

2011 ENGINE

Engine Exhaust - CTS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	English
Catalytic Converter Nut (LSA,LLT)	50 N.m	37 lb ft
Catalytic Converter Nut (LF1)-First Pass	20 N.m	15 lb ft
Catalytic Converter (LF1)-Final Pass	46 N.m	34 lb ft
Exhaust Cylinder Head Studs (LF1)	22 N.m	16 lb ft
Exhaust Hanger Mounting Bracket Bolts (LF1,LLT)	22 N.m	16 lb ft
Exhaust Hanger Mounting Bracket Bumper Nuts	22 N.m	16 lb ft
Exhaust Manifold Bolt (LP1, LY7, LLT)	20 N.m	15 lb ft
Exhaust Manifold Heat Shield Bolt (LP1, LY7, LLT)	10 N.m	89 lb in
Exhaust Manifold Heat Shield Bolt (LSA)	9 N.m	80 lb in
Exhaust Pipe Front Hanger Bracket Bolt (LF1 AWD)	65 N.m	48 lb ft
Exhaust Pipe Front Hanger Bracket Bolt (LF1 RWD)	22 N.m	16 lb ft
Exhaust Pipe Nut	17 N.m	13 lb ft
Floor Panel Tunnel Brace Bolt	25 N.m	18 lb ft

DIAGNOSTIC INFORMATION AND PROCEDURES

SYMPTOMS - ENGINE EXHAUST

- Review the exhaust system description in order to familiarize yourself with the exhaust system components and the intended function of the components. Refer to **Exhaust System Description**.
- All diagnostics on a vehicle should follow a logical process. Strategy Based Diagnostics is a uniform approach for repairing all systems. The diagnostic flow is the place to start when repairs are necessary and may always be used in order to resolve a system problem. For a detailed explanation, refer to **Strategy Based Diagnosis**.

Visual/Physical Inspection

- Inspect for aftermarket or non-OEM devices such as, but not limited to; tailpipe extensions, headers, and exhaust cutouts. Any aftermarket exhaust system devices could affect the operation and proper performance of the exhaust system.
- Verify the exact operating conditions under which the concern exists. Note factors such as engine RPM, engine temperature, engine load, and frequency of concern.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause any symptom.

Intermittent

Test the vehicle under the same conditions that the customer reported in order to verify the system is operating as designed.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- Loss of power

Refer to **Restricted Exhaust**

- Poor acceleration

Refer to **Restricted Exhaust**

- Poor fuel economy

Refer to **Restricted Exhaust**

- Excessive smoke diesel

Refer to **Restricted Exhaust**

- Exhaust hissing noise

Refer to **Exhaust Leakage**

- Exhaust popping noise

Refer to **Exhaust Leakage**

- Exhaust rattle noise

Refer to **Exhaust Noise**

- Loud exhaust noise

Refer to **Exhaust Noise**

- Exhaust buzz, groan, hum noise

Refer to **Exhaust Noise**

RESTRICTED EXHAUST

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

Special Tools**J 35314-A:** Exhaust Back Pressure Gauge**Diagnostic Aids****WARNING:** Refer to **HOT EXHAUST SYSTEM WARNING** .

For dual exhaust systems a quick check of exhaust flow will help determine which side of the exhaust system is restricted. The side that has less exhaust flow is the side that will be suspect, and diagnosis should begin there.

Test Description

The numbers below refer to the step numbers on the diagnostic table.

4: The exhaust system has very low back pressure under normal conditions. If the exhaust system is restricted, a significant increase in the exhaust pressure is noticed on the **J 35314-A: Exhaust Back Pressure Gauge**. Removing the HO2S sensor may set a DTC. When finishing this diagnostic table, be sure to clear all codes.

5: This step will isolate the catalytic converter from the remainder of the exhaust system.

8: Confirming that the condition has been fixed is essential. If the symptom still exists and the vehicle has a dual exhaust system, proceed to step 2 and repeat diagnostic procedure on the opposite exhaust pipe.

Restricted Exhaust

Step	Action	Value(s)	Yes	No
1	Did you verify the customers complaint?	-	Go to Step 2	-
2	Did you review the exhaust symptoms diagnostic information and perform the necessary inspections?	-	Go to Step 3	Go to <u>Symptoms - Engine Exhaust</u> Symptoms - Engine Exhaust
3	Is the system equipped with dual exhaust?	-	Go to Diagnostic Aids	Go to Step 4
4	1. Remove the heated oxygen sensor (HO2S) that is in front of the catalytic converter. Refer <u>Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LF1)</u> or <u>Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LLT)</u> Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 or <u>Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LF1)</u> or <u>Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LLT)</u> Heated Oxygen Sensor Replacement - Bank 2 Sensor 1.	9 kPa (1.25		

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

	2. Install the J 35314-A: Exhaust Back Pressure Gauge in place of the HO2S sensor. 3. Start the engine. 4. Increase and monitor the engine speed at 2,500 RPM. 5. Observe the exhaust system back pressure reading on the gauge.	psi)		
	Does the reading exceed the specified value?		Go to Step 5	Go to Step 8
5	1. Turn the engine off and place the ignition in the lock position. 2. Remove the J 35314-A J 35314-A. See Special Tools. 3. Re-install the HO2S sensor. Refer to Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LF1) or Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LLT) Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 or Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LF1) or Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LLT) Heated Oxygen Sensor Replacement - Bank 2 Sensor 1. 4. Remove the post-catalyst HO2S sensor. Refer to Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1) or Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LLT) Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 or Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 (LF1) or Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 (LLT) Heated Oxygen Sensor Replacement - Bank 2 Sensor 2. 5. Install the J 35314-A J 35314-A in place of the post HO2S sensor. See Special Tools. 6. Start the engine. 7. Increase and monitor the engine speed at 2,500 RPM. 8. Observe the exhaust system back pressure reading on the gauge.	9 kPa (1.25 psi)		

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

	Does the reading exceed the specified value?		Go to Step 6	Go to Step 7
6	Inspect the exhaust system for the following conditions: • Secondary catalyst restricted • Damage in the exhaust pipe • Debris in the exhaust pipe • Muffler or resonator internal failure • Two-layer exhaust pipe separation Did you find and correct the condition?	-		Replace the exhaust muffler or resonator. Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u>.
7	Replace the catalytic converter. Refer to <u>Catalytic Converter Replacement - Left Side (LF1)</u> or <u>Catalytic Converter Replacement - Left Side (LLT)</u> or <u>Catalytic Converter Replacement - Left Side (LSA)</u> Catalytic Converter Replacement - Left Side or <u>Catalytic Converter Replacement - Right Side (LF1)</u> or <u>Catalytic Converter Replacement - Right Side (LLT)</u> or <u>Catalytic Converter Replacement - Right Side (LSA)</u> Catalytic Converter Replacement - Right Side. Did you find and correct the condition?	-	Go to Step 8	
	1. Remove the J 35314-A J 35314-A. See <u>Special Tools</u>. 2. Reinstall the applicable HO2S sensor. Refer to <u>Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)</u> or <u>Heated Oxygen Sensor Replacement -</u>			

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

8	<u>Bank 1 Sensor 2 (LLT)</u> Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 or <u>Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 (LF1)</u> or <u>Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 (LLT)</u> Heated Oxygen Sensor Replacement - Bank 2 Sensor 2. 3. Clear any codes. 4. Road test the vehicle in order to verify the repair. Did you correct the condition?	-	System OK	Go to Step 2
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EXHAUST LEAKAGE

Condition	Action
WARNING: Refer to <u>HOT EXHAUST SYSTEM WARNING</u> . DEFINITION: An exhaust leak may show stains at the area of the leak. The leak may be felt by holding a hand close to the suspected areas or using a smoke pencil. The leak may make a popping or hissing noise. Refer to <u>Symptoms - Engine Exhaust</u> prior to beginning this table.	
Misaligned or improperly installed exhaust system components	- Align and tighten the exhaust system components to the specifications. Refer to <u>Fastener Tightening Specifications</u>. - Ensure the exhaust hangers are in the proper locations and not loose. Refer to <u>Exhaust System Insulator, Hanger, Bracket Replacement</u> or <u>Exhaust Hanger Mounting Bracket Replacement (LF1,LLT,LSA-Coupe)</u> or <u>Exhaust Hanger Mounting Bracket Replacement (LSA-Sedan/Wagon)</u>.
Exhaust leaks at the following connections: - Exhaust manifold to pipe - Flanges - Pipe clamps	Tighten the components to the specifications. Refer to <u>Fastener Tightening Specifications</u> .
Seals or gaskets leaking; - Exhaust manifold to cylinder head - Exhaust pipes to exhaust manifold - Catalytic converter connection	Replace the leaking seal or gasket. Refer to the affected components procedure for service.
Irregularities at the mating	Repair as required or replace the affected component. Refer to the

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

surfaces on the flange connections	affected components procedure for service.
Exhaust manifold cracked or broken	Replace the exhaust manifold. Refer to <u>Exhaust Manifold Replacement - Left Side (LLT)</u> or <u>Exhaust Manifold Replacement - Left Side (LSA)</u> or <u>Exhaust Manifold Replacement - Right Side (LLT)</u> or <u>Exhaust Manifold Replacement - Right Side (LSA)</u> .
Exhaust system component connection welds leaking	Replace the leaking component. Refer to the affected component's procedure for service.
Muffler or resonator, if equipped, damaged or leaking at the seams	Replace the affected muffler or resonator, if equipped. Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u>

EXHAUST NOISE

Condition	Action
WARNING: Refer to <u>HOT EXHAUST SYSTEM WARNING</u> .	
DEFINITION: An audible or physical noise due to a faulty component or damaged components causing a loose or misaligned exhaust system resulting in a rattle or vibration noise, i.e. buzz, groan, hum. Refer to <u>Symptoms - Engine Exhaust</u> Symptoms - Engine Exhaust prior to beginning this table.	
Popping or hissing noise	Exhaust leak-Refer to <u>Exhaust Leakage</u> Exhaust Leakage.
Loud exhaust	1. Compare to a known good vehicle. 2. Inspect for a damaged or failed muffler or resonator, if equipped. 3. Replace the faulty muffler or resonator (if equipped). Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u> Exhaust System Replacement
External rattle or vibration noise	1. Inspect for a bent or loose hanger, loose heat shield, or loose clamp. 2. Inspect for a exhaust pipe causing interference. 3. Repair or replace the affected component. Refer to <u>Exhaust Pipe Front Hanger Bracket Replacement (AWD)</u> or <u>Exhaust Hanger Mounting Bracket Replacement (LF1,LLT,LSA-Coupe)</u> or <u>Exhaust Hanger Mounting Bracket Replacement (LSA-Sedan/Wagon)</u>.
Internal rattle	1. Test the components by tapping with a rubber mallet to confirm a rattle.

2. Replace the faulty catalytic converter, resonator, if equipped, or muffler. Refer to Catalytic Converter Replacement - Left Side (LF1) or Catalytic Converter Replacement - Left Side (LLT) or Catalytic Converter Replacement - Left Side (LSA), Catalytic Converter Replacement - Right Side (LF1) or Catalytic Converter Replacement - Right Side (LLT) or Catalytic Converter Replacement - Right Side (LSA) or Exhaust System Replacement (LF1-Single) or Exhaust System Replacement (LSA-Coupe) or Exhaust System Replacement (LF1-Sedan/Wagon) or Exhaust System Replacement (LLT-Coupe) or Exhaust System Replacement (LLT-Sedan/Wagon) or Exhaust System Replacement (LSA-Sedan/Wagon) Exhaust System Replacement

REPAIR INSTRUCTIONS

EXHAUST MANIFOLD REPLACEMENT - LEFT SIDE (LLT)

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

1. Remove the exhaust manifold heat shield. Refer to Exhaust Manifold Heat Shield Replacement - Left Side (LLT) or Exhaust Manifold Heat Shield Replacement - Left Side (LSA).
2. Remove the oil level indicator and tube. Refer to Oil Level Indicator Tube Replacement (LF1) or Oil Level Indicator Tube Replacement (LLT) .

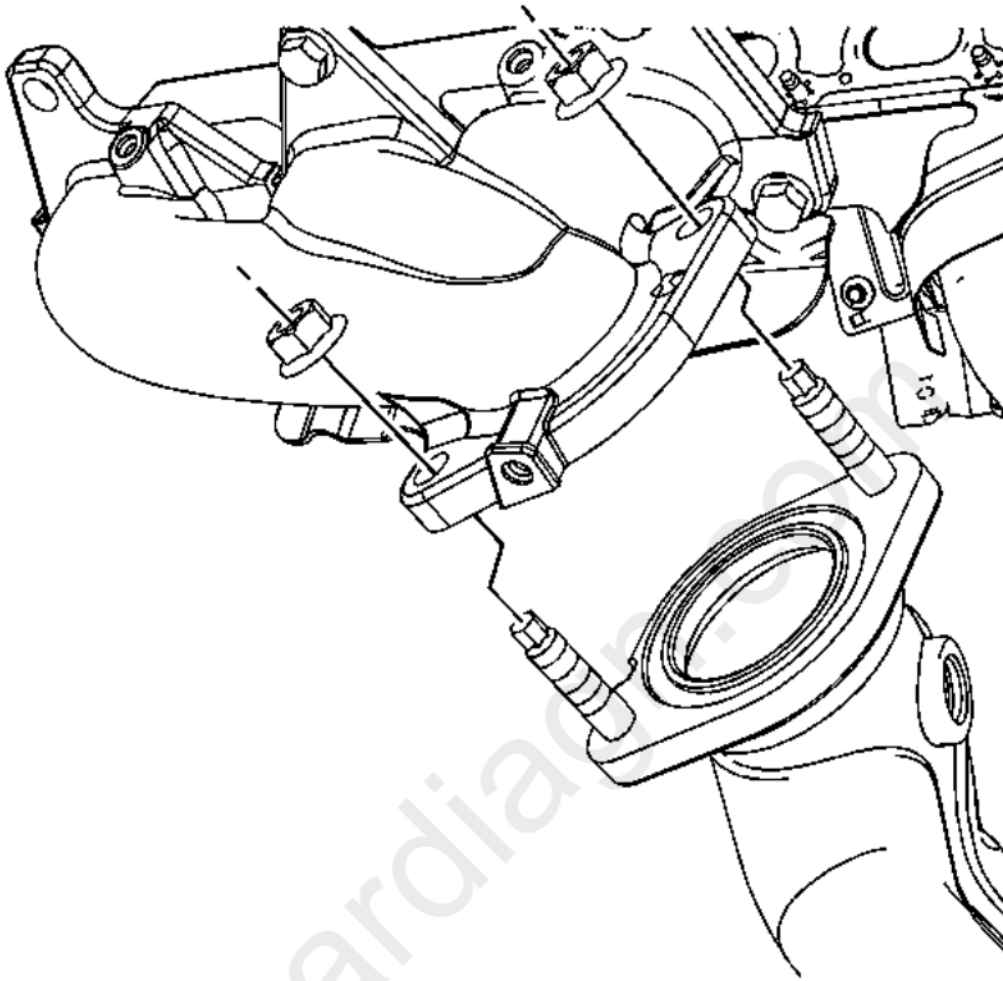


Fig. 1: View of Catalytic Converter & Nuts
Courtesy of GENERAL MOTORS CORP.

3. Remove the lower intermediate steering shaft. Refer to **Lower Intermediate Steering Shaft Replacement** .

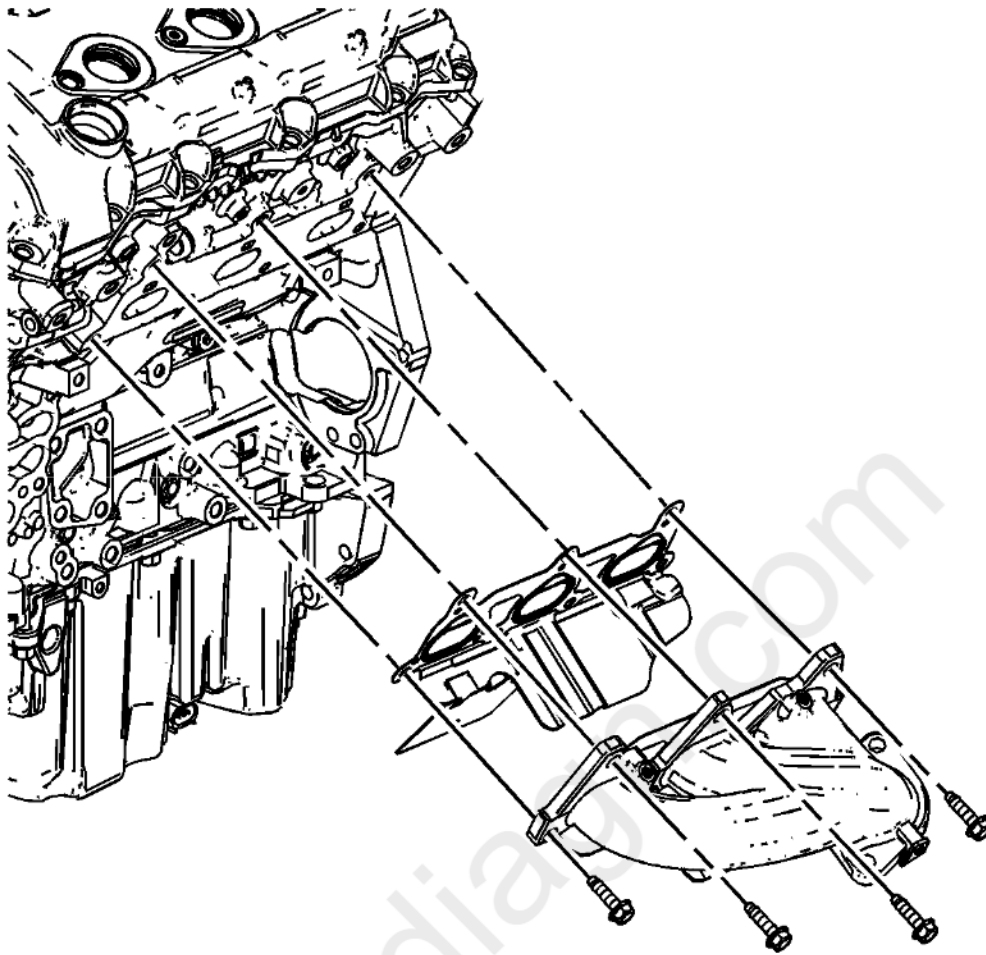


Fig. 2: View Of Left Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

4. Remove the catalytic converter. Refer to **Catalytic Converter Replacement - Left Side (LF1)** or **Catalytic Converter Replacement - Left Side (LLT)** or **Catalytic Converter Replacement - Left Side (LSA)**.
5. Remove the exhaust manifold and discard the exhaust manifold gasket.
6. If reusing the exhaust manifold, clean and inspect the exhaust manifold sealing surfaces. Refer to **Exhaust Manifold Cleaning and Inspection - Left Side** .

Installation Procedure

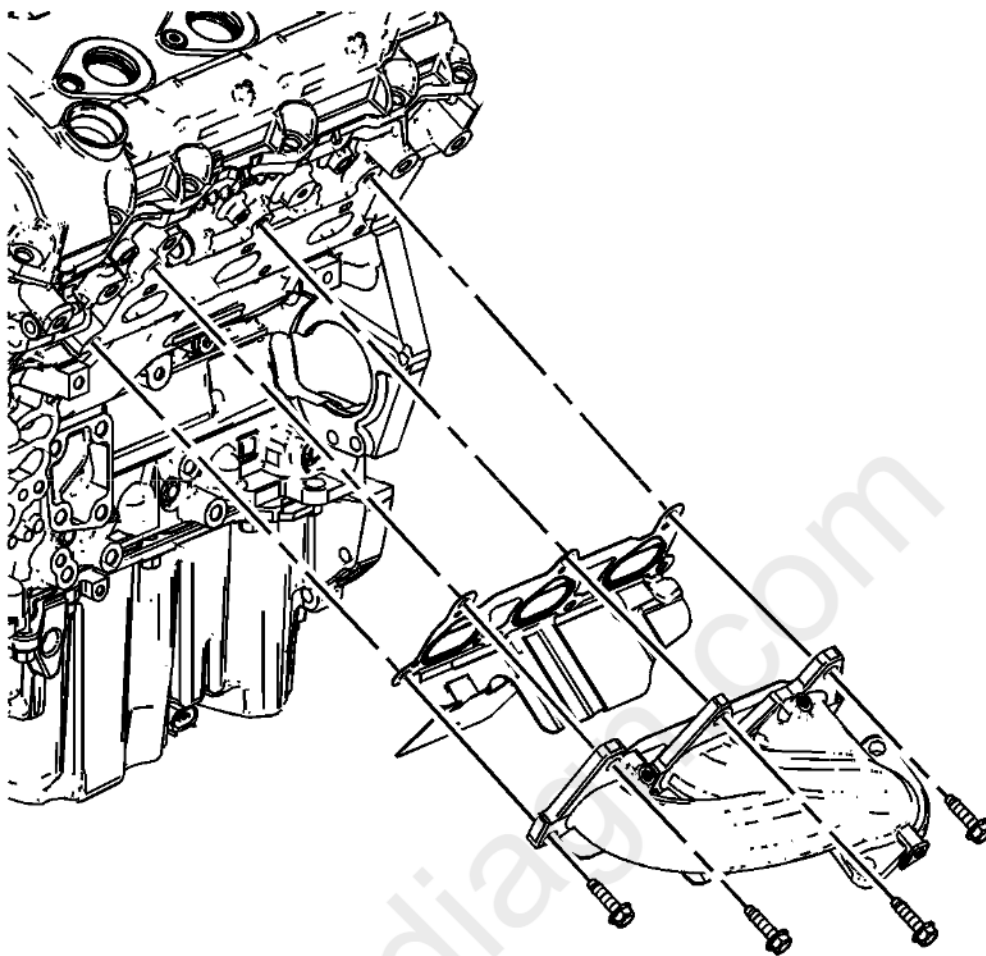


Fig. 3: View Of Left Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW exhaust manifold gasket to the exhaust manifold.
2. Install the exhaust manifold and the gasket to the cylinder head.

CAUTION: Refer to FASTENER CAUTION .

3. Install the exhaust manifold bolts and tighten to 20 N.m (15 lb ft).

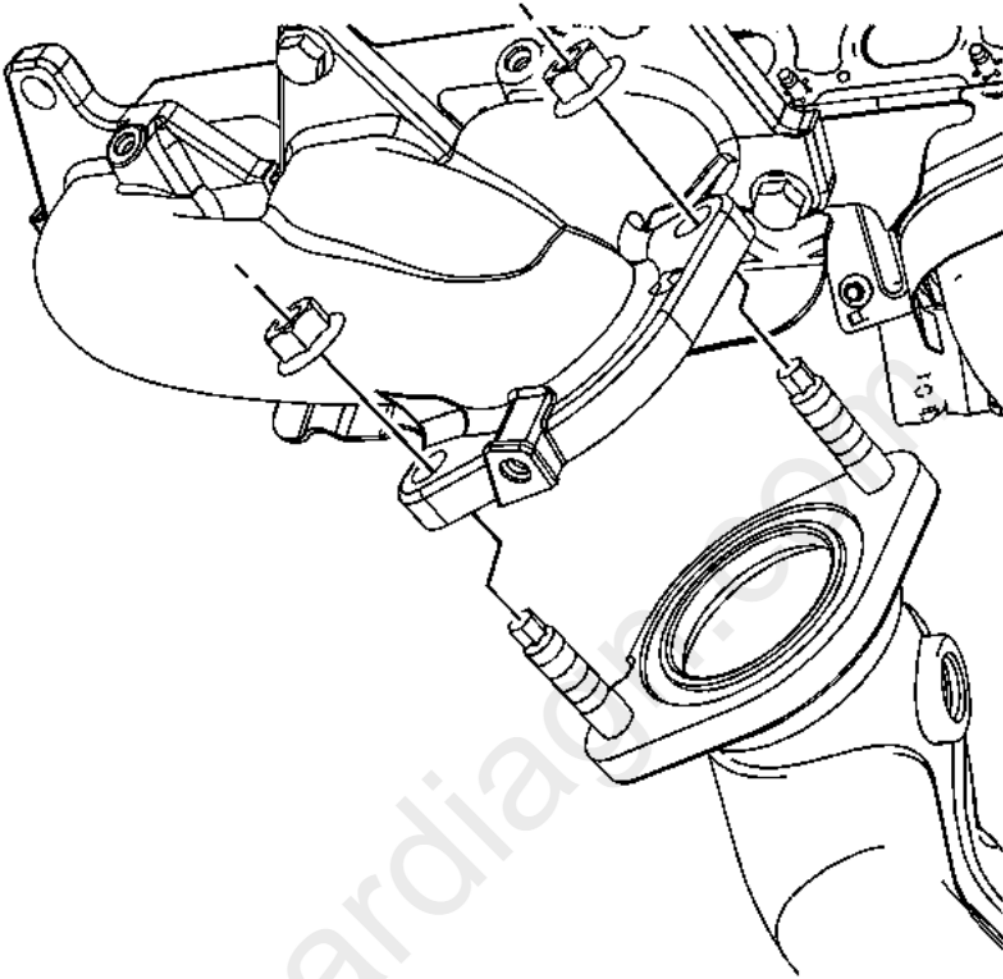


Fig. 4: View of Catalytic Converter & Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: Inspect the catalytic converter seal/heat shield sealing surface. Replace the seal/heat shield if the sealing surface is worn or damaged.

4. Install the catalytic converter to the exhaust manifold. Refer to Catalytic Converter Replacement - Left Side (LF1) or Catalytic Converter Replacement - Left Side (LLT) or Catalytic Converter Replacement - Left Side (LSA).
5. Install the lower intermediate steering shaft. Refer to Lower Intermediate Steering Shaft Replacement.
6. Install the oil level indicator and tube. Refer to Oil Level Indicator Tube Replacement (LF1) or Oil

Level Indicator Tube Replacement (LLT) .

7. Install the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Left Side (LLT)** or **Exhaust Manifold Heat Shield Replacement - Left Side (LSA)**.
8. Inspect the exhaust system for leaks.

EXHAUST MANIFOLD REPLACEMENT - LEFT SIDE (LSA)**Removal Procedure**

1. Remove the engine sight shield. Refer to **Intake Manifold Cover Replacement - Front** .
2. Remove the left bank coil assembly. Refer to **Ignition Coil Replacement** .
3. Remove the left bank spark plugs. Refer to **Spark Plug Replacement** .
4. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .

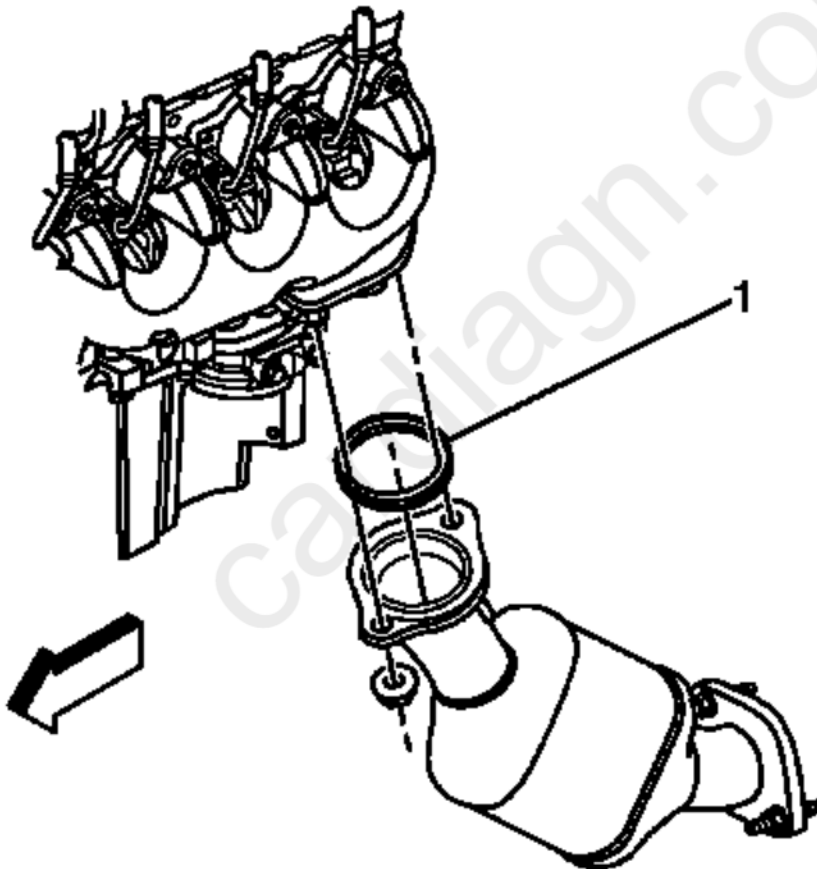


Fig. 5: View Of Left Catalytic Converter & Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the left catalytic converter and seal (1). Refer to **Catalytic Converter Replacement - Left Side (LF1)** or **Catalytic Converter Replacement - Left Side (LLT)** or **Catalytic Converter Replacement - Left Side (LSA)**.

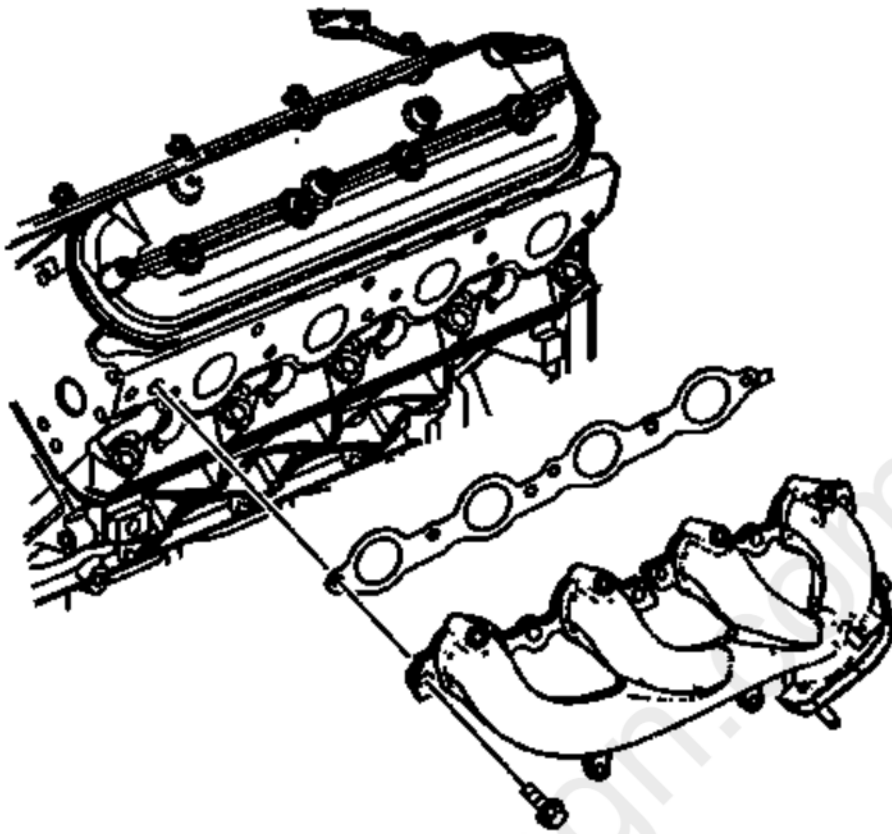


Fig. 6: View Of Left Exhaust Manifold, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Disconnect the center steering shaft from the lower steering shaft. Separate the shafts and position aside to provide a removal envelope for the manifold. Refer to **Intermediate Steering Shaft Replacement** .
7. Lower the vehicle.
8. Remove the exhaust manifold bolts.
9. Remove the exhaust manifold, bolts, and gasket. Discard the gasket.
10. Remove the heat shield from the manifold, if required.
11. Clean and inspect the exhaust manifold. Refer to **Exhaust Manifold Cleaning and Inspection** .

Installation Procedure

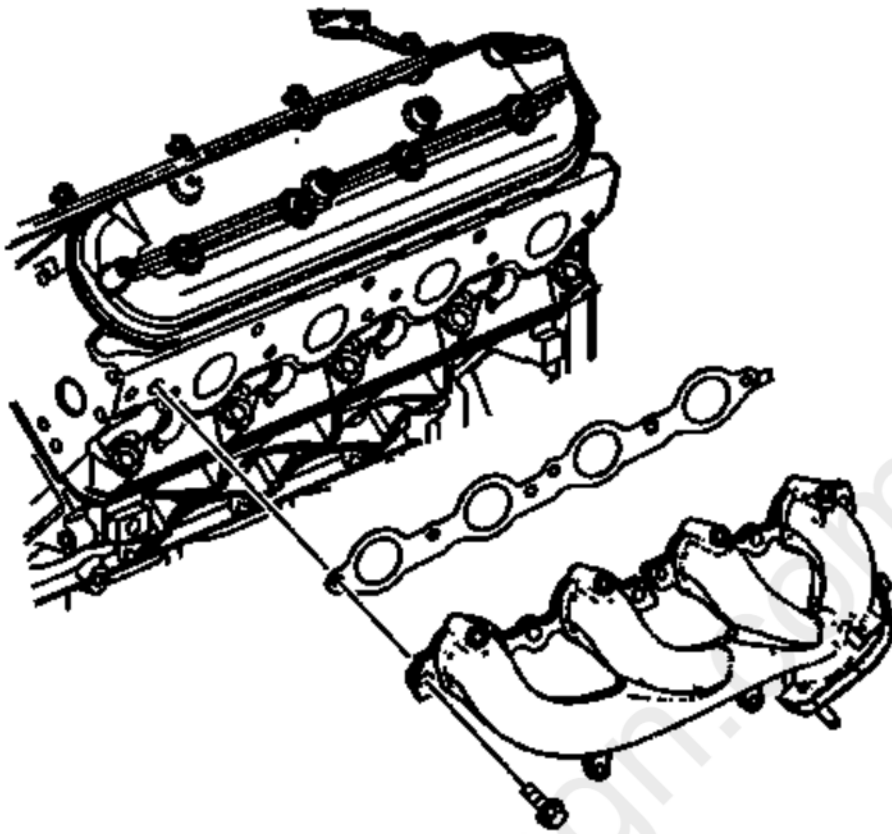


Fig. 7: View Of Left Exhaust Manifold, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE: Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets may effect vehicle emissions and/or On-Board Diagnostics (OBD) II system performance.

1. If necessary, install the exhaust manifold heat shield and bolts and tighten to 10 N.m (89 lb in).
2. Position the exhaust manifold and a NEW gasket into place.
3. Lower the vehicle.
4. Install the exhaust manifold bolts. Refer to Exhaust Manifold Installation - Left Side .
5. Connect the center steering shaft to the lower steering shaft. Refer to Intermediate Steering Shaft Replacement .

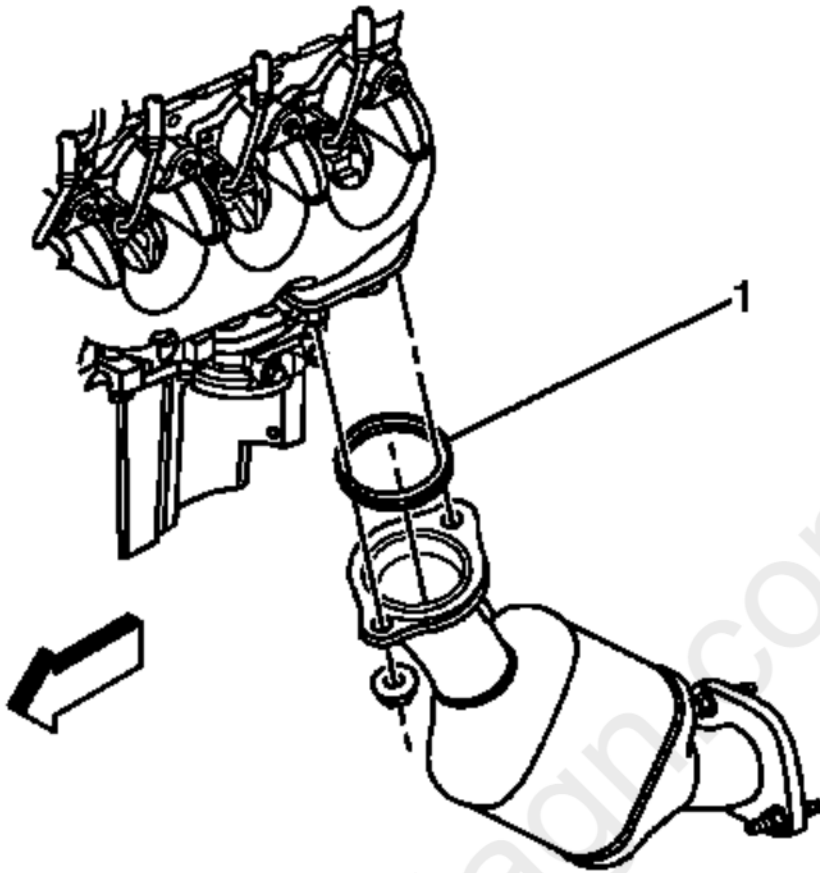


Fig. 8: View Of Left Catalytic Converter & Gasket
Courtesy of GENERAL MOTORS CORP.

6. Install the left catalytic converter and seal (1). Refer to Catalytic Converter Replacement - Left Side (LF1) or Catalytic Converter Replacement - Left Side (LLT) or Catalytic Converter Replacement - Left Side (LSA).
7. Lower the vehicle.
8. Install the left bank spark plugs. Refer to Spark Plug Replacement.
9. Install the left bank coil assembly. Refer to Ignition Coil Replacement.
10. Install the engine sight shield. Refer to Intake Manifold Cover Replacement - Front.

EXHAUST MANIFOLD REPLACEMENT - RIGHT SIDE (LLT)

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING.

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING.

1. Remove the exhaust manifold heat shield. Refer to Exhaust Manifold Heat Shield Replacement - Right Side (LLT) or Exhaust Manifold Heat Shield Replacement - Right Side (LSA).

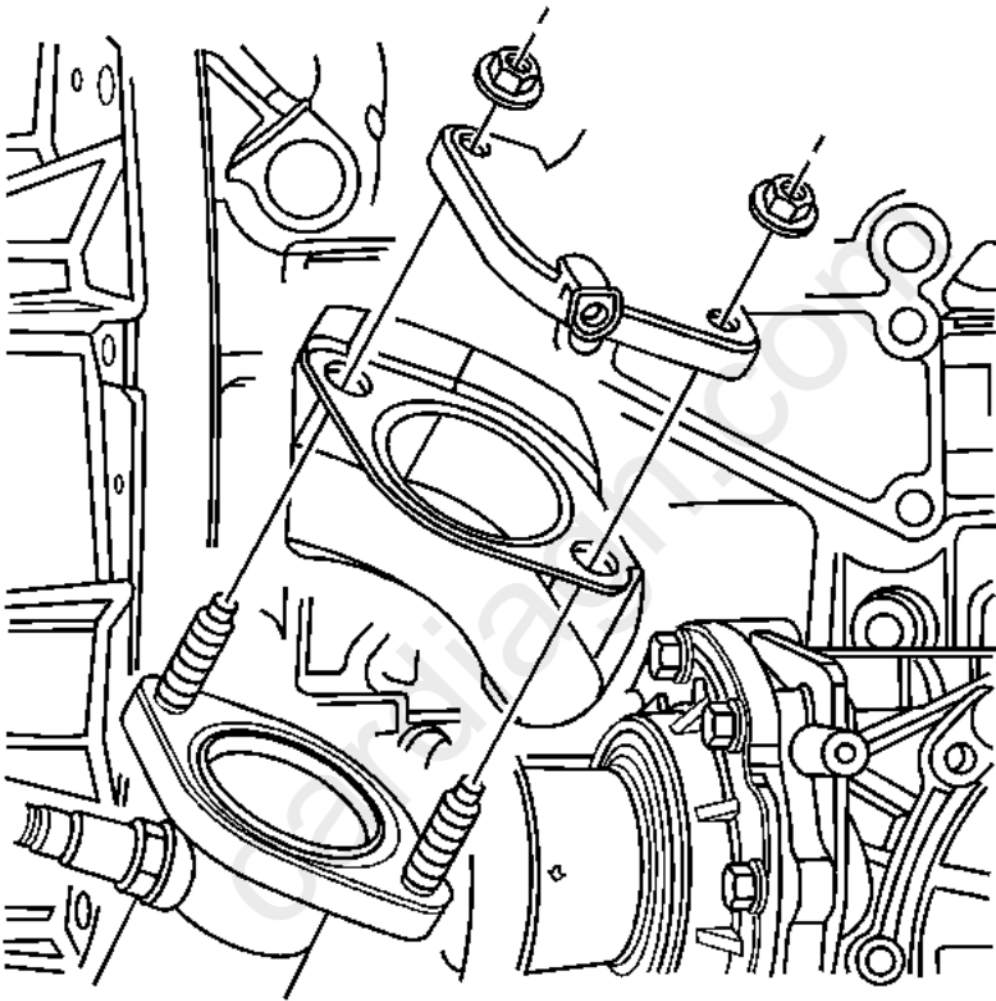


Fig. 9: View Of Right Catalytic Converter - LY7
Courtesy of GENERAL MOTORS CORP.

2. Remove the catalytic converter nuts.

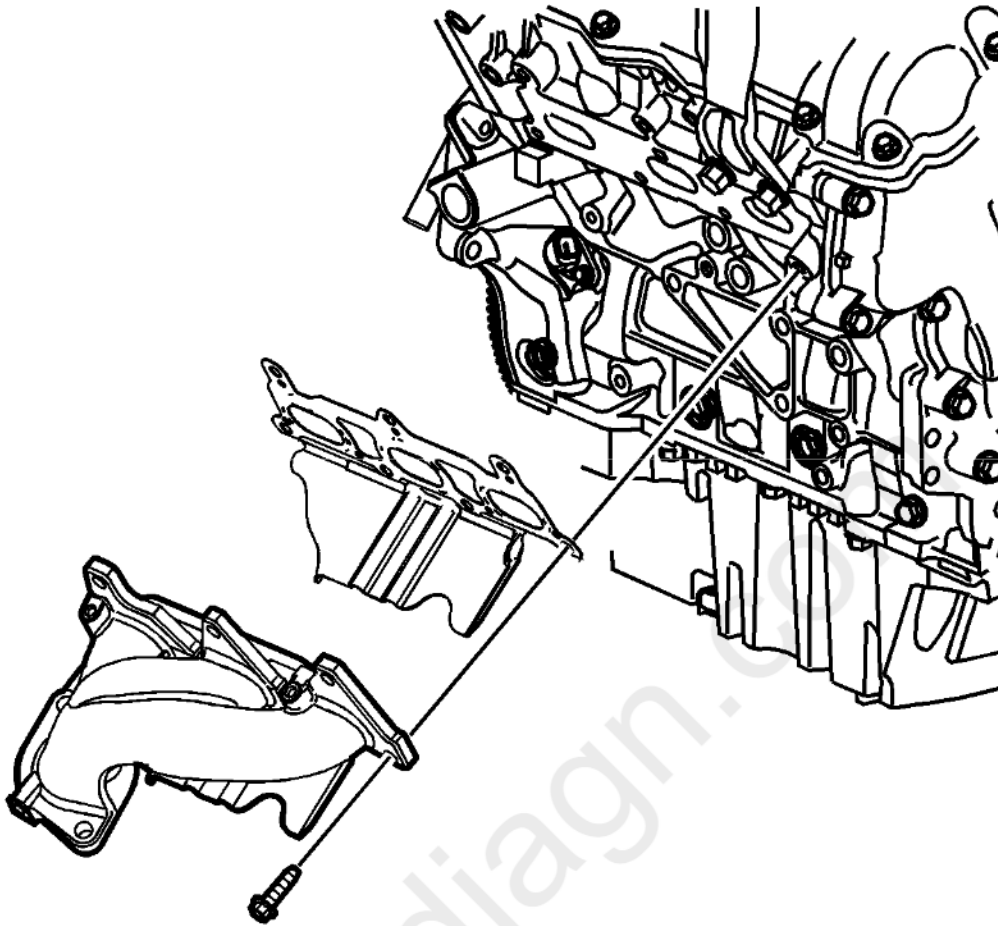


Fig. 10: Right Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the exhaust manifold bolts.
4. Remove the exhaust manifold and discard the exhaust manifold gasket.
5. If reusing the exhaust manifold, clean and inspect the exhaust manifold sealing surfaces. Refer to **Exhaust Manifold Cleaning and Inspection - Right Side** .

Installation Procedure

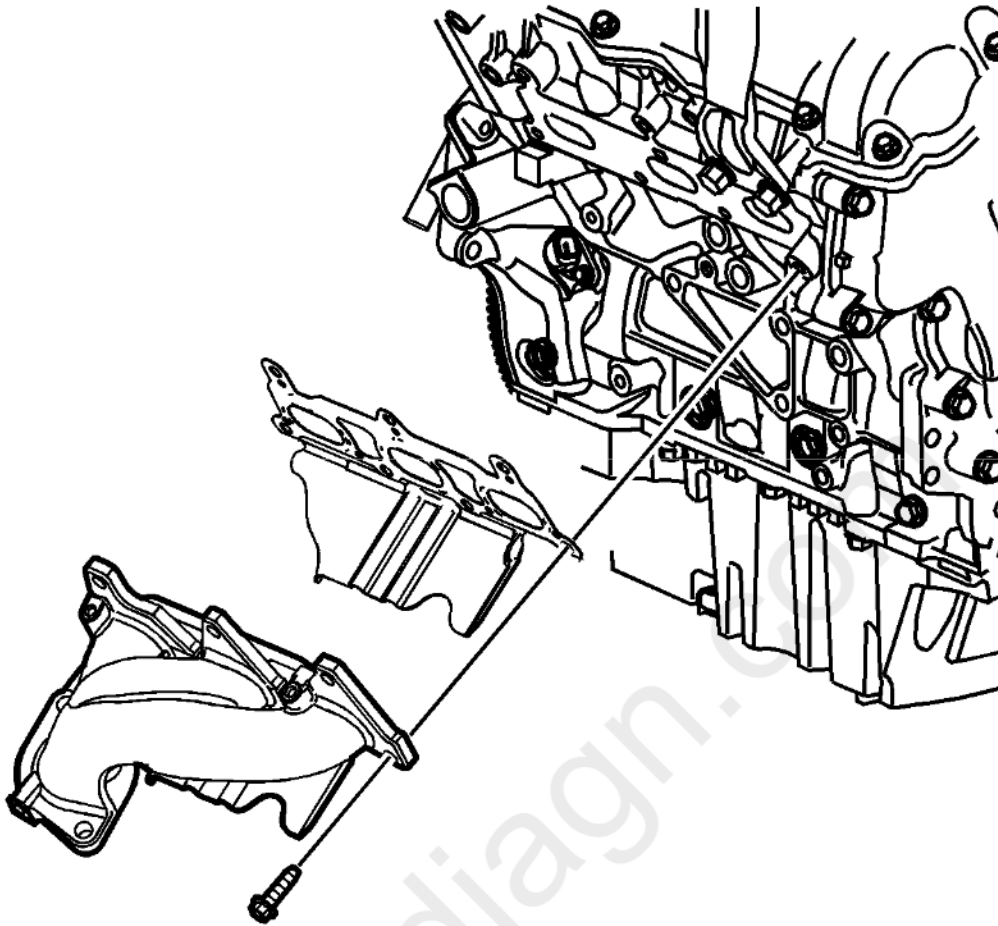


Fig. 11: Right Exhaust Manifold & Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE: Inspect the catalytic converter seal/heat shield sealing surface. Replace the seal/heat shield if the sealing surface is worn or damaged.

1. Install a NEW exhaust manifold gasket to the exhaust manifold.
2. Install the exhaust manifold with the gasket to the cylinder head and the catalytic converter.

CAUTION: Refer to FASTENER CAUTION .

3. Install the exhaust manifold bolts and tighten to 20 N.m (15 lb ft).

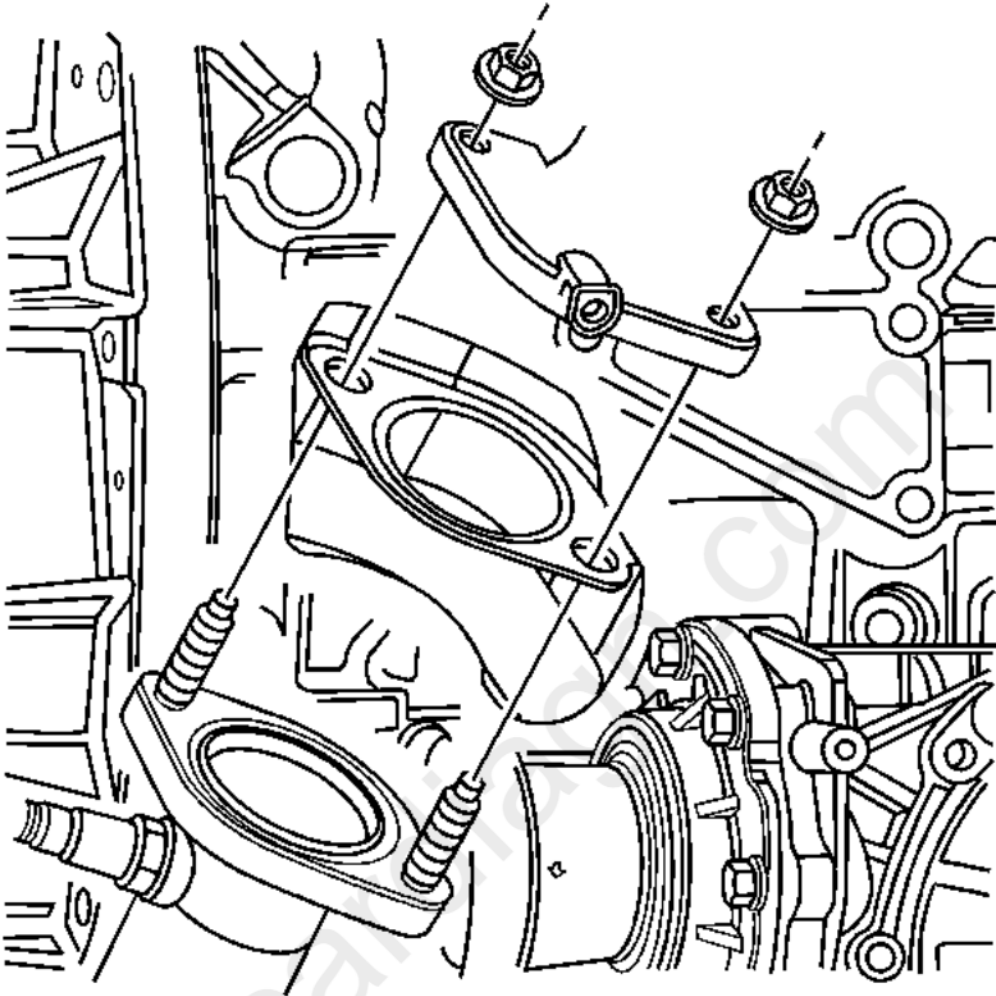


Fig. 12: View Of Right Catalytic Converter - LY7
Courtesy of GENERAL MOTORS CORP.

4. Install the catalytic converter nuts and tighten to 50 N.m (37 lb ft).
5. Install the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Right Side (LLT)** or **Exhaust Manifold Heat Shield Replacement - Right Side (LSA)**.
6. Inspect the exhaust system for leaks.

EXHAUST MANIFOLD REPLACEMENT - RIGHT SIDE (LSA)

Removal Procedure

1. Remove the engine sight shield. Refer to **Intake Manifold Cover Replacement - Front** .
2. Remove the right bank coil assembly. Refer to **Ignition Coil Replacement** .
3. Remove the right bank spark plugs. Refer to **Spark Plug Replacement** .
4. Remove the oil level dipstick tube. Refer to **Oil Level Indicator Tube Replacement** .
5. Raise and suitably support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
6. Remove the right catalytic converter. Refer to **Catalytic Converter Replacement - Right Side (LF1)** or **Catalytic Converter Replacement - Right Side (LLT)** or **Catalytic Converter Replacement - Right Side (LSA)**.

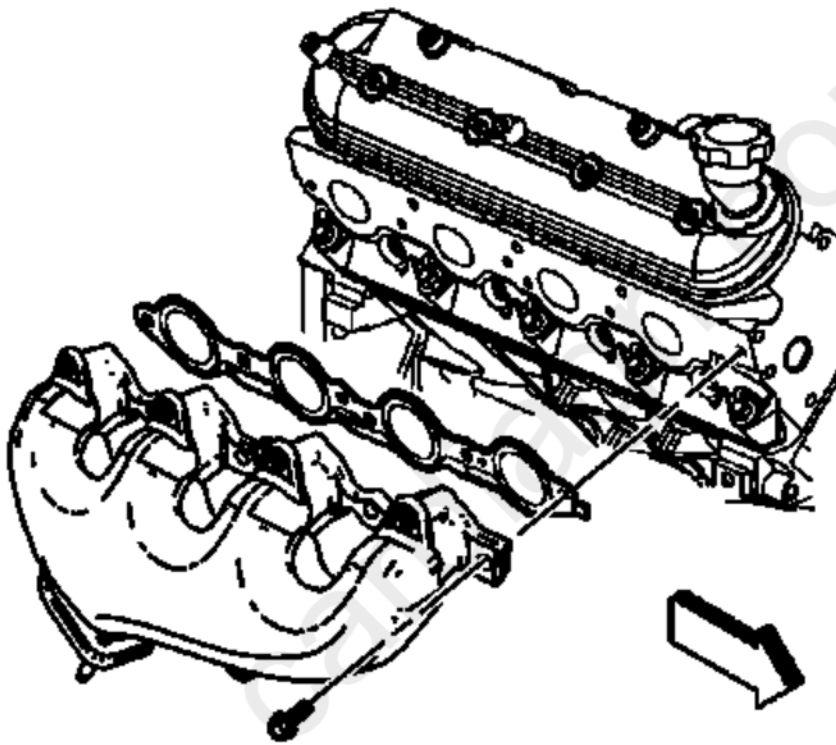


Fig. 13: Identifying Right Exhaust Manifold, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the starter motor. Refer to **Starter Replacement (LF1/LLT)** or **Starter Replacement (LSA)** .
8. Remove the exhaust manifold bolts.
9. Remove the exhaust manifold, bolts, and gasket. Discard the gasket.
10. Remove the heat shield from the manifold, if required.
11. Clean and inspect the exhaust manifold. Refer to **Exhaust Manifold Cleaning and Inspection** .

Installation Procedure

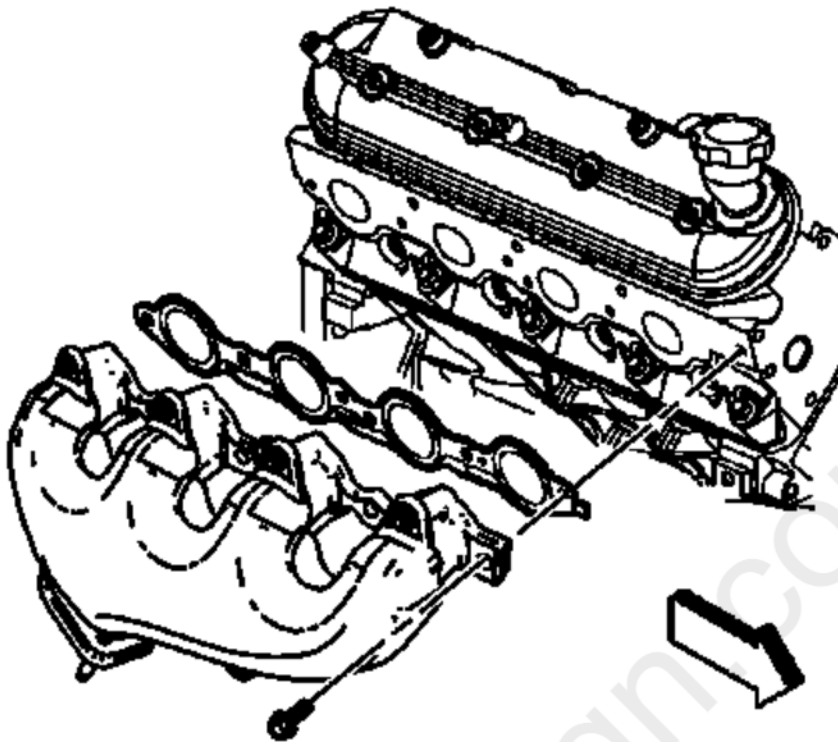


Fig. 14: Identifying Right Exhaust Manifold, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE: Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets may effect vehicle emissions and/or On-Board Diagnostics (OBD) II system performance.

1. If necessary, install the exhaust manifold heat shield and bolts and tighten to 9 N.m (80 lb in).
2. Position the exhaust manifold and a NEW gasket into place.
3. Install the exhaust manifold bolts. Refer to Exhaust Manifold Installation - Right Side .
4. Install the starter motor. Refer to Starter Replacement (LF1/LLT) or Starter Replacement (LSA) .
5. Install the right catalytic converter. Refer to Catalytic Converter Replacement - Right Side (LF1) or Catalytic Converter Replacement - Right Side (LLT) or Catalytic Converter Replacement - Right Side (LSA).
6. Lower the vehicle.

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

7. Install the right bank spark plugs. Refer to **Spark Plug Replacement** .
8. Install the right bank coil assembly. Refer to **Ignition Coil Replacement** .
9. Install the oil level dipstick tube. Refer to **Oil Level Indicator Tube Replacement** .
10. Install the engine sight shield. Refer to **Intake Manifold Cover Replacement - Front** .

EXHAUST SYSTEM REPLACEMENT (LF1-SINGLE)

Removal Procedure

WARNING: Refer to **EXHAUST SERVICE WARNING** .

WARNING: Refer to **PROTECTIVE GOGGLES AND GLOVE WARNING** .

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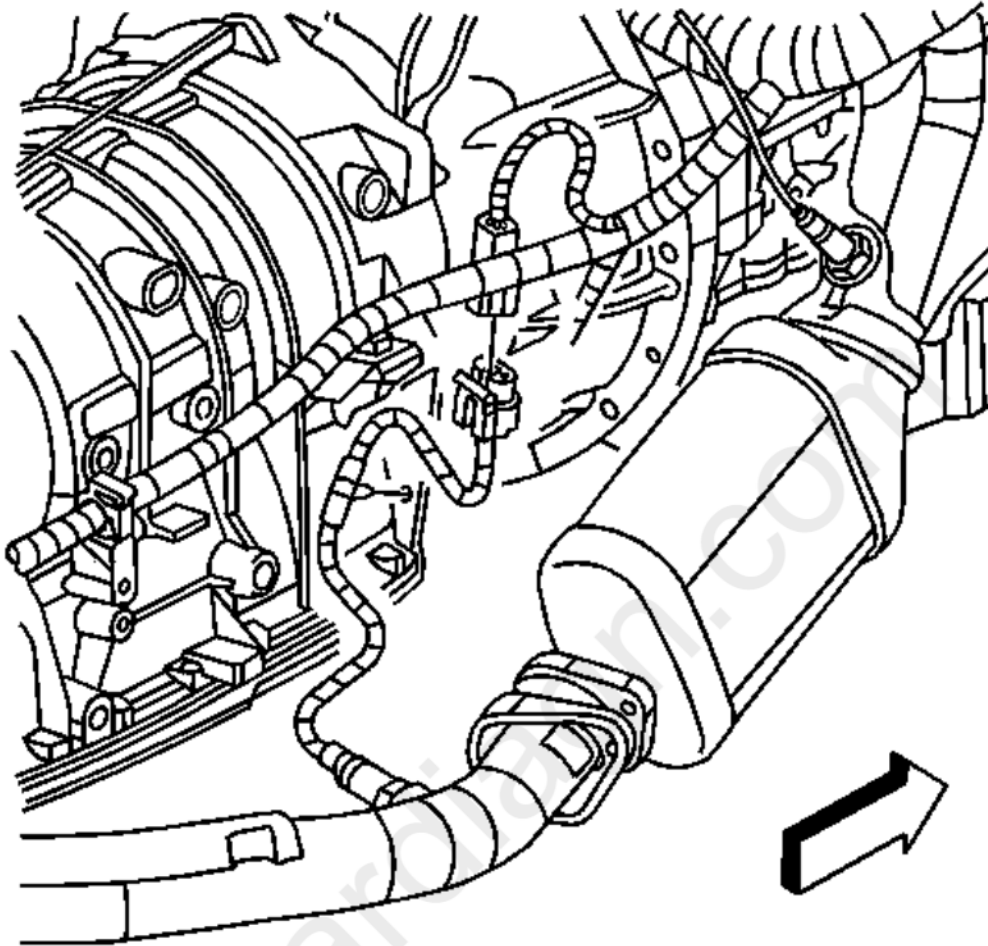


Fig. 15: View Of HO2S Electrical Connector, Sensor 2 (Bank 1 Shown, Bank 2 Similar)
Courtesy of GENERAL MOTORS CORP.

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Disconnect the left bank and the right bank 2 heated oxygen sensor (HO2S) electrical connectors (bank 1 shown, bank 2 similar) from the harnesses.
3. Remove the HO2S wiring harnesses from the transmission case.

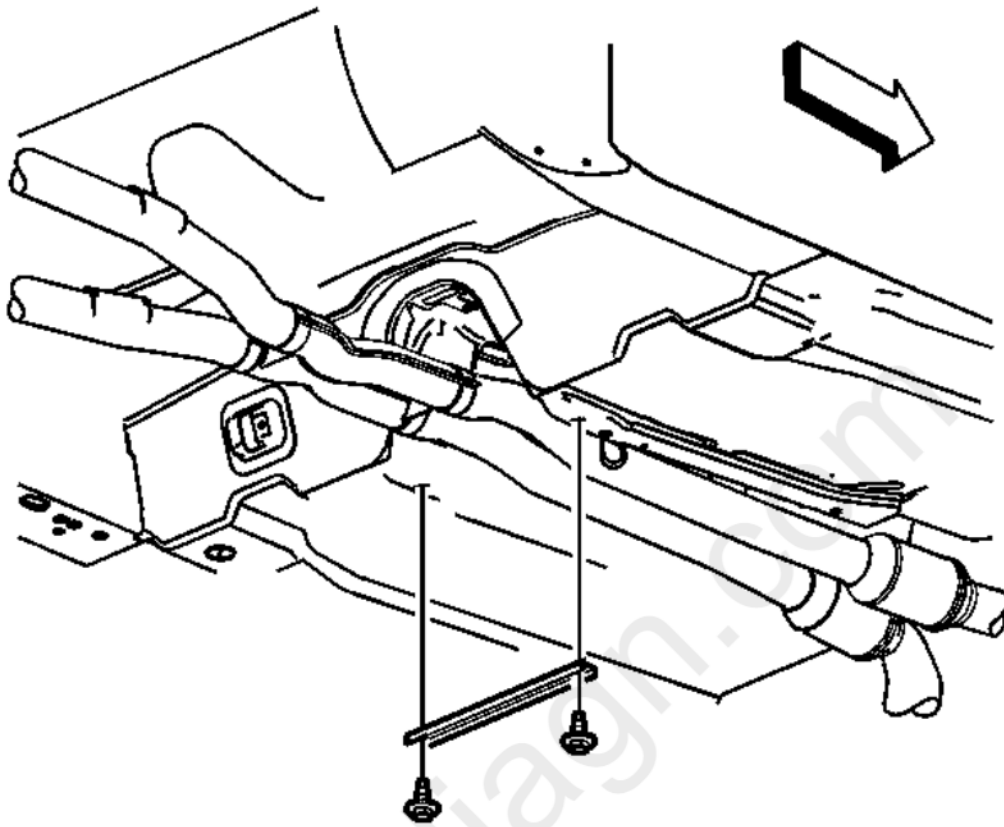


Fig. 16: Identifying Floor Panel Tunnel Brace And Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the floor panel tunnel brace bolts.
5. Remove the floor panel tunnel brace from the floor panel.

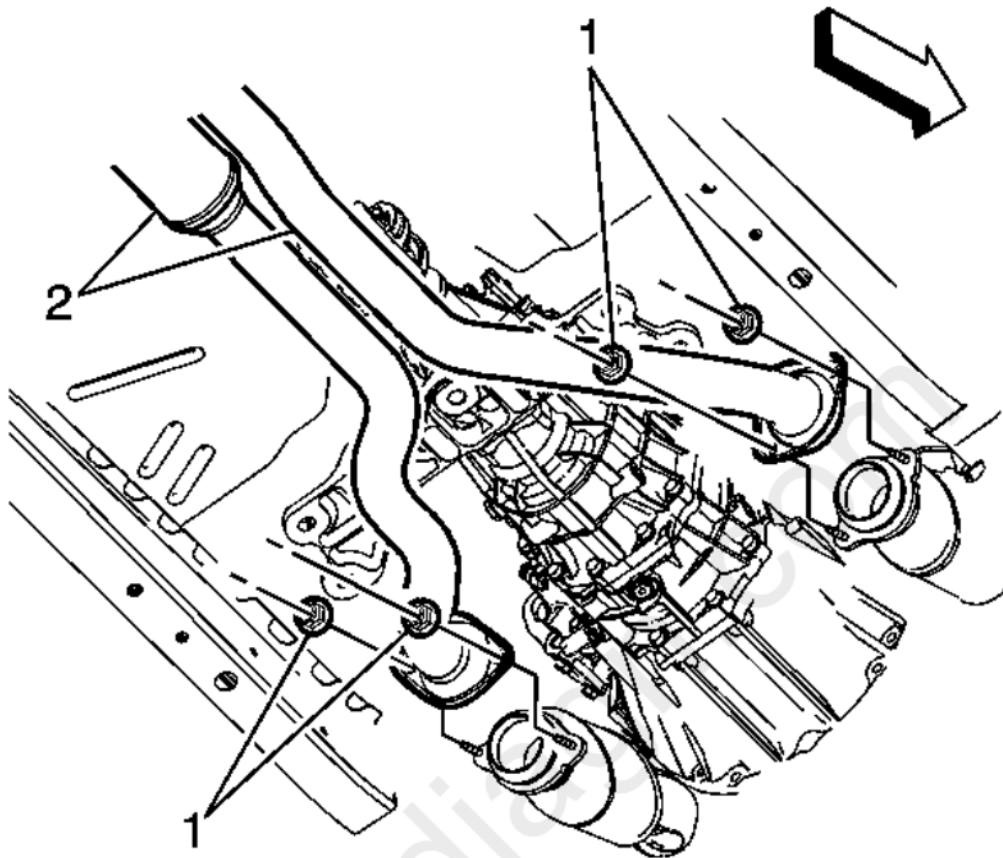


Fig. 17: View Of Catalytic Converter, Exhaust Pipe, Nuts And Exhaust System
Courtesy of GENERAL MOTORS CORP.

6. Remove the catalytic converter to the exhaust pipe nuts (1) and separate the exhaust system (2) from the catalytic converters.
7. Using an adjustable jack stand, support the rear of the exhaust system.
8. Apply a non petroleum based lubricant to the exhaust insulators and the muffler hanger rods to aid in removal and installation.
9. Remove the exhaust pipe front hanger bracket. Refer to **Exhaust Pipe Front Hanger Bracket Replacement (AWD)**.

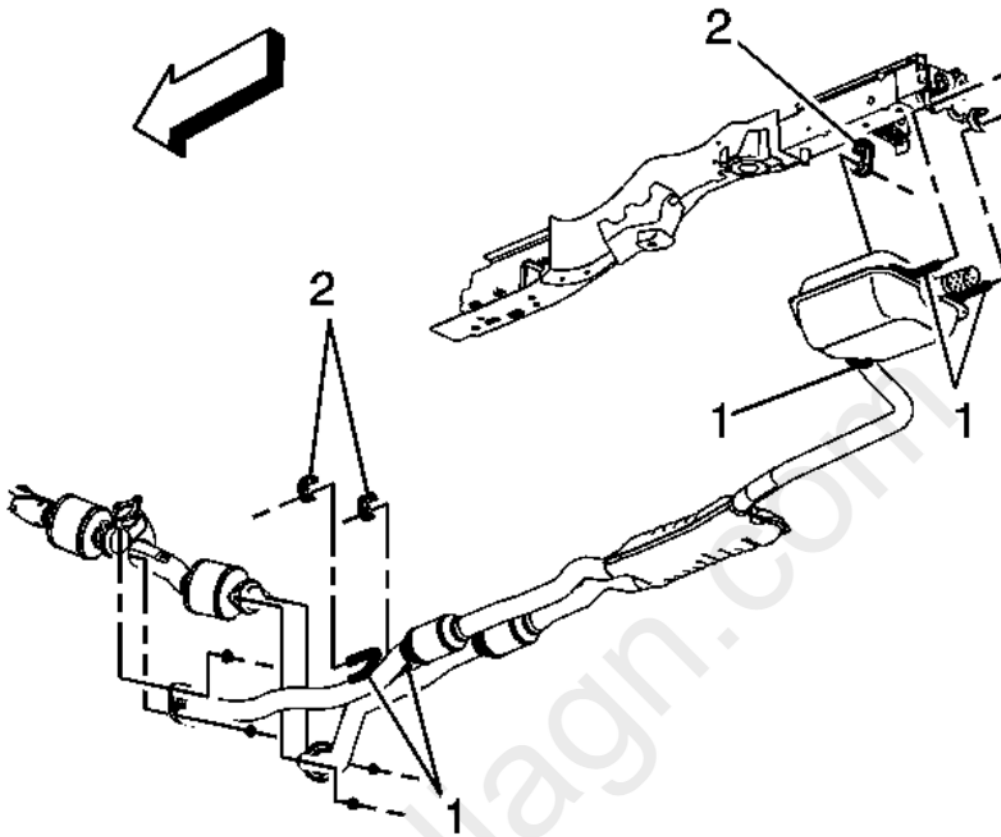


Fig. 18: Identifying Rear Muffler Insulators And Muffler Hanger Rods
Courtesy of GENERAL MOTORS CORP.

10. Remove the rear muffler insulators (3) from the muffler hanger rods (2) leaving the insulators attached to the vehicle. Refer to **Exhaust System Insulator, Hanger, Bracket Replacement**.
11. With the aid of an assistant, lower the exhaust system from the vehicle.
12. Remove the left bank and the right bank HO2S from the exhaust system. Refer to **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)** or **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LLT)**.

Installation Procedure

1. Install the left bank and the right bank HO2S to the exhaust system. Refer to **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)** or **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LLT)**.

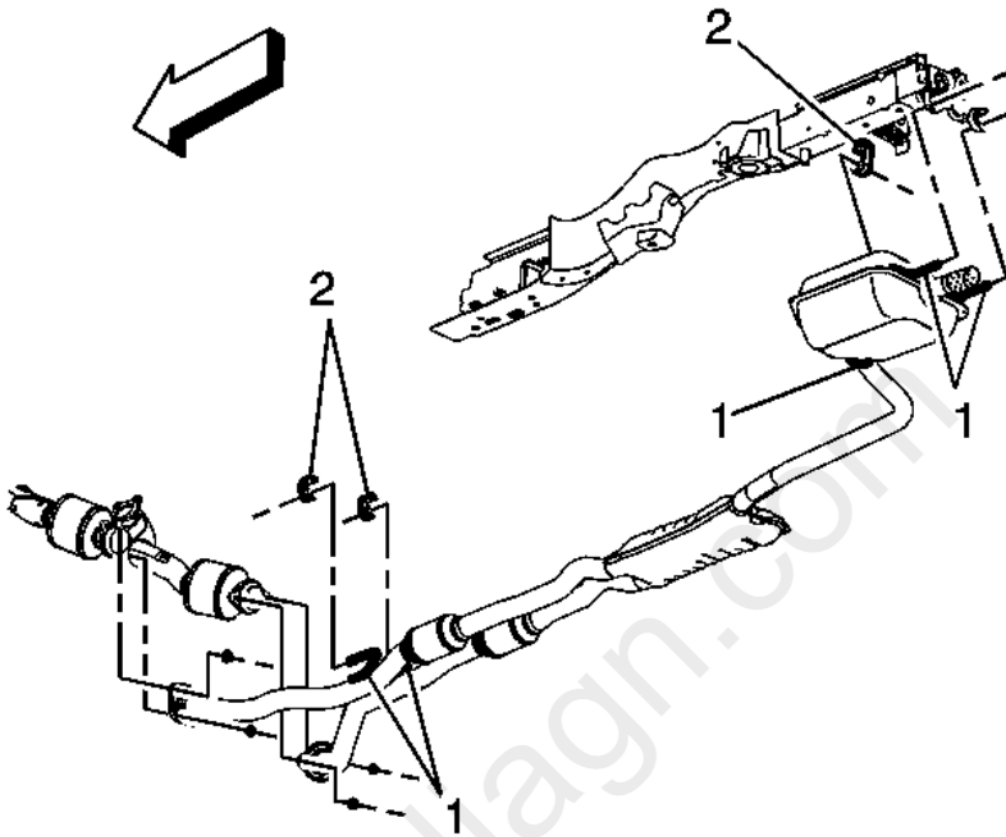


Fig. 19: Identifying Rear Muffler Insulators And Muffler Hanger Rods
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Exhaust System Inspection Caution .

2. With the aid of an assistant, raise the exhaust system to the body insulators and to the catalytic converters.
3. Install the muffler hanger rods (1) to the muffler insulators (2). Refer to Exhaust System Insulator, Hanger, Bracket Replacement.
4. Install the muffler hanger rods (1) to the exhaust pipe front hanger bracket. Refer to Exhaust Pipe Front Hanger Bracket Replacement (AWD).

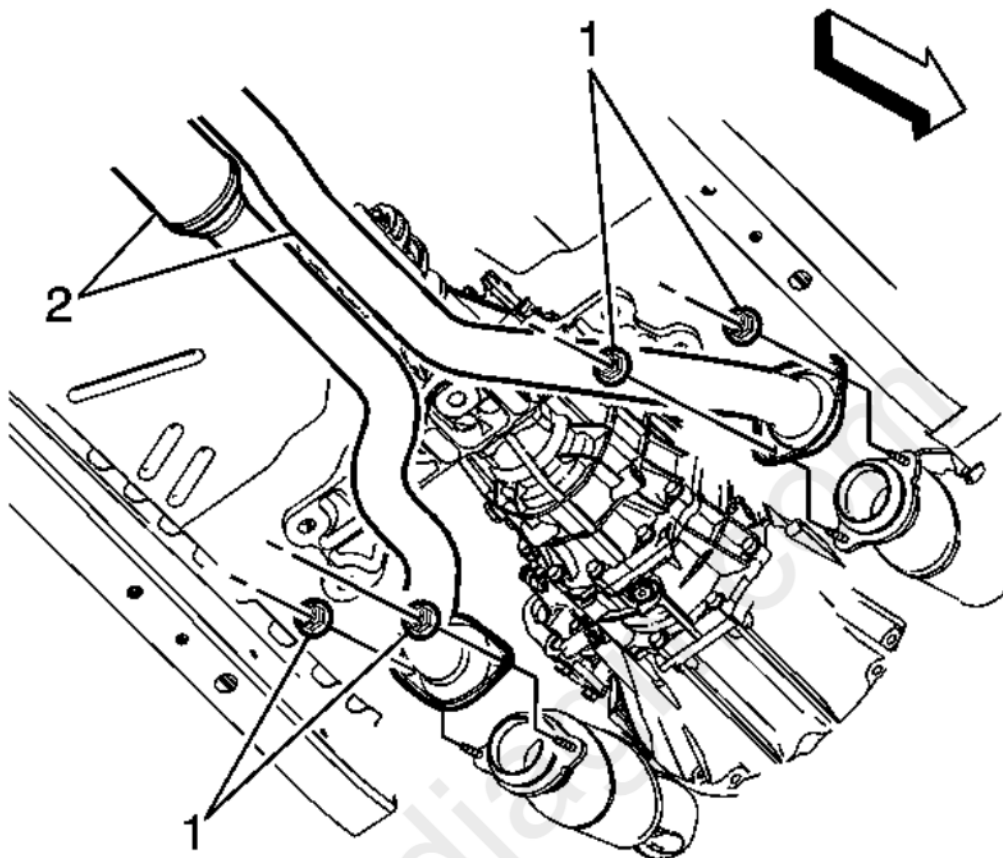


Fig. 20: View Of Catalytic Converter, Exhaust Pipe, Nuts And Exhaust System
Courtesy of GENERAL MOTORS CORP.

5. Position the exhaust pipe to the catalytic converts.

CAUTION: Refer to FASTENER CAUTION .

6. Install the catalytic converter to exhaust pipe nuts and tighten to 17 N.m (13 lb ft).

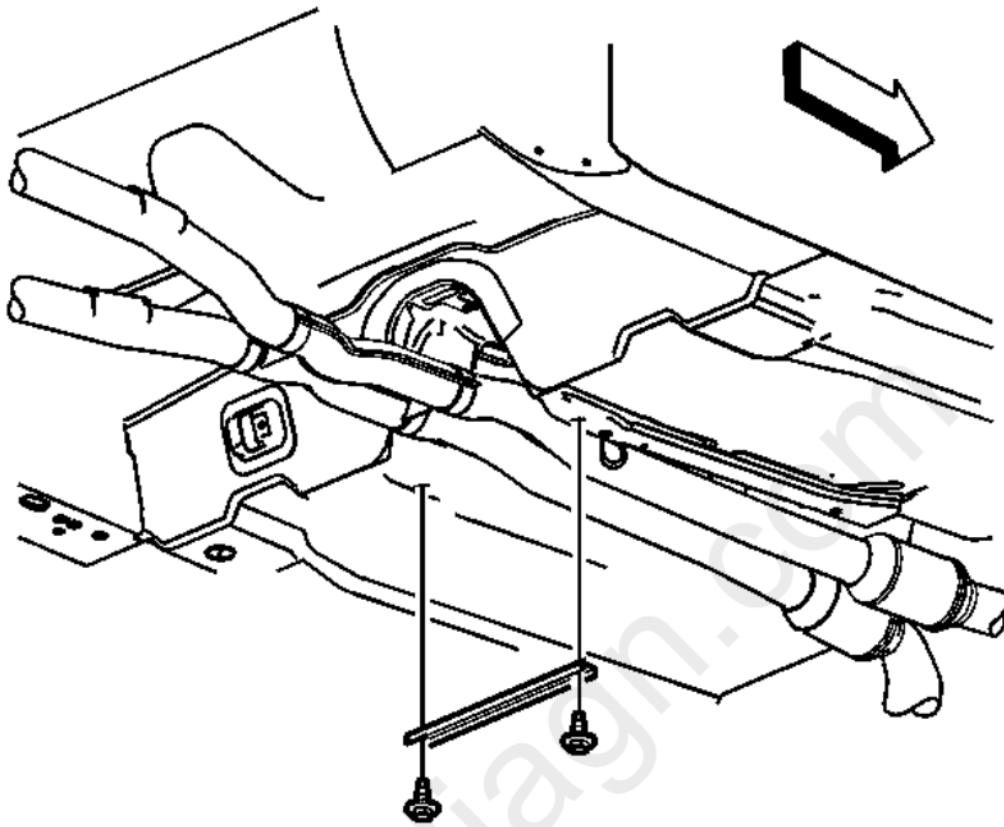


Fig. 21: Identifying Floor Panel Tunnel Brace And Bolts
Courtesy of GENERAL MOTORS CORP.

7. Install the floor panel tunnel brace to the floor panel.
8. Install the floor panel tunnel brace bolts and tighten to 25 N.m (18 lb ft).

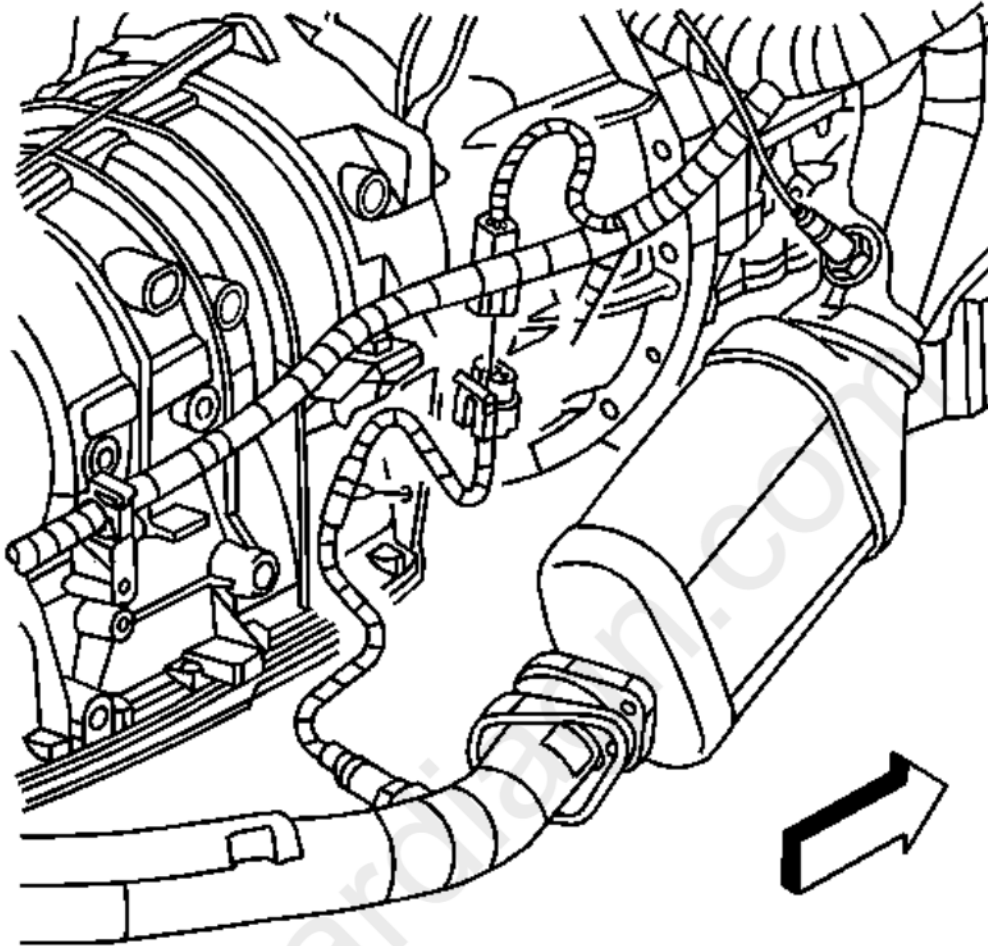


Fig. 22: View Of HO2S Electrical Connector, Sensor 2 (Bank 1 Shown, Bank 2 Similar)
Courtesy of GENERAL MOTORS CORP.

9. Connect the left and right bank 2 HO2S electrical connectors (bank 1 shown, bank 2 similar) to the harnesses.
10. Install the HO2S wiring harnesses to the transmission case.
11. Lower the vehicle.

EXHAUST SYSTEM REPLACEMENT (LSA-COUPE)

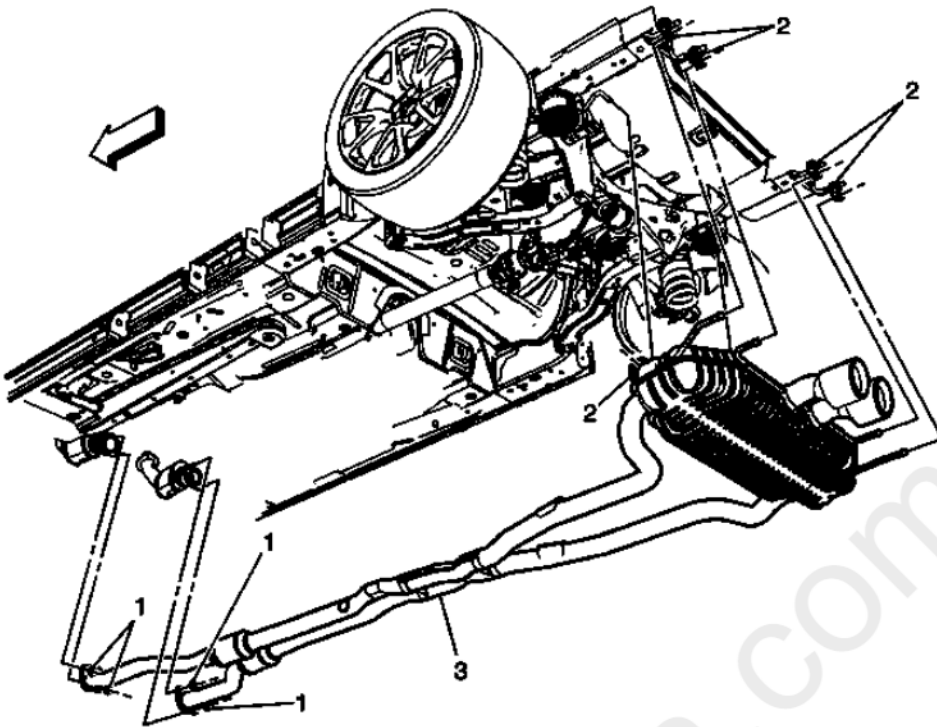


Fig. 23: Exhaust System (LSA-Coupe)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to <u>EXHAUST SERVICE WARNING</u> .	
WARNING: Refer to <u>PROTECTIVE GOGGLES AND GLOVE WARNING</u> .	
Preliminary Procedure	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the floor panel tunnel brace.	
1	Exhaust Pipe Nut (Qty: 4) CAUTION: Refer to <u>Exhaust System Inspection Caution</u> . Tighten: 17 N.m (12 lb ft).
2	Exhaust Insulators (Qty: 6)
3	Exhaust Muffler and Converters

EXHAUST SYSTEM REPLACEMENT (LF1-SEDAN/WAGON)

Removal Procedure

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

WARNING: Refer to EXHAUST SERVICE WARNING .

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the floor panel tunnel brace bolts.
3. Remove the floor panel tunnel brace from the floor panel.

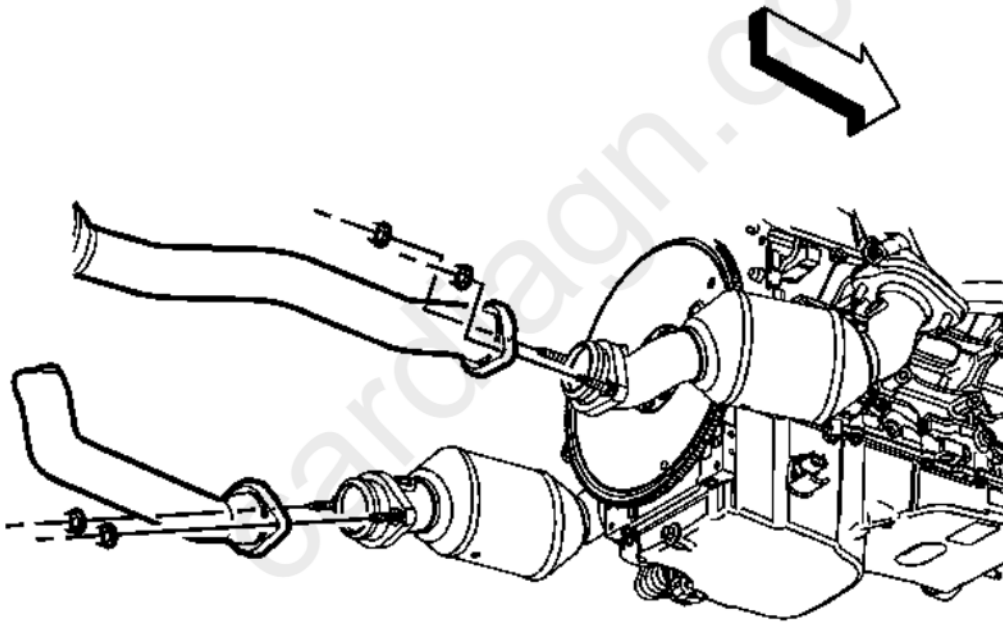


Fig. 24: View Of Catalytic Converter And Exhaust Pipe Nuts
Courtesy of GENERAL MOTORS CORP.

4. Remove the catalytic converter to the exhaust pipe nuts and separate the exhaust system from the catalytic converters.
5. Using an adjustable jack stand, support the rear of the exhaust system.
6. Apply a non petroleum based lubricant to the exhaust insulators and the hanger rods to aid in removal and installation.

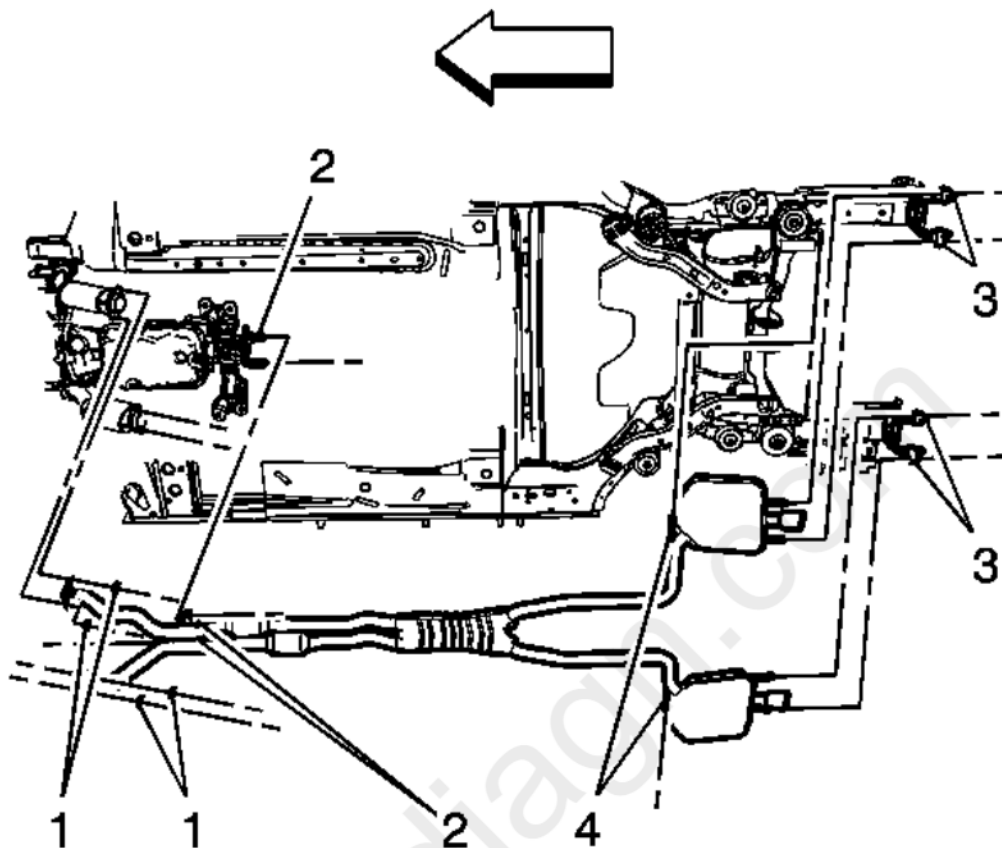


Fig. 25: Identifying Rear Muffler Insulators And Muffler Hanger Rods
Courtesy of GENERAL MOTORS CORP.

7. Remove the rear exhaust system insulators (3) from the exhaust hangers, leaving the insulators attached to the body hangers. Refer to **Exhaust System Insulator, Hanger, Bracket Replacement**.
8. With the aid of an assistant, lower the exhaust system (3) from the vehicle.
9. Remove the left bank and the right bank HO₂S from the exhaust system. Refer to **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LF1)** or **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2 (LLT)** and **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 (LF1)** or **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2 (LLT)**.

Installation Procedure

CAUTION: Refer to **Exhaust System Inspection Caution**.

CAUTION: Refer to Flex Decoupler Caution .

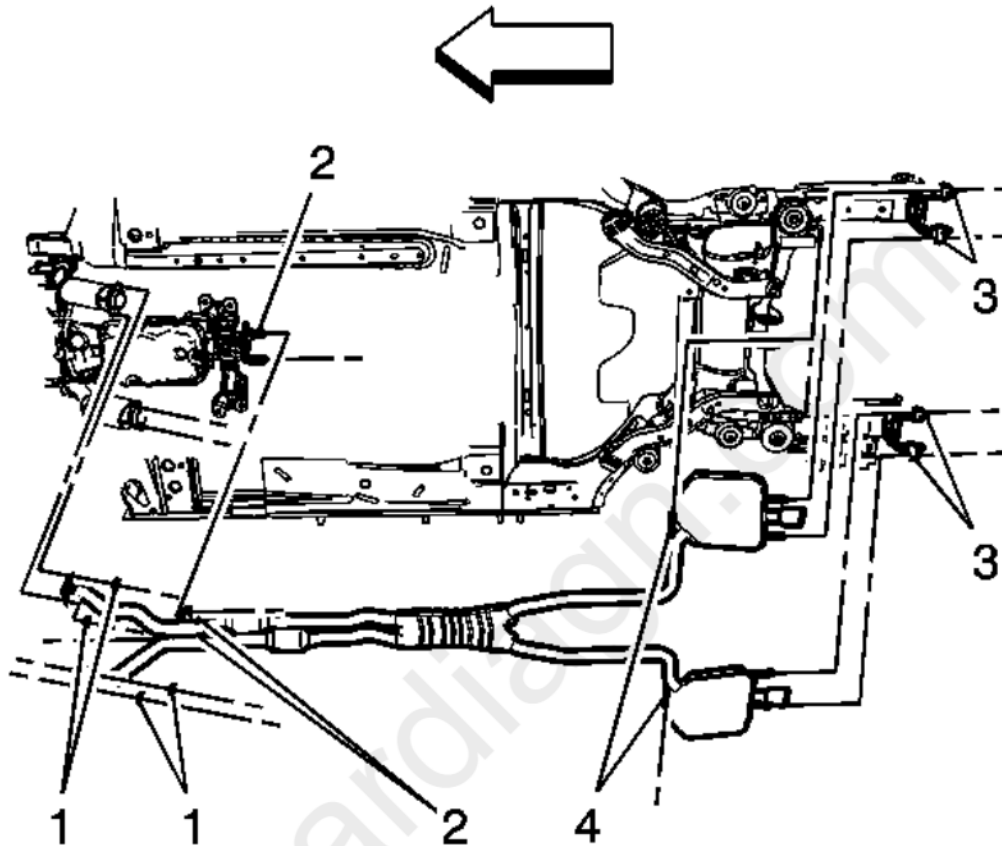


Fig. 26: Identifying Rear Muffler Insulators And Muffler Hanger Rods
Courtesy of GENERAL MOTORS CORP.

1. With the aid of an assistant, raise the exhaust system to the insulators (3) and to the catalytic converters.
2. Install the muffler hanger rods to the body insulators. Refer to **Exhaust System Insulator, Hanger, Bracket Replacement**.

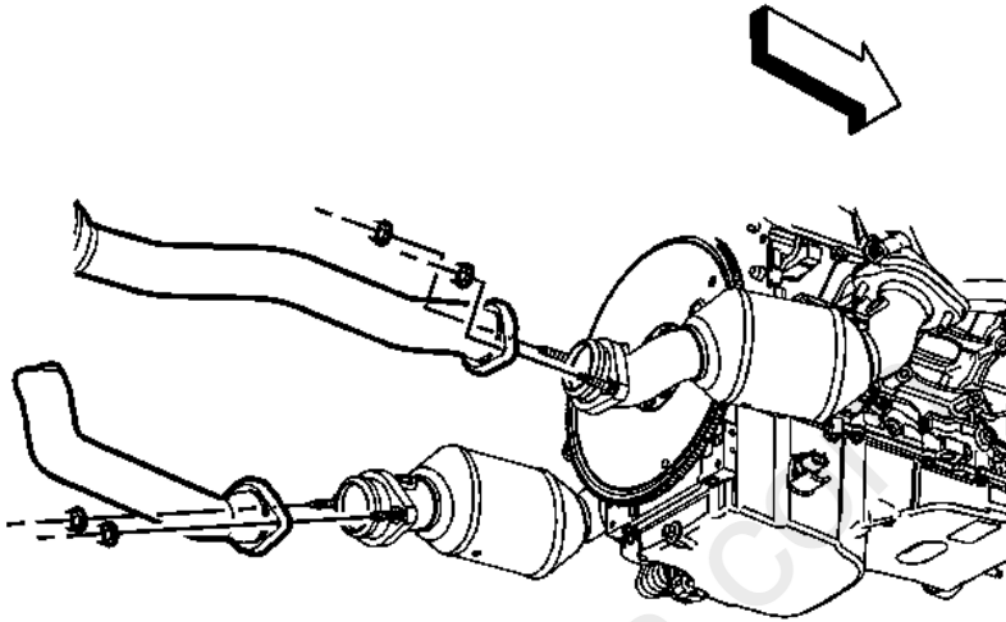


Fig. 27: View Of Catalytic Converter And Exhaust Pipe Nuts
Courtesy of GENERAL MOTORS CORP.

3. Position the exhaust pipe to the catalytic converters.

CAUTION: Refer to FASTENER CAUTION .

4. Install the catalytic converter to the exhaust pipe nuts and tighten to 17 N.m (13 lb ft).
5. Install the floor panel tunnel brace to the floor panel.
6. Install the floor panel tunnel brace bolts and tighten to 25 N.m (18 lb ft).
7. Lower the vehicle.
8. Inspect for exhaust leaks.

EXHAUST SYSTEM REPLACEMENT (LLT-COUPE)

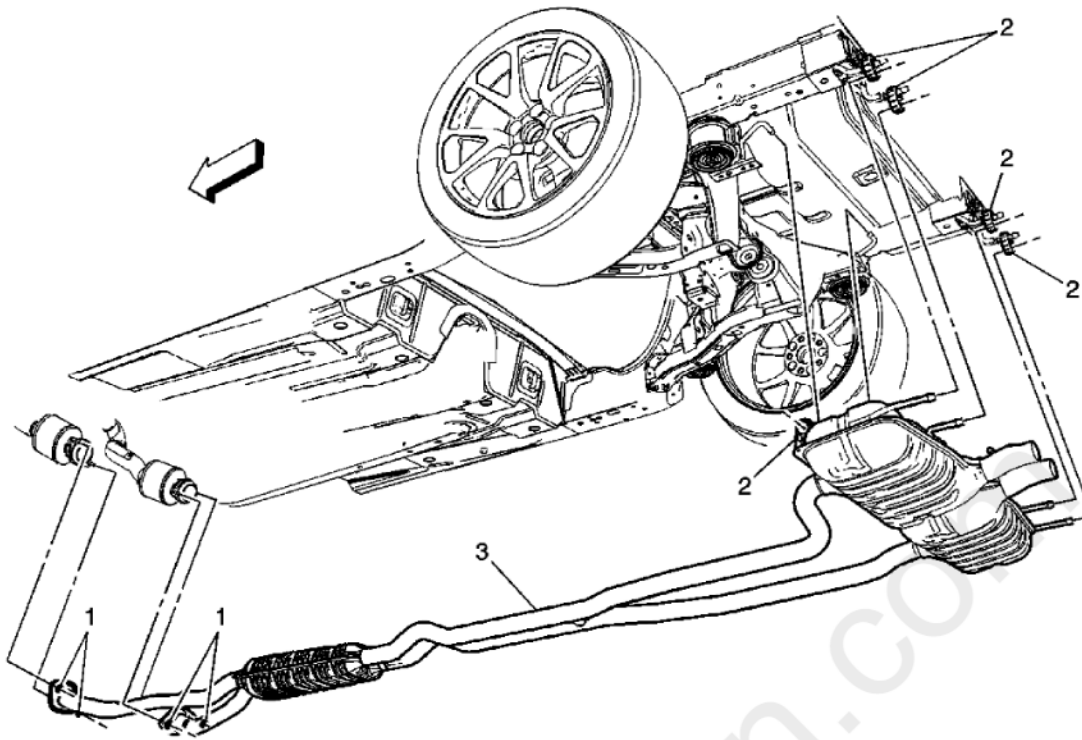
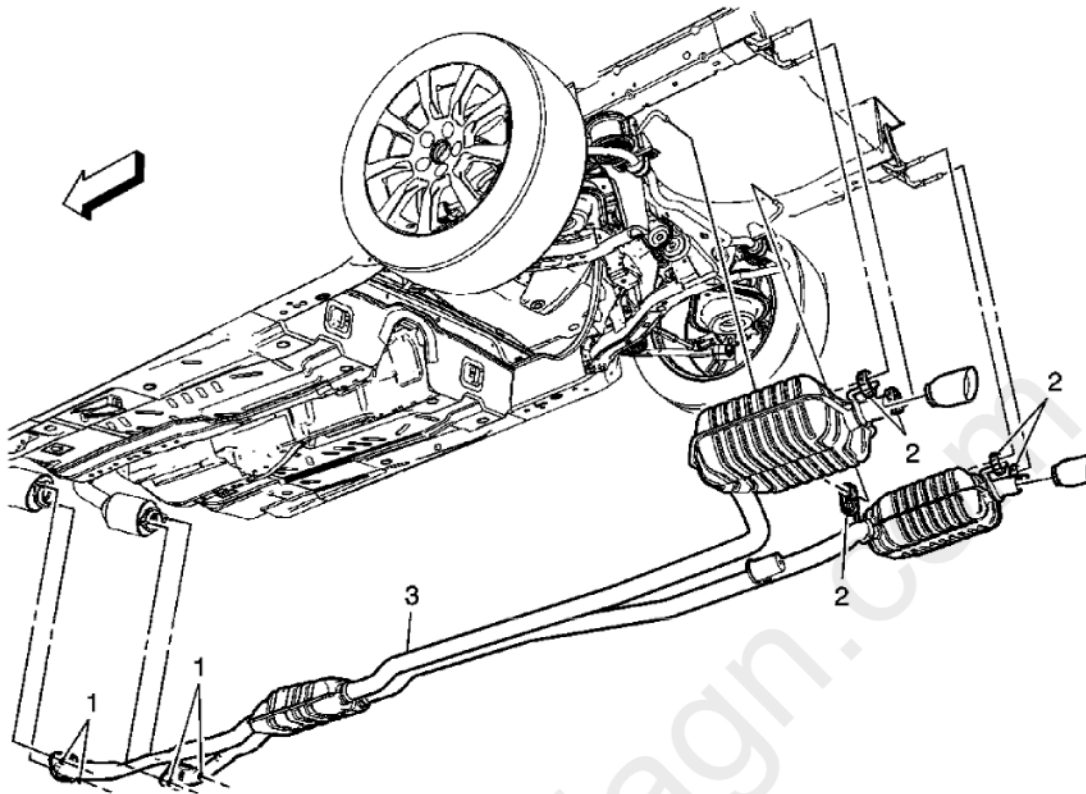


Fig. 28: Exhaust System (LLT-Coupe)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to <u>EXHAUST SERVICE WARNING</u> .	
WARNING: Refer to <u>PROTECTIVE GOGGLES AND GLOVE WARNING</u> .	
Preliminary Procedure	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the floor panel tunnel brace.	
1	Exhaust Pipe Nut (Qty: 4) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 17 N.m (12 lb ft).
2	Exhaust Insulators (Qty: 6)
3	Exhaust Muffler and Resonator

EXHAUST SYSTEM REPLACEMENT (LLT-SEDAN/WAGON)**Fig. 29: Exhaust System (LLT-Sedan/Wagon)**

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to <u>EXHAUST SERVICE WARNING</u> .	
WARNING: Refer to <u>PROTECTIVE GOGGLES AND GLOVE WARNING</u> .	
Preliminary Procedure	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the floor panel tunnel brace.	
1	Exhaust Pipe Nut (Qty: 4) CAUTION: Refer to <u>FASTENER CAUTION</u> .

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

	Tighten: 17 N.m (12 lb ft).
2	Exhaust Insulators (Qty: 6)
3	Exhaust Muffler and Resonator

EXHAUST SYSTEM REPLACEMENT (LSA-SEDAN/WAGON)

Servicing of the muffler, resonator or pipe requires the replacement of the exhaust system as a complete one-piece unit.

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
2. Remove the bolts securing the floor panel tunnel brace to the floor panel.
3. Remove the floor panel tunnel brace from the floor panel.
4. Suitably support the exhaust system.
5. Remove the exhaust pipe nuts securing the exhaust pipes to the catalytic converters.

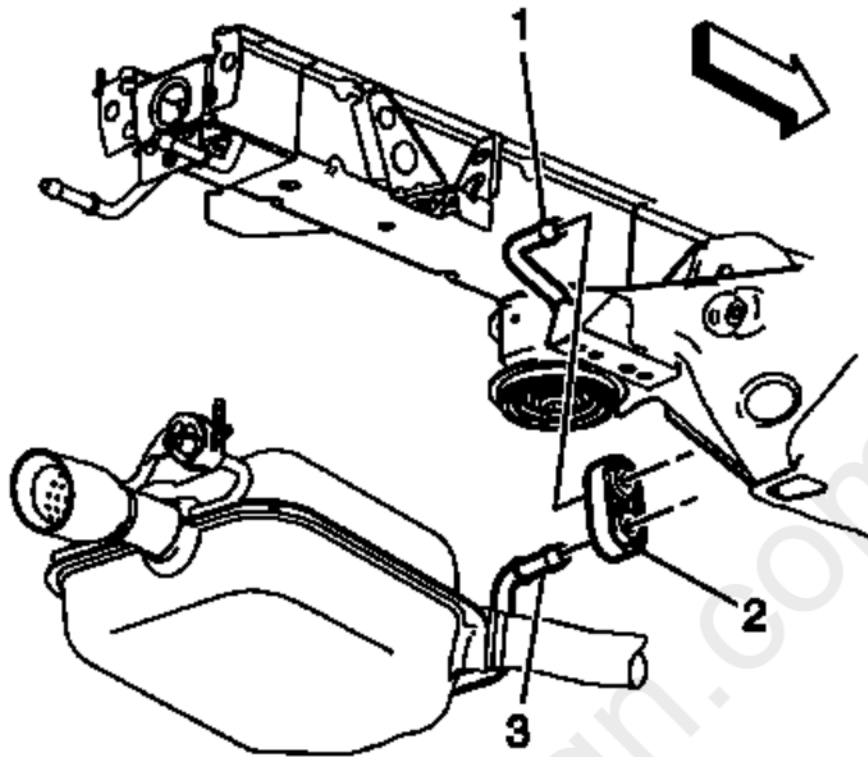


Fig. 30: Identifying Front Exhaust Hangers And Rear Suspension Hanger Rods
Courtesy of GENERAL MOTORS CORP.

6. Pry the front exhaust hangers (1) free from the rear suspension hanger rods.

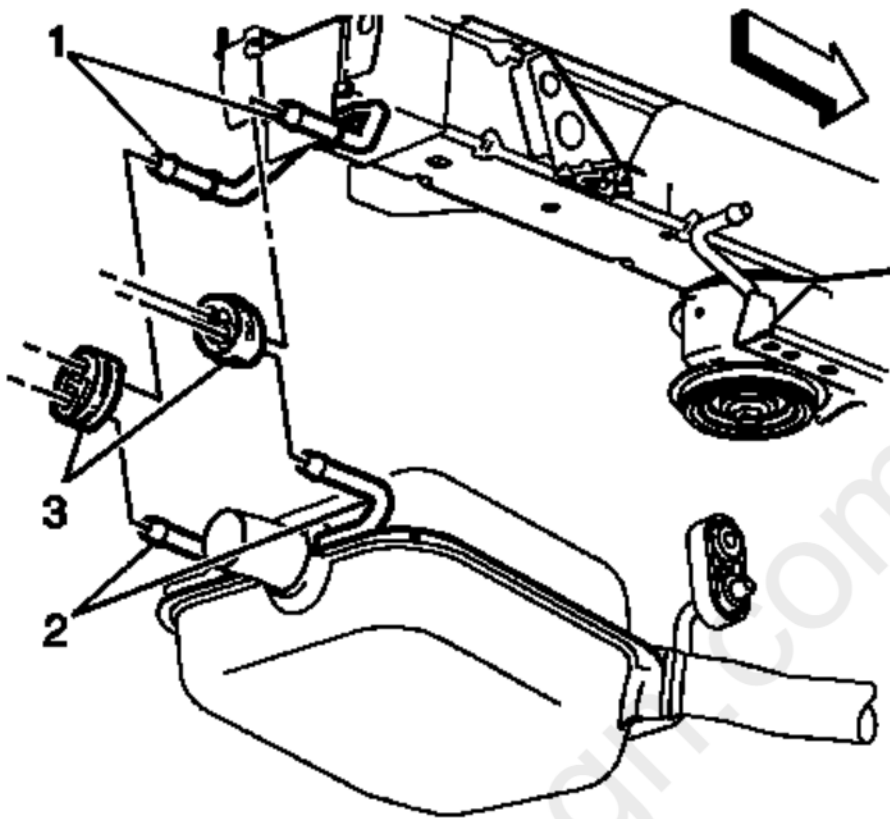


Fig. 31: View Tail Pipe Hangers And Tail Pipe Insulators
Courtesy of GENERAL MOTORS CORP.

7. Apply a suitable lubricant to the tail pipe hanger rods in order to ease the removal of the tail pipe hanger Insulators (3).
8. Pry the tail pipe hangers (1) free from the tail pipe insulators (3).

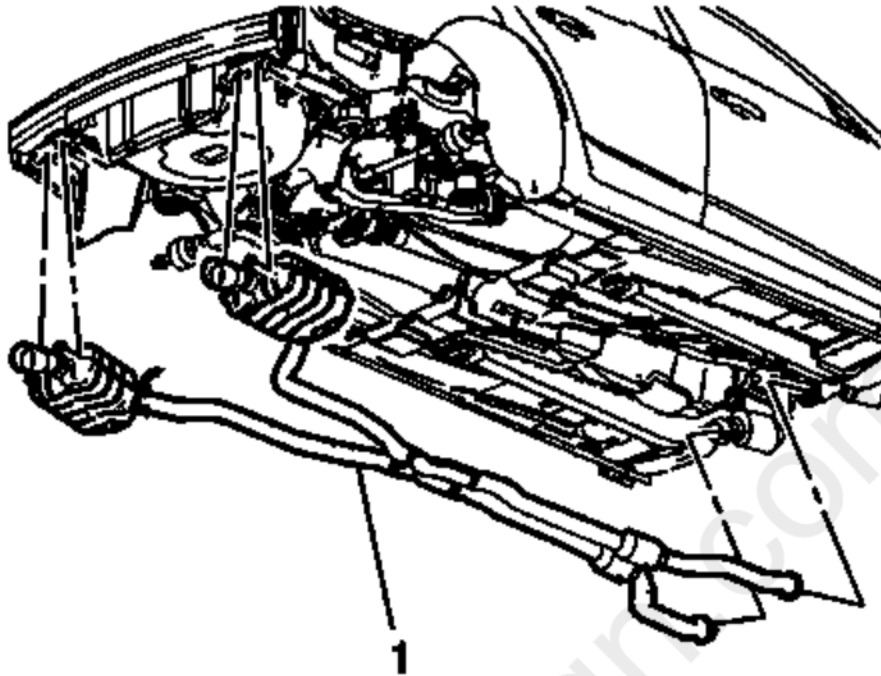


Fig. 32: Identifying Exhaust System

Courtesy of GENERAL MOTORS CORP.

9. With the aid of an assistant, lower the exhaust system (1).
10. Remove the catalytic converter seals. Do not reuse the seals.

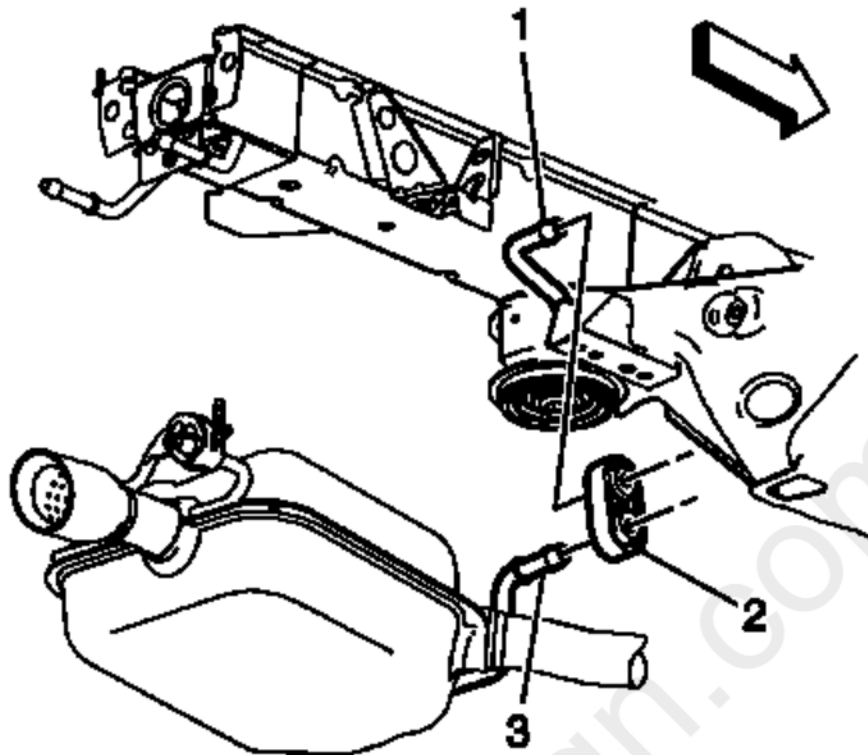


Fig. 33: Identifying Front Exhaust Hangers And Rear Suspension Hanger Rods
Courtesy of GENERAL MOTORS CORP.

11. While the exhaust system is on the floor complete the following:
 1. Apply a suitable lubricant to the exhaust pipe hanger rods (3) in order to ease the removal of the front exhaust hanger insulators (2).
 2. Pull the front exhaust hanger insulators (2) from the exhaust pipe hanger rods.

Installation Procedure

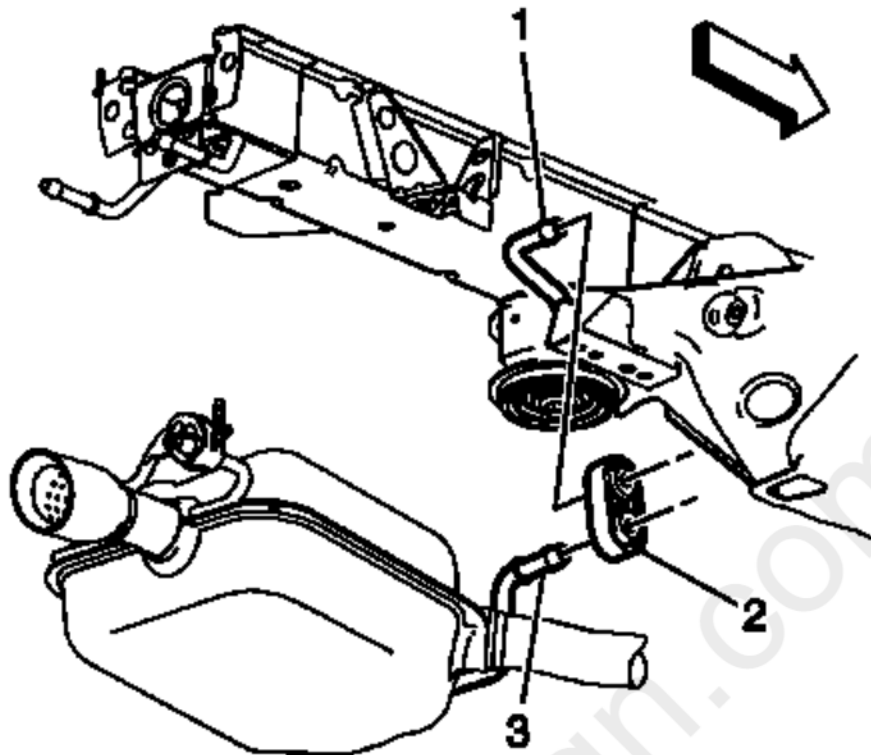


Fig. 34: Identifying Front Exhaust Hangers And Rear Suspension Hanger Rods
Courtesy of GENERAL MOTORS CORP.

1. While the exhaust system is on the floor complete the following:
 1. Apply a soapy solution to the following in order to ease the installation of the hangers:
 - The inner diameter of the front exhaust hangers
 - The exhaust pipe hanger rods (3)
 - The inner diameter of the tail pipe hanger insulators (2)
 - The tail pipe hanger rods (1)
 2. Press the front exhaust hangers over the exhaust pipe hanger rods.
2. Place NEW seals on the catalytic converter flanges.

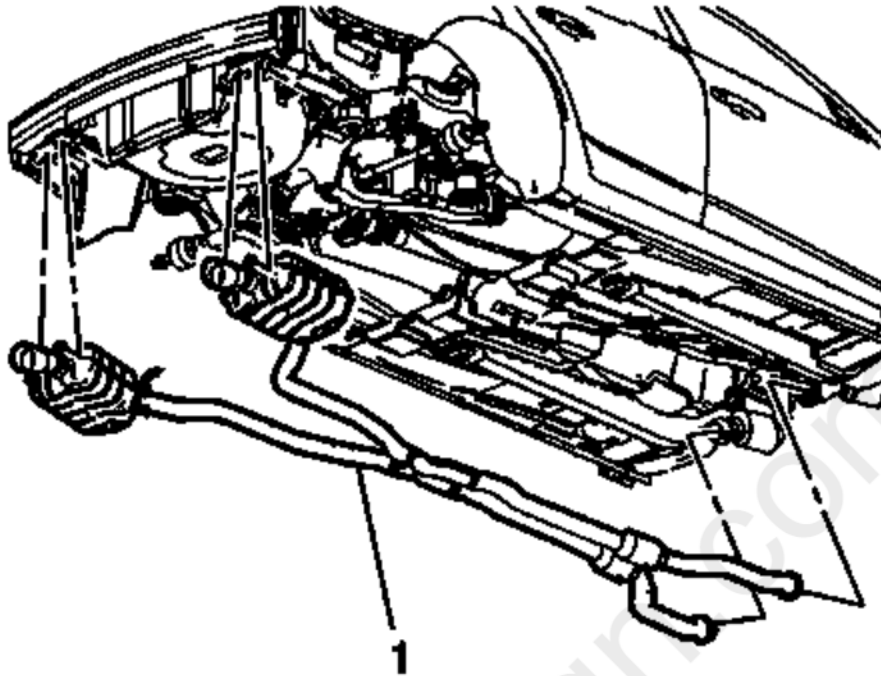


Fig. 35: Identifying Exhaust System

Courtesy of GENERAL MOTORS CORP.

3. With the aid of an assistant, raise the exhaust system (1) into position, aligning the exhaust pipe flanges with the studs located in the rear of the catalytic converters.
4. Finger tighten the exhaust pipe nuts to the catalytic converter studs.

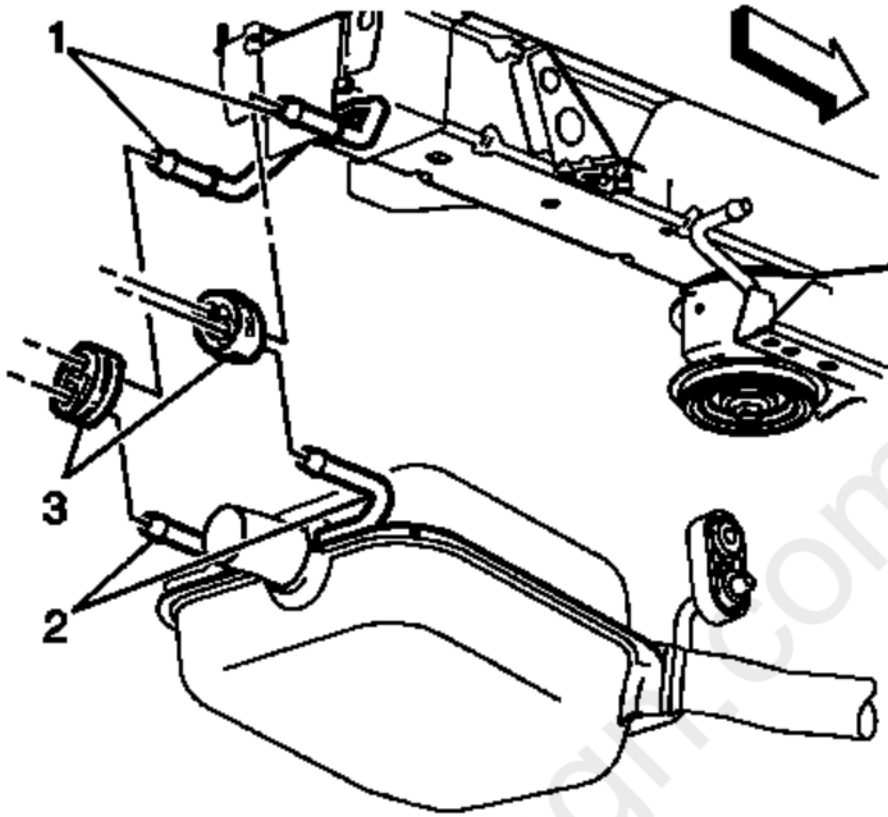


Fig. 36: View Tail Pipe Hangers And Tail Pipe Insulators
 Courtesy of GENERAL MOTORS CORP.

5. Press the tail pipe hanger insulators (3) over the tail pipe hanger rods.

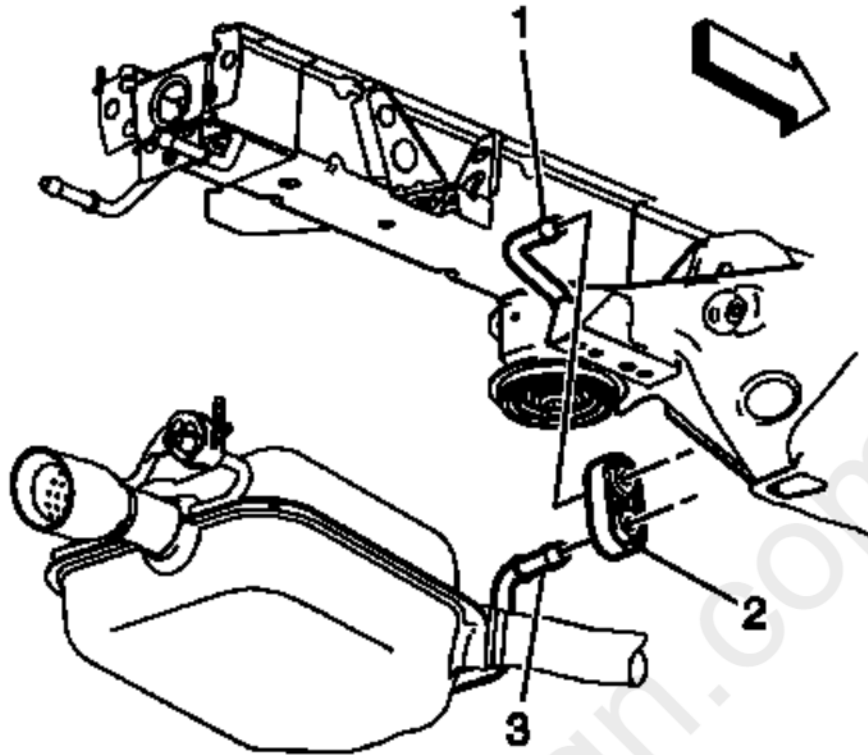


Fig. 37: Identifying Front Exhaust Hangers And Rear Suspension Hanger Rods
 Courtesy of GENERAL MOTORS CORP.

6. Press the front exhaust hanger insulators (2) over the rear suspension hanger rods (1).

CAUTION: Refer to FASTENER CAUTION .

7. Tighten the exhaust pipe nuts to 17 N.m (13 lb ft).
8. Position the floor panel tunnel brace to the floor panel.
9. Install the bolts securing the floor panel tunnel brace to the floor panel and tighten to 25 N.m (18 lb ft).
10. Lower the vehicle.

CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE (LF1)

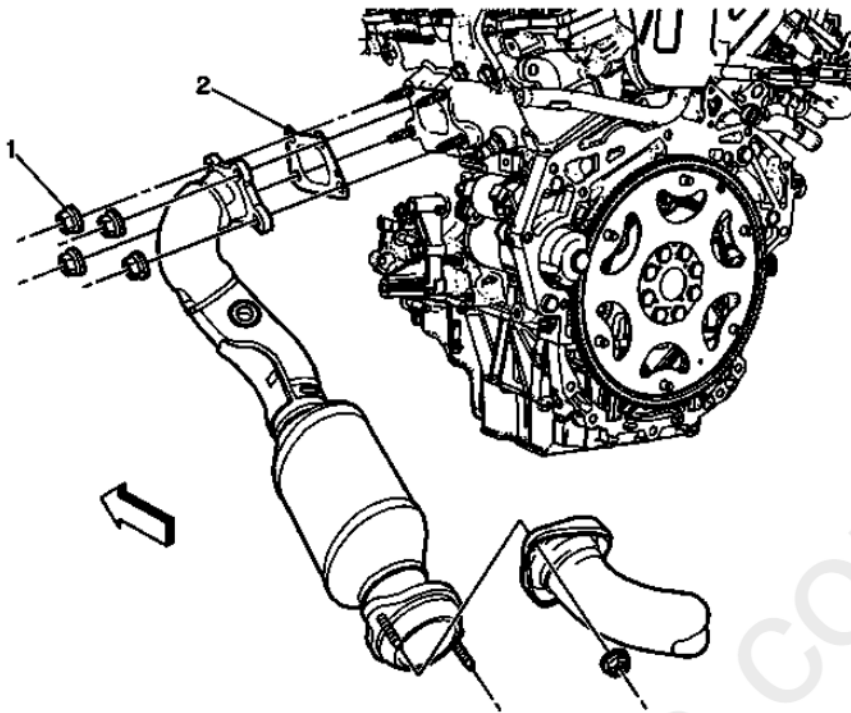


Fig. 38: Catalytic Converter Replacement - Left Side (LF1)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the exhaust muffler. Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u> .	
1	Catalytic Converter Nut (Qty: 4) CAUTION: Refer to. CAUTION: To prevent damage to the exhaust manifold flange or stud, make sure the flange is fully seated before tightening. Procedure 1. Remove and inspect the nuts, replace as necessary. 2. Clean and inspect the studs on the engine cylinder head, replace as necessary. 3. Verify that the studs are fully seated. Stud collar should touch the surface of the engine cylinder head.

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

4. Tighten nuts in a criss-cross pattern.

Tighten:

- First Pass: 20 N.m (15 lb ft)
- Final Pass: 46 N.m (34 lb ft)

CAUTION:

To prevent damage to the studs or flange, make sure flange is fully seated before tightening.

2

Gasket

Tip: Replace the gasket with a new one.

CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE (LLT)

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

1. Remove the exhaust manifold heat shield. Refer to Exhaust Manifold Heat Shield Replacement - Left Side (LLT) or Exhaust Manifold Heat Shield Replacement - Left Side (LSA).

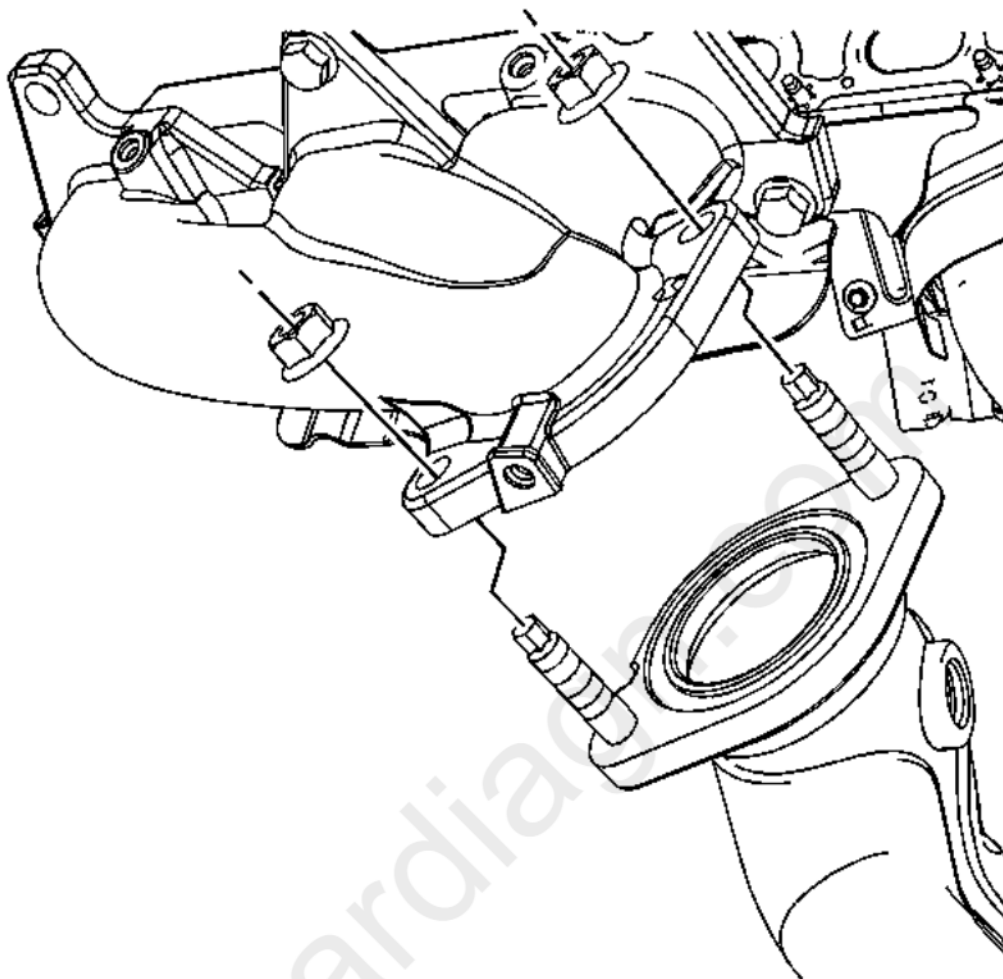


Fig. 39: View of Catalytic Converter & Nuts
Courtesy of GENERAL MOTORS CORP.

2. Remove the catalytic converter nuts.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Disconnect the oxygen sensor electrical connector.

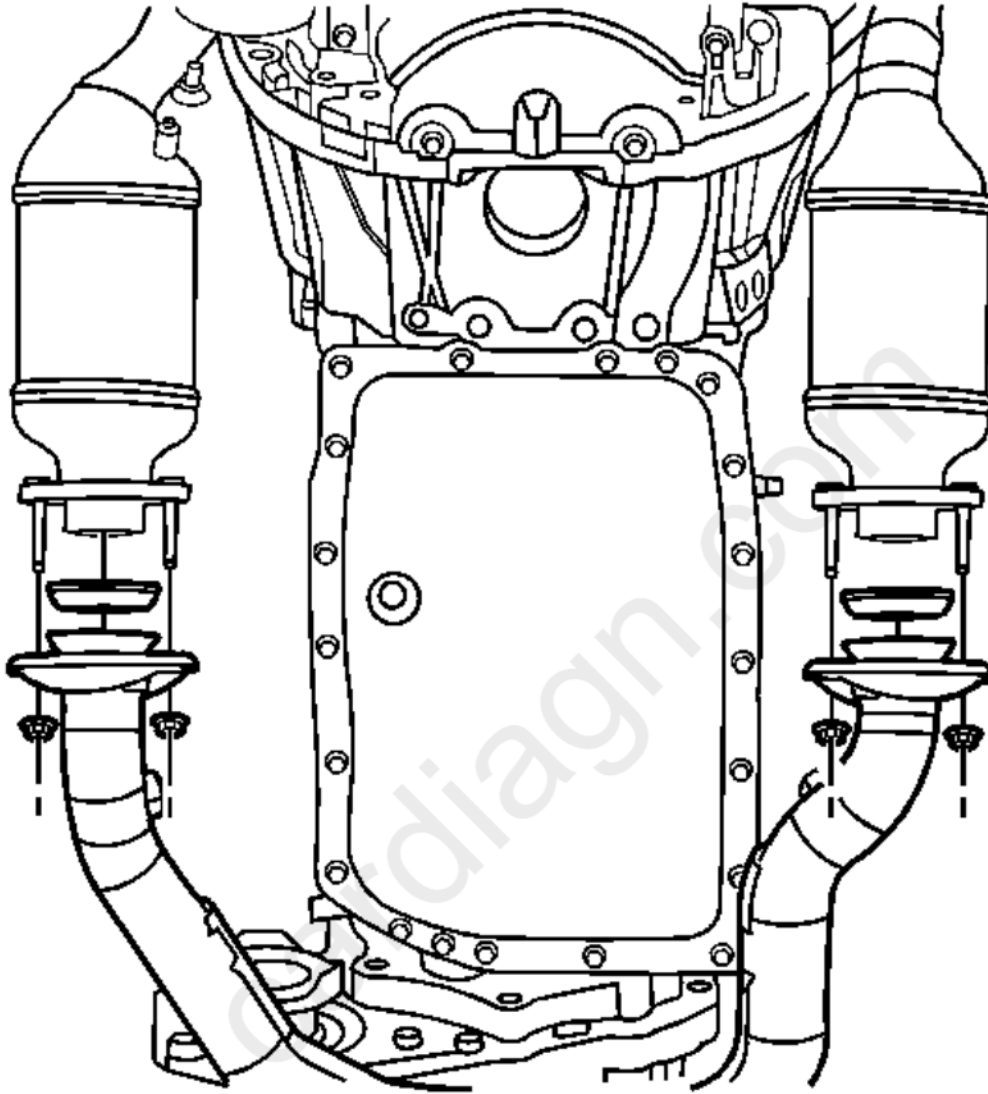


Fig. 40: Identifying Muffler Pipes At Left And Right Side Catalytic Converters
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the muffler pipe from the left and the right side catalytic converters.
6. Carefully remove the catalytic converter with the seal/heat shield and oxygen sensor from the exhaust manifold. Remove and discard the catalytic converter inlet seal/heat shield from the converter assembly. Do not reuse.
7. Remove the oxygen sensor from the catalytic converter. Refer to **Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LF1)** or **Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LLT)** .

Installation Procedure

1. Install the oxygen sensor to the catalytic converter. Refer to Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LF1) or Heated Oxygen Sensor Replacement - Bank 2 Sensor 1 (LLT) .

NOTE: Do not reuse the catalytic converter inlet seal/heat shield. Always replace with new.

2. Install the NEW catalytic converter seal/heat shield to the catalytic converter.

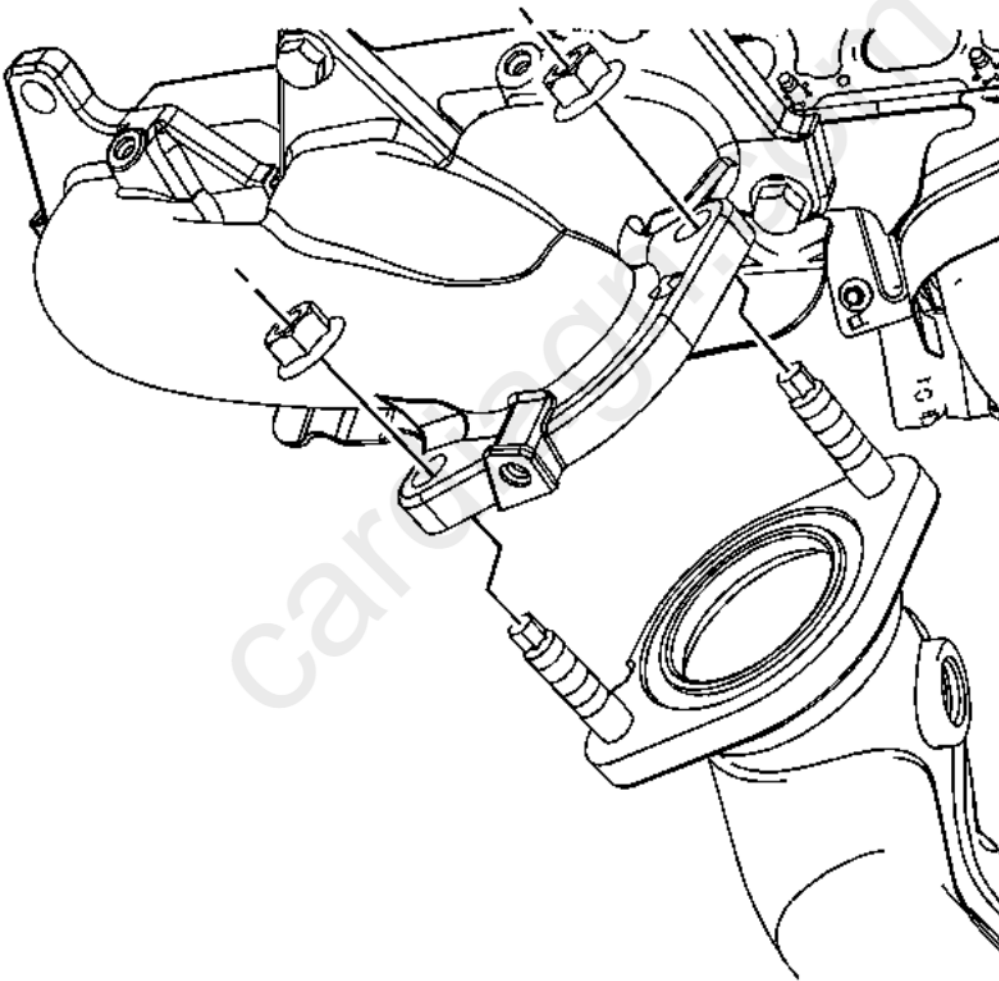


Fig. 41: View of Catalytic Converter & Nuts
Courtesy of GENERAL MOTORS CORP.

3. Install the catalytic converter to the exhaust manifold.
4. Partially install the catalytic converter nuts to the exhaust manifold.
5. Connect the oxygen sensor electrical connector.

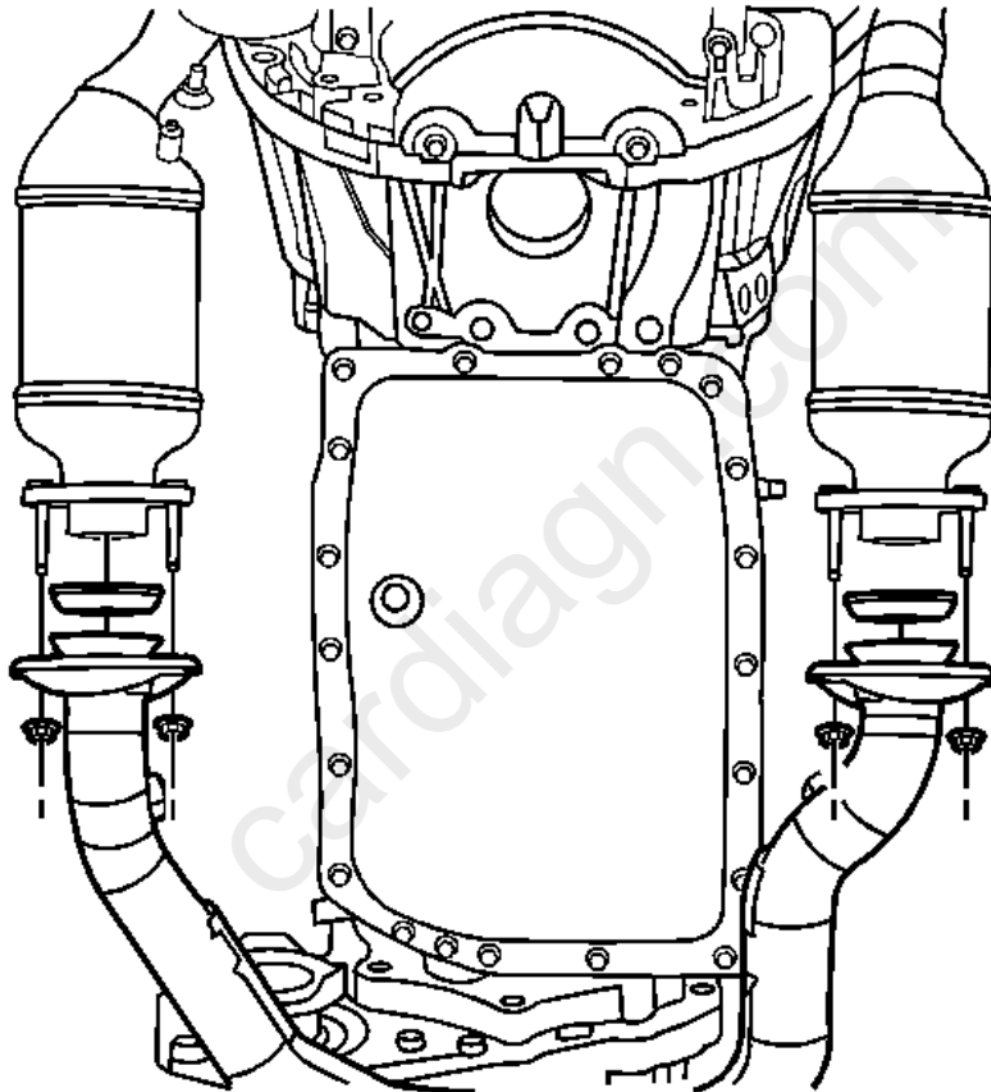


Fig. 42: Identifying Muffler Pipes At Left And Right Side Catalytic Converters
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE: **Inspect the catalytic converter seals. Replace the seals if they are worn or damaged.**

6. Install the exhaust pipe to the left and the right side catalytic converters and tighten to 17 N.m (13 lb ft).
7. Lower the vehicle.
8. Tighten the catalytic converter to exhaust manifold nuts to 50 N.m (37 lb ft).
9. Install the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Left Side (LLT)** or **Exhaust Manifold Heat Shield Replacement - Left Side (LSA)**.
10. Inspect the exhaust system for leaks.

CATALYTIC CONVERTER REPLACEMENT - LEFT SIDE (LSA)

Removal Procedure

WARNING: Refer to **EXHAUST SERVICE WARNING** .

WARNING: Refer to **PROTECTIVE GOGGLES AND GLOVE WARNING** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Support the exhaust with a suitable screw jack.

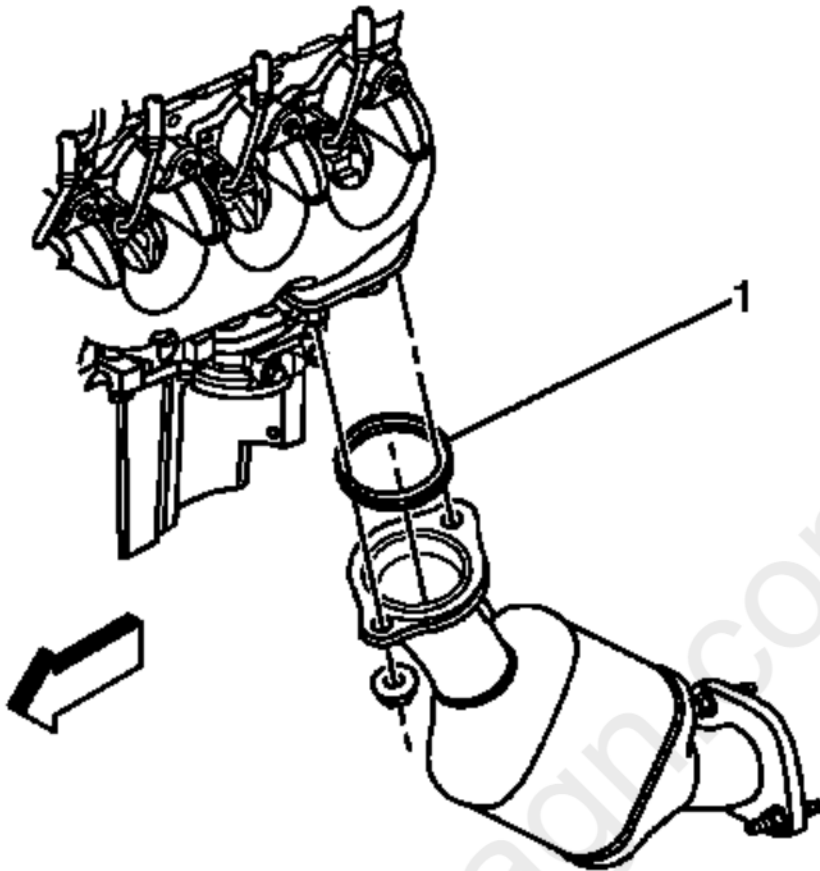


Fig. 43: View Of Left Catalytic Converter & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the exhaust system from the left and right side catalytic converters. Refer to **Exhaust System Replacement (LF1-Single)** or **Exhaust System Replacement (LSA-Coupe)** or **Exhaust System Replacement (LF1-Sedan/Wagon)** or **Exhaust System Replacement (LLT-Coupe)** or **Exhaust System Replacement (LLT-Sedan/Wagon)** or **Exhaust System Replacement (LSA-Sedan/Wagon)**.
4. Using the screw jack, lower the exhaust system.
5. Disconnect the oxygen sensor electrical connectors.
6. Remove the left bank catalytic converter to exhaust manifold nuts.
7. Carefully remove the catalytic converter with the gasket (1) and oxygen sensors from the exhaust manifold.
8. Remove the oxygen sensors from the catalytic converter. Refer to **Heated Oxygen Sensor Replacement - Bank 1 Sensor 1** and **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2**.

Installation Procedure

1. Install the oxygen sensors to the catalytic converter. Refer to **Heated Oxygen Sensor Replacement - Bank 1 Sensor 1** and **Heated Oxygen Sensor Replacement - Bank 1 Sensor 2**.

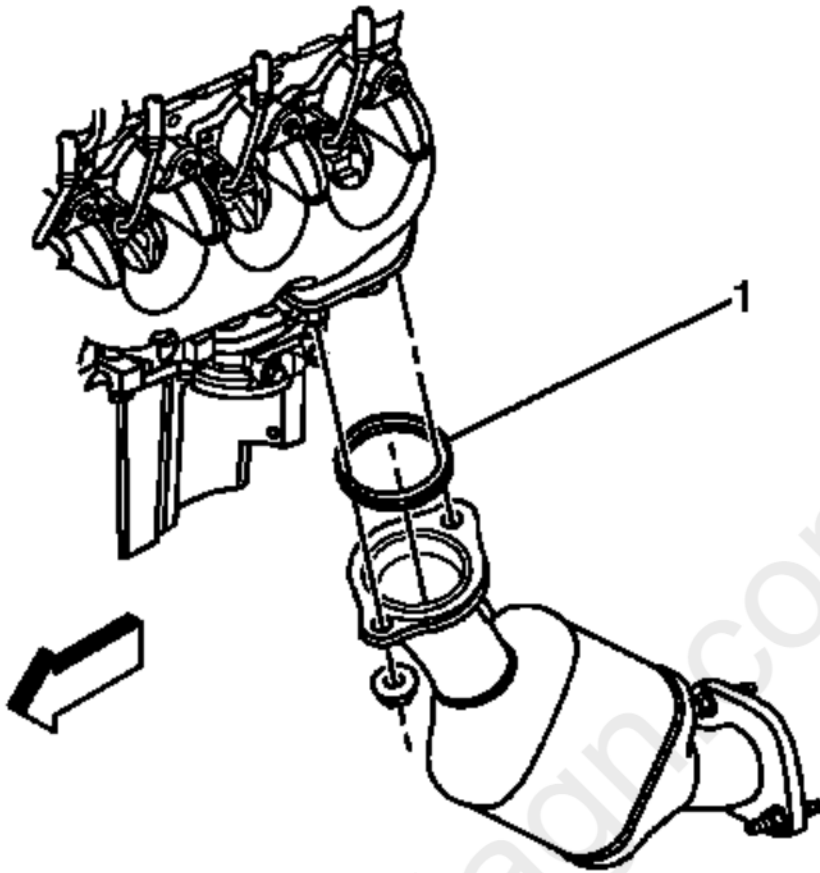


Fig. 44: View Of Left Catalytic Converter & Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install the catalytic converter gasket (1) to the catalytic converter.
3. Carefully install the catalytic converter to the exhaust manifold.

CAUTION: Refer to FASTENER CAUTION .

4. Install the catalytic converter nuts and tighten to 50 N.m (37 lb ft).
5. Connect the oxygen sensor electrical connectors.
6. Using the screw jack, raise the exhaust system.
7. Connect the exhaust system to the left and right side catalytic converters. Refer to Exhaust System Replacement (LF1-Single) or Exhaust System Replacement (LSA-Coupe) or Exhaust System Replacement (LF1-Sedan/Wagon) or Exhaust System Replacement (LLT-Coupe) or Exhaust System Replacement (LLT-Sedan/Wagon) or Exhaust System Replacement (LSA-Sedan/Wagon).
8. Remove the screw jack.
9. Lower the vehicle.

CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE (LF1)

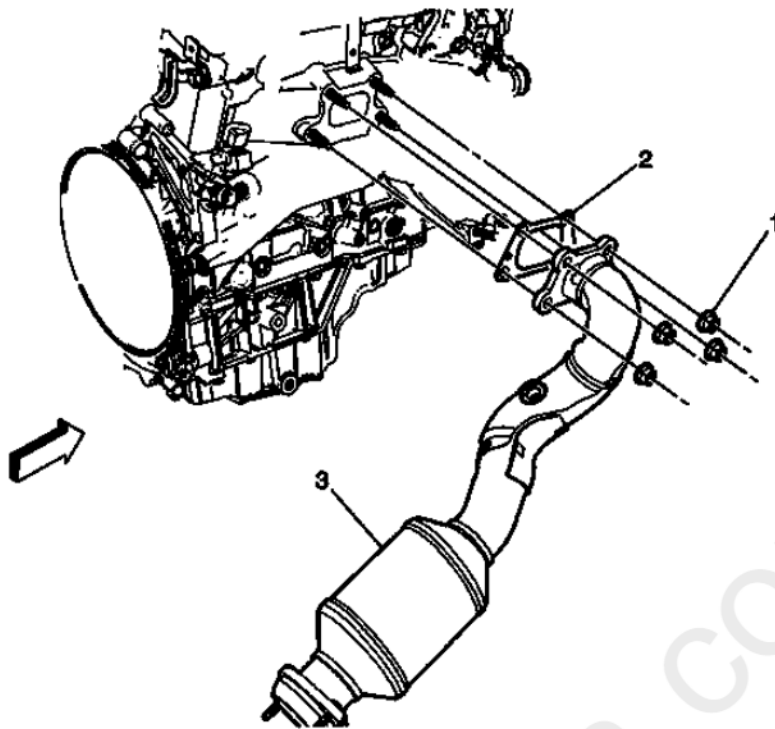


Fig. 45: Catalytic Converter Replacement - Right Side (LF1)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the exhaust muffler. Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u> .	
1	Catalytic Converter Nut (Qty: 4) CAUTION: Refer to <u>FASTENER CAUTION</u> . CAUTION: To prevent damage to the exhaust manifold flange or stud, make sure the flange is fully seated before tightening. Procedure 1. Remove and inspect the nuts, replace as necessary. 2. Clean and inspect the studs on the engine cylinder head, replace as necessary. 3. Verify that the studs are fully seated. Stud collar should touch the surface of the engine cylinder head.

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

	4. Tighten nuts in a criss-cross pattern. Tighten: • First Pass: 20 N.m (15 lb ft) • Final Pass: 46 N.m (34 lb ft)
2	Gasket Tip: Replace the gasket with a new one.
3	Catalytic Converter

CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE (LLT)

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

1. Remove the exhaust manifold heat shield. Refer to Exhaust Manifold Heat Shield Replacement - Right Side (LLT) or Exhaust Manifold Heat Shield Replacement - Right Side (LSA).

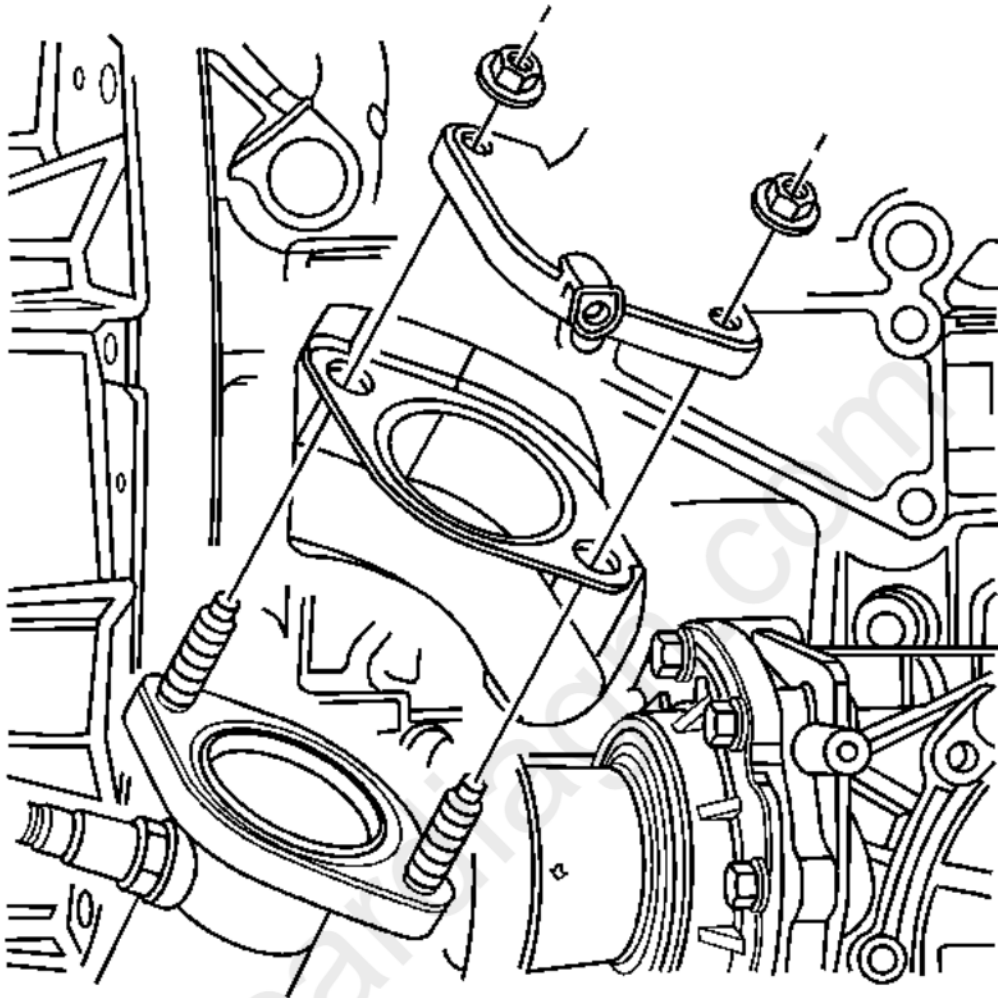


Fig. 46: View Of Right Catalytic Converter - LY7
Courtesy of GENERAL MOTORS CORP.

2. Remove the catalytic converter nuts.
3. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
4. Disconnect the oxygen sensor electrical connector.

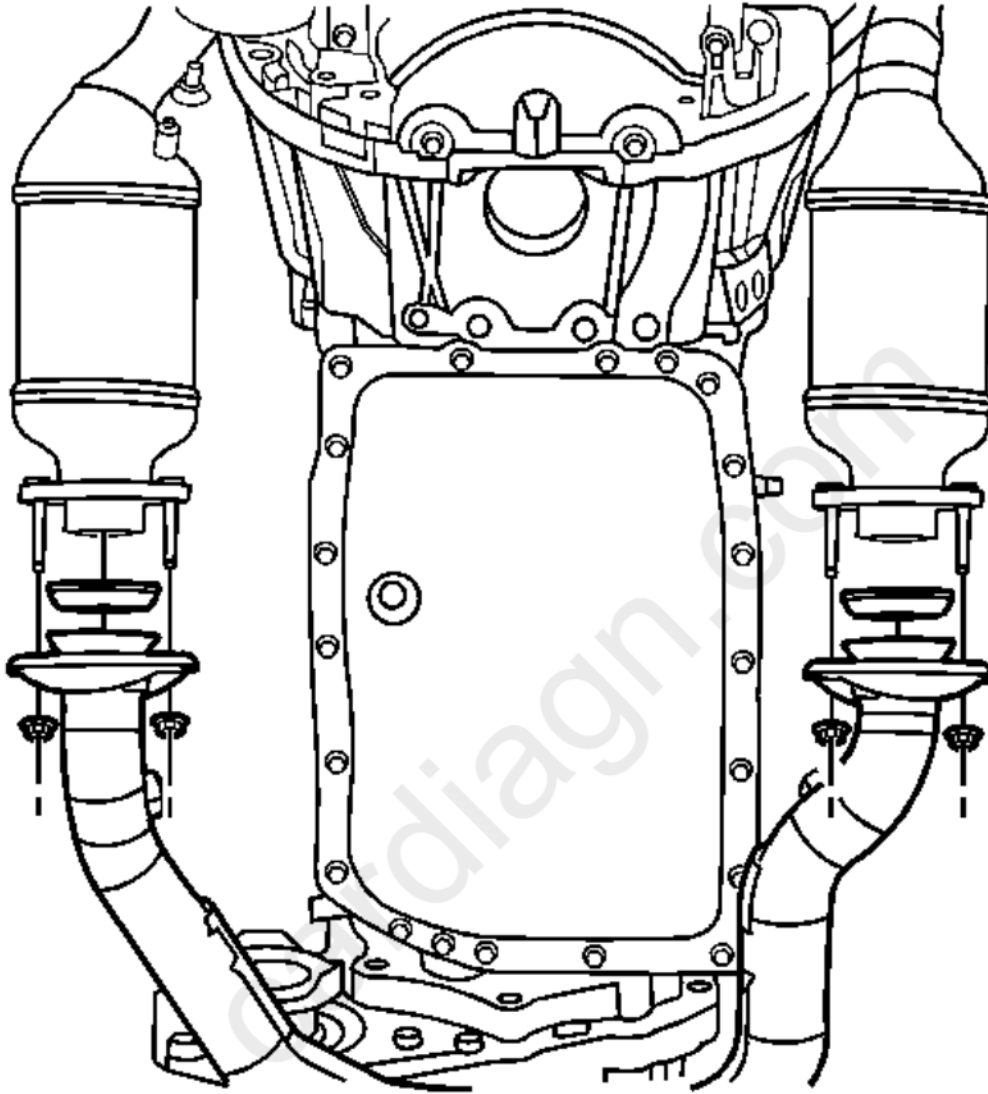


Fig. 47: Identifying Muffler Pipes At Left And Right Side Catalytic Converters
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the exhaust pipe from the left and right side catalytic converters.
6. Remove the catalytic converter with the seal/heat shield and oxygen sensor from the exhaust manifold. Remove and discard the catalytic converter inlet seal/heat shield from the converter assembly. Do not reuse.
7. Remove the oxygen sensor from the catalytic converter. Refer to **Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LF1)** or **Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LLT)** .

Installation Procedure

1. Install the oxygen sensor to the catalytic converter. Refer to Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LF1) or Heated Oxygen Sensor Replacement - Bank 1 Sensor 1 (LLT) .

NOTE: Do not reuse the catalytic converter inlet seal/heat shield. Always replace with new.

2. Install the NEW catalytic converter seal/heat shield to the catalytic converter.

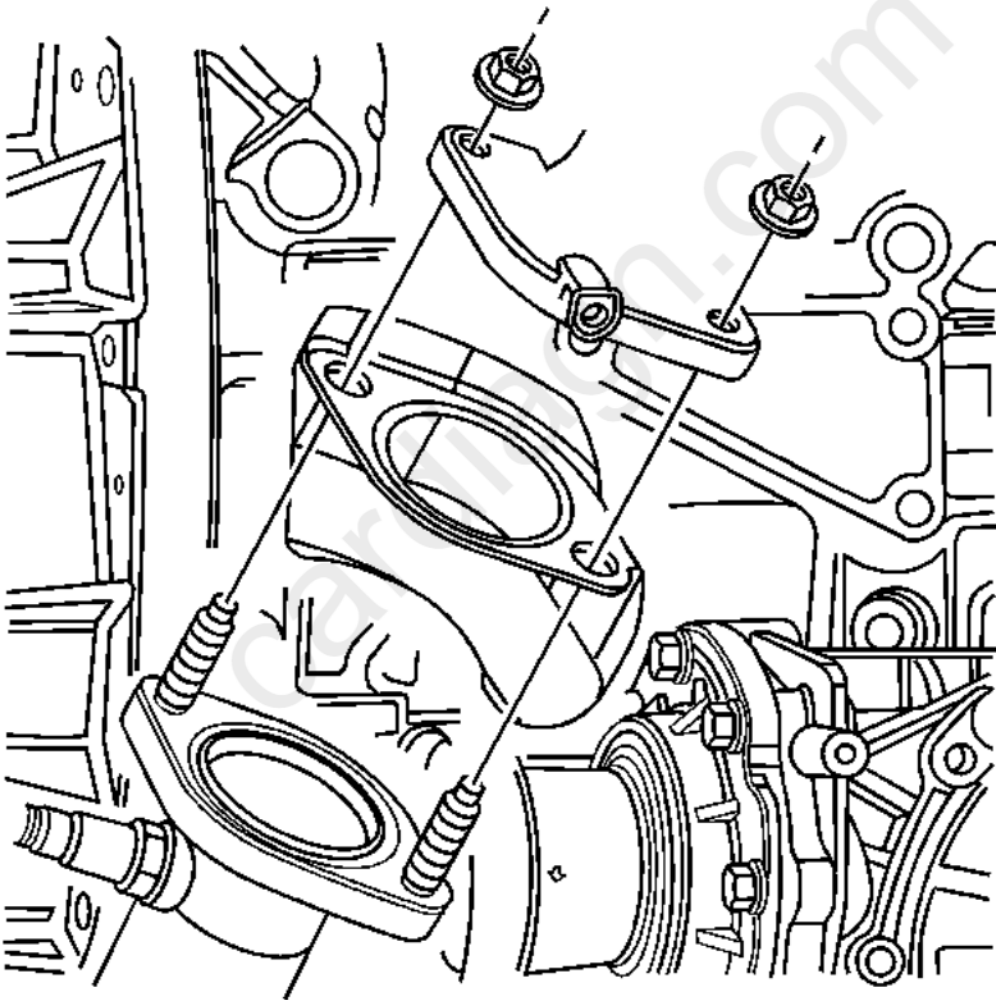


Fig. 48: View Of Right Catalytic Converter - LY7
Courtesy of GENERAL MOTORS CORP.

3. Install the catalytic converter to the exhaust manifold.
4. Partially install the catalytic converter to exhaust manifold nuts.
5. Connect the oxygen sensor electrical connector.

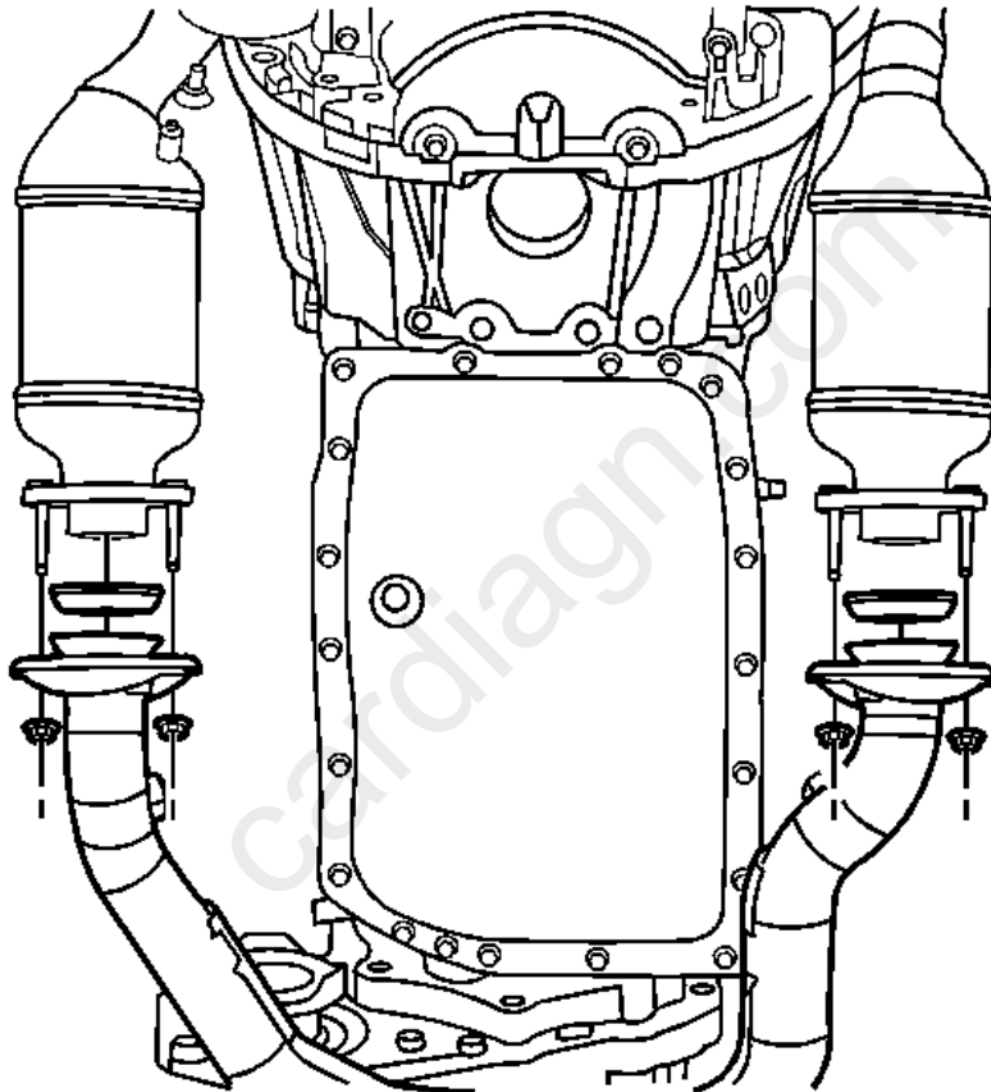


Fig. 49: Identifying Muffler Pipes At Left And Right Side Catalytic Converters
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE: **Inspect the catalytic converter seal. Replace the seal if it is worn or damaged.**

6. Install the exhaust pipes and nuts to the left and right side catalytic converters and tighten to 17 N.m (13 lb ft).
7. Lower the vehicle.
8. Tighten the catalytic converter nuts to 50 N.m (37 lb ft).
9. Install the exhaust manifold heat shield. Refer to **Exhaust Manifold Heat Shield Replacement - Right Side (LLT)** or **Exhaust Manifold Heat Shield Replacement - Right Side (LSA)**.
10. Inspect the exhaust system for leaks.

CATALYTIC CONVERTER REPLACEMENT - RIGHT SIDE (LSA)

Removal Procedure

WARNING: Refer to **EXHAUST SERVICE WARNING** .

WARNING: Refer to **PROTECTIVE GOGGLES AND GLOVE WARNING** .

1. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** .
2. Support the exhaust with a suitable screw jack.

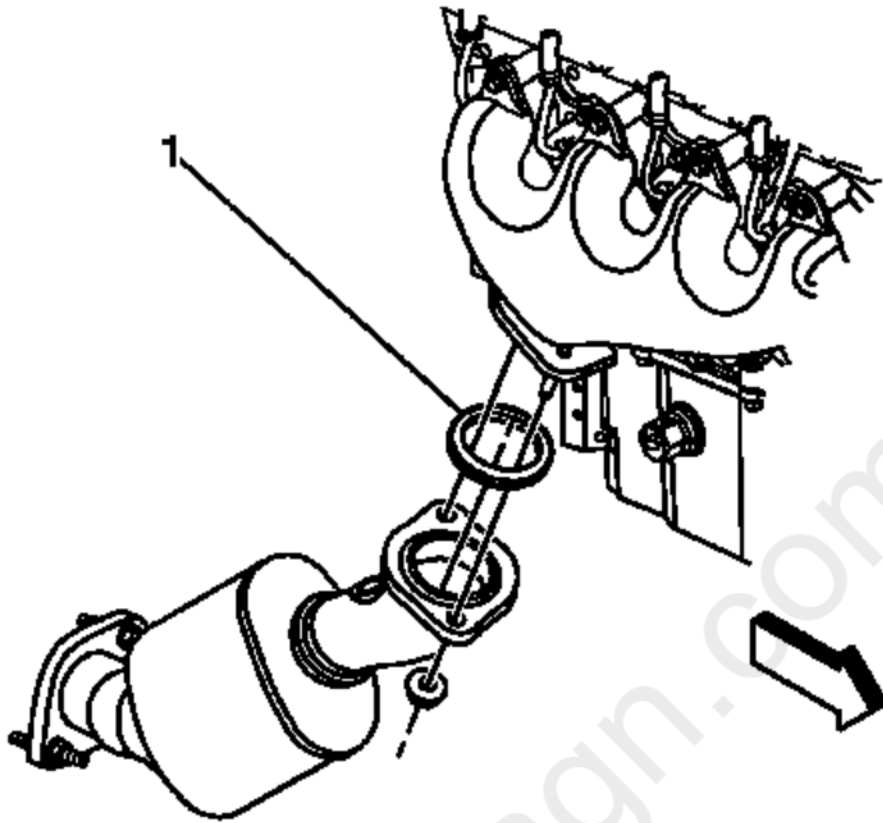


Fig. 50: View Of Right Side Catalytic Converter
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the exhaust system from the left and right side catalytic converters. Refer to **Exhaust System Replacement (LF1-Single)** or **Exhaust System Replacement (LSA-Coupe)** or **Exhaust System Replacement (LF1-Sedan/Wagon)** or **Exhaust System Replacement (LLT-Coupe)** or **Exhaust System Replacement (LLT-Sedan/Wagon)** or **Exhaust System Replacement (LSA-Sedan/Wagon)**.
4. Using the screw jack, lower the exhaust system.
5. Disconnect the oxygen sensor electrical connectors.
6. Remove the right bank catalytic converter to exhaust manifold nuts.
7. Carefully remove the catalytic converter with the gasket (1) and oxygen sensors from the exhaust manifold.
8. Remove the oxygen sensors from the catalytic converter. Refer to **Heated Oxygen Sensor Replacement - Bank 2 Sensor 1** and **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2**.

Installation Procedure

1. Install the oxygen sensors to the catalytic converter. Refer to **Heated Oxygen Sensor Replacement - Bank 2 Sensor 1** and **Heated Oxygen Sensor Replacement - Bank 2 Sensor 2**.

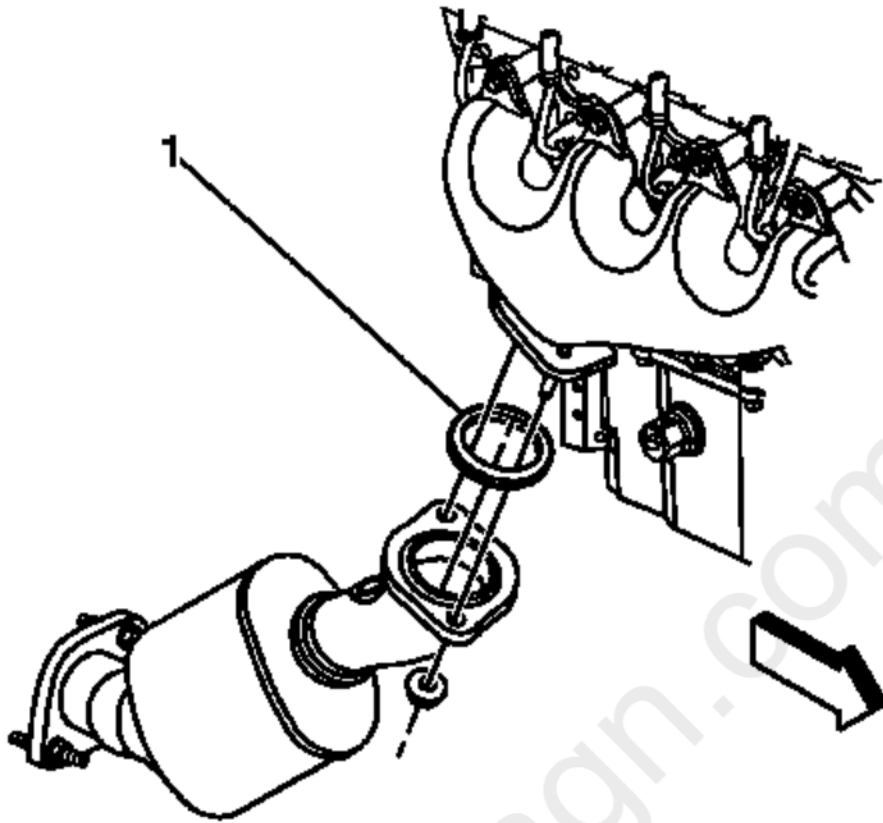


Fig. 51: View Of Right Side Catalytic Converter
Courtesy of GENERAL MOTORS CORP.

2. Install the catalytic converter gasket (1) to the catalytic converter.
3. Carefully install the catalytic converter to the exhaust manifold.

CAUTION: Refer to FASTENER CAUTION .

4. Install the catalytic converter nuts and tighten to 50 N.m (37 lb ft).
5. Tighten the catalytic converter to exhaust manifold nuts.
6. Connect the oxygen sensor electrical connectors.
7. Using the screw jack, raise the exhaust system.
8. Connect the exhaust system to the left and right side catalytic converters. Refer to Exhaust System Replacement (LF1-Single) or Exhaust System Replacement (LSA-Coupe) or Exhaust System Replacement (LF1-Sedan/Wagon) or Exhaust System Replacement (LLT-Coupe) or Exhaust System Replacement (LLT-Sedan/Wagon) or Exhaust System Replacement (LSA-Sedan/Wagon).
9. Remove the screw jack.
10. Lower the vehicle.

EXHAUST SYSTEM INSULATOR, HANGER, BRACKET REPLACEMENT

NOTE: Service the exhaust hangers individually in order to retain the support of the exhaust system.

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

1. Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .

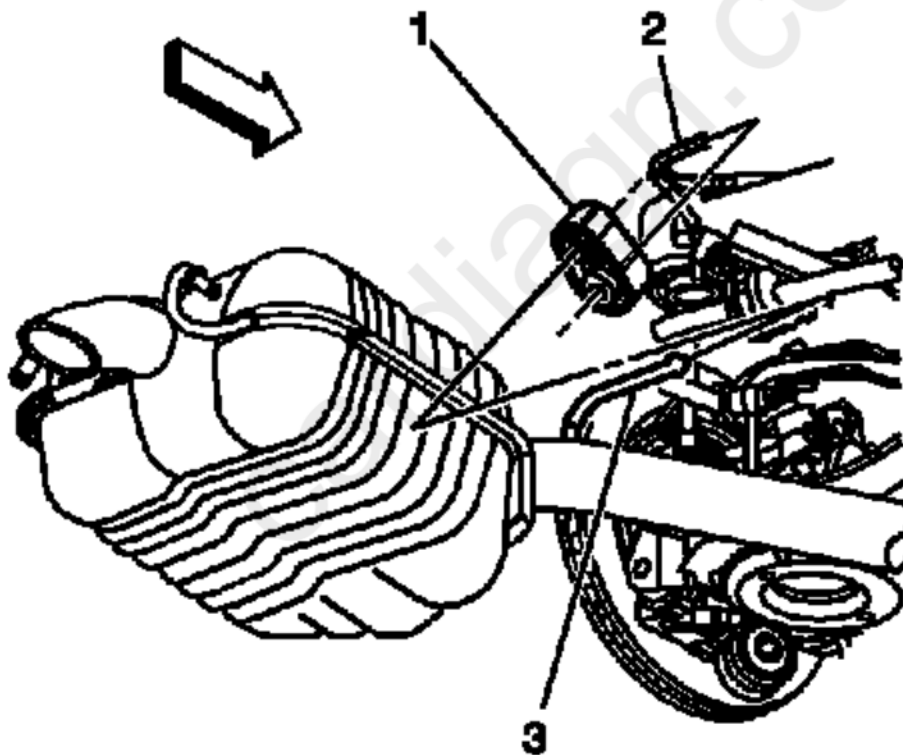


Fig. 52: View Of Front Exhaust, Rear Suspension & Exhaust Pipe Hanger Rods
Courtesy of GENERAL MOTORS CORP.

2. Apply a non petroleum based lubricant to the insulators and the hanger rods to aid in removal.
3. Remove the muffler insulator (1) from the rear suspension hanger rod (2).

4. Remove the muffler insulator (1) from the muffler hanger rod (3).

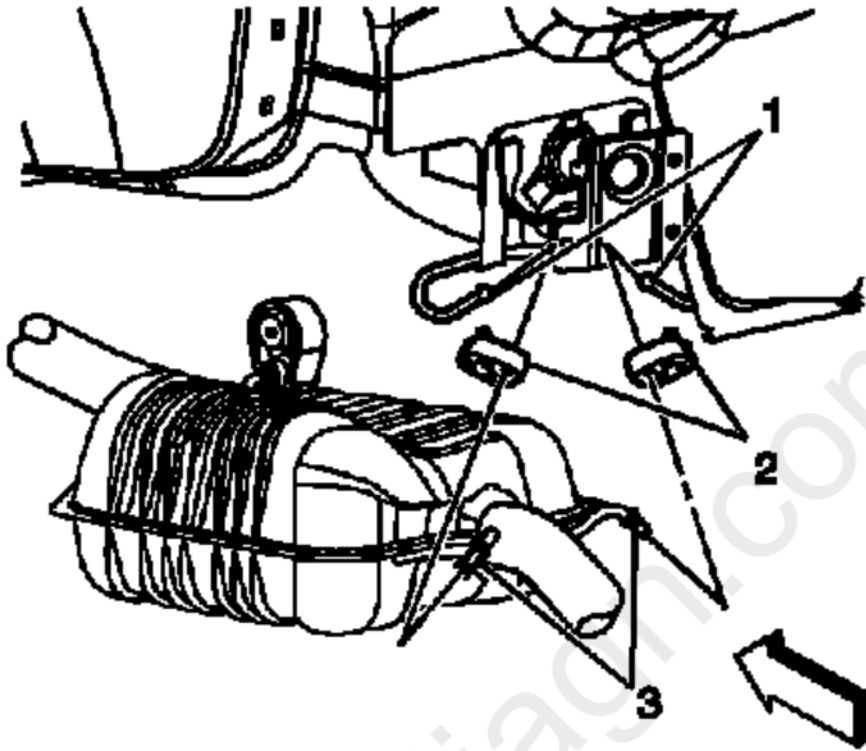


Fig. 53: View Of Body Support Bracket Rod, Tail Pipe Hanger Rod & Tail Pipe Hanger
Courtesy of GENERAL MOTORS CORP.

5. Remove the tail pipe insulators (2) from the body support hanger rods (1).
6. Remove the tail pipe insulators (2) from the muffler hanger rods (3).

Installation Procedure

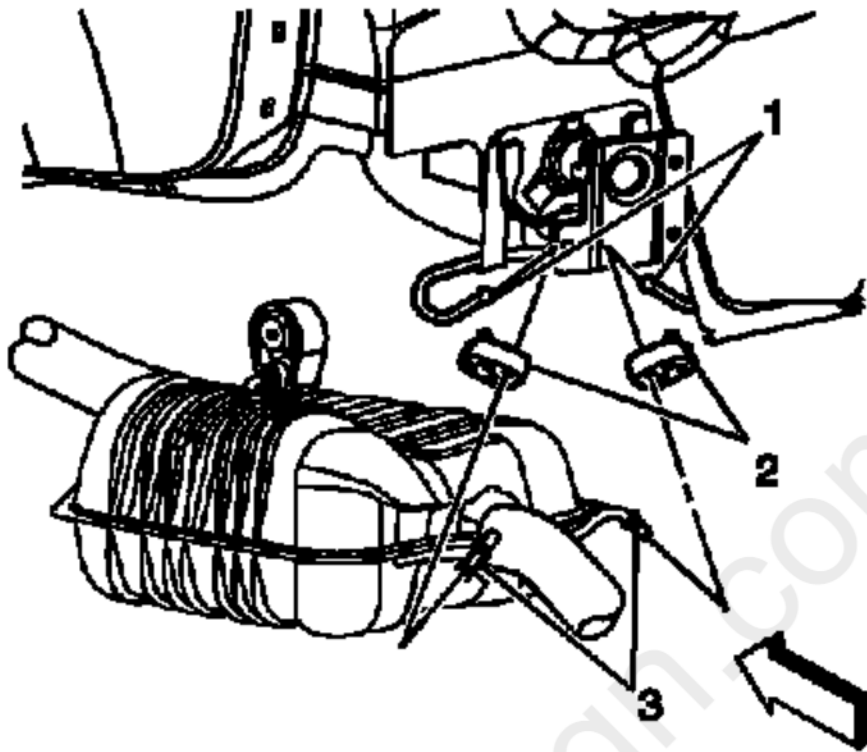


Fig. 54: View Of Body Support Bracket Rod, Tail Pipe Hanger Rod & Tail Pipe Hanger
Courtesy of GENERAL MOTORS CORP.

1. Apply a non petroleum based lubricant to the insulators and the hanger rods to aid in installation.
2. Install the tail pipe insulators (2) to the tail pipe hanger rods (3).
3. Install the tail pipe insulators (2) over the body support bracket rods (1).

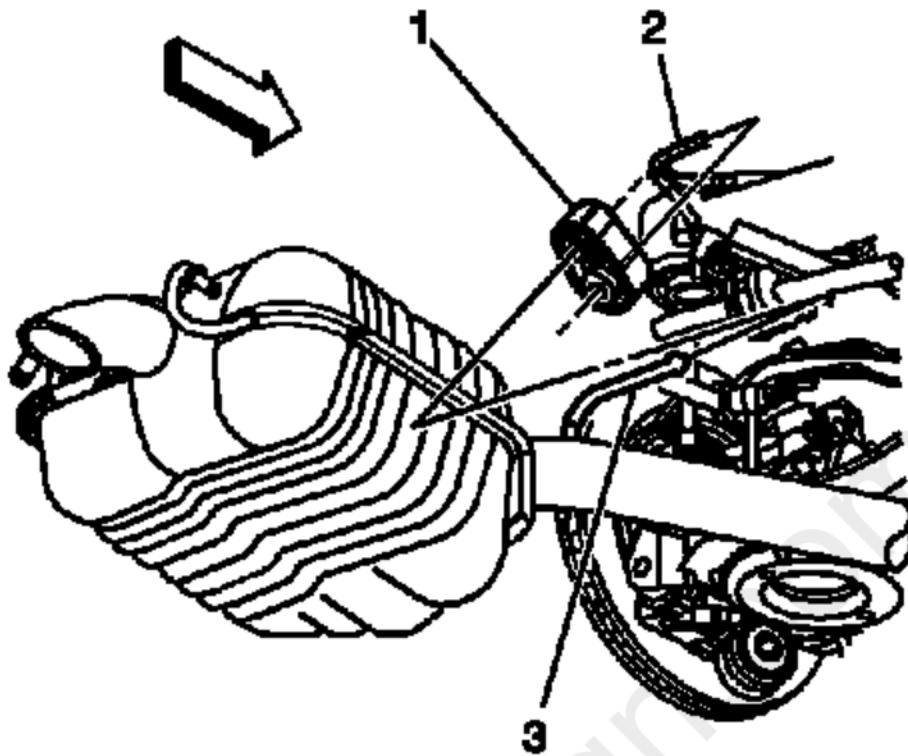


Fig. 55: View Of Front Exhaust, Rear Suspension & Exhaust Pipe Hanger Rods
Courtesy of GENERAL MOTORS CORP.

4. Install the muffler insulator (1) to the muffler hanger rod (3).
5. Install the muffler insulator (1) to the rear suspension hanger rod (2).
6. Inspect for underbody clearance and tail pipe alignment.

EXHAUST FRONT PIPE HANGER REPLACEMENT (RWD OR CTS-V)

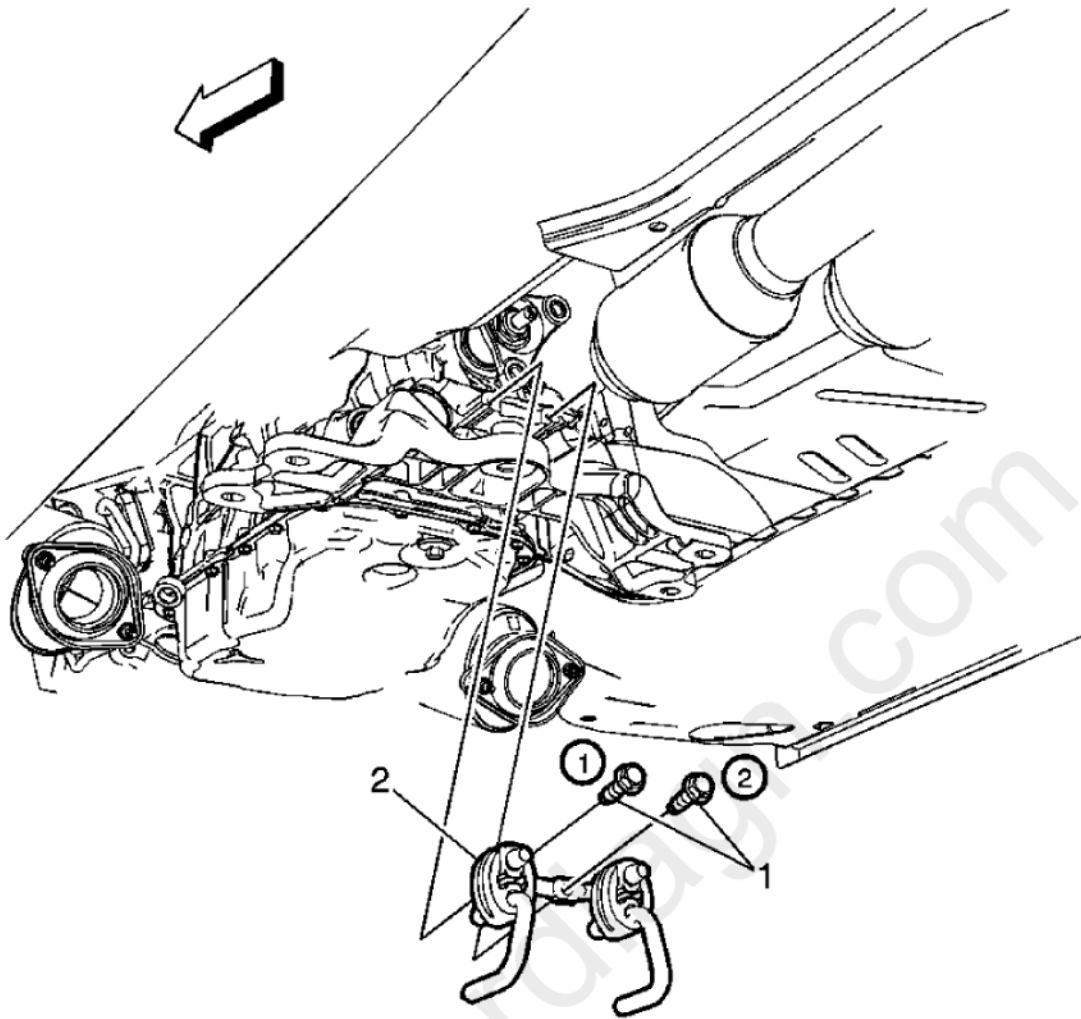


Fig. 56: Exhaust Pipe Front Hanger Bracket Replacement (RWD)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to <u>HOT EXHAUST SYSTEM WARNING</u> .	
Preliminary Procedures	
1. Remove the exhaust muffler from the front catalytic converters. Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u>	
2. Remove the exhaust muffler from the exhaust pipe front hanger bracket insulator.	
	Bolt (Qty: 2)

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

1	CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 22 N.m (16 lb ft)
2	Exhaust Pipe Front Hanger Bracket.

EXHAUST HANGER MOUNTING BRACKET REPLACEMENT (LF1,LLT,LSA-COUPE)

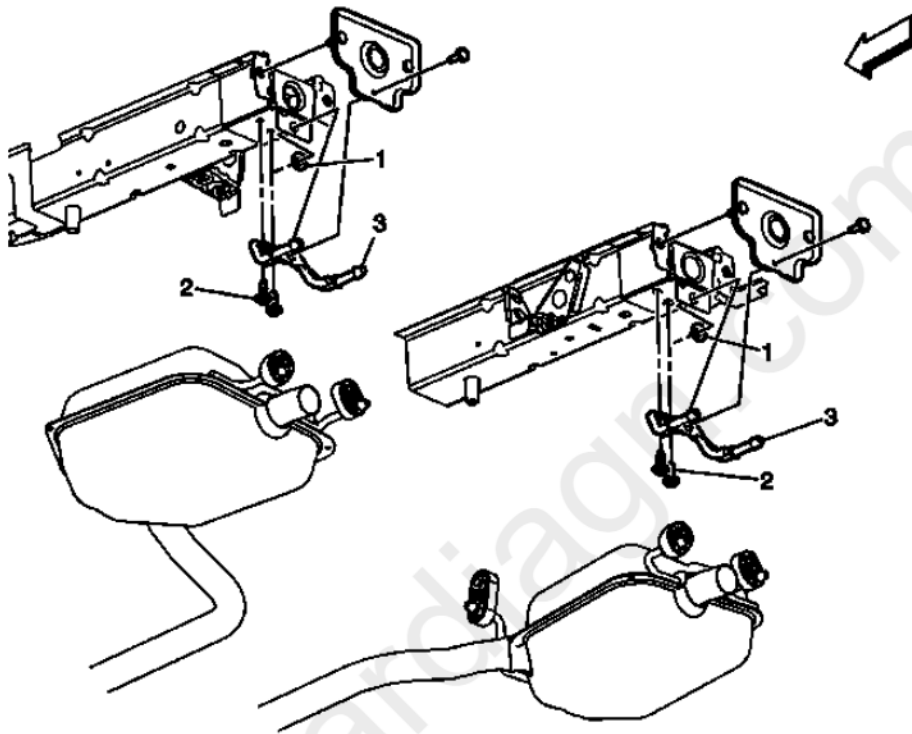


Fig. 57: Exhaust Hanger Mounting Bracket Replacement (LF1,LLT,LSA-Coupe)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure	
1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Disengage the rear exhaust muffler from the insulators and support the exhaust.	
1	Nut CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 22 N.m (16 lb ft).
	Bolt (Qty: 2)

2	Tighten: 22 N.m (16 lb ft).
3	Exhaust Hanger Mounting Bracket

EXHAUST HANGER MOUNTING BRACKET REPLACEMENT (LSA-SEDAN/WAGON)

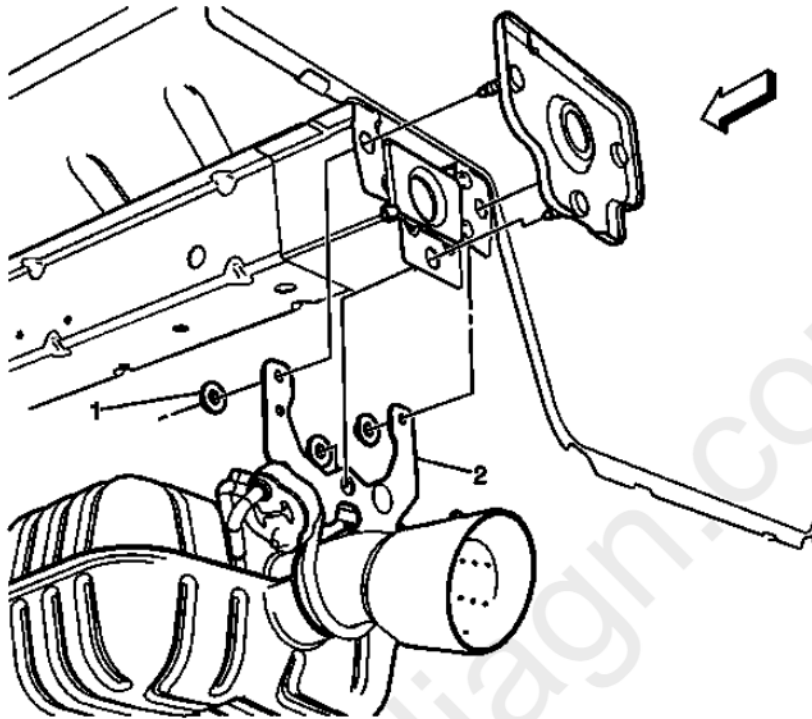


Fig. 58: Exhaust Hanger Mounting Bracket (LSA-Sedan/Wagon)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> .	
1	Exhaust Hanger Bracket Nut (Qty: 3) WARNING: Refer to <u>HOT EXHAUST SYSTEM WARNING</u> . CAUTION: Refer to <u>Exhaust System Inspection Caution</u> . Tighten: 22 N.m (16 lb ft).
2	Exhaust Hanger Mounting Bracket

EXHAUST PIPE FRONT HANGER BRACKET REPLACEMENT (AWD)

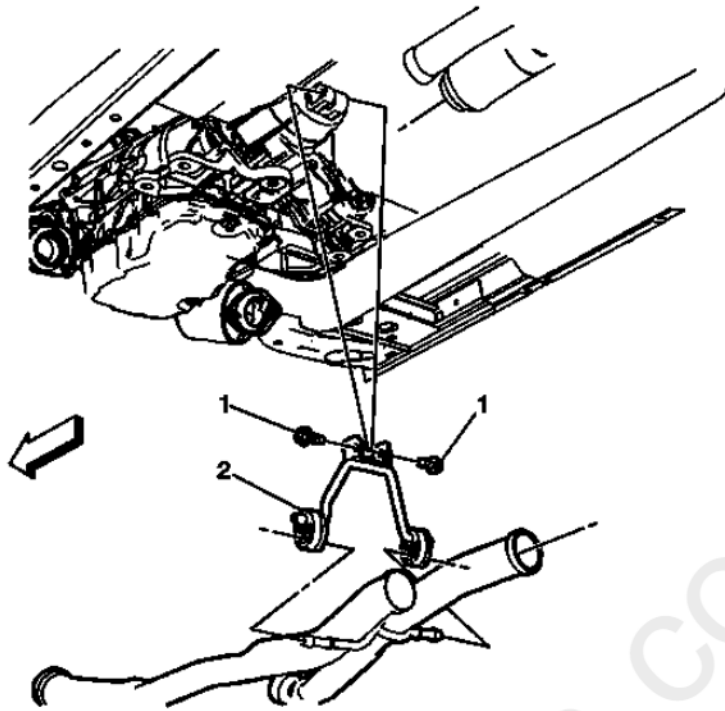


Fig. 59: Exhaust Pipe Front Hanger Bracket (AWD)
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
WARNING: Refer to <u>HOT EXHAUST SYSTEM WARNING</u> .	
Preliminary Procedures	
1. Remove the exhaust muffler from the front catalytic converters. Refer to <u>Exhaust System Replacement (LF1-Single)</u> or <u>Exhaust System Replacement (LSA-Coupe)</u> or <u>Exhaust System Replacement (LF1-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LLT-Coupe)</u> or <u>Exhaust System Replacement (LLT-Sedan/Wagon)</u> or <u>Exhaust System Replacement (LSA-Sedan/Wagon)</u> . 2. Remove the exhaust muffler from the exhaust pipe front hanger bracket insulator.	
1	Bolt (Qty: 2) CAUTION: Refer to <u>FASTENER CAUTION</u> . Procedure 1. Hand tighten the exhaust front hanger bolts. 2. Following the sequence shown, tighten the driver side exhaust hanger bolt first and

the passenger side bolt last.

Tighten: 65 N.m (48 lb ft)

2 Exhaust Pipe Front Hanger Bracket

EXHAUST HEAT SHIELD REPLACEMENT - REAR FASCIA (COUPE)

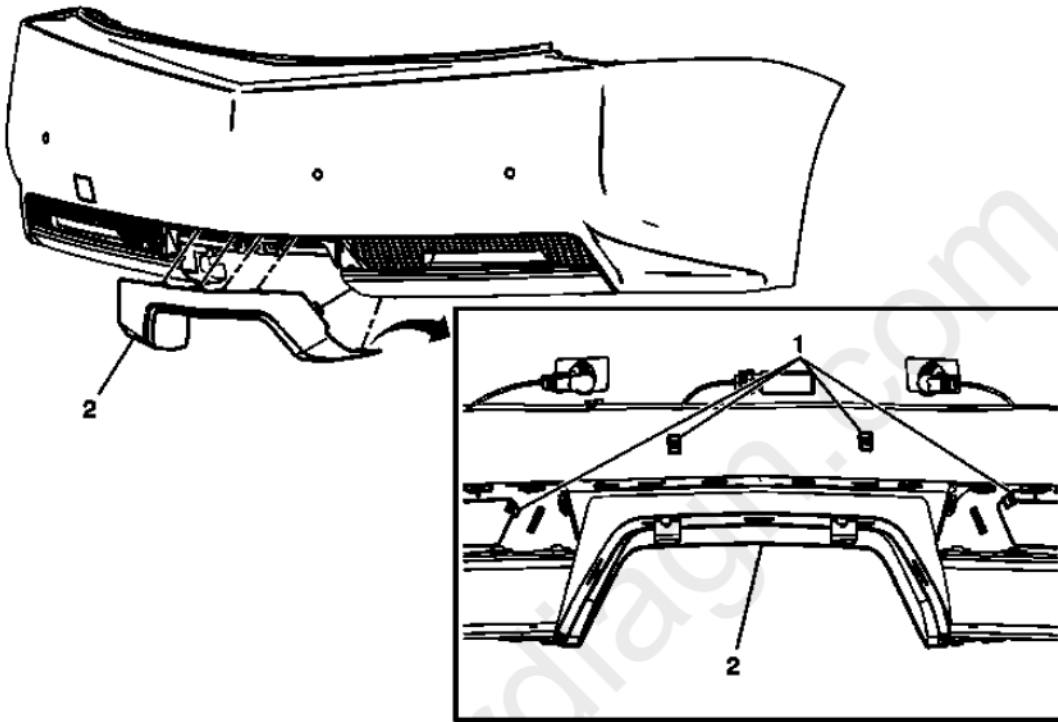


Fig. 60: Exhaust Heat Shield - Rear Fascia (Coupe)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure: Remove the rear bumper fascia energy absorber. Refer to <u>Rear Bumper Fascia Energy Absorber Replacement (Coupe)</u> or <u>Rear Bumper Fascia Energy Absorber Replacement (Sedan and Wagon)</u> .	
1	Exhaust Heat Shield Insert Clip (Qty: 4) Procedure: Use a small flat-bladed tool to release the clips.
2	Exhaust Heat Shield - Rear Fascia

FRONT AXLE PROPELLER SHAFT HEAT SHIELD REPLACEMENT

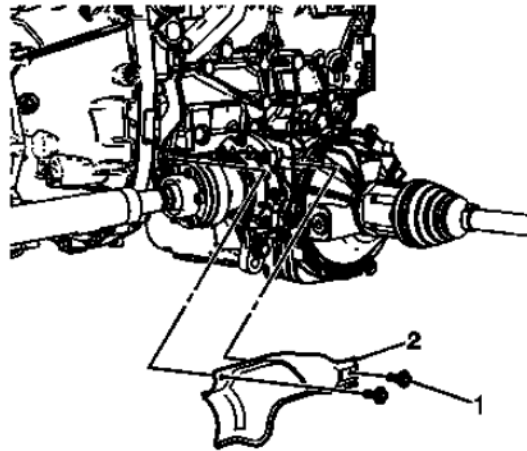


Fig. 61: Front Axle Propeller Shaft Heat Shield
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
Preliminary Procedure 1. Raise and support the vehicle. Refer to <u>Lifting and Jacking the Vehicle</u> . 2. Remove the right catalytic convertor. Refer to <u>Catalytic Converter Replacement - Right Side (LF1)</u> or <u>Catalytic Converter Replacement - Right Side (LLT)</u> or <u>Catalytic Converter Replacement - Right Side (LSA)</u>.	
1	Front Axle Propeller Shaft Heat Shield Bolt (Qty: 2) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 9 N.m (80 lb in)
2	Front Axle Propeller Shaft Heat Shield

EXHAUST MANIFOLD HEAT SHIELD REPLACEMENT - RIGHT SIDE (LLT)

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

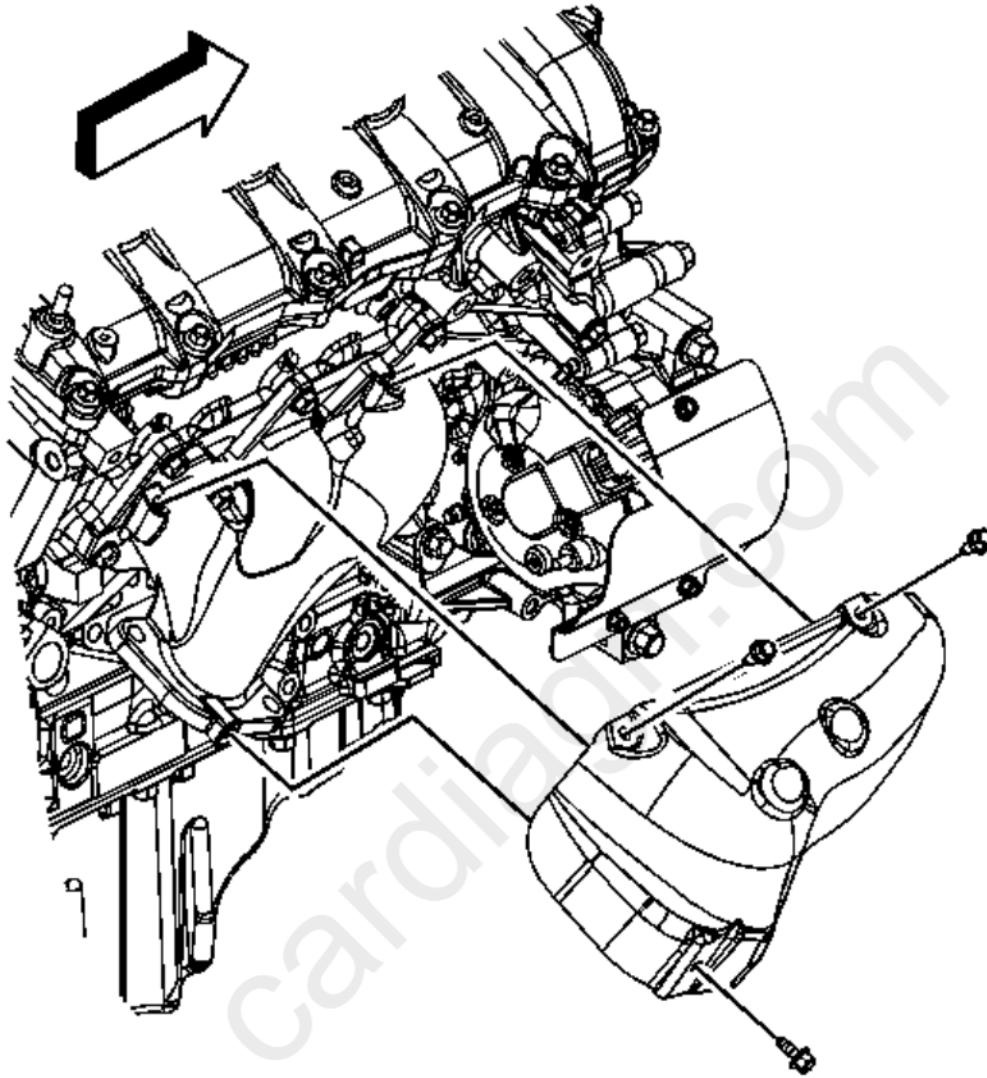


Fig. 62: View Of Upper Exhaust Manifold Heat Shield & Fasteners
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel injector sight shield. Refer to **Fuel Injector Sight Shield Replacement (LP1, LY7)** or **Fuel Injector Sight Shield Replacement (LLT)** .
2. Remove the engine coolant inlet pipe. Refer to **Engine Coolant Inlet Pipe Replacement** .
3. Remove the exhaust manifold heat shield bolts.
4. Remove the exhaust manifold heat shield from the exhaust manifold.

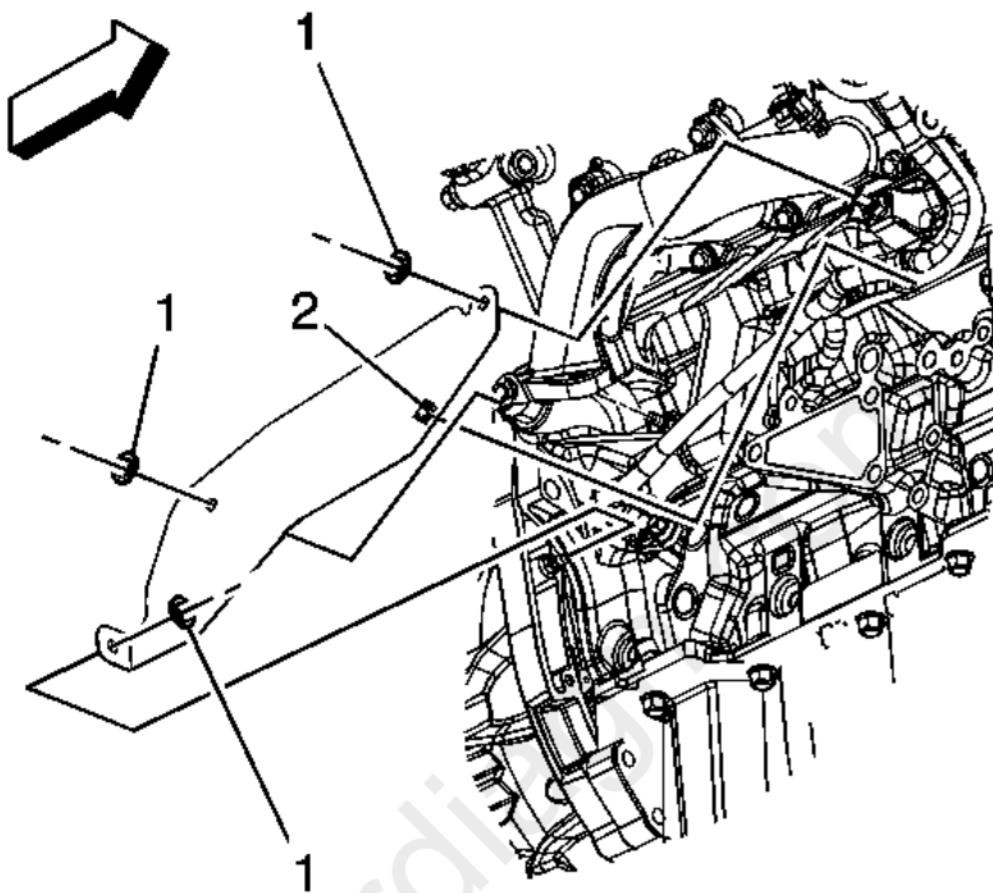


Fig. 63: View Of Lower Exhaust Manifold Heat Shield & Fasteners
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower exhaust manifold heat shield retainers (1), if necessary.
6. Remove the lower exhaust manifold heat shield (2), if necessary.

Installation Procedure

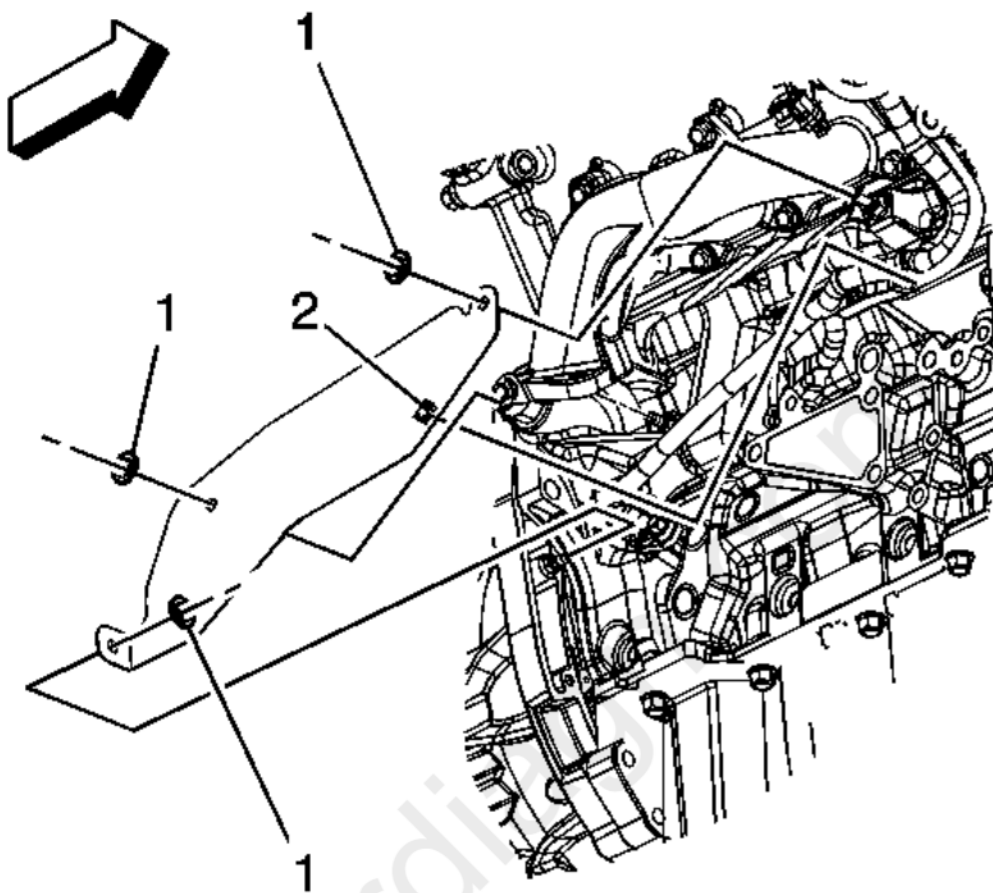


Fig. 64: View Of Lower Exhaust Manifold Heat Shield & Fasteners
 Courtesy of GENERAL MOTORS CORP.

1. Install the lower exhaust manifold heat shield (2), if necessary.
2. Install the lower exhaust manifold heat shield retainers (1), if necessary.

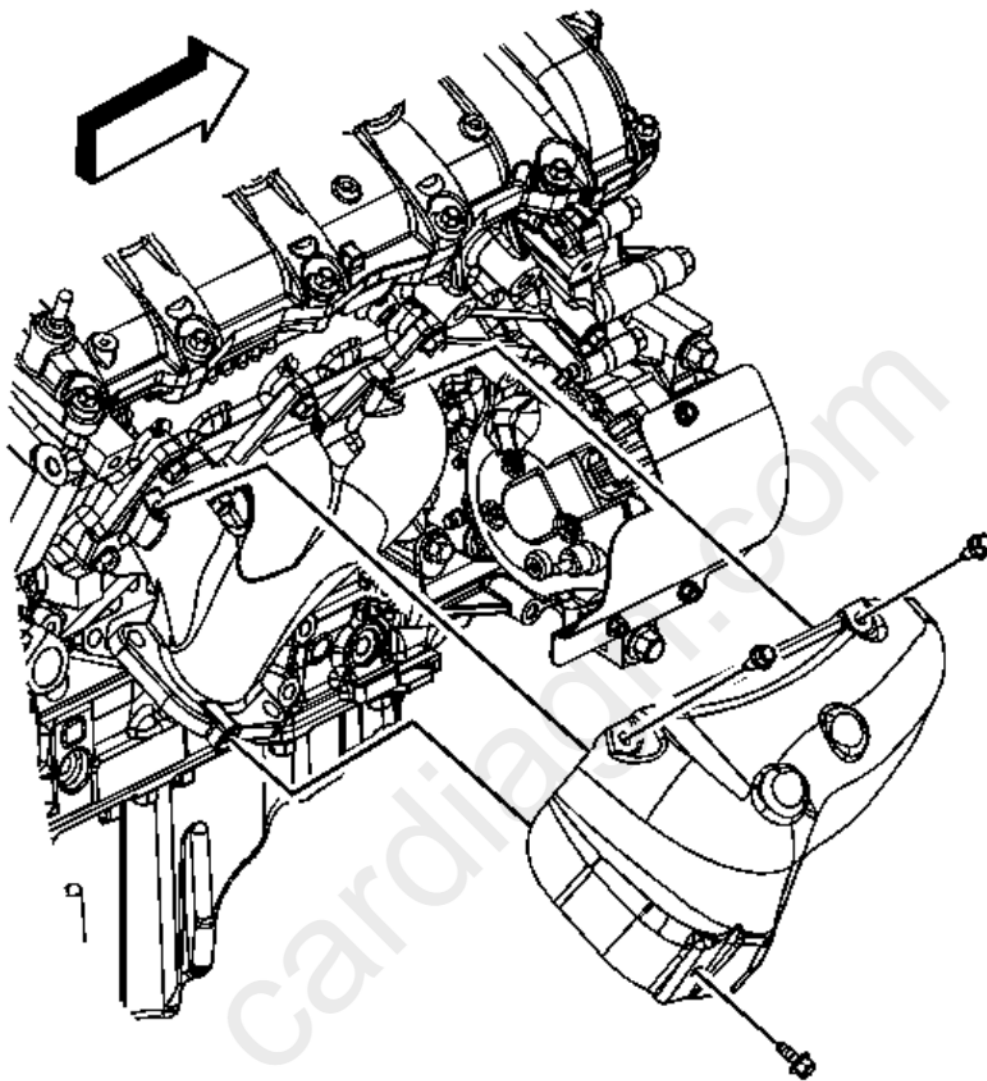


Fig. 65: View Of Upper Exhaust Manifold Heat Shield & Fasteners
Courtesy of GENERAL MOTORS CORP.

3. Install the exhaust manifold heat shield to the exhaust manifold.

CAUTION: Refer to **FASTENER CAUTION** .

4. Install the exhaust manifold heat shield bolts and tighten to 10 N.m (89 lb in).

5. Install the engine coolant inlet pipe. Refer to Engine Coolant Inlet Pipe Replacement .
6. Install the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement (LP1, LY7) or Fuel Injector Sight Shield Replacement (LLT) .

EXHAUST MANIFOLD HEAT SHIELD REPLACEMENT - RIGHT SIDE (LSA)

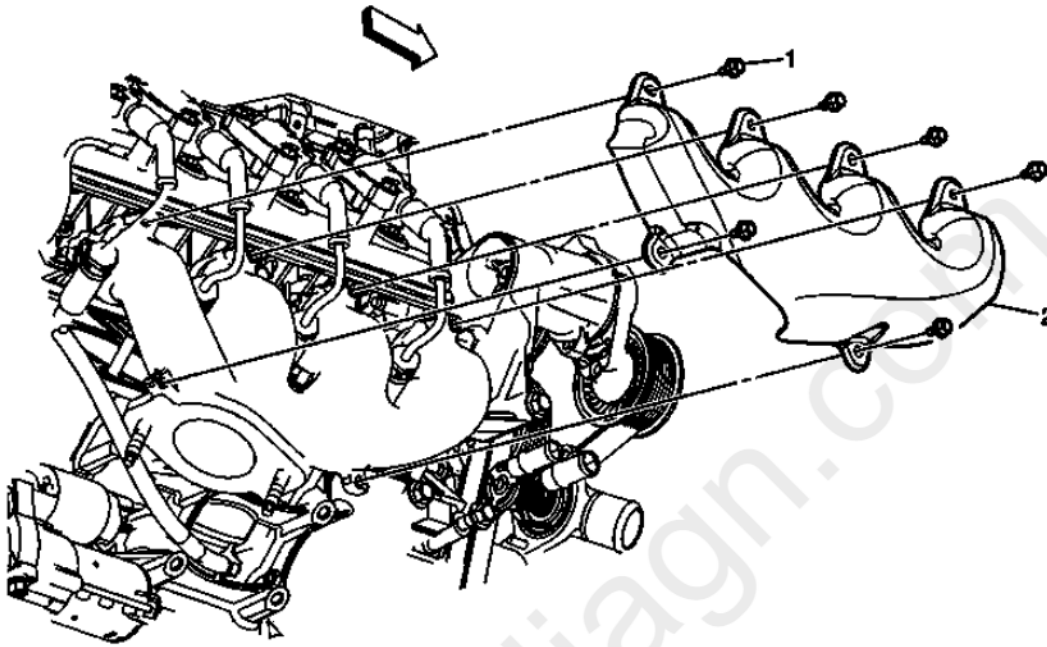


Fig. 66: Exhaust Manifold Heat Shield - Right Side (LSA)
Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Bolt (Qty: 6) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (88 lb in)
2	Exhaust Manifold Heat Shield - Right

EXHAUST MANIFOLD HEAT SHIELD REPLACEMENT - LEFT SIDE (LLT)

Removal Procedure

WARNING: Refer to EXHAUST SERVICE WARNING .

WARNING: Refer to PROTECTIVE GOGGLES AND GLOVE WARNING .

1. Remove the fuel injector sight shield. Refer to Fuel Injector Sight Shield Replacement (LP1, LY7) or Fuel Injector Sight Shield Replacement (LLT) .

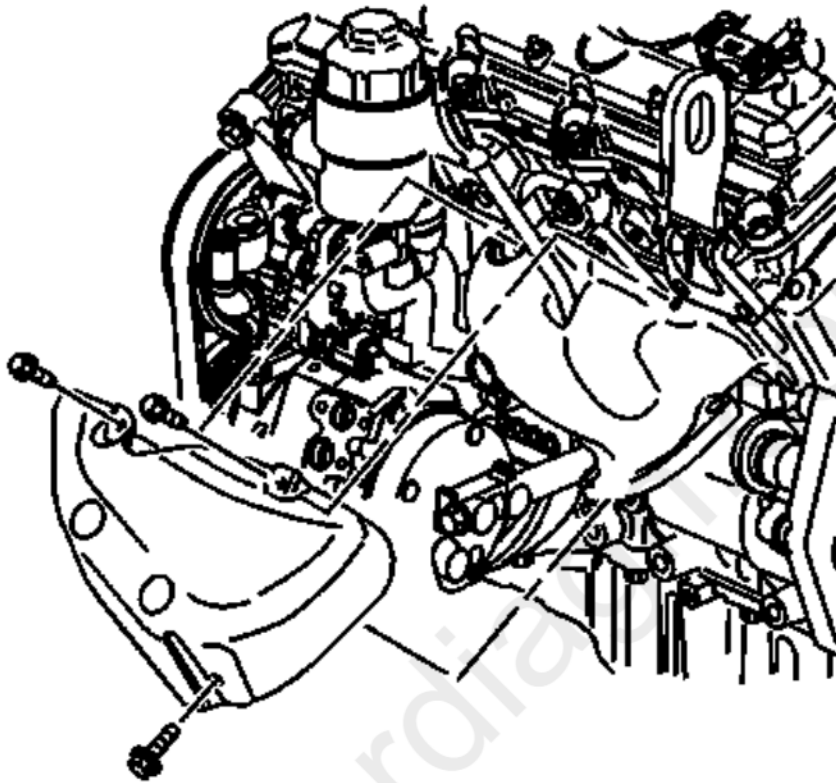


Fig. 67: View Of Left Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

2. Remove the exhaust manifold heat shield bolts.
3. Remove the exhaust manifold heat shield.

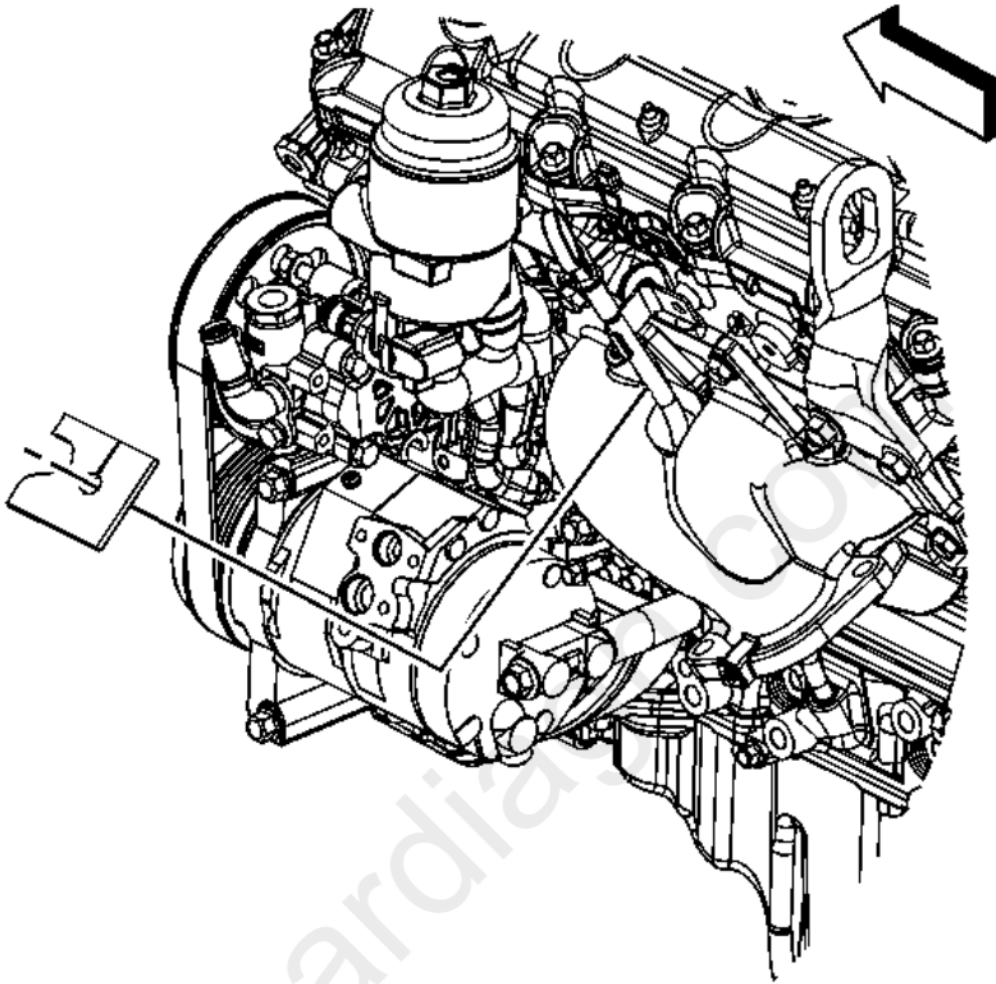


Fig. 68: View Of Upper Exhaust Manifold Heat Shield Insulator
Courtesy of GENERAL MOTORS CORP.

4. Remove the upper exhaust manifold heat shield insulator from the oil level indicator tube, if necessary.

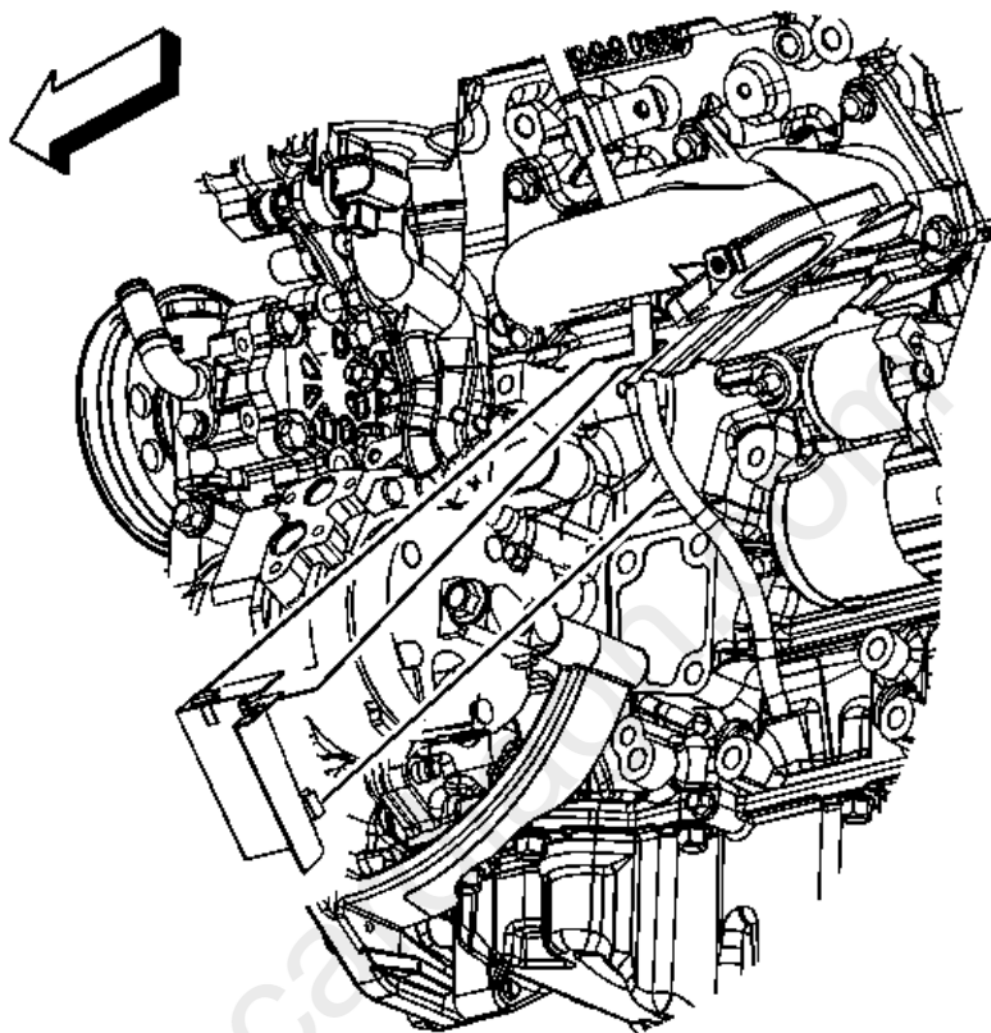


Fig. 69: View Of Lower Exhaust Manifold Heat Shield Insulator
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower exhaust manifold heat shield insulator from the oil level indicator and exhaust gasket, if necessary.

Installation Procedure

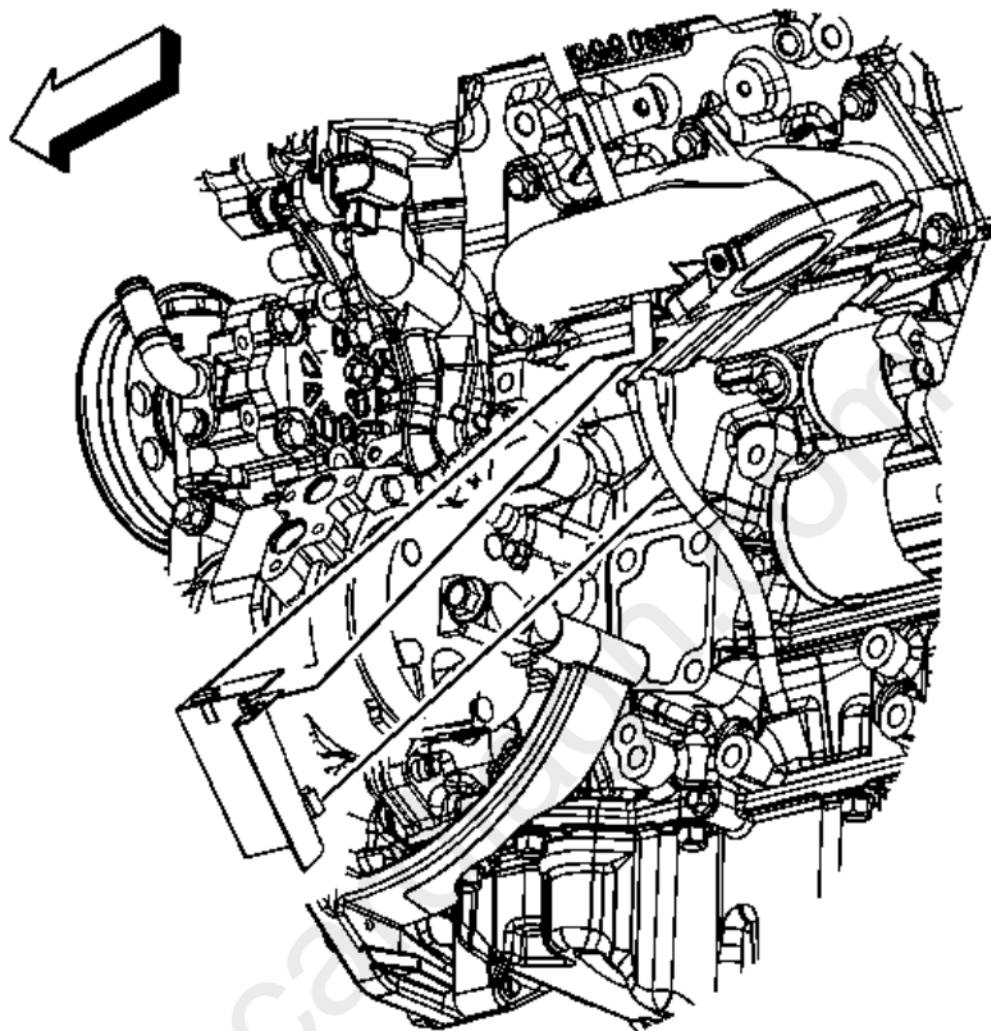


Fig. 70: View Of Lower Exhaust Manifold Heat Shield Insulator
Courtesy of GENERAL MOTORS CORP.

1. Install the lower exhaust manifold heat shield insulator to the oil level indicator and exhaust gasket, if necessary.

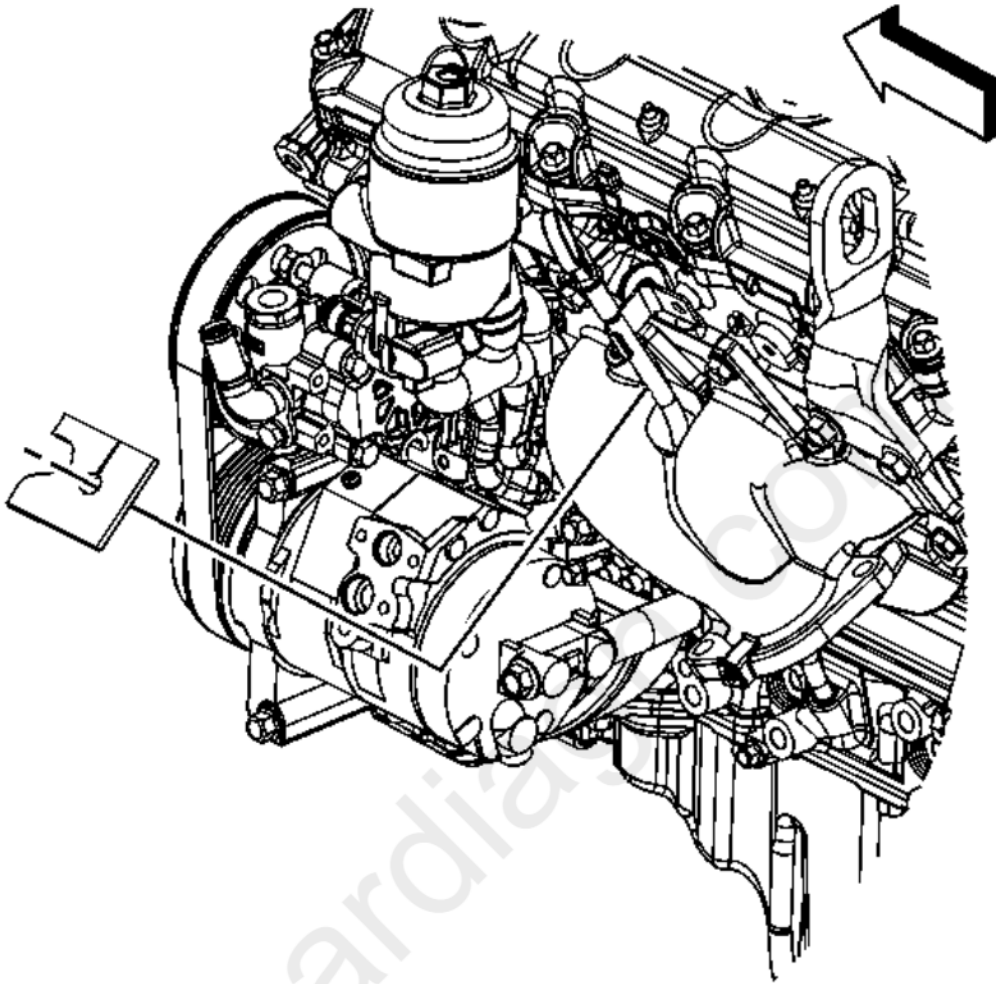


Fig. 71: View Of Upper Exhaust Manifold Heat Shield Insulator
Courtesy of GENERAL MOTORS CORP.

2. Install the upper exhaust manifold heat shield insulator to the oil level indicator tube, if necessary.

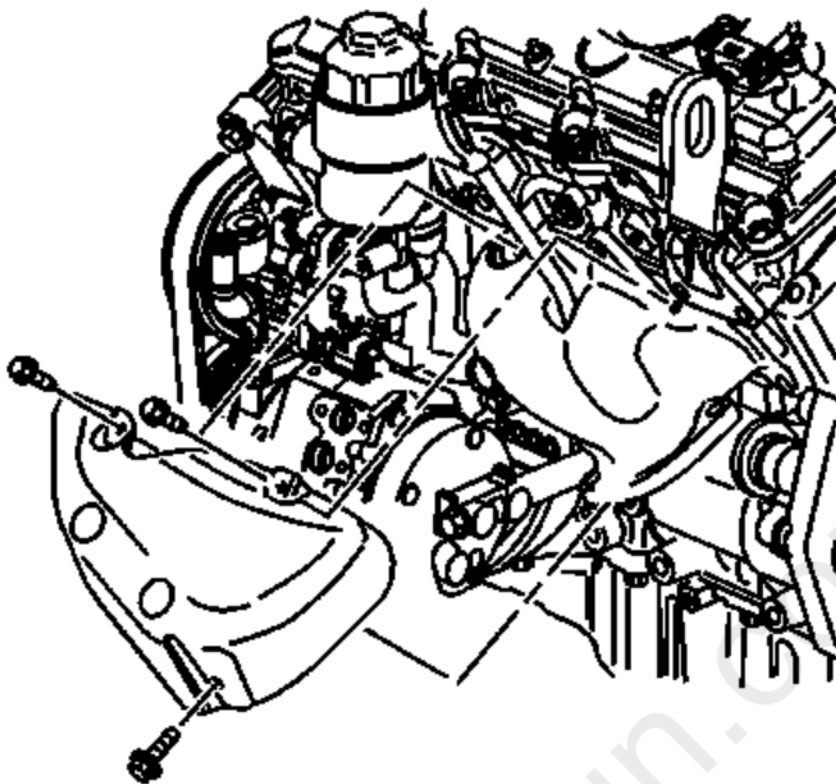


Fig. 72: View Of Left Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

3. Install the exhaust manifold heat shield and tighten the bolts to 10 N.m (89 lb in).

EXHAUST MANIFOLD HEAT SHIELD REPLACEMENT - LEFT SIDE (LSA)

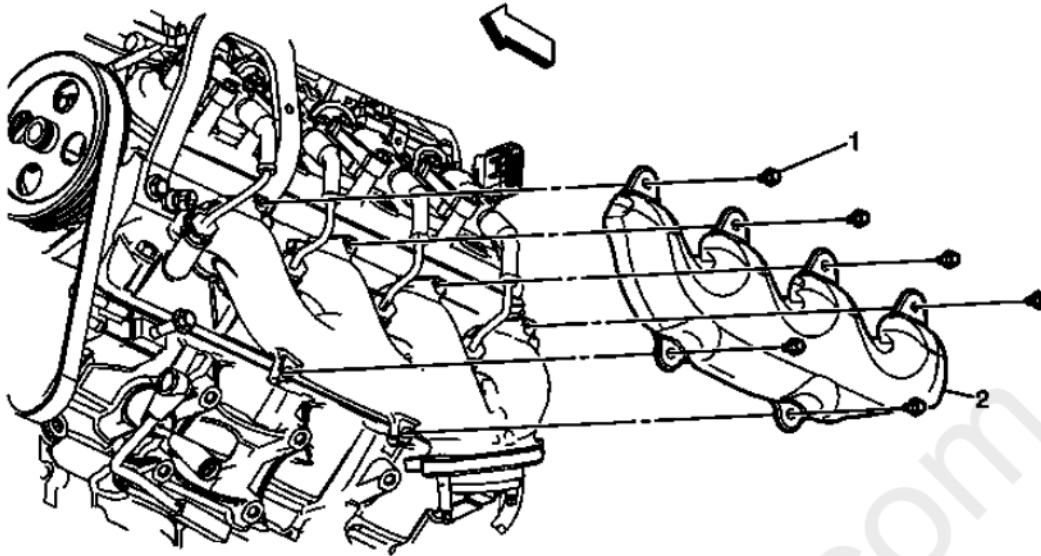


Fig. 73: Exhaust Manifold Heat Shield - Left Side (LSA)

Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Bolt (Qty: 6) CAUTION: Refer to <u>FASTENER CAUTION</u> . Tighten: 10 N.m (88 lb in)
2	Exhaust Manifold Heat Shield - Left

DESCRIPTION AND OPERATION

EXHAUST SYSTEM DESCRIPTION

IMPORTANT: Use of non-OEM parts may cause driveability concerns.

The exhaust system carries exhaust gases, treated by the catalytic converter, through a resonator, if applicable and into the exhaust muffler where exhaust noise is lessened.

In order to secure the exhaust pipe to the exhaust manifold, a flange and seal-joint coupling is utilized. The exhaust system may utilize a slip-joint coupling design with a clamp and a U-bolt or a flange connection with a gasket.

Exhaust hangers and rubber insulators help to support the weight of the exhaust pipe along with insulating any exhaust system vibration, rattle, or noise.

Exhaust hangers also space the exhaust system away from the underbody of the vehicle and allows the exhaust system to expand as the exhaust system warms up.

Exhaust heat shields are used to protect the body and other components from damage due to the heat from the exhaust system.

The exhaust system may be comprised of the following components:

- Exhaust manifold
- Exhaust pipes
- Catalytic converters
- Exhaust muffler
- Exhaust resonator, if equipped
- Exhaust tail pipe, if equipped
- Exhaust hangers
- Exhaust heat shields

Resonator

Some exhaust systems are equipped with a resonator. The resonator, located either before or after the muffler, allows the use of mufflers with less back pressure. Resonators are used when vehicle characteristics require specific exhaust tuning.

Catalytic Converter

The catalytic converter is an emission control device added to the engine exhaust system in order to reduce hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) pollutants from the exhaust gas.

The catalytic converter is comprised of a ceramic monolith substrate, supported in insulation and housed within a sheet metal shell. The substrate may be washcoated with 3 noble metals:

- Platinum (Pt)
- Palladium (Pd)
- Rhodium (Rh)

The catalyst in the converter is not serviceable.

Muffler

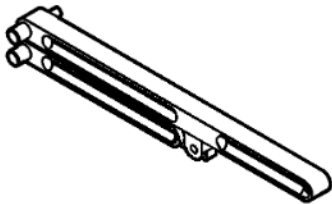
The exhaust muffler reduces the noise levels of the engine exhaust by the use of tuning tubes. The tuning tubes create channels inside the exhaust muffler that lower the sound levels created by the combustion of the engine.

2011 Cadillac CTS

2011 ENGINE Engine Exhaust - CTS

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS

Illustration	Tool Number/ Description
	EN 35314-A J 35314-A Exhaust Back Pressure Gauge