

2018 ENGINE PERFORMANCE

Engine Controls And Fuel - 1.5L (LYX) - Repair Instructions - Equinox & Terrain

REPAIR INSTRUCTIONS

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](#)

FUEL RAIL PRESSURE RELIEF VALVE LEARNED VALUES 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

Conditions for Running the Procedure

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 Rail Pressure Relief Valve Learned Values Reset
7. Follow the instructions on the scan tool.

Repair Instructions

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

HO2S HEATER RESISTANCE LEARNED VALUES 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:B52 Heated Oxygen Sensor - Resistance

When to Perform the Procedure

NOTE:

- **This procedure is only required when the component is replaced for a mechanical issue with no DTC set.**
- **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:B52 Heated Oxygen Sensor - Replaced

Conditions for Running the Procedure

Ignition Switch = 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: HO2S Heater Resistance Learned Values 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
8. All OK.

Repair Instructions

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

INTAKE SYSTEM LEARNED VALUES 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: [Turbocharger System Description](#)

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

- B65 Intake Manifold Pressure and Air Temperature Sensor
- B74 Manifold Absolute Pressure Sensor
- B75B Mass Air Flow/Intake Air Temperature Sensor
- B75C Multifunction Intake Air Sensor
- B111B Turbocharger Boost/Intake Air Temperature Sensor
- Q38 Throttle Body
- Q40 Turbocharger Bypass Solenoid Valve
- Q42 Turbocharger Wastegate Solenoid Valve
- Intake Air Duct - Collapsed/Leaking/Loose/Restricted
- Turbocharger

Conditions for Running the Procedure

- DTC P0033, P0034, P0035, P0068, P00C7, P0101, P0102, P0103, P0106, P0107, P0108, P0234, P0236, P0237, P0238, P0243, P0245, P0246, P0299, P1101, P2227-P2230, P2261 = Not set
- 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:Intake System Learned Values Reset
7. Follow the instructions on the scan tool.

Repair Instructions

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

THROTTLE BODY IDLE AIR FLOW COMPENSATION 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: [Throttle Actuator Control \(TAC\) System Description](#)

This procedure triggers the control module to learn the values of the component: Q38 Throttle Body - 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.

Perform this procedure when the following component has been serviced:

- Q38 Throttle Body - Cleaned/Replaced
- K20 Engine Control Module - Replaced

Conditions for Running the Procedure

- DTC P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0120, P0122, P0123, P0128, P0171, P0172, P0174, P0175, P0201-P0208, P0220, P0222, P0223, P0261, P0262, P0264, P0265, P0267, P0268, P0270, P0271, P0273, P0274, P0276, P0277, P0279, P0280, P0282, P0283, P0300-P0308, P0351-P0358, P0496, P0601, P0604, P0606, P060D, P0641, P0651, P0697, P06A3, P06D2, P1248, P1249, P124A, P124B, P1516, P16A0-P16A2, P2101, P2119, P2120, P2122, P2123, P2125, P2127, P2128, P2135, P2138, P2147, P2148, P2150, P2151, P2153, P2154, P2156, P2157, P216B, P216C, P216E, P216F, P217B, P217C, P217E, P217F, P2176, P2300, P2301, P2303, P2304, P2306, P2307, P2309, P2310, P2312, P2313, P2315, P2316, P2318, P2319, P2321, P2322 = Not set
- Ignition = On
- Vehicle Speed Sensor = 0km/h (0MPH)

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:Throttle Body Idle Air Flow Compensation Reset
7. Follow the instructions on the scan tool.
8. Verify the scan tool parameter:Throttle Body Idle Air Flow Compensation = 0%
 - **If greater than 0**

Repeat step 1
 - **Go to next step: If 0**
9. Engine - Idling - At normal operating temperature
10. Verify the scan tool parameter:Engine Speed = -100 to +200 RPM of the Desired Idle Speed
 - **{Test failed 1 time(s)}If not in the specified range**
 1. Engine idling. - For greater than 3 min
 2. Ignition/Vehicle - Off - For greater than 1 min
 3. Engine idling. - For greater than 3 min
 4. Repeat step 9
 - **{Test failed 2 time(s)}If not in the specified range**
 1. Perform the following action:Road test the vehicle.
 2. Vehicle Speed - Greater than 70 km (44 mi)
 3. Decelerate - For 2 s
 4. Repeat step 10.2 - 3 times
 5. Engine idling. - For greater than 3 min
 6. Repeat step 9
 - **{Test failed 3 time(s)}If not in the specified range**

Refer to:[Diagnostic System Check - Vehicle](#)
 - **Go to next step: If in the specified range**
11. All OK.

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)

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

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.

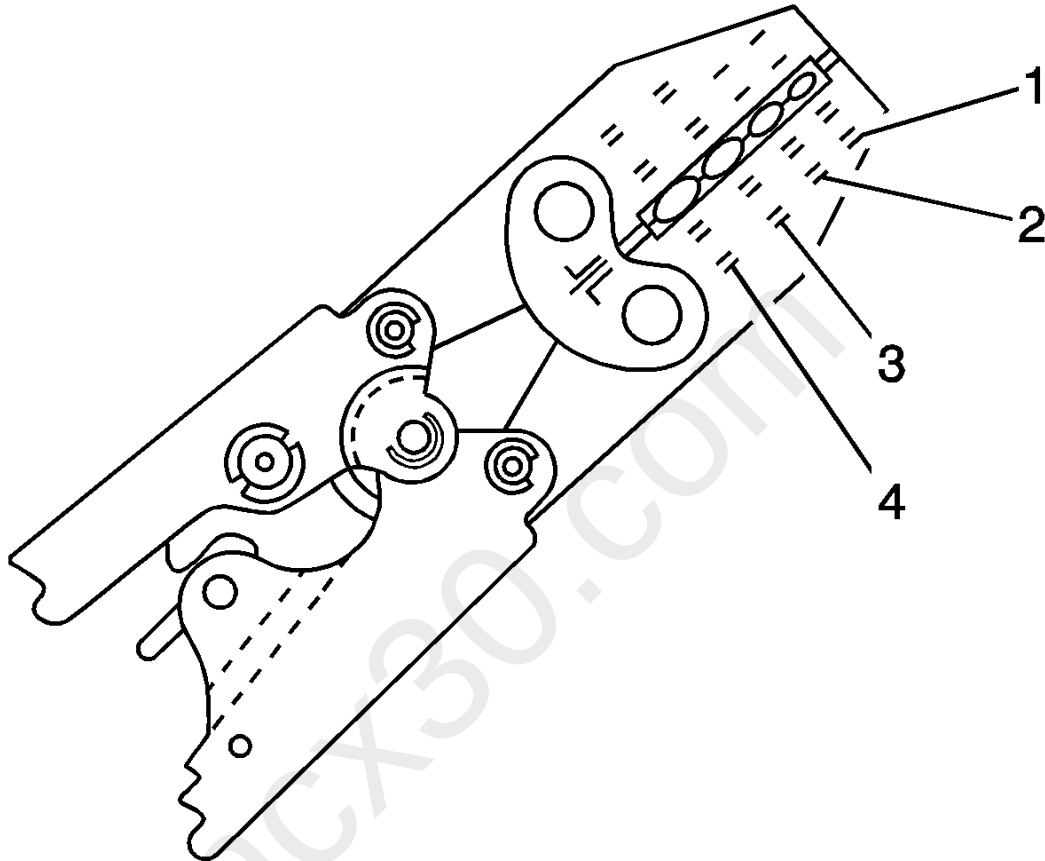


Fig. 1: Splice Sleeve Crimping Tool With 4 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

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.

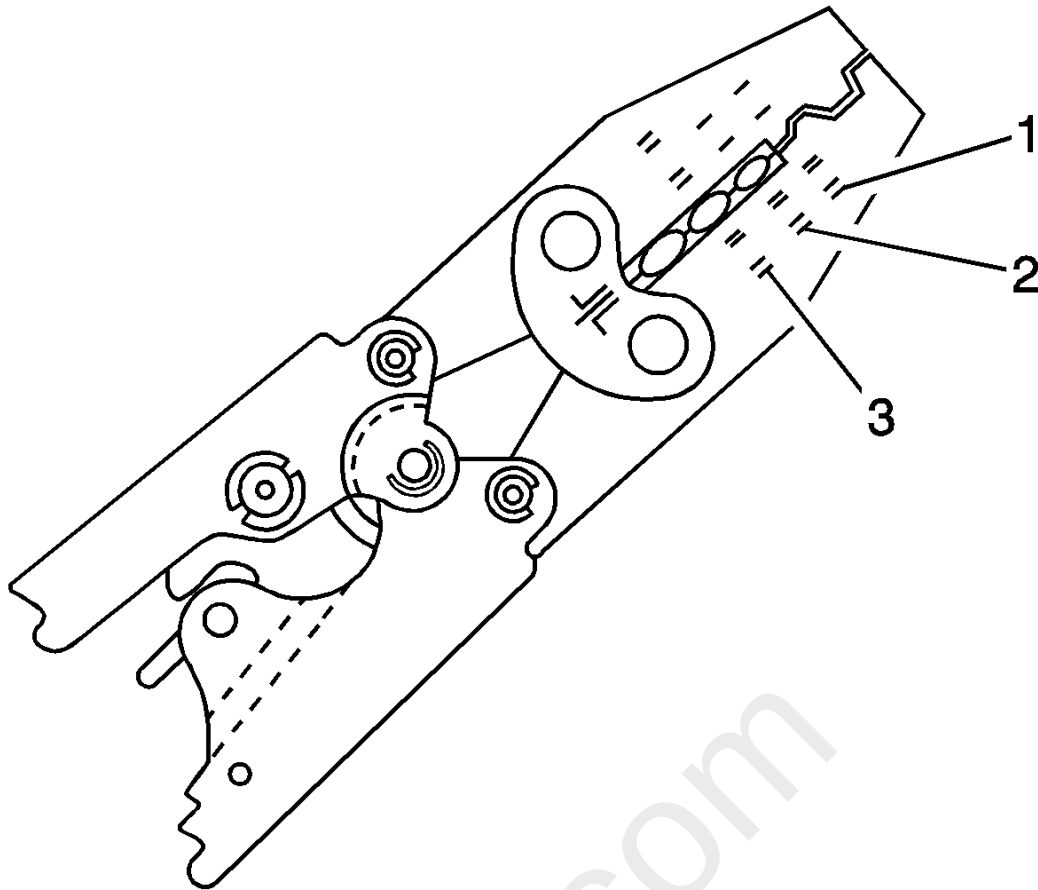


Fig. 2: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

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).

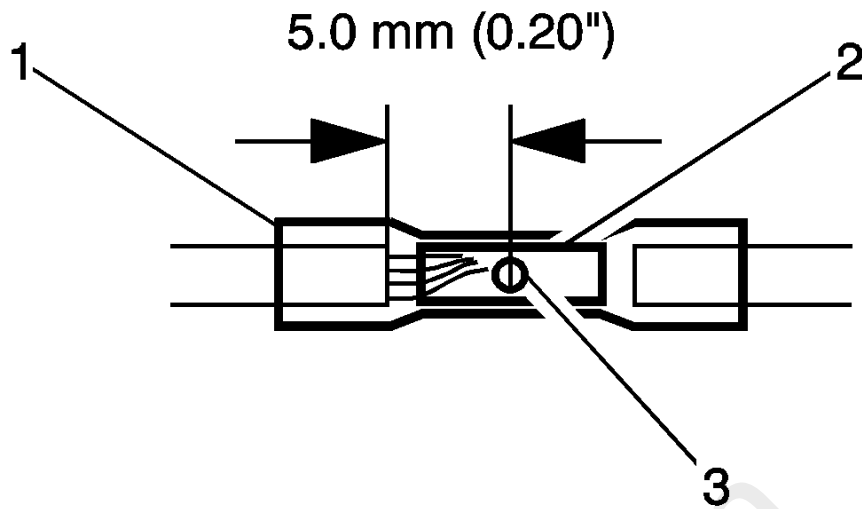


Fig. 3: Identifying DuraSeal Splice Sleeve

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.

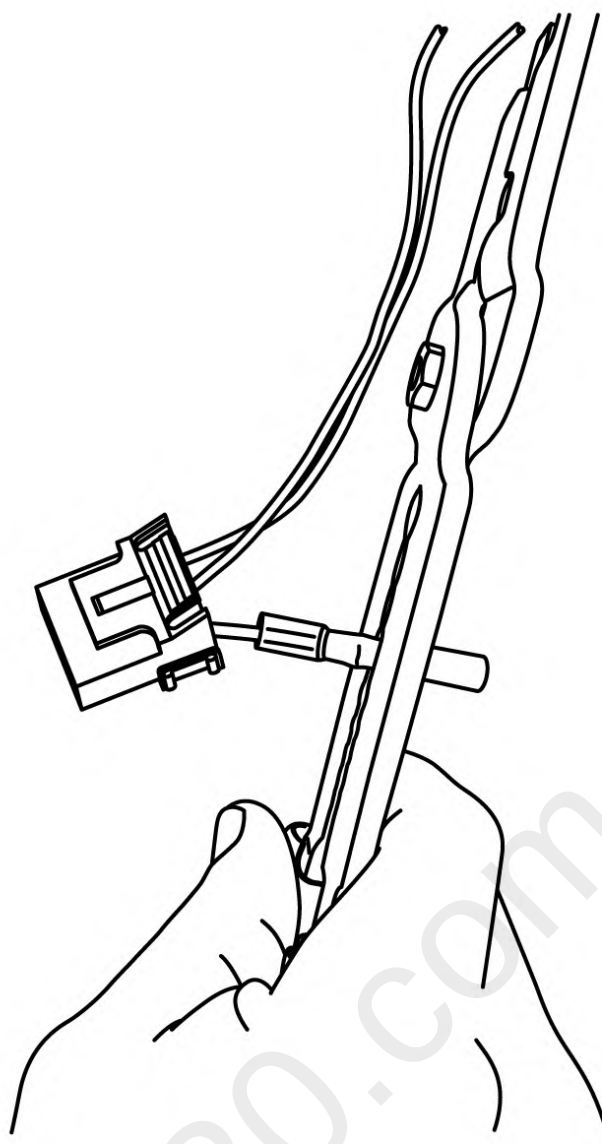


Fig. 6: Tightly Close Handles Of Crimp Tool

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.

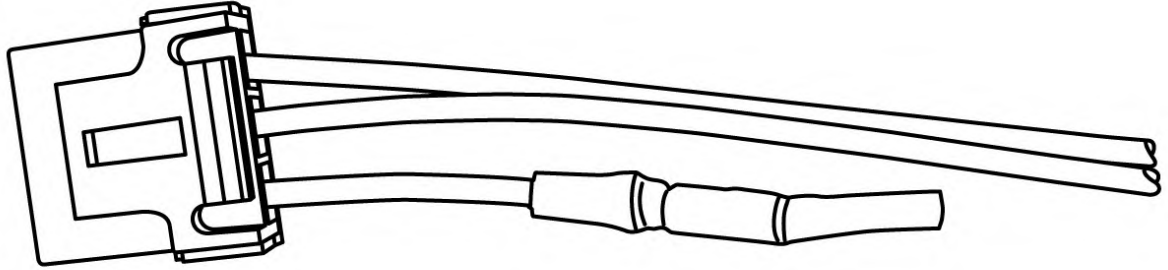


Fig. 7: Heat To Crimped Area Of Barrel

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.

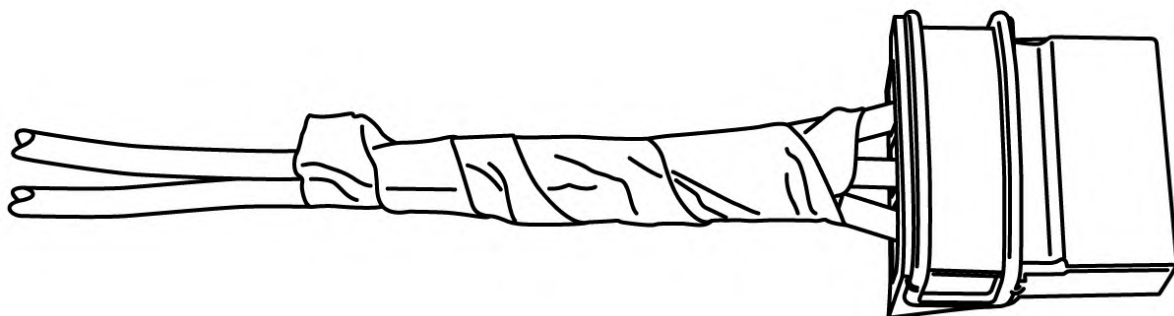


Fig. 8: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

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.

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. Refer to [Fuel Pressure Relief](#).

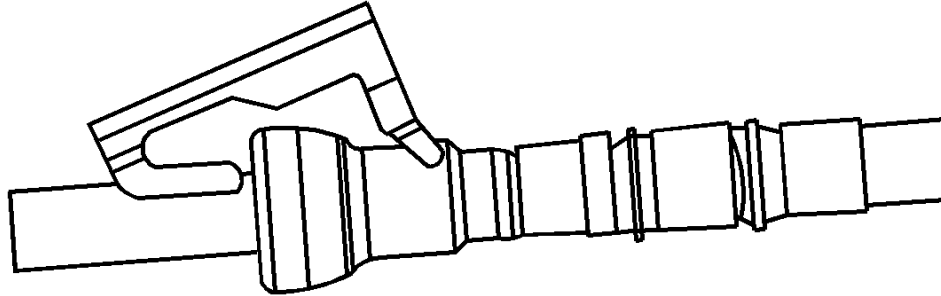


Fig. 9: View Of Quick-Connect Fitting Retainer
Courtesy of GENERAL MOTORS COMPANY

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

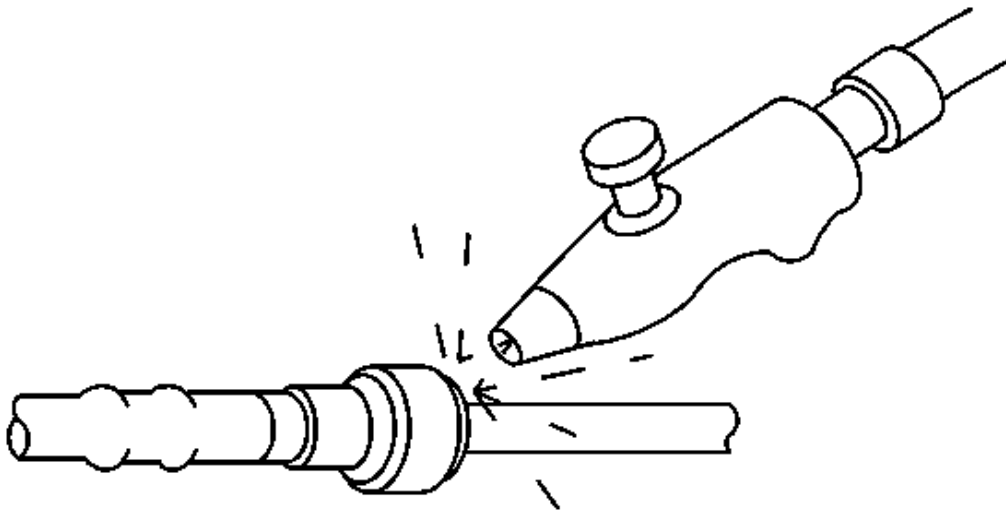


Fig. 10: Blowing Dirt Out Of Fitting.(Metal Collar)

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.

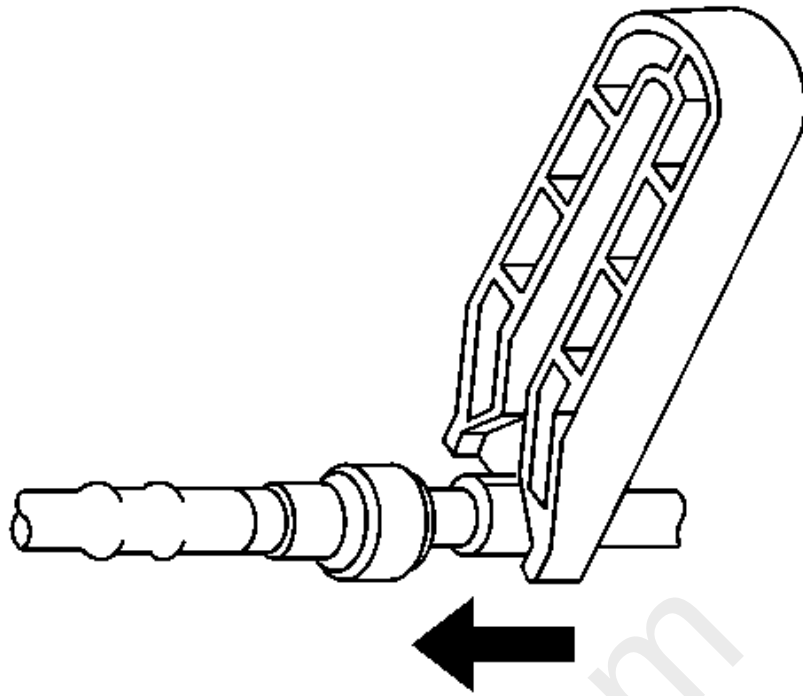


Fig. 11: View Of Quick Connect Locking Tabs (Metal Collar)

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.

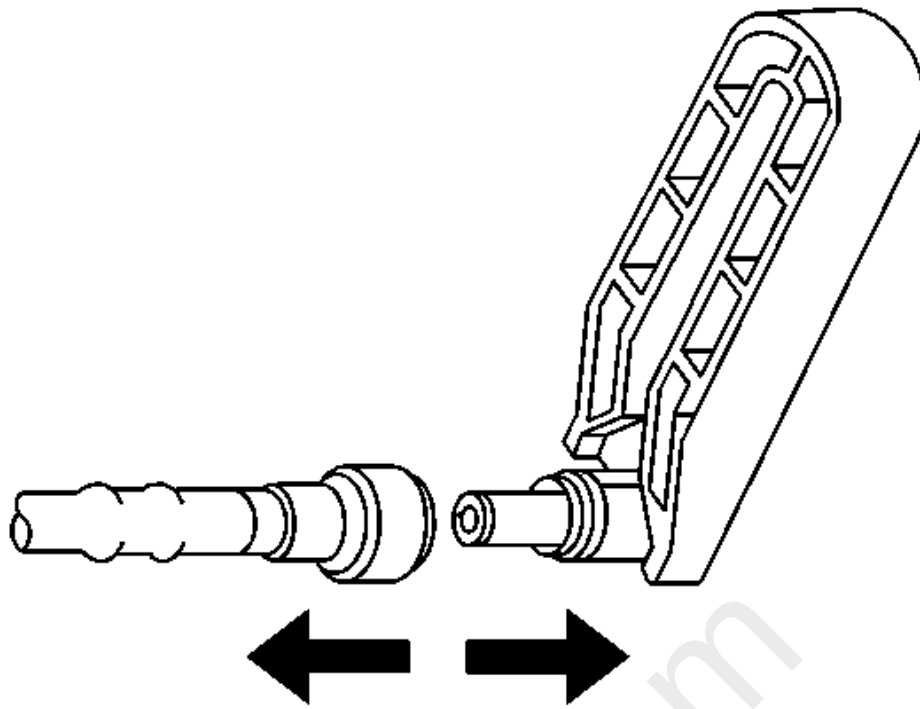


Fig. 12: View Of Quick Connect Locking Tabs (Metal Collar)
Courtesy of GENERAL MOTORS COMPANY

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.

8. Clean or replace the components as required.

Installation Procedure

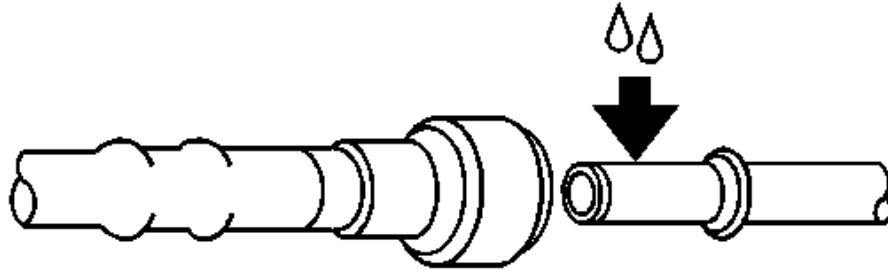


Fig. 13: Oiling Male Pipe Ends (Metal Collar).
Courtesy of GENERAL MOTORS COMPANY

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.

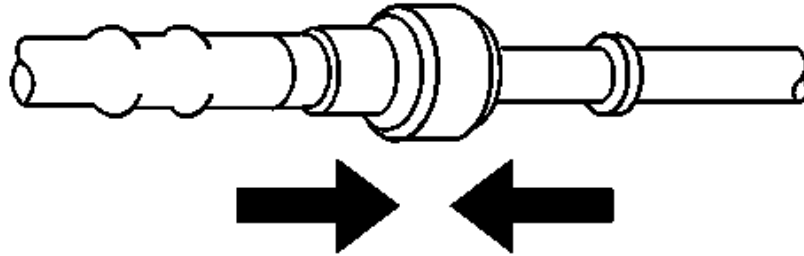


Fig. 14: View Of Connectors (Metal Collar)

Courtesy of GENERAL MOTORS COMPANY

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

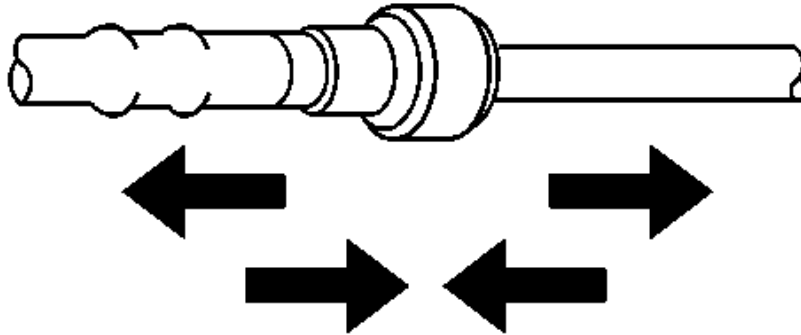


Fig. 15: Ensuring Connection (Metal Collar) Is Secure
Courtesy of GENERAL MOTORS COMPANY

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

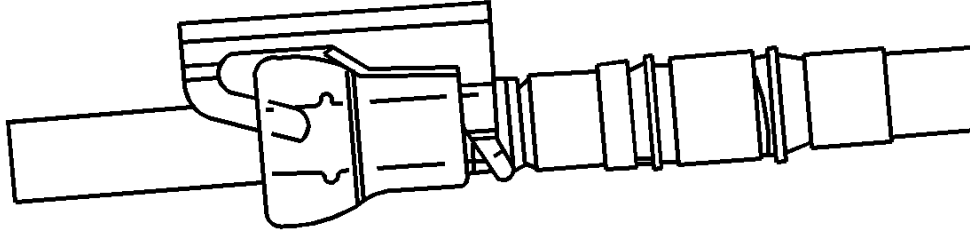


Fig. 16: View Of Fuel Pipe Retainer

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.

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.

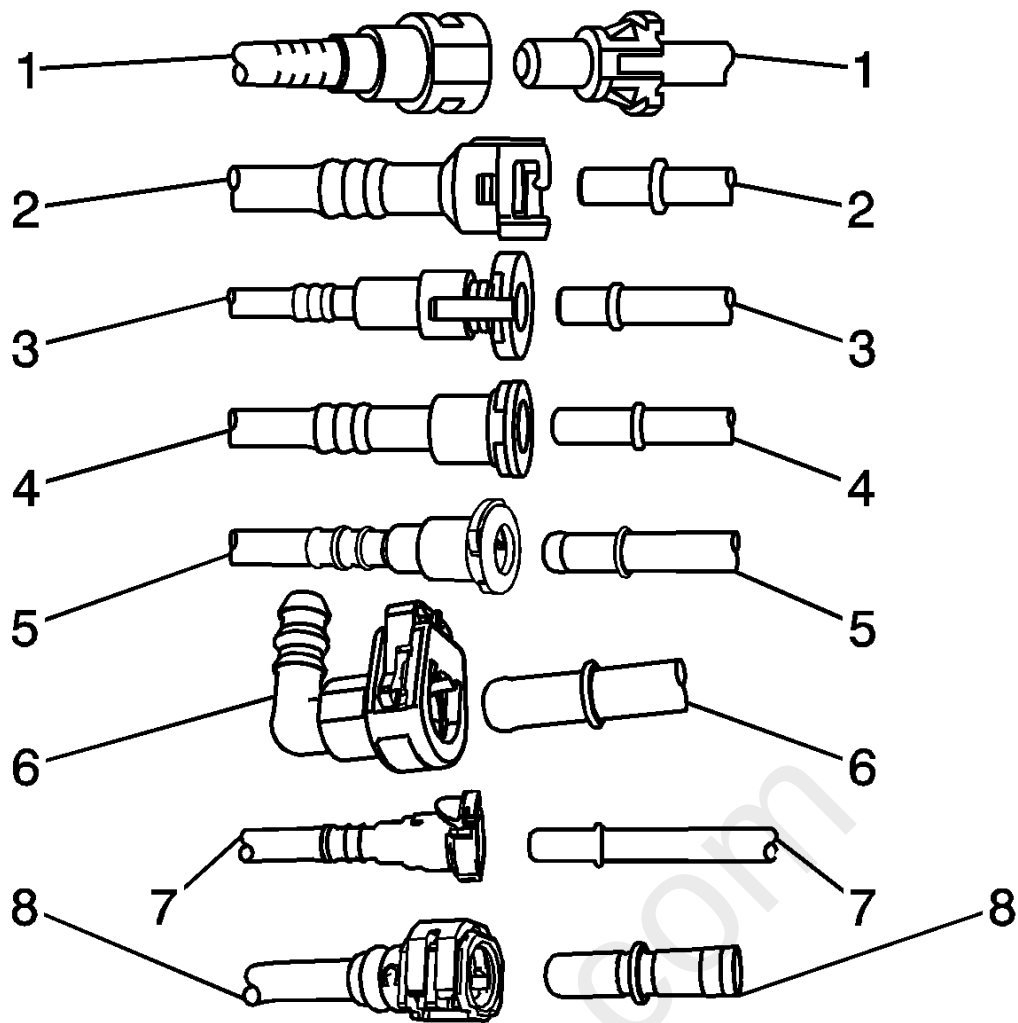


Fig. 17: Plastic Collar Quick Connect Fitting Service

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.

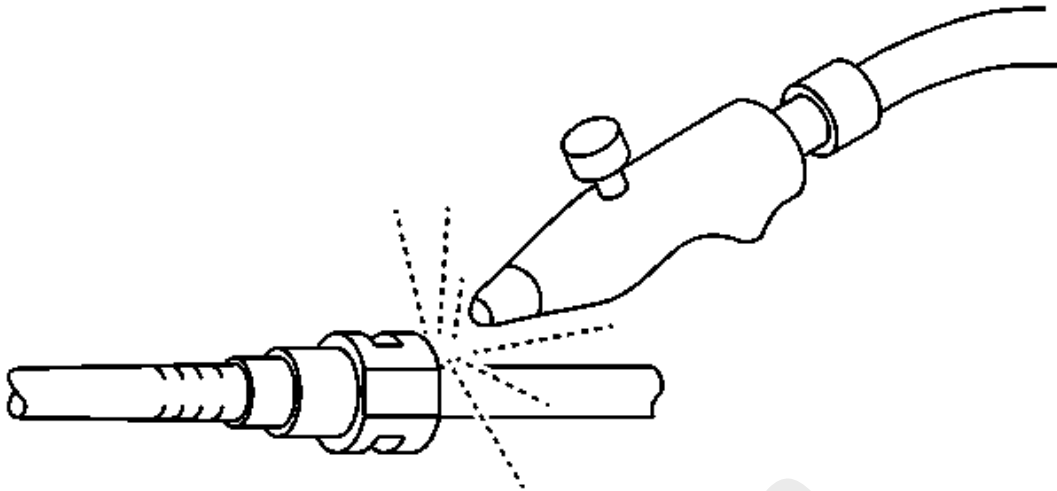


Fig. 18: Blowing Dirt Out Of Fitting (Plastic Collar)

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.

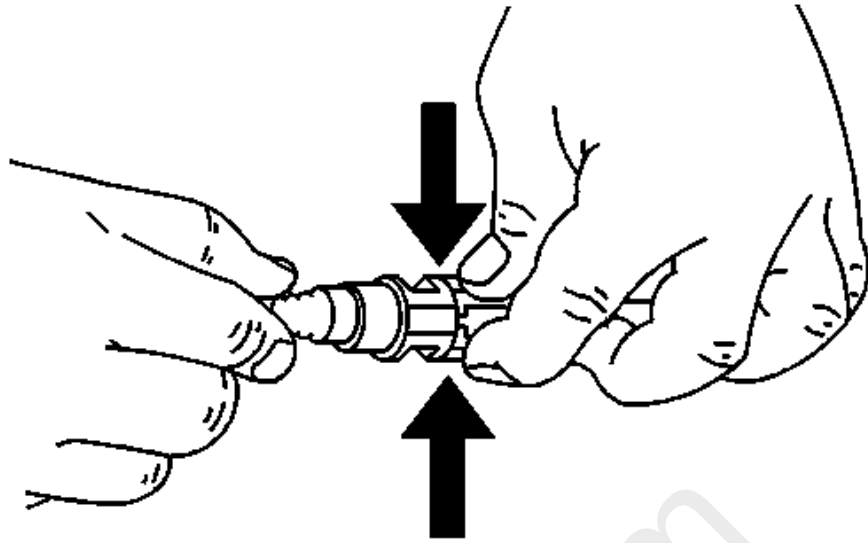


Fig. 19: View Of Quick Connect Fitting Release Tabs (Plastic Collar)
Courtesy of GENERAL MOTORS COMPANY

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

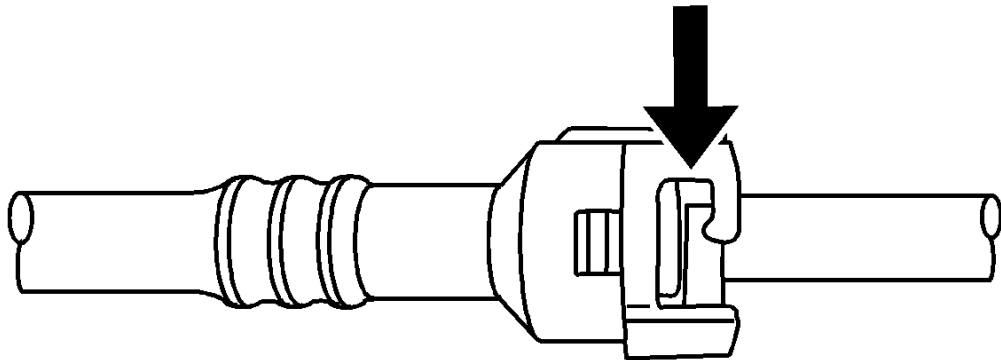


Fig. 20: Releasing Q Release Style Connectors (Plastic Collar).

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.

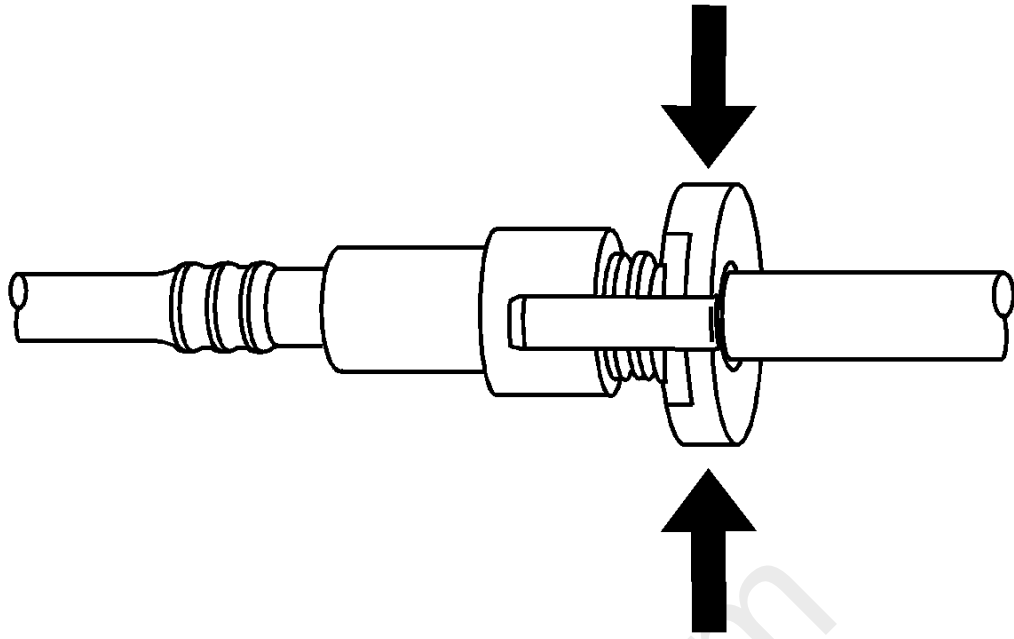


Fig. 21: Disengaging Quick Connect Fitting (Plastic Collar)

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.

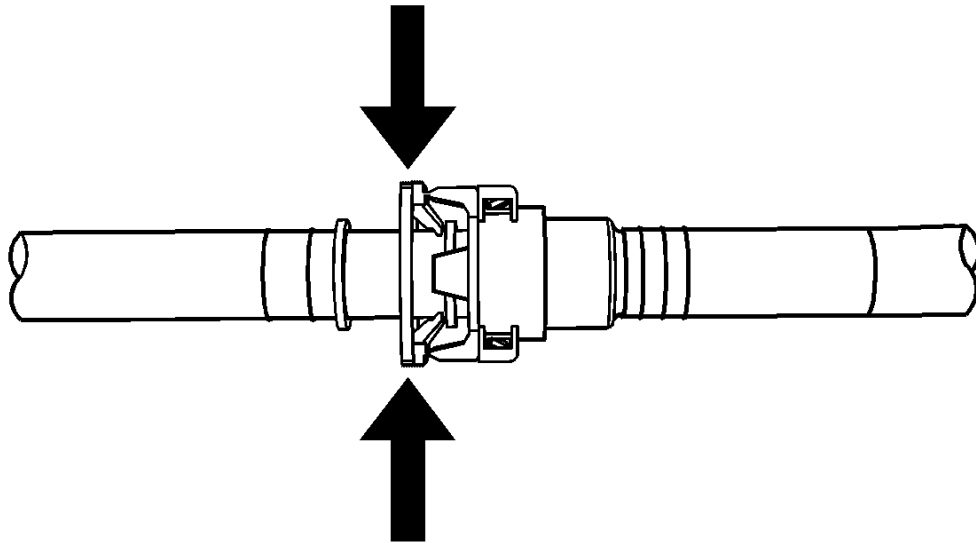


Fig. 22: Pushing In Male Side Of Connector
 Courtesy of GENERAL MOTORS COMPANY

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. 23: 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.

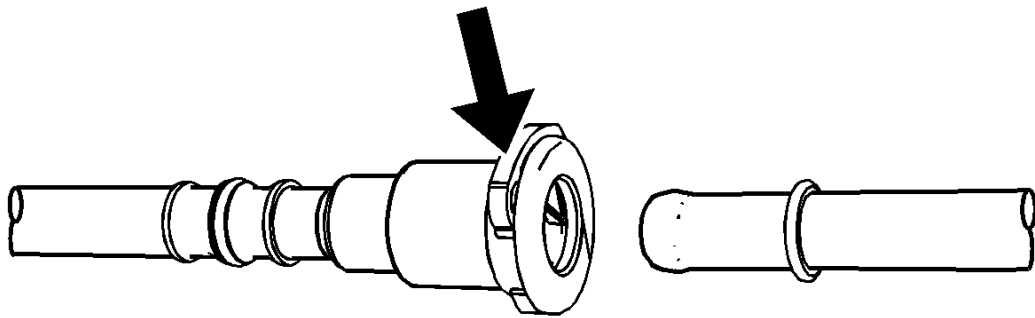


Fig. 24: Global Connector Style

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.

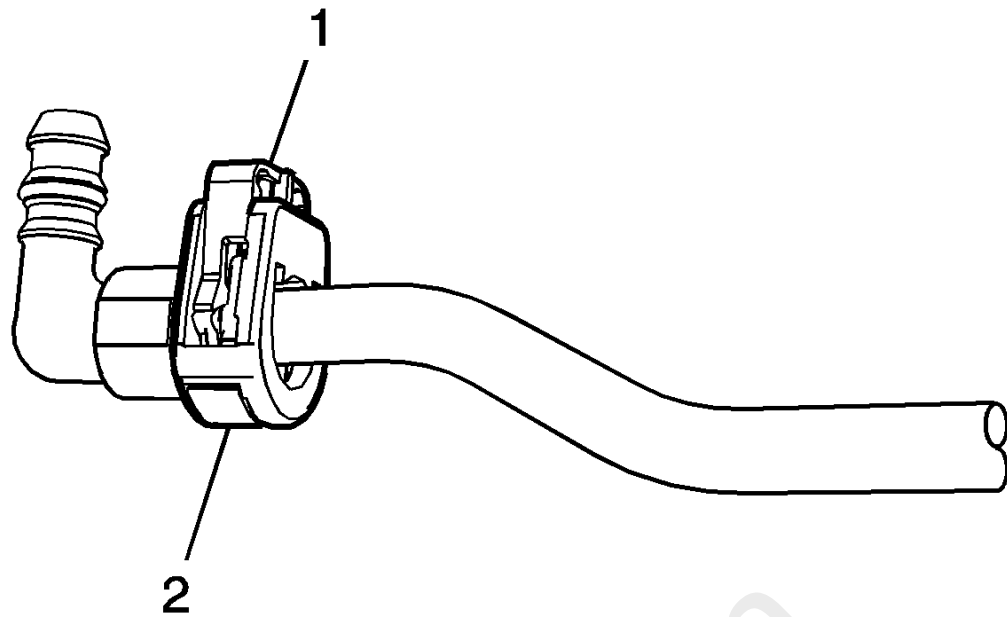


Fig. 25: TI Loc style

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.

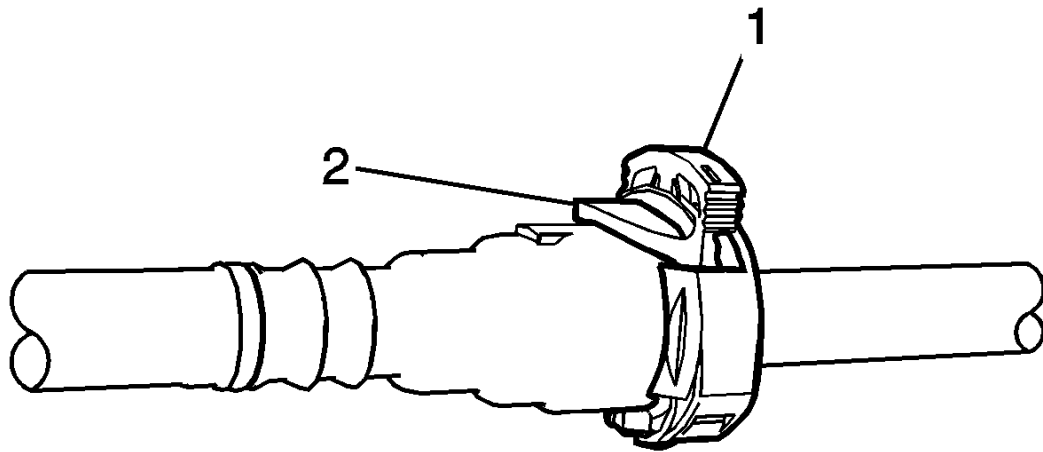


Fig. 26: Safe Lock Style

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.

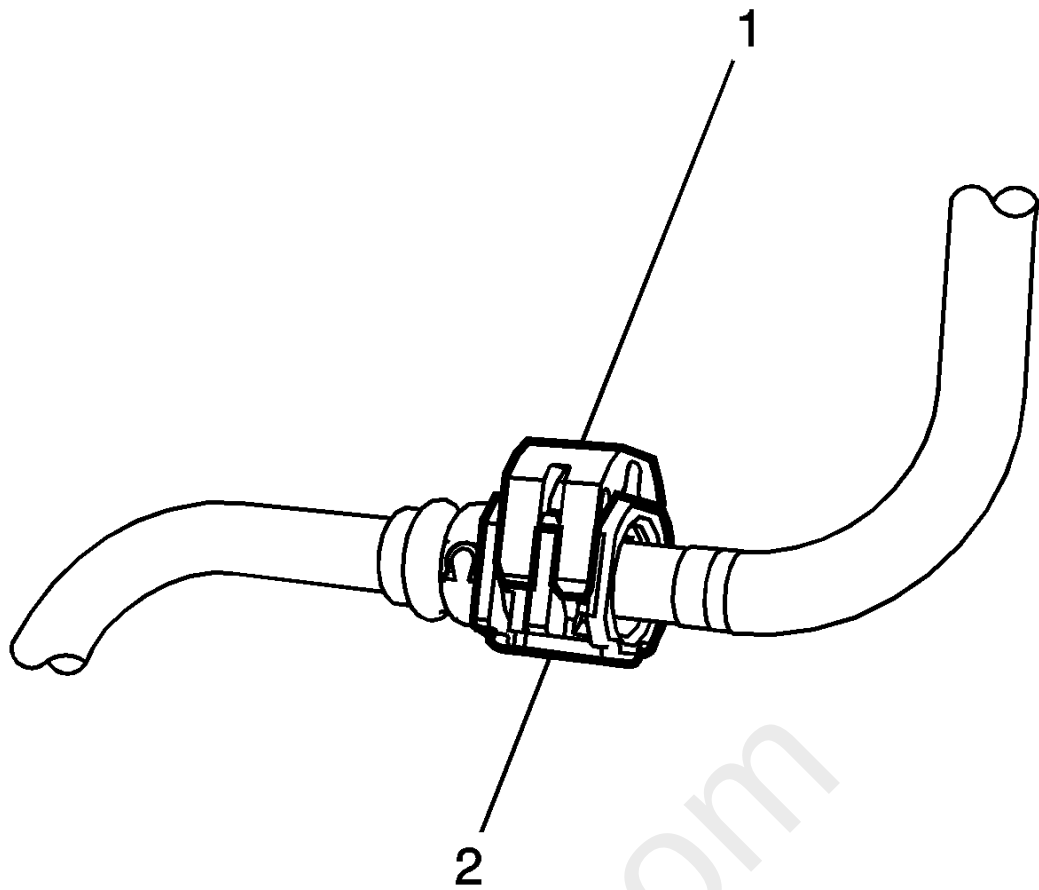


Fig. 27: Latch And Connector Straight Out
Courtesy of GENERAL MOTORS COMPANY

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

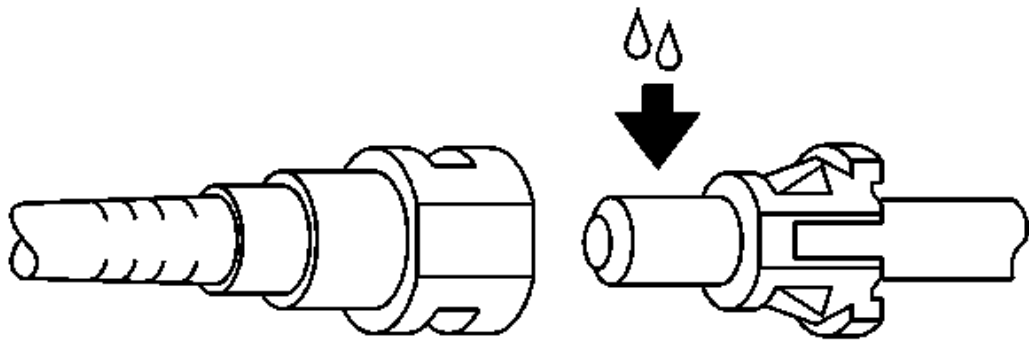


Fig. 28: Lubricating Male Pipe End

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.

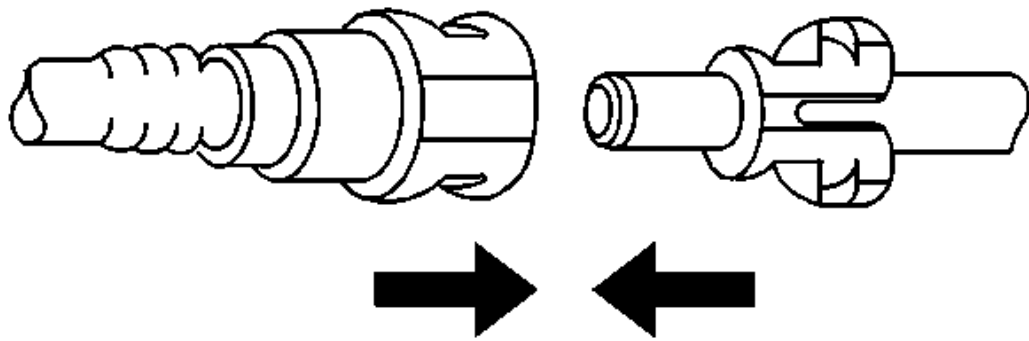


Fig. 29: Connecting Quick-Connect Fittings

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.

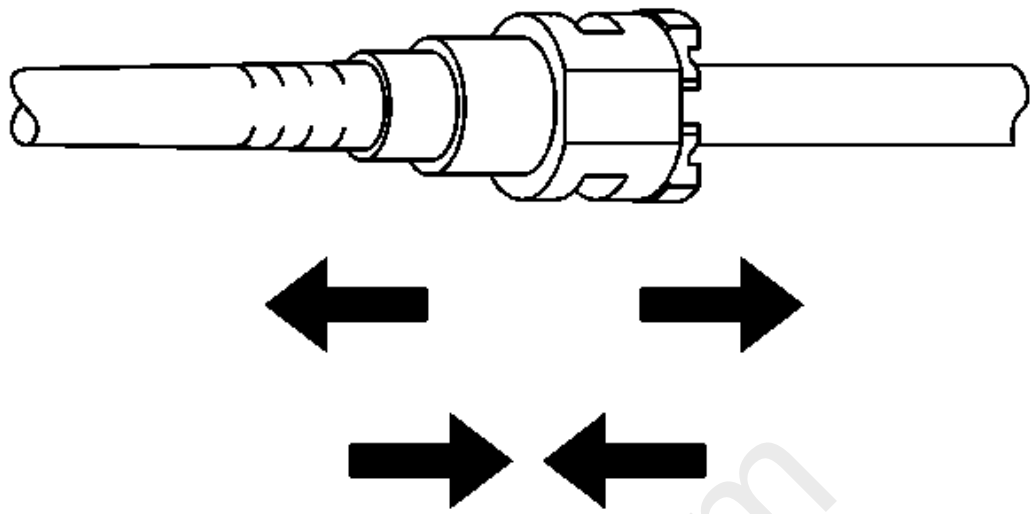


Fig. 30: View Of Quick-Connect Fitting
Courtesy of GENERAL MOTORS COMPANY

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

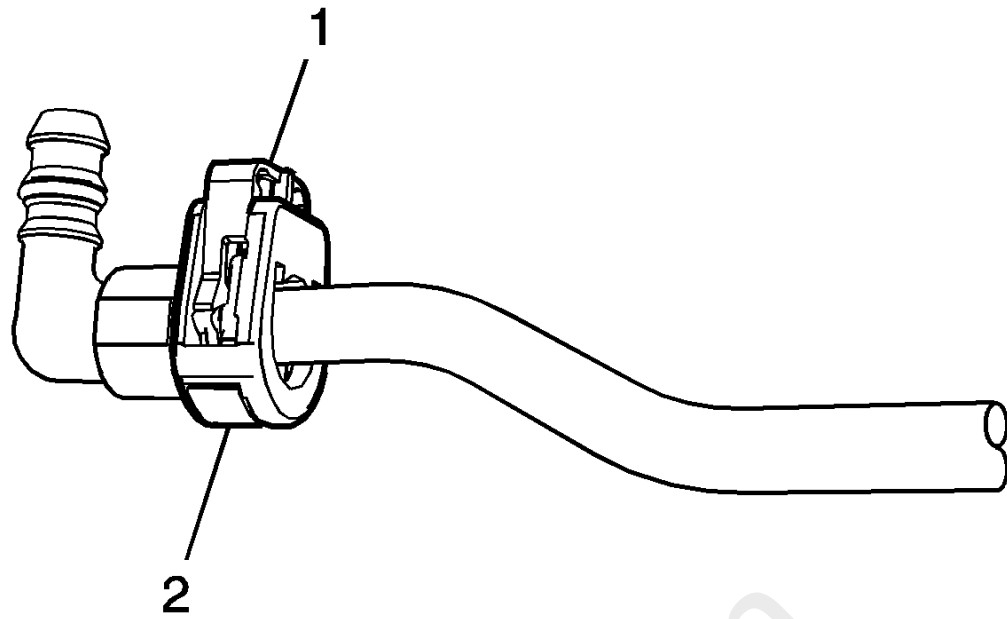


Fig. 31: TI Loc style

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.

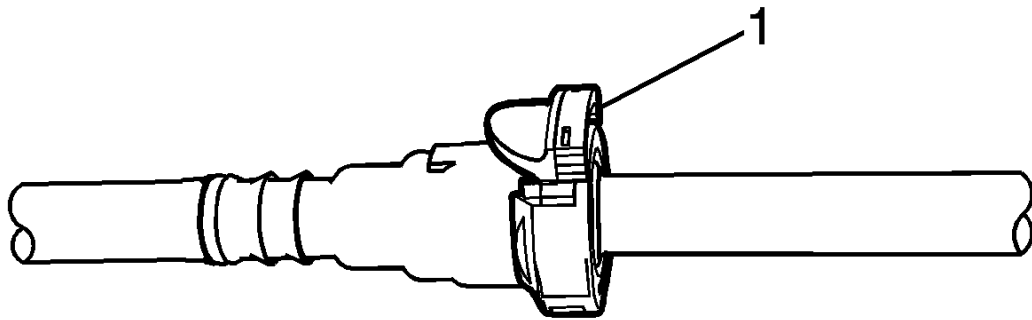


Fig. 32: Redundant Latch

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.

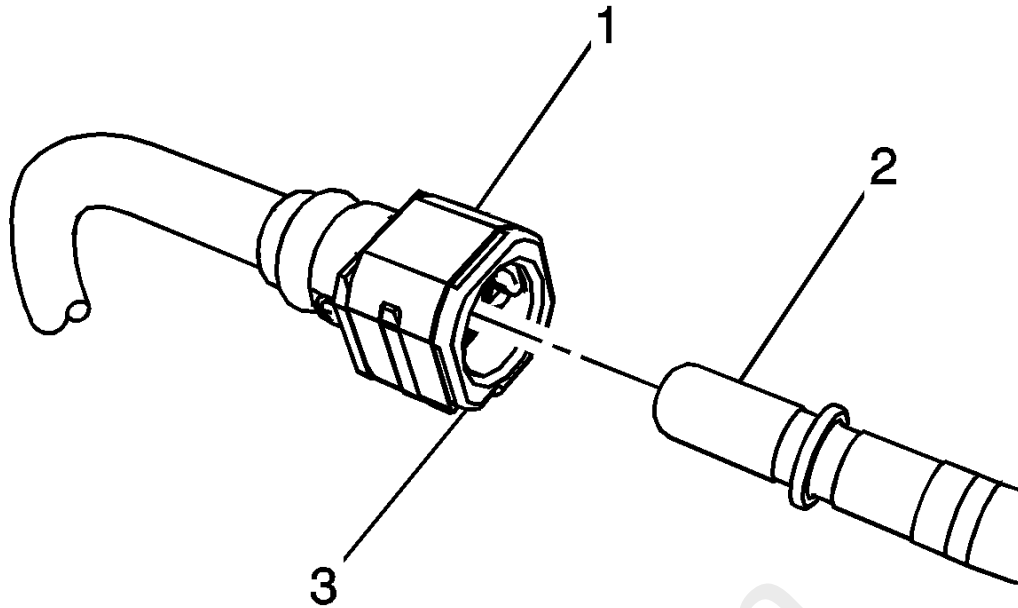


Fig. 33: Latch And Connector

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.

EVAPORATIVE EMISSION SYSTEM CLEANING

Special Tools

GE 41413 - 200 Evaporative Pressure and Purge Station

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

Inspection Procedure

CAUTION: Use the Evaporative Emission (EVAP) System Tester GE 41413-A in order to provide a clean, dry, low pressure nitrogen gas source. Do not substitute any other pressurized source, gas or otherwise. Damage may result to the EVAP system, test equipment or cause a safety risk.

NOTE: Proceed with the following procedure only if referenced by an evaporative emission (EVAP) diagnostic or repair procedure.

1. Turn OFF the ignition.
2. Remove the EVAP canister purge valve. [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
3. Lightly tap the EVAP canister purge valve on a hard surface.
4. Inspect for carbon particles exiting either of the vacuum ports.
 - If no carbon particles were detected, but a blockage was detected during a diagnostic procedure, install the original EVAP canister purge valve. Continue with the cleaning procedure.
 - If carbon particles are found during the inspection procedure, continue with the cleaning procedure.
 - If a diagnostic procedure directed you to replace the EVAP canister purge valve and no carbon particles were detected, replace the EVAP canister purge valve. Return to the published service procedure.

Cleaning Procedure

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Remove the EVAP canister. [Evaporative Emission Canister Replacement \(FWD\)Evaporative Emission Canister Replacement \(AWD\)](#)
3. Turn OFF the main valve on the **GE 41413 - 200** station.
4. Disconnect the hose from the diagnostic station pressure regulator.
5. Using a section of vacuum hose, connect one end onto the EVAP pressure/purge diagnostic station pressure regulator.
6. Connect the other end of the vacuum hose to the canister side of the purge pipe.
7. Turn ON the main nitrogen cylinder valve and continue to discharge nitrogen for 15 seconds.
8. If the nitrogen does not clear the blockage, replace the purge pipe.
9. Return the EVAP pressure/purge diagnostic station to the stations original condition.
10. Install a new EVAP canister. [Evaporative Emission Canister Replacement \(FWD\)Evaporative Emission Canister Replacement \(AWD\)](#)
11. Lower the vehicle.
12. Install a new EVAP canister purge valve. [Evaporative Emission Canister Purge Solenoid Valve Replacement](#)
13. Return to the diagnostic table that sent you here.

ENGINE CONTROL MODULE REPLACEMENT

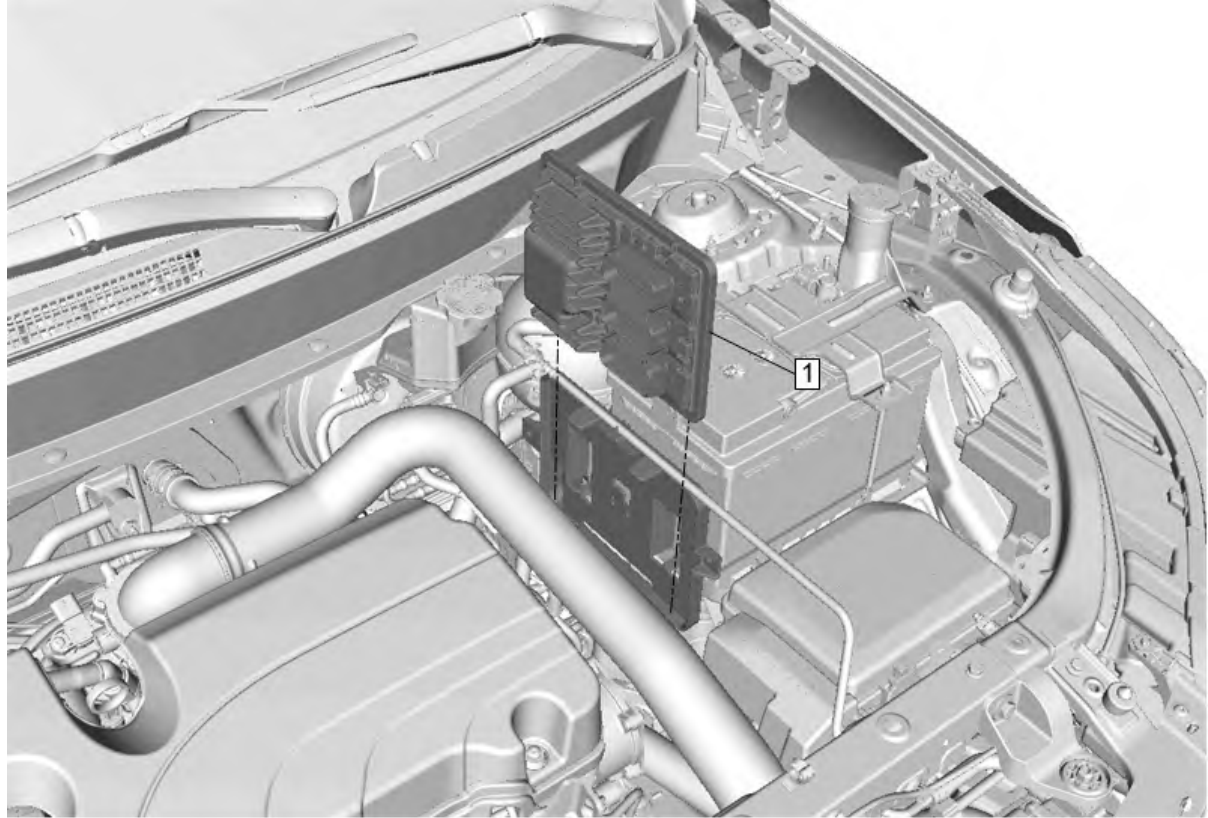


Fig. 34: Engine Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection (KL9)	

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 not 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. Disconnect the electrical connectors from the engine control module. 2. Use a suitable tool to pry back the locking tabs and remove the engine control module from the bracket. 3. Perform the throttle body idle air flow compensation reset. Throttle Body Idle Air Flow Compensation Reset 4. If replacing the engine control module, it is necessary to reprogram the replacement module. 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

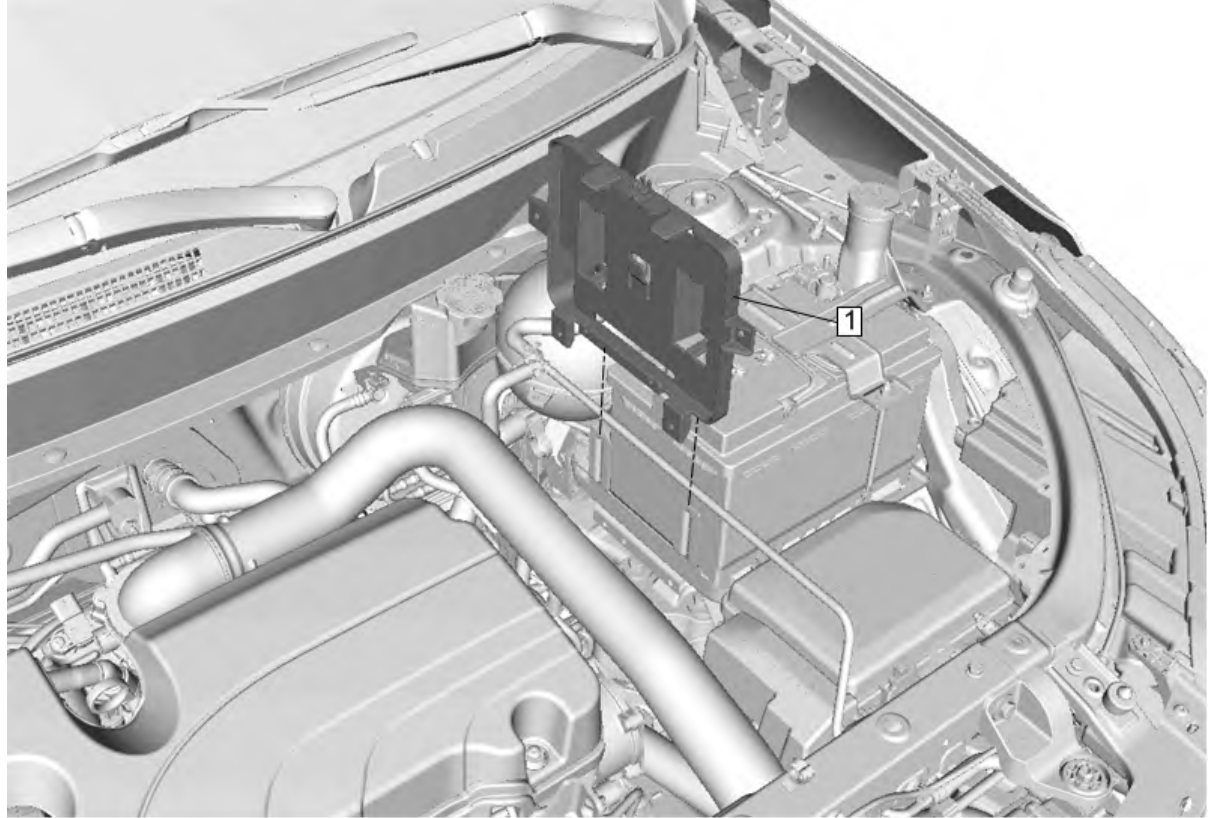


Fig. 35: Engine Control Module Bracket
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Engine Control Module Replacement</u> - Reposition away Engine Coolant Air Bleed Hose@Engine Control Module Bracket - <u>Engine Coolant Air Bleed Hose Replacement (Turbocharger Coolant Return pipe to Water Outlet, LYX)</u> <u>Engine Coolant Air Bleed Hose Replacement (Radiator Surge Tank to Turbocharger Coolant Return Pipe to Radiator, LYX)</u> - Remove wiring harness from engine control module bracket.	
1	Engine Control Module Bracket Procedure Release retaining tab to remove bracket from battery tray.

ACCELERATOR PEDAL ASSEMBLY REPLACEMENT

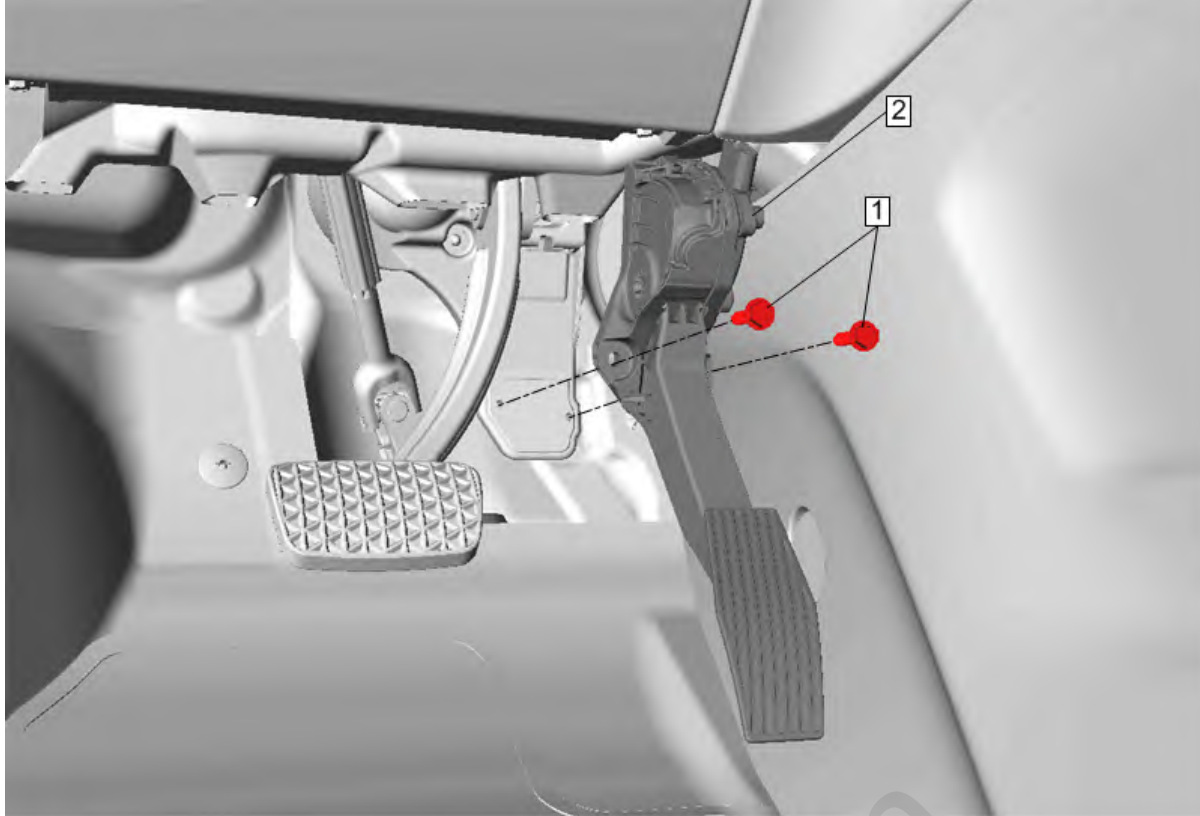


Fig. 36: Accelerator Pedal Assembly.
 Courtesy of GENERAL MOTORS COMPANY

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

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT - WATER OUTLET

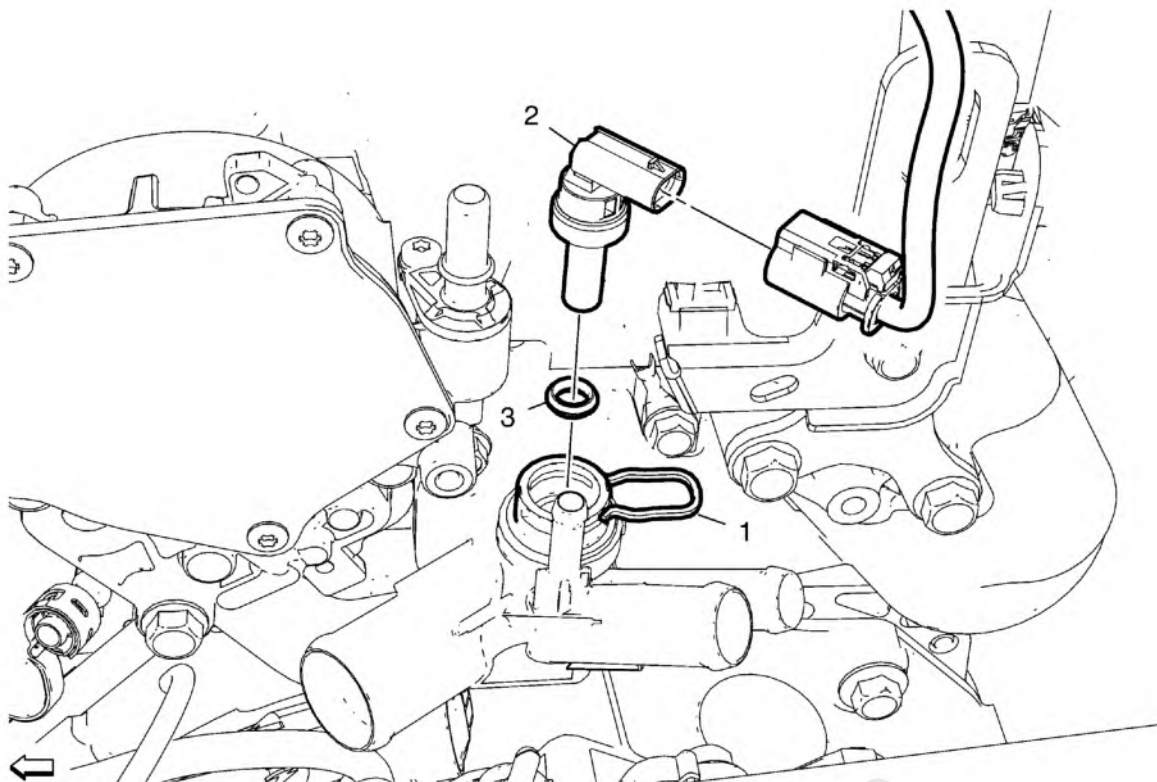


Fig. 37: Engine Coolant Temperature Sensor - Water Outlet

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Engine Lift Rear Bracket Replacement</u>	
1	Retaining Clamp
2	Engine Coolant Temperature Sensor Procedure Disconnect the electrical connector.
3	Engine Coolant Temperature Sensor Seal Procedure Install a NEW O-ring seal.

KNOCK SENSOR REPLACEMENT (SENSOR 1)

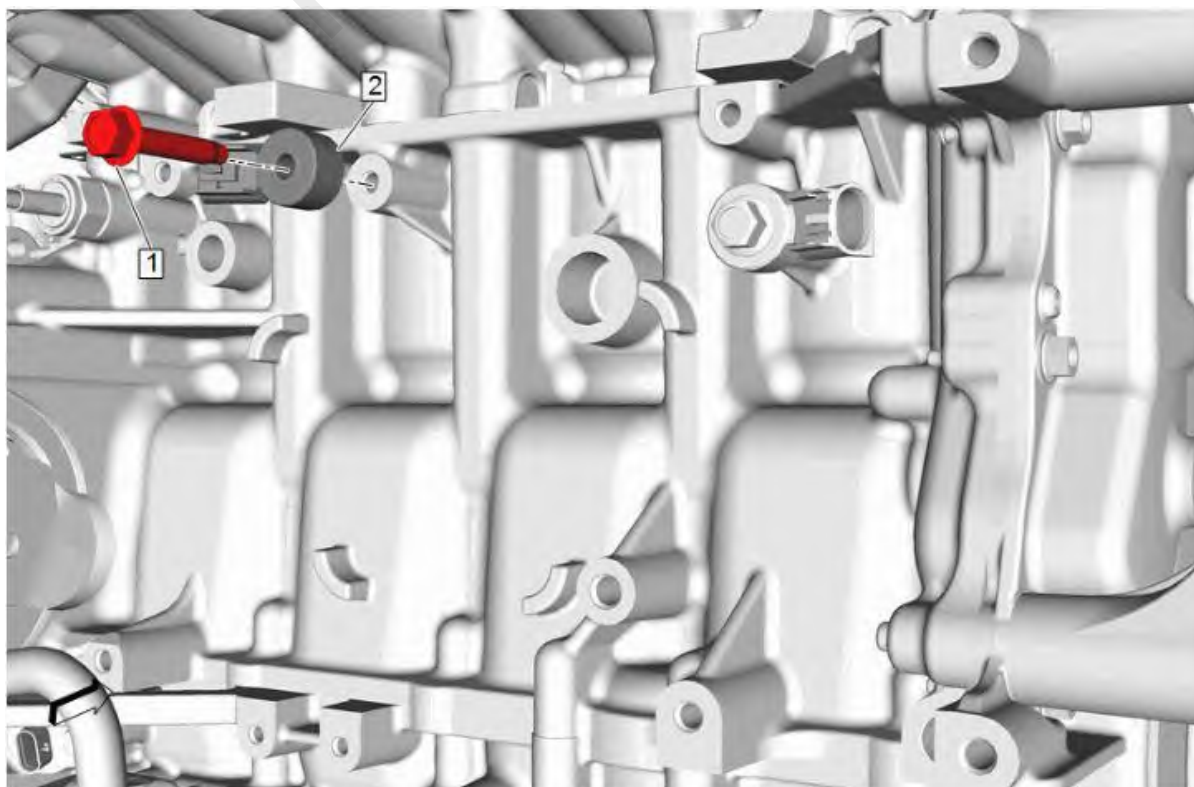


Fig. 38: Knock Sensor (Sensor 1)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Starter Replacement (LYX - All Wheel Drive)</u> <u>Starter Replacement (LYX - Front Wheel Drive)</u>	
1	Knock Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Knock Sensor Procedure Disconnect the electrical connector.

KNOCK SENSOR REPLACEMENT (SENSOR 2)

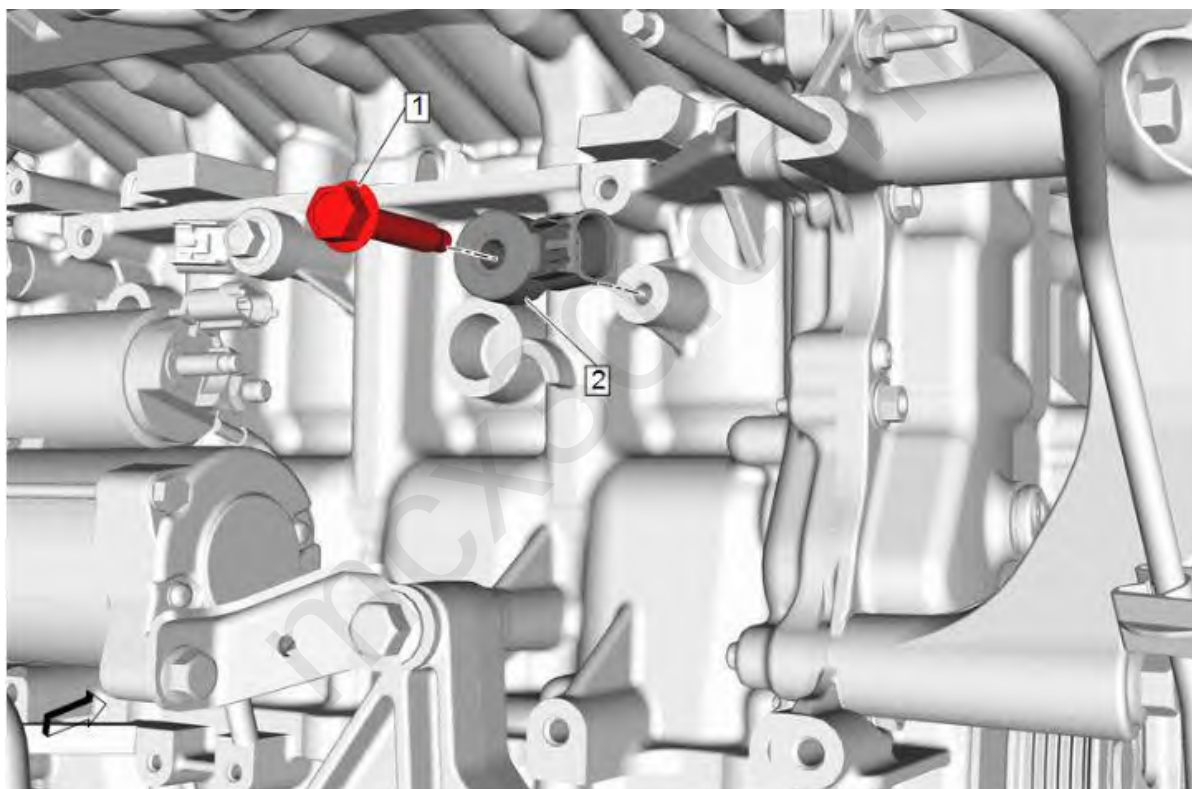


Fig. 39: Knock Sensor (Sensor 2)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Generator Replacement (LYX)</u> <u>Generator Replacement (LTG)</u>	
1	Knock Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)

Callout	Component Name
2	Knock Sensor Procedure Disconnect the electrical connector.

THROTTLE BODY ASSEMBLY REPLACEMENT

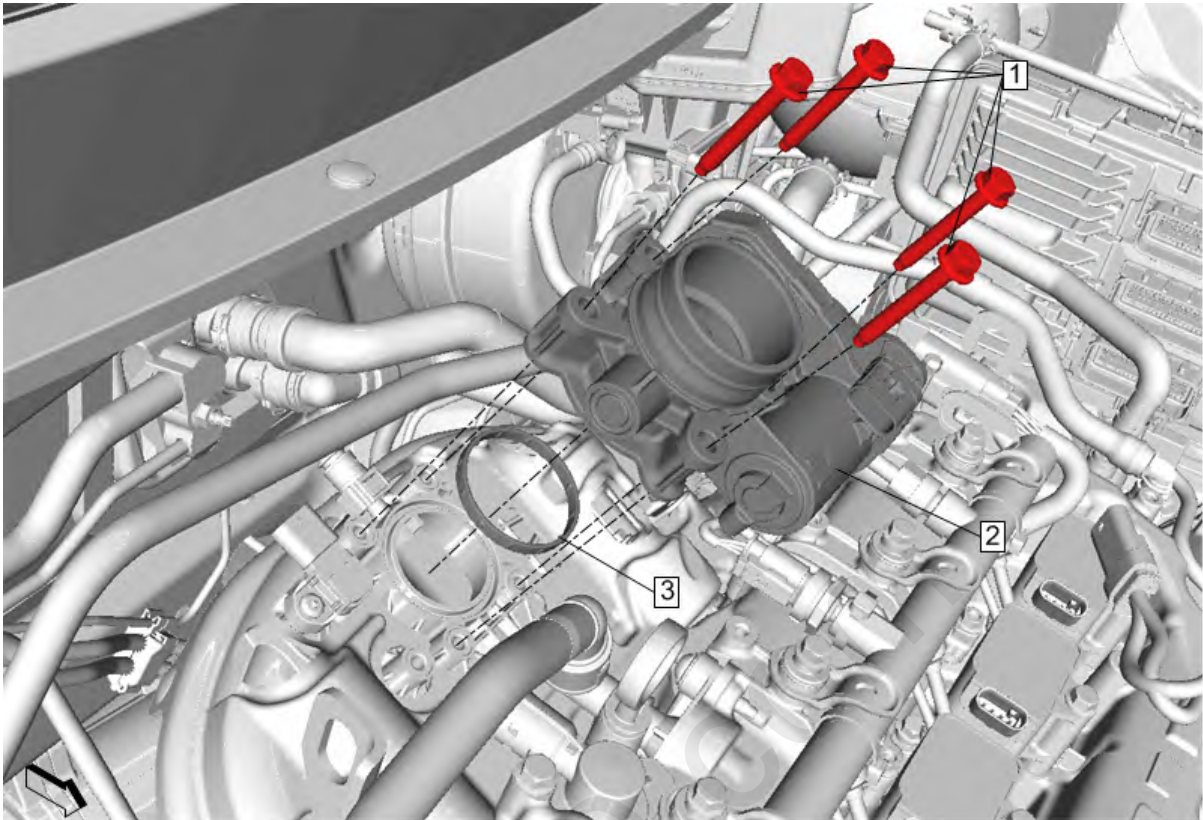


Fig. 40: Throttle Body Assembly
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Charge Air Cooler Outlet Air Tube Replacement</u> - Disconnect the electrical connector.	
1	Throttle Body Bolt [4x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Throttle Body Procedure - Perform the intake system learned values reset. <u>Intake System Learned Values Reset</u> - Perform throttle body idle air flow compensation reset. <u>Throttle Body Idle Air Flow Compensation Reset</u>
3	Throttle Body Seal Procedure Install a NEW throttle body seal.

THROTTLE BODY INSPECTION AND CLEANING

1. Remove [Throttle Body Assembly Replacement](#)

WARNING: Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.

CAUTION: Do not insert any tools into the throttle body bore in order to avoid damage to the throttle valve plate.

NOTE: Open the throttle valve in order to inspect all surfaces.

2. Inspect the throttle body bore and the throttle valve plate for deposits.

CAUTION: Do not use any solvent that contains Methyl Ethyl Ketone (MEK). This solvent may damage fuel system components.

3. Clean the throttle body bore and the throttle valve plate using a clean shop towel with an appropriate cleaner.

4. Install [Throttle Body Assembly Replacement](#).

5. [Throttle Body Idle Air Flow Compensation Reset](#)

FUEL PRESSURE RELIEF

WARNING: Fuel that flows out at high pressure can cause serious injury to the skin and eyes. ALWAYS depressurize the fuel system before removing components that are under high fuel pressure.

WARNING: Remove the fuel tank cap and relieve the fuel system pressure before servicing the fuel system in order to reduce the risk of personal injury. After you relieve the fuel system pressure, a small amount of fuel may be released when servicing the fuel lines, the fuel injection pump, or the connections. In order to reduce the risk of personal injury, cover the fuel system components with a shop towel before disconnection. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

Scan Tool Method - Preferred

1. Install a scan tool and turn the ignition ON.
2. Using the scan tool, command the fuel pump OFF allowing the low pressure fuel pump to shut off.
3. Start the vehicle and allow the engine to idle until the engine stops. The engine will stop in approximately 5-20 seconds.
4. Repeat step 3. Using the scan tool, verify pressure has dropped to a minimal level.
5. Turn the ignition OFF.

Alternate Method - If a scan tool is not available

1. Disable the fuel pump by removing the B+ fuel pump control module fuse. Refer to [Electrical Center Identification Views](#).
2. Start the vehicle and allow the engine to idle until the engine stops. The engine will stop in approximately 5-20 seconds.
3. Attempt to restart the vehicle to ensure pressure has dropped to a minimal level.
4. Turn the ignition OFF.

FUEL TANK DRAINING

WARNING: Never drain or store fuel in an open container. Always use an approved fuel storage container in order to reduce the chance of fire or explosion.

WARNING: Place a dry chemical (Class B) fire extinguisher nearby before performing any on-vehicle service procedures. Failure to follow these precautions may result in personal injury.

CAUTION: When performing a fuel tank draining procedure on a capless fuel system, only use the capless adapter funnel or equivalent. Using something other than the capless adapter funnel or equivalent may cause damage to the capless fuel system.

1. Insert the capless adapter funnel or equivalent into the capless fill pipe.

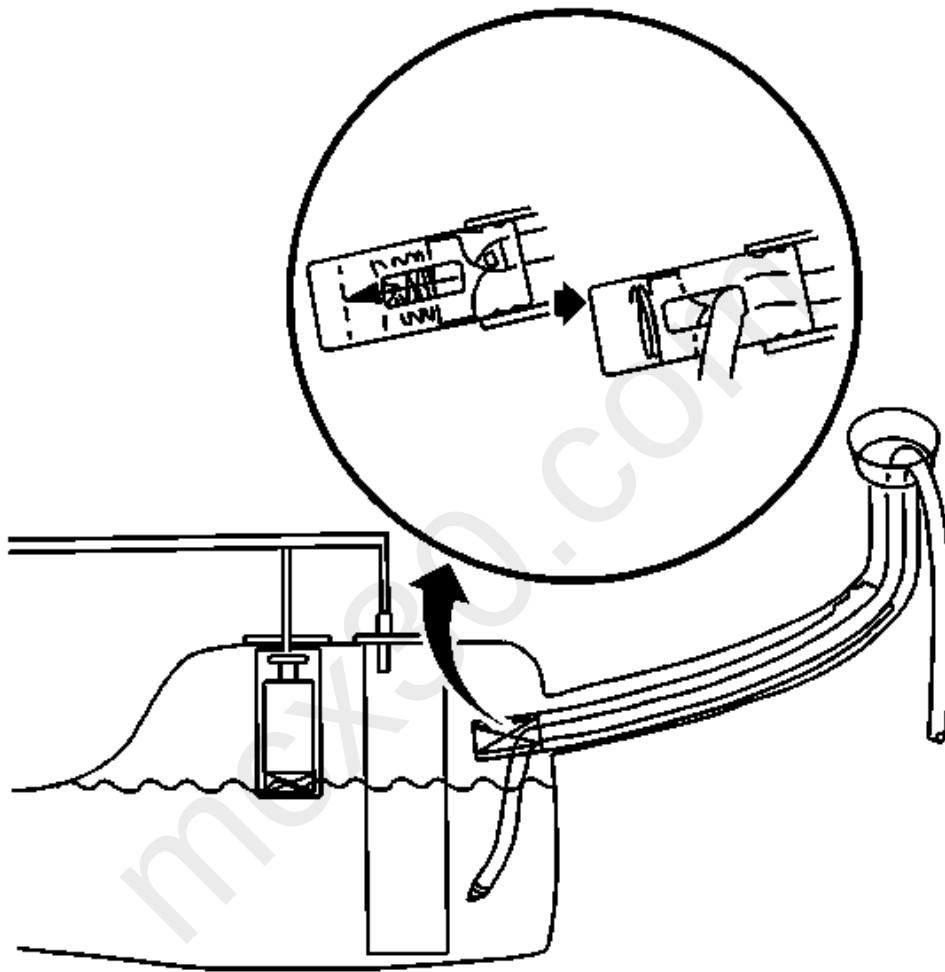


Fig. 41: Draining Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

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

2. Insert the a suitable suction hose into the fuel tank until the bottom is reached.
3. Attach a suitable suction hose to the hose used with the hand or air operated pump device.
4. Use a hand or air operated pump device in order to drain as much fuel through the fuel fill pipe as possible.

FUEL TANK FILLER PIPE REPLACEMENT

Removal Procedure

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

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

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

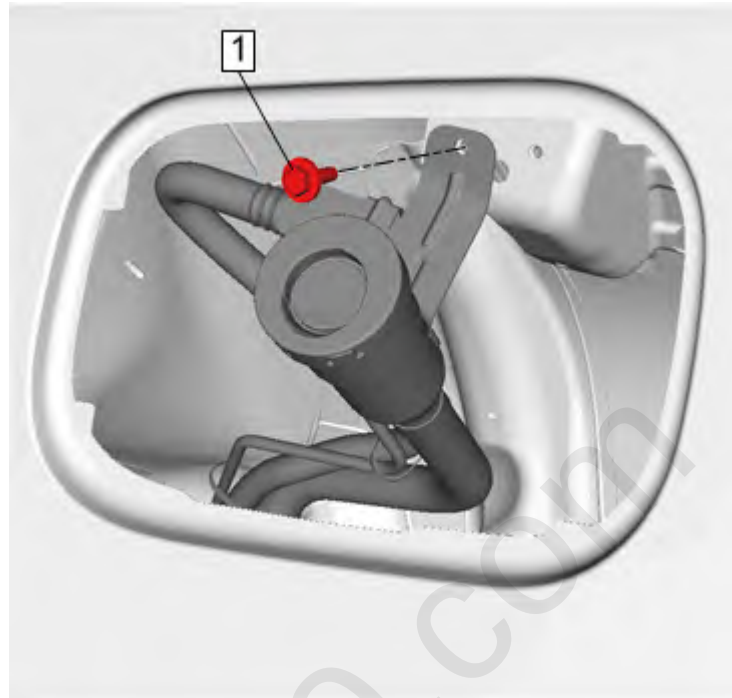


Fig. 42: Tank Filler Pipe Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

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

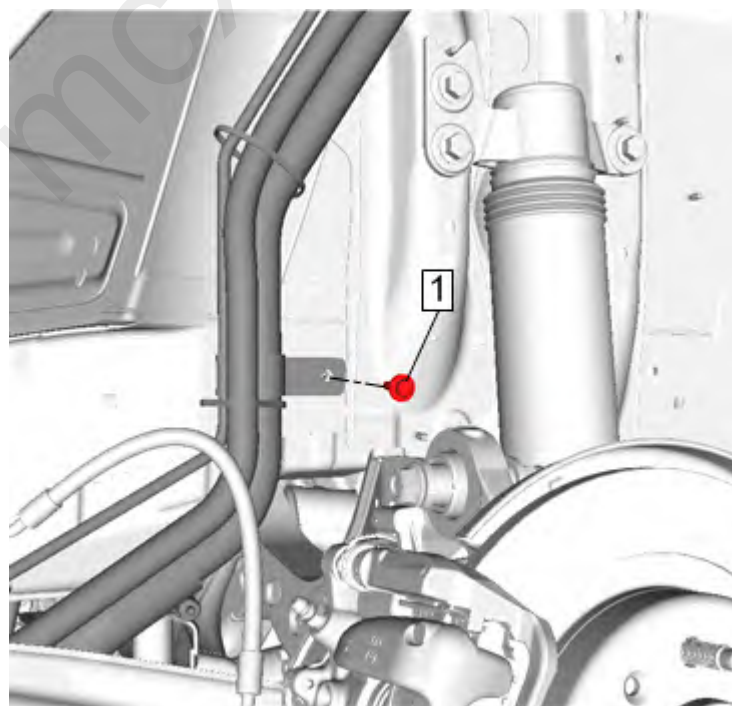


Fig. 43: Fuel Tank Filler Pipe Ground Bolt
Courtesy of GENERAL MOTORS COMPANY

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

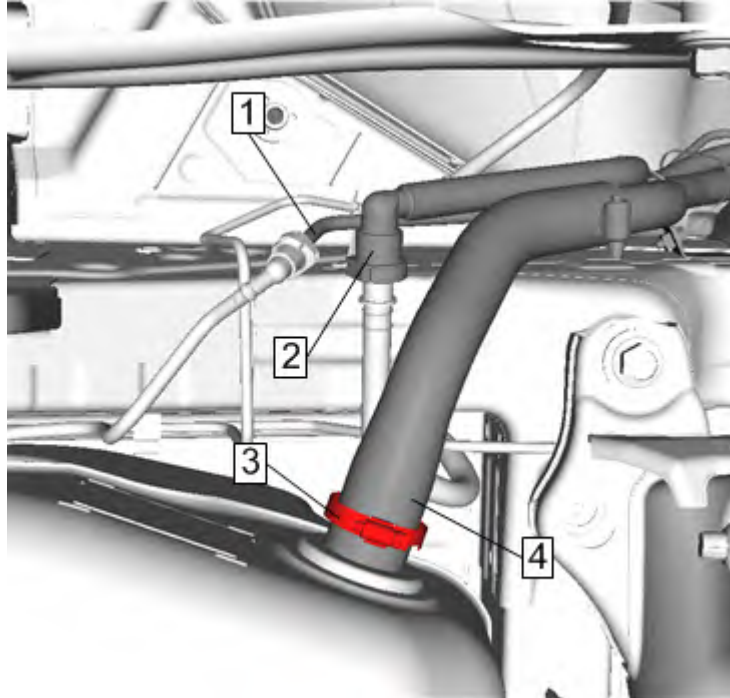


Fig. 44: Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Fuel Tank Filler Pipe (1) [Plastic Collar Quick Connect Fitting Service](#)
7. Disconnect Evaporative Emission Canister Vent Hose (2) [Plastic Collar Quick Connect Fitting Service](#)
8. Remove Fuel Tank Filler Hose Clamp (3)
9. Remove Fuel Tank Filler Hose (4)

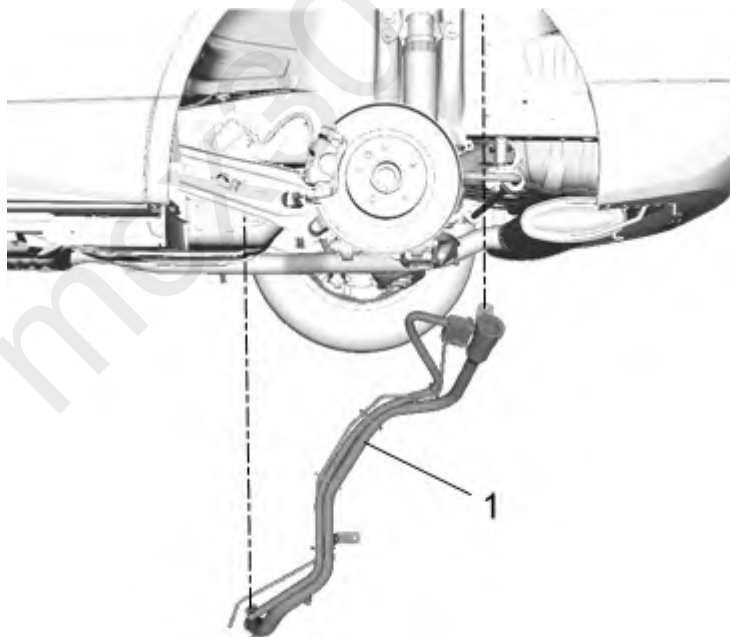


Fig. 45: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

10. Remove Fuel Tank Filler Pipe (1)

Installation Procedure

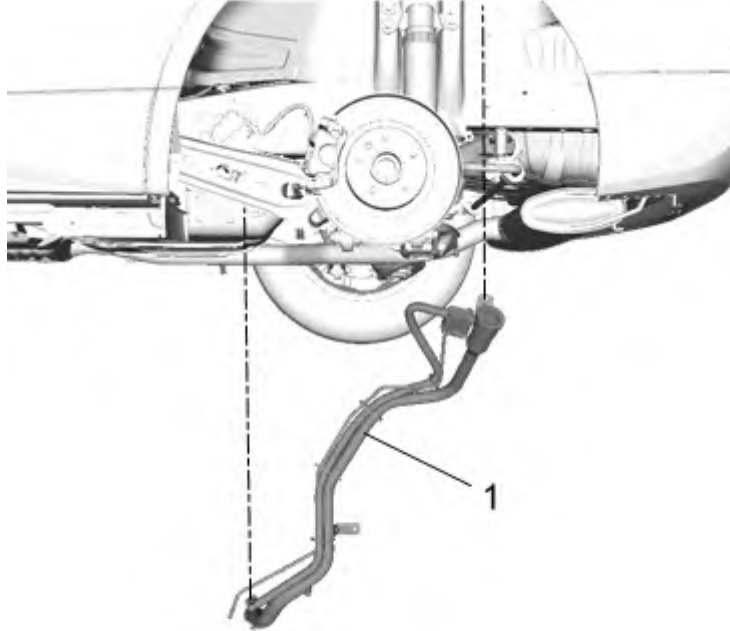


Fig. 46: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Tank Filler Pipe (1)

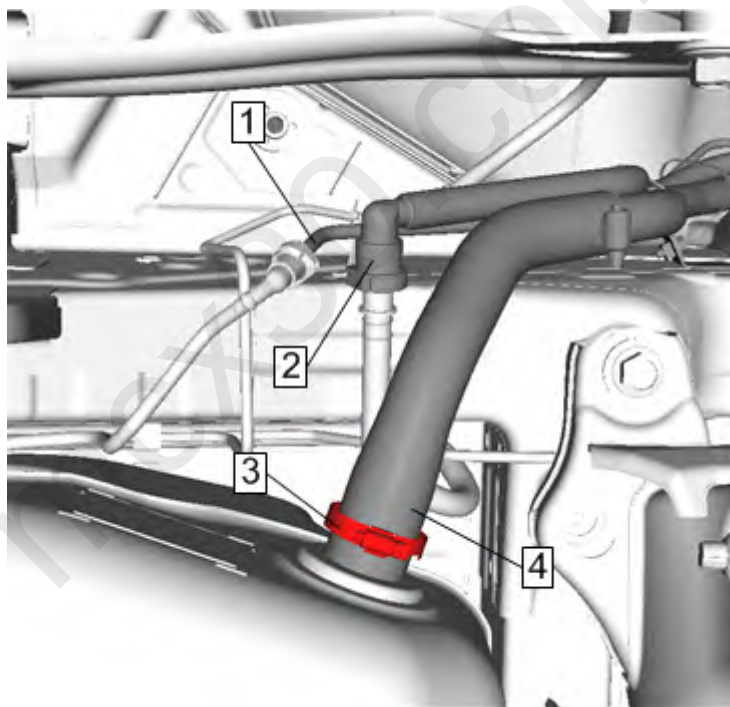


Fig. 47: Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

2. Install Fuel Tank Filler Hose (4)

CAUTION: Refer to **Fastener Caution** .

3. Install Fuel Tank Filler Hose Clamp (3) and tighten 4 N.m (35 lb in)
4. Connect Evaporative Emission Canister Vent Hose (2)-**Plastic Collar Quick Connect Fitting Service**
5. Connect Fuel Tank Filler Pipe (1) - **Plastic Collar Quick Connect Fitting Service**

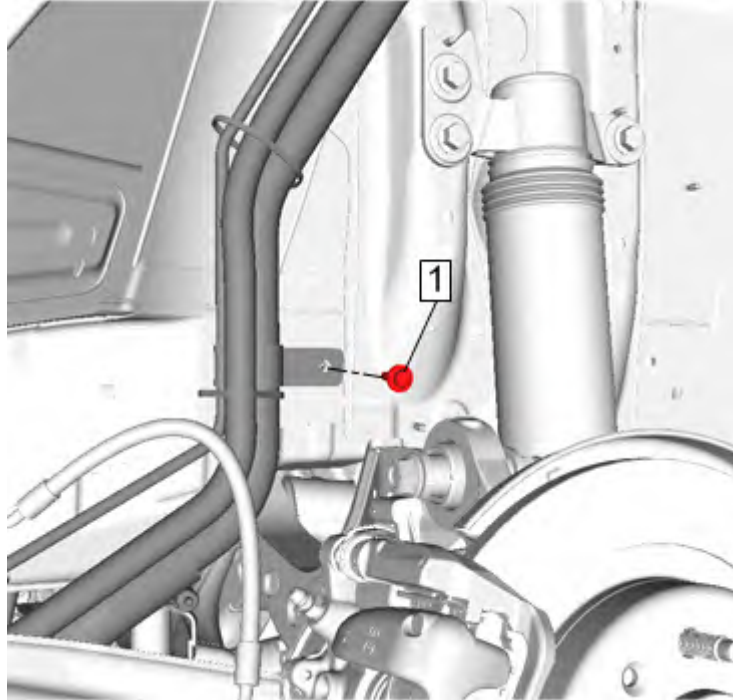


Fig. 48: Fuel Tank Filler Pipe Ground Bolt
 Courtesy of GENERAL MOTORS COMPANY

6. Install Fuel Tank Filler Pipe Ground Bolt(1) and tighten 9 N.m (80 lb in)

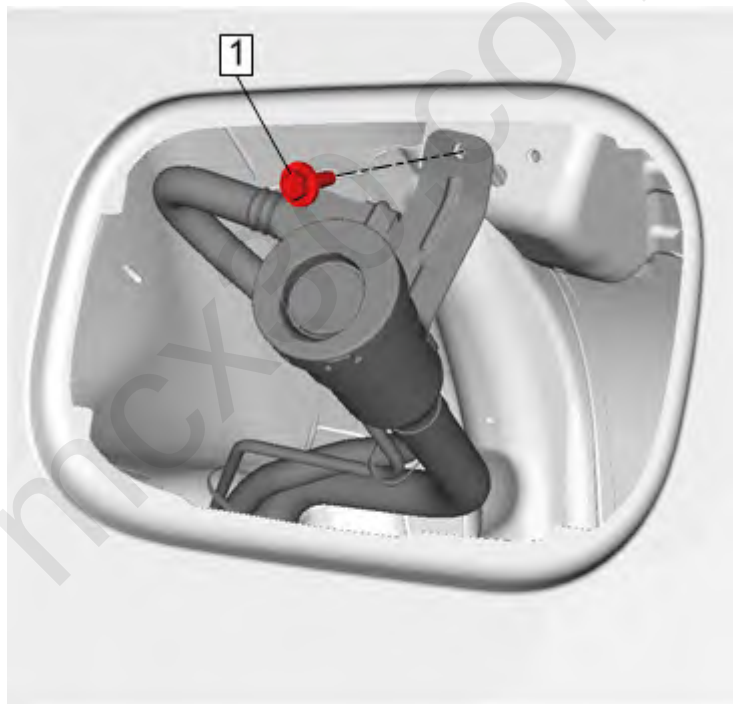


Fig. 49: Tank Filler Pipe Ground Bolt
 Courtesy of GENERAL MOTORS COMPANY

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

FUEL FEED PIPE REPLACEMENT (FWD)

Removal Procedure

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

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

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect Fuel Feed Front Pipe - [Fuel Feed Front Pipe Replacement](#)
3. Remove Exhaust Front Pipe - [Exhaust Front Pipe Replacement \(LYX\)](#).

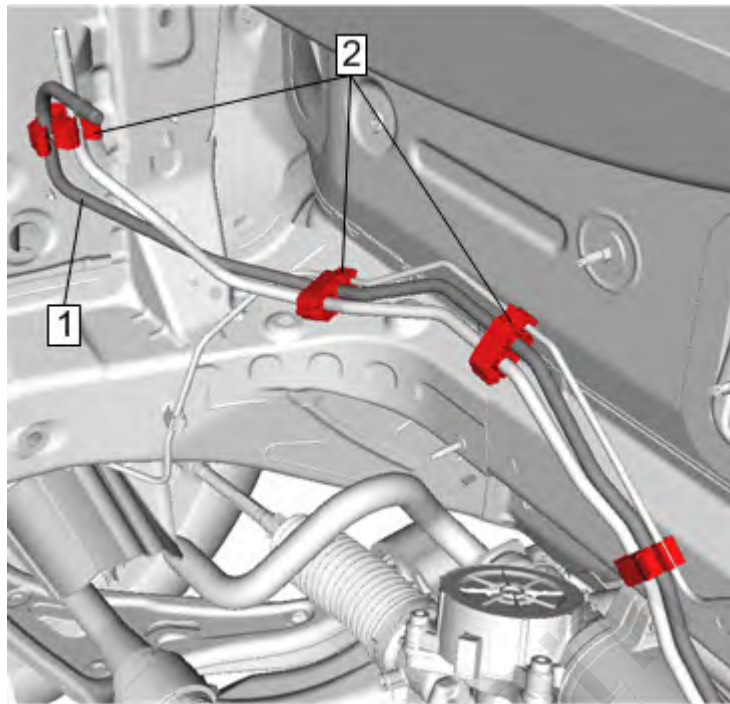


Fig. 50: Fuel Feed Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Remove Fuel Feed Pipe (1) @Retainer (2) - [4x]
5. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#) .

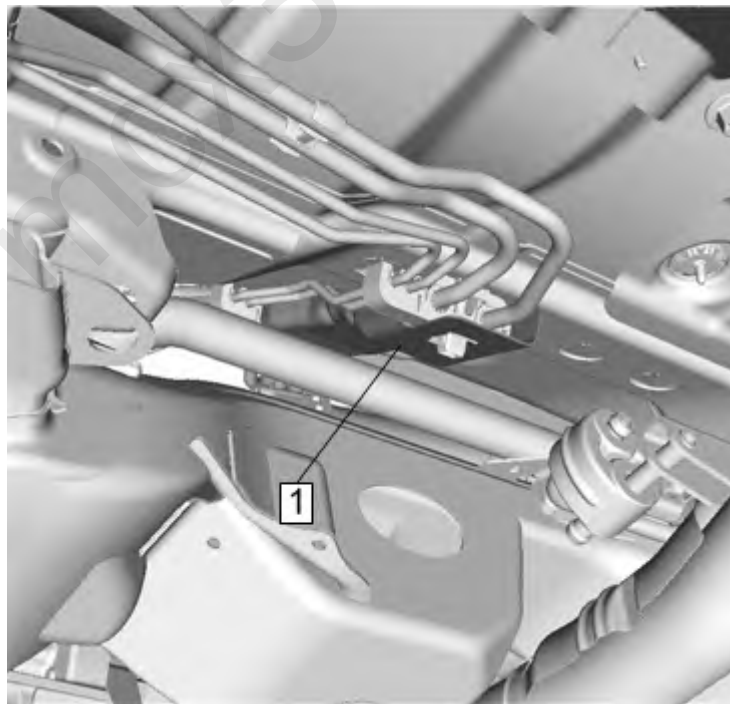


Fig. 51: Shield
Courtesy of GENERAL MOTORS COMPANY

6. Remove Shield (1).

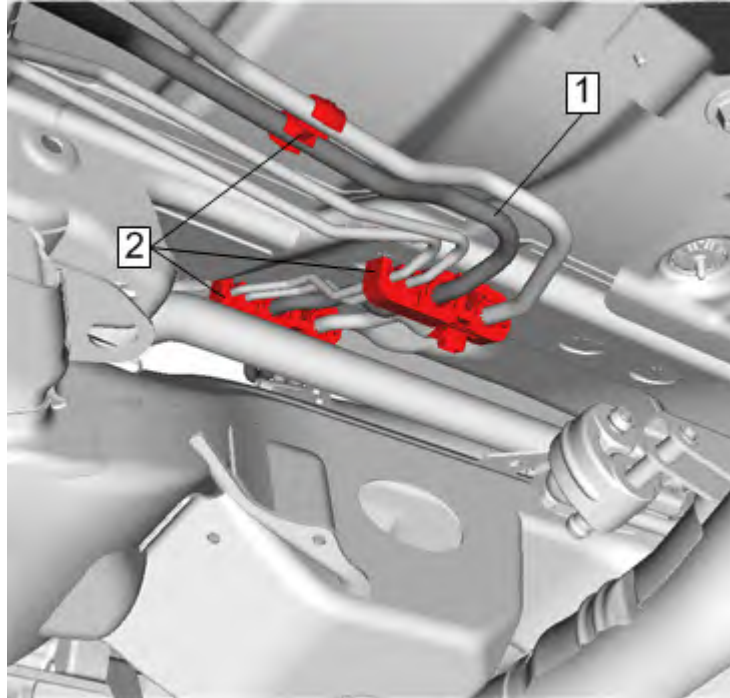


Fig. 52: Fuel Feed Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Remove Fuel Feed Pipe (1) @Retainer (2) - [3x]
8. Remove Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#)

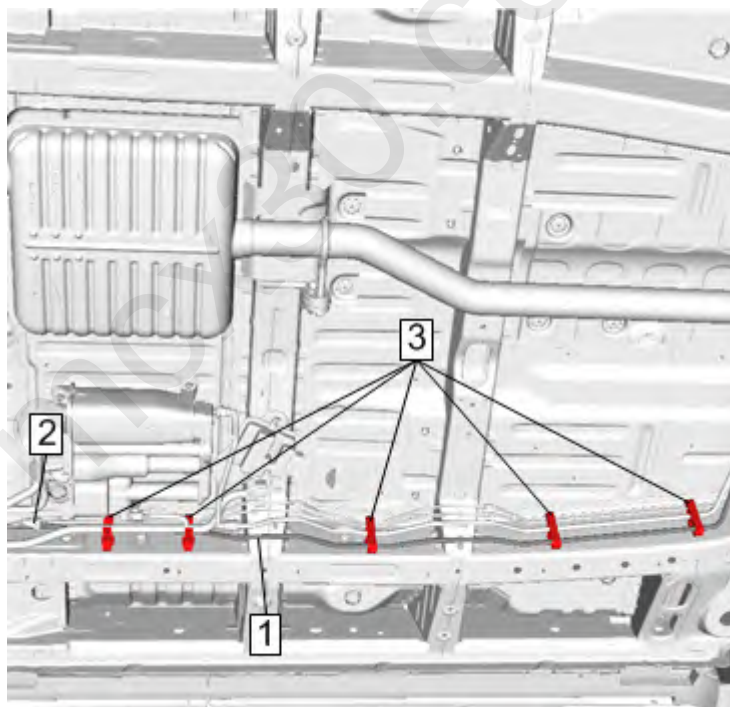


Fig. 53: Fuel Feed Pipe And Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

9. Disconnect Fuel Feed Pipe(1)@Fuel Pump Fuel Feed Hose(2) - [Plastic Collar Quick Connect Fitting Service](#)
10. Remove Fuel Feed Pipe (1) @Retainer (3) - [5x]

Installation Procedure

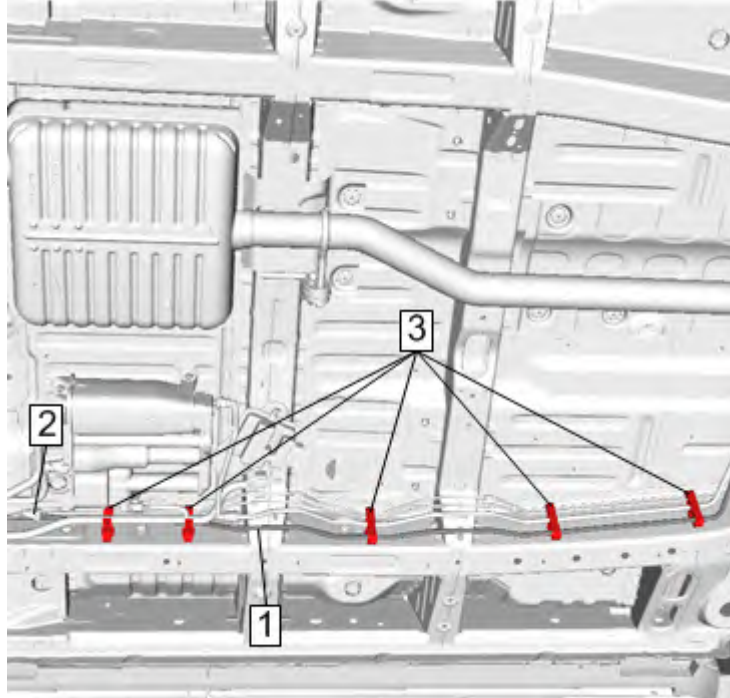


Fig. 54: Fuel Feed Pipe And Fuel Pump Fuel Feed Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Feed Pipe(1)@Retainer(3) - [5x]
2. Connect Fuel Feed Pipe(1)@Fuel Pump Fuel Feed Hose(2) - [Plastic Collar Quick Connect Fitting Service](#)
3. Install Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#)

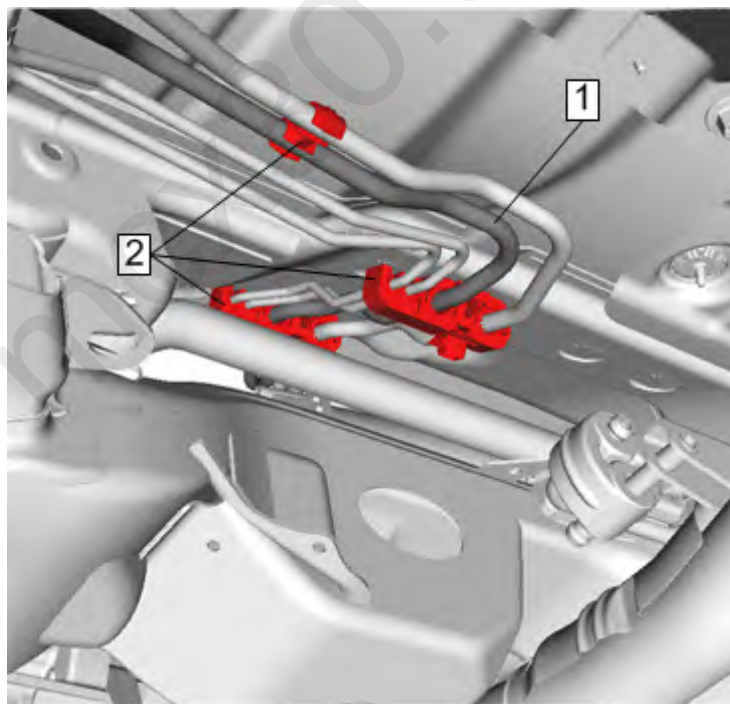


Fig. 55: Fuel Feed Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install Fuel Feed Pipe(1)@Retainer(2) - [3x]

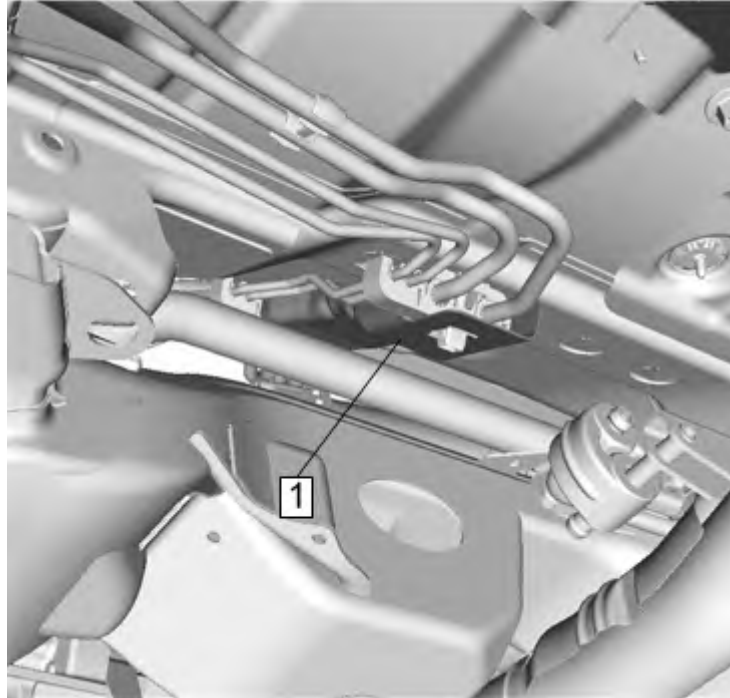


Fig. 56: Shield

Courtesy of GENERAL MOTORS COMPANY

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

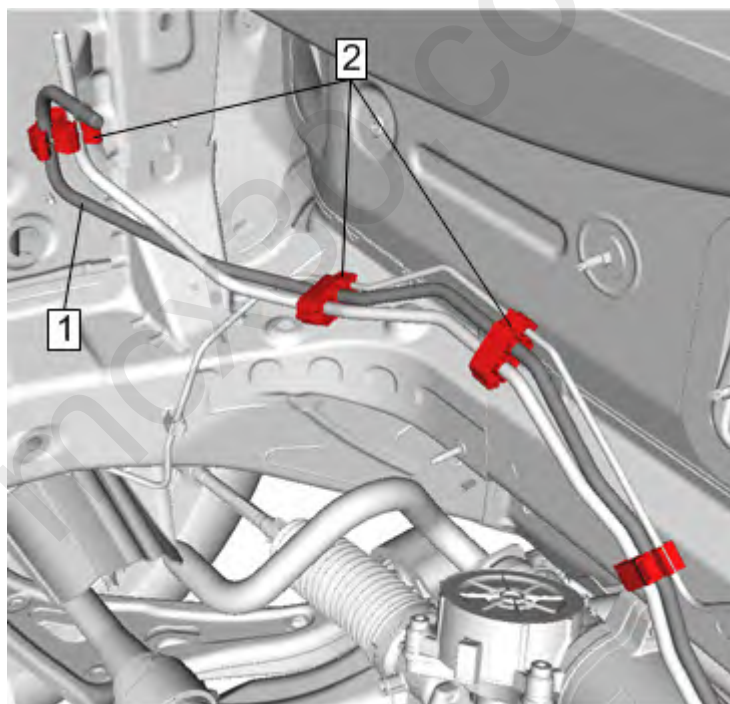


Fig. 57: Fuel Feed Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Install Fuel Feed Pipe(1)@Retainer(2) -[4x]
8. Install Exhaust Front Pipe - [Exhaust Front Pipe Replacement \(LYX\)](#).
9. Connect Fuel Feed Front Pipe -[Fuel Feed Front Pipe Replacement](#)
10. 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. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect Fuel Feed Front Pipe - [Fuel Feed Front Pipe Replacement](#)

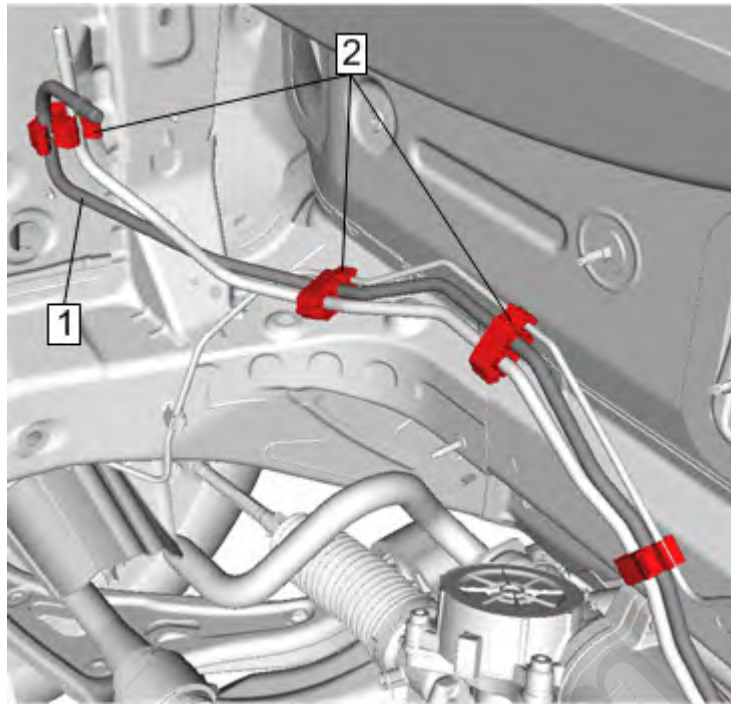


Fig. 58: Fuel Feed Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Remove Fuel Feed Pipe(1)@Retainer(2) - [4x]
4. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#) .

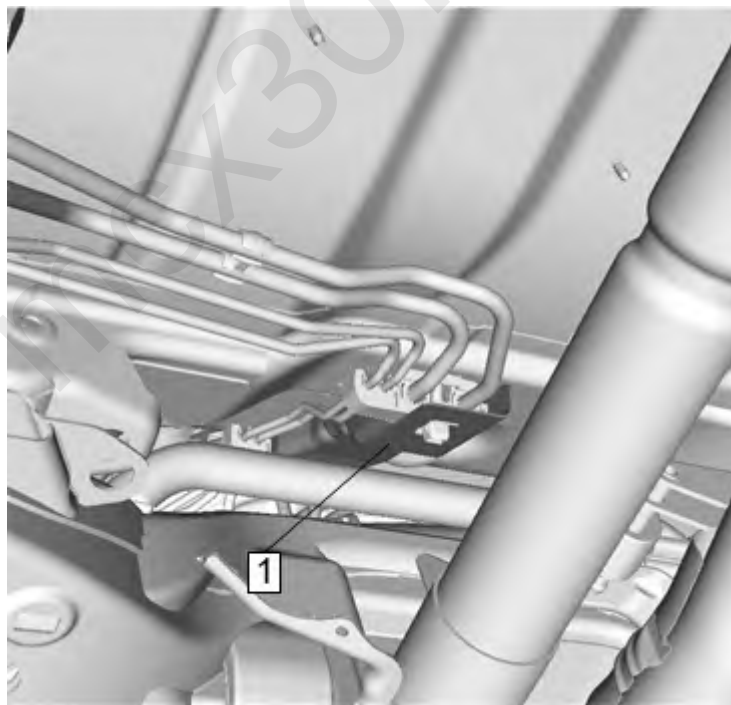


Fig. 59: Shield

Courtesy of GENERAL MOTORS COMPANY

5. Remove Shield (1)

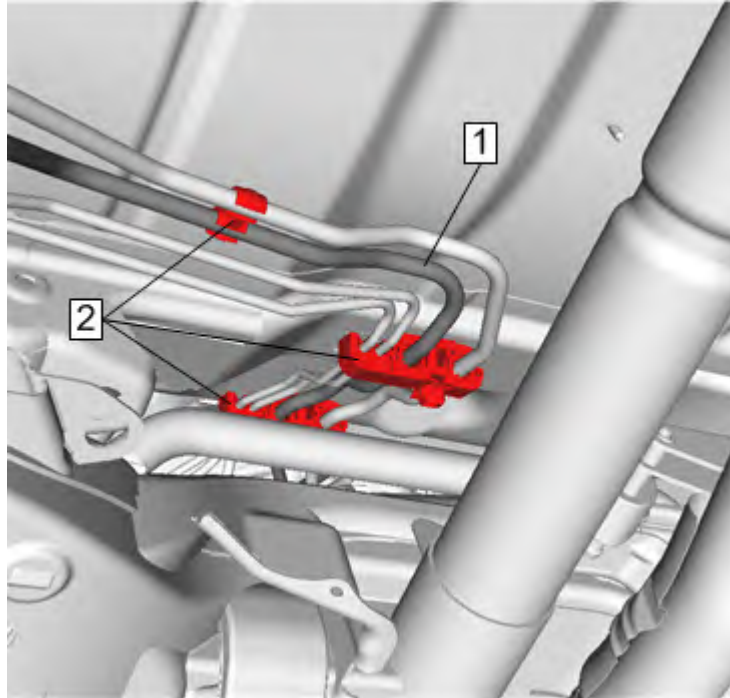


Fig. 60: Fuel Feed Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Remove Fuel Feed Pipe(1)@Retainer(2) - [3x]
7. Remove Underbody Rear Air Deflector - Underbody Rear Air Deflector Replacement (All Wheel Drive)

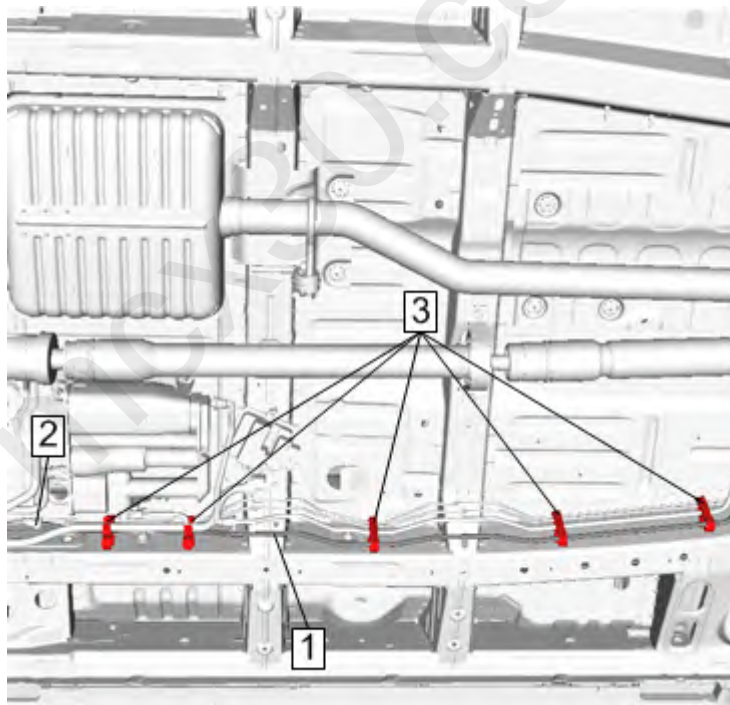


Fig. 61: Fuel Feed Pipe And Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Fuel Feed Pipe(1)@Fuel Pump Fuel Feed Hose(2) - Plastic Collar Quick Connect Fitting Service
9. Remove Fuel Feed Pipe(1)@Retainer(3) - [5x]

Installation Procedure

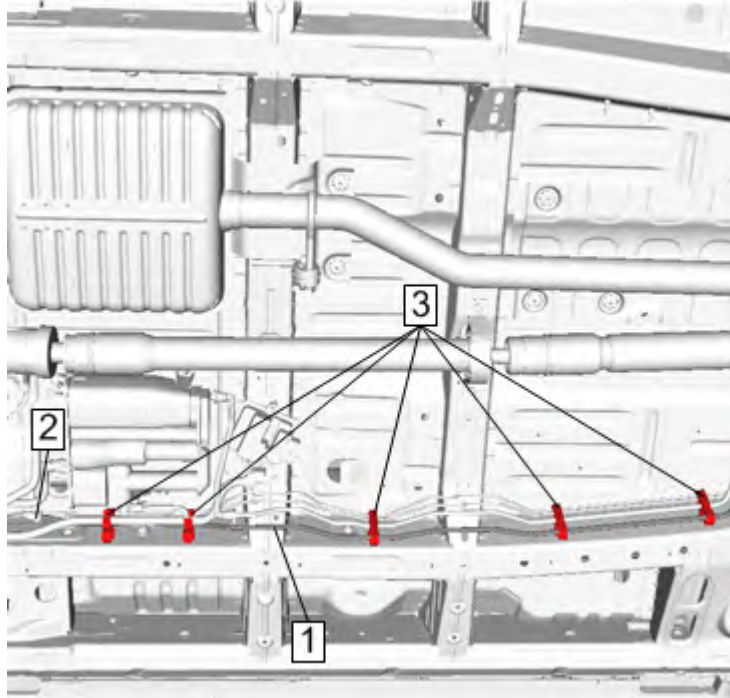


Fig. 62: Fuel Feed Pipe And Fuel Pump Fuel Feed Hose
Courtesy of GENERAL MOTORS COMPANY

1. Install Fuel Feed Pipe(1)@Retainer(3) - [5x]
2. Connect Fuel Feed Pipe(1)@Fuel Pump Fuel Feed Hose(2) - [Plastic Collar Quick Connect Fitting Service](#)
3. Install Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#)

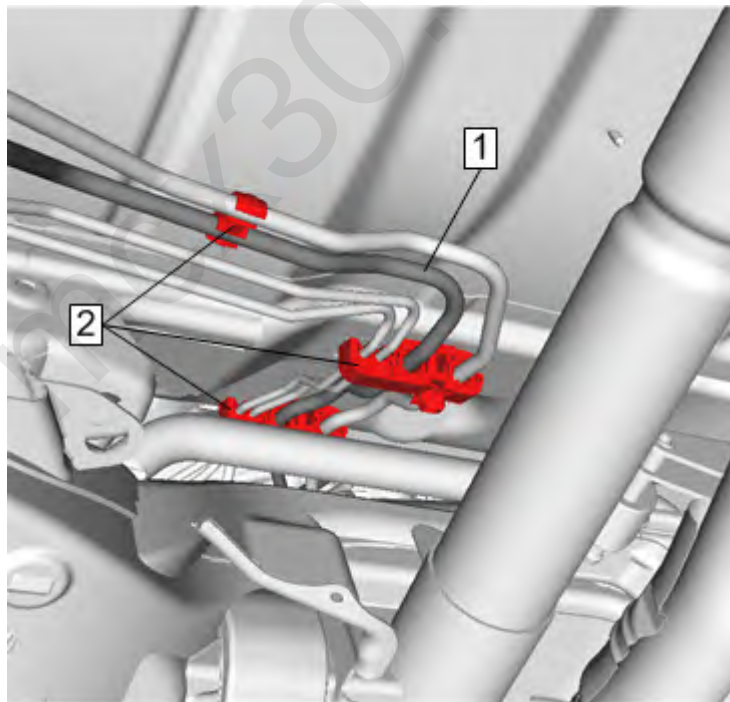


Fig. 63: Fuel Feed Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

4. Install Fuel Feed Pipe(1)@Retainer(2) - [3x]

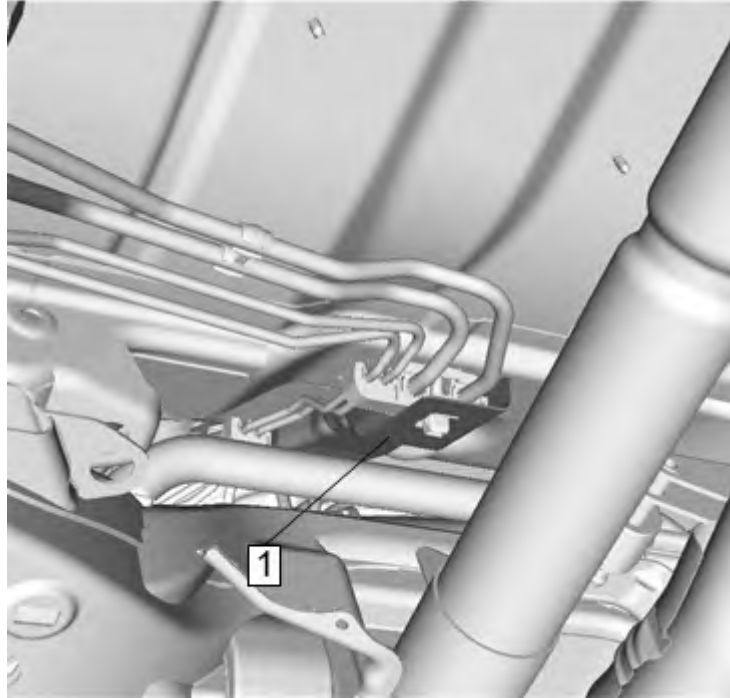


Fig. 64: Shield

Courtesy of GENERAL MOTORS COMPANY

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

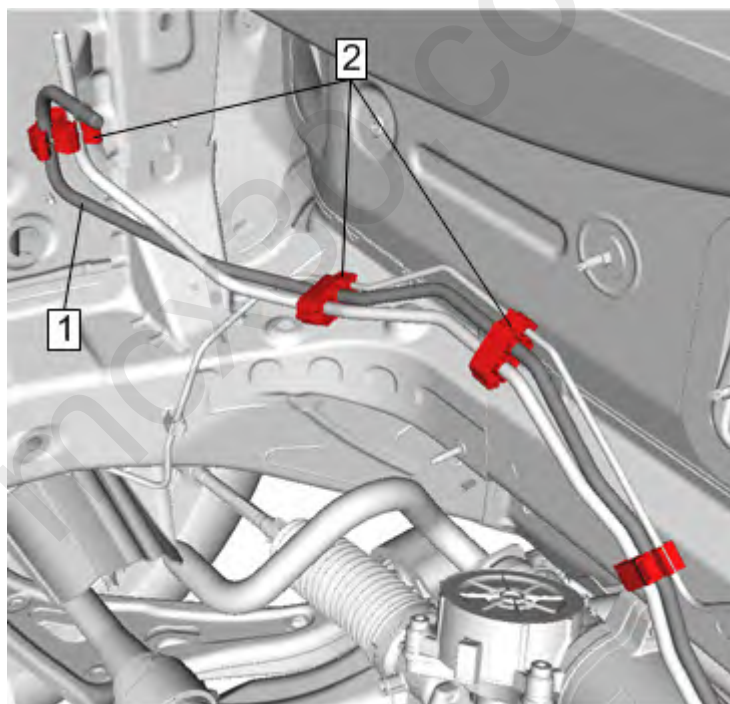


Fig. 65: Fuel Feed Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Install Fuel Feed Pipe(1)@Retainer(2) - [4x]
8. Connect Fuel Feed Front Pipe - **Fuel Feed Front Pipe Replacement**
9. Pressurize fuel system and check for fuel leaks.

FUEL TANK VENT HOSE REPLACEMENT (FWD)

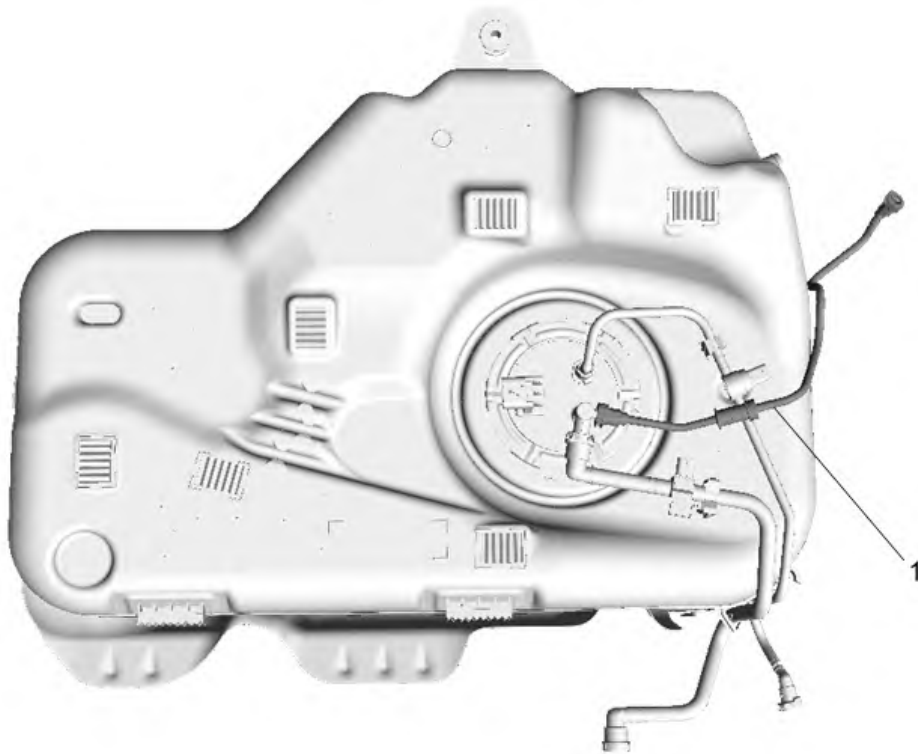


Fig. 66: Fuel Tank Vent Hose (FWD)

Courtesy of GENERAL MOTORS COMPANY

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

FUEL TANK VENT HOSE REPLACEMENT (AWD)

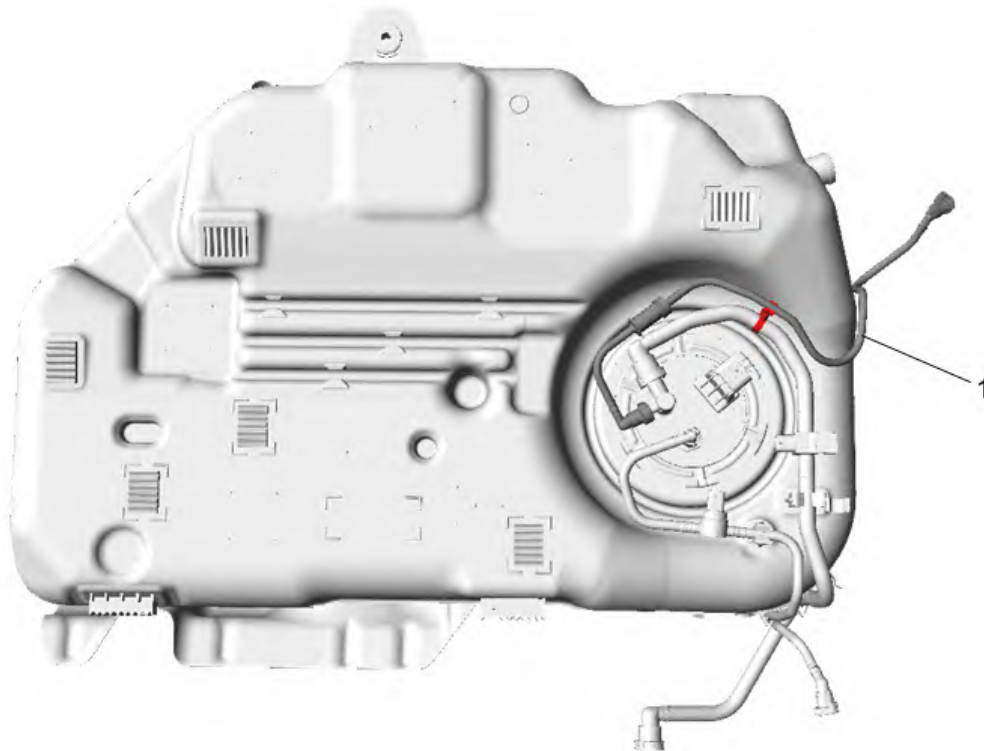


Fig. 67: Fuel Tank Vent Hose (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Fuel Tank Replacement (AWD)	
1	Fuel Tank Vent Hose Procedure Disconnect the fuel tank vent hose and remove from retainer. 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 - [Fuel Tank Replacement \(FWD\)](#).

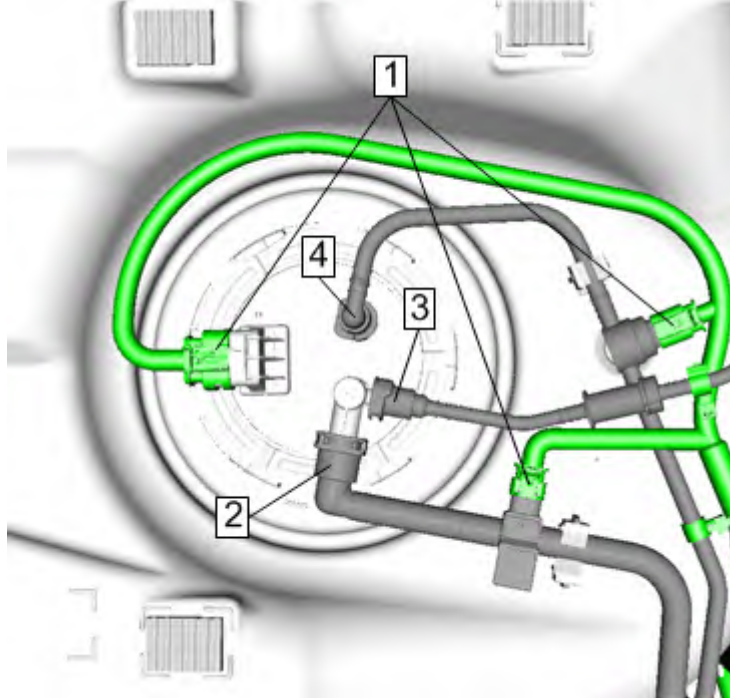


Fig. 68: Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1)
3. Disconnect Evaporative Emission Canister Vent Hose (2) - [Plastic Collar Quick Connect Fitting Service](#)
4. Disconnect Fuel Tank Vent Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
5. Disconnect Fuel Pump Fuel Feed Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)

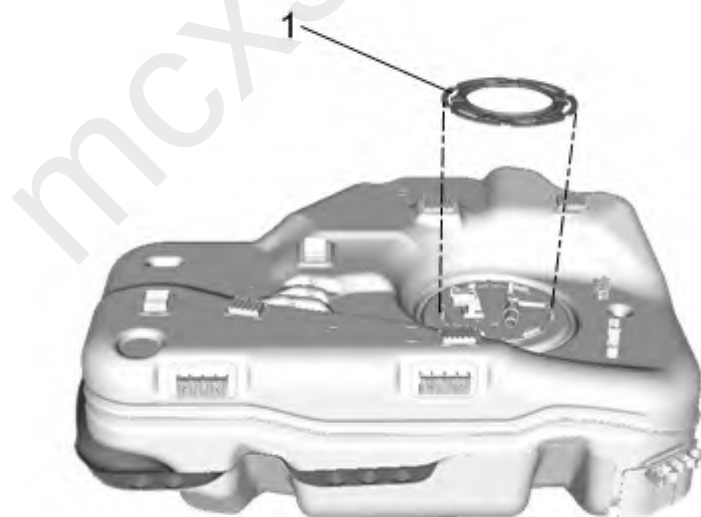


Fig. 69: Fuel Pump Lock Ring

Courtesy of GENERAL MOTORS COMPANY

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

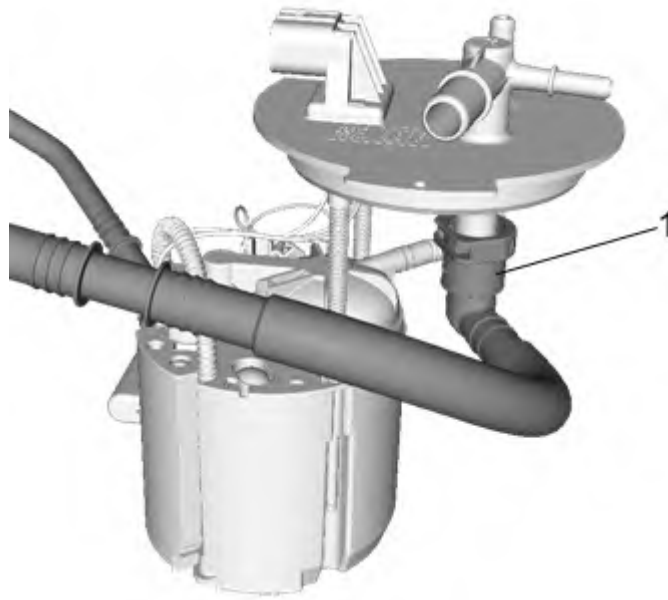


Fig. 70: Fuel Tank Vent Hose

Courtesy of GENERAL MOTORS COMPANY

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

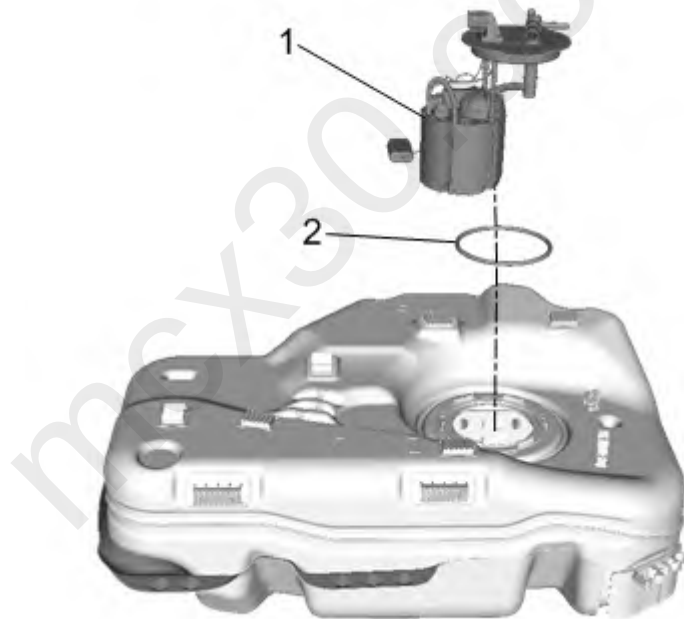


Fig. 71: Fuel Tank Fuel Pump Module

Courtesy of GENERAL MOTORS COMPANY

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

Installation Procedure

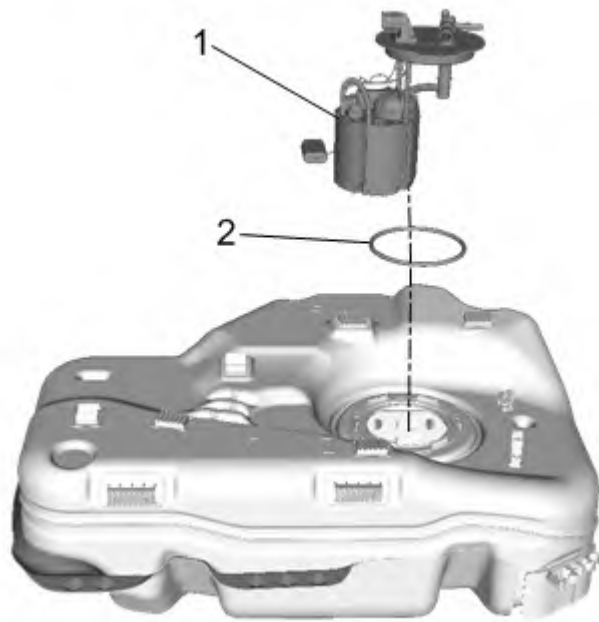


Fig. 72: Fuel Tank Fuel Pump Module

Courtesy of GENERAL MOTORS COMPANY

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

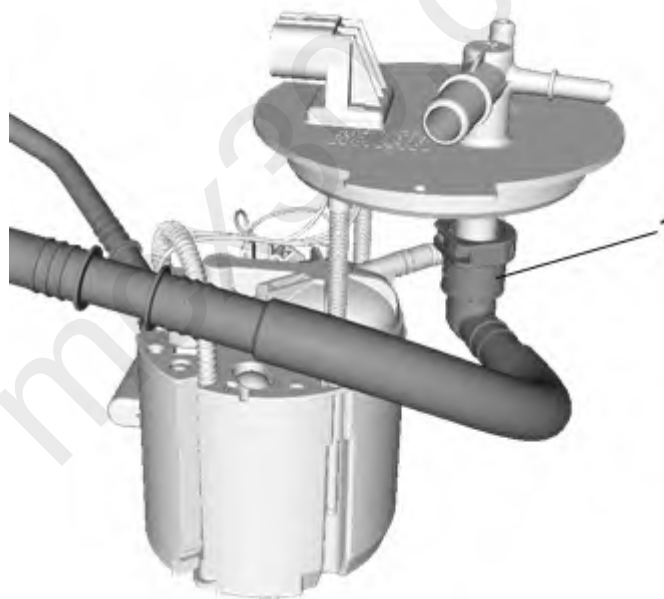


Fig. 73: Fuel Tank Vent Hose

Courtesy of GENERAL MOTORS COMPANY

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

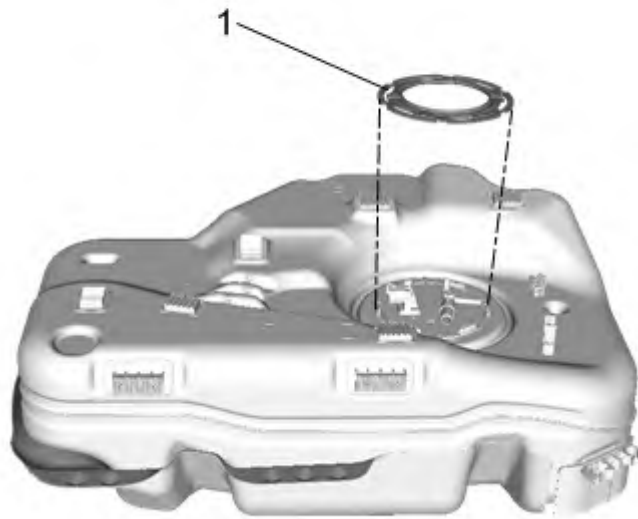


Fig. 74: Fuel Pump Lock Ring

Courtesy of GENERAL MOTORS COMPANY

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

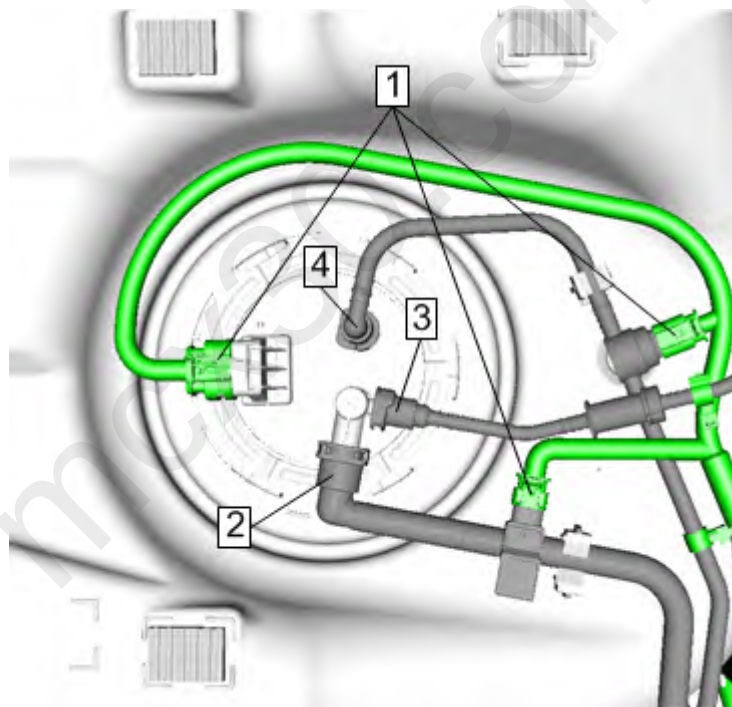


Fig. 75: Fuel Pump Fuel Feed Hose

Courtesy of GENERAL MOTORS COMPANY

5. Connect Fuel Pump Fuel Feed Hose (4) - **Plastic Collar Quick Connect Fitting Service**
6. Connect Fuel Tank Vent Hose (3) - **Plastic Collar Quick Connect Fitting Service**
7. Connect Evaporative Emission Canister Vent Hose (2) **Plastic Collar Quick Connect Fitting Service**
8. Connect Electrical Connector (1)
9. Install Fuel Tank - **Fuel Tank Replacement (FWD)**

FUEL TANK FUEL PUMP MODULE REPLACEMENT (AWD)

Special Tools

CH 52075 Fuel Sender Lock Ring Wrench

Removal Procedure

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

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

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

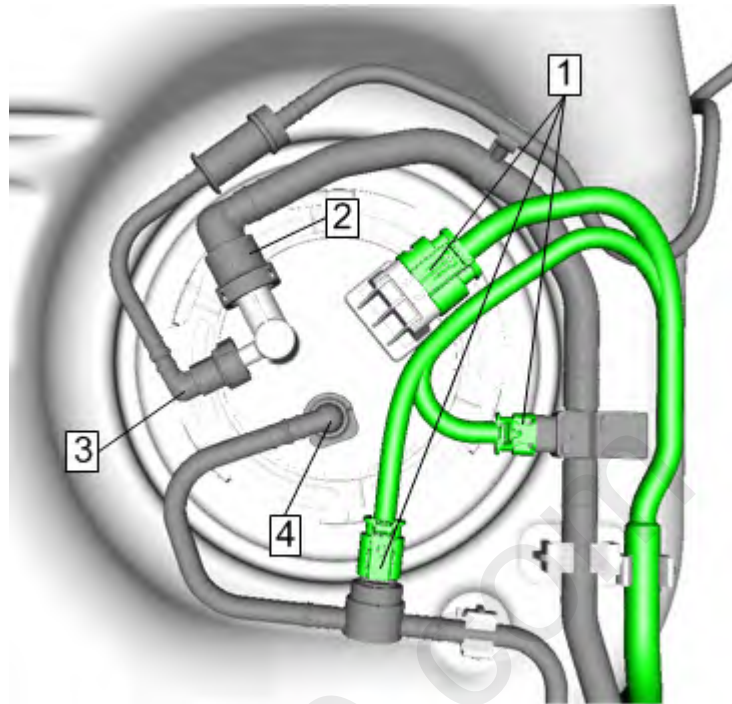


Fig. 76: Electrical Connector And Evaporative Emission Canister Vent Hose
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect Electrical Connector (1) -
3. Disconnect Evaporative Emission Canister Vent Hose (2) - [Plastic Collar Quick Connect Fitting Service](#)
4. Disconnect Fuel Tank Vent Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
5. Disconnect Fuel Pump Fuel Feed Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)

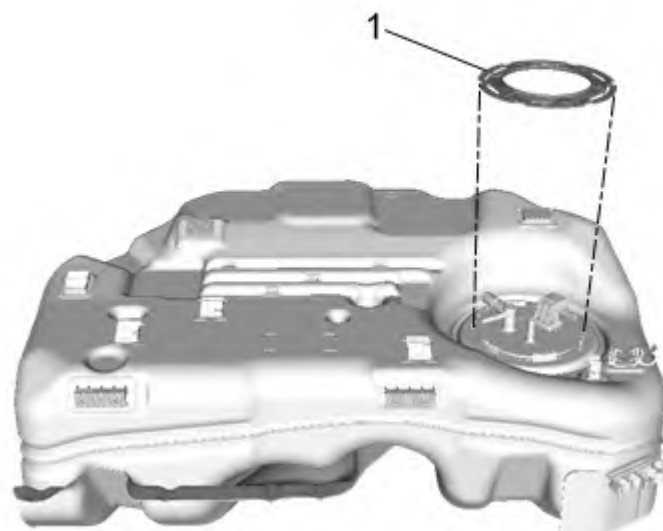


Fig. 77: Fuel Pump Lock Ring
Courtesy of GENERAL MOTORS COMPANY

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

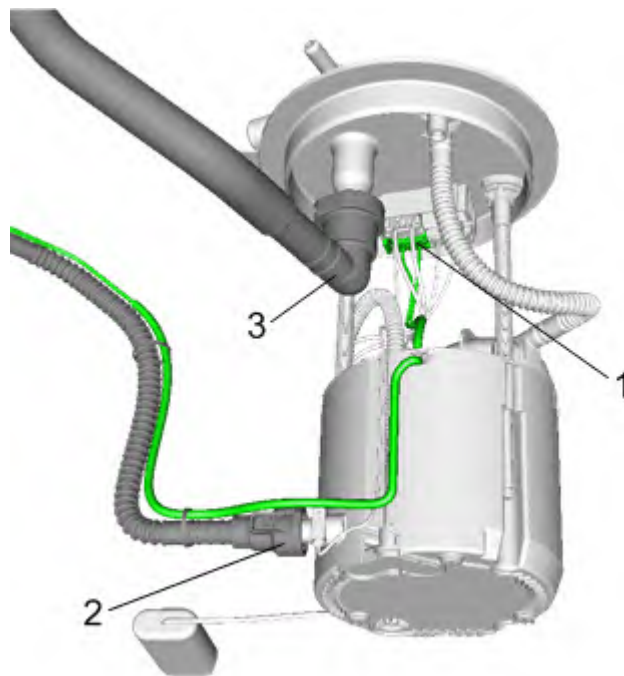


Fig. 78: Electrical Connector, Electrical Connector And Transfer Hose
Courtesy of GENERAL MOTORS COMPANY

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

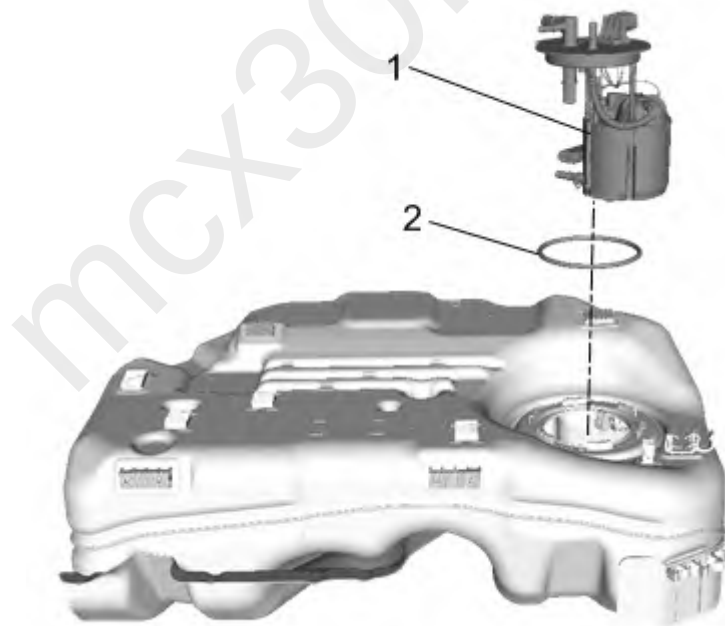


Fig. 79: Fuel Tank Fuel Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

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

Installation Procedure



Fig. 80: Inspect Bottom Of Fuel Pump Module For Green Rubber Pads
Courtesy of GENERAL MOTORS COMPANY

1. Inspect bottom of fuel pump module for 3 green rubber pads (1). If rubber pads are present, remove and discard them from fuel pump module prior to installing the fuel pump module in the tank.

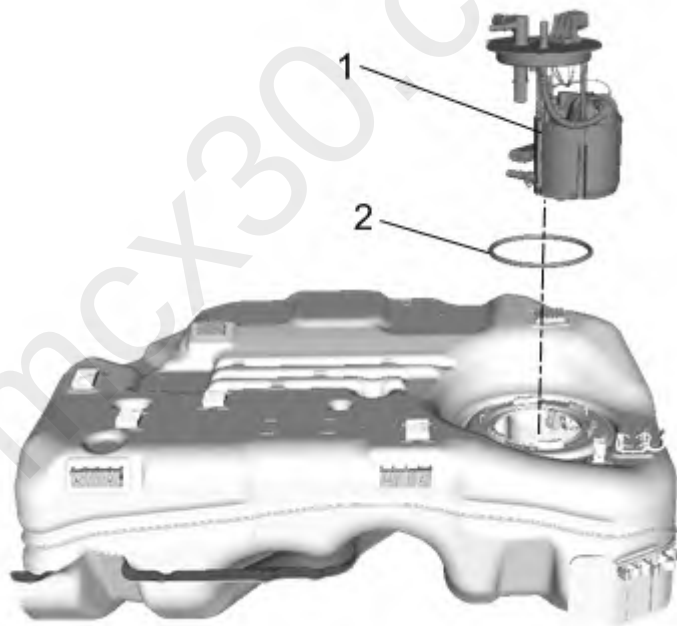


Fig. 81: Fuel Tank Fuel Pump Module And O-Ring
Courtesy of GENERAL MOTORS COMPANY

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

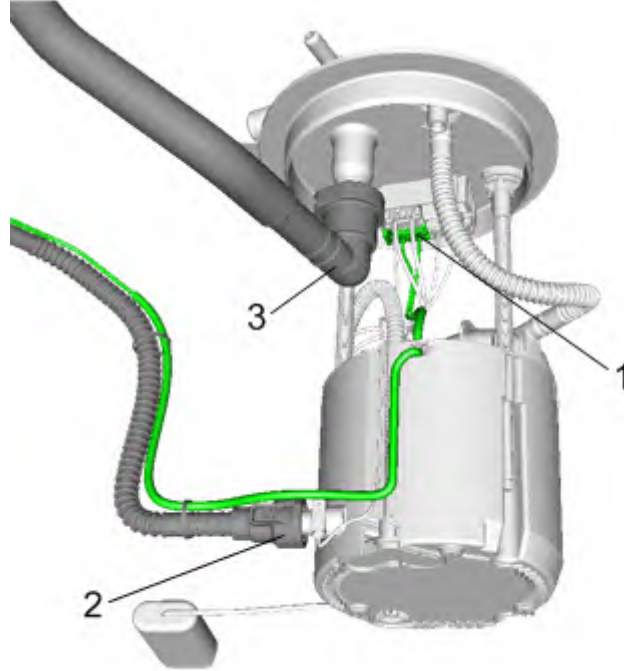


Fig. 82: Electrical Connector, Electrical Connector And Transfer Hose
 Courtesy of GENERAL MOTORS COMPANY

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

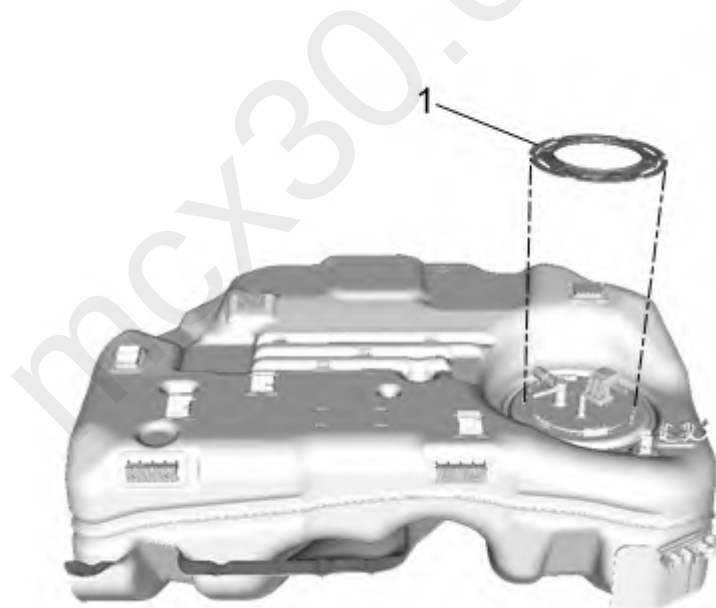


Fig. 83: Fuel Pump Lock Ring
 Courtesy of GENERAL MOTORS COMPANY

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

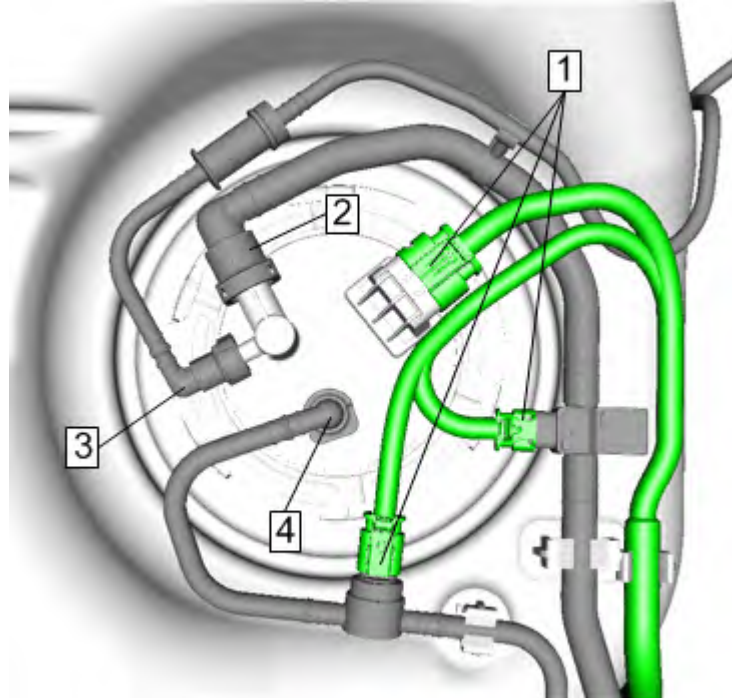


Fig. 84: Electrical Connector And Evaporative Emission Canister Vent Hose
 Courtesy of GENERAL MOTORS COMPANY

8. Connect Fuel Pump Fuel Feed Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)
9. Connect Fuel Tank Vent Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
10. Connect Evaporative Emission Canister Vent Hose (2) - [Plastic Collar Quick Connect Fitting Service](#)
11. Connect Electrical Connector (1)
12. Install Fuel Tank - [Fuel Tank Replacement \(AWD\)](#)

FUEL TANK SHIELD REPLACEMENT (FWD)

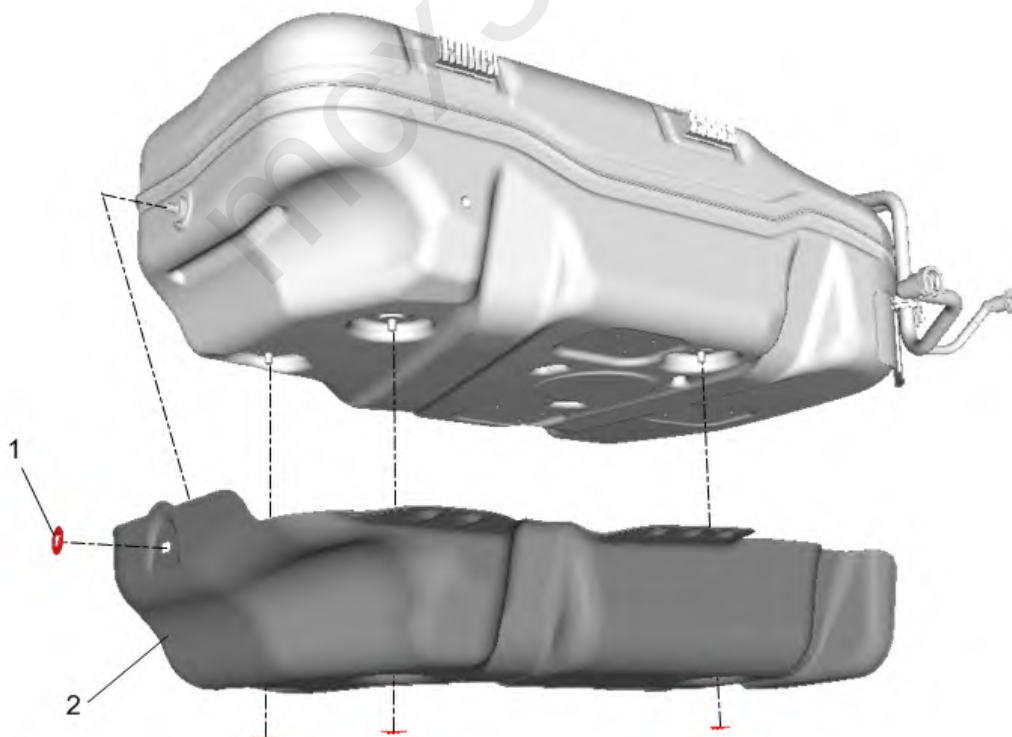


Fig. 85: Fuel Tank Shield (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement (FWD)	
1	Fuel Tank Shield Retainer[4x]
2	Fuel Tank Shield

FUEL TANK SHIELD REPLACEMENT (AWD)

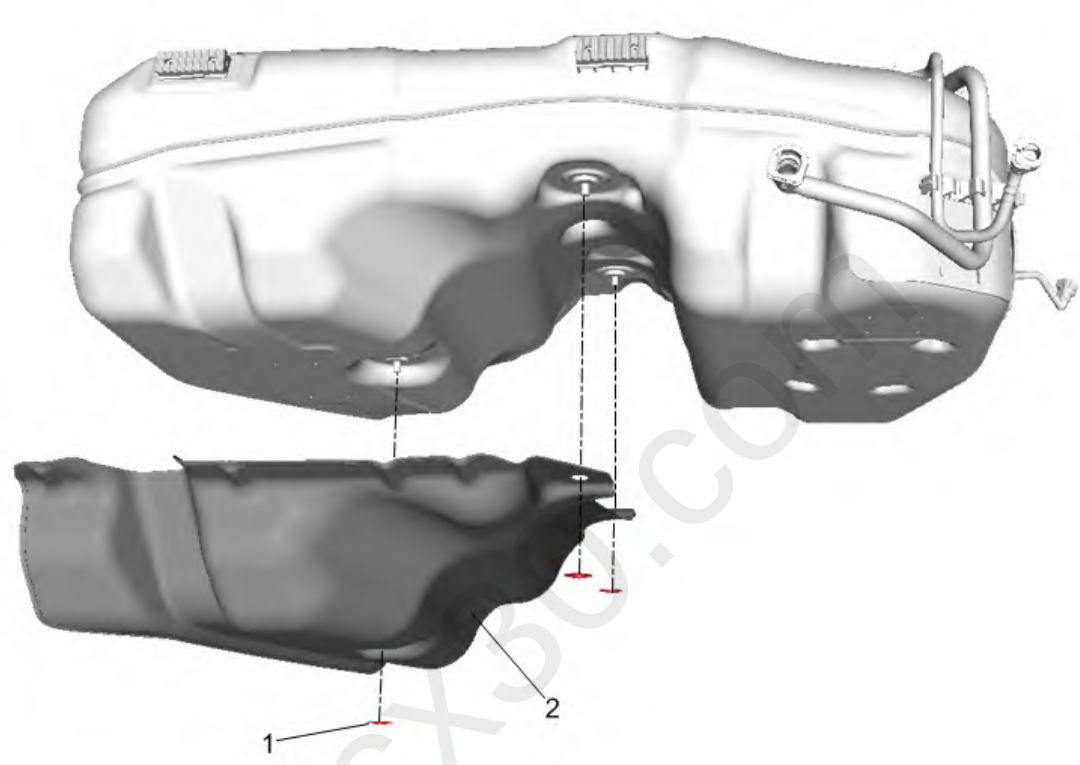


Fig. 86: Fuel Tank Shield (AWD).
Courtesy of GENERAL MOTORS COMPANY

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

FUEL TANK REPLACEMENT (FWD)

Removal Procedure

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

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

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Drain the fuel tank. [Fuel Tank Draining](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. Remove Exhaust Muffler Assembly - [Exhaust Muffler Replacement \(LTG, LYX\)](#)
5. Remove Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#)

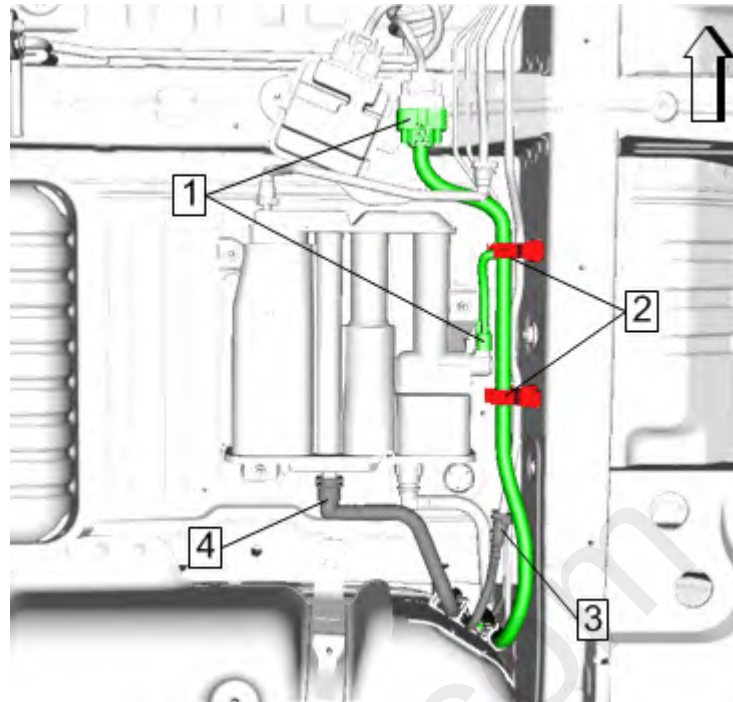


Fig. 87: Fuel Tank Fuel Pump Module Wiring Harness And Fuel Pump Fuel Feed Hose
 Courtesy of GENERAL MOTORS COMPANY

6. Disconnect Fuel Tank Fuel Pump Module Wiring Harness (1) - [2x]
7. Remove Fuel Tank Fuel Pump Module Wiring Harness (1) @Retainer - [2x]
8. Disconnect Fuel Pump Fuel Feed Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
9. Disconnect Evaporative Emission Canister Vent Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)

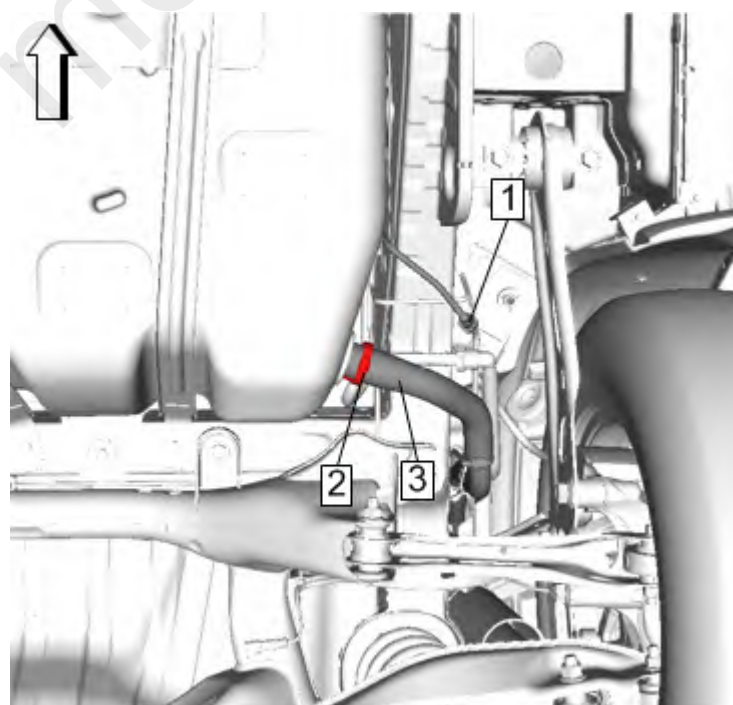


Fig. 88: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp
 Courtesy of GENERAL MOTORS COMPANY

10. Disconnect Fuel Tank Vent Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)

11. Remove Fuel Tank Filler Hose Clamp (2)
12. Remove Fuel Tank Filler Hose (3)

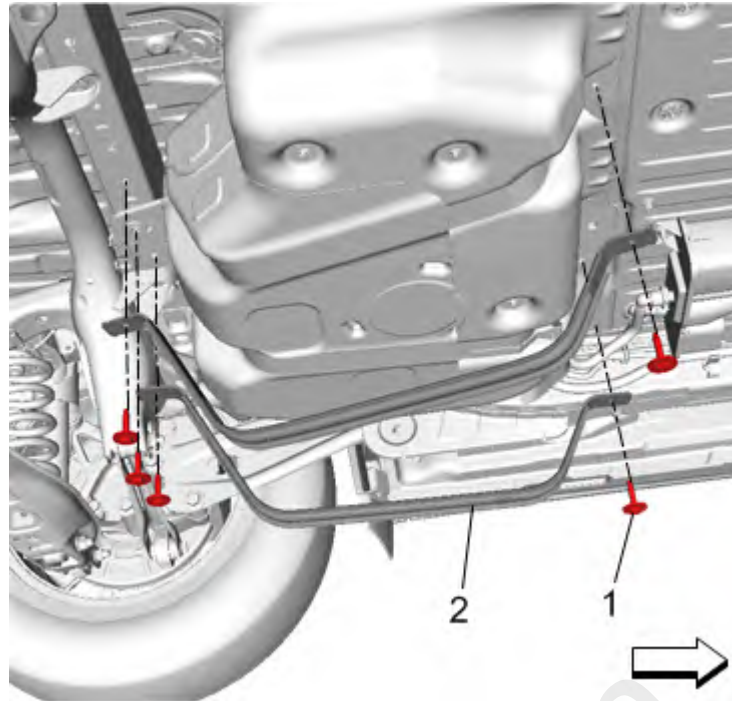


Fig. 89: Fuel Tank Strap And Bolt
Courtesy of GENERAL MOTORS COMPANY

13. Place a suitable adjustable jack under the fuel tank.
14. Remove Fuel Tank Strap Bolt (1)
15. Remove Fuel Tank Strap (2)

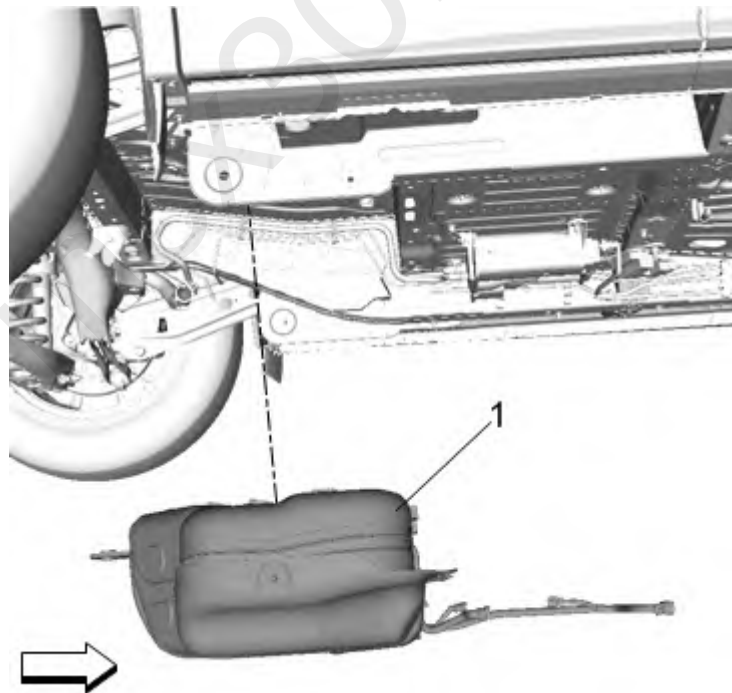


Fig. 90: Fuel Tank
Courtesy of GENERAL MOTORS COMPANY

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

Installation Procedure

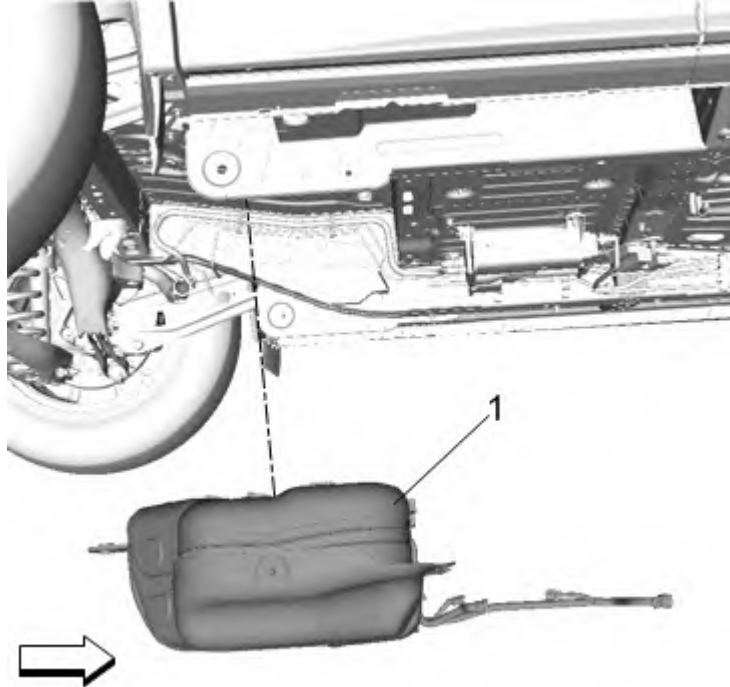


Fig. 91: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

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

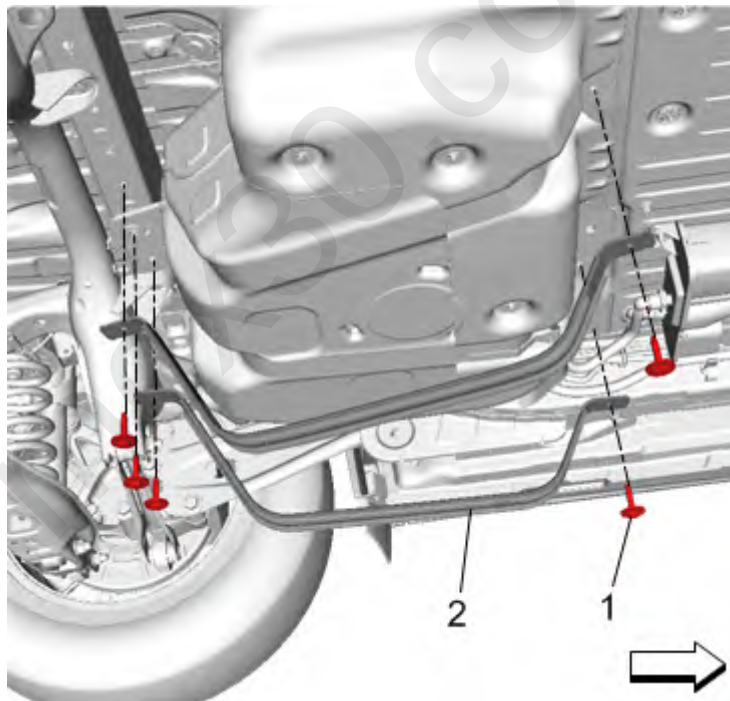


Fig. 92: Fuel Tank Strap And Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Install Fuel Tank Strap (2)

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

4. Install Fuel Tank Strap Bolt (1) and tighten [5x] 22 N.m (16 lb ft)

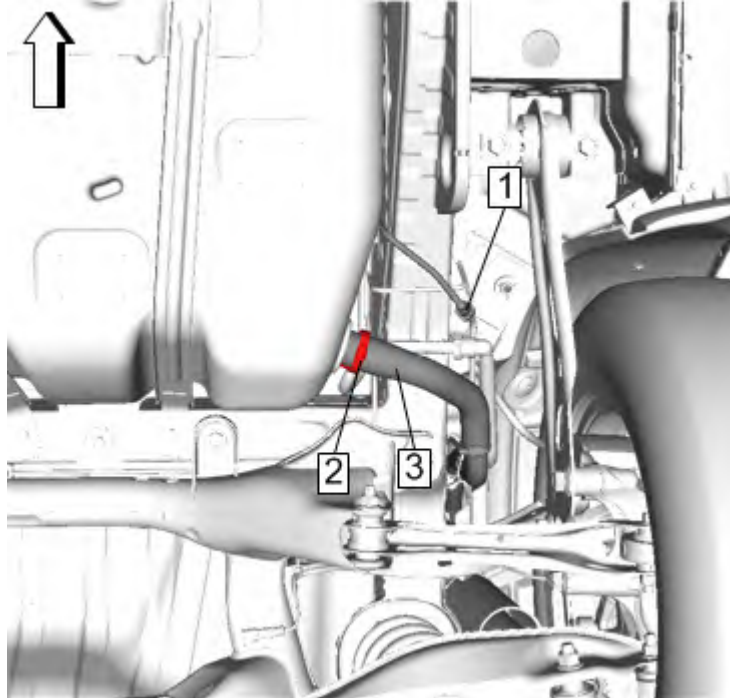


Fig. 93: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp
Courtesy of GENERAL MOTORS COMPANY

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

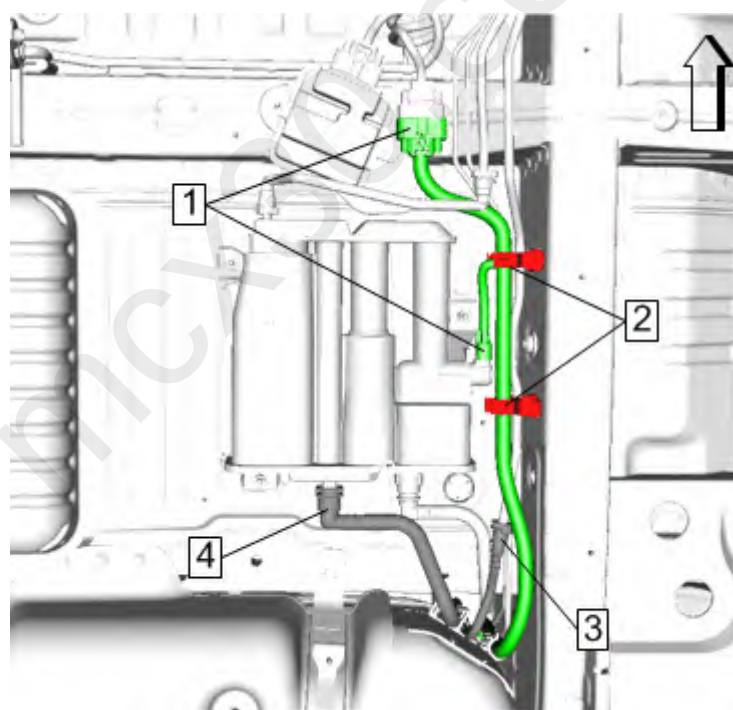


Fig. 94: Fuel Tank Fuel Pump Module Wiring Harness And Fuel Pump Fuel Feed Hose
Courtesy of GENERAL MOTORS COMPANY

8. Connect Evaporative Emission Canister Vent Hose (4) [Plastic Collar Quick Connect Fitting Service](#)
9. Connect Fuel Pump Fuel Feed Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
10. Install Fuel Tank Fuel Pump Module Wiring Harness (1) @Retainer - [2x]
11. Connect Fuel Tank Fuel Pump Module Wiring Harness (1) - [2x]
12. Install Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#)
13. Install Exhaust Muffler Assembly - [Exhaust Muffler Replacement \(LTG, LYX\)](#)
14. Lower the vehicle.

15. Refill the fuel tank.
16. Inspect for fuel leaks.

FUEL TANK REPLACEMENT (AWD)

Removal Procedure

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

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

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Drain the fuel tank. [Fuel Tank Draining](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#) .
4. Remove Exhaust Muffler Assembly - [Exhaust Muffler Replacement \(LTG, LYX\)](#)
5. Remove Driveline Torque Tube - [Driveline Torque Tube Replacement](#)
6. Remove Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#).

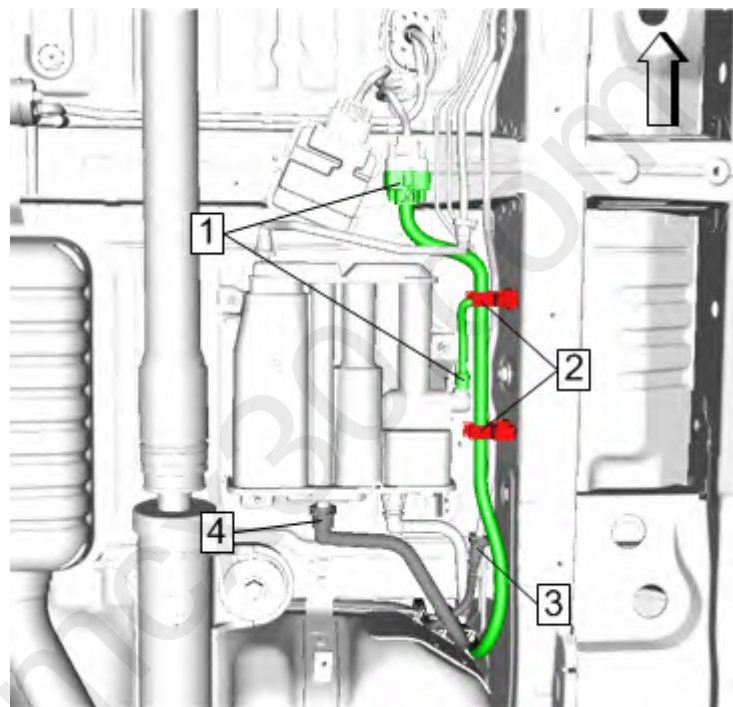


Fig. 95: Fuel Tank Fuel Pump Module Wiring Harness, Fuel Pump Fuel Feed Hose And Evaporative Emission Canister Vent Hose

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Fuel Tank Fuel Pump Module Wiring Harness (1) - [2x]
8. Remove Fuel Tank Fuel Pump Module Wiring Harness (1) @Retainer - [2x]
9. Disconnect Fuel Pump Fuel Feed Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
10. Disconnect Evaporative Emission Canister Vent Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)

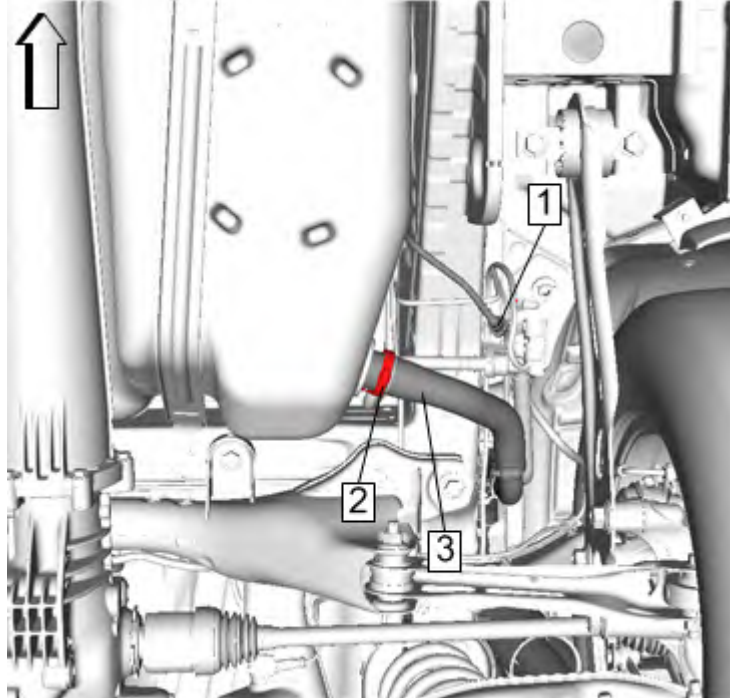


Fig. 96: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp
 Courtesy of GENERAL MOTORS COMPANY

11. Disconnect Fuel Tank Vent Hose (1) - [Plastic Collar Quick Connect Fitting Service](#)
12. Remove Fuel Tank Filler Hose Clamp (2)
13. Remove Fuel Tank Filler Hose (3)

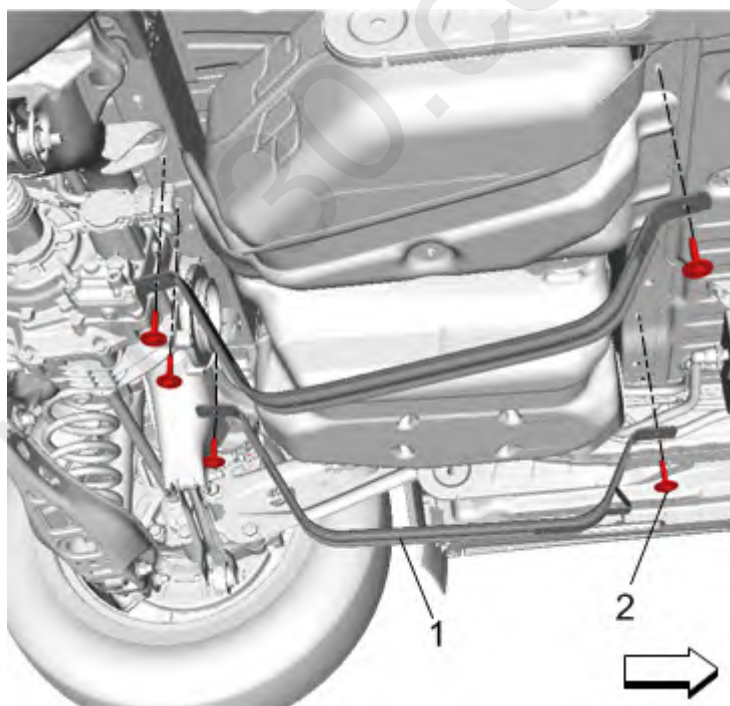


Fig. 97: Fuel Tank Strap And Bolt
 Courtesy of GENERAL MOTORS COMPANY

14. Place a suitable adjustable jack under the fuel tank.
15. Remove Fuel Tank Strap Bolt (2)
16. Remove Fuel Tank Strap (1)

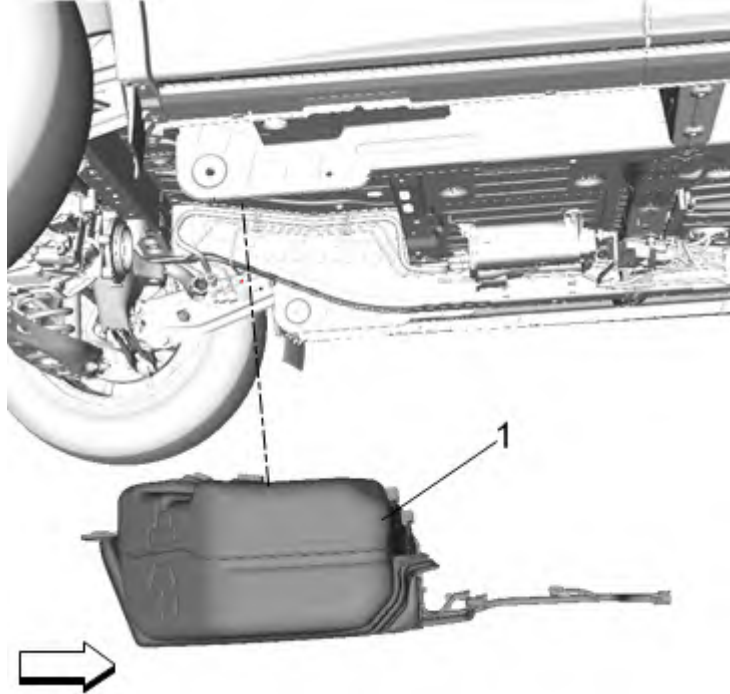


Fig. 98: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

17. Remove Fuel Tank (1)
18. If replacing fuel tank transfer parts as necessary.

Installation Procedure

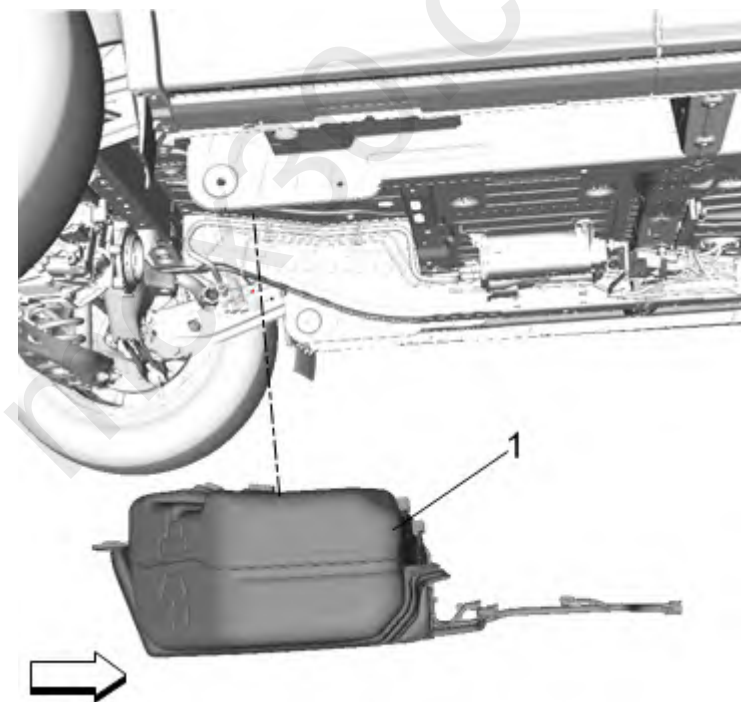


Fig. 99: Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

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

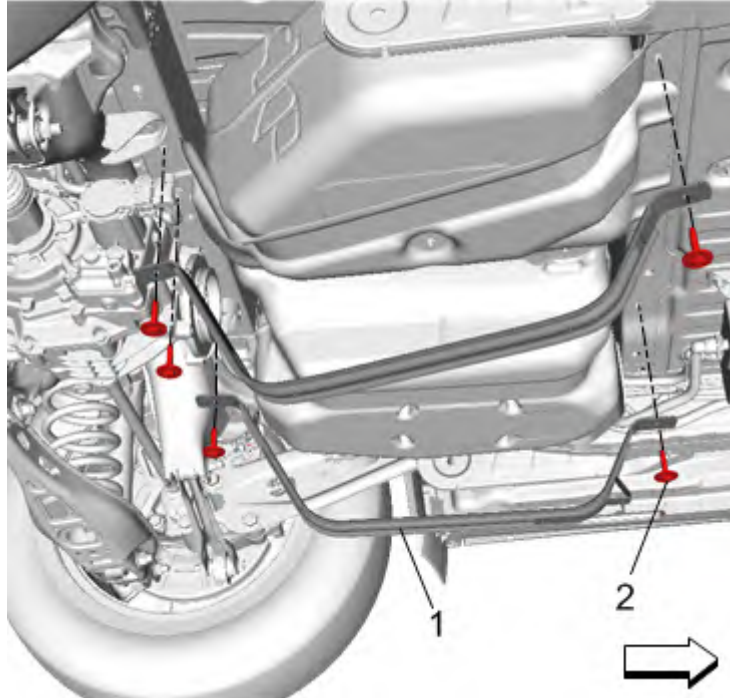


Fig. 100: Fuel Tank Strap And Bolt

Courtesy of GENERAL MOTORS COMPANY

3. Install Fuel Tank Strap (1)

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

4. Install Fuel Tank Strap Bolt (2) and tighten 22 N.m (16 lb ft)

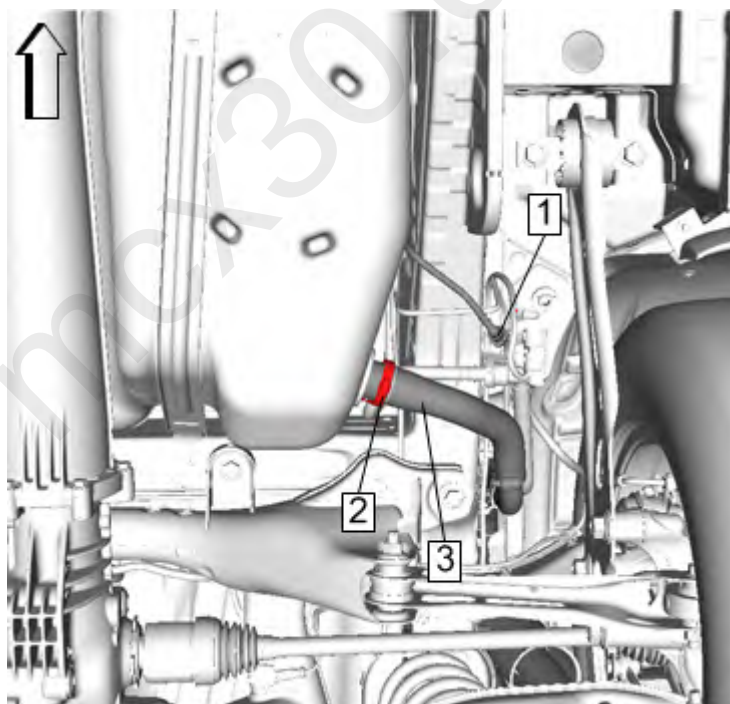


Fig. 101: Fuel Tank Vent Hose, Fuel Tank Filler Hose And Clamp

Courtesy of GENERAL MOTORS COMPANY

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

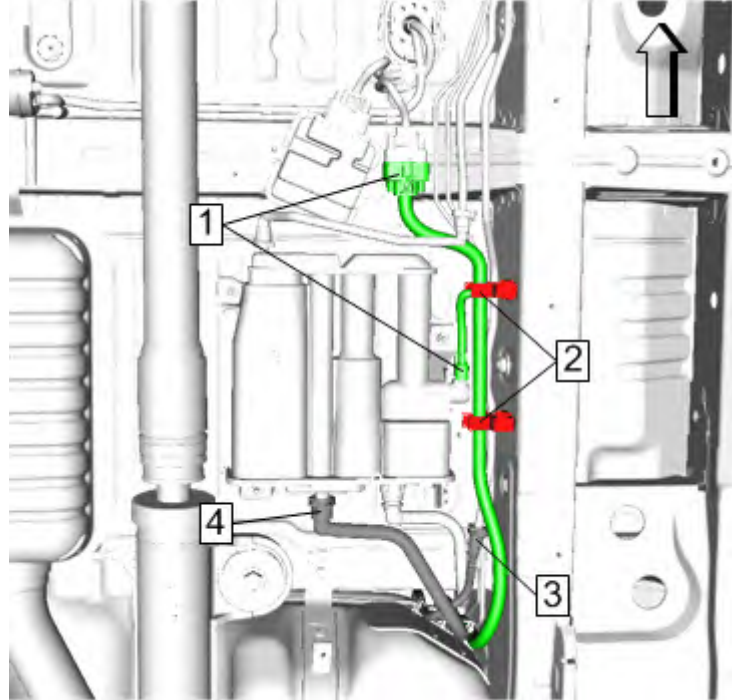


Fig. 102: Fuel Tank Fuel Pump Module Wiring Harness, Fuel Pump Fuel Feed Hose And Evaporative Emission Canister Vent Hose
Courtesy of GENERAL MOTORS COMPANY

8. Connect Evaporative Emission Canister Vent Hose (4) - [Plastic Collar Quick Connect Fitting Service](#)
9. Connect Fuel Pump Fuel Feed Hose (3) - [Plastic Collar Quick Connect Fitting Service](#)
10. Install Fuel Tank Fuel Pump Module Wiring Harness (1) @Retainer - [2x]
11. Connect Fuel Tank Fuel Pump Module Wiring Harness (1) - [2x]
12. Install Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(All Wheel Drive\)](#)
13. Install Driveline Torque Tube - [Driveline Torque Tube Replacement](#)
14. Install Exhaust Muffler Assembly - [Exhaust Muffler Replacement \(LTG, LYX\)](#)
15. Lower the vehicle.
16. Refill the fuel tank.
17. Inspect for fuel leaks.

FUEL TANK PRESSURE SENSOR REPLACEMENT (FWD)

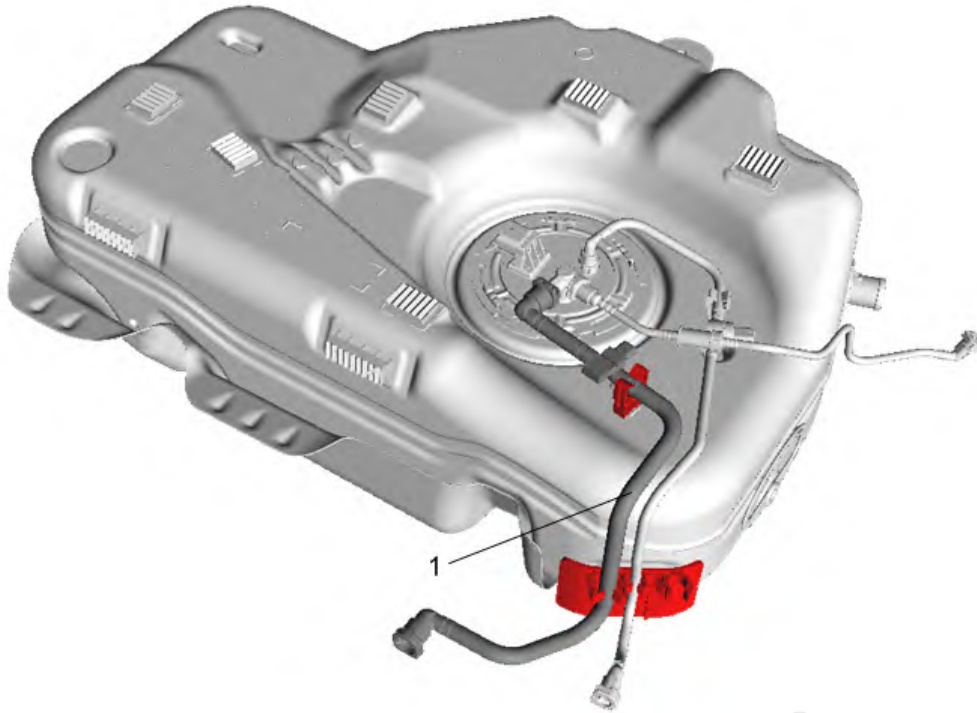


Fig. 103: Fuel Tank Pressure Sensor (FWD)
Courtesy of GENERAL MOTORS COMPANY

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

FUEL TANK PRESSURE SENSOR REPLACEMENT (AWD)

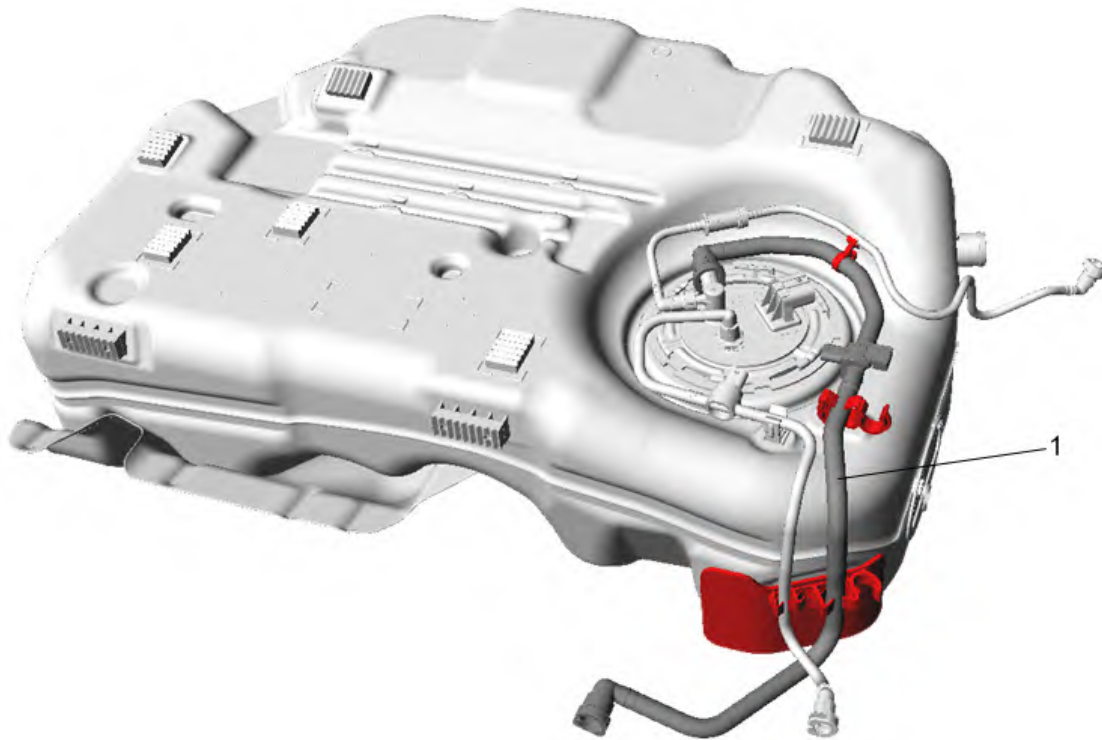


Fig. 104: Fuel Tank Pressure Sensor (AWD)
 Courtesy of GENERAL MOTORS COMPANY

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

FUEL TANK FILLER HOSE REPLACEMENT (FWD)

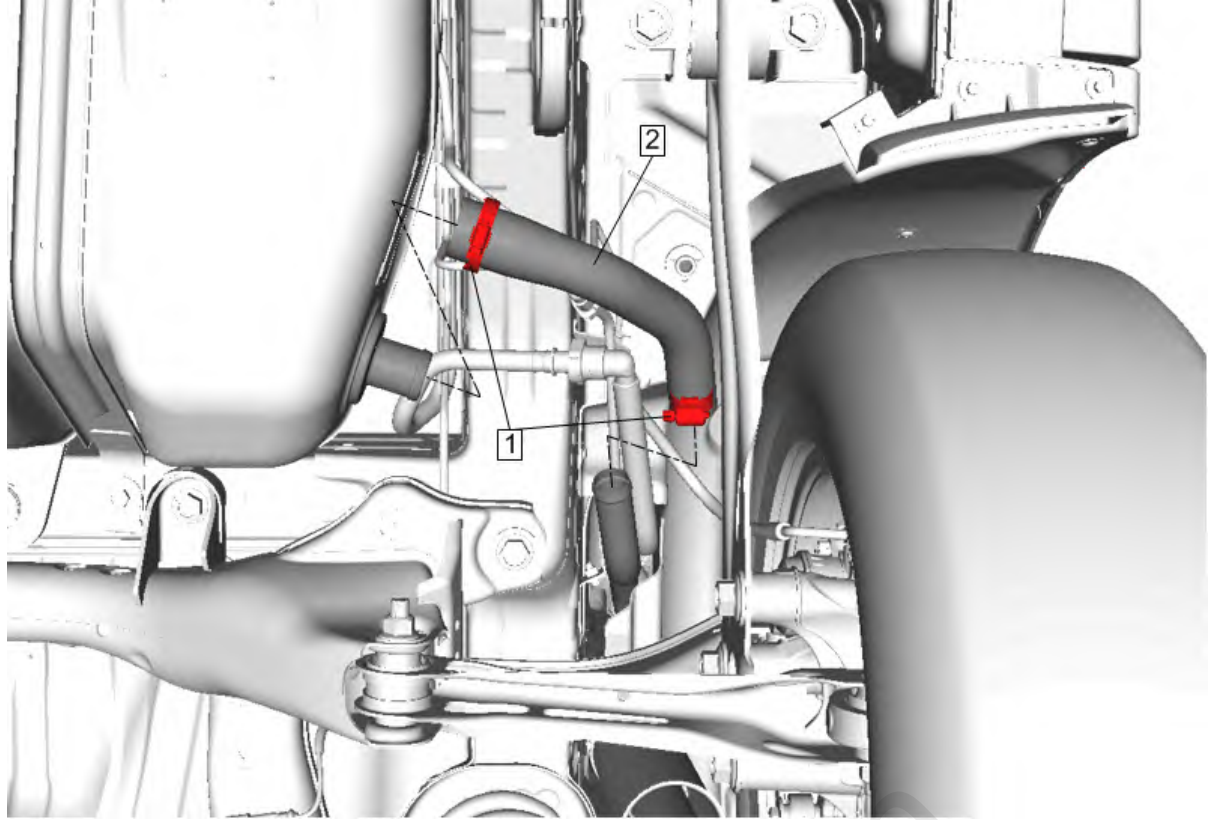


Fig. 105: Fuel Tank Filler Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures 1. Fuel Tank Draining 2. Lifting and Jacking the Vehicle	
1	Fuel Tank Filler Hose Clamp CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Fuel Tank Filler Hose

FUEL TANK FILLER HOSE REPLACEMENT (AWD)

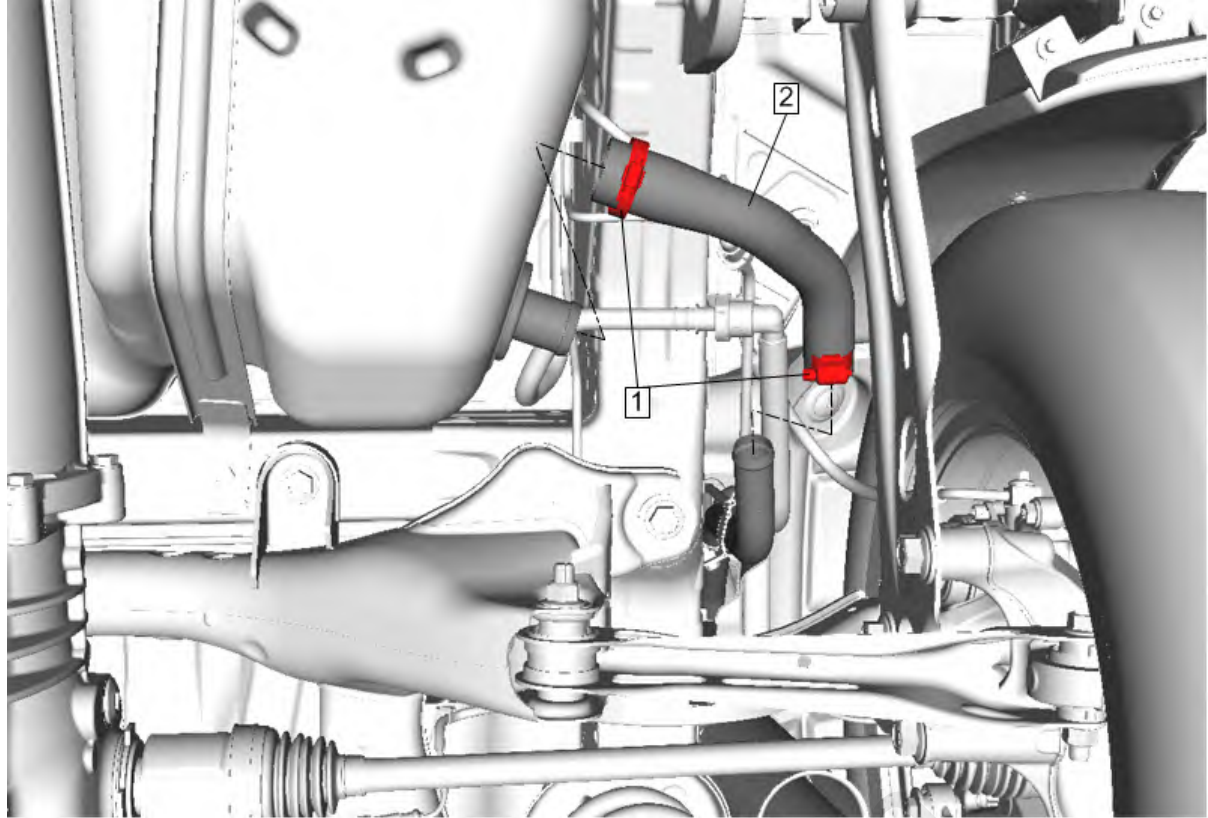


Fig. 106: Fuel Tank Filler Hose (AWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures Fuel Tank Draining Lifting and Jacking the Vehicle	
1	Fuel Tank Filler Hose Clamp CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Fuel Tank Filler Hose

FUEL PUMP REPLACEMENT

Special Tools

EN-51365 High Pressure Fuel Pump Installation Alignment Gauge

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

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: Fuel/gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

WARNING: Wear safety glasses in order to avoid eye damage.

CAUTION: Refer to [Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution](#) .

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
3. Remove Intake Manifold - [Intake Manifold Replacement](#)

NOTE: High pressure fuel feed pipes are one time use only. ALWAYS install a NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened.

4. Remove Fuel Feed Intermediate Pipe and DISCARD - [Fuel Feed Intermediate Pipe Replacement](#)

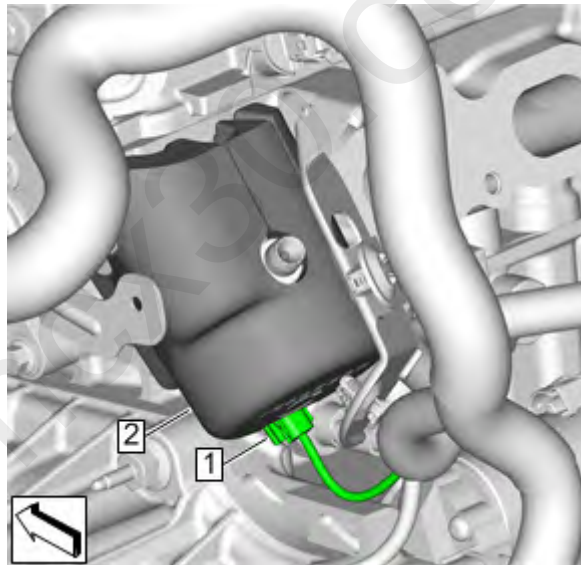


Fig. 107: Fuel Pump Insulator And Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the electrical connector (1).
6. Remove the fuel pump insulator (2).

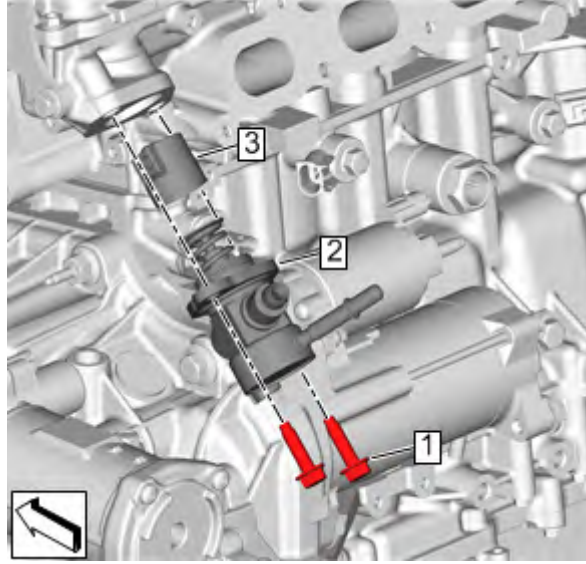


Fig. 108: Fuel Pump And Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Alternately loosen the fuel pump bolts one turn at a time until the pump is fully disengaged from fuel pump lifter follower. Trying to remove the pump bolts without even side-to-side loosening may result in pump plunger damage

7. Remove and DISCARD the fuel pump bolts (1).

NOTE: Ensure that during removal of the fuel pump that the valve lifter follower does NOT fall apart.

8. Remove the fuel pump (2).

NOTE:

- The valve lifter follower MAY remain in the cylinder head bore after removing the fuel pump.
- If the valve lifter follower does NOT pull out of the cylinder head bore with the fuel pump, then remove it afterwards.

9. Remove the valve lifter follower (3).

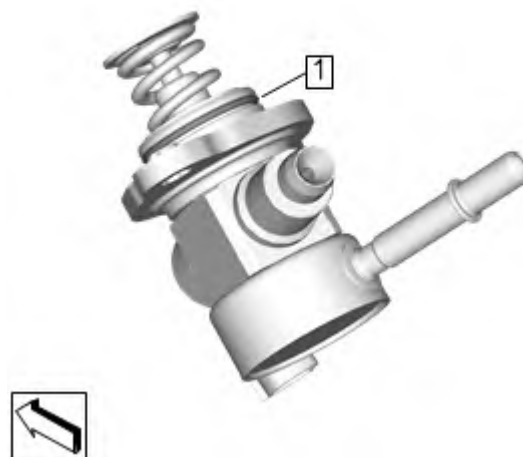


Fig. 109: Fuel Pump Housing Seal

Courtesy of GENERAL MOTORS COMPANY

10. Remove and DISCARD the fuel pump housing seal (1).

1. Before continuing, lubricate the cylinder head bore with clean engine oil. [Adhesives, Fluids, Lubricants, and Sealers](#)

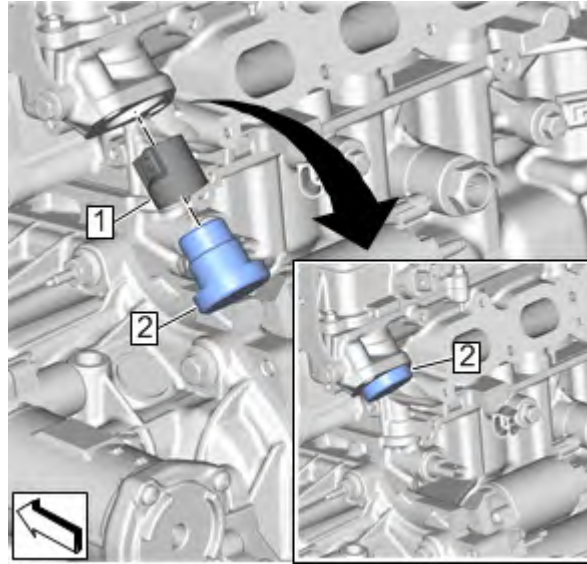


Fig. 110: Valve Lifter Follower

Courtesy of GENERAL MOTORS COMPANY

2. Lubricate the valve lifter follower (1) with clean engine oil and install it into the cylinder head bore. [Adhesives, Fluids, Lubricants, and Sealers](#)

NOTE:

- The camshaft **MUST** be at the base circle position before the fuel pump is installed.
- At the base circle position, the EN-51365 alignment gauge will sit flush with the cylinder head.

3. Install the **EN-51365** alignment gauge (2) and turn the crankshaft until the camshaft lobe is at the base circle position.
4. Remove the **EN-51365** alignment gauge (2) and valve lifter follower (1).

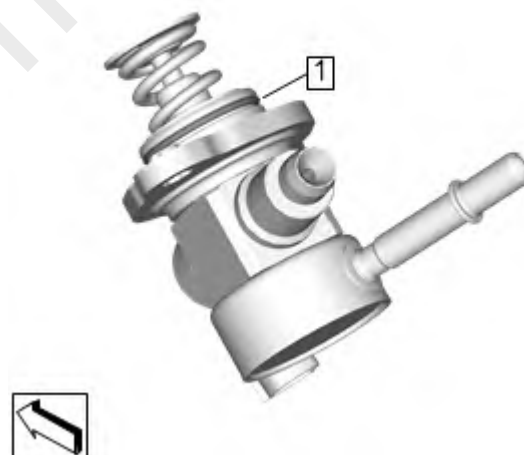


Fig. 111: Fuel Pump Housing Seal

Courtesy of GENERAL MOTORS COMPANY

5. Lubricate the NEW fuel pump housing seal (1) with clean engine oil and install it on the fuel pump. [Adhesives, Fluids, Lubricants, and Sealers](#)

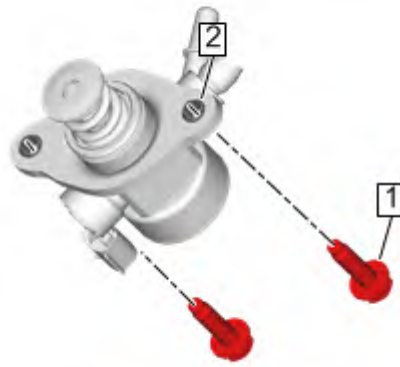


Fig. 112: Fuel Pump Bolts And Fuel Pump Bolt Retainers

Courtesy of GENERAL MOTORS COMPANY

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

NOTE:

- ALWAYS make sure the fuel pump bolt retainers are present before installing the fuel pump bolts.
- If ANY fuel pump bolt retainers are missing or NOT suitable for reuse, replace the retainers as necessary.

6. Install the NEW fuel pump bolts (1) through the fuel pump bolt retainers (2).

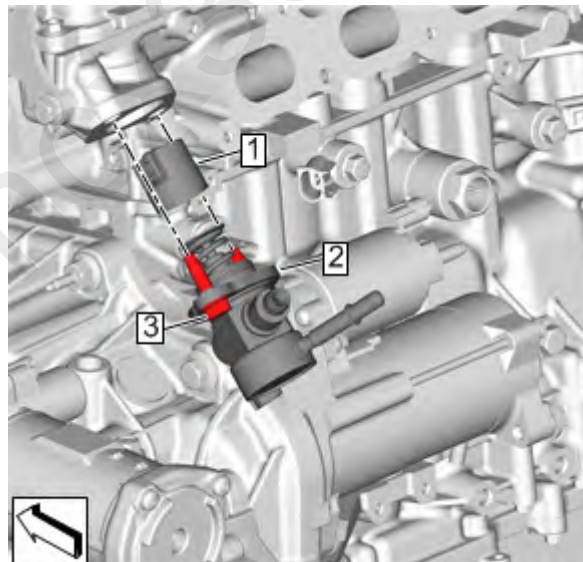


Fig. 113: Valve Lifter Follower, Fuel Pump Assembly And Fuel Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

7. Lubricate the valve lifter follower (1) again with clean engine oil, if necessary, and install it into the cylinder head bore. [Adhesives, Fluids, Lubricants, and Sealers](#)
8. Install the fuel pump assembly (2) into the cylinder head and start the NEW fuel pump bolts (3) by hand.

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

CAUTION: Alternately hand-tighten the fuel pump bolts one turn at a time until the pump is fully seated. Trying to draw down the pump without

even side-to-side tightening may result in pump plunger damage.

9. Tighten the NEW fuel pump bolts (3) to 25 N.m (18 lb ft).

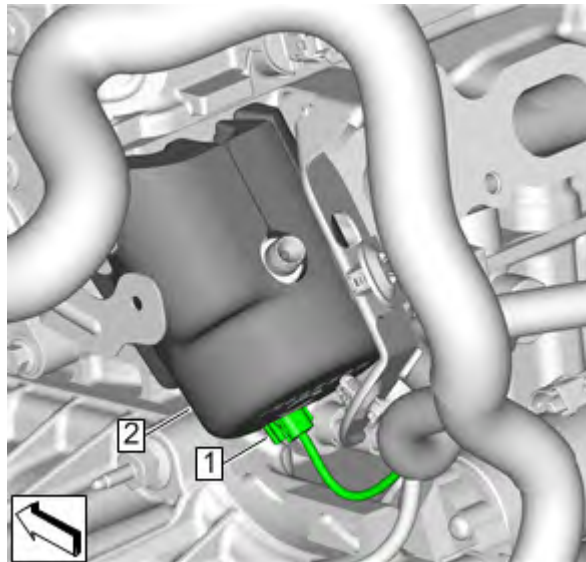


Fig. 114: Fuel Pump Insulator And Electrical Connector

Courtesy of GENERAL MOTORS COMPANY

10. Install the fuel pump insulator (2).
11. Connect the electrical connector (1).

NOTE: High pressure fuel feed pipes are one time use only. ALWAYS install a NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened.

12. Install the NEW fuel feed intermediate pipe. [Fuel Feed Intermediate Pipe Replacement](#)

NOTE: The fuel feed front pipe will need to be disconnected after the fuel leak inspection to allow for installation of the intake manifold.

13. Connect the fuel feed front pipe to the fuel pump. [Fuel Feed Front Pipe Replacement](#)
14. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
15. Inspect for leaks using the following procedure:
 1. Turn ON the ignition with the engine OFF for 2 seconds.
 2. Turn OFF the ignition for 10 seconds.
 3. Turn ON the ignition with the engine OFF.
 4. Inspect for fuel leaks.
16. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
17. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
18. Disconnect the fuel feed front pipe from the fuel pump. [Fuel Feed Front Pipe Replacement](#)
19. Intake Manifold - [Intake Manifold Replacement](#)
20. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
21. Perform the fuel rail pressure relief valve learned values reset. [Fuel Rail Pressure Relief Valve Learned Values Reset](#)

FUEL PUMP FUEL FEED HOSE REPLACEMENT (FWD)

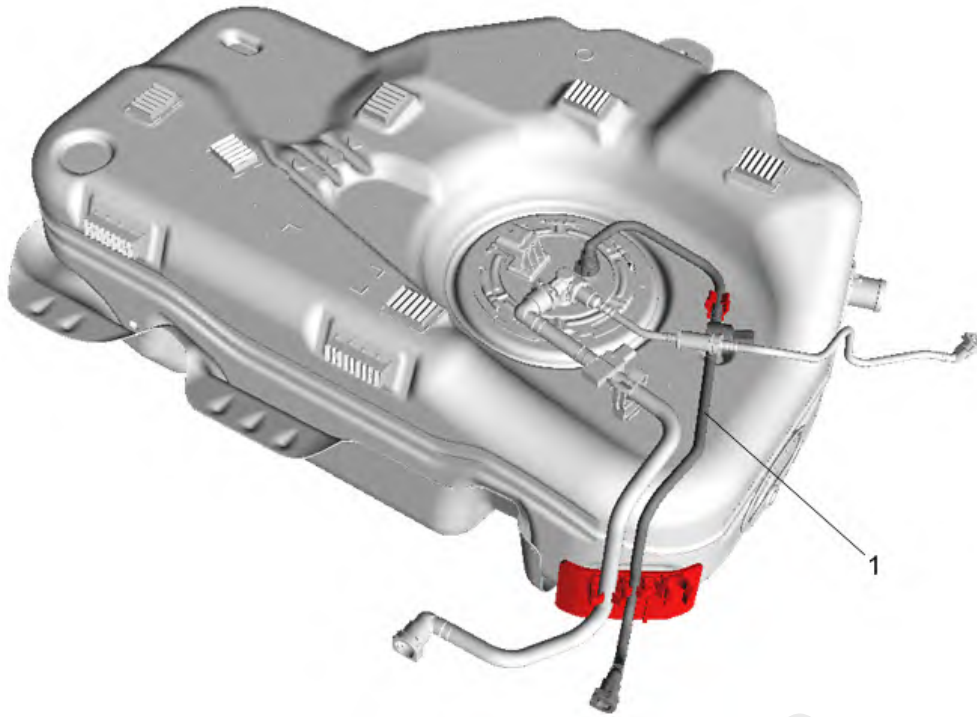


Fig. 115: Fuel Pump Fuel Feed Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

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

FUEL PUMP FUEL FEED HOSE REPLACEMENT (AWD)

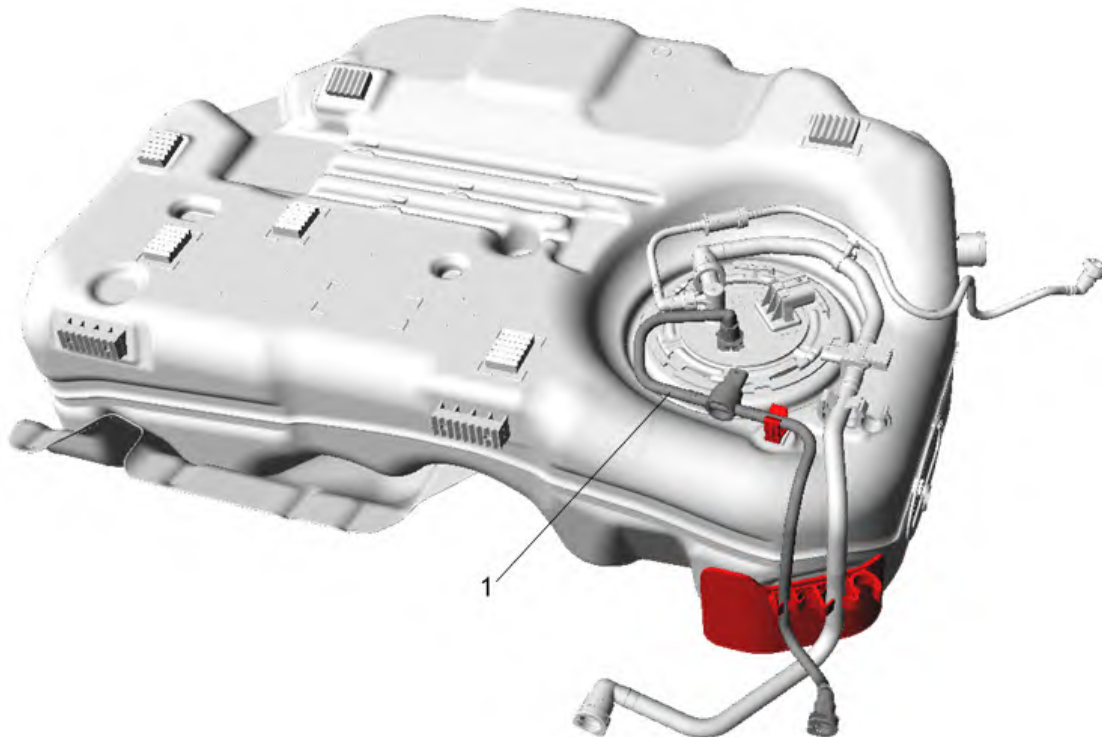


Fig. 116: Fuel Pump Fuel Feed Hose (AWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure 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. Plastic Collar Quick Connect Fitting Service

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT

Special Tools

- EN-51146 Fuel Injector Removal/Installation Kit
- EN-51146 - 2 - 5 Calibration Tool
- EN-51146 - 100 Fuel Injector Removal Plate

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

Removal Procedure

WARNING: Wear safety glasses in order to avoid eye damage.

WARNING: Fuel/gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in

an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

CAUTION: When working on the fuel rail and fuel injectors, always maintain a clean work surface. Failure to maintain a clean work surface can result in contaminant on the injector seals and cause leaks.

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
3. Remove Ignition Coil - [Ignition Coil Replacement](#)
4. Disconnect Fuel Injection Fuel Rail Wiring Harness@Engine Wiring Harness
5. Remove Fuel Feed Intermediate Pipe - [Fuel Feed Intermediate Pipe Replacement](#)

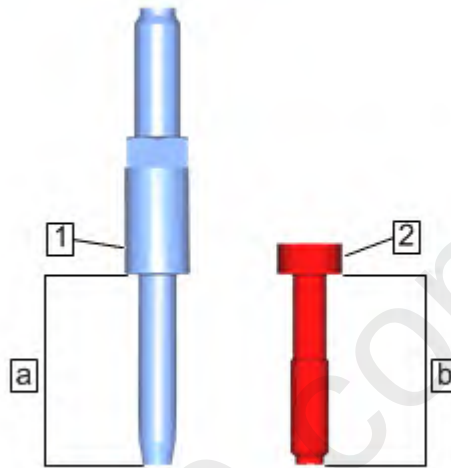


Fig. 117: Demounting Screw And Fuel Injector Bolt
Courtesy of GENERAL MOTORS COMPANY

6. Adjust the length (a) of one EN-51146 - 1 - 6 demounting screw (1) to match the length (b) of one NEW fuel injector bolt (2).

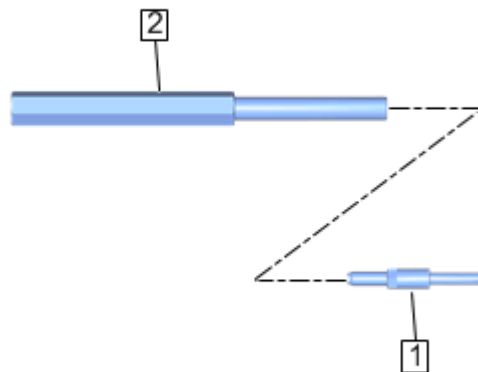


Fig. 118: Demounting Screw And Support
Courtesy of GENERAL MOTORS COMPANY

7. Install the EN-51146 - 1 - 6 demounting screw (1) into a EN-51146 - 1 - 1 support (2) and tighten to 7 N.m (62 lb in).

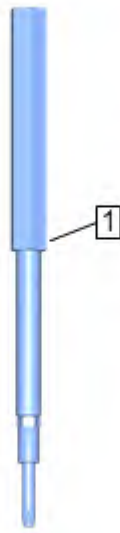


Fig. 119: Support

Courtesy of GENERAL MOTORS COMPANY

8. Repeat the previous instructions for a total of eight **EN-51146 - 1 - 6** demounting screw and **EN-51146 - 1 - 1** support combinations (1).

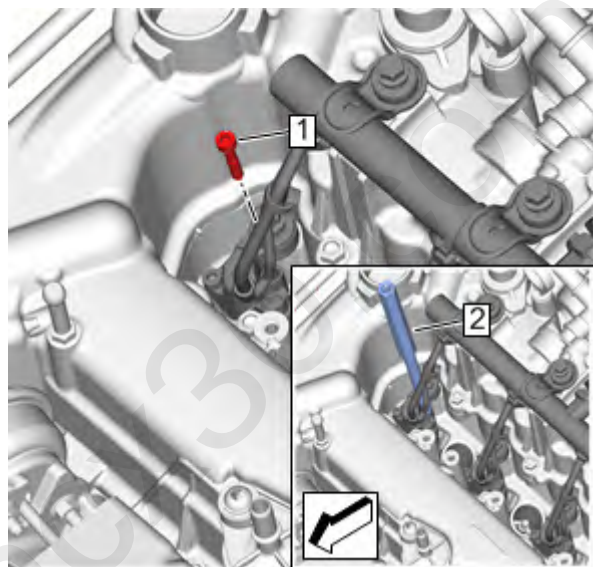


Fig. 120: Inner Fuel Injector Bolt

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Do NOT loosen or remove both the inner and outer fuel injector bolts at the same time on any single fuel injector.
- Ensure the **EN-51146 - 1 - 6** demounting screw and the **EN-51146 - 1 - 1** support combination is properly installed in the inner fuel injector bolt hole before removing the corresponding outer fuel injector bolt.

9. At Cylinder 1, remove and DISCARD the inner fuel injector bolt (1).
10. Install the **EN-51146 - 1 - 6** demounting screw and **EN-51146 - 1 - 1** support combination (2) into the inner fuel injector bolt hole and tighten to 5 N.m (44 lb in).

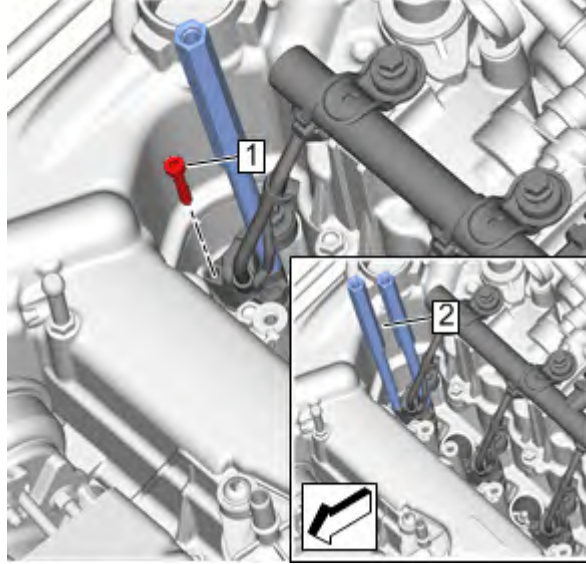


Fig. 121: Outer Fuel Injector Bolt

Courtesy of GENERAL MOTORS COMPANY

11. At Cylinder 1, remove and DISCARD the outer fuel injector bolt (1).
12. Install the **EN-51146 - 1 - 6** demounting screw and **EN-51146 - 1 - 1** support combination (2) into the outer fuel injector bolt hole and tighten to 5 N.m (44 lb in).

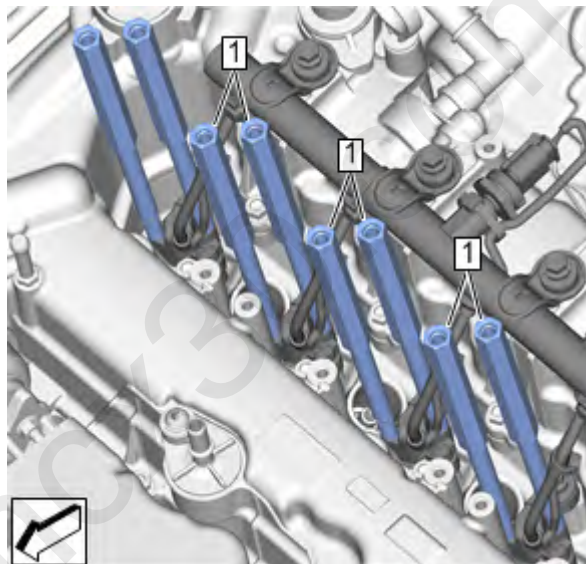


Fig. 122: Support

Courtesy of GENERAL MOTORS COMPANY

13. In order, from Cylinder 1 to Cylinder 4, repeat the previous instructions to install the remaining **EN-51146 - 1 - 6** demounting screw and **EN-51146 - 1 - 1** support combinations (1).

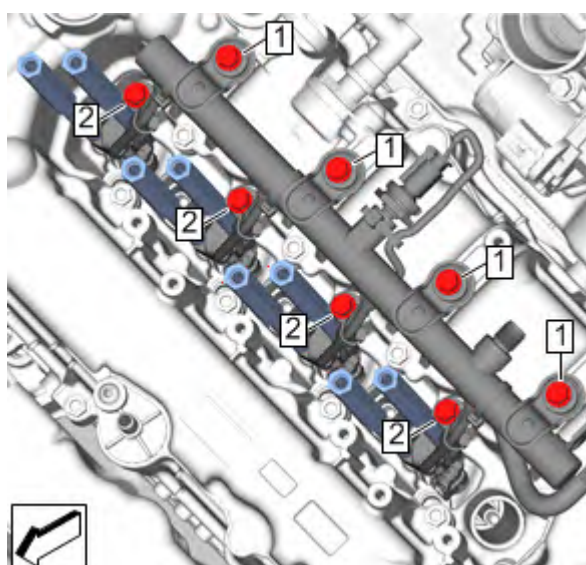


Fig. 123: Upper And Lower Fuel Injection Fuel Rail Bolts
Courtesy of GENERAL MOTORS COMPANY

14. LOOSEN the upper fuel injection fuel rail bolts (1) completely from the cylinder head, but do NOT remove the bolts from the bolt retainers.
15. LOOSEN the lower fuel injection fuel rail bolts (2) completely from the cylinder head, but do NOT remove the bolts from the bolt retainers.

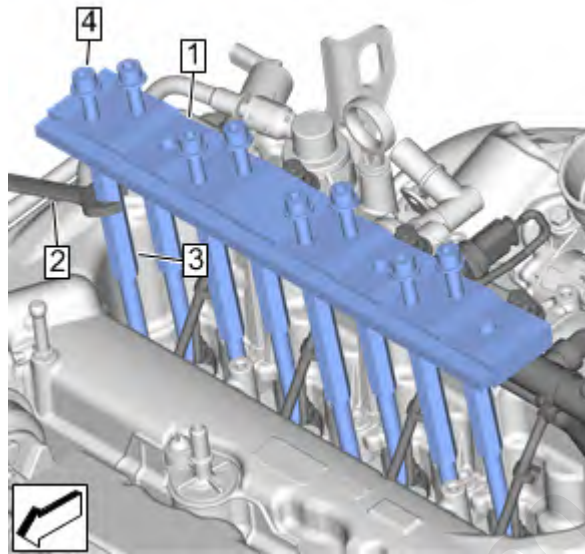


Fig. 124: Plate
Courtesy of GENERAL MOTORS COMPANY

16. Position the **EN-51146 - 100** plate (1).
17. Use a suitable wrench (2) to hold each **EN-51146 - 1 - 1** support (3) and tighten each corresponding plate bolt (4) to 5 N.m (44 lb in).

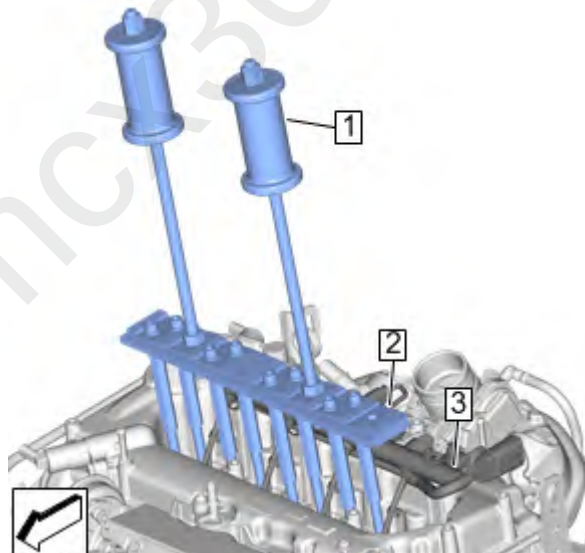


Fig. 125: Slider Hammers And Plate
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- The alignment of the fuel injectors within the cylinder head bores is **CRITICAL** for fuel injection system function.
- **ALWAYS** use equal force on each slide hammer to ensure the fuel injectors are removed from the cylinder head bores without tilting.

18. Install the **EN-51146 - 1 - 3** slide hammers (1) to the **EN-51146 - 100** plate (2) and apply slight upwards force equally to both hammers to remove the fuel injection fuel rail and fuel injectors as an assembly (3).

Observe the alignment of the fuel injection fuel rail and fuel injectors while removing and allocate more force to the hammers as necessary.

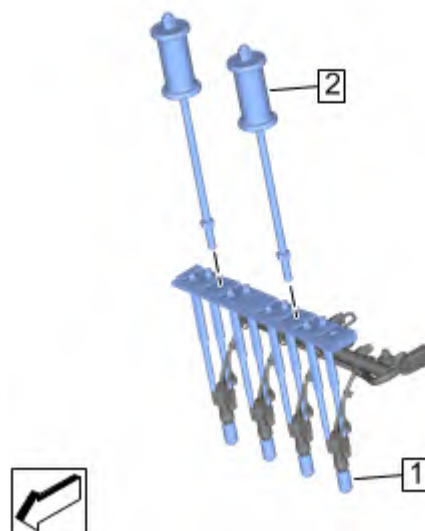


Fig. 126: Calibration Tools And Slide Hammers

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- After removing the fuel injection fuel rail and fuel injectors, position the assembly on a clean work surface with the fuel injectors pointing upwards.
- Do NOT allow the weight of the fuel injection fuel rail to rest on the fuel injectors.

19. Install the EN-51146 - 2 - 5 calibration tools (1) onto the fuel injector tips to protect the injectors.
20. Remove the EN-51146 - 1 - 3 slide hammers (2).
21. Cover the cylinder head bores to prevent any contamination.

Installation Procedure

1. Clean ALL cylinder head bores and clean ANY fuel injectors that will be reused. **Fuel Injector and Fuel Injector Bore Cleaning and Inspection**



Fig. 127: Combustion Fuel Injector Seals

Courtesy of GENERAL MOTORS COMPANY

2. ANY fuel injectors being reused MUST have NEW combustion fuel injector seals (1) installed. **Fuel Rail and Injectors Installation**

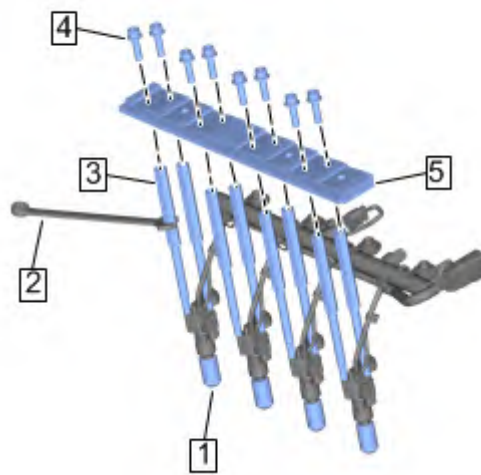


Fig. 128: Calibration Tools

Courtesy of GENERAL MOTORS COMPANY

NOTE: If the EN-51146 - 100 plate is NOT installed, then it is likely that one or more fuel injectors have been replaced. Disregard the following steps for any fuel injectors that have already been replaced.

3. Do NOT remove the EN-51146 - 2 - 5 calibration tools (1) except for when servicing the combustion fuel injector seals.
4. Use a suitable wrench (2) to hold the EN-51146 - 1 - 1 support (3) while removing the corresponding plate screw (4).
5. Use the previous instructions to remove ALL remaining plate screws (4).
6. Remove the EN-51146 - 100 plate (5).

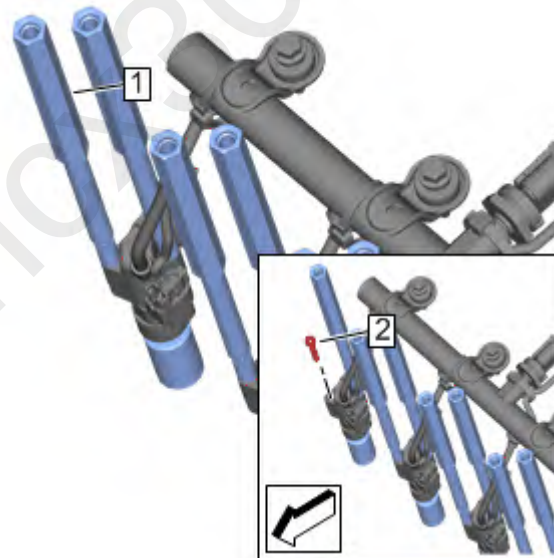


Fig. 129: Demounting Screw And Support Combination

Courtesy of GENERAL MOTORS COMPANY

7. At the fuel injector for Cylinder 1, remove the outer EN-51146 - 1 - 6 demounting screw and EN-51146 - 1 - 1 support combination (1).

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

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

8. Perform the following steps to install the NEW outer fuel injector bolt (2):

1. Apply one drop of thread locking adhesive to the bolt. [Adhesives, Fluids, Lubricants, and Sealers](#)

2. Install the bolt and tighten to 5 N.m (44 lb in).

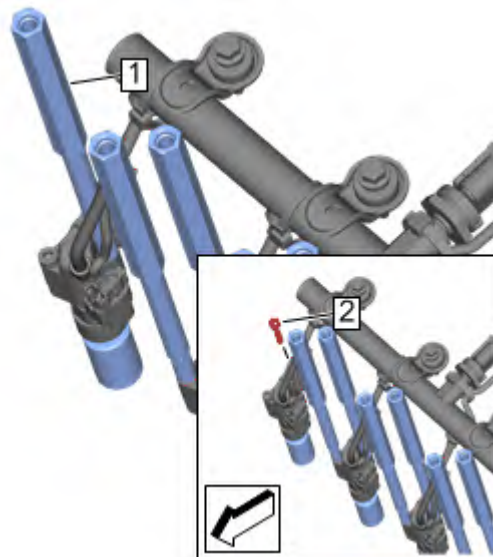


Fig. 130: Demounting Screw And Support Combination

Courtesy of GENERAL MOTORS COMPANY

9. At the fuel injector for Cylinder 1, remove the inner EN-51146 - 1 - 6 demounting screw and EN-51146 - 1 - 1 support combination (1).
10. Perform the following steps to install the NEW inner fuel injector bolt (2):
 1. Apply one drop of thread locking adhesive to the bolt. [Adhesives, Fluids, Lubricants, and Sealers](#)
 2. Install the bolt and tighten to 5 N.m (44 lb in).
11. As necessary, use the previous instructions to install NEW fuel injection bolts, in order, from Cylinder 1 to Cylinder 4.

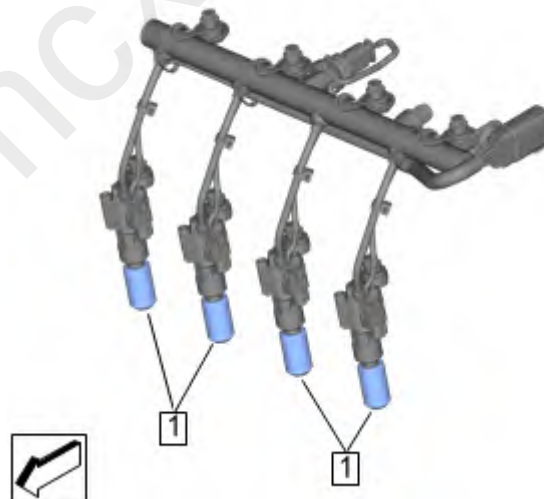


Fig. 131: Calibration Tools

Courtesy of GENERAL MOTORS COMPANY

12. Remove the EN-51146 - 2 - 5 calibration tools (1) from the fuel injectors.

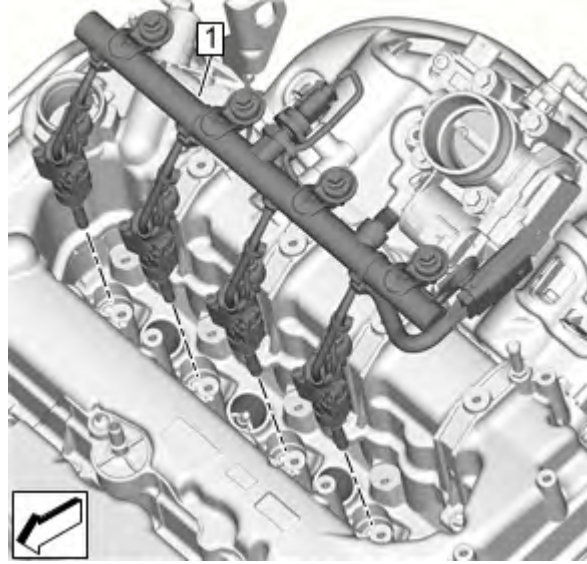


Fig. 132: Fuel Injection Fuel Rail And Fuel Injector Assembly.
Courtesy of GENERAL MOTORS COMPANY

NOTE:

- The alignment of the fuel injectors within the cylinder head bores is **CRITICAL** for fuel injection system function.
- During installation of the fuel injectors, the injectors **MUST** remain positioned straight in the cylinder head bores.

13. Carefully install the fuel injection fuel rail and fuel injectors as an assembly (1) into the cylinder head bores.

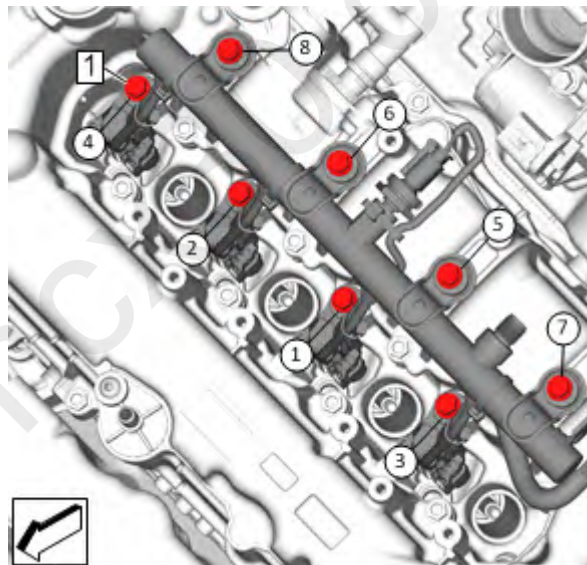


Fig. 133: Lower And Upper Fuel Rail Bolt Tightening Sequence
Courtesy of GENERAL MOTORS COMPANY

14. Perform the following steps to install the fuel injection fuel rail bolts (1):
1. Install and tighten the fuel rail bolts in the sequence shown in increments of one turn each until all bolts are seated.
 2. Tighten the lower fuel rail bolts in the sequence shown to 10 N.m (89 lb in).
 3. Tighten the upper fuel rail bolts in the sequence shown to 10 N.m (89 lb in).
15. Install Fuel Feed Intermediate Pipe - **Fuel Feed Intermediate Pipe Replacement**
16. Connect Fuel Injection Fuel Rail Wiring Harness@Engine Wiring Harness -
17. Install Ignition Coil - **Ignition Coil Replacement**
18. Connect the battery negative cable. **Battery Negative Cable Disconnection and Connection (KL9)**
19. Inspect for fuel leaks using the following procedure:
1. Turn ON the ignition with the engine OFF for 2 seconds.

2. Turn OFF the ignition for 10 seconds.
3. Turn ON the ignition with the engine OFF.
4. Inspect for fuel leaks.

FUEL INJECTOR REPLACEMENT

Special Tools

- EN-51146 Fuel Injector Removal/Installation Kit
- EN-51146 - 2 - 5 Calibration Tool
- EN-51146 - 100 Fuel Injector Removal Plate

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

Removal Procedure

WARNING: Wear safety glasses in order to avoid eye damage.

WARNING: Fuel/gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

CAUTION: When working on the fuel rail and fuel injectors, always maintain a clean work surface. Failure to maintain a clean work surface can result in contaminant on the injector seals and cause leaks.

1. Remove the fuel injection fuel rail assembly. [Fuel Injection Fuel Rail Assembly Replacement](#)

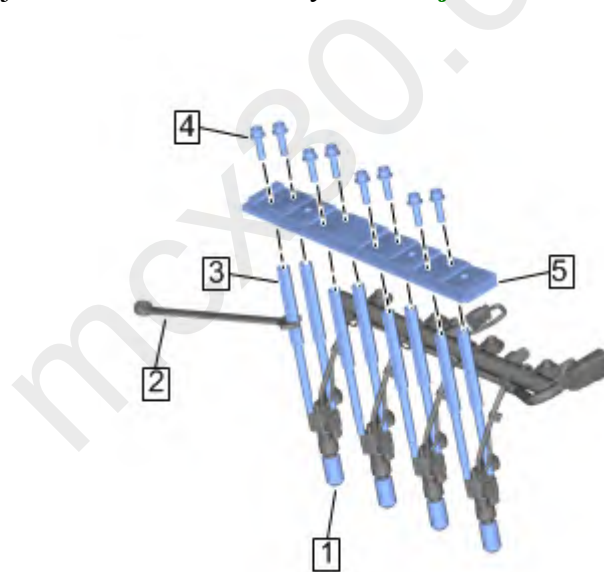


Fig. 134: Calibration Tools

Courtesy of GENERAL MOTORS COMPANY

2. Do NOT remove the EN-51146 - 2 - 5 calibration tools (1) except for when servicing the combustion fuel injector seals.
3. Use a suitable wrench (2) to hold the EN-51146 - 1 - 1 support (3) while removing the corresponding plate screw (4).
4. Use the previous instructions to remove ALL remaining plate screws (4).
5. Remove the EN-51146 - 100 plate (5).

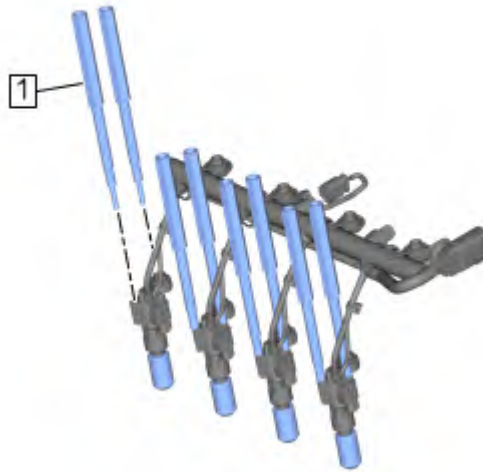


Fig. 135: Support Combinations

Courtesy of GENERAL MOTORS COMPANY

NOTE: The EN-51146 - 1 - 1 supports **MUST** remain installed at **ANY** fuel injectors that will **NOT** be removed or replaced.

6. Remove the EN-51146 - 1 - 6 demounting screw and EN-51146 - 1 - 1 support combinations (1) from the inner and outer fuel injector bolt holes for ANY fuel injector being serviced or replaced.

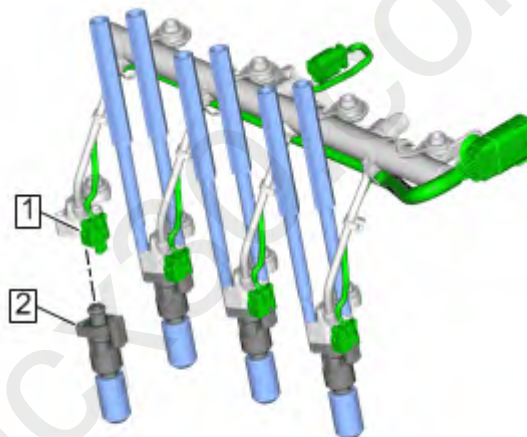


Fig. 136: Wiring Harness Connector And Fuel Injector

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the wiring harness connector (1).
8. Remove the fuel injector (2) from the fuel injection fuel rail.

Cleaning Procedure

1. Clean ALL cylinder head bores and clean ANY fuel injectors that will be reused. **Fuel Injector and Fuel Injector Bore Cleaning and Inspection**

Installation Procedure



Fig. 137: Combustion Fuel Injector Seals

Courtesy of GENERAL MOTORS COMPANY

1. ANY fuel injectors being reused MUST have NEW combustion fuel injector seals (1) installed.

Fuel Rail and Injectors Installation

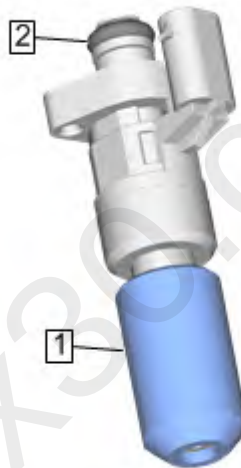


Fig. 138: Calibration Tool

Courtesy of GENERAL MOTORS COMPANY

NOTE: ALWAYS install a NEW fuel injector seal when the fuel injector is removed from the fuel injection fuel rail.

2. Install the **EN-51146 - 2 - 5** calibration tool (1) on the fuel injector.
3. Lightly coat the NEW fuel injector seal (2) with clean engine oil. **Adhesives, Fluids, Lubricants, and Sealers**

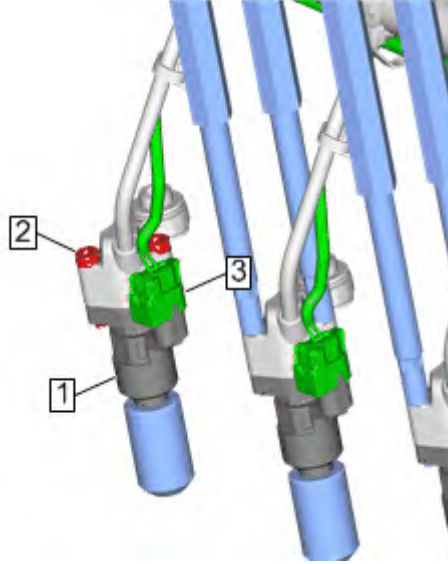


Fig. 139: Inner And Outer Fuel Injector Bolts With Wiring Harness Connectors
Courtesy of GENERAL MOTORS COMPANY

4. Install the fuel injector (1) into the fuel injection fuel rail.

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

CAUTION: This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

5. Perform the following steps to install the NEW inner and outer fuel injector bolts (2):
 1. Apply one drop of thread locking adhesive to each bolt. [Adhesives, Fluids, Lubricants, and Sealers](#)
 2. Install the bolts and tighten to 5 N.m (44 lb in).
6. Connect the wiring harness connector (3).
7. Install the fuel injection fuel rail assembly. [Fuel Injection Fuel Rail Assembly Replacement](#)

FUEL INJECTOR WIRING HARNESS REPLACEMENT

Removal Procedure

1. Remove Fuel Injection Fuel Rail Assembly - [Fuel Injection Fuel Rail Assembly Replacement](#)

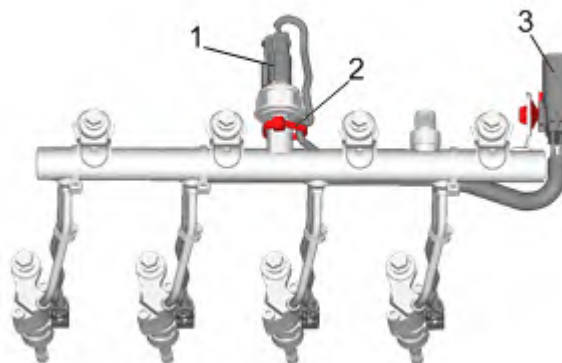


Fig. 140: Fuel Injector Wiring Harness, Connector And Tie Strap
Courtesy of GENERAL MOTORS COMPANY

2. Disconnect the fuel injector wiring harness connector (1) from the fuel injection fuel rail fuel pressure sensor.
3. Cut the fuel injector wiring harness tie strap (2) and DISCARD.
4. Unclip the fuel injector wiring harness (3) from the fuel injection fuel rail.

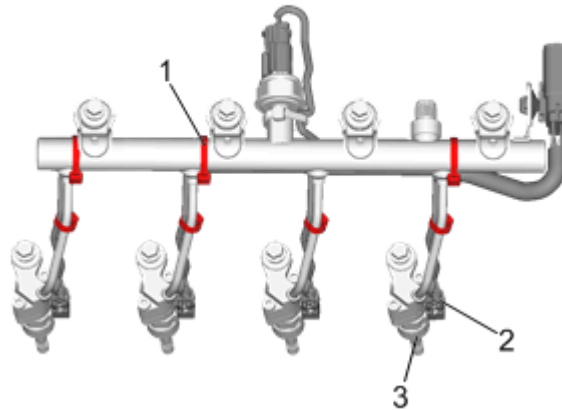


Fig. 141: Fuel Injectors, Wiring Harness And Tie Straps
Courtesy of GENERAL MOTORS COMPANY

5. Cut the remaining fuel injector wiring harness tie straps (1) and DISCARD.
6. Disconnect the fuel injector wiring harness connectors (2) from the fuel injectors (3).

Installation Procedure

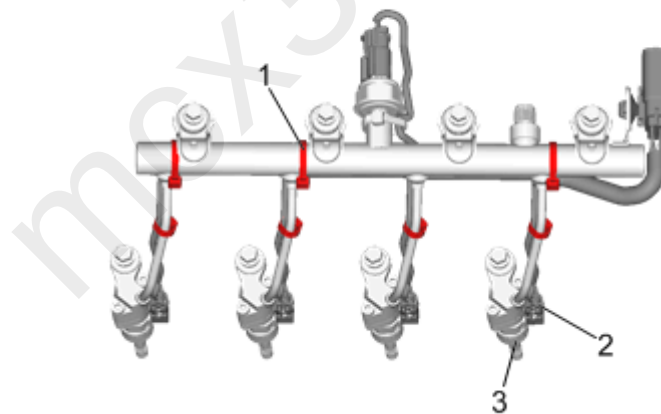


Fig. 142: Fuel Injectors, Wiring Harness And Tie Straps
Courtesy of GENERAL MOTORS COMPANY

1. Connect the fuel injector wiring harness connectors (2) to the fuel injectors (3).
2. Position the fuel injector wiring harness to the fuel injection fuel rail and install NEW wiring harness tie straps (1).

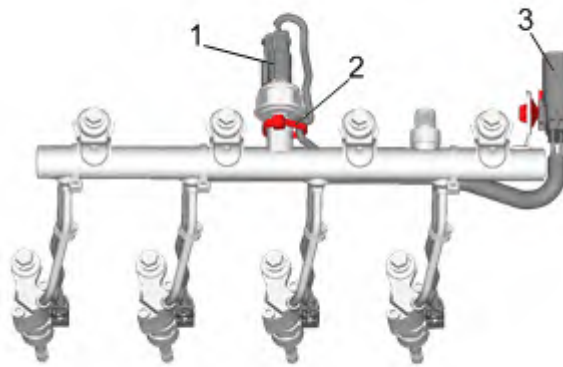


Fig. 143: Fuel Injector Wiring Harness, Connector And Tie Strap
Courtesy of GENERAL MOTORS COMPANY

3. Connect the fuel injector wiring harness connector (1) to the fuel injection fuel rail fuel pressure sensor.
4. Install a NEW wiring harness tie strap (1).
5. Clip the fuel injector wiring harness (3) to the fuel injection fuel rail.
6. Install Fuel Injection Fuel Rail Assembly - [Fuel Injection Fuel Rail Assembly Replacement](#)

FUEL INJECTION FUEL RAIL FUEL PRESSURE SENSOR REPLACEMENT

Removal Procedure

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Remove Intake Manifold Cover - [Intake Manifold Cover Replacement](#)

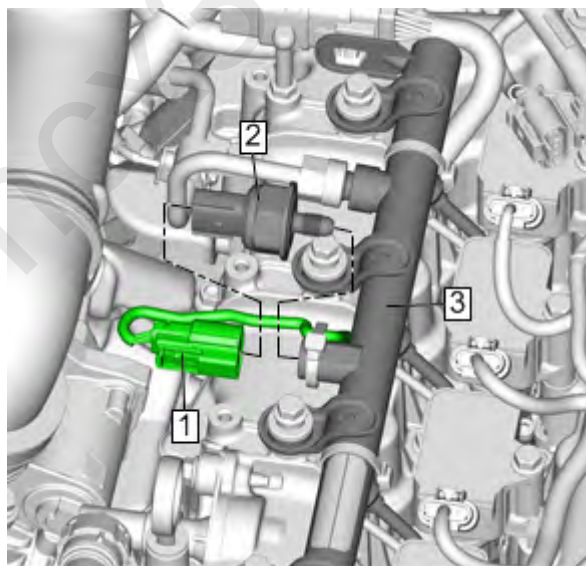


Fig. 144: Fuel Injection Fuel Rail Fuel Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connector (1).

CAUTION: Refer to [Fuel and Evaporative Emission Hose/Pipe Connection Cleaning Caution](#) .

NOTE:

- Do NOT apply force to the plastic housing of the fuel injection fuel rail fuel pressure sensor. ONLY apply force to the attached hexagon.

- Some fuel may leak from the fuel injection fuel rail orifice after the sensor is removed. Dry the area around the orifice using a lint free cloth.
- After removal, the area around the fuel injection fuel rail sealing surface should be inspected. The surface should be free of fuel, dirt, debris, and burrs.

4. Remove and DISCARD the fuel injection fuel rail fuel pressure sensor (2).

Installation Procedure

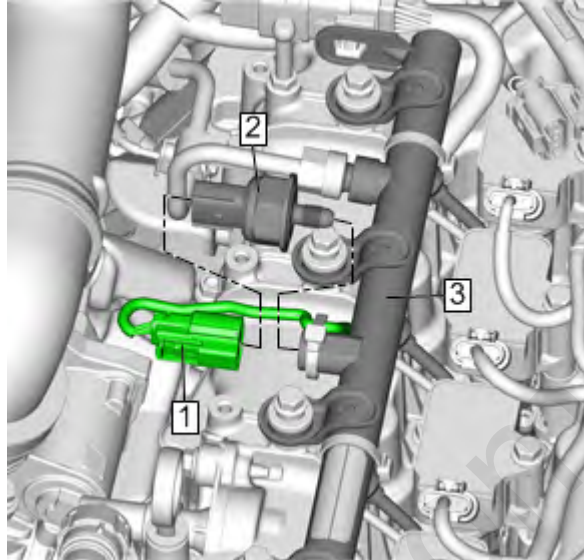


Fig. 145: Fuel Injection Fuel Rail Fuel Pressure Sensor Electrical Connector
Courtesy of GENERAL MOTORS COMPANY

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

NOTE:

- Do NOT apply force to the plastic housing of the fuel injection fuel rail fuel pressure sensor. ONLY apply force to the attached hexagon.
- BEFORE installation of the fuel injection fuel rail fuel pressure sensor, the fuel injection fuel rail threads MUST be clean and free of any fuel or the sensor will NOT seal properly.

1. To install the NEW fuel injection fuel rail fuel pressure sensor (2) properly, perform the following steps:

1. Lubricate the sensor threads and sealing surface with one drop of clean engine oil.
2. Install the sensor and hand tighten.
3. Remove the sensor.
4. Re-lubricate the sensor threads and sealing surface with one drop of clean engine oil.
5. Install the sensor and tighten to 33 N.m (24 lb ft).

2. Connect the electrical connector (1).

NOTE: If a fuel leak occurs at the fuel injection fuel rail, the fuel rail will need to be replaced.

3. Pressurize the fuel system and inspect for leaks.

4. Intake Manifold Cover - [Intake Manifold Cover Replacement](#)

FUEL PRESSURE SENSOR REPLACEMENT - FUEL FEED PIPE (FWD)

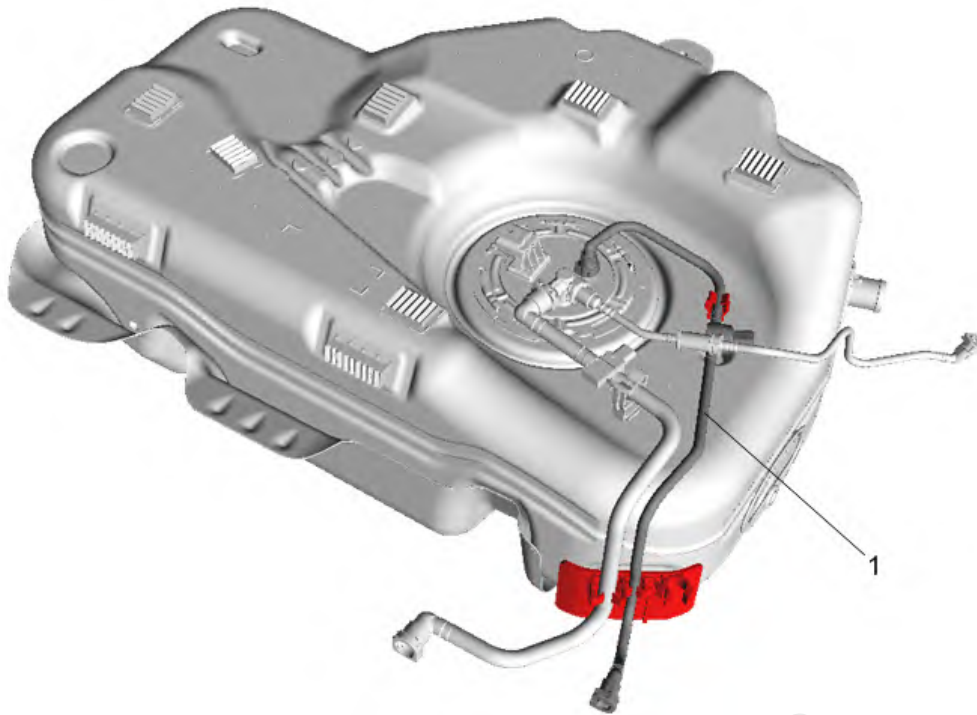


Fig. 146: Fuel Pump Fuel Feed Hose (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Fuel Tank Replacement (FWD)	
1	Fuel Pressure Sensor Procedure 1. Disconnect the electrical connector. 2. Disconnect the fuel hose and remove from retainers. 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 (AWD)

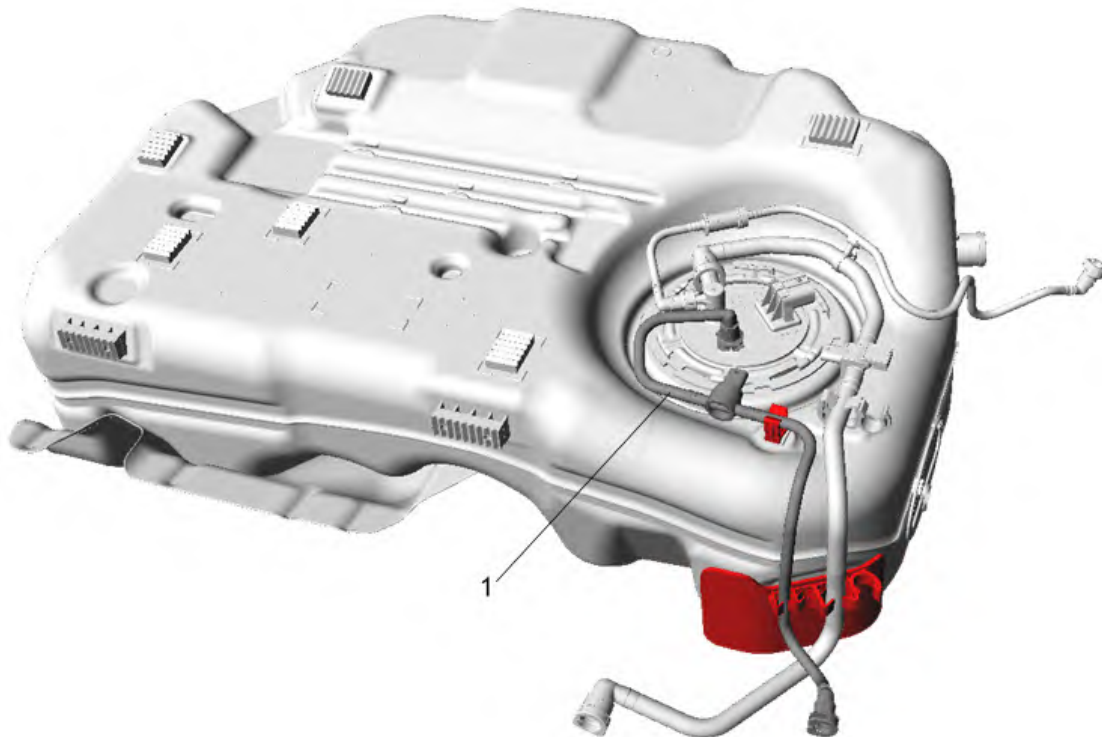


Fig. 147: Fuel Pressure Sensor - Fuel Feed Pipe (AWD).

Courtesy of GENERAL MOTORS COMPANY

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

FUEL SYSTEM CLEANING

NOTE: When flushing the fuel tank, treat the fuel and water mixture as a hazardous material. Handle the material in accordance with all local, state and federal laws and regulations.

NOTE: Whenever the fuel tank is cleaned, inspect the fuel pump fuel strainer. If the fuel pump fuel strainer is contaminated, replace the fuel pump fuel strainer and inspect the fuel pump.

NOTE: Always maintain cleanliness when servicing fuel system components.

1. Remove the fuel tank fuel pump module. [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).
2. Inspect the fuel pump inlet for dirt and debris. If dirt and debris are found, replace the fuel pump.
3. Flush fuel tank with hot water.
4. Pour the water out of the fuel sender assembly opening in the fuel tank. Rock the fuel tank in order to ensure that the removal of the water from the fuel tank is complete.
5. Allow tank to dry completely before reassembly.
6. Install the fuel tank fuel pump module. [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(AWD\)](#).

FUEL FEED FRONT PIPE REPLACEMENT

Removal Procedure

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

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

1. Remove Intake Manifold Cover - [Intake Manifold Cover Replacement](#)
2. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
3. Remove Charge Air Cooler Outlet Air Tube - [Charge Air Cooler Outlet Air Tube Replacement](#)

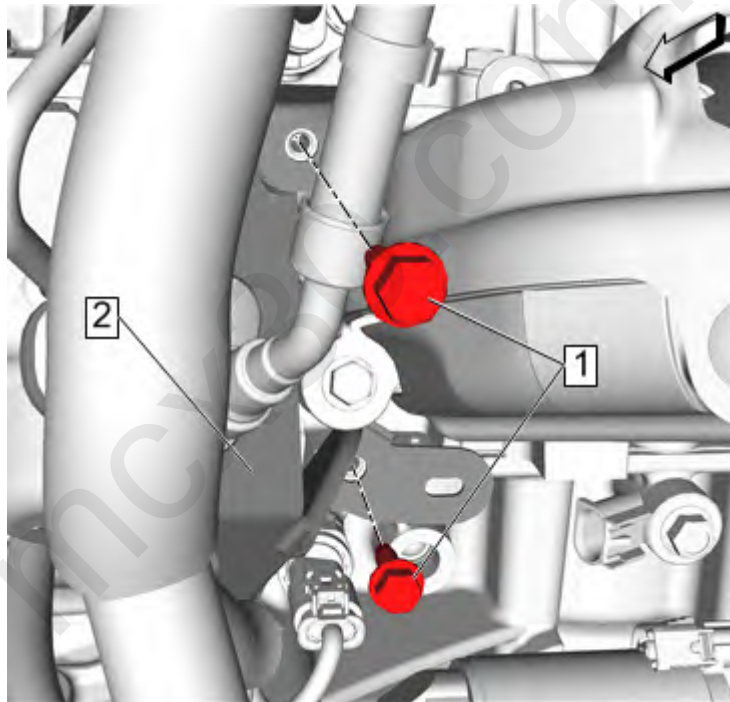


Fig. 148: Engine Control Module, Engine Wiring Harness Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

4. Remove Engine Control Module and Engine Wiring Harness Bracket Bolt (1)
5. Reposition Engine Control Module and Engine Wiring Harness Bracket (2)

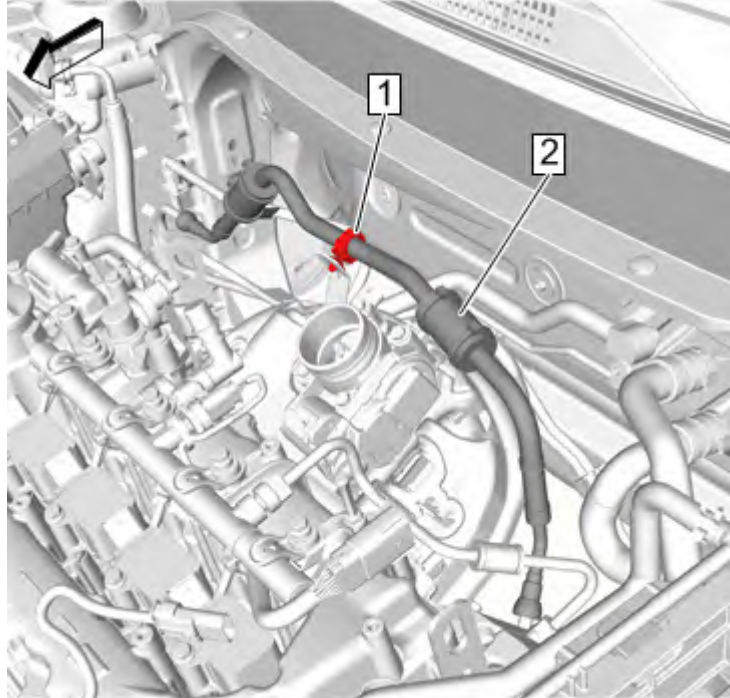


Fig. 149: Fuel Feed Front Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

6. Remove Fuel Feed Front Pipe Retainer (1)

7. Disconnect Fuel Feed Front Pipe (2) [Metal Collar Quick Connect Fitting Service](#)

Installation Procedure

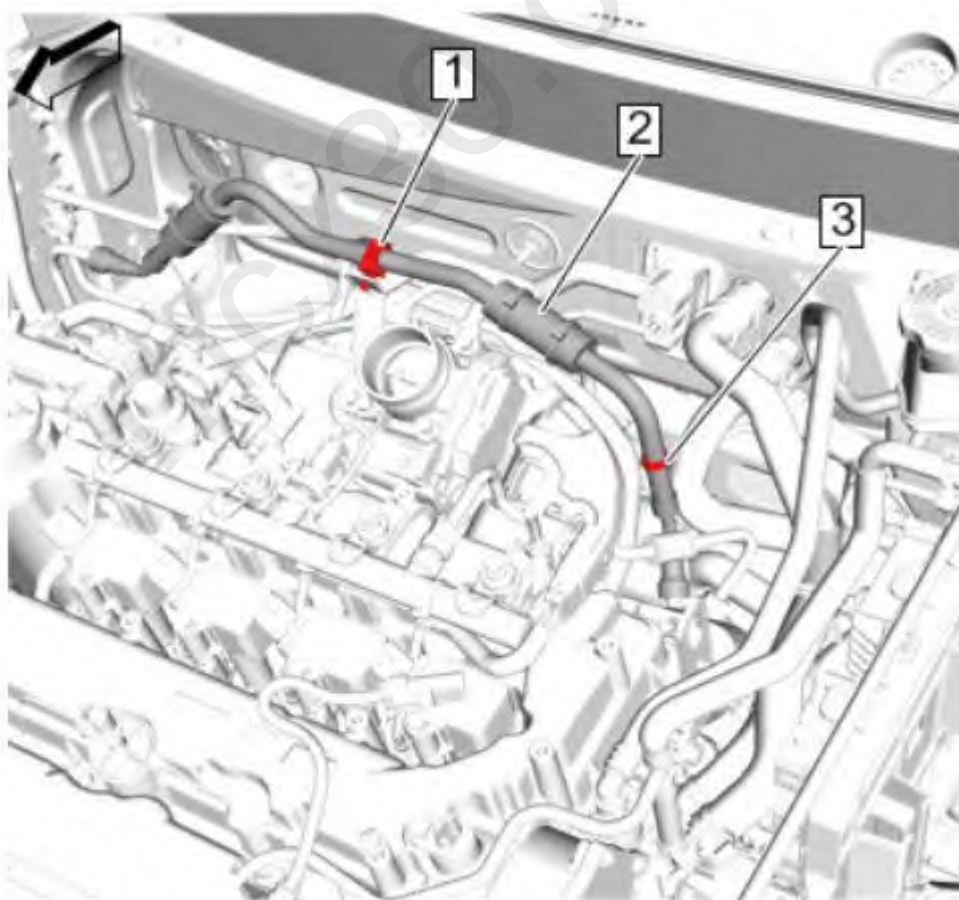


Fig. 150: Fuel Feed Front Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- Fuel feed front pipe contains a check valve and needs to be installed properly to prevent engine performance issues.
- The fuel feed front pipe end with Oetiker clamp (3) must be connected to the high pressure pump on the engine.

1. Connect Fuel Feed Front Pipe (2) - [Metal Collar Quick Connect Fitting Service](#)
2. Install Fuel Feed Front Pipe Retainer (1).

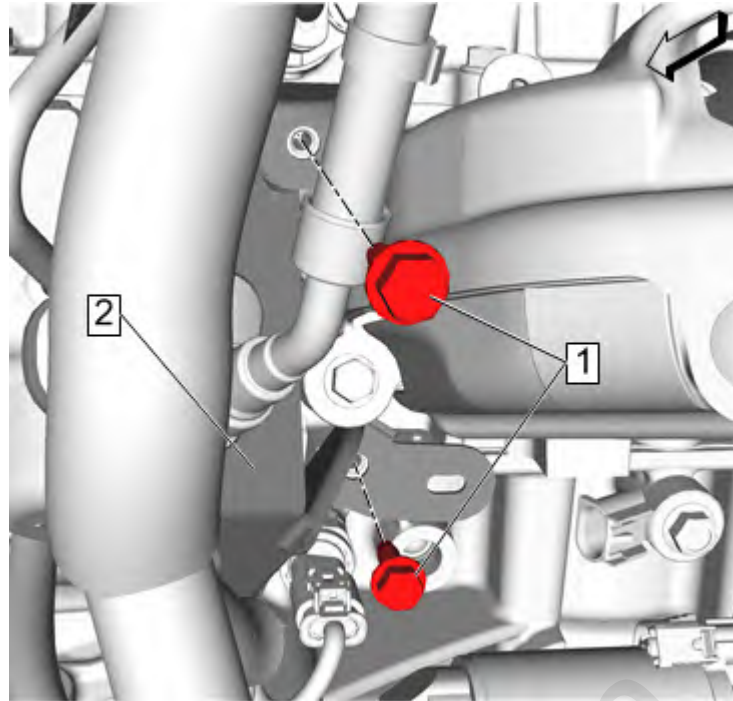


Fig. 151: Engine Control Module, Engine Wiring Harness Bracket And Bolt
Courtesy of GENERAL MOTORS COMPANY

3. Install Engine Control Module and Engine Wiring Harness Bracket (1).

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

4. Install Engine Control Module and Engine Wiring Harness Bracket Bolt (1) and tighten 9 N.m (80 lb in)
5. Install Charge Air Cooler Outlet Air Tube - [Charge Air Cooler Outlet Air Tube Replacement](#)
6. Install Intake Manifold Cover - [Intake Manifold Cover Replacement](#)
7. Cycle ignition to pressurize fuel system and check for fuel leaks.

FUEL FEED INTERMEDIATE PIPE 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 [Diesel/Gasoline Vapors Warning](#) .

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

NOTE: High pressure fuel feed pipes are one time use only. **ALWAYS** install a **NEW** high pressure fuel feed pipe if the pipe is removed **OR** the fittings are loosened.

1. Relieve the fuel system pressure. [Fuel Pressure Relief](#)
2. Remove Intake Manifold Cover - [Intake Manifold Cover Replacement](#)
3. Separate the charge air cooler outlet air tube from the throttle body and set aside. [Charge Air Cooler Outlet Air Tube Replacement](#)

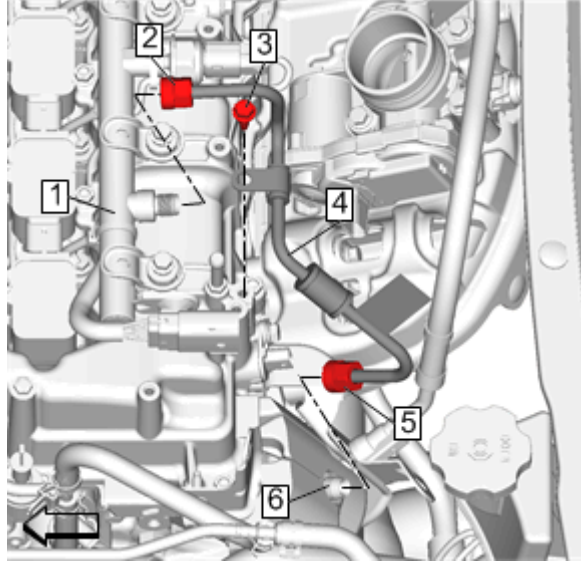


Fig. 152: High Pressure Fuel Feed Intermediate Pipe
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lay a lint-free cloth under the fuel feed intermediate pipe to absorb any excess fuel spillage.

4. Remove the fuel injection fuel feed pipe clip bolt (3).
5. Loosen the fuel feed intermediate pipe fittings (2, 5).
6. Remove the fuel feed intermediate pipe (4) from the fuel injection fuel rail (1) and the fuel pump (6).
7. Remove and DISCARD the fuel feed intermediate pipe (4).

Installation Procedure

1. Ensure ALL fittings are clean and dry prior to assembly.
2. Lubricate the fuel feed intermediate pipe fittings with silicon free engine oil.

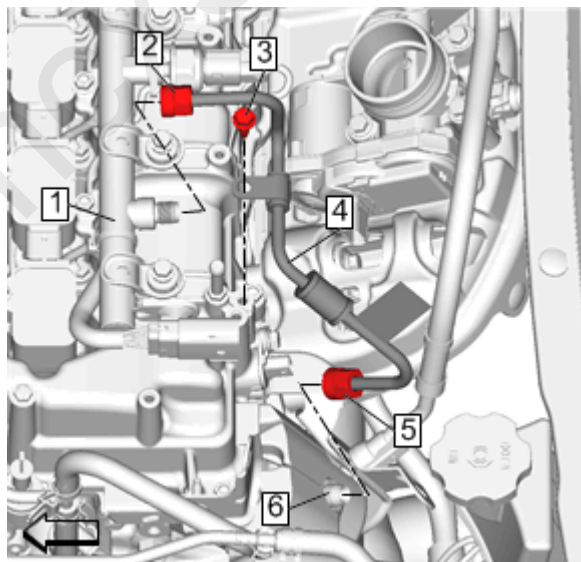


Fig. 153: High Pressure Fuel Feed Intermediate Pipe
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to Component Fastener Tightening Caution .

3. To install the NEW fuel feed intermediate pipe (4) to the fuel injection fuel rail (1) and to the fuel pump (6), perform the following steps:
 1. Hand tighten the fuel feed intermediate pipe fitting (2) to the fuel injection fuel rail (1).
 2. Hand tighten the fuel feed intermediate pipe fitting (5) to the fuel pump (6).
 3. Tighten the fuel feed intermediate pipe fittings (2, 5) to 30 N.m (22 lb ft).

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

4. Install the fuel injection fuel feed pipe clip bolt (3) and tighten to 10 N.m (89 lb in).

NOTE: If a fuel leak occurs at the fuel pump or the fuel injection fuel rail fitting, the corresponding component will need to be replaced.

5. Inspect for leaks using the following procedure:

1. Turn ON the ignition with the engine OFF for 2 seconds.
2. Turn OFF the ignition for 10 seconds.
3. Turn ON the ignition with the engine OFF.
4. Inspect for fuel leaks.

6. Install the charge air cooler outlet air tube to the throttle body. [Charge Air Cooler Outlet Air Tube Replacement](#)

7. Install Intake Manifold Cover - [Intake Manifold Cover Replacement](#)

EVAPORATIVE EMISSION CANISTER REPLACEMENT (FWD)

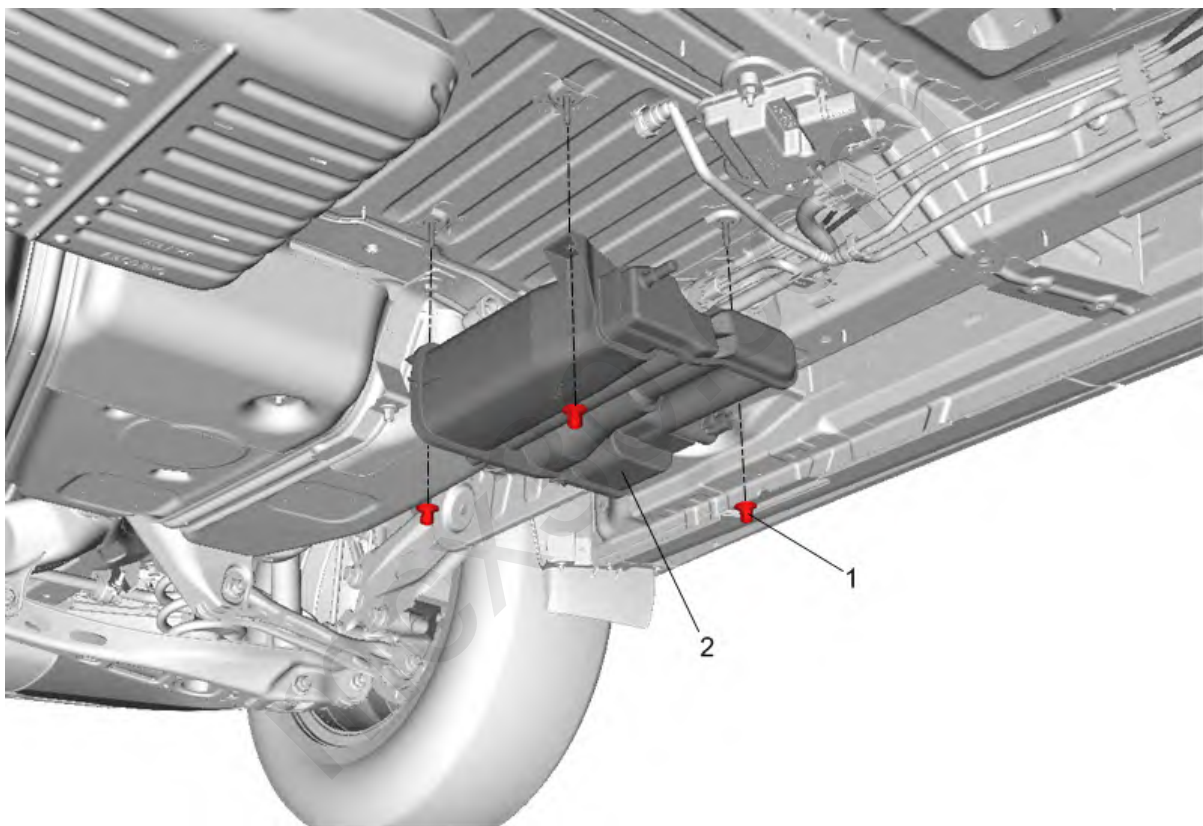


Fig. 154: Evaporative Emission Canister (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedures 1. Underbody Rear Air Deflector Replacement (Front Wheel Drive) 2. Disconnect Evaporative Emission Canister Purge Solenoid Valve Hose@Evaporative Emission Canister - Plastic Collar Quick Connect Fitting Service 3. Disconnect Evaporative Emission Canister Filter Pipe@Evaporative Emission Canister - Plastic Collar Quick Connect Fitting Service 4. Disconnect Evaporative Emission Canister Vent Hose@Evaporative Emission Canister - Plastic Collar Quick Connect Fitting Service	
1	Evaporative Emission Canister Nut[3x] CAUTION: Refer to Fastener Caution . Tighten 9N.m (80 lb in)
2	Evaporative Emission Canister Procedure Disconnect the electrical connector.

EVAPORATIVE EMISSION CANISTER REPLACEMENT (AWD)

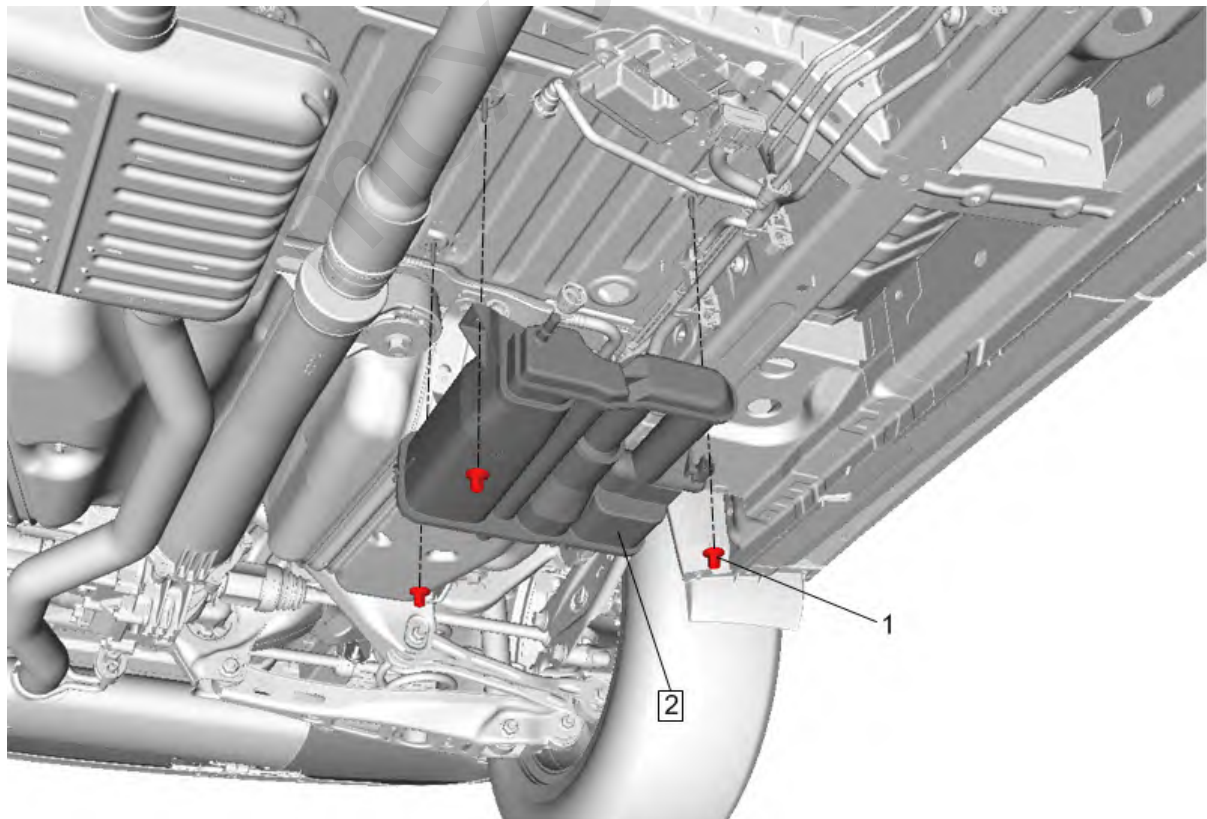


Fig.155: Evaporative Emission Canister (AWD).
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedures 1. Underbody Rear Air Deflector Replacement (All Wheel Drive) 2. Disconnect Evaporative Emission Canister Purge Solenoid Valve Hose@Evaporative Emission Canister - Plastic Collar Quick Connect Fitting Service 3. Disconnect Evaporative Emission Canister Filter Pipe@Evaporative Emission Canister - Plastic Collar Quick Connect Fitting Service 4. Disconnect Evaporative Emission Canister Vent Hose@Evaporative Emission Canister - Plastic Collar Quick Connect Fitting Service	
1	Evaporative Emission Canister Nut[3x] CAUTION: Refer to Fastener Caution . Tighten 9N.m (80 lb in)
2	Evaporative Emission Canister Procedure Disconnect the electrical connector.

EVAPORATIVE EMISSION CANISTER FILTER PIPE REPLACEMENT (FWD)

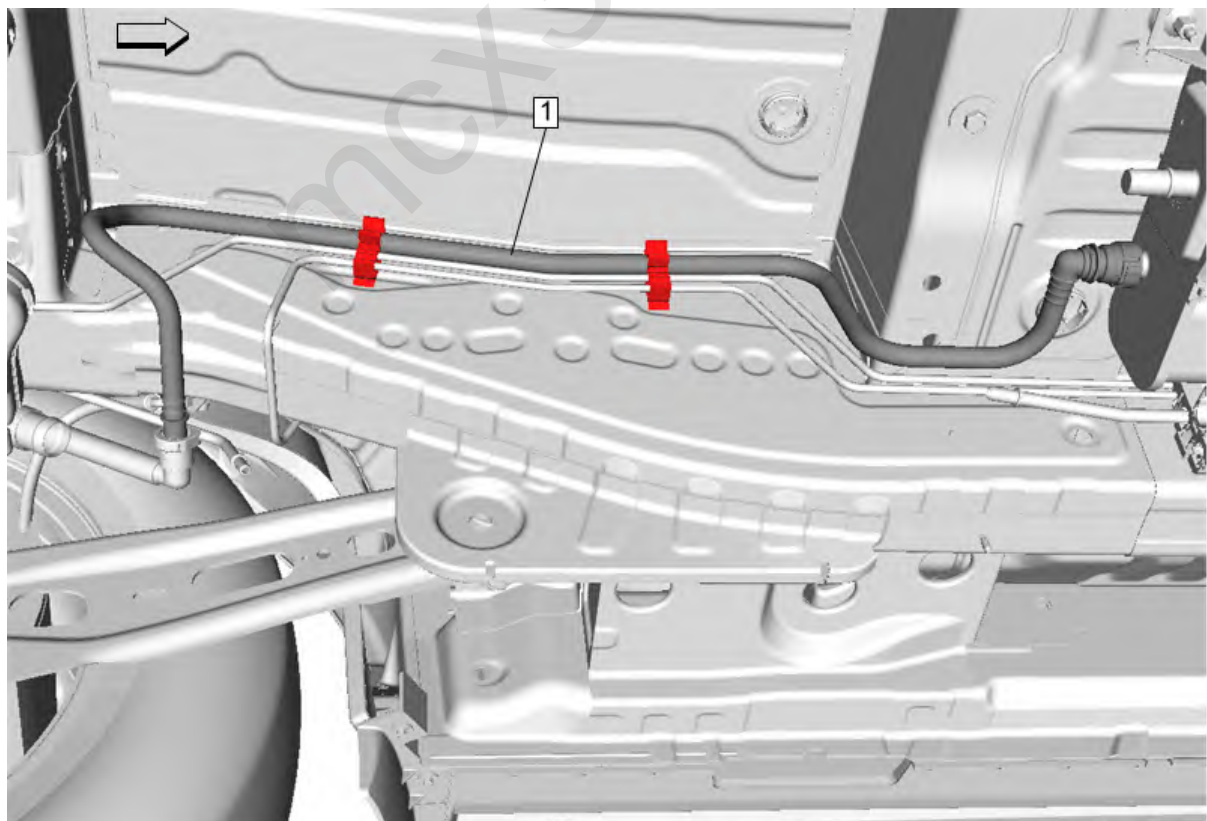


Fig. 156: Evaporative Emission Canister Filter Pipe (FWD).
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement (FWD)	
1	Evaporative Emission Canister Filter Pipe Procedure Disconnect the evaporative emission canister filter pipe and remove from retainers. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER FILTER PIPE REPLACEMENT (AWD)

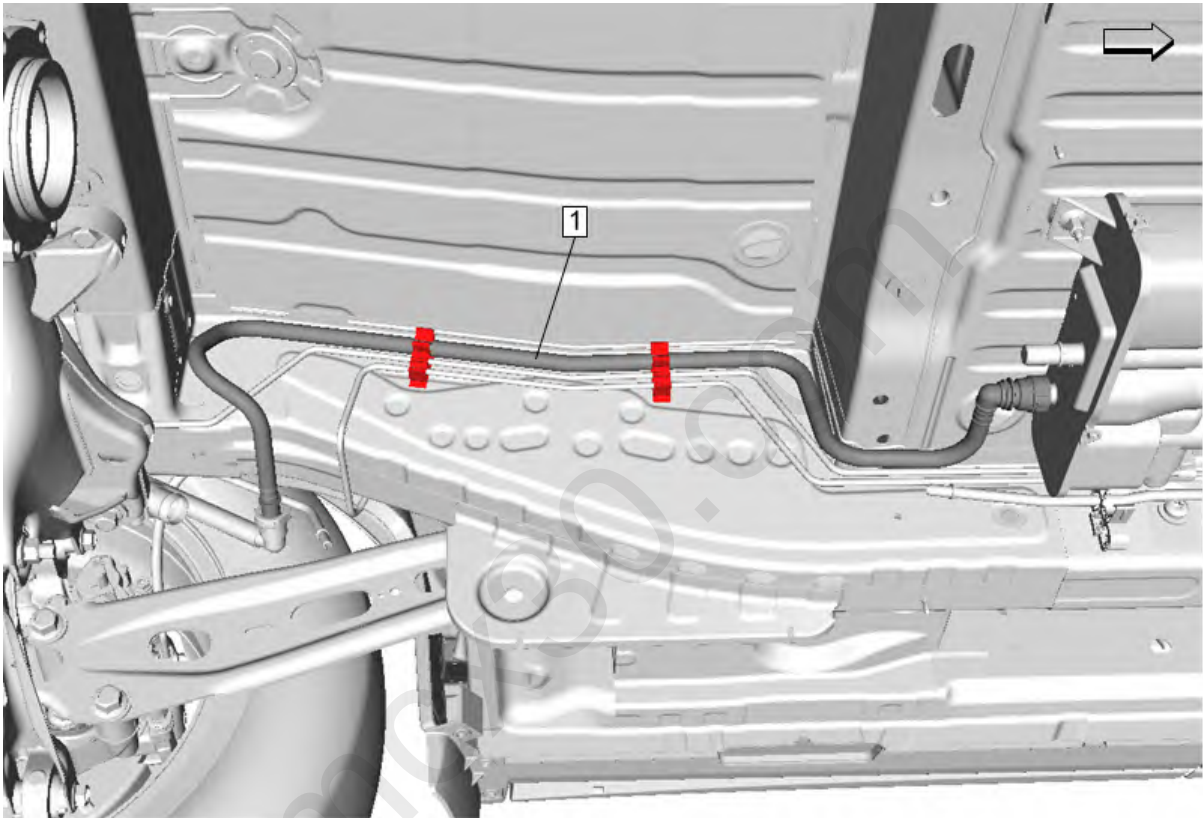


Fig. 157: Evaporative Emission Canister Filter Pipe (AWD).
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement (AWD)	
1	Evaporative Emission Canister Filter Pipe Procedure Disconnect the evaporative emission canister filter pipe and remove from retainers. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT

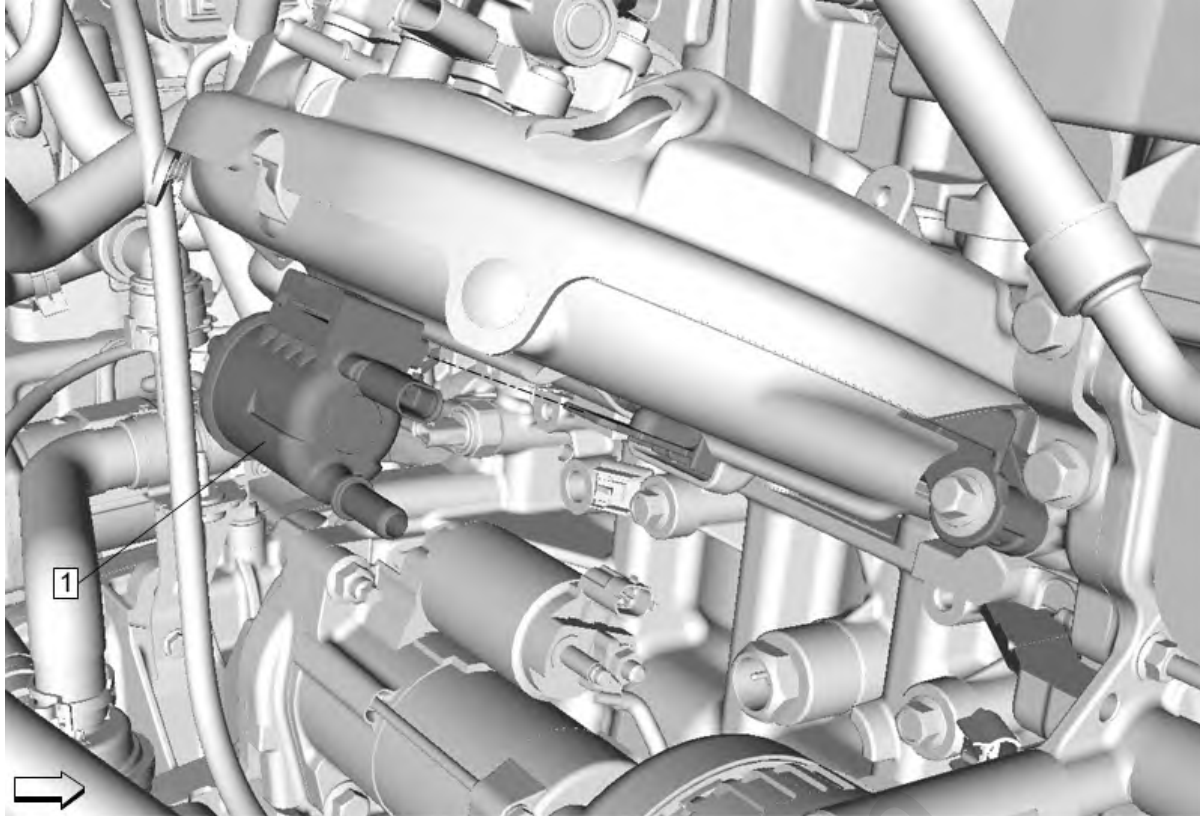


Fig. 158: Evaporative Emission Canister Purge Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Disconnect the evaporative emission pipe. Plastic Collar Quick Connect Fitting Service	
1	Evaporative Emission Canister Purge Solenoid Valve Procedure 1. Disconnect the electrical connector. 2. Release retaining tab.

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE HOSE REPLACEMENT (FWD)

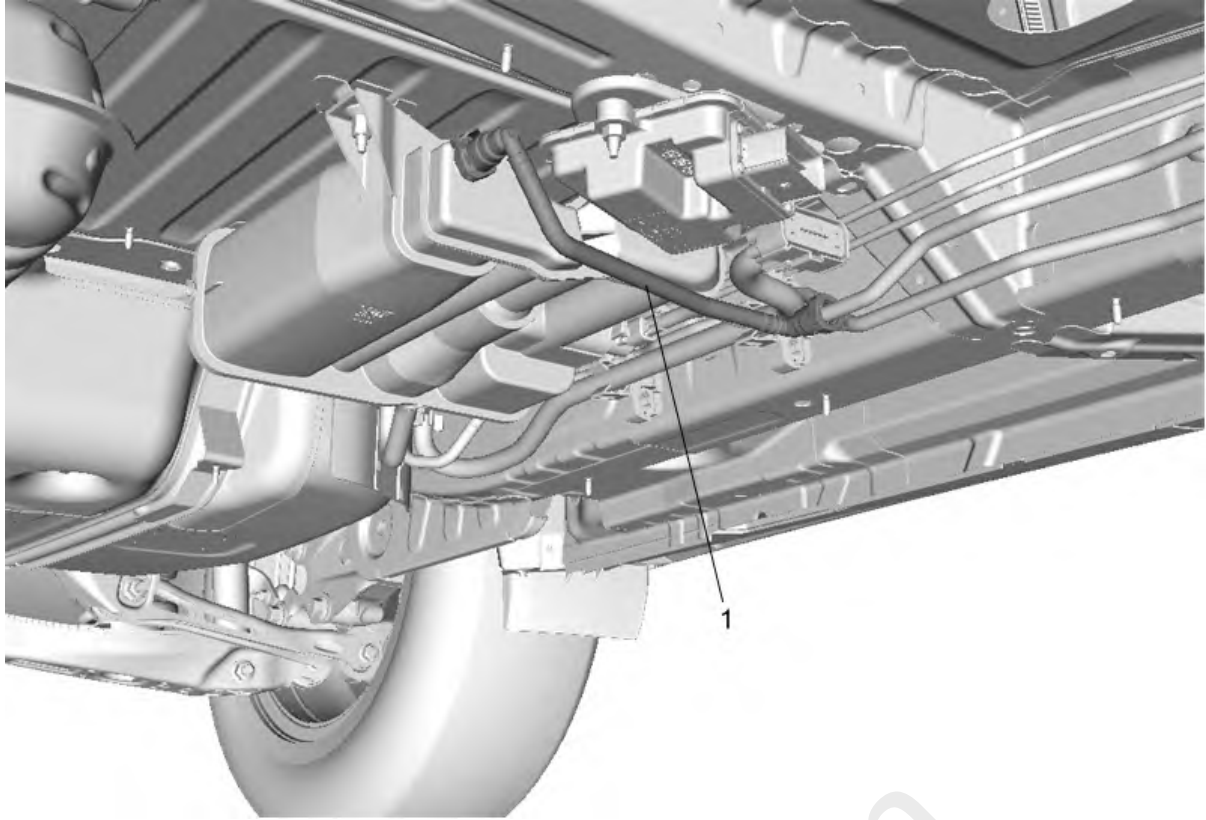


Fig. 159: Evaporative Emission Canister Purge Solenoid Valve Hose (FWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Underbody Rear Air Deflector Replacement (Front Wheel Drive) .	
1	Evaporative Emission Canister Purge Solenoid Valve Hose Procedure Disconnect the evaporative emission canister purge solenoid valve hose. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE HOSE REPLACEMENT (AWD)

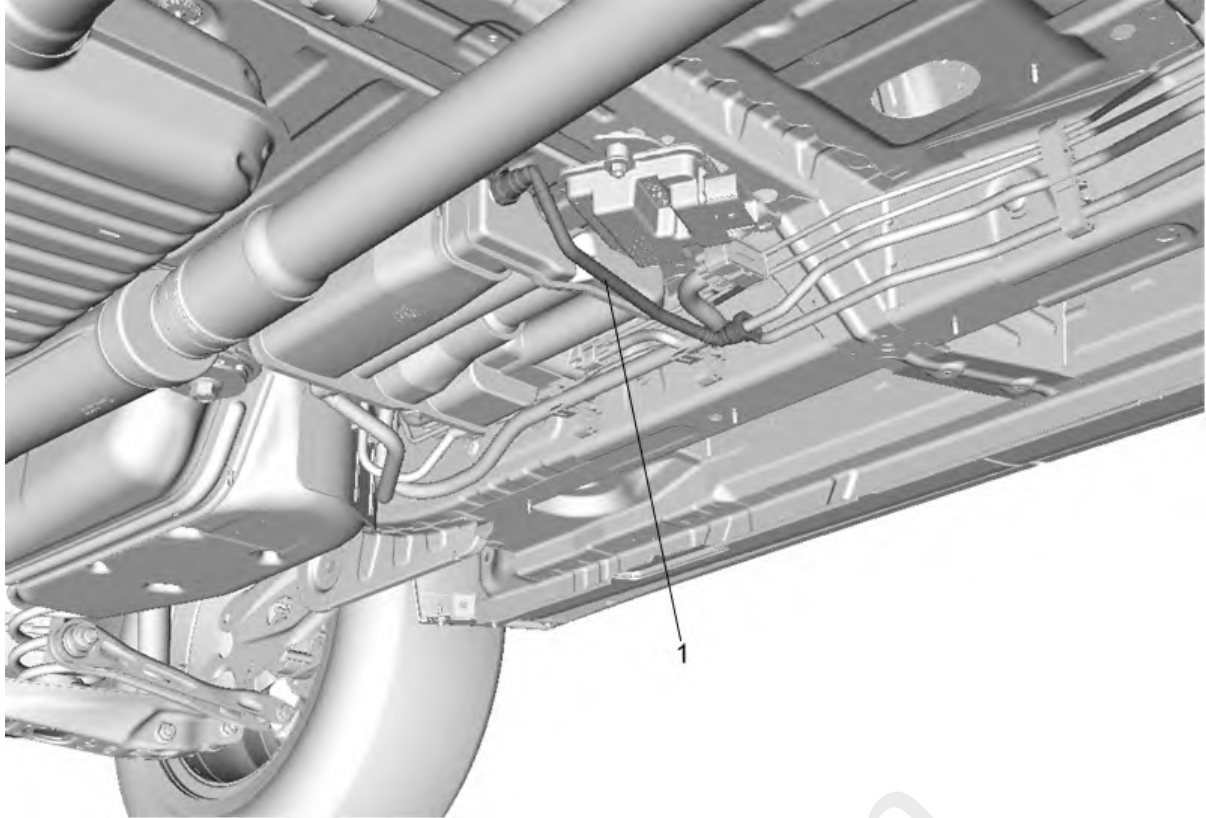


Fig. 160: Evaporative Emission Canister Purge Solenoid Valve Hose (AWD).
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Underbody Rear Air Deflector Replacement (All Wheel Drive) .	
1	Evaporative Emission Canister Purge Solenoid Valve Hose Procedure Disconnect the evaporative emission canister purge solenoid valve hose. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER PURGE TUBE REPLACEMENT

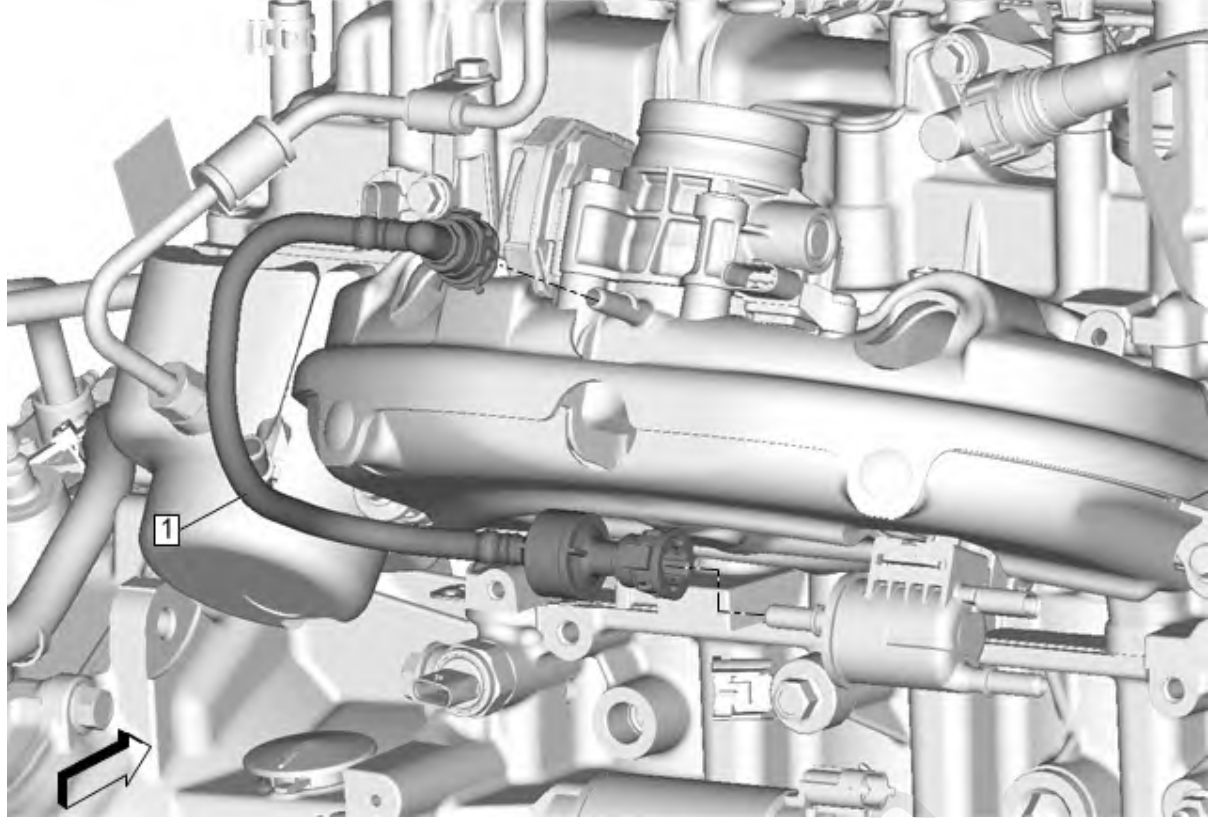


Fig. 161: Evaporative Emission Canister Purge Tube

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Evaporative Emission Canister Purge Tube Procedure Disconnect the evaporative emission canister purge tube from the intake manifold and the evaporative emission canister purge valve. <u>Plastic Collar Quick Connect Fitting Service</u>

EVAPORATIVE EMISSION CANISTER VENT SOLENOID VALVE REPLACEMENT

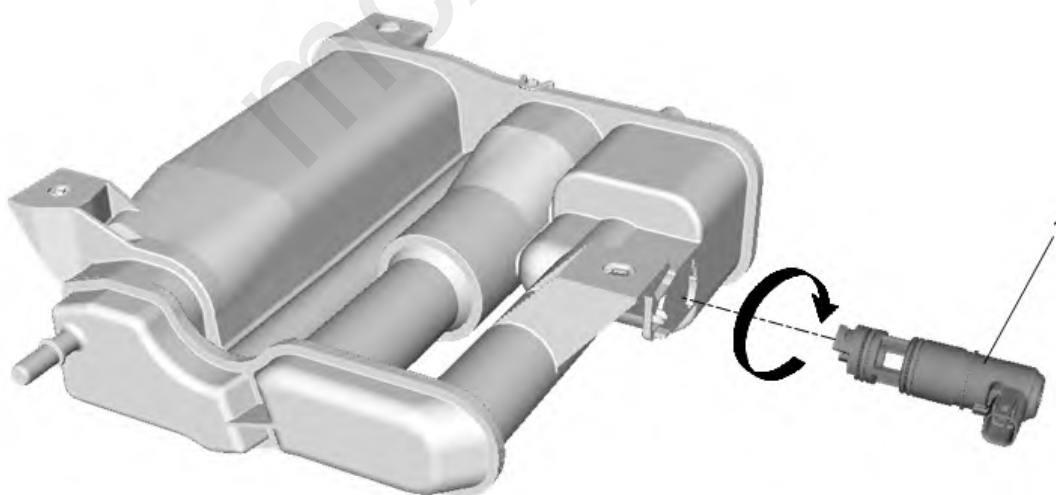


Fig. 162: Evaporative Emission Canister Vent Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Evaporative Emission Canister Replacement (FWD) Evaporative Emission Canister Replacement (AWD)	
1	Evaporative Emission Canister Vent Solenoid Valve

EVAPORATIVE EMISSION CANISTER VENT HOSE REPLACEMENT (AT TANK FWD)

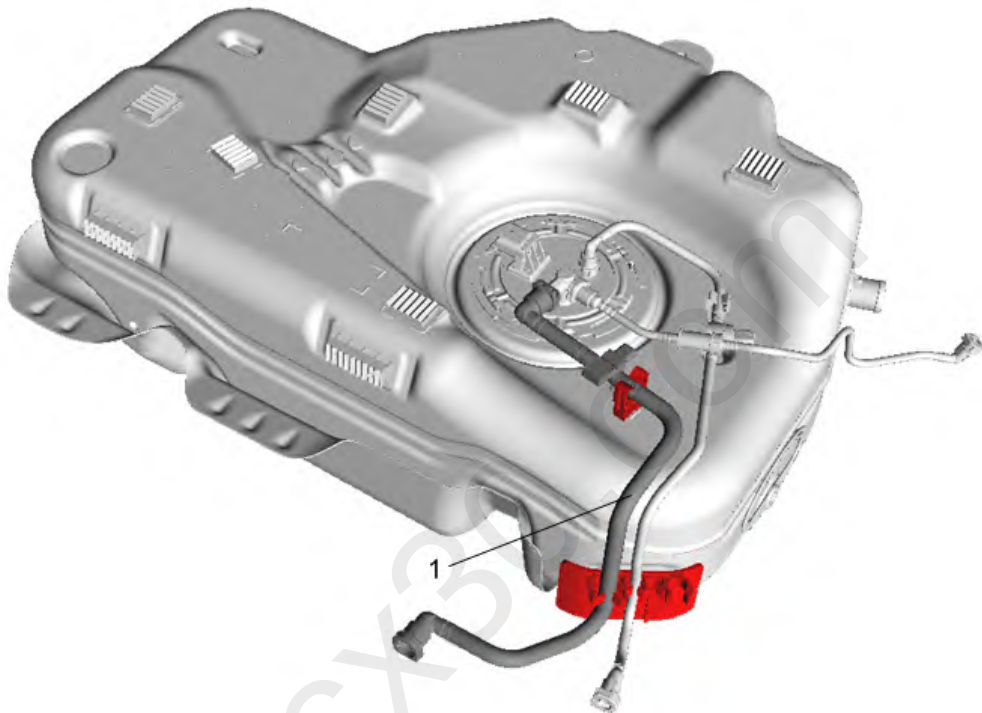


Fig. 163: Evaporative Emission Canister Vent Hose (FWD)
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement (FWD)	
1	Evaporative Emission Canister Vent Hose Procedure 1. Disconnect the electrical connector. 2. Disconnect the evaporative emission canister vent hose and remove from retainers. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER VENT HOSE REPLACEMENT (AT TANK AWD)

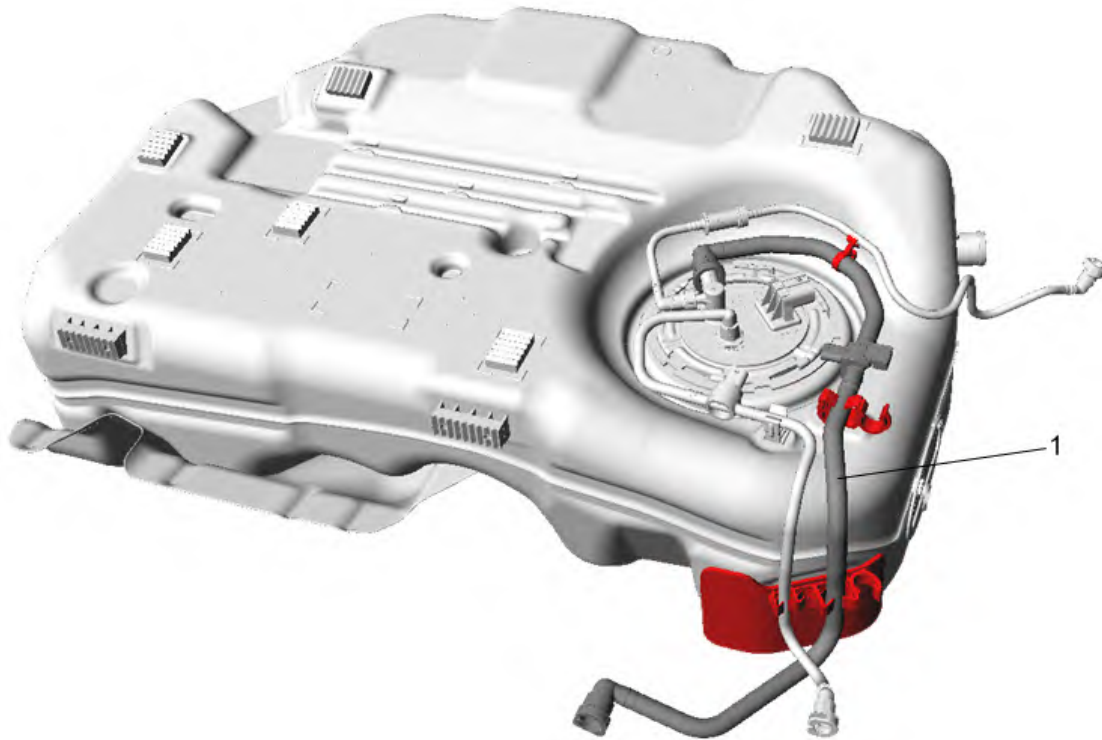


Fig. 164: Evaporative Emission Canister Vent Hose (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement (AWD)	
1	Evaporative Emission Canister Vent Hose Procedure 1. Disconnect the electrical connector. 2. Disconnect the evaporative emission canister vent hose and remove from retainers. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION CANISTER VENT HOSE REPLACEMENT (AT FILLER PIPE)

Removal Procedure

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

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

- 1.
2. Remove Rear Wheelhouse Liner - Left Side - [Rear Wheelhouse Liner Replacement- Left Side \(Equinox\)](#) [Rear Wheelhouse Liner Replacement- Left Side \(Terrain\)](#)

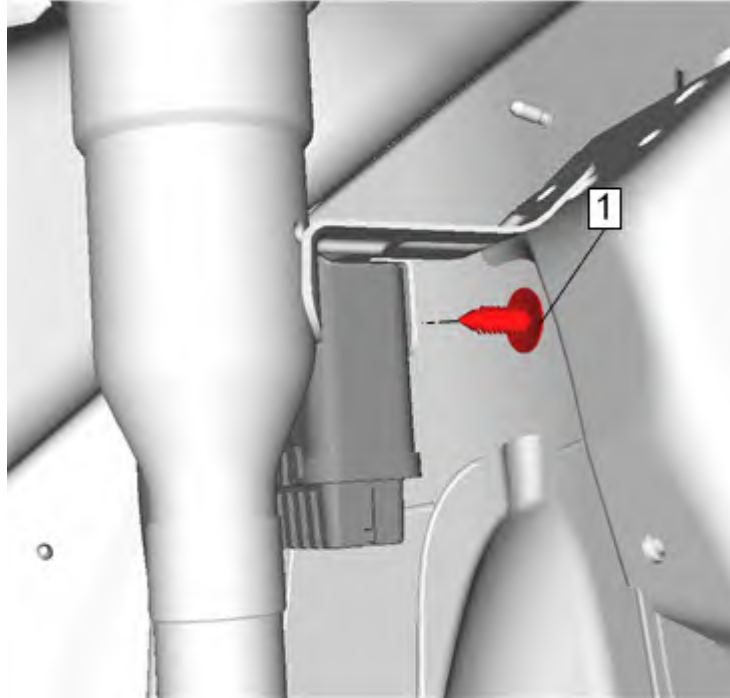


Fig. 165: Retainer

Courtesy of GENERAL MOTORS COMPANY

3. Remove Retainer (1)

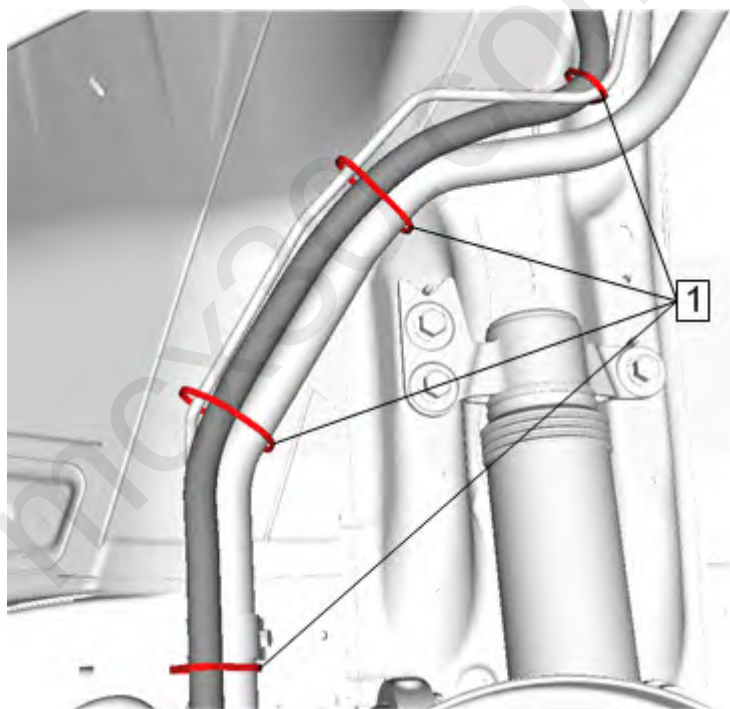


Fig. 166: Tie Strap

Courtesy of GENERAL MOTORS COMPANY

4. Remove Tie Strap (1) and DISCARD[4x]

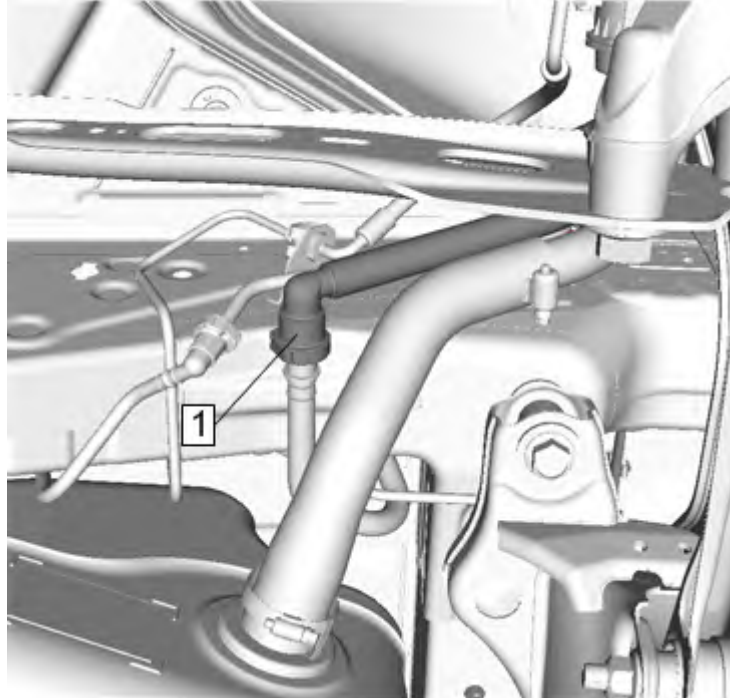


Fig. 167: Evaporative Emission Canister Vent Hose
Courtesy of GENERAL MOTORS COMPANY

5. Disconnect Evaporative Emission Canister Vent Hose (1) - **Plastic Collar Quick Connect Fitting Service**

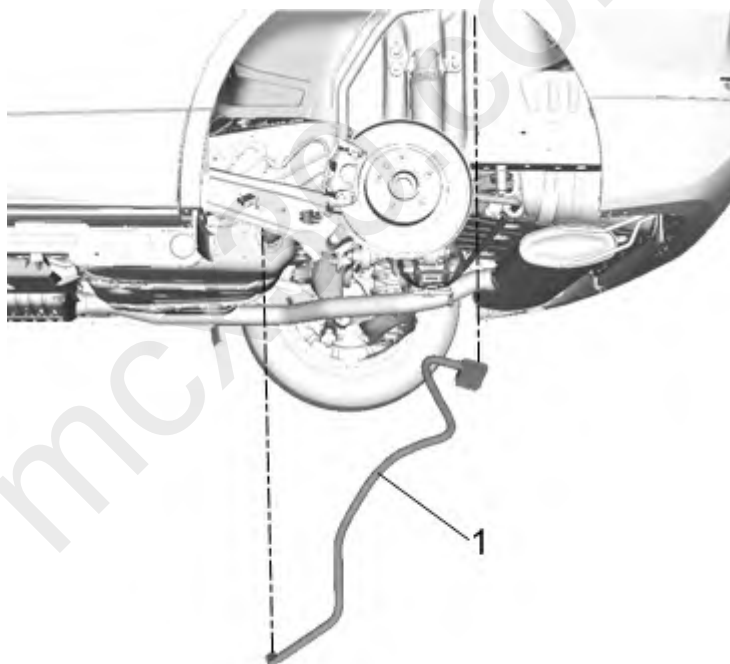


Fig. 168: Evaporative Emission Canister Vent Hose
Courtesy of GENERAL MOTORS COMPANY

6. Remove Evaporative Emission Canister Vent Hose (1) -

Installation Procedure

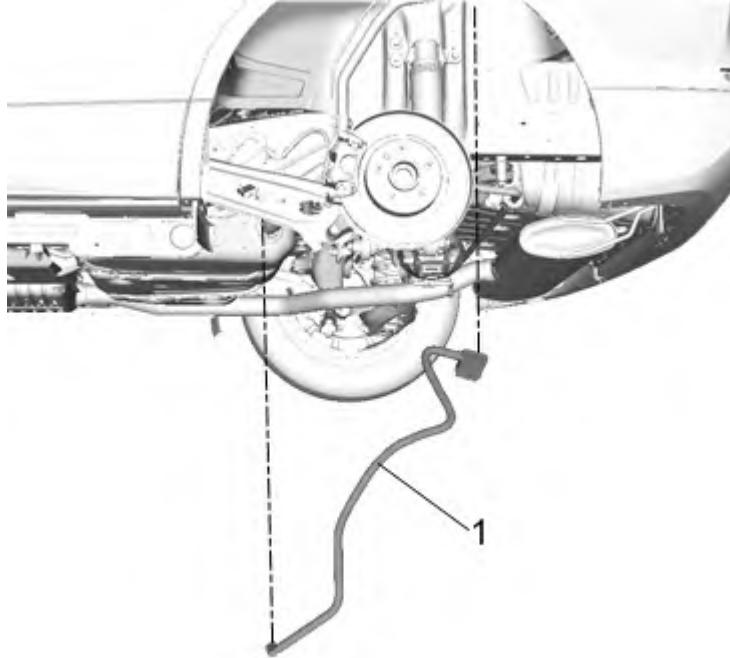


Fig. 169: Evaporative Emission Canister Vent Hose
 Courtesy of GENERAL MOTORS COMPANY

1. Install Evaporative Emission Canister Vent Hose (1)

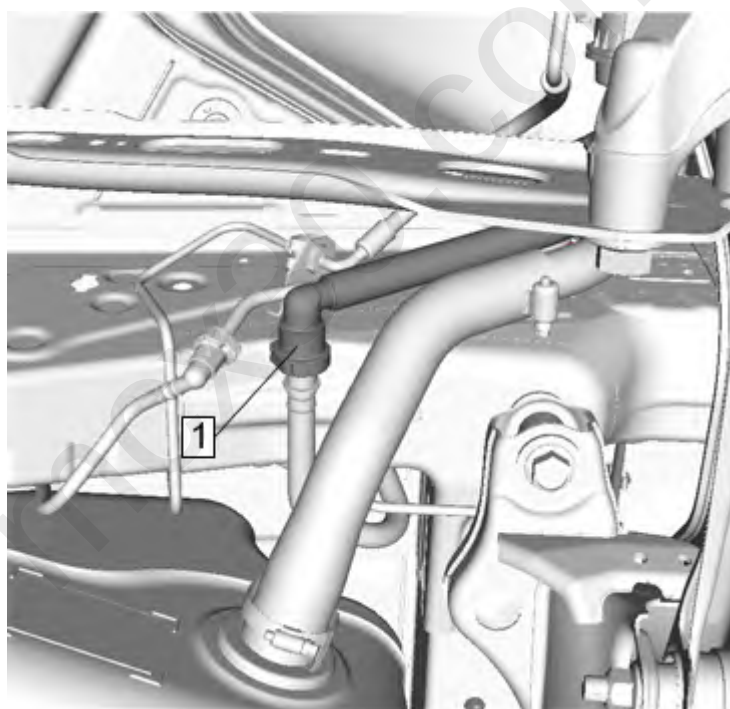


Fig. 170: Evaporative Emission Canister Vent Hose
 Courtesy of GENERAL MOTORS COMPANY

2. Connect Evaporative Emission Canister Vent Hose (1) Plastic Collar Quick Connect Fitting Service

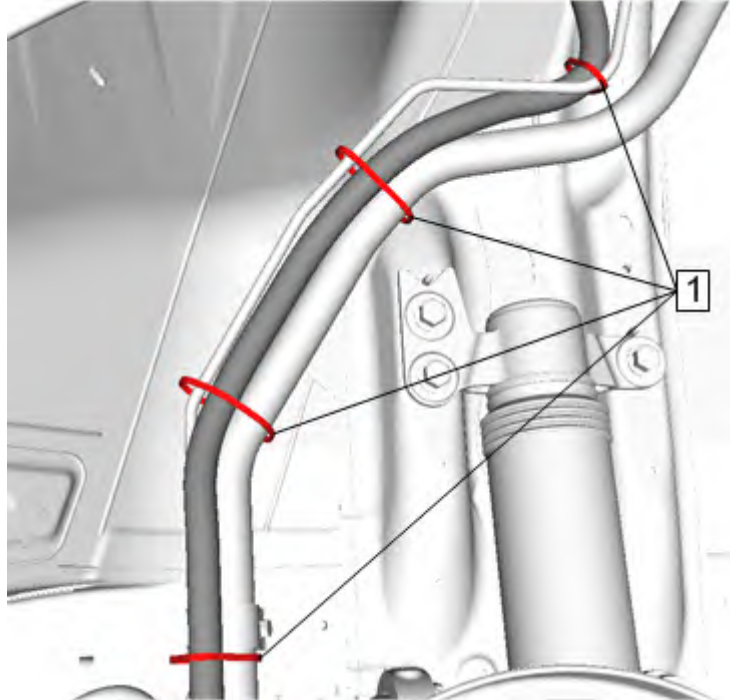


Fig. 171: Tie Strap

Courtesy of GENERAL MOTORS COMPANY

3. Install NEW Tie Strap (1) - [4x]

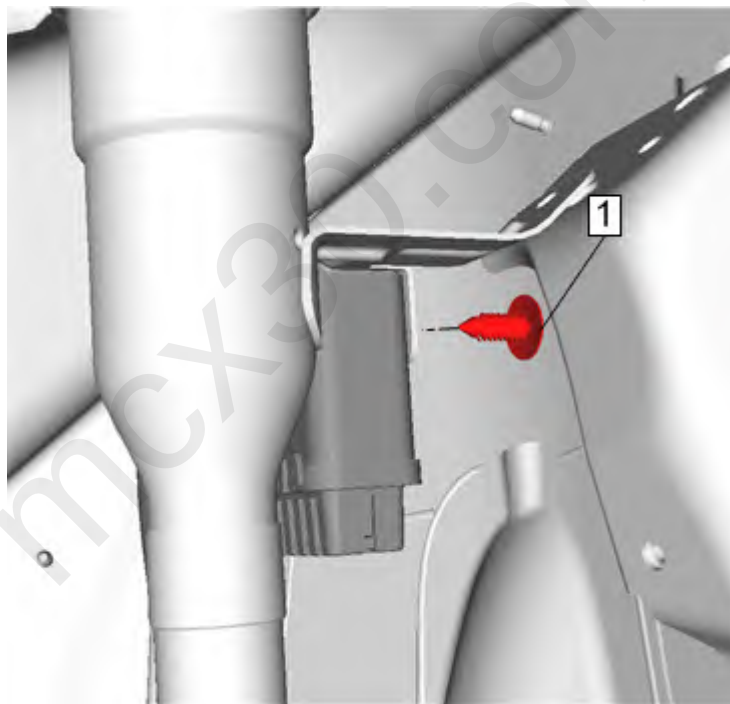


Fig. 172: Retainer

Courtesy of GENERAL MOTORS COMPANY

4. Install Retainer(1) -
5. Install Rear Wheelhouse Liner - Left Side - **Rear Wheelhouse Liner Replacement- Left Side (Equinox)** **Rear Wheelhouse Liner Replacement- Left Side (Terrain)**

EVAPORATIVE EMISSION FRONT HOSE REPLACEMENT

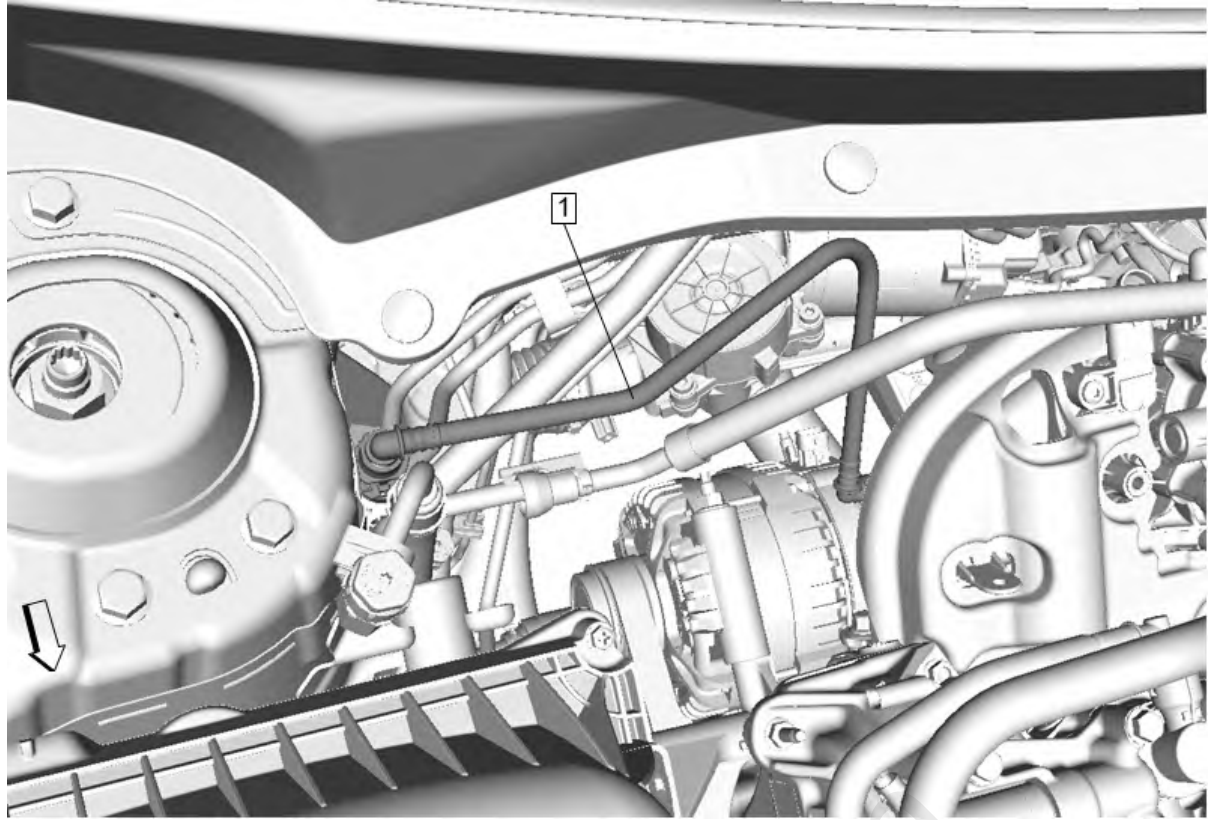


Fig. 173: Evaporative Emission Front Hose
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Evaporative Emission Front Hose Procedure Disconnect evaporative emission front hose. Plastic Collar Quick Connect Fitting Service

EVAPORATIVE EMISSION FRONT PIPE REPLACEMENT (FWD)

Removal Procedure

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

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

1. Remove Evaporative Emission Front Hose - [Evaporative Emission Front Hose Replacement](#)
2. Remove Exhaust Front Pipe - [Exhaust Front Pipe Replacement \(LYX\)](#).

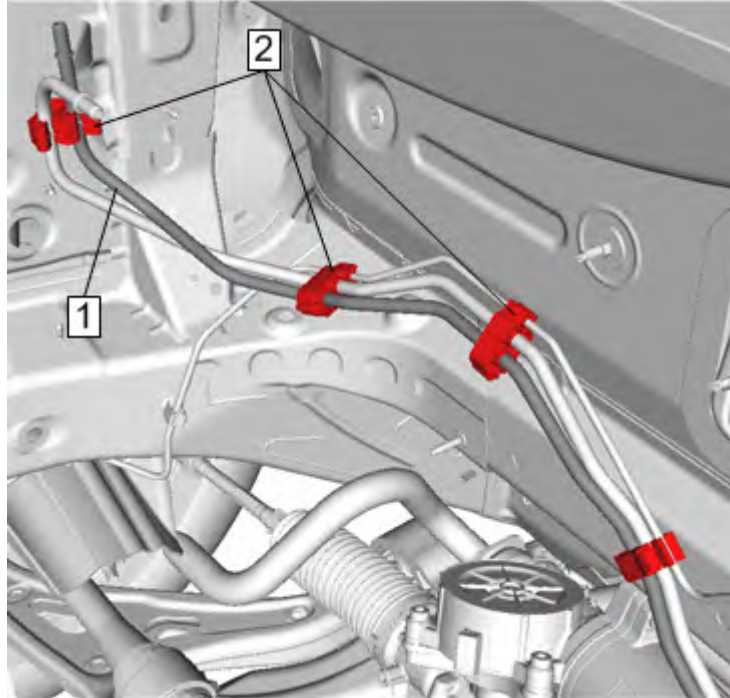


Fig. 174: Evaporative Emission Front Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

3. Remove Evaporative Emission Front Pipe(1)@Retainer(2) - [4x]
4. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#) .

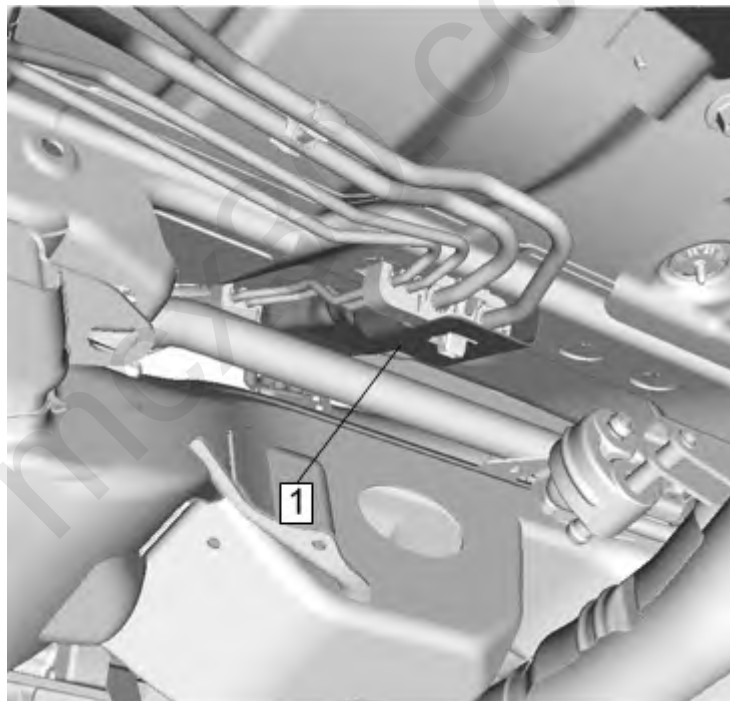


Fig. 175: Shield
Courtesy of GENERAL MOTORS COMPANY

5. Remove Shield (1)

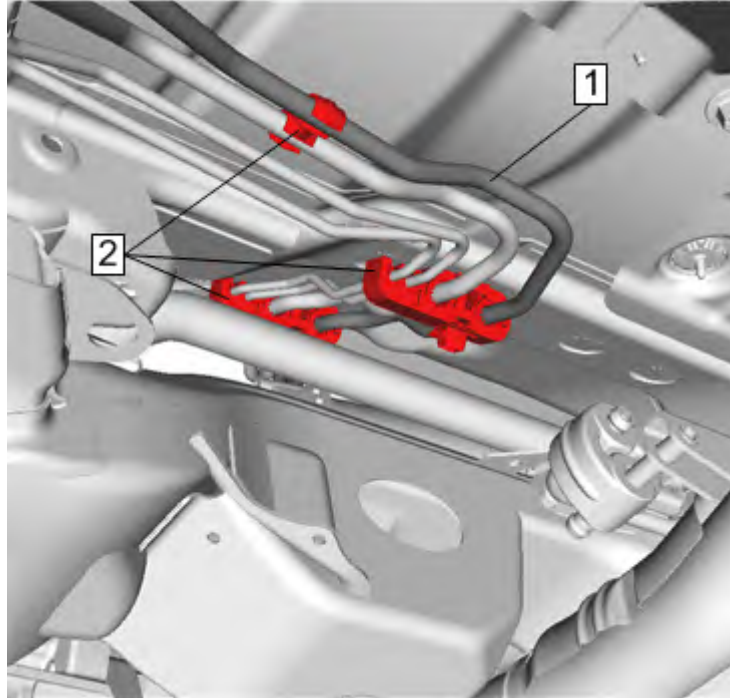


Fig. 176: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

6. Remove Evaporative Emission Front Pipe(1)@Retainer(2) - [3x]
7. Remove Underbody Rear Air Deflector - **Underbody Rear Air Deflector Replacement (Front Wheel Drive)**

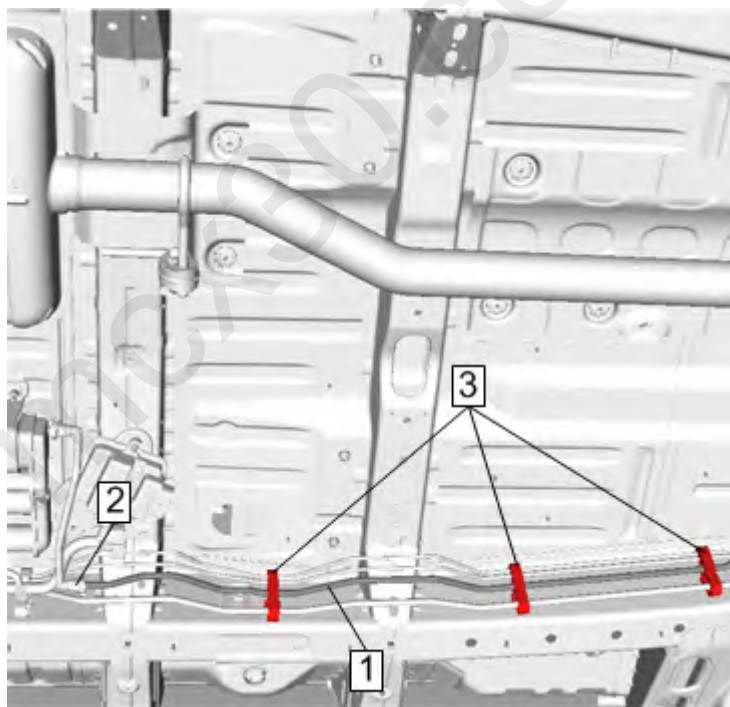


Fig. 177: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

8. Disconnect Evaporative Emission Front Pipe(1)@Evaporative Emission Canister Purge Solenoid Valve Hose(2) - **Plastic Collar Quick Connect Fitting Service**
9. Remove Evaporative Emission Front Pipe(1)@Retainer(3) - [3x]

Installation Procedure

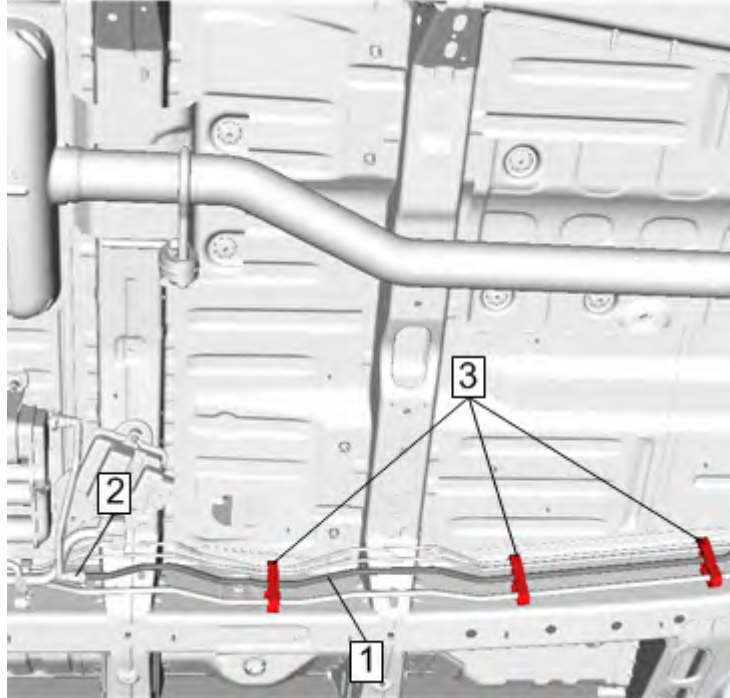


Fig. 178: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

1. Install Evaporative Emission Front Pipe(1)@Retainer(3) - [3x]
2. Connect Evaporative Emission Front Pipe(1)@Evaporative Emission Canister Purge Solenoid Valve Hose(2) - [Plastic Collar Quick Connect Fitting Service](#)
3. Install Underbody Rear Air Deflector - [Underbody Rear Air Deflector Replacement \(Front Wheel Drive\)](#)

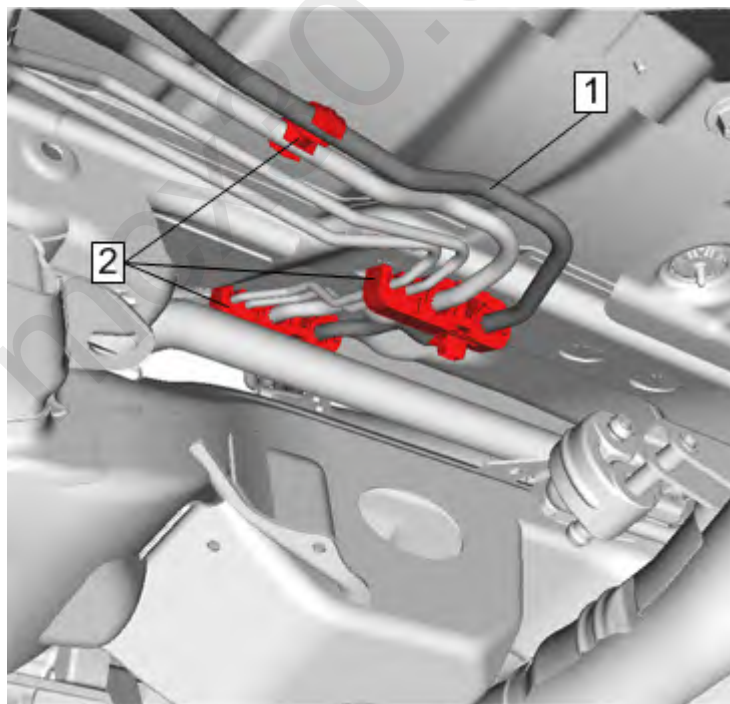


Fig. 179: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Install Evaporative Emission Front Pipe(1)@Retainer(2) - [3x]

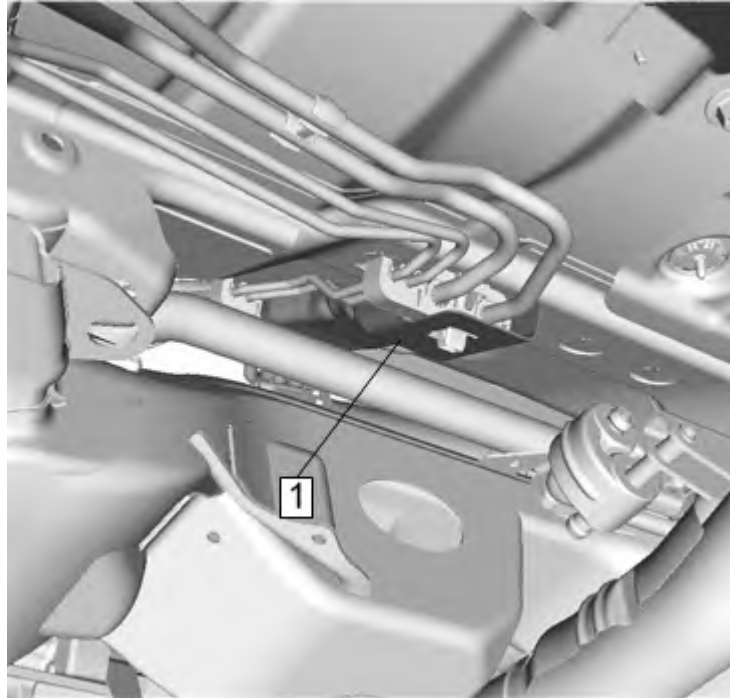


Fig. 180: Shield

Courtesy of GENERAL MOTORS COMPANY

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

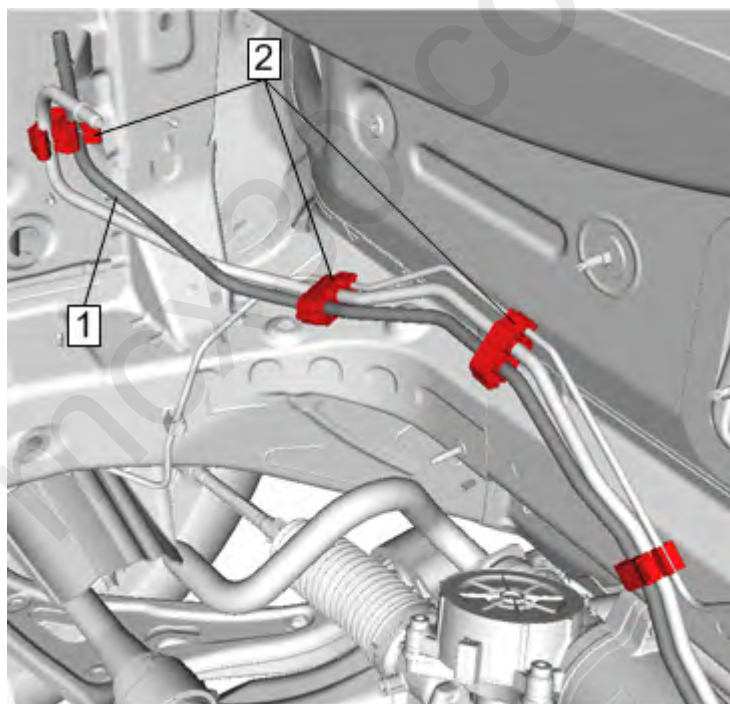


Fig. 181: Evaporative Emission Front Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Install Evaporative Emission Front Pipe(1)@Retainer(2) - [4x]
8. Install Exhaust Front Pipe - [Exhaust Front Pipe Replacement \(LYX\)](#)
9. Install Evaporative Emission Front Hose - [Evaporative Emission Front Hose Replacement](#)

EVAPORATIVE EMISSION FRONT PIPE REPLACEMENT (AWD)

Removal Procedure

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

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

1. Remove Evaporative Emission Front Hose - [Evaporative Emission Front Hose Replacement](#)

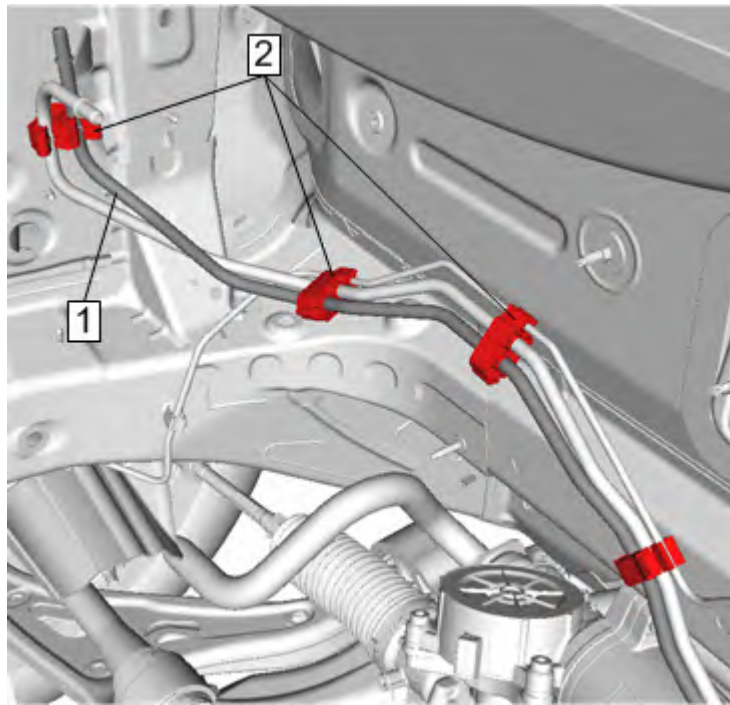


Fig. 182: Evaporative Emission Front Pipe And Retainer
Courtesy of GENERAL MOTORS COMPANY

2. Remove Evaporative Emission Front Pipe(1)@Retainer(2) - [4x]
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#) .

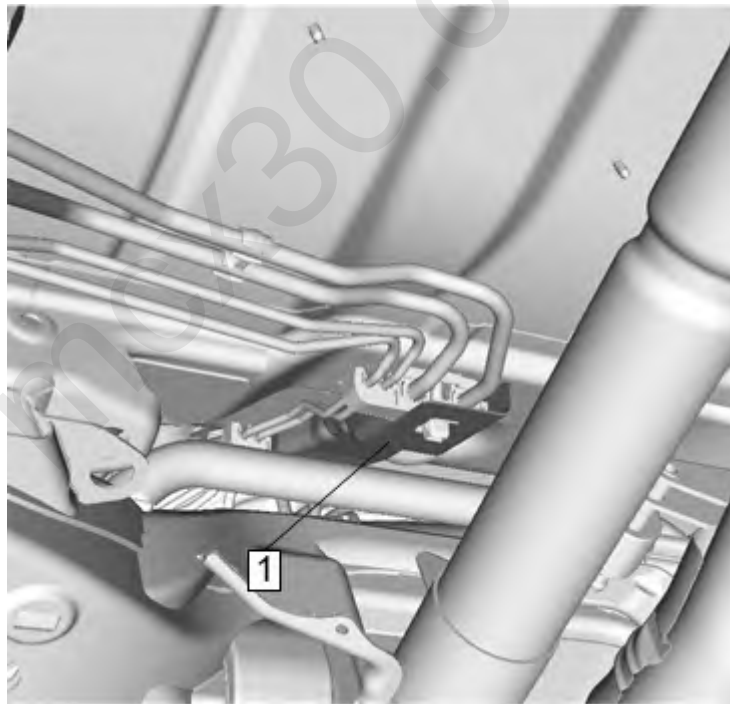


Fig. 183: Shield
Courtesy of GENERAL MOTORS COMPANY

4. Remove Shield (1) -

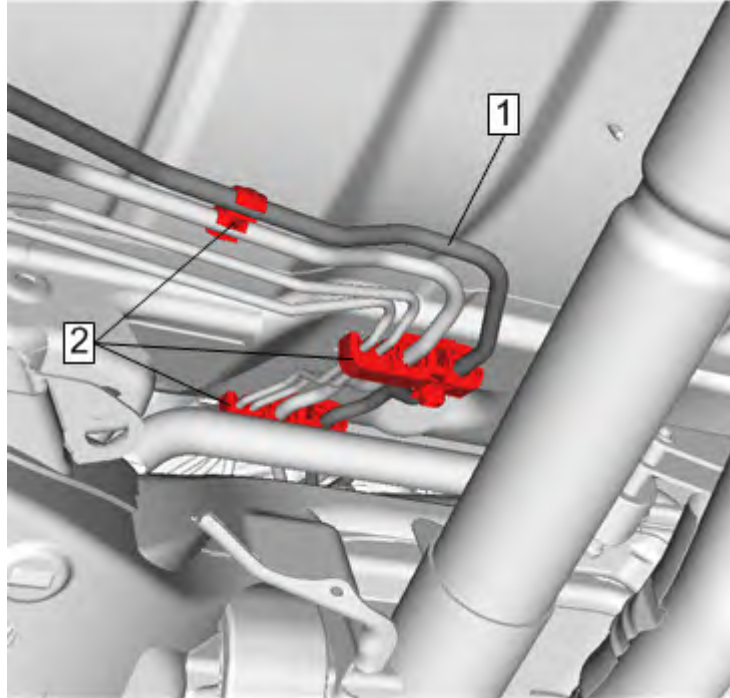


Fig. 184: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

5. Remove Evaporative Emission Front Pipe(1)@Retainer(2) - [3x]
6. Remove Underbody Rear Air Deflector - **Underbody Rear Air Deflector Replacement (All Wheel Drive)**

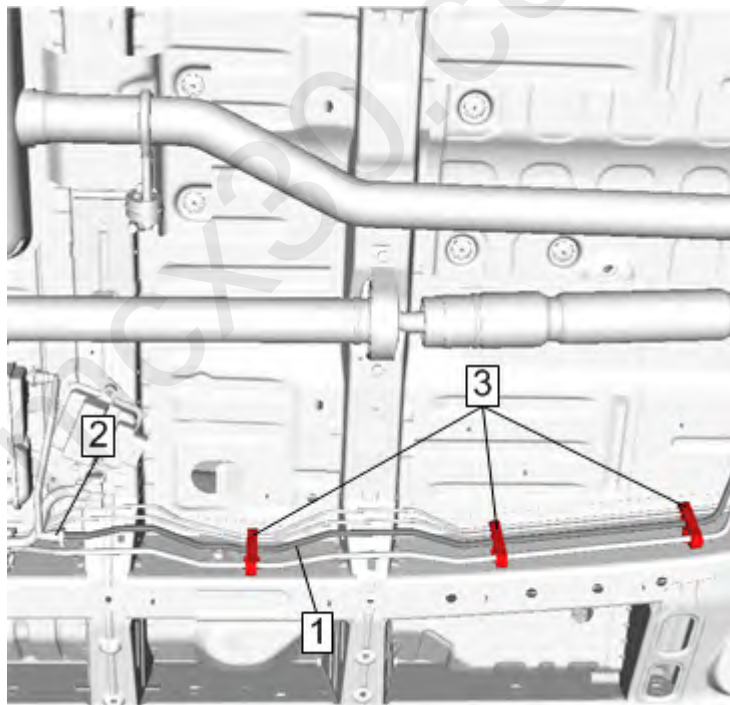


Fig. 185: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

7. Disconnect Evaporative Emission Front Pipe(1)@Evaporative Emission Canister Purge Solenoid Valve Hose(2) - **Plastic Collar Quick Connect Fitting Service**
8. Remove Evaporative Emission Front Pipe(1)@Retainer(3) - [3x]

Installation Procedure

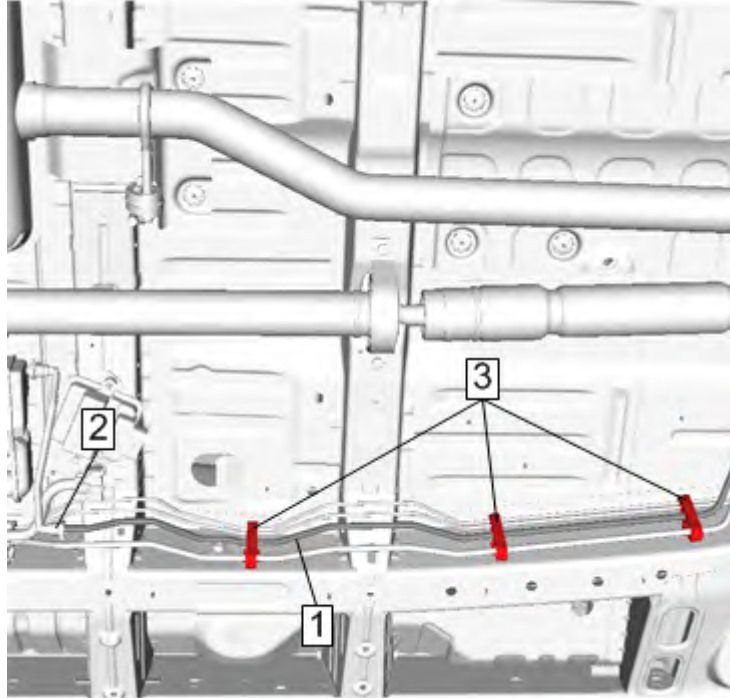


Fig. 186: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

1. Install Evaporative Emission Front Pipe(1)@Retainer(3) - [3x]
2. Connect Evaporative Emission Front Pipe(1)@Evaporative Emission Canister Purge Solenoid Valve Hose(2) - **Plastic Collar Quick Connect Fitting Service**
3. Install Underbody Rear Air Deflector - **Underbody Rear Air Deflector Replacement (All Wheel Drive)**

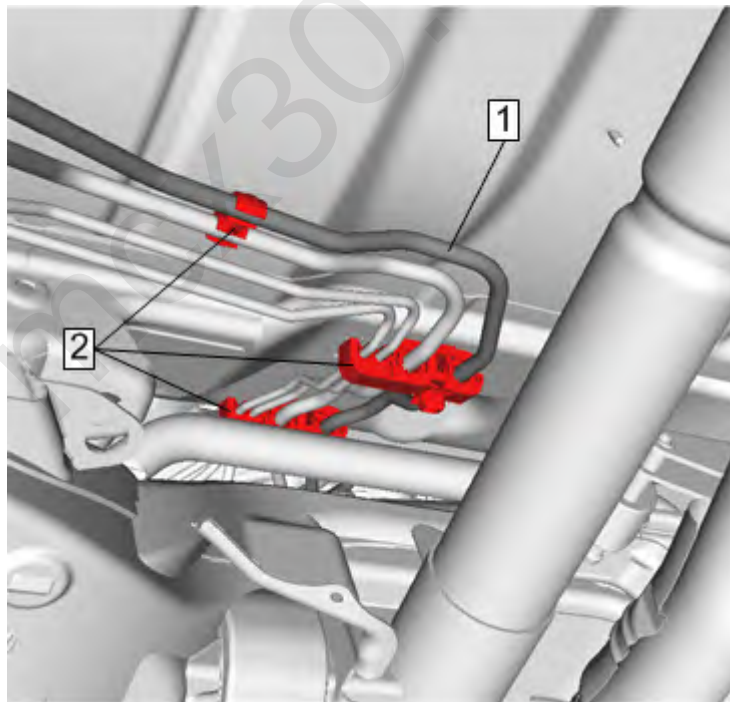


Fig. 187: Evaporative Emission Front Pipe And Retainer
 Courtesy of GENERAL MOTORS COMPANY

4. Install Evaporative Emission Front Pipe(1)@Retainer(2) - [3x]

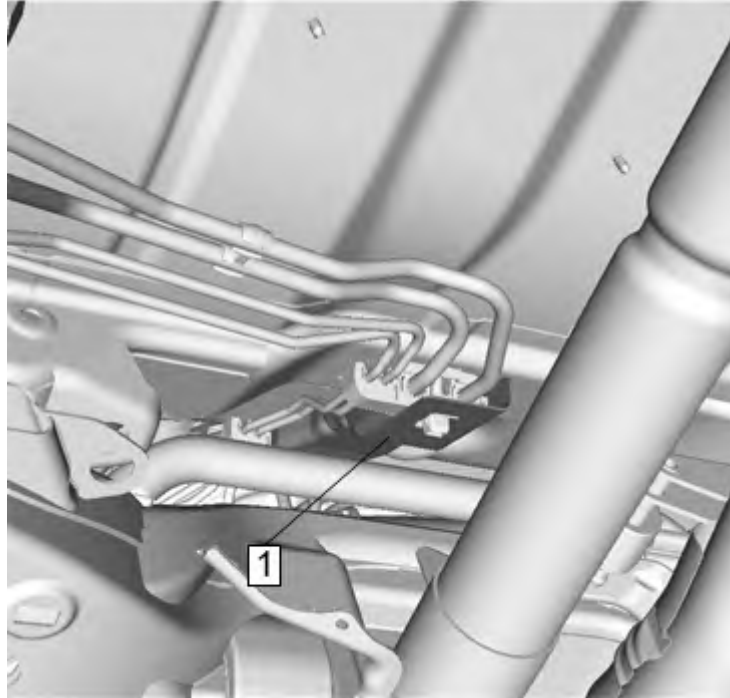


Fig. 188: Shield

Courtesy of GENERAL MOTORS COMPANY

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

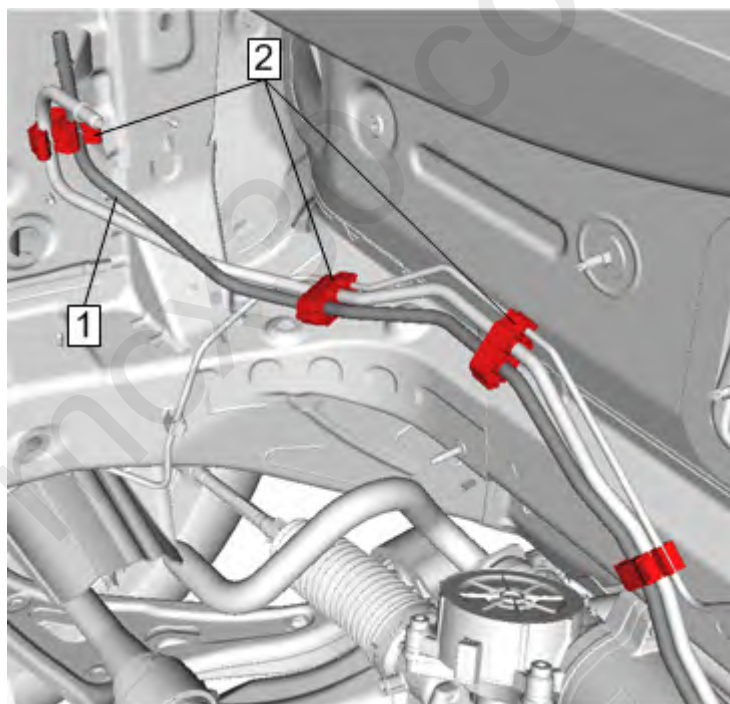


Fig. 189: Evaporative Emission Front Pipe And Retainer

Courtesy of GENERAL MOTORS COMPANY

7. Install Evaporative Emission Front Pipe(1)@Retainer(2) - [4x]
8. Install Evaporative Emission Front Hose - [Evaporative Emission Front Hose Replacement](#)

IGNITION COIL REPLACEMENT

Removal Procedure

1. Remove Intake Manifold Cover - [Intake Manifold Cover Replacement](#)
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL2\)](#)

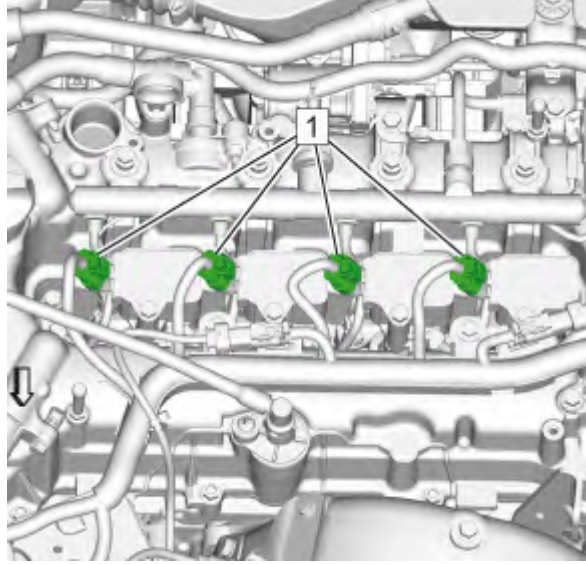


Fig. 190: Ignition Coil Electrical Connectors
 Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the electrical connectors (1).

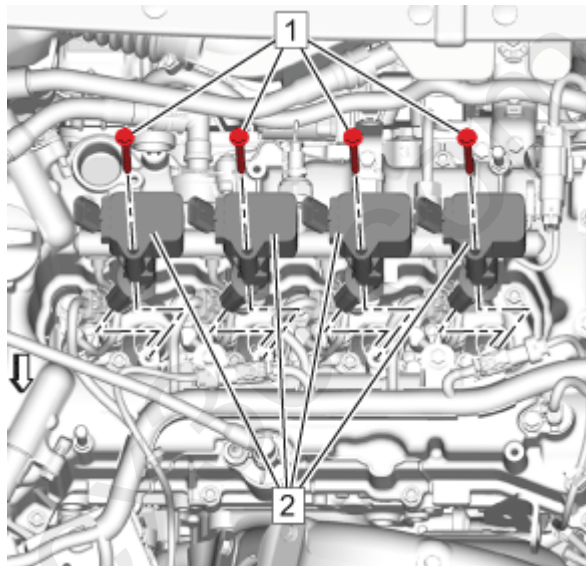


Fig. 191: Ignition Coils And Bolts
 Courtesy of GENERAL MOTORS COMPANY

4. Remove the ignition coil bolts (1).
5. Remove the ignition coils (2).

Installation Procedure

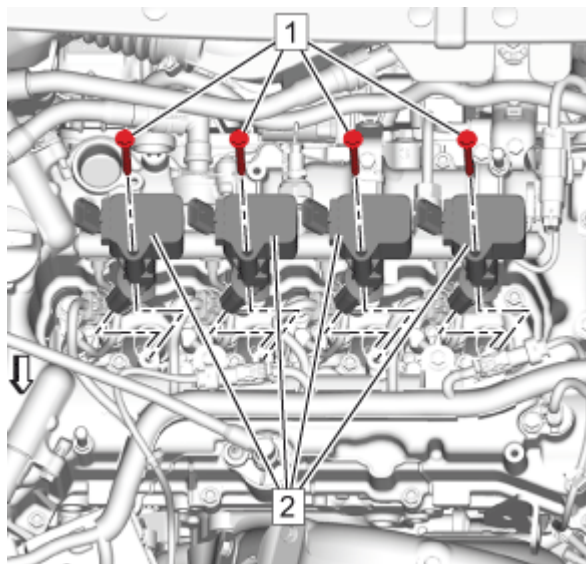


Fig. 192: Ignition Coils And Bolts
Courtesy of GENERAL MOTORS COMPANY

1. Install the ignition coils (2).

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

2. Install the ignition coil bolts (1) and tighten to 10 N.m (89 lb in).

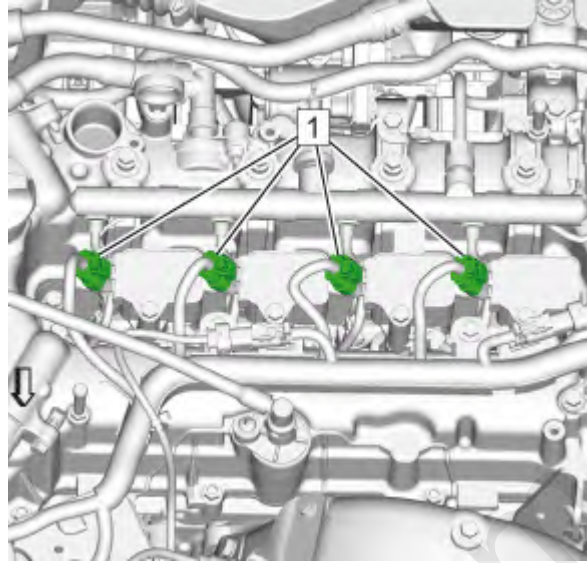


Fig. 193: Ignition Coil Electrical Connectors
Courtesy of GENERAL MOTORS COMPANY

NOTE: The ignition coil wiring harness cylinders 1 and 3 are marked white.

3. Connect the electrical connectors (1).
4. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
5. Install Intake Manifold Cover - [Intake Manifold Cover Replacement](#)

SPARK PLUG INSPECTION

Spark Plug Usage

1. Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to [Ignition System Specifications](#) for the correct spark plug.
2. Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
 - Spark plug fouling - Colder plug
 - Pre-ignition causing spark plug and/or engine damage - Hotter plug

Spark Plug Inspection

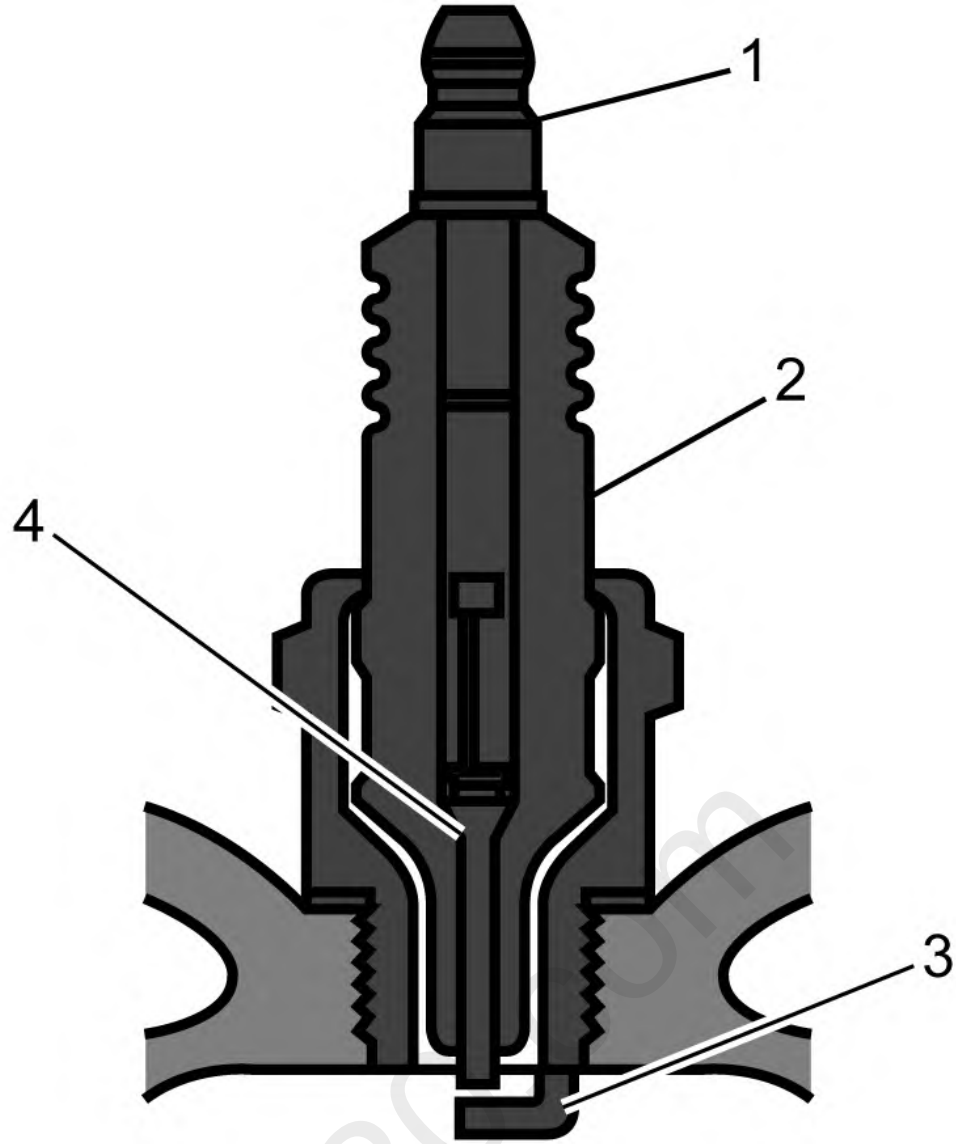


Fig. 194: Cross Sectional View Of Spark Plug
Courtesy of GENERAL MOTORS COMPANY

1. Inspect the terminal post (1) for damage.
 - Inspect for a bent or broken terminal post (1).
 - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should NOT move.

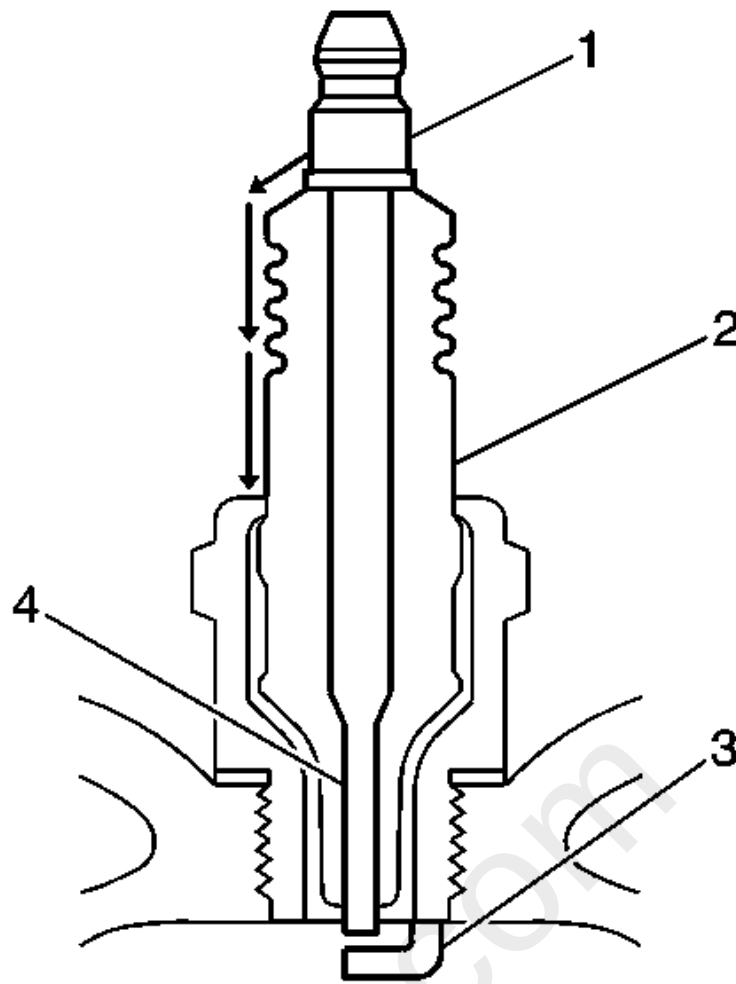


Fig. 195: Inspecting Spark Plug For Flashover Or Carbon Tracking Soot
Courtesy of GENERAL MOTORS COMPANY

2. Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:
 - Inspect the spark plug boot for damage.
 - Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated causes arcing to ground.

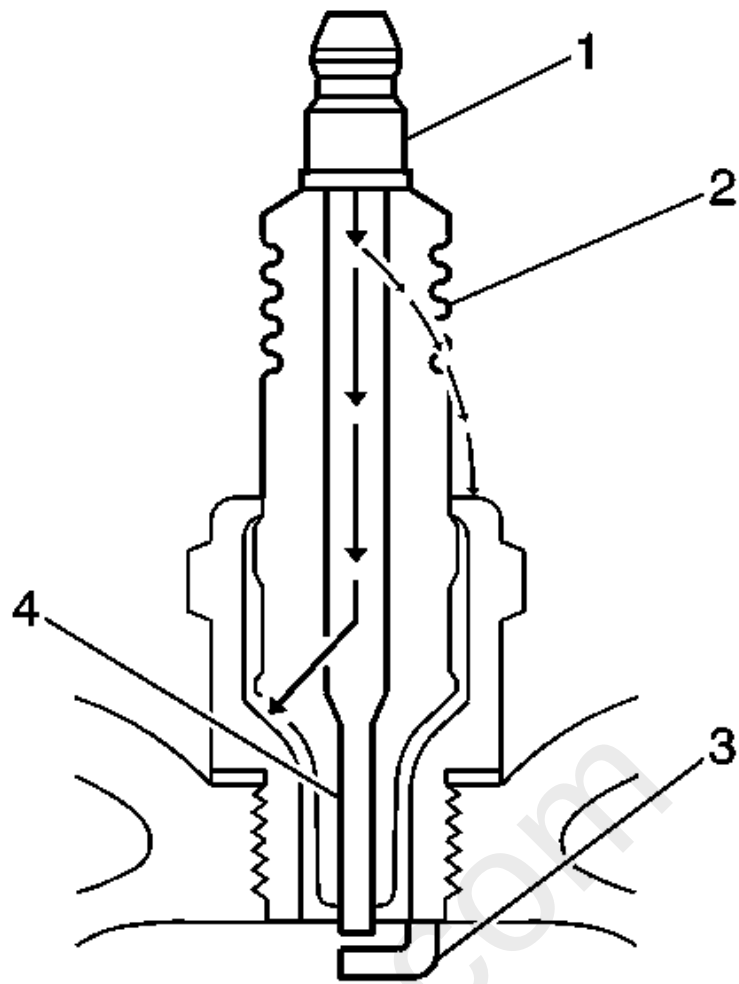


Fig. 196: Inspecting Spark Plug Insulator
Courtesy of GENERAL MOTORS COMPANY

3. Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).

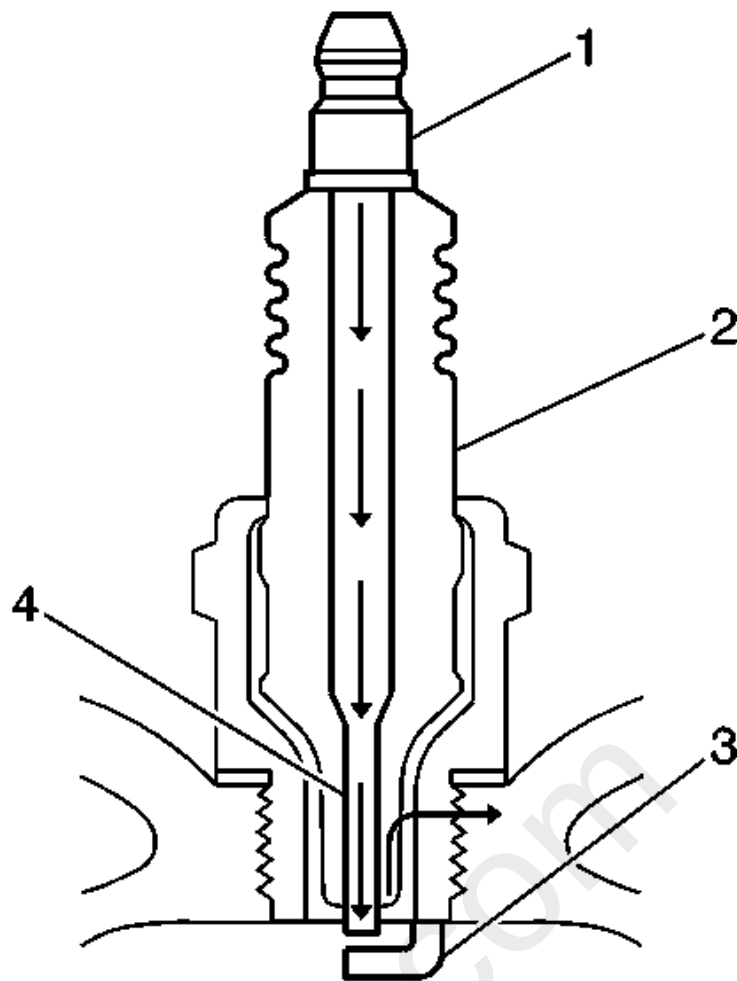


Fig. 197: Cutaway/Description View Of Spark Plug
Courtesy of GENERAL MOTORS COMPANY

4. Inspect for evidence of improper arcing.
 - Measure the gap between the center electrode (4) and the side electrode (3) terminals. Refer to **Ignition System Specifications** . An excessively wide electrode gap can prevent correct spark plug operation.
 - Inspect for the correct spark plug torque. Insufficient torque can prevent correct spark plug operation. An over torqued spark plug, causes the insulator (2) to crack.
 - Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
 - Inspect for a broken or worn side electrode (3).
 - Inspect for a broken, worn, or loose center electrode (4) by shaking the spark plug.
5. A rattling sound indicates internal damage.
6. A loose center electrode (4) reduces the spark intensity.
 - Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
 - Inspect for worn or missing platinum pads on the electrodes (3, 4) If equipped.
 - Inspect for excessive fouling.
 - Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

Spark Plug Visual Inspection

1. Normal operation - Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
2. Carbon Fouled - Dry, fluffy black carbon, or soot caused by the following conditions:

- Rich fuel mixtures
- Leaking fuel injectors
- Excessive fuel pressure
- Restricted air filter element
- Incorrect combustion
- Reduced ignition system voltage output
- Weak coils
- Worn ignition wires
- Incorrect spark plug gap
- Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
- Deposit Fouling - Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

SPARK PLUG REPLACEMENT

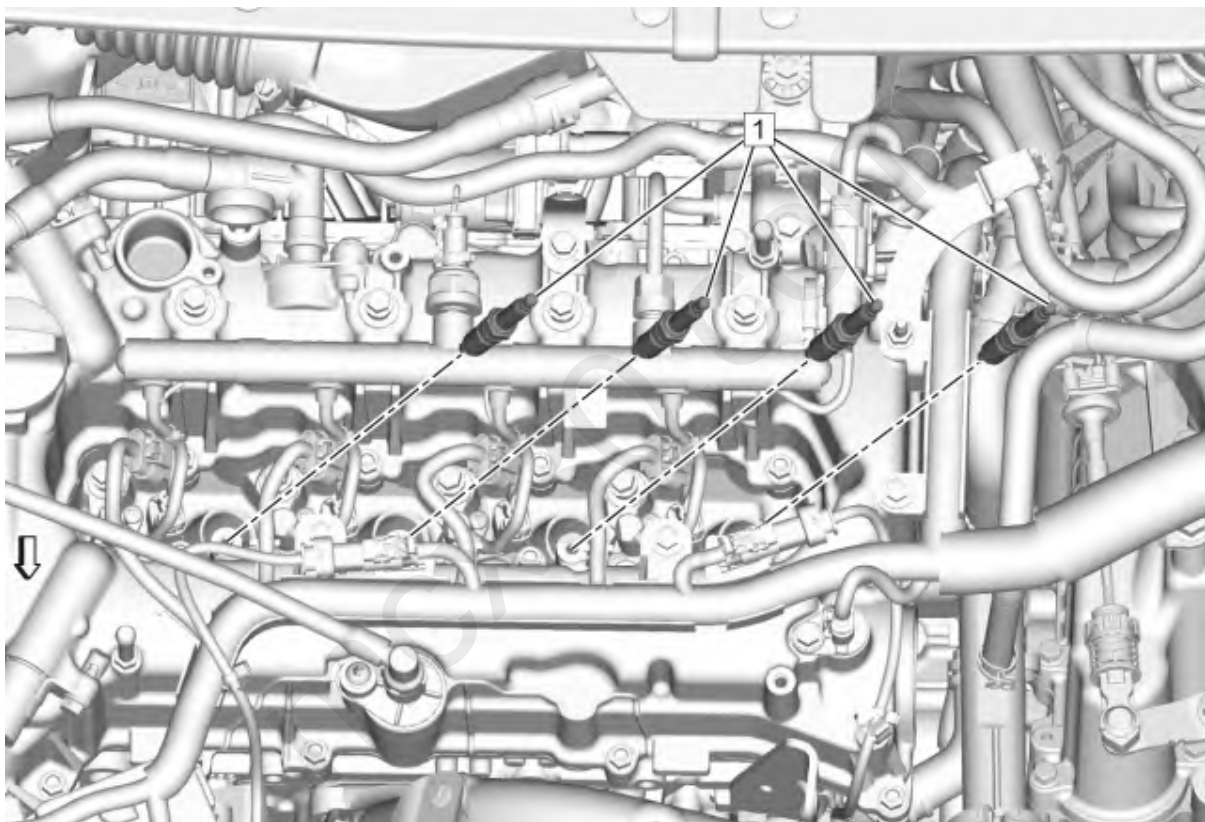


Fig. 198: Spark Plugs

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Ignition Coil Replacement	
1	Spark Plug[4x] CAUTION: Refer to: <u>Component Fastener Tightening Caution</u> Tighten 17 N.m (13 lb ft)

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT - INTAKE

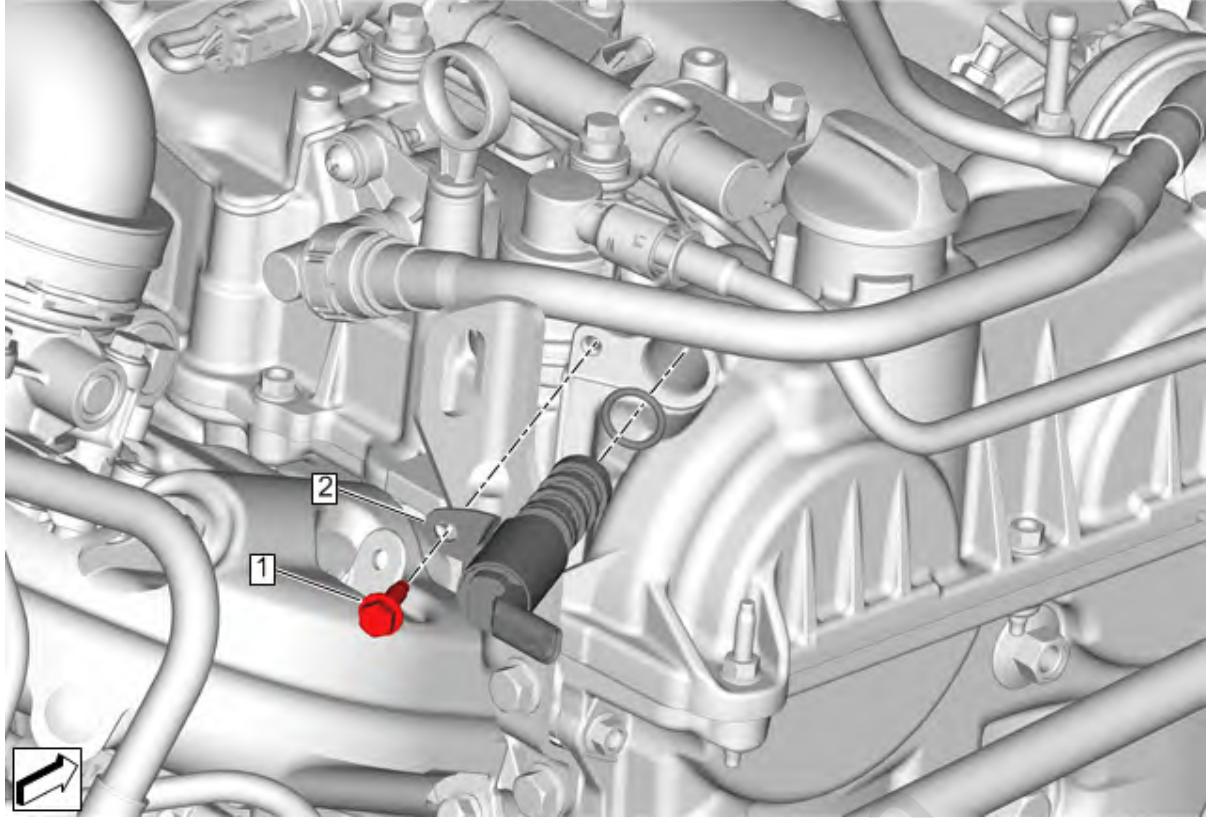


Fig. 199: Camshaft Position Actuator Solenoid Valve - Intake
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Actuator Solenoid Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Actuator Solenoid Valve Procedure 1. Disconnect the electrical connector. 2. Install a NEW O-ring seal.

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT - EXHAUST

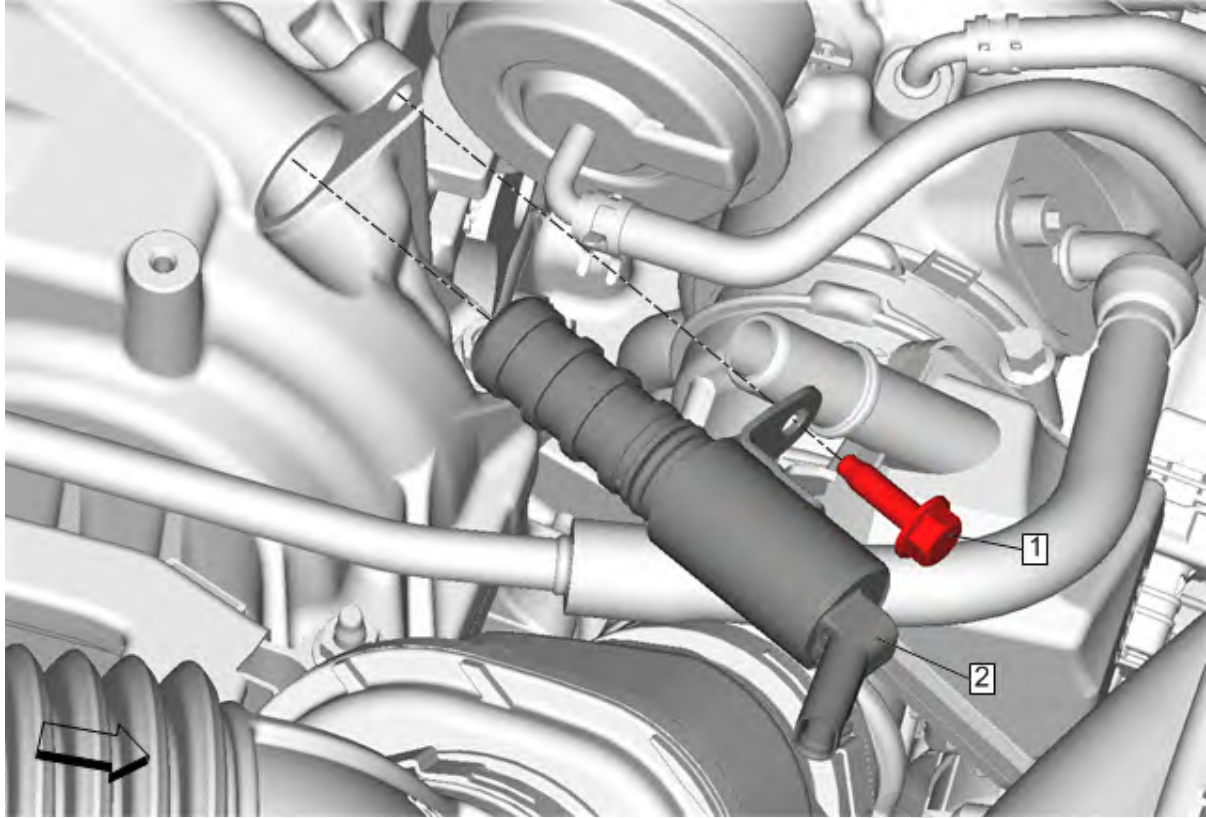


Fig. 200: Camshaft Position Actuator Solenoid Valve - Exhaust
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Actuator Solenoid Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Actuator Solenoid Valve Procedure 1. Disconnect the electrical connector. 2. Install a NEW seal if reinstalling the solenoid valve.

CRANKSHAFT POSITION SENSOR REPLACEMENT (FWD)

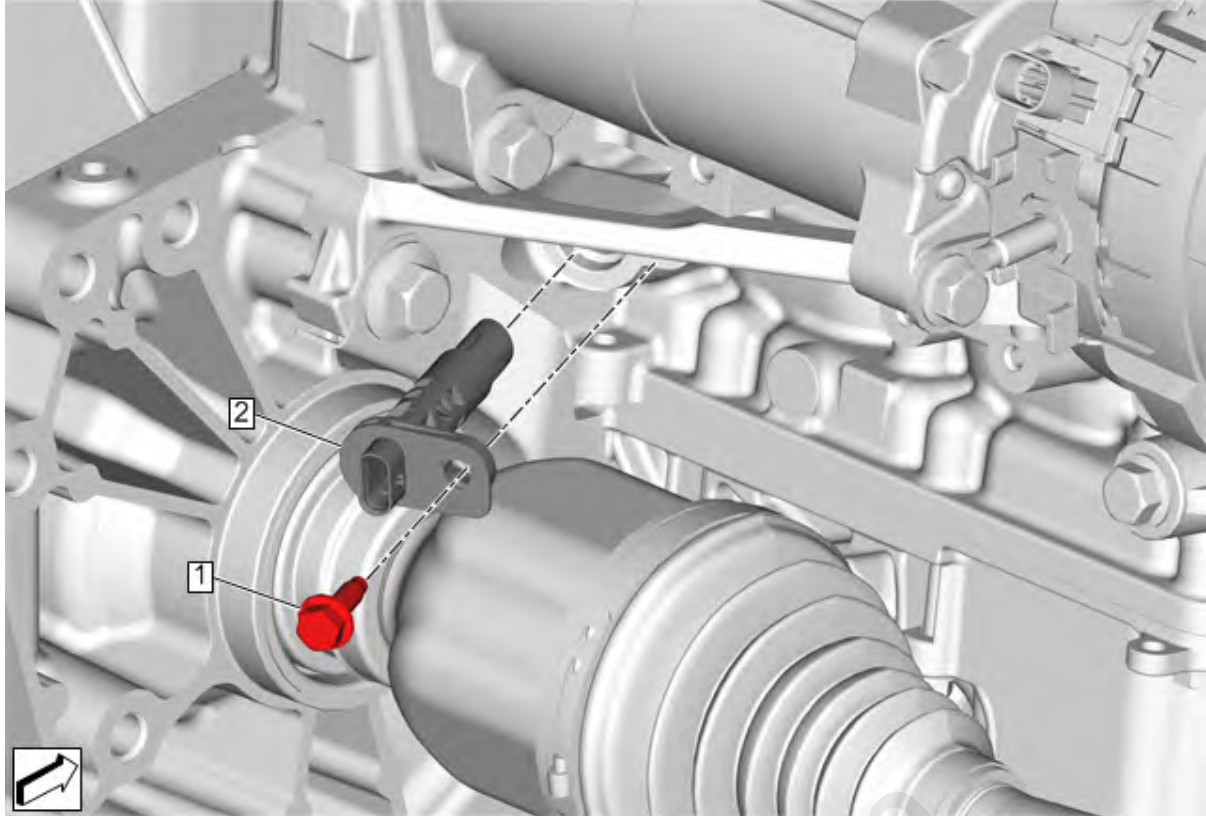


Fig. 201: Crankshaft Position Sensor (FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection (KL9). 2. Raise and support the vehicle. Lifting and Jacking the Vehicle 3. Disconnect the electrical connector.	
1	Crankshaft Position Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Crankshaft Position Sensor Procedure Perform the crankshaft position variation learn. Crankshaft Position Variation Learn

CRANKSHAFT POSITION SENSOR REPLACEMENT (AWD)

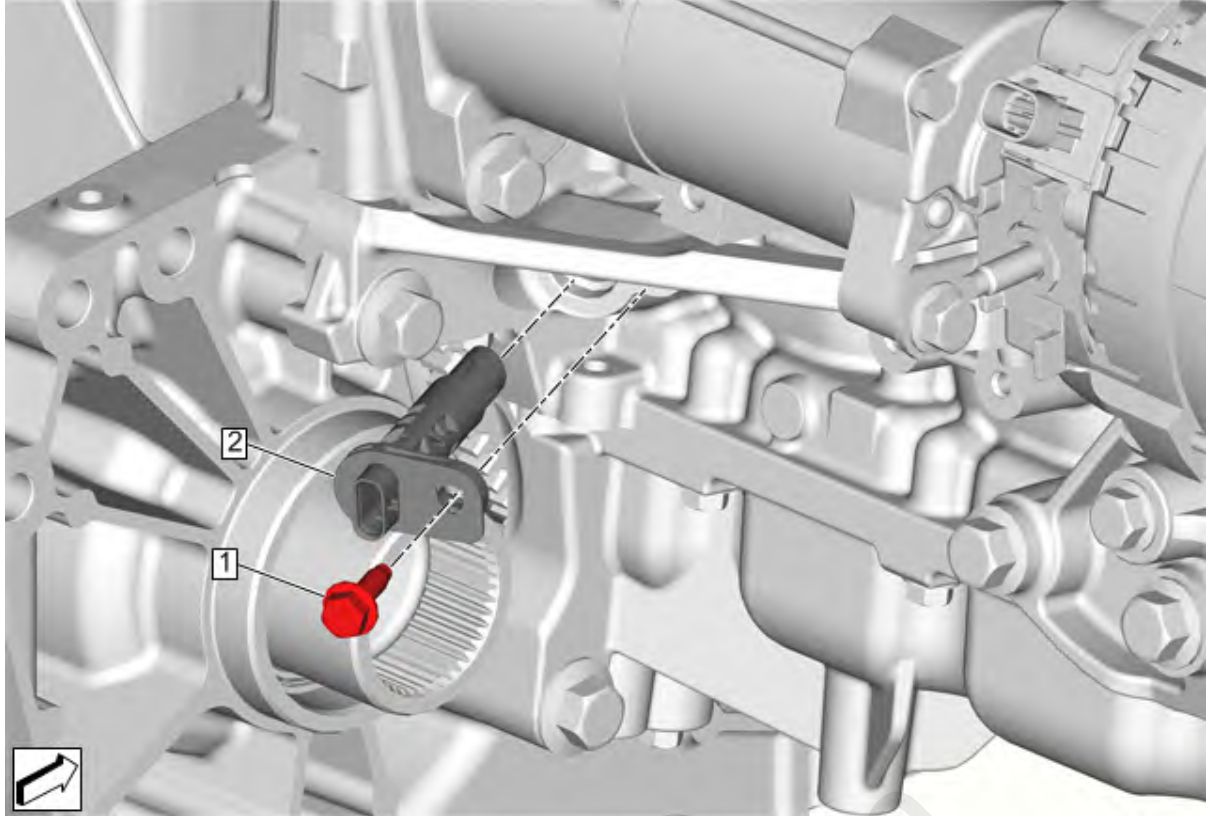


Fig. 202: Crankshaft Position Sensor (AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the battery negative cable. Battery Negative Cable Disconnection and Connection (KL9). 2. Power Transfer Unit Case Replacement (MNH Transmission with LYX Engine). 3. Disconnect the electrical connector.	
1	Crankshaft Position Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Crankshaft Position Sensor Procedure Perform the crankshaft position variation learn. Crankshaft Position Variation Learn

CAMSHAFT POSITION SENSOR REPLACEMENT - INTAKE

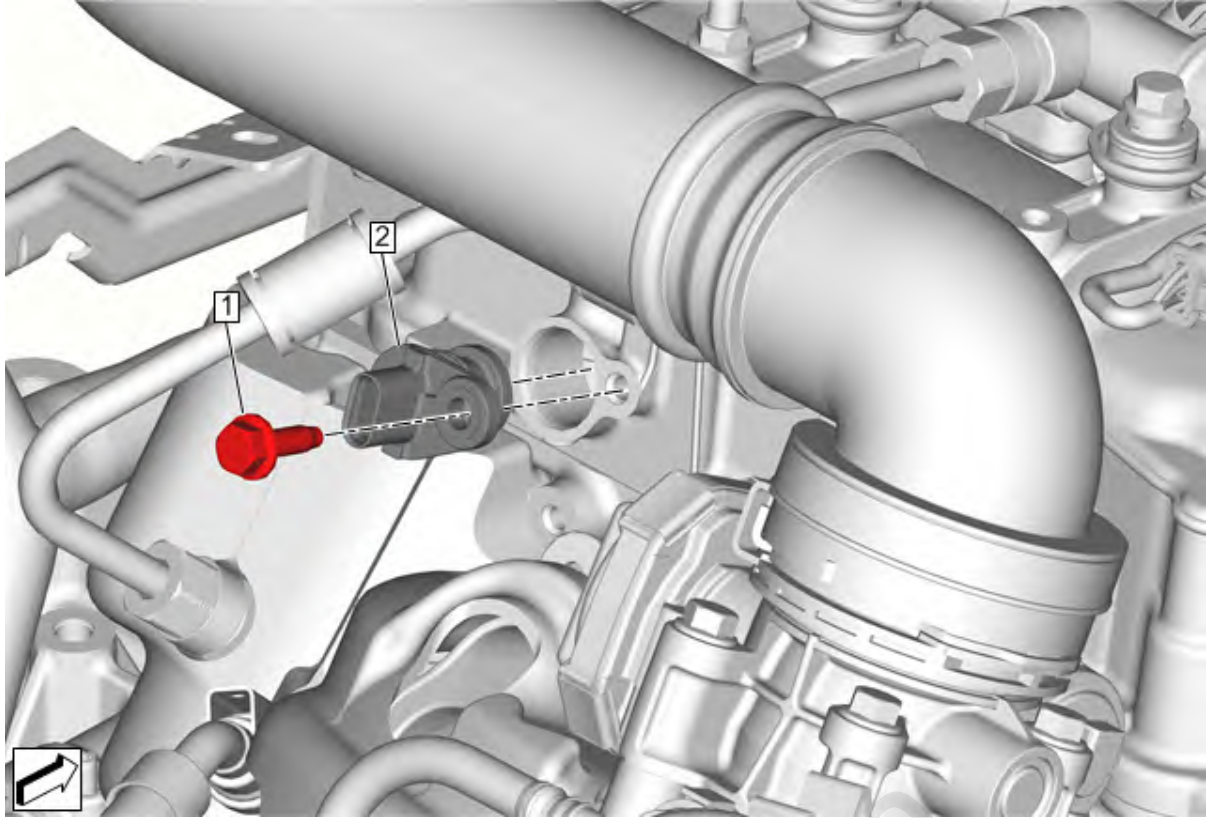


Fig. 203: Camshaft Position Sensor - Intake
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Sensor Procedure 1. Disconnect the electrical connector. 2. Install a NEW seal if not replacing the sensor.

CAMSHAFT POSITION SENSOR REPLACEMENT - EXHAUST

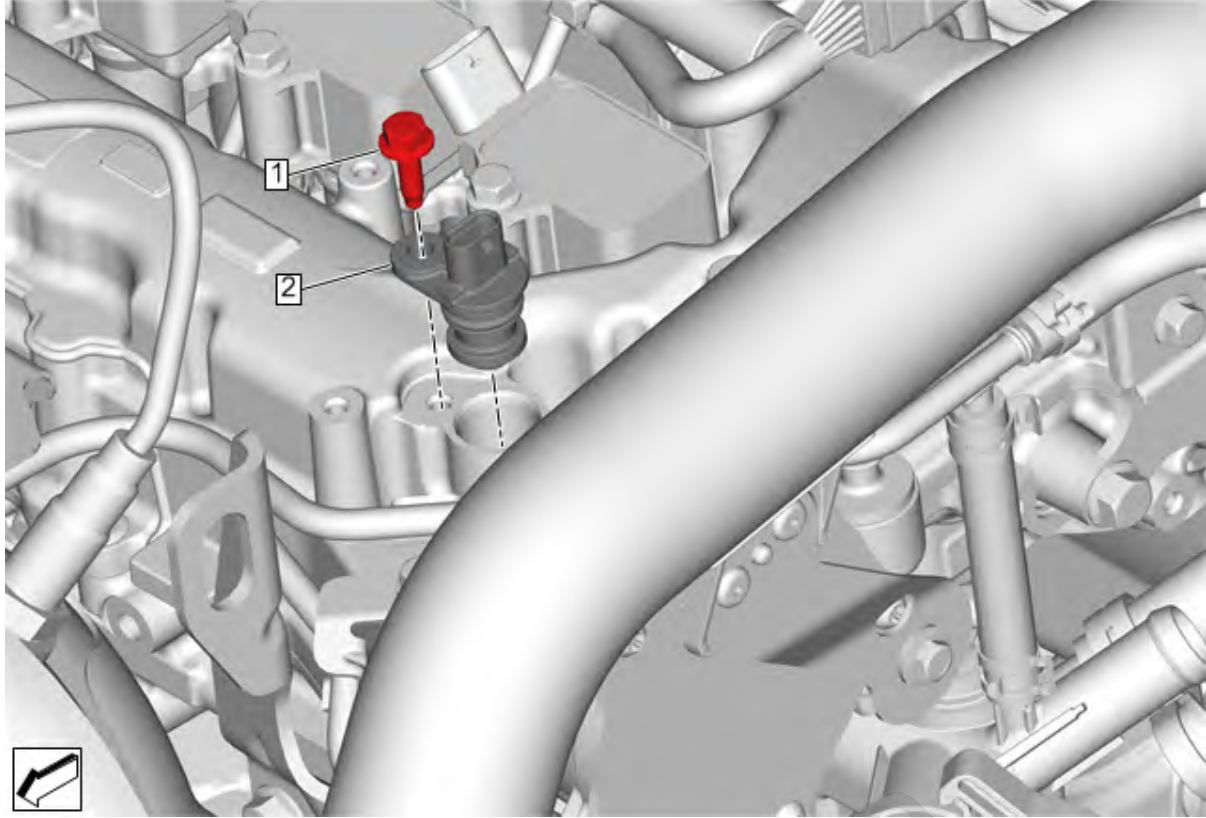


Fig. 204: Camshaft Position Sensor - Exhaust
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Sensor Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Sensor Procedure 1. Disconnect the electrical connector. 2. Install a NEW seal if not replacing the sensor.

CAMSHAFT POSITION ACTUATOR LOCATING PIN CONTROL VALVE REPLACEMENT

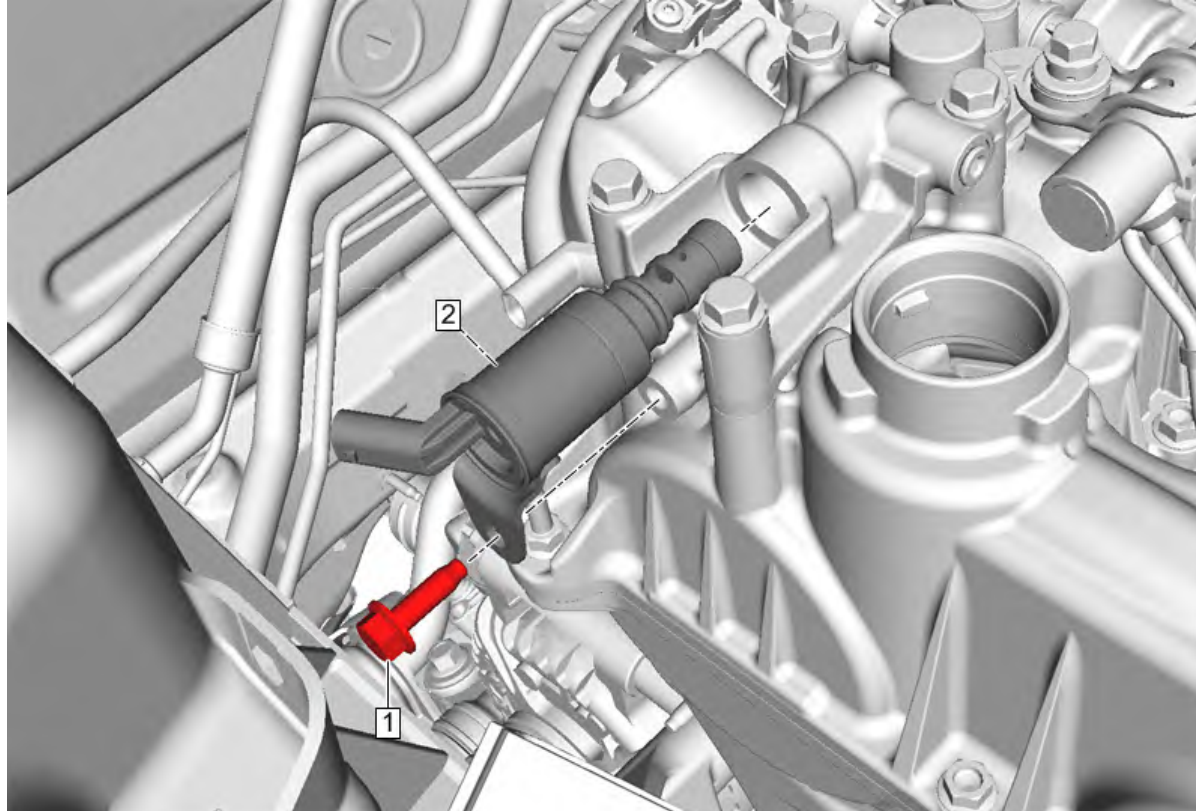


Fig. 205: Camshaft Position Actuator Locating Pin Control Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Camshaft Position Actuator Locating Pin Control Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 10 N.m (89 lb in)
2	Camshaft Position Actuator Locating Pin Control Valve Procedure 1. Disconnect the electrical connector. 2. If reusing the OLD control valve, install a NEW seal. NOTE: A NEW control valve will come with a NEW seal.

VACUUM PUMP ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect Power Brake Booster Vacuum Pipe@Vacuum Pump Assembly - Power Brake Booster Vacuum Pipe Replacement (LYX)
2. Remove Charge Air Cooler Outlet Air Tube - Charge Air Cooler Outlet Air Tube Replacement

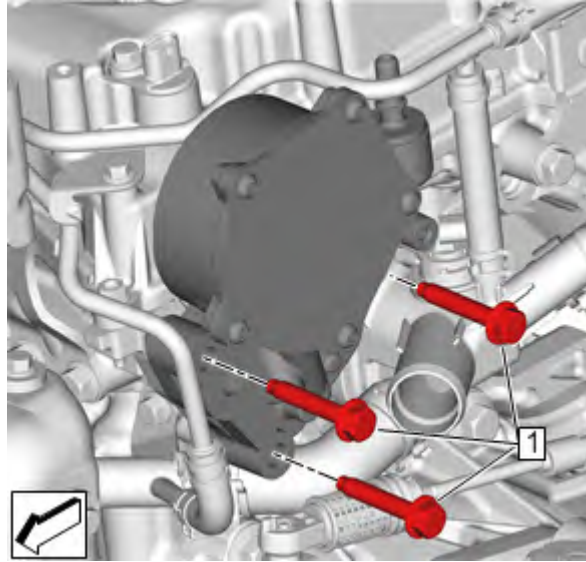


Fig. 206: Vacuum Pump Bolts

Courtesy of GENERAL MOTORS COMPANY

3. Remove the vacuum pump bolts (1).

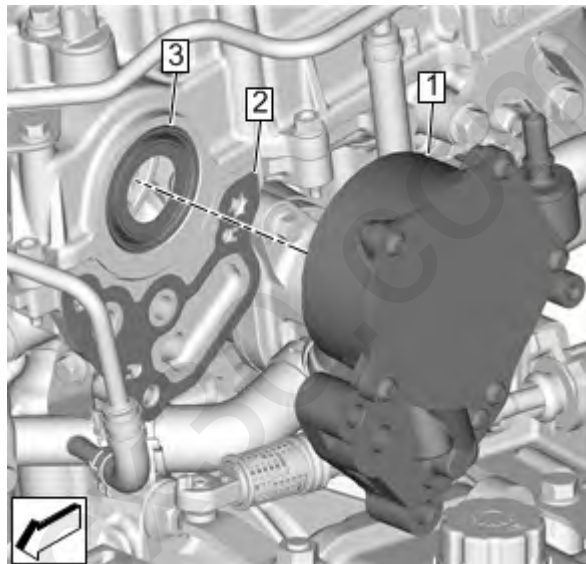


Fig. 207: Vacuum Pump

Courtesy of GENERAL MOTORS COMPANY

4. Remove the vacuum pump (1).
5. Remove and DISCARD the vacuum pump gasket (2).
6. Inspect the vacuum pump seal (3) and replace if necessary. [Vacuum Pump Seal Replacement](#)

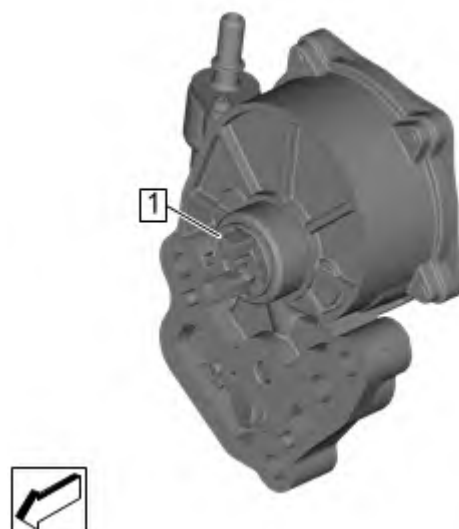


Fig. 208: Vacuum Pump Shaft

Courtesy of GENERAL MOTORS COMPANY

7. If replacing the vacuum pump, turn the NEW vacuum pump shaft (1) to match the position of the OLD vacuum pump shaft to allow proper alignment with the engine camshaft.

Installation Procedure

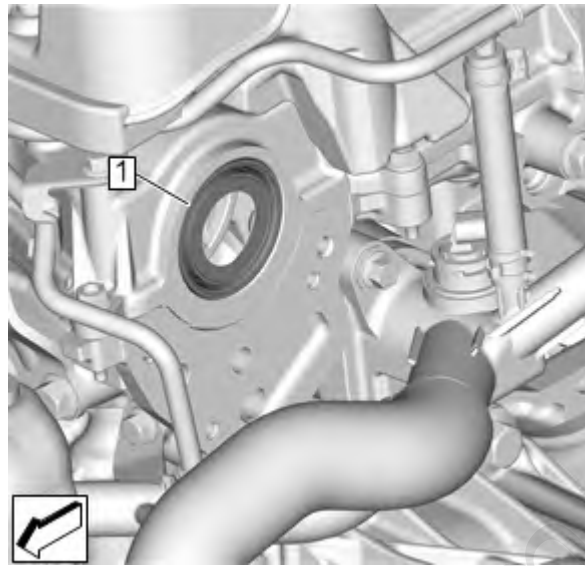


Fig. 209: Vacuum Pump Seal

Courtesy of GENERAL MOTORS COMPANY

1. Lubricate the vacuum pump seal (1) with clean engine oil before installing the vacuum pump.

Adhesives, Fluids, Lubricants, and Sealers

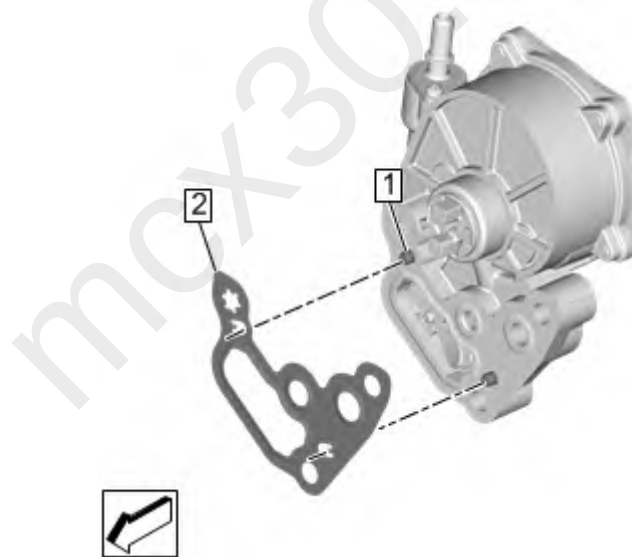


Fig. 210: Vacuum Pump Locating Pins & Gasket

Courtesy of GENERAL MOTORS COMPANY

2. Before continuing, make sure that the vacuum pump locating pins (1) are installed in the vacuum pump.
3. Install the vacuum pump gasket (2) over the vacuum pump locating pins (1).

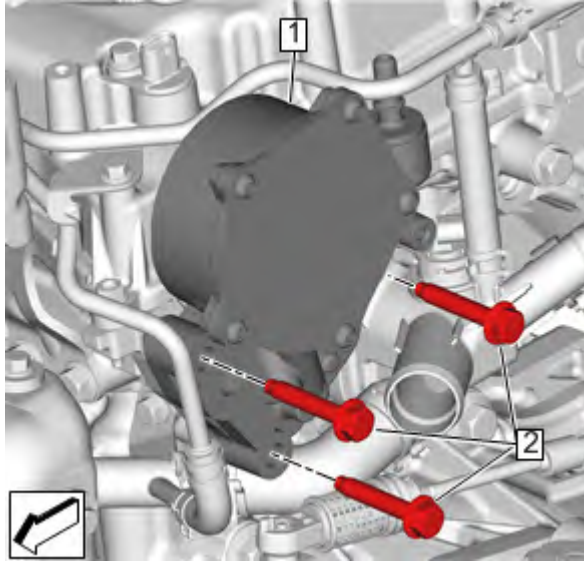


Fig. 211: Vacuum Pump And Bolts

Courtesy of GENERAL MOTORS COMPANY

4. Install the vacuum pump (1) and start the vacuum pump bolts (2) by hand.

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

5. Tighten the vacuum pump bolts (2) to:

1. First Pass: 15 N.m (11 lb ft)

2. Final Pass: 25 N.m (18 lb ft)

6. Install Charge Air Cooler Outlet Air Tube - [Charge Air Cooler Outlet Air Tube Replacement](#)

7. Install Power Brake Booster Vacuum Pipe@Vacuum Pump Assembly - [Power Brake Booster Vacuum Pipe Replacement \(LYX\)](#).

VACUUM PUMP SEAL REPLACEMENT

Special Tools

DT-45866 Seal Installer

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

Removal Procedure

1. Remove Engine Control Module Bracket - [Engine Control Module Bracket Replacement](#)
2. Reposition the engine wiring harness junction block.
3. Remove Vacuum Pump Assembly - [Vacuum Pump Assembly Replacement](#)

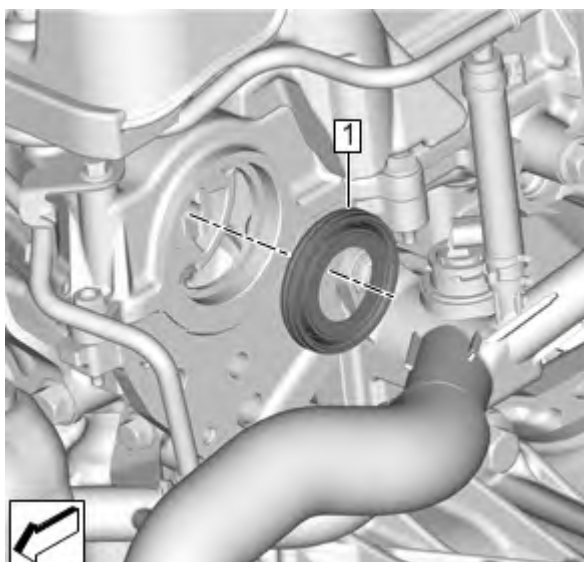


Fig. 212: Vacuum Pump Seal

Courtesy of GENERAL MOTORS COMPANY

4. Remove and DISCARD the vacuum pump seal (1) with a suitable tool.

Installation Procedure

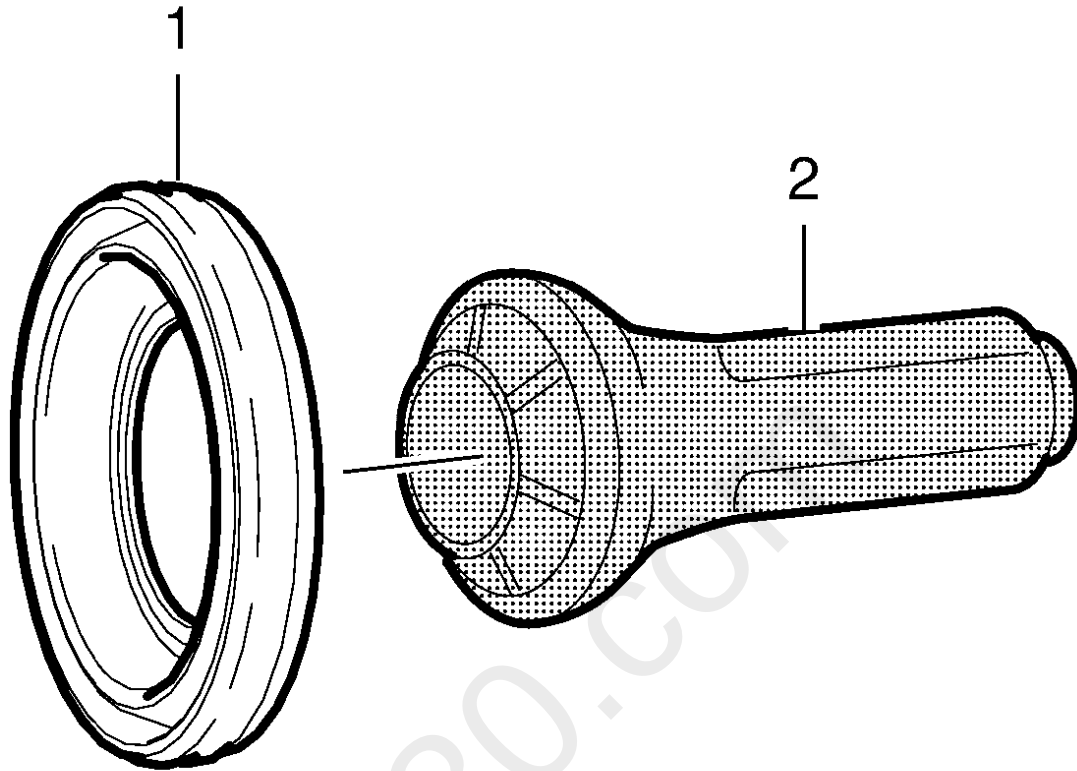


Fig. 213: Vacuum Pump Seal And Installer

Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the NEW vacuum pump seal with clean engine oil before installing to the special tool.

1. Install the NEW vacuum pump seal (1) to the **DT-45866** installer (2).

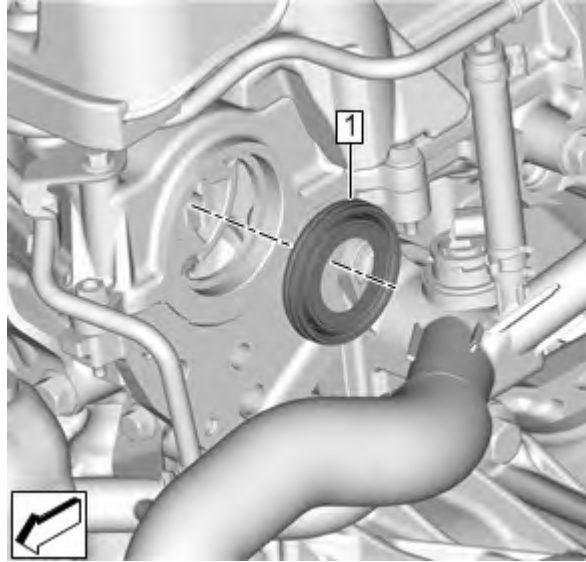


Fig. 214: Vacuum Pump Seal

Courtesy of GENERAL MOTORS COMPANY

NOTE:

- The vacuum pump seal must NOT deform during the installation procedure.
- Ensure the vacuum pump seal is FULLY seated into the camshaft cover.

2. Use the **DT-45866** installer to install the NEW vacuum pump seal (1) into the camshaft cover.
3. Install Vacuum Pump Assembly - [Vacuum Pump Assembly Replacement](#)
4. Position the engine wiring harness junction block.
5. Install Engine Control Module Bracket - [Engine Control Module Bracket Replacement](#)

AIR CLEANER ASSEMBLY REPLACEMENT

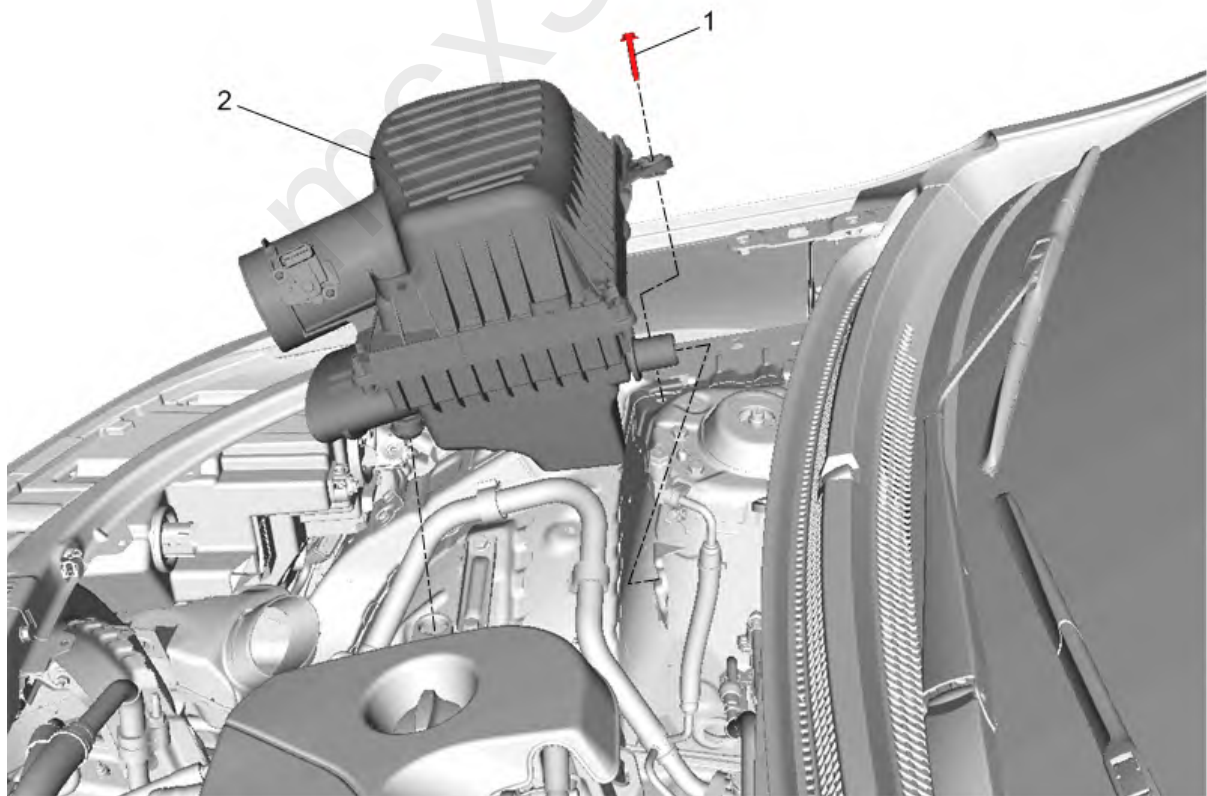


Fig. 215: Air Cleaner Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
Preliminary Procedure 1. Air Cleaner Outlet Duct Replacement 2. Intake Air Duct Replacement 3. Disconnect the electrical connector. 4. Remove the two wiring harness retainers from the air cleaner assembly.	
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. Transfer parts as necessary.

AIR CLEANER ELEMENT REPLACEMENT

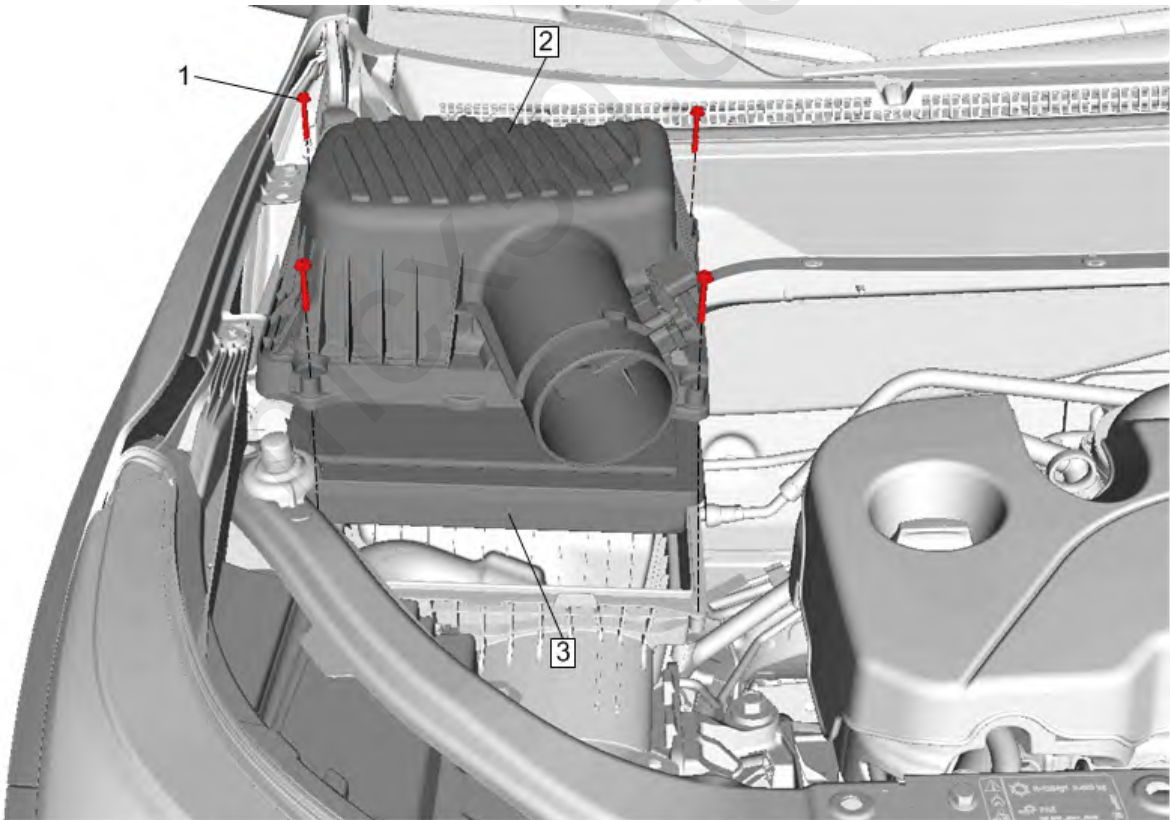


Fig. 216: Air Cleaner Element
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Air Cleaner Outlet Duct Replacement 2. Disconnect the electrical connector.	

Callout	Component Name
1	Air Cleaner Upper Housing Bolt CAUTION: Refer to Fastener Caution . Tighten 4 N.m (35 lb in)
2	Air Cleaner Upper Housing
3	Air Cleaner Element NOTE: Align the tab on the filter element to the correct position on the lower housing.

AIR CLEANER OUTLET DUCT REPLACEMENT

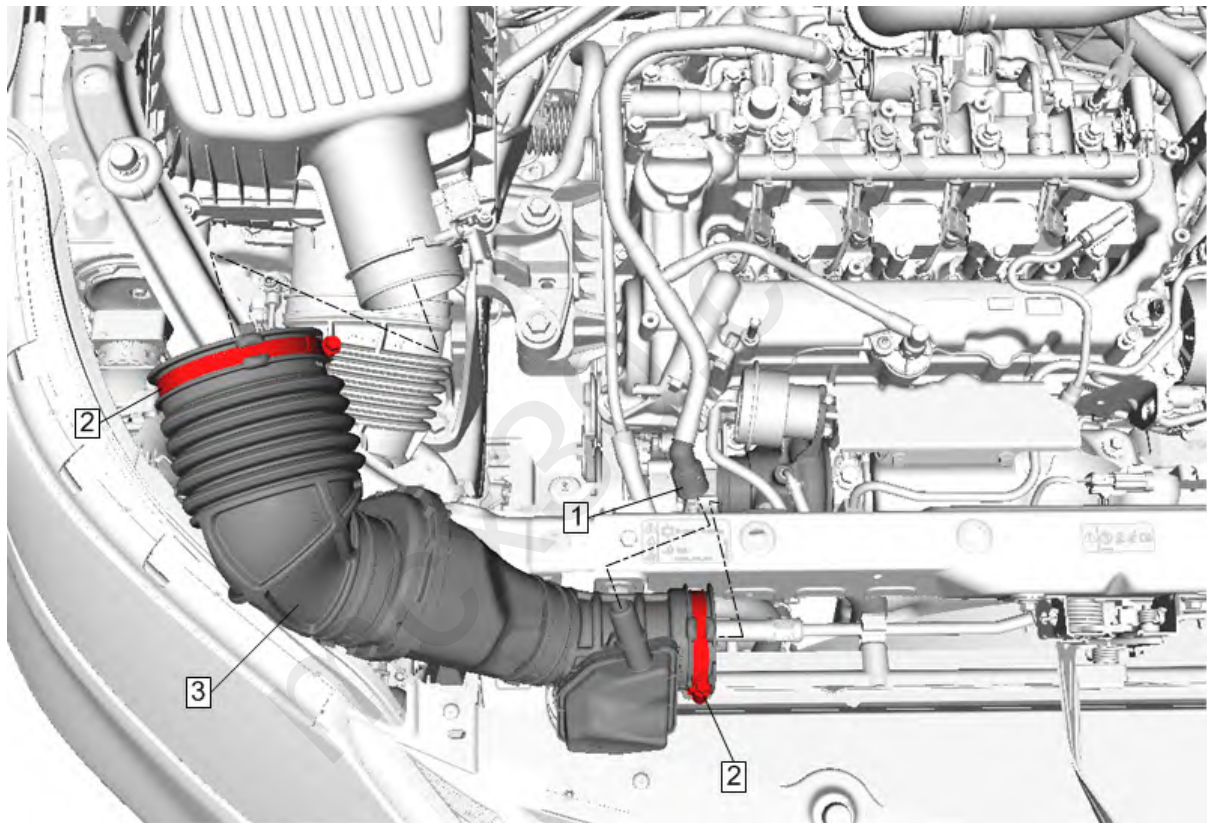


Fig. 217: Air Cleaner Outlet Duct
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Positive Crankcase Ventilation Tube Procedure Disconnect Positive Crankcase Ventilation Tube@Air Cleaner Outlet Duct - Positive Crankcase Ventilation Tube Replacement (Fresh Air) . Positive Crankcase Ventilation Tube Replacement (Foul Air) .
2	Air Cleaner Outlet Duct Clamp [2x] CAUTION: Refer to Fastener Caution . Tighten 3.5 N.m (31 lb in)

Callout	Component Name
3	Air Cleaner Outlet Duct

CHARGE AIR COOLER OUTLET AIR TUBE REPLACEMENT

Removal Procedure

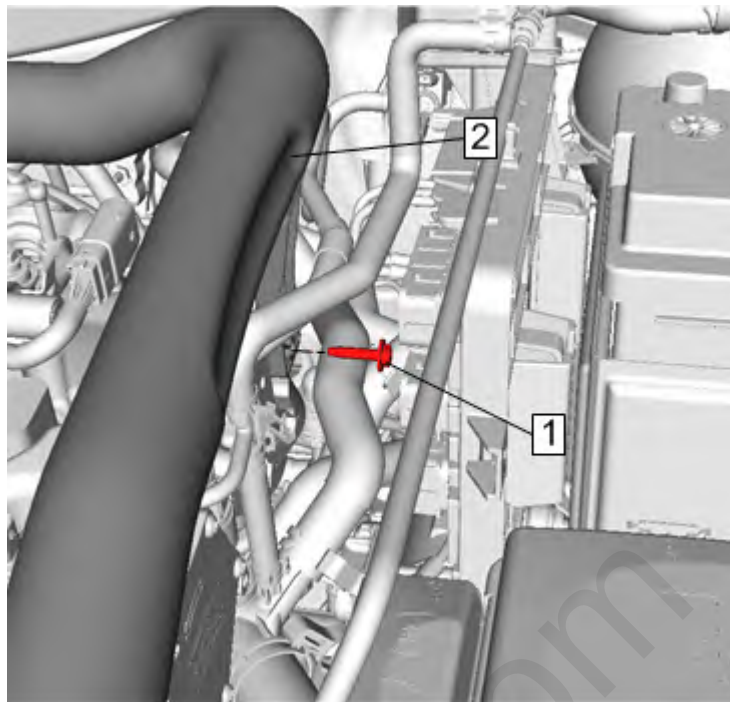


Fig. 218: Charge Air Cooler Bracket Bolt
 Courtesy of GENERAL MOTORS COMPANY

1. Remove Charge Air Cooler Bracket Bolt(1)@Charge Air Cooler Outlet Air Tube (2)

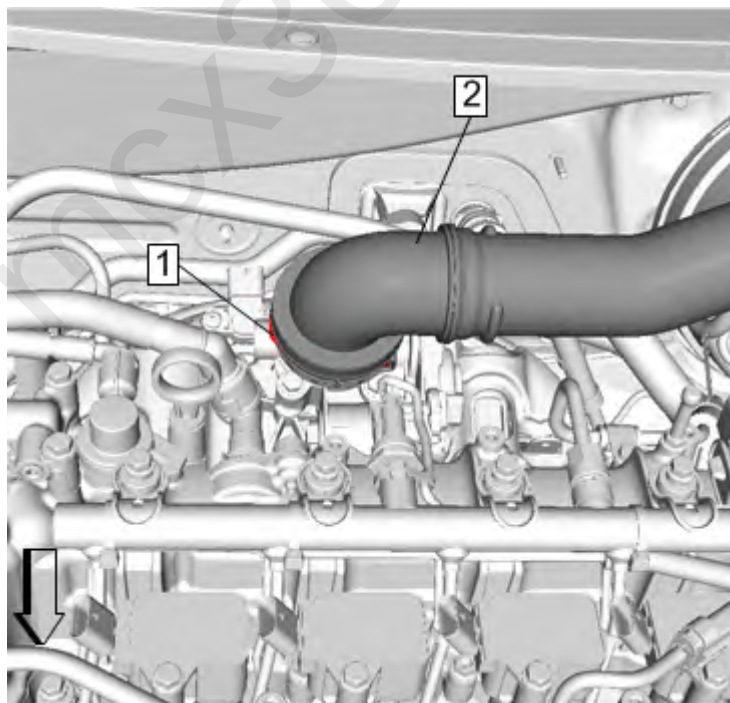


Fig. 219: Charge Air Cooler Outlet Air Tube And Retainer Spring
 Courtesy of GENERAL MOTORS COMPANY

2. Release Retainer Spring (1)
3. Remove Charge Air Cooler Outlet Air Tube (2)
4. Remove Underbody Front Air Deflector - [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#)

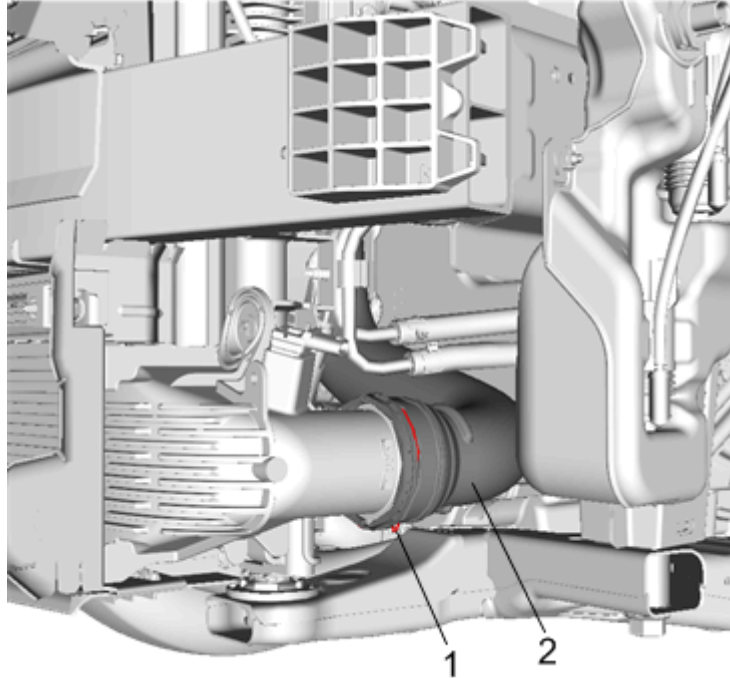


Fig. 220: Charge Air Cooler Outlet Air Tube And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

5. Release Retainer Spring (1)
6. Remove Charge Air Cooler Outlet Air Tube (2)
7. Remove the charge air cooler outlet air tube assembly (2) from the vehicle.

Installation Procedure

1. Install the charge air cooler outlet air tube assembly to the vehicle.

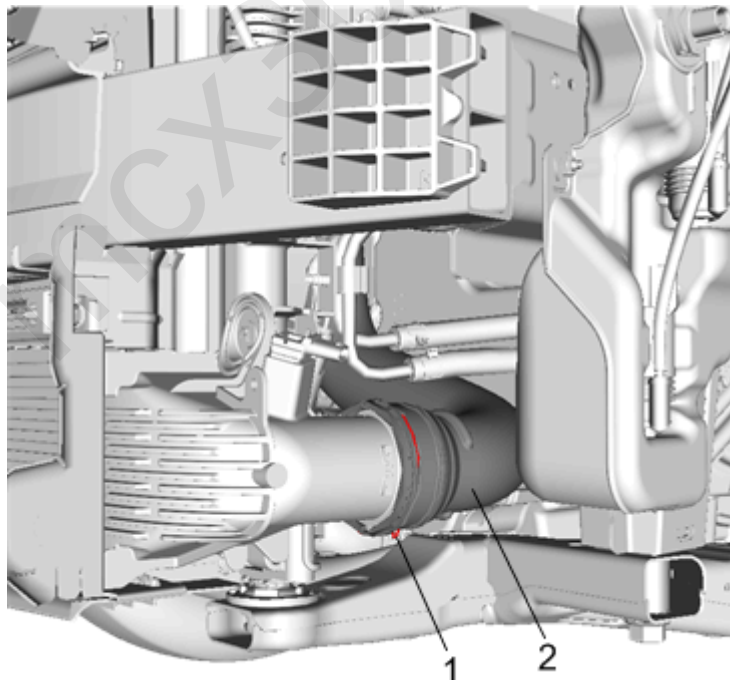


Fig. 221: Charge Air Cooler Outlet Air Tube And Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

2. Install Charge Air Cooler Outlet Air Tube (2)
3. Engage Retainer Spring (1)
4. Install Underbody Front Air Deflector - **[Underbody Front Air Deflector Replacement \(Equinox\)](#)** **[Underbody Front Air Deflector Replacement \(Terrain\)](#)**

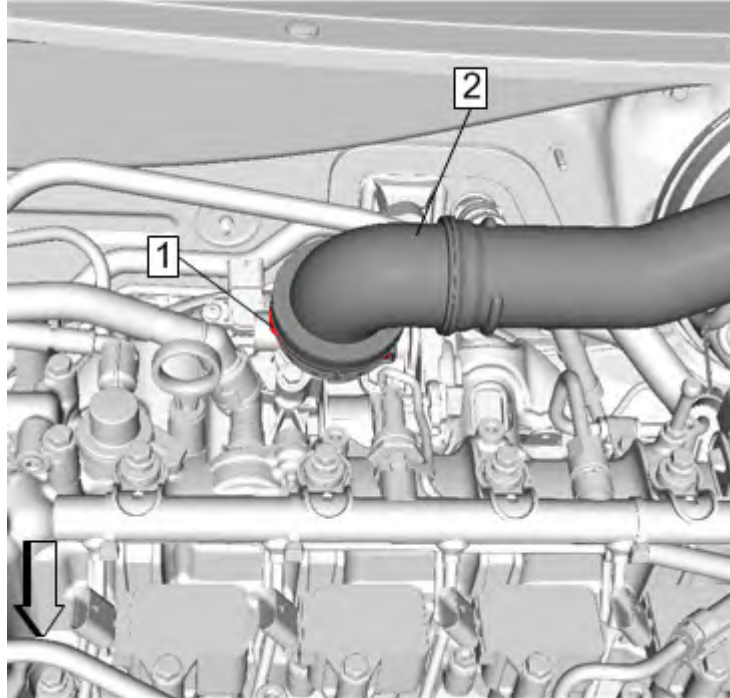


Fig. 222: Charge Air Cooler Outlet Air Tube And Retainer Spring
 Courtesy of GENERAL MOTORS COMPANY

5. Install Charge Air Cooler Outlet Air Tube (2)
6. Engage Retainer Spring (1)

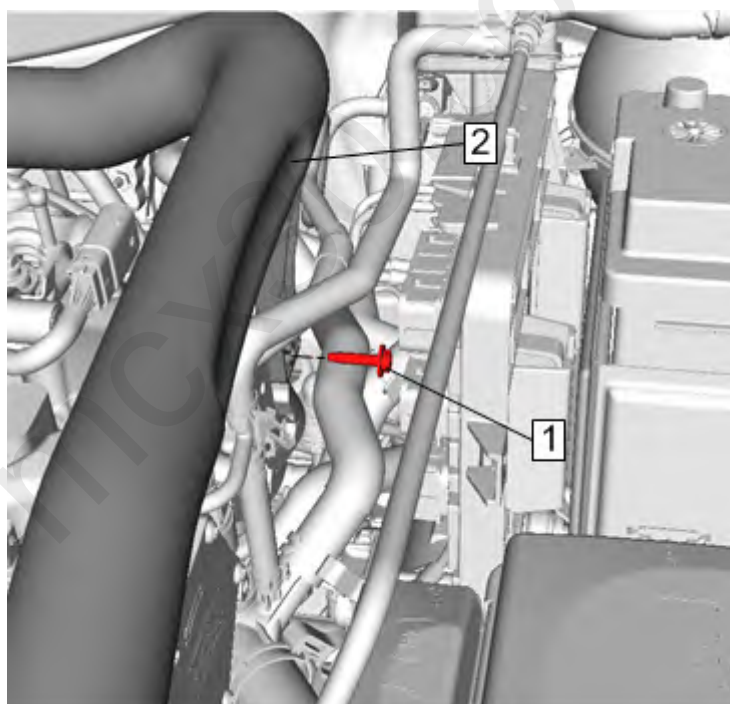


Fig. 223: Charge Air Cooler Bracket Bolt
 Courtesy of GENERAL MOTORS COMPANY

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

7. Install Charge Air Cooler Bracket Bolt (1) @Charge Air Cooler Outlet Air Tube and tighten 9 N.m (80 lb in)

CHARGE AIR COOLER INLET AIR TUBE REPLACEMENT

Removal Procedure

1. Remove Underbody Front Air Deflector - [Underbody Front Air Deflector Replacement \(Equinox\)](#), [Underbody Front Air Deflector Replacement \(Terrain\)](#)

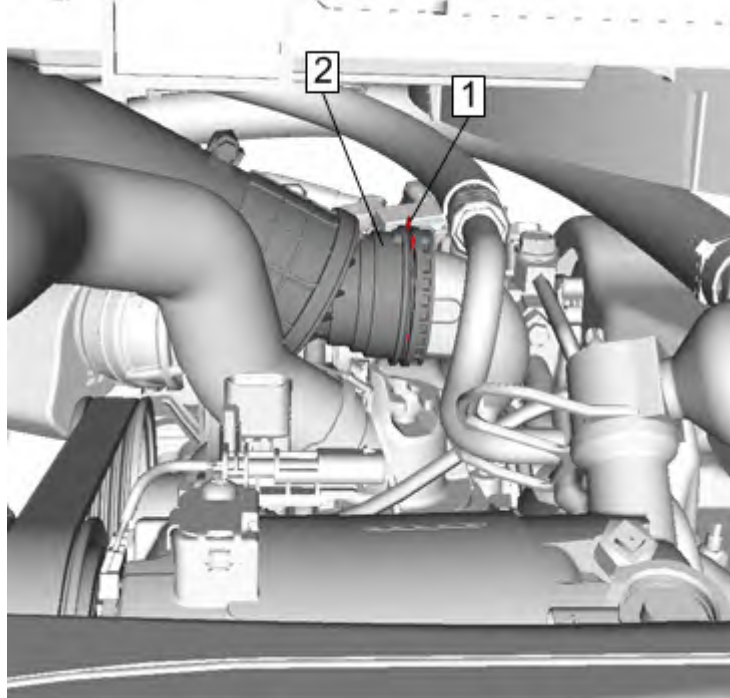


Fig. 224: Retainer Spring And Charge Air Cooler Inlet Air Tube
Courtesy of GENERAL MOTORS COMPANY

2. Release Retainer Spring (1)
3. Remove Charge Air Cooler Inlet Air Tube (2)

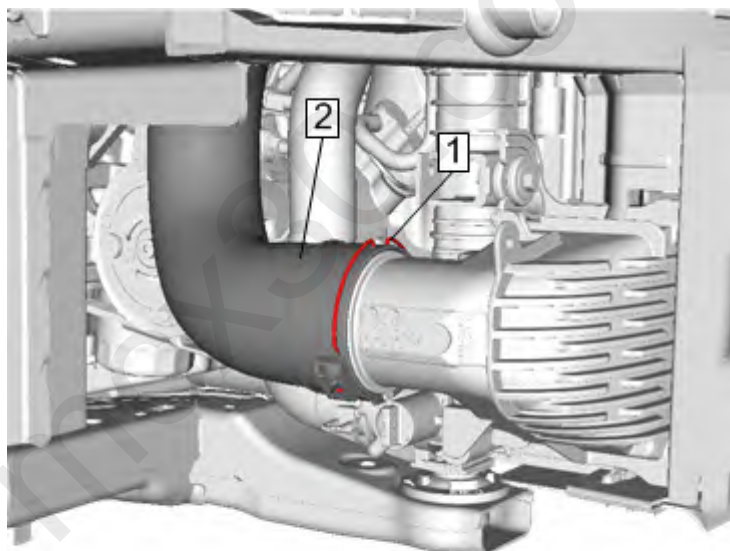


Fig. 225: Retainer Spring And Charge Air Cooler Inlet Air Tube
Courtesy of GENERAL MOTORS COMPANY

4. Release Retainer Spring (1)
5. Remove Charge Air Cooler Inlet Air Tube (2)

Installation Procedure

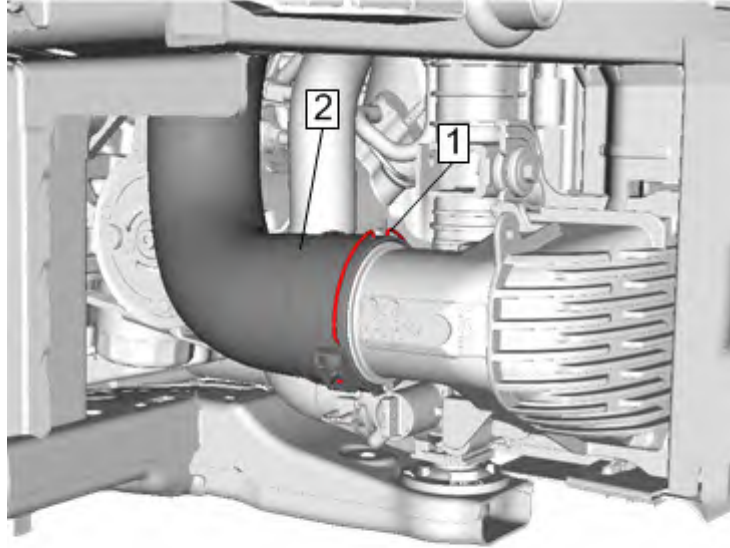


Fig. 226: Retainer Spring And Charge Air Cooler Inlet Air Tube
Courtesy of GENERAL MOTORS COMPANY

1. Install Charge Air Cooler Inlet Air Tube (2)
2. Engage Retainer Spring (1)

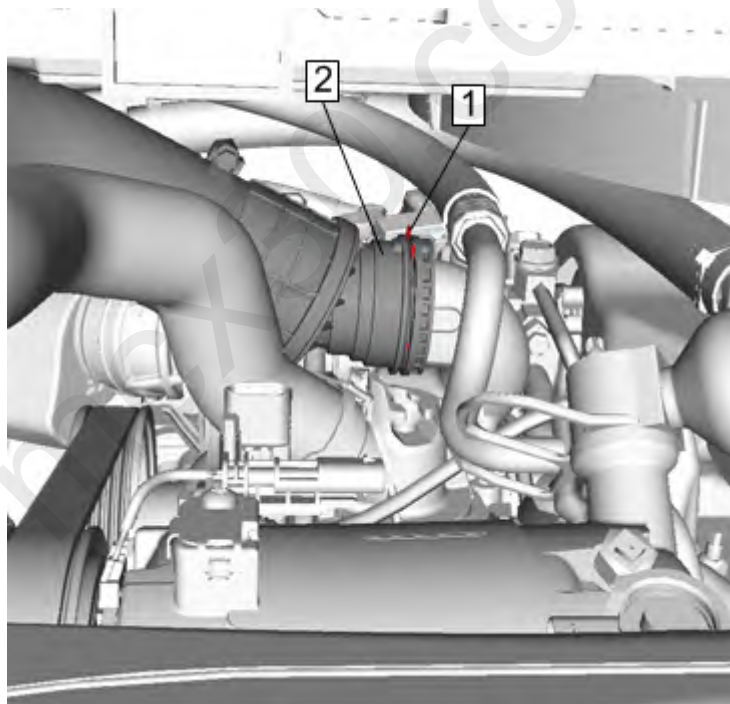


Fig. 227: Retainer Spring And Charge Air Cooler Inlet Air Tube
Courtesy of GENERAL MOTORS COMPANY

3. Install Charge Air Cooler Inlet Air Tube (2)
4. Engage Retainer Spring (1)
5. Install Underbody Front Air Deflector - **Underbody Front Air Deflector Replacement (Equinox)**, **Underbody Front Air Deflector Replacement (Terrain)**

CHARGE AIR COOLER REPLACEMENT

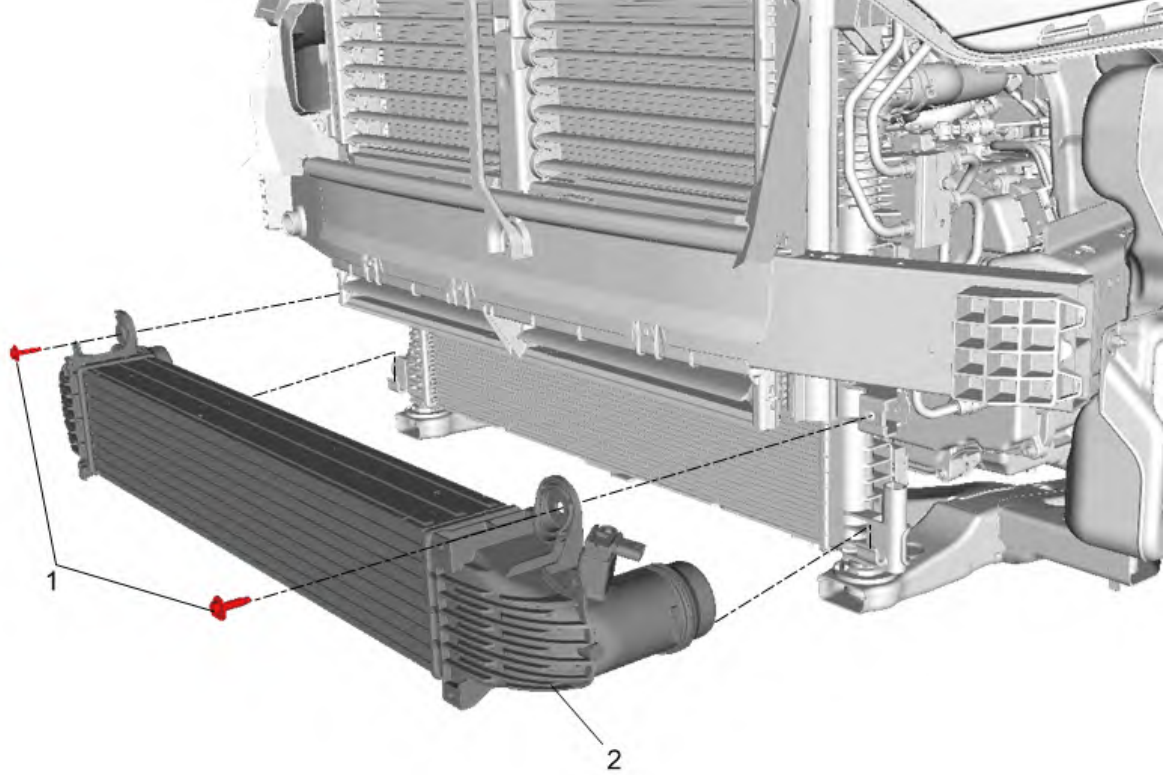


Fig. 228: Charge Air Cooler

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. <u>Radiator Air Lower Baffle Replacement (LH7 LTG LYX)</u> 2. Disconnect Charge Air Cooler Outlet Air Tube@Charge Air Cooler - <u>Charge Air Cooler Outlet Air Tube Replacement</u> 3. Disconnect Charge Air Cooler Inlet Air Tube@Charge Air Cooler - <u>Charge Air Cooler Inlet Air Tube Replacement</u> 4. Disconnect the electrical connector.	
1	Charge Air Cooler Bolt[2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Charge Air Cooler

FUEL LEVEL SENSOR REPLACEMENT (FWD)

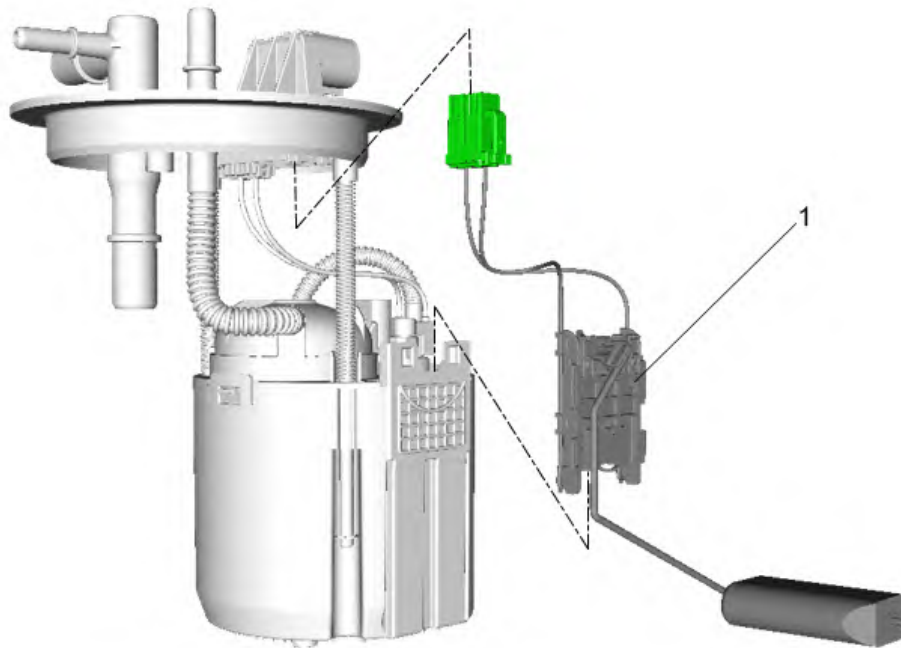


Fig. 229: Fuel Level Sensor (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedure Fuel Tank Fuel Pump Module Replacement (FWD)	
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 (AWD)

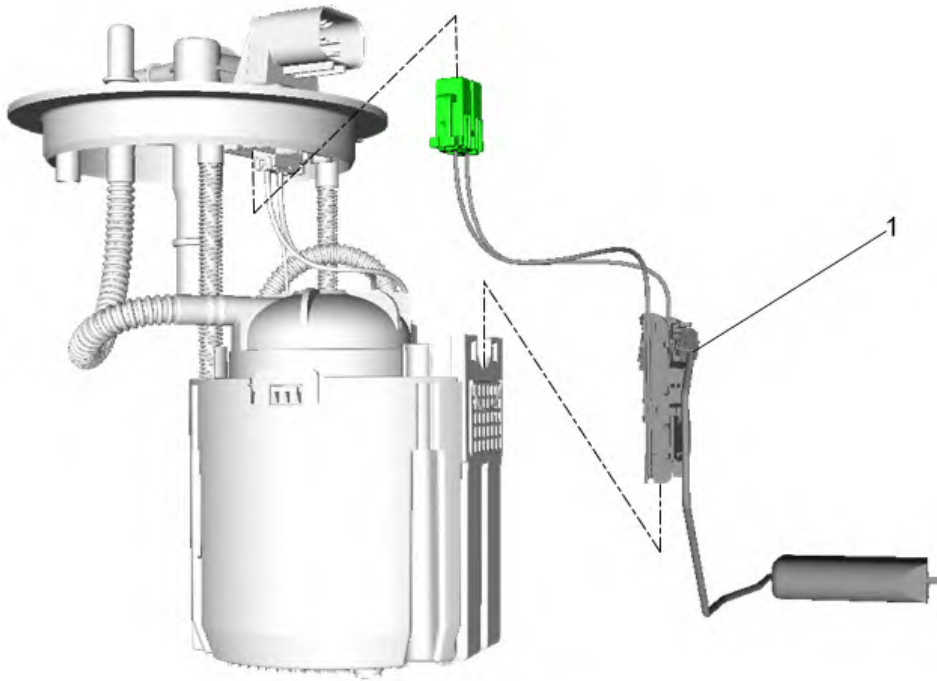


Fig. 230: Fuel Level Sensor (AWD)

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 <u>Fuel Tank Fuel Pump Module Replacement (AWD)</u>	
1	Fuel Level Sensor Procedure 1. Release tabs and slide fuel level sensor up to remove. 2. Disconnect the electrical connector.

FUEL PUMP POWER CONTROL MODULE REPLACEMENT (FWD)

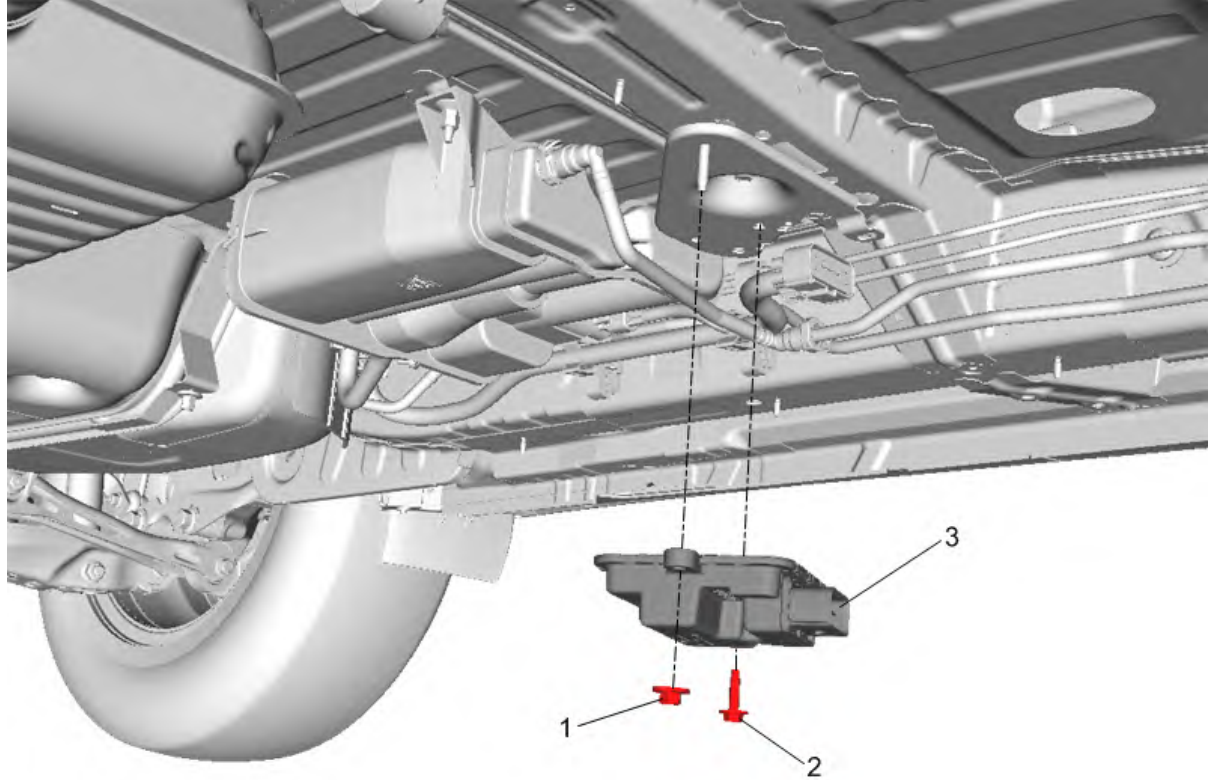


Fig. 231: Fuel Pump Power Control Module (FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Underbody Rear Air Deflector Replacement (Front Wheel Drive)</u>	
1	Fuel Pump Power Control Module Nut CAUTION: Refer to <u>Fastener Caution</u> . 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. <u>Control Module References</u>

FUEL PUMP POWER CONTROL MODULE REPLACEMENT (AWD)

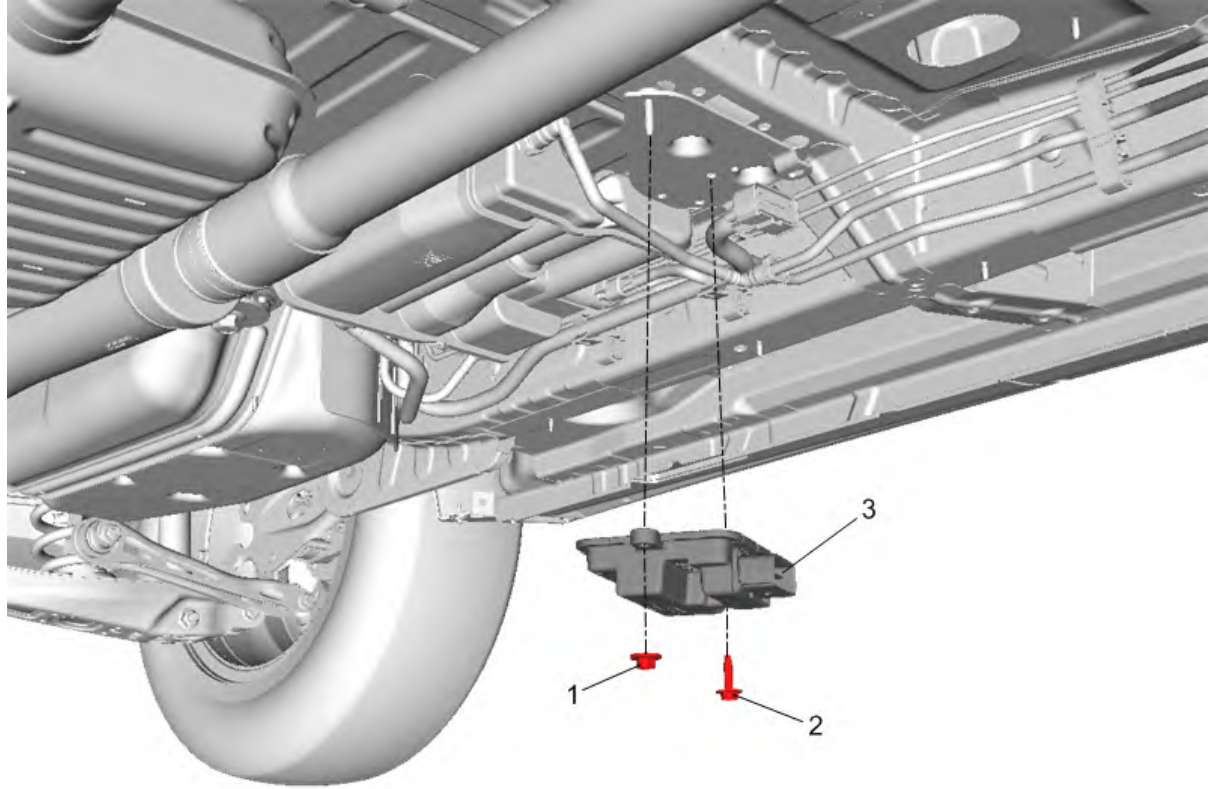


Fig. 232: Fuel Pump Power Control Replacement (AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Underbody Rear Air Deflector Replacement (All Wheel Drive)</u>	
1	Fuel Pump Power Control Module Nut CAUTION: Refer to <u>Fastener Caution</u> . 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. <u>Control Module References</u>

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 1

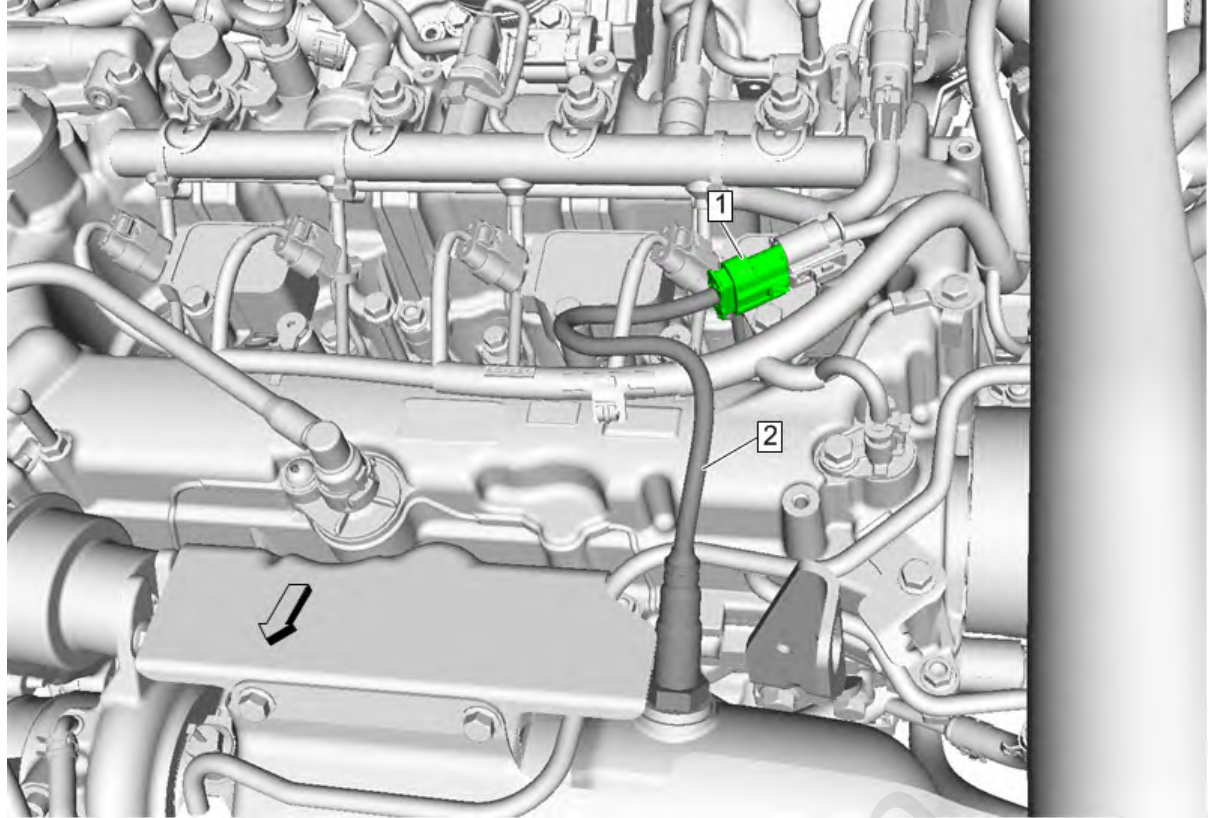


Fig. 233: Heated Oxygen Sensor - Sensor 1
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING: In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool. WARNING: Avoid contact with HOT components. Wear safety glasses and protective gloves to avoid personal injury. Preliminary Procedure Intake Manifold Cover Replacement	

Callout	Component Name
1	Heated Oxygen Sensor CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: Refer to Heated Oxygen and Oxygen Sensor Caution . CAUTION: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution . CAUTION: The use of excessive force may damage the threads in the exhaust manifold/pipe. Procedure 1. Disconnect the electrical connector. 2. If replacing, perform the HO2S heater resistance learned values reset. HO2S Heater Resistance Learned Values Reset NOTE: • The heated oxygen sensor in-line connector and louvered end MUST be kept clear of all grease, dirt, and other contaminants. Do NOT use cleaning solvents of any type. Do NOT drop or roughly handle the sensor. • The heated oxygen sensor MAY be difficult to remove when the engine temperature is less than 48Â°C (120Â°F). • A special anti-seize compound is used on the heated oxygen sensor threads. The compound consists of liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will have the compound already applied to the threads. IF a sensor is removed and is to be reinstalled, the threads MUST have an anti-seize compound applied before installation. Adhesives, Fluids, Lubricants, and Sealers Tighten 42 N.m (31 lb ft) Special Tools EN-6179 Heated Oxygen Sensor Remover/Installer Equivalent regional tools:Special Tools (Diagnostic Tools) Special Tools (Mechanical Tools)

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 2

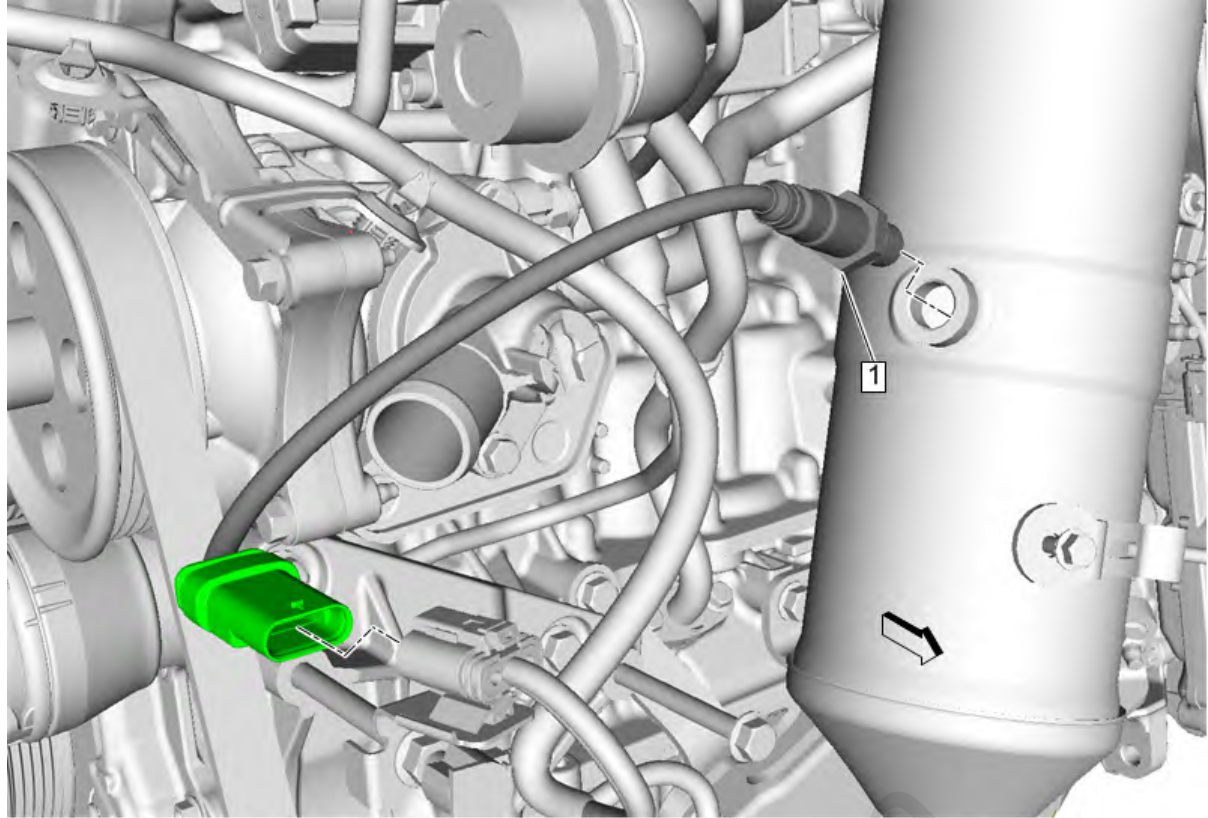


Fig. 234: Heated Oxygen Sensor - Sensor 2
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
WARNING:	In order to avoid being burned, do not service the exhaust system while it is still hot. Service the system when it is cool.
WARNING:	Avoid contact with HOT components. Wear safety glasses and protective gloves to avoid personal injury.
Preliminary Procedure Raise and support the vehicle. Lifting and Jacking the Vehicle	

Callout	Component Name
1	Heated Oxygen Sensor CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: Refer to Heated Oxygen and Oxygen Sensor Caution . CAUTION: Refer to Heated Oxygen Sensor Resistance Learn Reset Caution . CAUTION: The use of excessive force may damage the threads in the exhaust manifold/pipe. Procedure 1. Disconnect the electrical connector. 2. If replacing, perform the HO2S heater resistance learned values reset. HO2S Heater Resistance Learned Values Reset NOTE: • The heated oxygen sensor in-line connector and louvered end MUST be kept clear of all grease, dirt, and other contaminants. Do NOT use cleaning solvents of any type. Do NOT drop or roughly handle the sensor. • The heated oxygen sensor MAY be difficult to remove when the engine temperature is less than 48Â°C (120Â°F). • A special anti-seize compound is used on the heated oxygen sensor threads. The compound consists of liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove. New or service sensors will have the compound already applied to the threads. IF a sensor is removed and is to be reinstalled, the threads MUST have an anti-seize compound applied before installation. Adhesives, Fluids, Lubricants, and Sealers Tighten 42 N.m (31 lb ft) Special Tools EN-6179 Heated Oxygen Sensor Remover/Installer Equivalent regional tools: Special Tools (Diagnostic Tools) Special Tools (Mechanical Tools)

INTAKE AIR PRESSURE AND TEMPERATURE SENSOR REPLACEMENT

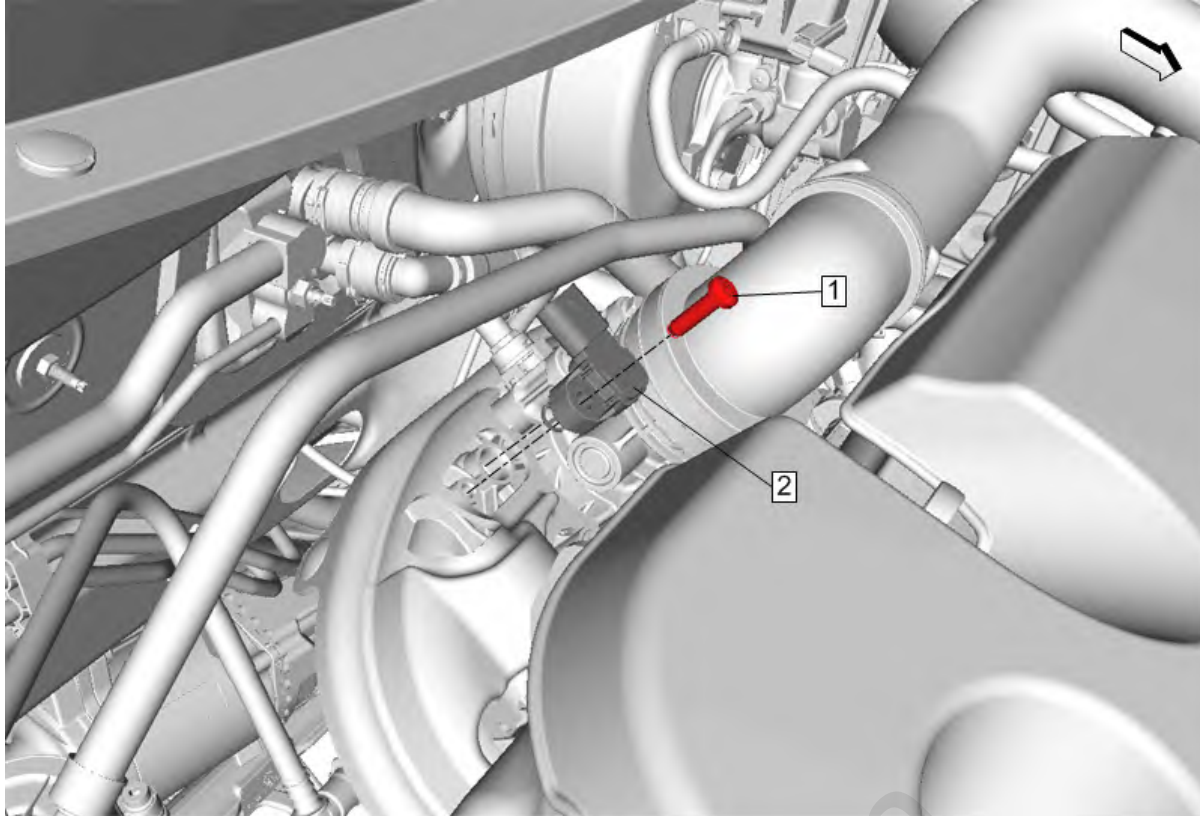


Fig. 235: Intake Air Pressure And Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Intake Air Pressure and Temperature Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
2	Intake Air Pressure and Temperature Sensor Procedure 1. Disconnect the electrical connector. 2. Perform the intake system learned values reset. Intake System Learned Values Reset

MASS AIRFLOW SENSOR REPLACEMENT

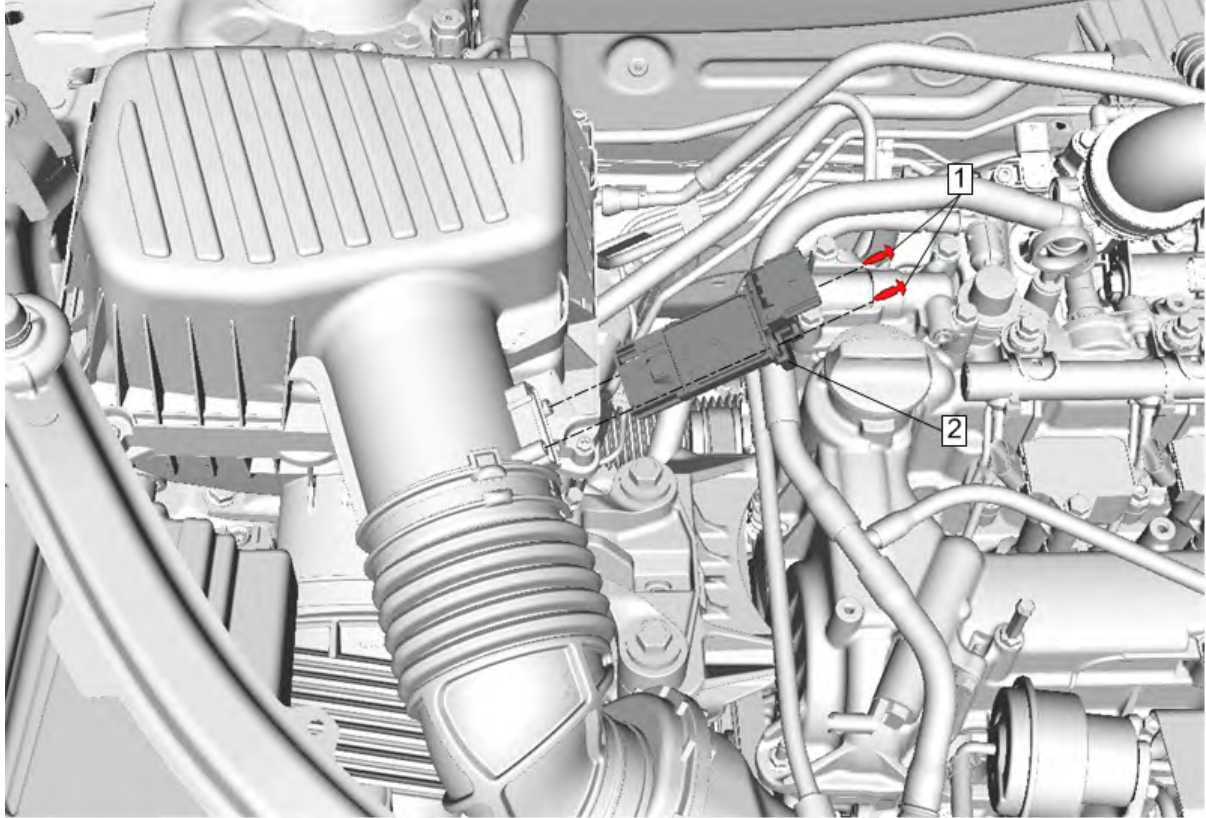


Fig. 236: Mass Airflow Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Mass Airflow Sensor Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 4 N.m (35 lb in)
2	Mass Airflow Sensor Procedure 1. Disconnect the electrical connector. 2. Perform the intake system learned values reset. <u>Intake System Learned Values Reset</u>

ENGINE OIL PRESSURE SENSOR REPLACEMENT

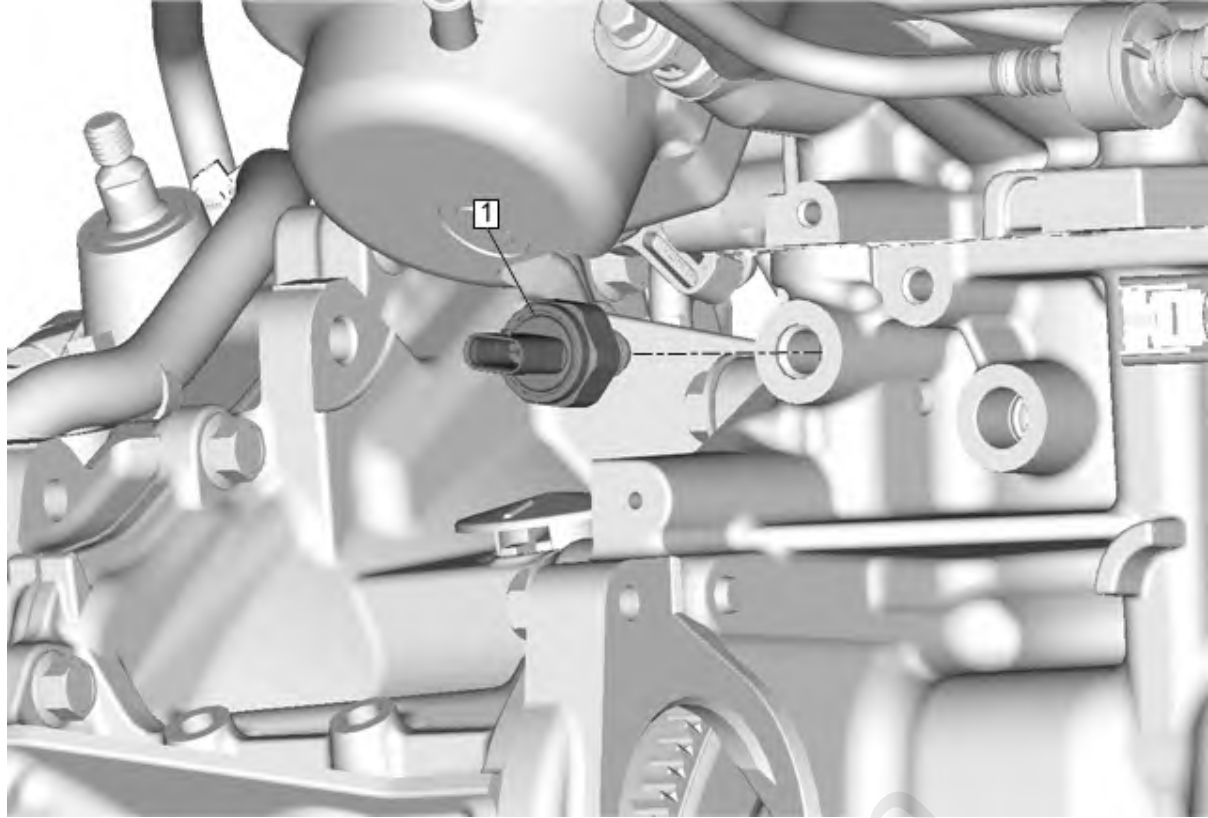


Fig. 237: Engine Oil Pressure Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Starter Replacement (LYX - All Wheel Drive) Starter Replacement (LYX - Front Wheel Drive).</u>	
1	Engine Oil Pressure Sensor CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure Disconnect the electrical connector. Tighten 35 N.m (26 lb ft)

INTAKE AIR BAFFLE REPLACEMENT

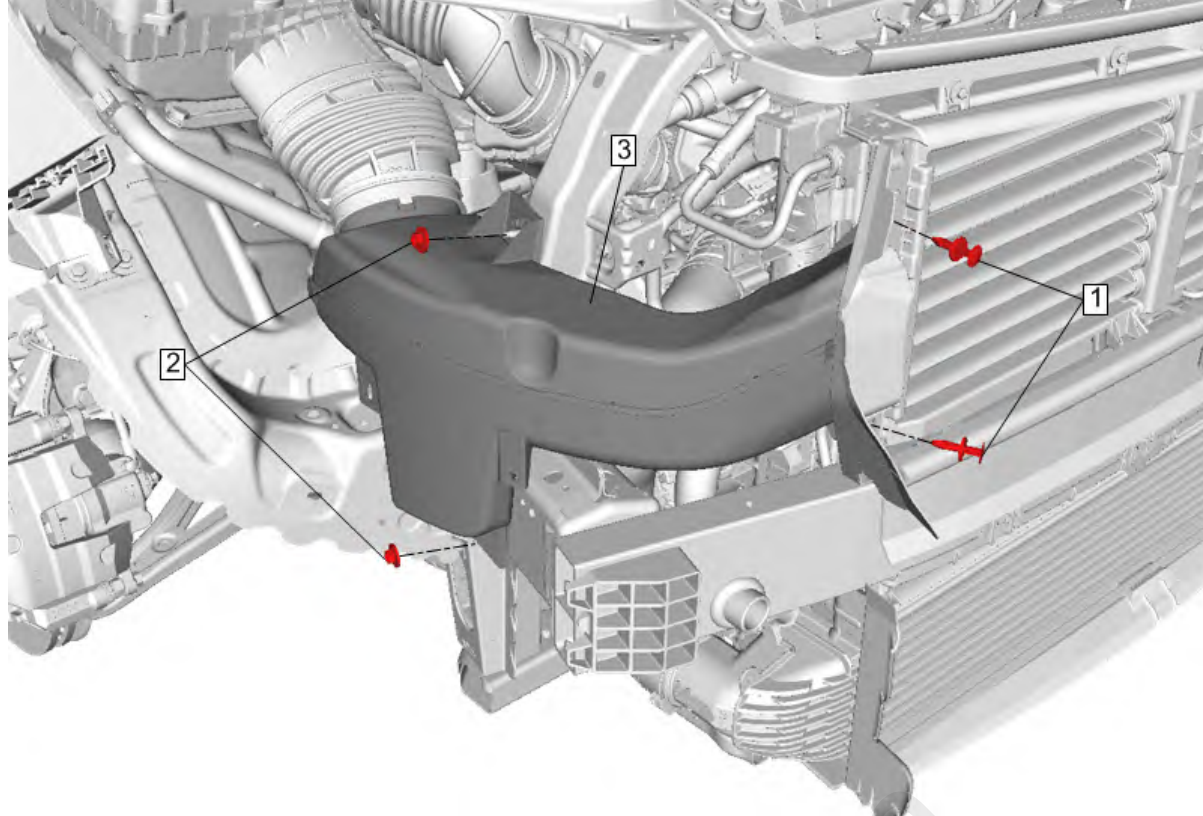


Fig. 238: Intake Air Baffle

Courtesy of GENERAL MOTORS COMPANY

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

INTAKE AIR DUCT REPLACEMENT

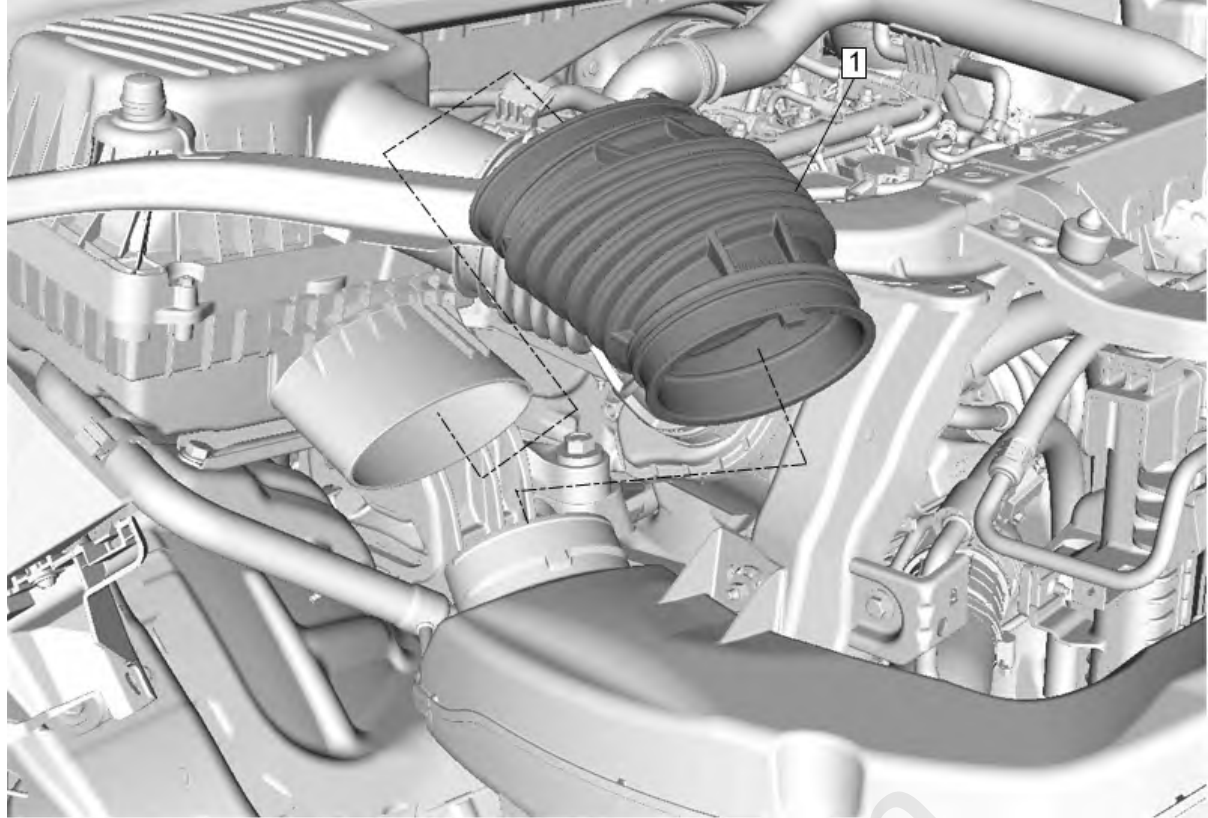


Fig. 239: Intake Air Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Air Cleaner Outlet Duct Replacement</u>	
1	Intake Air Duct Procedure Perform the intake system learned values reset. <u>Intake System Learned Values Reset</u> NOTE: Align the tab on the duct to the correct position on the intake air baffle.

TURBOCHARGER AIR PRESSURE SENSOR REPLACEMENT

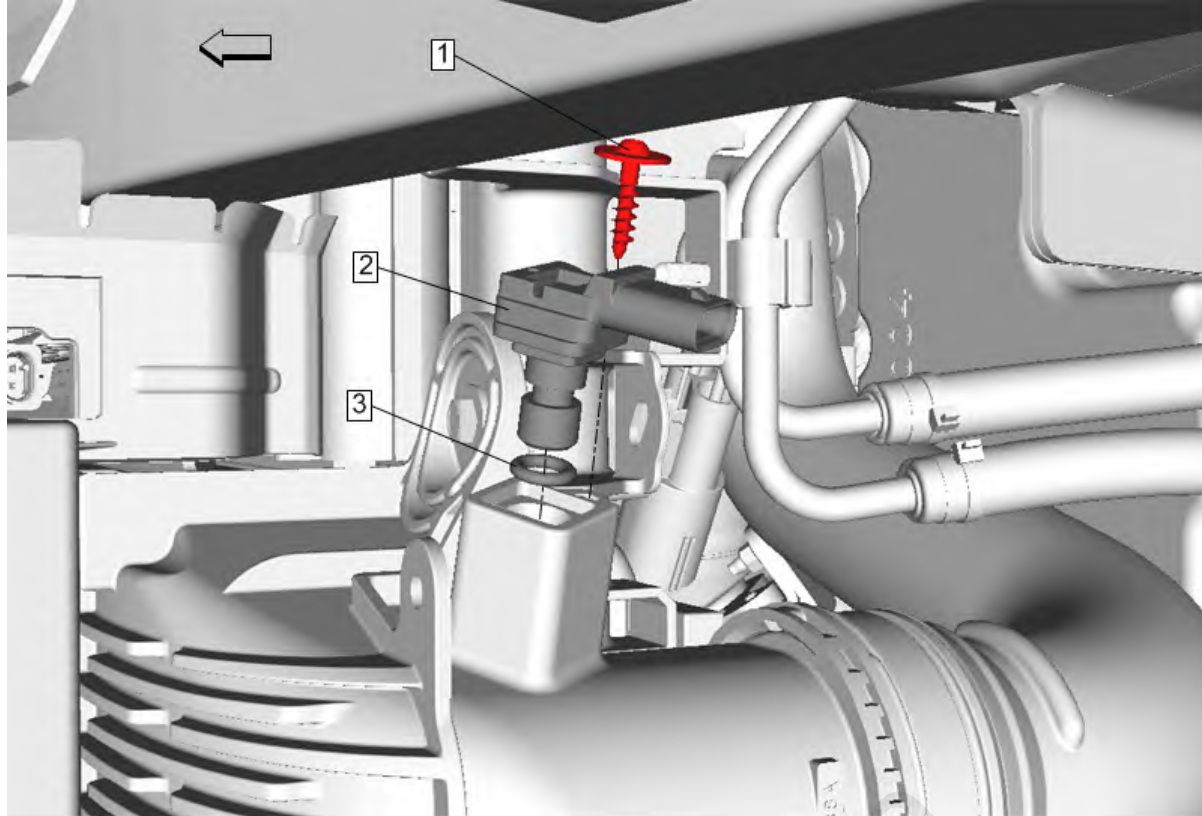


Fig. 240: Turbocharger Air Pressure Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Front Bumper Fascia Replacement (Equinox) Front Bumper Fascia Replacement (Terrain). - Disconnect the electrical connector.	
1	Turbocharger Air Pressure Sensor Bolt CAUTION: Refer to Fastener Caution . Tighten 3.8 N.m (34 lb in)
2	Turbocharger Air Pressure Sensor
3	Turbocharger Air Pressure Sensor Seal Procedure - DISCARD the seal. - Lubricate the NEW seal with clean engine oil. Adhesives, Fluids, Lubricants, and Sealers - Perform the intake system learned values reset. Intake System Learned Values Reset

TURBOCHARGER BYPASS VALVE SOLENOID REPLACEMENT

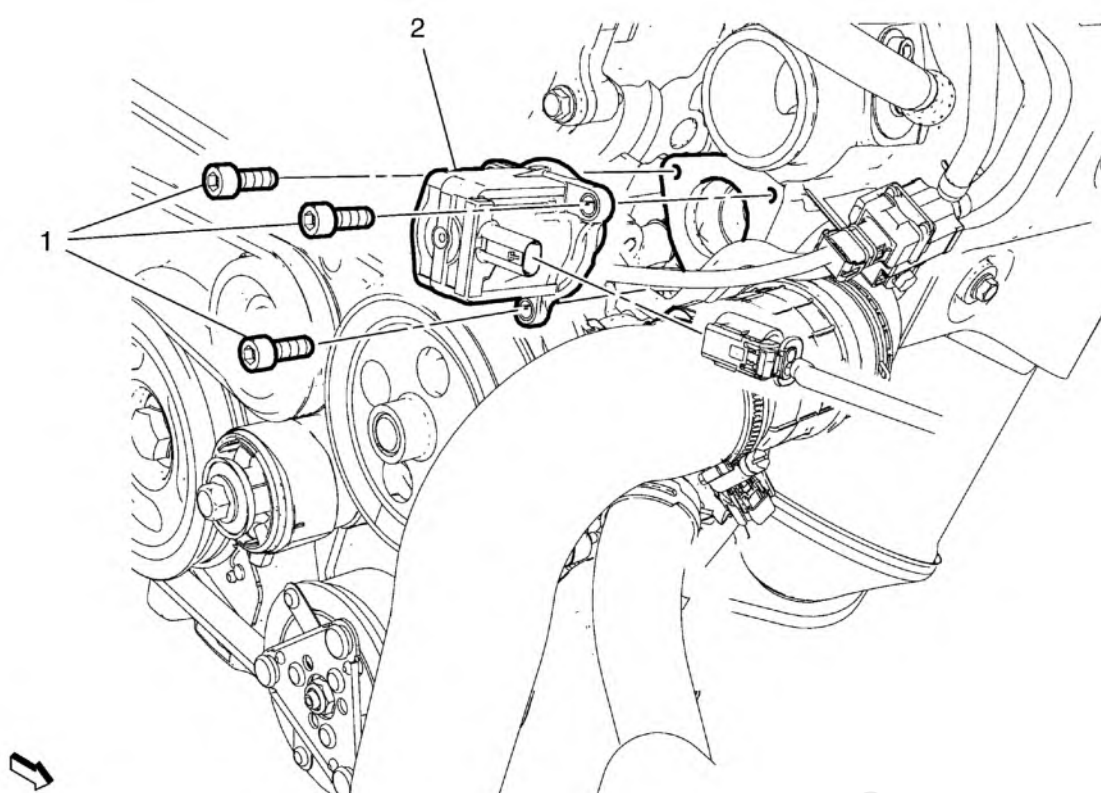


Fig. 241: Turbocharger Bypass Valve Solenoid
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Air Cleaner Outlet Duct Replacement</u>	
1	Turbocharger Bypass Valve Solenoid Bolt [3x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Turbocharger Bypass Valve Solenoid Procedure 1. Disconnect the electrical connector. 2. Perform the intake system learned values reset. <u>Intake System Learned Values Reset</u>

TURBOCHARGER WASTEGATE ACTUATOR REPLACEMENT

Removal Procedure

1. Remove Turbocharger Heat Shield - **Turbocharger Heat Shield Replacement**

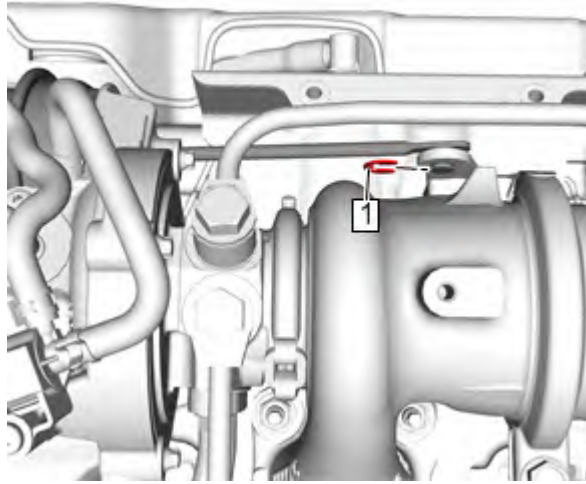


Fig. 242: Clip

Courtesy of GENERAL MOTORS COMPANY

2. Remove Clip (1)

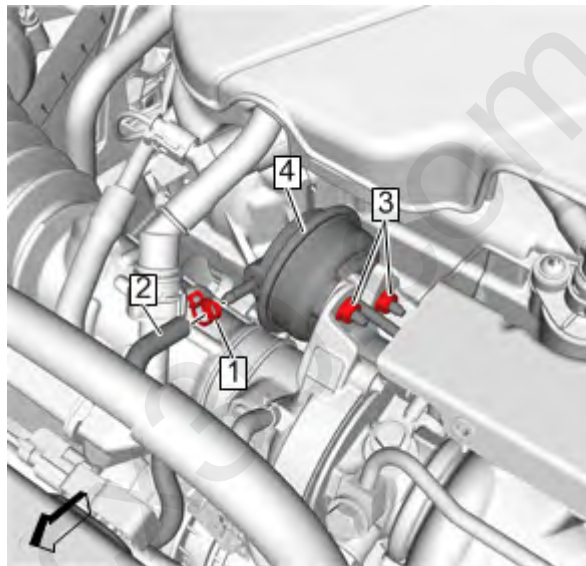


Fig. 243: Turbocharger Wastegate Actuator

Courtesy of GENERAL MOTORS COMPANY

3. Disengage Hose Clamp (1) [Hose Clamp Replacement Guidelines - Spring Type](#)
4. Disconnect Vacuum Hose (2)
5. Remove Turbocharger Wastegate Actuator Fastener (3)
6. Remove Turbocharger Wastegate Actuator (4)

Installation Procedure

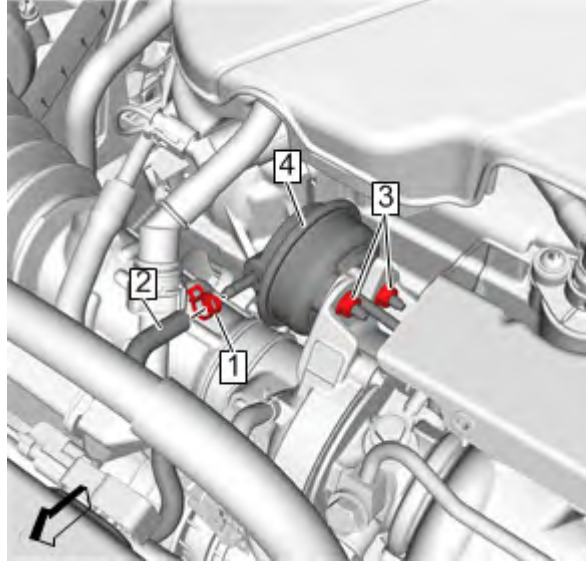


Fig. 244: Turbocharger Wastegate Actuator
 Courtesy of GENERAL MOTORS COMPANY

1. Install Turbocharger Wastegate Actuator (4)

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

2. Install Turbocharger Wastegate Actuator Fastener (3) and tighten 10 N.m (89 lb in)
3. Connect Vacuum Hose (2)
4. Engage Hose Clamp (1) [Hose Clamp Replacement Guidelines - Spring Type](#)

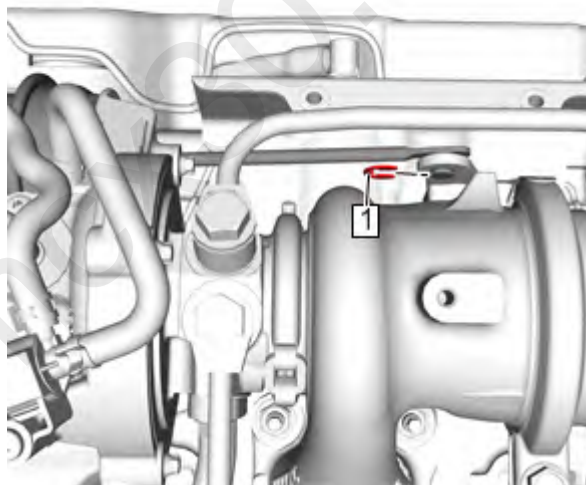


Fig. 245: Clip
 Courtesy of GENERAL MOTORS COMPANY

5. Install Clip (1)
6. Install Turbocharger Heat Shield - [Turbocharger Heat Shield Replacement](#)

TURBOCHARGER WASTEGATE REGULATOR SOLENOID VALVE REPLACEMENT

Removal Procedure

1. Disconnect Battery Negative Cable - [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
2. Disconnect the positive crankcase ventilation tube (foul air) from the turbocharger assembly and position away. [Positive Crankcase Ventilation Tube Replacement \(Fresh Air\)](#), [Positive Crankcase Ventilation Tube Replacement \(Foul Air\)](#)
3. Remove Air Cleaner Outlet Duct - [Air Cleaner Outlet Duct Replacement](#)

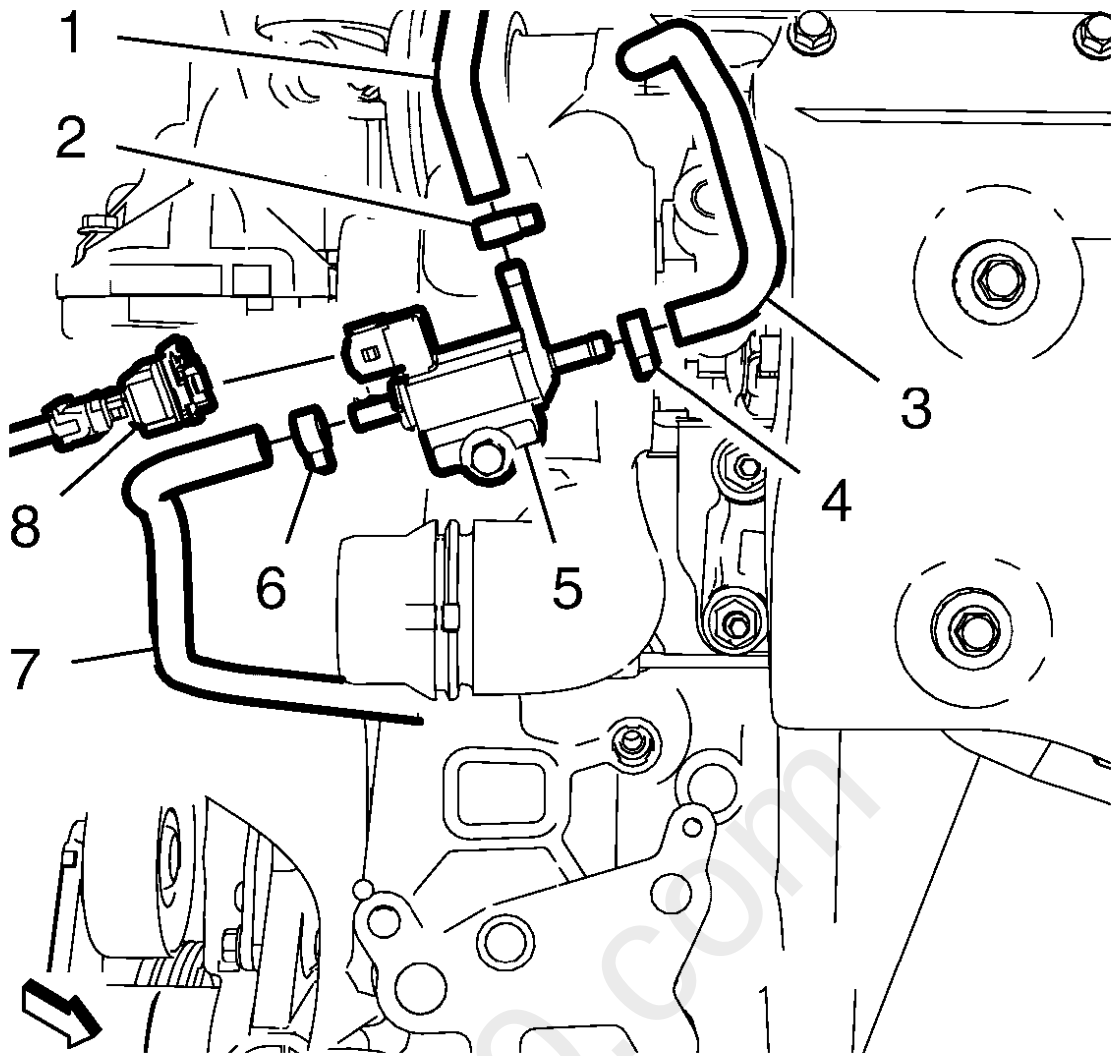


Fig. 246: Turbocharger Wastegate Regulator Solenoid Valve Components

Courtesy of GENERAL MOTORS COMPANY

4. Disconnect the turbocharger wastegate regulator solenoid valve electrical connector (8) from the turbocharger wastegate regulator solenoid valve (5).
5. Disengage Hose Clamp (2, 4, 6) - **Hose Clamp Replacement Guidelines - Spring Type**
6. Remove the 3 turbocharger wastegate regulator solenoid valve hoses (1, 3, 7) from the turbocharger wastegate regulator solenoid valve (5).

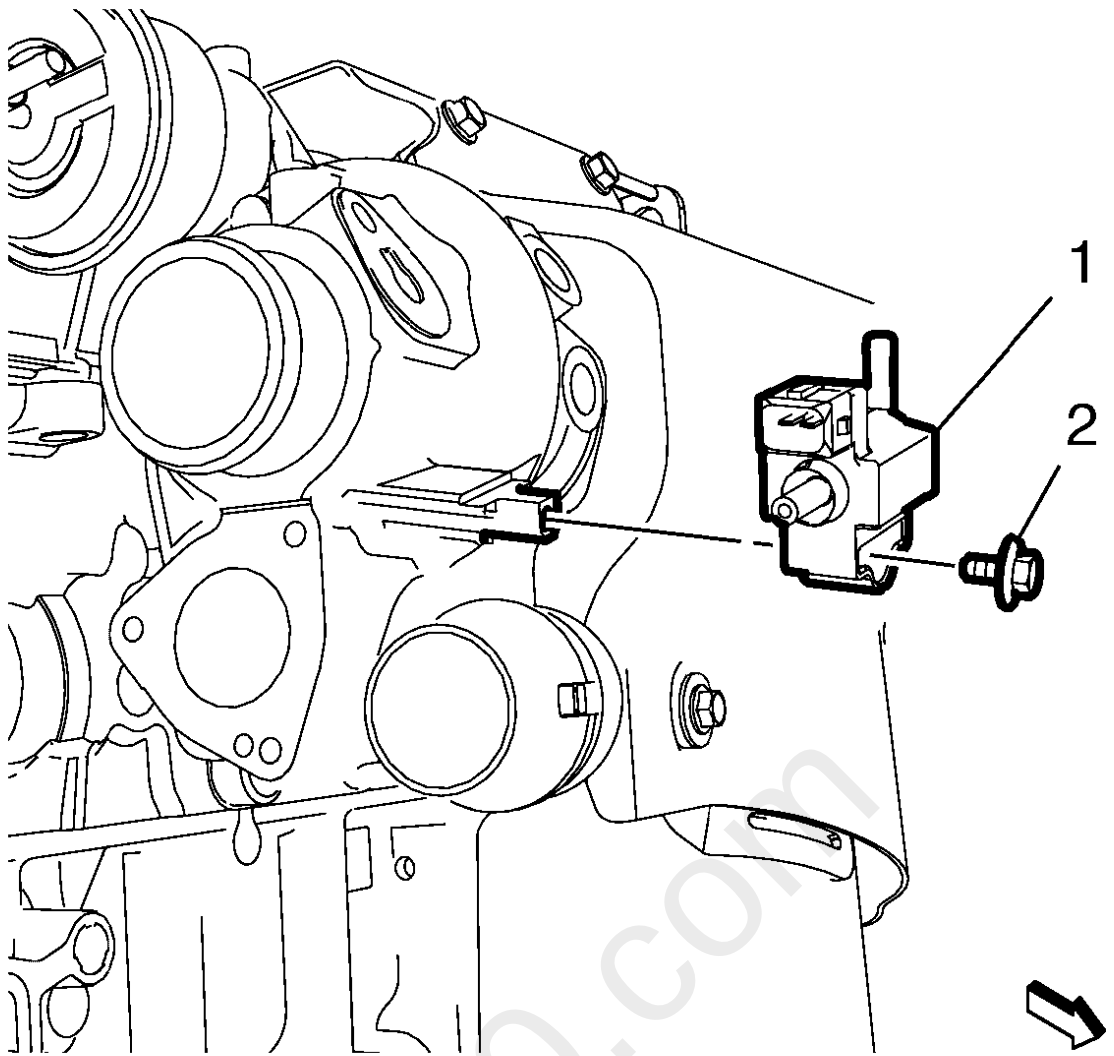


Fig. 247: Turbocharger Wastegate Regulator Solenoid Valve And Bolt
Courtesy of GENERAL MOTORS COMPANY

7. Remove the turbocharger wastegate regulator solenoid valve bolt (2).
8. Remove the turbocharger wastegate regulator solenoid valve (1).

Installation Procedure

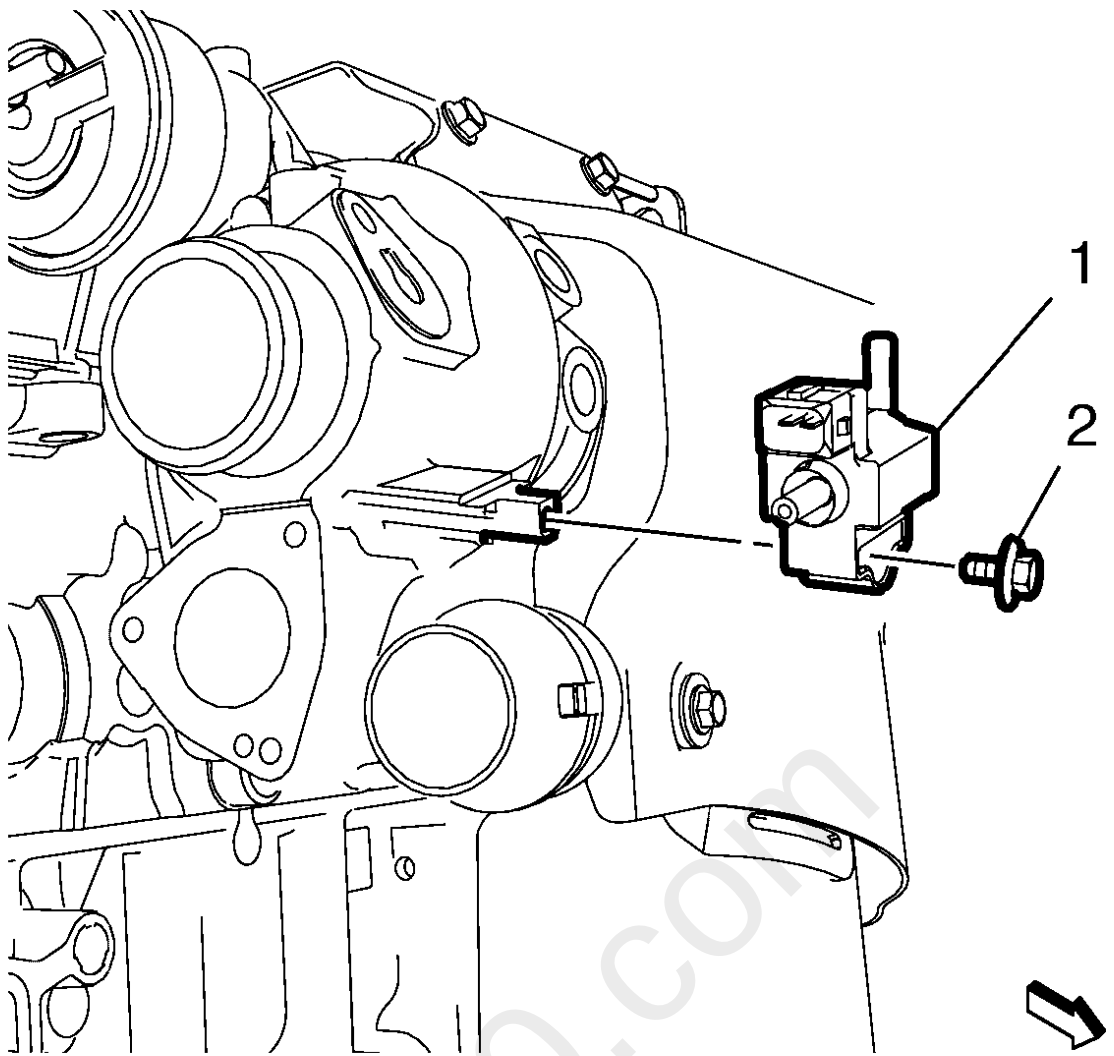


Fig. 248: Turbocharger Wastegate Regulator Solenoid Valve And Bolt
Courtesy of GENERAL MOTORS COMPANY

1. Install the turbocharger wastegate regulator solenoid valve (1).

CAUTION: Refer to **Fastener Caution** .

2. Install the turbocharger wastegate regulator solenoid valve bolt (2) and tighten to 8 N.m (71 lb in).

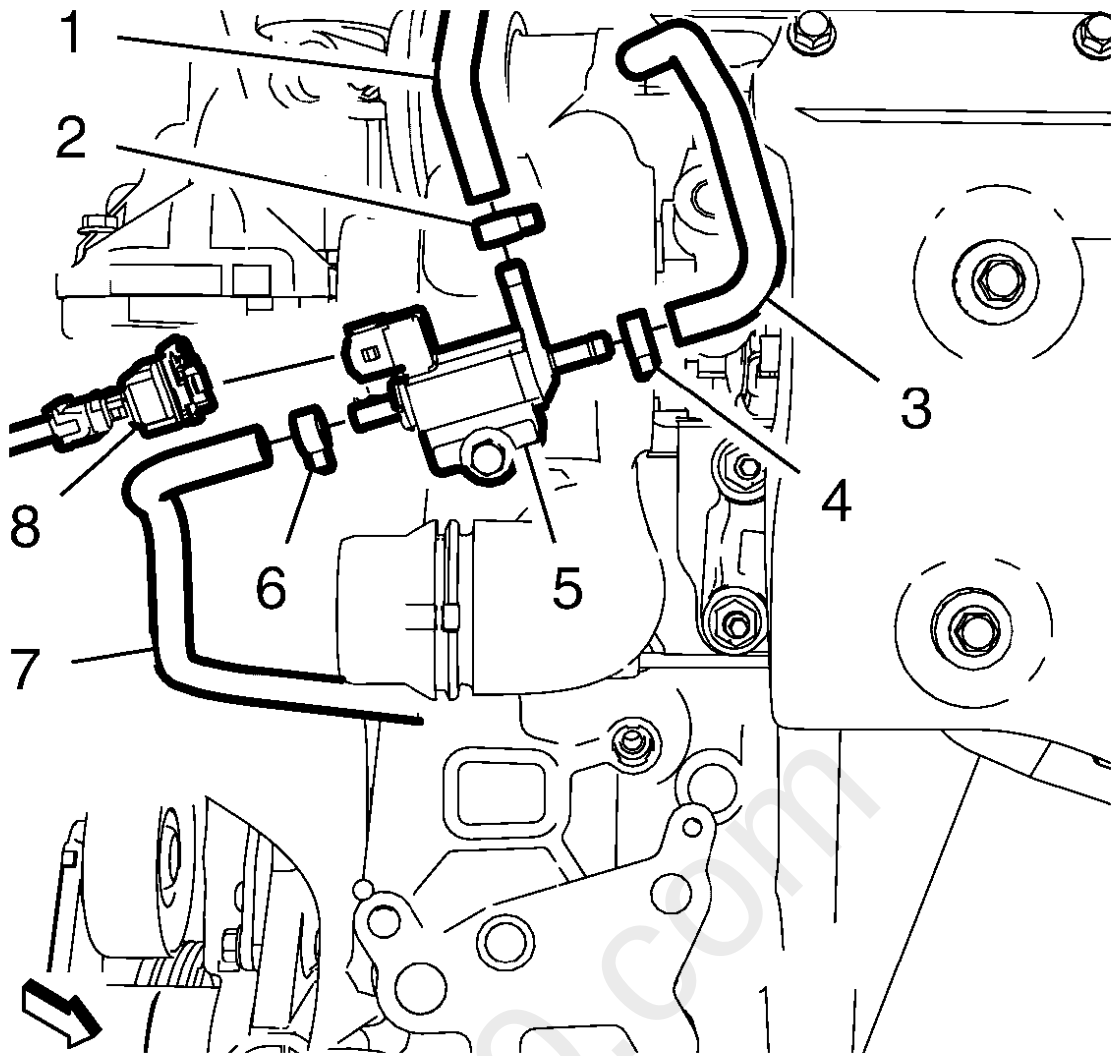


Fig. 249: Turbocharger Wastegate Regulator Solenoid Valve Components

Courtesy of GENERAL MOTORS COMPANY

3. Install the 3 turbocharger wastegate regulator solenoid valve hoses (1, 3, 7) to the turbocharger wastegate regulator solenoid valve (5).
4. Engage Hose Clamp (2, 4, 6) - [Hose Clamp Replacement Guidelines - Spring Type](#)
5. Connect the turbocharger wastegate regulator solenoid valve wiring harness plug (8) to the turbocharger wastegate regulator solenoid valve (5).
6. Install Air Cleaner Outlet Duct - [Air Cleaner Outlet Duct Replacement](#)
7. Connect the positive crankcase ventilation tube (foul air) to the turbocharger assembly. [Positive Crankcase Ventilation Tube Replacement \(Fresh Air\)](#) [Positive Crankcase Ventilation Tube Replacement \(Foul Air\)](#)
8. Connect Battery Negative Cable - [Battery Negative Cable Disconnection and Connection \(KL9\)](#)
9. Perform the Intake System Learned Values Reset. [Intake System Learned Values Reset](#)

**TURBOCHARGER WASTEGATE REGULATOR SOLENOID VALVE HOSE REPLACEMENT
(WASTEGATE SOLENOID TO ACTUATOR)**

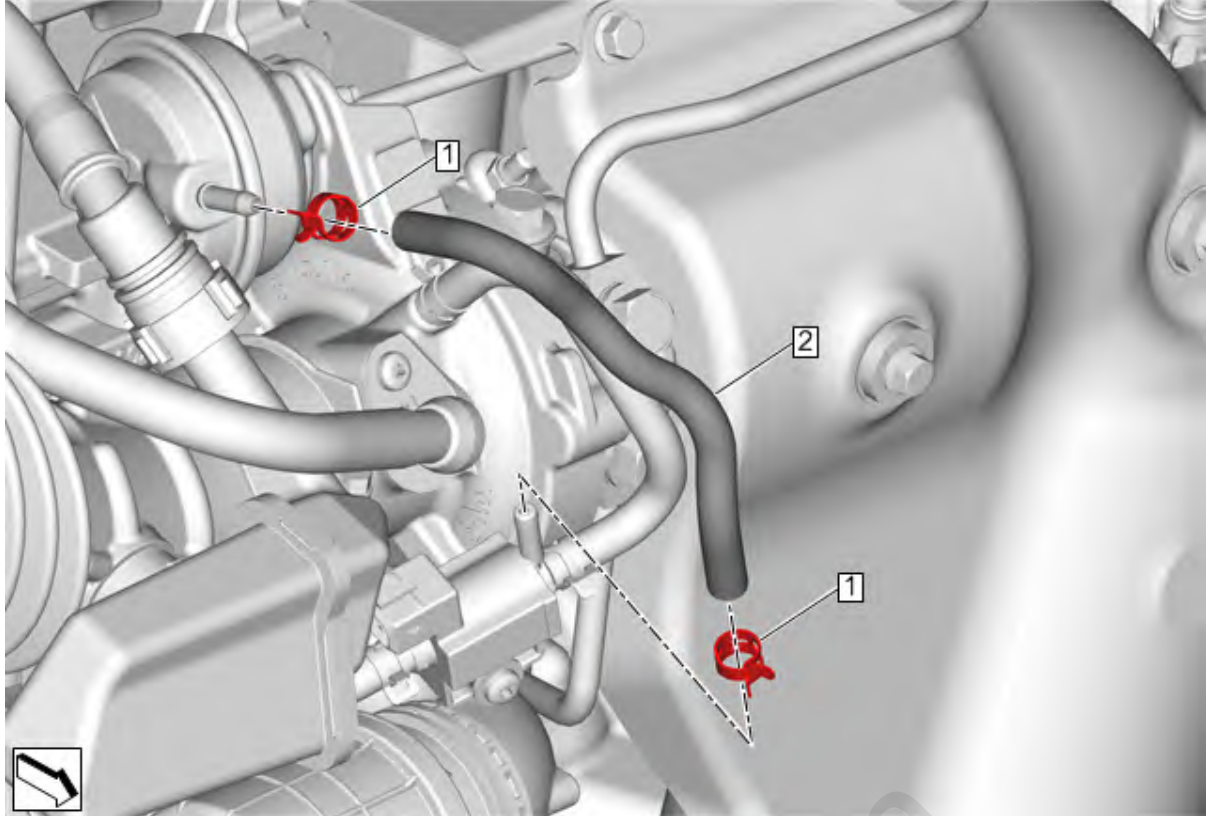


Fig. 250: Turbocharger Wastegate Regulator Solenoid Valve Hose (Wastegate Actuator to Solenoid Valve)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Turbocharger Wastegate Regulator Solenoid Valve Hose Clamp
2	Turbocharger Wastegate Regulator Solenoid Valve Hose

TURBOCHARGER WASTEGATE REGULATOR SOLENOID VALVE HOSE REPLACEMENT (COMPRESSOR INLET TO SOLENOID)

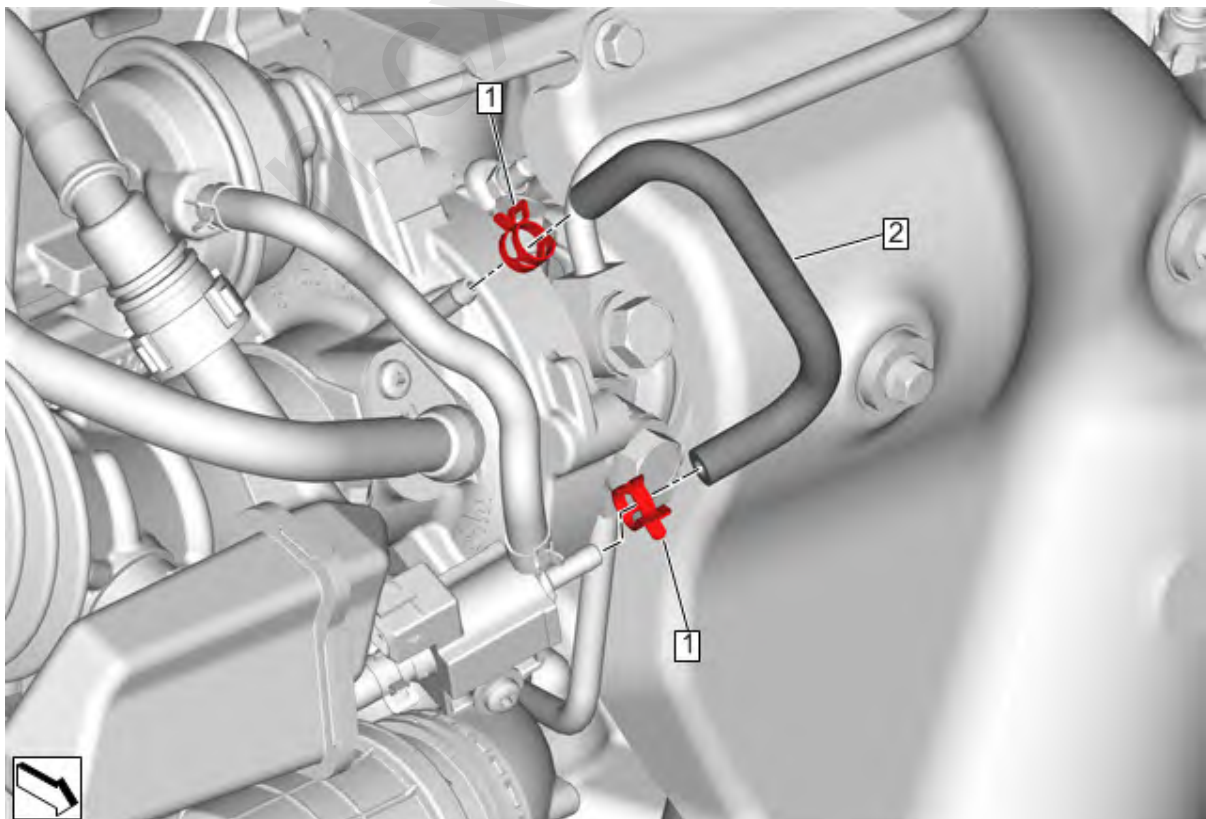


Fig. 251: Turbocharger Wastegate Regulator Solenoid Valve Hose (Compressor Inlet to Solenoid Valve)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Turbocharger Wastegate Regulator Solenoid Valve Hose Clamp
2	Turbocharger Wastegate Regulator Solenoid Valve Hose

**TURBOCHARGER WASTEGATE REGULATOR SOLENOID VALVE HOSE REPLACEMENT
(COMPRESSOR OUTLET TO SOLENOID)**

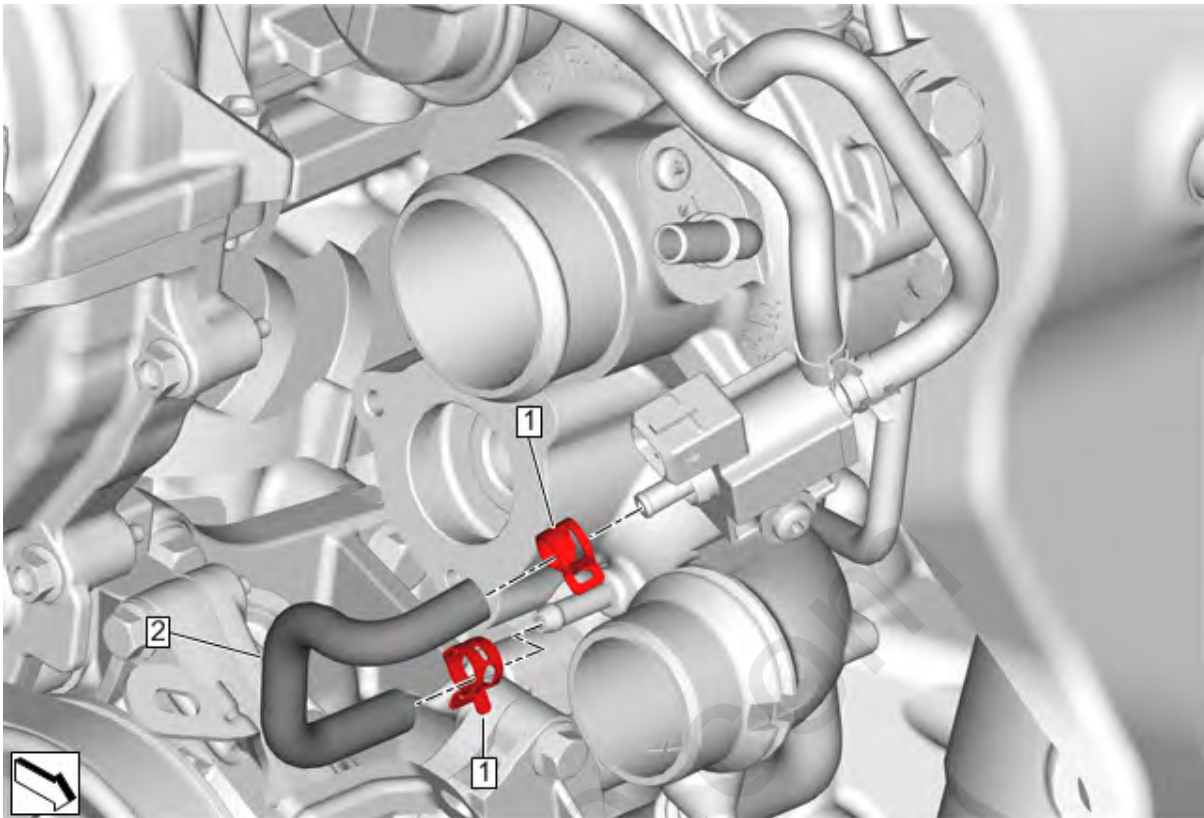


Fig. 252: Turbocharger Wastegate Regulator Solenoid Valve Hose (Compressor Outlet to Solenoid Valve)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure	
<u>Turbocharger Bypass Valve Solenoid Replacement</u>	
1	Turbocharger Wastegate Regulator Solenoid Valve Hose Clamp
2	Turbocharger Wastegate Regulator Solenoid Valve Hose