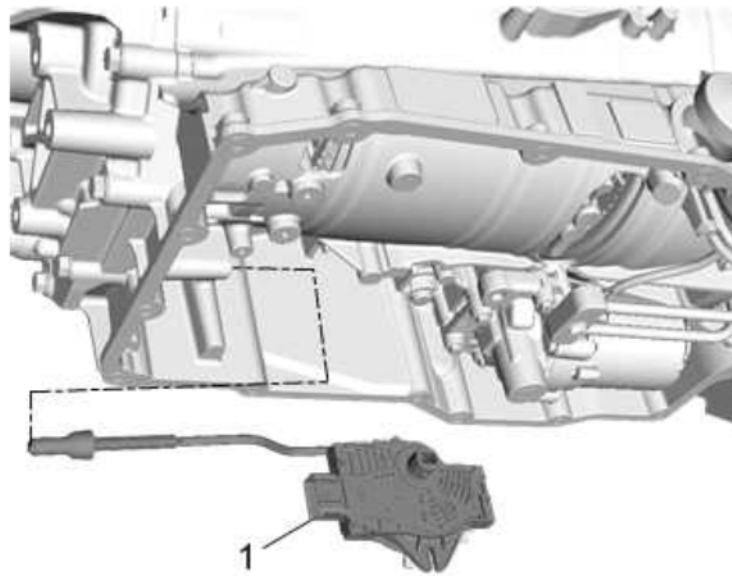


Fig. 91: Automatic Transmission Manual Shift Shaft Position Switch
Courtesy of GENERAL MOTORS COMPANY

4. Remove the park pawl actuator from the automatic transmission manual shift shaft position switch (1).
5. Remove the nine case extension bolts (1).

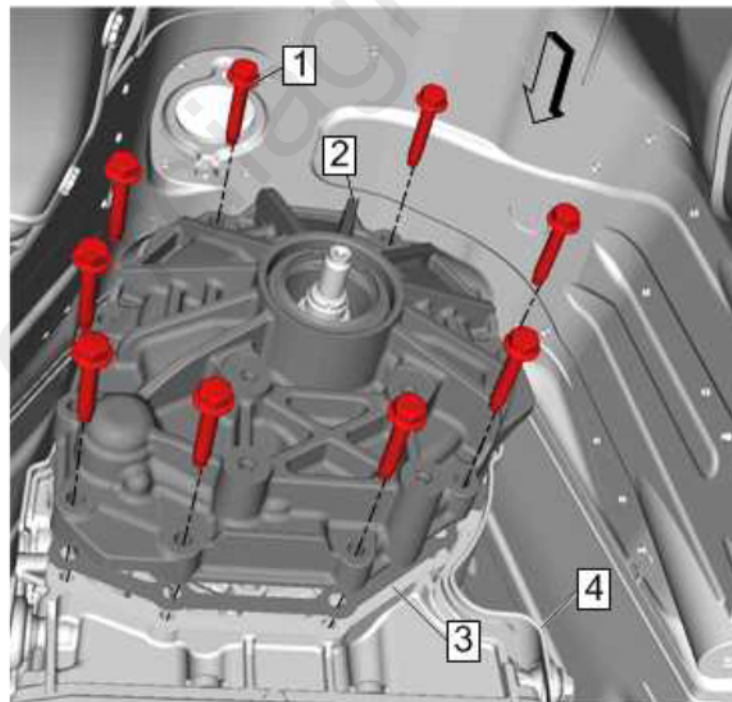


Fig. 92: Case Extension Bolts
Courtesy of GENERAL MOTORS COMPANY

6. Remove the case extension from the transmission (2).
7. Remove and inspect the case extension gasket (3).
8. Remove the park pawl components from the case extension. Refer to [Case Extension Disassemble](#)

Installation Procedure

1. Install the park pawl actuator to the automatic transmission manual shift shaft position switch (1).

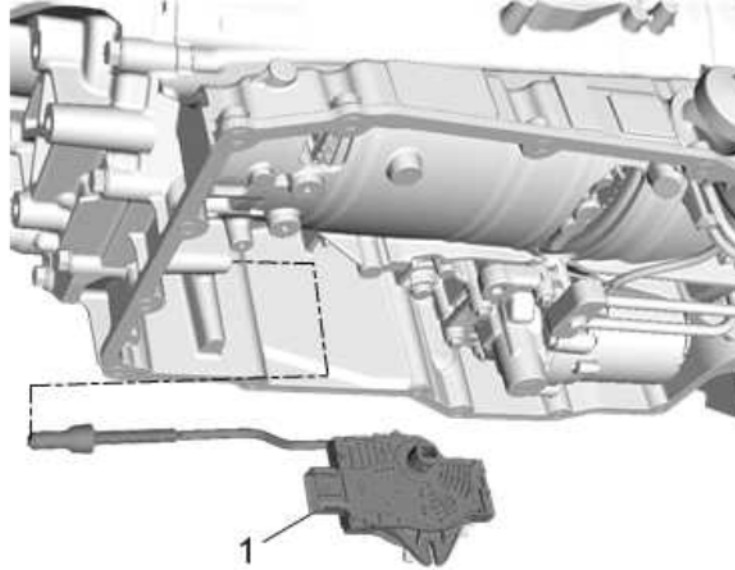


Fig. 93: Automatic Transmission Manual Shift Shaft Position Switch
 Courtesy of GENERAL MOTORS COMPANY

2. Install the automatic transmission manual shift shaft position switch (1) to the transmission. Refer to [Automatic Transmission Manual Shift Shaft Position Switch Replacement](#)
3. Install the park pawl components to the case extension. Refer to [Case Extension Assemble](#)
4. Install the case extension gasket (3), replace the gasket with a new gasket, if necessary.

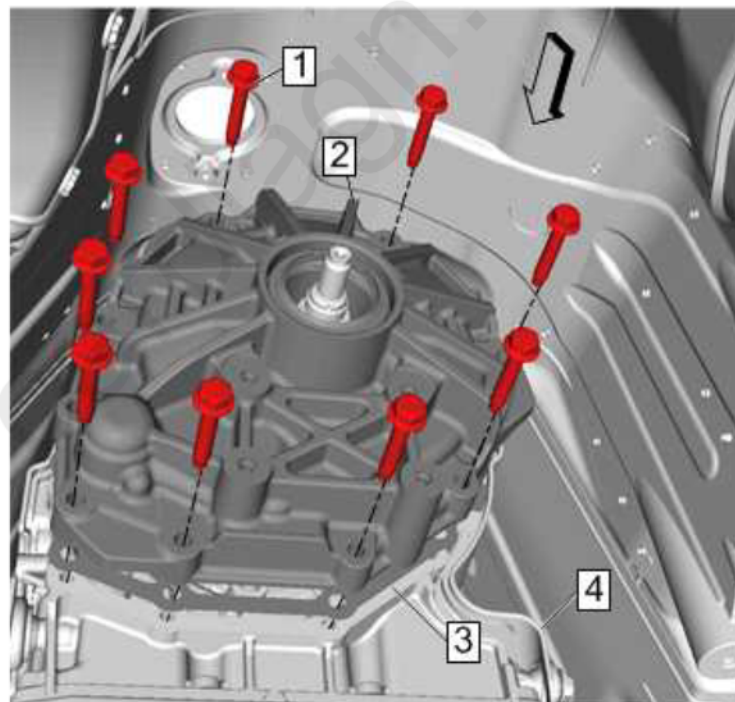


Fig. 94: Case Extension Bolts
 Courtesy of GENERAL MOTORS COMPANY

5. Install the case extension to the transmission (2).
6. Install the nine case extension bolts (1) and tighten in the sequence shown to 22 N.m (16 lb ft).

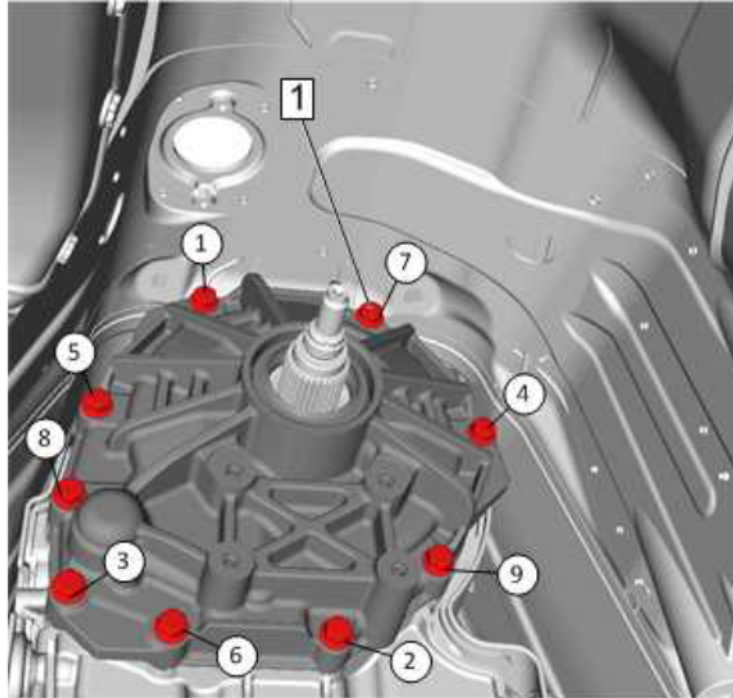


Fig. 95: Case Extension Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

7. Install the transmission support crossmember. Refer to [Transmission Support Crossmember Replacement \(LTG\)](#)
8. Install the propeller shaft flange to the transmission. Refer to [Transmission Propeller Shaft Flange Replacement](#)

TRANSMISSION VENT HOSE REPLACEMENT

Removal Procedure

1. Remove the transmission from the vehicle. Refer to [Transmission Replacement](#)
2. Disconnect the transmission vent hose assembly (1) from the engine bracket.

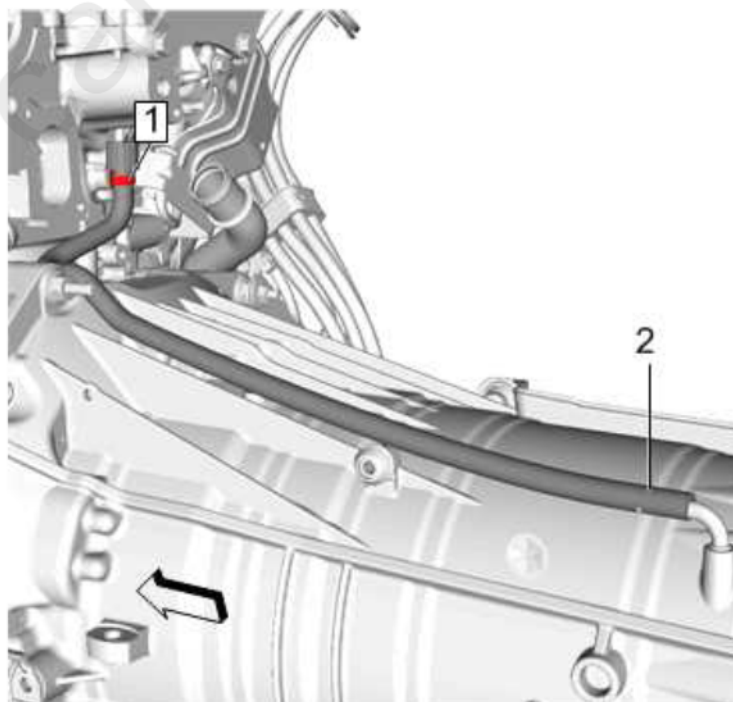


Fig. 96: Transmission Vent Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

NOTE: Thermostat removed for clarity.

3. Remove the transmission vent hose assembly (2) from the vehicle.

Installation Procedure

1. Connect the transmission vent hose assembly (1) to the engine bracket.

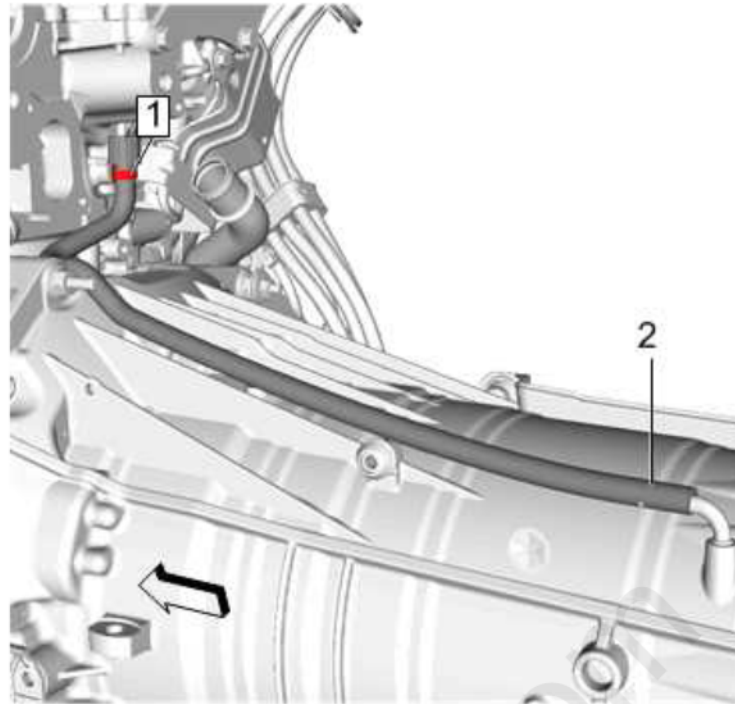


Fig. 97: Transmission Vent Hose Assembly
Courtesy of GENERAL MOTORS COMPANY

2. Connect the transmission vent hose assembly (2) to the transmission.

NOTE: Ensure the vent hoses are free of kinks and routed clear of sharp objects.

3. Install the transmission to the vehicle. Refer to [Transmission Replacement](#)

TRANSMISSION REPLACEMENT

Removal Procedure

1. Disable the high voltage system. Refer to [High Voltage Disabling](#)

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure includes the following steps:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Before working on any high voltage system, be sure to wear the following Personal Protection Equipment:

- Safety glasses with appropriate side shields when within 15 meters (50 feet) of the vehicle, either indoors or outdoors.
- Certified and up-to-date Class "0" Insulation gloves rated at 1000 V with leather protectors.

- Visually and functionally inspect the gloves before use.
- Wear the Insulation gloves with leather protectors at all times when working with the high voltage battery assembly, whether the system is energized or not.

Failure to follow the procedures may result in serious injury or death.

2. Remove the drivetrain and front suspension cradle plate. Refer to [Drivetrain and Front Suspension Cradle Plate Replacement](#)
3. Propeller Shaft» Remove - [Propeller Shaft Replacement](#)
4. Disconnect the transmission range selector lever cable terminal (1) from the transmission manual shift lever pin (6).

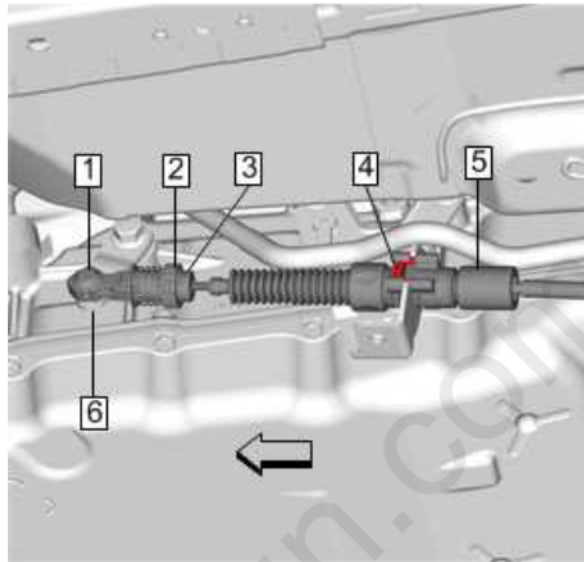


Fig. 98: Transmission Range Selector Lever Cable
 Courtesy of GENERAL MOTORS COMPANY

5. Slide the retainer (4) forward to release the transmission range selector lever cable (5) from the bracket.
6. Disconnect the electrical connectors (1, 2) from the transmission.

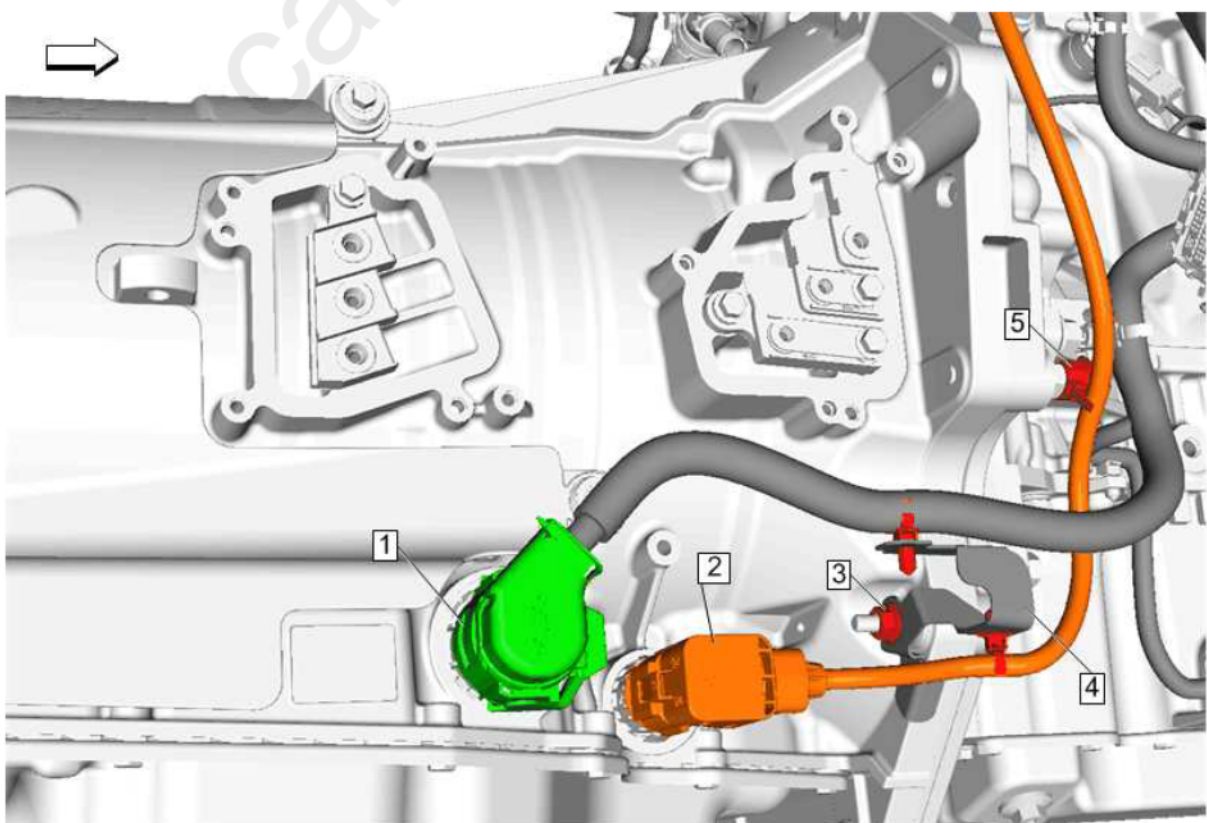


Fig. 99: High Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Remove the wiring harness bracket nut (3), then position the wiring harness and bracket out of the way.
8. Place an oil drain pan under the transmission fluid cooler pipes (2).

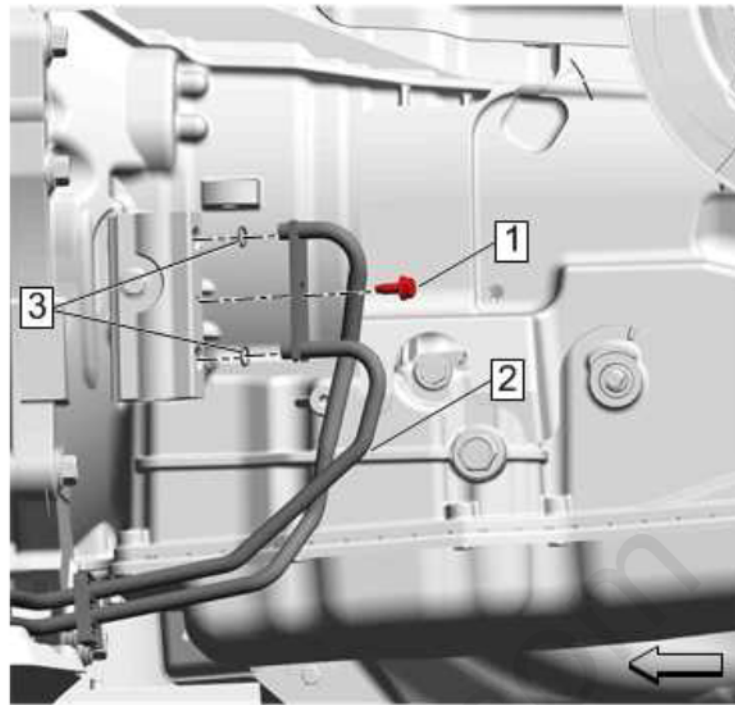


Fig. 100: Transmission Fluid Cooler Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

9. Remove the transmission fluid cooler inlet and outlet pipes (2) from the transmission and position aside or remove from the vehicle as necessary. Refer to [**Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LTG\)**](#) , [**Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LTG With HP9\)**](#) and/or [**Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGW\)**](#)
10. Plug the open fluid ports to prevent fluid loss and contamination.
11. Support the transmission with a suitable transmission jack.
12. Transmission Support Crossmember» Remove - [**Transmission Support Crossmember Replacement \(LTG\)**](#)
13. Lower the transmission 40 mm to access the high voltage cable cover bolts.
14. Remove the high voltage connector cover bolts (1, 3).

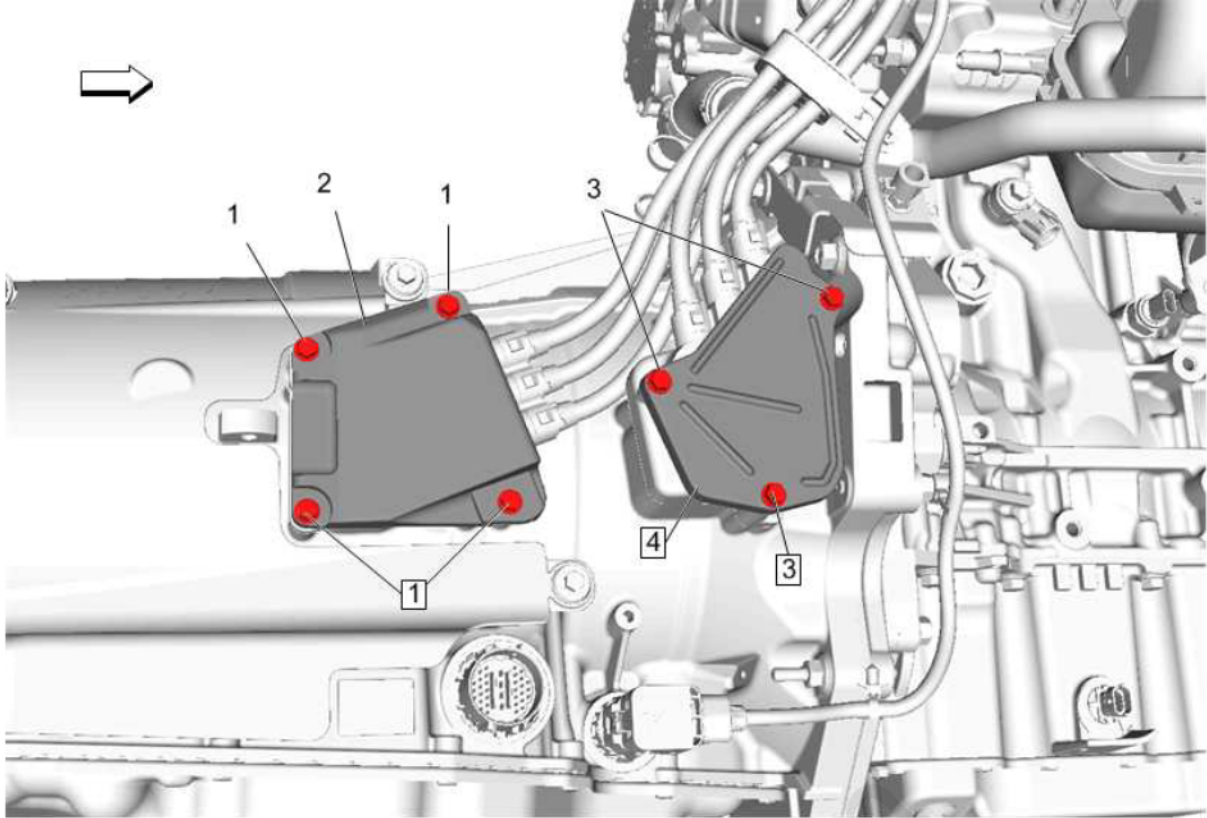


Fig. 101: High Voltage Connector Cover Bolts
 Courtesy of GENERAL MOTORS COMPANY

15. Remove the high voltage connector covers (2, 4).
16. Remove the six high voltage cable connector bolts (1, 2).

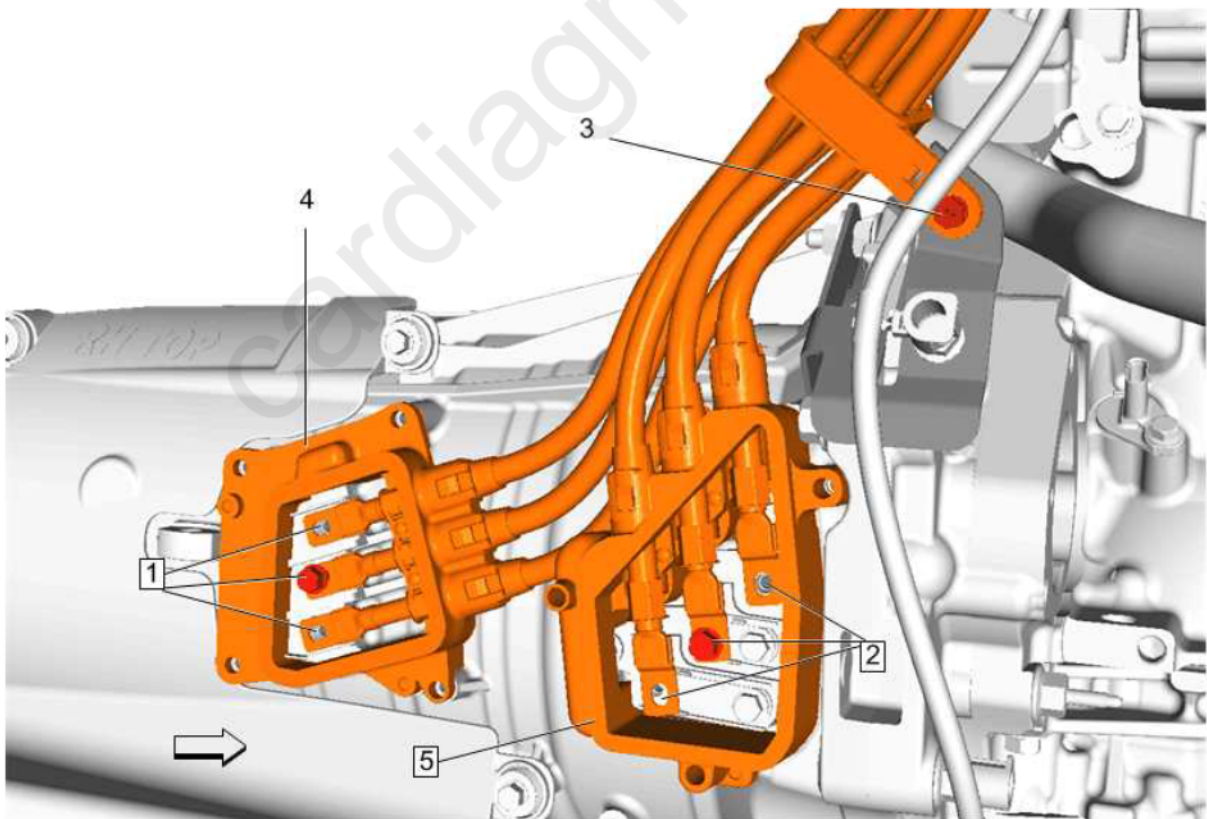


Fig. 102: High Voltage Cable Connector Bolts
 Courtesy of GENERAL MOTORS COMPANY

17. Remove the high voltage cable bracket nut (1).

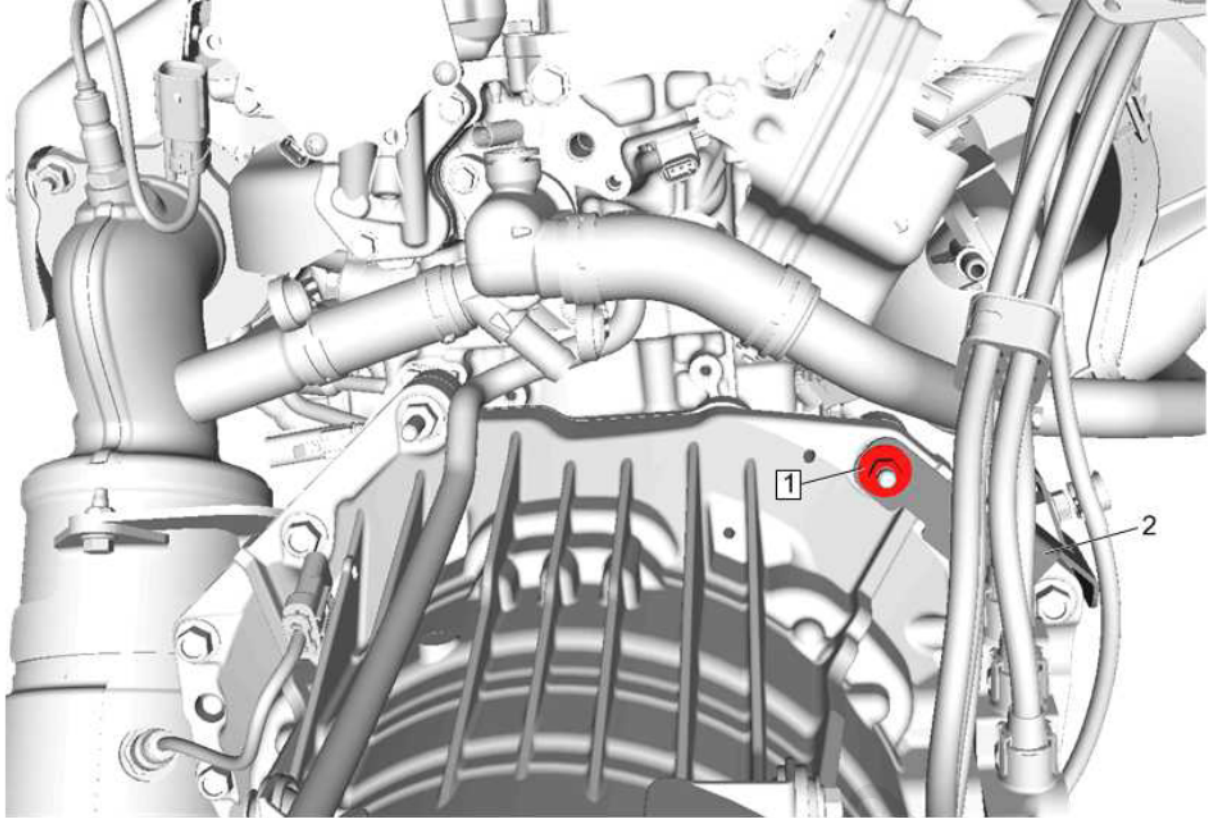


Fig. 103: High Voltage Cable Bracket Nut
Courtesy of GENERAL MOTORS COMPANY

18. Position the high voltage cables and bracket (2) out of the way.
19. Disconnect the electrical wiring harness retainers from the transmission to engine fasteners and from the transmission case.
20. Remove the lower right transmission to engine bolts (1, 2, 3, 4).

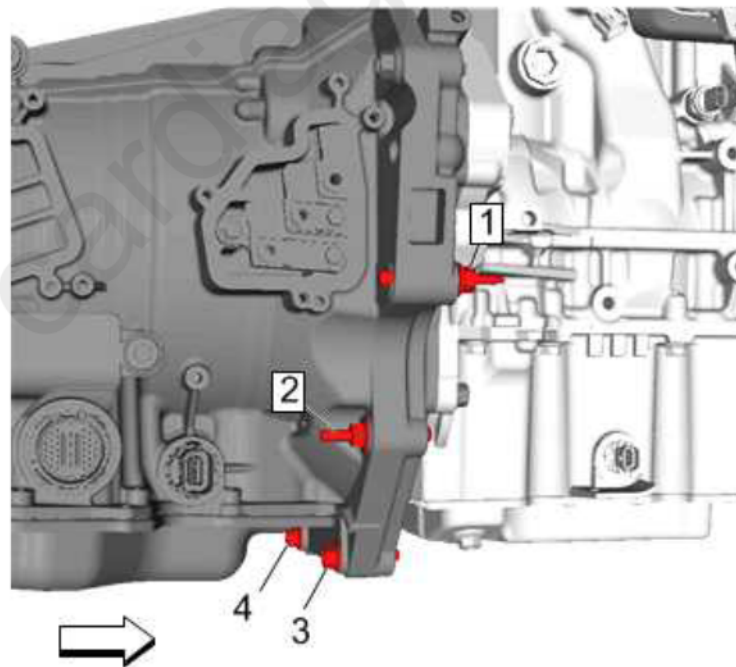


Fig. 104: Lower Right Transmission To Engine Bolts
Courtesy of GENERAL MOTORS COMPANY

21. Remove the left lower transmission to engine bolt (1).

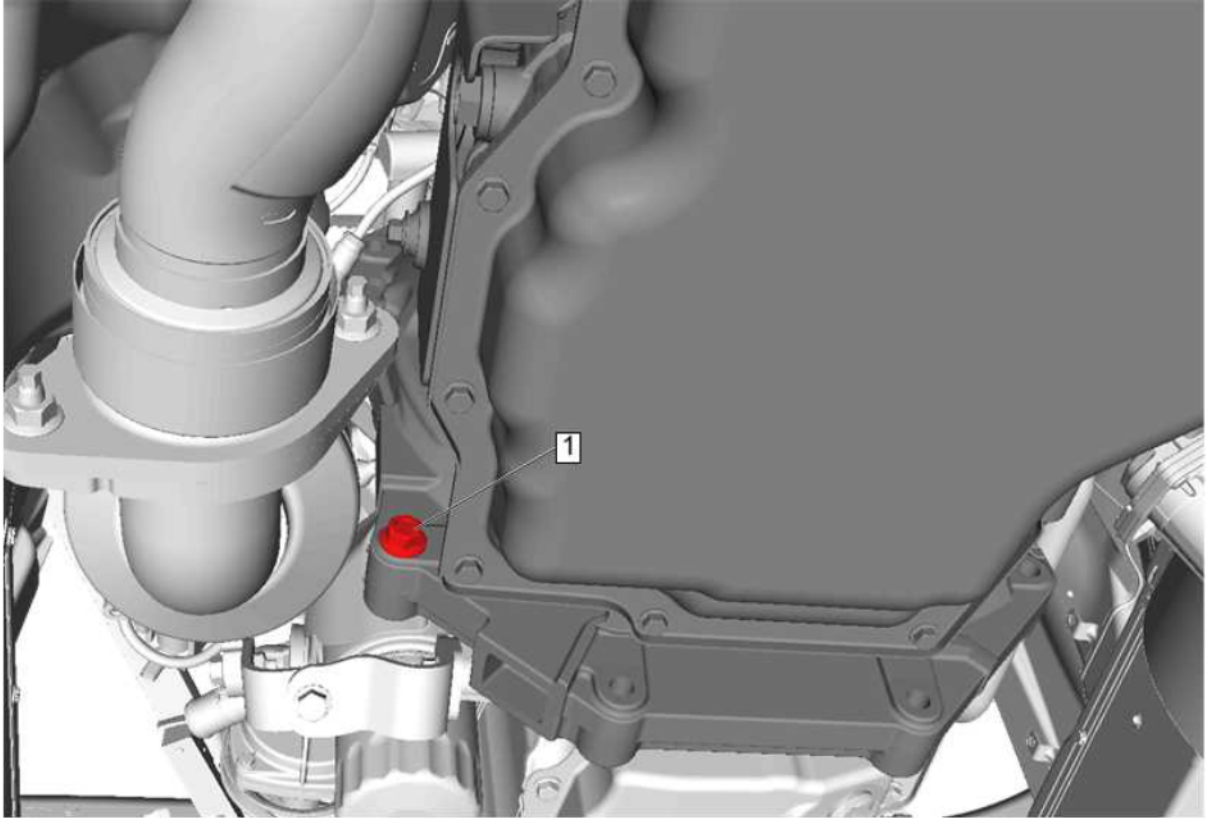


Fig. 105: Left Lower Transmission To Engine Bolt
 Courtesy of GENERAL MOTORS COMPANY

22. Remove the upper transmission to engine bolts (1, 2, 3, 4, 5, 6).

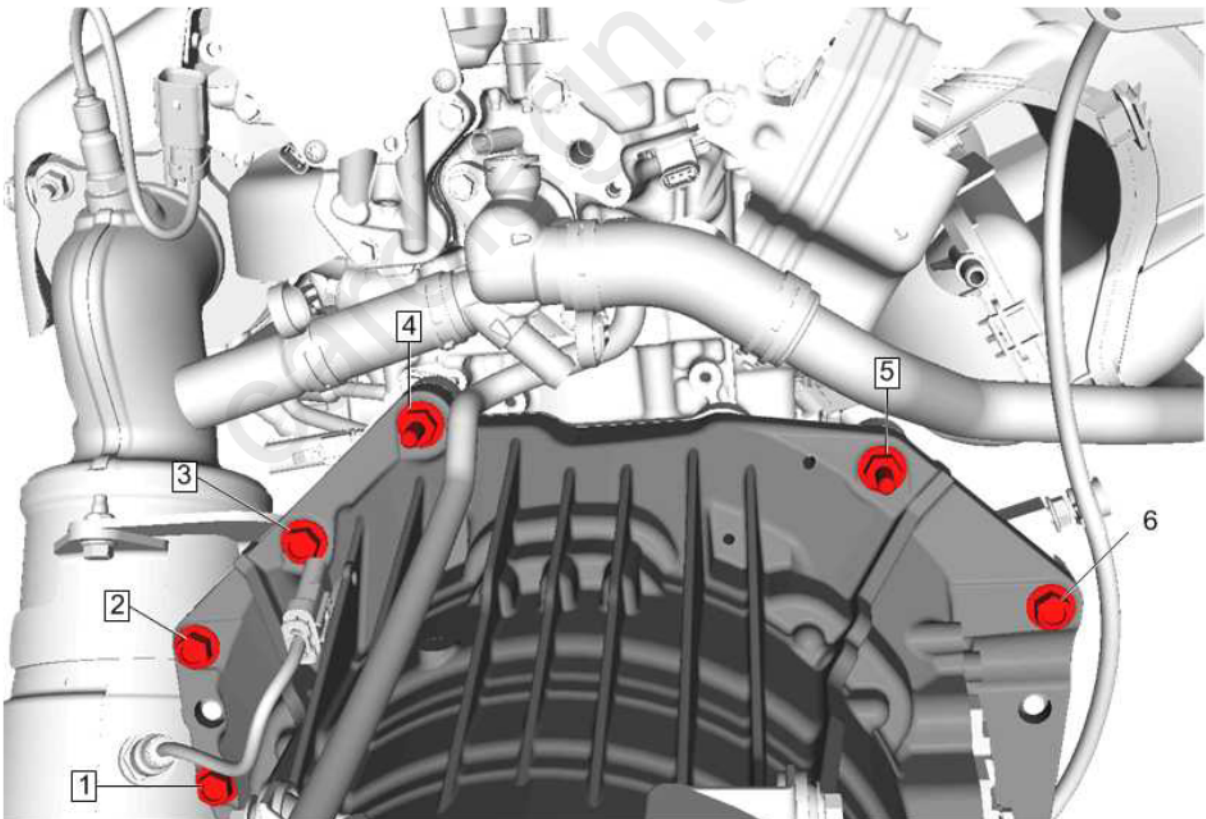


Fig. 106: Upper Transmission To Engine Bolts
 Courtesy of GENERAL MOTORS COMPANY

23. Disconnect the vent hose (1) from the transmission.

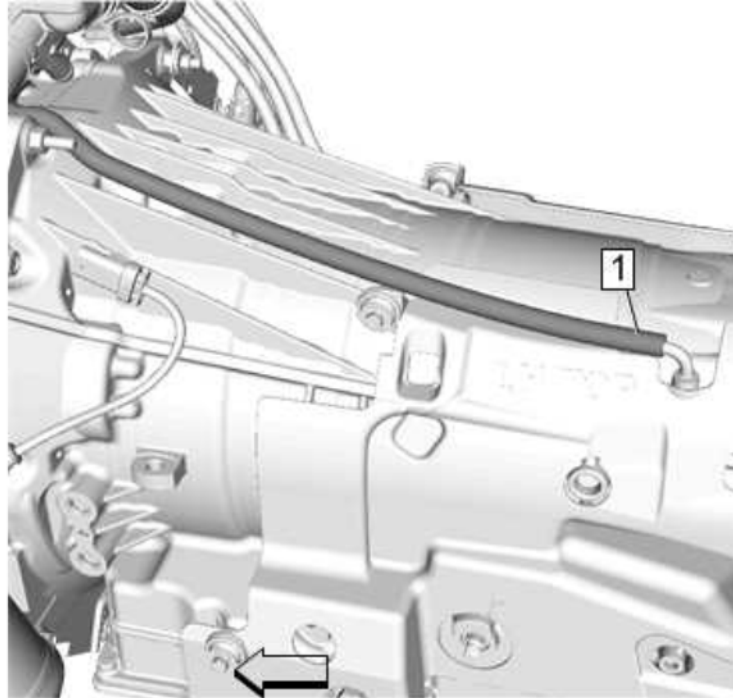


Fig. 107: Vent Hose

Courtesy of GENERAL MOTORS COMPANY

24. Disconnect the heated oxygen sensor connector from the transmission and position out of the way.
25. Remove the transmission from the vehicle.
26. Transfer components as necessary.
27. Flush and flow test the transmission cooler and transmission pipes. Refer to [Transmission Fluid Cooler Flow Test and Flushing \(8L90\)](#) and/or [Transmission Fluid Cooler Flow Test and Flushing \(4EL70\)](#).

Installation Procedure

1. Position the transmission in the vehicle.

NOTE: Ensure the transmission alignment dowels pins are not missing or damaged. Replace as necessary before positioning the transmission.

2. Connect the vent hose (1) to the transmission.

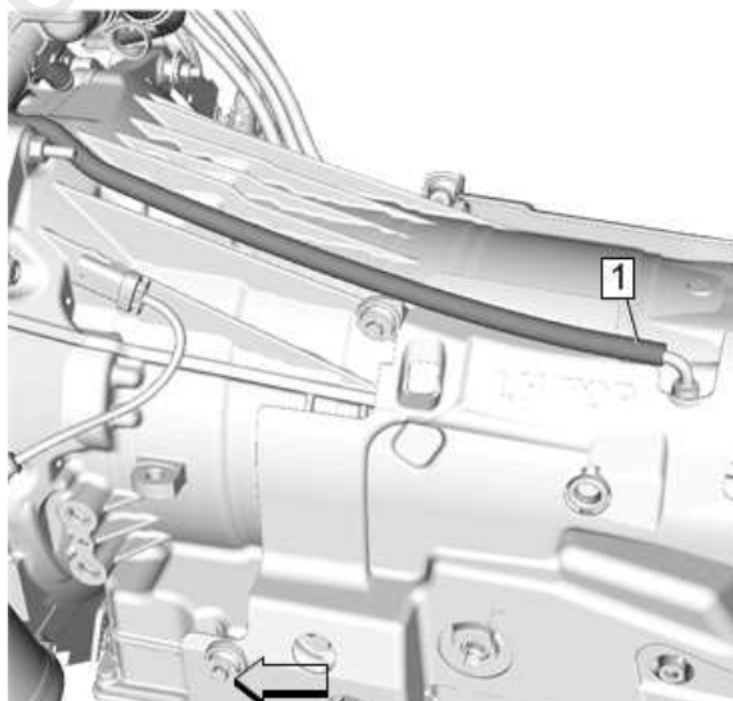


Fig. 108: Vent Hose

Courtesy of GENERAL MOTORS COMPANY

3. Install the upper transmission to engine bolts (1, 2, 3, 4, 5, 6) and tighten to 58 N.m (43 lb ft).

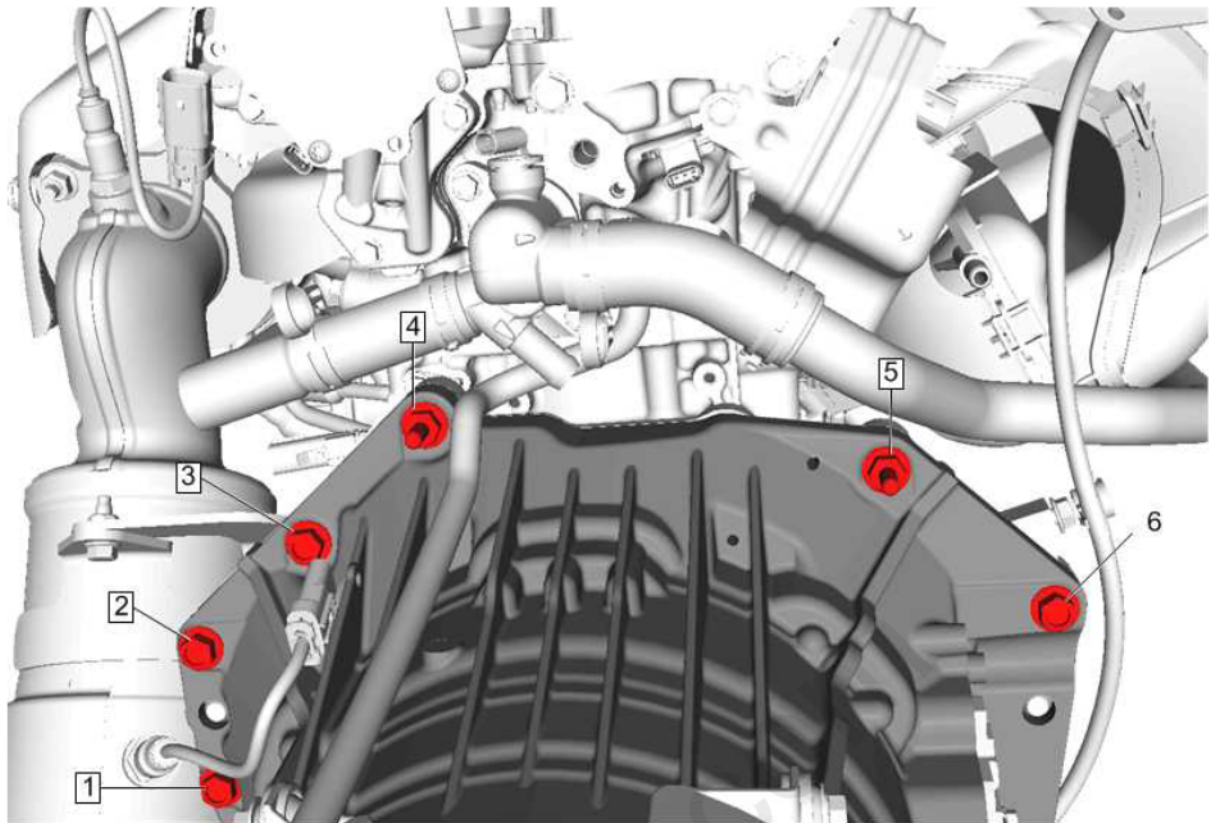


Fig. 109: Upper Transmission To Engine Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

4. Install the left lower transmission to engine bolt (1) and tighten to 58 N.m (43 lb ft).

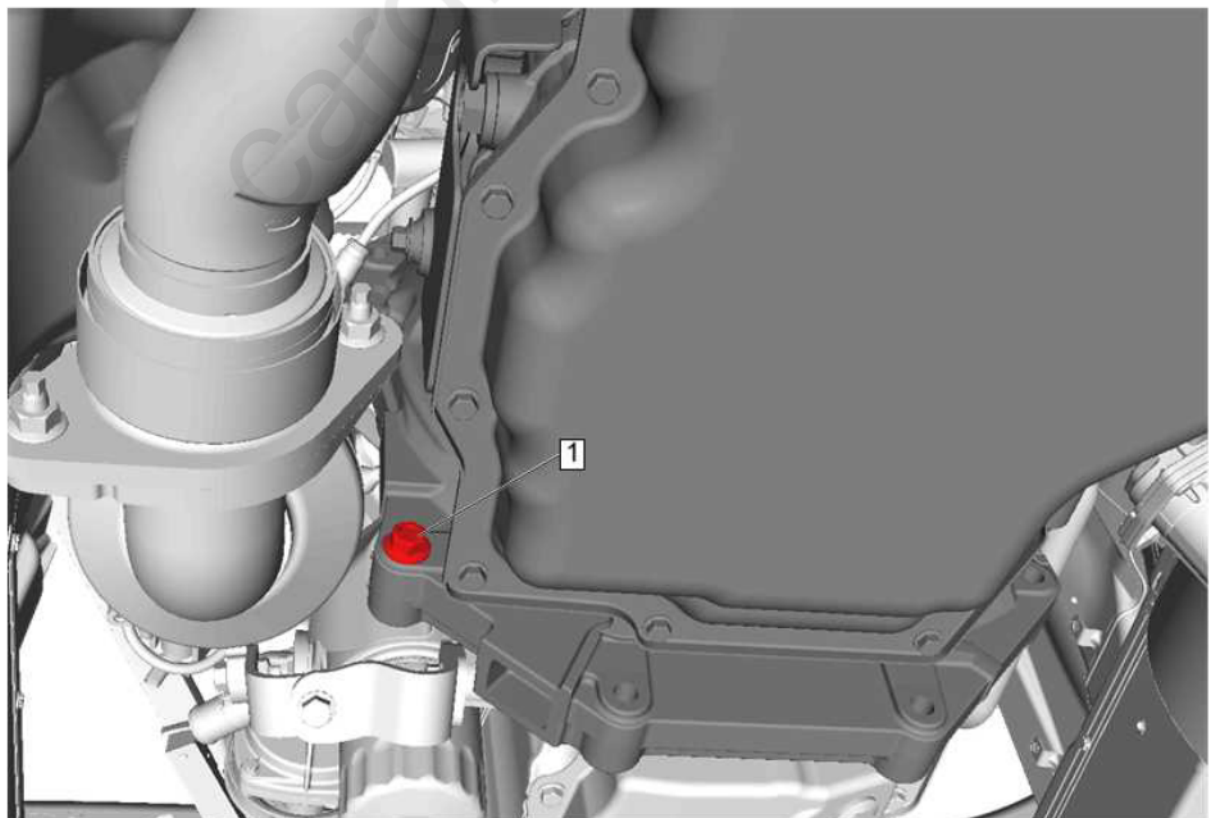


Fig. 110: Left Lower Transmission To Engine Bolt

Courtesy of GENERAL MOTORS COMPANY

5. Install the lower right transmission to engine bolts (1, 2, 3, 4) and tighten to 58 N.m (43 lb ft).

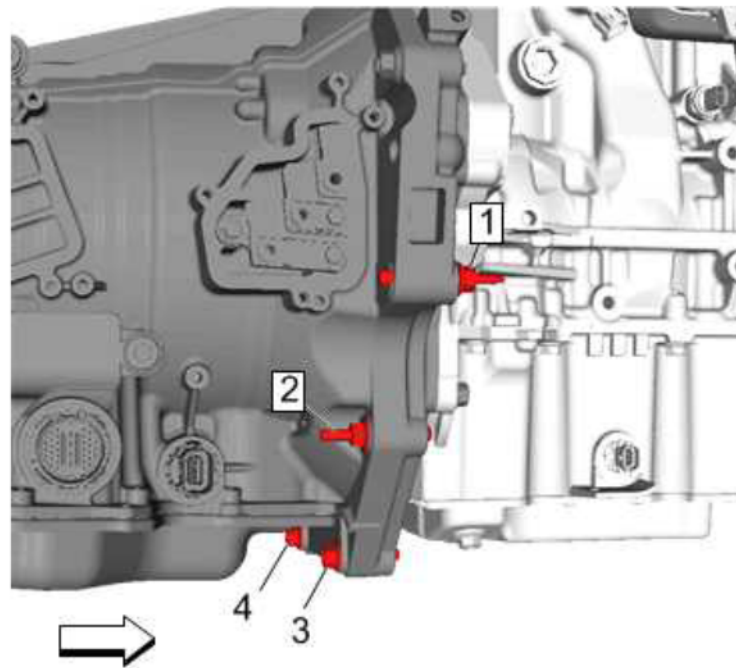


Fig. 111: Lower Right Transmission To Engine Bolts

Courtesy of GENERAL MOTORS COMPANY

6. Connect the heated oxygen sensor connector to the transmission.

7. Install the high voltage cable bracket nut (1) and tighten to 22 N.m (16 lb ft).

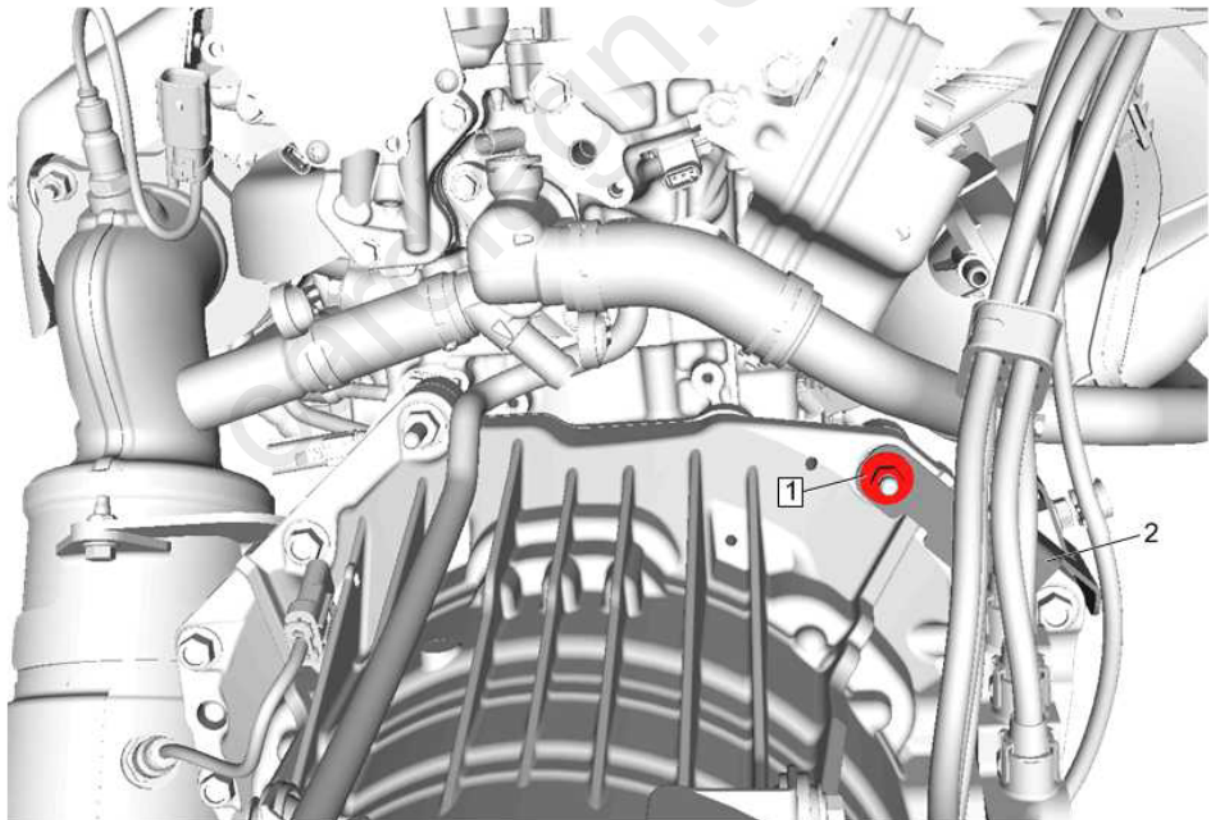


Fig. 112: High Voltage Cable Bracket Nut

Courtesy of GENERAL MOTORS COMPANY

8. Install the six high voltage cable connector bolts (1, 2) and tighten to 9 N.m (80 lb in).

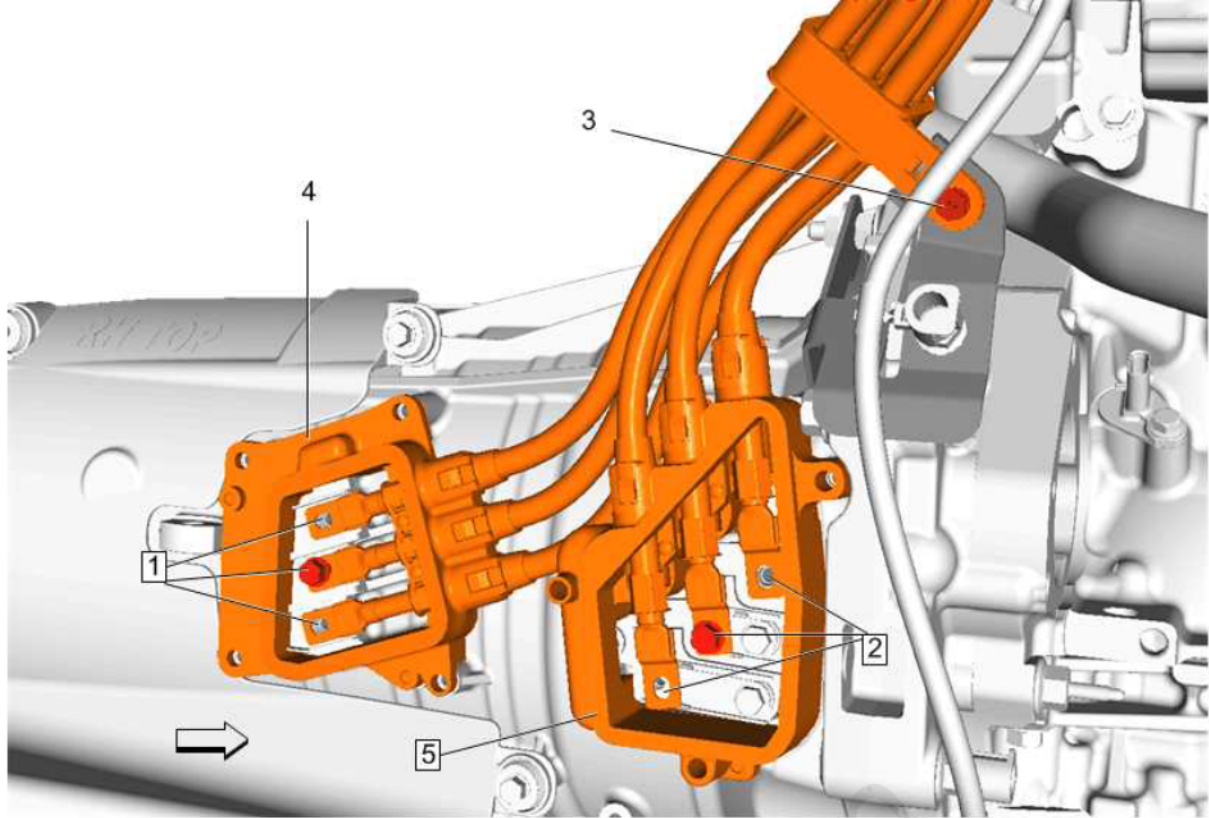


Fig. 113: High Voltage Cable Connector Bolts
Courtesy of GENERAL MOTORS COMPANY

9. Tighten the six high voltage cable connector bolts (1, 2) again to 9 N.m (80 lb in) to ensure a final torque of 9 N.m (80 lb in).

NOTE: Critical high voltage fastener. Perform second torque verification check following re-assembly.

10. Install the high voltage connector covers (2, 4).

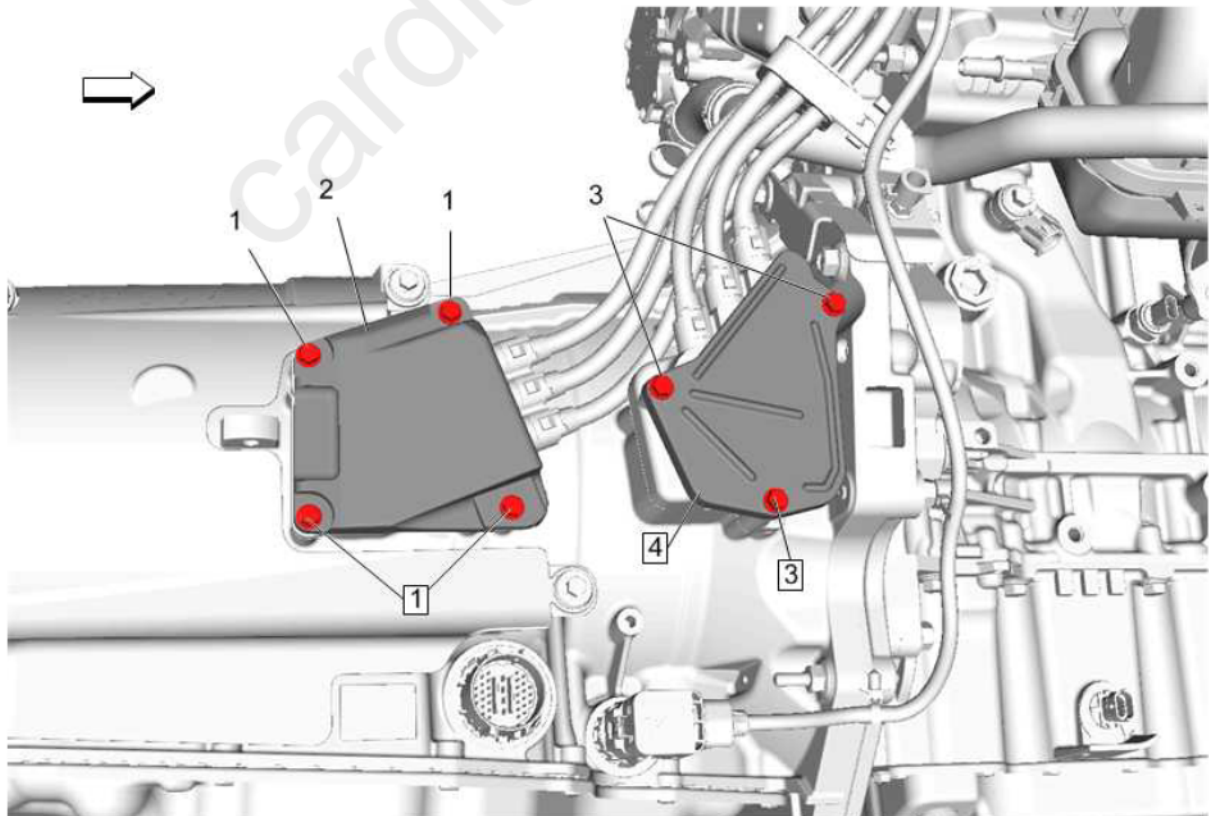


Fig. 114: High Voltage Connector Covers
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure the cover seals have not rolled out of position during

installation.

11. Install the high voltage connector cover bolts (1, 3) and tighten to 9 N.m (80 lb in).
12. Connect the electrical connectors (1, 2) to the transmission.

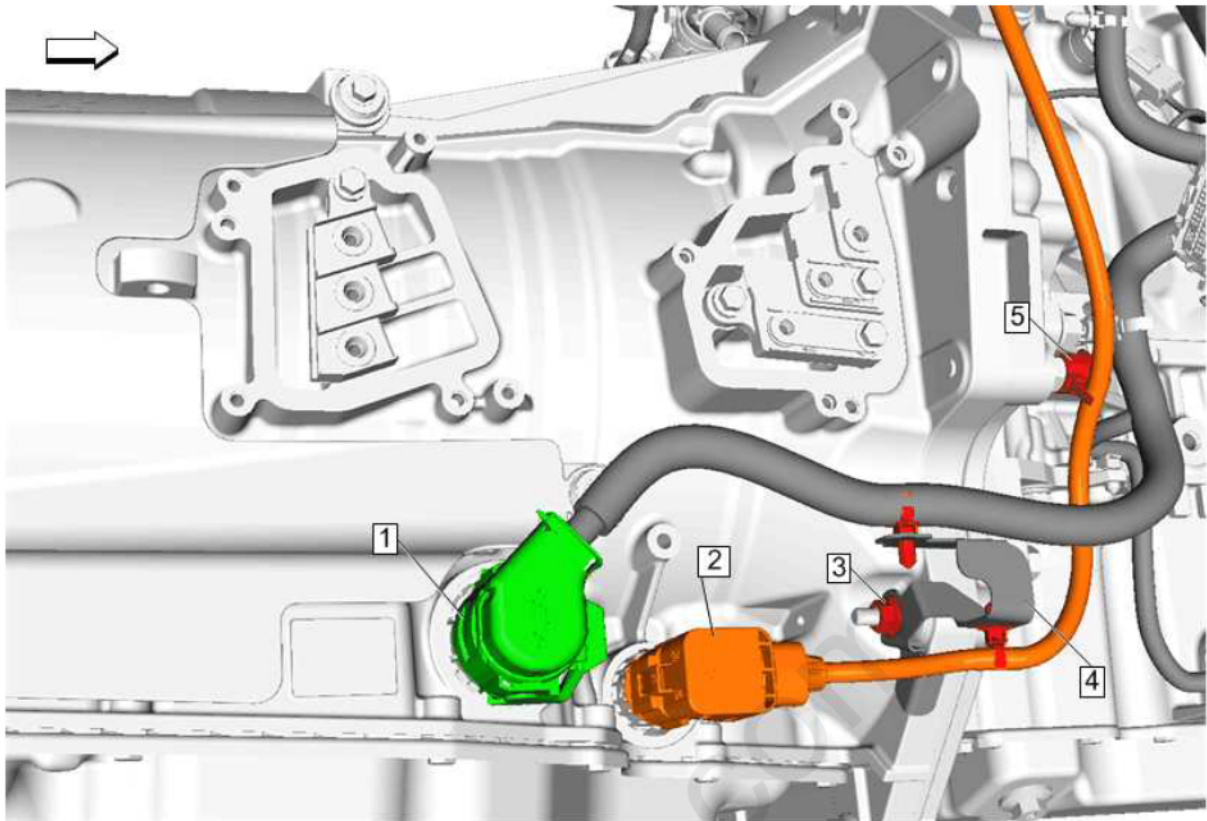


Fig. 115: High Voltage Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

13. Install the wiring harness bracket nut (3) and tighten to 22 N.m (16 lb ft).
14. Connect the transmission range selector lever cable terminal (1) to the transmission manual shift lever pin (6).

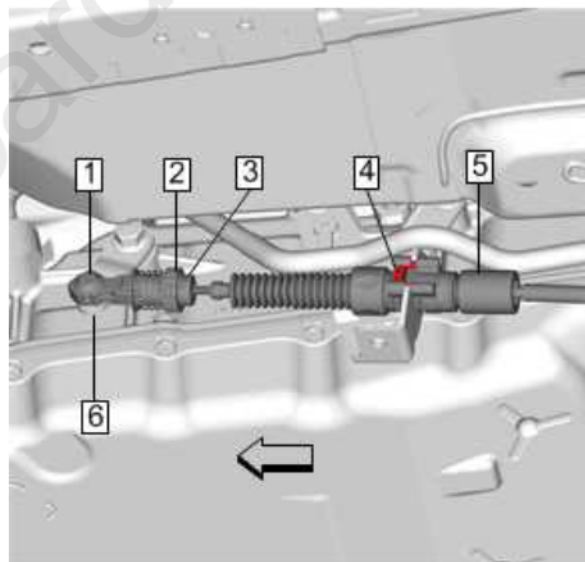


Fig. 116: Transmission Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

15. Slide the retainer (4) rearward to engage the transmission range selector lever cable (5) to the bracket.
16. Transmission support crossmember» Install - **Transmission Support Crossmember Replacement (LTG)**
17. Remove the transmission jack.

18. Transmission fluid cooler inlet and outlet pipes. » Install - [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LTG\)](#) , [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LTG With HP9\)](#) and/or [Transmission Fluid Cooler Inlet and Outlet Pipe Replacement \(LGW\)](#)

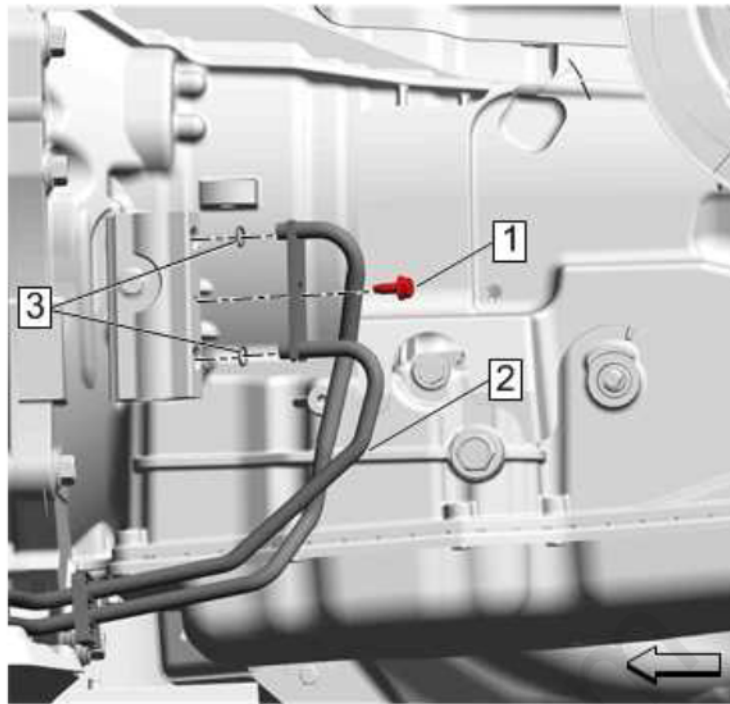


Fig. 117: Transmission Fluid Cooler Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Connect the electrical wiring harness retainers to the transmission and the engine fasteners.
20. Propeller shaft » Install - [Propeller Shaft Replacement](#)
21. Install the drivetrain and front suspension cradle plate. Refer to [Drivetrain and Front Suspension Cradle Plate Replacement](#)
22. Enable the high voltage system. Refer to [High Voltage Enabling](#)
23. Reprogram the HPCM2, [Control Module References](#)
-

2017 TRANSMISSION

Automatic Transmission - 4EL70 (MRD) - Schematic Wiring Diagrams - Automatic Transmission Controls Schematics - CT6

SCHEMATIC WIRING DIAGRAMS

AUTOMATIC TRANSMISSION CONTROLS WIRING SCHEMATICS

Power, Ground, Serial Data, MIL and Fluid Temperature

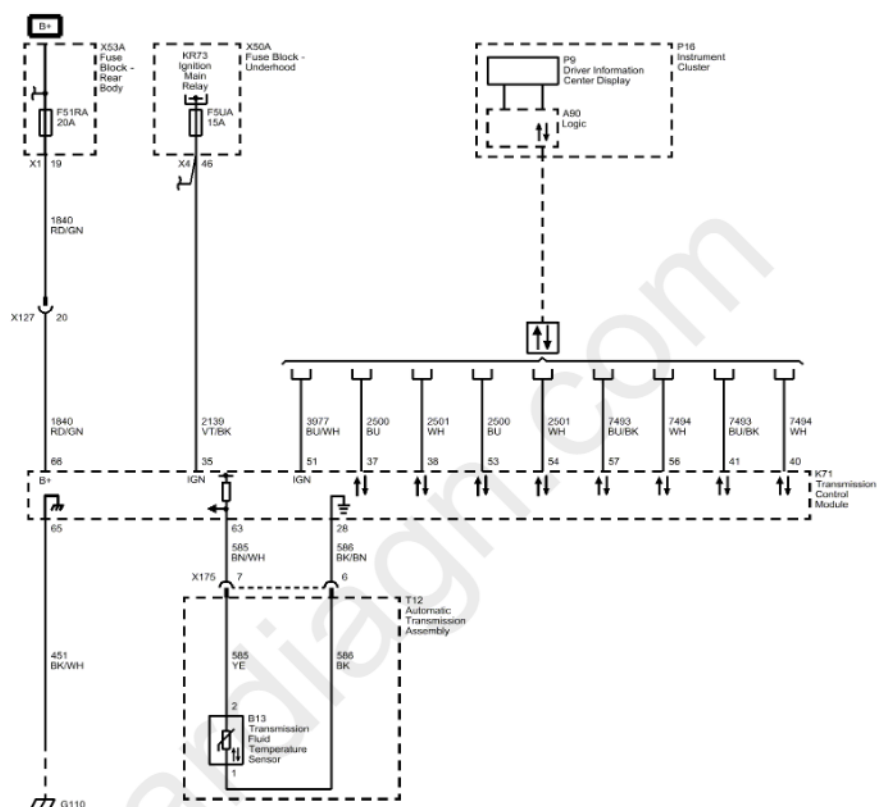


Fig. 1: Power, Ground, Serial Data, MIL and Fluid Temperature
Courtesy of GENERAL MOTORS COMPANY

Pressure and Shift Controls

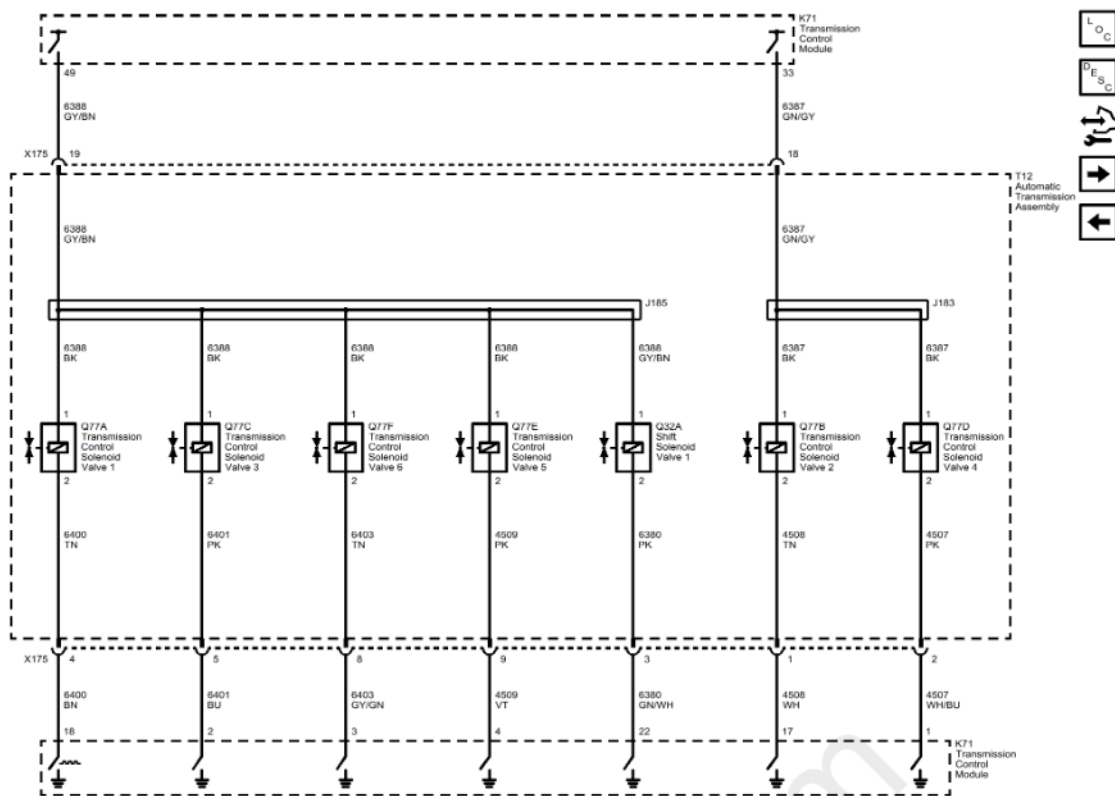


Fig. 2: Pressure and Shift Controls
Courtesy of GENERAL MOTORS COMPANY

Output Speed Sensor and Internal Mode Switch

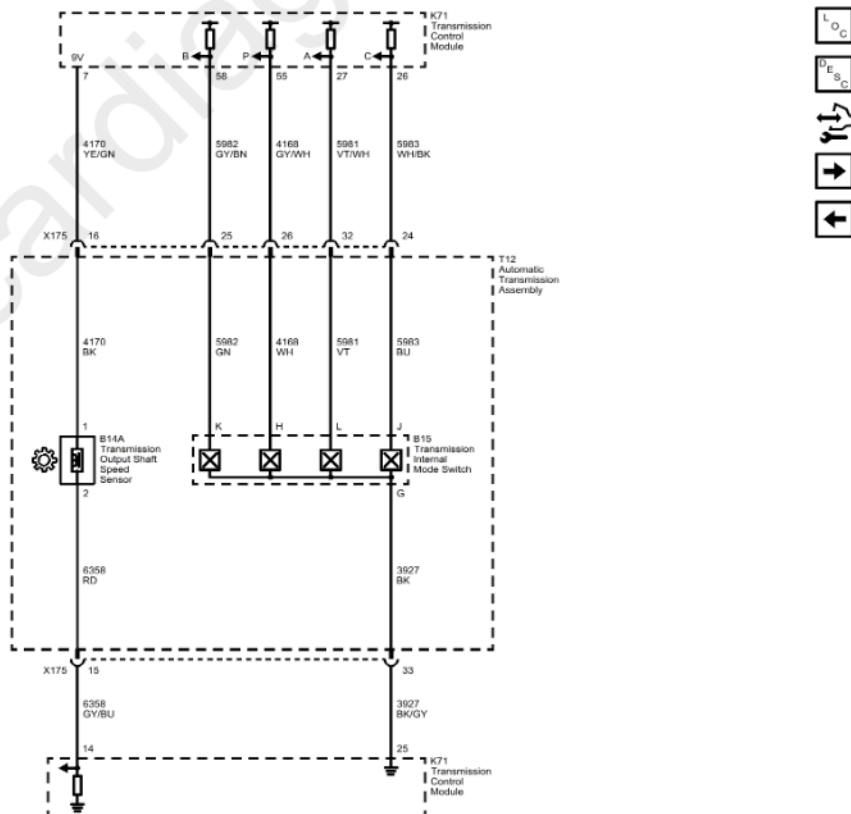


Fig. 3: Output Speed Sensor and Internal Mode Switch
Courtesy of GENERAL MOTORS COMPANY

Tap Up/Tap Down Switches

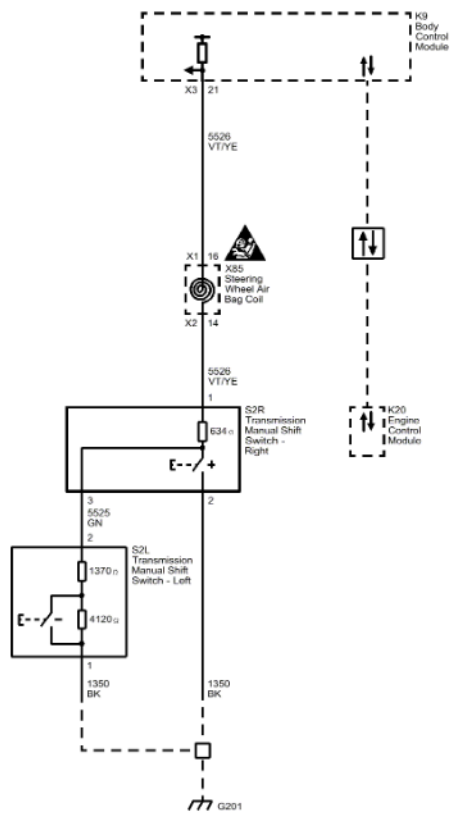


Fig. 4: Tap Up/Tap Down Switches
 Courtesy of GENERAL MOTORS COMPANY

2017 TRANSMISSION

Automatic Transmission - 4EL70 (MRD) - Special Tools and Equipment - Special Tools - CT6

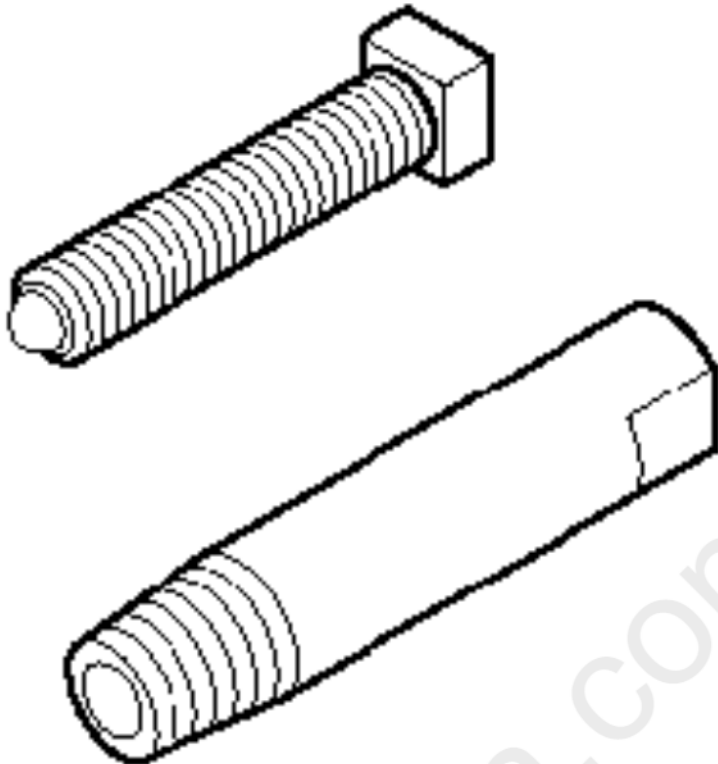
SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/Description
	DT-03289-20 J-3289-20 Holding Fixture (Base)

Illustration	Tool Number/Description
	DT-22828 J-22828 Input and Countershaft Race Installer

Illustration	Tool Number/Description
	DT-23129 J-23129 Universal Seal Remover

Illustration	Tool Number/Description
 The illustration shows two mechanical components. The top component is a bolt with a hexagonal head and a threaded shank. The bottom component is a longer threaded rod, also with a hexagonal head, featuring a longer threaded section than the bolt above it. A faint watermark 'cardiagn.com' is visible across the lower right portion of the illustration area.	DT-43911 J-43911 Selector Shaft Seal Remover

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Illustration	Tool Number/Description
	DT-45012 J-45012 Holding Fixture
	DT-45096 J-45096 Transmission Oil Cooling System Flush and Flow Test Tool



Illustration	Tool Number/Description
 The image shows two blue metal transmission cooler flusher adapters. Each adapter has a long, cylindrical body with a hexagonal base and a threaded end. The adapters are positioned diagonally, with one slightly above and to the right of the other. A large, light gray watermark reading 'cardiasoft.com' is oriented diagonally across the center of the image.	DT-45096-30 J-45096-30 Transmission Cooler Flusher Adapters

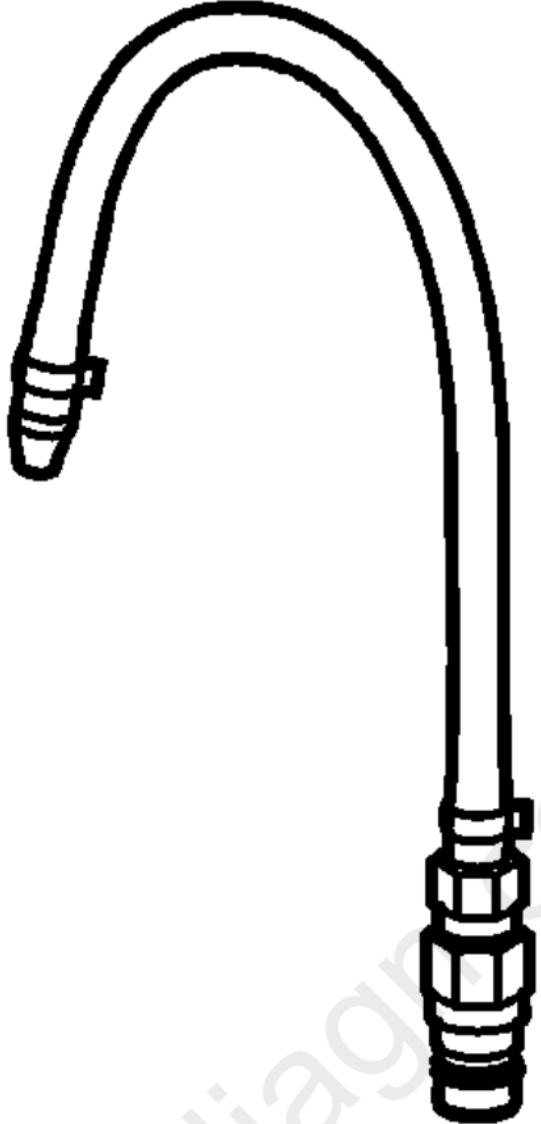
Illustration	Tool Number/Description
	DT-45096-40 J-45096-40 Transflow Oil Fill Adapter

Illustration	Tool Number/Description
 The illustration shows three blue mechanical tools. The top tool is a short, thick cylinder with a hexagonal base and a flared, cup-like top. The middle tool is a long, thin rod with a hexagonal base and a small, circular tip. The bottom tool is a shorter rod with a hexagonal base and a more complex, multi-ported tip. A large, diagonal watermark 'cardiacgr.com' is overlaid across the image.	DT-45201 J-45201 Cooler Line Seal Remover

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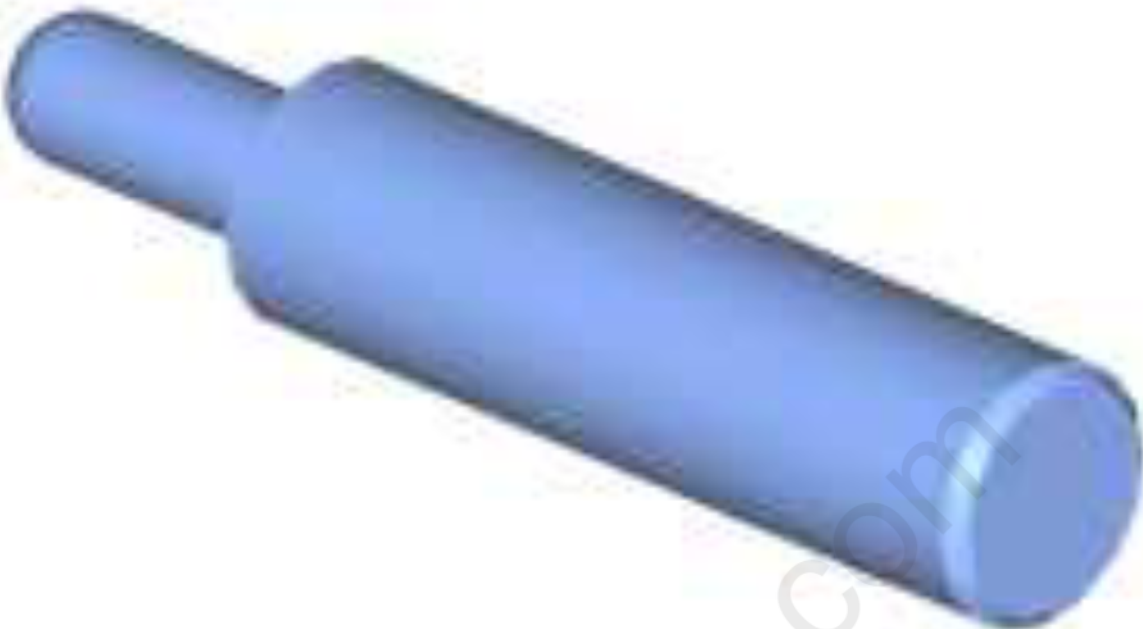
Illustration	Tool Number/Description
	DT-46626 J-46626 Seal Installer

Illustration	Tool Number/Description
	DT-48989 Holding Fixture

cardiagn.com

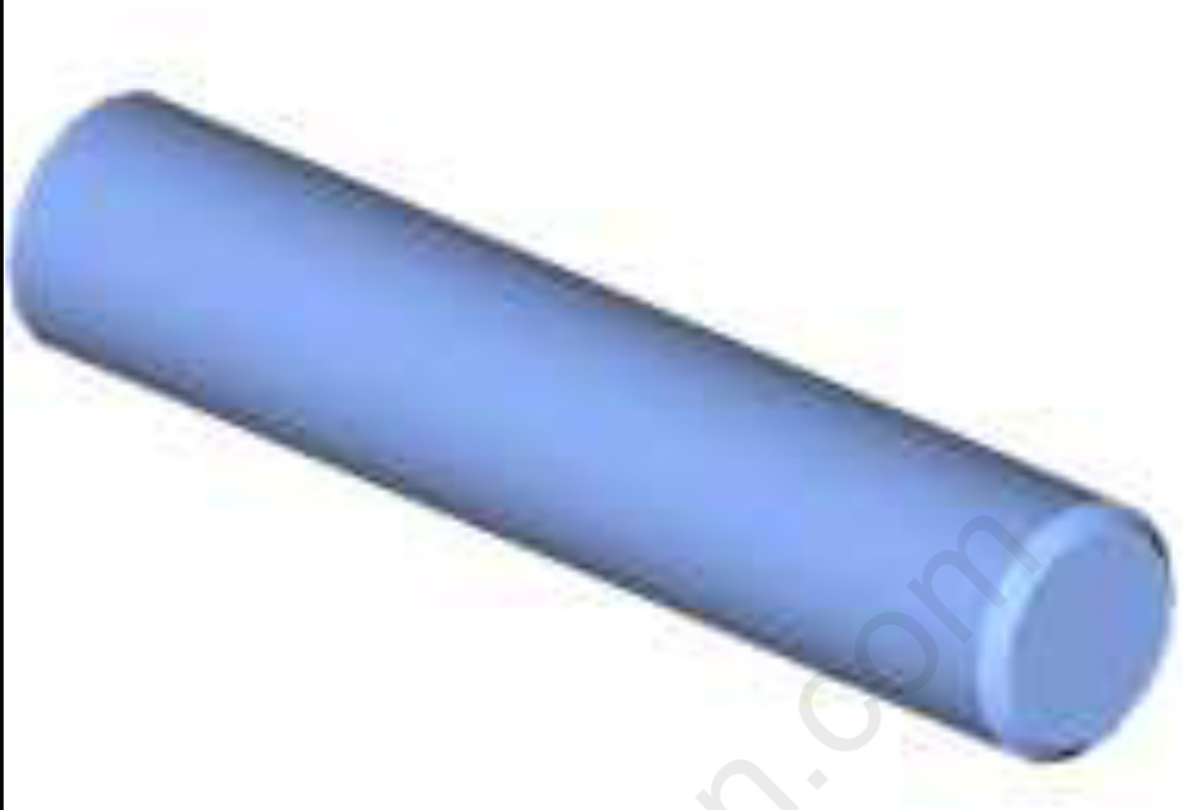
Illustration	Tool Number/Description
 A blue cylindrical tool, likely a seal installer, shown at an angle. The tool is a solid blue cylinder with a slightly wider base. A large, diagonal watermark 'cardiagn.com' is overlaid across the image.	DT-49101 Seal Installer

Illustration	Tool Number/Description
	DT-50896 Seal Installer

Illustration	Tool Number/Description
	DT-51884 Motor A and B Lift Assist

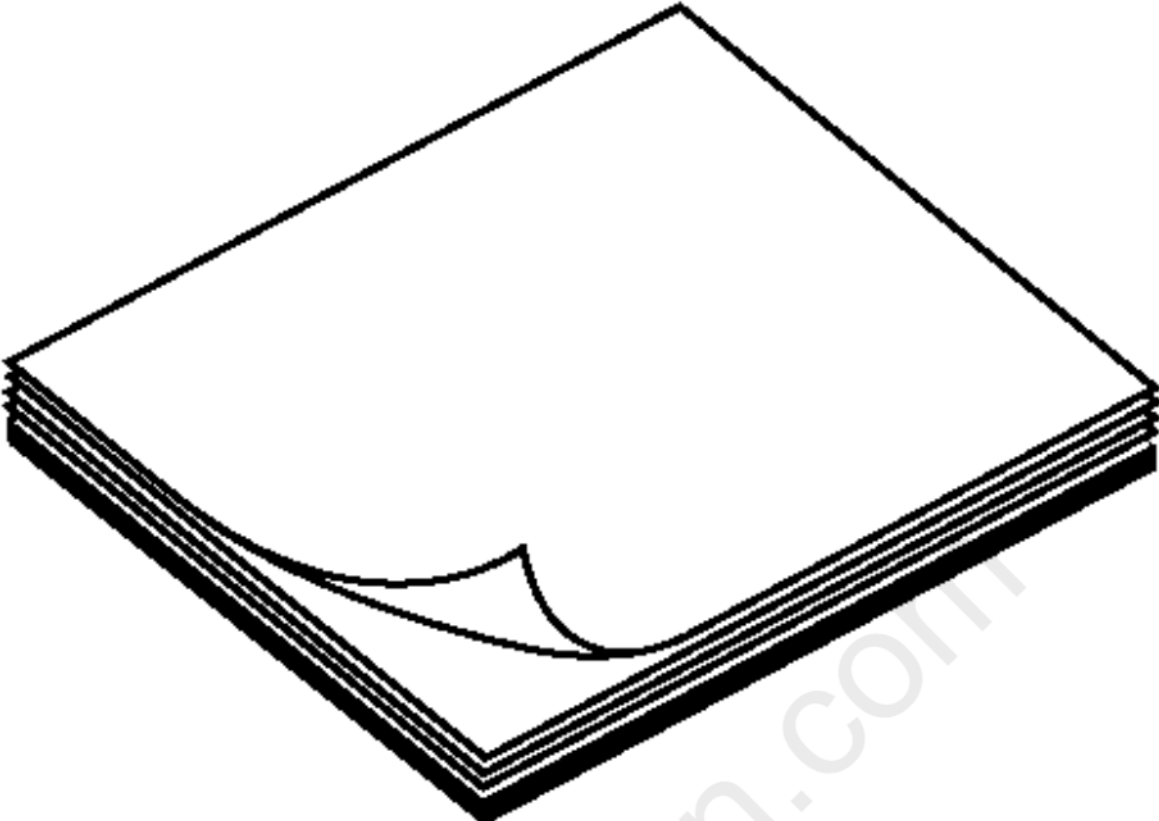
Illustration	Tool Number/Description
 A line drawing of a square stator protector. It is shown from a perspective view, revealing multiple layers. A small tab or notch is visible on one of the layers. The drawing is simple, using black outlines on a white background.	DT-51887 Stator Protector

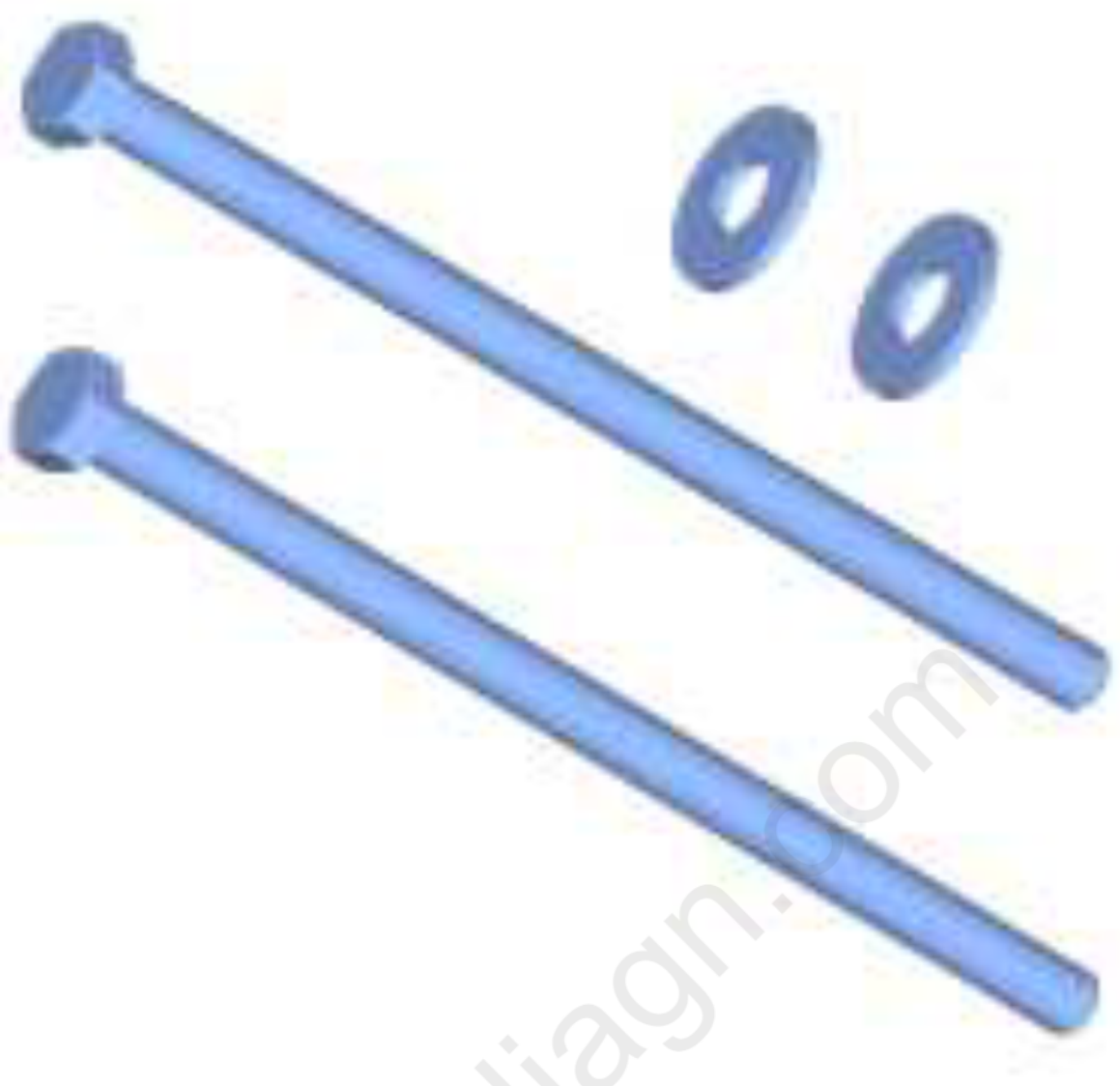
Illustration	Tool Number/Description
 The illustration shows two long, blue bolts with hexagonal heads and two blue washers. The bolts are positioned diagonally, with one above the other. The washers are positioned between the two bolts. A large, light gray watermark 'cardiagn.com' is overlaid diagonally across the entire image.	DT-51889 Bolt Set

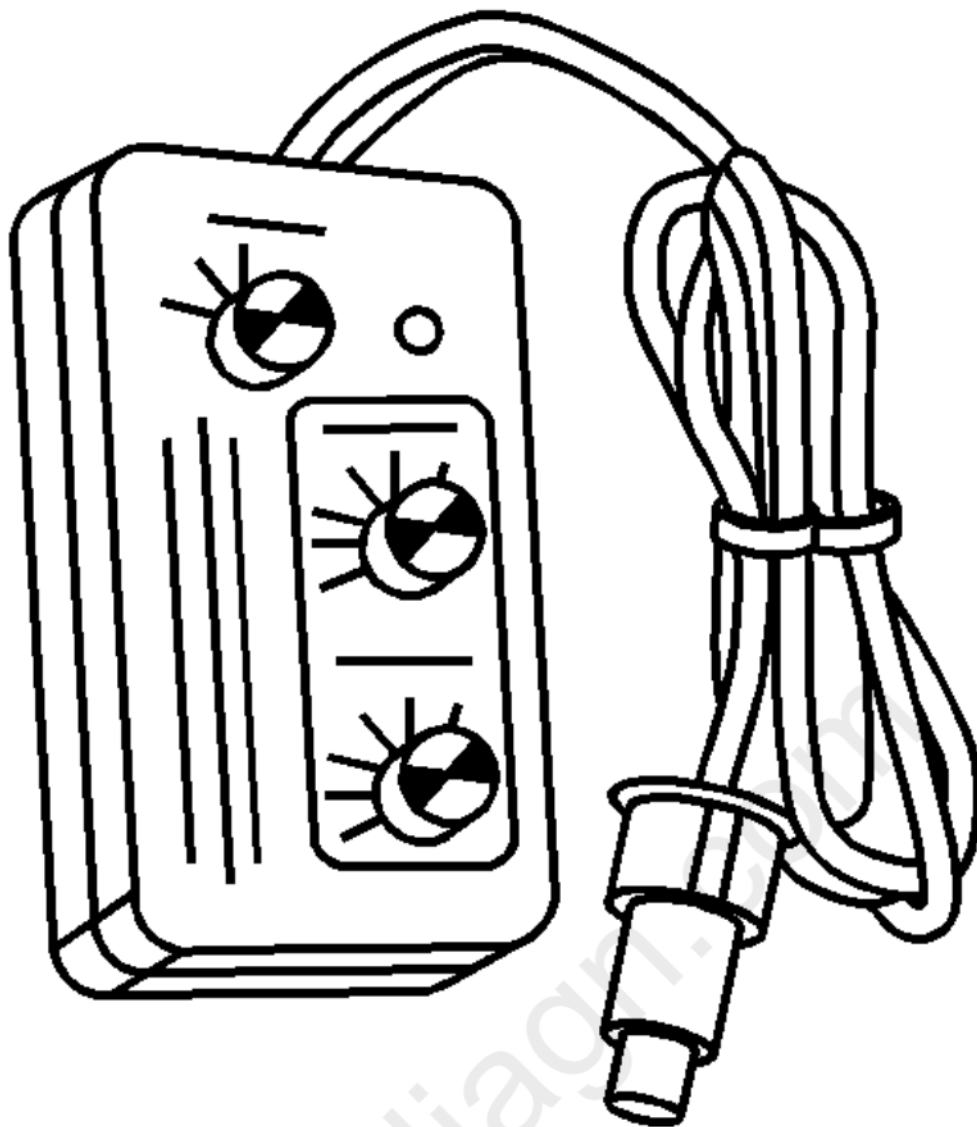
Illustration	Tool Number/Description
	DT-51891 Stator Alignment Pins

Illustration	Tool Number/Description
 The illustration shows the components of the DT-51892 Bridge Kit. At the top center is a large, blue, Y-shaped handle with three arms. To the left of the handle is a long, thin blue rod. Below the rod are three small blue circular components. To the right of the handle are three blue bridge assemblies, each consisting of a long blue rod with a small blue pin at the top and a blue base. A large, semi-transparent watermark 'cardiagn.com' is overlaid diagonally across the image.	DT-51892 Bridge Kit

Illustration	Tool Number/Description
 A blue cylindrical tool, likely a shift shaft retainer and roll pin installer. It has a hole at one end and a flange at the other. The tool is shown at an angle, highlighting its cylindrical shape and the hole.	DT-51893 Shift Shaft Retainer and Roll Pin Installer

Illustration

Tool
Number/Description



EL-38522
Variable Signal
Generator

Illustration	Tool Number/Description
	EN-38416-B J-38416-B Harmonic Balancer Remover

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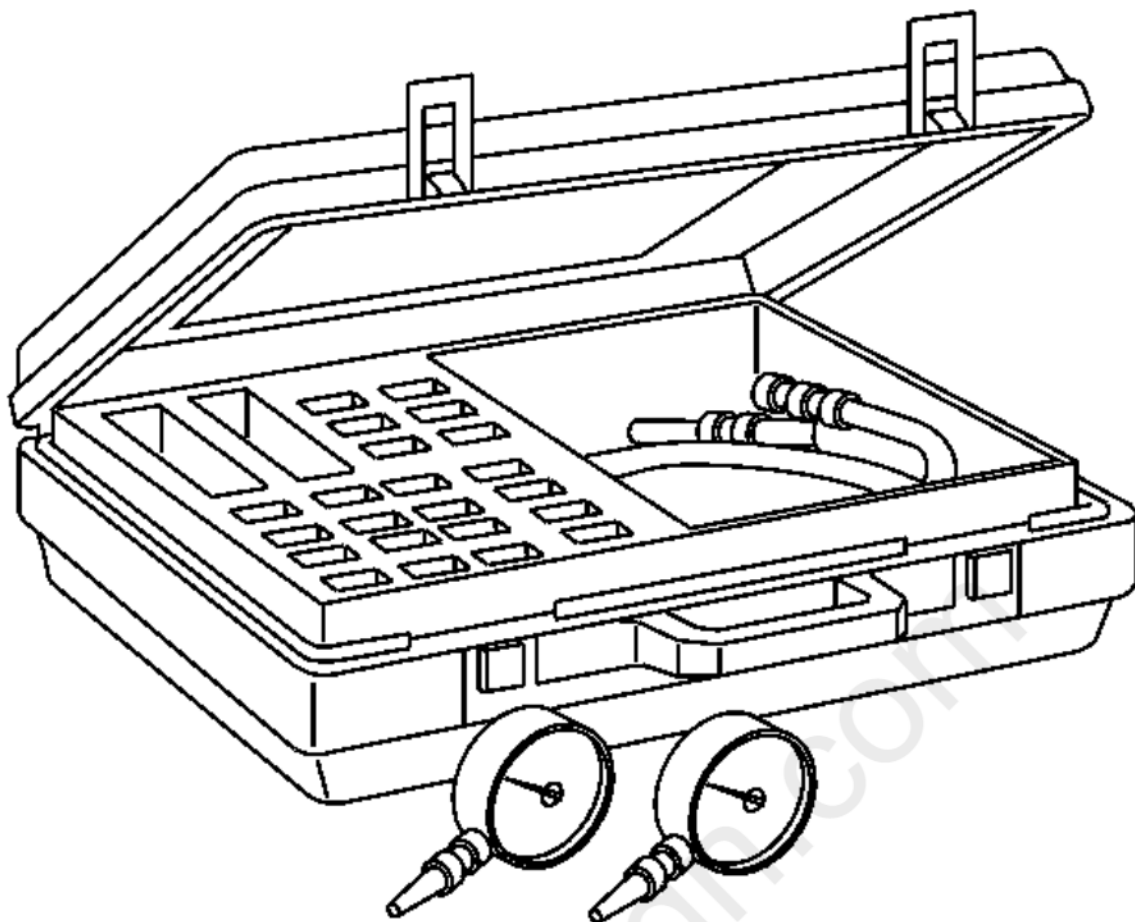
Illustration	Tool Number/Description
 A blue slide hammer tool, consisting of a long, thin shaft with a handle in the middle and a sliding mechanism at the top. The tool is shown diagonally. A large, light blue watermark "cardiagn.com" is overlaid across the image.	GE-6125-1B J-6125-1B Slide Hammer with Adapters

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Illustration	Tool Number/Description
 A blue metal puller bar, likely made of steel, with a central threaded rod and a hexagonal nut. The bar has a T-shaped cross-section and a central hole for the rod. The nut is positioned in the middle of the bar. The bar is shown at an angle, with the top left corner pointing towards the upper left and the bottom right corner pointing towards the lower right. A watermark "cardiagn.com" is visible diagonally across the image.	GE-8433-1 J-8433-1 Puller Bar

Illustration

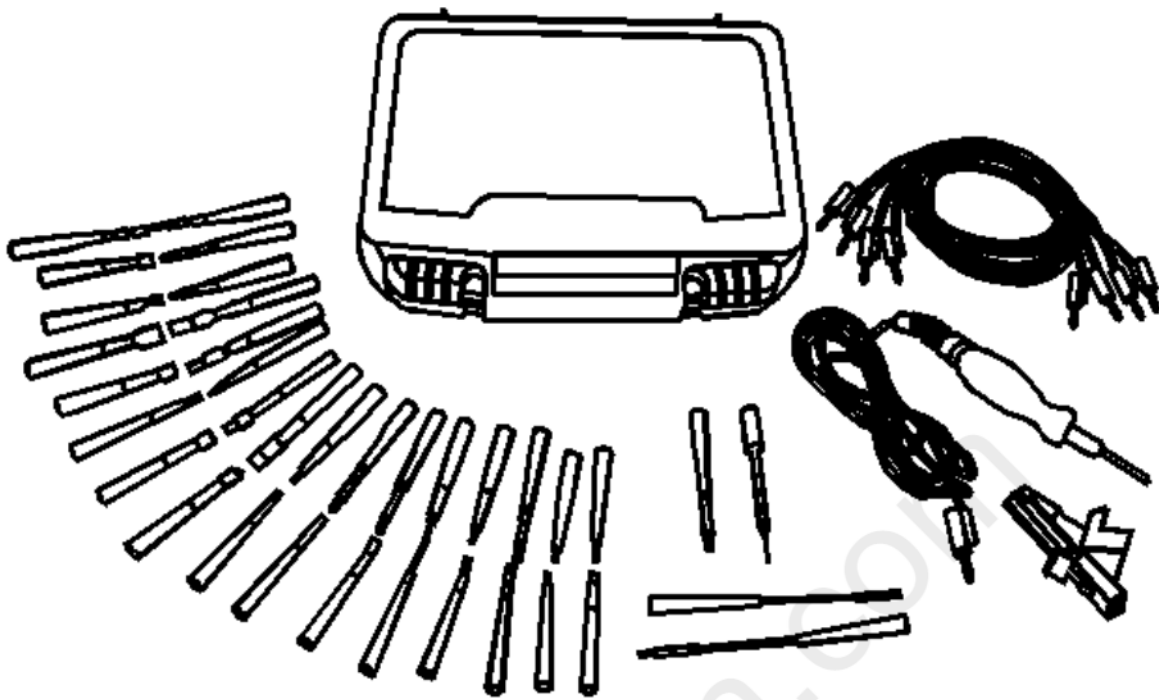
Tool
Number/Description



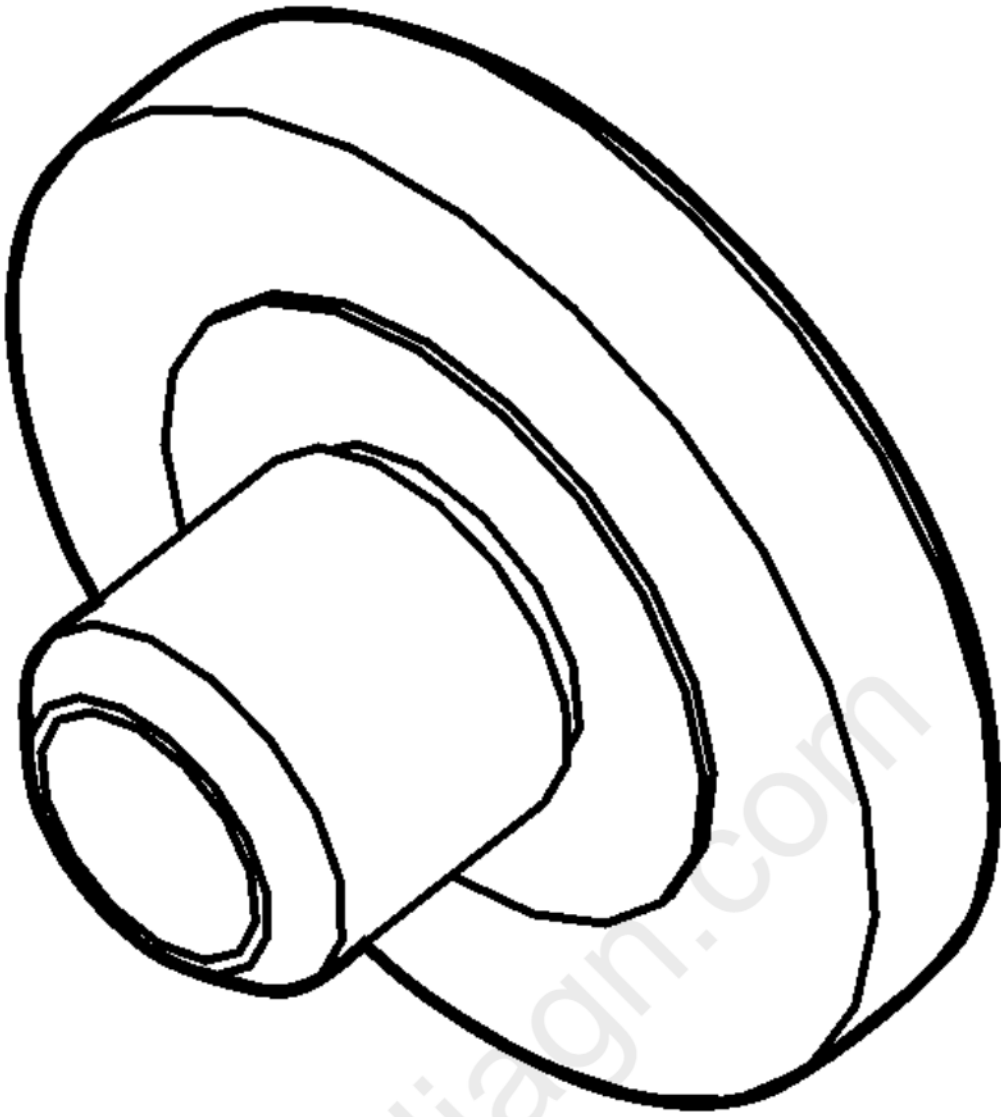
GE-21867-A
J-21867-A
Oil Pressure Gauge
Kit

Illustration

Tool
Number/Description



J-35616
GM-Approved
Terminal Test Kit

Illustration	Tool Number/Description
	J-42737 Sector Bearing Installer

2017 TRANSMISSION**Automatic Transmission - 4EL70 (MRD) - Specifications - CT6****SPECIFICATIONS****TEMPERATURE VERSUS RESISTANCE**

Temperature	Temperature	Minimum Resistance	Nominal Resistance	Maximum Resistance
°C	°F	Ω	Ω	Ω
-40	-40	39.245534	43.321454	105, 777
-35	-31	29.905159	32.860203	75, 798
-30	-22	22.993468	25.154850	54, 923
-25	-13	17.831006	19.425092	40, 207
-20	-4	13.940662	15.125610	29, 725
-15	5	10.984031	11.871391	22, 183
-10	14	8.718791	9.387948	16, 700
-5	23	6.969824	7.477758	12, 678
0	32	5.609478	5.997420	9, 701
5	41	4.543915	4.841935	7, 485
10	50	3.703609	3.933796	5, 823
15	59	3.036643	3.215342	4, 564
20	68	2.503973	2.643357	3, 604
25	77	2.076023	2.185220	2, 865
30	86	1.730240	1.816133	2, 295
35	95	1.449314	1.517126	1, 849
40	104	1.219875	1.273591	1, 500
45	113	1.031537	1.074215	1, 223
50	122	0.876182	0.910179	1, 002
55	131	0.747432	0.774574	827
60	140	0.640249	0.661957	686
65	149	0.550630	0.568017	47.815904
70	158	0.475383	0.489320	36.103635
75	167	0.411946	0.423122	27.516650
80	176	0.358257	0.367216	21.159572
85	185	0.312645	0.319820	16.409636
90	194	0.273755	0.279491	12.829155
95	203	0.240479	0.245051	10.107451
100	212	0.211909	0.215539	8.021907
105	221	0.187299	0.190164	6.411552
110	230	0.166032	0.168276	5.158985
115	239	0.147598	0.149337	4.177872
120	248	0.131571	0.132900	3.404216
125	257	0.117215	0.118592	2.790221
130	266	0.104704	0.106101	2.299929
135	275	0.093769	0.095167	1.906098
140	284	0.084186	0.085571	1.587952
145	293	0.075766	0.077126	1.329541
150	302	0.068349	0.069676	1.118547

FASTENER SPECIFICATIONS (OFF VEHICLE)**Single Use Threaded Fastener/Component Tightening Specifications**

NOTE: <i>All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.</i>				
Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Transmission Fluid Filler Plug	9, 22	2	M20x2.5	21 N.m (15 lb ft)
Automatic Transmission Fluid Pressure Test Hole Plug	21	1	0.4375-20 in	10.5 N.m (93 lb in)
Front Propeller Shaft Flange Nut	19	1	M22x1.5	105 N.m (77 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE: <i>All fasteners listed in this table can be reused after removal.</i>				
Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Automatic Transmission Case Bolt	7	8	M6x1x36	9 N.m (80 lb in)
Automatic Transmission Case Bolt	1	10	M6x1x35	9 N.m (80 lb in)
Automatic Transmission Case Bolt	113	6	M6x1x20	9 N.m (80 lb in)
Automatic Transmission Case Bolt	133	7	M6x1x16	9 N.m (80 lb in)
Automatic Transmission Case Bolt	207	13	M6x1x50	9 N.m (80 lb in)
Automatic Transmission Case Bolt	110	3	M6x1x25	9 N.m (80 lb in)
Automatic Transmission Case Extension Bolt	16	9	M8x1.25x45	22 N.m (16 lb ft)
Automatic Transmission Control Bolt	39	4	M6x1x70	9 N.m (80 lb in)
Automatic Transmission Fluid Pan Bolt	34	16	M6x1x20	9 N.m (80 lb in)
Automatic Transmission Fluid Pump Bolt	30	4	M6x1x45	9 N.m (80 lb in)
Automatic Transmission Output Speed Sensor Bolt	24	1	M6x1x25	9 N.m (80 lb in)

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Reference number from Disassembled Views	Quantity	Size	Specification
				Metric (English)
Automatic Transmission Speed Sensor Bolt	505	1	M6x1x25	9 N.m (80 lb in)
Automatic Transmission Torque Dampener Housing Bolt	315	8	M6x1x35	9 N.m (80 lb in)
Automatic Transmission Torque Dampener Housing Bolt	304	4	M6x1x35	9 N.m (80 lb in)
Control Valve Assembly				
• Control Valve Body Bolt - Lower	407	3	M6x1x55	9 N.m (80 lb in)
• Shift Solenoid Valve Bolt	408	6	M5x0.8x20	4.7 (42 lb in)
• Valve Body Bolt	401	18	M6x1x35	9 N.m (80 lb in)
Manual Shift Detent Spring Bolt	607	1	M6x1x25	9 N.m (80 lb in)
Park Pawl Actuator Guide Bolt	608	1	M6x1x25	9 N.m (80 lb in)
Valve Body Bolt	37	2	M6x1x25	9 N.m (80 lb in)
Variable 1-4 and 1-3 Clutch Bolt	114	8	M6x1x25	9 N.m (80 lb in)
Variable 1-4 and 1-3 Clutch Bolt	500	4	M6x1x25	9 N.m (80 lb in)
Wiring Harness Connector Bolt	5	6	M6x1x12	9 N.m (80 lb in)
Wiring Harness Connector Bolt	118, 137	2	M6x1x25	9 N.m (80 lb in)

FASTENER SPECIFICATIONS (ON VEHICLE)

Single Use Threaded Fastener/Component Tightening Specifications

NOTE:

All fasteners/components listed in this table MUST BE DISCARDED and replaced with NEW after removal.

Application	Specification
	Metric (English)
Propeller Shaft Transmission Flange Nut	105 N.m (77 lb ft)
Transmission Fluid Filler Plug	21 N.m (15 lb ft)

Reusable Threaded Fastener Tightening Specifications

NOTE:

All fasteners listed in this table can be reused after removal.

Application	Specification
	Metric (English)
Automatic Transmission Fluid Pan Bolts	9 N.m (80 lb in)
Automatic Transmission Fluid Pressure Test Hole Plug	10.5 N.m (93 lb in)
Automatic Transmission Range Selector Lever Cable Bracket Bolt	22 N.m (16 lb ft)
Automatic Transmission Range Selector Lever Cable Grommet Bolt	9 N.m (80 lb in)
Automatic Transmission Range Selector Lever Cable Lever Nut	25 N.m (18 lb ft)
Case Extension Bolts	22 N.m (16 lb ft)
Control Valve Body Bolts	9 N.m (80 lb ft)
Control Valve Body Fluid Manifold Bolts	9 N.m (80 lb in)
High Voltage Cable Bracket Nut	22 N.m (16 lb ft)
High Voltage Cable Connector Bolts	9 N.m (80 lb in)
High Voltage Cable Connector Cover Bolts	9 N.m (80 lb in)
Manual Shift Detent Spring Bolt	9 N.m (80 lb in)
Output Speed Sensor Bolt	9 N.m (80 lb in)
Transmission Adapter Plate Bolts	58 N.m (43 lb ft)
Transmission Bracket Bolt	22 N.m (16 lb ft)
Transmission Control Fastener	9 N.m (80 lb in)
Transmission Control Module Bracket Bolts	9 N.m (80 lb in)
Transmission to Engine Bolts	58 N.m (43 lb ft)
Transmission Fluid Pump Bolt	9 N.m (80 lb in)
Transmission Housing Sound Insulator Bolt	10 N.m (89 lb in)
Transmission Support Crossmember Bolt	58 N.m (43 lb ft)
Upper Transmission Control Retaining Bolt	2.5 N.m (22 lb in)
Wiring Harness Bracket Nut	22 N.m (16 lb ft)

APPROXIMATE FLUID CAPACITIES

Application	Specification	
	Metric	English
4EL70		
Pan Removal and Filter Replacement - Approximate Capacity	9.5 liters	10 quarts
Overhaul - Approximate Capacity (Transmission Volume Only)	9.5 liters	10 quarts
Overhaul - Approximate Capacity (Includes Cooling System)	10 liters	10.5 quarts

TRANSMISSION GENERAL SPECIFICATIONS

Name	4EL70
RPO Codes	MRD
Production Location	Baltimore MD
Transmission Drive	Rear Wheel Drive Transmission
Electric Vehicle Mode 1 Electric Vehicle Mode 3 Electric Vehicle Mode 4	Drive Motor - Position 1 and Drive Motor - Position 2 combine to provide or absorb vehicle torque for electric only operation

Name	4EL70
Drive Mode 1 Drive Mode 2 Drive Mode 3 Drive Mode 4 First Gear Second Gear Third Gear	Online optimizer balances engine, Drive Motor - Position 1 and Drive Motor - Position 2 to achieve the most efficient vehicle operation
Pressure Tap	Line Pressure
Transmission Fluid Type	DEXRON [®] HP
Transmission Type: Electric	Electrically Variable
Transmission Type: EV	MRD: Drive Motor - Position 1 - Peak Power: 93.6 kW at 5000 RPM - Continuous Power: 59 kW at 6000 RPM Drive Motor - Position 2 - Peak Power: 85 kW at 4000 RPM - Continuous Power: 61 kW at 4000 RPM
Transmission Type: L	Longitude Mount
Transmission Type: 70	Product Series
Position Quadrant	P, R, N, D, L
Case Material	Die Cast Aluminum
Transmission Net Weight (Wet)	133.32 kg (294 pounds)
Maximum Trailer Towing Capacity	MRD: N/A

ADHESIVES, FLUIDS, LUBRICANTS AND SEALERS

Application	Type of Material	GM Part Number
Automatic Transmission Fluid	DEXRON [®] HP	Refer to Electronic Parts Catalog
Clutch Housing Seal	DEXRON [®] HP	Refer to Electronic Parts Catalog
Drive Motor Stator Housing Front Seal	DEXRON [®] HP	Refer to Electronic Parts Catalog
Drive Motor Stator Housing Rear Seal	DEXRON [®] HP	Refer to Electronic Parts Catalog
Variable 3-4 and 2-3 Clutch Housing Fluid Passage Hub Gasket	Trans Jell	Refer to Electronic Parts Catalog

RANGE REFERENCE

Mode Chart			VFS Line Pressure Reg Solenoid (PR)	ON/OFF Variable 1-2 & 1-2 Clutch (C1)	ON/OFF Variable 3-4 & 2-3 Clutch (C2)	ON/OFF Variable 1-4 & 1-3 Clutch (C3)	ON/OFF Variable 2-3 & 1-2-3 Clutch (C4)	ON/OFF Variable 1-2-3-4 Clutch (C5)	ON/OFF Stator Valve
Unpowered State (pressure)			Normally High	Normally Low	Normally Low	Normally Low	Normally Low	Normally Low	Normally Low
PCS Number			-	PCS1	PCS2	PCS3	PCS4	PCS5	PCS6
Range State	Park/Neutral*	Engine Off	Regulating	OFF	OFF	OFF	OFF	OFF	On Demand**

Mode Chart			VFS Line Pressure Reg Solenoid (PR)	ON/OFF Variable 1-2 & 1-2 Clutch (C1)	ON/OFF Variable 3-4 & 2-3 Clutch (C2)	ON/OFF Variable 1-4 & 1-3 Clutch (C3)	ON/OFF Variable 2-3 & 1-2-3 Clutch (C4)	ON/OFF Variable 1-2-3-4 Clutch (C5)	ON/OFF Stator Valve
	Park/Neutral-C3	Engine On		OFF	OFF	ON	OFF	OFF	
	Park/Neutral-C34	Engine Off		OFF	OFF	ON	ON	OFF	
	Park/Neutral-C35	Engine Off		OFF	OFF	ON	OFF	ON	
	Neutral C4	Engine On		OFF	OFF	OFF	ON	OFF	
	Neutral C45	Engine Off		OFF	OFF	OFF	ON	ON	
	Drive Mode 1	Engine On		ON	OFF	ON	OFF	OFF	
	Drive Mode 2	Engine On		ON	OFF	OFF	ON	OFF	
	Drive Mode 3	Engine On		OFF	ON	OFF	ON	OFF	
	Drive Mode 4	Engine On		OFF	ON	ON	OFF	OFF	
	First Gear	Engine On		ON	OFF	ON	ON	OFF	
	Second Gear	Engine On		ON	ON	OFF	ON	OFF	
	Third Gear	Engine On		OFF	ON	ON	ON	OFF	
	Electric Vehicle Mode 1	Engine Off		ON	OFF	ON	OFF	ON	
	Electric Vehicle Mode 3	Engine Off		OFF	ON	OFF	ON	ON	
	Electric Vehicle Mode 4	Engine Off		OFF	ON	ON	OFF	ON	

* *Demand based on the need to actively cool the motor stators as calculated real-time by the control system.

*A stop in Park/Neutral-Full is supported for shutdown purposes only.

TRANSMISSION INTERNAL MODE SWITCH LOGIC

Internal Mode Switch (IMS) IMS Circuits/Parameter	Selector Position			
	Park	Reverse	Neutral	Drive
Direction Switch Operating Conditions: Vehicle ON, range selector in appropriate gear				
Direction IMS D1	High	High	Low	Low
Direction IMS D2	Low	Low	High	High
Direction IMS R1	High	Low	Low	High
Direction IMS R2	Low	High	High	Low
Direction IMS Start	Low	High	Low	High
Range Switch Operating Conditions: Vehicle ON, range selector in appropriate gear				
IMS A	Low	Low	High	High
IMS B	High	Low	Low	Low
IMS C	High	High	High	Low

Internal Mode Switch (IMS) IMS Circuits/Parameter	Selector Position			
	Park	Reverse	Neutral	Drive
IMS P	Low	High	Low	High
Always High status: Open/short to voltage condition Always Low status: Short to ground condition Every status High for either switch indicates an open ground circuit or connector for that portion of the IMS.				

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