

2018 ENGINE PERFORMANCE

Engine Controls And Fuel - 1.6L (LH7) Diesel - Repair Instructions - Equinox & Terrain

REPAIR INSTRUCTIONS

DIESEL PARTICULATE FILTER (DPF) SERVICE REGENERATION

Circuit/System Description

A service regeneration of the diesel particulate filter (DPF) is required when the scan tool DPF Accumulation Status parameter displays 30 grams or more of accumulated soot. When commanded, the engine control module (ECM) controls the service regeneration as follows:

1. The exhaust system is warmed up for about 8 min. Engine speed is slowly increased to 2 000 RPM and then to 2 500 RPM.
2. Once the DPF reaches its calibrated regeneration temperature, the ECM maintains engine speed between 2 000 - 2 500 RPM for about 20 min until regeneration is complete, is cancelled by the technician, or is aborted due to abnormal conditions.
3. The ECM then slowly decreases engine speed to 1 600 RPM, then to 800 RPM, and finally to normal idle speed over a 5 min period. This is done to allow the DPF to cool down.

The DPF Service Regeneration will be terminated if any of the following conditions occur:

- The DPF Service Regeneration is commanded OFF using the scan tool
- The scan tool is disconnected from the vehicle

Conditions for Running

The following conditions must be met in order to enable DPF Service Regeneration:

- DTCs P2463 is the only active DTC.
- The battery voltage is greater than 10 V.
- The engine speed is between 500 - 2 700 RPM.
- The vehicle speed is 0.
- The transmission is not in Drive or Reverse
- The exhaust gas temperature sensors 1 is between 20 - 500°C (68 - 932°F).
- The exhaust gas temperature sensors 3 is between 20 - 735°C (68 - 1, 355°F).
- The engine coolant temperature sensor is greater than 70°C (158°F).
- The fuel temperature is less than 150°C (302°F).
- The BARO pressure is greater than 40 kPa (5.8 PSI)
- The APP sensor is less than 1%.
- The diesel exhaust fluid temperature is greater than -7°C (+19°F).
- The diesel exhaust fluid tank is not empty.
- The brake pedal and accelerator pedal are in the released position.
- The transmission is in Park or Neutral.

Diagnostic Aids

The scan tool DPF Regeneration Inhibit reason parameter will display a reason for not enabling or aborting the DPF service regeneration. Refer to the reasons that are displayed and the corrective action for each reason.

Service Regeneration Unsuccessful

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DPF Regeneration Parameters	Unsuccessful Regeneration - Number of Completed Regenerations Did Not Increment By One	Corrective Action For An Unsuccessful Regeneration
DPF Service Regeneration Inhibit Reason	APP - The APP position sensor indicated over 1%	Ensure the accelerator pedal was not applied during the service regeneration. • If the accelerator pedal was not applied, test the accelerator pedal position (APP) sensor.
	BPP Applied - The brake pedal position indicated Applied.	Ensure that the brake pedal was not applied during the service regeneration procedure. • If the brake pedal was not applied, test the brake pedal switch.
	NOTE: The scan tool must remain connected to the data communication link during the entire service regeneration procedure. Device Control - The scan tool has interrupted service regeneration. A loss of communication between the scan tool and the vehicle has occurred.	• The scan tool Exit or OFF soft key button was depressed. • Inspect for a poor connection at data communication link.
	DPF Temperature - DPF service regeneration temperatures are less than a calibrated threshold.	• Observe the DTC information. • Test for a degraded diesel oxidation catalyst (DOC). • Test for a skewed exhaust temperature sensor, EGT sensor 2.
	Ignition Voltage - Battery voltage was less than 11 V.	Test the battery and charging system for proper operation.
	None	Refer to the DPF Regeneration Status parameter
	Not in Park - Transmission gear selector is not in Park.	Ensure that the transmission gear selector remained in Park during the Service Regeneration procedure. • If the gear selector remained in the Park position, test the transmission range switch and circuits.

DPF Regeneration Parameters	Unsuccessful Regeneration - Number of Completed Regenerations Did Not Increment By One	Corrective Action For An Unsuccessful Regeneration
DPF Normal Regeneration Inhibit Reason	Regen Timed Out	A regeneration has timed out attempting a regeneration for greater than 90 min for this key cycle
	EGT 2 High	Exhaust temperature sensor 2 greater than 750Â°C (1 382Â°F)
	EGT 1 High	Exhaust temperature 1 greater than 650Â°C (1 202Â°F)
	DTC Set	An active DTC is set
	Axle Torque Limit	Torque Limiting is active to prevent an engine overheat condition
	Decel Too Long	A long decel condition of greater than 40 s was active
	Fuel Level	Fuel level is below 15%
	TC Temp Too High	Turbocharger temperature is too high
	TCM Override	A condition within the TCM is present
	Eng Run Time	Engine has not run long enough to complete a regeneration or has not warmed to operating temperature
	DLC Override	A scan tool is connected to the DLC
	Idle Spd Ovrde	Vehicle is shifted into Park or Neutral while a normal regeneration is active

Reference Information

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

DPF Service Regeneration

WARNING: Tailpipe outlet exhaust temperature will be greater than 300Â°C (572Â°F) during this procedure. To help prevent personal injury or property damage from fire or burns, perform the following:

1. Do not connect any shop exhaust removal hoses to the vehicle tailpipe.
2. Park the vehicle outdoors and keep people, other vehicles, and combustible material away during this procedure.
3. Do not leave the vehicle unattended.

WARNING: To avoid extremely elevated exhaust temperatures, inspect and remove any debris or mud build up at the exhaust cooler located at the tailpipe.

CAUTION: Due to the elevated engine temperatures created while performing this procedure it is imperative to keep the front of vehicle in an open

environment, with the hood open, away from any walls or buildings. This will ensure proper airflow across the radiator.

NOTE:

- If you were not referred to this procedure from another diagnostic, **DO NOT** perform the Service Regeneration.
- Do not refuel the vehicle during DPF Service Regeneration.
- The scan tool must remain connected to the data communication link during the entire service regeneration procedure.
- Do not perform the DPF Service Regeneration if the diesel exhaust fluid temperature (DEF) is less than -7°C (+19°F).
- Fuel level should be greater 15% to ensure a successful regeneration.

1. Ignition ON.

2. Verify there are no DTCs set, except DTC P2463.

- **If another DTC is set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

- **Go to next step: If another DTC is not set**

NOTE: Due to elevated exhaust temperatures it is necessary to remove Front Compartment Insulator

3.

4. With the vehicle in Park, use the throttle to increase the engine speed to 3 000 RPM while looking for the speedometer to move slightly (greater than 1 mph). If this signal noise exists, inch the vehicle forward, place in park and repeat until there is no response seen from the speedometer. This will avoid a vehicle speed based interrupt of the service regeneration.

5. Place the transmission in Park and apply the parking brake.

6. Clear the DTCs with a scan tool before commanding a DPF Service Regeneration.

7. Observe the scan tool DPF Regenerations Completed parameter and record the value.

8. Open the hood.

9. Check the following fluid levels before and after this procedure:

- Reductant
- Engine oil
- Engine coolant
- Power steering
- Transmission

10. Select the DPF Service Regeneration in the Output Controls menu and follow the instruction on the scan tool.

NOTE: If a scan tool message of Oil Temperature Out Of Range is displayed once a service regeneration is commanded, disregard the message and command the service regeneration procedure.

11. Command the DPF Service Regeneration ON with a scan tool.

- **If the service regeneration failed to start**

verify with a scan tool that the DPF Reg Inhibit Reason parameter on the scan tool to identify the Reg Inhibit Reason and refer to the Service Regeneration Unsuccessful table in Diagnostic Aids.

- **Go to next step: If the service regeneration starts**

12. When the service regeneration is complete, the DPF Regeneration Status parameter will display Complete and the DPF Regenerations Completed parameter will increment by 1 from the value previously recorded.

- **If the service regeneration did not complete, was aborted, or the Regeneration Completed did not increment**

Refer to the Service Regeneration Unsuccessful table in Diagnostic Aids

- **Go to next step: If the Service Regeneration completed**

NOTE: DTC P202E may set after a DPF Service Regeneration. The excessive exhaust temperatures created during a DPF Service Regeneration causes the diesel exhaust fluid (DEF) to crystallize. The crystallized reductant will cause the Q61 emission reduction fluid injector to stick. Idling the engine for 15 min will cause the reductant to liquefy and un-stick the injector.

13. Allow the engine to cool by idling for an additional 10 min. Command the Reductant Injector ON and OFF several times with a scan tool.

14. Clear the DTCs with a scan tool.

15. Ignition OFF for 90 s.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) .

Refer to [Exhaust Front Pipe Replacement \(LH7\)](#) .

BARO SENSOR RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

For an overview of the component/system, refer to: [Engine Control Module Description](#)

This procedure resets the control module learned values of the component/system: Barometric Pressure Sensor - Airflow Adaptive Values

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

This procedure is required when the following component has been repaired, replaced, removed, or serviced:

- B75C Multifunction Intake Air Sensor
- K20 Engine Control Module

Conditions for Running the Procedure

- DTC P00C7, P2227-P2230, P227B-P227E = Not set
- Engine = Off
- Ignition = On

Reference Information

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: BARO Sensor Reset
7. Follow the instructions on the scan tool.

Repair Instructions

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

CATALYST RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Oxidation Catalytic Converter

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: Oxidation Catalytic Converter
- Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Catalyst Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

CRANKSHAFT POSITION VARIATION LEARN

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

The crankshaft position sensor variation or reluctor ring learn is used to calculate reference period errors caused by slight tolerance variations in the crankshaft and the crankshaft position sensor. The calculated error allows the ECM to accurately compensate for reference period variations. This enhances the ability of the ECM to detect misfire events over a wider range of engine speed and load. The compensation values are stored in ECM memory after a learn procedure has been performed.

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced:

- B26 Crankshaft Position Sensor
- Any repair which disturbs the alignment between the components: B26 Crankshaft Position Sensor & Crankshaft
- Crankshaft
- Crankshaft Balancer
- Engine Assembly

Conditions for Running the Procedure

- DTC P0117, P0118, P0335, P0336 = Not set
- ECT = Greater than 60°C (140°F)
- Ignition Voltage = Greater than 11 V

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Verify there are no other DTCs set, except for DTC P0300-P0308, P0315.
 - **If any other DTCs are set**

Refer to: [Diagnostic Trouble Code \(DTC\) List - Vehicle](#)

- **Go to next step: If no other DTCs are set**
3. Select: Module Diagnostics
 4. Select: Engine Control Module
 5. Select: Configuration/Reset Functions
 6. Select: Learn Functions

7. Select: Crankshaft Position Variation Learn

8. Follow the instructions on the scan tool.

Verify the scan tool procedure was successful.

- **If the procedure was not successful and first time here**

1. Ignition/Vehicle - Off

2. Verify the following conditions do not exist:

- B26 Crankshaft Position Sensor & Reluctor Ring - Foreign material passing between the components/Incorrect air gap
- Battery Voltage - Low
- Crankshaft Bearing - Worn
- Crankshaft - Excessive runout/Visible Damage
- Reluctor Ring - Misaligned/Visible Damage
- Signal circuit @ B26 Crankshaft Position Sensor - Electromagnetic Interference
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Repeat step 1

- **If the procedure was not successful and performed 4 times or less**

Repeat step 6

- **If the procedure was not successful and performed 5 times**

Replace the component: K20 Engine Control Module

- **Go to next step: If the procedure was successful**

9. All OK.

Repair Instructions

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

For control module replacement, programming, and setup refer to: [Control Module References](#)

DPF PRESSURE SENSOR RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: B154 Diesel Particulate Filter Exhaust Differential Pressure Sensor

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: B154 Diesel Particulate Filter Exhaust Differential Pressure Sensor - Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: DPF Pressure Sensor Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

DPF RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Exhaust Particulate Filter

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: Exhaust Particulate Filter - Replaced

Conditions for Running the Procedure

- Engine = Not Running
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: DPF Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

EXHAUST GAS TEMPERATURE SENSOR RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: B131 Exhaust Temperature Sensor @ Diesel Particulate Filter - Inlet

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: B131 Exhaust Temperature Sensor - Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Exhaust Gas Temperature Sensor Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

FUEL FILTER LIFE RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Fuel Filter

When to Perform the Procedure

Perform this procedure when the following component has been serviced:

- K20 Engine Control Module - Replaced
- Fuel Filter - Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Fuel Filter Life Reset
7. Follow the instructions on the scan tool.

Without Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Transmission in Park

NOTE: The Fuel Filter Life will only display on the DIC if the Ignition is On, the vehicle is in Service Mode, and the gear selector is in Park.

3. Display the Fuel Filter Life Remaining on the DIC. If the vehicle does not have DIC buttons, use the trip odometer reset stem.
4. Press and hold the SET/RESET button on the DIC, or the trip odometer reset stem if the vehicle does not have DIC buttons, for more than two seconds. The Fuel Filter Life Remaining will change to 100 percent.
5. Verify the procedure was successful.
 - **If the procedure was not successful**
Refer to: Step 1
 - **Go to next step: If the procedure was successful**
6. All OK.

Repair Instructions

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

FUEL INJECTION SMALL QUANTITY LEARN

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)

- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure triggers the control module to learn the values of the component: Q17 Fuel Injector - All

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced:

- B47B Fuel Rail Pressure Sensor - Replaced
- K20 Engine Control Module - Replaced
- Q17 Fuel Injector - Replaced

Conditions for Running the Procedure

- Accelerator Pedal = Released
- BARO = In Range
- Clutch Pedal Switch = Released
- DPF Regeneration = No
- DTC Present = No
- Engine Coolant Temperature = Operating temperature
- Engine = Running
- Engine Speed = Idle
- Fuel Temperature Sensor = In Range
- Generator F-Terminal Signal = In Range
- HVAC Controls = Off
- Ignition Voltage = In Range
- Intake Air Temperature Sensor = In Range
- Learn Procedure Already Performed This Ignition Cycle = No
- Transmission Fluid Temperature = In Range
- Transmission = Park/Neutral
- Vehicle Speed = 0 km/h (0 MPH)

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Learn Functions
6. Select: Fuel Injection Small Quantity Learn
7. Follow the instructions on the scan tool. - The procedure will complete within 5 min

Verify the scan tool procedure was successful.

- **If the procedure was not successful**

Refer to: Step 1

- **Go to next step: If the procedure was successful**

8. All OK.

Repair Instructions

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

FUEL INJECTION SMALL QUANTITY LEARNING ODOMETER RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Q17 Fuel Injector

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: K20 Engine Control Module - Unsuccessful Programming Recovery

Conditions for Running the Procedure

Ignition/Vehicle = On & Engine = Off

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Fuel Injection Small Quantity Learning Odometer Reset
7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Verify the scan tool procedure was successful.

- **If the procedure was not successful**

Refer to: Step 1

- **Go to next step: If the procedure was successful**

8. All OK.

Repair Instructions

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

FUEL INJECTOR FLOW RATE PROGRAMMING

Circuit/System Description

The control functions for the fuel injection system are integrated in the ECM. Each injectors flow rate information, or injection quantity adjustment flow rate numbers, and cylinder position are stored in the memory of the ECM. The fuel injector flow rate programming must be done when any of the following procedures are performed:

- The ECM is replaced.
- A fuel injector is replaced.

Injector Flow Rate Programming

1. Ignition OFF
2. Record all the injection quantity adjustment codes from the corresponding cylinder from each injector that is being replaced or from all injectors if the ECM was replaced.

NOTE: If replacing injectors, enter the injection quantity adjustment code from the new injector or injectors. If ECM is being replaced, enter the injection quantity adjustment code from the original injectors.

3. Perform the scan tool Injector Flow Rate Programming and follow the instructions on the screen.

Repair Verification

1. Install any components or connectors that have been removed or replaced during diagnosis.
2. Perform any adjustment, programming or setup procedures that are required when a component or module is removed or replaced.
3. Ignition OFF for 60 s.
4. Ignition ON, engine OFF.
5. Clear the DTCs.
6. If the repair was related to a DTC, duplicate the Conditions for Running the DTC and use the Freeze Frame/Failure Records, if applicable, in order to verify the DTC does not reset. If the DTC resets or another DTC is present, refer to the [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) and perform the appropriate diagnostic procedure.

FUEL TRIM RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Q17 Fuel Injector

When to Perform the Procedure

Perform this procedure when the following component has been serviced: Q17 Fuel Injector

Conditions for Running the Procedure

- Engine = Off
- Ignition = On

Reference Information

Scan Tool Reference

[Control Module References](#)

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Fuel Trim Reset
7. Follow the instructions on the scan tool.

Repair Instructions

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

HIGH PRESSURE FUEL CORRECTION RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: G18 High Pressure Fuel Pump

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced:

- G18 High Pressure Fuel Pump - Replaced
- Q17 Fuel Injector - Replaced
- Q18 Fuel Pressure Regulator - Replaced
- Fuel Rail - Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

[Control Module References](#)

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: High Pressure Fuel Correction Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

NOX CATALYST REDUCTANT LOADING RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Reductant System

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced:

- A38 Reductant Pump and Sensor Assembly - Replaced
- B75 Mass Air Flow Sensor - Replaced
- B131 Exhaust Temperature Sensor - Replaced
- B195A Nitrogen Oxides Sensor 1 - Replaced
- B195B Nitrogen Oxides Sensor 2 - Replaced
- Q61 Reductant Injector - Replaced
- Nitrogen Oxides Catalytic Converter - Replaced

Conditions for Running the Procedure

- Engine = Off
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: NOx Catalyst Reductant Loading Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

NOX CATALYST RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Exhaust Aftertreatment System

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: Nitrogen Oxides Catalytic Converter - Replaced

Conditions for Running the Procedure

- Engine = Not Running
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: NOx Catalyst Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

NOX SENSOR 1 RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: B195A Nitrogen Oxides Sensor 1

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: B195A Nitrogen Oxides Sensor 1 - Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: NOx Sensor 1 Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

NOX SENSOR 2 RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: B195B Nitrogen Oxides Sensor 2

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: B195B Nitrogen Oxides Sensor 2 - Replaced

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: NOx Sensor 2 Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

REDUCTANT FLUID TANK LEVEL RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Reductant System

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced:

- A38 Reductant Pump and Sensor Assembly - Replaced
- A39 Reductant Tank - Replaced

Conditions for Running the Procedure

- Ignition = Run/Crank
- Reductant Tank Level - Actual & Calculated = Do not match

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Reductant Fluid Tank Level Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

REDUCTANT SYSTEM DATA RESET

Diagnostic Instructions

- Perform the Diagnostic System Check prior to using this diagnostic procedure: [Diagnostic System Check - Vehicle](#)
- Review the description of Strategy Based Diagnosis: [Strategy Based Diagnosis](#)

Description

This procedure resets the control module learned values of the component/system: Exhaust Aftertreatment System

When to Perform the Procedure

NOTE: Failure to perform this procedure may result in poor system performance, DTCs being set, or customer dissatisfaction.

Perform this procedure when the following component has been serviced: K20 Engine Control Module - Replaced

Conditions for Running the Procedure

- Engine = Not Running
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

1. Ignition - On/Vehicle - In Service Mode
2. Select: Module Diagnostics
3. Select: Engine Control Module
4. Select: Configuration/Reset Functions
5. Select: Reset Functions
6. Select: Reductant System Data Reset

NOTE: The scan tool does not display the learn/reset status.

7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Repair Instructions

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

WIRE TO WIRE REPAIR - ENGINE CONTROLS AND FUEL

Special Tools

- EL-38125-10 Splice Sleeve Crimping Tool (non GMNA)
- J-38125-5A Ultra Torch Special Tool
- J-38125-8 Splice Sleeve Crimping Tool (GMNA)

WARNING: In order to reduce the risk of personal injury, loss of high voltage isolation to ground and higher system impedance, do not attempt to repair any HV wiring, connector, or terminal that is damaged. High voltage coaxial type cables are not repairable. Never attempt to repair a coaxial type cable. The entire cable/harness or component must be replaced. In order to maintain system integrity and personal safety, never attempt to repair any high voltage wiring, cables, or terminals. Performing this procedure on high voltage circuits may result in serious injury or death.

NOTE: If the wiring harness internal to the transmission is damaged, the wiring harness must be replaced. The use of splice sleeves in an attempt to repair the internal transmission wires, connectors, or terminals could result in performance issues.

NOTE: Do not splice wires in Door Harness Grommets.

NOTE: The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

Use only DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except high voltage and specialty cables. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Selection

Splice Sleeve Color	Crimp Tool Nest Color		Wire Gauge mm ² / (AWG)
	3 Crimp Nests	4 Crimp Nests	
Salmon (Yellow-Pink) 19300089	Red (1) or Red/Green (1)	Red (2)	0.22 - 0.8/(18 - 26)
Blue 19168447	Blue (2)	Blue (3)	1.0 - 2.0/(14 - 16)
Yellow 19168448	Yellow (3)	Yellow (4)	3.0 - 5.0/(10 - 12)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except Tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 5.0 mm (0.20 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. For high temperature wiring, slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
 5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

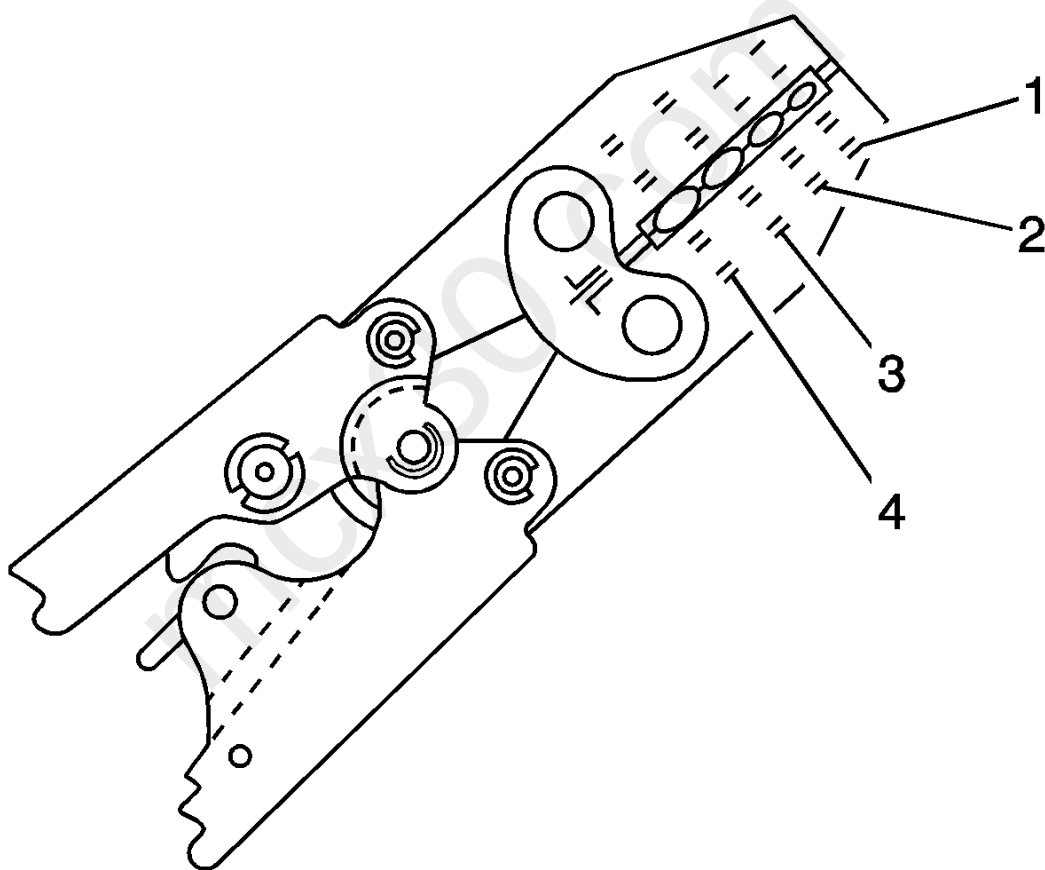


Fig. 1: Splice Sleeve Crimping Tool With 4 Crimp Nests
 Courtesy of GENERAL MOTORS COMPANY

6. The **EL-38125-10** splice sleeve crimping tool has four crimp nests. The largest crimp nest (4) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (3) is used for crimping 14 and 16 gauge wires. The third largest crimp nest (2) is used for crimping 18 and 20 gauge wires. The smallest crimp nest (1) is used for crimping 22 to 26 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.

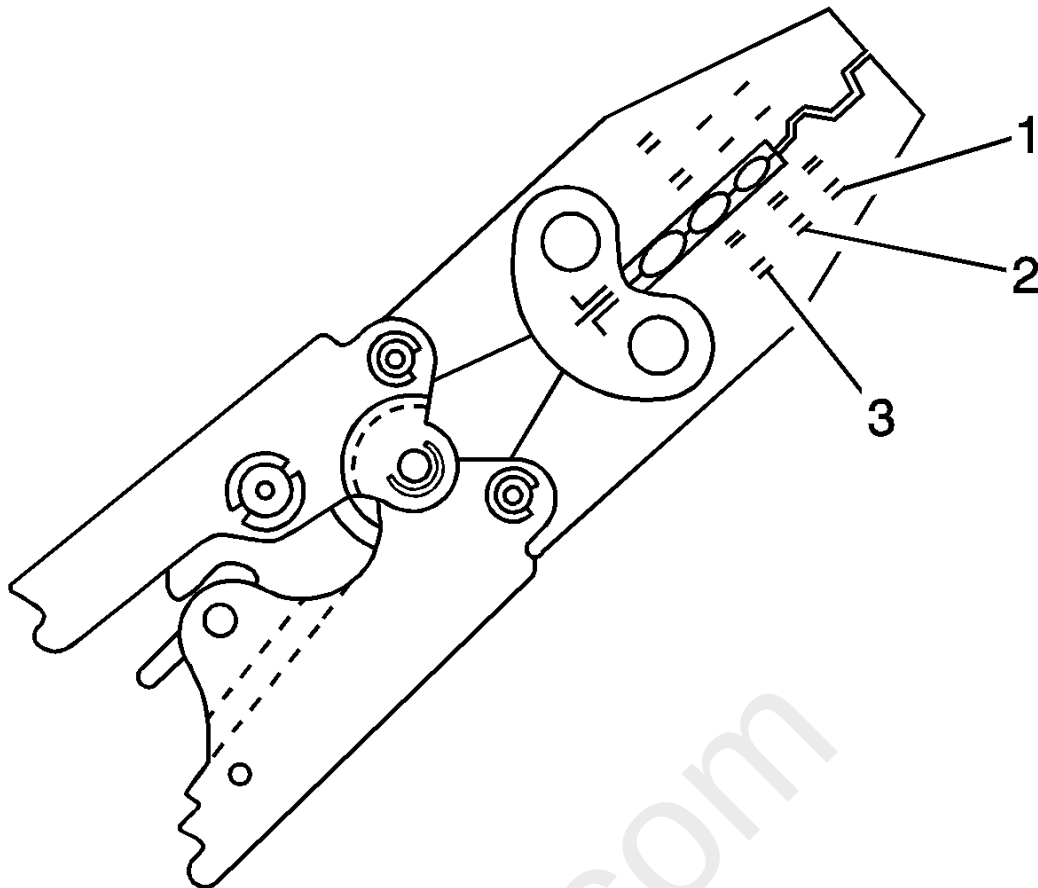


Fig. 2: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

7. The **J-38125-8** splice sleeve crimping tool has three crimp nests. The largest crimp nest (3) is used for crimping 10 and 12 gauge wires. The second largest crimp nest (2) is used for crimping 14 and 16 gauge wires. The smallest crimp nest (1) is used for crimping 18 to 20 gauge wires. The crimp nests are referenced in the table (farther above) under the crimp tool nest color.
8. Use the splice sleeve crimp tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. For the four crimp nest tool, use the three largest crimp nests to crimp the splice sleeves. For the three crimp nest tool, use all three crimp nests to crimp the splice sleeves. Use the four and three crimp tool diagrams (above) and the table (farther above) to match the splice sleeve with the correct crimp nest. The crimp tool diagram callout numbers match the numbers in the table (under crimp tool nest color).

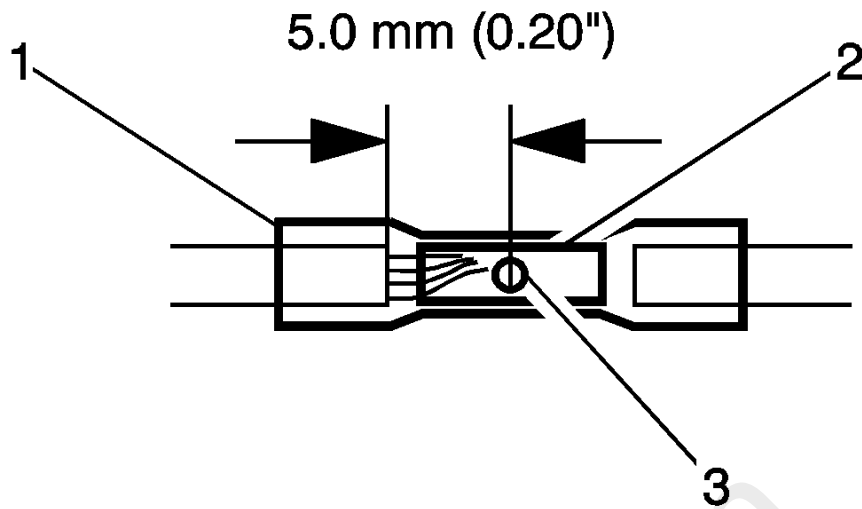


Fig. 3: Identifying DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

9. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 4: Crimped DuraSeal Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

10. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.
11. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 6 for the opposite end of the splice.



Fig. 5: Heated Splice Sleeve

Courtesy of GENERAL MOTORS COMPANY

12. Using the heat torch, apply heat to the crimped area of the barrel.
13. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Weatherpack™ Wiring Repair

NOTE: Some replacement pigtail connectors may be delivered without the terminated leads installed into the connector. For Weatherpack™ connectors, all terminated leads included in the package should to be installed into the connector. If the connector end view shows that a terminal is not occupied, the extra terminated lead(s) need to be installed and the end(s) sealed using a DuraSeal splice sleeve and taped back into the harness.

1. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop. Refer to **Folded-Over Wire Repair** for splicing wires of 0.35 mm or less (22, 24, 26 gauge sizes) and for splicing wires of different gauges.

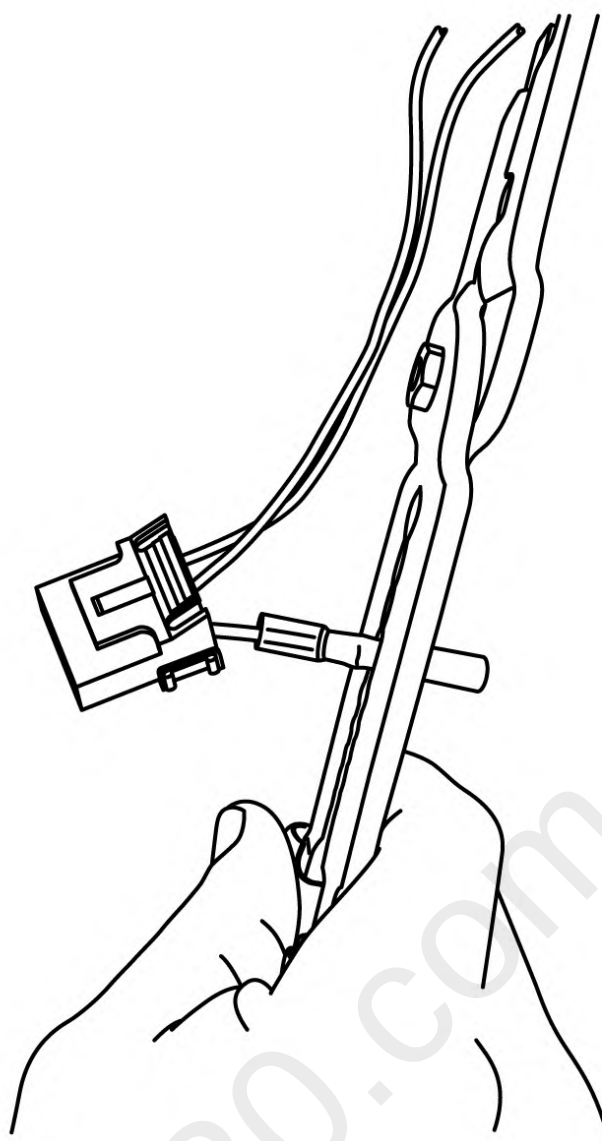


Fig. 6: Tightly Close Handles Of Crimp Tool

Courtesy of GENERAL MOTORS COMPANY

2. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Holding the DuraSeal with one hand gently tug on the wire to ensure it is crimped in the DuraSeal.

3. Using the heat torch, apply heat to the crimped area of the barrel.

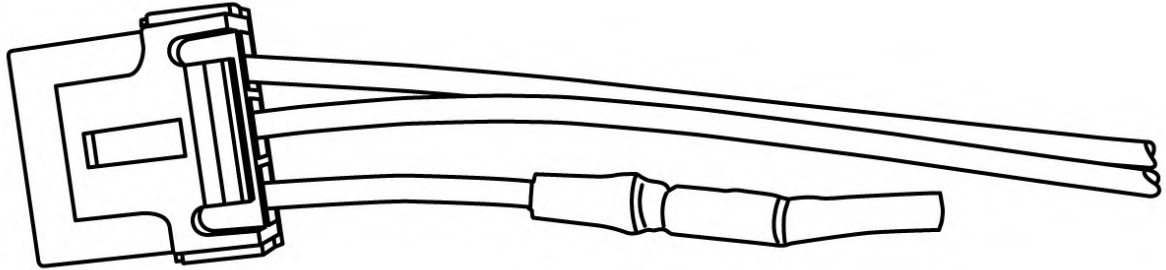


Fig. 7: Heat To Crimped Area Of Barrel

Courtesy of GENERAL MOTORS COMPANY

4. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

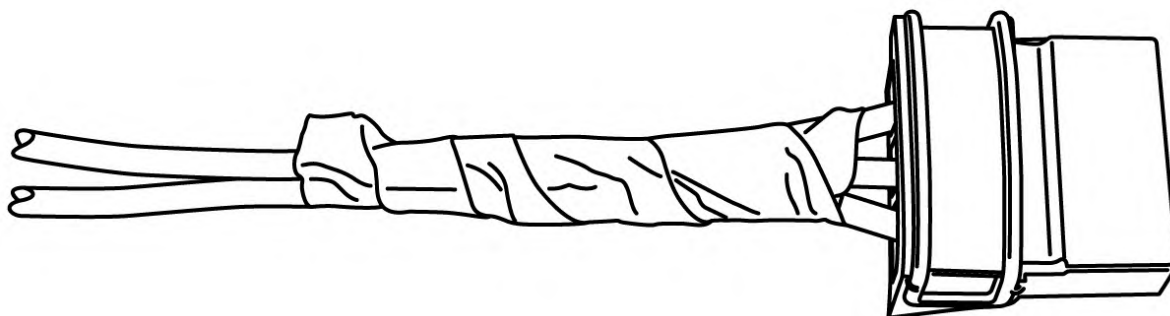


Fig. 8: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

5. Tape the extra terminated lead(s) back into the harness.

High Temperature Wiring Repairs

Use the following procedures to perform high temperature wiring repairs:

1. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
2. Using the heat torch, apply heat to the high temperature heat shrink tubing.
3. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.
4. Replace any reflective tape and clips that may have been removed during the repair.

CONNECTOR RECONNECTION - ENGINE CONTROLS AND FUEL

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 Wiring 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 Wiring 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.

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.**

- 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.

ENGINE CONTROL MODULE REPLACEMENT

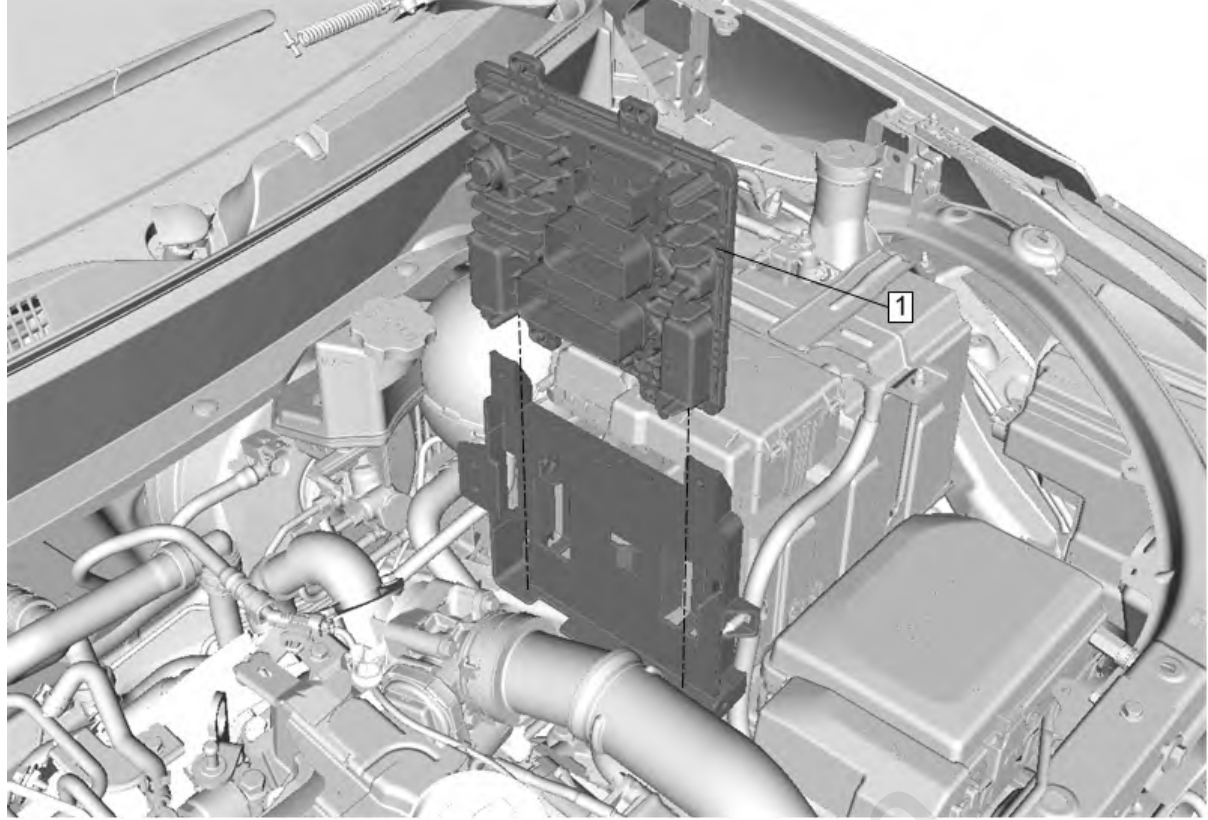


Fig. 9: Engine Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures	
1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (KL9). 2. Remove Charge Air Cooler Outlet Air Tube. Refer to Charge Air Cooler Outlet Air Tube Replacement	

Callout	Component Name
1	Engine Control Module WARNING: Refer to Safety Glasses Warning . CAUTION: Always turn the ignition off when installing or removing the ECM connectors in order to prevent damage to the components. CAUTION: • Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery cable, powertrain control module (PCM)/engine control module (ECM)/transaxle control module (TCM) pigtail, control module fuse, jumper cables, etc.) in order to prevent internal control module damage. • Control module damage may result when the metal case contacts battery voltage. DO NOT contact the control module metal case with battery voltage when servicing a control module, using battery booster cables, or when charging the vehicle battery. • In order to prevent any possible electrostatic discharge damage to the control module, do no touch the connector pins or the soldered components on the circuit board. • Remove any debris from around the control module connector surfaces before servicing the control module. Inspect the control module connector gaskets when diagnosing or replacing the control module. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the control module. • The replacement control module must be programmed. Procedure 1. Use a suitable tool to pry back the locking tabs and remove the engine control module from the bracket. 2. Disconnect the electrical connectors from the engine control module. 3. If replacing the engine control module, it is necessary to reprogram the replacement module. Refer to Control Module References NOTE: Before removing the engine control module (ECM), record the oil life percentage remaining. Use the scan tool to reset the Engine Oil Life remaining back to the original percentage recorded.

ENGINE CONTROL MODULE BRACKET REPLACEMENT

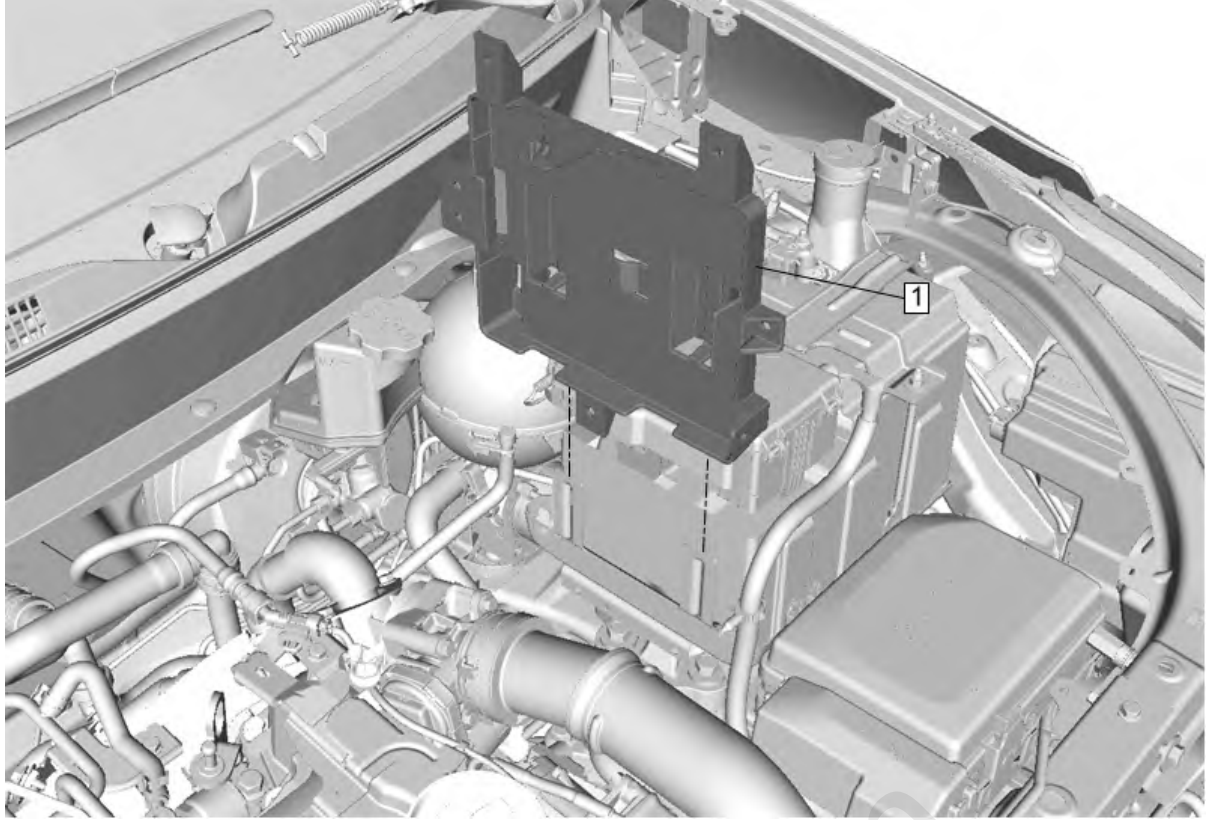


Fig. 10: Engine Control Module Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Engine Control Module. Refer to Engine Control Module Replacement 2. Reposition away Engine Coolant Air Bleed Hose @ Engine Control Module Bracket. Refer to Engine Coolant Air Bleed Hose Replacement (Radiator Surge Tank to Exhaust Gas Recirculation Cooler Housing and Radiator LH7). 3. Remove wiring harness from engine control module bracket.	
1	Engine Control Module Bracket Procedure Release retaining tab to remove bracket from battery tray.

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT (FWD)

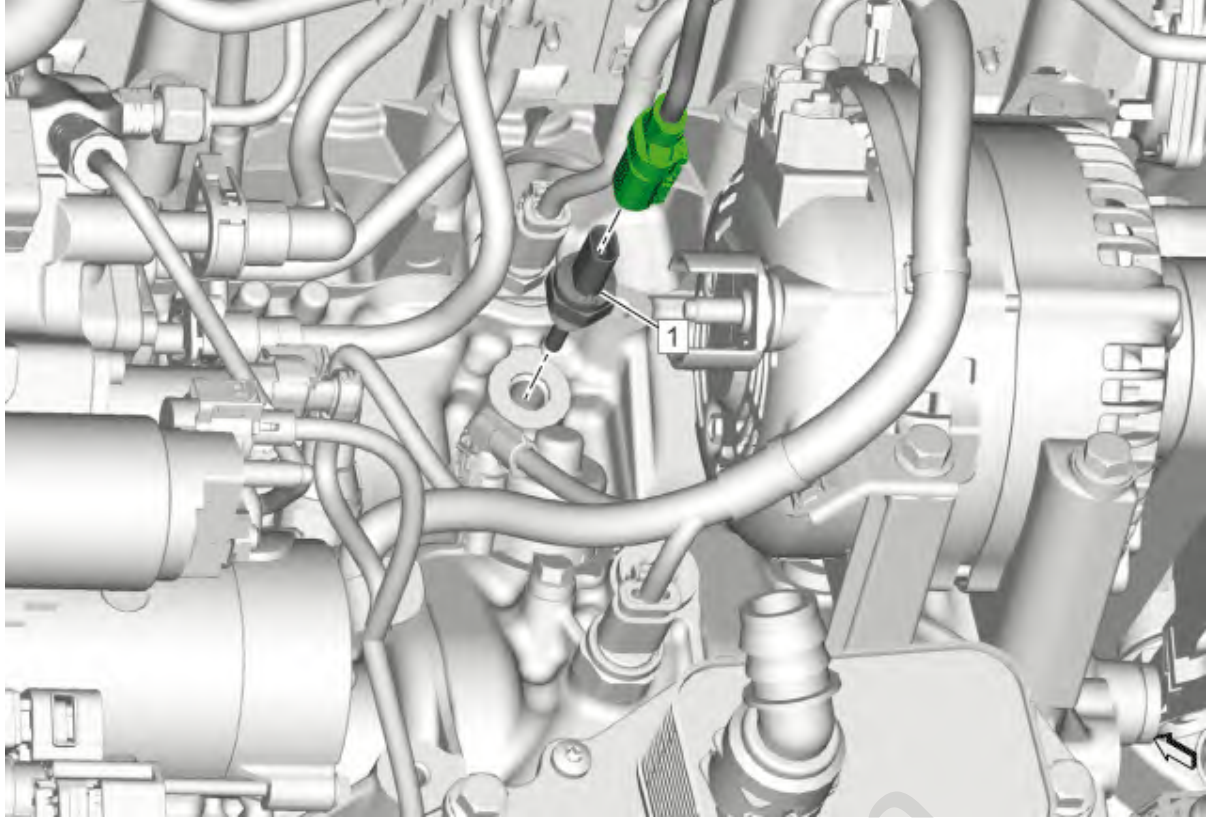


Fig. 11: Engine Coolant Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Allow sufficient time for the engine to cool before removing the ECT sensor. A hot engine may cause an excessive coolant loss or a personal injury. CAUTION: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system. Preliminary Procedures 1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection (KL9). 2. Remove Exhaust Front Pipe. Refer to Exhaust Front Pipe Replacement (LH7). 3. Drain cooling system. Refer to Cooling System Draining and Filling (GE 47716). Cooling System Draining and Filling (Static).	
1	Engine Coolant Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution Procedure Disconnect the engine coolant temperature sensor electrical connector. Tighten 45 N.m (33 lb ft)

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT (AWD)

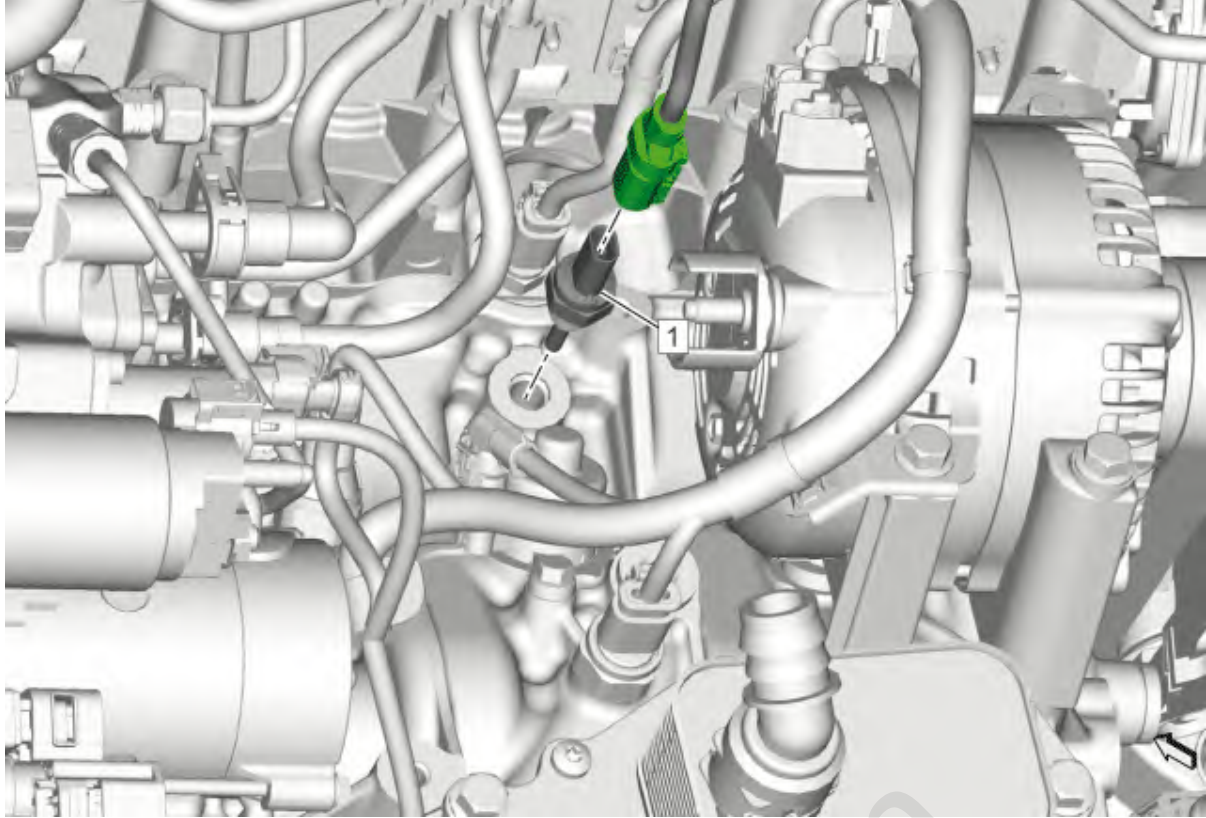


Fig. 12: Engine Coolant Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Allow sufficient time for the engine to cool before removing the ECT sensor. A hot engine may cause an excessive coolant loss or a personal injury. CAUTION: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system. Preliminary Procedures 1. Disconnect Battery Negative Cable. Refer to Battery Negative Cable Disconnection and Connection (KL9). 2. Drain cooling system. Refer to Cooling System Draining and Filling (GE 47716) Cooling System Draining and Filling (Static). 3. Remove Power Transfer Unit Case. Refer to Power Transfer Unit Case Replacement (MHG Transmission with LH7 Engine).	
1	Engine Coolant Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution Procedure Disconnect the engine coolant temperature sensor electrical connector. Tighten 45 N.m (33 lb ft)

AIR CLEANER ASSEMBLY REPLACEMENT

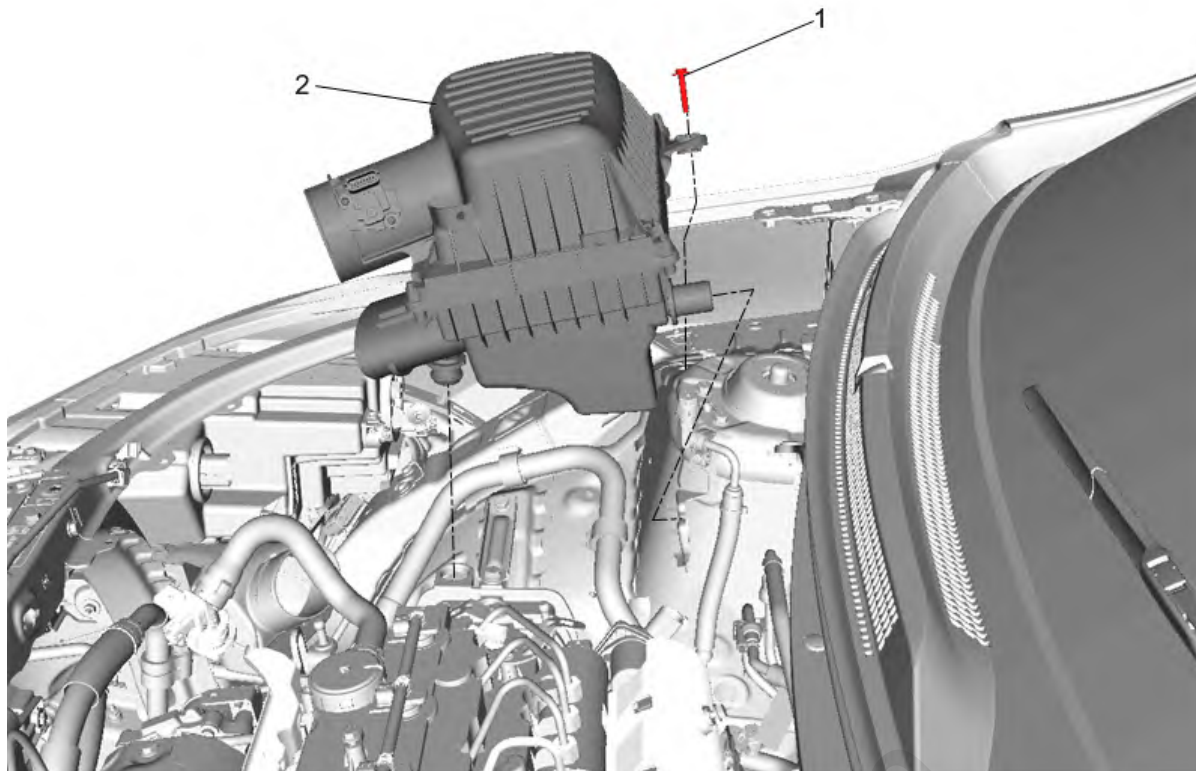


Fig. 13: Air Cleaner Assembly And Fastener
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Air Cleaner Outlet Duct. Refer to Air Cleaner Outlet Duct Replacement 2. Remove Intake Air Duct. Refer to Intake Air Duct Replacement 3. Disconnect the electrical connector.	
1	Air Cleaner Bolt CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Air Cleaner Assembly Procedure 1. Remove the air cleaner housing from the retainers. 2. Remove wiring harness from air cleaner assembly. 3. Transfer parts as necessary.

AIR CLEANER ELEMENT REPLACEMENT

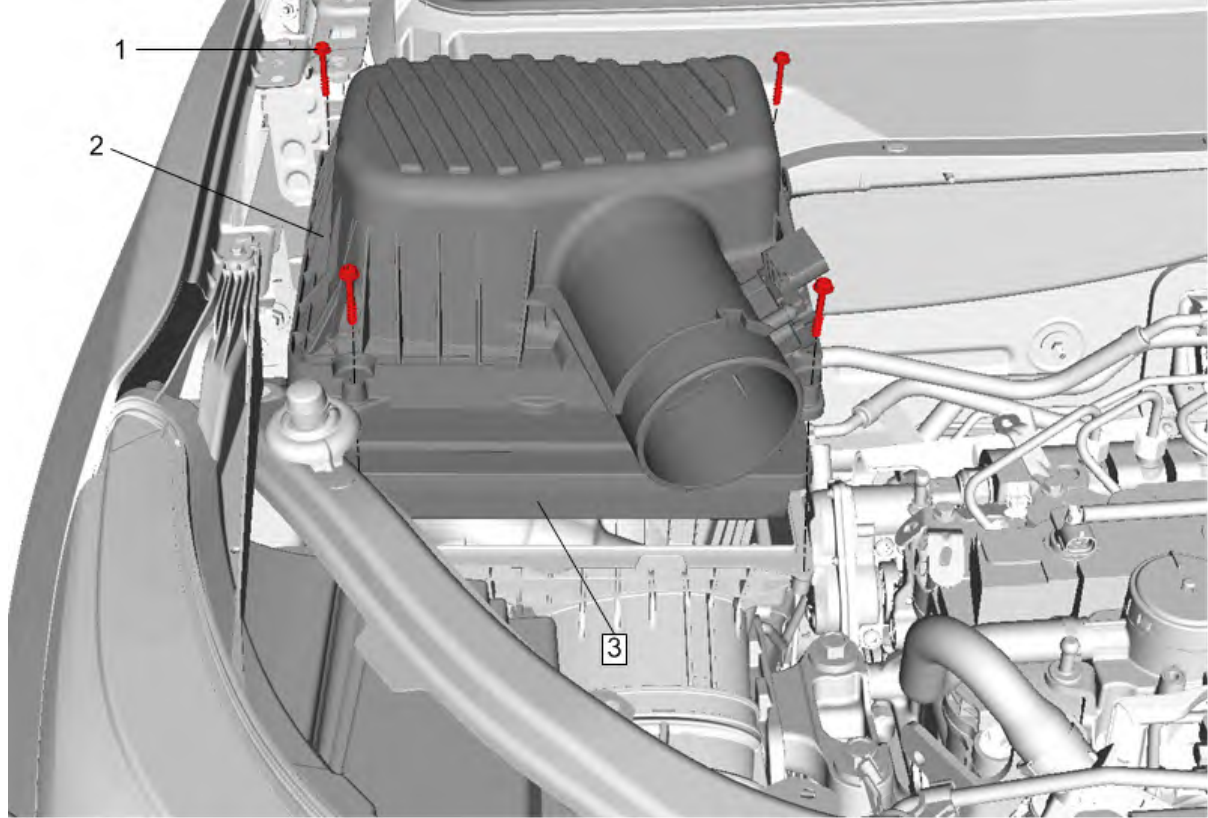


Fig. 14: Air Cleaner Element

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Remove Air Cleaner Outlet Duct. Refer to Air Cleaner Outlet Duct Replacement 2. Disconnect the electrical connector. 3. Remove wiring harness from air cleaner upper housing.	
1	Air Cleaner Upper Housing Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Air Cleaner Upper Housing
3	Air Cleaner Element

AIR CLEANER OUTLET DUCT REPLACEMENT

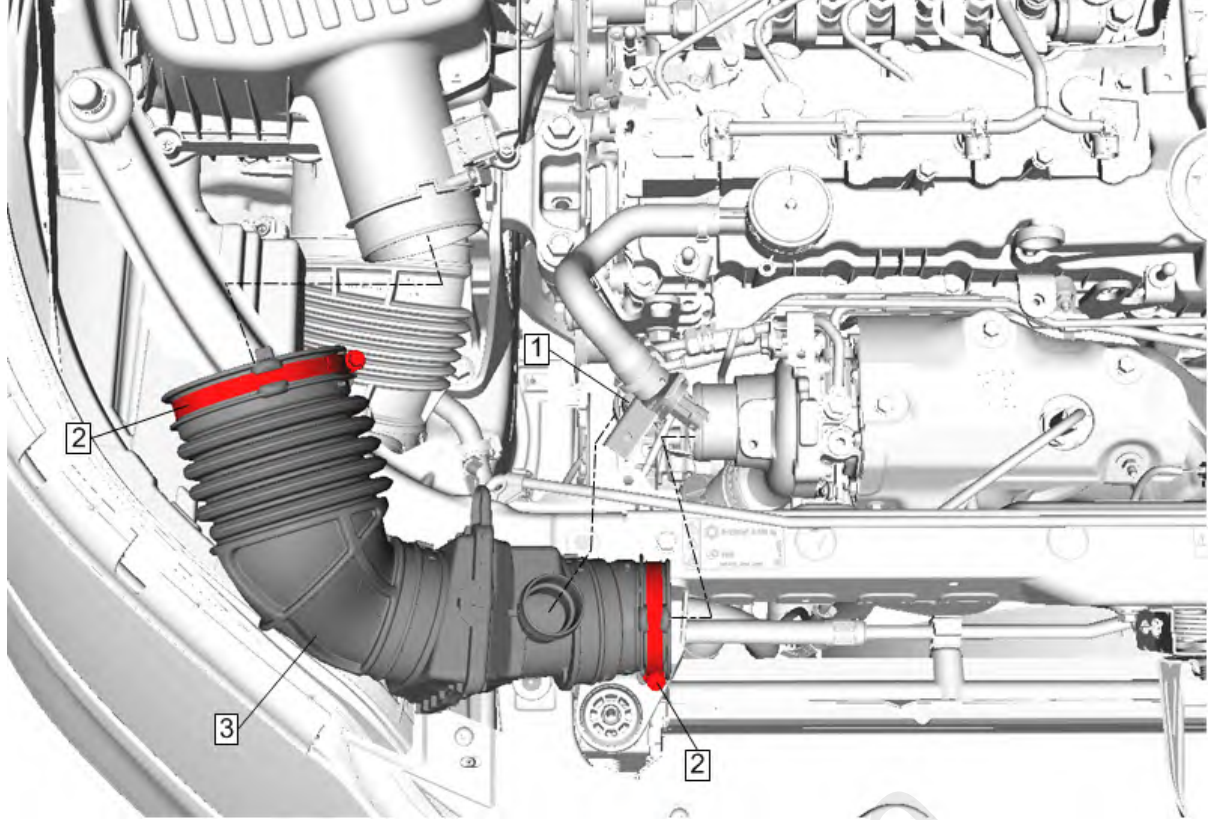


Fig. 15: Air Cleaner Outlet Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Positive Crankcase Ventilation Heater Procedure Disconnect Positive Crankcase Ventilation Heater @ Air Cleaner Outlet Duct
2	Air Cleaner Outlet Duct Clamp (Qty: 2) CAUTION: Refer to <u>Fastener Caution</u> . Tighten 3.5 N.m (31 lb in)
3	Air Cleaner Outlet Duct Procedure Remove wiring harness from air cleaner outlet duct.

INTAKE AIR BAFFLE REPLACEMENT

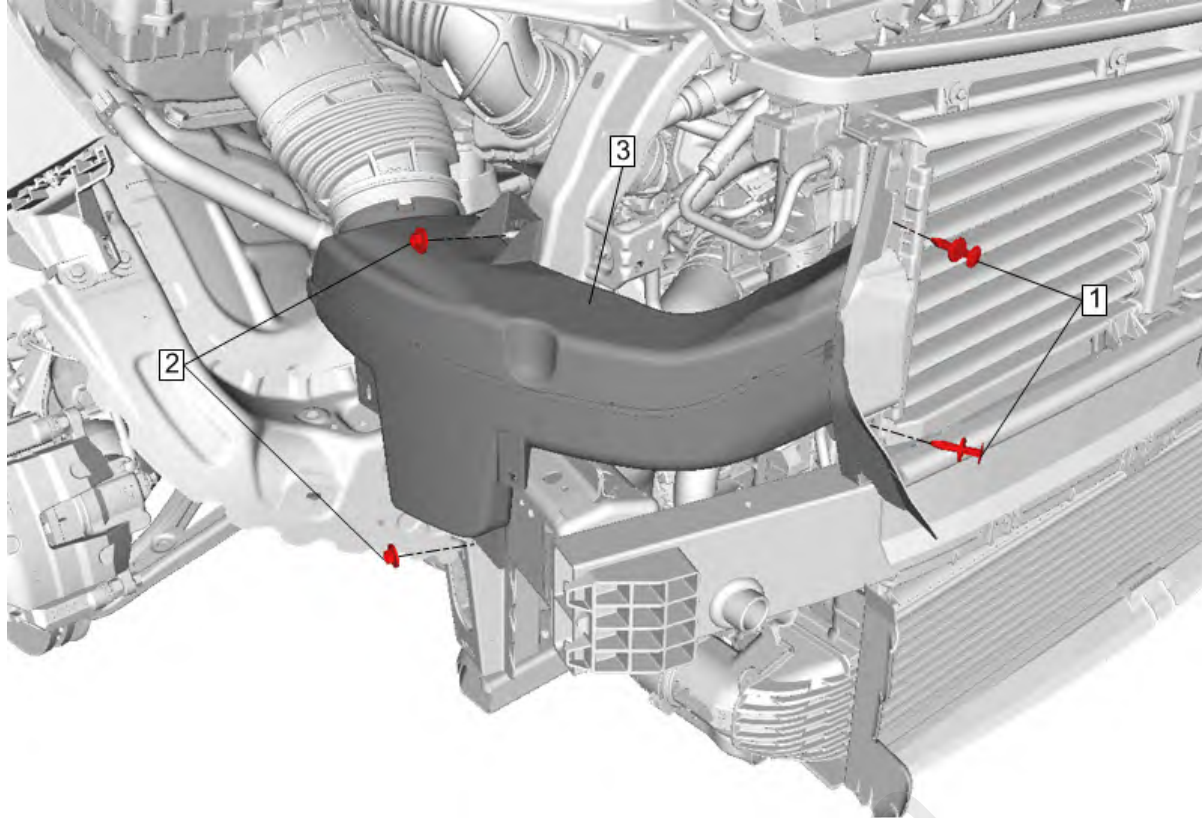


Fig. 16: Intake Air Baffle

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Headlamp. Refer to Headlamp Replacement (Chevrolet) , Headlamp Replacement (GMC) .	
1	Intake Air Baffle Retainer (Qty: 2)
2	Front Intake Air Duct Nut (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
3	Intake Air Baffle Procedure Remove wiring harness retainers from intake air baffle.

INTAKE AIR DUCT REPLACEMENT

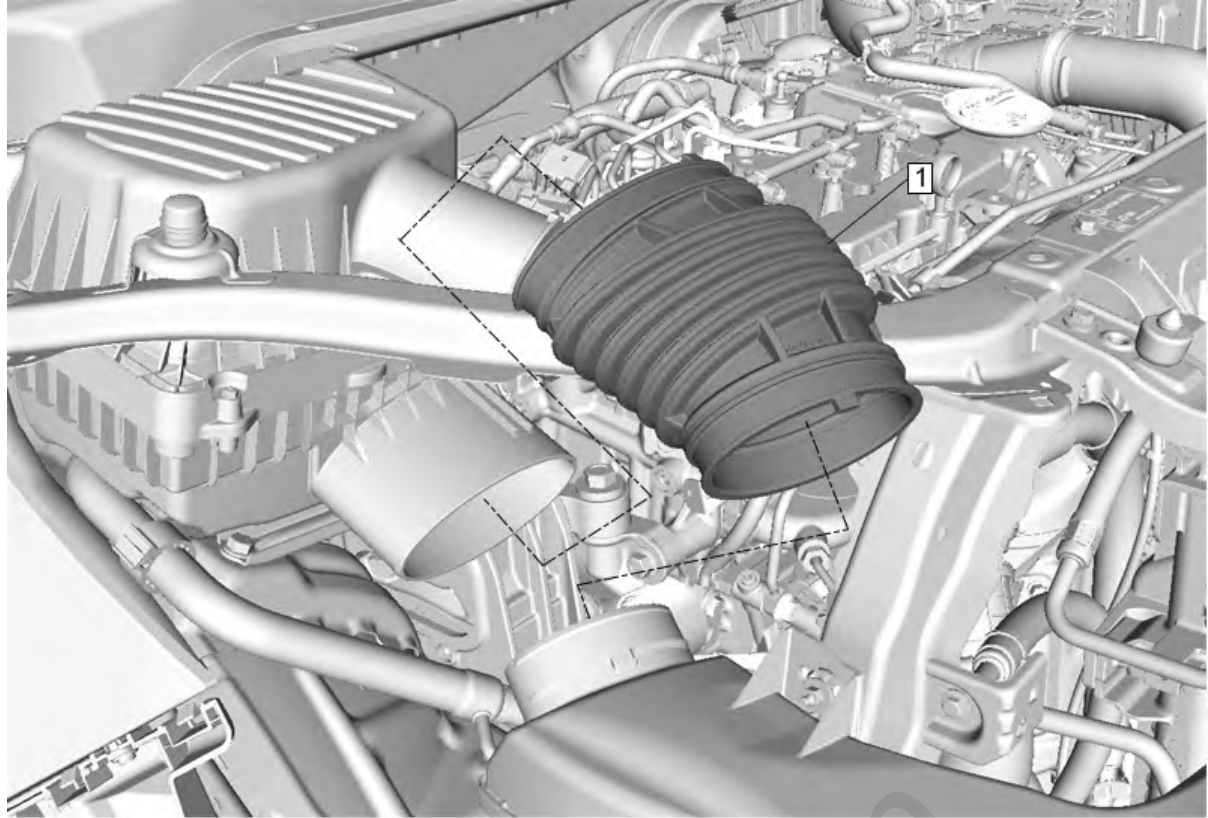


Fig. 17: Intake Air Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Remove Air Cleaner Outlet Duct. Refer to Air Cleaner Outlet Duct Replacement	
1	Intake Air Duct

INTAKE AIR PRESSURE AND TEMPERATURE SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

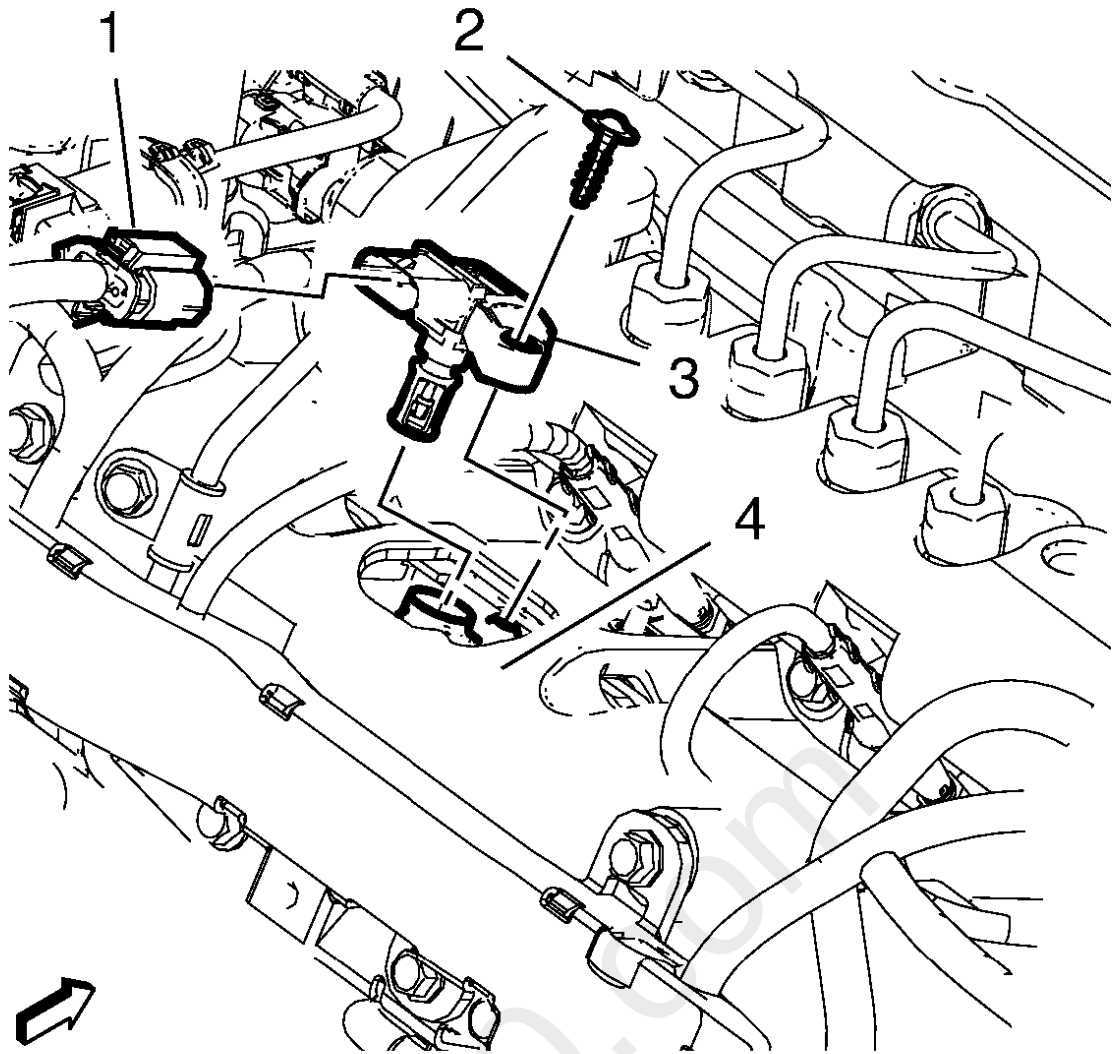


Fig. 18: Intake Air Pressure And Temperature Sensor, Bolt And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector (1) from the intake air pressure and temperature sensor (3).
4. Remove the intake air pressure and temperature sensor bolt (2).
5. Remove the intake air pressure and temperature sensor (3) from intake manifold (4).

Installation Procedure

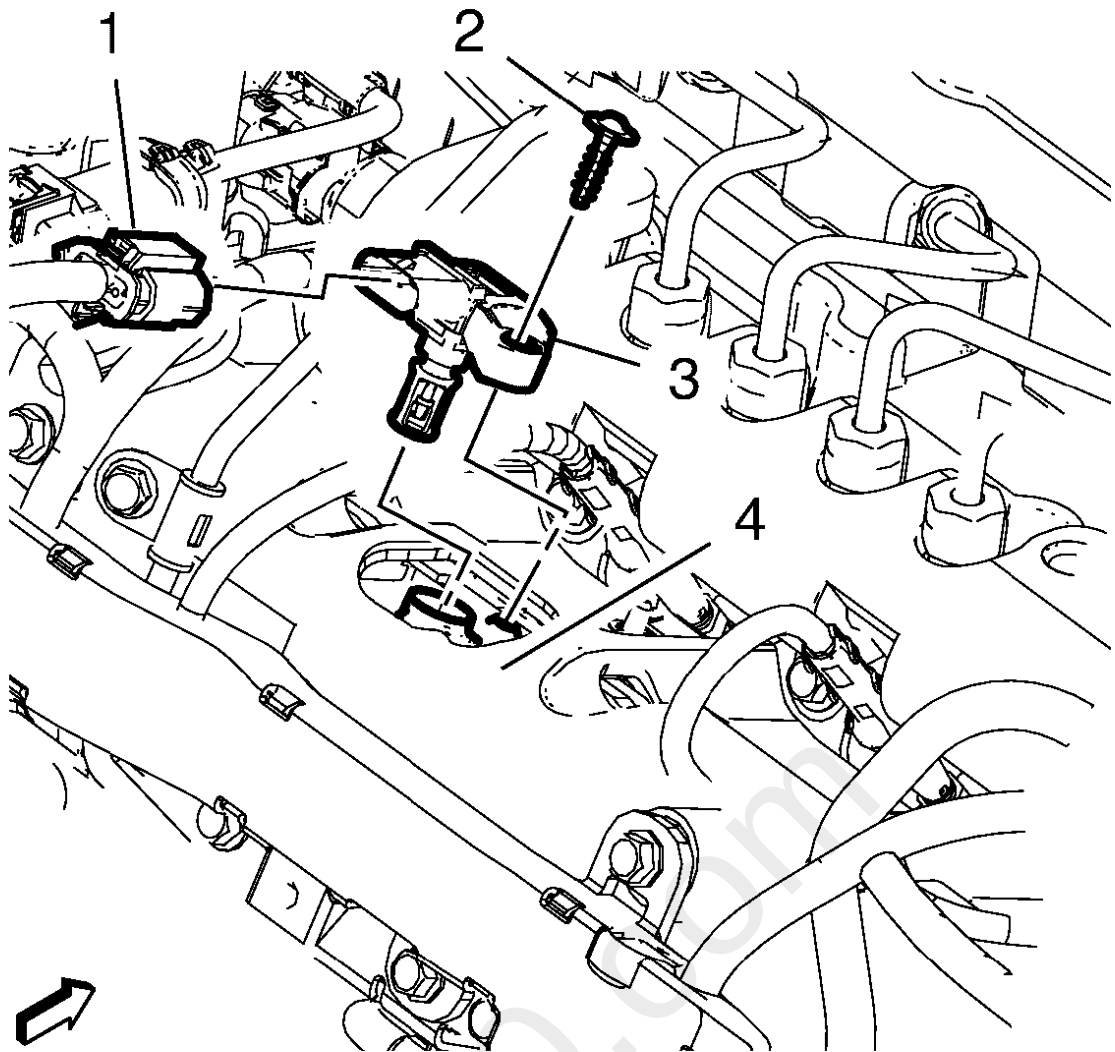


Fig. 19: Intake Air Pressure And Temperature Sensor, Bolt And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install the intake air pressure and temperature sensor (3) to the intake manifold (4).

CAUTION: Refer to [Fastener Caution](#) .

2. Install the bolt (2) to intake air pressure and temperature sensor (3) and tighten to 1.6 N.m (14 lb in).
3. Connect the wiring harness plug (2) to the intake air pressure and temperature sensor (3).
4. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
5. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

MASS AIRFLOW SENSOR REPLACEMENT

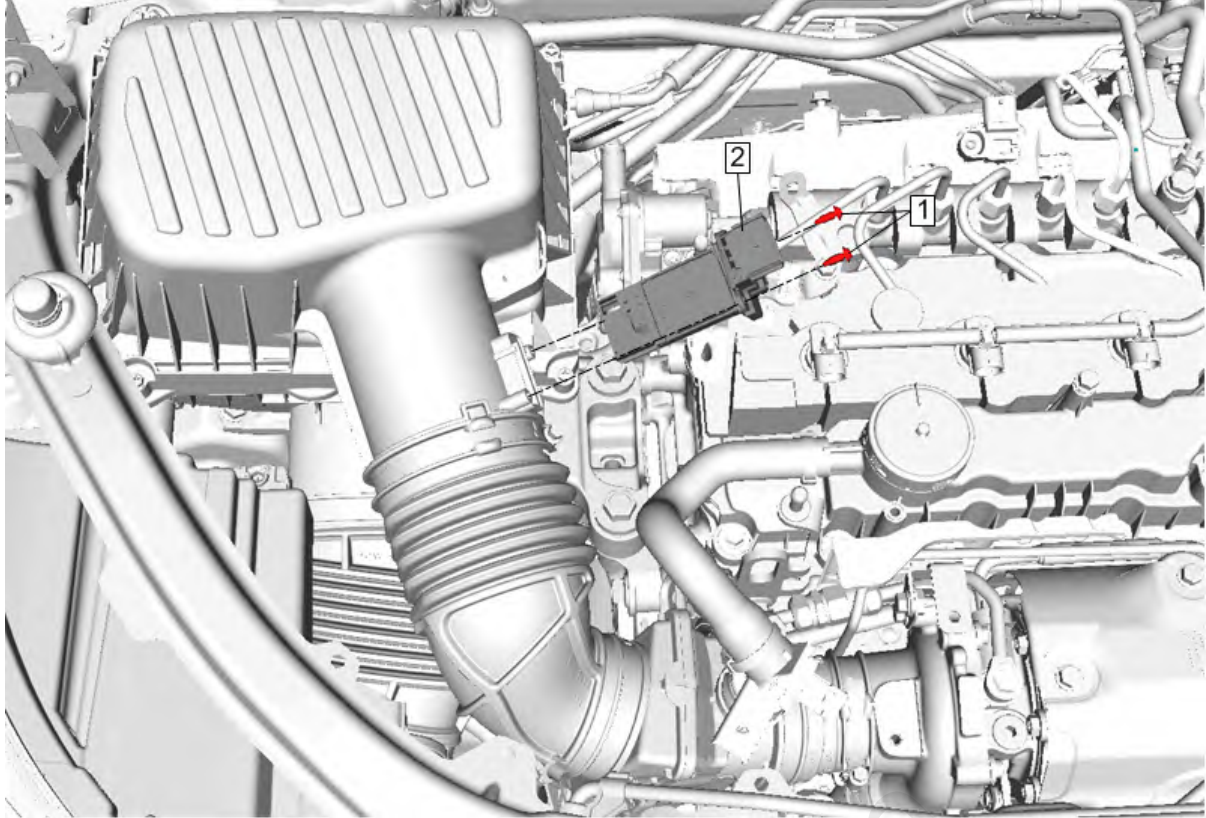


Fig. 20: Mass Airflow Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Mass Airflow Sensor Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Mass Airflow Sensor Procedure Disconnect the electrical connector.

ACCELERATOR PEDAL POSITION SENSOR REPLACEMENT

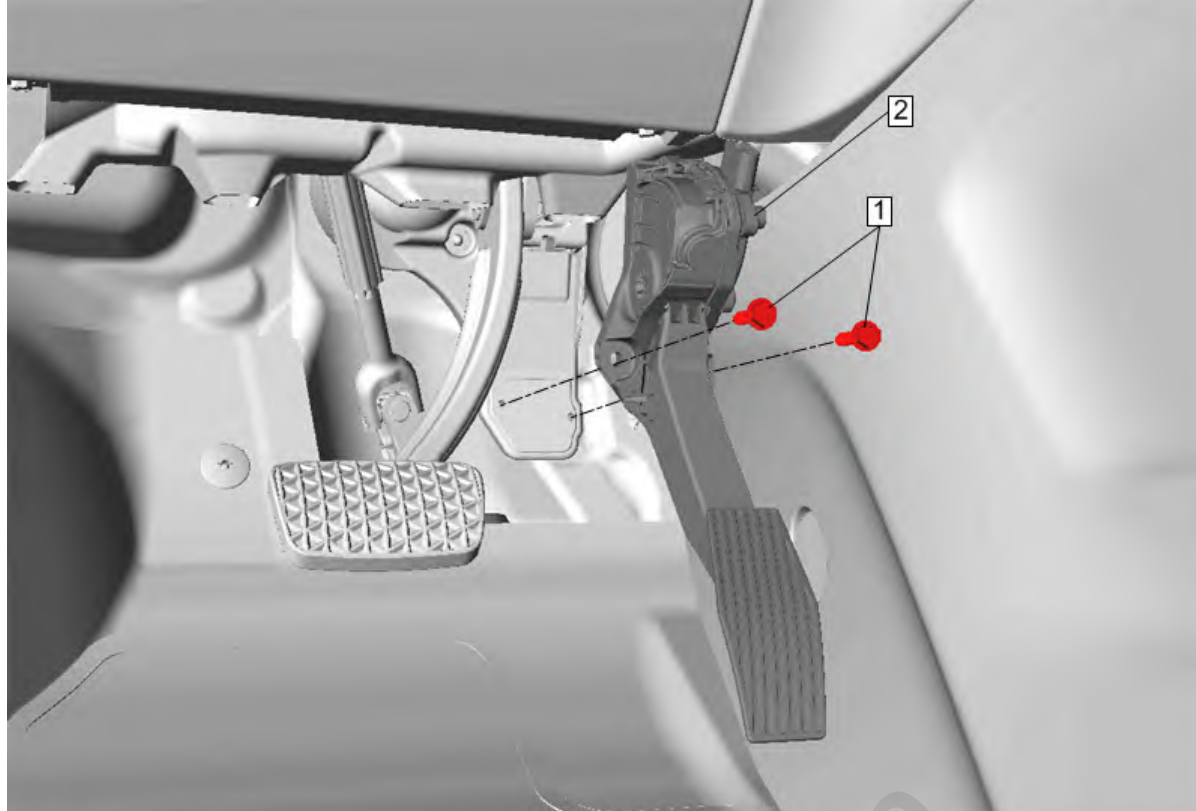


Fig. 21: Accelerator Pedal Position Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Accelerator Pedal Position Sensor Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Accelerator Pedal Position Sensor Procedure Disconnect the electrical connector.

THROTTLE BODY ASSEMBLY REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

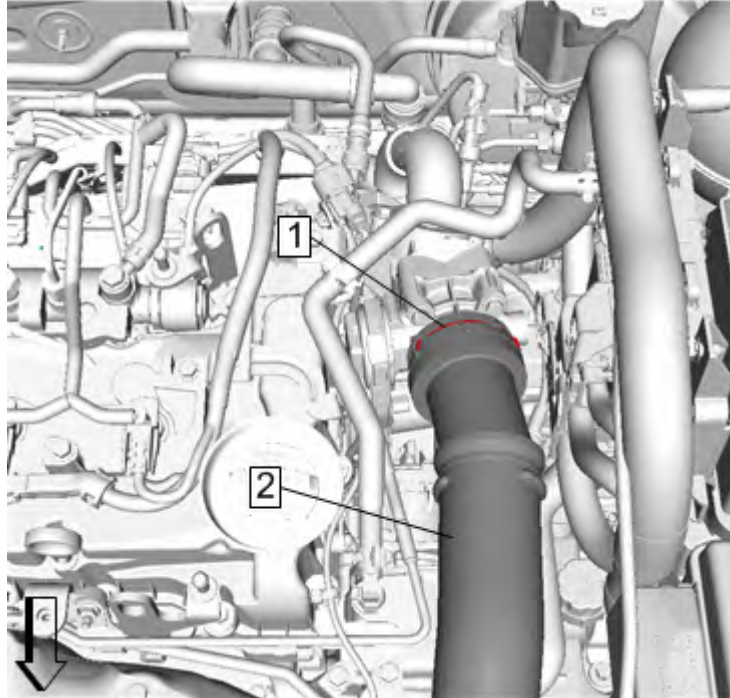


Fig. 22: Charge Air Cooler Outlet Air Tube And Retaining Clip
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Charge Air Cooler Outlet Air Tube (2) @ Throttle Body. Refer to [Charge Air Cooler Outlet Air Tube Replacement](#)

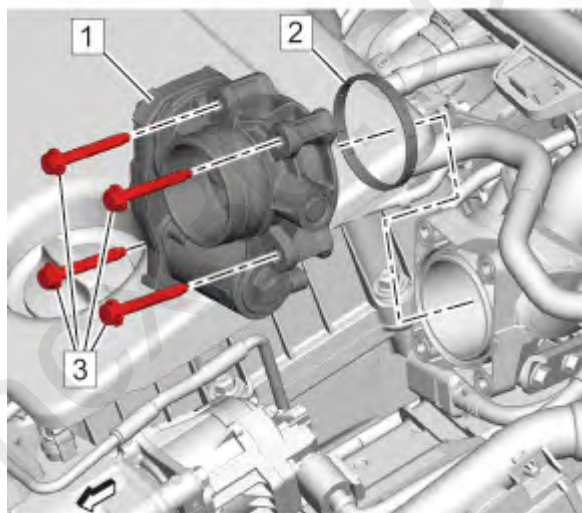


Fig. 23: Throttle Body, Bolts And Gasket
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Throttle Body Bolts (3) (Qty: 4)

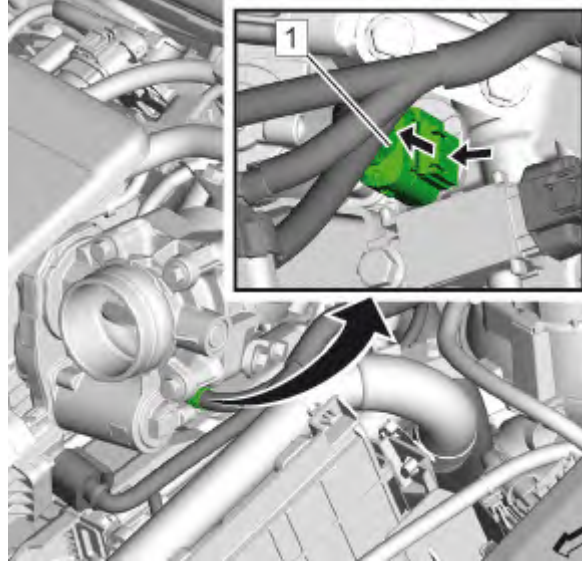


Fig. 24: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector. (1)
5. Remove the throttle body. (1)
6. Remove and DISCARD the throttle body gasket. (2)

Installation Procedure

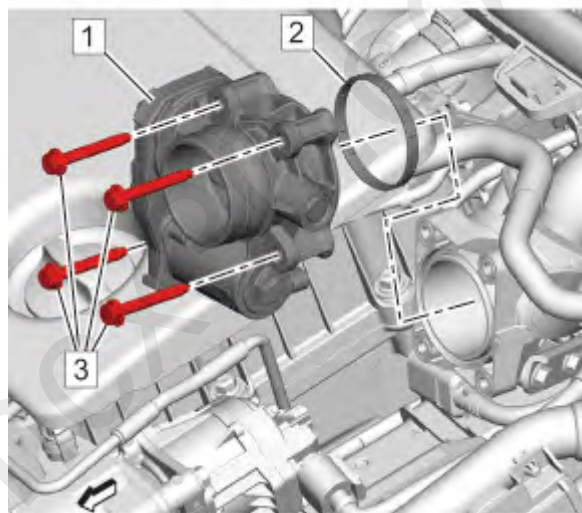


Fig. 25: Throttle Body, Bolts And Gasket

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW throttle body gasket. (2)
2. Install the throttle body. (1)

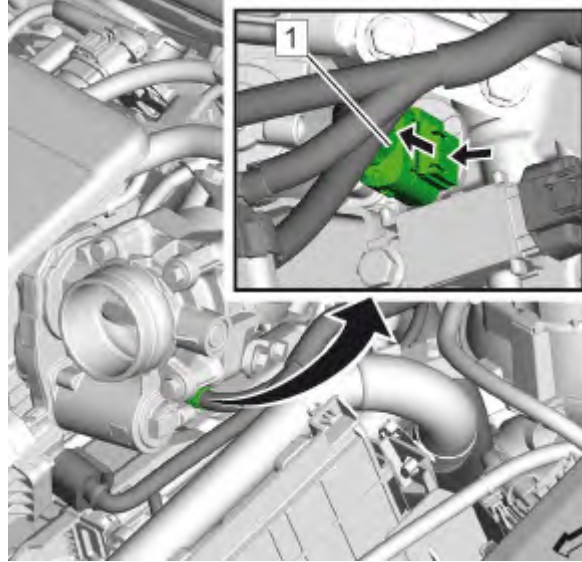


Fig. 26: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector. (1)

CAUTION: Refer to [Fastener Caution](#)

4. Install and tighten Throttle Body Bolts (3) (Qty: 4) to 10 N.m (89 lb in)

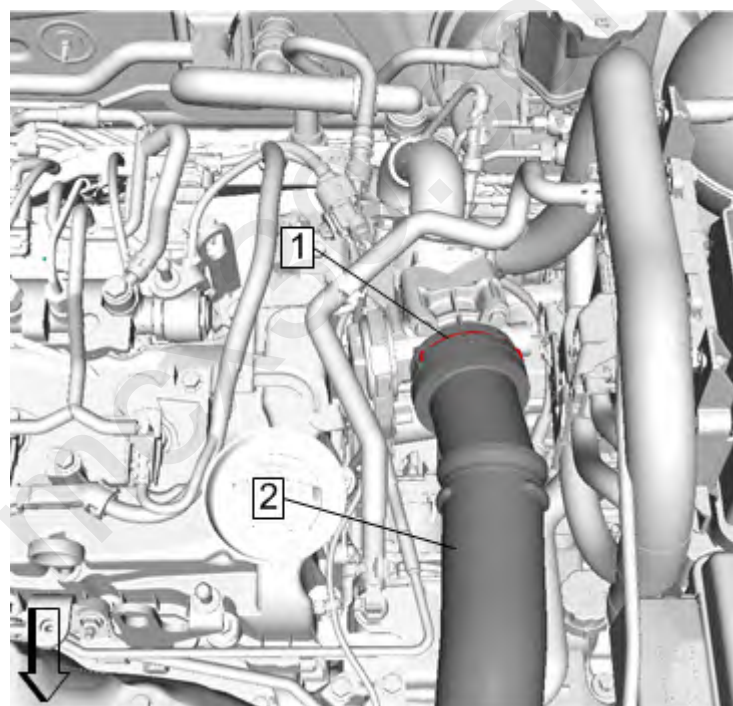


Fig. 27: Charge Air Cooler Outlet Air Tube And Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

5. Install Charge Air Cooler Outlet Air Tube (2) @ Throttle Body. Refer to [Charge Air Cooler Outlet Air Tube Replacement](#)
6. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
7. When the replacement is completed, use a scan tool to perform the appropriate reset functions. Refer to [Control Module References](#)

PLASTIC COLLAR QUICK CONNECT FITTING SERVICE

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

NOTE: If servicing a fuel system, insure the fuel pressure has been relieved.

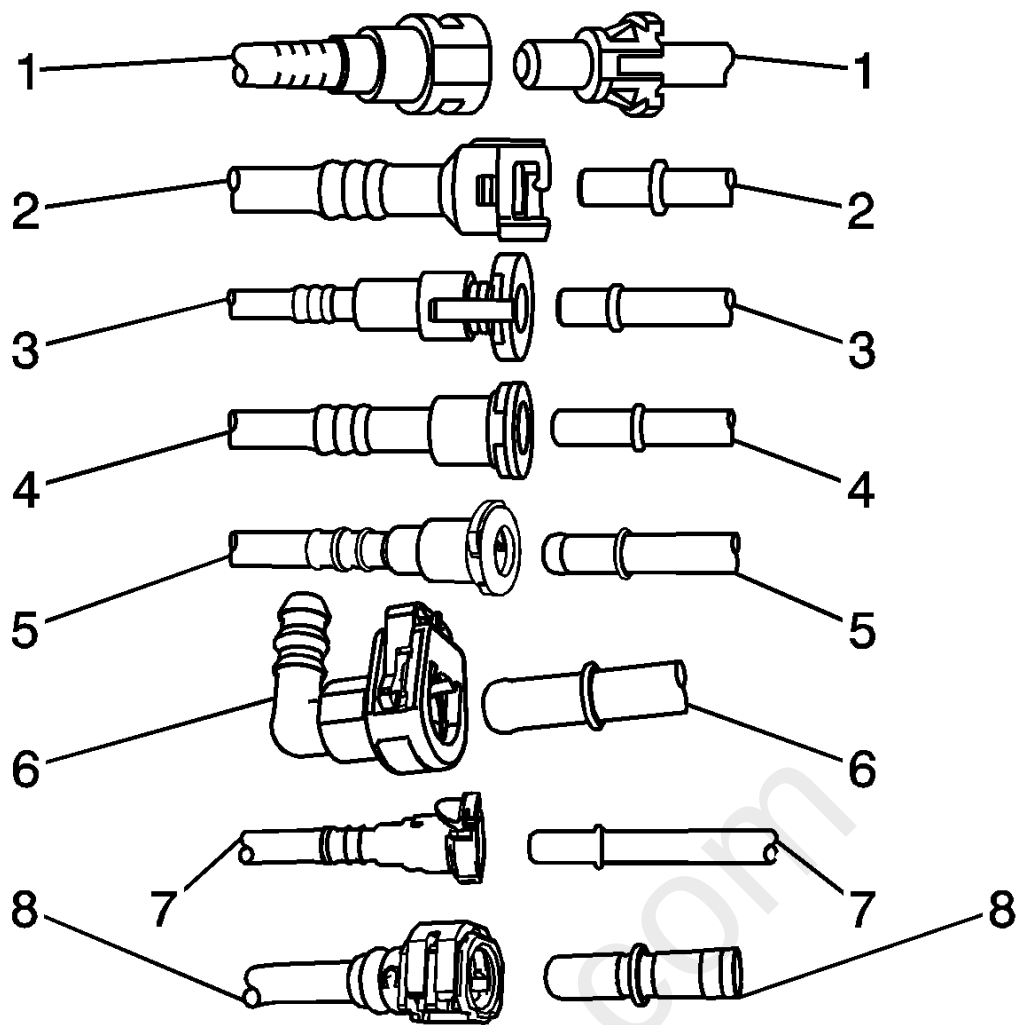


Fig. 28: Identifying Plastic Collar Quick Connect Fitting Types

Courtesy of GENERAL MOTORS COMPANY

NOTE:

There are several types of plastic collar fuel and evaporative emission quick connect fittings used on this vehicle.

- Bartholomew (1)
- Q Release (2)
- Squeeze to Release (3)
- Sliding Retainer (4)
- Global Connect (5)
- TI Loc (6)
- Safe Lock (7)
- Plastic Connector (8)

The following instructions apply to all of these types of plastic collar quick connect fittings except where indicated.

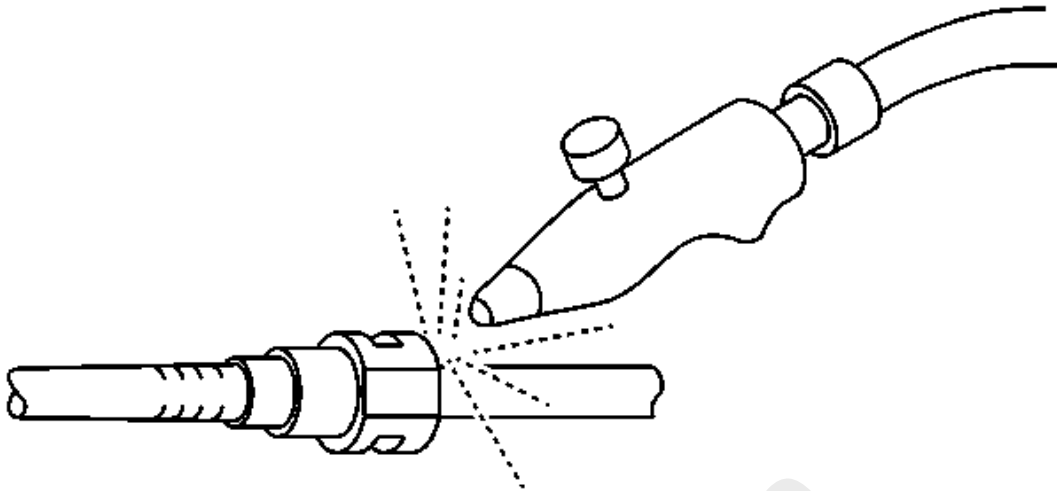


Fig. 29: Blowing Dirt Out Of Fitting (Plastic Collar)

Courtesy of GENERAL MOTORS COMPANY

WARNING: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

1. Using compressed air, blow any dirt out of the quick-connect fitting.

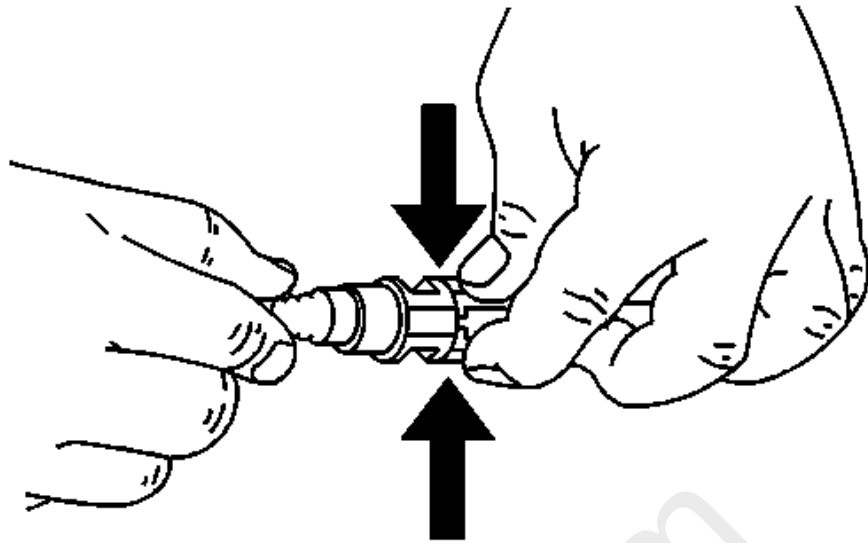


Fig. 30: Quick Connect Fitting Release Tabs (Plastic Collar).

Courtesy of GENERAL MOTORS COMPANY

2. This step applies to Bartholomew style connectors ONLY. Squeeze the plastic quick-connect fitting release tabs.

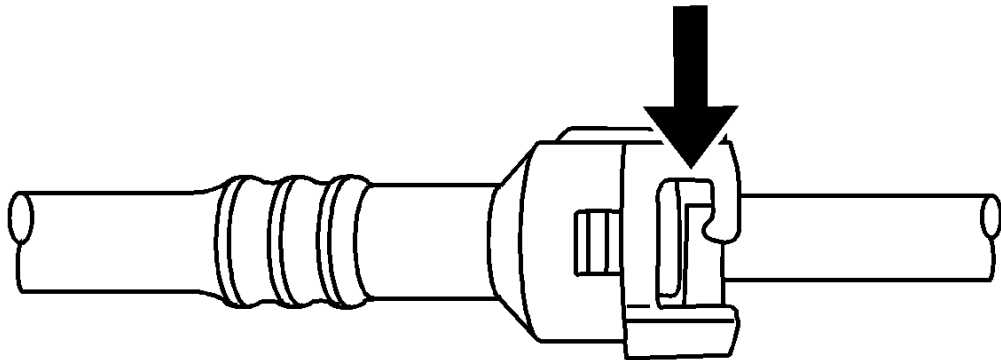


Fig. 31: Q Release Style Connectors (Plastic Collar)

Courtesy of GENERAL MOTORS COMPANY

3. This step applies to Q Release style connectors ONLY. Release the fitting by Pushing the tab toward the other side of the slot in the fitting.

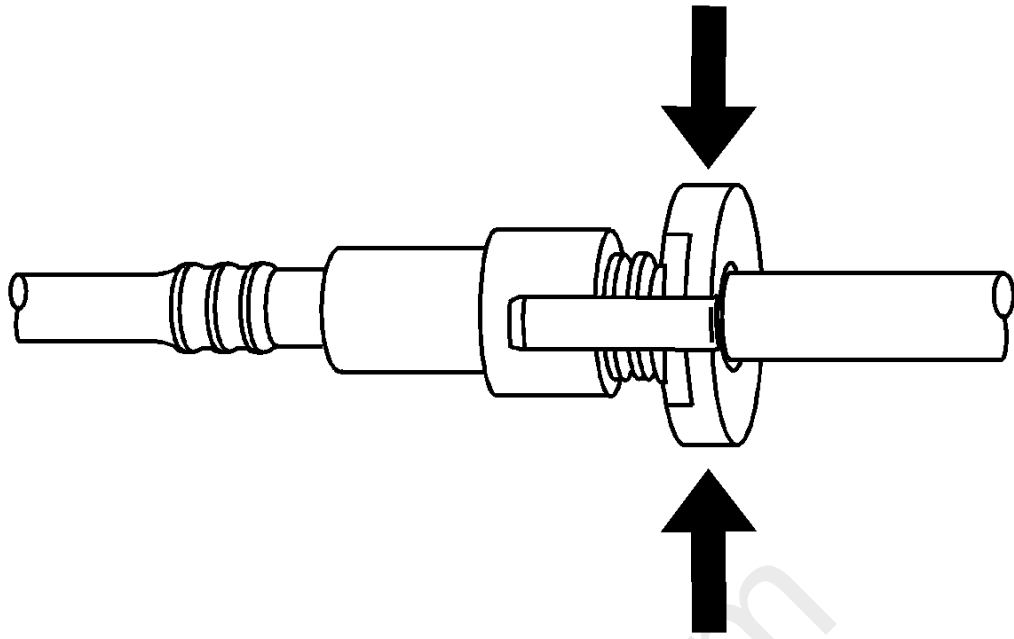


Fig. 32: Squeeze To Release Quick Connect Fitting (Plastic Collar).

Courtesy of GENERAL MOTORS COMPANY

4. This step applies to Squeeze to Release style connectors ONLY. Squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick-connect fitting.

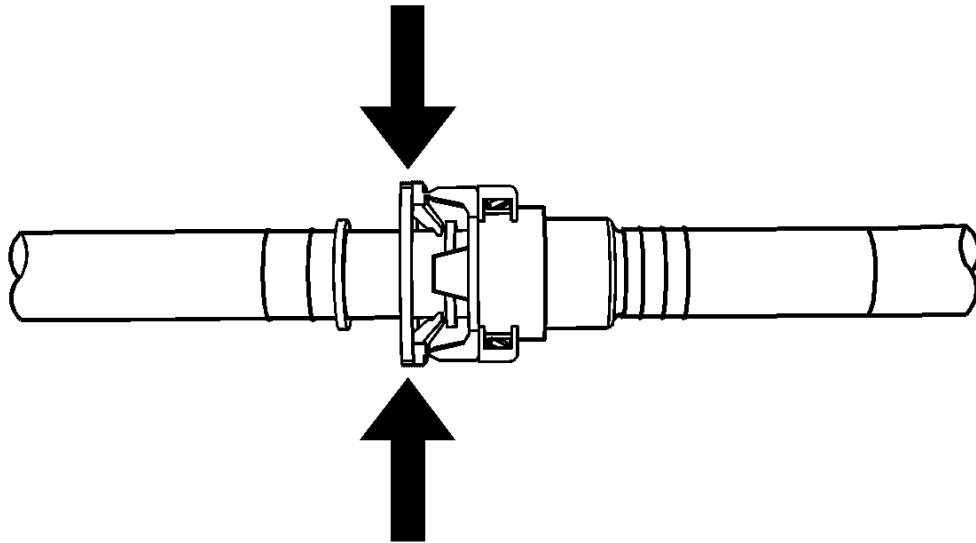


Fig. 33: Pushing In Male Side Of Connector - Squeeze To Release
 Courtesy of GENERAL MOTORS COMPANY

5. This step applies to Squeeze to Release style connectors ONLY. Push in the male side slightly in order to slide the retainer away from the retainers, squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick-connect fitting.



Fig. 34: Identifying Variants Of Sliding Retainer Style Connectors
 Courtesy of GENERAL MOTORS COMPANY

NOTE: There are two variants of sliding retainer style connectors shown above, both have the same release and installation procedure.

6. This step applies to Sliding Retainer style connectors ONLY. Release the fitting by pressing on one side of the release tab causing it to push in slightly. If the tab doesn't move try pressing the tab in from the opposite side. The tab will only move in one direction.

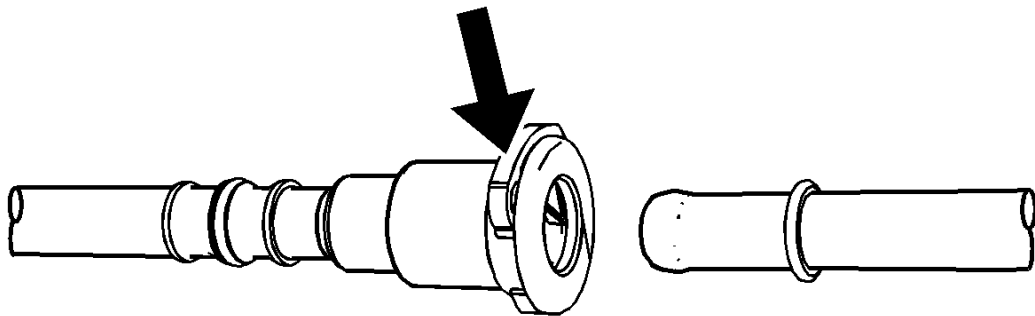


Fig. 35: Global Connector Style

Courtesy of GENERAL MOTORS COMPANY

7. This step applies to the Global Connector style only. Push the connector toward the tube in order to release the pressure. Press and hold down the release mechanism, and pull the connector straight out.

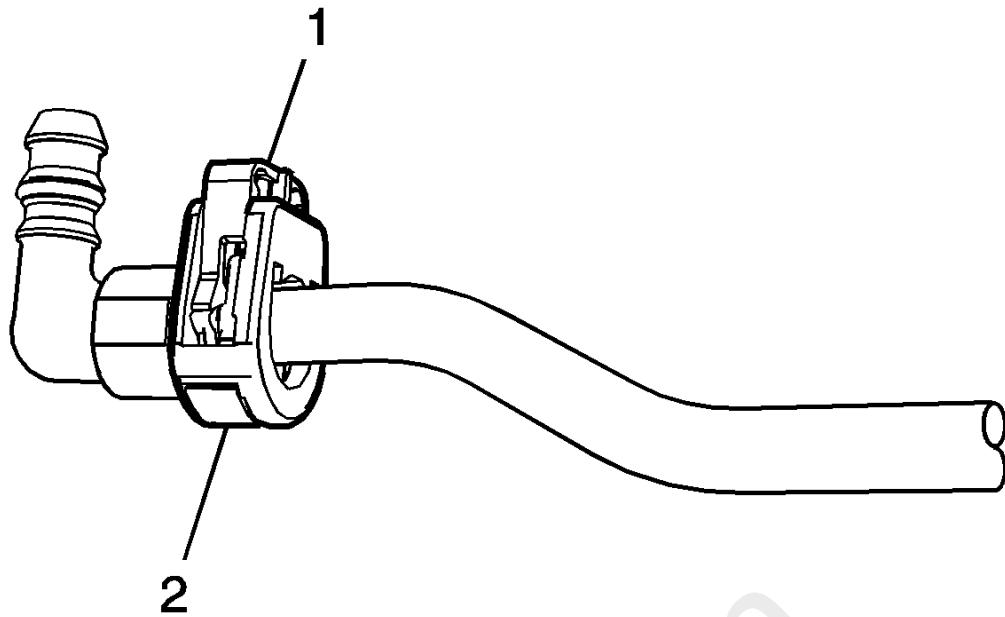


Fig. 36: Redundant Latch And Release Mechanism - TI Loc Style
Courtesy of GENERAL MOTORS COMPANY

8. This step applies to the TI Loc style only. Push the connector toward the tube in order to release the pressure. Release the redundant latch (1) with two fingers or a flat bladed tool. Then press and hold down the bottom release mechanism (2) and pull the connector straight out.

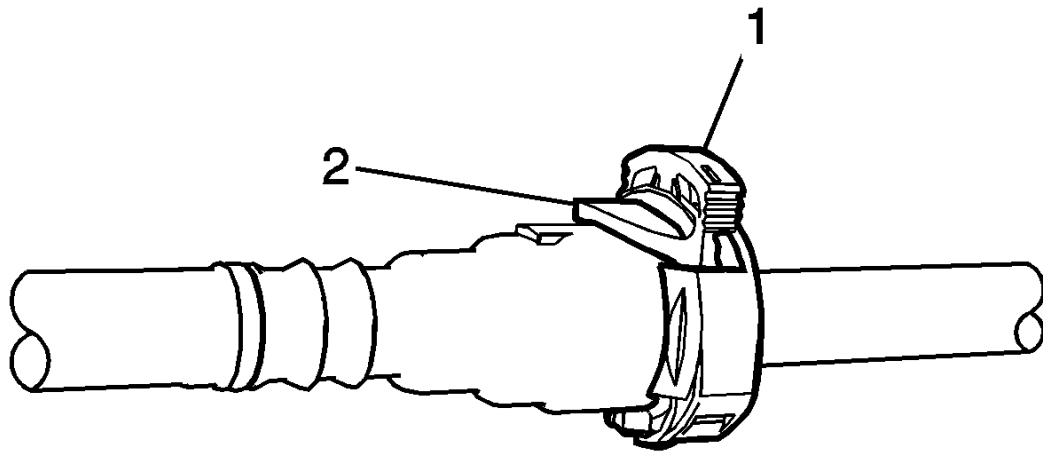


Fig. 37: Second Latch And Release Mechanism - Safe Lock Style
Courtesy of GENERAL MOTORS COMPANY

WARNING: Refer to [Relieving Fuel Pressure Warning](#) .

9. This step applies to the Safe Lock style only. Push the connector toward the tube in order to release the pressure. Release the second latch (1) with two fingers. Then press and hold down the bottom release mechanism (2) and pull the connector straight out.

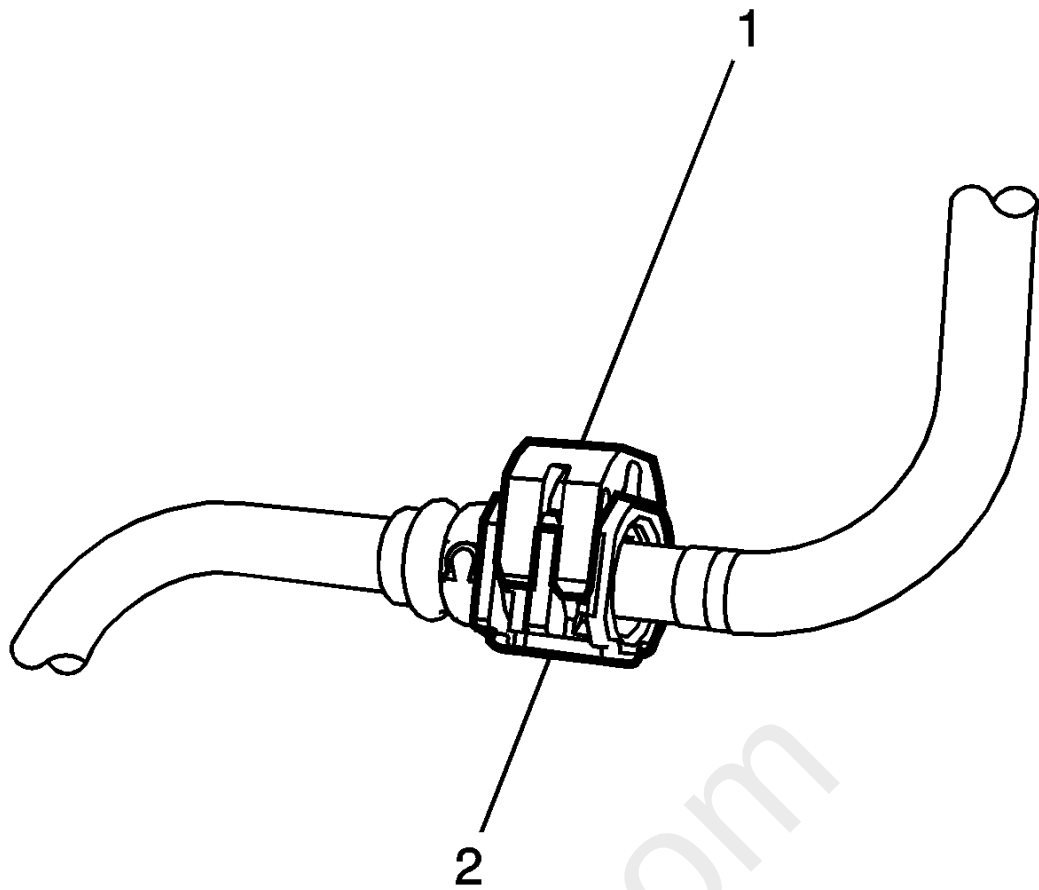


Fig. 38: Latch And Connector - Plastic Connector Style 8

Courtesy of GENERAL MOTORS COMPANY

10. This step applies to the Plastic Connector style 8, push the connector toward the tube in order to release the pressure. Press the latch (1) inward in order to release the pipe, while pulling the connector (2) straight out.
11. Using a clean shop towel, wipe off the male pipe end.
12. Inspect both ends of the fitting for dirt and burrs.
13. Clean or replace components as necessary.

Installation Procedure

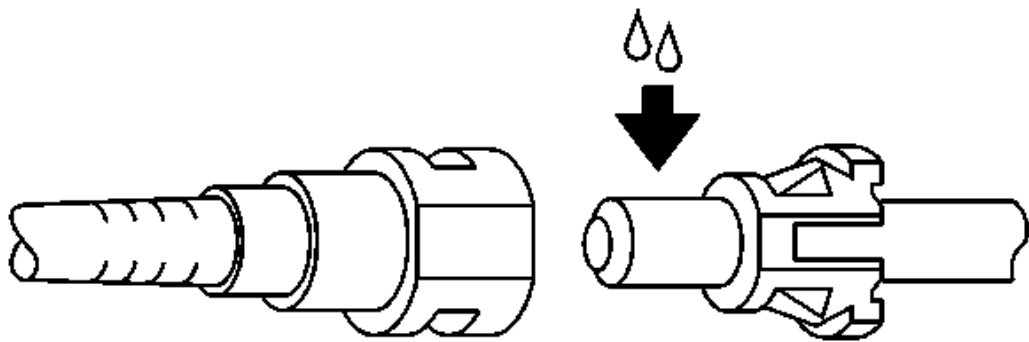


Fig. 39: Lubricating Male Pipe End

Courtesy of GENERAL MOTORS COMPANY

WARNING: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

1. Apply a few drops of clean engine oil to the male pipe end.

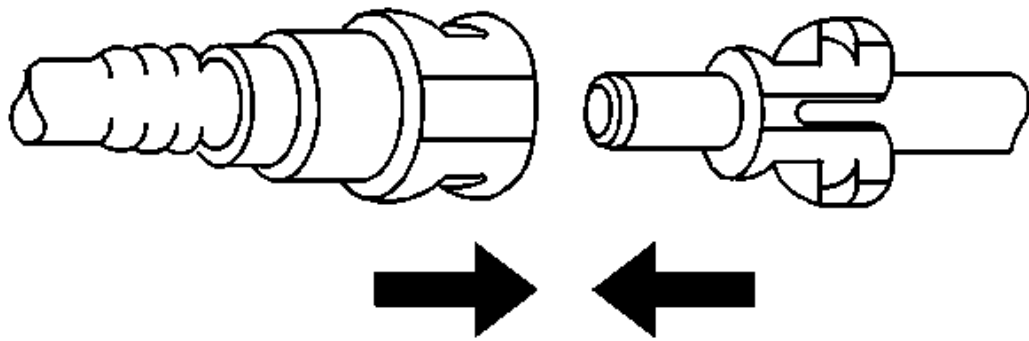


Fig. 40: Connecting Quick-Connect Fittings

Courtesy of GENERAL MOTORS COMPANY

2. Push both sides of the quick-connect fitting together in order to cause the retaining feature to snap into place.

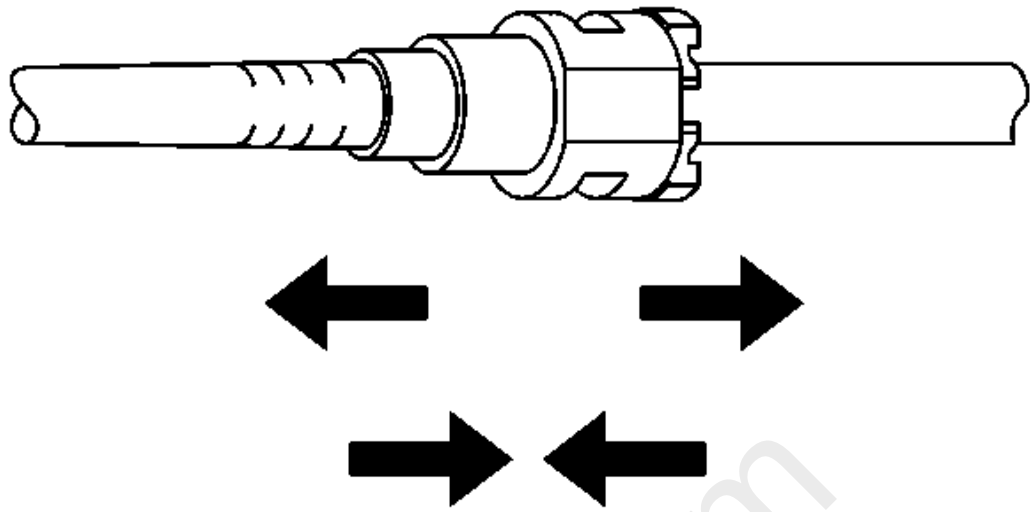


Fig. 41: Ensuring Quick-Connect Fitting Is Secure
Courtesy of GENERAL MOTORS COMPANY

3. Pull on both sides of the quick-connect fitting to make sure the connection is secure.

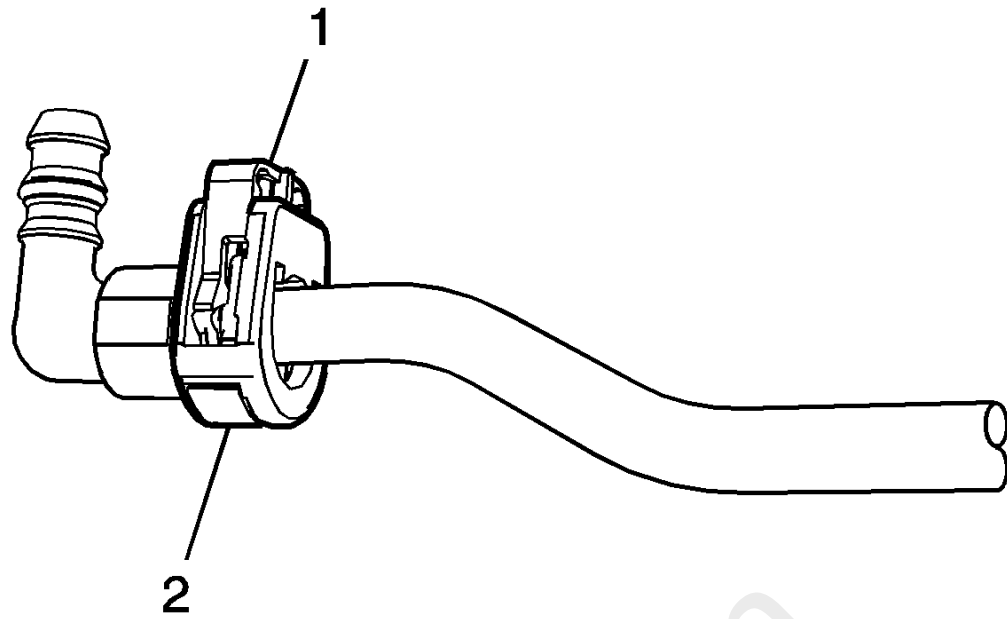


Fig. 42: Redundant Latch And Release Mechanism - TI Loc Style
Courtesy of GENERAL MOTORS COMPANY

4. Insert the tube in the connector until the retainer snaps in place.
5. Push down on the redundant latch (1) until it is fully engaged and snapped into position.

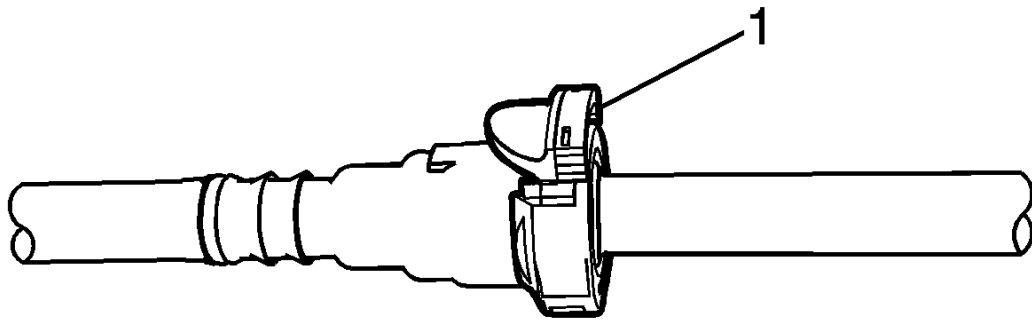


Fig. 43: Second Latch - Safe Lock Style
Courtesy of GENERAL MOTORS COMPANY

6. Insert the tube in the connector until the retainer snaps in place.
7. Push down on the second latch (1) in order to secure the connection.

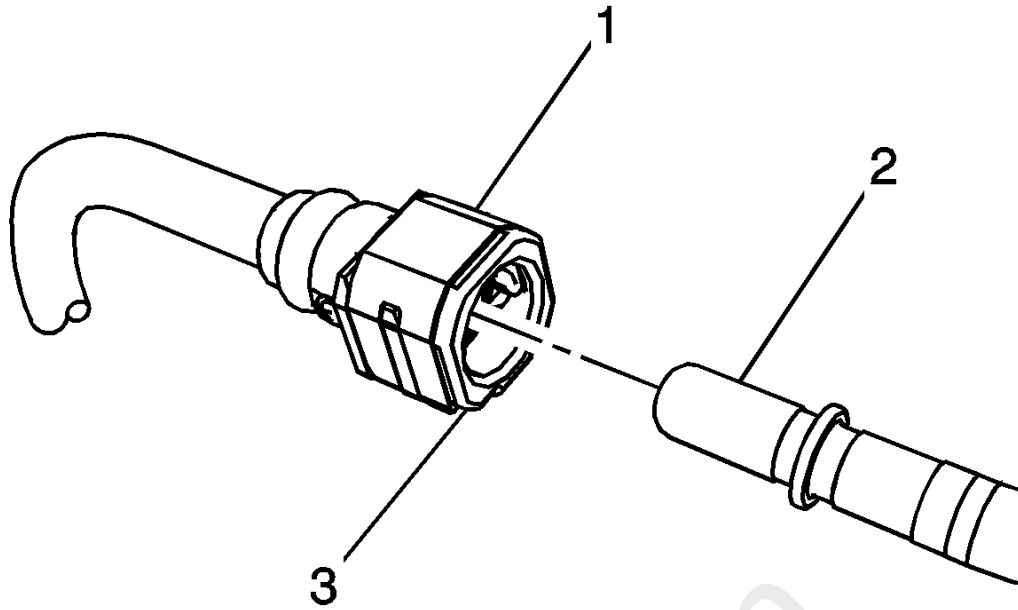


Fig. 44: Latch And Connector - Plastic Connector Type 8
Courtesy of GENERAL MOTORS COMPANY

8. For the plastic connector type 8, depress the latch (1) while inserting the connector (3) on to the pipe (2).
9. Move the latch (1) upward in order to secure the connection.
10. Inspect for leaks using the following procedure:
 1. Turn the ignition ON, with the engine OFF for 2 seconds.
 2. Turn the ignition OFF, for 10 seconds.
 3. Turn the ignition ON, with the engine OFF for 2 seconds.
 4. Turn the ignition OFF.
 5. Inspect for leaks.

METAL COLLAR QUICK CONNECT FITTING SERVICE

Special Tools

- **CH-41769** Fuel Line Disconnect Tool Set
- **CH-44581** Fuel Line Disconnect Tool

For equivalent regional tools, refer to [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Mechanical Tools\)](#) .

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

1. Relieve the fuel system pressure before servicing any fuel system connection.

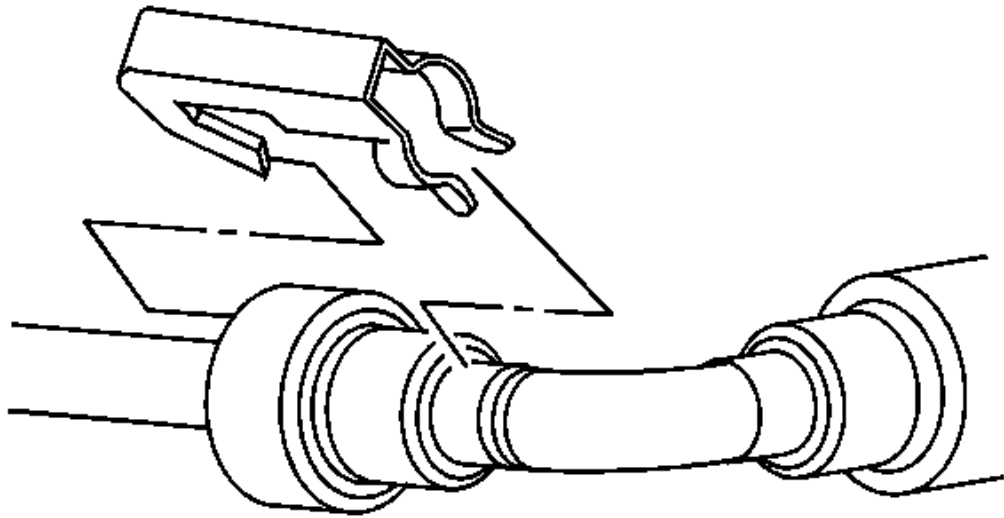


Fig. 45: Quick-Connect Fitting Retainer (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

2. Remove the retainer from the quick-connect fitting.

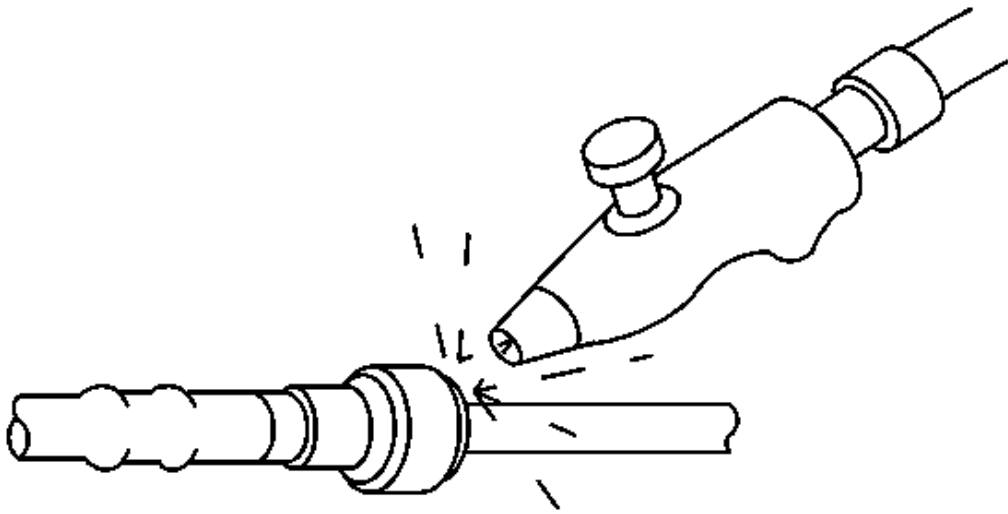


Fig. 46: Blowing Dirt Out Of Fitting.(Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

3. Blow dirt out of the fitting using compressed air.

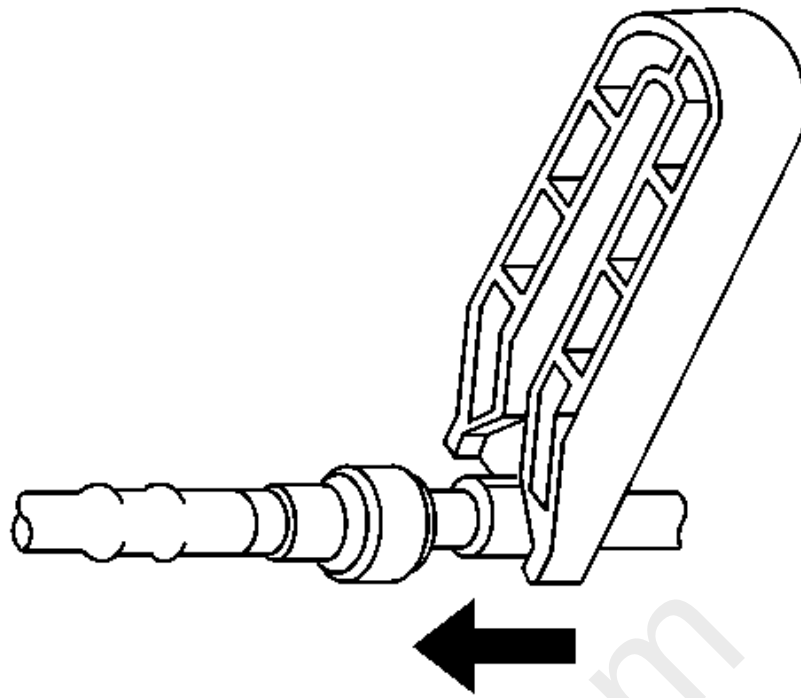


Fig. 47: Releasing Quick Connect Locking Tabs (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

4. Depending on the fuel line size and ability to access the fitting, choose the appropriate tool: **CH-41769** fuel line disconnect tool set or **CH-44581** fuel line disconnect tool. Insert the **CH-41769** fuel line disconnect tool set or **CH-44581** fuel line disconnect tool into the female connector, then push inward to release the locking tabs.

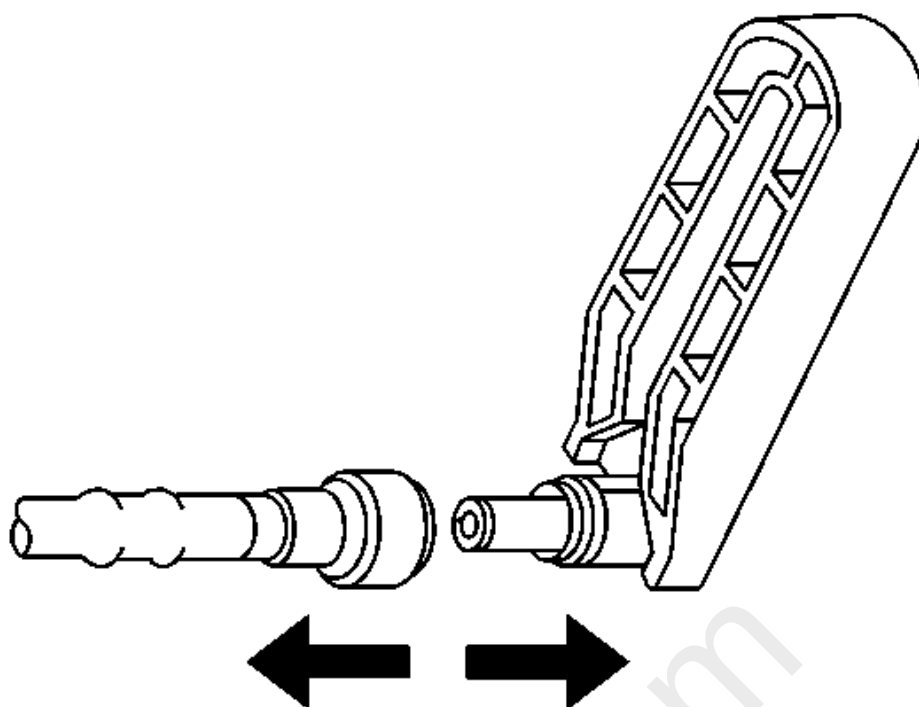


Fig. 48: Pulling Connection Apart (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

5. Pull the connection apart.

CAUTION: If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.

6. Using a clean shop towel, wipe off the male pipe end.

7. Inspect both ends of the fitting for dirt and burrs.

Clean or replace the components as required.

Installation Procedure

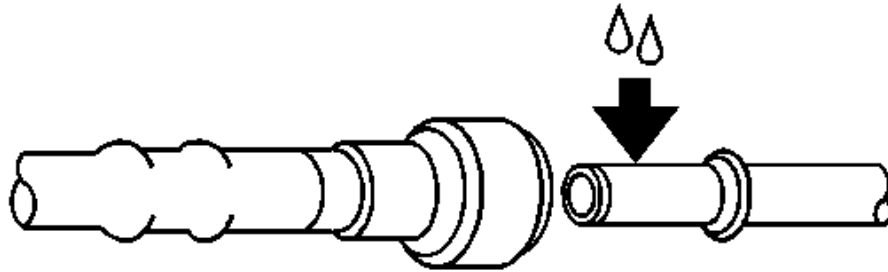


Fig. 49: Oiling Male Pipe Ends (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

WARNING: In order to reduce the risk of fire and personal injury, before connecting fuel pipe fittings, always apply a few drops of clean engine oil to the male pipe ends.

This will ensure proper reconnection and prevent a possible fuel leak.

During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.

1. Apply a few drops of clean engine oil to the male pipe end.

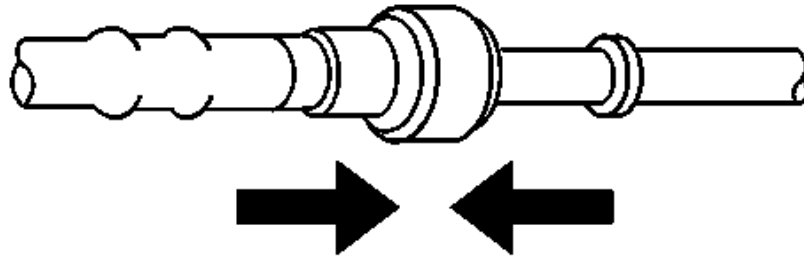


Fig. 50: Pushing Connectors Together (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

2. Push both sides of the quick-connect fitting together in order to snap the retaining tabs into place.

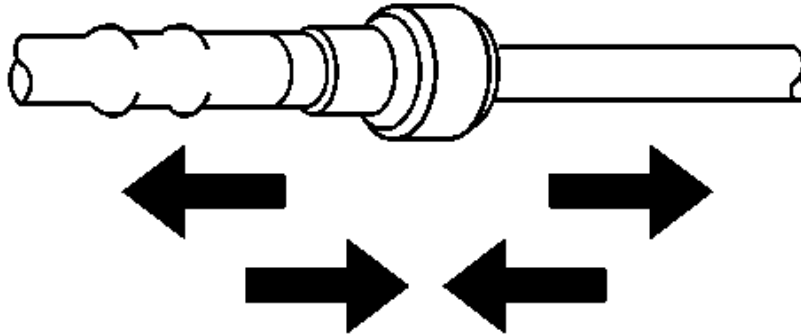


Fig. 51: Ensuring Connection Is Secure (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

3. Pull on both sides of the quick-connect fitting to make sure the connection is secure.

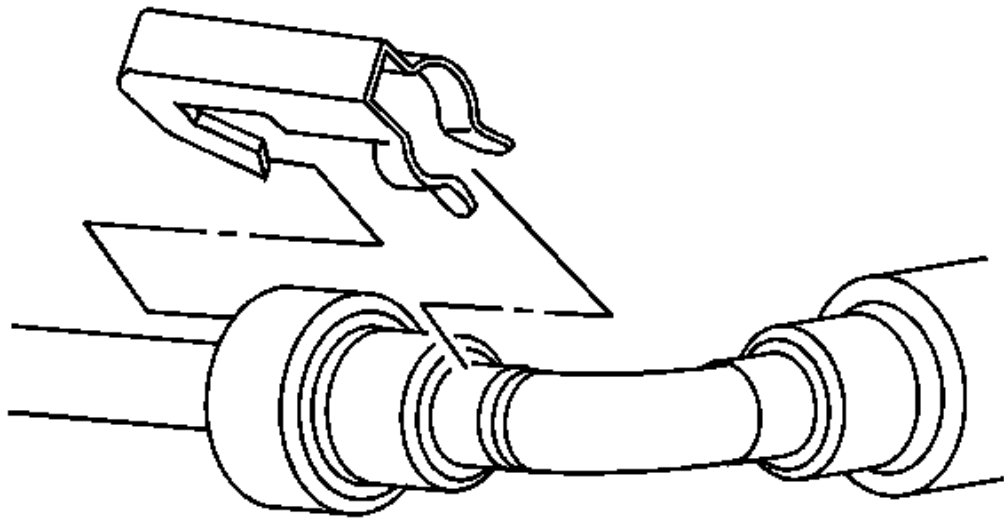


Fig. 52: Quick-Connect Fitting Retainer (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

4. Install the retainer to the quick-connect fitting.
5. Inspect for leaks using the following procedure:
 1. Turn the ignition ON, with the engine OFF for 2 seconds.
 2. Turn the ignition OFF, for 10 seconds.
 3. Turn the ignition ON, with the engine OFF for 2 seconds.
 4. Turn the ignition OFF.
 5. Inspect for leaks.

FUEL SYSTEM PRIMING

NOTE:

For the fuel system to work properly, air cannot be in the fuel lines. If air gets in, the engine may not start and the fuel lines will need to be primed before operating the vehicle.

If air is present, the following may have happened:

- The vehicle ran out of fuel.
- The filter was removed.
- The fuel lines were removed or disconnected.
- The fuel filter water drain valve was opened while the engine was running.

If one or more of the above occurred, air has entered the fuel system and you will need to prime the system prior to operating the vehicle.

1. Prior to priming the engine, ensure that the following has been completed:

- There is fuel in the fuel tank.
 - The fuel filter has been installed and properly tightened.
 - The fuel lines are properly connected.
2. With the engine off, press and hold ENGINE START/STOP button without applying the brake for five seconds to place the vehicle in Service Mode. Wait approximately five seconds and press ENGINE START/STOP again to turn it off. Complete this step three times while the engine is off.
 3. Press and hold ENGINE START/STOP button while applying the brake for a maximum of 40 seconds at a time, with five seconds between attempts, until the engine starts. If the engine tries to run, but does not run smoothly, increase the RPM's slightly by using the accelerator pedal. This will help force air through the system.
 4. Repeat Step 3 if the engine stalls and will not restart.
 5. Once engine starts and runs, allow it to idle for a few minutes to make sure air is purged from fuel system.
 6. Stop engine.

FUEL FILTER ASSEMBLY REPLACEMENT (AWD)

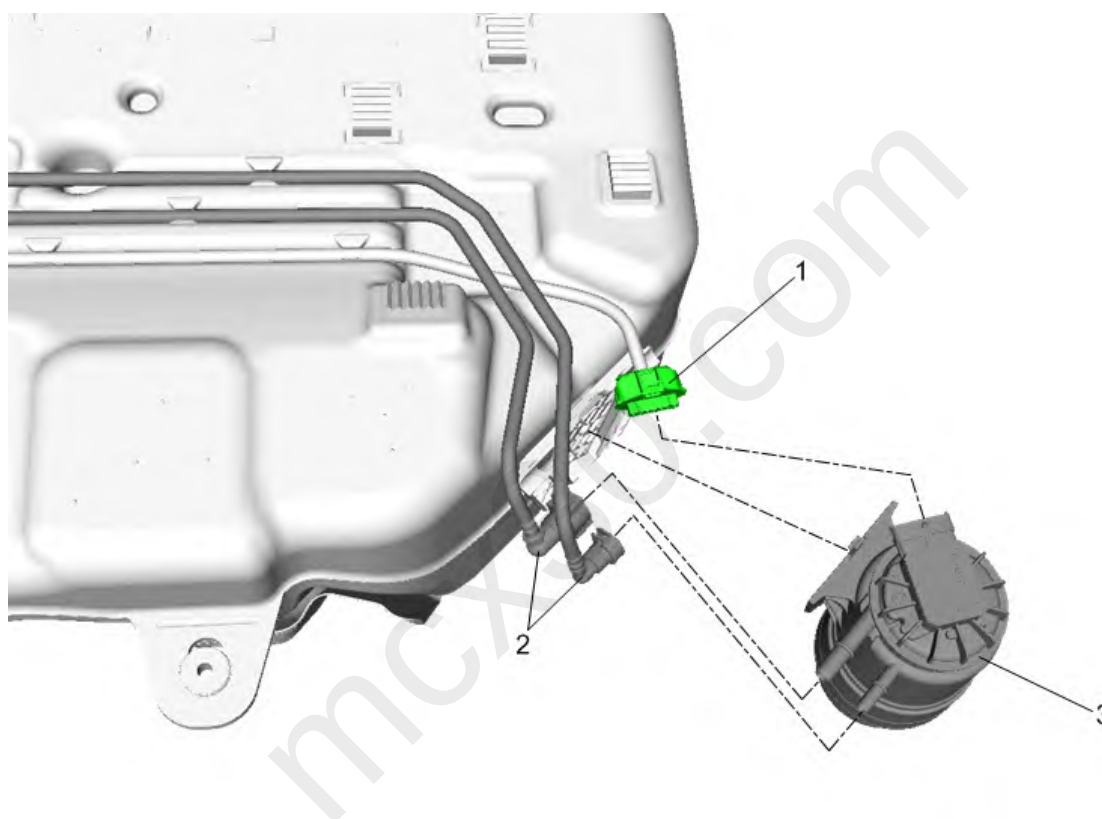


Fig. 53: Fuel Filter Assembly (AWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Electrical Connector
2	Fuel Hose (Qty: 2) Procedure Disconnect the fuel hoses from the fuel filter assembly. Refer to Plastic Collar Quick Connect Fitting Service

Callout	Component Name
2	Fuel Filter Assembly Procedure 1. Release retaining tab and slide fuel filter assembly up to remove. 2. Reset fuel filter life monitor only is assembly is replaced with a new assembly. Refer to Fuel Filter Life Reset

FUEL FILTER ASSEMBLY REPLACEMENT (FWD)

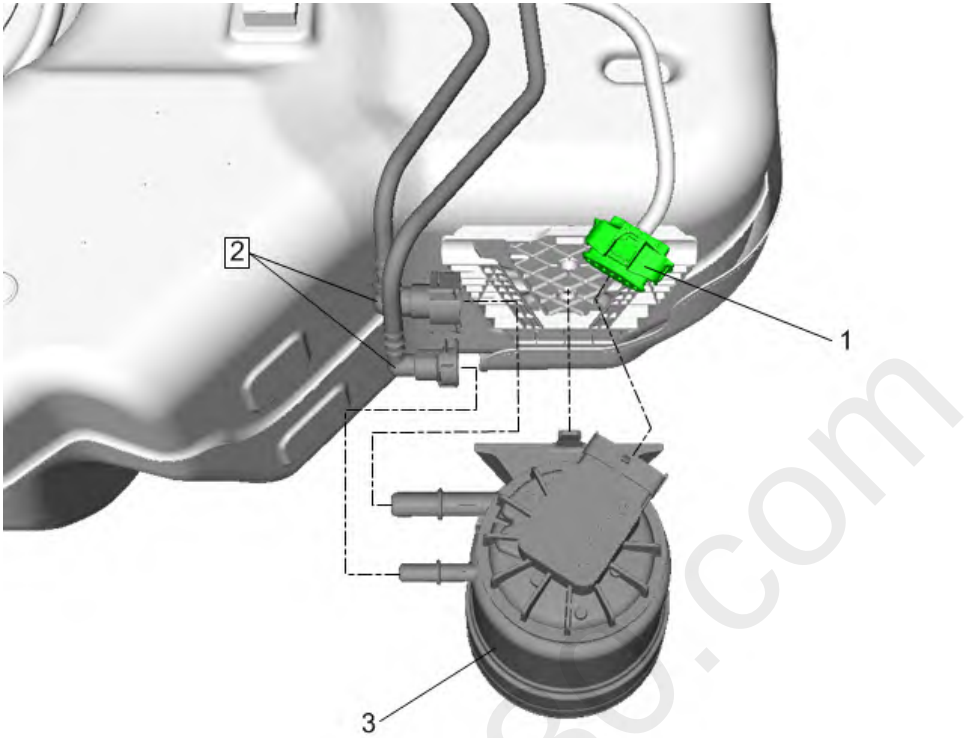


Fig. 54: Fuel Filter Assembly (FWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD)	
1	Electrical Connector
2	Fuel Hose (Qty: 2) Procedure Disconnect the fuel hoses from the fuel filter assembly. Refer to Plastic Collar Quick Connect Fitting Service
3	Fuel Filter Assembly Procedure 1. Release retaining tab and slide fuel filter assembly up to remove. 2. Reset fuel filter life monitor only is assembly is replaced with a new assembly. Refer to Fuel Filter Life Reset

FUEL FILTER REPLACEMENT (AWD)

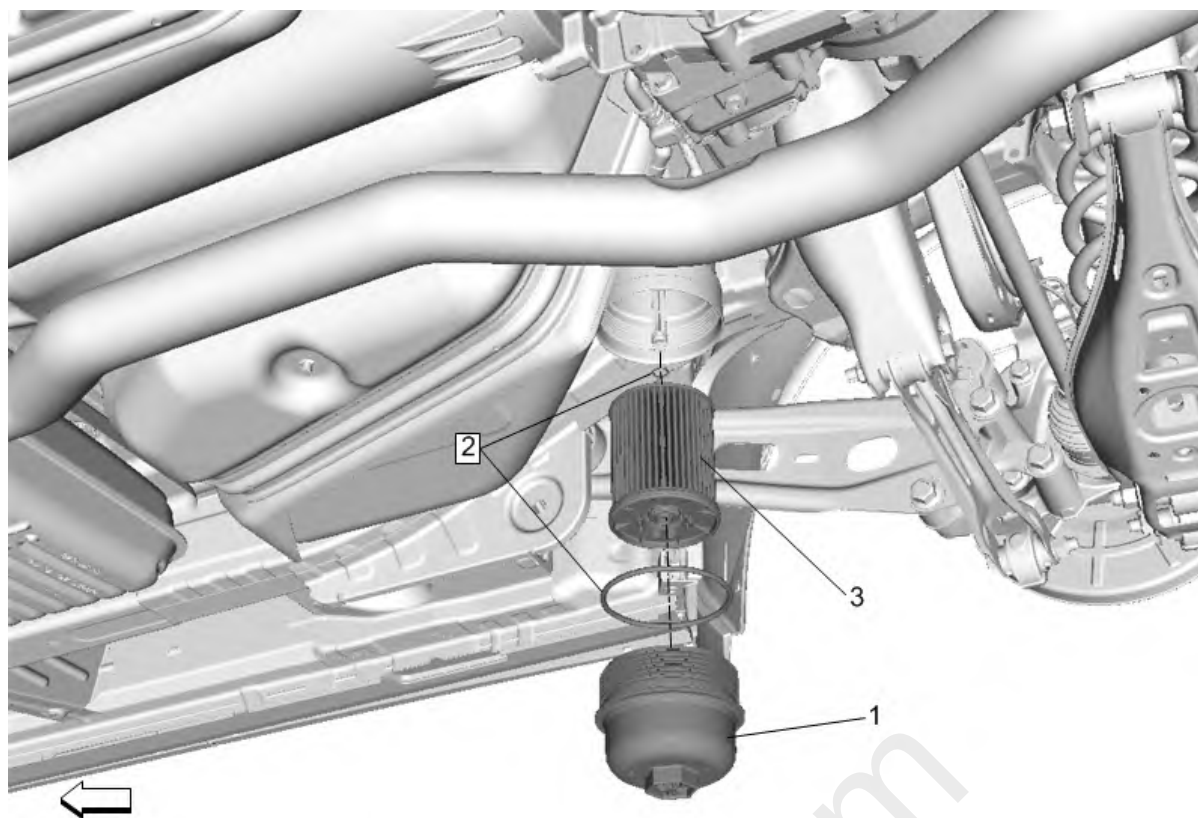


Fig. 55: Fuel Filter (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Drain the fuel from the fuel filter. Refer to Water-in-Fuel Draining	
1	Fuel/Water Separator Reservoir CAUTION: Refer to Component Fastener Tightening Caution . Tighten 25 N.m (18 lb ft)
2	Fuel Filter Seal (Qty: 2) NOTE: Install NEW seal.
3	Fuel Filter Procedure 1. Prime the fuel system. Refer to Fuel System Priming 2. Inspect for fuel leaks. 3. Reset fuel filter life monitor. Refer to Fuel Filter Life Reset

FUEL FILTER REPLACEMENT (FWD)

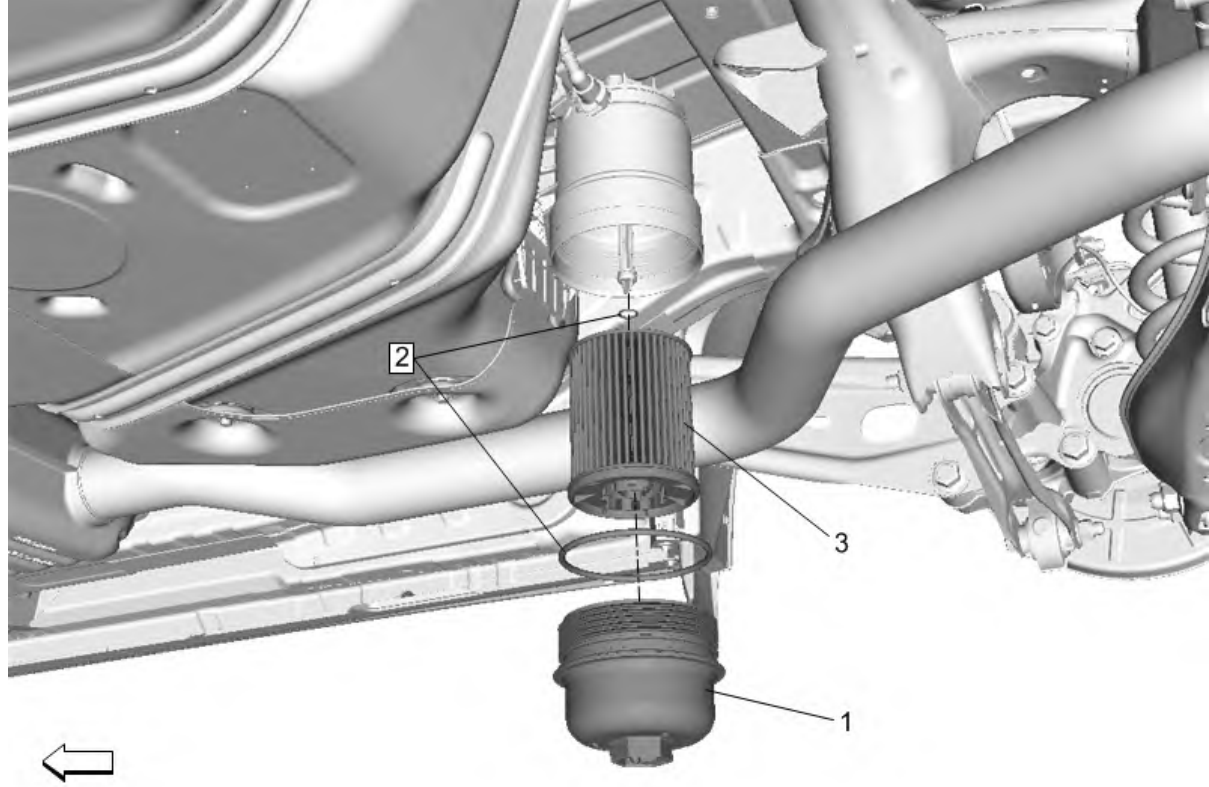


Fig. 56: Fuel Filter (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Drain the fuel from the fuel filter. Refer to Water-in-Fuel Draining	
1	Fuel/Water Separator Reservoir CAUTION: Refer to Component Fastener Tightening Caution . Tighten 25 N.m (18 lb ft)
2	Fuel Filter Seal (Qty: 2) NOTE: Install NEW seal.
3	Fuel Filter Procedure 1. Prime the fuel system. Refer to Fuel System Priming 2. Inspect for fuel leaks. 3. Reset fuel filter life monitor. Refer to Fuel Filter Life Reset

FUEL PUMP TO FUEL FILTER HOSE REPLACEMENT (AWD)

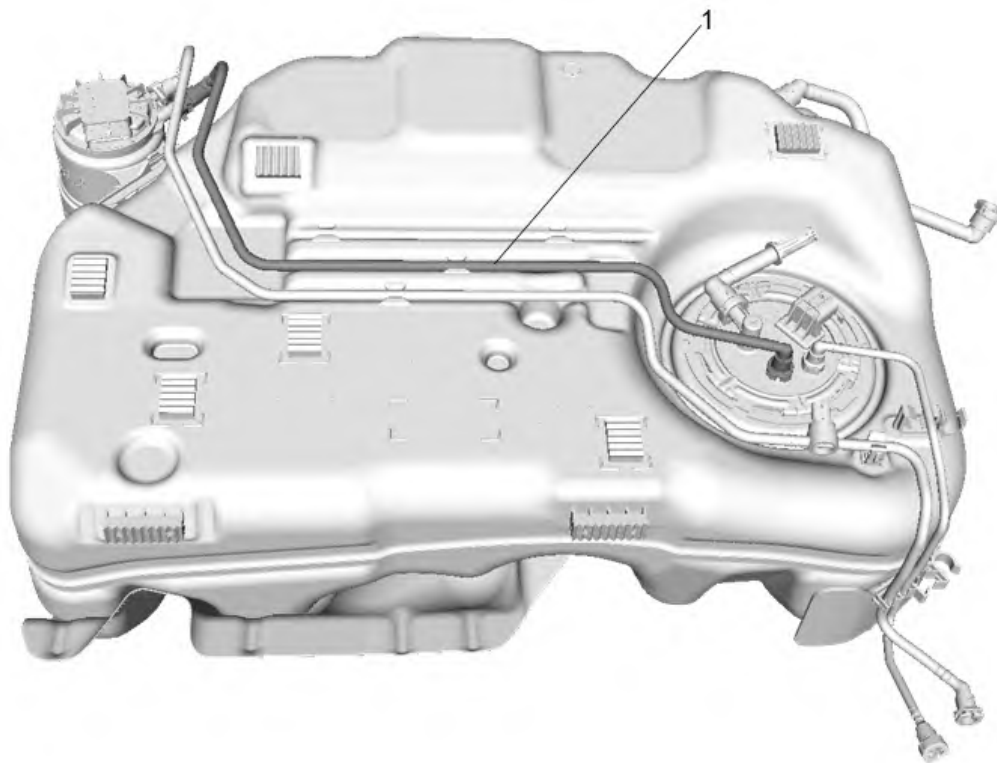


Fig. 57: Fuel Pump To Fuel Filter Hose (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Pump to Fuel Filter Hose Procedure Disconnect the fuel pump to fuel filter hose. Refer to Plastic Collar Quick Connect Fitting Service

FUEL PUMP TO FUEL FILTER HOSE REPLACEMENT (FWD)

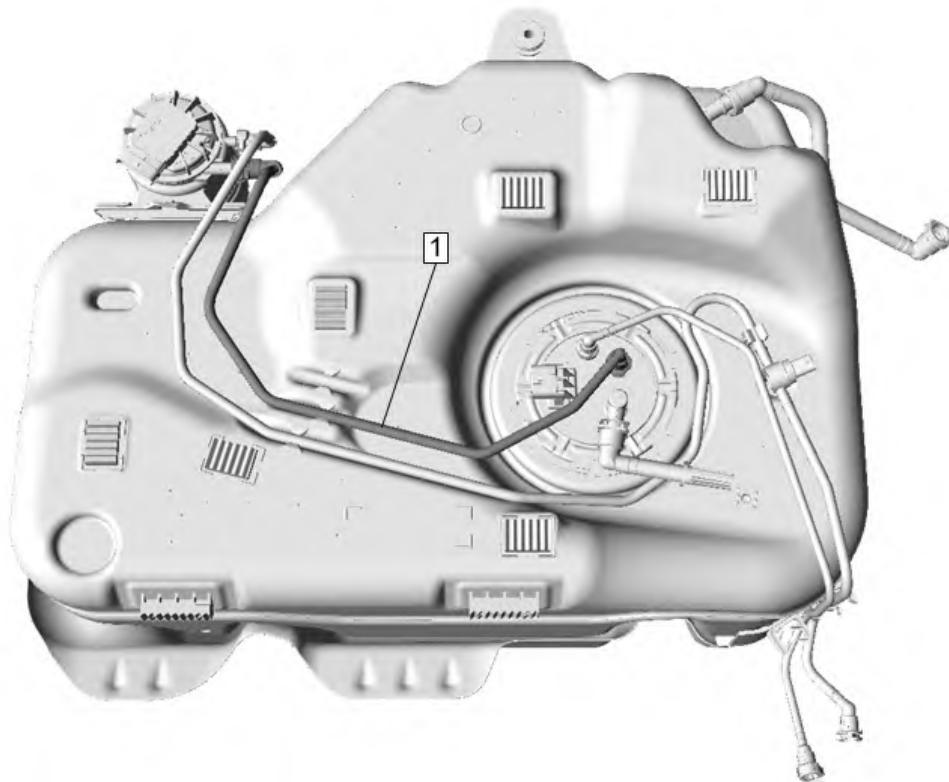


Fig. 58: Fuel Pump To Fuel Filter Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD) .	
1	Fuel Pump to Fuel Filter Hose Procedure Disconnect the fuel pump to fuel filter hose. Refer to Plastic Collar Quick Connect Fitting Service

WATER-IN-FUEL DRAINING

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
2. Attach a small piece of hose to the fuel filter drain plug.
3. Place an approved fuel-resistant container under the fuel filter.



Fig. 59: Fuel Filter Drain Plug

Courtesy of GENERAL MOTORS COMPANY

4. Open the fuel filter drain plug (1) until the water contaminated fuel seeps from the fuel filter drain plug.
5. With the engine off, press and hold ENGINE START/STOP button without applying the brake for five seconds to place the vehicle in Service Mode. Wait approximately five seconds, and then press ENGINE START/STOP again to turn it off. This operation will enhance water flow out of the filter. Repeat step until only diesel fuel is visible.

CAUTION: Refer to Component Fastener Tightening Caution .

6. Tighten the fuel filter drain plug to 1.6 N.m (14 lb in).
7. Remove the container and hose.
8. Start the engine and let it run for a few minutes. During the draining process, air may have entered the fuel system. If the engine stalls, the fuel system may need to be primed. Refer to Fuel System Priming
9. Inspect for fuel leaks.

FUEL TANK DRAINING

Special Tools

CH 45004 Fuel Tank Siphon Hose

WARNING: Refer to Diesel/Gasoline Vapors Warning .

WARNING: Refer to Safety Glasses Warning .

1. Remove the fuel fill cap.

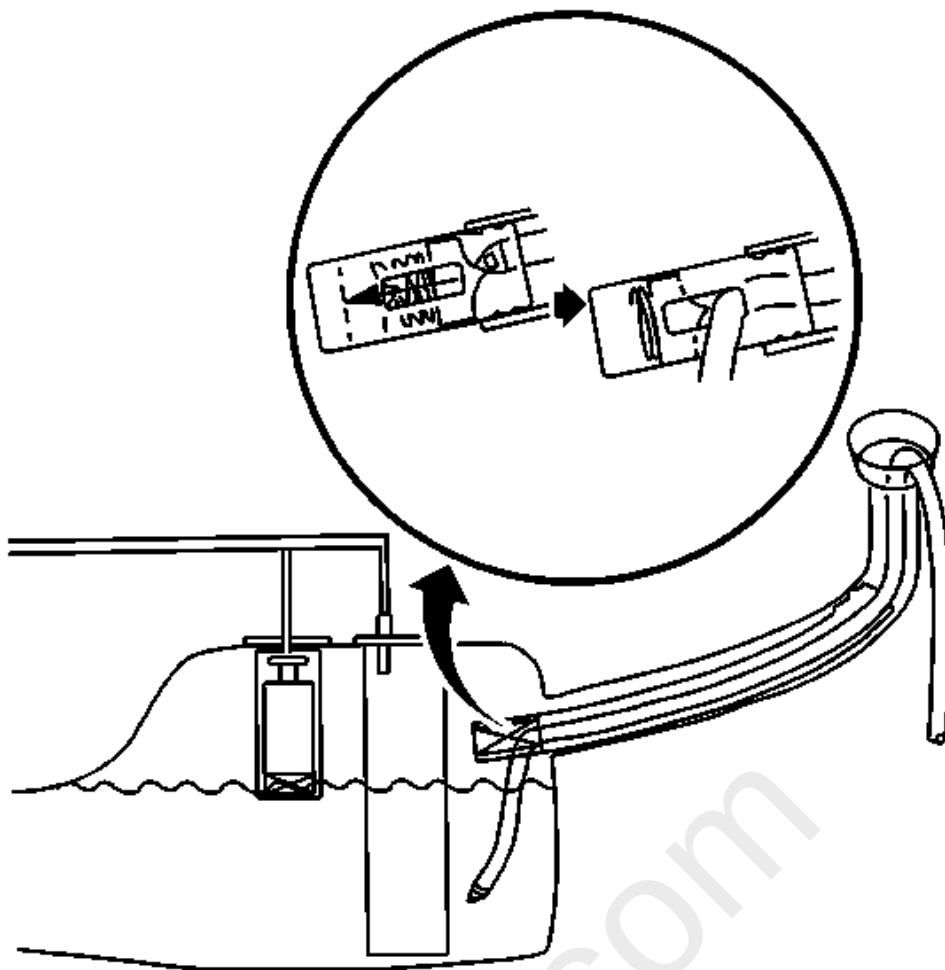


Fig. 60: Fuel Tank Draining Procedure
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the fuel drain hose with Transjel Lubricant or equivalent to aid in hose insertion.

2. Insert the **CH 45004** hose into the fuel tank filler pipe.
3. Attach the **CH 45004** hose to a hand or air operated pump device.
4. Using a hand or air operated pump drain as much fuel from the tank as possible.

FUEL TANK FILLER HOSE REPLACEMENT (AWD)

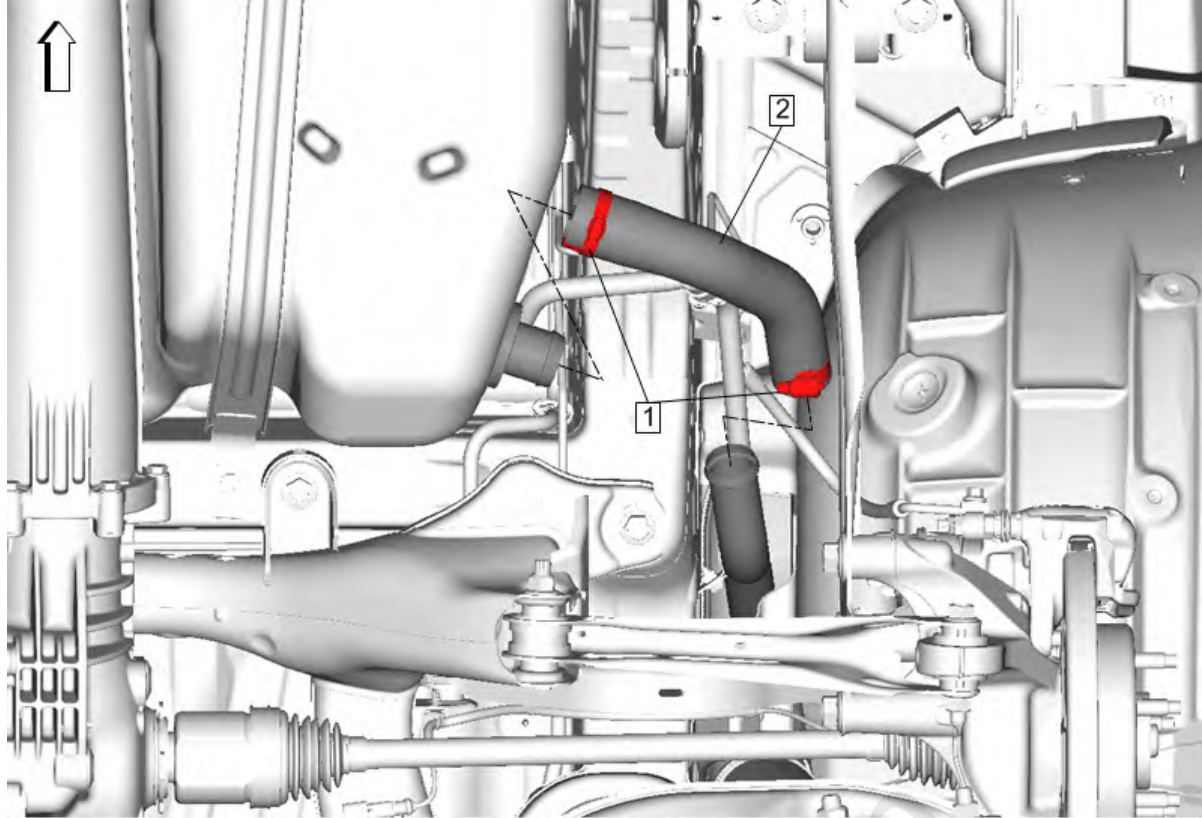


Fig. 61: Fuel Tank Filler Hose (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain fuel tank. Refer to Fuel Tank Draining 2. Raise and support vehicle. Refer to Lifting and Jacking the Vehicle	
1	Fuel Tank Filler Hose Clamp (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Fuel Tank Filler Hose

FUEL TANK FILLER HOSE REPLACEMENT (FWD)

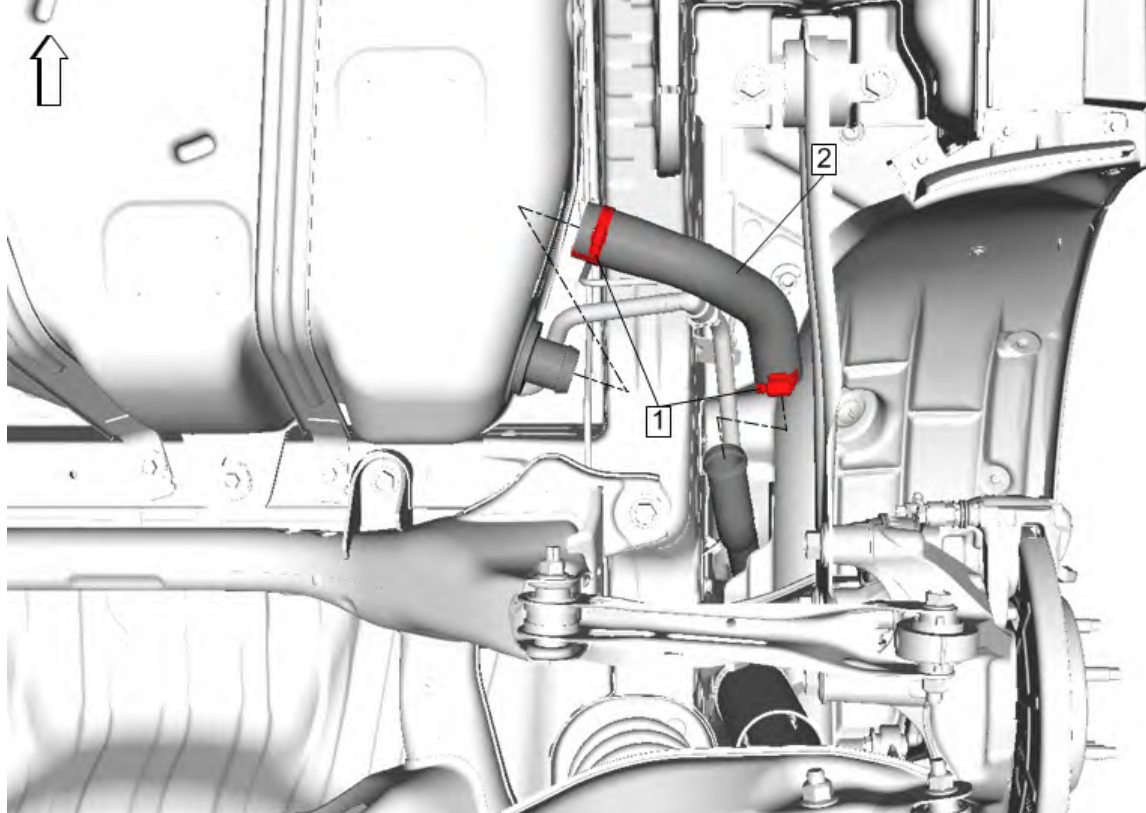


Fig. 62: Fuel Tank Filler Hose (FWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain fuel tank. Refer to Fuel Tank Draining 2. Raise and support vehicle. Refer to Lifting and Jacking the Vehicle	
1	Fuel Tank Filler Hose Clamp (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Fuel Tank Filler Hose

FUEL TANK REPLACEMENT (AWD)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Drain the fuel tank. Refer to [Fuel Tank Draining](#)
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)
4. Remove Exhaust Muffler Assembly. Refer to [Exhaust Muffler Replacement \(LH7\)](#)
5. Remove Driveline Torque Tube. Refer to [Driveline Torque Tube Replacement](#)

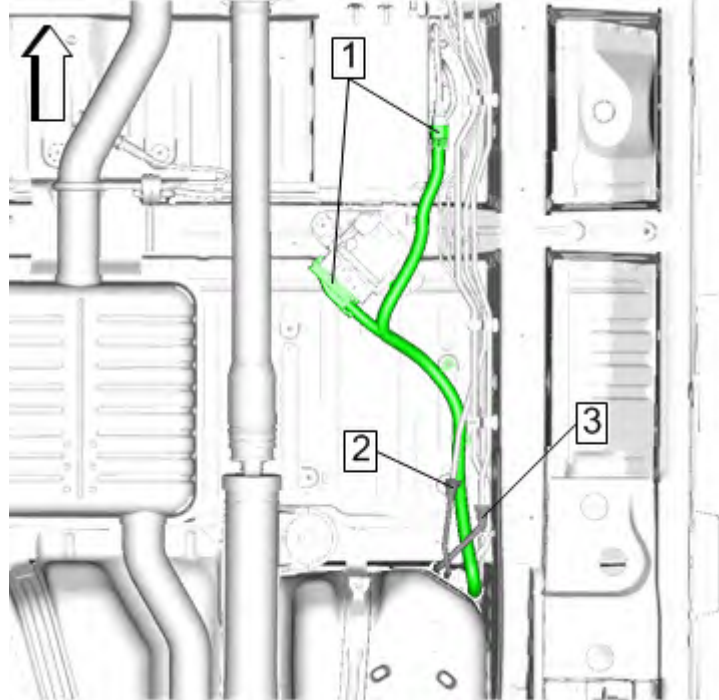


Fig. 63: Fuel Tank Fuel Pump Module Wiring Harness, Fuel Pump Fuel Return Hose And Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Fuel Tank Fuel Pump Module Wiring Harness (1) (Qty: 2)
7. Disconnect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
8. Disconnect Fuel Pump Fuel Feed Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)

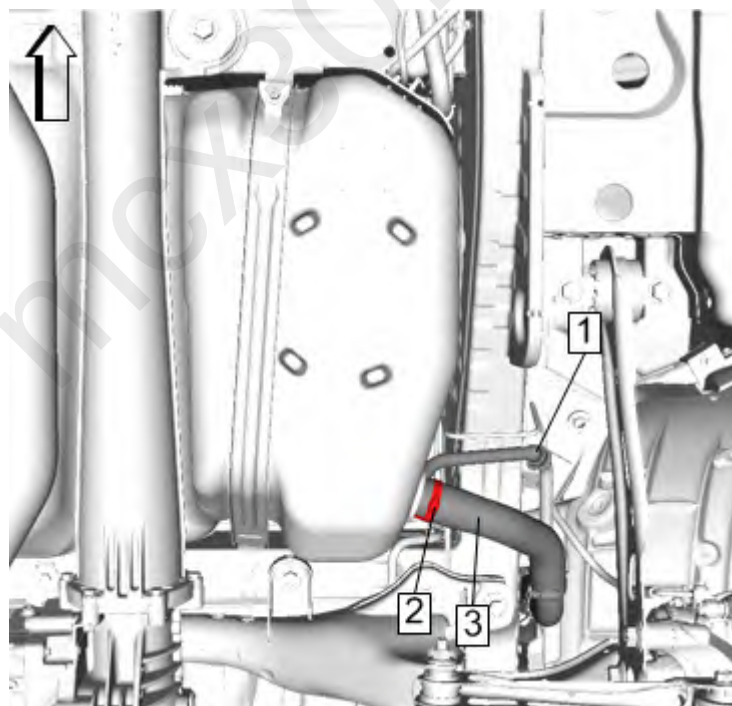


Fig. 64: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)
10. Remove Fuel Tank Filler Hose Clamp (2)
11. Remove Fuel Tank Filler Hose (3)

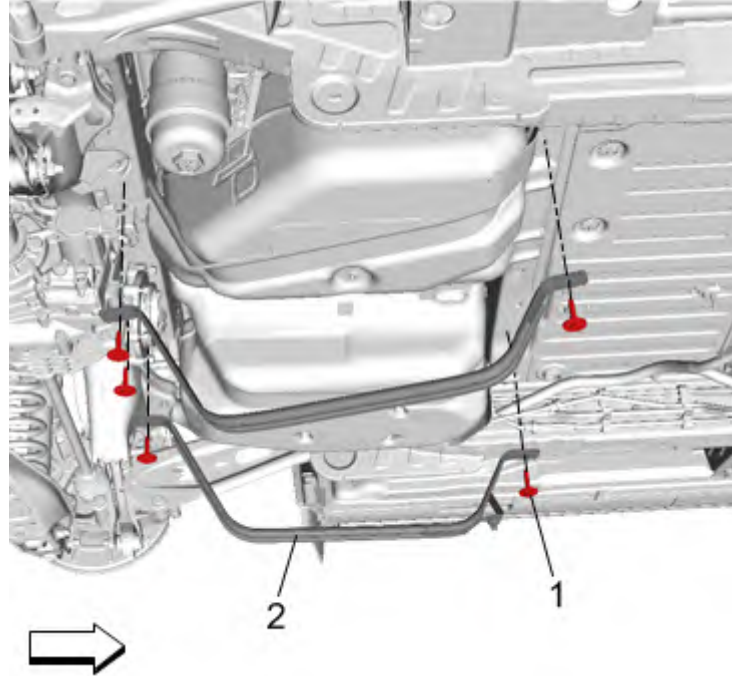


Fig. 65: Fuel Tank Straps And Bolts

Courtesy of GENERAL MOTORS COMPANY

12. Place a suitable adjustable jack under the fuel tank.
13. Remove Fuel Tank Strap Bolts (1) (Qty: 5)
14. Remove Fuel Tank Straps (2) (Qty: 2)

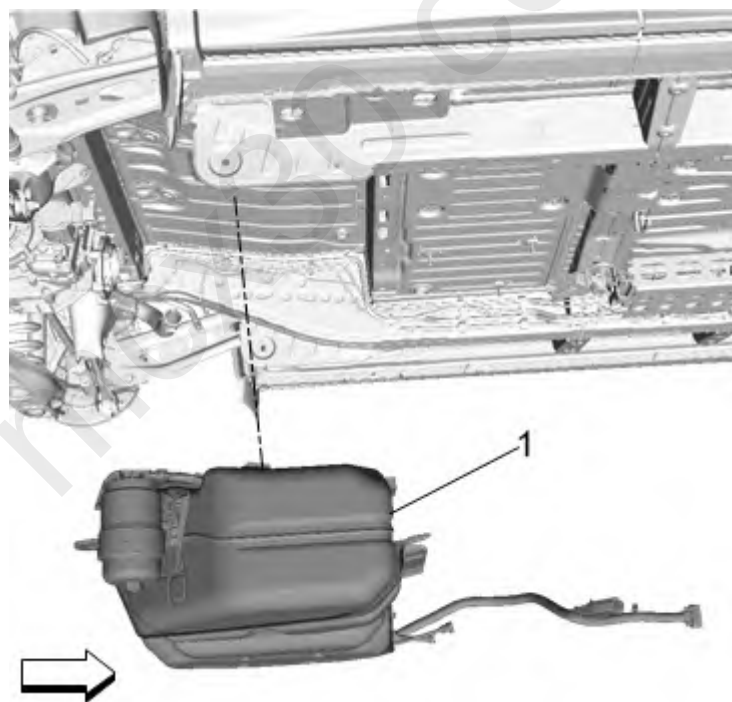


Fig. 66: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

15. Remove Fuel Tank (1)
16. If replacing fuel tank transfer parts as necessary.

Installation Procedure

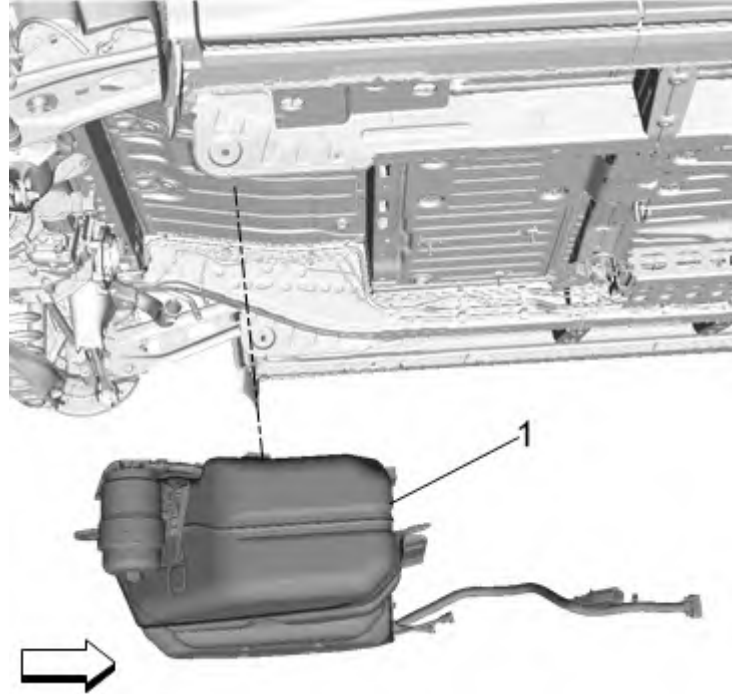


Fig. 67: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

1. Place a suitable adjustable jack under the fuel tank.
2. Install Fuel Tank (1)

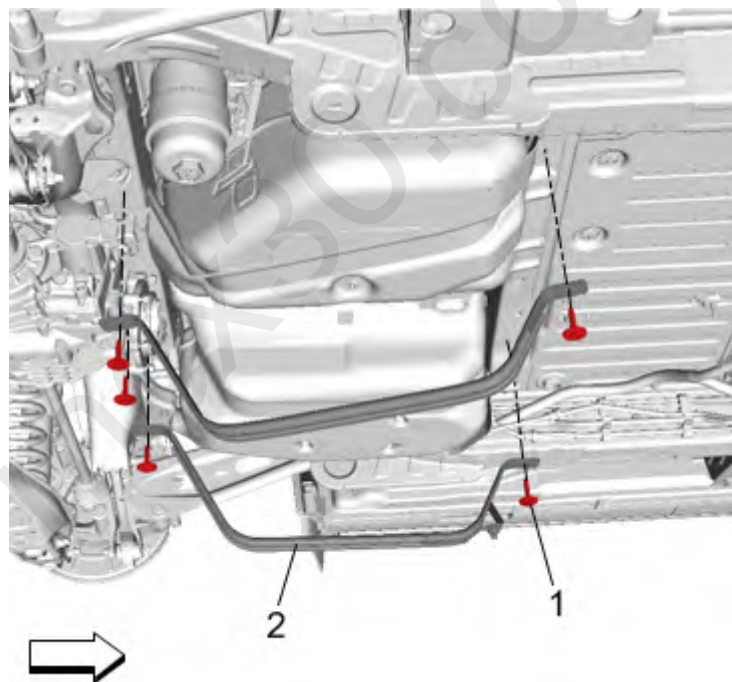


Fig. 68: Fuel Tank Straps And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install Fuel Tank Straps (2) (Qty: 2)

CAUTION: Refer to [Fastener Caution](#) .

4. Install and tighten Fuel Tank Strap Bolts (1) (Qty: 5) to 22 N.m (16 lb ft)

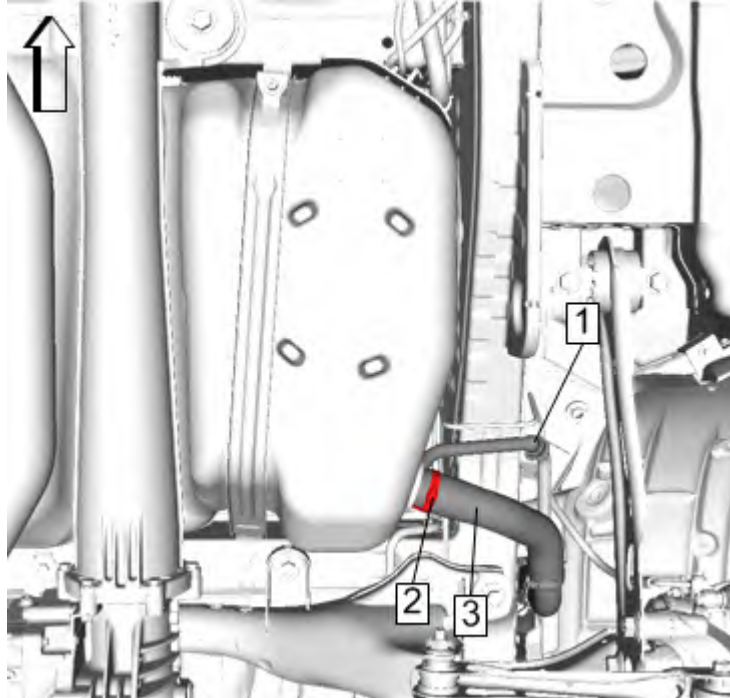


Fig. 69: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Tank Filler Hose (3)
6. Install and tighten Fuel Tank Filler Hose Clamp (2) and tighten to 4 N.m (35 lb in)
7. Connect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)

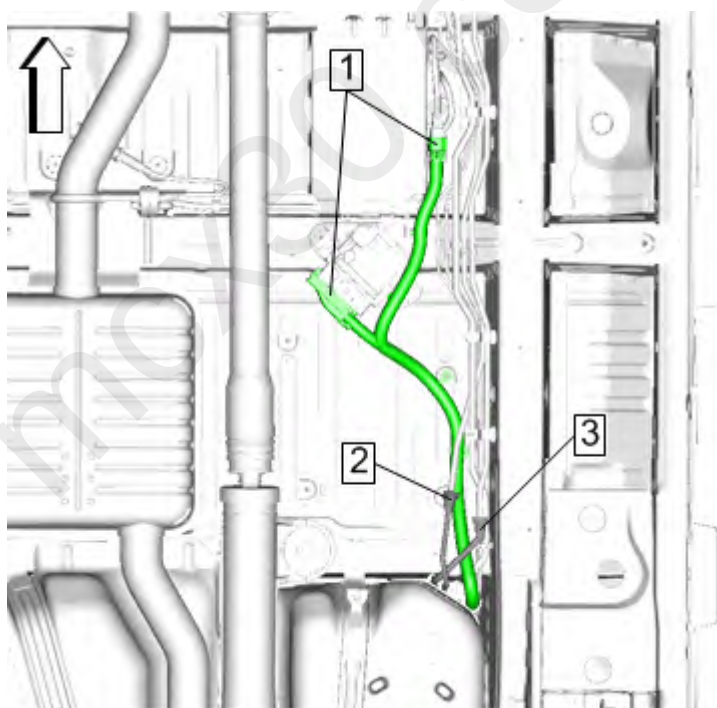


Fig. 70: Fuel Tank Fuel Pump Module Wiring Harness, Fuel Pump Fuel Return Hose And Fuel Pump Fuel Feed Hose
Courtesy of GENERAL MOTORS COMPANY

8. Connect Fuel Pump Fuel Feed Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
9. Connect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
10. Connect Fuel Tank Fuel Pump Module Wiring Harness (1) (Qty: 2)
11. Install Driveline Torque Tube. Refer to [Driveline Torque Tube Replacement](#)
12. Install Exhaust Muffler Assembly. Refer to [Exhaust Muffler Replacement \(LH7\)](#)
13. Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)

14. Lower the vehicle.
15. Refill the fuel tank.
16. Prime the fuel system. Refer to [Fuel System Priming](#)
17. Inspect for fuel leaks.

FUEL TANK REPLACEMENT (FWD)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Drain the fuel tank. Refer to [Fuel Tank Draining](#)
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#) [Underbody Rear Air Deflector Replacement \(Diesel\)](#).
4. Remove Exhaust Muffler Assembly. Refer to [Exhaust Muffler Replacement \(LH7\)](#).



Fig. 71: Fuel Tank Fuel Pump Module Wiring Harness, Fuel Pump Fuel Return Hose And Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Fuel Tank Fuel Pump Module Wiring Harness (1) (Qty: 2)
6. Disconnect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
7. Disconnect Fuel Pump Fuel Feed Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)

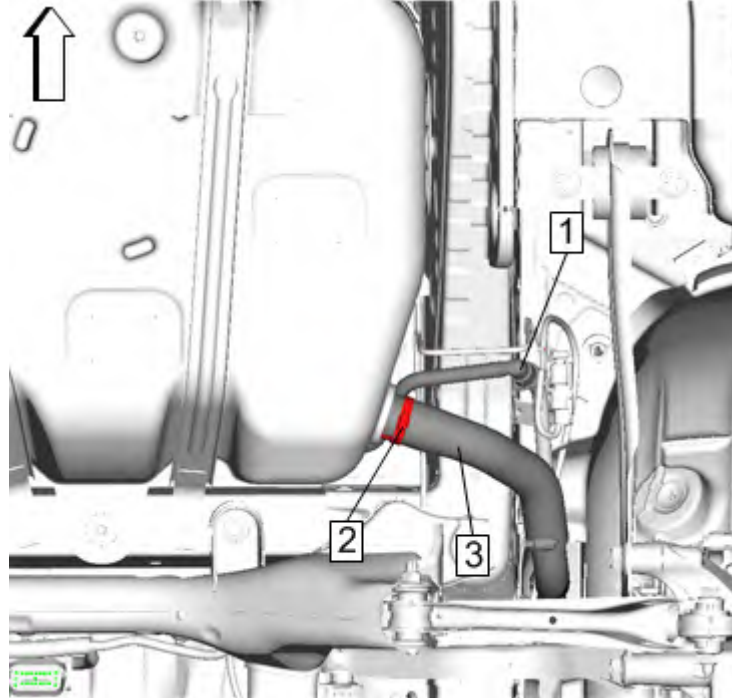


Fig. 72: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp
 Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)
9. Remove Fuel Tank Filler Hose Clamp (2)
10. Remove Fuel Tank Filler Hose (3)

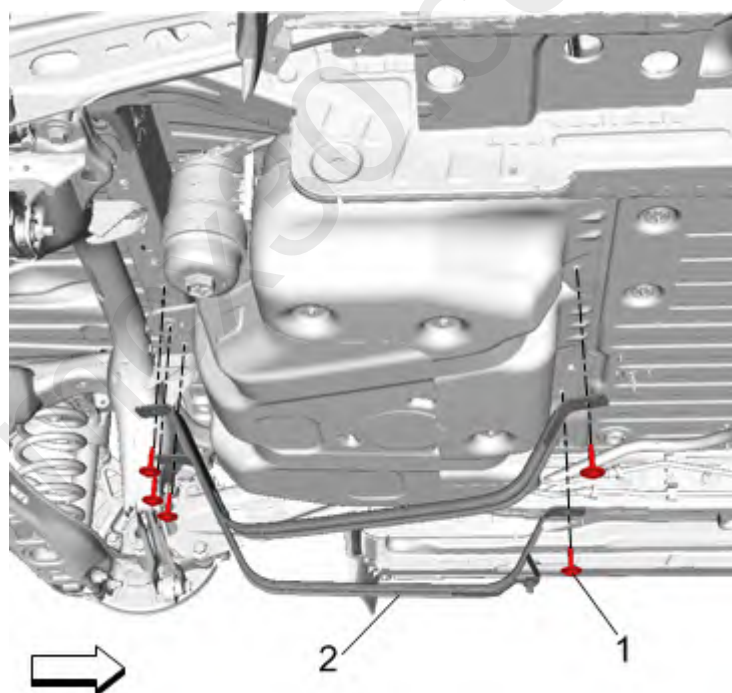


Fig. 73: Fuel Tank Straps And Bolts
 Courtesy of GENERAL MOTORS COMPANY

11. Place a suitable adjustable jack under the fuel tank.
12. Remove Fuel Tank Strap Bolts (1) (Qty: 5)
13. Remove Fuel Tank Straps (2) (Qty: 2)

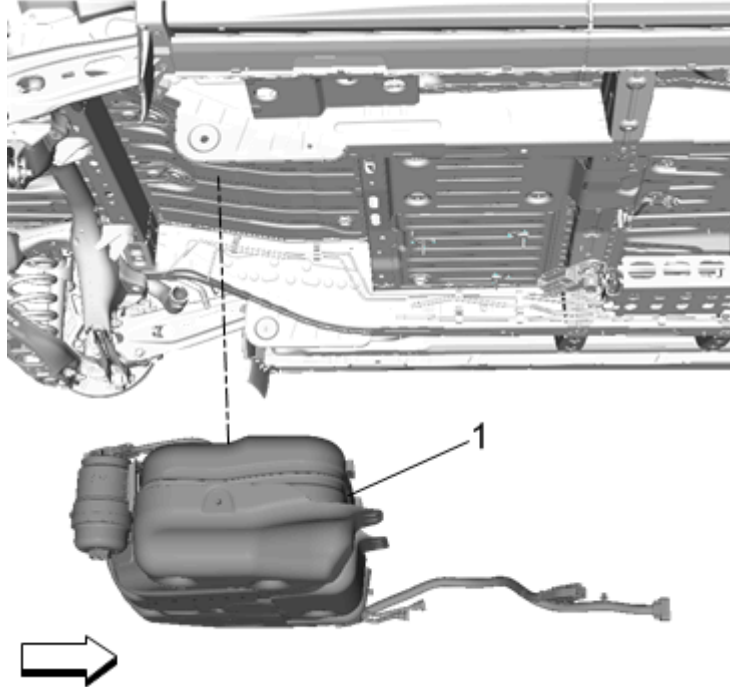


Fig. 74: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

14. Remove Fuel Tank (1)
15. If replacing fuel tank transfer parts as necessary.

Installation Procedure

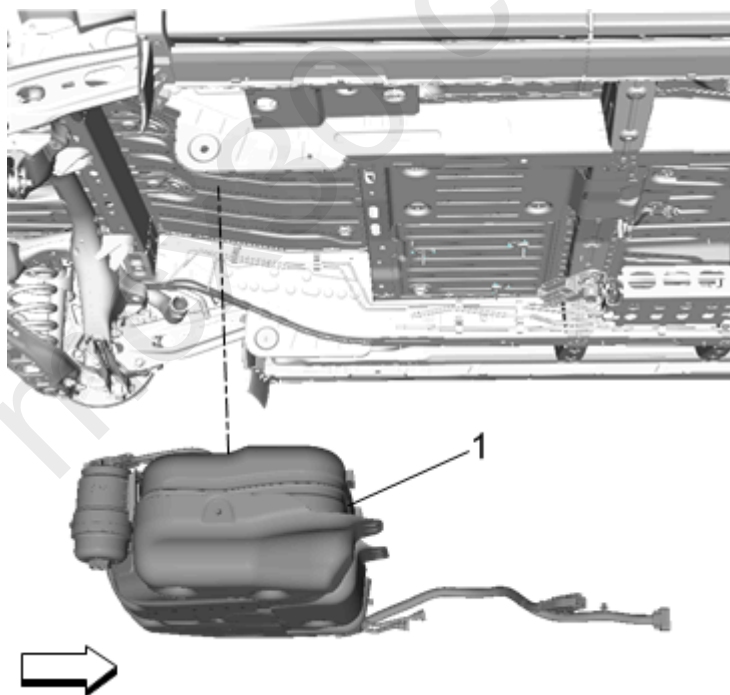


Fig. 75: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

1. Place a suitable adjustable jack under the fuel tank.
2. Install Fuel Tank (1)

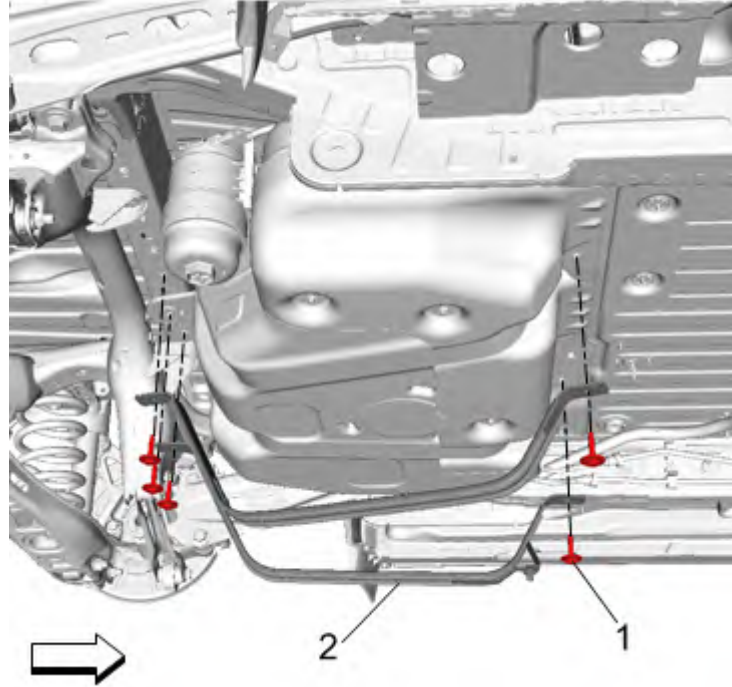


Fig. 76: Fuel Tank Straps And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install Fuel Tank Straps (2) (Qty: 2)

CAUTION: Refer to [Fastener Caution](#) .

4. Install and tighten Fuel Tank Strap Bolts (1) (Qty: 5) to 22 N.m (16 lb ft)

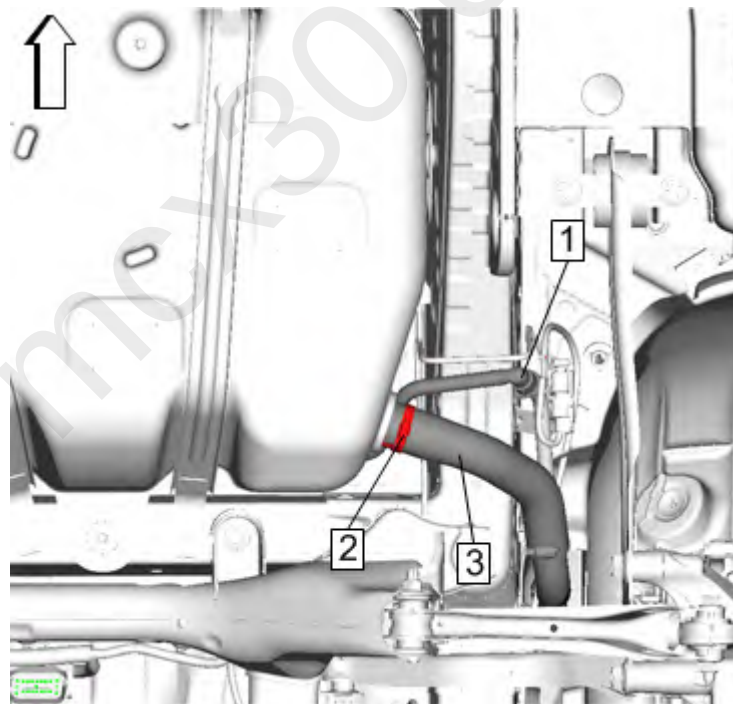


Fig. 77: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Tank Filler Hose (3)
6. Install and tighten Fuel Tank Filler Hose Clamp (2) to 4 N.m (35 lb in)
7. Connect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)



Fig. 78: Fuel Tank Fuel Pump Module Wiring Harness, Fuel Pump Fuel Return Hose And Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

8. Connect Fuel Pump Fuel Feed Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
9. Connect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
10. Connect Fuel Tank Fuel Pump Module Wiring Harness (1) (Qty: 2)
11. Install Exhaust Muffler Assembly. Refer to [Exhaust Muffler Replacement \(LH7\)](#).
12. Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#) [Underbody Rear Air Deflector Replacement \(Diesel\)](#).
13. Lower the vehicle.
14. Refill the fuel tank.
15. Prime the fuel system. Refer to [Fuel System Priming](#)
16. Inspect for fuel leaks.

FUEL TANK SHIELD REPLACEMENT (AWD)

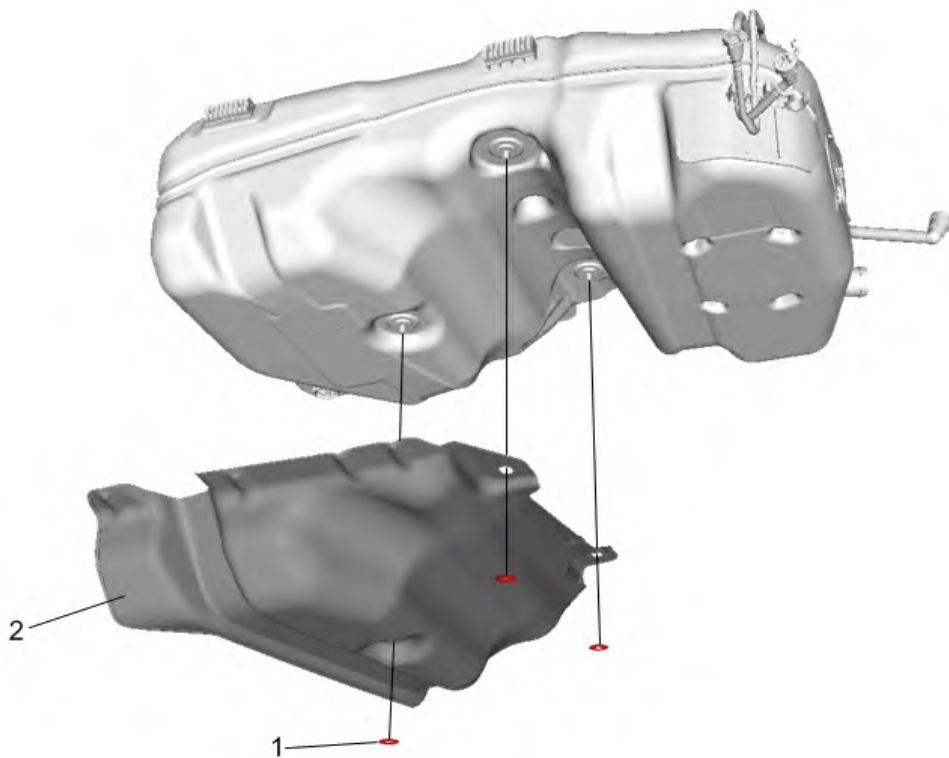


Fig. 79: Fuel Tank Shield (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Tank Shield Retainer (Qty: 3)
2	Fuel Tank Shield

FUEL TANK SHIELD REPLACEMENT (FWD)

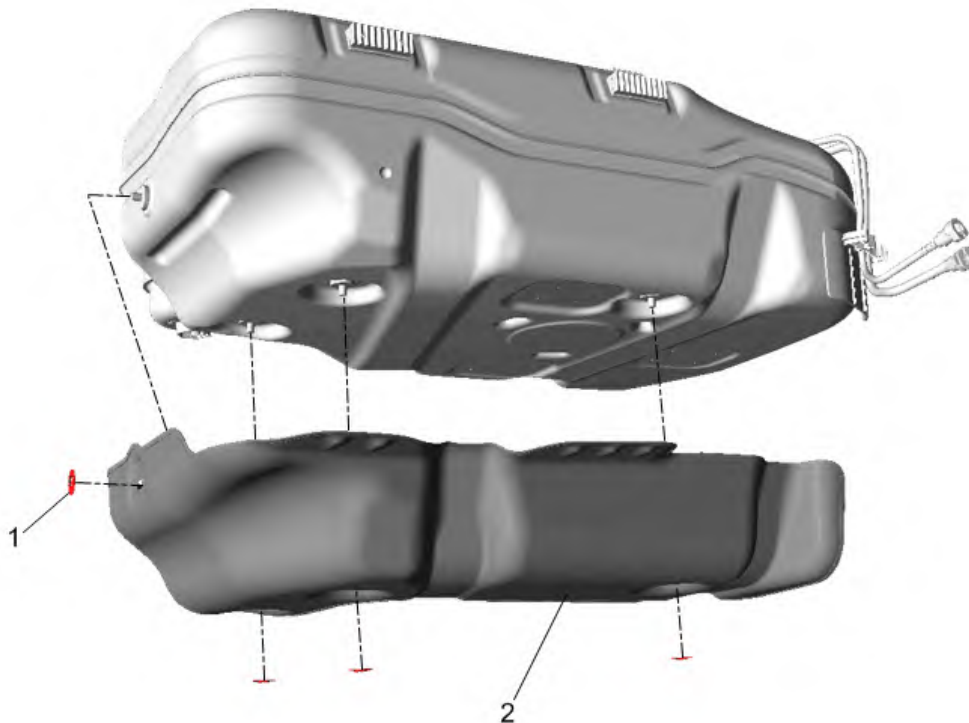


Fig. 80: Fuel Tank Shield (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to <u>Diesel/Gasoline Vapors Warning</u> . WARNING: Refer to <u>Safety Glasses Warning</u> . Preliminary Procedure Remove Fuel Tank. Refer to <u>Fuel Tank Replacement (FWD)</u> .	
1	Fuel Tank Shield Retainer (Qty: 4)
2	Fuel Tank Shield

FUEL TANK VENT REPLACEMENT (AWD)

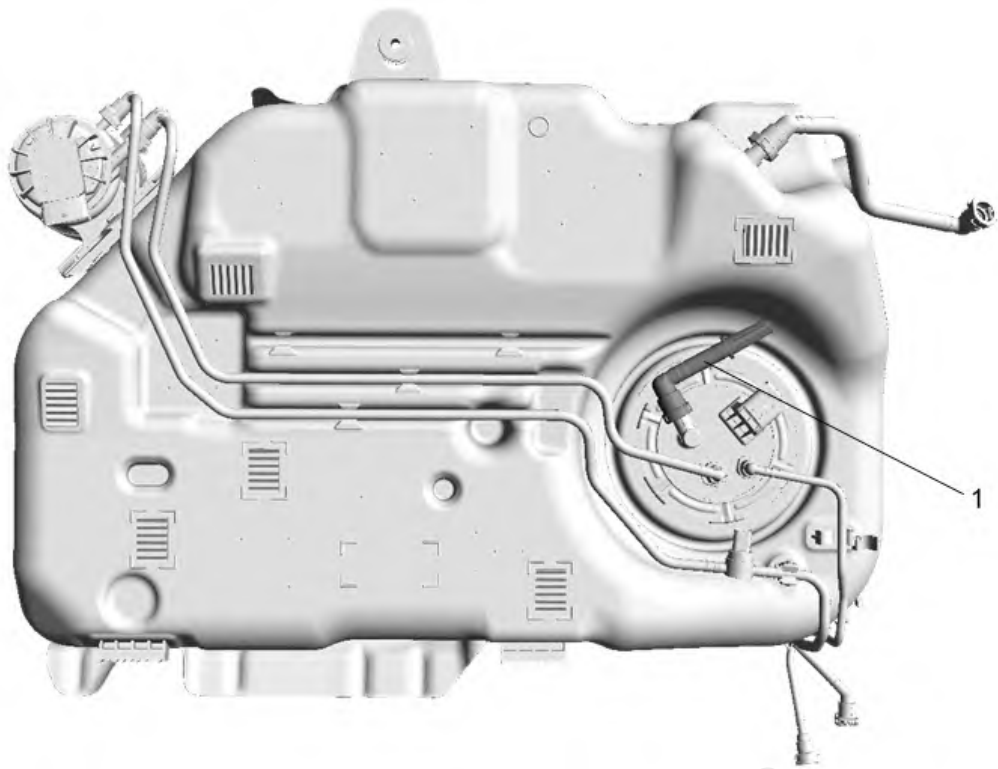


Fig. 81: Fuel Tank Vent (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Tank Vent Procedure Disconnect the fuel tank vent. Refer to Plastic Collar Quick Connect Fitting Service

FUEL TANK VENT REPLACEMENT (FWD)

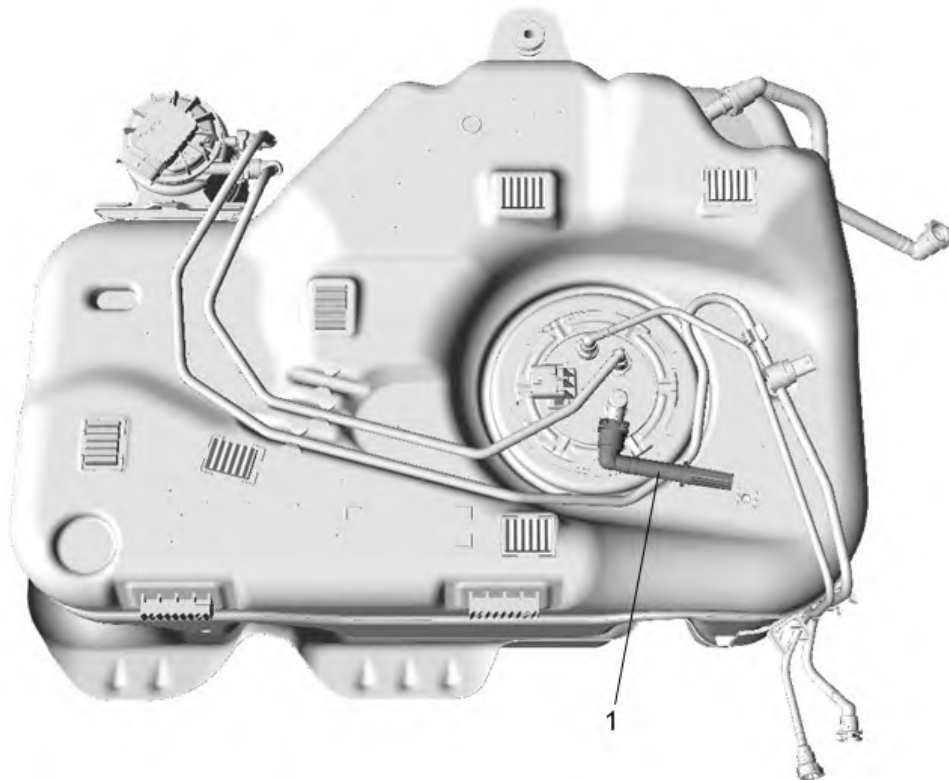


Fig. 82: Fuel Tank Vent (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD) .	
1	Fuel Tank Vent Procedure Disconnect the fuel tank vent. Refer to Plastic Collar Quick Connect Fitting Service

FUEL TANK VENT HOSE REPLACEMENT (FWD)

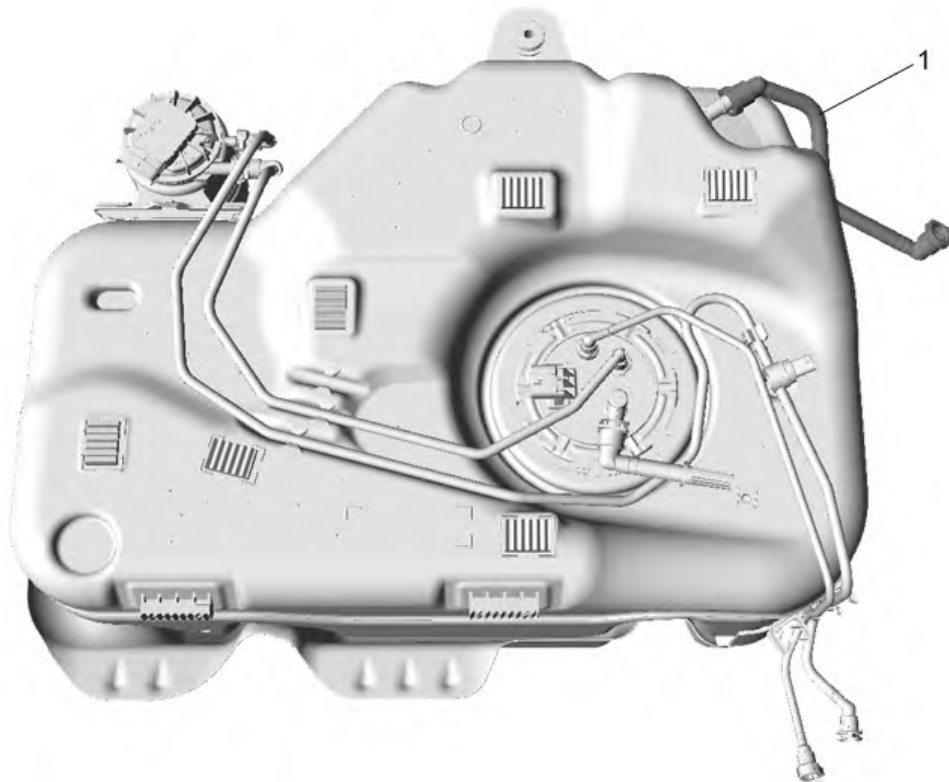


Fig. 83: Fuel Tank Vent Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD) .	
1	Fuel Tank Vent Hose Procedure Disconnect the fuel tank vent hose. Refer to Plastic Collar Quick Connect Fitting Service

FUEL TANK VENT HOSE REPLACEMENT (AWD)

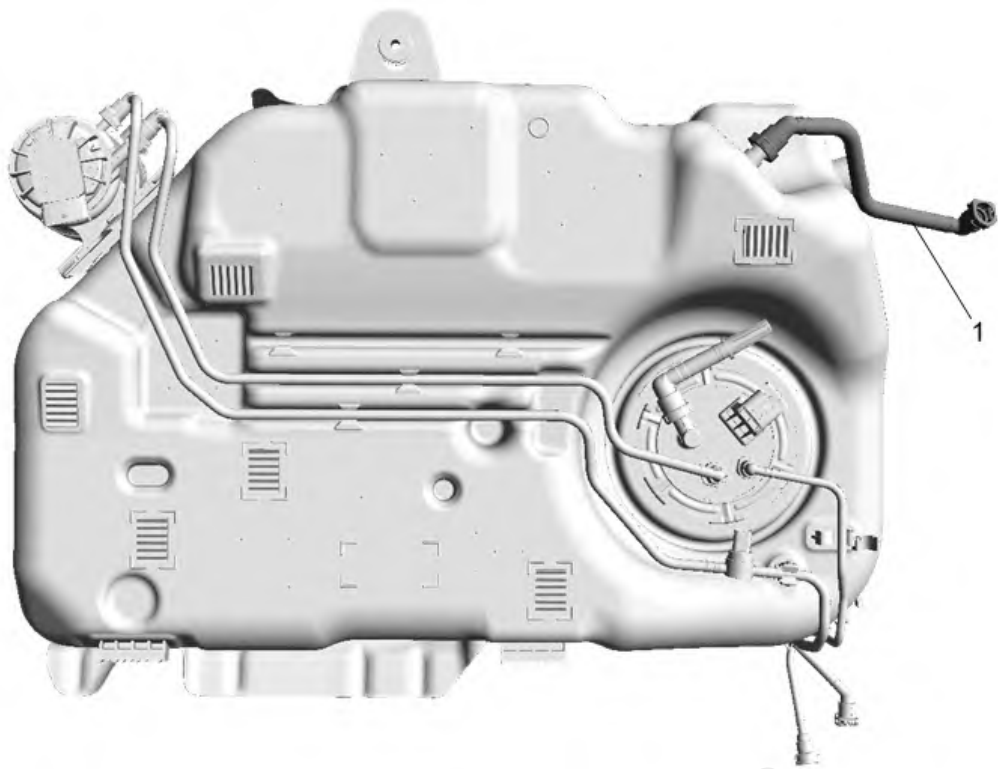


Fig. 84: Fuel Tank Vent Hose (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Tank Vent Hose Procedure Disconnect the fuel tank vent hose. Refer to Plastic Collar Quick Connect Fitting Service

FUEL TANK FUEL PUMP MODULE REPLACEMENT (FWD)

Special Tools

CH 52075 Fuel Sender Lock Ring Wrench

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Mechanical Tools\)](#)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Remove Fuel Tank. Refer to [Fuel Tank Replacement \(FWD\)](#).

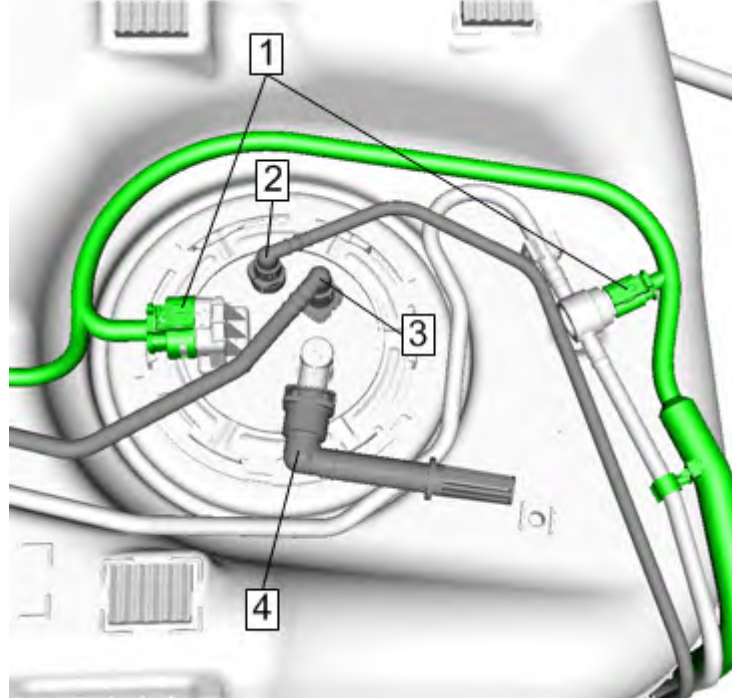


Fig. 85: Electrical Connectors, Fuel Pump Fuel Return Hose, Fuel Pump To Fuel Filter Hose And Fuel Tank Vent

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connectors (1) (Qty: 2)
3. Disconnect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
4. Disconnect Fuel Pump to Fuel Filter Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
5. Disconnect Fuel Tank Vent (4). Refer to [Plastic Collar Quick Connect Fitting Service](#)

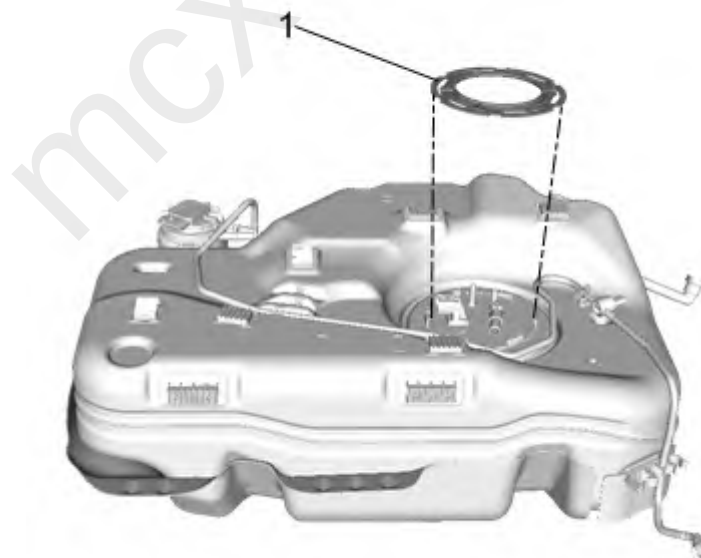


Fig. 86: Fuel Pump Lock Ring

Courtesy of GENERAL MOTORS COMPANY

6. Remove Fuel Pump Lock Ring (1) - **CH 52075** Fuel Sender Lock Ring Wrench

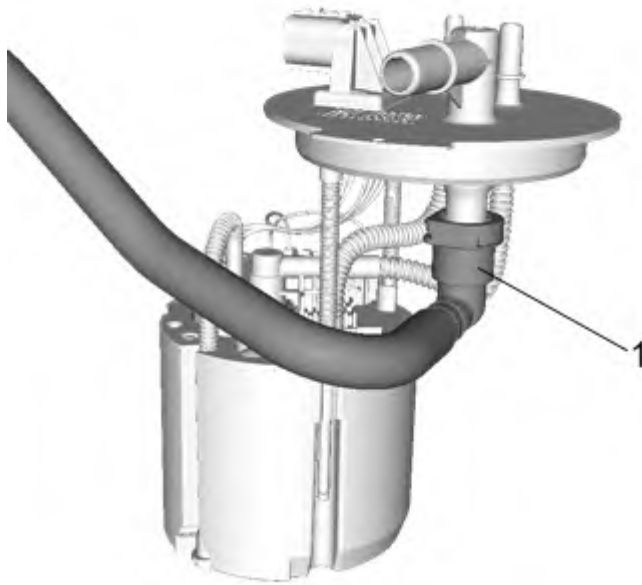


Fig. 87: Fuel Tank Vent Hose

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)

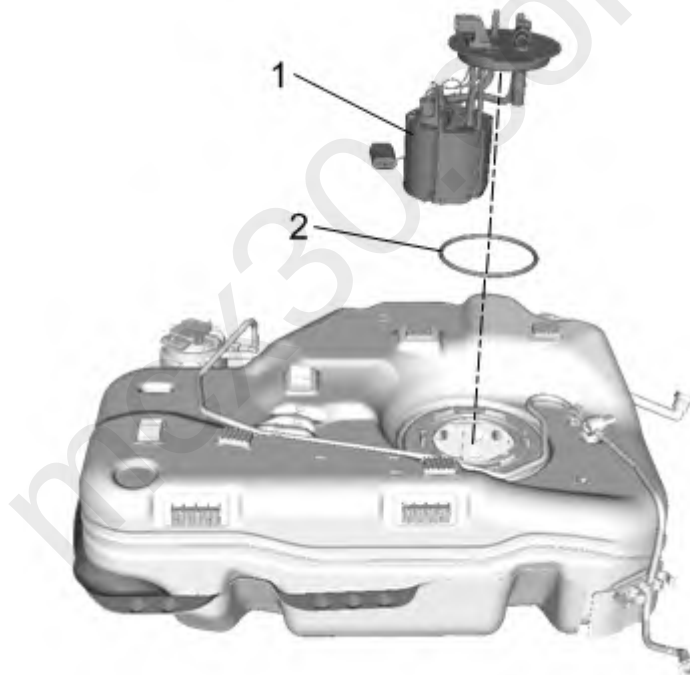


Fig. 88: Fuel Tank Fuel Pump Module And O-Ring

Courtesy of GENERAL MOTORS COMPANY

8. Remove Fuel Tank Fuel Pump Module (1)
9. Remove and DISCARD O-Ring (2)

Installation Procedure

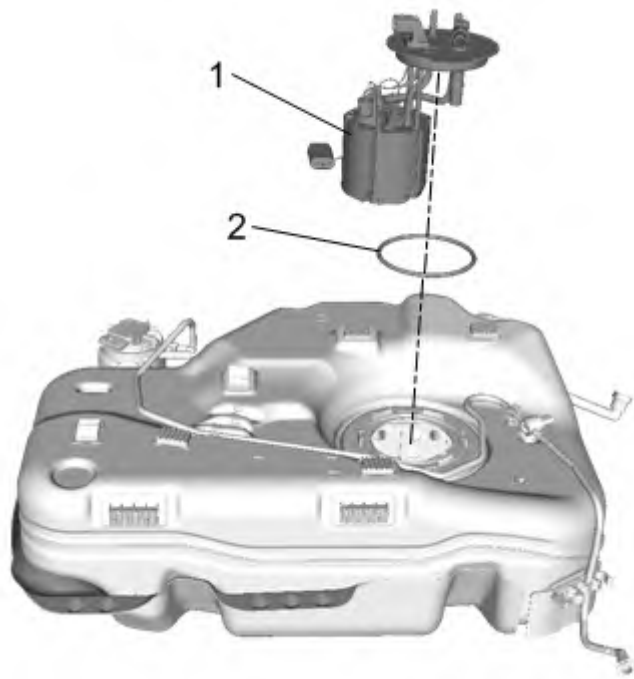


Fig. 89: Fuel Tank Fuel Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW O-Ring (2)
2. Install Fuel Tank Fuel Pump Module (1)

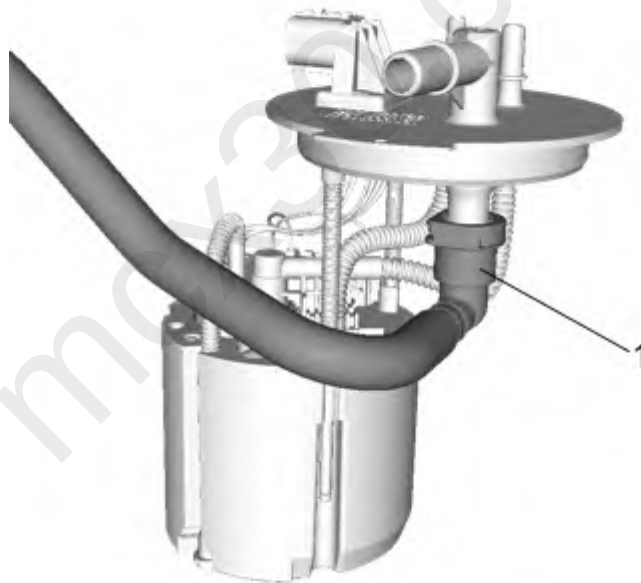


Fig. 90: Fuel Tank Vent Hose
Courtesy of GENERAL MOTORS COMPANY

3. Connect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)

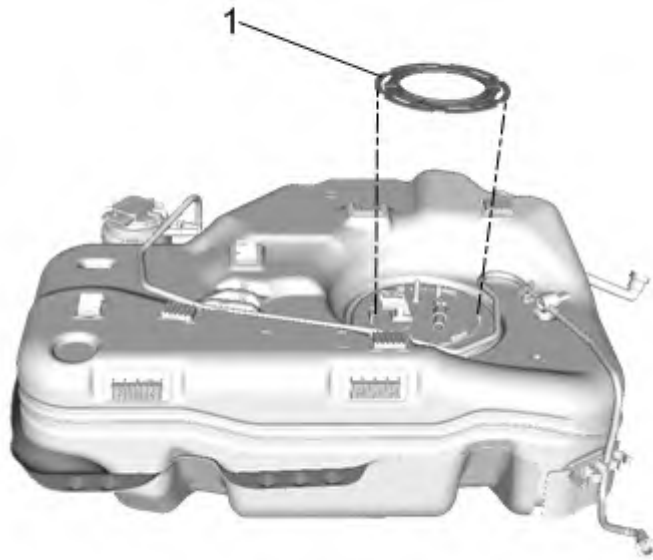


Fig. 91: Fuel Pump Lock Ring

Courtesy of GENERAL MOTORS COMPANY

4. Install Fuel Pump Lock Ring (1) - **CH 52075** Fuel Sender Lock Ring Wrench

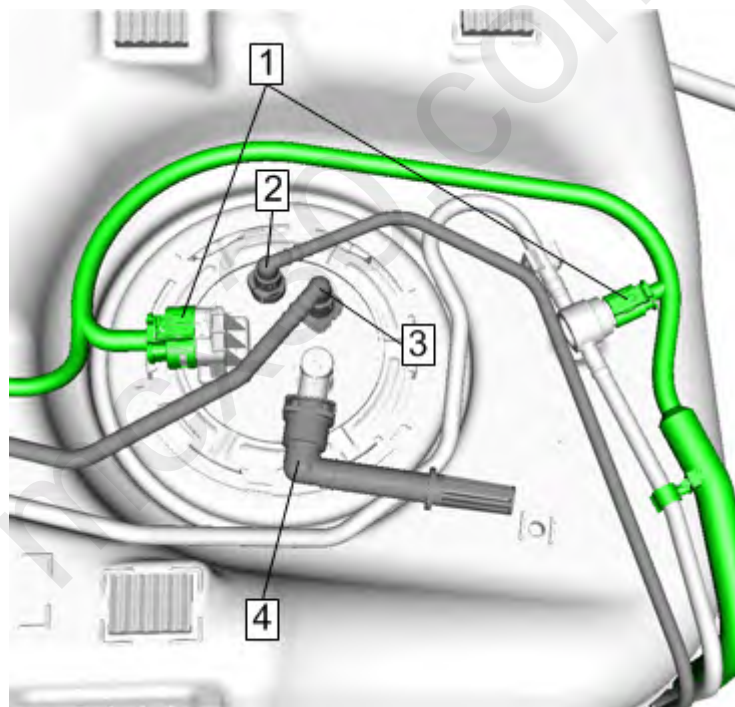


Fig. 92: Electrical Connectors, Fuel Pump Fuel Return Hose, Fuel Pump To Fuel Filter Hose And Fuel Tank Vent

Courtesy of GENERAL MOTORS COMPANY

5. Connect Fuel Tank Vent (4). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Connect Fuel Pump to Fuel Filter Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
7. Connect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
8. Connect Electrical Connectors (1) (Qty: 2)
9. Install Fuel Tank. Refer to [Fuel Tank Replacement \(AWD\)](#)

FUEL TANK FUEL PUMP MODULE REPLACEMENT (AWD)

Special Tools

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Mechanical Tools\)](#)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Remove Fuel Tank. Refer to [Fuel Tank Replacement \(AWD\)](#).

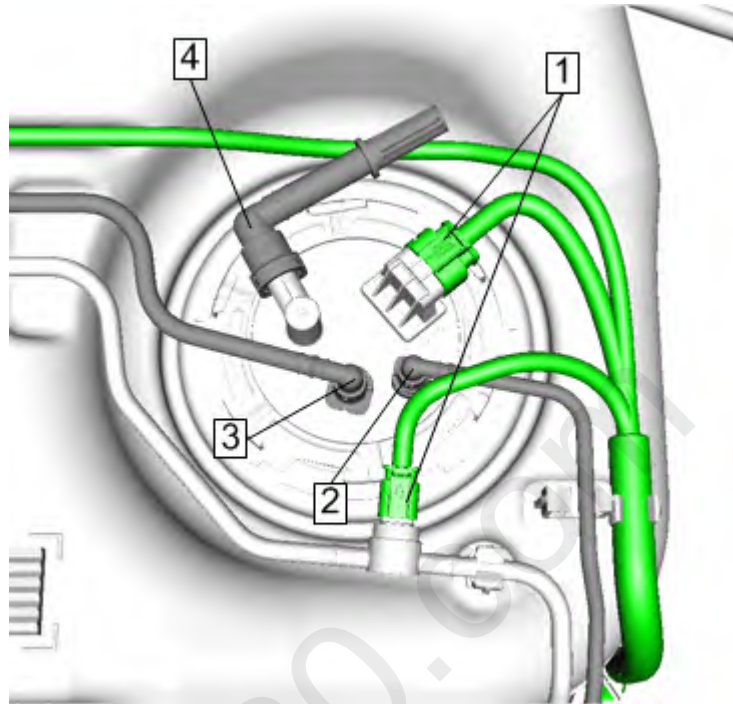


Fig. 93: Electrical Connectors, Fuel Pump Fuel Return Hose, Fuel Pump To Fuel Filter Hose And Fuel Tank Vent

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connectors (1) (Qty: 2)
3. Disconnect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
4. Disconnect Fuel Pump to Fuel Filter Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
5. Disconnect Fuel Tank Vent (4). Refer to [Plastic Collar Quick Connect Fitting Service](#)

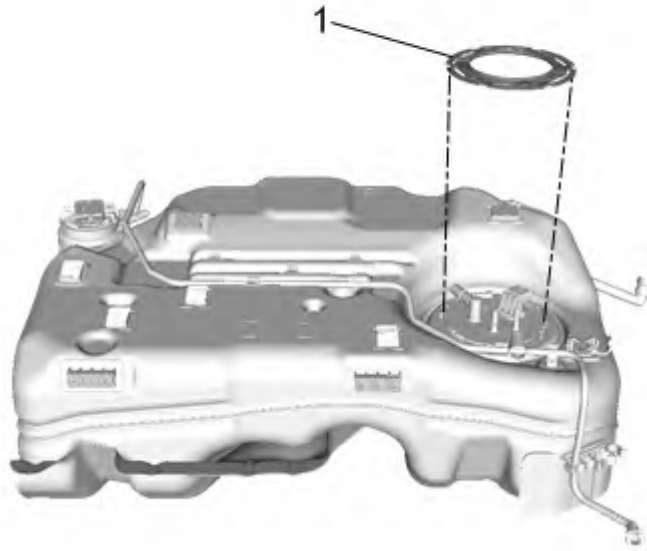


Fig. 94: Fuel Pump Lock Ring

Courtesy of GENERAL MOTORS COMPANY

6. Remove Fuel Pump Lock Ring (1) - **CH 52075** Fuel Sender Lock Ring Wrench

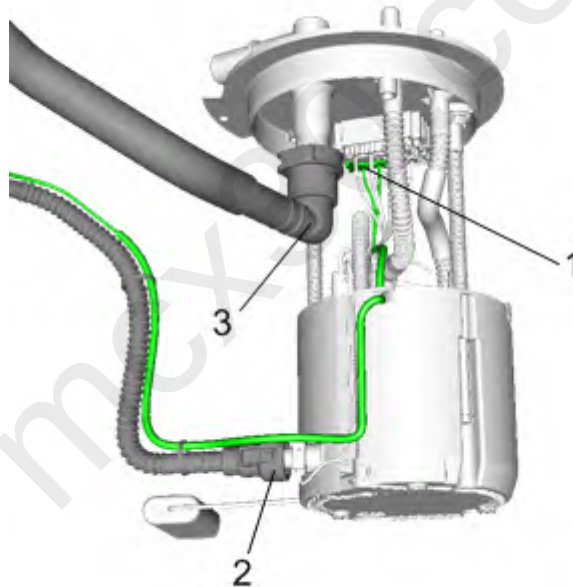


Fig. 95: Electrical Connector, Transfer Hose And Fuel Tank Vent Hose

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Electrical Connector (1)
8. Disconnect Transfer Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
9. Disconnect Fuel Tank Vent Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)

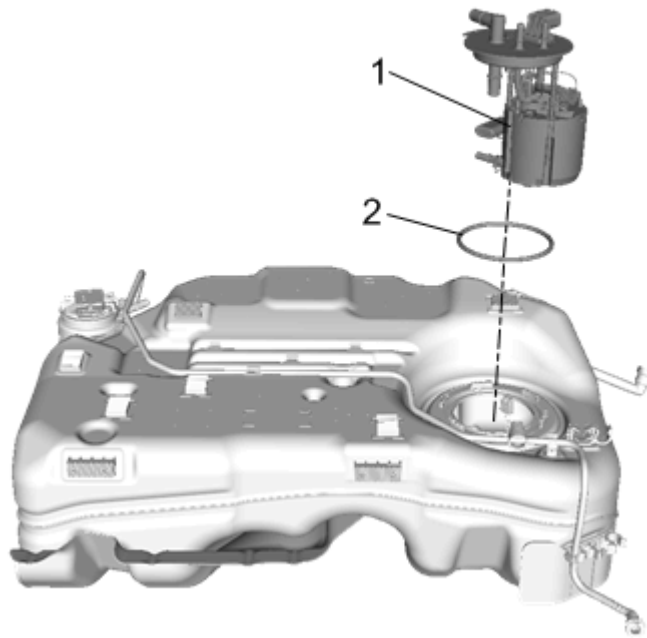


Fig. 96: Fuel Tank Fuel Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

10. Remove Fuel Tank Fuel Pump Module (1)
11. Remove and DISCARD O-Ring (2)

Installation Procedure

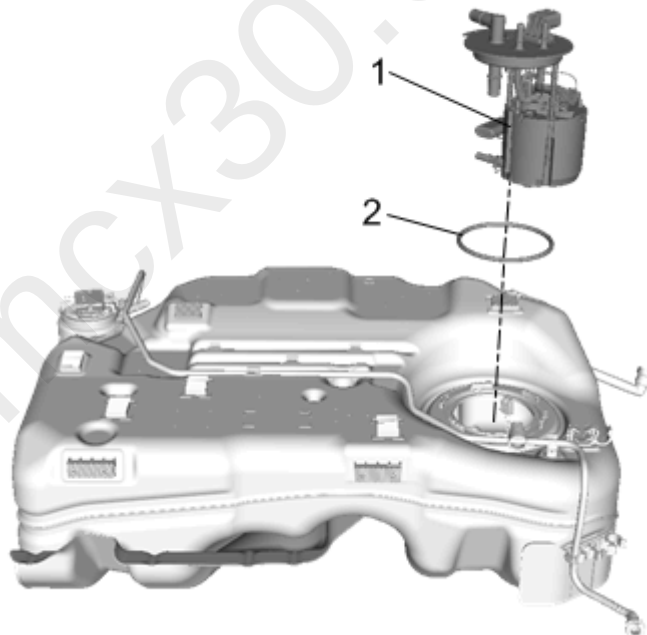


Fig. 97: Fuel Tank Fuel Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW O-Ring (2)
2. Install Fuel Tank Fuel Pump Module (1)

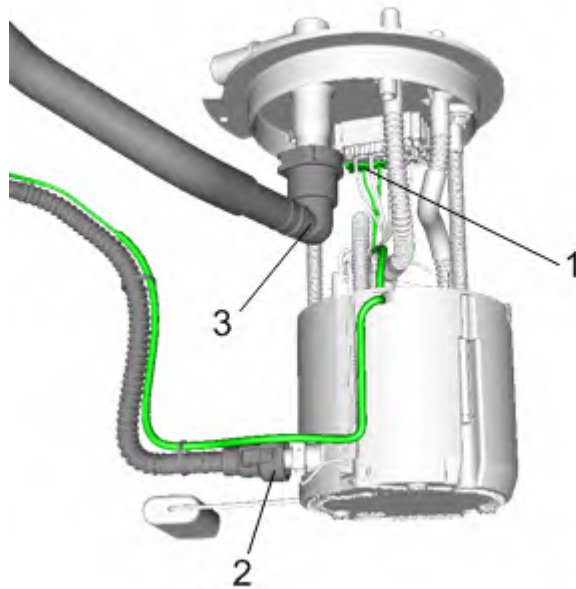


Fig. 98: Electrical Connector, Transfer Hose And Fuel Tank Vent Hose
 Courtesy of GENERAL MOTORS COMPANY

3. Connect Fuel Tank Vent Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
4. Connect Transfer Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
5. Connect Electrical Connector (1)

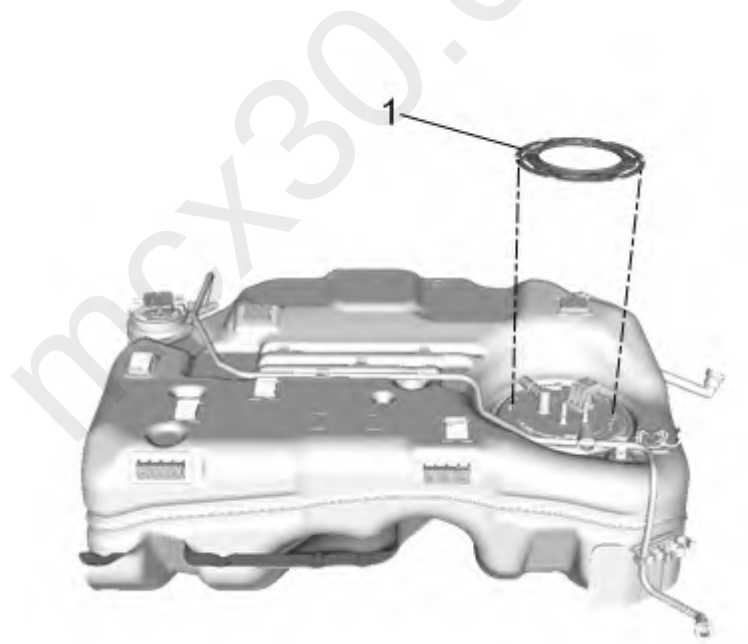


Fig. 99: Fuel Pump Lock Ring
 Courtesy of GENERAL MOTORS COMPANY

6. Install Fuel Pump Lock Ring (1) - CH 52075 Fuel Sender Lock Ring Wrench

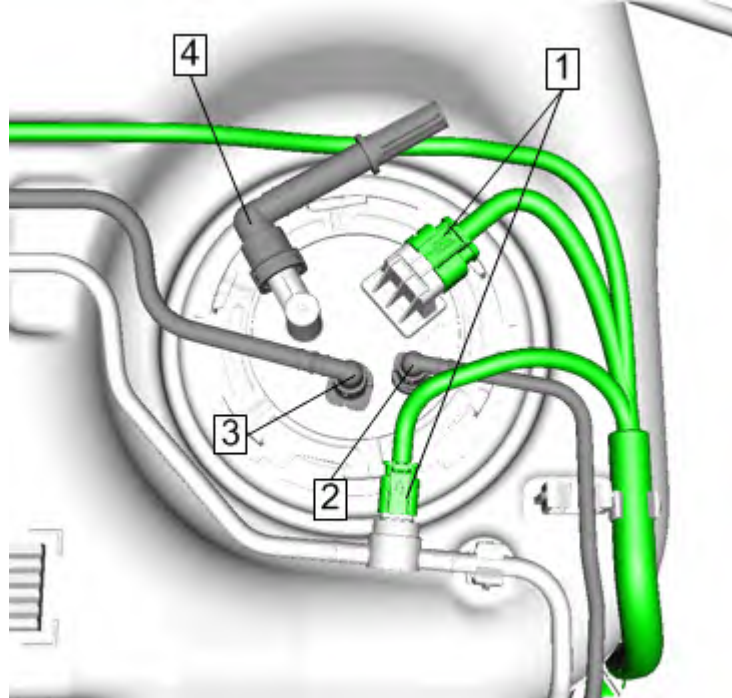


Fig. 100: Electrical Connectors, Fuel Pump Fuel Return Hose, Fuel Pump To Fuel Filter Hose And Fuel Tank Vent

Courtesy of GENERAL MOTORS COMPANY

7. Connect Fuel Tank Vent (4). Refer to [Plastic Collar Quick Connect Fitting Service](#)
8. Connect Fuel Pump to Fuel Filter Hose (3). Refer to [Plastic Collar Quick Connect Fitting Service](#)
9. Connect Fuel Pump Fuel Return Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
10. Connect Electrical Connectors (1) (Qty: 2)
11. Install Fuel Tank. Refer to [Fuel Tank Replacement \(AWD\)](#)

FUEL TANK FILLER PIPE REPLACEMENT

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Remove Fuel Tank Filler Pipe Housing. Refer to [Fuel Tank Filler Pipe Housing Replacement \(Equinox\)](#) [Fuel Tank Filler Pipe Housing Replacement \(Terrain\)](#).
2. Remove Rear Wheelhouse Liner-Left Side. Refer to [Rear Wheelhouse Liner Replacement- Left Side \(Equinox\)](#) [Rear Wheelhouse Liner Replacement- Left Side \(Terrain\)](#).
3. Drain the fuel tank below the fuel tank filler pipe. Refer to [Fuel Tank Draining](#)



Fig. 101: Fuel Tank Filler Pipe Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Fuel Tank Filler Pipe Ground Bolt (1)

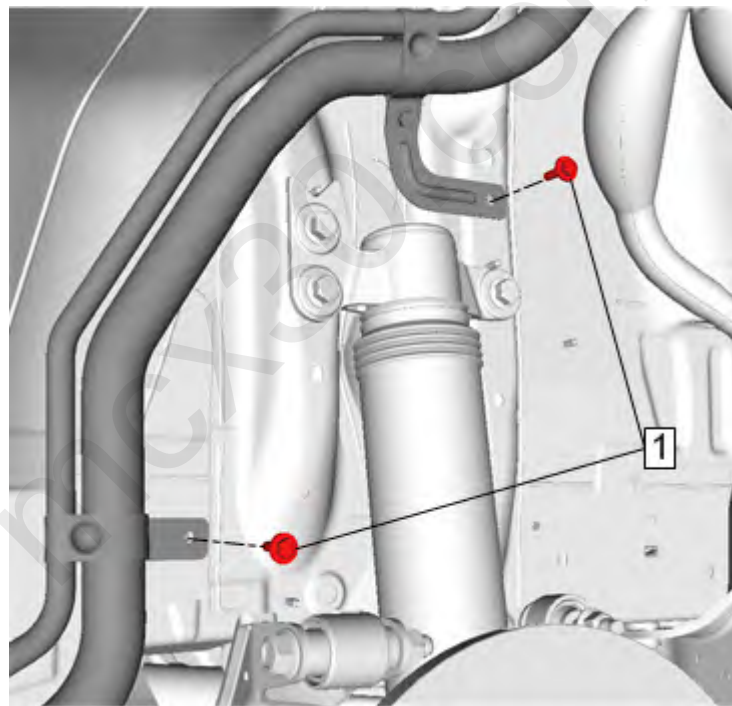


Fig. 102: Fuel Tank Filler Pipe Ground Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Remove Fuel Tank Filler Pipe Ground Bolts (1) (Qty: 2)

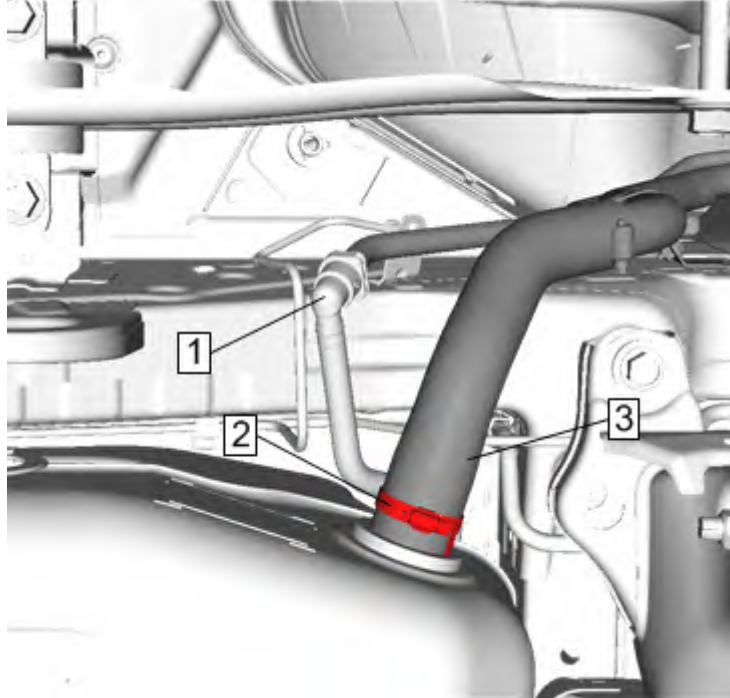


Fig. 103: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)
7. Remove Fuel Tank Filler Hose Clamp (2)
8. Remove Fuel Tank Filler Hose (3)

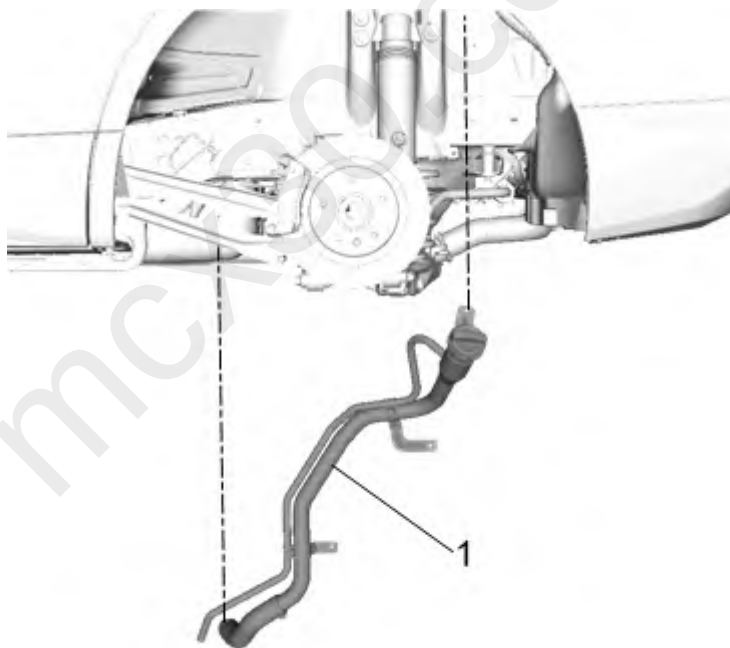


Fig. 104: Fuel Tank Filler Pipe
Courtesy of GENERAL MOTORS COMPANY

9. Remove Fuel Tank Filler Pipe (1)

Installation Procedure

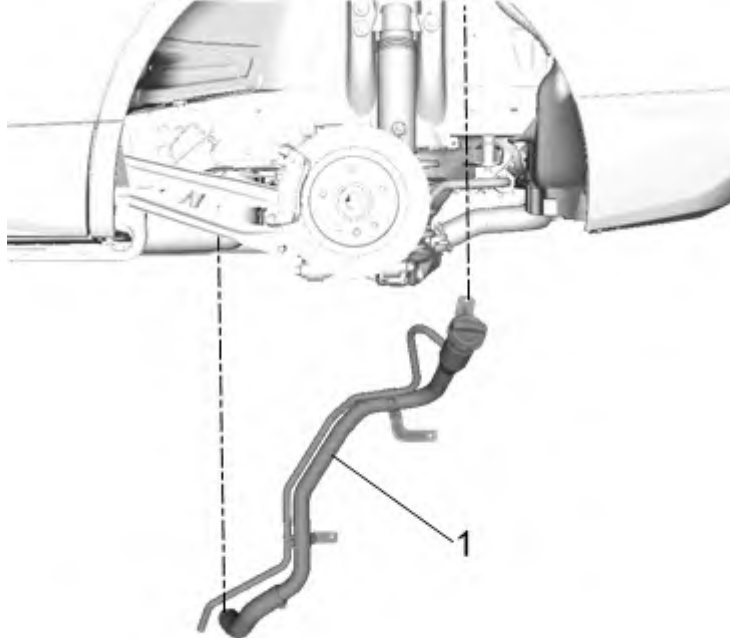


Fig. 105: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Tank Filler Pipe (1)

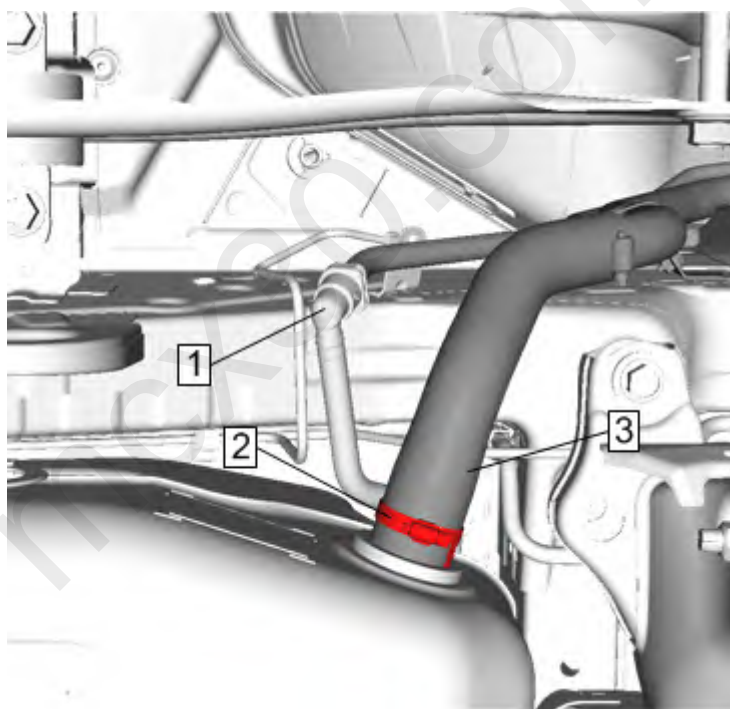


Fig. 106: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

2. Install Fuel Tank Filler Hose (3)

CAUTION: Refer to [Fastener Caution](#) .

3. Install and tighten Fuel Tank Filler Hose Clamp (2) to 4 N.m (35 lb in)
4. Connect Fuel Tank Vent Hose (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)

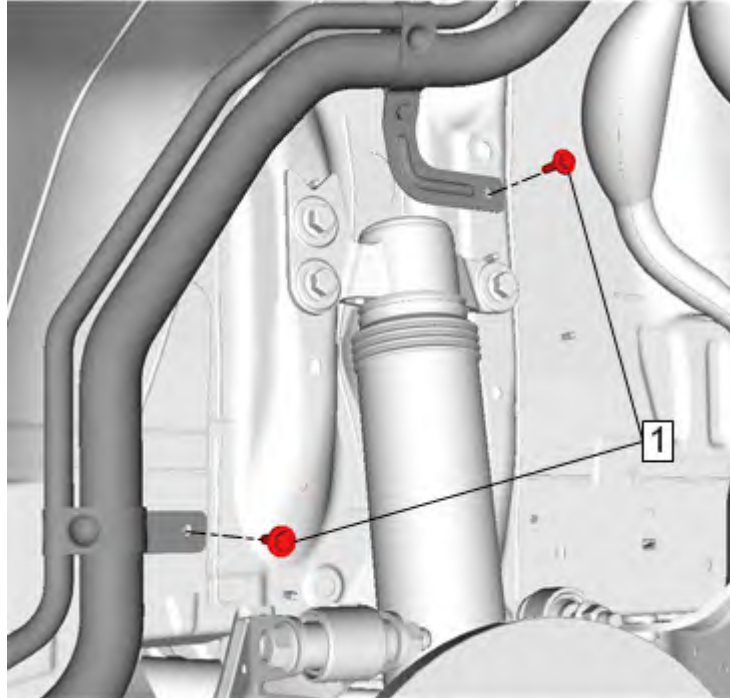


Fig. 107: Fuel Tank Filler Pipe Ground Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Fuel Tank Filler Pipe Ground Bolts (1) (Qty: 2) to 9 N.m (80 lb in)

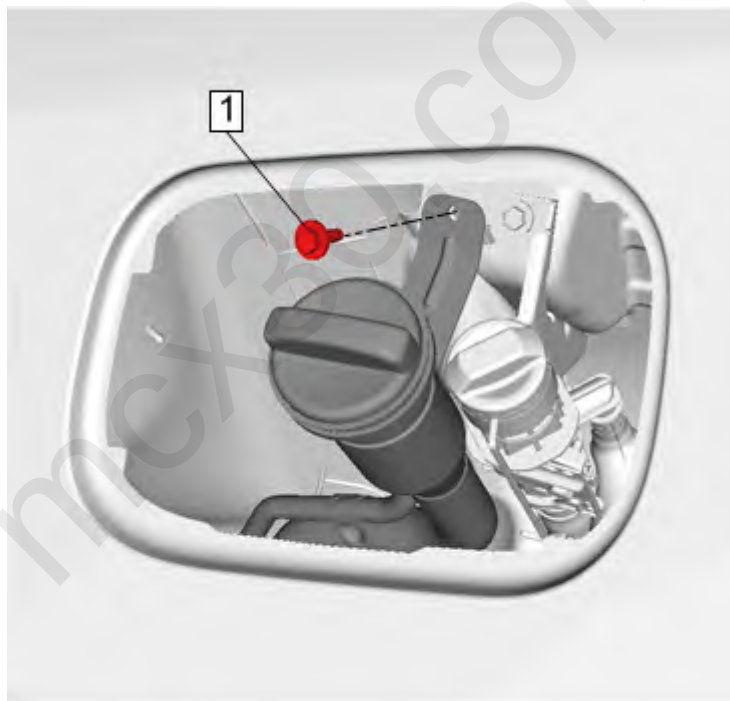


Fig. 108: Fuel Tank Filler Pipe Ground Bolt

Courtesy of GENERAL MOTORS COMPANY

6. Install and tighten Fuel Tank Filler Pipe Ground Bolt (1) to 9 N.m (80 lb in)
7. Install Rear Wheelhouse Liner-Left Side. Refer to [Rear Wheelhouse Liner Replacement- Left Side \(Equinox\)](#) [Rear Wheelhouse Liner Replacement- Left Side \(Terrain\)](#).
8. Install Fuel Tank Filler Pipe Housing. Refer to [Fuel Tank Filler Pipe Housing Replacement \(Equinox\)](#) [Fuel Tank Filler Pipe Housing Replacement \(Terrain\)](#).
9. Fill the fuel tank.

FUEL LEVEL SENSOR REPLACEMENT (AWD)

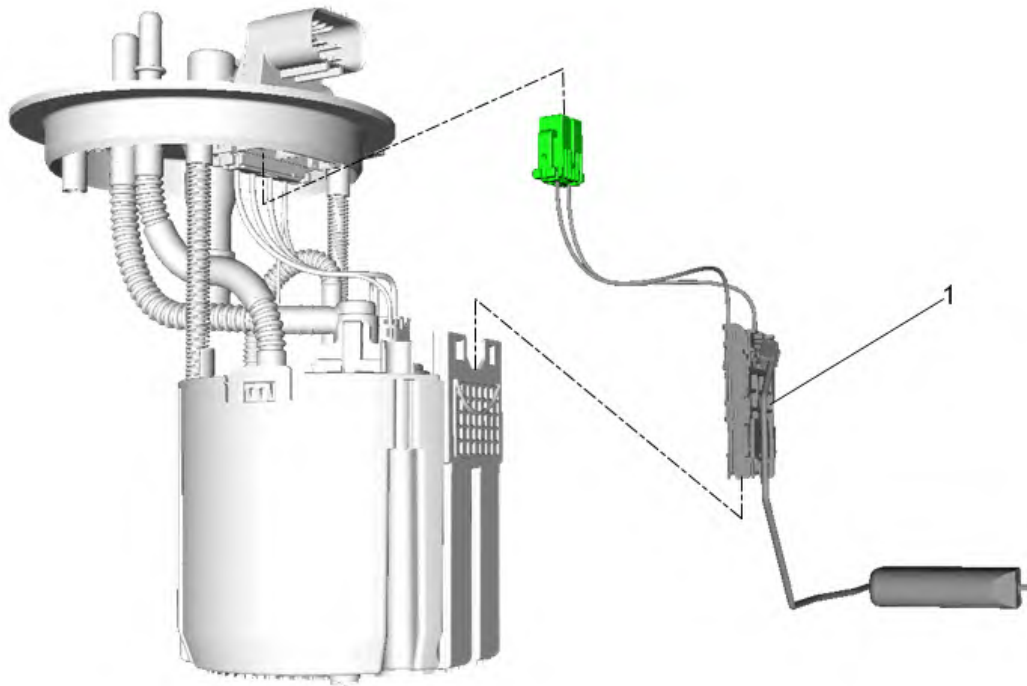


Fig. 109: Fuel Level Sensor (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank Fuel Pump Module. Refer to Fuel Tank Fuel Pump Module Replacement (AWD) .	
1	Fuel Level Sensor Procedure 1. Release tabs and slide fuel level sensor up to remove. 2. Disconnect the electrical connector.

FUEL LEVEL SENSOR REPLACEMENT (FWD)

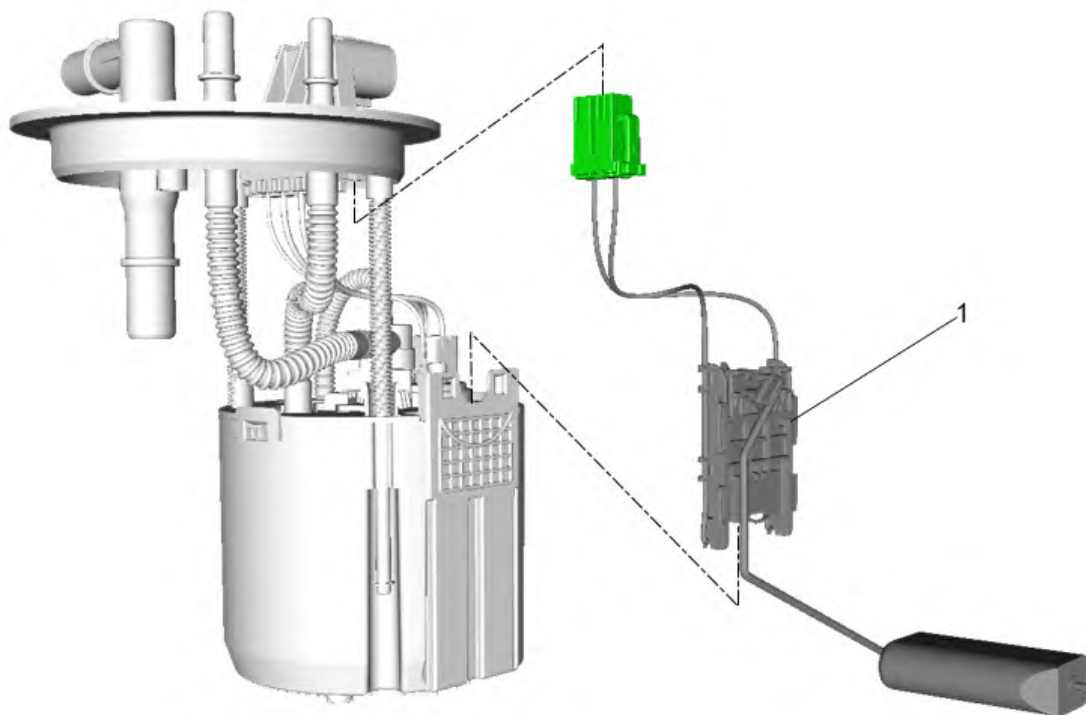


Fig. 110: Fuel Level Sensor (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to <u>Diesel/Gasoline Vapors Warning</u> . WARNING: Refer to <u>Safety Glasses Warning</u> . Preliminary Procedure Remove Fuel Tank Fuel Pump Module. Refer to <u>Fuel Tank Fuel Pump Module Replacement (FWD)</u> .	
1	Fuel Level Sensor Procedure 1. Release tabs and slide fuel level sensor up to remove. 2. Disconnect the electrical connector.

FUEL COOLER REPLACEMENT (AWD)

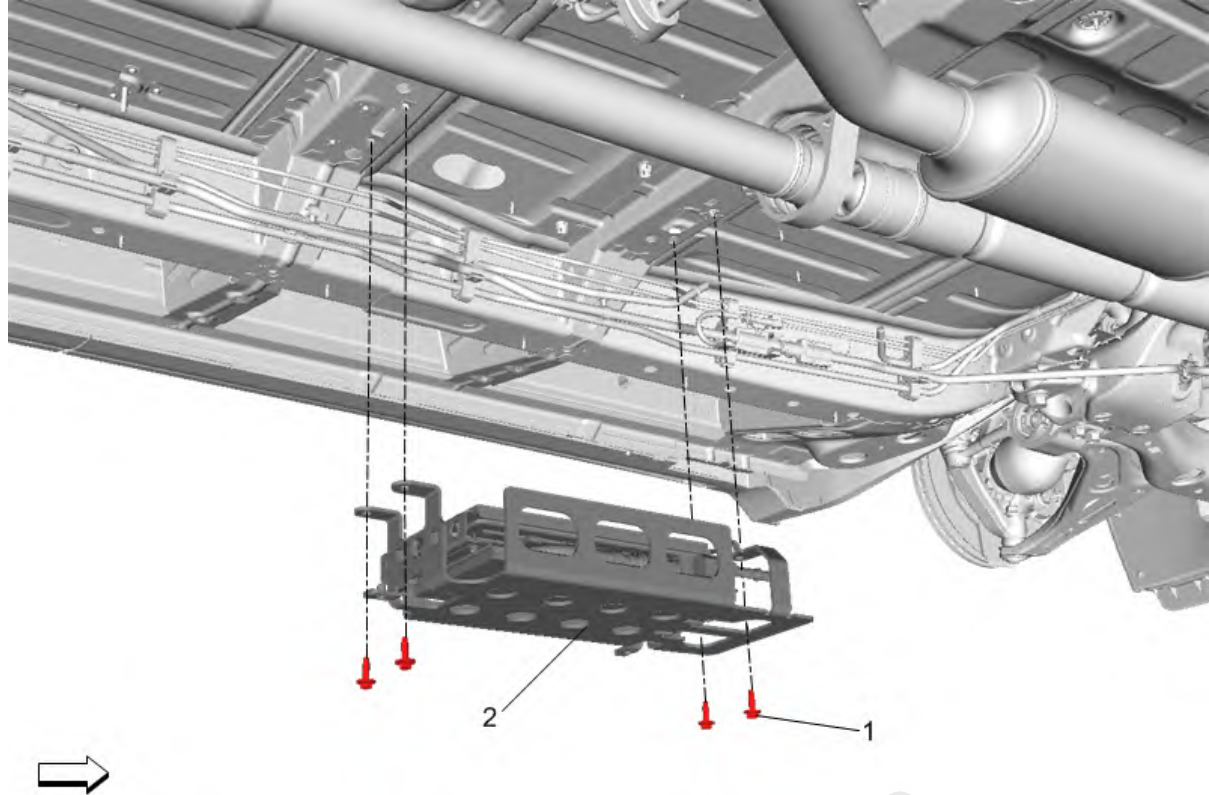


Fig. 111: Fuel Cooler (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures 1. Remove Fuel Pump Power Control Module Bracket. Refer to Fuel Pump Power Control Module Bracket Replacement (AWD) . 2. Disconnect the fuel return pipes (Qty: 2). Refer to Metal Collar Quick Connect Fitting Service	
1	Fuel Cooler Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Fuel Cooler

FUEL COOLER REPLACEMENT (FWD)

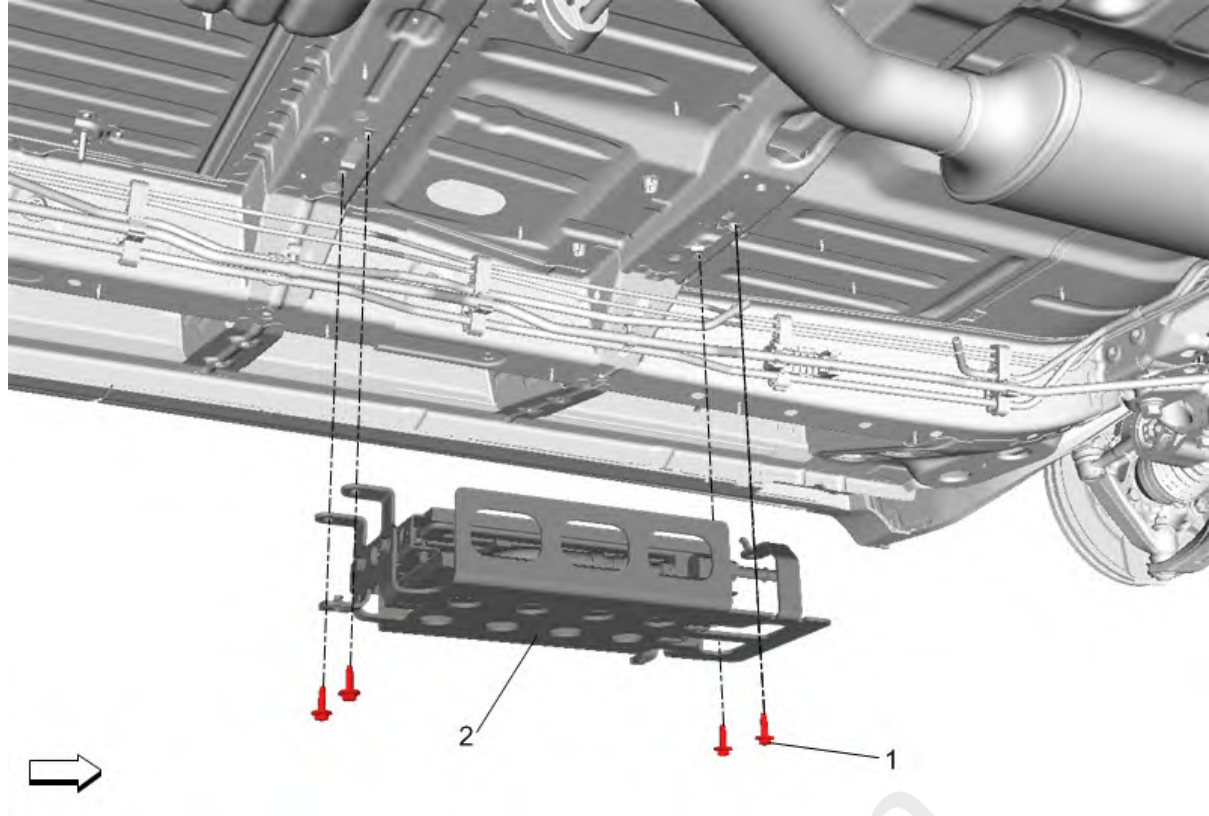


Fig. 112: Fuel Cooler (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures 1. Remove Fuel Pump Power Control Module Bracket. Refer to Fuel Pump Power Control Module Bracket Replacement (FWD) . 2. Disconnect the fuel return pipes (Qty: 2). Refer to Metal Collar Quick Connect Fitting Service 3. Remove the wiring harness from the fuel cooler. (Qty: 2)	
1	Fuel Cooler Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Fuel Cooler

FUEL PUMP FUEL FEED HOSE REPLACEMENT (AWD)

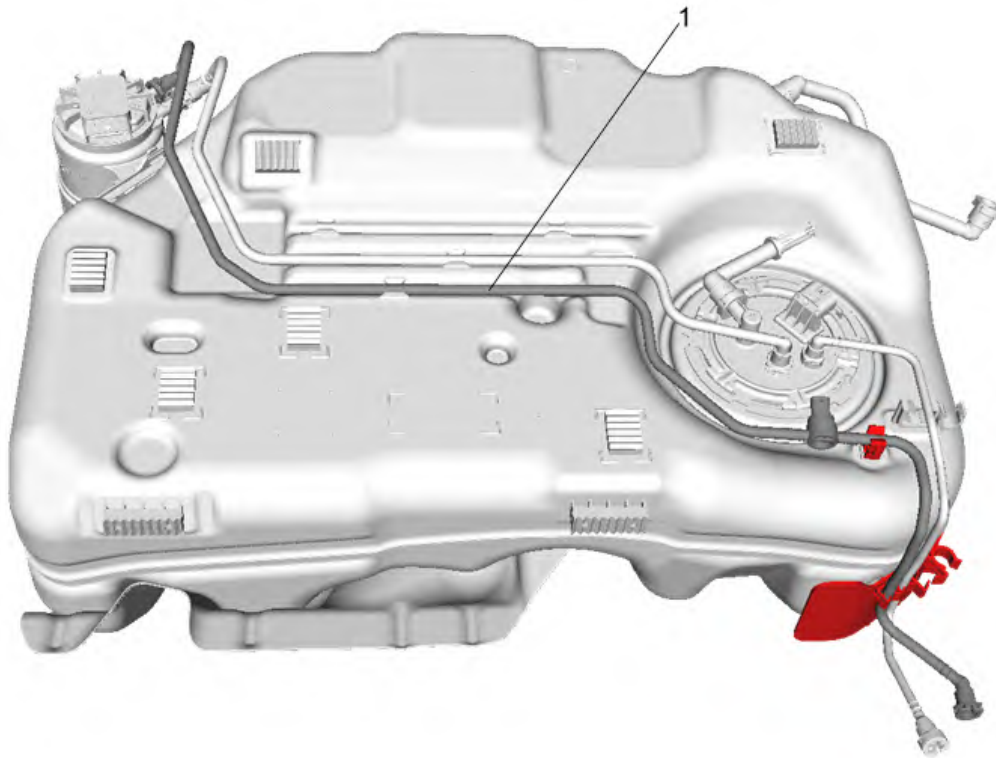


Fig. 113: Fuel Pump Fuel Feed Hose (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Pump Fuel Feed Hose Procedure 1. Disconnect the electrical connector. 2. Disconnect the fuel pump fuel feed hose and remove from retainers. Refer to Plastic Collar Quick Connect Fitting Service

FUEL PUMP FUEL FEED HOSE REPLACEMENT (FWD)

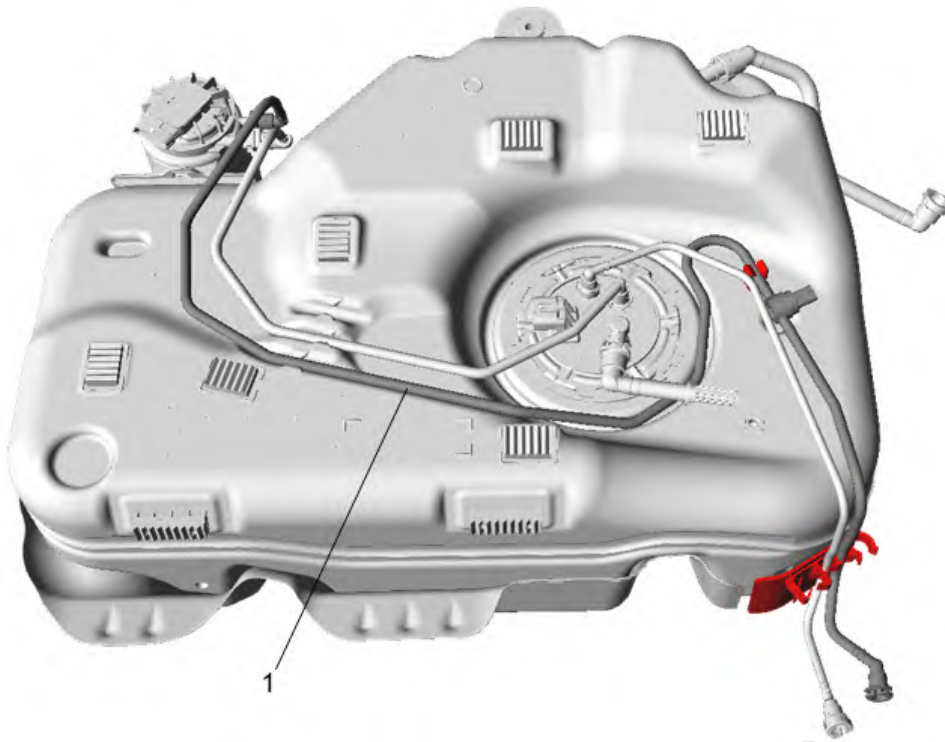


Fig. 114: Fuel Pump Fuel Feed Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD) .	
1	Fuel Pump Fuel Feed Hose Procedure 1. Disconnect the electrical connector. 2. Disconnect the fuel pump fuel feed hose and remove from retainers. Refer to Plastic Collar Quick Connect Fitting Service

FUEL PUMP FUEL RETURN HOSE REPLACEMENT (AWD)

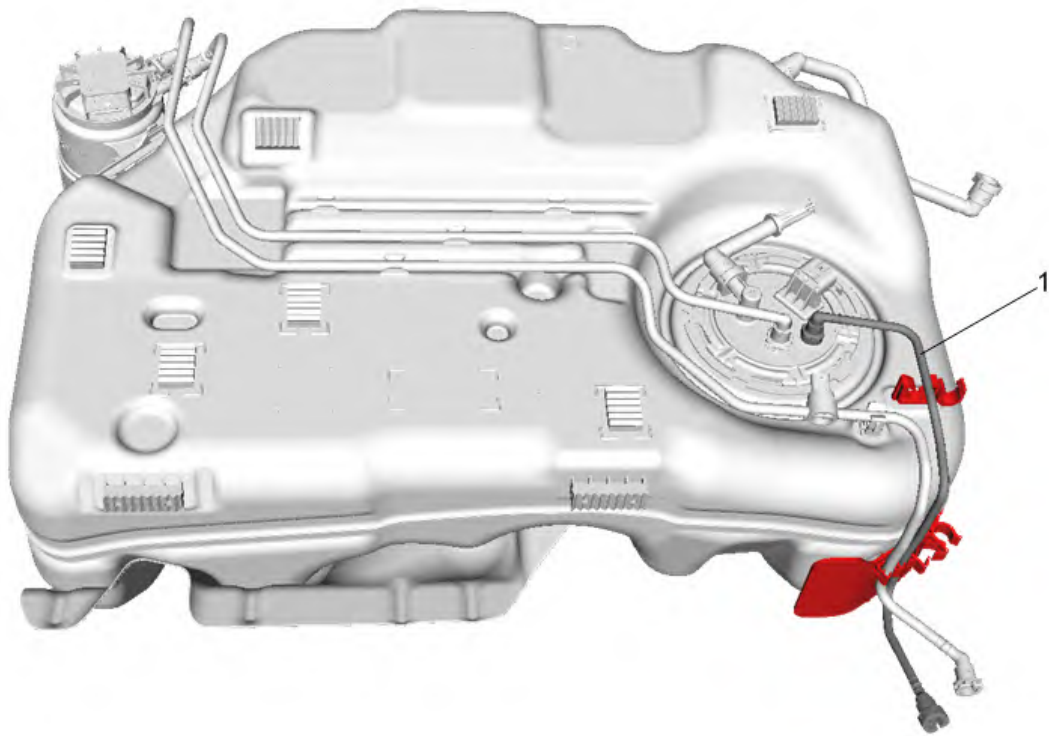


Fig. 115: Fuel Pump Fuel Return Hose (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Pump Fuel Return Hose Procedure Disconnect the fuel pump fuel return hose and remove from retainers. Refer to Plastic Collar Quick Connect Fitting Service

FUEL PUMP FUEL RETURN HOSE REPLACEMENT (FWD)

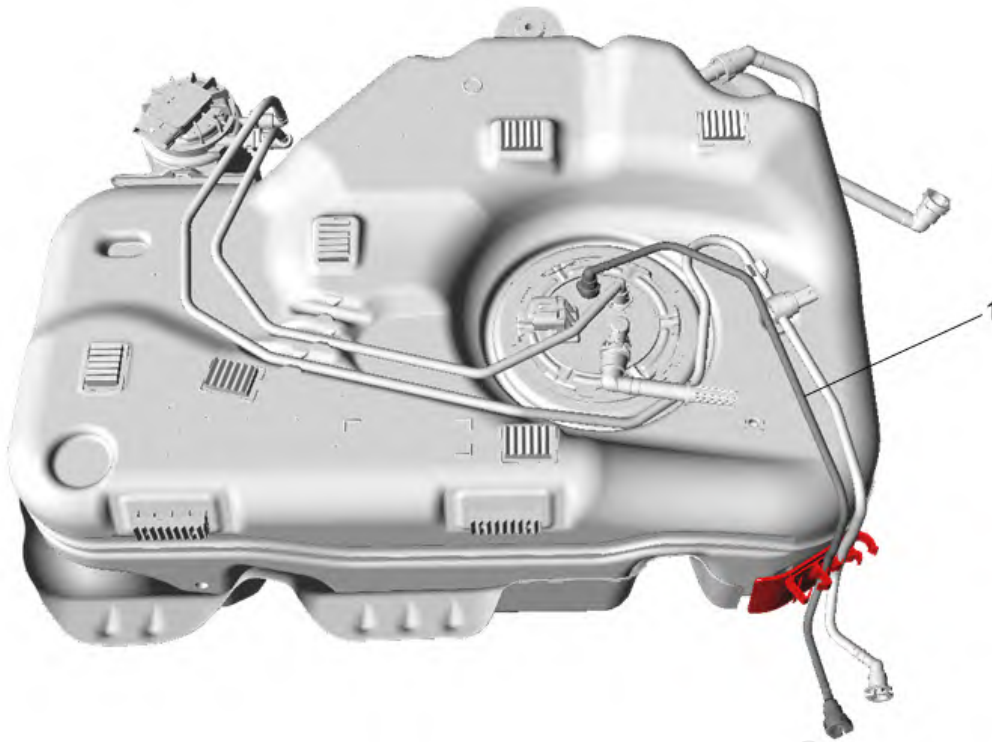


Fig. 116: Fuel Pump Fuel Return Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD) .	
1	Fuel Pump Fuel Return Hose Procedure Disconnect the fuel pump fuel return hose and remove from retainers. Refer to Plastic Collar Quick Connect Fitting Service

FUEL FEED FRONT PIPE REPLACEMENT

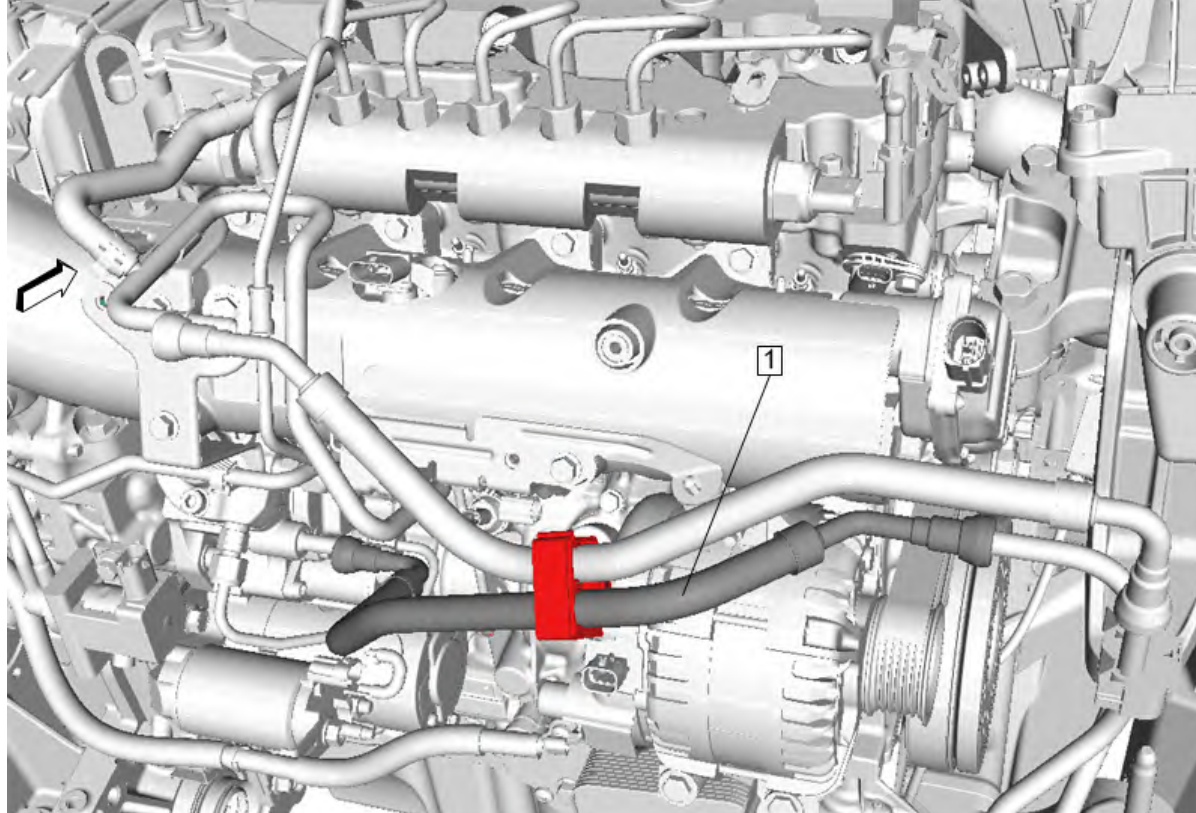


Fig.117: Fuel Feed Front Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures 1. Remove Intake Manifold Cover. Refer to Intake Manifold Cover Replacement 2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle	
1	Fuel Feed Front Pipe Procedure 1. Disconnect the fuel feed front pipe and remove from retainer. Refer to Metal Collar Quick Connect Fitting Service 2. Prime the fuel system. Refer to Fuel System Priming 3. Pressurize fuel system and check for fuel leaks.

FUEL RETURN FRONT PIPE REPLACEMENT

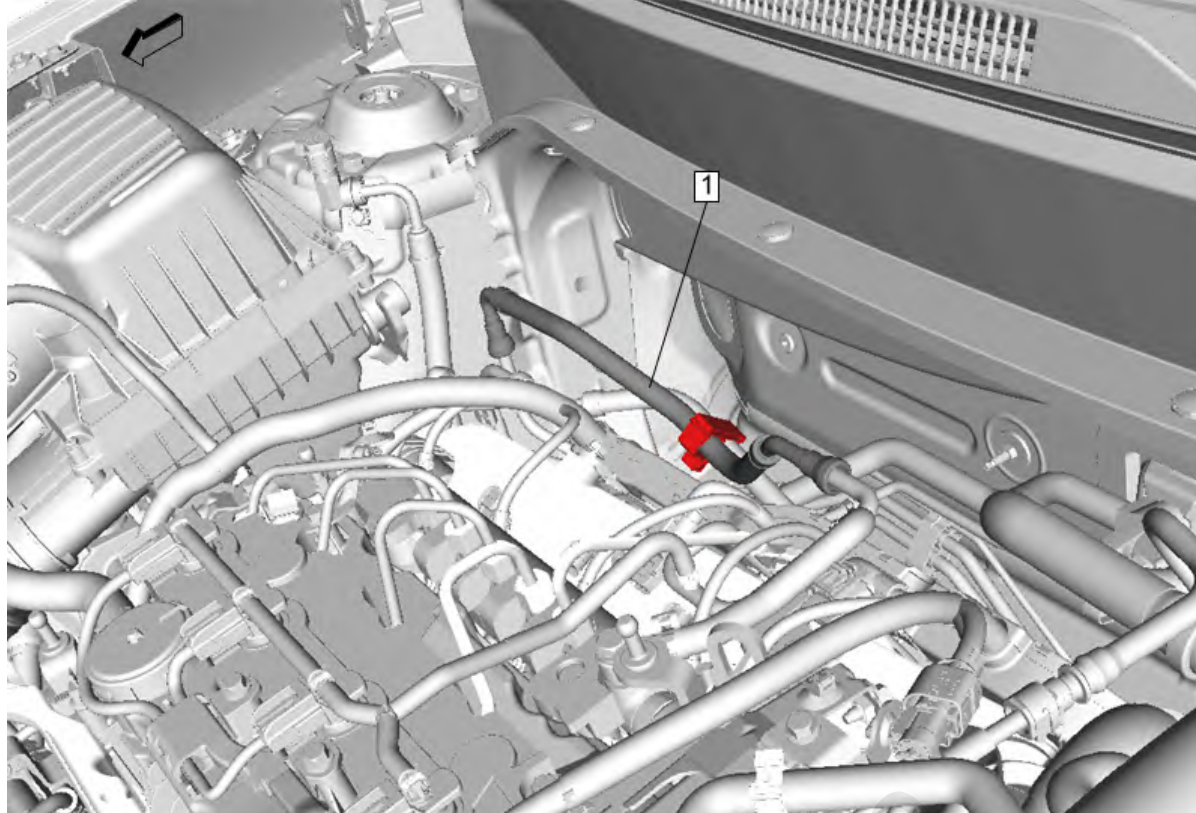


Fig. 118: Fuel Return Front Pipe

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Intake Manifold Cover. Refer to Intake Manifold Cover Replacement	
1	Fuel Return Front Pipe Procedure 1. Disconnect the fuel return front pipe and remove from retainer. Refer to Metal Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL FEED PIPE REPLACEMENT (FWD)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Disconnect Fuel Feed Front Pipe. Refer to [Fuel Feed Front Pipe Replacement](#)

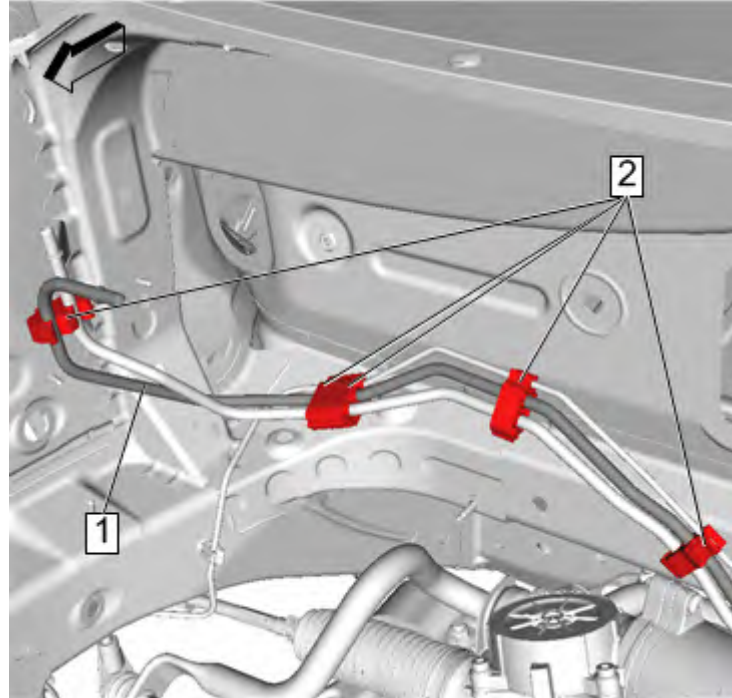


Fig. 119: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Remove Fuel Feed Pipe (1) @ Retainers (2) (Qty: 5)

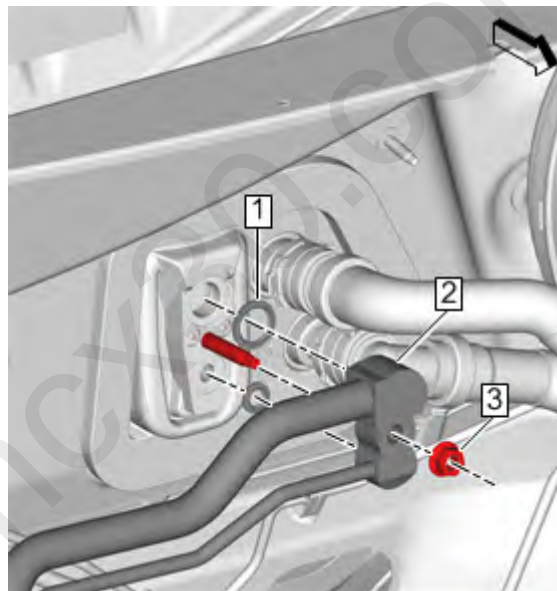


Fig. 120: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals

Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).

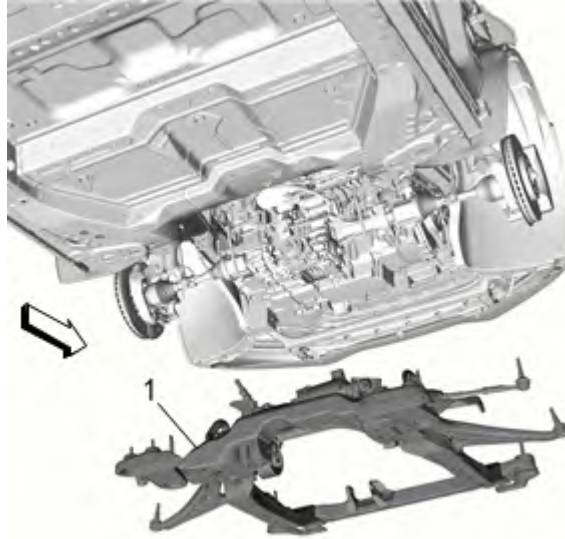


Fig. 121: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

5. Lower drivetrain and front suspension cradle (1) as necessary in order to remove the fuel feed pipe from the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#).

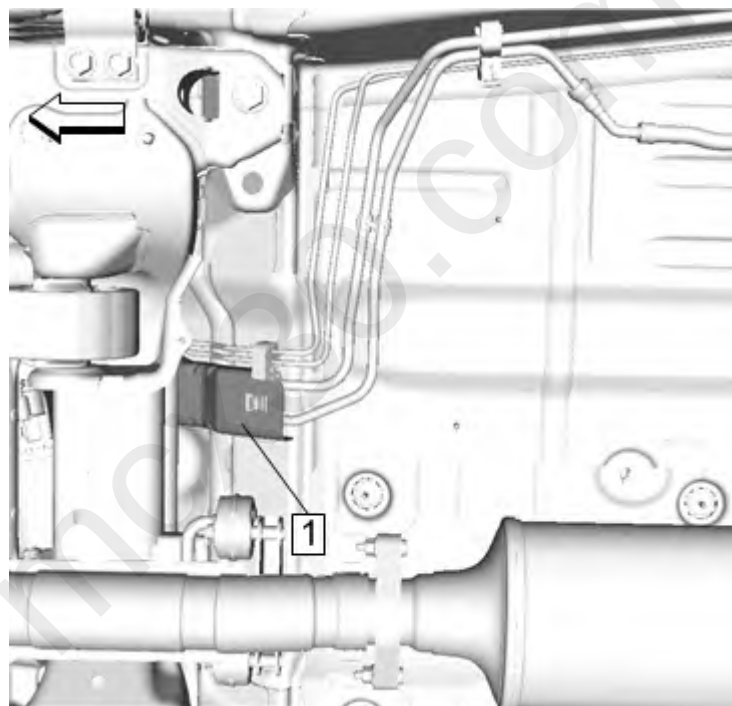


Fig. 122: Shield

Courtesy of GENERAL MOTORS COMPANY

6. Remove Shield (1)

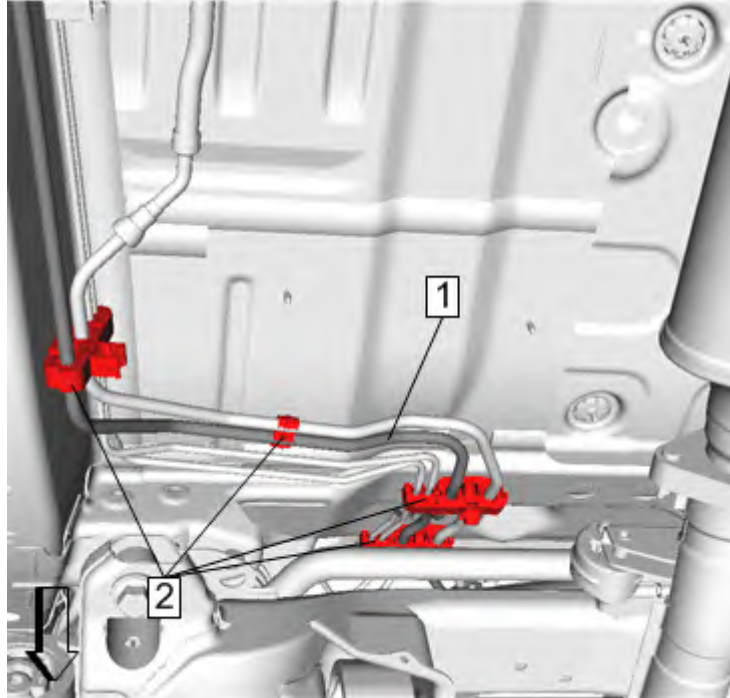


Fig. 123: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

7. Remove Fuel Feed Pipe (1) @ Retainers (2) (Qty: 4)
8. {If equipped} Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#). [Underbody Rear Air Deflector Replacement \(Diesel\)](#).

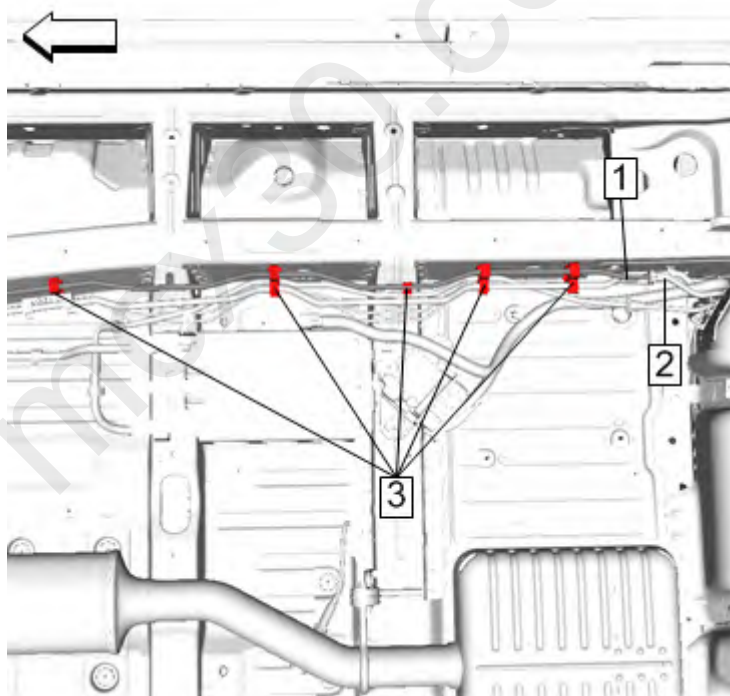


Fig. 124: Fuel Feed Pipe, Fuel Pump Fuel Feed Hose And Retainers

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Fuel Feed Pipe (1) @ Fuel Pump Fuel Feed Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
10. Fuel Feed Pipe (1) @ Retainers (3) (Qty: 5)
11. Remove fuel feed pipe (1) from the vehicle.

Installation Procedure

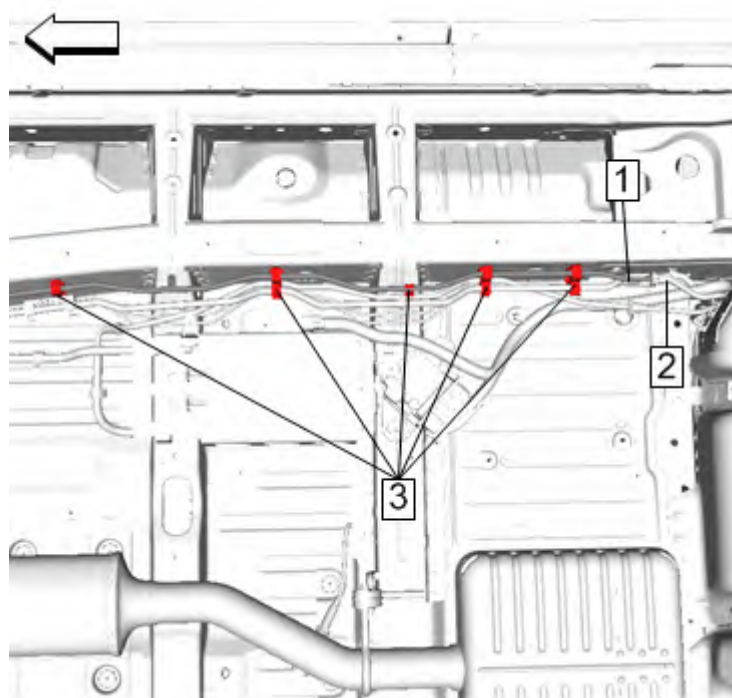


Fig. 125: Fuel Feed Pipe, Fuel Pump Fuel Feed Hose And Retainers
Courtesy of GENERAL MOTORS COMPANY

1. Install fuel feed pipe (1) into the vehicle.
2. Install Fuel Feed Pipe (1) @ Retainers (3) (Qty: 5)
3. Connect Fuel Feed Pipe (1) @ Fuel Pump Fuel Feed Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
4. {If equipped} Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#)

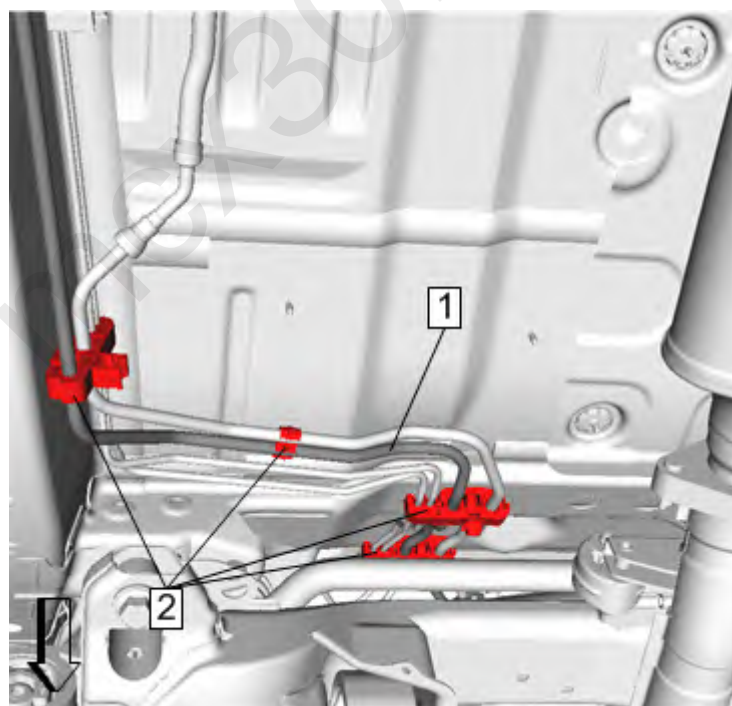


Fig. 126: Fuel Feed Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Feed Pipe (1) @ Retainers (2) (Qty: 4)

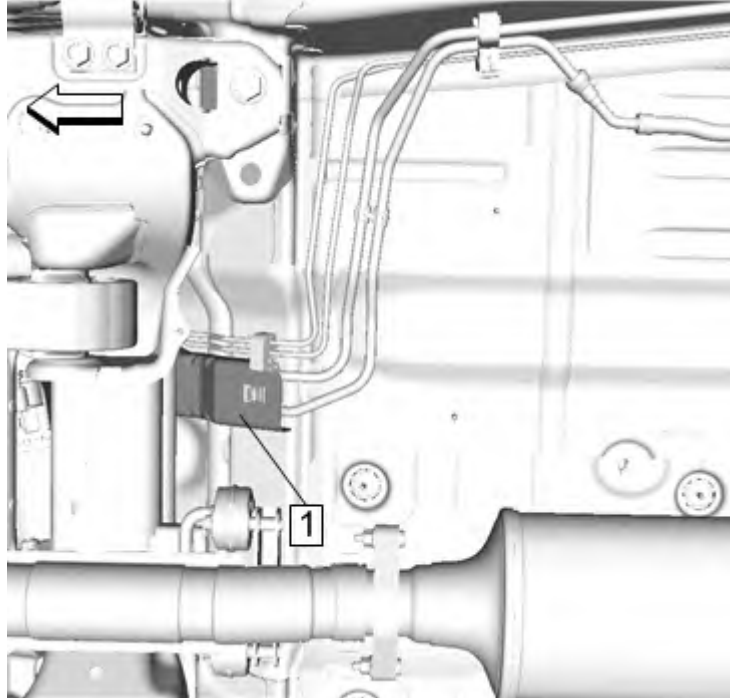


Fig. 127: Shield

Courtesy of GENERAL MOTORS COMPANY

6. Install Shield (1)



Fig. 128: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

7. Install Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#).
8. Lower the vehicle.

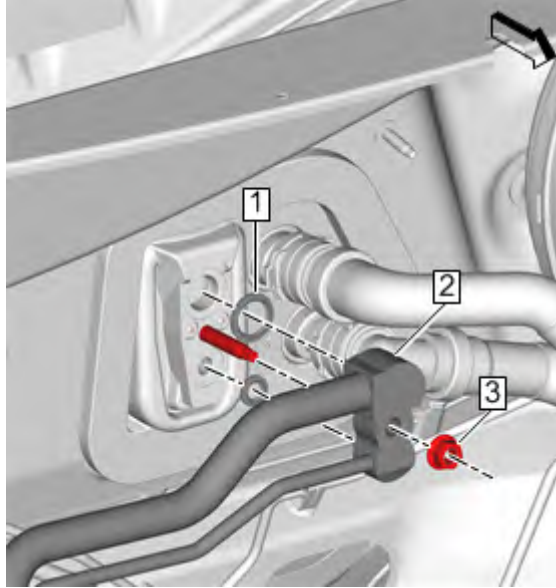


Fig. 129: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals
Courtesy of GENERAL MOTORS COMPANY

9. Install Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).

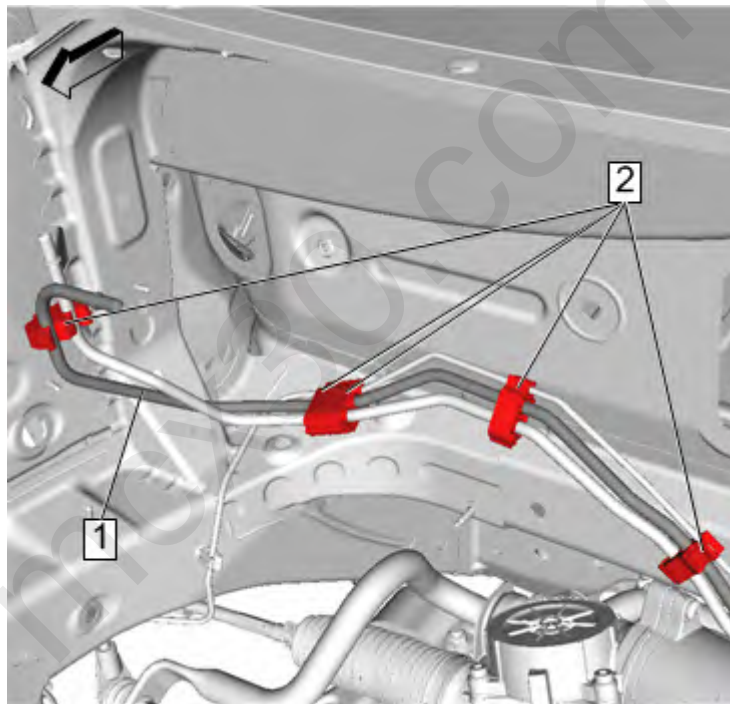


Fig. 130: Fuel Feed Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

10. Install Fuel Feed Pipe (1) @ Retainers (2) (Qty: 5)
11. Connect Fuel Feed Front Pipe. Refer to [Fuel Feed Front Pipe Replacement](#)
12. Prime the fuel system. Refer to [Fuel System Priming](#)
13. Pressurize fuel system and check for fuel leaks.

FUEL FEED PIPE REPLACEMENT (AWD)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Disconnect Fuel Feed Front Pipe. Refer to [Fuel Feed Front Pipe Replacement](#)

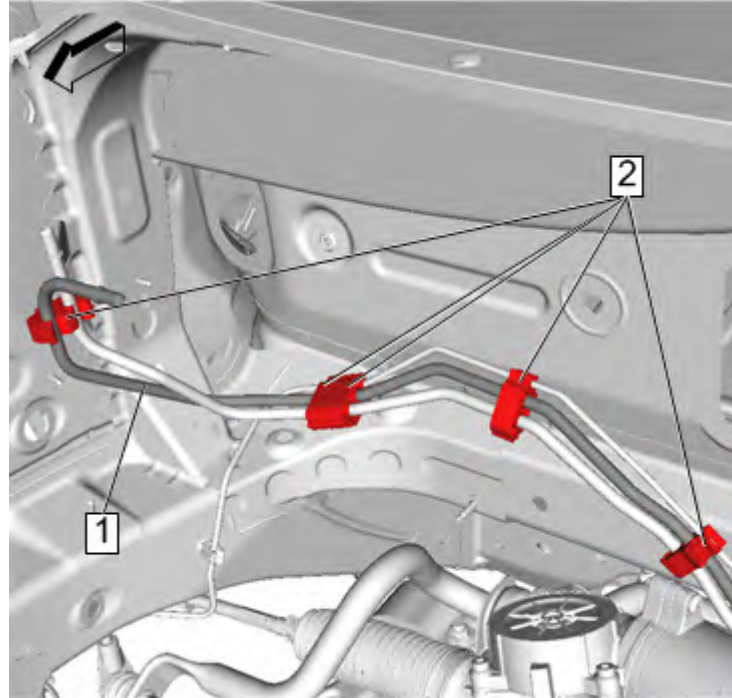


Fig. 131: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Remove Fuel Feed Pipe (1) @ Retainers (2) (Qty: 5)

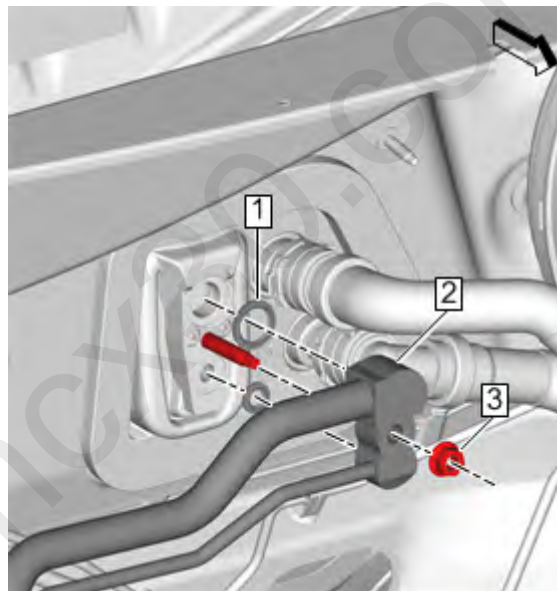


Fig. 132: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals

Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#).

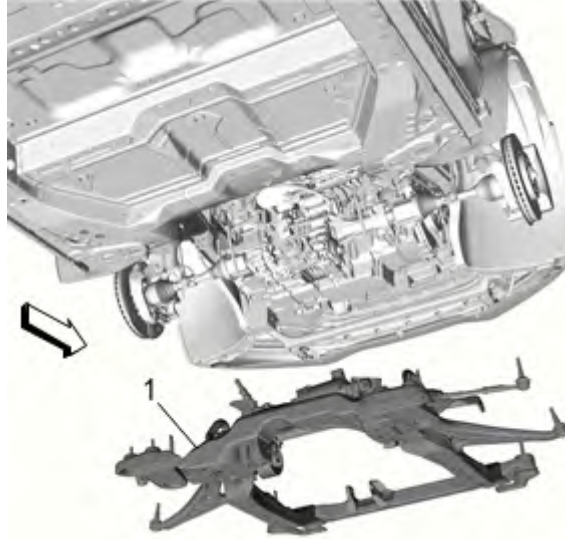


Fig. 133: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

5. Lower drivetrain and front suspension cradle (1) as necessary in order to remove the fuel feed pipe from the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#).

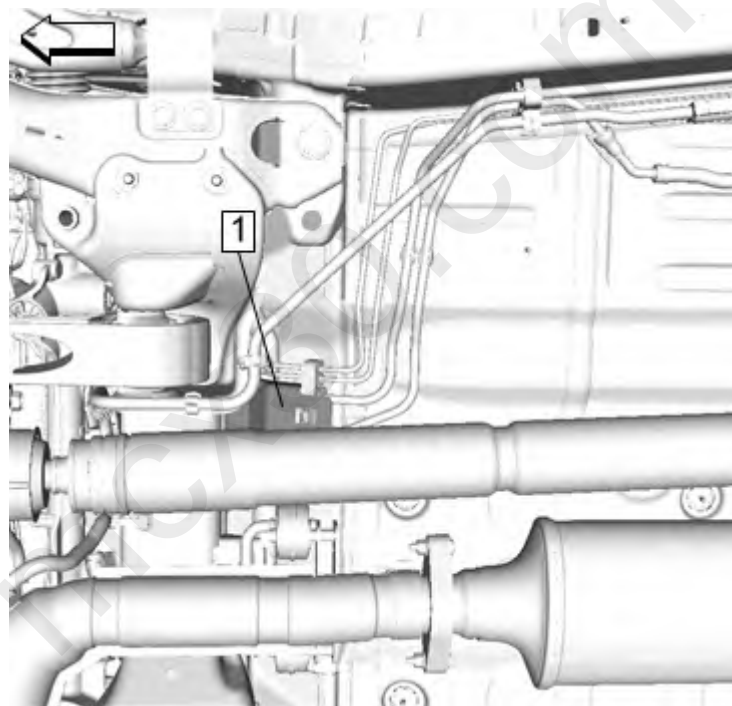


Fig. 134: Shield

Courtesy of GENERAL MOTORS COMPANY

6. Remove Shield (1)

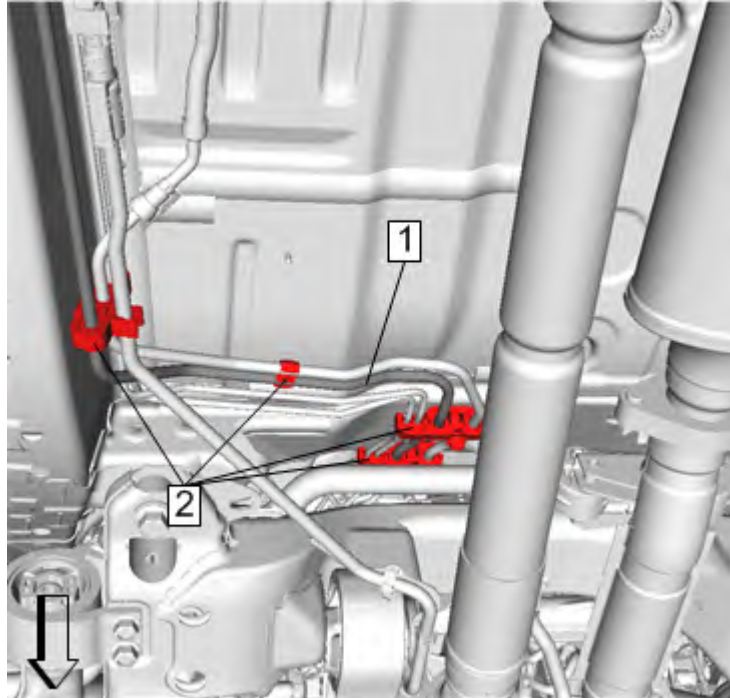


Fig. 135: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

7. Remove Fuel Feed Pipe (1) @ Retainers (2) (Qty: 4)
8. Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#). [Underbody Rear Air Deflector Replacement \(Diesel\)](#).

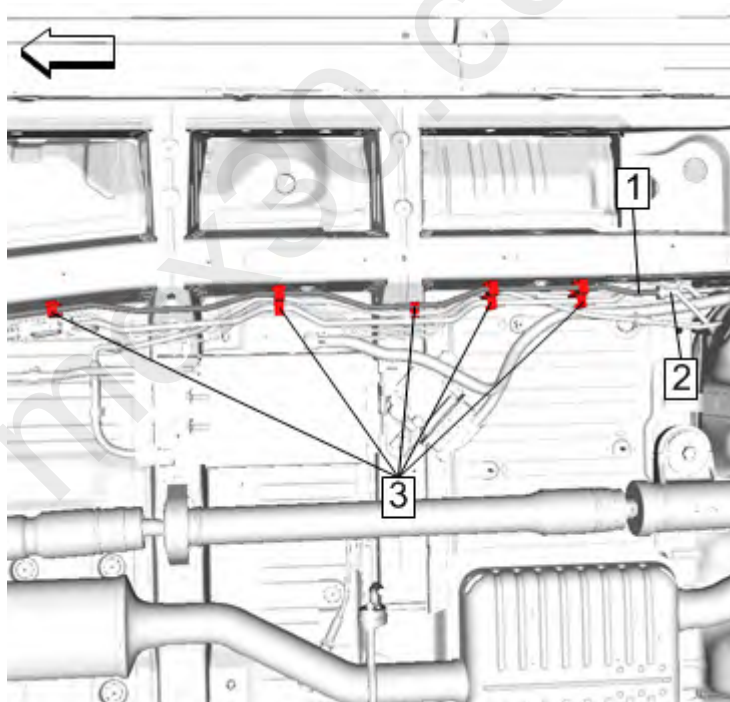


Fig. 136: Fuel Feed Pipe, Fuel Pump Fuel Feed Hose And Retainers

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Fuel Feed Pipe (1) @ Fuel Pump Fuel Feed Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
10. Remove Fuel Feed Pipe (1) @ Retainers (3) (Qty: 5)
11. Remove fuel feed pipe (1) from the vehicle.

Installation Procedure

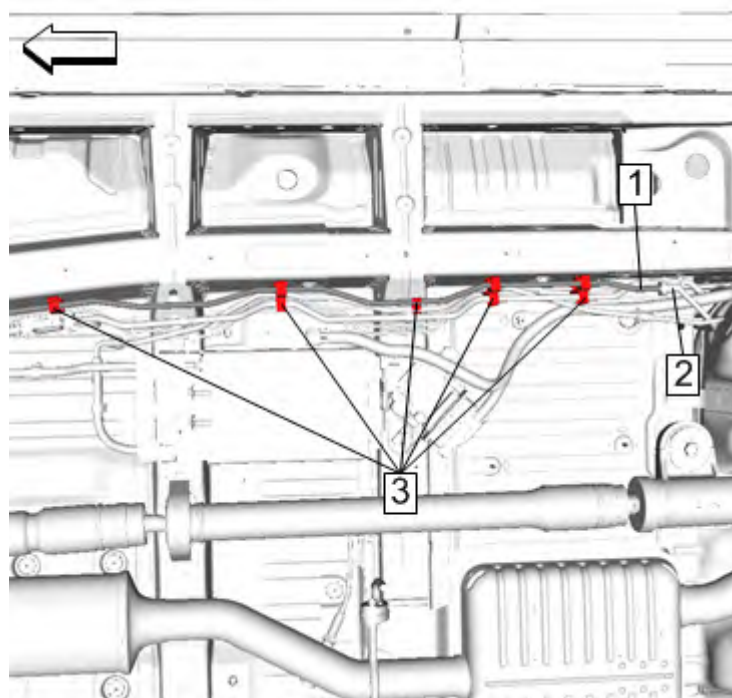


Fig. 137: Fuel Feed Pipe, Fuel Pump Fuel Feed Hose And Retainers
 Courtesy of GENERAL MOTORS COMPANY

1. Install fuel feed pipe (1) into the vehicle.
2. Install Fuel Feed Pipe (1) @ Retainers (3) (Qty: 5)
3. Connect Fuel Feed Pipe (1) @ Fuel Pump Fuel Feed Hose (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
4. Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#). [Underbody Rear Air Deflector Replacement \(Diesel\)](#).

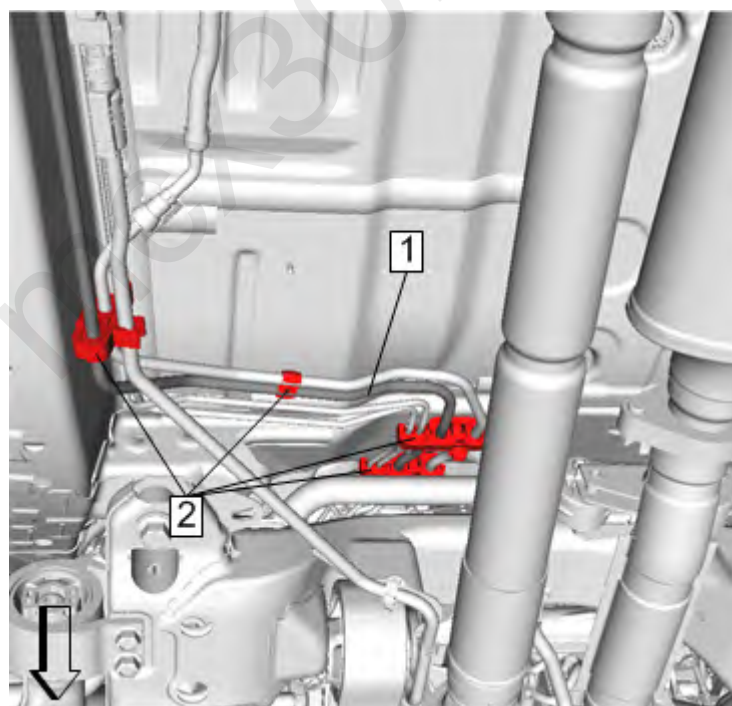


Fig. 138: Fuel Feed Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Feed Pipe (1) @ Retainers (2) (Qty: 4)

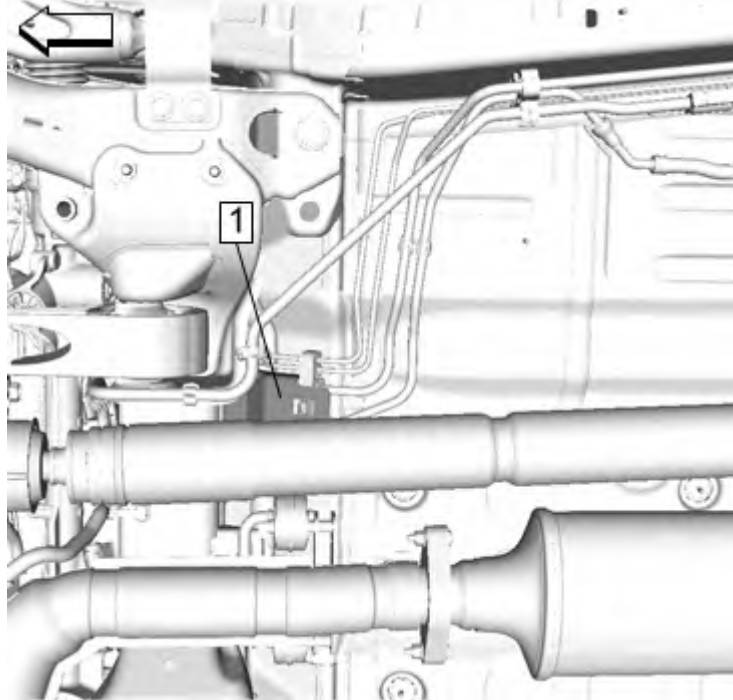


Fig. 139: Shield

Courtesy of GENERAL MOTORS COMPANY

6. Install Shield (1)

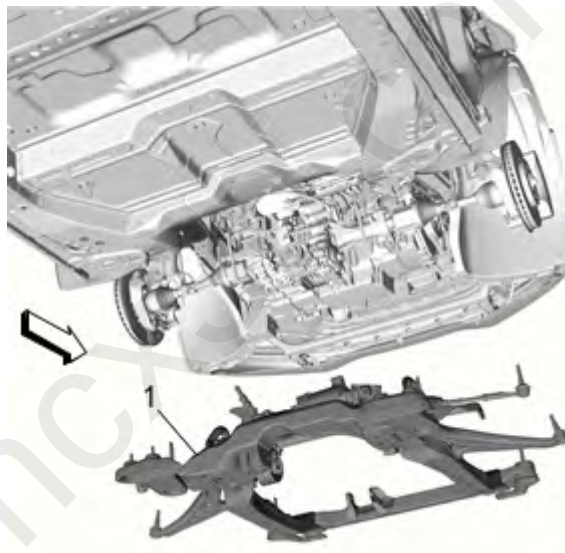


Fig. 140: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

7. Install Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)
8. Lower the vehicle.

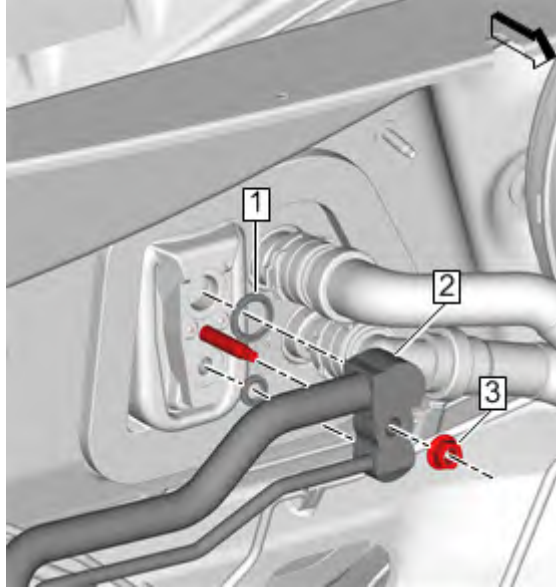


Fig. 141: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals
 Courtesy of GENERAL MOTORS COMPANY

9. Install Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).

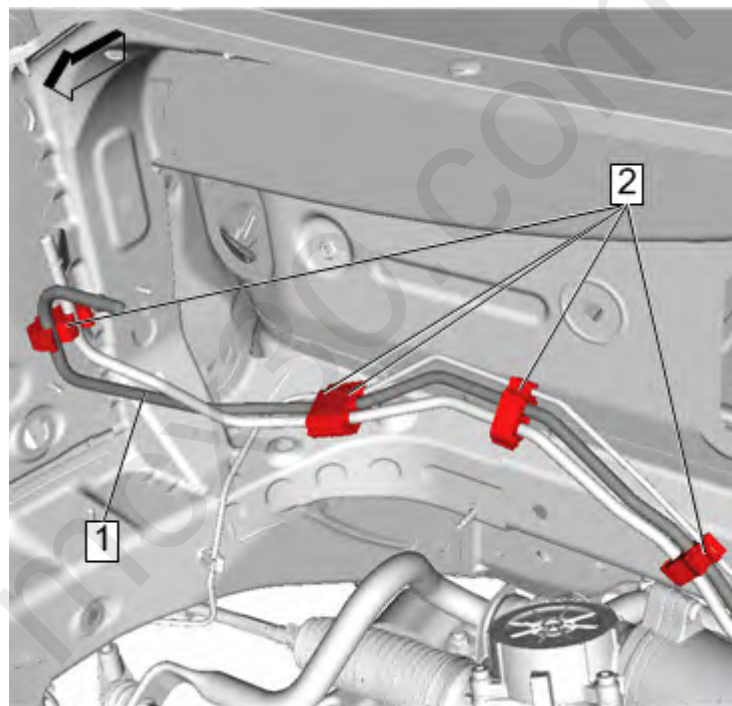


Fig. 142: Fuel Feed Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

10. Install Fuel Feed Pipe (1) @ Retainers (2) (Qty: 5)
11. Connect Fuel Feed Front Pipe. Refer to [Fuel Feed Front Pipe Replacement](#)
12. Prime the fuel system. Refer to [Fuel System Priming](#)
13. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (COOLER TO REAR PIPE AWD)

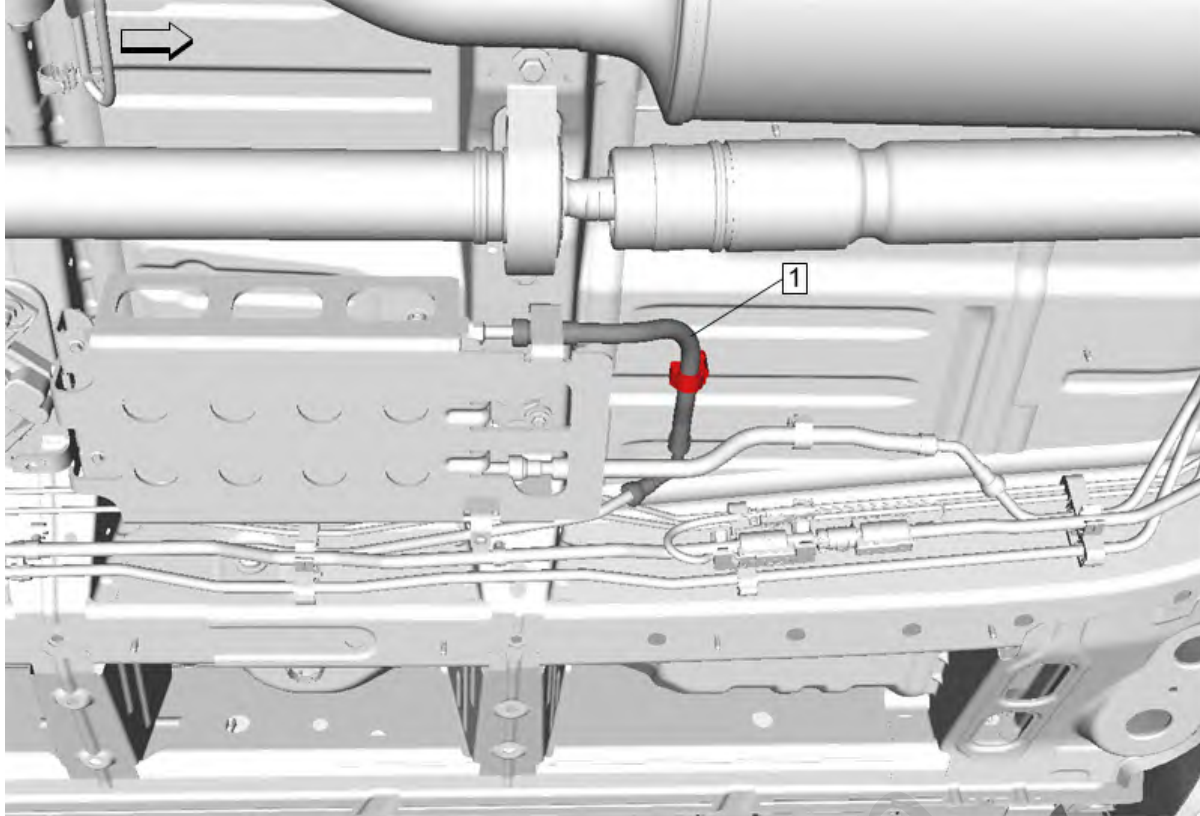


Fig. 143: Fuel Return Pipe (Cooler To Rear Pipe AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (All Wheel Drive) , Underbody Rear Air Deflector Replacement (Diesel) .	
1	Fuel Return Pipe Procedure 1. Disconnect the fuel return pipe and remove from retainer. Refer to Metal Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (COOLER TO REAR PIPE FWD)

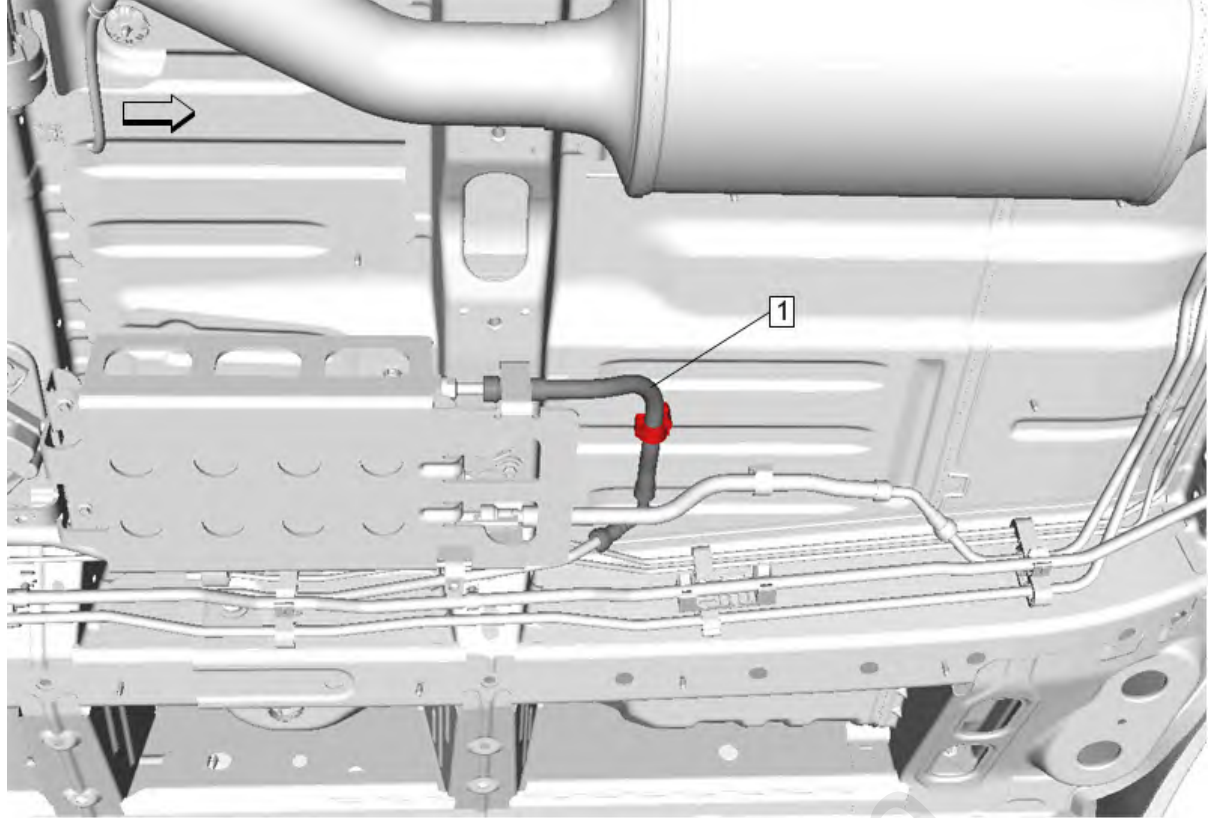


Fig. 144: Fuel Return Pipe (Cooler To Rear Pipe FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure {If equipped} Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (Front Wheel Drive) . Underbody Rear Air Deflector Replacement (Diesel) .	
1	Fuel Return Pipe Procedure 1. Disconnect the fuel return pipe and remove from retainer. Refer to Metal Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (COOLER TO FRONT PIPE AWD)

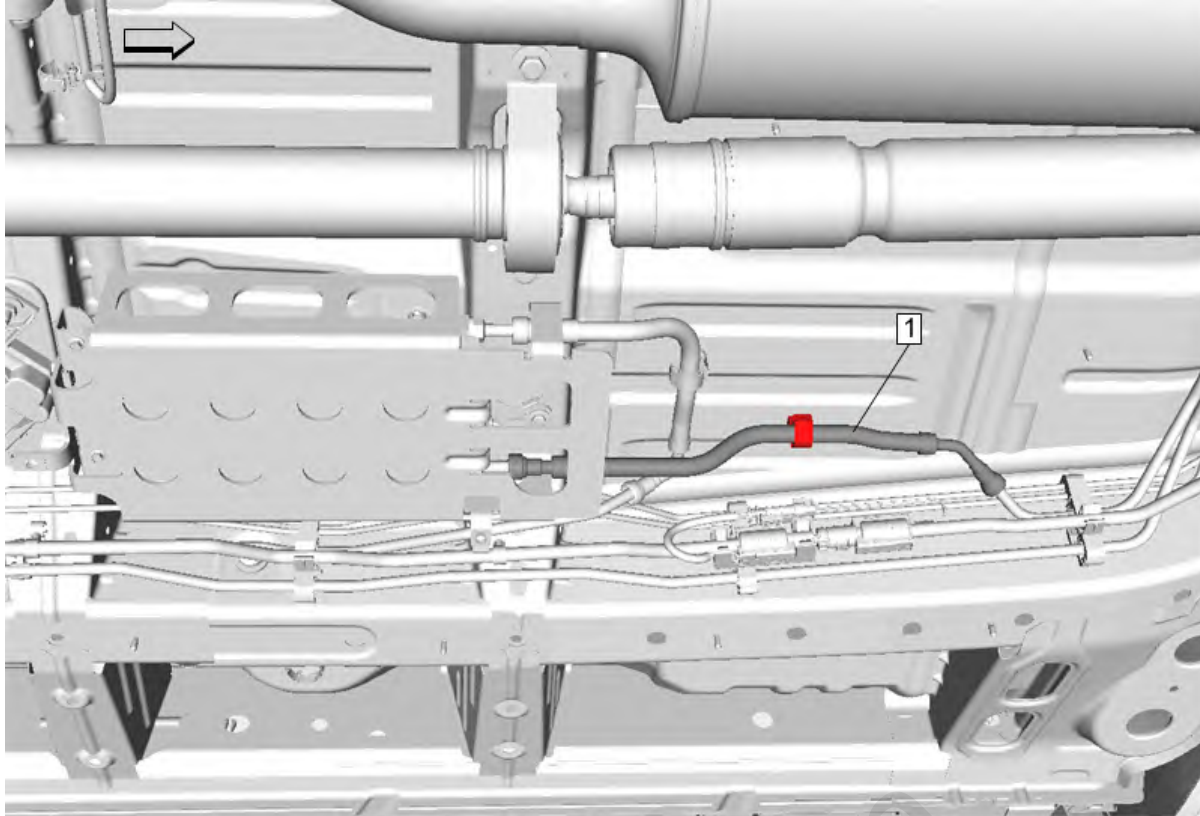


Fig. 145: Fuel Return Pipe (Cooler To Front Pipe AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (All Wheel Drive) , Underbody Rear Air Deflector Replacement (Diesel) .	
1	Fuel Return Pipe Procedure 1. Disconnect the fuel return pipe and remove from retainer. Refer to Metal Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (COOLER TO FRONT PIPE FWD)

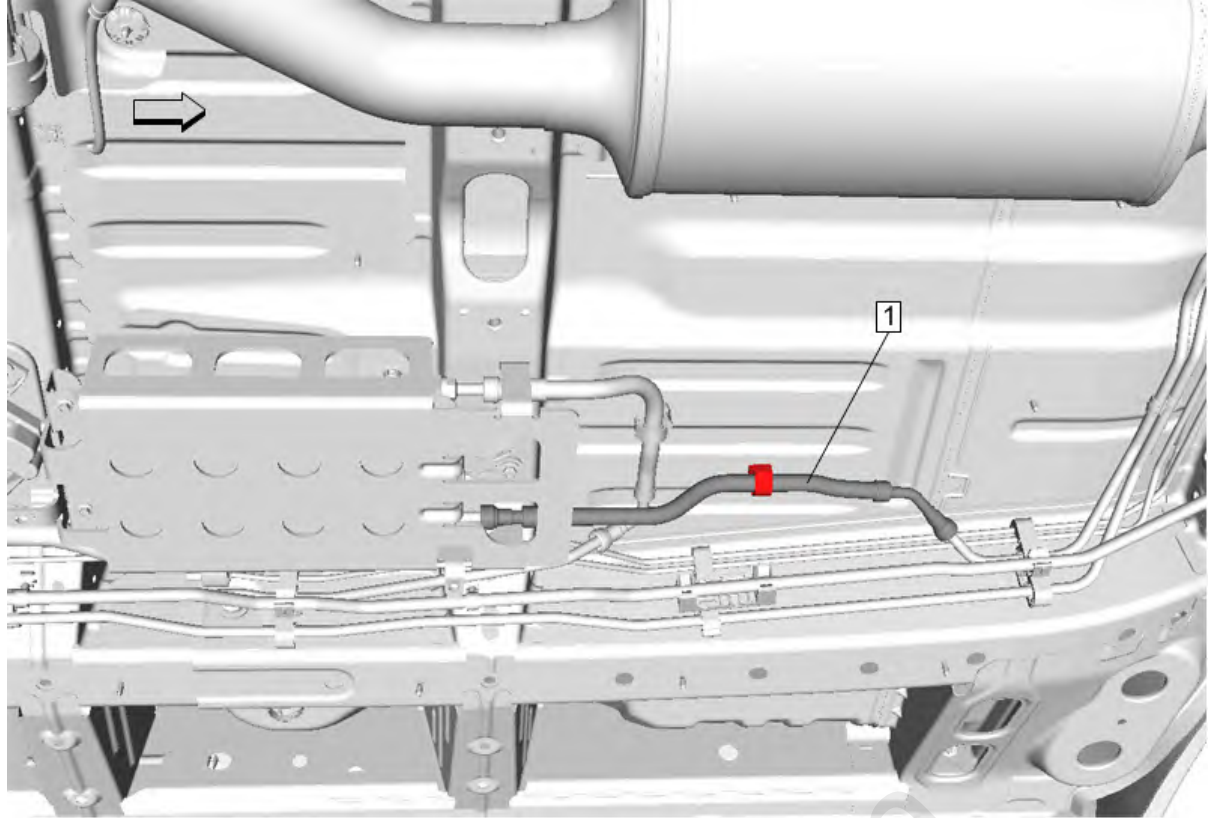


Fig. 146: Fuel Return Pipe (Cooler To Front Pipe FWD).

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure {If equipped} Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (Front Wheel Drive) . Underbody Rear Air Deflector Replacement (Diesel) .	
1	Fuel Return Pipe Procedure 1. Disconnect the fuel return pipe and remove from retainer. Refer to Metal Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (CHASSIS AWD)

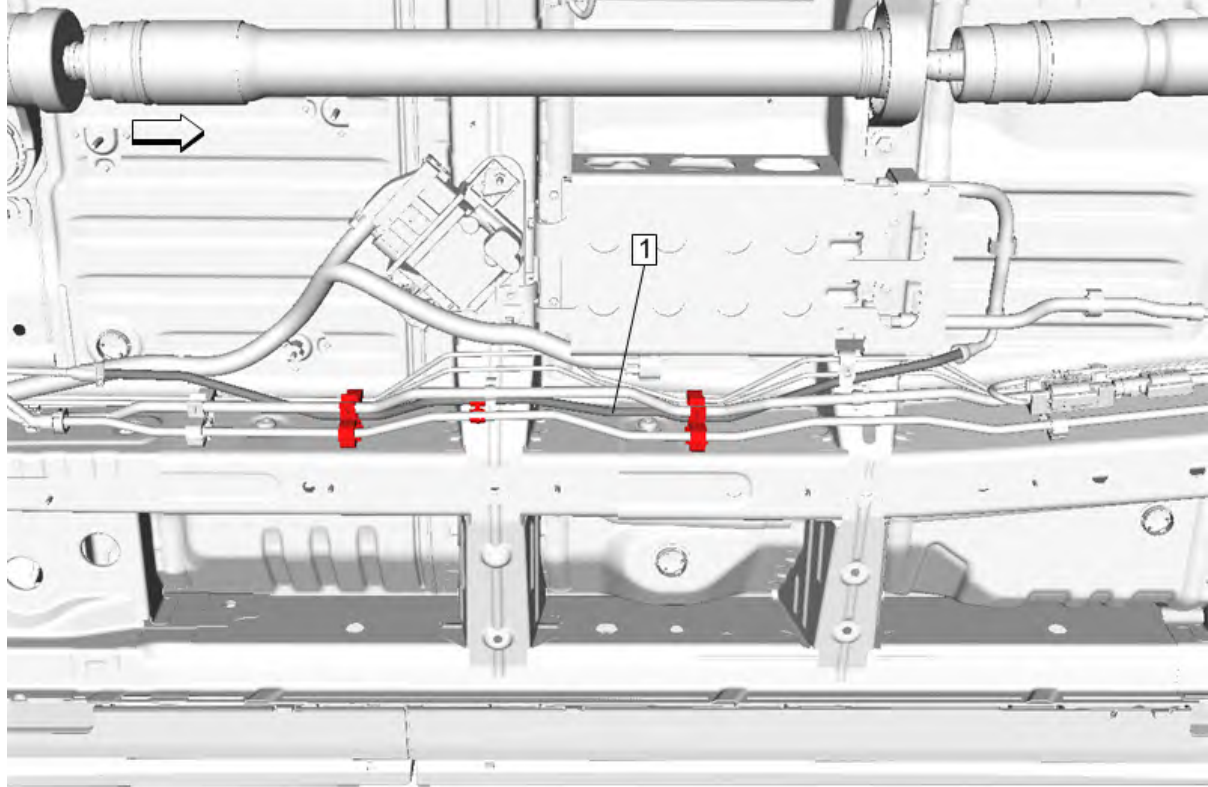


Fig. 147: Fuel Return Pipe (Chassis AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (All Wheel Drive) , Underbody Rear Air Deflector Replacement (Diesel) .	
1	Fuel Return Pipe Procedure 1. Disconnect the fuel return pipe and remove from retainers. Refer to Metal Collar Quick Connect Fitting Service , and Plastic Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (CHASSIS FWD)

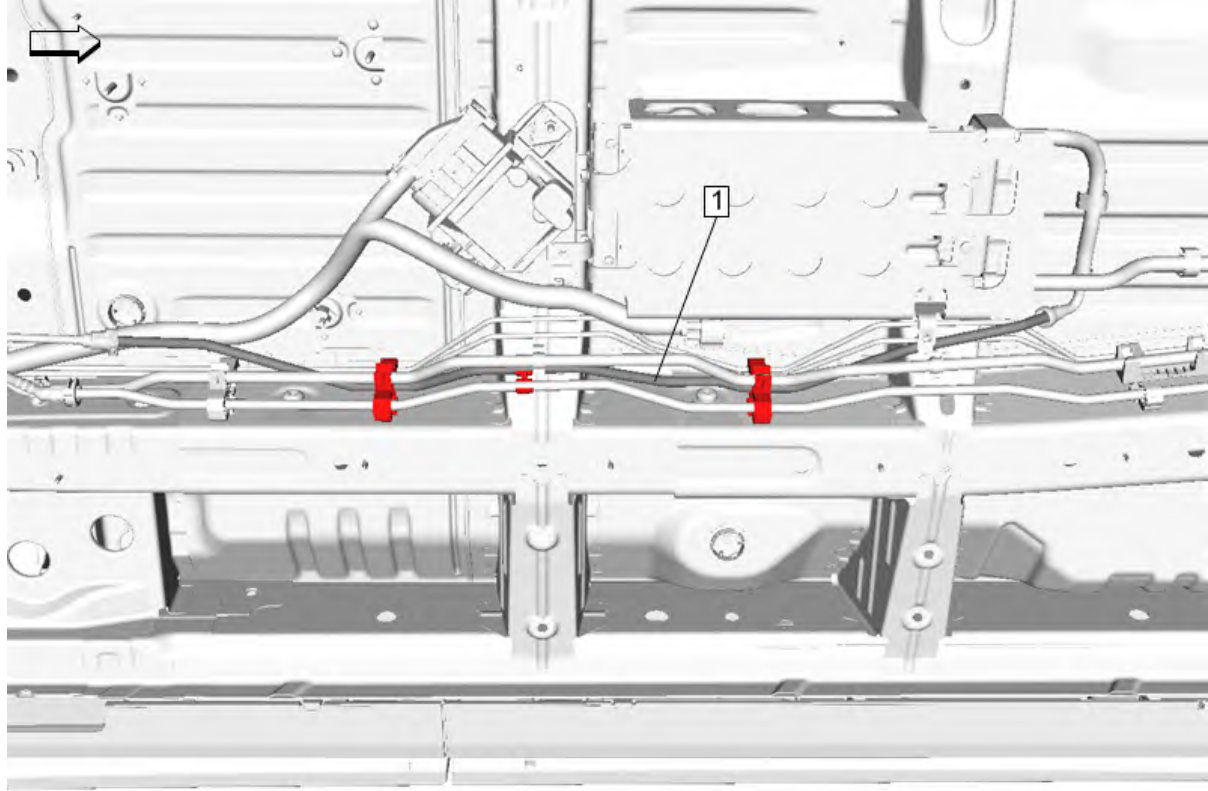


Fig. 148: Fuel Return Pipe (Chassis FWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (Front Wheel Drive) , Underbody Rear Air Deflector Replacement (Diesel) .	
1	Fuel Return Pipe Procedure 1. Disconnect the fuel return pipe and remove from retainers. Refer to Metal Collar Quick Connect Fitting Service , and Plastic Collar Quick Connect Fitting Service 2. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (ENGINE TO PIPE FWD)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Disconnect Fuel Return Front Pipe. Refer to [Fuel Return Front Pipe Replacement](#)

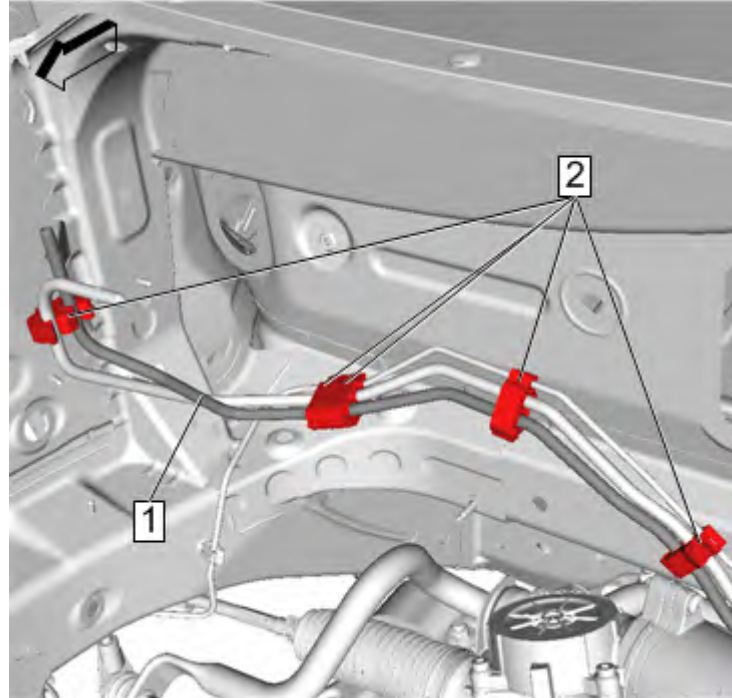


Fig. 149: Fuel Return Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

2. Remove Fuel Return Pipe (1) @ Retainers (2) (Qty: 5)

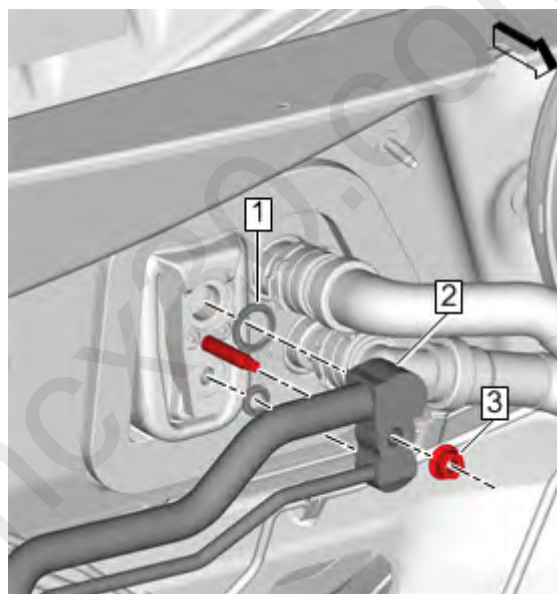


Fig. 150: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals
 Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

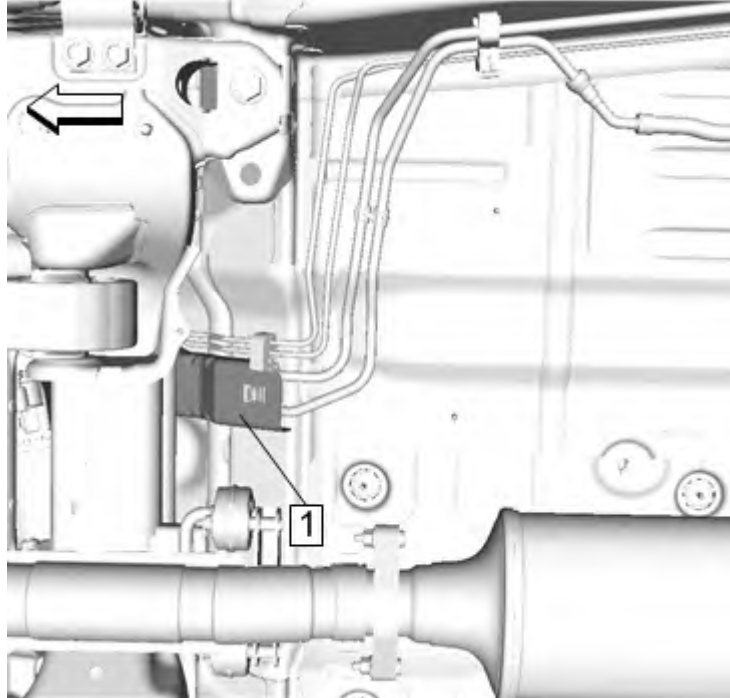


Fig. 151: Shield

Courtesy of GENERAL MOTORS COMPANY

5. Remove Shield (1)
6. {If equipped} Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#).

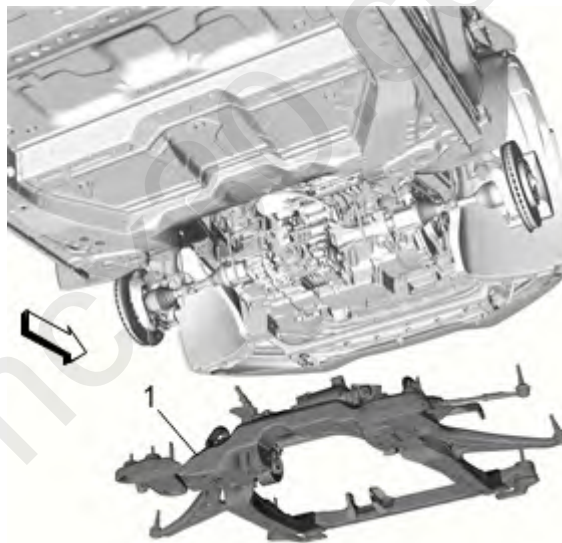


Fig. 152: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

7. Lower drivetrain and front suspension cradle (1) as necessary in order to remove the fuel return pipe from the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#).

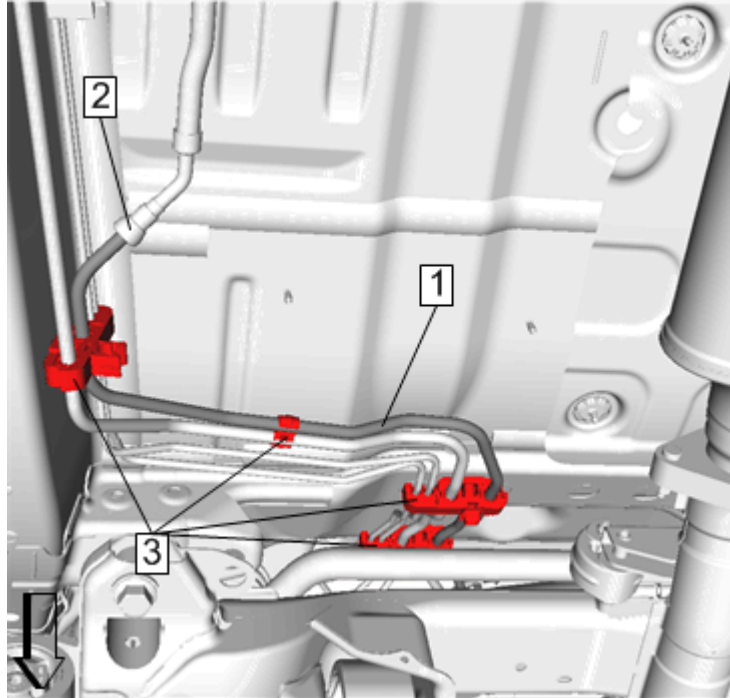


Fig. 153: Fuel Return Pipes And Retainers
 Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Fuel Return Pipe (1) @ Fuel Return Pipe (2). Refer to [Metal Collar Quick Connect Fitting Service](#)
9. Remove Fuel Return Pipe (1) @ Retainers (3) (Qty: 4)
10. Remove fuel return pipe (1) from the vehicle.

Installation Procedure

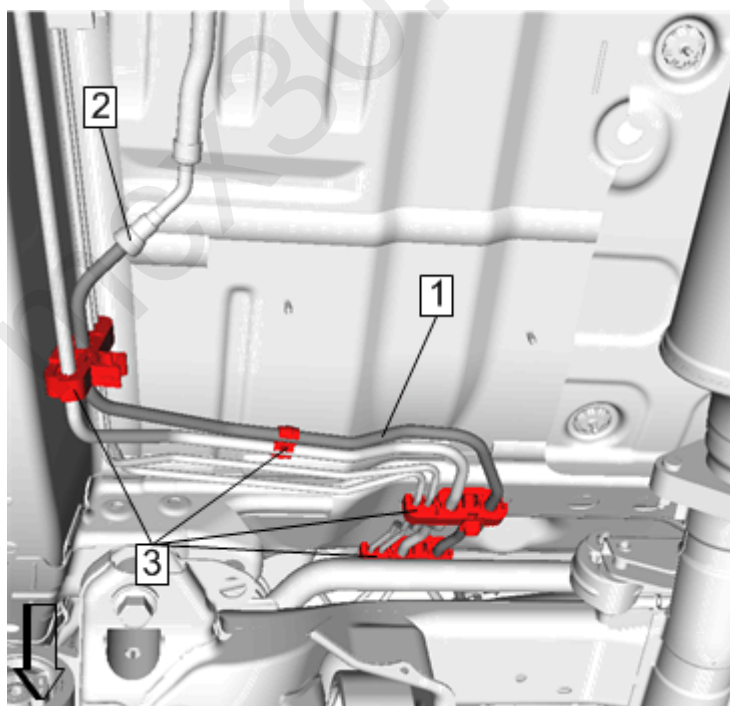


Fig. 154: Fuel Return Pipes And Retainers
 Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel return pipe (1) into the vehicle.
2. Install Fuel Return Pipe (1) @ Retainer (3) (Qty: 4)
3. Connect Fuel Return Pipe (1) @ Fuel Return Pipe (2). Refer to [Metal Collar Quick Connect Fitting Service](#)

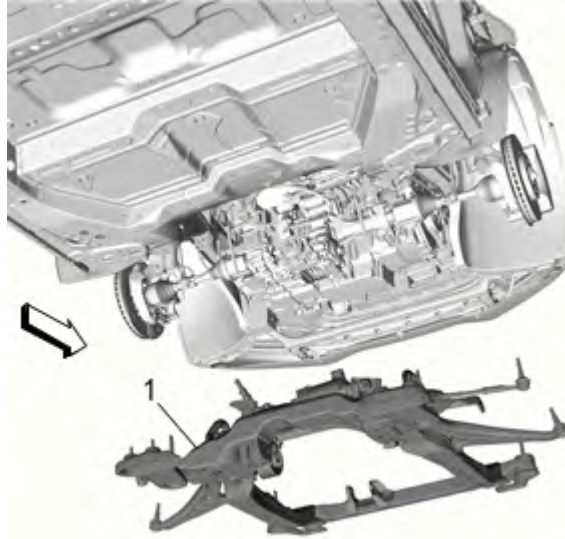


Fig. 155: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

4. Install Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement \(Front Wheel Drive\)](#).
5. {If equipped} Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#).

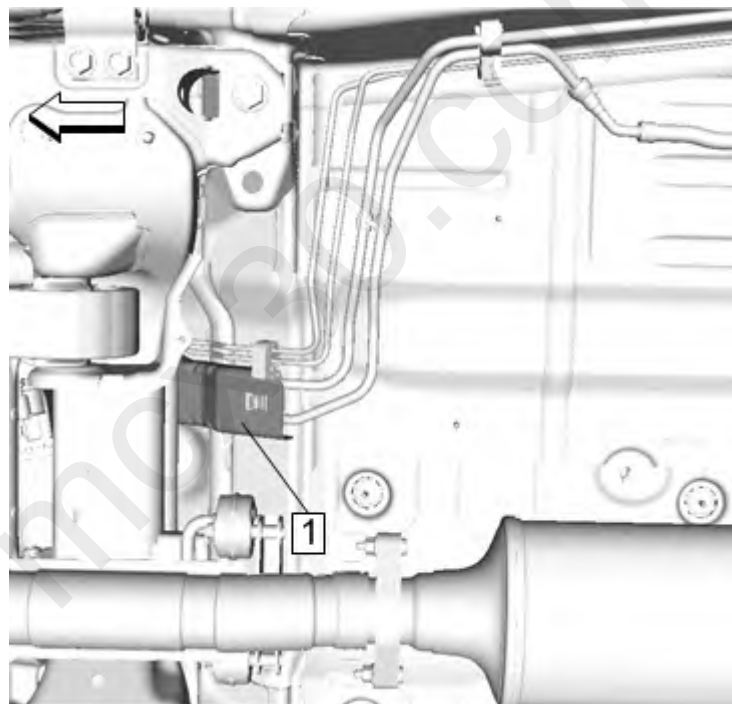


Fig. 156: Shield

Courtesy of GENERAL MOTORS COMPANY

6. Install Shield (1)
7. Lower the vehicle.

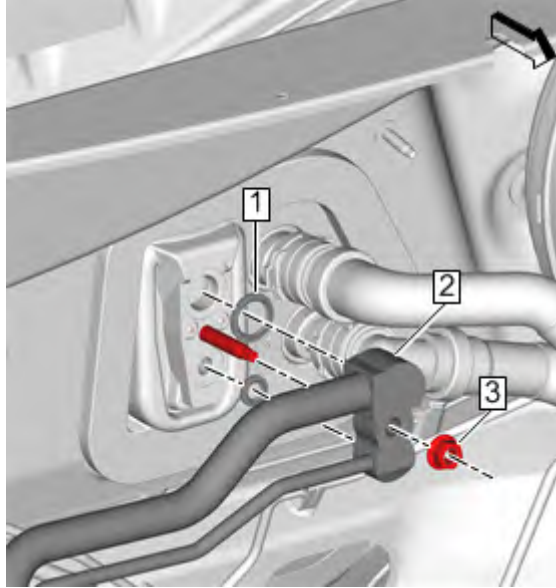


Fig. 157: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals
 Courtesy of GENERAL MOTORS COMPANY

8. Install Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).

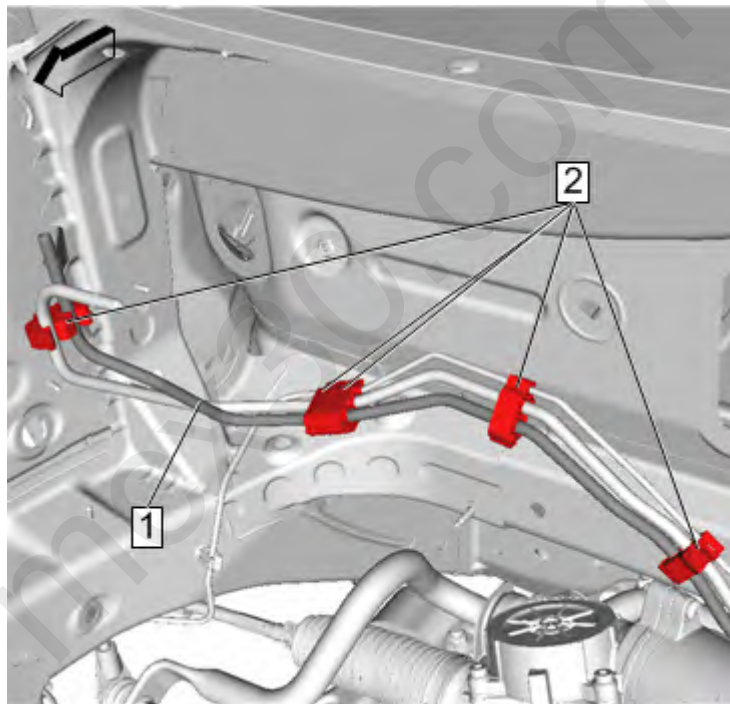


Fig. 158: Fuel Return Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

9. Install Fuel Return Pipe (1) @ Retainers (2) (Qty: 5)
10. Connect Fuel Return Front Pipe. Refer to [Fuel Return Front Pipe Replacement](#)
11. Pressurize fuel system and check for fuel leaks.

FUEL RETURN PIPE REPLACEMENT (ENGINE TO PIPE AWD)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

WARNING: Refer to [Safety Glasses Warning](#) .

1. Disconnect Fuel Return Front Pipe. Refer to [Fuel Return Front Pipe Replacement](#)

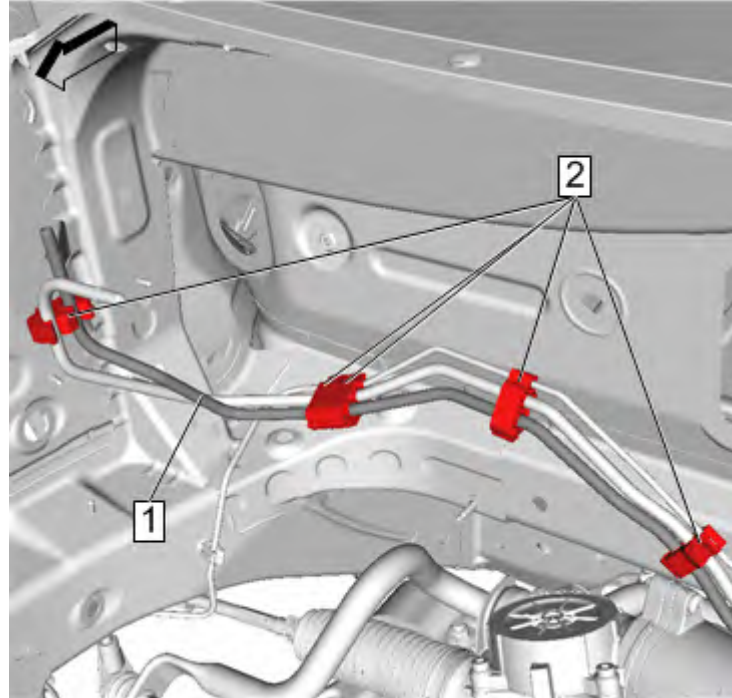


Fig. 159: Fuel Return Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

2. Remove Fuel Return Pipe (1) @ Retainer (2) (Qty: 5)

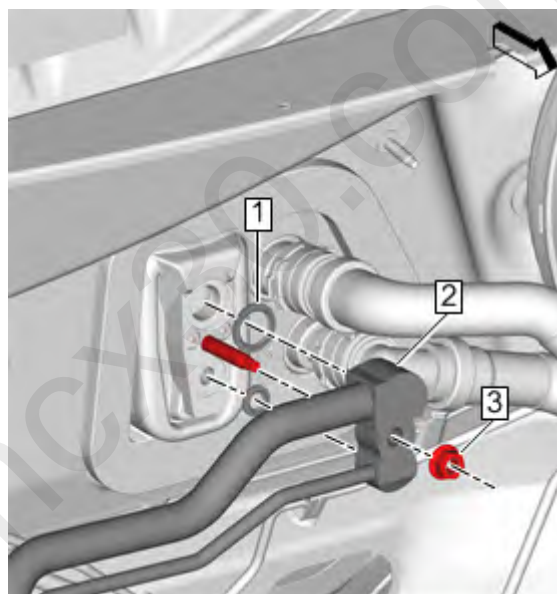


Fig. 160: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals
Courtesy of GENERAL MOTORS COMPANY

3. Remove Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).
4. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

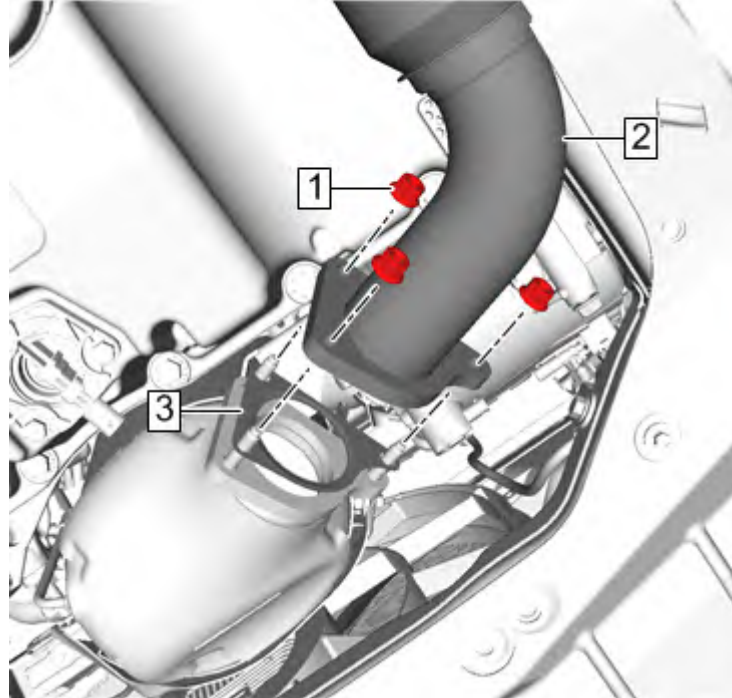


Fig. 161: Exhaust Front Pipe, Nut And Gasket
 Courtesy of GENERAL MOTORS COMPANY

5. Remove Exhaust Front Pipe (2). Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).

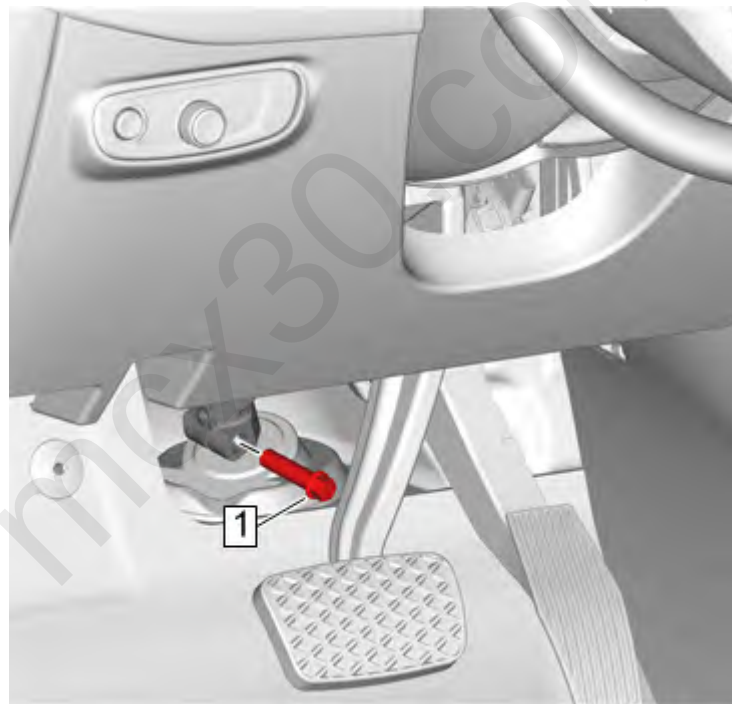


Fig. 162: Intermediate Shaft Pinch Bolt
 Courtesy of GENERAL MOTORS COMPANY

6. Remove lower steering shaft bolt (1) and remove steering shaft from steering rack. Refer to [Intermediate Steering Shaft Replacement \(Equinox\)](#), [Intermediate Steering Shaft Replacement \(Terrain\)](#).

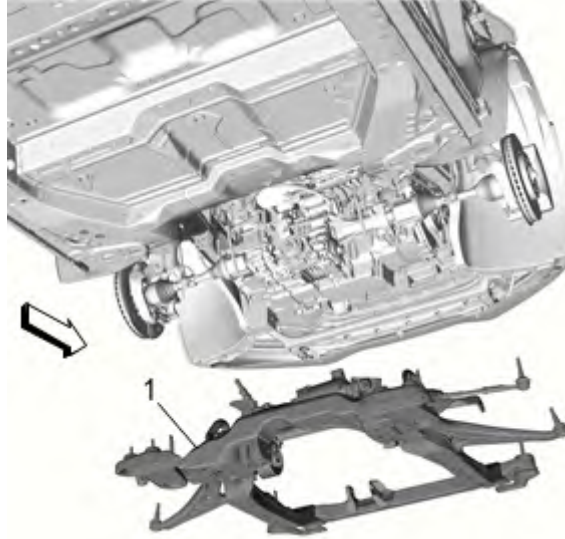


Fig. 163: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

7. Lower drivetrain and front suspension cradle (1) as necessary in order to remove the fuel return pipe from the vehicle. Refer to [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#).

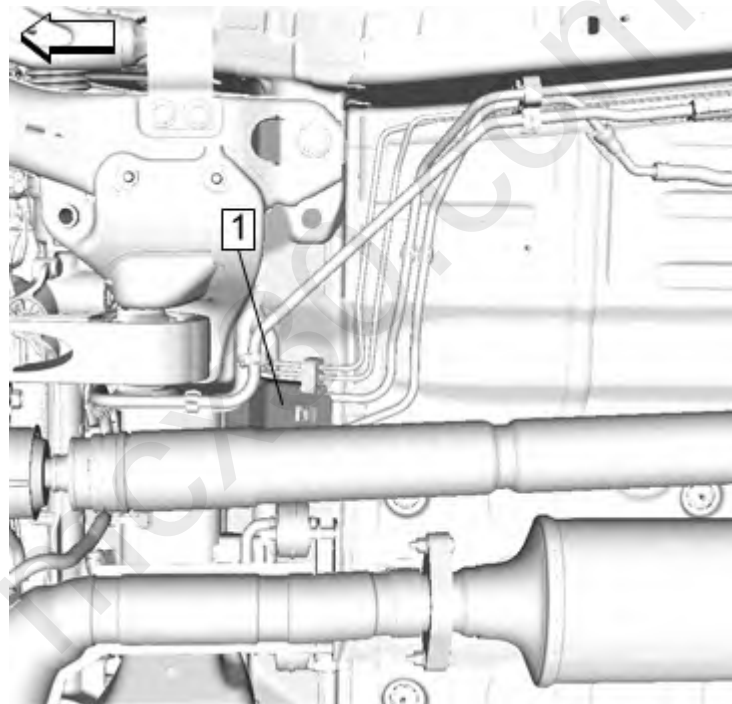


Fig. 164: Shield

Courtesy of GENERAL MOTORS COMPANY

8. Remove Shield (1)
9. {If equipped} Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#).

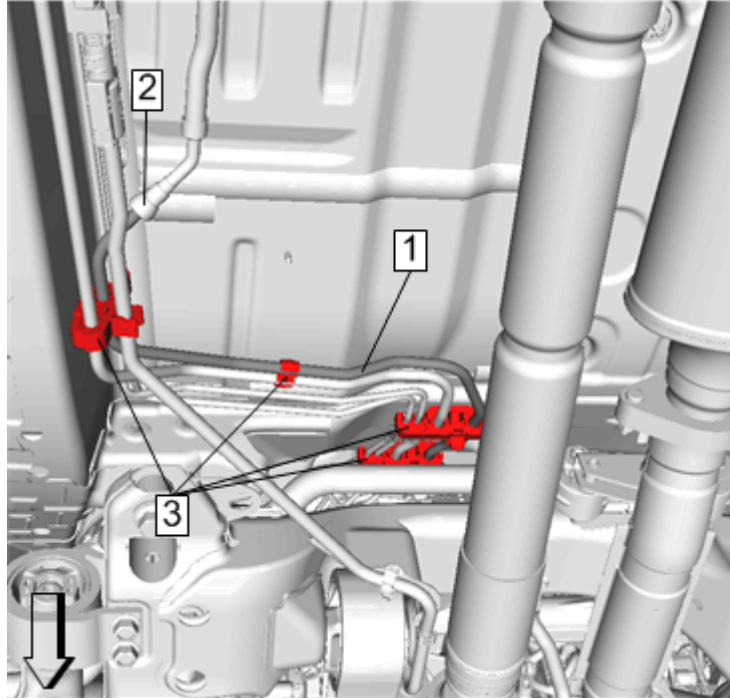


Fig. 165: Fuel Return Pipes And Retainers

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Fuel Return Pipe (1) @ Fuel Return Pipe (2). Refer to [Metal Collar Quick Connect Fitting Service](#)
11. Remove Fuel Return Pipe (1) @ Retainers (3) (Qty: 4)
12. Remove fuel return pipe (1) from the vehicle.

Installation Procedure

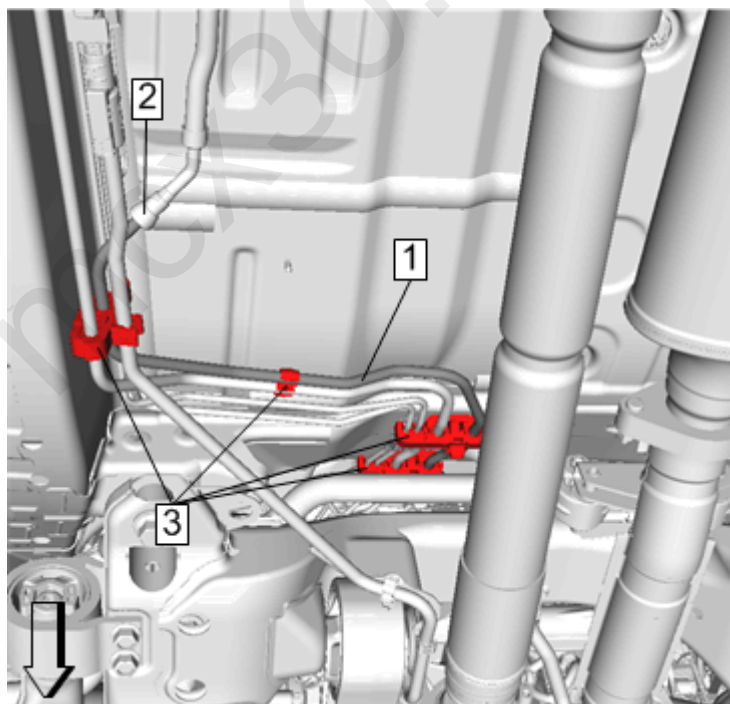


Fig. 166: Fuel Return Pipes And Retainers

Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel return pipe (1) into the vehicle.
2. Install Fuel Return Pipe (1) @ Retainers (3) (Qty: 4)
3. Connect Fuel Return Pipe (1) @ Fuel Return Pipe (2). Refer to [Metal Collar Quick Connect Fitting Service](#)
4. {If equipped} Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)

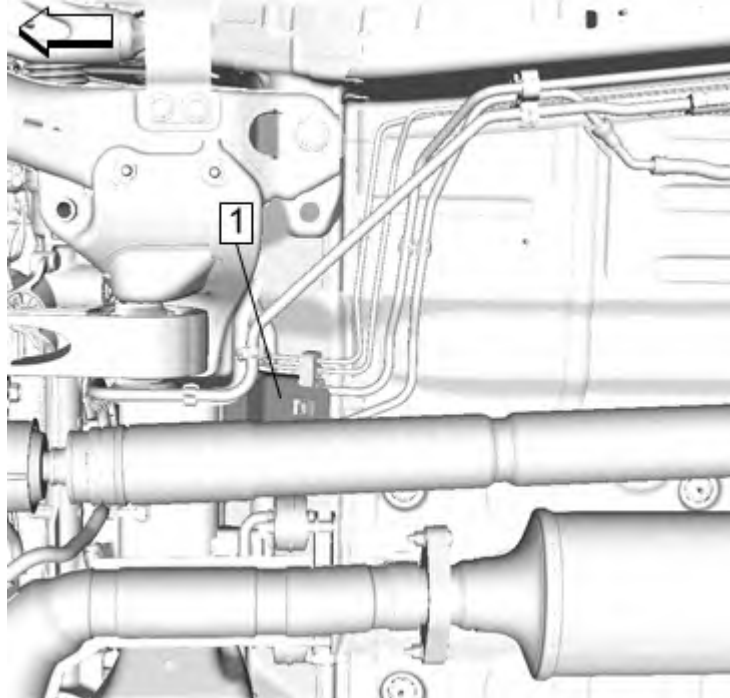


Fig. 167: Shield

Courtesy of GENERAL MOTORS COMPANY

5. Install Shield (1)



Fig. 168: Drivetrain And Front Suspension Cradle

Courtesy of GENERAL MOTORS COMPANY

6. Install Drivetrain and Front Suspension Cradle (1). Refer to [Drivetrain and Front Suspension Cradle Replacement \(All Wheel Drive\)](#)



Fig. 169: Intermediate Shaft Pinch Bolt

Courtesy of GENERAL MOTORS COMPANY

7. Install lower steering shaft bolt (1) after installing steering shaft to steering rack. Refer to [Intermediate Steering Shaft Replacement \(Equinox\)](#), [Intermediate Steering Shaft Replacement \(Terrain\)](#).

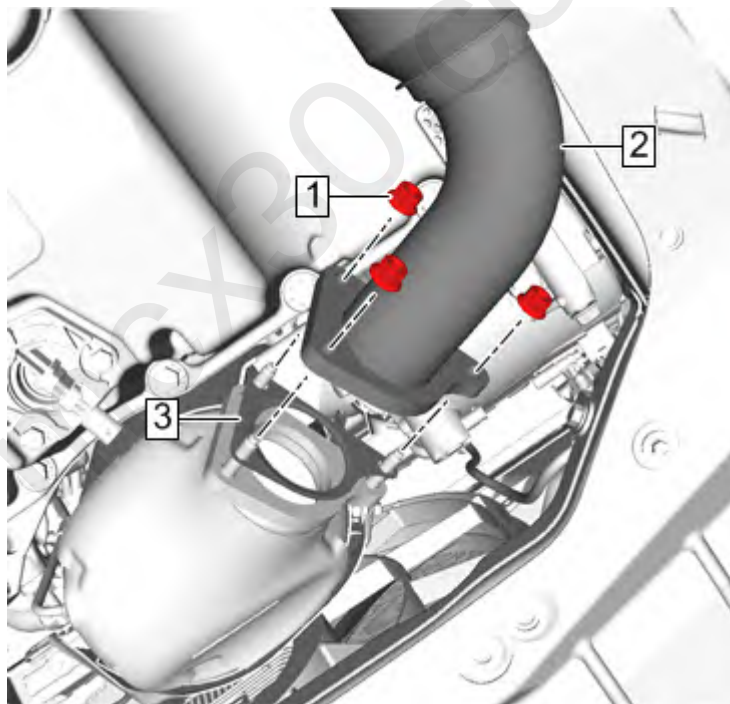


Fig. 170: Exhaust Front Pipe, Nut And Gasket

Courtesy of GENERAL MOTORS COMPANY

8. Install Exhaust Front Pipe (2). Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).
9. Lower the vehicle.

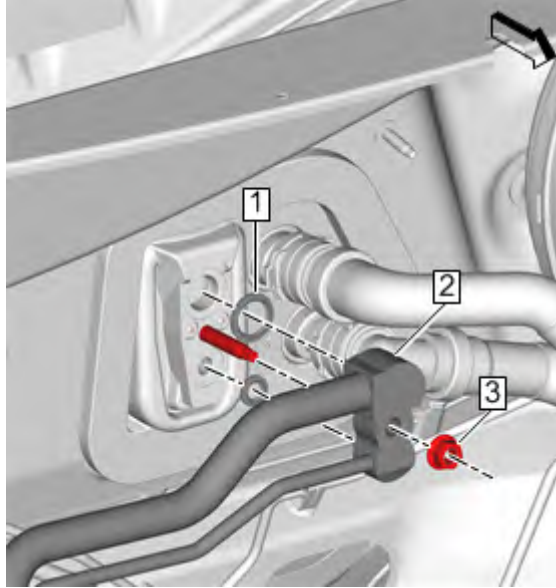


Fig. 171: Air Conditioning Refrigerant Heat Exchanger, Nut And Seals
 Courtesy of GENERAL MOTORS COMPANY

10. Install Air Conditioning Refrigerant Heat Exchanger (2). Refer to [Air Conditioning Refrigerant Heat Exchanger Replacement \(LH7\)](#).

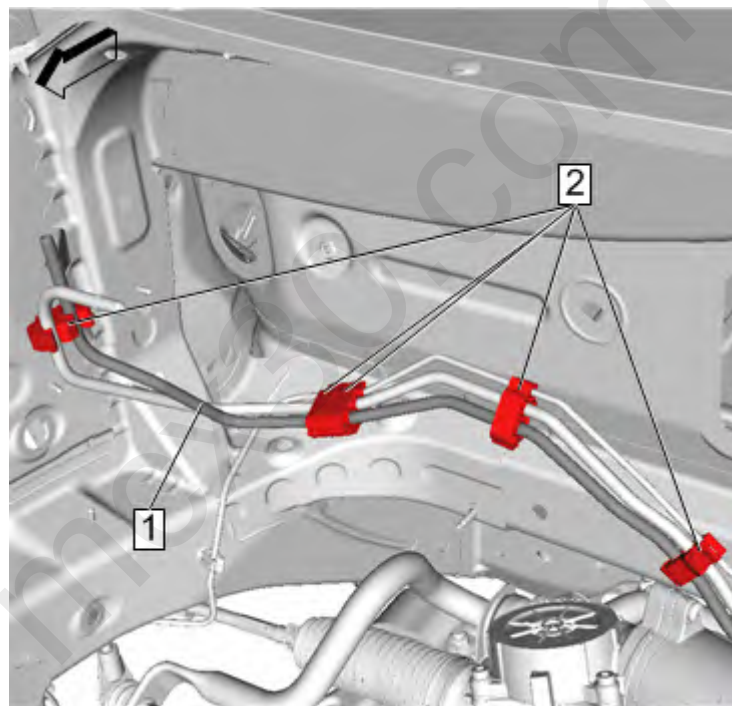


Fig. 172: Fuel Return Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

11. Install Fuel Return Pipe (1) @ Retainers (2) (Qty: 5)
12. Connect Fuel Return Front Pipe. Refer to [Fuel Return Front Pipe Replacement](#)
13. Pressurize fuel system and check for fuel leaks.

FUEL INJECTION FUEL FEED PIPE REPLACEMENT - FUEL INJECTION PUMP TO FUEL RAIL

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

CAUTION: Clean all fuel pipe and hose connections and surrounding areas before disassembling to avoid possible contamination of the fuel system. Spray

the fuel pump module cam-lock ring tang with penetrating oil prior to attempting removal.

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

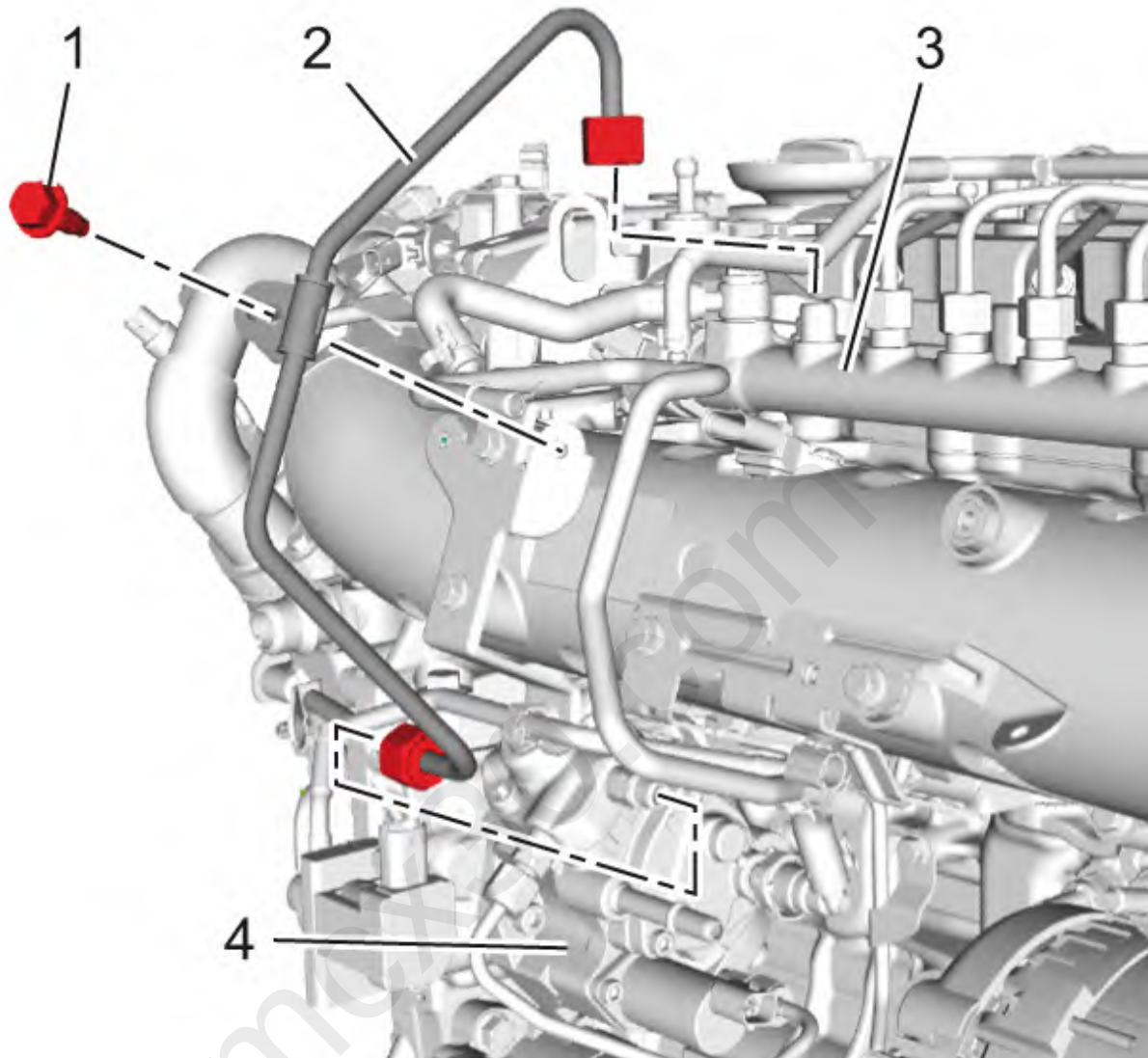


Fig. 173: Fuel Injection Fuel Feed Pipe And Components - Fuel Injection Pump to Fuel Rail
Courtesy of GENERAL MOTORS COMPANY

3. Remove Fuel Injection Fuel Feed Pipe Bracket Bolt (1)
4. Loosen Fuel Injection Fuel Feed Pipe (2) @ Fuel Rail (3)

NOTE: Counterhold at the fuel injection pump hexagon connector.

5. Loosen Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Pump (4)
6. Remove and DISCARD Fuel Injection Fuel Feed Pipe (2)
7. Close the fuel rail using suitable closure plugs.

Installation Procedure

1. Remove the suitable closure plugs.

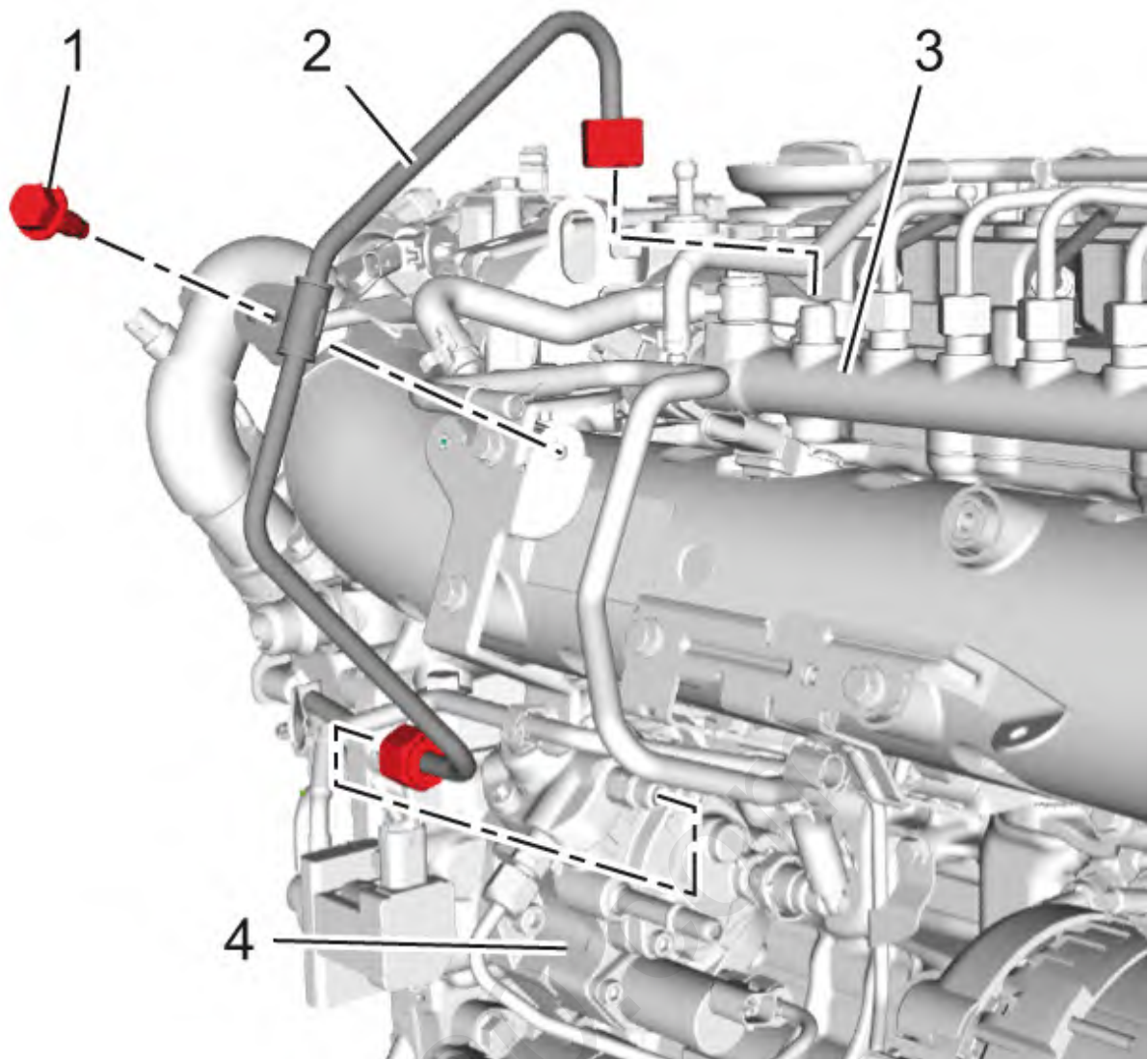


Fig. 174: Fuel Injection Fuel Feed Pipe And Components - Fuel Injection Pump to Fuel Rail
Courtesy of GENERAL MOTORS COMPANY

2. Install New Fuel Injection Fuel Feed Pipe (2)

NOTE: Counterhold at the fuel injection pump hexagon connector.

3. Install Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Pump (4)

4. Install Fuel Injection Fuel Feed Pipe (2) @ Fuel Rail (3)

NOTE: Counterhold at the fuel injection pump hexagon connector.

CAUTION: Refer to [Fastener Caution](#)

5. Tighten Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Pump (4) to 28 N.m (21 lb ft)
6. Tighten Fuel Injection Fuel Feed Pipe (2) @ Fuel Rail (3) to 28 N.m (21 lb ft)
7. Install and tighten Fuel Injection Fuel Feed Pipe Bracket Bolt (1) to 9 N.m (80 lb in)
8. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
9. Check the fuel system for leaks. Refer to [Fuel Leak Diagnosis](#)
10. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

FUEL INJECTION FUEL FEED PIPE REPLACEMENT - FUEL RAIL TO FUEL INJECTOR

Removal Procedure

WARNING: The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam

component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

CAUTION: Refer to [Fuel Contamination Caution](#)

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

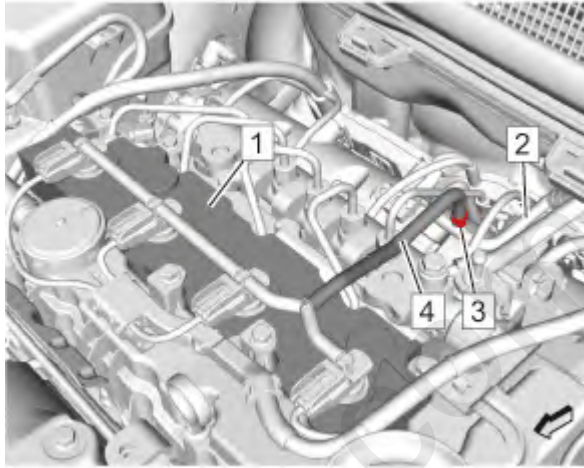


Fig. 175: Fuel Return Hose, Diesel Fuel Separator, Fuel Injector Insulator And Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Remove and DISCARD Clamp (3)
4. Disconnect Fuel Return Hose (4) @ Diesel Fuel Separator (2)
5. Remove Fuel Injector Insulator (1)

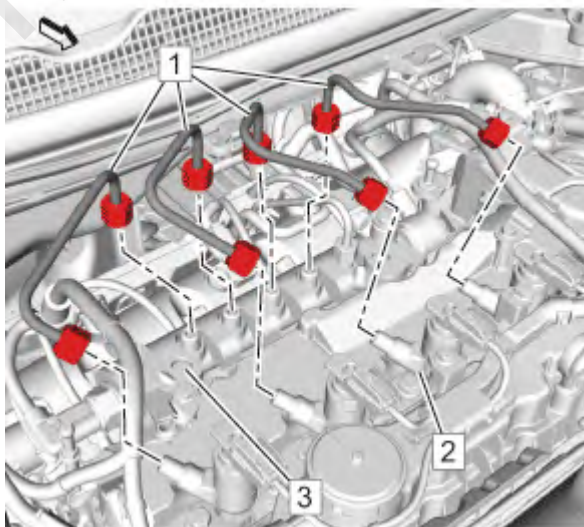


Fig. 176: Fuel Injection Fuel Feed Pipes, Fuel Rail And Fuel Injectors
Courtesy of GENERAL MOTORS COMPANY

6. Loosen Fuel Injection Fuel Feed Pipes (1) @ Fuel Injection Fuel Rail (3) (Qty: 4)
7. Loosen Fuel Injection Fuel Feed Pipes (1) @ Fuel Injectors (2) (Qty: 4)
8. Remove and DISCARD Fuel Injection Fuel Feed Pipes (1) (Qty: 4)

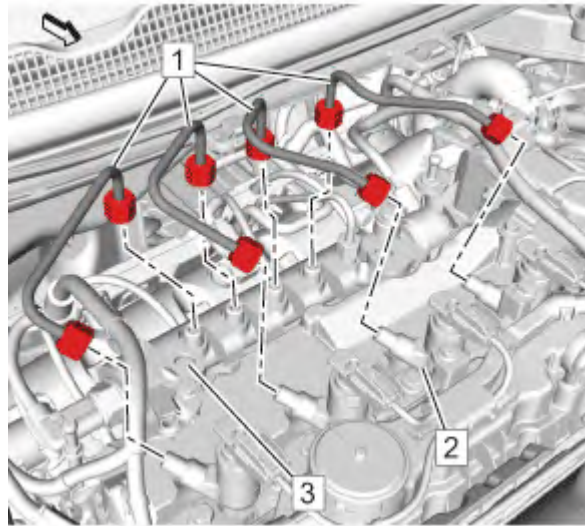


Fig. 177: Fuel Injection Fuel Feed Pipes, Fuel Rail And Fuel Injectors
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Fuel Injection Fuel Feed Pipes (1) (Qty: 4)
2. Hand tighten Fuel Injection Fuel Feed Pipes (1) @ Fuel Injectors (2) (Qty: 4)
3. Hand tighten Fuel Injection Fuel Feed Pipes (1) @ Fuel Injection Fuel Rail (3) (Qty: 4)

CAUTION: Refer to [Fastener Caution](#)

4. Tighten Fuel Injection Fuel Feed Pipes (1) (Qty: 8) to 28 N.m (21 lb ft)

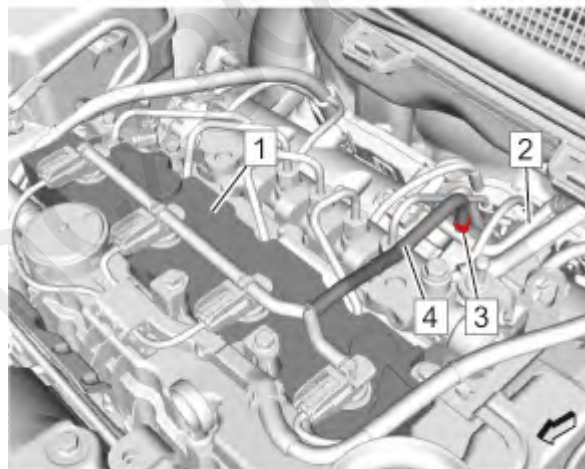


Fig. 178: Fuel Return Hose, Diesel Fuel Separator, Fuel Injector Insulator And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Injector Insulator (1)
6. Connect Fuel Return Hose (4) @ Diesel Fuel Separator (2)
7. Install a NEW clamp. (3)
8. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
9. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

FUEL PRESSURE SENSOR REPLACEMENT

Removal Procedure

WARNING: The noise cancelling foam component **MUST** be replaced if it has been

exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

CAUTION: Refer to [Fuel Contamination Caution](#)

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

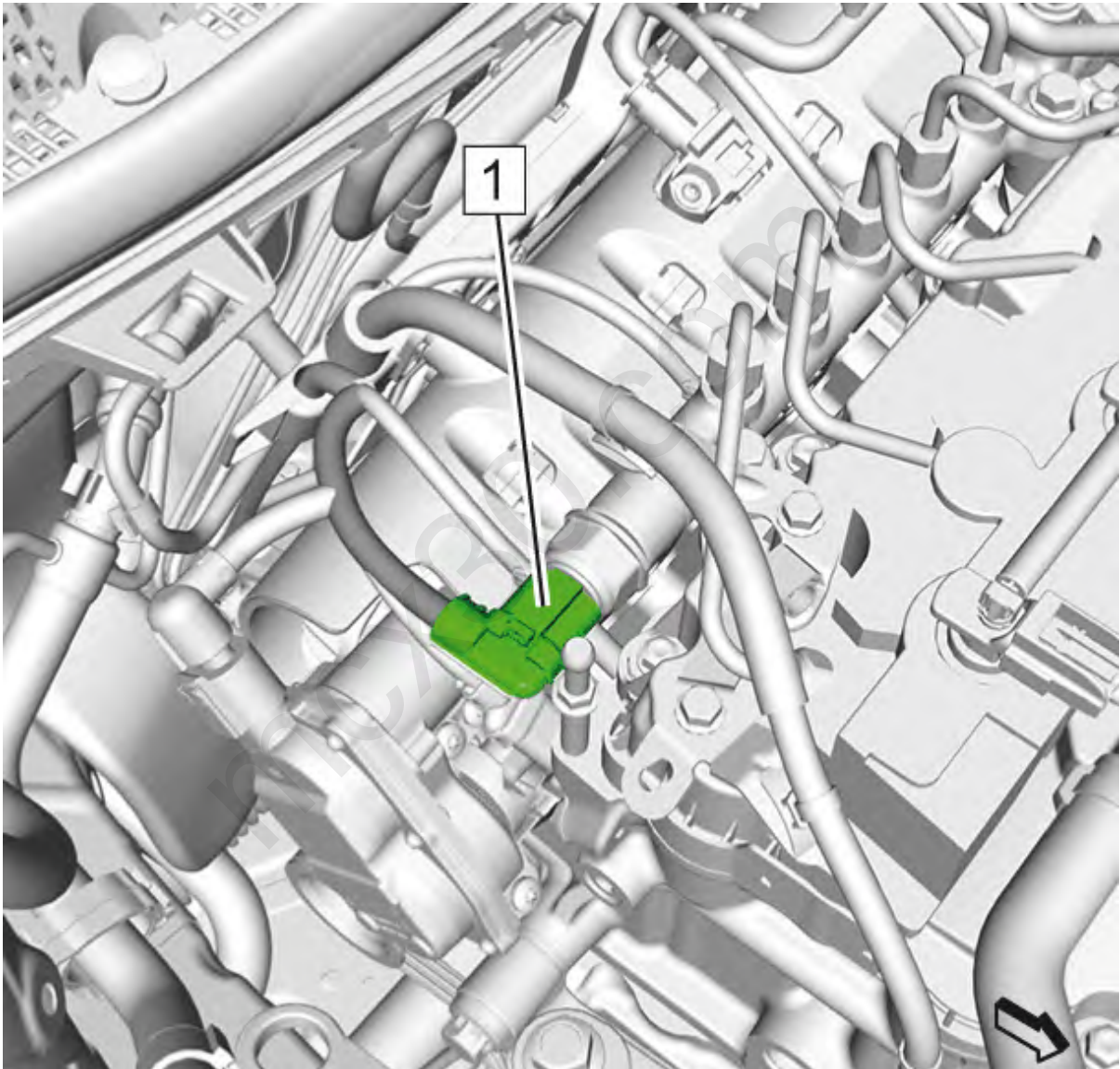


Fig. 179: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector (1)

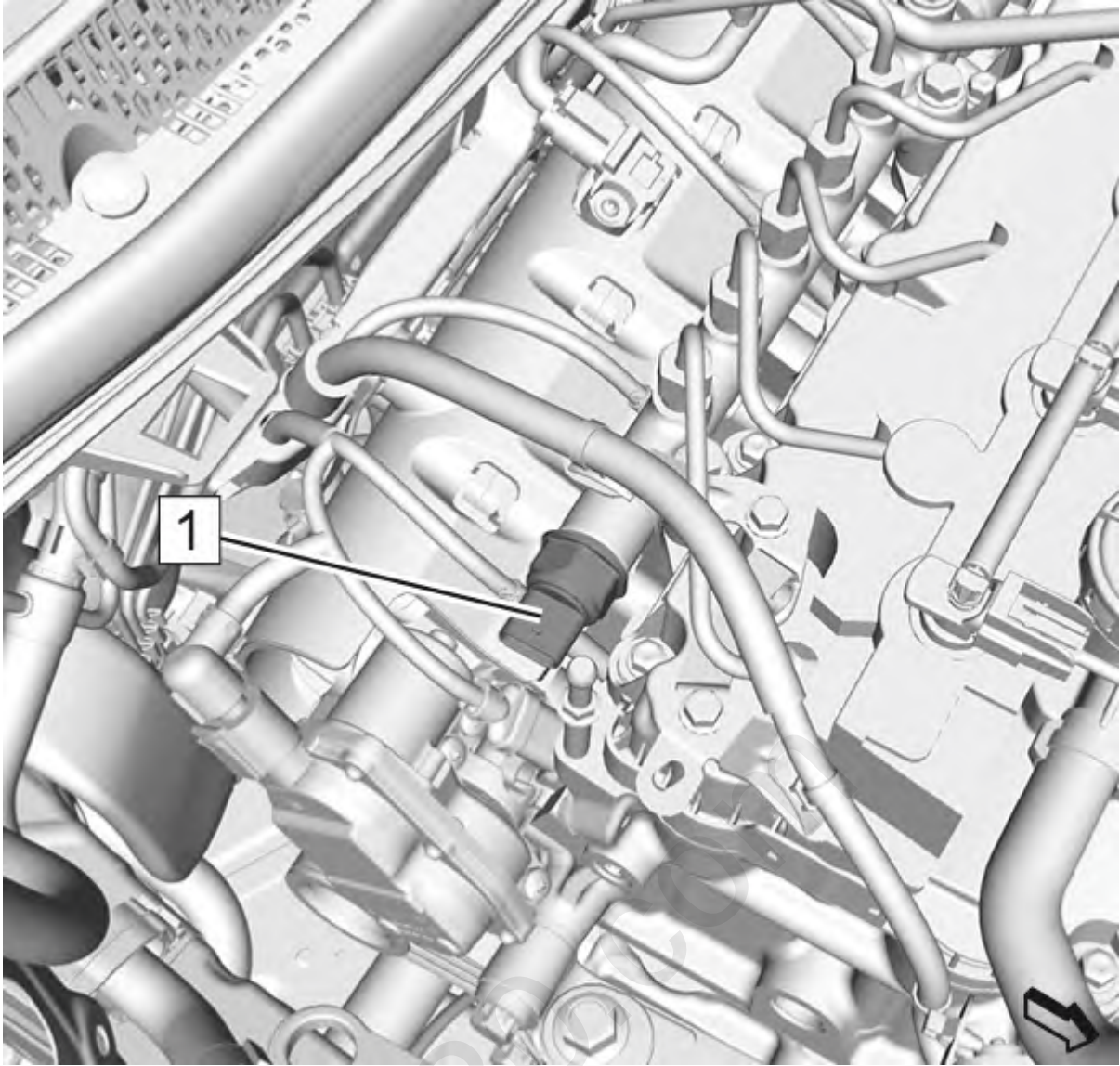


Fig. 180: Fuel Pressure Sensor
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD Fuel Pressure Sensor (1)

Installation Procedure

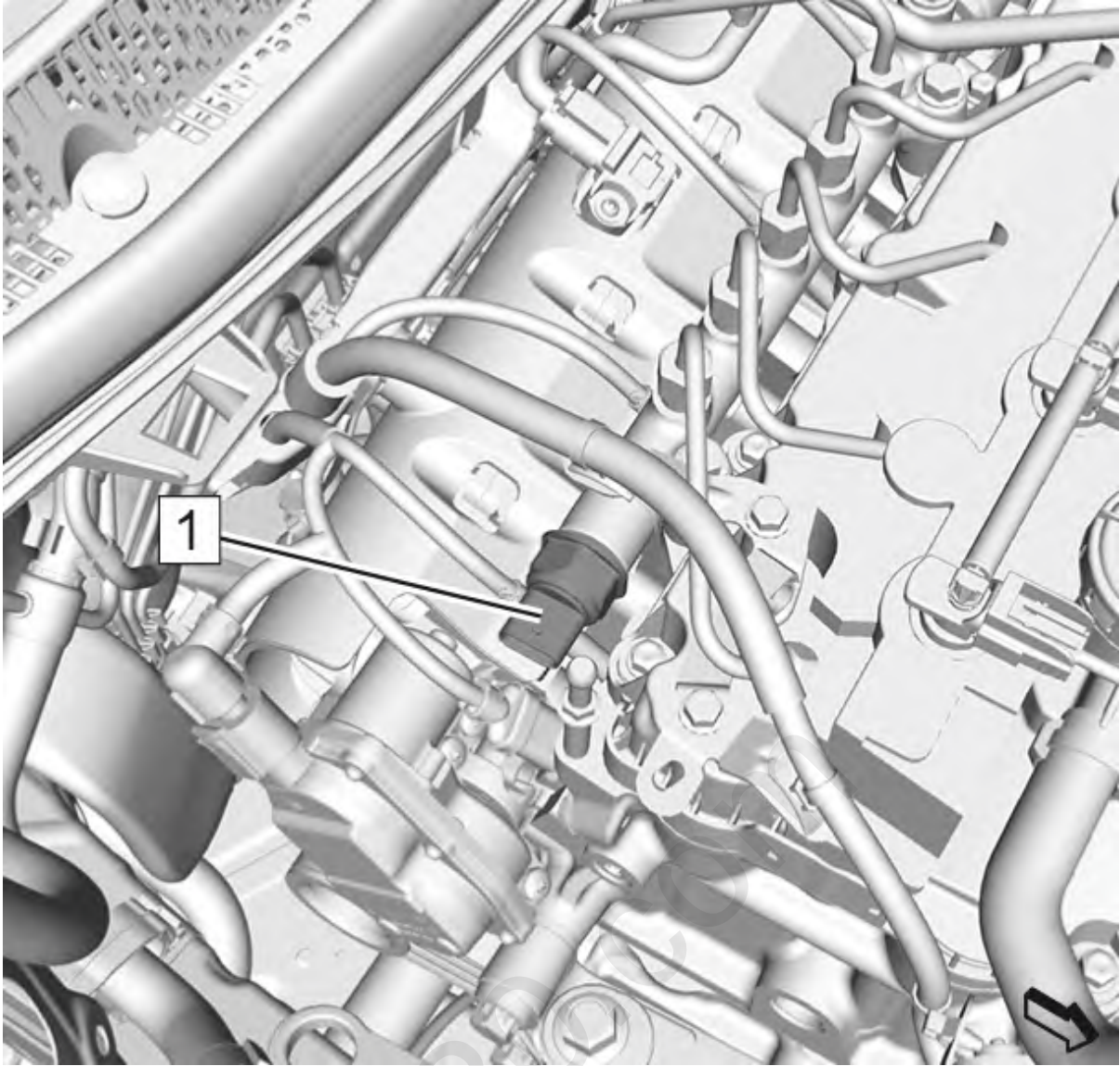


Fig. 181: Fuel Pressure Sensor

Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Fuel Pressure Sensor (1) - Hand tighten

CAUTION: Refer to [Component Fastener Tightening Caution](#)

2. Tighten Fuel Pressure Sensor (1) to 35 N.m (26 lb ft)

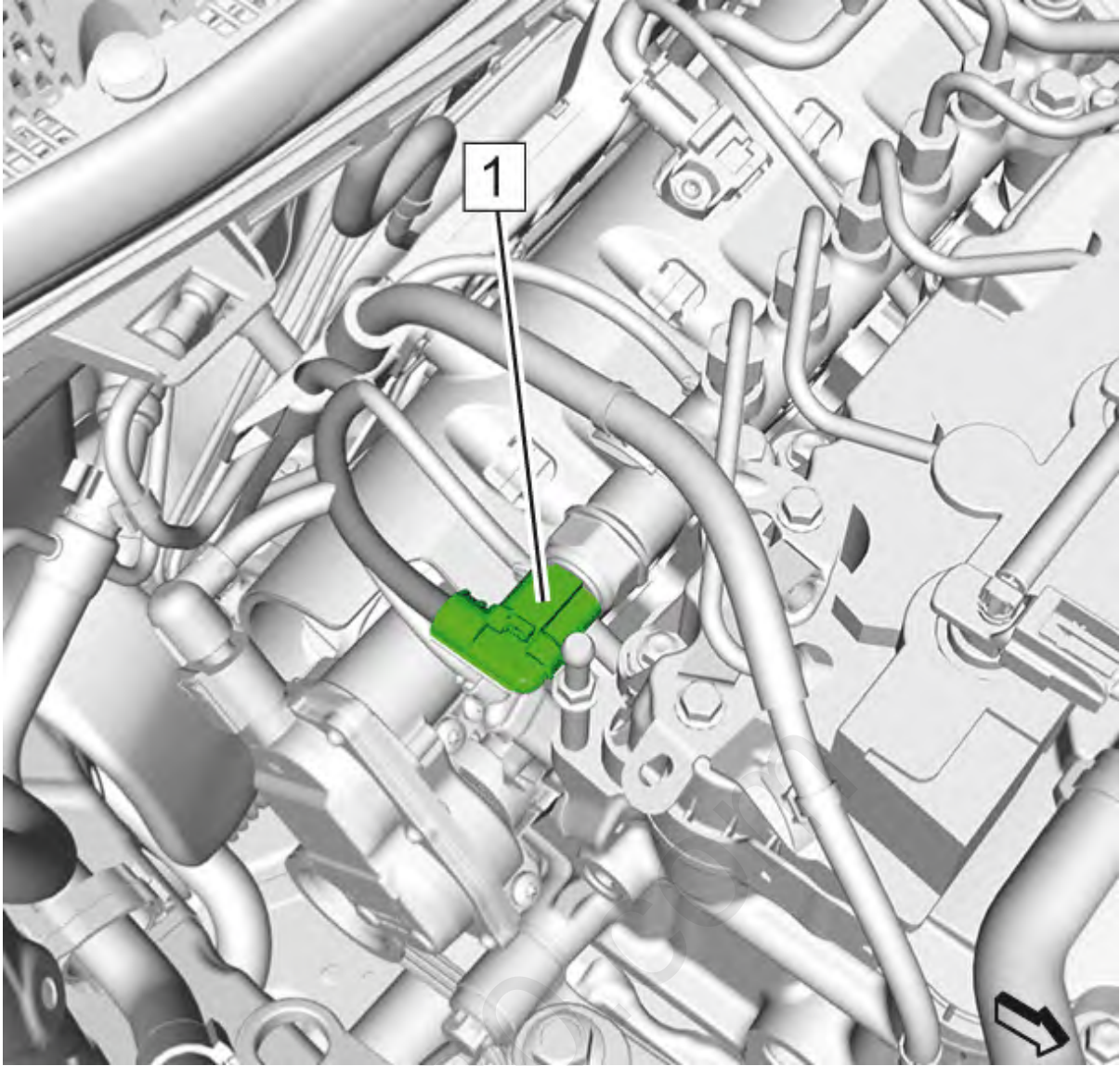


Fig. 182: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Connect Electrical Connector (1)
4. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
5. Start the engine and check for fuel leaks.
6. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
7. If replacing, perform the fuel injection small quantity learn. Refer to [Fuel Injection Small Quantity Learn](#)

FUEL PRESSURE SENSOR REPLACEMENT - FUEL FEED PIPE (AWD)

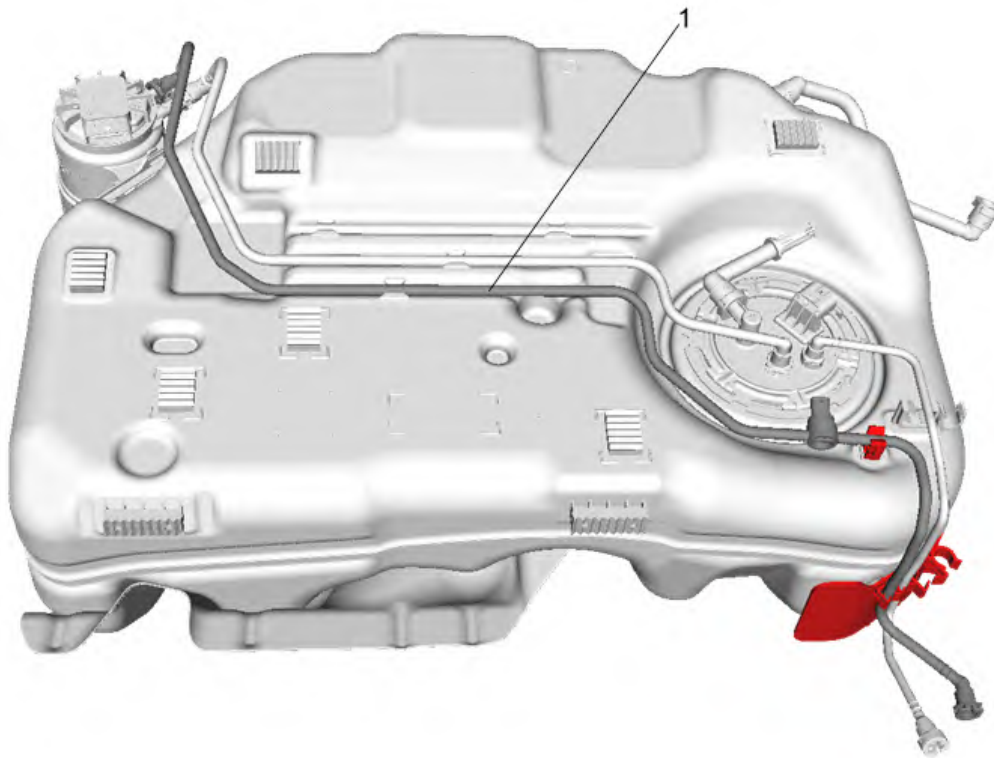


Fig. 183: Fuel Pressure Sensor - Fuel Feed Pipe (AWD).

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Pressure Sensor Procedure 1. Disconnect the electrical connector. 2. Disconnect the fuel hose and remove from retainers. Refer to Plastic Collar Quick Connect Fitting Service NOTE: Fuel pressure sensor is serviced as part of fuel hose assembly.

FUEL PRESSURE SENSOR REPLACEMENT - FUEL FEED PIPE (FWD)

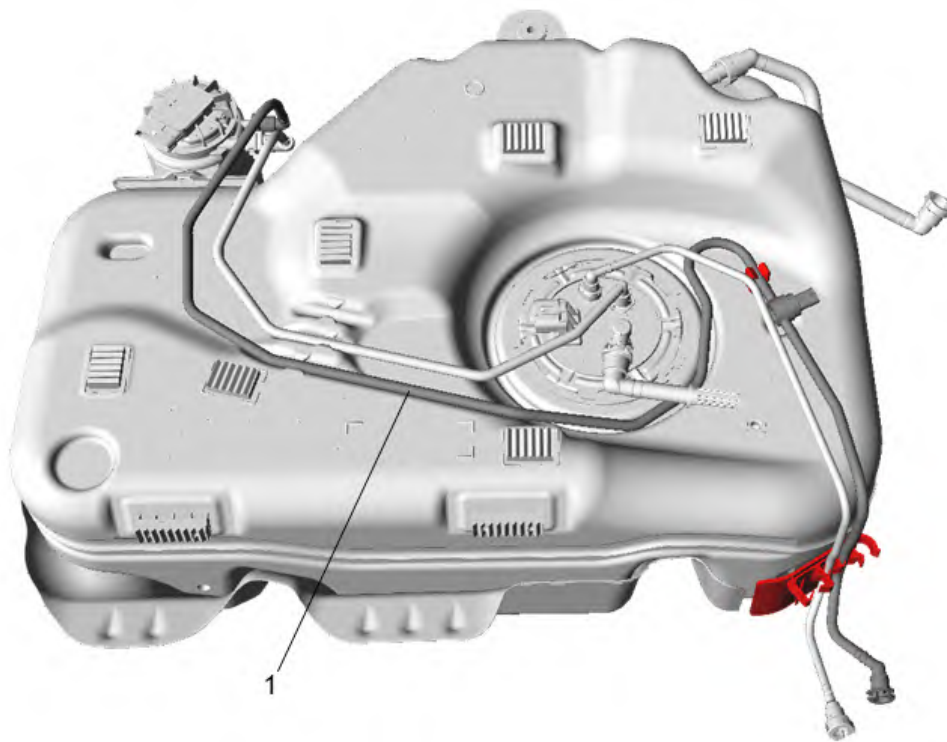


Fig. 184: Fuel Pressure Sensor - Fuel Feed Pipe (FWD).

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Remove Fuel Tank. Refer to Fuel Tank Replacement (FWD) .	
1	Fuel Pressure Sensor Procedure 1. Disconnect the electrical connector. 2. Disconnect the fuel hose and remove from retainers. Refer to Plastic Collar Quick Connect Fitting Service NOTE: Fuel pressure sensor is serviced as part of fuel hose assembly.

FUEL SYSTEM CLEANING

Fungi and other microorganisms can survive and multiply in diesel fuel if water is present. The fungi can be present in any part of the fuel handling system. These fungi grow into long strings and will form into large globules. The growths appear slimy and are usually black, green, or brown. The fungi may grow anywhere in the fuel but are most plentiful where diesel fuel and water meet. As the fuel is agitated, when service station tanks are being filled, fungi are distributed throughout the tank and may be pumped into a vehicle.

Fungi use the fuel as their main energy supply and need only trace amounts of water and minerals. As they grow and multiply, they change fuel into water, sludge, acids, and products of metabolism. The most common symptom is fuel filter plugging; however, various metal components including the fuel sending unit, pipes, fuel injectors, and injection pump can corrode.

If fungi have caused fuel system contamination, use a diesel fuel biocide to sterilize the fuel system. Do not exceed the dosage recommended on the label. Discontinue the use of a biocide when towing a trailer. It is permissible to have biocide in the fuel when starting to tow, but do not add any biocide while towing.

Steam cleaning may be necessary if most of the fungus growth cannot be removed with biocides.

The presence of water or gasoline in diesel fuel may also cause injection pump and nozzle damage.

This procedure checks for the presence of water and gasoline in diesel fuel that may cause injection pump and nozzle damage.

Remove and inspect the fuel filter element.

- If water, gasoline or fungi/bacteria are not present, end the inspection.
- If water or fungi/bacteria are present, proceed to Cleaning Water from the Fuel System.
- If gasoline is present, proceed to Cleaning Gasoline from the Fuel System.

Cleaning Water from the Fuel System

1. Disconnect the negative battery. Refer to [**Battery Negative Cable Disconnection and Connection \(KL9\)**](#).
2. Remove the fuel tank fuel pump module. Refer to [**Fuel Tank Fuel Pump Module Replacement \(FWD\)**](#)[**Fuel Tank Fuel Pump Module Replacement \(AWD\)**](#).
3. Inspect the fuel tank and the fuel tank fuel pump module for rust, fungi or bacteria. If there is rust, replace the rusted components. If rust, fungi or bacteria is found in fuel tank fuel pump module, replace the fuel pump module.
4. Clean the inside of the fuel tank with hot water.
5. Use compressed air in order to dry the fuel tank.
6. Disconnect the ends of the following lines:
 - The fuel filter inlet line (both ends)
 - The fuel filter outlet line (both ends)
 - The fuel filter drain
 - The fuel return line (both ends)
 - The fuel feed pipe (both ends)
7. Inspect each of the pipes and lines.
8. Replace any rusted pipes.
9. Clean the inside of the fuel filter housing.
10. Dry the fuel filter housing with compressed air.
11. Dry the inside of each line with low pressure air.
12. Install a new fuel filter. Refer to [**Fuel Filter Replacement \(AWD\)**](#)[**Fuel Filter Replacement \(FWD\)**](#).
13. Install the fuel tank fuel pump module. Refer to [**Fuel Tank Fuel Pump Module Replacement \(FWD\)**](#)[**Fuel Tank Fuel Pump Module Replacement \(AWD\)**](#).
14. Reconnect the following lines:
 - The fuel filter inlet line (both ends)
 - The fuel filter outlet line (both ends)
 - The fuel return line (tank end)
 - The fuel feed pipe (both ends)
15. Install the fuel tank into the vehicle. Refer to [**Fuel Tank Replacement \(AWD\)**](#)[**Fuel Tank Replacement \(FWD\)**](#).
16. Add clean diesel fuel to the tank until the tank is 1/4 full.

17. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
18. Connect the fuel filter drain to a line that flows into a clean metal container.
19. Cycle the ignition or use a scan tool to command the fuel pump on until clean fuel flows from the fuel filter drain into a metal container.
20. Close the fuel filter drain and remove the bleeder hose. Refer to [Water-in-Fuel Draining](#)
21. Disconnect the crankshaft position sensor.
22. Install a hose on the chassis fuel return pipe and insert other end into a 7.6 liters (2 gallon) metal container.
23. Crank the engine for 15 second time intervals, with 1 minute cool-down periods. Continue until 3.8 liters (1 gallon) of fuel has passed into the container.
24. Connect the fuel return pipe.
25. Reconnect the crankshaft position sensor.
26. Start and run the engine.
27. Stop the engine.
28. Clean any fuel spillage from the engine.
29. Fill the fuel tank and add a biocide, if needed.
30. Clear the engine control module of any diagnostic trouble codes (DTCs).

Cleaning Gasoline from the Fuel System

1. Drain the fuel tank. For AWD applications remove the fuel tank to remove fuel from the auxiliary side of the tank. Refer to [Fuel Tank Replacement \(AWD\)](#)[Fuel Tank Replacement \(FWD\)](#).
2. Fill the fuel tank to 1/4 full.
3. Loosen the fuel filter drain and connect the filter to a hose that flows into a metal container.
4. Cycle the ignition or use a scan tool to command the fuel pump on until clean fuel flows from the fuel filter drain into the metal container.
5. Tighten the fuel filter drain and disconnect the hose. Refer to [Water-in-Fuel Draining](#)
6. Install a hose on the chassis fuel return pipe at the fuel tank, and insert the other end into a 7.6 liters (2 gallon) metal container.
7. Disconnect the crankshaft position sensor.
8. Crank the engine for 15 second time intervals, with 1 minute cool-down periods. Continue until 3.8 liters (1 gallon) of fuel has passed into the container.
9. Reconnect the fuel return pipe.
10. Reconnect the crankshaft position sensor.
11. Attempt to start and run the engine for 15 minutes. If the engine does not start, cycle the ignition on/off ten times to prime the fuel system.
12. Stop the engine.
13. Clean any fuel spillage from the engine.
14. Clear the engine of any diagnostic trouble codes (DTCs).

Fuel Tank Cleaning

NOTE:

- Only use oil free compressed air to blow out the fuel pipes.
- Inspect the fuel tank internally and clean the fuel tank if you find a plugged fuel filter.

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Drain the fuel tank. Refer to [Fuel Tank Draining](#)
3. Remove the fuel tank. Refer to [Fuel Tank Replacement \(AWD\)](#)[Fuel Tank Replacement \(FWD\)](#).
4. Remove the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).

5. Inspect the fuel pump inlet for dirt and debris. Replace the fuel pump if you find dirt or debris in the fuel pump inlet. Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).
6. Locate a stand or fixture suitable to support the weight of the fuel tank and water.

NOTE:

- When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water mixture in accordance with all applicable local, state and federal laws and regulations.
 - Do not drill any access or drain holes in the fuel tank.
7. Flush the fuel tank with running hot water for at least five minutes. Pour the water out of the fuel pump module opening. Rock the fuel tank in order to ensure that the removal of the water from the fuel tank is complete.
 8. Using a high pressure wand, dry all interior tank surfaces. Tank should be tipped accordingly to facilitate removal of water. Assure pressurized air does not contain any contaminants.
 9. Hand dry tank surfaces with a white towel to confirm dryness and cleanliness.
 10. Install the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).
 11. Install the fuel tank. Refer to [Fuel Tank Replacement \(AWD\)](#)[Fuel Tank Replacement \(FWD\)](#).
 12. Fill the tank with clean fuel.

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT

Removal Procedure

WARNING: The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

CAUTION: Refer to [Fuel Contamination Caution](#)

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

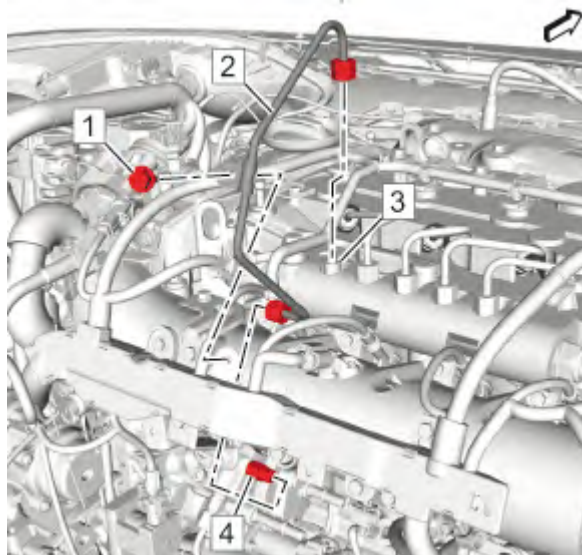


Fig. 185: Fuel Injection Fuel Feed Pipe, Fuel Injection Pump, Fuel Injection Fuel Rail And Bracket Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Remove Fuel Injection Fuel Feed Pipe Bracket Bolt (1)

NOTE: Counterhold at the fuel injection pump connector (4).

4. Loosen Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Pump (4)
5. Loosen Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Fuel Rail (3)
6. Remove and DISCARD Fuel Injection Fuel Feed Pipe (2)
7. Close all open connections with suitable closure plugs.

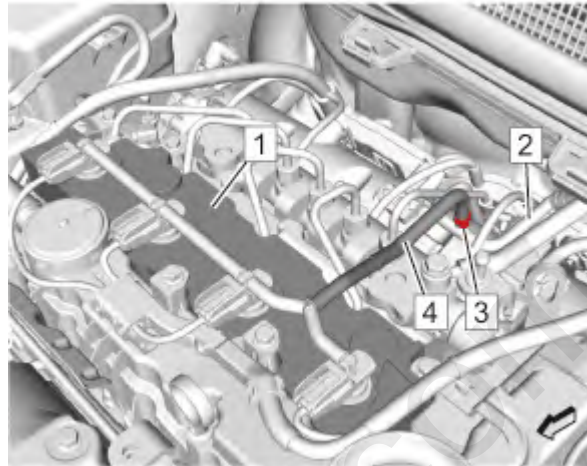


Fig. 186: Fuel Return Hose, Diesel Fuel Separator, Fuel Injector Insulator And Clamp

Courtesy of GENERAL MOTORS COMPANY

8. Remove and DISCARD Clamp (3)
9. Disconnect Fuel Return Hose (4) @ Diesel Fuel Separator (2)
10. Remove Fuel Injector Insulator (1)

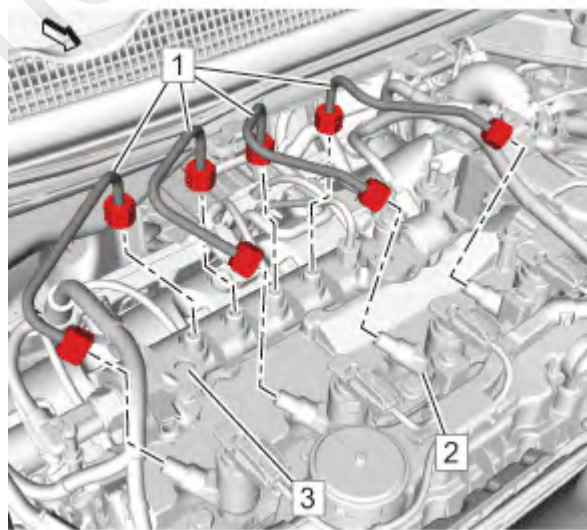


Fig. 187: Fuel Injection Fuel Feed Pipes, Fuel Rail And Fuel Injectors

Courtesy of GENERAL MOTORS COMPANY

11. Loosen Fuel Injection Fuel Feed Pipes (1) @ Fuel Injection Fuel Rail (3) (Qty: 4)
12. Loosen Fuel Injection Fuel Feed Pipes (1) @ Fuel Injector (2) (Qty: 4)
13. Remove and DISCARD Fuel Injection Fuel Feed Pipes (1) (Qty: 4)

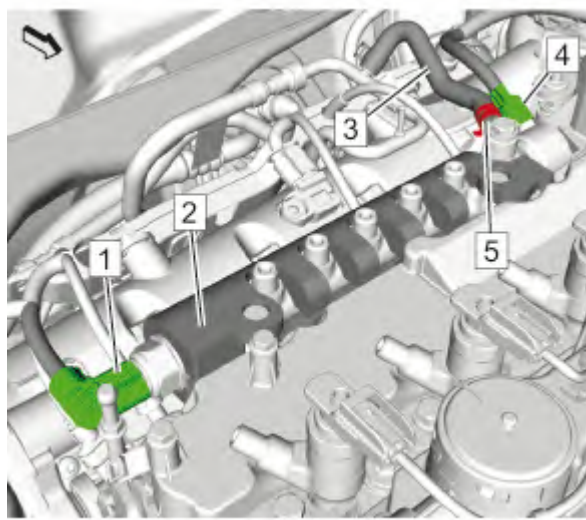


Fig. 188: Fuel Injection Fuel Rail Noise Shield, Diesel Fuel Separator Hose, Clamp And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

14. Disconnect the electrical connector:
 1. Fuel Pressure Sensor (1)
 2. Fuel Pressure Regulator (4)
15. Remove Fuel Injection Fuel Rail Noise Shield (2)
16. Remove Diesel Fuel Separator Hose Clamp (5)
17. Disconnect Diesel Fuel Separator Hose (3) @ Fuel Injection Fuel Rail

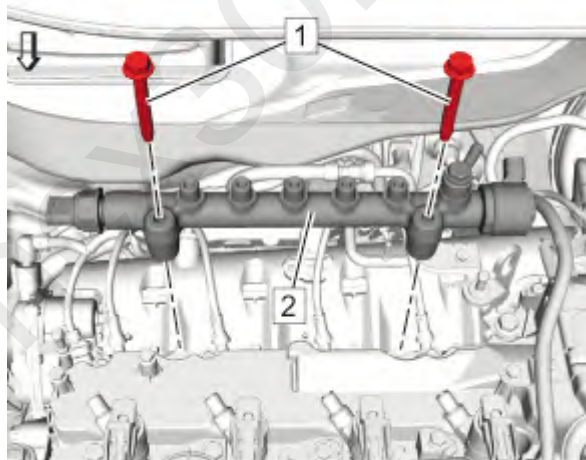


Fig. 189: Fuel Injection Fuel Rail And Bolts

Courtesy of GENERAL MOTORS COMPANY

18. Remove Fuel Injection Fuel Rail Bolts (1) (Qty: 2)
19. Remove Fuel Injection Fuel Rail (2)

Installation Procedure

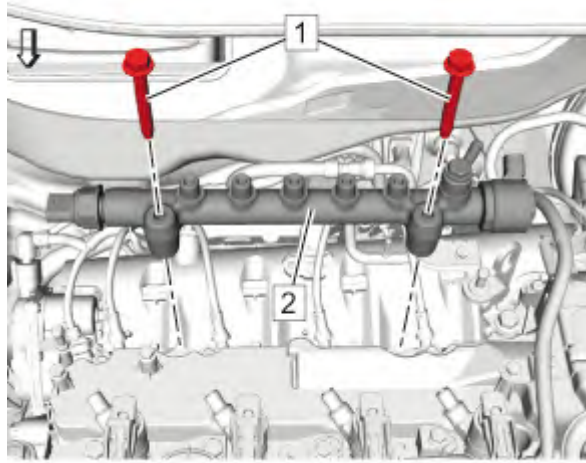


Fig. 190: Fuel Injection Fuel Rail And Bolts

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Injection Fuel Rail (2)

CAUTION: Refer to **Fastener Caution**

2. Install and tighten Fuel Injection Fuel Rail Bolts (1) (Qty: 2) to 25 N.m (18 lb ft)

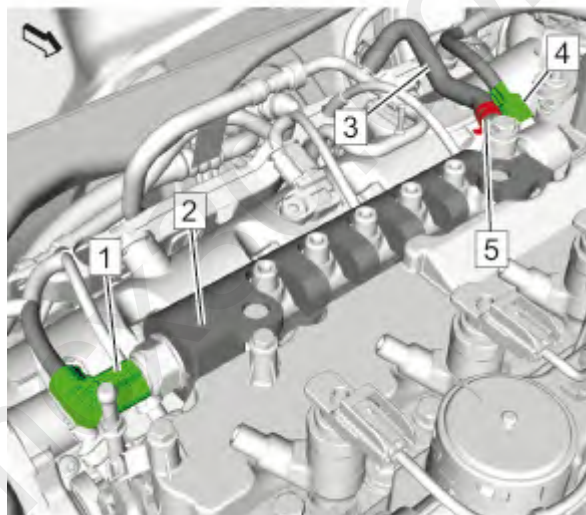


Fig. 191: Fuel Injection Fuel Rail Noise Shield, Diesel Fuel Separator Hose, Clamp And Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

3. Connect Diesel Fuel Separator Hose (3) @ Fuel Injection Fuel Rail
4. Install Diesel Fuel Separator Hose Clamp (5)
5. Install Fuel Injection Fuel Rail Noise Shield (2)
6. Connect the electrical connector:
 1. Fuel Pressure Sensor (1)
 2. Fuel Pressure Regulator (4)

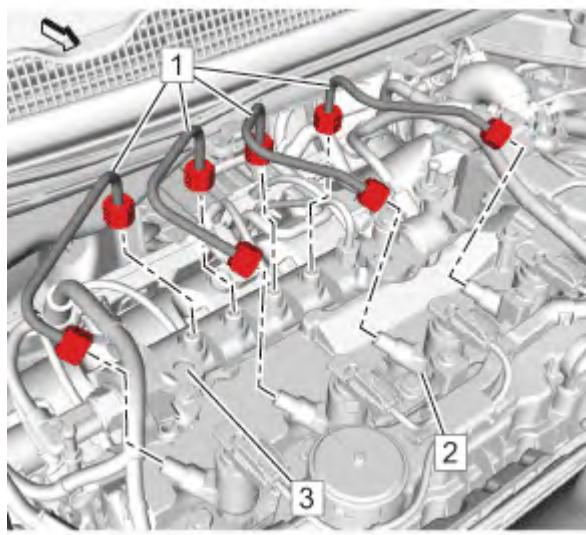


Fig. 192: Fuel Injection Fuel Feed Pipes, Fuel Rail And Fuel Injectors
Courtesy of GENERAL MOTORS COMPANY

7. Install NEW Fuel Injection Fuel Feed Pipes (1) (Qty: 4)
8. Hand Tighten Fuel Injection Fuel Feed Pipes (1) @ Fuel Injector (Qty: 4)
9. Hand tighten Fuel Injection Fuel Feed Pipes (1) @ Fuel Injection Fuel Rail (3) (Qty: 4)
10. Tighten Fuel Injection Fuel Feed Pipes (1) (Qty: 8) to 28 N.m (21 lb ft)

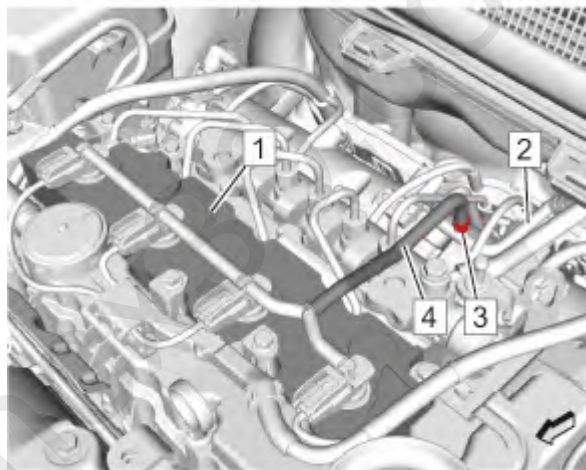


Fig. 193: Fuel Return Hose, Diesel Fuel Separator, Fuel Injector Insulator And Clamp
Courtesy of GENERAL MOTORS COMPANY

11. Install Fuel Injector Insulator (1)
12. Connect Fuel Injector Fuel Return Hose (4) @ Diesel Fuel Separator (2)
13. Install a NEW clamp. (3)

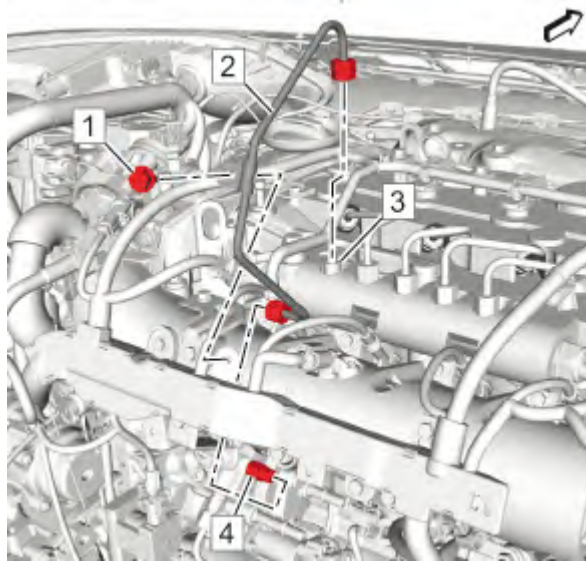


Fig. 194: Fuel Injection Fuel Feed Pipe, Fuel Injection Pump, Fuel Injection Fuel Rail And Bracket Bolt

Courtesy of GENERAL MOTORS COMPANY

14. Remove the suitable closure plugs from all connections.
15. Install NEW Fuel Injection Fuel Feed Pipe (2)
16. Hand tighten Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Fuel Rail (3)
17. Hand tighten Fuel Injection Fuel Feed Pipe (2) @ Fuel Injection Pump (4)

NOTE: Counterhold at the fuel injection pump connector (4).

18. Tighten Fuel Injection Fuel Feed Pipes (2) (Qty: 2) to 28 N.m (21 lb ft)
19. Install and tighten Fuel Injection Fuel Feed Pipe Bracket Bolt (1) to 9 N.m (80 lb in)
20. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
21. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
22. If replacing, perform the high pressure fuel correction reset. Refer to [High Pressure Fuel Correction Reset](#)

FUEL INJECTION PUMP THROTTLE SHAFT SEAL REPLACEMENT

Special Tools

EN-50885-1 Remover/Installer

EN-50885-2 Fixing Tool

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Mechanical Tools\)](#)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

WARNING: Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

NOTE: Be very thorough in terms of cleanliness when working in the fuel system. Malfunctions can also occur due to very small dirt particles. Prevent dirt from entering the fuel system by cleaning the hoses and plugging the pipes and lines upon removal. Store the components so that contaminants cannot enter.

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
2. Remove the intake manifold. Refer to [Intake Manifold Replacement](#)

3. Remove the engine control module bracket. Refer to [Engine Control Module Bracket Replacement](#)
4. Remove the auxiliary fluid accumulator. Refer to [Auxiliary Fluid Accumulator Replacement \(Equinox\)](#) [Auxiliary Fluid Accumulator Replacement \(Terrain\)](#).

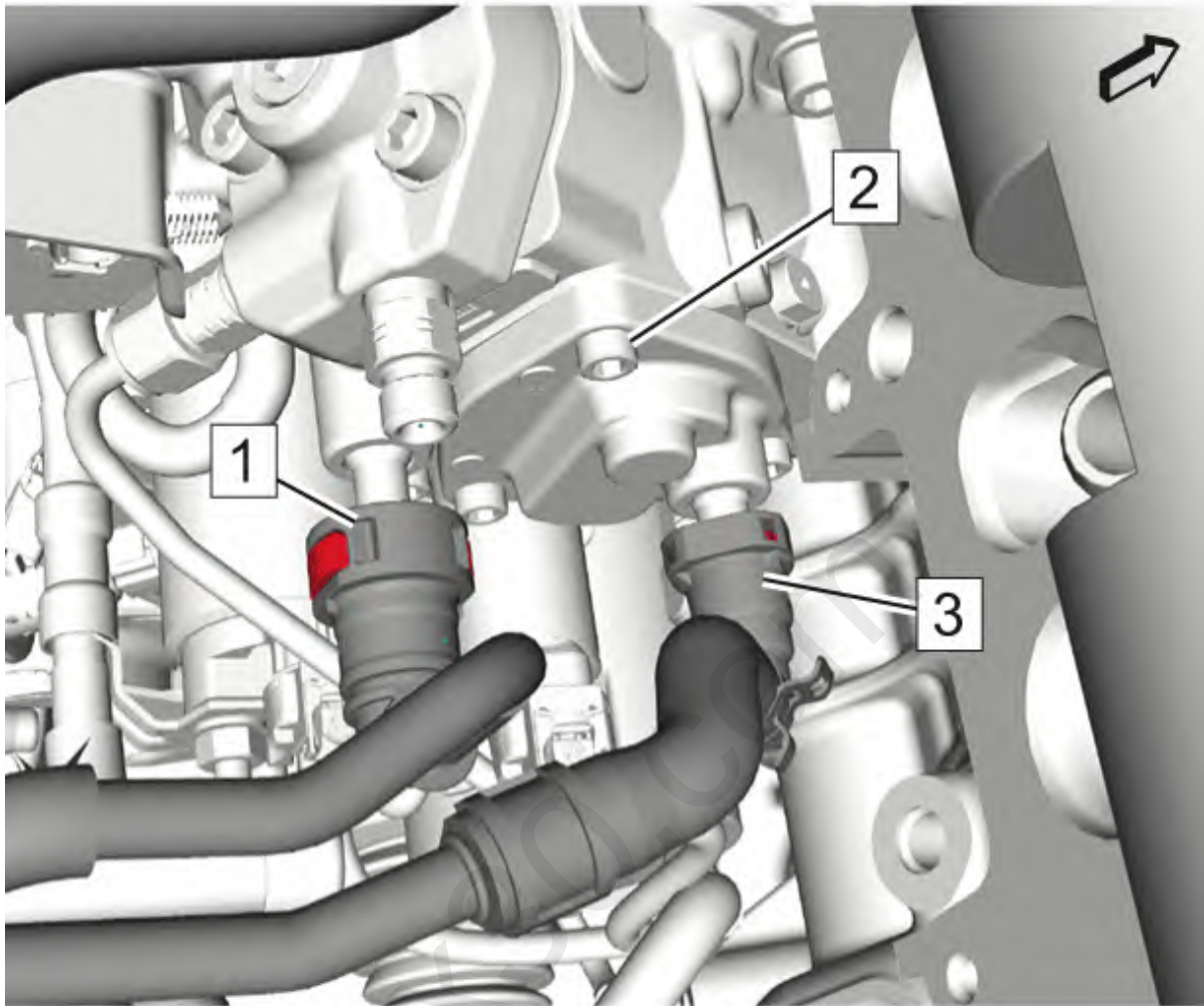


Fig. 195: Fuel Feed Pipe, Fuel Injection Pump And Diesel Fuel Separator

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Fuel Feed Pipe (1) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Disconnect Diesel Fuel Separator (3) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
7. Close all open connectors with suitable closure plug.

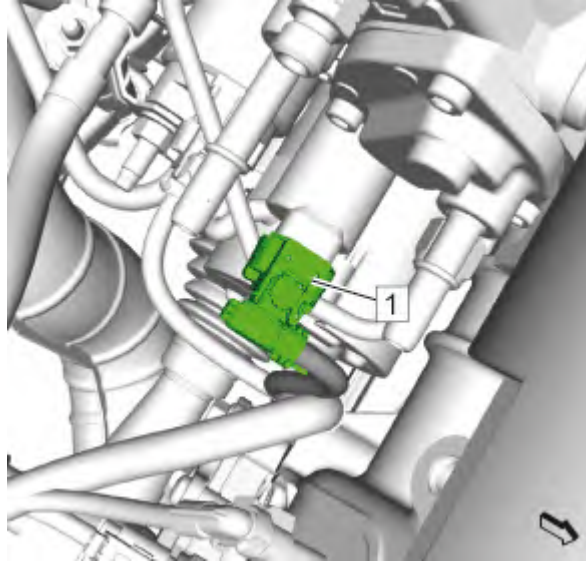


Fig. 196: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the electrical connector. (1)

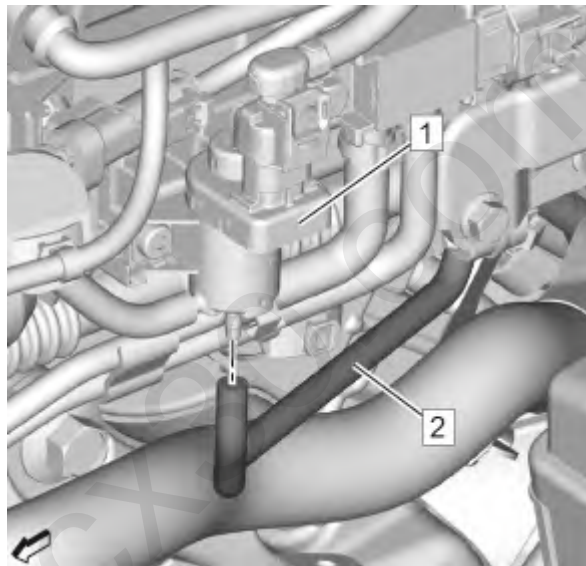


Fig. 197: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Charge Air Bypass Regulator Solenoid Valve Inlet Tube (2) @ Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (1)

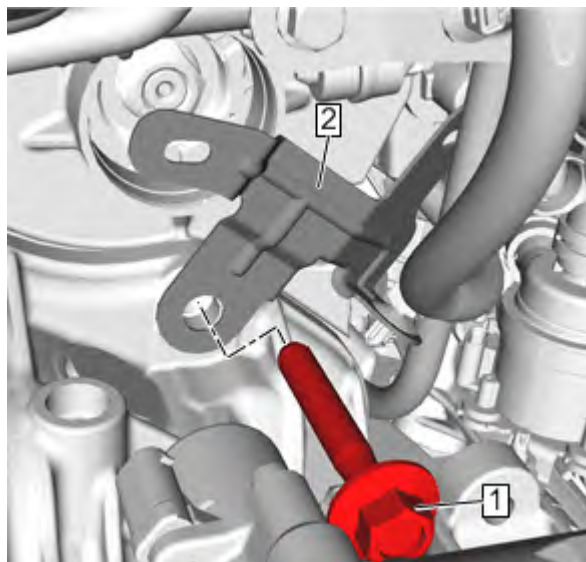


Fig. 198: Engine Wiring Harness Bracket And Transmission Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove Transmission Bolt (1)
11. Reposition Engine Wiring Harness Bracket (2)

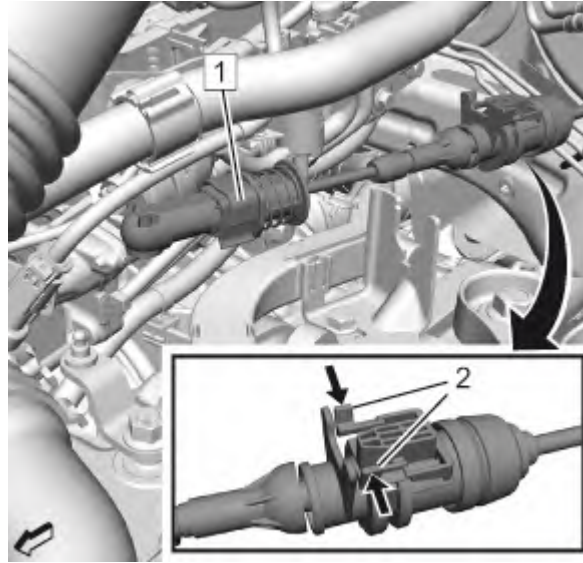


Fig. 199: Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

12. Remove Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever - Use a suitable tool.
13. Remove Range Selector Lever Cable (1) @ Transmission Range Selector Lever Cable Bracket
Push (arrows) the tabs (2) to release the range selector lever cable.
14. Position aside Range Selector Lever Cable (1)

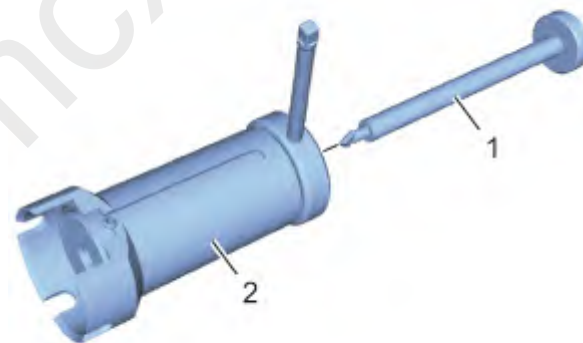


Fig. 200: Special Tools
Courtesy of GENERAL MOTORS COMPANY

15. Install the spike (1) to the EN-50885-1 remover (2).

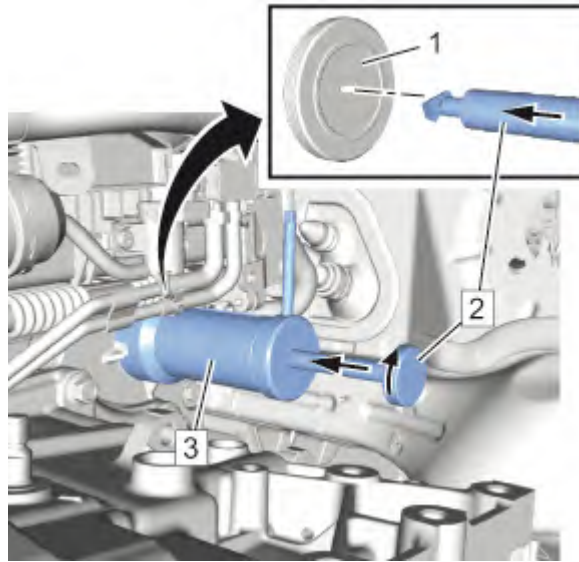


Fig. 201: Fuel Injection Pump Sprocket Access Hole Plug And Special Tools
Courtesy of GENERAL MOTORS COMPANY

16. Install **EN-50885-1** remover (3)
17. Press the spike (2) into the fuel injection pump sprocket access hole plug (1).
18. Turn the spike 90 degrees to secure it to the fuel injection pump sprocket access hole plug.

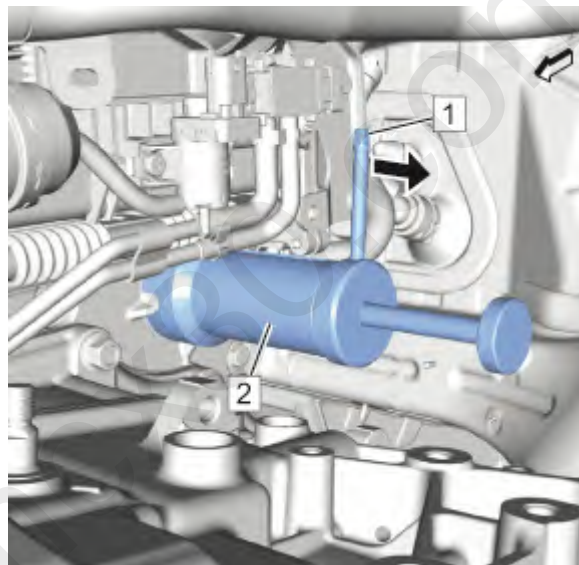
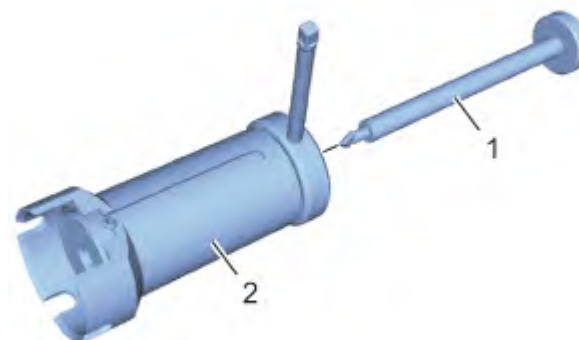


Fig. 202: Fuel Injection Pump Sprocket Access Hole Plug And Special Tools
Courtesy of GENERAL MOTORS COMPANY

19. Remove the fuel injection pump sprocket access hole plug by exerting a strong pull at the handle (1) of the **EN-50885-1** remover (2).



20. Remove the spike (1) from the **EN-50885-1** remover (2).

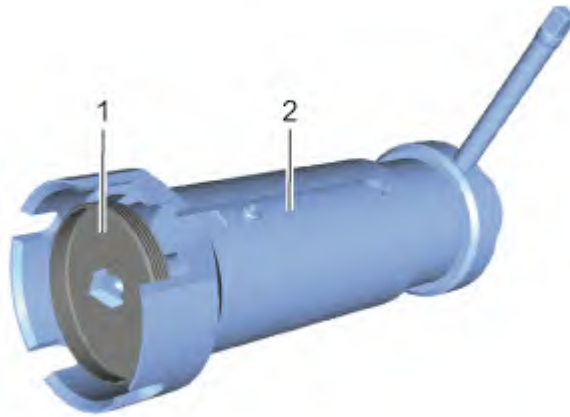


Fig. 204: Fuel Injection Pump Sprocket Access Hole Plug And Special Tool

Courtesy of GENERAL MOTORS COMPANY

21. Remove and DISCARD the fuel injection pump sprocket access hole plug (1) from the **EN-50885-1** remover (2).

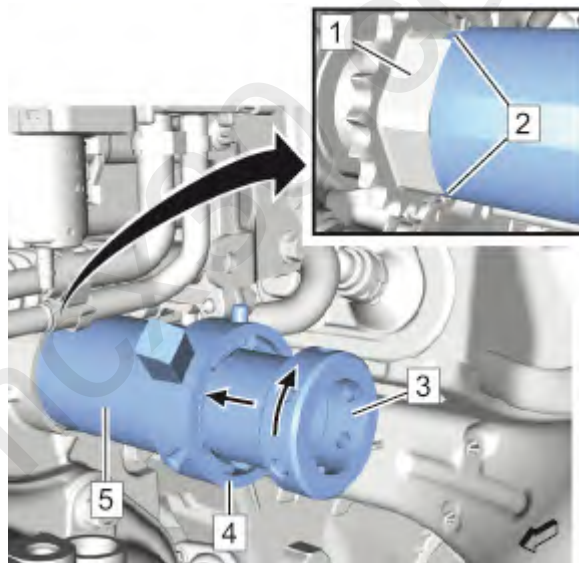


Fig. 205: Fuel Injection Pump Driven Sprocket, Tappets And Special Tools

Courtesy of GENERAL MOTORS COMPANY

22. Install **EN-50885-2** fixing tool (3)
1. Install the housing (5) to the fuel injection pump driven sprocket. Ensure that the 3 tappets (2) mesh with the 3 slots of the fuel injection pump driven sprocket (1).
 2. Position the ring (4) to allow for installation of a 1/2 inch-drive extension.
 3. Screw the fixing tool (3) into the fuel injection pump driven sprocket.

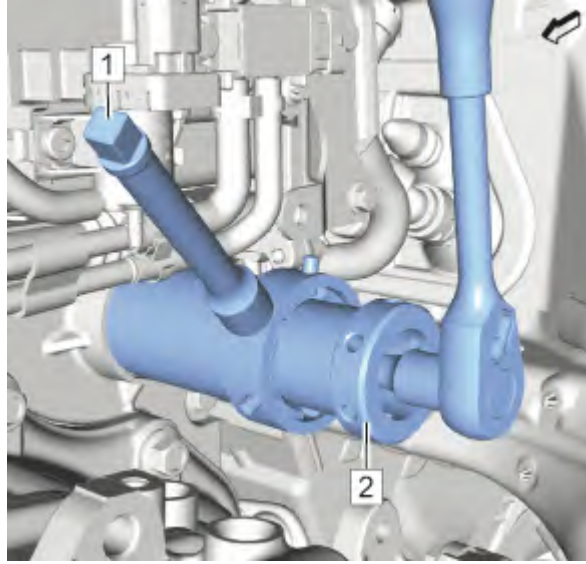


Fig. 206: Extension And Special Tool

Courtesy of GENERAL MOTORS COMPANY

23. Install a 1/2 inch-drive extension (1) to the EN-50885-2 fixing tool (2) to counterhold.
24. Loosen Fuel Injection Pump Drive Pulley Nut

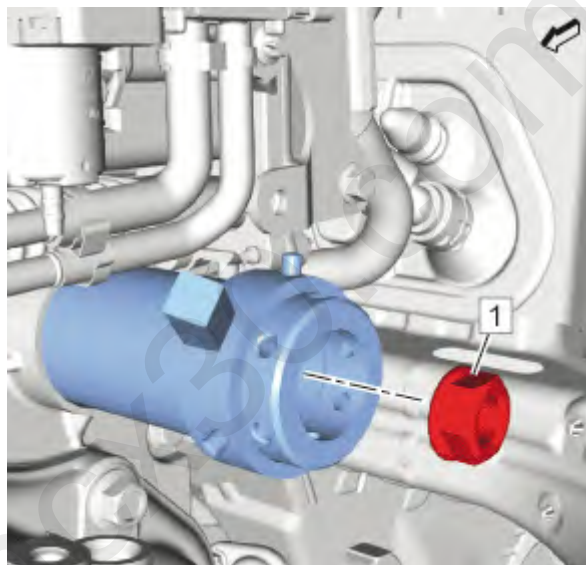


Fig. 207: Fuel Injection Pump Drive Pulley Nut

Courtesy of GENERAL MOTORS COMPANY

25. Remove Fuel Injection Pump Drive Pulley Nut (1)

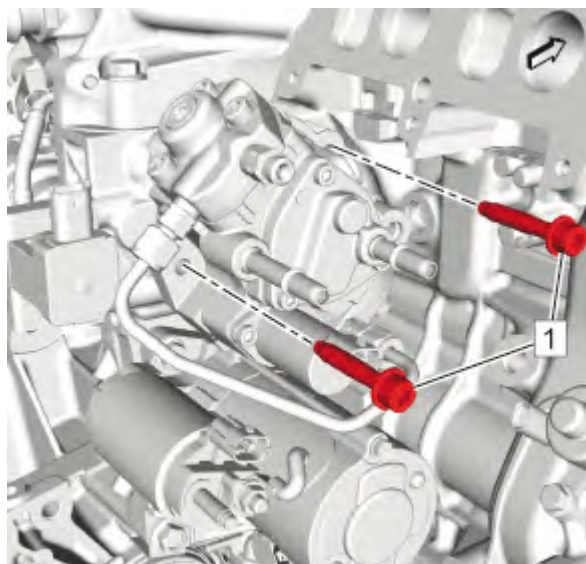


Fig. 208: Fuel Injection Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

26. Remove Fuel Injection Pump Bolts (1) (Qty: 2)

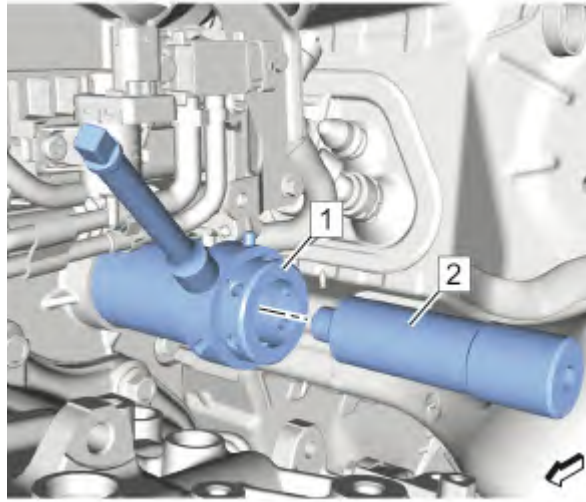


Fig. 209: Special Tools

Courtesy of GENERAL MOTORS COMPANY

27. Install the pressure spindle (2) to the **EN-50885-2** fixing tool (1).

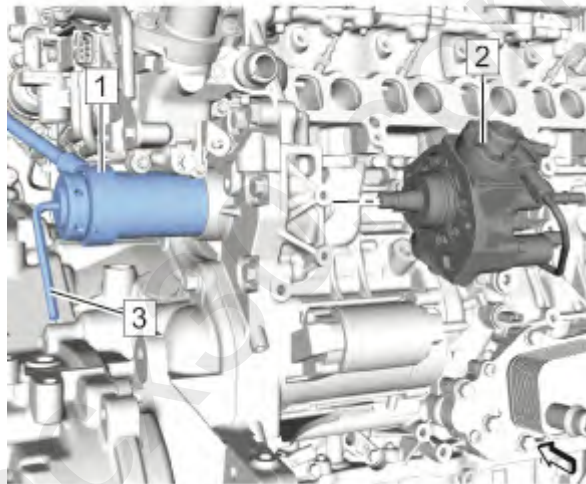


Fig. 210: Fuel Injection Pump And Special Tools

Courtesy of GENERAL MOTORS COMPANY

CAUTION: DO NOT press out the fuel injection pump with the pressure spindle. Doing so can result in damage to the fuel injection pump driven sprocket.

28. Loosen the fuel injection fuel pump sprocket, by screwing in the pressure spindle with a hexagon socket wrench (3) into the **EN-50885-2** fixing tool (1) until the fuel injection pump sprocket is disengaged.

29. Remove Fuel Injection Pump (2)

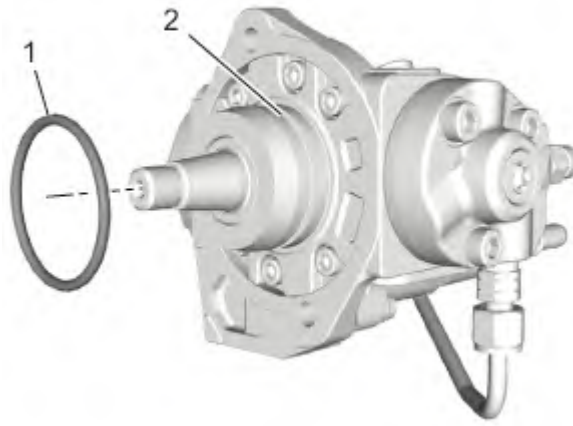


Fig. 211: Fuel Injection Pump Throttle Shaft Seal And Fuel Injection Pump Sealing Groove
 Courtesy of GENERAL MOTORS COMPANY

30. Remove and DISCARD the fuel injection pump throttle shaft seal (1) from the fuel injection pump sealing groove (2).

Installation Procedure

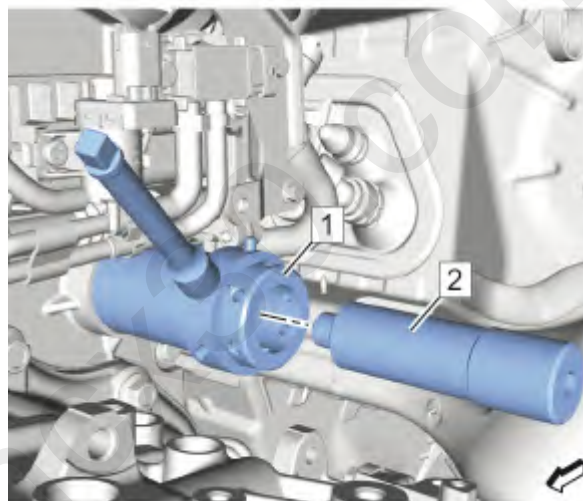
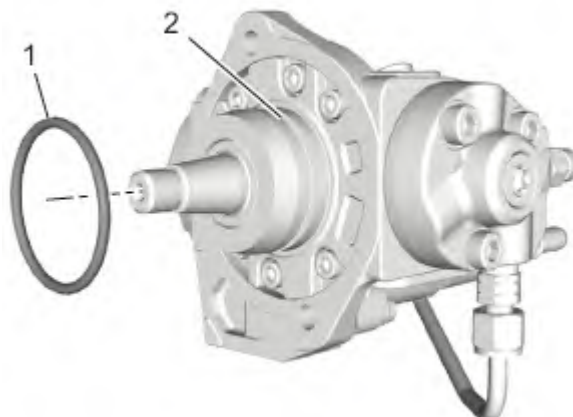


Fig. 212: Special Tools
 Courtesy of GENERAL MOTORS COMPANY

1. Remove the pressure spindle (2) from the EN-50885-2 fixing tool (1).



2. Install a NEW fuel injection pump throttle shaft seal (1) to the fuel injection pump sealing groove (2).

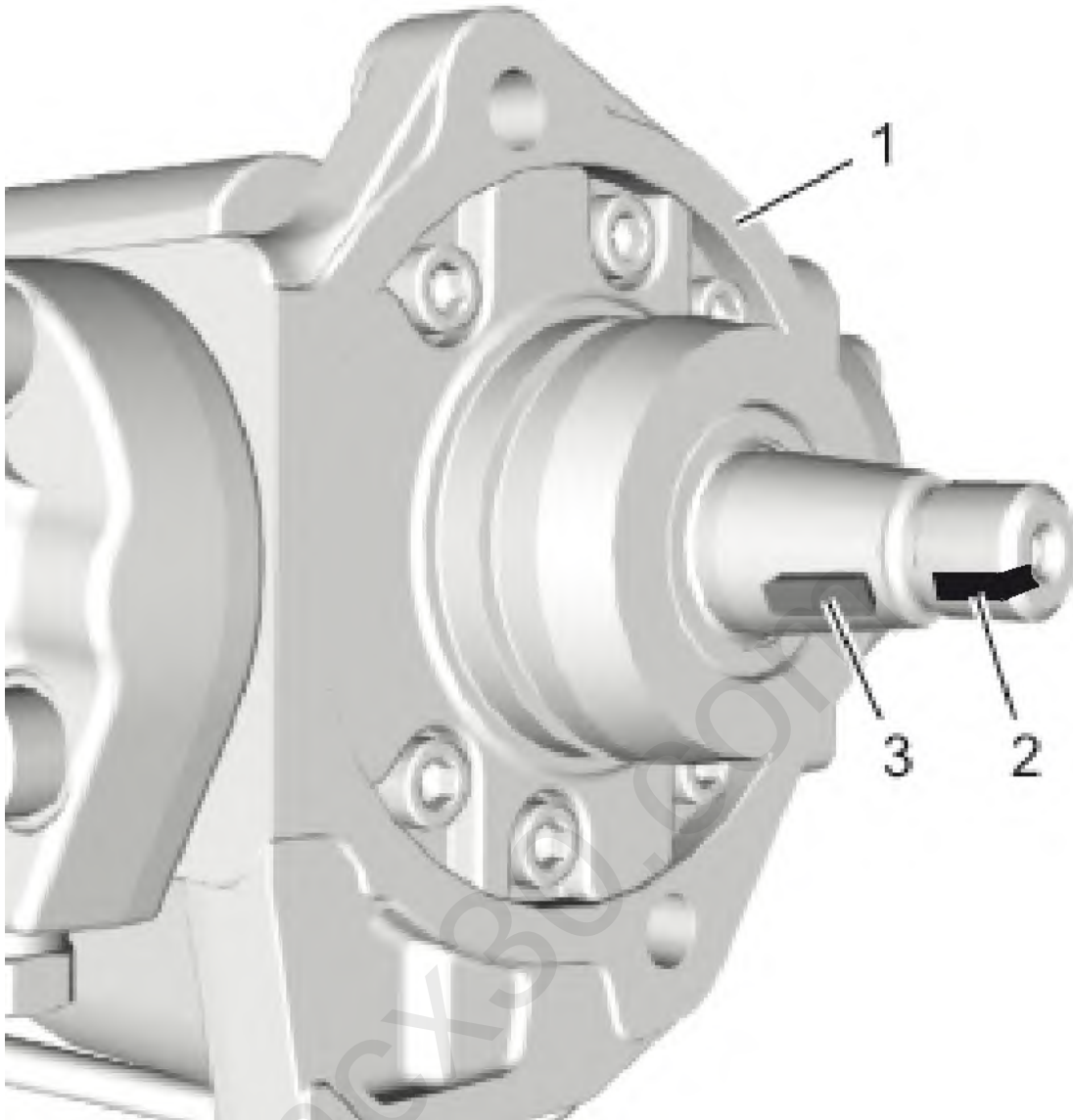
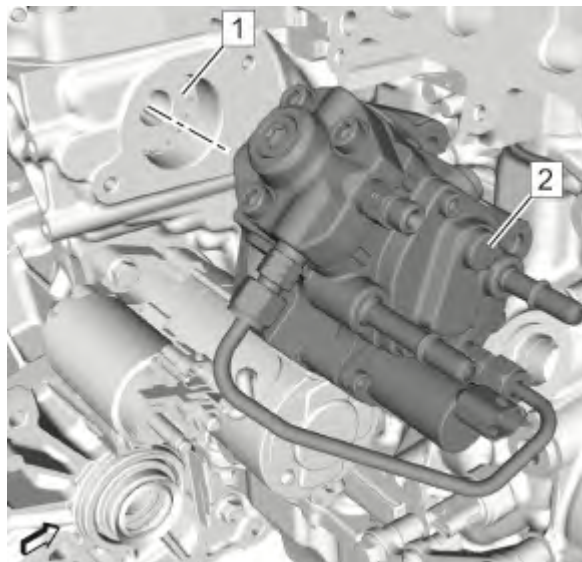


Fig. 214: Mark Position Of Wedge With Paint Mark On End Of Fuel Injection Fuel Pump Shaft
Courtesy of GENERAL MOTORS COMPANY

3. Mark the position of the wedge (3) with a paint mark (2) on the end of the fuel injection fuel pump (1) shaft.



NOTE: Position the fuel pump shaft in order to align the wedge with the fuel injection pump sprocket groove.

4. Position the fuel injection pump (2) to the fuel injection pump sprocket and the sprocket groove (1).



Fig. 216: Fuel Injection Pump Sprocket, Paint Mark And Sprocket Groove
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a mirror to see the fuel injection pump sprocket from the transmission side.

5. Position the fuel injection pump to the fuel injection pump sprocket (2).
 1. Turn the fuel injection pump so that the paint mark (1) matches with the sprocket groove (3).
 2. Press in the fuel injection pump.

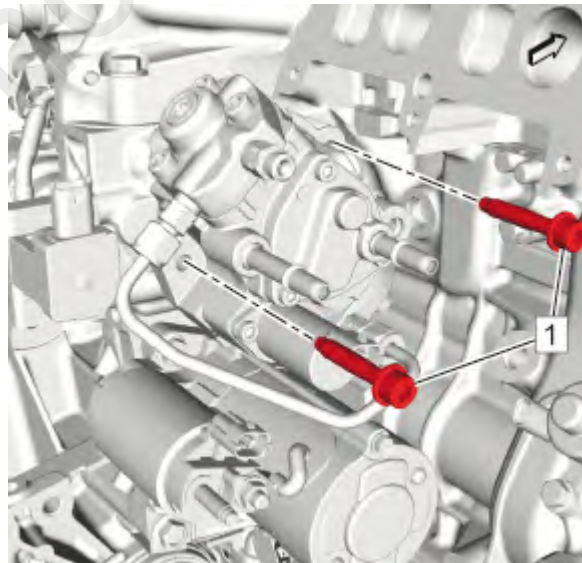


Fig. 217: Fuel Injection Pump Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

6. Install and tighten Fuel Injection Pump Bolts (1) (Qty: 2) to 25 N.m (18 lb ft)

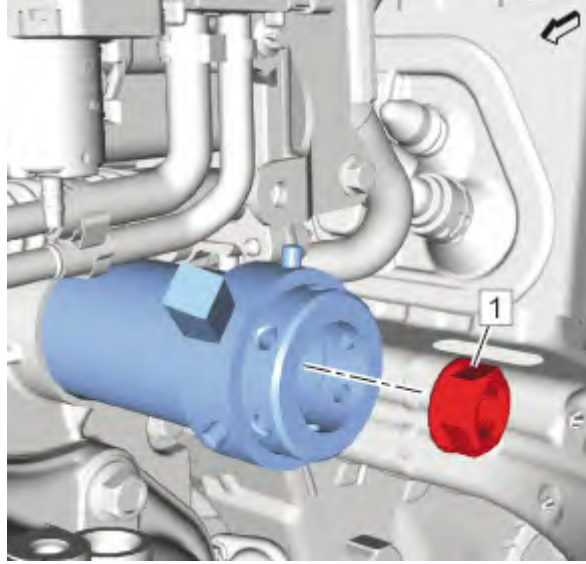


Fig. 218: Fuel Injection Pump Drive Pulley Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install Fuel Injection Pump Drive Pulley Nut (1)

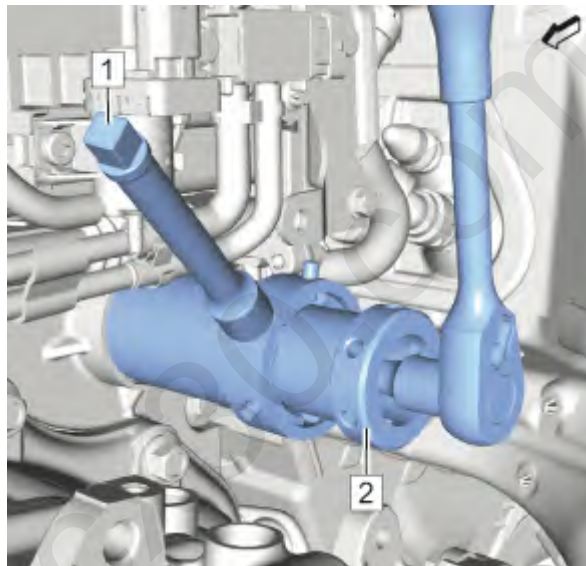
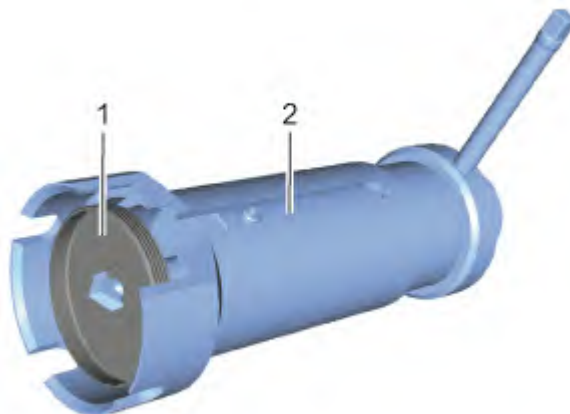


Fig. 219: Extension And Special Tool
Courtesy of GENERAL MOTORS COMPANY

8. Install a 1/2 inch-drive extension (1) to the **EN-50885-2** fixing tool (2) to counterhold.
9. Tighten Fuel Injection Pump Drive Pulley Nut to 64 N.m (47 lb ft)
10. Remove the 1/2 inch-drive extension (1).
11. Remove **EN-50885-2** fixing tool (2)



12. Install the NEW fuel injection pump sprocket access hole plug (1) onto the EN-50885-1 installer (2).

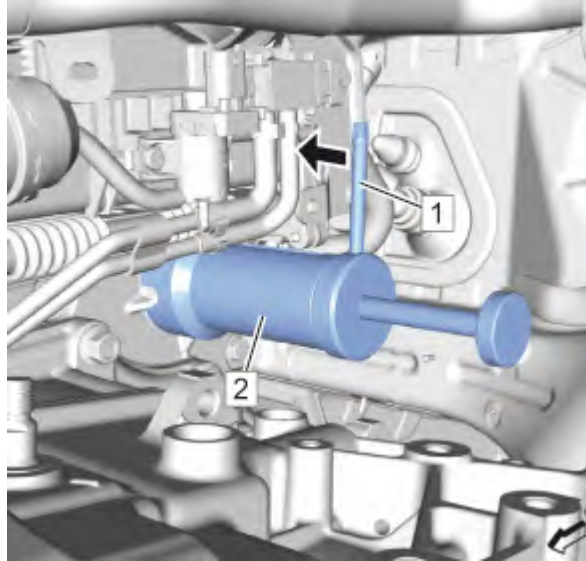


Fig. 221: Special Tools
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the EN-50885-1 installer on the timing chain lower housing rests against.

13. Install the fuel injection pump sprocket access hole plug by hitting the handle (1) of the EN-50885-1 installer (2).

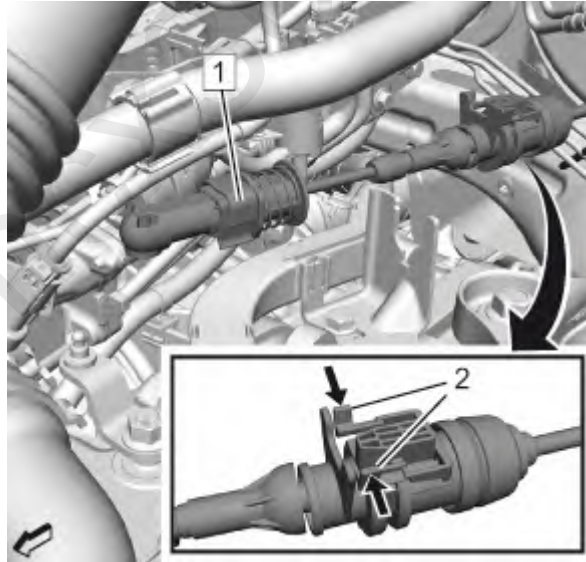


Fig. 222: Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

14. Install Range Selector Lever Cable (1) @ Transmission Range Selector Lever Cable Bracket
Push the range selector lever cable into the bracket.
15. Install Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

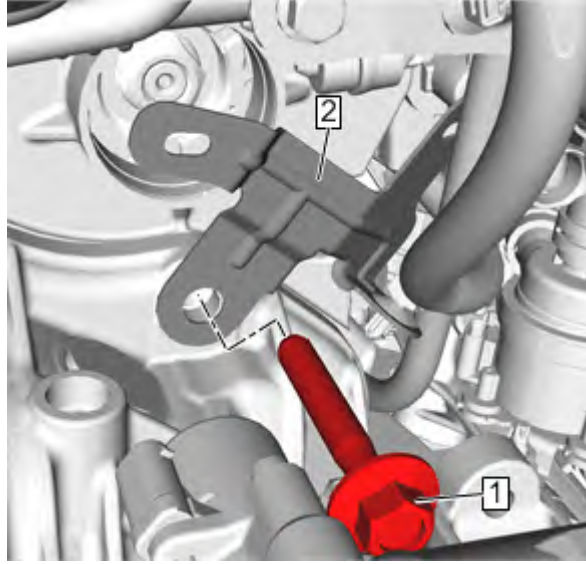


Fig. 223: Engine Wiring Harness Bracket And Transmission Bolt
 Courtesy of GENERAL MOTORS COMPANY

16. Reposition Engine Wiring Harness Bracket (2)
17. Install and tighten Transmission Bolt (1) to 58 N.m (43 lb ft)

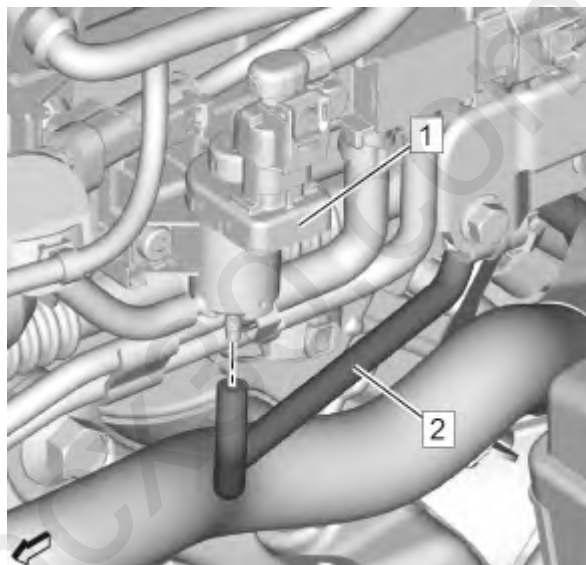
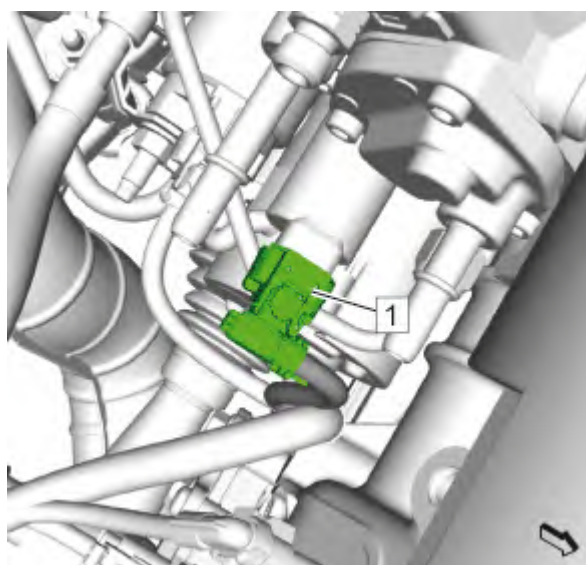


Fig. 224: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

18. Connect Charge Air Bypass Regulator Solenoid Valve Inlet Tube (2) @ Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (1)



19. Connect the electrical connector. (1)

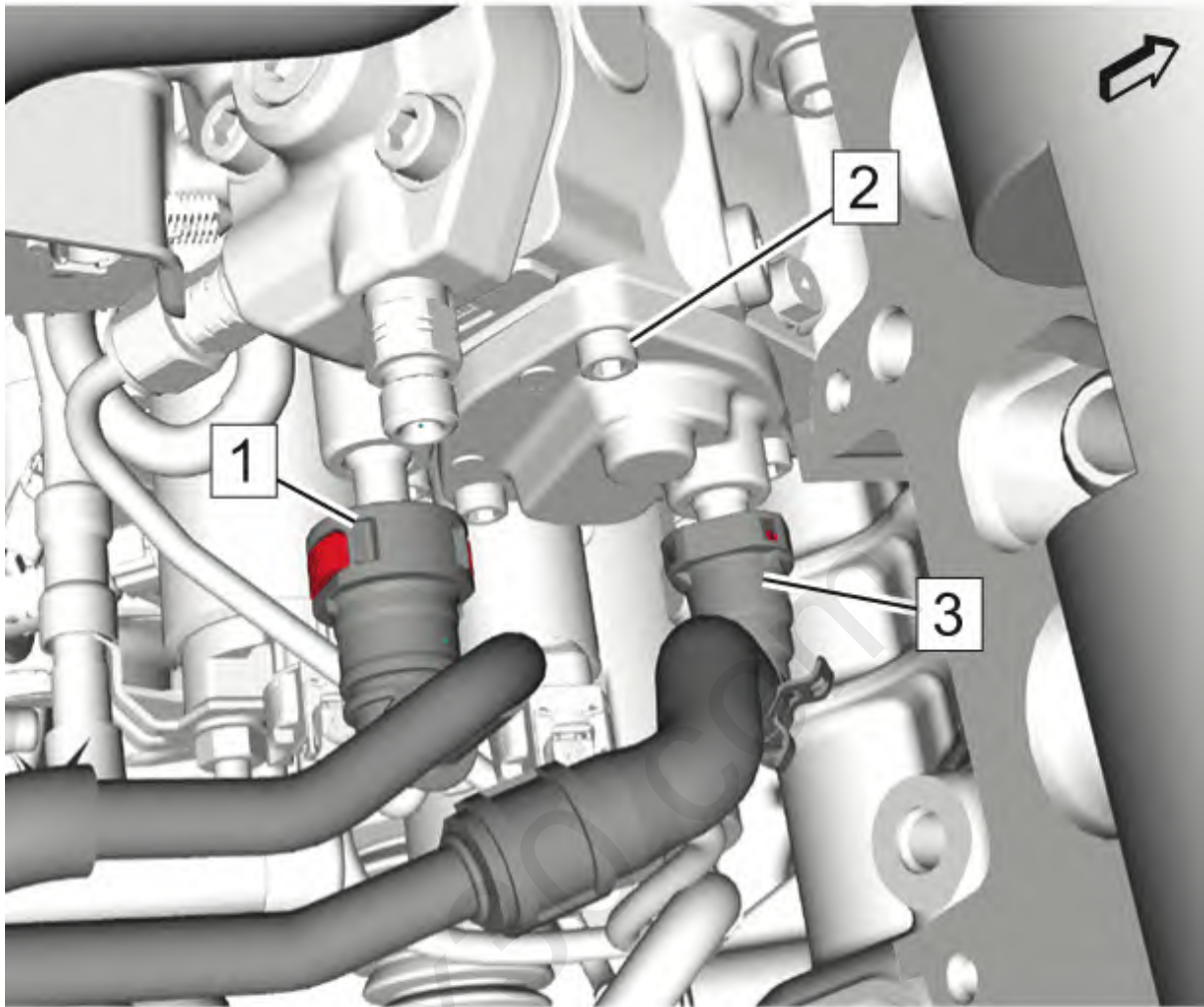


Fig. 226: Fuel Feed Pipe, Fuel Injection Pump And Diesel Fuel Separator
Courtesy of GENERAL MOTORS COMPANY

20. Connect Diesel Fuel Separator (3) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
21. Connect Fuel Feed Pipe (1) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
22. Install the intake manifold. Refer to [Intake Manifold Replacement](#)
23. Install the auxiliary fluid accumulator. Refer to [Auxiliary Fluid Accumulator Replacement \(Equinox\)](#), [Auxiliary Fluid Accumulator Replacement \(Terrain\)](#)
24. Install the engine control module. Refer to [Engine Control Module Bracket Replacement](#)
25. Check the fuel system for leaks. Refer to [Fuel Leak Diagnosis](#)
26. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

FUEL INJECTION PUMP REPLACEMENT

Special Tools

EN-50885-1 Remover/Installer

EN-50885-2 Fixing Tool

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#), [Special Tools \(Mechanical Tools\)](#)

WARNING: Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

NOTE: Be very thorough in terms of cleanliness when working in the fuel system. Malfunctions can also occur due to very small dirt particles. Prevent dirt from entering the fuel system by cleaning the hoses and plugging the pipes and lines upon removal. Store the components so that contaminants cannot enter.

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
2. Remove the intake manifold. Refer to [Intake Manifold Replacement](#)
3. Remove the engine control module bracket. Refer to [Engine Control Module Bracket Replacement](#)
4. Remove the auxiliary fluid accumulator. Refer to [Auxiliary Fluid Accumulator Replacement \(Equinox\)](#), [Auxiliary Fluid Accumulator Replacement \(Terrain\)](#).

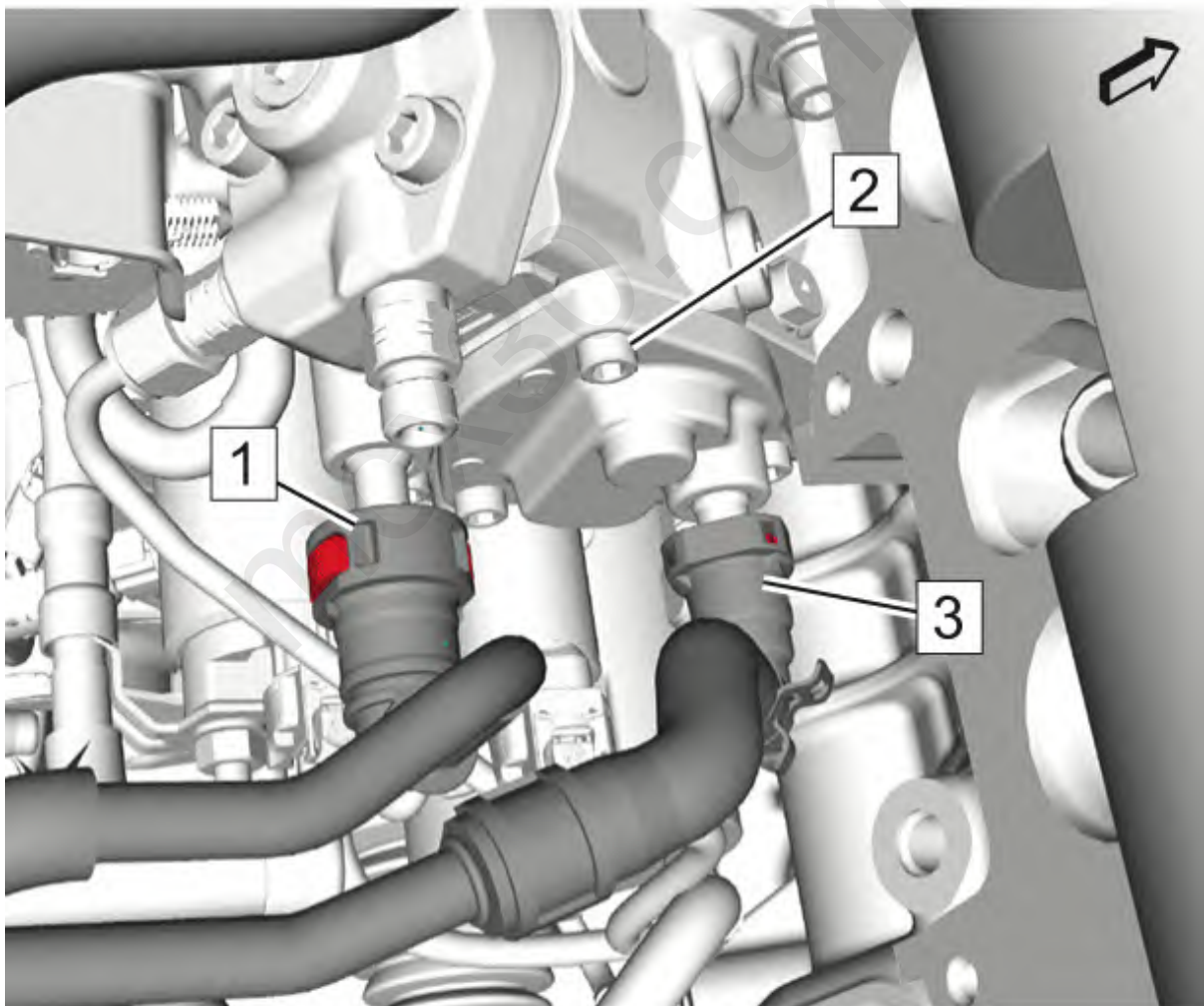


Fig. 227: Fuel Feed Pipe, Fuel Injection Pump And Diesel Fuel Separator
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Fuel Feed Pipe (1) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Disconnect Diesel Fuel Separator (3) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)

7. Close all open connectors with suitable closure plugs.

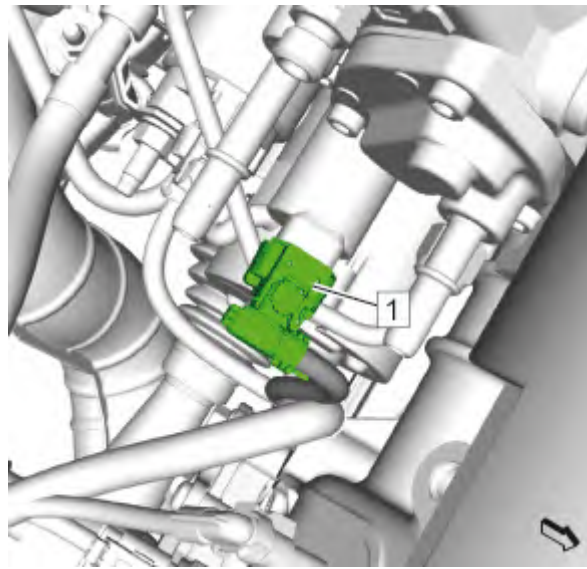


Fig. 228: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

8. Disconnect the electrical connector. (1)

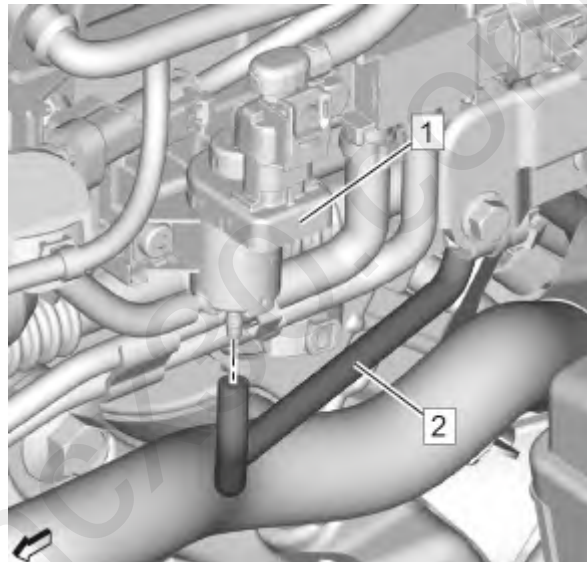


Fig. 229: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Charge Air Bypass Regulator Solenoid Valve Inlet Tube (2) @ Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (1)

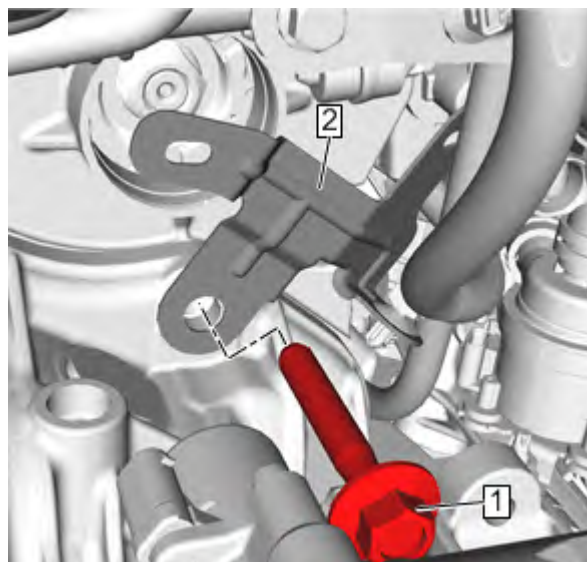


Fig. 230: Engine Wiring Harness Bracket And Transmission Bolt
Courtesy of GENERAL MOTORS COMPANY

10. Remove Transmission Bolt (1)
11. Reposition Engine Wiring Harness Bracket (2)

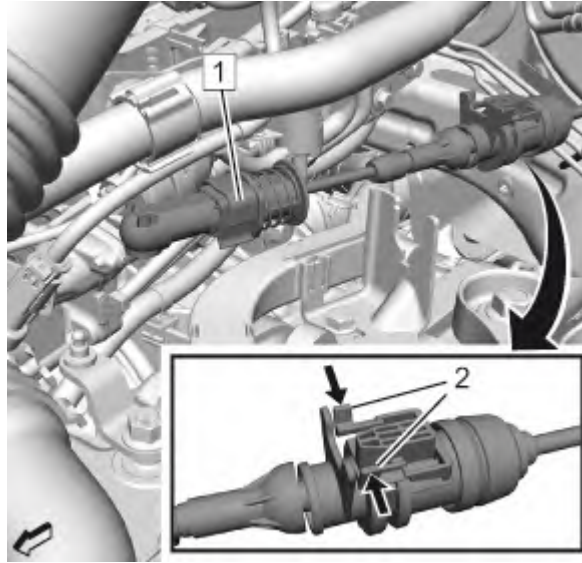


Fig. 231: Range Selector Lever Cable
Courtesy of GENERAL MOTORS COMPANY

12. Remove Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever - Use a suitable tool.
13. Remove Range Selector Lever Cable (1) @ Transmission Range Selector Lever Cable Bracket
Push (arrows) the tabs (2) to release the range selector lever cable.
14. Position aside Range Selector Lever Cable (1)

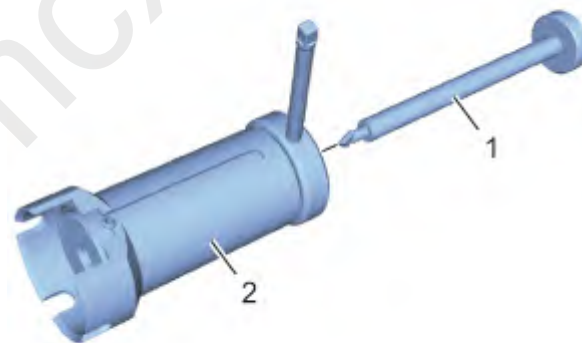


Fig. 232: Special Tools
Courtesy of GENERAL MOTORS COMPANY

15. Install the spike (1) to the EN-50885-1 remover (2).

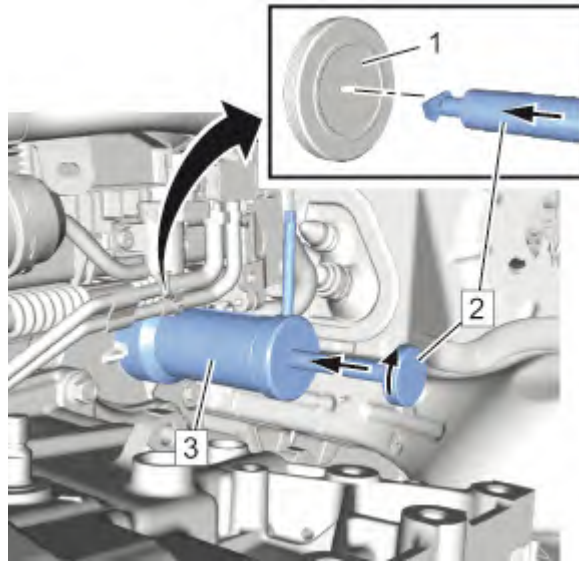


Fig. 233: Fuel Injection Pump Sprocket Access Hole Plug And Special Tools
Courtesy of GENERAL MOTORS COMPANY

16. Install **EN-50885-1** remover (3)
17. Press the spike (2) into the fuel injection pump sprocket access hole plug (1).
18. Turn the spike 90 degrees to secure it to the fuel injection pump sprocket access hole plug.

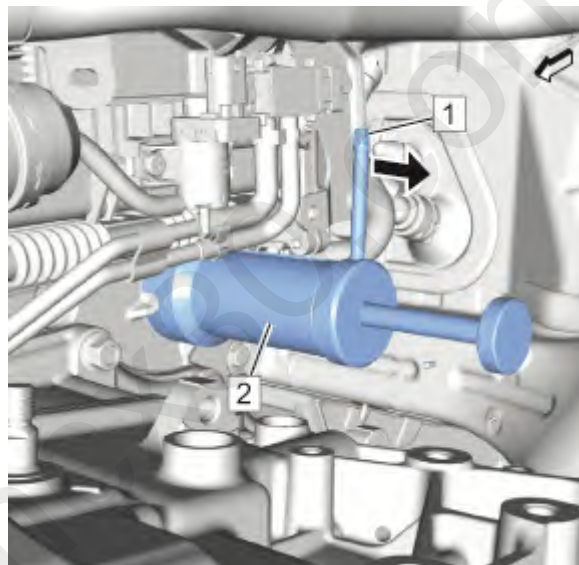
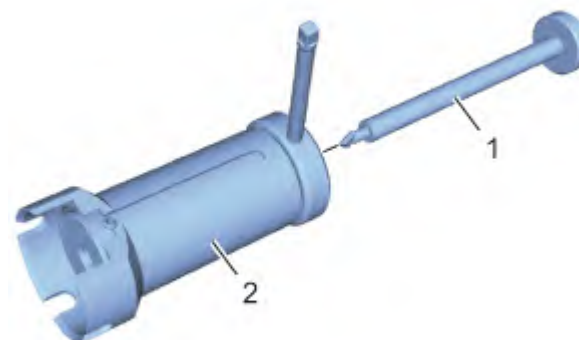


Fig. 234: Fuel Injection Pump Sprocket Access Hole Plug And Special Tools
Courtesy of GENERAL MOTORS COMPANY

19. Remove the fuel injection pump sprocket access hole plug by exerting a strong pull at the handle (1) of the **EN-50885-1** remover (2).



20. Remove the spike (1) from the **EN-50885-1** remover (2).

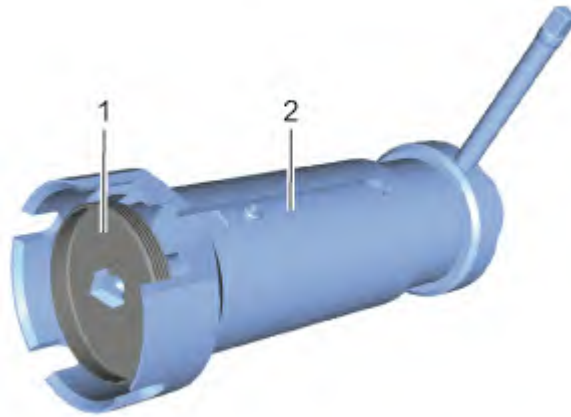


Fig. 236: Fuel Injection Pump Sprocket Access Hole Plug And Special Tool

Courtesy of GENERAL MOTORS COMPANY

21. Remove and DISCARD the fuel injection pump sprocket access hole plug (1) from the **EN-50885-1** remover (2).

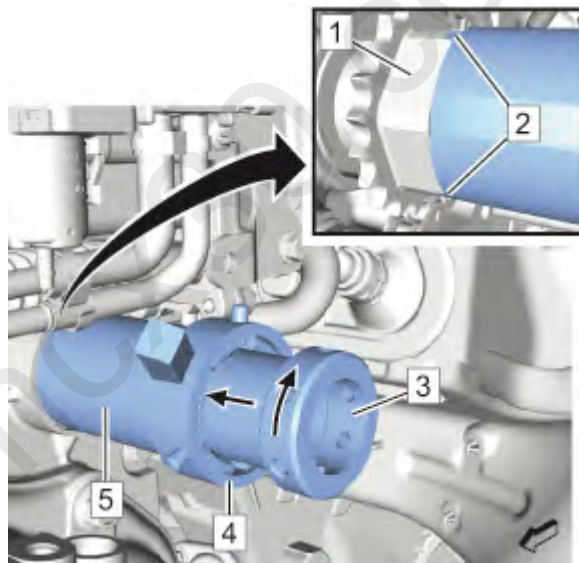


Fig. 237: Fuel Injection Pump Driven Sprocket, Tappets And Special Tools

Courtesy of GENERAL MOTORS COMPANY

22. Install **EN-50885-2** fixing tool (3)
1. Install the housing (5) to the fuel injection pump driven sprocket. Ensure that the 3 tappets (2) mesh with the 3 slots of the fuel injection pump driven sprocket (1).
 2. Position the ring (4) to allow for installation of a 1/2 inch-drive extension.
 3. Screw the fixing tool (3) into the fuel injection pump driven sprocket.

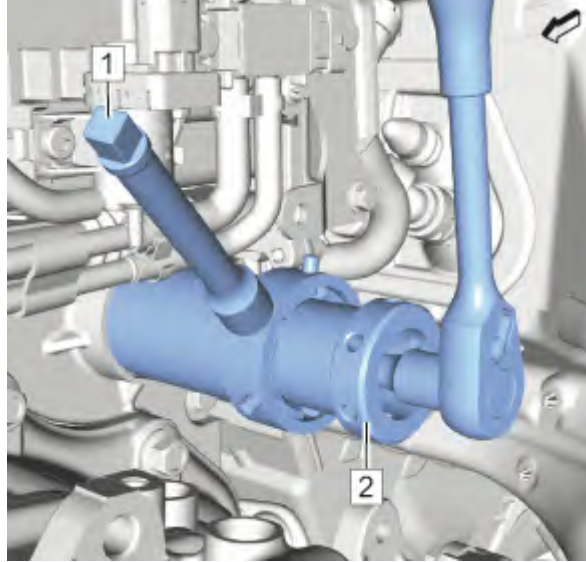


Fig. 238: Extension And Special Tool

Courtesy of GENERAL MOTORS COMPANY

23. Install a 1/2 inch-drive extension (1) to the EN-50885-2 fixing tool (2) to counterhold.
24. Loosen Fuel Injection Pump Drive Pulley Nut

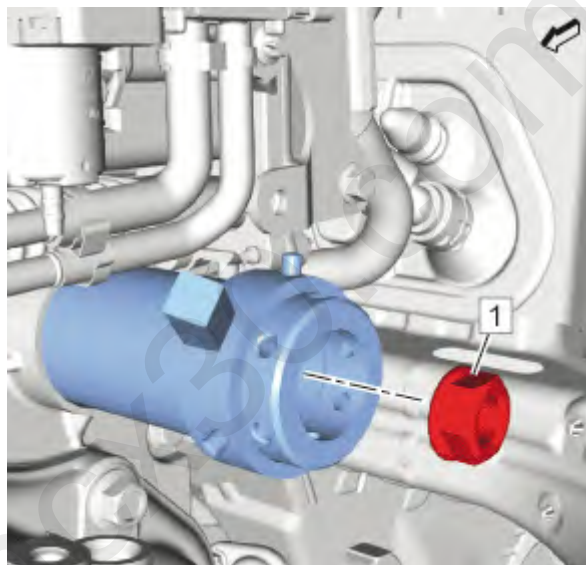


Fig. 239: Fuel Injection Pump Drive Pulley Nut

Courtesy of GENERAL MOTORS COMPANY

25. Remove Fuel Injection Pump Drive Pulley Nut (1)

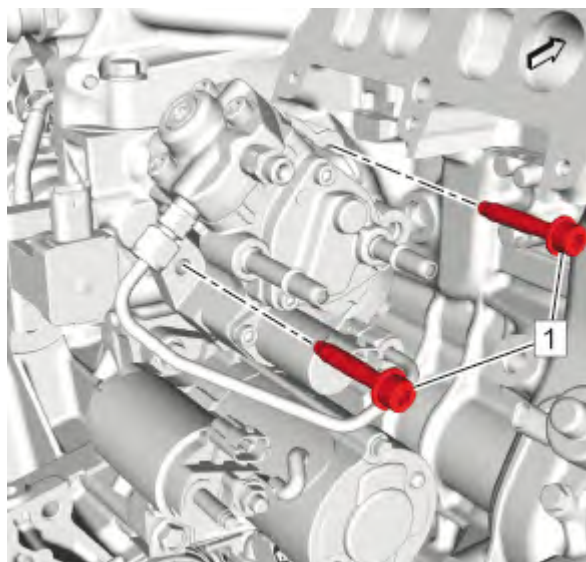


Fig. 240: Fuel Injection Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

26. Remove Fuel Injection Pump Bolts (1) (Qty: 2)

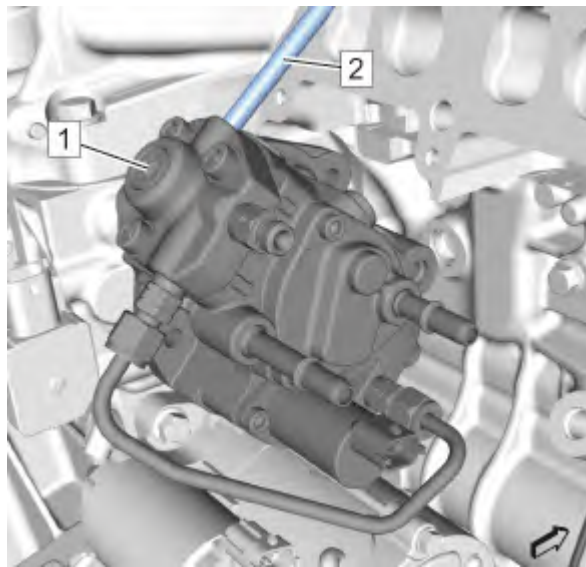


Fig. 241: Fuel Injection Pump And Suitable Aluminum Punch
Courtesy of GENERAL MOTORS COMPANY

NOTE: Only loosen the fuel injection fuel pump with light hammer blows if the fuel injection fuel pump should be replaced.

27. Use a suitable aluminum punch (2).

28. Loosen the fuel injection pump (1) by light hammer blows on the punch.

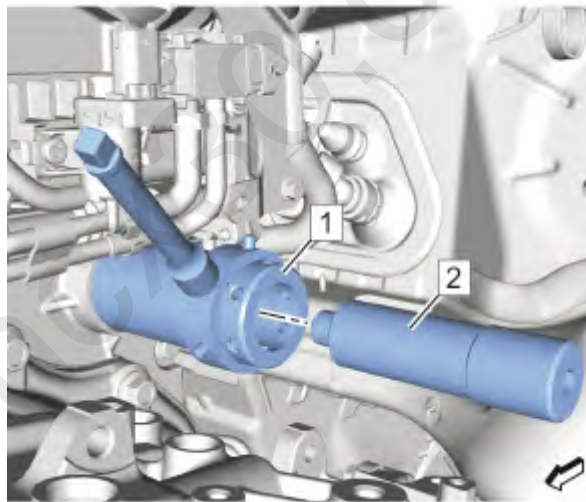


Fig. 242: Special Tools
Courtesy of GENERAL MOTORS COMPANY

29. Install the pressure spindle (2) to the EN-50885-2 fixing tool (1).

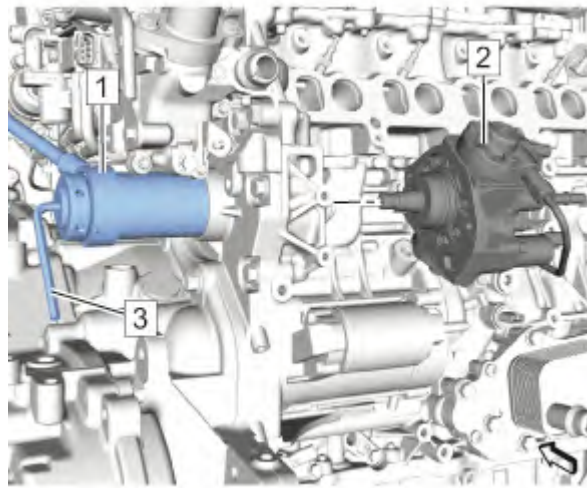


Fig. 243: Fuel Injection Pump And Special Tools
Courtesy of GENERAL MOTORS COMPANY

CAUTION: DO NOT press out the fuel injection pump with the pressure spindle. Doing so can result in damage to the fuel injection pump driven sprocket.

30. Loosen the fuel injection fuel pump sprocket, by screwing in the pressure spindle with a hexagon socket wrench (3) into the EN-50885-2 fixing tool (1) until the fuel injection pump sprocket is disengaged.
31. Remove Fuel Injection Pump (2)

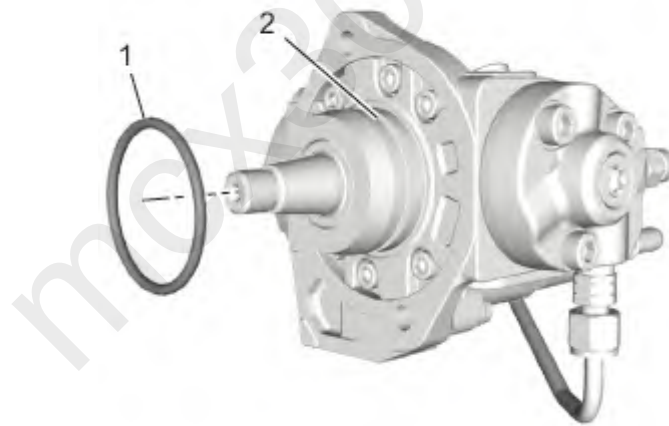


Fig. 244: Fuel Injection Pump Seal Ring And Fuel Injection Pump Sealing Groove
Courtesy of GENERAL MOTORS COMPANY

32. Remove and DISCARD the fuel injection pump seal ring (1) from the fuel injection pump sealing groove (2).

Installation Procedure

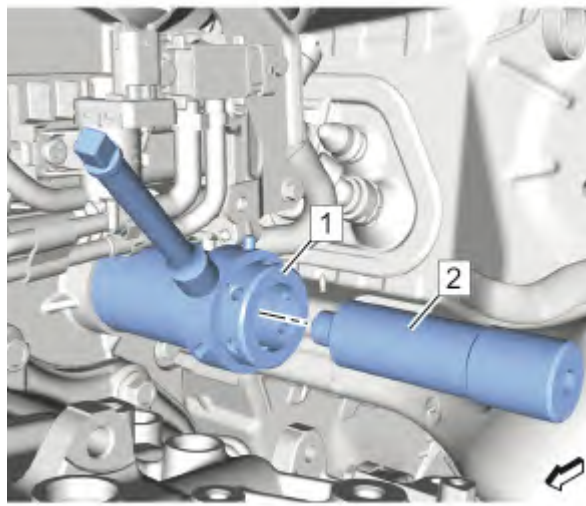


Fig. 245: Special Tools

Courtesy of GENERAL MOTORS COMPANY

1. Remove the pressure spindle (2) from the EN-50885-2 fixing tool (1).

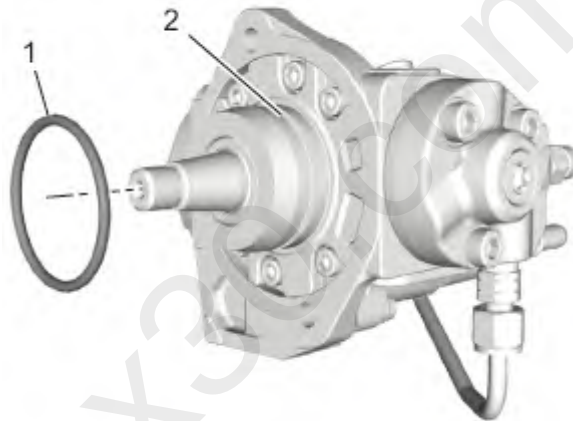


Fig. 246: Fuel Injection Pump Seal Ring And Fuel Injection Pump Sealing Groove

Courtesy of GENERAL MOTORS COMPANY

2. Install a NEW fuel injection pump seal ring (1) to the fuel injection pump sealing groove (2).

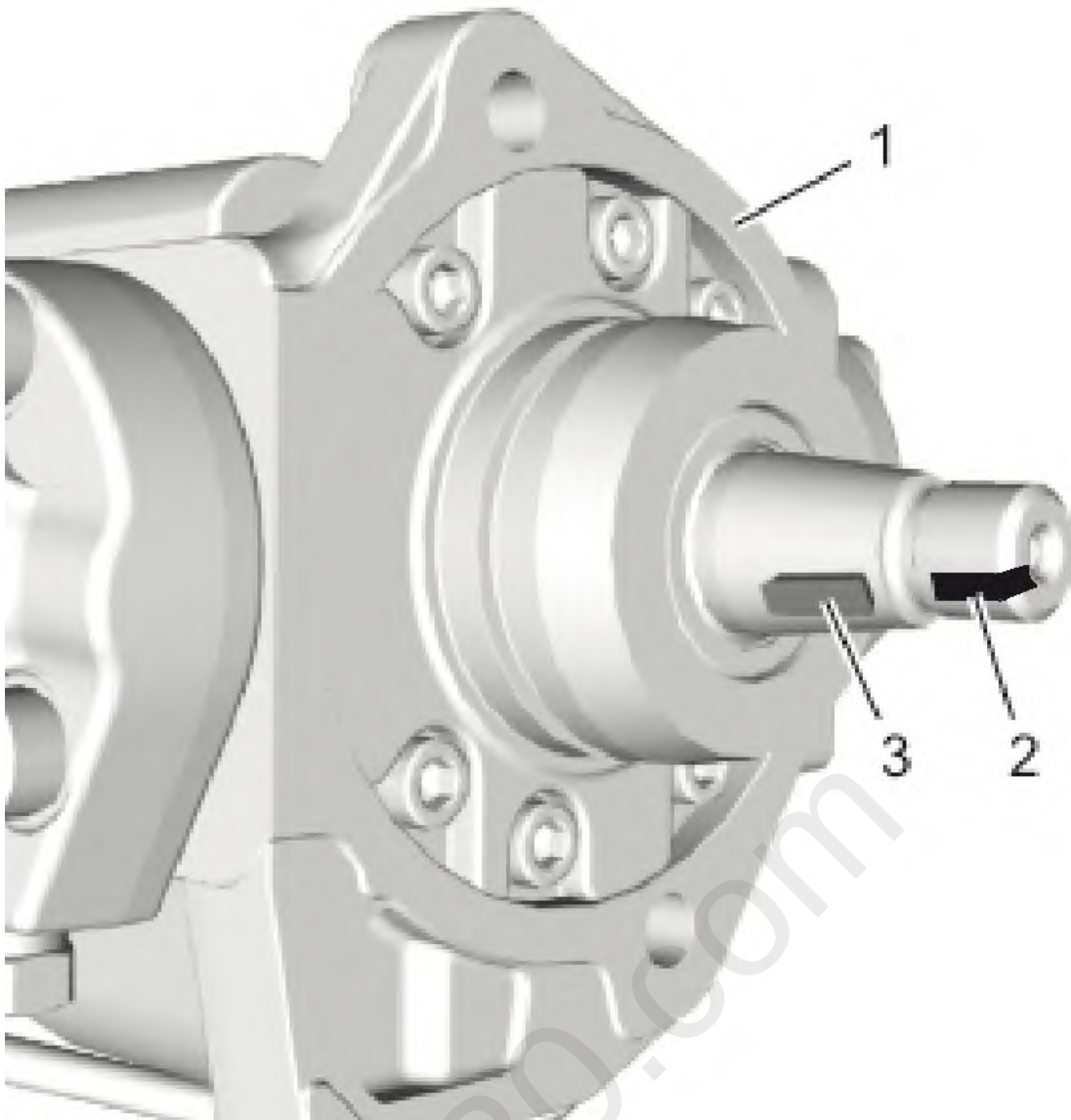


Fig. 247: Mark Position Of Wedge With Paint Mark On End Of Fuel Injection Fuel Pump Shaft

Courtesy of GENERAL MOTORS COMPANY

3. Mark the position of the wedge (3) with a paint mark (2) on the end of the shaft of the fuel injection fuel pump (1).

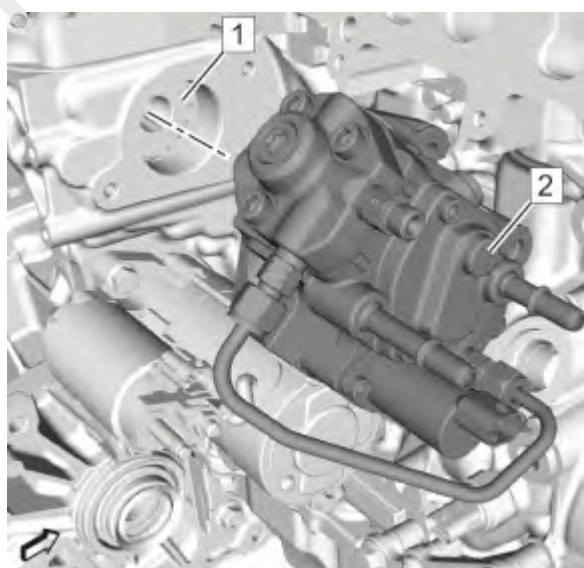


Fig. 248: Fuel Injection Pump, Fuel Injection Pump Sprocket And Sprocket Groove

Courtesy of GENERAL MOTORS COMPANY

NOTE: Position the fuel pump shaft in order to align the wedge with the fuel injection pump sprocket groove.

4. Position the fuel injection pump (2) to the fuel injection pump sprocket and the sprocket groove (1).



Fig. 249: Fuel Injection Pump Sprocket, Paint Mark And Sprocket Groove
Courtesy of GENERAL MOTORS COMPANY

NOTE: Use a mirror to see the fuel injection pump sprocket from the transmission side.

5. Position the fuel injection pump to the fuel injection pump sprocket (2).
 1. Turn the fuel injection pump so that the paint mark (1) matches with the sprocket groove (3).
 2. Press in the fuel injection pump.

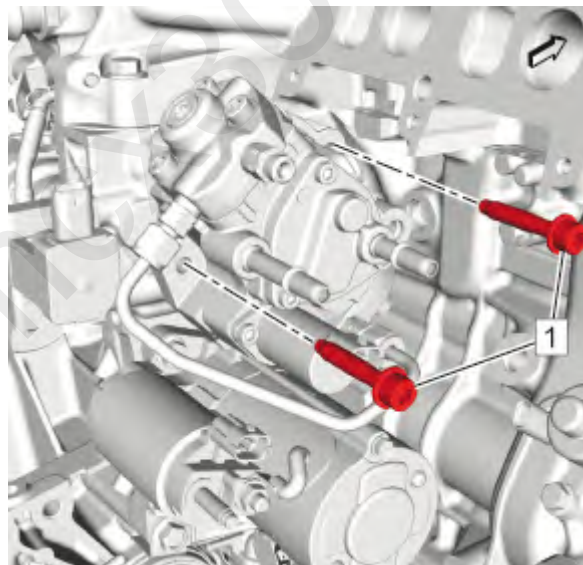


Fig. 250: Fuel Injection Pump Bolts
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution

6. Install and tighten Fuel Injection Pump Bolts (1) (Qty: 2) to 25 N.m (18 lb ft)

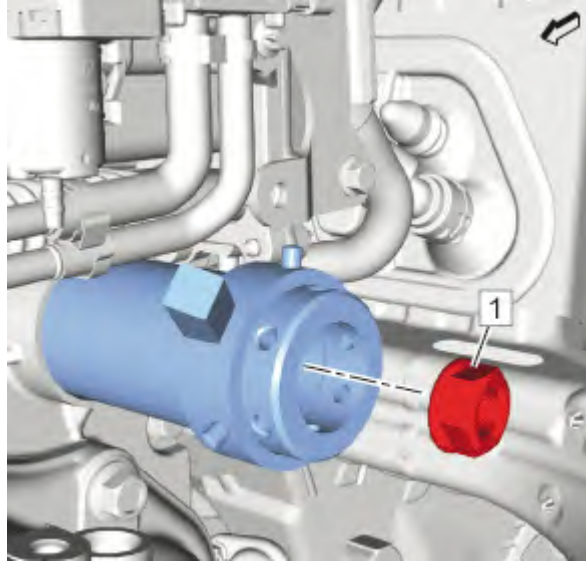


Fig. 251: Fuel Injection Pump Drive Pulley Nut
Courtesy of GENERAL MOTORS COMPANY

7. Install Fuel Injection Pump Drive Pulley Nut (1)

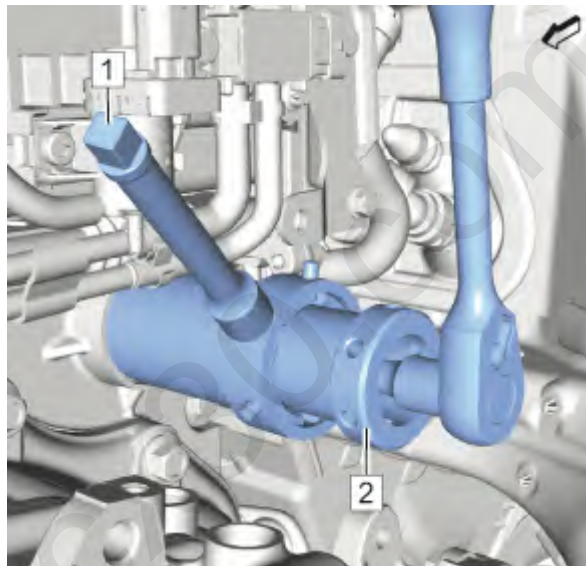


Fig. 252: Extension And Special Tool
Courtesy of GENERAL MOTORS COMPANY

8. Install a 1/2 inch-drive extension (1) to the **EN-50885-2** fixing tool (2) to counterhold.
9. Tighten Fuel Injection Pump Drive Pulley Nut to 64 N.m (47 lb ft)
10. Remove the 1/2 inch-drive extension (1).
11. Remove **EN-50885-2** fixing tool (2)

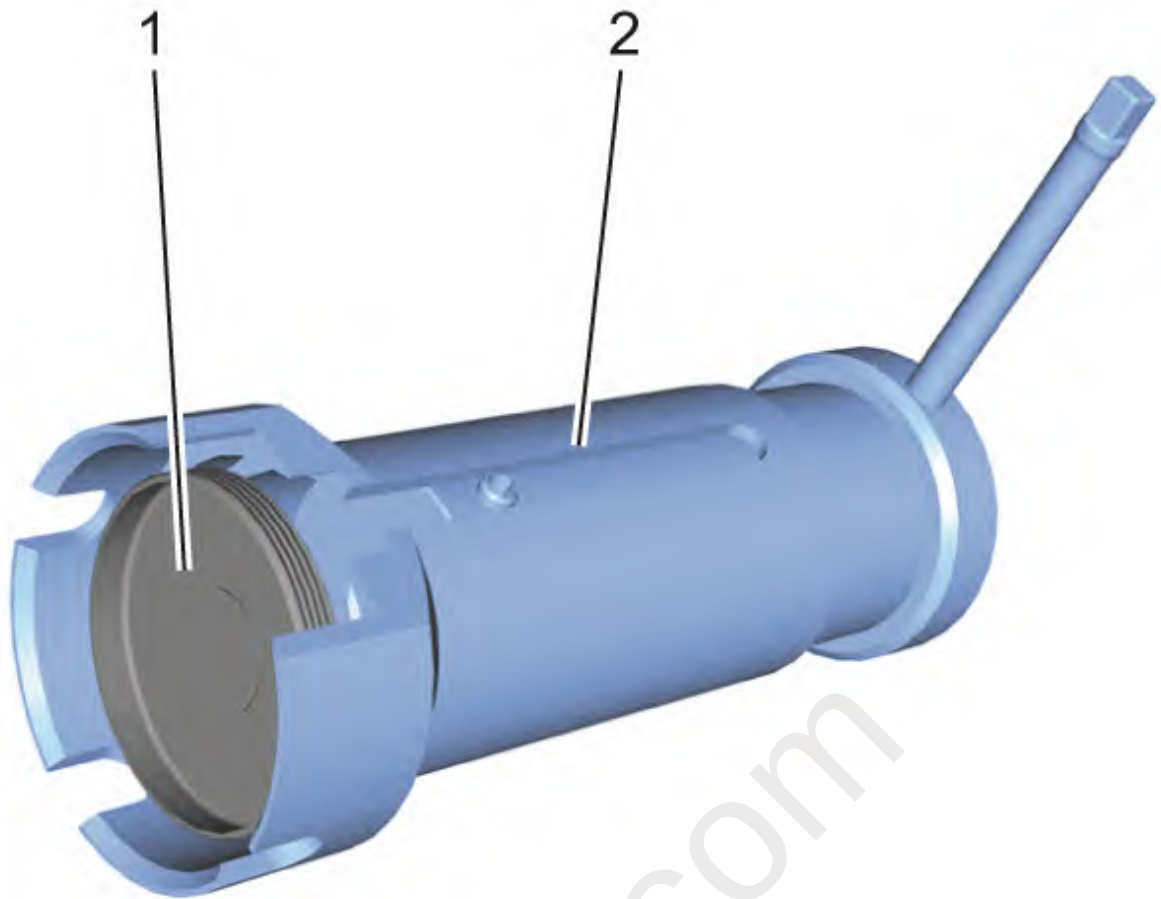


Fig. 253: Fuel Injection Pump Sprocket Access Hole Plug And Special Tool
 Courtesy of GENERAL MOTORS COMPANY

12. Install the NEW fuel injection pump sprocket access hole plug (1) onto the **EN-50885-1** installer (2).

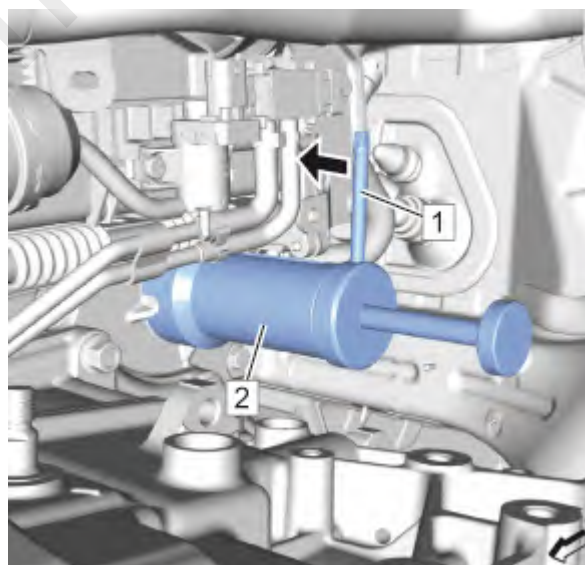


Fig. 254: Special Tools
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure that the EN-50885-1 installer on the timing chain lower housing rests against.

13. Install the fuel injection pump sprocket access hole plug by hitting the handle (1) of the **EN-50885-1** installer (2).

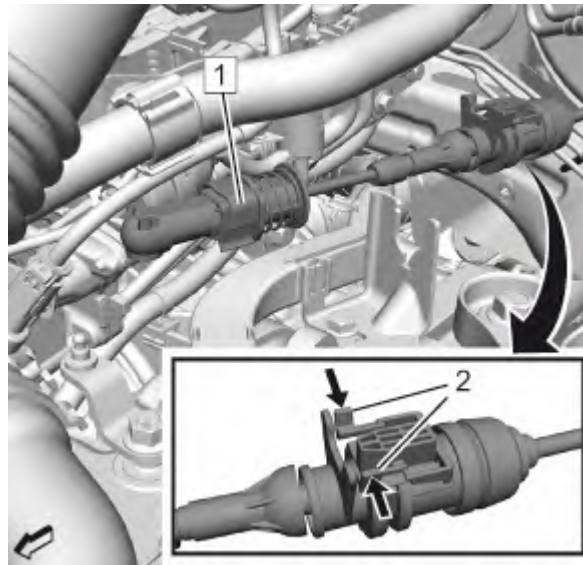


Fig. 255: Range Selector Lever Cable

Courtesy of GENERAL MOTORS COMPANY

14. Install Range Selector Lever Cable (1) @ Transmission Range Selector Lever Cable Bracket
Push the range selector lever cable into the bracket.
15. Install Range Selector Lever Cable (1) @ Range Selector Lever Cable Lever

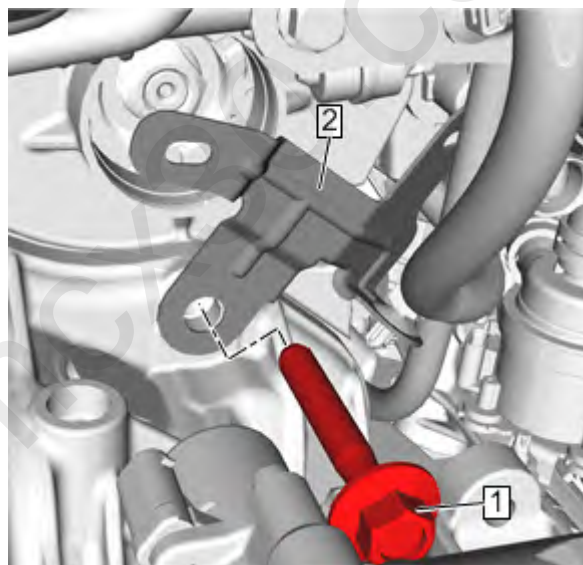


Fig. 256: Engine Wiring Harness Bracket And Transmission Bolt

Courtesy of GENERAL MOTORS COMPANY

16. Reposition Engine Wiring Harness Bracket (2)
17. Install and tighten Transmission Bolt (1) to 58 N.m (43 lb ft)

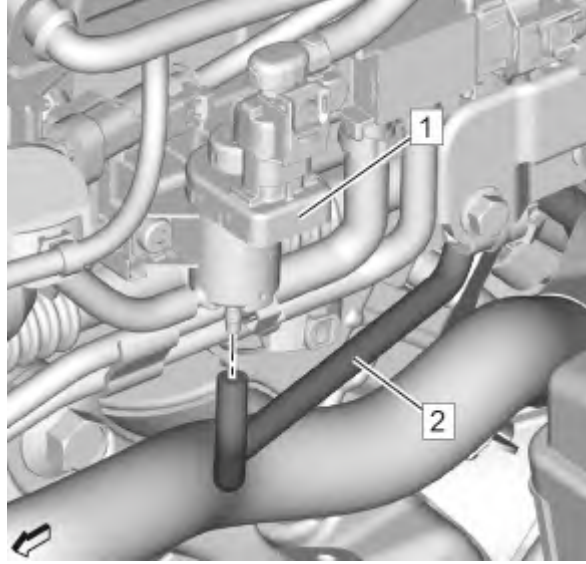


Fig. 257: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

18. Connect Charge Air Bypass Regulator Solenoid Valve Inlet Tube (2) @ Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (1)

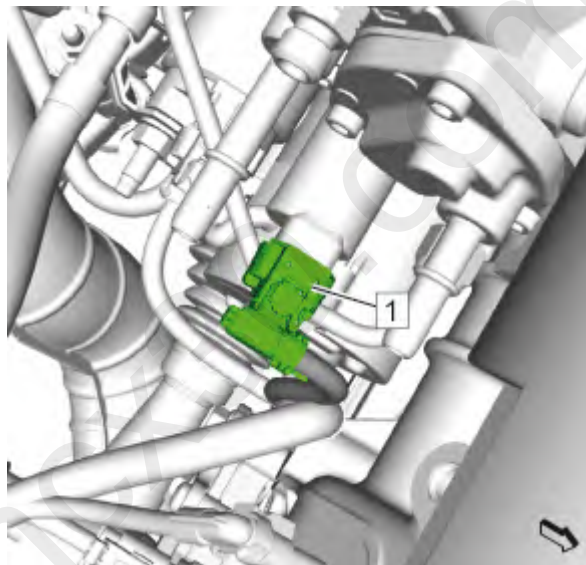


Fig. 258: Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

19. Connect the electrical connector. (1)

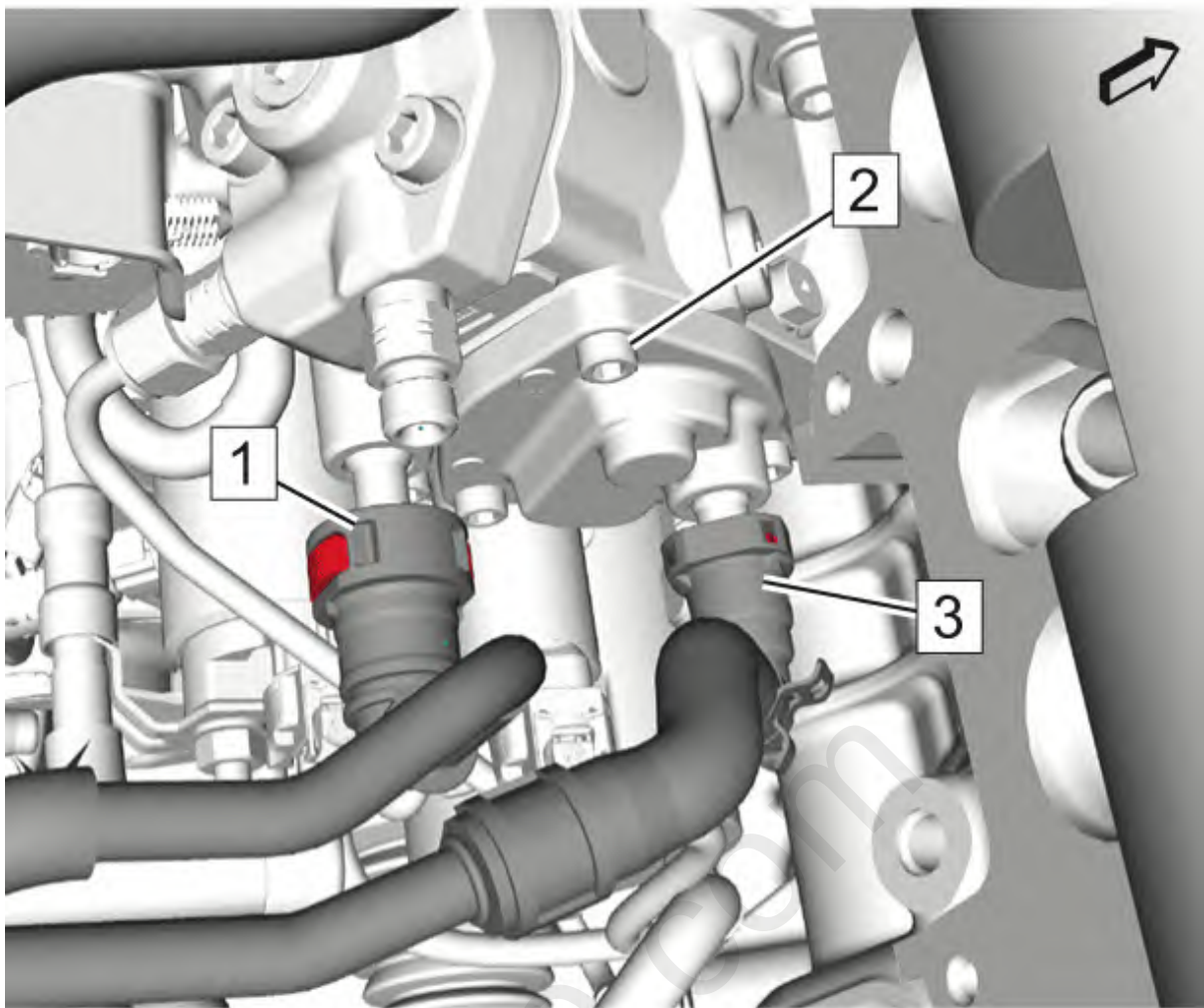


Fig. 259: Fuel Feed Pipe, Fuel Injection Pump And Diesel Fuel Separator
Courtesy of GENERAL MOTORS COMPANY

20. Remove the closure plugs from all connections.
21. Connect Diesel Fuel Separator (3) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
22. Connect Fuel Feed Pipe (1) @ Fuel Injection Pump (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
23. Install the auxiliary fluid accumulator. Refer to [Auxiliary Fluid Accumulator Replacement \(Equinox\)](#) [Auxiliary Fluid Accumulator Replacement \(Terrain\)](#).
24. Install the intake manifold. Refer to [Intake Manifold Replacement](#)
25. Install the engine control module. Refer to [Engine Control Module Bracket Replacement](#)
26. Check the fuel system for leaks. Refer to [Fuel Leak Diagnosis](#)
27. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
28. If replacing, perform the high pressure fuel correction reset. Refer to [High Pressure Fuel Correction Reset](#)

FUEL INJECTION PUMP DRIVEN SPROCKET REPLACEMENT

Special Tools

EN-50885-2 Locking Tool

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#), [Special Tools \(Mechanical Tools\)](#) .

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
3. Remove the camshaft timing chain. Refer to [Camshaft Timing Chain Replacement](#).

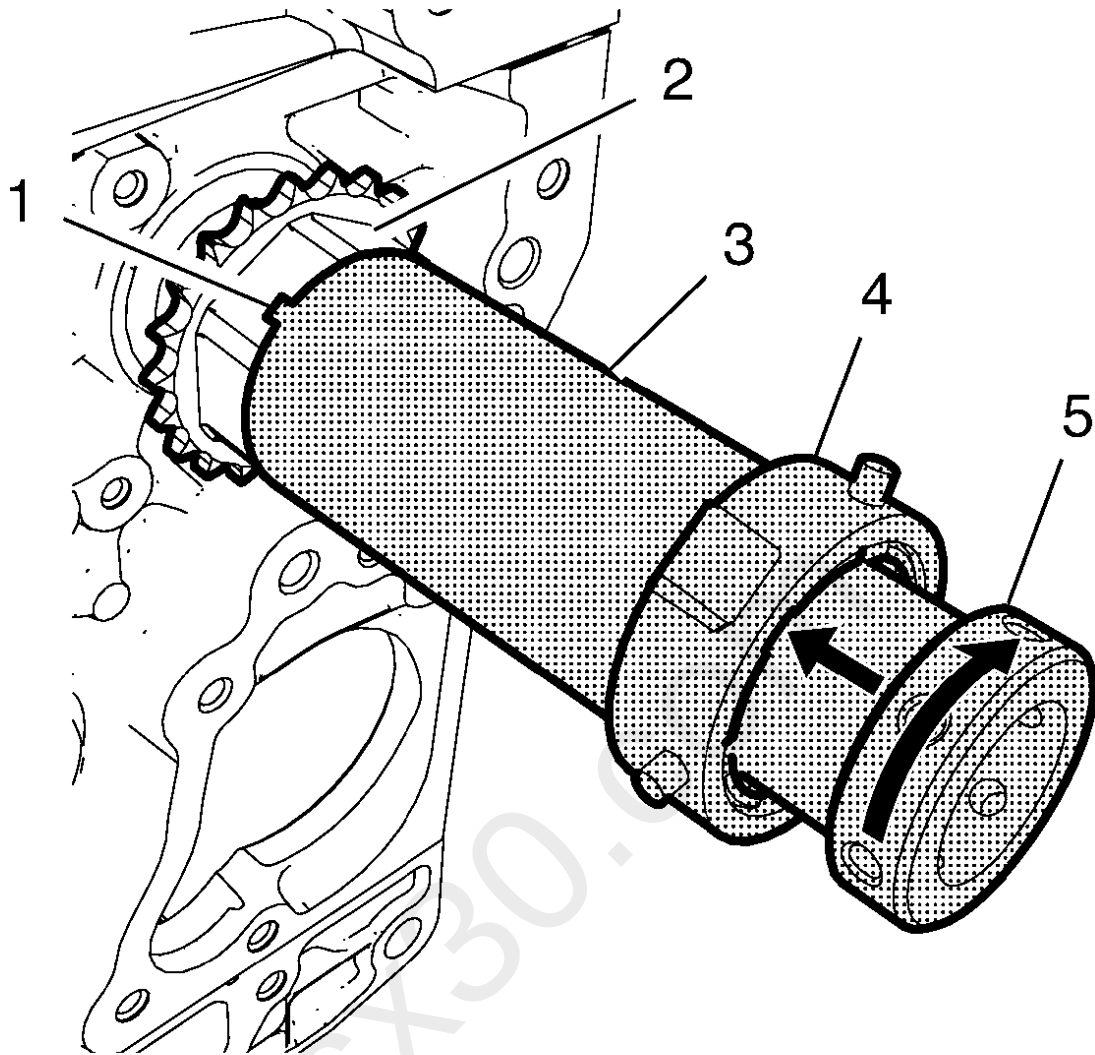


Fig. 260: Locking Tool Installed

Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-50885-2** locking tool.
 1. Install the housing (3) to the fuel injection pump driven sprocket nut (2). Ensure that the 3 tappets (1) mesh with the 3 slots of the fuel injection pump driven sprocket nut.
 2. Position the ring (4) to allow for installation of a 1/2 inch-drive extension.
 3. Install the fixing tool (5) into the fuel injection pump driven sprocket nut.

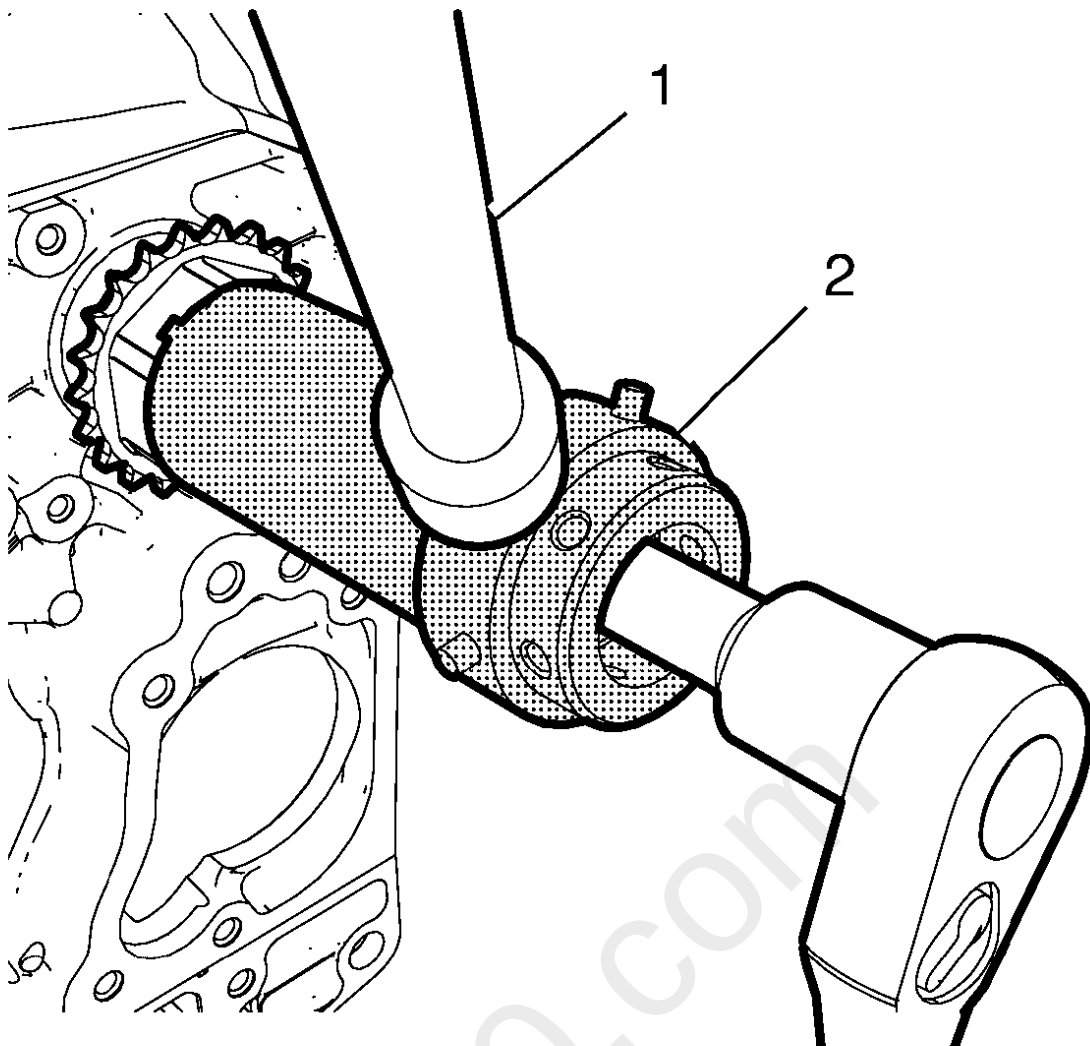


Fig. 261: Extension And Locking Tool

Courtesy of GENERAL MOTORS COMPANY

5. Install a 1/2 inch-drive extension (1) to the EN-50885-2 locking tool (2) to counterhold.
6. Loosen the fuel injection pump driven sprocket nut.

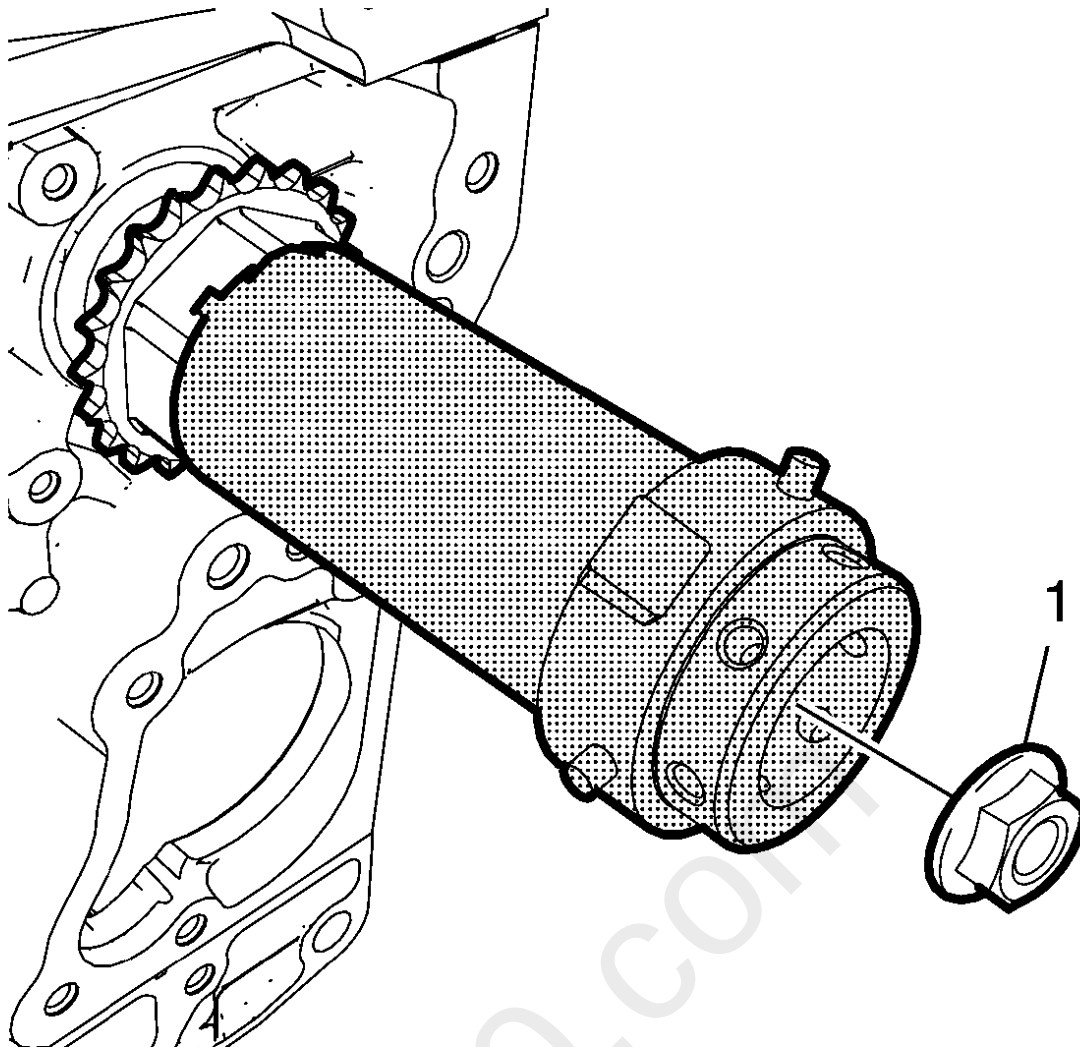


Fig. 262: Fuel Injection Pump Driven Sprocket Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove the fuel injection pump driven sprocket nut (1).

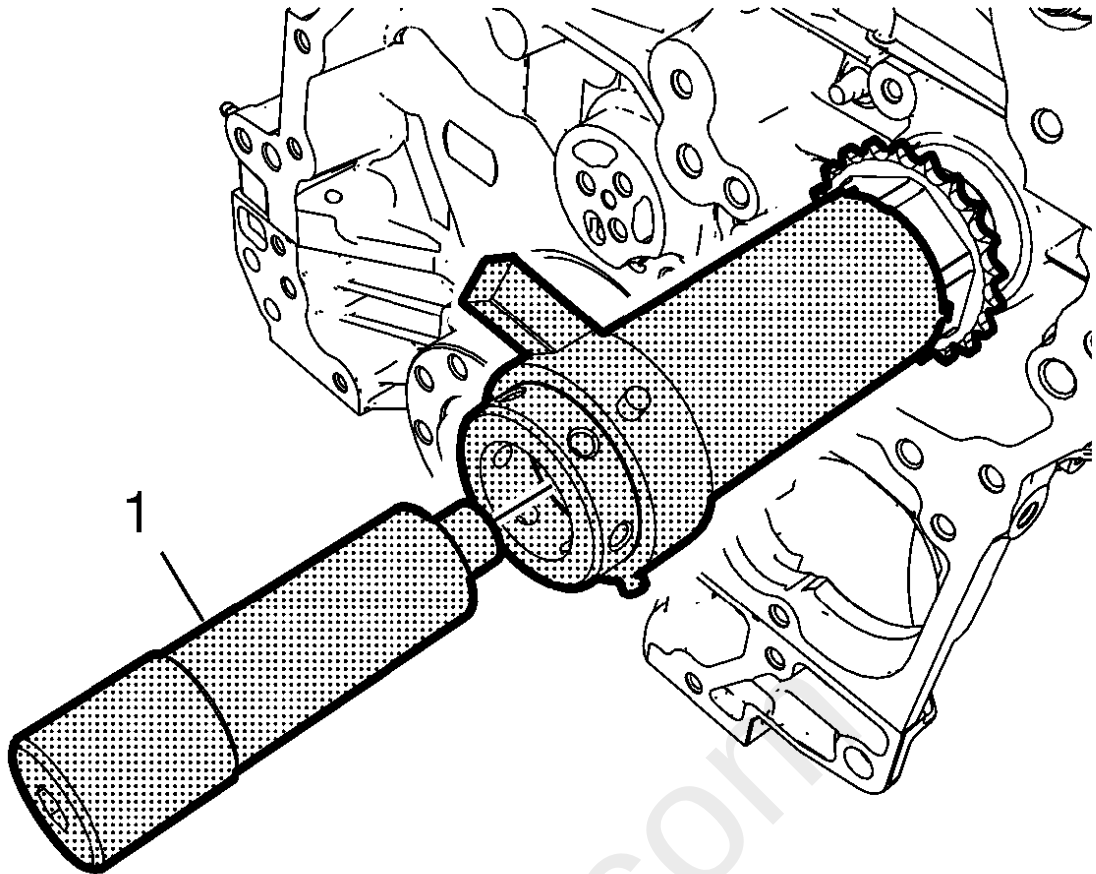


Fig. 263: Pressure Spindle And Locking Tool

Courtesy of GENERAL MOTORS COMPANY

8. Install the pressure spindle (1) to the EN-50885-2 locking tool (2).

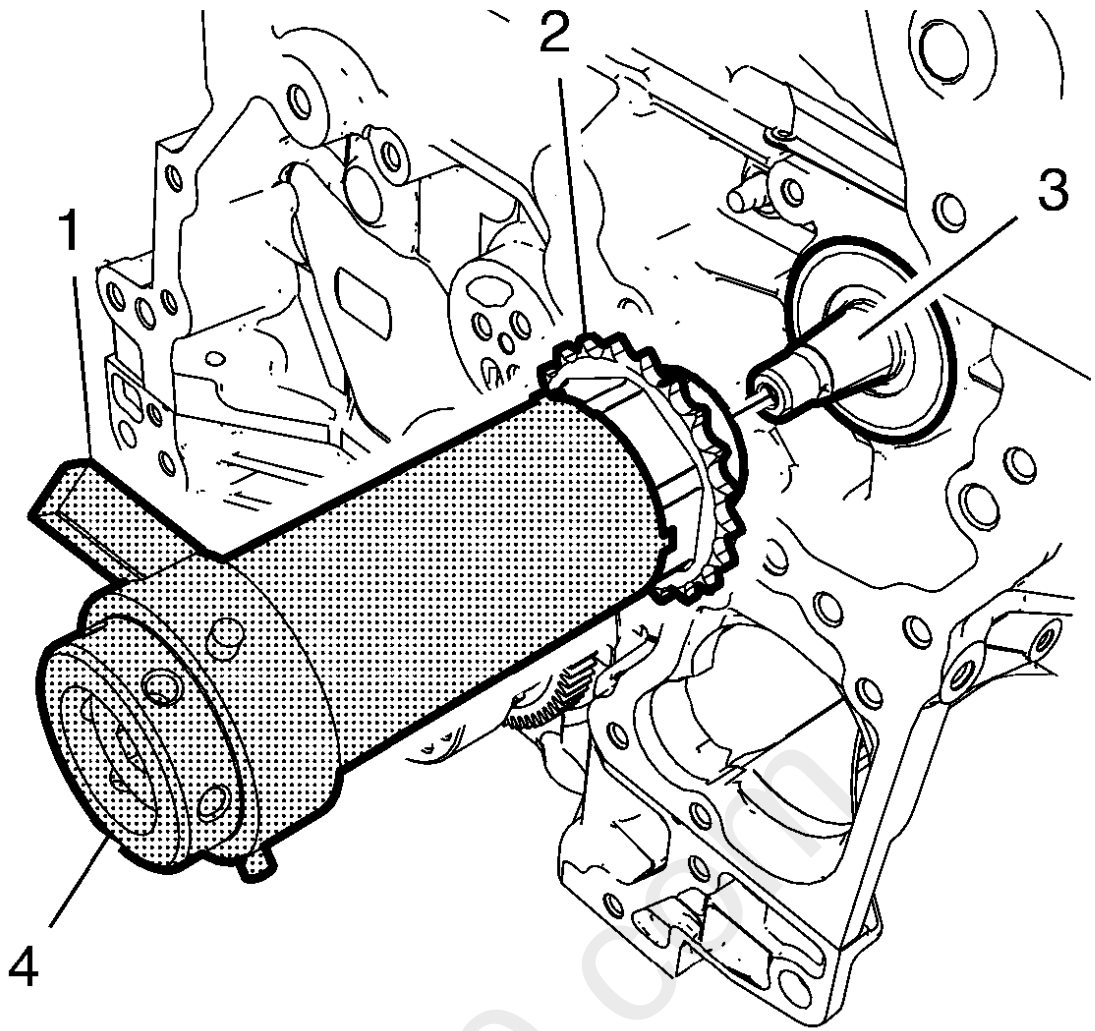


Fig. 264: Fuel Injection Pump Sprocket, Pressure Spindle And Locking Tool
Courtesy of GENERAL MOTORS COMPANY

9. Press out the fuel injection pump sprocket (2), by screwing in the pressure spindle (4) into the **EN-50885-2** fixing tool (1).
10. Remove the fuel injection fuel pump driven sprocket.
11. Remove the **EN-50885-2** fixing tool from the fuel injection pump driven sprocket.

Installation Procedure

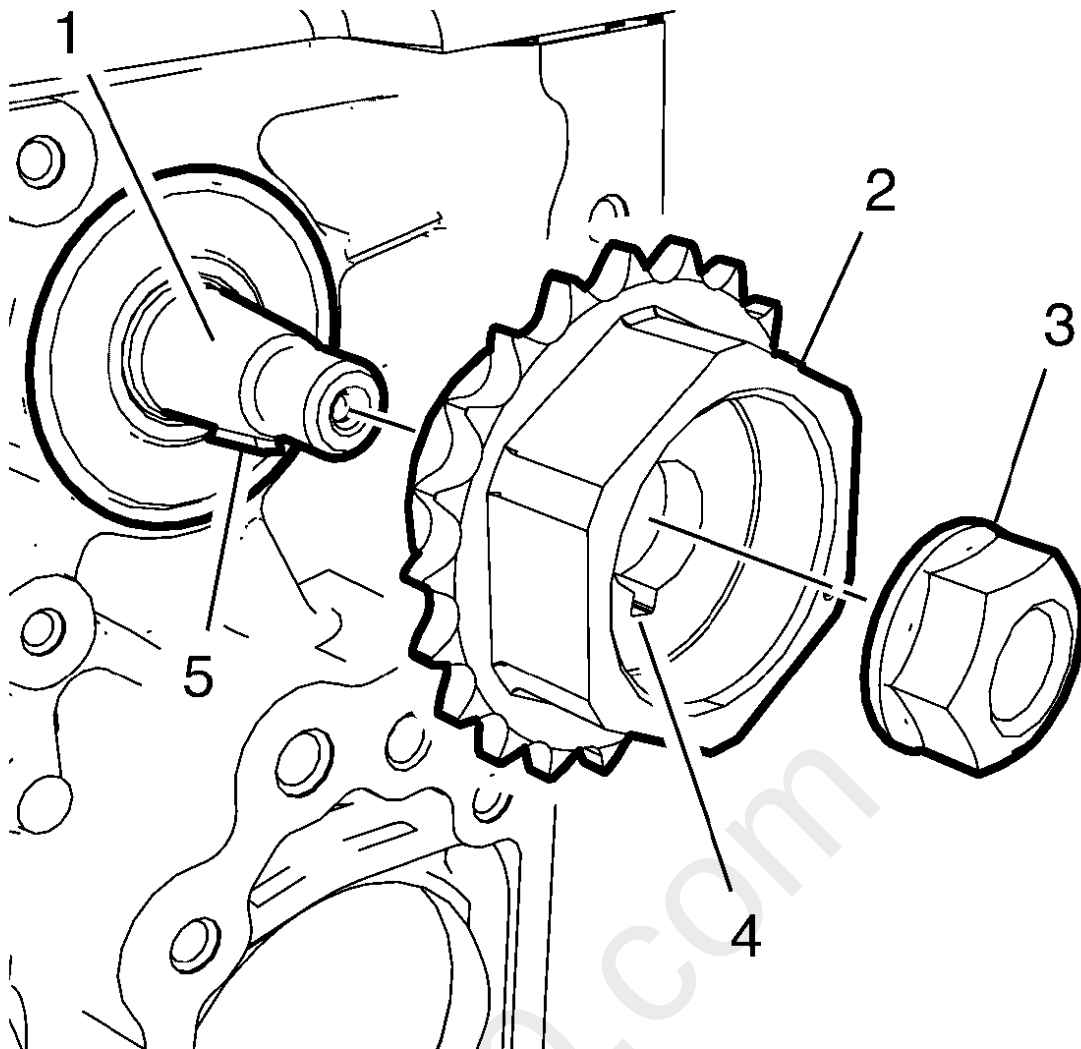


Fig. 265: Fuel Injection Pump, Driven Sprocket, Pump Shaft Wedge, Sprocket Groove And Nut

Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel injection pump sprocket (2) to the fuel injection pump (1). Ensure the fuel injection pump shaft wedge (5) and the fuel injection pump driven sprocket groove (4) are aligned.
2. Pre-install the fuel injection pump driven sprocket nut (3).

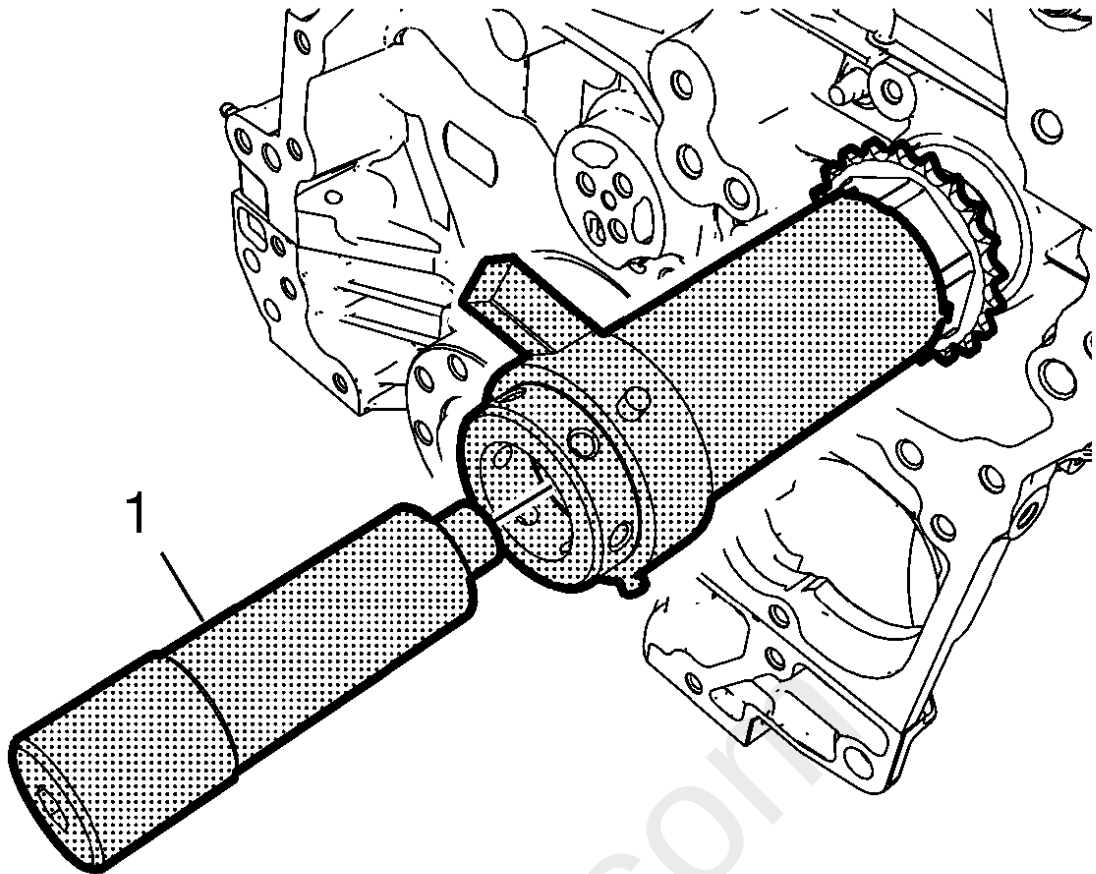


Fig. 266: Pressure Spindle And Locking Tool

Courtesy of GENERAL MOTORS COMPANY

3. Remove the pressure spindle (1) from the EN-50885-2 locking tool (2).

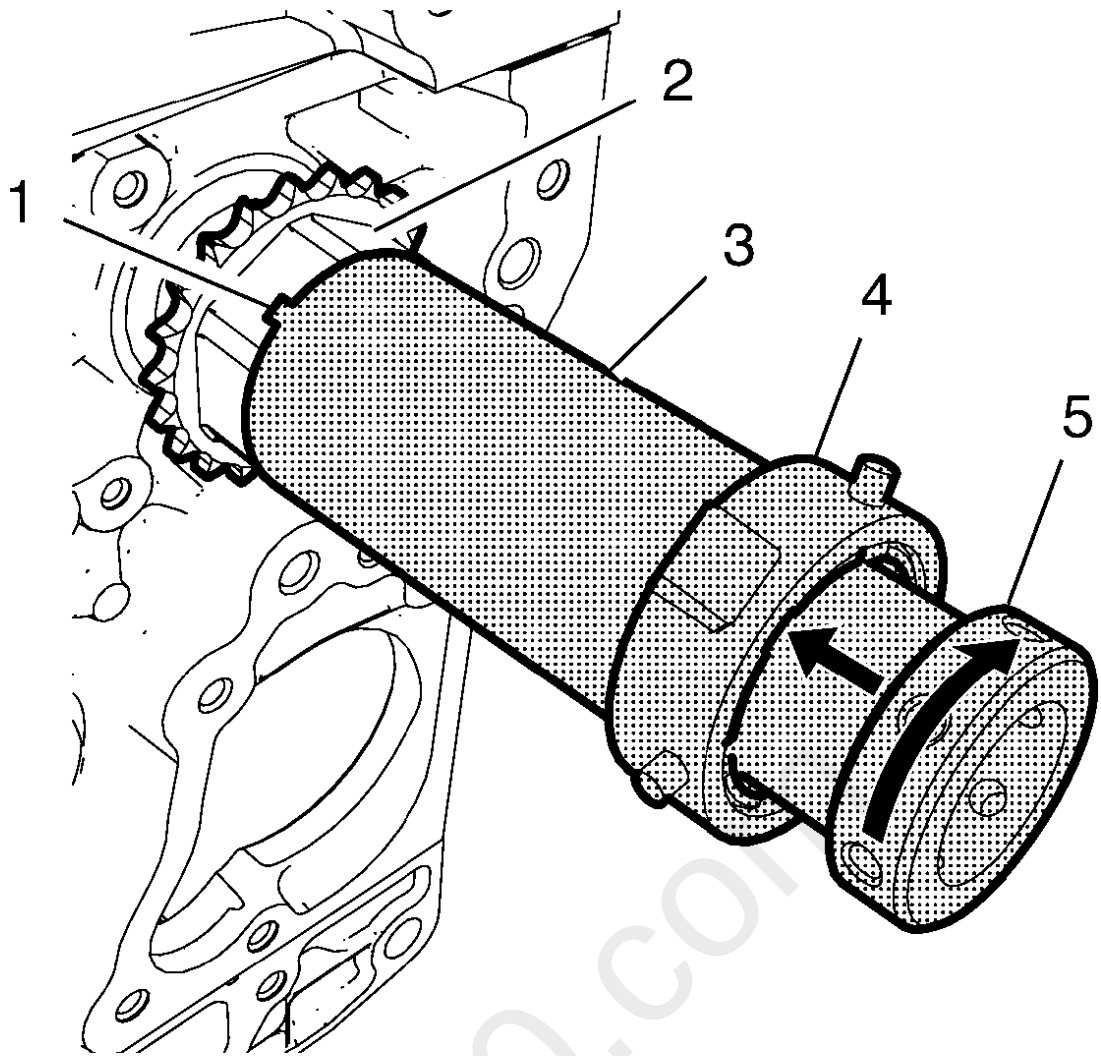


Fig. 267: Locking Tool Installed

Courtesy of GENERAL MOTORS COMPANY

4. Install the **EN-50885-2** locking tool.
 1. Install the housing (3) to the fuel injection pump driven sprocket nut (2). Ensure that the 3 tappets (1) mesh with the 3 slots of the fuel injection pump driven sprocket nut.
 2. Position the ring (4) to allow for installation of a 1/2 inch-drive extension.
 3. Screw in the fixing tool (5) into the fuel injection pump driven sprocket nut.

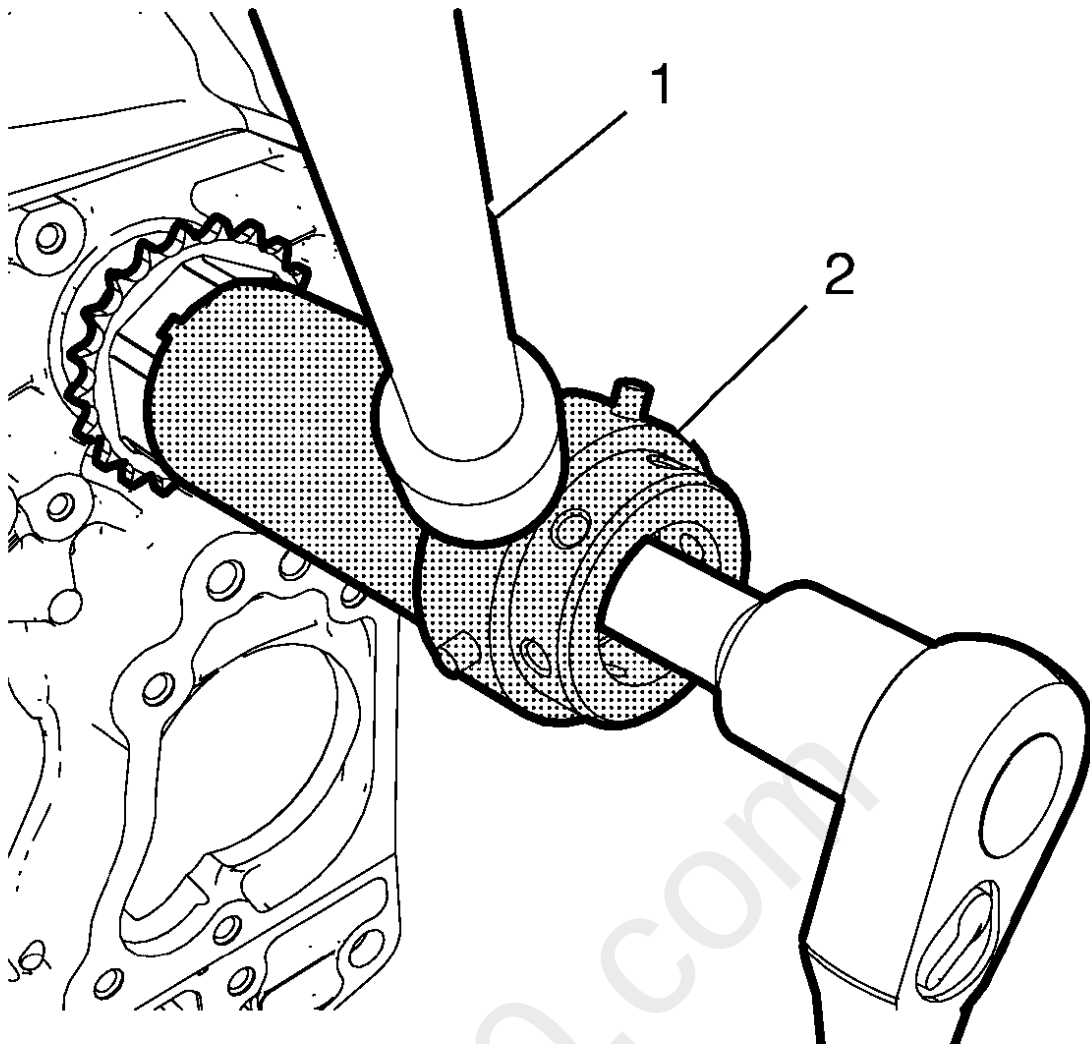


Fig. 268: Extension And Locking Tool

Courtesy of GENERAL MOTORS COMPANY

5. Install a 1/2 inch-drive extension (1) to the EN-50885-2 locking tool (2) to counterhold.

CAUTION: Refer to [Fastener Caution](#) .

6. Tighten the fuel injection pump driven sprocket nut to 64 N.m (47 lb ft).
7. Remove the EN-50885-2 locking tool.
8. Install the camshaft timing chain. Refer to [Camshaft Timing Chain Replacement](#) .
9. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
10. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#) .

FUEL INJECTOR REPLACEMENT

Special Tools

EN-45059 Angle Meter

EN-51146-1-3 Sliding Hammer

EN-51187 Injector Remover

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Mechanical Tools\)](#)

Removal Procedure

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

NOTE:

- Be very thorough in terms of cleanliness when working in the fuel system. Malfunctions can also occur due to very small dirt particles. Prevent dirt from entering the fuel system by cleaning the hoses and plugging the pipes and lines upon removal. Store the components so that contaminants cannot enter.
- In order to reuse the injectors, mark the injectors so that they can be installed to the same cylinder.

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

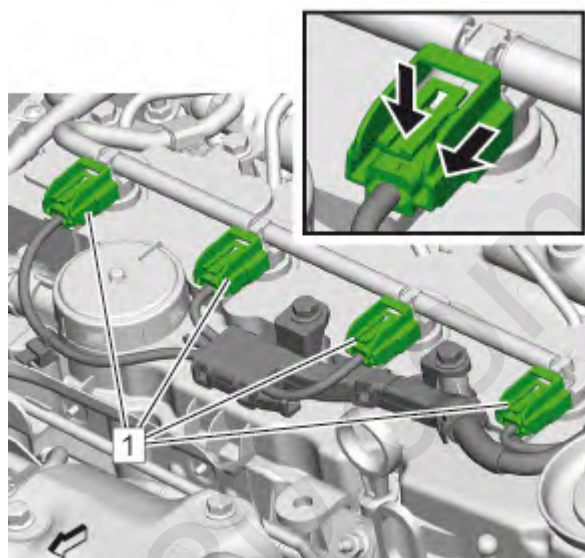


Fig. 269: Fuel Injector Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Fuel Injector Electrical Connectors (1) (Qty: 4)

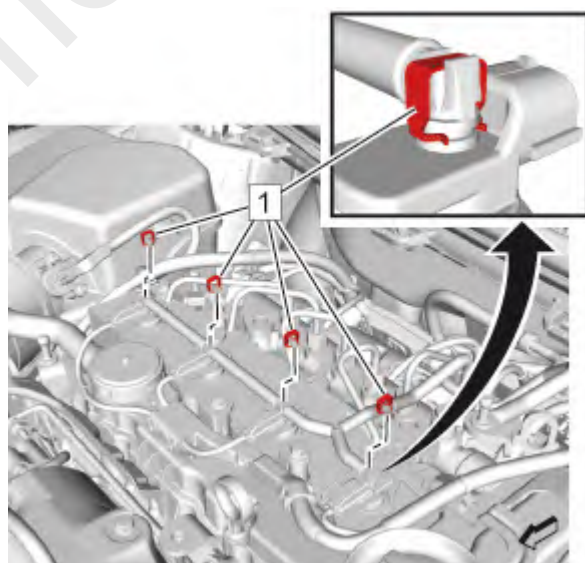


Fig. 270: Fuel Return Hose Clamps
Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD the 4 fuel return hose clamps (1).

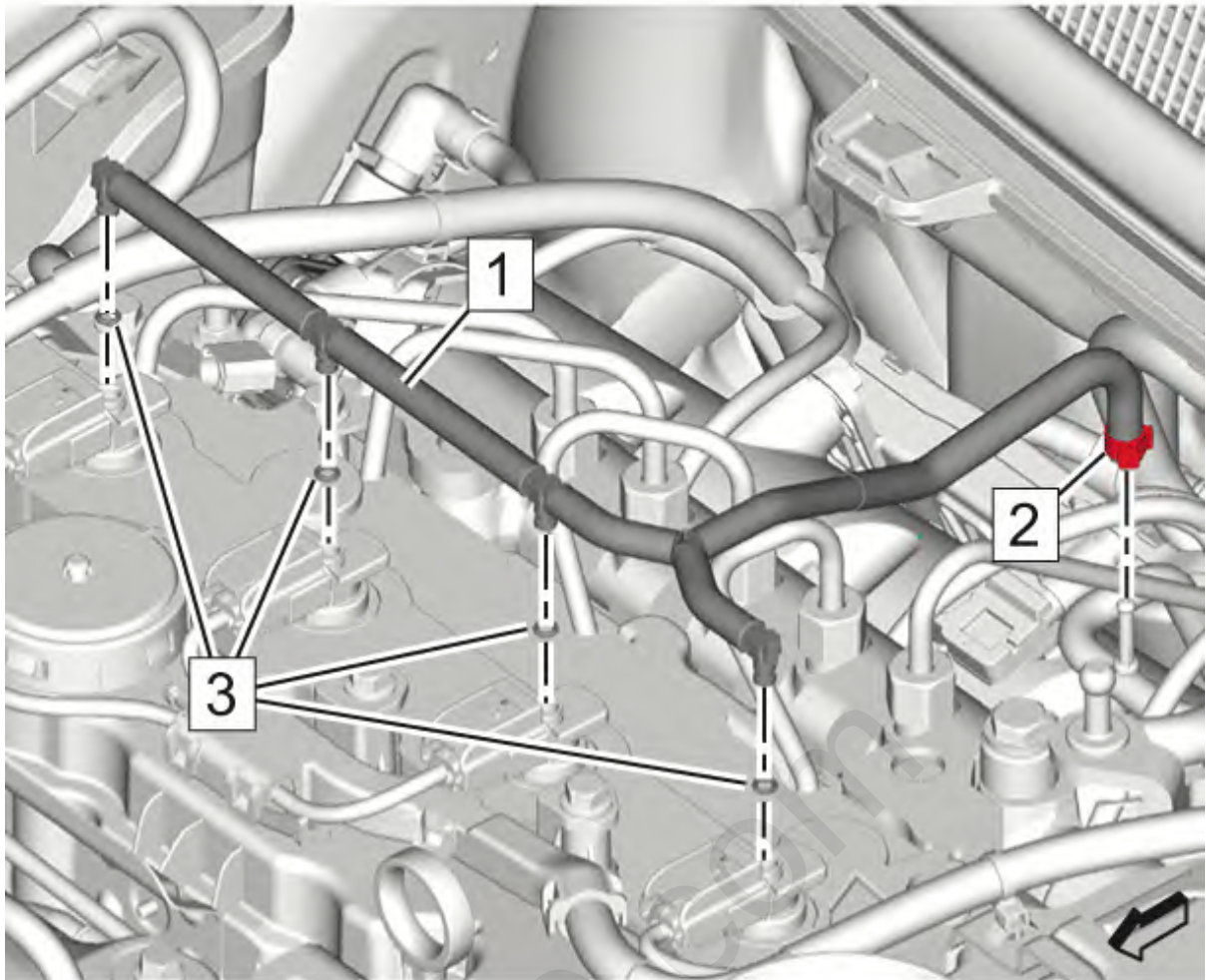


Fig. 271: Fuel Return Hose, Seals And Clamp
Courtesy of GENERAL MOTORS COMPANY

5. Remove and DISCARD Clamp (2)
6. Disconnect Fuel Return Hose (1) @ Diesel Fuel Separator
7. Unclip Fuel Return Hose (1) @ Fuel Injector (Qty: 4)
8. Remove Fuel Return Hose (1)
9. Remove and DISCARD the seals. (3) (Qty: 4)

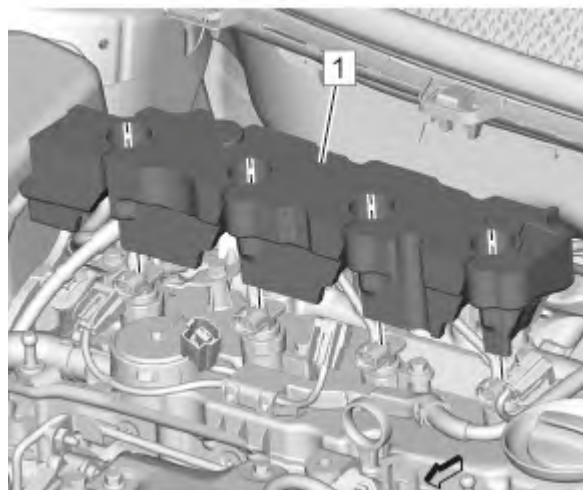


Fig. 272: Fuel Injector Insulator
Courtesy of GENERAL MOTORS COMPANY

10. Remove Fuel Injector Insulator (1)

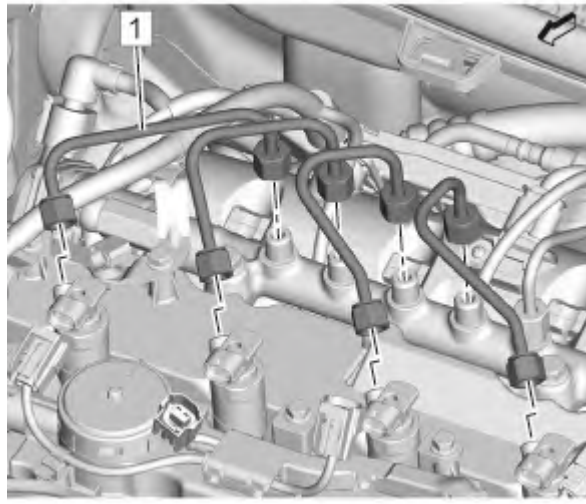


Fig. 273: Fuel Injection Fuel Feed Pipes
Courtesy of GENERAL MOTORS COMPANY

11. Remove and DISCARD Fuel Injection Fuel Feed Pipes (1) (Qty: 4)

12. Close all open connections, using suitable closure plugs.

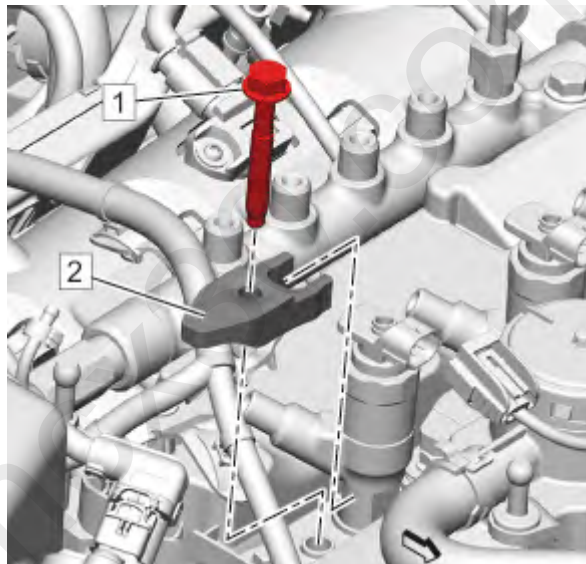


Fig. 274: Fuel Injector Brackets And Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove and DISCARD Fuel Injector Bracket Bolts (1) (Qty: 4)

14. Remove Fuel Injector Brackets (2) (Qty: 4)

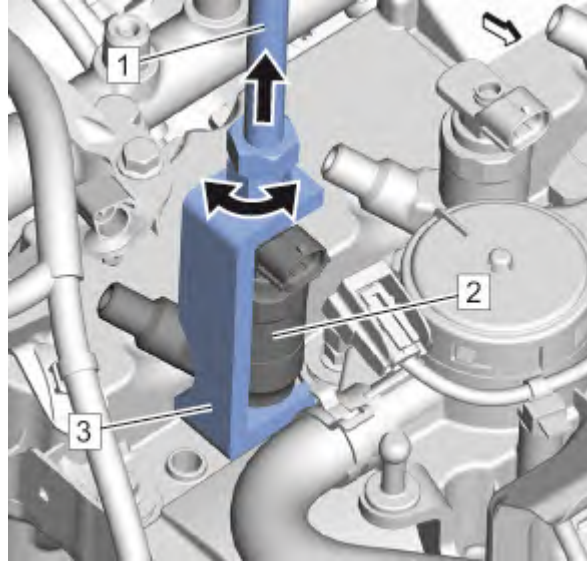


Fig. 275: Fuel Injector And Special Tools
 Courtesy of GENERAL MOTORS COMPANY

NOTE: If the injector can not be removed by hand, use the EN-51187 remover and remove the injector by turning at the hexagon.

15. Pull out the 4 fuel injectors (2) with the EN-51187 remover (3) along with the EN-51146-1-3 sliding hammer (1).

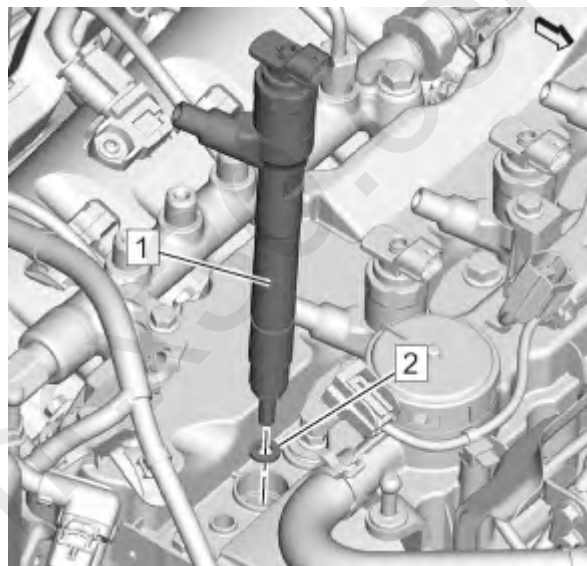


Fig. 276: Fuel Injectors And Washers
 Courtesy of GENERAL MOTORS COMPANY

16. Remove Fuel Injectors (1) (Qty: 4)
17. Remove and DISCARD Fuel Injector Washers (2) (Qty: 4)
18. Protect the 4 fuel injector nozzles with suitable caps.

Installation Procedure

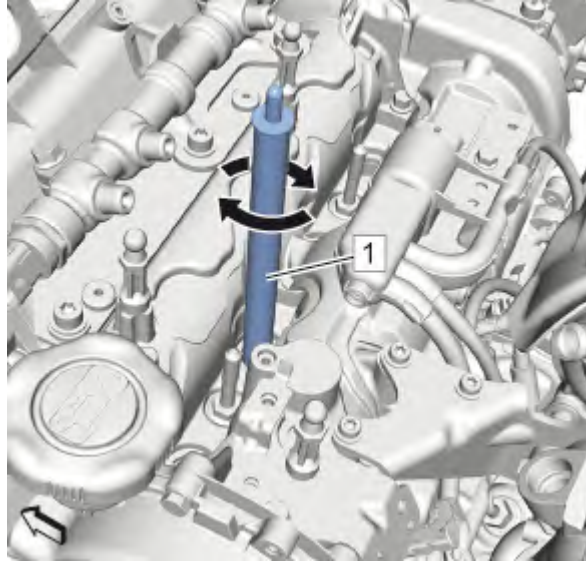


Fig. 277: Cleaning Tool

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [EN-47632 Cleaning Tool Rotation Caution](#)

1. Clean the 4 injector sealing surfaces in the cylinder head with a suitable cleaning tool (1) in the following procedure:
 1. First take the brush side to loosen the dirt.
 2. Accordingly take the sponge side to remove the dirt.

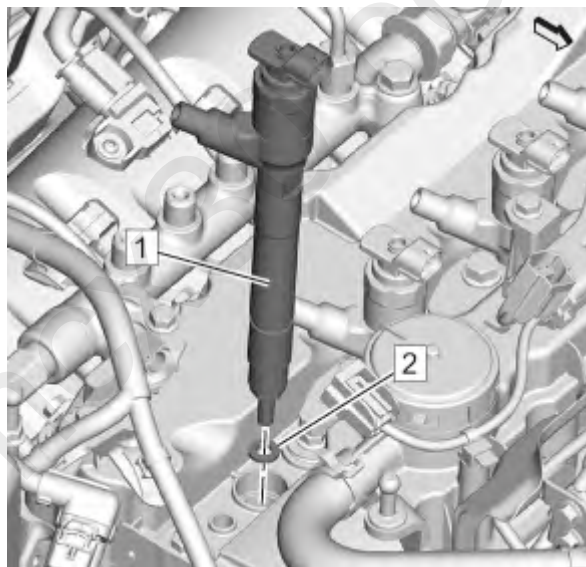


Fig. 278: Fuel Injectors And Washers

Courtesy of GENERAL MOTORS COMPANY

2. Remove the suitable caps from the 4 fuel injector nozzles.
3. Install NEW Fuel Injector Washers (2) (Qty: 4)
4. Install Fuel Injectors (1) (Qty: 4)

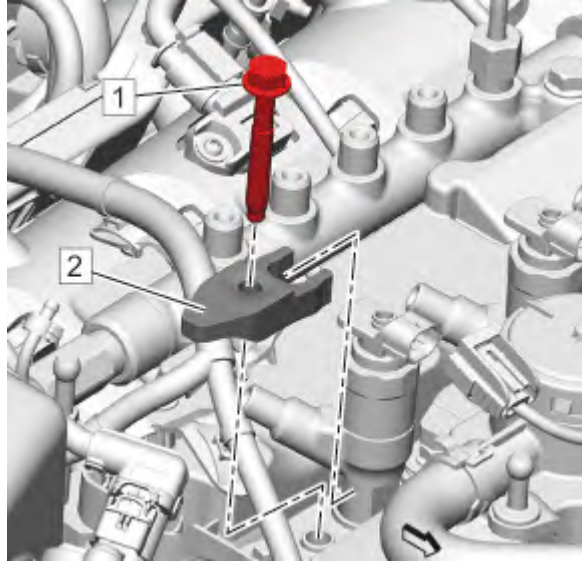


Fig. 279: Fuel Injector Brackets And Bolts
Courtesy of GENERAL MOTORS COMPANY

5. Install Fuel Injector Brackets (2) (Qty: 4)
6. Install and hand tighten the 4 NEW fuel injector bracket bolts (1)

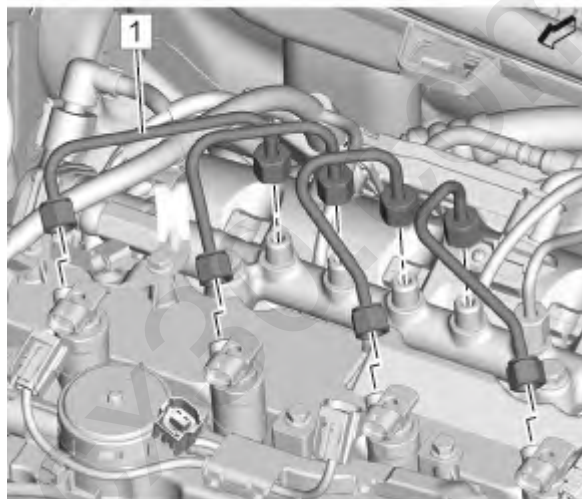
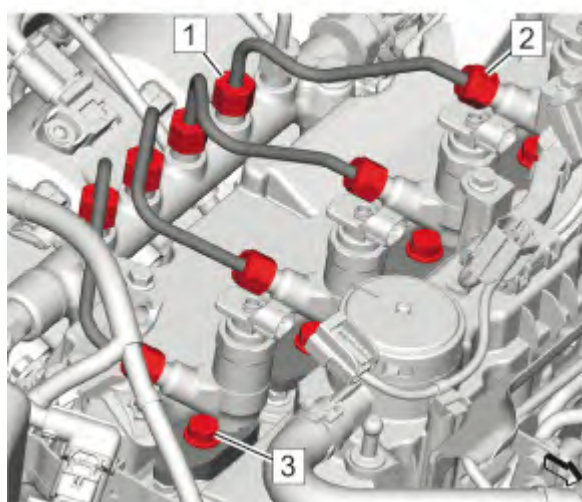


Fig. 280: Fuel Injection Fuel Feed Pipes
Courtesy of GENERAL MOTORS COMPANY

7. Remove the suitable closure plugs.
8. Install NEW Fuel Injection Fuel Feed Pipes (1) (Qty: 4)
9. Hand tighten the 8 fuel injection fuel feed pipe nuts.



CAUTION: Refer to **Fastener Caution**

10. Tighten Fuel Injector Bracket Bolt (3) in sequence
 1. First Pass: 10 N.m (89 lb in)
 2. Final Pass: 60 degrees Use the special tool: **EN-45059** meter
11. Tighten the 4 fuel injection fuel feed pipe nuts (2) to the 4 fuel injectors to 28 N.m (21 lb ft).
12. Tighten the 4 fuel injection fuel feed pipe nuts (1) to the fuel rail to 28 N.m (21 lb ft).

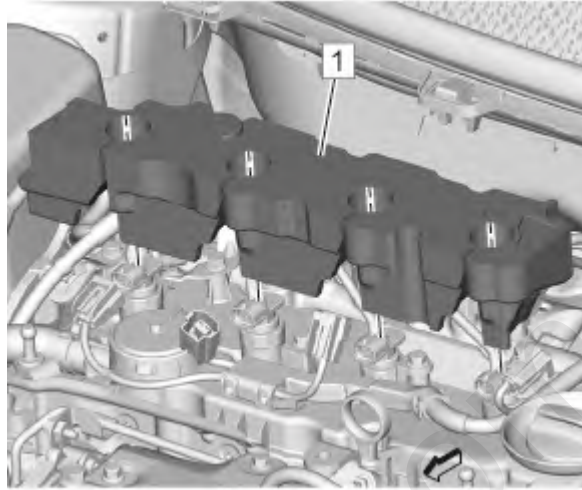


Fig. 282: Fuel Injector Insulator
Courtesy of GENERAL MOTORS COMPANY

13. Install Fuel Injector Insulator (1)

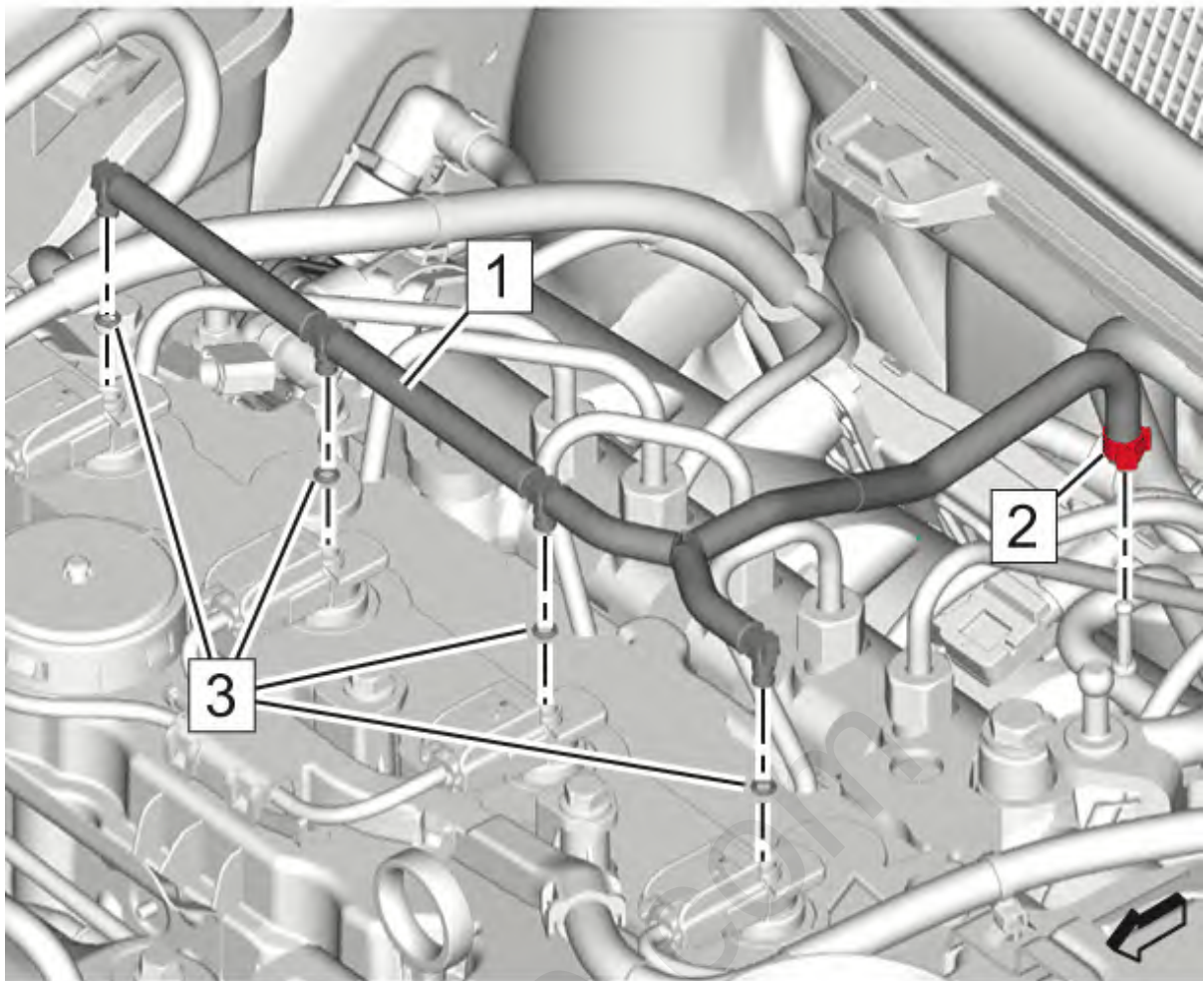


Fig. 283: Fuel Return Hose, Seals And Clamp
 Courtesy of GENERAL MOTORS COMPANY

14. Install 4 NEW fuel injector fuel return hose seal rings (3).
15. Install Fuel Return Hose (1) @ Fuel Injector (Qty: 4)
16. Connect Fuel Return Hose (1) @ Diesel Fuel Separator
17. Install a NEW clamp. (2)

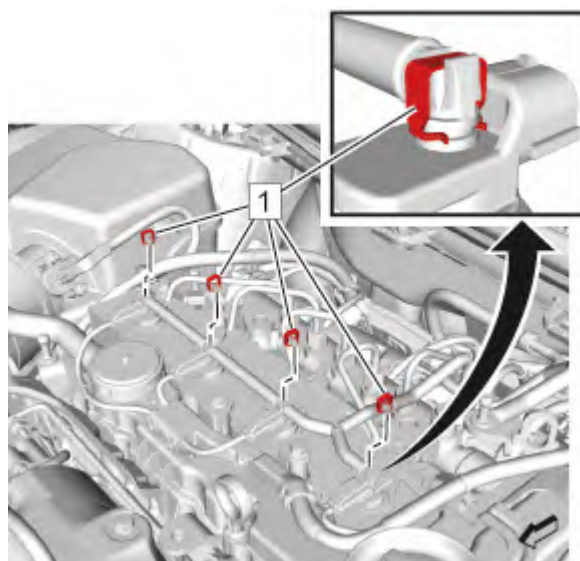


Fig. 284: Fuel Return Hose Clamps
 Courtesy of GENERAL MOTORS COMPANY

18. Install 4 NEW fuel return hose clamps (1).

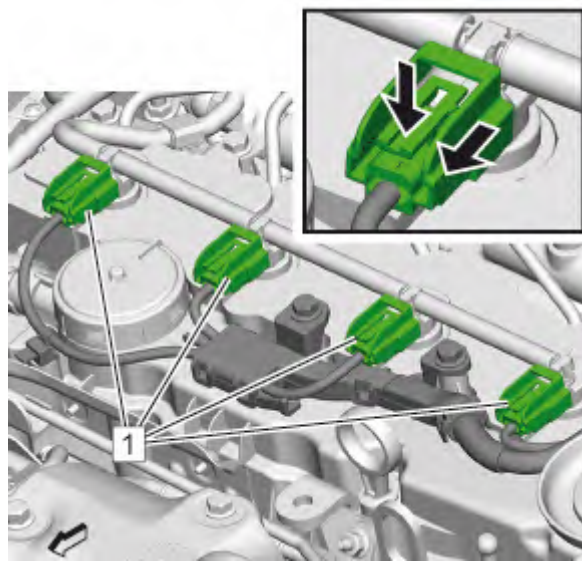


Fig. 285: Fuel Injector Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

19. Connect Fuel Injector Electrical Connectors (1) (Qty: 4)
20. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
21. Check the fuel system for leaks. Refer to [Fuel Leak Diagnosis](#).
22. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
23. Perform the fuel injection small quantity learn. Refer to [Fuel Injection Small Quantity Learn](#)
24. Perform the fuel trim reset. Refer to [Fuel Trim Reset](#)
25. Perform the high pressure fuel correction reset. Refer to [High Pressure Fuel Correction Reset](#)
26. Perform the fuel injector flow rate programming. Refer to [Fuel Injector Flow Rate Programming](#)

FUEL INJECTION PUMP METERING VALVE REPLACEMENT

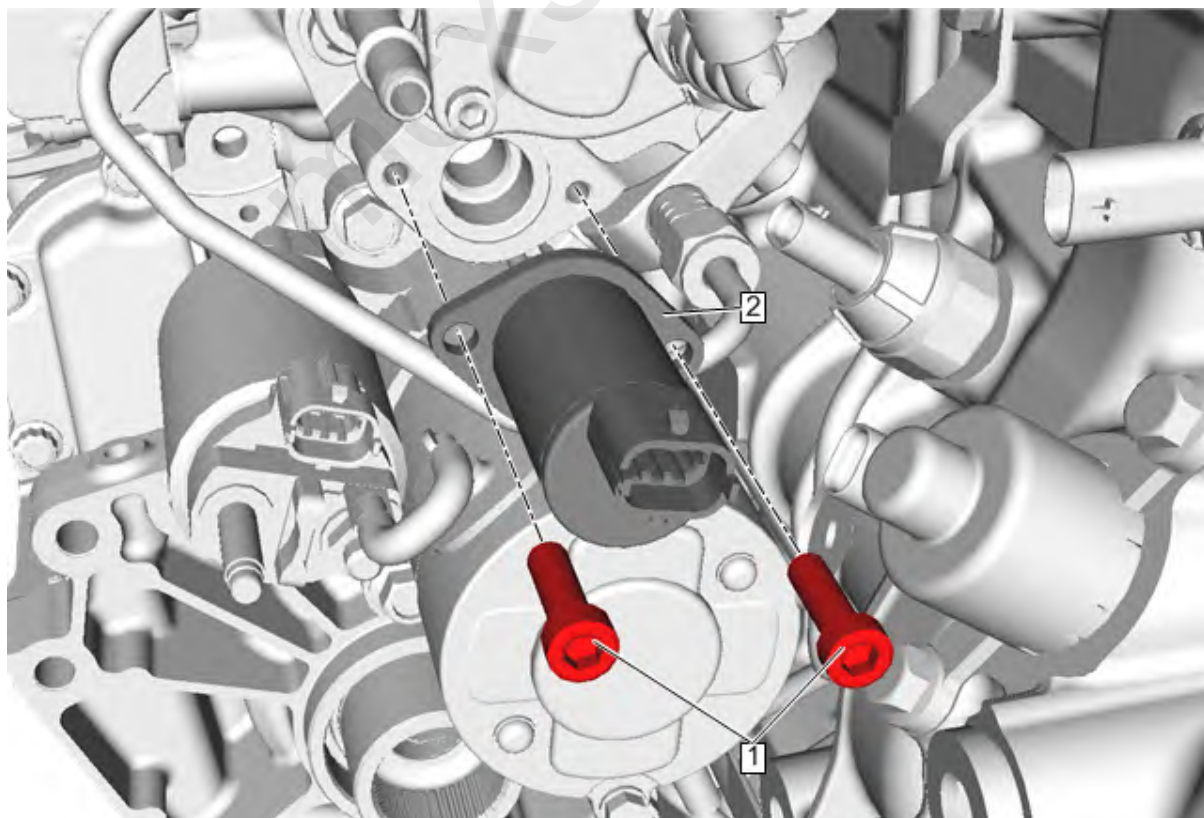


Fig. 286: Fuel Injection Pump Metering Valve
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure Remove Intake Manifold. Refer to Intake Manifold Replacement	
1	Fuel Injection Pump Metering Valve Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Fuel Injection Pump Metering Valve Procedure 1. Disconnect Fuel Injection Pump Metering Valve Electrical Connector 2. Install a NEW O-ring seal. 3. If replacing, perform the high pressure fuel correction reset. Refer to High Pressure Fuel Correction Reset

FUEL PUMP POWER CONTROL MODULE REPLACEMENT (AWD)

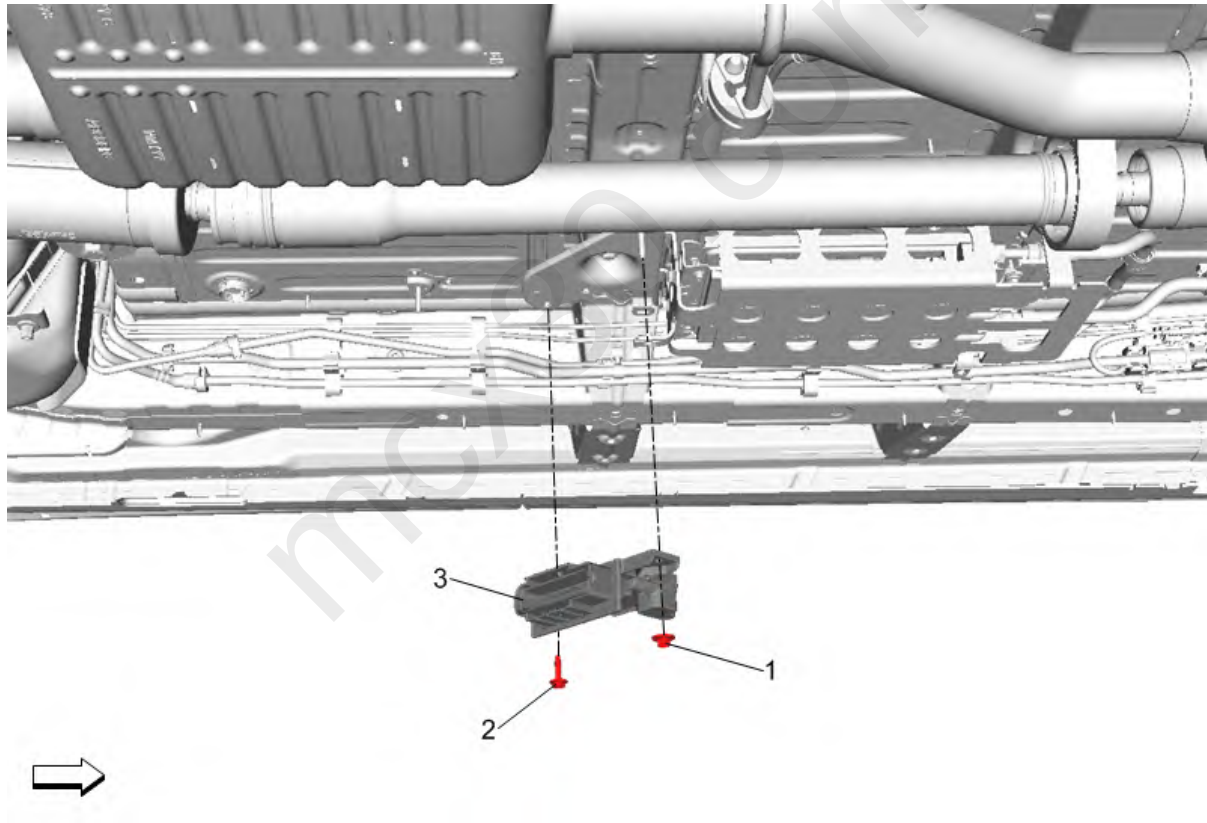


Fig. 287: Fuel Pump Power Control Module (AWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (All Wheel Drive) Underbody Rear Air Deflector Replacement (Diesel)	

Callout	Component Name
1	Fuel Pump Power Control Module Nut CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Fuel Pump Power Control Module Bolt Tighten 9 N.m (80 lb in)
3	Fuel Pump Power Control Module Procedure 1. Disconnect the electrical connector. 2. If replacing, reprogram the module. Refer to Control Module References

FUEL PUMP POWER CONTROL MODULE REPLACEMENT (FWD)

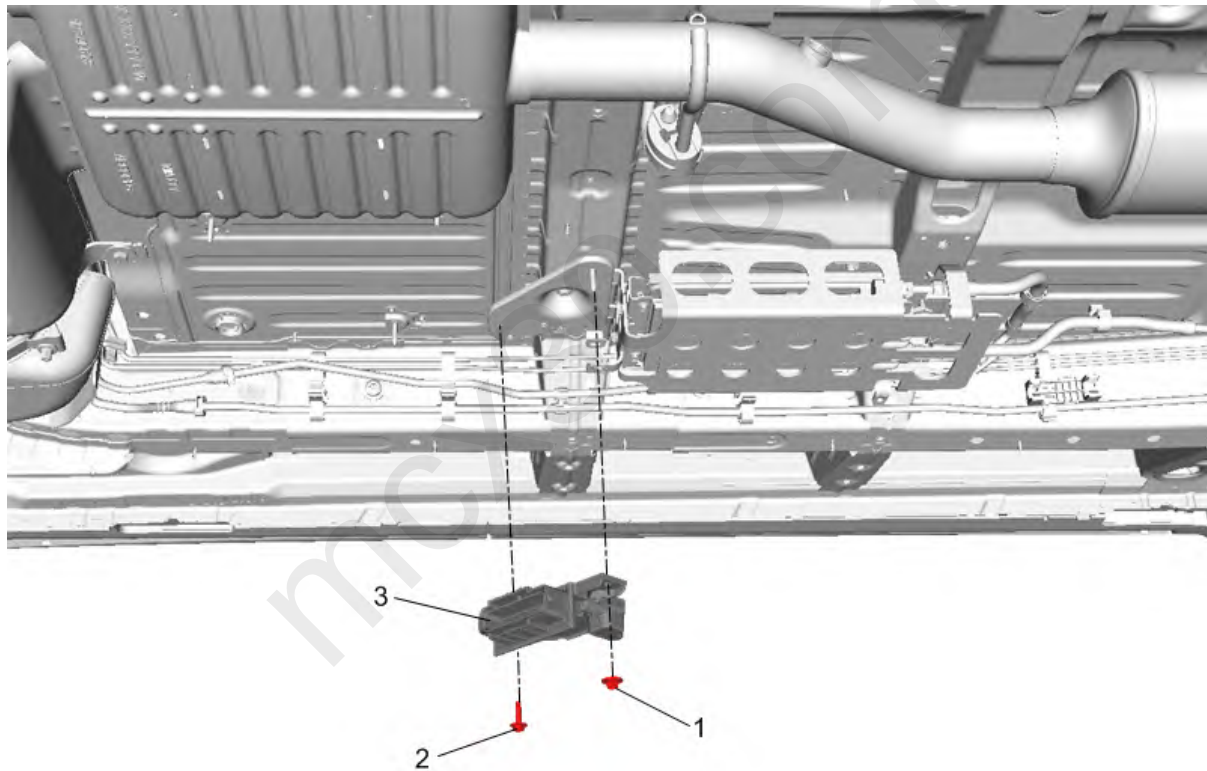


Fig. 288: Fuel Pump Power Control Module (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure {If equipped} Remove Underbody Rear Air Deflector. Refer to Underbody Rear Air Deflector Replacement (Front Wheel Drive) Underbody Rear Air Deflector Replacement (Diesel)	
1	Fuel Pump Power Control Module Nut CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

Callout	Component Name
2	Fuel Pump Power Control Module Bolt Tighten 9 N.m (80 lb in)
3	Fuel Pump Power Control Module Procedure 1. Disconnect the electrical connector. 2. If replacing, reprogram the module. Refer to Control Module References

FUEL PUMP POWER CONTROL MODULE BRACKET REPLACEMENT (AWD)

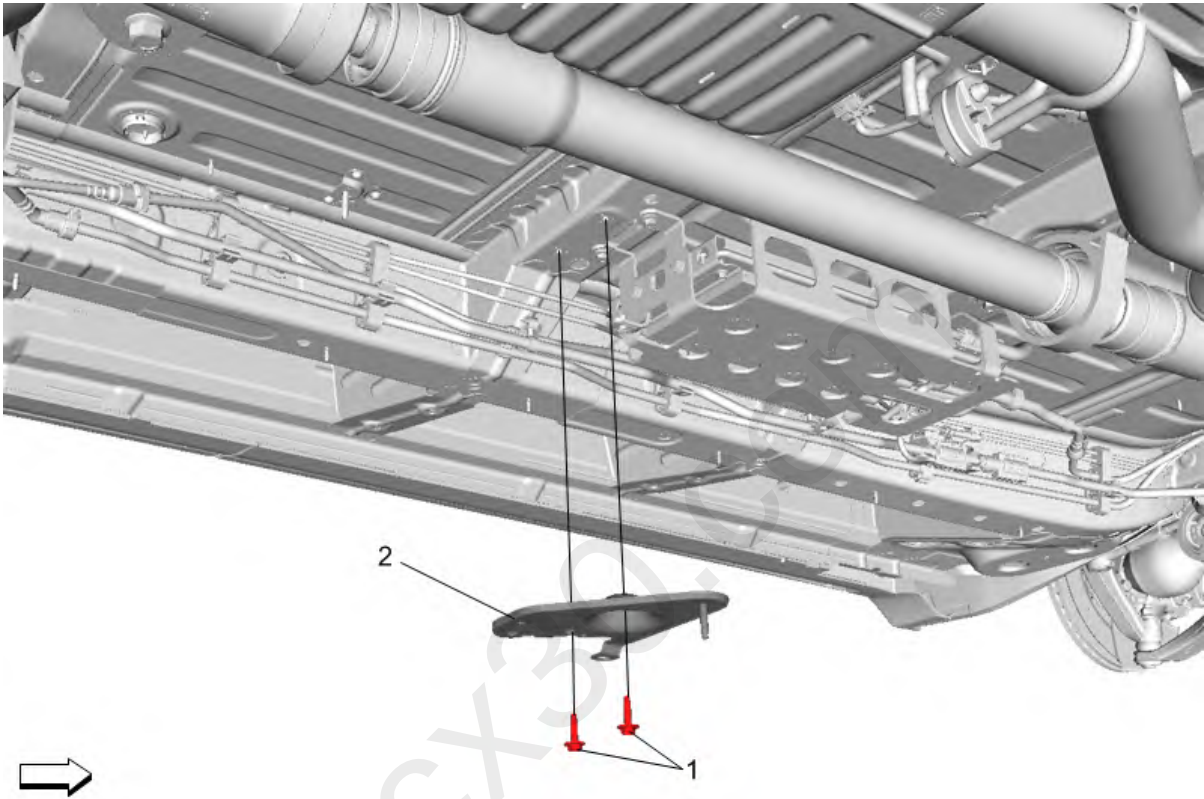


Fig. 289: Fuel Pump Power Control Module Bracket (AWD).
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Fuel Pump Power Control Module. Refer to Fuel Pump Power Control Module Replacement (AWD) .	
1	Fuel Pump Power Control Module Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Fuel Pump Power Control Module Bracket

FUEL PUMP POWER CONTROL MODULE BRACKET REPLACEMENT (FWD)

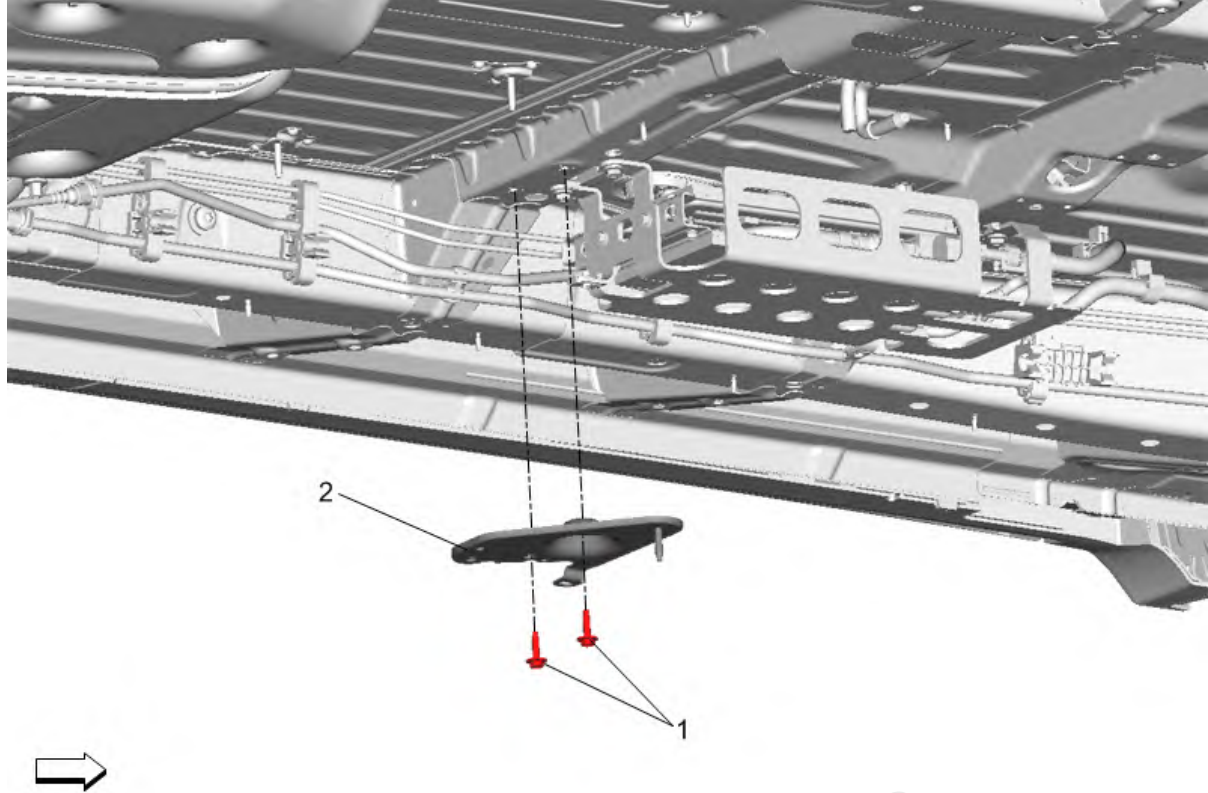


Fig. 290: Fuel Pump Power Control Module Bracket (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Fuel Pump Power Control Module. Refer to Fuel Pump Power Control Module Replacement (FWD) .	
1	Fuel Pump Power Control Module Bracket Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Fuel Pump Power Control Module Bracket

DIESEL FUEL SEPARATOR REPLACEMENT

Special Tools

J-42572 CV Boot Clamp Pliers

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#), [Special Tools \(Mechanical Tools\)](#)

Removal Procedure

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

WARNING: The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an engine fire resulting in catastrophic engine damage, and possible injury or death.

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
3. Remove Fuel Injection Fuel Feed Pipe. Refer to [Fuel Injection Fuel Feed Pipe Replacement - Fuel Injection Pump to Fuel Rail](#)

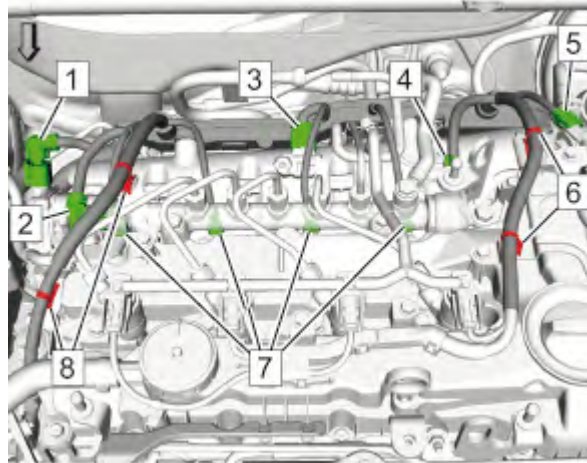


Fig. 291: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connectors:
 1. Intake Manifold Runner Control Valve Actuator (1)
 2. Fuel Rail Pressure Sensor (2)
 3. Intake Air Pressure and Temperature Sensor (3)
 4. Fuel Pressure Regulator (4)
 5. Exhaust Temperature Sensor - Position 1 (5)
 6. Glow Plugs (7) (Qty: 4)
5. Unclip Wiring Harness Retainers (6, 8) (Qty: 4)

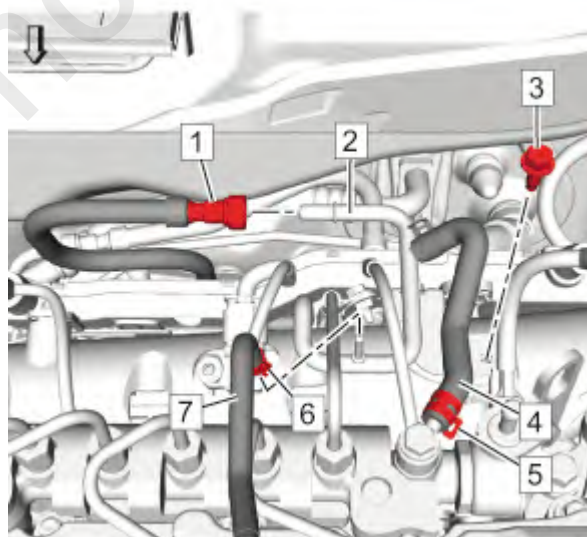


Fig. 292: Diesel Fuel Separator And Components
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Fuel Return Front Pipe (1) @ Diesel Fuel Separator (2). Refer to [Metal Collar Quick Connect Fitting Service](#)
7. Close all open connections with the suitable closure plugs.
8. Disengage Diesel Fuel Separator Hose Clamp (5)
9. Disconnect Diesel Fuel Separator Hose (4) @ Fuel Rail

10. Remove and DISCARD Clamp (6)
11. Disconnect Fuel Return Hose (7) @ Diesel Fuel Separator (2)
12. Remove Diesel Fuel Separator Bolt (3)

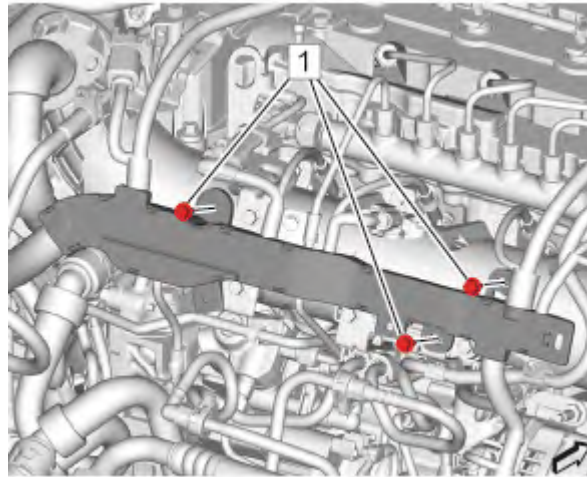


Fig. 293: Engine Wiring Harness Conduit Bolts
Courtesy of GENERAL MOTORS COMPANY

13. Remove Engine Wiring Harness Conduit Bolts (1) (Qty: 3)

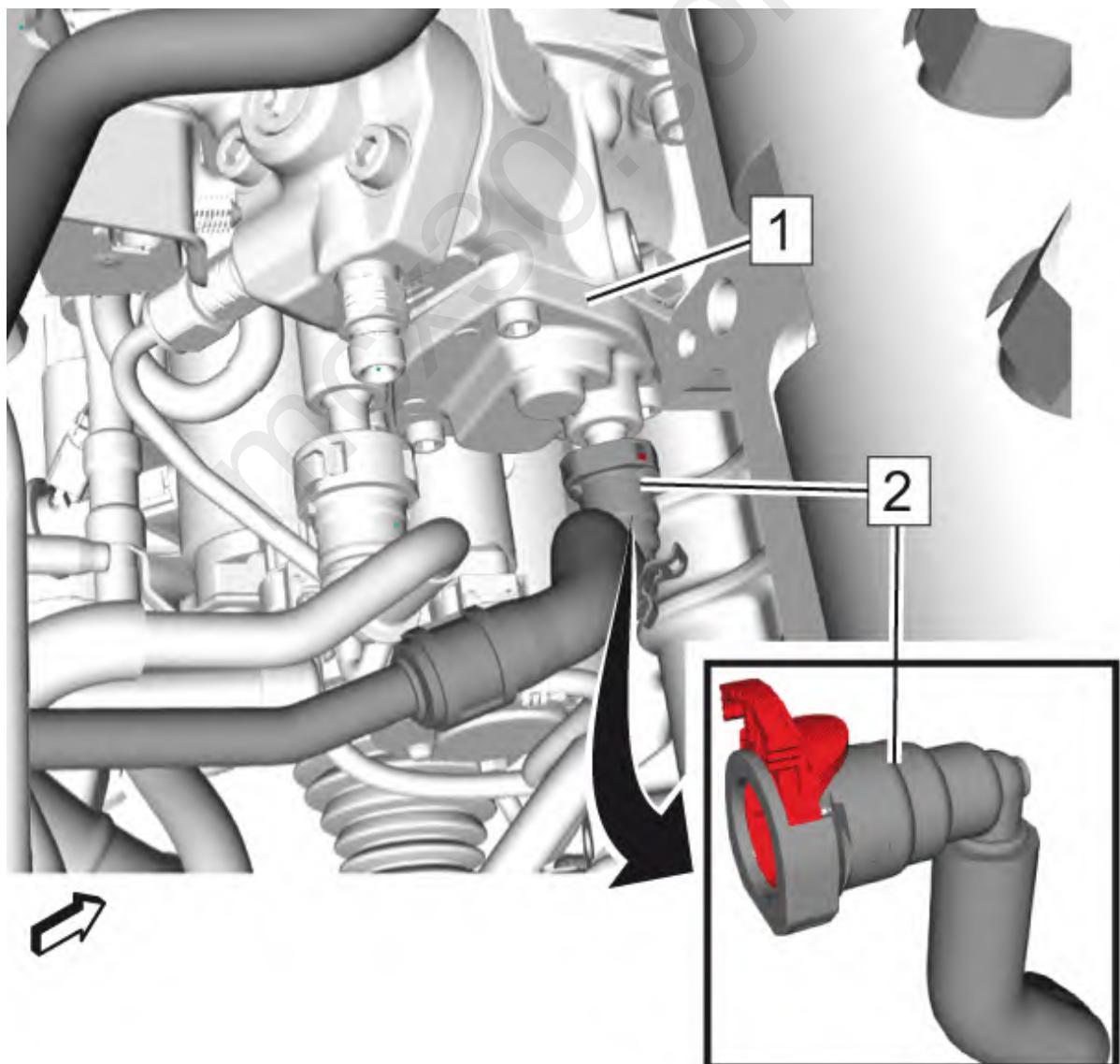


Fig. 294: Diesel Fuel Separator And Fuel Injection Pump
Courtesy of GENERAL MOTORS COMPANY

14. Disconnect Diesel Fuel Separator (2) @ Fuel Injection Pump (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)
15. Close all open connections with the suitable closure plugs.

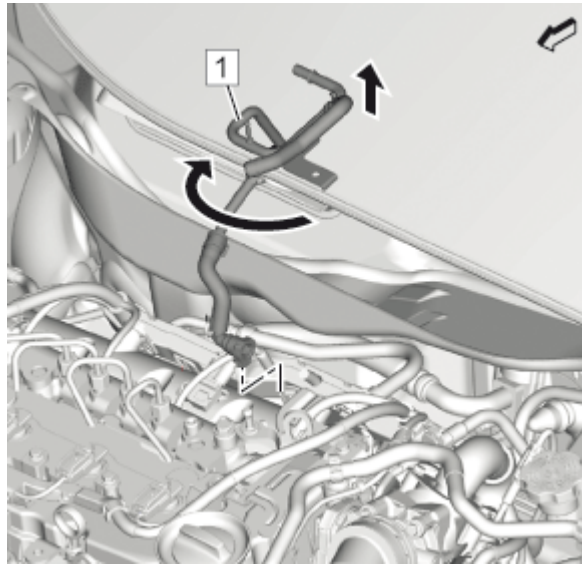


Fig. 295: Diesel Fuel Separator
Courtesy of GENERAL MOTORS COMPANY

16. Remove the diesel fuel separator (1) by rotating clockwise while pulling up the diesel fuel separator.

Installation Procedure

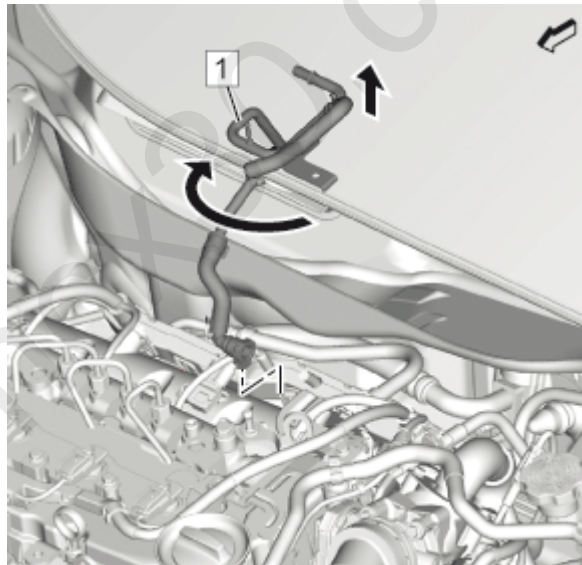


Fig. 296: Diesel Fuel Separator
Courtesy of GENERAL MOTORS COMPANY

1. Install Diesel Fuel Separator (1)

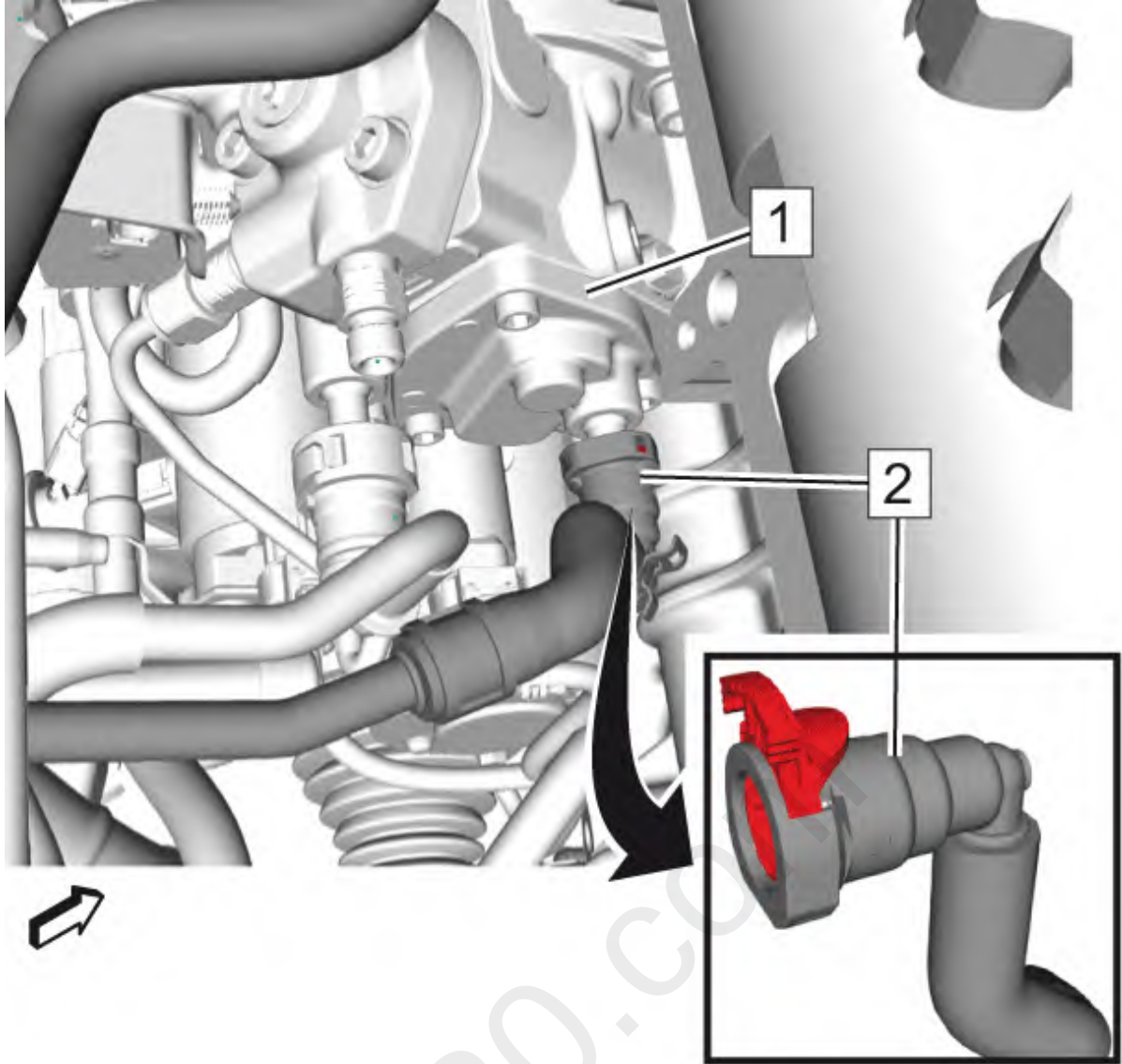


Fig. 297: Diesel Fuel Separator And Fuel Injection Pump
 Courtesy of GENERAL MOTORS COMPANY

2. Remove the closure plugs from all connections.
3. Connect Diesel Fuel Separator (2) @ Fuel Injection Pump (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)

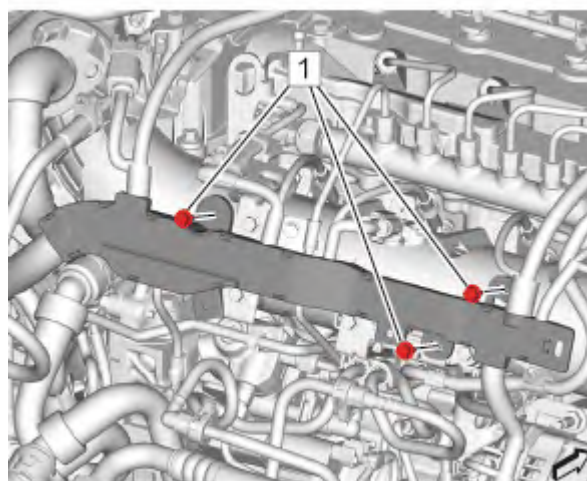


Fig. 298: Engine Wiring Harness Conduit Bolts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

4. Install and tighten Engine Wiring Harness Conduit Bolts (1) (Qty: 3) to 9 N.m (80 lb in)

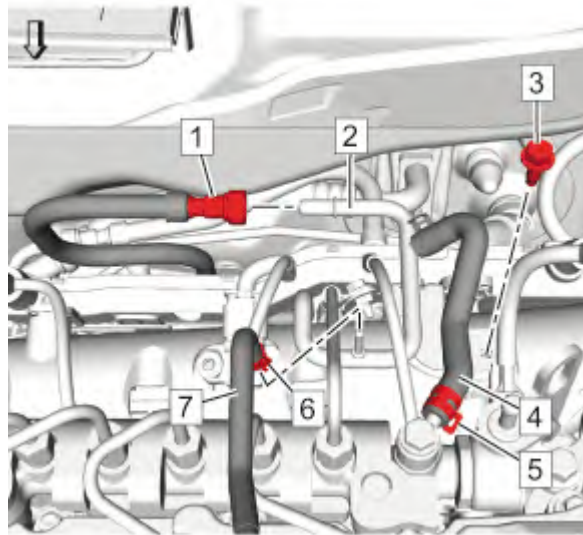


Fig. 299: Diesel Fuel Separator And Components
Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Diesel Fuel Separator Bolt (3) to 10 N.m (89 lb in)
6. Connect Fuel Injector Fuel Return Hose (7) @ Diesel Fuel Separator (2)
7. Install a NEW clamp. (6) - J-42572 CV Boot Clamp Pliers
8. Connect Diesel Fuel Separator Hose (4) @ Fuel Rail
9. Engage Diesel Fuel Separator Hose Clamp (5)
10. Remove the closure plugs from all connections.
11. Connect Fuel Return Front Pipe (1) @ Diesel Fuel Separator (2). Refer to [Metal Collar Quick Connect Fitting Service](#)

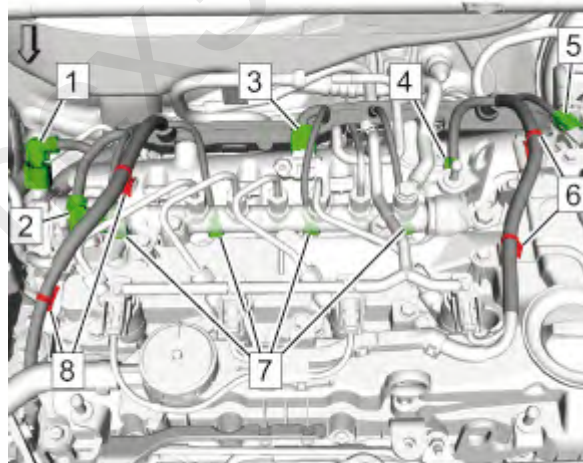


Fig. 300: Electrical Connectors And Retainers
Courtesy of GENERAL MOTORS COMPANY

12. Connect the electrical connectors:
 1. Intake Manifold Runner Control Valve Actuator (1)
 2. Fuel Rail Pressure Sensor (2)
 3. Intake Air Pressure and Temperature Sensor (3)
 4. Fuel Pressure Regulator (4)
 5. Exhaust Temperature Sensor - Position 1 (5)
 6. Glow Plugs (7) (Qty: 4)
13. Install Wiring Harness Retainers (6, 8) (Qty: 4)

14. Install Fuel Injection Fuel Feed Pipe. Refer to [Fuel Injection Fuel Feed Pipe Replacement - Fuel Injection Pump to Fuel Rail](#)
15. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
16. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

GLOW PLUG REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

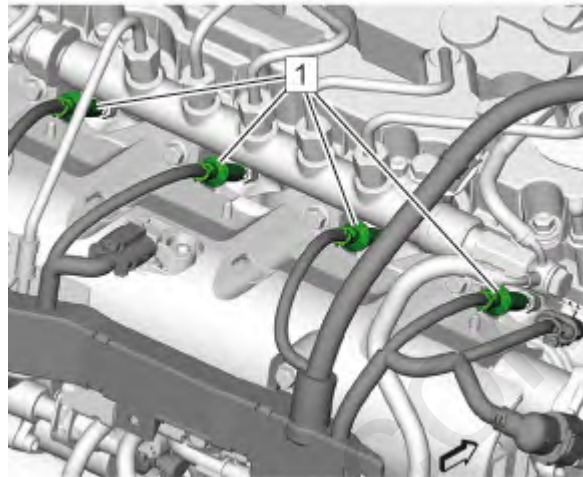


Fig. 301: Glow Plug Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Glow Plug Electrical Connectors (1) (Qty: 4) @ Glow Plug
4. Clean around each of the glow plugs.

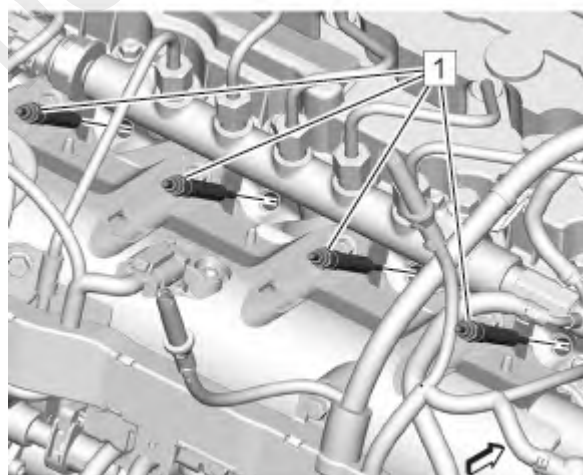


Fig. 302: Glow Plugs
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 4 glow plugs (1).

Installation Procedure

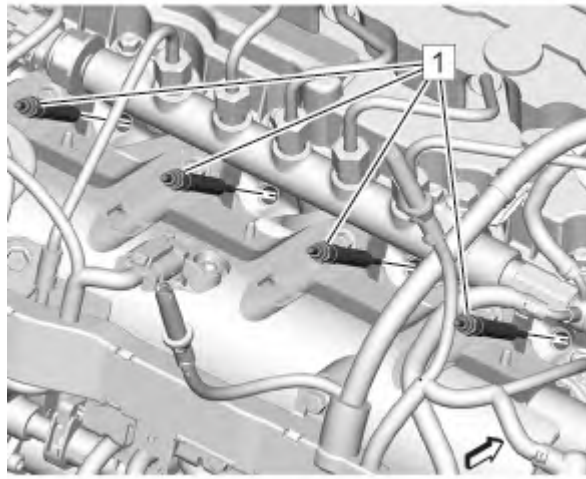


Fig. 303: Glow Plugs

Courtesy of GENERAL MOTORS COMPANY

NOTE: To aid in hand starting glow plugs into their bores, a hose or tube with an inner diameter of 4 mm can be used as an extension when installed on the end of the glow plug.

CAUTION: Refer to [Fastener Caution](#)

1. Install the 4 glow plugs (1) and tighten to 16.5 N.m (12 lb ft).

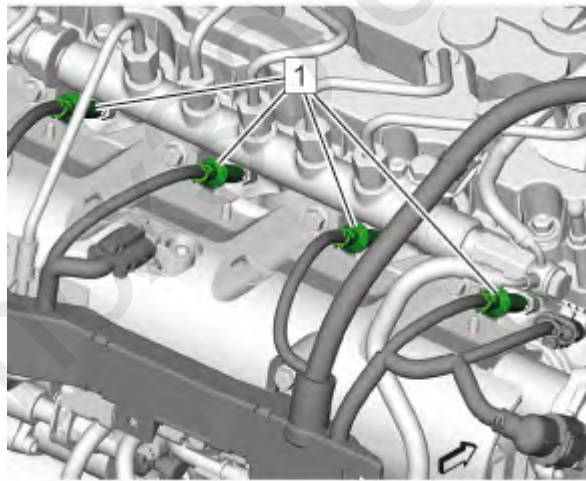


Fig. 304: Glow Plug Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

2. Connect Glow Plug Electrical Connectors (1) (Qty: 4) @ Glow Plug
3. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
4. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

CRANKSHAFT POSITION SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Exhaust Gas Recirculation Cooler Housing. Refer to [Exhaust Gas Recirculation Cooler Housing Replacement](#)

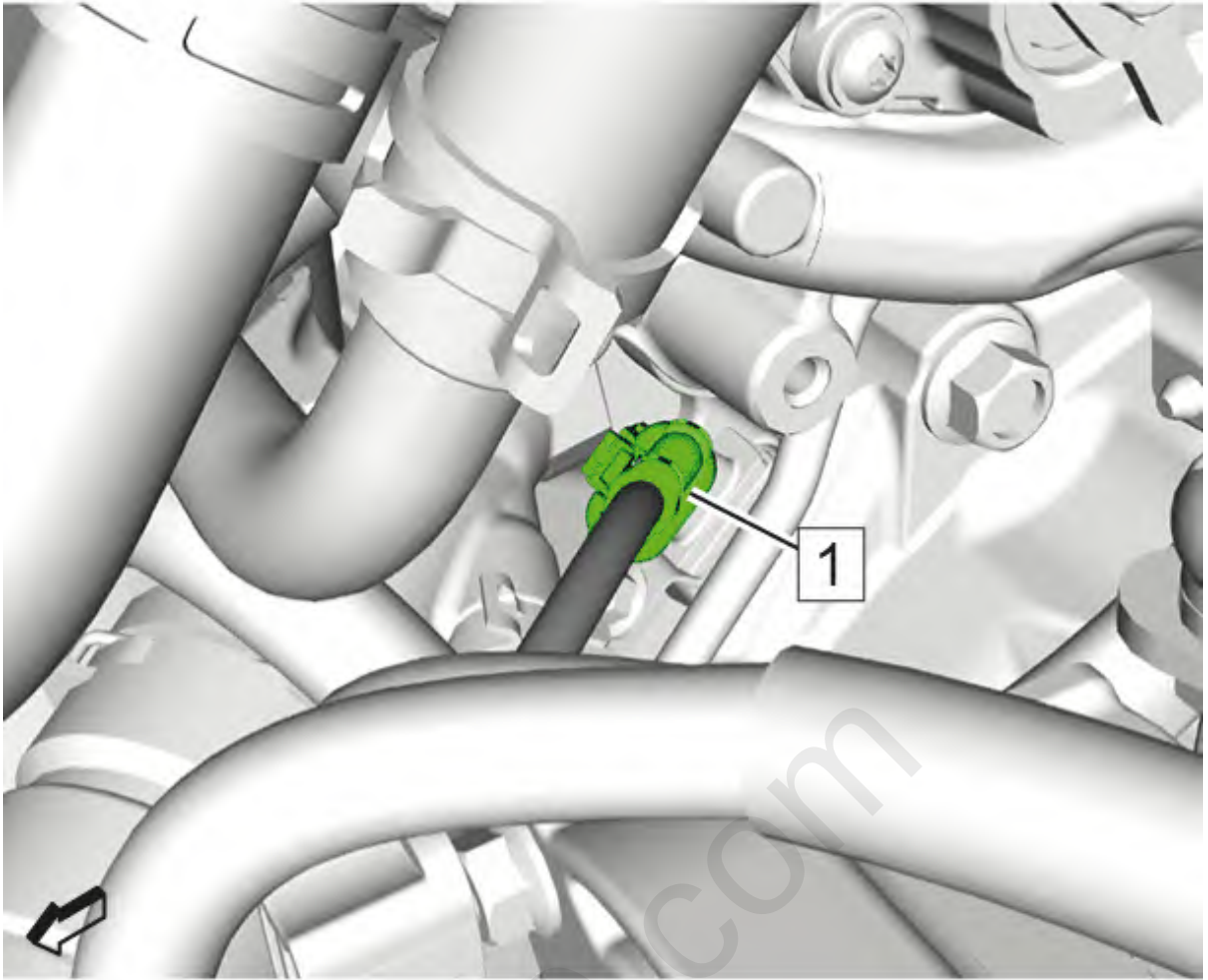


Fig.305: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector. (1)

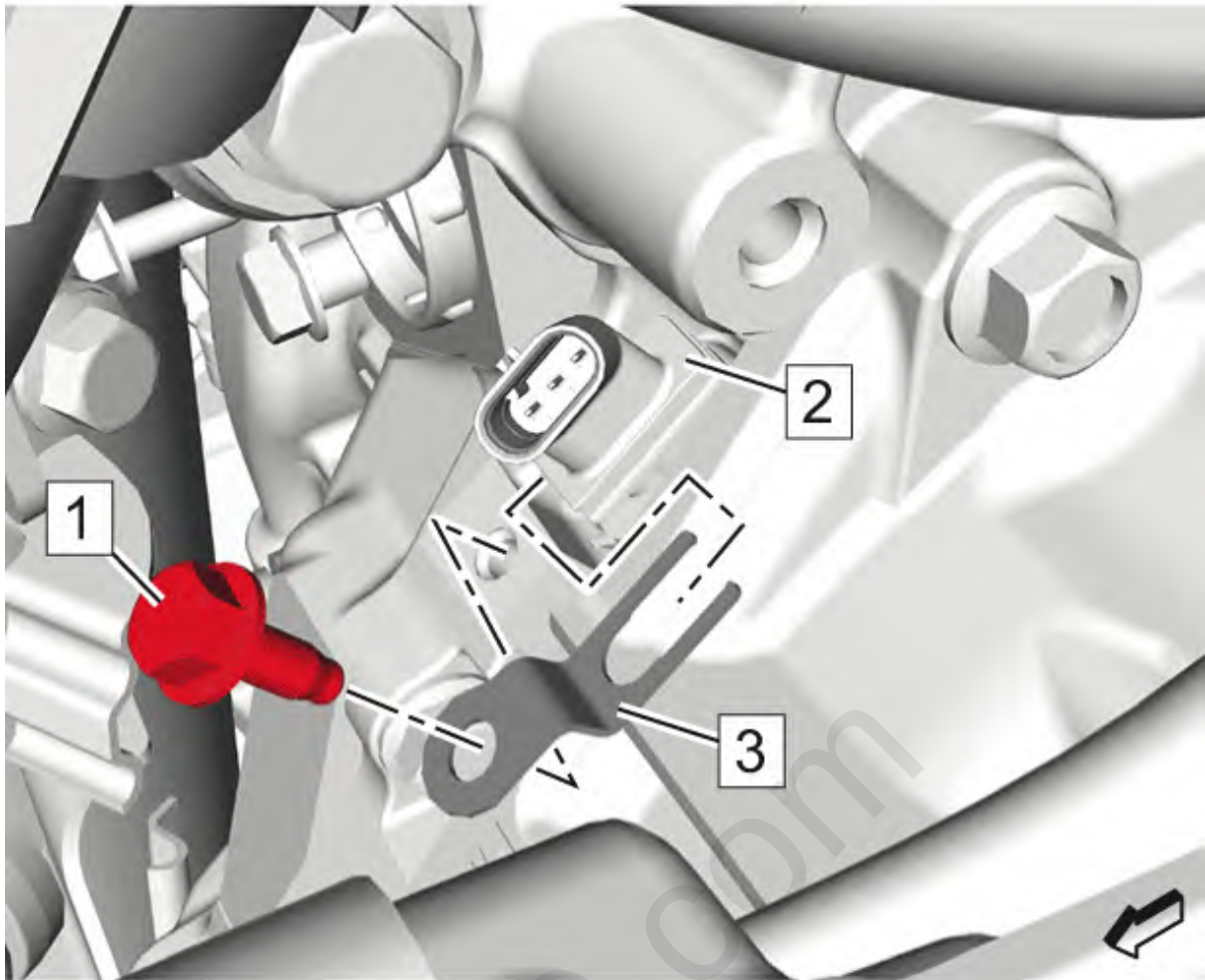


Fig. 306: Crankshaft Position Sensor, Bolt And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

4. Remove Crankshaft Position Sensor Bolt (1)
5. Remove Retainer Spring (3) @ Crankshaft Position Sensor (2)

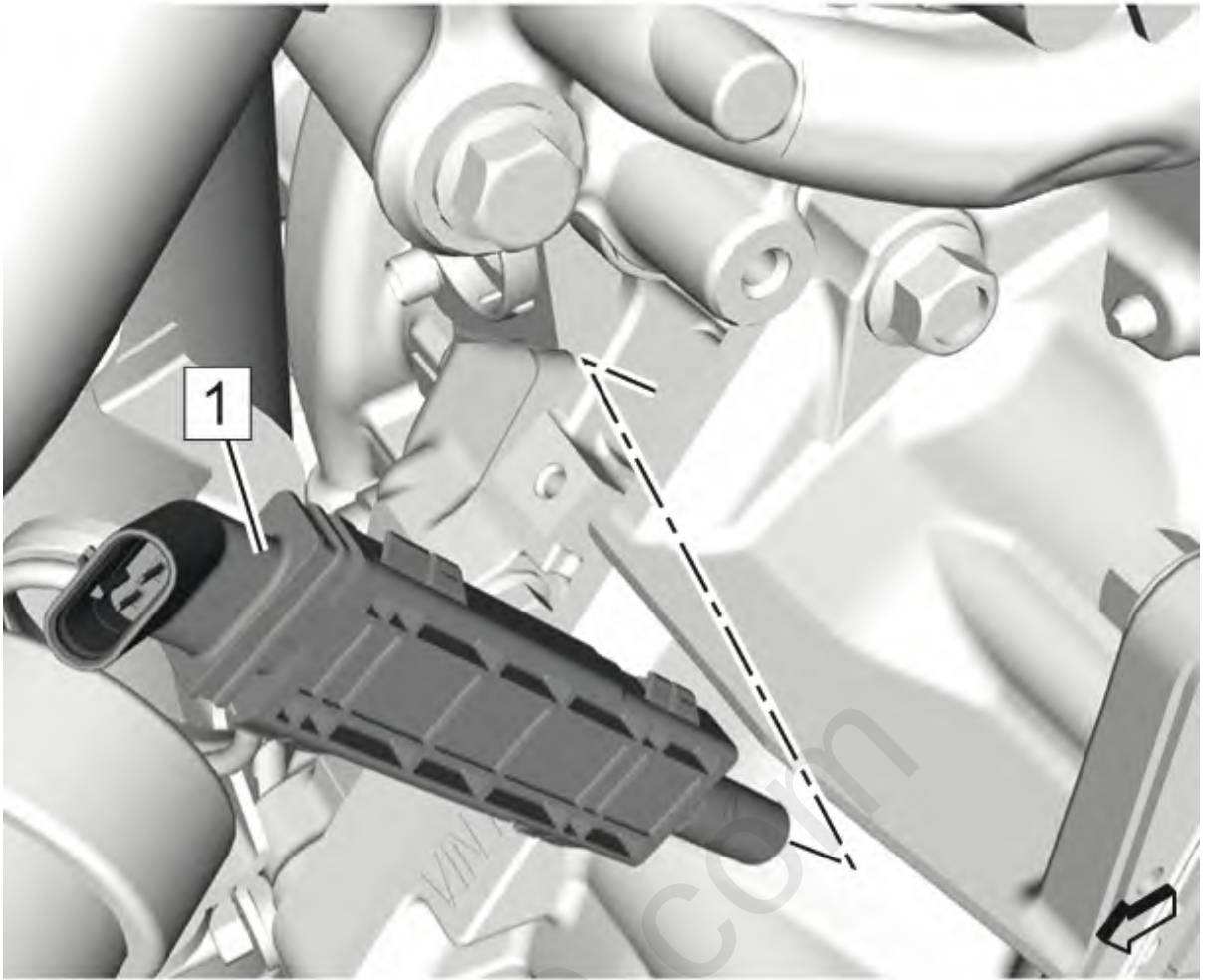


Fig. 307: Crankshaft Position Sensor
Courtesy of GENERAL MOTORS COMPANY

6. Remove Crankshaft Position Sensor (1)

Installation Procedure

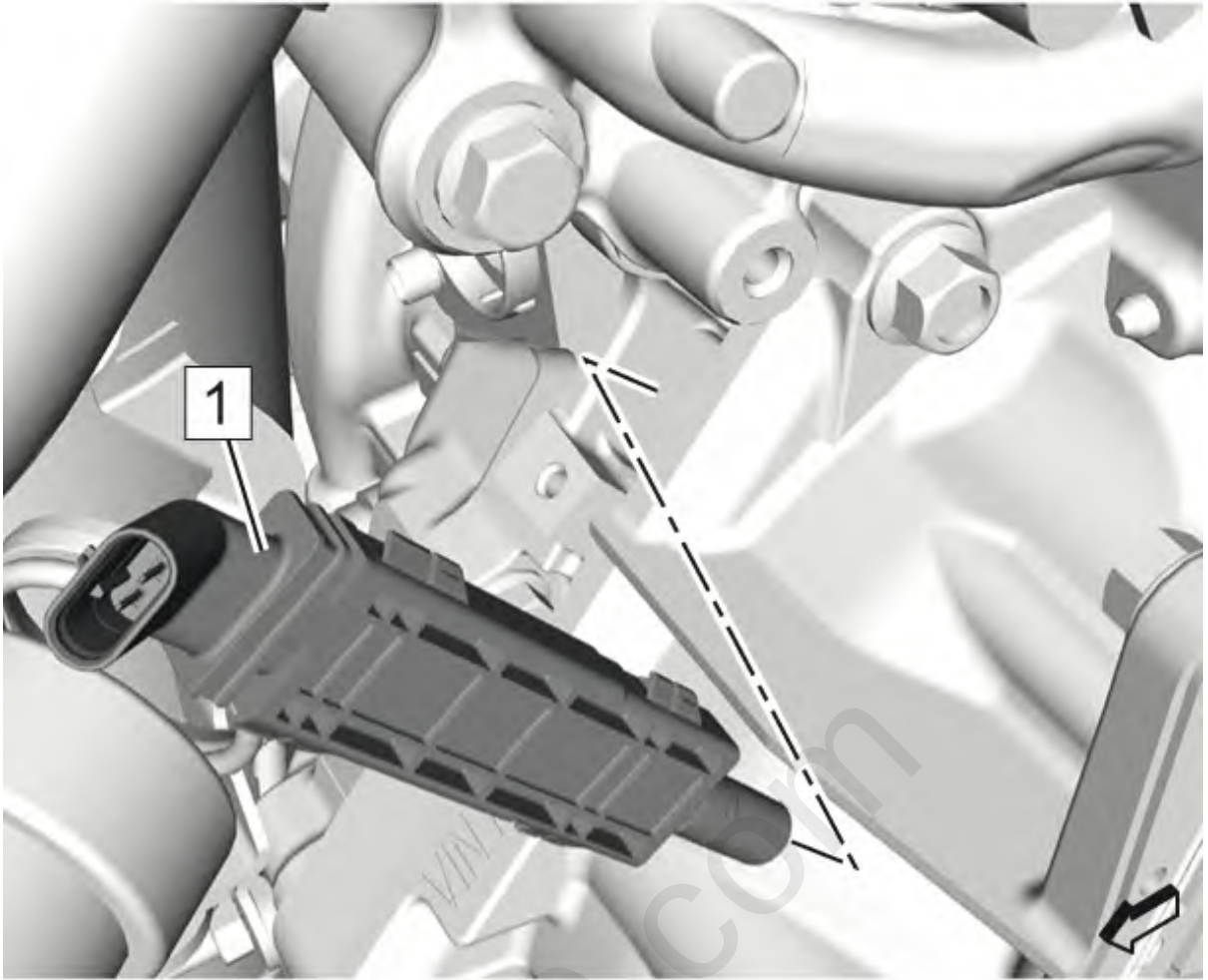


Fig. 308: Crankshaft Position Sensor

Courtesy of GENERAL MOTORS COMPANY

1. Install Crankshaft Position Sensor (1)

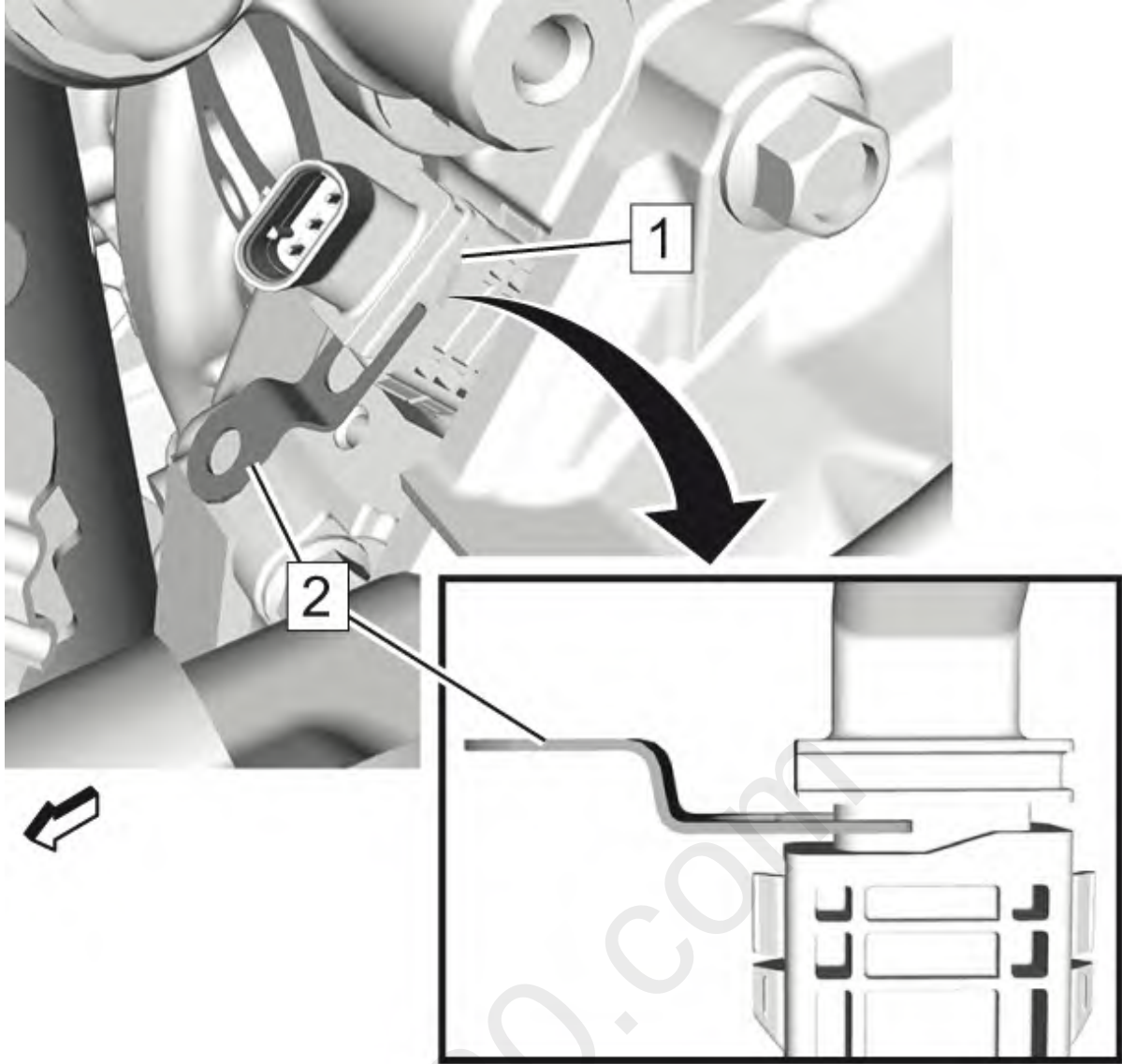


Fig. 309: Crankshaft Position Sensor Retainer Spring Into Correct Channel

Courtesy of GENERAL MOTORS COMPANY

NOTE: Slightly lift the crankshaft position sensor to install the retainer spring.

2. Install the crankshaft position sensor retainer spring (2) into the correct channel (1) of the crankshaft position sensor.

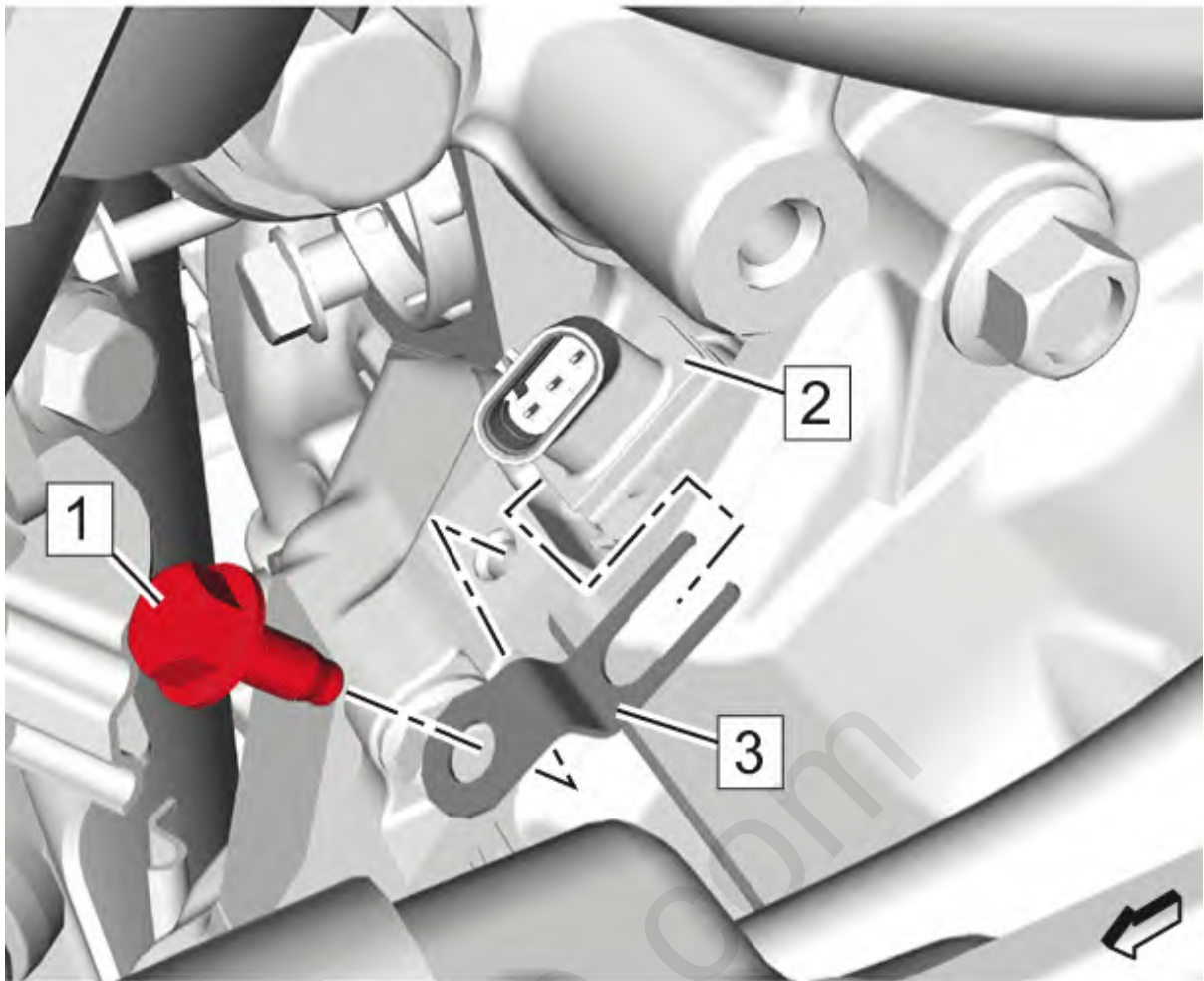


Fig. 310: Crankshaft Position Sensor, Bolt And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Fastener Caution

3. Install and tighten Crankshaft Position Sensor Bolt (1) to 10 N.m (89 lb in)

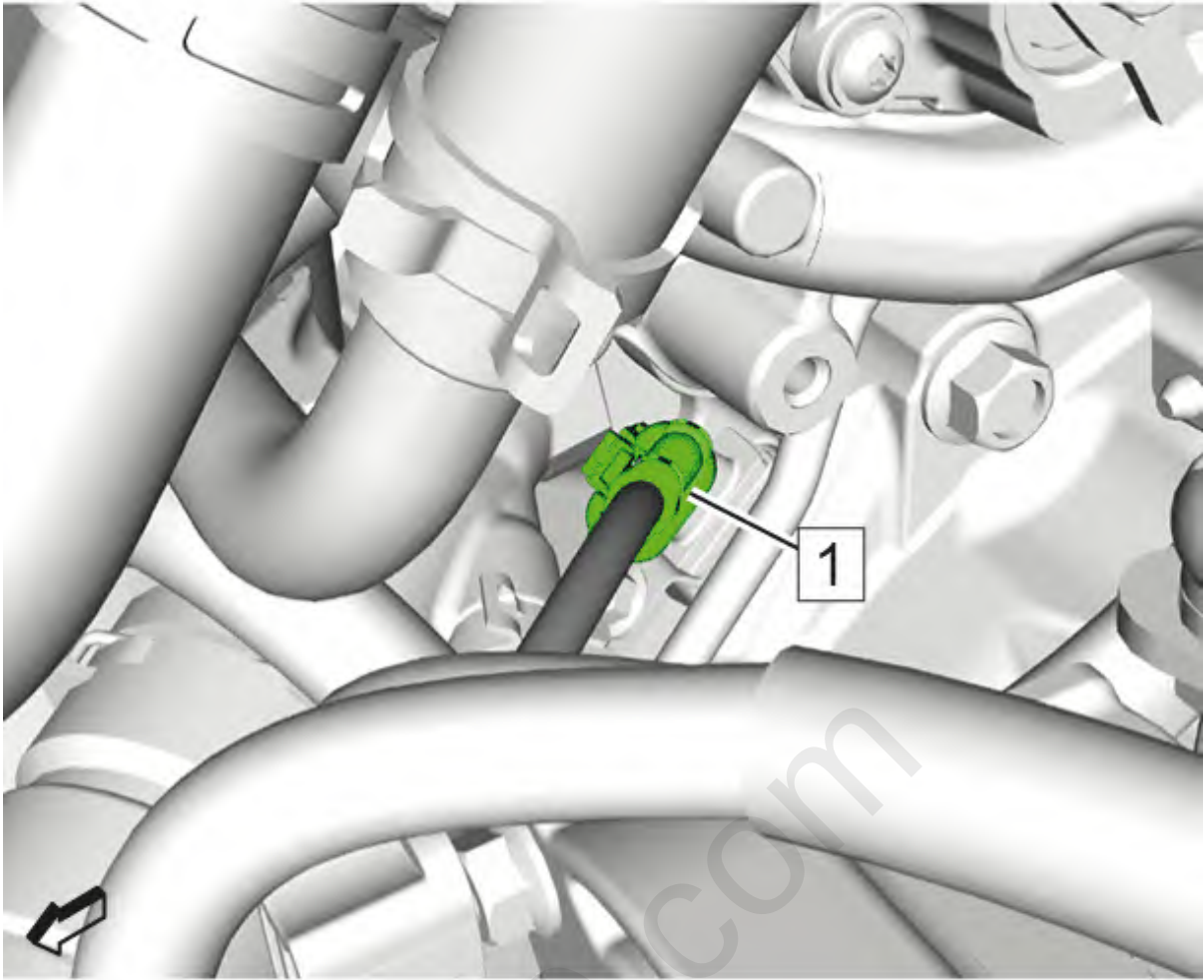


Fig.311: Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

4. Connect the electrical connector. (1)
5. Install Exhaust Gas Recirculation Cooler Housing. Refer to [Exhaust Gas Recirculation Cooler Housing Replacement](#)
6. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
7. Perform the crankshaft position reluctor ring learn. Refer to [Crankshaft Position Variation Learn](#)

CAMSHAFT POSITION SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

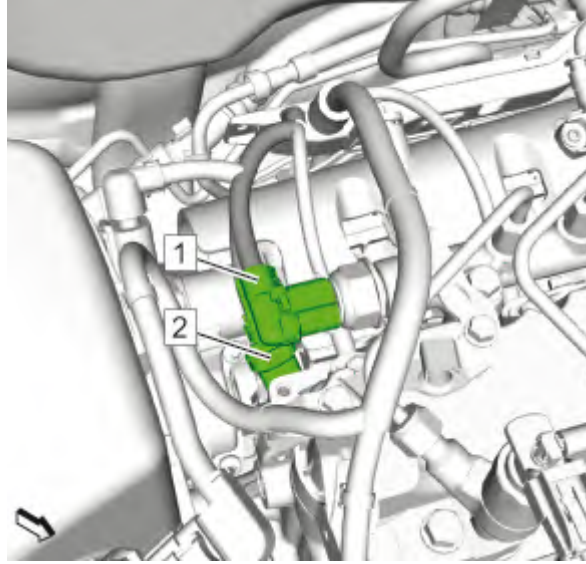


Fig. 312: Electrical Connectors

Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connectors:
 1. Fuel Injection Fuel Rail Fuel Pressure Sensor (1)
 2. Camshaft Position Sensor (2)

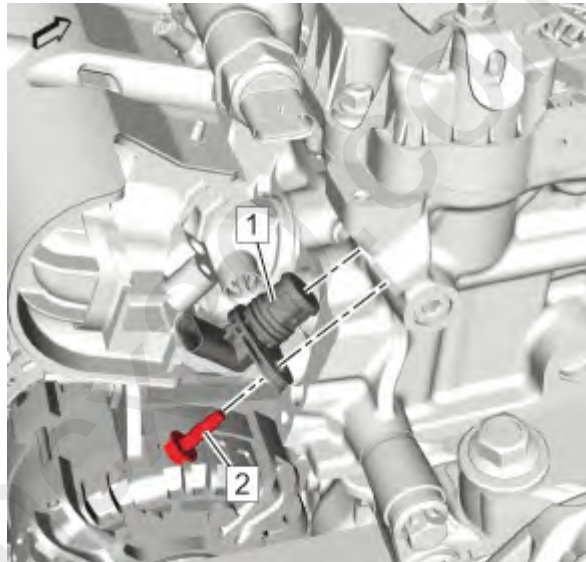


Fig. 313: Camshaft Position Sensor And Bolt

Courtesy of GENERAL MOTORS COMPANY

4. Remove Camshaft Position Sensor Bolt (2)
5. Remove Camshaft Position Sensor (1)

Installation Procedure

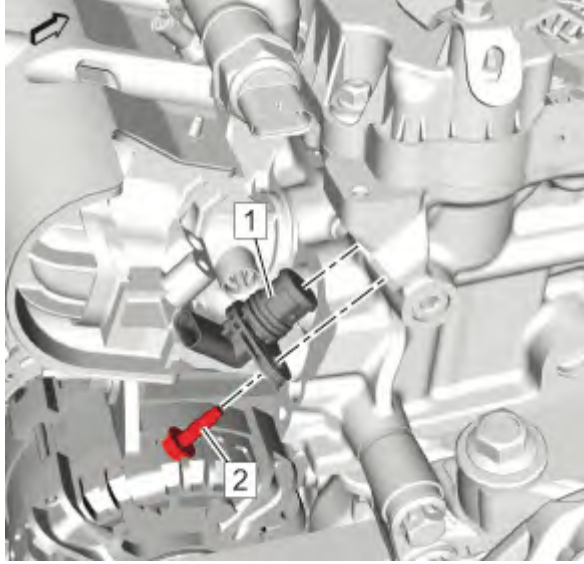


Fig. 314: Camshaft Position Sensor And Bolt
 Courtesy of GENERAL MOTORS COMPANY

1. Install Camshaft Position Sensor (1)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Camshaft Position Sensor Bolt (2) to 10 N.m (89 lb in)

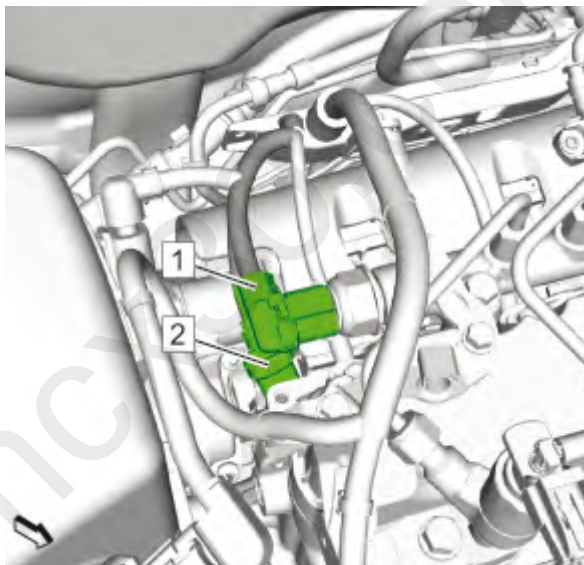


Fig. 315: Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

3. Connect the electrical connector:
 1. Fuel Injection Fuel Rail Fuel Pressure Sensor (1)
 2. Camshaft Position Sensor (2)
4. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
5. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 1

Removal Procedure

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

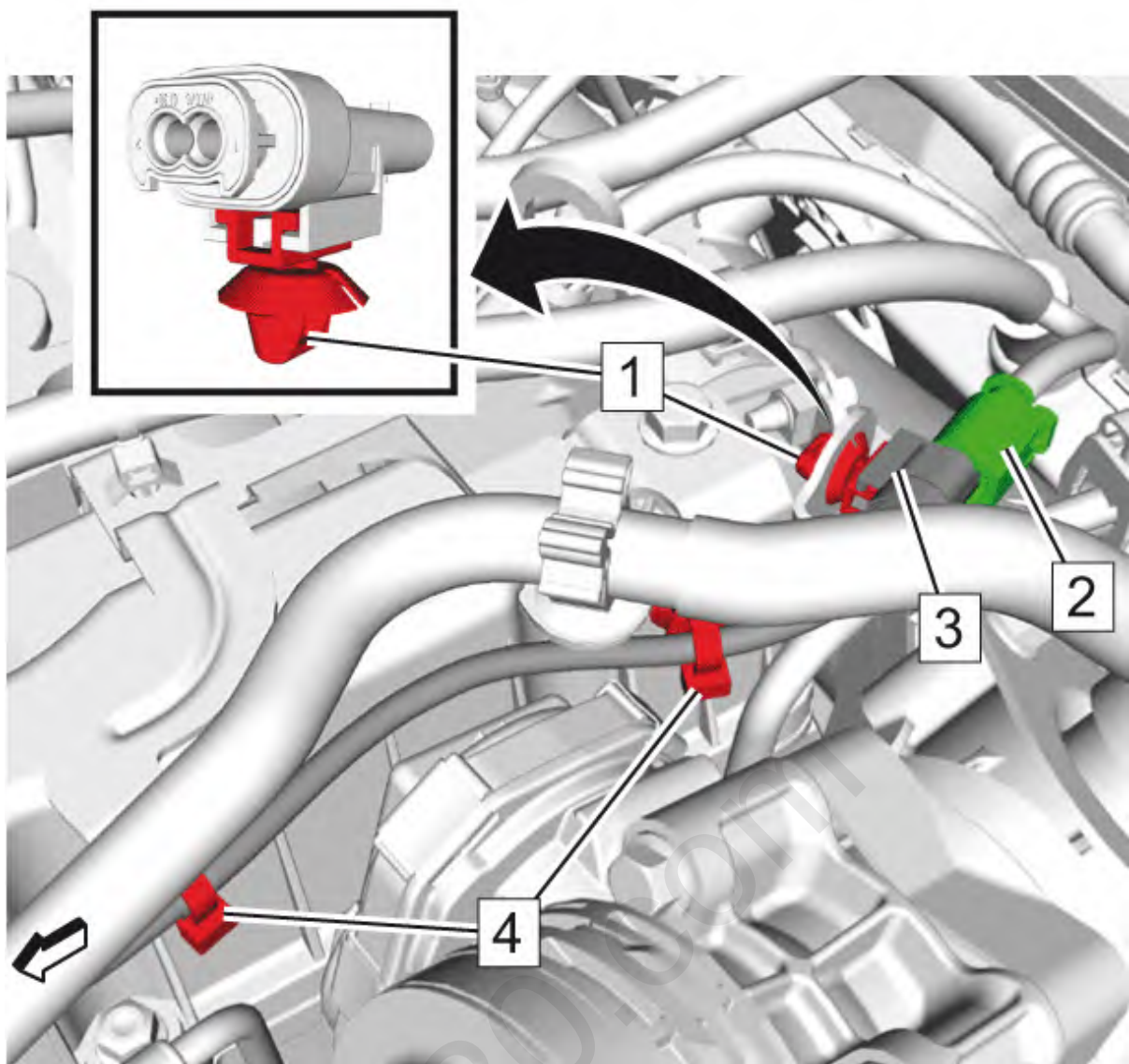


Fig. 316: Exhaust Temperature Sensor Electrical Connector And Retainers
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Exhaust Temperature Sensor Electrical Connector (2)
3. Remove Exhaust Temperature Sensor Electrical Connector (3) @ Wiring Harness Retainer (1)
4. Remove Wiring Harness Retainers (4) (Qty: 2)

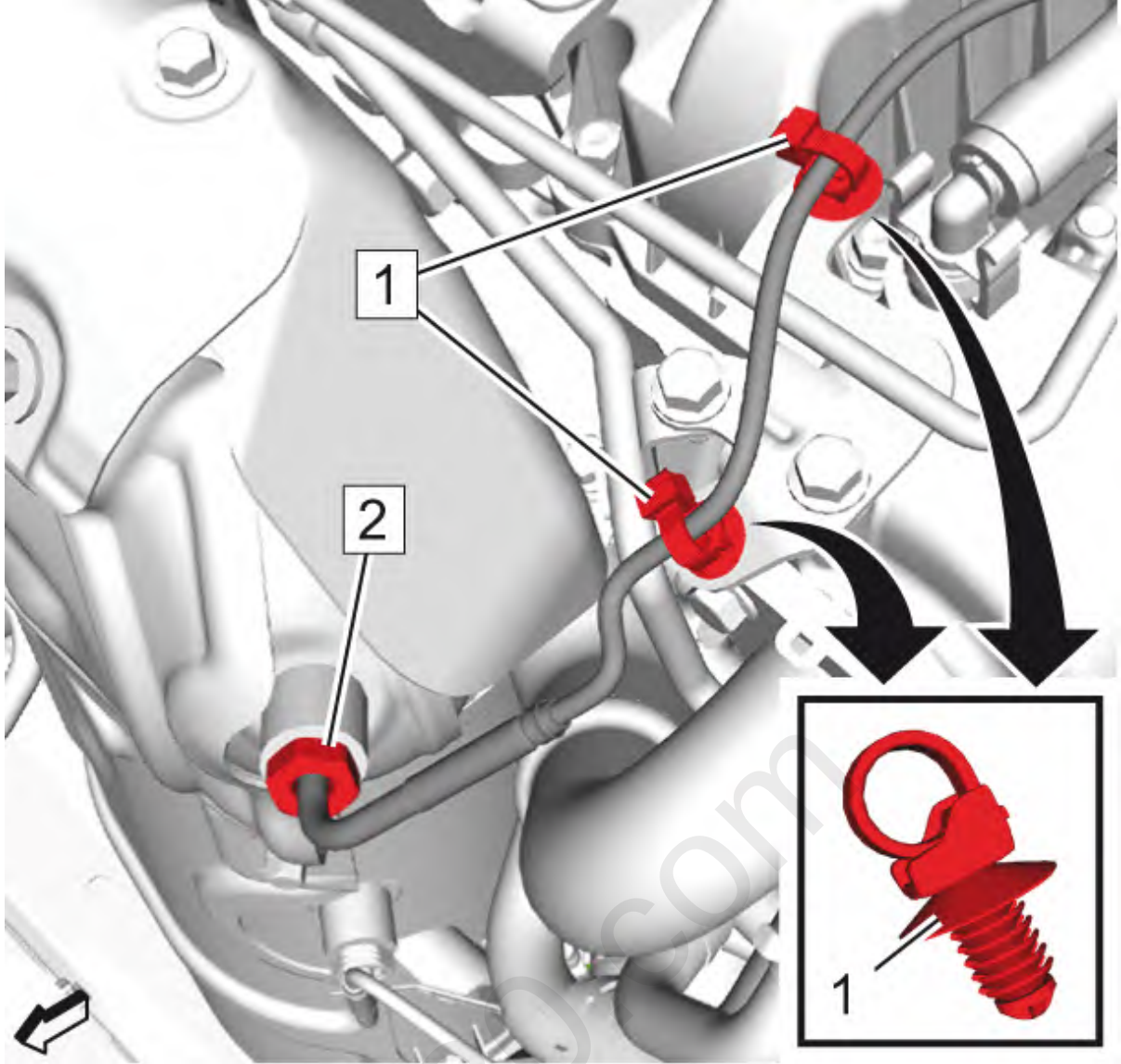


Fig. 317: Exhaust Temperature Sensor - Position 1 And Retainers
Courtesy of GENERAL MOTORS COMPANY

5. Remove Wiring Harness Retainers (1) (Qty: 2)
6. Remove Exhaust Temperature Sensor - Position 1 (2)

Installation Procedure

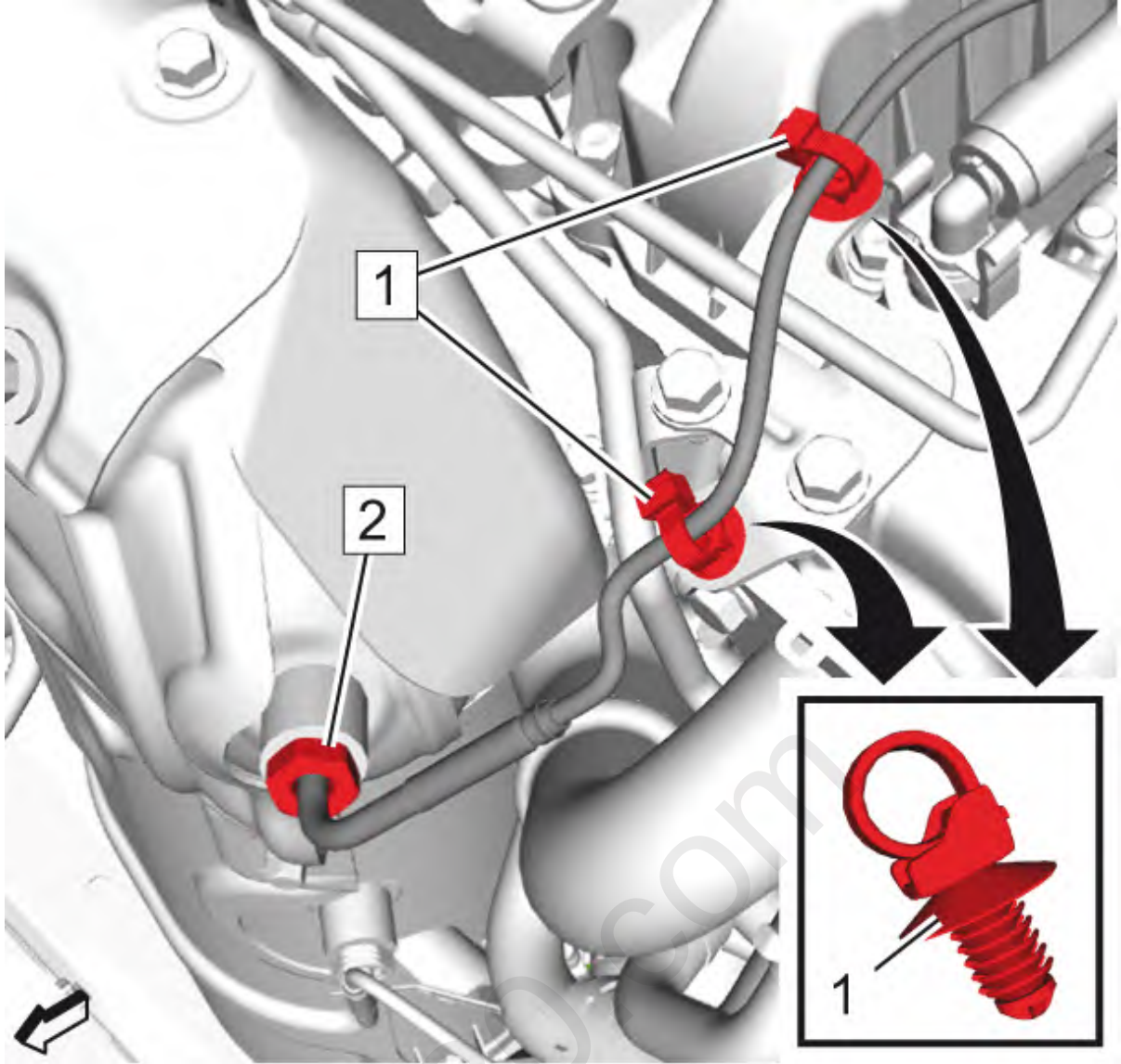


Fig. 318: Exhaust Temperature Sensor - Position 1 And Retainers
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#)

1. Install and tighten Exhaust Temperature Sensor - Position 1 (2) to 45 N.m (33 lb ft)
2. Install Wiring Harness Retainers (1) (Qty: 2)

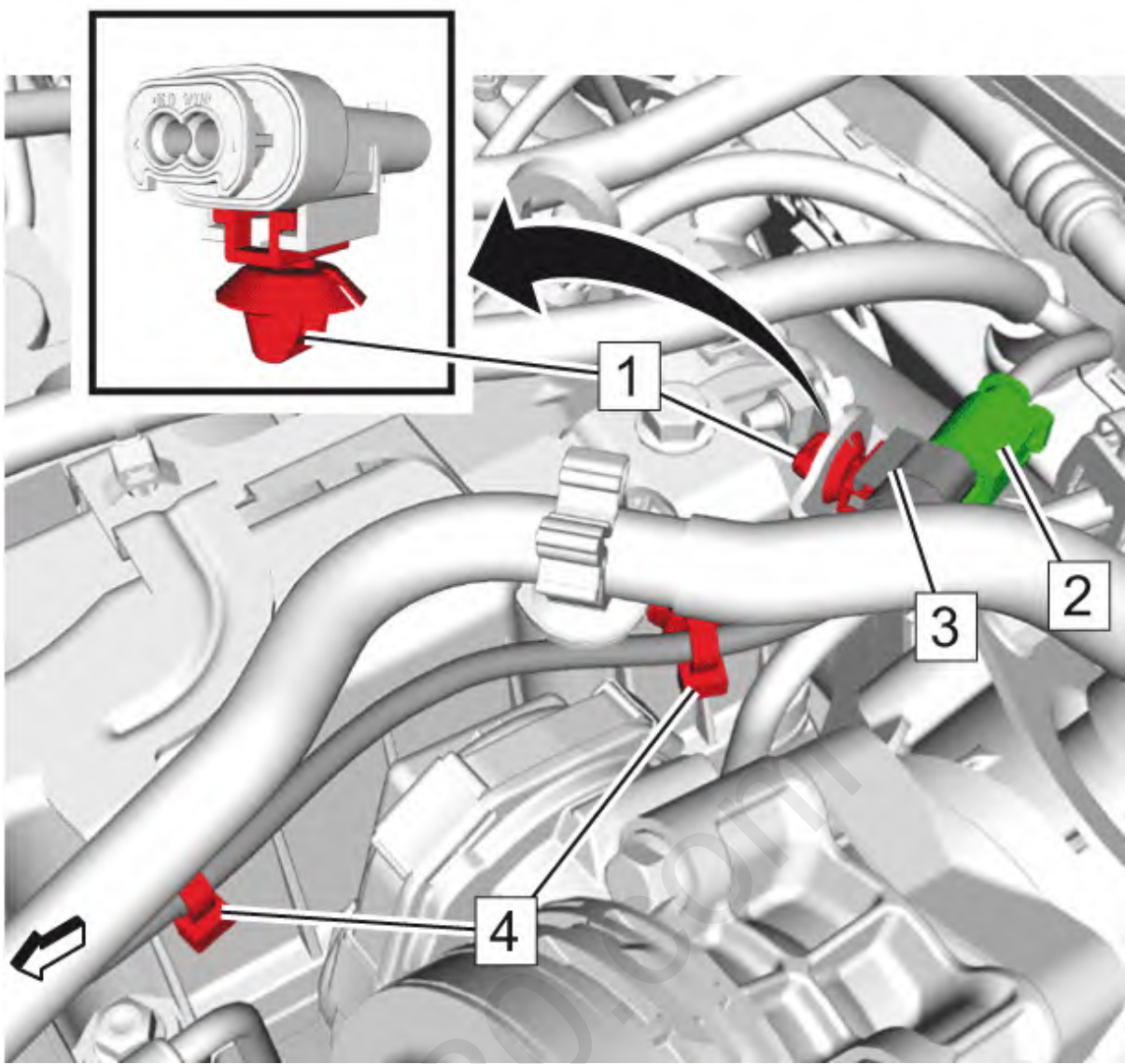


Fig.319: Exhaust Temperature Sensor Electrical Connector And Retainers
 Courtesy of GENERAL MOTORS COMPANY

3. Install Wiring Harness Retainers (4) (Qty: 2)
4. Install Exhaust Temperature Sensor Electrical Connector (3) @ Wiring Harness Retainer (1)
5. Connect Exhaust Temperature Sensor Electrical Connector (2)
6. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
7. If replacing, perform the exhaust gas temperature sensor reset. Refer to [Exhaust Gas Temperature Sensor Reset](#)
8. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 2

Removal Procedure

WARNING: Refer to [Exhaust Service Warning](#)

WARNING: Refer to [Protective Goggles and Glove Warning](#)

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

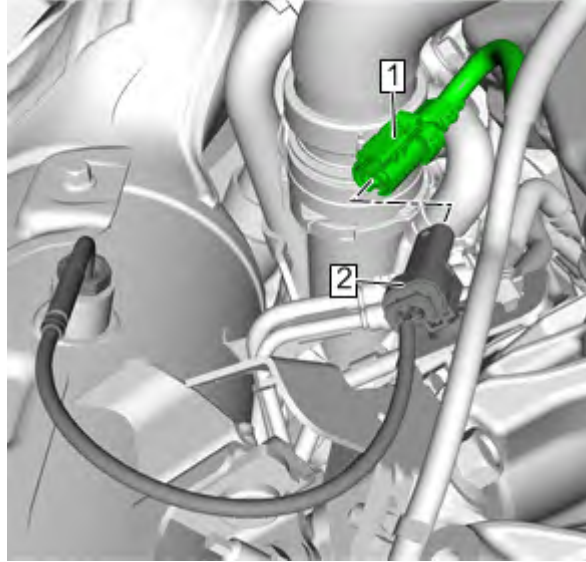


Fig. 320: Electrical Connector And Exhaust Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect Electrical Connector (1) @ Exhaust Temperature Sensor (2)

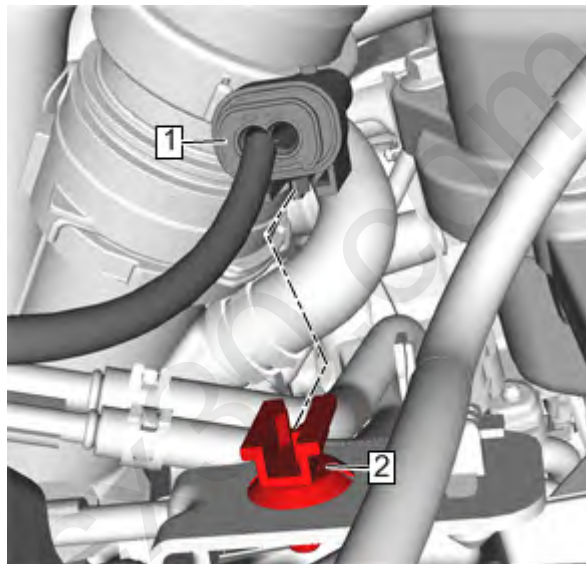


Fig. 321: Exhaust Temperature Sensor And Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Unclip Exhaust Temperature Sensor (1) @ Retainer (2)

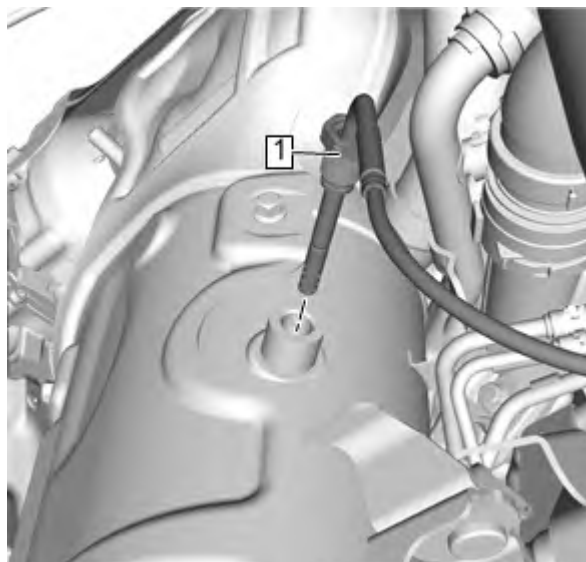


Fig. 322: Exhaust Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

5. Remove Exhaust Temperature Sensor (1)

Installation Procedure

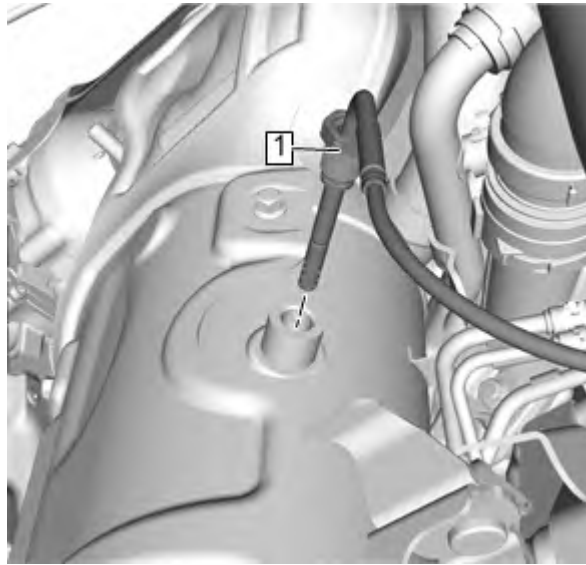


Fig. 323: Exhaust Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#)

1. Install and tighten Exhaust Temperature Sensor (1) to 45 N.m (33 lb ft)

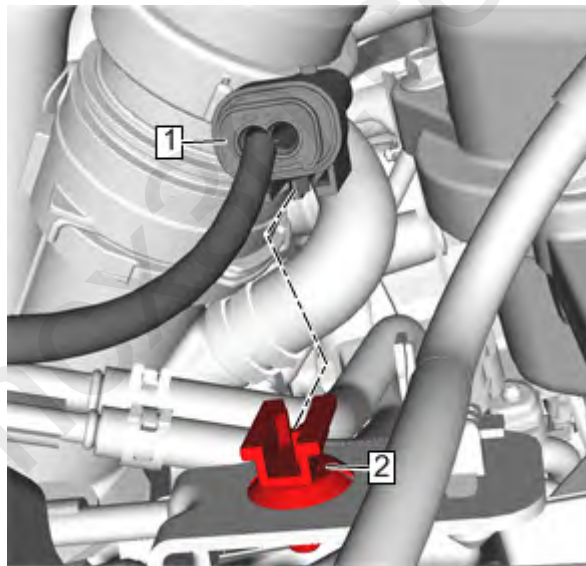


Fig. 324: Exhaust Temperature Sensor And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Install Exhaust Temperature Sensor (1) @ Retainer (2)

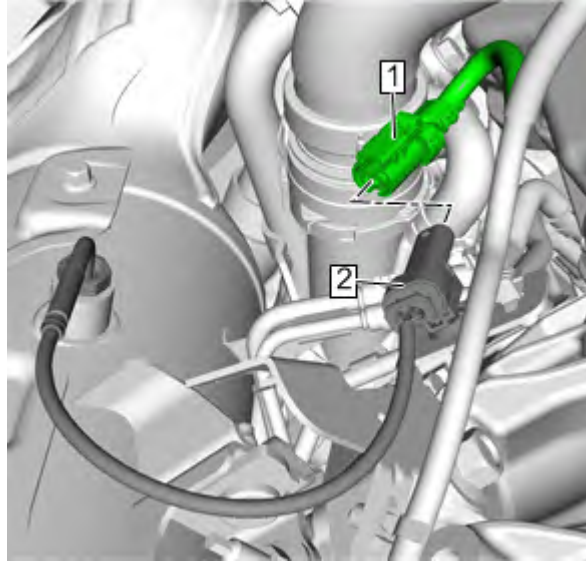


Fig. 325: Electrical Connector And Exhaust Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

3. Connect Electrical Connector (1) @ Exhaust Temperature Sensor (2)
4. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
6. If replacing, perform the exhaust gas temperature sensor reset. Refer to [Exhaust Gas Temperature Sensor Reset](#)
7. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 3

Removal Procedure

WARNING: Refer to [Exhaust Service Warning](#)

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

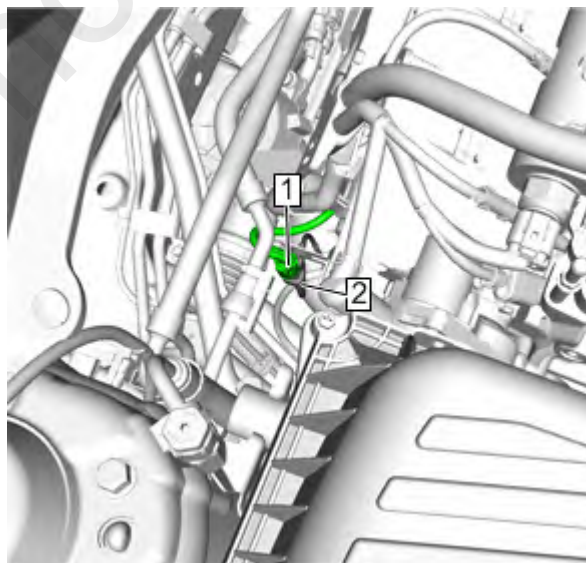


Fig. 326: Electrical Connector And Exhaust Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1) @ Exhaust Temperature Sensor (2)
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

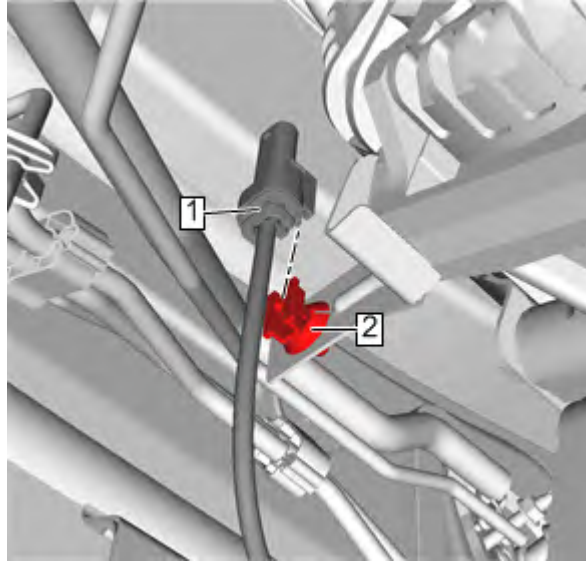


Fig. 327: Exhaust Temperature Sensor And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Unclip Exhaust Temperature Sensor (1) @ Retainer (2)

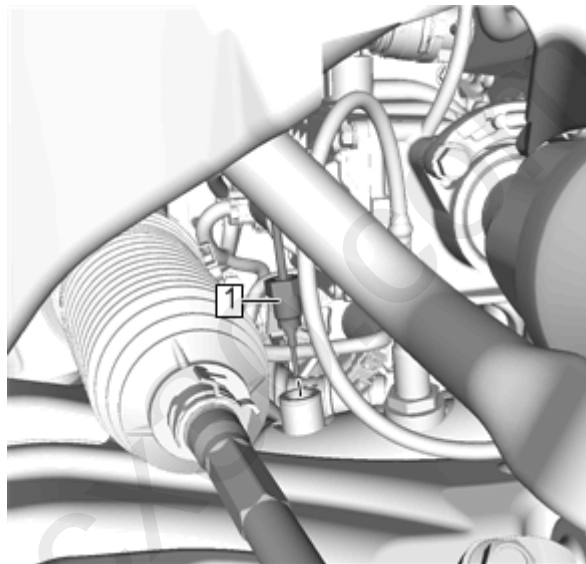
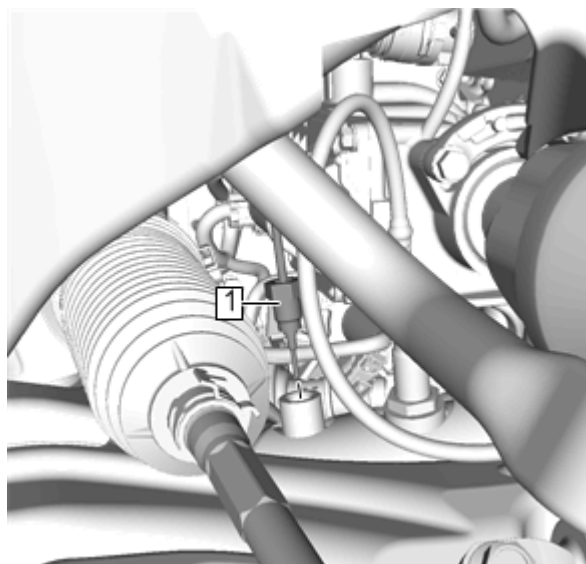


Fig. 328: Exhaust Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

5. Remove Exhaust Temperature Sensor (1)

Installation Procedure



CAUTION: Refer to [Component Fastener Tightening Caution](#)

1. Install and tighten Exhaust Temperature Sensor (1) to 45 N.m (33 lb ft)

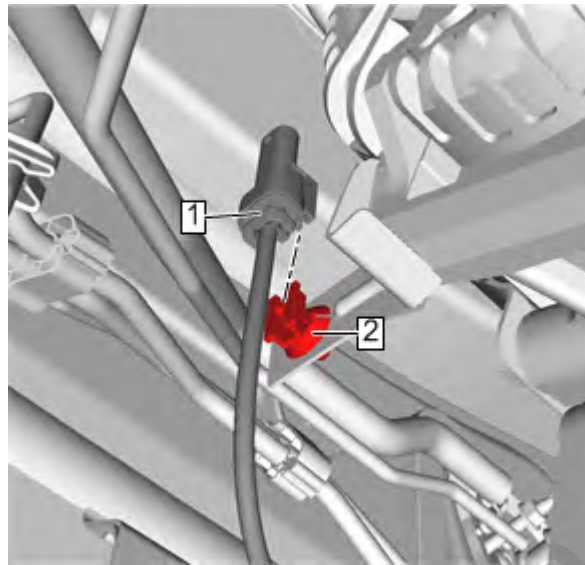


Fig. 330: Exhaust Temperature Sensor And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Install Exhaust Temperature Sensor (1) @ Retainer (2)
3. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

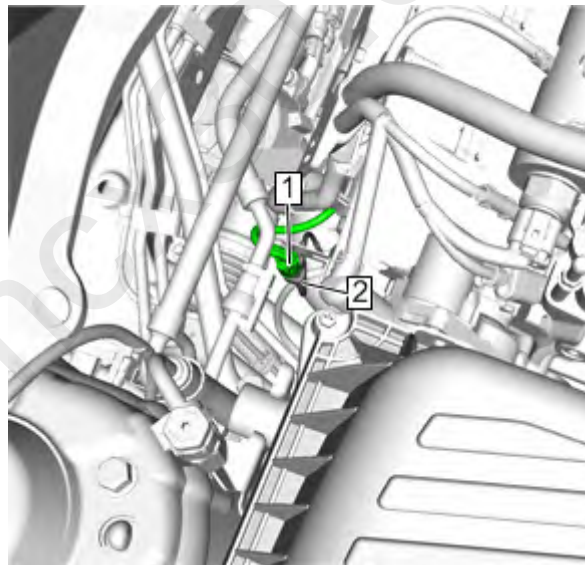


Fig. 331: Electrical Connector And Exhaust Temperature Sensor
Courtesy of GENERAL MOTORS COMPANY

4. Connect Electrical Connector (1) @ Exhaust Temperature Sensor (2)
5. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
6. If replacing, perform the exhaust gas temperature sensor reset. Refer to [Exhaust Gas Temperature Sensor Reset](#)
7. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

EXHAUST PARTICULATE SENSOR REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove the right front tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#)

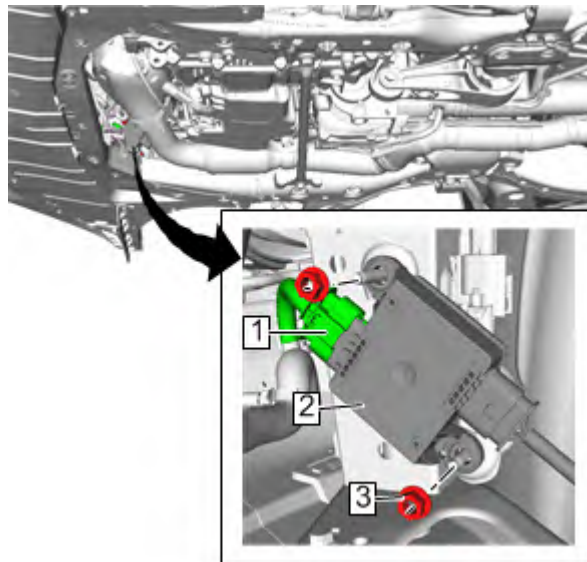


Fig. 332: Electrical Connector, Exhaust Particulate Sensor Control Module And Bracket Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not bend the exhaust flex pipe more than 10 degrees in any direction. Bending of more than 10 degrees or twisting in a range of ± 0.5 degrees will damage the exhaust flex decoupler.

4. Disconnect Electrical Connector (1) @ Exhaust Particulate Sensor Control Module (2)

NOTE: Secure the exhaust particulate sensor control module from falling down in order to prevent a defect on the control module.

5. Remove Exhaust Particulate Sensor Control Module Bracket Nuts (3) (Qty: 2)

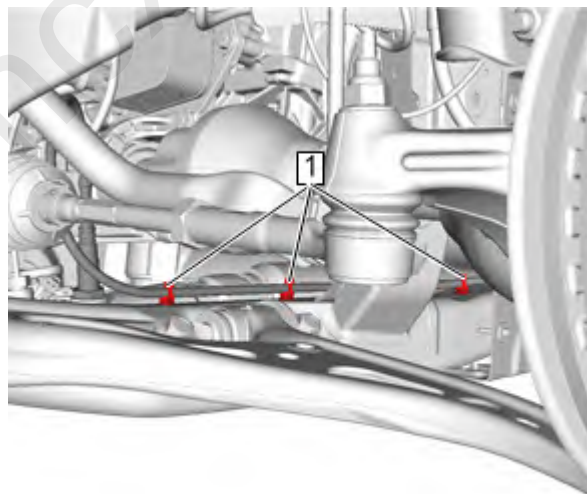


Fig. 333: Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

6. Remove Wiring Harness Retainers (1) (Qty: 3) @ Drivetrain and Front Suspension Cradle

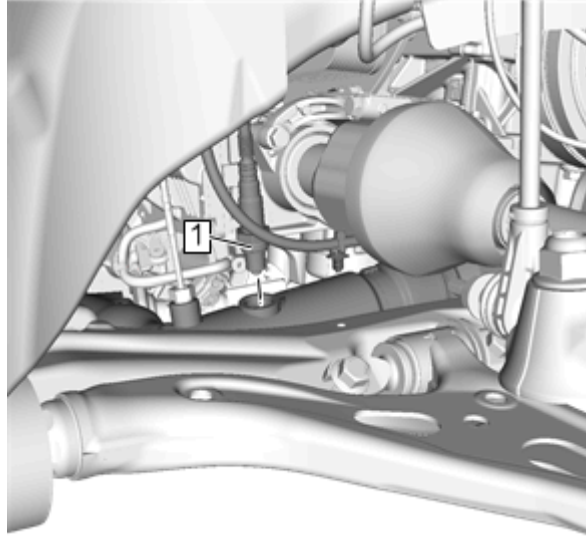


Fig. 334: Exhaust Particulate Sensor

Courtesy of GENERAL MOTORS COMPANY

NOTE: Do NOT bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position.

7. Remove Exhaust Particulate Sensor (1)

Installation Procedure

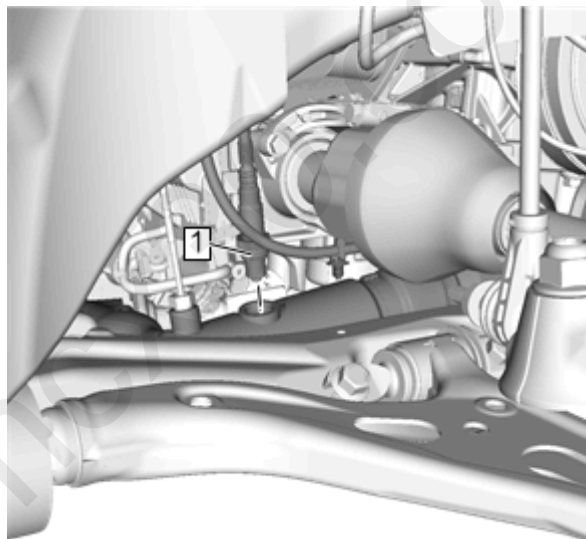


Fig. 335: Exhaust Particulate Sensor

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not bend the exhaust flex pipe more than 10 degrees in any direction. Bending of more than 10 degrees or twisting in a range of ± 0.5 degrees will damage the exhaust flex decoupler.

CAUTION: Refer to [Component Fastener Tightening Caution](#)

NOTE: Do NOT bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position.

1. Install and tighten Exhaust Particulate Sensor (1) to 45 N.m (33 lb ft)

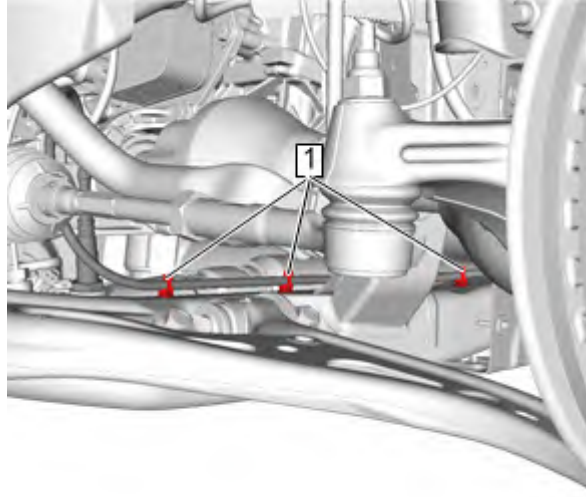


Fig. 336: Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Install Wiring Harness Retainers (1) (Qty: 3) @ Drivetrain and Front Suspension Cradle

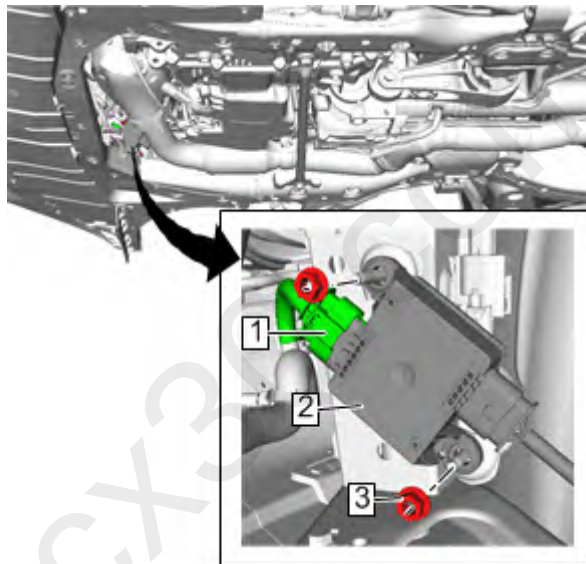


Fig. 337: Electrical Connector, Exhaust Particulate Sensor Control Module And Bracket Nuts

Courtesy of GENERAL MOTORS COMPANY

3. Install Exhaust Particulate Sensor Control Module (2)

CAUTION: Refer to Fastener Caution .

4. Install and tighten Exhaust Particulate Sensor Control Module Bracket Nuts (3) (Qty: 2) to 9 N.m (80 lb in)
5. Connect Electrical Connector (1) @ Exhaust Particulate Sensor Control Module (2)
6. Install the right front tire and wheel assembly. Refer to Tire and Wheel Removal and Installation
7. Remove the supports and lower the vehicle. Refer to Lifting and Jacking the Vehicle
8. Connect the battery negative cable. Refer to Battery Negative Cable Disconnection and Connection (KL9).
9. When the replacement is completed, use a scan tool to perform the appropriate reset functions. Refer to Control Module References

EXHAUST PRESSURE DIFFERENTIAL SENSOR REPLACEMENT

Removal Procedure

1. Remove Engine Control Module. Refer to [Engine Control Module Replacement](#)

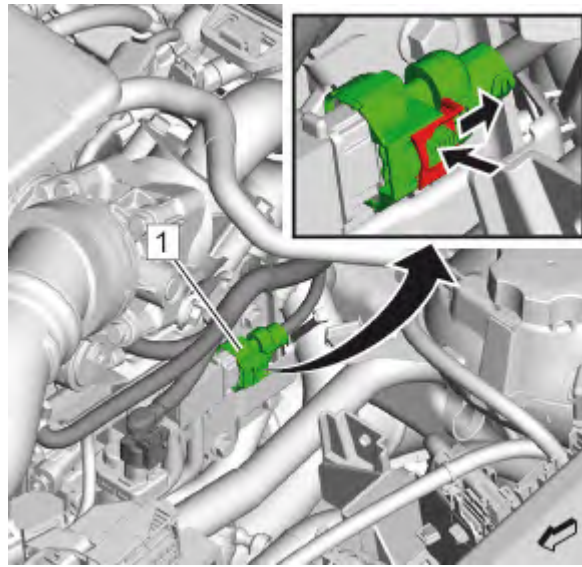


Fig. 338: Exhaust Pressure Differential Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1) @ Exhaust Pressure Differential Sensor

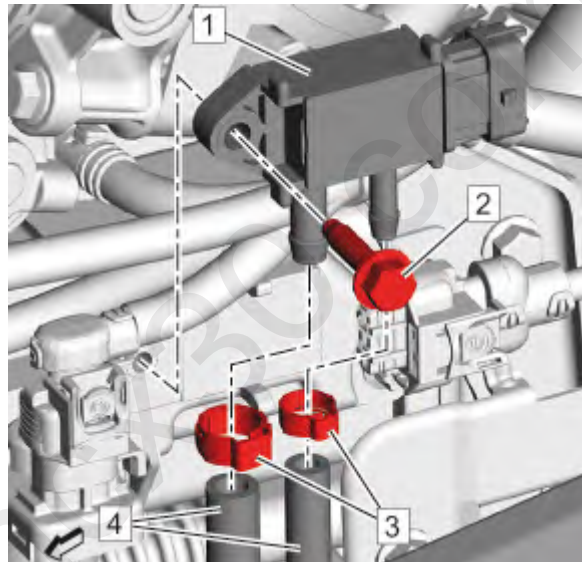


Fig. 339: Exhaust Pressure Differential Sensor, Bolt, Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

3. Remove the exhaust pressure sensor hose clamps. (3) (Qty: 2)

NOTE: Mind the difference hose diameters.

4. Remove the exhaust pressure sensor hoses. (4) (Qty: 2)
5. Remove Exhaust Pressure Differential Sensor Bolt (2)
6. Remove Exhaust Pressure Differential Sensor (1)

Installation Procedure

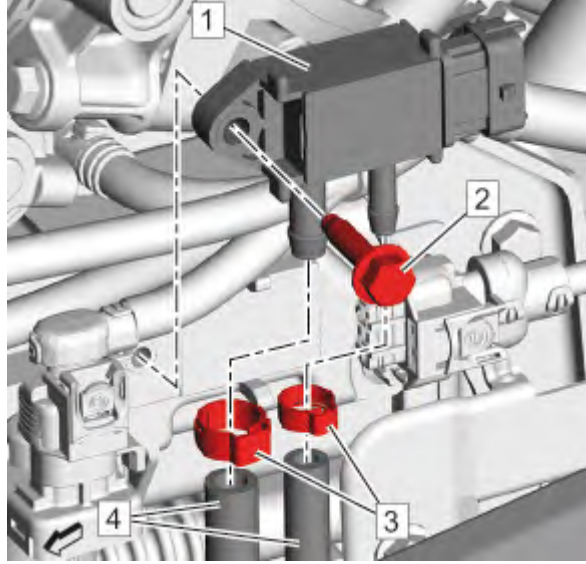


Fig. 340: Exhaust Pressure Differential Sensor, Bolt, Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

1. Install Exhaust Pressure Differential Sensor (1)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Exhaust Pressure Differential Sensor Bolt (2) to 9 N.m (80 lb in)

NOTE: Mind the difference hose diameters.

3. Install Exhaust Pressure Sensor Hoses (4) (Qty: 2)
4. Install Exhaust Pressure Sensor Hose Clamps (1) (Qty: 3)

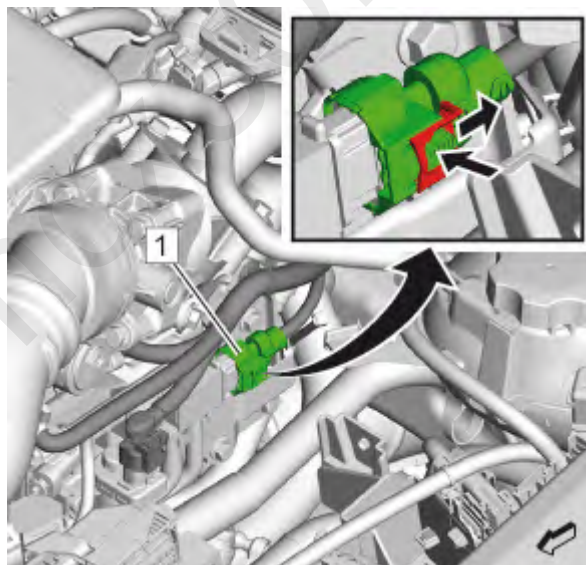


Fig. 341: Exhaust Pressure Differential Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Connect Electrical Connector (1) @ Exhaust Pressure Differential Sensor
6. Install Engine Control Module. Refer to [Engine Control Module Replacement](#)
7. If replacing, perform the DPF pressure sensor reset. Refer to [DPF Pressure Sensor Reset](#)

EXHAUST GAS RECIRCULATION VALVE REPLACEMENT

Removal Procedure

1. Remove the throttle body assembly. Refer to [Throttle Body Assembly Replacement](#).

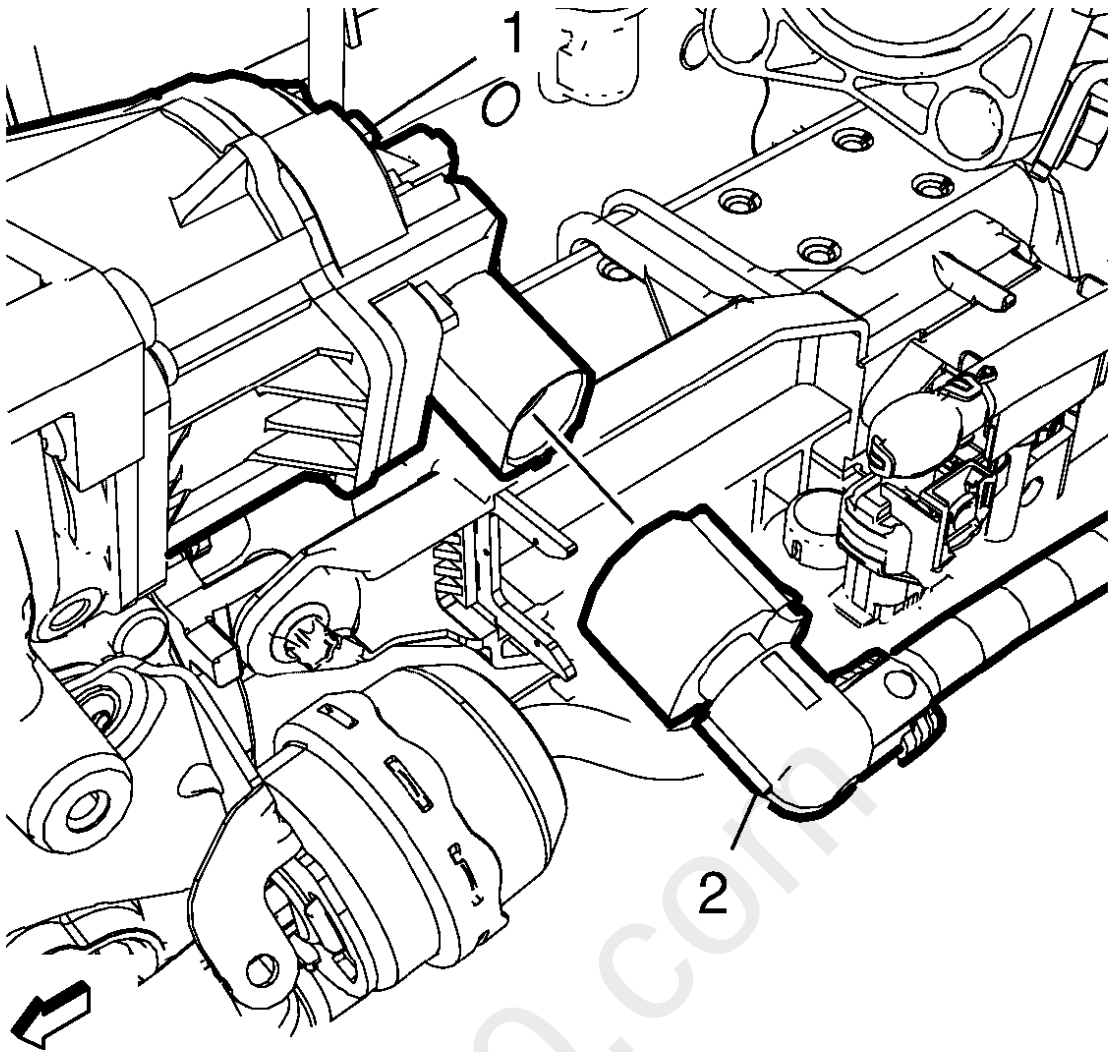


Fig. 342: Exhaust Gas Recirculation (EGR) Valve And Wiring Harness Plug
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the exhaust gas recirculation (EGR) valve wiring harness plug (2) from the EGR valve (1).

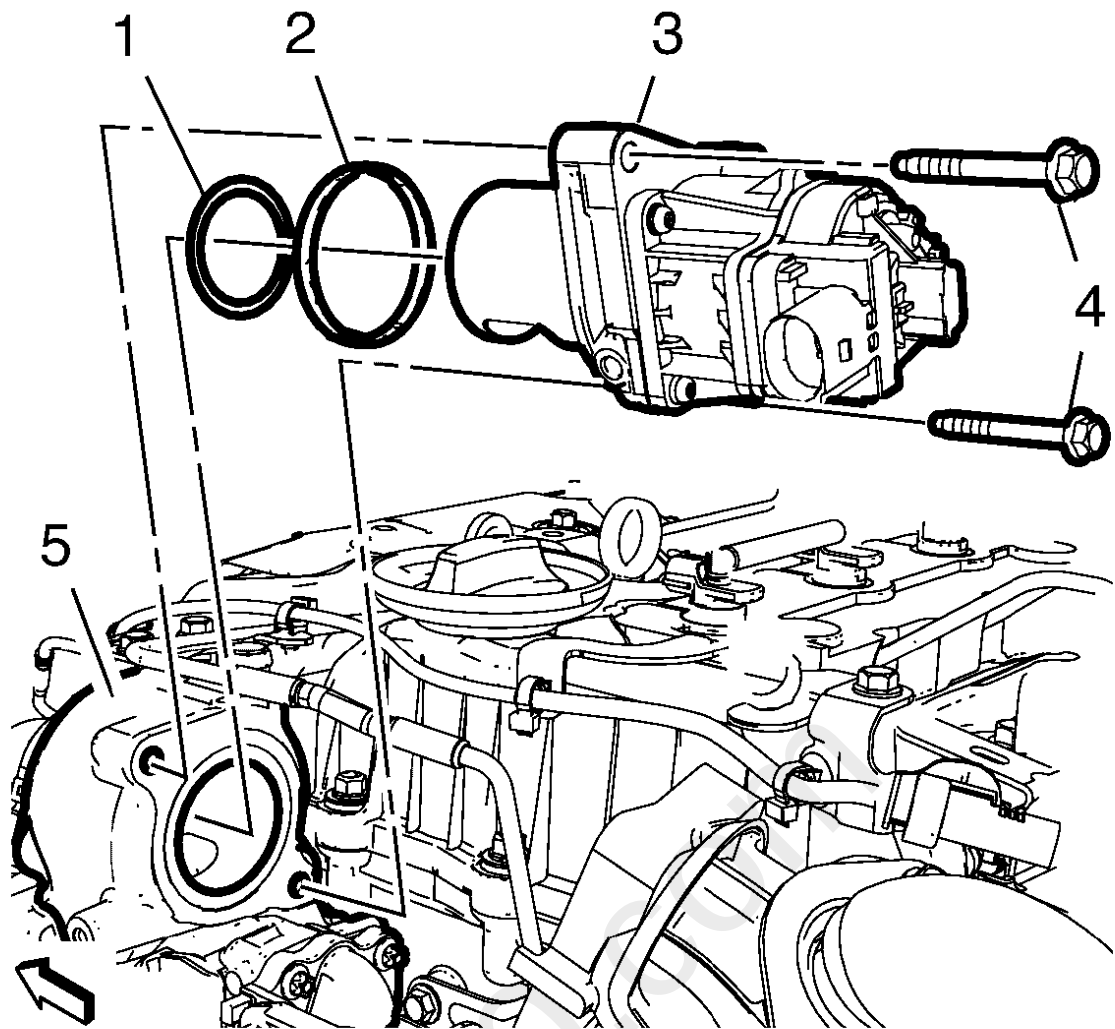


Fig. 343: EGR Valve, EGR Cooler Housing, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

3. Remove the 2 EGR valve bolts (4).
4. Remove the EGR valve (3) from the EGR cooler housing (5).
5. Remove and DISCARD the EGR valve gasket (2).
6. Remove and DISCARD the EGR valve seat gasket (1).

Installation Procedure

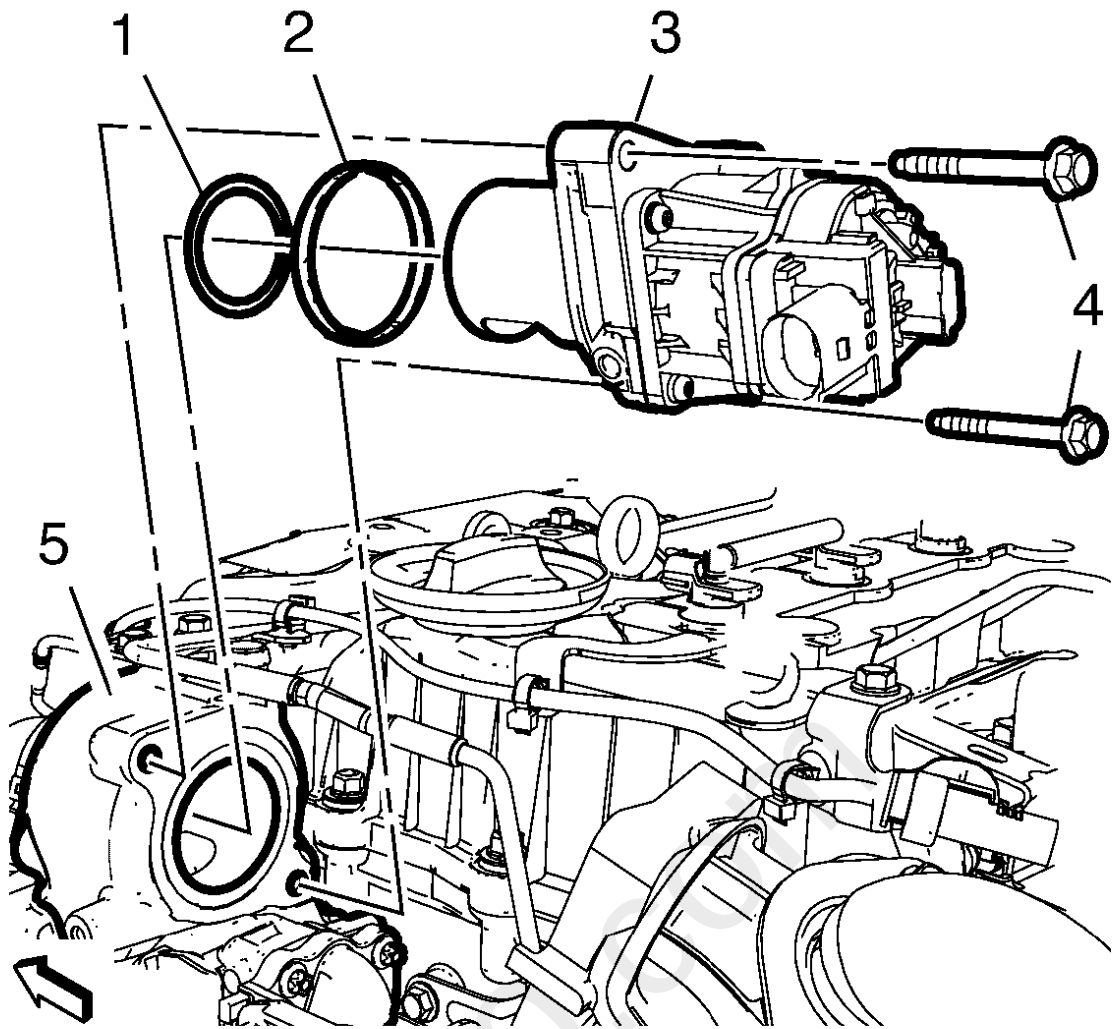


Fig. 344: EGR Valve, EGR Cooler Housing, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW EGR valve seat gasket (1) into the EGR cooler housing (5).
2. Install a NEW EGR valve gasket (2).
3. Install the EGR valve (3) to the EGR cooler housing (5).

CAUTION: Refer to [Fastener Caution](#) .

4. Install the 2 EGR valve bolts (4) and tighten to 10 N.m (89 lb in).

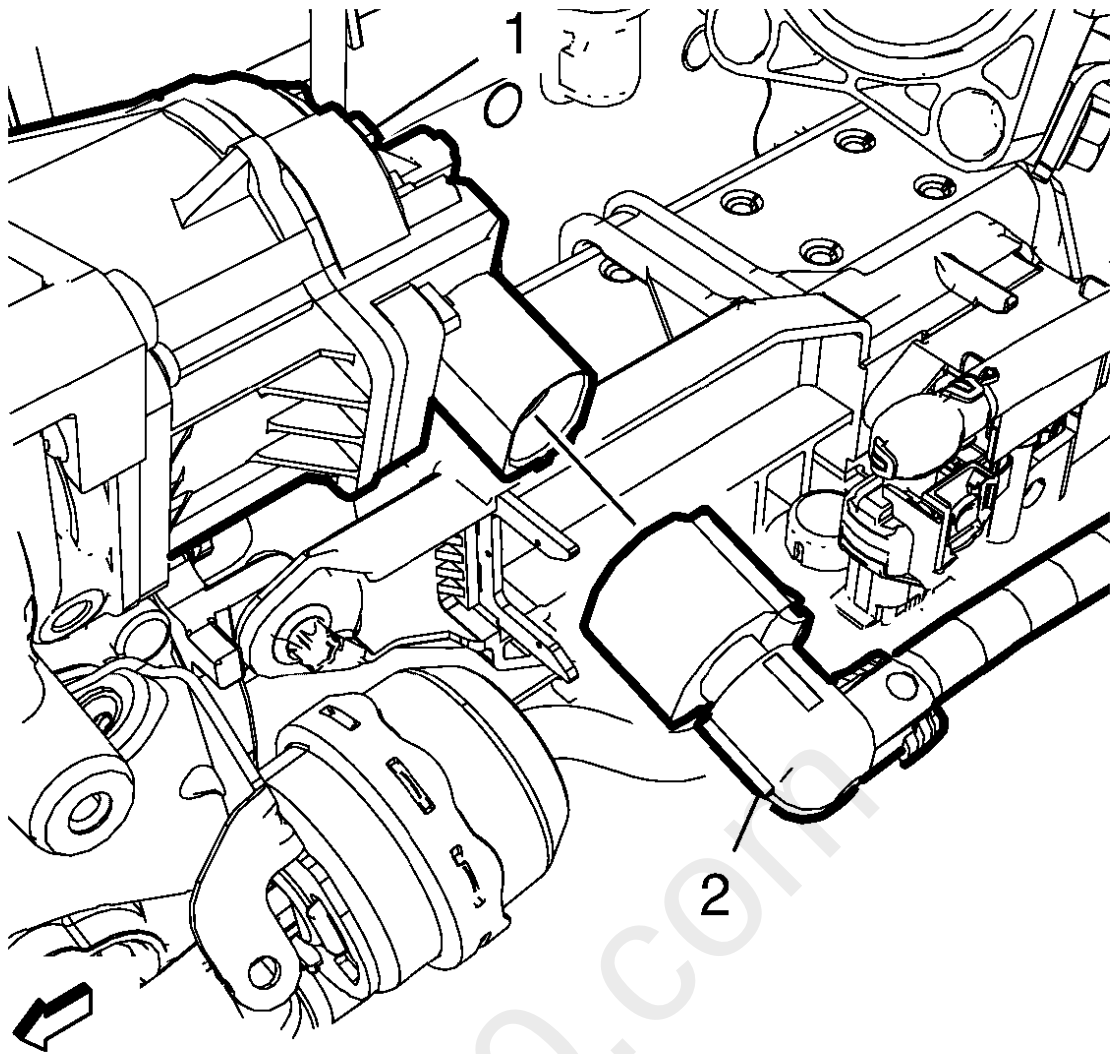


Fig. 345: Exhaust Gas Recirculation (EGR) Valve And Wiring Harness Plug
Courtesy of GENERAL MOTORS COMPANY

5. Connect the EGR valve wiring harness plug (2) to the EGR valve (1).
6. Install the throttle body assembly. Refer to [Throttle Body Assembly Replacement](#).

EXHAUST GAS RECIRCULATION COOLER TEMPERATURE SENSOR REPLACEMENT - POSITION 1

Removal Procedure

1. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

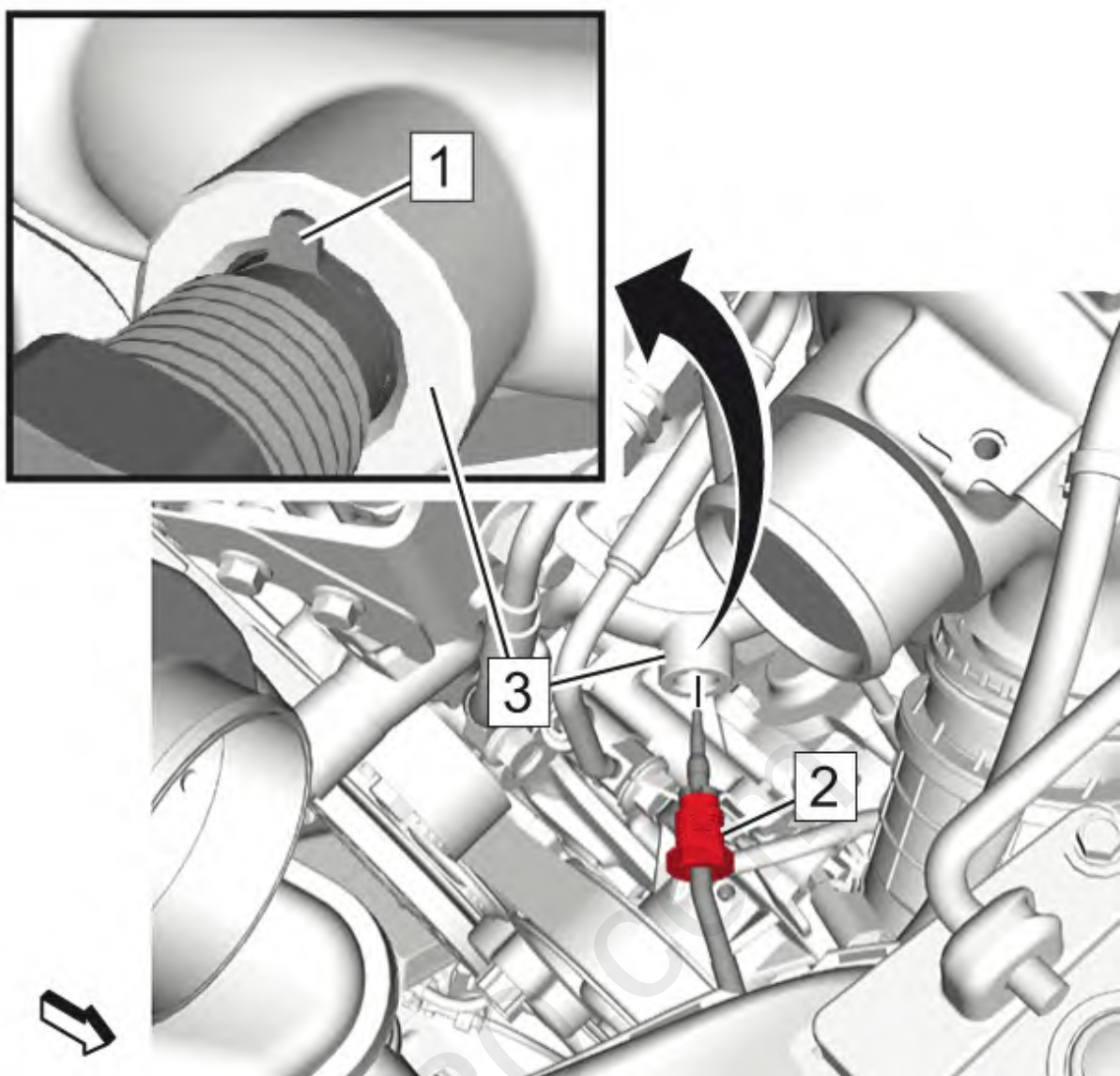


Fig.346: Exhaust Gas Recirculation Cooler Temperature Sensor - Position 1 And Exhaust Manifold

Courtesy of GENERAL MOTORS COMPANY

2. Remove Exhaust Gas Recirculation Cooler Temperature Sensor (2) @ Exhaust Manifold (3)
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

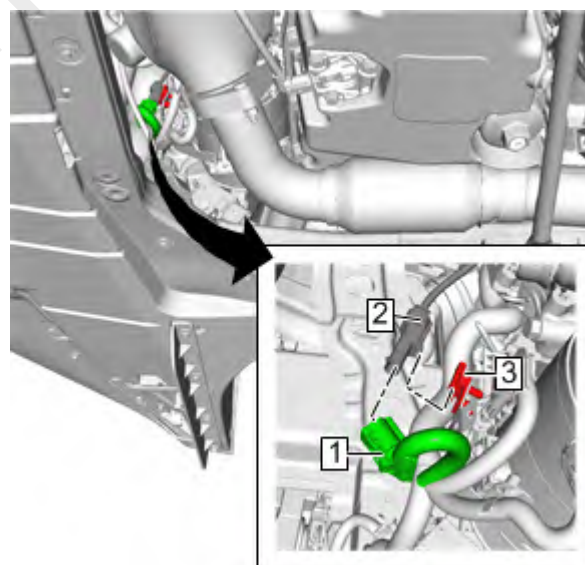


Fig.347: Exhaust Gas Recirculation Cooler Temperature Sensor, Electrical Connector And Wiring Harness Clip

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connector (1)

5. Unclip Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (2) @ Wiring Harness Clip (3)
6. Remove Exhaust Gas Recirculation Cooler Temperature Sensor (2)

Installation Procedure

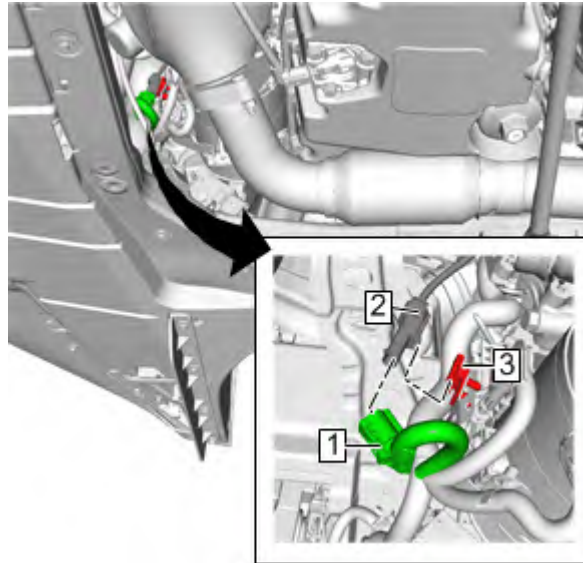


Fig. 348: Exhaust Gas Recirculation Cooler Temperature Sensor, Electrical Connector And Wiring Harness Clip

Courtesy of GENERAL MOTORS COMPANY

1. Install Exhaust Gas Recirculation Cooler Temperature Sensor (2)
2. Install Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (2) @ Wiring Harness Clip (3)
3. Connect Electrical Connector (1)
4. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

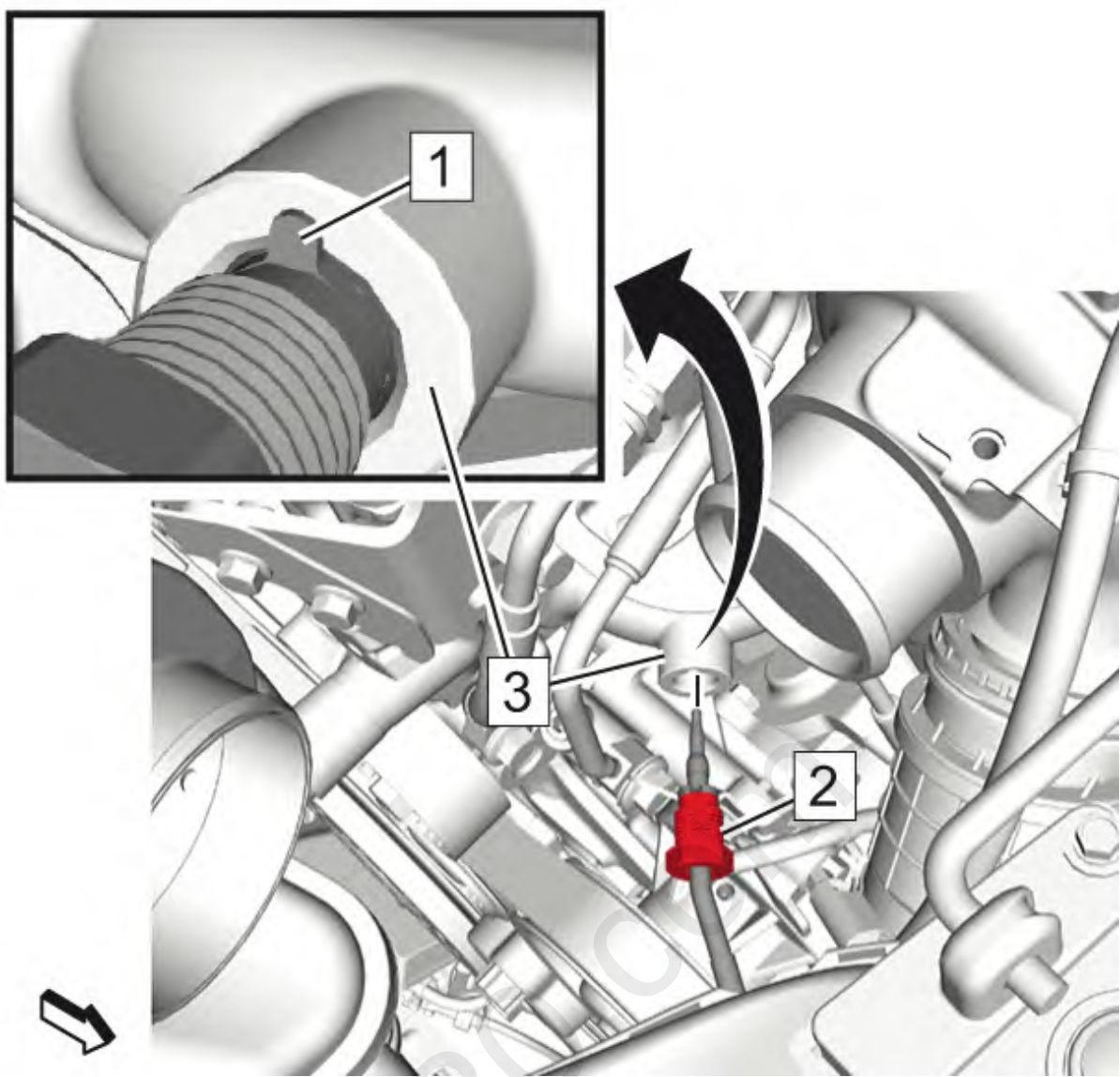


Fig. 349: Exhaust Gas Recirculation Cooler Temperature Sensor - Position 1 And Exhaust Manifold

Courtesy of GENERAL MOTORS COMPANY

NOTE: The guide lug (1) must fit the groove.

CAUTION: Refer to [Component Fastener Tightening Caution](#)

5. Install and tighten Exhaust Gas Recirculation Cooler Temperature Sensor (2) to 45 N.m (33 lb ft)
6. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
7. If replacing, perform the exhaust gas temperature sensor reset. Refer to [Exhaust Gas Temperature Sensor Reset](#)
8. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

EXHAUST GAS RECIRCULATION COOLER TEMPERATURE SENSOR REPLACEMENT - POSITION 2

Removal Procedure

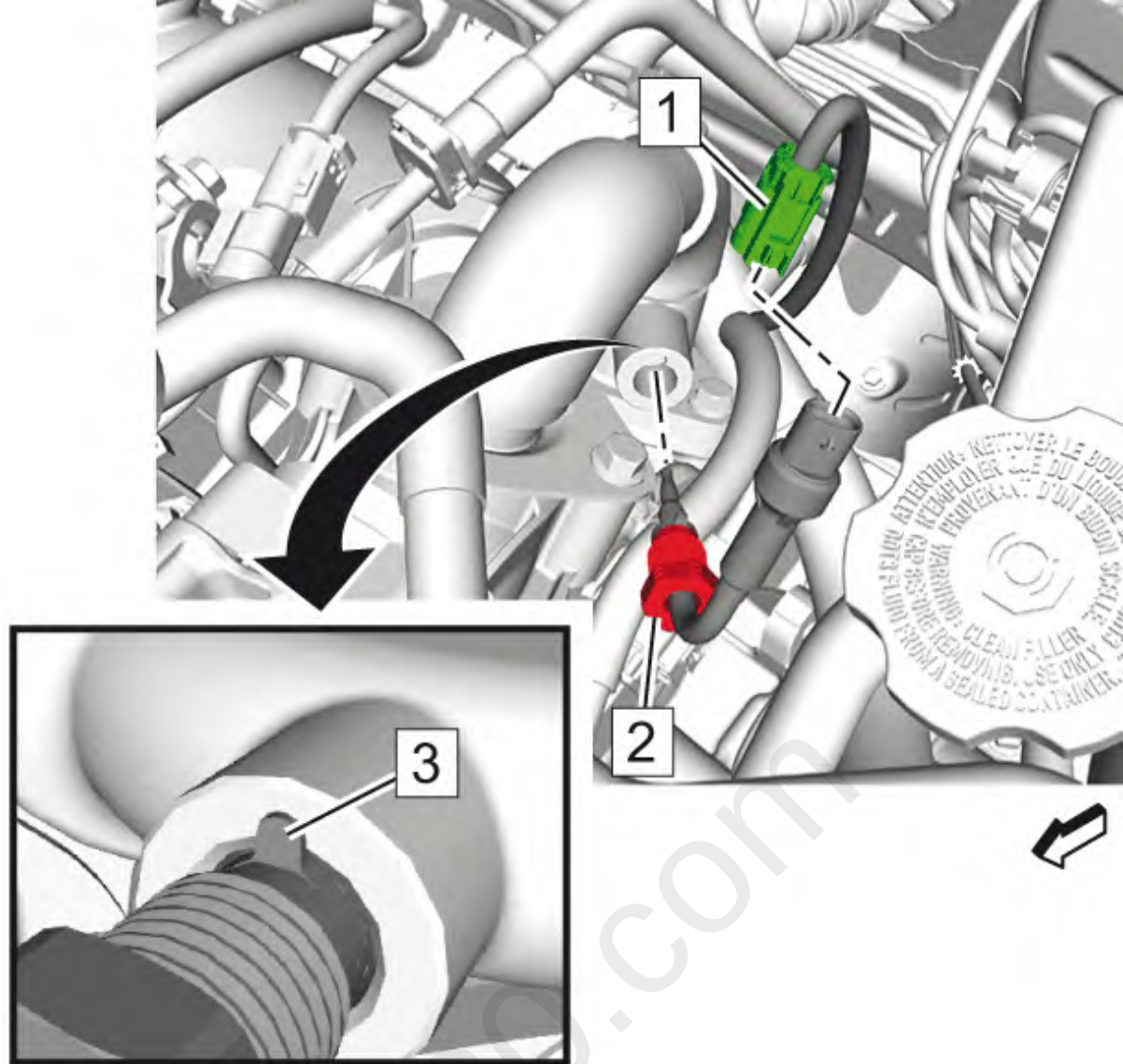


Fig. 350: Exhaust Gas Recirculation Cooler Temperature Sensor - Position 2 And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (1)
2. Remove Exhaust Gas Recirculation Cooler Temperature Sensor - Position 2 (2)

Installation Procedure

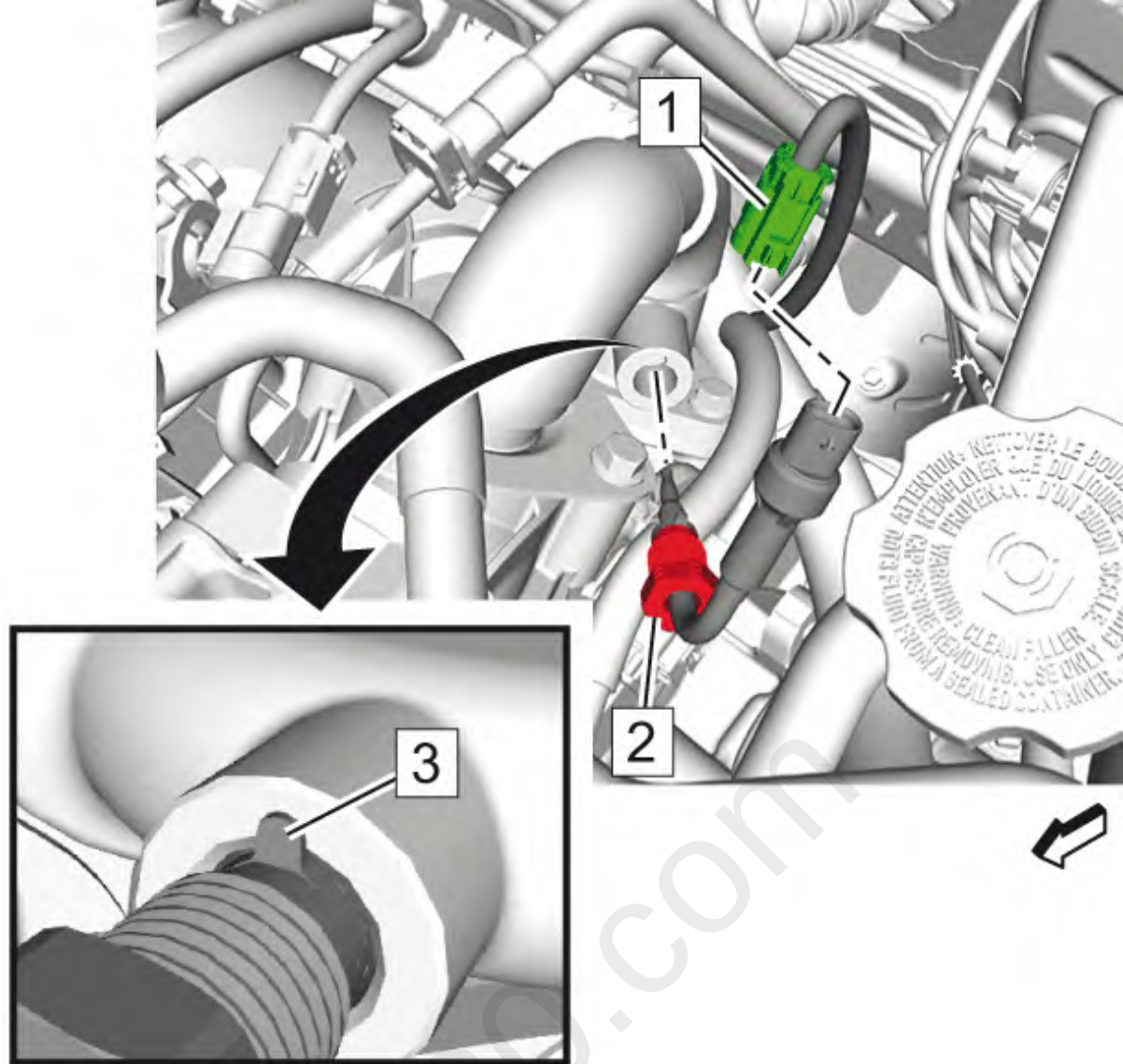


Fig. 351: Exhaust Gas Recirculation Cooler Temperature Sensor - Position 2 And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: The guide lug (3) must fit the groove.

CAUTION: Refer to [Fastener Caution](#)

1. Install and tighten Exhaust Gas Recirculation Cooler Temperature Sensor - Position 2 (2) to 45 N.m (33 lb ft)
2. Connect Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (1)
3. If replacing, perform the exhaust gas temperature sensor reset. Refer to [Exhaust Gas Temperature Sensor Reset](#)
4. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

EXHAUST GAS RECIRCULATION COOLER HOUSING REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
2. Drain the cooling system. Refer to [Cooling System Draining and Filling \(GE 47716\) Cooling System Draining and Filling \(Static\)](#)

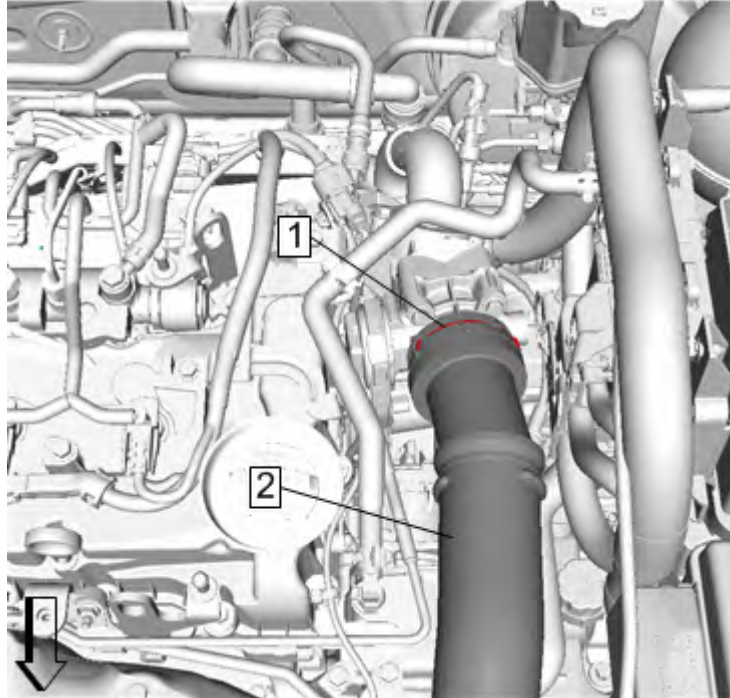


Fig. 352: Charge Air Cooler Outlet Air Tube And Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

NOTE: Reposition the charge air cooler outlet air tube as necessary.

3. Remove Charge Air Cooler Outlet Air Tube (2) @ Throttle Body. Refer to [Charge Air Cooler Outlet Air Tube Replacement](#)

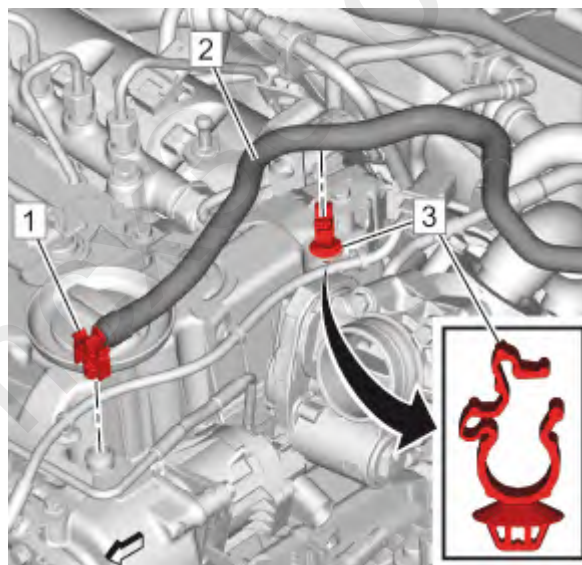


Fig. 353: Engine Coolant Air Bleed Hose, Connector And Retainer Clip

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Engine Coolant Air Bleed Hose Connector (1)
5. Remove Engine Coolant Air Bleed Hose (2) @ Retainer Clip (3)
6. Position aside Engine Coolant Air Bleed Hose (2)

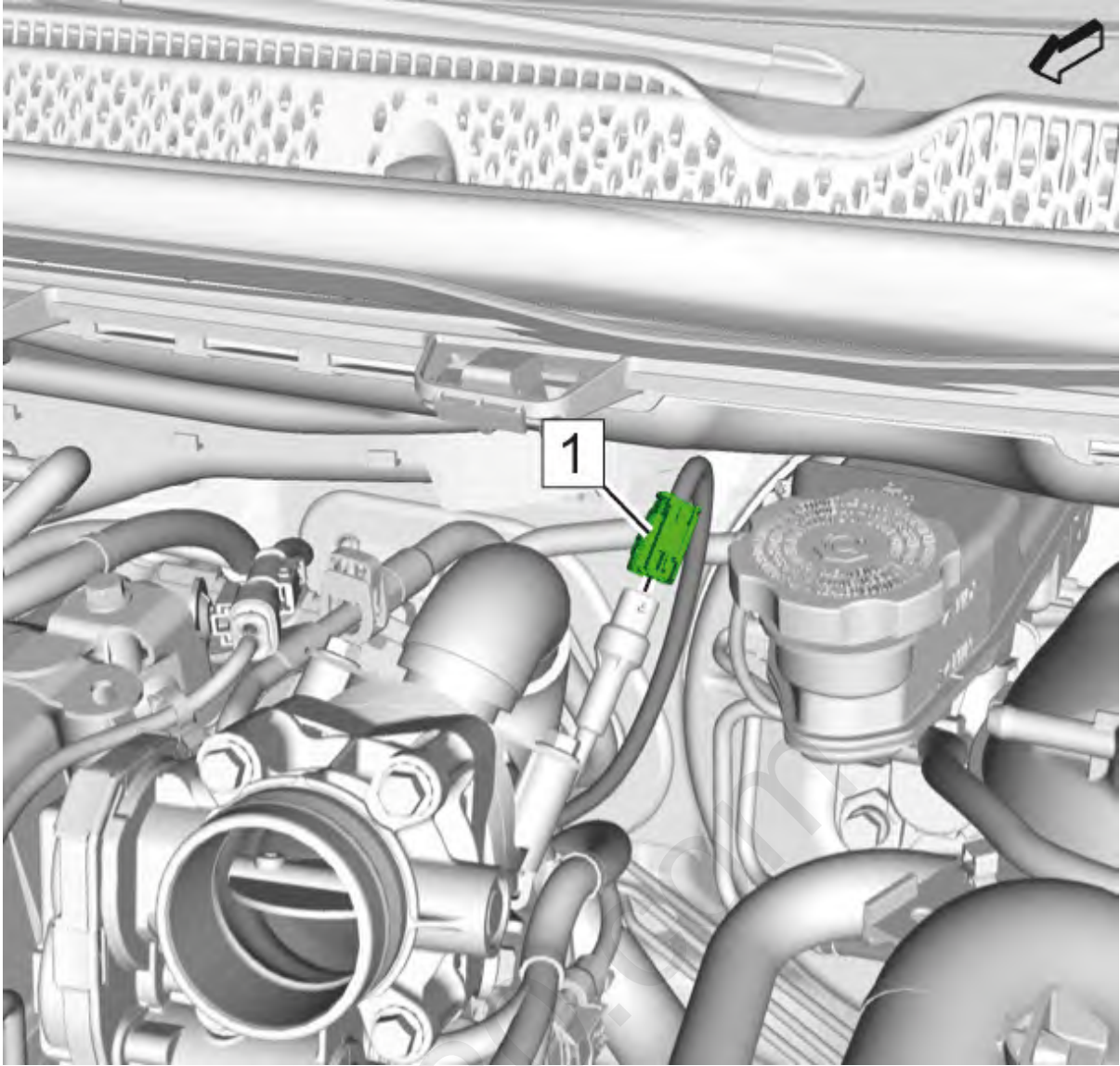


Fig. 354: Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (1)

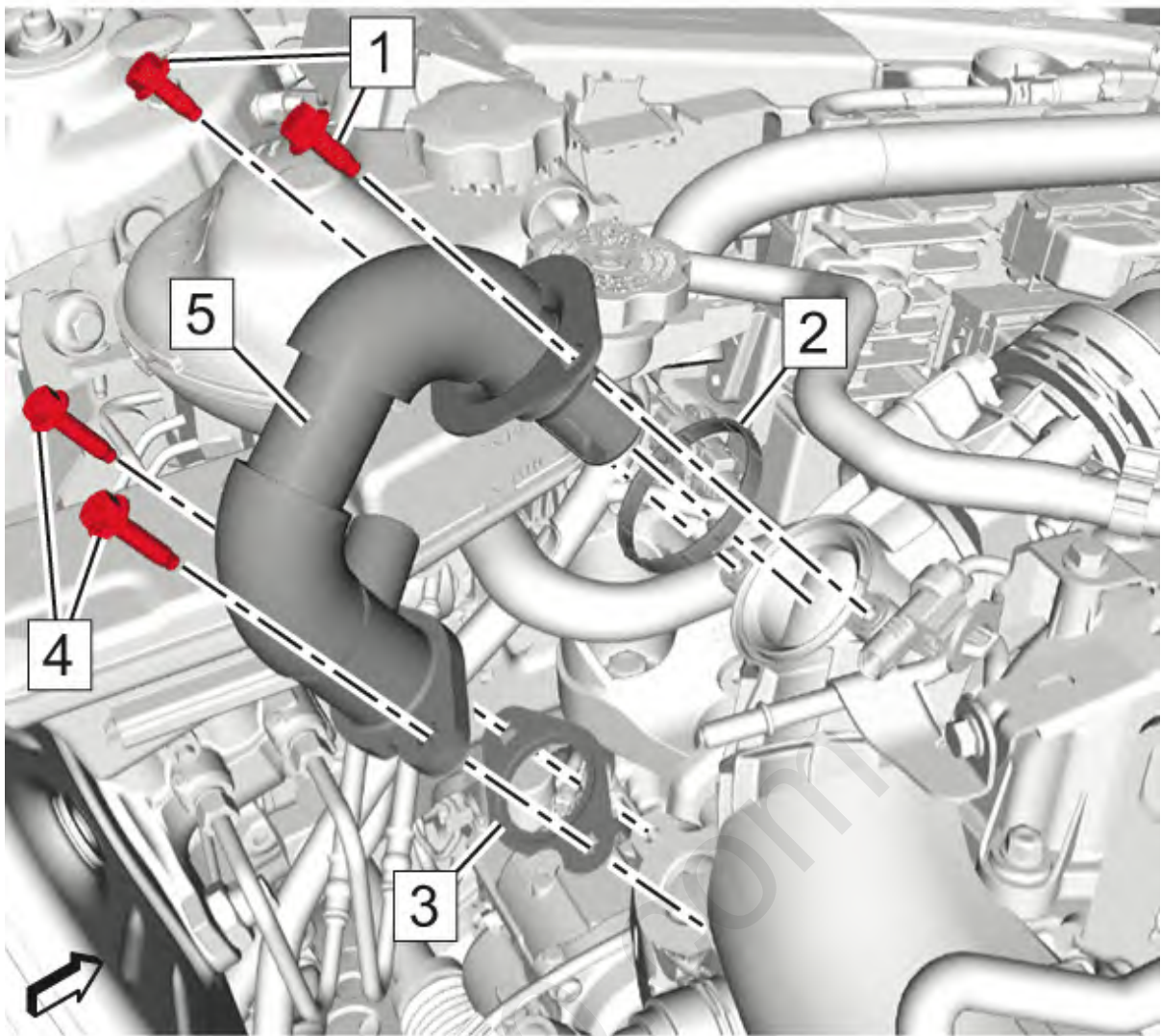


Fig.355: Exhaust Gas Recirculation Cooler Outlet Pipe, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

8. Remove Exhaust Gas Recirculation Pipe Bolts (1, 4) (Qty: 4)
9. Remove Exhaust Gas Recirculation Pipe (5)
10. Remove and DISCARD Exhaust Gas Recirculation Cooler Pipe Gasket (2)
11. Remove and DISCARD Exhaust Gas Recirculation Cooler Outlet Pipe Gasket (3)

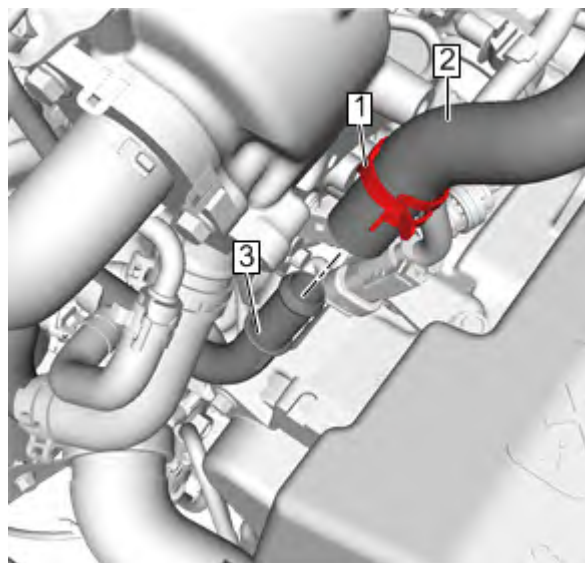


Fig.356: Radiator Surge Tank Overflow Hose, Thermostat Bypass Pipe And Clamp
Courtesy of GENERAL MOTORS COMPANY

12. Disengage Radiator Surge Tank Overflow Hose Clamp (1)

13. Disconnect Radiator Surge Tank Overflow Hose (2) @ Thermostat Bypass Pipe (3)
14. Position aside Radiator Surge Tank Overflow Hose (2)

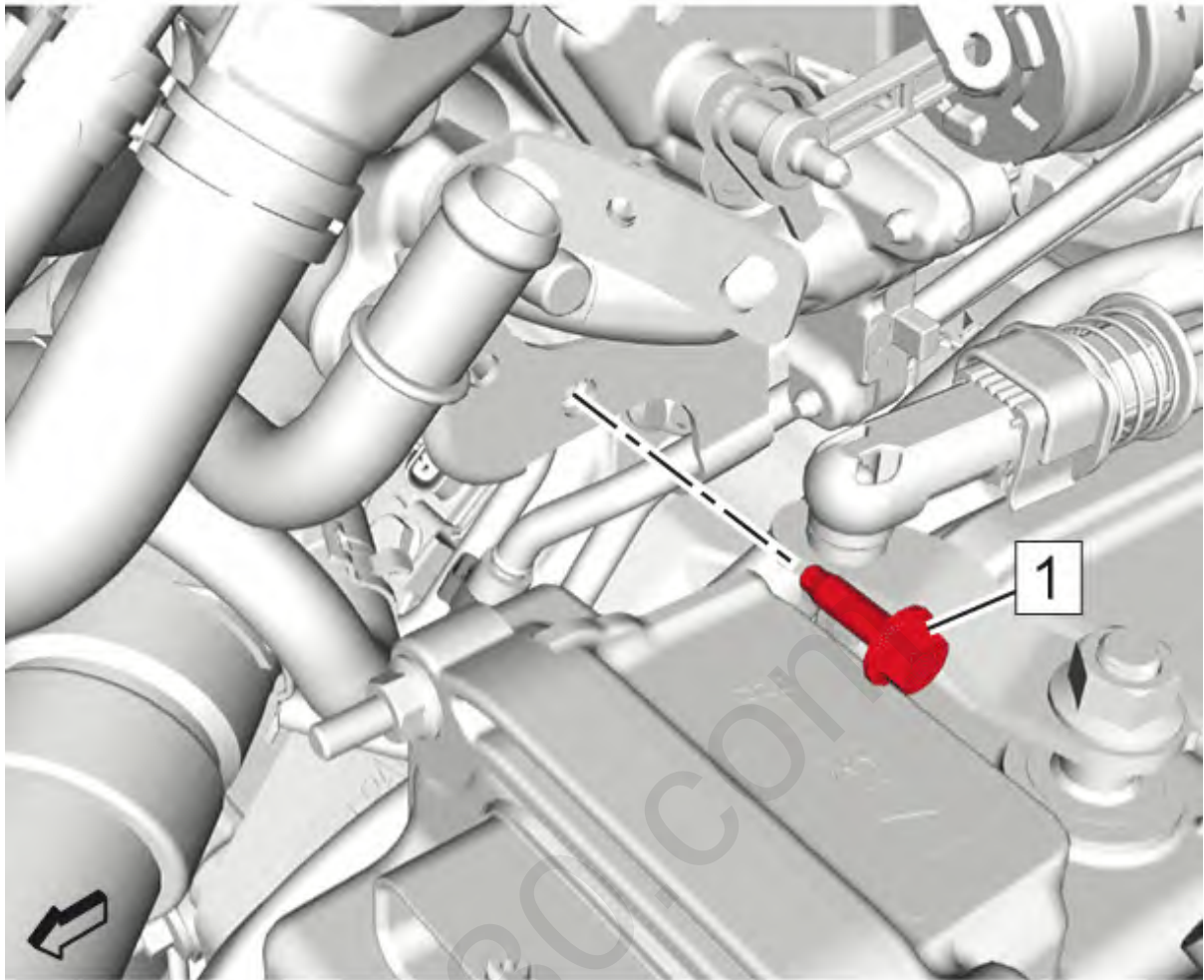


Fig. 357: Exhaust Pressure Sensor Pipe Bolt
Courtesy of GENERAL MOTORS COMPANY

15. Remove Exhaust Pressure Differential Sensor Bracket Bolt (1)

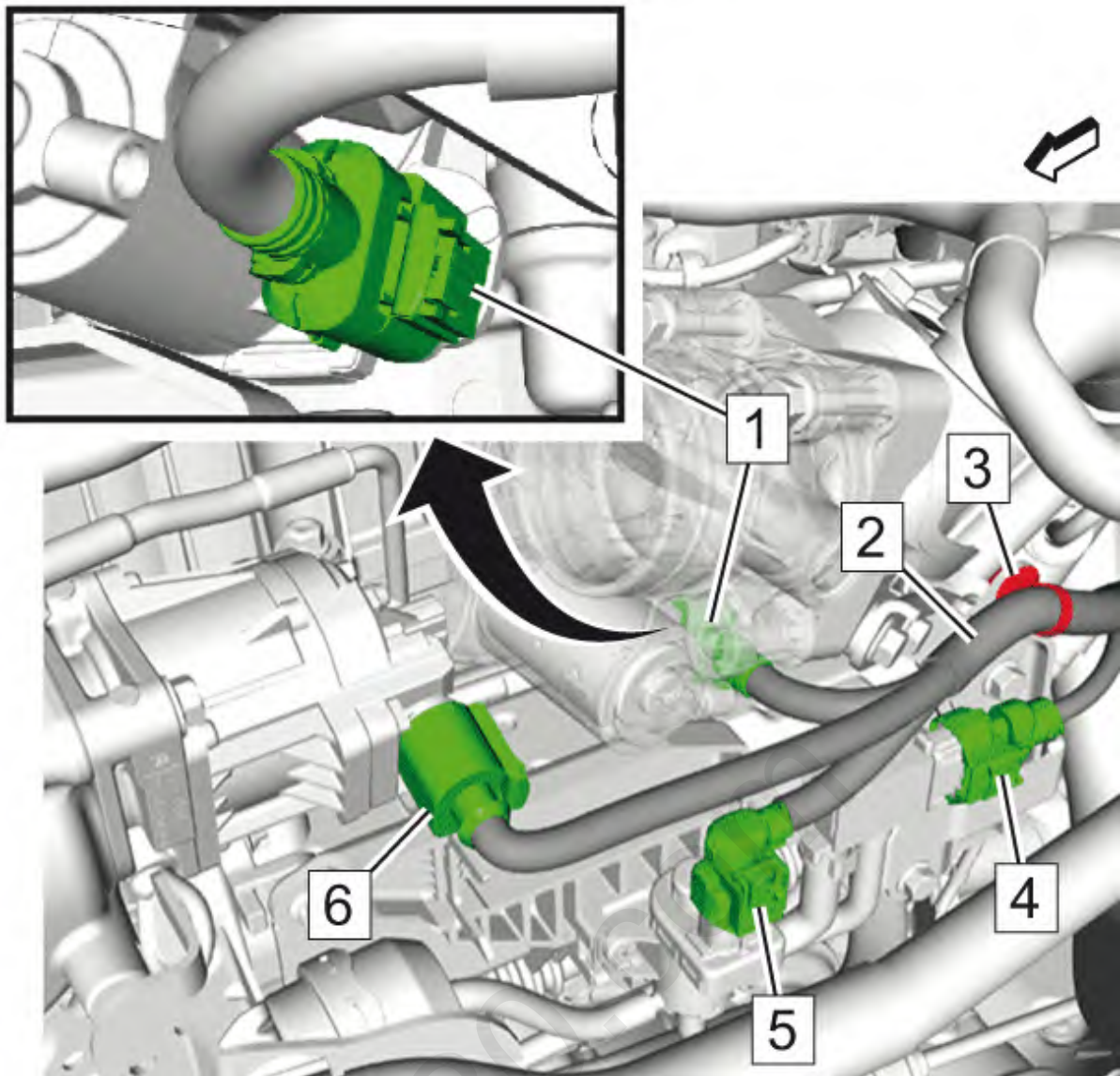


Fig. 358: Electrical Connectors, Engine Wiring Harness And Clip
 Courtesy of GENERAL MOTORS COMPANY

16. Disconnect the electrical connectors:

1. Exhaust Gas Recirculation Valve (6)
2. Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (5)
3. Exhaust Pressure Differential Sensor (4)
4. Throttle Body (1)

17. Unclip Engine Wiring Harness Clip (3)

18. Position aside Engine Wiring Harness (2)

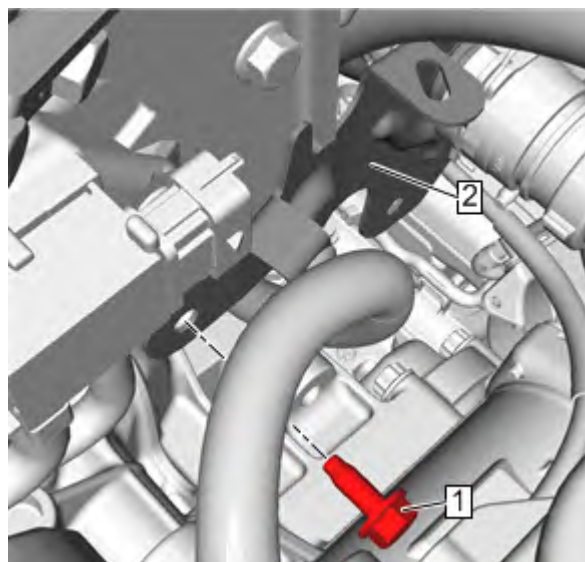


Fig. 359: Heater Inlet/Outlet Pipe Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Remove Heater Inlet Pipe Bracket Bolt (1)
20. Reposition Heater Inlet and Outlet Pipe Bracket (2)

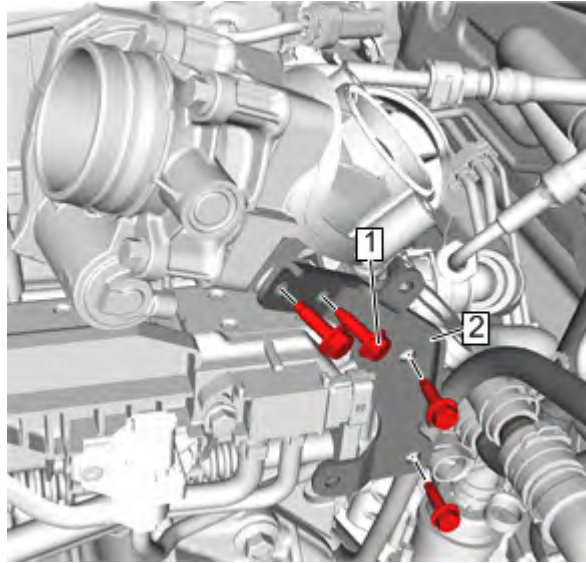


Fig. 360: Intake Manifold Brace And Bolts
Courtesy of GENERAL MOTORS COMPANY

21. Remove Intake Manifold Brace Bolts (1) (Qty: 4)
22. Position aside Intake Manifold Brace (2)

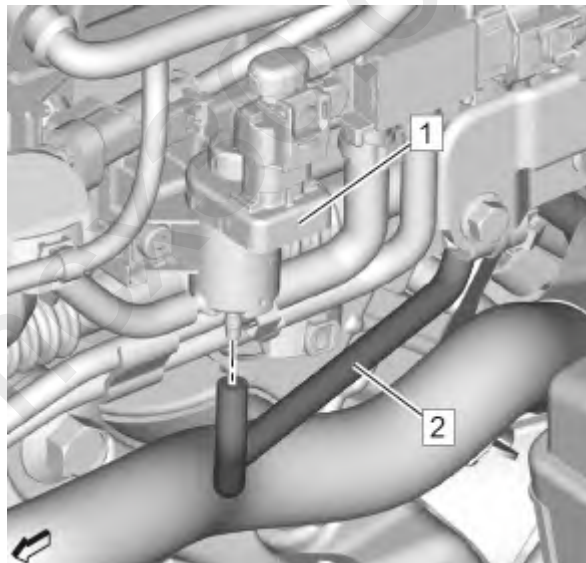


Fig. 361: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

23. Disconnect Charge Air Bypass Regulator Solenoid Valve Inlet Tube (2) @ Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (1)

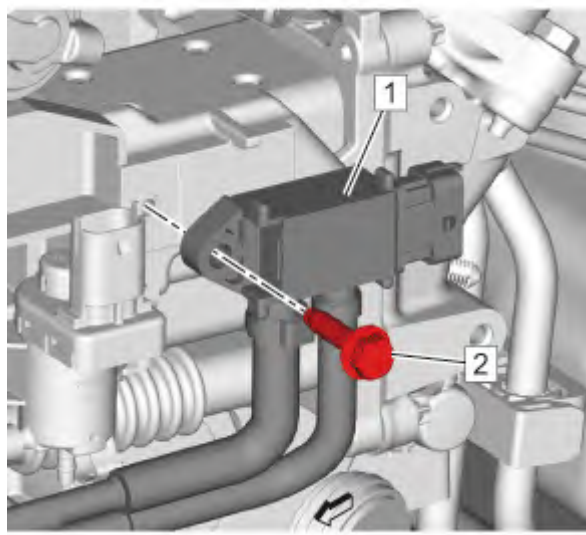


Fig. 362: Exhaust Pressure Differential Sensor And Bolt
 Courtesy of GENERAL MOTORS COMPANY

- 24. Remove Exhaust Pressure Differential Sensor Bolt (2)
- 25. Position aside Exhaust Pressure Differential Sensor (1)

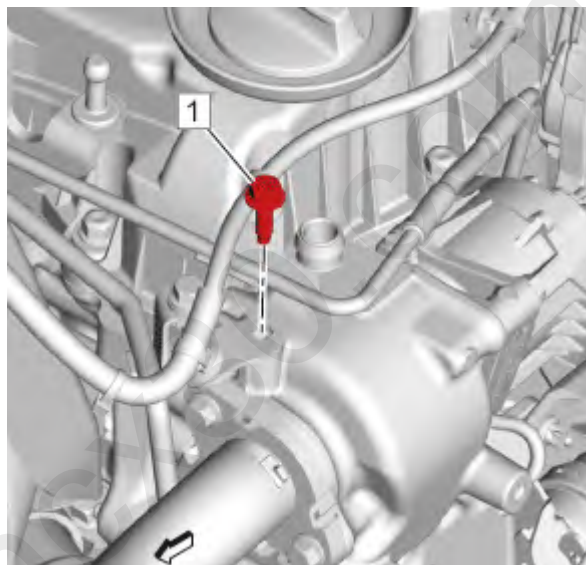


Fig. 363: Turbocharger Actuator Pipe Bracket Bolt
 Courtesy of GENERAL MOTORS COMPANY

- 26. Remove the turbocharger actuator pipe bracket bolt (1).

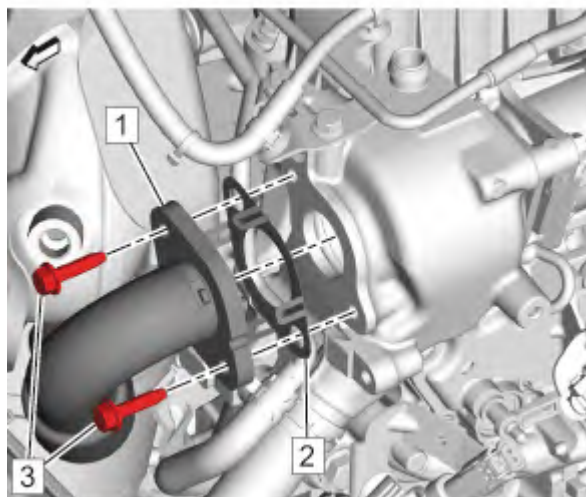


Fig. 364: Exhaust Manifold Pipe, Bolts And Gasket
 Courtesy of GENERAL MOTORS COMPANY

27. Remove the 2 exhaust manifold pipe bolts (3).
28. Remove the exhaust manifold pipe (1) from the EGR cooler housing.
29. Remove and DISCARD the gasket. (2)

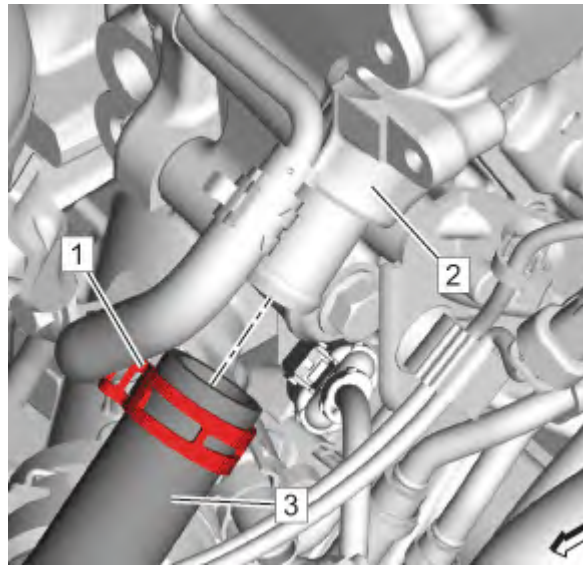


Fig. 365: Exhaust Gas Recirculation Cooler Housing, Thermostat Bypass Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

30. Loosen Thermostat Bypass Hose Clamp (1)
31. Remove Thermostat Bypass Hose (3) @ Exhaust Gas Recirculation Cooler Housing (2)

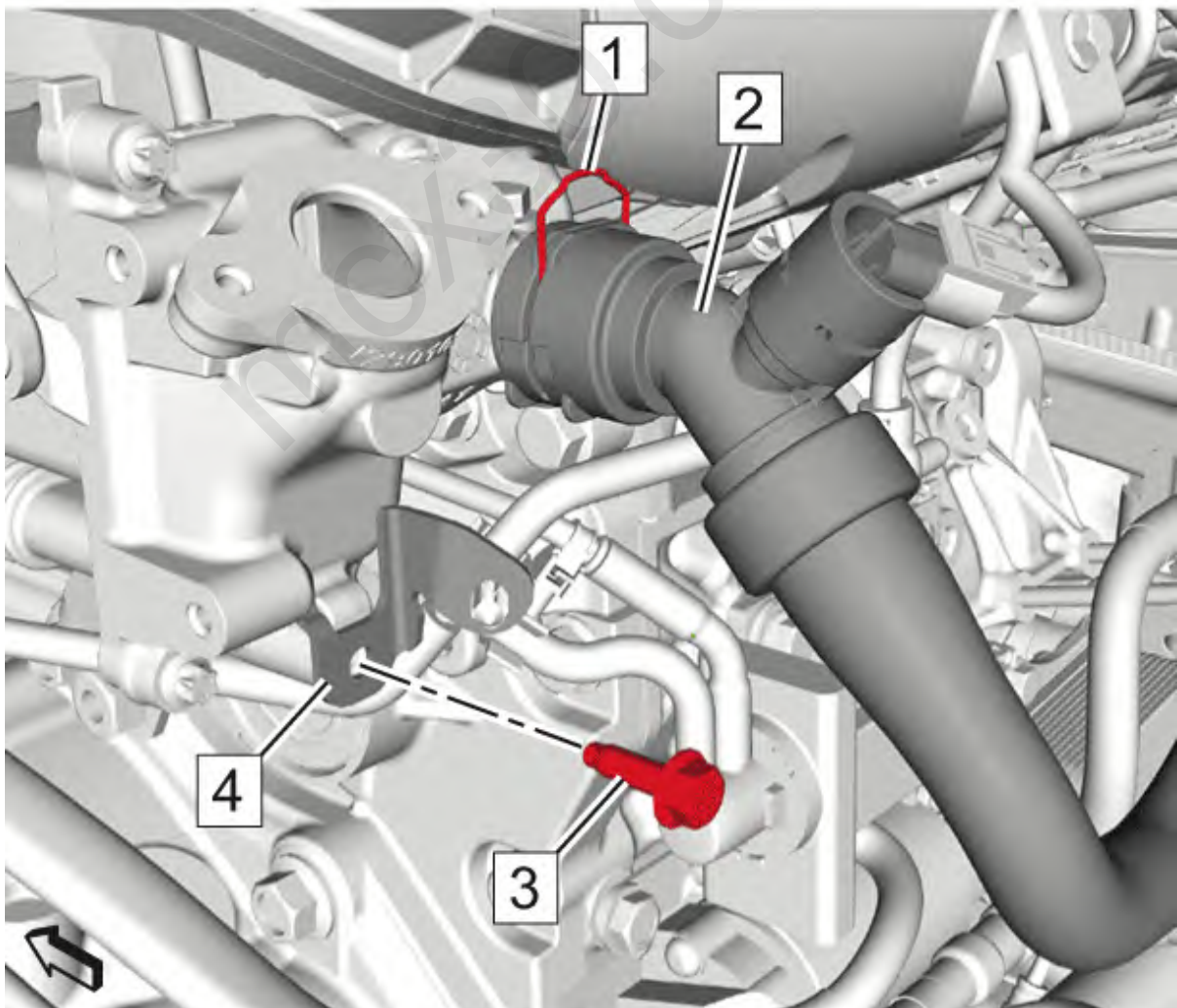


Fig. 366: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Bracket, Heater Outlet Hose, Bolt And Clamp

32. Loosen Quick Connector Clamp (1)
33. Remove Heater Outlet Hose (2)
34. Remove the turbocharger wastegate actuator vacuum control solenoid valve bracket bolt (3).
35. Position aside Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Bracket (4)

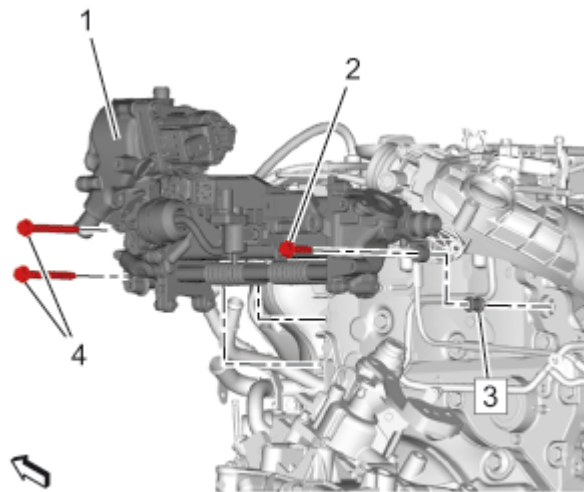


Fig.367: Exhaust Gas Recirculation Cooler Housing, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

36. Remove the 3 EGR cooler housing bolts (2, 4).
37. Remove Exhaust Gas Recirculation Cooler Housing (1)
38. Remove and DISCARD the gasket. (3)

Disassemble Procedure

Remove Exhaust Gas Recirculation Valve. Refer to [Exhaust Gas Recirculation Valve Replacement](#)

Assemble Procedure

Install Exhaust Gas Recirculation Valve. Refer to [Exhaust Gas Recirculation Valve Replacement](#)

Installation Procedure

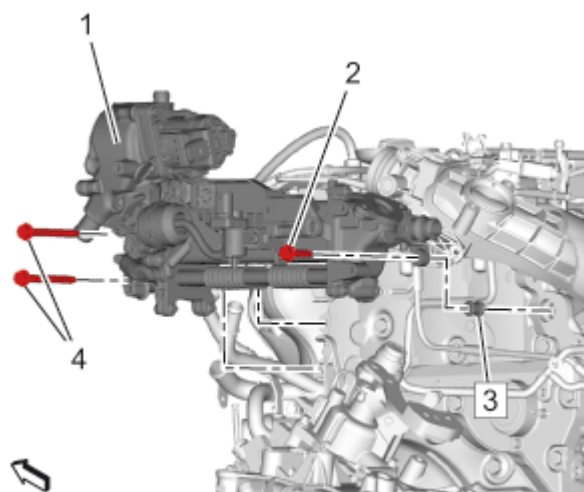


Fig.368: Exhaust Gas Recirculation Cooler Housing, Bolts And Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW gasket. (3)
2. Install Exhaust Gas Recirculation Cooler Housing (1)

CAUTION: Refer to [Fastener Caution](#)

3. Install the 3 EGR cooler housing bolts (2, 4) and tighten to 25 N.m (18 lb ft).

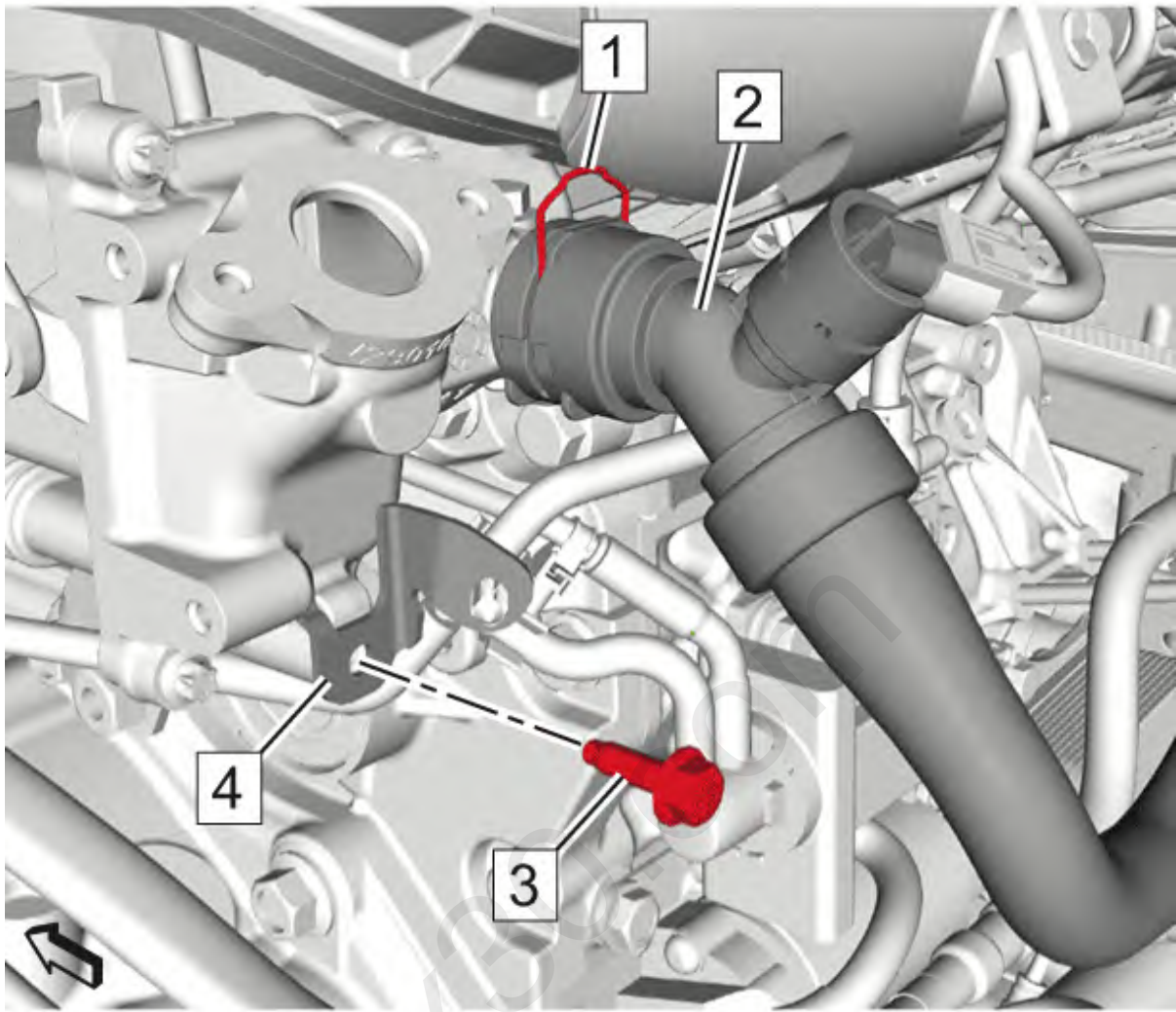


Fig. 369: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Bracket, Heater Outlet Hose, Bolt And Clamp

Courtesy of GENERAL MOTORS COMPANY

4. Reposition Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Bracket (4)
5. Install the turbocharger wastegate actuator vacuum control solenoid valve bracket bolt (3) and tighten to 10 N.m (89 lb in).
6. Install Heater Outlet Hose (2)
7. Install Quick Connector Clamp (1)

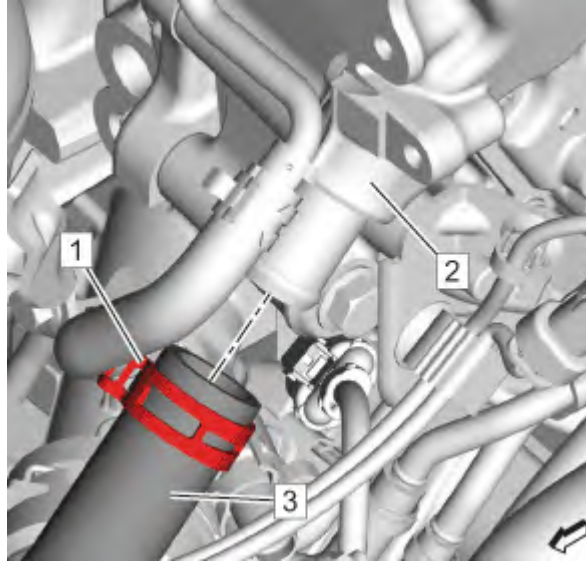


Fig. 370: Exhaust Gas Recirculation Cooler Housing, Thermostat Bypass Hose And Clamp
 Courtesy of GENERAL MOTORS COMPANY

8. Install Thermostat Bypass Hose (3) @ Exhaust Gas Recirculation Cooler Housing (2)
9. Install Thermostat Bypass Hose Clamp (1)

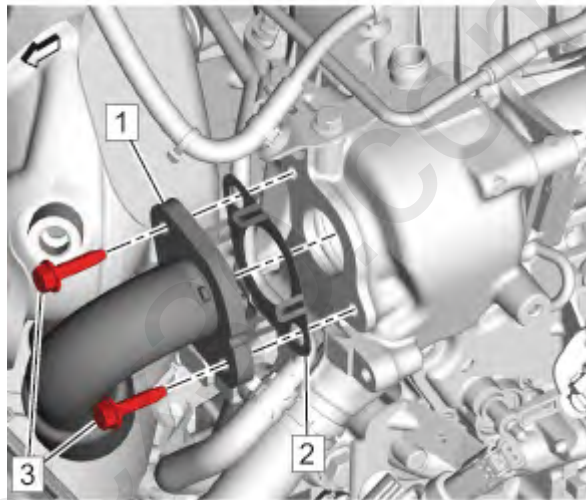


Fig. 371: Exhaust Manifold Pipe, Bolts And Gasket
 Courtesy of GENERAL MOTORS COMPANY

10. Install a NEW gasket. (2)
11. Install the exhaust manifold pipe (1) to the EGR cooler housing.
12. Install the 2 exhaust manifold pipe bolts (3) and tighten to 10 N.m (89 lb in).

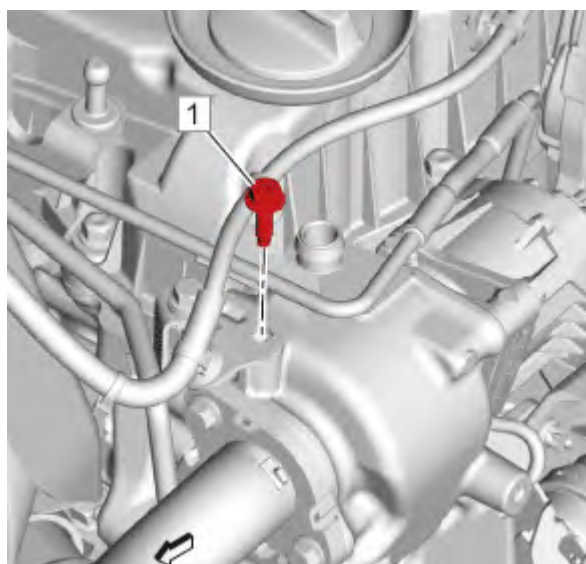


Fig. 372: Turbocharger Actuator Pipe Bracket Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Install the turbocharger actuator pipe bracket bolt (1) and tighten to 10 N.m (89 lb in).

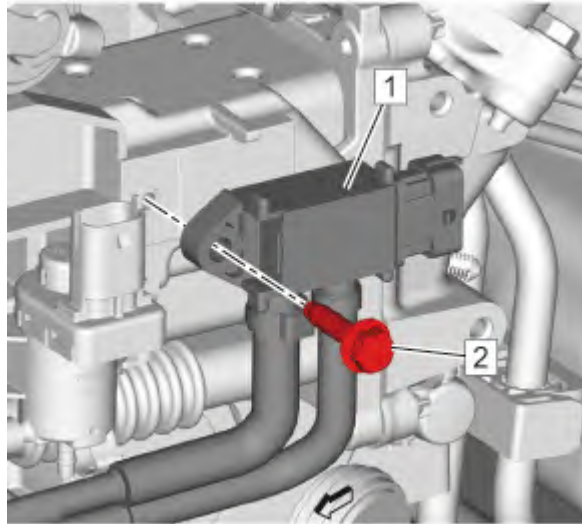


Fig. 373: Exhaust Pressure Differential Sensor And Bolt
Courtesy of GENERAL MOTORS COMPANY

14. Reposition Exhaust Pressure Differential Sensor (1)
15. Install and tighten Exhaust Pressure Differential Sensor Bolt (2) to 9 N.m (80 lb in)

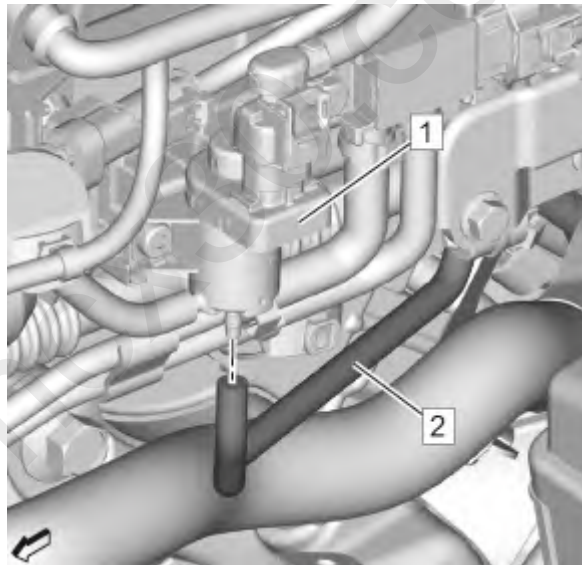


Fig. 374: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

16. Connect Charge Air Bypass Regulator Solenoid Valve Inlet Tube (2) @ Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (1)

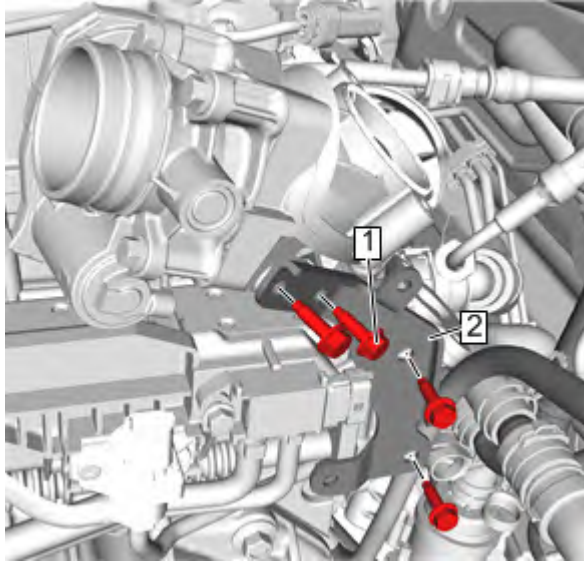


Fig. 375: Intake Manifold Brace And Bolts
Courtesy of GENERAL MOTORS COMPANY

17. Reposition Intake Manifold Brace (2)
18. Install and tighten Intake Manifold Brace Bolts (1) (Qty: 4) to 10 N.m (89 lb in)

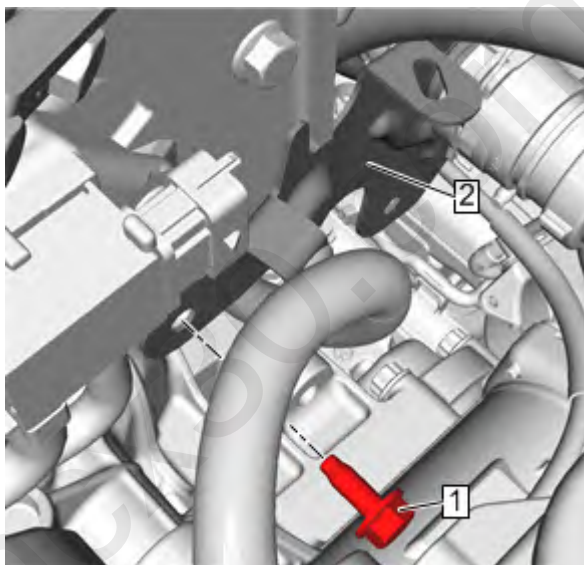


Fig. 376: Heater Inlet/Outlet Pipe Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

19. Install Heater Inlet and Outlet Pipe Bracket (2)
20. Install and tighten Heater Inlet Pipe Bracket Bolt (1) to 9 N.m (80 lb in)

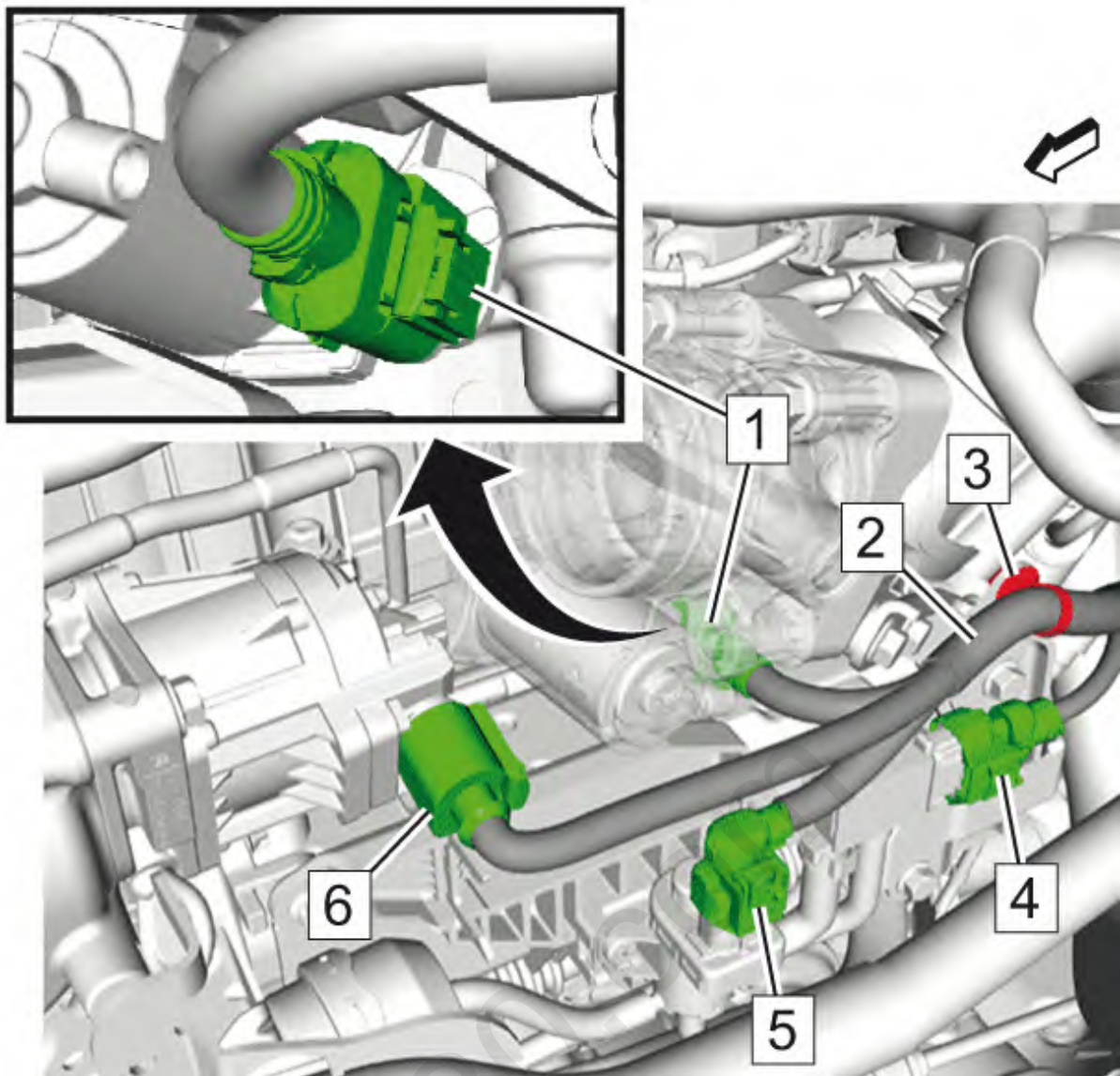


Fig.377: Electrical Connectors, Engine Wiring Harness And Clip
Courtesy of GENERAL MOTORS COMPANY

21. Connect the electrical connectors:
 1. Exhaust Gas Recirculation Valve (6)
 2. Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve (5)
 3. Exhaust Pressure Differential Sensor (4)
 4. Throttle Body (1)
22. Reposition Engine Wiring Harness (2)
23. Install Engine Wiring Harness Clip (3)

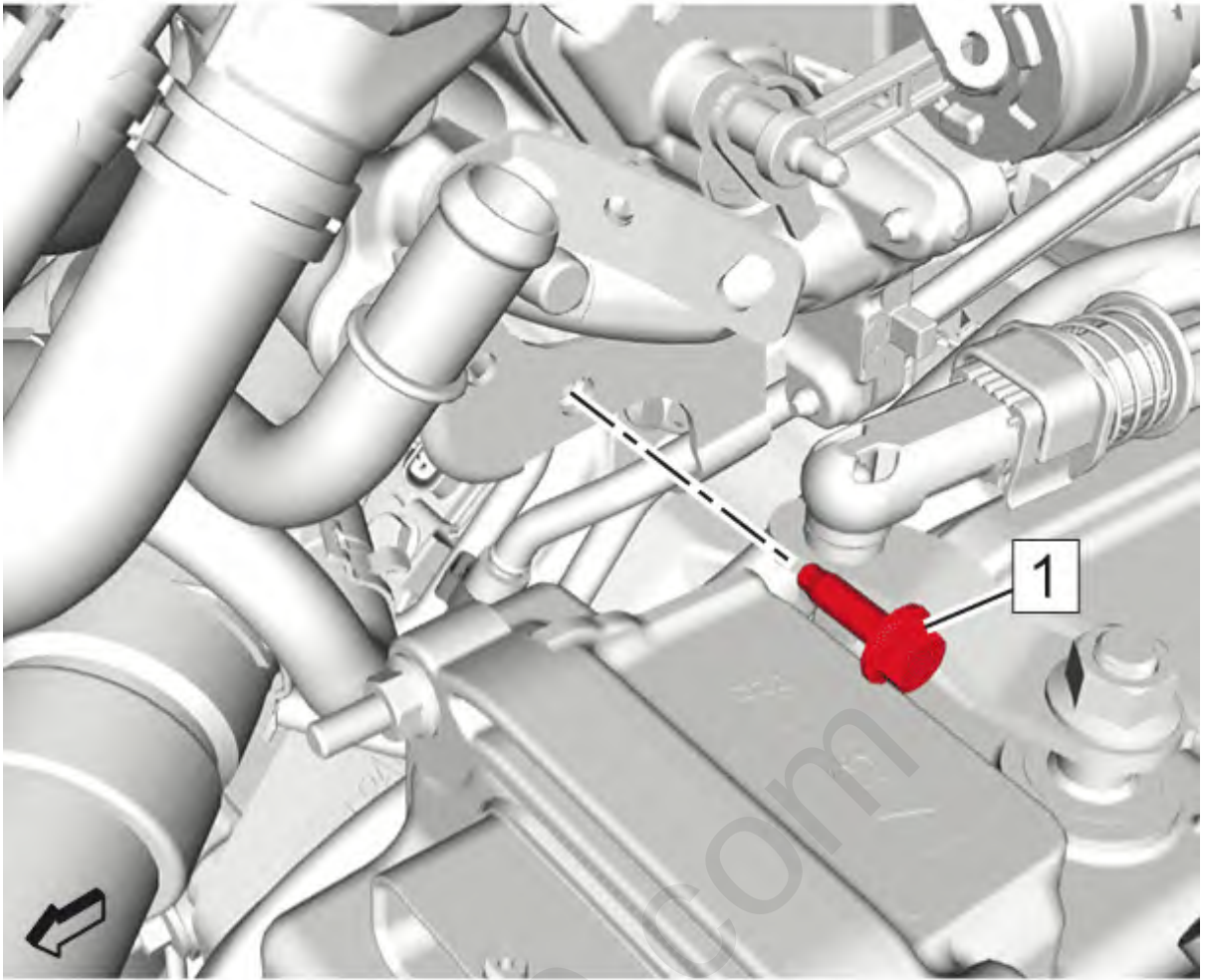


Fig. 378: Exhaust Pressure Sensor Pipe Bolt

Courtesy of GENERAL MOTORS COMPANY

24. Install and tighten Exhaust Pressure Differential Sensor Bracket Bolt (1) to 9 N.m (80 lb in)

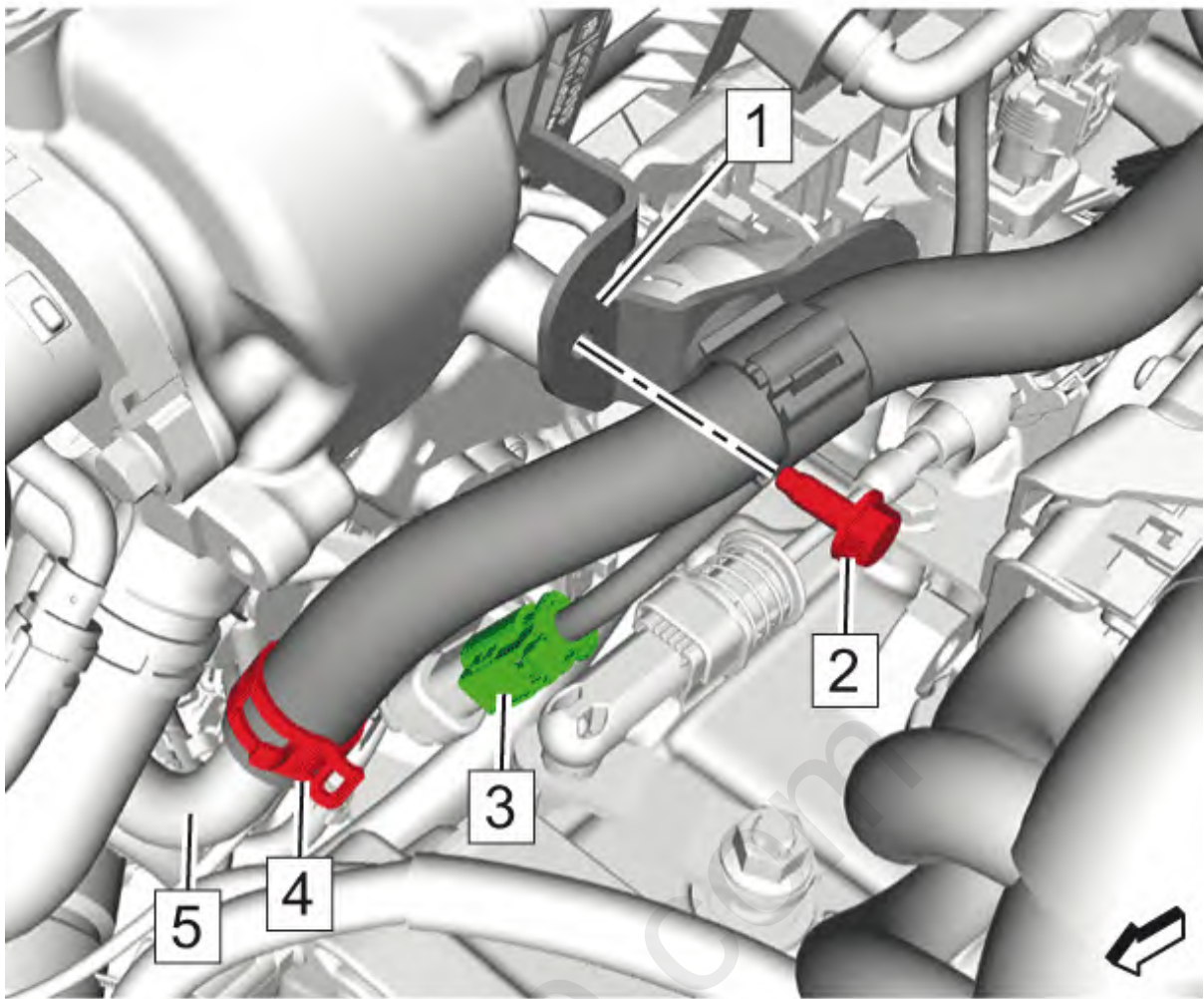


Fig.379: Exhaust Temperature Sensor Electrical Connector and Radiator Surge Tank Components

Courtesy of GENERAL MOTORS COMPANY

25. Reposition the radiator surge tank engine hose bracket (1) along with the radiator surge tank hose (4).
26. Connect Radiator Surge Tank Overflow Hose (4) @ Thermostat Bypass Pipe (6)
27. Install Radiator Surge Tank Overflow Hose Clamp (5)
28. Connect Exhaust Temperature Sensor Electrical Connector (3)
29. Install the radiator surge tank outlet hose bracket bolt (2) and tighten to 10 N.m (89 lb in).

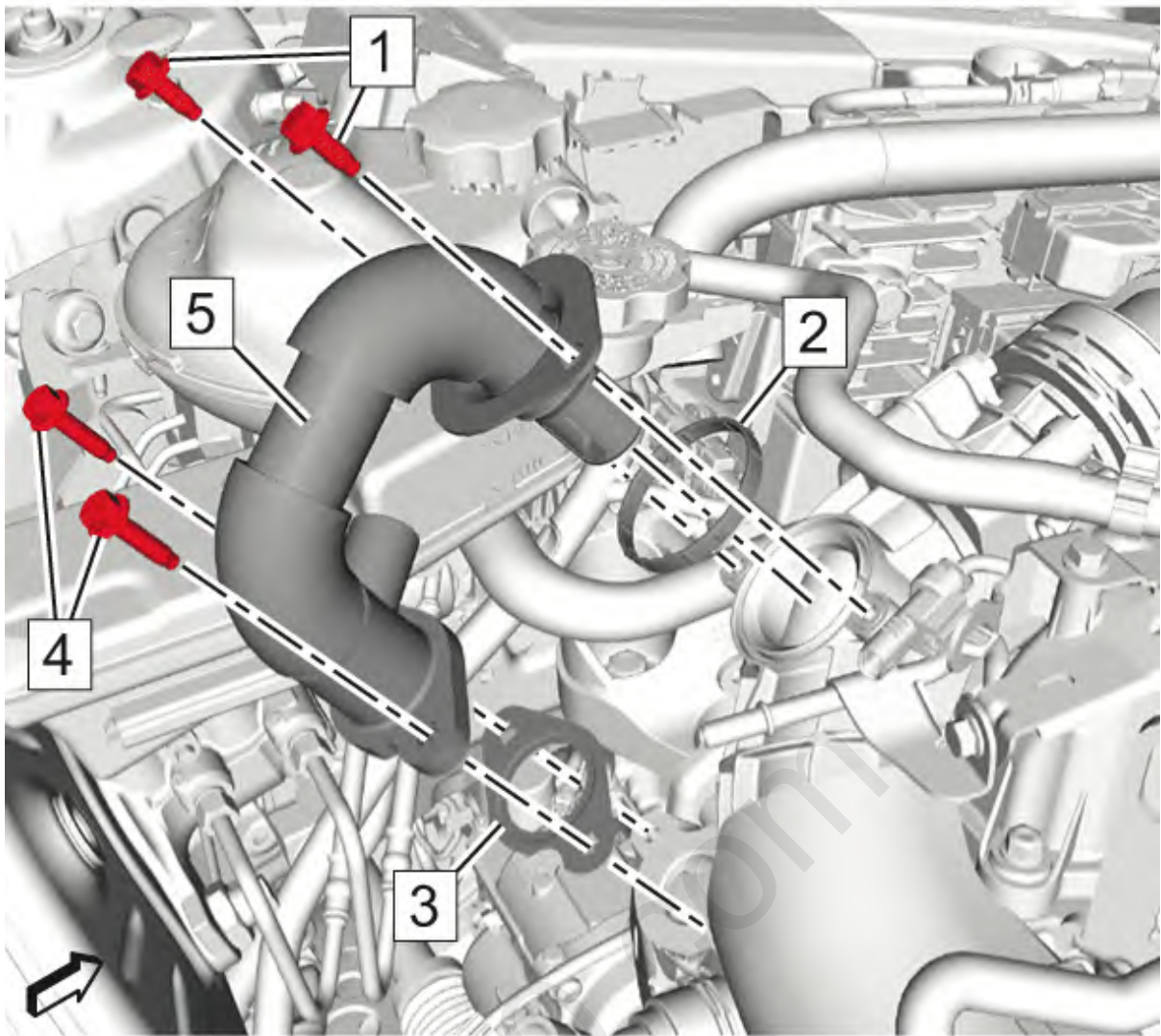


Fig.380: Exhaust Gas Recirculation Cooler Outlet Pipe, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

30. Install NEW Exhaust Gas Recirculation Cooler Outlet Pipe Gasket (3)
31. Install NEW Exhaust Gas Recirculation Cooler Pipe Gasket (2)
32. Install Exhaust Gas Recirculation Pipe (5)
33. Install and tighten Exhaust Gas Recirculation Pipe Bolts (1, 4) (Qty: 4) to 10 N.m (89 lb in)

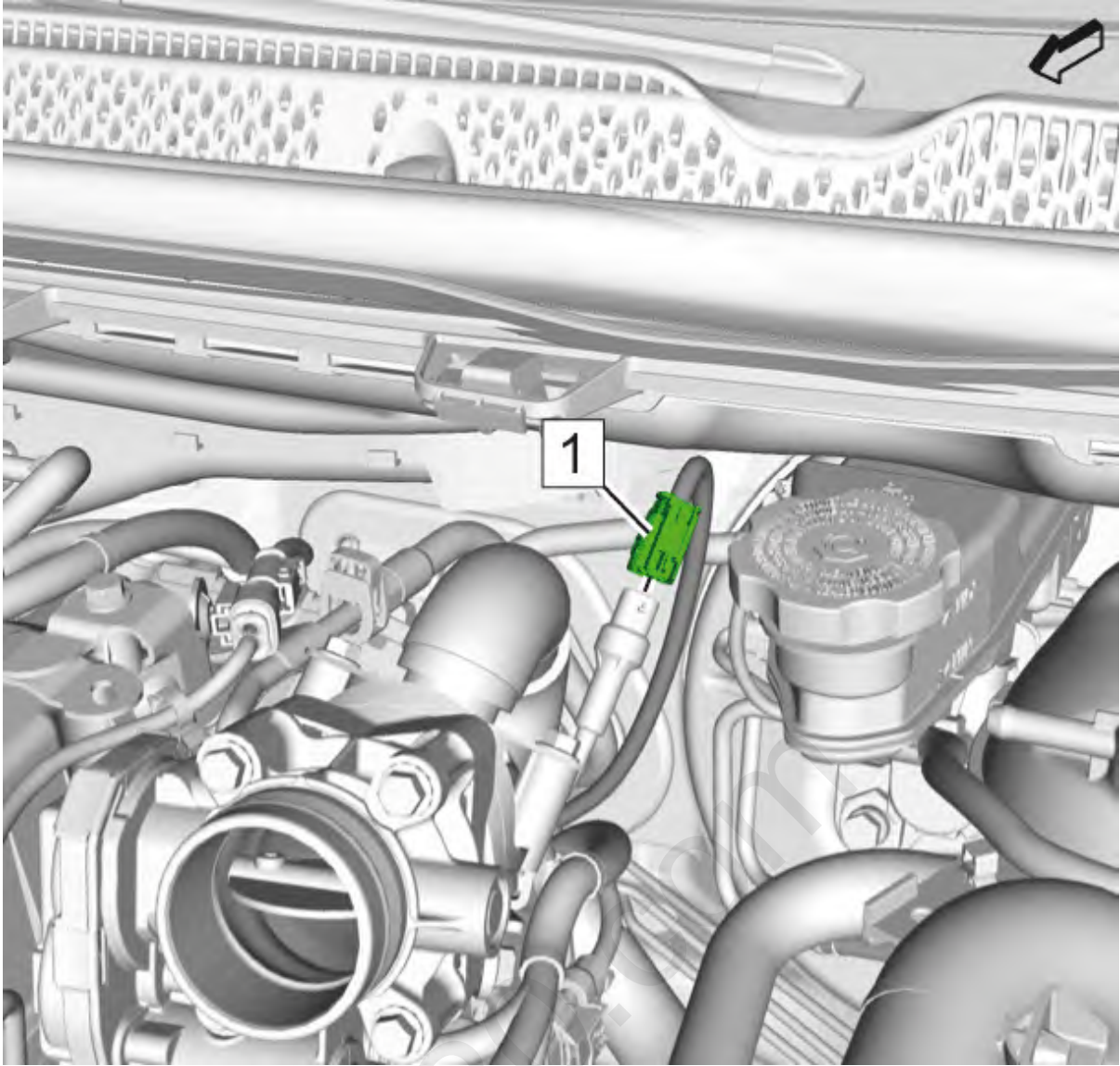


Fig. 381: Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

34. Connect Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (1)

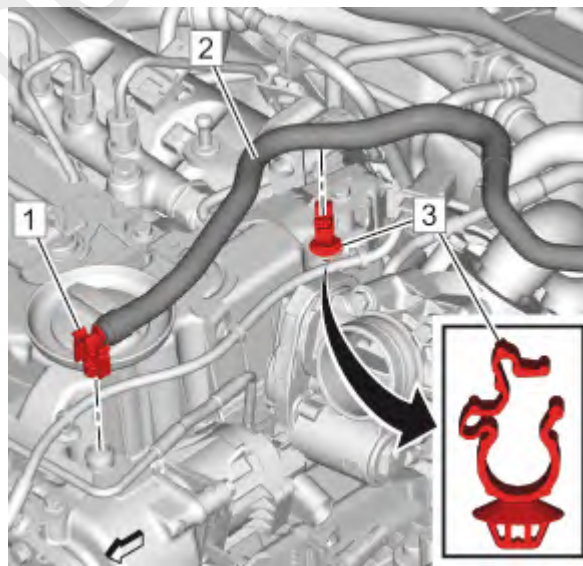


Fig. 382: Engine Coolant Air Bleed Hose, Connector And Retainer Clip
 Courtesy of GENERAL MOTORS COMPANY

35. Reposition Engine Coolant Air Bleed Hose (2)

36. Install Engine Coolant Air Bleed Hose (2) @ Retainer Clip (3)

37. Connect Engine Coolant Air Bleed Hose Connector (1)

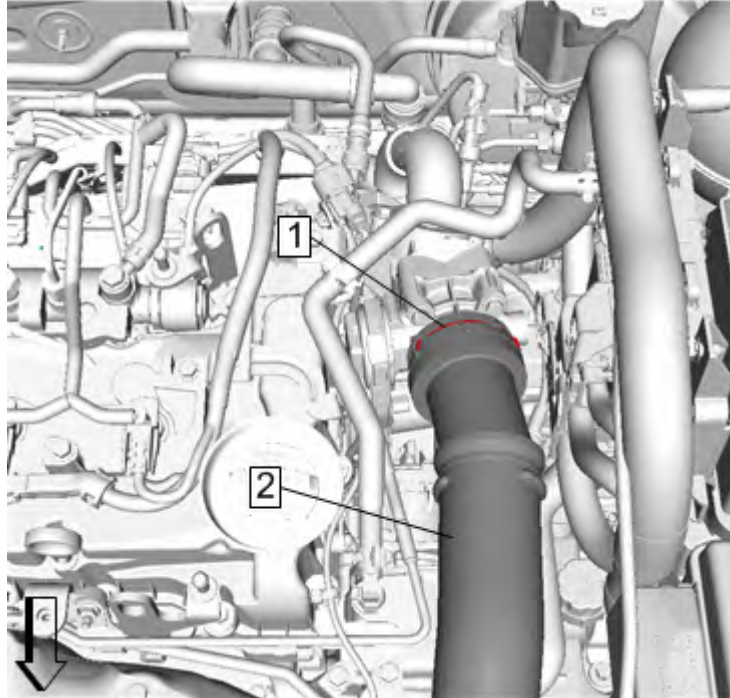


Fig. 383: Charge Air Cooler Outlet Air Tube And Retaining Clip

Courtesy of GENERAL MOTORS COMPANY

38. Install Charge Air Cooler Outlet Air Tube (2) @ Throttle Body. Refer to [Charge Air Cooler Outlet Air Tube Replacement](#)
39. Fill the cooling system. Refer to [Cooling System Draining and Filling.\(GE 47716\). Cooling System Draining and Filling.\(Static\)](#)
40. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

EXHAUST GAS RECIRCULATION VACUUM REGULATOR SOLENOID VALVE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Charge Air Cooler Outlet Air Tube. Refer to [Charge Air Cooler Outlet Air Tube Replacement](#)

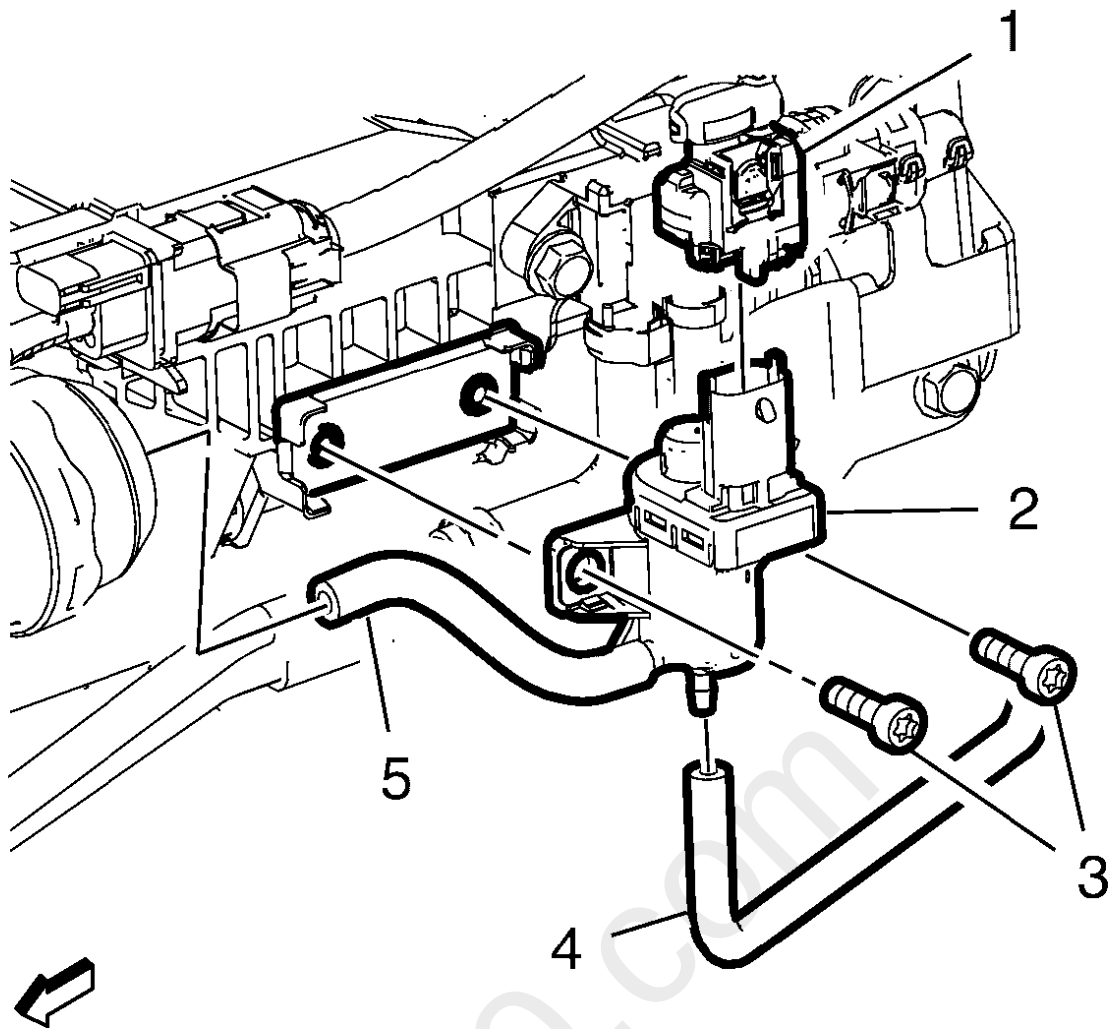


Fig. 384: Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve And Components
Courtesy of GENERAL MOTORS COMPANY

3. Remove the electrical connector (1) from the exhaust gas recirculation vacuum regulator solenoid valve (2).
4. Remove the charge air bypass regulator solenoid valve inlet tube (4) from the exhaust gas recirculation vacuum regulator solenoid valve (2).
5. Remove the exhaust gas recirculation vacuum regulator valve hose (5).
6. Remove the 2 exhaust gas recirculation vacuum regulator solenoid valve bolts (3).
7. Remove the exhaust gas recirculation vacuum regulator solenoid valve (2).

Installation Procedure

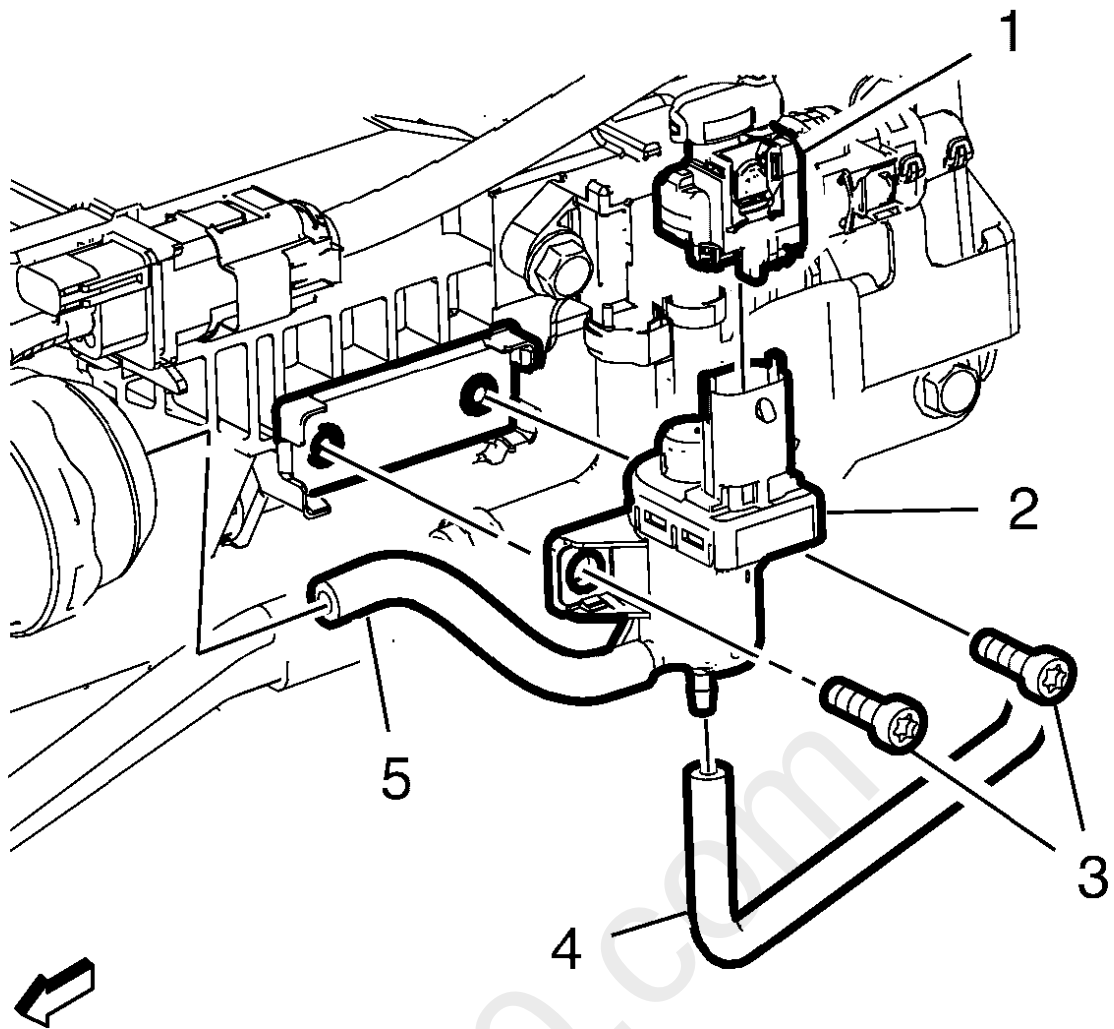


Fig. 385: Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve And Components
 Courtesy of GENERAL MOTORS COMPANY

1. Install exhaust gas recirculation vacuum regulator solenoid valve (2).

CAUTION: Refer to [Fastener Caution](#)

2. Install the 2 exhaust gas recirculation vacuum regulator solenoid valve bolts (3) and tighten to 7 N.m (62 lb in).
3. Install the exhaust gas recirculation vacuum regulator valve hose (5).
4. Install the charge air bypass regulator solenoid valve inlet tube (4) to the exhaust gas recirculation vacuum regulator solenoid valve (2).
5. Install the electrical connector (1) to the exhaust gas recirculation vacuum regulator solenoid valve (2).
6. Install Charge Air Cooler Outlet Air Tube. Refer to [Charge Air Cooler Outlet Air Tube Replacement](#)
7. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

EXHAUST GAS RECIRCULATION COOLER OUTLET PIPE REPLACEMENT

Removal Procedure

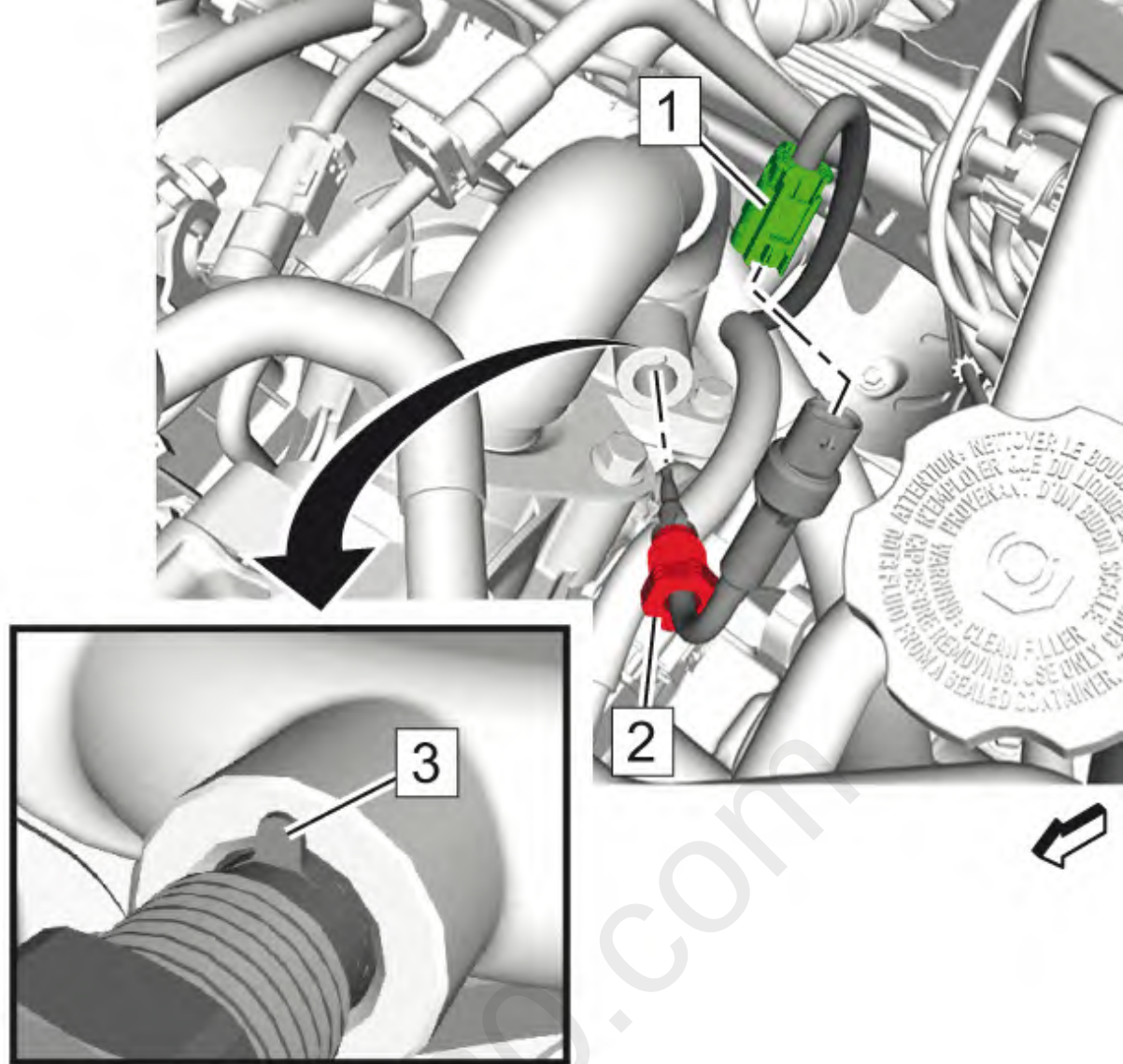


Fig. 386: Exhaust Gas Recirculation Cooler Temperature Sensor - Position 2 And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the electrical connector. (1)
2. Remove Exhaust Gas Recirculation Cooler Temperature Sensor (2)

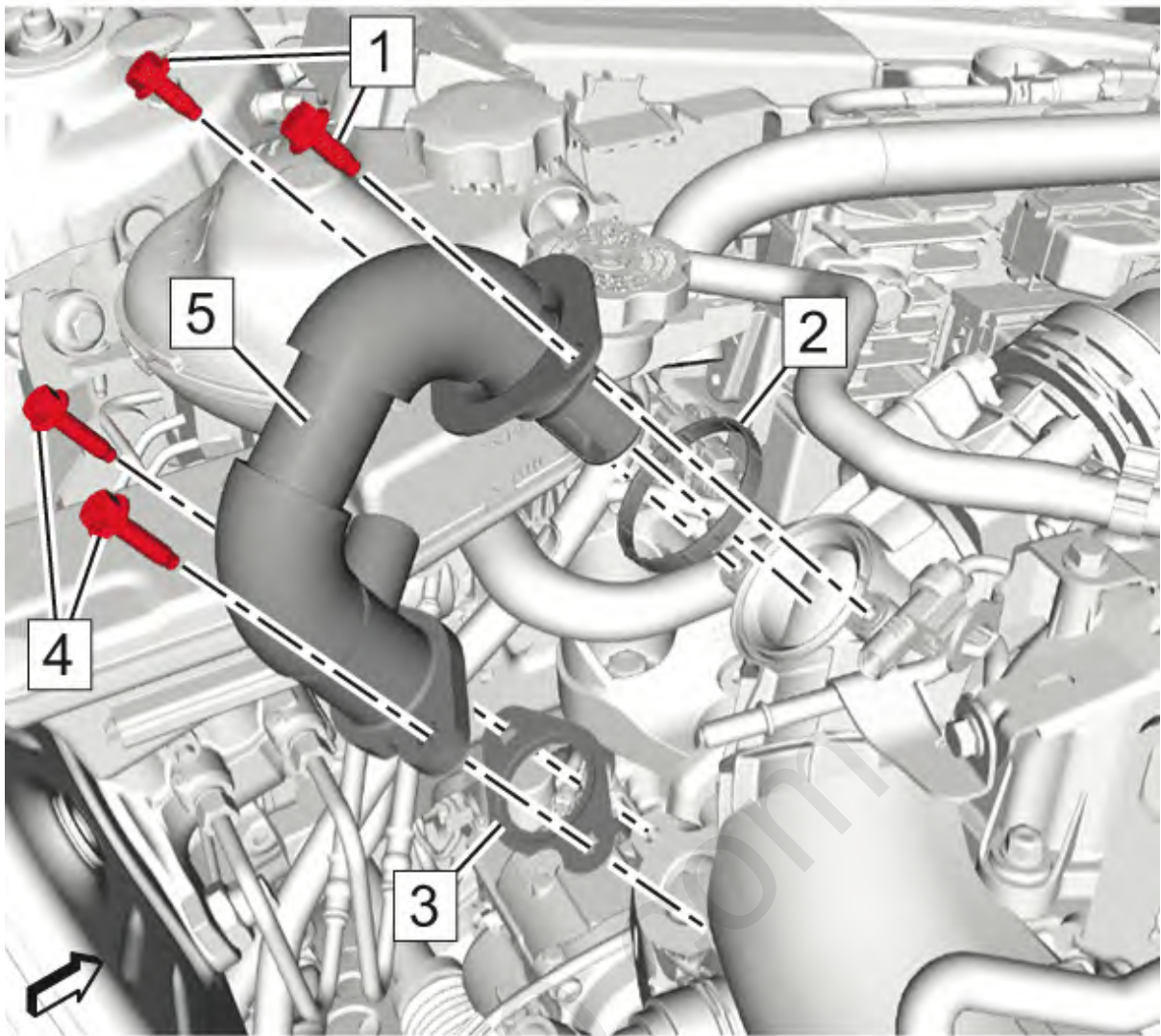


Fig.387: Exhaust Gas Recirculation Cooler Outlet Pipe, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

3. Remove Exhaust Gas Recirculation Cooler Outlet Pipe Bolts (1) (Qty: 2) @ Intake Manifold
4. Remove Exhaust Gas Recirculation Cooler Outlet Pipe Bolts (4) (Qty: 2) @ Exhaust Gas Recirculation Cooler
5. Remove Exhaust Gas Recirculation Cooler Outlet Pipe (5)
6. Remove and DISCARD Exhaust Gas Recirculation Cooler Outlet Pipe Gasket (3)
7. Remove and DISCARD Exhaust Gas Recirculation Cooler Outlet Pipe Seal (2)

Installation Procedure

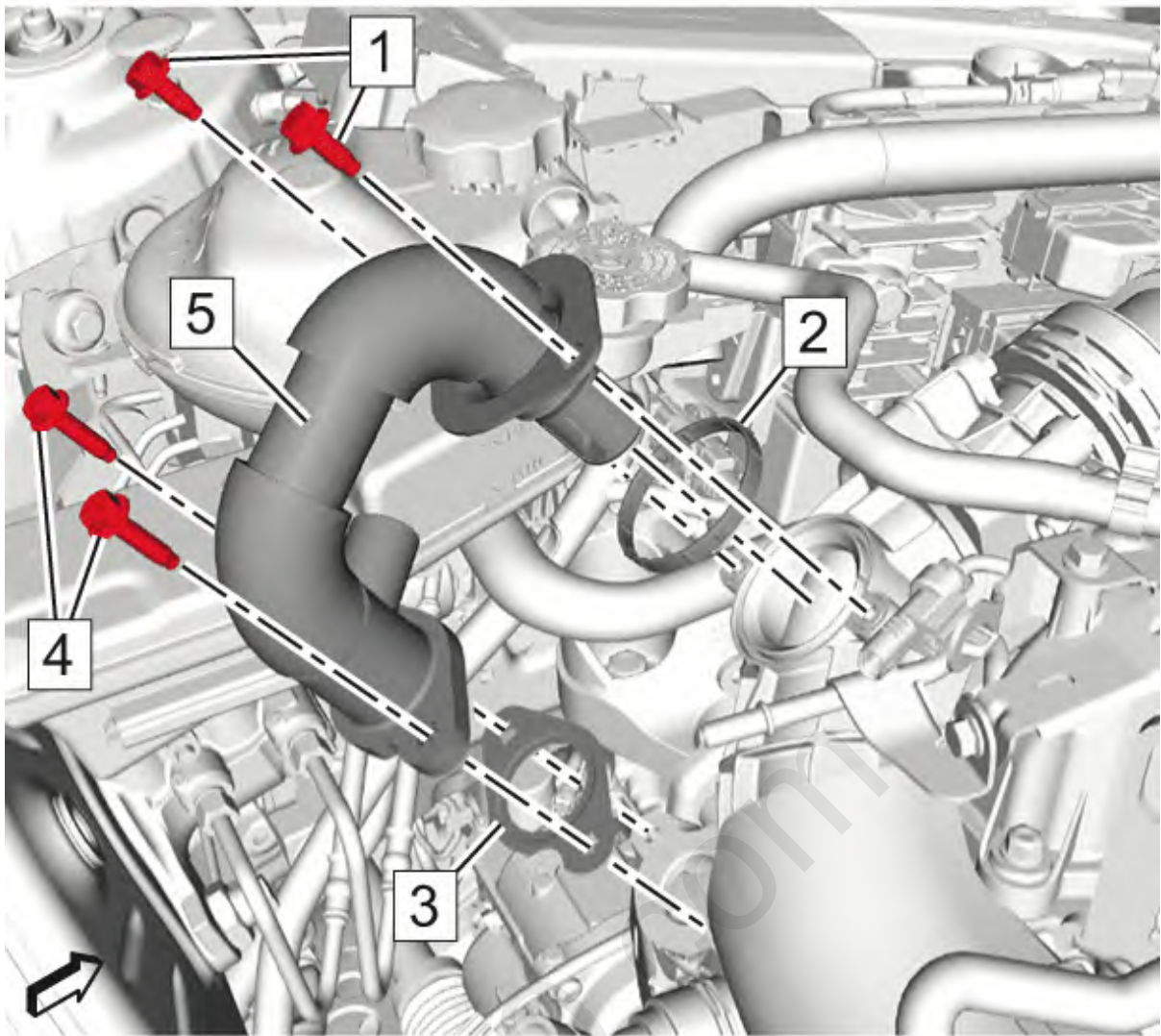


Fig.388: Exhaust Gas Recirculation Cooler Outlet Pipe, Bolts And Gaskets
Courtesy of GENERAL MOTORS COMPANY

1. Install NEW Exhaust Gas Recirculation Cooler Outlet Pipe Seal (2)
2. Install NEW Exhaust Gas Recirculation Cooler Outlet Pipe Gasket (3)
3. Install Exhaust Gas Recirculation Cooler Outlet Pipe (5)

CAUTION: Refer to **Fastener Caution**

4. Install and tighten Exhaust Gas Recirculation Cooler Outlet Pipe Bolts (4) (Qty: 2) @ Exhaust Gas Recirculation Cooler to 10 N.m (89 lb in)
5. Install and tighten Exhaust Gas Recirculation Cooler Outlet Pipe Bolts (1) (Qty: 2) @ Intake Manifold to 10 N.m (89 lb in)

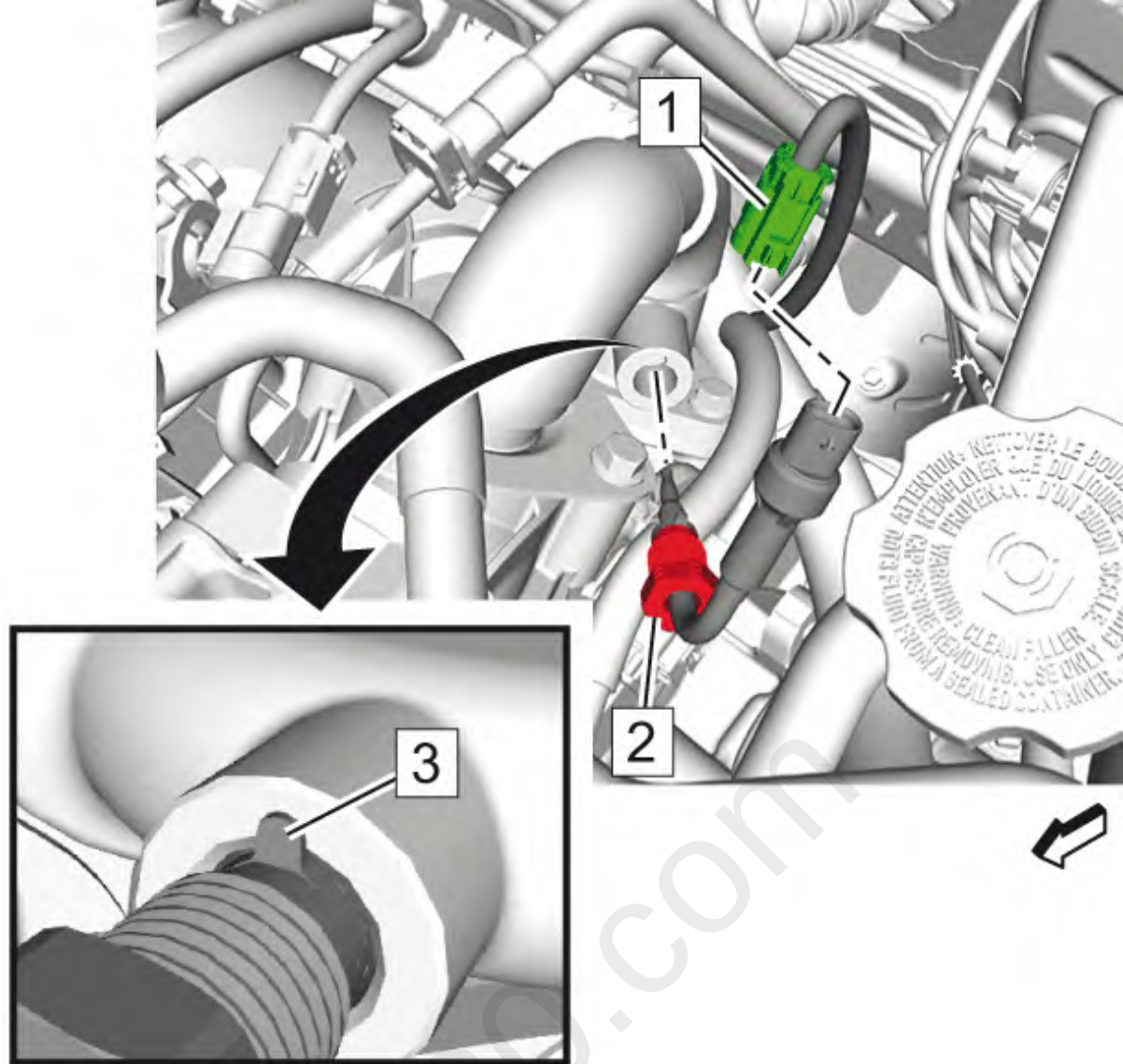


Fig. 389: Exhaust Gas Recirculation Cooler Temperature Sensor - Position 2 And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

NOTE: The guide lug (1) must fit the groove.

6. Install and tighten Exhaust Gas Recirculation Cooler Temperature Sensor (2) to 45 N.m (33 lb ft)
7. Connect the electrical connector. (1)

PISTON OIL NOZZLE OIL CONTROL SOLENOID VALVE REPLACEMENT (AWD)

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).

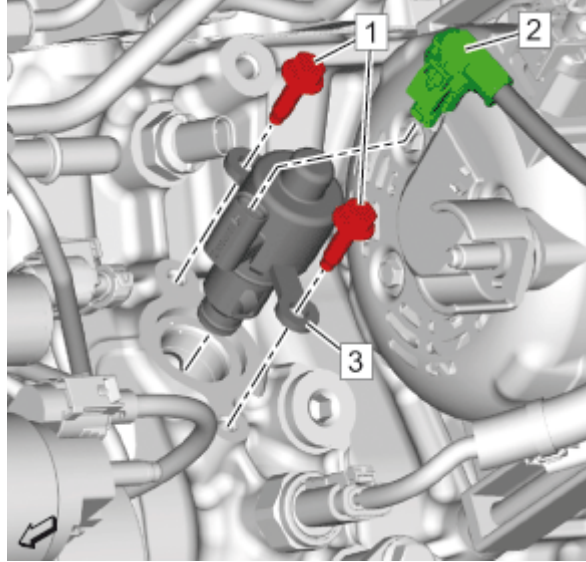


Fig. 390: Piston Oil Nozzle Oil Control Solenoid Valve, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connector (2)
5. Remove Piston Oil Nozzle Oil Control Solenoid Valve Bolts (1) (Qty: 2)

NOTE: Inspect the piston oil nozzle oil control solenoid valve o-rings and replace as necessary.

6. Remove Piston Oil Nozzle Oil Control Solenoid Valve (3)

Installation Procedure

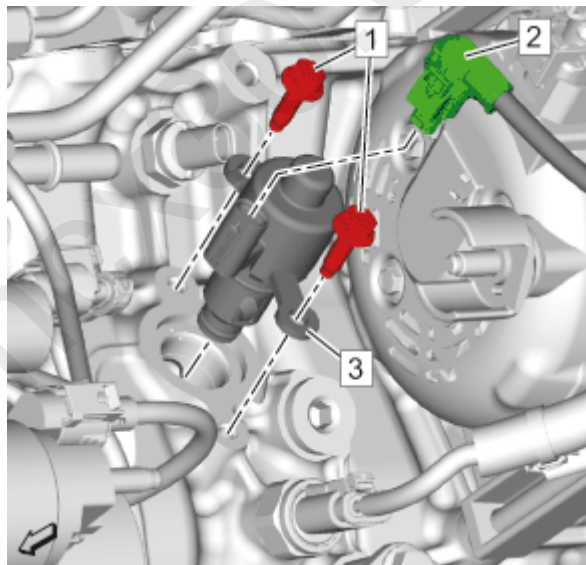


Fig. 391: Piston Oil Nozzle Oil Control Solenoid Valve, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install Piston Oil Nozzle Oil Control Solenoid Valve (3)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Piston Oil Nozzle Oil Control Solenoid Valve Bolts (1) (Qty: 2) to 10 N.m (89 lb in)
3. Connect Electrical Connector (2)
4. Install Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).
5. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
6. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).

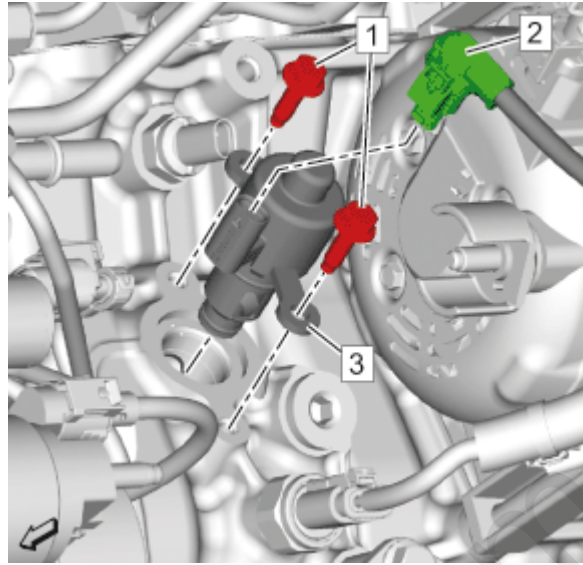


Fig. 392: Piston Oil Nozzle Oil Control Solenoid Valve, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Electrical Connector (2)
5. Remove Piston Oil Nozzle Oil Control Solenoid Valve Bolts (1) (Qty: 2)

NOTE: Inspect the piston oil nozzle oil control solenoid valve o-rings and replace as necessary.

6. Remove Piston Oil Nozzle Oil Control Solenoid Valve (3)

Installation Procedure

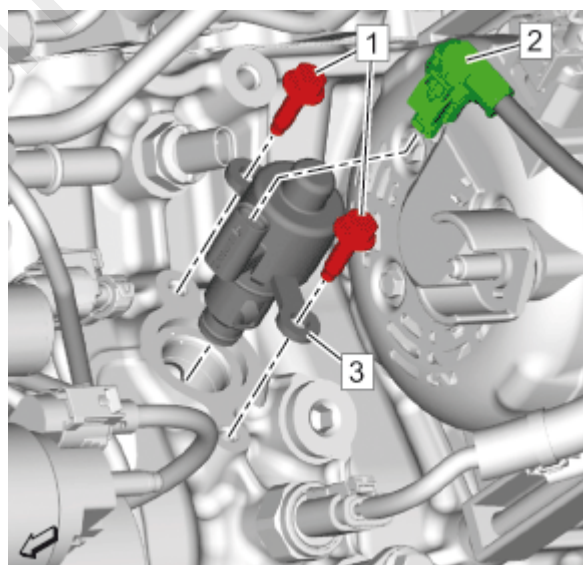


Fig. 393: Piston Oil Nozzle Oil Control Solenoid Valve, Bolts And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install Piston Oil Nozzle Oil Control Solenoid Valve (3)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Piston Oil Nozzle Oil Control Solenoid Valve Bolts (1) (Qty: 2) to 10 N.m (89 lb in)
3. Connect Electrical Connector (2)
4. Install Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).
5. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
6. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

OIL PUMP FLOW CONTROL SOLENOID VALVE REPLACEMENT (AWD)

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).

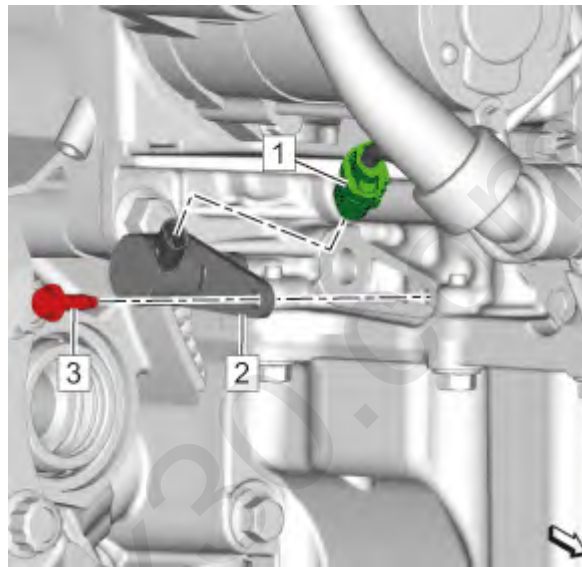


Fig. 394: Oil Pump Flow Control Solenoid Valve, Bolt And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector. (1)
5. Remove Oil Pump Flow Control Solenoid Valve Bolt (3)
6. Remove Oil Pump Flow Control Solenoid Valve (2)

Installation Procedure

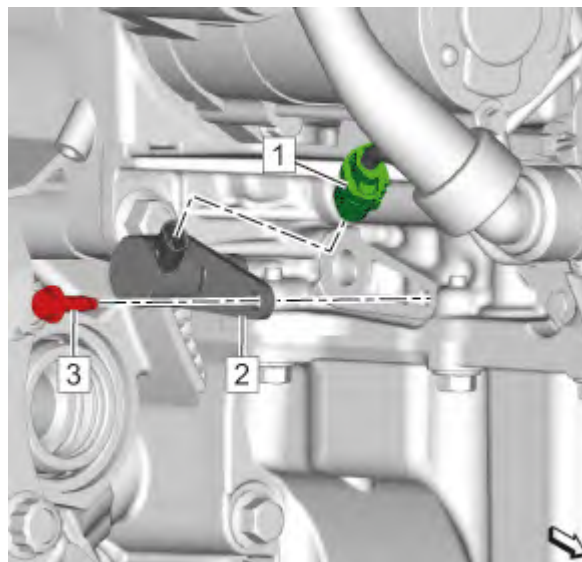


Fig. 395: Oil Pump Flow Control Solenoid Valve, Bolt And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install Oil Pump Flow Control Solenoid Valve (2)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Oil Pump Flow Control Solenoid Valve Bolt (3) to 10 N.m (89 lb in)
3. Connect the electrical connector. (1)
4. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Install Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).
6. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

OIL PUMP FLOW CONTROL SOLENOID VALVE REPLACEMENT (FWD)

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).

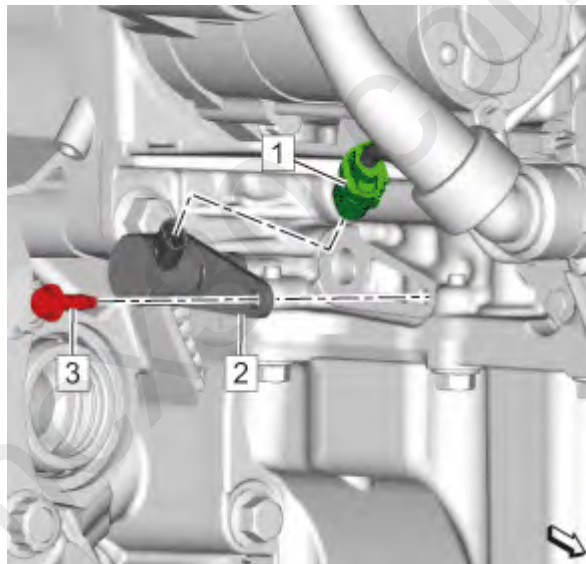


Fig. 396: Oil Pump Flow Control Solenoid Valve, Bolt And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector. (1)
5. Remove Oil Pump Flow Control Solenoid Valve Bolt (3)
6. Remove Oil Pump Flow Control Solenoid Valve (2)

Installation Procedure

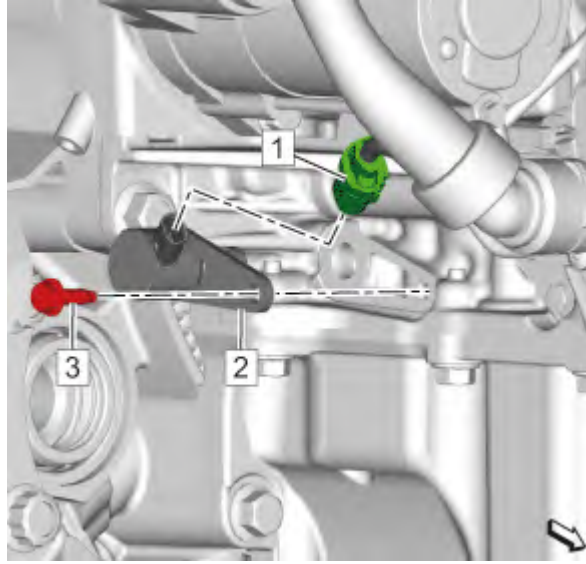


Fig. 397: Oil Pump Flow Control Solenoid Valve, Bolt And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

1. Install Oil Pump Flow Control Solenoid Valve (2)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Oil Pump Flow Control Solenoid Valve Bolt (3) to 10 N.m (89 lb in)
3. Connect the electrical connector. (1)
4. Remove the supports and lower the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
5. Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).
6. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

TURBOCHARGER WASTEGATE ACTUATOR VACUUM CONTROL SOLENOID VALVE REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

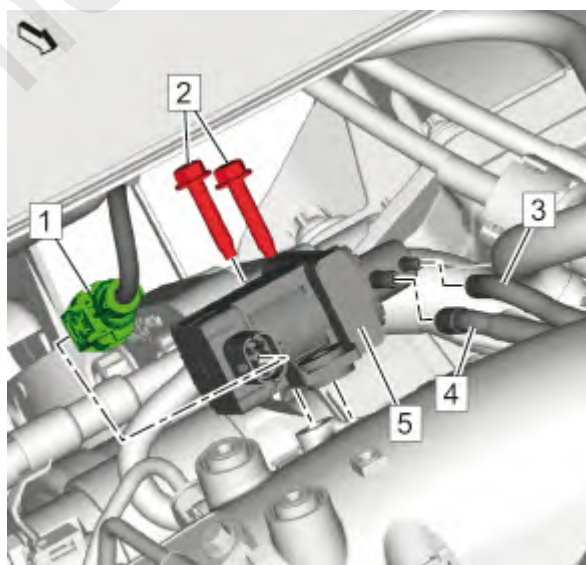


Fig. 398: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve And Components
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1)
3. Disconnect Turbocharger Wastegate Actuator Pipe (3)
4. Disconnect Power Brake Booster Vacuum Pipe (4)

5. Remove Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Bolts (2) (Qty: 2)
6. Remove Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve (5)

Installation Procedure

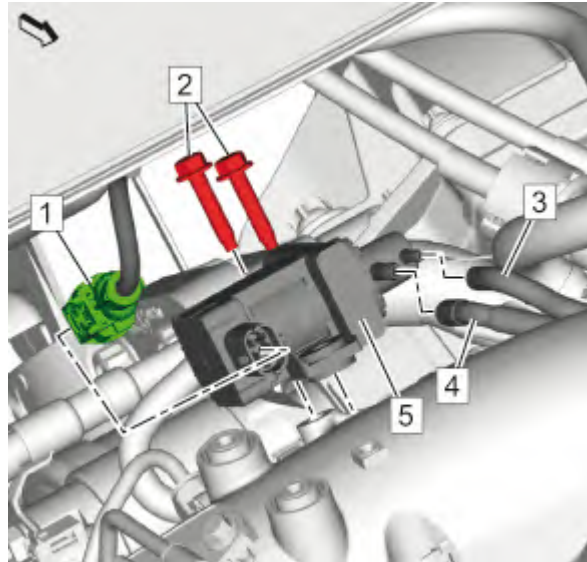


Fig. 399: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve And Components

Courtesy of GENERAL MOTORS COMPANY

1. Install Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve (5)

CAUTION: Refer to [Fastener Caution](#)

2. Install and tighten Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve Bolts (2) (Qty: 2) to 10 N.m (89 lb in)
3. Connect Power Brake Booster Vacuum Pipe (4)
4. Connect Turbocharger Wastegate Actuator Pipe (3)
5. Connect Electrical Connector (1)
6. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

TURBOCHARGER WASTEGATE ACTUATOR PIPE REPLACEMENT (TO WASTEGATE ACTUATOR VACUUM CONTROL SOLENOID VALVE AND EGR VACUUM REGULATOR SOLENOID VALVE - FWD)

Removal Procedure

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Position aside Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#)

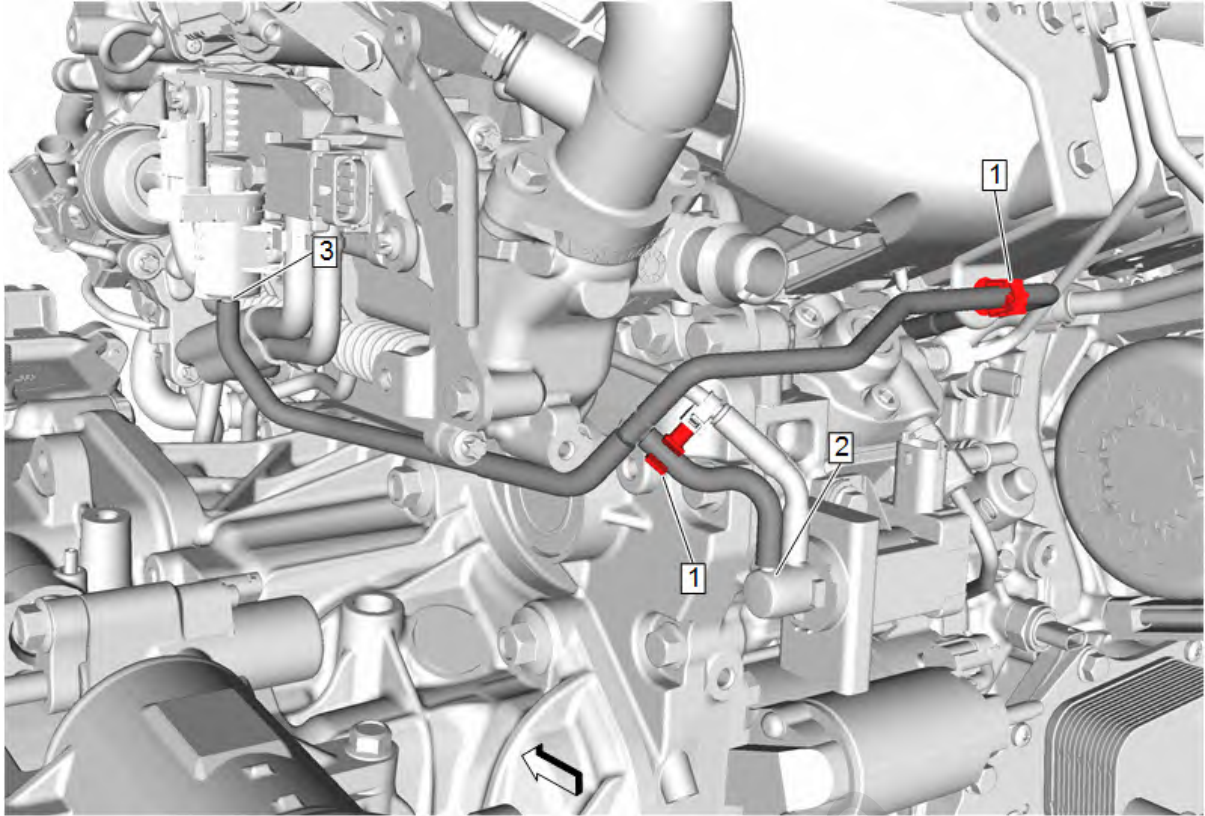


Fig. 400: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve, Vacuum Regulator Solenoid Valve And Retainer Clips
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the turbocharger wastegate actuator pipe from the 2 retainer clips (1).
5. Remove the turbocharger wastegate actuator pipe from the turbocharger wastegate actuator vacuum control solenoid valve (2).
6. Remove the turbocharger wastegate actuator pipe from the exhaust gas recirculation vacuum regulator solenoid valve (3).

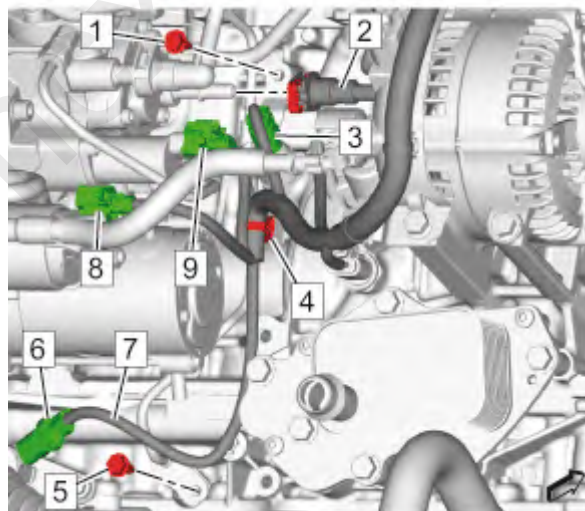


Fig. 401: Fuel Return Front Pipe, Wiring Harness, Connectors, Bolts And Clip
 Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Fuel Return Front Pipe (2) @ Fuel Injection Pump. Refer to [Plastic Collar Quick Connect Fitting Service](#)
8. Close all connections with suitable closure plugs.
9. Disconnect the electrical connectors:
 1. Engine Oil Pressure Switch (3)
 2. Fuel Injection Pump (9)
 3. Starter (8)

4. Oil Pump Flow Control Solenoid Valve (6)

10. Remove Wiring Harness Clip (4)

11. Hang the wiring harness (7) aside.

12. Remove the 2 turbocharger wastegate actuator pipe bracket bolts (1, 5)

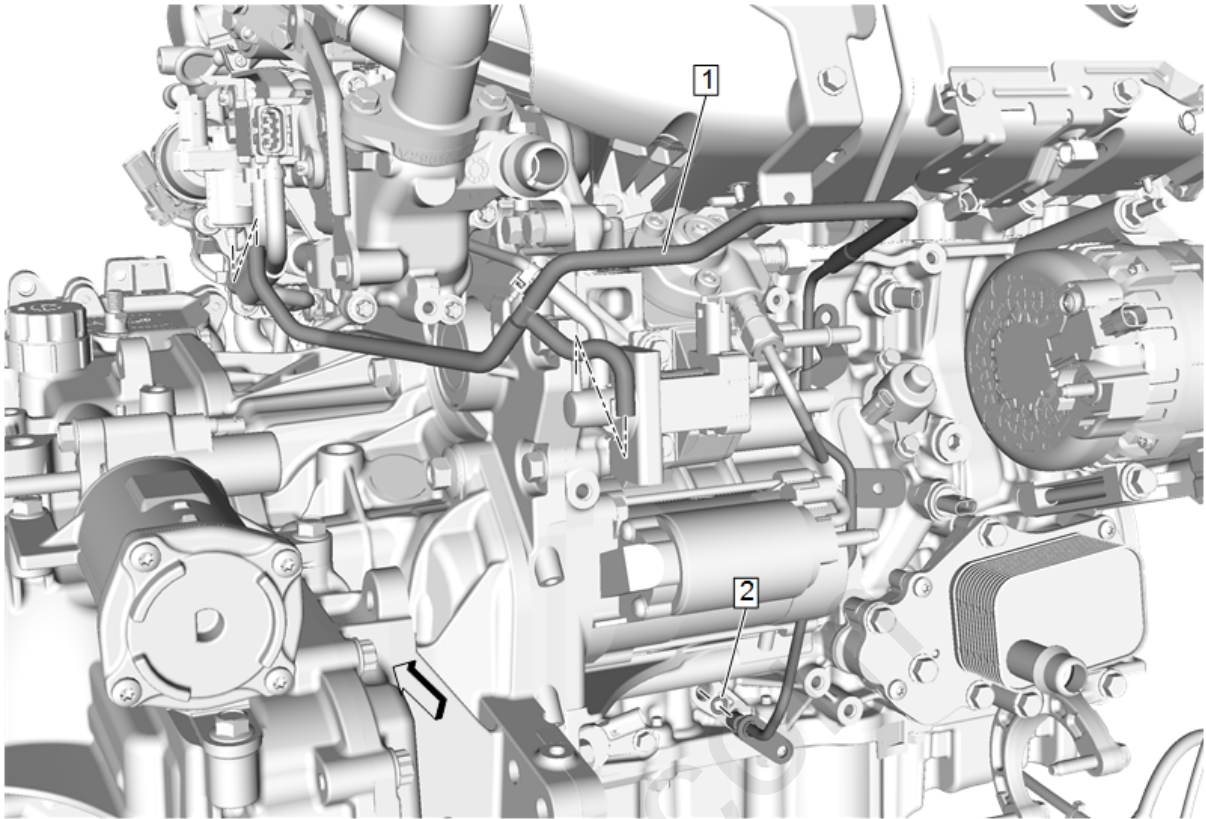


Fig. 402: Turbocharger Wastegate Actuator Pipe And Seal

Courtesy of GENERAL MOTORS COMPANY

13. Remove the turbocharger wastegate actuator pipe (1).

14. Remove and DISCARD the turbocharger wastegate actuator pipe seal (2).

Installation Procedure

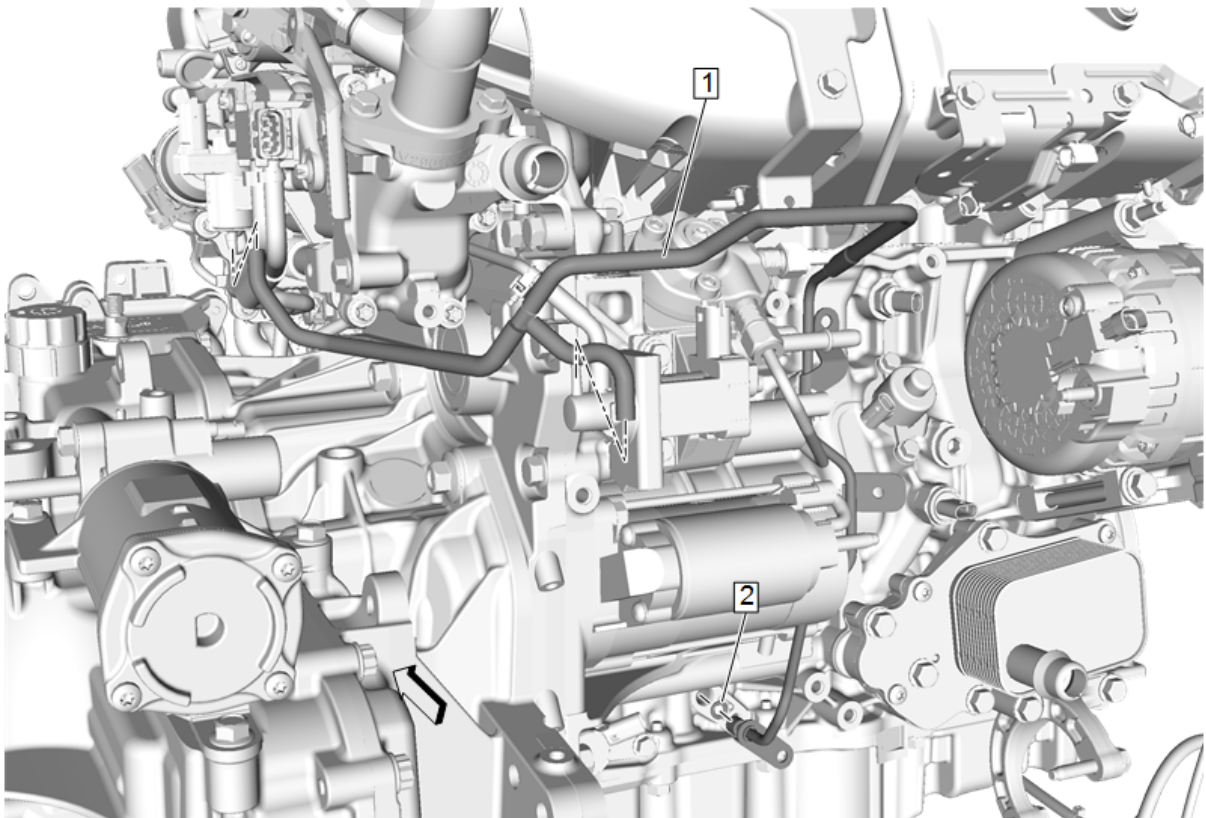


Fig. 403: Turbocharger Wastegate Actuator Pipe And Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW turbocharger wastegate actuator pipe seal (2).
2. Install the turbocharger wastegate actuator pipe (1).

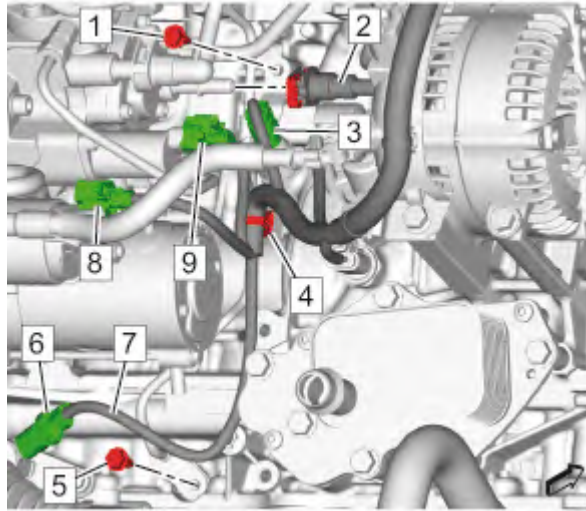


Fig. 404: Fuel Return Front Pipe, Wiring Harness, Connectors, Bolts And Clip
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

3. Install the 2 turbocharger wastegate actuator pipe bracket bolts (1, 5) and tighten to 10 N.m (89 lb in)
4. Position the wiring harness. (7)
5. Install Wiring Harness Clip (4)
6. Connect the electrical connector:
 1. Engine Oil Pressure Switch (3)
 2. Fuel Injection Pump (9)
 3. Starter (8)
 4. Oil Pump Flow Control Solenoid Valve (6)
7. Remove the closure plugs from all connections.
8. Connect Fuel Return Front Pipe (2) @ Fuel Injection Pump. Refer to [Plastic Collar Quick Connect Fitting Service](#)

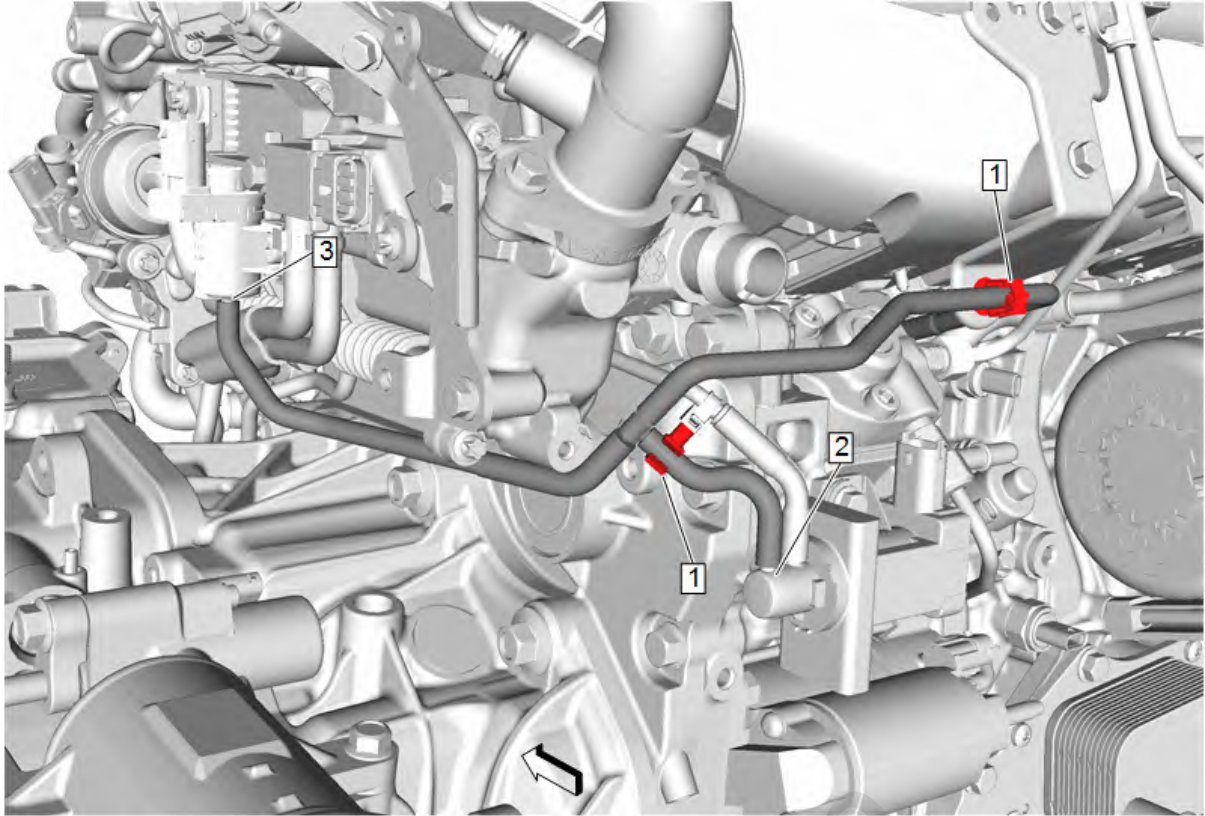


Fig. 405: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve, Vacuum Regulator Solenoid Valve And Retainer Clips
Courtesy of GENERAL MOTORS COMPANY

9. Install the turbocharger wastegate actuator pipe to the exhaust gas recirculation vacuum regulator solenoid valve (3).
10. Install the turbocharger wastegate actuator pipe to the turbocharger wastegate actuator vacuum control solenoid valve (2).
11. Install the turbocharger wastegate actuator pipe to the 2 retainer clips (1).
12. Install Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).
13. Lower the vehicle.
14. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

TURBOCHARGER WASTEGATE ACTUATOR PIPE REPLACEMENT (TO WASTEGATE ACTUATOR VACUUM CONTROL SOLENOID VALVE AND EGR VACUUM REGULATOR SOLENOID VALVE - AWD)

Removal Procedure

WARNING: Refer to [Safety Goggles and Fuel Warning](#)

WARNING: Refer to [Diesel/Gasoline Vapors Warning](#)

1. Disconnect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).

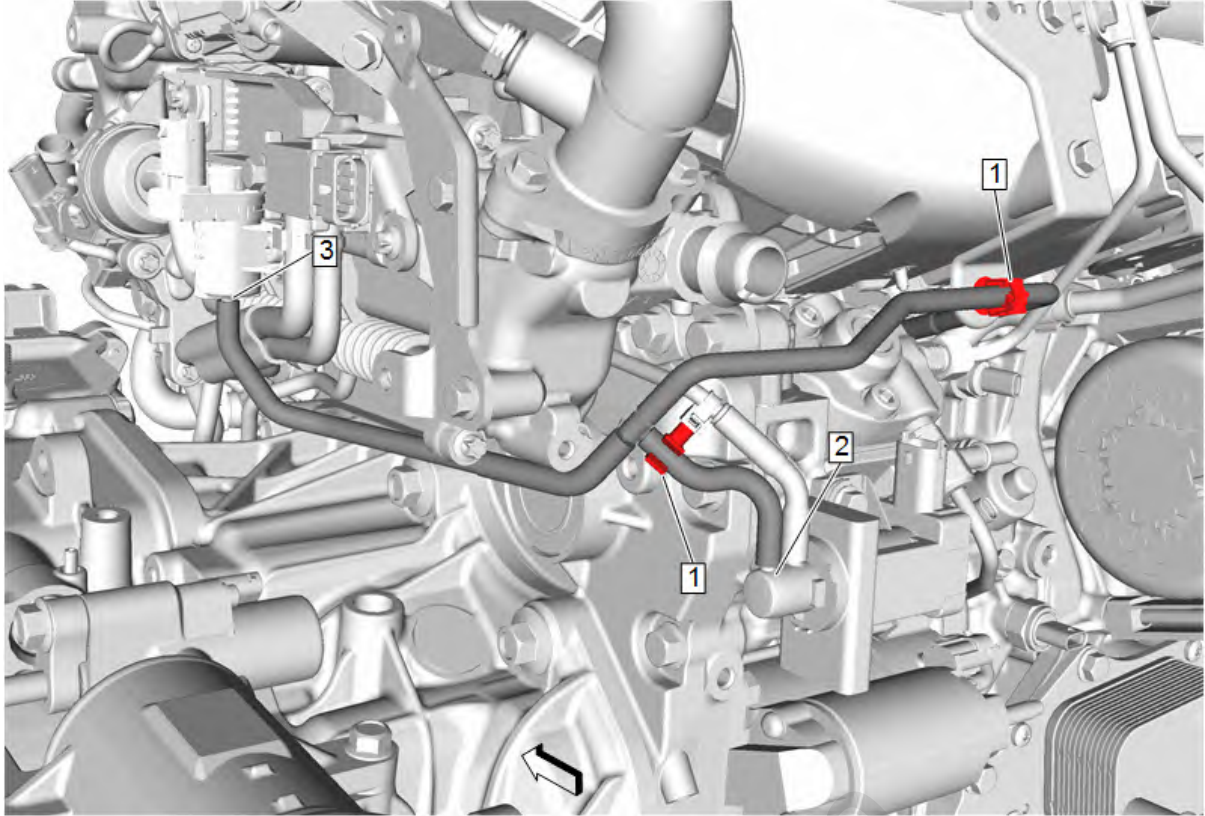


Fig. 406: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve, Vacuum Regulator Solenoid Valve And Retainer Clips
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the turbocharger wastegate actuator pipe from the 2 retainer clips (1).
5. Remove the turbocharger wastegate actuator pipe from the turbocharger wastegate actuator vacuum control solenoid valve (2).
6. Remove the turbocharger wastegate actuator pipe from the exhaust gas recirculation vacuum regulator solenoid valve (3).

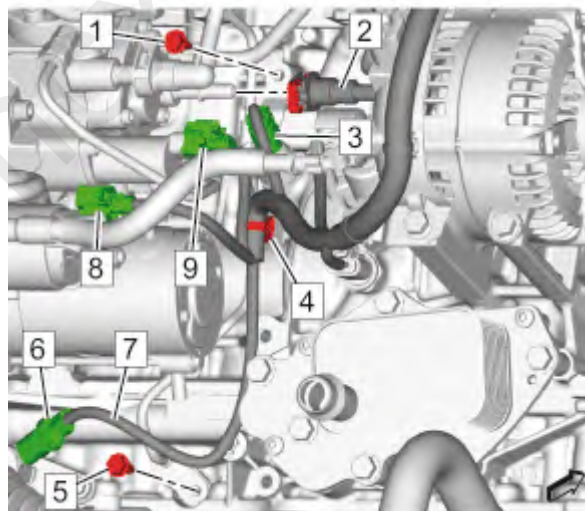


Fig. 407: Fuel Return Front Pipe, Wiring Harness, Connectors, Bolts And Clip
 Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Fuel Return Front Pipe (2) @ Fuel Injection Pump. Refer to **Plastic Collar Quick Connect Fitting Service**
8. Close all connections with suitable closure plugs.
9. Disconnect the electrical connectors:
 1. Engine Oil Pressure Switch (3)
 2. Fuel Injection Pump (9)
 3. Starter (8)

4. Oil Pump Flow Control Solenoid Valve (6)

10. Remove Wiring Harness Clip (4)

11. Hang the wiring harness (7) aside.

12. Remove the 2 turbocharger wastegate actuator pipe bracket bolts (1, 5)

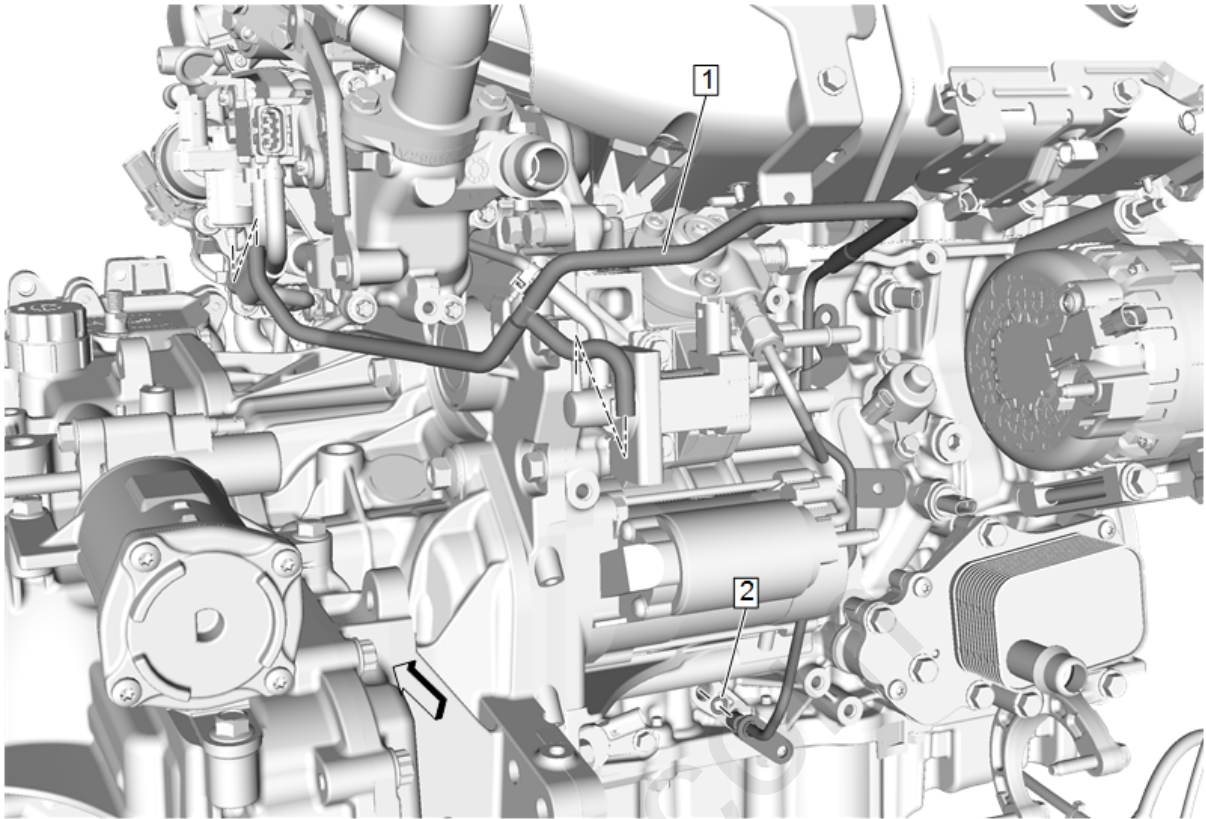


Fig. 408: Turbocharger Wastegate Actuator Pipe And Seal

Courtesy of GENERAL MOTORS COMPANY

13. Remove the turbocharger wastegate actuator pipe (1).

14. Remove and DISCARD the turbocharger wastegate actuator pipe seal (2).

Installation Procedure

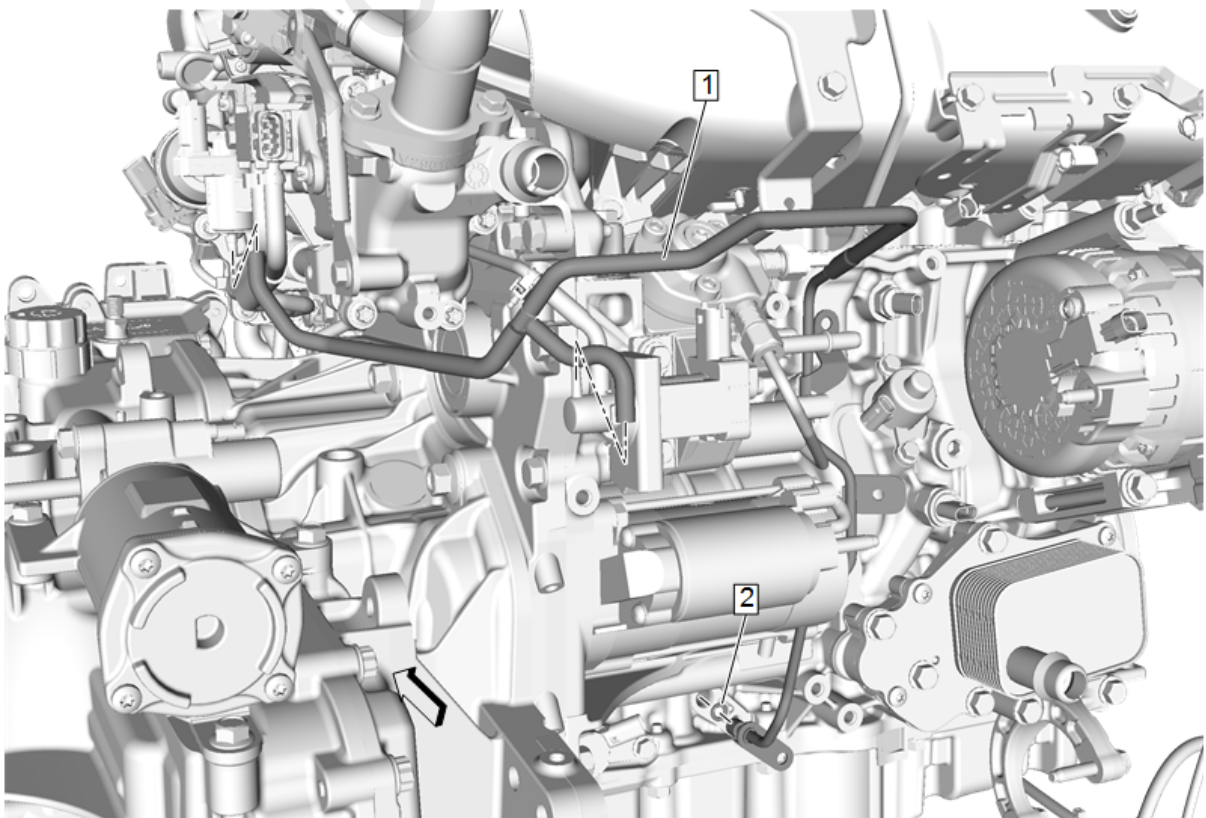


Fig. 409: Turbocharger Wastegate Actuator Pipe And Seal
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW turbocharger wastegate actuator pipe seal (2).
2. Install the turbocharger wastegate actuator pipe (1)

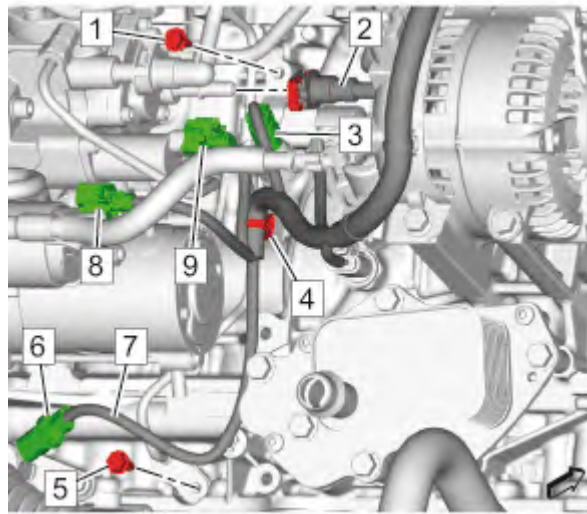


Fig. 410: Fuel Return Front Pipe, Wiring Harness, Connectors, Bolts And Clip
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

3. Install the 2 turbocharger wastegate actuator pipe bracket bolts (1, 5) and tighten to 10 N.m (89 lb in)
4. Position the wiring harness. (7)
5. Install Wiring Harness Clip (4)
6. Connect the electrical connectors:
 1. Engine Oil Pressure Switch (3)
 2. Fuel Injection Pump (9)
 3. Starter (8)
 4. Oil Pump Flow Control Solenoid Valve (6)
7. Remove the closure plugs from all connections.
8. Connect Fuel Return Front Pipe (2) @ Fuel Injection Pump. Refer to [Plastic Collar Quick Connect Fitting Service](#)

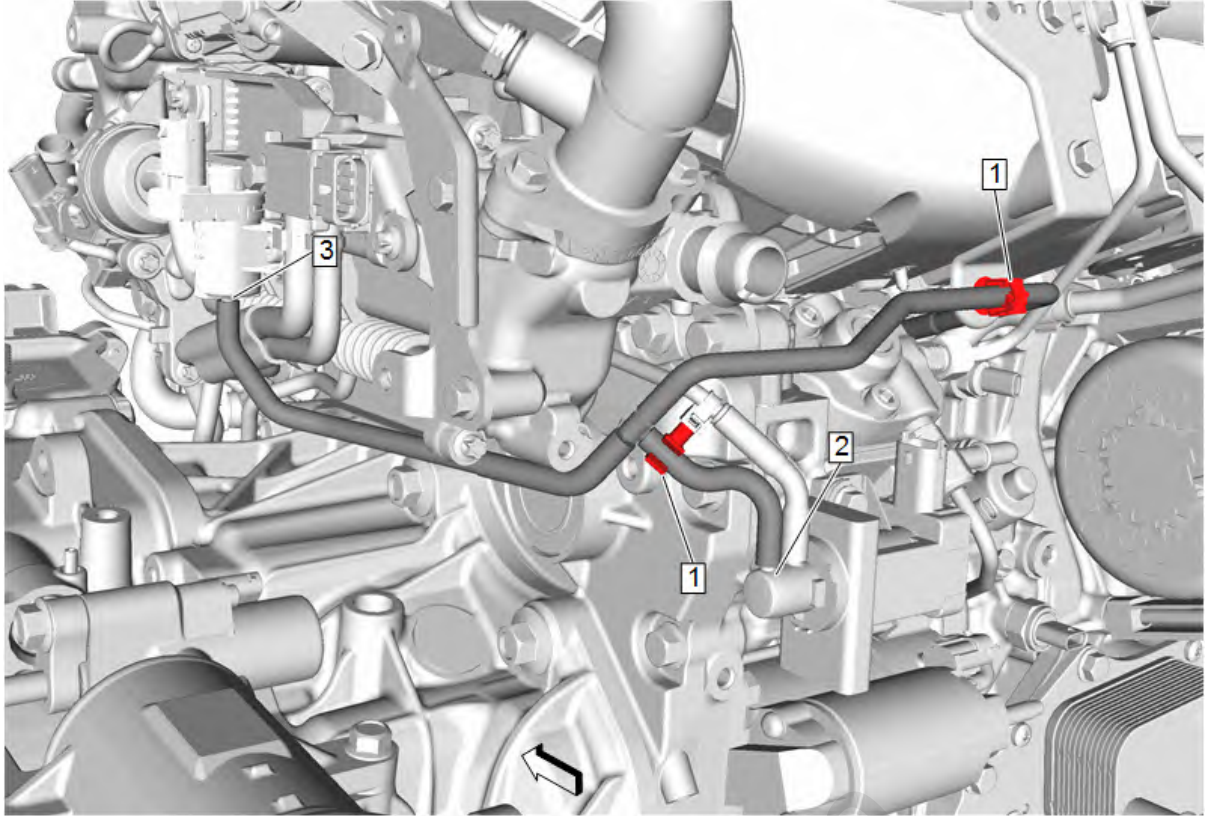


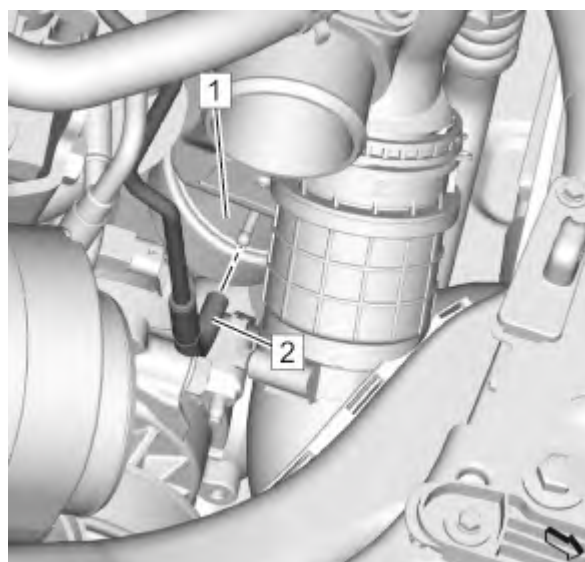
Fig. 411: Turbocharger Wastegate Actuator Vacuum Control Solenoid Valve, Vacuum Regulator Solenoid Valve And Retainer Clips
Courtesy of GENERAL MOTORS COMPANY

9. Install the turbocharger wastegate actuator pipe to the exhaust gas recirculation vacuum regulator solenoid valve (3).
10. Install the turbocharger wastegate actuator pipe to the turbocharger wastegate actuator vacuum control solenoid valve (2).
11. Install the turbocharger wastegate actuator pipe to the 2 retainer clips (1).
12. Install Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).
13. Lower the vehicle.
14. Connect the negative battery cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

TURBOCHARGER WASTEGATE ACTUATOR PIPE REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
2. Remove the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)



3. Remove Turbocharger Wastegate Actuator Pipe (2) @ Turbocharger (1)

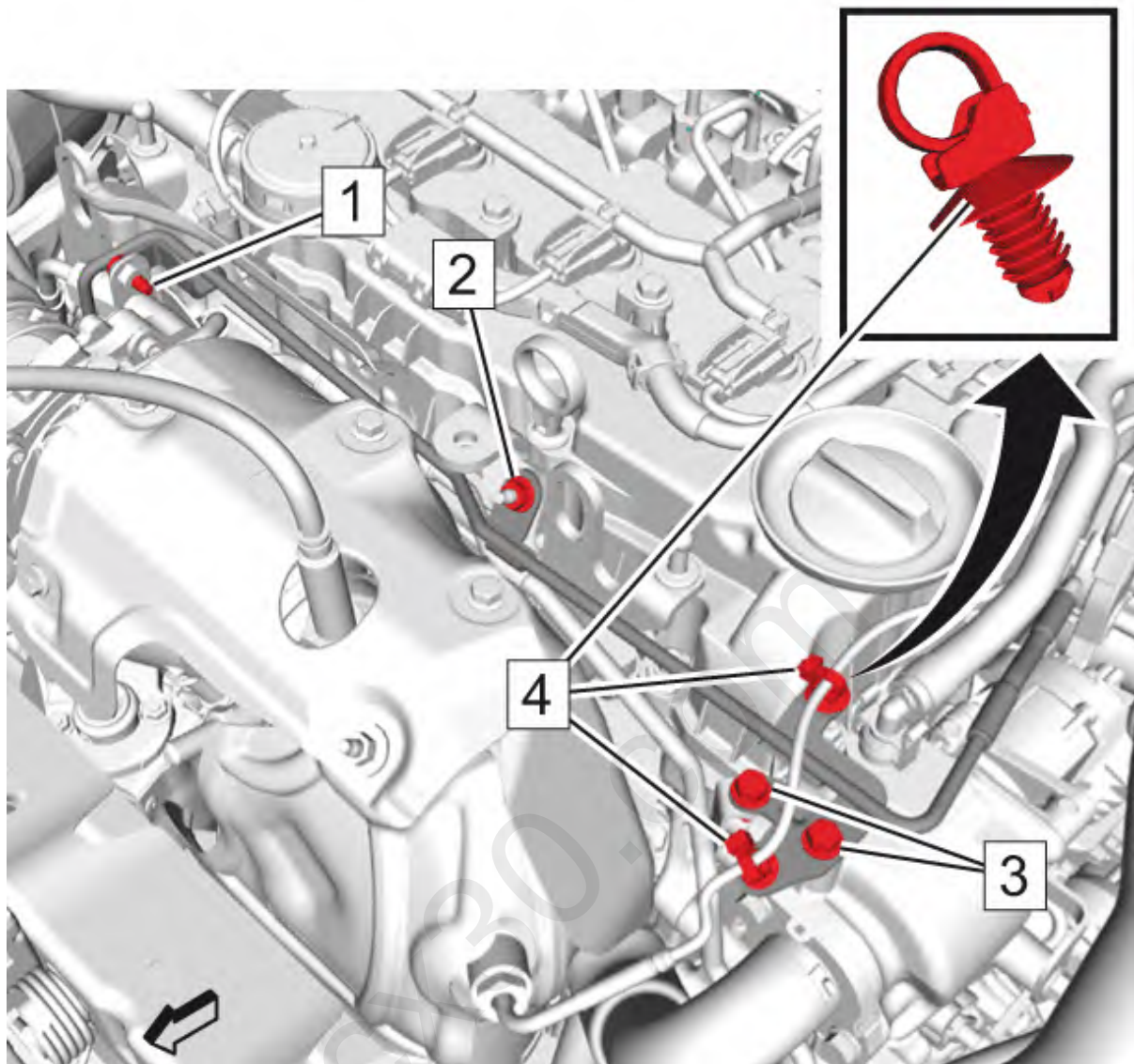


Fig. 413: Turbocharger Wastegate Actuator Pipe Bolts, Nut And Clips
Courtesy of GENERAL MOTORS COMPANY

4. Unclip Wiring Harness Clips (4) (Qty: 2)
5. Remove Turbocharger Wastegate Actuator Pipe Bolts (1, 3) (Qty: 3)
6. Remove the turbocharger wastegate actuator pipe nut (2).

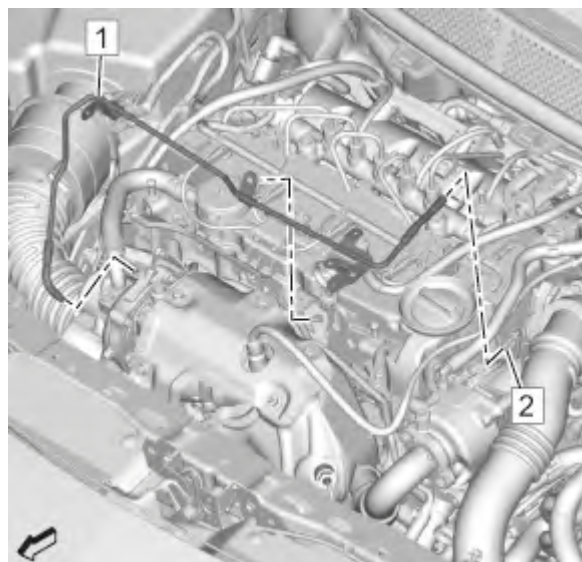


Fig. 414: Turbocharger Wastegate Actuator Pipe And Power Brake Booster Inlet Hose Connector Fitting

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Turbocharger Wastegate Actuator Pipe (1) @ Power Brake Booster Inlet Hose Connector Fitting (2)
8. Remove Turbocharger Wastegate Actuator Pipe (1) @ Vehicle

Installation Procedure

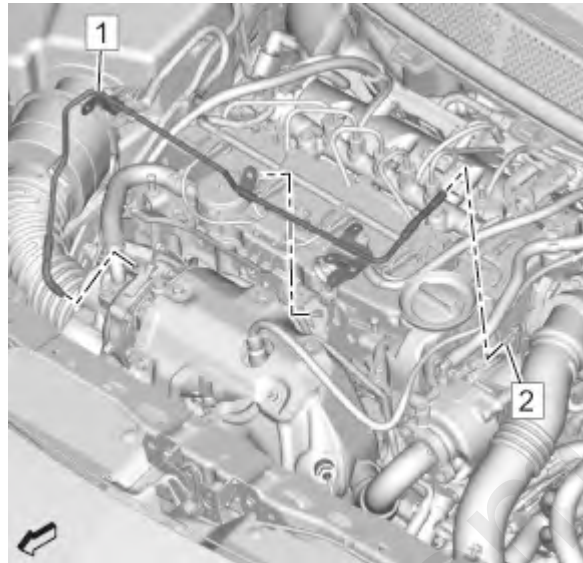


Fig. 415: Turbocharger Wastegate Actuator Pipe And Power Brake Booster Inlet Hose Connector Fitting

Courtesy of GENERAL MOTORS COMPANY

1. Install Turbocharger Wastegate Actuator Pipe (1) @ Vehicle
2. Connect Turbocharger Wastegate Actuator Pipe (1) @ Power Brake Booster Inlet Hose Connector Fitting (2)

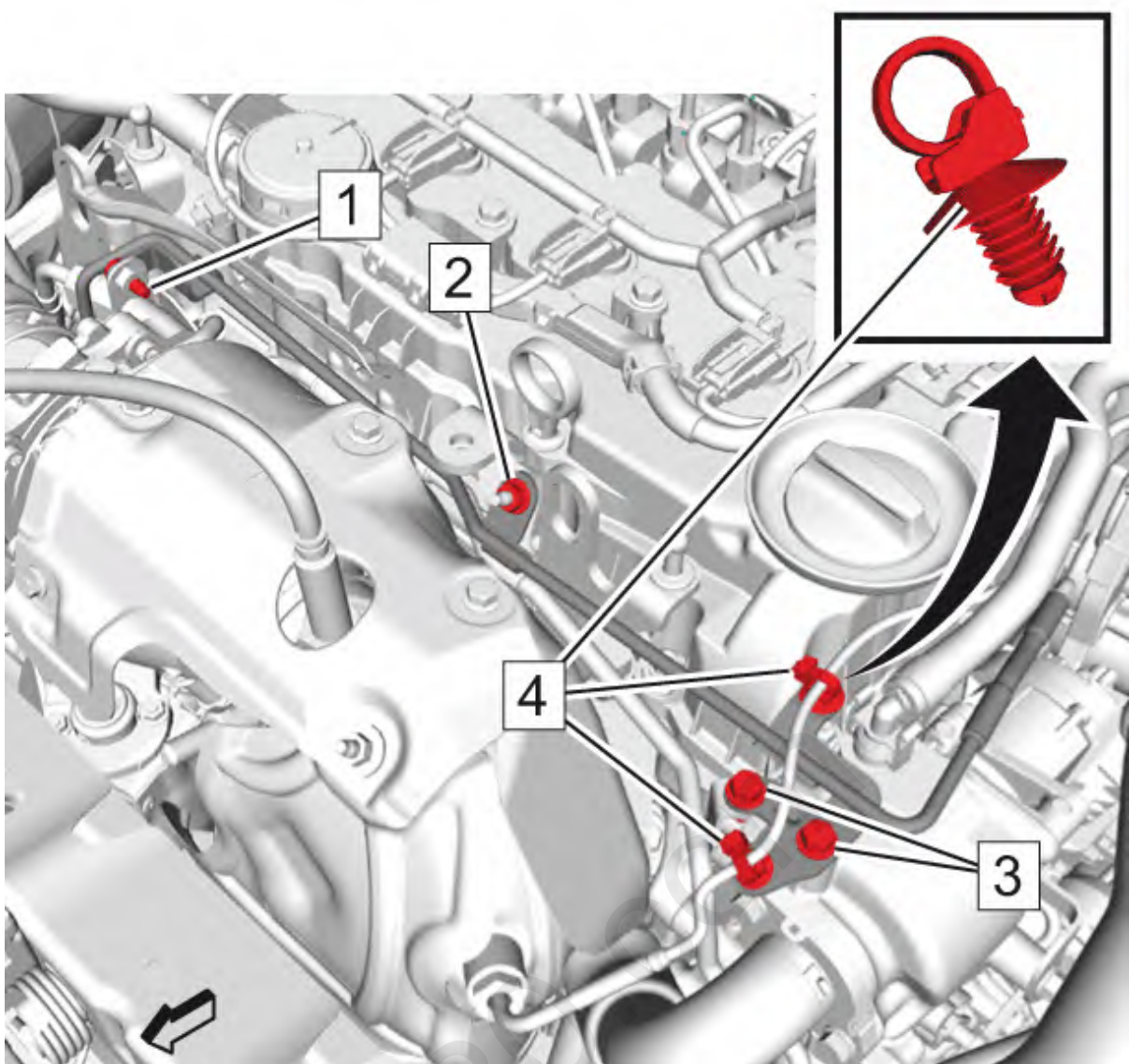


Fig. 416: Turbocharger Wastegate Actuator Pipe Bolts, Nut And Clips
 Courtesy of GENERAL MOTORS COMPANY

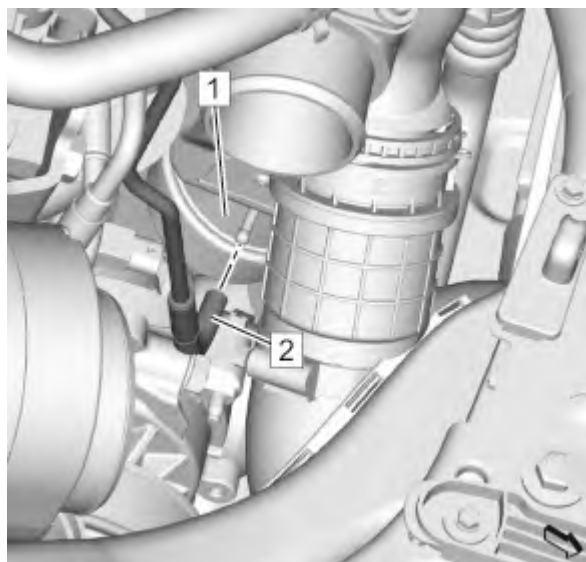
3. Install the turbocharger wastegate actuator pipe nut (2).

CAUTION: Refer to [Fastener Caution](#)

4. Install and tighten Turbocharger Wastegate Actuator Pipe Bolts (1, 3) (Qty: 3) to 10 N.m (89 lb in)

5. Tighten the turbocharger wastegate actuator pipe nut (2) to 10 N.m (89 lb in).

6. Install Wiring Harness Clips (4) (Qty: 2)



7. Install Turbocharger Wastegate Actuator Pipe (2) @ Turbocharger (1)
8. Install the air cleaner outlet duct. Refer to [Air Cleaner Outlet Duct Replacement](#)
9. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

POWER BRAKE BOOSTER INLET HOSE CONNECTOR FITTING REPLACEMENT

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
3. Remove the throttle body assembly. Refer to [Throttle Body Assembly Replacement](#)
4. Remove the exhaust gas recirculation cooler housing. Refer to [Exhaust Gas Recirculation Cooler Housing Replacement](#)
5. Remove Oxidation Catalytic Converter. Refer to [Oxidation Catalytic Converter Replacement \(LH7\)](#).

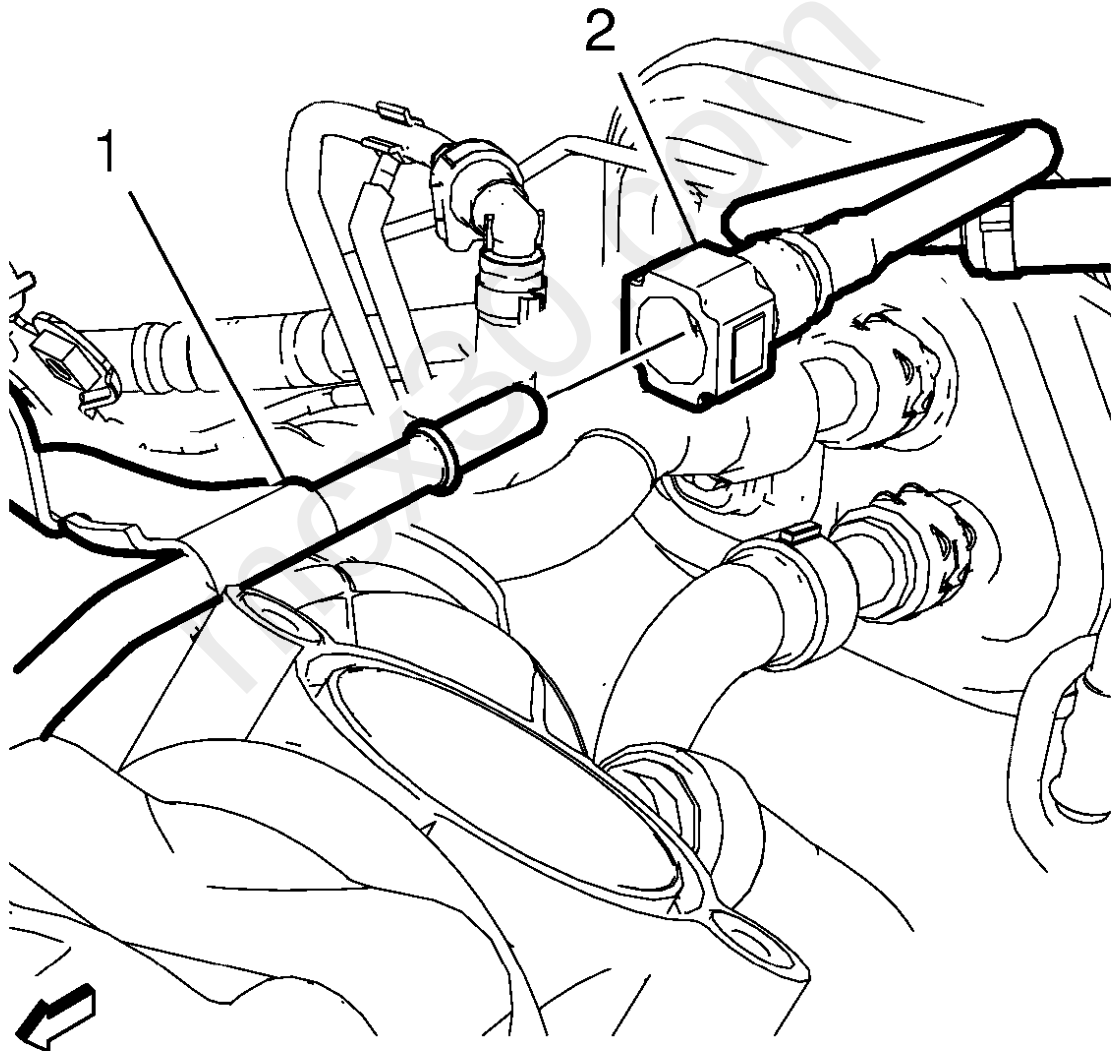


Fig. 418: Power Brake Booster Vacuum Pipe And Power Brake Booster Inlet Hose Fitting
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect the power brake booster vacuum pipe (2) from the power brake booster inlet hose fitting (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)

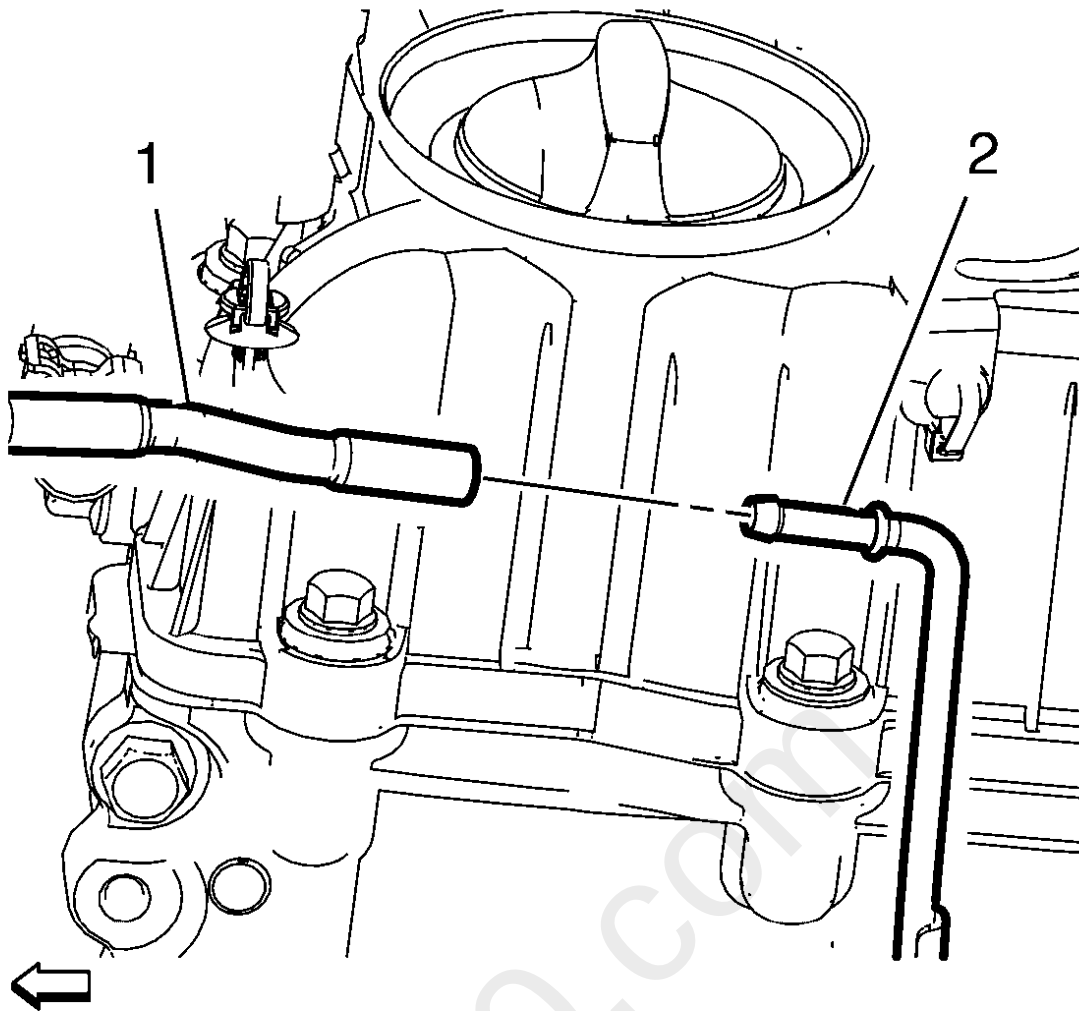


Fig. 419: Power Brake Booster Inlet Hose Connector Fitting And Turbocharger Wastegate Actuator Pipe

Courtesy of GENERAL MOTORS COMPANY

7. Remove the power brake booster inlet hose connector fitting (2) from the turbocharger wastegate actuator pipe (1).

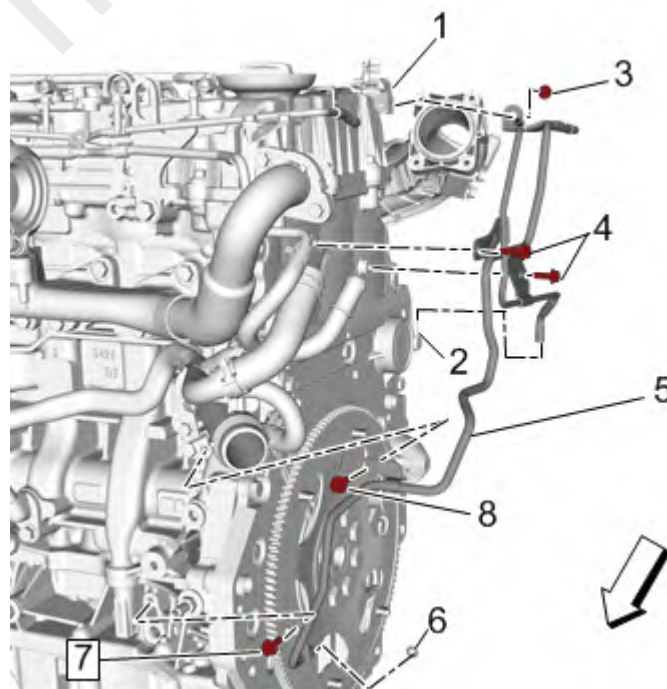


Fig. 420: Power Brake Booster Inlet Hose Connector Fitting And Components

Courtesy of GENERAL MOTORS COMPANY

8. Remove the power brake booster inlet hose connector fitting bracket bolt (3) from the exhaust temperature sensor wiring harness bracket (1).
9. Remove the 2 power brake booster inlet hose connector fitting bolts (4)
10. Remove the power brake booster inlet hose connector fitting bracket bolt (8) from the engine coolant outlet pipe bracket.
11. Remove the power brake booster inlet hose from the turbocharger wastegate actuator vacuum control solenoid valve (2).
12. Remove Thermostat Bypass Pipe. Refer to [Thermostat Bypass Pipe Replacement \(LH7\)](#).
13. Remove Engine Coolant Outlet Pipe. Refer to [Engine Coolant Outlet Pipe Removal](#)
14. Remove the power brake booster inlet hose connector fitting bolt (7) from the lower crankcase.
15. Remove the power brake booster inlet hose connector fitting (5).
16. Remove the power brake booster inlet hose connector fitting seal (6).

Installation Procedure

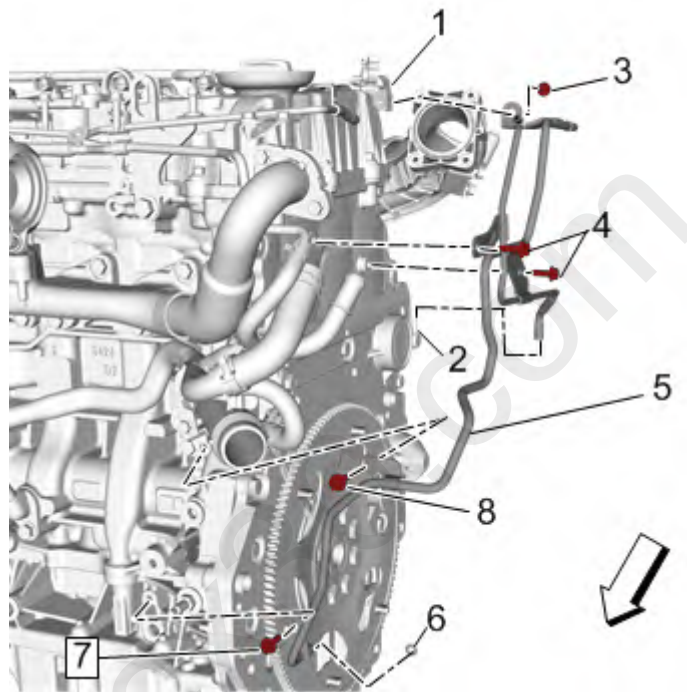


Fig. 421: Power Brake Booster Inlet Hose Connector Fitting And Components
 Courtesy of GENERAL MOTORS COMPANY

1. Install the power brake booster inlet hose connector fitting seal (6).
2. Install the power brake booster inlet hose connector fitting (5).

CAUTION: Refer to [Fastener Caution](#) .

3. Install the power brake booster inlet hose connector fitting bolt (7) to lower crankcase and tighten to 10 N.m (89 lb in).
4. Install the power brake booster inlet hose connector fitting bracket bolt (8) to the engine coolant outlet pipe bracket and tighten to 10 N.m (89 lb in).
5. Install the 2 power brake booster inlet hose connector fitting bolts (4) and tighten to 10 N.m (89 lb in).
6. Install the power brake booster inlet hose to the turbocharger wastegate actuator vacuum control solenoid valve (2).
7. Install Thermostat Bypass Pipe. Refer to [Thermostat Bypass Pipe Replacement \(LH7\)](#).
8. Install Engine Coolant Outlet Pipe. Refer to [Engine Coolant Outlet Pipe Removal](#)
9. Install the power brake booster inlet hose connector fitting bracket bolt (3) to the exhaust temperature sensor wiring harness bracket (1) and tighten to 10 N.m (89 lb in).

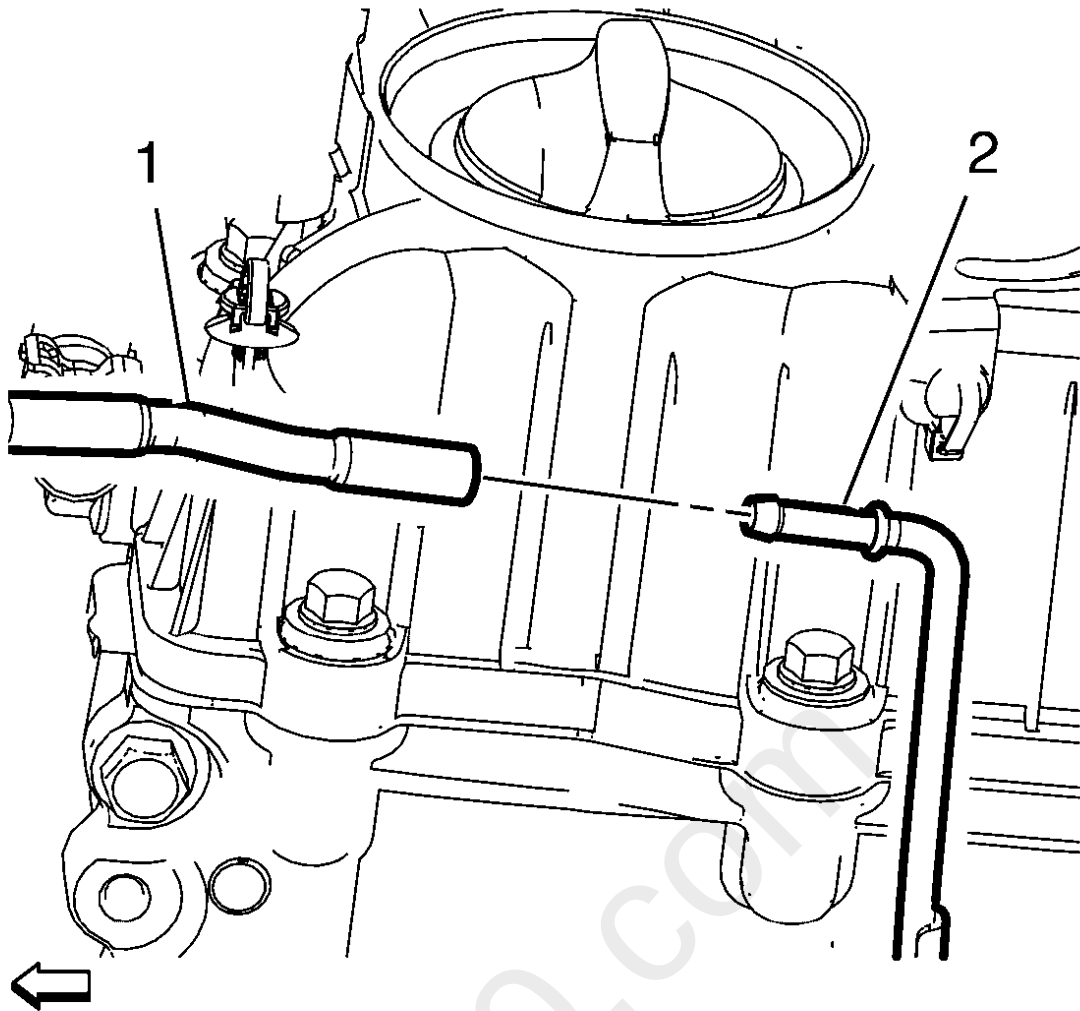


Fig. 422: Power Brake Booster Inlet Hose Connector Fitting And Turbocharger Wastegate Actuator Pipe

Courtesy of GENERAL MOTORS COMPANY

10. Install the power brake booster inlet hose connector fitting (2) to the turbocharger wastegate actuator pipe (1).

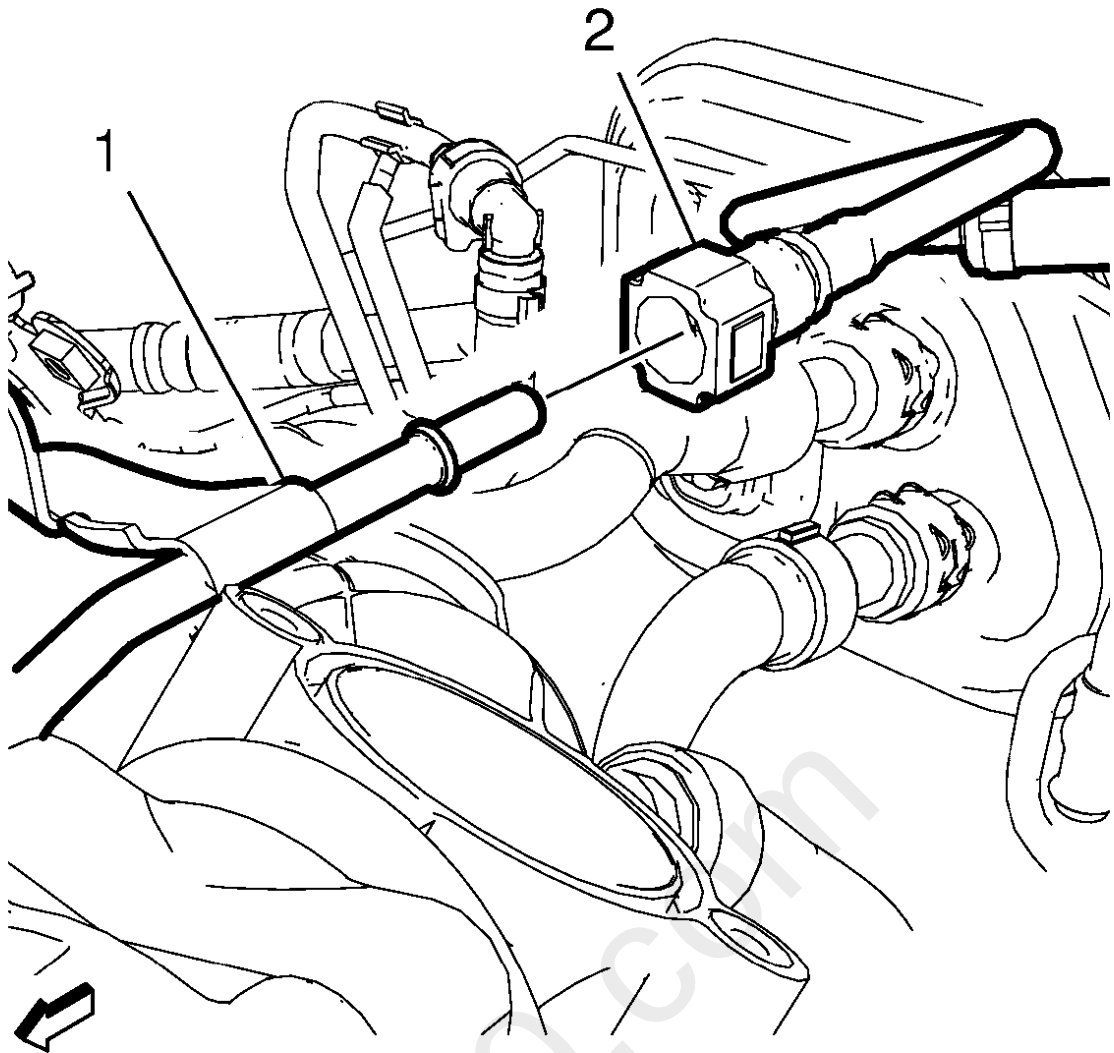


Fig. 423: Power Brake Booster Vacuum Pipe And Power Brake Booster Inlet Hose Fitting
Courtesy of GENERAL MOTORS COMPANY

11. Connect the power brake booster vacuum pipe (2) to the power brake booster inlet hose fitting (1). Refer to [Plastic Collar Quick Connect Fitting Service](#)
12. Install Oxidation Catalytic Converter. Refer to [Oxidation Catalytic Converter Replacement \(LH7\)](#)
13. Install the exhaust gas recirculation cooler housing. Refer to [Exhaust Gas Recirculation Cooler Housing Replacement](#)
14. Install the throttle body assembly. Refer to [Throttle Body Assembly Replacement](#)
15. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
16. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#)

CHARGE AIR BYPASS VALVE VACUUM HOSE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
2. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

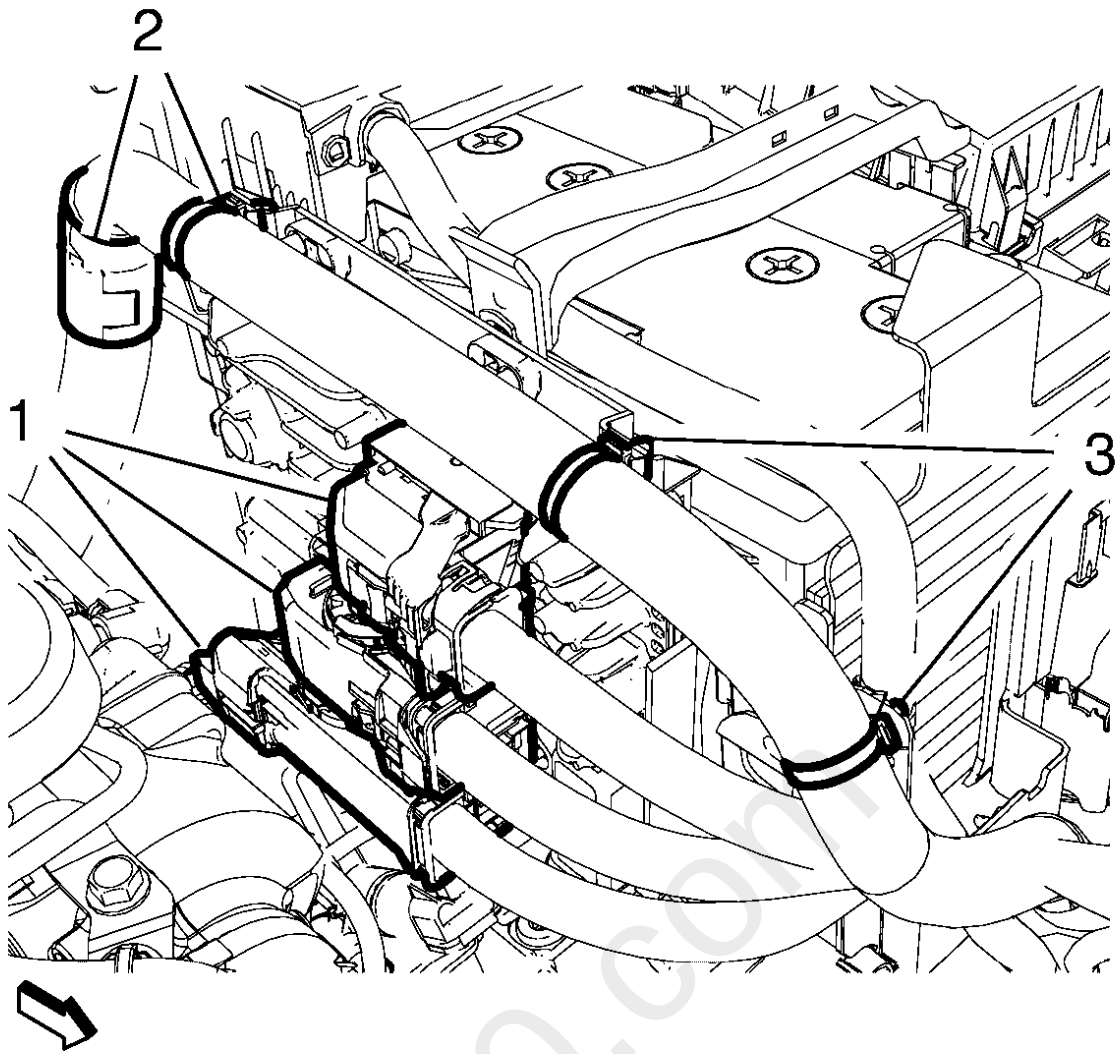


Fig. 424: Engine Control Module Electrical Connectors And Harness Clips
Courtesy of GENERAL MOTORS COMPANY

3. Unclip the 4 wiring harness clips (2, 3) from the bracket.
4. Remove the engine control module bracket along with the engine control module in top direction from the battery tray.
5. Disconnect the 3 engine control module electrical connectors (1) from the engine control module and hang it aside.

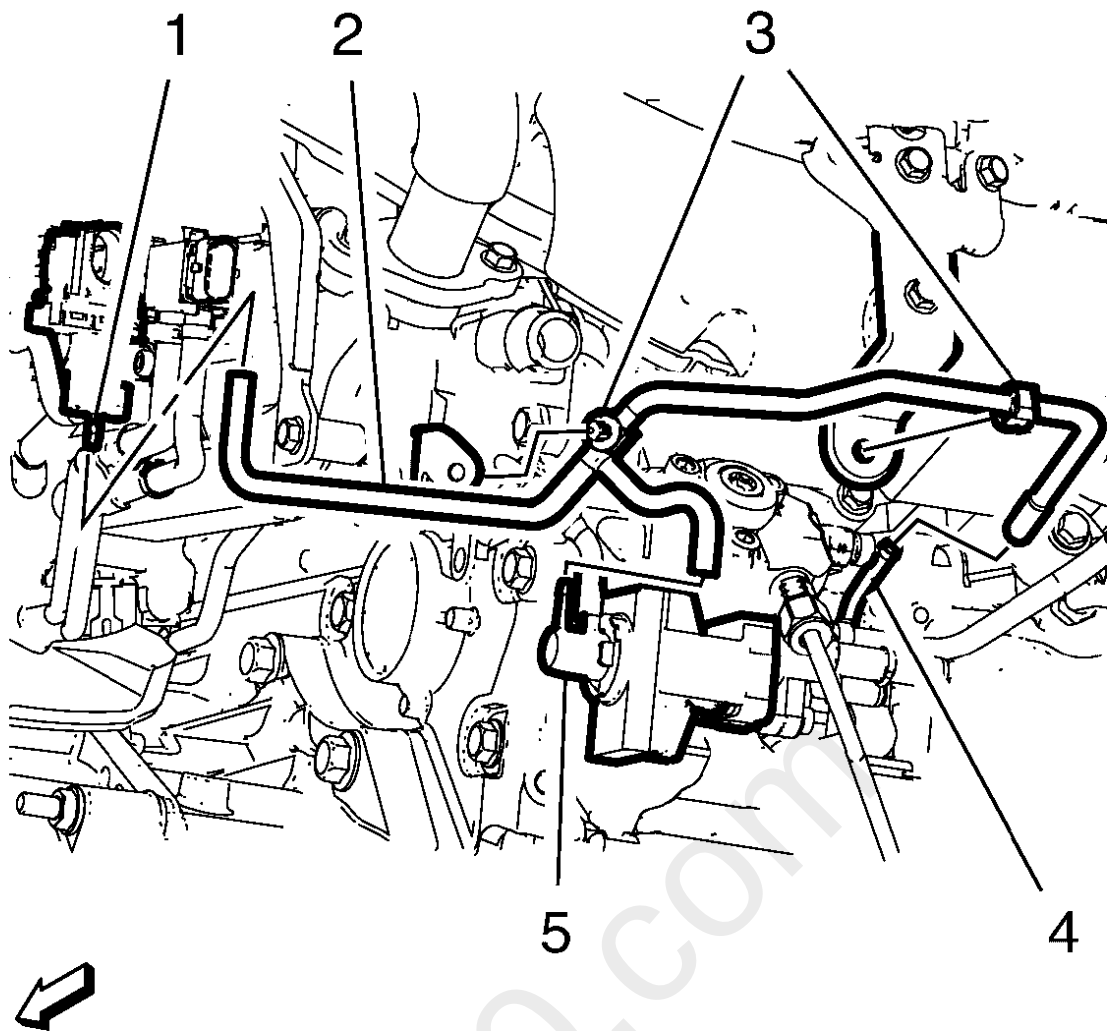


Fig. 425: Charge Air Bypass Valve Vacuum Hose And Components
Courtesy of GENERAL MOTORS COMPANY

6. Remove the charge air bypass valve vacuum hose (2) from the exhaust gas recirculation vacuum regulator solenoid valve (1).
7. Remove the charge air bypass valve vacuum hose (2) from the turbocharger wastegate actuator vacuum control solenoid valve (5).
8. Remove the charge air bypass valve vacuum hose (2) from the charge air bypass regulator solenoid valve vacuum tube (4).
9. Unclip the charge air bypass valve vacuum hose (2) clips from the brackets (3).
10. Remove the charge air bypass valve vacuum hose (2).

Installation Procedure

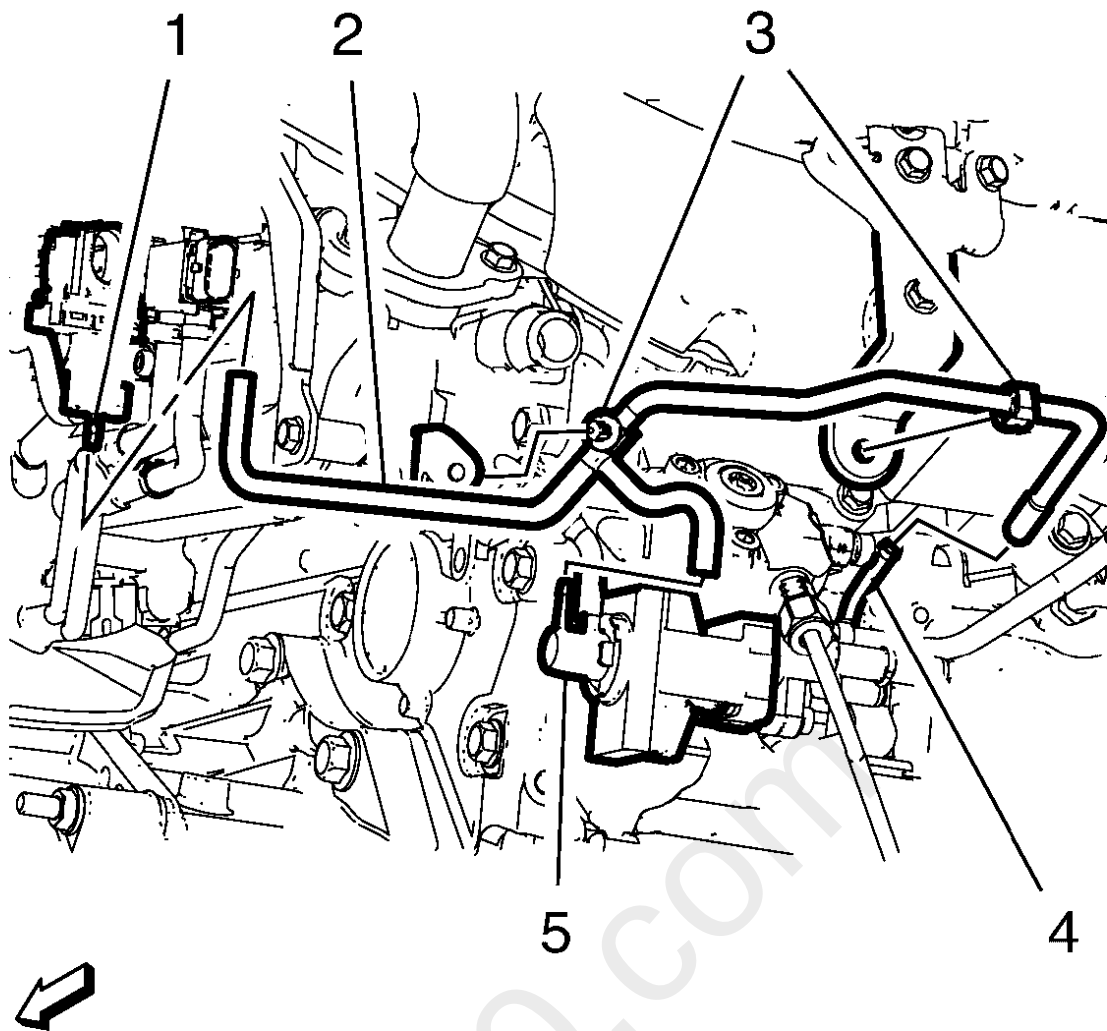


Fig. 426: Charge Air Bypass Valve Vacuum Hose And Components
Courtesy of GENERAL MOTORS COMPANY

1. Install the charge air bypass valve vacuum hose (2).
2. Clip in the charge air bypass valve vacuum hose (2) clips to the brackets (3).
3. Install the charge air bypass valve vacuum hose (2) to the charge air bypass regulator solenoid valve vacuum tube (4).
4. Install the charge air bypass valve vacuum hose (2) to the turbocharger wastegate actuator vacuum control solenoid valve (5).
5. Install the charge air bypass valve vacuum hose (2) to the exhaust gas recirculation vacuum regulator solenoid valve (1).

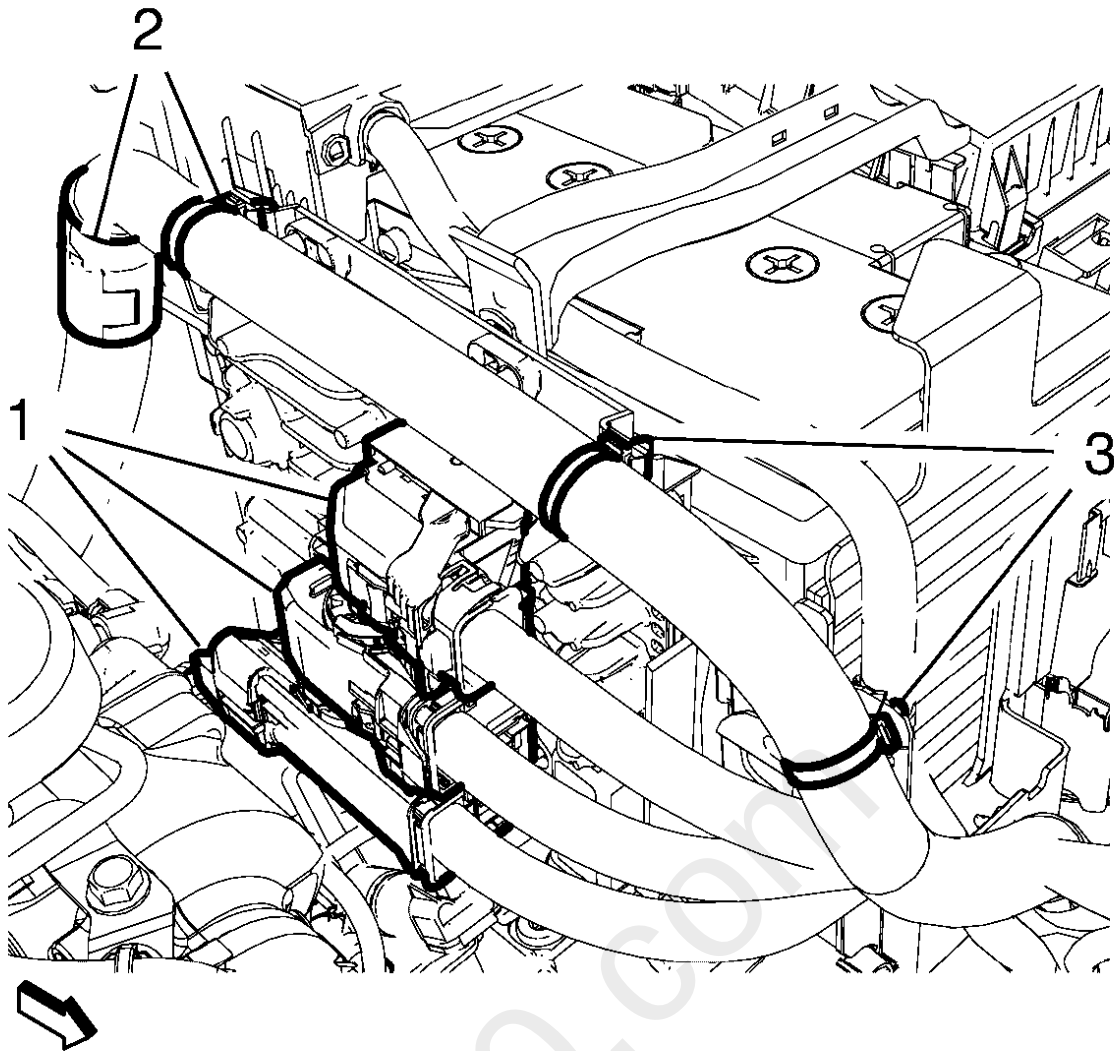


Fig. 427: Engine Control Module Electrical Connectors And Harness Clips
Courtesy of GENERAL MOTORS COMPANY

6. Connect the 3 engine control module electrical connectors (1) from the engine control module.
7. Install the engine control module bracket along with the engine control module in down direction to the battery tray.
8. Clip in the 4 wiring harness clips (2, 3) to the bracket.
9. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)
10. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

EXHAUST PRESSURE DIFFERENTIAL SENSOR PIPE REPLACEMENT

Removal Procedure

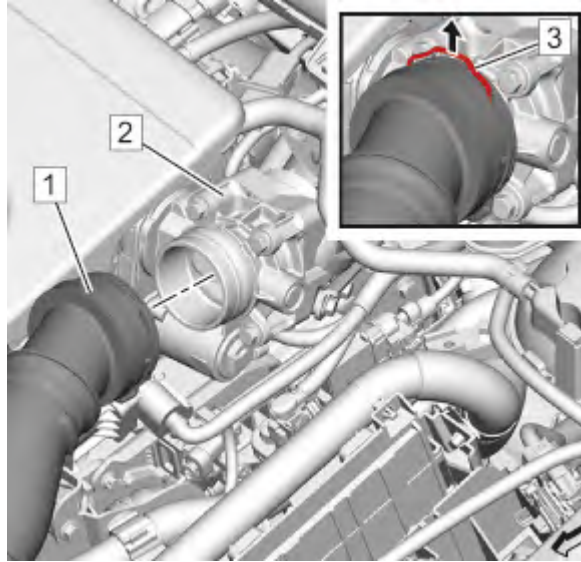


Fig. 428: Charge Air Cooler Outlet Air Hose, Throttle Body And Clamp
Courtesy of GENERAL MOTORS COMPANY

1. Loosen Quick Connector Clamp (3)
2. Remove Charge Air Cooler Outlet Air Hose (1) @ Throttle Body (2)

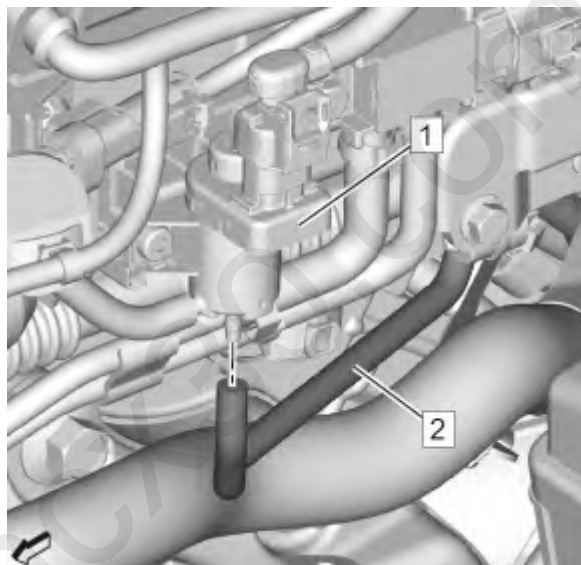


Fig. 429: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve
Courtesy of GENERAL MOTORS COMPANY

3. Remove the charge air bypass regulator solenoid valve vacuum tube (2) from the exhaust gas recirculation (EGR) valve regulator solenoid valve (1).

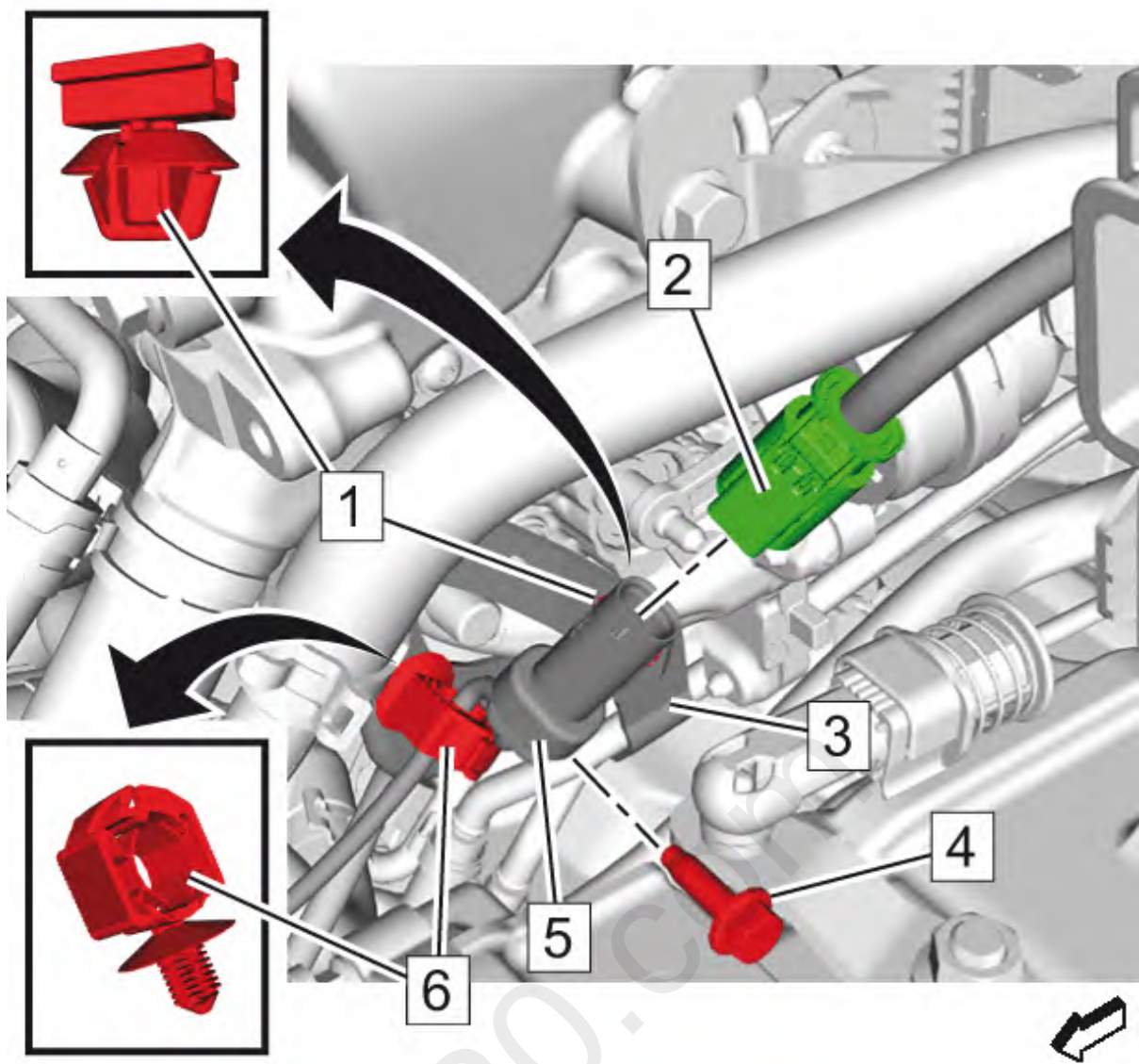


Fig. 430: Exhaust Temperature Sensor, Electrical Connector, Bracket, Bolts And Clips
 Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Exhaust Temperature Sensor Electrical Connector (2)
5. Remove Wiring Harness Clips (1, 6) (Qty: 3) @ Bracket (3)
6. Position aside Exhaust Temperature Sensor - Position 2 (5)
7. Remove Exhaust Pressure Differential Sensor Bracket Bolt (4)

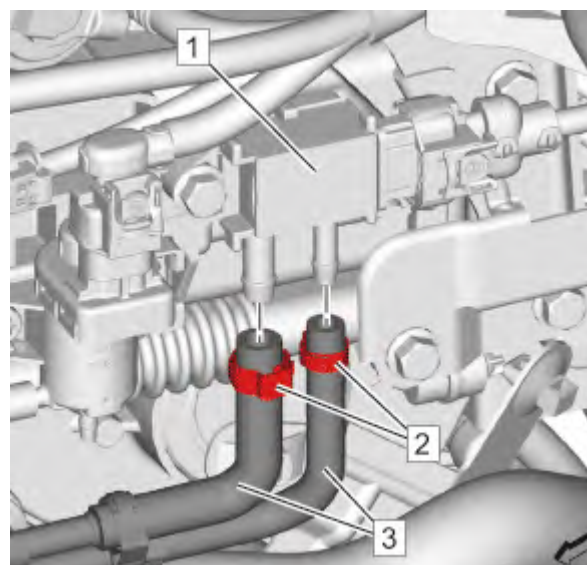


Fig. 431: Exhaust Pressure Differential Sensor, Hoses And Clamps
 Courtesy of GENERAL MOTORS COMPANY

8. Remove and DISCARD Clamps (2) (Qty: 2)

NOTE: Mind the different hose diameters.

9. Remove the 2 exhaust pressure differential sensor hoses (3) from the exhaust pressure differential sensor (1).
10. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
11. Remove Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#).

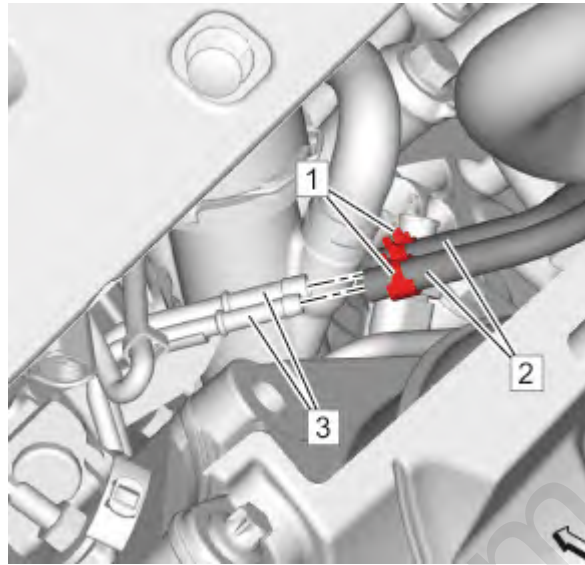


Fig. 432: Exhaust Pressure Differential Sensor Hoses And Pipes
Courtesy of GENERAL MOTORS COMPANY

12. Disengage Clamps (1) (Qty: 2). Refer to [Hose Clamp Replacement Guidelines - Spring Type](#)

NOTE: Mind the different hose diameters.

13. Remove the 2 exhaust pressure differential sensor hoses (2) from the exhaust pressure differential sensor pipes (3).
14. Remove Exhaust Pressure Differential Sensor Pipe
15. Transfer components as necessary.

Installation Procedure

1. Install Exhaust Pressure Differential Sensor Pipe.

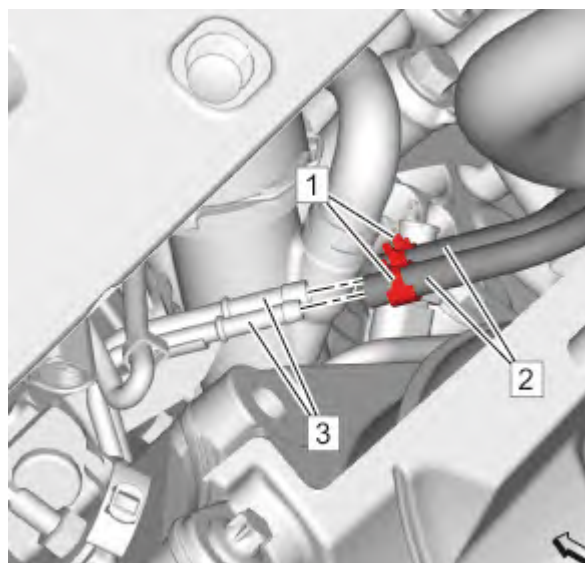


Fig. 433: Exhaust Pressure Differential Sensor Hoses And Pipes
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the different hose diameters.

2. Install the 2 exhaust pressure differential sensor hoses (2) to the exhaust pressure differential sensor pipes (3).
3. Engage Clamps (1) (Qty: 2). Refer to [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Install Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#). [Underbody Front Air Deflector Replacement \(Terrain\)](#)
5. Lower the vehicle.

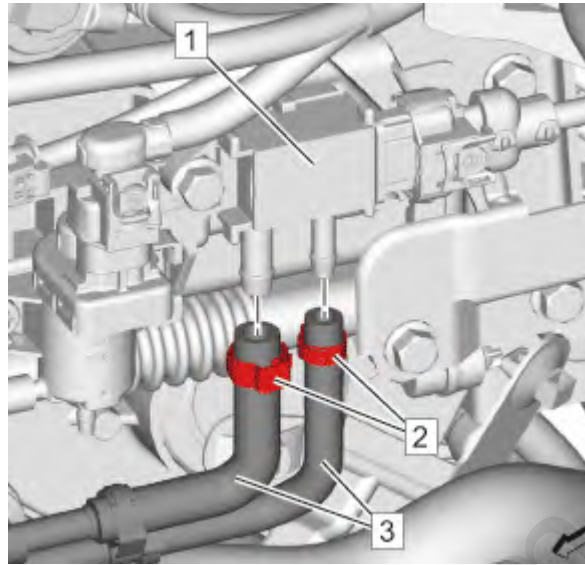


Fig. 434: Exhaust Pressure Differential Sensor, Hoses And Clamps
Courtesy of GENERAL MOTORS COMPANY

NOTE: Mind the different hose diameters.

6. Install the 2 exhaust pressure differential sensor hoses (3) to the exhaust pressure differential sensor (1).
7. Install NEW Clamps (2) (Qty: 2)

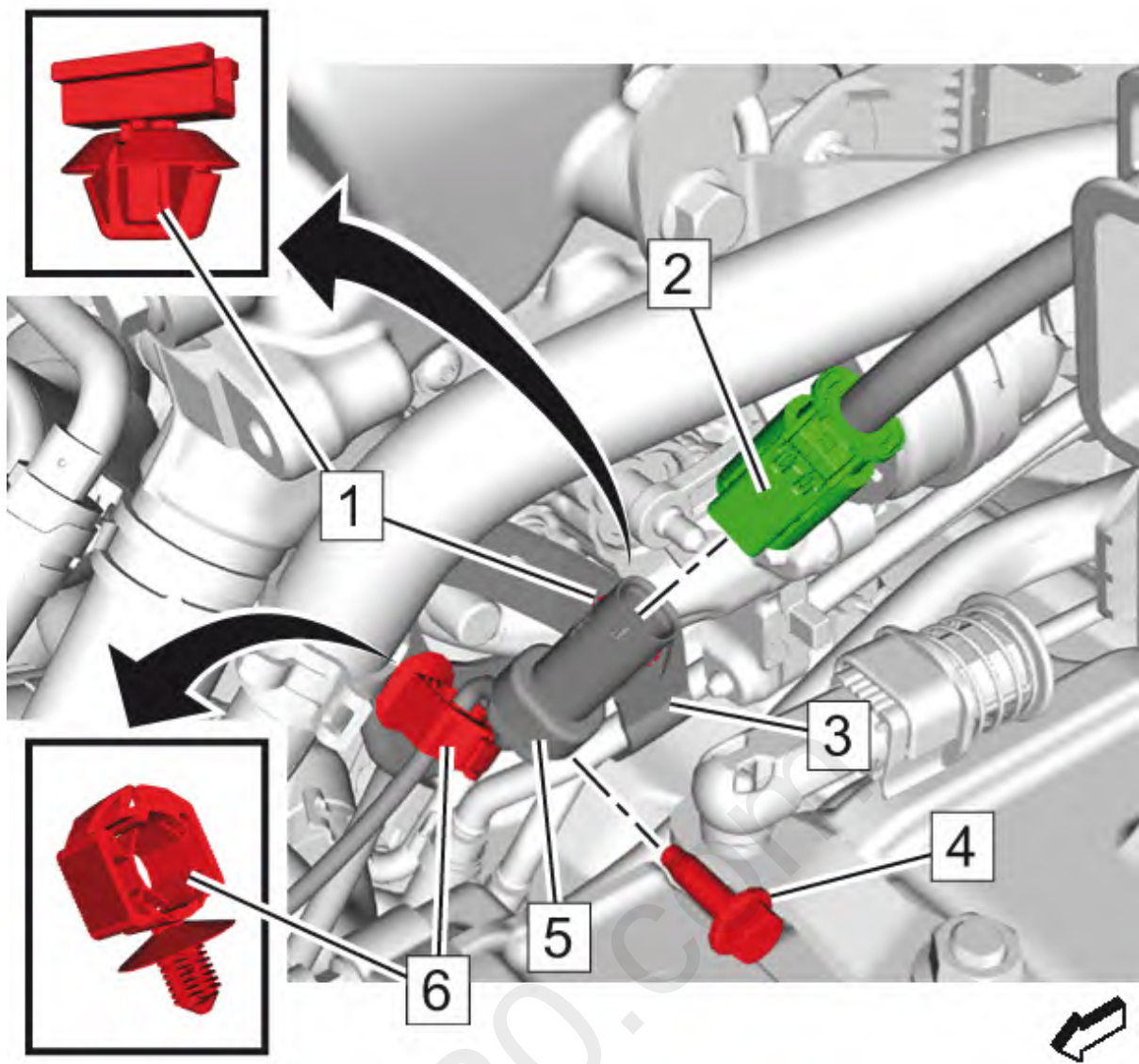


Fig. 435: Exhaust Temperature Sensor, Electrical Connector, Bracket, Bolts And Clips
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

8. Install and tighten Exhaust Pressure Differential Sensor Bracket Bolt (4) to 9 N.m (80 lb in)
9. Reposition Exhaust Temperature Sensor - Position 2 (5)
10. Install Wiring Harness Clips (1, 6) (Qty: 2) @ Bracket (3)
11. Connect Exhaust Temperature Sensor Electrical Connector (2)

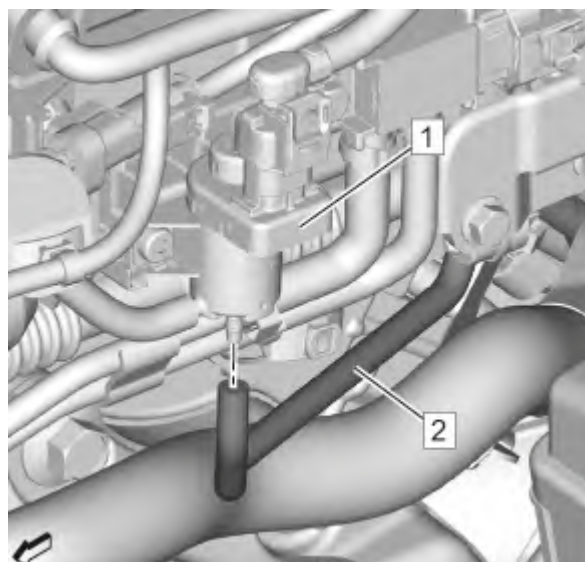


Fig. 436: Charge Air Bypass Regulator Solenoid Valve Inlet Tube And Exhaust Gas Recirculation Vacuum Regulator Solenoid Valve

12. Install the charge air bypass regulator solenoid valve vacuum tube (2) to the exhaust gas recirculation (EGR) valve regulator solenoid valve (1).

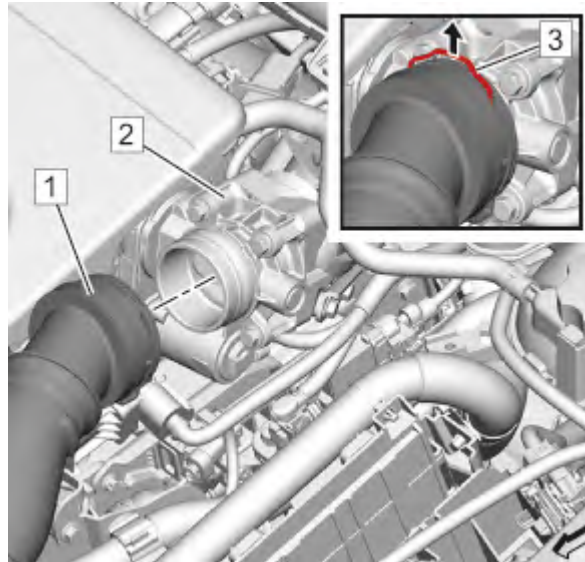


Fig. 437: Charge Air Cooler Outlet Air Hose, Throttle Body And Clamp
Courtesy of GENERAL MOTORS COMPANY

13. Install Charge Air Cooler Outlet Air Hose (1) @ Throttle Body (2)
14. Install Quick Connector Clamp (3)

ENGINE OIL PRESSURE SENSOR REPLACEMENT (FWD)

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [**Battery Negative Cable Disconnection and Connection \(KL9\)**](#).
2. Raise and support the vehicle. Refer to [**Lifting and Jacking the Vehicle**](#)
3. Remove Exhaust Front Pipe. Refer to [**Exhaust Front Pipe Replacement \(LH7\)**](#)

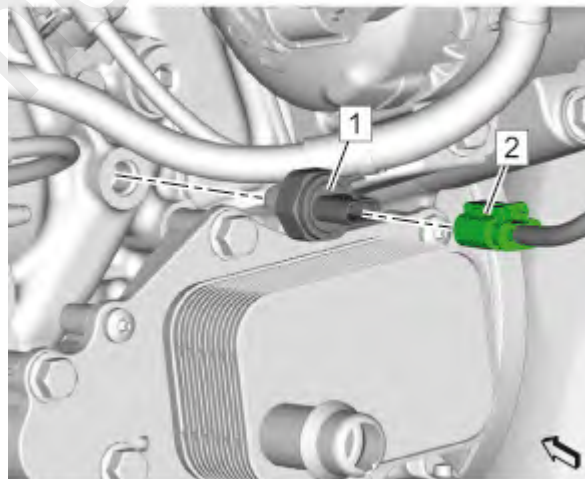


Fig. 438: Engine Oil Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector. (2)
5. Remove Engine Oil Pressure Sensor (1)

Installation Procedure

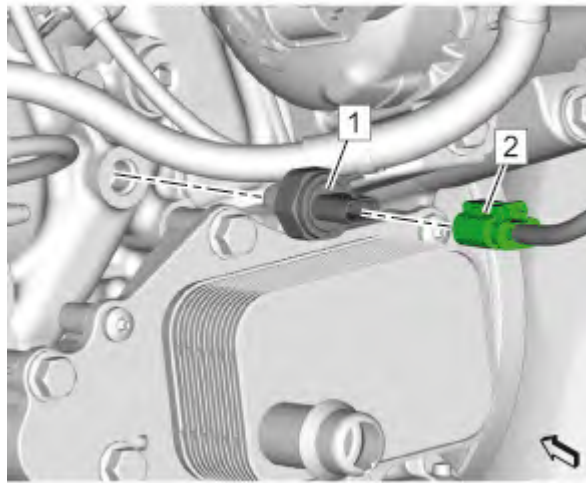


Fig. 439: Engine Oil Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#)

1. Install and tighten Engine Oil Pressure Sensor (1) to 35 N.m (26 lb ft)
2. Connect the electrical connector. (2)
3. Install Exhaust Front Pipe. Refer to [Exhaust Front Pipe Replacement \(LH7\)](#).
4. Lower the vehicle.
5. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

ENGINE OIL PRESSURE SENSOR REPLACEMENT (AWD)

Removal Procedure

1. Disconnect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)
3. Remove Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).

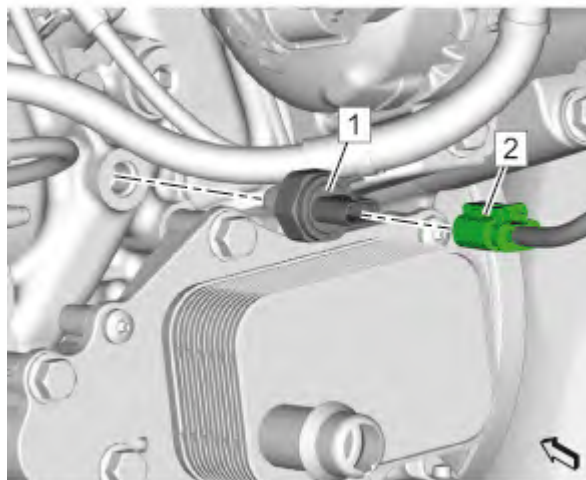


Fig. 440: Engine Oil Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the electrical connector. (2)
5. Remove Engine Oil Pressure Sensor (1)

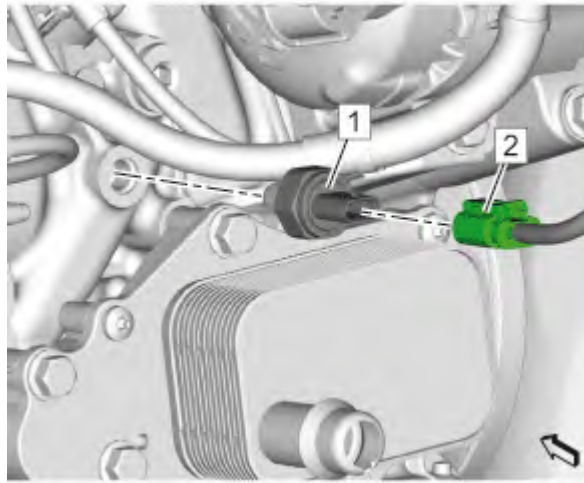


Fig. 441: Engine Oil Pressure Sensor And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#)

1. Install and tighten Engine Oil Pressure Sensor (1) to 35 N.m (26 lb ft)
2. Connect the electrical connector. (2)
3. Install Power Transfer Unit Case. Refer to [Power Transfer Unit Case Replacement \(MHG Transmission with LH7 Engine\)](#).
4. Lower the vehicle.
5. Connect Battery Negative Cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).

EMISSION REDUCTION FLUID CONTROLLER REPLACEMENT

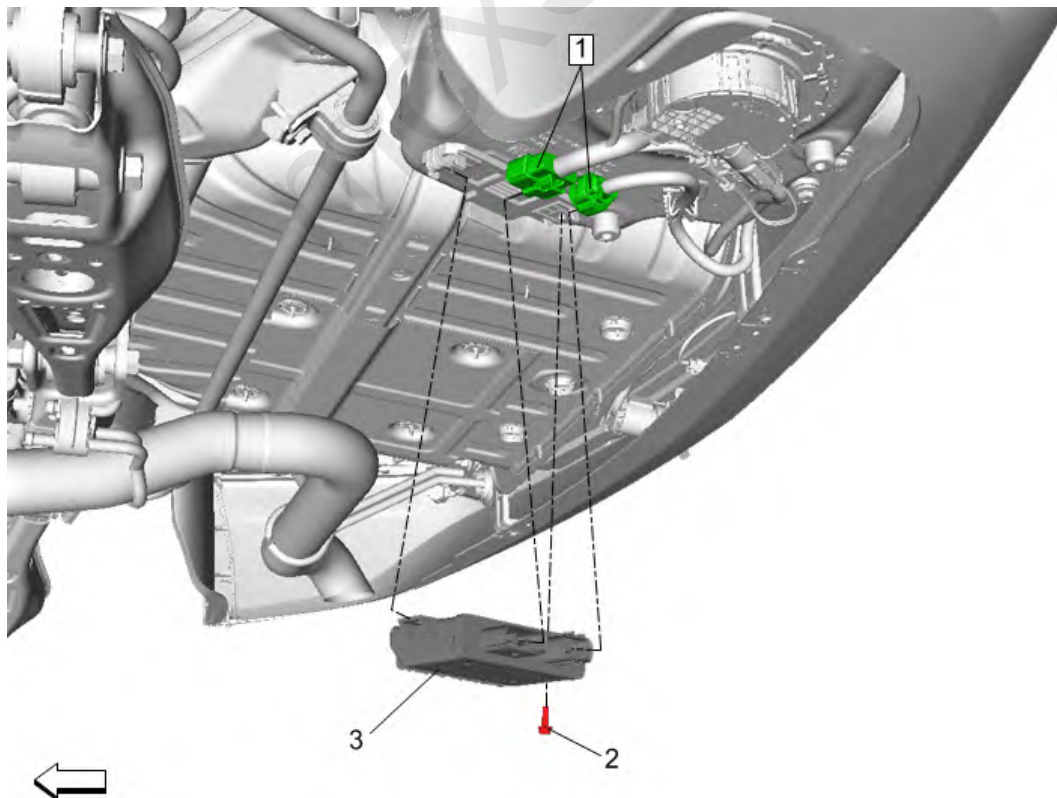


Fig. 442: Emission Reduction Fluid Controller
Courtesy of GENERAL MOTORS COMPANY

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

Callout	Component Name
Preliminary Procedure Remove Emission Reduction Fluid Tank Protector. Refer to Emission Reduction Fluid Tank Protector Replacement	
1	Emission Reduction Fluid Pump Module Wiring Harness (Qty: 2)
2	Emission Reduction Fluid Controller Bolt CAUTION: Refer to Fastener Caution . Tighten 2 N.m (18 lb in)
3	Emission Reduction Fluid Controller

EMISSION REDUCTION FLUID EXHAUST FRONT PIPE INJECTOR SUPPLY PIPE REPLACEMENT (FWD)

Removal Procedure

1. {If equipped} Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#).
2. Remove Fuel Tank. Refer to [Fuel Tank Replacement \(FWD\)](#).
3. Remove Emission Reduction Fluid Tank. Refer to [Emission Reduction Fluid Tank Replacement](#)

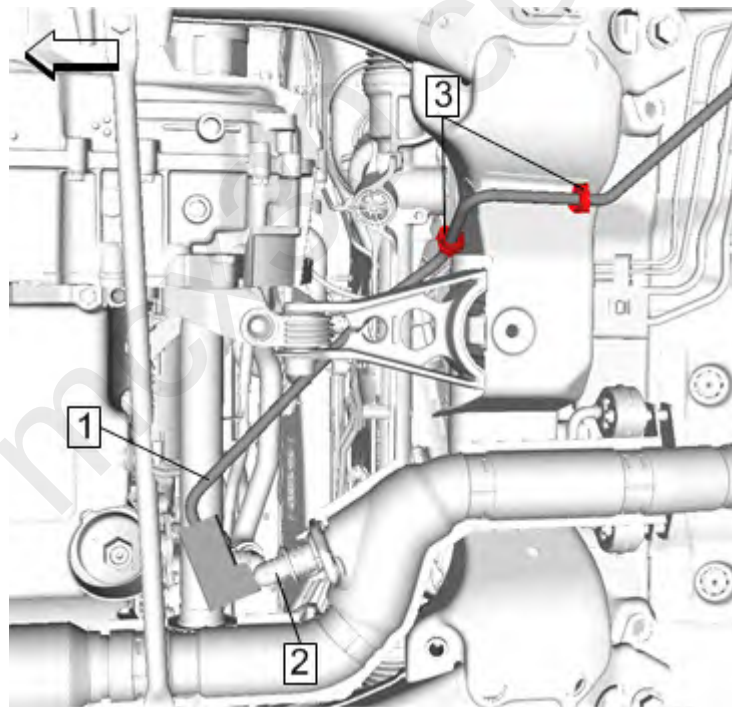


Fig. 443: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Emission Reduction Fluid Injector And Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
5. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (3) (Qty: 2)

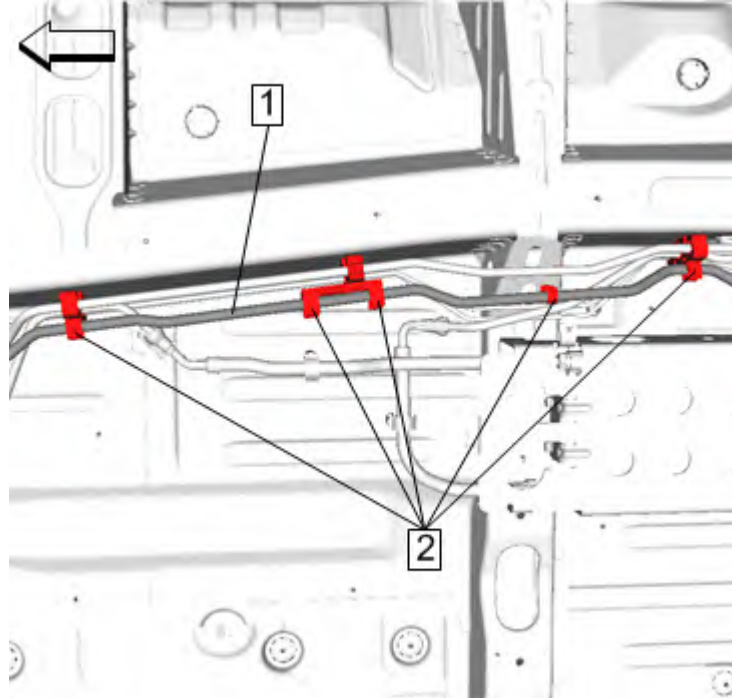


Fig. 444: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

6. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 5)

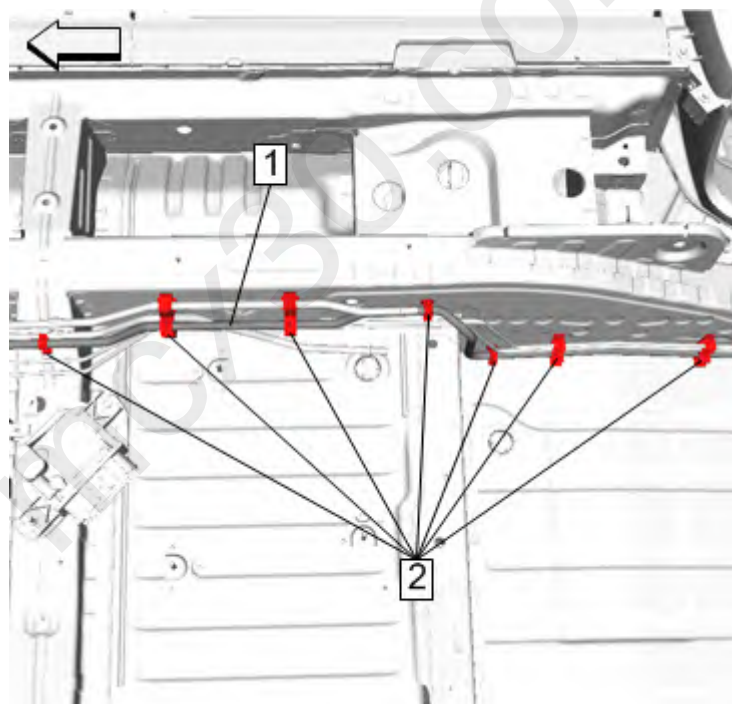


Fig. 445: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

7. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 7)

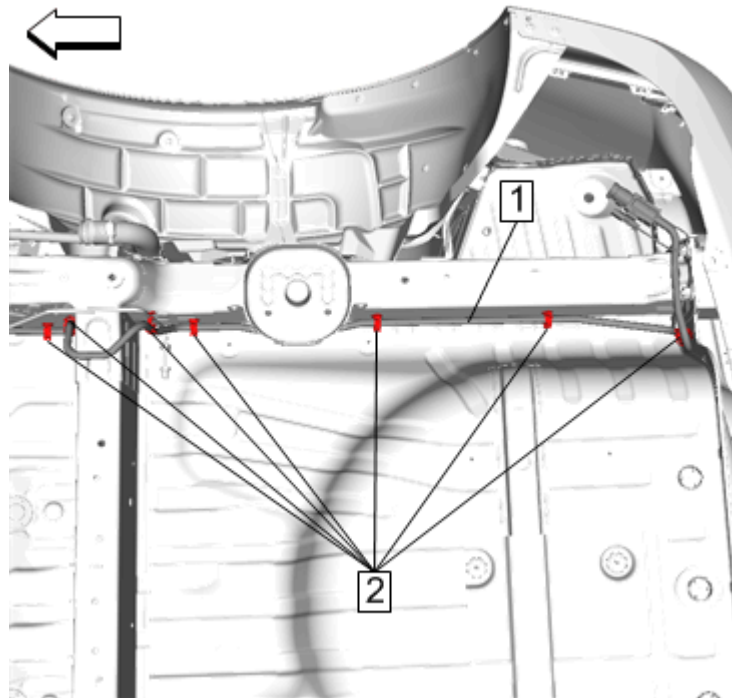


Fig. 446: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

8. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 7)

Installation Procedure

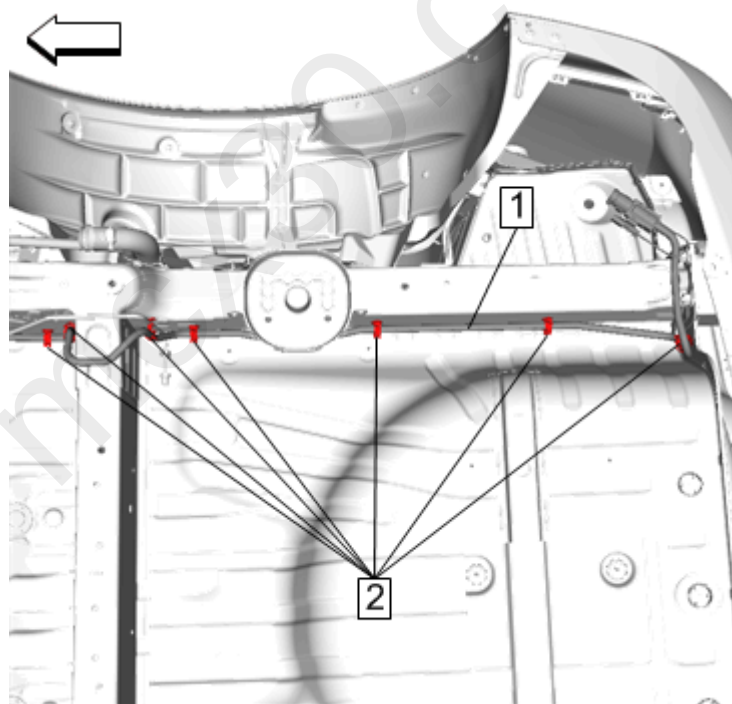


Fig. 447: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

1. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 7)

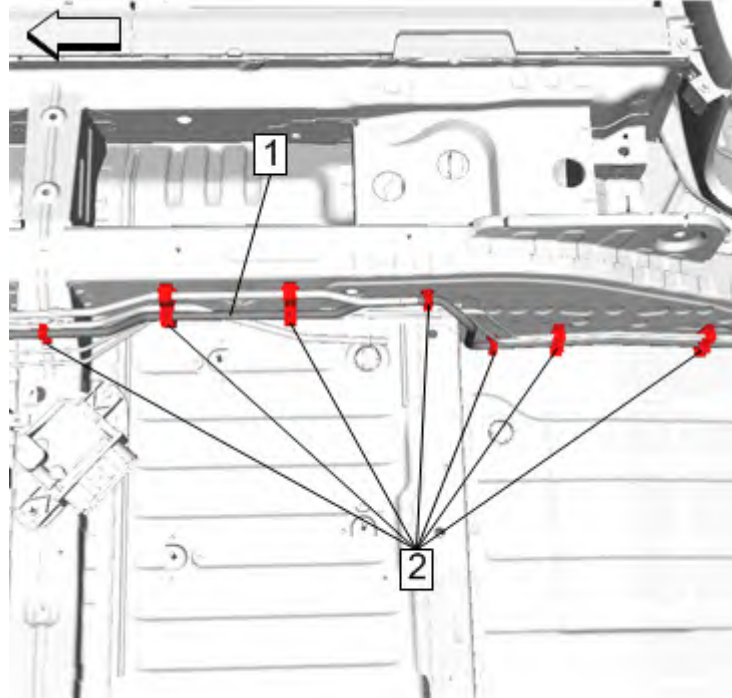


Fig. 448: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

2. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 7)

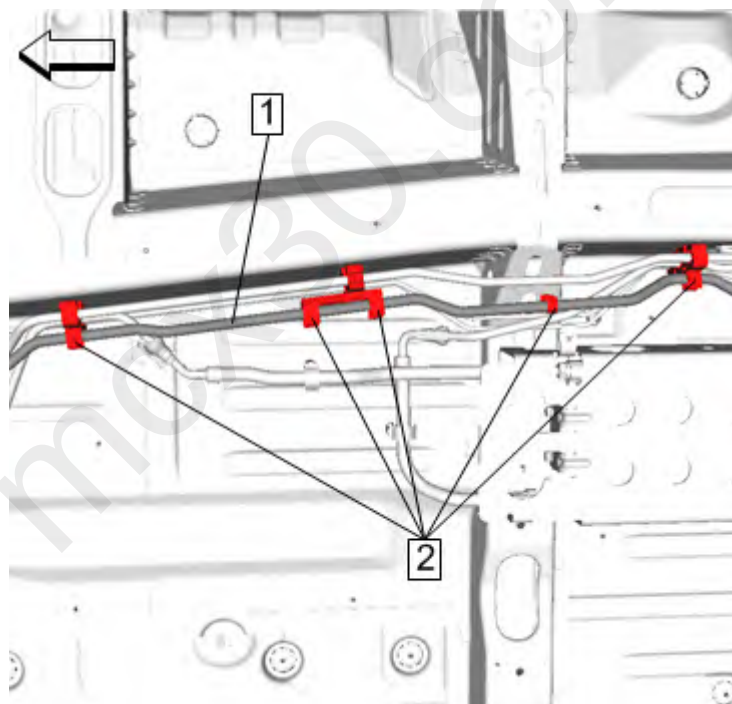


Fig. 449: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

3. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 5)

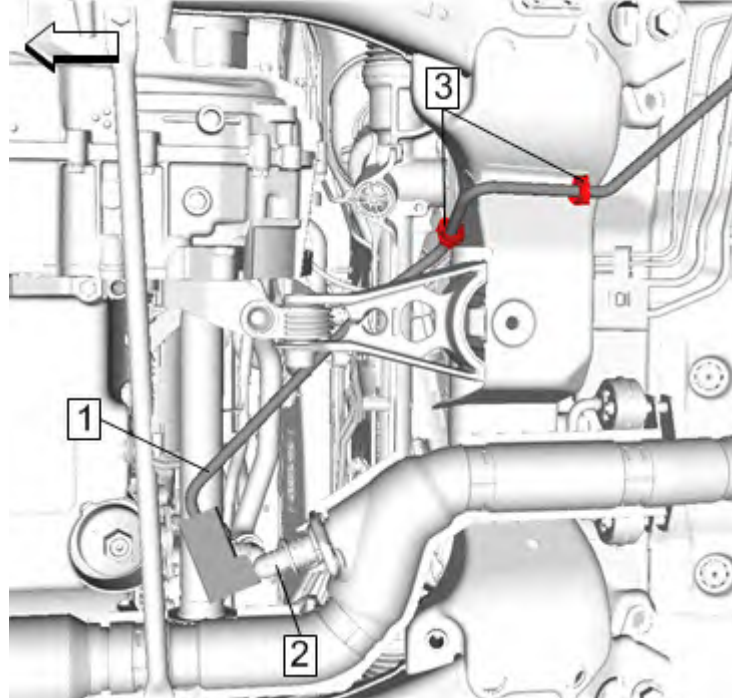


Fig. 450: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Emission Reduction Fluid Injector And Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (3) (Qty: 2)
5. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Install Emission Reduction Fluid Tank. Refer to [Emission Reduction Fluid Tank Replacement](#)
7. Install Fuel Tank. Refer to [Fuel Tank Replacement \(FWD\)](#)
8. {If equipped} Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)

EMISSION REDUCTION FLUID EXHAUST FRONT PIPE INJECTOR SUPPLY PIPE REPLACEMENT (FRONT AWD)

Removal Procedure

1. Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)

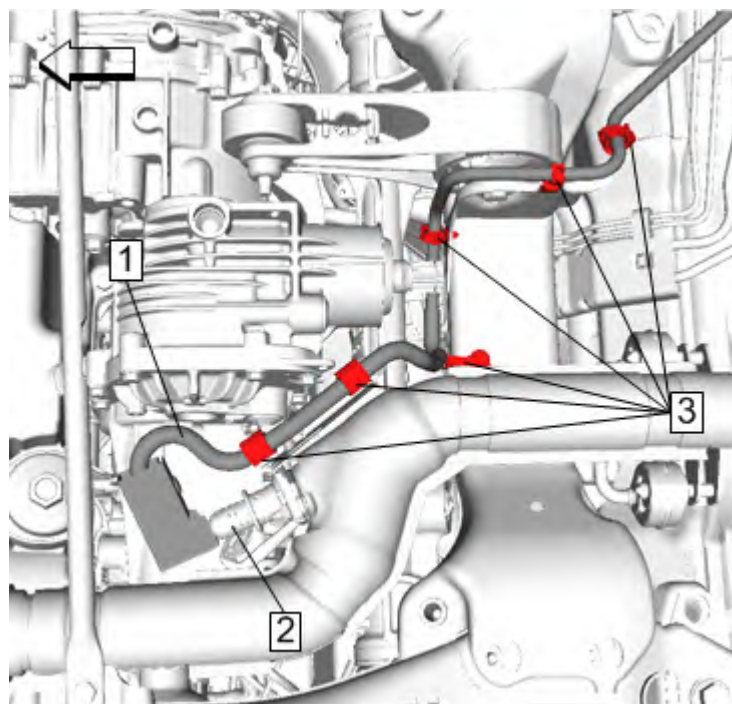


Fig. 451: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Emission Reduction Fluid Injector And Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [**Plastic Collar Quick Connect Fitting Service**](#)
3. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (3) (Qty: 6)

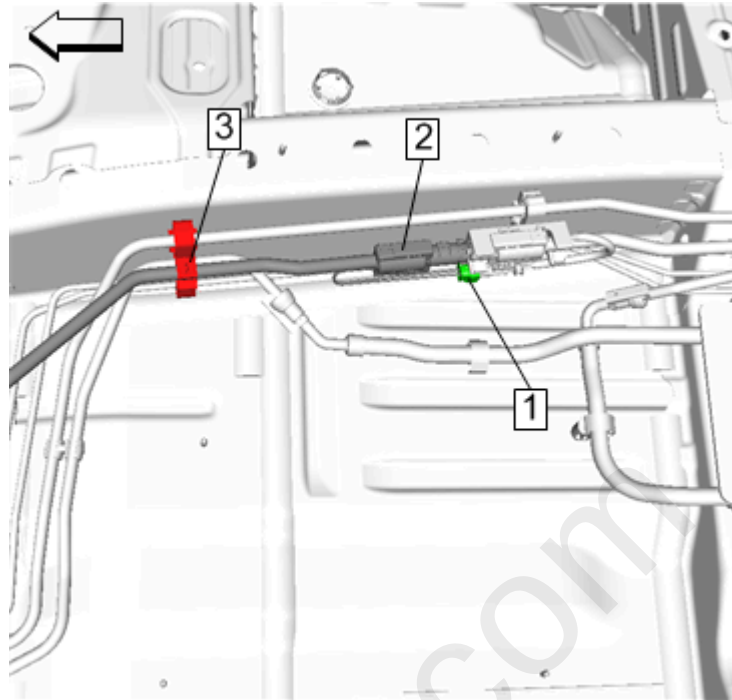


Fig. 452: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Electrical Connector And Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Electrical Connector (1)
5. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2). Refer to [**Plastic Collar Quick Connect Fitting Service**](#)
6. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Retainer (3)

Installation Procedure



Fig. 453: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Electrical Connector And Retainer

Courtesy of GENERAL MOTORS COMPANY

1. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Retainer (3)
2. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
3. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Electrical Connector (1)

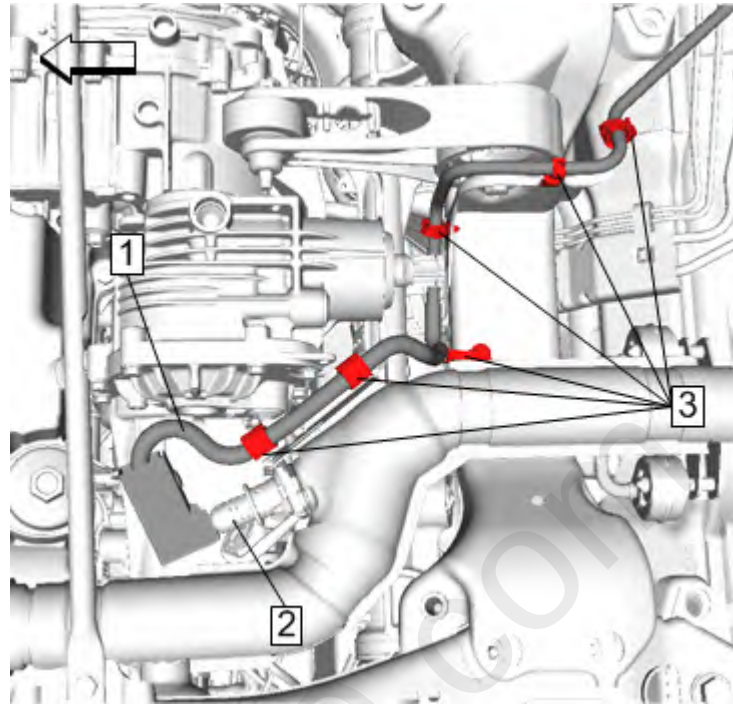


Fig. 454: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Emission Reduction Fluid Injector And Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (3) (Qty: 6)
5. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Install Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)

EMISSION REDUCTION FLUID EXHAUST FRONT PIPE INJECTOR SUPPLY PIPE REPLACEMENT (REAR AWD)

Removal Procedure

1. {If equipped} Remove Underbody Rear Air Deflector. Refer to [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#), [Underbody Rear Air Deflector Replacement \(Diesel\)](#)
2. Remove Fuel Tank. Refer to [Fuel Tank Replacement \(AWD\)](#)
3. Remove Emission Reduction Fluid Tank. Refer to [Emission Reduction Fluid Tank Replacement](#)

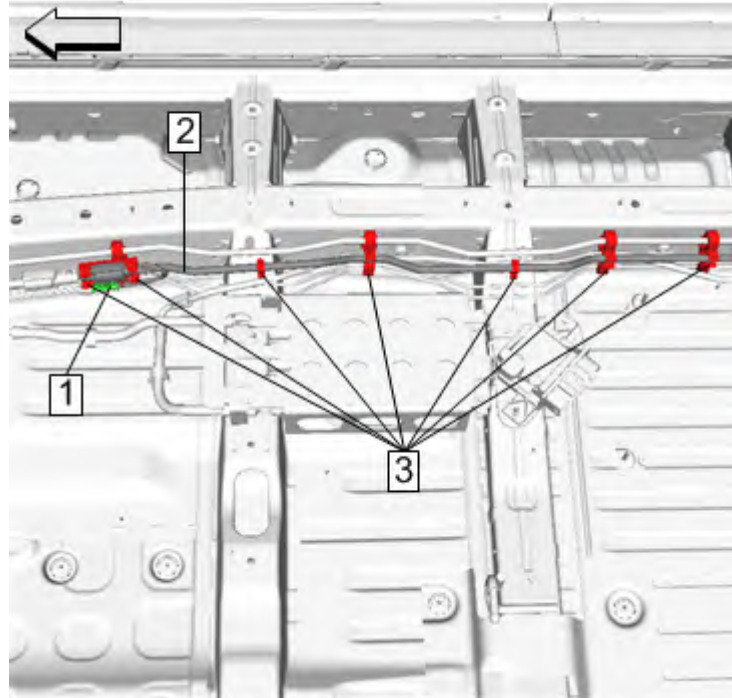


Fig. 455: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Electrical Connector And Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Electrical Connector (1)
5. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Retainers (3) (Qty: 7)

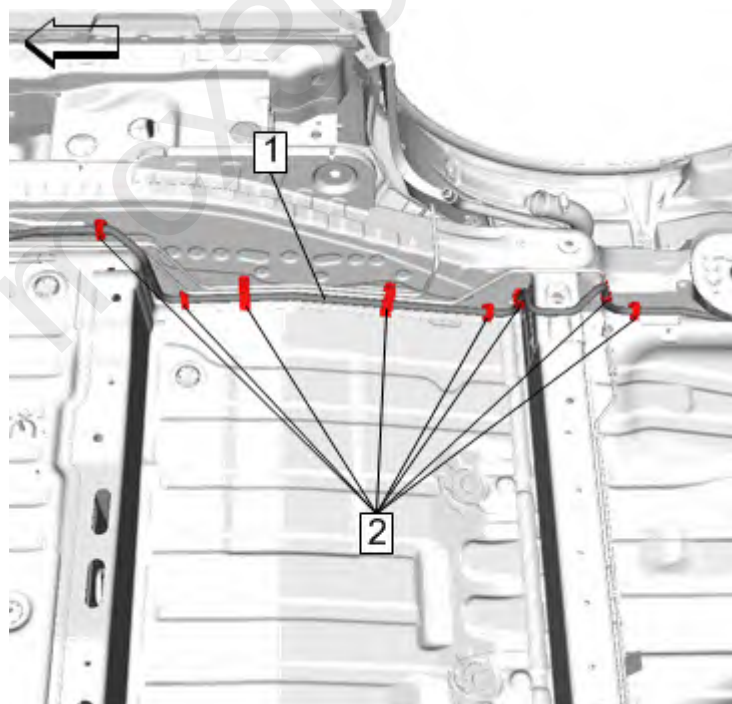


Fig. 456: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

7. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2) (Qty: 8)

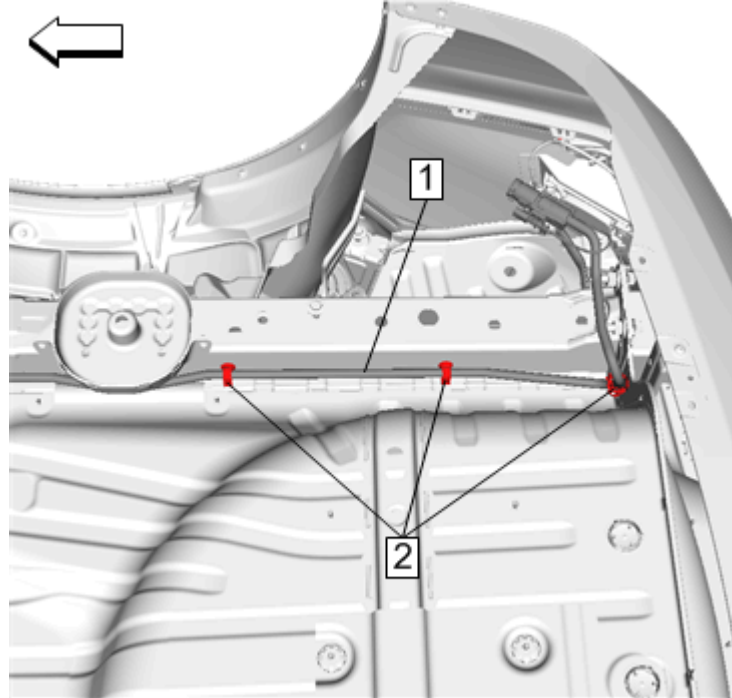


Fig. 457: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

8. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 3)

Installation Procedure

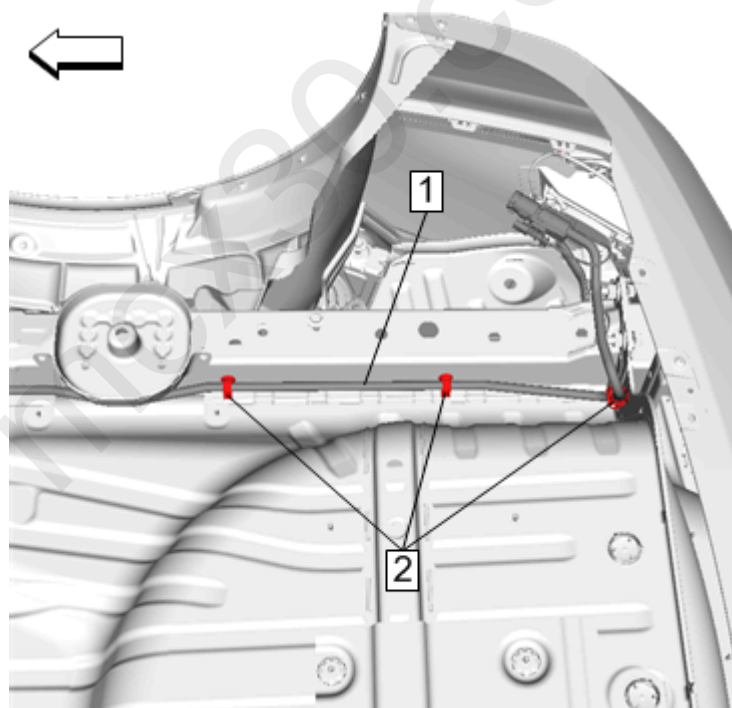


Fig. 458: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
 Courtesy of GENERAL MOTORS COMPANY

1. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 3)

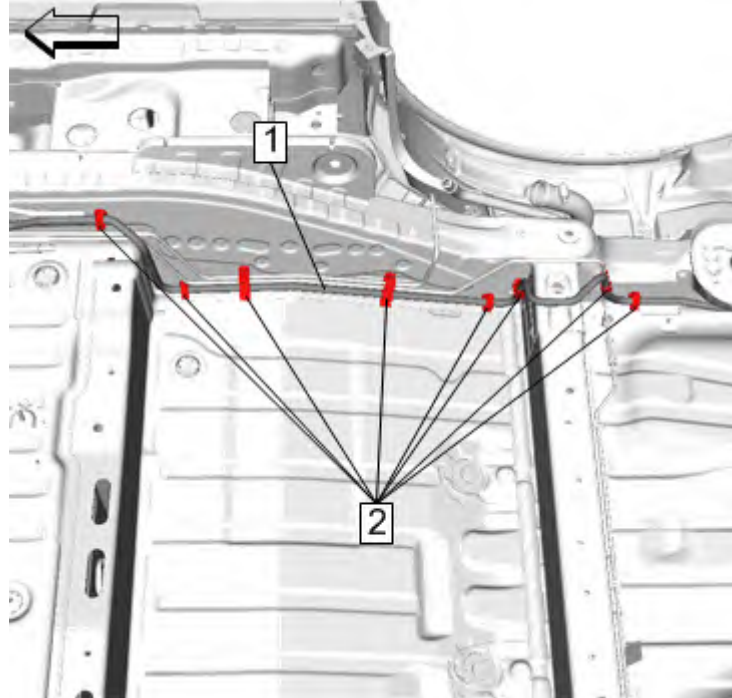


Fig. 459: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Retainers
Courtesy of GENERAL MOTORS COMPANY

2. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (2)
 (Qty: 8)

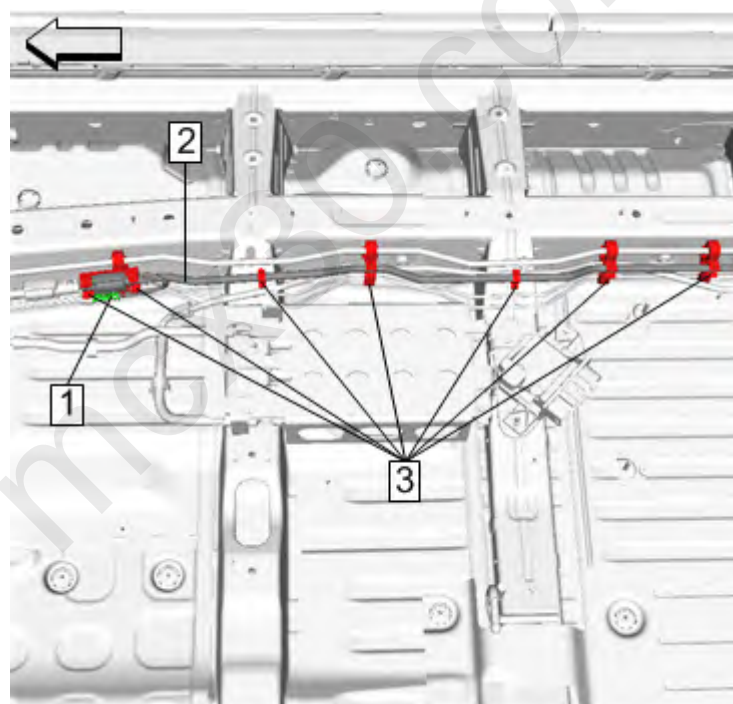


Fig. 460: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Electrical Connector And Retainers
Courtesy of GENERAL MOTORS COMPANY

3. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Retainers (3)
 (Qty: 7)
4. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2). Refer to [**Plastic Collar Quick Connect Fitting Service**](#)
5. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Electrical Connector (1)
6. Install Emission Reduction Fluid Tank. Refer to [**Emission Reduction Fluid Tank Replacement**](#)
7. Install Fuel Tank. Refer to [**Fuel Tank Replacement \(AWD\)**](#)
8. {If equipped} Install Underbody Rear Air Deflector. Refer to [**Underbody Rear Air Deflector Replacement \(All Wheel Drive\)**](#), [**Underbody Rear Air Deflector Replacement \(Diesel\)**](#)

EMISSION REDUCTION FLUID SUPPLY PUMP MODULE REPLACEMENT

Special Tools

CH 45722 Fuel Sender Lock Ring Wrench

Equivalent regional tools: [Special Tools \(Diagnostic Tools\)](#) [Special Tools \(Mechanical Tools\)](#)

Removal Procedure

1. Remove Emission Reduction Fluid Tank. Refer to [Emission Reduction Fluid Tank Replacement](#)

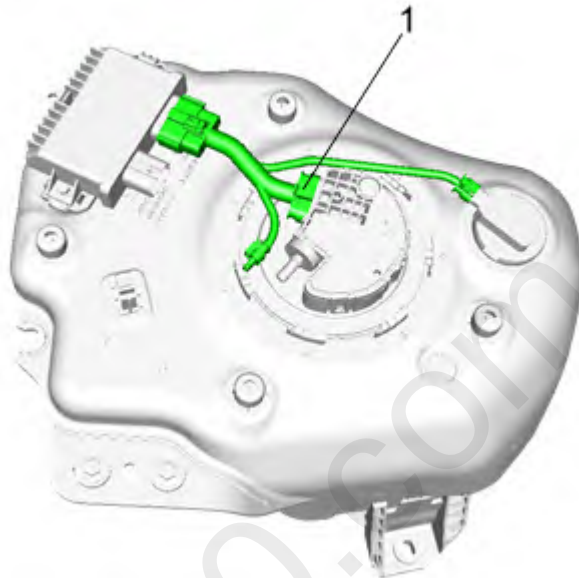


Fig. 461: Emission Reduction Fluid Pump Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Emission Reduction Fluid Pump Module Wiring Harness (1)



Fig. 462: Lock Ring
Courtesy of GENERAL MOTORS COMPANY

3. Remove Lock Ring (1) - **CH 45722** Fuel Sender Lock Ring Wrench

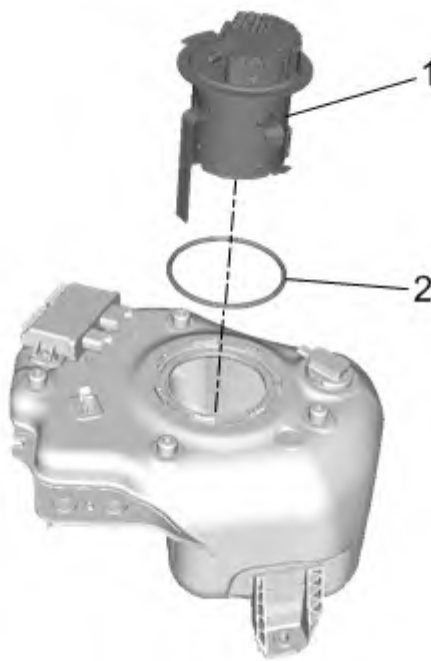


Fig. 463: Emission Reduction Fluid Supply Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

4. Remove Emission Reduction Fluid Supply Pump Module (1)
5. Remove and DISCARD O-Ring (2)

Installation Procedure

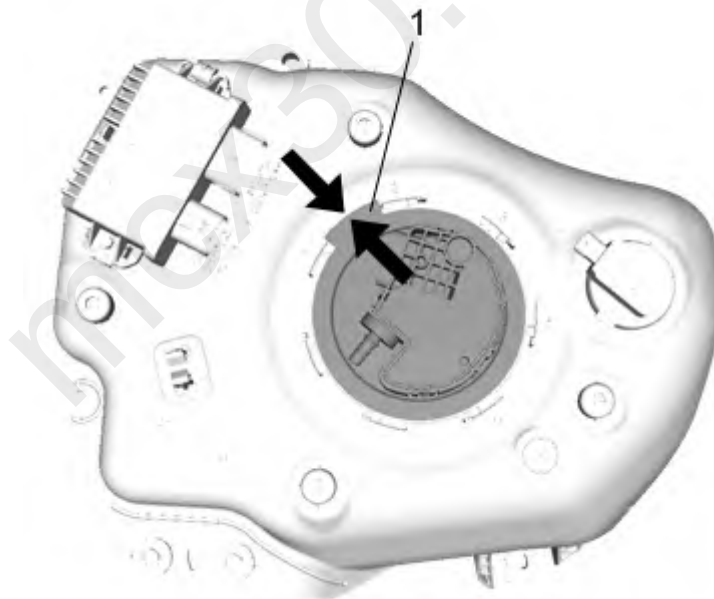


Fig. 464: Lining Up Emission Reduction Fluid Supply Pump Module At Arrows
Courtesy of GENERAL MOTORS COMPANY

1. Line up the emission reduction fluid supply pump module (1) at the arrows.

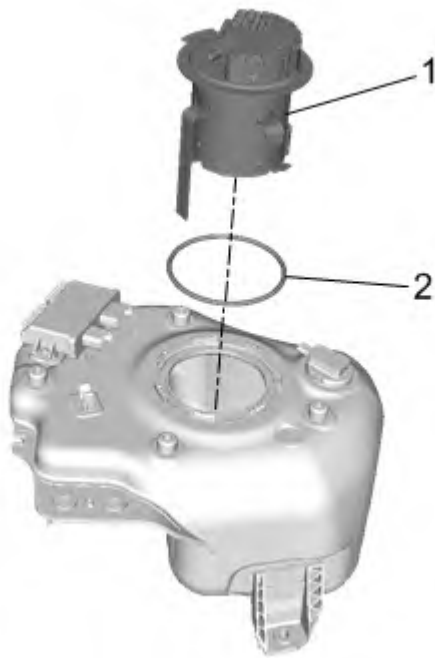


Fig. 465: Emission Reduction Fluid Supply Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

2. Install NEW O-Ring (2)
3. Install Emission Reduction Fluid Supply Pump Module (1)



Fig. 466: Lock Ring
Courtesy of GENERAL MOTORS COMPANY

4. Install Lock Ring (1) - CH 45722 Fuel Sender Lock Ring Wrench

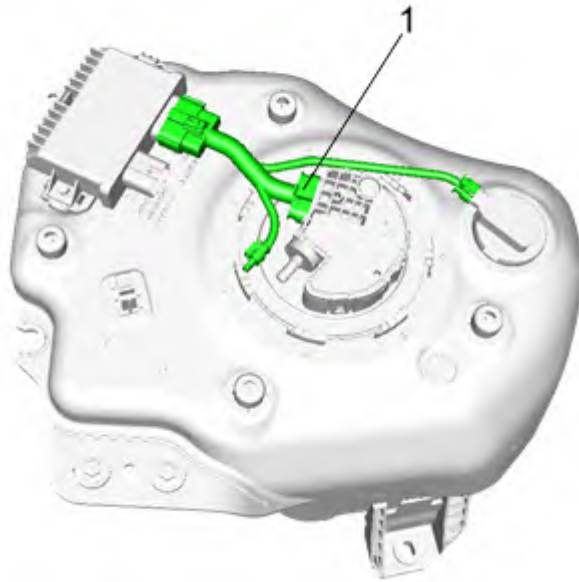


Fig. 467: Emission Reduction Fluid Pump Module Wiring Harness
Courtesy of GENERAL MOTORS COMPANY

5. Connect Emission Reduction Fluid Pump Module Wiring Harness (1)
6. Install Emission Reduction Fluid Tank. Refer to [Emission Reduction Fluid Tank Replacement](#)
7. Lower the vehicle.
8. Refill the emission reduction fluid tank, add a minimum of 9.5 liters (2.5 gallons).
9. Bleed the emission reduction fluid system:
 1. Connect the scan tool to the vehicle.
 2. Start the emission reduction system leak test using the scan tool.
 3. Wait until the emission reduction fluid pump has reached the delivery pressure of 5 bar (72.5 psi).
 4. Stop the emission reduction system leak test using the scan tool.
 5. Remove the scan tool.
 6. If pump fails to prime disconnect the emission reduction fluid exhaust front pipe injector supply pipe. Refer to [Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement \(FWD\)](#)[Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement \(Front AWD\)](#)[Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement \(Rear AWD\)](#)
 7. Start the emission reduction system leak test using the scan tool.
 8. Once fluid is present at front pipe, stop the emission reduction system leak test using the scan tool.
 9. Reconnect the emission reduction fluid exhaust front pipe injector supply pipe. Refer to [Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement \(FWD\)](#)[Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement \(Front AWD\)](#)[Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement \(Rear AWD\)](#)
 10. Start the emission reduction system leak test using the scan tool.
 11. Wait until the emission reduction fluid pump has reached the delivery pressure of 5 bar (72.5 psi).
 12. Stop the emission reduction system leak test using the scan tool.
 13. Remove the scan tool.
10. Perform the reductant fluid tank level reset. Refer to [Reductant Fluid Tank Level Reset](#)

EMISSION REDUCTION FLUID INJECTOR REPLACEMENT (AWD)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

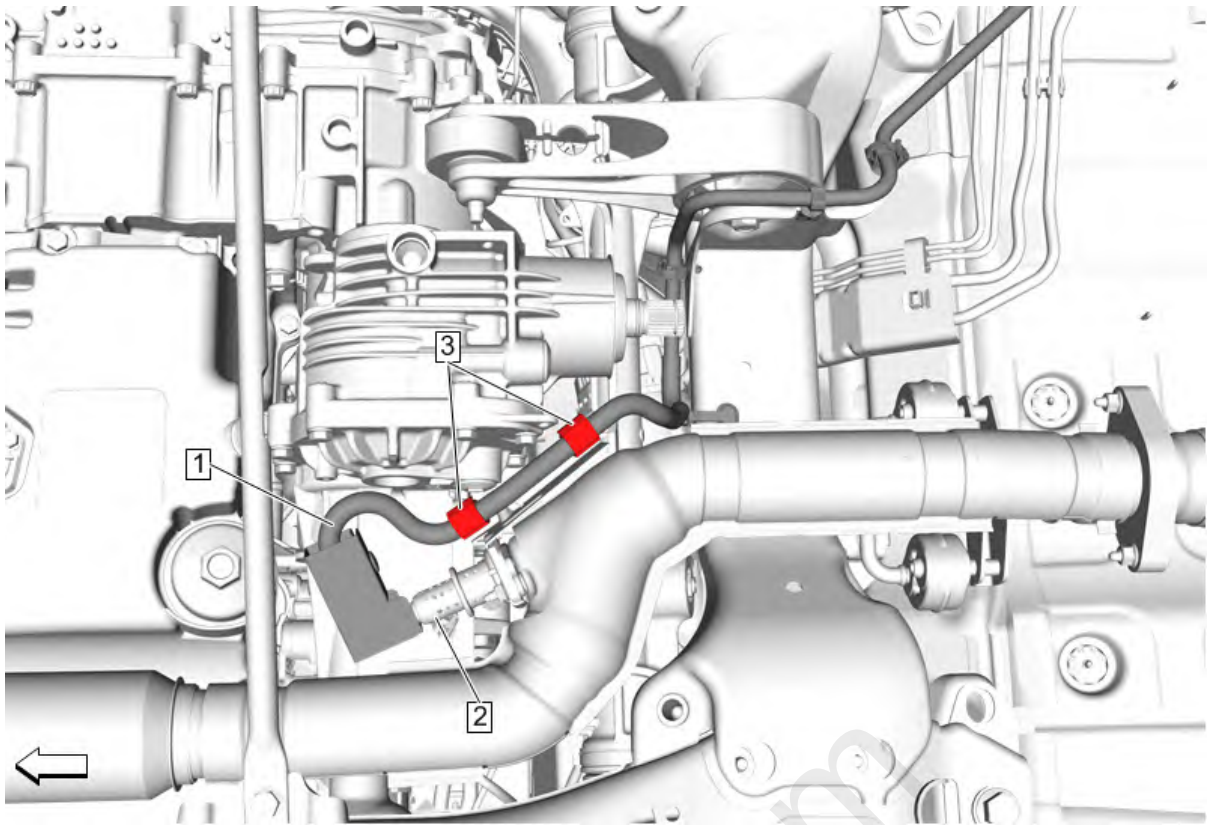


Fig. 468: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Emission Reduction Fluid Injector And Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
3. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (3) (Qty: 2)
4. Disconnect the electrical connector.

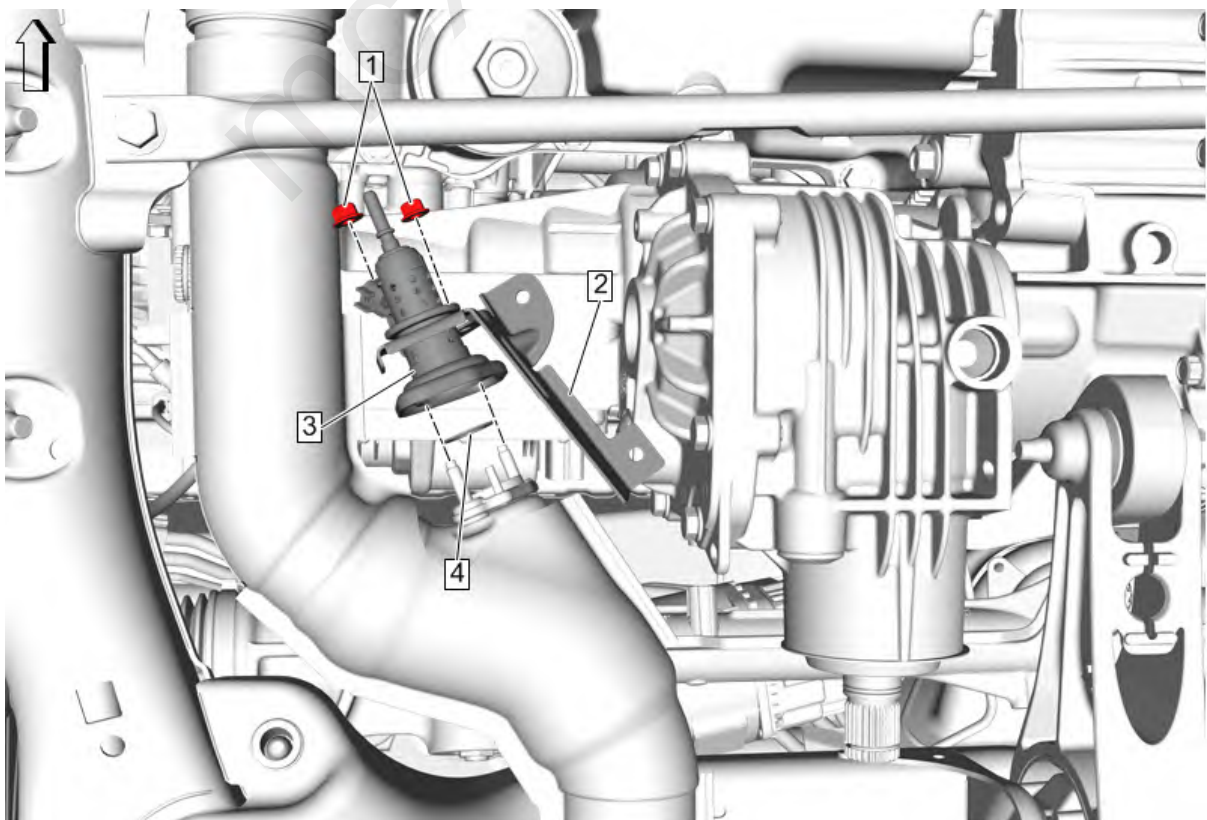


Fig. 469: Emission Reduction Fluid Injector, Nuts, Pipe Bracket And Gasket

Courtesy of GENERAL MOTORS COMPANY

5. Remove Emission Reduction Fluid Injector Nuts (1) (Qty: 2)
6. Remove Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Bracket (2)

NOTE: Do not use a prying tool to remove the injector.

7. Remove Emission Reduction Fluid Injector (3)
8. Remove and DISCARD Gasket (4)
9. Clean the exhaust mounting flange and injector mounting surfaces to remove any soot or emission reduction fluid deposits.

Installation Procedure

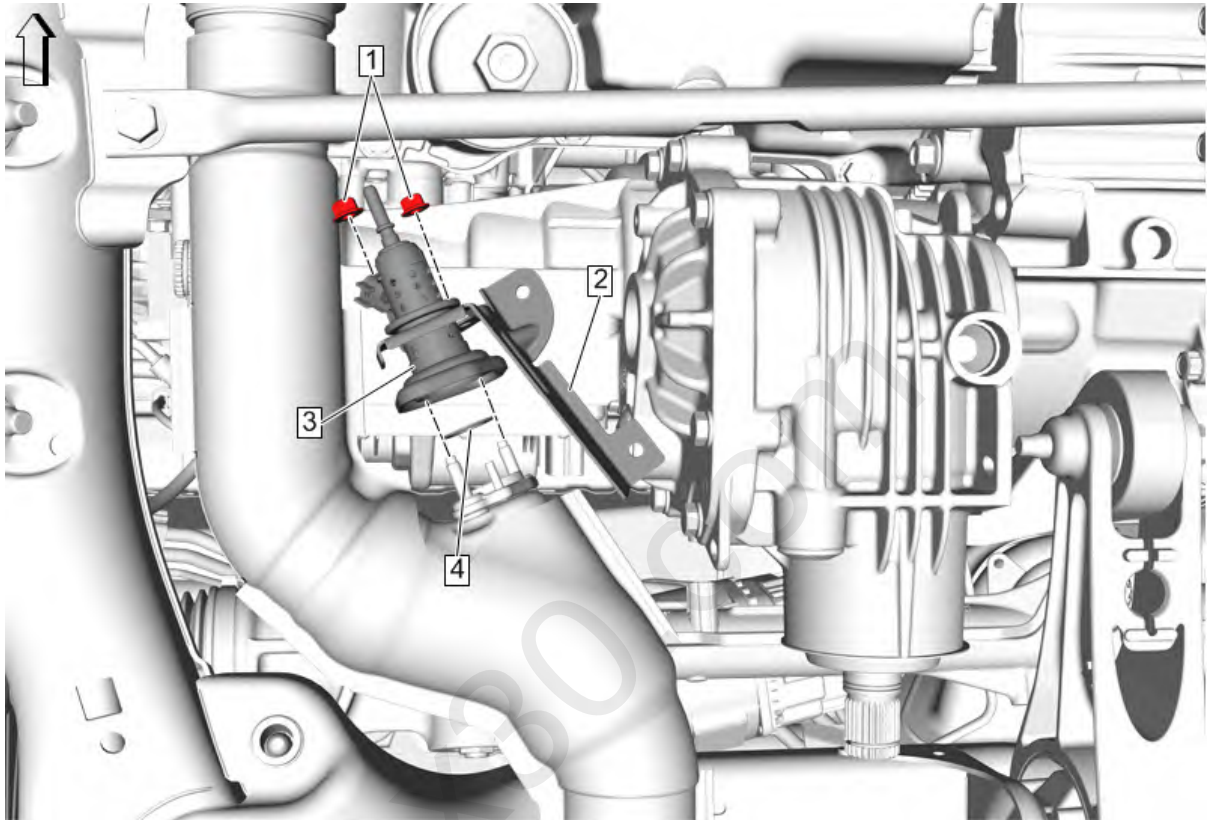


Fig. 470: Emission Reduction Fluid Injector, Nuts, Pipe Bracket And Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: A NEW emission reduction fluid injector will have a new gasket as part of assembly (POA).

1. Install NEW Gasket (4)
2. Install Emission Reduction Fluid Injector (3)
3. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Bracket (2)

CAUTION: Refer to **Fastener Caution** .

4. Install and tighten Emission Reduction Fluid Injector Nuts (1) (Qty: 2) to 9 N.m (80 lb in)
5. Connect the electrical connector.

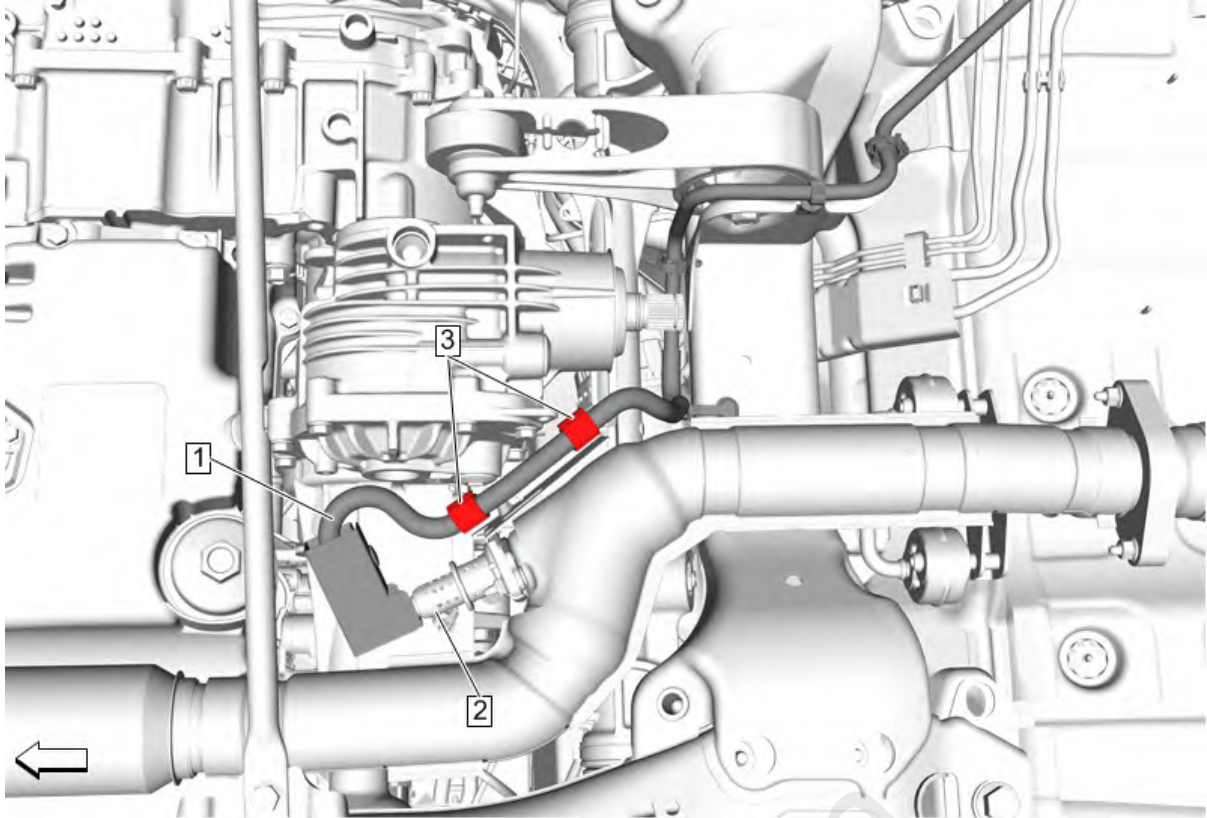


Fig. 471: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Emission Reduction Fluid Injector And Retainers

Courtesy of GENERAL MOTORS COMPANY

6. Install Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainers (3) (Qty: 2)
7. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
8. Check for leaks and ensure the emission reduction fluid injector joint is properly sealed.
9. If replacing with NEW injector, perform the NOx Catalyst Reductant Loading Reset. Refer to [NOx Catalyst Reductant Loading Reset](#)
10. Lower the vehicle.

EMISSION REDUCTION FLUID INJECTOR REPLACEMENT (FWD)

Removal Procedure

1. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

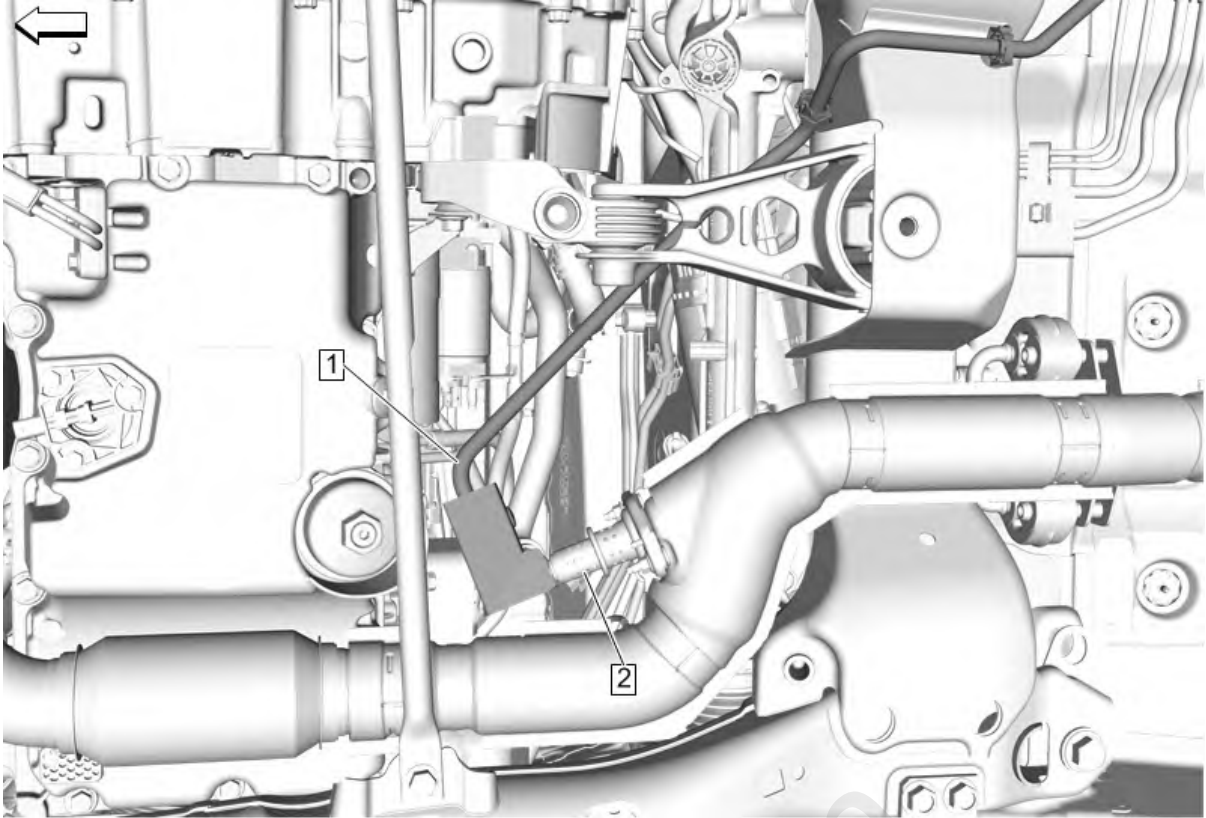


Fig. 472: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Emission Reduction Fluid Injector

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
3. Disconnect the electrical connector.

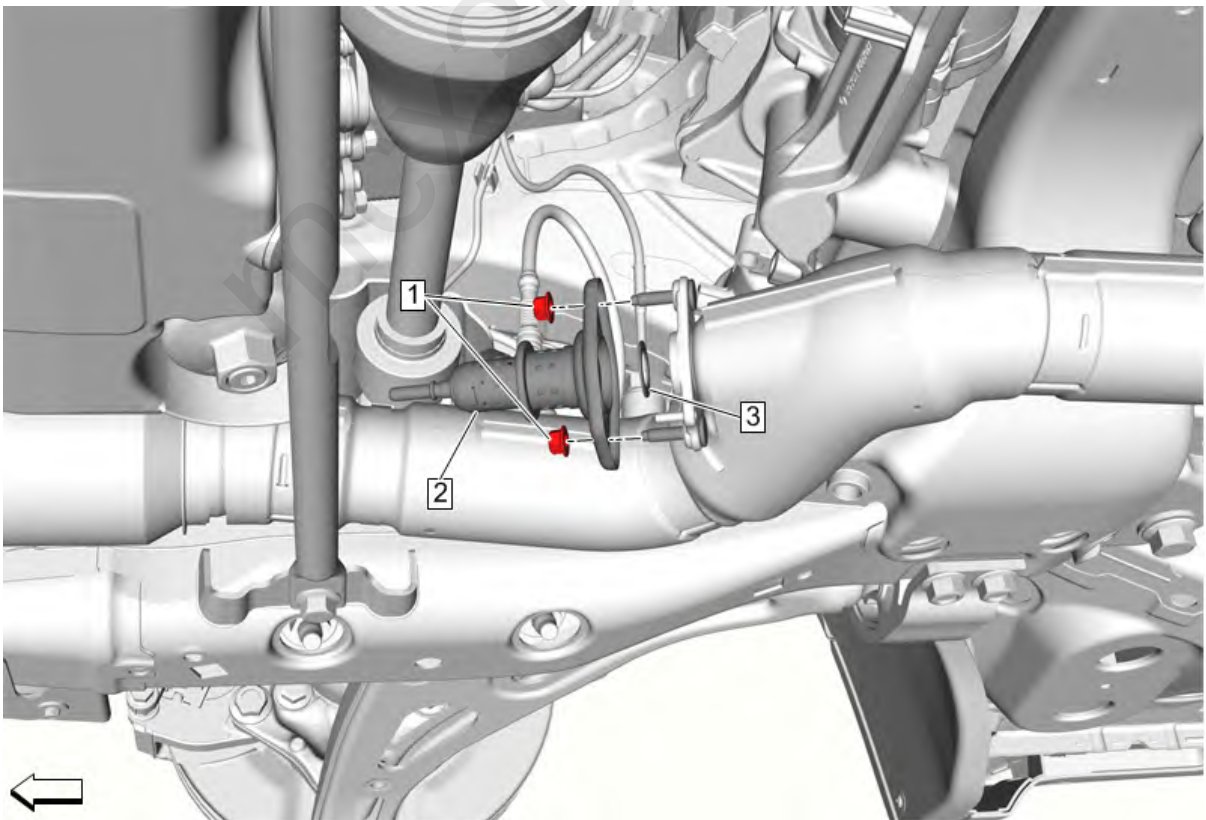


Fig. 473: Emission Reduction Fluid Injector, Nuts And Gasket

Courtesy of GENERAL MOTORS COMPANY

4. Remove Emission Reduction Fluid Injector Nuts (1) (Qty: 2)

NOTE: Do not use a prying tool to remove the injector.

5. Remove Emission Reduction Fluid Injector (2)
6. Remove and DISCARD Gasket (3)
7. Clean the exhaust mounting flange and injector mounting surfaces to remove any soot or emission reduction fluid deposits.

Installation Procedure

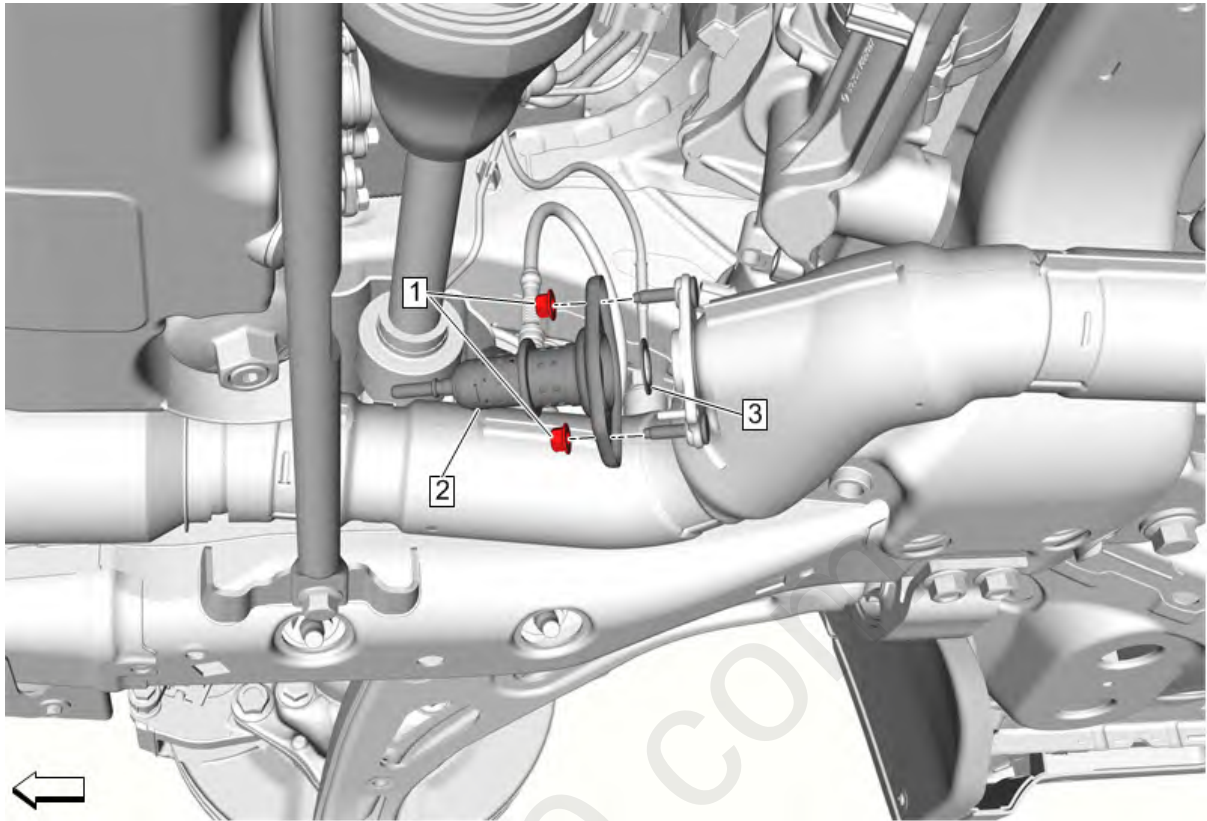


Fig. 474: Emission Reduction Fluid Injector, Nuts And Gasket
Courtesy of GENERAL MOTORS COMPANY

NOTE: A NEW emission reduction fluid injector will have a new gasket as part of assembly (POA).

1. Install NEW Gasket (3)
2. Install Emission Reduction Fluid Injector (2)

CAUTION: Refer to **Fastener Caution** .

3. Install and tighten Emission Reduction Fluid Injector Nuts (1) (Qty: 2) to 9 N.m (80 lb in)
4. Connect the electrical connector.

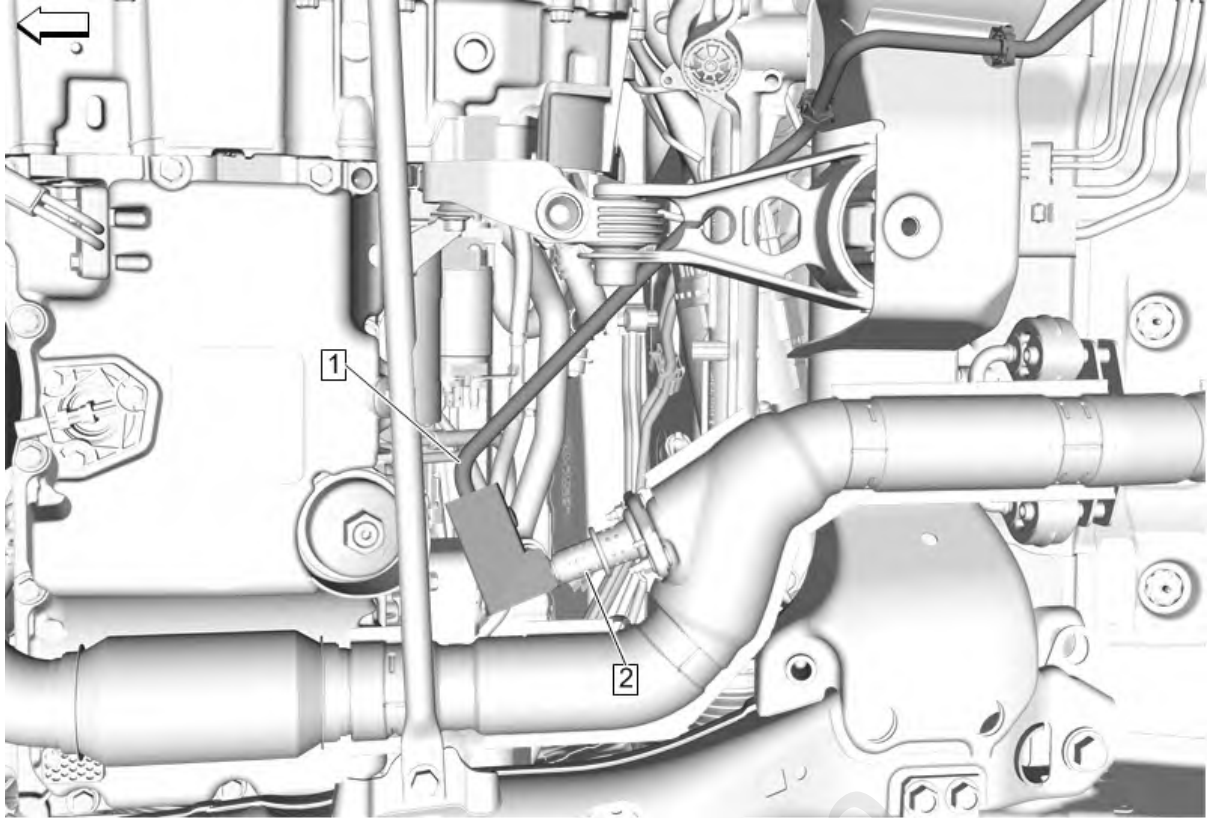


Fig. 475: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe And Emission Reduction Fluid Injector

Courtesy of GENERAL MOTORS COMPANY

5. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2). Refer to [Plastic Collar Quick Connect Fitting Service](#)
6. Check for leaks and ensure the emission reduction fluid injector joint is properly sealed.
7. If replacing with NEW injector, perform the NOx Catalyst Reductant Loading Reset. Refer to [NOx Catalyst Reductant Loading Reset](#)
8. Lower the vehicle.

EMISSION REDUCTION FLUID TANK OPENING FILLER REPLACEMENT

Removal Procedure

1. Remove Fuel Tank Filler Pipe Housing. Refer to [Fuel Tank Filler Pipe Housing Replacement \(Equinox\)](#) [Fuel Tank Filler Pipe Housing Replacement \(Terrain\)](#).
2. Remove Rear Wheelhouse Liner-Left Side. Refer to [Rear Wheelhouse Liner Replacement- Left Side \(Equinox\)](#) [Rear Wheelhouse Liner Replacement- Left Side \(Terrain\)](#).

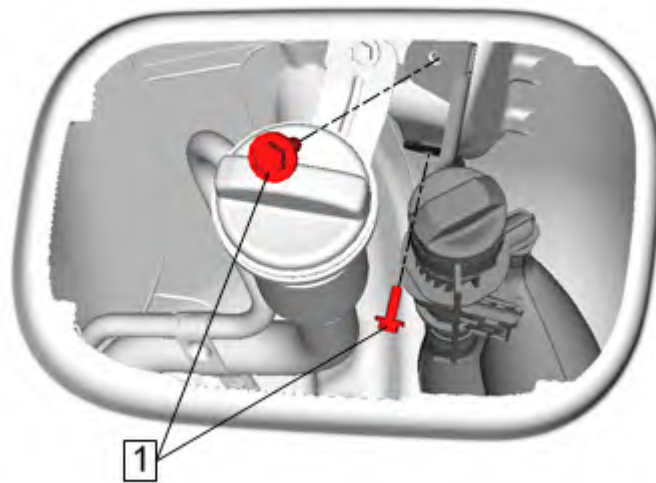


Fig. 476: Fuel Tank Filler Pipe Ground Bolts
Courtesy of GENERAL MOTORS COMPANY

3. Remove Fuel Tank Filler Pipe Ground Bolts (1) (Qty: 2)
4. Using only a low-pressure clean water hose, spray the upper surface of the emission reduction fluid tank, emission reduction filler pipe and connections to remove dirt and debris.
5. Using only a low pressure air wand or air gun, dry the emission reduction tank, emission reduction filler pipe and connections.

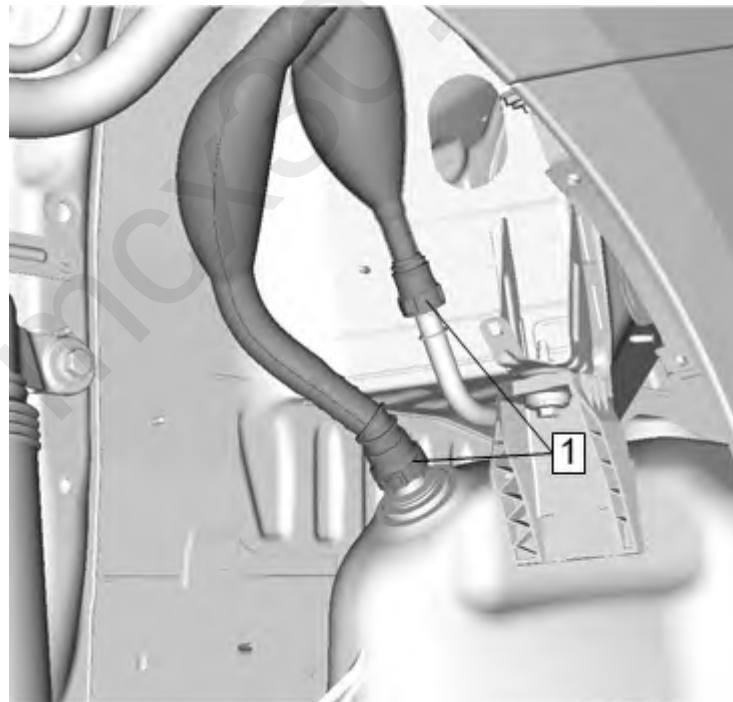


Fig. 477: Emission Reduction Fluid Tank Opening Filler Hoses
Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Emission Reduction Fluid Tank Opening Filler (1) (Qty: 2). Refer to [**Plastic Collar Quick Connect Fitting Service**](#)

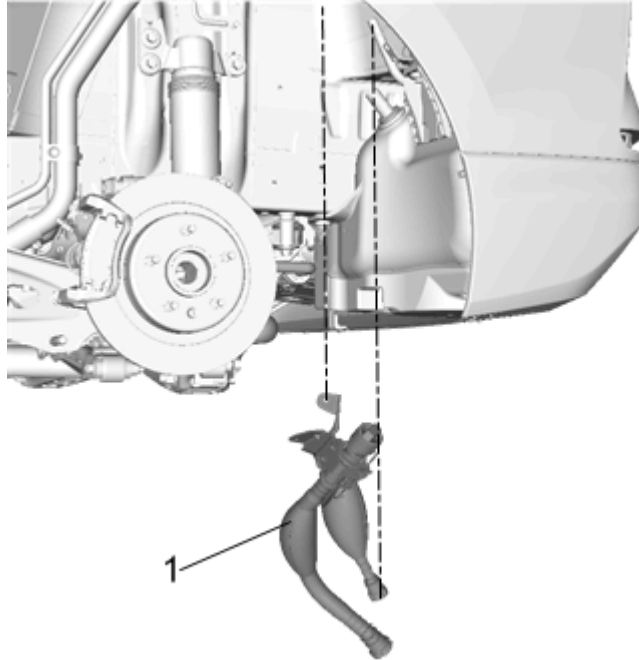


Fig. 478: Emission Reduction Fluid Tank Opening Filler
Courtesy of GENERAL MOTORS COMPANY

7. Remove Emission Reduction Fluid Tank Opening Filler (1)

Installation Procedure

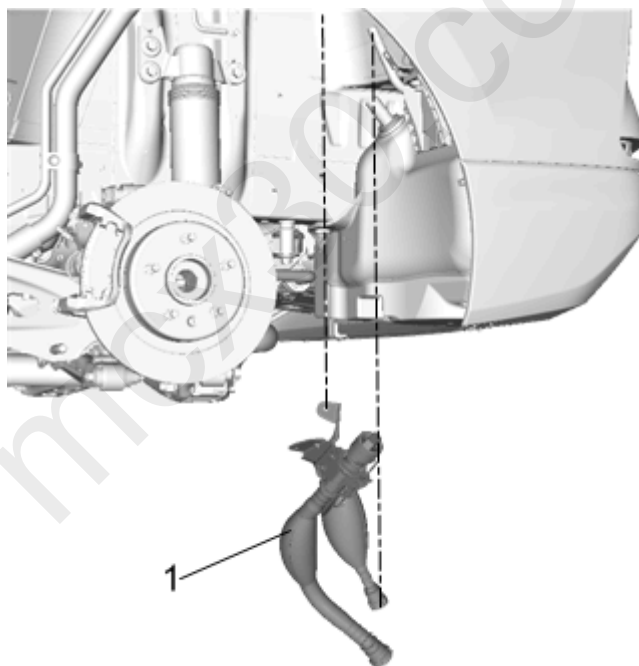


Fig. 479: Emission Reduction Fluid Tank Opening Filler
Courtesy of GENERAL MOTORS COMPANY

1. Install Emission Reduction Fluid Tank Opening Filler (1)

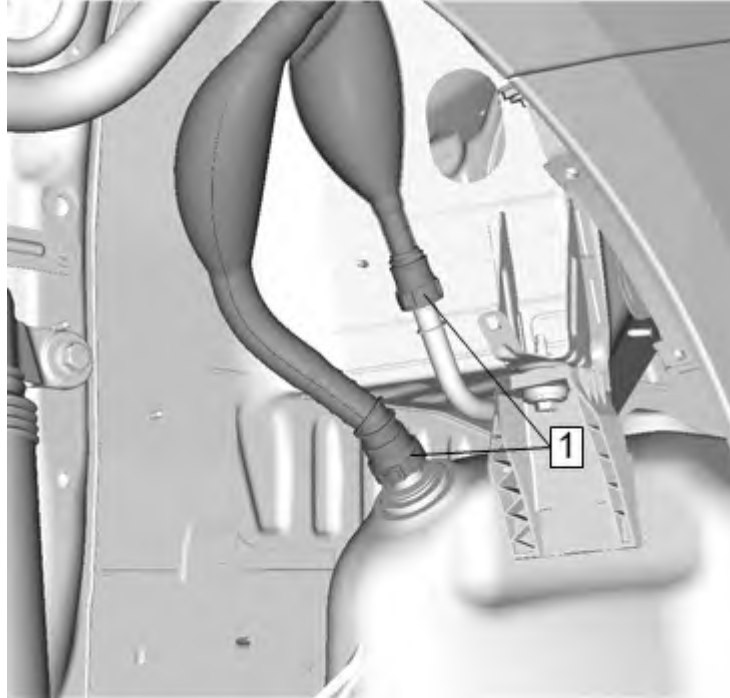


Fig. 480: Emission Reduction Fluid Tank Opening Filler Hoses
 Courtesy of GENERAL MOTORS COMPANY

2. Connect Emission Reduction Fluid Tank Opening Filler (1) (Qty: 2). Refer to [Plastic Collar Quick Connect Fitting Service](#)

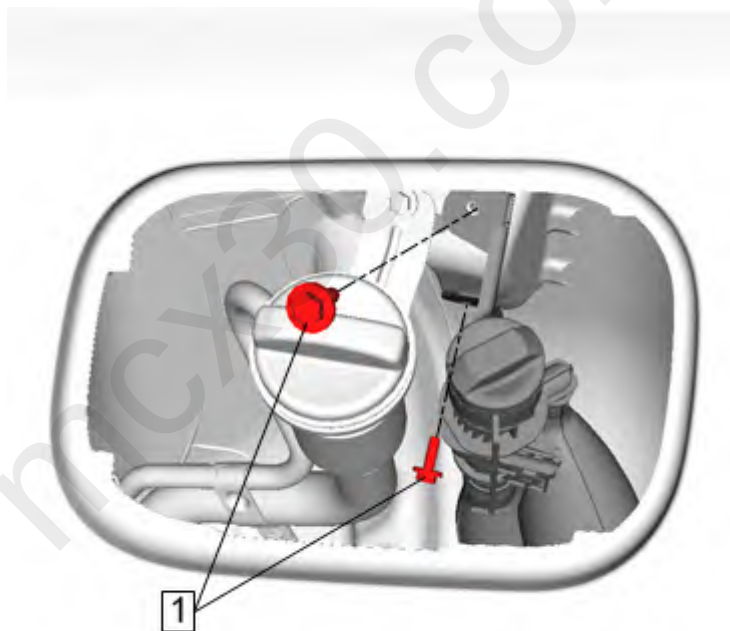


Fig. 481: Fuel Tank Filler Pipe Ground Bolts
 Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

3. Install and tighten Fuel Tank Filler Pipe Ground Bolts (1) (Qty: 2) to 9 N.m (80 lb in)
4. Install Rear Wheelhouse Liner-Left Side. Refer to [Rear Wheelhouse Liner Replacement- Left Side \(Equinox\)](#), [Rear Wheelhouse Liner Replacement- Left Side \(Terrain\)](#).
5. Install Fuel Tank Filler Pipe Housing. Refer to [Fuel Tank Filler Pipe Housing Replacement \(Equinox\)](#), [Fuel Tank Filler Pipe Housing Replacement \(Terrain\)](#).

EMISSION REDUCTION FLUID TANK PROTECTOR REPLACEMENT

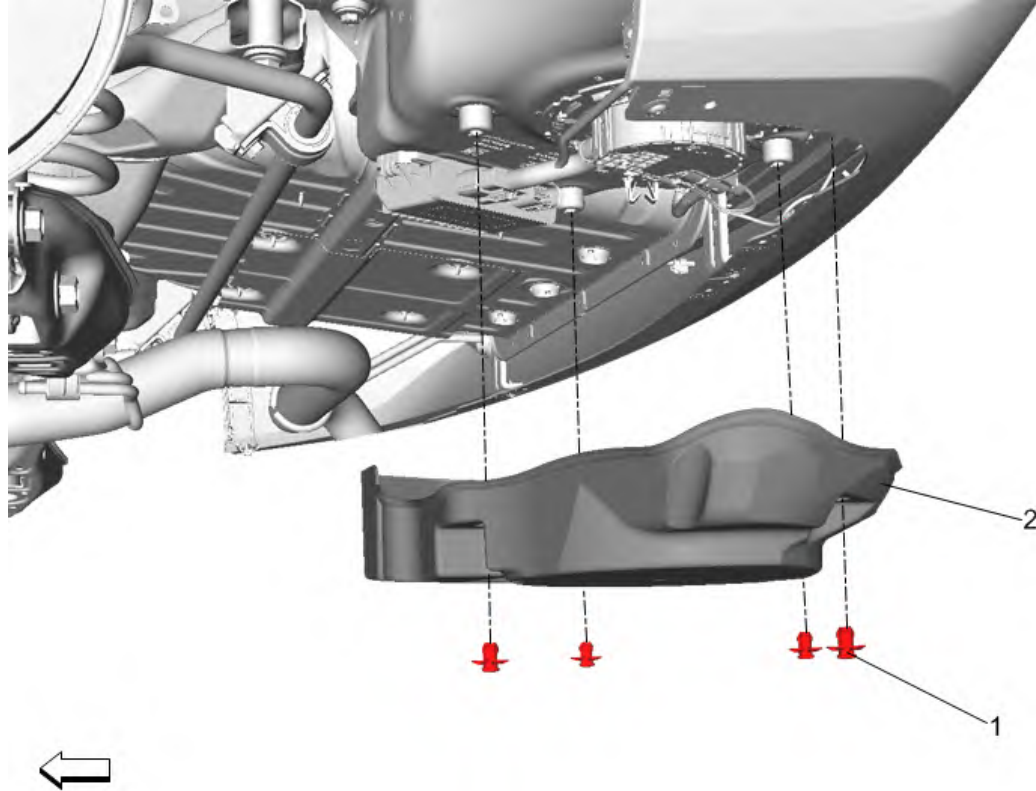


Fig. 482: Emission Reduction Fluid Tank Protector
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Retainer (Qty: 4)
2	Emission Reduction Fluid Tank Protector

EMISSION REDUCTION FLUID TANK REPLACEMENT

Removal Procedure

1. Remove Rear Bumper Fascia. Refer to [Rear Bumper Fascia Replacement \(Equinox\)](#) [Rear Bumper Fascia Replacement \(Terrain\)](#).
2. Drain the emission reduction fluid tank. Refer to [Emission Reduction Fluid Tank Draining](#).
3. Remove Emission Reduction Fluid Tank Protector. Refer to [Emission Reduction Fluid Tank Protector Replacement](#).
4. Using only a low-pressure clean water hose, spray the upper and lower surface of the emission reduction fluid tank, emission reduction filler pipe and connections to remove dirt and debris.
5. Using only a low pressure air wand or air gun, dry the emission reduction tank, emission reduction filler pipe and connections.

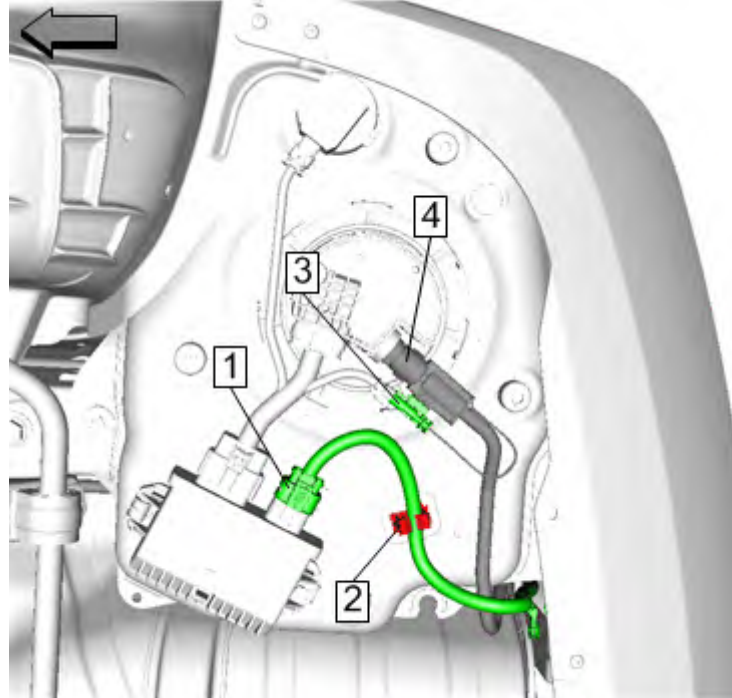


Fig. 483: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Electrical Connectors And Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Electrical Connector (1)
7. Remove Electrical Connector (1) @ Retainer (2)
8. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Electrical Connector (3)
9. Disconnect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (4). Refer to [Plastic Collar Quick Connect Fitting Service](#)

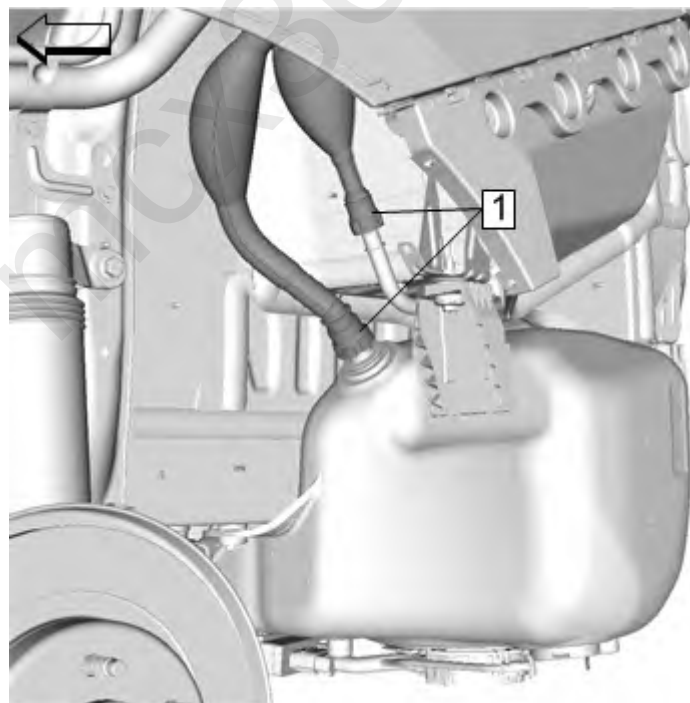


Fig. 484: Emission Reduction Fluid Tank Opening Filler Hoses

Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Emission Reduction Fluid Tank Opening Filler (1) (Qty: 2). Refer to [Plastic Collar Quick Connect Fitting Service](#)

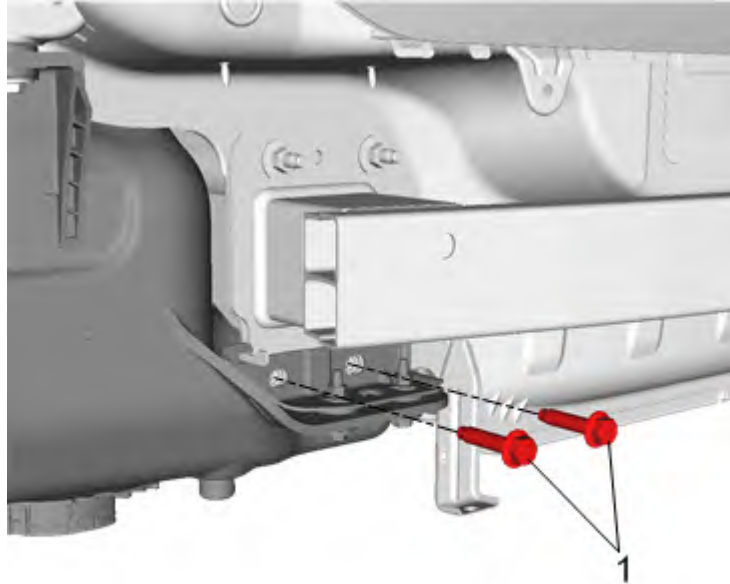


Fig. 485: Emission Reduction Fluid Tank Bolts
 Courtesy of GENERAL MOTORS COMPANY

11. Remove Emission Reduction Fluid Tank Bolts (1) (Qty: 2)

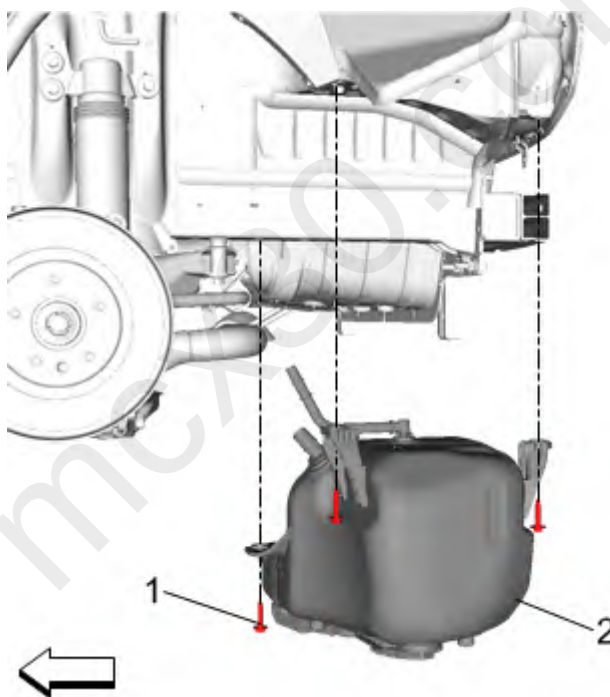


Fig. 486: Emission Reduction Fluid Tank And Bolts
 Courtesy of GENERAL MOTORS COMPANY

12. Remove Emission Reduction Fluid Tank Bolts (1) (Qty: 3)
13. Remove Emission Reduction Fluid Tank (2)

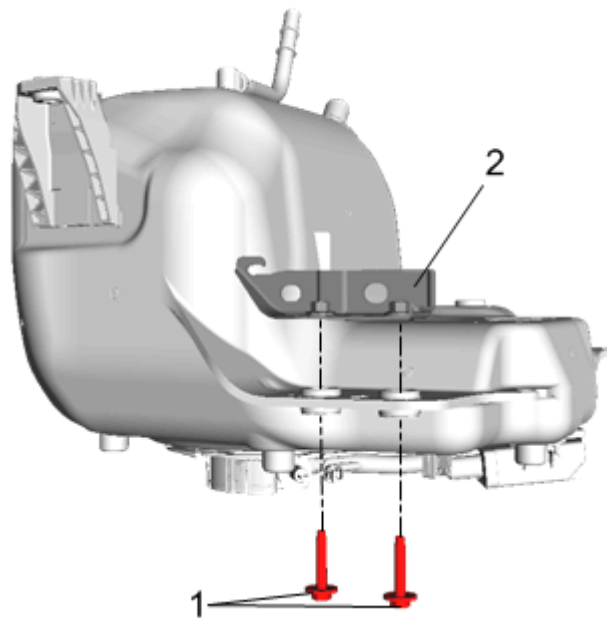


Fig. 487: Emission Reduction Fluid Tank Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: If replacing the emission reduction fluid tank remove the metal mounting bracket.

14. Remove Emission Reduction Fluid Tank Bracket Bolts (1) (Qty: 2)
15. Remove Emission Reduction Fluid Tank Bracket (2)
16. Transfer components as necessary.

Installation Procedure

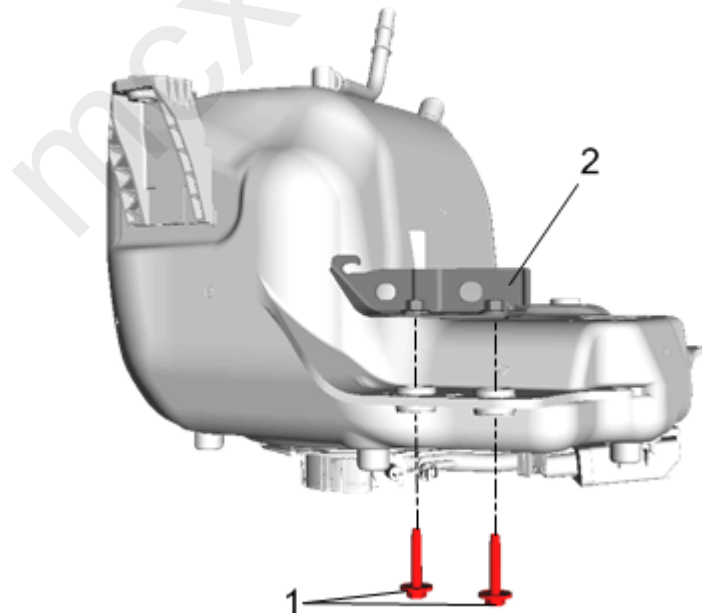


Fig. 488: Emission Reduction Fluid Tank Bracket And Bolts

Courtesy of GENERAL MOTORS COMPANY

NOTE: If tank was replaced with a new assembly, install the metal mounting bracket. Center bracket over hole in tank.

1. Install Emission Reduction Fluid Tank Bracket (2)

CAUTION: Refer to [Fastener Caution](#) .

2. Install and tighten Emission Reduction Fluid Tank Bracket Bolts (1) (Qty: 2) to 20 N.m (15 lb ft)

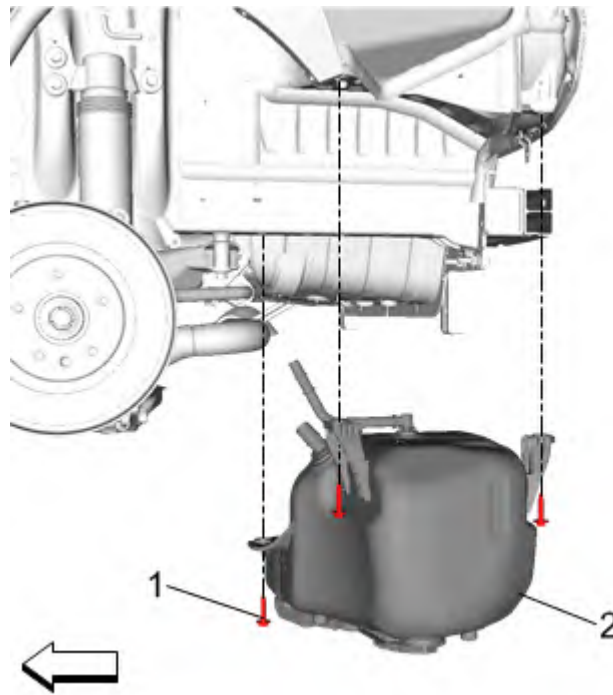


Fig. 489: Emission Reduction Fluid Tank And Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Install Emission Reduction Fluid Tank (2)
4. Install and tighten Emission Reduction Fluid Tank Bolts (1) (Qty: 3) to 22 N.m (16 lb ft)

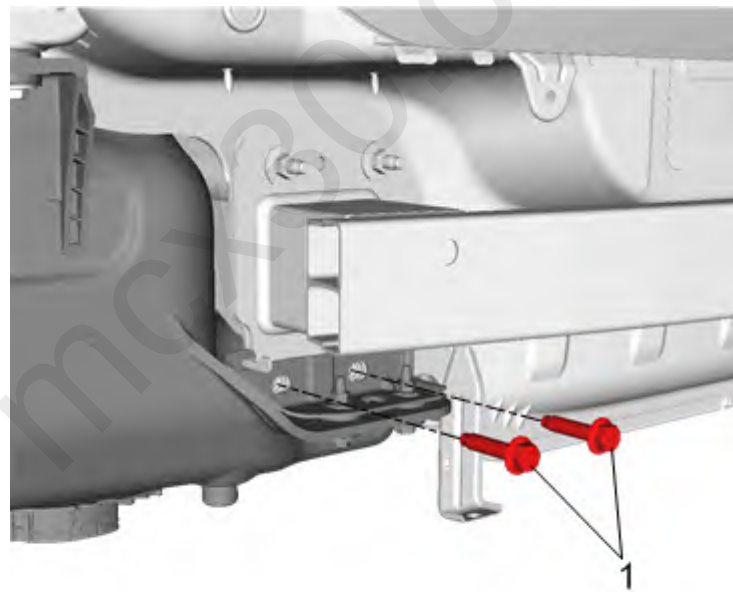


Fig. 490: Emission Reduction Fluid Tank Bolts

Courtesy of GENERAL MOTORS COMPANY

5. Install and tighten Emission Reduction Fluid Tank Bolts (1) (Qty: 2) to 58 N.m (43 lb ft)

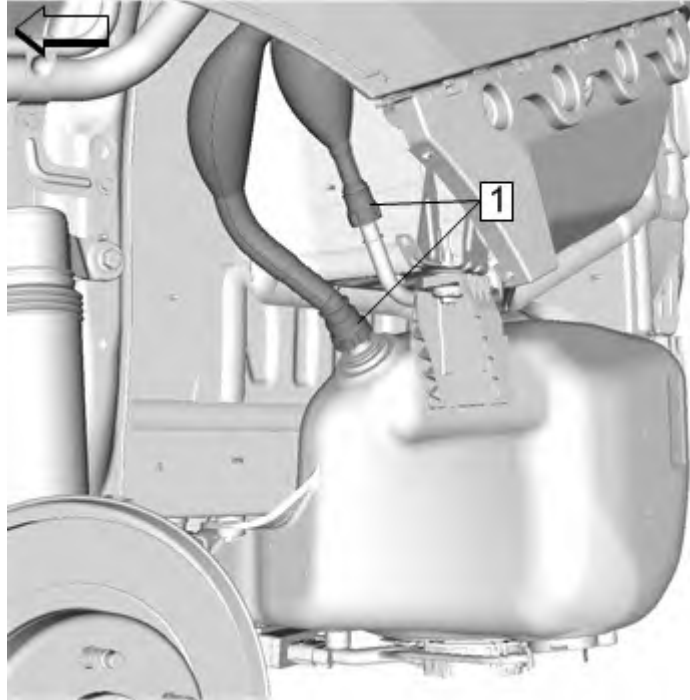


Fig. 491: Emission Reduction Fluid Tank Opening Filler Hoses
 Courtesy of GENERAL MOTORS COMPANY

6. Connect Emission Reduction Fluid Tank Opening Filler (1) (Qty: 2). Refer to [Plastic Collar Quick Connect Fitting Service](#)

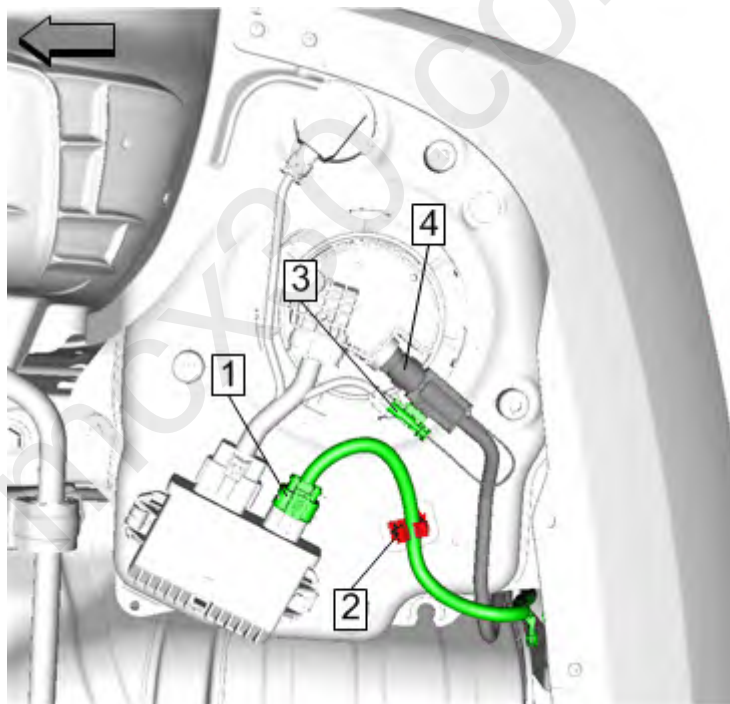


Fig. 492: Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe, Electrical Connectors And Retainer
 Courtesy of GENERAL MOTORS COMPANY

7. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (4). Refer to [Plastic Collar Quick Connect Fitting Service](#)
8. Connect Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Electrical Connector (3)
9. Install Electrical Connector (1) @ Retainer (2)
10. Connect Electrical Connector (1)
11. Install Emission Reduction Fluid Tank Protector. Refer to [Emission Reduction Fluid Tank Protector Replacement](#)
12. Install Rear Bumper Fascia. Refer to [Rear Bumper Fascia Replacement \(Equinox\)](#). [Rear Bumper Fascia Replacement \(Terrain\)](#).

13. Refill the emission reduction fluid tank, add a minimum of 9.5 liters (2.5 gallons).

14. Perform the reductant fluid tank level reset. Refer to [Reductant Fluid Tank Level Reset](#)

EMISSION REDUCTION FLUID TANK RESERVOIR WIRE HARNESS REPLACEMENT

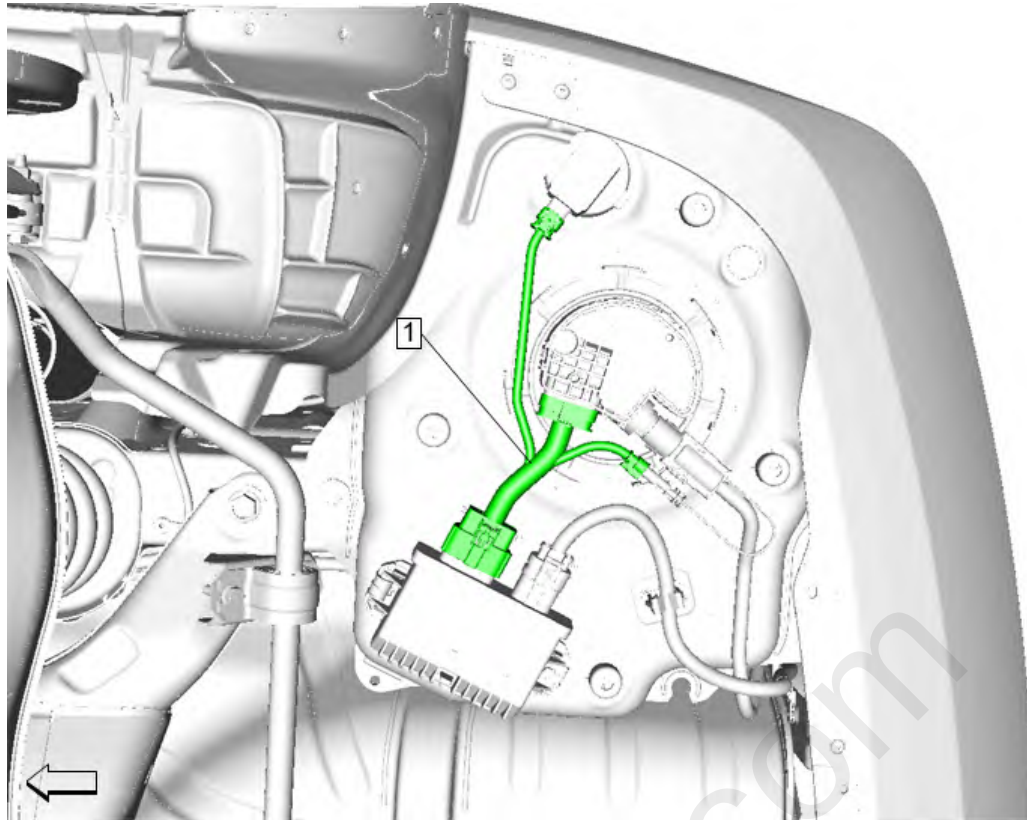


Fig. 493: Emission Reduction Fluid Tank Reservoir Wire Harness

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Emission Reduction Fluid Tank Protector. Refer to Emission Reduction Fluid Tank Protector Replacement	
1	Emission Reduction Fluid Tank Reservoir Wire Harness Procedure Disconnect the emission reduction fluid tank wire harness connectors.

EMISSION REDUCTION FLUID TANK DRAINING

CAUTION: The diesel exhaust fluid (DEF) system is part of the emission system for this vehicle, and must be serviced while observing extreme care to prevent foreign contamination of any kind from entering this system. If extreme care is NOT taken to prevent contamination from dirt, debris, fluids other than DEF, etc., reduced performance and/or damage to the DEF system may result.

- Cleanliness of the diesel exhaust fluid (DEF) system is crucial to ensure proper operation. Before opening any part of the DEF system, ensure connections and joints are thoroughly clean and dry of any dirt, debris, or other contaminants. Use only low pressure water and low pressure air, as directed.
- Diesel exhaust fluid (DEF) will have a tendency over time to develop areas of dried crystallization residue. Crystallization residue is a normal process for this fluid. Dried DEF crystallization residue can be wiped away, or flushed away with clean water, depending on location of the crystallization.

1. Ensure the ignition is OFF.

2. Using only a low pressure clean water hose, spray the filler hose cap and filler pocket to remove all dirt and debris.
3. Using only a low pressure air wand or air gun, direct air along the same surfaces to both dry and remove any further contaminants.
4. Remove the emission reduction fluid tank filler cap.

CAUTION: The diesel exhaust fluid (DEF) must be drained by a clean dedicated siphoning pump and hose. It must NOT have any traces of gasoline, diesel fuel, or any oil based substances. If extreme care is NOT taken to prevent contamination from fluids other than DEF, reduced performance and/or damage to the DEF system may result.

5. Insert the hose from the pump device into the emission reduction fluid tank.
6. Using a hand or air operated pump device, drain as much emission reduction fluid from the tank as possible into an approved container and dispose of properly.

Refilling Emission Reduction Fluid Tank

1. Refill the emission reduction fluid tank, add a minimum of 9.5 liters (2.5 gallons).
2. Perform the reductant fluid tank level reset. Refer to [Reductant Fluid Tank Level Reset](#)

NITROGEN OXIDES SENSOR REPLACEMENT - POSITION 1

Special Tools

- EN-6179 Oxygen Sensor Wrench

For equivalent regional tools, refer to [Special Tools](#) .

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Remove Front Wheelhouse Liner-Right Side. Refer to [Front Wheelhouse Liner Replacement - Right Side \(Equinox\)](#), [Front Wheelhouse Liner Replacement - Right Side \(Terrain\)](#).
3. Remove Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#).

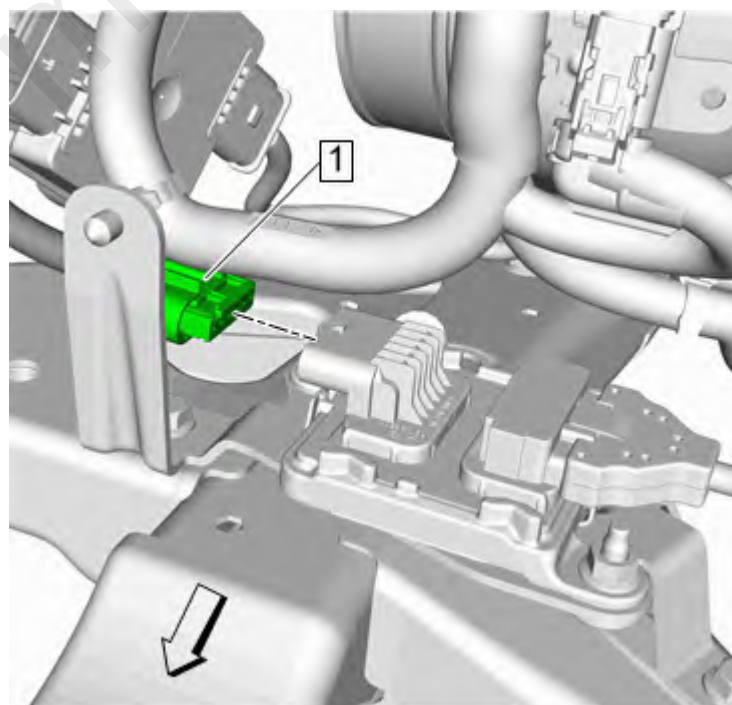


Fig. 494: Nitrogen Oxides Sensor - Position 1 Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION:

Do not disconnect the nitrogen oxide sensor from the nitrogen oxide sensor control module. A separation of the two components may cause a defect on the nitrogen oxide sensor control module. Always replace the nitrogen oxide sensor along with the nitrogen oxide sensor control module as an assembly.

4. Disconnect the electrical connector. (1)

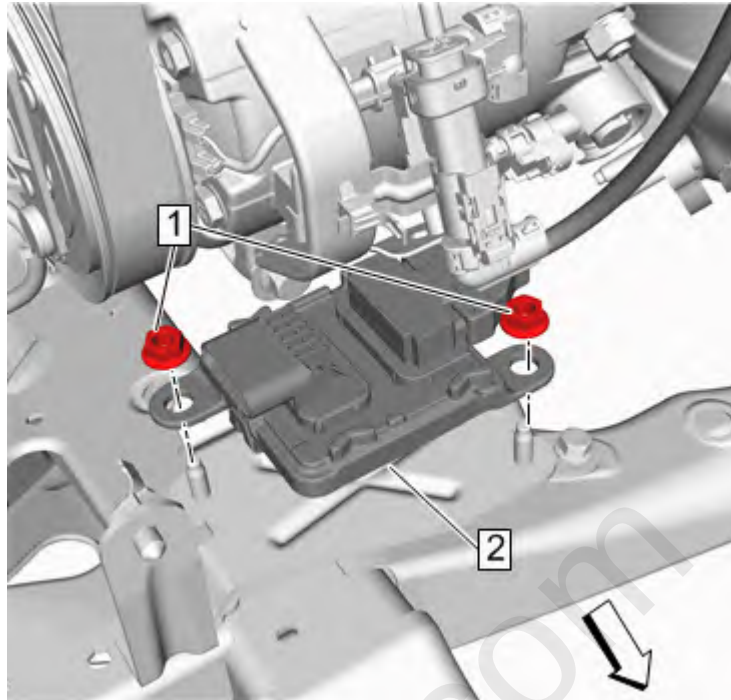


Fig. 495: Nitrogen Oxides Sensor - Position 1 Control Module And Nuts
Courtesy of GENERAL MOTORS COMPANY

5. Remove the 2 nitrogen oxides sensor control module nuts (1).

NOTE: Do not bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position

6. Remove the nitrogen oxides sensor control module (2).
7. Lower the vehicle.

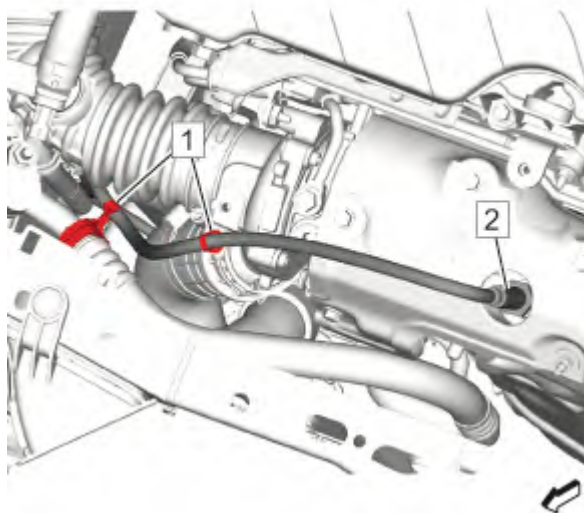


Fig. 496: Nitrogen Oxides Sensor - Position 1 And Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position

8. Unclip Wiring Harness Retainers (1) (Qty: 2)

9. Remove Turbocharger Heat Shield. Refer to [Turbocharger Heat Shield Replacement \(LH7\)](#).

NOTE: Use the special tool: *EN-6179 Oxygen Sensor Wrench*

10. Remove Nitrogen Oxides Sensor (2)

11. Remove the nitrogen oxides sensor assembly from the vehicle.

Installation Procedure

1. Install the nitrogen oxides sensor assembly to the vehicle.

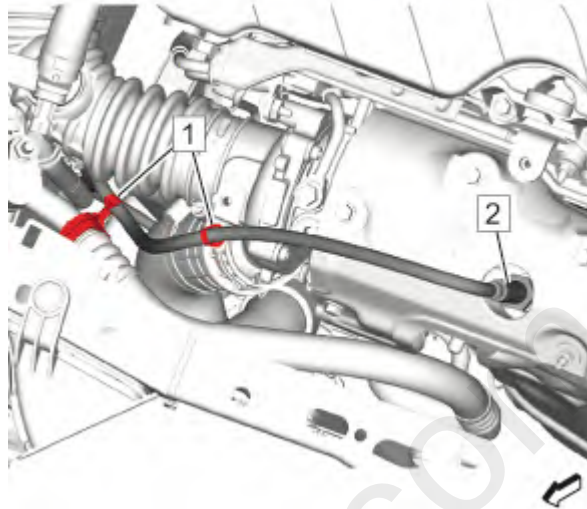


Fig. 497: Nitrogen Oxides Sensor - Position 1 And Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#)

NOTE: Do not bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position

NOTE: Use the special tool: *EN-6179 Oxygen Sensor Wrench*

2. Install and tighten Nitrogen Oxides Sensor (2) to 50 N.m (37 lb ft)

3. Install Turbocharger Heat Shield. Refer to [Turbocharger Heat Shield Replacement \(LH7\)](#).

4. Install Wiring Harness Retainers (1) (Qty: 2)

5. Raise the vehicle.

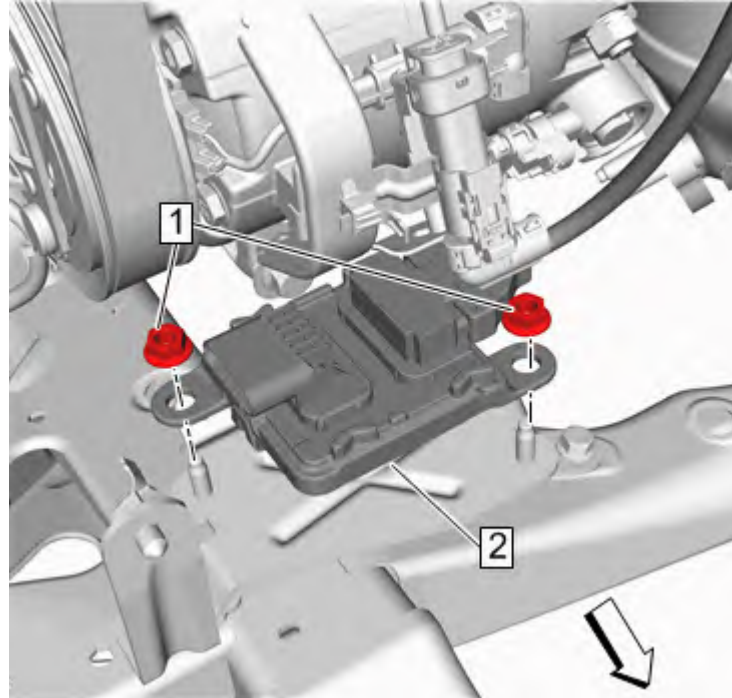


Fig. 498: Nitrogen Oxides Sensor - Position 1 Control Module And Nuts
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position

6. Install the nitrogen oxides sensor control module (2).

CAUTION: Refer to [Fastener Caution](#)

7. Install the 2 nitrogen oxides sensor control module nuts (1) and tighten to 9 N.m (80 lb in).

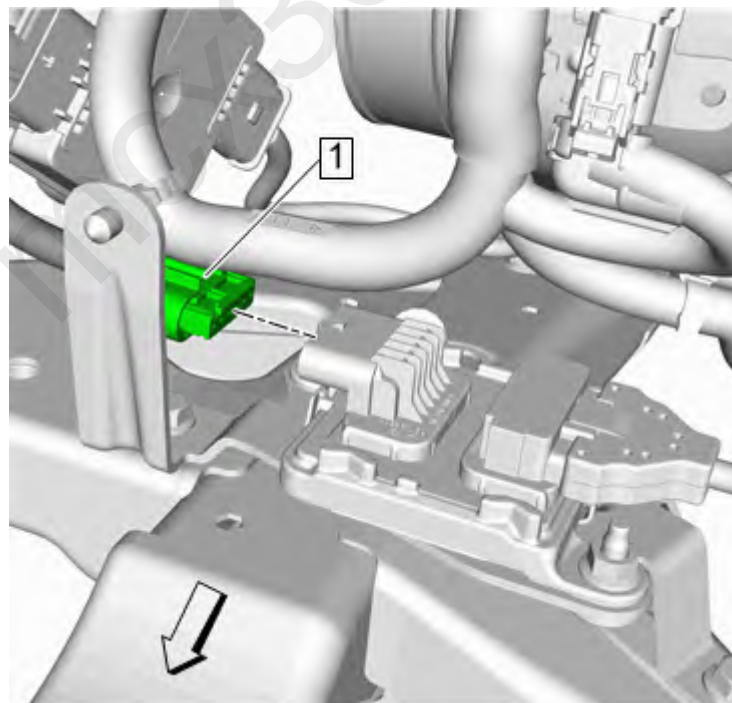


Fig. 499: Nitrogen Oxides Sensor - Position 1 Electrical Connector
 Courtesy of GENERAL MOTORS COMPANY

8. Connect the electrical connector. (1)
9. Install Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#)
10. Install Front Wheelhouse Liner-Right Side. Refer to [Front Wheelhouse Liner Replacement - Right Side \(Equinox\)](#), [Front Wheelhouse Liner Replacement - Right Side \(Terrain\)](#)

11. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
12. If replacing, perform the NOx sensor 1 reset. Refer to [NOx Sensor 1 Reset](#)
13. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

NITROGEN OXIDES SENSOR REPLACEMENT - POSITION 2

Removal Procedure

WARNING: Refer to [Exhaust Service Warning](#)

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
2. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#)

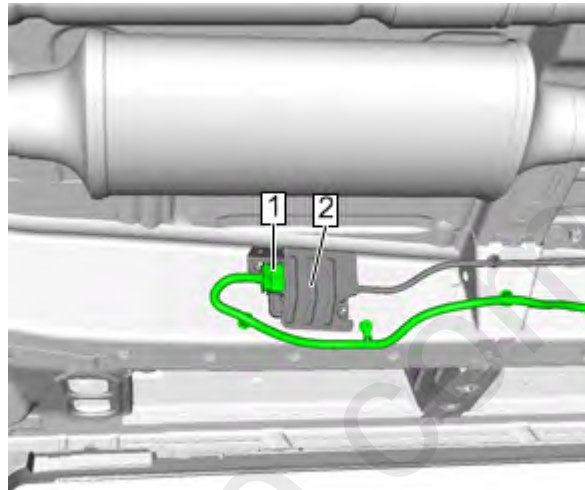


Fig. 500: Nitrogen Oxides Sensor - Position 2 Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Do not disconnect the nitrogen oxide sensor from the nitrogen oxide sensor control module. A separation of the two components may cause a defect on the nitrogen oxide sensor control module. Always replace the nitrogen oxide sensor along with the nitrogen oxide sensor control module as an assembly.

3. Remove Electrical Connector (1)

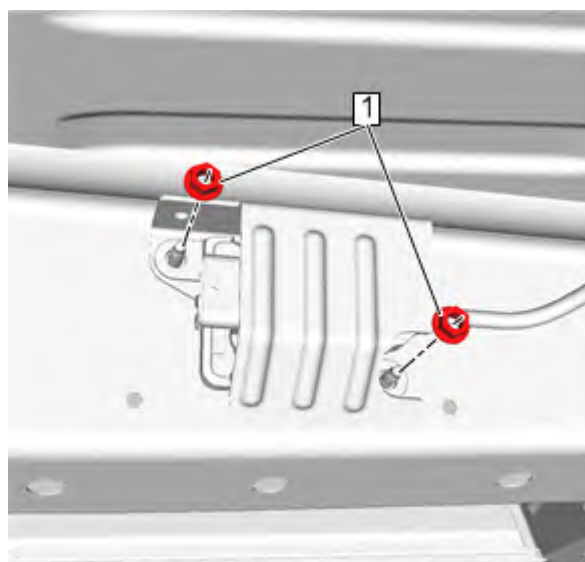


Fig. 501: Nitrogen Oxides Sensor - Position 2 Nuts
Courtesy of GENERAL MOTORS COMPANY

4. Remove Nitrogen Oxides Sensor Nuts (1) (Qty: 2)

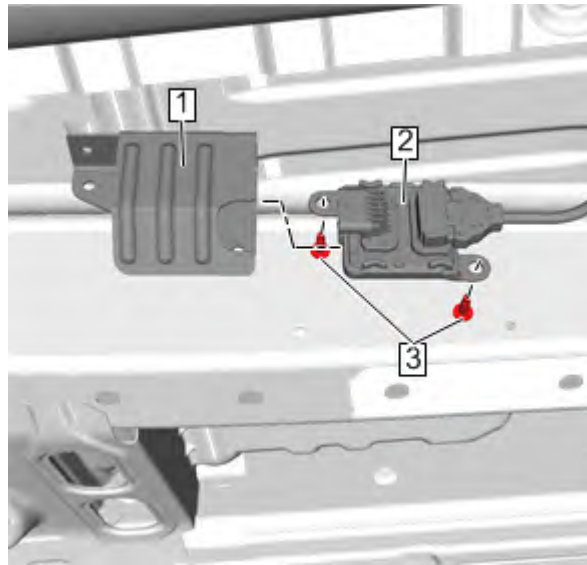


Fig. 502: Nitrogen Oxides Sensor - Position 2 Control Module, Bracket And Side Rail Studs
Courtesy of GENERAL MOTORS COMPANY

NOTE: Secure the nitrogen oxides sensor control module in a location that prevents unnecessary binding or strain on the cable.

5. Remove both the nitrogen oxides sensor control module bracket (1) and the nitrogen oxides sensor control module (2) from the front compartment side rail studs (3).

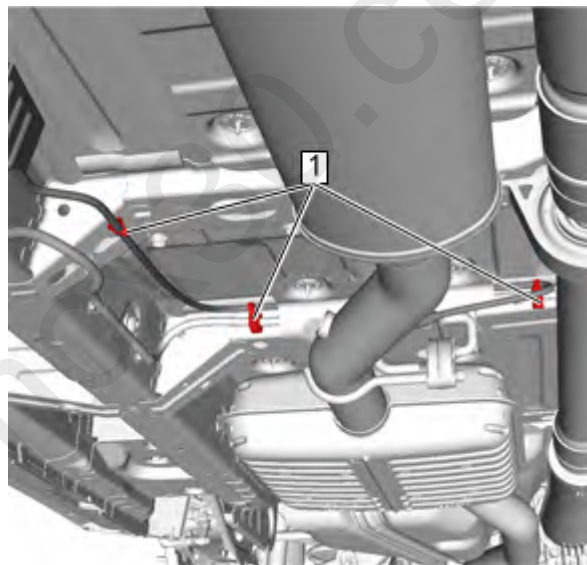


Fig. 503: Wiring Harness Retainers
Courtesy of GENERAL MOTORS COMPANY

6. Unclip Wiring Harness Retainers (1) (Qty: 3)

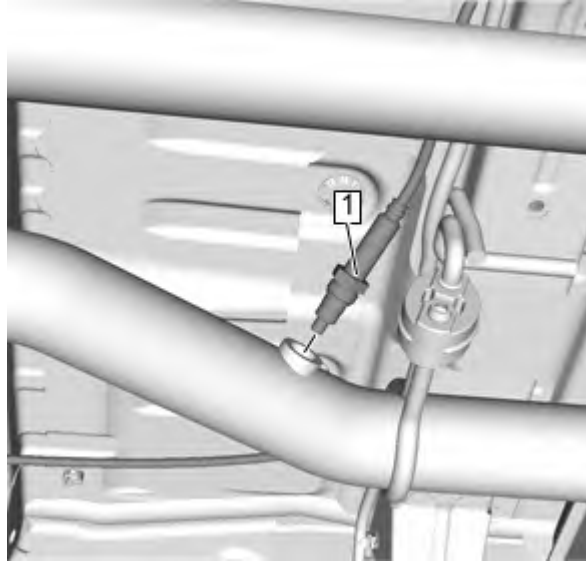


Fig. 504: Nitrogen Oxides Sensor - Position 2
Courtesy of GENERAL MOTORS COMPANY

NOTE: Do not bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position

7. Remove the nitrogen oxides sensor (1) from the exhaust pipe.

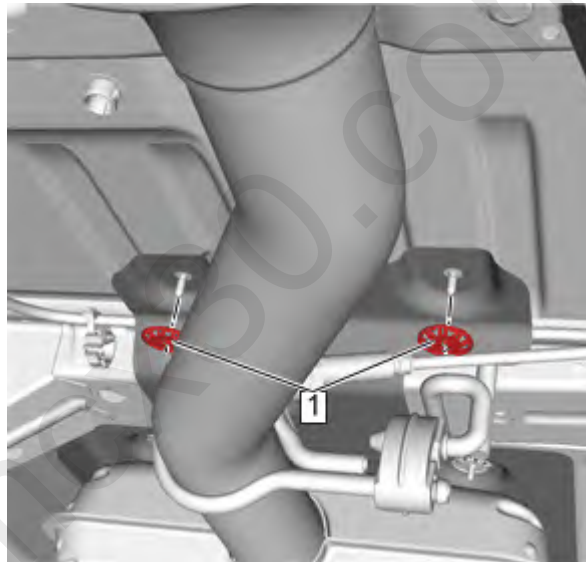


Fig. 505: Exhaust Heat Shield Retainers
Courtesy of GENERAL MOTORS COMPANY

8. Remove Exhaust Heat Shield Retainers (1) (Qty: 2)
9. Remove the nitrogen oxides sensor assembly from the vehicle.

Installation Procedure

CAUTION: Do not disconnect the nitrogen oxide sensor from the nitrogen oxide sensor control module. A separation of the two components may cause a defect on the nitrogen oxide sensor control module. Always replace the nitrogen oxide sensor along with the nitrogen oxide sensor control module as an assembly.

1. Install the nitrogen oxides sensor assembly to the vehicle.

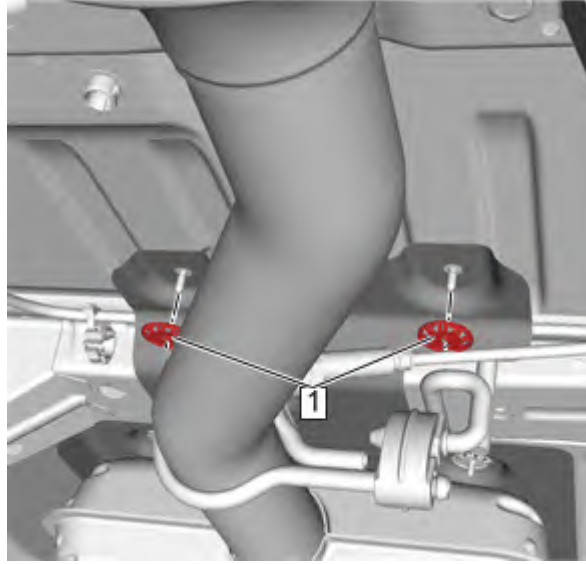


Fig. 506: Exhaust Heat Shield Retainers

Courtesy of GENERAL MOTORS COMPANY

2. Install Exhaust Heat Shield Retainers (1) (Qty: 2)

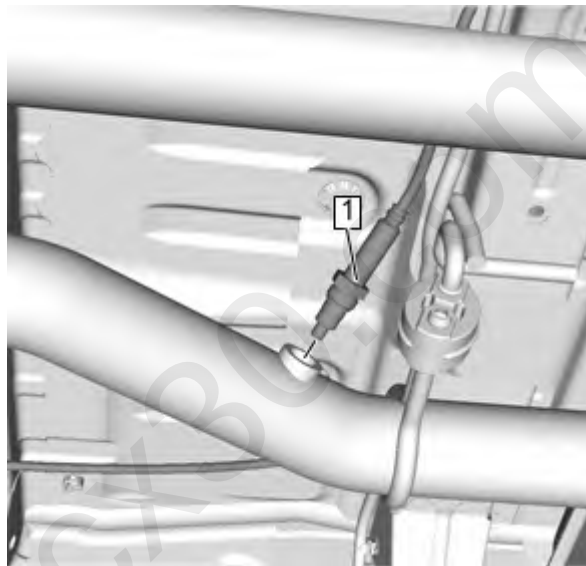


Fig. 507: Nitrogen Oxides Sensor - Position 2

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Component Fastener Tightening Caution](#) .

NOTE: Do not bend the cable sharply at the base of either the sensing unit or sensor ECU in the final mounting position

3. Install the nitrogen oxides sensor (1) to the exhaust pipe and tighten to 50 N.m (37 lb ft).

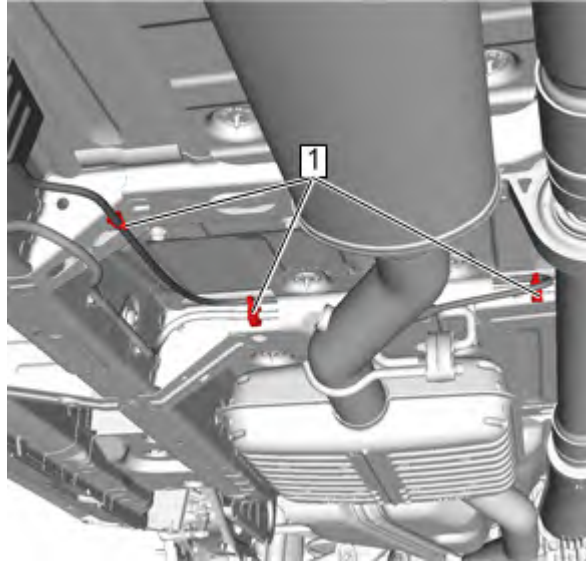


Fig. 508: Wiring Harness Retainers

Courtesy of GENERAL MOTORS COMPANY

4. Install Wiring Harness Retainers (1) (Qty: 3)

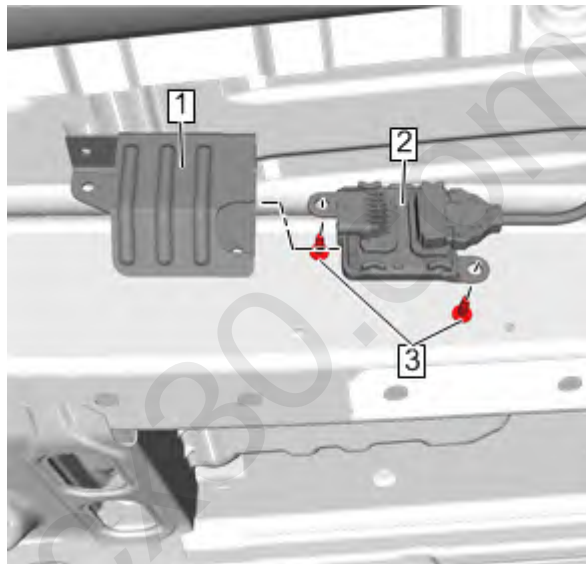


Fig. 509: Nitrogen Oxides Sensor - Position 2 Control Module, Bracket And Side Rail Studs

Courtesy of GENERAL MOTORS COMPANY

5. Install both the nitrogen oxides sensor control module bracket (1) and the nitrogen oxides sensor control module (2) to the front compartment side rail studs (3).

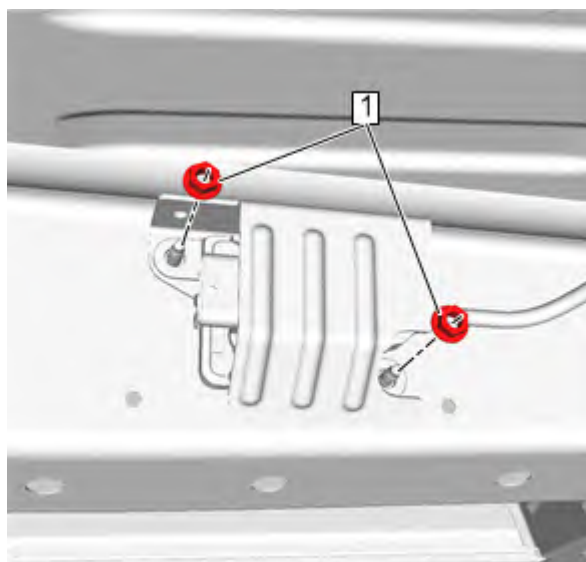


Fig. 510: Nitrogen Oxides Sensor - Position 2 Nuts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

6. Install and tighten Nitrogen Oxides Sensor Nuts (1) (Qty: 2) to 9 N.m (80 lb in)

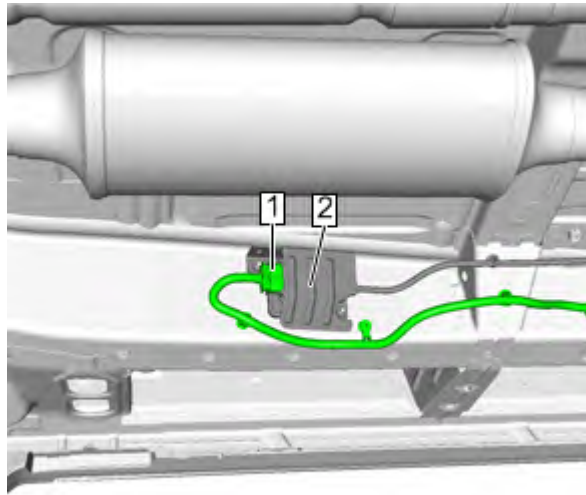


Fig. 511: Nitrogen Oxides Sensor - Position 2 Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

7. Connect Electrical Connector (1)
8. Remove the supports and lower the vehicle.
9. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(KL9\)](#).
10. If replacing, perform the NOx sensor 2 reset. Refer to [NOx Sensor 2 Reset](#)
11. If replacing, perform the NOx catalyst reductant loading reset. Refer to [NOx Catalyst Reductant Loading Reset](#)

CHARGE AIR COOLER INLET AIR TUBE REPLACEMENT

Removal Procedure

1. Remove Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

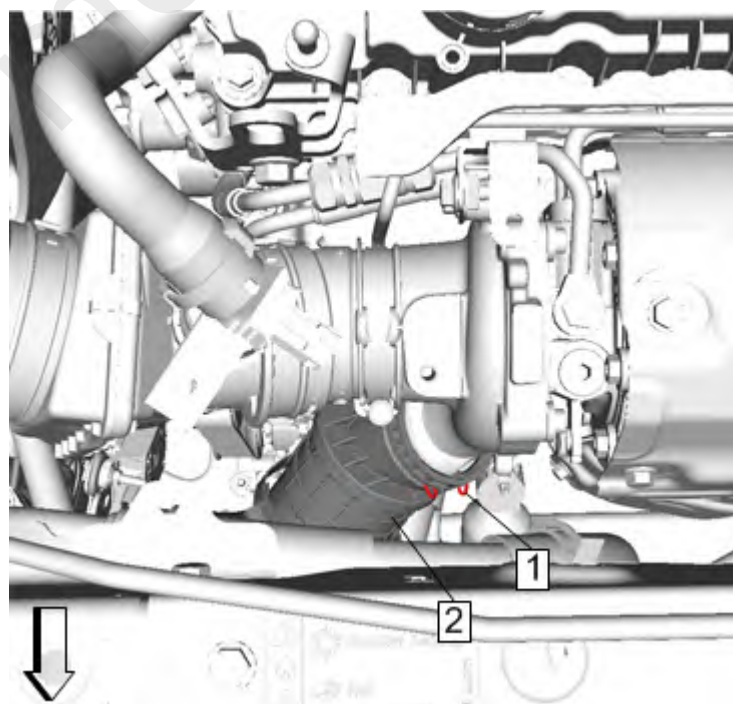


Fig. 512: Charge Air Cooler Inlet Air Tube And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

2. Release Retainer Spring (1)

3. Remove Charge Air Cooler Inlet Air Tube (2)
4. Remove Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#)

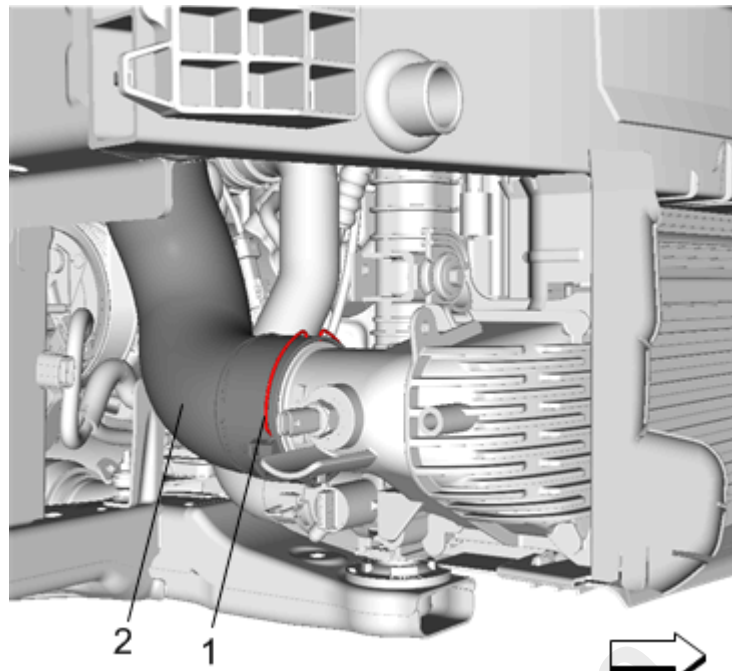


Fig. 513: Charge Air Cooler Inlet Air Tube And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

5. Release Retainer Spring (1)
6. Remove Charge Air Cooler Inlet Air Tube (2)

Installation Procedure

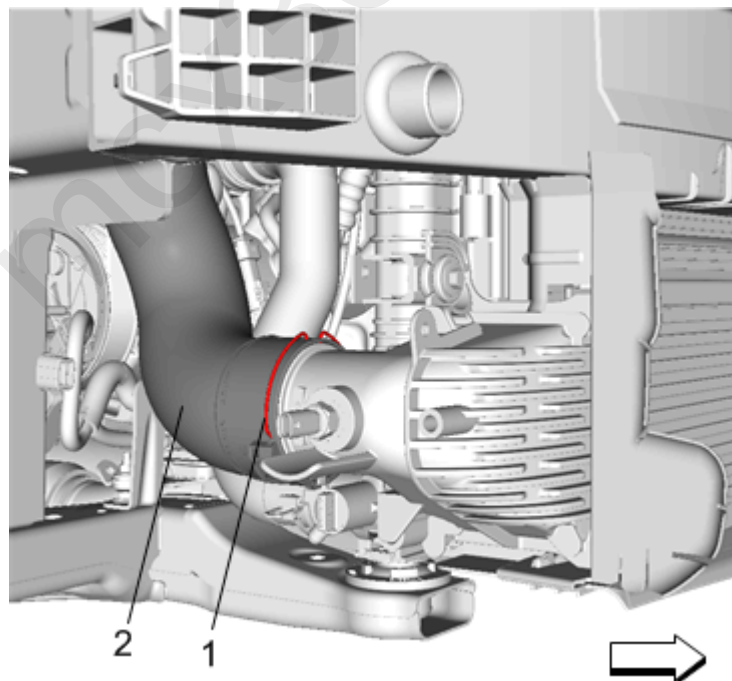


Fig. 514: Charge Air Cooler Inlet Air Tube And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

1. Install Charge Air Cooler Inlet Air Tube (2)
2. Engage Retainer Spring (1)
3. Install Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#)

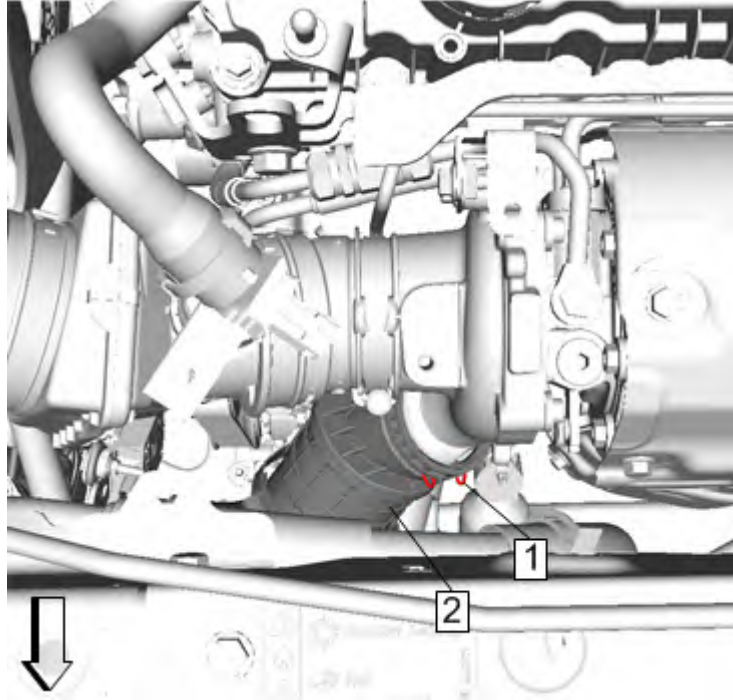


Fig. 515: Charge Air Cooler Inlet Air Tube And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

4. Install Charge Air Cooler Inlet Air Tube (2)
5. Engage Retainer Spring (1)
6. Install Air Cleaner Outlet Duct. Refer to [Air Cleaner Outlet Duct Replacement](#)

CHARGE AIR COOLER OUTLET AIR TUBE REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

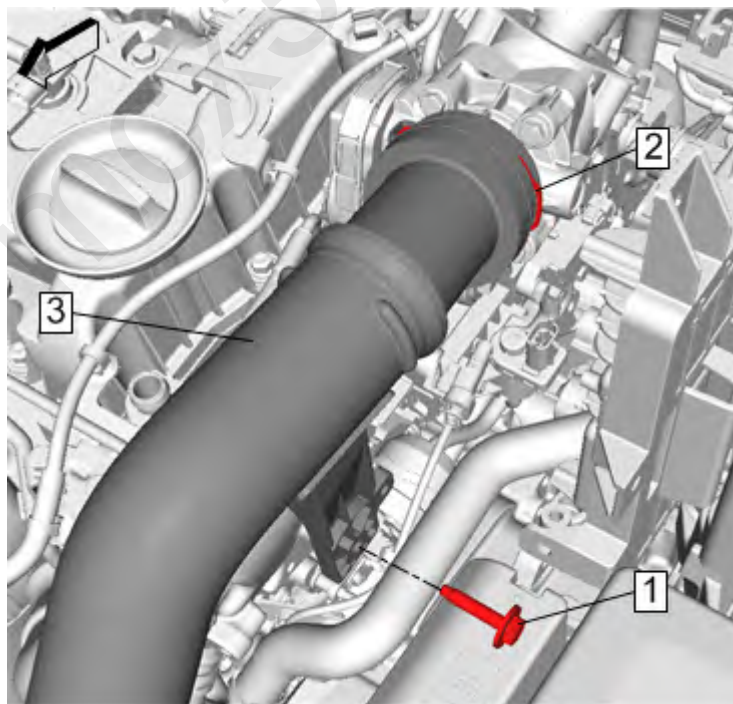


Fig. 516: Charge Air Cooler Outlet Air Tube, Bolt And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

2. Remove Charge Air Cooler Outlet Air Tube Bolt (1)
3. Release Retainer Spring (2)
4. Remove Charge Air Cooler Outlet Air Tube (3)
5. Disconnect harness retainer.

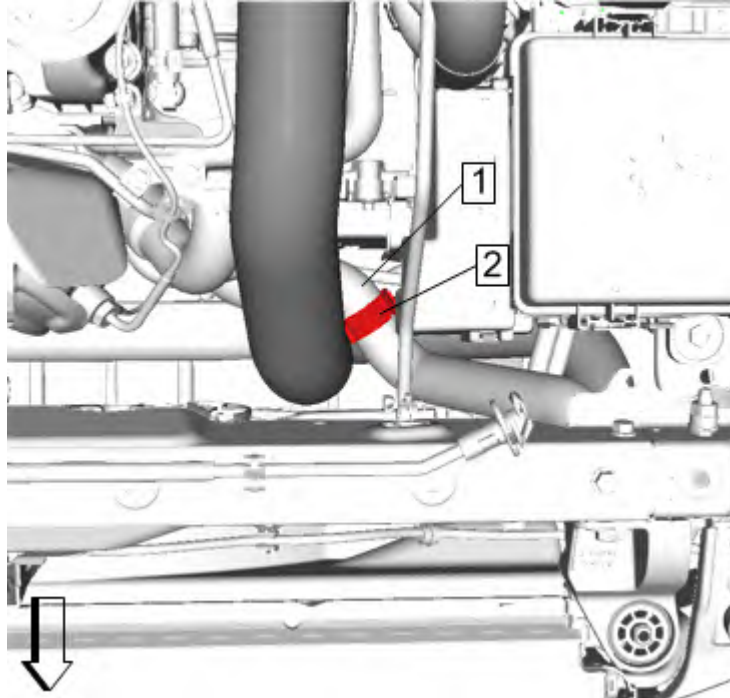


Fig. 517: Radiator Inlet Hose And Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Remove Radiator Inlet Hose (1) @ Retainer (2)
7. Remove Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#) [Underbody Front Air Deflector Replacement \(Terrain\)](#).
8. Disconnect the cooling fan 2 wire connector and disconnect from the shroud.

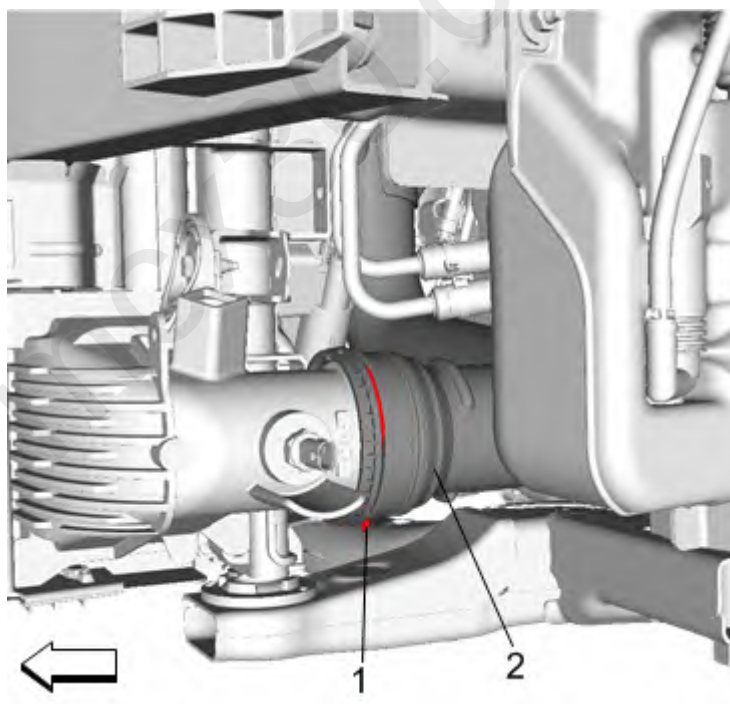


Fig. 518: Charge Air Cooler Outlet Air Tube And Retainer Spring

Courtesy of GENERAL MOTORS COMPANY

9. Release Retainer Spring (1)

NOTE: Remove the tube from the vehicle from the top.

10. Remove Charge Air Cooler Outlet Air Tube (2)

Installation Procedure

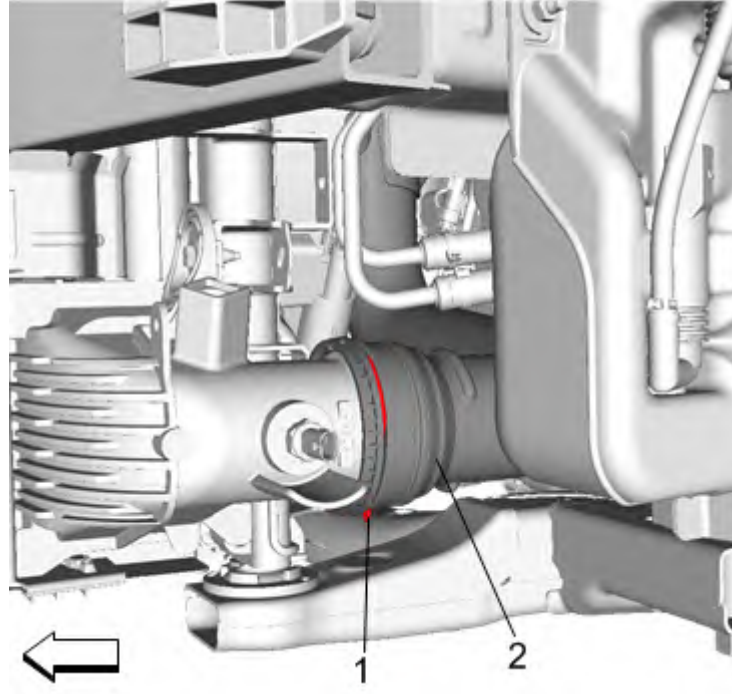


Fig. 519: Charge Air Cooler Outlet Air Tube And Retainer Spring
 Courtesy of GENERAL MOTORS COMPANY

NOTE: Install the tube to the vehicle from the top.

1. Install Charge Air Cooler Outlet Air Tube (2)
2. Engage Retainer Spring (1)
3. Reconnect the 2 wire cooling fan connector and retainer to the shroud.
4. Install Underbody Front Air Deflector. Refer to [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#)

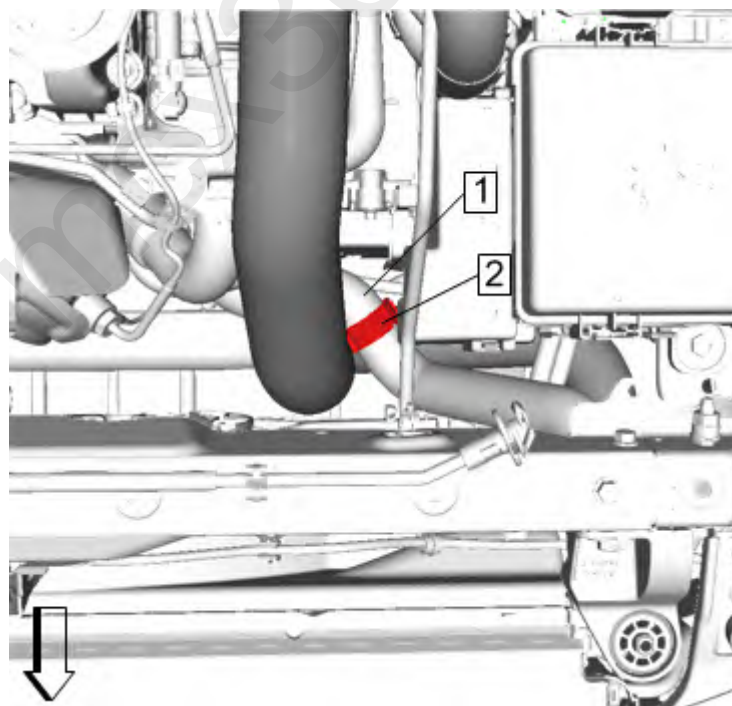


Fig. 520: Radiator Inlet Hose And Retainer
 Courtesy of GENERAL MOTORS COMPANY

5. Install Radiator Inlet Hose (1) @ Retainer (2)

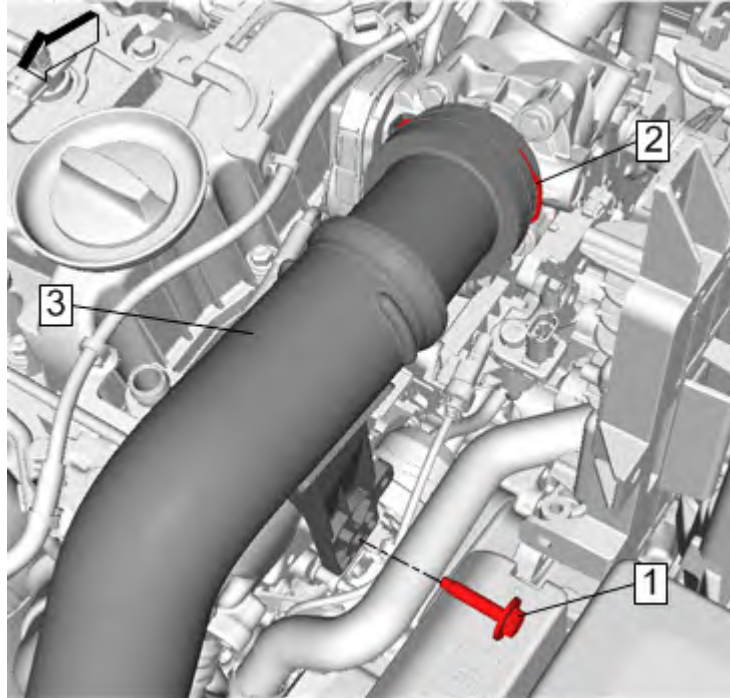


Fig. 521: Charge Air Cooler Outlet Air Tube, Bolt And Retainer Spring
 Courtesy of GENERAL MOTORS COMPANY

6. Install Charge Air Cooler Outlet Air Tube (3)
7. Engage Retainer Spring (2)

CAUTION: Refer to [Fastener Caution](#) .

8. Install and tighten Charge Air Cooler Outlet Air Tube Bolt (1) to 9 N.m (80 lb in)
9. Install the wire harness retainer.
10. Install Intake Manifold Cover. Refer to [Intake Manifold Cover Replacement](#)

CHARGE AIR TEMPERATURE SENSOR REPLACEMENT (INLET)

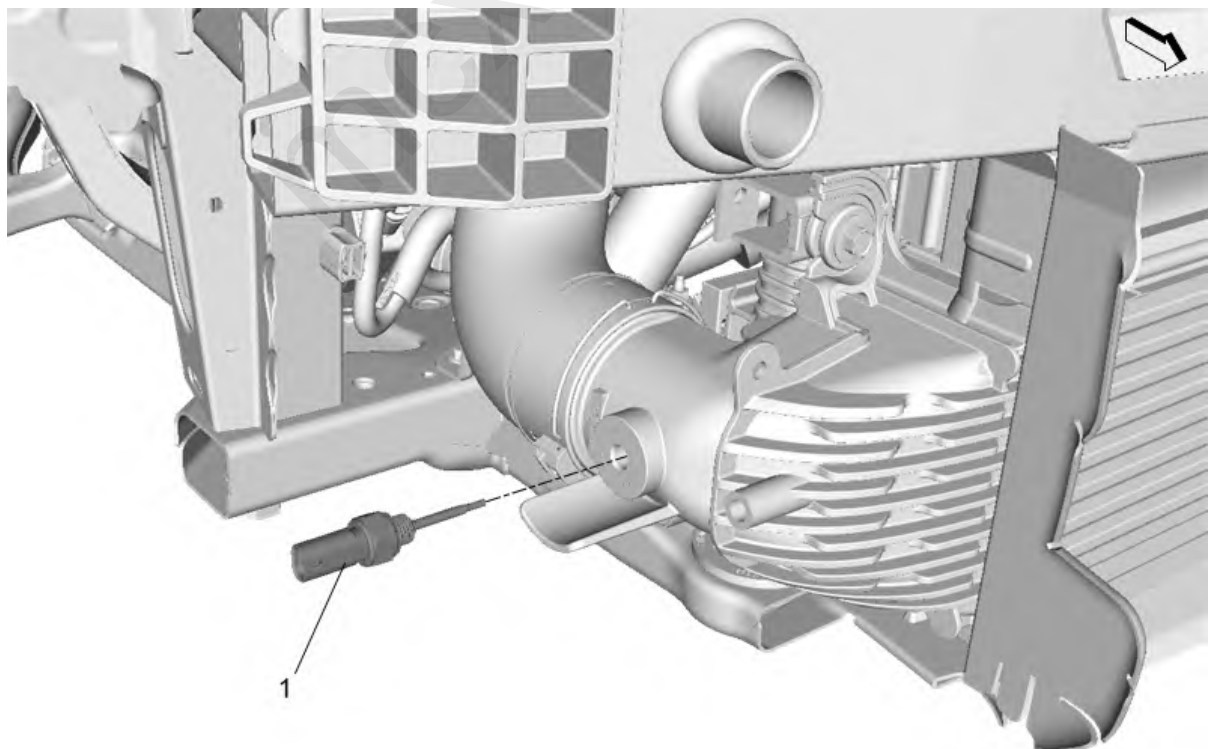


Fig. 522: Charge Air Temperature Sensor (Inlet)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Underbody Front Air Deflector. Refer to Underbody Front Air Deflector Replacement (Equinox) , Underbody Front Air Deflector Replacement (Terrain) .	
1	Charge Air Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution . Procedure Disconnect the electrical connector. Tighten 19 N.m (14 lb ft)

CHARGE AIR TEMPERATURE SENSOR REPLACEMENT (OUTLET)

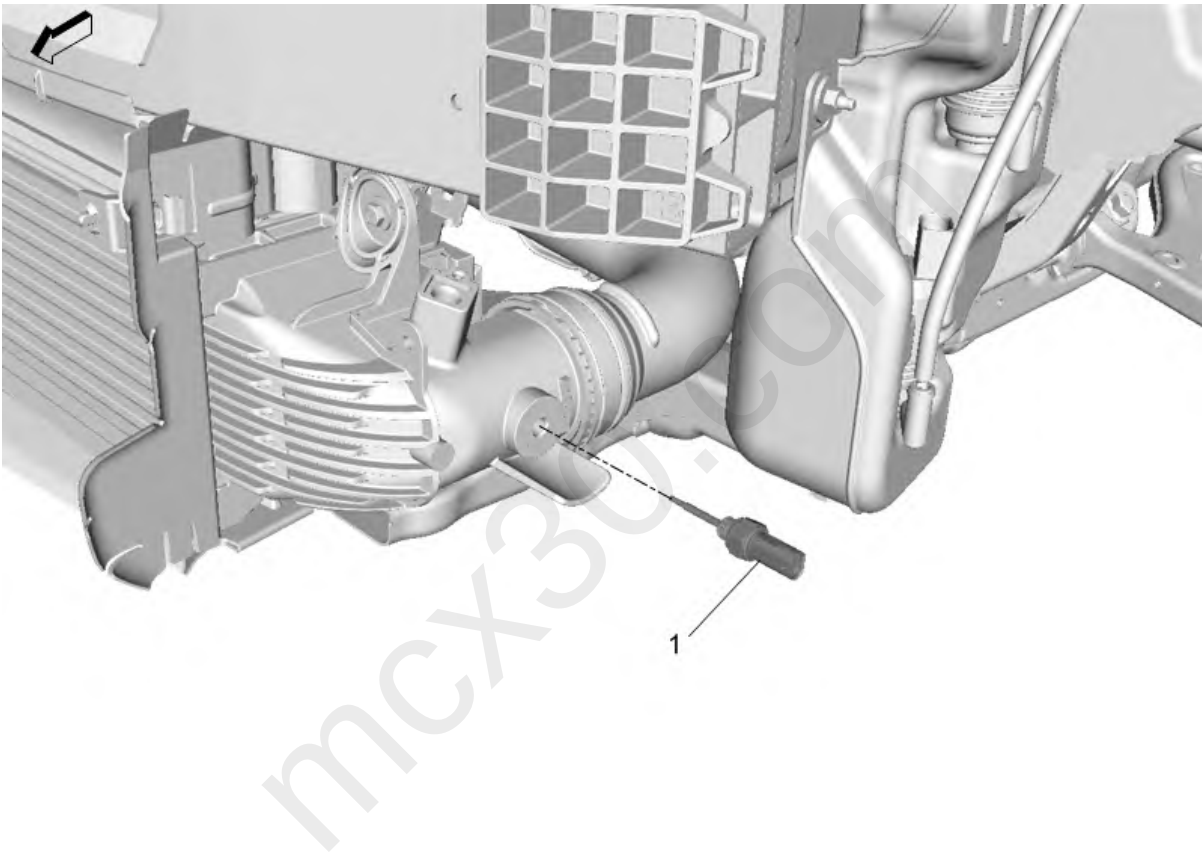


Fig. 523: Charge Air Temperature Sensor (Outlet)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove Underbody Front Air Deflector. Refer to Underbody Front Air Deflector Replacement (Equinox) , Underbody Front Air Deflector Replacement (Terrain) .	
1	Charge Air Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution . Procedure Disconnect the electrical connector. Tighten 19 N.m (14 lb ft)

CHARGE AIR COOLER REPLACEMENT

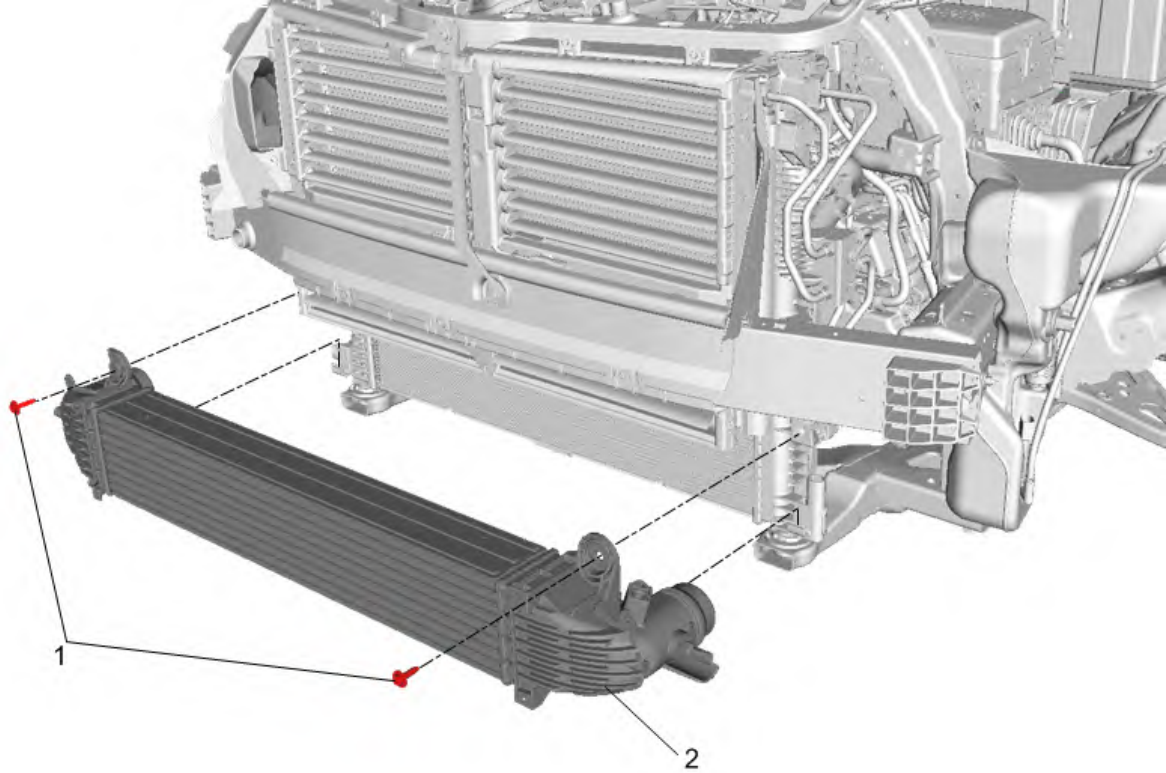


Fig. 524: Charge Air Cooler

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Remove Radiator Air Lower Baffle. Refer to Radiator Air Lower Baffle Replacement (LH7/LTG/LYX). 2. Disconnect Charge Air Cooler Outlet Air Tube @ Charge Air Cooler. Refer to Charge Air Cooler Outlet Air Tube Replacement. 3. Disconnect Charge Air Cooler Inlet Air Tube @ Charge Air Cooler. Refer to Charge Air Cooler Inlet Air Tube Replacement. 4. Disconnect the electrical connector.	
1	Charge Air Cooler Bolt (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Charge Air Cooler Procedure Transfer parts as necessary.