

2021 ENGINE PERFORMANCE

Engine Controls And Fuel - 2.8L (LWN) Diesel - Repair Instructions - Canyon, Colorado

REPAIR INSTRUCTIONS

DIESEL PARTICULATE FILTER (DPF) SERVICE REGENERATION

Circuit/System Description

A service regeneration of the diesel particulate filter (DPF) is required during certain diagnostic procedures. When commanded, the engine control module (ECM) controls the service regeneration as follows:

1. The exhaust system is warmed up for about 5 minutes. Engine speed is slowly increased to 3,000 RPM.
2. Once the DPF reaches its calibrated regeneration temperature, the ECM maintains engine speed for about 30 minutes until regeneration is complete, is cancelled by the technician, or is aborted due to abnormal conditions.
3. The ECM then decreases engine speed to normal idle speed.

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

- Battery voltage is greater than 11 V.
- Engine speed is between 500 - 2,700 RPM.
- Vehicle speed is 0.
- Engine oil temperature is in range.
- Exhaust gas temperature (EGT) sensors 1 is between 20 - 725°C (68 - 1,337°F).
- Exhaust gas temperature (EGT) sensors 2 is between 95 - 750°C (203 - 1,382°F).
- Exhaust gas temperature (EGT) sensors 5 is between 30 - 750°C (86 - 1,382°F).
- Engine coolant temperature (ECT) sensor is greater than 65°C (149°F).
- Fuel temperature is less than 150°C (302°F).
- BARO pressure is greater than 51 kPa (7.4 psi)
- Accelerator Pedal Position (APP) sensor is less than 1 percent.
- The brake pedal is in the released position.
- The transmission is in Park or Neutral.
- Fuel level is greater than 15%.

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

- The DPF Service Regeneration is commanded Off using the scan tool.
- The scan tool is disconnected from the vehicle.
- The vehicle is shifted out of Park or Neutral.
- The brake or accelerator pedal is applied.

Diagnostic Aids

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

Service Regeneration Unsuccessful

DPF Regeneration Parameters	Unsuccessful Regeneration - Number of Completed Regenerations Did Not Increment By One	Corrective Action For An Unsuccessful Regeneration
DPF Service Regeneration Inhibit Reason	Activation Timer Has Expired - The regeneration has not started due to out of range sensor	Ensure engine and exhaust is at operating temperature
	APP - The APP position sensor indicated over 1 percent	Ensure the accelerator pedal was not applied during the service regeneration. If the accelerator pedal was not applied, test the accelerator pedal position (APP) sensor.
	Brake Pedal Applied - The brake pedal position indicated Applied.	Ensure that the brake pedal was not applied during the service regeneration procedure. If the brake pedal was not applied, test the brake pedal switch.
	Battery Voltage Exceeds Limits - Battery voltage was less than 11 V.	- The scan tool Exit or Off soft key button was depressed. - Inspect for a poor connection at DCL.
	Diesel Particulate Filter Temperature Out of Range - DPF service regeneration temperatures not within a calibrated threshold.	- Observe the DTC information. - Test for a degraded diesel oxidation catalyst (DOC). - Test for a skewed exhaust temperature sensor, EGT sensor 2.
	Engine Coolant Temperature Out of Range	Verify engine is at normal operating temperature.
	Engine Load Out of Range	Engine must be at idle speed and in park or neutral to start the test.
	Engine Speed Out of Range	Engine must be running.
	Exhaust Gas Temperature Out of Range	Engine must be at normal operating temperature.
	Fuel Temperature Too High	Verify fuel temperature is less than 150B°C (302B°F).
	Incorrect Power Mode - Check ignition switch	Verify the ignition is in the Run position.
	Malfunctions Present or Enable Conditions Not Met	Verify no DTCs are present and Conditions for Running are satisfied.
	None	Refer to the DPF Regeneration Status parameter

DPF Regeneration Parameters	Unsuccessful Regeneration - Number of Completed Regenerations Did Not Increment By One	Corrective Action For An Unsuccessful Regeneration
DPF Normal Regeneration Inhibit Reason	Transmission must be in Park or Neutral - Transmission gear selector is not in Park or Neutral.	Ensure that the transmission gear selector remained in Park during the Service Regeneration procedure. If the gear selector remained in the Park position, test the transmission range switch and circuits.
	Vehicle speed too high	Vehicle speed must be 0.
	Soot Accumulation Too High	Replace diesel particulate filter
	Diesel Particulate Filter Service Regeneration Required	Perform <u>Diesel Particulate Filter (DPF) Service Regeneration</u>
	Incorrect Power Mode	Ensure ignition switch is in the RUN position.

Reference Information

Component View Reference

ELECTRICAL COMPONENT LOCATOR

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

DPF Service Regeneration

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

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

CAUTION: Due to the elevated engine temperatures created while performing this procedure it is imperative to keep the front of vehicle in an open environment away from any walls or buildings. This will ensure proper airflow across the radiator. Engine damage may occur if the engine overheats.

NOTE:

- If you were not referred to this procedure from another diagnostic, DO NOT perform the Service Regeneration.
- Do not refuel the vehicle during DPF Service Regeneration.
- The scan tool must remain connected to the data communication link (DCL) during the entire service regeneration procedure.

- **Fuel level should be greater 15% to ensure a successful regeneration.**

1. Ignition On.
2. Verify there are no DTCs set, except DTC P2463.
 - **If another DTC is set**

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

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

3. Park the vehicle outside the repair facility and away from any obstacles.
4. Place the transmission in Park and apply the parking brake.
5. Check the following fluid levels before and after this procedure:
 - Reductant
 - Engine oil
 - Engine coolant
 - Transmission
6. Clear the DTCs with a scan tool before commanding a DPF Service Regeneration.
7. Observe the scan tool Number of Completed DPF Regenerations parameter and record the value.
8. Select Control Functions, DPF Regeneration and then DPF Service Regeneration and follow the instruction on the scan tool.
9. Command the DPF Service Regeneration On with a scan tool.
 - **If the service regeneration does not start**

Observe the DPF Regeneration Inhibit Reason parameter on the scan tool to identify the Regeneration Inhibit Reason and refer to the Service Regeneration Unsuccessful table in Diagnostic Aids.

• **Go to next step: If the service regeneration starts**
10. The scan tool may display Device Limits Exceeded - System or Component Protection Wait Time Active when the service regeneration is complete. Verify the regeneration completed successfully by observing the Number of Completed DPF Regenerations parameter. The number will increment by 1 from the value previously recorded after a successful regeneration.
 - **If the service regeneration did not complete, was aborted, or the Number of Completed DPF Regenerations did not increment**

Refer to the Service Regeneration Unsuccessful table in Diagnostic Aids
 - **Go to next step: If the Service Regeneration completed**

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

11. Command the Reductant Injector On and Off several times with a scan tool.
12. Clear any DTCs with a scan tool.
13. Ignition Off for 90 s.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) .

Exhaust Particulate Filter Replacement (LWN) for diesel particulate filter replacement.

Perform the scan tool DPF/Catalyst 2 Reset after replacing the exhaust particulate filter.

DIESEL PARTICULATE FILTER (DPF) REGENERATION ENABLE

NOTE: The DPF Regeneration Enable is required when specific service procedures have been performed. Do not perform a DPF Regeneration Enable unless instructed to in the Repair Instruction section of the service procedure. After the system is repaired, perform the following to avoid possible damage to the DPF.

1. Ignition ON, clear the DTCs with a scan tool.
2. Select DPF Regeneration Enable with a scan tool.

NOTE: The engine control module (ECM) activates the DPF Regeneration when the engine running conditions are met.

3. Select ON.
4. Exit the Special Function menu. Remove the scan tool.

BARO SENSOR RESET

Diagnostic Instructions

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

Description

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

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

When to Perform the Procedure

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

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

- B75C Multifunction Intake Air Sensor
- K20 Engine Control Module

Conditions for Running the Procedure

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

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

Repair Instructions

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

CATALYST RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

[Control Module References](#)

With Scan Tool

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

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

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

8. All OK.

Repair Instructions

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

CRANKSHAFT POSITION VARIATION LEARN

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

Perform this procedure when the following component has been serviced:

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

Conditions for Running the Procedure

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

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

- If any other DTCs are set

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

- Go to next step: If no other DTCs are set

3. Select: Module Diagnostics

4. Select: Body Control Module
5. Select: Configuration/Reset Functions
6. Select: Brake Pedal Position Sensor Learn
7. Follow the instructions on the scan tool.

Verify the scan tool parameter: Brake Pedal Position Sensor Learn = Yes

- **If not the specified state**

Repeat step 6

- **Go to next step: If the specified state**

8. Select: Module Diagnostics
9. Select: Engine Control Module
10. Select: Configuration/Reset Functions
11. Select: Learn Functions
12. Select: Crankshaft Position Variation Learn
13. Follow the instructions on the scan tool.

Verify the scan tool procedure was successful.

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

1. Ignition/Vehicle - Off
2. Verify the following conditions do not exist:
 - B26 Crankshaft Position Sensor & Reluctor Ring - Foreign material passing between the components/Incorrect air gap
 - Battery Voltage - Low
 - Crankshaft Bearing - Worn
 - Crankshaft - Excessive runout/Visible Damage
 - Reluctor Ring - Misaligned/Visible Damage
 - Signal circuit @ B26 Crankshaft Position Sensor - Electromagnetic Interference
 - If a condition exists - Repair or replace as necessary
 - If no condition exists - Repeat step 8

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

Repeat step 12

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

Replace the component: K20 Engine Control Module

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

14. All OK.

Repair Instructions

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

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

DPF PRESSURE SENSOR RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

DPF RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

- Engine = Not Running
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

EXHAUST AFTERTREATMENT FUEL INJECTOR RESET

Diagnostic Instructions

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

Description

This procedure resets the control module learned values of the component/system: Q67 Exhaust Aftertreatment Fuel Injector

When to Perform the Procedure

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

Perform this procedure when the following component has been serviced: Q67 Exhaust Aftertreatment Fuel Injector - Replaced

Conditions for Running the Procedure

- DTC Present = No
- Battery Voltage = Greater than 11 V

- Ignition = On

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

Verify the scan tool procedure was successful.

- **If the procedure was not successful**

1. Verify the following conditions do not exist:

- Battery Voltage - Low
- DTC Present
- If a condition exists - Repair or replace as necessary Repeat step 1
- If no condition exists - Repeat step 1

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

8. All OK.

Repair Instructions

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

EXHAUST GAS TEMPERATURE SENSOR RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

FUEL INJECTOR CORRECTION VALUE RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

- Battery Voltage = Greater than 11 V
- DTC Present = No
- Ignition = On

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: Fuel Injector Correction Reset

6. Select: Cylinder 1 - 4 Fuel Injector Correction Value Reset or All Cylinders Fuel Injector Correction Value Reset
7. Select: Reset
8. Follow the instructions on the scan tool.

Verify the scan tool parameter: Cylinder 1 - 4 Fuel Injector Correction Value = 0 ms

- **If not the specified state**

Refer to: Step 1

- **Go to next step: If the specified state**

9. All OK.

Repair Instructions

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

FUEL INJECTOR CORRECTION VALUE PRESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

- Battery Voltage = Greater than 11 V
- DTC Present = No
- Ignition = On

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

6. Follow the instructions on the scan tool.

Repair Instructions

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

FUEL INJECTOR FLOW RATE PROGRAMMING

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

Fuel injectors are solenoid valves that inject fuel either into the intake system or directly into the cylinder. The amount of fuel injected depends on the length of the electrical pulse that is applied.

The injector flow rate identifier is stored in the engine control module. This identifier is written on the injector and indicates the actual flow rate for this specific injector. This is used to compensate manufacturing tolerances of the injectors.

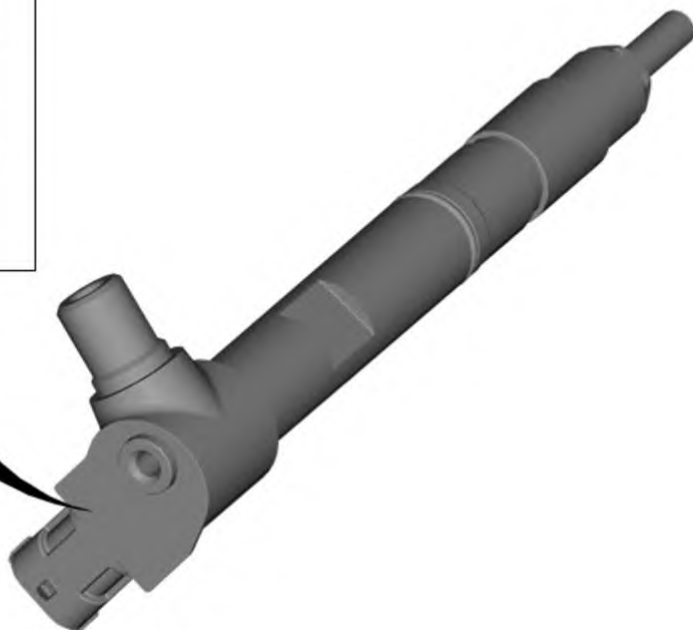
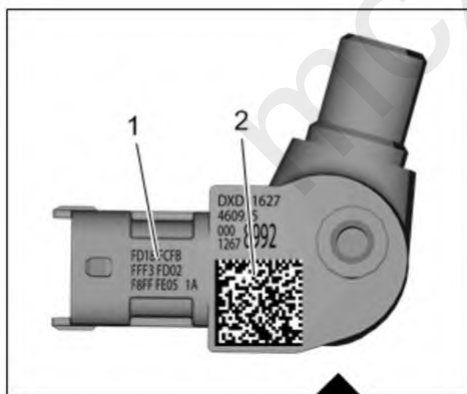
When to Perform the Procedure

The injector flow rate programming must be performed if one or more of the following components have been replaced:

- K20 Engine Control Module
- Q17 Fuel Injector

Diagnostic Aids

Injector Flow Identifier - Location



Option1

Injector Flow Identifier (1) - Record the Injector Flow Identifier information from all injectors.

Option2

1. QR Code (2) - Scan with smartphone or suitable device
2. Injector Flow Identifier = Digit 42-65, 68, 69

NOTE:

**Bold text =
Digit 42-65,
68, 69**

*For example: QR Code = DXD316274609551267899200001741609929234F7

FD18FCBFFF3FD02F8FFFE05 00 1A - Select: Injector Flow Identifier Digit 42-65, 68, 69 =
FD18FCBFFF3FD02F8FFFE051A

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

NOTE: This procedure is only for control modules that cannot communicate and injector replacement.

1. Perform the following action:
 - {Q17 Fuel Injector - Replaced} Record the Injector Flow Identifier information from the new injectors.
 - {K20 Engine Control Module - Replaced} Record the Injector Flow Identifier information from all injectors.
2. Ignition - On / Vehicle - In Service Mode
3. Select: Module Diagnostics
4. Select: Engine Control Module
5. Select: Configuration/Reset Functions
6. Select: Injector Flow Rate Programming
7. Select: Cylinder 1-4 Injector Flow Identifier
8. Enter the recorded injector flow identifier for each injector.

Verify the scan tool procedure was successful.

- **If the procedure was not successful**

Repeat step 1

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

9. All OK.

Repair Instructions

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

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

FUEL RAIL PRESSURE RELIEF VALVE LEARNED VALUES RESET

Diagnostic Instructions

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

Description

This procedure resets the control module learned values of the component/system: Q18B Fuel Pressure Regulator 2

When to Perform the Procedure

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

Perform this procedure when the following component has been serviced: G18 High Pressure Fuel Pump - Replaced

Conditions for Running the Procedure

- Ignition = On

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: Fuel Rail Pressure Relief Valve Learned Values Reset
6. Select: Reset
7. Follow the instructions on the scan tool. - The procedure will complete within 10 s

Verify the scan tool procedure was successful.

- **If the procedure was not successful**

Refer to: Step 1

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

8. All OK.

Repair Instructions

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

NOX ADSORBER CATALYST RESET

Diagnostic Instructions

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

Description

This procedure resets the control module learned values of the component/system: B195 Nitrogen Oxides Sensor

When to Perform the Procedure

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

Perform this procedure when the following component has been serviced:

- Diesel Particulate Filter - Replaced
- Nitrogen Oxides Catalytic Converter - Replaced

Conditions for Running the Procedure

Ignition = Running

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

NOX CATALYST REDUCTANT LOADING RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

Perform this procedure when the following component has been serviced:

- A38 Reductant Pump and Sensor Assembly - Replaced

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

Conditions for Running the Procedure

- Engine = Off
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

NOX CATALYST RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

- Engine = Not Running
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

NOX SENSOR 1 RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

NOX SENSOR 2 RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

Ignition = Run/Crank

Reference Information

Scan Tool Reference

[Control Module References](#)

With Scan Tool

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

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

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

Repair Instructions

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

REDUCTANT FLUID TANK LEVEL RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

Perform this procedure when the following component has been serviced:

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

Conditions for Running the Procedure

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

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

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

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

Repair Instructions

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

REDUCTANT SYSTEM DATA RESET

Diagnostic Instructions

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

Description

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

When to Perform the Procedure

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

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

Conditions for Running the Procedure

- Engine = Not Running
- Ignition = Run/Crank

Reference Information

Scan Tool Reference

Control Module References

With Scan Tool

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

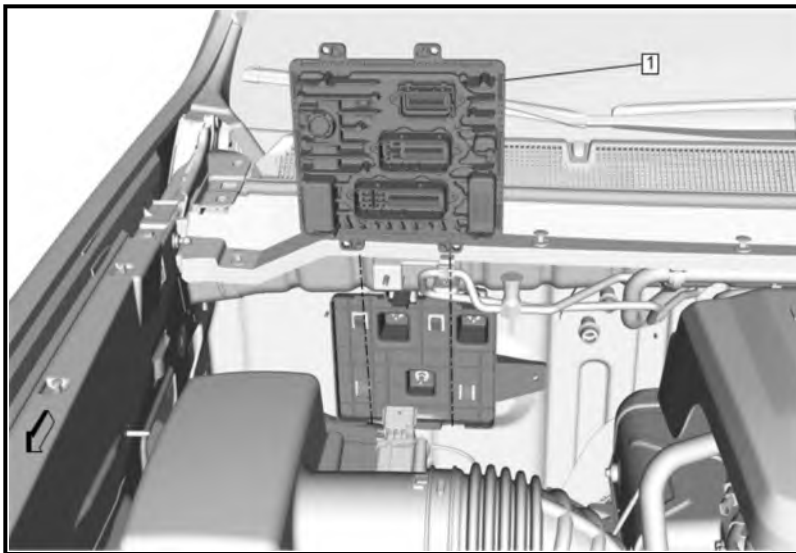
NOTE: The scan tool does not display the learn/reset status.

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

Repair Instructions

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

ENGINE CONTROL MODULE REPLACEMENT



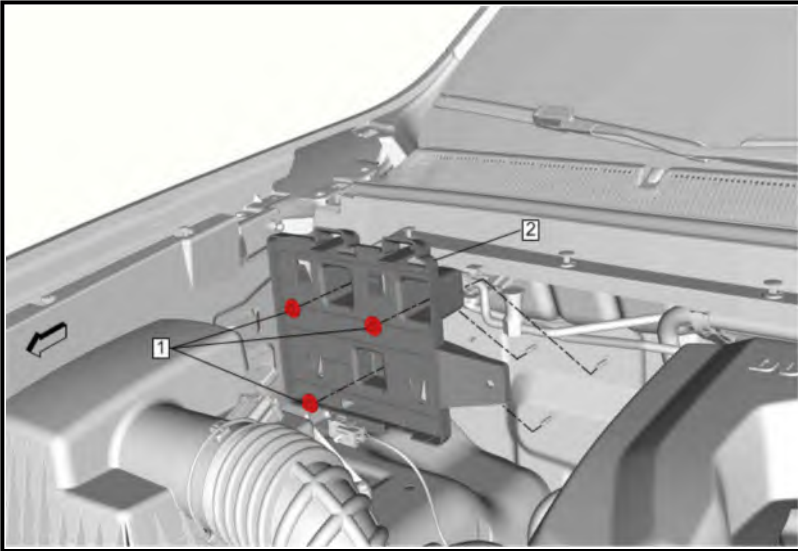
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection	
1	Engine Control Module WARNING: Refer to Safety Glasses Warning . CAUTION: Always turn the ignition off when installing or removing the ECM connectors in order to prevent damage to the components. CAUTION: • Turn the ignition OFF when installing or removing the control module connectors and disconnecting or reconnecting the power to the control module (battery

Callout	Component Name
	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

Callout	Component Name
	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), record the oil life percentage remaining and the fuel injector flow identifier codes. Use the scan tool to reset the Engine Oil Life remaining back to the original percentage recorded. Procedure 1. Disconnect the electrical connectors. 2. Use a suitable tool to pry back the locking tabs and remove the engine control module from the bracket. 3. If replacing the engine control module, it is necessary to reprogram the replacement module. Control Module References

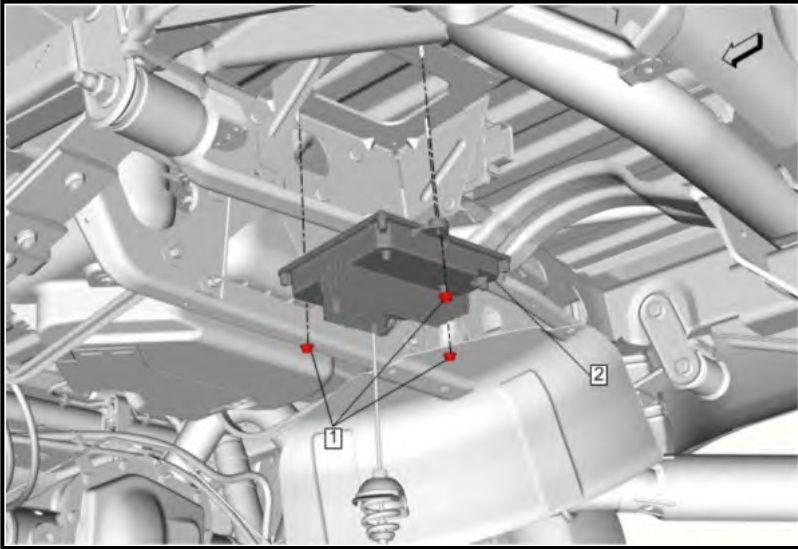
ENGINE CONTROL MODULE BRACKET REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Engine Control Module Replacement</u>	
1	Engine Control Module Bracket Nut [3x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Engine Control Module Bracket Procedure Remove the wiring harness from the engine control module bracket.

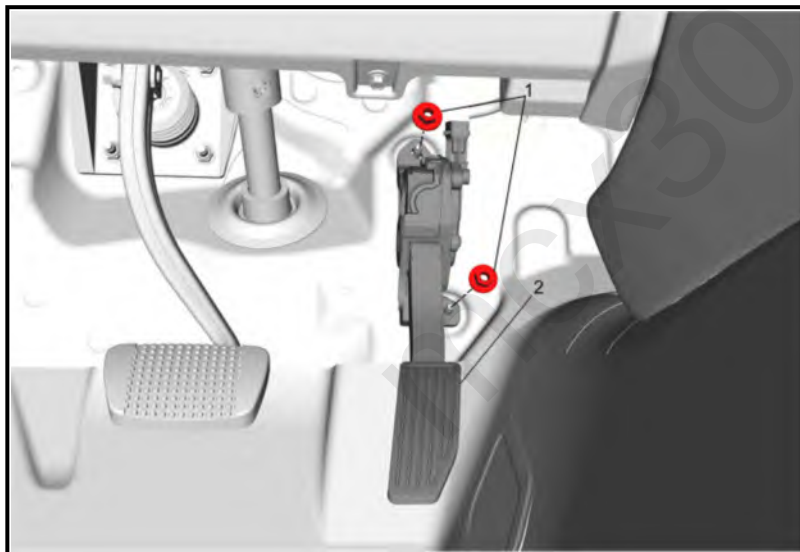
CHASSIS CONTROL MODULE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. Remove the spare tire.	
1	Chassis Control Module Fastener [3x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Chassis Control Module Procedure 1. Disconnect the electrical connector. 2. If replacing, reprogram the module. Control Module References

ACCELERATOR PEDAL POSITION SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

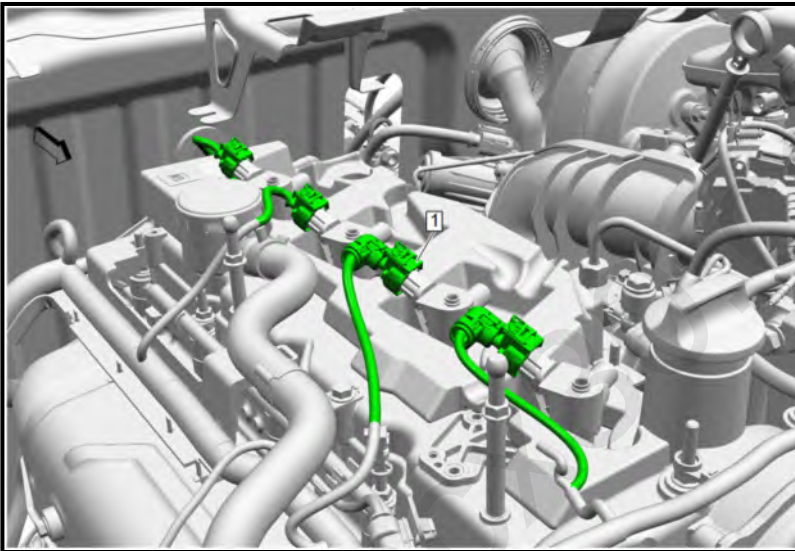
Callout	Component Name
Preliminary Procedure Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .	
1	Accelerator Pedal Position Sensor Fastener (Qty: 2) CAUTION: Refer to Fastener Caution .

Callout	Component Name
	Tighten 9 N.m (80 lb in)
2	Accelerator Pedal Position Sensor Procedure Disconnect the electrical wiring harness connector from the accelerator pedal position sensor.

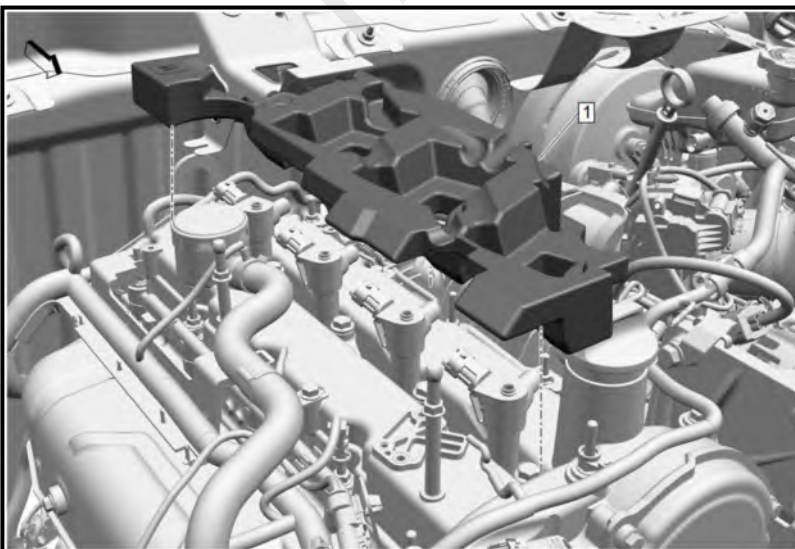
FUEL INJECTOR DEADENER REPLACEMENT

Removal Procedure

1. Plenum Front Panel Replacement - Remove
2. Fuel Injection Fuel Return Pipe Replacement - Remove
3. Fuel Injection Fuel Rail Assembly Replacement - Remove
4. Intake Manifold Tuning Valve Vacuum Control Solenoid Valve Replacement - Remove
5. Fuel Injector Electrical Connector (1) - Disconnect [4x]



6. Fuel Injector Deadener (1) - Remove



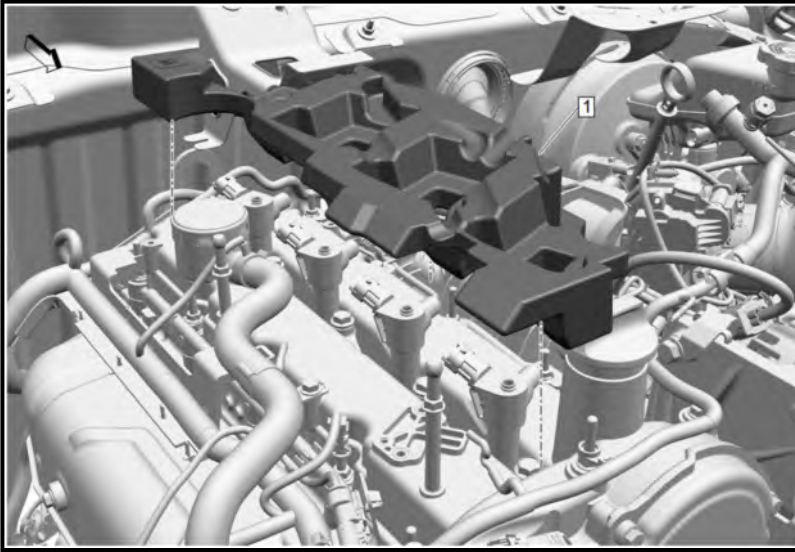
WARNING:

The noise cancelling foam component **MUST** be replaced if it has been exposed to engine fluids. Failure to replace the noise cancelling foam component that has been exposed to engine fluids may result in an

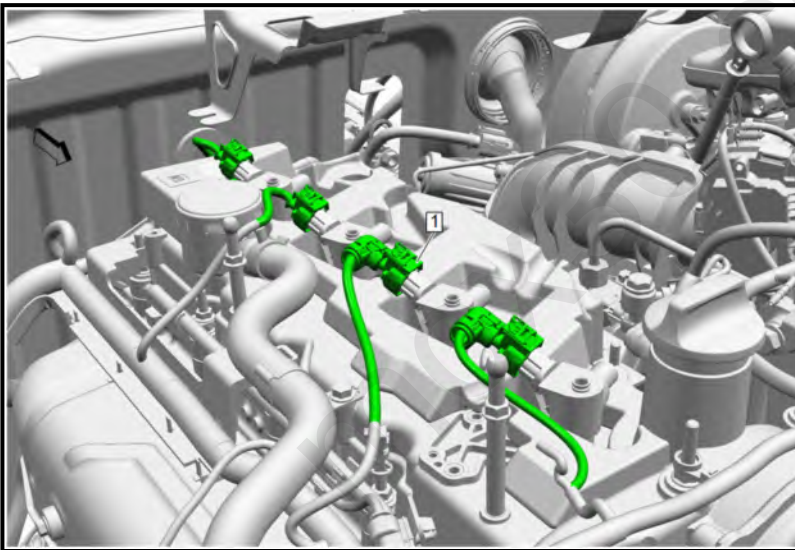
engine fire resulting in catastrophic engine damage, and possible injury or death.

Installation Procedure

1. Fuel Injector Deadener (1) - Install

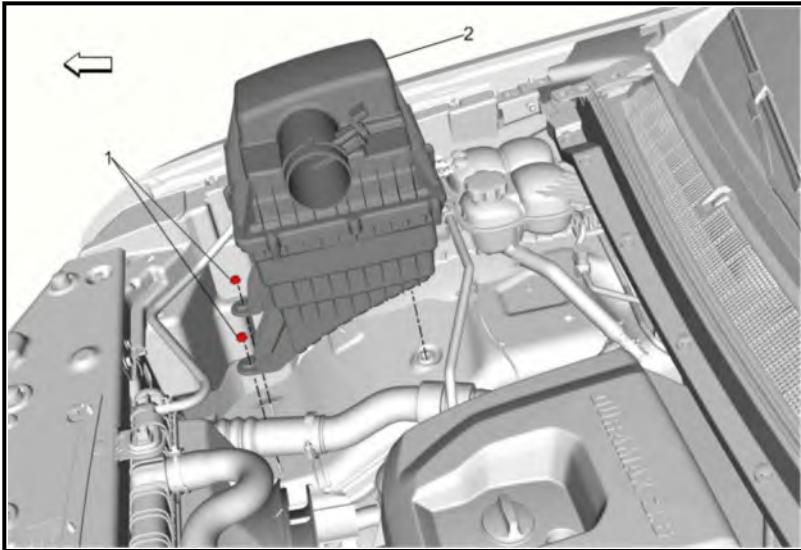


2. Fuel Injector Electrical Connector (1) - Connect [4x]



3. [Intake Manifold Tuning Valve Vacuum Control Solenoid Valve Replacement](#) - Install
4. [Fuel Injection Fuel Rail Assembly Replacement](#) - Install
5. [Fuel Injection Fuel Return Pipe Replacement](#) - Install
6. [Plenum Front Panel Replacement](#) - Install

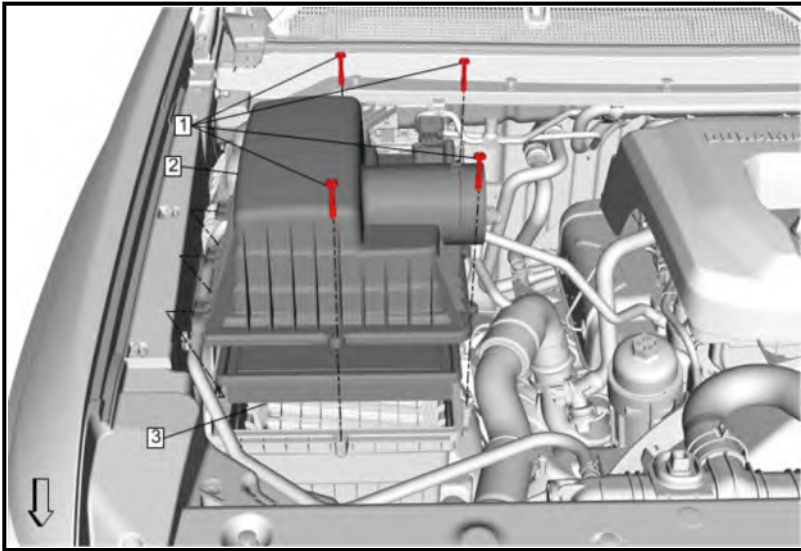
AIR CLEANER ASSEMBLY REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures <u>Air Cleaner Outlet Duct Replacement</u> - Disconnect the electrical connector.	
1	Air Cleaner Assembly Fastener [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 12 N.m (106 lb in)
2	Air Cleaner Assembly Procedure Pull up on the assembly to release lower retainer.

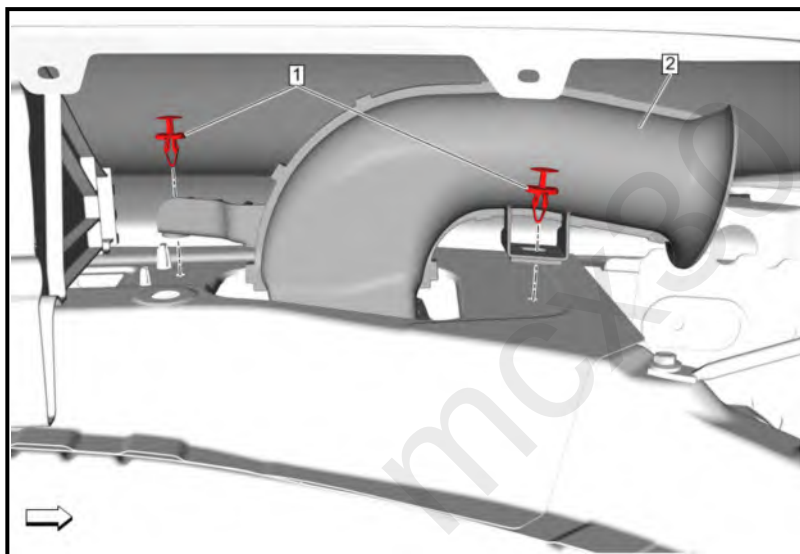
AIR CLEANER ELEMENT REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Air Cleaner Outlet Duct Replacement 2. Disconnect the electrical connector.	
1	Air Cleaner Assembly Fastener [4x] CAUTION: Refer to Fastener Caution . Tighten 3.1 N.m (27 lb in)
2	Air Cleaner Upper Cover
3	Air Cleaner Element

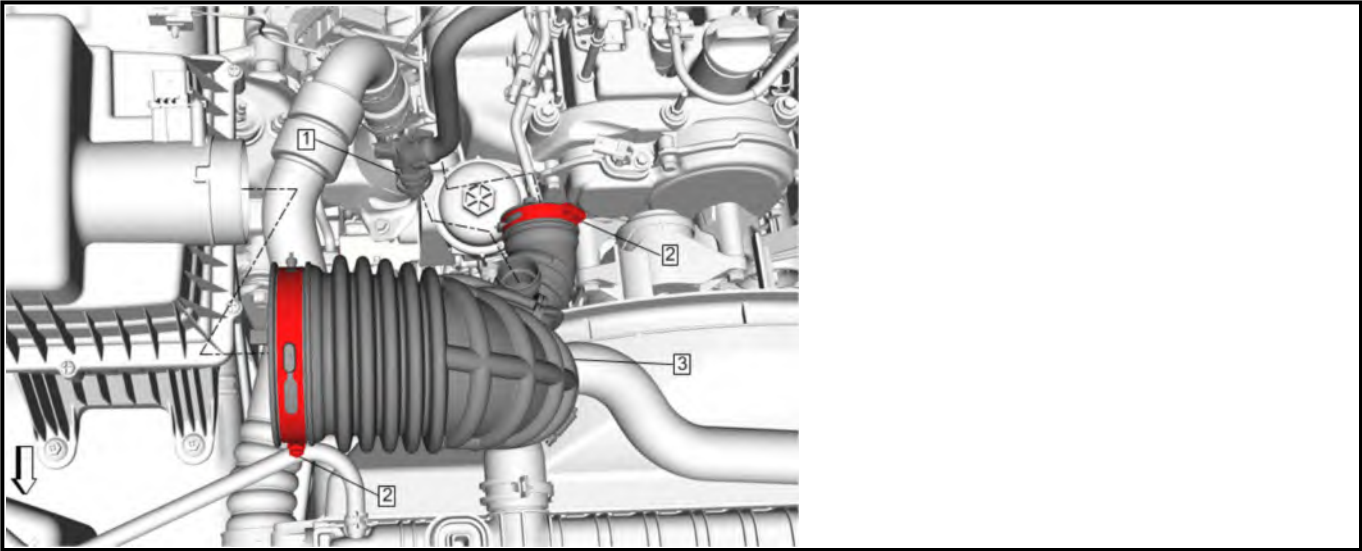
FRONT INTAKE AIR DUCT REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Front Wheelhouse Liner-Right Side - Remove - Front Wheelhouse Liner Replacement (Without ZR2) , or Front Wheelhouse Liner Replacement (With ZR2) , or Front Wheelhouse Liner Replacement (Bison)	
1	Retainer [2x] CAUTION: Refer to Fastener Caution .
2	Front Intake Air Duct Procedure Pull out on front intake air duct to remove from air cleaner assembly.

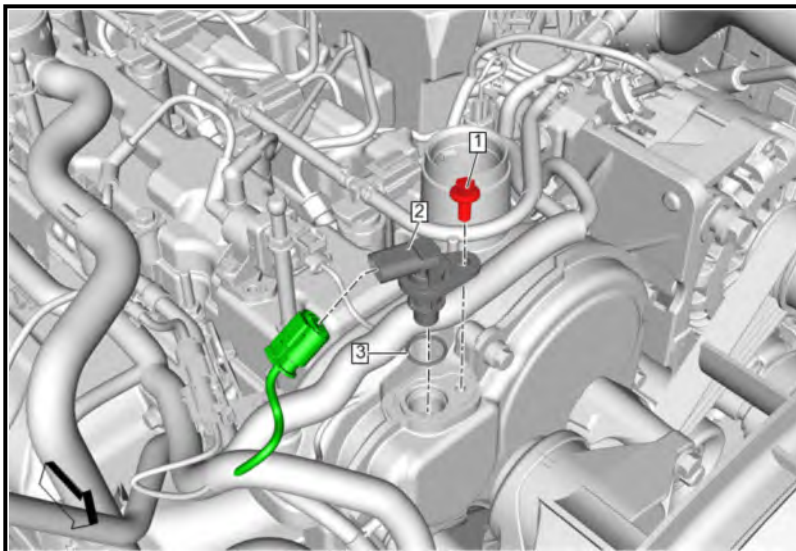
AIR CLEANER OUTLET DUCT REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
1	PCV Heater Procedure Disconnect PCV heater from air cleaner outlet duct. Plastic Collar Quick Connect Fitting Service
2	Air Cleaner Outlet Duct Clamp [2x] 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. Tighten 3.5 N.m (31 lb in)
3	Air Cleaner Outlet Duct

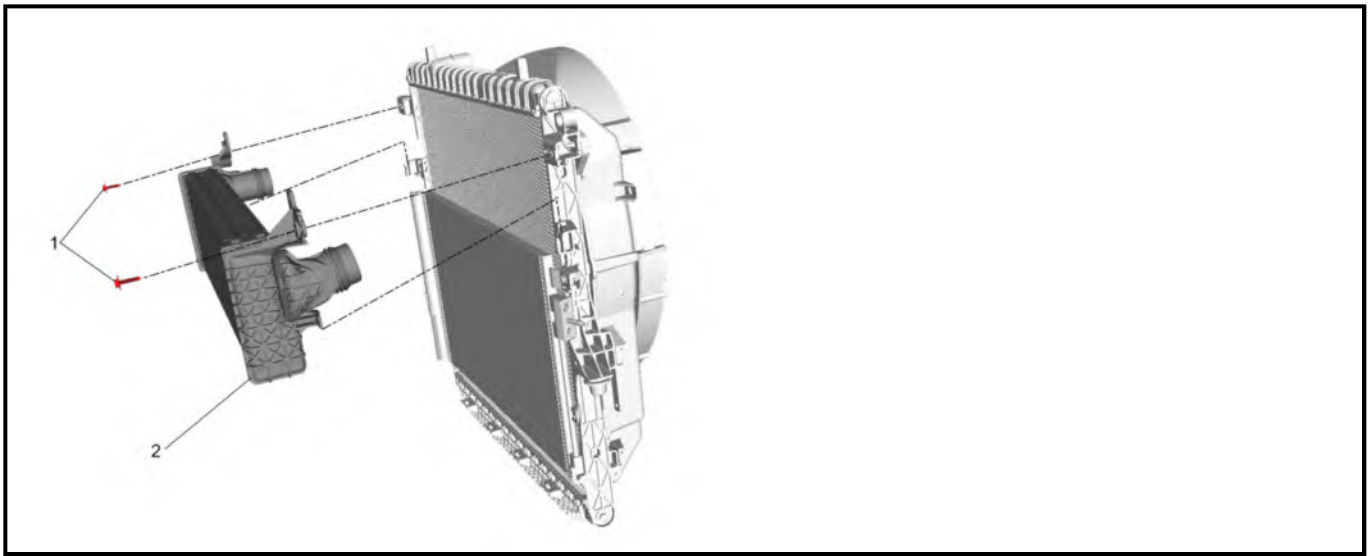
CAMSHAFT POSITION SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Remove the Intake Manifold Cover Insulator from the top of the engine. Intake Manifold Cover Insulator Replacement (Top of Engine) , or Intake Manifold Cover Insulator Replacement (Left Side)	
1	Camshaft Position Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 11 N.m (97 lb in)
2	Camshaft Position Sensor Procedure Disconnect the electrical connector from the camshaft position sensor.
3	Camshaft Position Sensor Seal NOTE: If reinstalling the sensor, inspect the seal and replace as needed. Always install the NEW seal supplied with the sensor.

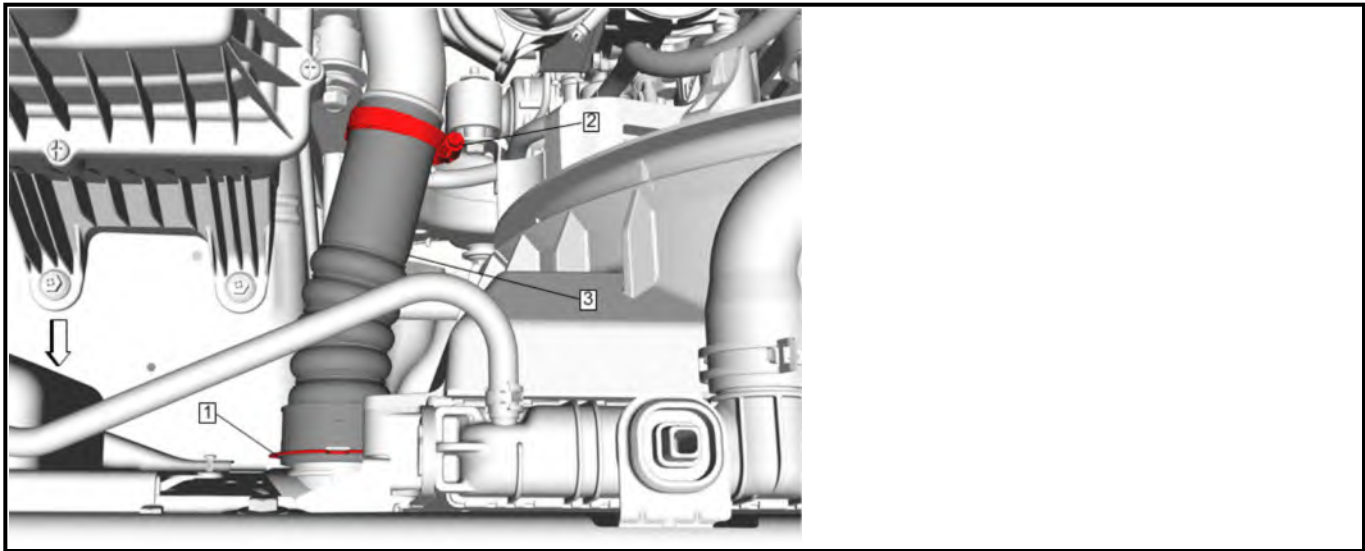
CHARGE AIR COOLER REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures <u>Condenser, Fan, and Radiator Assembly Removal and Installation (LWN)</u> , or <u>Condenser, Fan, and Radiator Assembly Removal and Installation (LWN Bison)</u>. <u>Radiator Air Side Baffle Replacement - Left Side (LWN)</u>. <u>Radiator Air Side Baffle Replacement - Right Side (LWN)</u>.	
1	Charge Air Cooler Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 9 N.m (80 lb in)
2	Charge Air Cooler

CHARGE AIR COOLER INLET HOSE REPLACEMENT

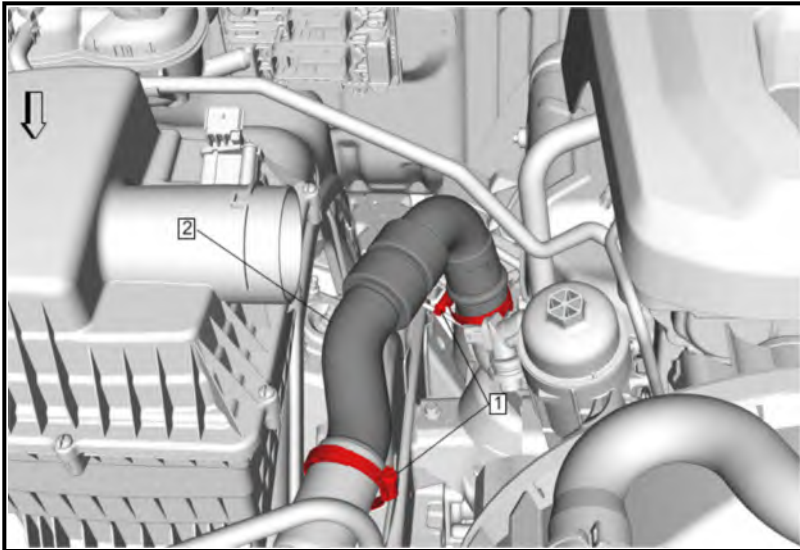


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
1	Charge Air Cooler Inlet Hose Retainer Spring Procedure Unclip the retaining spring.
2	Charge Air Cooler Inlet Hose Clamp CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
3	CAUTION: Handle the charge air cooler inlet and outlet air tubes only by the outside surface, making sure to avoid touching the internal seals. Touching the internal seals can dislodge them from their intended location and lead to seal damage and leaks during tube installation. CAUTION: Verify the charge air cooler inlet and outlet air tube quick connect seal condition and location prior to installation.

Callout	Component Name
	Seal must be evenly seated in the quick connector body and sealing surface must be free of deformation and damage. Deformed or damaged seals can lead to reduced engine power and/or engine stalling. Charge Air Cooler Inlet Hose NOTE: DO NOT insert fingers inside quick connect to manipulate duct during disassembly/assembly. Rubber pad gloves increase risk to dislodge seal. Procedure 1. Position charge air cooler inlet hose perpendicular to charge air cooler and install. 2. Verify connection is properly made by pulling and pushing on the hose at the quick connector location. 3. Start vehicle and listen for whistling at the charge air cooler inlet hose quick connect located at the charge air cooler.

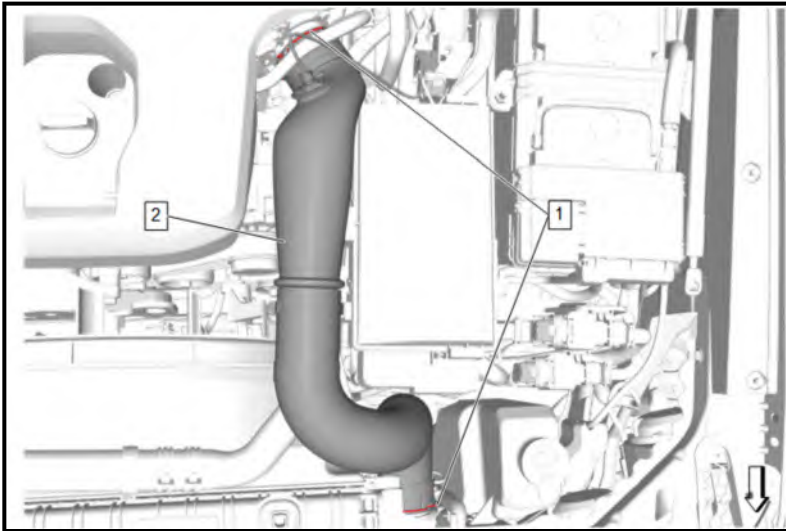
CHARGE AIR COOLER INLET DUCT REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures Air Cleaner Outlet Duct Replacement Charge Air Cooler Air Temperature Sensor Replacement (Inlet Duct), or Charge Air Cooler Air Temperature Sensor Replacement (Outlet Duct)	
1	Charge Air Cooler Inlet Duct Clamp [2x] CAUTION: Refer to Fastener Caution . Tighten 5 N.m (44 lb in)
2	Charge Air Cooler Inlet Duct

CHARGE AIR COOLER OUTLET DUCT REPLACEMENT

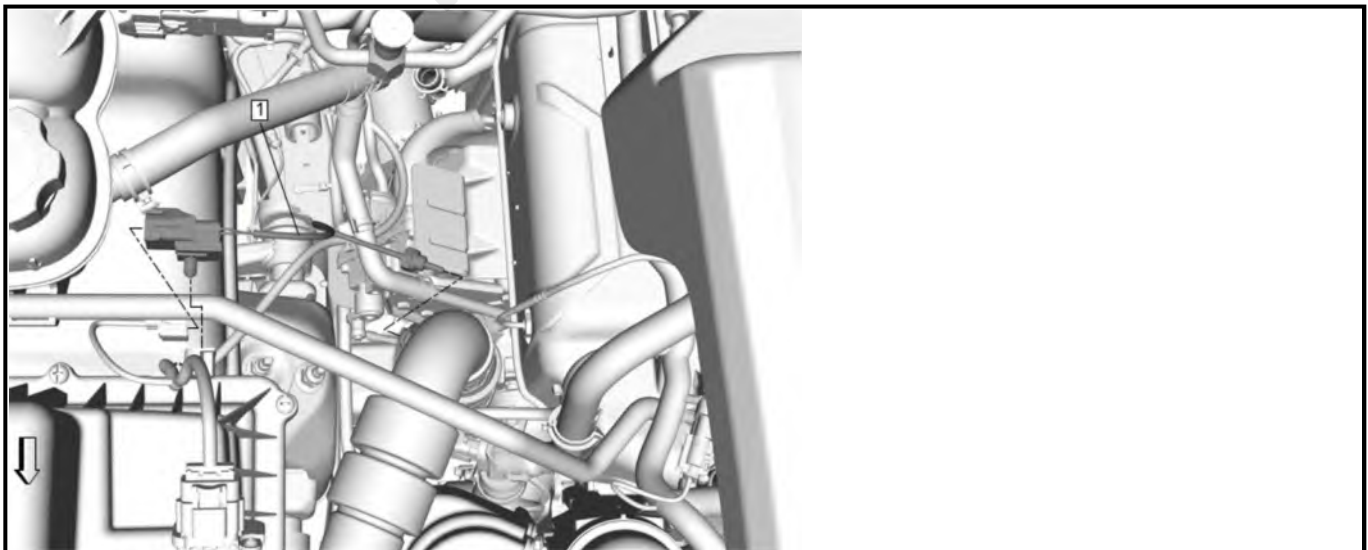


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Disconnect the charge air temperature sensor electrical connector. Charge Air Cooler Air Temperature Sensor Replacement (Inlet Duct) , or Charge Air Cooler Air Temperature Sensor Replacement (Outlet Duct) .	
1	Charge Air Cooler Outlet Duct Retainer Spring [2x] Procedure Unclip the retaining spring.
2	CAUTION: Handle the charge air cooler inlet and outlet air tubes only by the outside surface, making sure to avoid touching the internal seals. Touching the internal seals can dislodge them from their intended location and lead to seal damage and leaks during tube installation. CAUTION: Verify the charge air cooler inlet and outlet air tube quick connect seal condition and location prior to installation. Seal must be evenly seated in the quick connector body and sealing surface must

Callout	Component Name
	be free of deformation and damage. Deformed or damaged seals can lead to reduced engine power and/or engine stalling. Charge Air Cooler Outlet Duct NOTE: DO NOT insert fingers inside quick connect to manipulate duct during disassembly/assembly. Rubber pad gloves increase risk to dislodge seal. Procedure 1. Position charge air cooler outlet duct perpendicular to charge air cooler and install. 2. Verify connection is properly made by pulling and pushing on the duct at the quick connector location. 3. Start vehicle and listen for whistling at the charge air cooler outlet duct quick connect located at the charge air cooler.

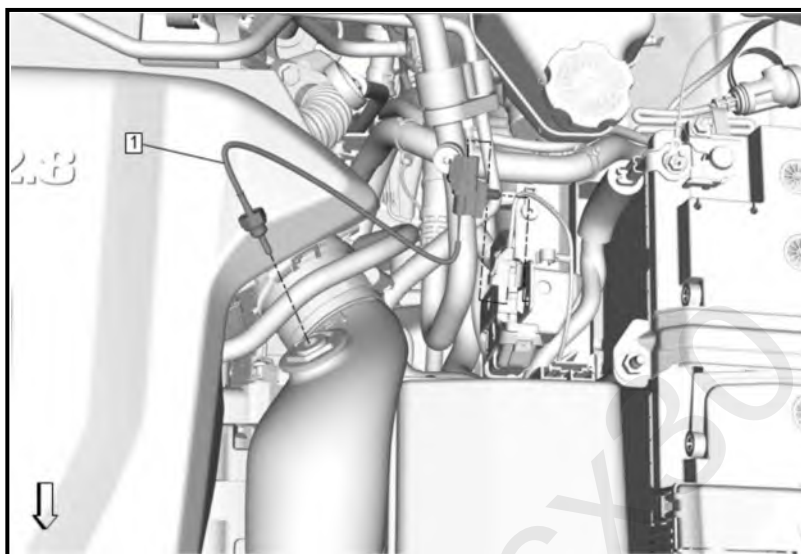
CHARGE AIR COOLER AIR TEMPERATURE SENSOR REPLACEMENT (INLET DUCT)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Disconnect the electrical connector.	
1	Charge Air Temperature Sensor CAUTION: Refer to <u>Component</u> <u>Fastener</u> <u>Tightening</u> <u>Caution</u> . Tighten 19 N.m (14 lb ft)

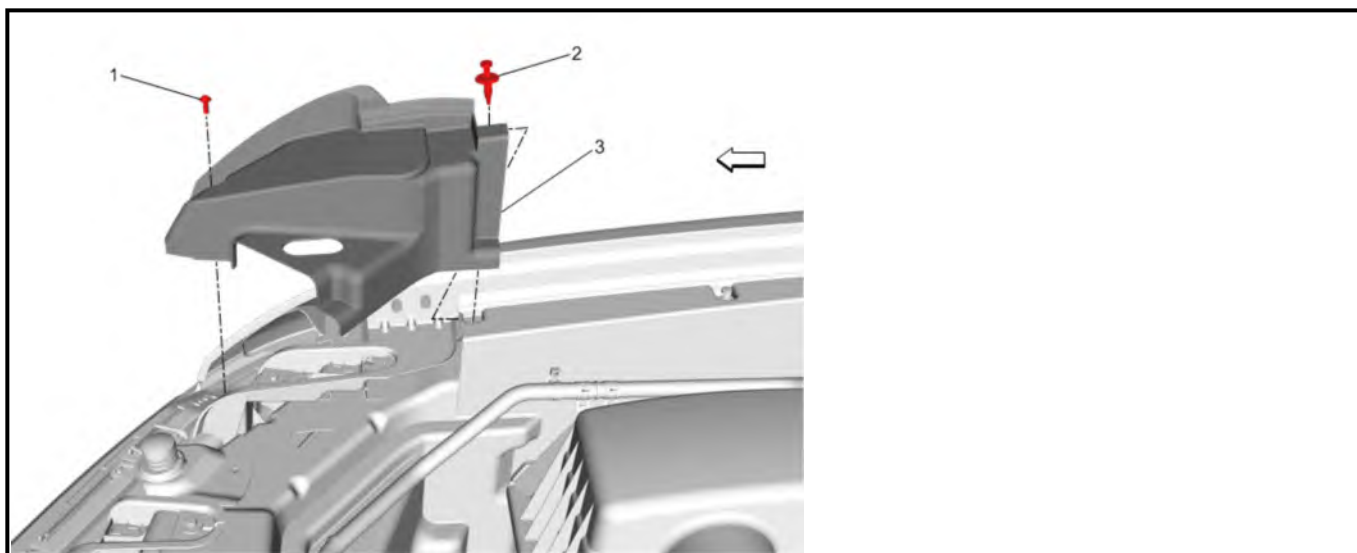
CHARGE AIR COOLER AIR TEMPERATURE SENSOR REPLACEMENT (OUTLET DUCT)



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Disconnect the electrical connector.	
1	Charge Air Temperature Sensor CAUTION: Refer to <u>Component</u> <u>Fastener</u> <u>Tightening</u> <u>Caution</u> . Tighten 19 N.m (14 lb ft)

INTAKE AIR BAFFLE REPLACEMENT



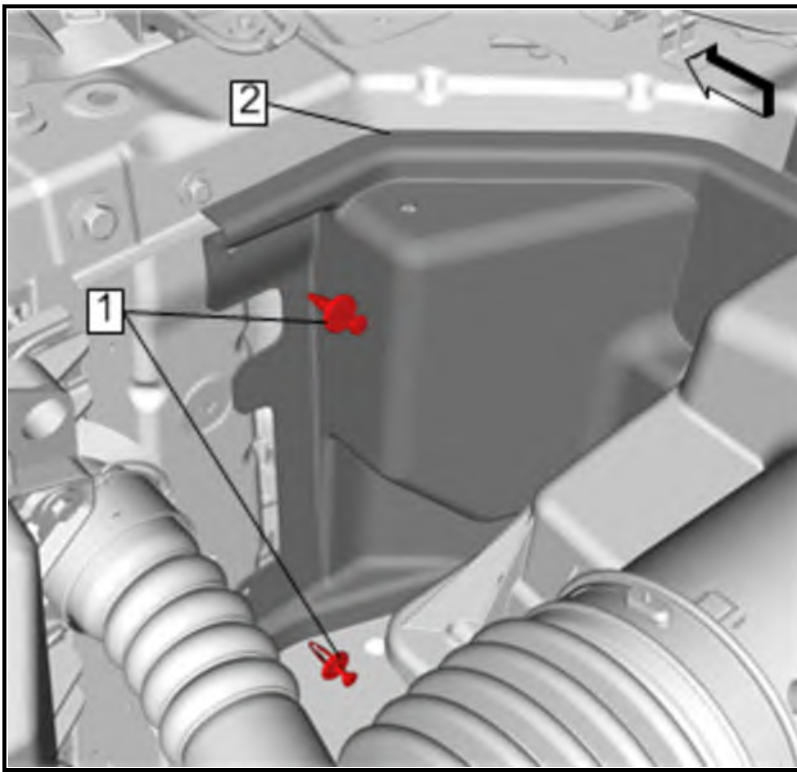
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure If equipped remove the front compartment front sight shield. Front Compartment Front Sight Shield Replacement	
1	Intake Air Baffle Bolt CAUTION: Refer to Fastener Caution . Tighten 1.5 N.m (13 lb in)
2	Intake Air Baffle Retainer
3	Intake Air Baffle Procedure Lift up and slide forward to remove from underneath intake air splash shield.

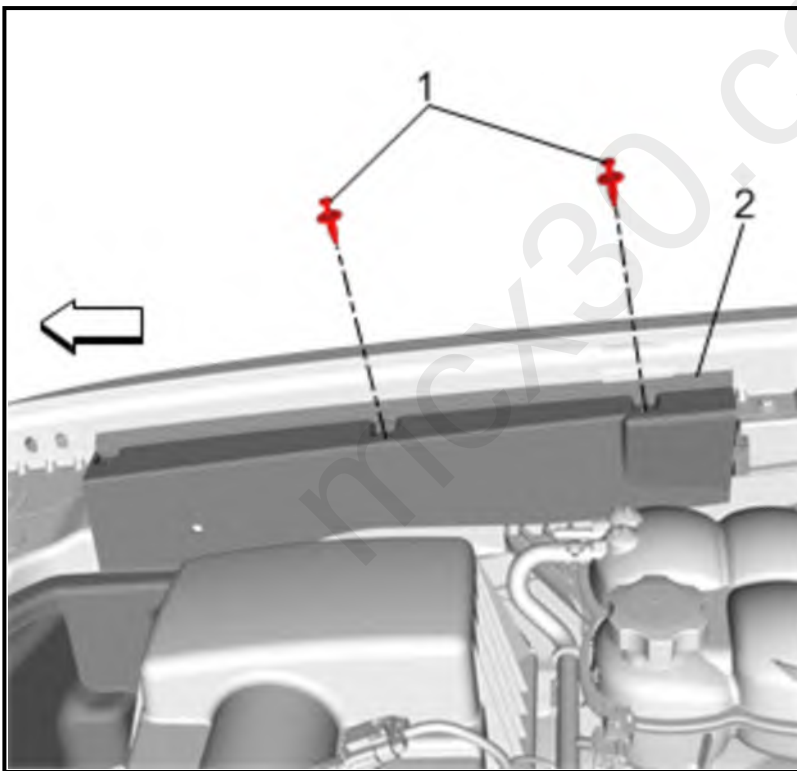
INTAKE AIR SPLASH SHIELD REPLACEMENT

Removal Procedure

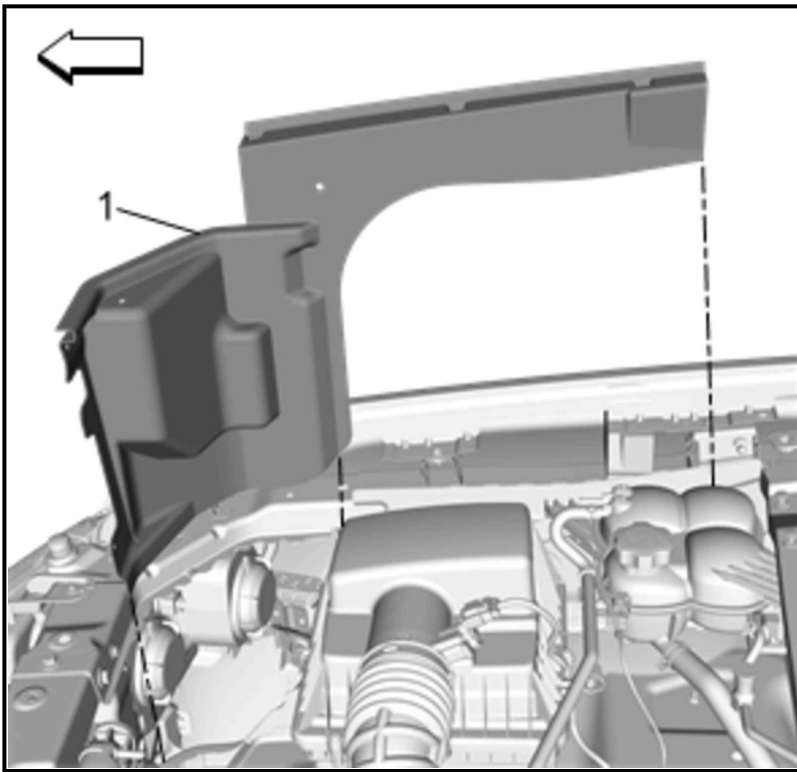
1. Radiator Vent Outlet Hose - Unclip and Reposition - [Radiator Vent Outlet Hose Replacement \(LWN\)](#).
2. [Intake Air Baffle Replacement](#) - Remove
3. Intake Air Splash Shield Retainer (1) @ Intake Air Splash Shield (2) - Remove [2x]



4. Intake Air Splash Shield Retainer (1) @ Intake Air Splash Shield (2) - Remove [2x]

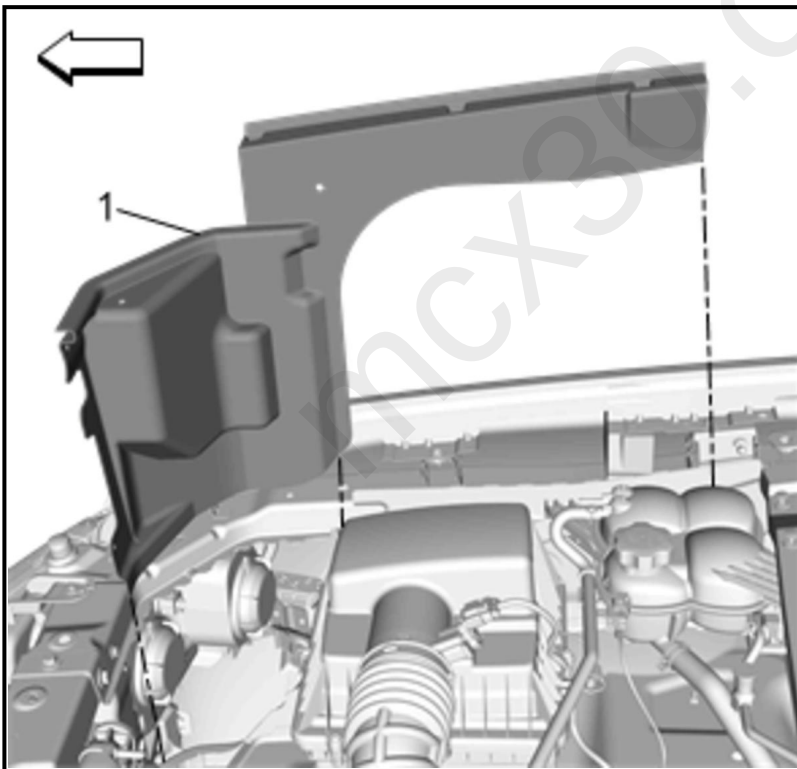


5. Intake Air Splash Shield (1) - Remove

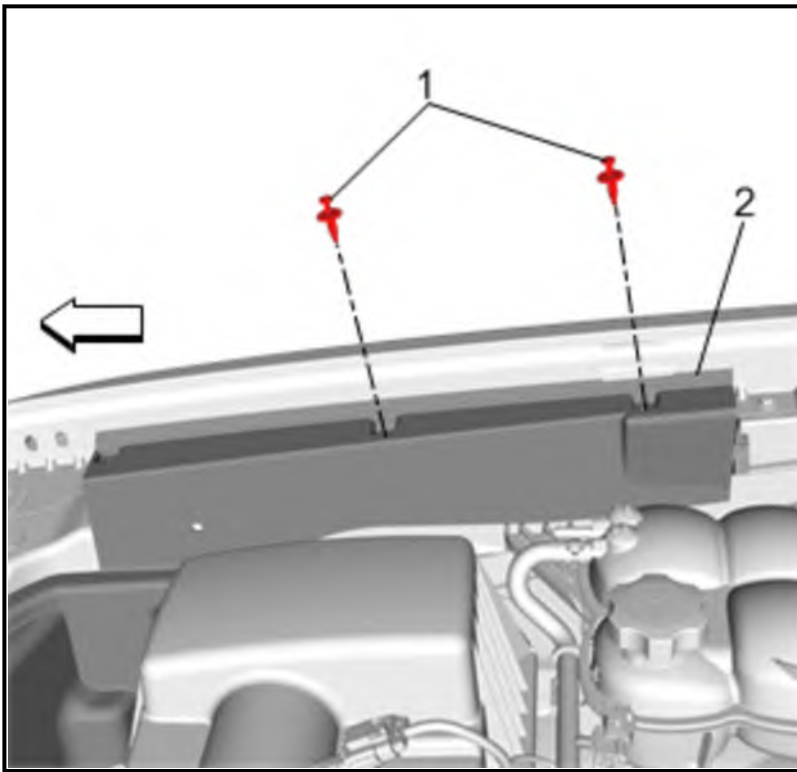


Installation Procedure

1. Intake Air Splash Shield (1) - Install

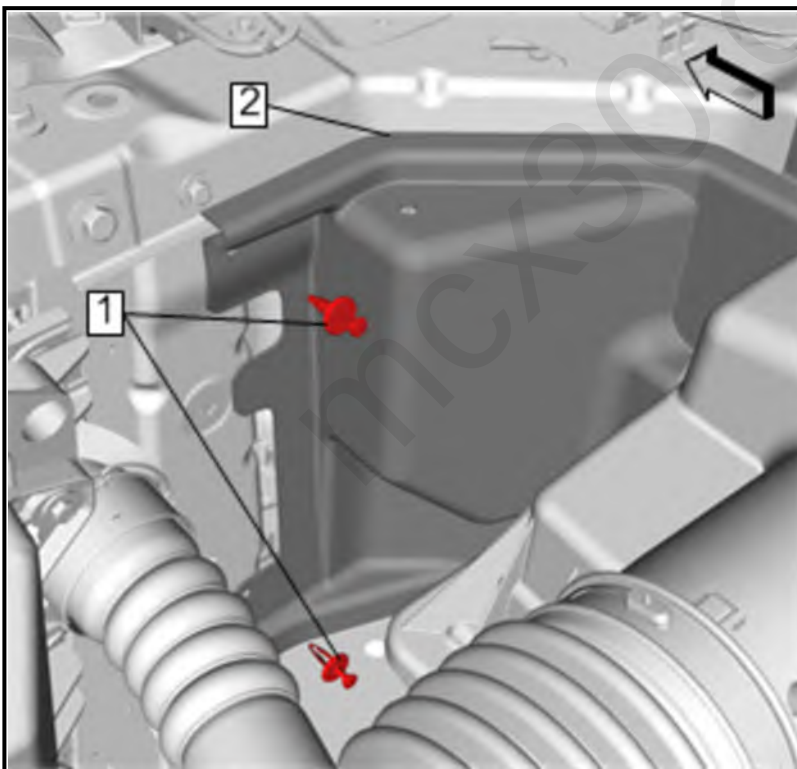


2. Intake Air Splash Shield Retainer (1) @ Intake Air Splash Shield (2) - Install [2x]



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

3. Intake Air Splash Shield Retainer (1) @ Intake Air Splash Shield (2) - Install [2x]



4. [Intake Air Baffle Replacement](#) - Install
 5. Radiator Vent Outlet Hose - Reposition and Clip - [Radiator Vent Outlet Hose Replacement \(LWN\)](#)

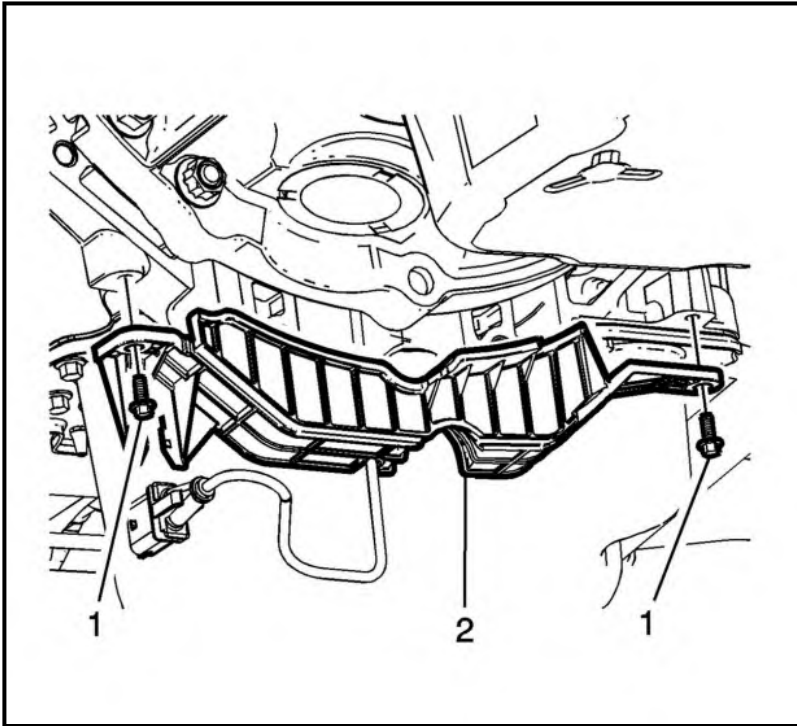
CRANKSHAFT POSITION SENSOR REPLACEMENT

Removal Procedure

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Drivetrain and Front Suspension Frame Front Crossmember - Remove - [Drivetrain and Front Suspension Frame Front Crossmember Replacement \(4 Wheel Drive\)](#) , or [Drivetrain and Front](#)

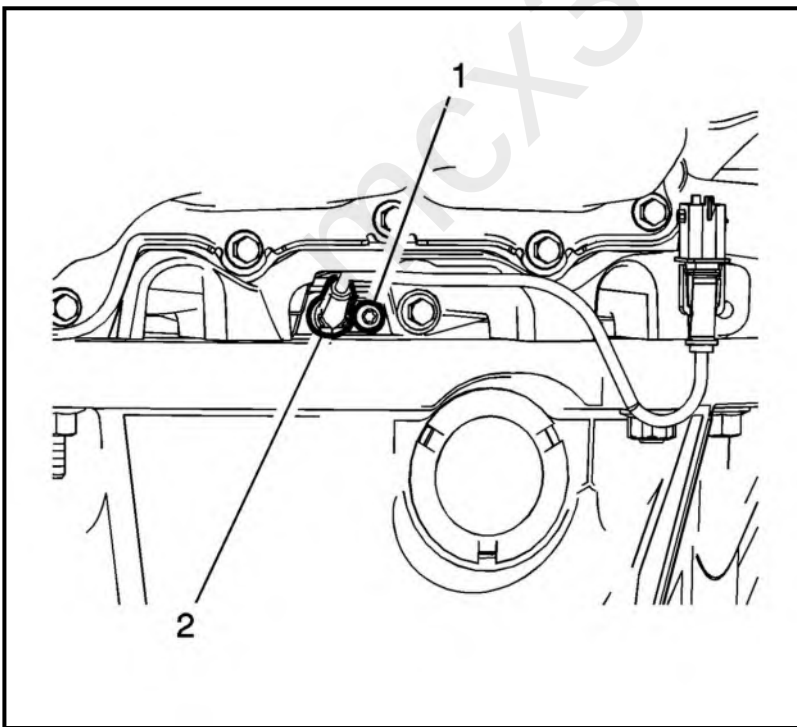
Suspension Frame Front Crossmember Replacement (2 Wheel Drive)

3. Remove the flywheel and crank shaft position sensor access cover fasteners (1).



NOTE: Unclip the crankshaft position sensor electrical wiring harness connector from the flywheel and crankshaft position sensor access cover.

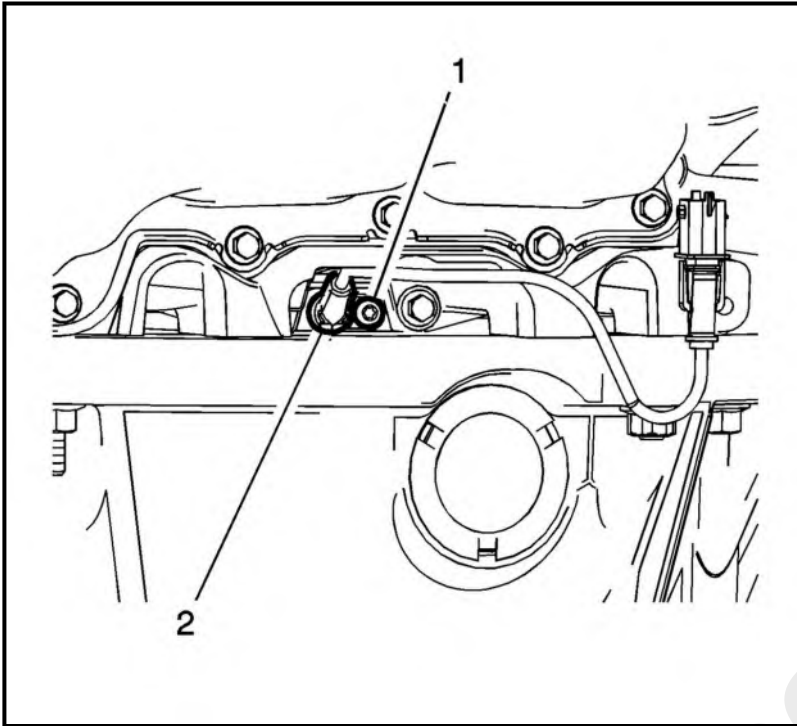
4. Remove the flywheel and crankshaft position sensor access cover (2).
5. Remove the crankshaft position sensor fastener (1) and remove the crankshaft position sensor (2).



CAUTION: Do not allow the crankshaft position sensor reluctor ring to come into contact with external magnetic fields or sharp metal objects. Do not drop the crankshaft position sensor reluctor ring. Do not damage the rubberized encoder track. Failure to follow these precautions may cause damage to the component.

Installation Procedure

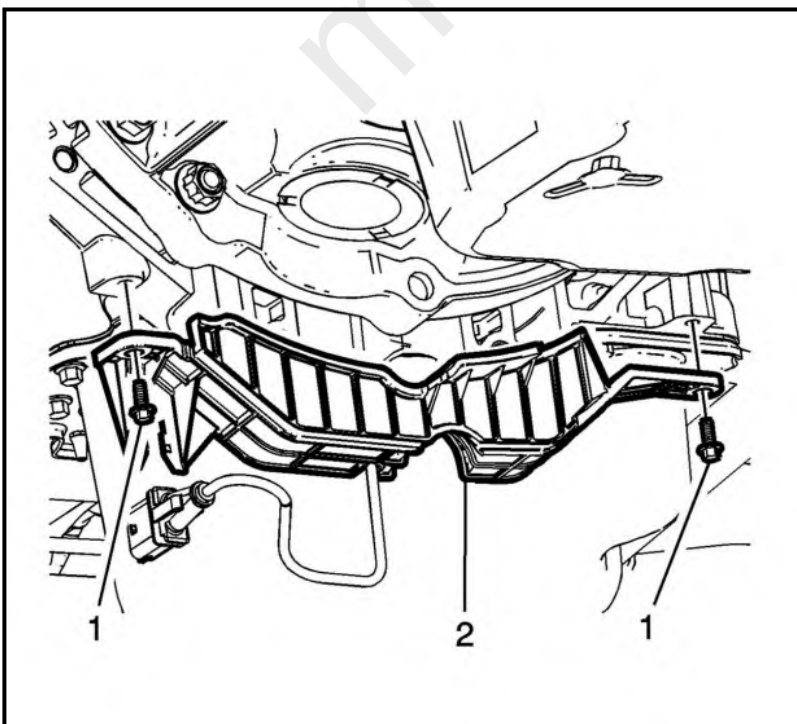
1. Install the crankshaft position sensor (2) and crankshaft position sensor fastener (1) and tighten the fastener to 5 N.m (44 lb in).



CAUTION: Do not allow the crankshaft position sensor reluctor ring to come into contact with external magnetic fields or sharp metal objects. Do not drop the crankshaft position sensor reluctor ring. Do not damage the rubberized encoder track. Failure to follow these precautions may cause damage to the component.

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

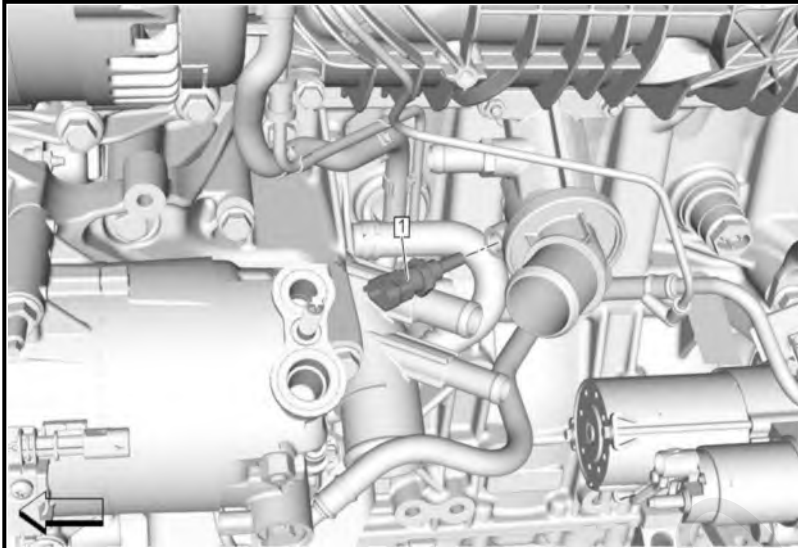
2. Position the flywheel and crankshaft position sensor access cover (2).



NOTE: Clip the crankshaft position sensor electrical wiring harness connector to the flywheel and crankshaft position sensor access cover.

3. Install the flywheel and crank shaft position sensor access cover fasteners (1) and tighten to 10 N.m (89 lb in).
4. Drivetrain and Front Suspension Frame Front Crossmember - Install - [Drivetrain and Front Suspension Frame Front Crossmember Replacement \(4 Wheel Drive\)](#) , or [Drivetrain and Front Suspension Frame Front Crossmember Replacement \(2 Wheel Drive\)](#).
5. Remove the supports and lower the vehicle.
6. Perform the crankshaft position variation learn. [Crankshaft Position Variation Learn](#)

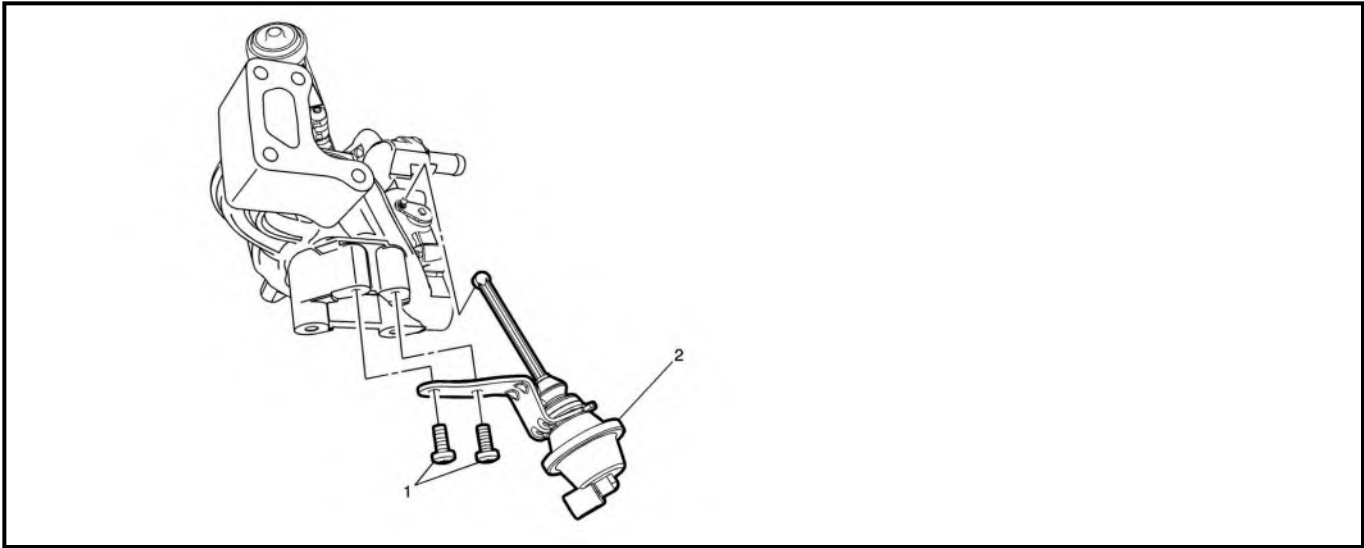
ENGINE COOLANT TEMPERATURE SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Exhaust Gas Recirculation Valve Replacement	
1	Engine Coolant Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution . Procedure Disconnect the electrical connector from the engine coolant temperature sensor. Tighten 15 N.m (11 lb ft)

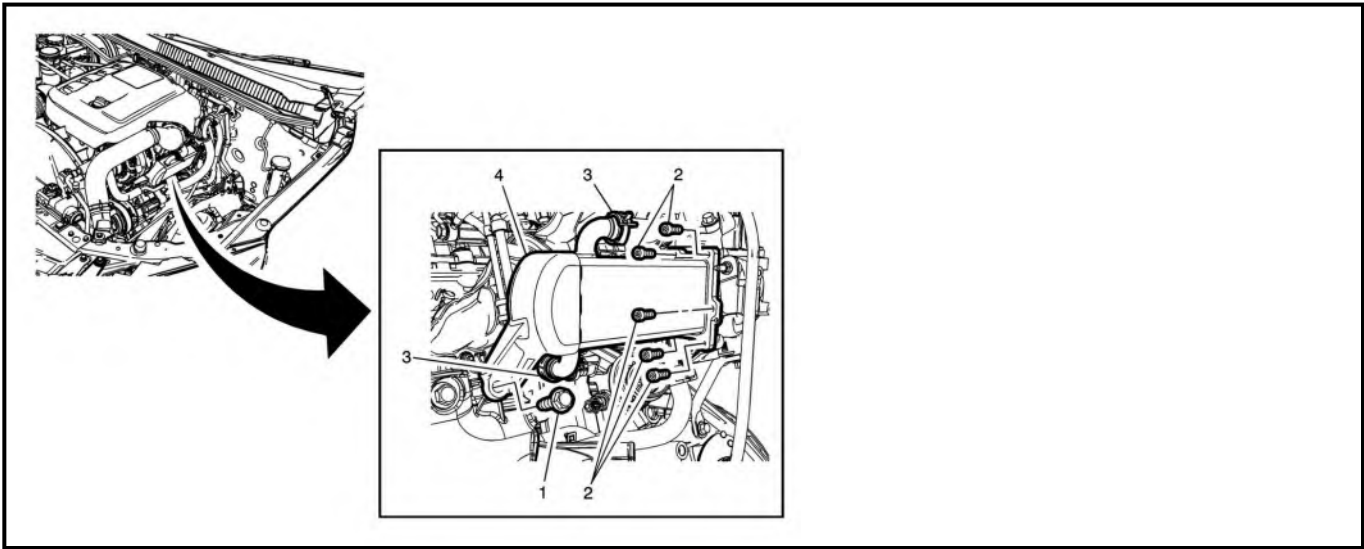
EXHAUST GAS RECIRCULATION COOLER BYPASS VALVE ACTUATOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Remove the exhaust gas recirculation valve assembly. Refer to Exhaust Gas Recirculation Valve Replacement .	
1	Exhaust Gas Recirculation Cooler Bypass Valve Actuator Fastener (Qty: 2) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Exhaust Gas Recirculation Cooler Bypass Valve Actuator Procedure Disconnect the bypass actuator arm from the EGR bypass door.

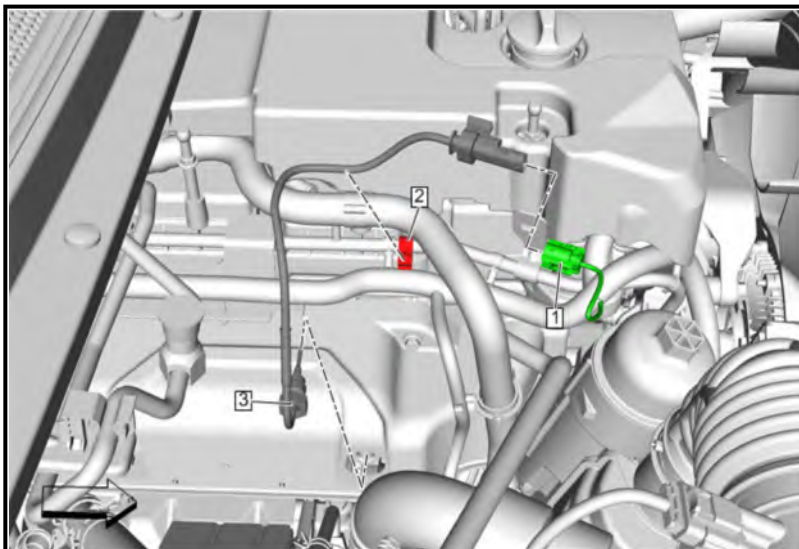
EXHAUST GAS RECIRCULATION COOLER REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures <u>Generator Replacement (LWN)</u> <u>Air Conditioning Compressor Replacement (LWN)</u> <u>Radiator Inlet Hose Replacement (LWN Radiator Side)</u> , or <u>Radiator Inlet Hose Replacement (LWN Engine Side)</u> <u>Radiator Upper Bracket Replacement</u>	
1	Exhaust Gas Recirculation Cooler Bolt @ Air Conditioning Compressor Bracket CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
2	Exhaust Gas Recirculation Cooler Bolt @ Exhaust Gas Recirculation Valve Machined Housing [6x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 15 N.m (11 lb ft)
3	Exhaust Gas Recirculation Valve Coolant Hose Clamps (Qty: 2)
4	Exhaust Gas Recirculation Valve Cooler Procedure Exhaust Gas Recirculation Cooler Gasket - Install a NEW gasket.

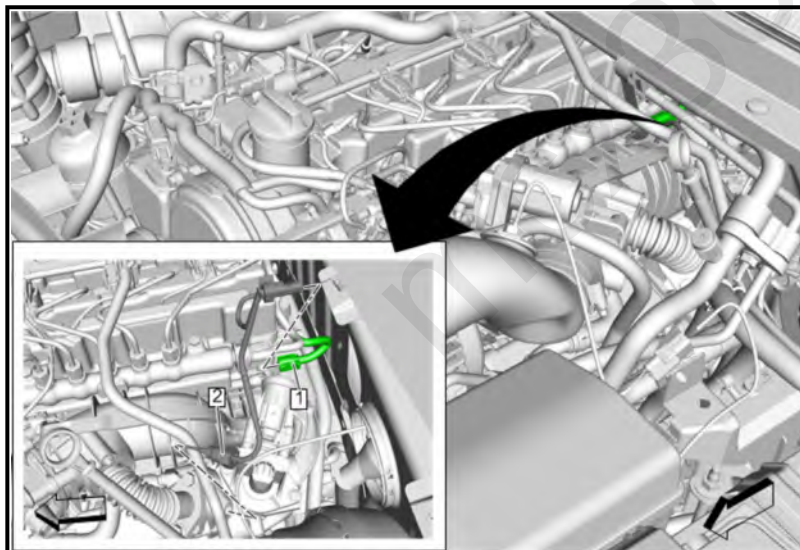
EXHAUST GAS RECIRCULATION COOLER TEMPERATURE SENSOR REPLACEMENT - POSITION 1



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Replacement</u>	
1	Electrical Connector
2	Retainer
3	Exhaust Gas Recirculation Cooler Temperature Sensor CAUTION: Refer to <u>Component</u> <u>Fastener</u> <u>Tightening</u> <u>Caution</u> . Procedure 1. If replacing, perform the exhaust gas temperature sensor reset. <u>Exhaust Gas Temperature Sensor Reset</u> 2. If replacing, perform the NOx catalyst reductant loading reset. <u>NOx Catalyst Reductant Loading Reset</u> Tighten 45 N.m (33 lb ft)

EXHAUST GAS RECIRCULATION COOLER TEMPERATURE SENSOR REPLACEMENT - POSITION 2



NOTE: Callouts in the following chart represent components shown in graphic above.

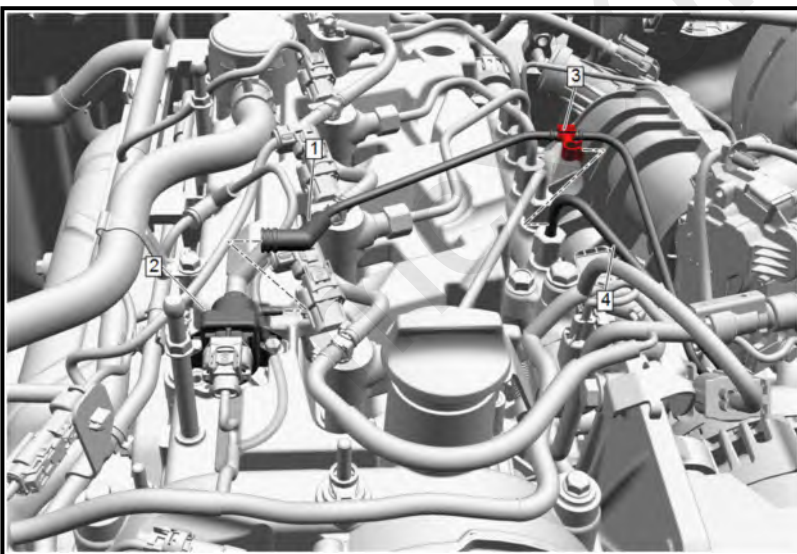
Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Insulator Replacement (Top of Engine)</u> , or <u>Intake Manifold Cover Insulator Replacement (Left Side)</u>	
1	Electrical Connector
2	Exhaust Gas Recirculation Cooler Temperature Sensor CAUTION:

Callout	Component Name
	Refer to <u>Component</u> <u>Fastener</u> <u>Tightening</u> <u>Caution</u> . Procedure 1. If replacing, perform the exhaust gas temperature sensor reset. <u>Exhaust Gas Temperature Sensor Reset</u> 2. If replacing, perform the NOx catalyst reductant loading reset. <u>NOx Catalyst Reductant Loading Reset</u> Tighten 45 N.m (33 lb ft)

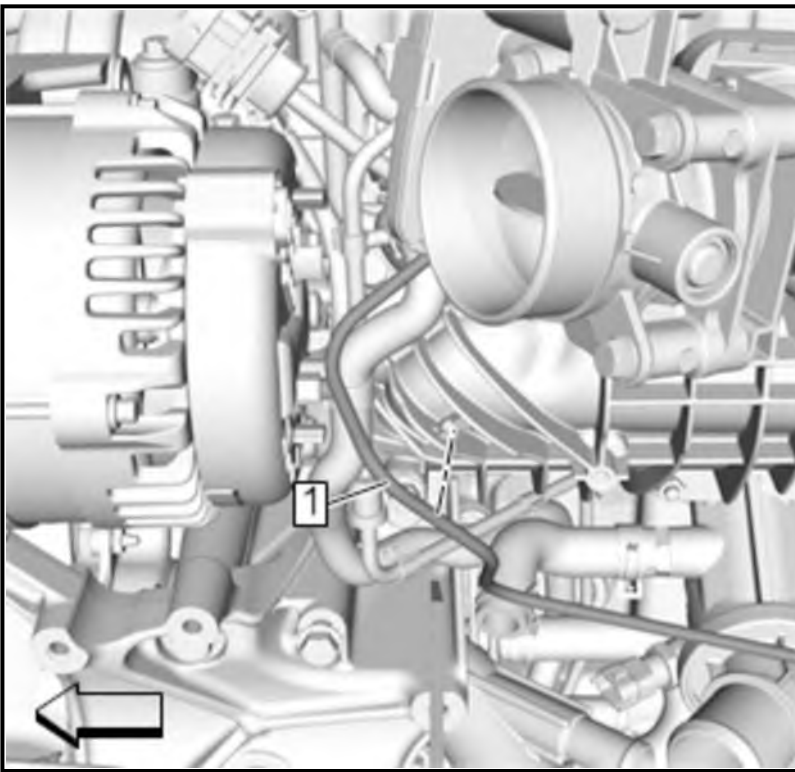
EXHAUST GAS RECIRCULATION VALVE VACUUM PIPE REPLACEMENT

Removal Procedure

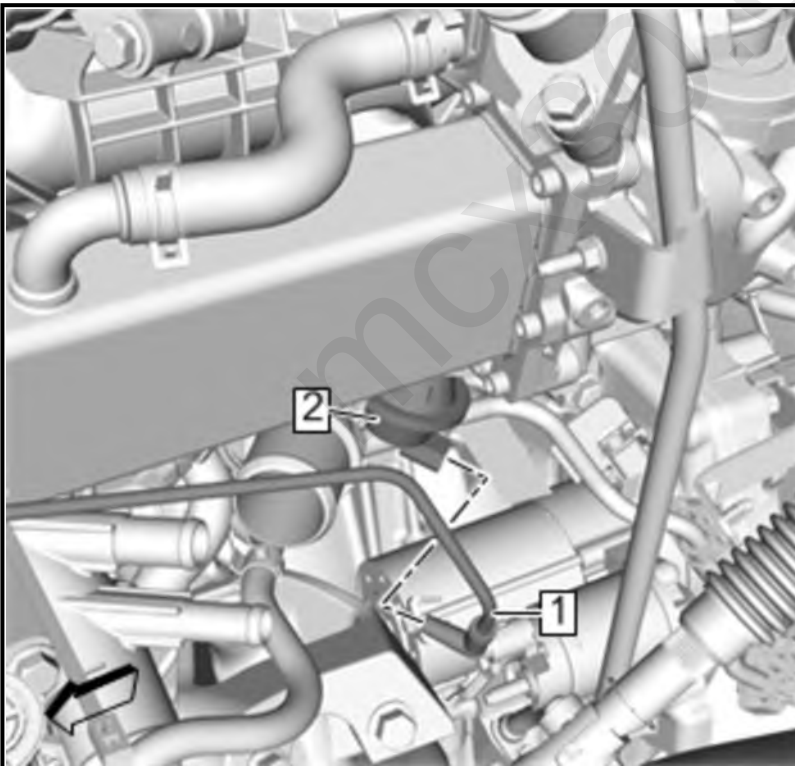
1. **Intake Manifold Cover Insulator Replacement (Top of Engine)** , or **Intake Manifold Cover Insulator Replacement (Left Side)** - Remove
2. **Charge Air Cooler Outlet Duct Replacement** - Remove
3. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Intake Manifold Tuning Vacuum Control Solenoid Valve (2) - Disconnect



4. Retainer (3) @ Fuel Feed Pipe (4) - Unclip
5. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Intake Manifold - Unclip



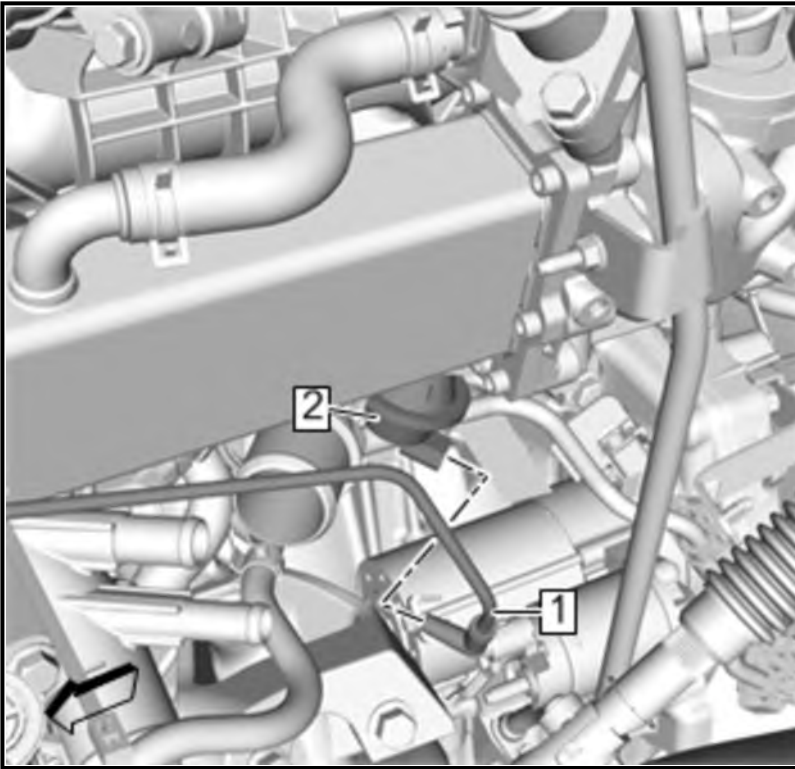
6. Remove left wheel to gain access to the lower portion of the pipe. [Tire and Wheel Removal and Installation](#)
7. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Exhaust Gas Recirculation Valve Cooler Bypass Valve Actuator (2) - Disconnect



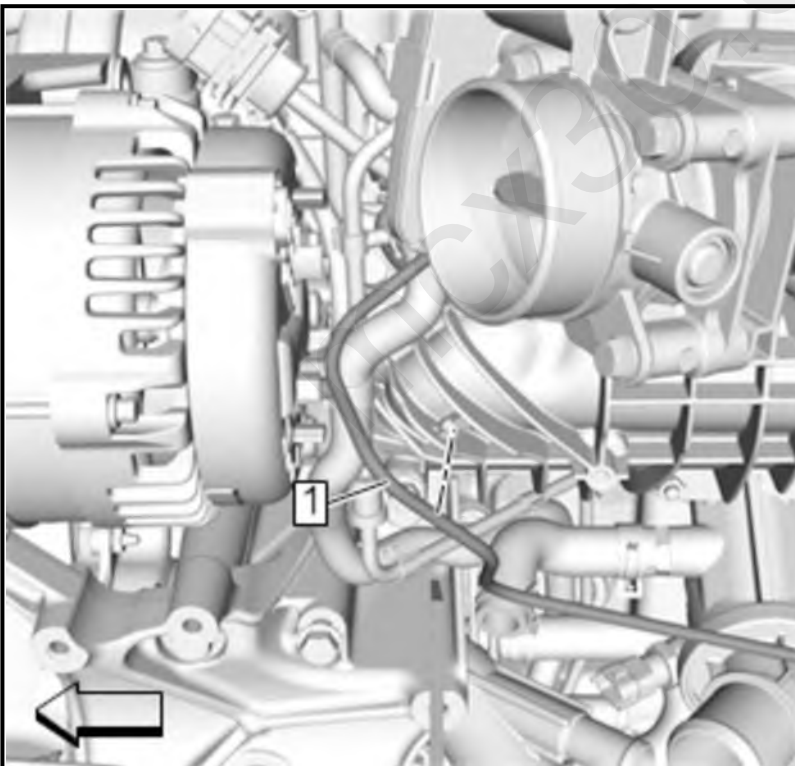
8. Remove the exhaust gas recirculation valve vacuum pipe from the vehicle from the top of the engine area.

Installation Procedure

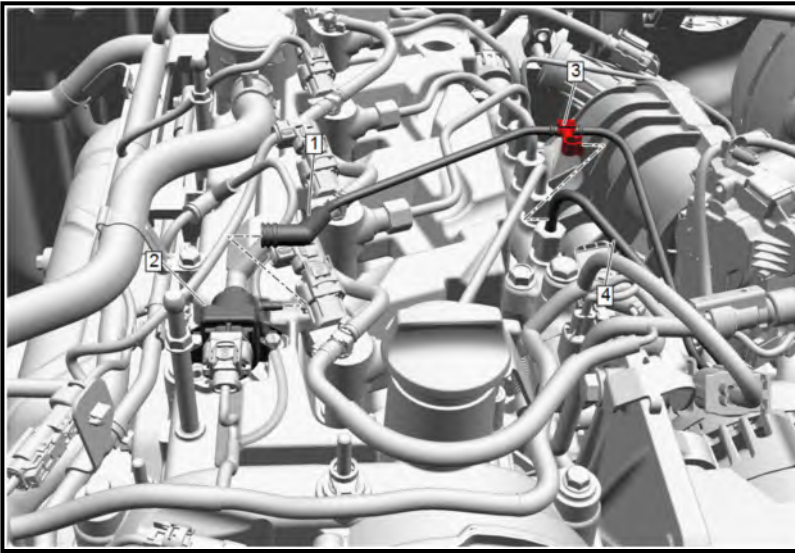
1. Install the exhaust gas recirculation valve vacuum pipe from the vehicle from the top of the engine area.



2. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Exhaust Gas Recirculation Valve Cooler Bypass Valve Actuator (2) - Connect
3. Install left wheel. [Tire and Wheel Removal and Installation](#)
4. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Intake Manifold - Install



5. Retainer (3) @ Fuel Feed Pipe (4) - Install

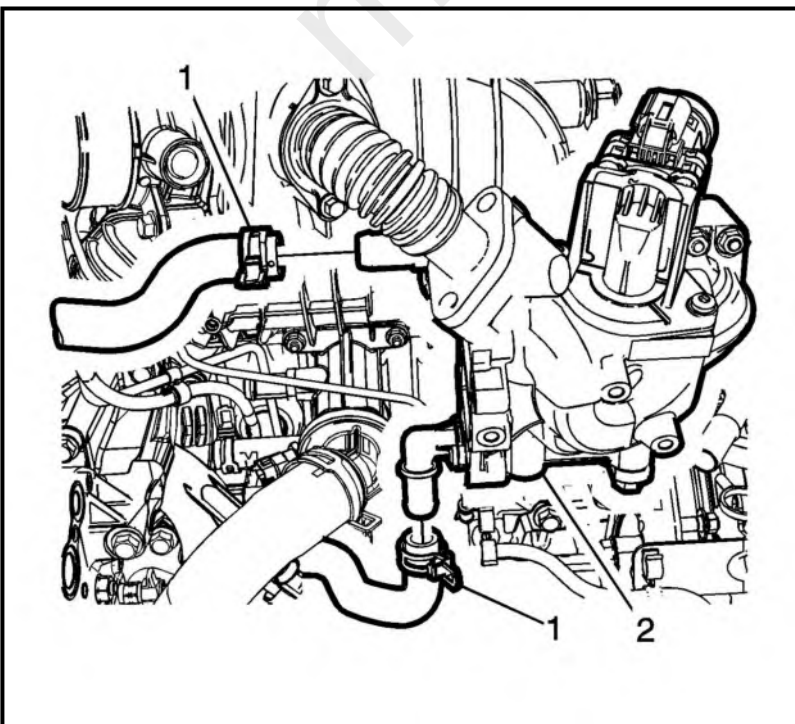


6. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Intake Manifold Tuning Vacuum Control Solenoid Valve (2) - Connect
7. [Charge Air Cooler Outlet Duct Replacement](#) - Install
8. [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#) - Install

EXHAUST GAS RECIRCULATION VALVE REPLACEMENT

Removal Procedure

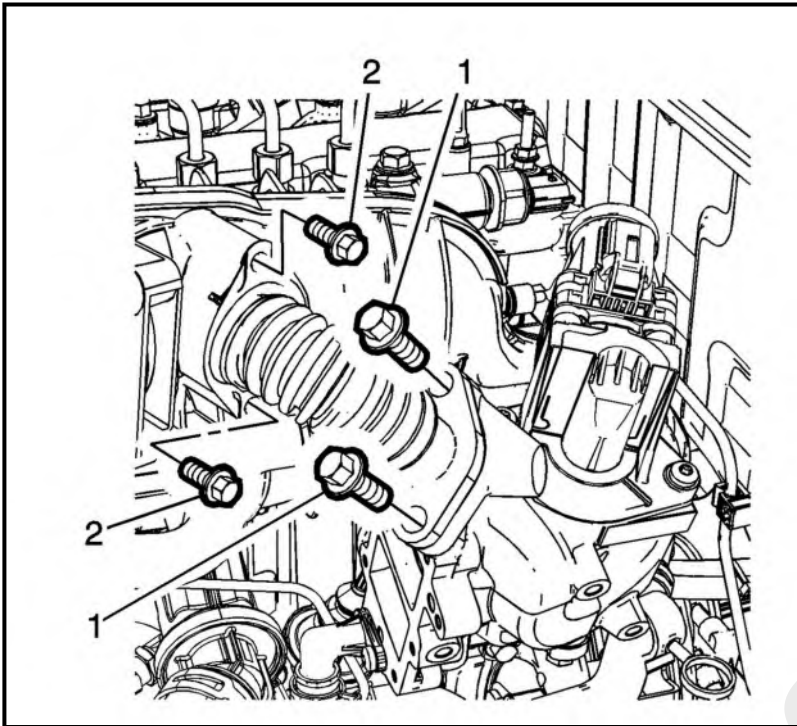
1. Intake Manifold Cover Insulator - Remove - [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#)
2. Charge Air Cooler Outlet Duct - Remove - [Charge Air Cooler Outlet Duct Replacement](#)
3. Plenum Front Panel - Remove - [Plenum Front Panel Replacement](#)
4. Power Brake Booster Vacuum Hose @ Power Brake Booster - Disconnect - [Power Brake Booster Vacuum Hose Replacement \(LWN\)](#)
5. Exhaust Gas Recirculation Cooler - Remove - [Exhaust Gas Recirculation Cooler Replacement](#)
6. Disconnect the cooler hoses (1) at the exhaust gas recirculation (EGR) valve housing assembly (2) and reposition.



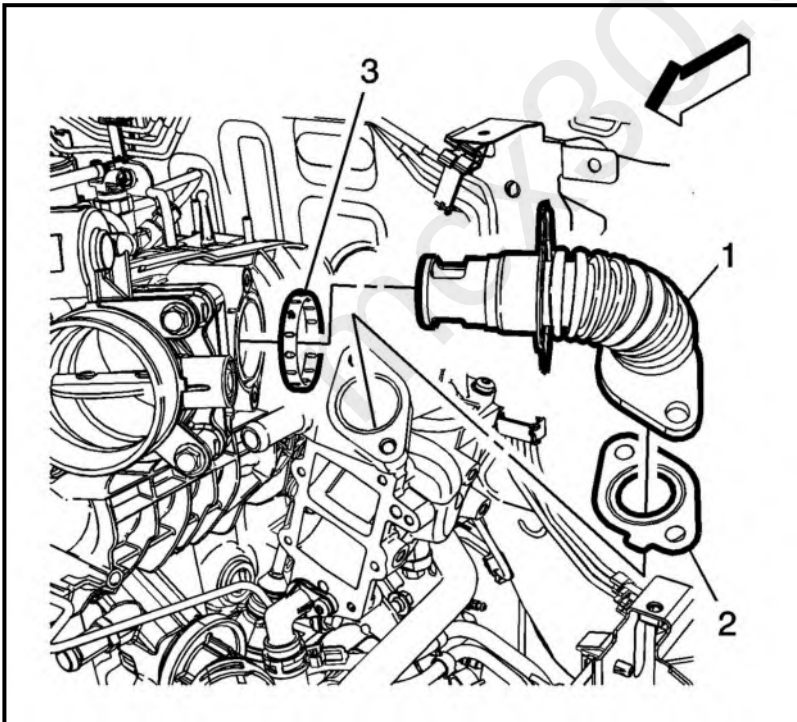
DISCARD the cooler hose clamps.

7. Oil Level Indicator Tube - Remove - [Oil Level Indicator Tube Replacement](#)

8. Remove the EGR pipe fasteners (1) and (2).



9. Remove the EGR pipe (1).

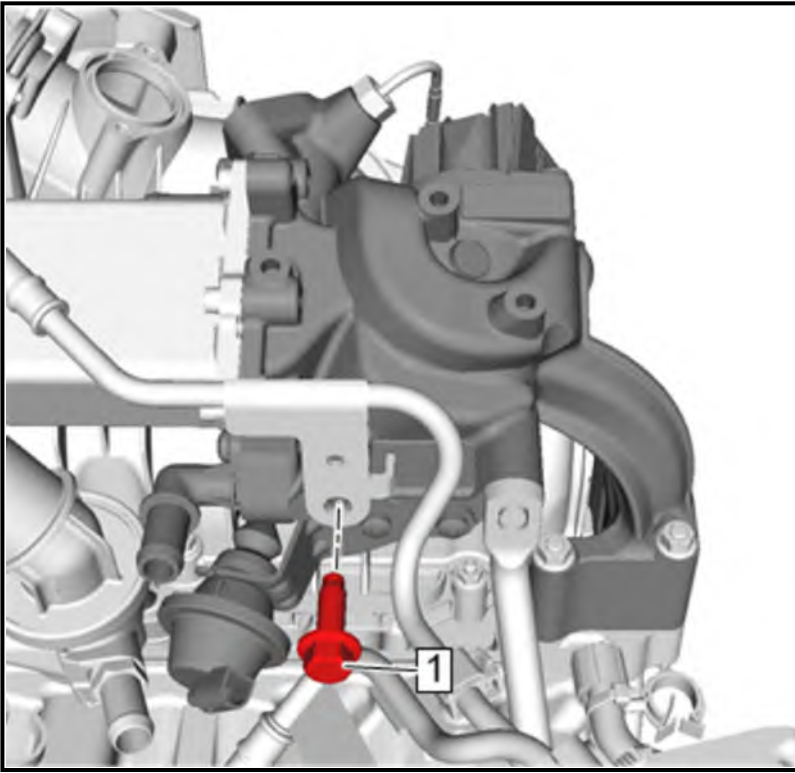


10. Remove the EGR pipe gasket (2) and EGR pipe seal (3).

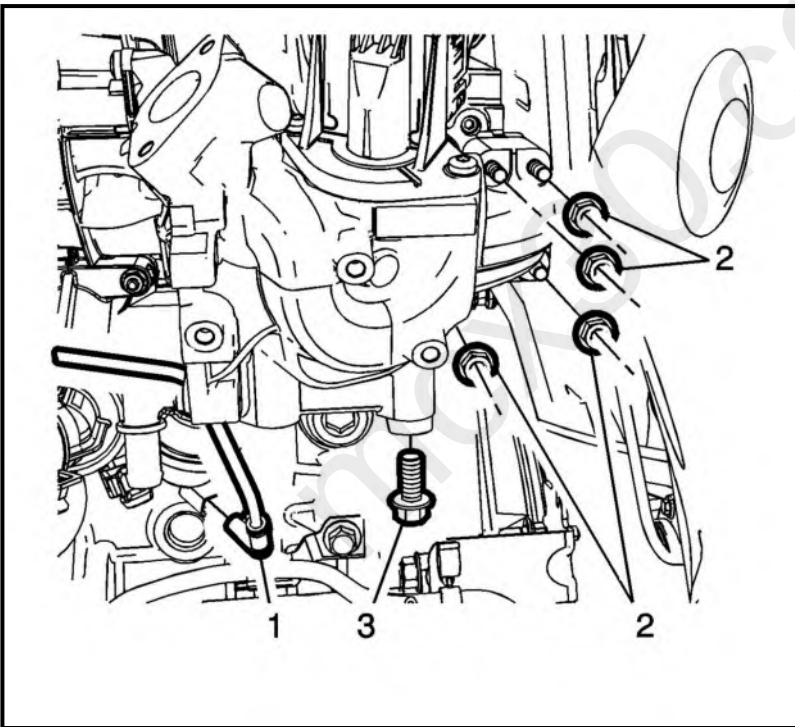
DISCARD the seal and gasket.

11. Front Wheelhouse Liner Left Side - Remove - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#)

12. Fuel Return Hose Bracket Bolt (1) - Remove



13. Disconnect the EGR bypass valve vacuum tube (1).



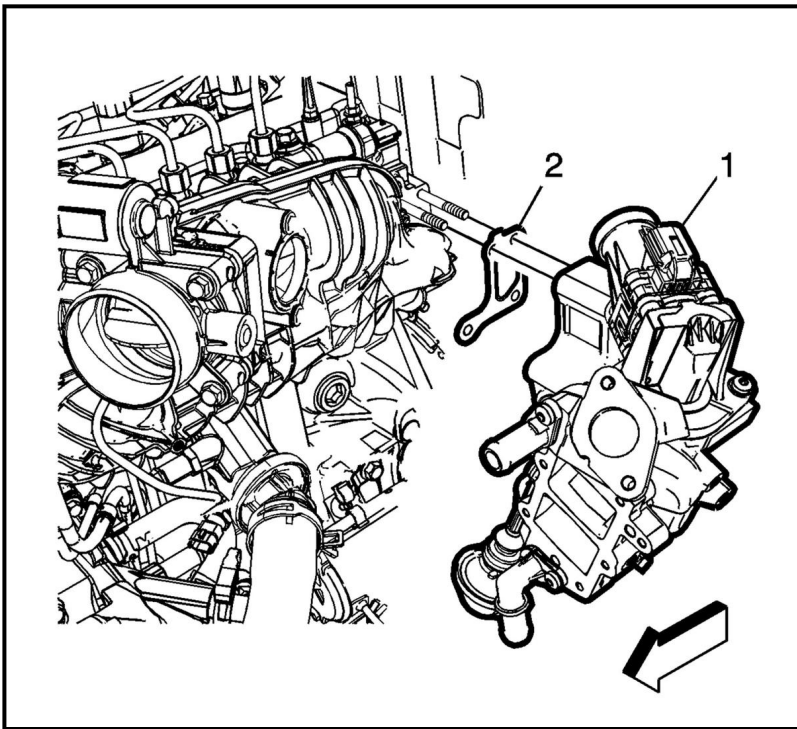
14. Exhaust Gas Recirculation Valve Adapter Nut (2) - Remove [4x]

15. Exhaust Gas Recirculation Manifold Brace Bolt (3) - Remove

16. Disconnect the EGR valve electrical connector.

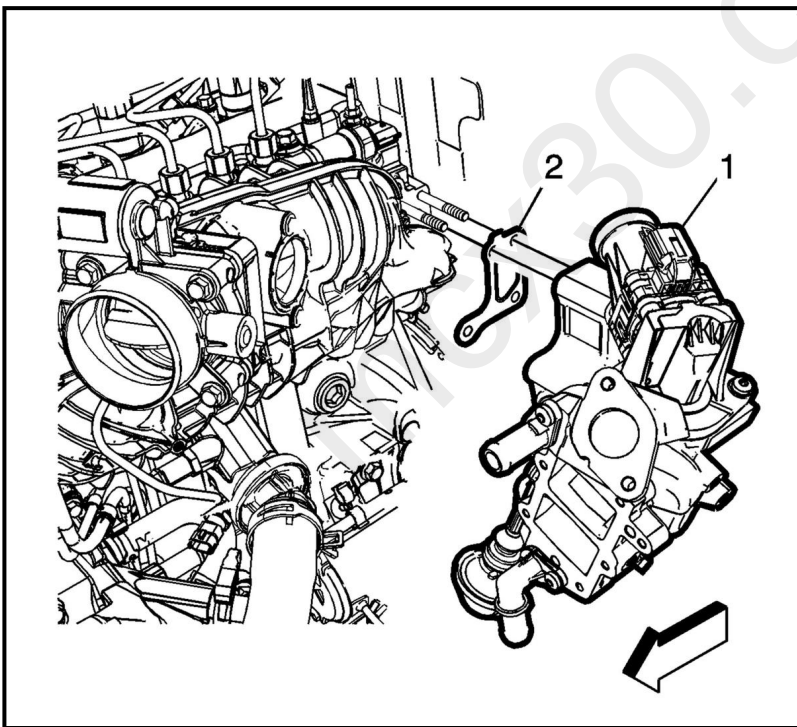
17. Disconnect the EGR cooler temperature sensor electrical connector. [Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 1](#)

18. Remove the EGR valve housing assembly (1) and gasket (2).

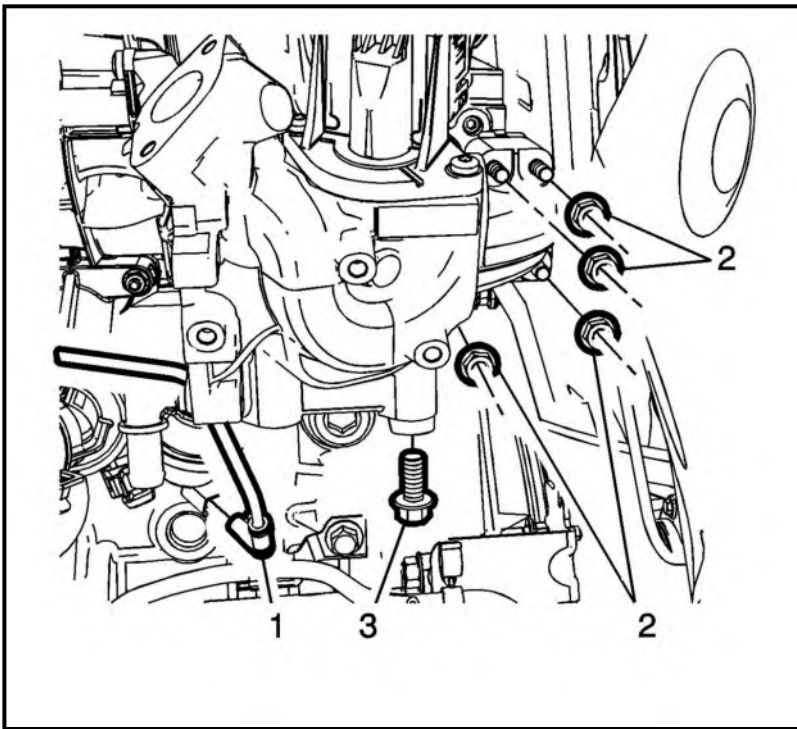


Installation Procedure

1. Position the EGR valve housing assembly gasket (2) and EGR valve housing assembly (1) in place and hand start the fasteners.

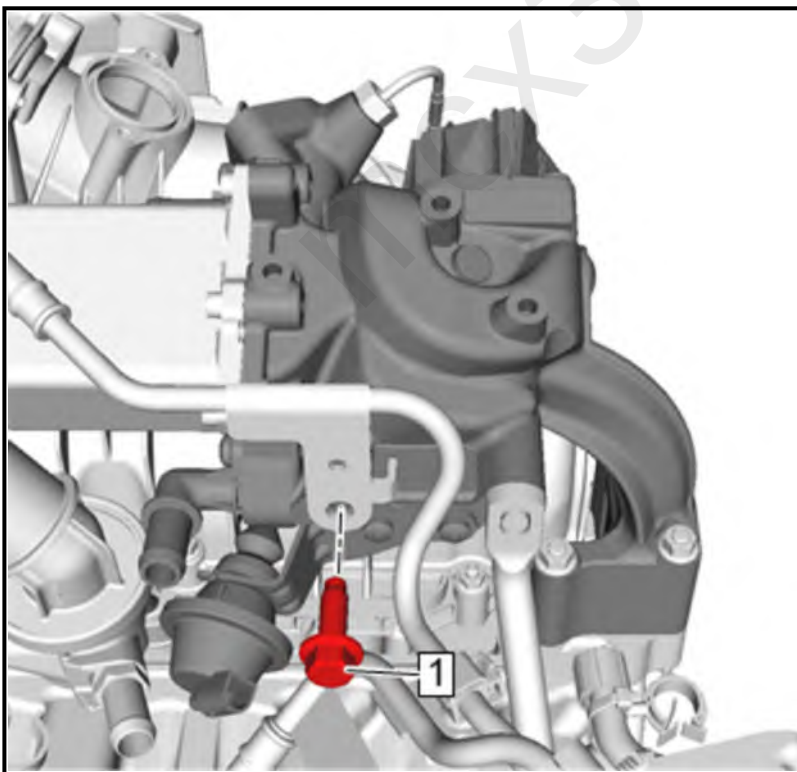


2. Exhaust Gas Recirculation Valve Adapter Nut (2) - Install and tighten [4x] 25 N.m (18 lb ft)

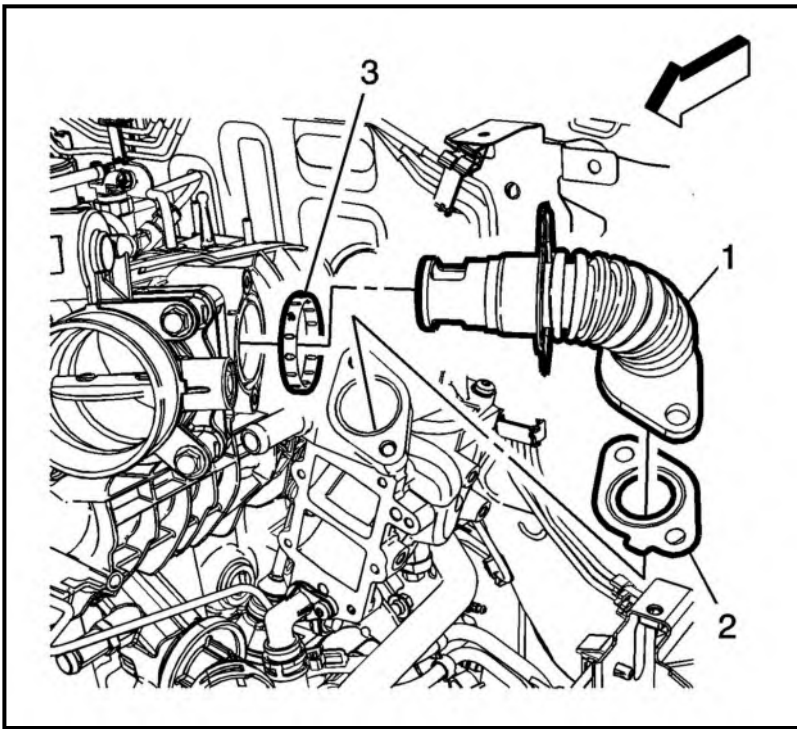


CAUTION: Refer to [Fastener Caution](#) .

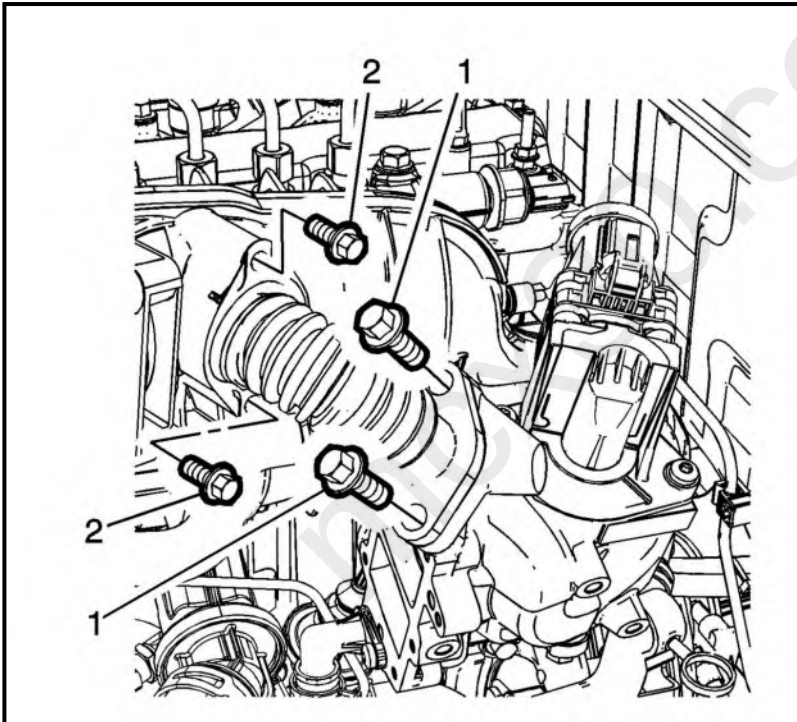
3. Exhaust Gas Recirculation Manifold Brace Bolt (3) - Install and tighten 58 N.m (43 lb ft)
4. Connect the EGR bypass vacuum tube (1).
5. Connect the EGR cooler temperature sensor electrical connector. [Exhaust Gas Recirculation Cooler Temperature Sensor Replacement - Position 1](#)
6. Connect the EGR valve electrical connector.
7. Fuel Return Hose Bracket Bolt (1) - Install and tighten 22 N.m (16 lb ft)



8. Front Wheelhouse Liner Left Side - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#)
9. Position the NEW EGR pipe seal (3), NEW gasket (2), and pipe in place then hand start the fasteners.



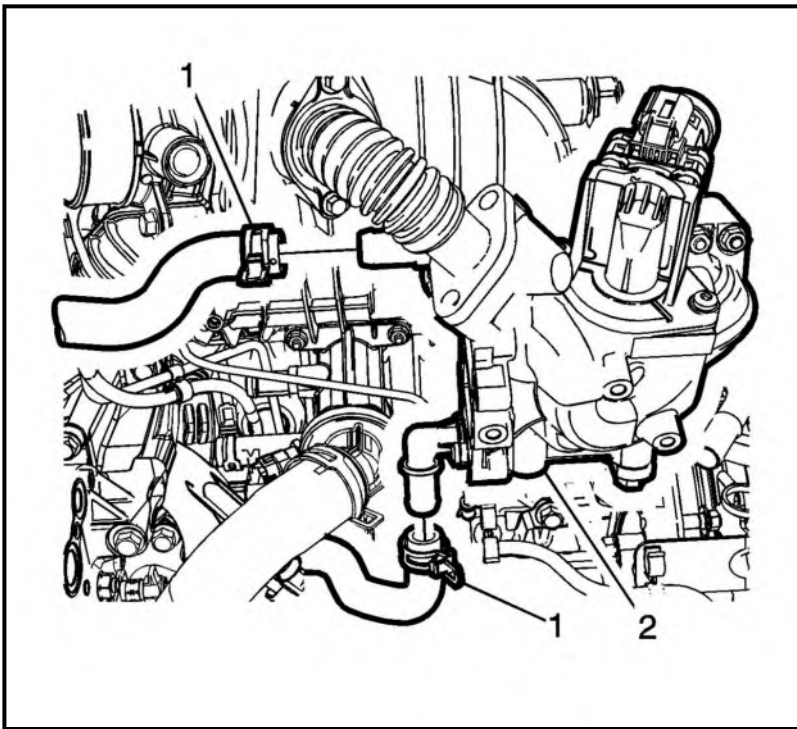
10. Tighten the EGR pipe fasteners (1) to 25 N.m (18 lb ft).



11. Tighten the EGR pipe fasteners (2) to 11 N.m (97 lb in).

12. Oil Level Indicator Tube - Install - [Oil Level Indicator Tube Replacement](#)

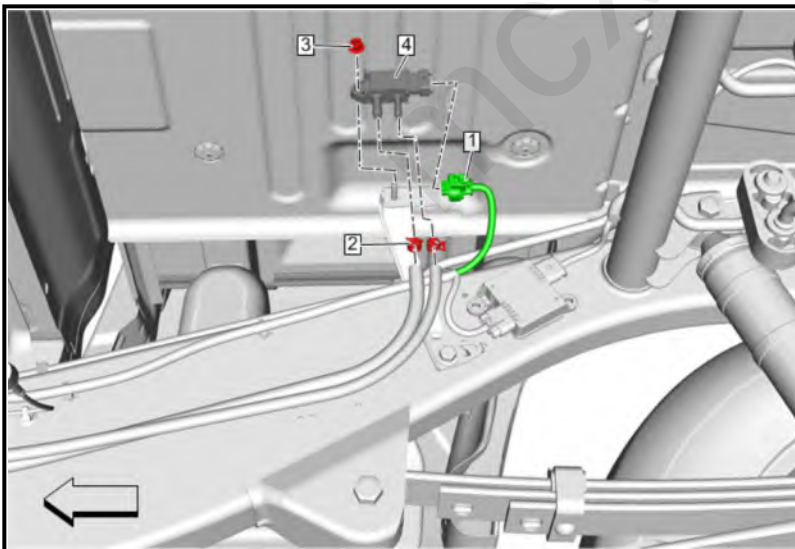
13. Connect the cooler hoses (1) to the EGR valve housing (2).



Install NEW cooler hose clamps.

14. Exhaust Gas Recirculation Cooler - Install - [Exhaust Gas Recirculation Cooler Replacement](#)
15. Power Brake Booster Vacuum Hose @ Power Brake Booster - Connect - [Power Brake Booster Vacuum Hose Replacement \(LWN\)](#)
16. Plenum Front Panel - Install - [Plenum Front Panel Replacement](#)
17. Charge Air Cooler Outlet Duct - Install - [Charge Air Cooler Outlet Duct Replacement](#)
18. Intake Manifold Cover Insulator - Install - [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#)

EXHAUST PRESSURE DIFFERENTIAL SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

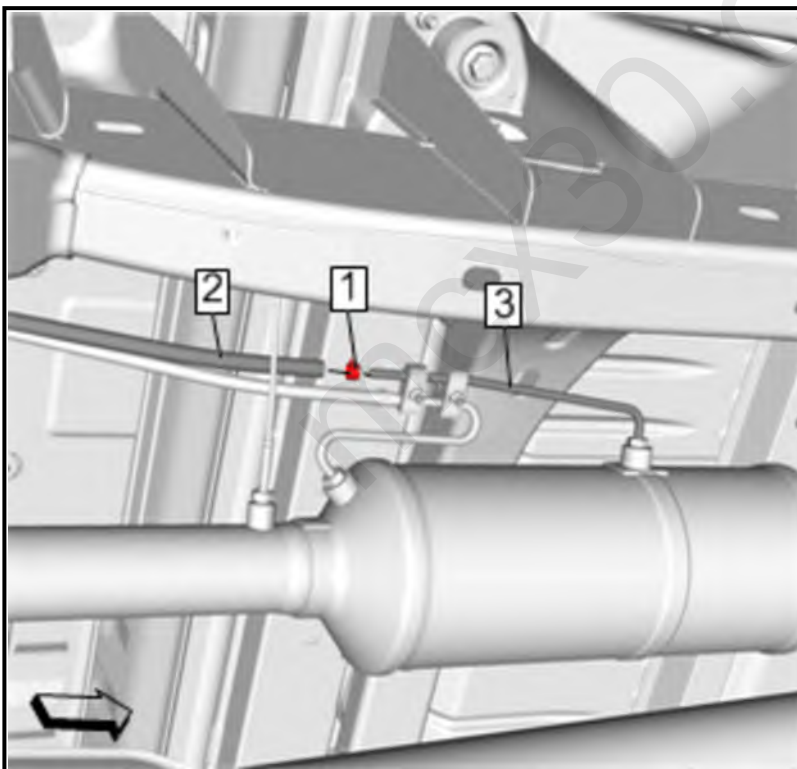
Callout	Component Name
Preliminary Procedure	
Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Electrical Connector

Callout	Component Name
2	Hose Clamp [2x] Procedure Install NEW clamps to ensure proper hose sealing.
3	Exhaust Pressure Differential Sensor Fastener CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Procedure If replacing, perform the DPF pressure sensor reset. <u>DPF Pressure Sensor Reset</u> Tighten 7 N.m (62 lb in)
4	Exhaust Pressure Differential Sensor

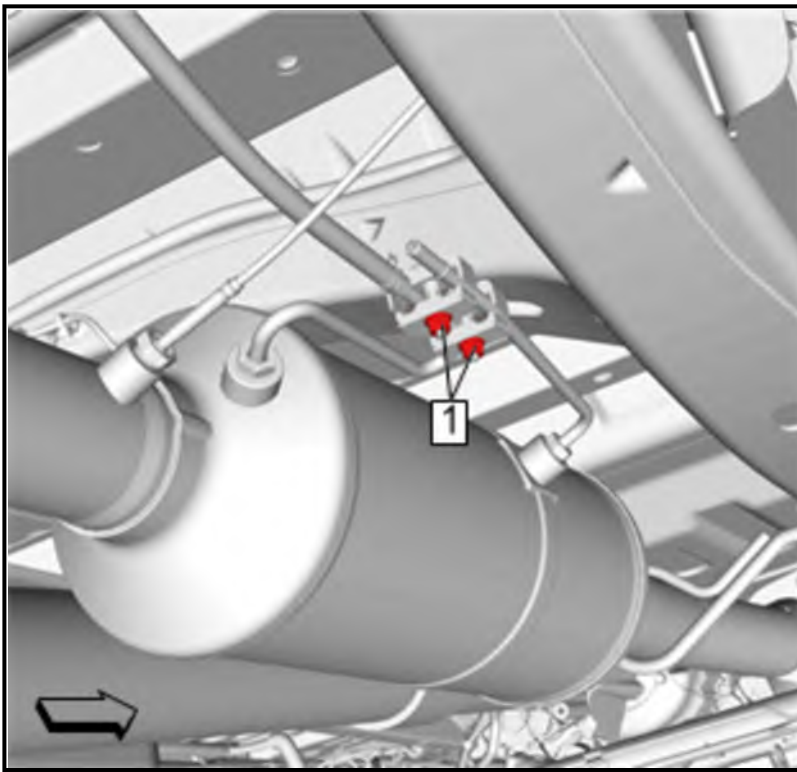
EXHAUST PRESSURE DIFFERENTIAL SENSOR PIPE REPLACEMENT (POSITION 1)

Removal Procedure

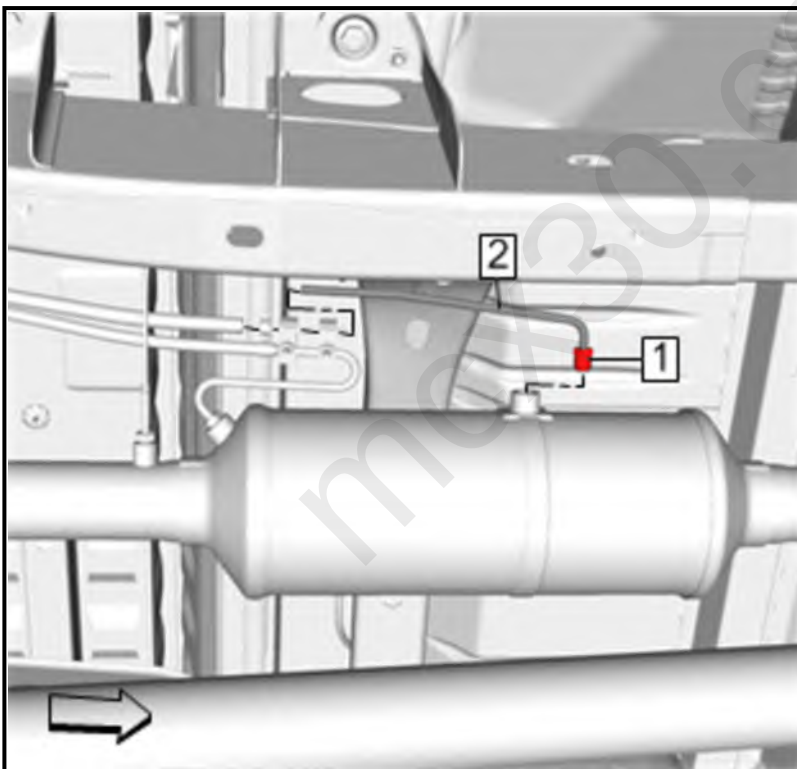
1. **Lifting and Jacking the Vehicle** Raise the vehicle.
2. Hose Clamp (1) - Loosen



3. Exhaust Pressure Sensor Hose (2) @ Exhaust Pressure Sensor Pipe (3) - Disconnect
4. Hose Clamp (1) - Remove and DISCARD
5. Exhaust Pressure Differential Sensor Pipe Clamp Nut (1) - Loosen [2x]



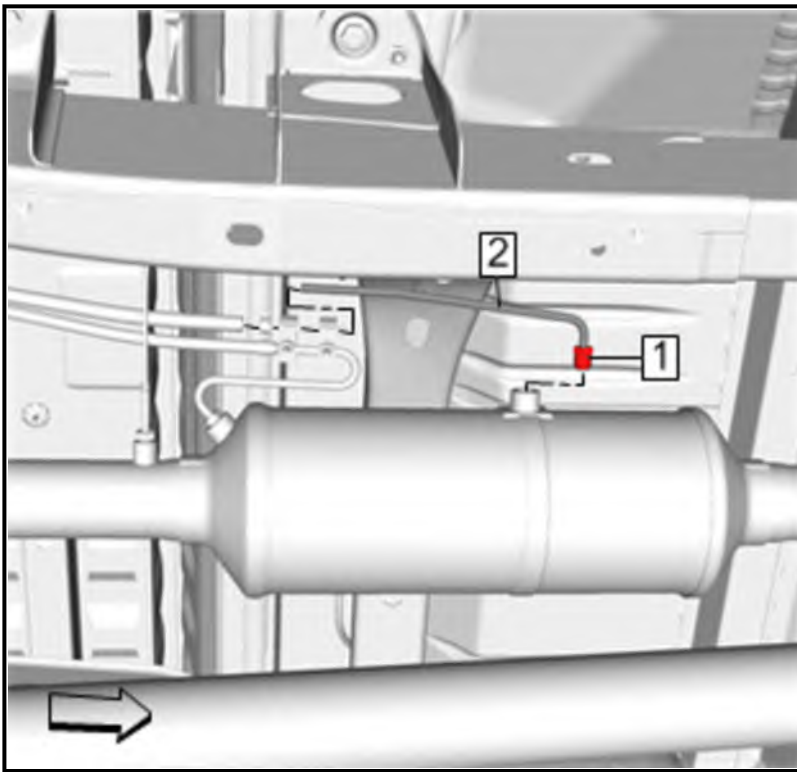
6. Exhaust Pressure Differential Sensor Nut (1) - Loosen



7. Exhaust Pressure Sensor Pipe (2) - Remove

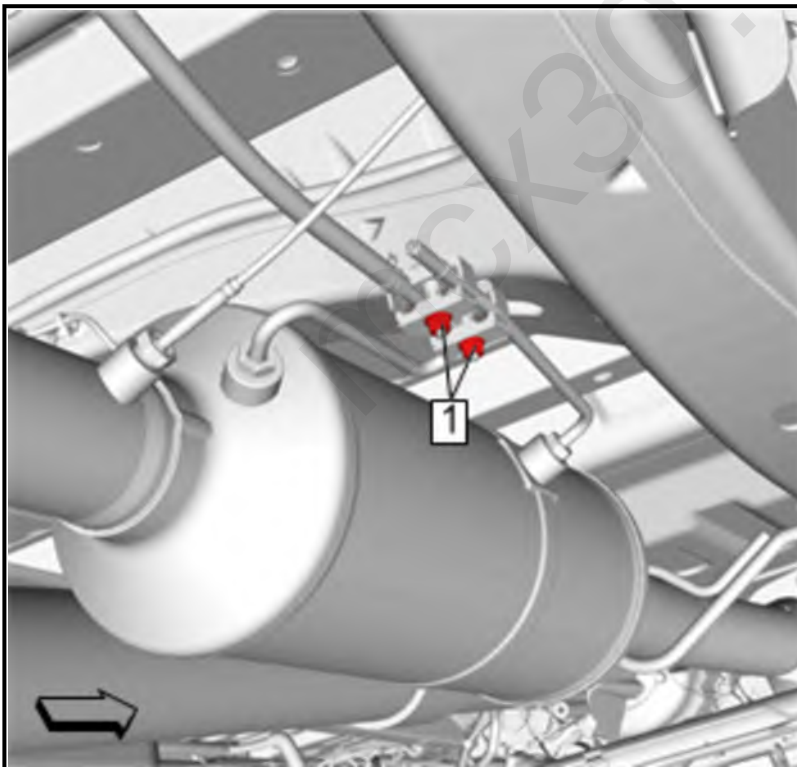
Installation Procedure

1. Exhaust Pressure Sensor Pipe (2) - Install



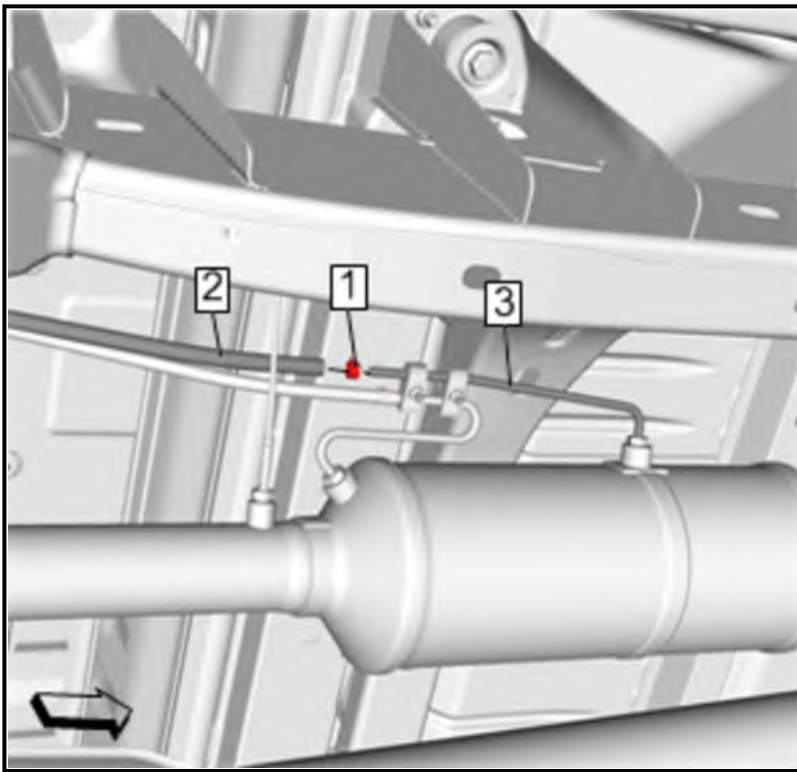
CAUTION: Refer to [Component Fastener Tightening Caution](#) .

2. Exhaust Pressure Differential Sensor Nut (1) - Tighten 45 N.m (33 lb ft)
3. Exhaust Pressure Differential Sensor Pipe Clamp Nut (1) - Tighten [2x] 9 N.m (80 lb in)



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

4. Hose Clamp (1) @ Exhaust Pressure Sensor Hose (2) - Loosely install



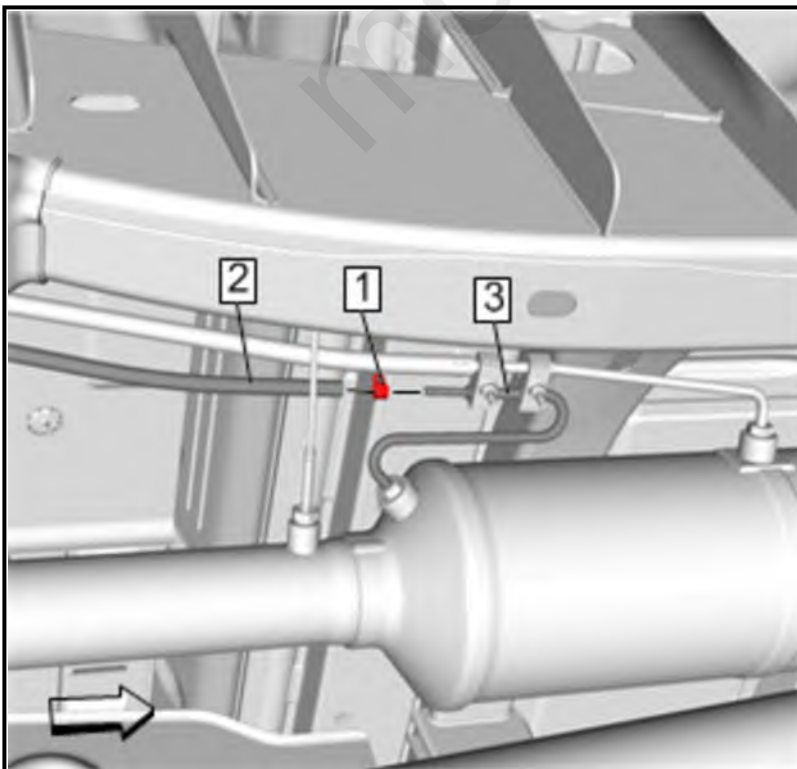
NOTE: Install a NEW hose clamp.

5. Exhaust Pressure Sensor Hose (2) @ Exhaust Pressure Sensor Pipe (3) - Connect
6. Secure the Exhaust Pressure Sensor Hose (2) with the Hose Clamp (1).
7. Lifting and Jacking the Vehicle - Lower the vehicle.

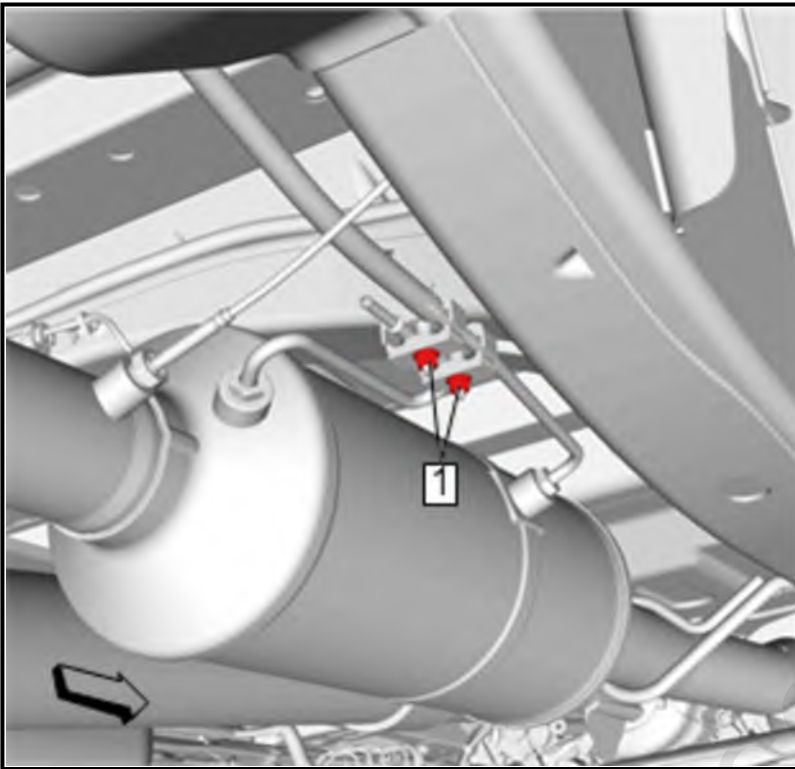
EXHAUST PRESSURE DIFFERENTIAL SENSOR PIPE REPLACEMENT (POSITION 2)

Removal Procedure

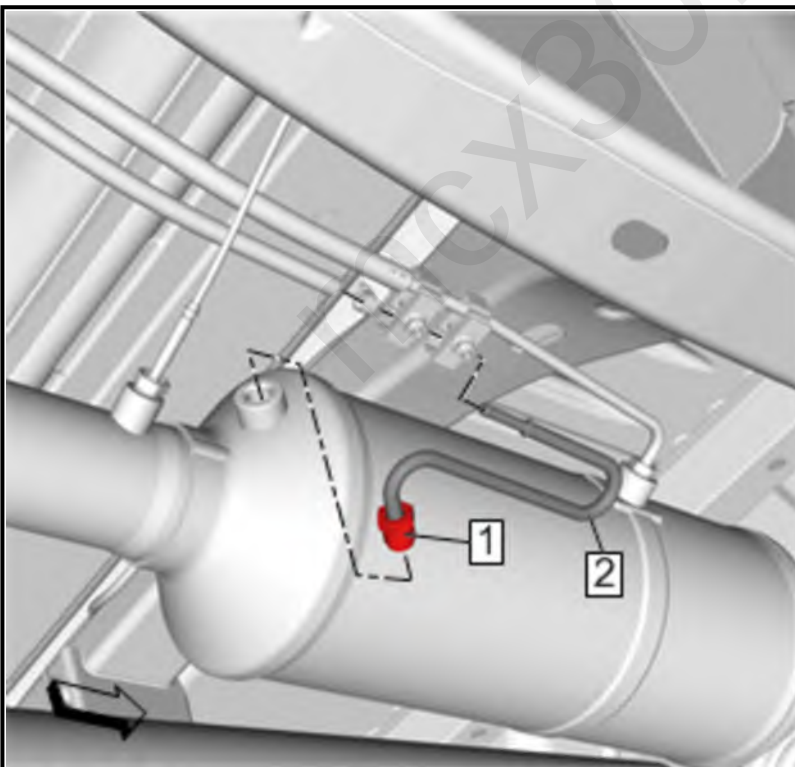
1. Lifting and Jacking the Vehicle Raise the vehicle.
2. Hose Clamp (1) - Loosen



3. Exhaust Pressure Sensor Hose (2) @ Exhaust Pressure Sensor Pipe (3) - Disconnect
4. Hose Clamp (1) - Remove and DISCARD
5. Exhaust Pressure Differential Sensor Pipe Clamp Nut (1) - Loosen [2x]



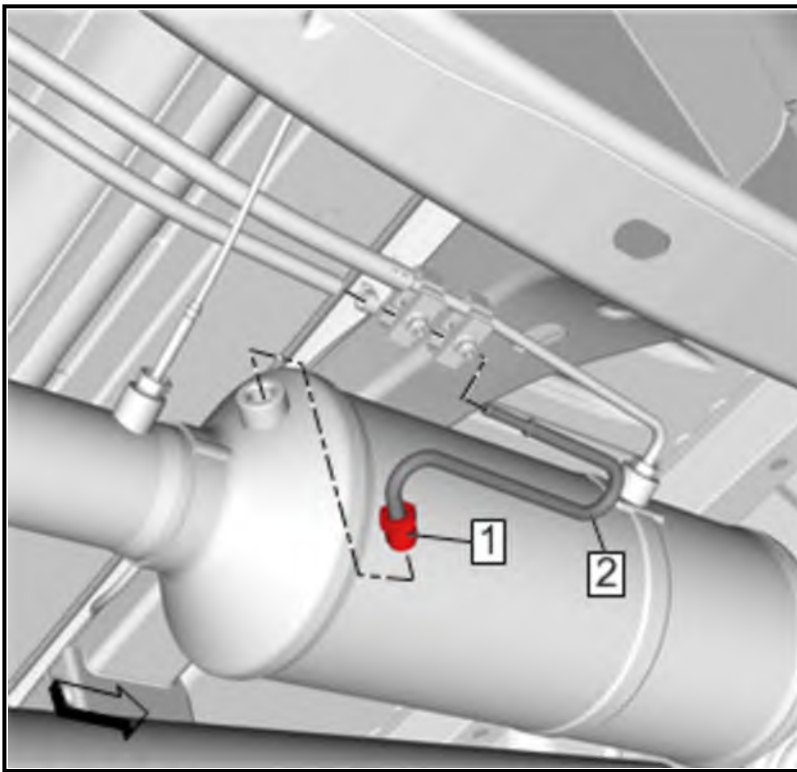
6. Exhaust Pressure Differential Sensor Nut (1) - Loosen



7. Exhaust Pressure Sensor Pipe (2) - Remove

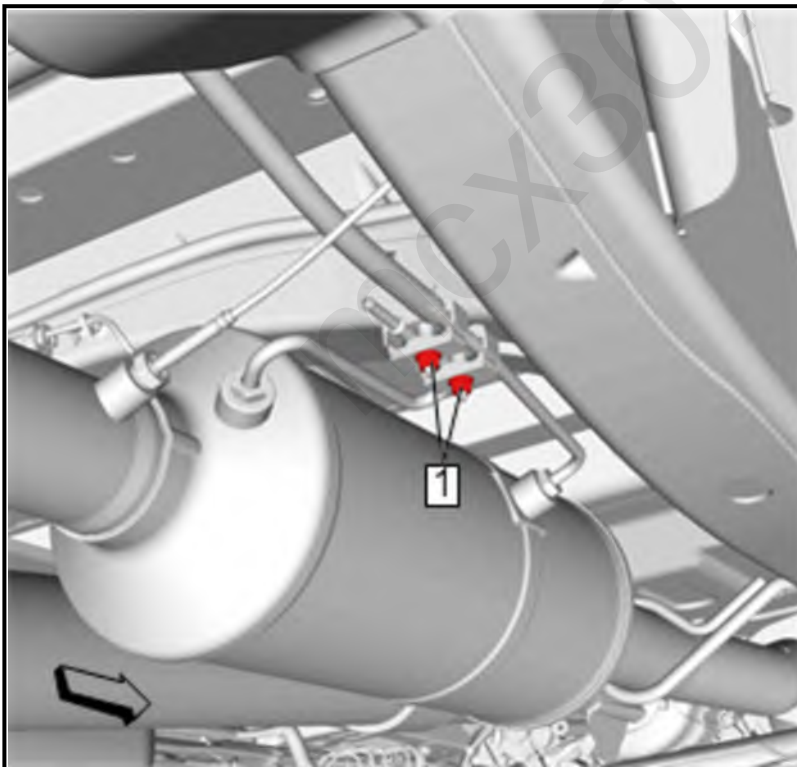
Installation Procedure

1. Exhaust Pressure Sensor Pipe (2) - Install



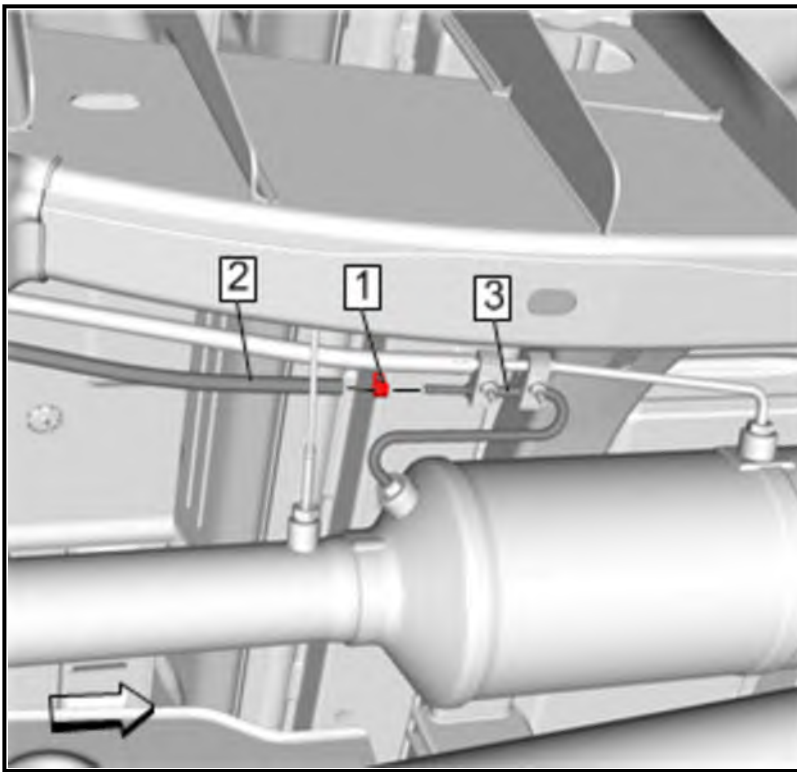
CAUTION: Refer to [Component Fastener Tightening Caution](#) .

2. Exhaust Pressure Differential Sensor Nut (1) - Tighten 45 N.m (33 lb ft)
3. Exhaust Pressure Differential Sensor Pipe Clamp Nut (1) - Tighten [2x] 9 N.m (80 lb in)



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

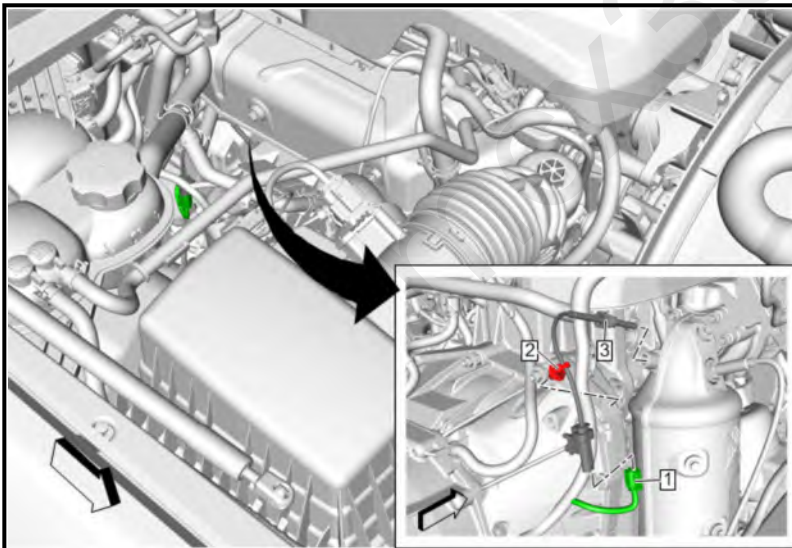
4. Hose Clamp (1) @ Exhaust Pressure Sensor Hose (2) - Loosely install



NOTE: Install a NEW hose clamp.

5. Exhaust Pressure Sensor Hose (2) @ Exhaust Pressure Sensor Pipe (3) - Connect
6. Secure the Exhaust Pressure Sensor Hose (2) with the Hose Clamp (1).
7. Lifting and Jacking the Vehicle - Lower the vehicle.

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 1

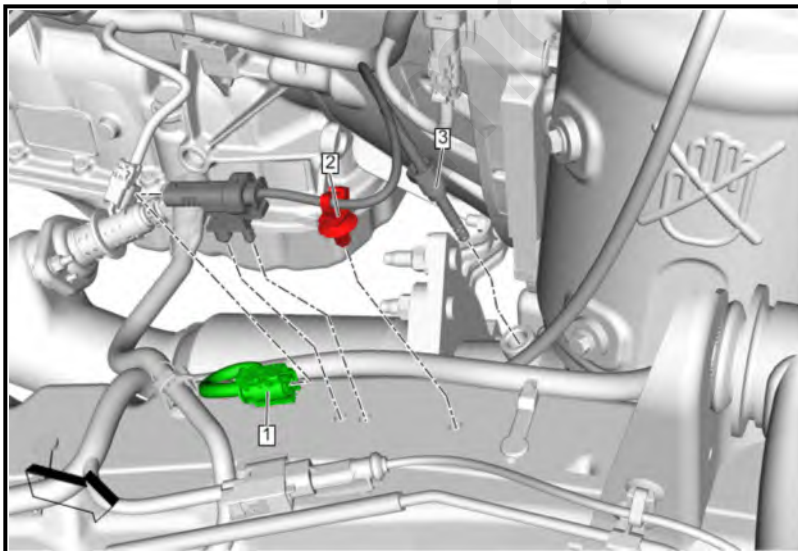


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
1	Electrical Connector
2	Retainer
3	Exhaust Temperature Sensor
CAUTION: Refer to <u>Component</u>	

Callout	Component Name
	<u>Fastener Tightening Caution</u> . NOTE: Apply penetrating oil to the sensor and allow to soak for 10 minutes prior to removal. Procedure 1. If reinstalling the old sensor, coat the threads with anti-sieze compound. <u>Adhesives, Fluids, Lubricants, and Sealers</u> . 2. If replacing, perform the exhaust gas temperature sensor reset. <u>Exhaust Gas Temperature Sensor Reset</u> 3. If replacing, perform the NOx catalyst reductant loading reset. <u>NOx Catalyst Reductant Loading Reset</u> 4. Perform the diesel particulate filter (DPF) regeneration enable. <u>Diesel Particulate Filter (DPF) Regeneration Enable</u> Tighten 45 N.m (33 lb ft)

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 2

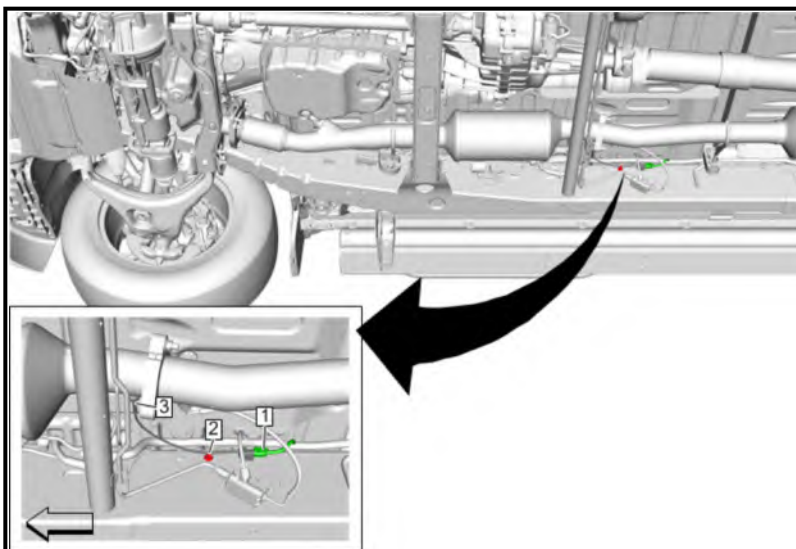


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Remove the right side front wheelhouse liner. <u>Front Wheelhouse Liner Replacement (Without ZR2)</u> , or <u>Front Wheelhouse Liner Replacement (With ZR2)</u> , or <u>Front Wheelhouse Liner Replacement (Bison)</u>	

Callout	Component Name
1	Electrical Connector
2	Retainer
3	Exhaust Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution . NOTE: Apply penetrating oil to the sensor and allow to soak for 10 minutes prior to removal. Procedure 1. If reinstalling the old sensor, coat the threads with anti-sieze compound. Adhesives, Fluids, Lubricants, and Sealers . 2. If replacing, perform the exhaust gas temperature sensor reset. Exhaust Gas Temperature Sensor Reset 3. If replacing, perform the NOx catalyst reductant loading reset. NOx Catalyst Reductant Loading Reset 4. Perform the diesel particulate filter (DPF) regeneration enable. Diesel Particulate Filter (DPF) Regeneration Enable Tighten 45 N.m (33 lb ft)

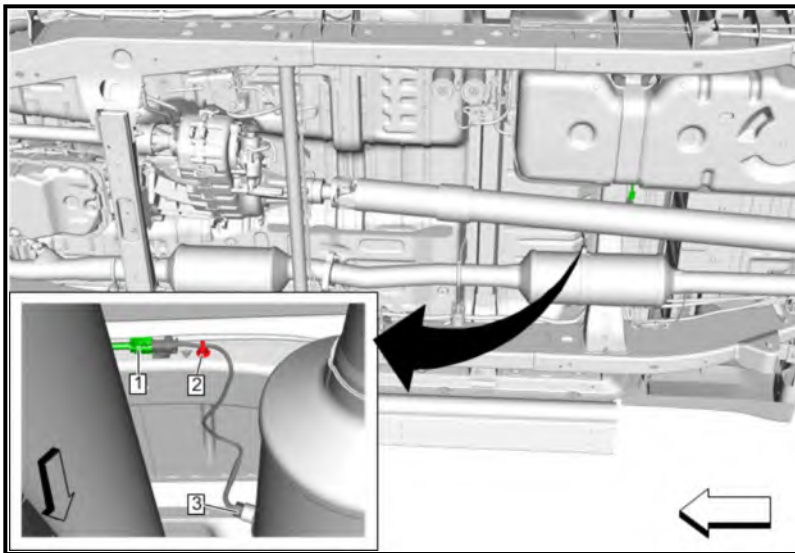
EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 3



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Electrical Connector
2	Retainer
3	Exhaust Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution . NOTE: Apply penetrating oil to the sensor and allow to soak for 10 minutes prior to removal. Procedure 1. If reinstalling the old sensor, coat the threads with anti-sieze compound. Adhesives, Fluids, Lubricants, and Sealers . 2. If replacing, perform the exhaust gas temperature sensor reset. Exhaust Gas Temperature Sensor Reset 3. If replacing, perform the NOx catalyst reductant loading reset. NOx Catalyst Reductant Loading Reset 4. Perform the diesel particulate filter (DPF) regeneration enable. Diesel Particulate Filter (DPF) Regeneration Enable Tighten 45 N.m (33 lb ft)

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 4

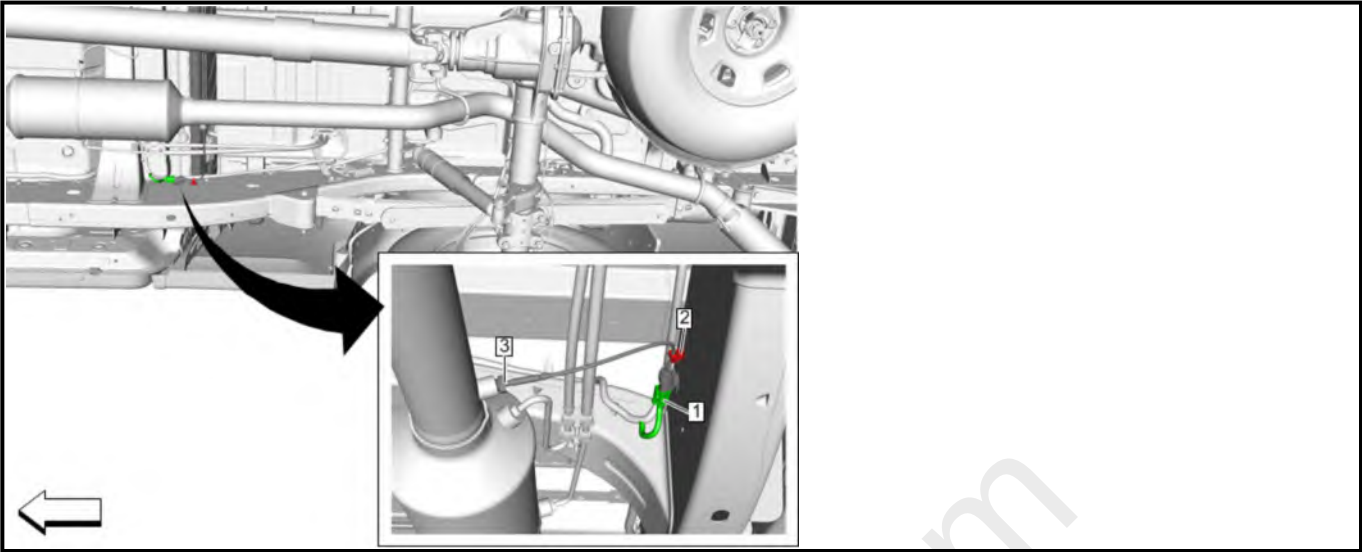


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Electrical Connector
2	Retainer
3	Exhaust Temperature Sensor CAUTION: Refer to Component Fastener Tightening Caution . NOTE: Apply penetrating oil to the sensor and allow to soak for 10 minutes prior to removal. Procedure 1. If reinstalling the old sensor, coat the threads with anti-sieze compound. Adhesives, Fluids, Lubricants, and Sealers . 2. If replacing, perform the exhaust gas temperature sensor reset. Exhaust Gas Temperature Sensor Reset 3. If replacing, perform the NOx catalyst reductant loading reset. NOx Catalyst Reductant Loading Reset 4. Perform the diesel particulate filter (DPF) regeneration enable. Diesel Particulate Filter (DPF) Regeneration Enable

Callout	Component Name
	Tighten 45 N.m (33 lb ft)

EXHAUST TEMPERATURE SENSOR REPLACEMENT - POSITION 5



NOTE: Callouts in the following chart represent components shown in graphic above.

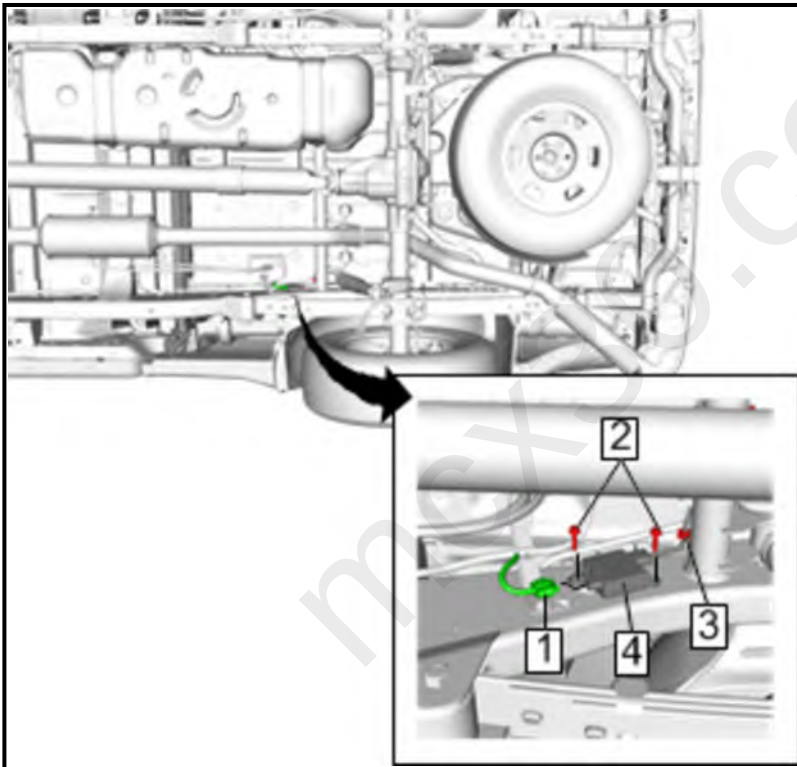
Callout	Component Name
Preliminary Procedure Raise and support the vehicle. <u>Lifting and Jacking the Vehicle</u>	
1	Electrical Connector
2	Retainer
3	Exhaust Temperature Sensor CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . NOTE: Apply penetrating oil to the sensor and allow to soak for 10 minutes prior to removal. Procedure 1. If reinstalling the old sensor, coat the threads with anti-sieze compound. <u>Adhesives, Fluids, Lubricants, and Sealers</u> .

Callout	Component Name
	- If replacing, perform the exhaust gas temperature sensor reset. Exhaust Gas Temperature Sensor Reset - If replacing, perform the NOx catalyst reductant loading reset. NOx Catalyst Reductant Loading Reset - Perform the diesel particulate filter (DPF) regeneration enable. Diesel Particulate Filter (DPF) Regeneration Enable Tighten 45 N.m (33 lb ft)

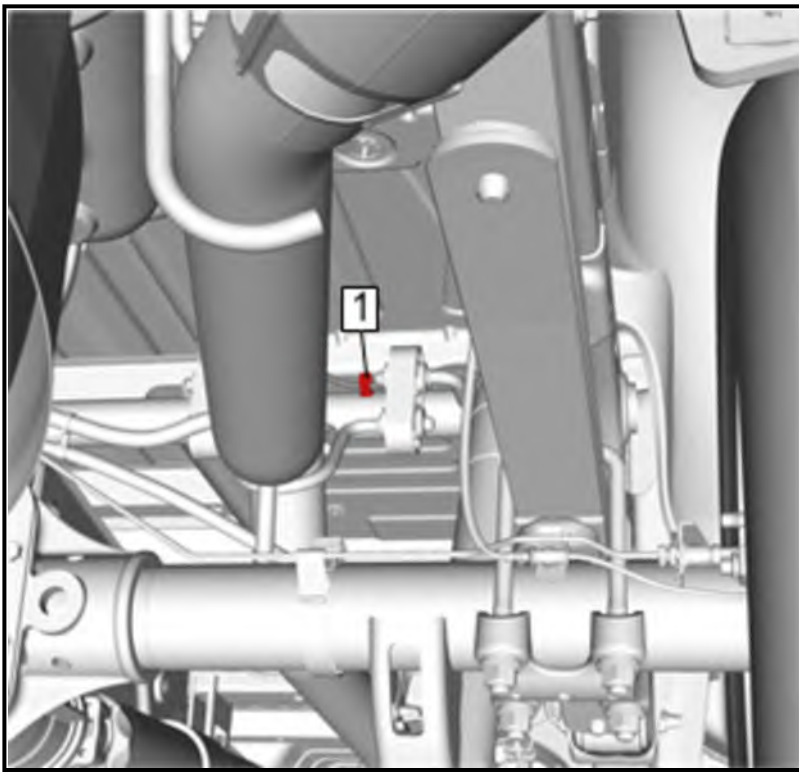
EXHAUST PARTICULATE MATTER SENSOR REPLACEMENT

Removal Procedure

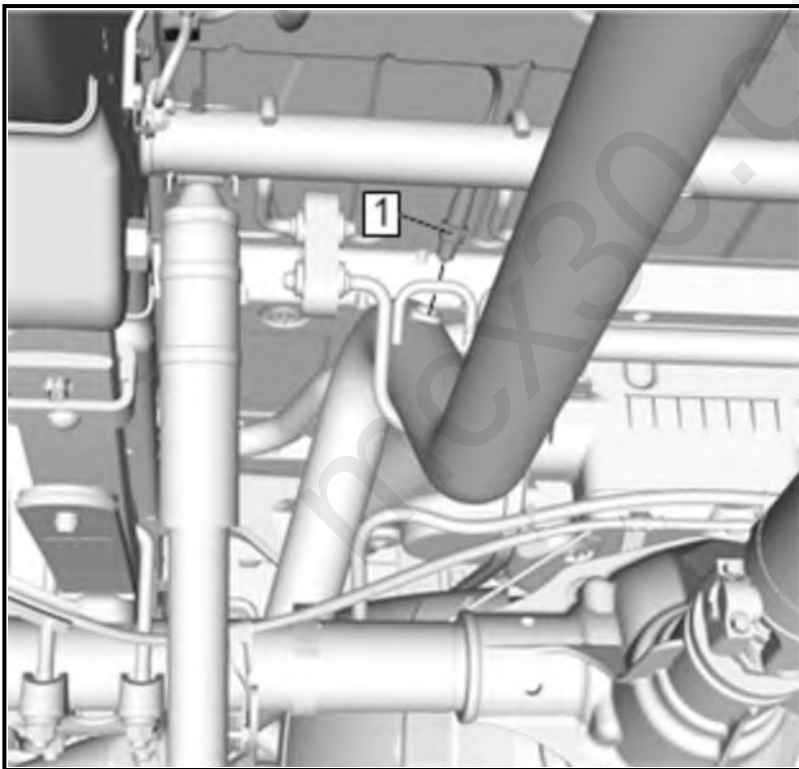
- [Battery Negative Cable Disconnection and Connection](#) - Disconnect
- Raise the vehicle. [Lifting and Jacking the Vehicle](#)
- Electrical Connector (1) @ Exhaust Particulate Sensor (4) - Disconnect



- Exhaust Particulate Sensor Fastener (2) - Remove [2x]
- Retainer (3) - Unclip
- Retainer (1) - Unclip



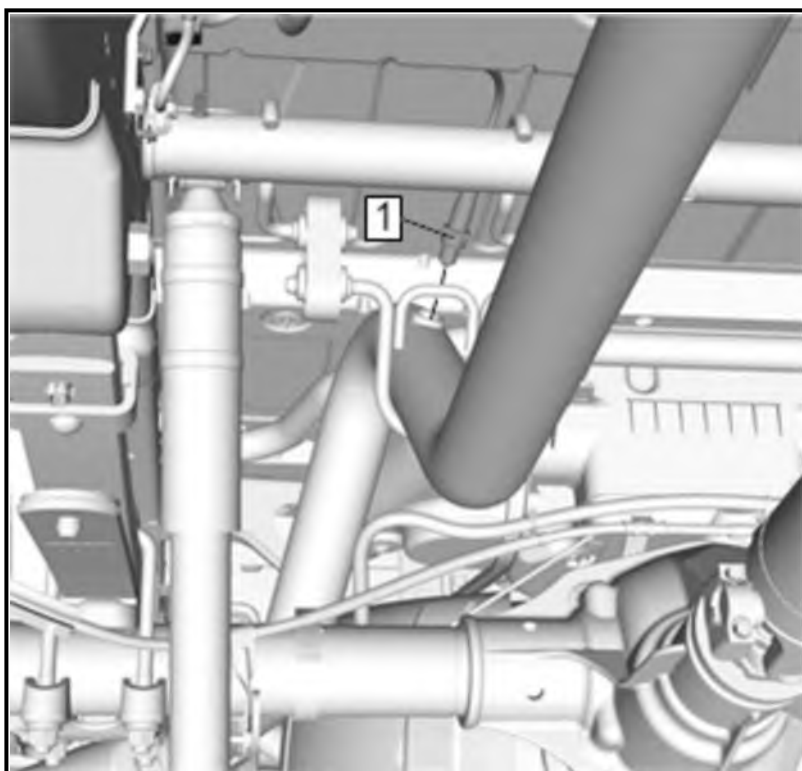
7. Exhaust Particulate Sensor (1) - Remove



WARNING: Refer to [Exhaust Service Warning](#) .

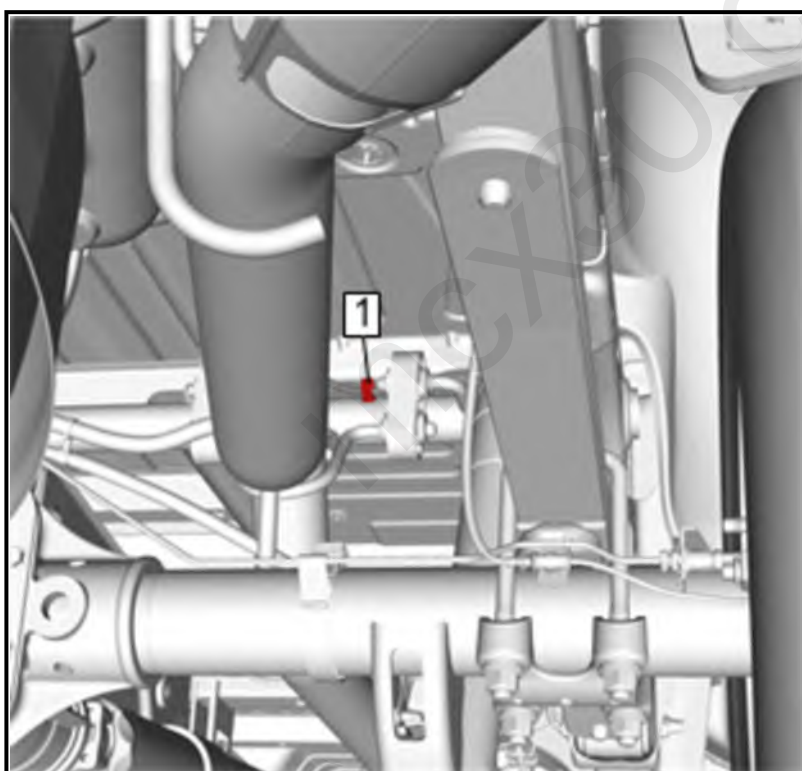
Installation Procedure

1. Exhaust Particulate Sensor (1) - Install and tighten 50 N.m (37 lb ft)

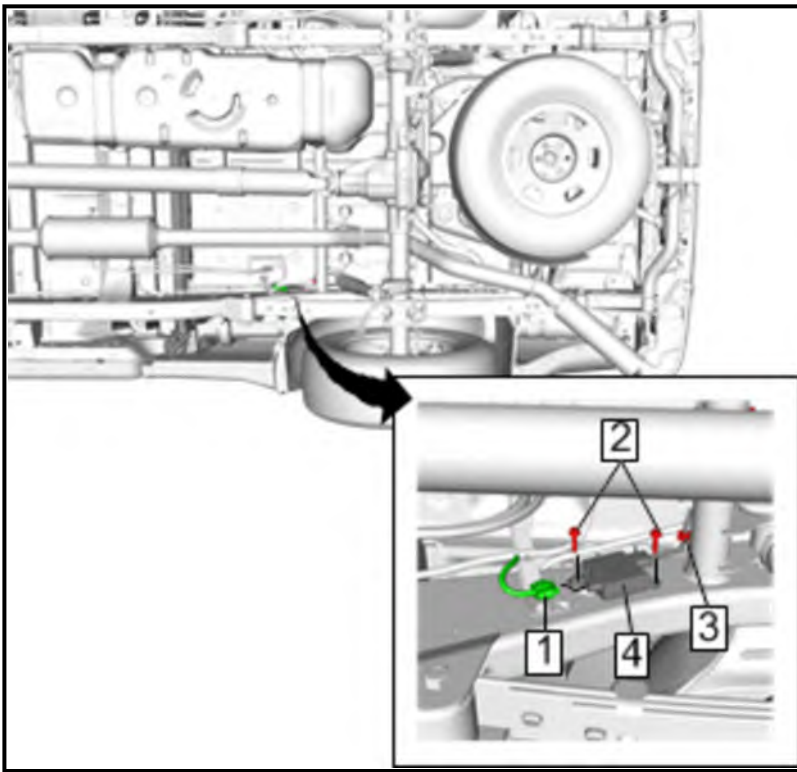


CAUTION: Refer to [Component Fastener Tightening Caution](#) .

2. Retainer (1) - Install



3. Retainer (3) - Install



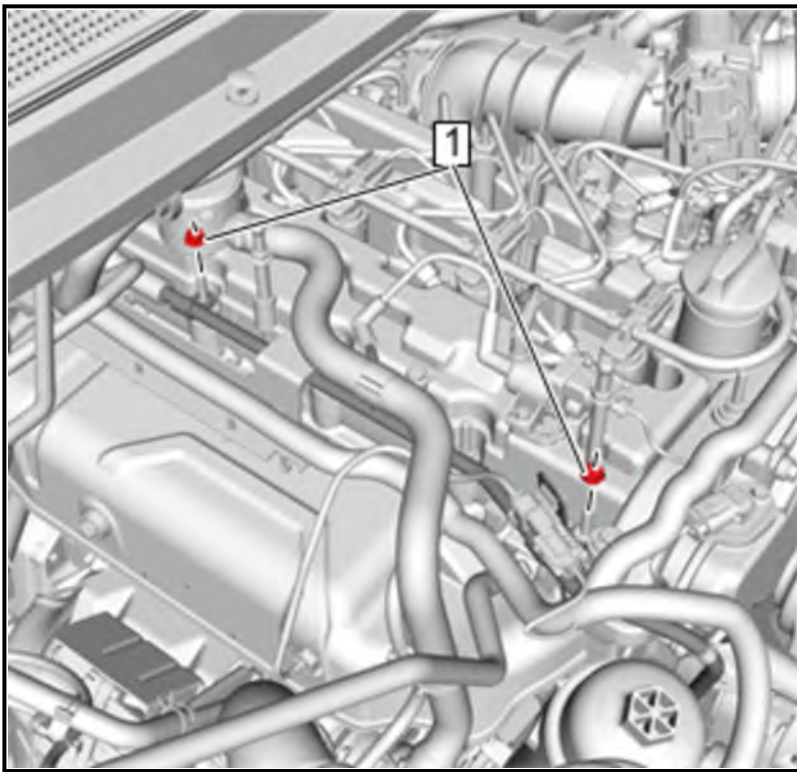
CAUTION: Refer to [Fastener Caution](#) .

4. Exhaust Particulate Sensor Fastener (2) - Install and tighten [2x] 9 N.m (80 lb in)
5. Electrical Connector (1) @ Exhaust Particulate Sensor (4) - Connect
6. Lower the vehicle. [Lifting and Jacking the Vehicle](#)
7. [Battery Negative Cable Disconnection and Connection](#) - Connect

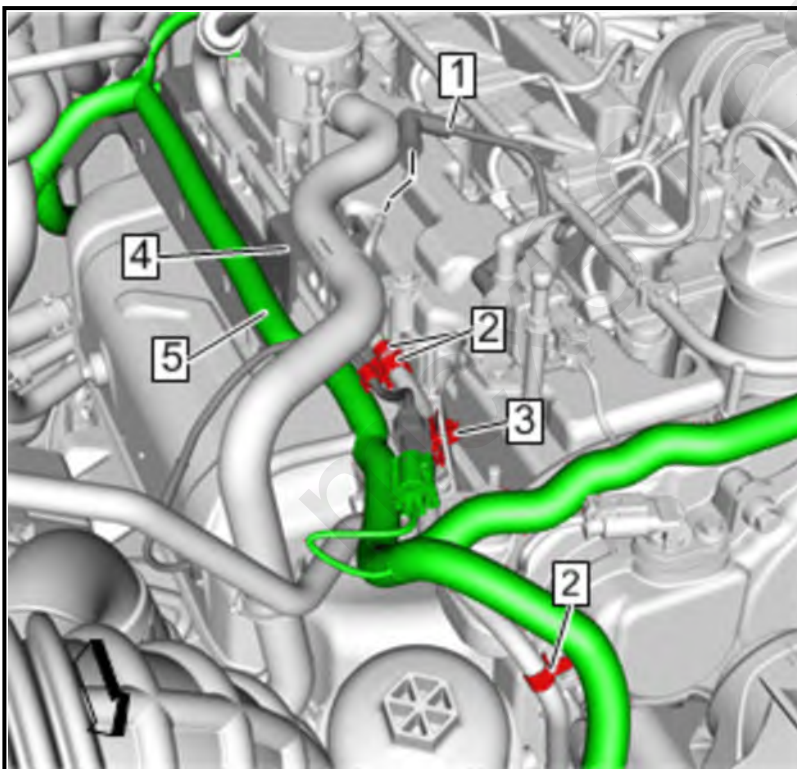
VACUUM PUMP PIPE REPLACEMENT

Removal Procedure

1. [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#) - Remove
2. [Engine Coolant Fan Shroud Replacement \(LWN\)](#) - Remove
3. Vacuum Pump Pipe Fastener (1) - Remove [2x]



4. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Vacuum Pump Pipe - Disconnect



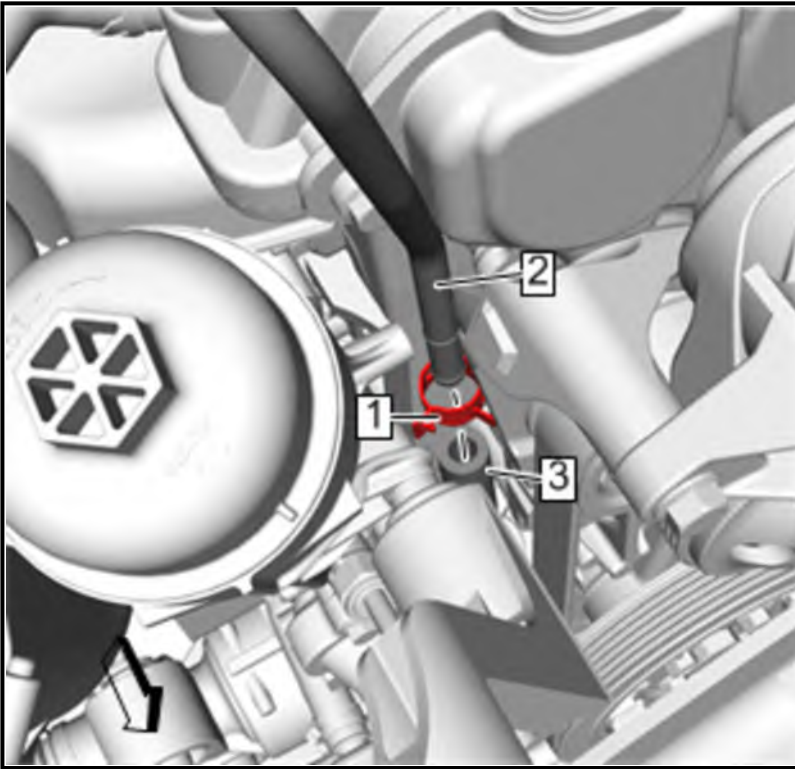
5. Engine Wiring Harness Retainer (2) - Unclip [3x]

6. Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (3) @ Vacuum Pump Pipe - Disconnect

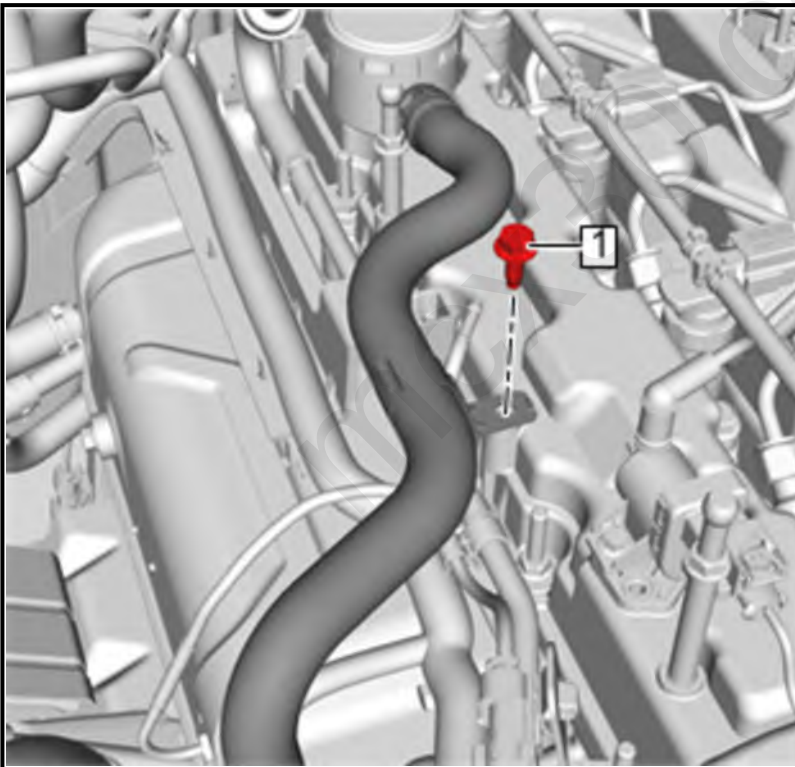
7. Engine Wiring Harness Channel (4) @ Valve Rocker Arm Cover Stud - Remove [2x]

8. Engine Wiring Harness (5) - Reposition

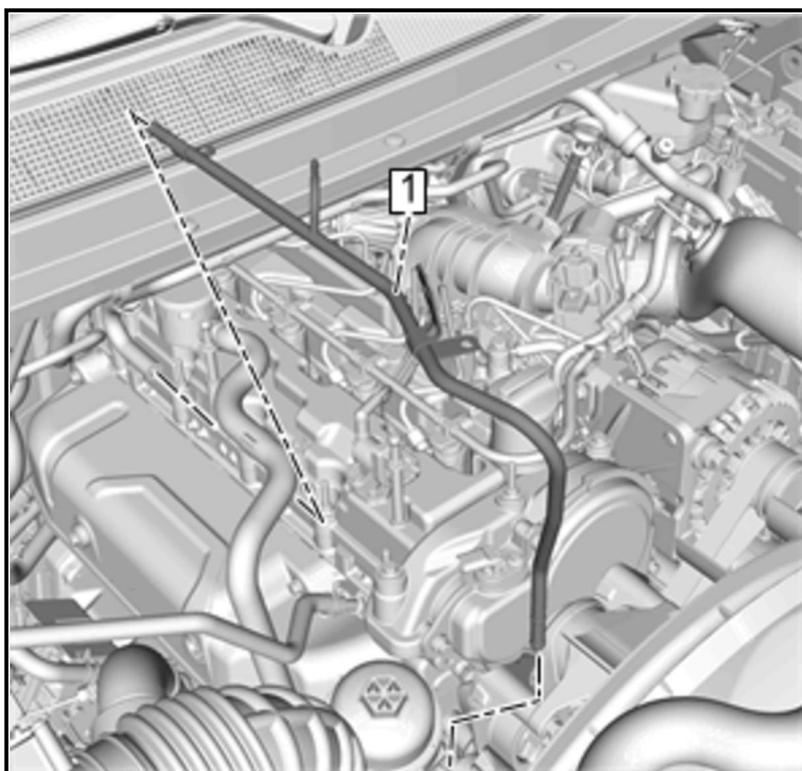
9. Hose Clamp (1) - Loosen



10. Vacuum Pump Pipe (2) @ Heater and A/C Control Vacuum Source Hose (3) - Disconnect
11. Positive Crankcase Ventilation Tube Bolt (1) - Remove

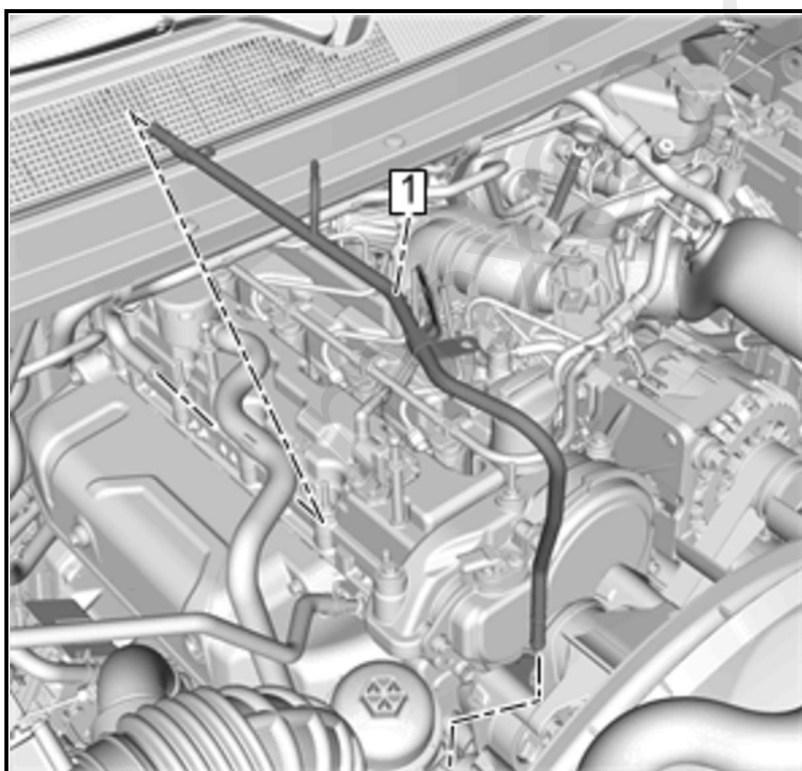


12. Vacuum Pump Pipe (1) - Remove

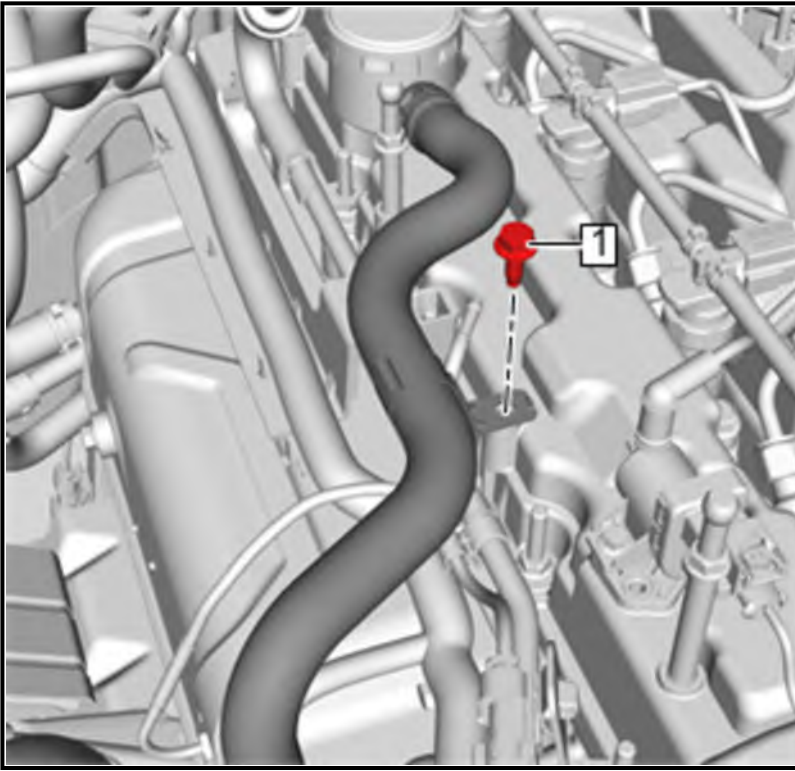


Installation Procedure

1. Vacuum Pump Pipe (1) - Install

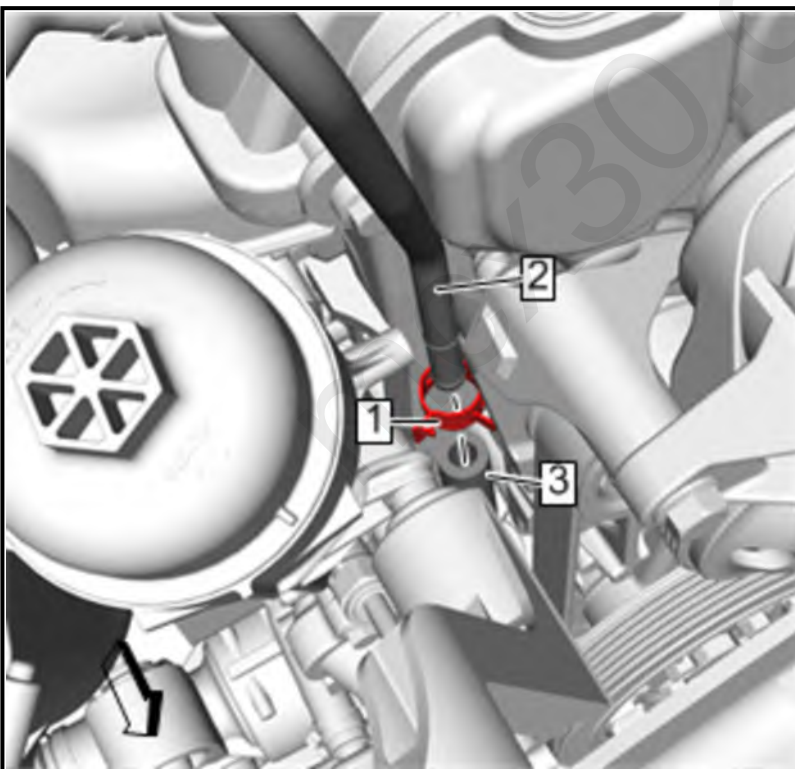


2. Positive Crankcase Ventilation Tube Bolt (1) - Install and tighten 9 N.m (80 lb in)

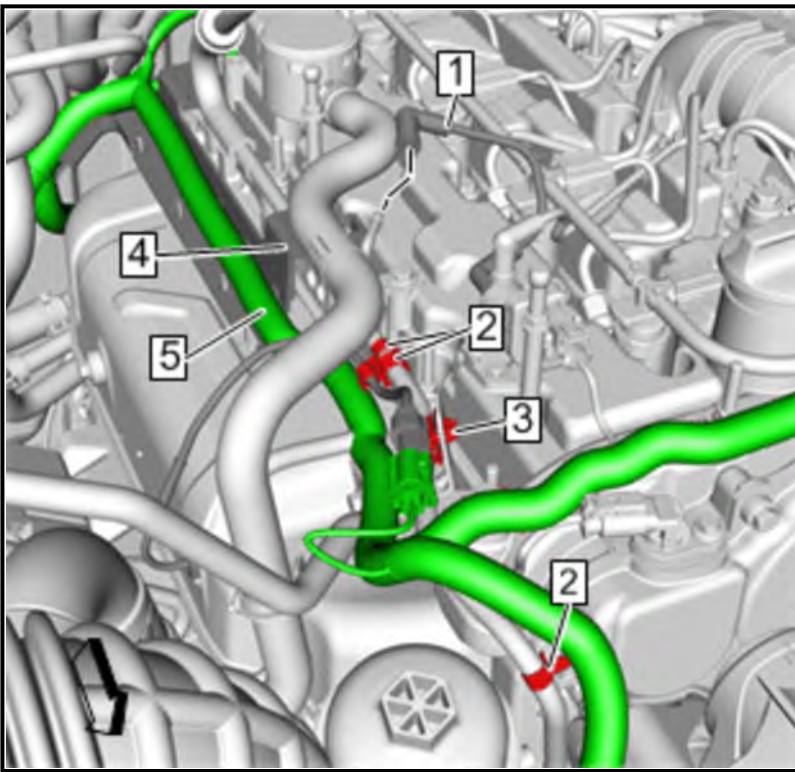


CAUTION: Refer to [Fastener Caution](#) .

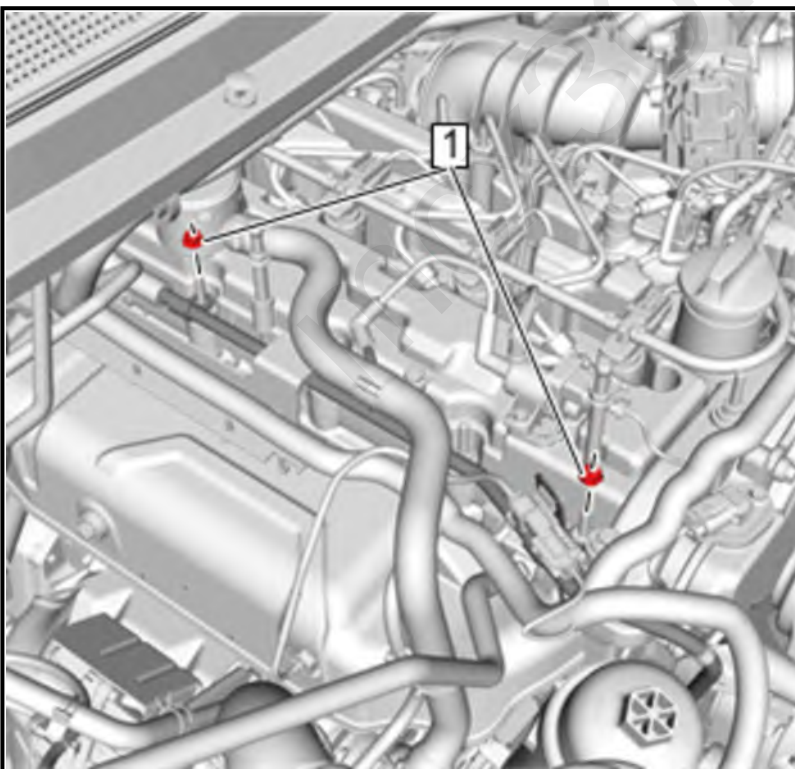
3. Hose Clamp (1) @ Vacuum Pump Hose (3) - Loosely install



4. Vacuum Pump Pipe (2) @ Heater and A/C Control Vacuum Source Hose (3) - Connect
5. Hose Clamp (1) @ Heater and A/C Control Vacuum Source Hose (3) - Secure the hose with the hose clamp.
6. Engine Wiring Harness Channel (4) @ Valve Rocker Arm Cover Stud - Install [2x]



7. Exhaust Gas Recirculation Cooler Temperature Sensor Electrical Connector (3) @ Vacuum Pump Pipe - Connect
8. Engine Wiring Harness Retainer (2) - Install [3x]
9. Exhaust Gas Recirculation Valve Vacuum Pipe (1) @ Vacuum Pump Pipe - Connect
10. Vacuum Pump Pipe Bolt (1) - Install and tighten [2x] 11 N.m (8 lb ft)



11. Engine Coolant Fan Shroud Replacement (LWN) - Install
12. Intake Manifold Cover Insulator Replacement (Top of Engine) , or Intake Manifold Cover Insulator Replacement (Left Side) - Install

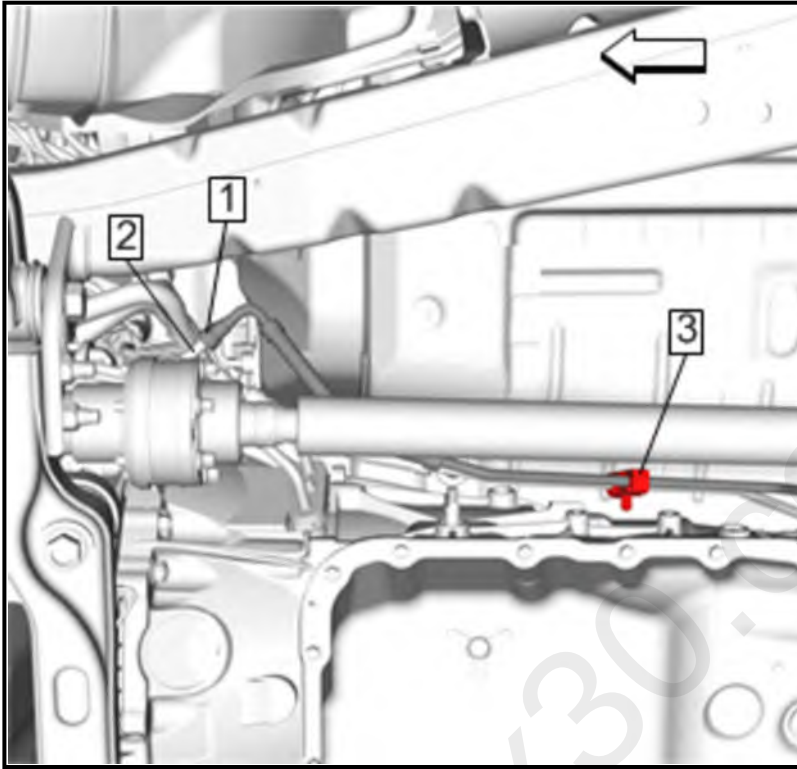
FUEL FEED FRONT PIPE REPLACEMENT

Removal Procedure

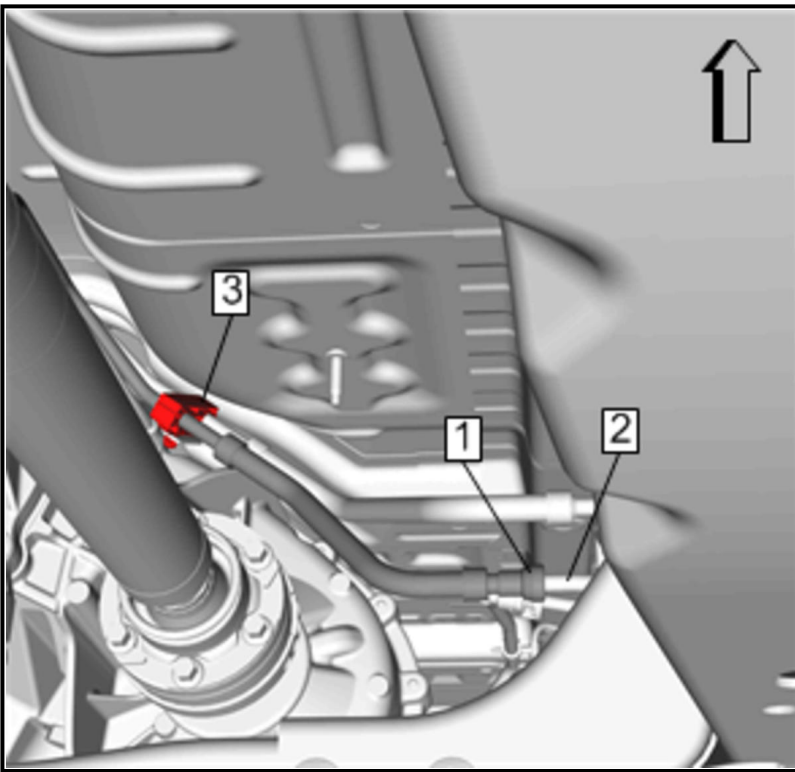
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Fuel Feed Front Pipe (1) @ Fuel Pump Fuel Feed Hose (2) Disconnect - [Metal Collar Quick Connect Fitting Service](#)



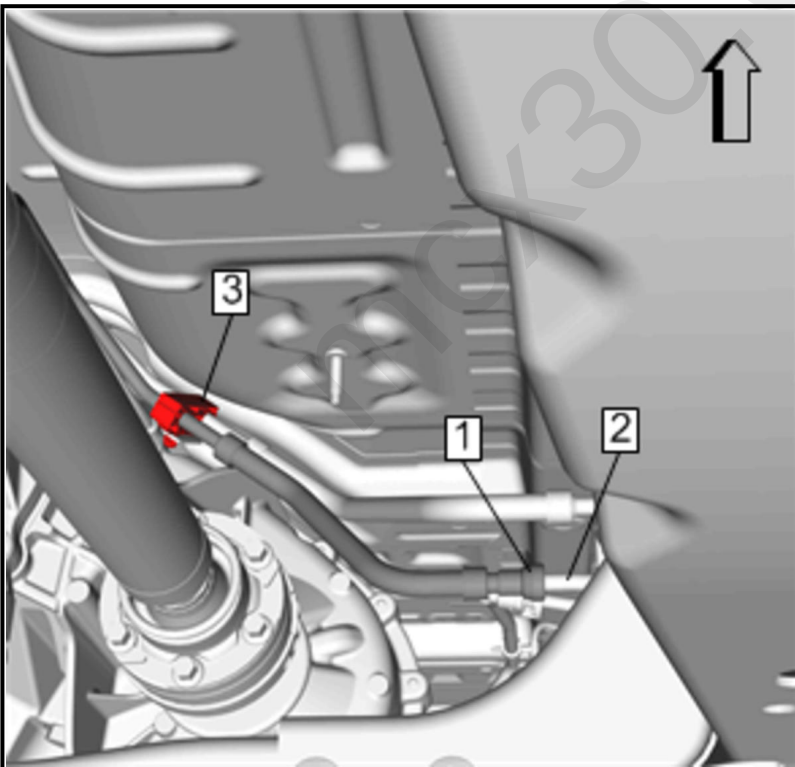
4. Fuel Feed Front Pipe (1) @ Retainer (3) - Unclip
5. Fuel Feed Front Pipe (1) @ Fuel Feed Rear Pipe (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



6. Fuel Feed Front Pipe (1) @ Retainer (3) - Unclip

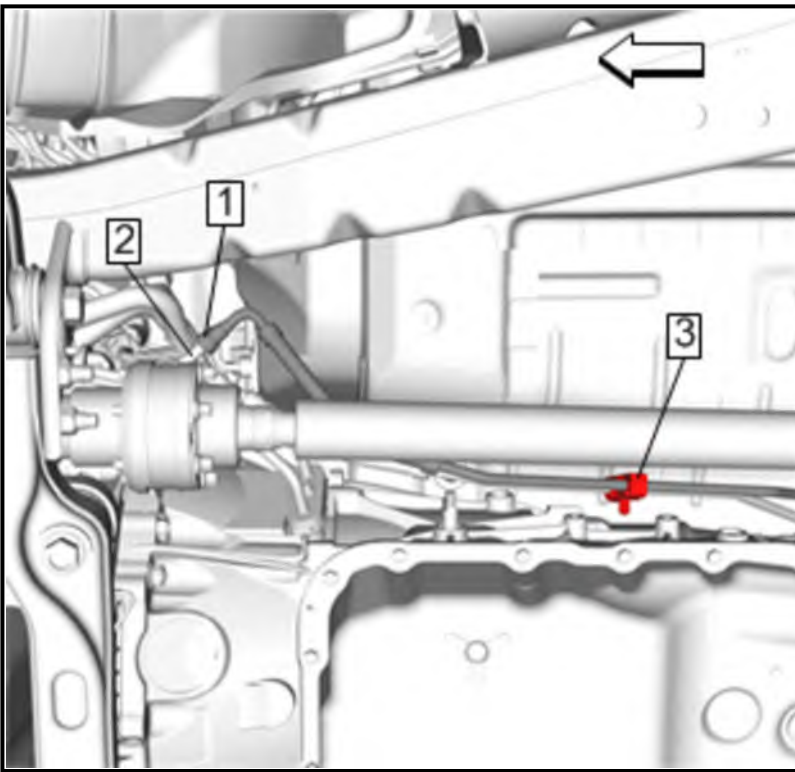
Installation Procedure

1. Fuel Feed Front Pipe (1) @ Retainer (3) - Clip



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

3. Fuel Feed Front Pipe (1) @ Retainer (3) - Clip



4. Fuel Feed Front Pipe (1) @ Fuel Pump Fuel Feed Hose (2) Connect - [Metal Collar Quick Connect Fitting Service](#)
5. Lower the vehicle.

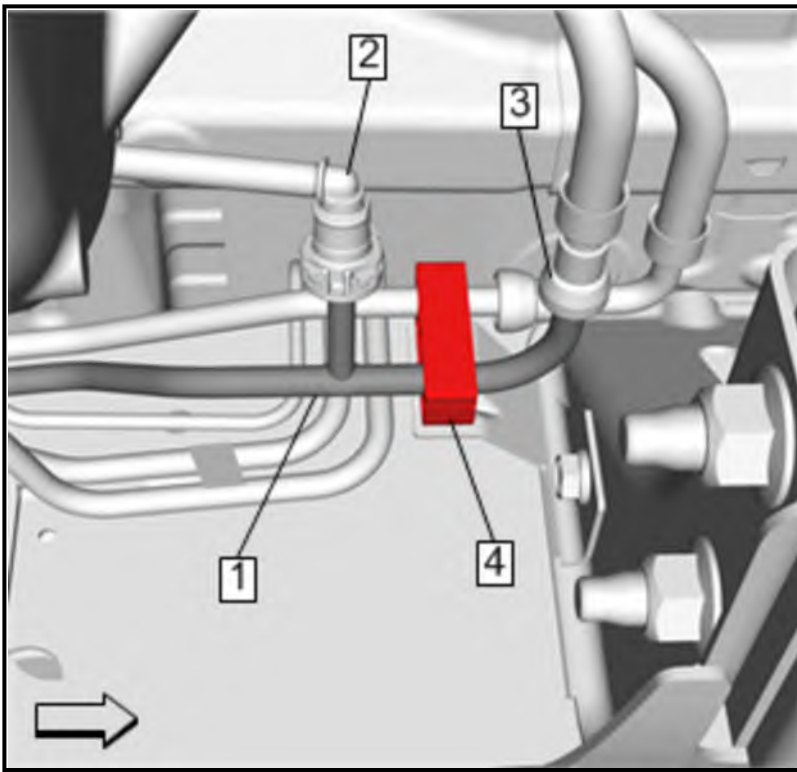
FUEL FEED REAR PIPE REPLACEMENT

Removal Procedure

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

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

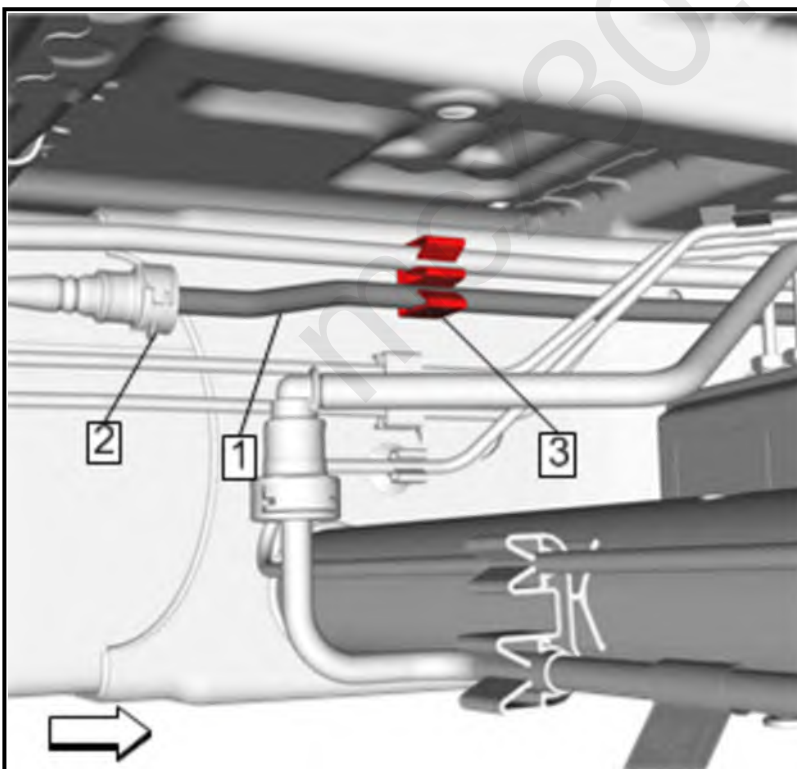
1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Fuel Feed Rear Pipe (1) @ Fuel Feed Hydrocarbon Injection Front Pipe (2) Disconnect - [Plastic Collar Quick Connect Fitting Service](#)



4. Fuel Feed Rear Pipe (1) @ Fuel Feed Front Pipe (3) Disconnect - [Metal Collar Quick Connect Fitting Service](#)

5. Fuel Feed Rear Pipe (1) @ Retainer (4) - Unclip

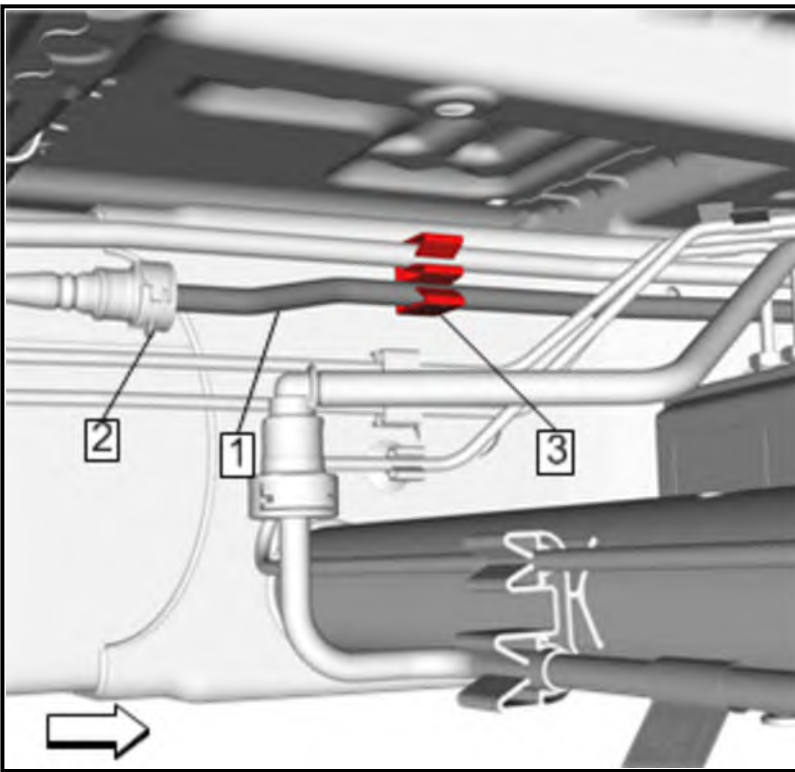
6. Fuel Feed Rear Pipe (1) @ Fuel Feed Tube (2) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)



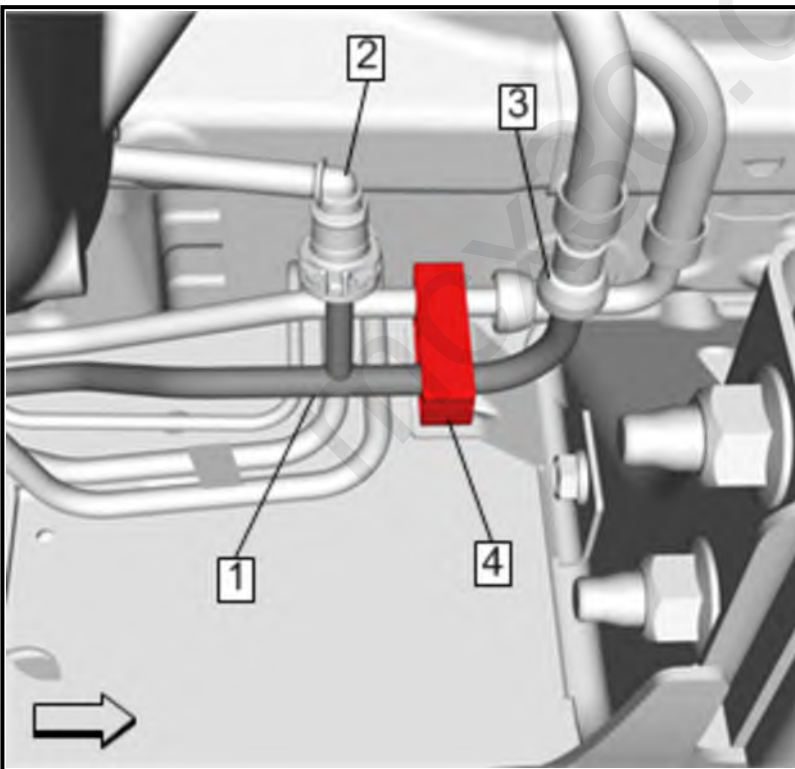
7. Fuel Feed Rear Pipe (1) @ Retainer (3) - Unclip

Installation Procedure

1. Fuel Feed Rear Pipe (1) @ Retainer (3) - Clip

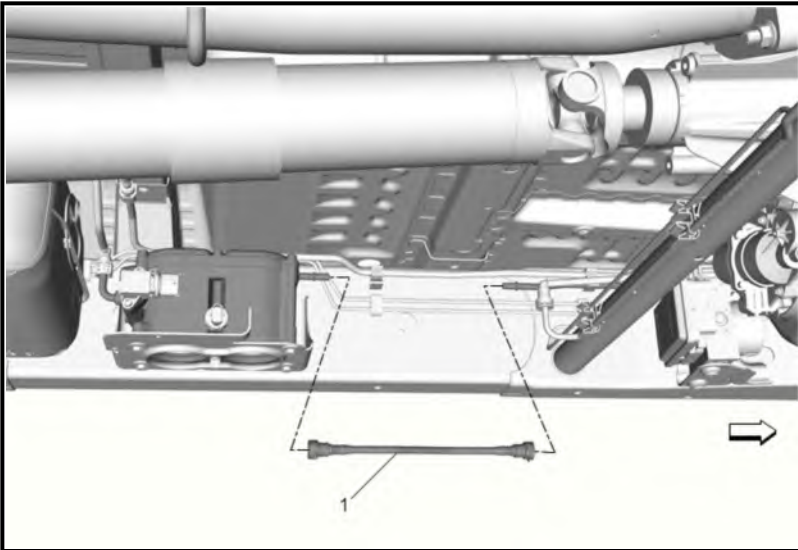


2. Fuel Feed Rear Pipe (1) @ Fuel Feed Tube (2) - Connect - [Plastic Collar Quick Connect Fitting Service](#)
3. Fuel Feed Rear Pipe (1) @ Retainer (4) - Clip



4. Fuel Feed Rear Pipe (1) @ Fuel Feed Front Pipe (3) Connect - [Metal Collar Quick Connect Fitting Service](#)
5. Fuel Feed Rear Pipe (1) @ Fuel Feed Hydrocarbon Injection Front Pipe (2) Connect - [Plastic Collar Quick Connect Fitting Service](#)
6. Lower the vehicle.

FUEL FEED TUBE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedures 1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Fuel Feed Tube Procedure Disconnect the quick disconnects. Plastic Collar Quick Connect Fitting Service

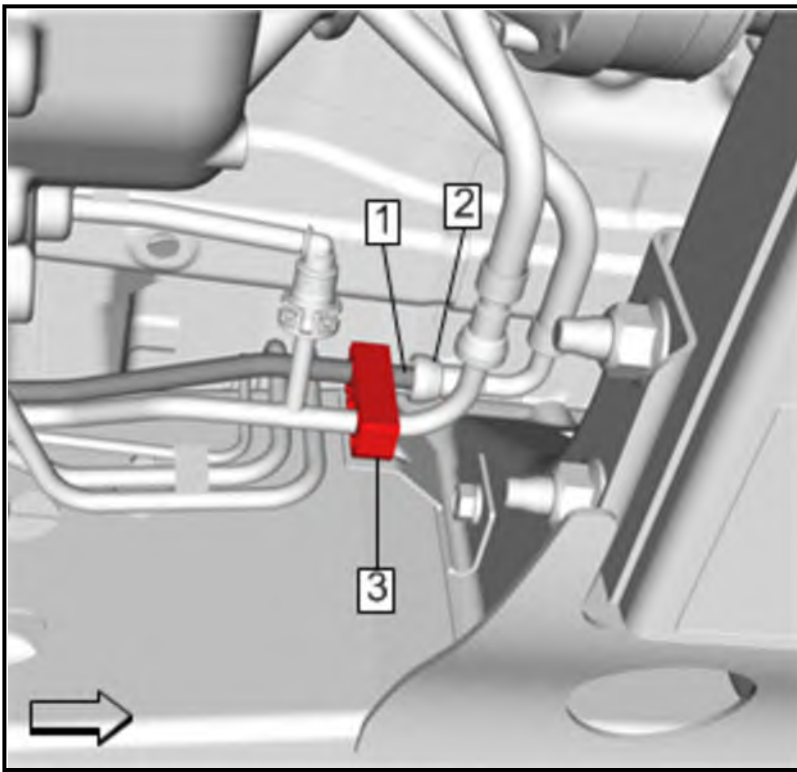
FUEL RETURN REAR PIPE REPLACEMENT

Removal Procedure

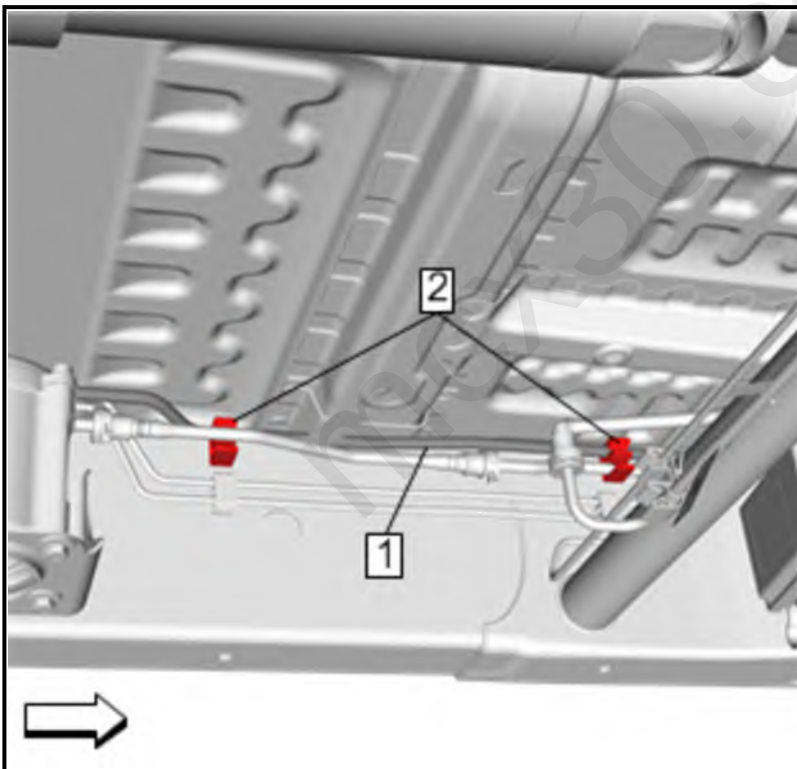
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

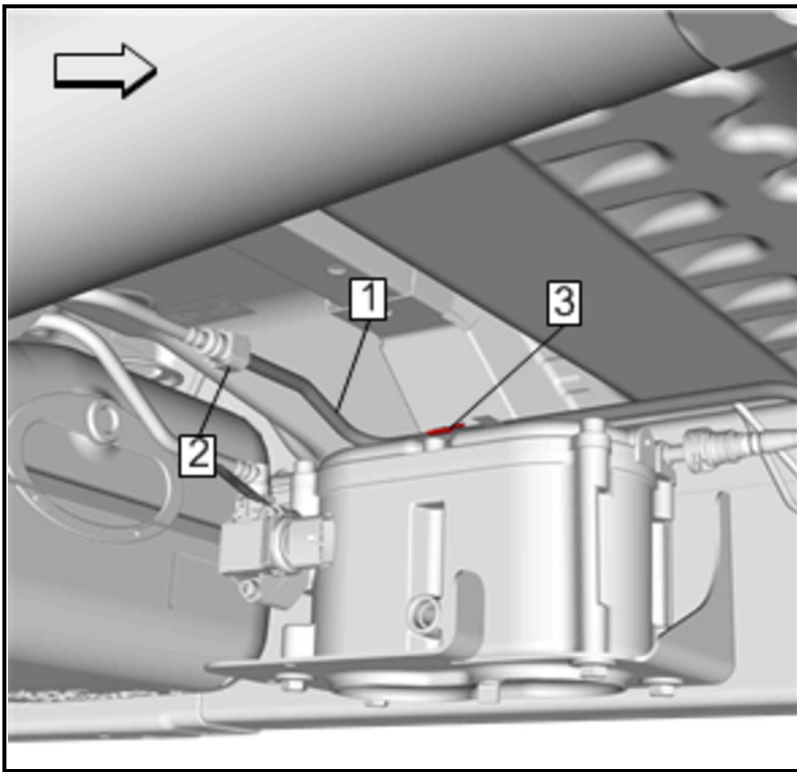
1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Fuel Return Rear Pipe (1) @ Fuel Return Front Pipe (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



4. Fuel Return Rear Pipe (1) @ Retainer (3) - Unclip
5. Fuel Return Rear Pipe (1) @ Retainer (2) - Unclip [2x]



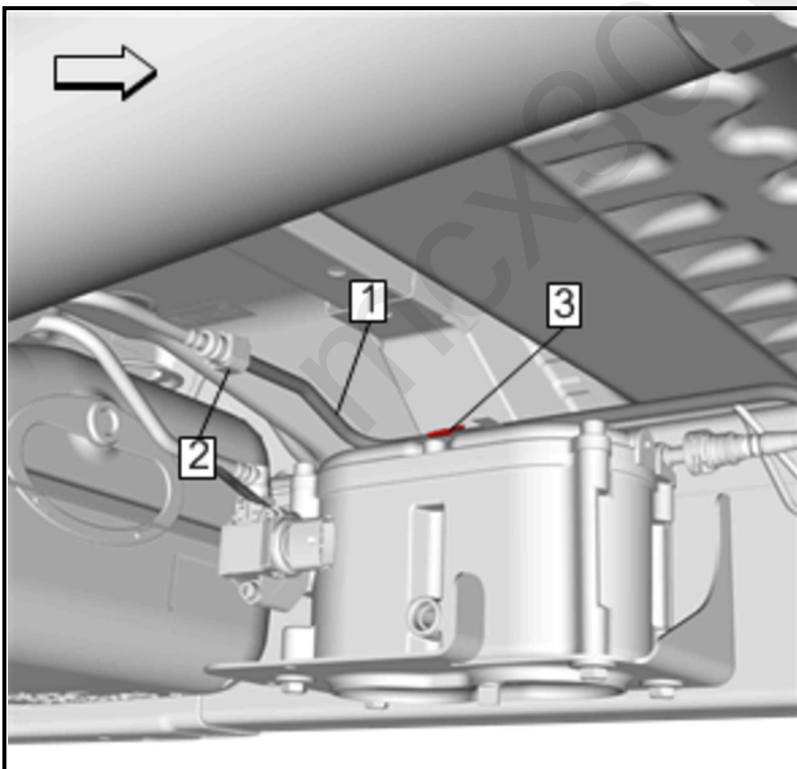
6. Fuel Return Rear Pipe (1) @ Fuel Return Pipe (2) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)



7. Fuel Return Rear Pipe (1) @ Retainer (3) - Unclip

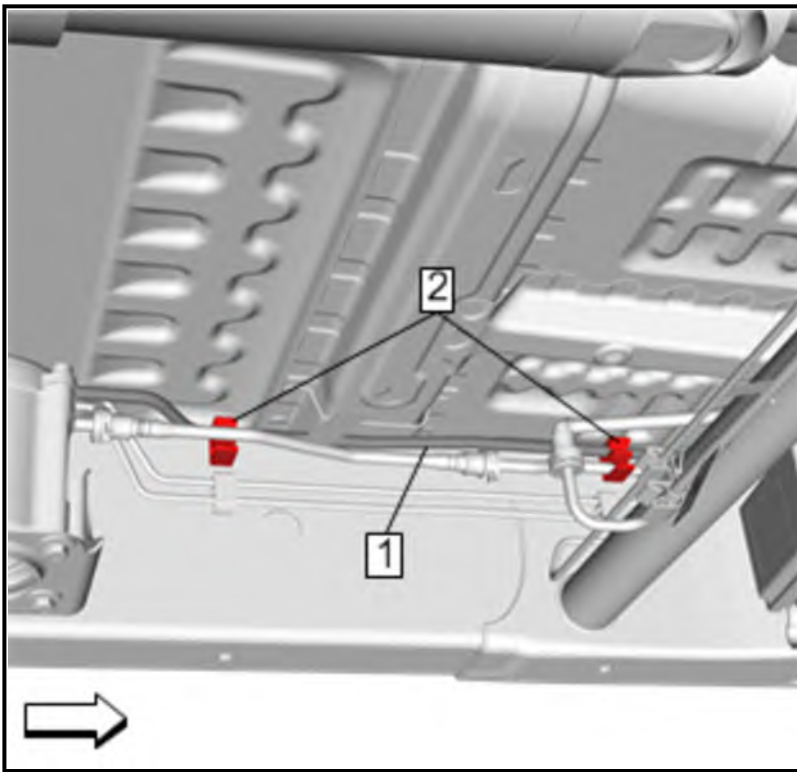
Installation Procedure

1. Fuel Return Rear Pipe (1) @ Retainer (3) - Clip

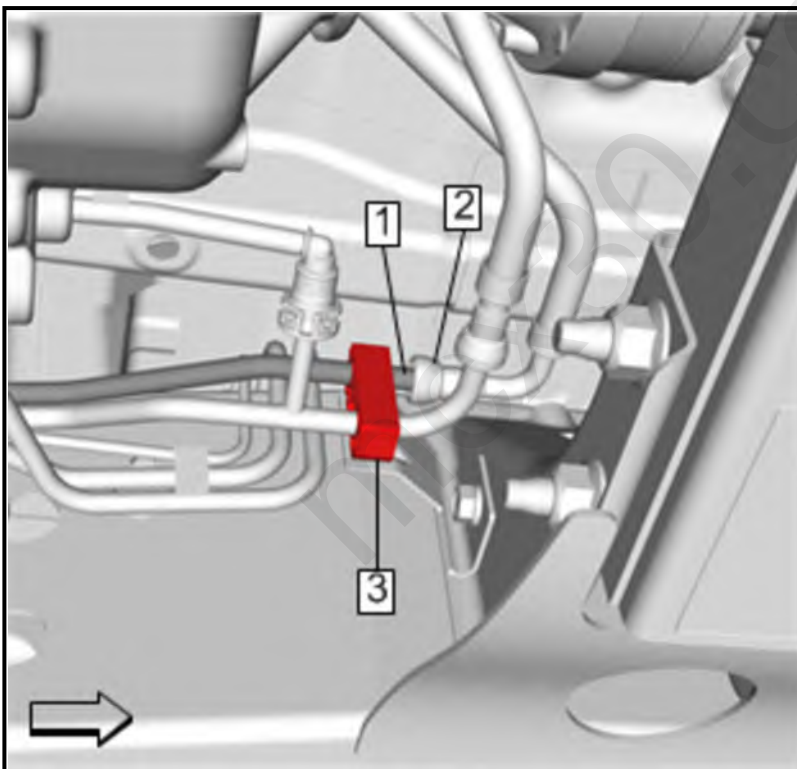


2. Fuel Return Rear Pipe (1) @ Fuel Return Pipe (2) - Connect - [Plastic Collar Quick Connect Fitting Service](#)

3. Fuel Return Rear Pipe (1) @ Retainer (2) - Clip [2x]



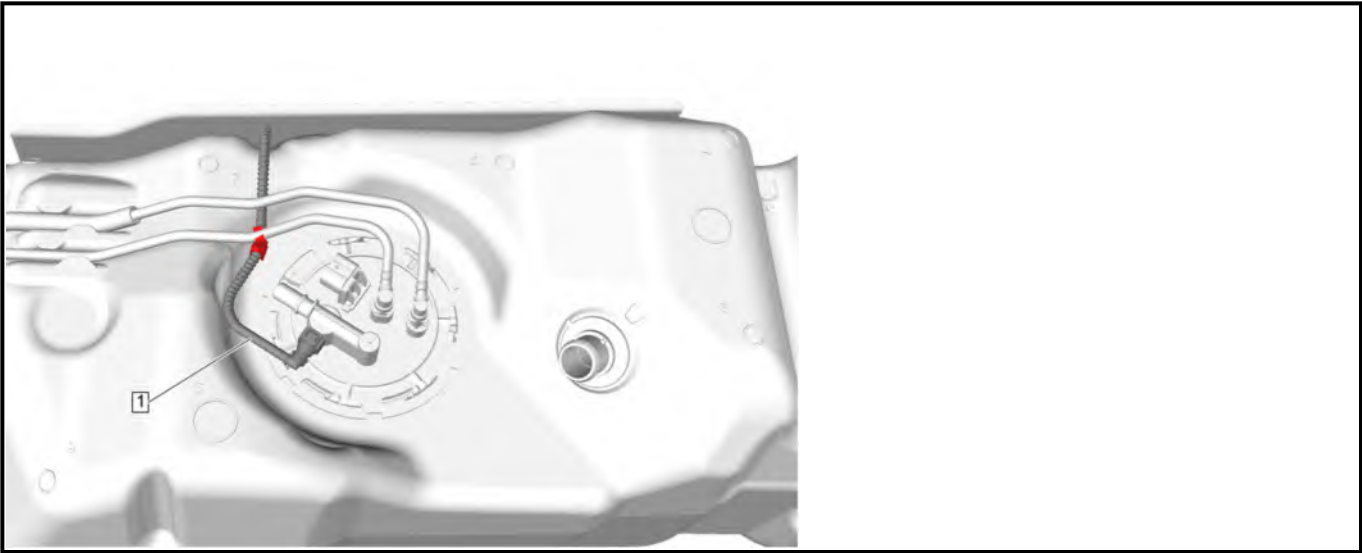
4. Fuel Return Rear Pipe (1) @ Retainer (3) - Clip



5. Fuel Return Rear Pipe (1) @ Fuel Return Front Pipe (2) - Connect - [Metal Collar Quick Connect Fitting Service](#)

6. Lower the vehicle.

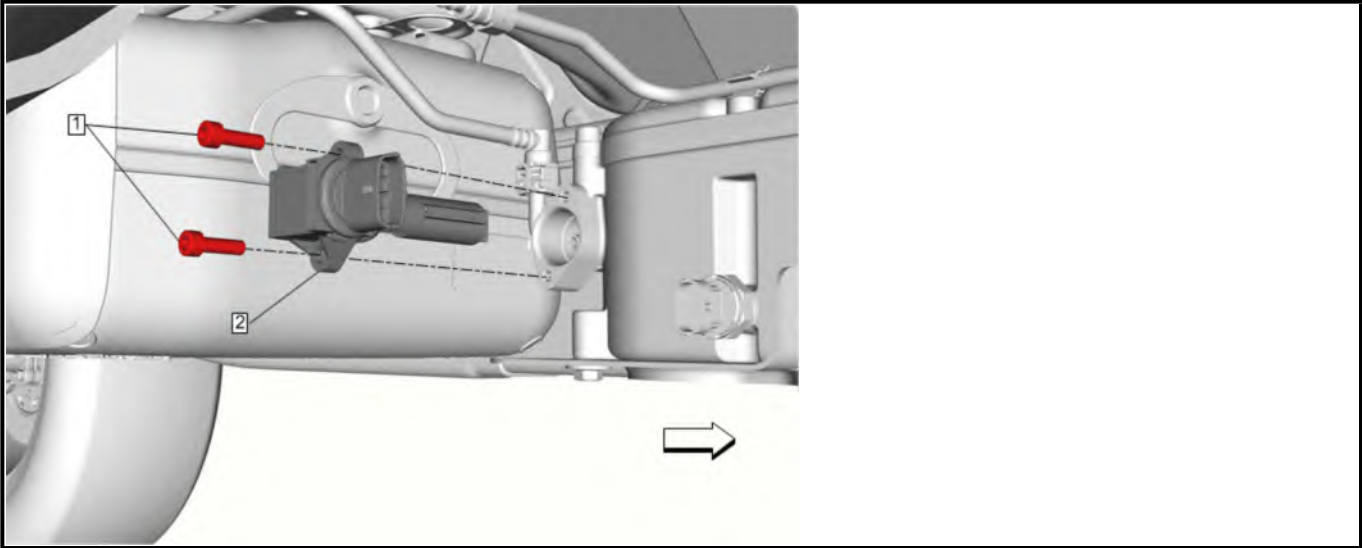
EVAPORATIVE EMISSION HOSE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement	
1	Evaporative Emission Hose Procedure Disconnect the evaporative emission hose and remove from the retainer. Plastic Collar Quick Connect Fitting Service

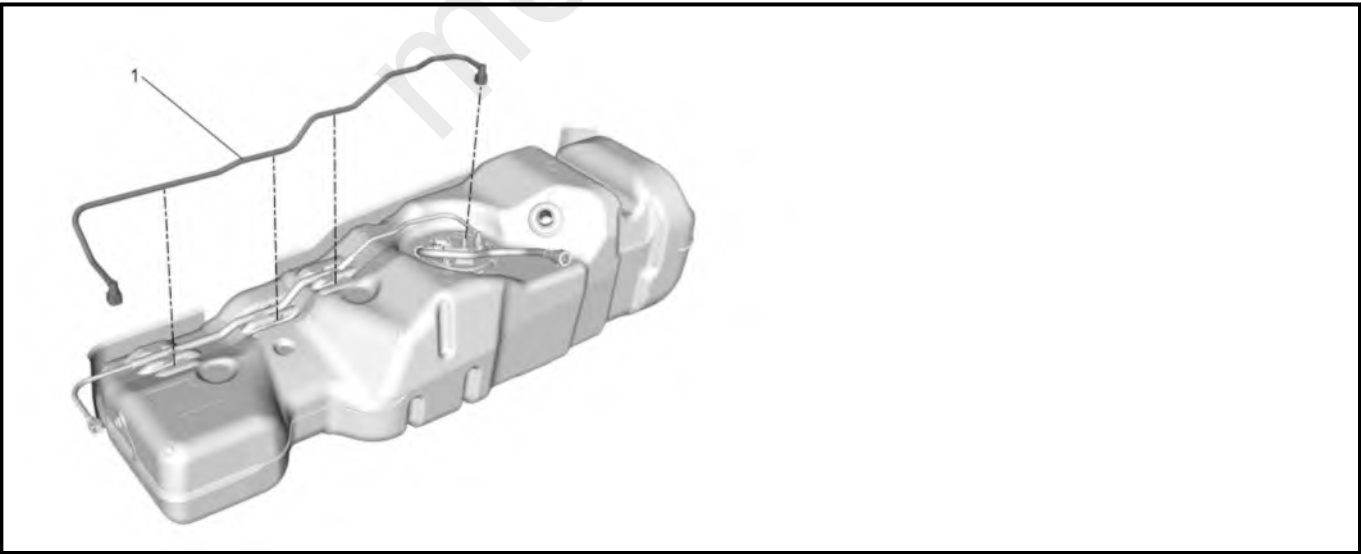
FUEL FILTER FUEL HEATER REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection 3. Raise and support the vehicle. Lifting and Jacking the Vehicle 4. Replace the fuel filter. Fuel Filter Replacement	
1	Fuel Filter Heater Bolt [2x] CAUTION: Refer to Fastener Caution Tighten 9 N.m (80 lb in)
2	Fuel Filter Heater NOTE: When the fuel filter heater is removed, fuel will drain.

FUEL FEED PIPE REPLACEMENT

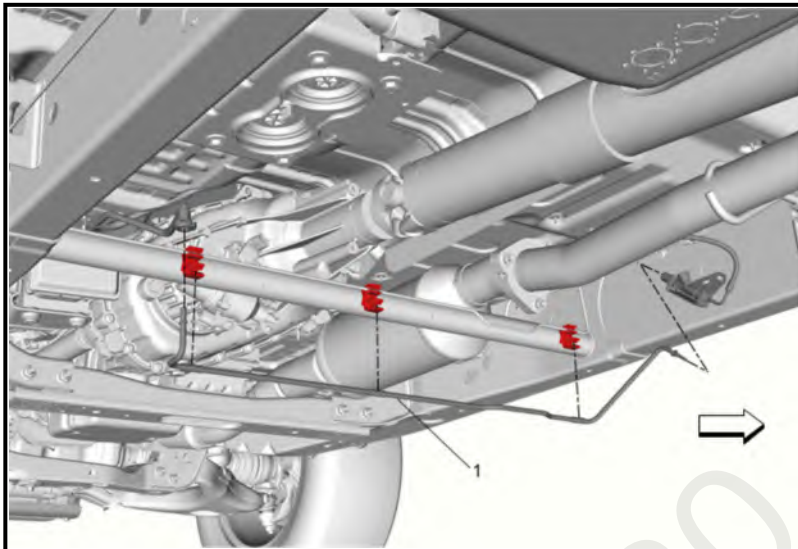


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING:	

Callout	Component Name
1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection 3. Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Fuel Feed Hydrocarbon Injection Front Pipe Procedure Disconnect the quick disconnects and remove from retainer. Plastic Collar Quick Connect Fitting Service

FUEL FEED HYDROCARBON INJECTION REAR PIPE REPLACEMENT (NON ZR2)

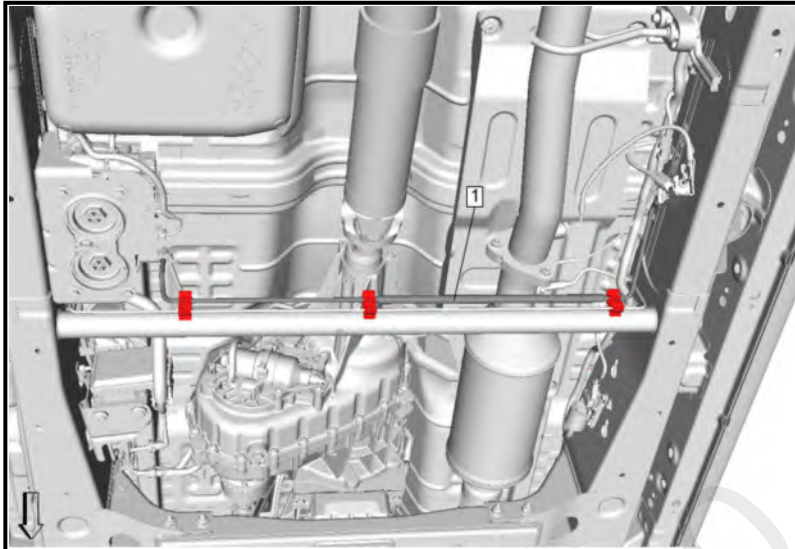


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures 1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection 3. Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Fuel Feed Hydrocarbon Injection Rear Pipe Procedure

Callout	Component Name
	1. Using CH-49736 Hydrocarbon Injector Quick Connect Release Tool disconnect pipe at injector. 2. Disconnect the quick disconnects and remove from retainers. Plastic Collar Quick Connect Fitting Service Special Tools CH-49736 Hydrocarbon Injector Quick Connect Release Tool Equivalent regional tools: Special Tools ((Diagnosis Tools)).

FUEL FEED HYDROCARBON INJECTION REAR PIPE REPLACEMENT (ZR2)

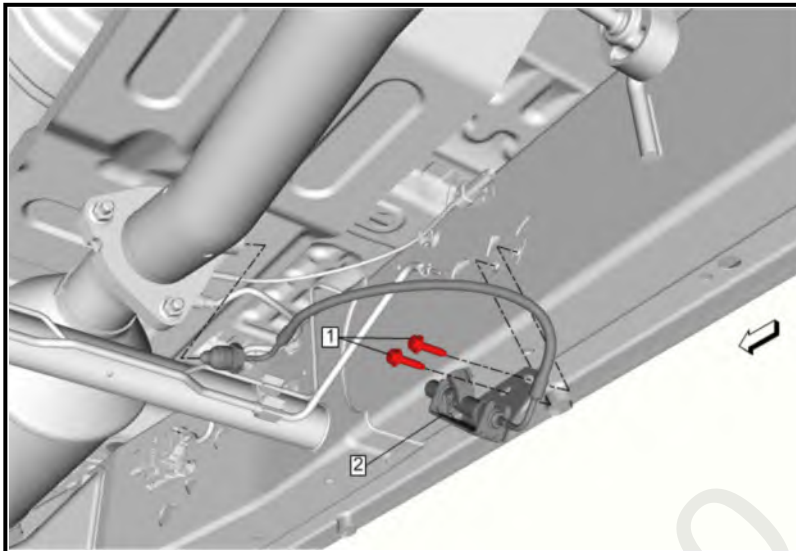


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning . Preliminary Procedures 1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection 3. Raise and support the vehicle. Lifting and Jacking the Vehicle	
1	Fuel Feed Hydrocarbon Injection Rear Pipe Procedure

Callout	Component Name
	- Using CH-49736 Hydrocarbon Injector Quick Connect Release Tool disconnect pipe at injector. - Disconnect the quick disconnects and remove from retainers. Plastic Collar Quick Connect Fitting Service Special Tools CH-49736 Hydrocarbon Injector Quick Connect Release Tool Equivalent regional tools: Special Tools ((Diagnosis Tools)).

LOW PRESSURE DIESEL HYDROCARBON INJECTOR REPLACEMENT

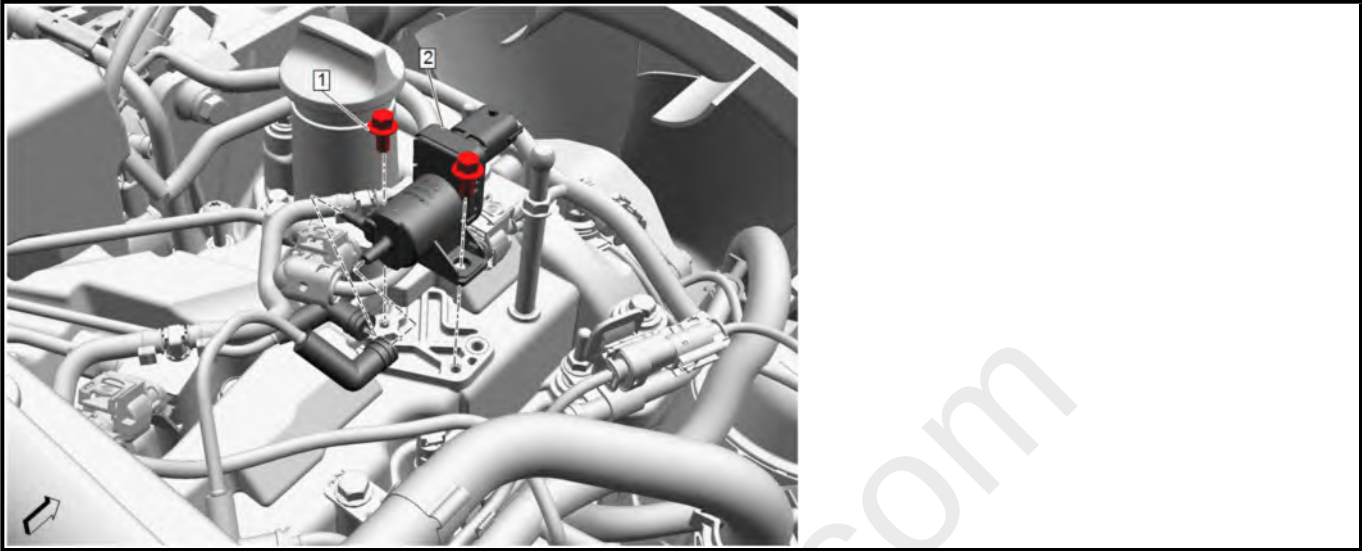


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures Fuel Feed Hydrocarbon Injection Rear Pipe Replacement (Non ZR2), or Fuel Feed Hydrocarbon Injection Rear Pipe Replacement (ZR2) - Disconnect the electrical connector.	
1	Low Pressure Diesel Hydrocarbon Injector Bolt [2x] CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Low Pressure Diesel Hydrocarbon Injector CAUTION: Refer to Component Fastener

Callout	Component Name
	<u>Tightening Caution</u> . Tighten 45 N.m (33 lb ft)

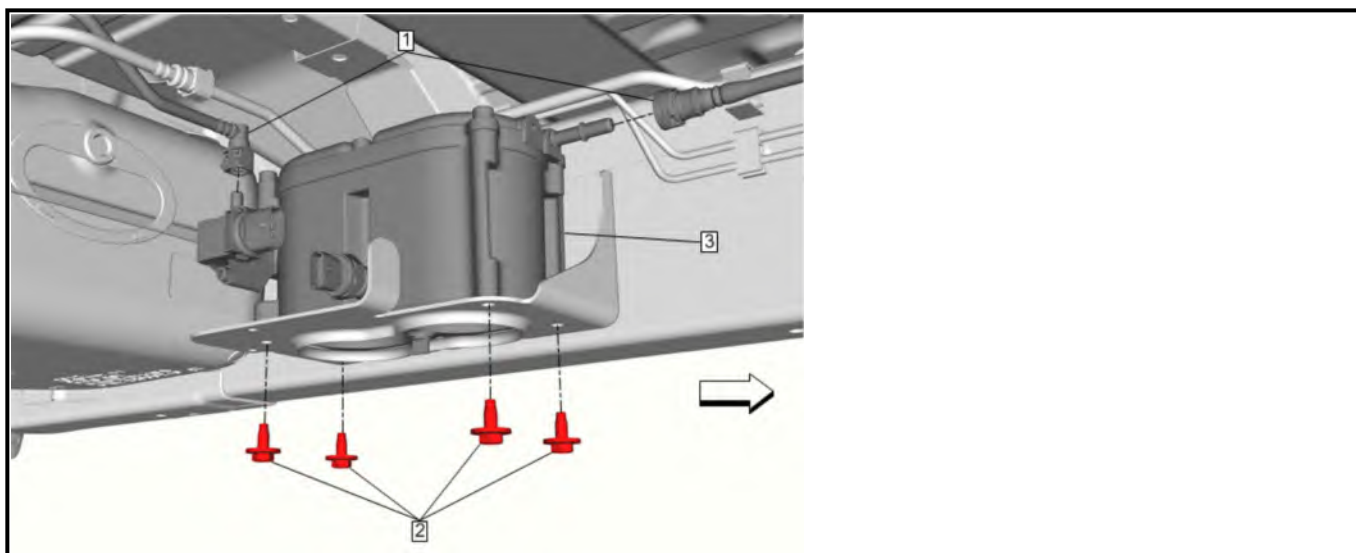
INTAKE MANIFOLD TUNING VALVE VACUUM CONTROL SOLENOID VALVE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Intake Manifold Cover Insulator Replacement (Top of Engine)</u> , or <u>Intake Manifold Cover Insulator Replacement (Left Side)</u>	
1	Intake Manifold Tuning Vacuum Control Solenoid Valve Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 7 N.m (62 lb in)
2	Intake Manifold Tuning Vacuum Control Solenoid Valve Procedure 1. Disconnect the vacuum hose.[2x] 2. Disconnect the electrical connector.

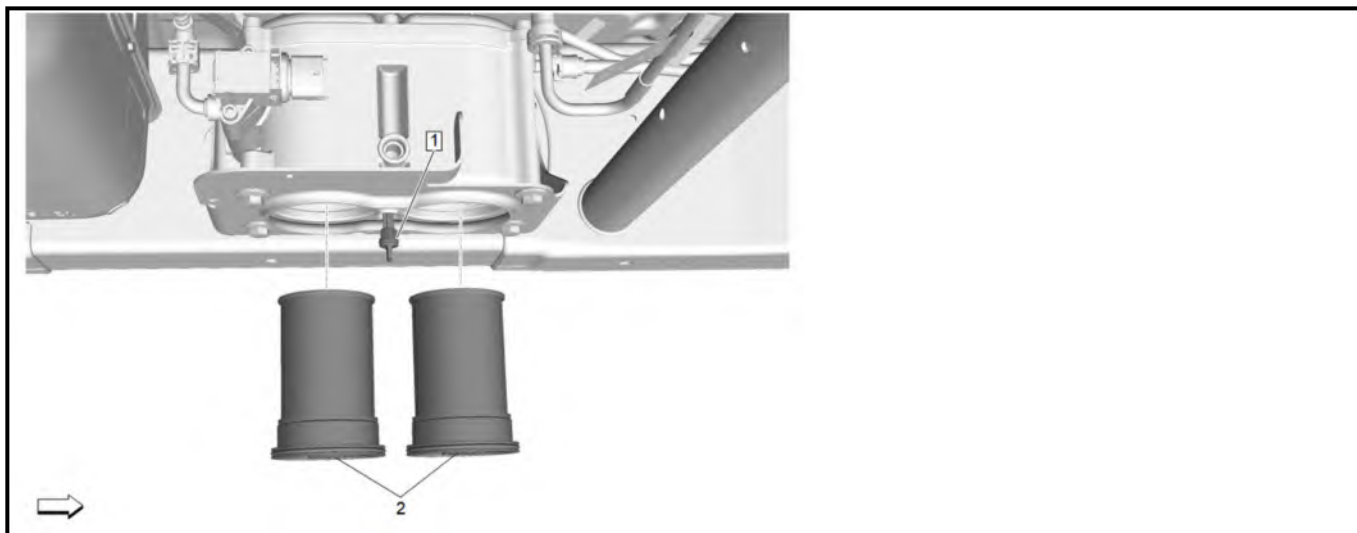
FUEL FILTER ASSEMBLY REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection 3. Raise and support the vehicle. Lifting and Jacking the Vehicle 4. Replace the fuel filter. Fuel Filter Replacement	
1	Fuel Feed Pipe [2x] Procedure Disconnect the fuel feed pipes. Plastic Collar Quick Connect Fitting Service
2	Fuel Filter Fastener [4x] CAUTION: Refer to Fastener Caution . Tighten 25 N.m (18 lb ft)
3	Fuel Filter Assembly Procedure Disconnect the fuel filter assembly wiring harness connectors.

FUEL FILTER REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Disconnect the negative battery cable. Battery Negative Cable Disconnection and Connection 3. Raise and support the vehicle. Lifting and Jacking the Vehicle 4. {If equipped} Transfer Case Skid Shield Replacement (NY7) , or Transfer Case Skid Shield Replacement (Bison) 5. Place a suitable drain pan under the vehicle.	
1	Fuel Filter Drain Plug CAUTION: Refer to Component Fastener Tightening Caution . Procedure Loosen drain plug to drain fuel from filter assembly. Tighten 2 N.m (18 lb in)
2	Fuel Filter [2x] Procedure 1. Remove the drain pan from under the vehicle. 2. Perform the GM fuel filter life system reset. GM Fuel Filter Life System Resetting (LWN) Tighten 20 N.m (15 lb ft)

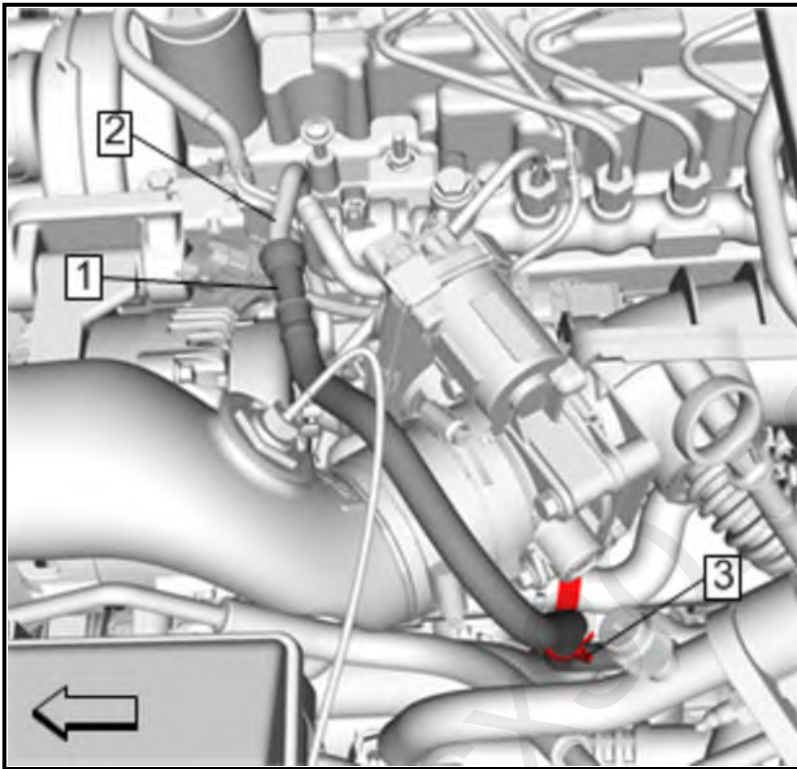
FUEL PUMP FUEL RETURN HOSE REPLACEMENT

Removal Procedure

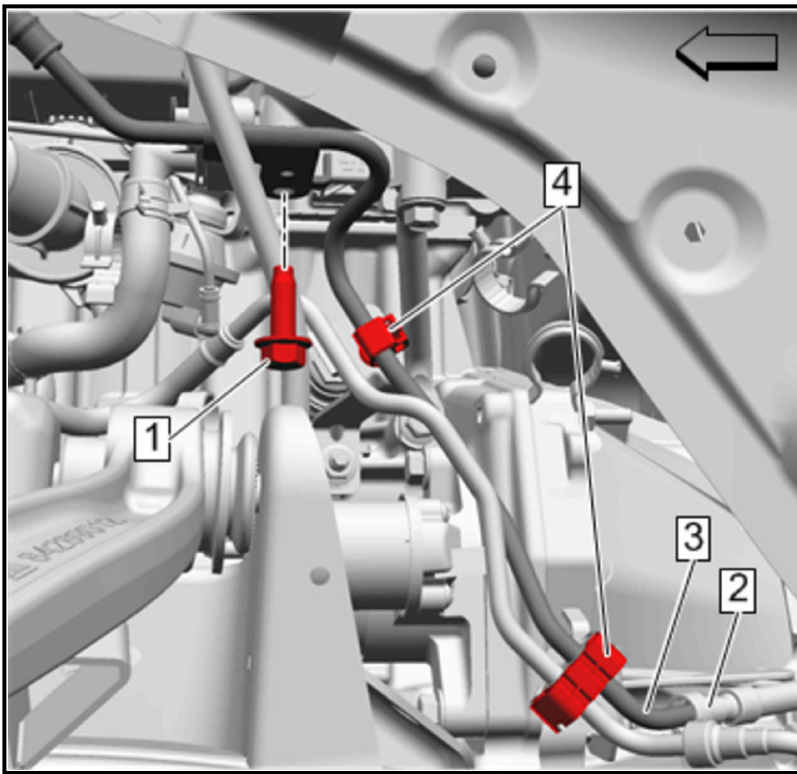
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Intake Manifold Cover - Remove - [Intake Manifold Cover Replacement](#)
3. Fuel Pump Fuel Return Hose (1) @ Engine (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



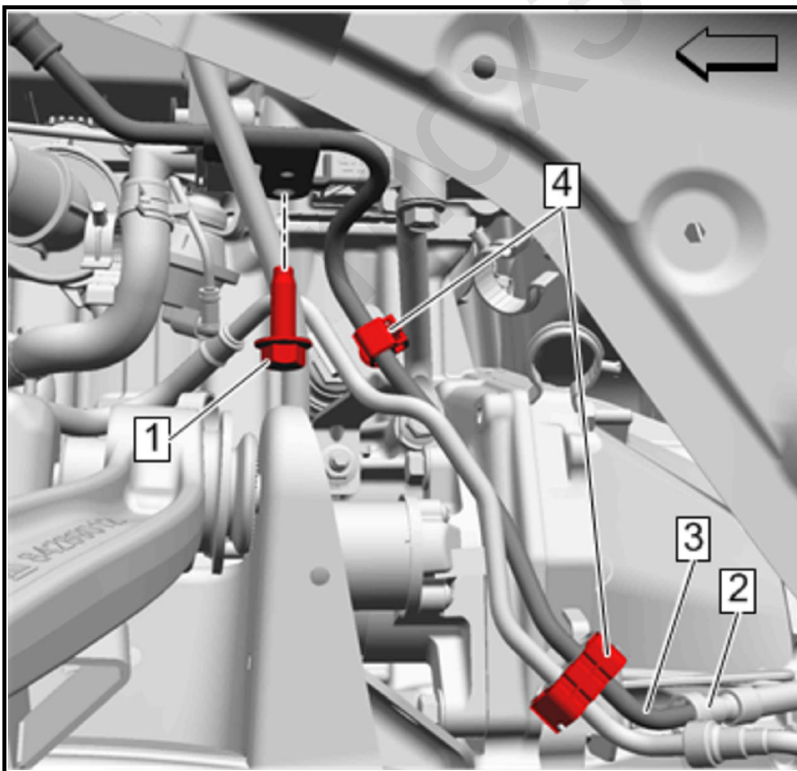
4. Fuel Pump Fuel Return Hose (1) @ Retainer (3) - Unclip
5. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
6. Front Wheelhouse Liner - Remove - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).
7. Remove wiring harness retainer from fuel pump fuel return hose.
8. Fuel Pump Fuel Return Hose Bolt (1) - Remove



9. Fuel Pump Fuel Return Hose (3) @ Fuel Return Front Pipe (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)
10. Fuel Pump Fuel Return Hose (3) @ Retainer (4) - Unclip [2x]
11. Fuel Pump Fuel Return Hose (3) - Remove

Installation Procedure

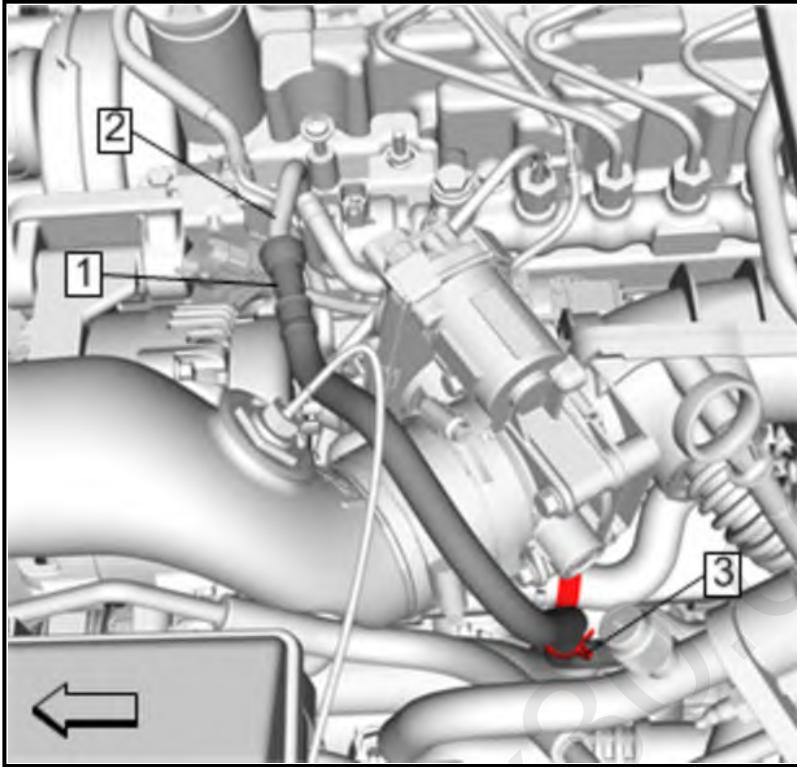
1. Fuel Pump Fuel Return Hose (3) - Install



2. Fuel Pump Fuel Return Hose (3) @ Retainer (4) - Clip [2x]
3. Fuel Pump Fuel Return Hose (3) @ Fuel Return Front Pipe (2) - Connect - [Metal Collar Quick Connect Fitting Service](#)

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

4. Fuel Pump Fuel Return Hose Bolt (1) - Install and tighten 22 N.m (16 lb ft)
5. Install wiring harness retainer from fuel pump fuel return hose.
6. Front Wheelhouse Liner - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).
7. Lower the vehicle.
8. Fuel Pump Fuel Return Hose (1) @ Retainer (3) - Clip



9. Fuel Pump Fuel Return Hose (1) @ Engine (2) - Connect - [Metal Collar Quick Connect Fitting Service](#)
10. Replace the fuel filter. [Fuel Filter Replacement](#)
11. Intake Manifold Cover - Install - [Intake Manifold Cover Replacement](#)

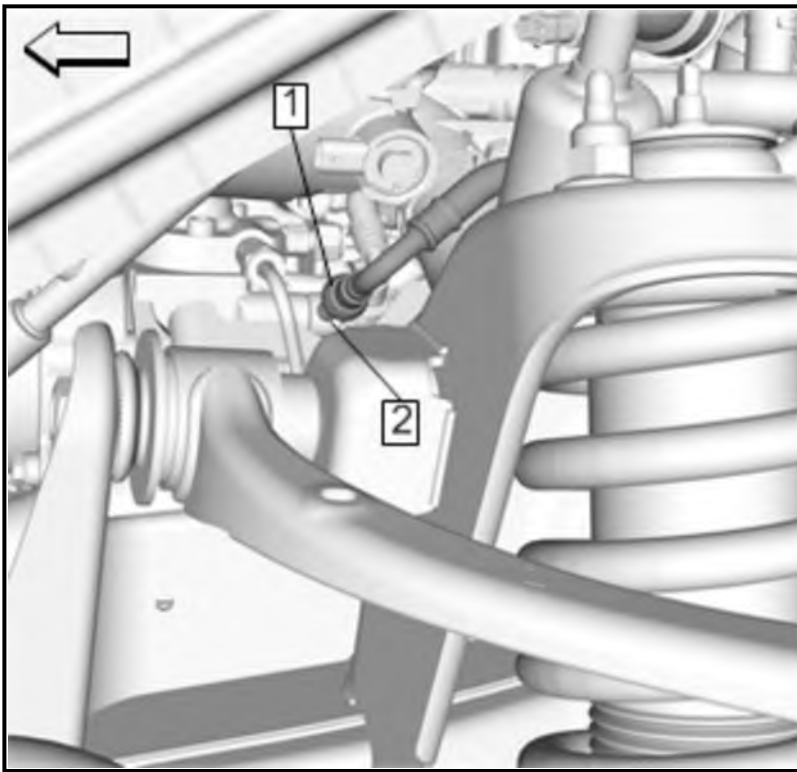
FUEL PUMP FUEL FEED HOSE REPLACEMENT

Removal Procedure

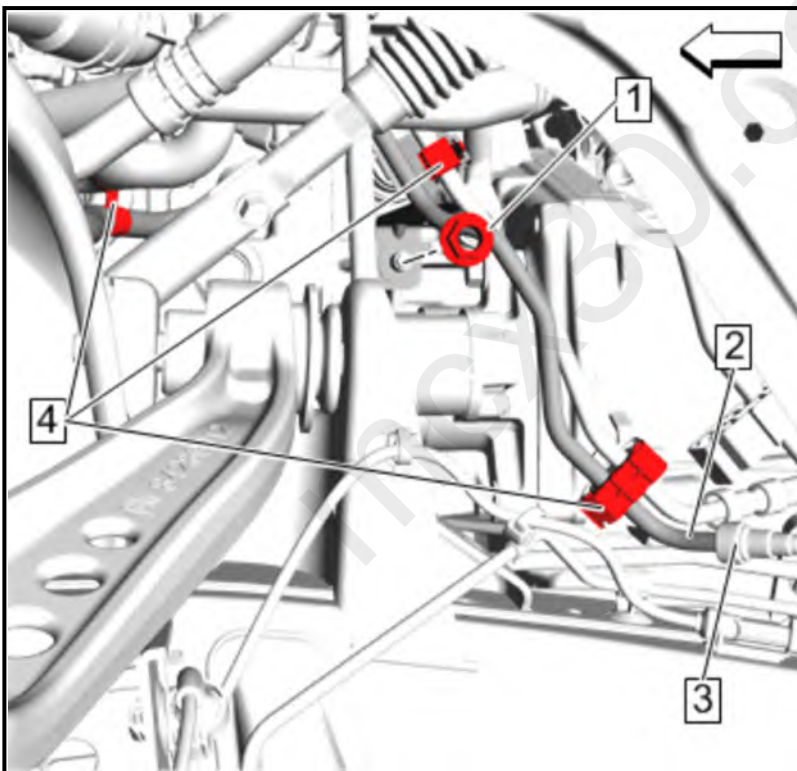
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Front Wheelhouse Liner - Remove - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).
4. Fuel Pump Fuel Feed Hose (1) @ Fuel Pump (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



5. Fuel Pump Fuel Feed Hose Nut (1) - Remove



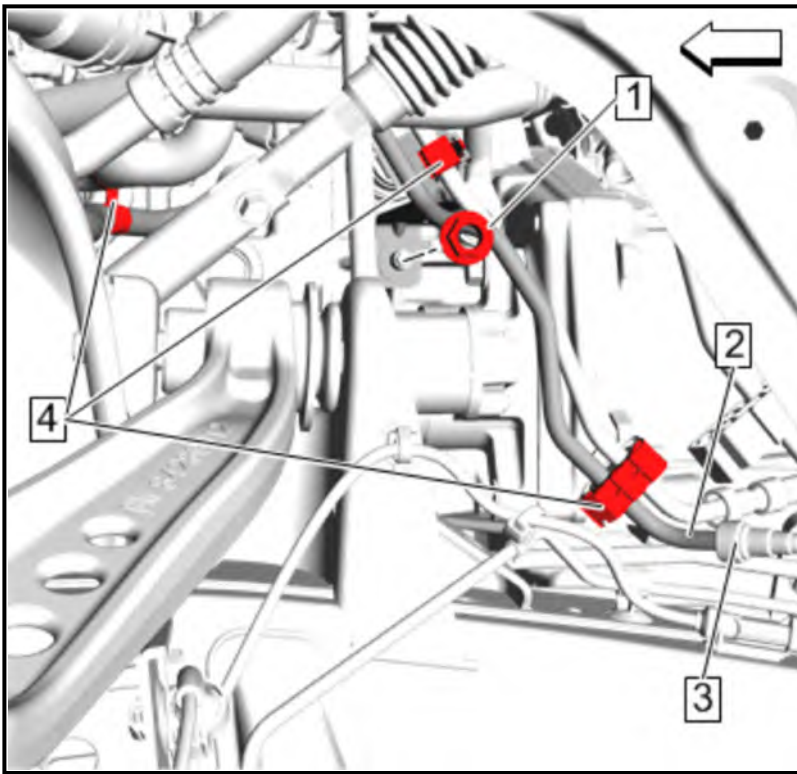
6. Fuel Pump Fuel Feed Hose (2) @ Fuel Feed Front Pipe (3) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)

NOTE: Carefully remove the fuel pump feed hose from around the coolant hoses.

7. Fuel Pump Fuel Feed Hose (2) @ Retainer (4) - Unclip [3x]

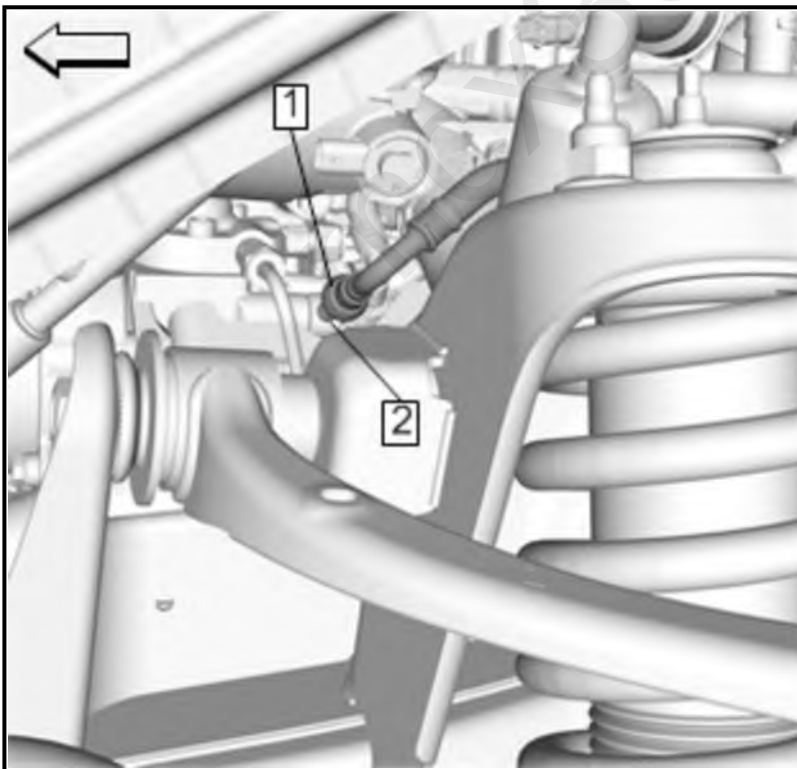
Installation Procedure

1. Fuel Pump Fuel Feed Hose Nut (1) - Install and tighten 58 N.m (43 lb ft)



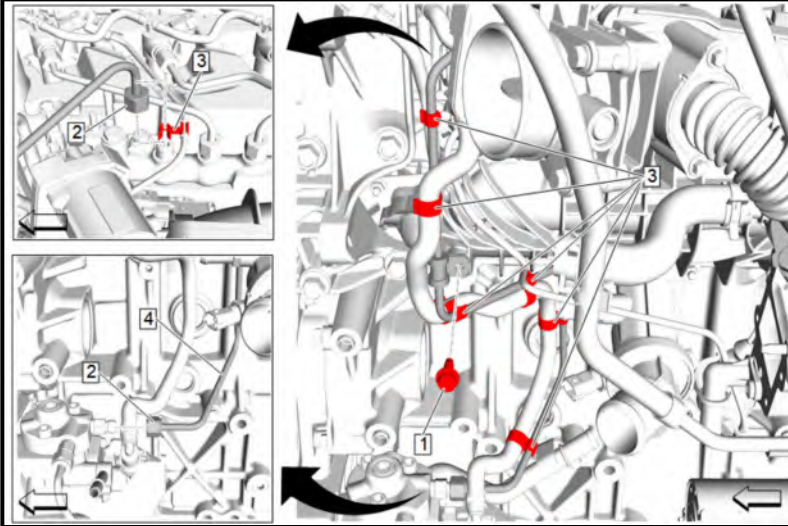
CAUTION: Refer to [Fastener Caution](#) .

2. Fuel Pump Fuel Feed Hose (2) @ Retainer (4) - Clip [3x]
3. Fuel Pump Fuel Feed Hose (2) @ Fuel Feed Front Pipe (3) - Connect - [Metal Collar Quick Connect Fitting Service](#)
4. Fuel Pump Fuel Feed Hose (1) @ Fuel Pump (2) - Connect - [Metal Collar Quick Connect Fitting Service](#)



5. Front Wheelhouse Liner - Install - [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#).
6. Lower the vehicle.

FUEL INJECTION FUEL FEED PIPE REPLACEMENT (FUEL PUMP TO FUEL RAIL)



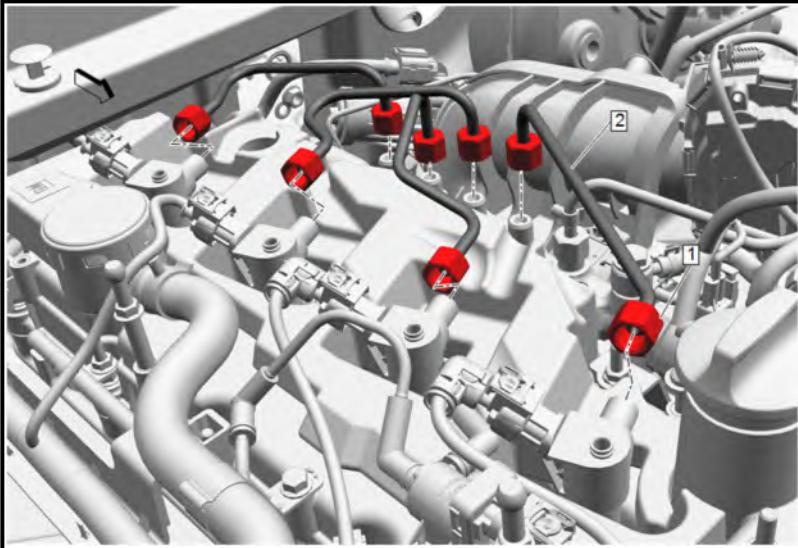
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when	

Callout	Component Name
servicing this fuel system. NOTE: • High pressure fuel feed pipes are one time use only. ALWAYS install a NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened. • If applicable, ALWAYS perform the fuel filter life reset after replacing the fuel filter. Preliminary Procedures 1. Turn OFF the engine for 30 seconds. This will completely purge the fuel pressure from the fuel system. 2. Remove both intake manifold cover insulators. <u>Intake Manifold Cover Insulator Replacement (Top of Engine)</u> , or <u>Intake Manifold Cover Insulator Replacement (Left Side)</u> 3. Remove the water pump inlet pipe and reposition the hoses as necessary. <u>Water Pump Inlet Pipe Replacement (LWN)</u>	
1	Fuel Feed Pipe Fastener CAUTION: Refer to <u>Fastener Caution</u> . Tighten 15 N.m (11 lb ft)
2	Fuel Feed Pipe Fitting [2x]

Callout	Component Name
	CAUTION: Refer to Component Fastener Tightening Caution . Procedure 1. Ensure ALL fittings are clean and dry prior to assembly. 2. Start both ends of the NEW fuel injection fuel feed pipe by hand. Tighten 30 N.m (22 lb ft)
3	Fuel Feed Pipe Retainer [7x] Procedure Remove the fuel feed pipe from the fuel feed pipe retainers. NOTE: • Note the routing of the fuel feed pipe to ensure proper installation. • Ensure that the retainers secure the fuel feed pipe properly.
4	Fuel Feed Pipe Procedure 1. Remove and DISCARD the pipe. 2. Transfer clamp bracket to new pipe. 3. Replace the fuel filter. Fuel Filter Replacement 4. Prime the fuel system. Fuel System Priming 5. With the engine running, check the fuel system for leaks. 6. Finish installing all remaining components.

FUEL INJECTION FUEL FEED PIPE REPLACEMENT (FUEL INJECTOR TO FUEL RAIL)



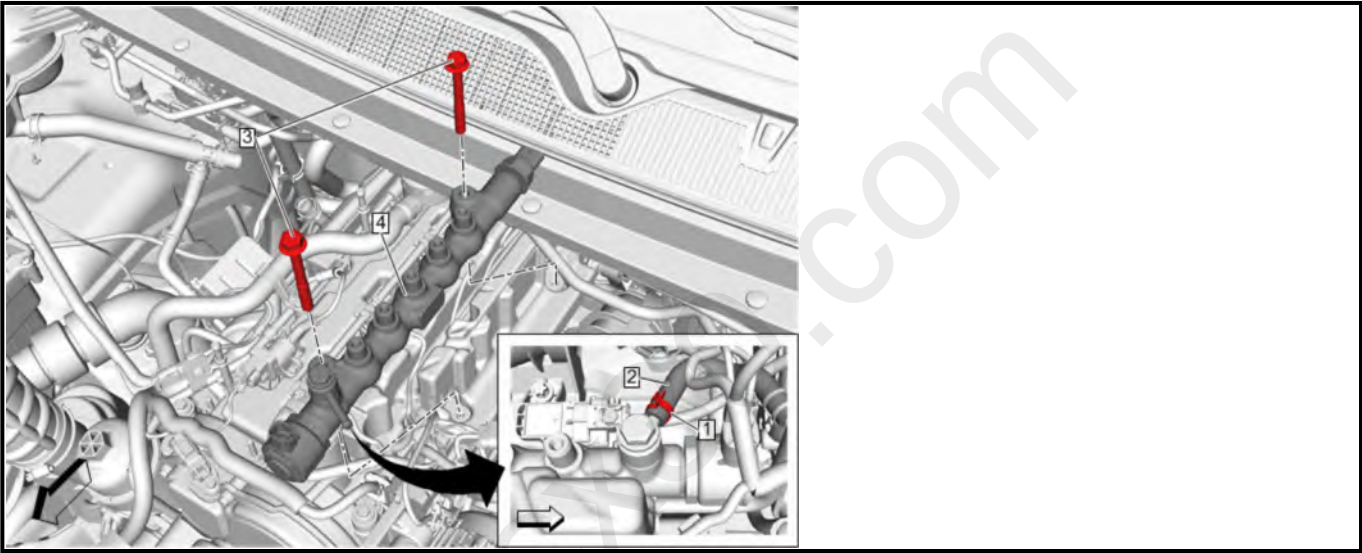
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when	

Callout	Component Name
servicing this fuel system. NOTE: • High pressure fuel feed pipes are one time use only. ALWAYS install a NEW high pressure fuel feed pipe if the pipe is removed OR the fittings are loosened. • If applicable, ALWAYS perform the fuel filter life reset after replacing the fuel filter. Preliminary Procedures 1. Turn OFF the engine for 30 seconds. This will completely purge the fuel pressure from the fuel system. 2. <u>Plenum Front Panel Replacement</u> 3. Remove both intake manifold cover insulators. <u>Intake Manifold Cover Insulator Replacement (Top of Engine)</u> , or <u>Intake Manifold Cover Insulator Replacement (Left Side)</u>	
1	Fuel Injection Fuel Feed Pipe Fitting [8x] CAUTION: Refer to <u>Component Fastener Tightening Caution</u> . Procedure 1. Ensure ALL fittings are clean and dry prior to assembly. 2. Start both ends of the NEW fuel injection fuel feed pipes by hand.

Callout	Component Name
	Tighten 30 N.m (22 lb ft)
2	Fuel Injection Fuel Feed Pipe [4x] Procedure 1. Remove and DISCARD the pipes. 2. Replace the fuel filter. Fuel Filter Replacement 3. Prime the fuel system. Fuel System Priming 4. With the engine running, check the fuel system for leaks. 5. Finish installing all remaining components.

FUEL INJECTION FUEL RAIL ASSEMBLY REPLACEMENT



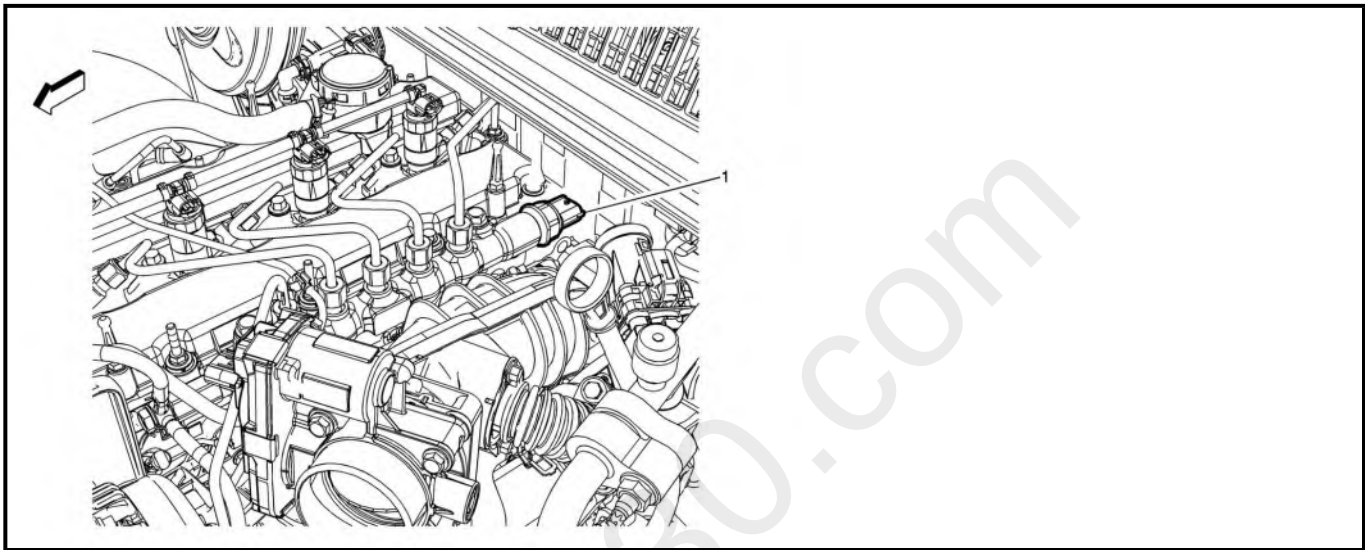
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures	
1. Turn OFF the engine for 30 seconds. This will completely purge the fuel pressure from the fuel system.	
NOTE: The fuel feed pipes are one time use ONLY. The fuel feed pipes MUST be replaced whenever they are loosened.	
2. Remove and DISCARD the fuel injection fuel feed pipes. Fuel Injection Fuel Feed Pipe Replacement (Fuel Pump to Fuel Rail) , or Fuel Injection Fuel Feed Pipe Replacement (Fuel	

Callout	Component Name
<u>Injector to Fuel Rail).</u> 3. Replace the fuel filter. <u>Fuel Filter Replacement</u>	
1	Hose Clamp
2	Diesel Fuel Separator Hose Procedure Disconnect the diesel fuel separator hose from the fuel injection fuel rail.
3	Fuel Injection Fuel Rail Fastener [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 25 N.m (18 lb ft)
4	Fuel Injection Fuel Rail Assembly WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing

Callout	Component Name
	when servicing this fuel system. Procedure 1. Disconnect all electrical connectors. 2. Prime the fuel system. Fuel System Priming 3. With the engine running, check the fuel system for leaks.

FUEL RAIL PRESSURE SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Turn OFF the engine for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. Intake Manifold Cover Insulator Replacement (Top of Engine) , or Intake Manifold Cover Insulator Replacement (Left Side).	
1	Fuel Injection Fuel Rail Fuel Pressure Sensor WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors.

Callout	Component Name
	This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when servicing this fuel system. CAUTION: Refer to Component Fastener Tightening Caution . Procedure 1. Disconnect the electrical connector. 2. Install a NEW fuel injection fuel rail fuel pressure sensor seal. 3. Install a NEW fuel injection fuel rail fuel pressure sensor. 4. Prime the fuel system. Fuel System Priming 5. With the engine running, check the fuel system for leaks. NOTE: The fuel injection fuel rail fuel pressure sensor MUST be replaced whenever loosened/removed. Tighten 35 N.m (26 lb ft)

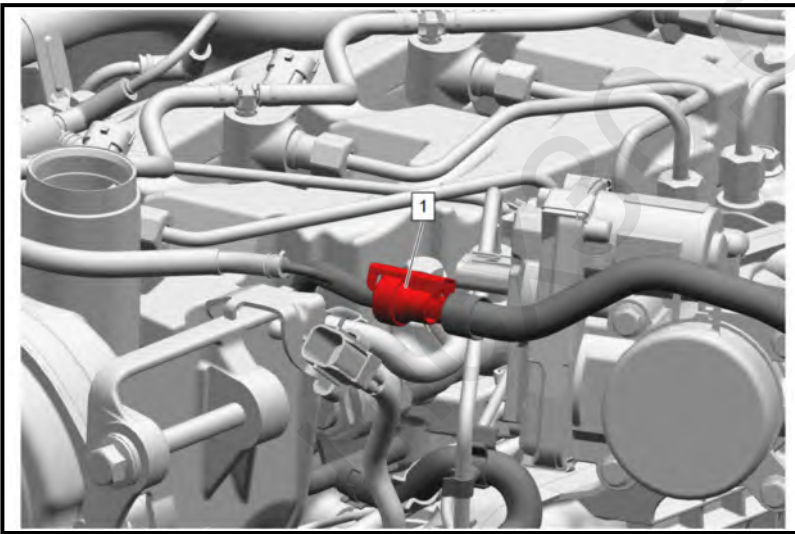
DIESEL FUEL SEPARATOR REPLACEMENT

Removal Procedure

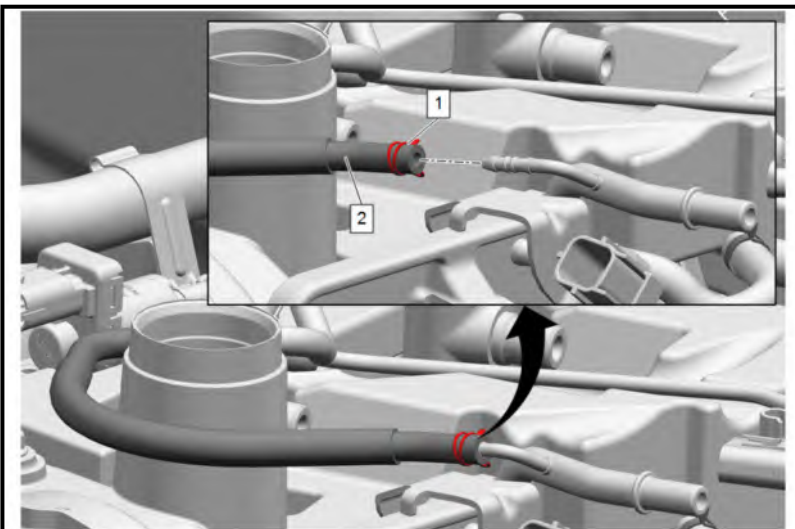
1. Power Brake Booster Vacuum Hose (1) @ Intake Manifold Cover - Disconnect



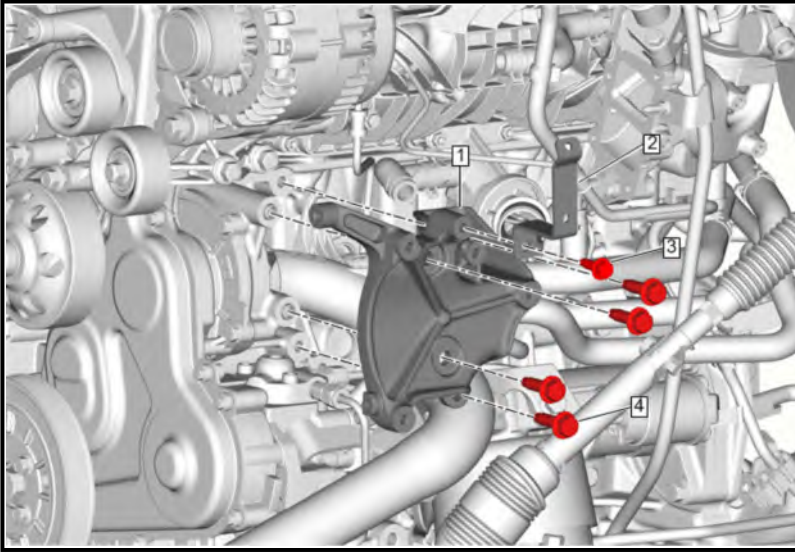
2. High Pressure Diesel Fuel Injection Rail - Remove - [Fuel Injection Fuel Rail Assembly Replacement](#)
3. Fuel Pump Fuel Return Hose (1) @ Diesel Fuel Separator - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



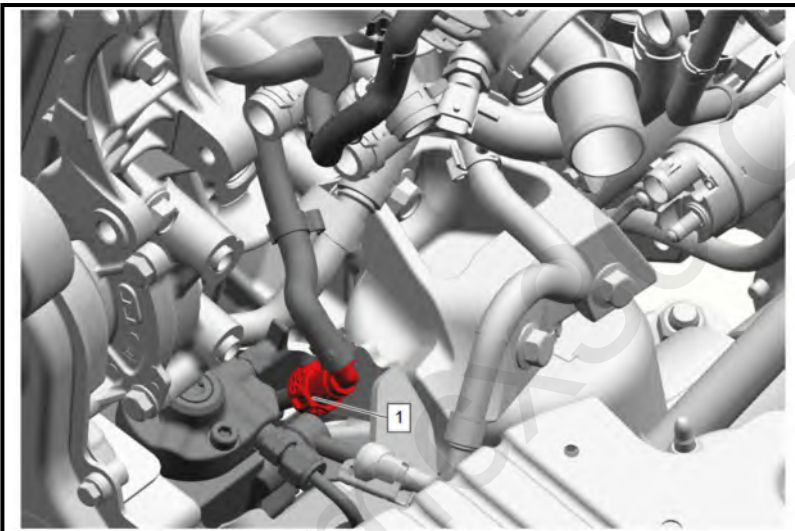
4. Clamp (1) @ Fuel Injection Fuel Return Pipe (2) - Release



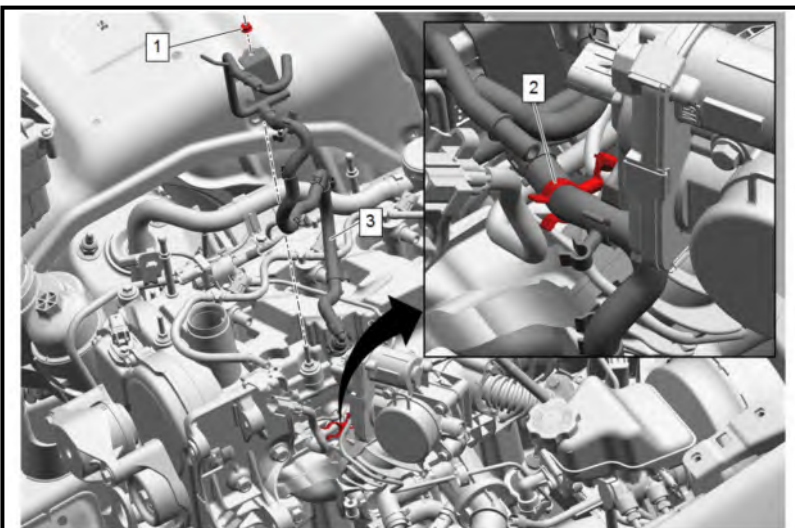
5. Fuel Injection Fuel Return Pipe (2) @ Diesel Fuel Separator - Disconnect
6. Air Conditioning Compressor Bracket (1) - Remove - [Air Conditioning Compressor Bracket Replacement \(LWN\)](#)



7. Disconnect the connector (1) on the diesel fuel separator at the fuel pump.



8. Fuel Pipe Bracket Nut (1) - Remove

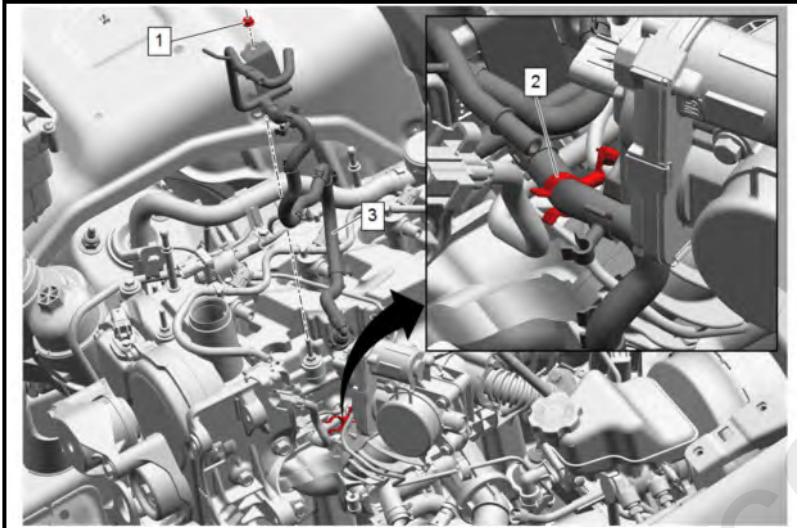


9. Unclip the diesel fuel separator from the map sensor connector (2).

10. Heater Outlet Hose @ Water Pump Inlet Pipe - Disconnect - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).
11. Radiator Surge Tank Outlet Hose @ Water Pump Inlet Pipe - Disconnect - [Radiator Surge Tank Outlet Hose Replacement - Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe \(LWN\)](#).
12. Diesel Fuel Separator (3) - Remove

Installation Procedure

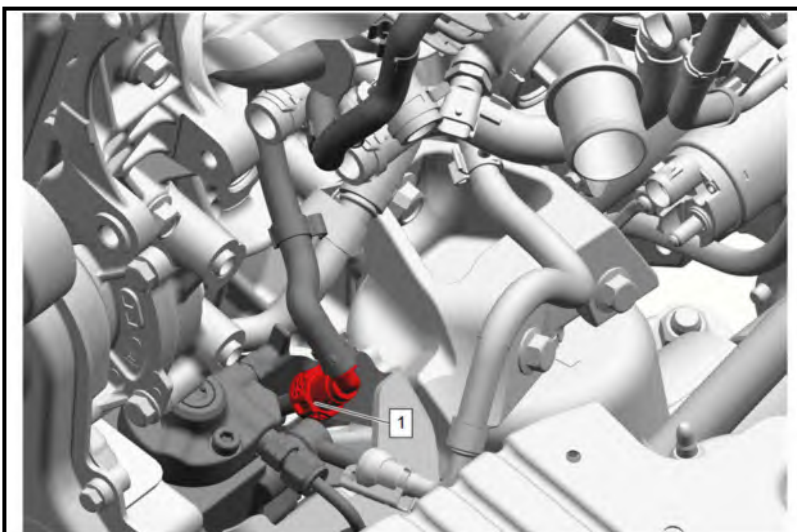
1. Diesel Fuel Separator (3) - Install



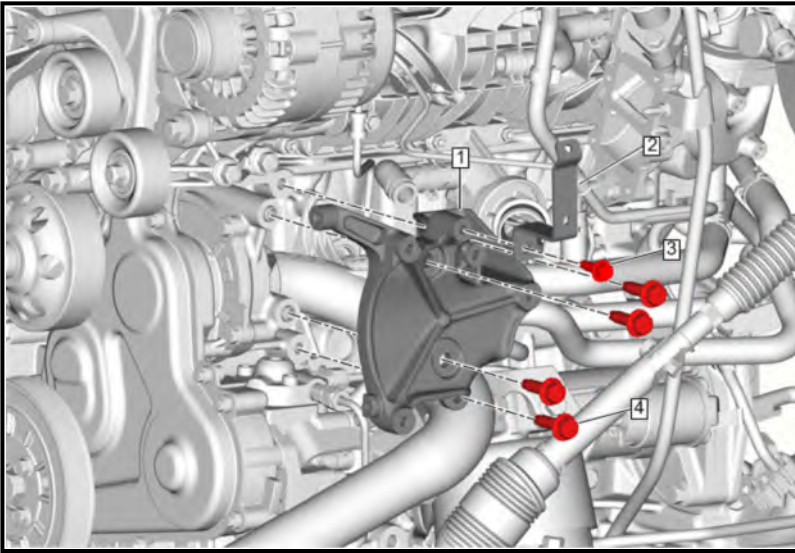
2. Radiator Surge Tank Outlet Hose @ Water Pump Inlet Pipe - Connect - [Radiator Surge Tank Outlet Hose Replacement - Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe \(LWN\)](#).
3. Heater Outlet Hose @ Water Pump Inlet Pipe - Connect - [Heater Outlet Hose Replacement \(Heater Core Outlet Pipe to Radiator Surge Tank Outlet Pipe LWN\)](#) , or [Heater Outlet Hose Replacement \(Radiator Surge Tank Outlet Pipe to Water Pump Inlet Pipe LWN\)](#).
4. Clip the diesel fuel separator to the map sensor connector (2).

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

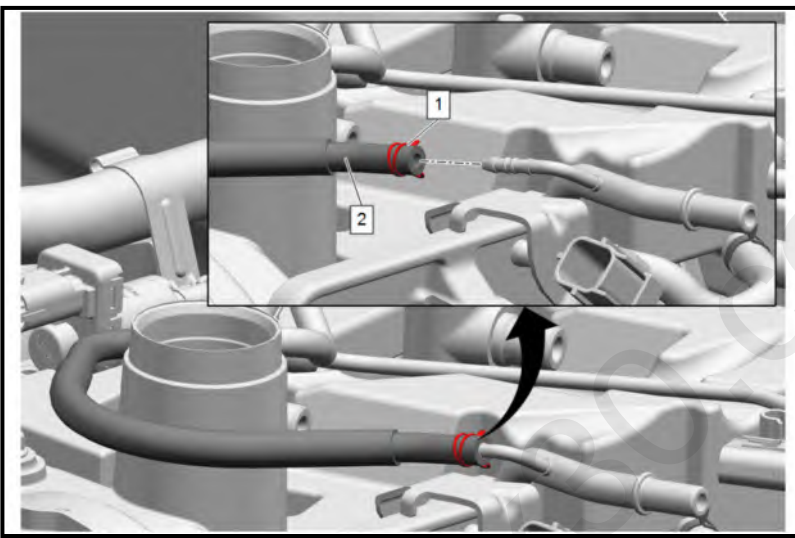
5. Fuel Pipe Bracket Nut (1) - Install and tighten 10 N.m (89 lb in)
6. Connect the connector (1) on the diesel fuel separator at the fuel pump.



7. Air Conditioning Compressor Bracket (1) - Install - [Air Conditioning Compressor Bracket Replacement \(LWN\)](#).

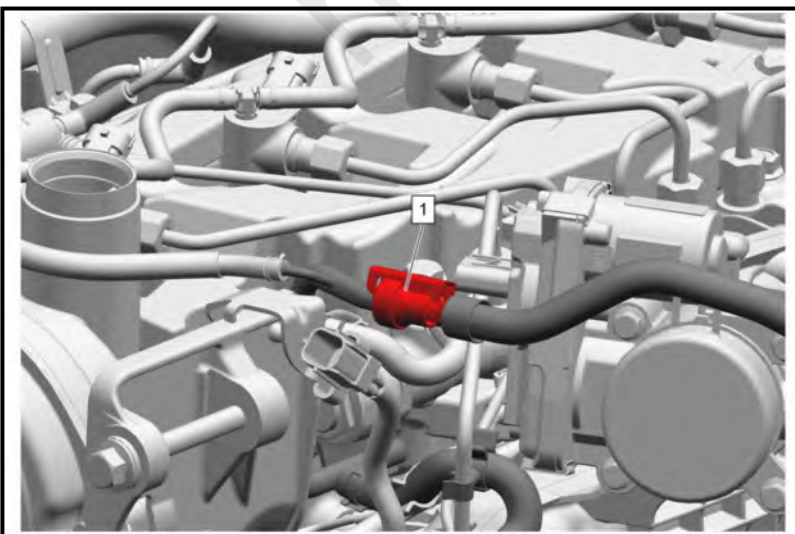


8. Clamp (1) @ Fuel Injection Fuel Return Pipe (2) - Release



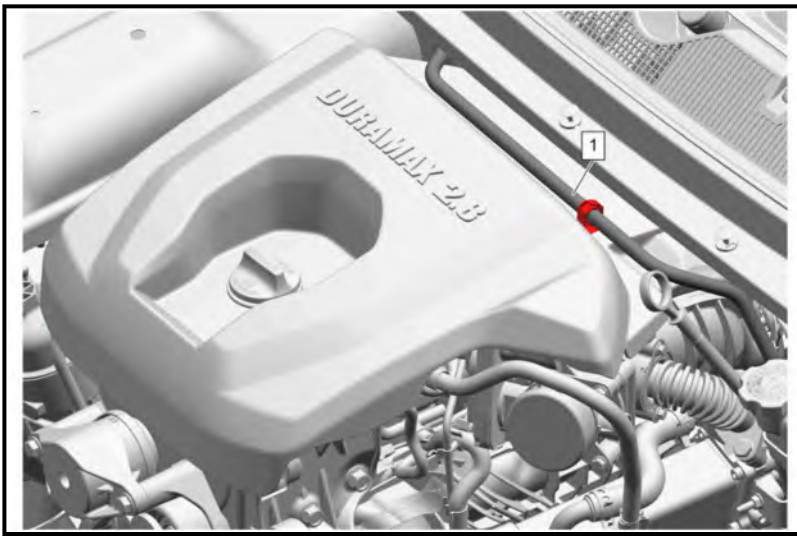
9. Fuel Injection Fuel Return Pipe (2) @ Diesel Fuel Separator - Connect

10. Fuel Pump Fuel Return Hose (1) @ Diesel Fuel Separator - Connect - [Metal Collar Quick Connect Fitting Service](#)

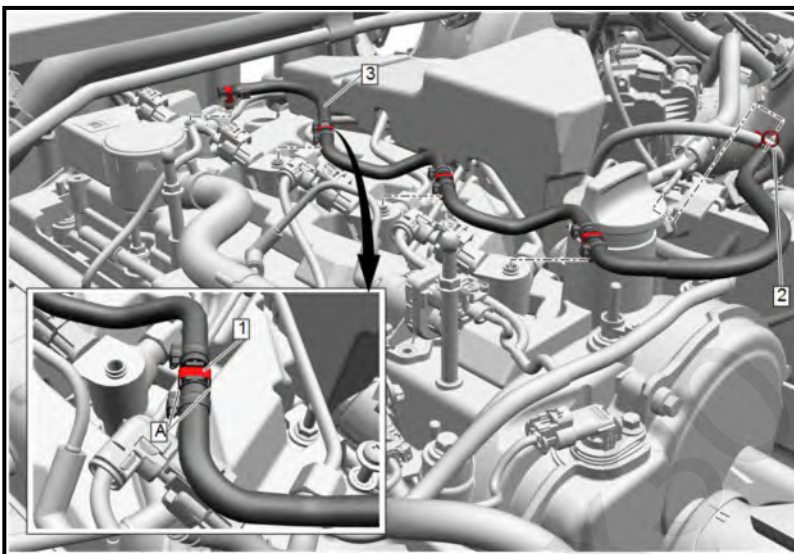


11. High Pressure Diesel Fuel Injection Rail - Install - [Fuel Injection Fuel Rail Assembly Replacement](#)

12. Power Brake Booster Vacuum Hose (1) @ Intake Manifold Cover - Connect



FUEL INJECTION FUEL RETURN PIPE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Turn OFF the engine for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system. 2. <u>Intake Manifold Cover Insulator Replacement (Top of Engine)</u> , or <u>Intake Manifold Cover Insulator Replacement (Left Side)</u>.	
1	Fuel Return Line Quick Connect Clip [4x] Procedure Insert a small flat bladed tool into points (A), simultaneously pull upward on the return pipe to release each side of the fuel return line quick connect clip. NOTE: Whenever the return hose or return hose clip is removed, a NEW quick

Callout	Component Name
	connect clip must be installed to prevent fuel leaks.
2	Fuel Injection Fuel Return Pipe Clamp NOTE: If replacing the hose, it is necessary to install a NEW fuel injection return pipe clamp.
3	Fuel Injection Fuel Return Pipe WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when

Callout	Component Name
	servicing this fuel system. Procedure 1. After installation perform the following: 1. Prime the fuel system. Fuel System Priming 2. With the engine running, check the fuel system for leaks.

FUEL INJECTION PUMP DRIVE PULLEY REPLACEMENT

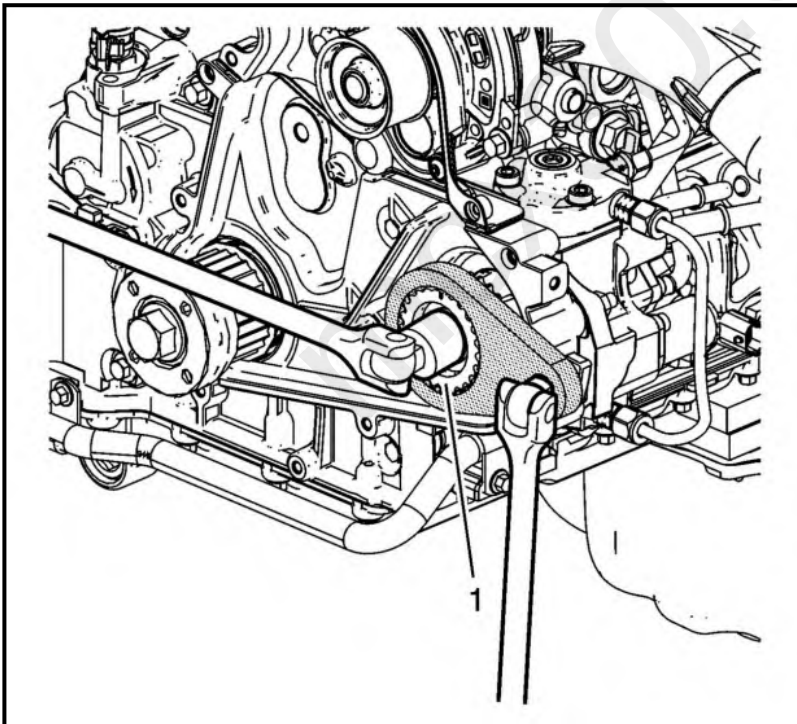
Special Tools

- EN-51104 Injection Pump Sprocket Holder
- J-22888 - 20A Universal Two Jaw Puller

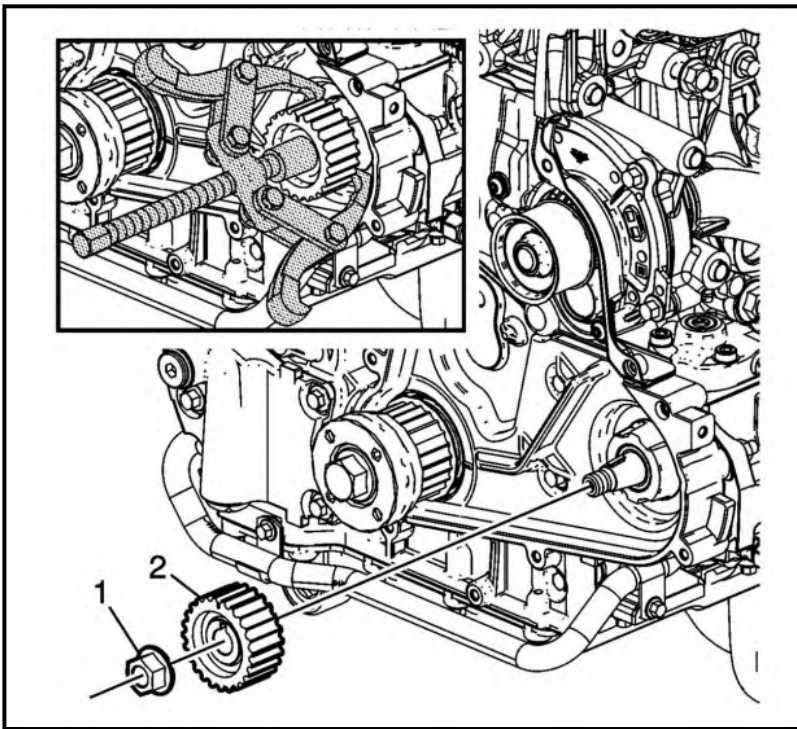
Equivalent regional tools: **Special Tools**

Removal Procedure

1. Remove the timing belt. **Timing Belt Replacement**
2. Hold the fuel injection pump drive pulley (1) with the EN-51104 holder (1) and loosen the fuel injection pump driven sprocket nut.



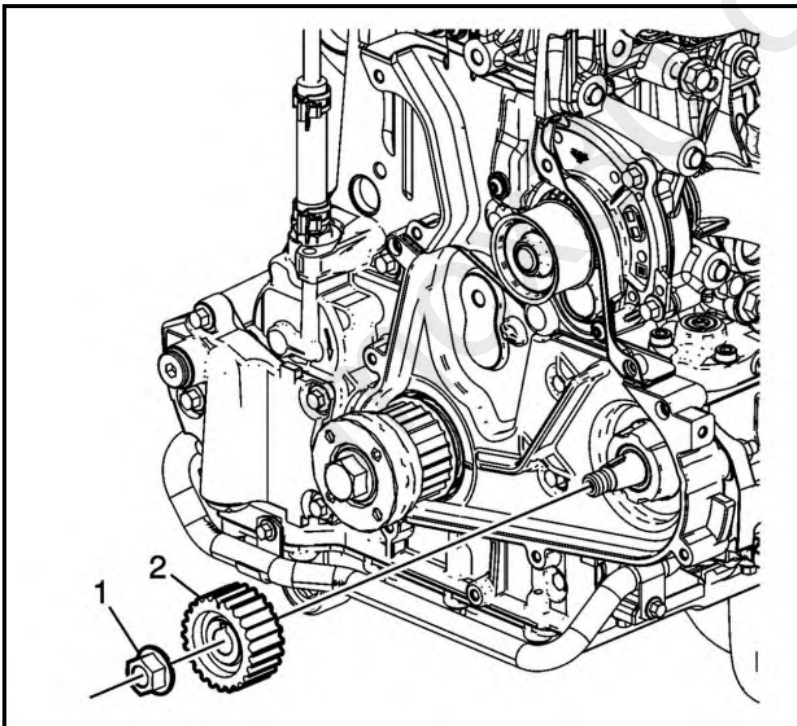
3. Remove the fuel injection pump driven sprocket nut (1).



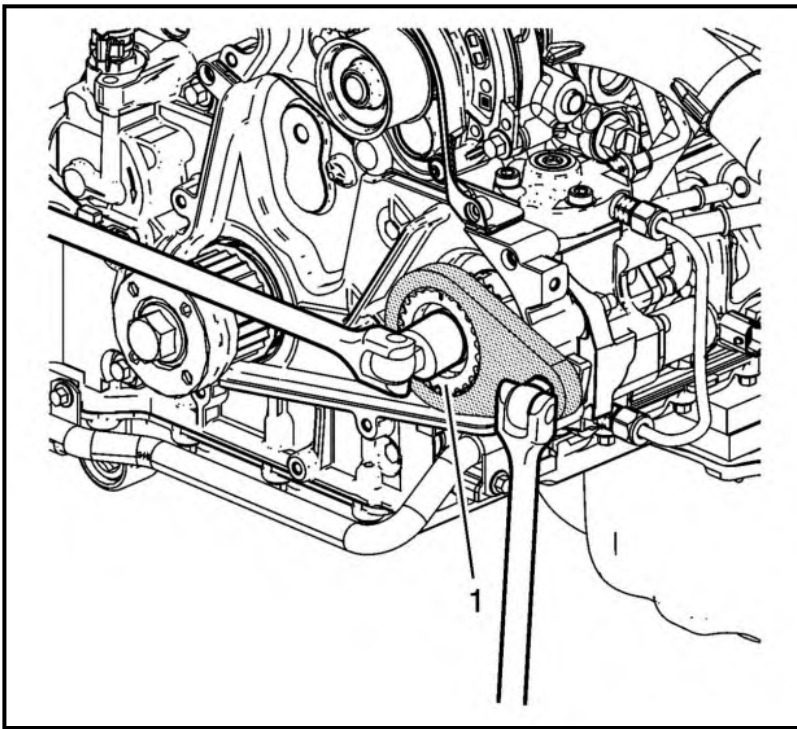
4. Use the **J-22888 - 20A** puller to remove the fuel injection pump drive pulley (2).

Installation Procedure

1. Install the fuel injection pump drive pulley (2) and fuel injection pump driven sprocket nut (1) by hand.



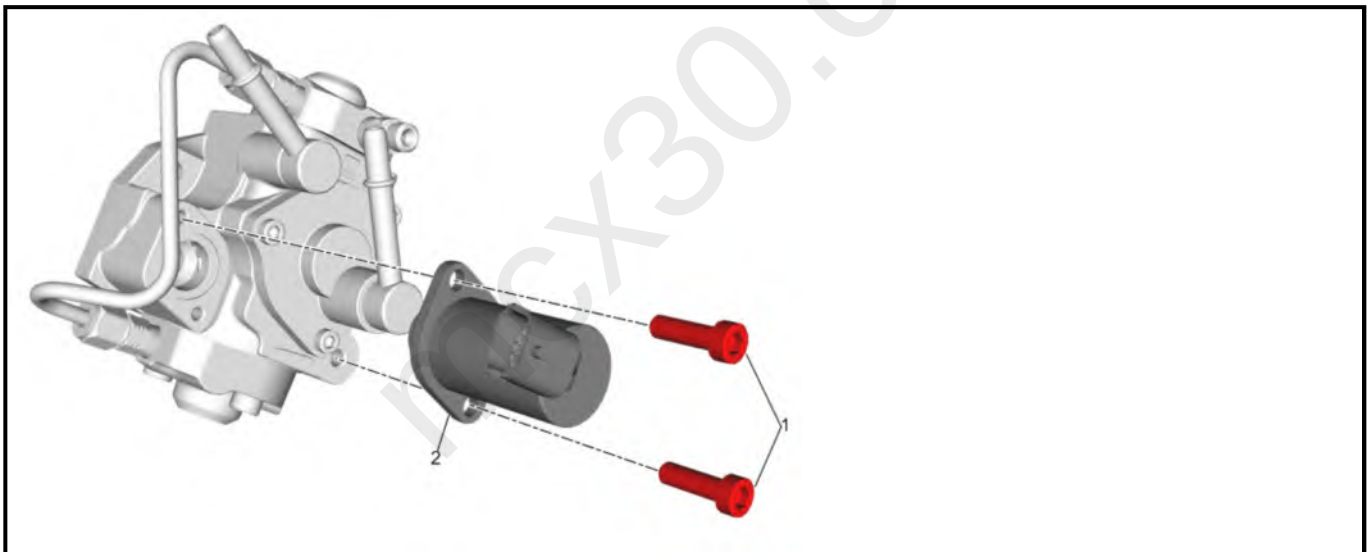
2. Hold the fuel injection pump drive pulley (1) with the **EN-51104** holder (1) and tighten the fuel injection pump driven sprocket nut to 88 N.m (65 lb ft).



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

3. Install the timing belt. [Timing Belt Replacement](#)

FUEL INJECTION PUMP METERING VALVE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

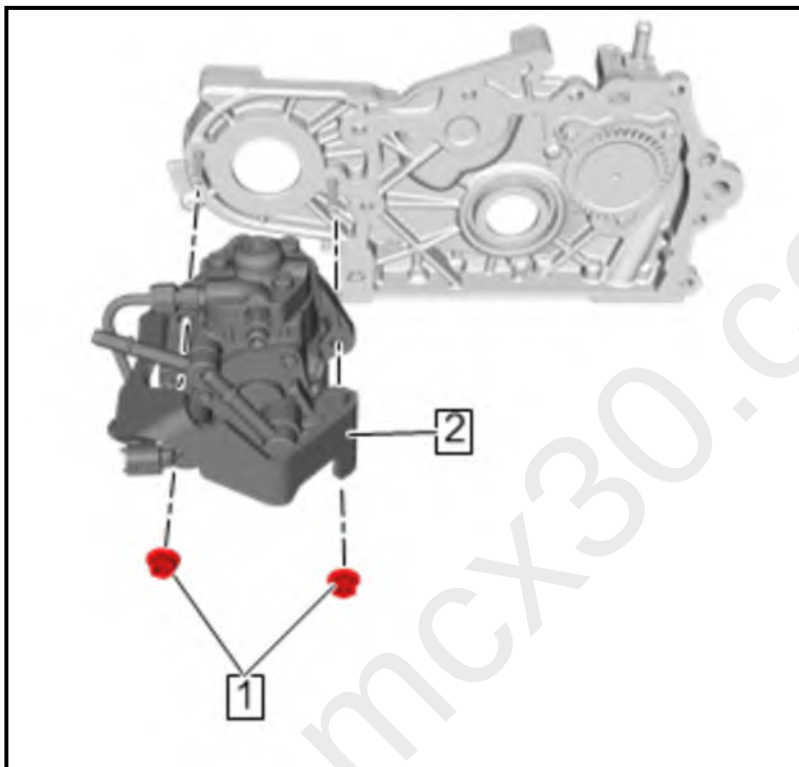
Callout	Component Name
Preliminary Procedure Fuel Injection Pump Replacement	
1	Fuel Injection Pump Metering Valve Fastener [2x] CAUTION: Refer to Fastener Caution . Tighten

Callout	Component Name
	9 N.m (80 lb in)
3	Fuel Injection Pump Metering Valve Procedure 1. Install a NEW O-ring seal.

FUEL INJECTION PUMP REPLACEMENT

Removal Procedure

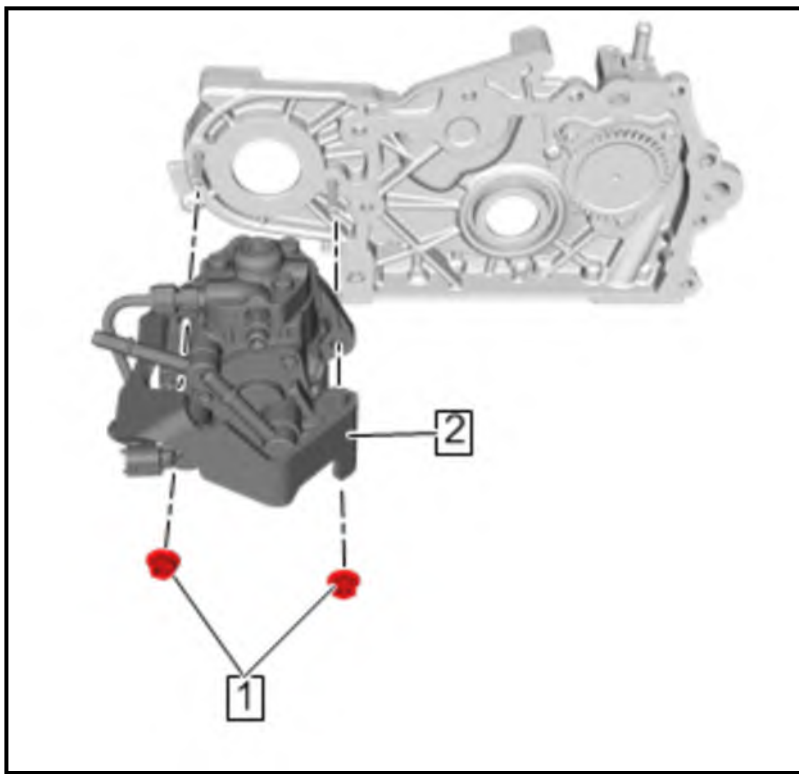
1. Fuel Injection Pump Drive Pulley - Remove - [Fuel Injection Pump Drive Pulley Replacement](#)
2. Engine Front Cover - Remove - [Engine Front Cover Replacement](#)
3. Fuel Pump Nut (1) - Remove [2x]



4. Fuel Pump (2) - Remove

Installation Procedure

1. Fuel Pump (2) - Install



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

2. Fuel Pump Nut (1) - Install and tighten 25 N.m (18 lb ft)
3. Engine Front Cover - Install - [Engine Front Cover Replacement](#)
4. Fuel Injection Pump Drive Pulley - Install - [Fuel Injection Pump Drive Pulley Replacement](#)
5. Replace the fuel filter. [Fuel Filter Replacement](#)
6. Prime the fuel system. [Fuel System Priming](#)

WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when servicing this fuel system.

7. With the engine running, check the fuel system for leaks.

FUEL INJECTOR REPLACEMENT (CYLINDER #1, #2, #3)

Removal Procedure

WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when servicing this fuel system.

NOTE: The fuel injector label located on the engine front cover will become invalid and **MUST** be removed and **DISCARDED** if ANY fuel injector is replaced.

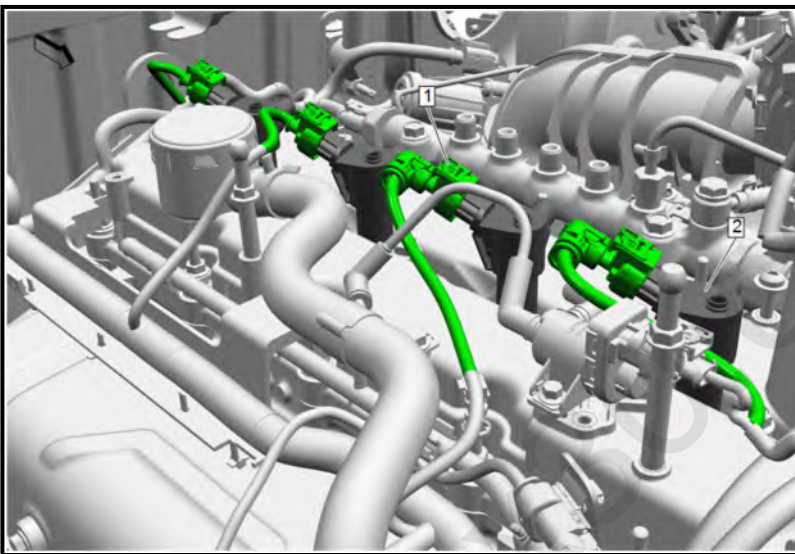
1. Turn OFF the engine for 30 seconds before proceeding. This will ensure fuel pressure has purged from the fuel system.
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)

NOTE: Only the intake manifold cover insulator replacement - top of engine procedure will need to be completed in order to remove the fuel injectors for cylinders #1, #2, and #3.

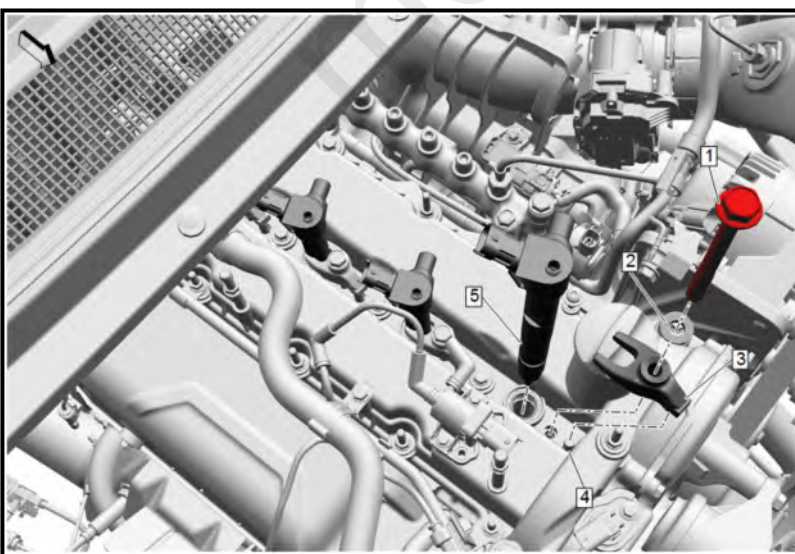
3. Intake Manifold Cover Insulator - Remove - [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#).

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

4. Fuel Injection Fuel Feed Pipe - Fuel Injector to Fuel Rail - Remove and DISCARD - [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Pump to Fuel Rail\)](#), or [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Injector to Fuel Rail\)](#)
5. Fuel Injection Fuel Return Pipe - Remove - [Fuel Injection Fuel Return Pipe Replacement](#)
6. Electrical Connector (1) @ Fuel Injector (2) - Disconnect



7. Fuel Injector Bracket Bolt (1) - Remove



NOTE:

- ALWAYS clean ANY debris from around the fuel injectors before removing to prevent contamination.

- **ALWAYS** mark the original fuel injector locations for correct reinstallation to the same engine cylinders. Failure to do so may result in a poor performance.

8. Fuel Injector Washer (2) - Remove
9. Remove the fuel injector (5) and the fuel injector hold down clamp (3) by pulling them both away from the valve rocker arm cover.
10. Combustion Fuel Injector Seal (1) - Remove and DISCARD

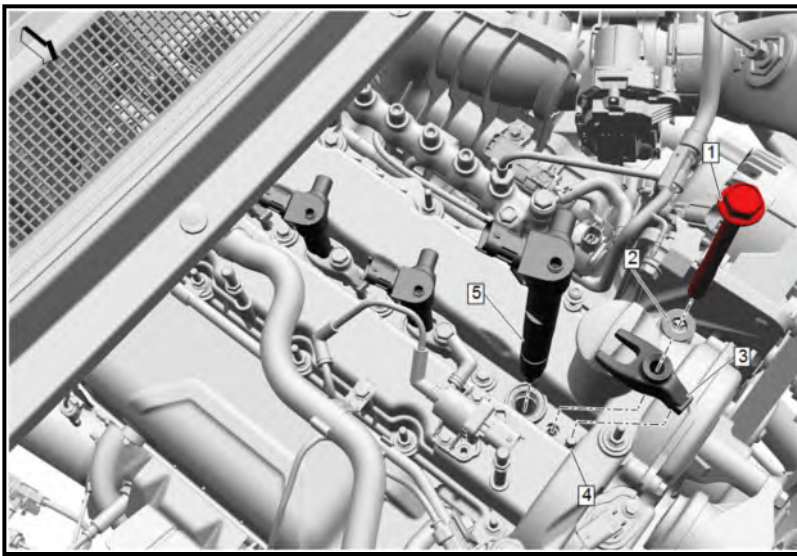


Installation Procedure

1. Clean and inspect the fuel injector prior to reinstalling it. [Fuel Injector Cleaning and Inspection](#)
2. Combustion Fuel Injector Seal (1) - Install NEW



3. Slide the fuel injector hold down clamp (3) into the grooves on the fuel injector (5) and install them together into the valve rocker arm cover ensuring that the fuel injector locating pin (4) engages the fuel injector hold down clamp (3).

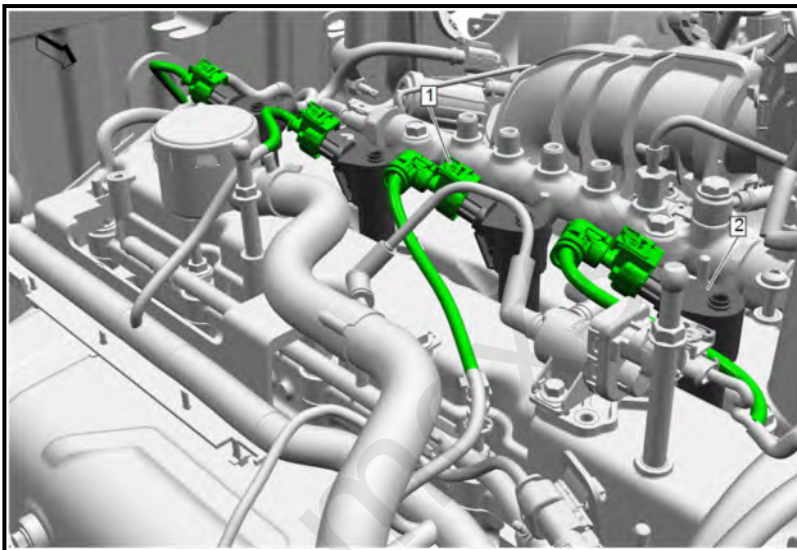


4. Fuel Injector Washer (2) - Install

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

5. Fuel Injector Bracket Bolt (1) - Install and tighten 32 N.m (24 lb ft)

6. Electrical Connector (1) @ Fuel Injector (2) - Connect



7. Fuel Injection Fuel Return Pipe - Install - [Fuel Injection Fuel Return Pipe Replacement](#)

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

8. Fuel Injection Fuel Feed Pipe - Fuel Injector to Fuel Rail - Install NEW - [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Pump to Fuel Rail\)](#), or [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Injector to Fuel Rail\)](#)

NOTE: If applicable, perform the fuel filter life reset after replacing the fuel filter.

9. Replace the fuel filter. [Fuel Filter Replacement](#)

10. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)

11. Prime the fuel system. [Fuel System Priming](#)

12. With the engine running, check the fuel system for leaks.

13. Intake Manifold Cover Insulator - Install [2x] - [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#)
14. Perform the fuel injector flow rate programming. [Fuel Injector Flow Rate Programming](#)
15. Perform the fuel injector correction value reset. [Fuel Injector Correction Value Reset](#)

FUEL INJECTOR REPLACEMENT (CYLINDER #4)

Removal Procedure

WARNING: High Pressure Lines deliver diesel fuel under extreme pressure from the injection pump to the fuel injectors. This may be as high as 1600 Bar (23, 200 psi). Use extreme caution when inspecting for high pressure leaks. Fuel under this amount of pressure can penetrate skin causing personal injury, or death. Wear safety goggles and adequate clothing when servicing this fuel system.

NOTE: The fuel injector label located on the engine front cover will become invalid and **MUST** be removed and **DISCARDED** if ANY fuel injector is replaced.

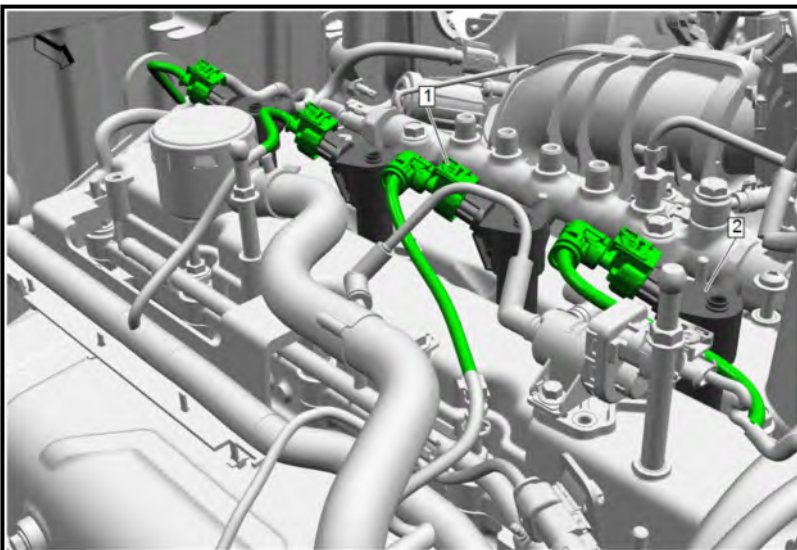
1. Turn OFF the engine for 30 seconds before proceeding. This will ensure fuel pressure has purged from the fuel system.
2. Disconnect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)
3. Plenum Front Panel - Remove - [Plenum Front Panel Replacement](#)

NOTE: Both intake manifold cover insulator replacement procedures will need to be completed in order to remove the fuel injector for cylinder #4.

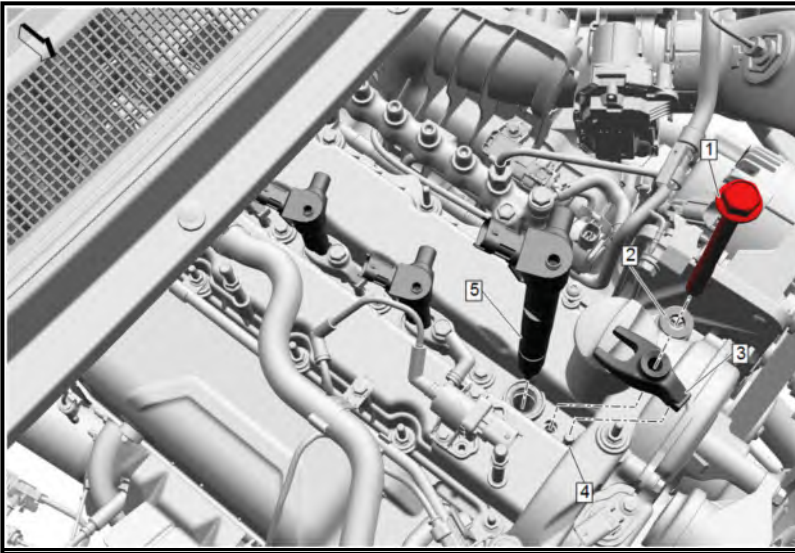
4. Intake Manifold Cover Insulator - Remove - [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#)

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

5. Fuel Injection Fuel Feed Pipe - Fuel Injector to Fuel Rail - Remove and DISCARD - [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Pump to Fuel Rail\)](#), or [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Injector to Fuel Rail\)](#)
6. Fuel Injection Fuel Return Pipe - Remove - [Fuel Injection Fuel Return Pipe Replacement](#)
7. Electrical Connector (1) @ Fuel Injector (2) - Disconnect



8. Fuel Injector Bracket Bolt (1) - Remove



NOTE:

- **ALWAYS** clean ANY debris from around the fuel injectors before removing to prevent contamination.
- **ALWAYS** mark the original fuel injector locations for correct reinstallation to the same engine cylinders. Failure to do so may result in a poor performance.

9. Fuel Injector Washer (2) - Remove
10. Remove the fuel injector (5) and the fuel injector hold down clamp (3) by pulling them both away from the valve rocker arm cover.
11. Combustion Fuel Injector Seal (1) - Remove and DISCARD

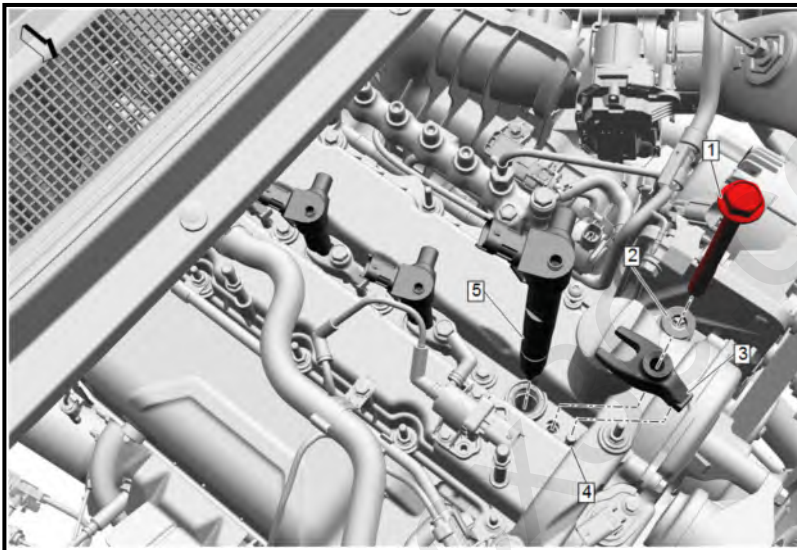


Installation Procedure

1. Clean and inspect the fuel injector prior to reinstalling it. [**Fuel Injector Cleaning and Inspection**](#)
2. Combustion Fuel Injector Seal (1) - Install NEW



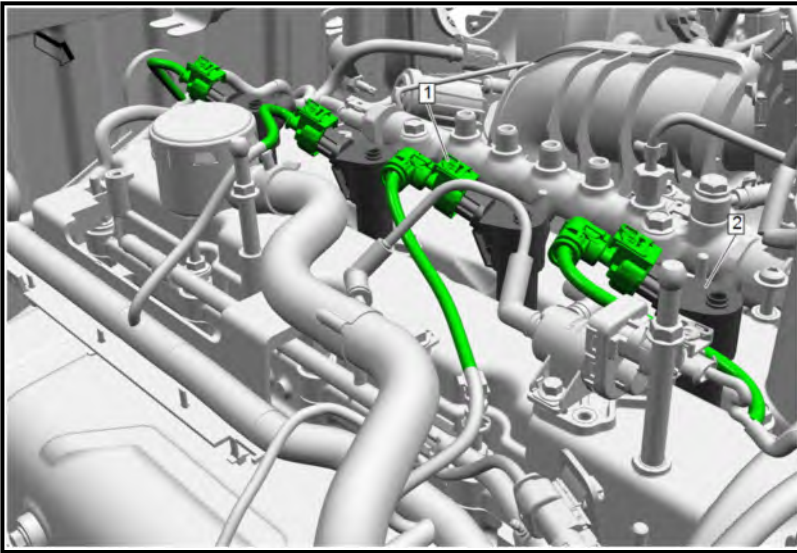
3. Slide the fuel injector hold down clamp (3) into the grooves on the fuel injector (5) and install them together into the valve rocker arm cover ensuring that the fuel injector locating pin (4) engages the fuel injector hold down clamp (3).



4. Fuel Injector Washer (2) - Install

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

5. Fuel Injector Bracket Bolt (1) - Install and tighten 32 N.m (24 lb ft)
6. Electrical Connector (1) @ Fuel Injector (2) - Connect



7. Fuel Injection Fuel Return Pipe - Install - [Fuel Injection Fuel Return Pipe Replacement](#)

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

8. Fuel Injection Fuel Feed Pipe - Fuel Injector to Fuel Rail - Install NEW - [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Pump to Fuel Rail\)](#), or [Fuel Injection Fuel Feed Pipe Replacement \(Fuel Injector to Fuel Rail\)](#)

NOTE: If applicable, perform the fuel filter life reset after replacing the fuel filter.

9. Replace the fuel filter. [Fuel Filter Replacement](#)

10. Connect the battery negative cable. [Battery Negative Cable Disconnection and Connection](#)

11. Prime the fuel system. [Fuel System Priming](#)

12. With the engine running, check the fuel system for leaks.

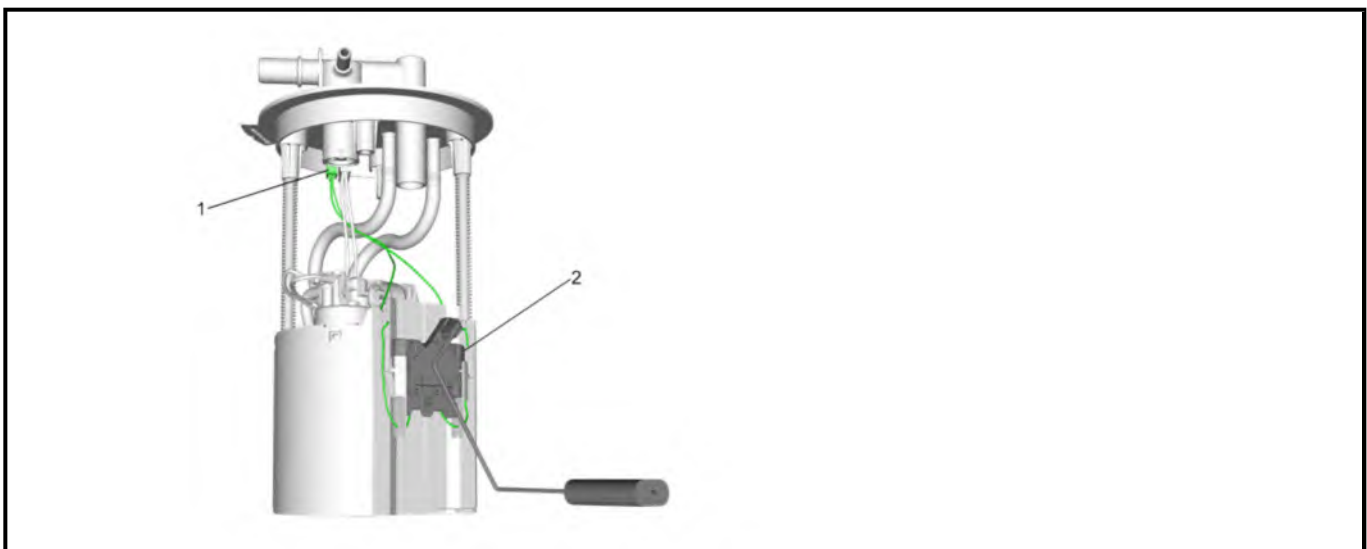
13. Intake Manifold Cover Insulator - Install [2x] - [Intake Manifold Cover Insulator Replacement \(Top of Engine\)](#) , or [Intake Manifold Cover Insulator Replacement \(Left Side\)](#)

14. Plenum Front Panel - Install - [Plenum Front Panel Replacement](#)

15. Perform the fuel injector flow rate programming. [Fuel Injector Flow Rate Programming](#)

16. Perform the fuel injector correction value reset. [Fuel Injector Correction Value Reset](#)

FUEL LEVEL SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure 1. Fuel Tank Fuel Pump Module Replacement 2. Replace the fuel filter. Fuel Filter Replacement	
1	Fuel Level Sensor Electrical Connector
2	Fuel Level Sensor Procedure Push the plastic tabs inward and simultaneously pull upward.

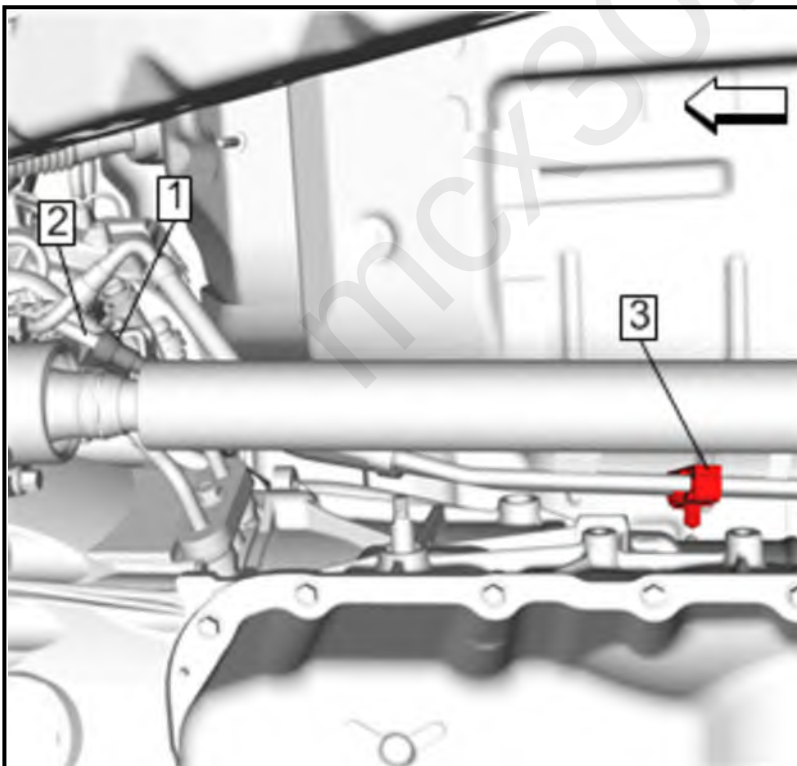
FUEL RETURN FRONT PIPE REPLACEMENT

Removal Procedure

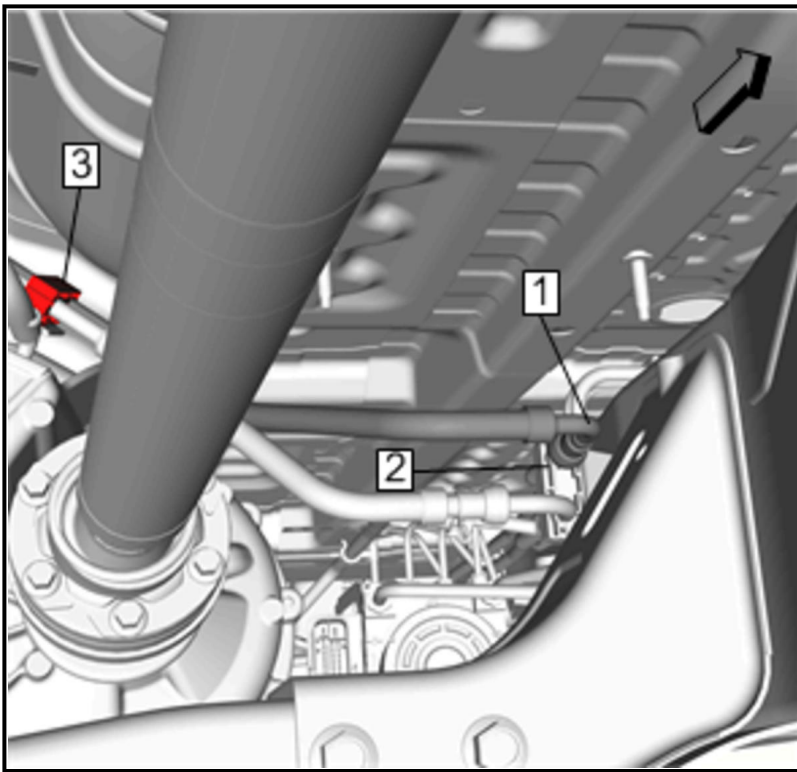
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Fuel Return Front Pipe (1) @ Fuel Pump Fuel Return Hose (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



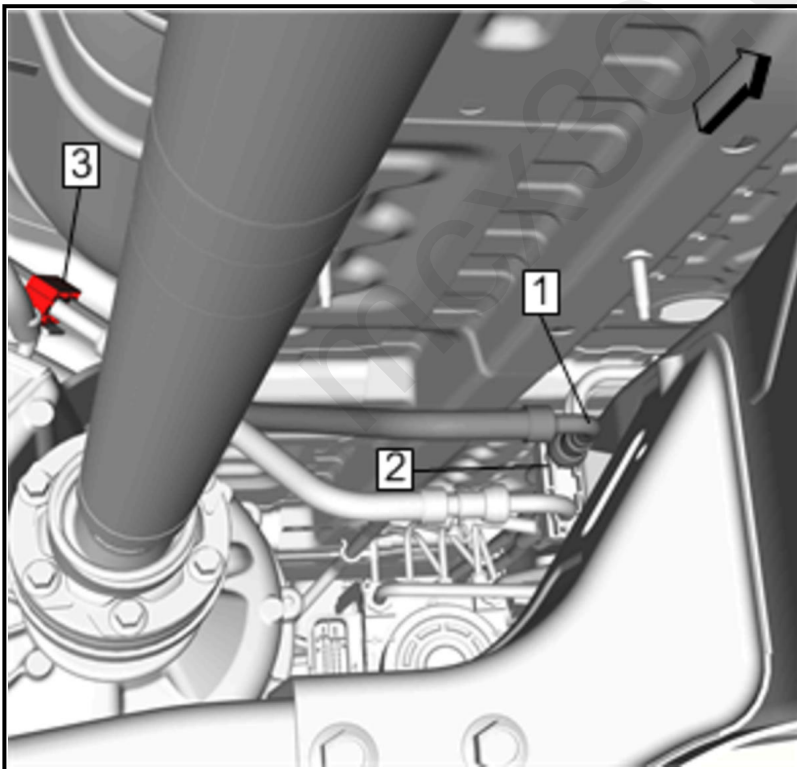
4. Fuel Return Front Pipe (1) @ Retainer (3) - Unclip
5. Fuel Return Front Pipe (1) @ Fuel Return Rear Pipe (2) - Disconnect - [Metal Collar Quick Connect Fitting Service](#)



6. Fuel Return Front Pipe (1) @ Retainer (3) - Unclip

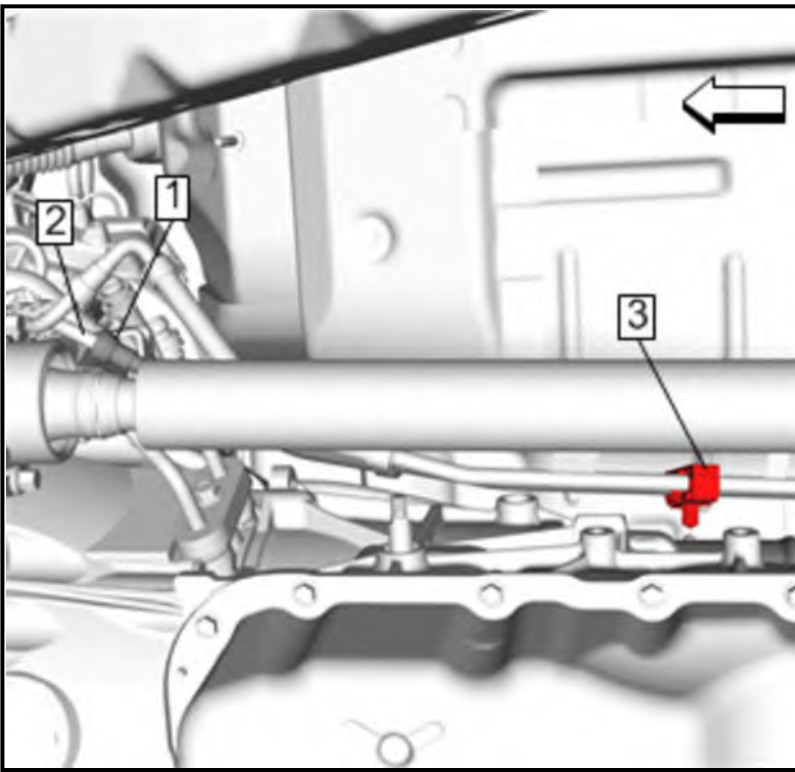
Installation Procedure

1. Fuel Return Front Pipe (1) @ Retainer (3) - Clip



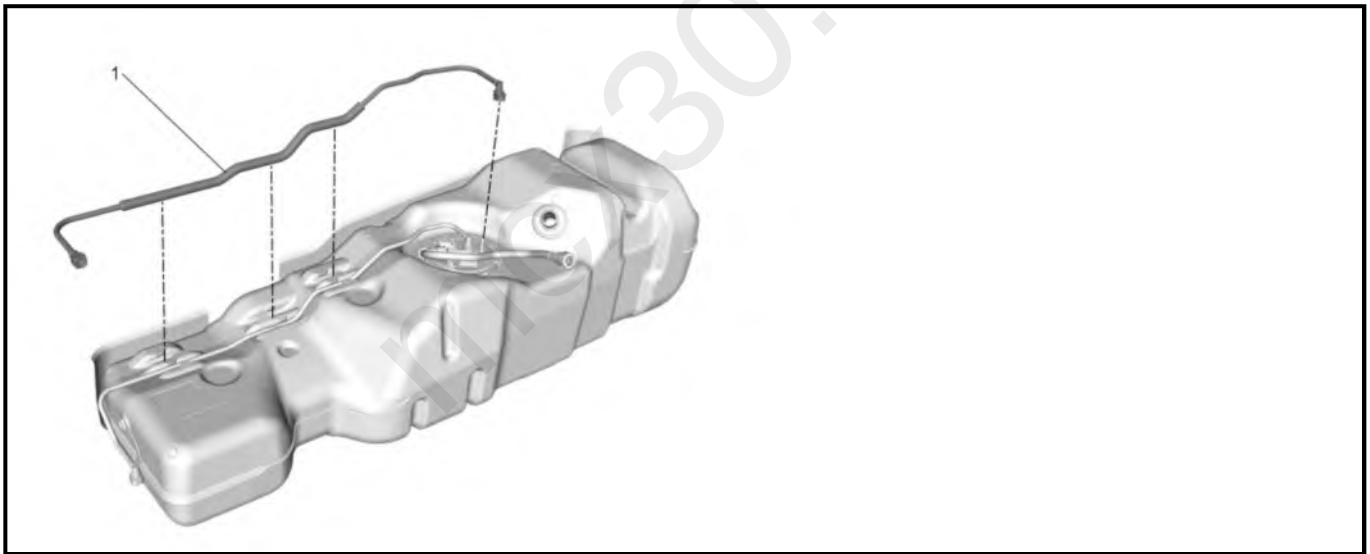
2. Fuel Return Front Pipe (1) @ Fuel Return Rear Pipe (2) - Connect - [Metal Collar Quick Connect Fitting Service](#)

3. Fuel Return Front Pipe (1) @ Retainer (3) - Clip



4. Fuel Return Front Pipe (1) @ Fuel Pump Fuel Return Hose (2) - Connect - [Metal Collar Quick Connect Fitting Service](#)
5. Lower the vehicle.

FUEL RETURN PIPE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning .	
WARNING: Refer to Safety .	

Callout	Component Name
Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement	
1	Fuel Return Pipe Procedure Disconnect the quick disconnects. Plastic Collar Quick Connect Fitting Service

FUEL SYSTEM CLEANING

Diesel Exhaust Fluid (DEF) is a corrosive fluid that also tends to form deposits on components. In case of DEF contamination in the gas tank, follow the guidelines below.

If the in-tank fuel pump has been run, then it must be assumed that DEF has been pumped through both the low-pressure system and high-pressure pump. For this case, there are two scenarios:

1. Engine has not been cranked. In this case, the system from fuel fill pipe to the high-pressure fuel pump and the high-pressure pipe from pump to rail must be replaced along with the low-pressure return lines.
2. Engine has been cranked. In this case, the entire fuel system from fuel fill pipe to high-pressure fuel pump, fuel rail, injectors, injector return fuel lines, high-pressure fuel pipes and low pressure return lines must be replaced.

If the in-tank fuel pump has not been run, the fuel fill pipe, tank and fuel pump module should be replaced.

The following procedure should not be used for cases of DEF contamination.

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

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

WARNING: **Avoid physical contact with the biocides in order to avoid personal injury.**

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

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

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

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

Remove and inspect the fuel filter element.

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

Cleaning Water or Diesel Exhaust Fluid from the Fuel System

Diesel Exhaust Fluid (DEF) is a corrosive fluid that also tends to form deposits on components. If the in-tank pump has been turned on, then it must be assumed that DEF has been pumped through the fuel system of the engine and fuel system components have been damaged. For this scenario, the entire fuel system must be replaced.

If the in-tank pump has not ran, the following procedure should be performed to clean DEF from the fuel system.

This procedure is also used for water contamination.

1. Disconnect the negative battery cable(s). [Battery Negative Cable Disconnection and Connection](#)
2. Remove the fuel sender assembly. [Fuel Tank Fuel Pump Module Replacement](#)
3. Inspect the fuel tank and the fuel sender for deposits, rust, fungi or bacteria. If any of these are present, replace the contaminated components.
4. Clean the inside of the fuel tank and the fuel sender with hot water.
5. Use compressed air in order to dry the fuel tank and the fuel sender.
6. Disconnect the ends of the following lines:
 - The fuel filter inlet line (both ends)
 - The transfer pump pressure line and suction line (if applicable)
 - The fuel filter outlet line (both ends)
 - The fuel filter drain
 - The fuel return line (both ends)
7. Inspect each of the pipes and lines.
8. Replace any rusted or contaminated pipes.
9. Clean the inside of the fuel filter housing.
10. Dry the fuel filter housing with compressed air.
11. Dry the inside of each line with low pressure air.
12. Install a new fuel filter. [Fuel Filter Replacement](#)
13. Install the fuel sender assembly. [Fuel Tank Fuel Pump Module Replacement](#)
14. Add clean diesel fuel to the primary tank until the tank is 1/4 full.
15. Reconnect the following lines:
 - The fuel filter inlet line
 - The fuel filter outlet line
 - The transfer pump pressure and suction (both ends) lines
 - The fuel return line (tank end)
16. Connect the fuel filter drain to a line that flows into a clean metal container.
17. Connect the negative battery cable(s). [Battery Negative Cable Disconnection and Connection](#)
18. Using the scan tool control function, cycle the fuel pump relay to operate the fuel pump until clean fuel flows from the fuel filter drain into a metal container.
19. Close the fuel filter drain and remove the bleeder hose.
20. Install a hose on the fuel return line at the engine and insert other end into a 7.6 liters (2 gallon) metal container.
21. Using the scan tool control function, cycle the fuel pump relay to operate the fuel pump until clean fuel flows from the fuel return line into a metal container.
22. Connect the fuel return line.
23. Start and run the engine. If the engine does not start, prime the fuel system. [Fuel System Priming](#)
24. Stop the engine.
25. Clean any fuel spillage from the engine.

26. Fill the fuel tank and add a biocide, if needed.
27. Clear the engine control module of any diagnostic trouble codes (DTCs).

Cleaning Gasoline from the Fuel System

1. Drain the fuel tank.
2. Disconnect the crankshaft position sensor.
3. Fill the fuel tank to 1/4 full.
4. Loosen the fuel filter drain and connect the filter to a hose that flows into a metal container.
5. Using the scan tool control function, cycle the fuel pump relay to operate the fuel pump until clean fuel flows from the fuel filter drain into a metal container.
6. Hand tighten the fuel filter drain and disconnect the hose.
7. Install a hose on the fuel return line at the engine and insert the other end into a 7.6 liters (2 gallon) metal container.
8. Using the scan tool control function, cycle the fuel pump relay to operate the fuel pump until clean fuel flows from the fuel return line into a metal container.
9. Reconnect the fuel return line.
10. Reconnect the crankshaft position sensor.
11. Start the engine. If the engine does not start, prime the fuel system. **Fuel System Priming**
12. Stop the engine.
13. Clean any fuel spillage from the engine.
14. Clear the engine of any diagnostic trouble codes (DTCs).

FUEL SYSTEM PRIMING

Priming Procedure

The electric fuel pump in the fuel tank is used to prime the complete fuel system utilizing the following procedure:

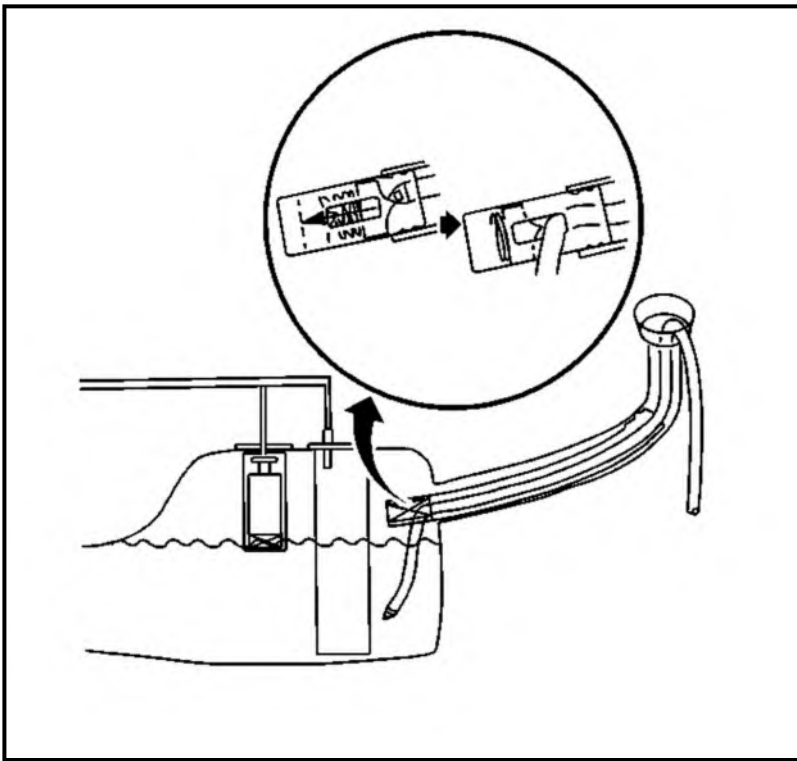
1. Turn ON the Ignition, with the engine OFF.
2. Wait 10 - 30 seconds for the system to prime.
3. Turn OFF the ignition.
4. Wait the ECM reset time.
5. Repeat steps 1 through 4.
6. After repeating steps 1 and 2, start the engine.

FUEL TANK DRAINING

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

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

1. Remove the fuel filler cap.
2. Insert the hose into the fuel tank until the hose reaches the bottom of the fuel tank.



NOTE: Lubricate a suitable hose to aid in hose insertion and removal.

3. Use an air operated pump device in order to drain the fuel into an approved diesel fuel container.
4. Simultaneously twist and pull in order to remove the hose from the fuel tank.

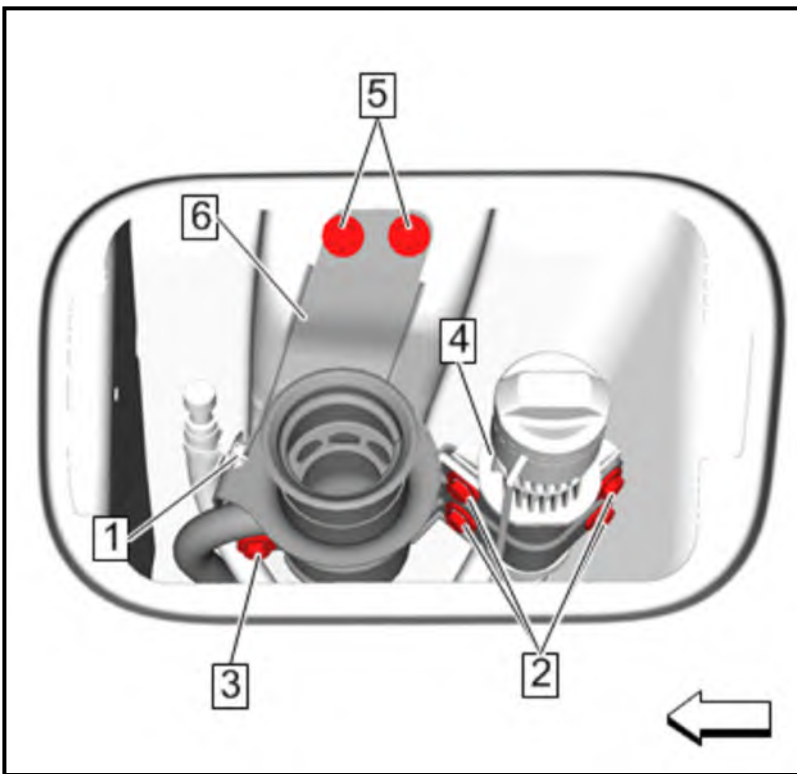
FUEL TANK FILLER PIPE REPLACEMENT

Removal Procedure

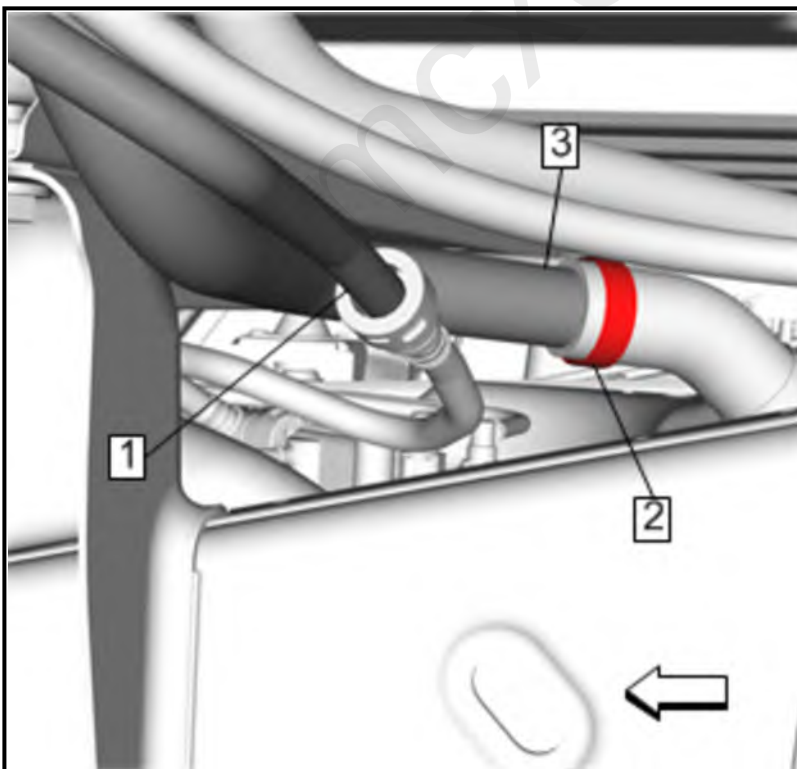
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

1. Fuel Tank Filler Pipe Housing - Remove - [Fuel Tank Filler Pipe Housing Replacement](#)
2. Rear Axle Vent Hose (1) @ Fuel Tank Filler Pipe (6) - Unclip



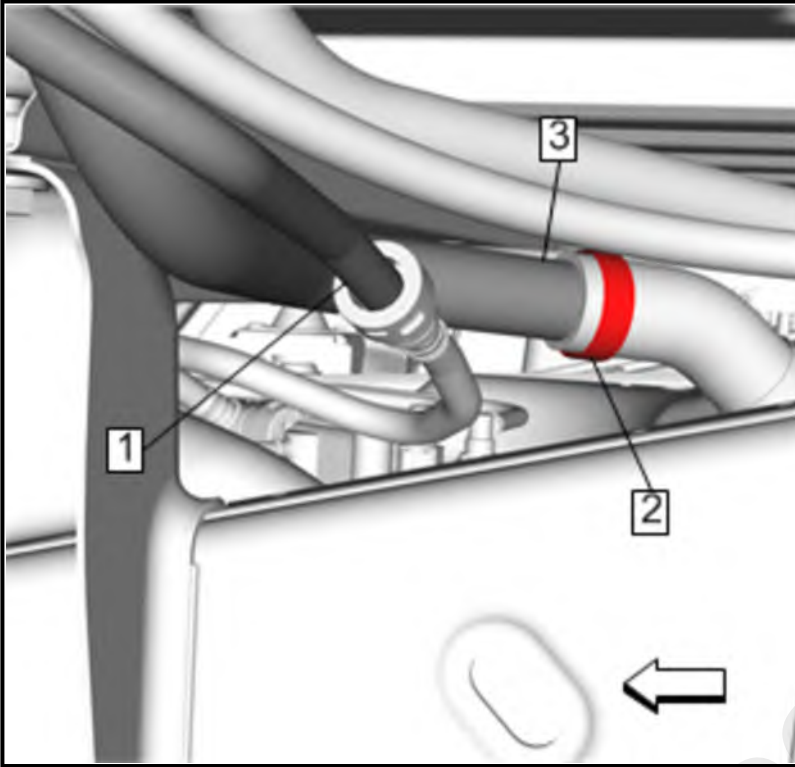
3. Emission Reduction Fluid Tank Filler Pipe Bolt (2) @ Emission Reduction Fluid Tank Filler Pipe (4) - Remove [4x]
4. Fuel Tank Filler Pipe Bracket Bolt (3) - Loosen
5. Emission Reduction Fluid Tank Filler Pipe (4) - Reposition
6. Fuel Tank Filler Pipe Bolt (5) @ Fuel Tank Filler Pipe (6) - Remove [2x]
7. Fuel Tank Filler Pipe (6) - Remove
8. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
9. Fuel Tank Filler Vent Pipe (1) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)



10. Fuel Tank Filler Pipe Clamp (2) - Loosen
11. Fuel Tank Filler Pipe (3) Remove

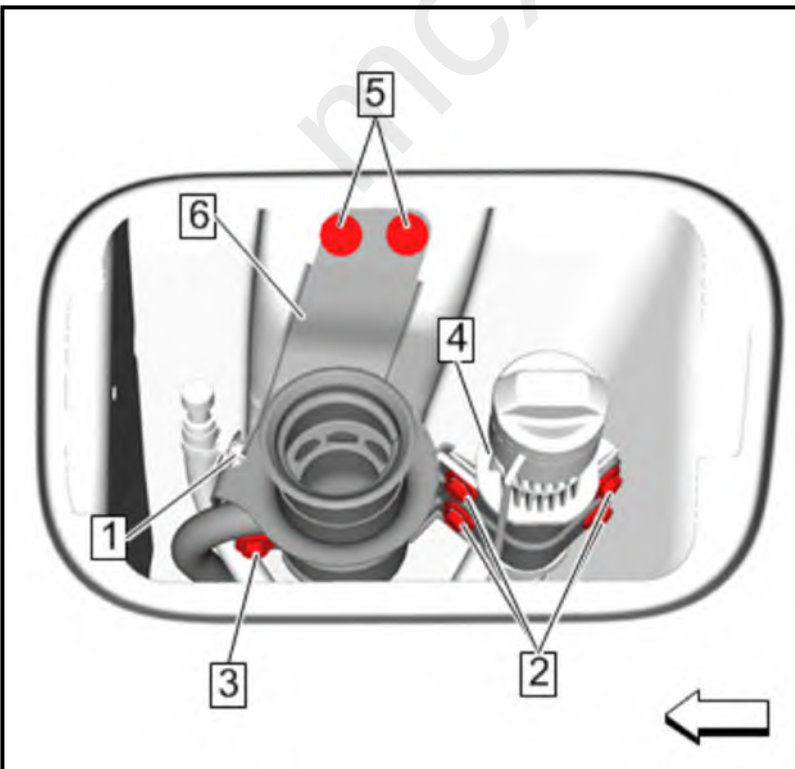
Installation Procedure

1. Fuel Tank Filler Pipe (3) Install



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

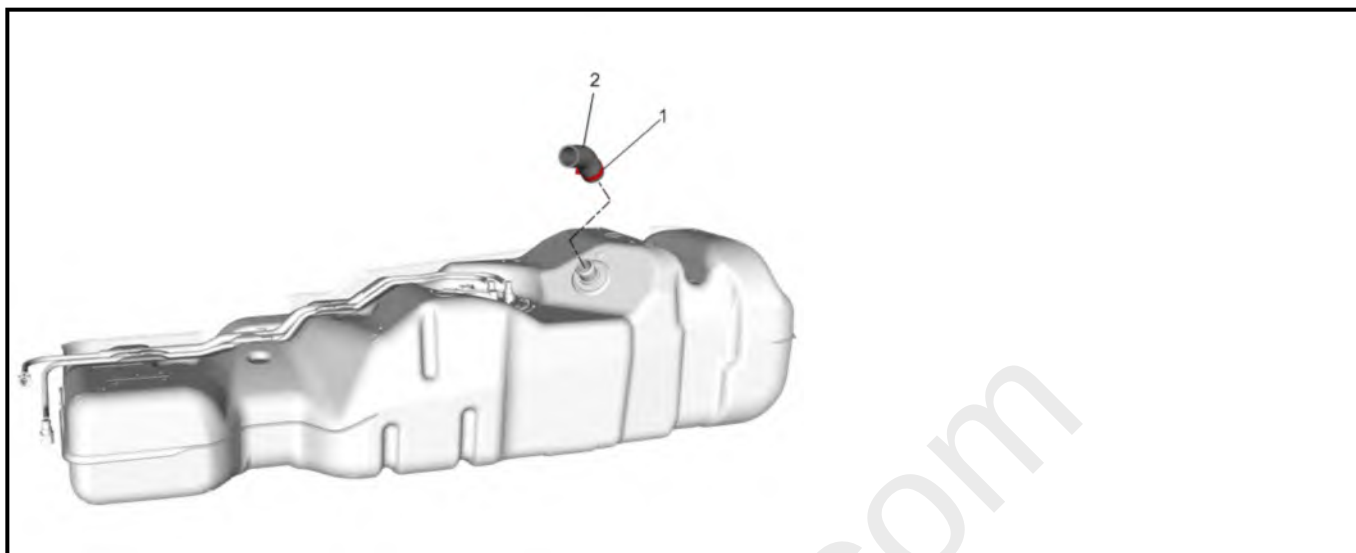
2. Fuel Tank Filler Pipe Clamp (2) - Tighten 3.5 N.m (31 lb in)
3. Fuel Tank Filler Vent Pipe (1) - Connect - [Plastic Collar Quick Connect Fitting Service](#)
4. Lower the vehicle.
5. Fuel Tank Filler Pipe (6) - Install



6. Fuel Tank Filler Pipe Bolt (5) @ Fuel Tank Filler Pipe (6) - Install and tighten [2x] 9 N.m (80 lb in)

7. Emission Reduction Fluid Tank Filler Pipe (4) - Install
8. Fuel Tank Filler Pipe Bracket Bolt (3) - Tighten 9 N.m (80 lb in)
9. Emission Reduction Fluid Tank Filler Pipe Bolt (2) @ Emission Reduction Fluid Tank Filler Pipe (4) - Install and tighten [4x] 9 N.m (80 lb in) [4x]
10. Rear Axle Vent Hose (1) @ Fuel Tank Filler Pipe (6) - Clip
11. Fuel Tank Filler Pipe Housing - Install - [Fuel Tank Filler Pipe Housing Replacement](#)

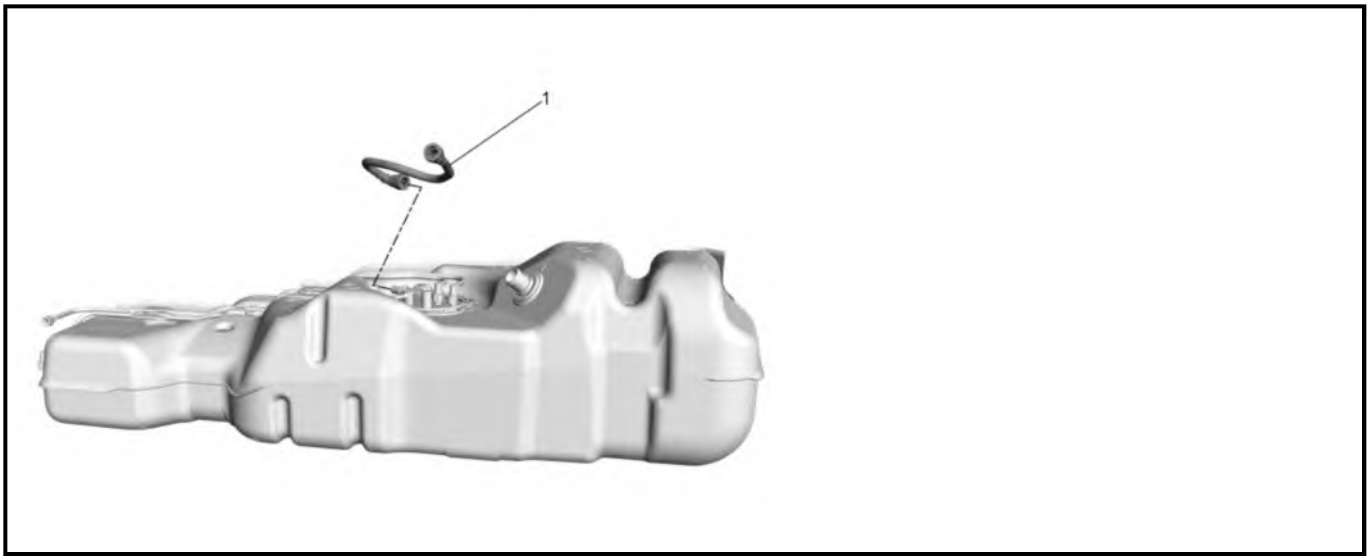
FUEL TANK FILLER HOSE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Fuel Tank Replacement	
1	Fuel Tank Filler Hose Clamp CAUTION: Refer to Fastener Caution . Tighten 3.5 N.m (31 lb in)
2	Fuel Tank Filler Hose

FUEL TANK FILLER VENT HOSE REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline Vapors Warning . WARNING: Refer to Safety Glasses Warning .	
Preliminary Procedure Fuel Tank Replacement	
1	Fuel Tank Filler Vent Hose Procedure Disconnect the quick disconnect. Plastic Collar Quick Connect Fitting Service

FUEL TANK REPLACEMENT

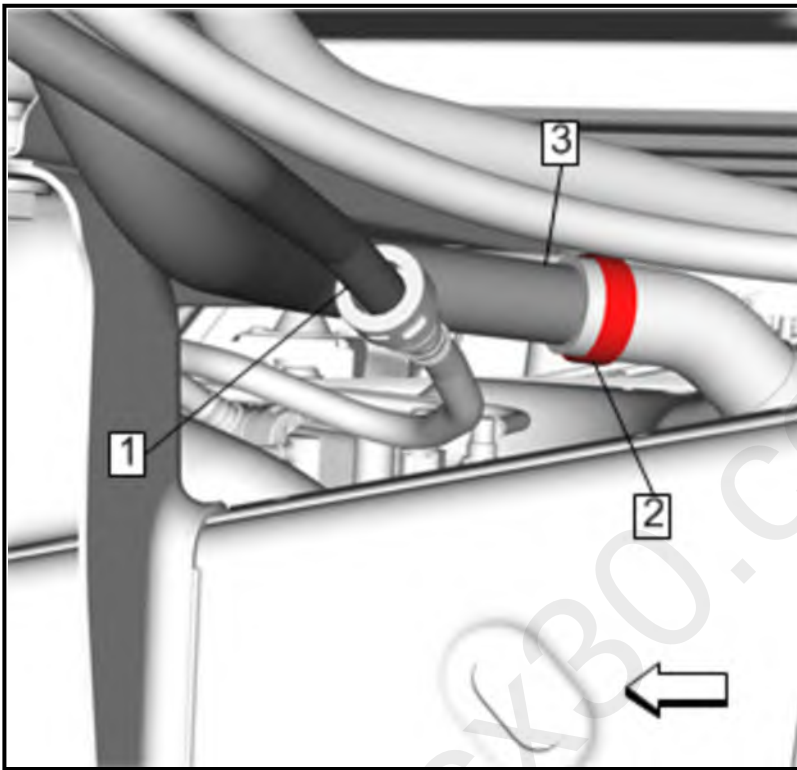
Removal Procedure

- WARNING:** To avoid any vehicle damage, serious personal injury or death:
- When major components are removed from the vehicle and the vehicle is supported by a hoist, support the vehicle with jack stands at the opposite end from which the components are being removed and strap the vehicle to the hoist.
 - When performing work in the engine compartment or under the vehicle, ensure that the hood is fully open, or opened to its secondary latch. When the hood is opened to the secondary latch, the vehicle will disable the remote start features from the key fob and OnStar mobile app. Failure to open the hood, or open the hood to the secondary latch while doing a repair in the engine compartment or under the vehicle can result in inadvertent vehicle starting which could result in personal injury or damage to a vehicle.

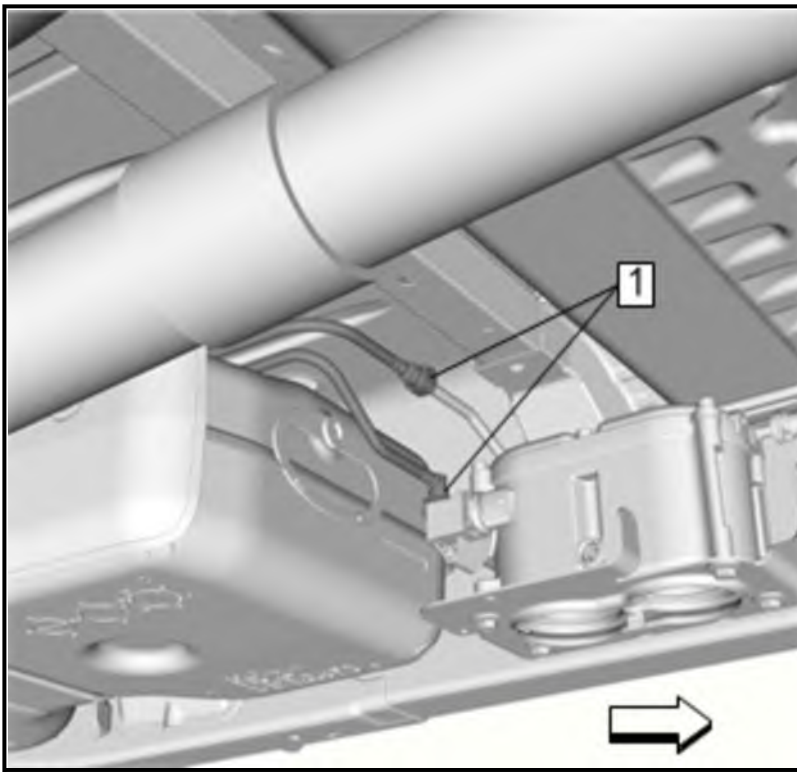
WARNING: Refer to [Diesel/Gasoline Vapors Warning](#) .

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

1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Drain the fuel tank. [Fuel Tank Draining](#)
3. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
4. {If equipped} Fuel Tank Shield - Remove - [Fuel Tank Shield Replacement](#)
5. Fuel Tank Filler Vent Pipe (1) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)

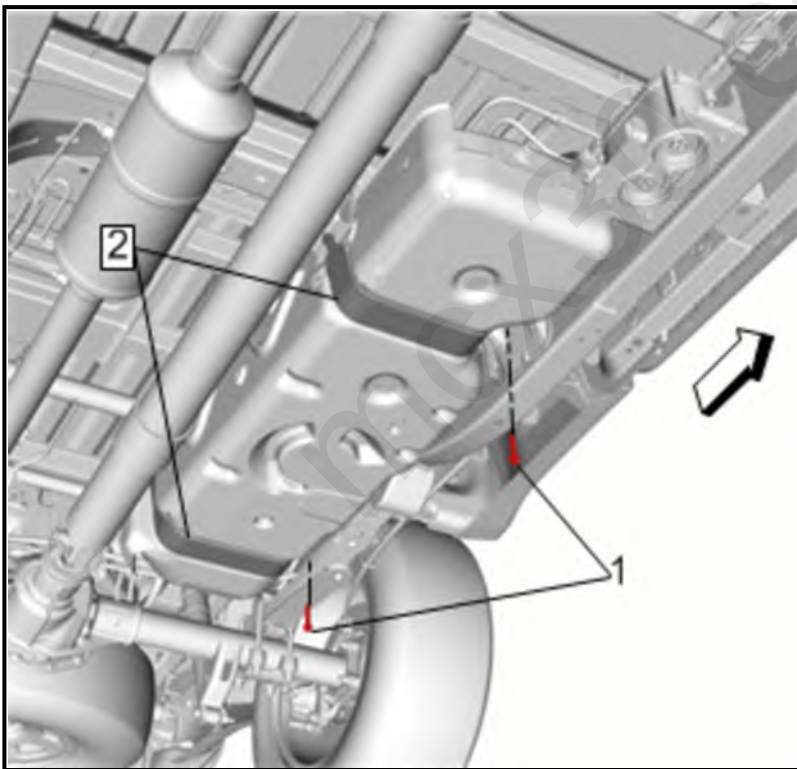


6. Fuel Tank Filler Pipe Clamp (2) - Remove
7. Fuel Tank Filler Pipe (3) - Remove
8. Fuel Feed and Return Pipe (1) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)



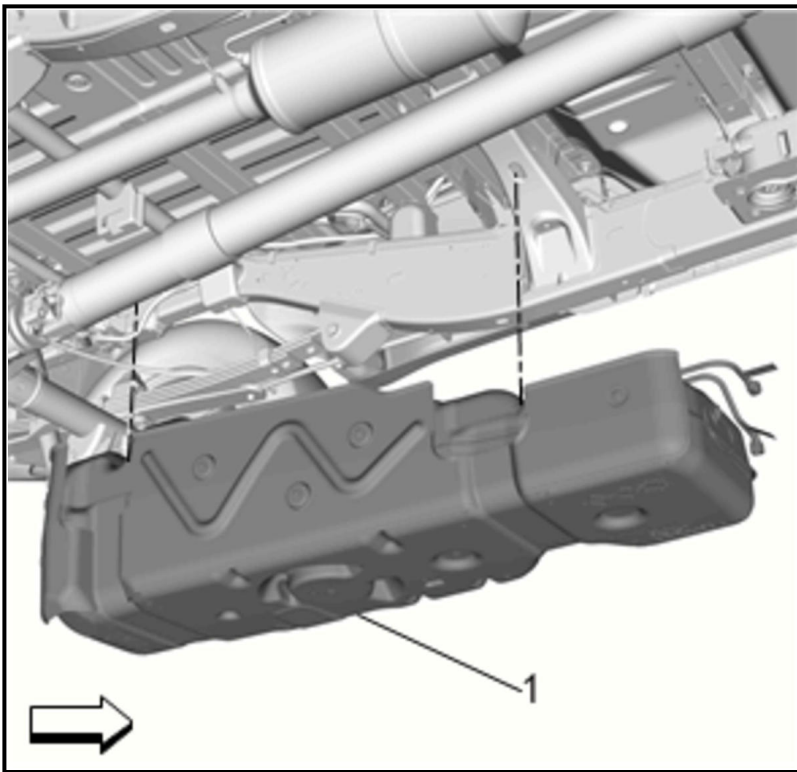
9. Support the fuel tank with a suitable jack.

10. Fuel Tank Strap Bolt (1) - Remove [2x]



11. Fuel Tank Strap (2) - Remove [2x]

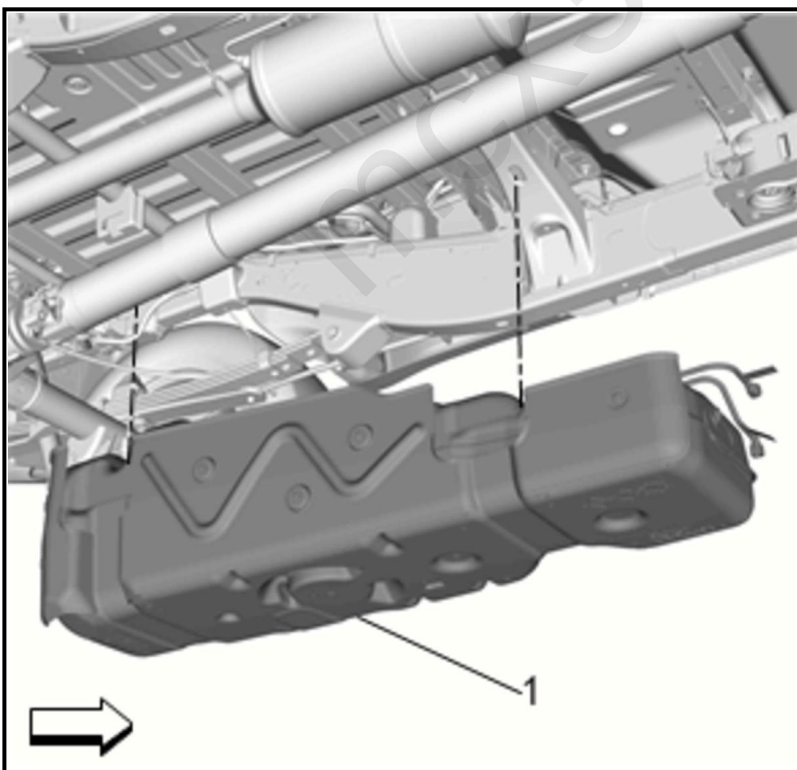
12. Lower the fuel tank (1)



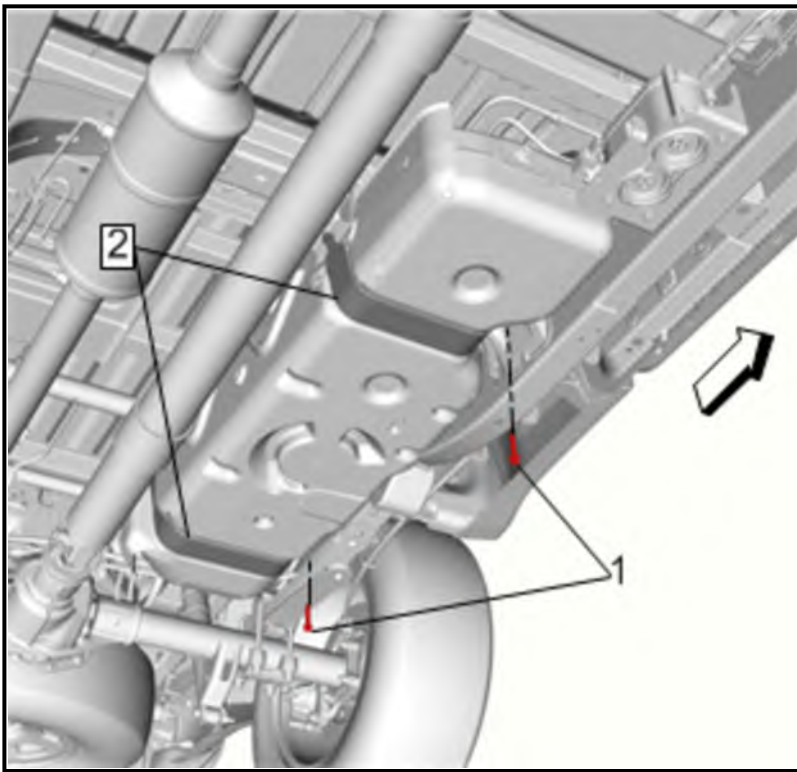
13. Disconnect the electrical connector.
14. Fuel Tank (1) - Remove
15. Transfer components as necessary.

Installation Procedure

1. Support the fuel tank with a suitable jack.
2. Position and raise the fuel tank (1)



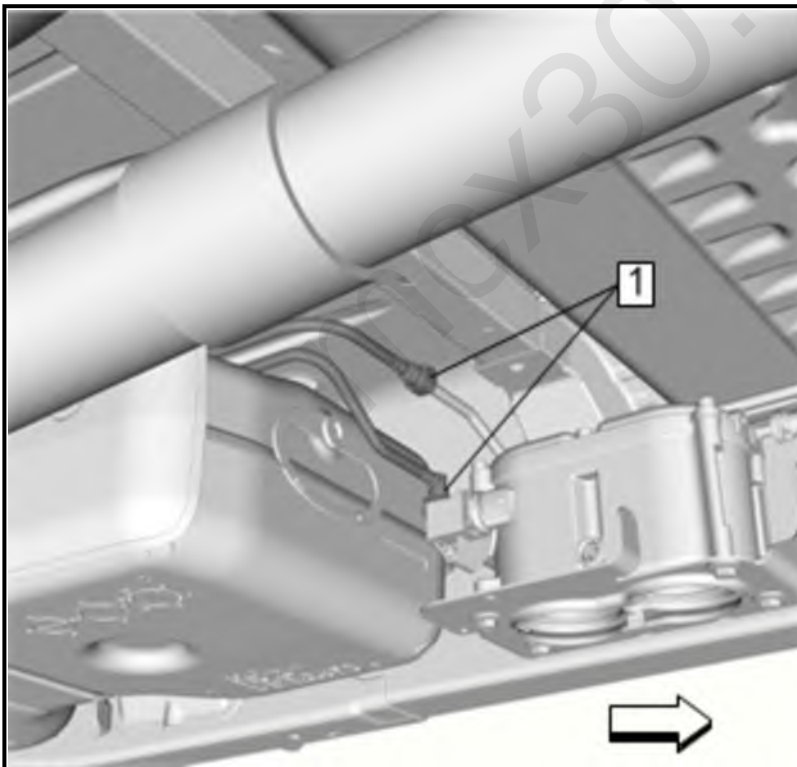
3. Connect the electrical connector.
4. Fuel Tank (1) - Install
5. Fuel Tank Strap (2) - Install [2x]



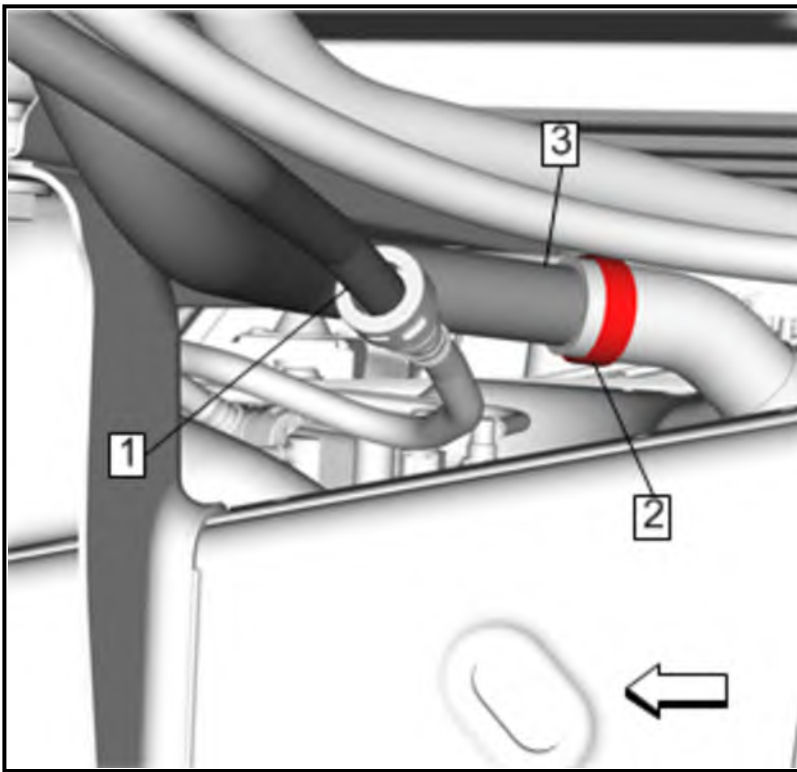
CAUTION: Refer to [Fastener Caution](#) .

6. Fuel Tank Strap Bolt (1) - Install [2x] 45 N.m (33 lb ft)

7. Fuel Feed and Return Pipe (1) - Connect - [Plastic Collar Quick Connect Fitting Service](#)

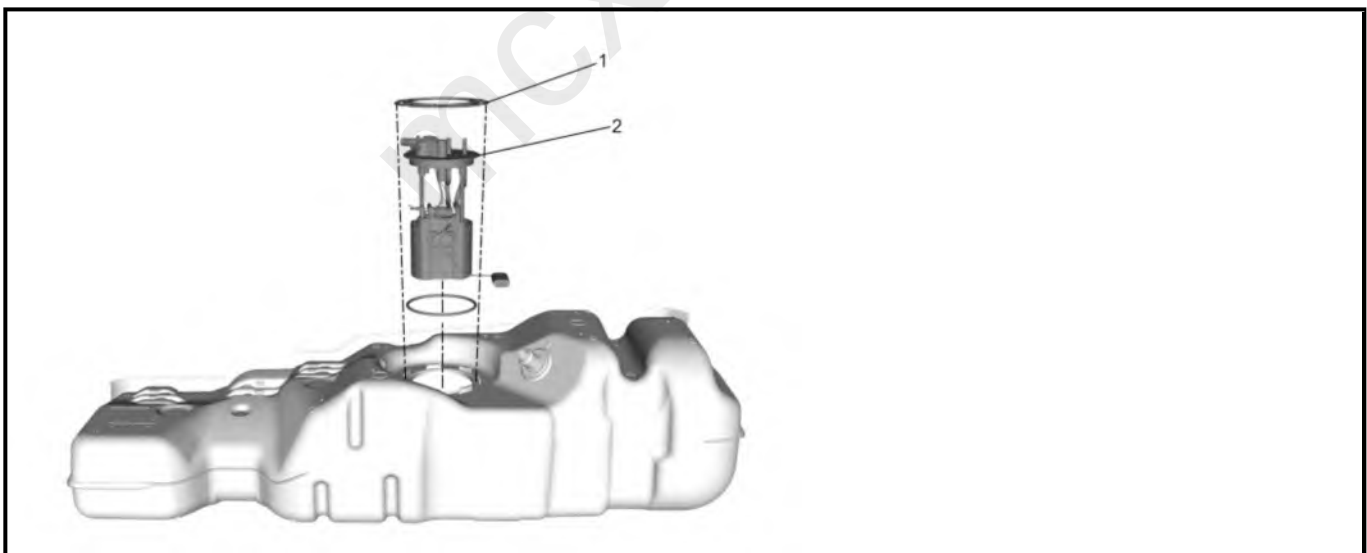


8. Fuel Tank Filler Pipe (3) - Install



9. Fuel Tank Filler Pipe Clamp (2) - Install 3.5 N.m (31 lb in)
10. Fuel Tank Filler Vent Pipe (1) - Connect - [Plastic Collar Quick Connect Fitting Service](#)
11. Replace the fuel filter. [Fuel Filter Replacement](#)
12. {If equipped} Fuel Tank Shield - Install - [Fuel Tank Shield Replacement](#)
13. Lower the vehicle.
14. Refill the fuel tank.
15. Inspect for fuel leaks.

FUEL TANK FUEL PUMP MODULE REPLACEMENT

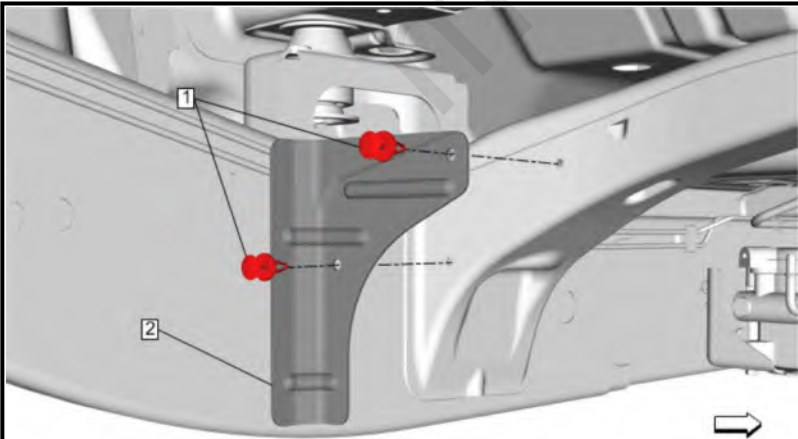


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
WARNING: Refer to Diesel/Gasoline	

Callout	Component Name
<u>Vapors Warning</u> . WARNING: Refer to <u>Safety Glasses Warning</u> . Preliminary Procedures 1. <u>Fuel Tank Replacement</u> 2. Disconnect the fuel feed, return, and vent pipes. <u>Plastic Collar Quick Connect Fitting Service</u>. 3. Disconnect the electrical connector. 4. Replace the fuel filter. <u>Fuel Filter Replacement</u>	
1	Fuel Sender Retainer CAUTION: Refer to <u>Fastener Caution</u> . Special Tools J-45722 Fuel Sender Lock Ring Wrench Equivalent regional tools: <u>Special Tools ((Diagnosis Tools))</u>.
2	Fuel Tank Fuel Pump Module Procedure Replace the O-ring seal.

FUEL TANK SHIELD REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

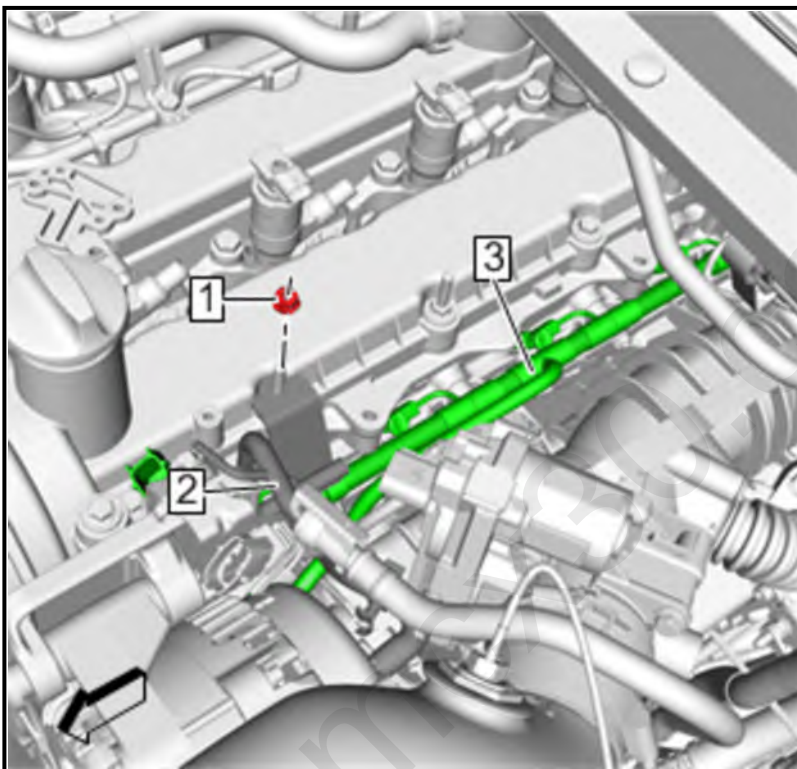
Callout	Component Name
Preliminary Procedure <u>Fuel Tank Replacement</u>	

Callout	Component Name
1	Fuel Tank Shield Retainer [2x] CAUTION: Refer to Fastener Caution .
2	Fuel Tank Shield

GLOW PLUG REPLACEMENT

Removal Procedure

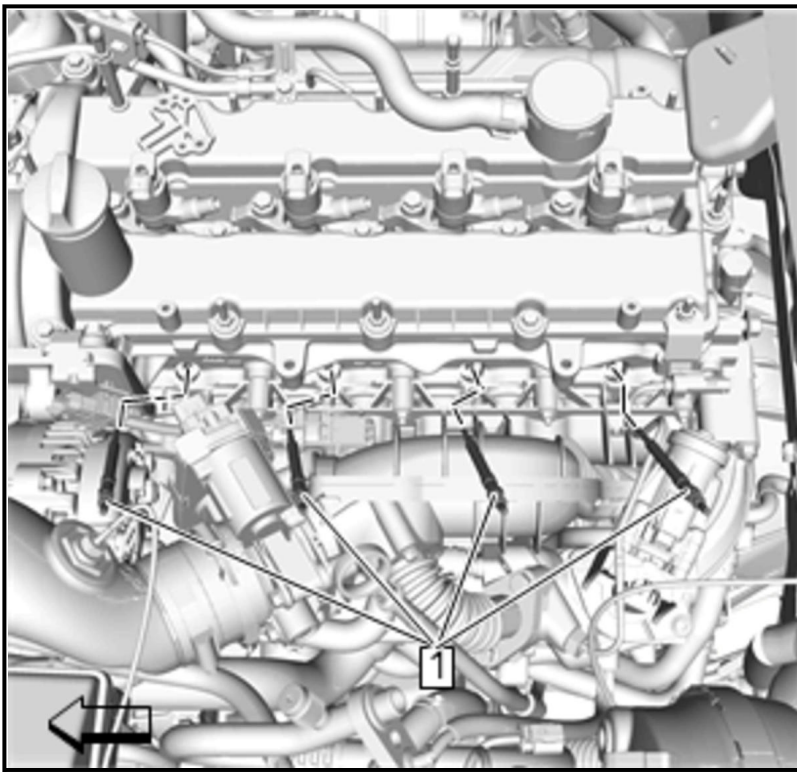
1. **Fuel Injector Deadener Replacement** - Remove
2. Diesel Fuel Separator Bracket Bolt (1) - Remove



3. Diesel Fuel Separator (2) - Reposition

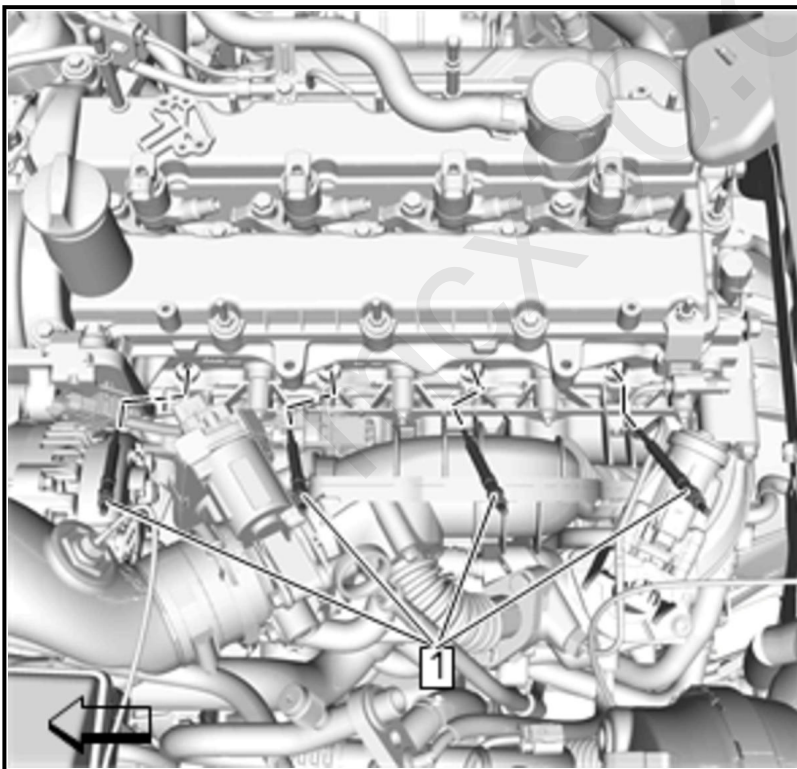
NOTE: Long nose pliers may be helpful in disconnecting the glow plug wiring harness from the glow plugs.

4. Diesel Glow Plug Wiring Harness (3) @ Glow Plug - Disconnect [4x]
5. Remove the glow plugs (1) from the cylinder head.[4x]



Installation Procedure

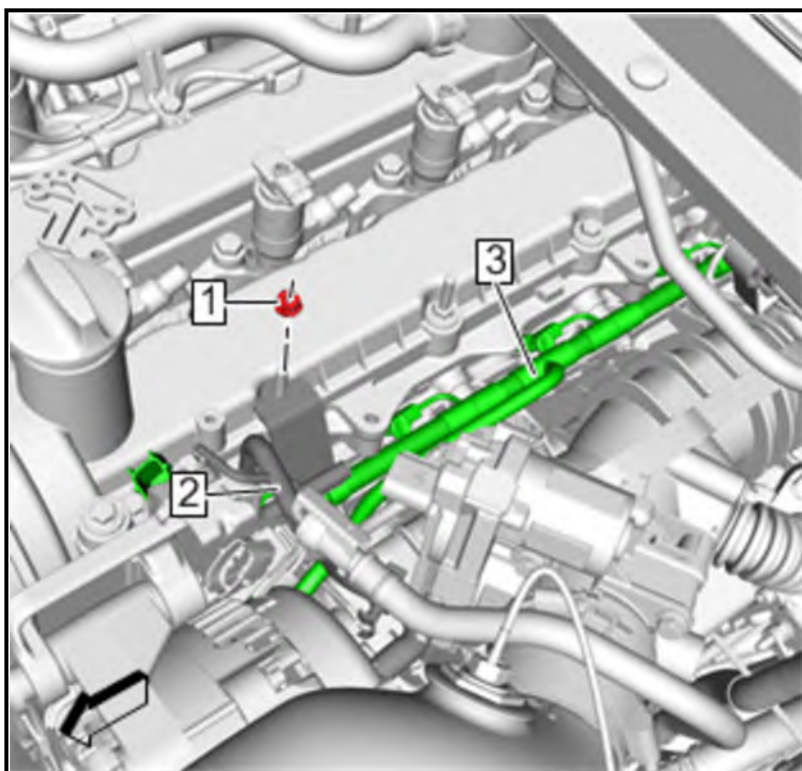
1. Hand start the glow plugs (1) into the cylinder head.



NOTE: To aid in hand starting glow plugs into their bores, a hose or tube with an inner diameter of 4mm can be used as an extension when installed on the end of the glow plug

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

1. Tighten the glow plugs to 14 N.m (10 lb ft).
2. Diesel Glow Plug Wiring Harness (3) @ Glow Plug - Connect [4x]



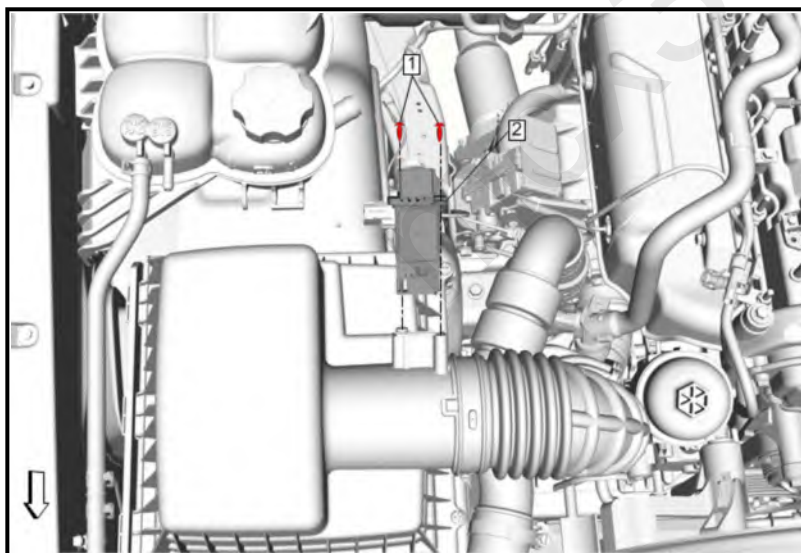
3. Diesel Fuel Separator (2) - Reposition

CAUTION: Refer to Fastener Caution .

4. Diesel Fuel Separator Bracket Bolt (1) - Install and tighten 7 N.m (62 lb in)

5. Fuel Injector Deadener Replacement - Install

MASS AIRFLOW SENSOR WITH INTAKE AIR TEMPERATURE SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
1	Mass Airflow Sensor with Intake Air Temperature Sensor Bolt [2x] CAUTION: Refer to <u>Fastener Caution</u> .

Callout	Component Name
	Tighten 1.5 N.m (13 lb in)
2	Mass Airflow Sensor with Intake Air Temperature Sensor Procedure Disconnect the electrical connector.

METAL COLLAR QUICK CONNECT FITTING SERVICE

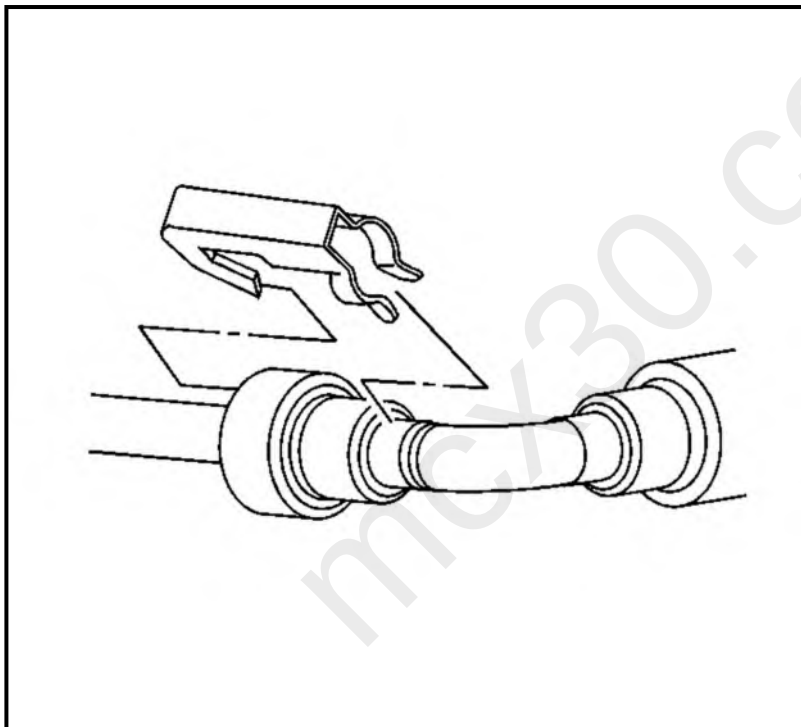
Special Tools

J-41769-1 Fuel Line Disconnect Tool Set

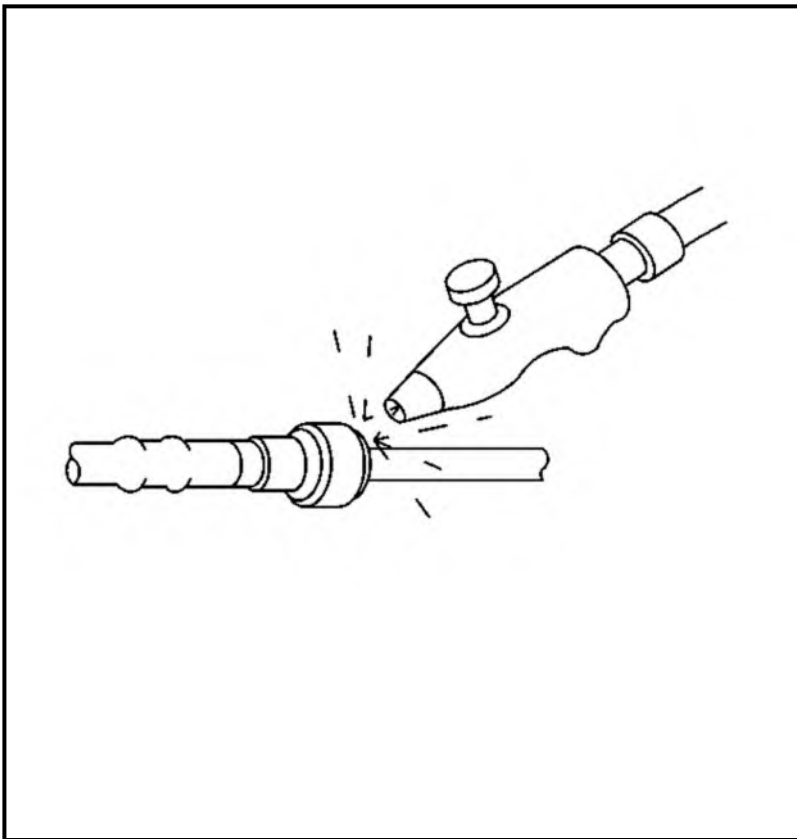
Removal Procedure

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

1. Relieve the fuel system pressure before servicing any fuel system connection.
2. Remove the retainer from the quick-connect fitting.

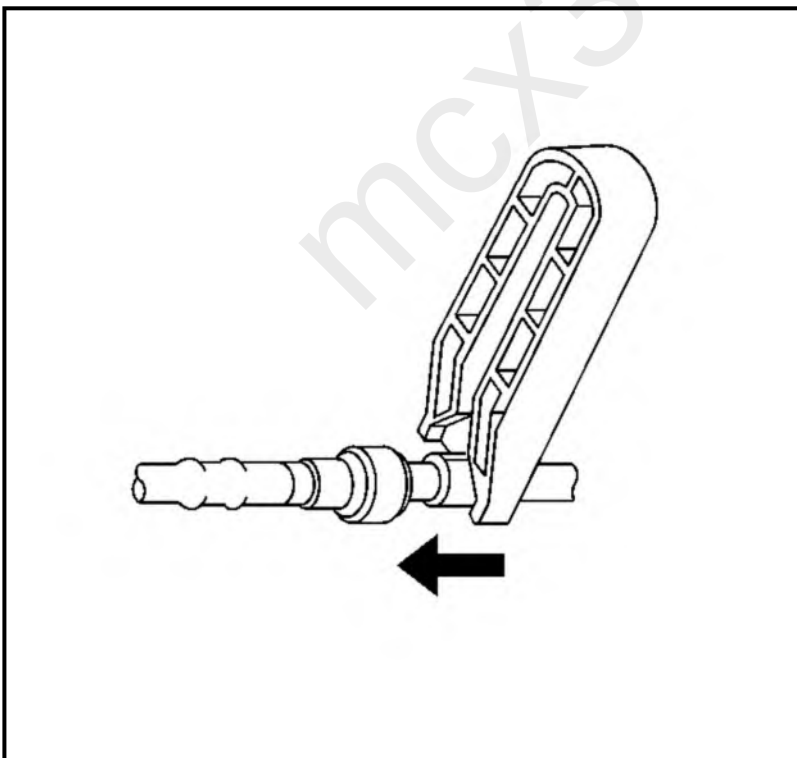


3. Blow dirt out of the fitting using compressed air.

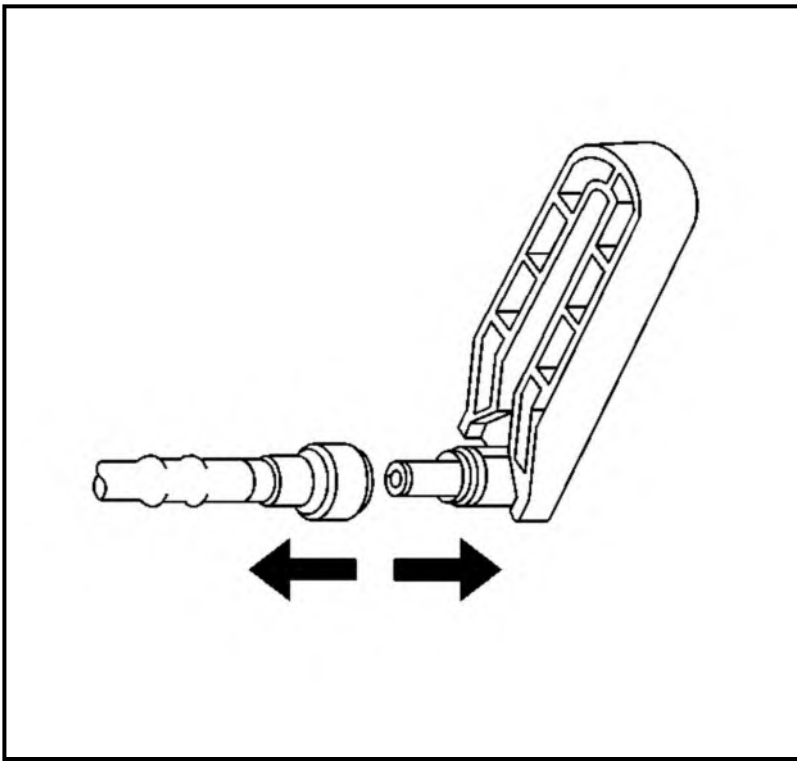


WARNING: Wear safety glasses when using compressed air, as flying dirt particles may cause eye injury.

4. Choose the correct **J-41769-1** fuel line disconnect tool set for the size of the fitting. Insert the **J-41769-1** fuel line disconnect tool set into the female connector, then push inward in order to release the locking tabs.



5. Pull the connection apart.



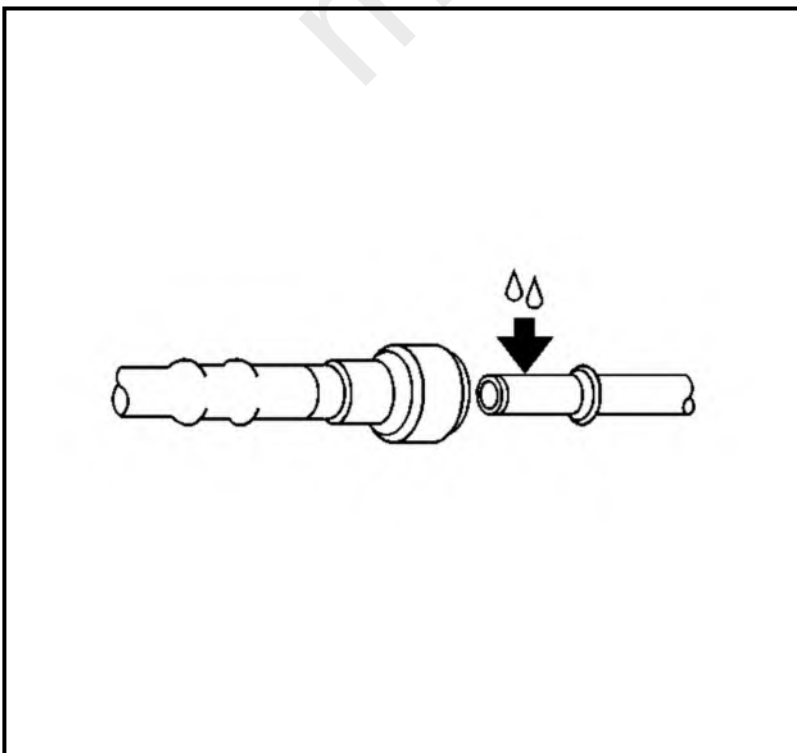
CAUTION: If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean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

6. Using a clean shop towel, wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs.

Clean or replace the components as required.

Installation Procedure

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



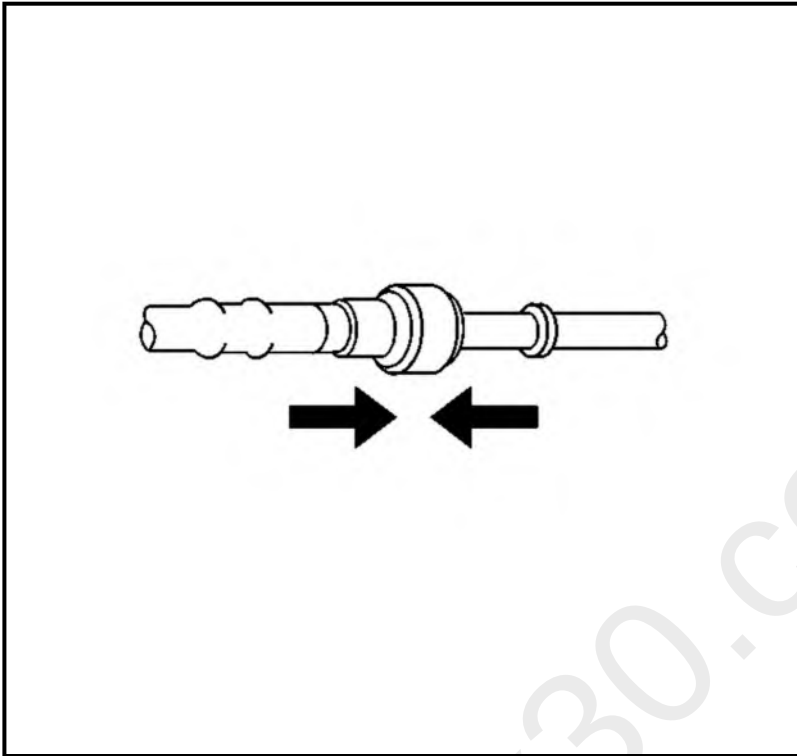
WARNING:

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

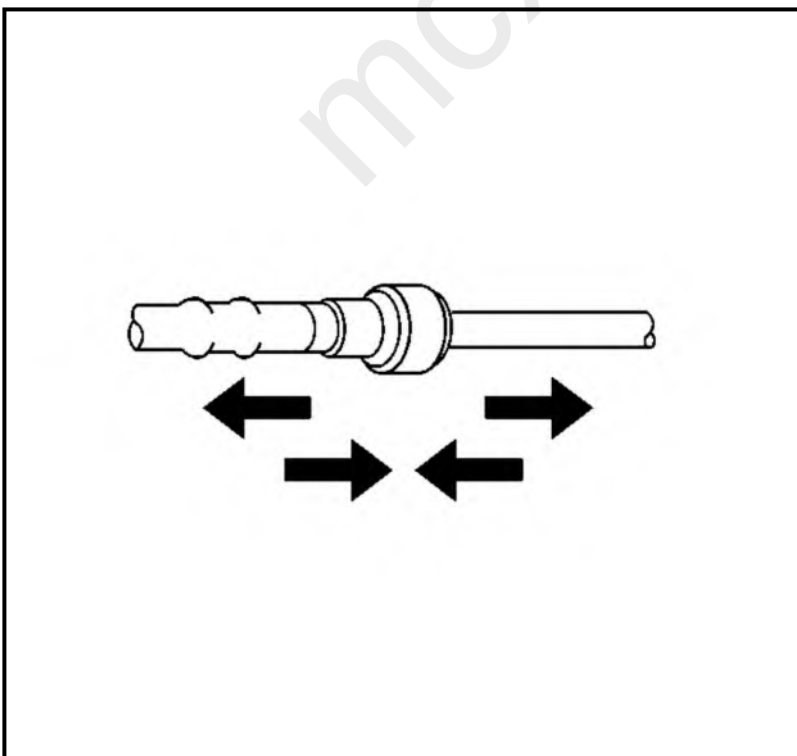
This will ensure proper reconnection and prevent a possible fuel leak.

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

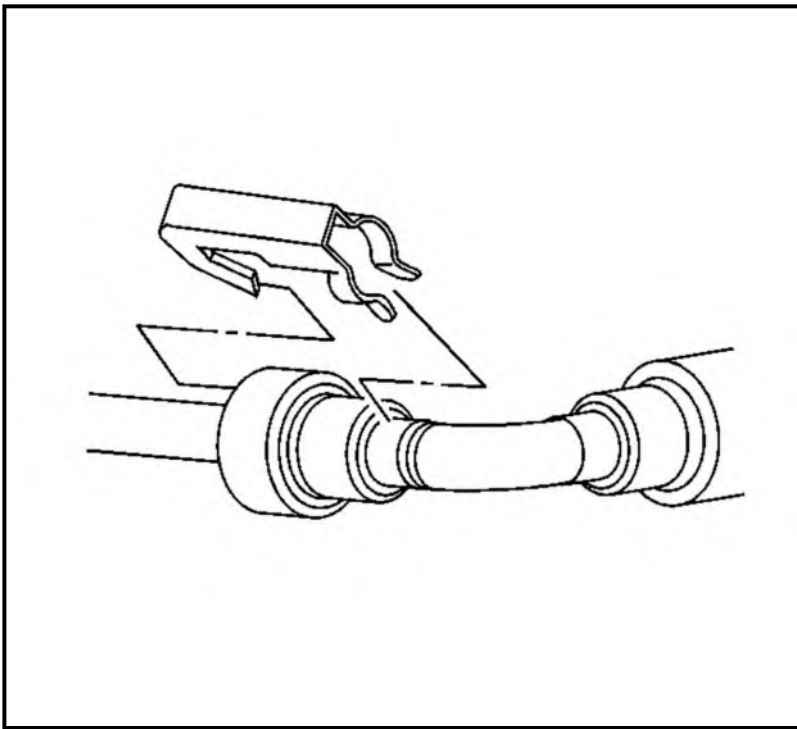
2. Push both sides of the quick-connect fitting together in order to snap the retaining tabs into place.



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



4. Install the retainer to the quick-connect fitting.



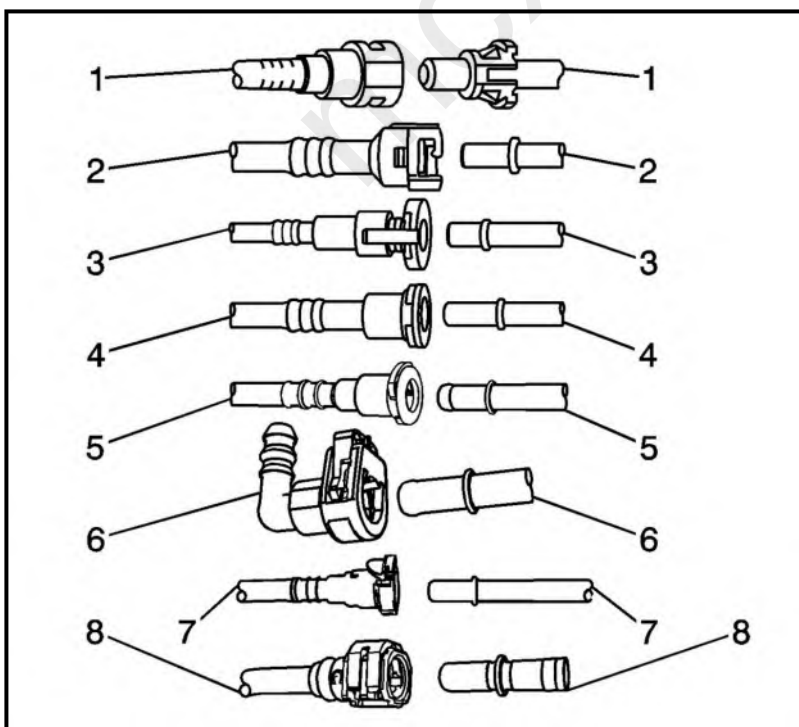
5. Inspect for leaks using the following procedure:

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

PLASTIC COLLAR QUICK CONNECT FITTING SERVICE

Removal Procedure

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



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

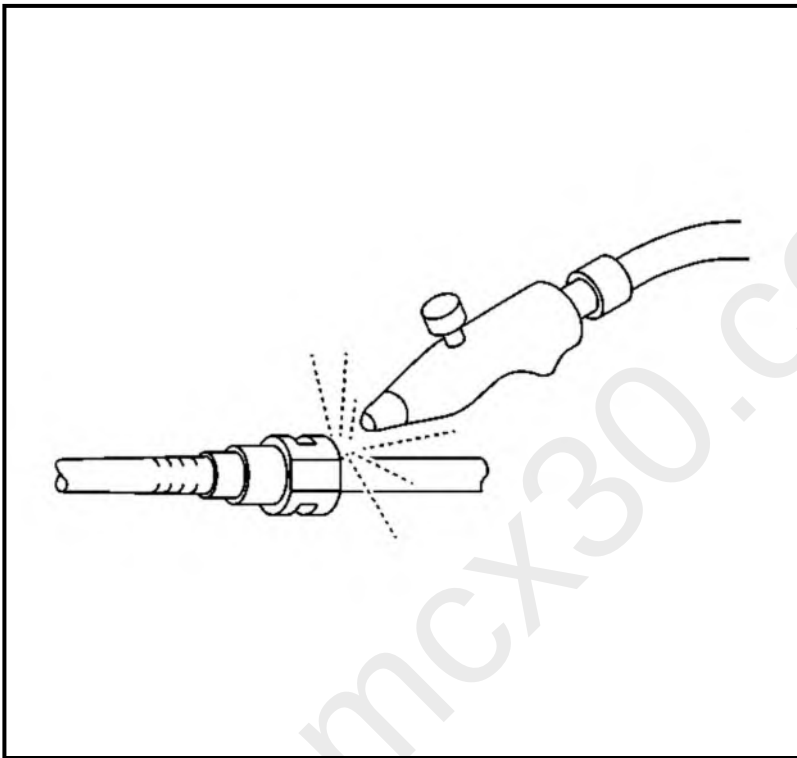
NOTE:

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)

The following instructions apply to all of these types of Plastic Collar Quick Connect Fittings except where indicated.

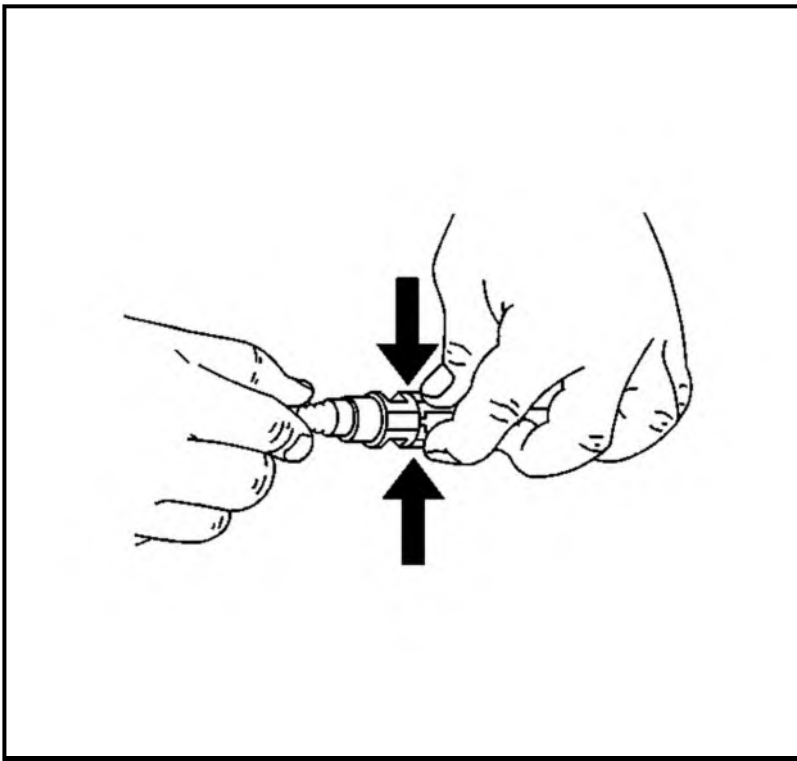
2. Using compressed air, blow any dirt out of the quick-connect fitting.



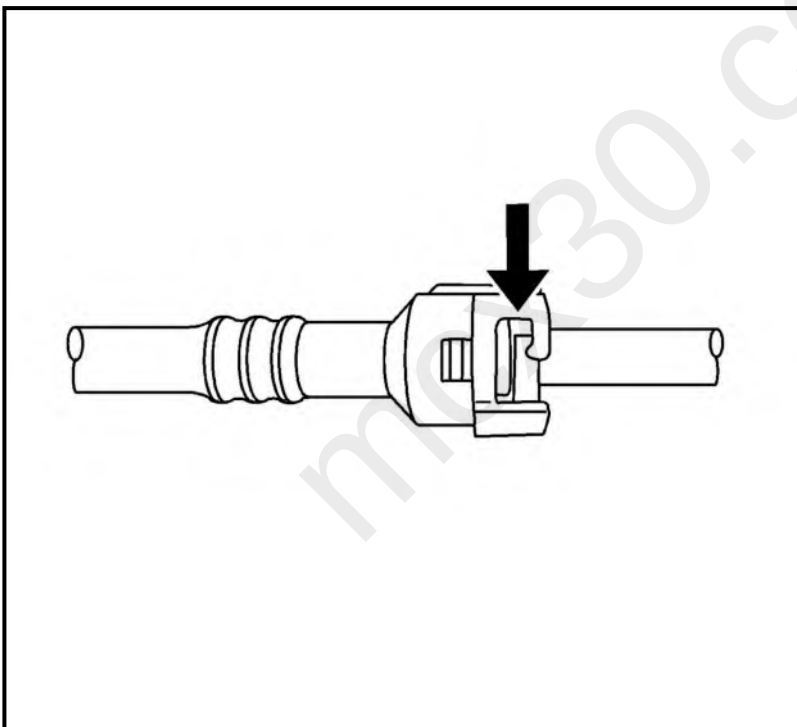
WARNING: Refer to [Safety Glasses and Compressed Air Warning](#) .

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

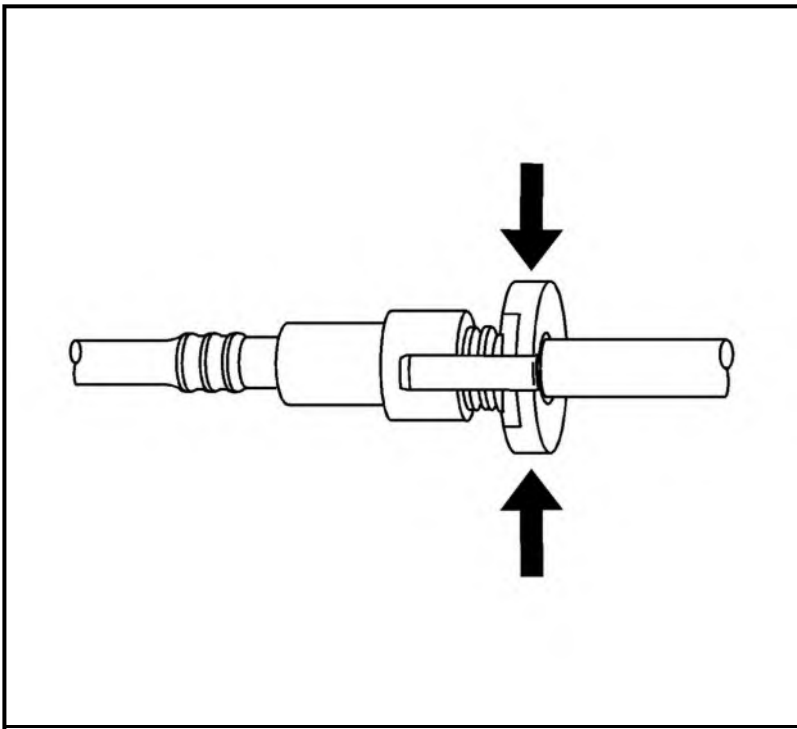
3. This step applies to Bartholomew style connectors ONLY. Squeeze the plastic quick-connect fitting release tabs.



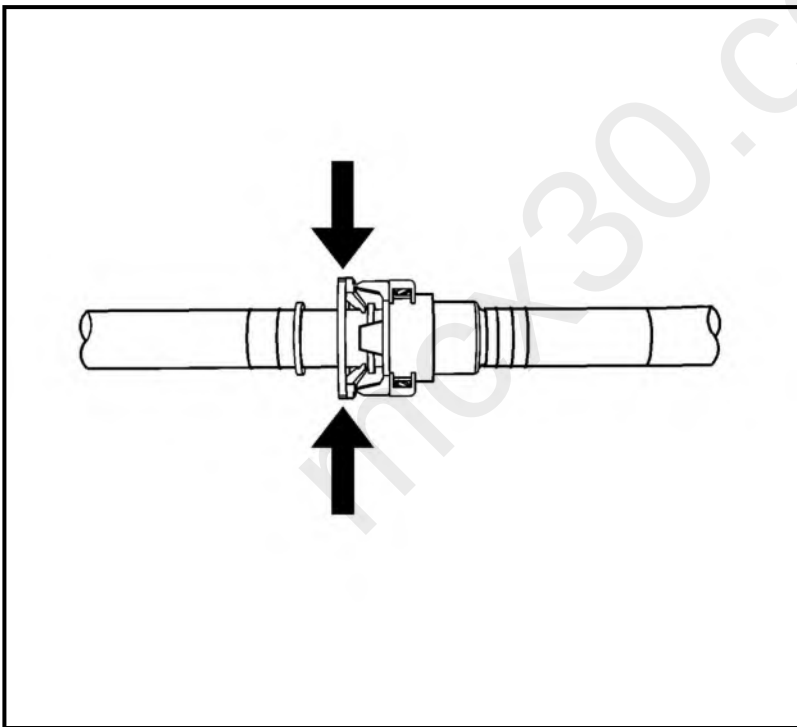
4. This step applies to Q Release style connectors ONLY. Release the fitting by Pushing the tab toward the other side of the slot in the fitting.



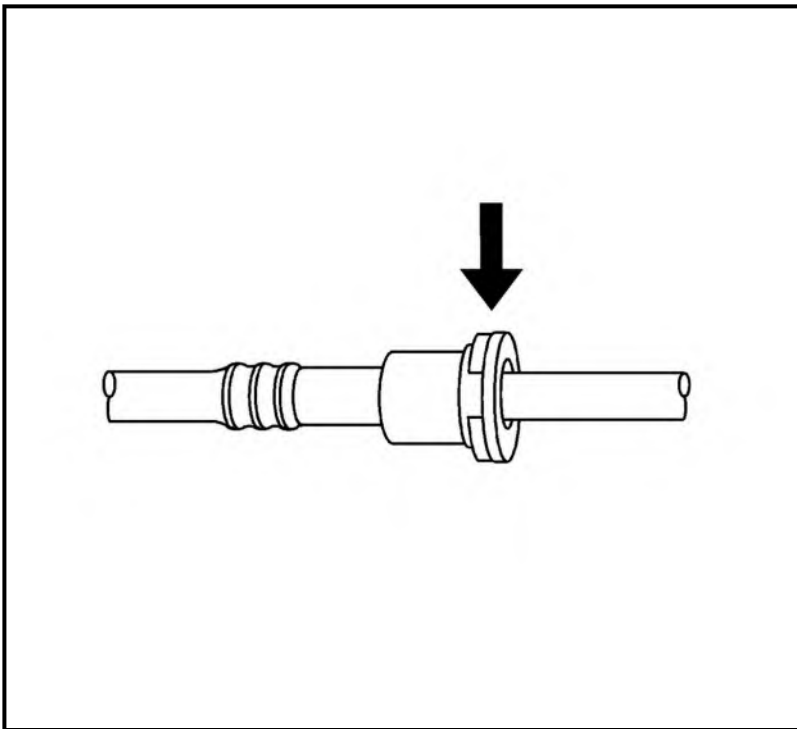
5. This step applies to Squeeze to Release style connectors ONLY. Squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick-connect fitting.



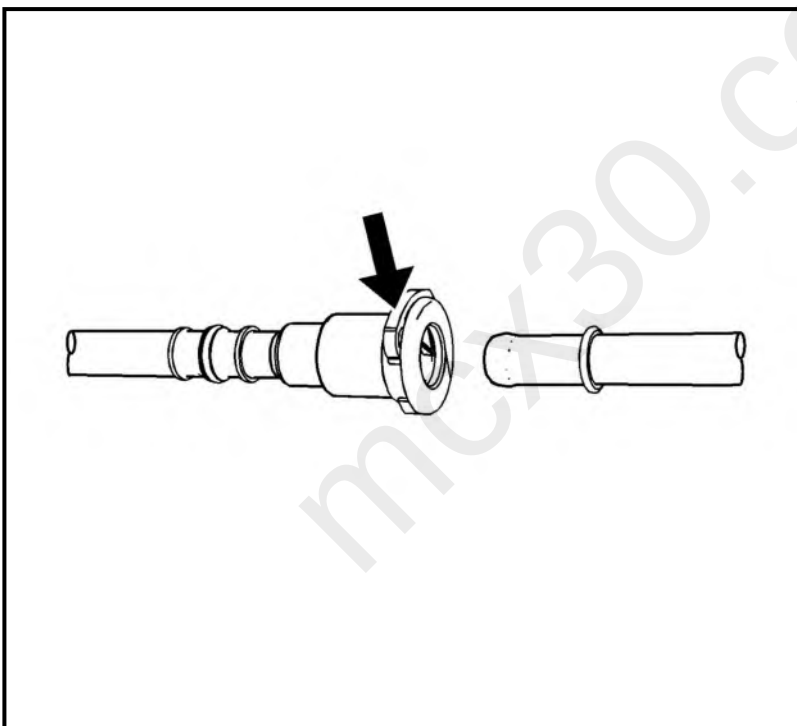
6. This step applies to Squeeze to Release style connectors ONLY. Push in the male side slightly in order to slide the retainer away from the retainers, squeeze where indicated by arrows on both sides of the plastic ring surrounding the quick-connect fitting.



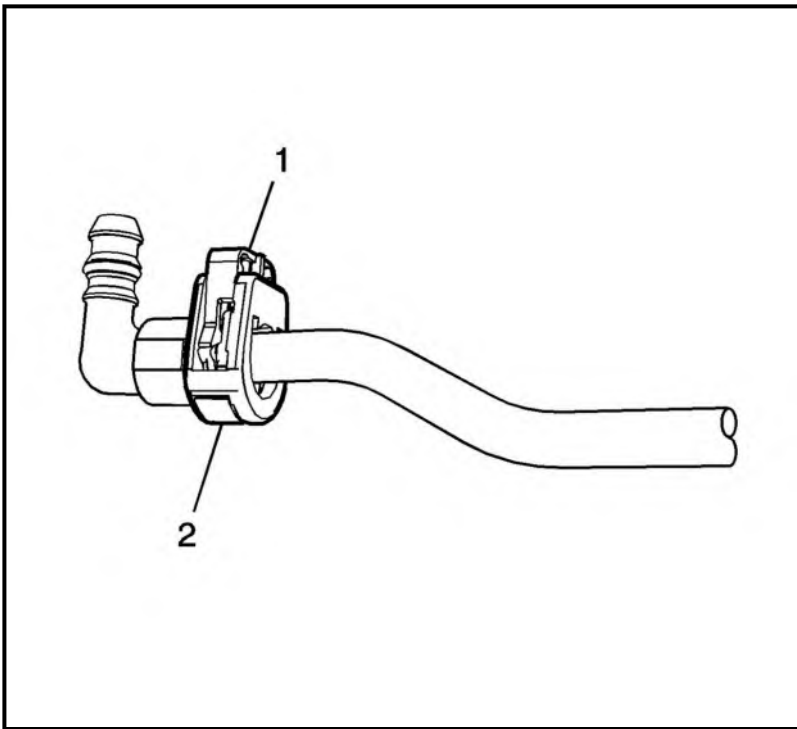
7. This step applies to Sliding Retainer style connectors ONLY. Release the fitting by pressing on one side of the release tab causing it to push in slightly. If the tab doesn't move try pressing the tab in from the opposite side. The tab will only move in one direction.



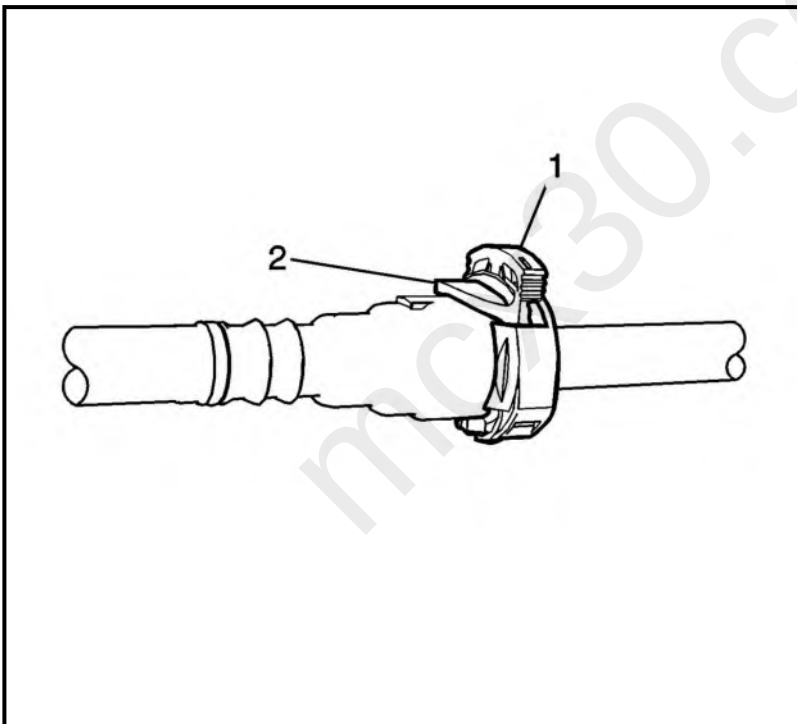
8. This step applies to the Global Connector style only. Push the connector toward the tube in order to release the pressure. Press and hold down the release mechanism, and pull the connector straight out.



9. 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.



10. 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.

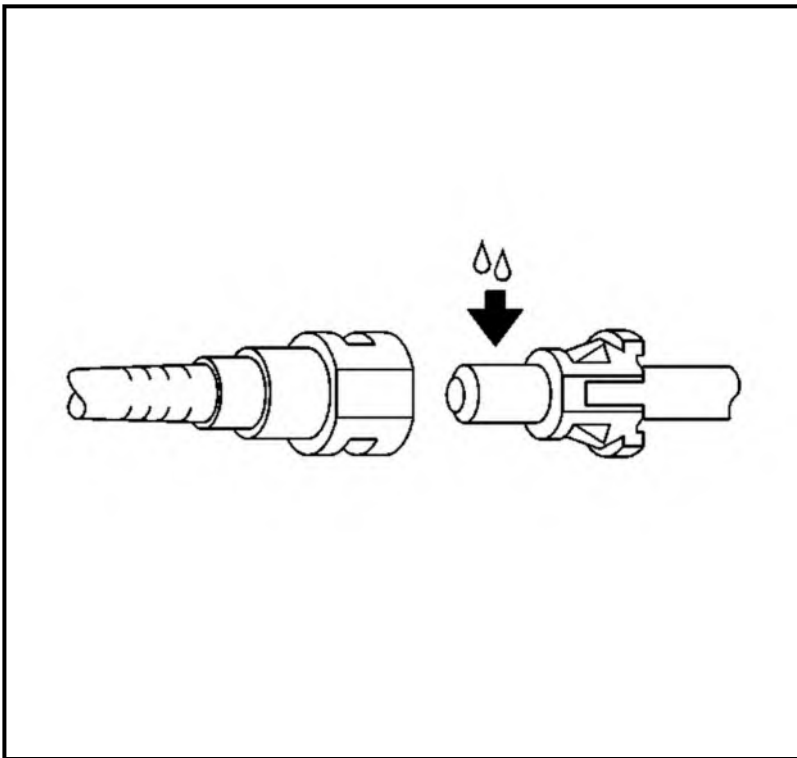


WARNING: Refer to [Relieving Fuel Pressure Warning](#) .

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

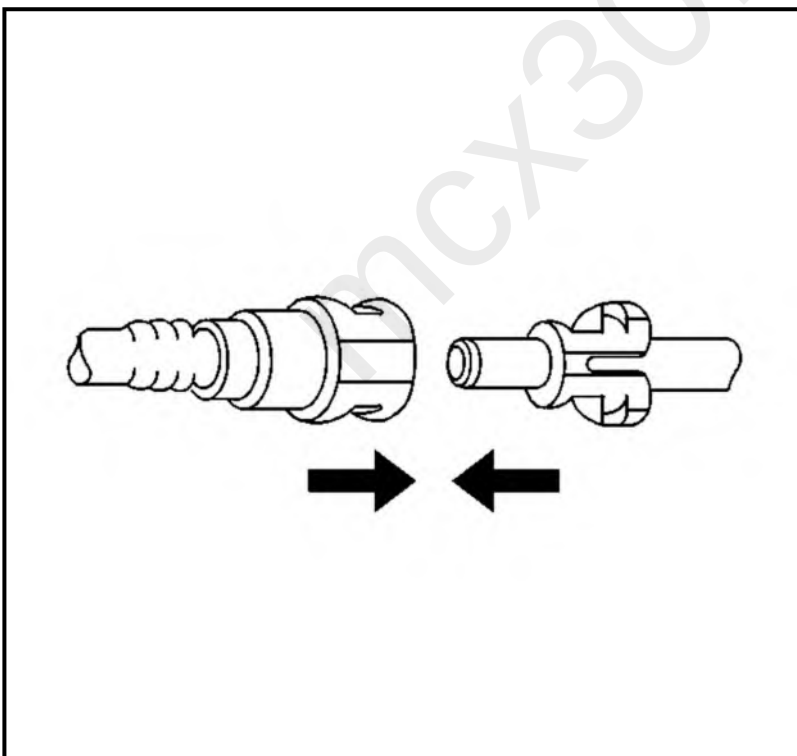
1. Apply a few drops of clean engine oil to the male pipe end.



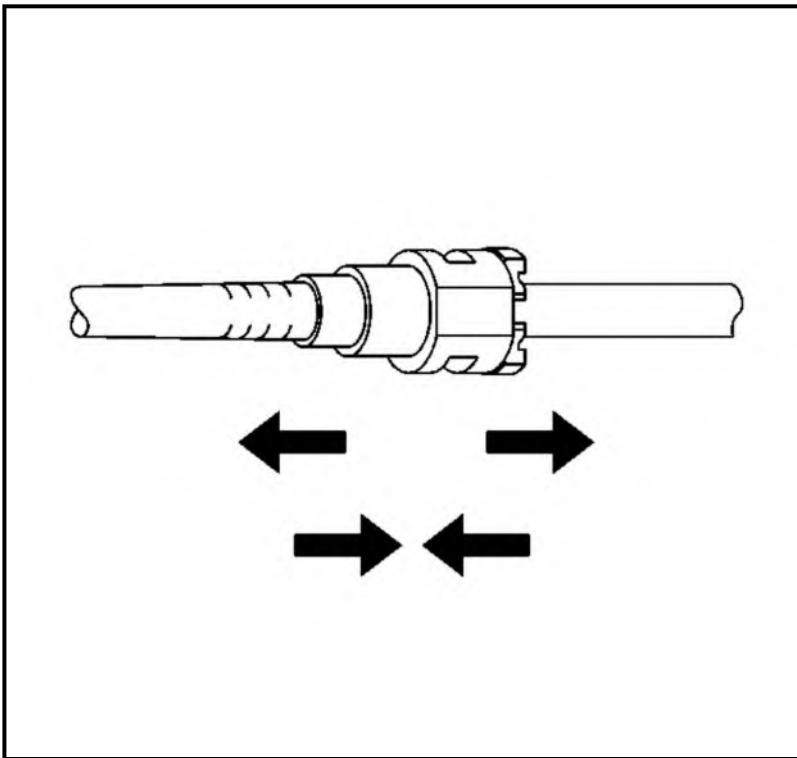
WARNING: Refer to [Fuel Pipe Fitting Warning](#) .

NOTE: Do not apply engine oil to DEF connections.

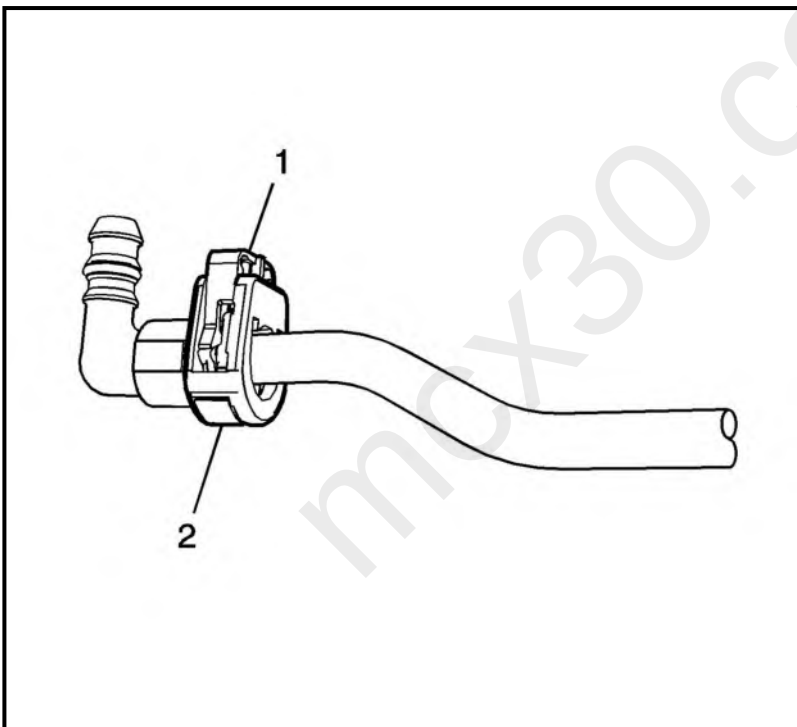
2. Push both sides of the quick-connect fitting together in order to cause the retaining feature to snap into place.



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

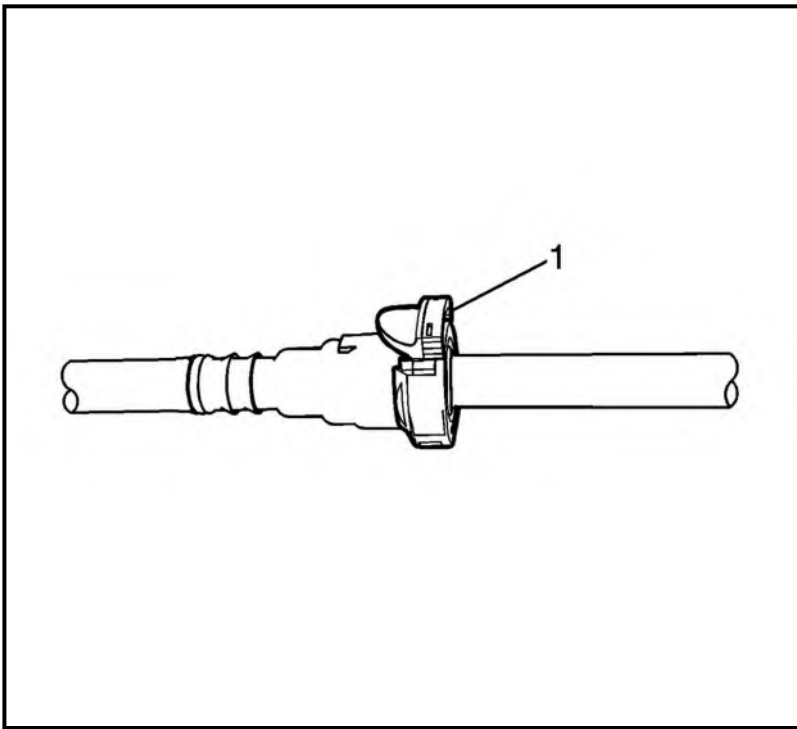


4. Insert the tube in the connector until the retainer snaps in place.



5. Push down on the redundant latch (1) until it is fully engaged and snapped into position.

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.

8. 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.

EMISSION REDUCTION FLUID AND EMISSION REDUCTION FLUID HANDLING

Usage

WARNING: Diesel Exhaust Fluid (DEF) is corrosive. Do not allow it to come in contact with your skin, eyes, or the finished surfaces of the vehicle. If exposed, it may cause skin and eye irritation. Wear skin and eye protection when handling. Inhalation may cause irritation to the upper respiratory tract. Store in a cool, well-ventilated area. For more safety information, see the label of the Diesel Exhaust Fluid container. Failure to follow this procedure may result in injury and/or vehicle damage.

- Emission reduction fluid solution is used in Selective Catalytic Reduction (SCR) to lower NO_x concentration in the exhaust emissions of diesel engines
- Emission reduction fluid is an aqueous urea solution blended with 32.5% high purity urea and 67.5% deionized water.

Used Designations

- Diesel Emission Fluid (DEF)
- Ad Blue™ - a trademark held by the German Association of the Automobile Industry (VDA)
- UREA

Chemistry

- Diesel engines run at over stoichiometric air-to-fuel ratio to ensure the combustion of soot and prevent unburned fuel from being emitted. The excess of oxygen necessarily leads to generation of nitrogen oxides (NO_x), which are harmful pollutants, from the nitrogen in the air.

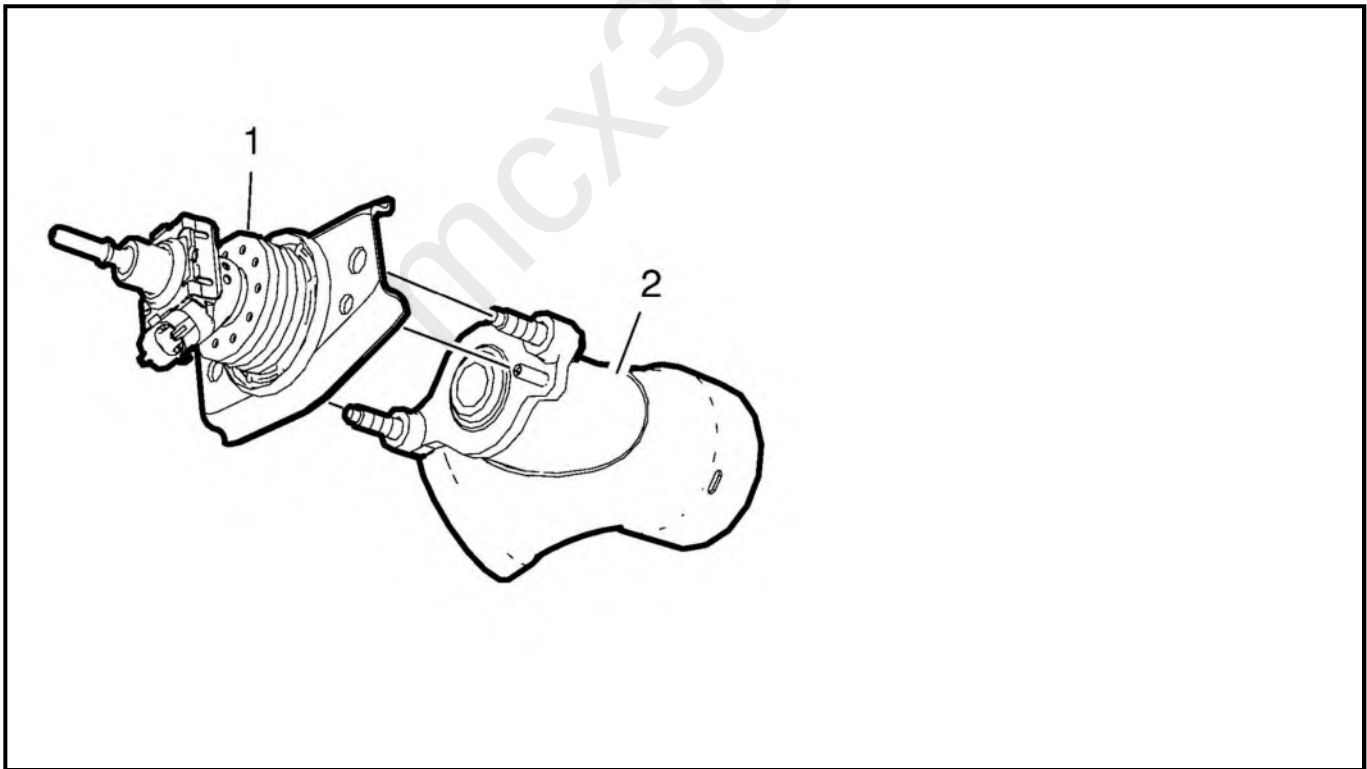
- Selective catalytic reduction is used to reduce the amount of NO_x released into the air using exhaust emission reduction fluid. Exhaust emission reduction fluid (from the exhaust emission reduction fluid tank located in large trucks) is injected in front of the SCR catalyst where it vaporizes and decomposes to form ammonia and carbon dioxide. With the SCR catalyst, the NO_x are catalytically reduced by the ammonia (NH₃) into water (H₂O) and nitrogen (N₂), which are both harmless and are released through the exhaust.

Storage

- SCR systems are sensitive to potential chemical impurities in the urea solution, therefore the solvent is demineralized water. Exhaust emission reduction fluid is an aqueous urea solution blended with 32.5% high purity urea and 67.5% deionized water.
- The solution is clear, non-toxic and safe to handle. However, it can corrode some metals and must be stored and transported carefully.
- Exhaust emission reduction fluid is stored in a tank on board the vehicle, and injected into the exhaust stream by a metering system at a rate of 2% of diesel consumption volume (4-6% in Europe).
- This low dosing rate ensures long fluid refill intervals and minimizes the tank's obstruction into vehicle packaging space.
- An electronic control unit adjusts the addition of fluid in accord with such parameters as engine operating temperature and speed.
- Exhaust emission reduction fluid is offered to consumers through a variety of quantities by manufacturers ranging from containers of it for single or repeated small usage to bulk carriers for consumers that require a large amount Exhaust emission reduction fluid. It is recommended that it be stored in a cool, dry, and well-ventilated area that is out of direct sunlight.

EMISSION REDUCTION FLUID SYSTEM DESCRIPTION

Emission Reduction Fluid Injector

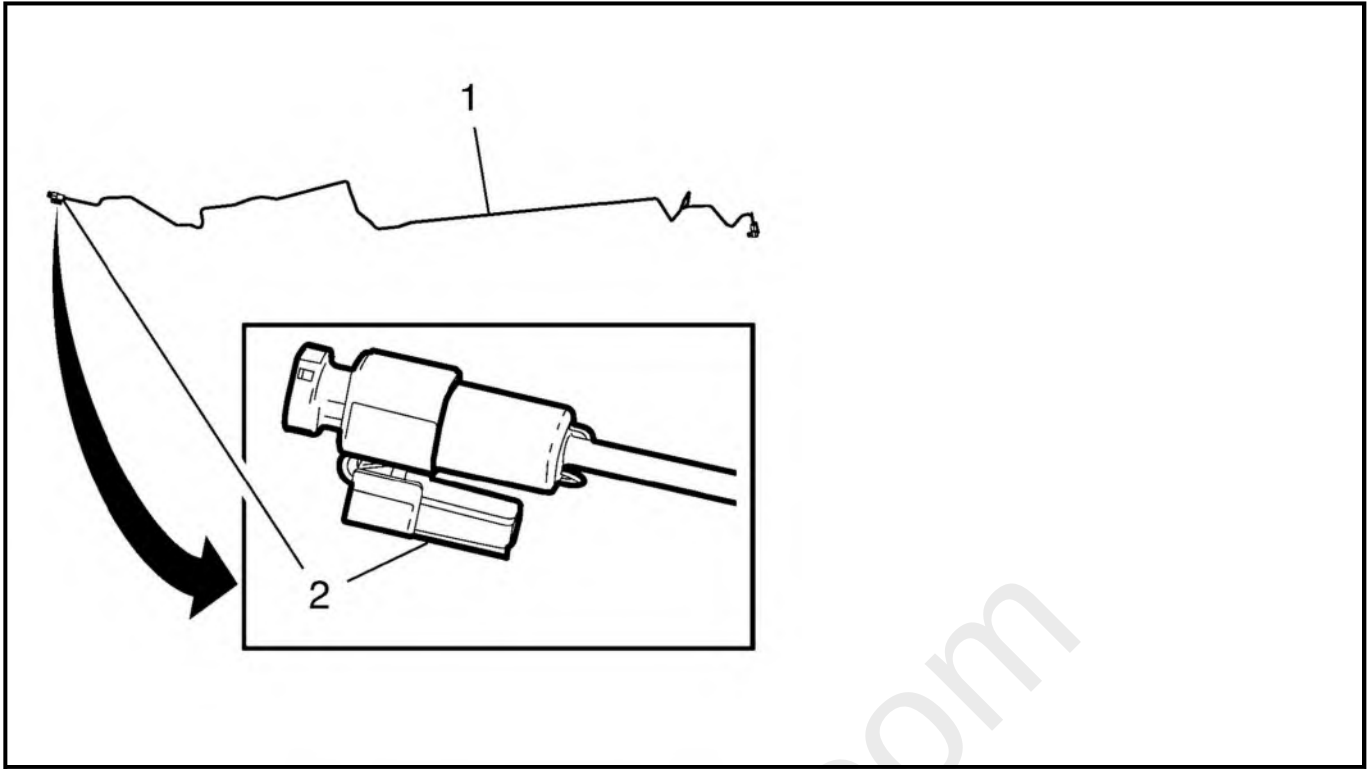


The emission reduction fluid injector (1) is placed at the exhaust pipe vaporizer (2), which is welded into the exhaust front pipe. The purpose is to inject the emission reduction fluid into the exhaust emission stream. This reduces the nitrogen oxides that were produced during the combustion. Depending on the amount of NO_x in the exhaust gas flow, the injection quantity of the emission reduction fluid is determined.

The emission reduction fluid injector is controlled by the emission reduction fluid controller.

The emission reduction fluid injector has three nozzles, which produce 1 spray circle.

Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe

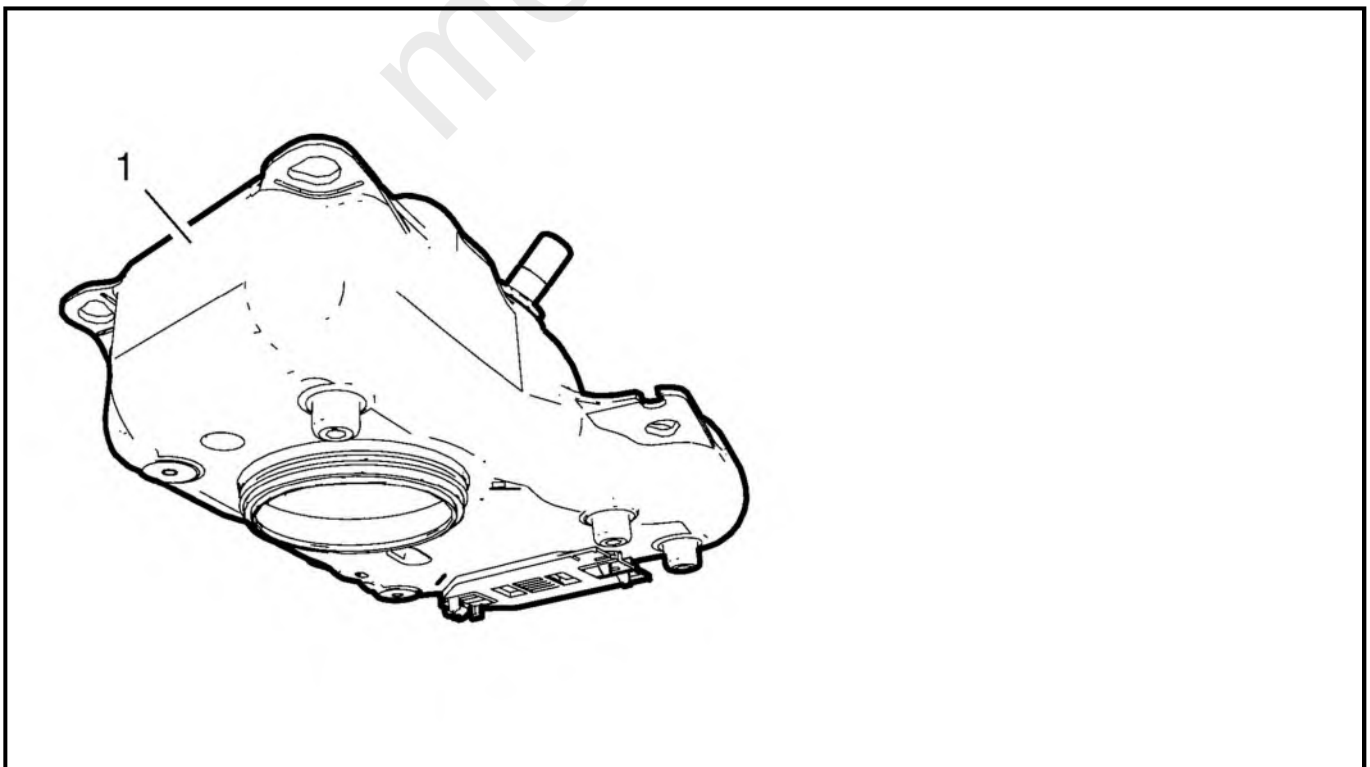


The emission reduction fluid exhaust front pipe injector supply pipe (1) connects the emission reduction injector with the emission reduction fluid tank module. It is fixed at the lower body structure.

Into the emission reduction fluid exhaust front pipe injector supply pipe (1) is one of the heaters integrated so that the freezing of the emission reduction fluid is prevented.

At the rear connector is a wiring harness plug (2) for the pipe heater installed.

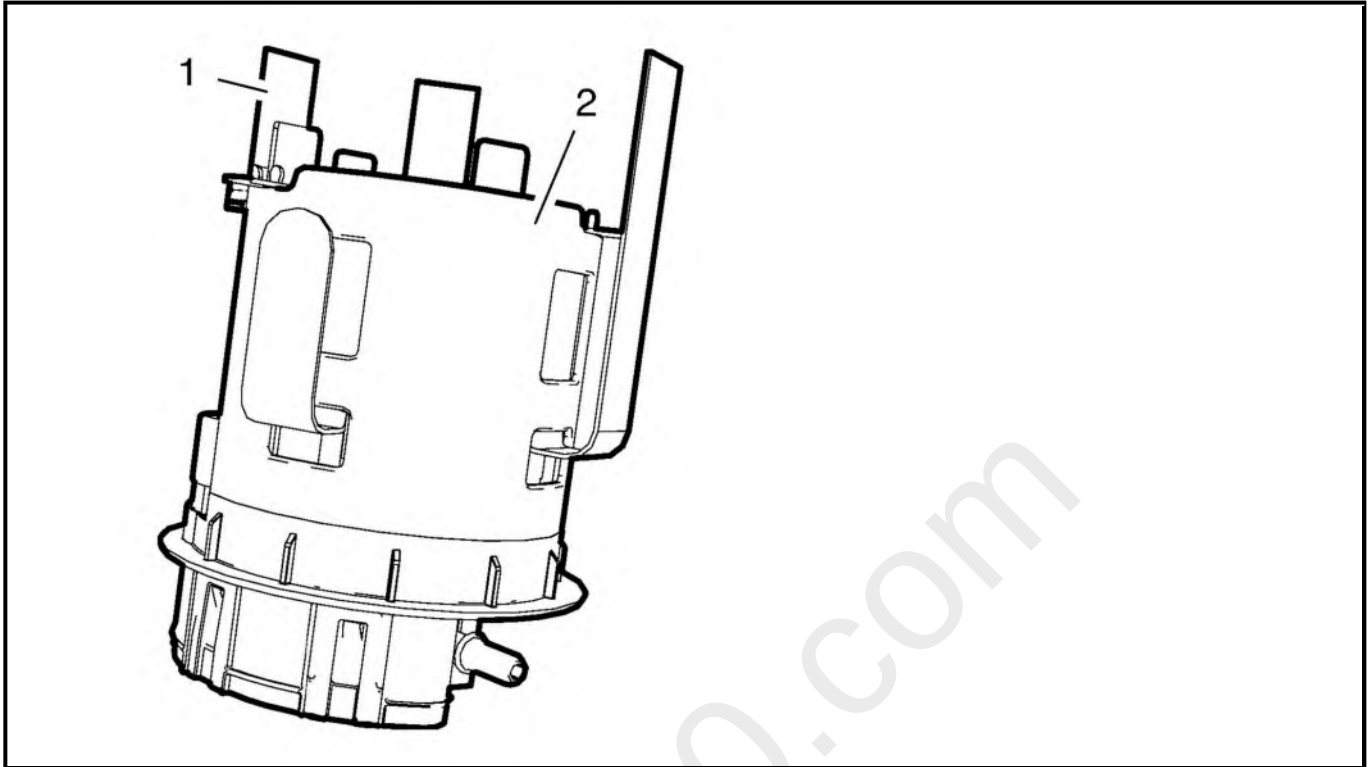
Emission Reduction Fluid Tank



The emission reduction fluid tank (1) is the reservoir for the emission reduction fluid and is installed at the rear right lower body structure.

In the emission reduction fluid tank (1) contains the emission reduction fluid tank pump module and the emission reduction fluid level sensor.

Emission Reduction Fluid Supply Pump Module



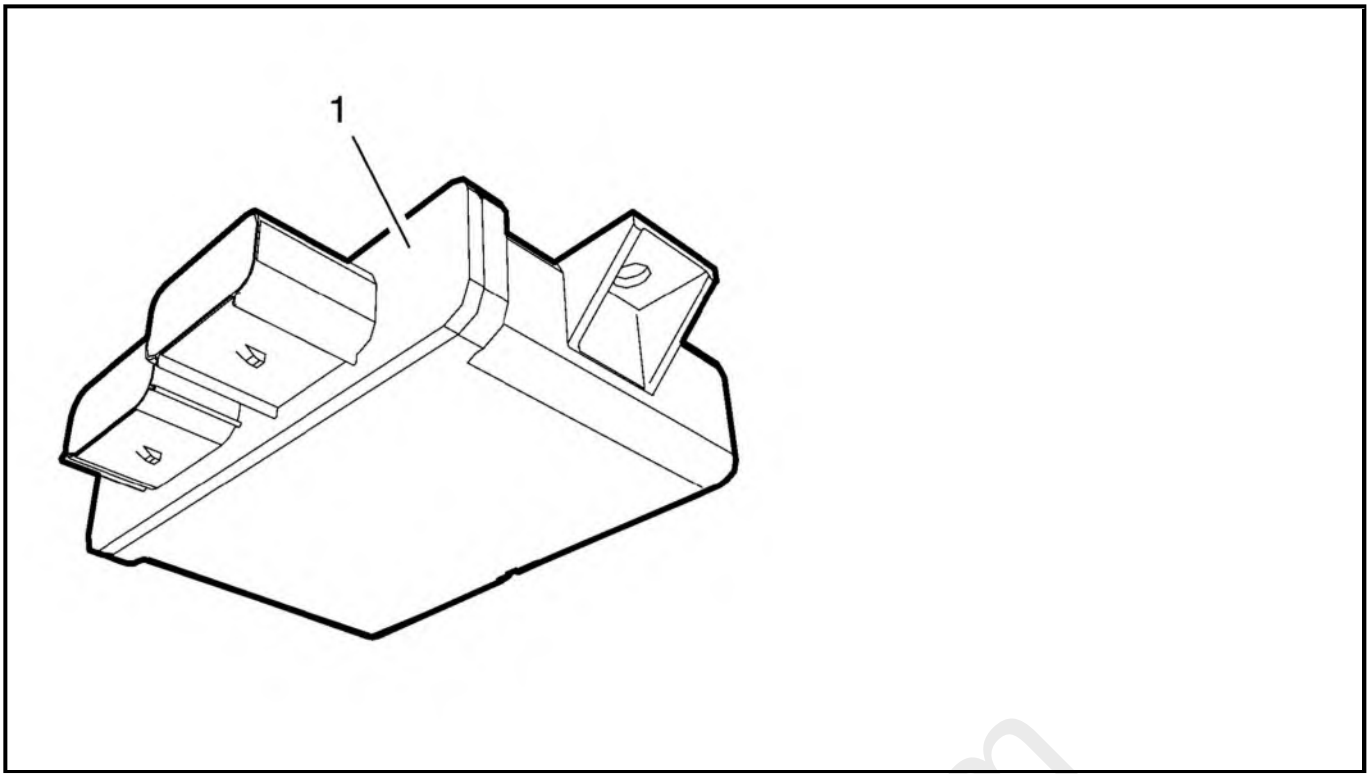
The emission reduction fluid supply pump module (2) is installed into the emission reduction fluid tank and is fixed by a ring.

The main task of the emission reduction supply pump is to deliver the emission reduction fluid from the tank to the fluid injector.

Following components are integrated into the emission reduction fluid pump:

- Emission reduction fluid pump
- Emission reduction fluid filter
- Emission reduction fluid tank heater
- Emission reduction fluid temperature sensor
- Emission reduction fluid pressure sensor

Emission Reduction Fluid Controller

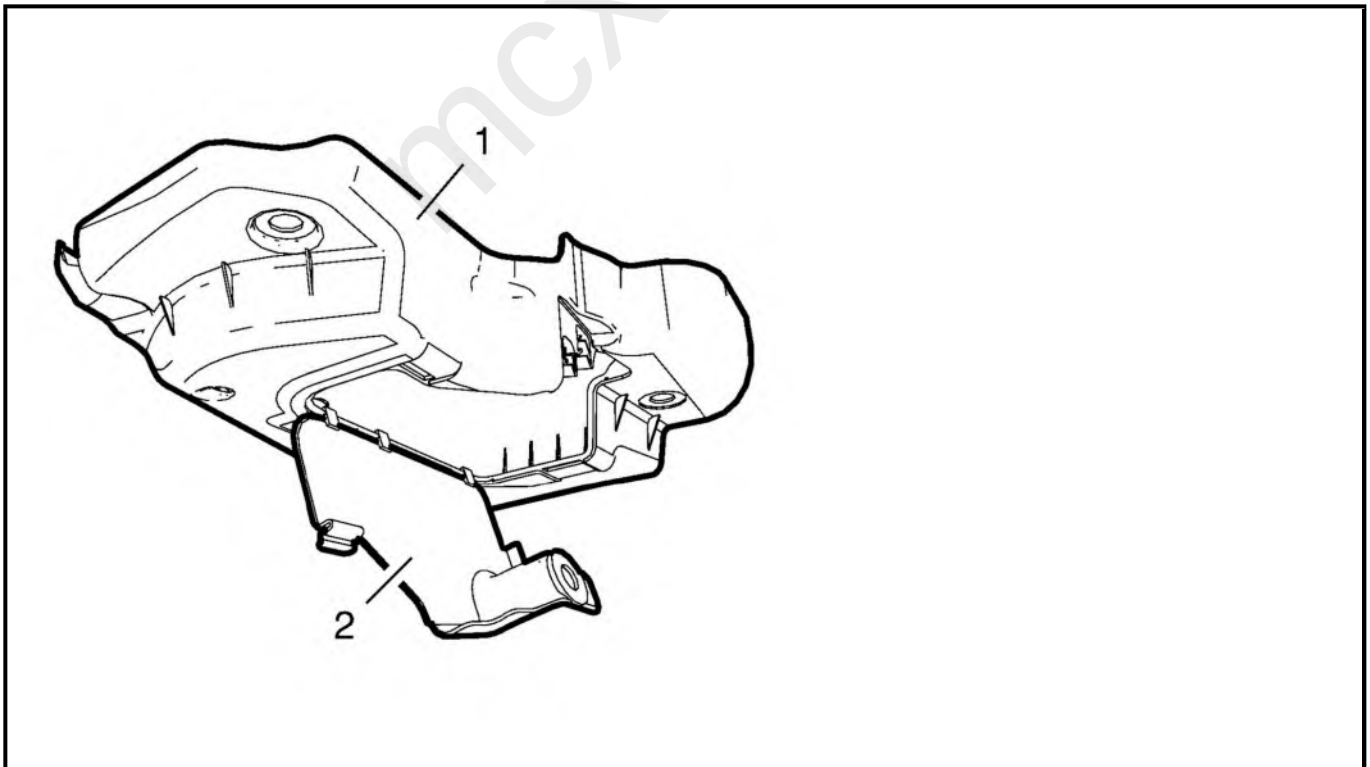


The emission reduction fluid controller (1) receives the activation requests coming from the ELM and activates the actuators accordingly.

The emission reduction fluid controller (1) is mounted at the bottom side of the emission reduction fluid tank.

One of the main tasks is that when the ignition is turned OFF, the reductant control module energizes the reductant injector and commands the reductant pump to pump in reverse to dry the reductant injector supply line. This is necessary to protect the supply line from becoming damaged by ice.

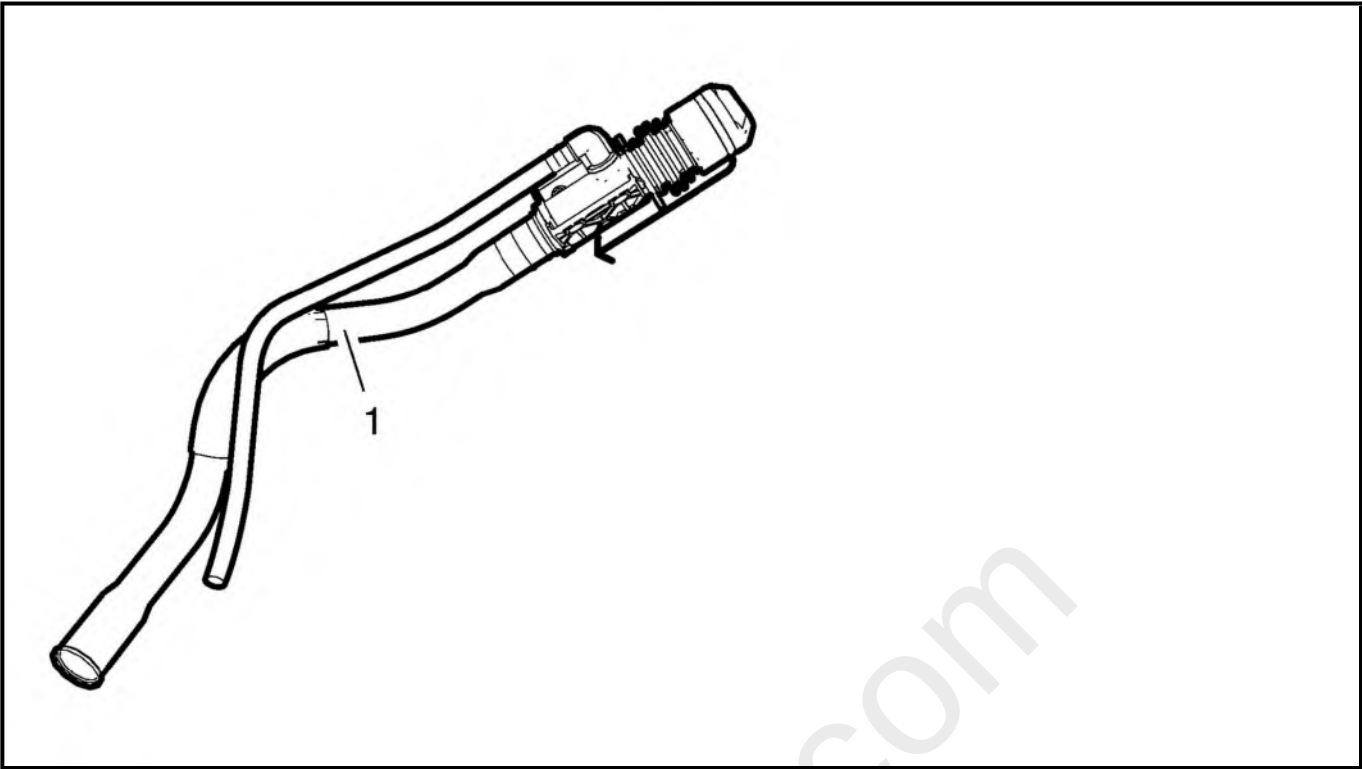
Emission Reduction Fluid Tank Shield



The emission reduction fluid tank shield (1) is a unit with an emission reduction fluid tank shield door (2).

The purpose is to protect the emission reduction fluid tank and the components underneath against environmental influences, mechanical effects and splash.

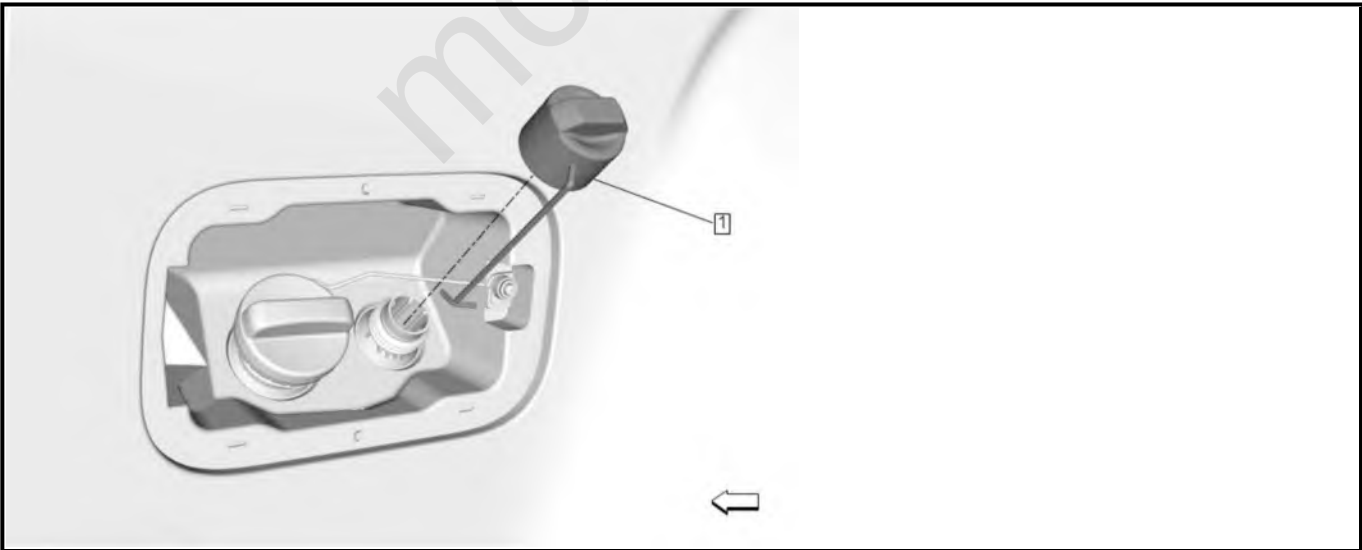
Emission Reduction Fluid Tank Filler Assembly



The emission reduction fluid tank filler assembly (1) is installed in the left rear wheelhouse. The fill opening is placed near the fuel tank fill opening.

The purpose is to enable a comfortable filling of the emission reduction fluid and the venting of the emission reduction fluid vapors.

EMISSION REDUCTION FLUID TANK FILLER CAP REPLACEMENT

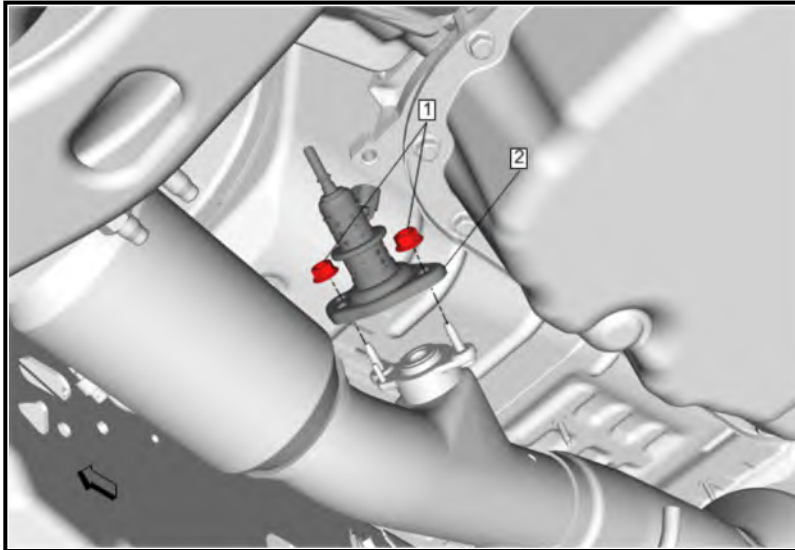


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure	
Open the fuel tank filler door.	

Callout	Component Name
1	Emission Reduction Fluid Tank Filler Cap Procedure Compress the emission reduction fluid filler cap tether to remove the emission reduction fluid filler cap.

REDUCTANT FLUID INJECTOR REPLACEMENT



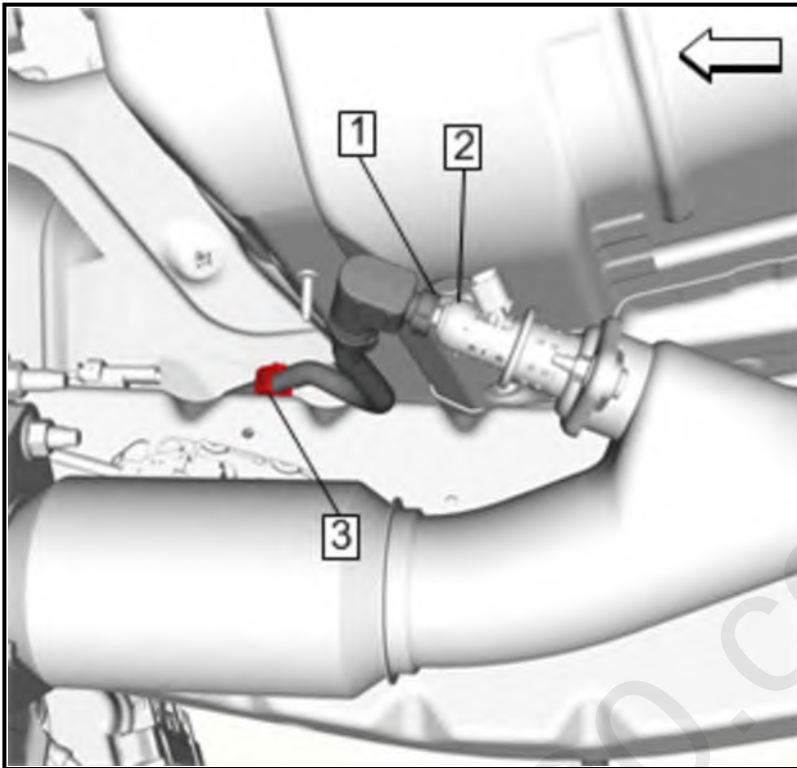
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures <u>Emission Reduction Fluid and Emission Reduction Fluid Handling</u> <u>Lifting and Jacking the Vehicle</u> <u>Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement</u>	
1	Emission Reduction Fluid Injector Nut [2x] CAUTION: Refer to <u>Fastener Caution</u> . Tighten 22 N.m (16 lb ft)
2	Emission Reduction Fluid Injector Procedure 1. Disconnect the electrical connector. 2. Remove and DISCARD the emission reduction fluid injector gasket. 3. Perform the exhaust aftertreatment fuel injector reset. <u>Exhaust Aftertreatment Fuel Injector Reset</u>

EMISSION REDUCTION FLUID EXHAUST FRONT PIPE INJECTOR SUPPLY PIPE REPLACEMENT

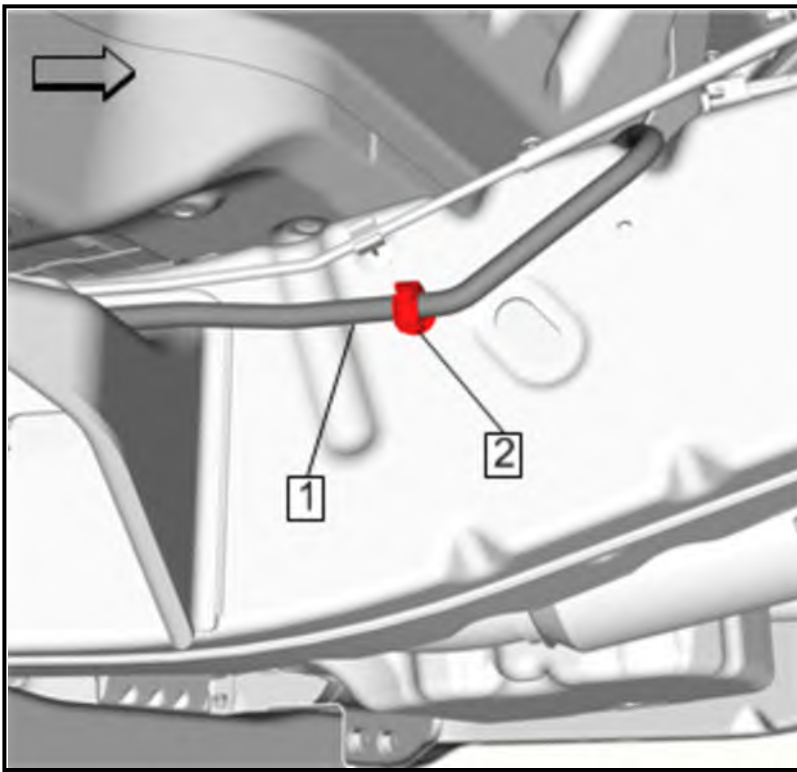
Removal Procedure

1. Before performing the first steps, review the [Emission Reduction Fluid and Emission Reduction Fluid Handling](#).
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)

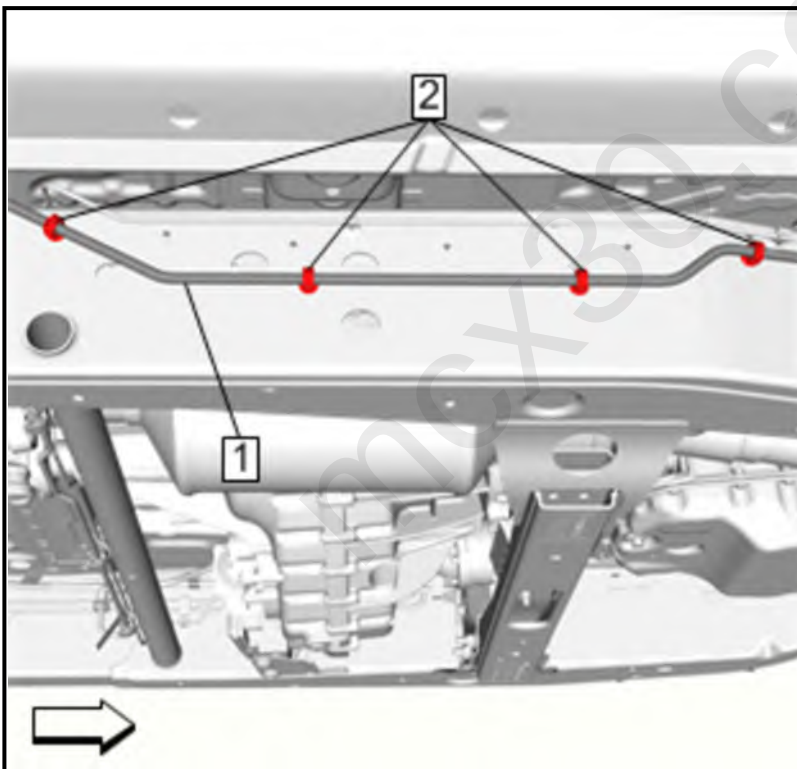


NOTE: After removing the Supply Pipe, carefully wipe any residual DEF off of the mating injector port with a clean towel to avoid urea crystal build up at the connection during installation. Urea crystal build-up can result in a future leak.

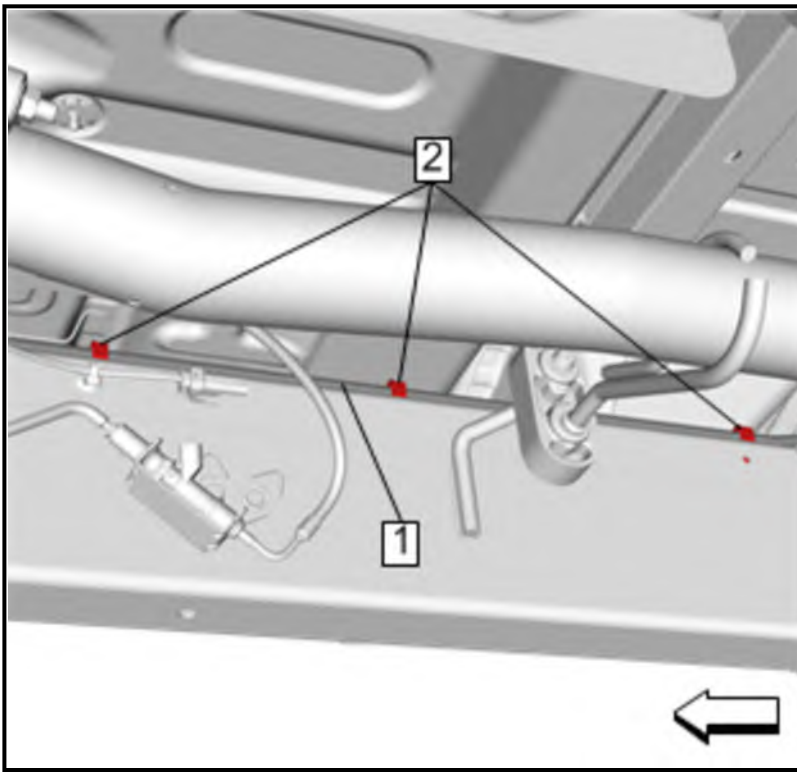
4. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (3) - Unclip
5. [Front Wheelhouse Liner Replacement \(Without ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(With ZR2\)](#) , or [Front Wheelhouse Liner Replacement \(Bison\)](#) - Remove
6. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Unclip



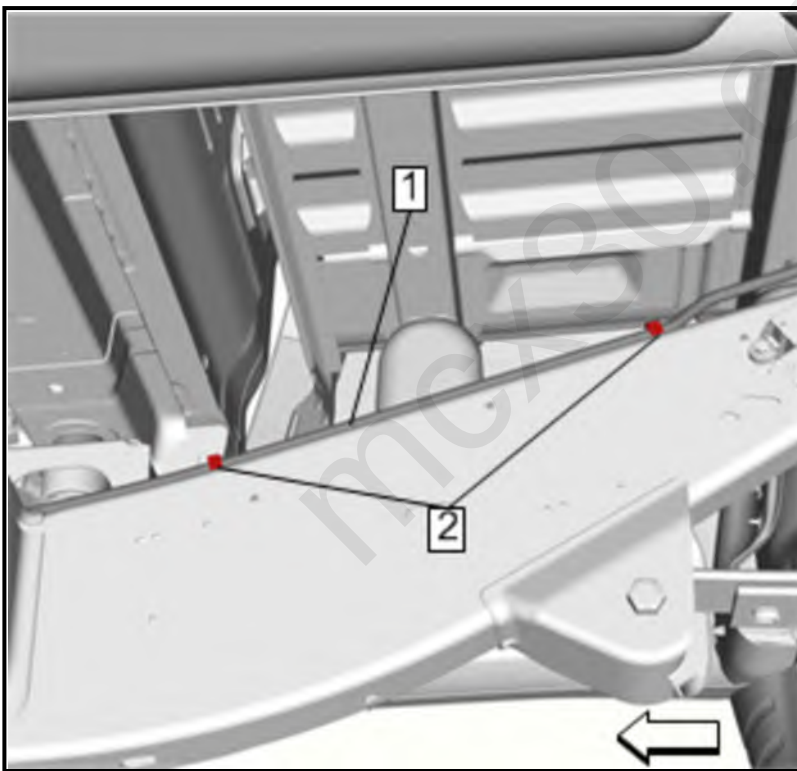
7. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Unclip [4x]



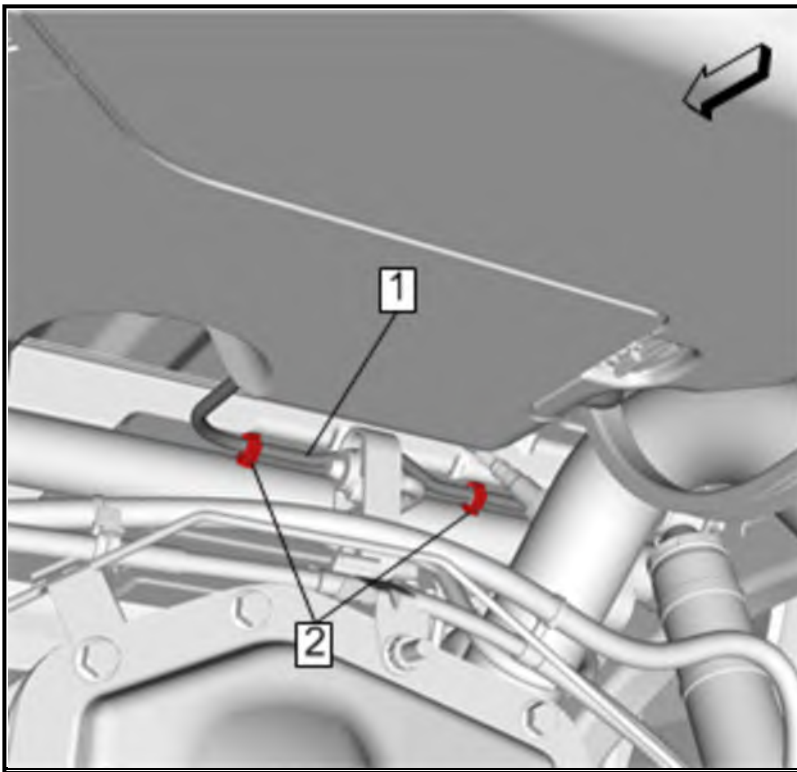
8. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Unclip [3x]



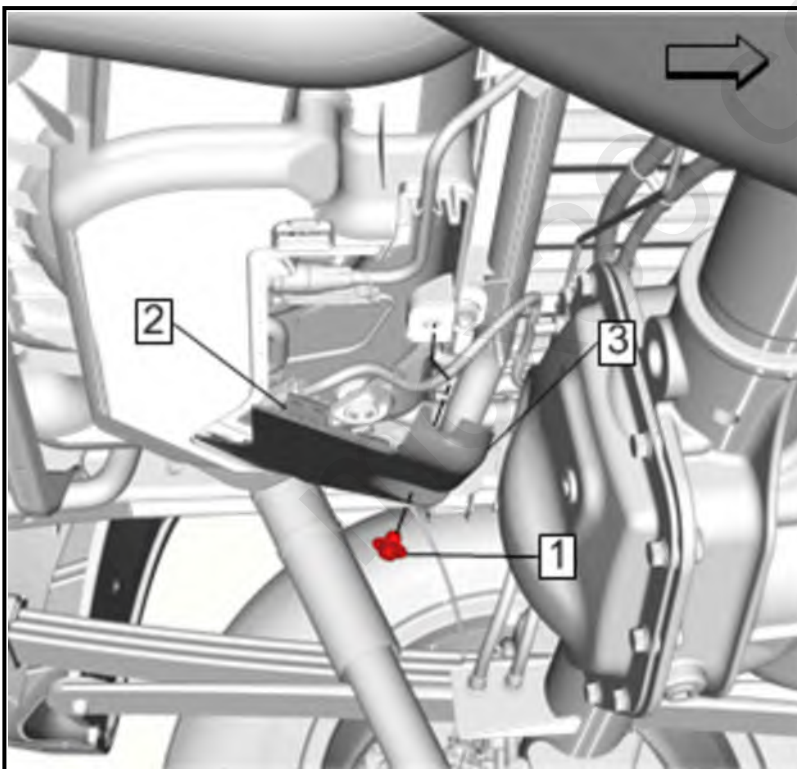
9. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Unclip [2x]



10. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Unclip [2x]



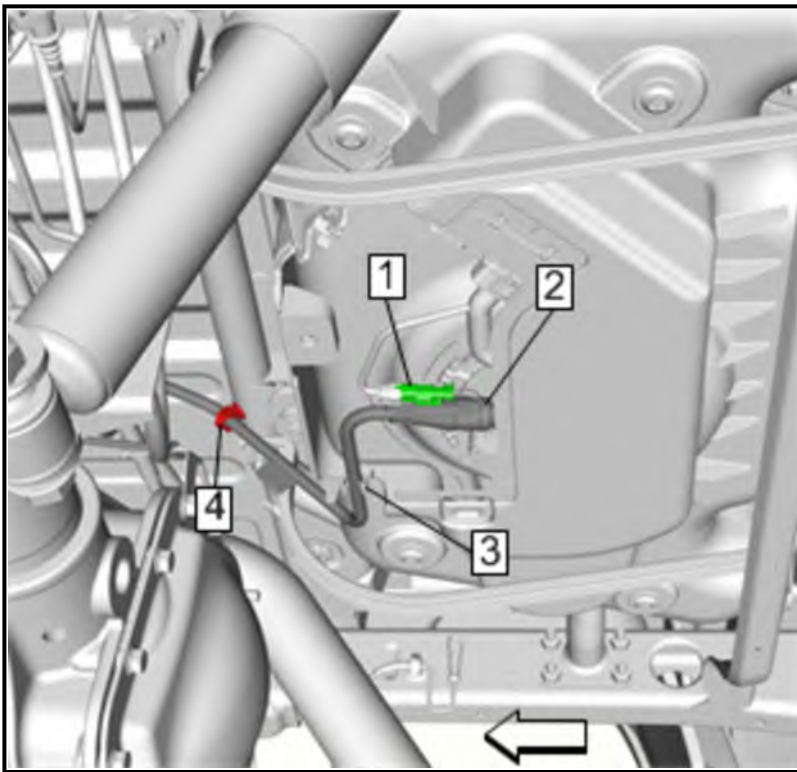
11. Retainer (1) - Remove



12. Emission Reduction Fluid Tank Shield Tab (2) - Unclip

13. Emission Reduction Tank Shield Door (3) - Open

14. Electrical Connector (1) - Disconnect

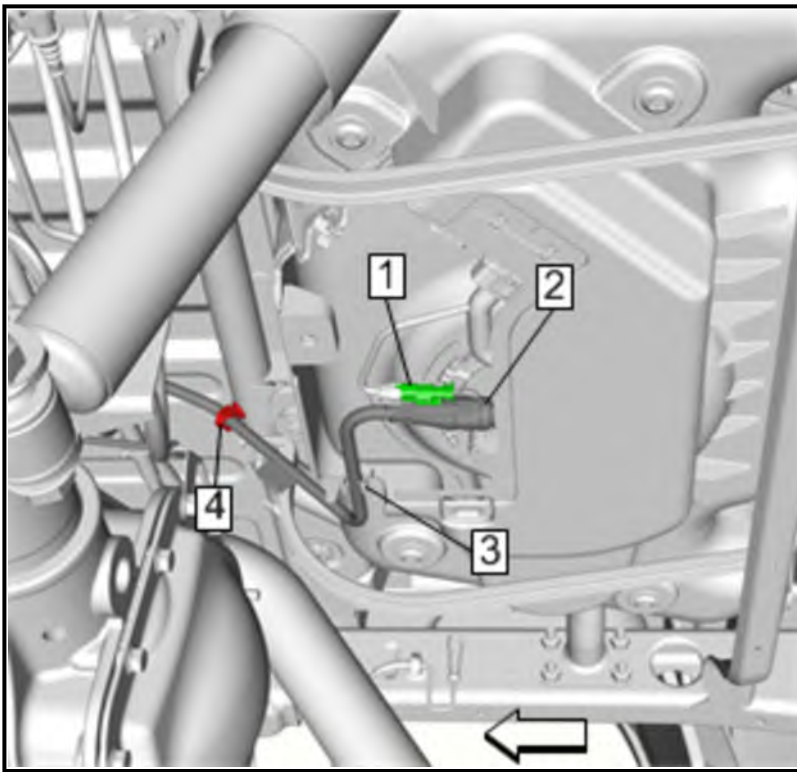


NOTE: After removing the Supply Pipe, carefully wipe any residual DEF off of the mating injector port with a clean towel to avoid urea crystal build up at the connection during installation. Urea crystal build-up can result in a future leak.

15. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Emission Reduction Fluid Supply Pump Module - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)
16. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Emission Reduction Fluid Tank Shield (3) - Unclip
17. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Retainer (4) - Unclip

Installation Procedure

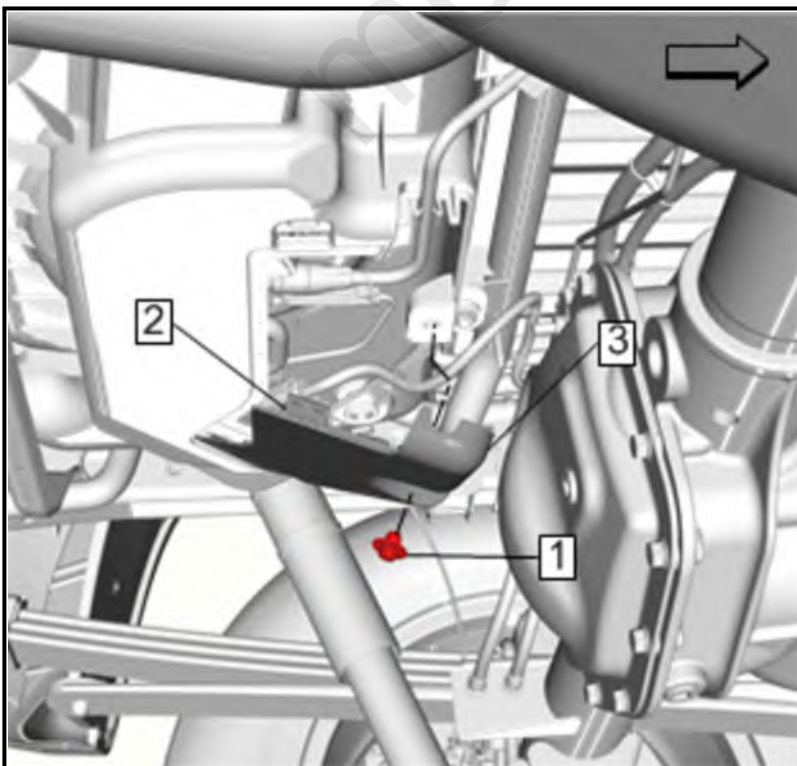
1. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Retainer (4) - Clip



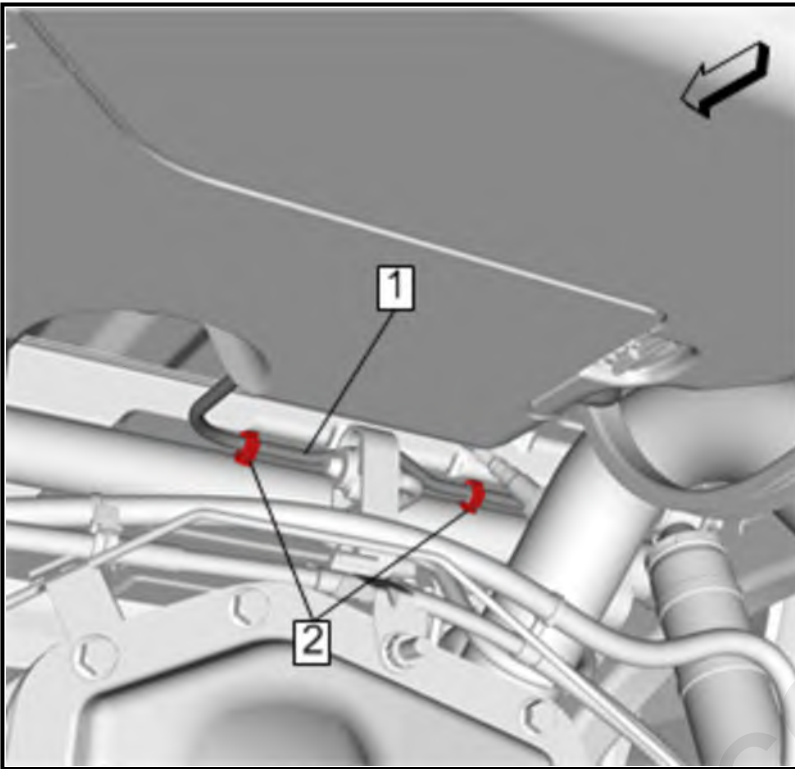
2. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Emission Reduction Fluid Tank Shield (3) - Clip

NOTE: Prior to install the Supply Pipe, make sure the supply pump port and supply pipe connector is clean and free of debris or crystal deposits. If required, flush with fresh distilled water in order to dissolve any residual crystal.

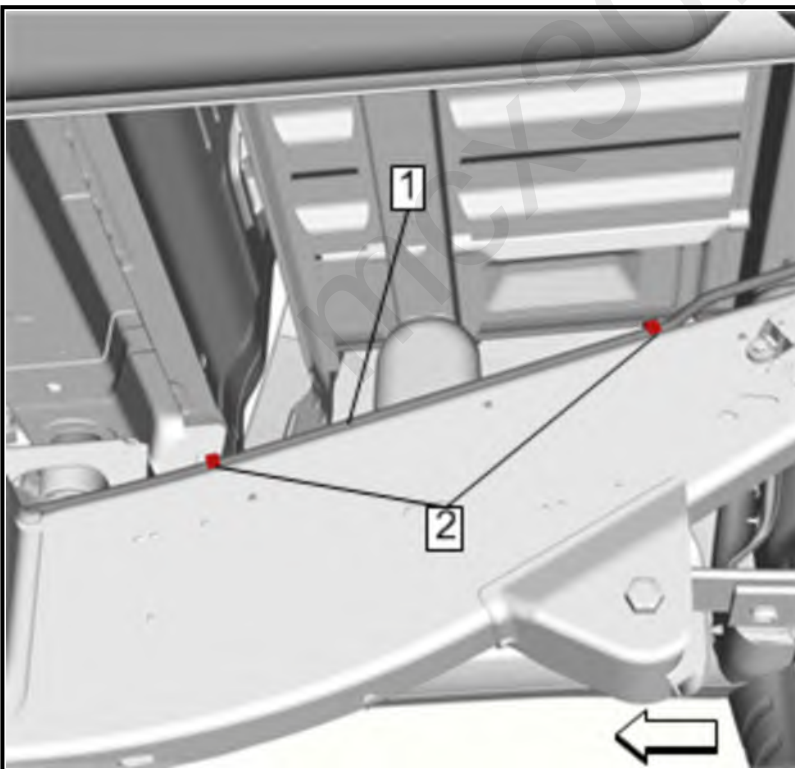
3. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (2) @ Emission Reduction Fluid Supply Pump Module - Connect - [Plastic Collar Quick Connect Fitting Service](#)
4. Electrical Connector (1) - Connect
5. Emission Reduction Tank Shield Door (3) - Close



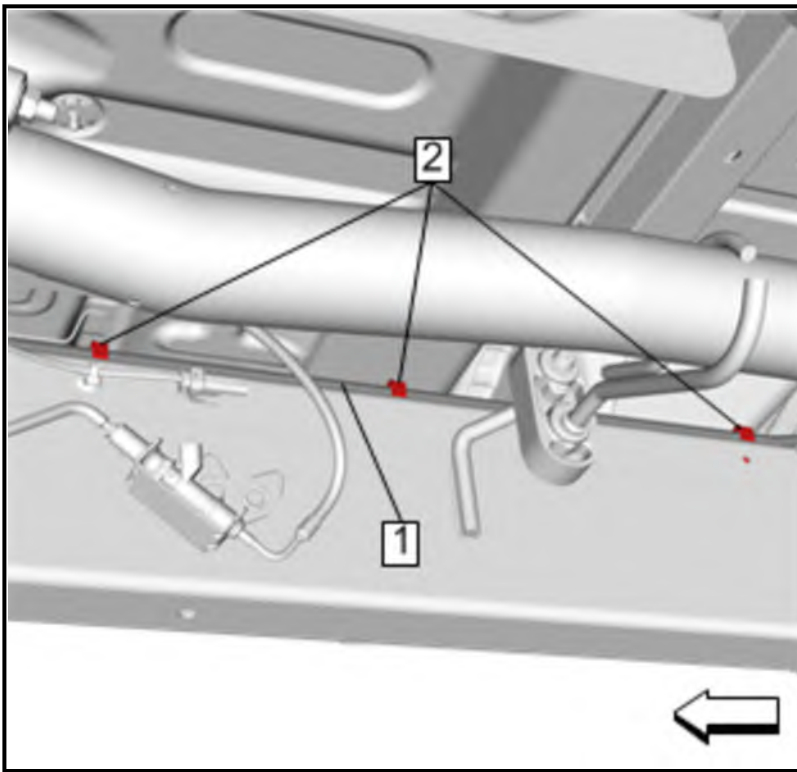
6. Emission Reduction Fluid Tank Shield Tab (2) - Clip
7. Retainer (1) - Install
8. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Clip [2x]



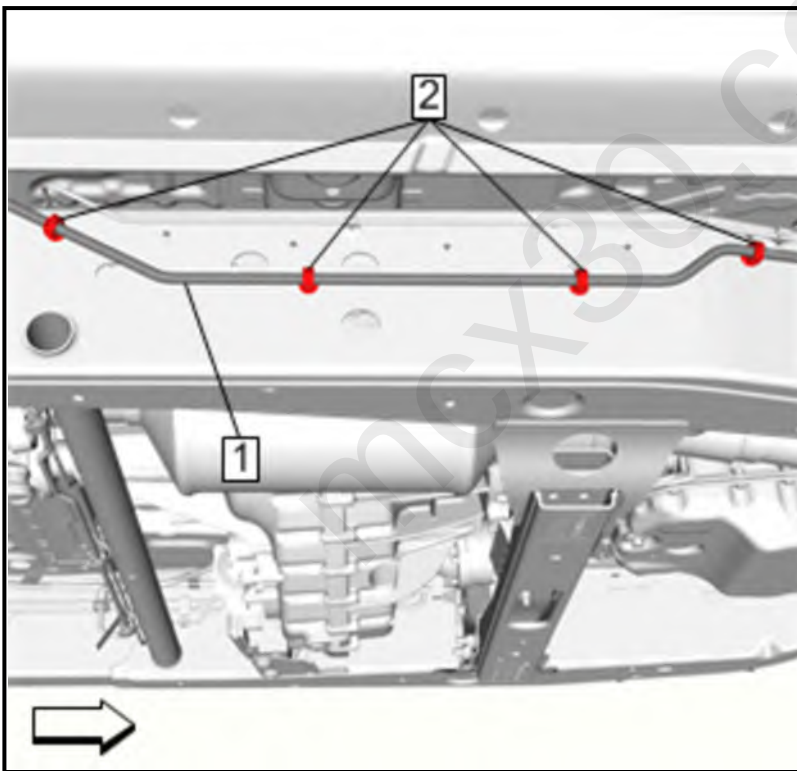
9. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Clip [2x]



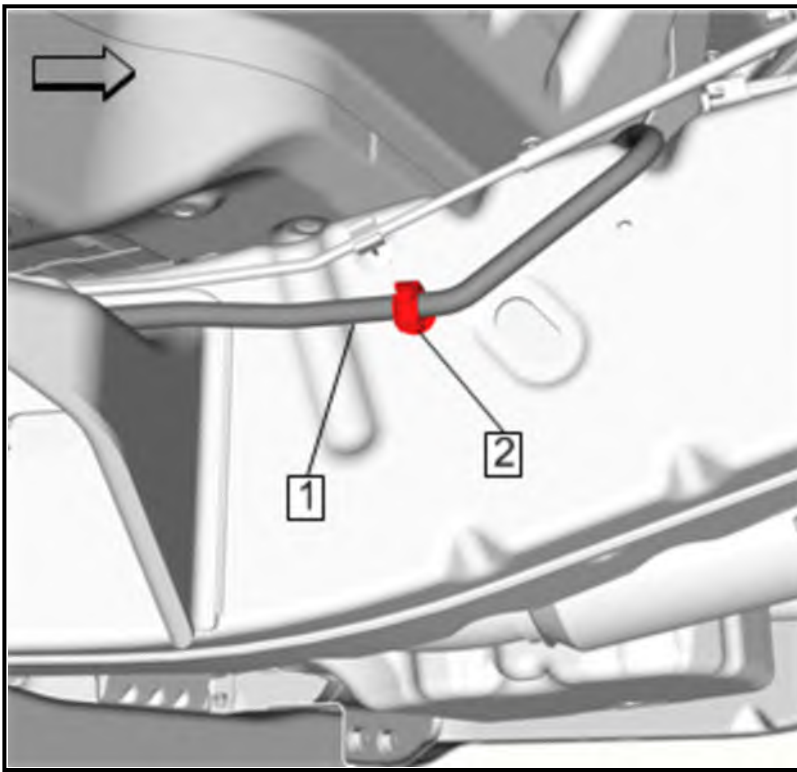
10. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Clip [3x]



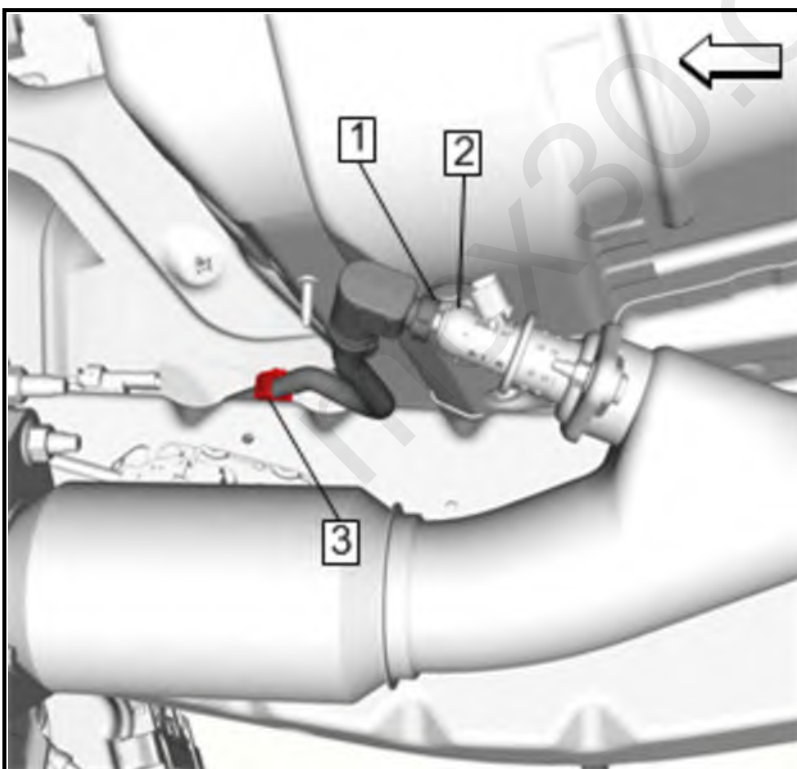
11. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Clip [4x]



12. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (2) - Clip



13. Front Wheelhouse Liner Replacement (Without ZR2) , or Front Wheelhouse Liner Replacement (With ZR2) , or Front Wheelhouse Liner Replacement (Bison) - Install
14. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Retainer (3) - Clip



NOTE: Prior to install the Supply Pipe, make sure the supply pump port and supply pipe connector is clean and free of debris or crystal deposits. If required, flush with fresh distilled water in order to dissolve any residual crystal.

15. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (1) @ Emission Reduction Fluid Injector (2) - Connect - Plastic Collar Quick Connect Fitting Service
16. Lower the vehicle.

EMISSION REDUCTION FLUID SUPPLY PUMP MODULE REPLACEMENT

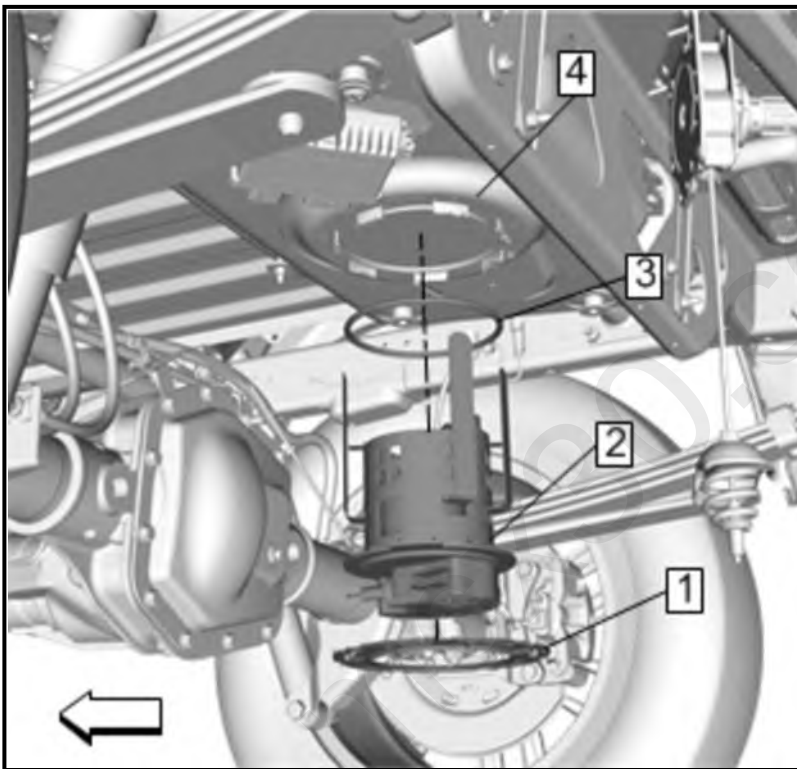
Special Tools

J-45722 Fuel Sender Lock Ring Wrench

Equivalent regional tools: Special Tools ((Diagnosis Tools)).

Removal Procedure

1. Before performing the first steps, review the Emission Reduction Fluid and Emission Reduction Fluid Handling.
2. Drain the emission reduction fluid tank. Emission Reduction Fluid Tank Draining
3. Emission Reduction Fluid Tank Shield Replacement - Remove
4. Emission Reduction Fluid Pump Module Wiring Harness Replacement - Remove
5. Emission reduction fluid tank pump module ring (1), use the **J-45722** Fuel Sender Lock Ring Wrench

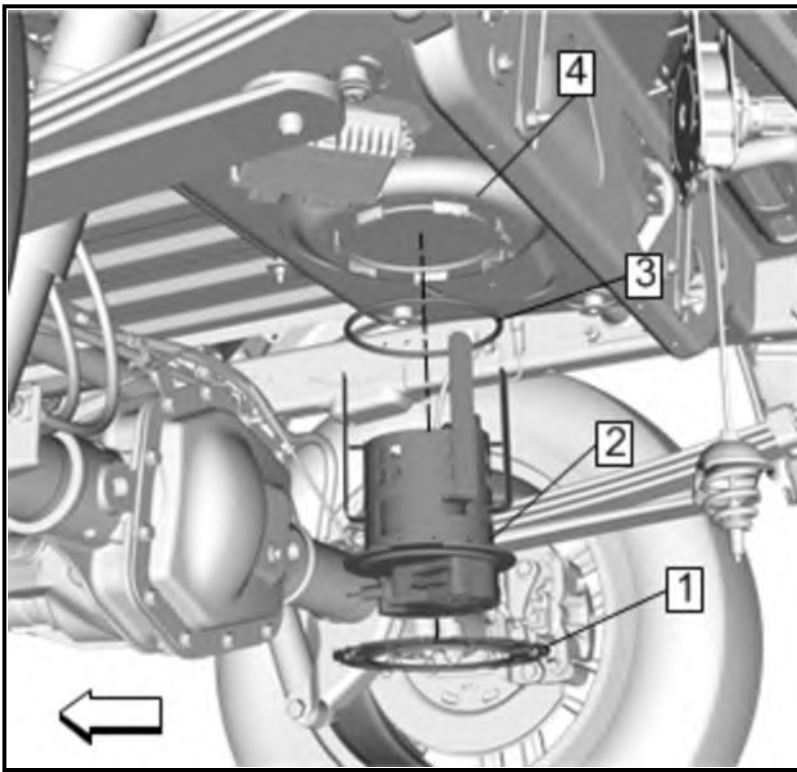


- Remove

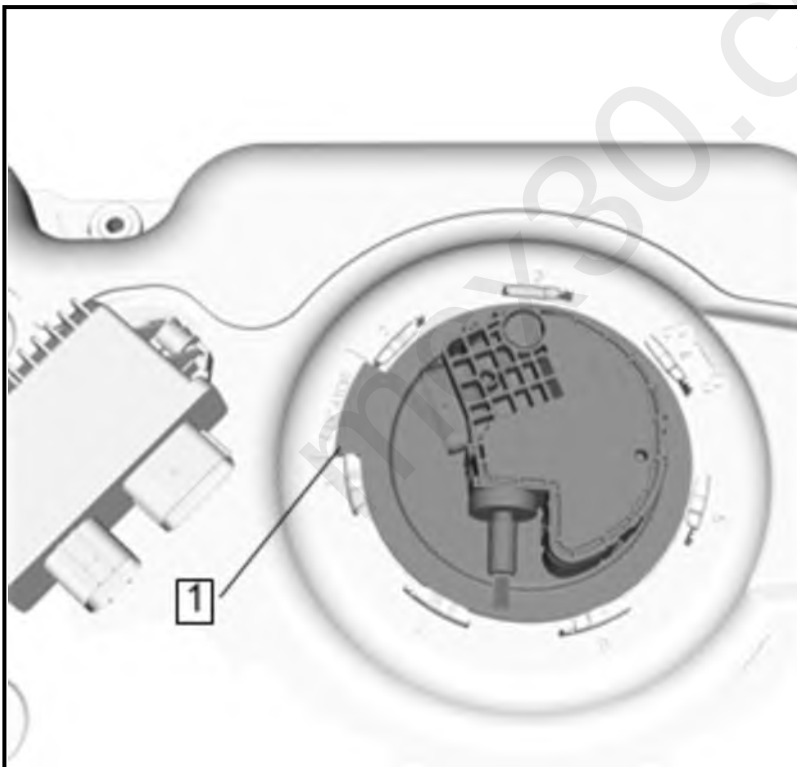
6. Emission reduction fluid supply pump module (2) @ emission reduction fluid tank (4) - Remove
7. Emission reduction fluid supply pump module seal (3) - Remove and DISCARD

Installation Procedure

1. NEW emission reduction fluid supply pump module seal (3) @ emission reduction fluid supply pump module (2) - Install



2. Emission reduction fluid supply pump module (2) @ emission reduction fluid tank (4) - Install
3. Bring the emission reduction fluid supply pump module in the installation position.

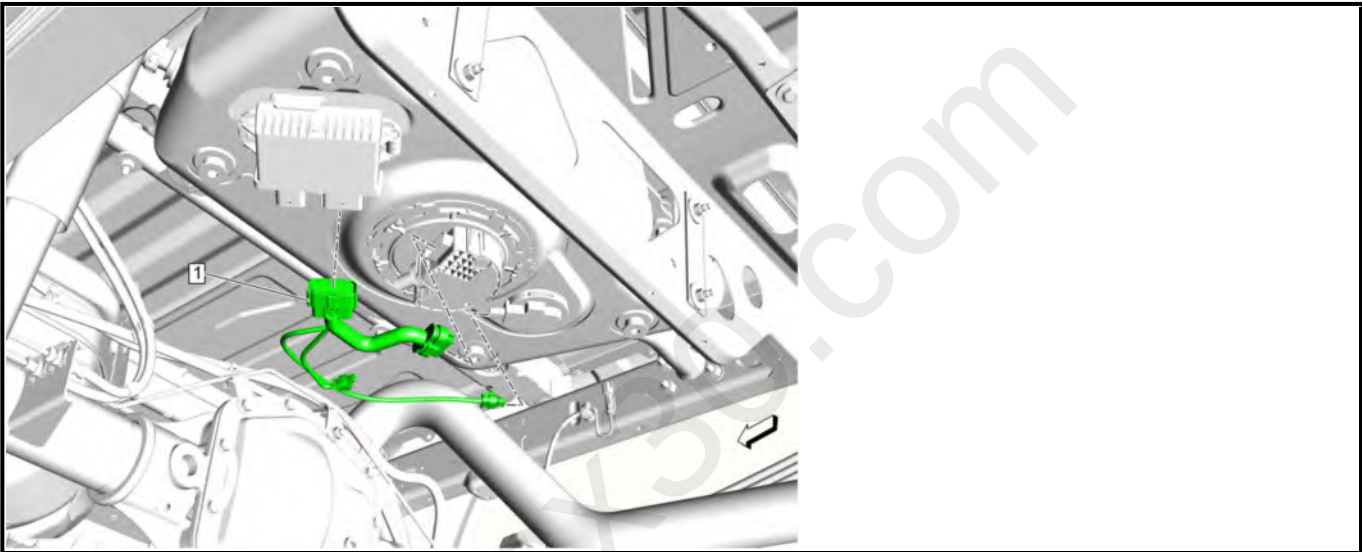


NOTE: The locator tab (1) must align with the word LOCATOR on the emission reduction fluid tank.

4. Install the emission reduction fluid tank pump module ring.
5. Tighten the emission reduction fluid tank pump module ring. Use the **J-45722** Fuel Sender Lock Ring Wrench.
6. Emission Reduction Fluid Pump Module Wiring Harness Replacement - Install
7. Emission Reduction Fluid Tank Shield Replacement - Install
8. Lower the vehicle.

9. Fill the emission reduction fluid tank.
10. Bleed the emission reduction fluid system:
 1. Connect the scan tool to the vehicle.
 2. Start the emission reduction system leak test using the scan tool.
 3. Wait until the emission reduction fluid pump has reached the delivery pressure of 5 bar (72.5 psi).
 4. Stop the emission reduction system leak test using the scan tool.
 5. Remove the scan tool.
 6. If pump fails to prime disconnect the emission reduction fluid exhaust front pipe injector supply pipe. [Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement](#)
 7. Prime pump to purge air from the system.
 8. Reconnect the emission reduction fluid exhaust front pipe injector supply pipe. [Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe Replacement](#)
 9. Prime system again.

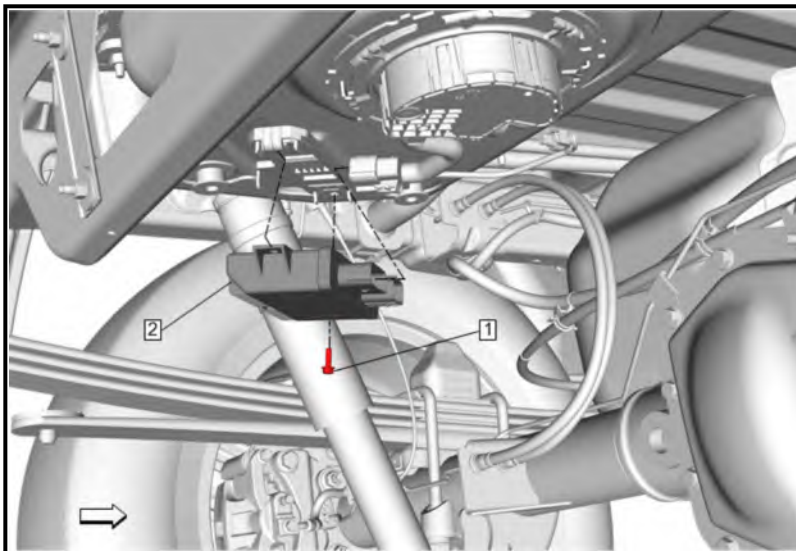
EMISSION REDUCTION FLUID PUMP MODULE WIRING HARNESS REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Emission Reduction Fluid Tank Shield Replacement	
1	Emission Reduction Fluid Pump Module Wiring Harness Procedure Disconnect the wiring harness from the emission reduction fluid controller and the emission reduction fluid supply pump module and level sensor.

REDUCTANT CONTROL MODULE REPLACEMENT



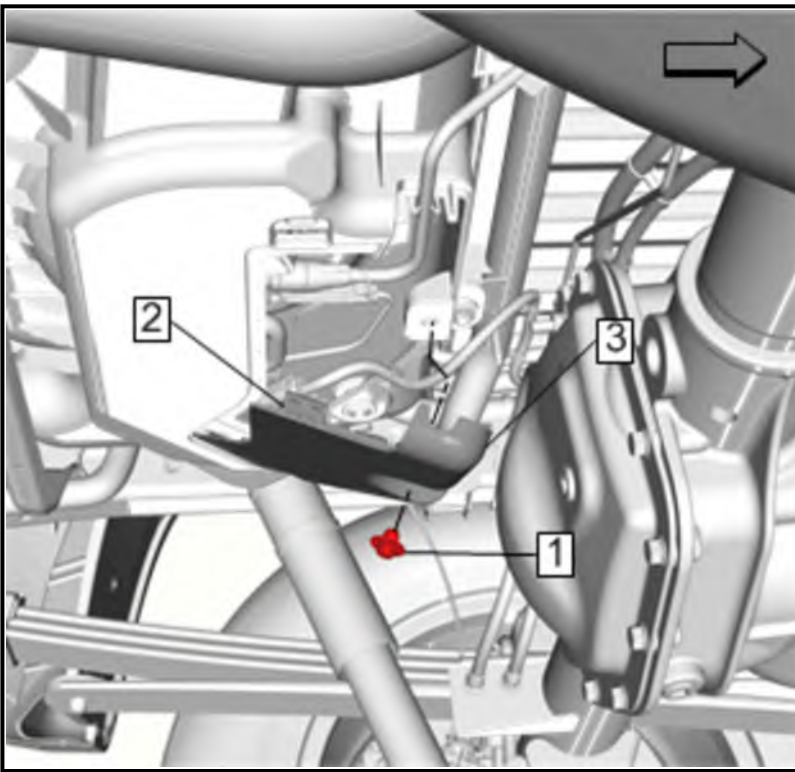
NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure <u>Emission Reduction Fluid Tank Shield Replacement</u>	
1	Emission Reduction Fluid Controller Bolt CAUTION: Refer to <u>Fastener</u> <u>Caution</u> . Tighten 5 N.m (44 lb in)
2	Emission Reduction Fluid Controller Procedure Disconnect the electrical connector.

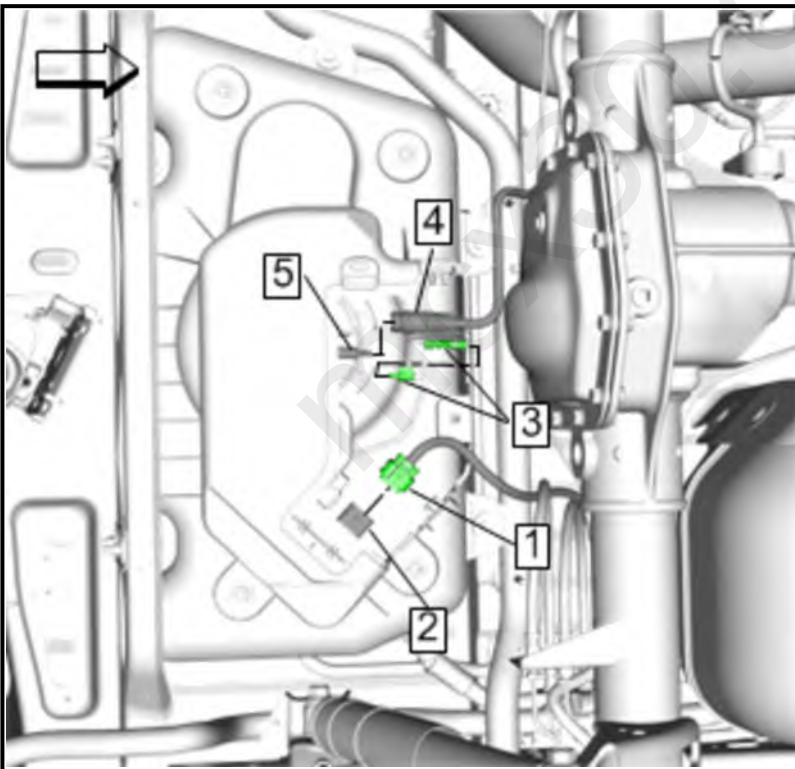
EMISSION REDUCTION FLUID TANK SHIELD REPLACEMENT

Removal Procedure

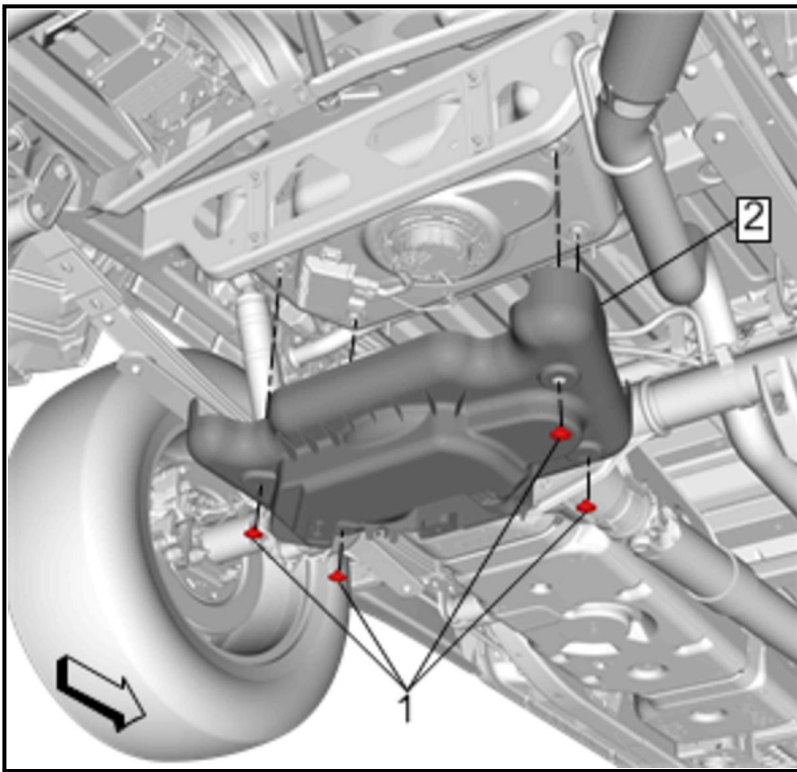
1. **Emission Reduction Fluid and Emission Reduction Fluid Handling**
2. **Emission Reduction Fluid Tank Protector Replacement** - Remove
3. Retainer (1) - Remove



4. Emission Reduction Fluid Tank Shield Tab (2) - Unclip
5. Emission Reduction Tank Shield Door (3) - Open
6. Electrical Connector (1) @ Emission Reduction Fluid Controller (2) - Disconnect



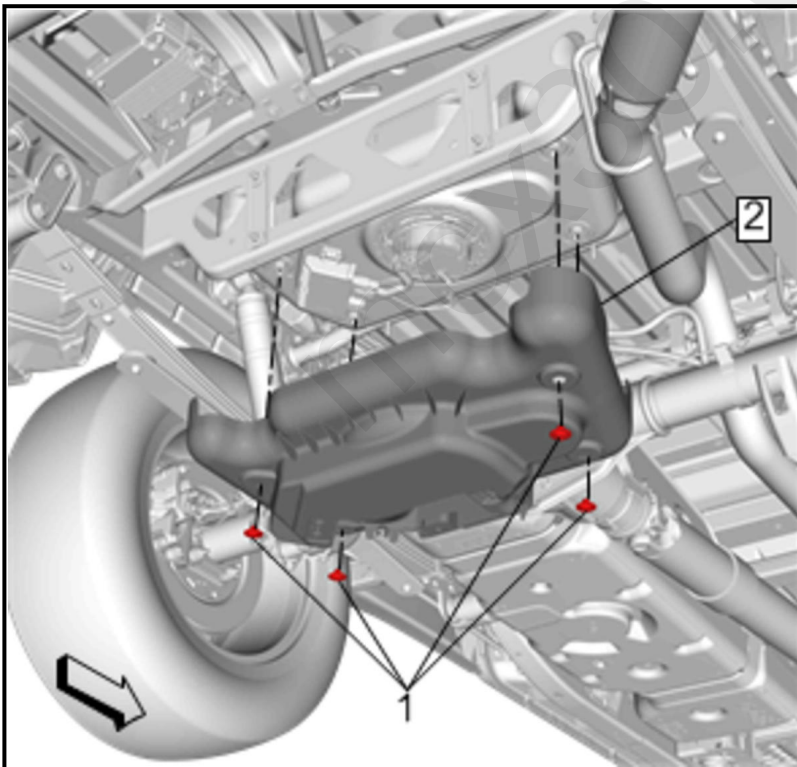
7. Electrical Connector (3) - Disconnect
8. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (4) @ Emission Reduction Fluid Supply Pump Module (5) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)
9. Retainer (1) - Remove [4x]



10. Emission Reduction Fluid Tank Shield (2) - Remove

Installation Procedure

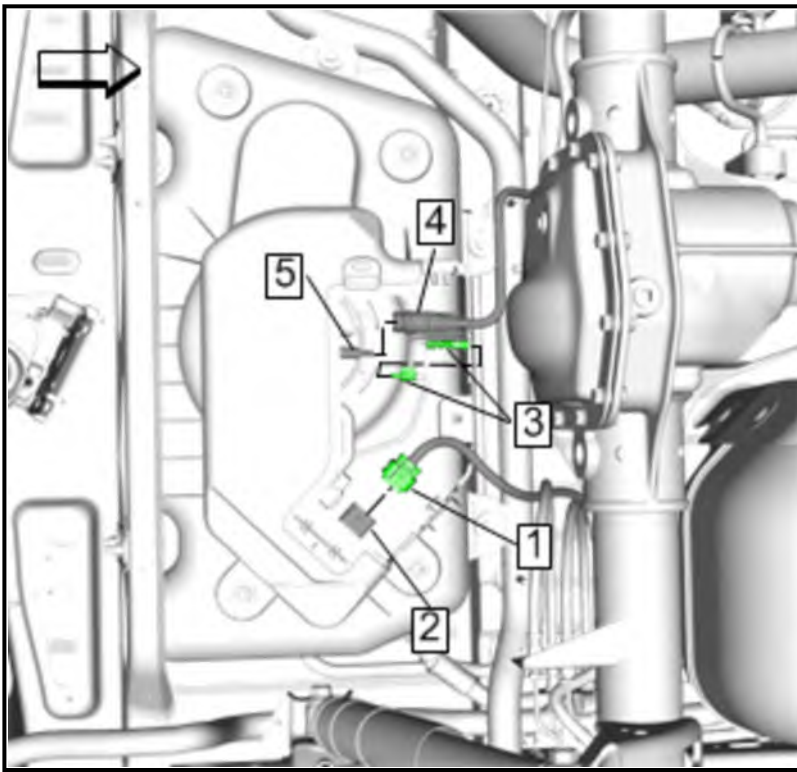
1. Emission Reduction Fluid Tank Shield (2) - Install



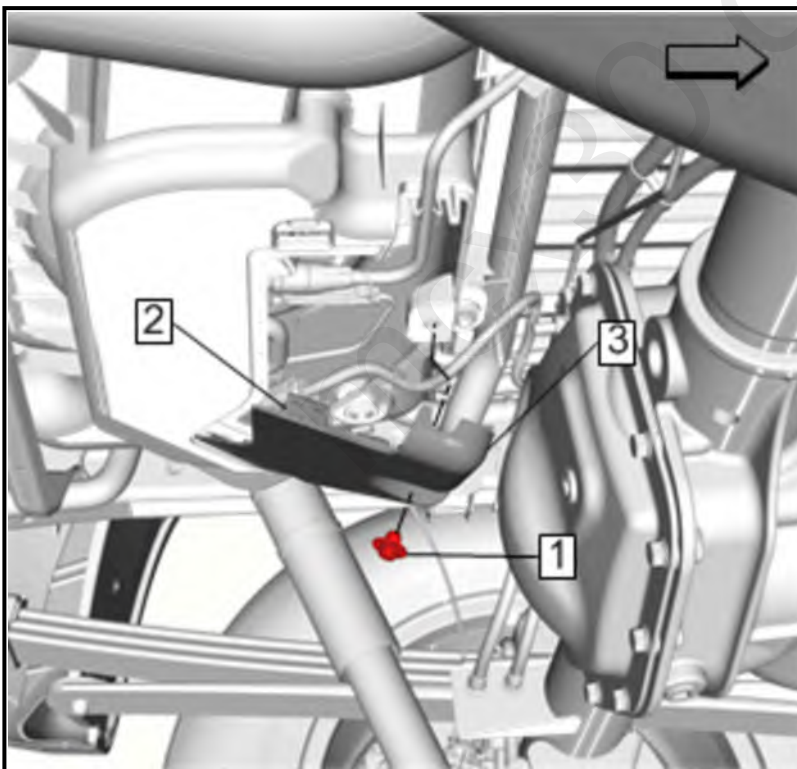
CAUTION: Refer to Fastener Caution

2. Retainer (1) - Install [4x]

3. Emission Reduction Fluid Exhaust Front Pipe Injector Supply Pipe (4) @ Emission Reduction Fluid Supply Pump Module (5) - Connect - Plastic Collar Quick Connect Fitting Service

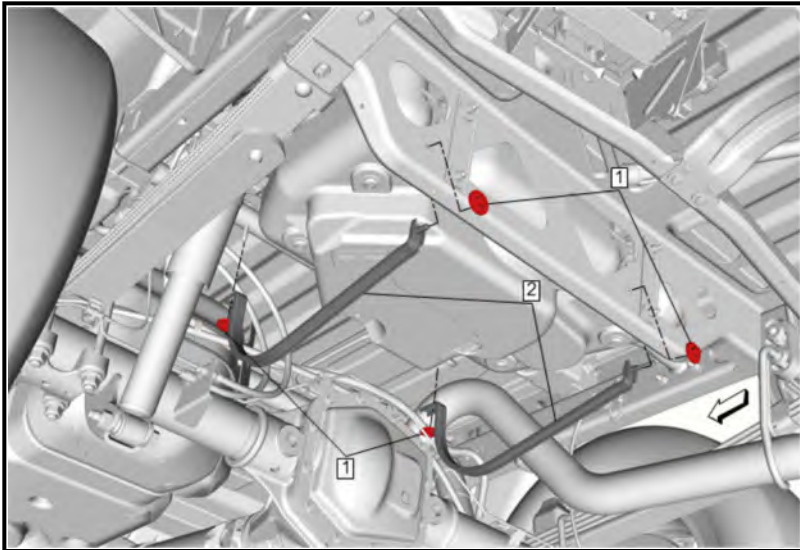


- 4. Electrical Connector (3) - Connect
- 5. Electrical Connector (1) @ Emission Reduction Fluid Controller (2) - Connect
- 6. Emission Reduction Tank Shield Door (3) Close



- 7. Emission Reduction Fluid Tank Shield Tab (2) - Clip
- 8. Retainer (1) - Install
- 9. Emission Reduction Fluid Tank Protector Replacement - Install

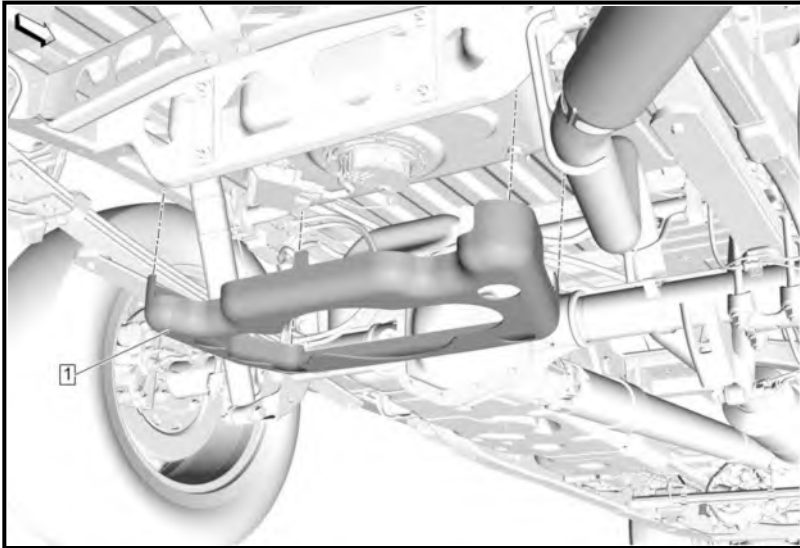
EMISSION REDUCTION FLUID TANK PROTECTOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. Spare Wheel Heat Shield Replacement	
1	Emission Reduction Fluid Tank Protector Nut [4x] CAUTION: Refer to Fastener Caution Tighten 22 N.m (16 lb ft)
2	Emission Reduction Fluid Tank Protector [2x]

EMISSION REDUCTION FLUID TANK INSULATOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure	
<u>Emission Reduction Fluid Tank Shield Replacement</u>	
1	Emission Reduction Fluid Tank Insulator

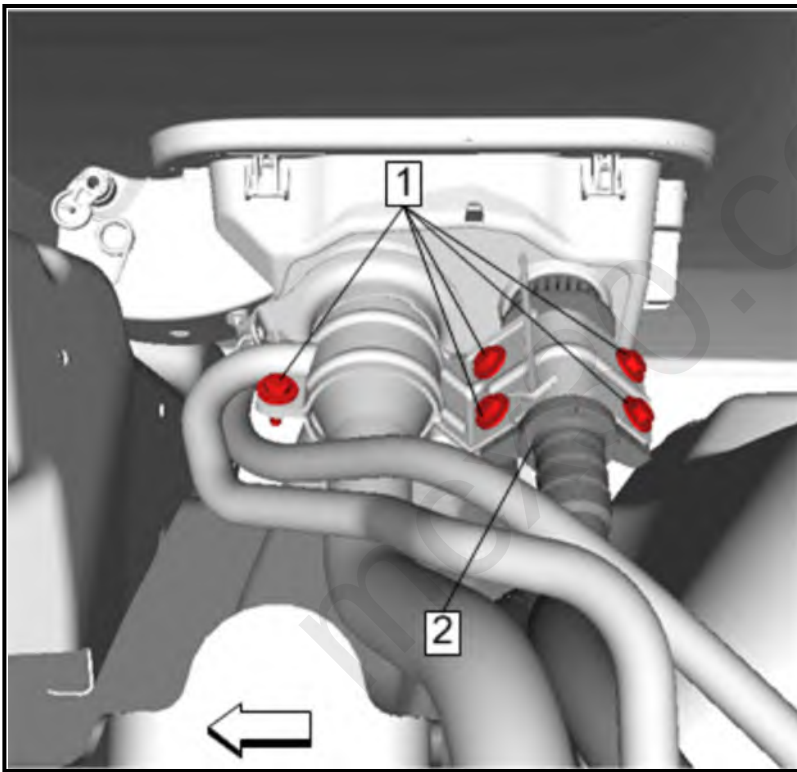
EMISSION REDUCTION FLUID TANK FILLER PIPE REPLACEMENT

Removal Procedure

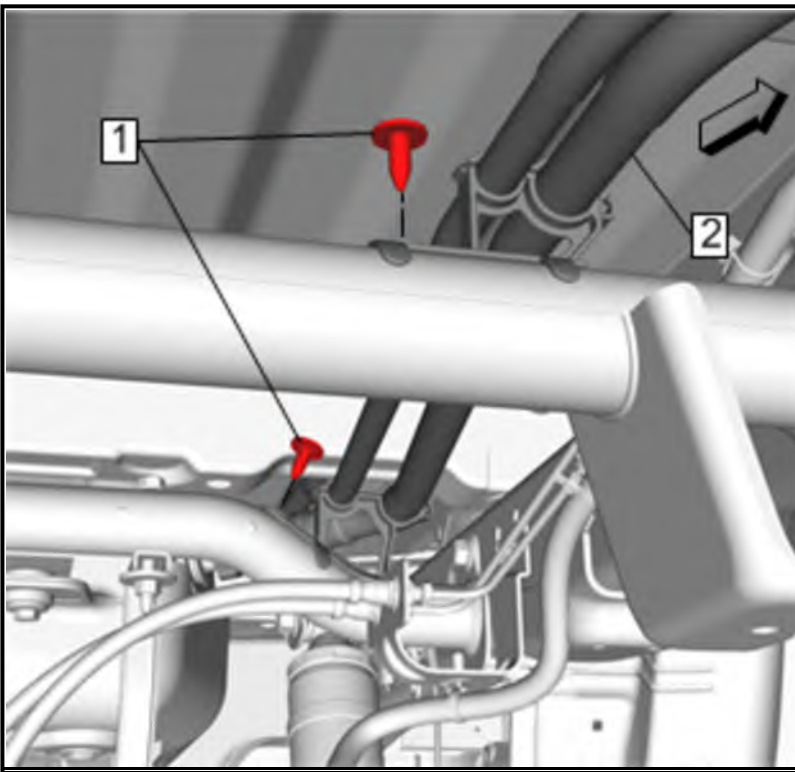
WARNING: Refer to **Diesel/Gasoline Vapors Warning** .

WARNING: Refer to **Safety Glasses Warning** .

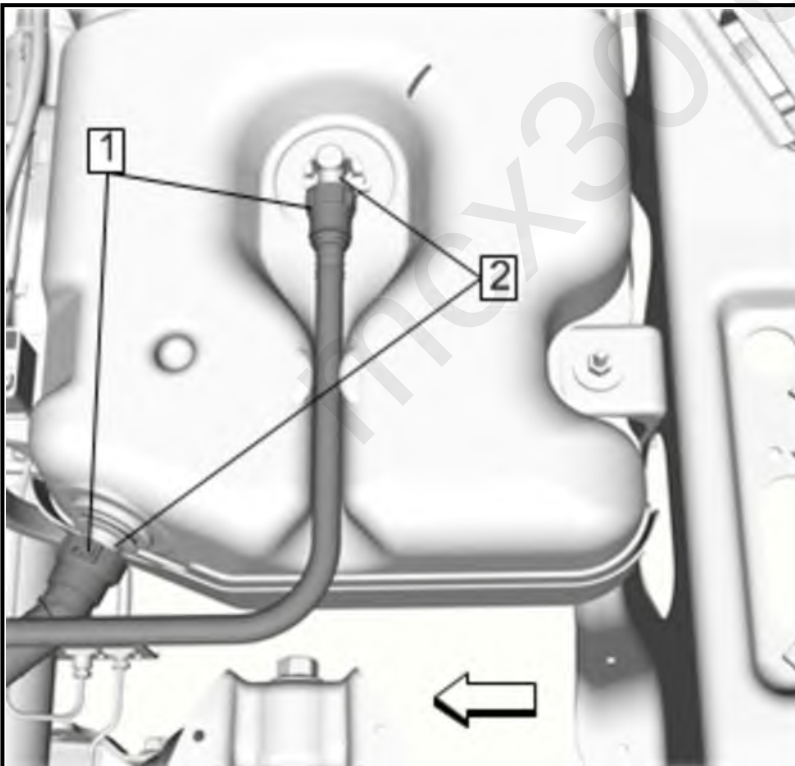
1. **Fuel Tank Filler Pipe Housing Replacement** - Remove
2. **Rear Wheelhouse Liner Replacement (Except Bison)** , or **Rear Wheelhouse Liner Replacement (Bison)** - Remove
3. Emission Reduction Fluid Tank Filler Pipe Bolt (1) @ Emission Reduction Fluid Tank Filler Pipe (2) - Remove [5x]



4. Emission Reduction Fluid Tank Filler Pipe Retainer (1) @ Emission Reduction Fluid Tank Filler Pipe (2) - Remove [2x]

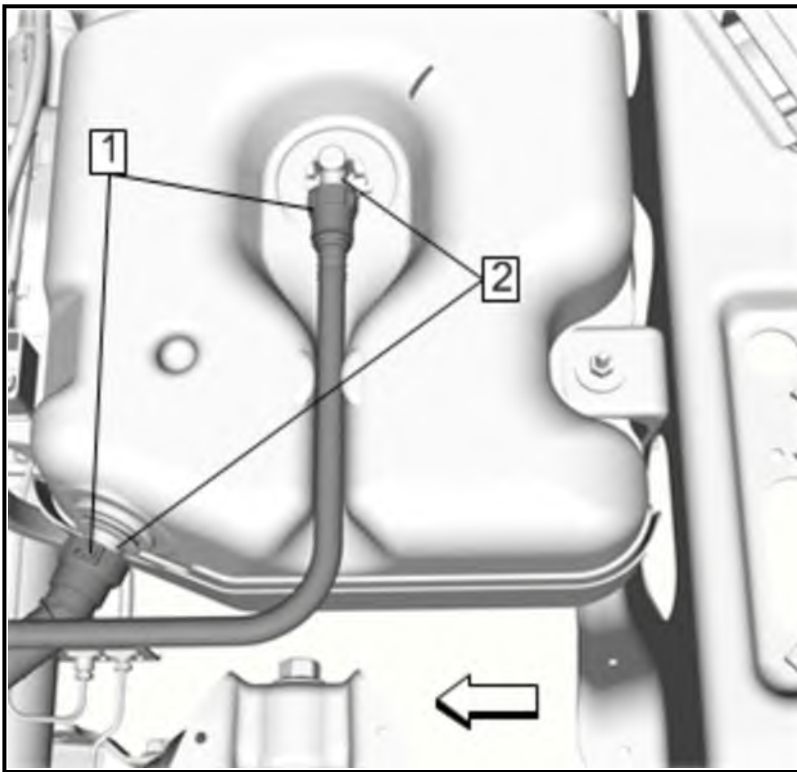


5. Lower the emission reduction fluid tank enough to gain access. [Emission Reduction Fluid Tank Replacement](#)
6. Emission Reduction Fluid Tank Filler Pipe (1) @ Emission Reduction Fluid Tank (2) - Disconnect - [Plastic Collar Quick Connect Fitting Service](#)



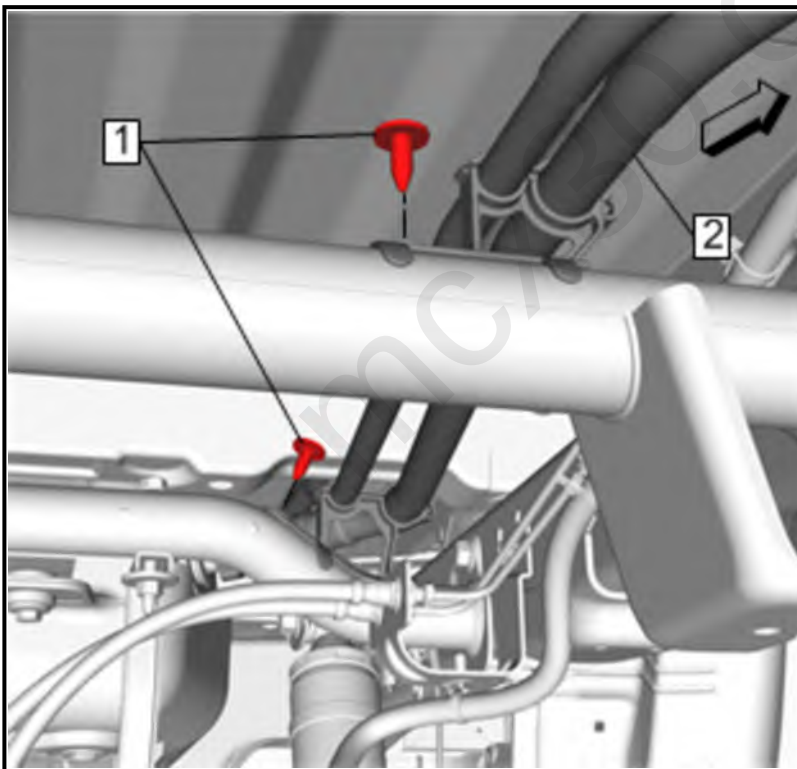
Installation Procedure

1. Emission Reduction Fluid Tank Filler Pipe (1) @ Emission Reduction Fluid Tank (2) - Connect - [Plastic Collar Quick Connect Fitting Service](#)

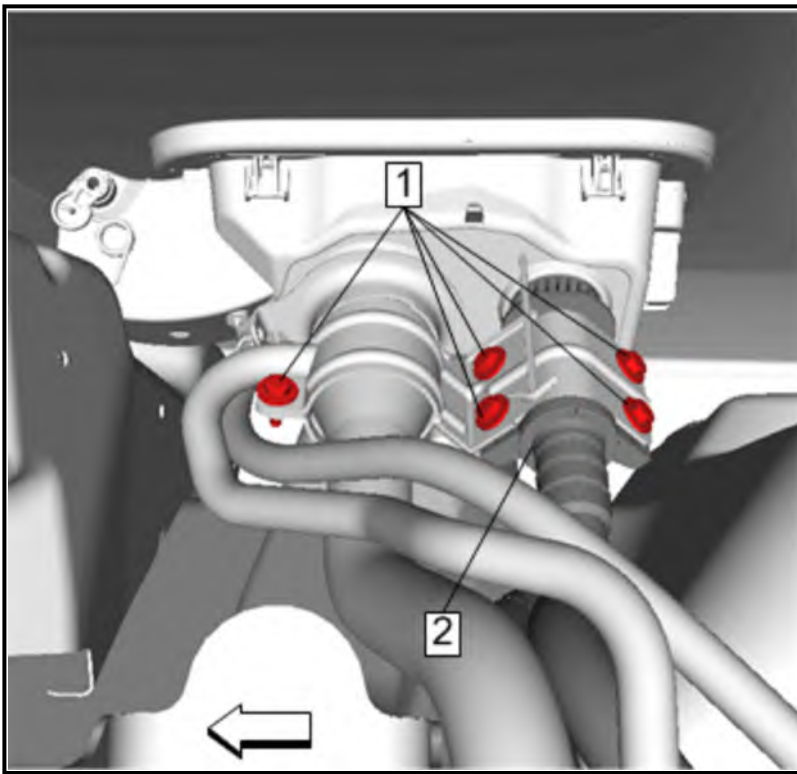


2. **Emission Reduction Fluid Tank Replacement** - Install

3. Emission Reduction Fluid Tank Filler Pipe Retainer (1) @ Emission Reduction Fluid Tank Filler Pipe (2)
- Install [2x]



4. Emission Reduction Fluid Tank Filler Pipe Bolt (1) @ Emission Reduction Fluid Tank Filler Pipe (2) -
Install 9 N.m (80 lb in) [5x]



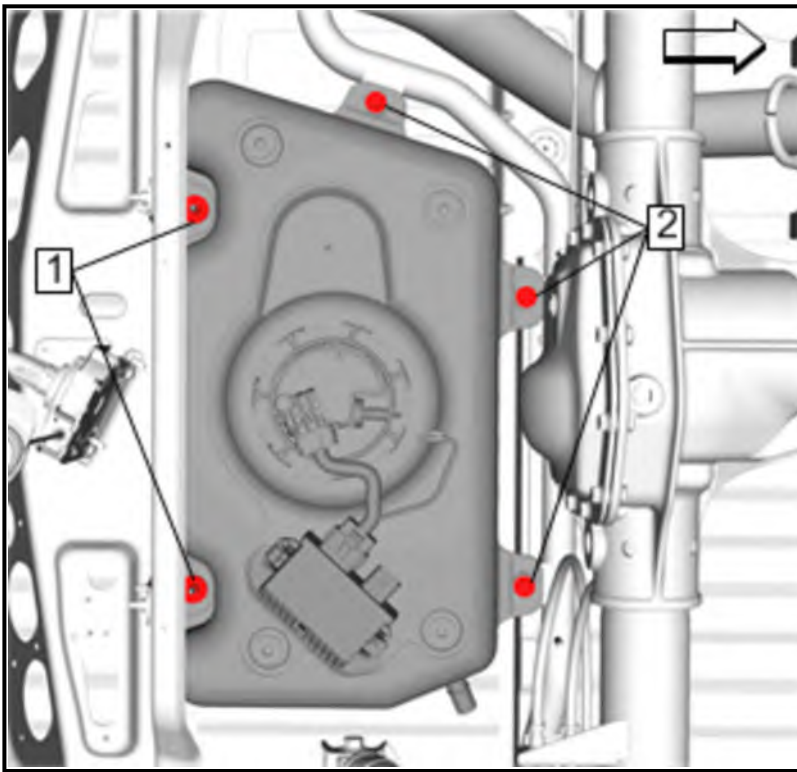
CAUTION: Refer to Fastener Caution .

5. Rear Wheelhouse Liner Replacement (Except Bison) , or Rear Wheelhouse Liner Replacement (Bison) - Install
6. Fuel Tank Filler Pipe Housing Replacement - Install

EMISSION REDUCTION FLUID TANK REPLACEMENT

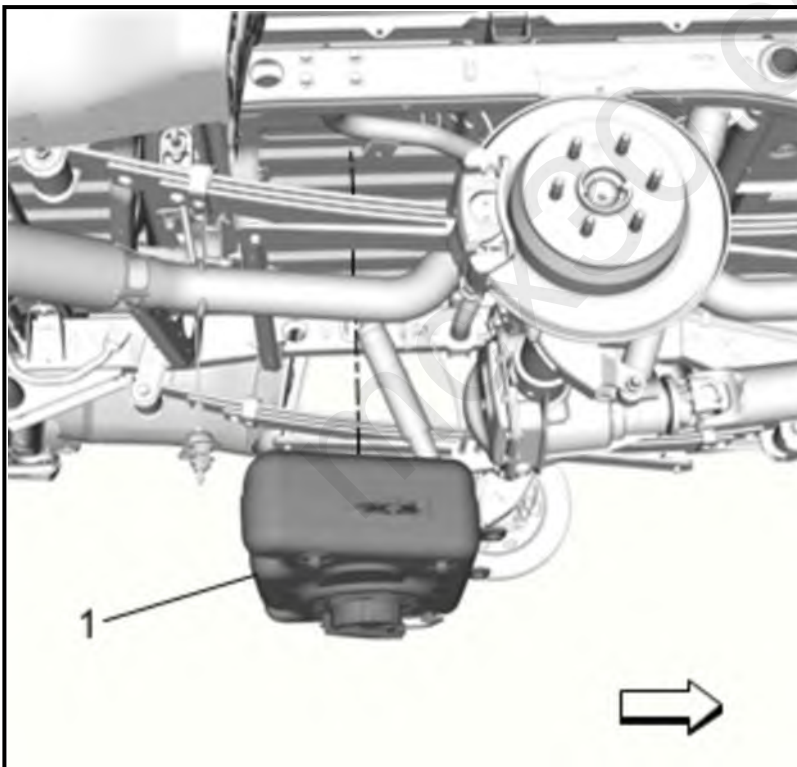
Removal Procedure

1. Before performing the first steps, review the Emission Reduction Fluid and Emission Reduction Fluid Handling.
2. Drain the emission reduction fluid tank. Emission Reduction Fluid Tank Draining
3. Emission Reduction Fluid Tank Shield Replacement - Remove
4. Emission Reduction Fluid Tank Nut (1) - Remove [2x]



5. Emission Reduction Fluid Tank Bolt (2) - Remove [3x]

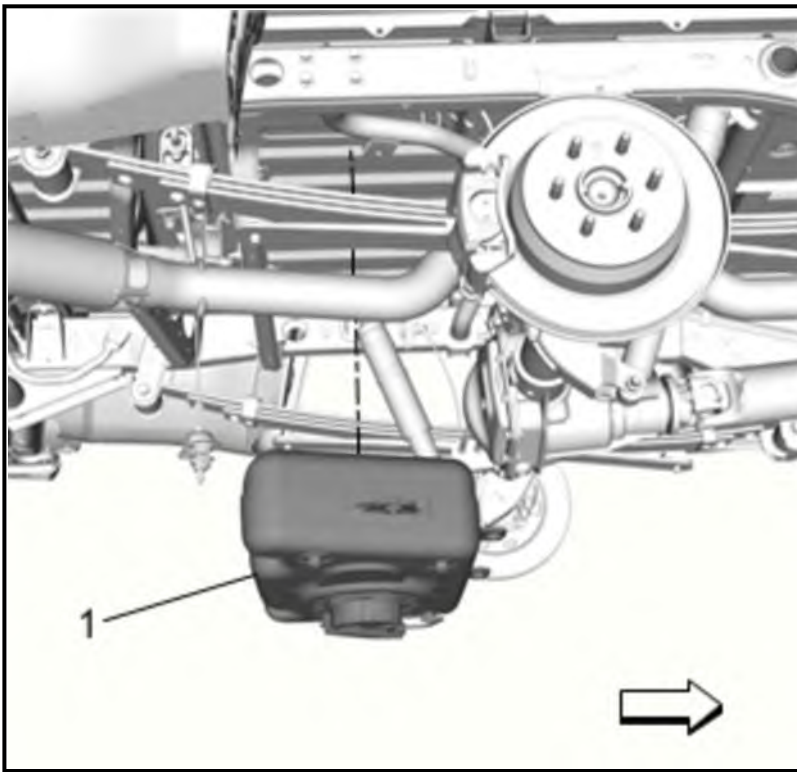
6. Emission Reduction Fluid Tank (1) - Remove



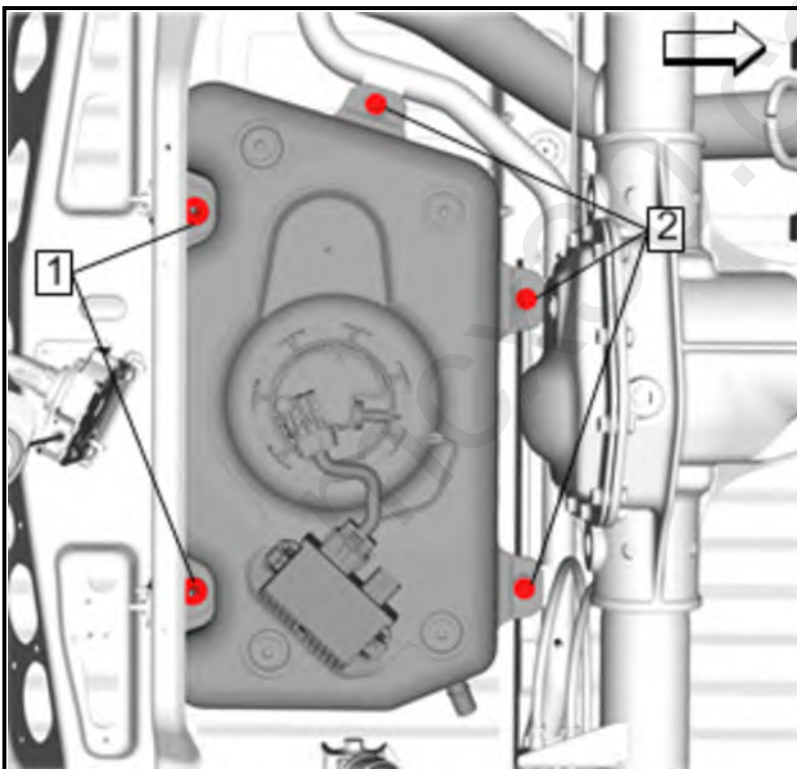
7. Transfer components as necessary.

Installation Procedure

1. Emission Reduction Fluid Tank (1) - Install



2. Emission Reduction Fluid Tank Bolt (2) - Install and tighten [3x] 22 N.m (16 lb ft)



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

3. Emission Reduction Fluid Tank Nut (1) - Install and tighten [2x] 28 N.m (21 lb ft)

4. [Emission Reduction Fluid Tank Shield Replacement](#) - Install

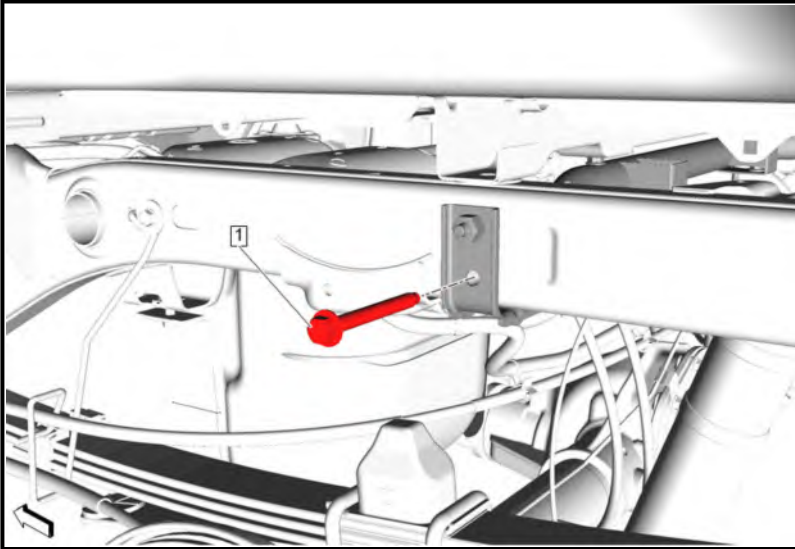
5. Fill the emission reduction fluid tank.

EMISSION REDUCTION FLUID TANK SUPPORT BRACKET REPLACEMENT

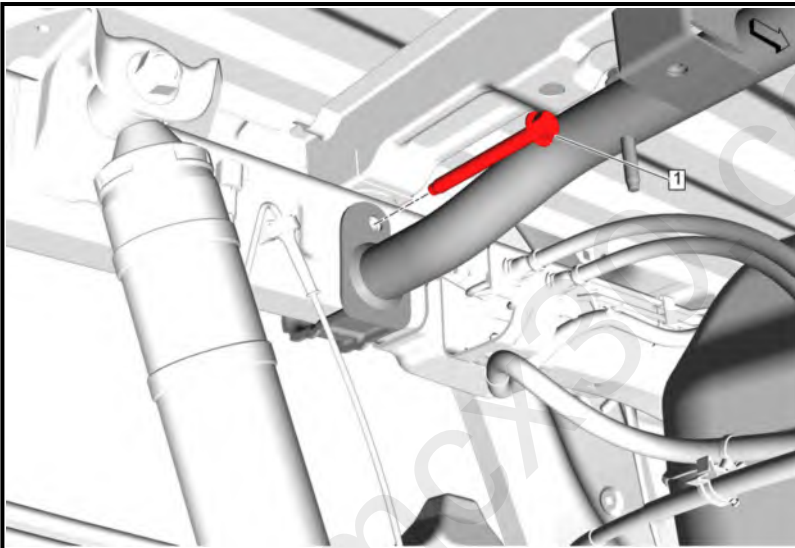
Removal Procedure

1. Emission Reduction Fluid Tank - Remove - [Emission Reduction Fluid Tank Replacement](#)

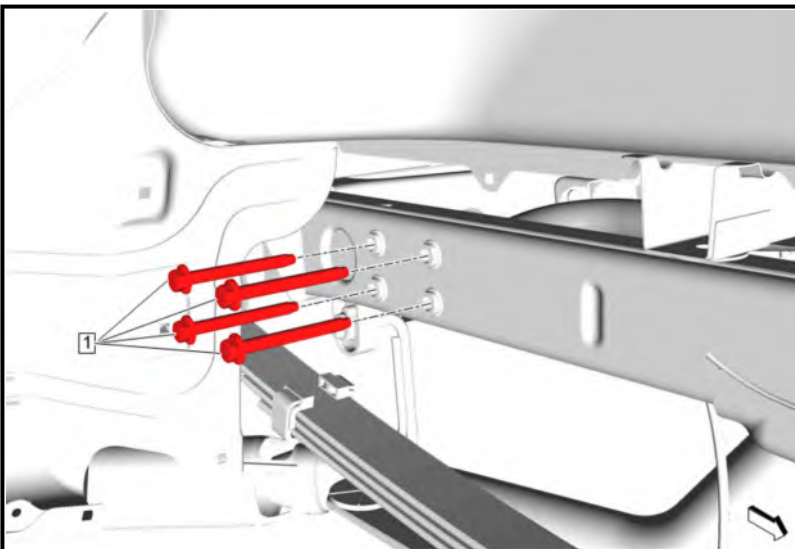
2. Remove all retainers from emission reduction fluid tank support bracket.
3. Emission Reduction Fluid Tank Support Bracket Bolt (1) - Remove



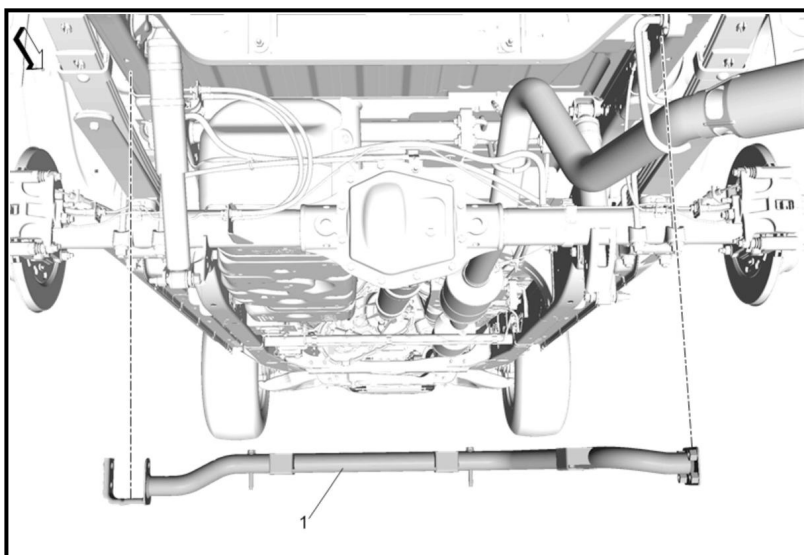
4. Emission Reduction Fluid Tank Support Bracket Bolt (1) - Remove



5. Emission Reduction Fluid Tank Support Bracket Bolt (1) - Remove [4x]

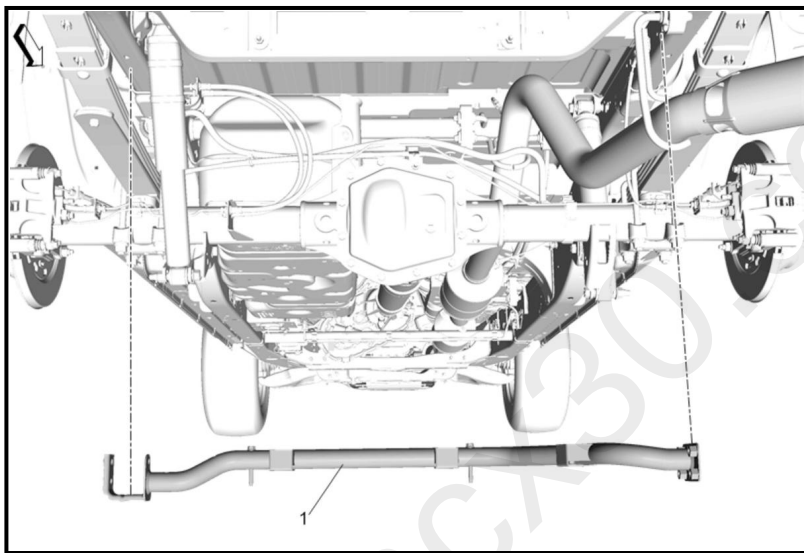


6. Emission Reduction Fluid Tank Support Bracket (1) - Remove

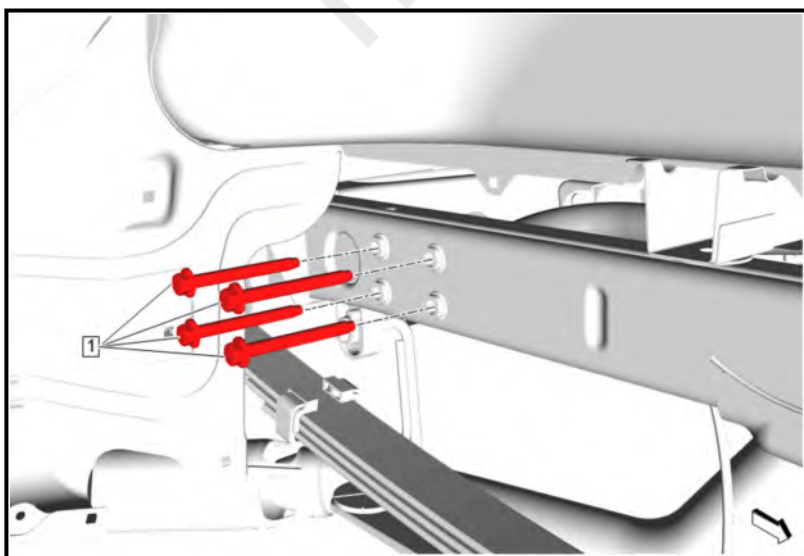


Installation Procedure

1. Emission Reduction Fluid Tank Support Bracket (1) - Install

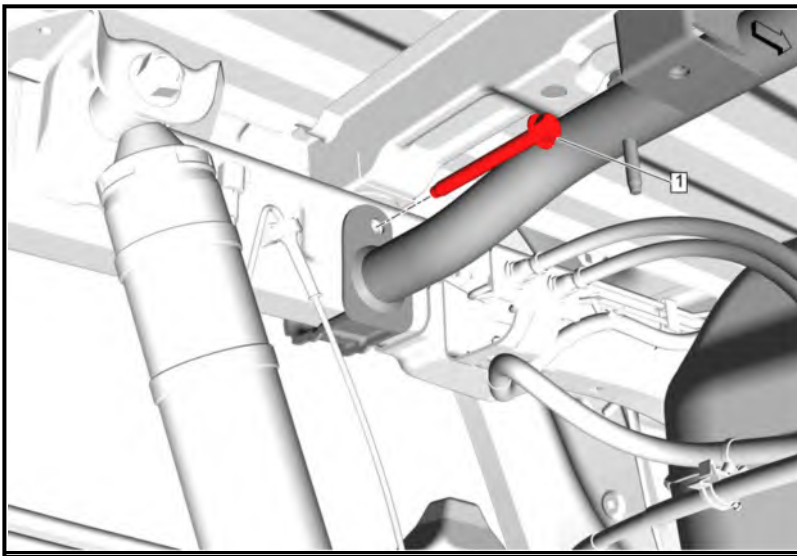


2. Emission Reduction Fluid Tank Support Bracket Bolt (1) - Install and tighten [4x] 58 N.m (43 lb ft)

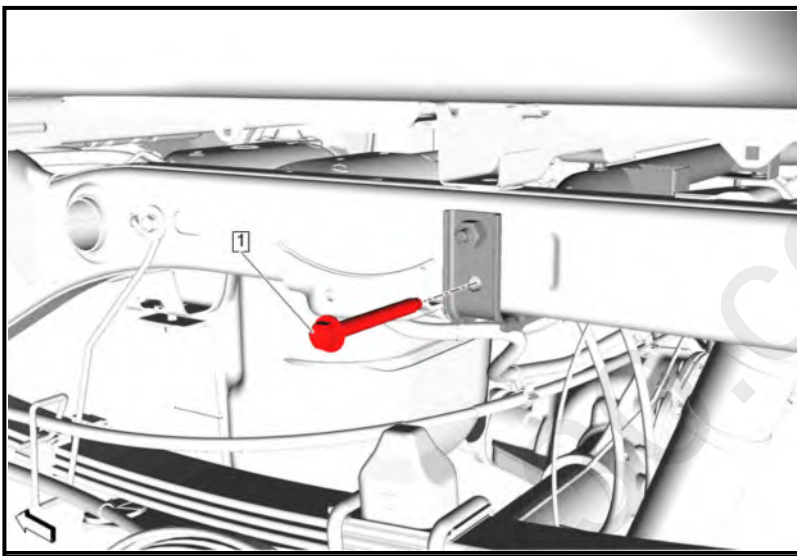


CAUTION: Refer to [Fastener Caution](#) .

3. Emission Reduction Fluid Tank Support Bracket Bolt (1) - Install and tighten 58 N.m (43 lb ft)



4. Emission Reduction Fluid Tank Support Bracket Bolt (1) - Install and tighten 58 N.m (43 lb ft)



5. Install all retainers to the emission reduction fluid tank support bracket.
 6. Emission Reduction Fluid Tank - Install - [Emission Reduction Fluid Tank Replacement](#)

EMISSION REDUCTION FLUID TANK DRAINING

Removal Procedure

1. [Emission Reduction Fluid and Emission Reduction Fluid Handling](#)
2. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
3. Using only a low-pressure clean water hose, spray the upper surface of the emission reduction fluid tank, emission reduction filler pipe and connections to remove dirt and debris.
4. Using only a low pressure air wand or air gun, dry the emission reduction tank, emission reduction filler pipe and connections.
5. Using a clean shop towel, dry emission reduction filler pipe and connections.
6. Place an appropriate sized fluid catch pan. Fluid will drain until level with the inlet neck on the tank.
7. [Emission Reduction Fluid Tank Filler Pipe Replacement](#) @ Emission Reduction Fluid Tank - Disconnect

CAUTION:

The diesel exhaust fluid (DEF) must be drained by a clean dedicated siphoning pump and hose. It must NOT have any traces of gasoline, diesel fuel, or any oil based substances. If extreme care is NOT taken to prevent

contamination from fluids other than DEF, reduced performance and/or damage to the DEF system may result.

8. Insert the hose from the pump device into the emission reduction fluid tank.
9. Using a hand or air operated pump, drain as much emission reduction fluid from the tank as possible into an approved container and dispose of properly.

Installation Procedure

1. **Emission Reduction Fluid Tank Filler Pipe Replacement** @ Emission Reduction Fluid Tank - Connect

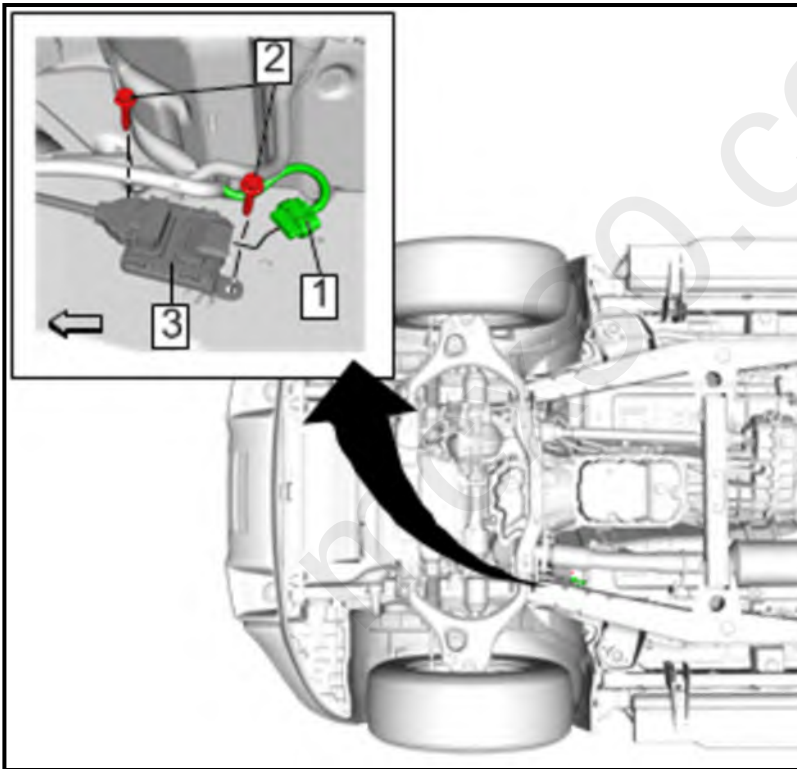
NOTE: **The drained emission reduction fluid should not be re-used.**

2. Refill the emission reduction fluid tank with NEW emission reduction fluid.

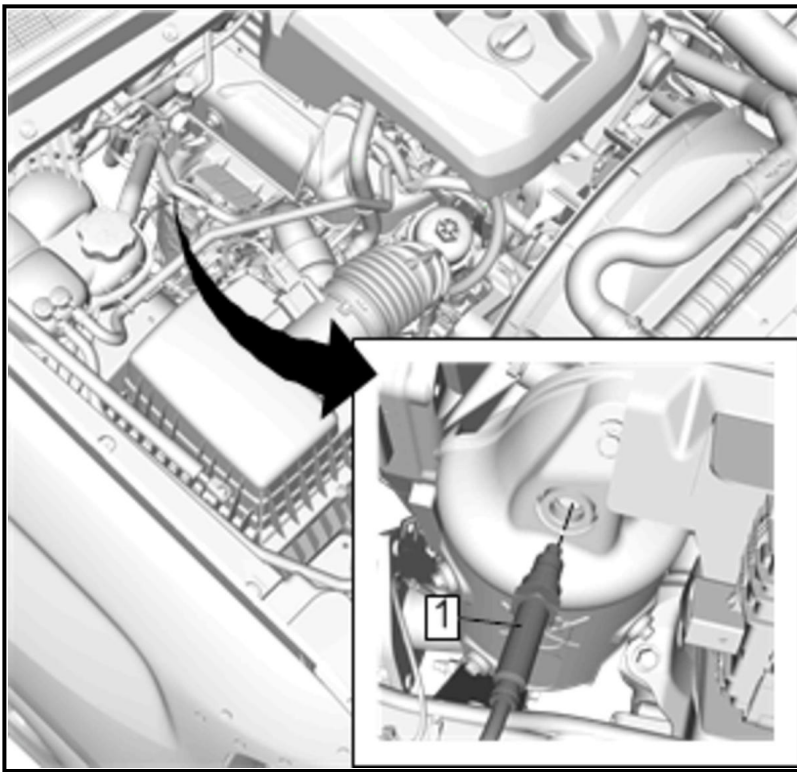
NITROGEN OXIDES SENSOR REPLACEMENT - POSITION 1

Removal Procedure

1. Raise and support the vehicle. **Lifting and Jacking the Vehicle**
2. Electrical Connector (1) @ Nitrogen Oxides Sensor (3) - Disconnect

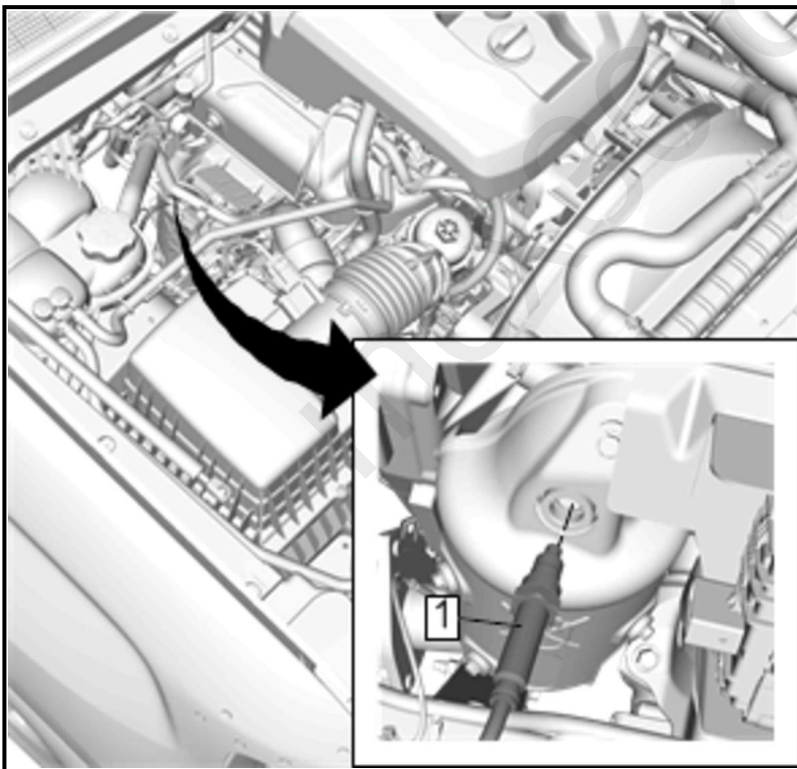


3. Nitrogen Oxides Sensor Fastener (2) - Remove [2x]
4. Nitrogen Oxides Sensor (1) - Remove



Installation Procedure

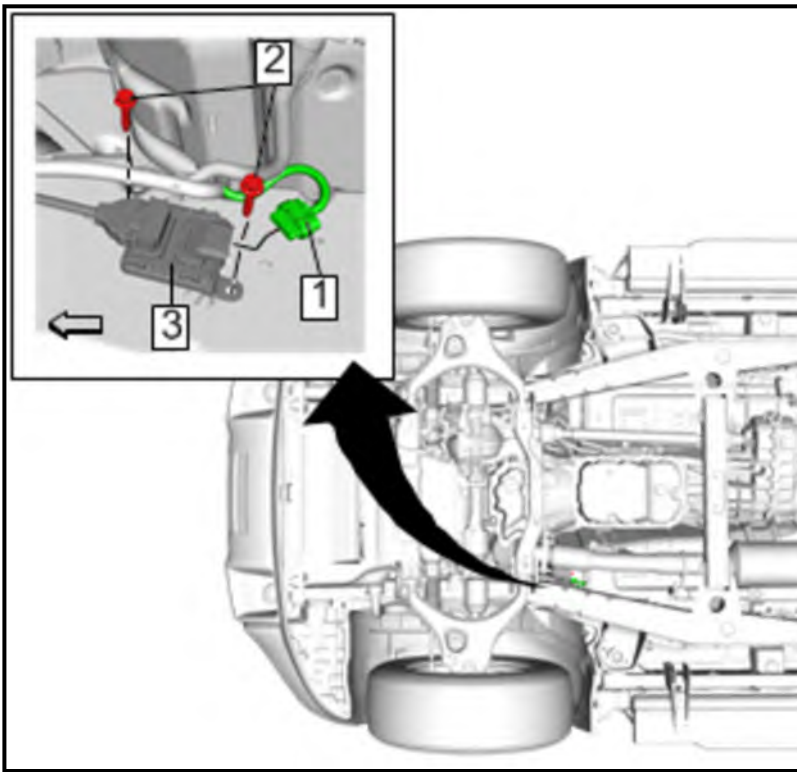
1. Nitrogen Oxides Sensor (1) - Install and tighten 50 N.m (37 lb ft)



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

NOTE: If reinstalling the old sensor, coat the threads with anti-sieze compound.
[Adhesives, Fluids, Lubricants, and Sealers](#)

2. Nitrogen Oxides Sensor (3) - Move into position



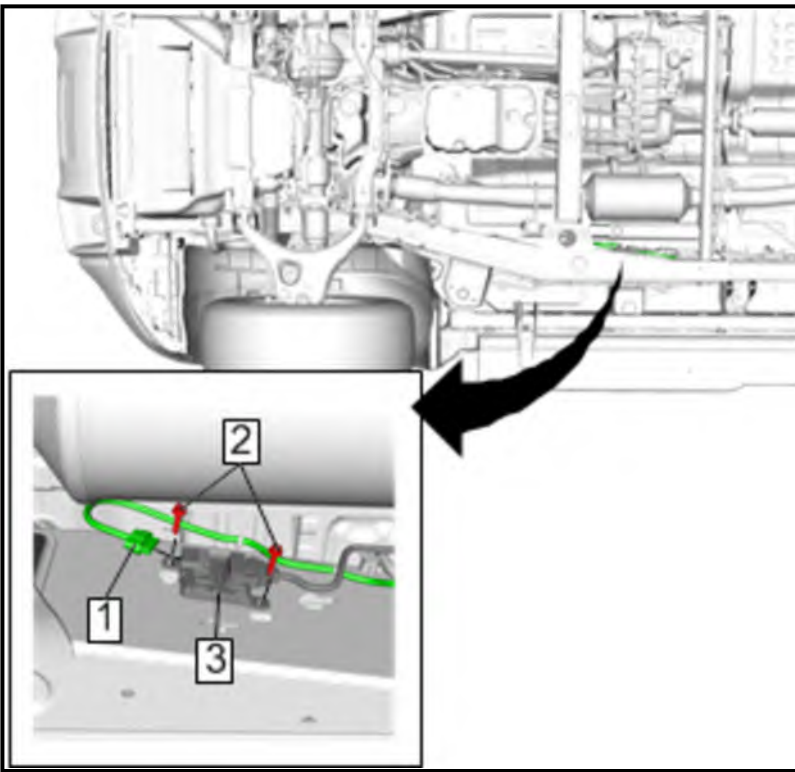
CAUTION: Refer to [Fastener Caution](#) .

3. Nitrogen Oxides Sensor Fastener (2) - Install and tighten [2x] 9 N.m (80 lb in)
4. Electrical Connector (1) @ Nitrogen Oxides Sensor (3) - Connect
5. Lower the vehicle.
6. If replacing, perform the NOx sensor 1 reset. [NOx Sensor 1 Reset](#)
7. If replacing, perform the NOx catalyst reductant loading reset. [NOx Catalyst Reductant Loading Reset](#)

NITROGEN OXIDES SENSOR REPLACEMENT - POSITION 2

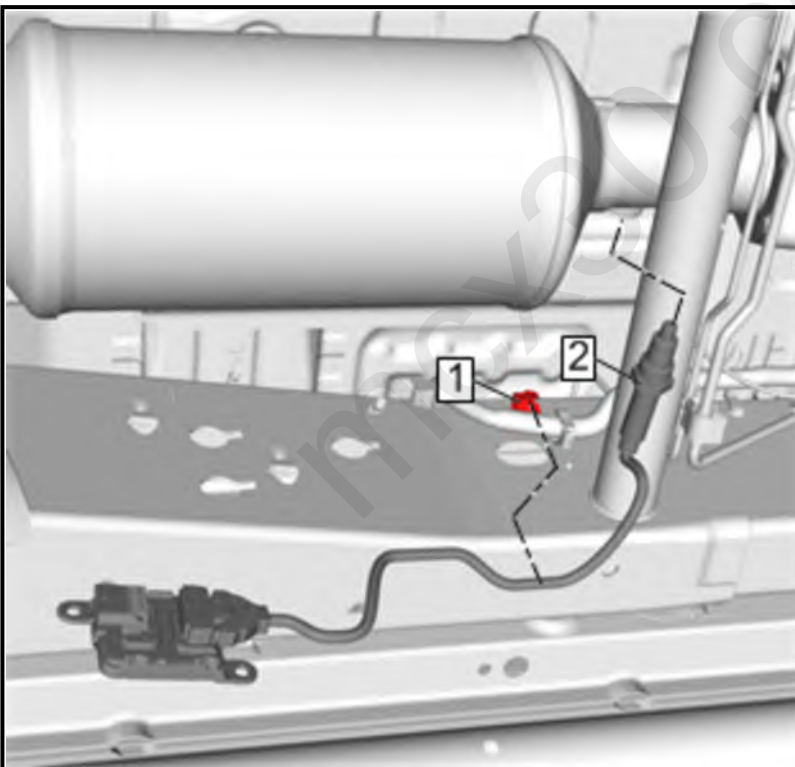
Removal Procedure

1. Raise and support the vehicle. [Lifting and Jacking the Vehicle](#)
2. Electrical Connector (1) @ Nitrogen Oxides Sensor (3) - Disconnect



3. Nitrogen Oxides Sensor Fastener (2) - Remove [2x]

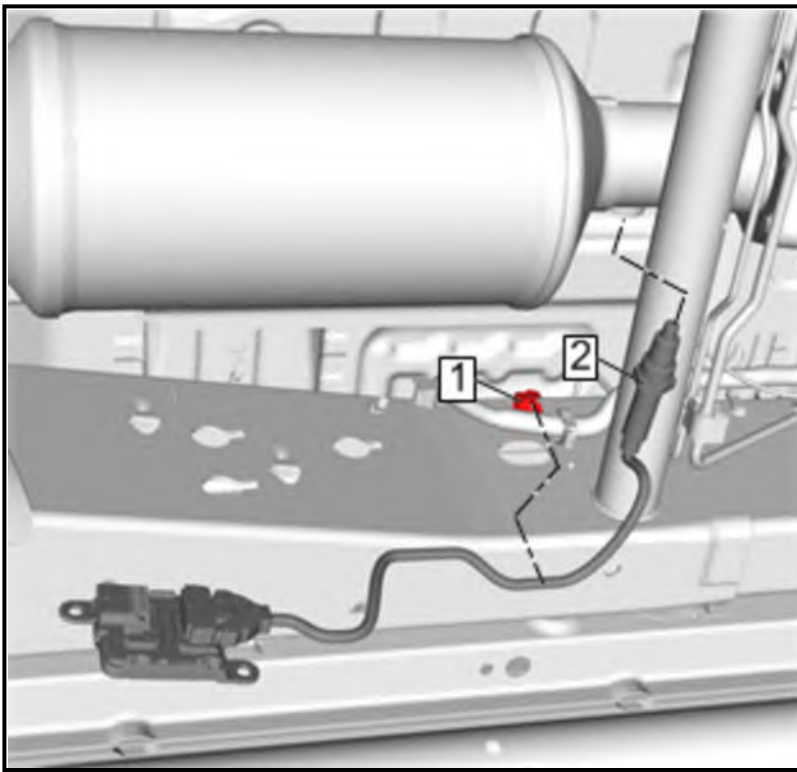
4. Nitrogen Oxides Sensor Cable @ Nitrogen Oxides Sensor Cable Clip (1) - Unclip



5. Nitrogen Oxides Sensor (2) - Remove

Installation Procedure

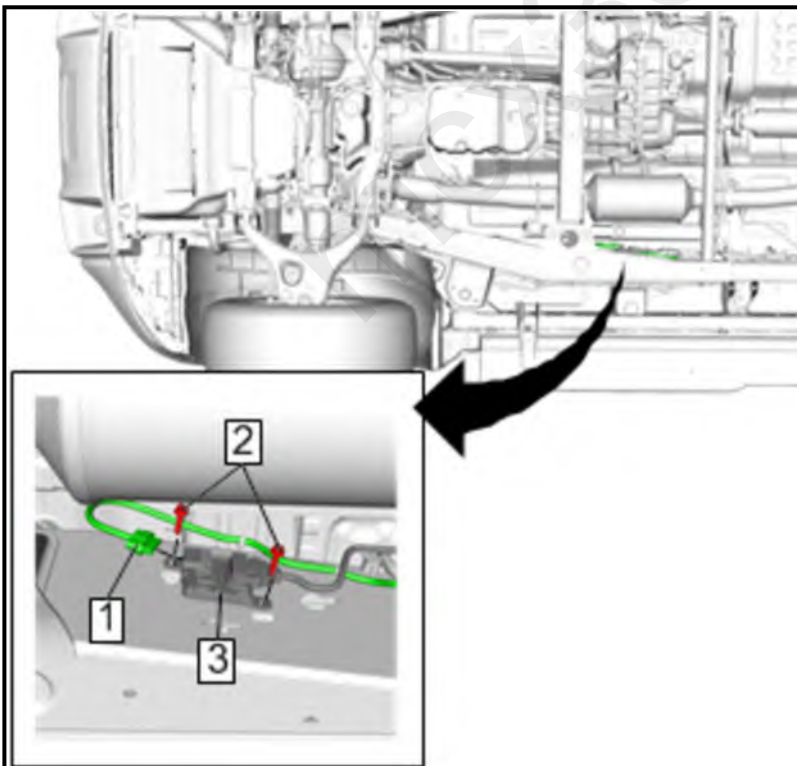
1. Nitrogen Oxides Sensor (2) - Install and tighten 50 N.m (37 lb ft)



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

NOTE: If reinstalling the old sensor, coat the threads with anti-sieze compound.
[Adhesives, Fluids, Lubricants, and Sealers](#)

2. Nitrogen Oxides Sensor Cable @ Nitrogen Oxides Sensor Cable Clip (1) - Install
3. Nitrogen Oxides Sensor (3) - Move into position

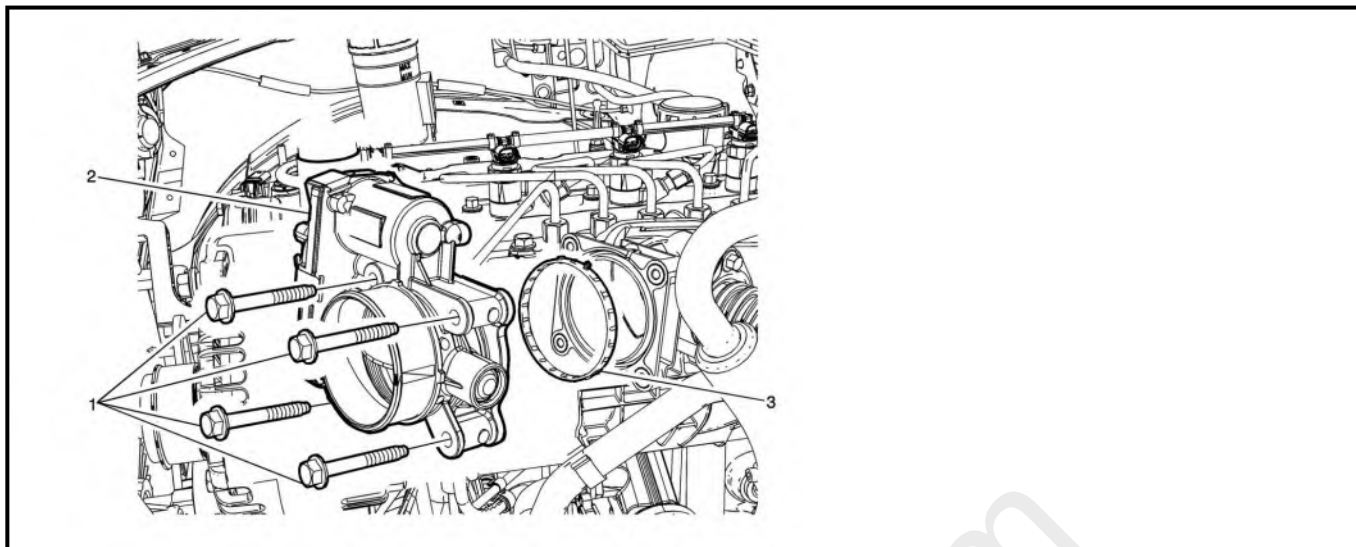


CAUTION: Refer to [Fastener Caution](#) .

4. Nitrogen Oxides Sensor Fastener (2) - Install and tighten [2x] 9 N.m (80 lb in)
5. Electrical Connector (1) @ Nitrogen Oxides Sensor (3) - Connect

6. Lower the vehicle.
7. If replacing, perform the NOx sensor 2 reset. [NOx Sensor 2 Reset](#)
8. If replacing, perform the NOx catalyst reductant loading reset. [NOx Catalyst Reductant Loading Reset](#)

THROTTLE BODY ASSEMBLY REPLACEMENT

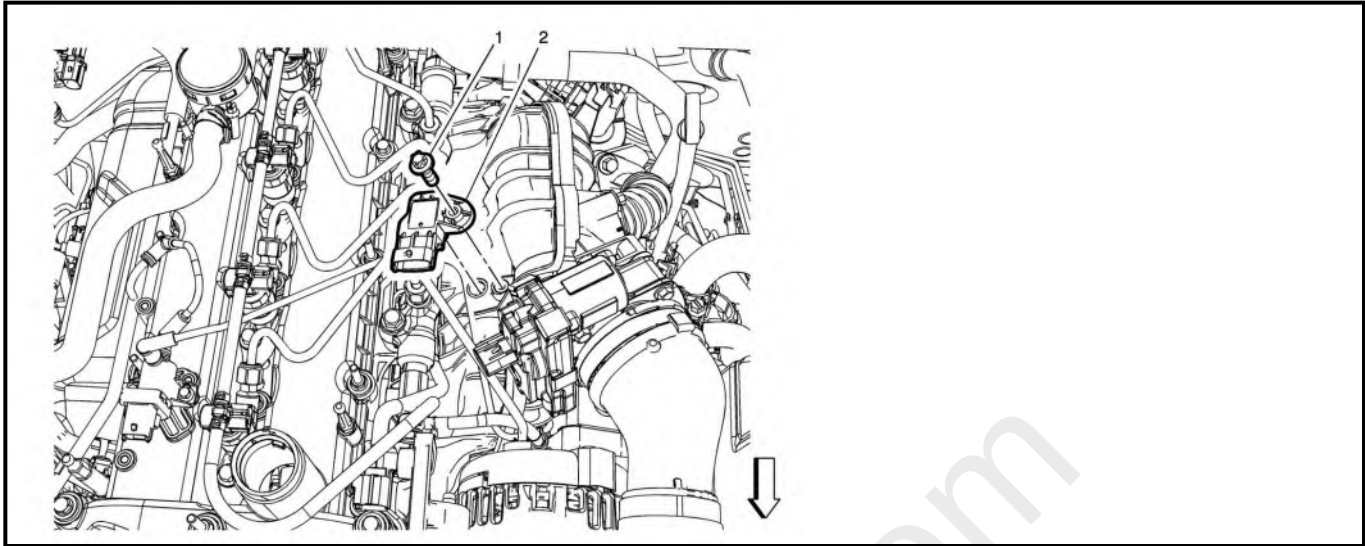


NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Remove the intake manifold cover. Intake Manifold Cover Replacement 2. Disconnect the charge air cooler outlet duct from the throttle body. Charge Air Cooler Outlet Duct Replacement	
1	Throttle Body Assembly Fastener [4x] CAUTION: Refer to Fastener Caution . Tighten 11 N.m (97 lb in)
2	Throttle Body Assembly Procedure 1. Disconnect the throttle body electrical connector. 2. Using a scan tool, perform the idle air control reset function.
3	Throttle Body Gasket NOTE: The throttle body gasket is one time use. A NEW

Callout	Component Name
	gasket must installed whenever it is removed.

THROTTLE INLET ABSOLUTE PRESSURE SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedure Remove the intake manifold cover insulator - left side. Intake Manifold Cover Insulator Replacement (Top of Engine) , or Intake Manifold Cover Insulator Replacement (Left Side) .	
1	Throttle Inlet Absolute Pressure Sensor Fastener CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)
2	Throttle Inlet Absolute Pressure Sensor Procedure Disconnect the electrical connector. NOTE: Always install the NEW seal that is supplied with the sensor. If reinstalling the sensor, inspect and replace the

Callout	Component Name
	sensor seal as needed.

THROTTLE BODY INSPECTION AND CLEANING

1. Charge Air Cooler Outlet Air Hose - Remove [Charge Air Cooler Outlet Duct Replacement](#)
2. Disconnect the electrical connector.
3. Fully open the throttle valve to inspect the throttle body bore and the throttle valve plate for any deposits.

CAUTION: Do not subject a throttle body assembly which contains the following components to an immersion cleaner or a strong solvent:

- Throttle position (TP) sensor
- Throttle actuator control components
- Sealed throttle shaft bearings

The cleaners will damage the electric components or sensors.

The cleaners will damage some of these components that contain seals or O-rings.

Solvents can wash away or break down the grease used on non-serviceable throttle shaft bearings.

Never use a wire brush or scraper to clean the throttle body. A wire brush or sharp tools may damage the throttle body components.

Do not use a cleaner that contains methyl ethyl ketone. This extremely strong solvent may damage components and is not necessary for this type of cleaning.

4. Use a clean shop towel and Top Engine Cleaner or equivalent product to clean the throttle body bore and the throttle valve plate. [Adhesives, Fluids, Lubricants, and Sealers](#)

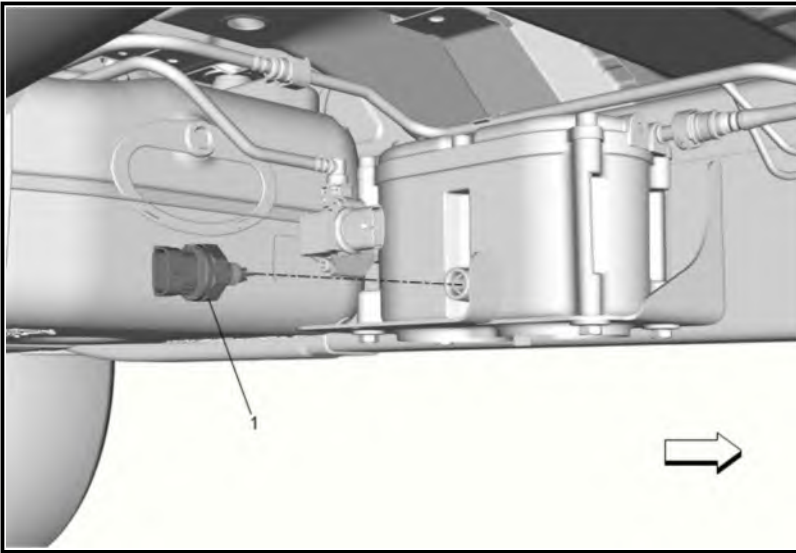
If necessary, use a Non- Abrasive parts cleaning brush to remove heavy deposits.

5. Connect the electrical connector.
6. Charge Air Cooler Outlet Air Hose - Install [Charge Air Cooler Outlet Duct Replacement](#)
7. Perform the diagnostic repair verification. [Diagnostic Repair Verification](#)

Perform the Throttle/Idle Learn procedure:

1. Verify T amb > 0B°C
2. Ignition On, T engine running > 50B°C in idle
3. Ignition Off, wait 1 minute before ignition On
4. Verify that no DTC set

WATER IN FUEL INDICATOR SENSOR REPLACEMENT



NOTE: Callouts in the following chart represent components shown in graphic above.

Callout	Component Name
Preliminary Procedures 1. Raise and support the vehicle. Lifting and Jacking the Vehicle 2. Drain the fuel filter water separator. Water-in-Fuel Draining 3. Replace the fuel filter. Fuel Filter Replacement	
1	Water In Fuel Indicator Sensor CAUTION: Refer to Component Fastener Tightening Caution . Procedure Disconnect the electrical connector.

WATER-IN-FUEL DRAINING

1. Turn OFF the engine, for 30 seconds before proceeding. This will purge the fuel pressure from the complete fuel system.
2. Turn the water - in - fuel drain screw counterclockwise.
3. Drain off water completely.
4. When finished, turn the drain screw clockwise until tightened.
5. Prime the fuel system. Refer to [Fuel System Priming](#).