

2017 ENGINE PERFORMANCE

Engine Controls and Fuel - 1.4L (LUV) - Repair Instructions - Encore, Trax

REPAIR INSTRUCTIONS

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.

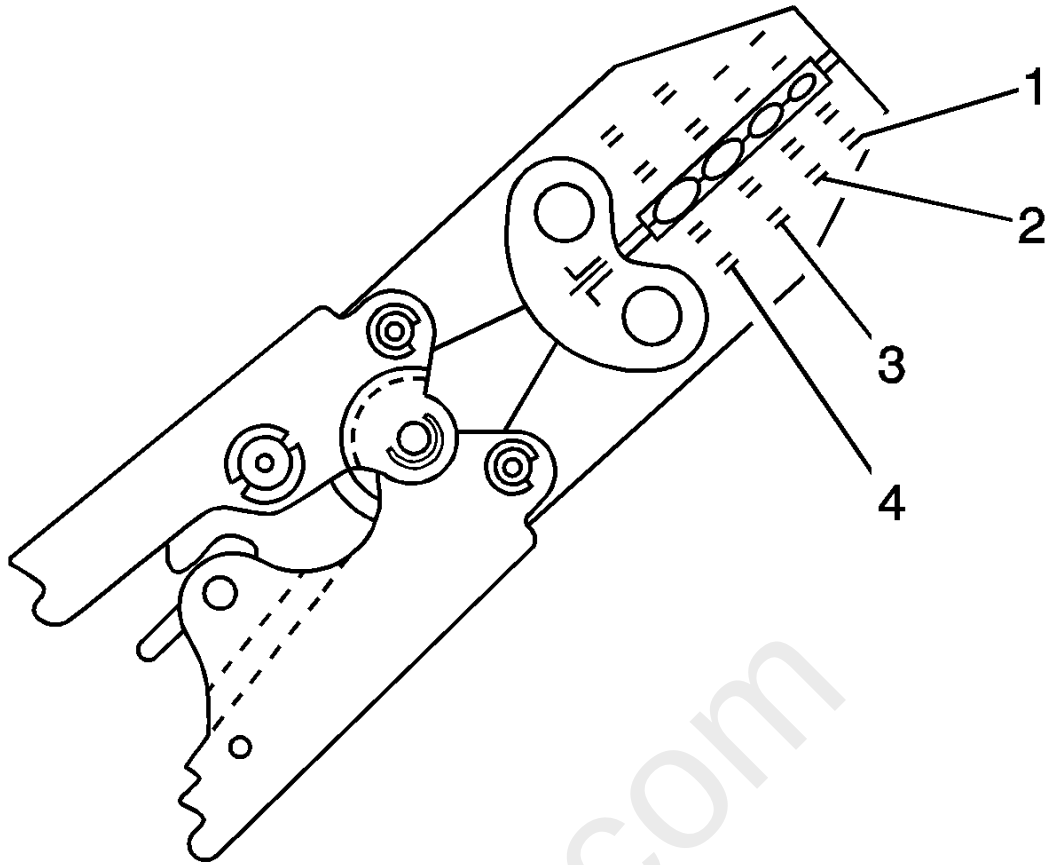


Fig. 1: Splice Sleeve Crimping Tool With 4 Crimp Nests

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.

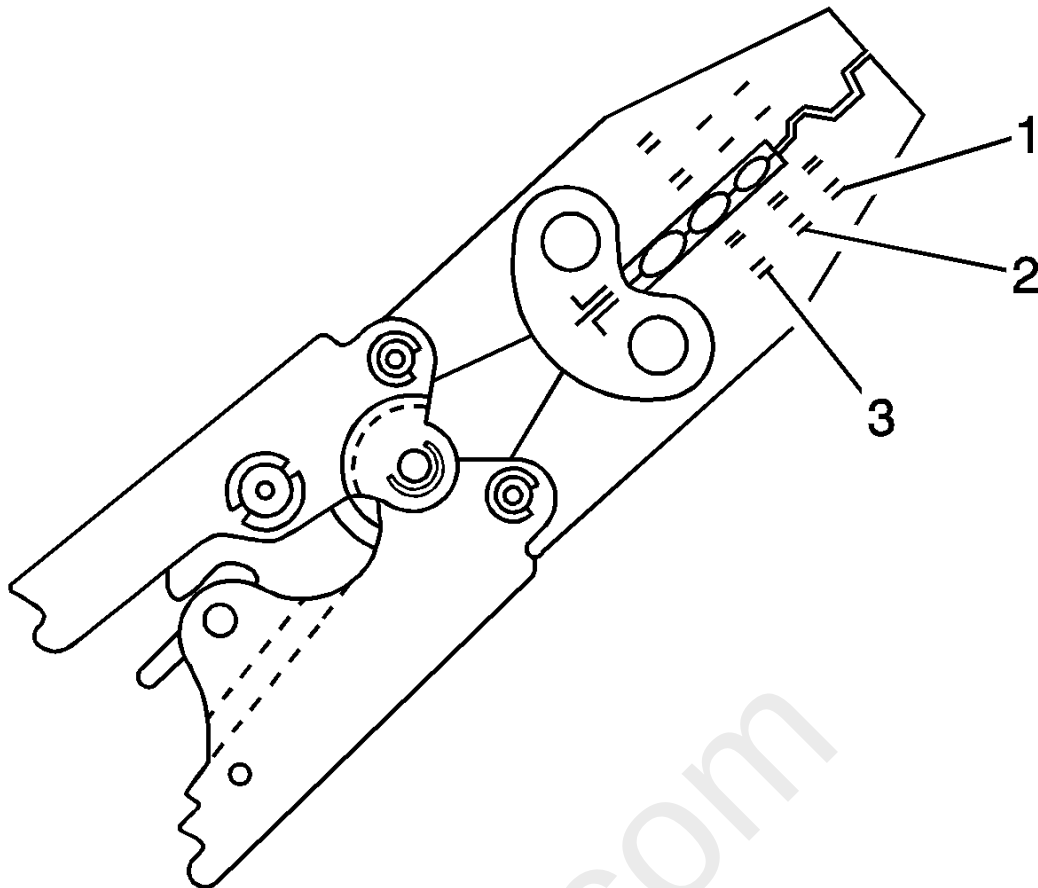


Fig. 2: Splice Sleeve Crimping Tool With 3 Crimp Nests
Courtesy of GENERAL MOTORS COMPANY

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).

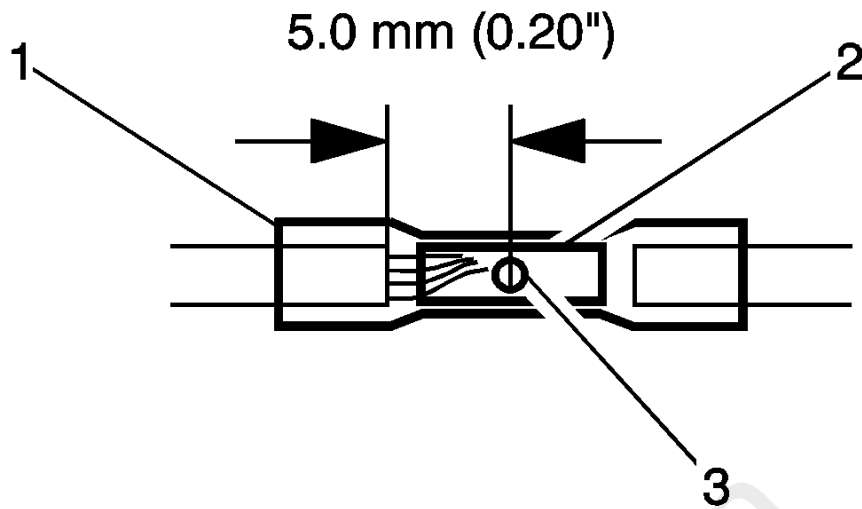


Fig. 3: Identifying Duraseal Splice Sleeve

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: Crimped Duraseal 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.

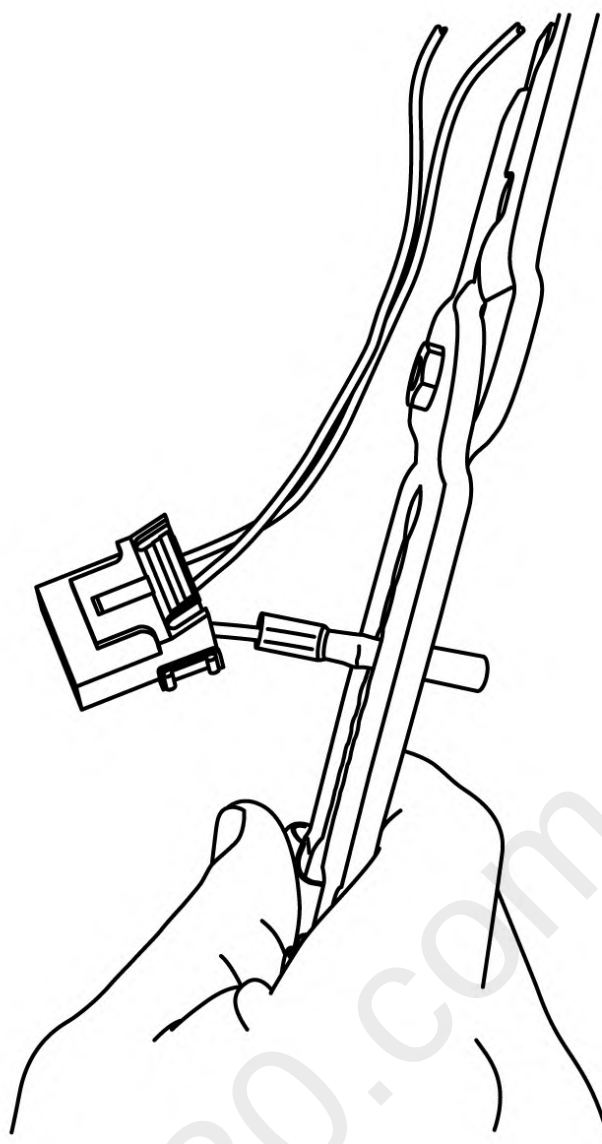


Fig. 6: Tightly Close Handles Of Crimp Tool

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.

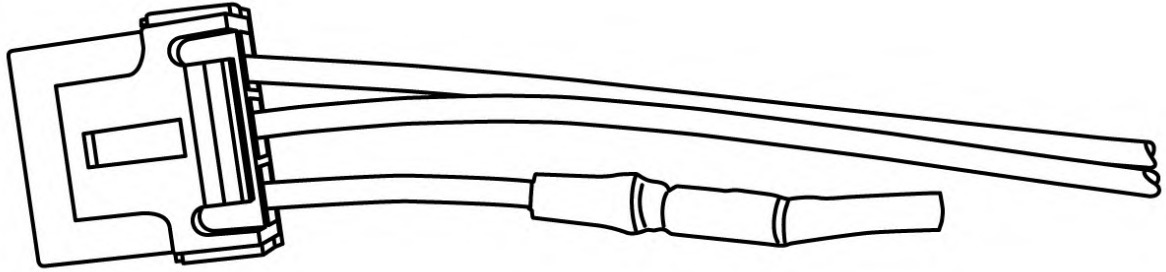


Fig. 7: Heat To Crimped Area Of Barrel

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.

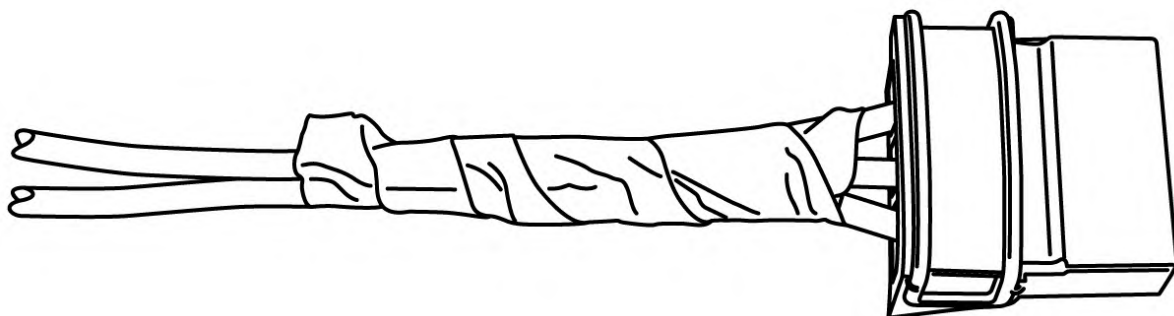


Fig. 8: Taping Extra Terminated Leads Back Into Harness
Courtesy of GENERAL MOTORS COMPANY

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 Schematics \(Buick\)](#) , [Power Distribution Schematics \(Chevrolet\)](#) .
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point (screw or stud). Inspect the connections at the component and in splice packs, where applicable. Operate the component to test the ability of the circuit to carry sufficient current. Refer to [Circuit Testing](#) , and [Ground Distribution Schematics \(Buick\)](#) , [Ground Distribution Schematics \(Chevrolet\)](#) .

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.

BRAKE PEDAL POSITION SENSOR LEARN

Calibration Criteria

NOTE: **Do not apply the brake pedal during the brake pedal position sensor calibration procedure. Any movement of the brake pedal during this procedure will cause the calibration procedure to fail. If this occurs, the brake pedal position sensor calibration must be repeated.**

Brake pedal position sensor calibration must be performed after the brake pedal position sensor, body control module (BCM), or engine control module (ECM) have been serviced. The calibration procedure will set the brake pedal position sensor home value. This value is used by the BCM and ECM to

determine the action of the driver applying the brake system and to provide this information to the vehicle subsystems via serial data.

Calibration Procedure

1. Apply the parking brake.
2. Ignition ON, engine OFF, place the transmission in the PARK position for automatic transmission or NEUTRAL position for manual transmission.
3. Install a scan tool.
4. Clear all DTCs before proceeding.
5. Navigate to the Configuration/Reset Functions menu of the BCM.
6. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.
7. Navigate to the Configuration/Reset Functions menu of the ECM.
8. Select the Learn Functions menu.
9. Select the Brake Pedal Position Sensor Learn procedure and follow the directions displayed on the screen.

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:

- B74 Manifold Absolute Pressure 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 P00C7, P0068, P0101, P0102, P0103, P0106, P0107, P0108, P010B, P010C, P010D, P0236, P0237, P0238, P1101, P2227-P2230, P222B-P222E = Not set
- Engine=Off
- Ignition=On

Reference Information

Control Module References

With Scan Tool

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

Description

The engine control module (ECM) learns the airflow through the throttle body to ensure the correct idle. The learned airflow values are stored within the ECM. These values are learned to adjust for production variation and will continuously learn during the life of the vehicle to compensate for reduced airflow due to throttle body coking. Anytime the throttle body airflow rate changes, for example due to cleaning or replacing, the values must be relearned.

An engine that had a heavily coked throttle body that has been cleaned or replaced may take several drive cycles to unlearn the coking. To accelerate the process, the scan tool has the ability to reset all learned values back to zero. A new ECM will also have values set to zero.

The idle may be unstable or a DTC may set if the learned values do not match the actual airflow.

Conditions for Running the Throttle Body Idle Air Flow Compensation Reset Procedure

Scan tool Throttle Body Idle Air Flow Compensation Reset

- DTCs 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, or P2322 are not set.
- Ignition ON, engine OFF.
- The vehicle speed sensor (VSS) is 0 km/h (0 mph).

Service Bay/On Road Reset Procedure

- DTCs 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, or P2322 are not set.
- The engine speed is between 450-4, 000 RPM.

- The manifold absolute pressure (MAP) is greater than 5 kPa.
- The mass air flow (MAF) is greater than 2 g/s.
- The ignition voltage is greater than 10 volts.

Diagnostic Aids

A un-metered air leak in the induction system or a small vacuum leak may not set a DTC. If the condition goes undetected, the ECM may learn an incorrect Throttle Body Idle Airflow Compensation value over time. The incorrectly learned value may cause various symptoms to occur such as rough or unstable idle speeds, and/or engine stall. If this condition is detected and repaired it will be necessary perform the Throttle Body Idle Air Flow Compensation Reset procedure to ensure any symptoms are corrected.

Throttle Body Idle Air Flow Compensation Reset

Scan Tool Reset Procedure - Performed after the throttle body is cleaned or replaced

1. Ignition ON, engine OFF, perform the Throttle Body Idle Air Flow Compensation Reset in Configuration/Reset or Module Setup.
2. Engine idling, verify the scan tool Throttle Body Idle Airflow Compensation value is equal 0% and the engine is idling at a normal idle speed.
3. Clear the DTCs and return to the diagnostic that referred you here.

Service Bay/On Road Reset Procedure - Performed after the ECM is programmed or replaced

NOTE: Do NOT perform this procedure if any DTCs are set. Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .

1. Engine idling for 3 m.
2. The ECM will start to learn the new idle cells and the scan tool Desired Idle Speed should start to decrease.
3. Ignition OFF for 60 s.
4. Start and idle the engine for 3 m.
5. Verify the engine is idling normally.

- If the engine idle is not correct

NOTE: During the drive cycle the check engine light may come on with idle speed DTCs. If idle speed codes are set, clear codes so the ECM can continue to learn.

1. Operate the vehicle at speeds above 70 km/h (44 mph) with several decelerations and extended idles.
2. Verify the engine is idling normally.
 - If the engine idle is not correct.

Ignition OFF for 60 s, repeat step 5.1.

- If the engine idle is correct.
3. Clear any DTCs and return to the diagnostic that referred you here.
 - If the engine idle is correct
 6. Clear any DTCs and return to the diagnostic that referred you here.

ENGINE CONTROL MODULE REPLACEMENT

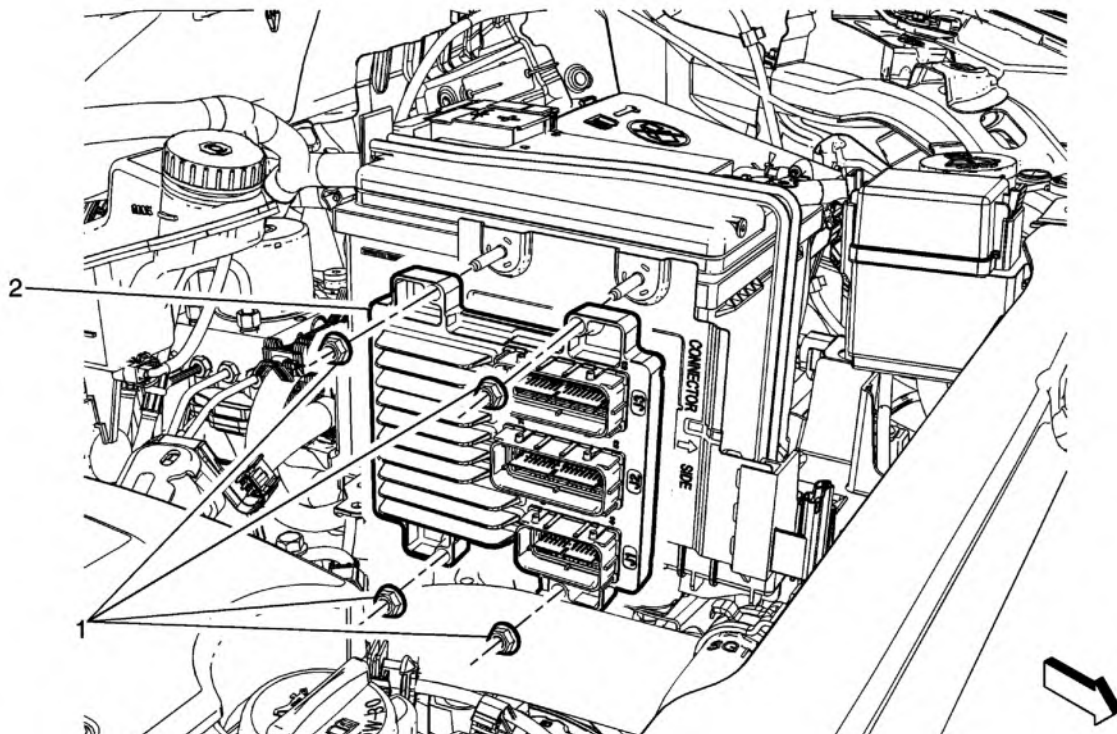


Fig. 9: Engine Control Module

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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. NOTE: Before removing the engine control module (ECM), use the scan tool to capture the ECM data. This captured data will then need to be restored into the NEW ECM. Refer to Control Module References . Preliminary Procedure Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection (without KL9) Battery Negative Cable Disconnection and Connection (with KL9) .	

Callout	Component Name
1	Engine Control Module Fasteners (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Engine Control Module Procedure 1. Disconnect the electrical connector. 2. If replacing, program the ECM. Refer to Control Module References .

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 A» On / Vehicle A» 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](#)

- **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 A» 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/Visual Damage
 - Reluctor Ring - Misaligned/Visual Damage
 - Signal circuit@B26 Crankshaft Position Sensor - Electromagnetic Interference
 - If a condition exists A» Repair or replace as necessary
 - If no condition exists A» 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

- **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](#)

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT (WATER OUTLET)

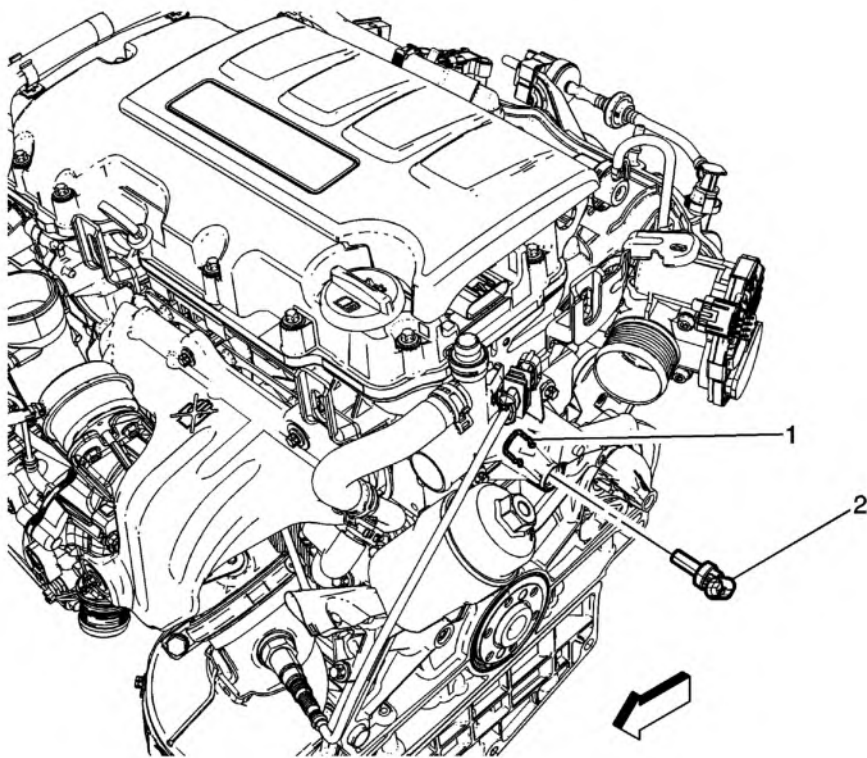


Fig. 10: Engine Coolant Temperature Sensor (Water Outlet).

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling . 2. Remove the charge air cooler outlet air hose. Refer to Charge Air Cooler Outlet Air Hose Replacement.	
1	Engine Coolant Temperature Sensor Retainer
2	Engine Coolant Temperature Sensor Procedure Disconnect the engine coolant temperature sensor electrical connector.

ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT (RADIATOR)

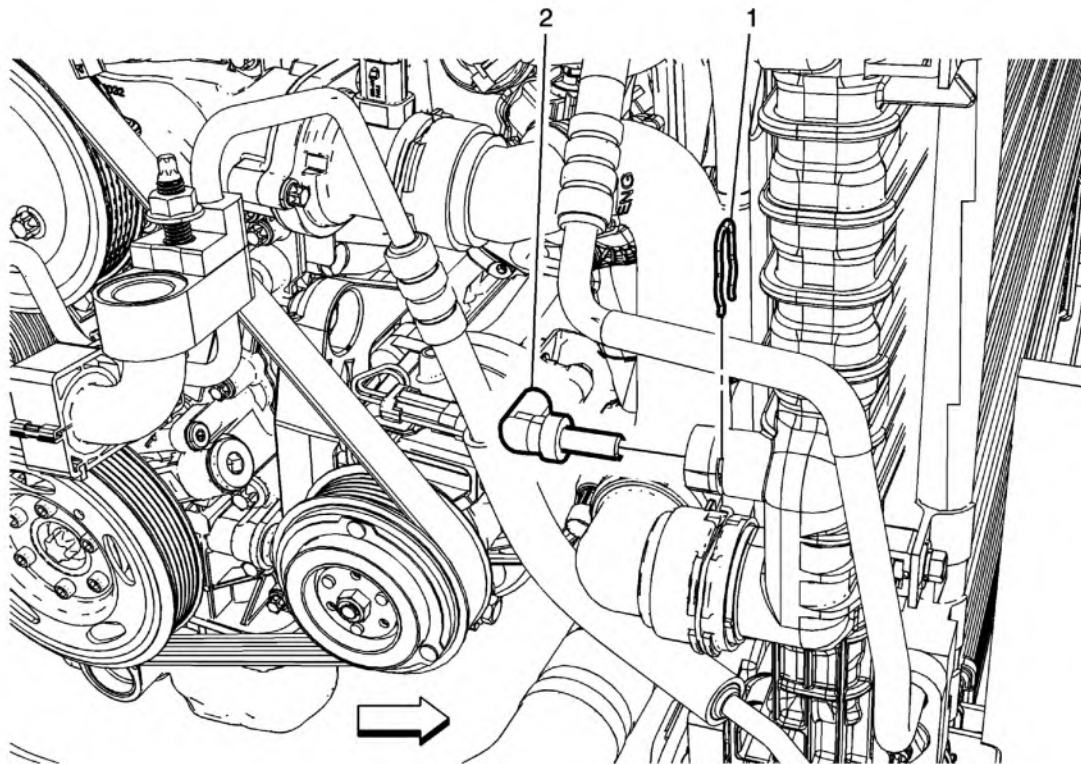


Fig. 11: Engine Coolant Temperature Sensor (Radiator)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Drain the cooling system. Refer to Cooling System Draining and Filling . 2. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .	
1	Engine Coolant Temperature Sensor Retainer
2	Engine Coolant Temperature Sensor Procedure Disconnect the engine coolant temperature sensor electrical connector.

MASS AIRFLOW SENSOR REPLACEMENT

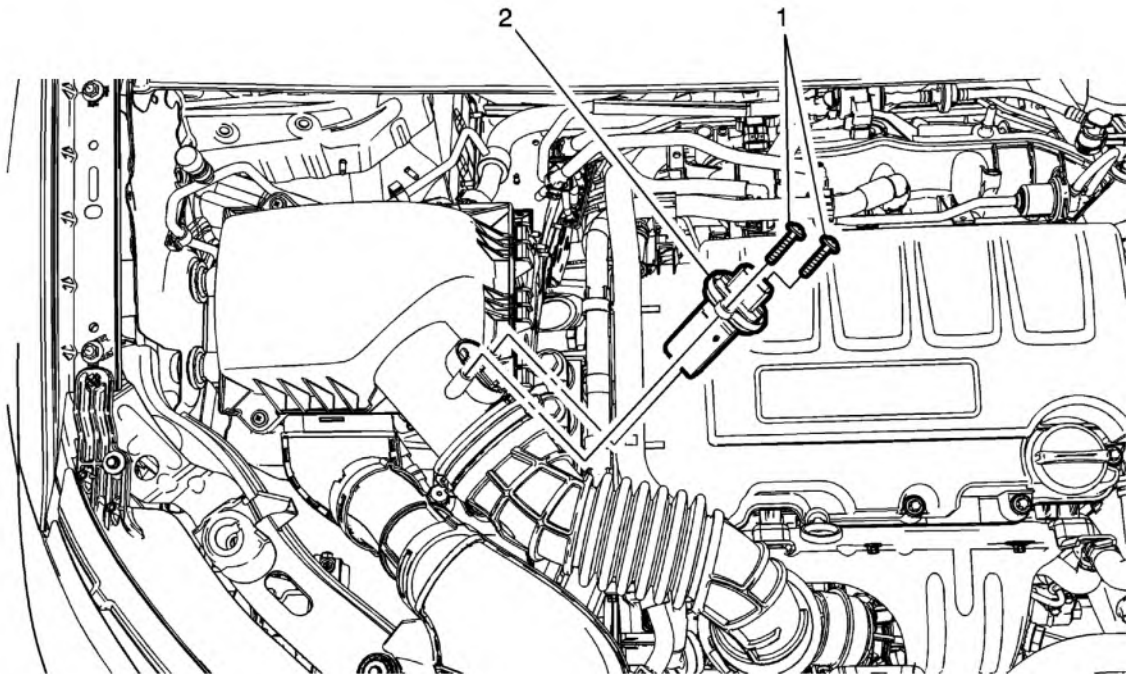


Fig. 12: Mass Airflow Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Mass Airflow Sensor Fasteners (Qty 2) CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
2	Mass Airflow Sensor Procedure Disconnect the mass airflow sensor electrical connector.

INTAKE AIR PRESSURE AND TEMPERATURE SENSOR REPLACEMENT

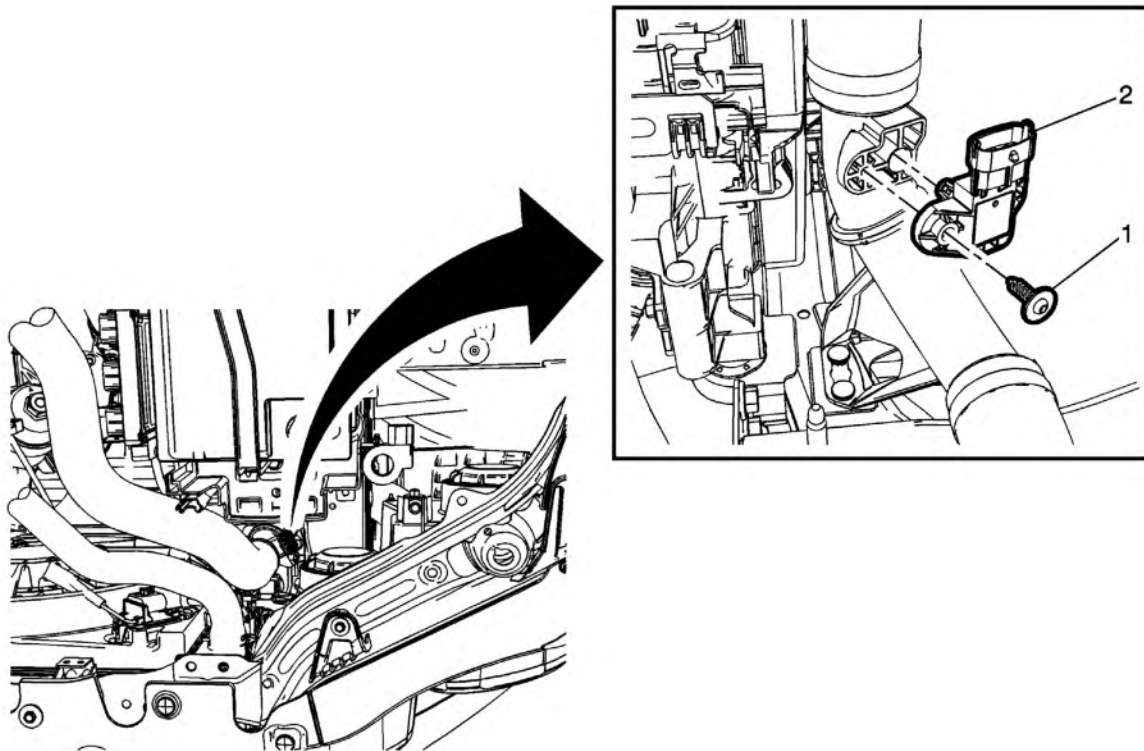


Fig. 13: Intake Air Pressure and Temperature Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Front Compartment Front Center Insulator Replacement</u>	
1	Intake Air Pressure and Temperature Sensor Fastener CAUTION: Refer to <u>Fastener Caution</u> .
2	Intake Air Pressure and Temperature Sensor Procedure Disconnect the intake air pressure and temperature sensor electrical connector.

MANIFOLD ABSOLUTE PRESSURE SENSOR REPLACEMENT

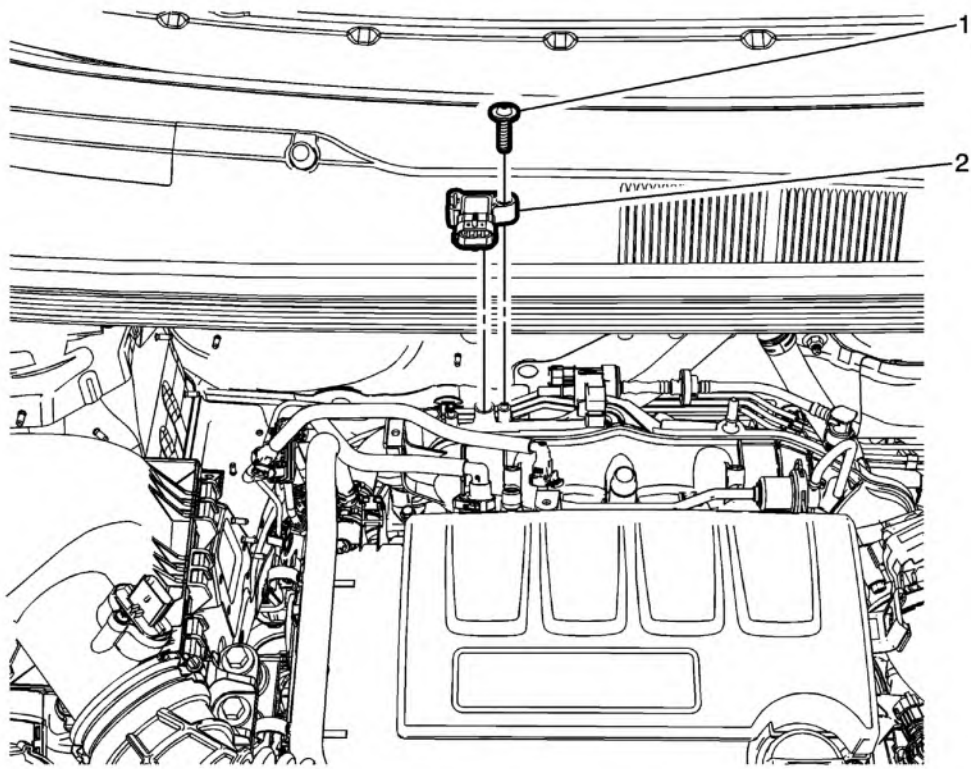


Fig. 14: Manifold Absolute Pressure Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Manifold Absolute Pressure Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Manifold Absolute Pressure Sensor Procedure Disconnect the manifold absolute pressure sensor electrical connector.

TURBOCHARGER WASTEGATE REGULATOR SOLENOID VALVE REPLACEMENT

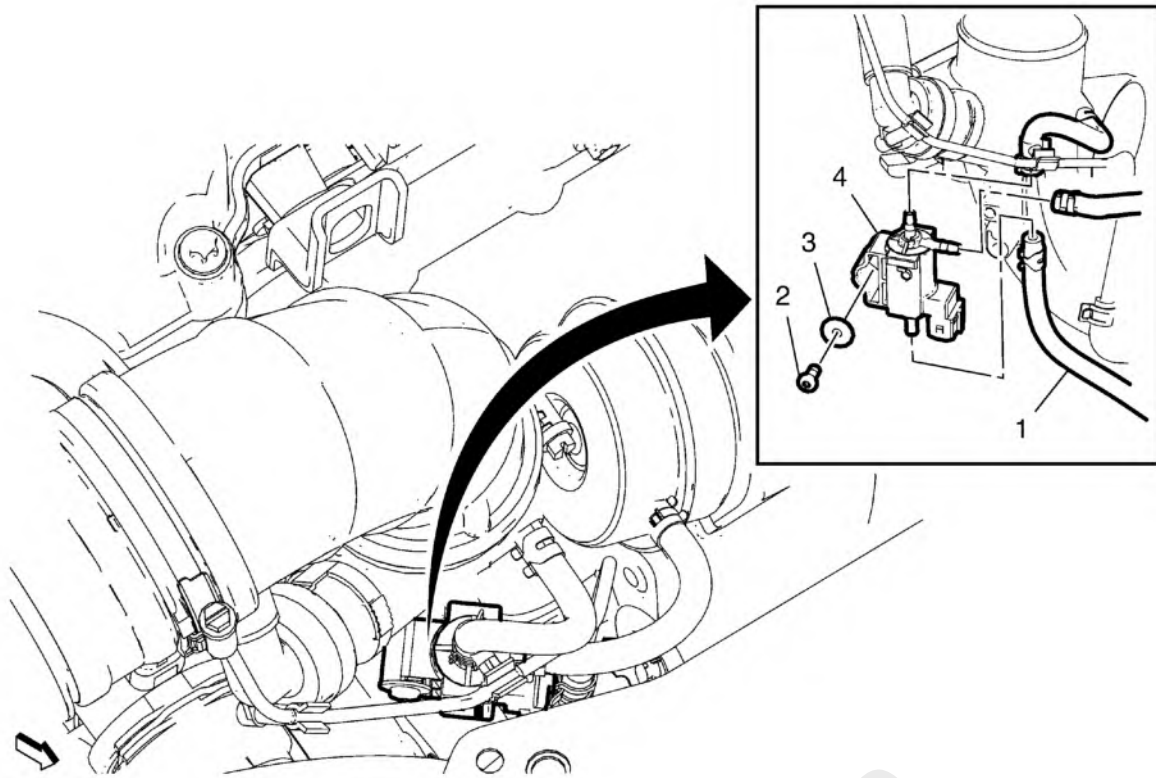


Fig. 15: Turbocharger Wastegate Regulator Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Cooling System Draining and Filling</u> . <u>Radiator Outlet Hose Replacement (LUV)</u>. - Disconnect the electrical connector.	
1	Turbocharger Wastegate Regulator Solenoid Valve Vacuum Hose (Qty: 3)
2	Turbocharger Wastegate Regulator Solenoid Valve Bolt CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 N.m (62 lb in)
3	Turbocharger Wastegate Regulator Solenoid Valve Bolt Washer
4	Turbocharger Wastegate Regulator Solenoid Valve

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 1

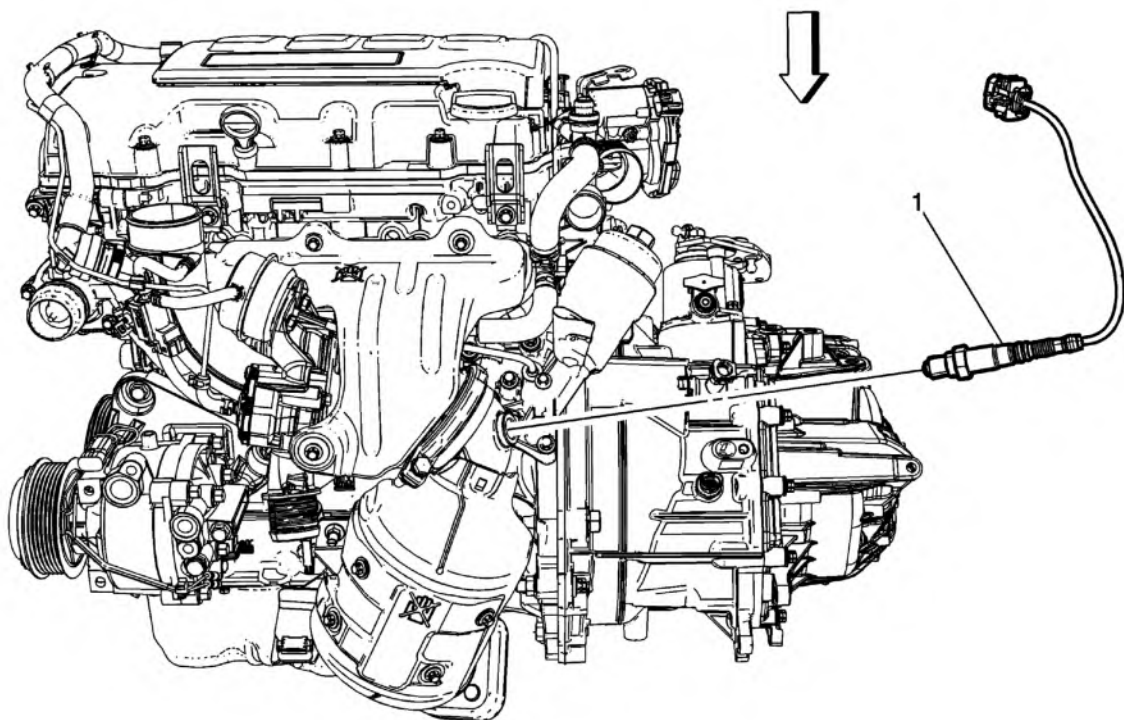


Fig. 16: Heated Oxygen Sensor 1

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name

Callout	Component Name
1	Heated Oxygen Sensor CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: The oxygen sensor uses a permanently attached pigtail and connector. Do not remove the pigtail from the oxygen sensor. Damage to or removal of the pigtail connector could affect proper operation of the oxygen sensor. CAUTION: The use of excessive force may damage the threads in the exhaust manifold/pipe. Procedure 1. Disconnect the heated oxygen sensor harness connector from the water outlet housing. 2. Disconnect the heated oxygen sensor harness connector from the engine wiring harness. 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. Tighten 42 N.m (31 lb ft)

HEATED OXYGEN SENSOR REPLACEMENT - SENSOR 2

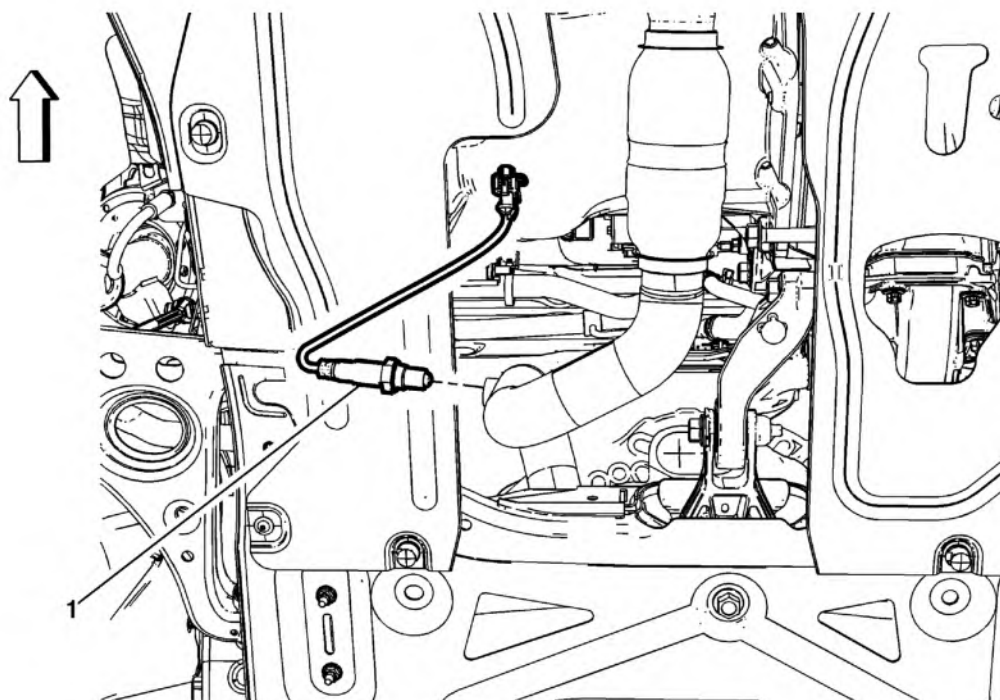


Fig. 17: Heated Oxygen Sensor 2

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. { If equipped }. Refer to Front Compartment Insulator Replacement	

Callout	Component Name
	Heated Oxygen Sensor CAUTION: Refer to Component Fastener Tightening Caution . CAUTION: The oxygen sensor uses a permanently attached pigtail and connector. Do not remove the pigtail from the oxygen sensor. Damage to or removal of the pigtail connector could affect proper operation of the oxygen sensor. CAUTION: The use of excessive force may damage the threads in the exhaust manifold/pipe. Procedure Disconnect the heated oxygen sensor harness connector. 1 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. Tighten 42 N.m (31 lb ft)

ENGINE OIL PRESSURE INDICATOR SWITCH REPLACEMENT

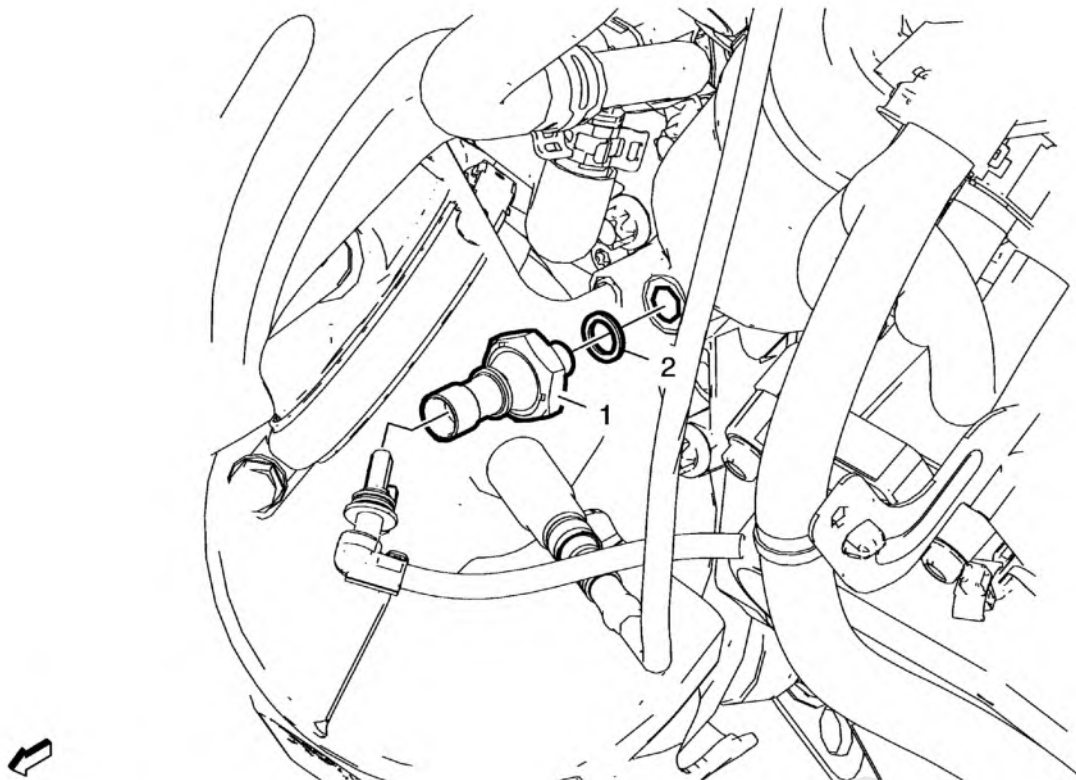


Fig. 18: Engine Oil Pressure Indicator Switch
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Engine Oil Pressure Indicator Switch CAUTION: Refer to Component Fastener Tightening Caution . Procedure 1. Place collecting basin underneath. 2. Disconnect the electrical connector. 3. Check engine oil level after replacement. Tighten 20 N.m (15 lb ft)
2	Engine Oil Pressure Indicator Switch Seal

ACCELERATOR PEDAL POSITION SENSOR REPLACEMENT

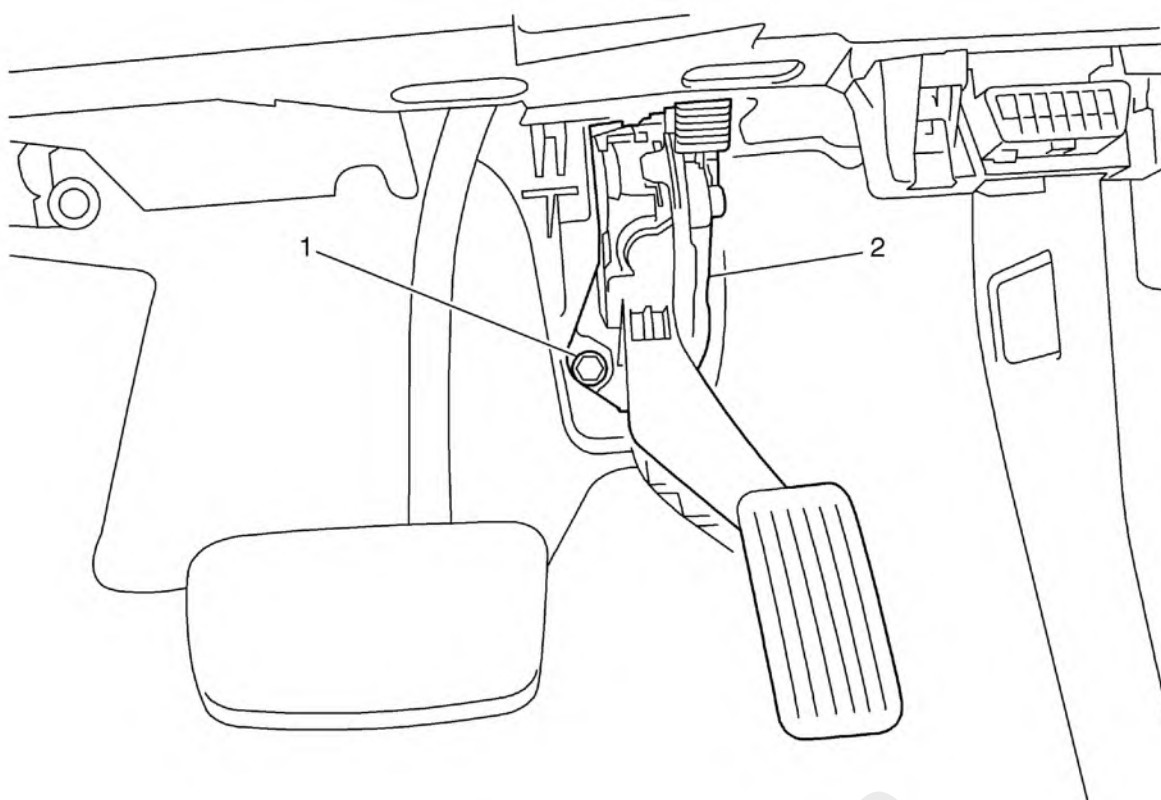


Fig. 19: Accelerator Pedal Position Sensor & Fastener
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Accelerator Pedal Position Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)
2	Accelerator Pedal Position Sensor Procedure Disconnect electrical connector.

THROTTLE BODY ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect the throttle body wiring harness connector.
2. Separate the charge air cooler outlet air hose from the throttle body. [Charge Air Cooler Outlet Air Hose Replacement](#)

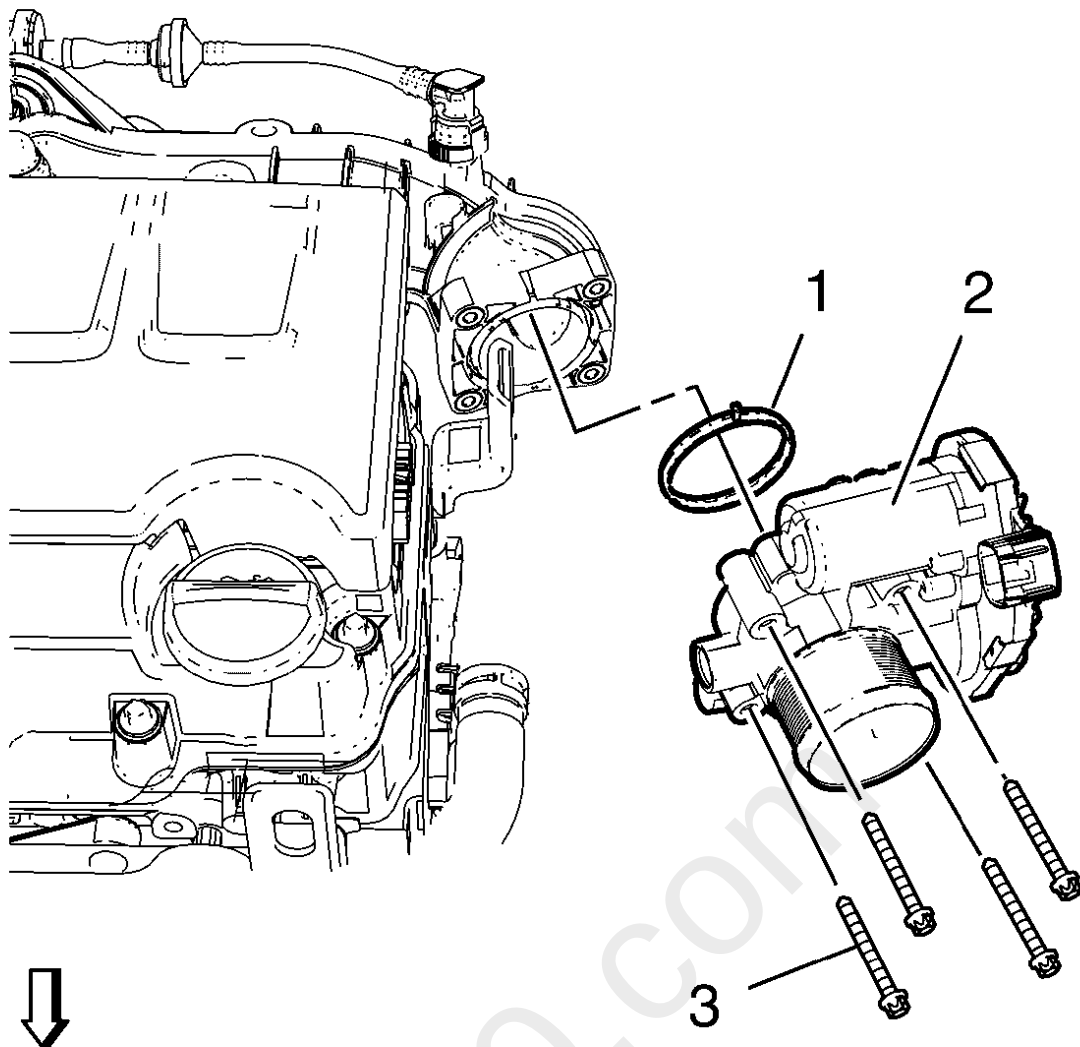


Fig. 20: Throttle Body.

Courtesy of GENERAL MOTORS COMPANY

3. Remove the throttle body fasteners (3).
4. Remove the throttle body (2).
5. Remove and DISCARD the throttle body seal ring (1).

Installation Procedure

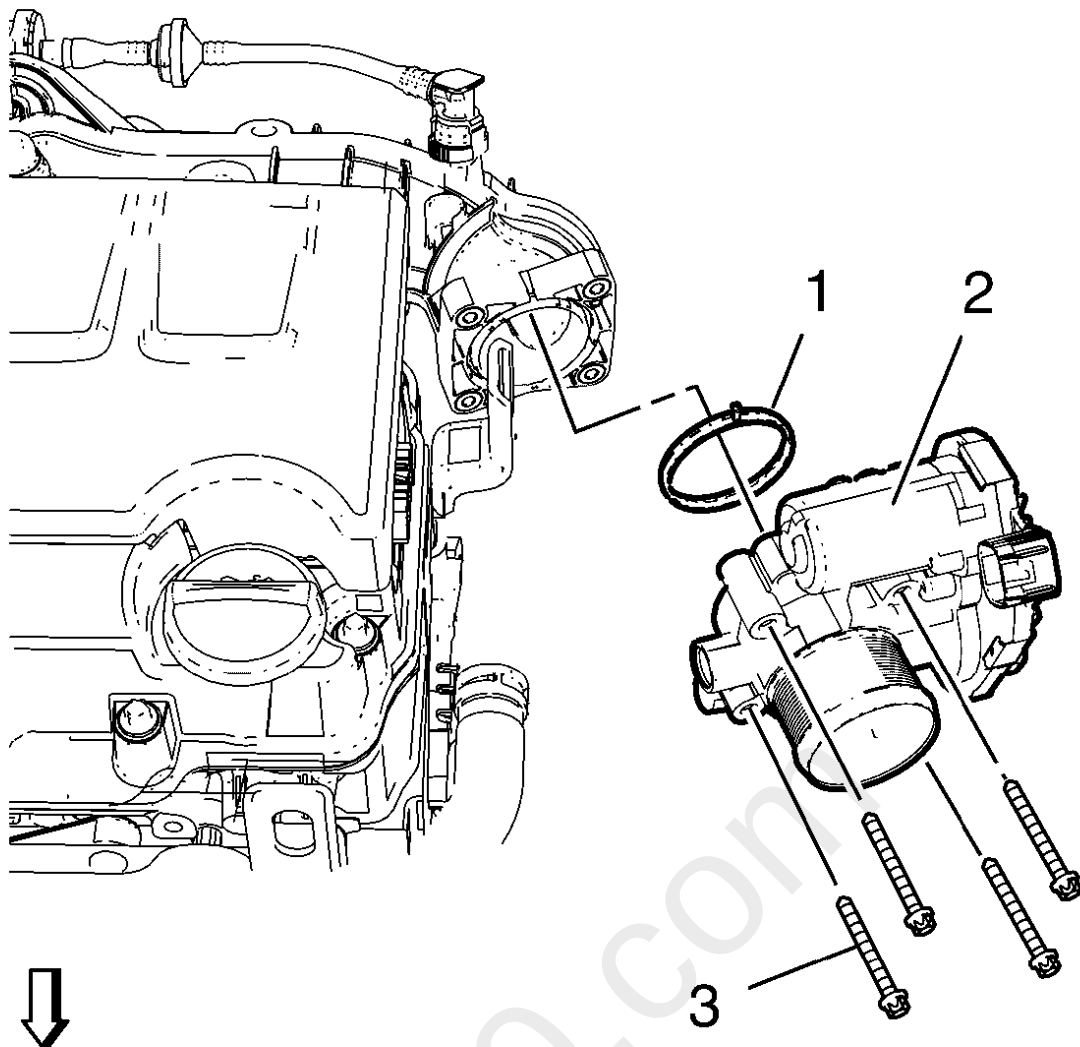


Fig. 21: Throttle Body

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW throttle body seal ring (1).
2. Position the throttle body (2).

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

3. Install the throttle body fasteners (3) and tighten to 8 N.m (71 lb in).
4. Install the charge air cooler outlet air hose to the throttle body. [Charge Air Cooler Outlet Air Hose Replacement](#)
5. Connect the throttle body wiring harness connector.
6. Perform the throttle body idle air flow compensation reset. [Throttle Body Idle Air Flow Compensation Reset](#)

THROTTLE BODY INSPECTION AND CLEANING

NOTE: Over extended time and mileage, deposits may accumulate on the back of the throttle valve plate. The source of the deposit is exhaust gas. Typically these deposits pose no problem. Occasionally the deposit may accumulate to a point where perceived pedal effort or throttle valve movement is effected. This procedure should not be performed on vehicles with mileage under 80, 450 km (50, 000 mi).

1. Remove the charge air cooler outlet air hose. Refer to [Charge Air Cooler Outlet Air Hose 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.

2. Inspect the throttle body bore and the throttle valve plate for deposits. You will need to open the throttle valve in order to inspect all surfaces.

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 the charge air cooler outlet air hose. Refer to [Charge Air Cooler Outlet Air Hose Replacement](#).

FUEL PRESSURE RELIEF

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

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.

1. Disconnect the battery. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#) [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Loosen the fuel fill cap in order to relieve the fuel tank vapor pressure.
3. Remove the engine cover, if required.
4. Remove the fuel rail service port cap.
5. Wrap a shop towel around the fuel rail service port and using a small flat bladed tool, depress (open) the fuel rail test port valve.
6. Remove the shop towel from around the fuel rail service port, and place in an approved gasoline container.
7. Install the fuel rail service port cap.
8. Install the engine cover, if required.
9. Tighten the fuel fill cap.

FUEL TANK DRAINING

Special Tool

CH 45004 Fuel Tank Drain Hose

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.

1. Remove the fuel fill cap.

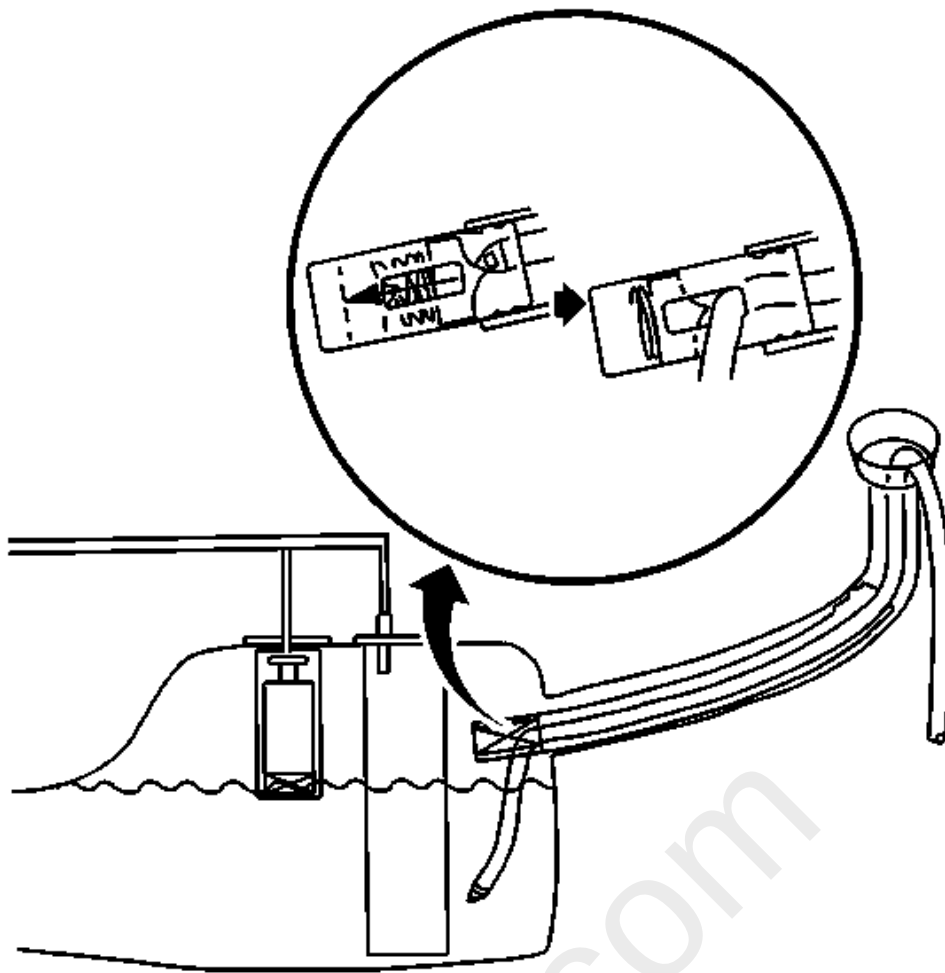


Fig. 22: Draining Fuel Tank

Courtesy of GENERAL MOTORS COMPANY

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

2. Insert the CH 45004 hose into the fuel tank until the bottom is reached.
3. Use a hand or air operated pump device in order to drain as much fuel through the fuel fill pipe as possible.

FUEL TANK REPLACEMENT (AWD)

Removal Procedure

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

1. Relieve the fuel system pressure. Refer to [Fuel Pressure Relief](#) .
2. Drain the fuel tank. Refer to [Fuel Tank Draining](#) .
3. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .
4. Remove the exhaust. Refer to [Exhaust Muffler Replacement \(LUV\)](#) .
5. Remove the propeller shaft. Refer to [Two-Piece Propeller Shaft Replacement](#) .
6. Remove the right rear wheelhouse panel liner. Refer to [Rear Wheelhouse Liner Replacement](#) .

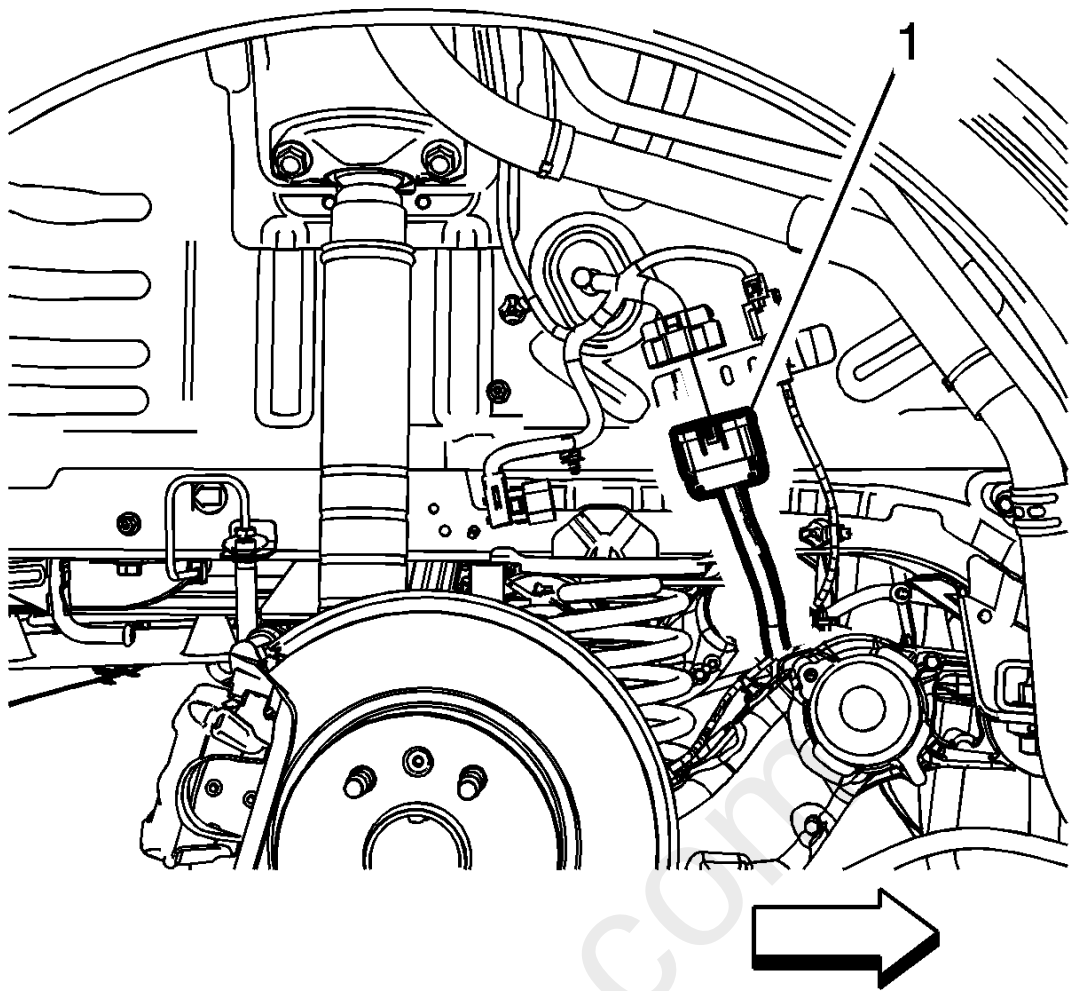


Fig. 23: Fuel Tank Fuel Pump Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

7. Disconnect the fuel tank fuel pump module wiring harness (1) and unclip the fuel tank module wiring harness from the chassis.
8. Disconnect the fuel tank filler pipe. Refer to [Fuel Tank Filler Pipe Replacement](#).
9. Disconnect the fuel feed pipe. Refer to [Fuel Feed Pipe Replacement \(At Tank AWD\)](#).
10. Disconnect the EVAP system hoses. Refer to [Evaporative Emission System Hose/Pipe Replacement \(Fuel Pump Module to Canister AWD\)](#)[Evaporative Emission System Hose/Pipe Replacement \(Canister to Pipe AWD\)](#).
11. Position a suitable hydraulic lift below the fuel tank.

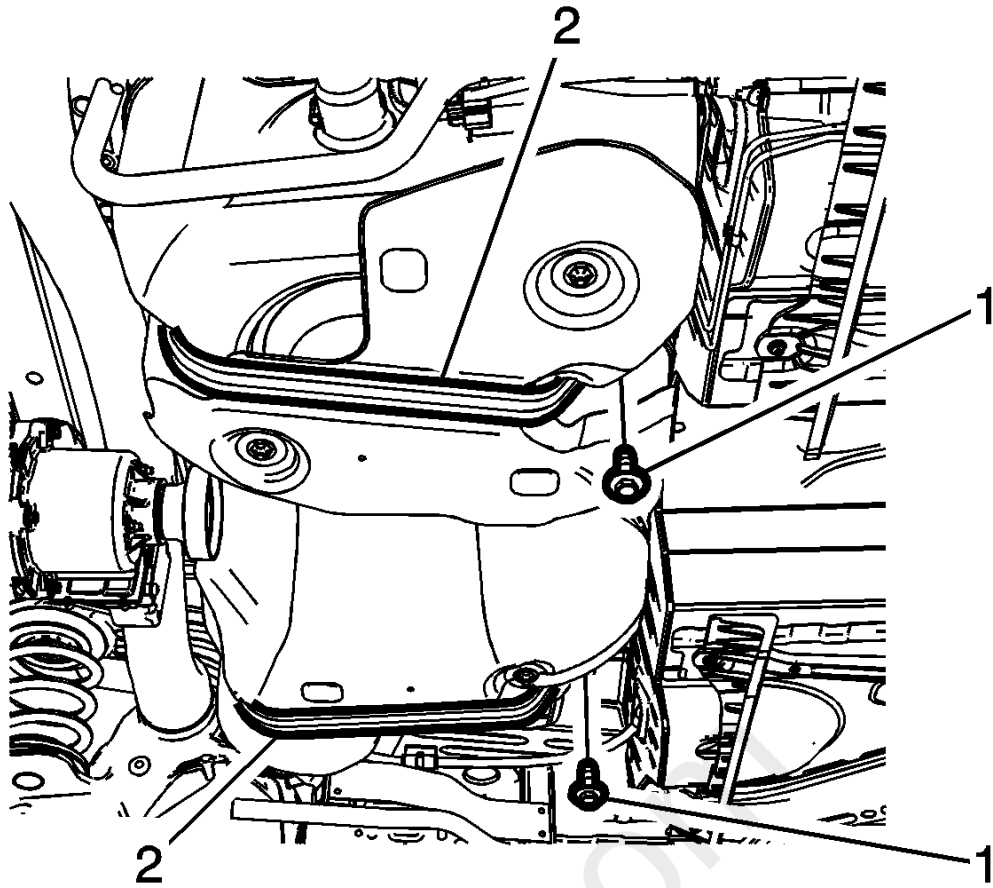


Fig. 24: Fuel Tank Straps And Fasteners
 Courtesy of GENERAL MOTORS COMPANY

12. Remove both fuel tank strap fasteners (1).
13. Remove both fuel tank straps from the fuel tank (2).

WARNING: To help avoid personal injury, always use jack stands when you are working on or under any vehicle that is supported only by a jack.

CAUTION: When you are jacking or lifting a vehicle at the frame side rails or other prescribed lift points, be certain that the lift pads do not contact the catalytic converter, the brake pipes or the fuel lines. If such contact occurs, vehicle damage or unsatisfactory vehicle performance may result.

14. With the aid of an assistant, lower the hydraulic lift to remove the fuel tank from the vehicle.
15. Remove the fuel tank from the hydraulic lift.
16. Remove the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#).
17. Remove the fuel sender assembly. Refer to [Fuel Sender Assembly Replacement \(AWD\)](#).
18. Remove the evaporative emission canister. Refer to [Evaporative Emission Canister Replacement \(AWD\)](#)[Evaporative Emission Canister Replacement \(FWD\)](#).

Installation Procedure

1. Install the fuel sender assembly. Refer to [Fuel Sender Assembly Replacement \(AWD\)](#).
2. Transfer the fuel tank fuel pump module. Refer to [Fuel Tank Fuel Pump Module Replacement \(FWD\)](#).

3. Transfer the evaporative emission canister. Refer to [Evaporative Emission Canister Replacement \(AWD\)](#)[Evaporative Emission Canister Replacement \(FWD\)](#).
4. Install the fuel tank to the hydraulic lift.

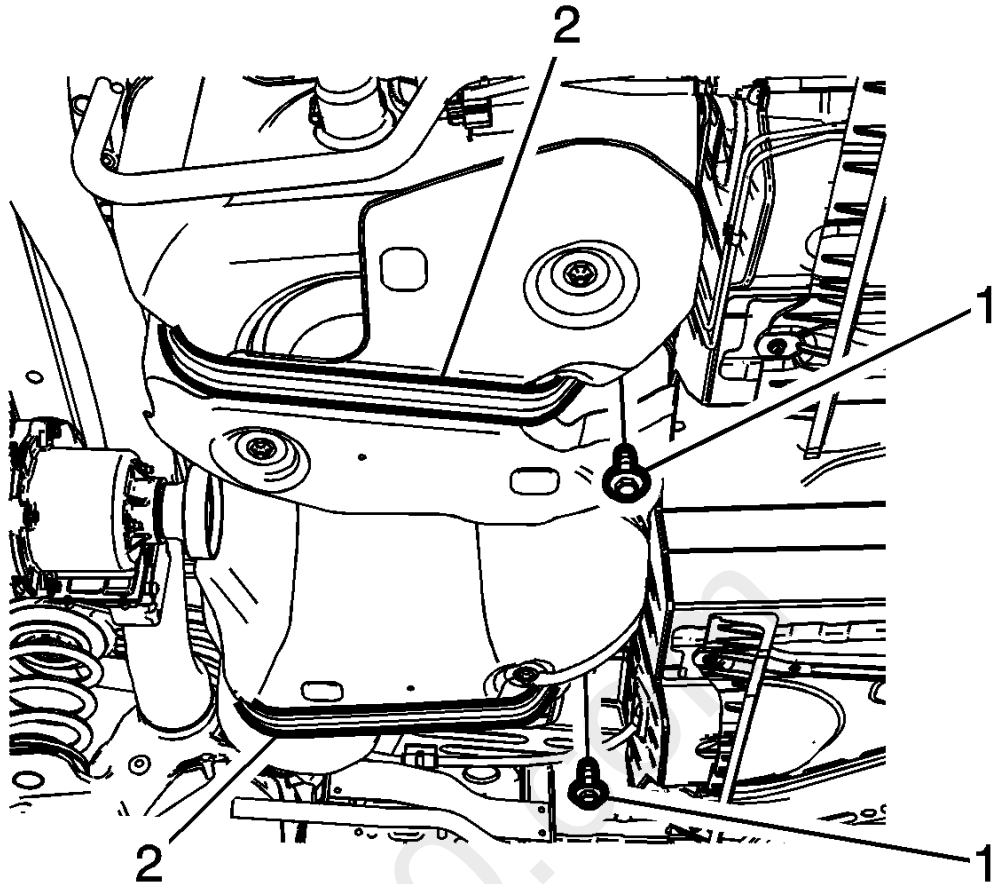


Fig. 25: Fuel Tank Straps And Fasteners

Courtesy of GENERAL MOTORS COMPANY

5. With the aid of an assistant, position the fuel tank to the vehicle.

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

6. Install both fuel tank straps to the fuel tank (2) and tighten the fasteners to 22 N.m (16 lb ft).
7. Remove the hydraulic lift from the fuel tank.
8. Connect the EVAP system hoses. Refer to [Evaporative Emission System Hose/Pipe Replacement \(Fuel Pump Module to Canister AWD\)](#)[Evaporative Emission System Hose/Pipe Replacement \(Canister to Pipe AWD\)](#).
9. Connect the fuel feed pipe. Refer to [Fuel Feed Pipe Replacement \(At Tank AWD\)](#).
10. Connect the fuel tank filler pipe. Refer to [Fuel Tank Filler Pipe Replacement](#).

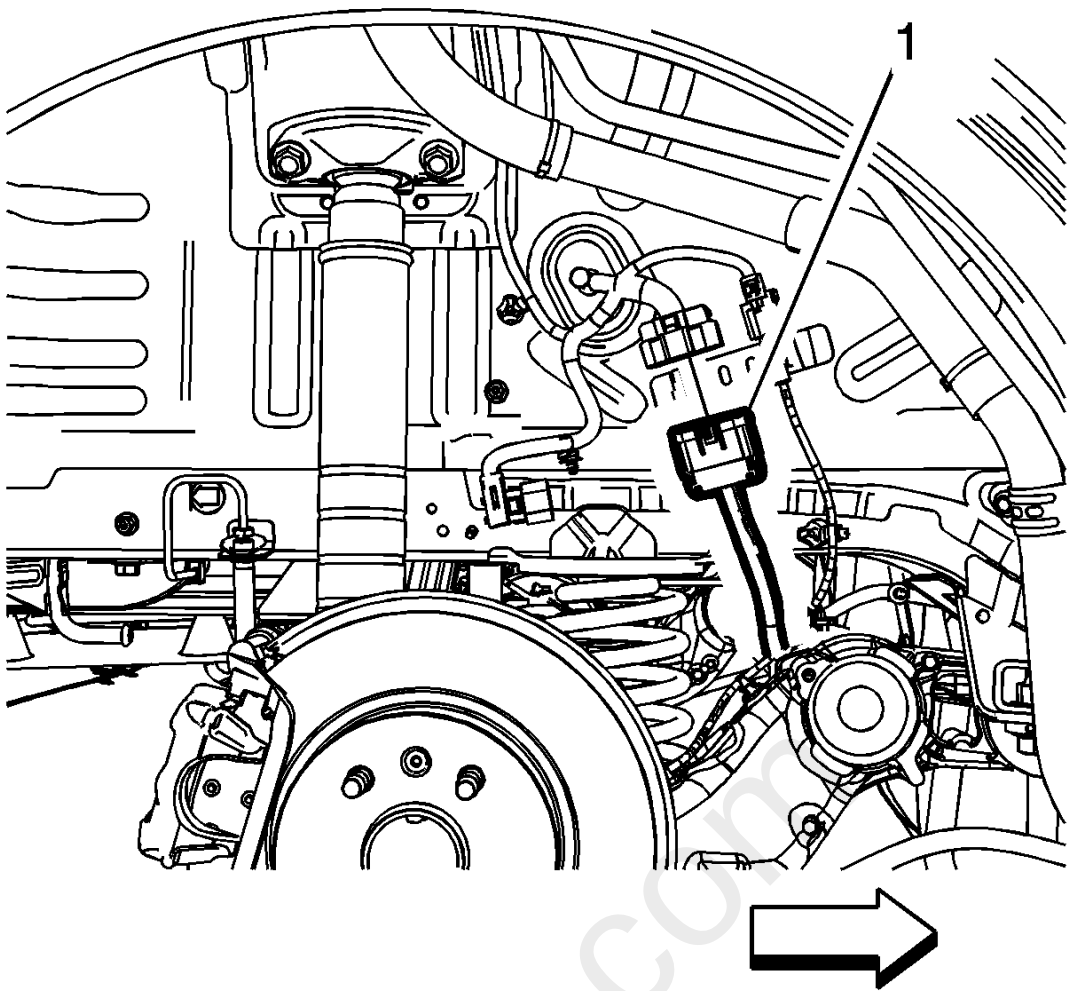


Fig. 26: Fuel Tank Fuel Pump Module Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

11. Connect the fuel tank fuel pump module wiring harness (1) and clip the fuel tank module wiring harness to the chassis.
12. Install the propeller shaft. Refer to [Two-Piece Propeller Shaft Replacement](#) .
13. Install the exhaust. Refer to [Exhaust Muffler Replacement \(LUV\)](#) .
14. Install the right rear wheelhouse panel liner. Refer to [Rear Wheelhouse Liner Replacement](#) .
15. Lower the vehicle.

FUEL TANK FILLER PIPE REPLACEMENT

Removal Procedure

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.

1. Remove the fuel cap.
2. Drain the fuel tank. [Fuel Tank Draining](#)
3. Remove the right rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#) .
4. Remove the right rear wheelhouse panel liner. Refer to [Rear Wheelhouse Liner Replacement](#) .

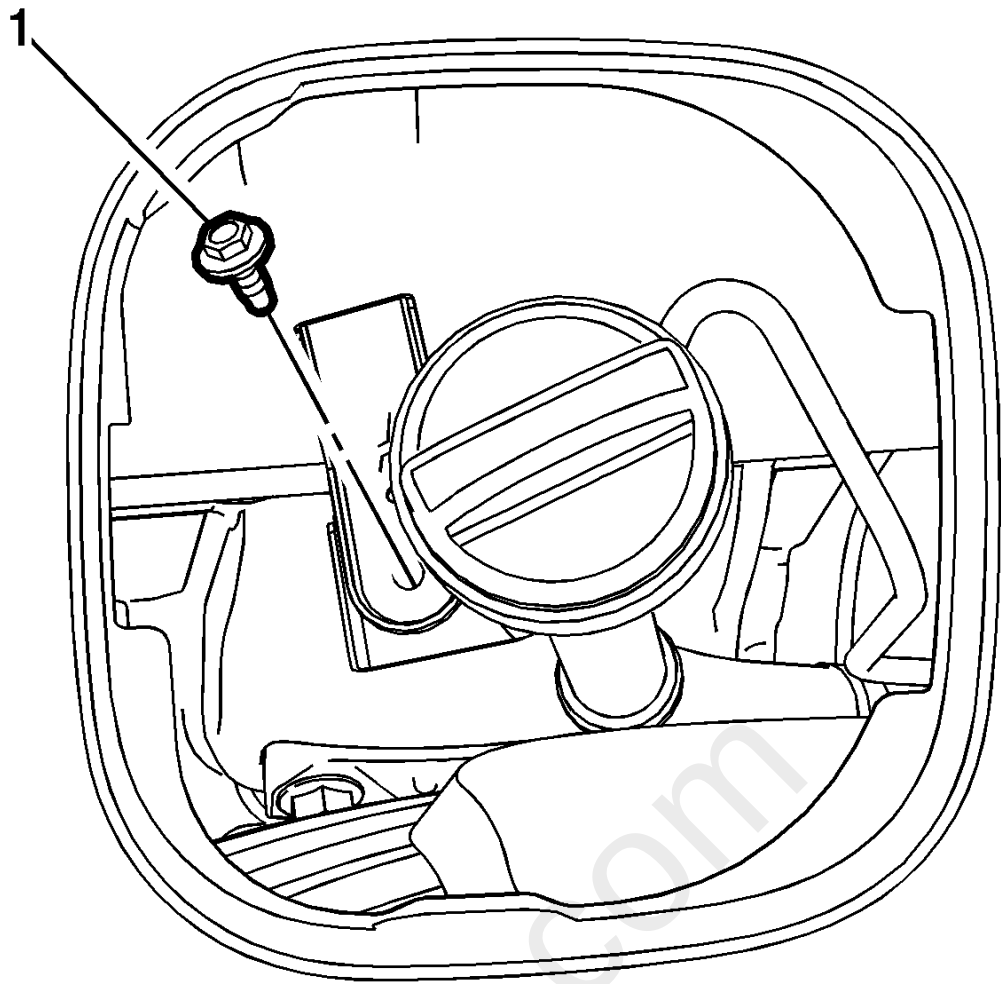


Fig. 27: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

5. Remove the fuel tank filler pipe fastener (1).
6. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

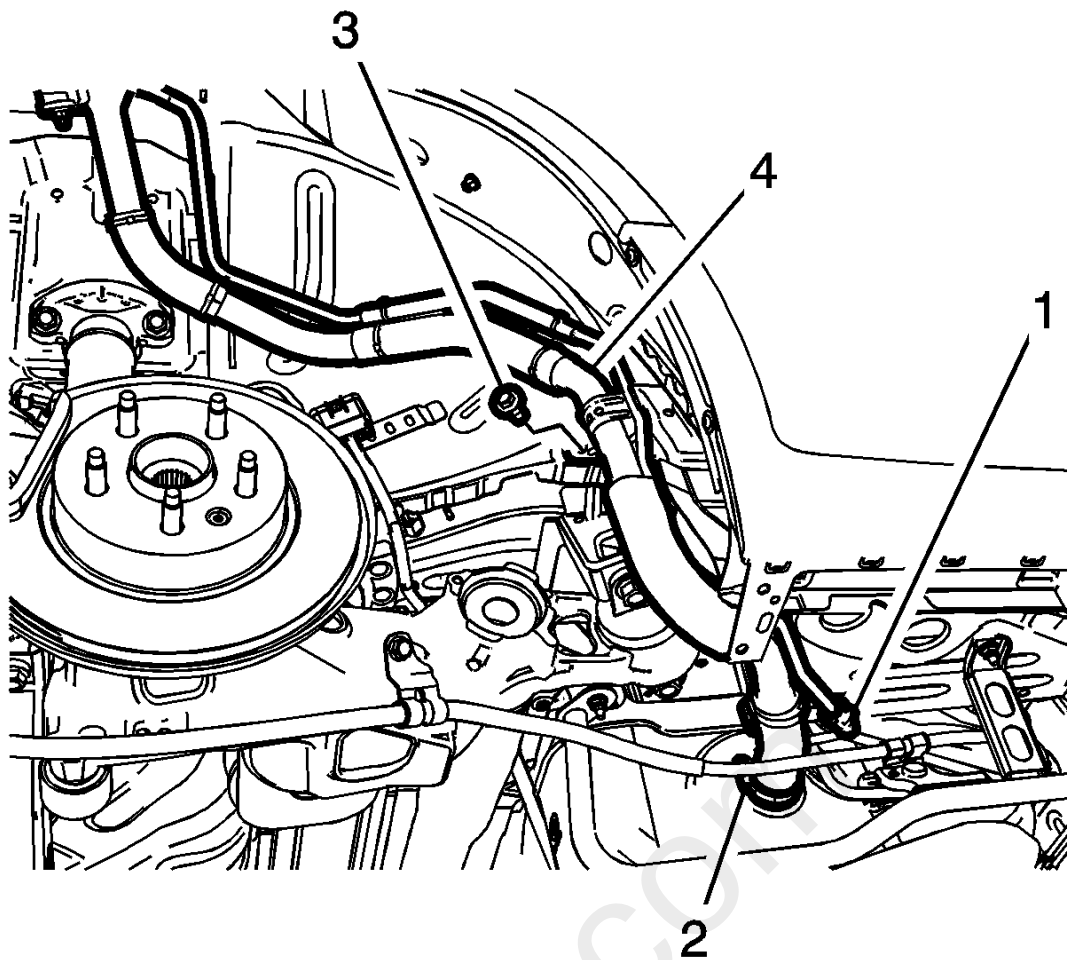


Fig. 28: Fuel Tank Filler Pipe Quick Connect Fitting
Courtesy of GENERAL MOTORS COMPANY

7. Remove the fuel tank filler pipe clamp (2).
8. Disconnect the fuel tank filler pipe quick connect fitting (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
9. Remove the fuel tank filler pipe fastener (3).
10. Remove the fuel tank filler pipe (4) from the vehicle.

Installation Procedure

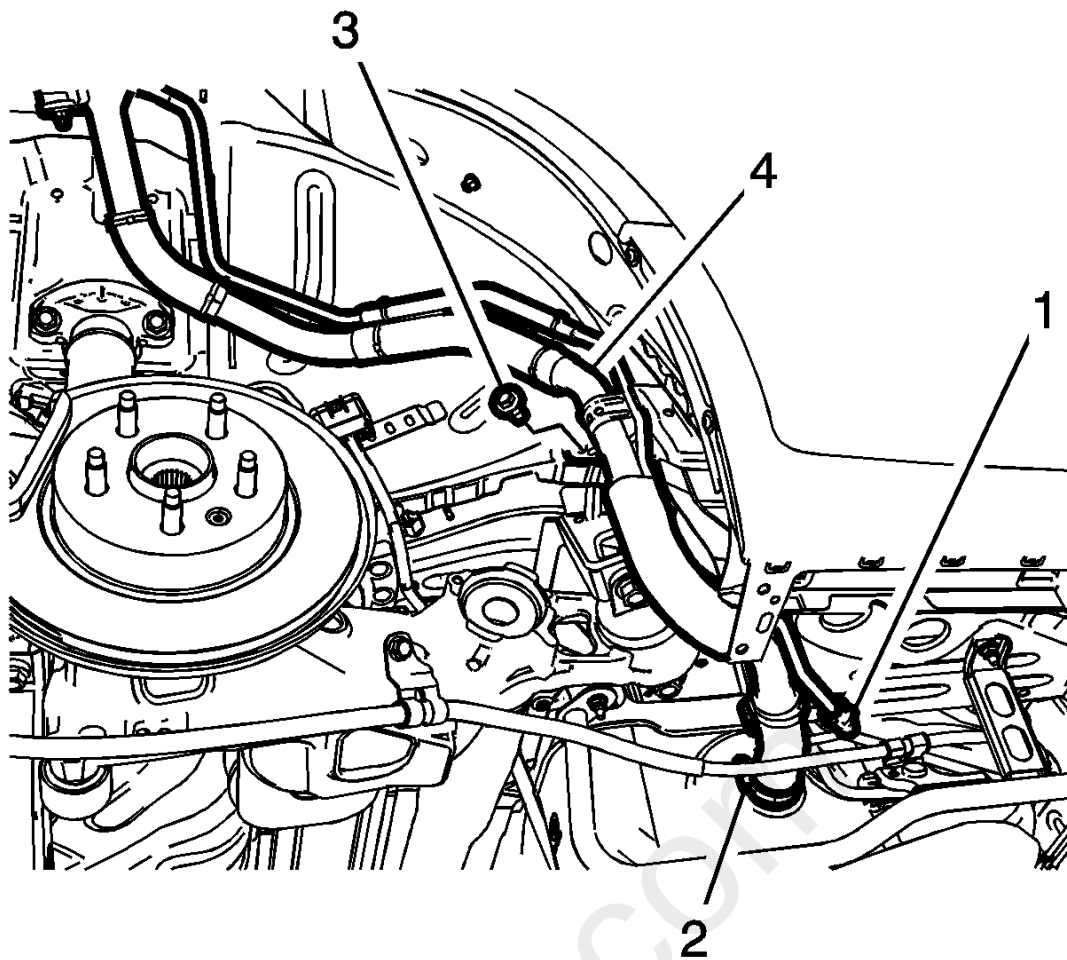


Fig. 29: Fuel Tank Filler Pipe Quick Connect Fitting
Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel tank filler pipe (4) to the vehicle.

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

2. Install the fuel tank filler pipe fastener (3) and tighten to 9 N.m (80 lb in).
3. Connect the fuel tank filler pipe quick connect fitting (1). Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Install the fuel tank filler pipe clamp (2).
5. Lower the vehicle.

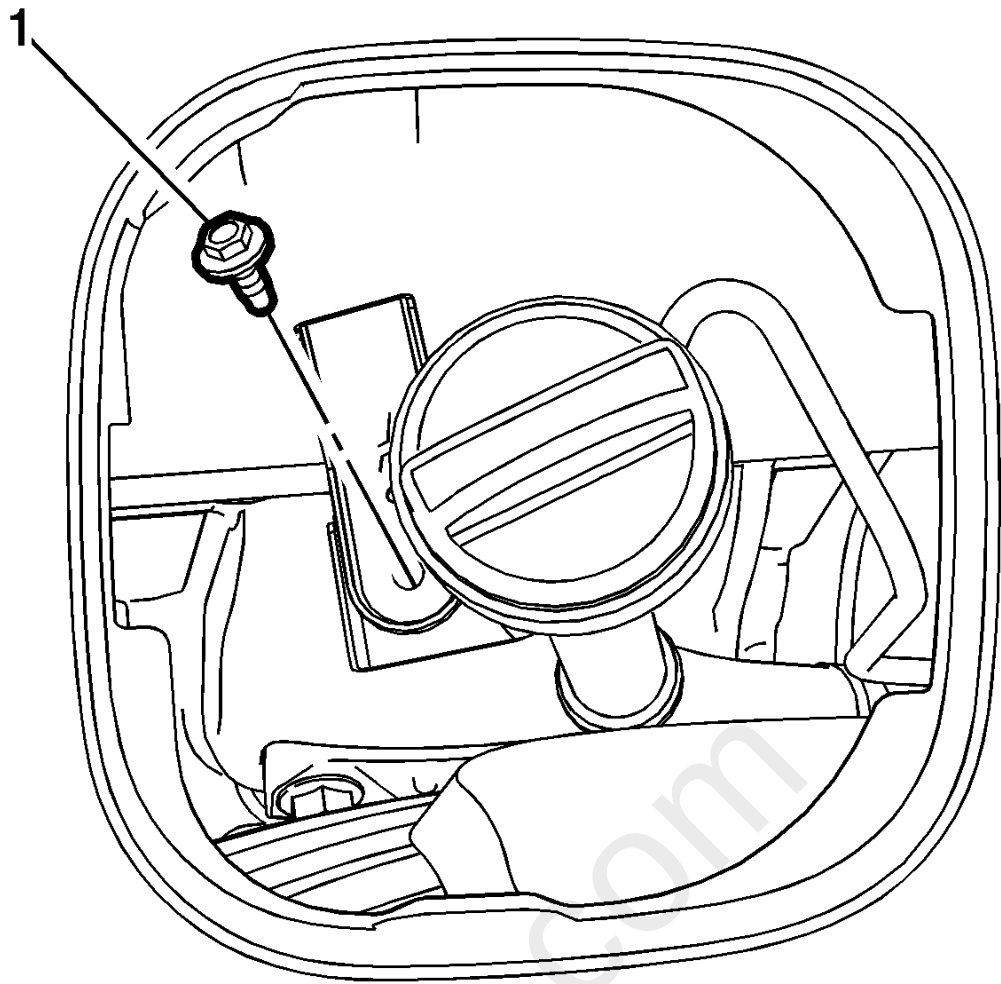


Fig. 30: Fuel Tank Filler Pipe

Courtesy of GENERAL MOTORS COMPANY

6. Install the fuel tank filler pipe fastener (1) and tighten to 9 N.m (80 lb in).
7. Install the right rear wheelhouse panel liner. Refer to [Rear Wheelhouse Liner Replacement](#).
8. Install the right rear tire and wheel assembly. Refer to [Tire and Wheel Removal and Installation](#).
9. Fill the fuel tank.
10. Install the fuel cap.

FUEL FEED PIPE REPLACEMENT (ENGINE TO TANK)

Removal Procedure

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.

1. Relieve the fuel pressure. Refer to [Fuel Pressure Relief](#).
2. Remove the fuel pressure sensor - fuel feed pipe. Refer to [Fuel Pressure Sensor Replacement - Fuel Feed Pipe](#).

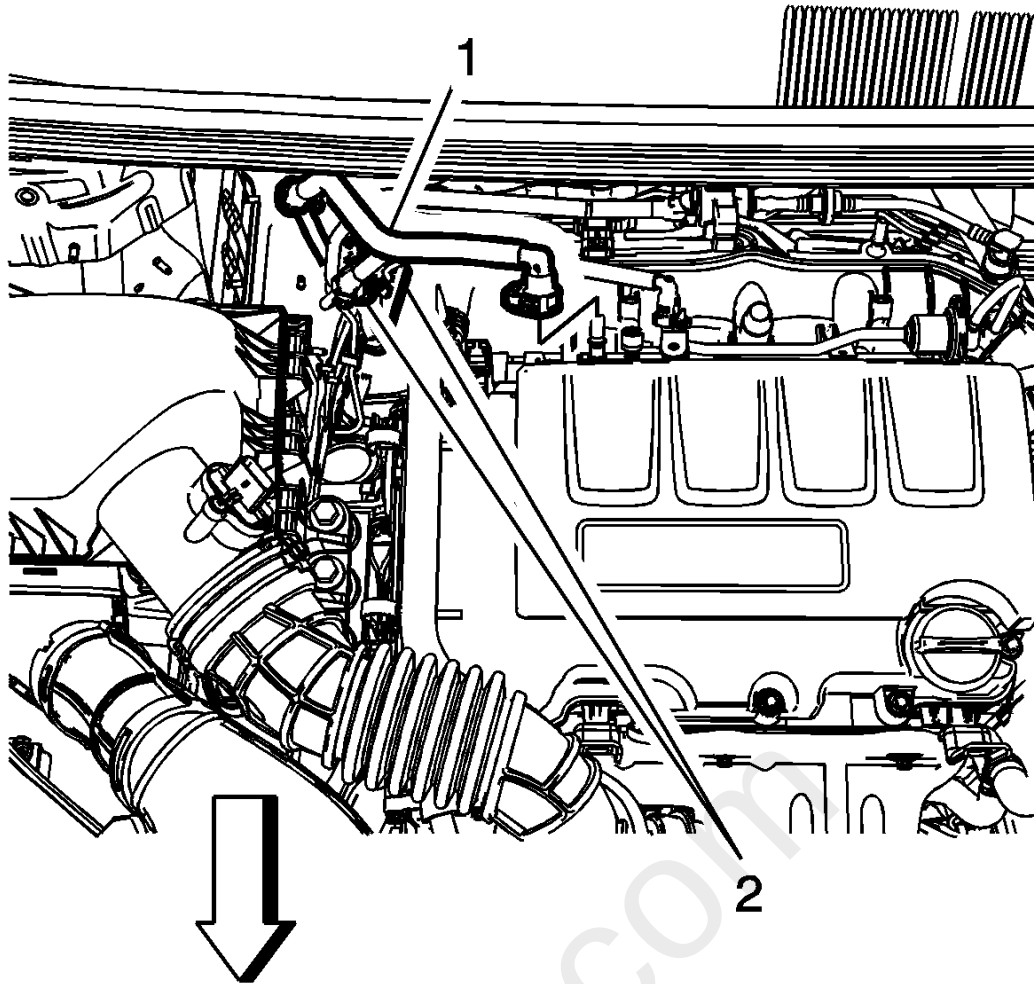


Fig.31: Fuel Feed Pipe

Courtesy of GENERAL MOTORS COMPANY

3. Remove the fuel feed pipe (1) from the fuel rail. Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Remove the fuel feed pipe (1) from the retainers (2).
5. Raise and support the vehicle. Refer to [Lifting and Jacking the Vehicle](#) .

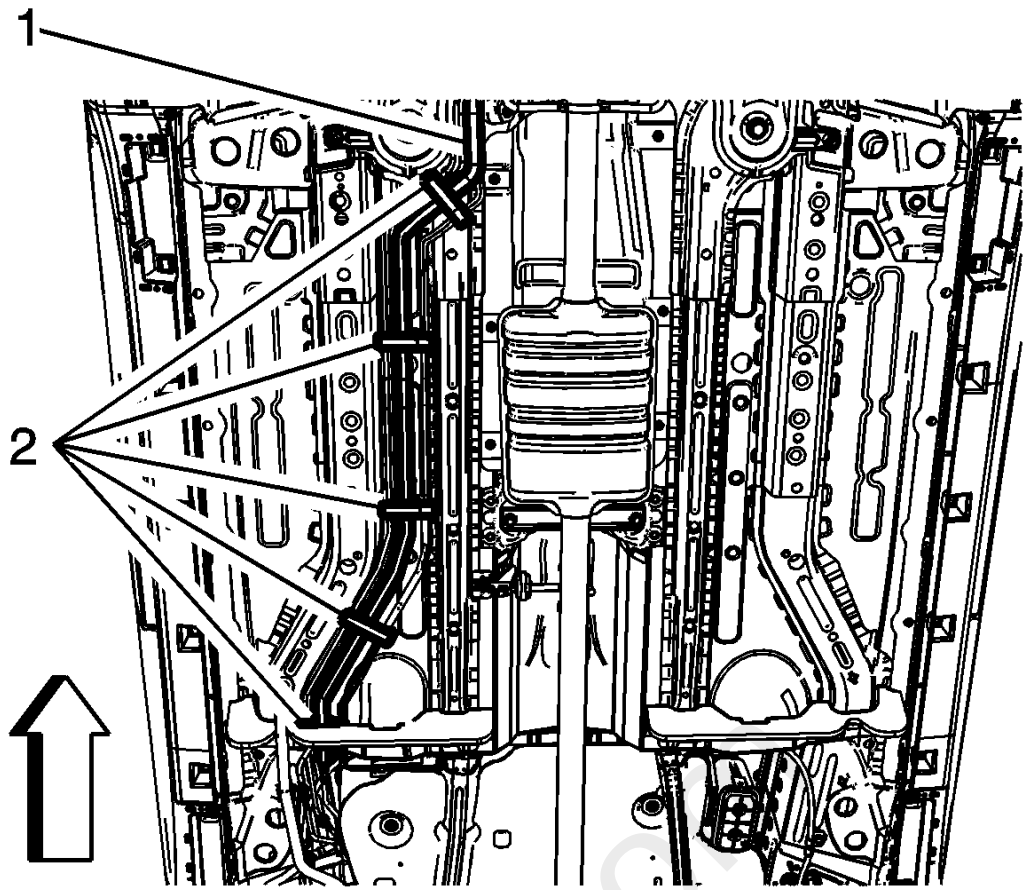


Fig. 32: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

6. Remove the fuel feed pipe (1) from the fuel feed pipe at the tank. Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Remove the underbody sill shield.
8. Remove the fuel feed pipe (1) from the retainers (2).
9. Remove the fuel feed pipe (1) from the vehicle.

Installation Procedure

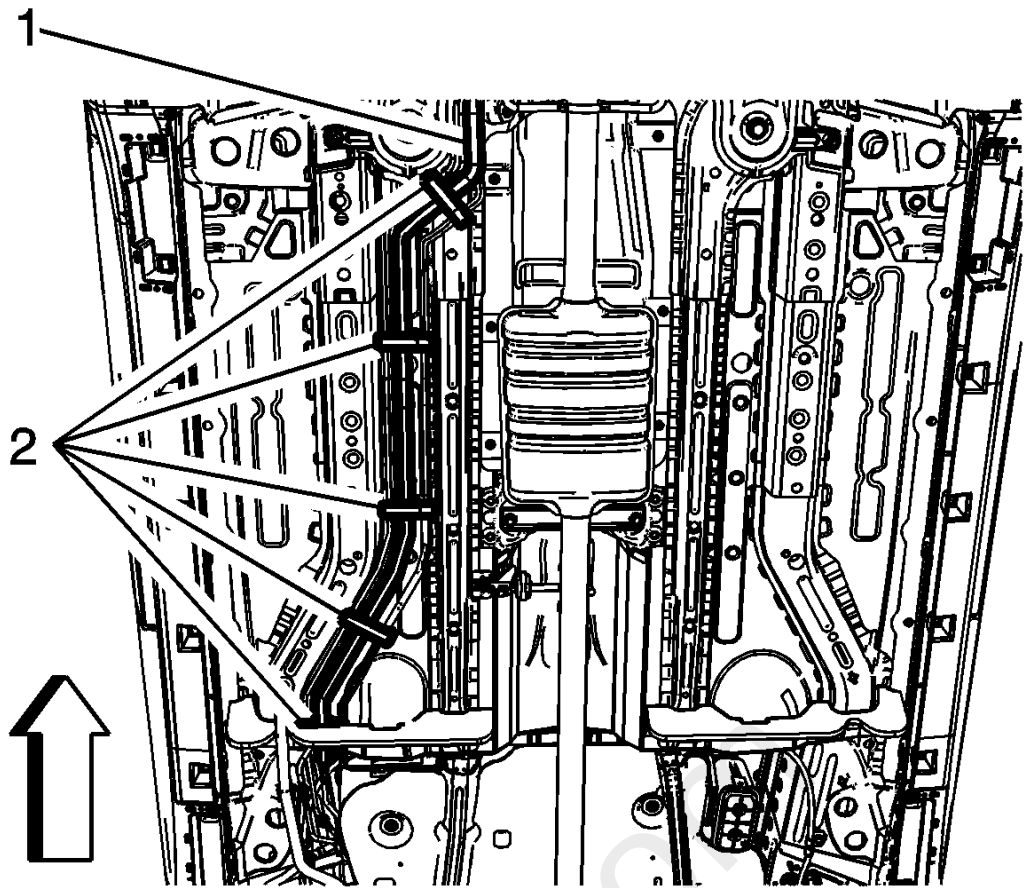


Fig. 33: Fuel Feed Pipe And Retainers

Courtesy of GENERAL MOTORS COMPANY

1. Install the fuel feed pipe (1) to the vehicle.
2. Install the fuel feed pipe (1) to the retainers (2).
3. Install the underbody sill shield.
4. Install the fuel feed pipe (1) to the fuel feed pipe at the tank. Refer to [Plastic Collar Quick Connect Fitting Service](#).
5. Lower the vehicle.

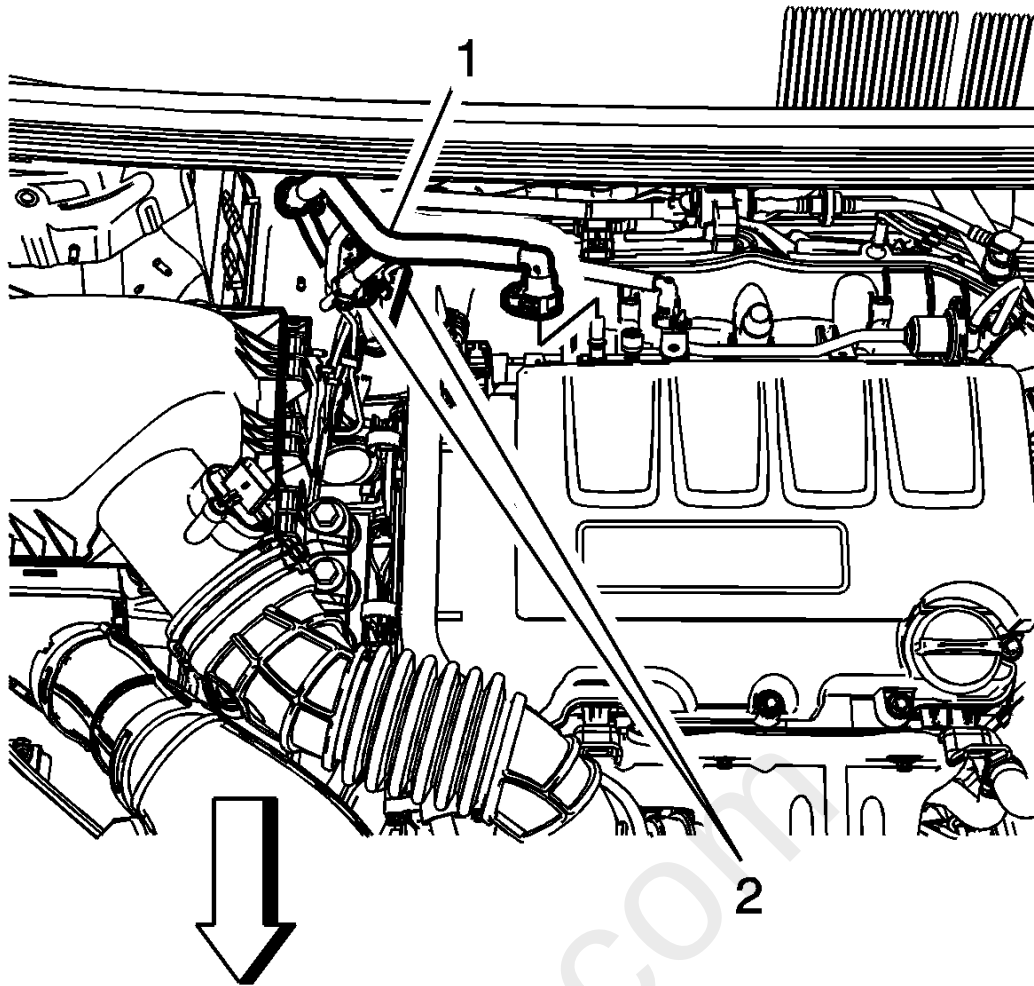


Fig. 34: Fuel Feed Pipe

Courtesy of GENERAL MOTORS COMPANY

6. Install the fuel feed pipe (1) to the retainers (2).
7. Install the fuel feed pipe (1) to the fuel rail. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Install the fuel pressure sensor - fuel feed pipe. Refer to [Fuel Pressure Sensor Replacement - Fuel Feed Pipe](#).

FUEL FEED PIPE REPLACEMENT (AT TANK AWD)

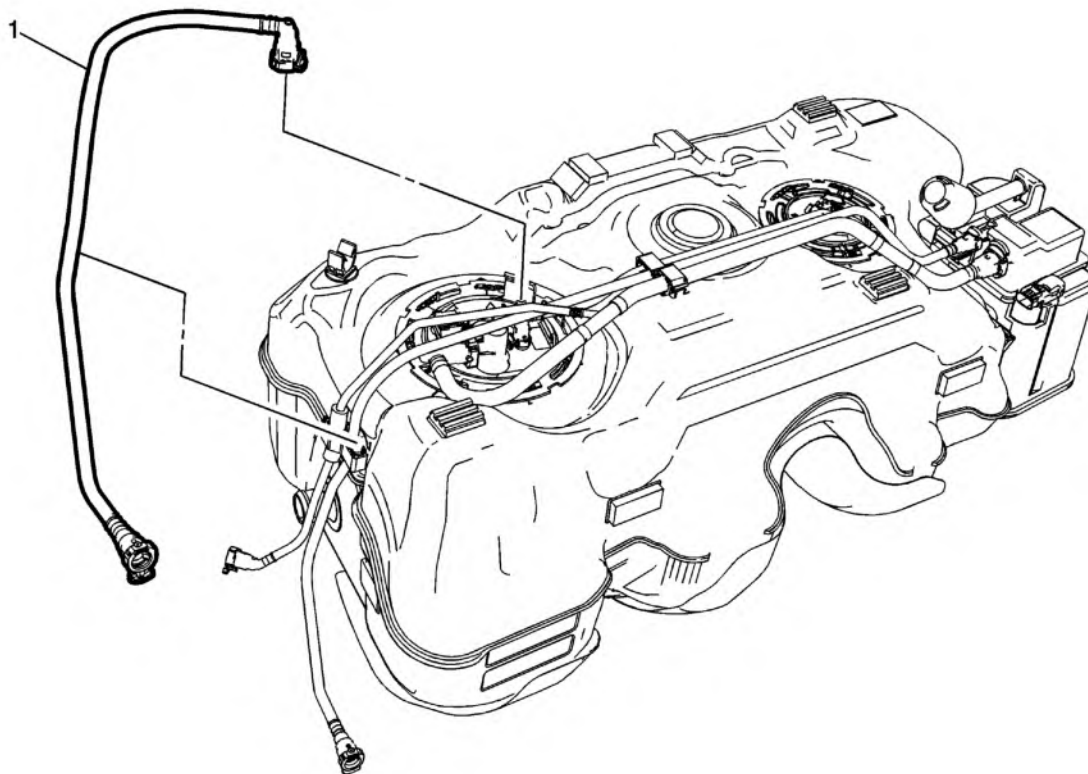


Fig. 35: Fuel Feed Pipe (At Tank - AWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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. Preliminary Procedures 1. Relieve the fuel pressure. Refer to Fuel Pressure Relief . 2. Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Feed Pipe Procedure Disconnect the quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service .

FUEL FEED PIPE REPLACEMENT (AT TANK FWD)

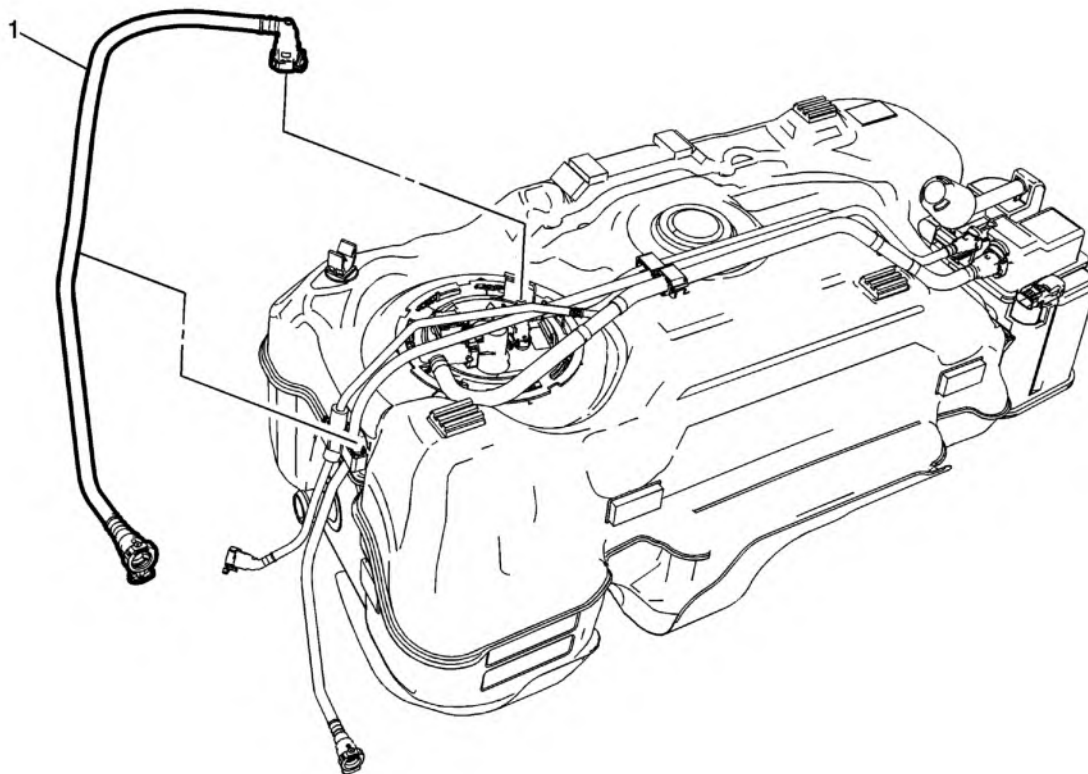


Fig. 36: Fuel Feed Pipe (At Tank - FWD)
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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. Preliminary Procedures 1. Relieve the fuel pressure. Refer to Fuel Pressure Relief . 2. Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Feed Pipe Procedure Disconnect the quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service .

FUEL TANK FUEL PUMP MODULE REPLACEMENT (AWD)

Special Tools

CH-45722 Fuel Pump Locking Ring Wrench

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

Removal Procedure

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

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

WARNING: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done

on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#) .
2. Remove the fuel sender assembly. Refer to [Fuel Sender Assembly Replacement \(AWD\)](#).
3. Disconnect the electrical connector.
4. Remove the fuel feed pipe. Refer to [Fuel Feed Pipe Replacement \(At Tank FWD\)](#) .
5. Remove the EVAP system hoses. Refer to [Evaporative Emission System Hose/Pipe Replacement \(Fuel Pump Module to Canister AWD\)](#)[Evaporative Emission System Hose/Pipe Replacement \(Canister to Pipe AWD\)](#).

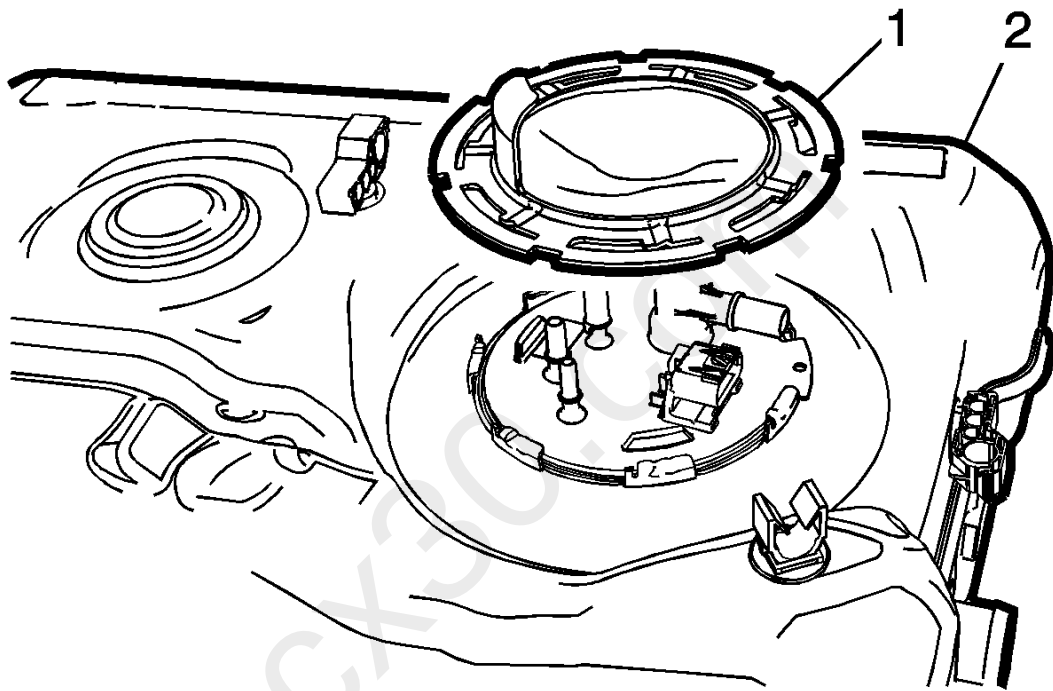


Fig. 37: Fuel Sender Lock Ring

Courtesy of GENERAL MOTORS COMPANY

6. Install the **CH-45722** Fuel Pump Locking Ring Wrench to the fuel pump module lock ring (1).
7. Using the **CH-45722** Fuel Pump Locking Ring Wrench and a long breaker-bar, rotate the fuel pump module lock ring (1) in a counterclockwise direction in order to unlock the lock ring from the fuel tank (2).

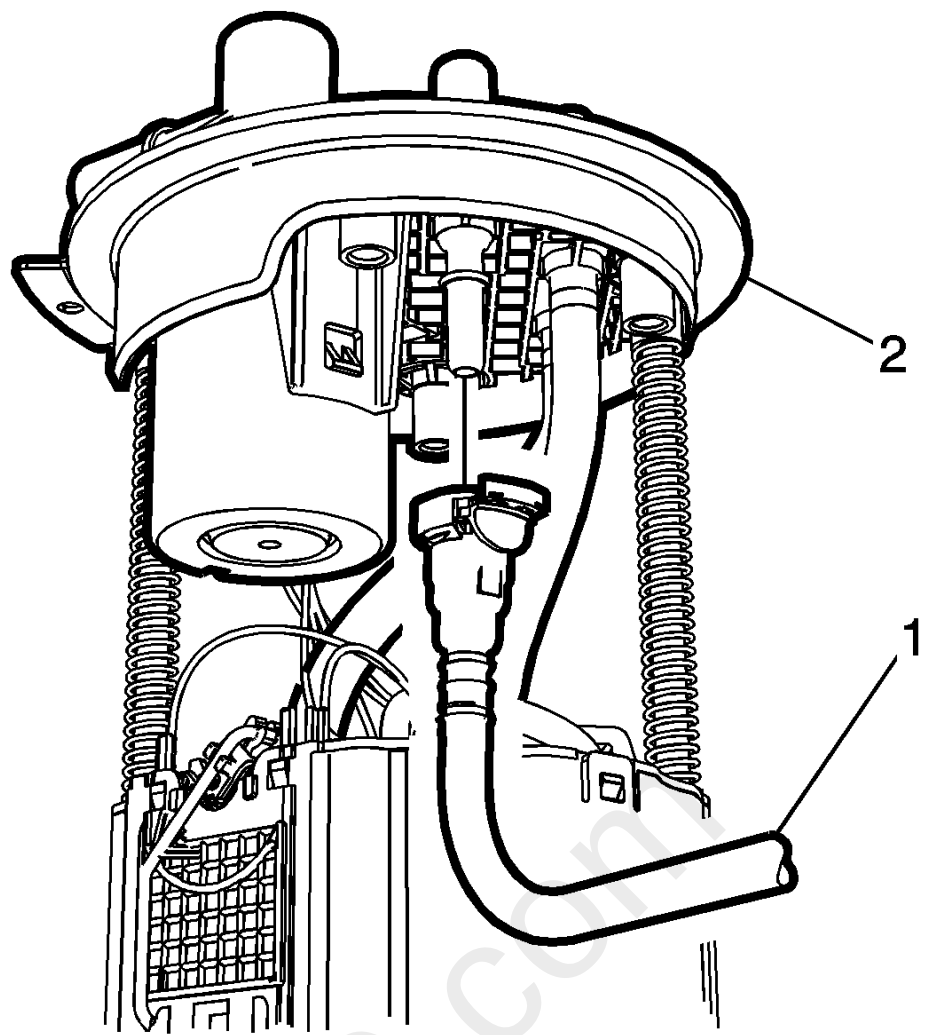


Fig. 38: Fuel Tank Vent Pipe

Courtesy of GENERAL MOTORS COMPANY

8. Raise the fuel pump module (2) enough to gain access to the fuel tank vent pipe (1) and disconnect the pipe from the fuel pump module. Refer to [**Plastic Collar Quick Connect Fitting Service**](#) .

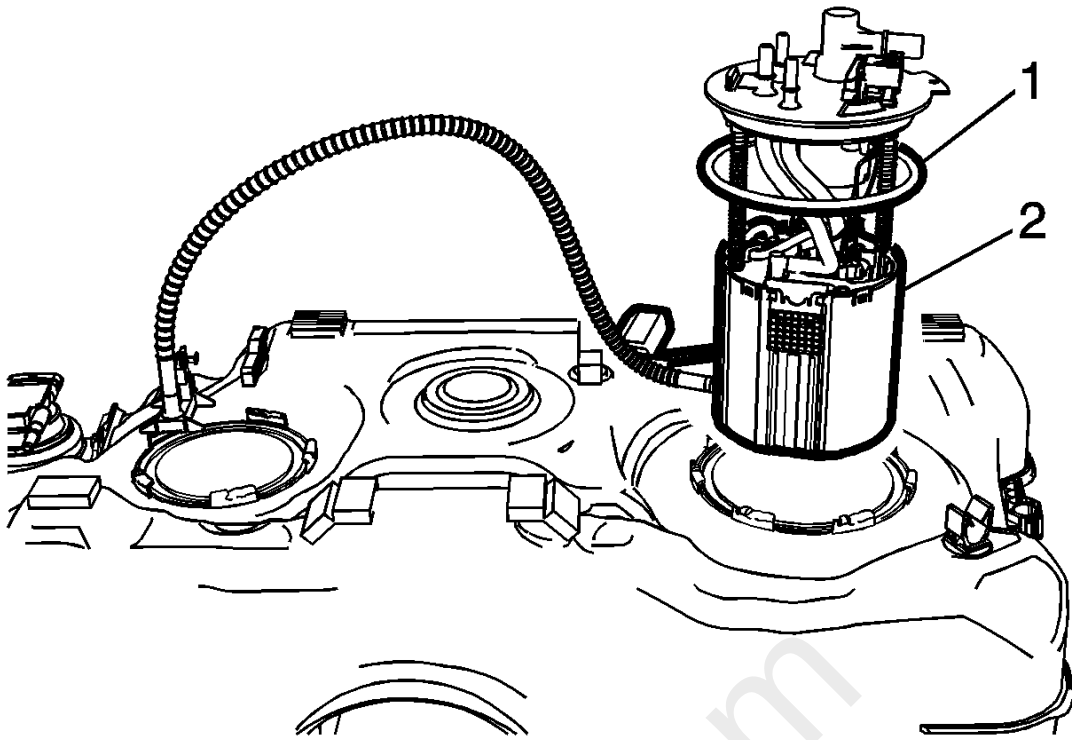


Fig. 39: Fuel Pump Module

Courtesy of GENERAL MOTORS COMPANY

9. Remove the fuel tank fuel pump module (2).
10. Remove and discard the fuel tank fuel pump module O-ring gasket (1).

Installation Procedure

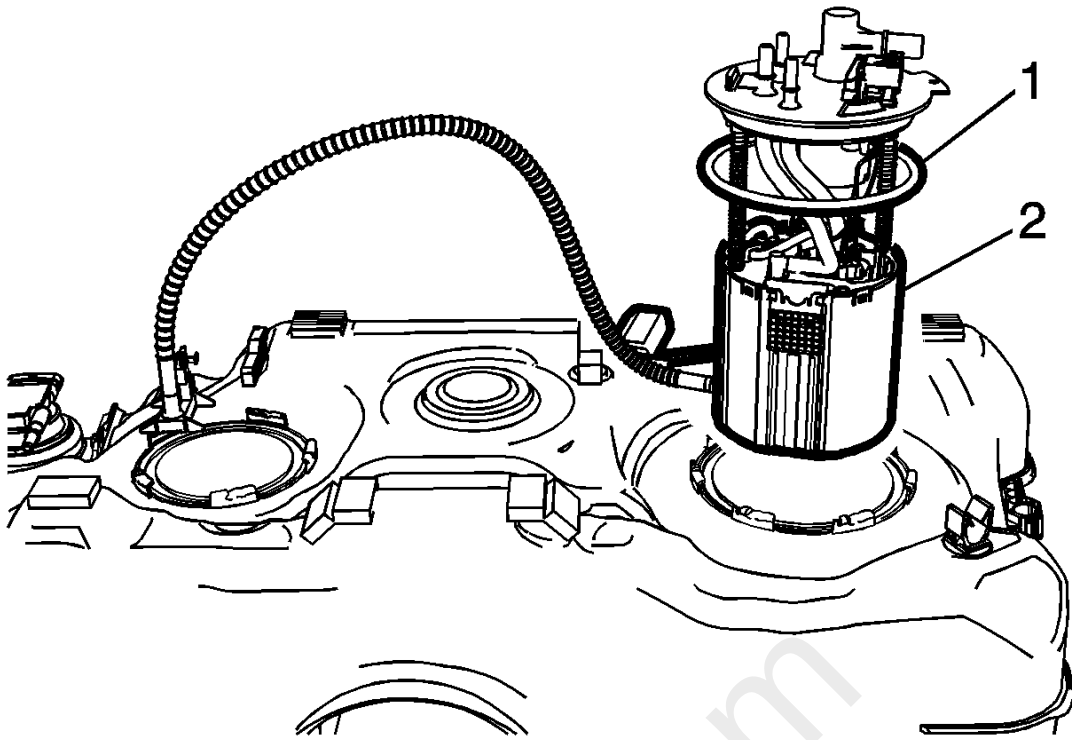


Fig. 40: Fuel Pump Module

Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW fuel tank fuel pump module O-ring gasket (1) to the fuel tank fuel pump module (2).

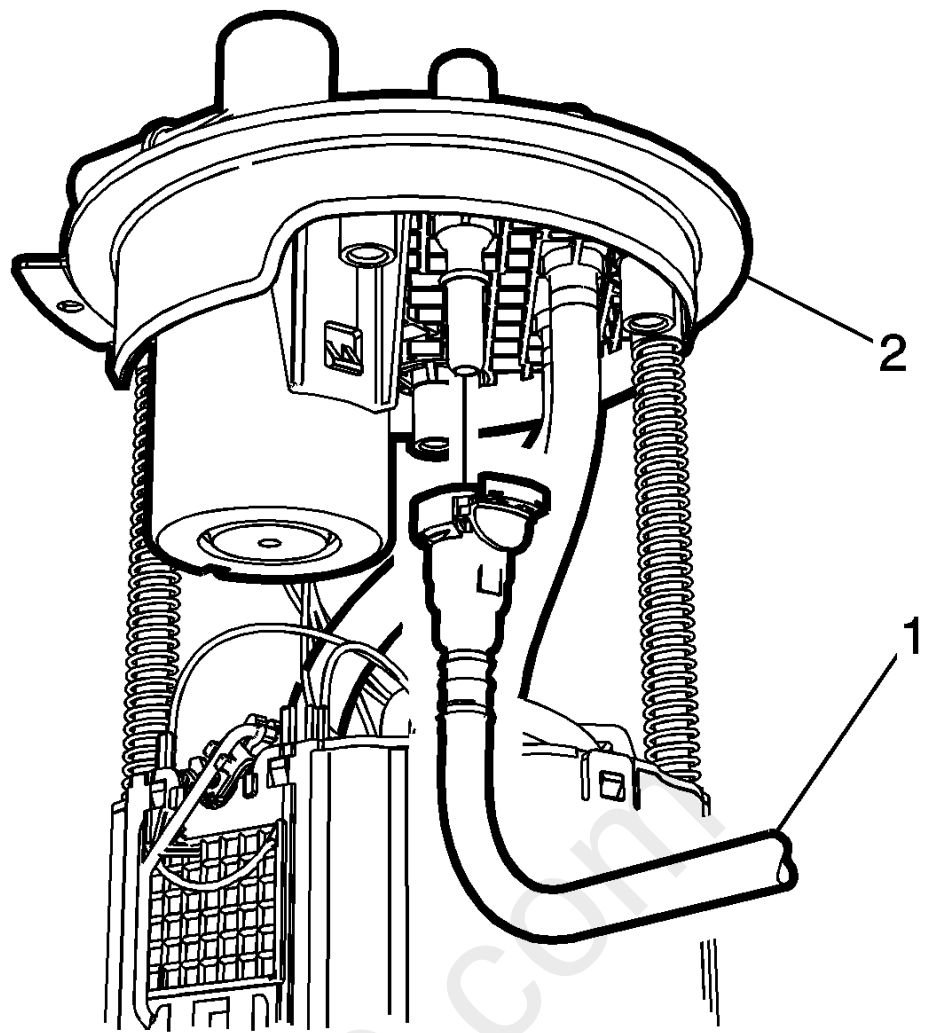


Fig. 41: Fuel Tank Vent Pipe

Courtesy of GENERAL MOTORS COMPANY

2. Lower the fuel pump module (2) into the fuel tank while connecting the fuel tank vent pipe (1) to the fuel pump module. Refer to [Plastic Collar Quick Connect Fitting Service](#) .

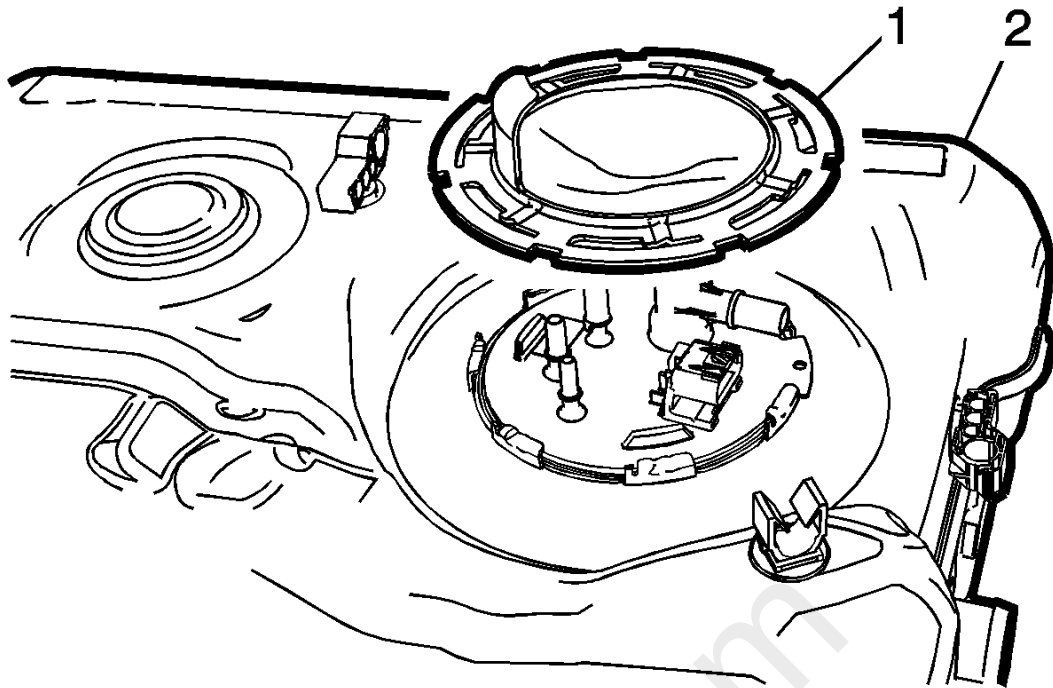


Fig. 42: Fuel Sender Lock Ring

Courtesy of GENERAL MOTORS COMPANY

3. Install the fuel tank fuel pump module lock ring (1) to the fuel tank (2).
4. Using the **CH-45722** Fuel Pump Locking Ring Wrench and a long breaker-bar, rotate the fuel pump module lock ring (1) in a clockwise direction in order to lock the lock ring.
5. Install the EVAP system hoses. Refer to [Evaporative Emission System Hose/Pipe Replacement \(Fuel Pump Module to Canister AWD\)](#)[Evaporative Emission System Hose/Pipe Replacement \(Canister to Pipe AWD\)](#).
6. Install the fuel feed pipe. Refer to [Fuel Feed Pipe Replacement \(At Tank AWD\)](#).
7. Connect the electrical connector.
8. Install the fuel sender assembly. Refer to [Fuel Sender Assembly Replacement \(AWD\)](#).
9. Install the fuel tank. Refer to [Fuel Tank Replacement](#).

FUEL TANK FUEL PUMP MODULE REPLACEMENT (FWD)

Special Tools

CH-45722 Fuel Pump Locking Ring Wrench

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

Removal Procedure

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

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

WARNING: Do not allow smoking or the use of open flames in the area where work

on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#) .
2. Disconnect the electrical connector.
3. Disconnect the fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
4. Disconnect the evaporative emission hoses. Refer to [Plastic Collar Quick Connect Fitting Service](#).

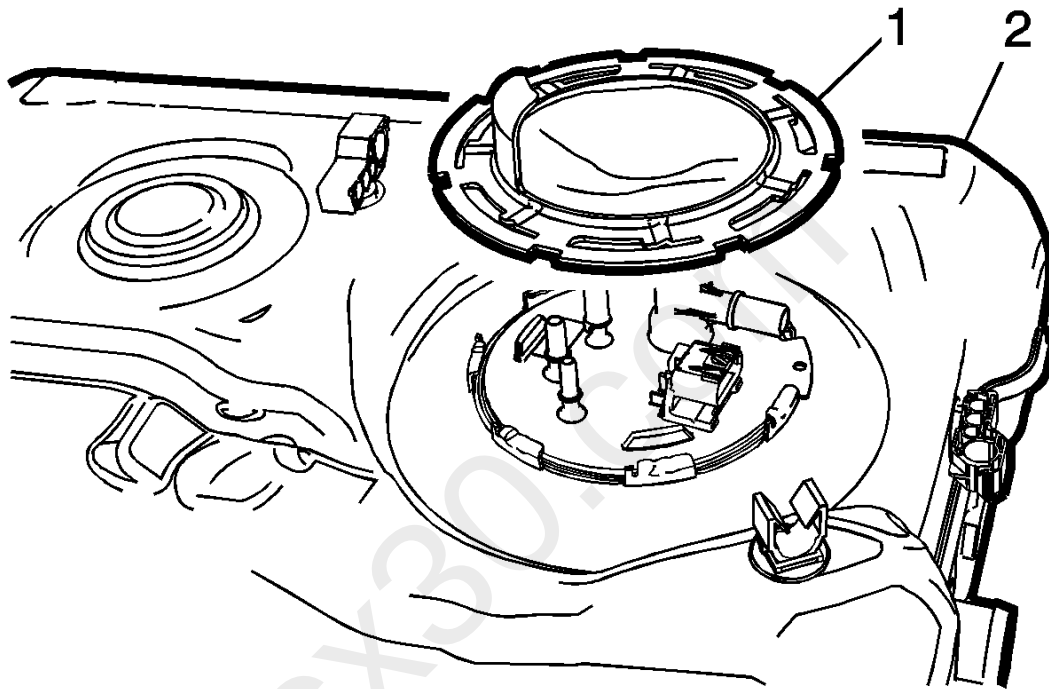


Fig. 43: Fuel Sender Lock Ring

Courtesy of GENERAL MOTORS COMPANY

5. Install the **CH-45722** Tool-Fuel Sender Lock Ring to the fuel pump module lock ring (1).
6. Using the **CH-45722** Tool-Fuel Sender Lock Ring and a long breaker-bar, rotate the fuel pump module lock ring (1) in a counterclockwise direction in order to unlock the lock ring from the fuel tank (2).

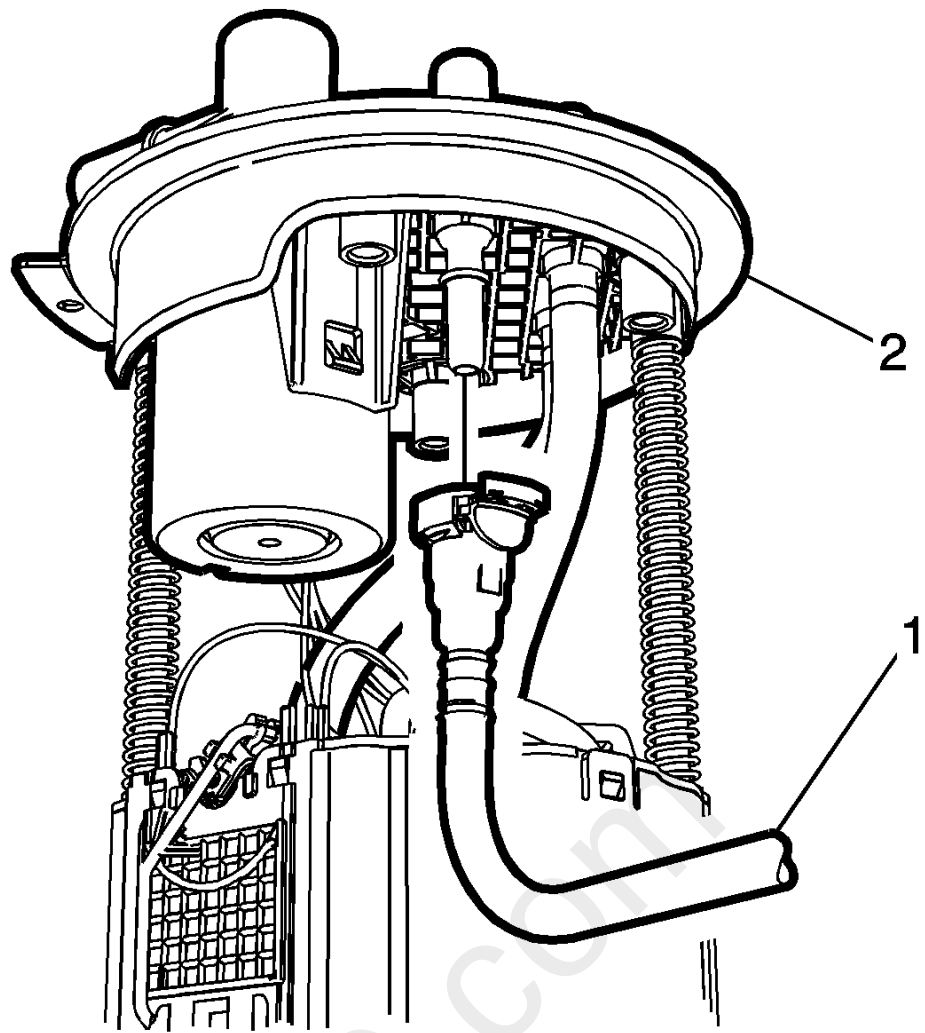


Fig. 44: Fuel Tank Vent Pipe

Courtesy of GENERAL MOTORS COMPANY

7. Raise the fuel pump module (2) enough to gain access to the fuel tank vent pipe (1) and disconnect the pipe from the fuel pump module. Refer to [**Plastic Collar Quick Connect Fitting Service**](#).

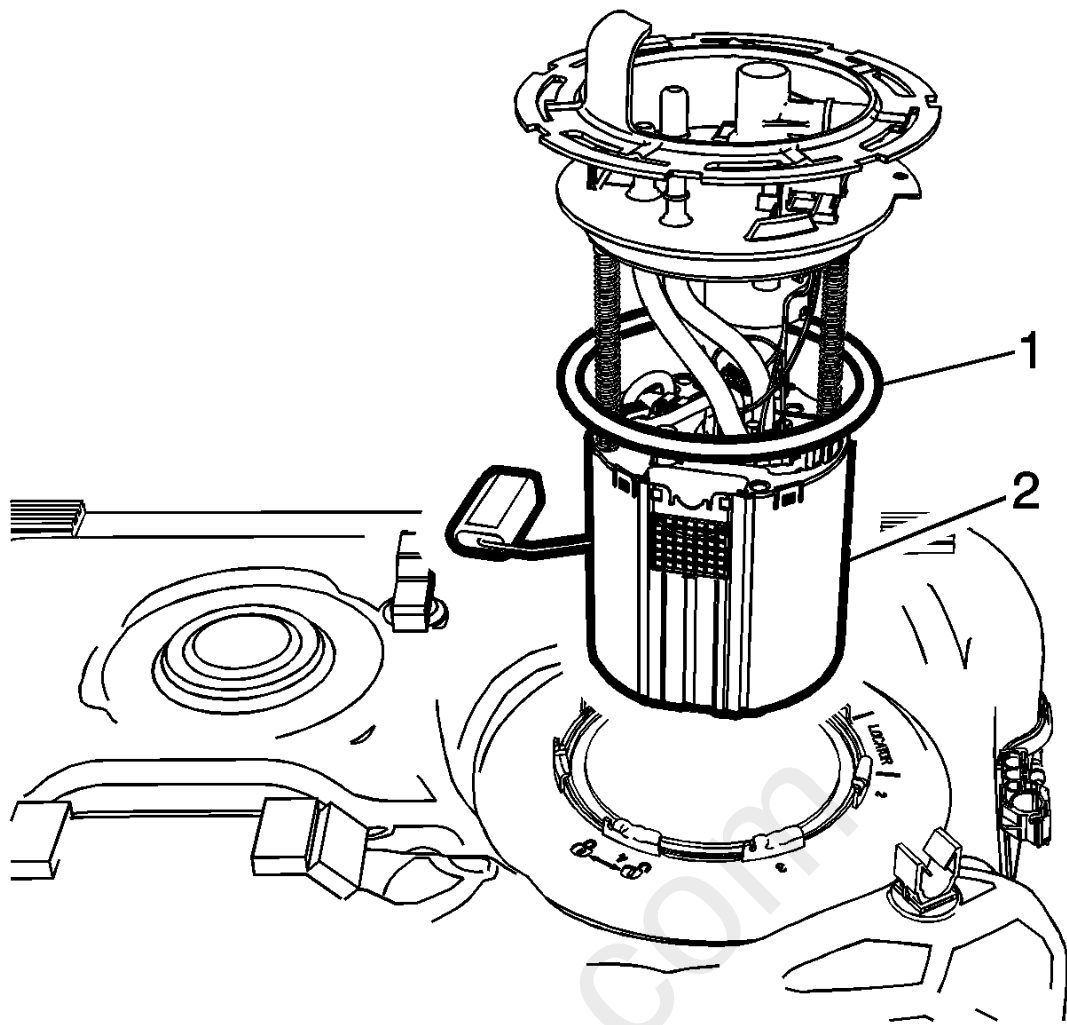


Fig. 45: Fuel Tank Fuel Pump Module
Courtesy of GENERAL MOTORS COMPANY

8. Remove the fuel tank fuel pump module (2).
9. Remove and discard the fuel tank fuel pump module O-ring gasket (1).

Installation Procedure

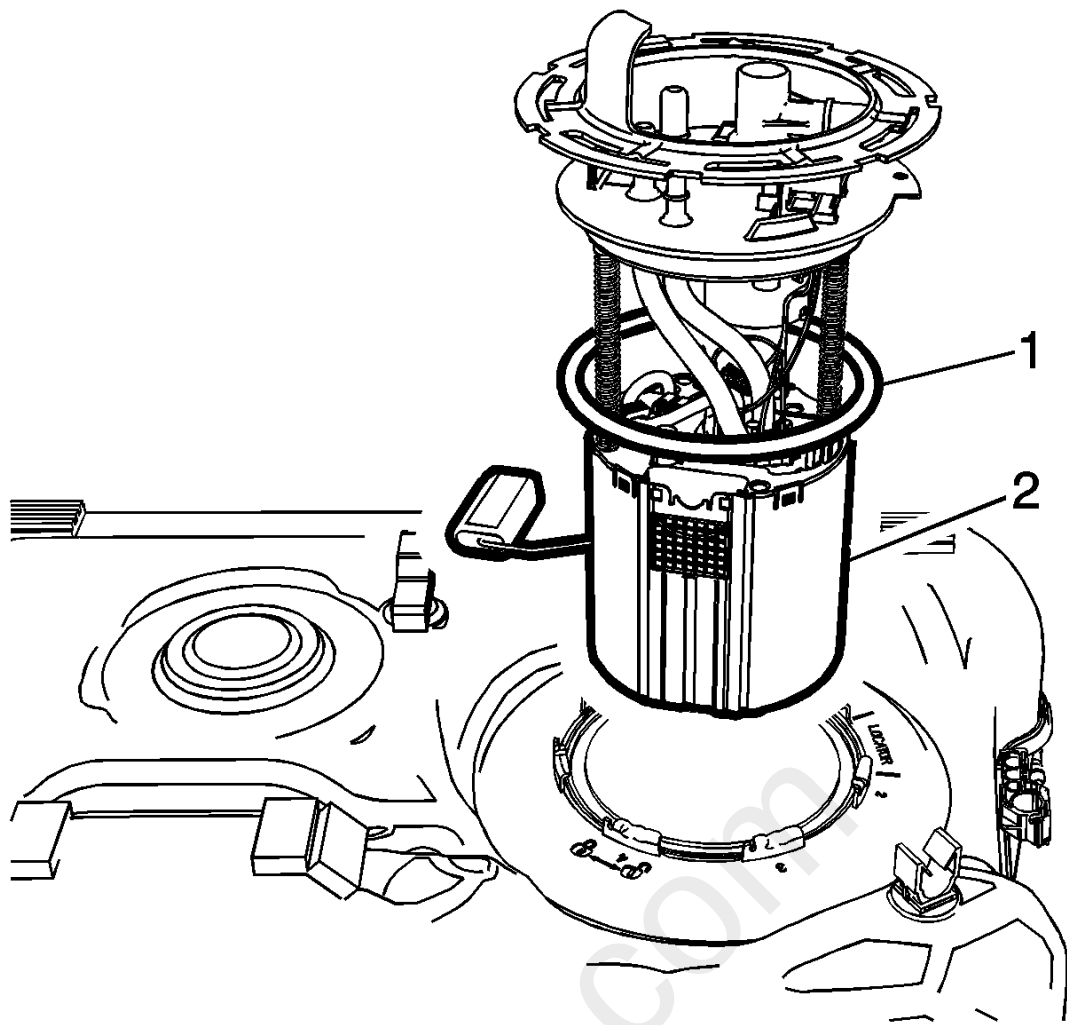


Fig. 46: Fuel Tank Fuel Pump Module
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW fuel tank fuel pump module O-ring gasket (1).
2. Install the fuel tank fuel pump module (2).

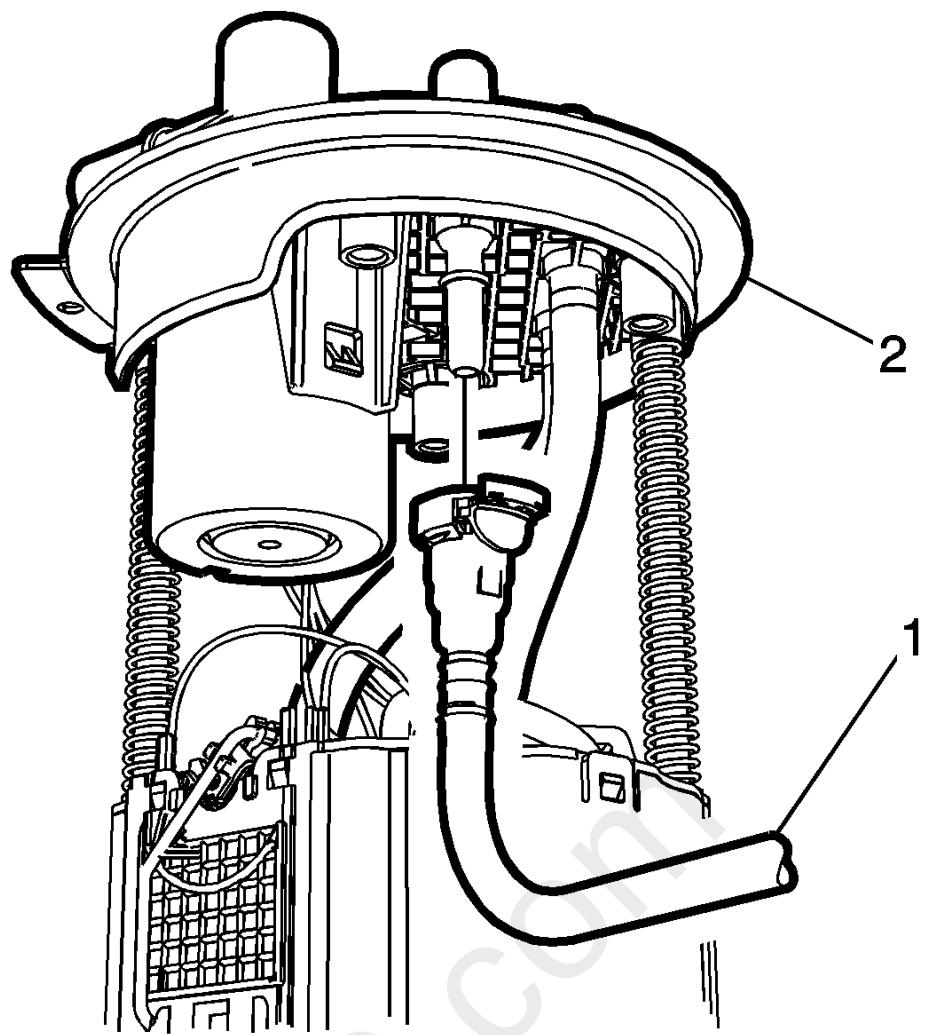


Fig. 47: Fuel Tank Vent Pipe

Courtesy of GENERAL MOTORS COMPANY

3. Lower the fuel pump module (2) into the fuel tank while connecting the fuel tank vent pipe (1) to the fuel pump module. Refer to [Plastic Collar Quick Connect Fitting Service](#)

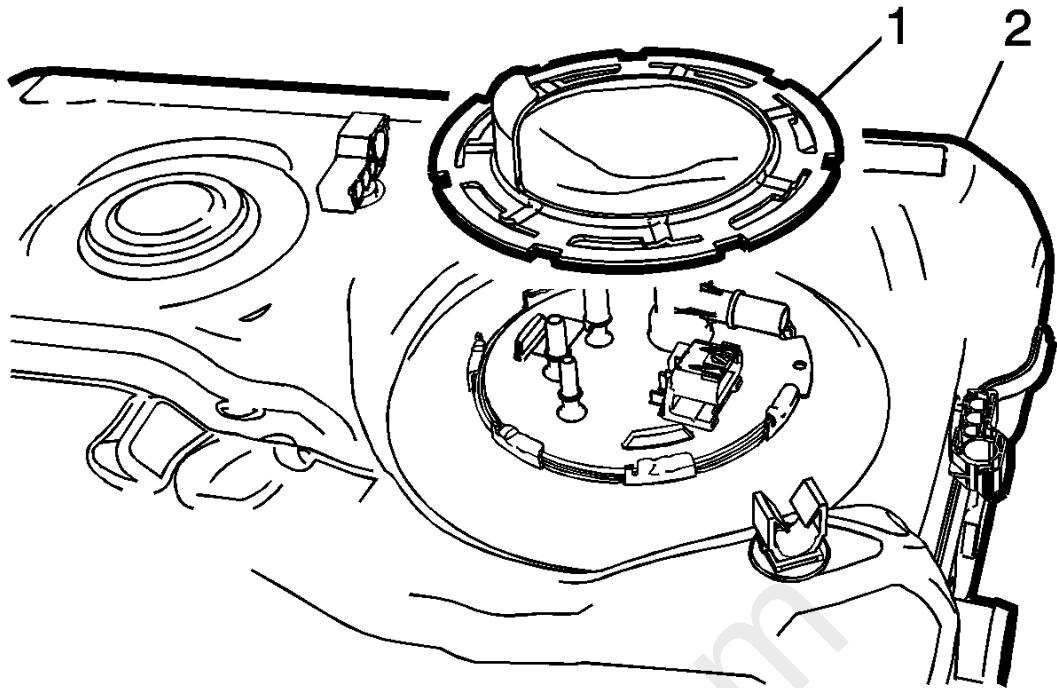


Fig. 48: Fuel Sender Lock Ring

Courtesy of GENERAL MOTORS COMPANY

4. Install the fuel tank fuel pump module lock ring (1) to the fuel tank (2).
5. Using the **CH-45722** Tool-Fuel Sender Lock Ring and a long breaker-bar, rotate the fuel pump module lock ring (1) in a clockwise direction in order to lock the lock ring.
6. Connect the evaporative emission hoses. Refer to [Plastic Collar Quick Connect Fitting Service](#).
7. Connect the fuel feed pipe. Refer to [Plastic Collar Quick Connect Fitting Service](#).
8. Connect the electrical connector.
9. Install the fuel tank. Refer to [Fuel Tank Replacement](#) .

FUEL TANK PRESSURE SENSOR REPLACEMENT

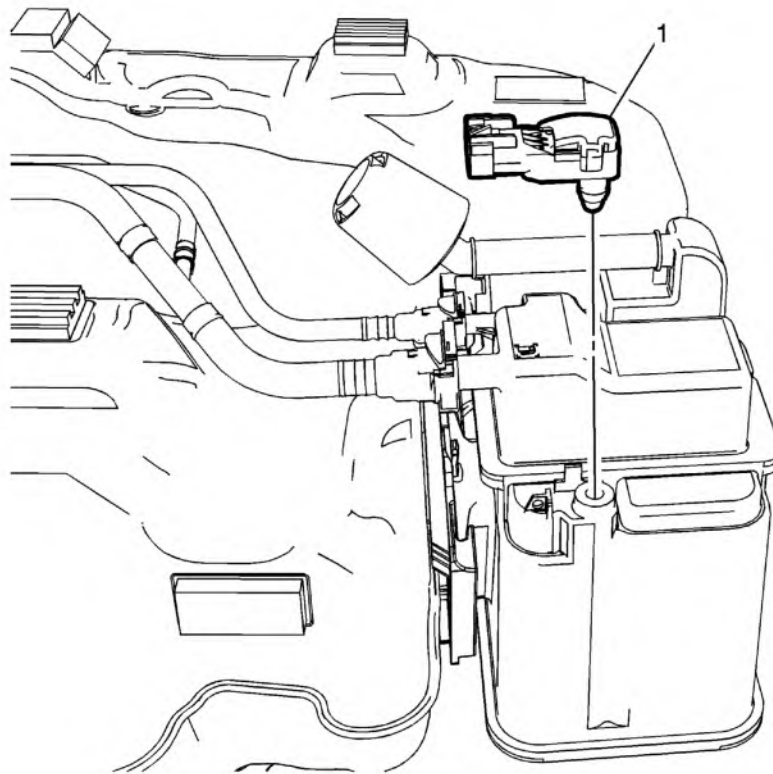


Fig. 49: Fuel Tank Pressure Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Fuel Tank Pressure Sensor Procedure Disconnect the electrical connector.

FUEL SENDER ASSEMBLY REPLACEMENT (AWD)

Special Tools

EN-48482 Fuel Sender Lock Ring Wrench

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

Removal Procedure

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

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

WARNING: Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, disconnect the negative battery cable, except for those tests where battery voltage is required.

1. Remove the fuel tank. Refer to [Fuel Tank Replacement](#) .

2. Disconnect the fuel tank wiring harness from the fuel sender.

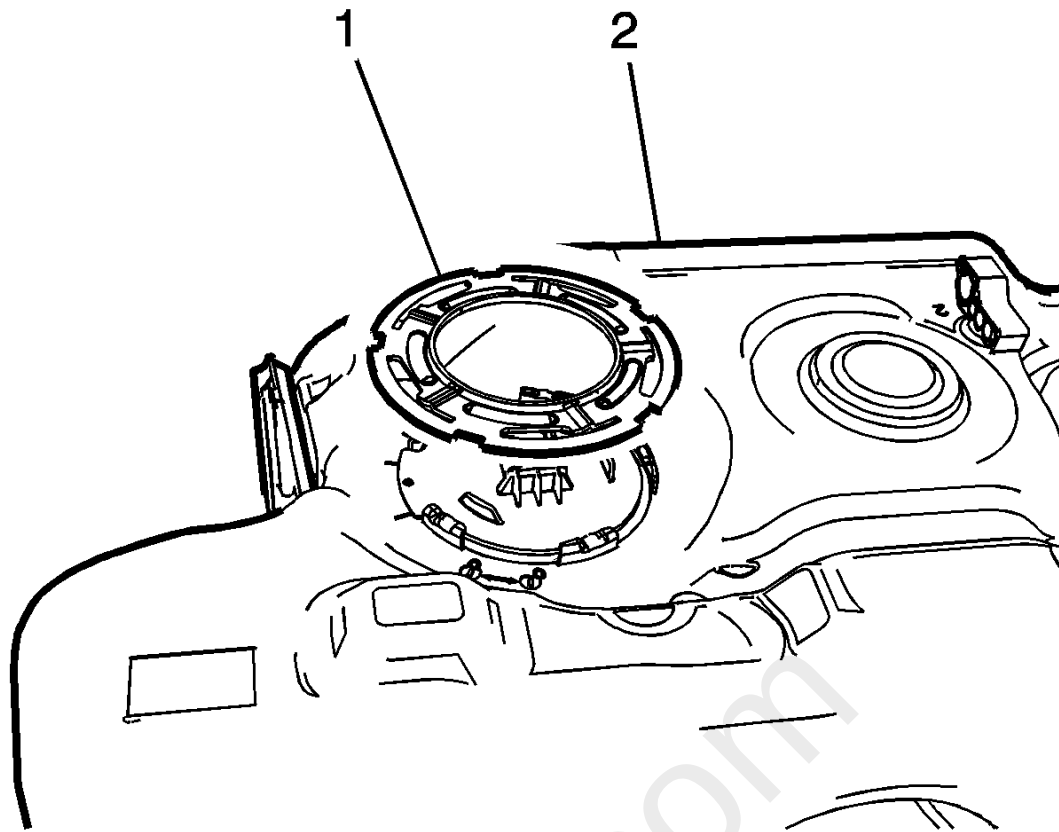


Fig. 50: Lock Ring

Courtesy of GENERAL MOTORS COMPANY

3. Install the **EN-48482** Fuel Sender Lock Ring Wrench to the fuel sender lock ring (1).
4. Using the **EN-48482** Fuel Sender Lock Ring Wrench and a long breaker-bar, rotate the fuel sender lock ring (1) in a counterclockwise direction in order to unlock the lock ring from the fuel tank (2).

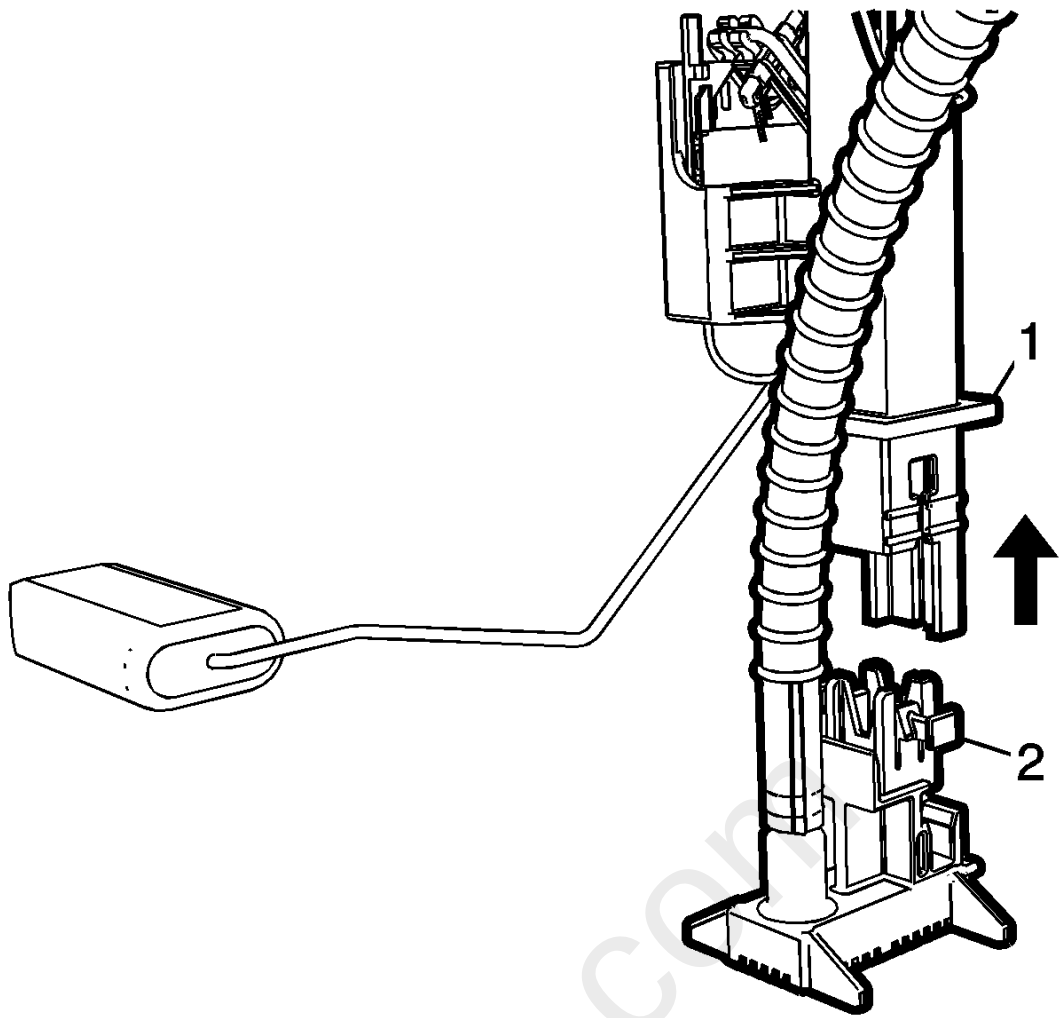


Fig. 51: Pump Module Fuel Pickup

Courtesy of GENERAL MOTORS COMPANY

5. Raise the fuel sender (1) enough to gain access to the fuel tank fuel pump module fuel pickup (2) and disconnect the fuel sender from the fuel pickup.

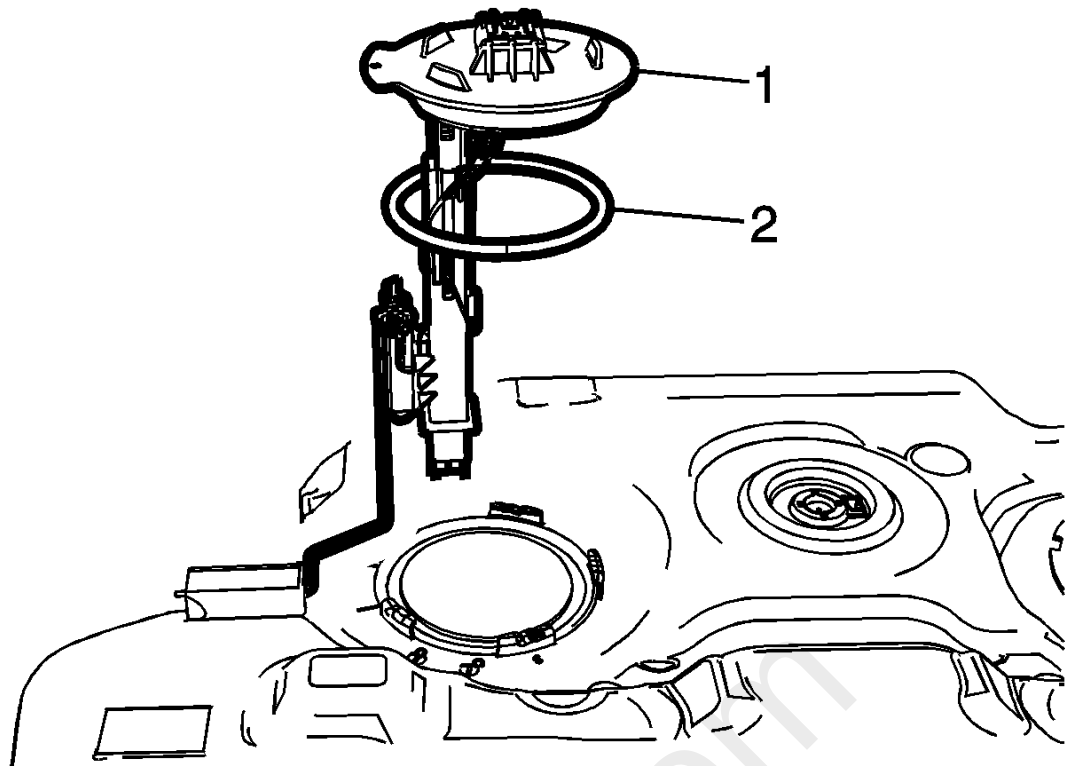


Fig. 52: Fuel Sender O-Ring Gasket

Courtesy of GENERAL MOTORS COMPANY

6. Remove the fuel sender (1).
7. Remove and discard the fuel sender O-ring gasket (2).

Installation Procedure

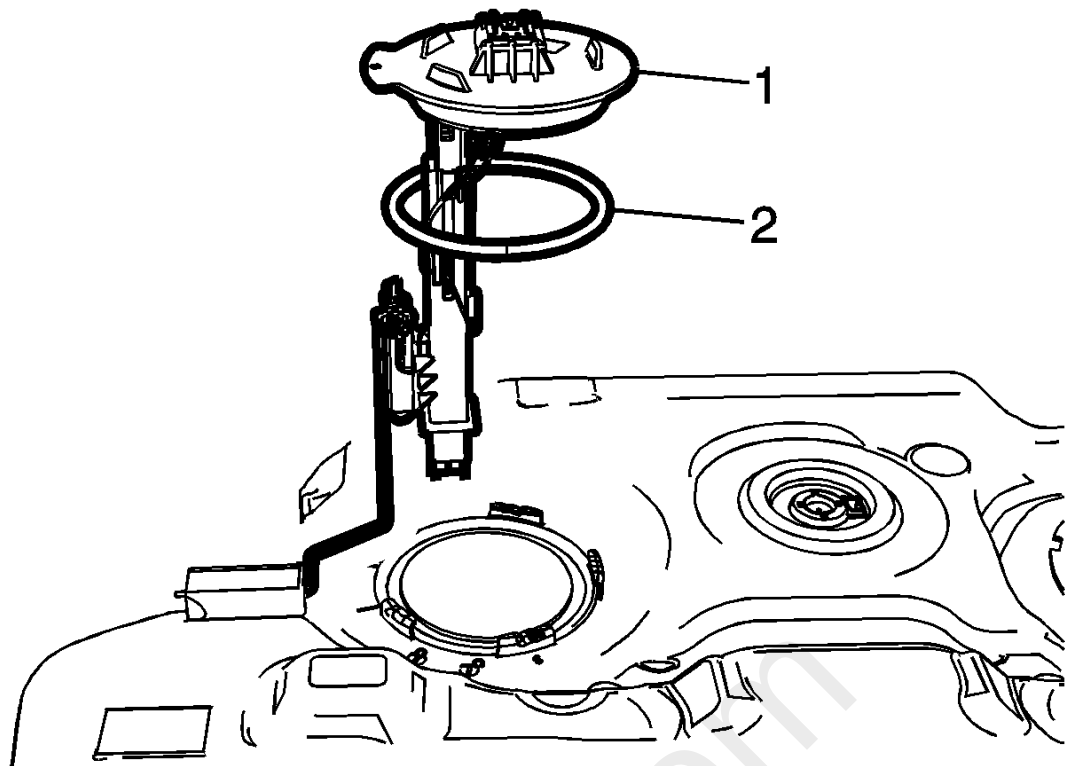


Fig. 53: Fuel Sender O-Ring Gasket
Courtesy of GENERAL MOTORS COMPANY

1. Install a NEW fuel sender O-ring gasket (2) to the fuel sender (1).

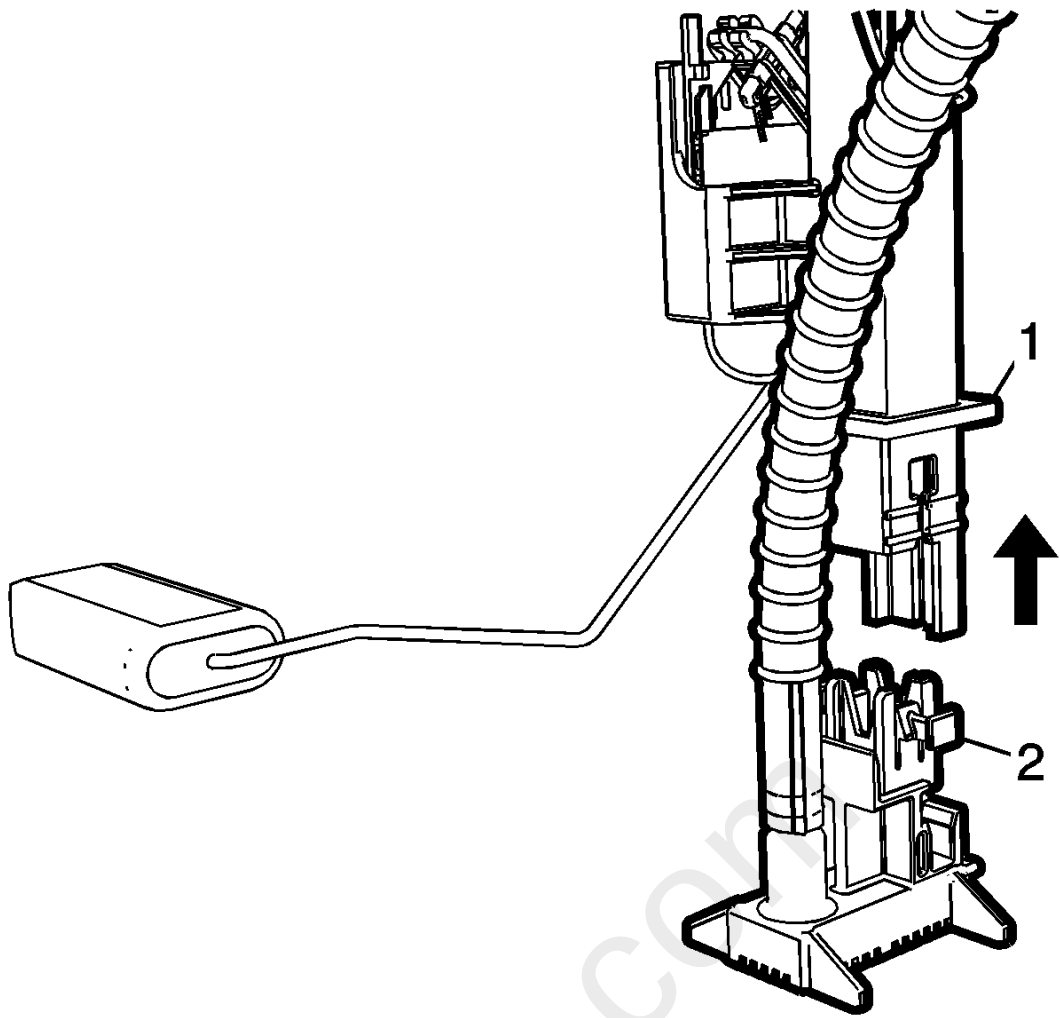


Fig. 54: Pump Module Fuel Pickup

Courtesy of GENERAL MOTORS COMPANY

2. Lower the fuel sender (1) into the fuel tank while connecting the fuel tank fuel pump module fuel pickup (2) to the fuel sender (1).

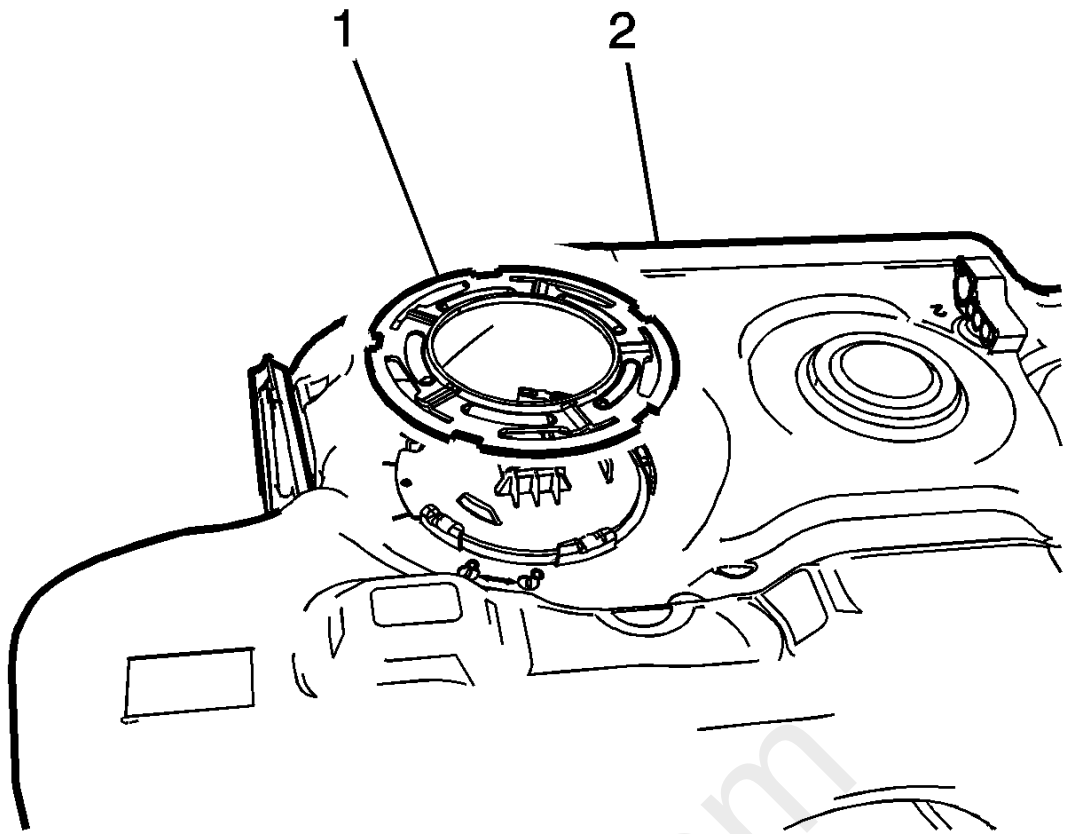


Fig. 55: Lock Ring

Courtesy of GENERAL MOTORS COMPANY

3. Install the fuel sender lock ring (1) to the fuel tank (2).
4. Install the **EN-48482** Fuel Sender Lock Ring Wrench to the fuel sender lock ring (1).
5. Using the **EN-48482** Fuel Sender Lock Ring Wrench and a long breaker-bar, rotate the fuel sender lock ring (1) in a clockwise direction in order to lock the lock ring.
6. Connect the fuel tank sender wiring harness electrical connector.
7. Install the fuel tank. Refer to **Fuel Tank Replacement** .

CHASSIS CONTROL MODULE REPLACEMENT

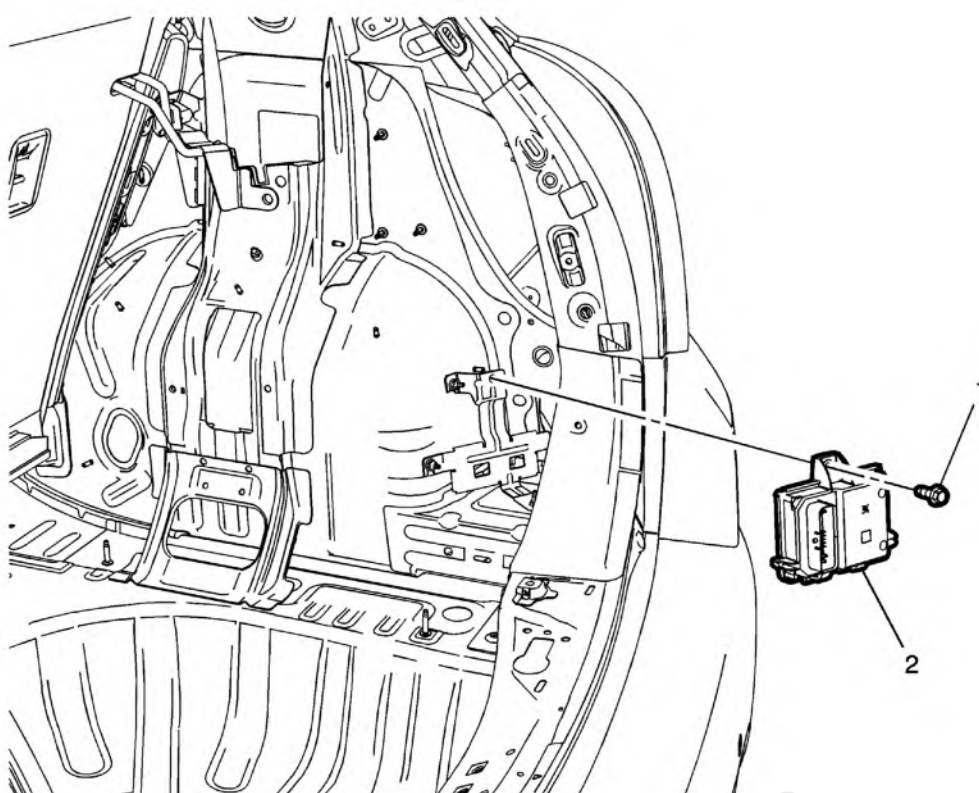


Fig. 56: Fuel Pump Flow Control Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove the quarter lower rear trim panel. Refer to Quarter Lower Rear Trim Panel Replacement .	
1	Fuel Pump Flow Control Module Bolt CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Fuel Pump Flow Control Module Procedure 1. Disconnect the electrical connector. 2. Program the fuel pump flow control module. Refer to Control Module References .

FUEL PUMP FLOW CONTROL MODULE REPLACEMENT

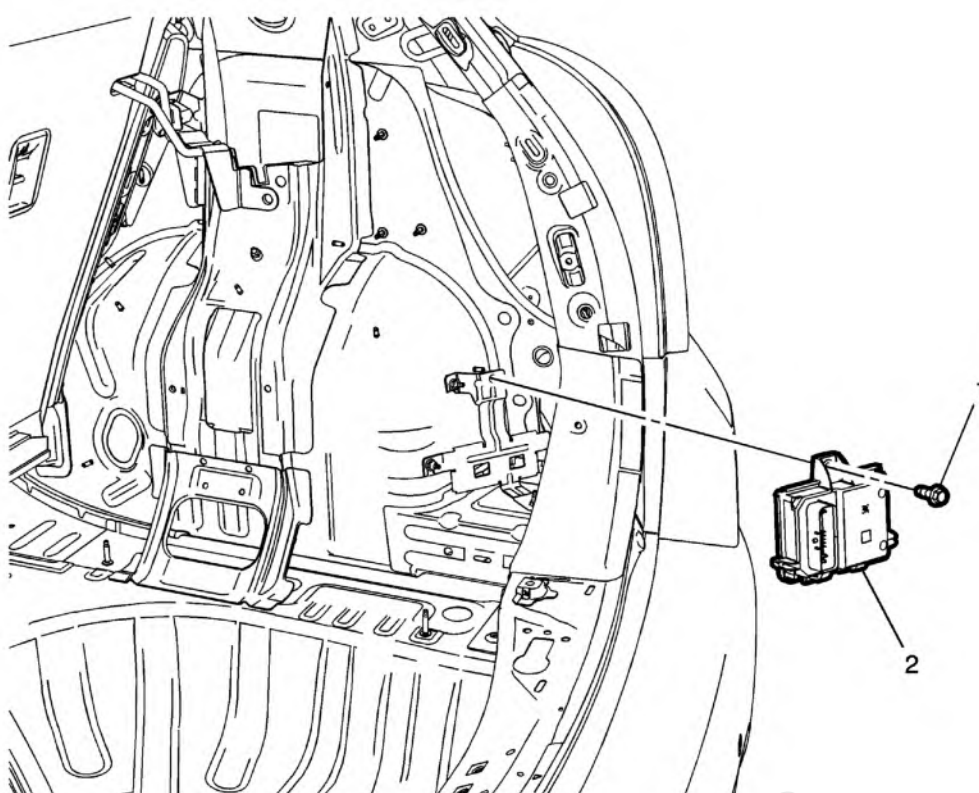


Fig. 57: Fuel Pump Flow Control Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove the quarter lower rear trim panel. Refer to Quarter Lower Rear Trim Panel Replacement .	
1	Fuel Pump Flow Control Module Bolt CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Fuel Pump Flow Control Module Procedure 1. Disconnect the electrical connector. 2. Program the fuel pump flow control module. Refer to Control Module References .

FUEL LEVEL SENSOR REPLACEMENT

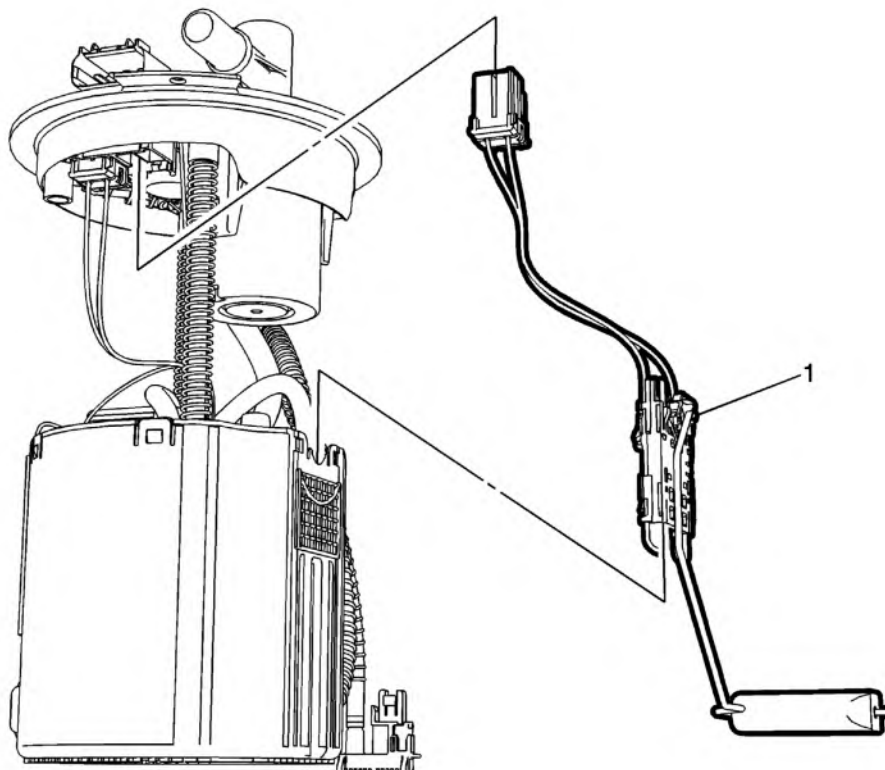


Fig. 58: Fuel Level Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures 1. Remove the fuel tank fuel pump module. Refer to Fuel Tank Fuel Pump Module Replacement (FWD) . 2. Disconnect the electrical connector.	
1	Fuel Level Sensor Procedure Release tabs and slide fuel level sensor up to remove.

FUEL PRESSURE SENSOR REPLACEMENT - FUEL FEED PIPE

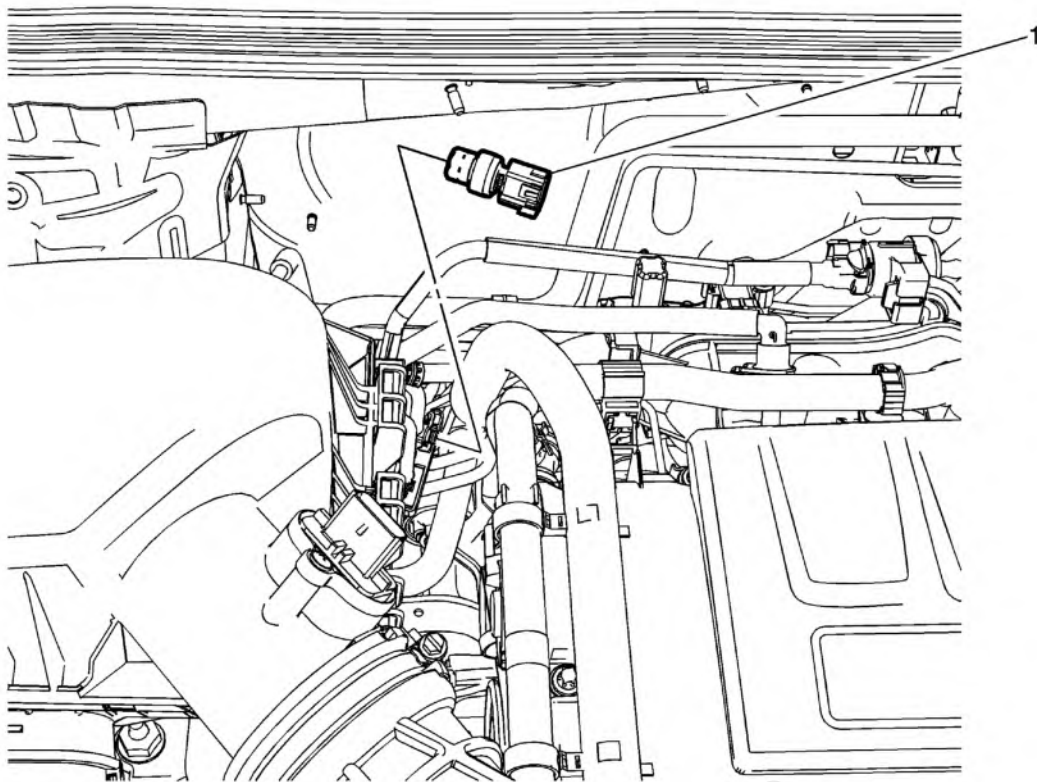


Fig. 59: Fuel Pressure Sensor - Fuel Feed Pipe
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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. Preliminary Procedures Relieve the fuel pressure. Refer to Fuel Pressure Relief .	
1	Fuel Pressure Sensor Procedure Disconnect the electrical connector.

PLASTIC COLLAR QUICK CONNECT FITTING SERVICE

Removal Procedure

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

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

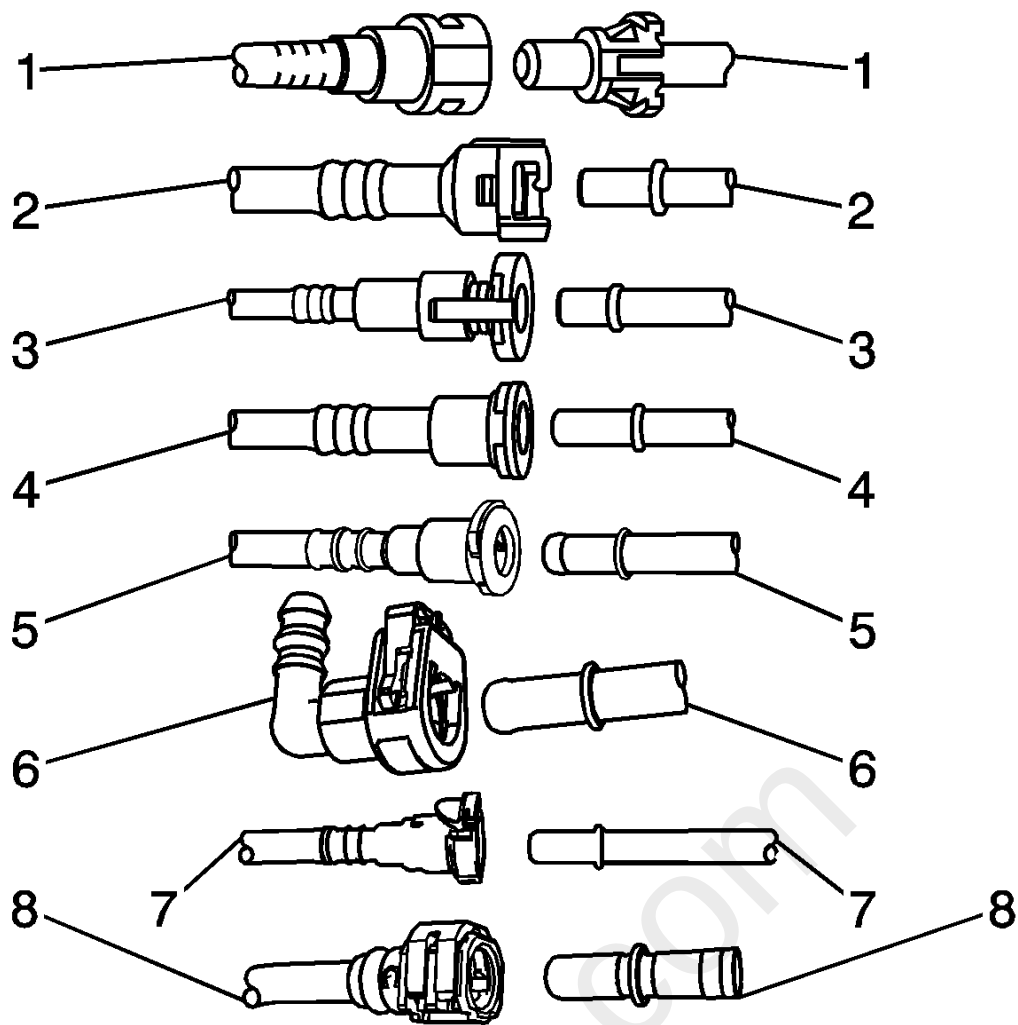


Fig. 60: Plastic Collar Quick Connect Fitting Service

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.

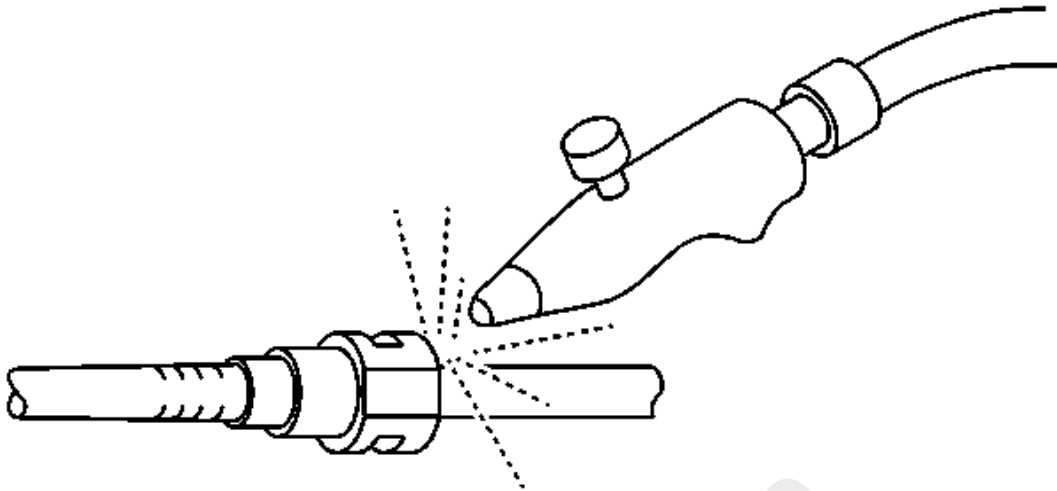


Fig. 61: Blowing Dirt Out Of Fitting (Plastic Collar)
Courtesy of GENERAL MOTORS COMPANY

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.

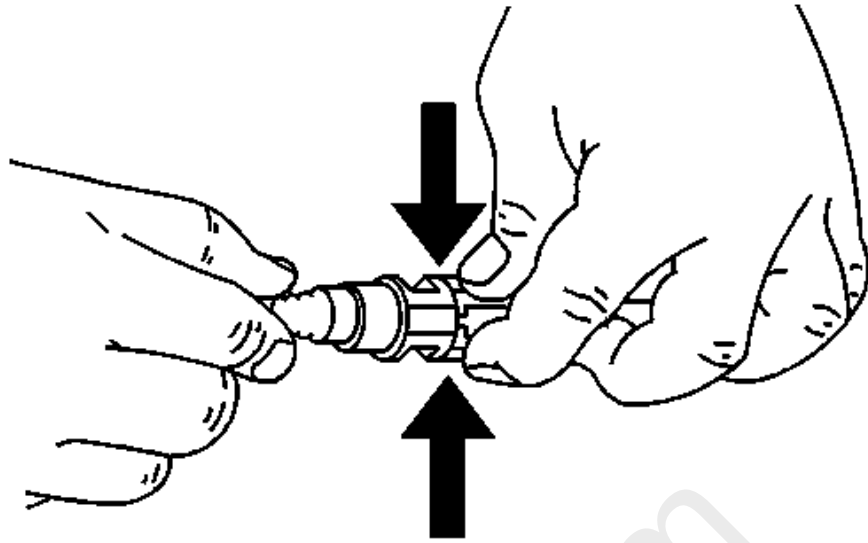


Fig. 62: View Of Quick Connect Fitting Release Tabs (Plastic Collar)
Courtesy of GENERAL MOTORS COMPANY

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

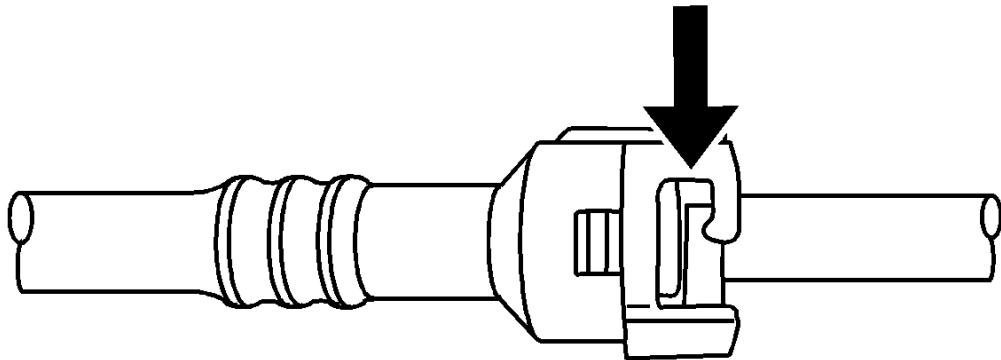


Fig. 63: Releasing Q Release Style Connectors (Plastic Collar).

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.

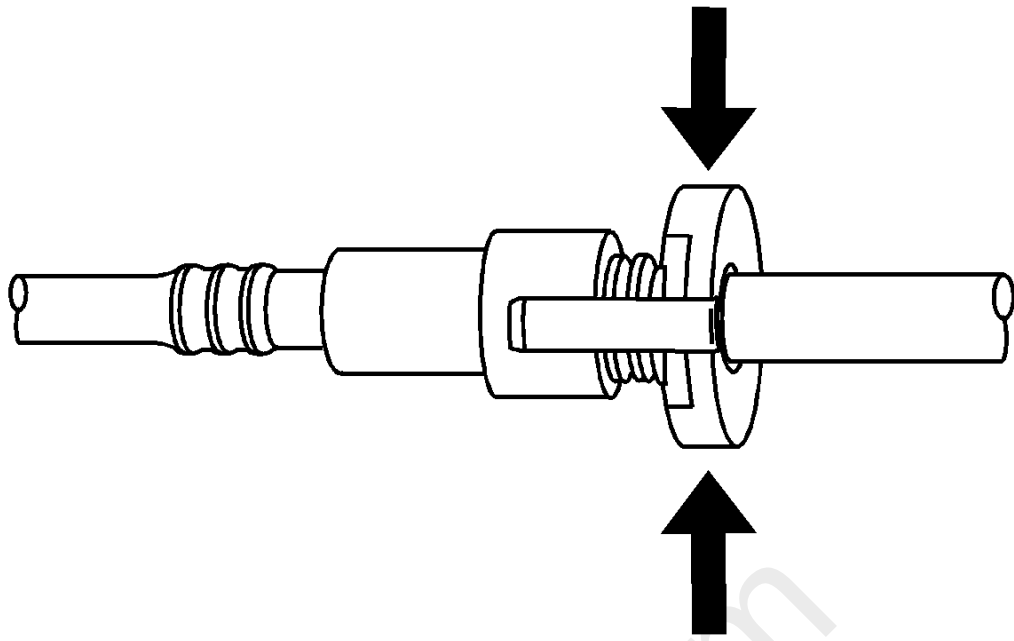


Fig. 64: Disengaging Quick Connect Fitting (Plastic Collar)

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.

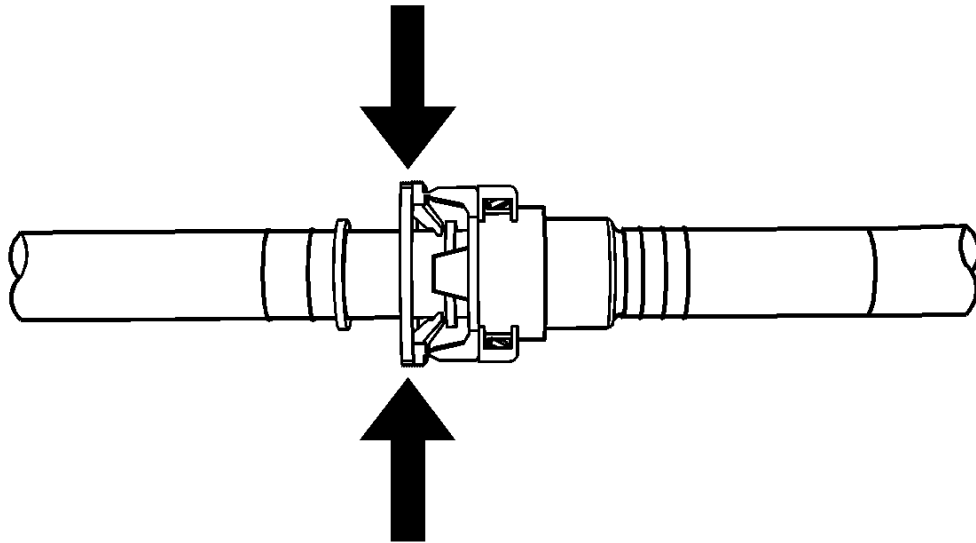


Fig. 65: Pushing In Male Side Of Connector
 Courtesy of GENERAL MOTORS COMPANY

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. 66: 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.

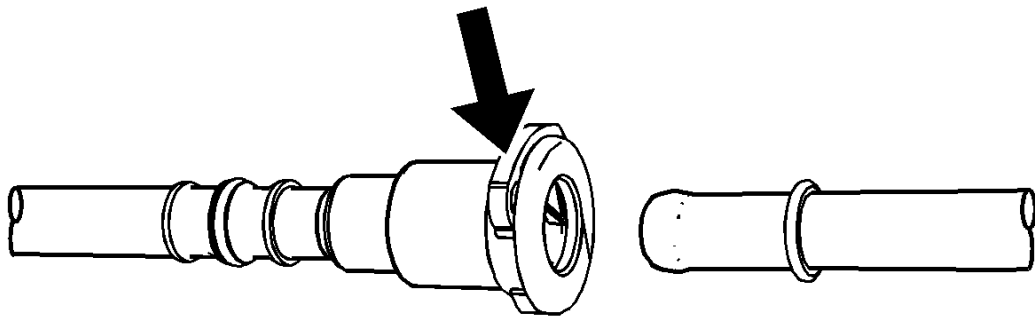


Fig. 67: Global Connector Style

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.

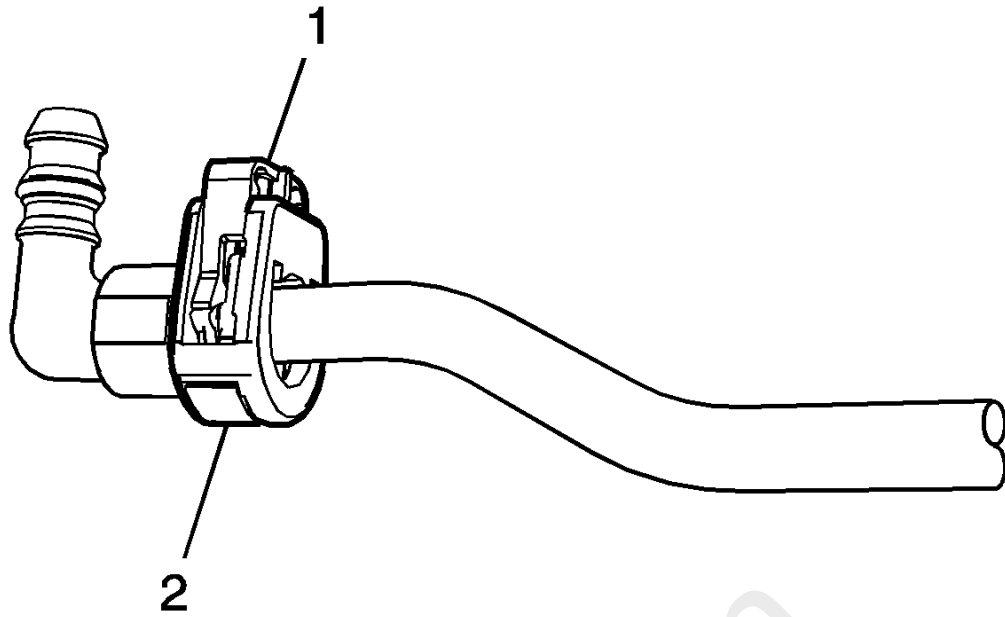


Fig. 68: TI Loc style

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.

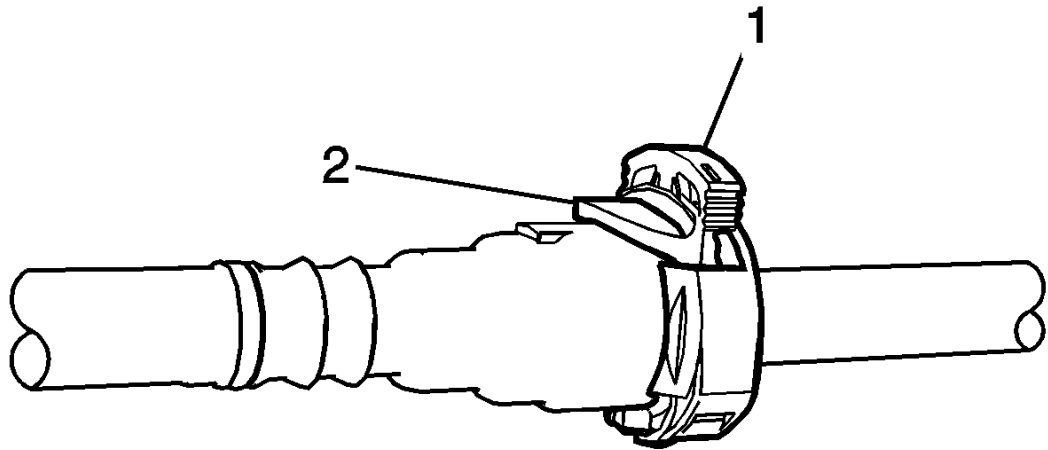


Fig. 69: Safe Lock Style

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.

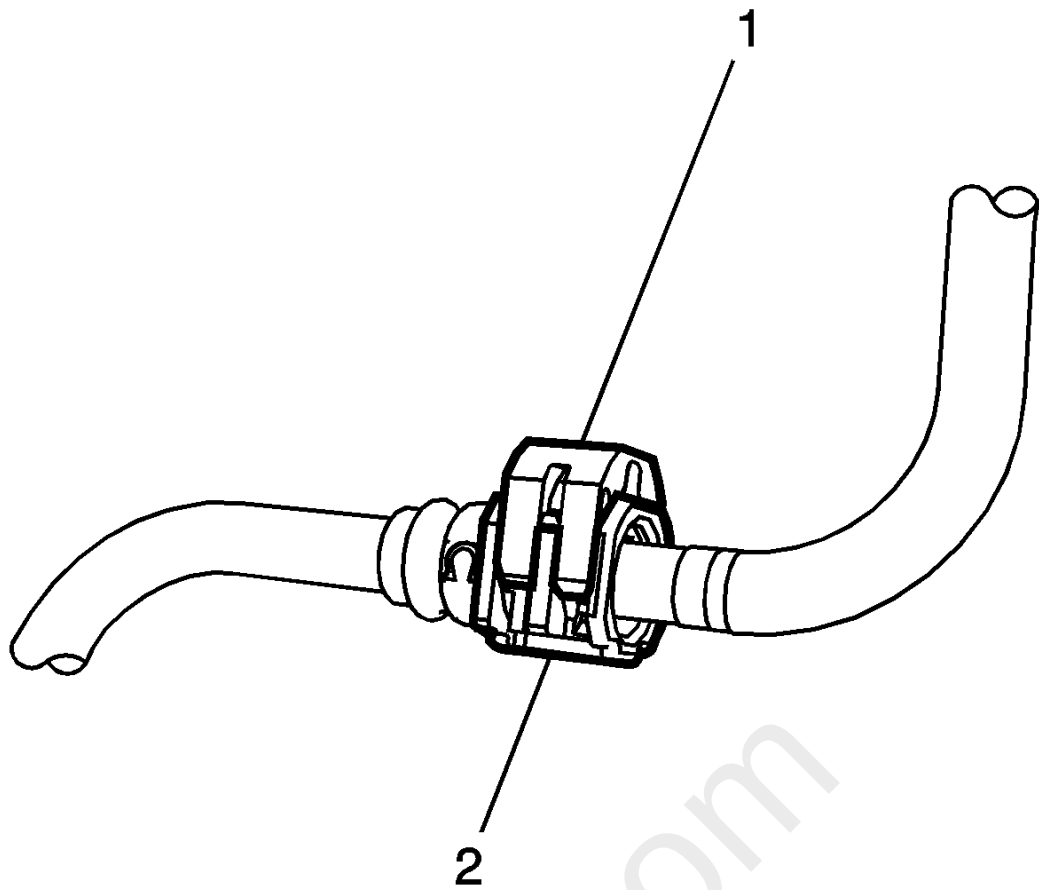


Fig. 70: Latch And Connector Straight Out

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

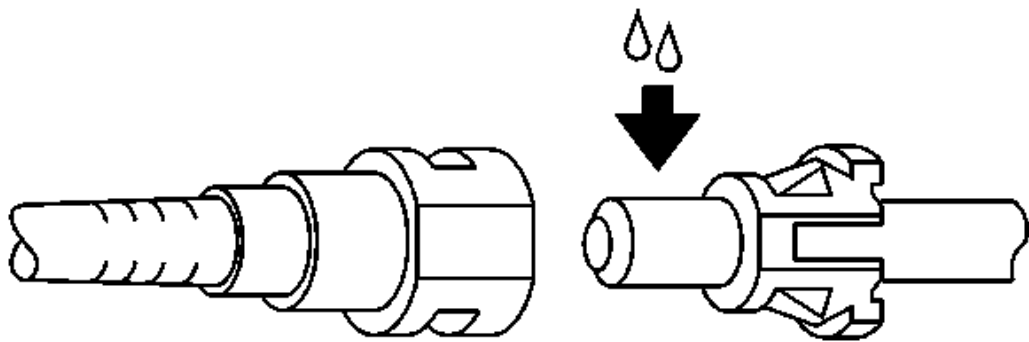


Fig. 71: Lubricating Male Pipe End

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.

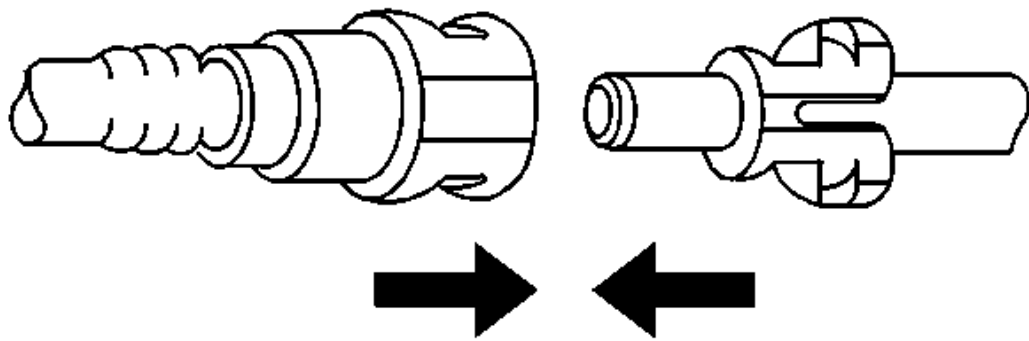


Fig. 72: Connecting Quick-Connect Fittings

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.

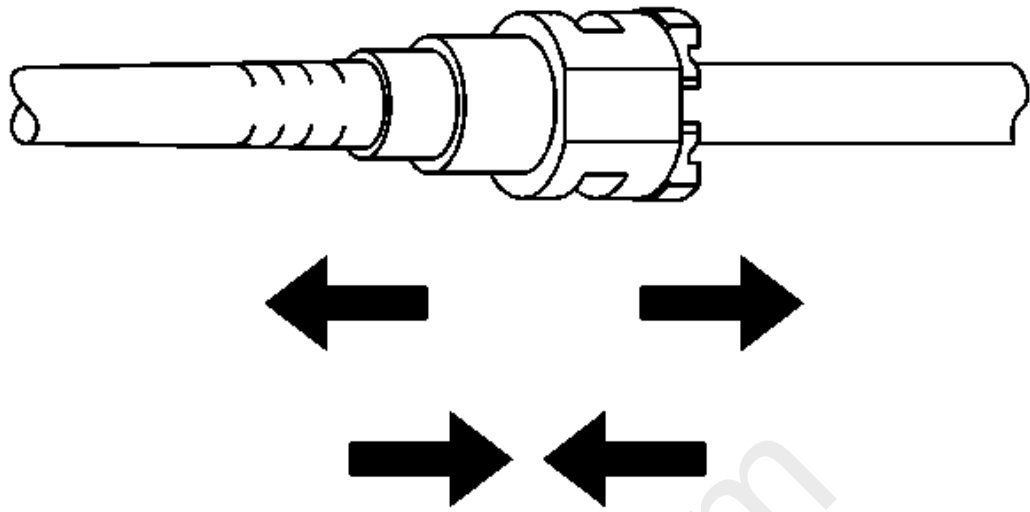


Fig. 73: View Of Quick-Connect Fitting
Courtesy of GENERAL MOTORS COMPANY

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

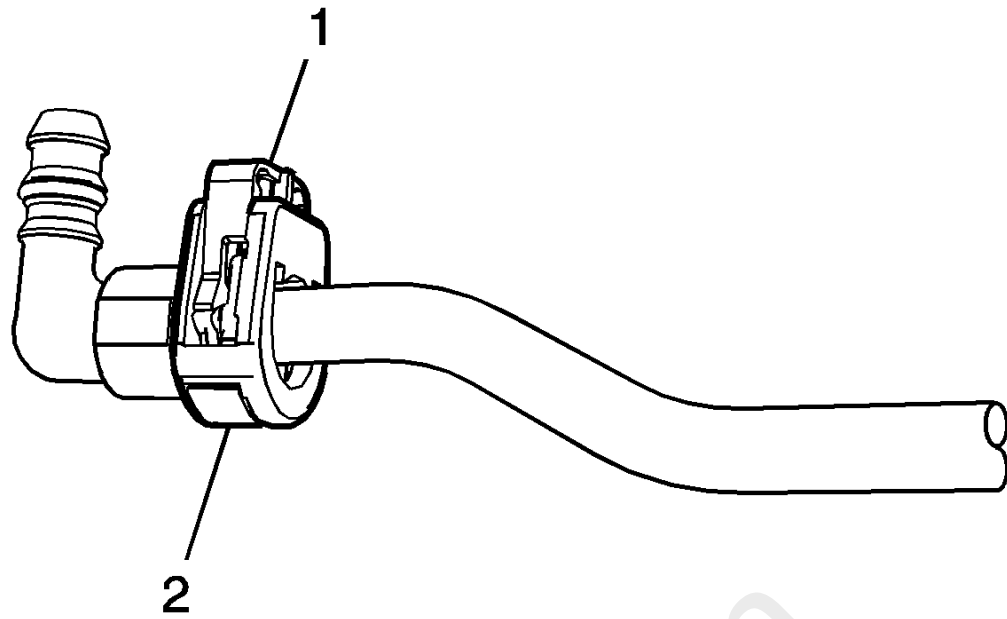


Fig. 74: TI Loc style

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.

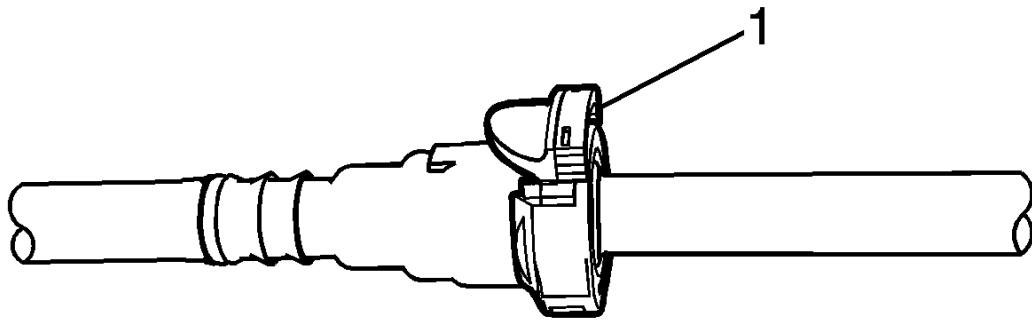


Fig. 75: Redundant Latch

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.

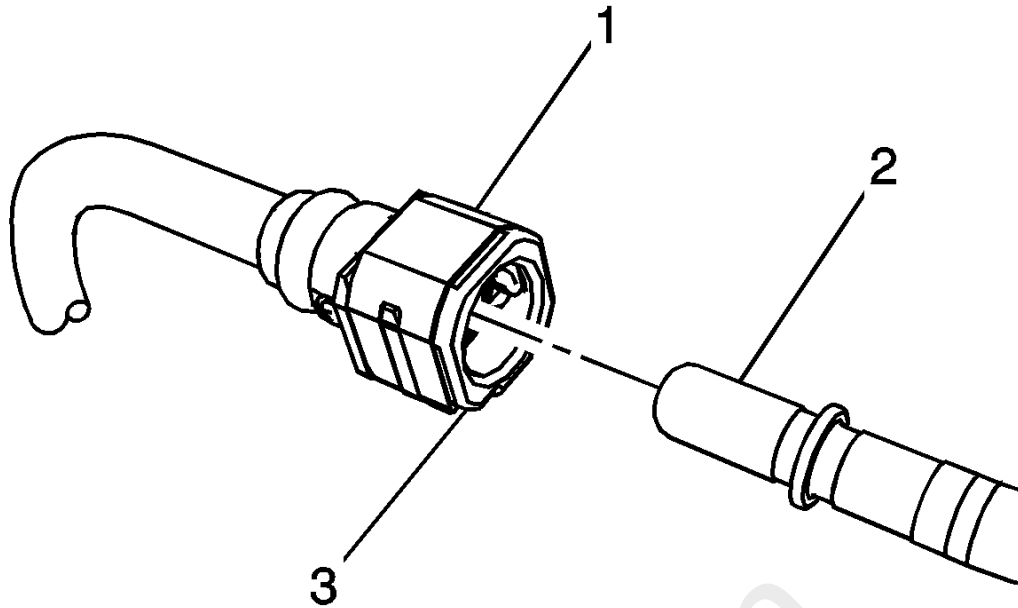


Fig. 76: Latch And Connector

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.

FUEL SYSTEM CLEANING

NOTE: If the fuel filter is plugged, the fuel tank should be inspected internally and cleaned if necessary.

1. Drain the fuel tank. Refer to [Fuel Tank Draining](#).
2. Remove the fuel pump module assembly. Refer to [Fuel Tank Fuel Pump Module Replacement \(AWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(FWD\)](#).
3. Inspect the fuel pump module strainer. Replace the pump module assembly if the fuel strainer is contaminated.

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

4. Flush the fuel tank with hot water.
5. Pour the water out of the fuel sender assembly opening in the fuel tank. Rock the fuel tank in order to be sure that the removal of the water from the fuel tank is complete.
6. Allow the tank to dry completely before reassembly.
7. Disconnect the fuel feed pipe at the engine fuel rail. Refer to [Plastic Collar Quick Connect Fitting Service](#).

NOTE: Only use oil-free compressed air to blow out the fuel pipes.

8. Clean the fuel pipes by applying air pressure in the opposite direction of the fuel flow.
9. Connect the fuel feed pipe to the engine fuel rail. Refer to [Plastic Collar Quick Connect Fitting Service](#).
10. Install the fuel pump module assembly. Refer to [Fuel Tank Fuel Pump Module Replacement \(AWD\)](#)[Fuel Tank Fuel Pump Module Replacement \(FWD\)](#).

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT

Removal Procedure

1. Disconnect battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#), [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).
2. Remove engine cover. Refer to [Engine Cover Replacement](#).
3. Remove the fuel feed pipe from fuel injection fuel rail. Refer to [Fuel Feed Pipe Replacement \(Engine to Tank\)](#)[Fuel Feed Pipe Replacement \(At Tank AWD\)](#)[Fuel Feed Pipe Replacement \(At Tank FWD\)](#).
4. Remove the positive crankcase ventilation pipe from the intake manifold. Refer to [Positive Crankcase Ventilation Pipe Removal](#).

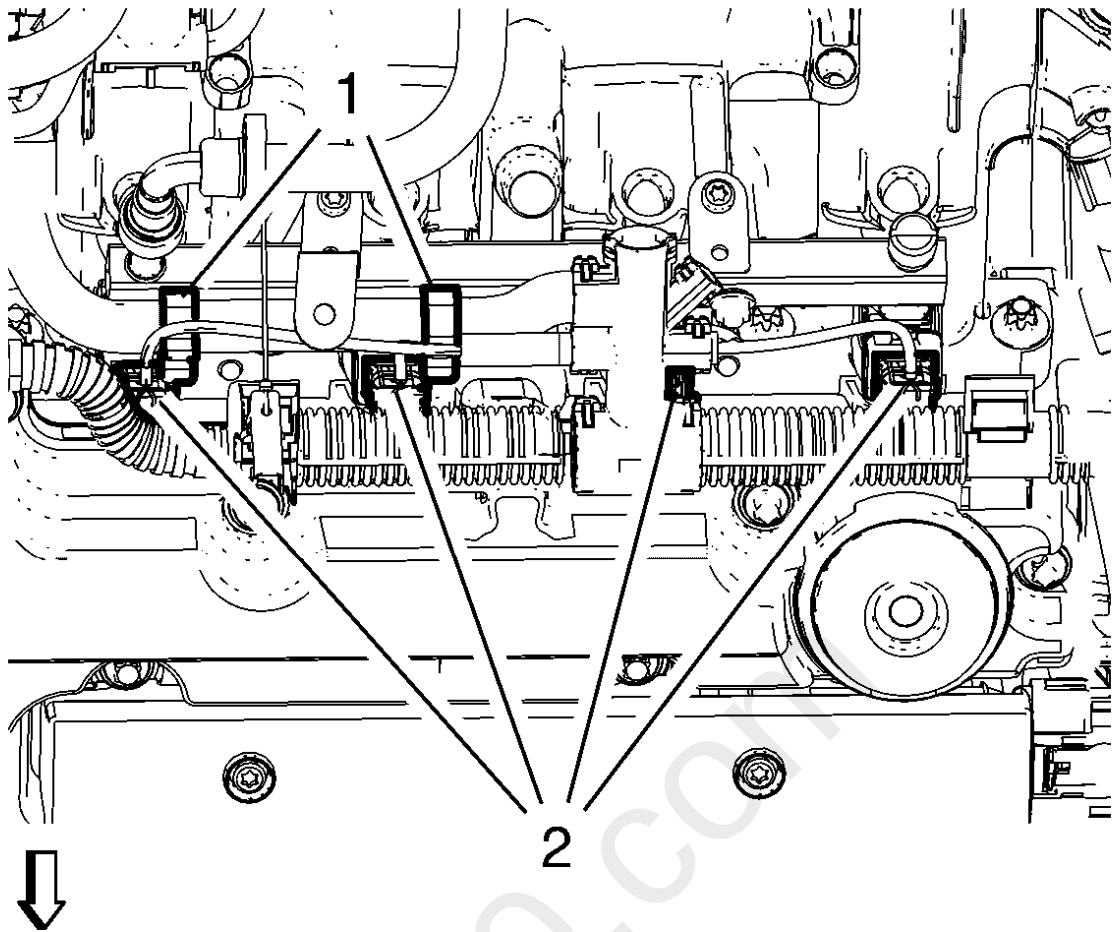


Fig. 77: Fuel Injector Wiring Harness Plugs

Courtesy of GENERAL MOTORS COMPANY

5. Disconnect the 4 fuel injector wiring harness plugs (2).
6. Unclip the ECM wiring harness from retainer clips (1) and the camshaft cover.

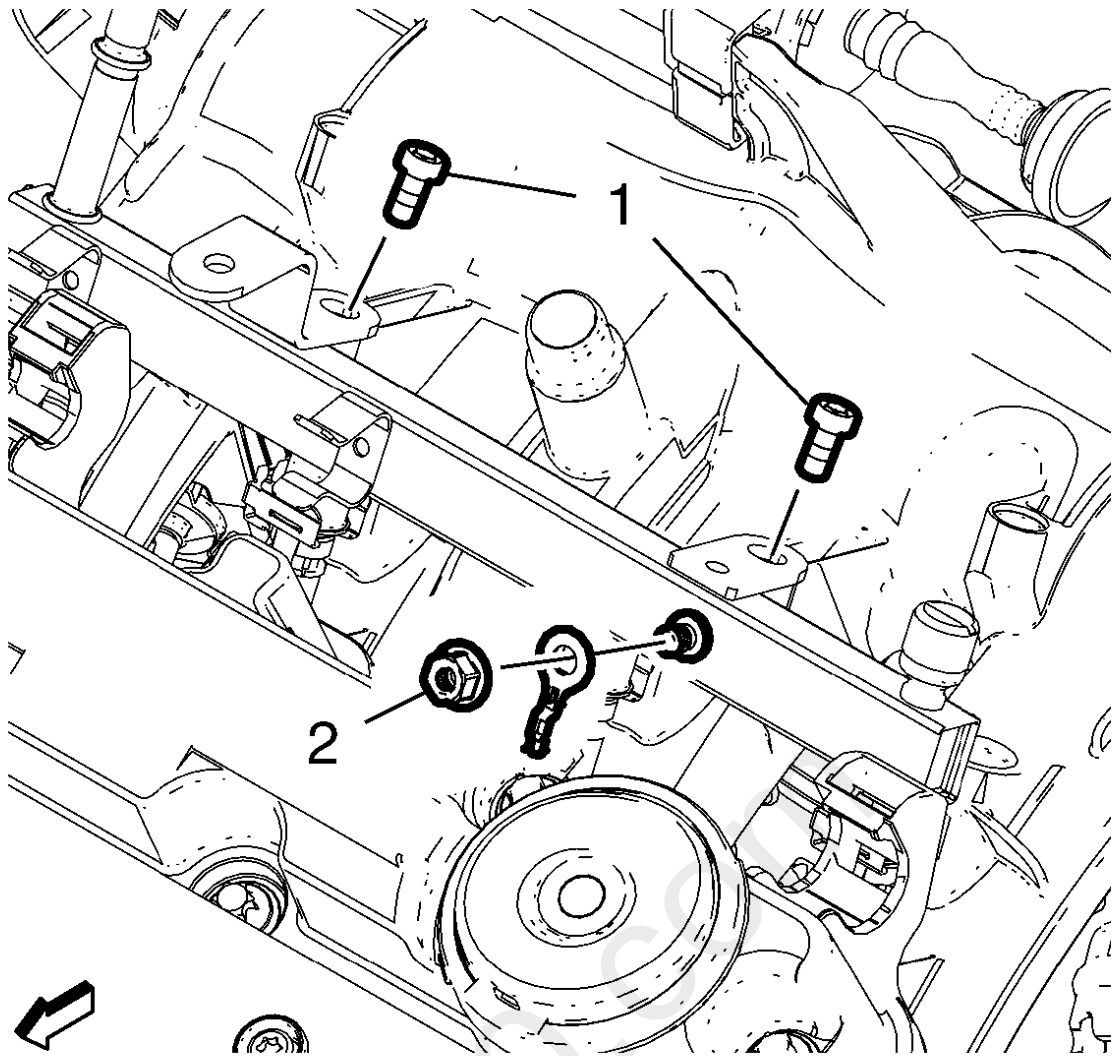


Fig. 78: Fuel Injection Fuel Rail Bolts And Ground Cable Nut
Courtesy of GENERAL MOTORS COMPANY

7. Remove the ground cable nut (2) and the ground cable.
8. Remove the 2 fuel injection fuel rail bolts (1).

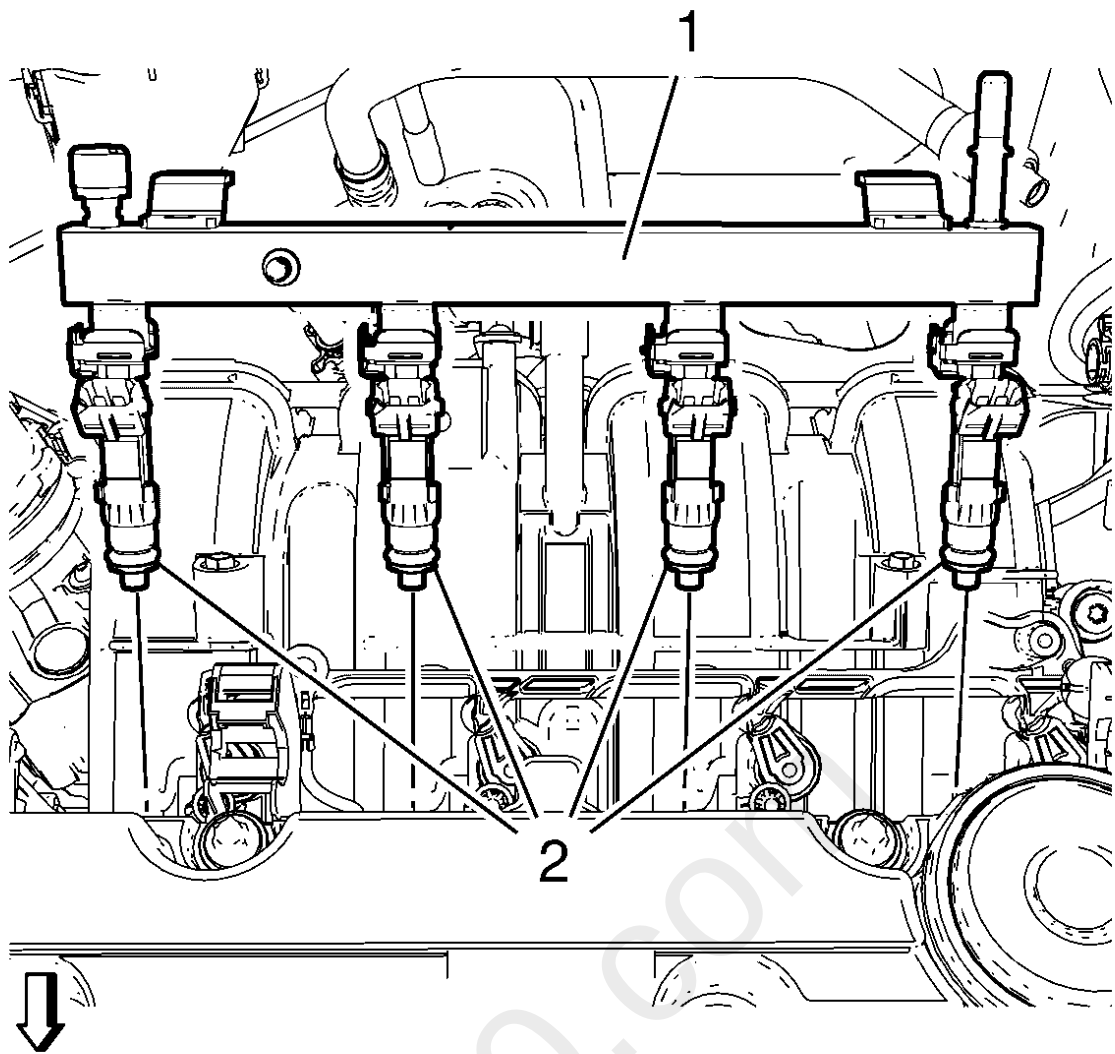


Fig. 79: Fuel Injection Fuel Rail Assembly.

Courtesy of GENERAL MOTORS COMPANY

9. Remove the fuel injection fuel rail assembly (1) and the 4 fuel injector seal rings (2).

Installation Procedure

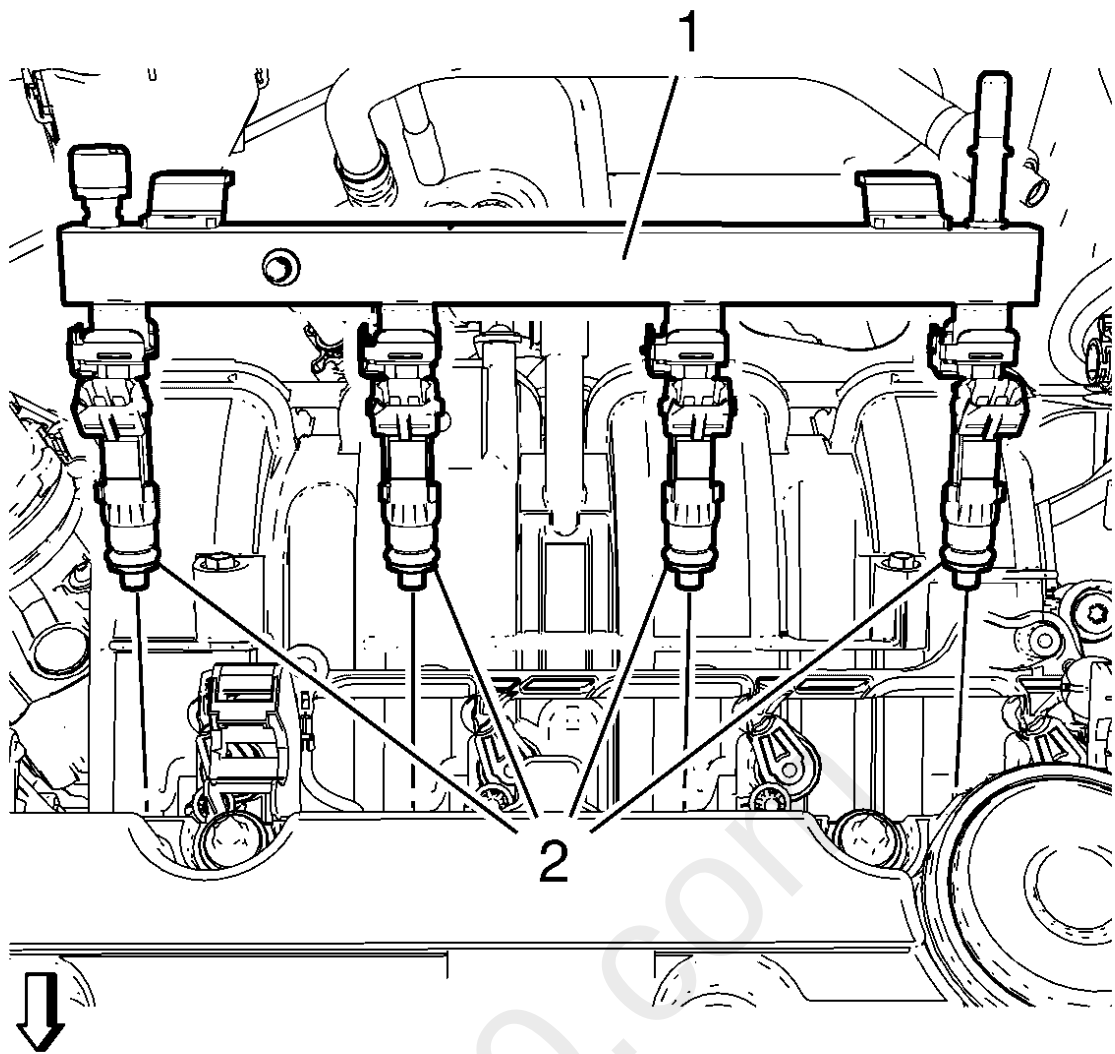


Fig. 80: Fuel Injection Fuel Rail Assembly.
Courtesy of GENERAL MOTORS COMPANY

NOTE: Lubricate the 4 fuel injector seal rings (2) with clean engine oil.

1. Install the fuel injection fuel rail assembly (1) to the intake manifold. Use NEW fuel injector seal rings (2).

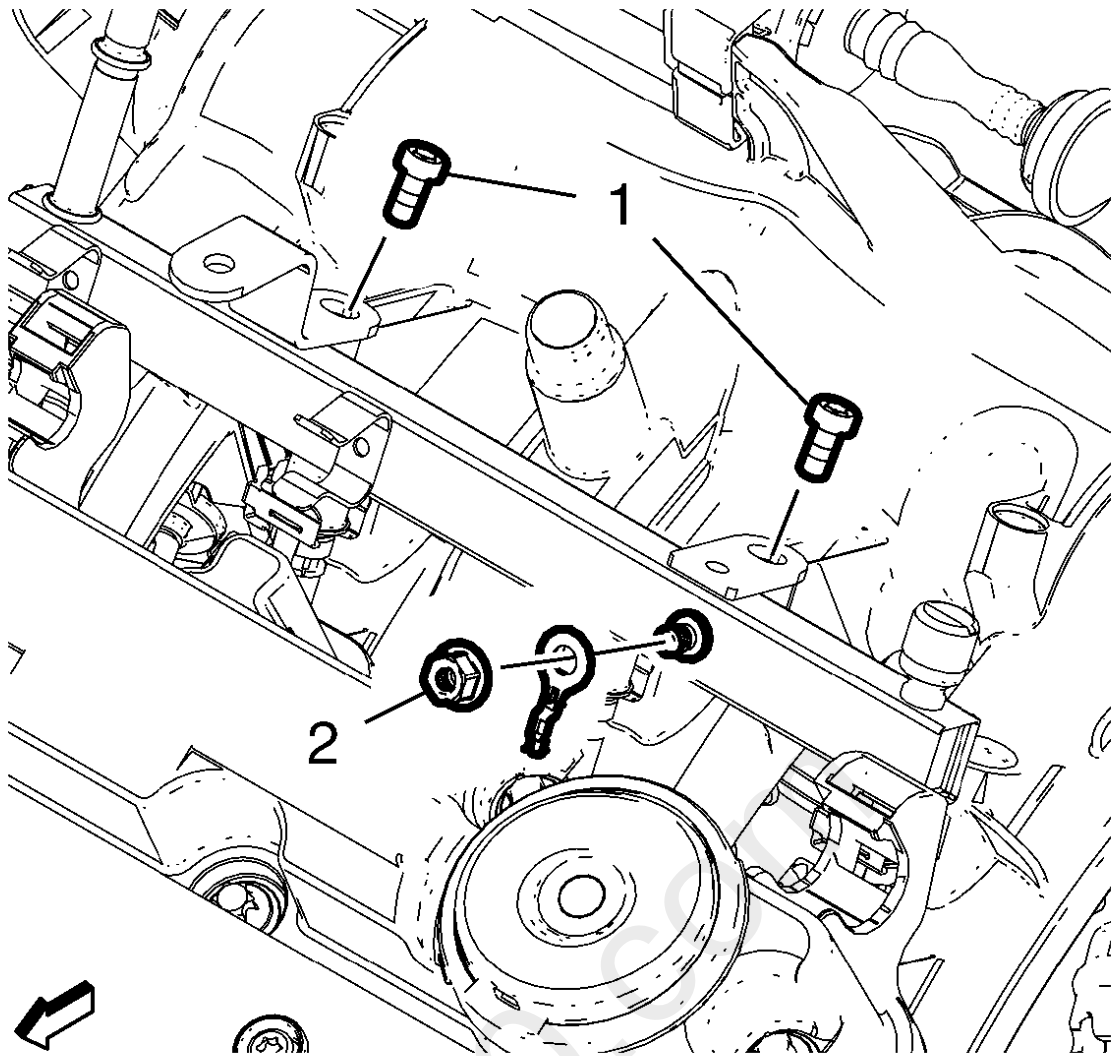


Fig. 81: Fuel Injection Fuel Rail Bolts And Ground Cable Nut
Courtesy of GENERAL MOTORS COMPANY

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

2. Install the 2 fuel injection fuel rail bolts (1) and tighten to 7 N.m (62 lb in).
3. Install the ground cable and the ground cable nut (2) and tighten.

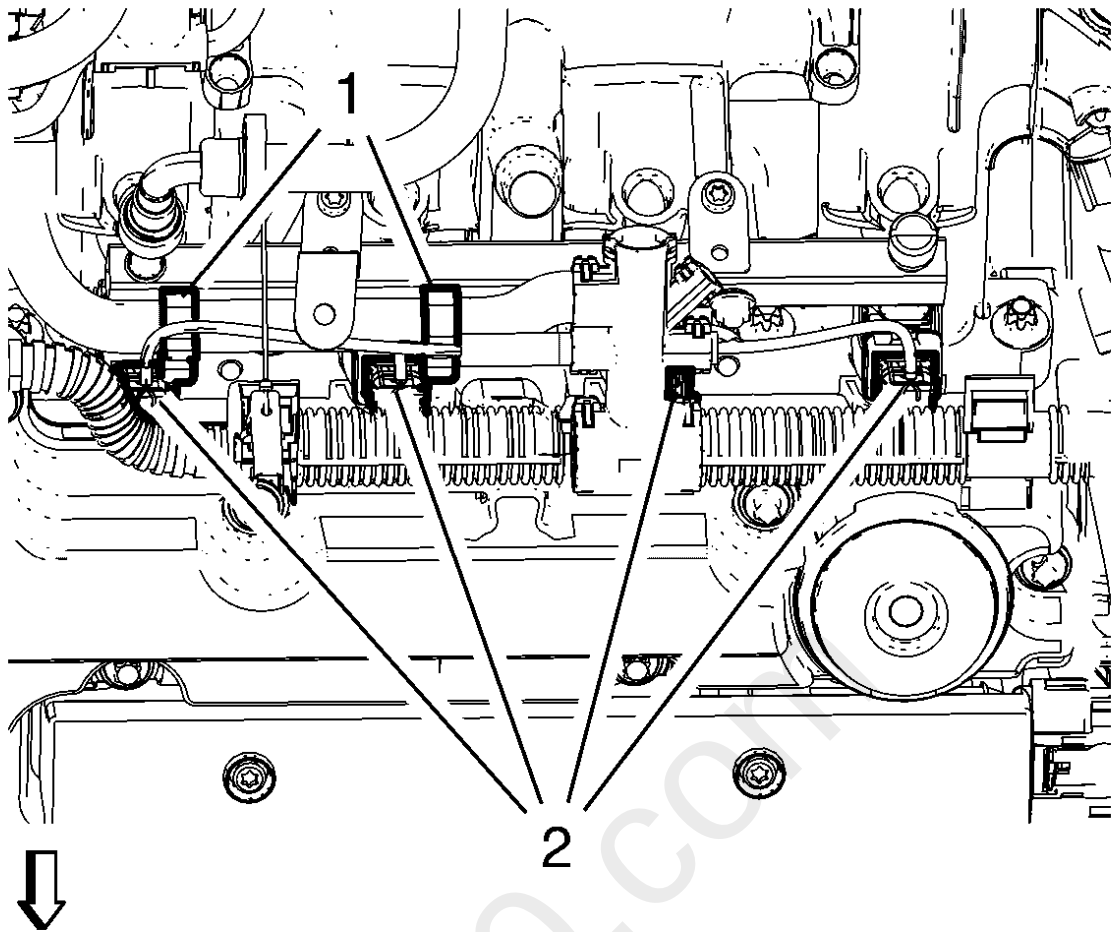


Fig. 82: Fuel Injector Wiring Harness Plugs

Courtesy of GENERAL MOTORS COMPANY

4. Connect the 4 fuel injector wiring harness plugs (2).
5. Clip the ECM wiring harness to the retainer clip (1) and the camshaft cover.
6. Remove the positive crankcase ventilation pipe from the intake manifold. Refer to [Positive Crankcase Ventilation Pipe Removal](#) .
7. Install the fuel feed pipe to the fuel injection fuel rail. Refer to [Fuel Feed Pipe Replacement \(Engine to Tank\)](#)[Fuel Feed Pipe Replacement \(At Tank AWD\)](#)[Fuel Feed Pipe Replacement \(At Tank FWD\)](#).
8. Install the engine sight shield. Refer to [Engine Cover Replacement](#) .
9. Connect battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#)[Battery Negative Cable Disconnection and Connection \(with KL9\)](#) .

FUEL INJECTOR REPLACEMENT

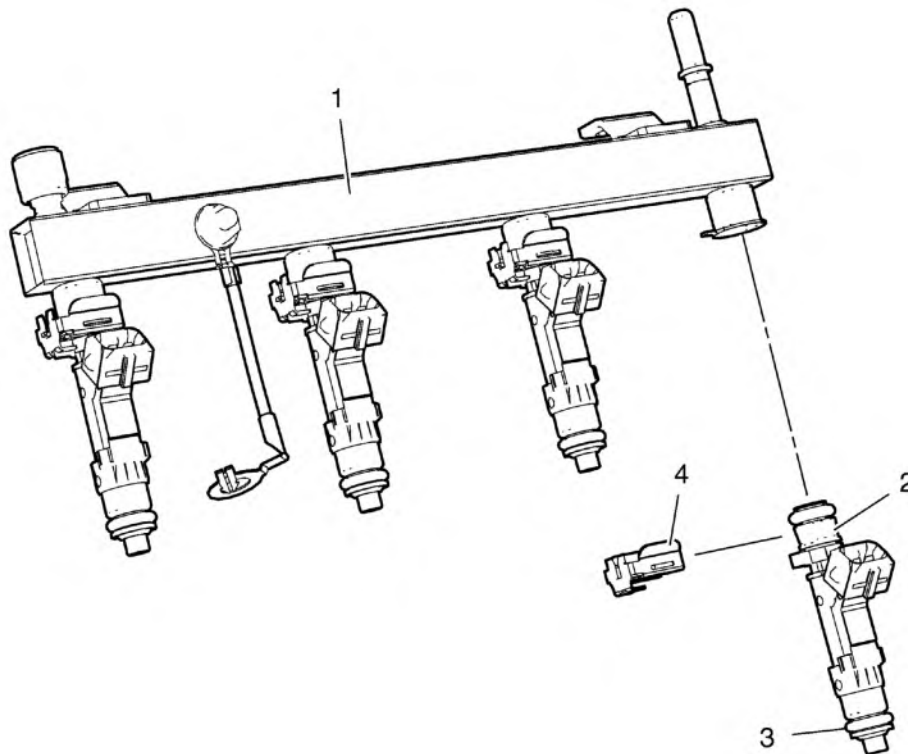


Fig. 83: Fuel Injectors And Rail

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Disconnect battery negative cable. Refer to Battery Negative Cable Disconnection and Connection (without KL9), Battery Negative Cable Disconnection and Connection (with KL9). 2. Remove the fuel injection fuel rail assembly. Refer to Fuel Injection Fuel Rail Assembly Replacement.	
1	Fuel Rail
2	Fuel Injector
3	Fuel Injector Seal Ring NOTE: Lubricate the NEW fuel injector O-ring seals with clean engine oil.
4	Fuel Injector Retainer Clamp

EVAPORATIVE EMISSION CANISTER VENT SOLENOID VALVE REPLACEMENT

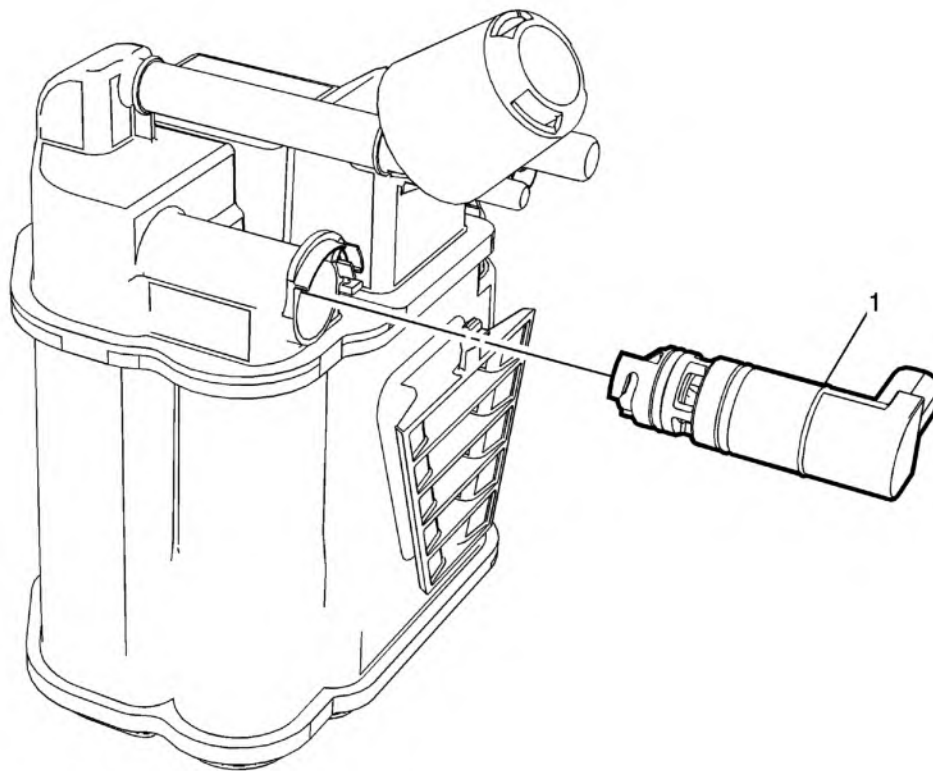


Fig. 84: Evaporative Emission Canister Vent Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the evaporative emission canister. Refer to Evaporative Emission Canister Replacement (AWD) Evaporative Emission Canister Replacement (FWD) .	
1	Evaporative Emission Canister Vent Solenoid Valve Procedure 1. Disconnect the electrical connector. 2. Rotate the solenoid counterclockwise to remove.

EVAPORATIVE EMISSION SYSTEM HOSE/PIPE REPLACEMENT (CANISTER TO PIPE AWD)

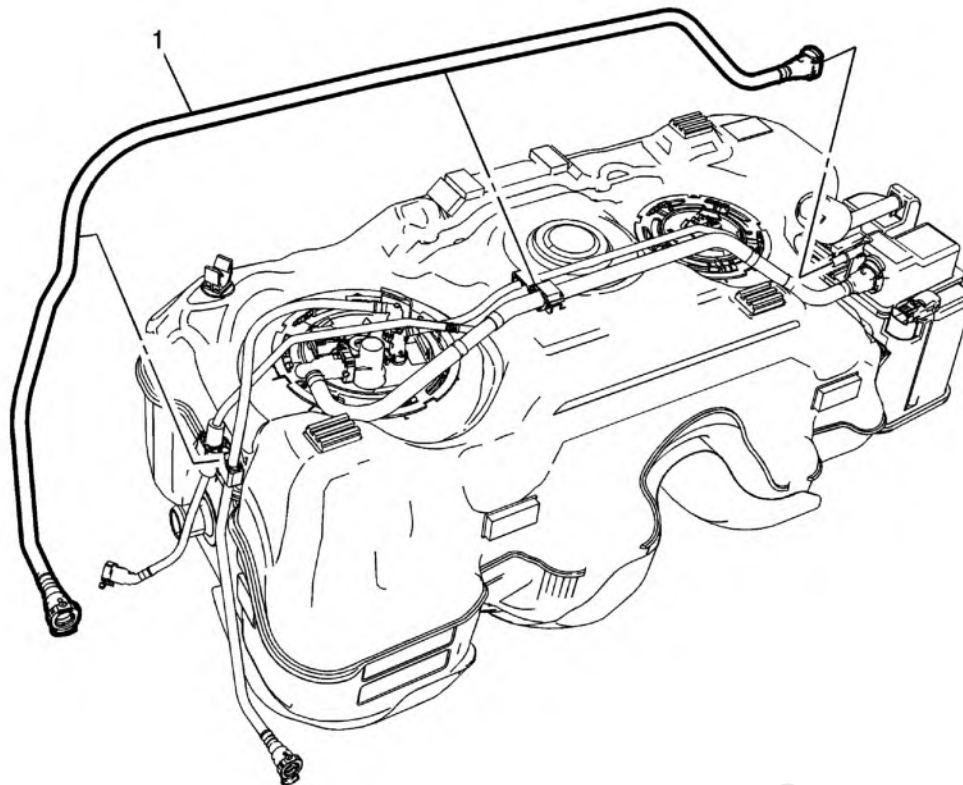


Fig. 85: Evaporative Emission System Hose/Pipe (canister To Pipe - AWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Evaporative Emission Pipe Procedure Disconnect the quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service .

EVAPORATIVE EMISSION SYSTEM HOSE/PIPE REPLACEMENT (CANISTER TO PIPE FWD)

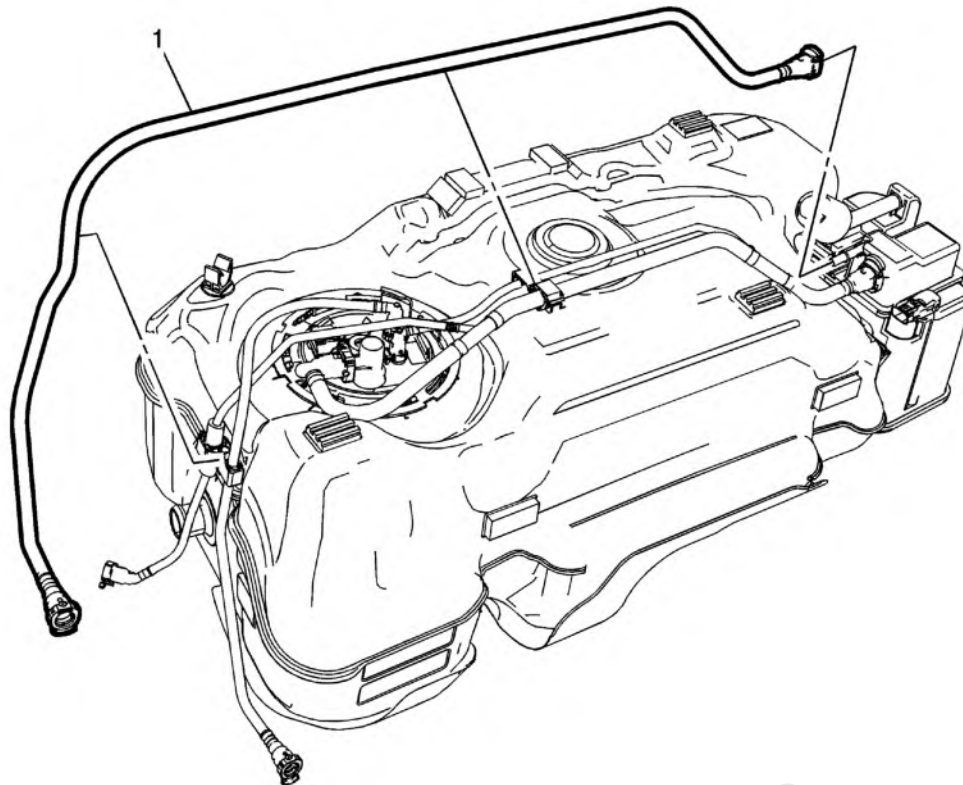


Fig. 86: Evaporative Emission System Hose/Pipe (canister To Pipe - FWD)

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Evaporative Emission Pipe Procedure Disconnect the quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service .

EVAPORATIVE EMISSION SYSTEM HOSE/PIPE REPLACEMENT (FUEL PUMP MODULE TO CANISTER AWD)

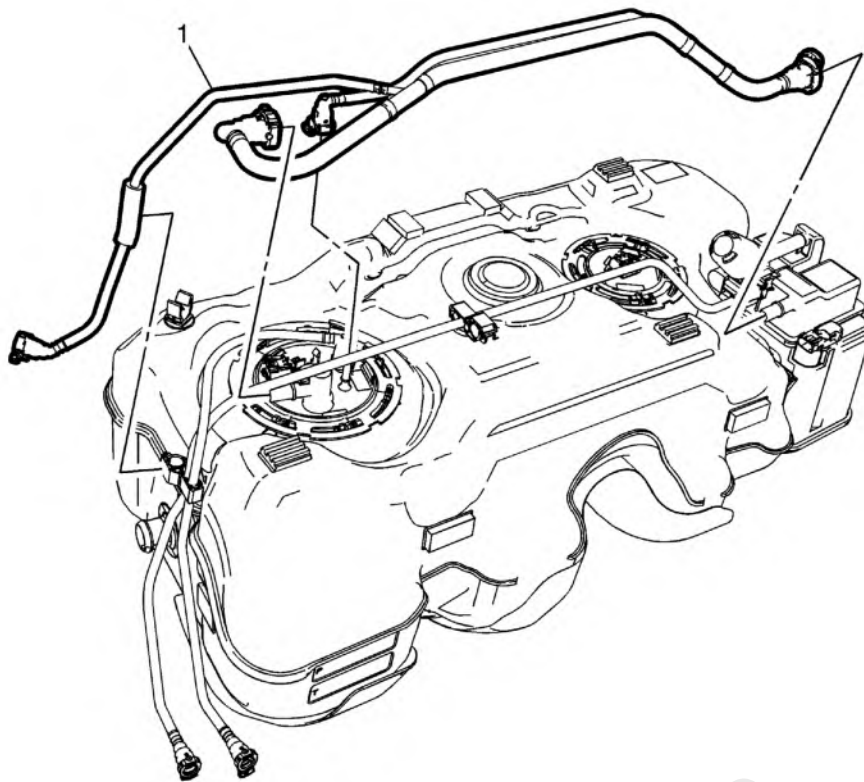


Fig. 87: Evaporative Emission System Hose/Pipe (Fuel Pump Module To Canister - AWD).
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Evaporative Emission Pipe Procedure Disconnect the quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service .

EVAPORATIVE EMISSION SYSTEM HOSE/PIPE REPLACEMENT (FUEL PUMP MODULE TO CANISTER FWD)

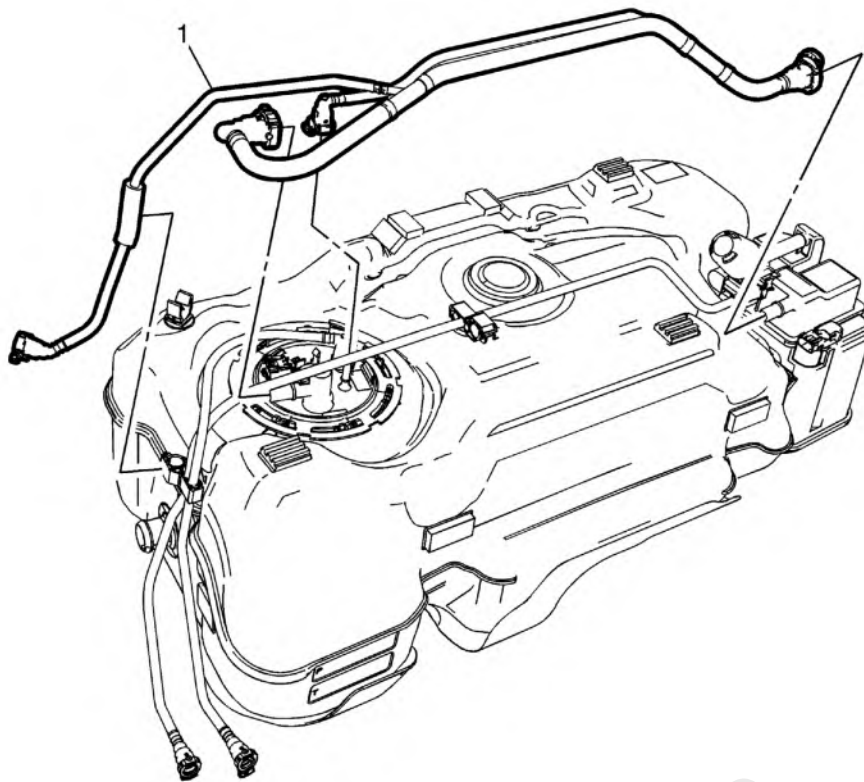


Fig. 88: Evaporative Emission System Hose/Pipe (Fuel Pump Module To Canister - FWD).
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures Remove the fuel tank. Refer to Fuel Tank Replacement (AWD) .	
1	Evaporative Emission Pipe Procedure Disconnect the quick connect fittings. Refer to Plastic Collar Quick Connect Fitting Service .

EVAPORATIVE EMISSION CANISTER REPLACEMENT (AWD)

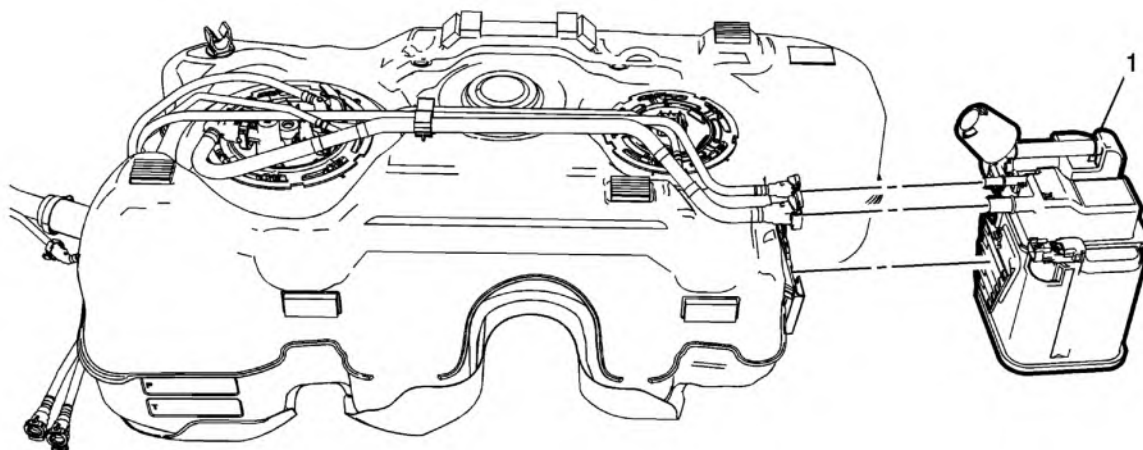


Fig. 89: Evaporative Emission Canister (AWD).
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures 1. Remove the fuel tank. Refer to Fuel Tank Replacement (AWD). 2. Remove the evaporative emission pipes. Refer to Plastic Collar Quick Connect Fitting Service.	
1	Evaporative Emission Canister

EVAPORATIVE EMISSION CANISTER REPLACEMENT (FWD)

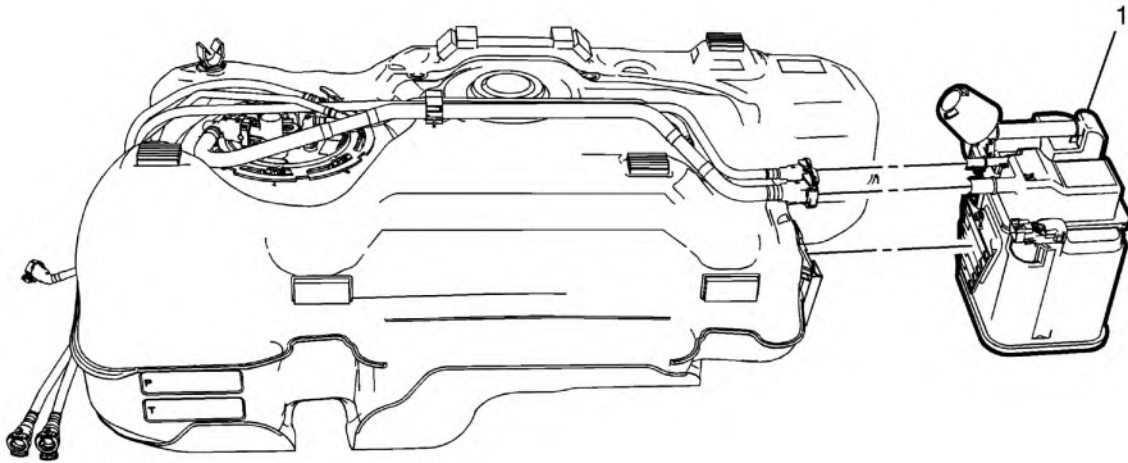


Fig. 90: Evaporative Emission Canister (FWD).
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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.	
Preliminary Procedures 1. Remove the fuel tank. Refer to Fuel Tank Replacement (AWD). 2. Remove the evaporative emission pipes. Refer to Plastic Collar Quick Connect Fitting Service.	
1	Evaporative Emission Canister

EVAPORATIVE EMISSION CANISTER PURGE SOLENOID VALVE REPLACEMENT

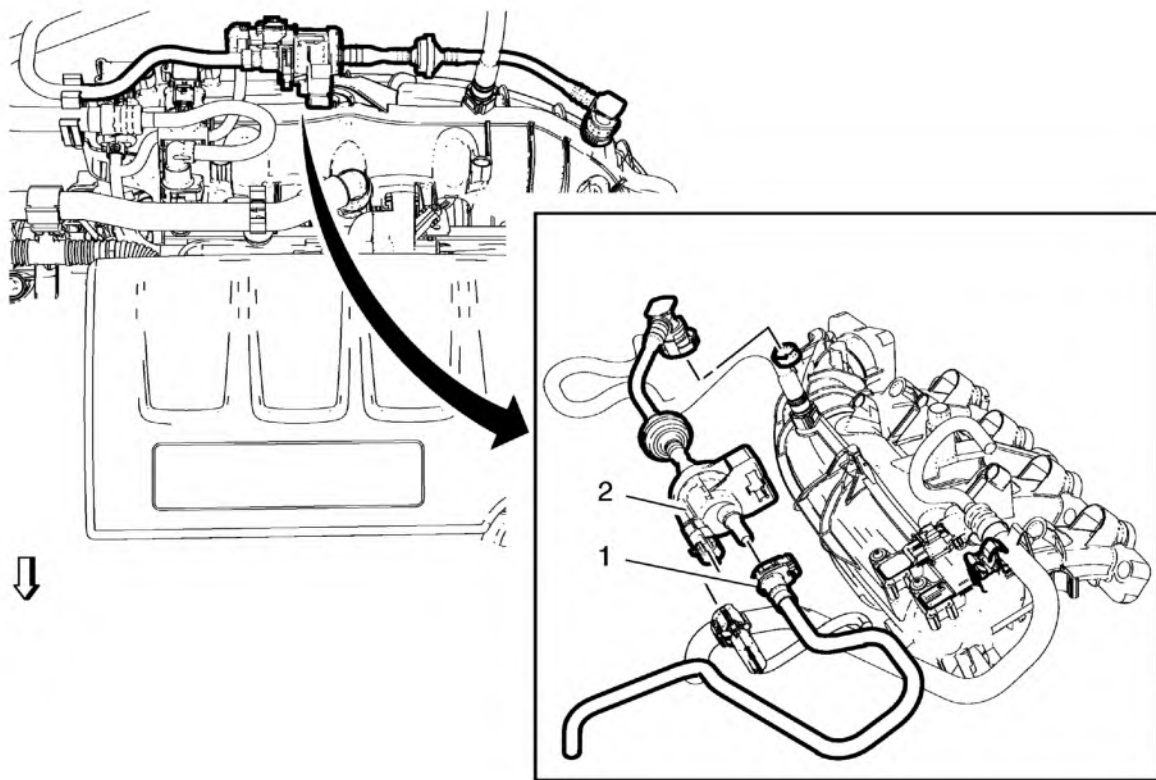


Fig. 91: Evaporative Emission Canister Purge Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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. Preliminary Procedure Disconnect purge solenoid quick connect fitting. Refer to Plastic Collar Quick Connect Fitting Service .	
1	Fuel Ventilation Pipe
2	Evaporative Emission Canister Purge Solenoid Valve
	Procedure Disconnect the electrical connector.

IGNITION COIL REPLACEMENT

Special tools

- EN-6009 Remover and Installer Ignition Coil

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

Removal Procedure

1. Disconnect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#). [Battery Negative Cable Disconnection and Connection \(with KL9\)](#) .
2. Remove the engine cover. Refer to [Engine Cover Replacement](#) .

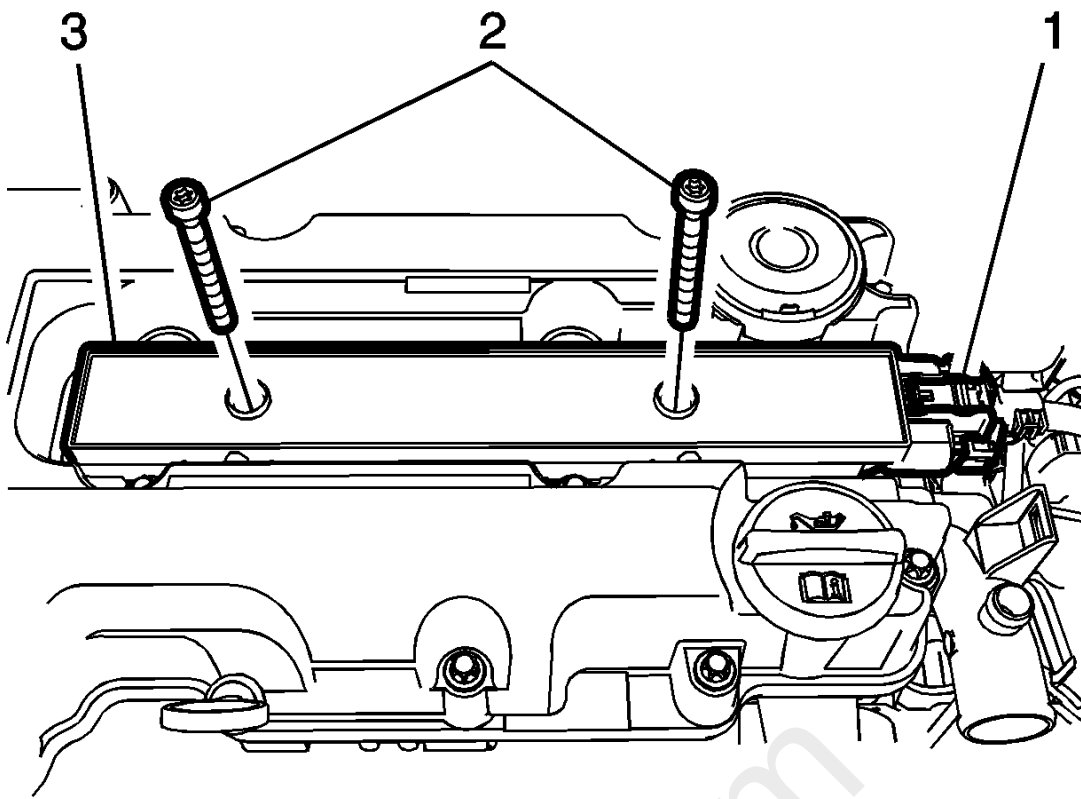


Fig. 92: Ignition Coil Wiring Harness Connector And Fasteners
Courtesy of GENERAL MOTORS COMPANY

3. Disconnect the ignition coil wiring harness connector (1).
4. Remove the 2 ignition coil fasteners (2) from the ignition coil assembly (3).

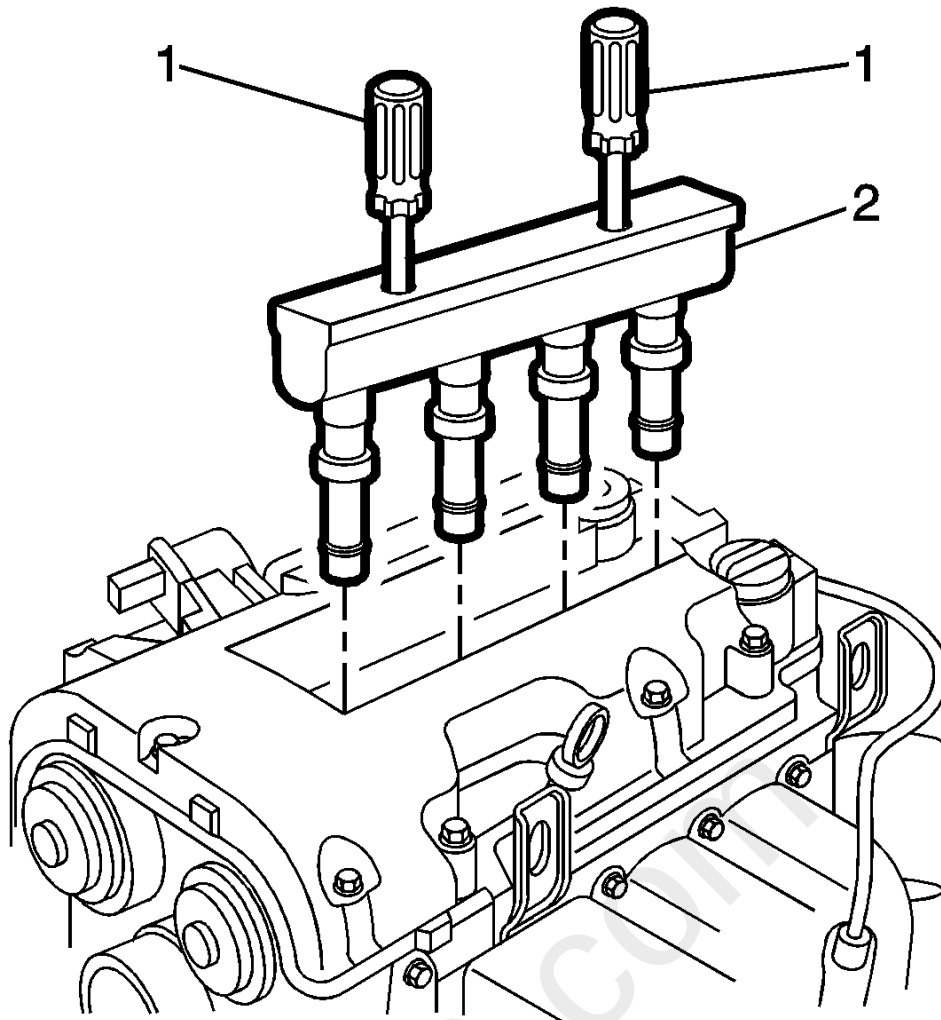


Fig. 93: Ignition Coil Remover/Installer
Courtesy of GENERAL MOTORS COMPANY

5. Install the EN-6009 remover/installer (1).
6. Remove the ignition coil (2).
7. Remove the EN-6009 remover/installer (1).

Installation Procedure

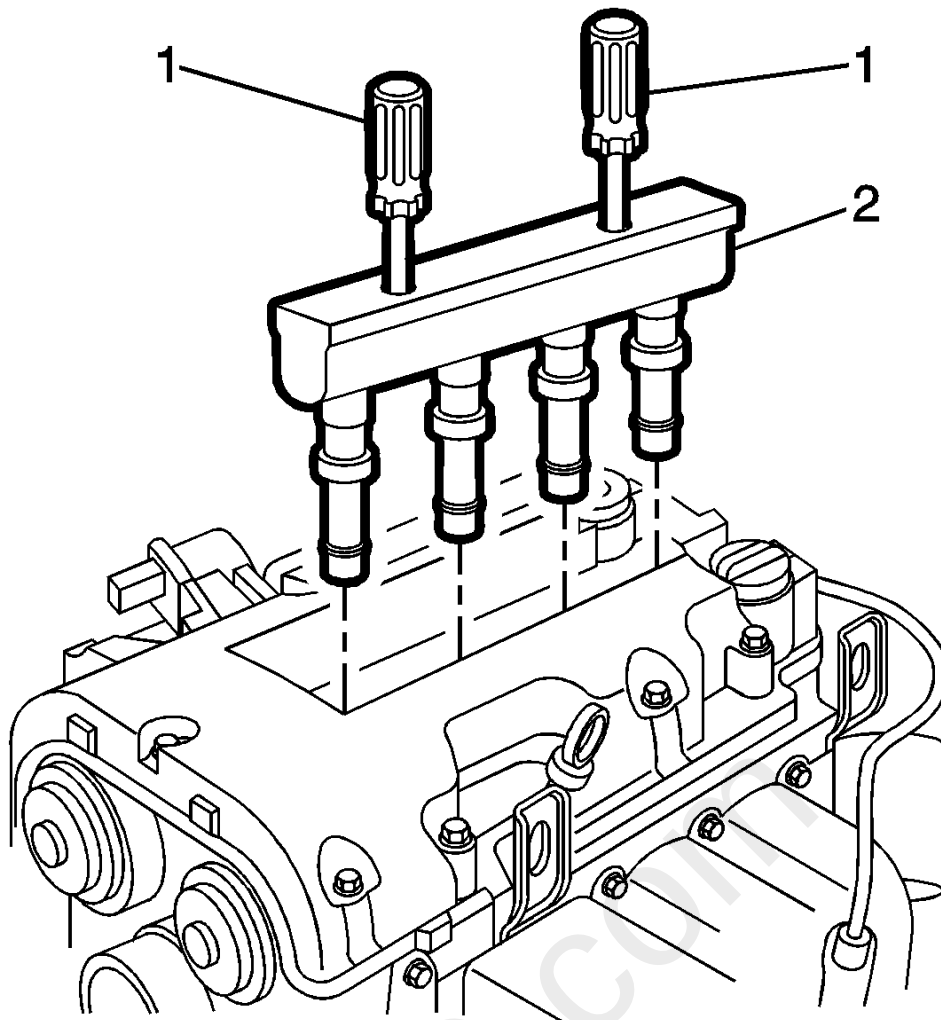


Fig. 94: Ignition Coil Remover/Installer
Courtesy of GENERAL MOTORS COMPANY

1. Install the EN-6009 remover/installer (1).
2. Install the ignition coil assembly (2).
3. Remove the EN-6009 remover/installer (1).

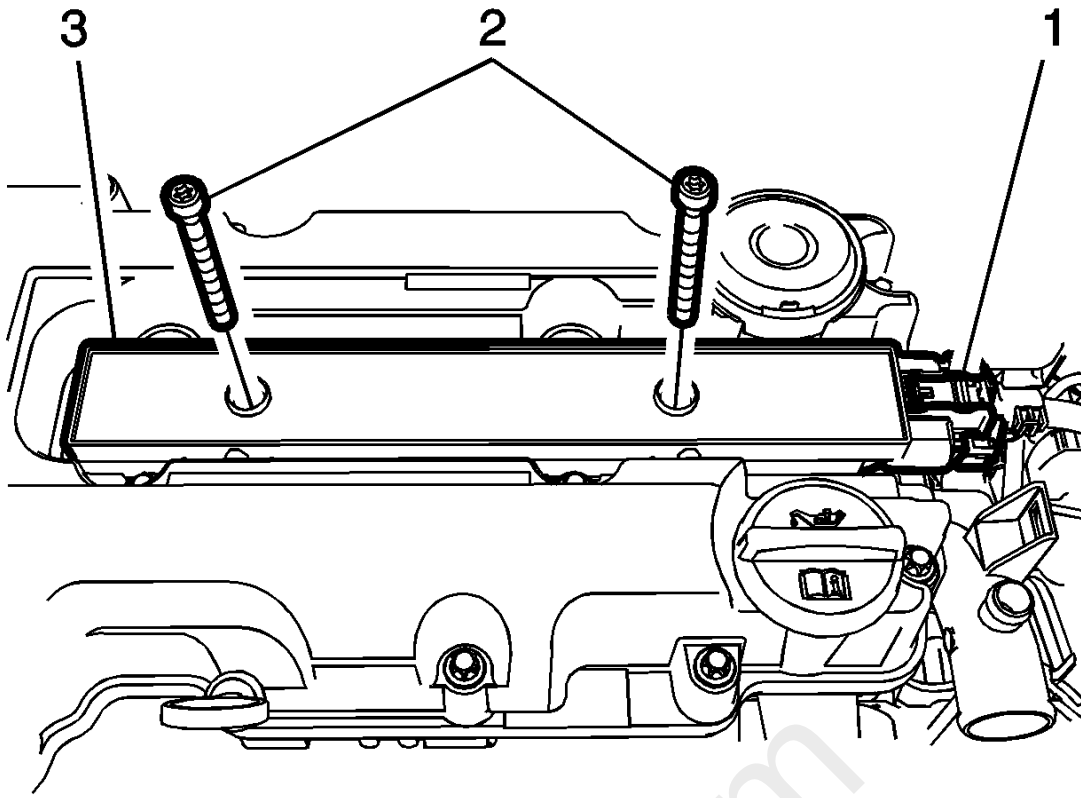


Fig. 95: Ignition Coil Wiring Harness Connector And Fasteners

Courtesy of GENERAL MOTORS COMPANY

4. Install the 2 ignition coil assembly fasteners (2) and tighten to 8 N.m (71 lb in).
5. Connect the ignition coil plug (1).
6. Install the engine cover. Refer to [Engine Cover Replacement](#).
7. Connect the battery negative cable. Refer to [Battery Negative Cable Disconnection and Connection \(without KL9\)](#), [Battery Negative Cable Disconnection and Connection \(with KL9\)](#).

SPARK PLUG INSPECTION

Spark Plug Usage

1. Ensure that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to the Electronic Parts Catalog.
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

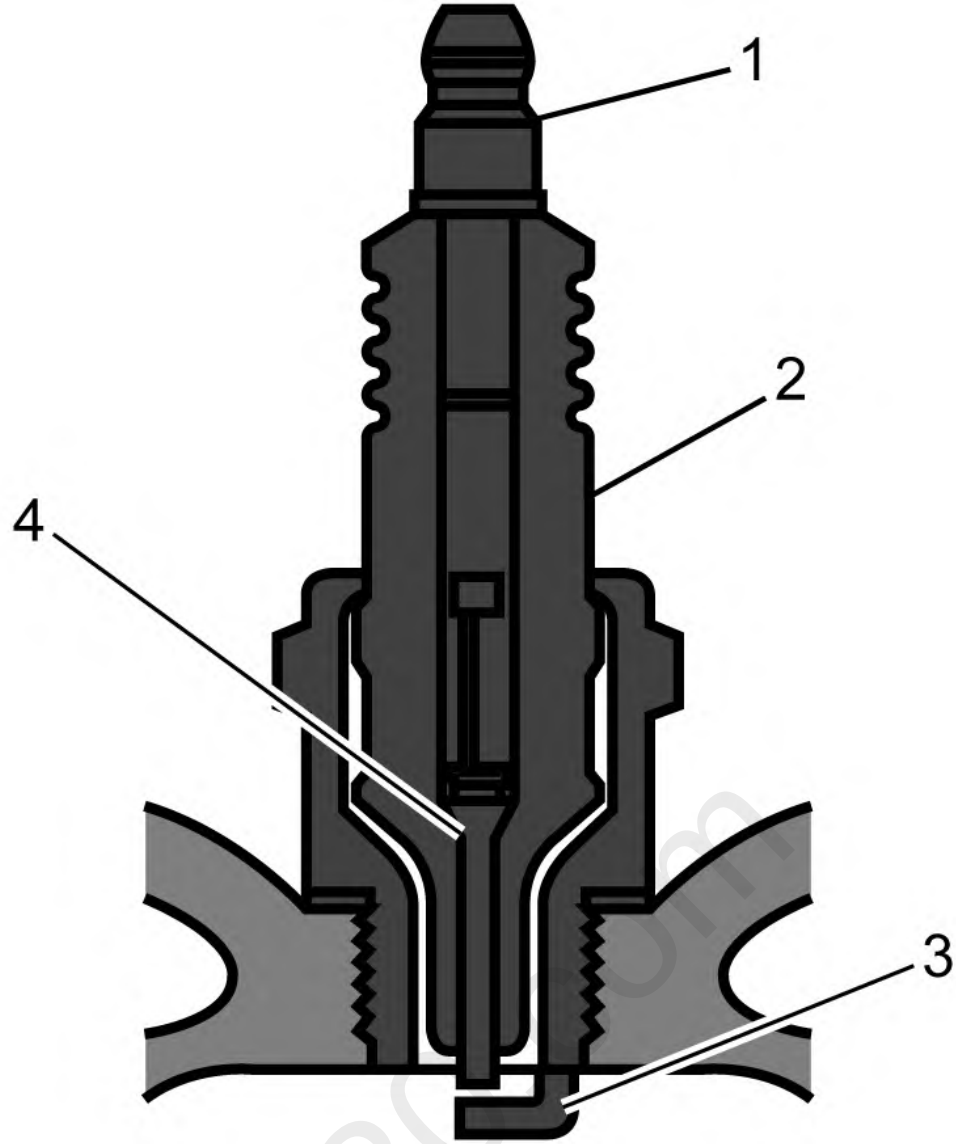


Fig. 96: Cross Sectional View Of Spark Plug
Courtesy of GENERAL MOTORS COMPANY

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.

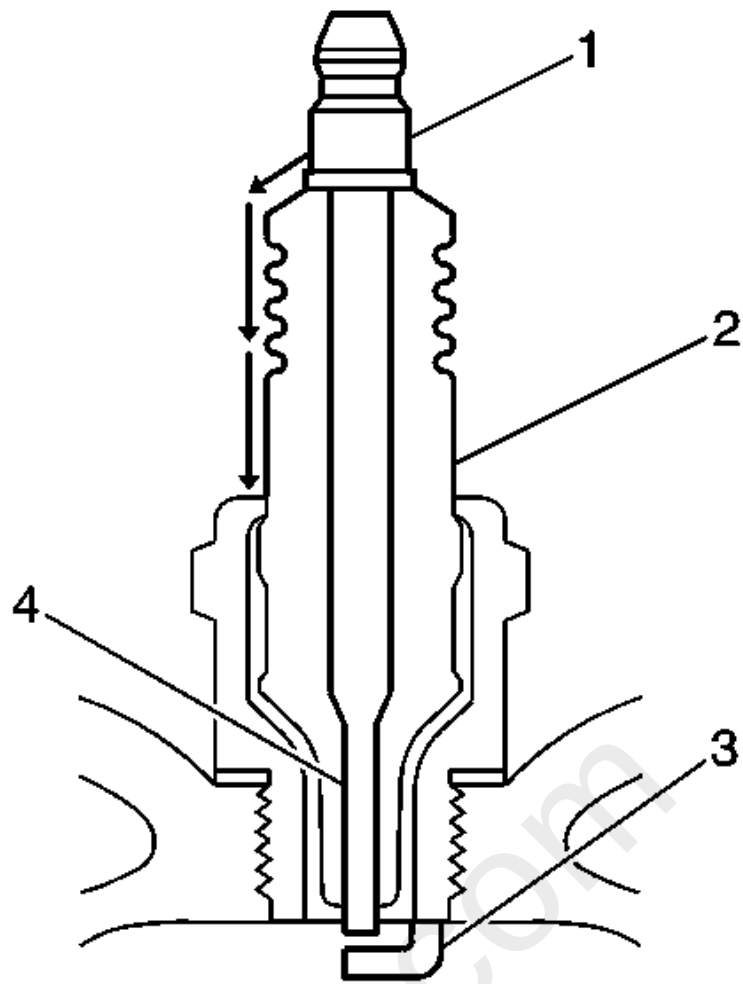


Fig. 97: Inspecting Spark Plug For Flashover Or Carbon Tracking Soot
Courtesy of GENERAL MOTORS COMPANY

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.

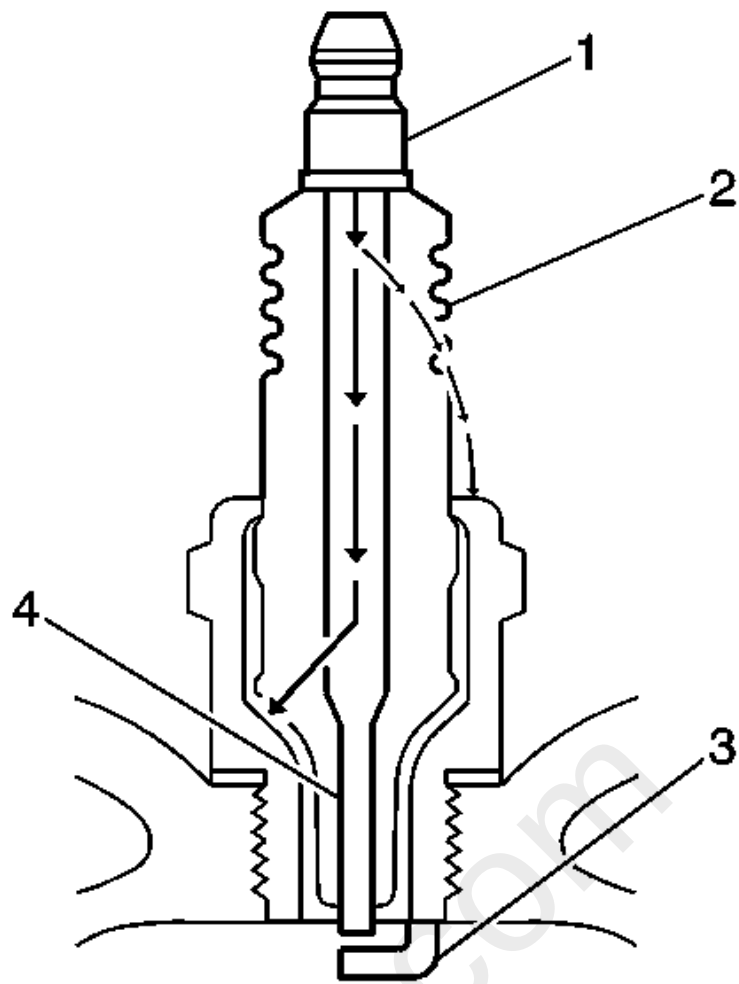


Fig. 98: Inspecting Spark Plug Insulator
Courtesy of GENERAL MOTORS COMPANY

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).

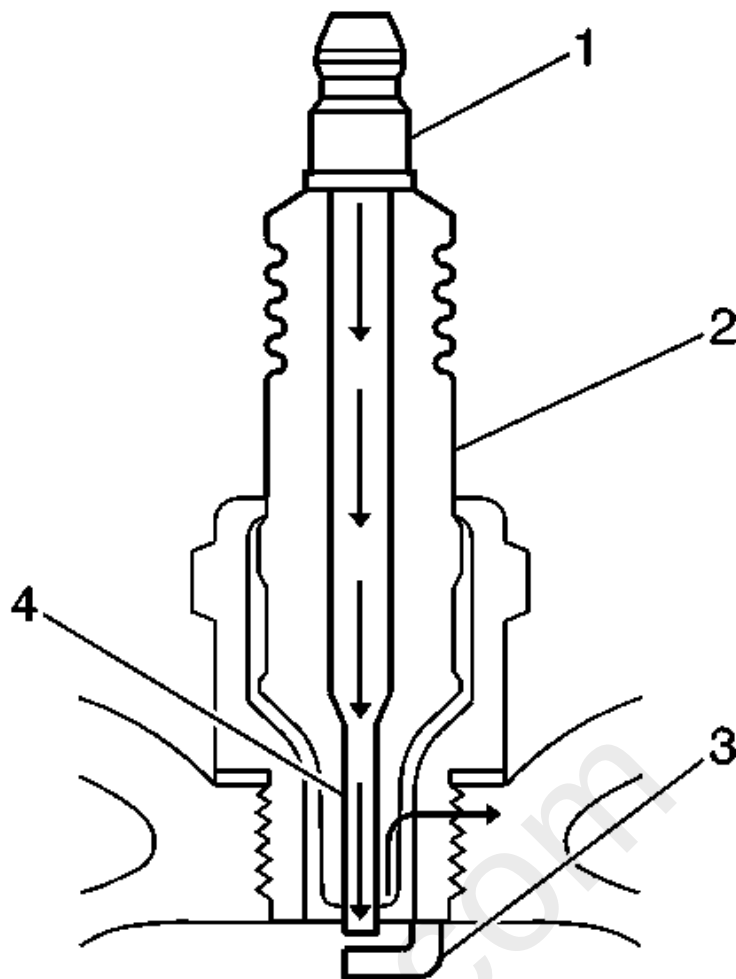


Fig. 99: Cutaway/Description View Of Spark Plug
Courtesy of GENERAL MOTORS COMPANY

4. Inspect for evidence of improper arcing.
 - Measure the gap between the center electrode (4) and the side electrode (3) terminals. 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

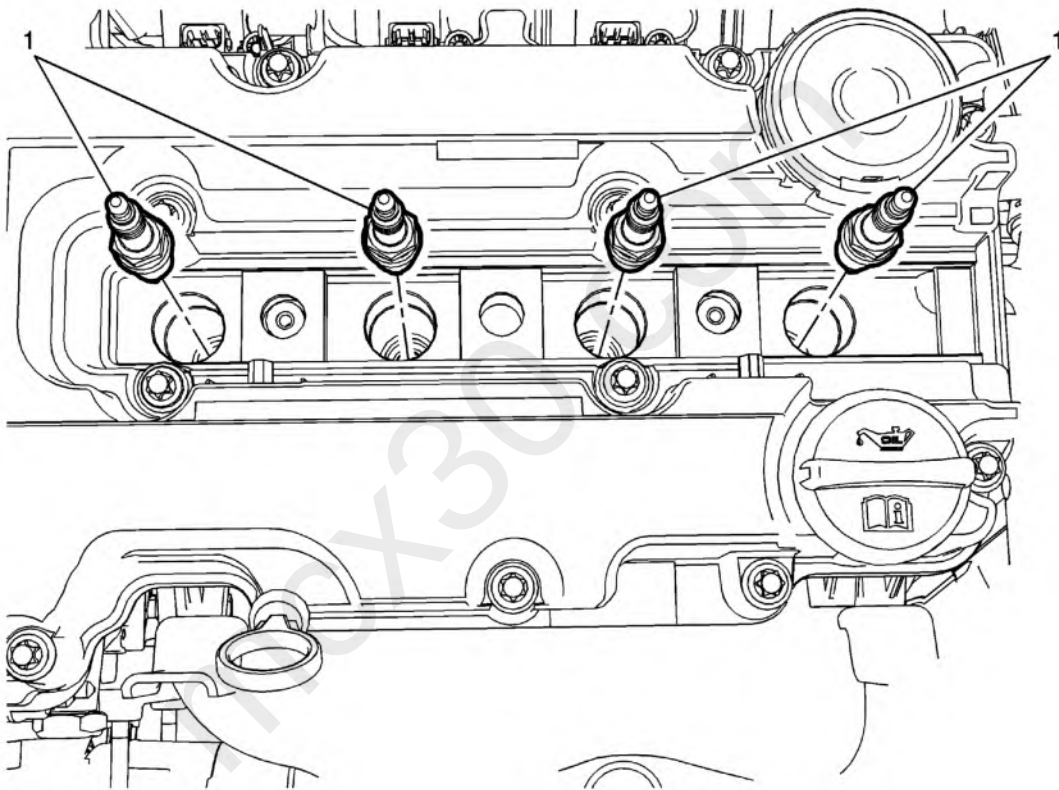


Fig. 100: Spark Plugs

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the ignition coil. Refer to Ignition Coil Replacement .	
1	Spark Plugs CAUTION: Refer to Component Fastener Tightening Caution . Tighten 25 N.m (18 lb ft)

CAMSHAFT POSITION ACTUATOR SOLENOID VALVE REPLACEMENT

Removal Procedure

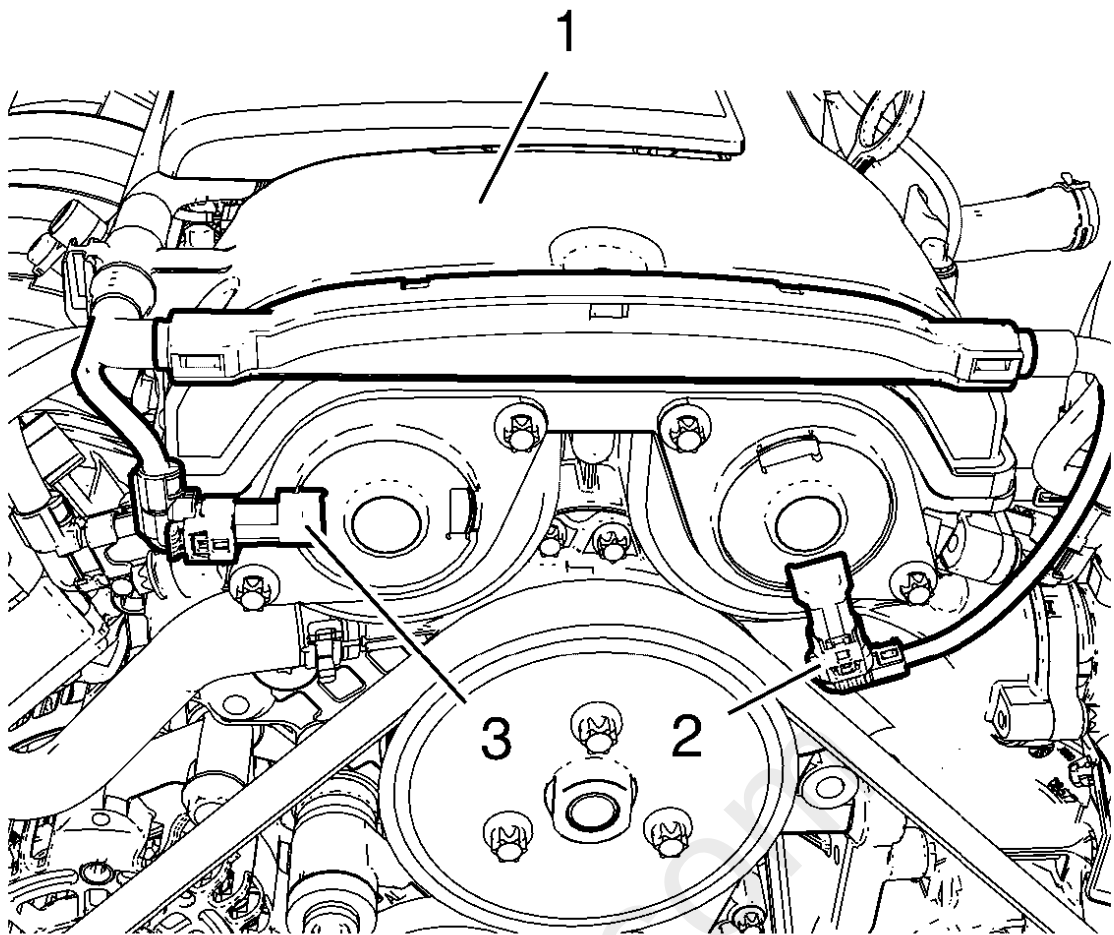


Fig. 101: ECM Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

1. Disconnect the intake camshaft position actuator solenoid valve wiring harness plug (3).
2. Disconnect the exhaust camshaft position actuator solenoid valve wiring harness plug (2).
3. Unclip ECM wiring harness (1) from camshaft cover.

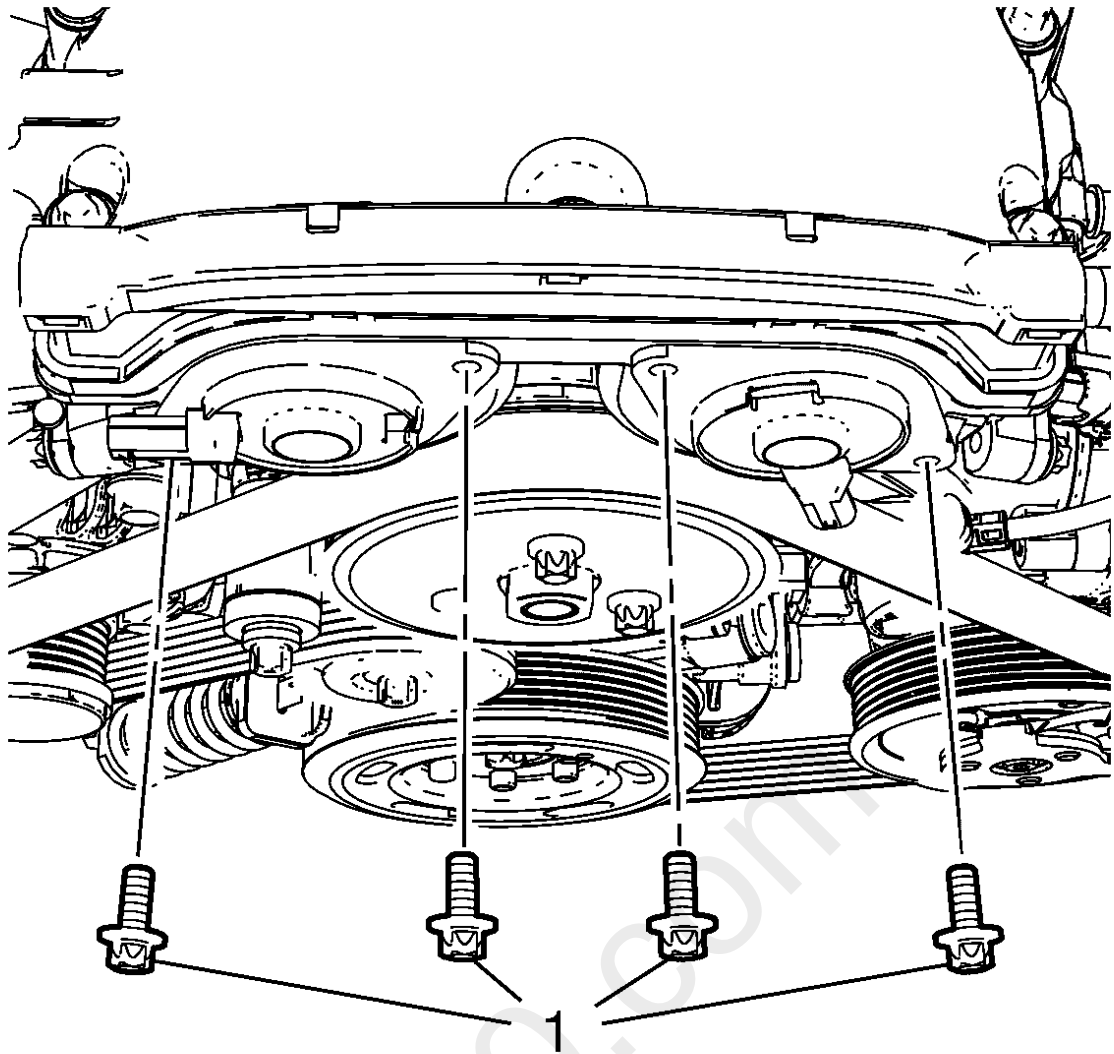


Fig. 102: Camshaft Position Actuator Solenoid Valve Bolts
Courtesy of GENERAL MOTORS COMPANY

4. Remove the 4 camshaft position actuator solenoid valve bolts (1).

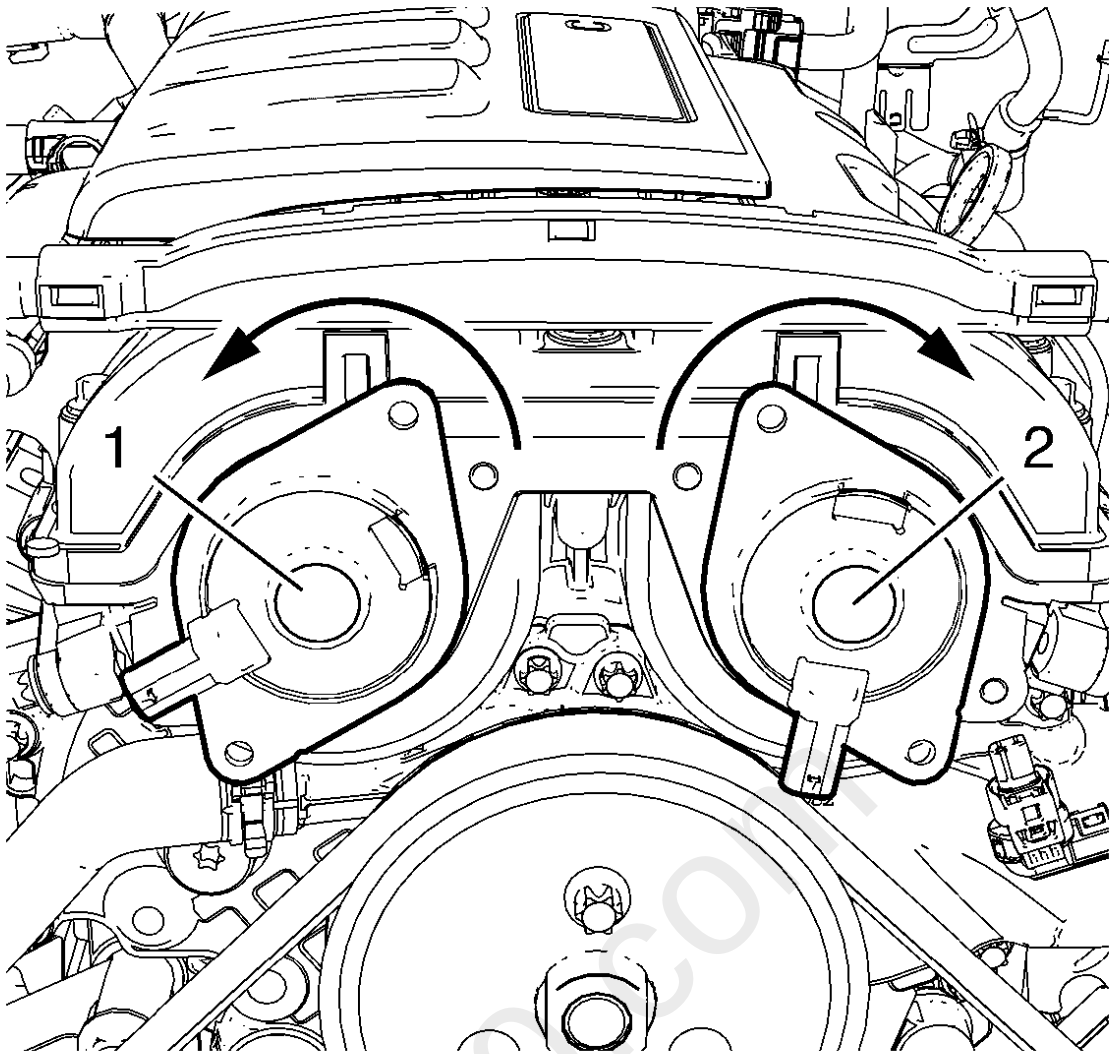


Fig. 103: Intake Camshaft Position Actuator Solenoid Valve And Exhaust Camshaft Position Actuator Solenoid Valve

Courtesy of GENERAL MOTORS COMPANY

5. Carefully rotate the intake camshaft position actuator solenoid valve (1) counter clockwise as shown.
6. Carefully rotate the exhaust camshaft position actuator solenoid valve (2) clockwise as shown.

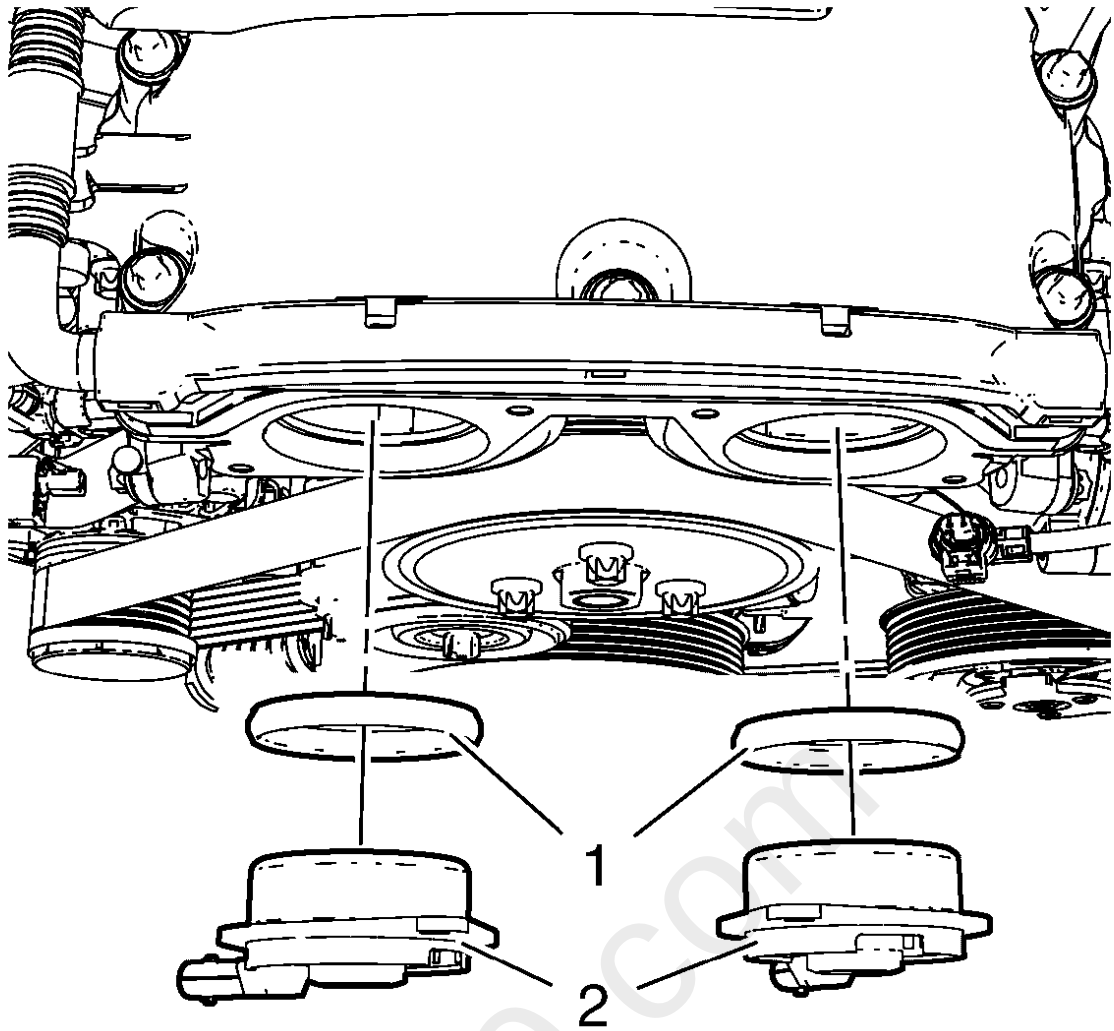


Fig. 104: Camshaft Position Actuator Solenoid Valves

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The camshaft position actuator solenoid valves must be kept parallel to the engine front cover during removal and installation. The camshaft position actuator solenoid valves can be damaged if they become wedged or stuck during this process.

7. Carefully remove the 2 camshaft position actuator solenoid valves (2) and the seal rings (1).

Installation Procedure

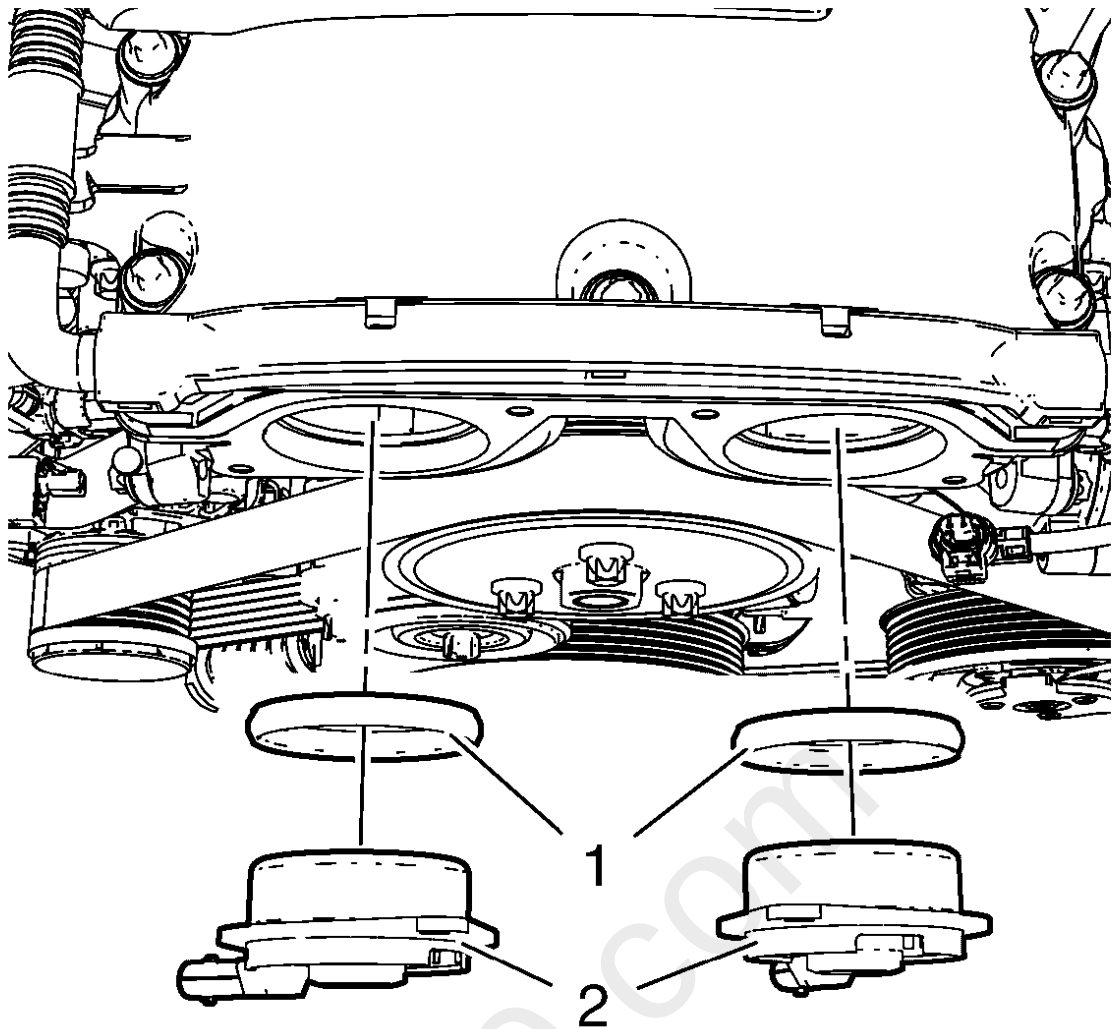


Fig. 105: Camshaft Position Actuator Solenoid Valves

Courtesy of GENERAL MOTORS COMPANY

CAUTION: The camshaft position actuator solenoid valves must be kept parallel to the engine front cover during removal and installation. The camshaft position actuator solenoid valves can be damaged if they become wedged or stuck during this process.

NOTE: Lubricate the seal rings with oil in order to make the installation easier.

1. Carefully install the 2 camshaft position actuator solenoid valves (2) and the 2 seal rings (1) by gently pressing into position.

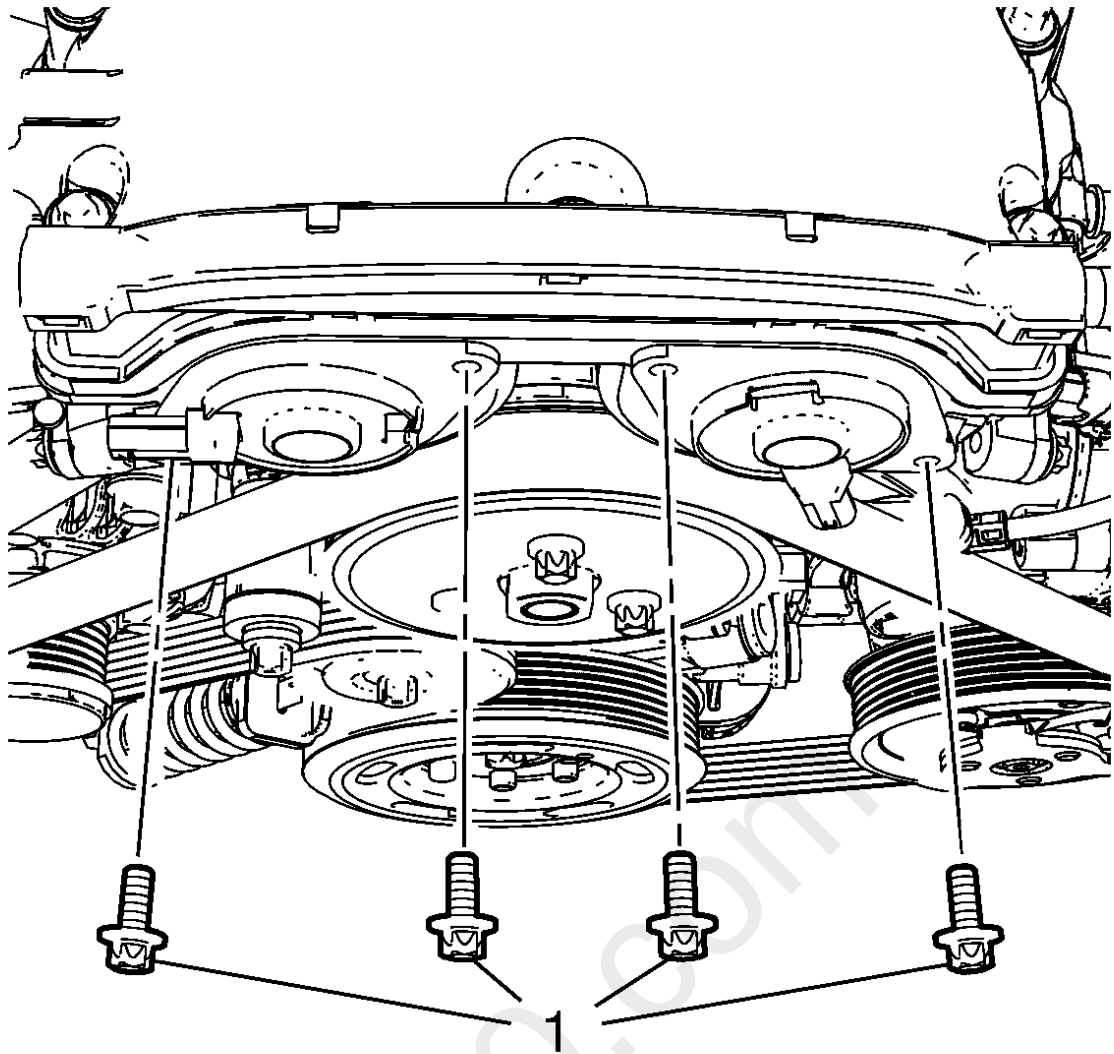


Fig. 106: Camshaft Position Actuator Solenoid Valve Bolts

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to **Fastener Caution** .

2. Install the 4 camshaft position actuator solenoid valve bolts (1) and tighten to 8 N.m (71 lb in).

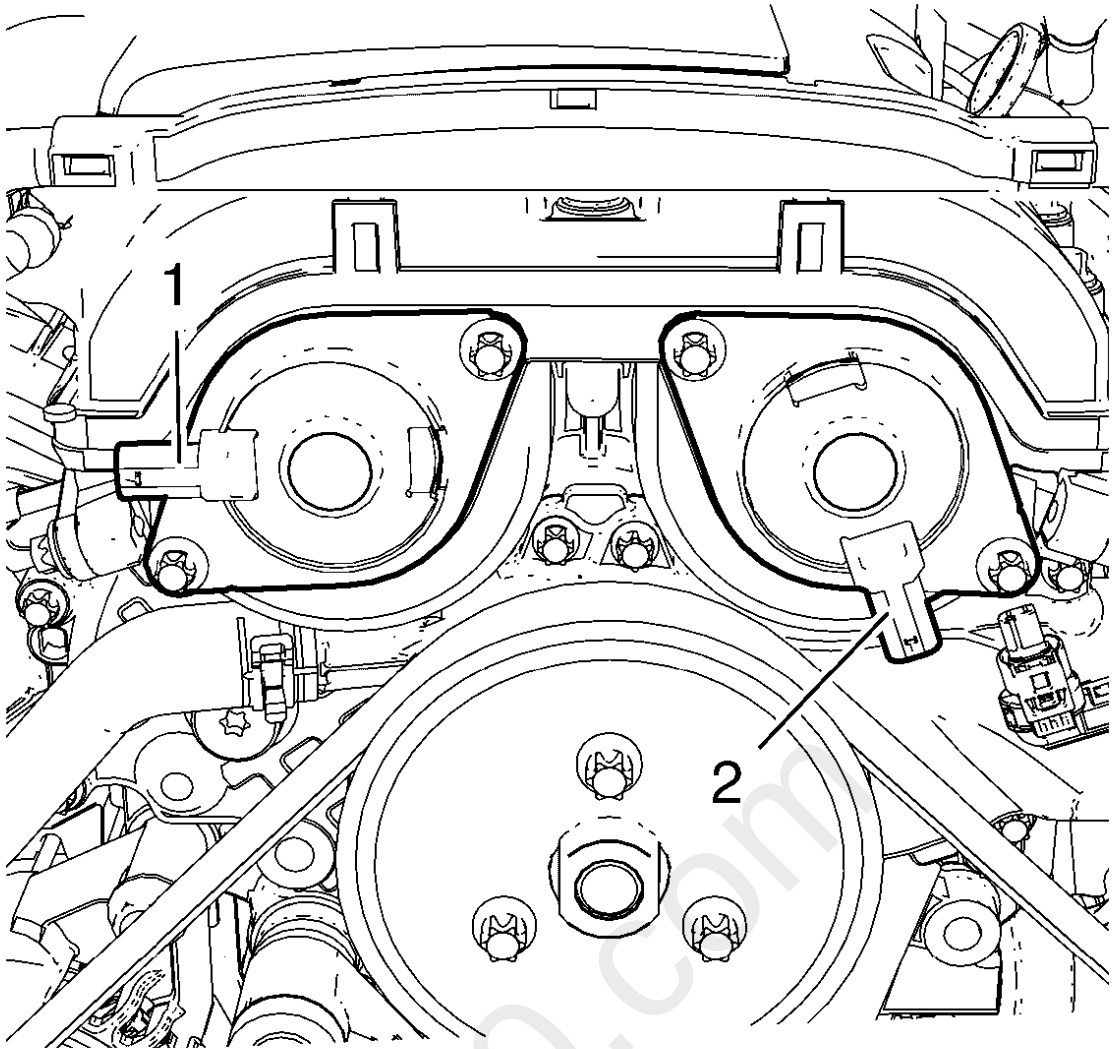


Fig. 107: Camshaft Position Actuator Solenoid Valves Proper Position

Courtesy of GENERAL MOTORS COMPANY

3. The 2 camshaft position actuator solenoid valves should be installed in the position as shown (1) and (2).

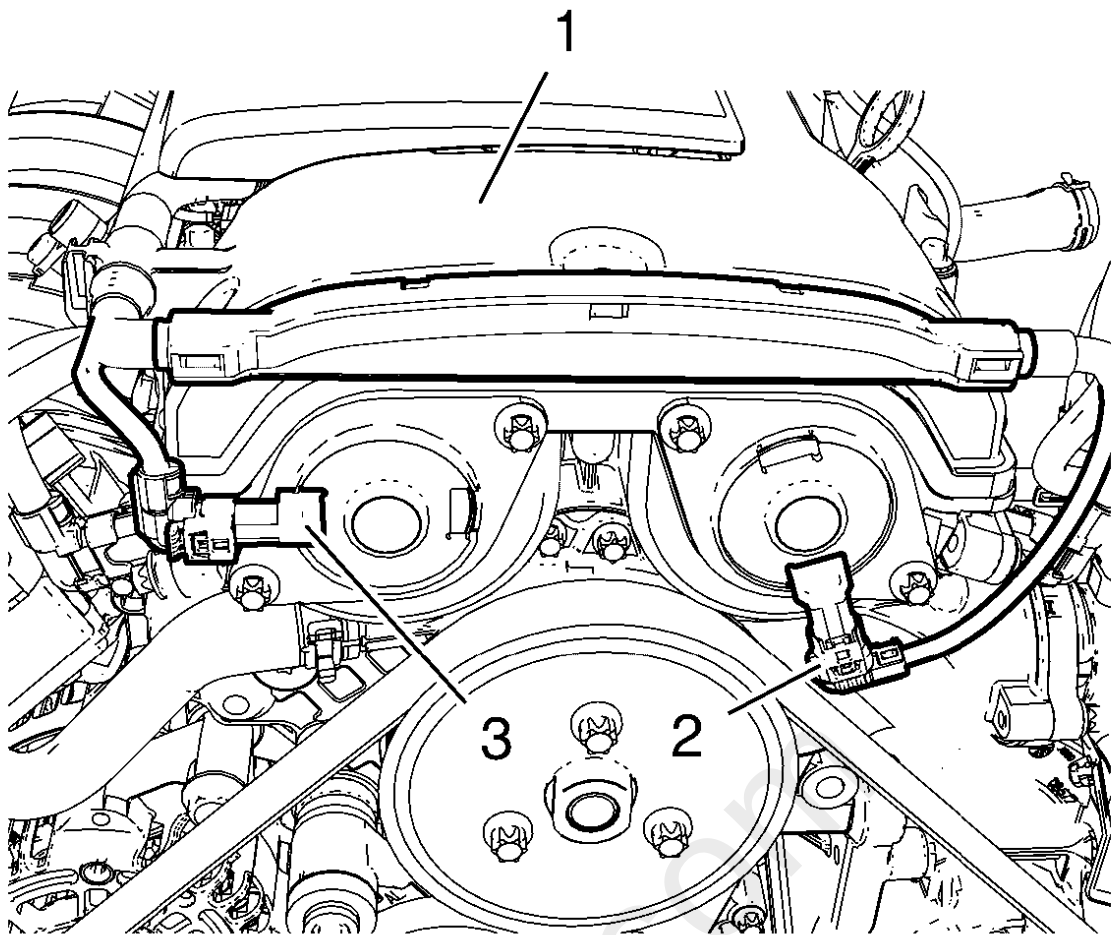


Fig. 108: ECM Wiring Harness

Courtesy of GENERAL MOTORS COMPANY

4. Clip ECM wiring harness (1) to camshaft cover.
5. Connect the exhaust camshaft position actuator solenoid valve wiring harness plug (2).
6. Connect the intake camshaft position actuator solenoid valve wiring harness plug (3).

CRANKSHAFT POSITION SENSOR REPLACEMENT

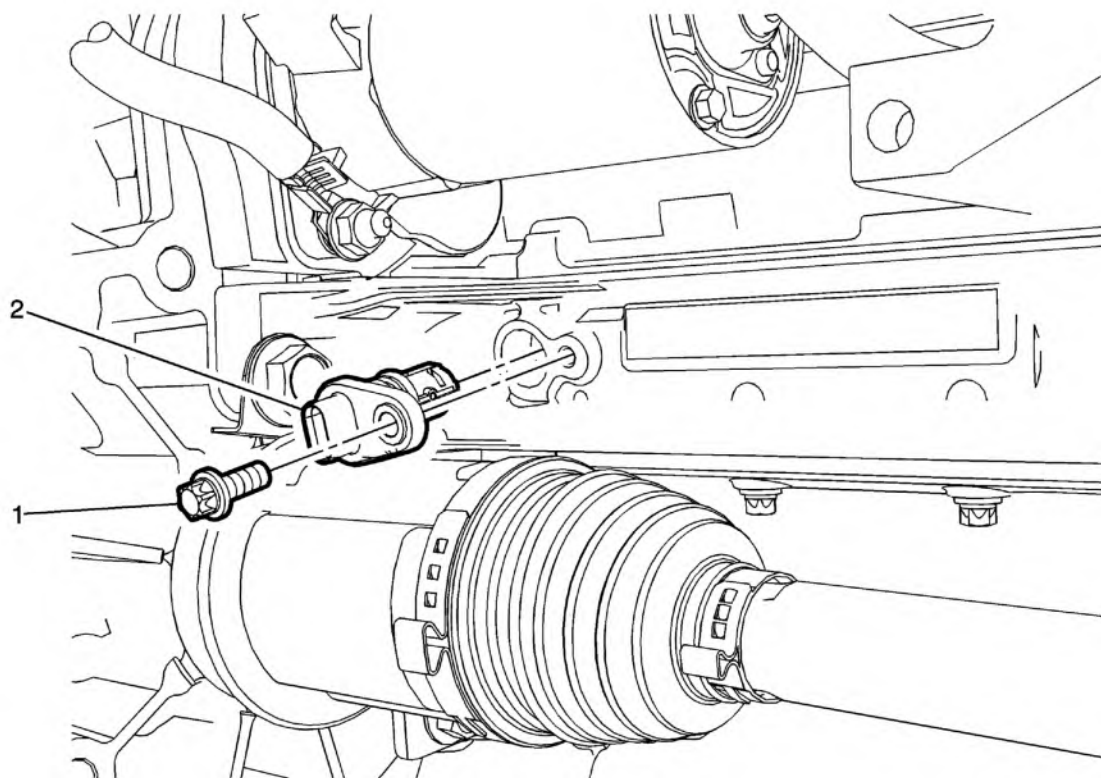


Fig. 109: Crankshaft Position Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the splash shield cover. 3. Remove the transfer case, if equipped. Refer to Transfer Case Replacement .	
1	Crankshaft Position Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 8 N.m (71 lb in)
2	Crankshaft Position Sensor Procedure 1. Disconnect the electrical wiring harness connector from the crankshaft position sensor. 2. After replacement of the crankshaft position sensor, use a scan tool to speed up the learn process. Refer to Crankshaft Position Variation Learn.

CAMSHAFT POSITION SENSOR REPLACEMENT

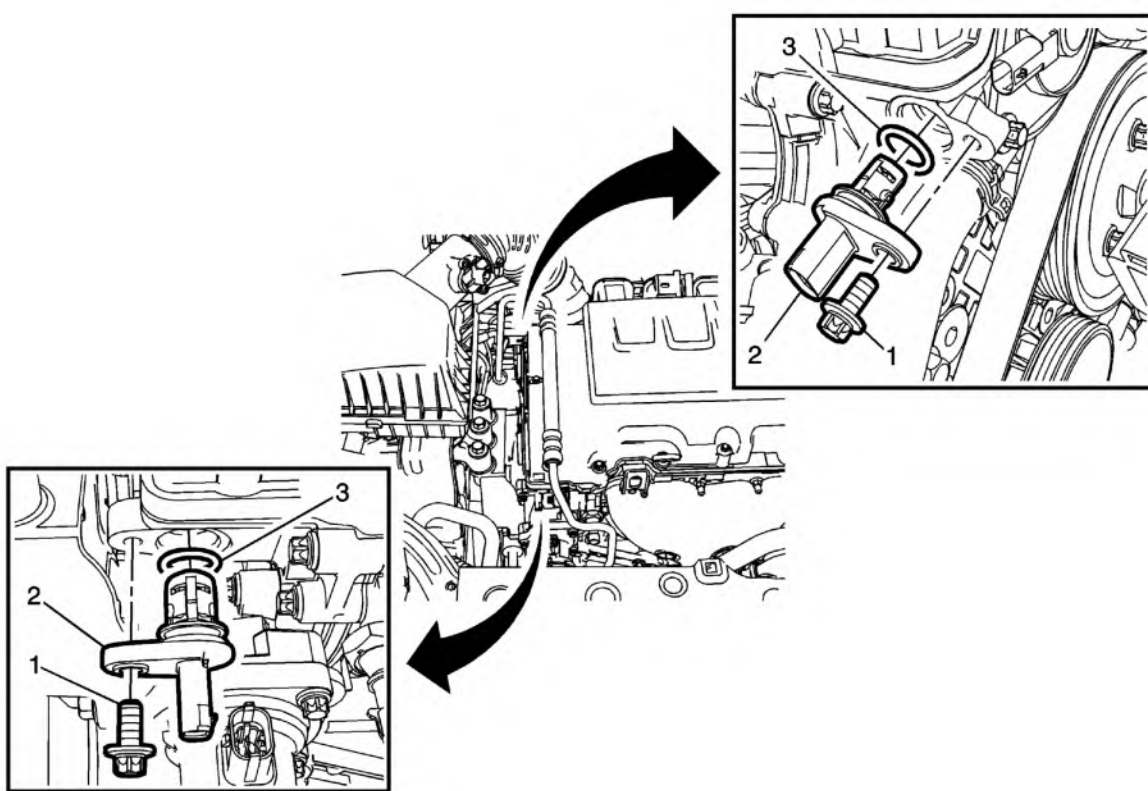


Fig. 110: Camshaft Position Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement .	
1	Camshaft Position Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 6 N.m (53 lb in)
2	Camshaft Position Sensor Procedure Disconnect the electrical wiring harness connector from the camshaft position sensor.
3	Camshaft Position Sensor Seal

KNOCK SENSOR REPLACEMENT (FWD, WITHOUT BTM)

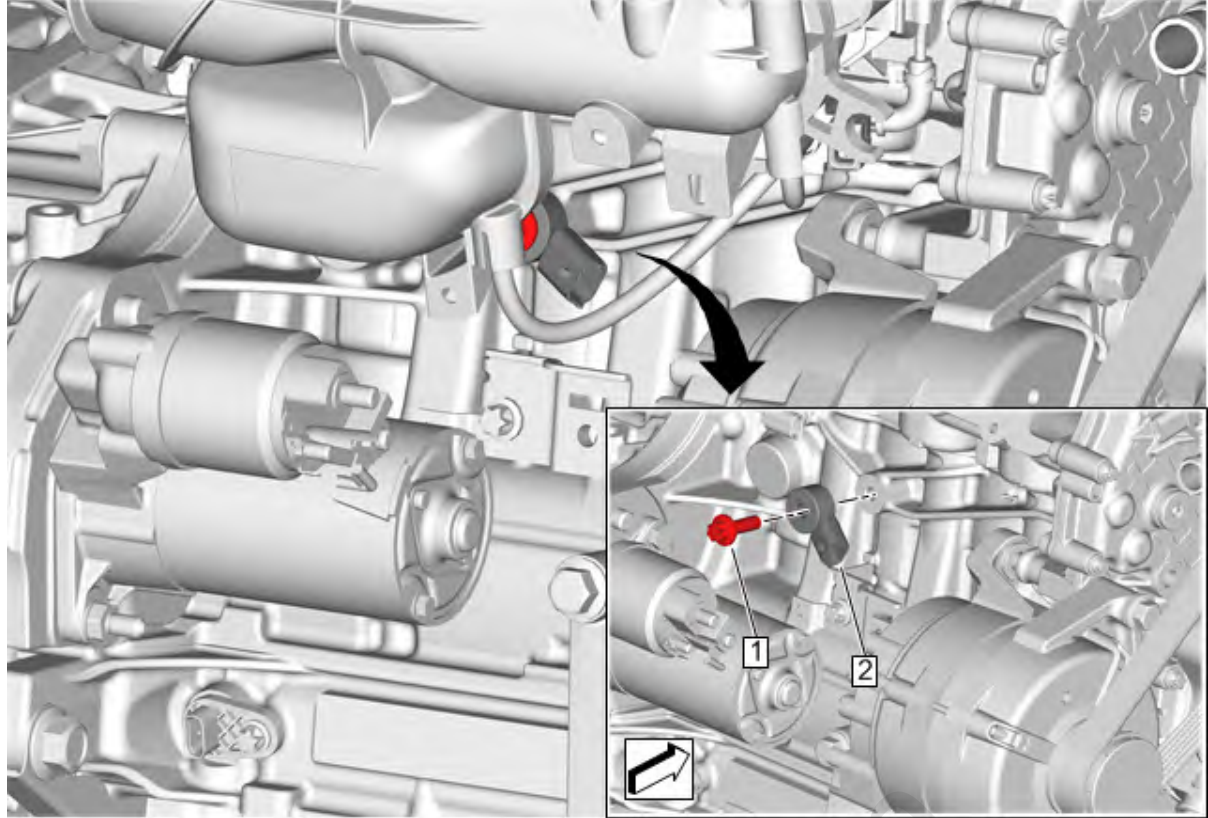


Fig. 111: Knock Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Exhaust Front Pipe Replacement (LUV)</u> - Disconnect the electrical connector.	
1	Knock Sensor Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 20 N.m (15 lb ft)
2	Knock Sensor

KNOCK SENSOR REPLACEMENT (FWD, WITH BTM)

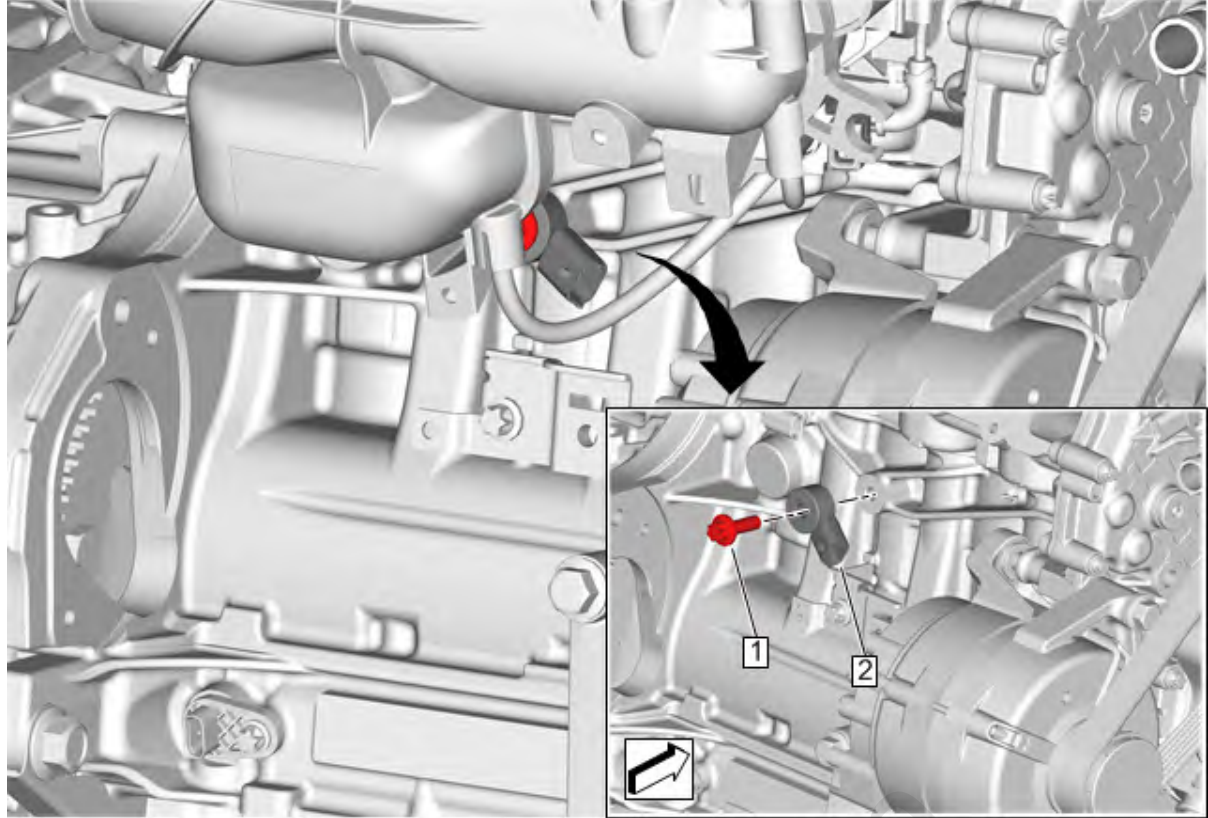


Fig. 112: Knock Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Exhaust Front Pipe Replacement (LUV).</u> <u>Starter Replacement (LUV).</u> - Disconnect the electrical connector.	
1	Knock Sensor Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 20 N.m (15 lb ft)
2	Knock Sensor

KNOCK SENSOR REPLACEMENT (AWD)

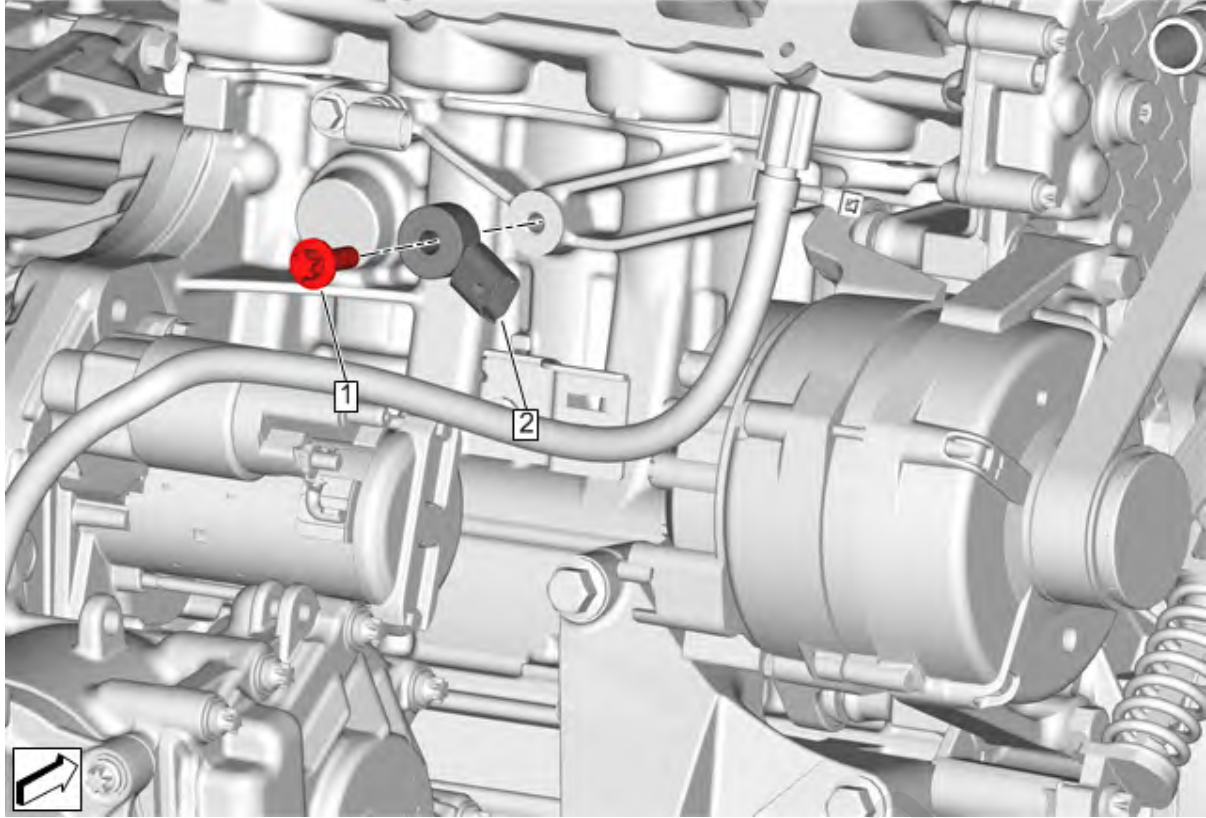


Fig. 113: Knock Sensor

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures Intake Manifold Replacement - Disconnect the electrical connector.	
1	Knock Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 20 N.m (15 lb ft)
2	Knock Sensor

AIR CLEANER INLET DUCT REPLACEMENT

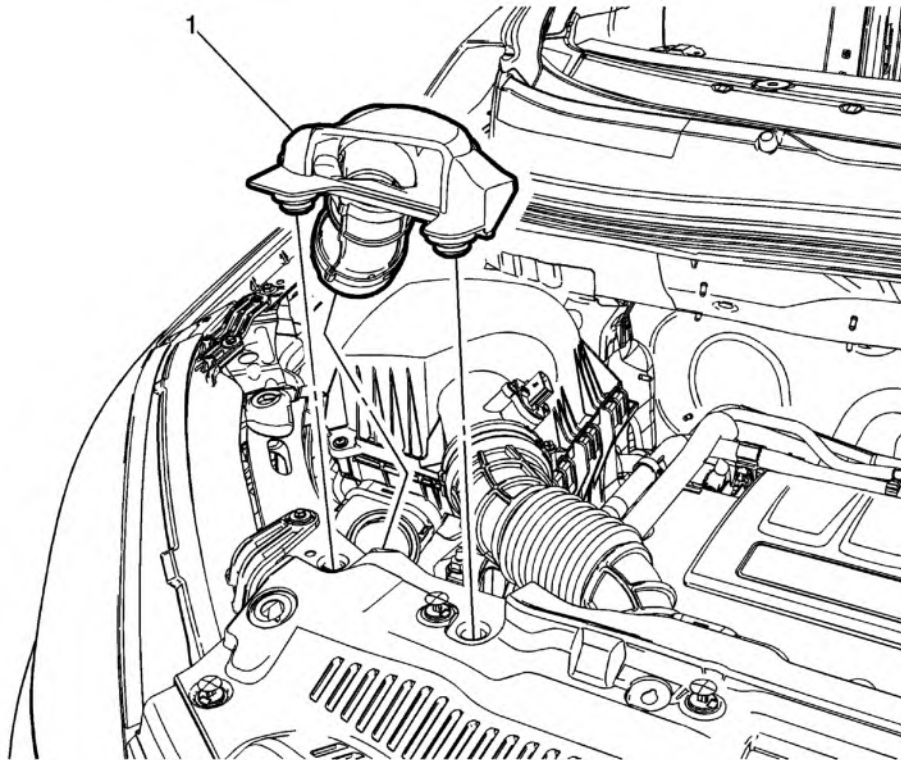


Fig. 114: Air Cleaner Inlet Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
1	Air Cleaner Inlet Duct Procedure Remove the air cleaner inlet duct by pulling upward to release the inlet duct from the rubber grommets and the air cleaner assembly.

AIR CLEANER OUTLET DUCT REPLACEMENT

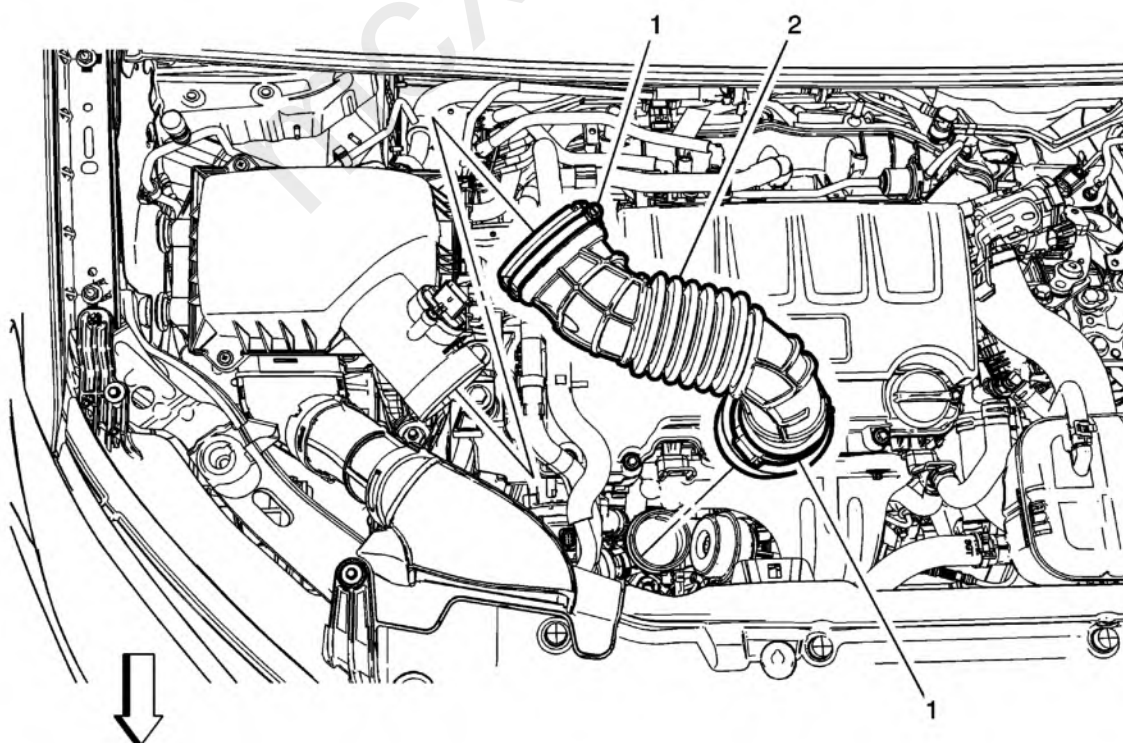


Fig. 115: Air Cleaner Outlet Duct

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
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Callout	Component Name
1	Air Cleaner Outlet Duct Clamps (Qty 2) CAUTION: Refer to Fastener Caution . NOTE: Ensure the outlet duct is fully seated to the mating surfaces before clamping. Verify that the cuff is not rolled under.
2	Air Cleaner Outlet Duct

AIR CLEANER ELEMENT REPLACEMENT

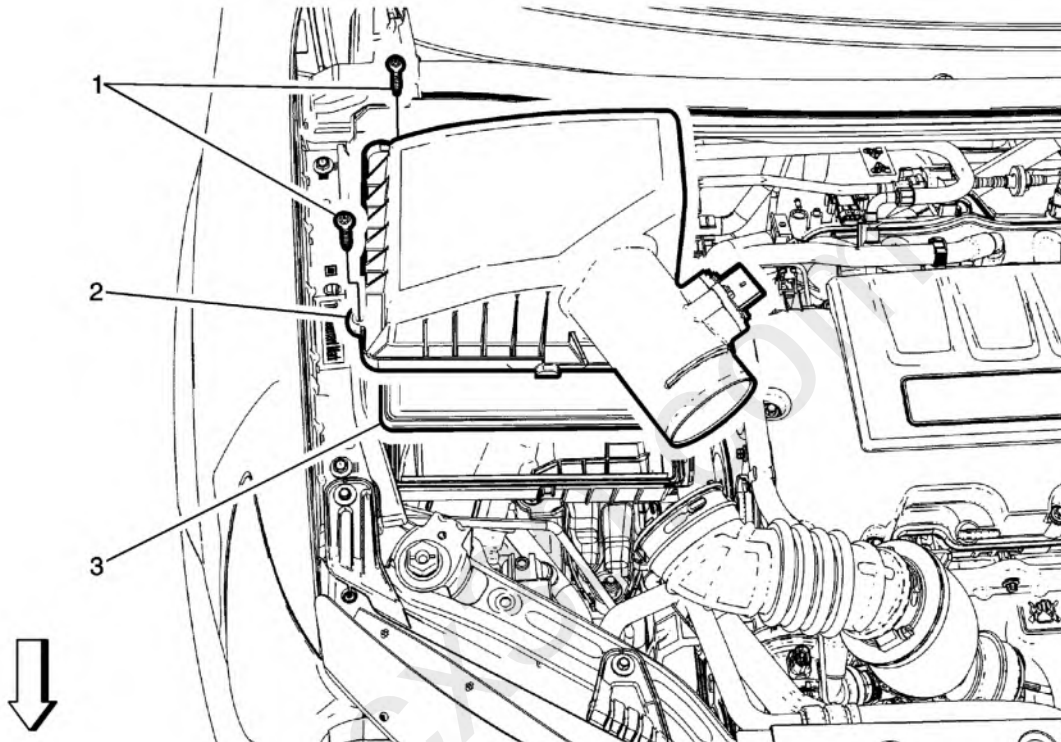


Fig. 116: Air Cleaner Element

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the mass airflow sensor electrical connector. 2. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement .	
1	Air Cleaner Housing Fasteners (Qty: 2)
2	Air Cleaner Housing
3	Air Cleaner Element

AIR CLEANER ASSEMBLY REPLACEMENT

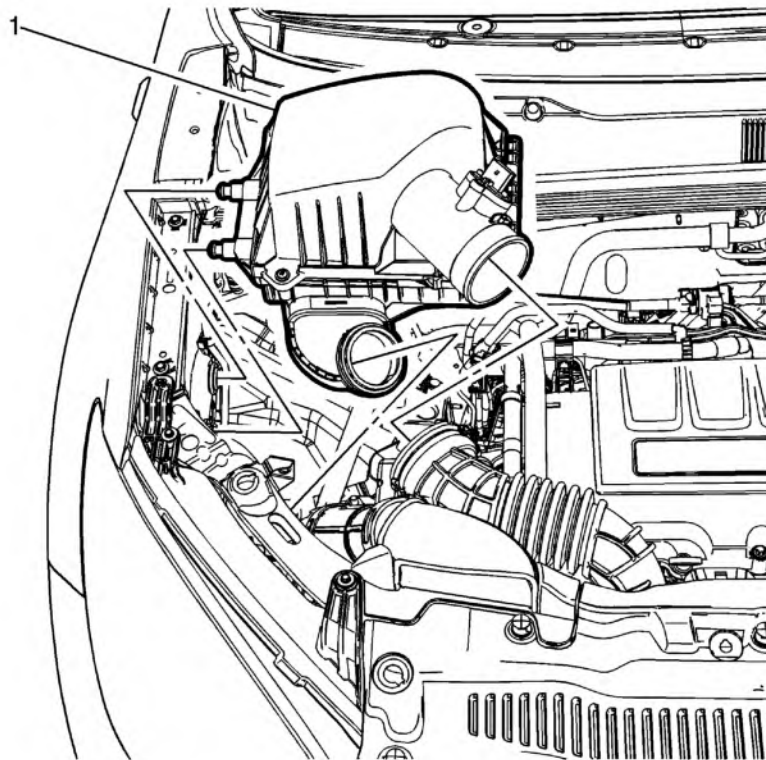


Fig. 117: Air Cleaner Assembly

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures 1. Disconnect the mass airflow sensor electrical connector. 2. Remove the air cleaner inlet duct. Refer to Air Cleaner Inlet Duct Replacement. 3. Remove the air cleaner outlet duct. Refer to Air Cleaner Outlet Duct Replacement.	
1	Air Cleaner Assembly Procedure Remove the air cleaner assembly by pulling upward to release the assembly from the lower rubber grommets and then pulling outward from the fender.

CHARGE AIR COOLER REPLACEMENT

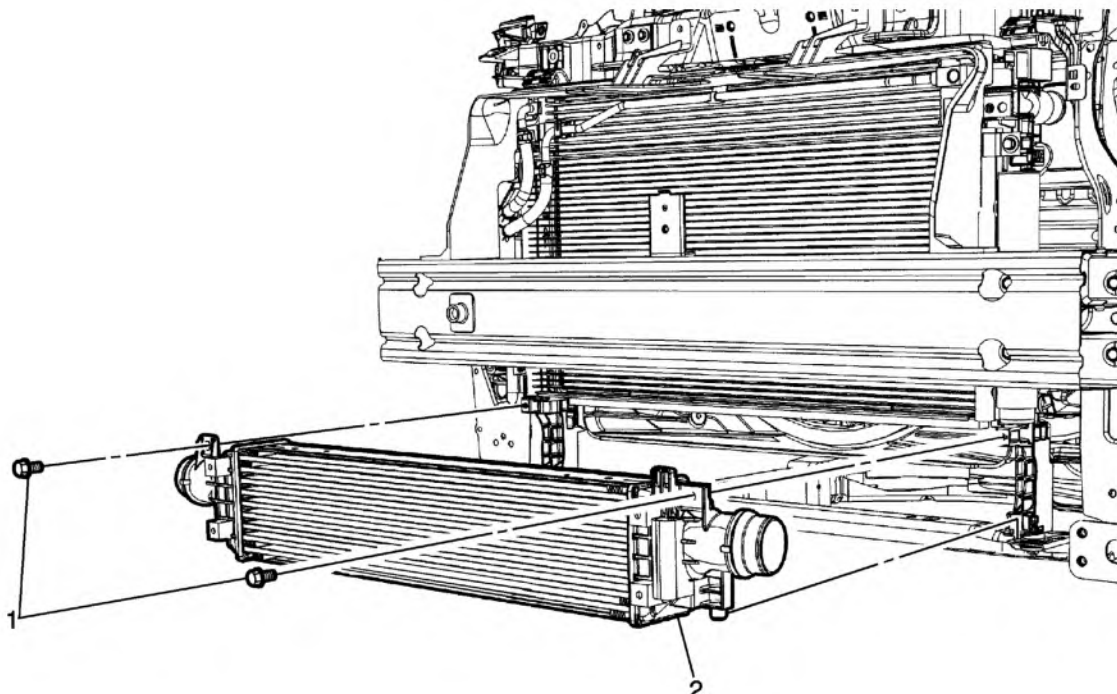


Fig. 118: Charge Air Cooler

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . 2. Remove the front fascia. Refer to Front Bumper Fascia Replacement (Chevrolet). Front Bumper Fascia Replacement (Buick) . 3. Remove the charge air cooler inlet air hose from the charge air cooler. Refer to Charge Air Cooler Inlet Air Hose Replacement. 4. Remove the charge air cooler outlet air hose from the charge air cooler. Refer to Charge Air Cooler Outlet Air Hose Replacement. 5. Remove the lower impact bar. Refer to Front Bumper Lower Impact Bar Replacement (Chevrolet) . 6. Remove the radiator air lower baffle and deflector. Refer to Radiator Air Lower Baffle and Deflector Replacement (LUV) .	
1	Charge Air Cooler Fasteners (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 10 N.m (89 lb in)
2	Charge Air Cooler

CHARGE AIR COOLER INLET AIR HOSE REPLACEMENT

Removal Procedure

1. Remove the front bumper fascia. [Front Bumper Fascia Replacement \(Chevrolet\)](#). [Front Bumper Fascia Replacement \(Buick\)](#).

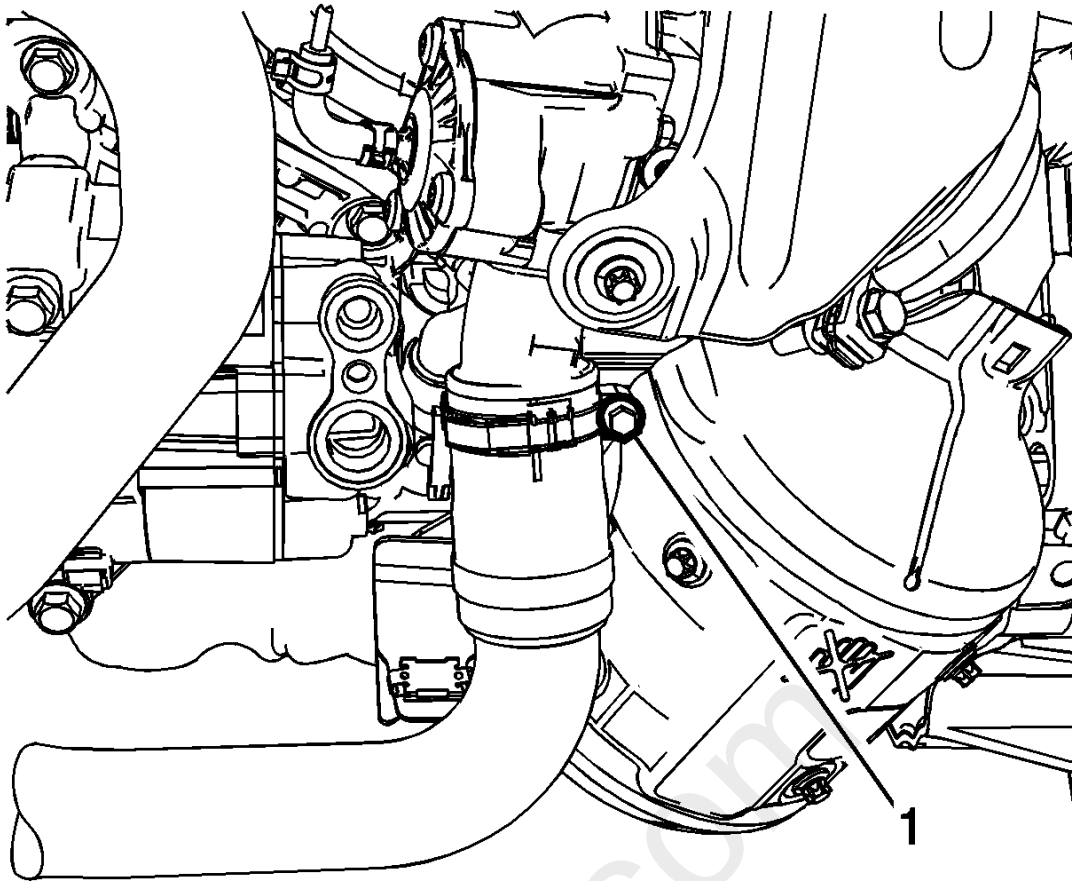


Fig. 119: Charge Air Cooler Inlet Air Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

2. Loosen the charge air cooler inlet air pipe clamp (1) at the turbocharger outlet.

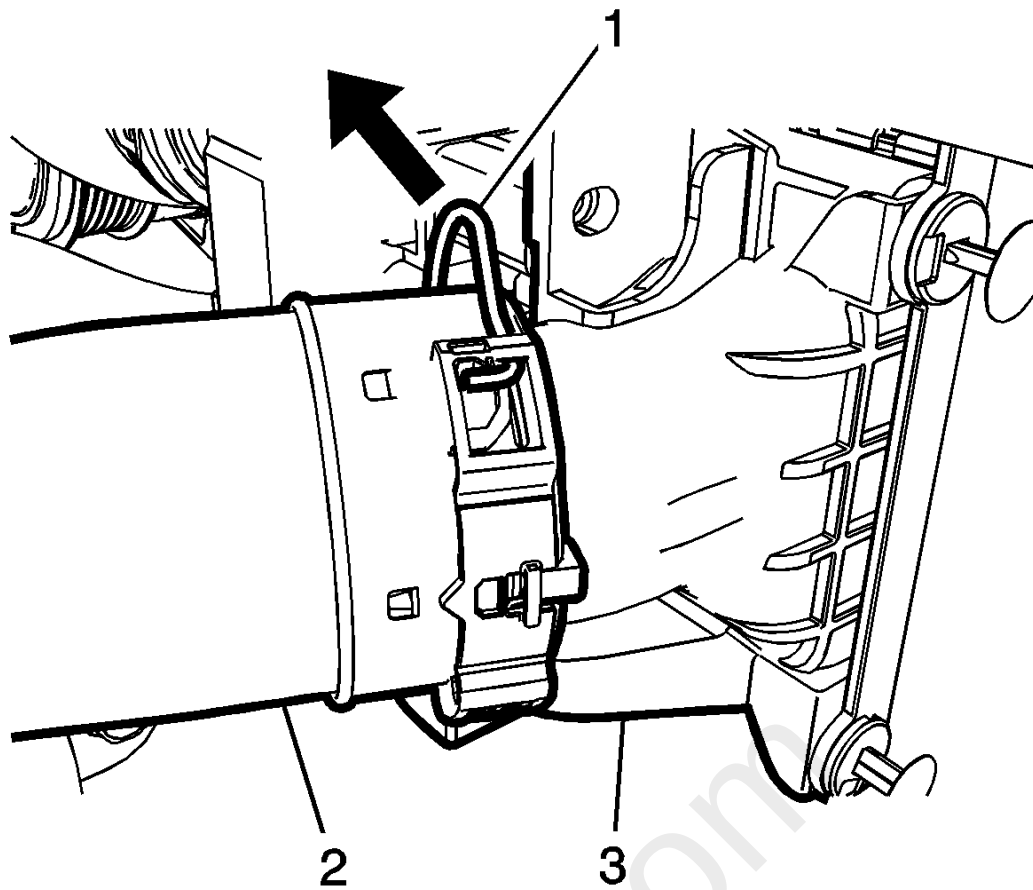


Fig. 120: Charge Air Cooler Inlet Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

3. Unclip the retainer spring (1) at the charge air cooler inlet.
4. Remove the charge air cooler inlet air hose (2) from the charge air cooler (3) and remove the hose from the vehicle.

Installation Procedure

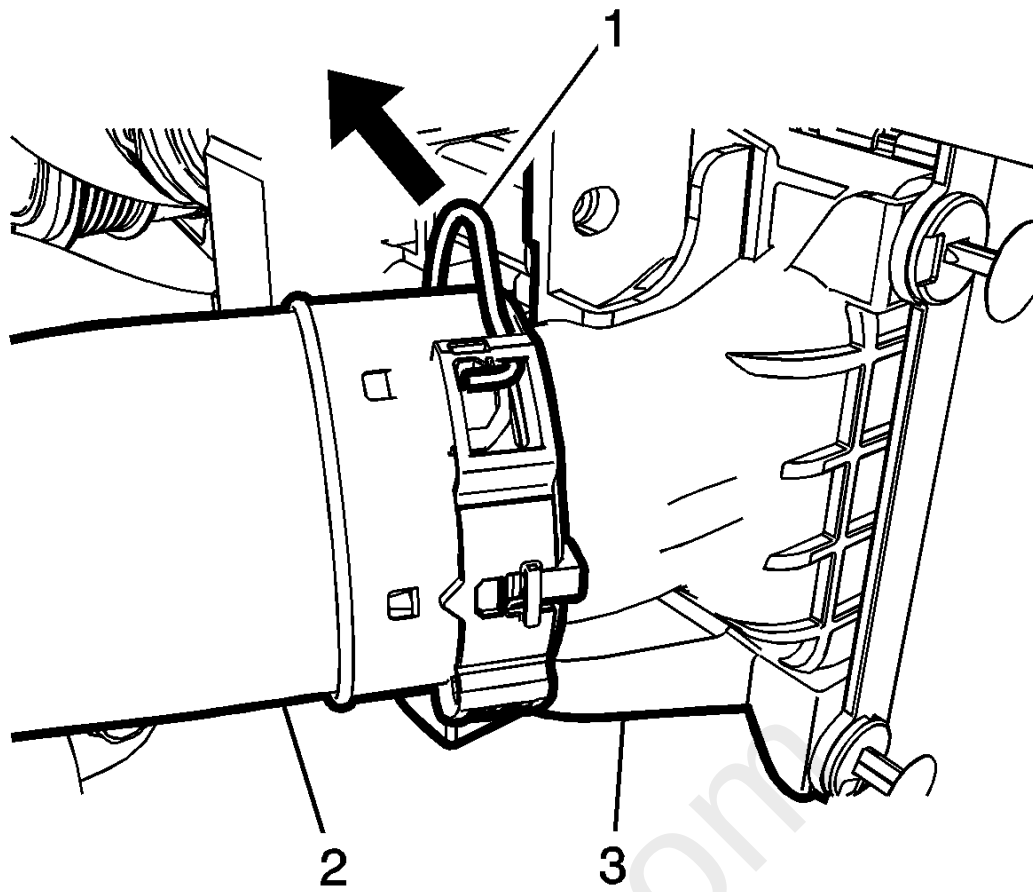


Fig. 121: Charge Air Cooler Inlet Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

1. Install the charge air cooler inlet air hose (2) to charge air cooler (3).
2. Clip the in retainer spring (1).

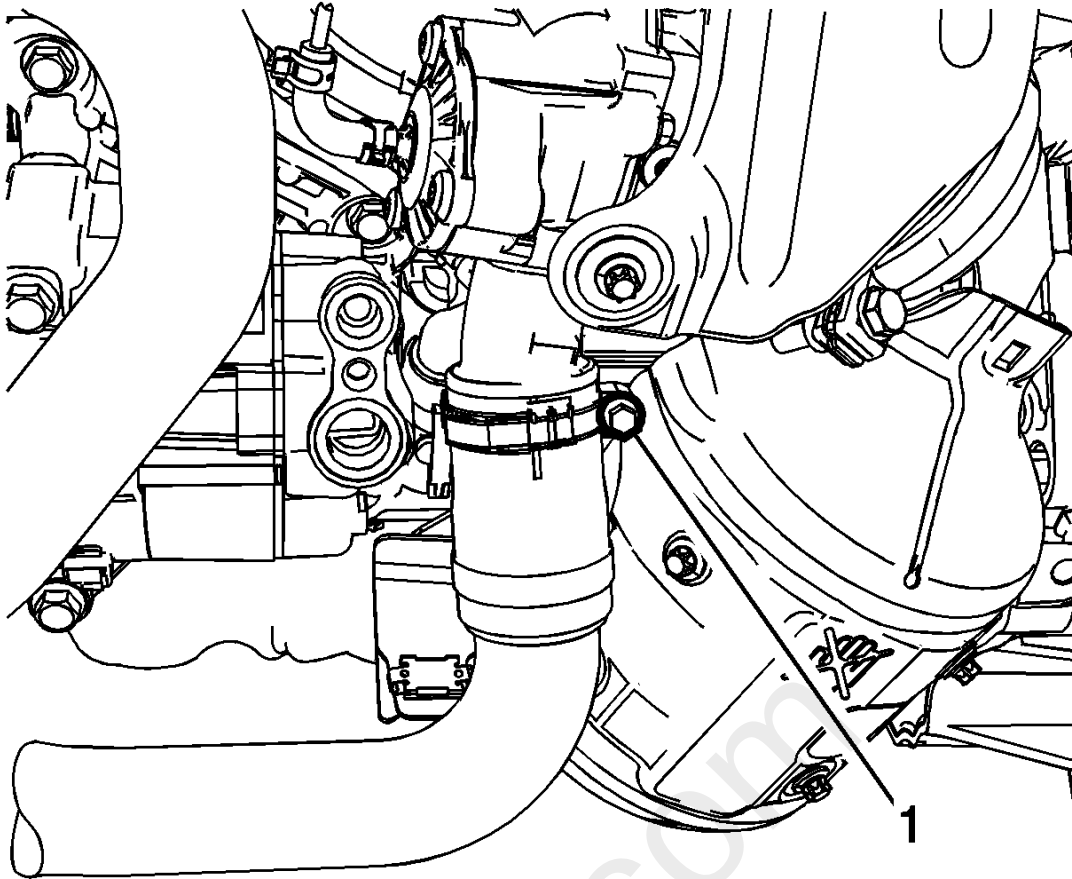


Fig. 122: Charge Air Cooler Inlet Air Hose Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Install the charge air cooler inlet air pipe to the turbocharger outlet.

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

4. Tighten the clamp (1).
5. Install the front bumper fascia. [Front Bumper Fascia Replacement \(Chevrolet\)](#) [Front Bumper Fascia Replacement \(Buick\)](#).

CHARGE AIR COOLER OUTLET AIR HOSE REPLACEMENT

Removal Procedure

1. Remove the front bumper fascia. Refer to [Front Bumper Fascia Replacement \(Chevrolet\)](#) [Front Bumper Fascia Replacement \(Buick\)](#) .
2. Disconnect the intake air pressure and temperature sensor electrical connector.

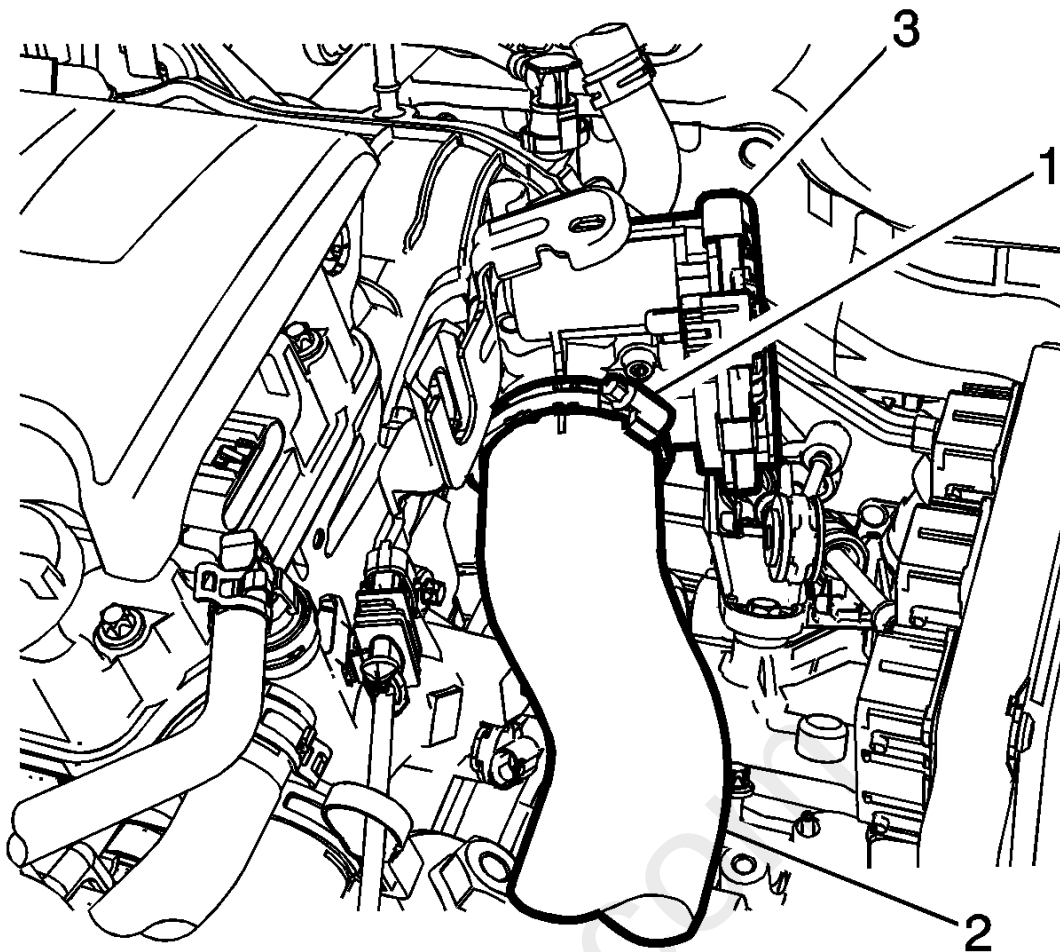


Fig. 123: Charge Air Cooler Outlet Air Hose, Throttle Body & Clamp
Courtesy of GENERAL MOTORS COMPANY

3. Loosen the clamp (1) at the charge air cooler outlet pipe (2) to throttle body (3).

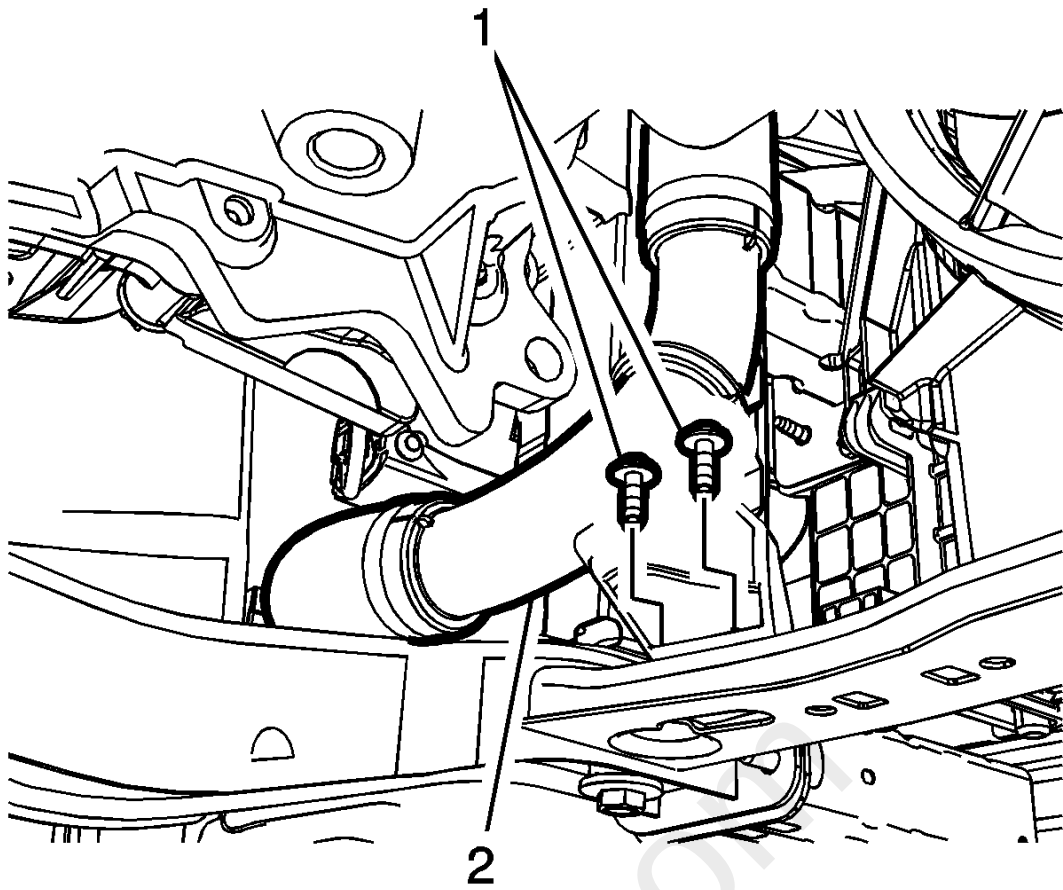


Fig. 124: Charge Air Cooler Outlet Air Pipe To Frame Bracket
Courtesy of GENERAL MOTORS COMPANY

4. Remove the fasteners (1) from the charge air cooler outlet air pipe to frame bracket (2).

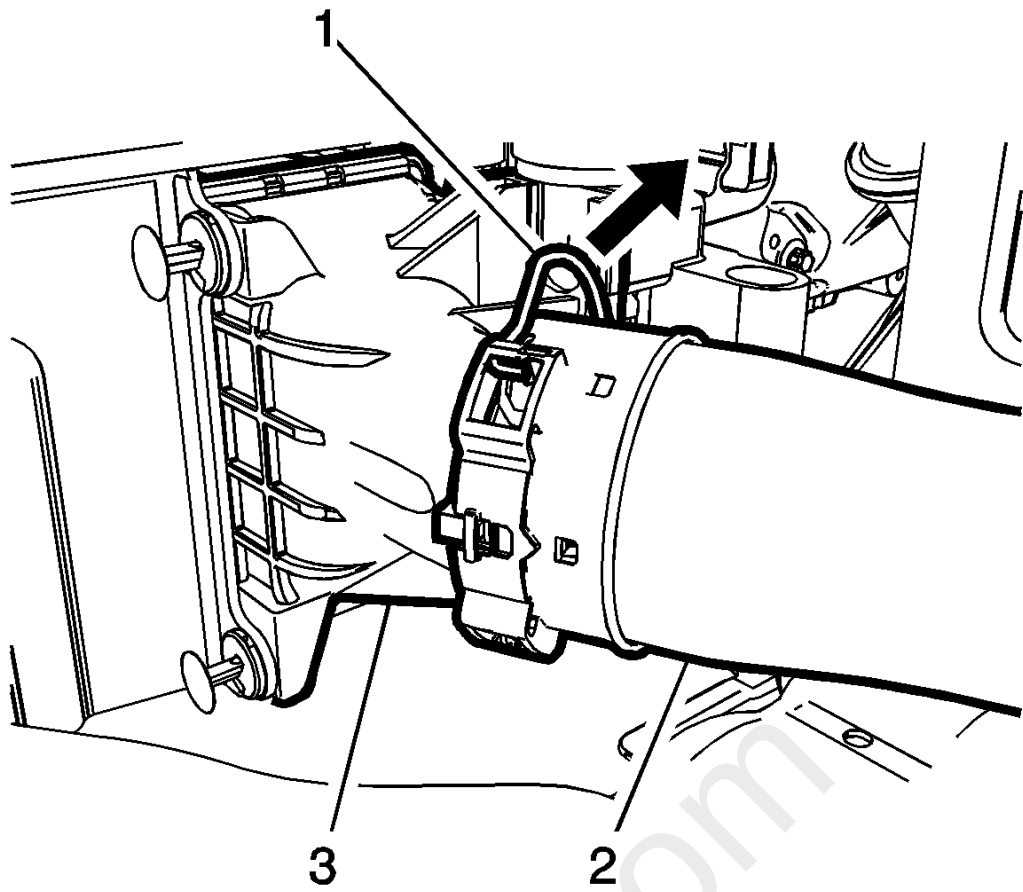


Fig. 125: Charge Air Cooler, Outlet Air Hose & Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

5. Unclip the retainer spring (1).
6. Remove the charge air cooler outlet air hose (2) from the charge air cooler (3).

Installation Procedure

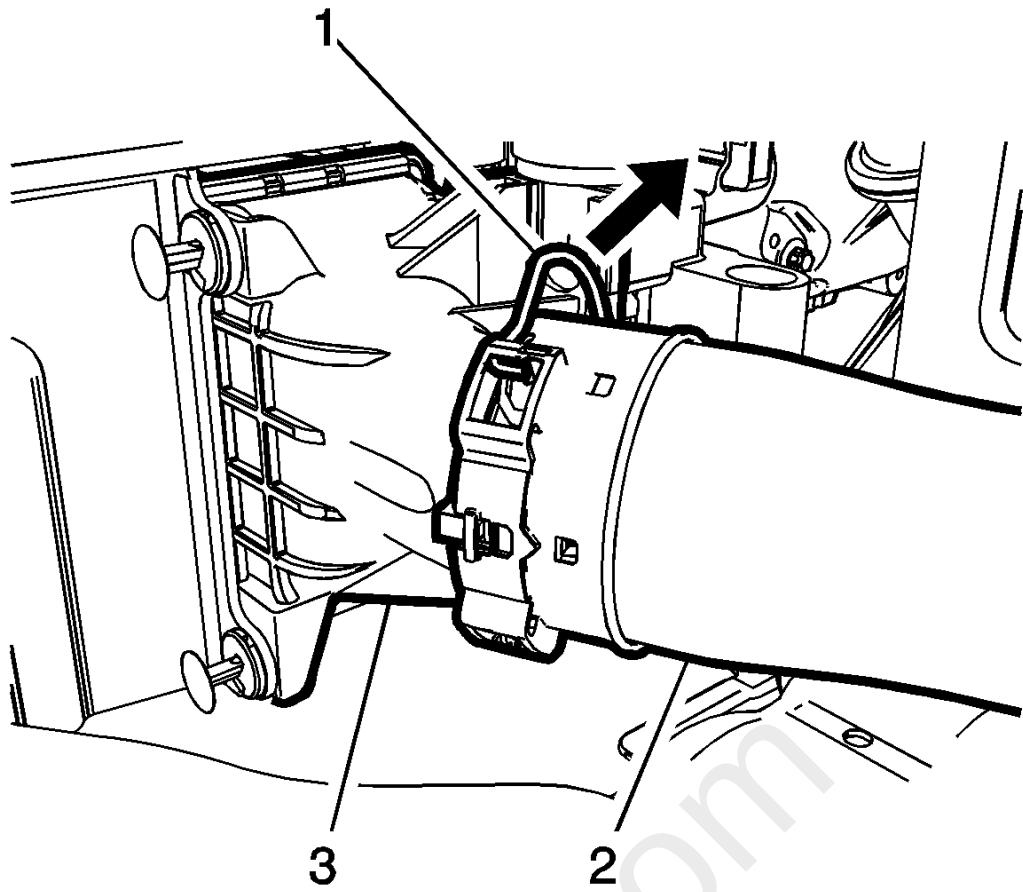


Fig. 126: Charge Air Cooler, Outlet Air Hose & Retainer Spring
Courtesy of GENERAL MOTORS COMPANY

1. Install the charge air cooler outlet air hose (2) to charge air cooler (3).
2. Clip the in retainer spring (1).

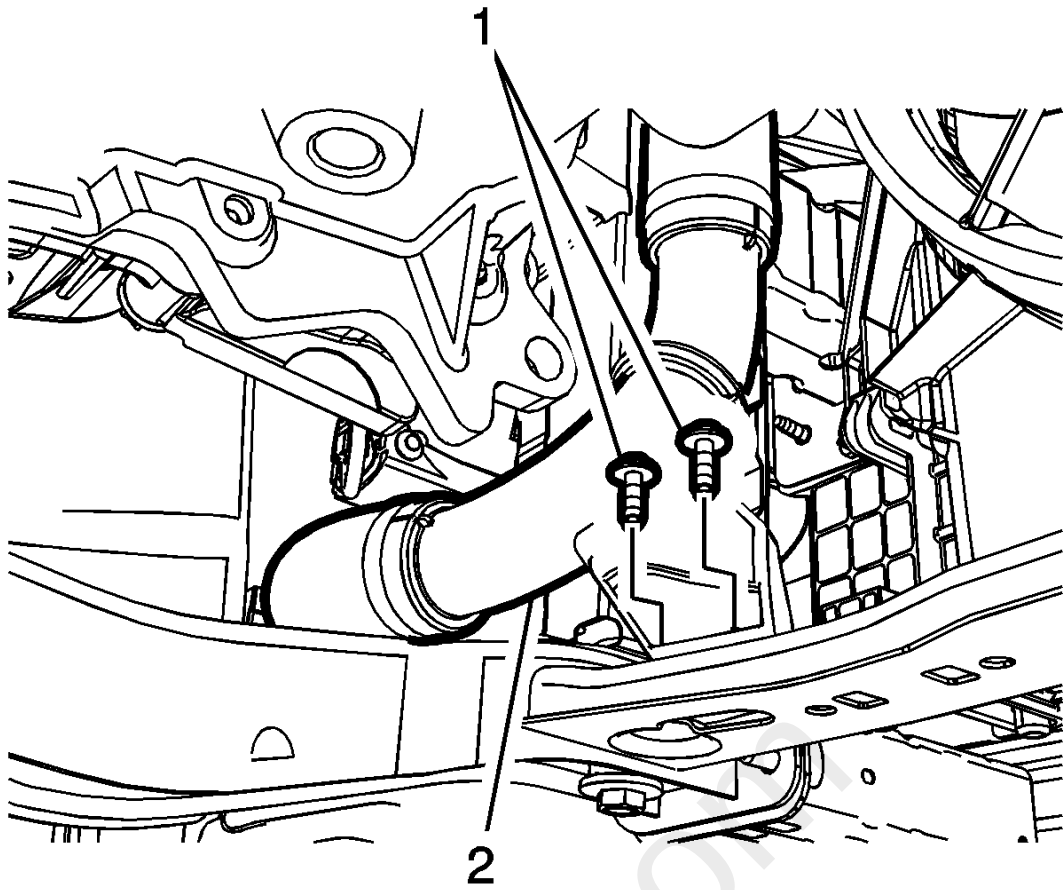


Fig. 127: Charge Air Cooler Outlet Air Pipe To Frame Bracket

Courtesy of GENERAL MOTORS COMPANY

3. Install the fasteners (1) to the charge air cooler outlet air pipe to frame bracket (2).

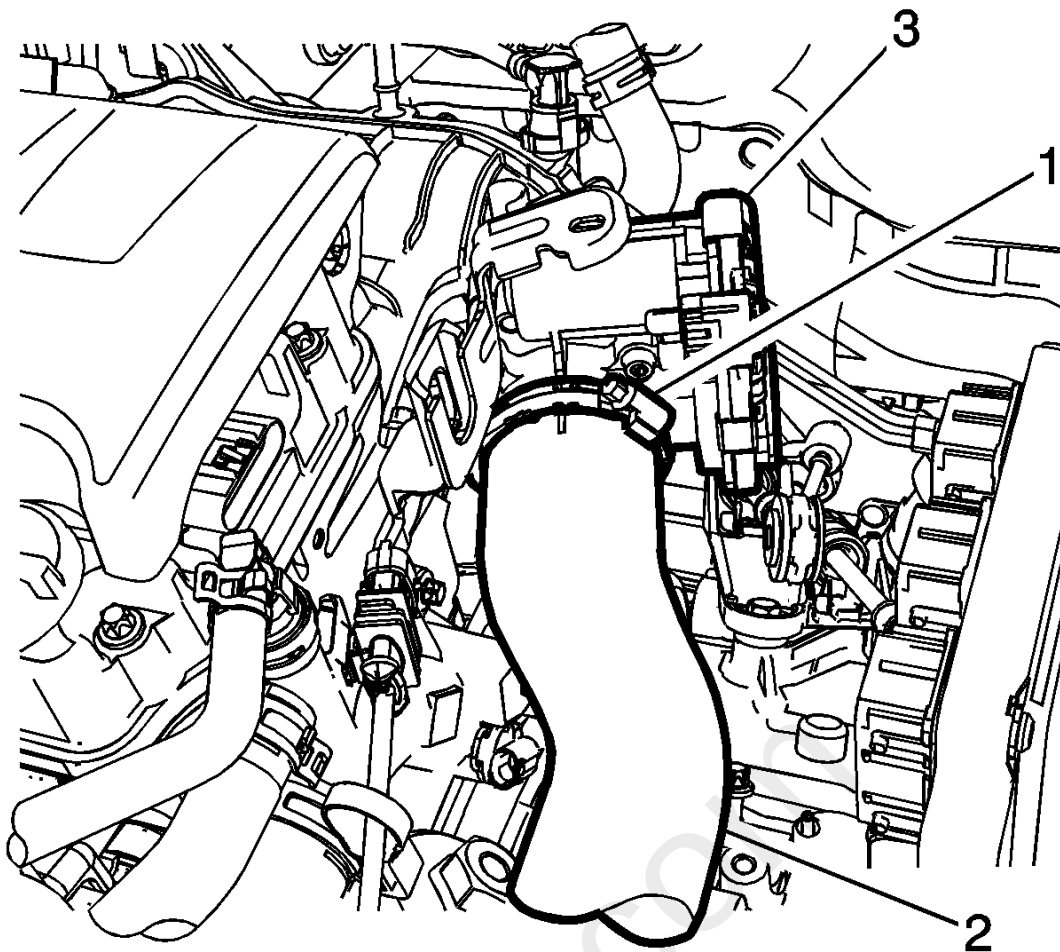


Fig. 128: Charge Air Cooler Outlet Air Hose, Throttle Body & Clamp
Courtesy of GENERAL MOTORS COMPANY

4. Install the charge air cooler inlet air pipe to the turbocharger.

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

5. Tighten the clamp (1).
6. Connect the intake air pressure and temperature sensor electrical connector.
7. Install the front bumper fascia. Refer to [Front Bumper Fascia Replacement \(Chevrolet\)](#), [Front Bumper Fascia Replacement \(Buick\)](#) .

CHARGE AIR BYPASS REGULATOR SOLENOID VALVE REPLACEMENT

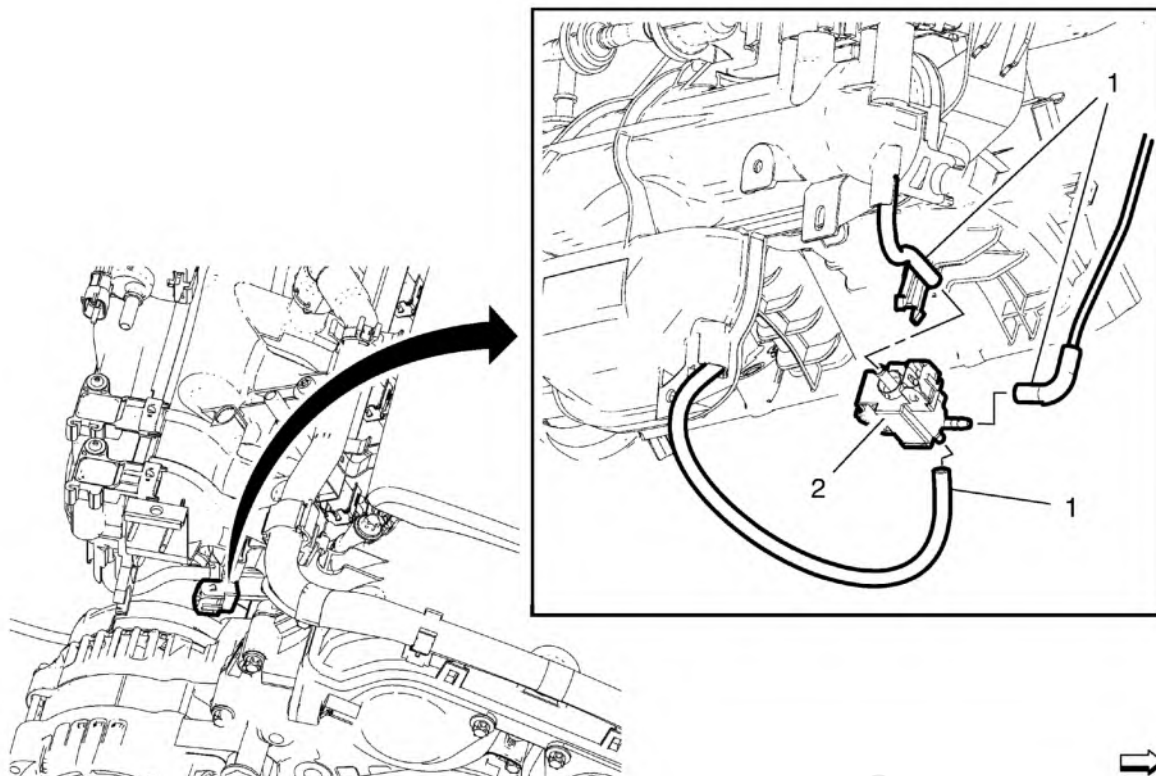


Fig. 129: Charge Air Bypass Regulator Solenoid Valve
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the air cleaner assembly. Refer to Air Cleaner Assembly Replacement .	
1	Charge Air Bypass Regulator Solenoid Valve Hose (Qty: 3) Procedure Disconnect the electrical connector.
2	Charge Air Bypass Regulator Solenoid Valve

CHARGE AIR BYPASS VALVE REPLACEMENT

Special Tools

GE-23738-A Vacuum Pump

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

Removal Procedure

1. Remove Exhaust Manifold Heat Shield [Exhaust Manifold Heat Shield Removal](#)
2. Remove Turbocharger Wastegate Actuator - [Turbocharger Disassemble](#)

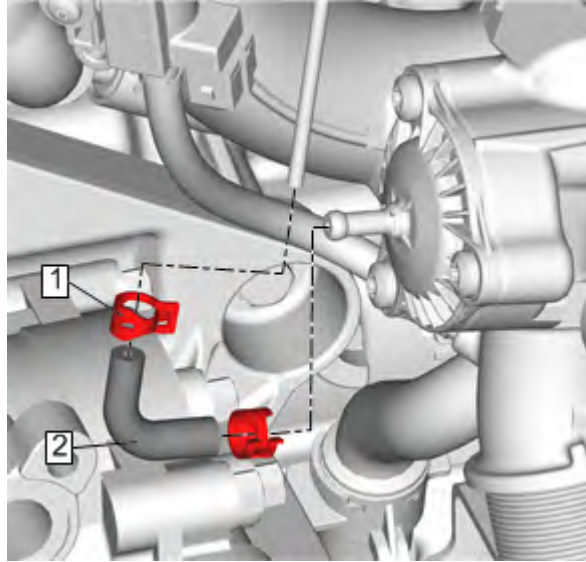


Fig. 130: Charge Air Bypass Valve Tube
 Courtesy of GENERAL MOTORS COMPANY

3. Loosen Hose Clamp (1) & Position aside
4. Remove Charge Air Bypass Valve Tube Connector (2)

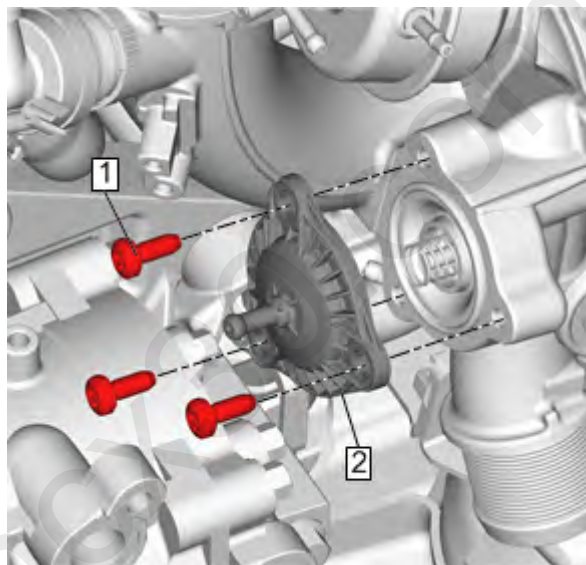


Fig. 131: Charge Air Bypass Valve Cover
 Courtesy of GENERAL MOTORS COMPANY

5. Remove Fastener (1)
6. Remove Charge Air Bypass Valve Cover (2)

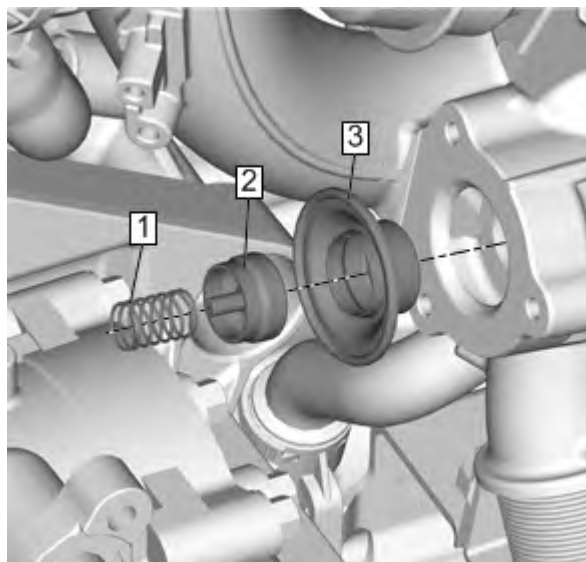


Fig. 132: Charge Air Bypass Valve Piston/Membrane
Courtesy of GENERAL MOTORS COMPANY

7. Remove Valve Spring (1)
8. Remove Charge Air Bypass Valve Piston (2)
9. Remove Charge Air Bypass Valve Membrane (3)

Installation Procedure

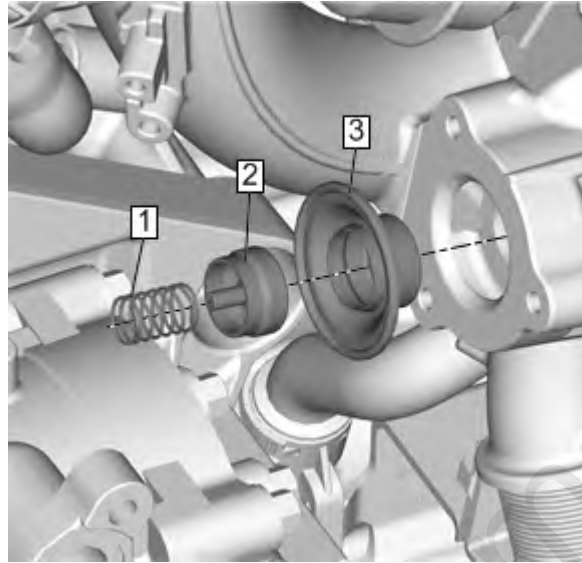


Fig. 133: Charge Air Bypass Valve Piston/Membrane
Courtesy of GENERAL MOTORS COMPANY

NOTE: Ensure there is no dirt or debris in the turbocharger housing valve cavity.

1. Install Charge Air Bypass Valve Membrane (3)
2. Install Charge Air Bypass Valve Piston (2)
3. Install Valve Spring (1)

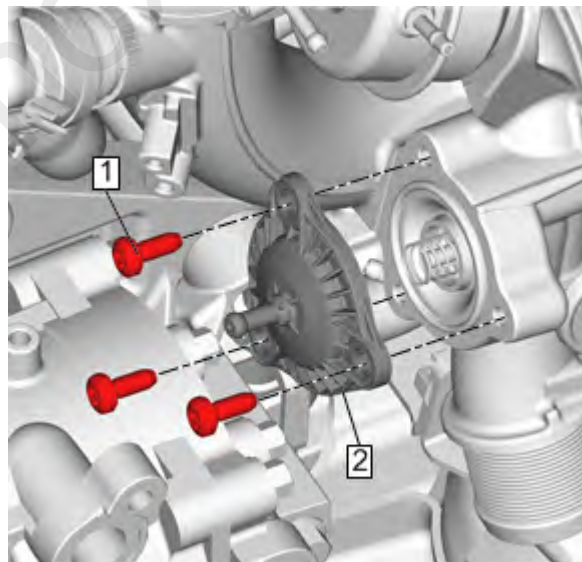


Fig. 134: Charge Air Bypass Valve Cover
Courtesy of GENERAL MOTORS COMPANY

NOTE: The charge air bypass valve piston guide pin fits inside the charge air bypass valve cover guide bore.

4. Install Charge Air Bypass Valve Cover (2)

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

5. Install Fastener (1) & Tighten the bolts until snug.
6. Install Fastener (1) Tighten 12 N.m (106 lb in)
7. Use **GE-23738-A** Vacuum Pump to check for vacuum leak.

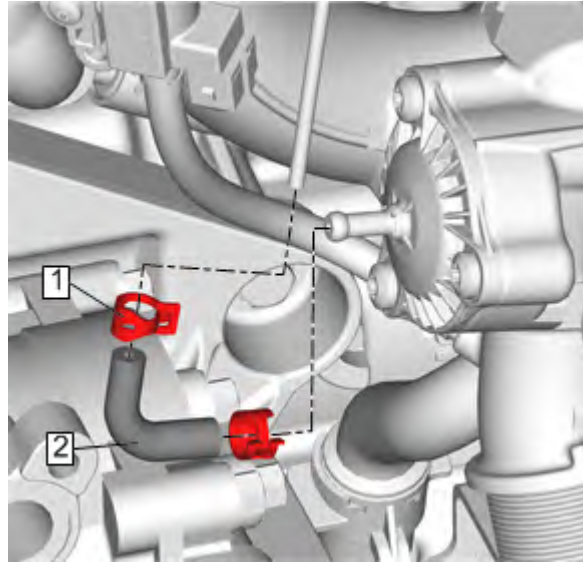


Fig. 135: Charge Air Bypass Valve Tube

Courtesy of GENERAL MOTORS COMPANY

8. Loosely install Hose Clamp (1) @Charge Air Bypass Valve Tube Connector (2)
 9. Install Charge Air Bypass Valve Tube Connector (2)
 10. Hose Clamp (1) @Charge Air Bypass Valve Tube Connector (2), Move into position & Tighten
 11. Install Turbocharger Wastegate Actuator - [Turbocharger Assemble](#)
 12. Install Exhaust Manifold Heat Shield. [Exhaust Manifold Heat Shield Installation](#) .
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