

2004 ENGINE

Engine Mechanical - 3.6L (LY7) (Repair Instructions, 4 Of 5) - SRX

REPAIR INSTRUCTIONS

EXHAUST MANIFOLD CLEANING AND INSPECTION - LEFT

Cleaning Procedure

1. Clean the exhaust manifold in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the exhaust manifold with compressed air.

Inspection Procedure

1. Inspect the left exhaust manifold for the following:
 - Damage or excessive corrosion to the exhaust manifold exterior (1)
 - Damage to the exhaust manifold mounting holes (2)
 - Damage to the threaded holes (3) for the heat shield
 - Damage to the exhaust manifold flange bolt holes (4)

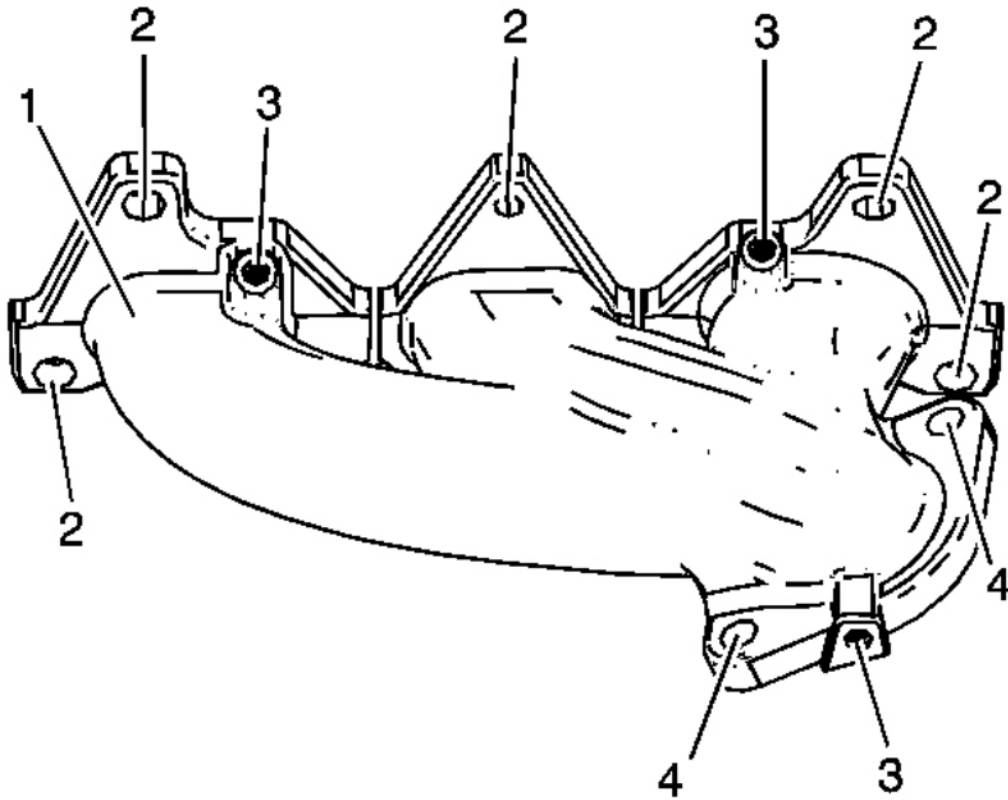


Fig. 1: Inspecting Left Exhaust Manifold For Corrosion & Bolt Hole Damage
Courtesy of GENERAL MOTORS CORP.

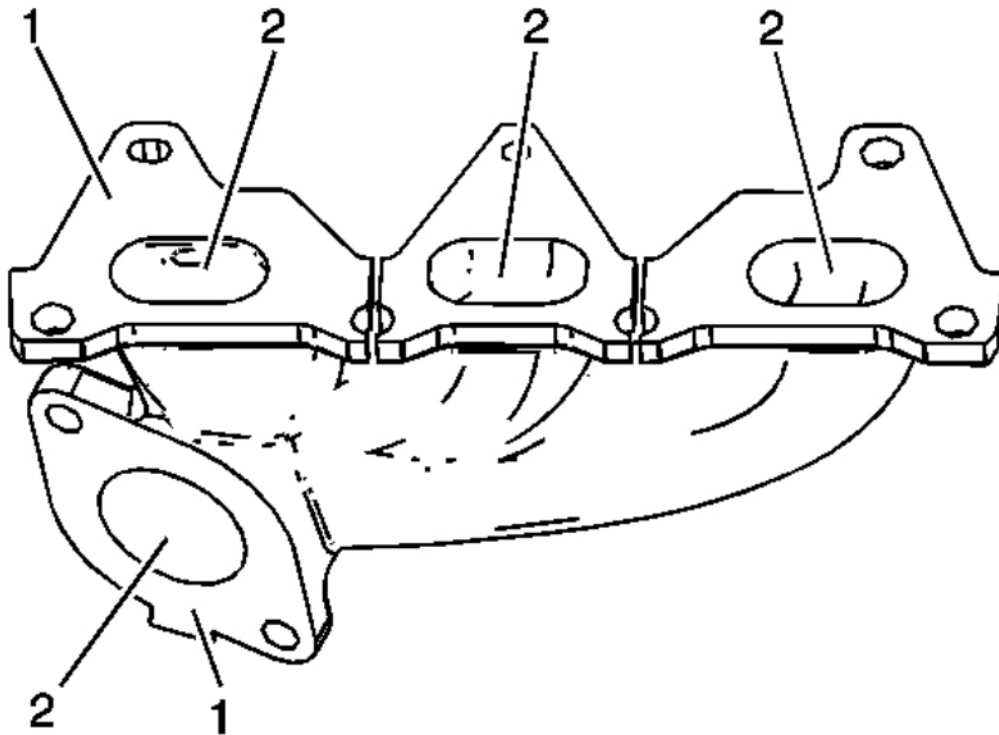


Fig. 2: Inspecting Left Exhaust Manifold For Damage To Exhaust Passages & Gasket Sealing Surfaces

Courtesy of GENERAL MOTORS CORP.

2. Inspect the left exhaust manifold for the following:
 - Damage to the gasket sealing surfaces (1)
 - Damage or restrictions within the exhaust passages (2)
3. Repair or replace the left exhaust manifold and/or components as necessary.

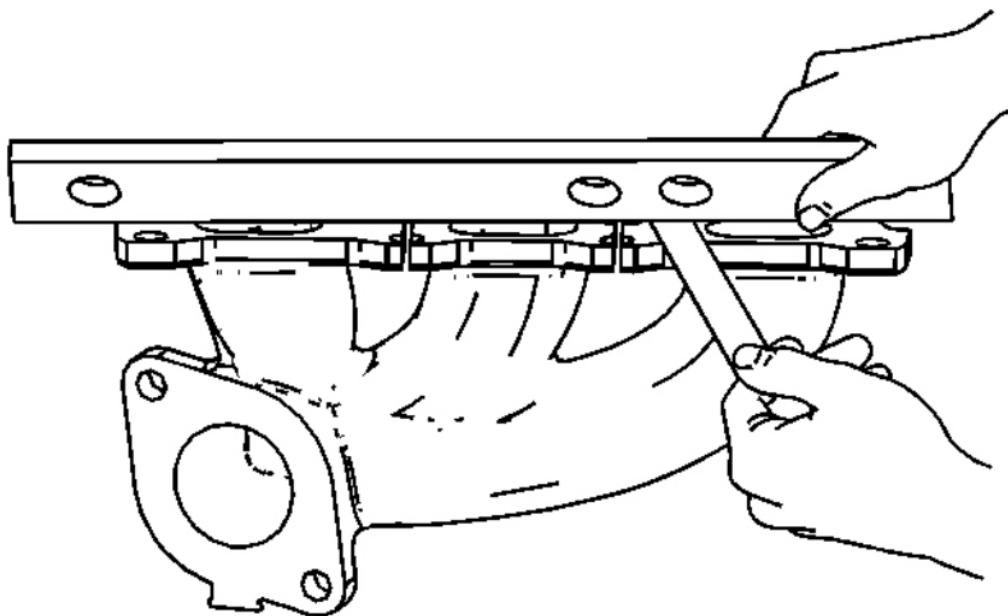


Fig. 3: Measuring Alignment Of Left Exhaust Manifold Flanges
Courtesy of GENERAL MOTORS CORP.

4. Measure the alignment or surface flatness of the exhaust manifold flanges, using a straight edge and a feeler gage. Exhaust manifold surface flatness must not exceed 0.254 mm (0.010 in).
5. If the surface flatness is not within specifications, the exhaust manifold is warped and must be replaced.

EXHAUST MANIFOLD CLEANING AND INSPECTION - RIGHT

Cleaning Procedure

1. Clean the exhaust manifold in solvent.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

2. Dry the exhaust manifold with compressed air.

Inspection Procedure

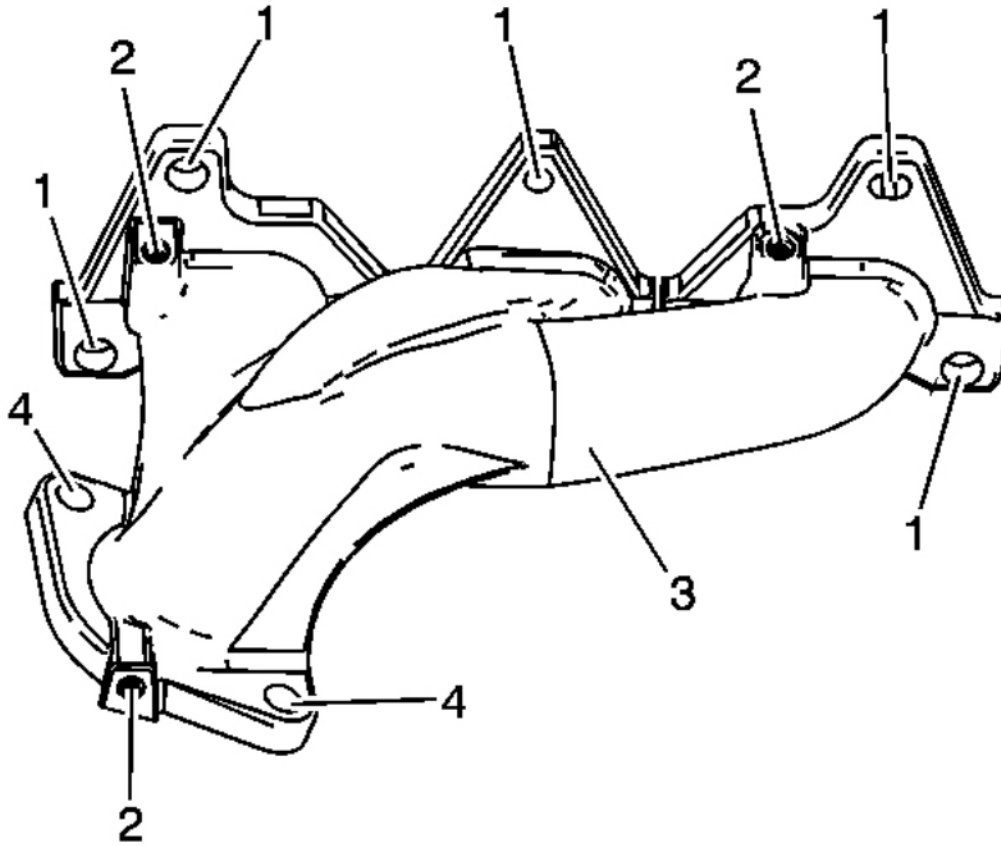


Fig. 4: Inspecting Right Exhaust Manifold For Corrosion & Bolt Hole Damage
Courtesy of GENERAL MOTORS CORP.

1. Inspect the right exhaust manifold for the following:
 - Damage to the exhaust manifold mounting holes (1)
 - Damage to the threaded holes (2) for the heat shield
 - Damage or excessive corrosion to the exhaust manifold exterior (3)
 - Damage to the exhaust manifold flange bolt holes (4)

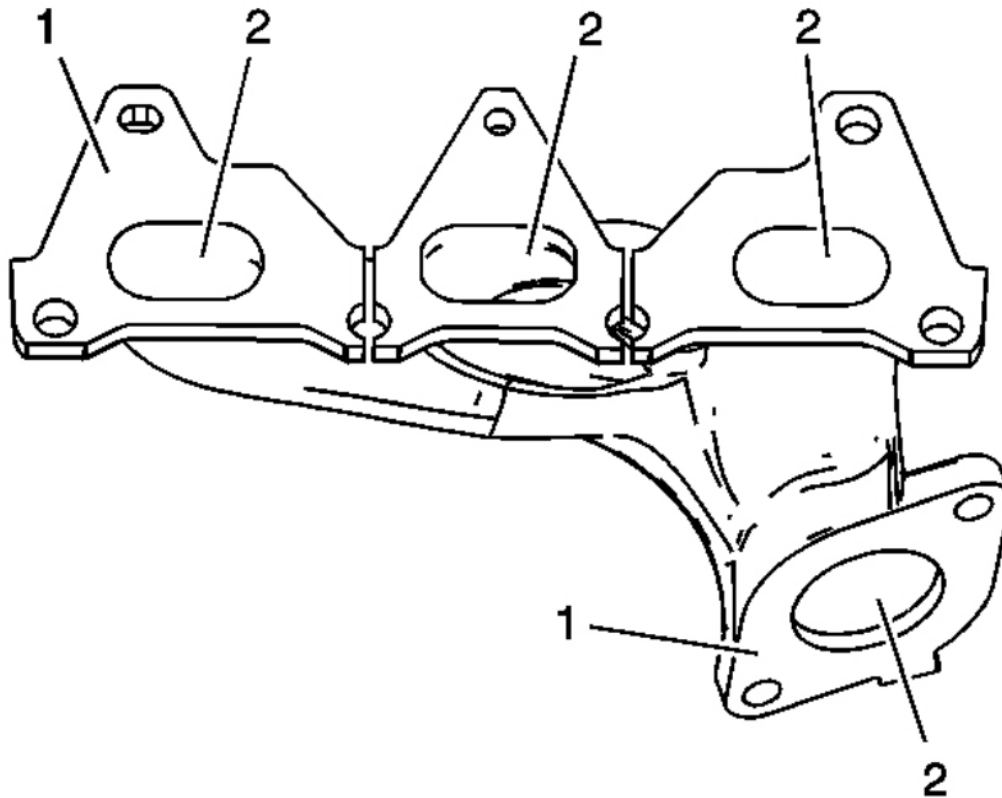


Fig. 5: Inspecting Right Exhaust Manifold For Damage To Exhaust Passages & Gasket Sealing Surfaces

Courtesy of GENERAL MOTORS CORP.

2. Inspect the right exhaust manifold for the following:
 - Damage to the gasket sealing surfaces (1)
 - Damage or restrictions within the exhaust passages (2)
3. Repair or replace the right exhaust manifold and/or components as necessary.

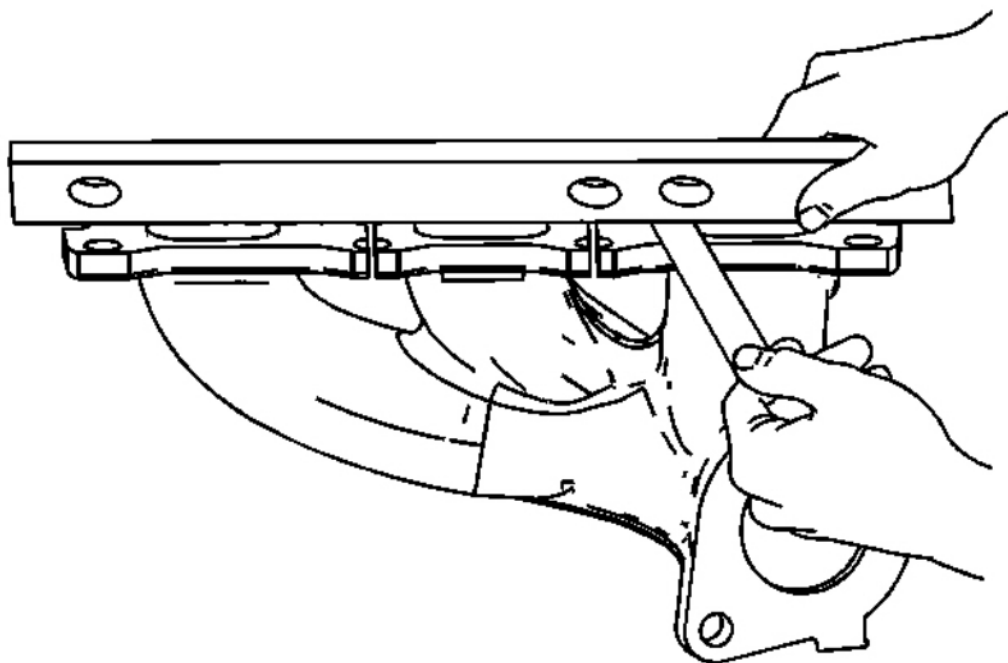


Fig. 6: Measuring Alignment Of Right Exhaust Manifold Flanges
Courtesy of GENERAL MOTORS CORP.

4. Measure the alignment or surface flatness of the exhaust manifold flanges, using a straight edge and a feeler gage. Exhaust manifold surface flatness must not exceed 0.254 mm (0.010 in).
5. If the surface flatness is not within specifications, the exhaust manifold is warped and must be replaced.

WATER PUMP CLEANING AND INSPECTION

Cleaning Procedure

NOTE: Do not immerse the water pump in solvent. The solvent may enter the water pump's permanently lubricated bearings and cause premature bearing failure.

1. Remove the old gasket material from the water pump sealing surfaces.
2. Clean all excess dirt and debris from the water pump housing.

Inspection Procedure

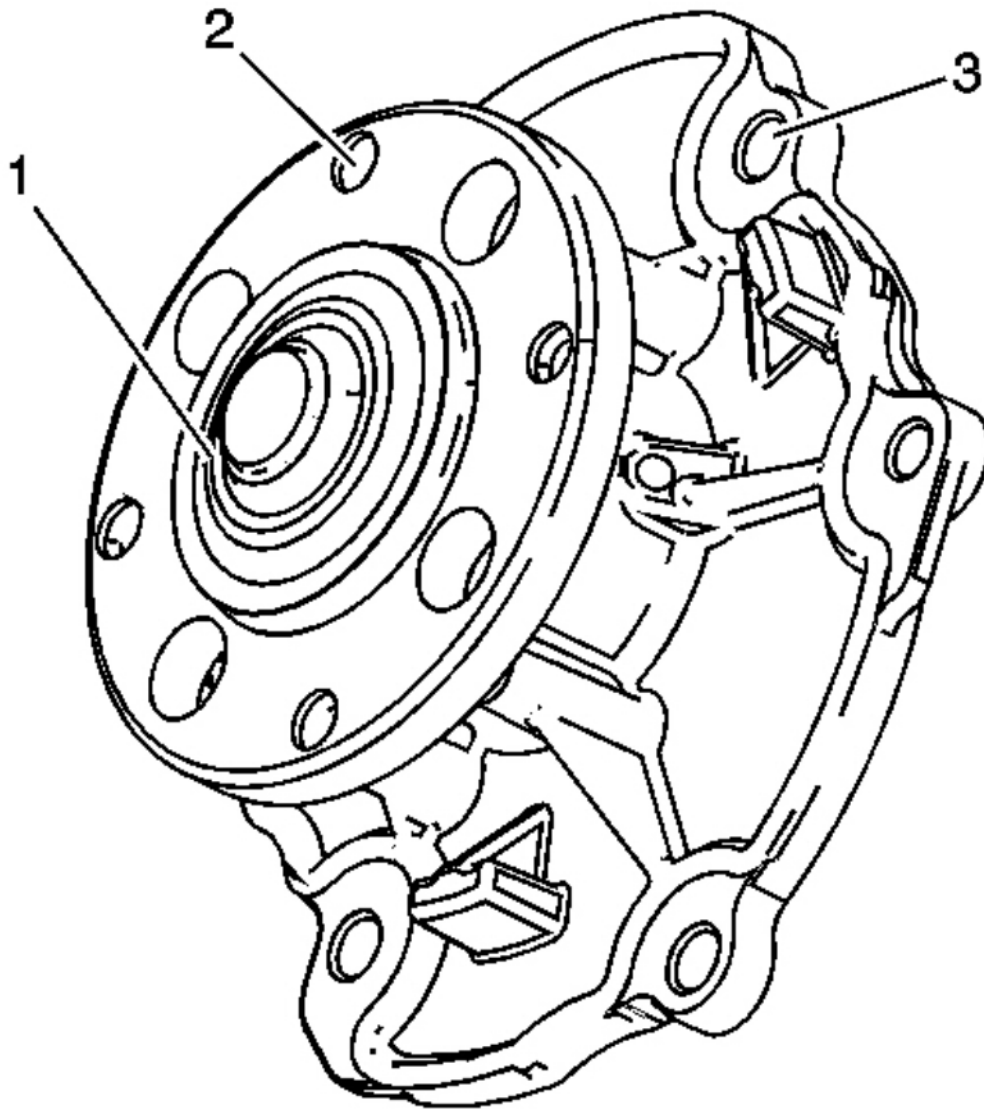


Fig. 7: Inspecting Exterior Of Water Pump
Courtesy of GENERAL MOTORS CORP.

1. Rotate the water pump hub (1). The water pump hub and impeller should turn straight and smoothly. If the hub wobbles, is noisy, or feels rough when rotated, replace the water pump.

2. Inspect the exterior of the water pump for the following:
 - Damage to the water pump hub bolt threads (2) for the water pump pulley
 - Damage to the water pump bolt holes (3)

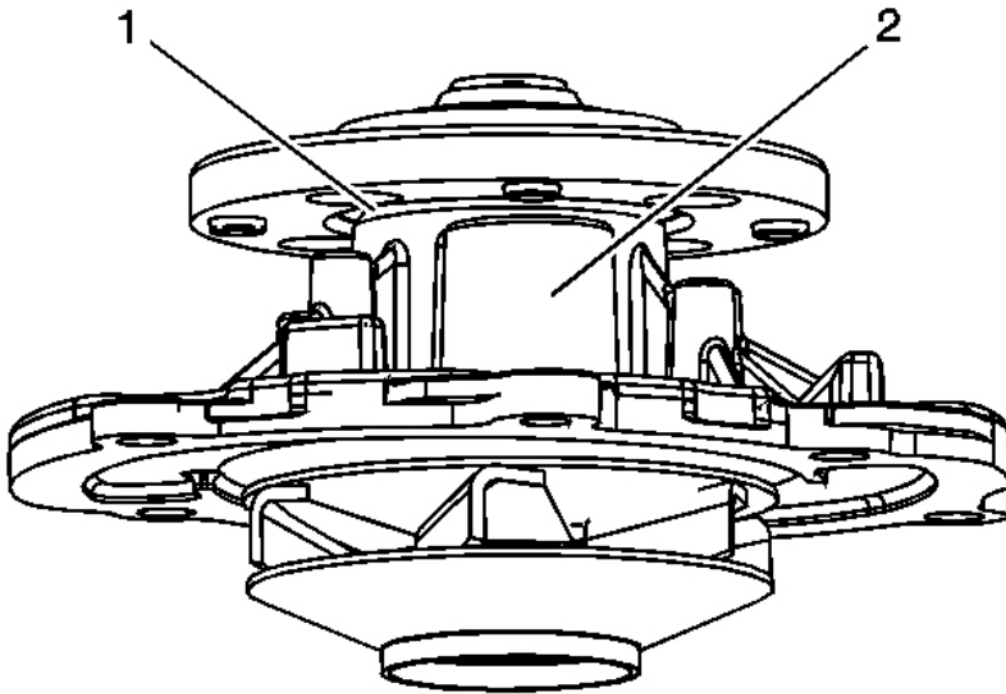


Fig. 8: Inspecting Water Pump Shaft & Weep Hole
Courtesy of GENERAL MOTORS CORP.

3. Examine the water pump shaft (1) and the weep hole (2) in the water pump body for signs of leakage. If coolant leakage is evident, replace the water pump.

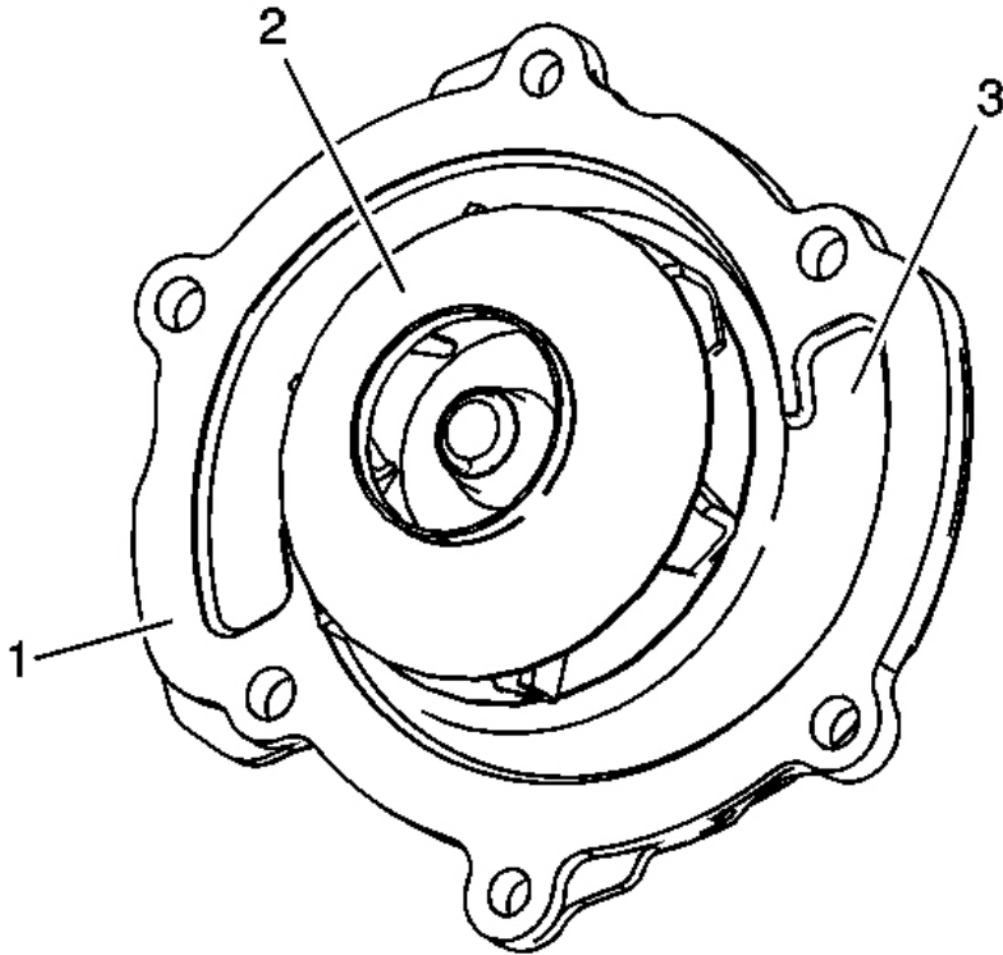


Fig. 9: Inspecting Interior Of Water Pump
Courtesy of GENERAL MOTORS CORP.

4. Inspect the interior of the water pump for the following:
 - Damage to the water pump gasket sealing surface (1)
 - Damage, corrosion or restrictions to the water pump impeller (2)
 - Damage, corrosion or restrictions to the coolant passages (3)
5. Repair or replace the water pump as necessary.

Tools Required

- **J 42385-700** High Feature Thread Repair Kit
- **J 42385-2000** Thread Insert Kit
- **J 43965** Thread Repair Extension Kit

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert. During the insert installation process, the installation driver tool cold-rolls the bottom internal threads and expands the bottom external threads of the insert into the base material. This action mechanically locks the insert into place.

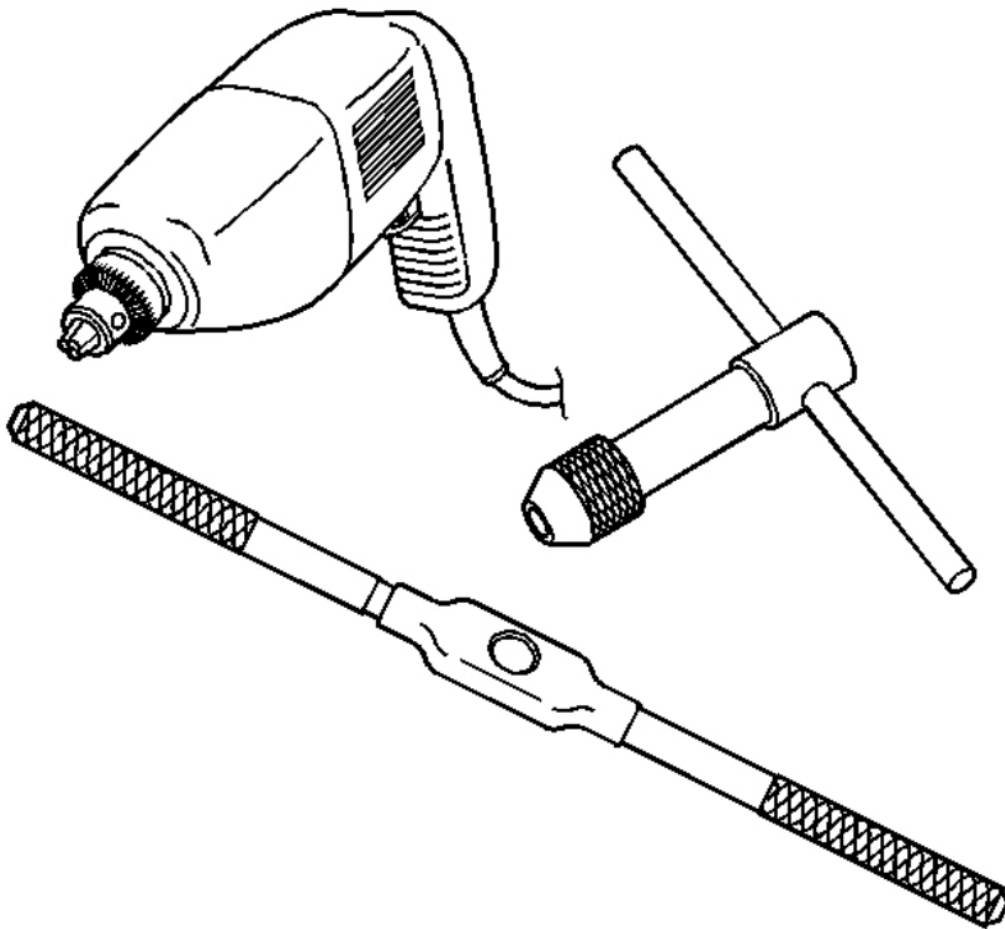


Fig. 10: View Of J 42385-400 Tool Kit

Courtesy of GENERAL MOTORS CORP.

The drill bit and counter bore tool from the tool kit **J 42385-700** and **J 42385-2000** is designed for use with either a suitable tap wrench or drill motor. Limited access and larger hole repair may process better using a tap wrench. An extension from kit **J 43965** may also be necessary to drive the thread repair tooling dependent on access to the hole being repaired. Use only a tap wrench when tapping the hole and during installation of the insert.

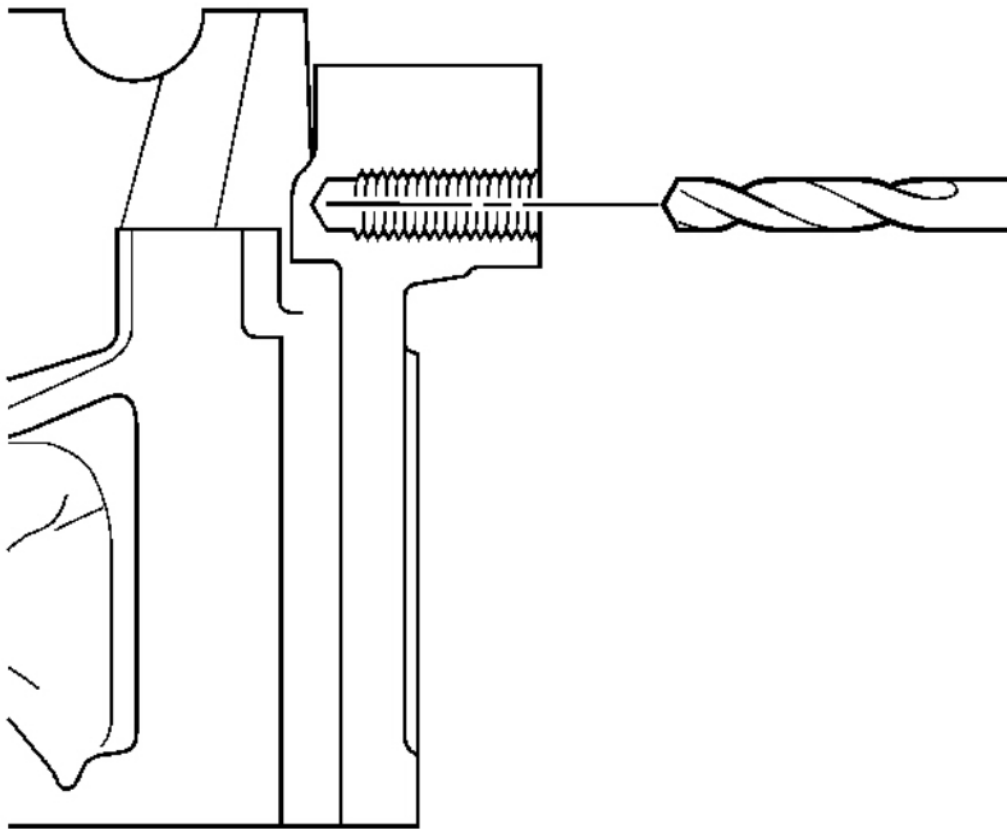


Fig. 11: Drilled Hole Centerline
Courtesy of GENERAL MOTORS CORP.

It is critical that the drilling, counterboring and tapping of the hole to be repaired follows the same centerline as the original hole.

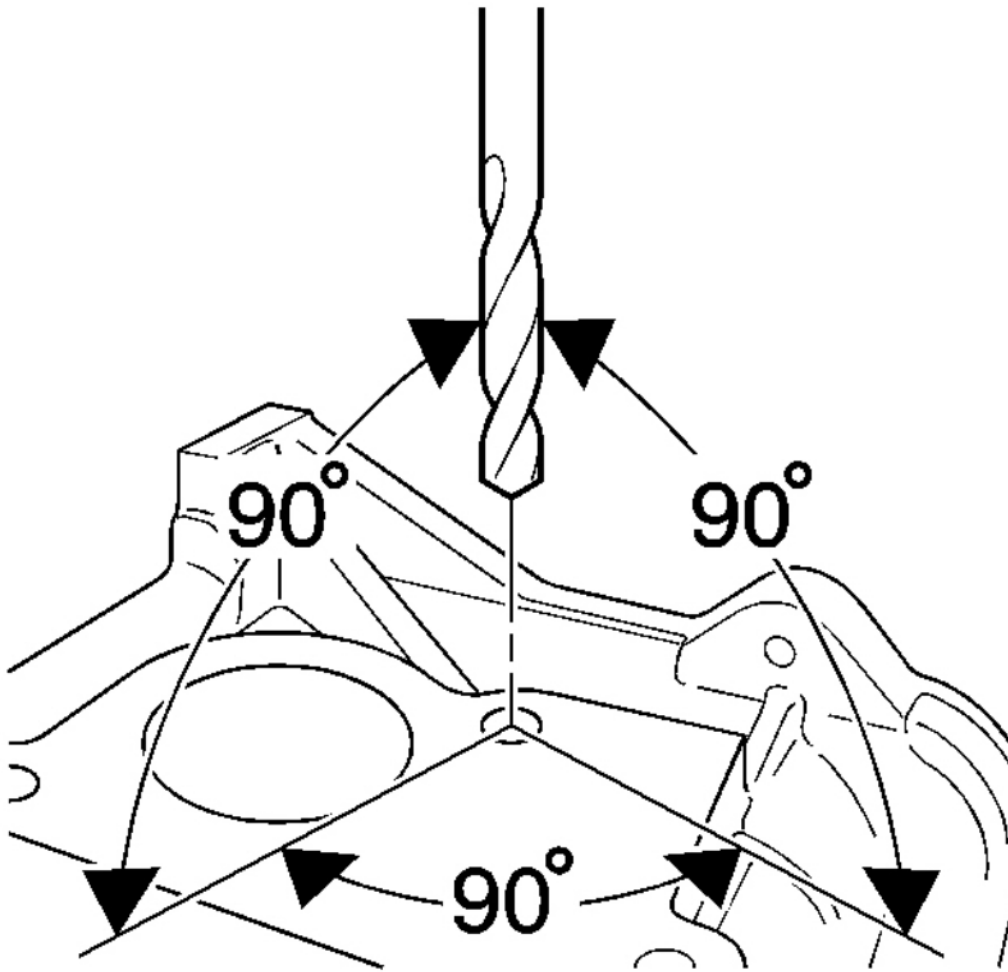


Fig. 12: Identifying Proper Drilling Angle
Courtesy of GENERAL MOTORS CORP.

During the drilling and tapping of the hole being repaired ensure the tooling is consistently machining perpendicular to the surface of the base material.

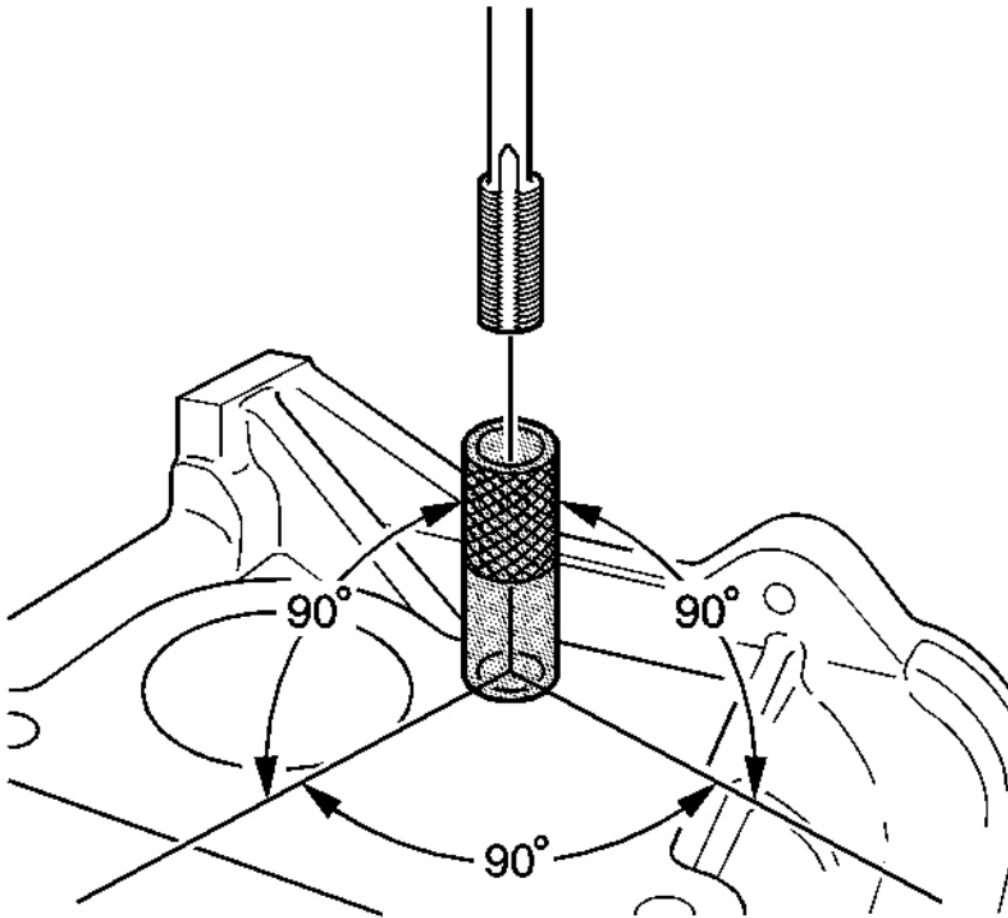


Fig. 13: View Of Tapping Guide
Courtesy of GENERAL MOTORS CORP.

If the threaded hole being repaired has a base surface perpendicular to the hole centerline, tapping guides are available to aid in tapping the hole.

Thread Repair

Tap Size	Tap Guide	Tape Size	Tape Guide	Tap Size	Tape Guide
-	J 42385-	-	J 42385-	-	J 42385-
6 x 1.0	729	10 x 1.5	731	14 x 1.5	736
8 x 1.25	730	12 x 1.5	732	20 x 1.5	737

Standard Thread Repair - Flush Hole

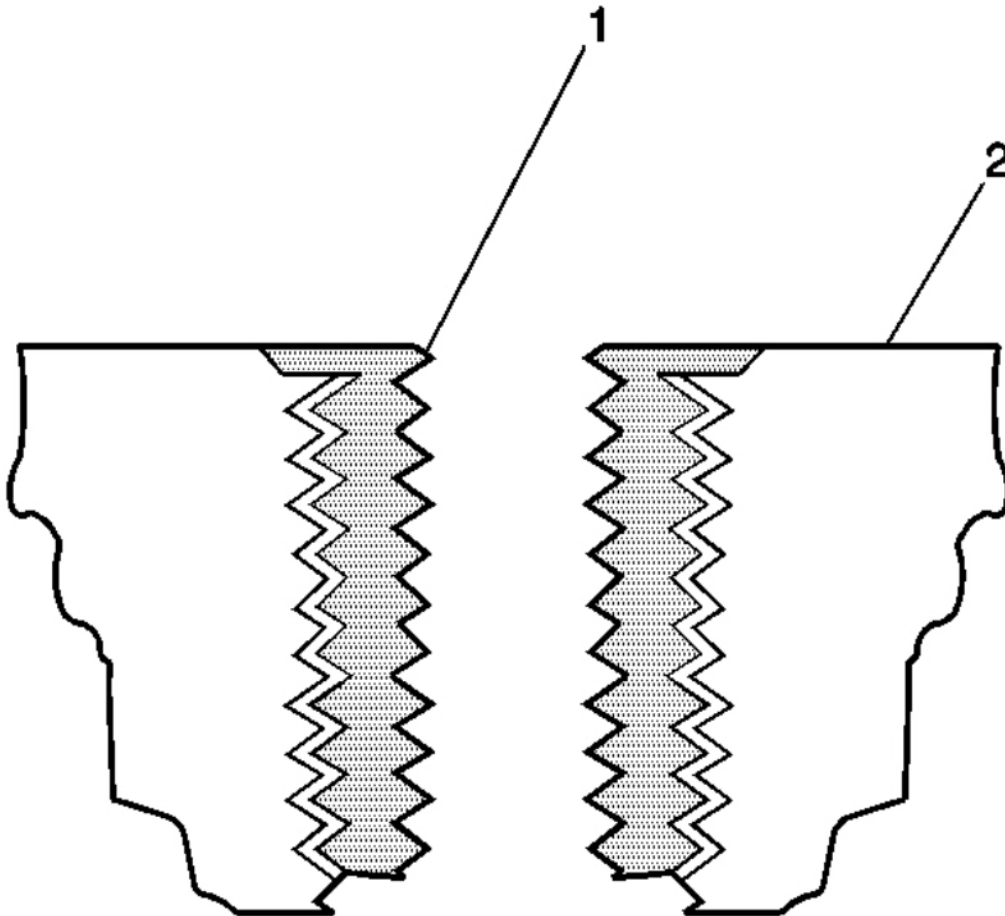


Fig. 14: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

IMPORTANT: The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.

When installed to the proper depth, the flange (1) of the insert will be seated against the counterbore of the drilled/tapped hole and just below the surface (2) of the base material.

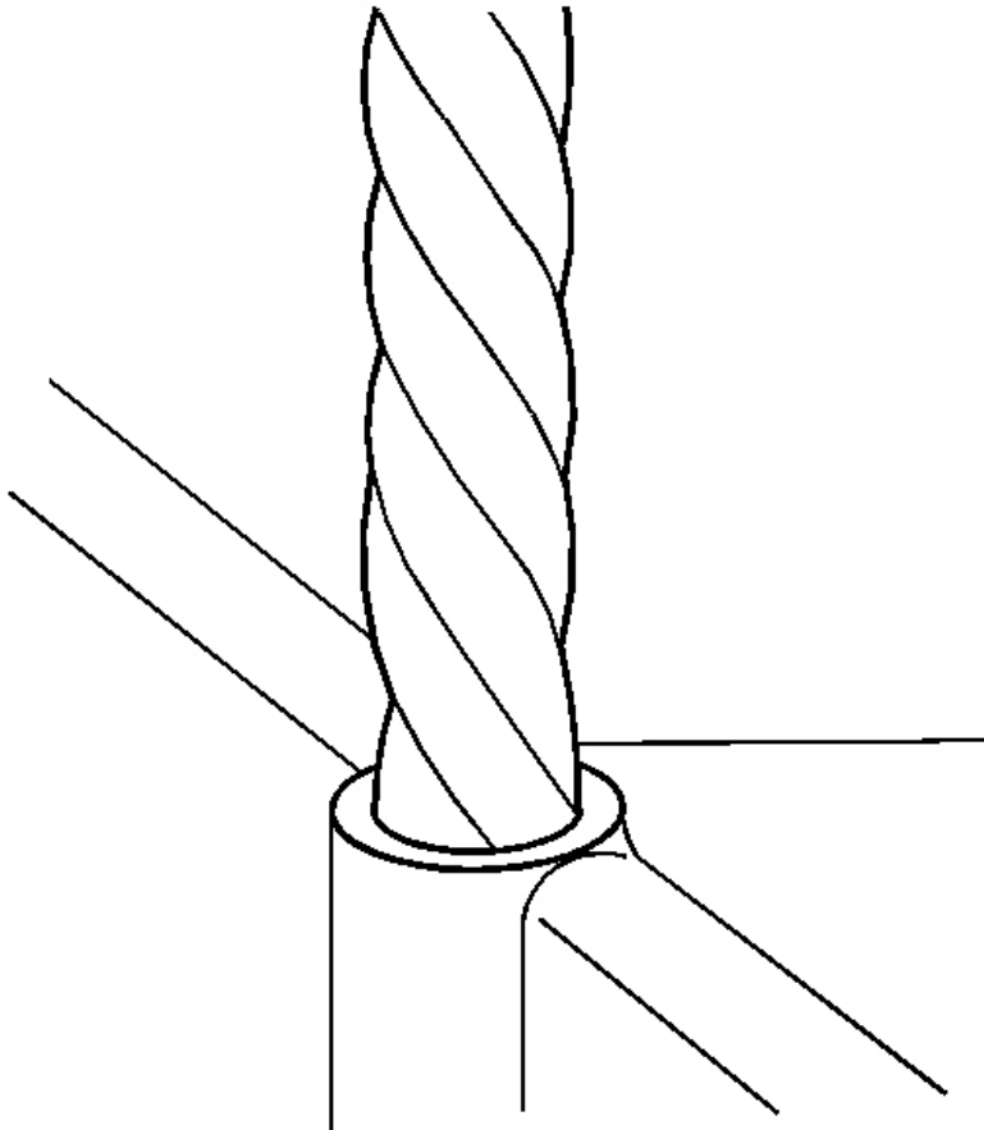


Fig. 15: Drilling Out Threads Of Damaged Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.
- Do NOT drill any further than the original hole depth.

1. Drill out the threads of the damaged hole.

Specifications:

- M6 inserts require a minimum drill depth of 15 mm (0.59 in).
- M8 inserts require a minimum drill depth of 20 mm (0.79 in).
- M10 inserts require a minimum drill depth of 23.5 mm (0.93 in).

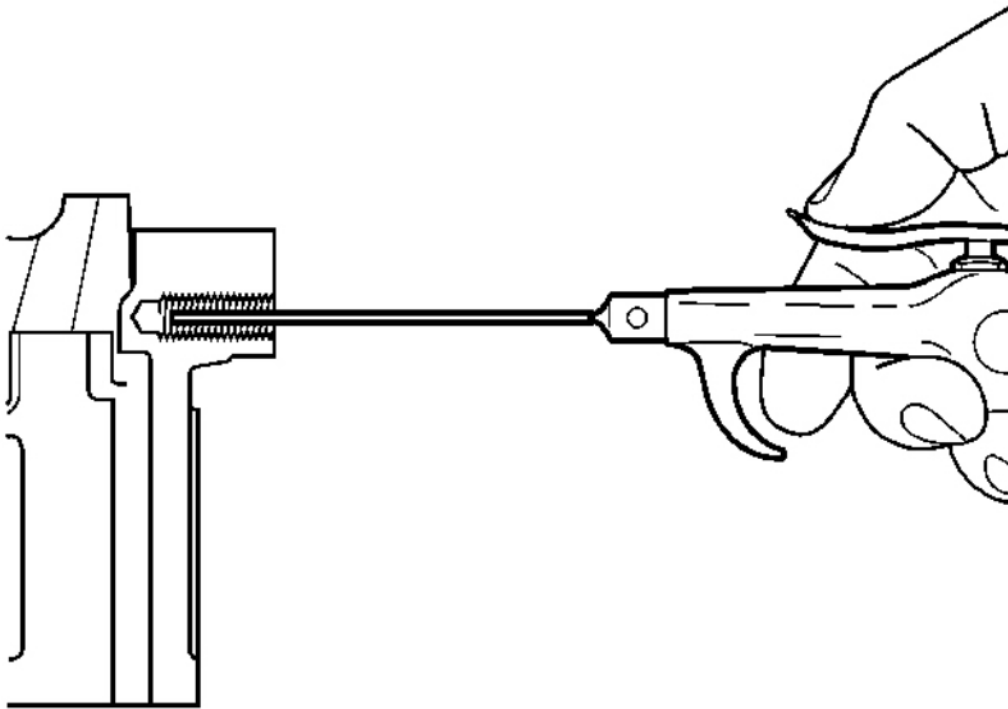


Fig. 16: Cleaning Out Metal Chips

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to

tapping.

2. Using compressed air, clean out any chips.

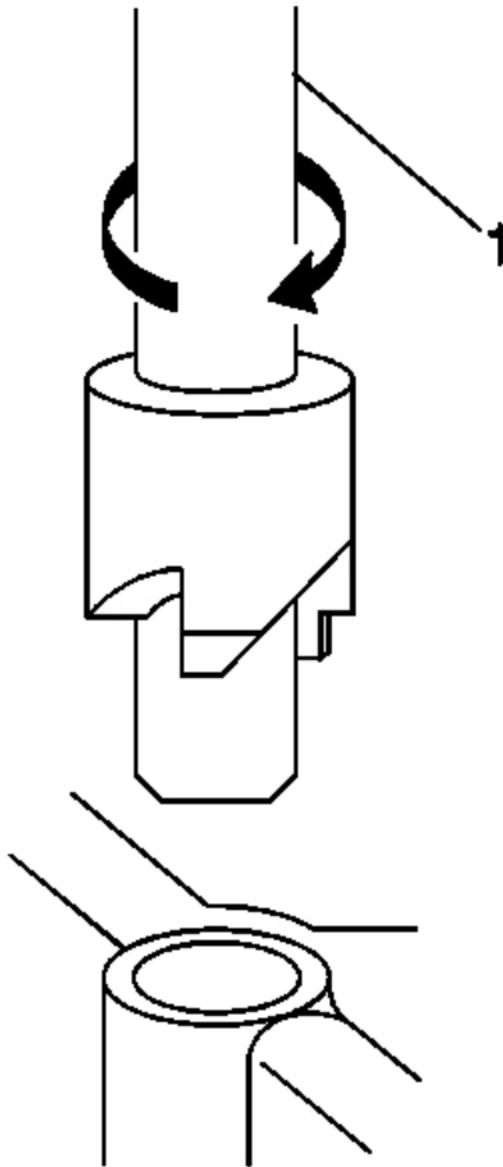


Fig. 17: View Of Counterbore Drill

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A properly counterbored hole will show a slight burnishing on the surface of the base material for 360 degrees around the drilled hole.

3. Counterbore the drilled hole to the full depth permitted by the tool (1).

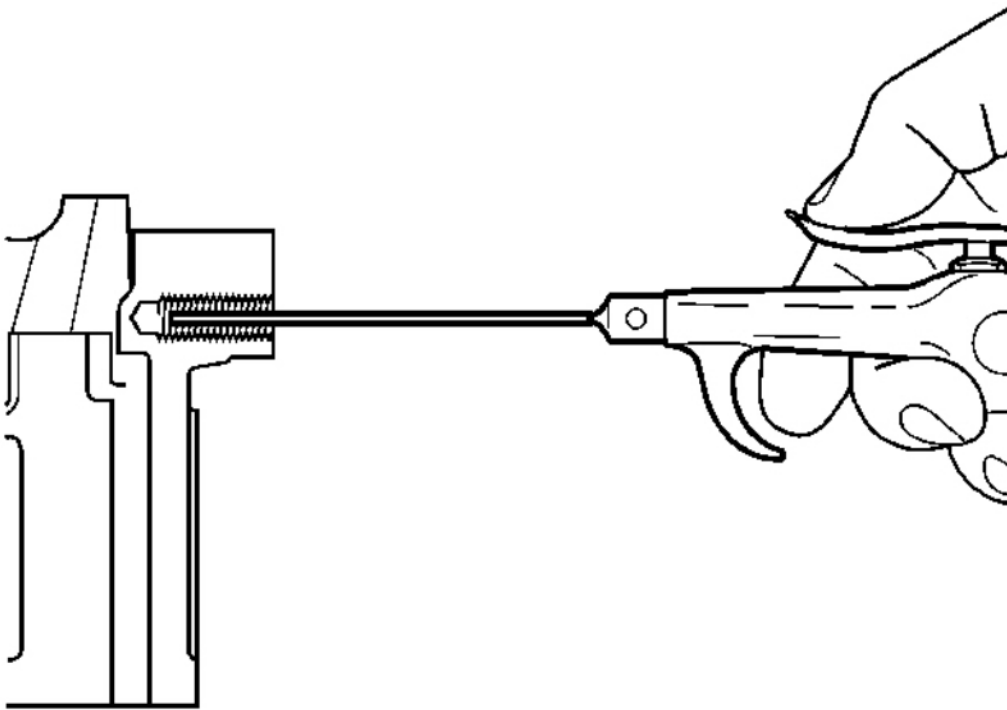


Fig. 18: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to tapping.

4. Using compressed air, clean out any chips.

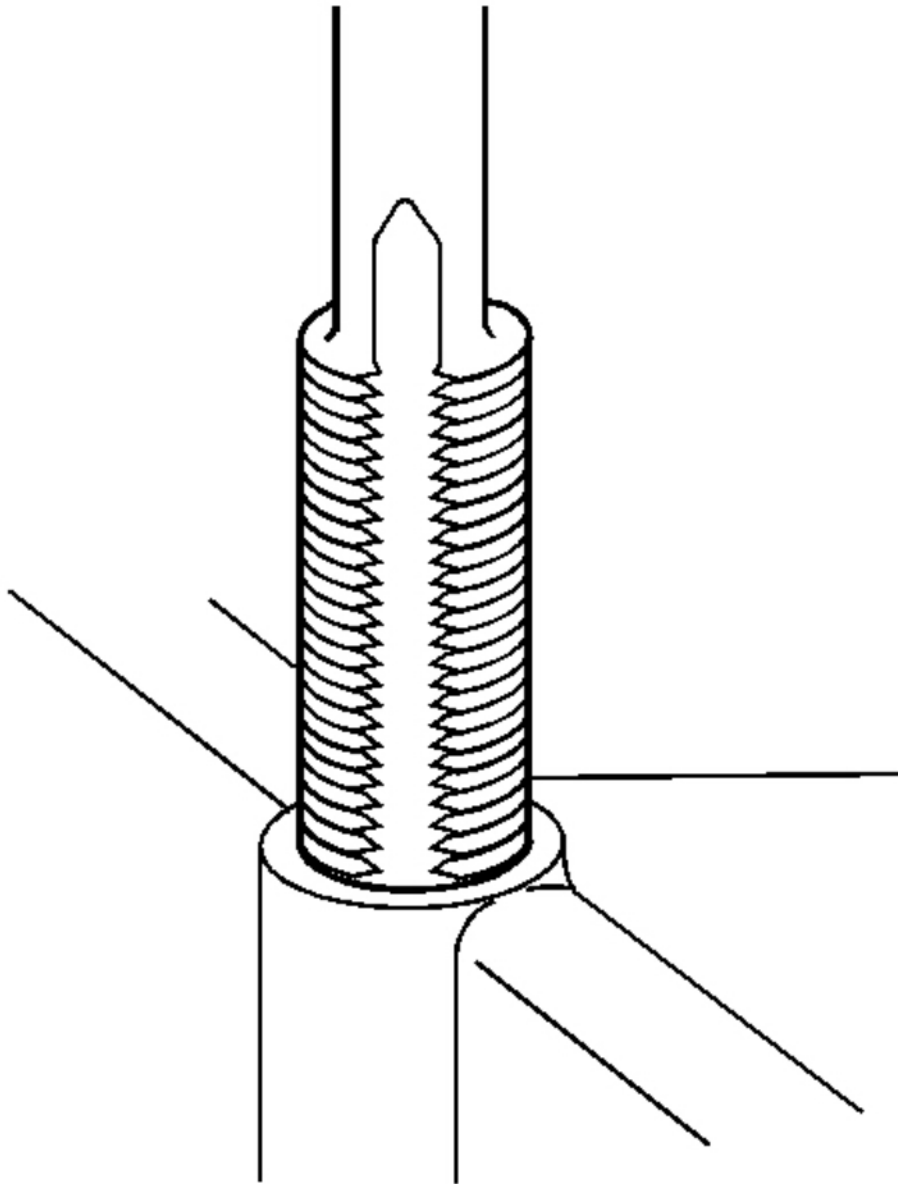


Fig. 19: Tapping Threads Of Drilled Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: • During the tapping process, it is necessary to repeatedly

remove the tap and clean chips from the hole and the flutes of the tap.

- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

5. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

Specifications:

- M6 inserts require a minimum tap depth of 15 mm (0.59 in).
- M8 inserts require a minimum tap depth of 20 mm (0.79 in).
- M10 inserts require a minimum tap depth of 23.5 mm (0.93 in).

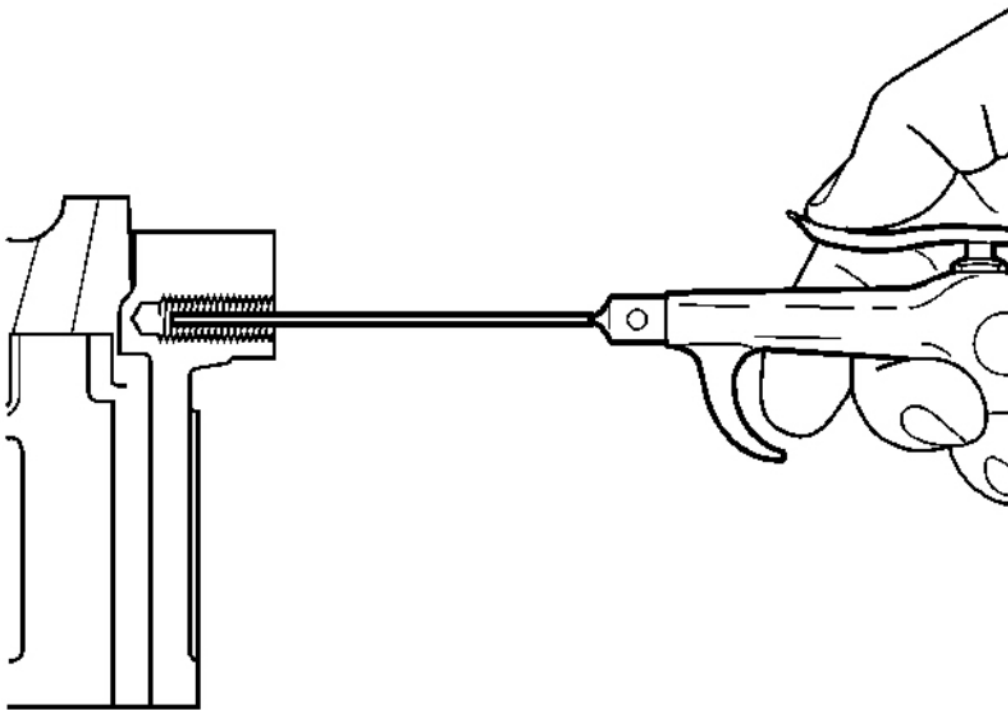


Fig. 20: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to

insert installation.

6. Using compressed air, clean out any chips.

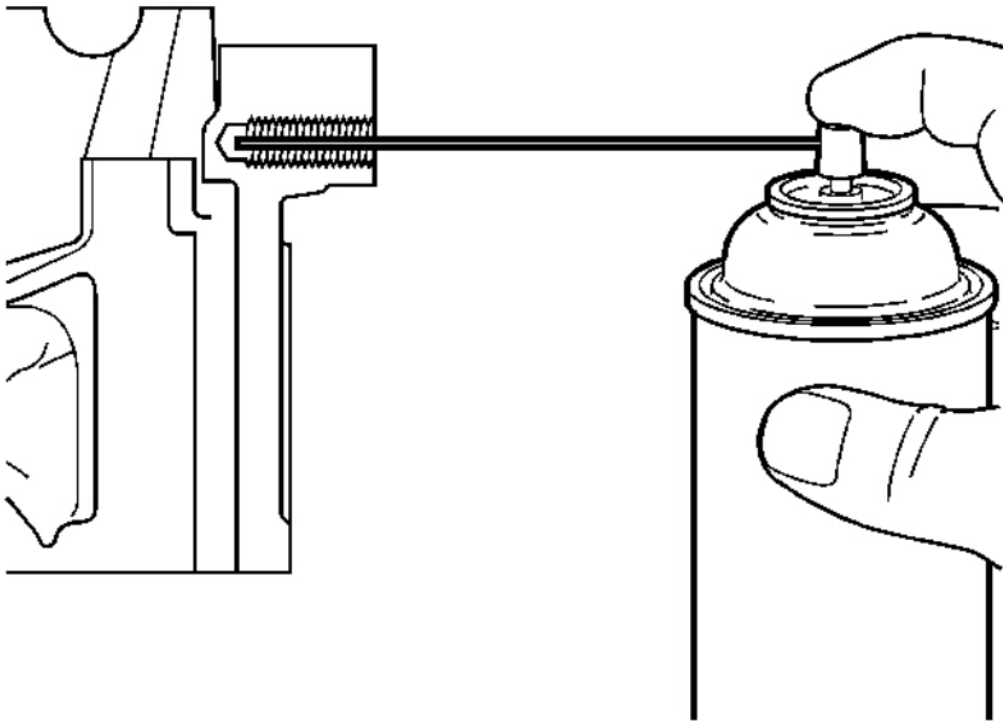


Fig. 21: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

7. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

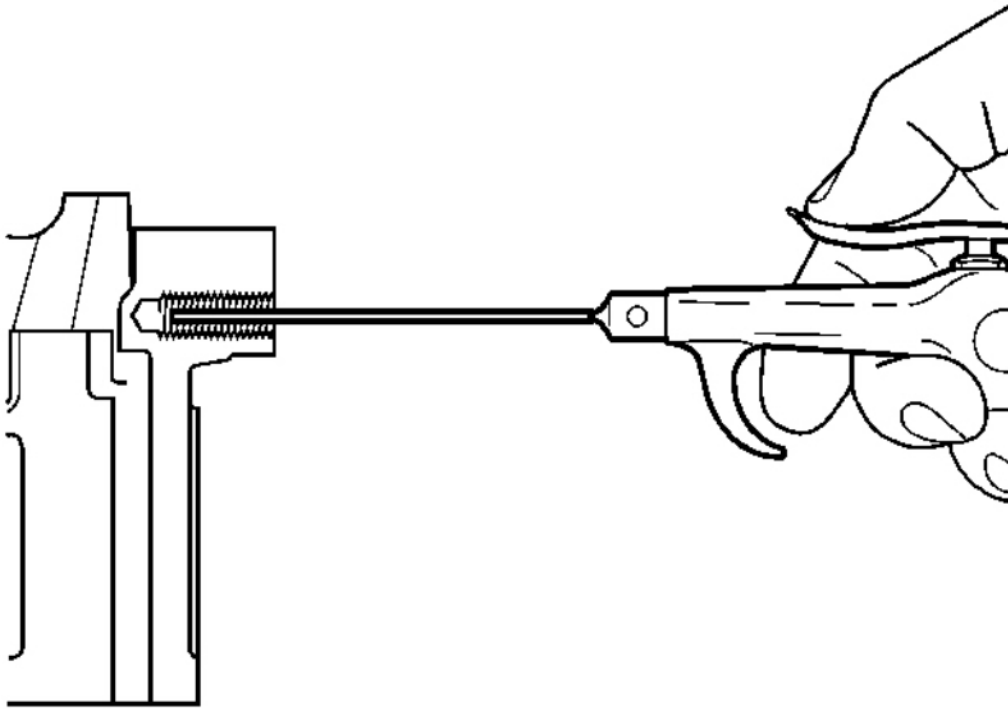


Fig. 22: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

8. Using compressed air, clean out any chips.

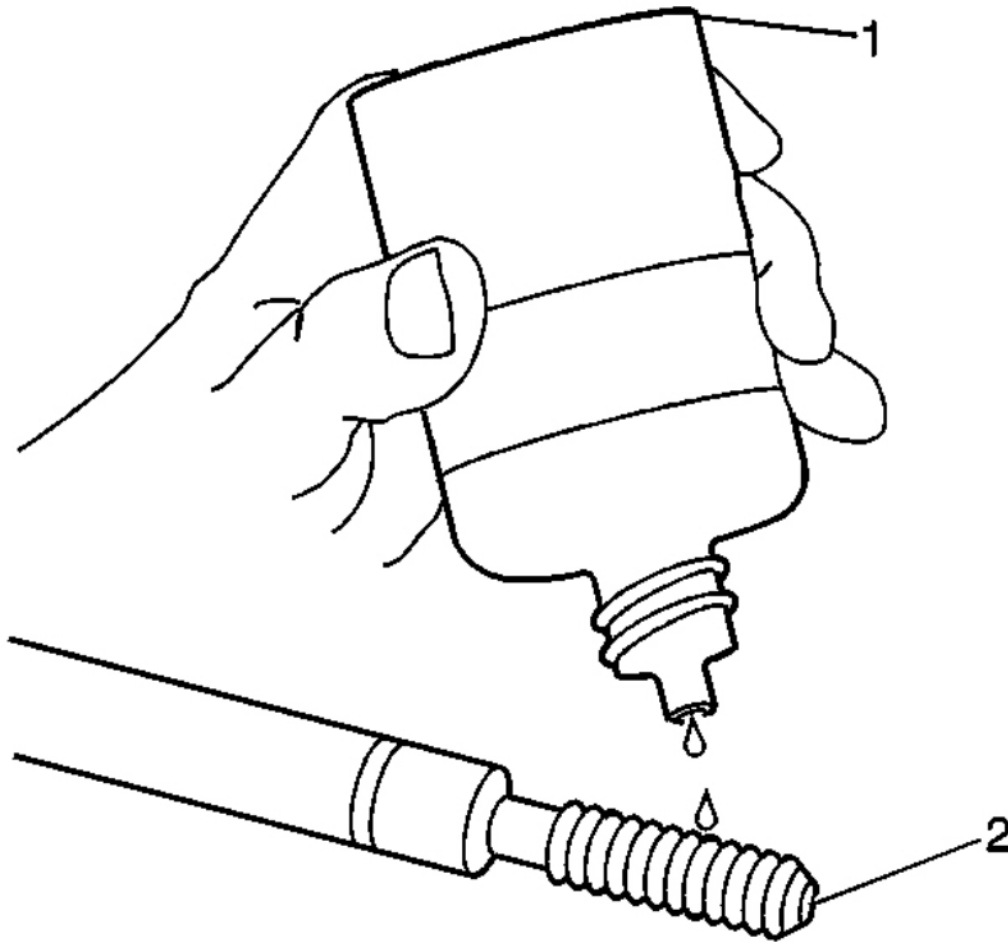


Fig. 23: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

9. Lubricate the threads of the driver installation tool (2) with the driver oil (1) J 42385-110.

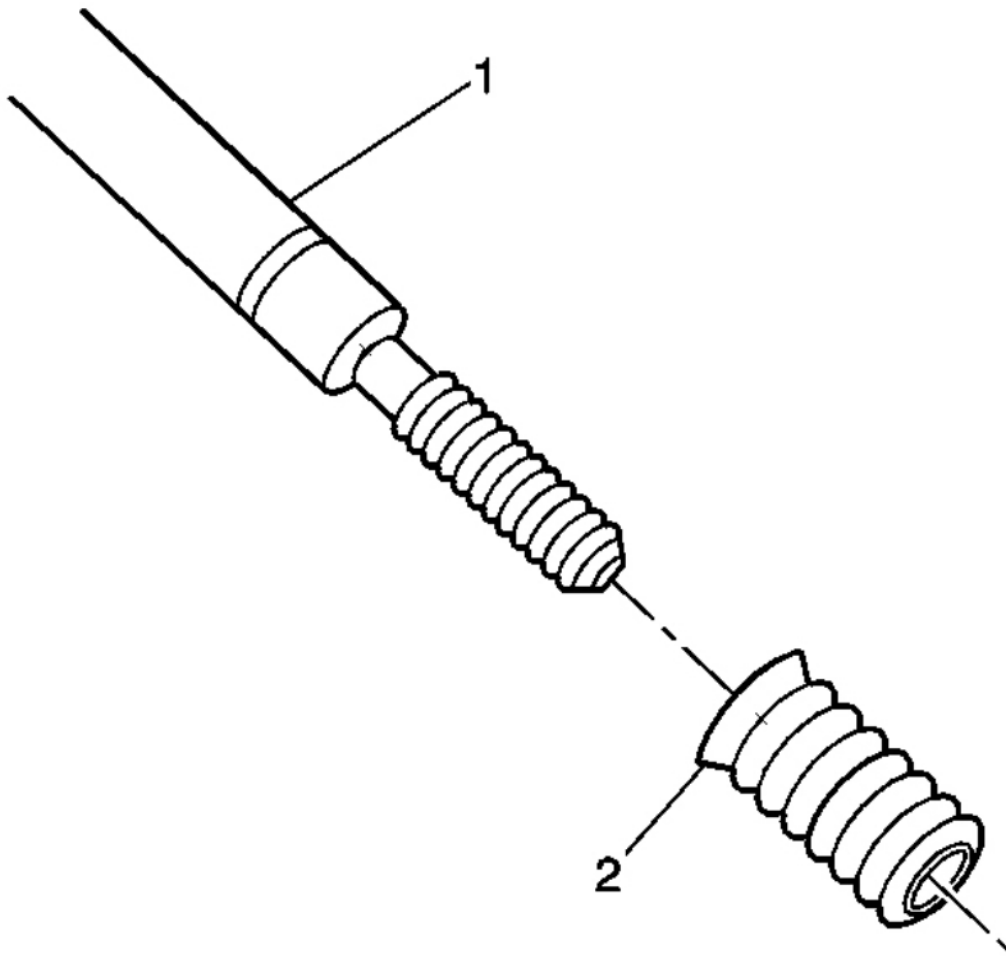


Fig. 24: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

10. Install the insert (2) onto the driver installation tool (1).

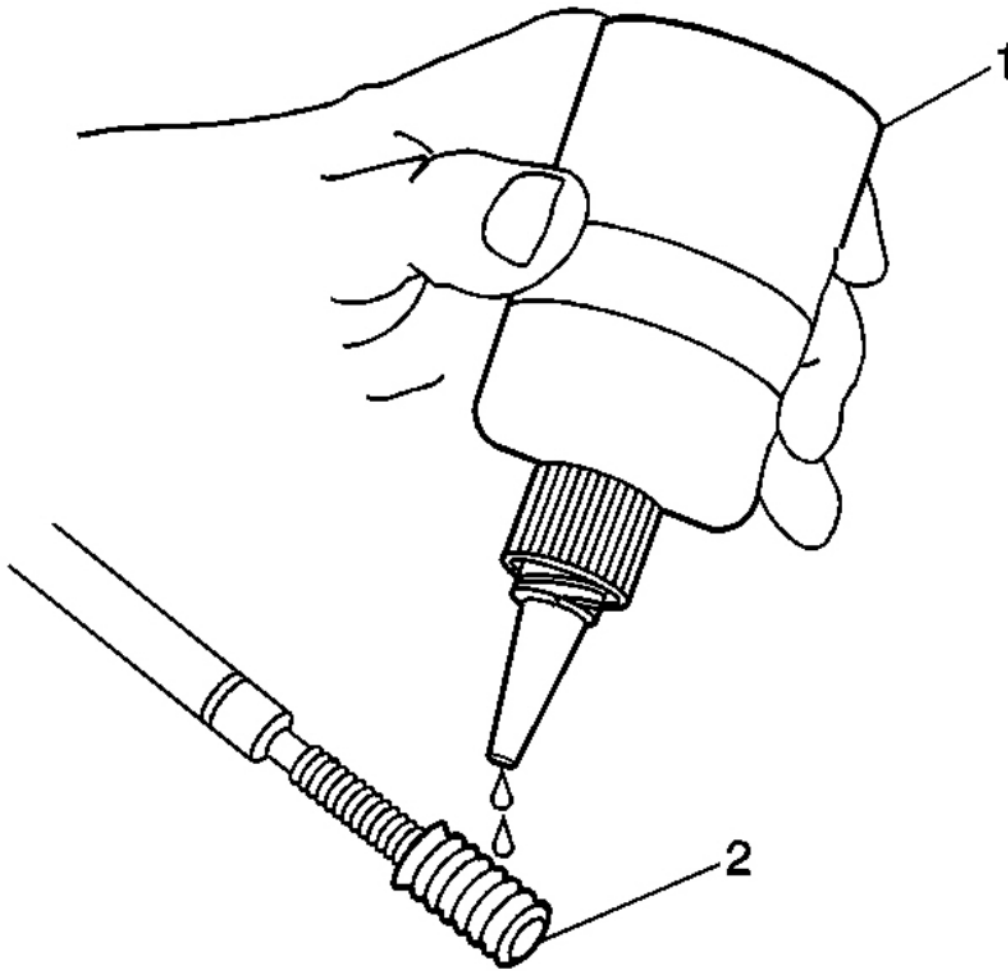


Fig. 25: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

11. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277® or equivalent (1) to the insert OD threads (2).

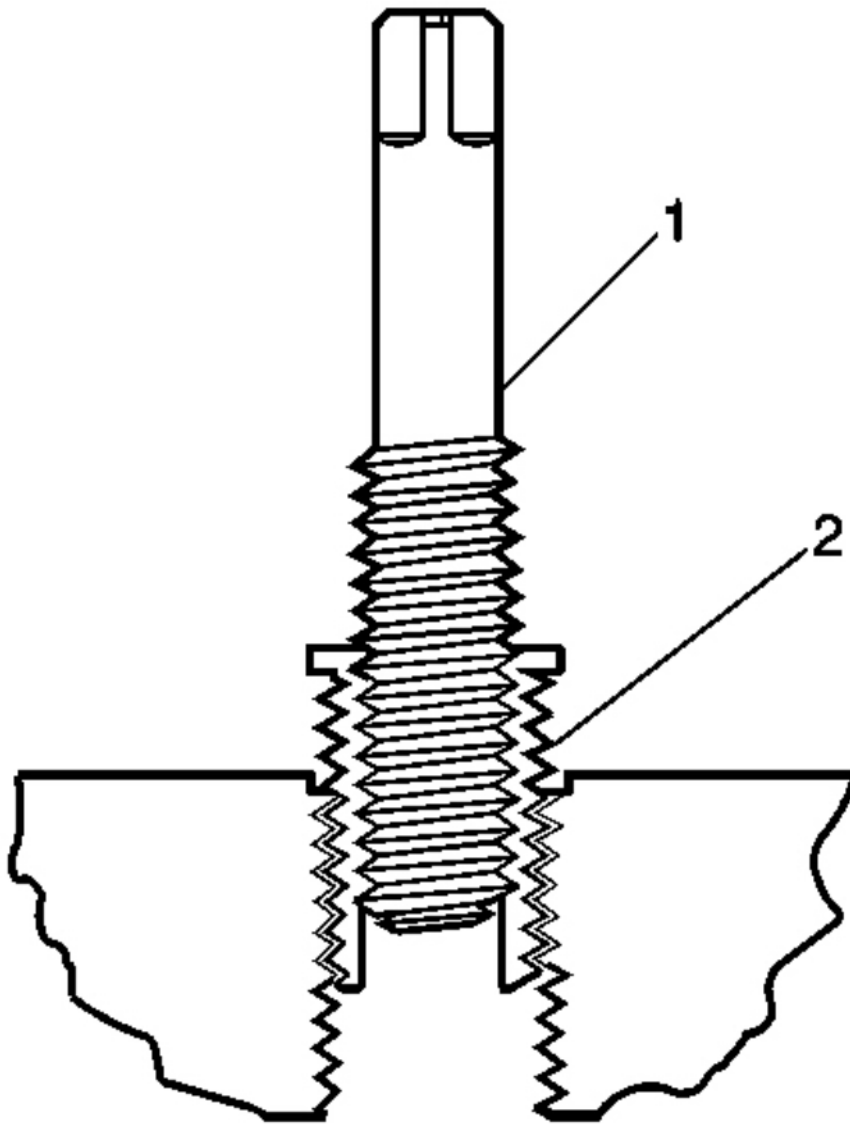


Fig. 26: Installing Insert Into Tapped Bolt Hole
Courtesy of GENERAL MOTORS CORP.

12. Install the insert (2) into the tapped hole by hand only.

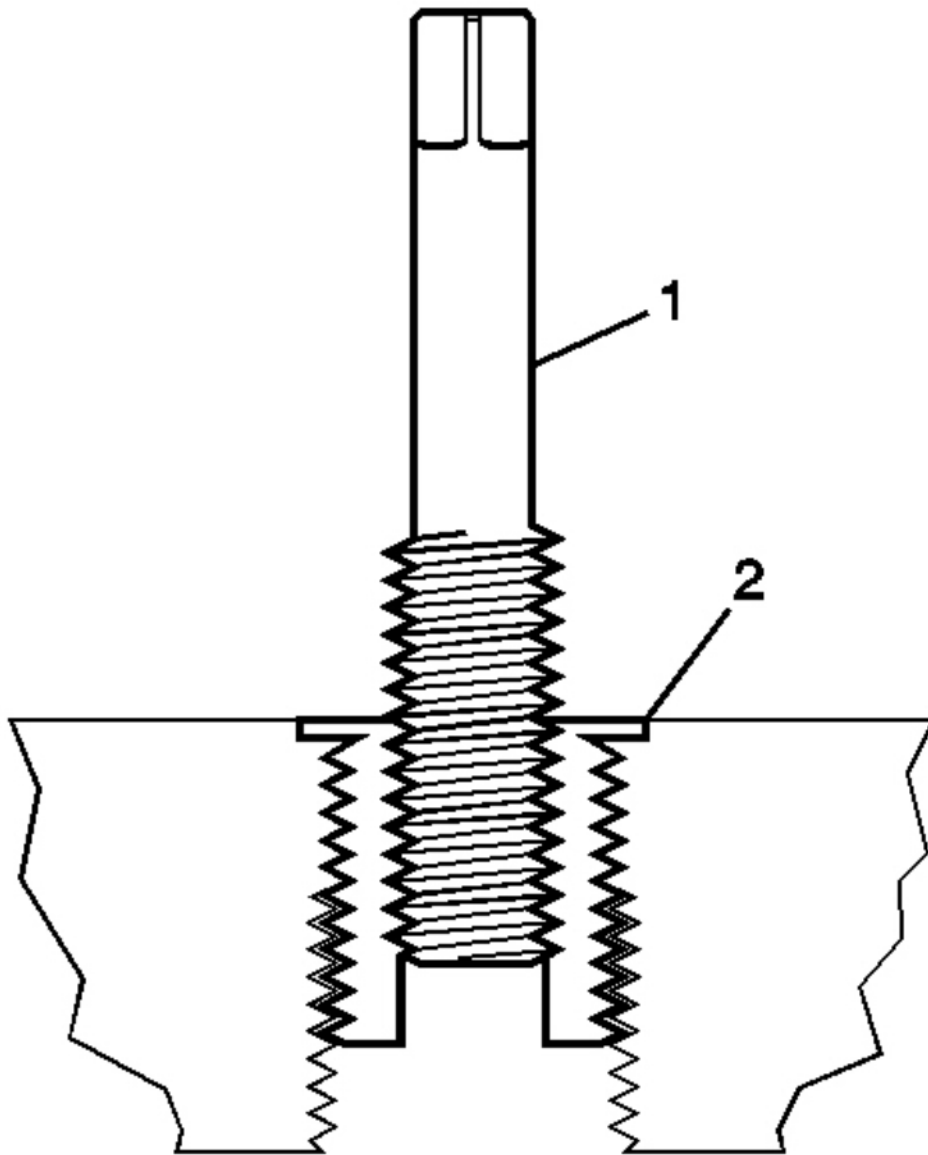


Fig. 27: Installing Insert - Standard Thread
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the insert will not thread down until the flange contacts the counterbored surface, remove the insert immediately with a

screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

13. Install the insert until the flange (2) of the insert contacts the counterbored surface.

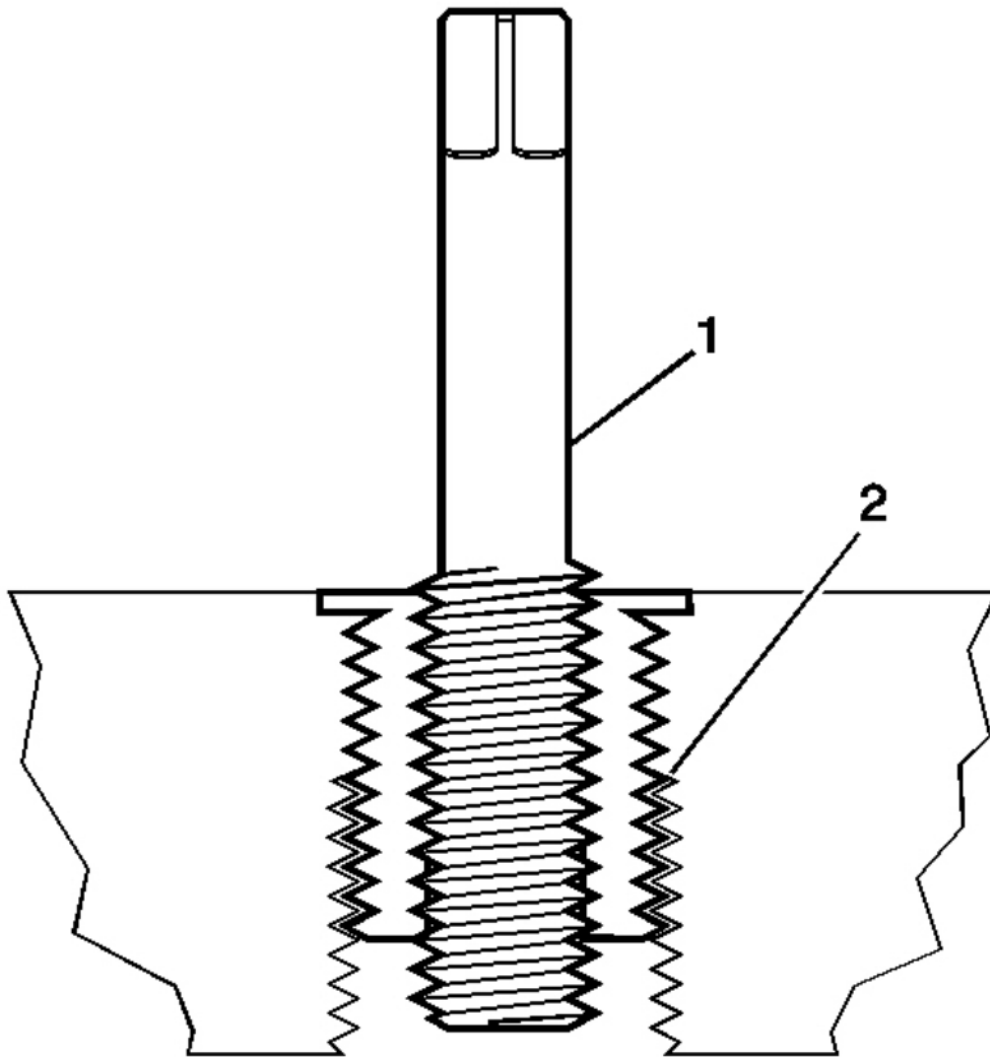


Fig. 28: View Insert And Tool - Standard Thread
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

14. Continue to rotate the driver installation tool (1) through the insert (2).

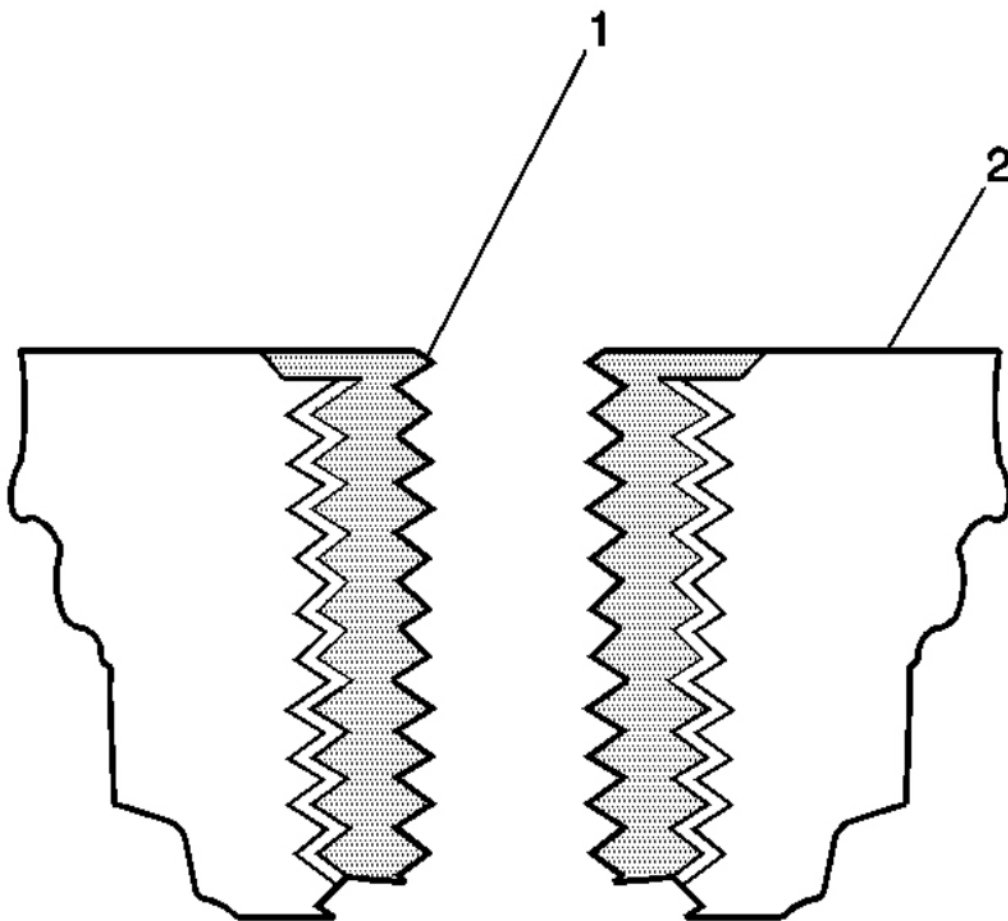


Fig. 29: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

15. Inspect the insert for proper installation into the tapped hole. A properly installed insert (1)

will be either flush or slightly below flush with the surface of the base material (2).

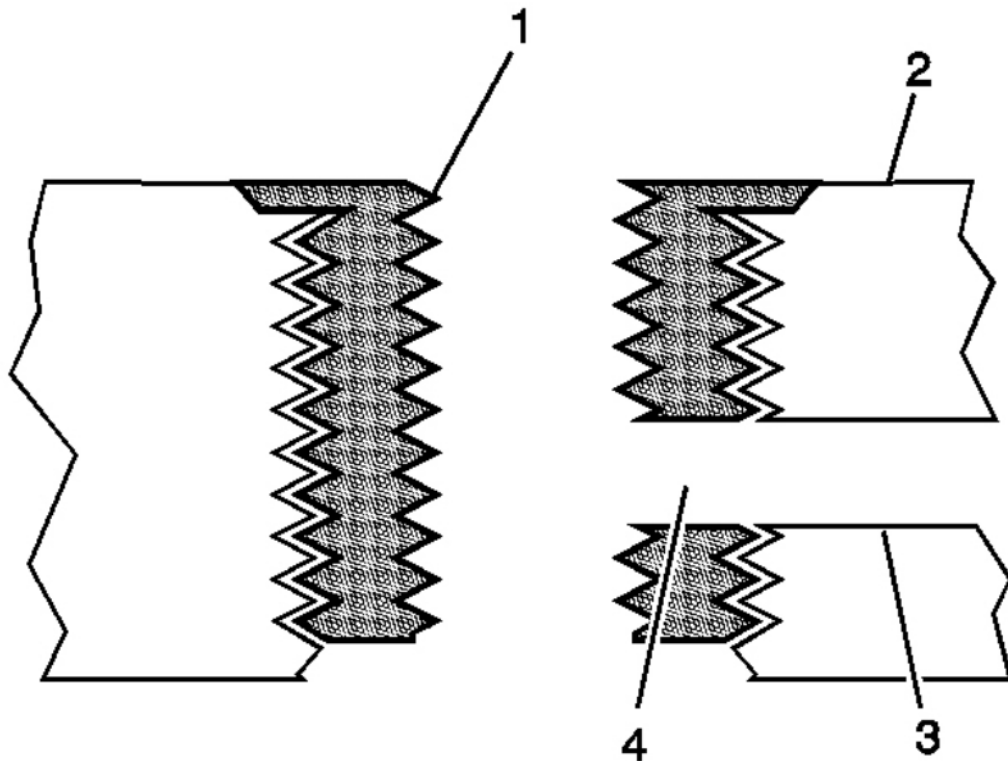


Fig. 30: View Of Restricted Engine Coolant Passages - Standard Thread Repair
Courtesy of GENERAL MOTORS CORP.

16. Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any chips and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

Recessed Thread Repair

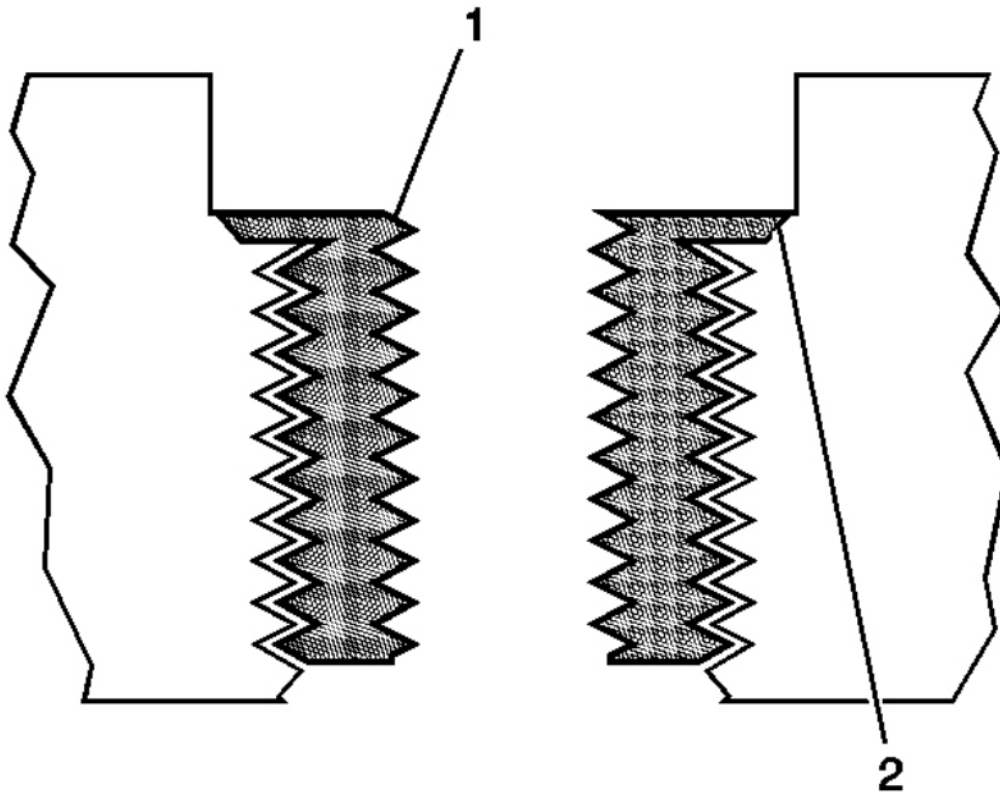


Fig. 31: Inspecting Insert For Proper Installation - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

- IMPORTANT:**
- The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.
 - Do NOT remove the original stop collar from a counterbore drill.

When installed to the proper depth, the flange of the insert (1) will be seated against the

counterbore (2) of the drilled/tapped hole.

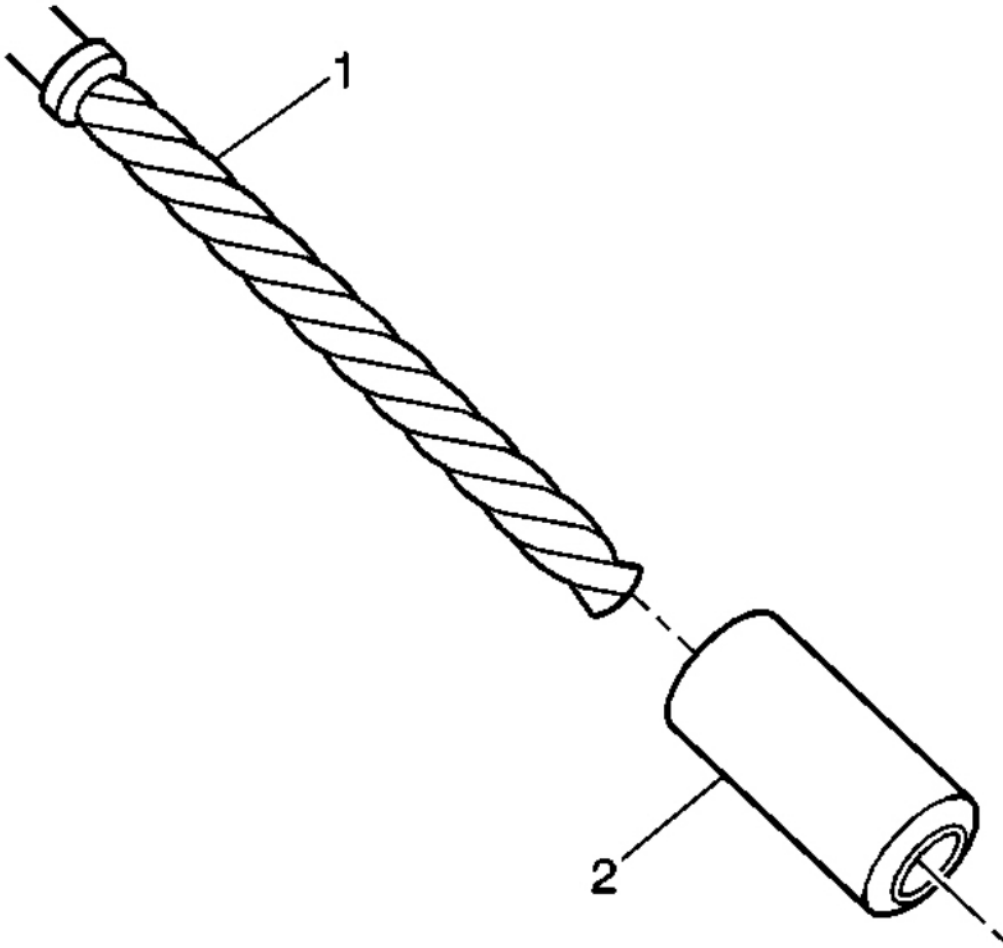


Fig. 32: View Of Stop Collar & Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

1. Install a stop collar (2) on the counterbore drill (1), if required.

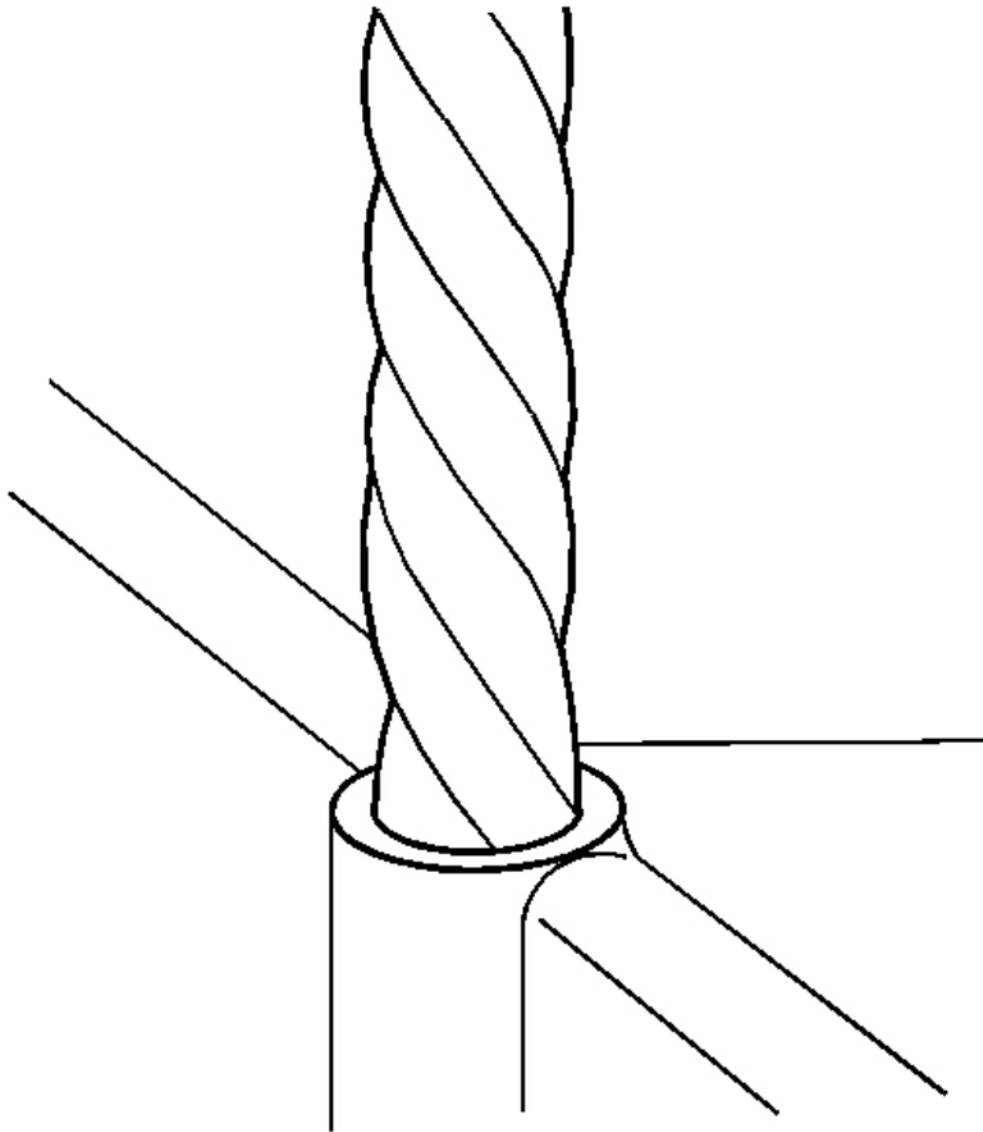


Fig. 33: Drilling Out Threads Of Damaged Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.

- **Drill the hole until the stop collar contacts the surface of the base material.**

2. Drill out the threads of the damaged hole.

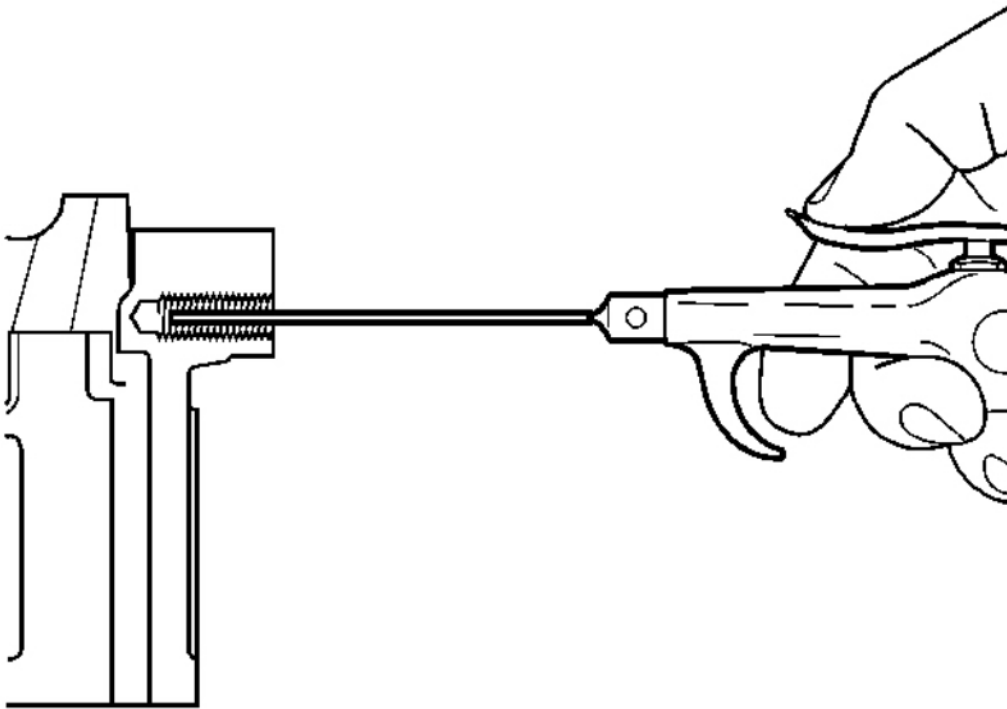


Fig. 34: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to tapping.

3. Using compressed air, clean out any chips.

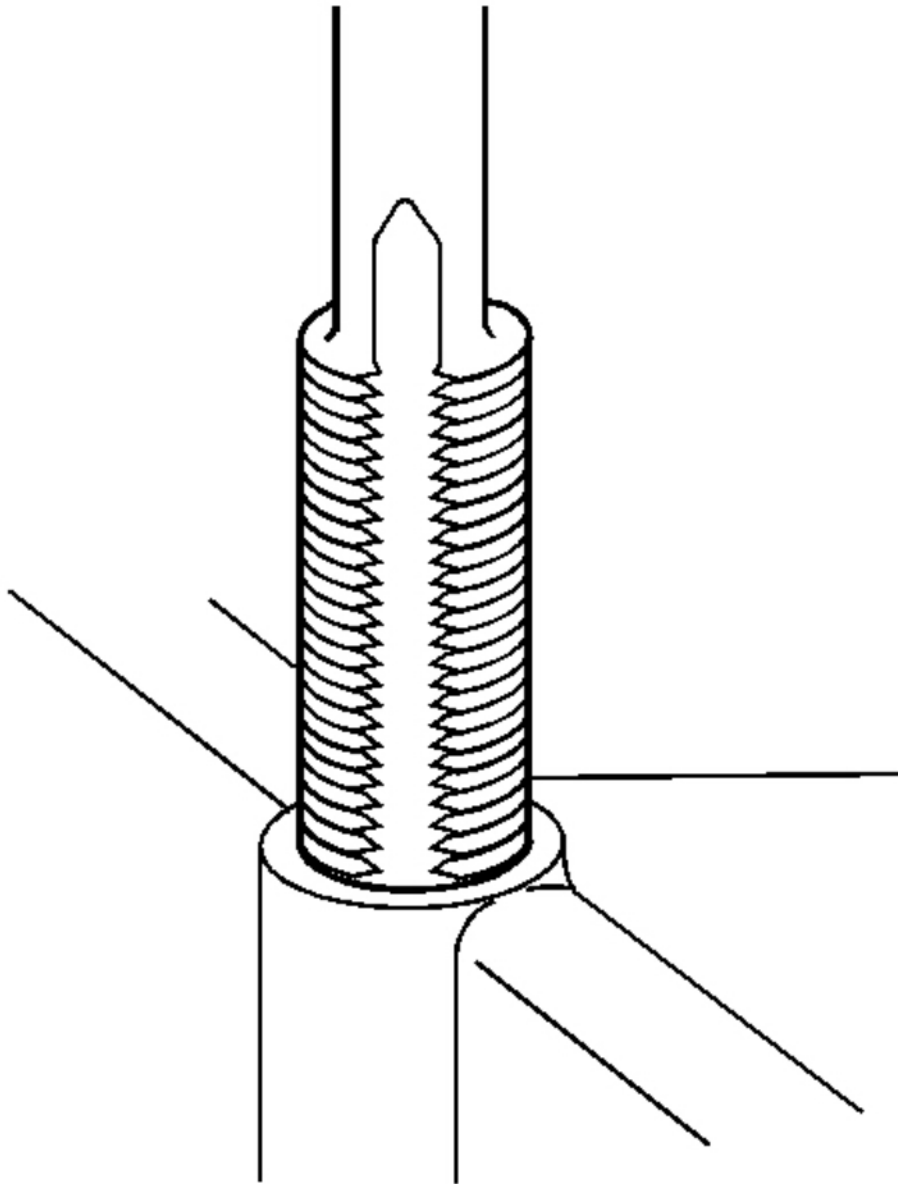


Fig. 35: Tapping Threads Of Drilled Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: • During the tapping process, it is necessary to repeatedly

remove the tap and clean chips from the hole and the flutes of the tap.

- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

4. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

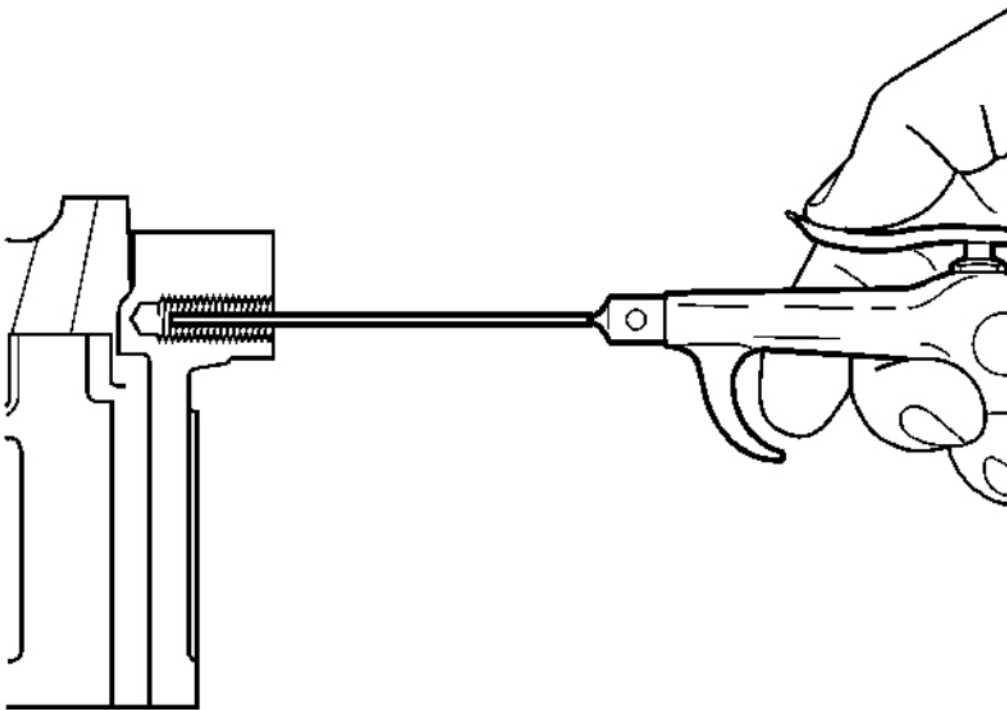


Fig. 36: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

5. Using compressed air, clean out any chips.

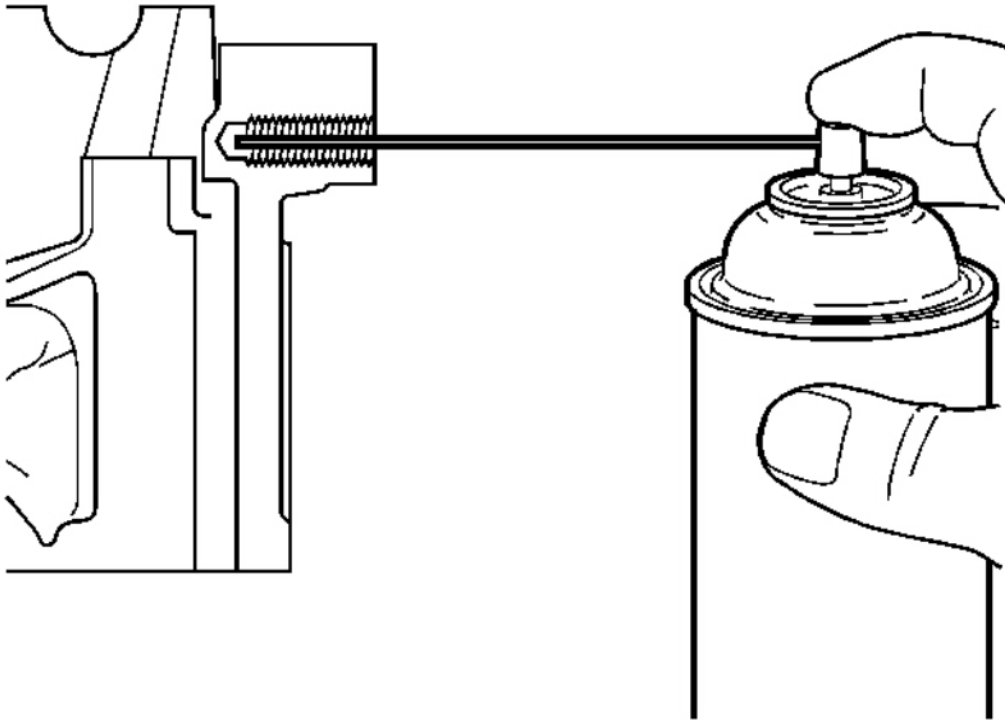


Fig. 37: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

6. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

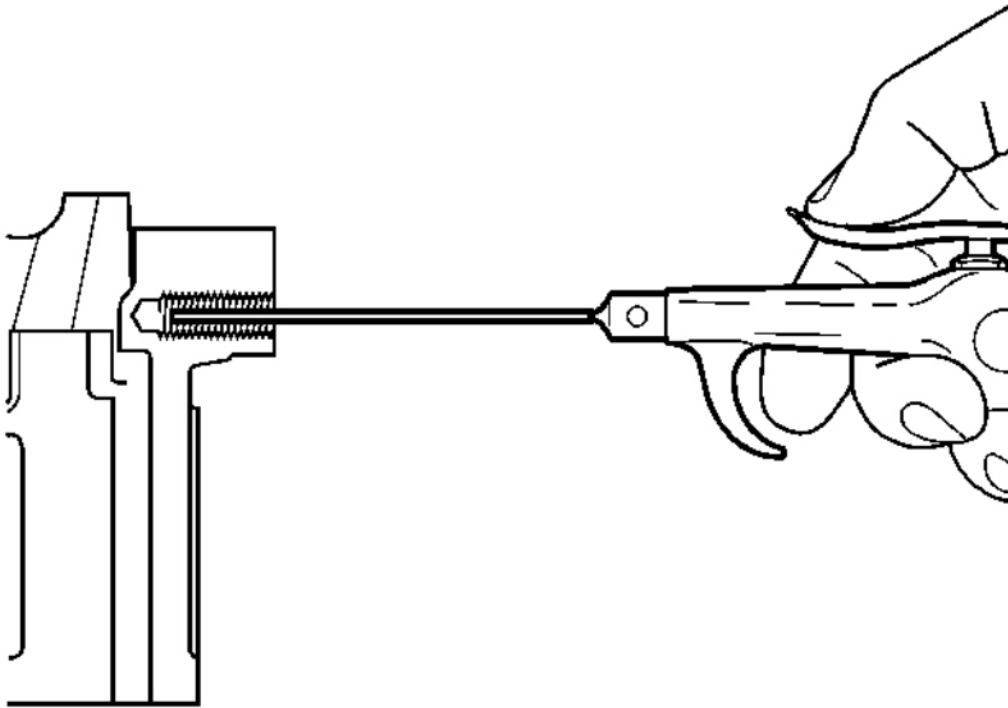


Fig. 38: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

7. Using compressed air, clean out any chips.

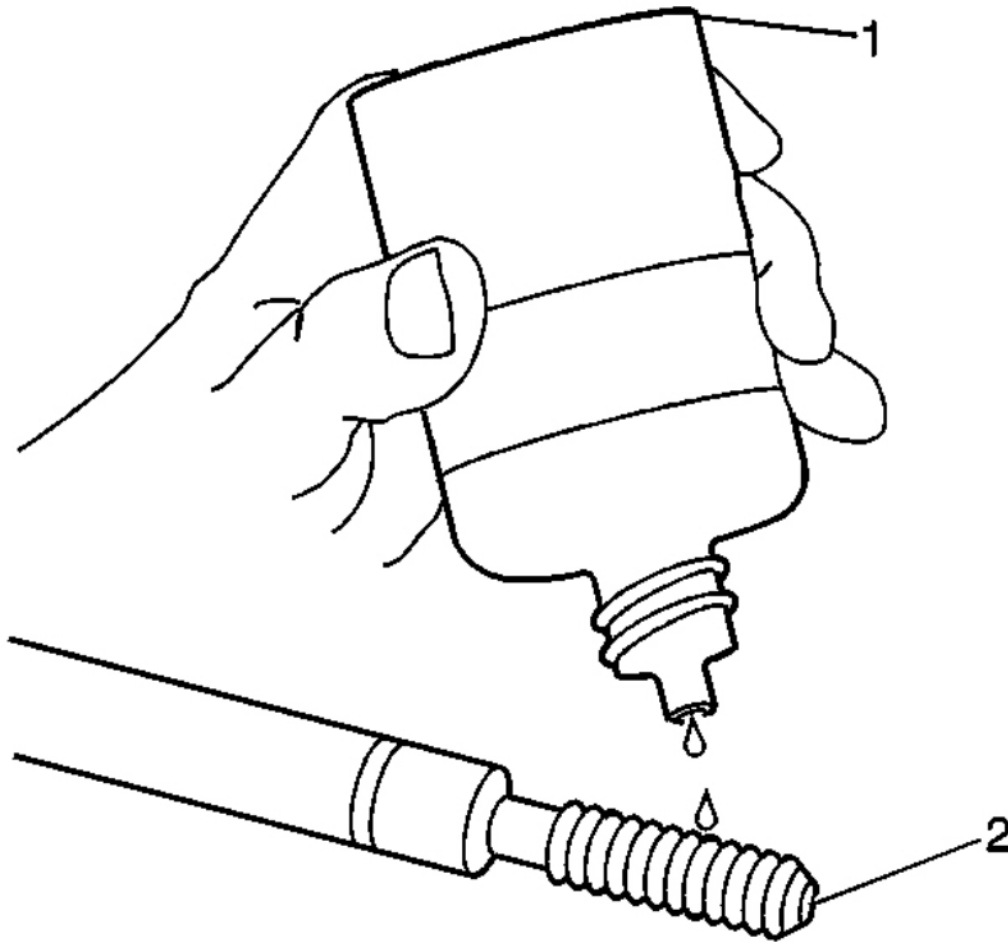


Fig. 39: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

8. Lubricate the threads of the driver installation tool (2) with the driver oil (1) J 42385-110.

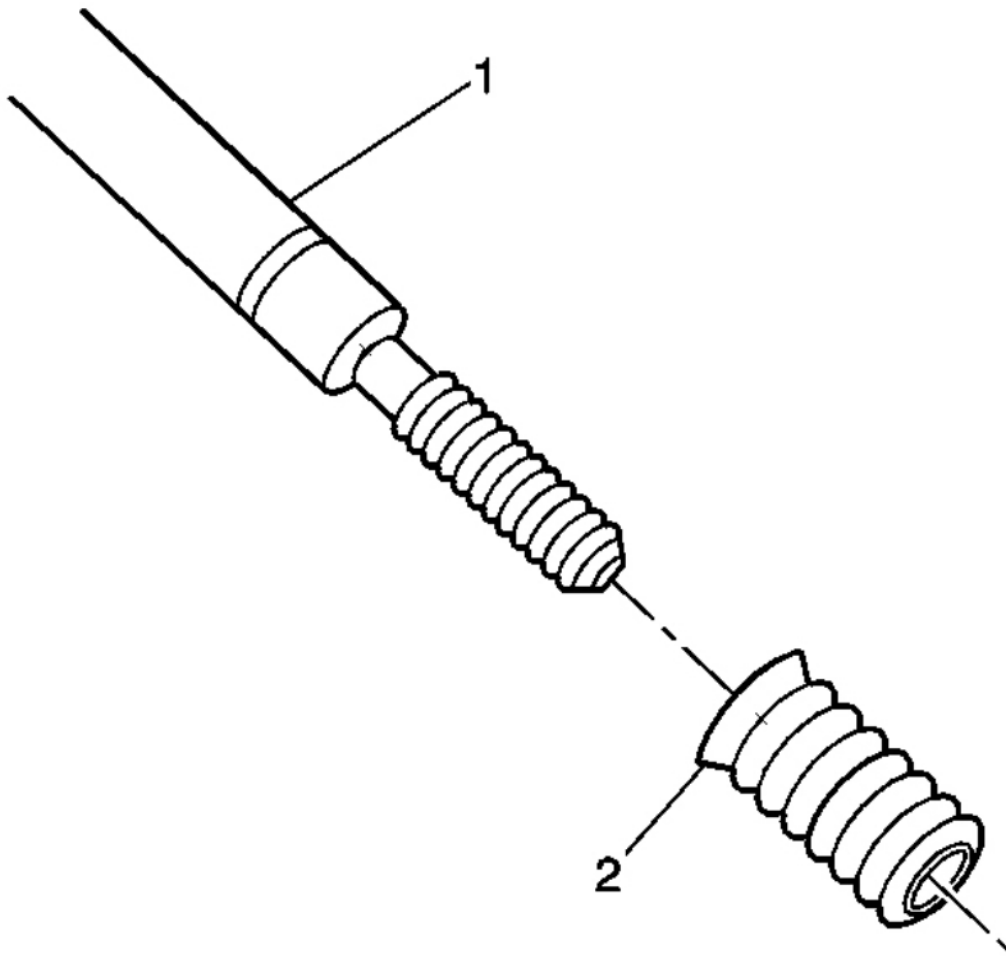


Fig. 40: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

9. Install the insert (2) onto the driver installation tool (1).

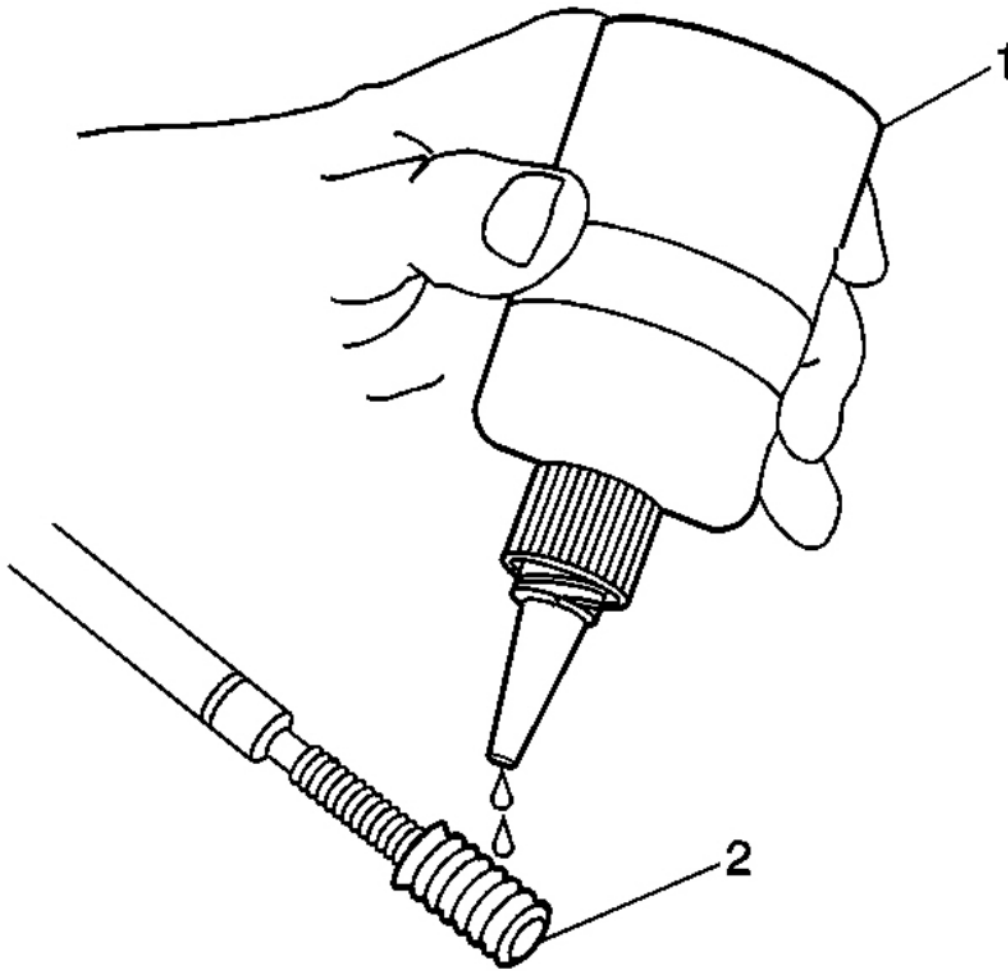


Fig. 41: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

10. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277® or equivalent (1) to the insert OD threads (2).

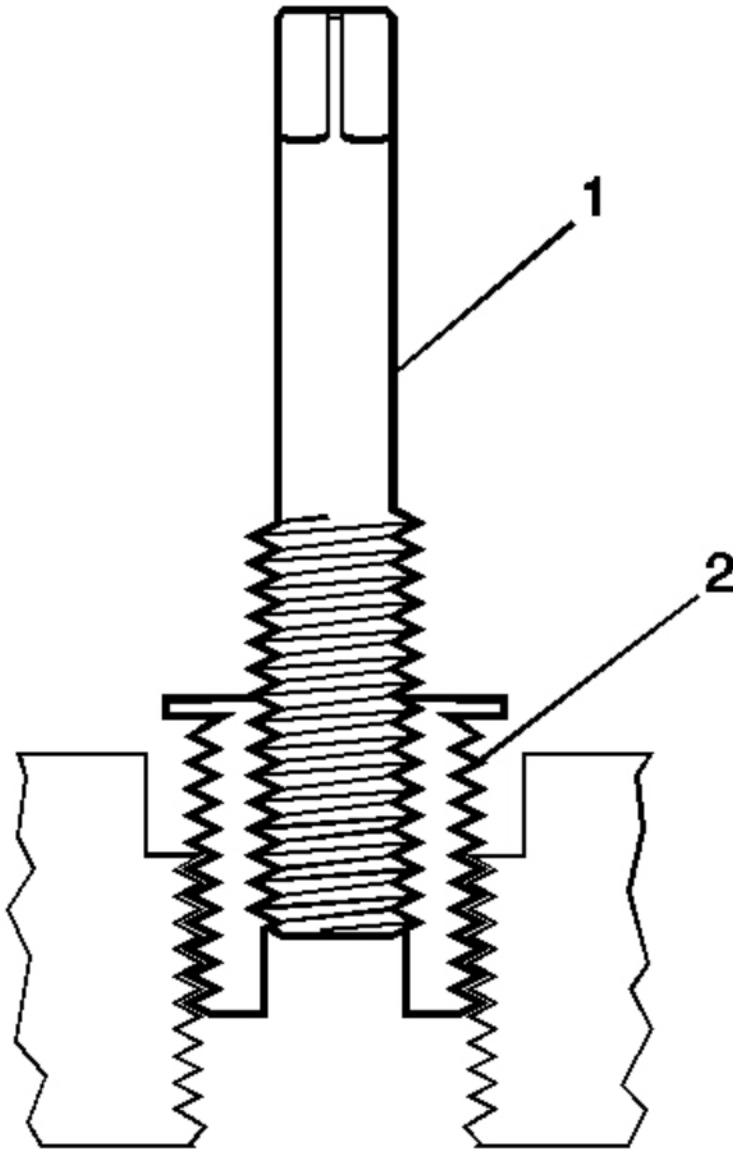


Fig. 42: Installing Insert - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

11. Install the insert (2) into the tapped hole by hand only.

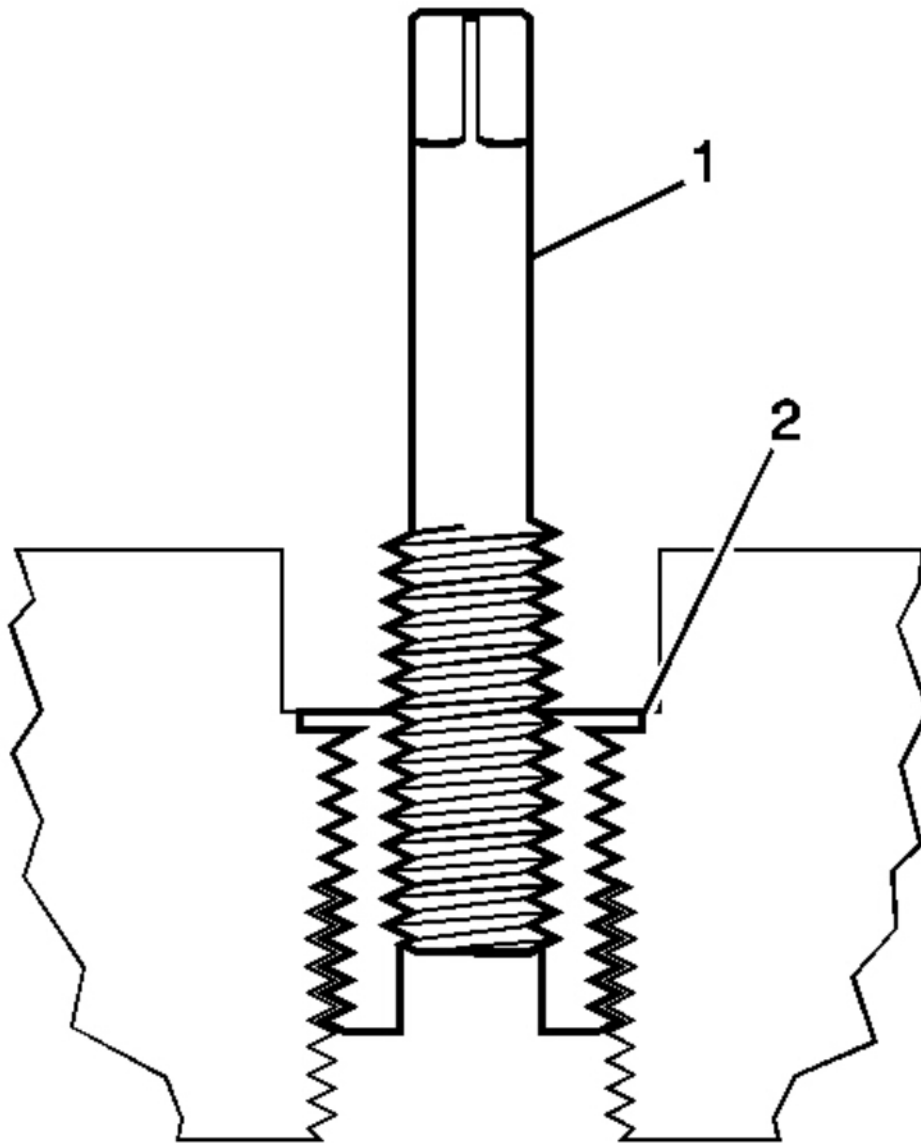


Fig. 43: View Of Installed Insert - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any

remaining chips and/or improper tapping.

12. Install the insert until the flange (2) of the insert contacts the counterbored surface.

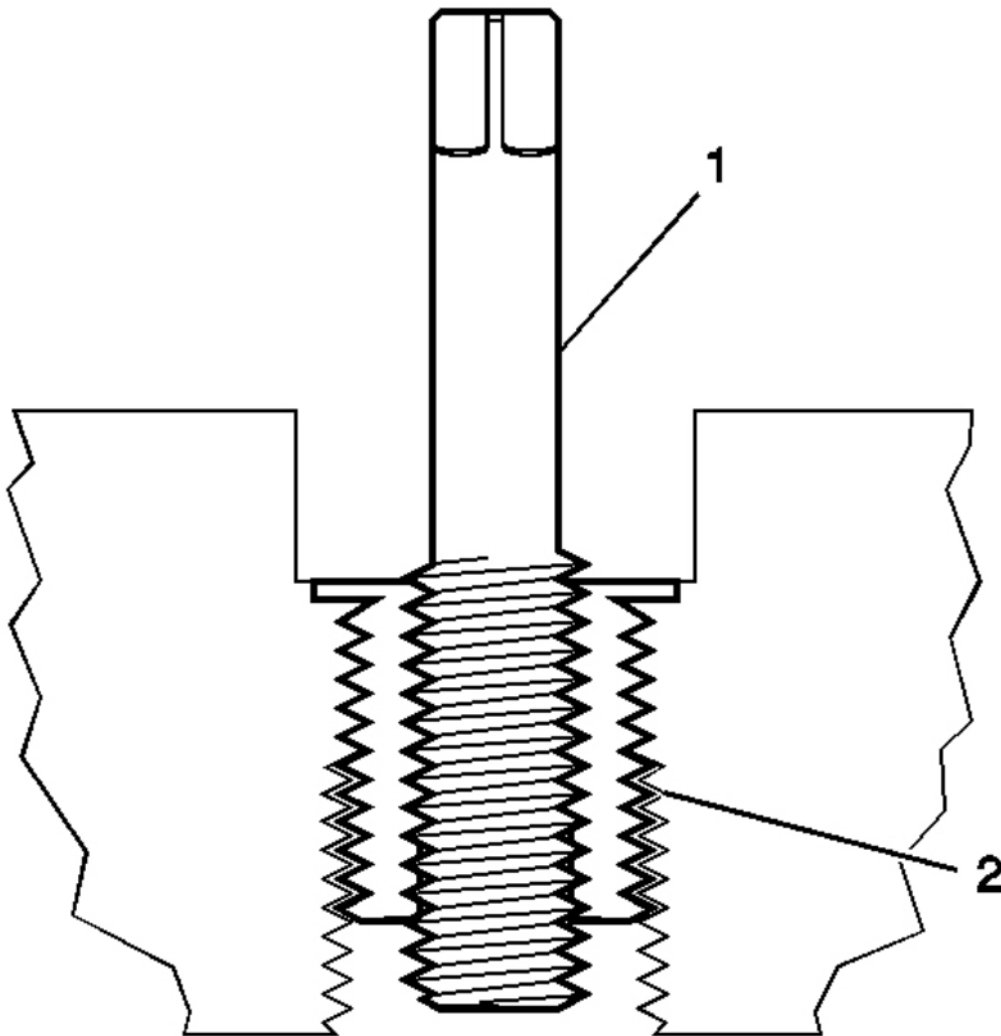


Fig. 44: Installed Insert - Recessed Thread Repair
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The

threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

13. Continue to rotate the driver installation tool (1) through the insert (2).

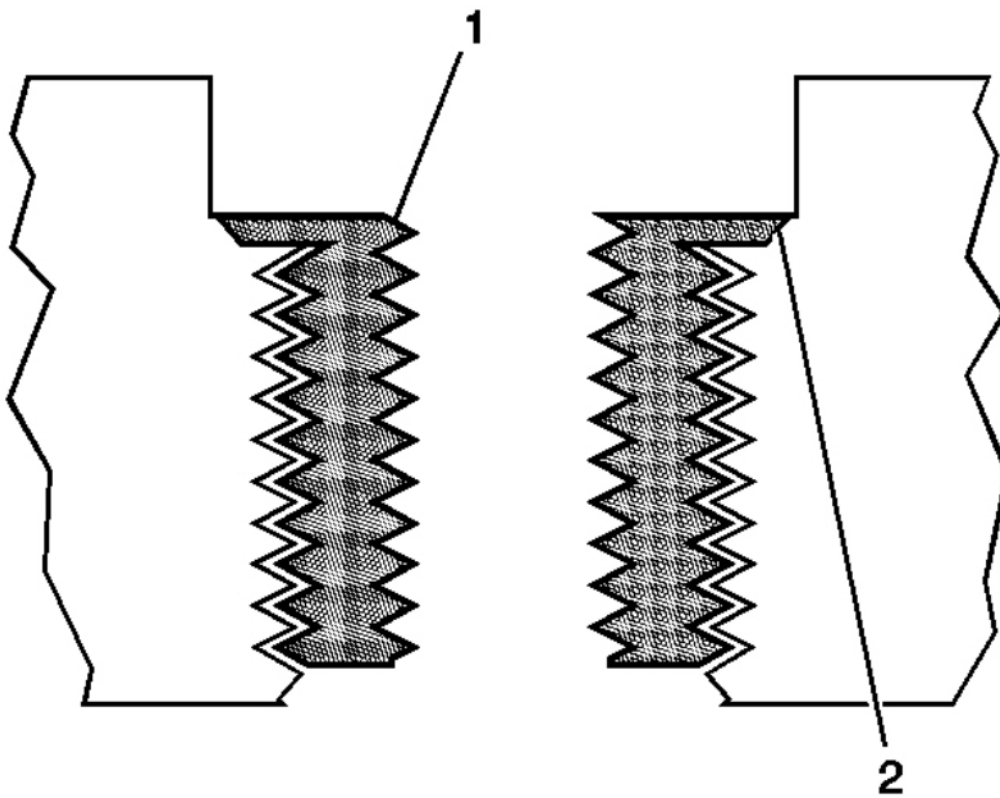


Fig. 45: Inspecting Insert For Proper Installation - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

14. Inspect the insert (1) for proper installation (2) into the tapped hole.

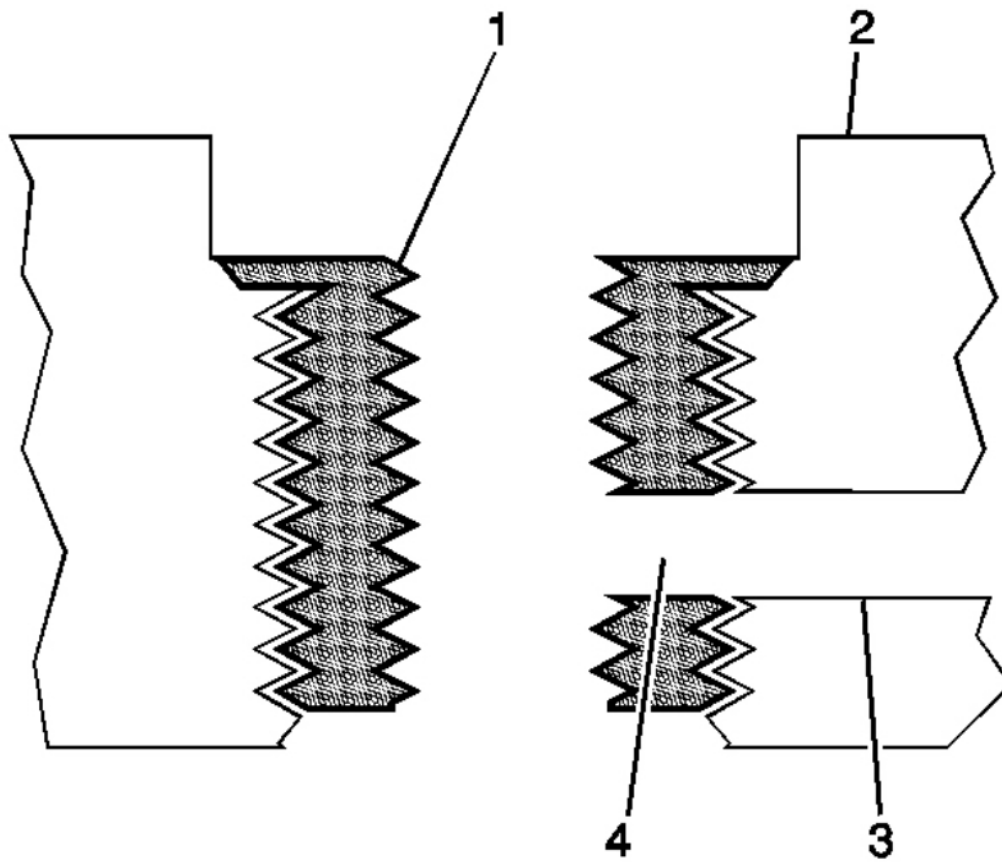


Fig. 46: View Of Restricted Engine Coolant Passage - Recessed Thread Repair
Courtesy of GENERAL MOTORS CORP.

15. Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any chips and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

Tapered Pipe Thread Repair

The thread repair insert for tapered pipe threads is coated with a clear silver zinc coating.

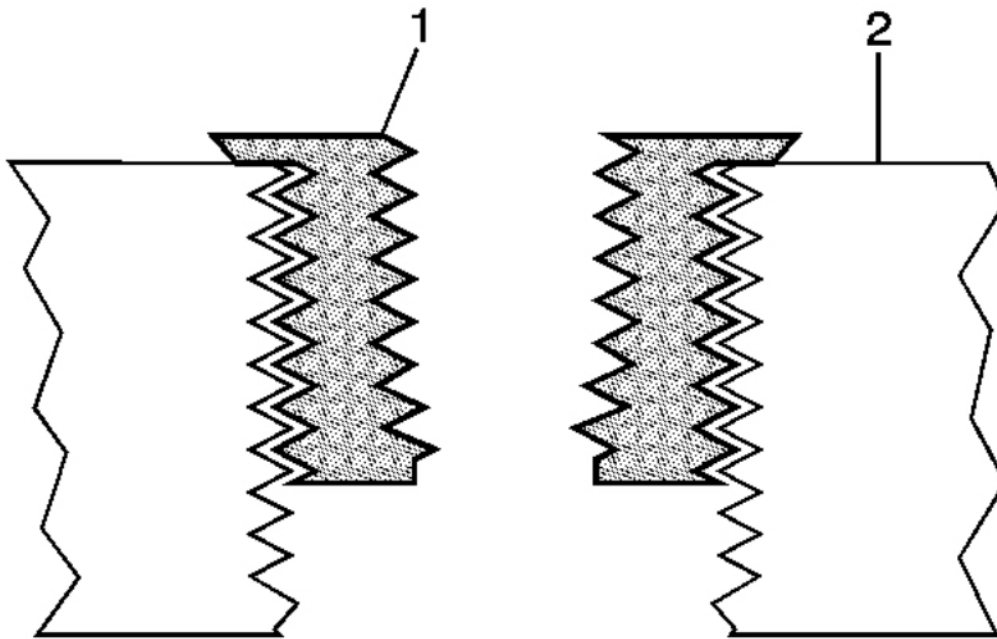


Fig. 47: Inspecting Insert For Proper Installation - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

IMPORTANT: The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.

When installed to the proper depth, the flange (1) of the insert will be seated against surface (2) of the base material of the drilled/tapped hole.

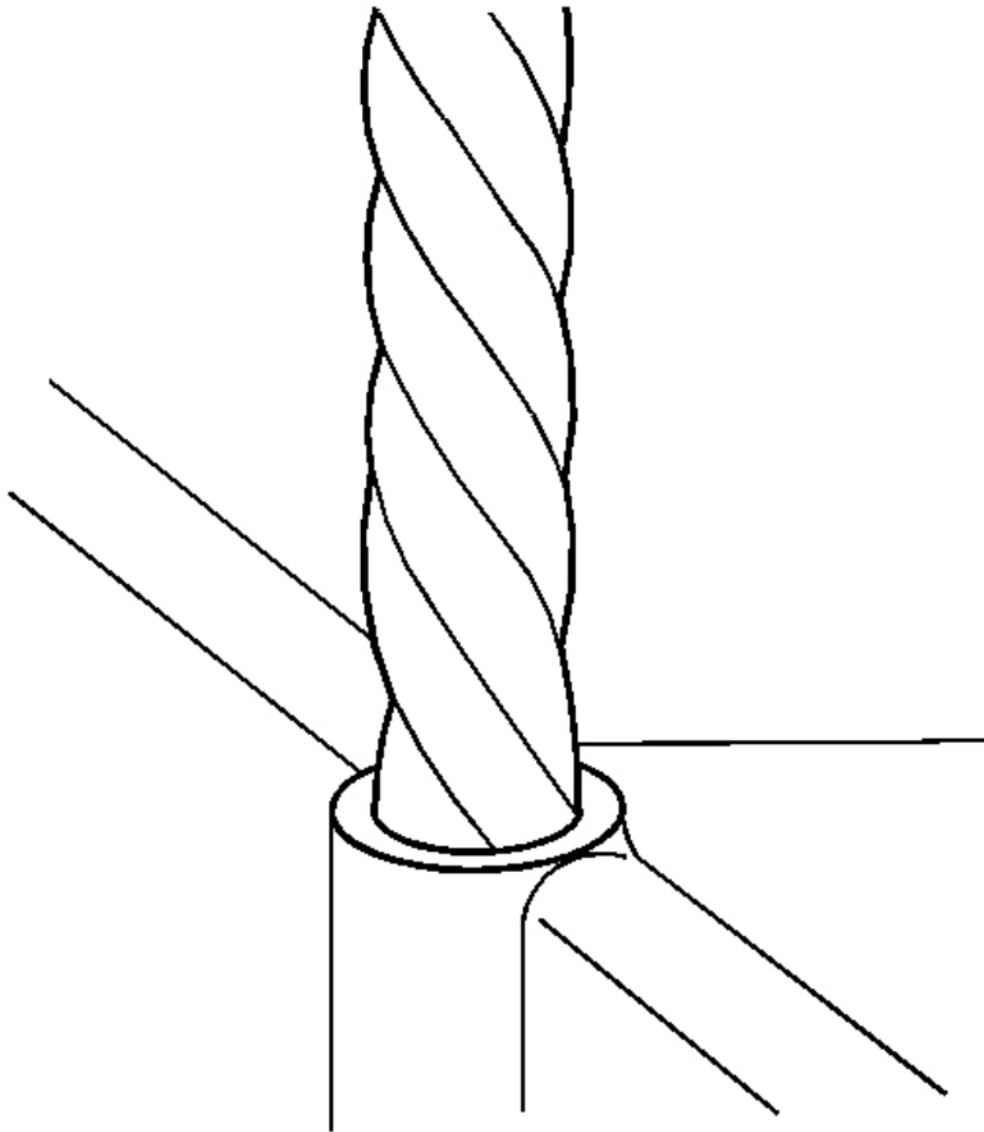


Fig. 48: Drilling Out Threads Of Damaged Hole

Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.

- **Drill the hole until the stop collar contacts the surface of the base material.**

1. Drill out the threads of the damaged hole.

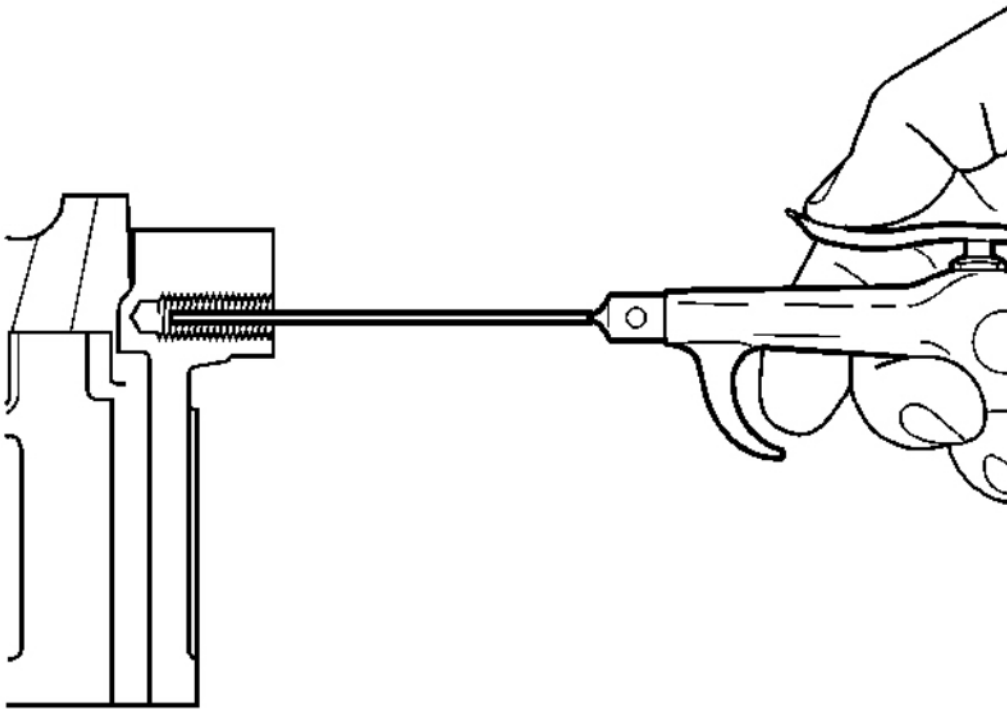


Fig. 49: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to tapping.

2. Using compressed air, clean out any chips.

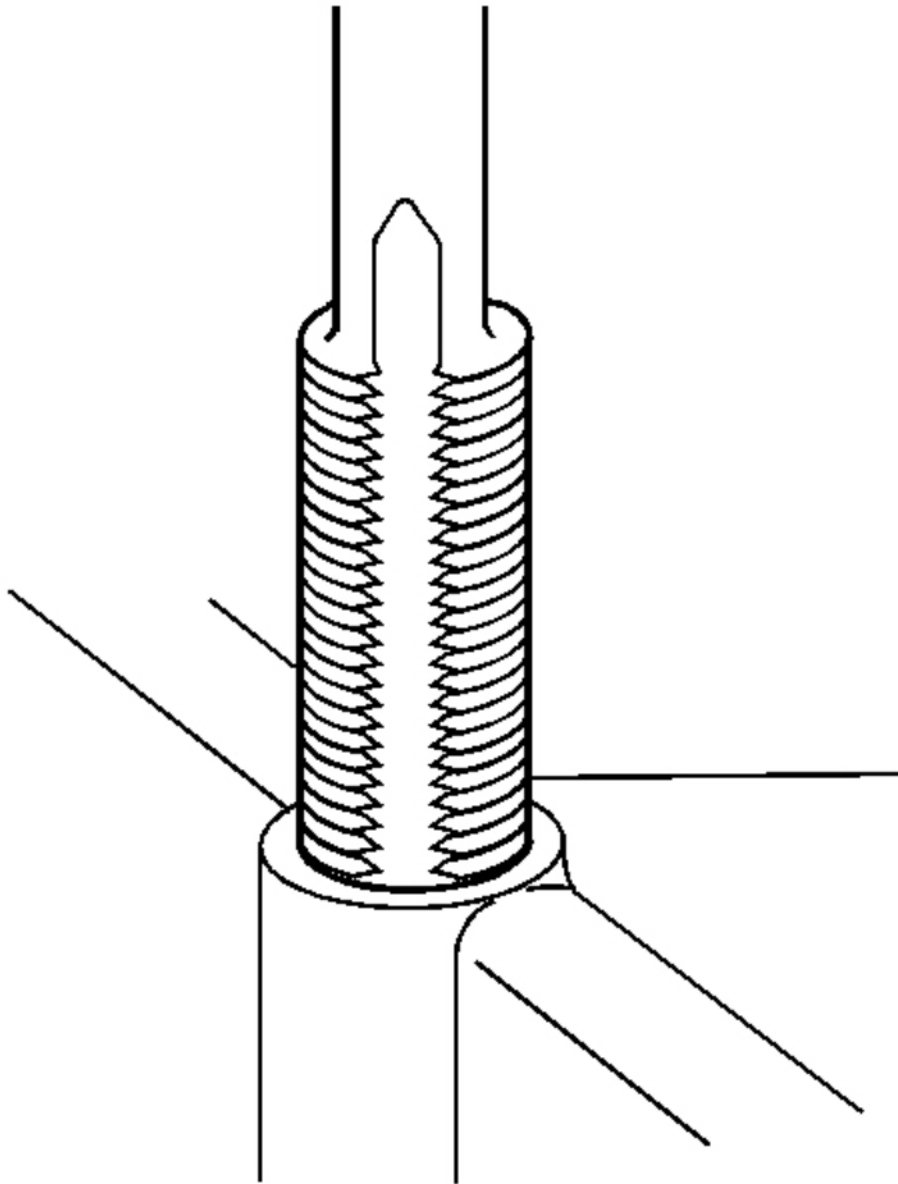


Fig. 50: Tapping Threads Of Drilled Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: • During the tapping process, it is necessary to repeatedly

remove the tap and clean chips from the hole and the flutes of the tap.

- **Ensure the tap has created full threads at least to the depth equal to the insert length.**

3. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

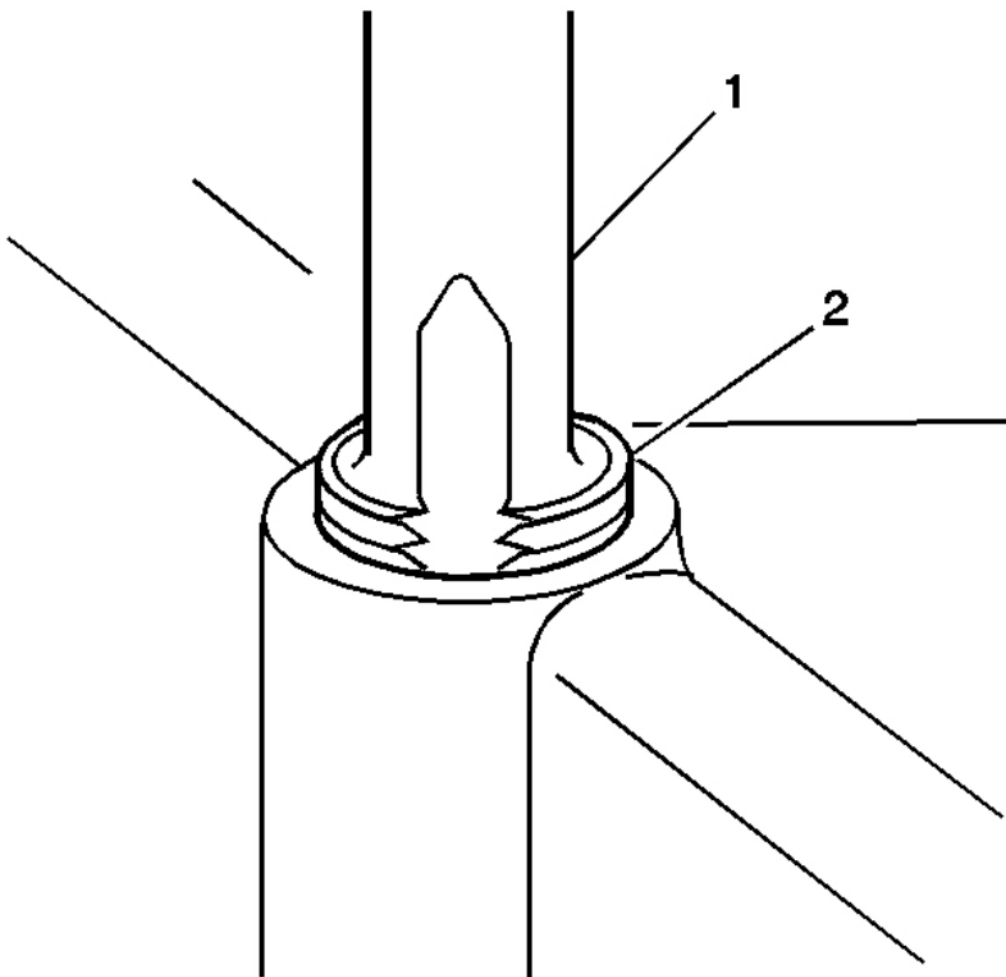


Fig. 51: View Of Proper Tapping Distance - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

4. Tap the drilled hole until the threads at the top of the tap (2) are down to the surface of the

base material.

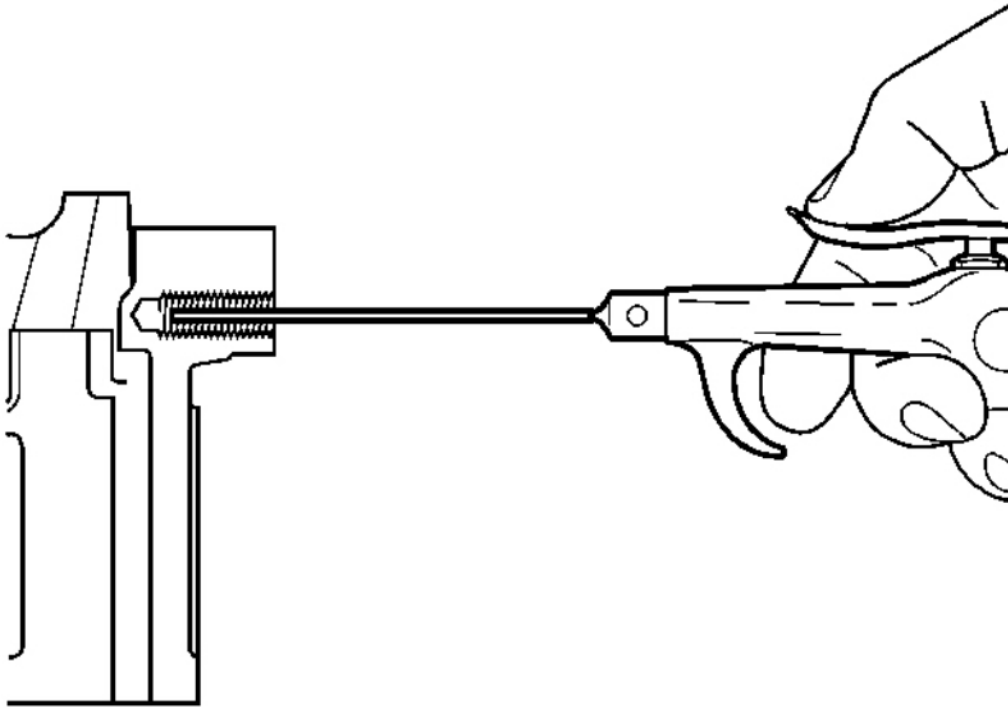


Fig. 52: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

5. Using compressed air, clean out any chips.

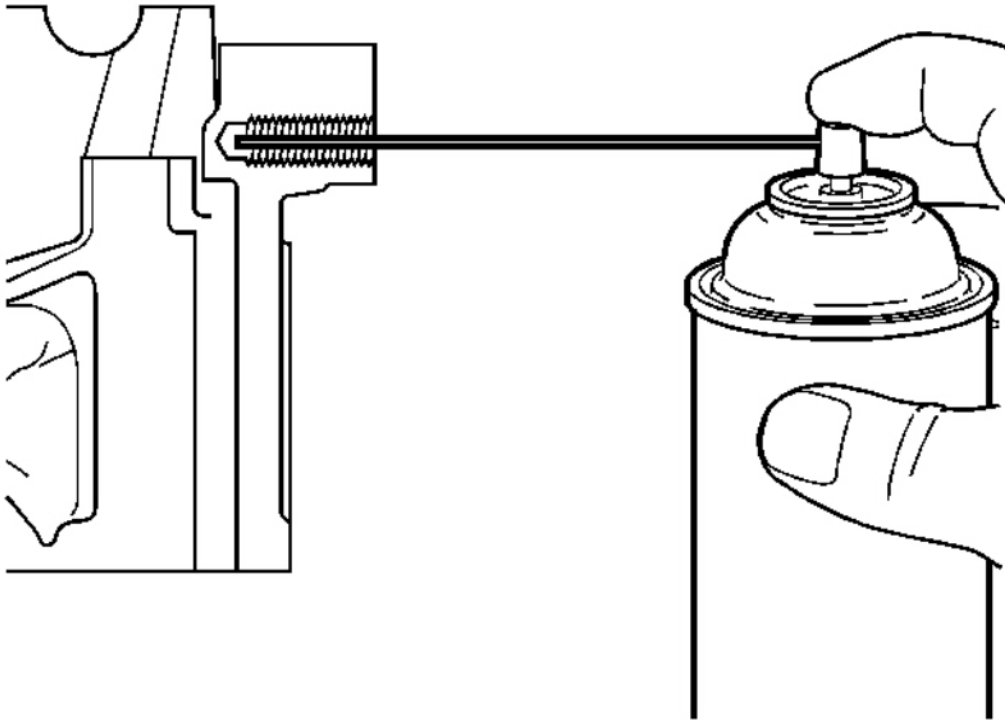


Fig. 53: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

6. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

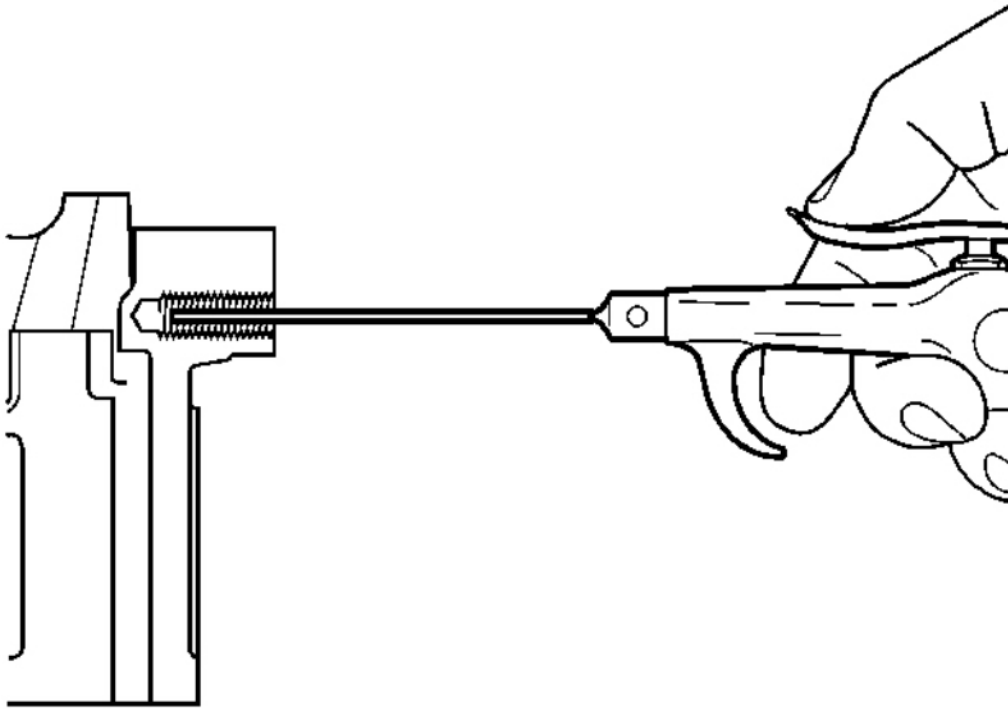


Fig. 54: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

7. Using compressed air, clean out any chips.

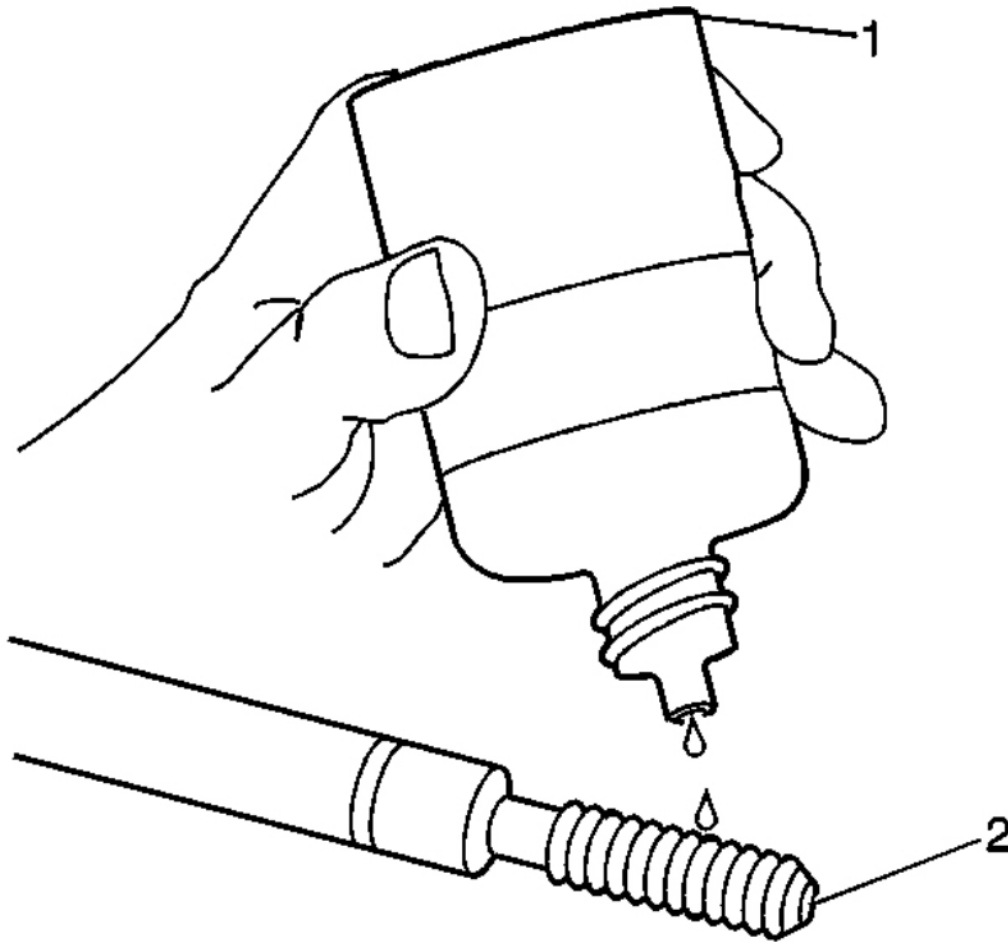


Fig. 55: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

8. Lubricate the threads of the driver installation tool (2) with the driver oil (1) J 42385-110.

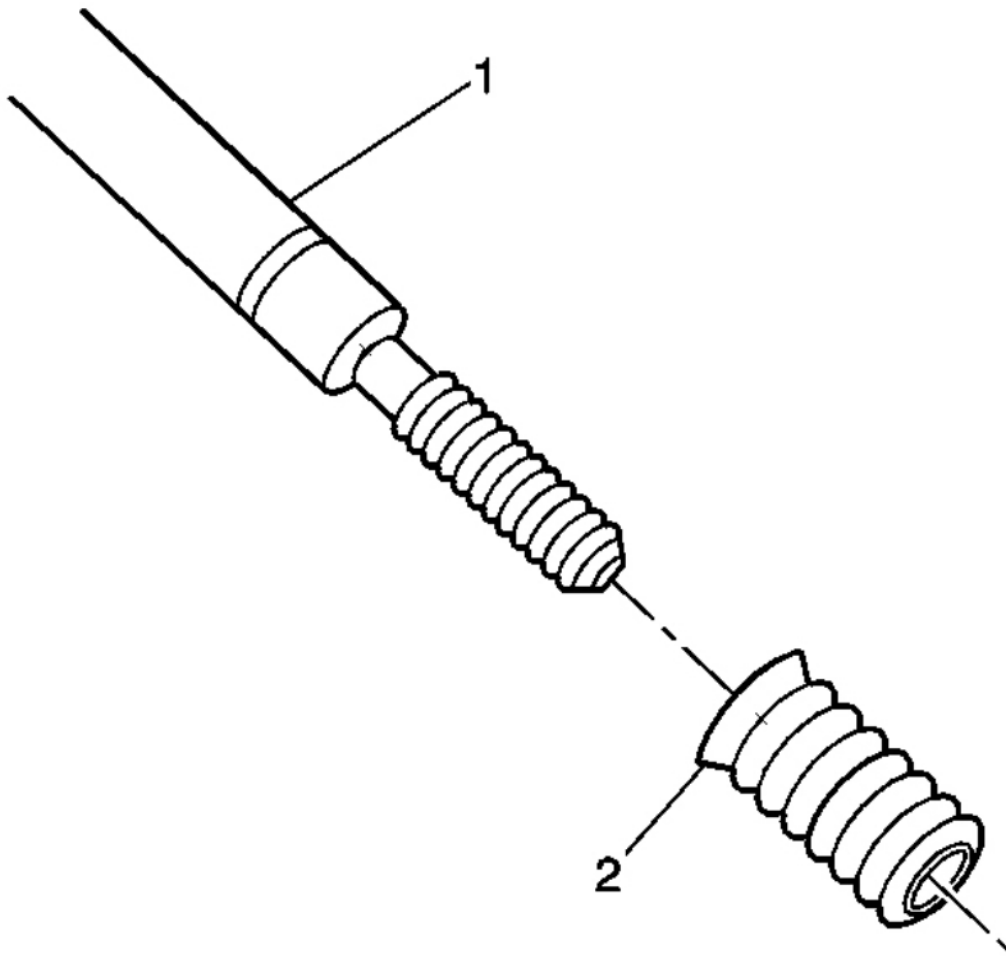


Fig. 56: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

9. Install the insert (2) onto the driver installation tool (1).

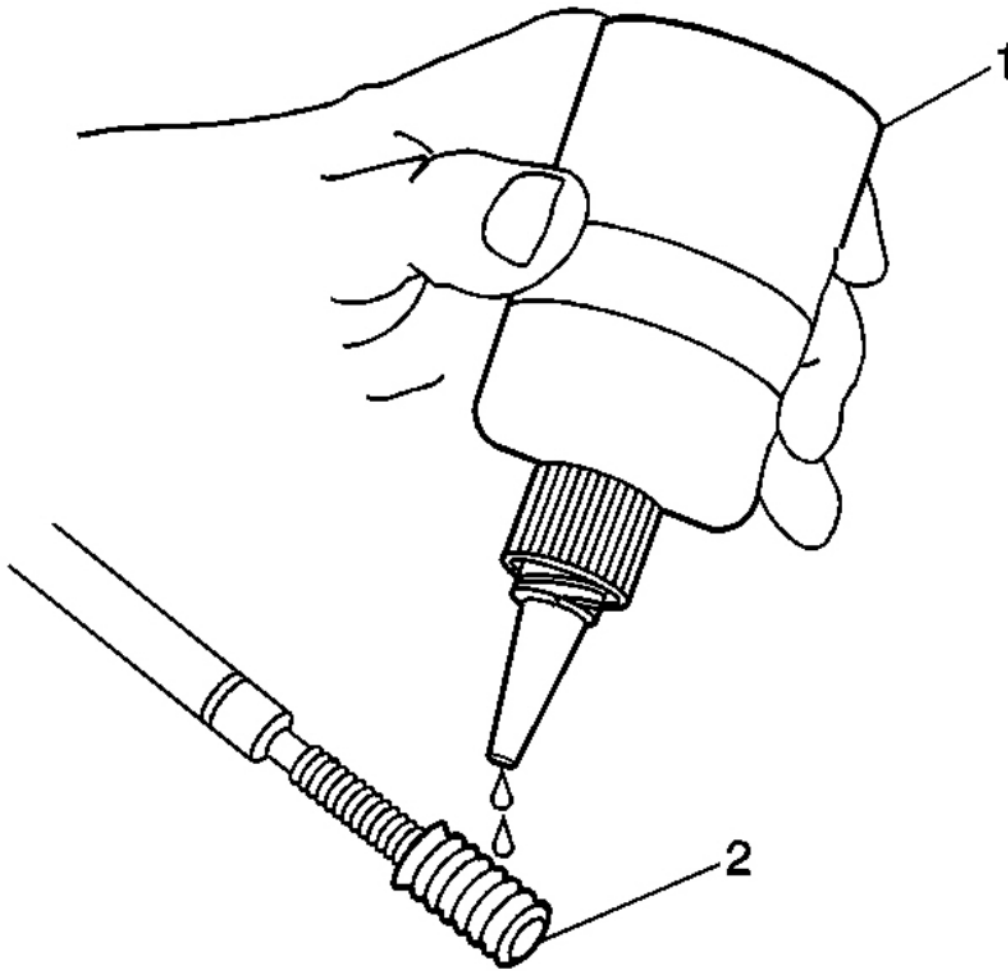


Fig. 57: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

10. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277® or equivalent (1) to the insert OD threads (2).

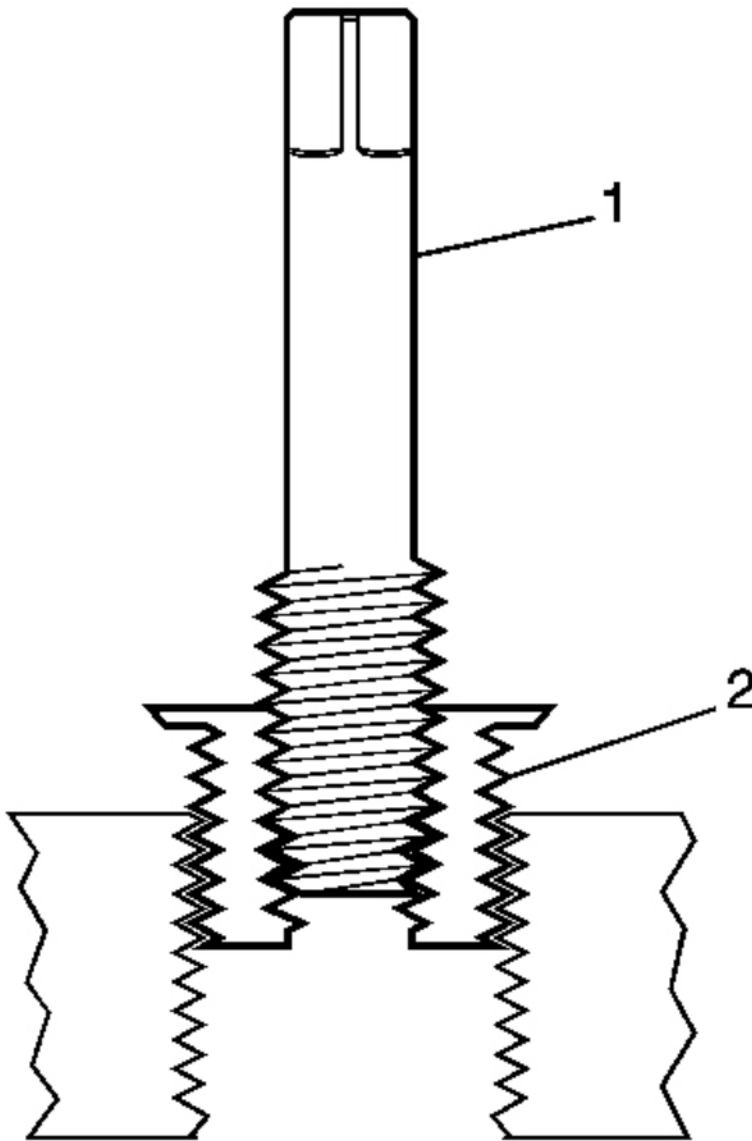


Fig. 58: Installing Insert - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

11. Install the insert (2) into the tapped hole by hand only.

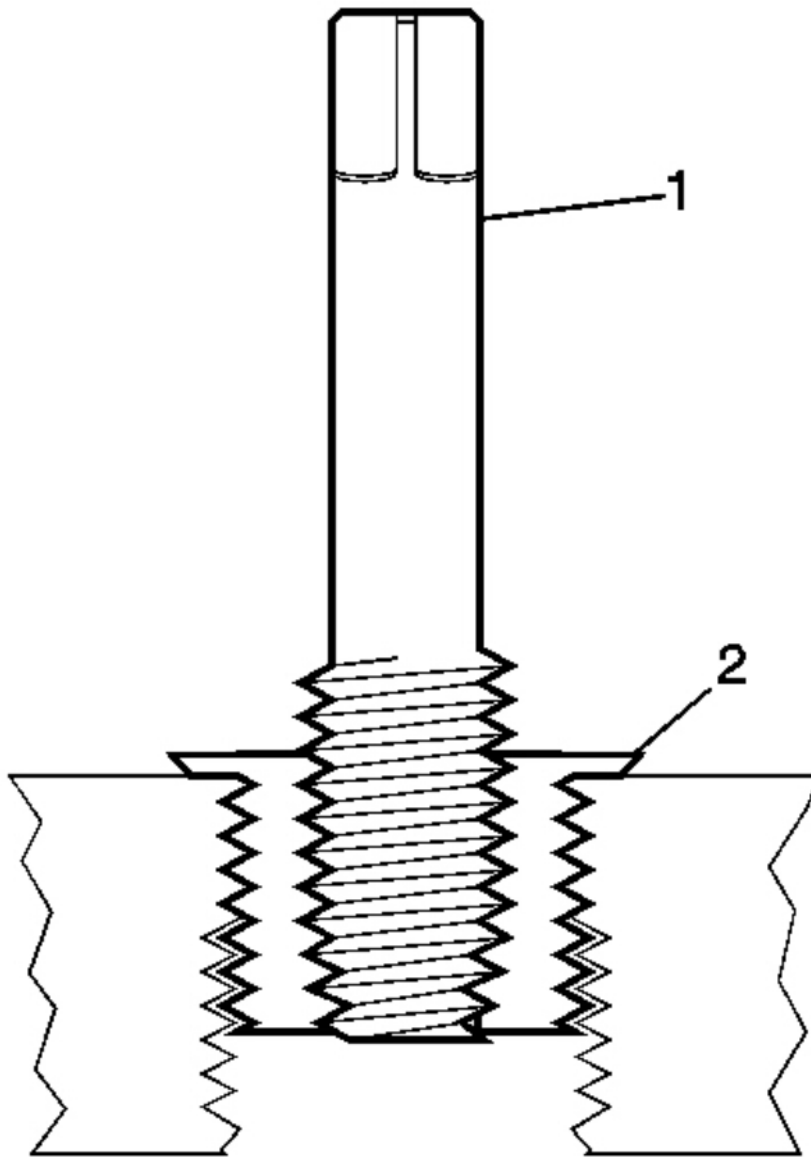


Fig. 59: Installing Insert - Tapered Pipe Thread Repair
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the insert will not thread down until the flange contacts the surface of the base material remove the insert immediately

with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

12. Install the insert until the flange (2) of the insert contacts the surface of the base material.

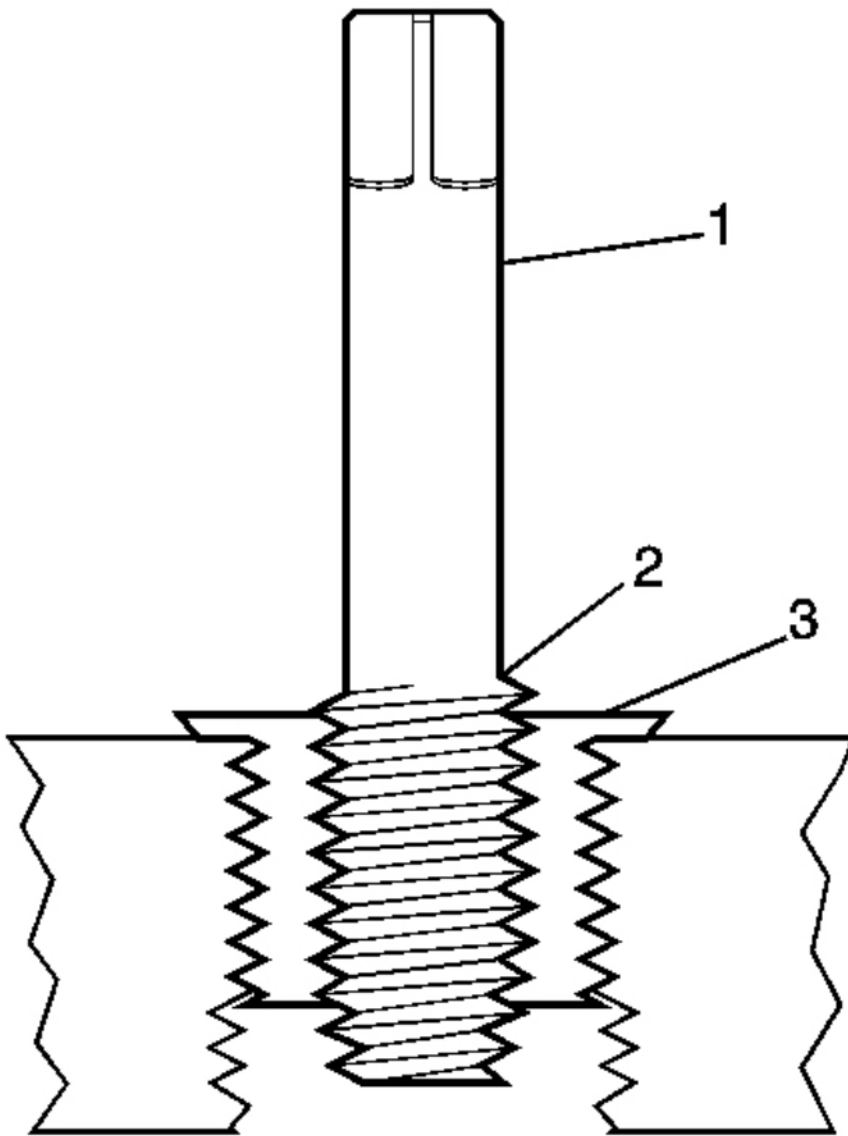


Fig. 60: Installed Insert - Tapered Pipe Thread Repair

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

13. Continue to rotate the driver installation tool (1) until the top of the threaded section (2) is level with the top of the insert (3).

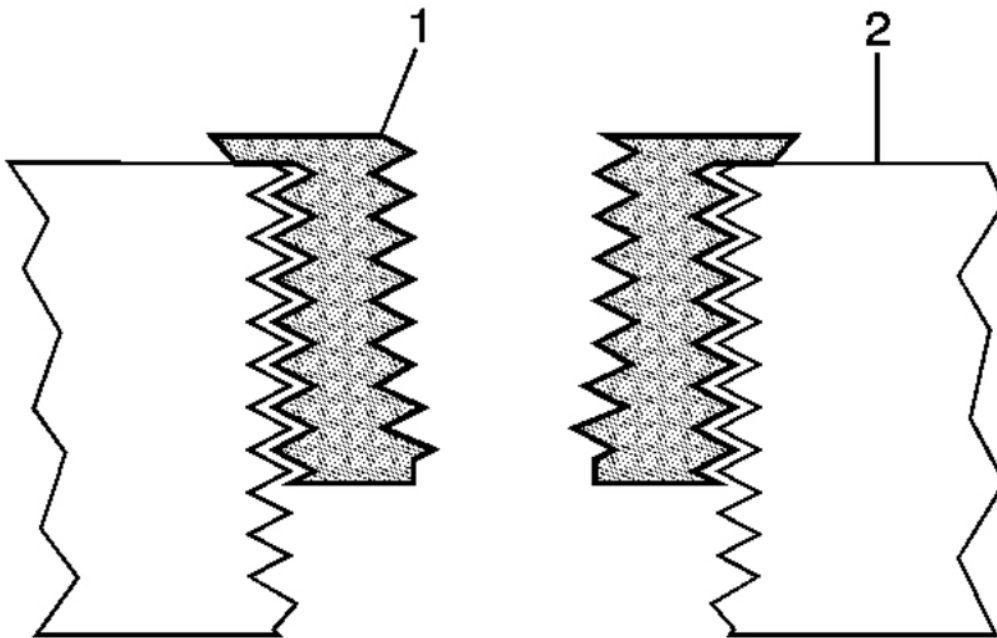


Fig. 61: Inspecting Insert For Proper Installation - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

14. Inspect the insert (1) for proper installation (2) into the tapped hole.

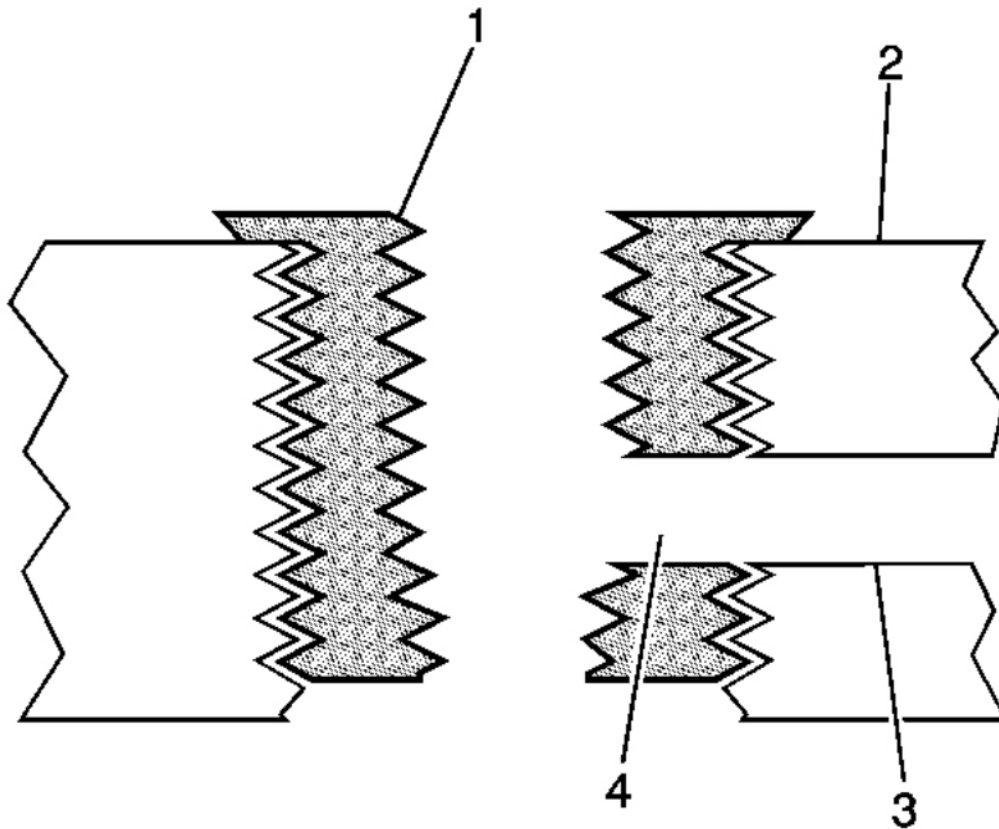


Fig. 62: View Of Restricted Engine Coolant Passages - Tapered Pipe Thread Repair
Courtesy of GENERAL MOTORS CORP.

15. Any installed insert that restricts or blocks an oil or engine coolant passage (3) will need to have the oil or engine coolant passage drilled out (4) to the original size of the oil or engine coolant passage. After drilling the restriction or blockage, clean out any chips and thread the installation driver tool through the insert again to remove any burrs caused by the drilling of the oil or engine coolant passage.

Cylinder Head Bolt Hole Thread Repair

Tools Required

- J 42385-700 High Feature Thread Repair Kit
- J 42385-2000 Thread Insert Kit

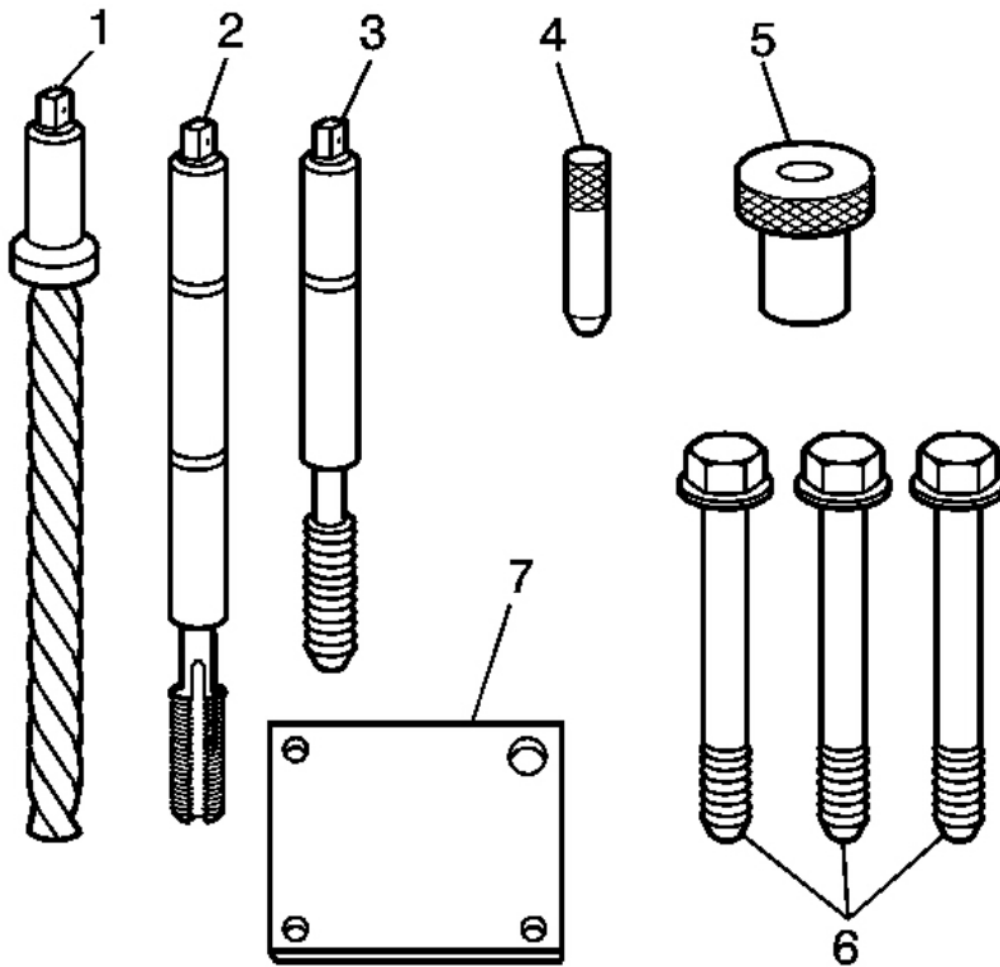


Fig. 63: View Of Cylinder Head Bolt Hole Thread Repair Kit
Courtesy of GENERAL MOTORS CORP.

The cylinder head bolt hole thread repair tooling are in the kits **J 42385-2000** and **J 42385-700** .
The cylinder head bolt hole thread repair components consist of the following:

- Drill (1) J 42385-723
- Tap (2) J 42385-724
- Installation driver (3) J 42385-725
- Alignment pin (4) J 42385-303

- Bushing (5) J 42385-302
- Bolts (6) J 42385-733
- Fixture plate (7) J 42385-401

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

- IMPORTANT:**
- Remove the fixture plate prior to installing the insert with the installer tool.
 - The use of a cutting type fluid GM P/N 1052864 (Canadian P/N 992881) WD 40®; or equivalent is recommended when performing the drilling, counterboring and tapping procedures.

When installed to the proper depth, the flange of the insert will be seated against the counterbore of the drilled/tapped hole.

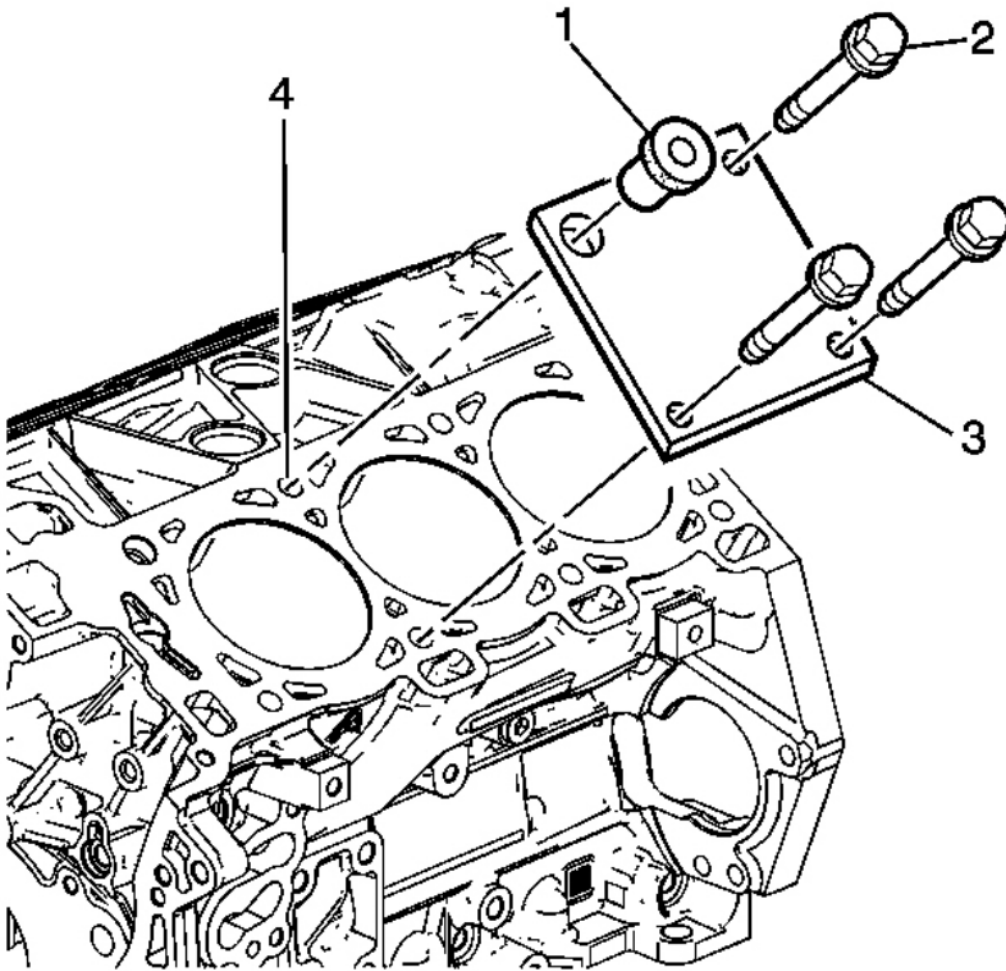


Fig. 64: View Of Fixture Plate & Components - Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

1. Position the fixture plate (3) with the bushing (1) installed over the cylinder head bolt hole to be repaired (4).
2. Loosely install the fixture plate bolts (2) into the remaining cylinder head bolt holes.

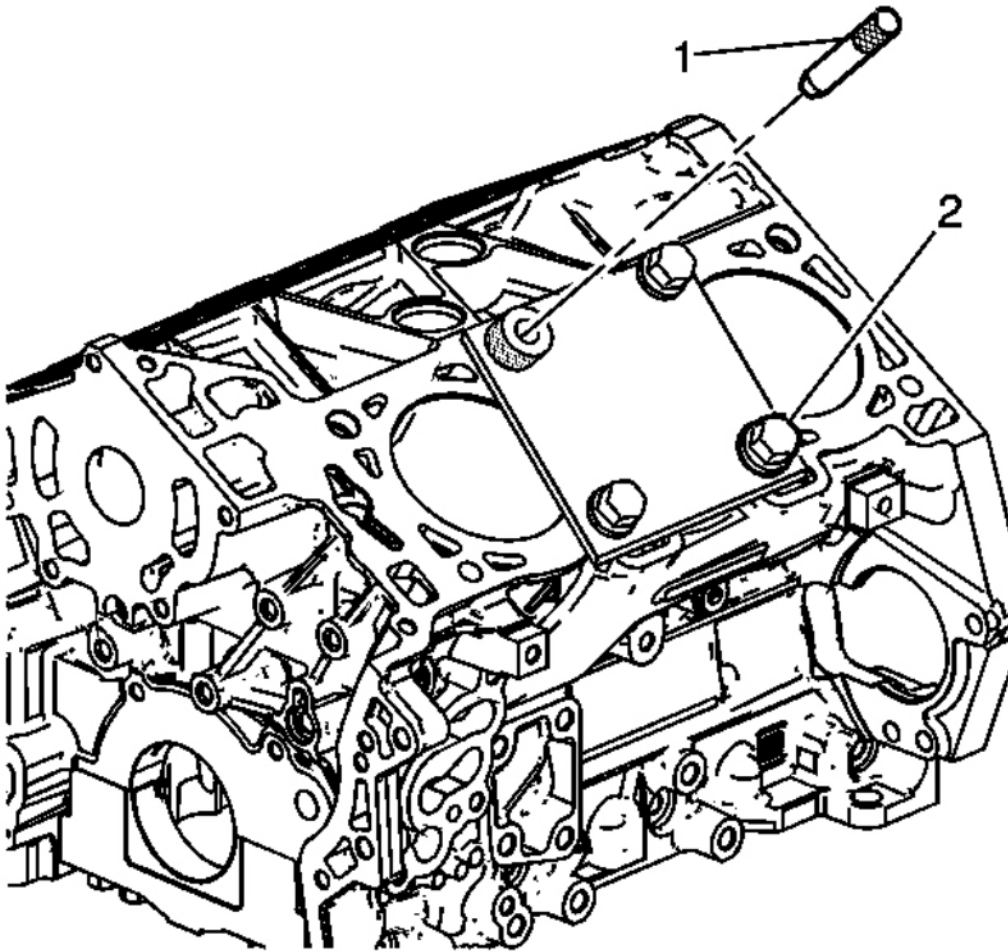


Fig. 65: Positioning Alignment Pin - Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

3. Position the alignment pin (1) through the bushing and into the cylinder head bolt hole.
4. With the alignment pin in the desired cylinder head bolt hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin (1) from the cylinder head bolt hole.

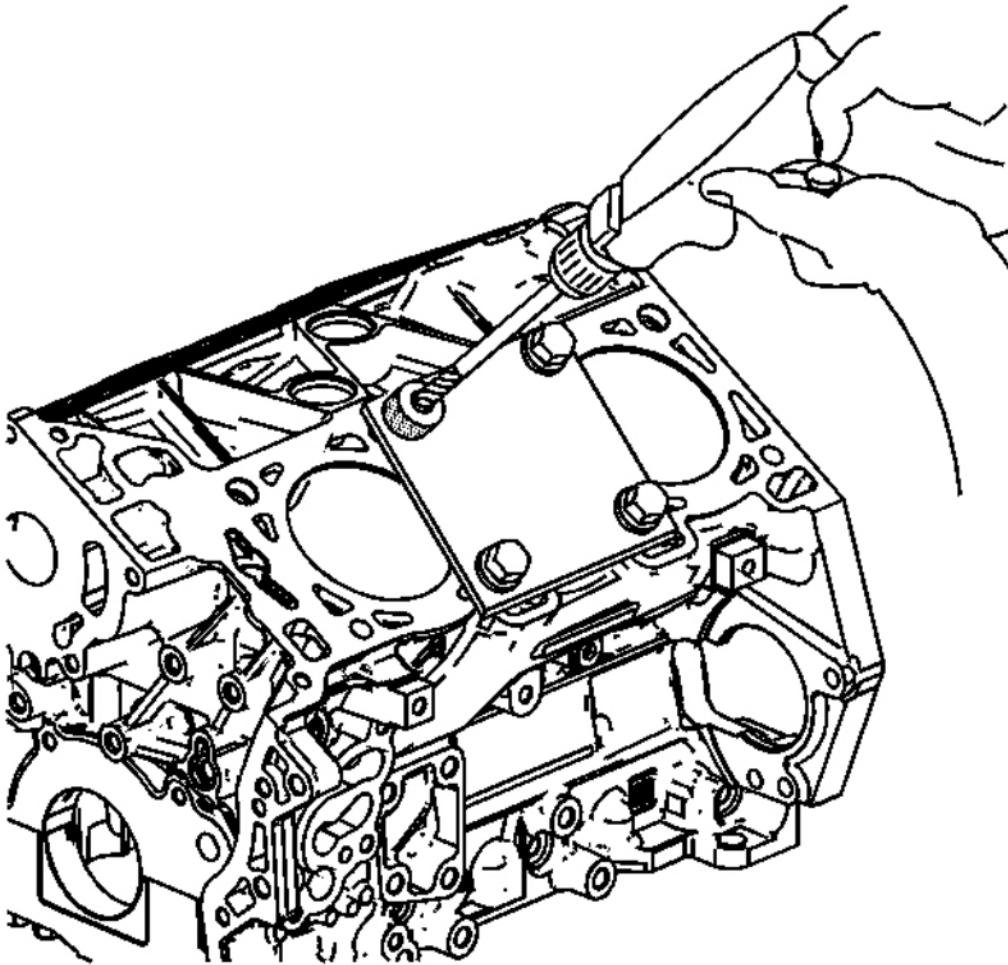


Fig. 66: Drilling Out Threads Of Damaged Hole - Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.
- Drill the hole until the stop collar contacts the top of the drill bushing.

6. Drill out the threads of the damaged hole.

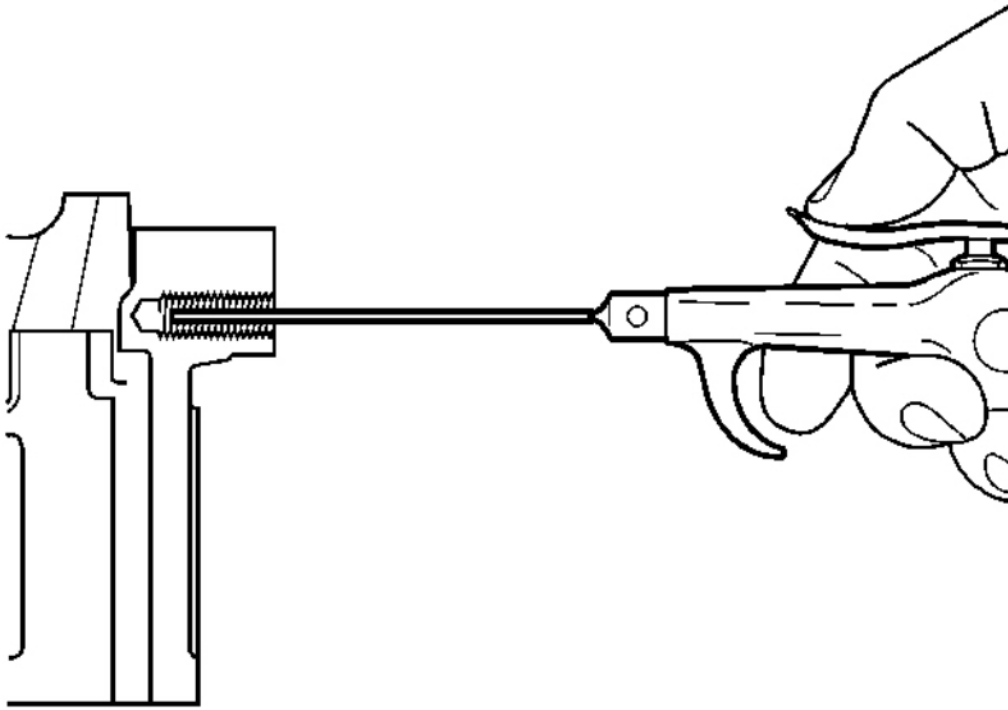


Fig. 67: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to tapping.

7. Using compressed air, clean out any chips.

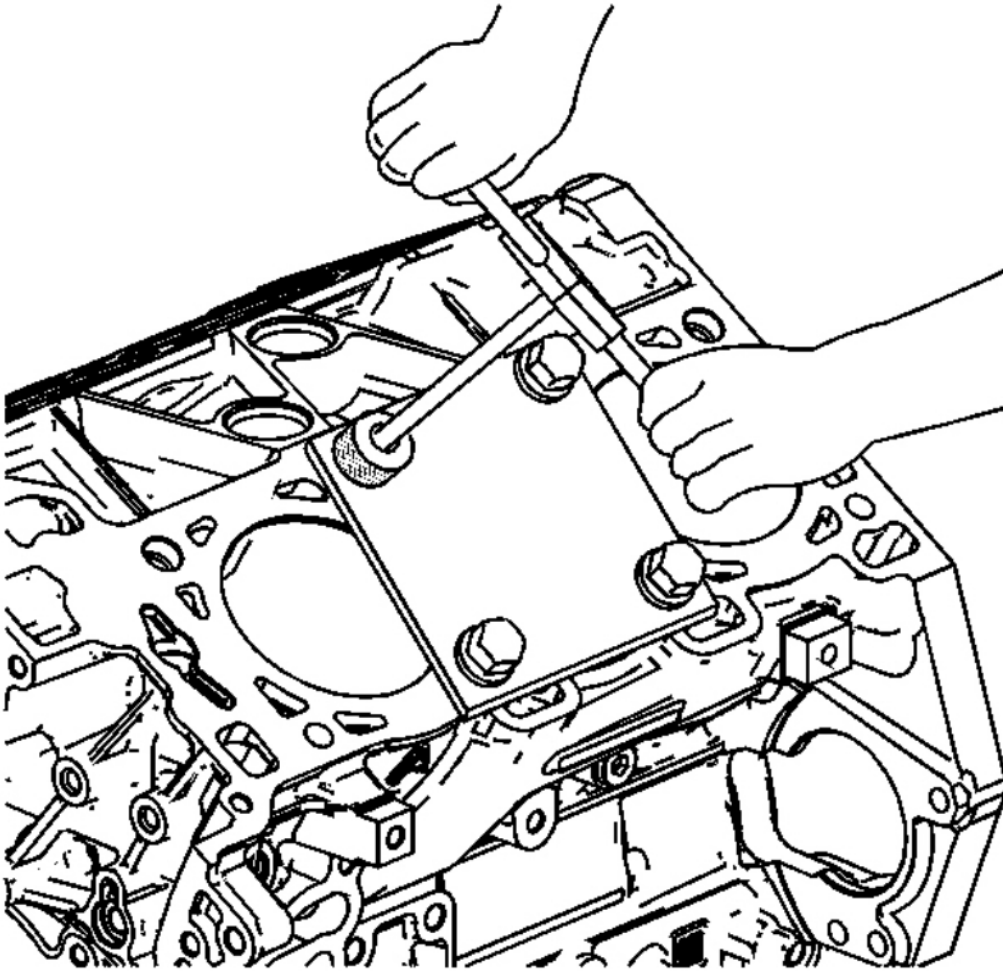


Fig. 68: Tapping Threads Of Drilled Hole Using Tapping Wrench - Cylinder Head Bolt Hole

Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

8. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

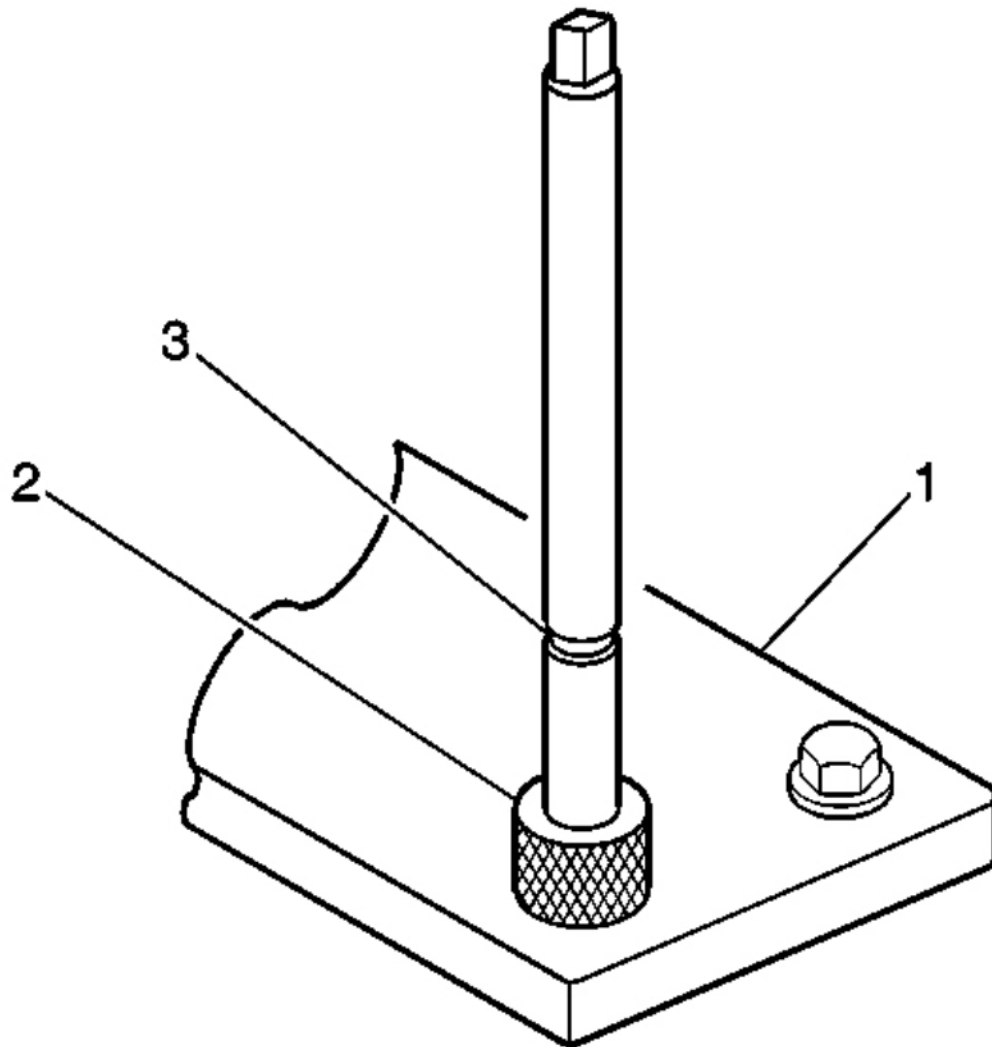


Fig. 69: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

9. In order to tap the new threads for the insert to the proper depth, rotate the tap into the cylinder head bolt hole until the mark (3) on the tap aligns with the top of the drill bushing (2).

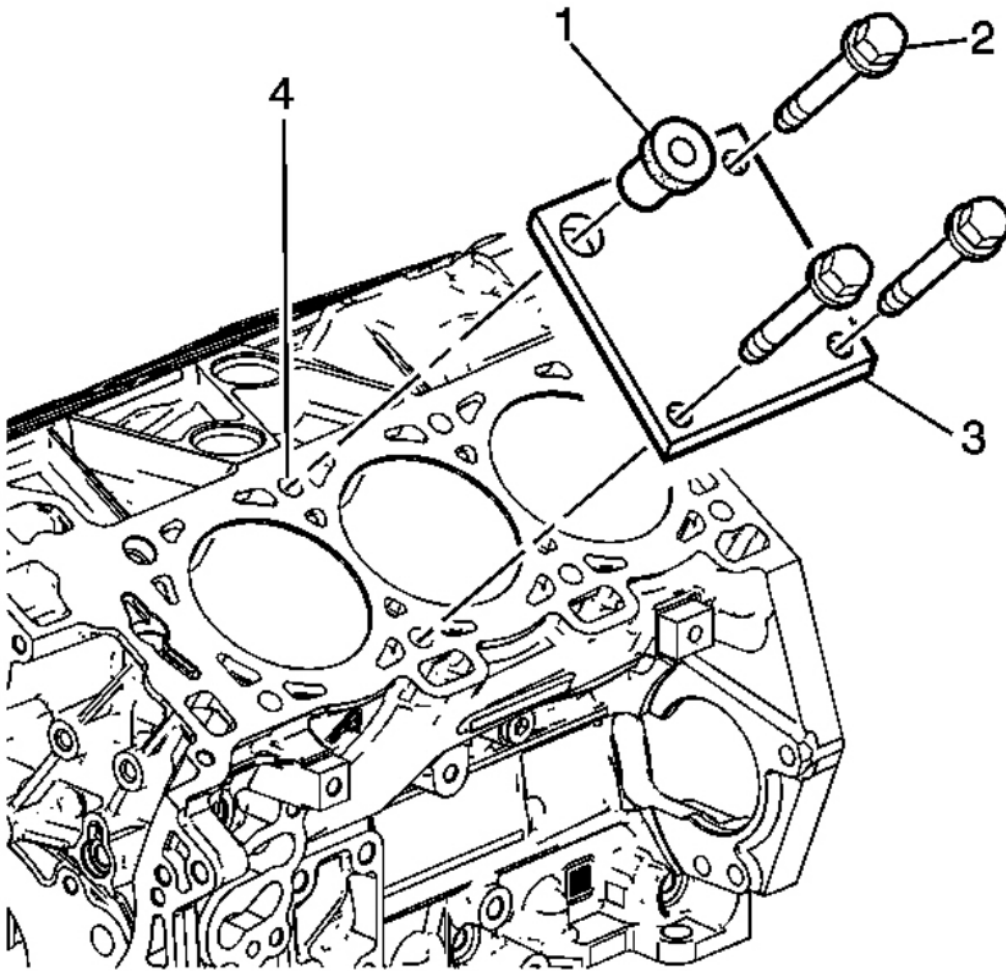


Fig. 70: View Of Fixture Plate & Components - Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Remove the fixture plate prior to installing the insert with the installer tool.

10. Remove the fixture plate bolts (2).
11. Remove the fixture plate (3) and bushing (1).

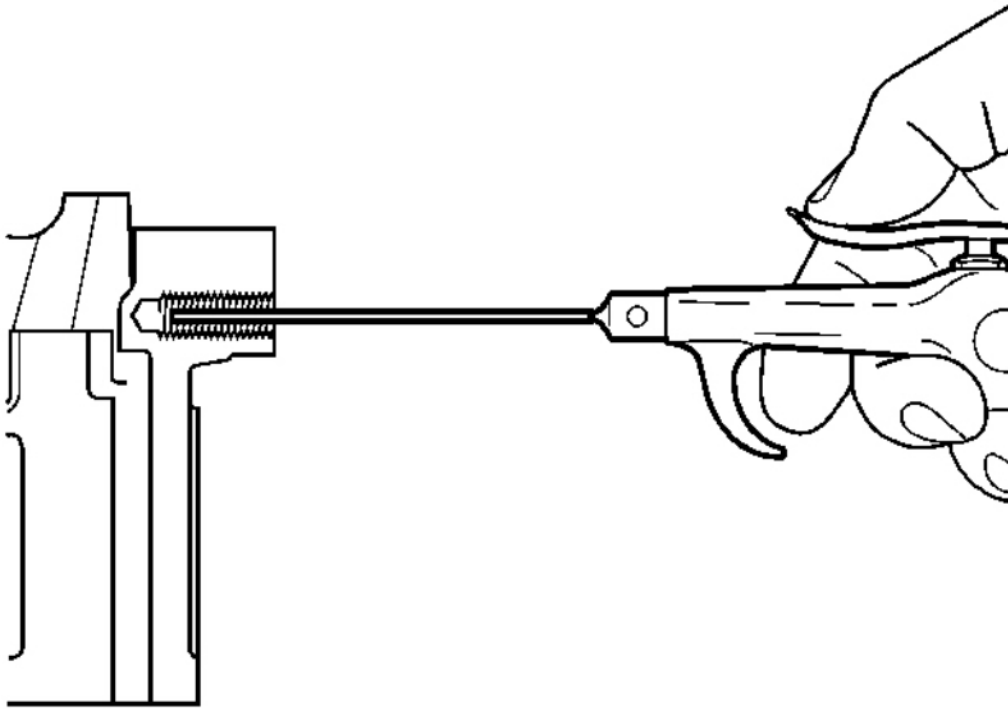


Fig. 71: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

12. Using compressed air, clean out any chips.

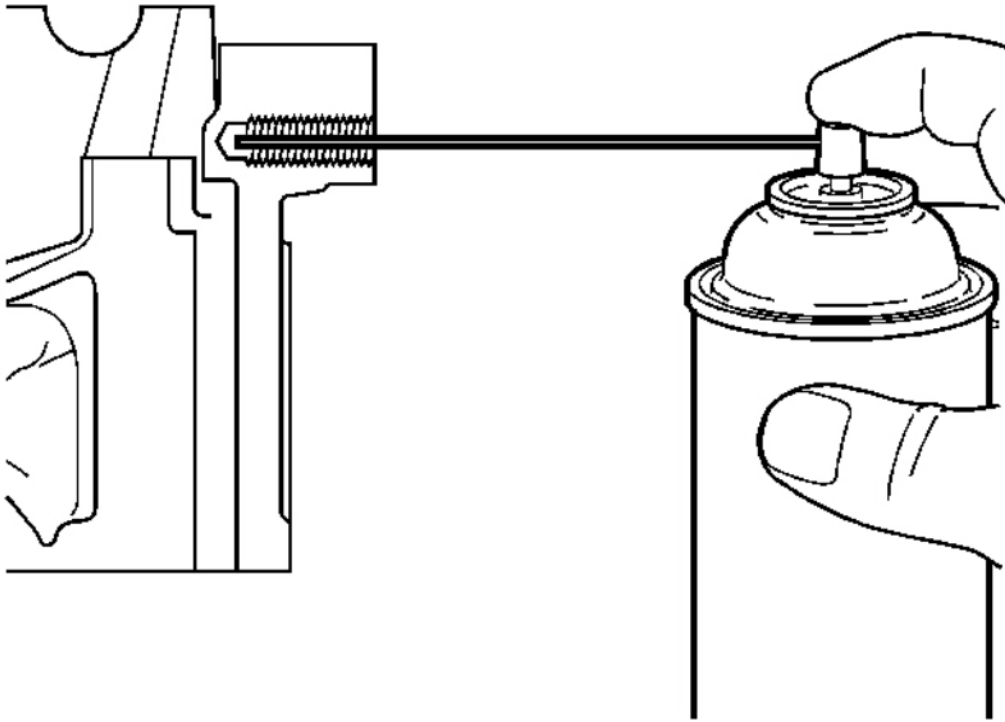


Fig. 72: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

13. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

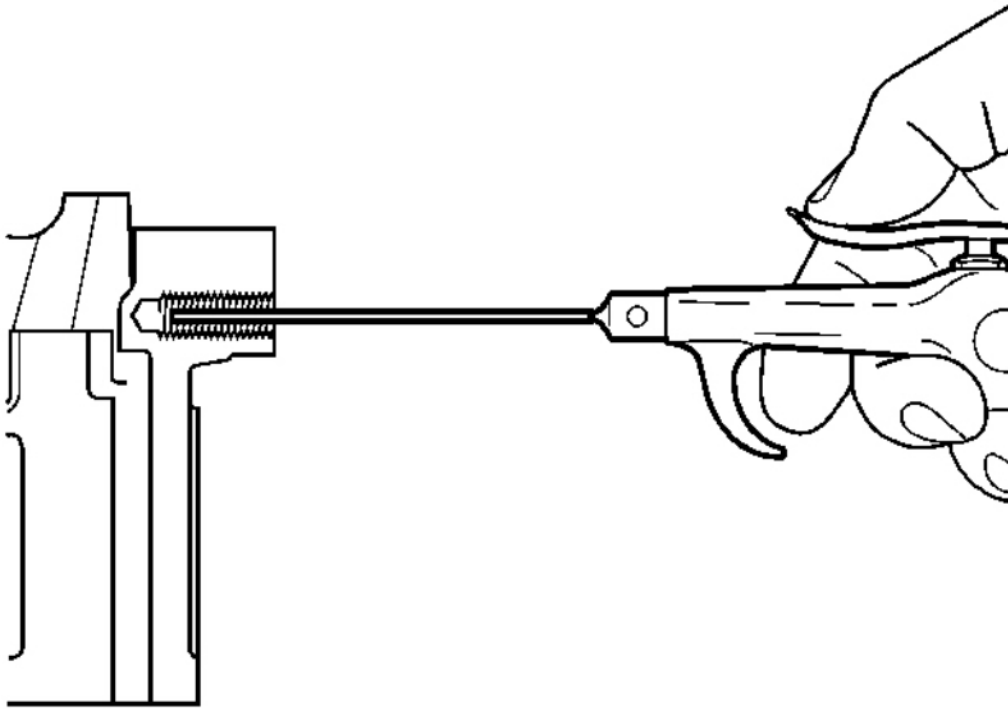


Fig. 73: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

14. Using compressed air, clean out any chips.

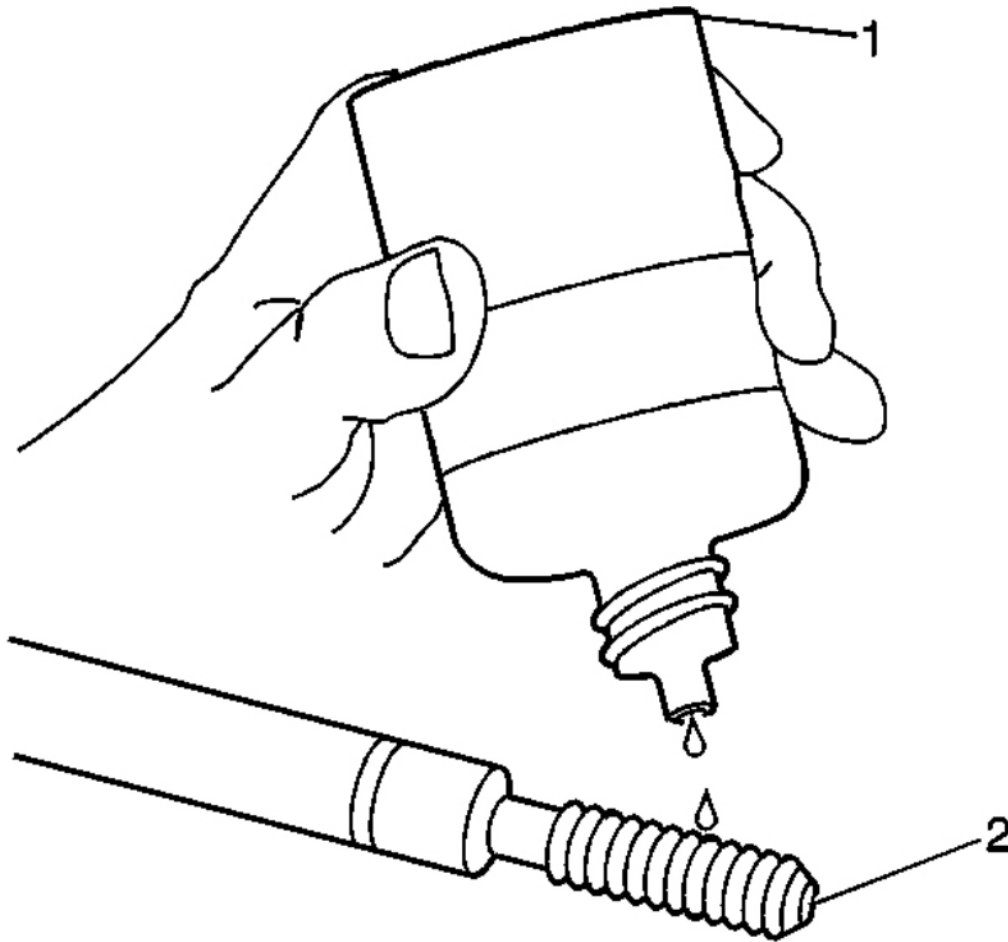


Fig. 74: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

15. Lubricate the threads of the driver installation tool (2) with the driver oil (1) J 42385-110.

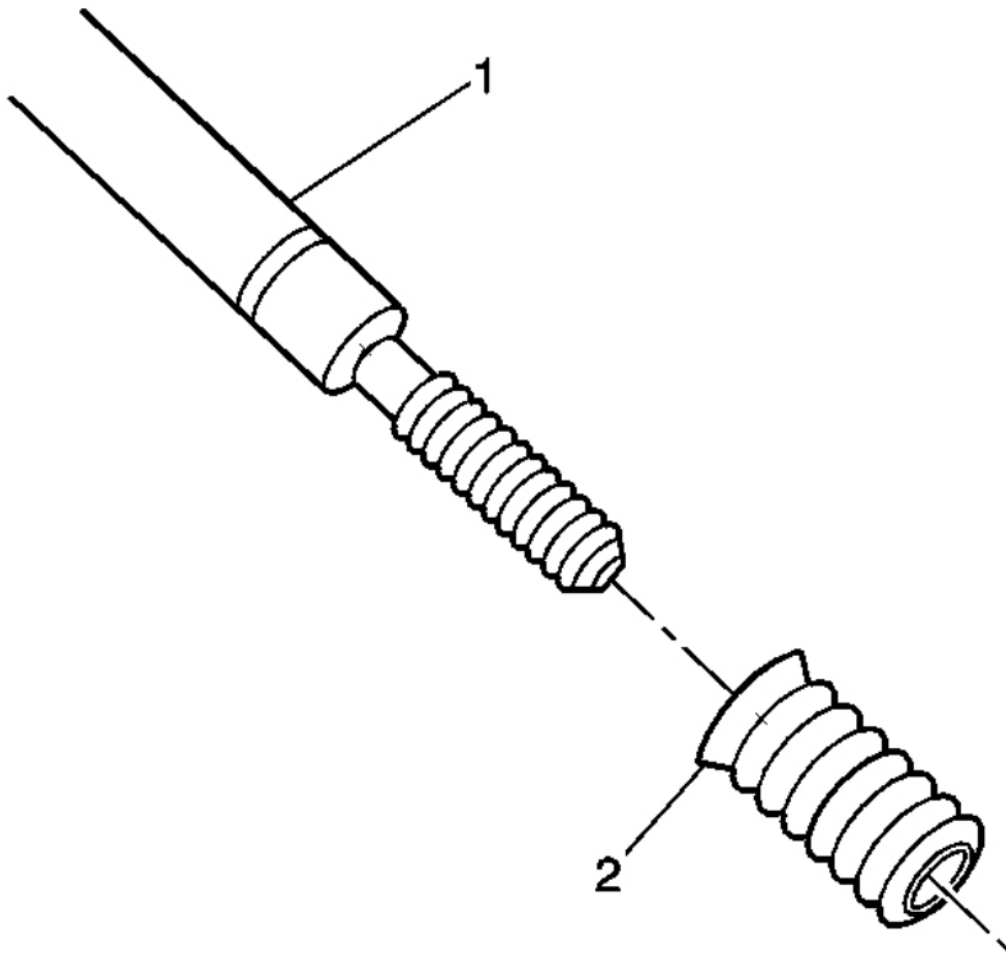


Fig. 75: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

16. Install the insert (2) onto the driver installation tool (1).

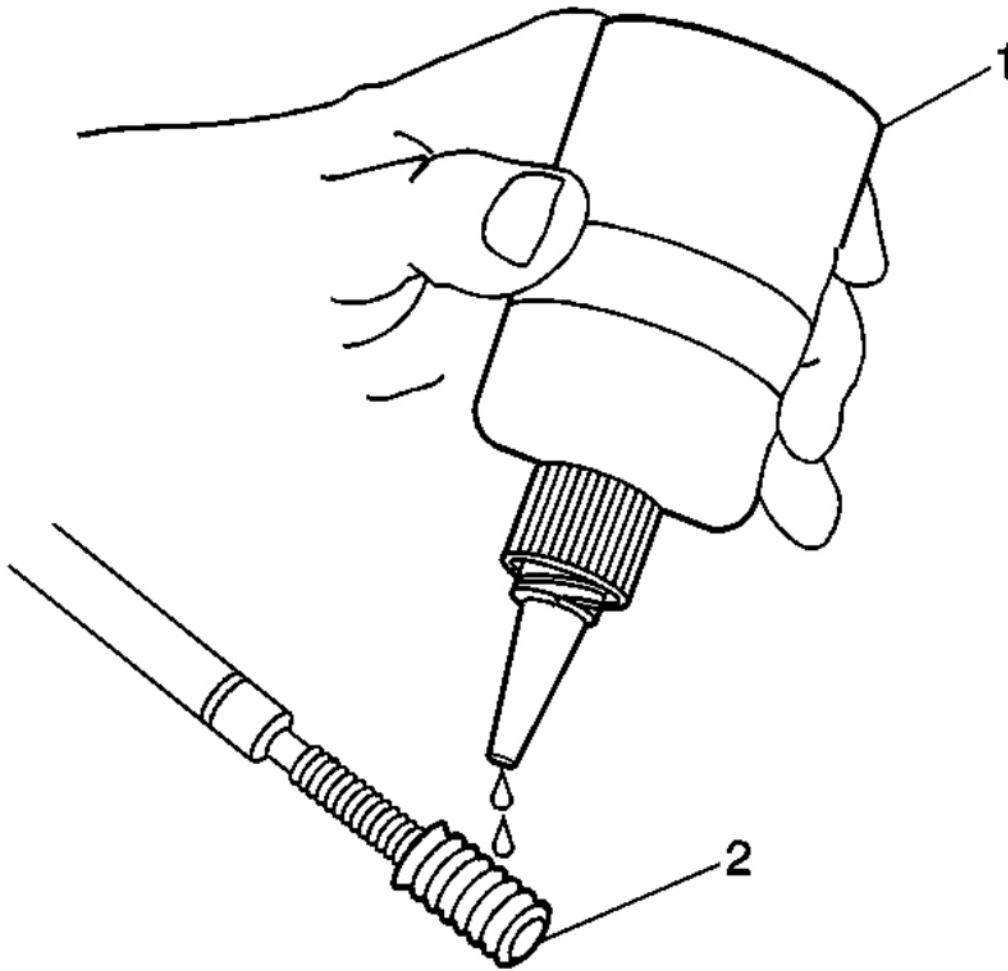


Fig. 76: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

17. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277®; or equivalent (1) to the insert OD threads (2).

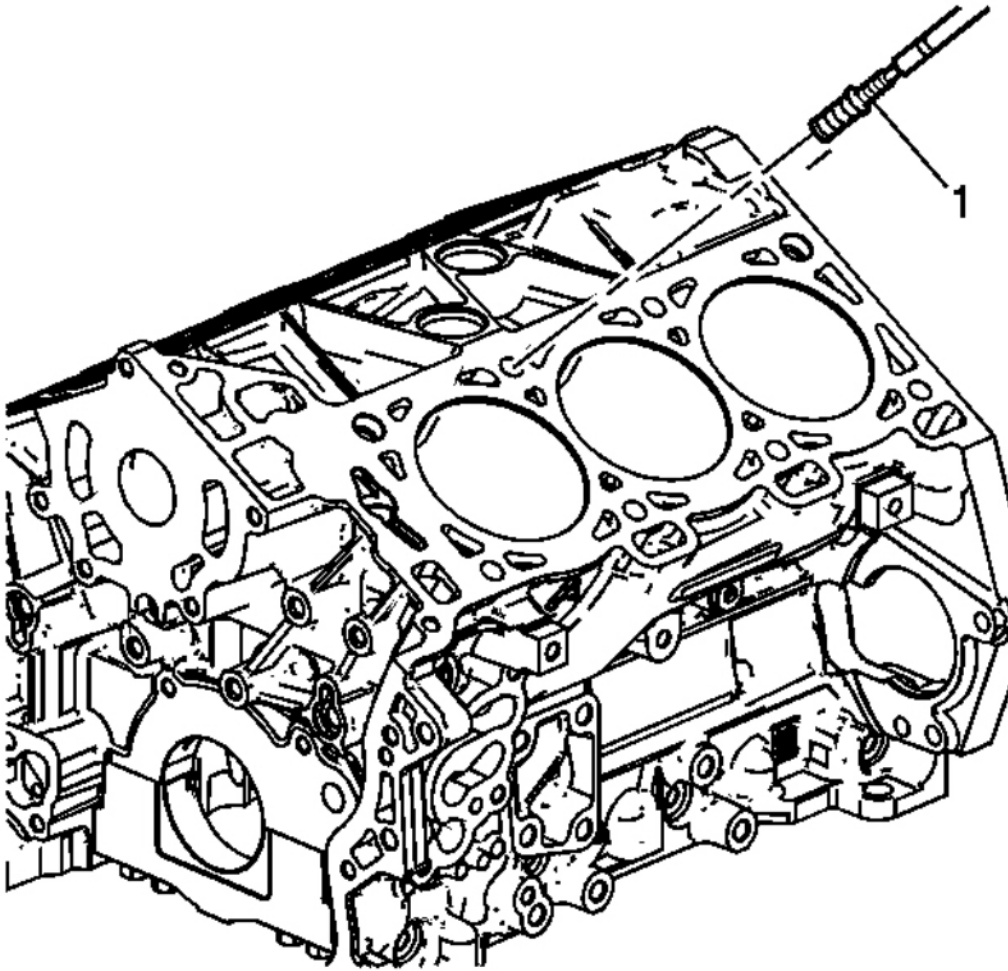


Fig. 77: Installing Insert & Installation Driver
Courtesy of GENERAL MOTORS CORP.

18. Install the insert and installation driver (1) into the tapped hole by hand only.
19. Start the insert into the threaded hole.

IMPORTANT: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

20. Install the insert until the flange of the insert contacts the counterbored surface.

IMPORTANT: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

21. Continue to rotate the driver installation tool through the insert.

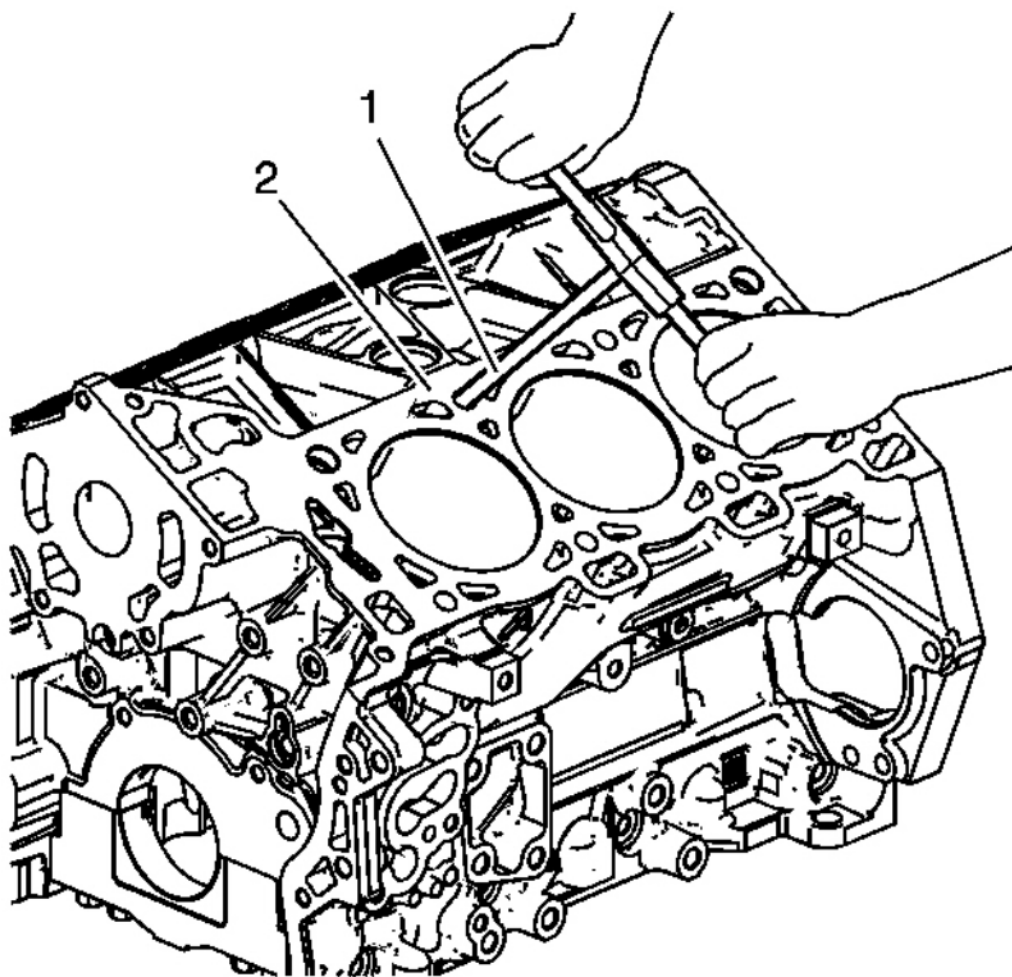


Fig. 78: Rotating Driver Installation Tool Through Insert - Cylinder Head Bolt Hole

Courtesy of GENERAL MOTORS CORP.

22. In order to completely form the new threads in the insert, rotate the driver installation tool through the insert until the mark (1) on the driver installation tool aligns with the surface of the engine block deck (2).
23. Inspect the insert for proper installation into the tapped hole.

Crankshaft Main Bolt Hole Thread Repair

Tools Required

- **J 42385-700** High Feature Thread Repair Kit
- **J 42385-2000** Thread Insert Kit

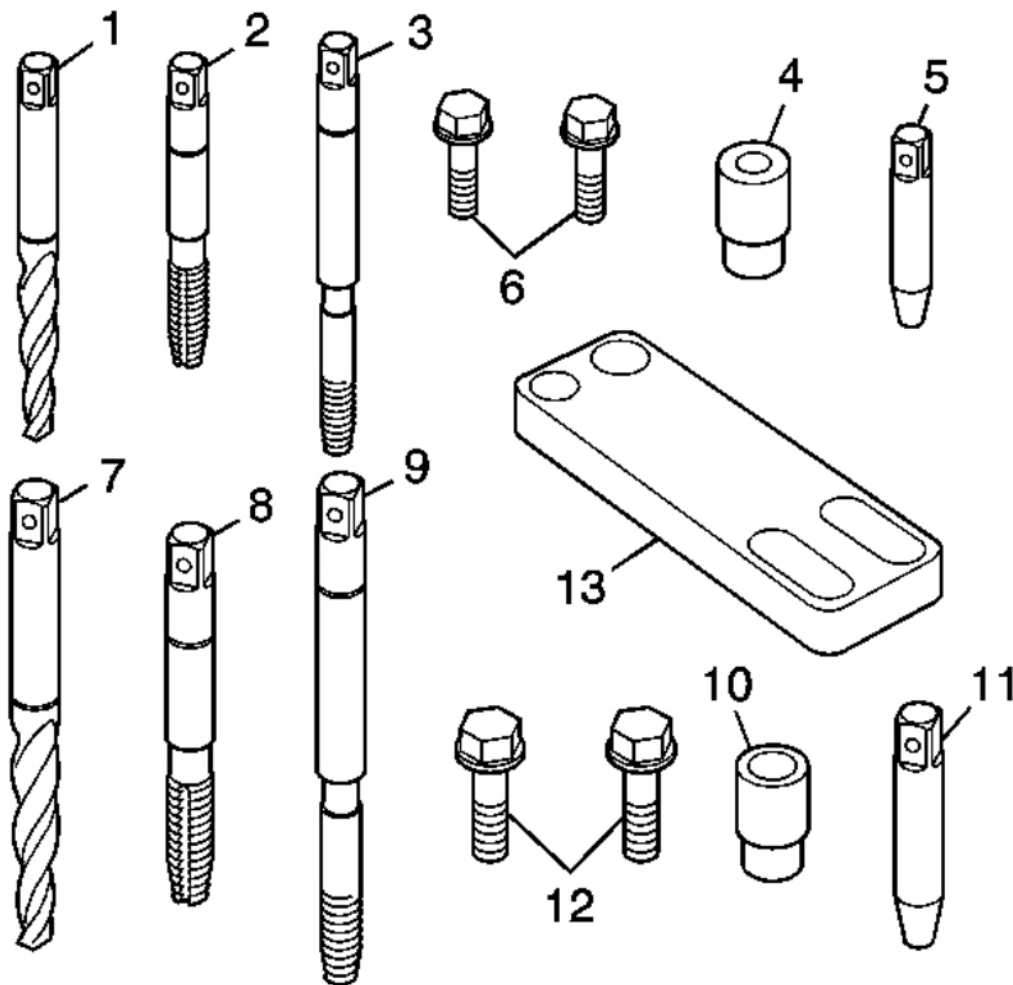


Fig. 79: View Of Crankshaft Main Bolt Hole Thread Repair Tools
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- In order to repair some crankshaft main bolt holes it will be necessary to mount the fixture plate upside down.
- Do NOT remove the fixture plate prior to installing the insert with the installation driver. The fixture plate remains in position throughout the thread repair process.

The crankshaft main bearing bolt hole thread repair tooling are in the kits **J 42385-2000** and **J**

42385-700 . The crankshaft main bearing bolt hole thread repair components consist of the following:

- Drill (1) for outboard holes J 42385-702
- Tap (2) for outboard holes J 42385-703
- Installation driver (3) for outboard holes J 42385-704
- Bushing (4) for outboard holes J 42385-726
- Alignment pin (5) for outboard holes J 42385-727
- Bolts (6) for outboard holes J 42385-728
- Drill (7) for inboard holes J 42385-720
- Tap (8) for inboard holes J 42385-721
- Installation driver (9) for inboard holes J 42385-722
- Bushing (10) J 42385-713
- Alignment pin (11) J 42385-308
- Bolts (12) J 42385-734
- Fixture plate (13) J 42385-712

Outboard Bolt Holes

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

- IMPORTANT:**
- **Ensure the fixture plate is installed during the machining and installation processes of the insert.**
 - **The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.**

When installed to the proper depth, the flange of the insert will be seated against the counterbore of the drilled/tapped hole.

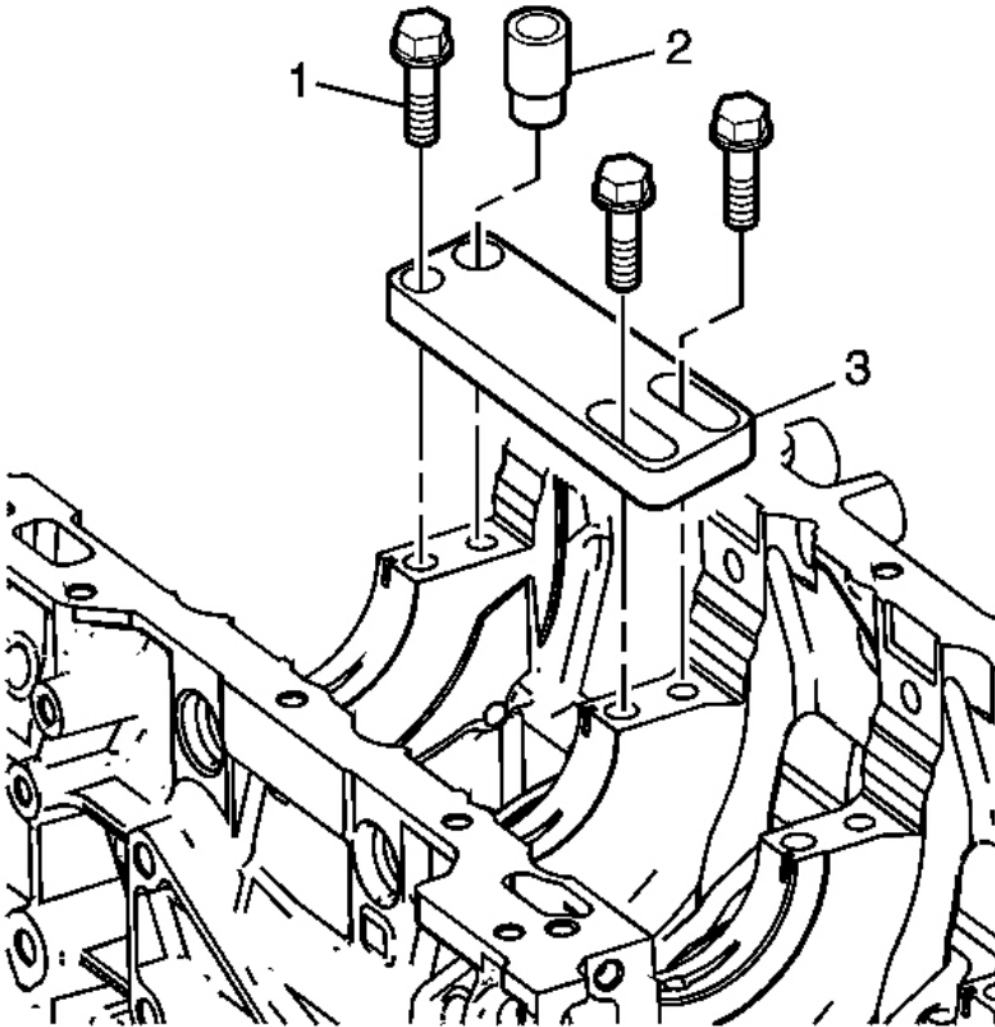


Fig. 80: View Of Fixture Plate & Components - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

1. Position the fixture plate (3) with the bushing (2) installed over the crankshaft main cap bolt hole to be repaired.
2. Loosely install the fixture plate bolts (1) into the remaining crankshaft main cap bolt holes.

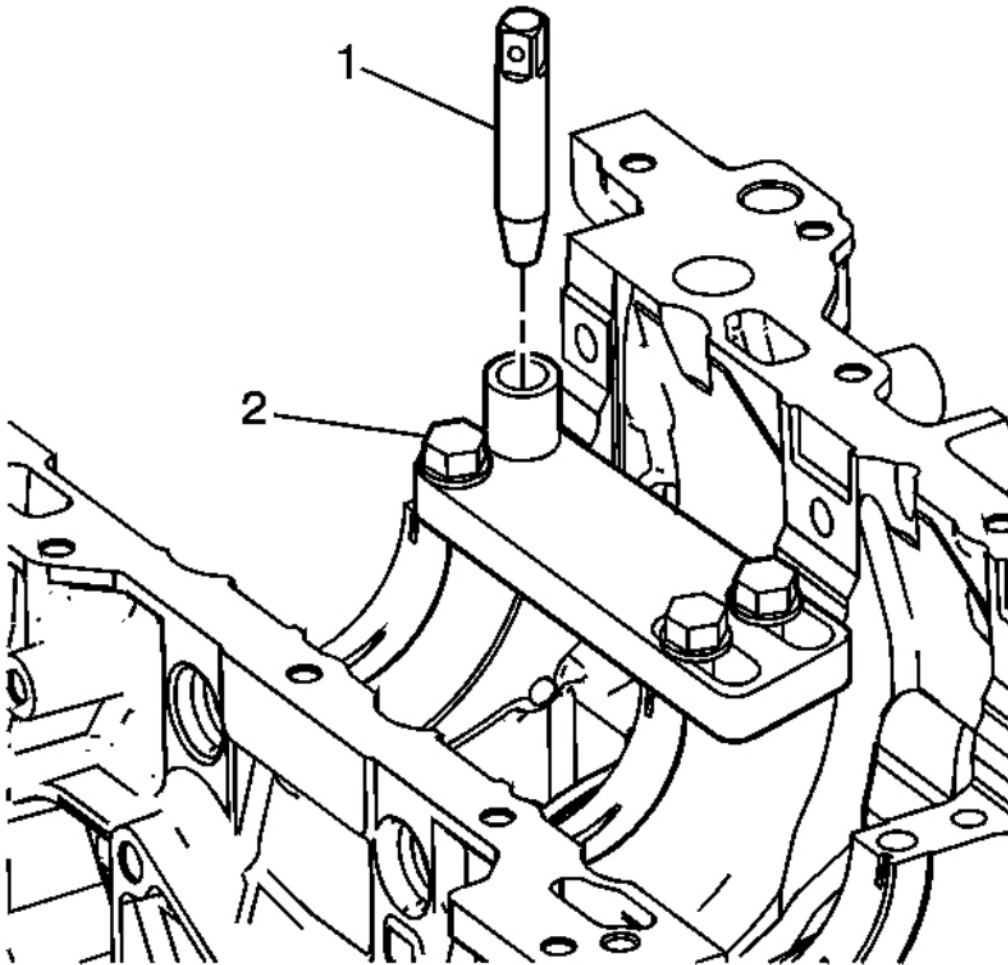


Fig. 81: Positioning Alignment Pin - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

3. Position the alignment pin (1) through the bushing and into the crankshaft main cap bolt hole.
4. With the alignment pin in the desired crankshaft main cap bolt hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin (1) from the crankshaft main cap bolt hole.

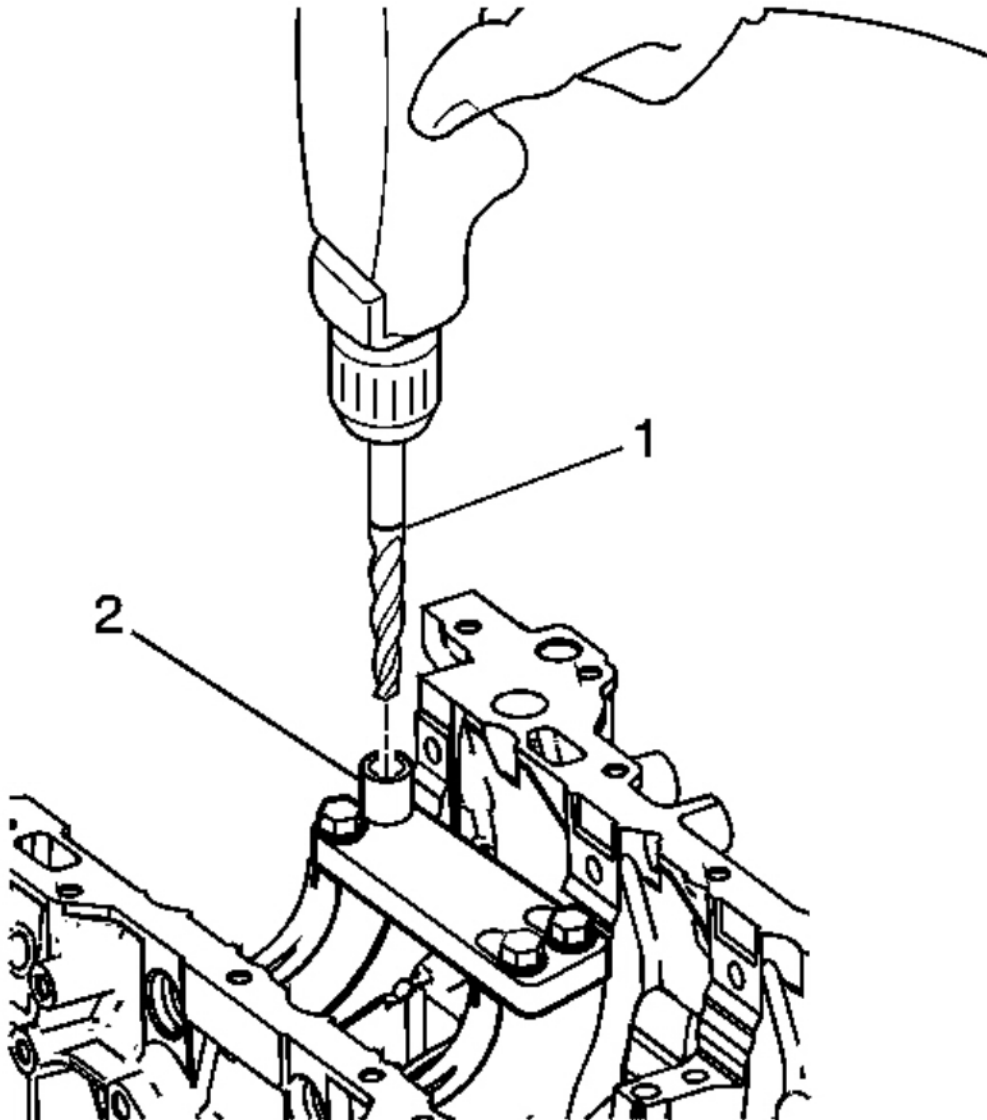


Fig. 82: Drilling Out Threads Of Damaged Hole - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the flutes of the drill.

- **Drill the crankshaft main bolt hole until the mark (1) on the drill aligns with the top of the drill bushing (2).**

6. Drill out the threads of the damaged hole.

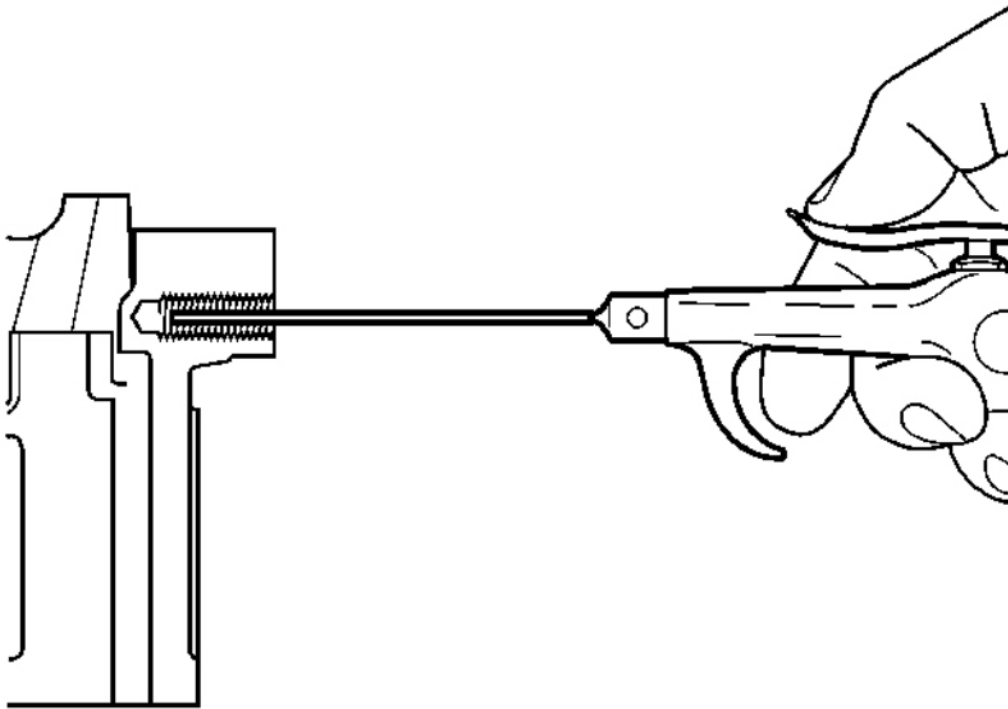


Fig. 83: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to tapping.

7. Using compressed air, clean out any chips.

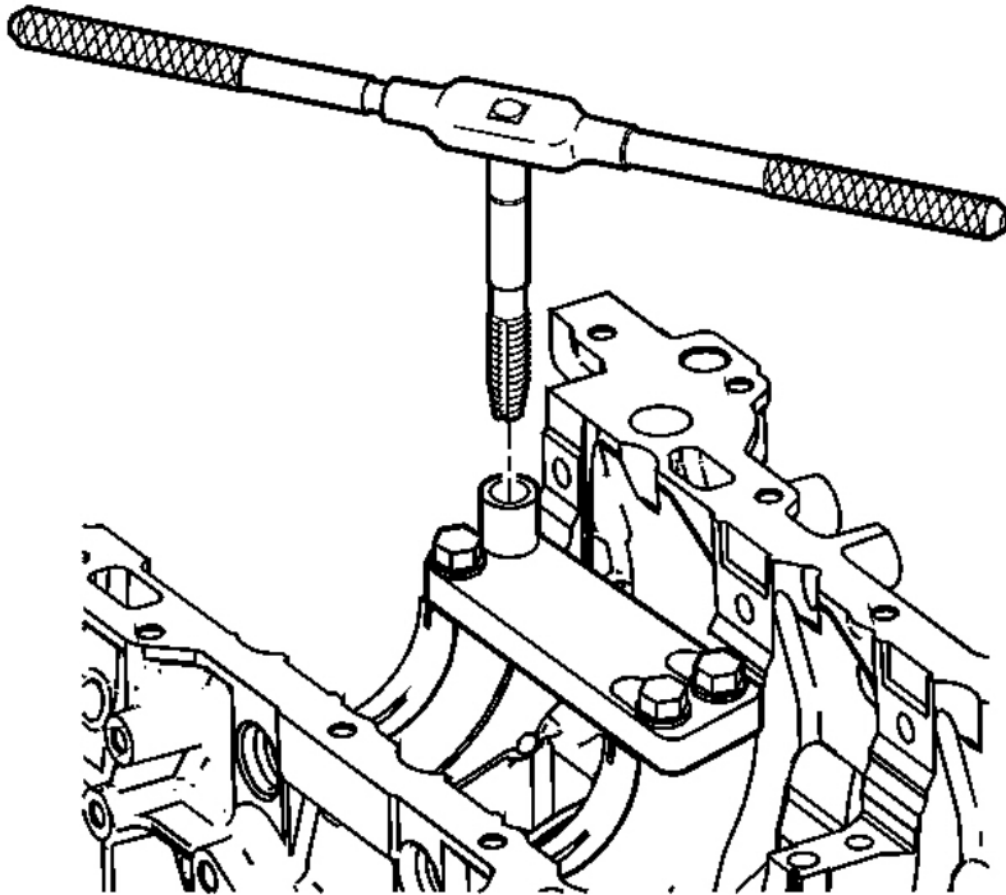


Fig. 84: Tapping Threads Of Drilled Hole Using Tapping Wrench - Outboard Bolt Holes

Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not remove the fixture plate, ensure the fixture plate is installed during the machining and installation processes of the insert.
- During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

8. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

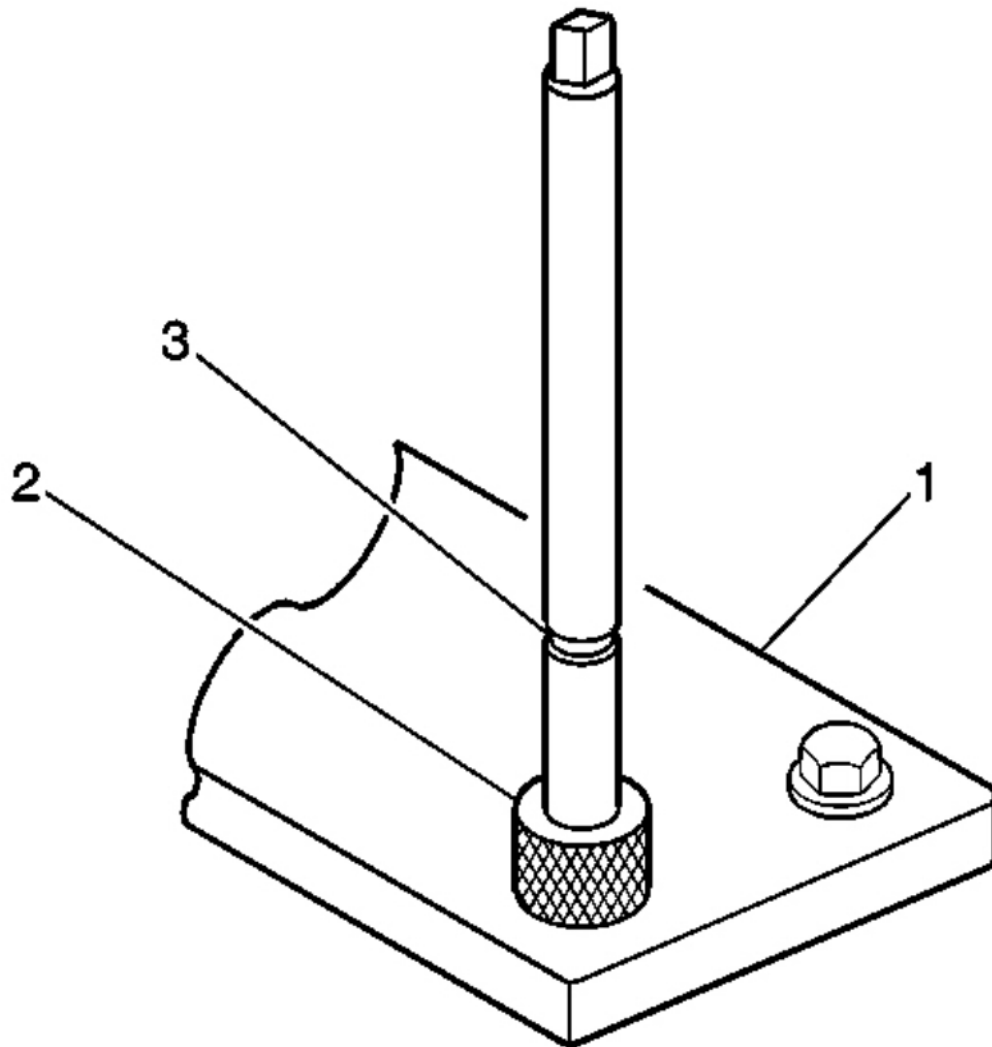


Fig. 85: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

9. In order to tap the new threads for the insert to the proper depth, rotate the tap into the crankshaft main cap bolt hole until the mark (3) on the tap aligns with the top of the drill bushing (2).

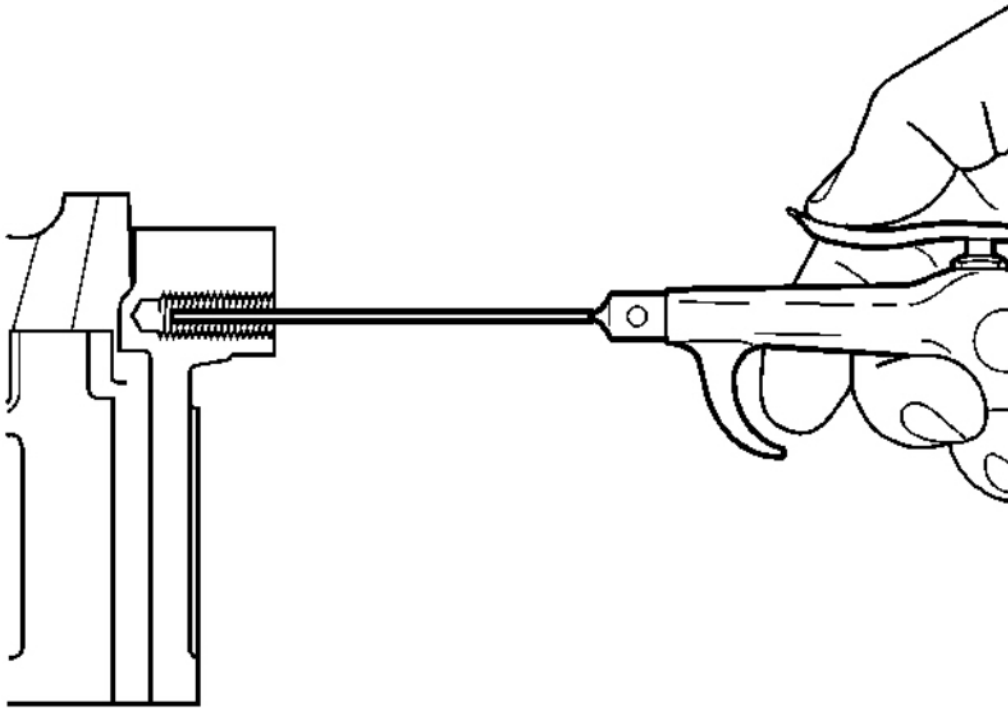


Fig. 86: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

10. Using compressed air, clean out any chips.

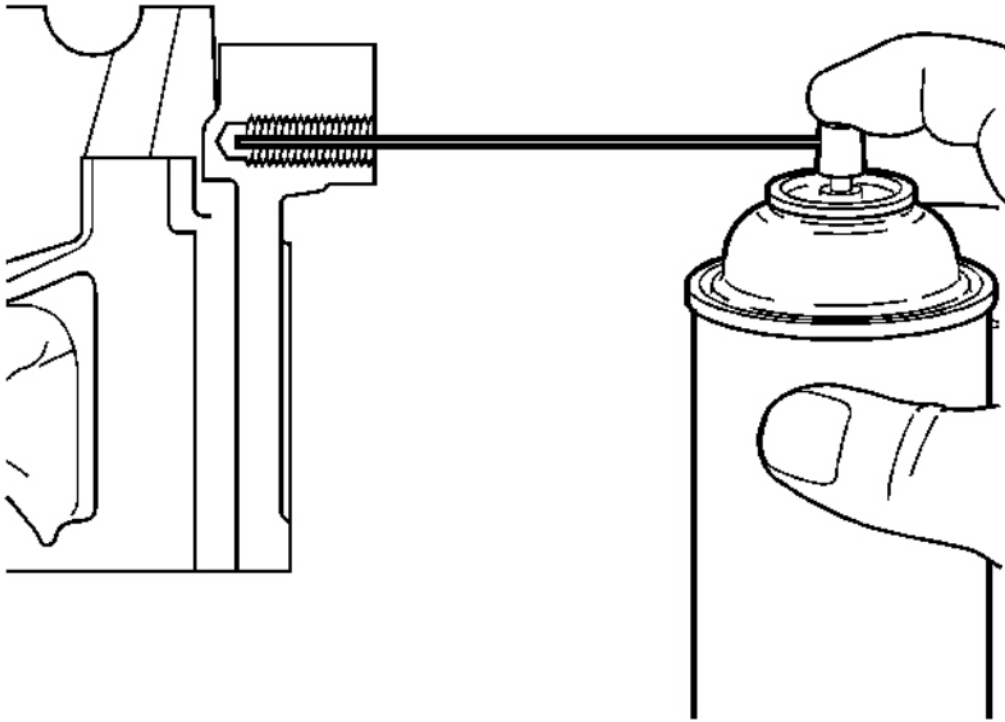


Fig. 87: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

11. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

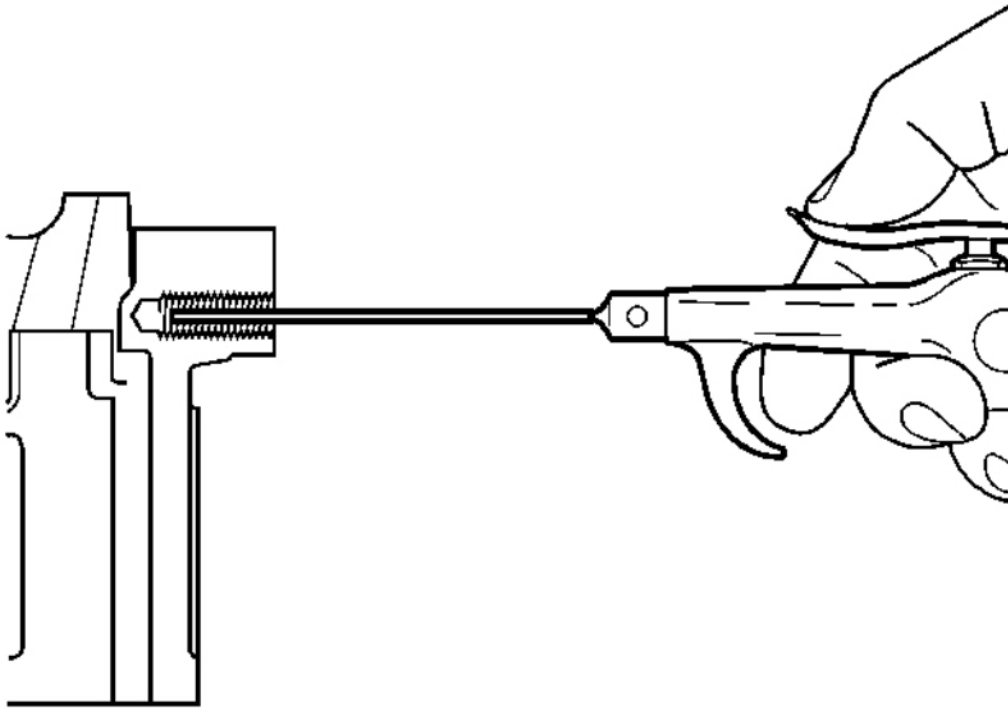


Fig. 88: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

12. Using compressed air, clean out any chips.

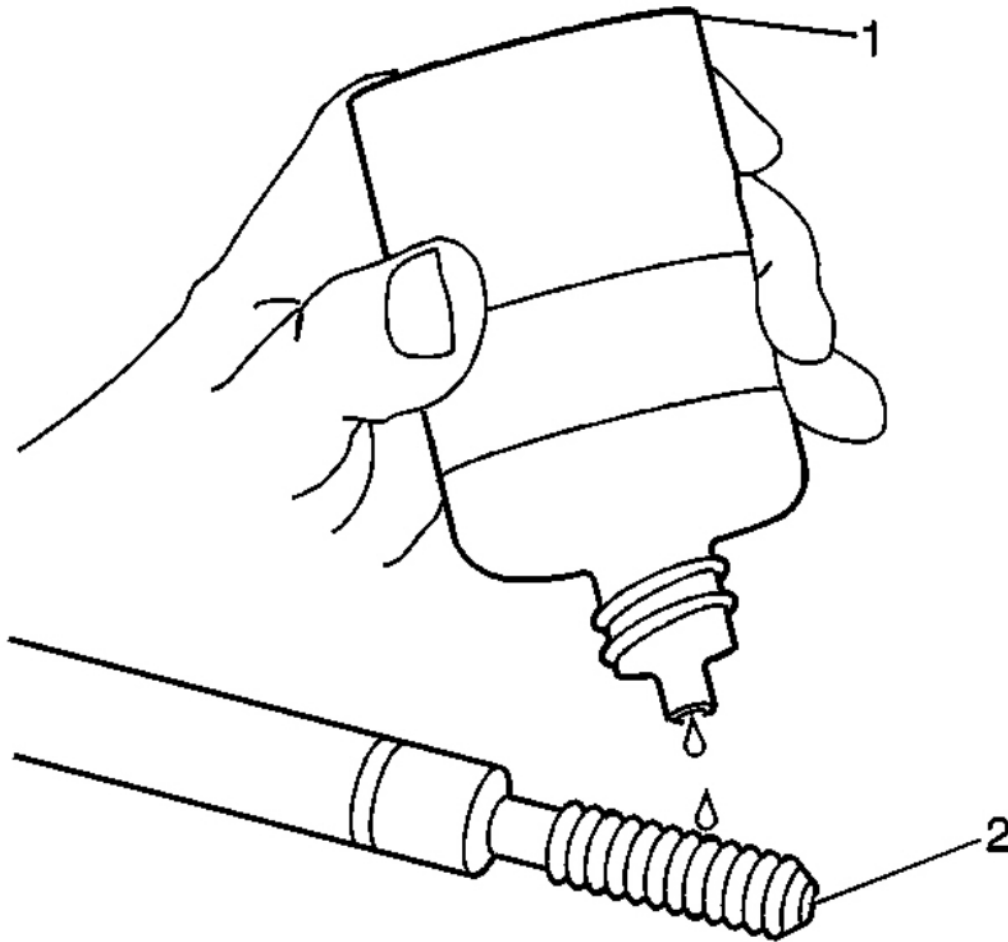


Fig. 89: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not remove the fixture plate, ensure the fixture plate is installed during the installation process of the insert.
- Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

13. Lubricate the threads of the driver installation tool (2) with the driver oil (1) J 42385-110.

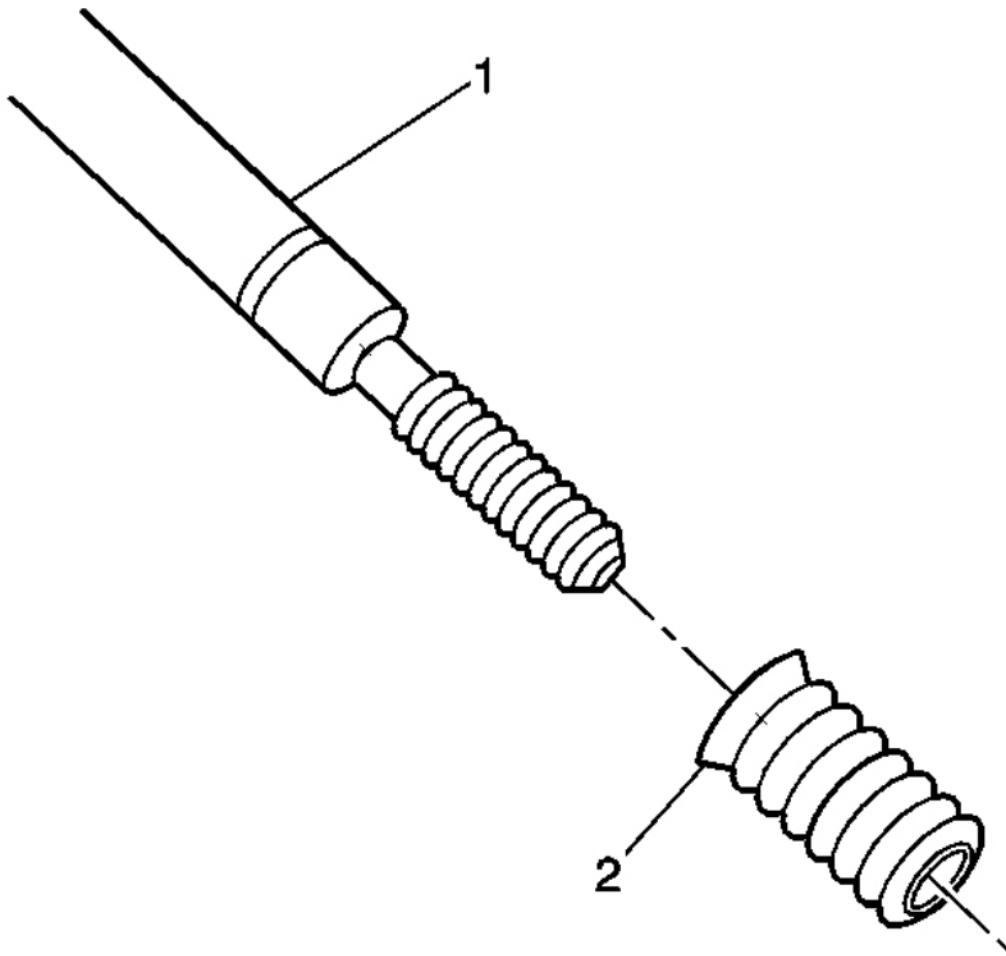


Fig. 90: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

14. Install the insert (2) onto the driver installation tool (1).

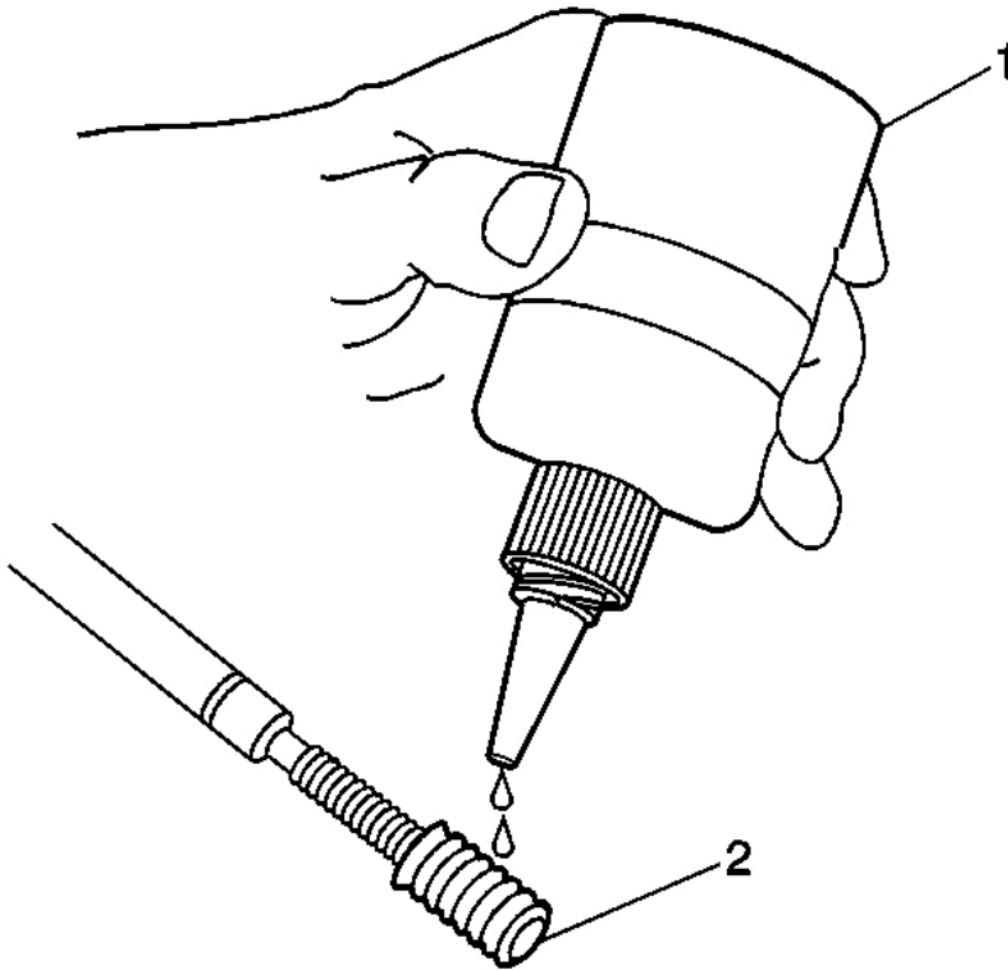


Fig. 91: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

15. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277®, or equivalent (1) to the insert OD threads (2).

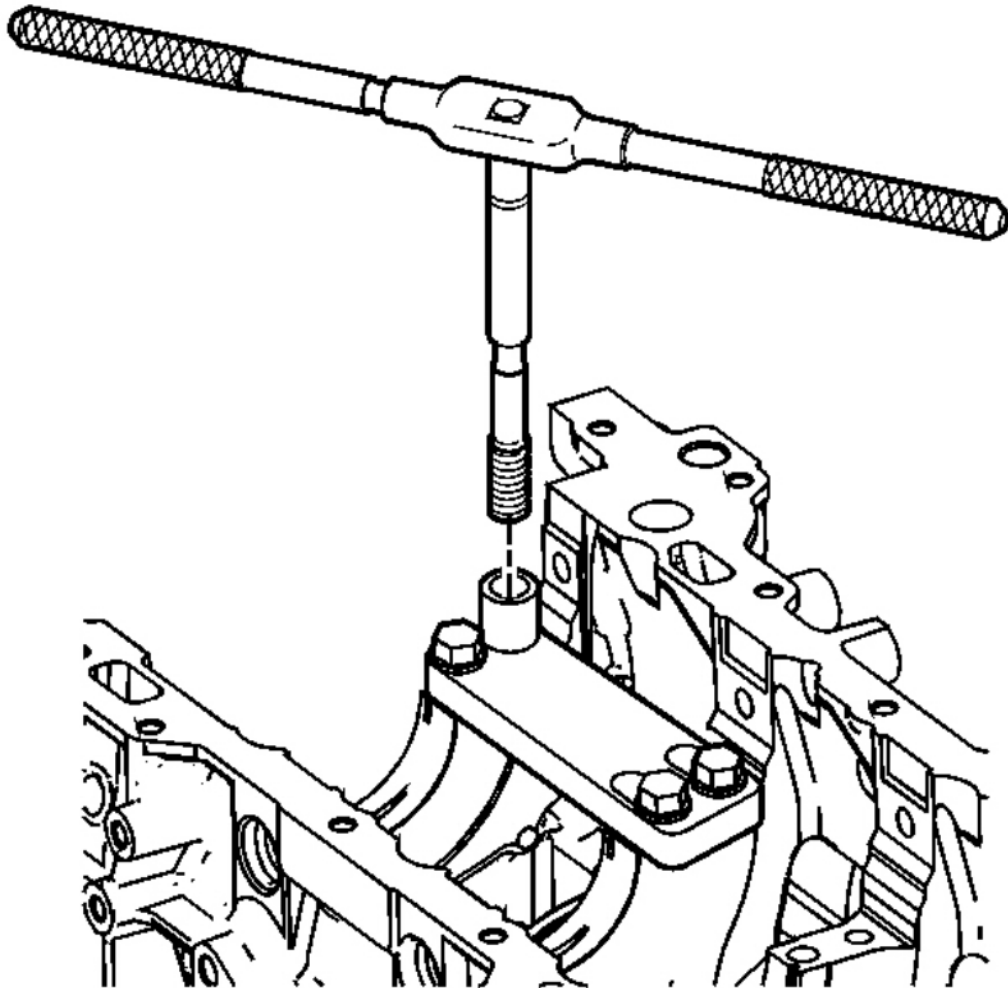


Fig. 92: Installing Insert & Installation Driver - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

16. Install the insert and installation driver into the tapped hole by hand only.
17. Start the insert into the threaded hole.

IMPORTANT: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

18. Install the insert until the flange of the insert contacts the counterbored surface.

IMPORTANT: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

19. Continue to rotate the driver installation tool through the insert.

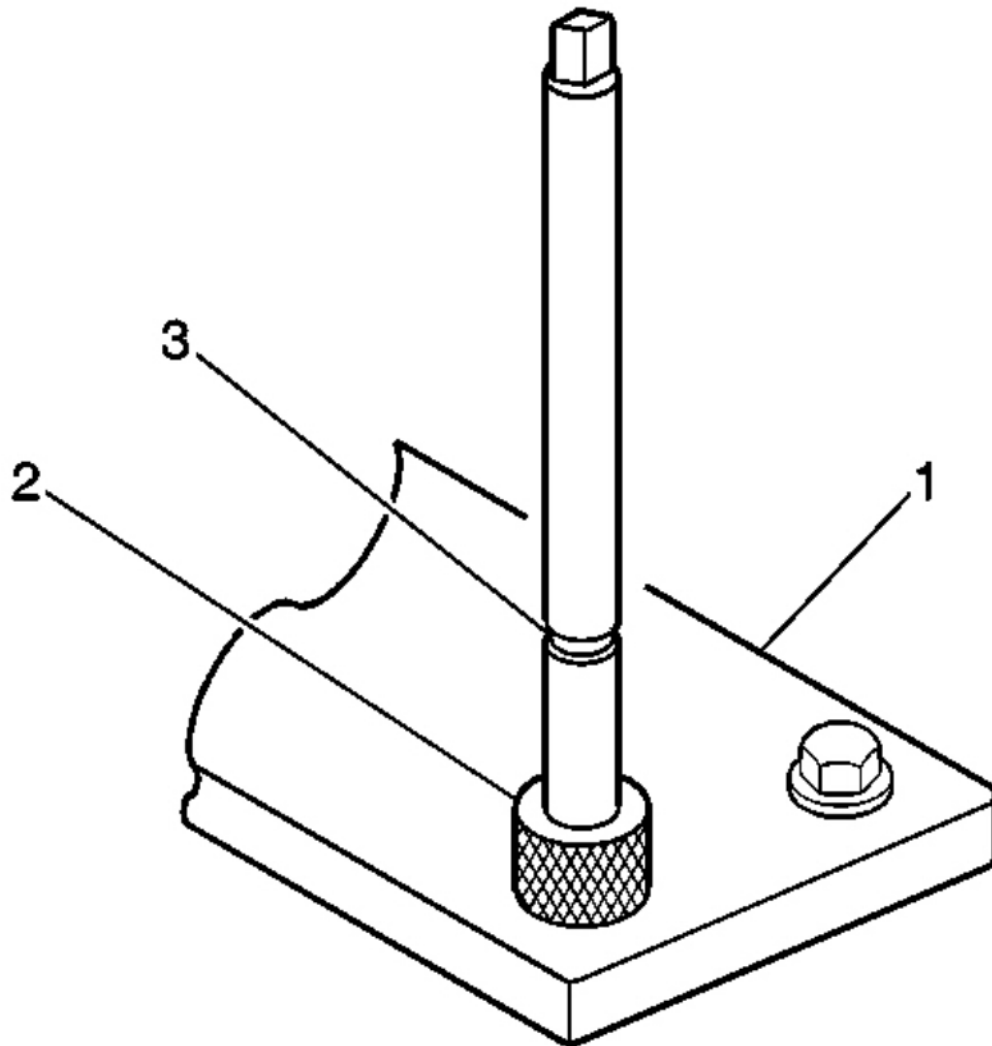


Fig. 93: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

20. Rotate the driver installation tool until the mark (3) on the driver installation tool aligns with the top of the drill bushing (2).
21. Inspect the insert for proper installation into the tapped hole.

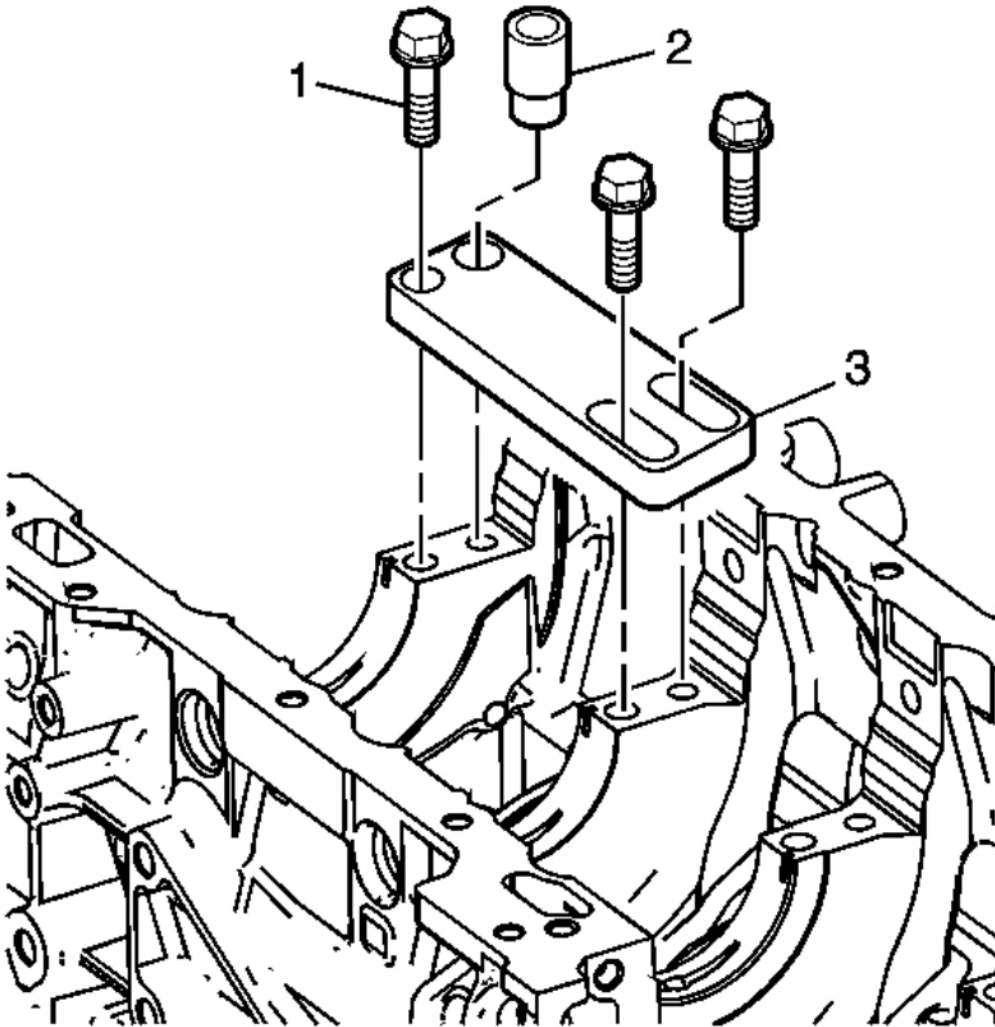


Fig. 94: View Of Fixture Plate & Components - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

22. Remove the fixture plate bolts (1).
23. Remove the fixture plate (3) and bushing (2).

Inboard Bolt Holes

CAUTION: Refer to Safety Glasses Caution in Cautions and Notices.

- IMPORTANT:**
- **Ensure the fixture plate is installed during the machining and installation processes of the insert.**
 - **The use of a cutting type fluid GM P/N 1052864, (Canadian P/N 992881), WD 40® or equivalent is recommended when performing the drilling, counterboring and tapping procedures.**

When installed to the proper depth, the flange of the insert will be seated against the counterbore of the drilled/tapped hole.

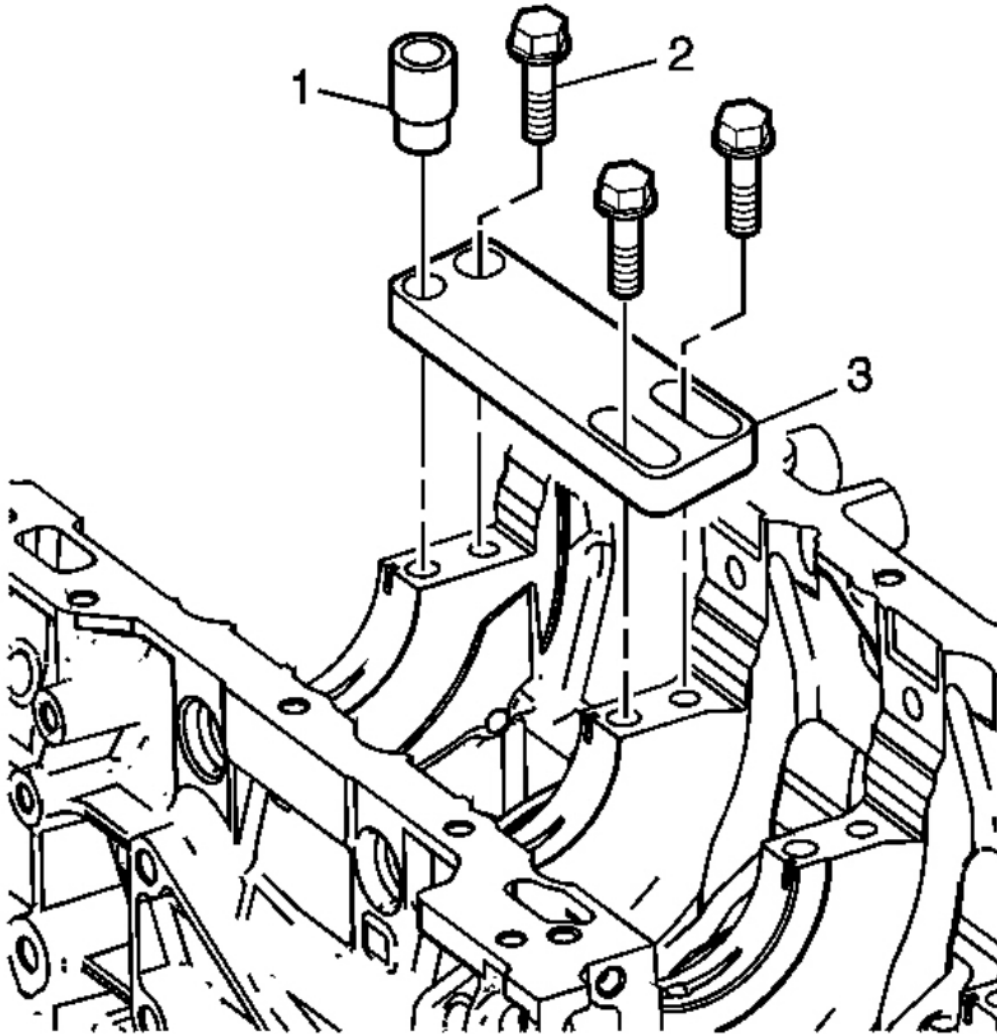


Fig. 95: View Of Fixture Plate & Components - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

1. Position the fixture plate (3) with the bushing (1) installed over the crankshaft main cap bolt hole to be repaired.
2. Loosely install the fixture plate bolts (2) into the remaining crankshaft main cap bolt holes.

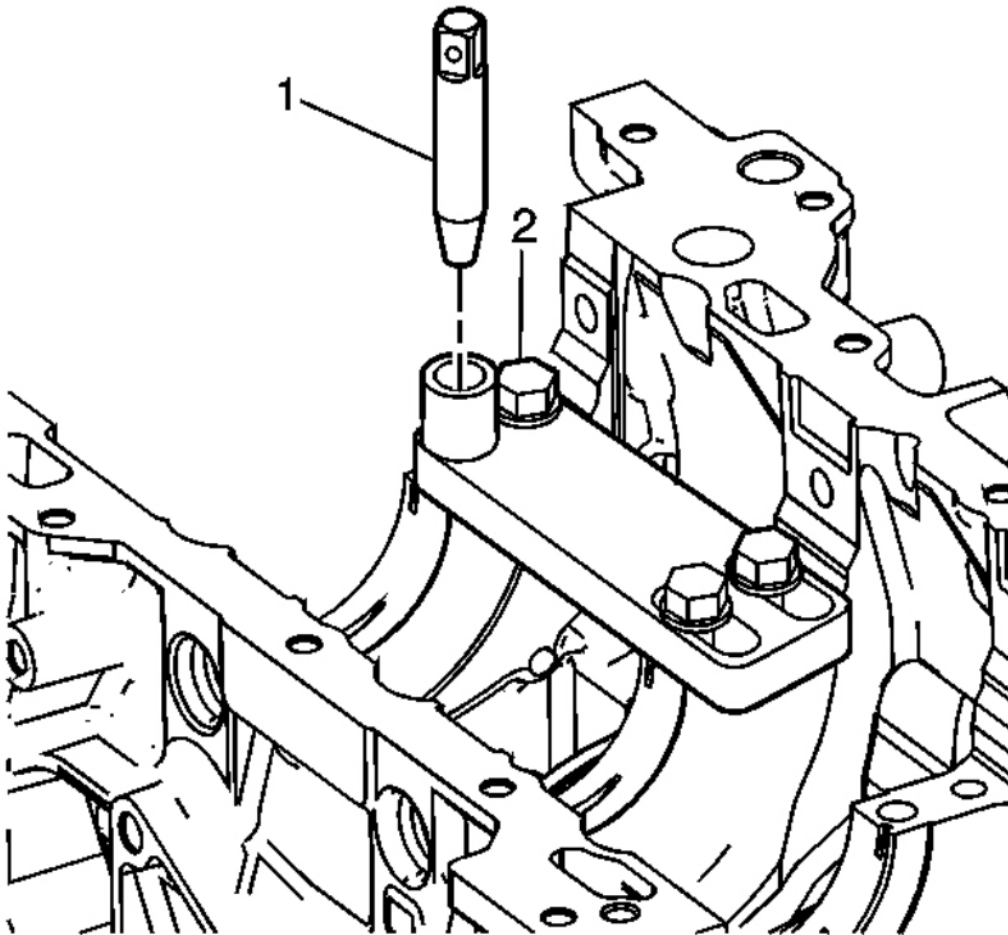


Fig. 96: Positioning Alignment Pin - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

3. Position the alignment pin (1) through the bushing and into the crankshaft main cap bolt hole.
4. With the alignment pin in the desired crankshaft main cap bolt hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin (1) from the crankshaft main cap bolt hole.

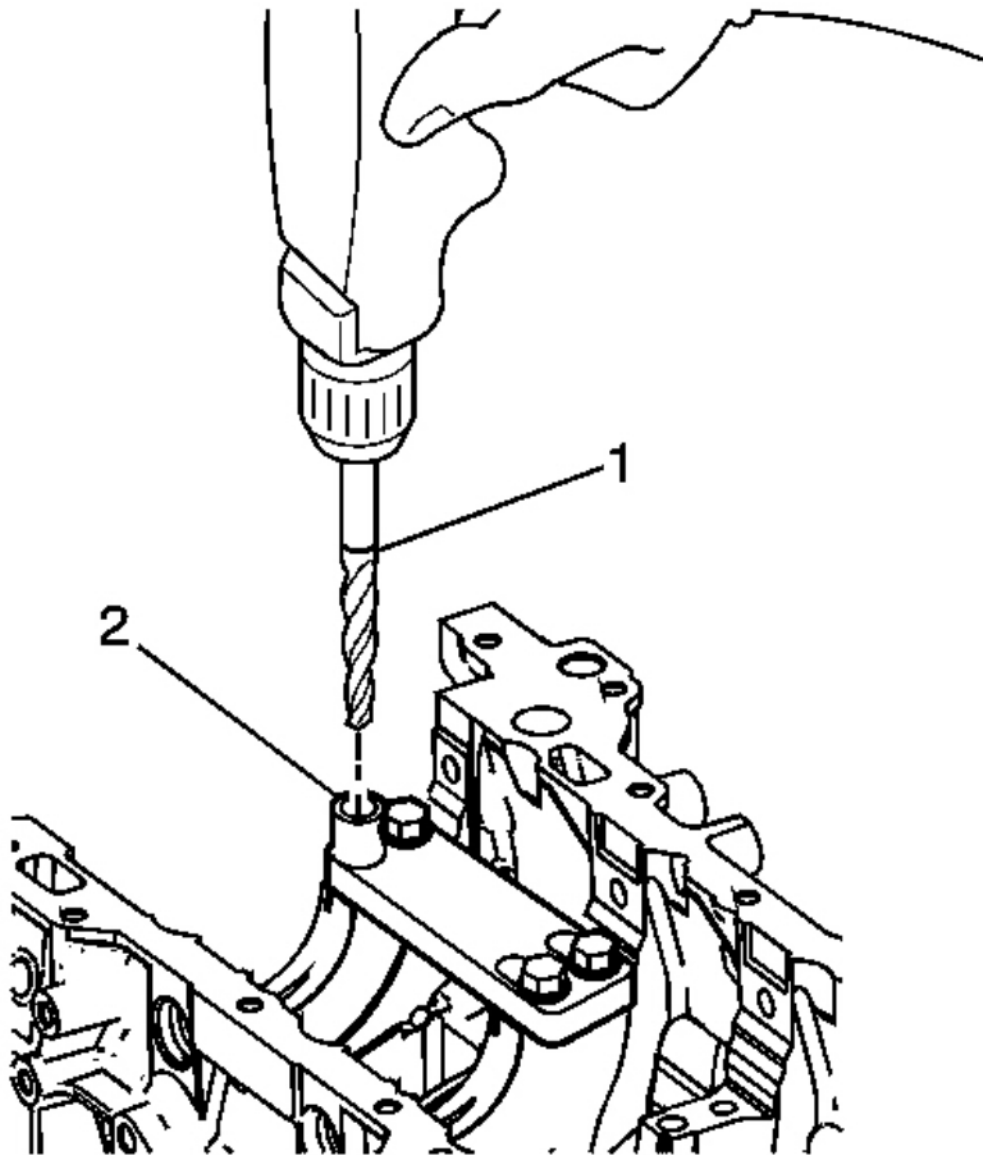


Fig. 97: Drilling Out Threads Of Damaged Hole - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- During the drilling process, it is necessary to repeatedly remove the drill and clean chips from the hole and the

flutes of the drill.

- **Drill the crankshaft main bolt hole until the mark (1) on the drill aligns with the top of the drill bushing (2).**

6. Drill out the threads of the damaged hole.

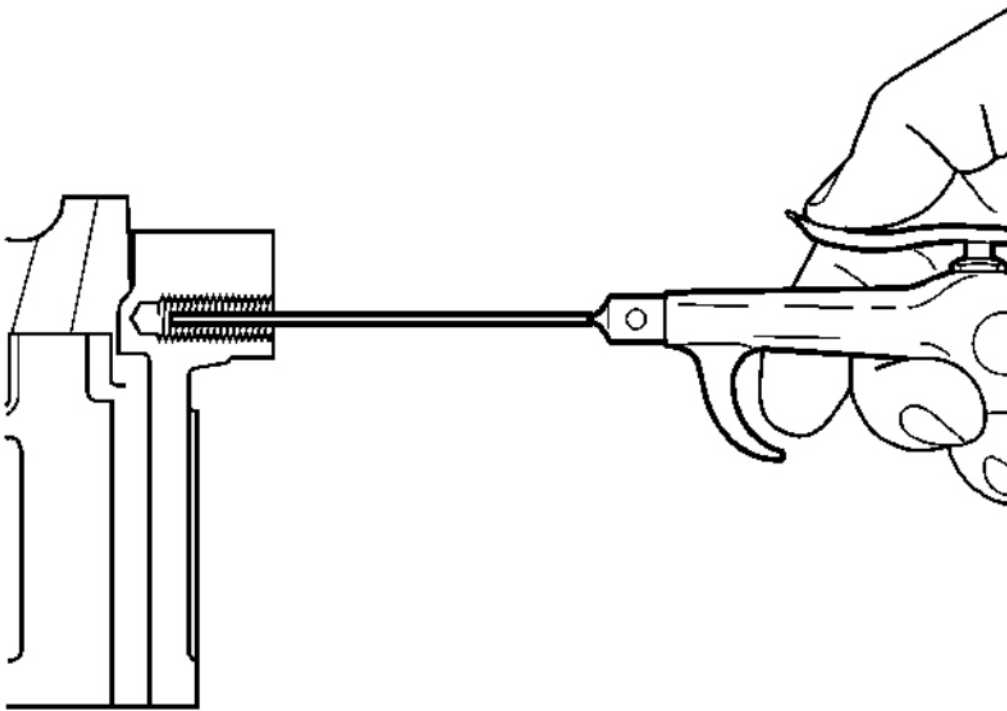


Fig. 98: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the drilled hole prior to tapping.

7. Using compressed air, clean out any chips.

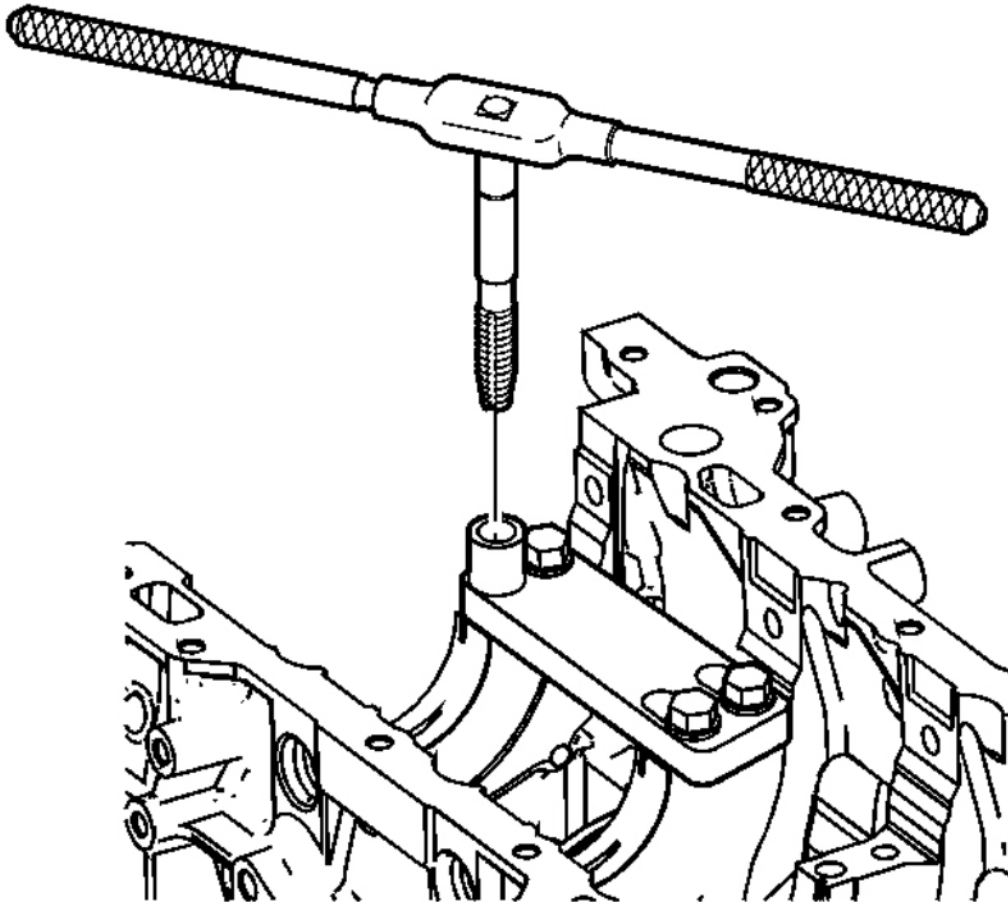


Fig. 99: Tapping Threads Of Drilled Hole Using Tapping Wrench - Inboard Bolt Holes

Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not remove the fixture plate, ensure the fixture plate is installed during the machining and installation processes of the insert.
- During the tapping process, it is necessary to repeatedly remove the tap and clean chips from the hole and the flutes of the tap.
- Ensure the tap has created full threads at least to the depth equal to the insert length.

8. Using a suitable tapping wrench, tap the threads of the drilled hole by hand only.

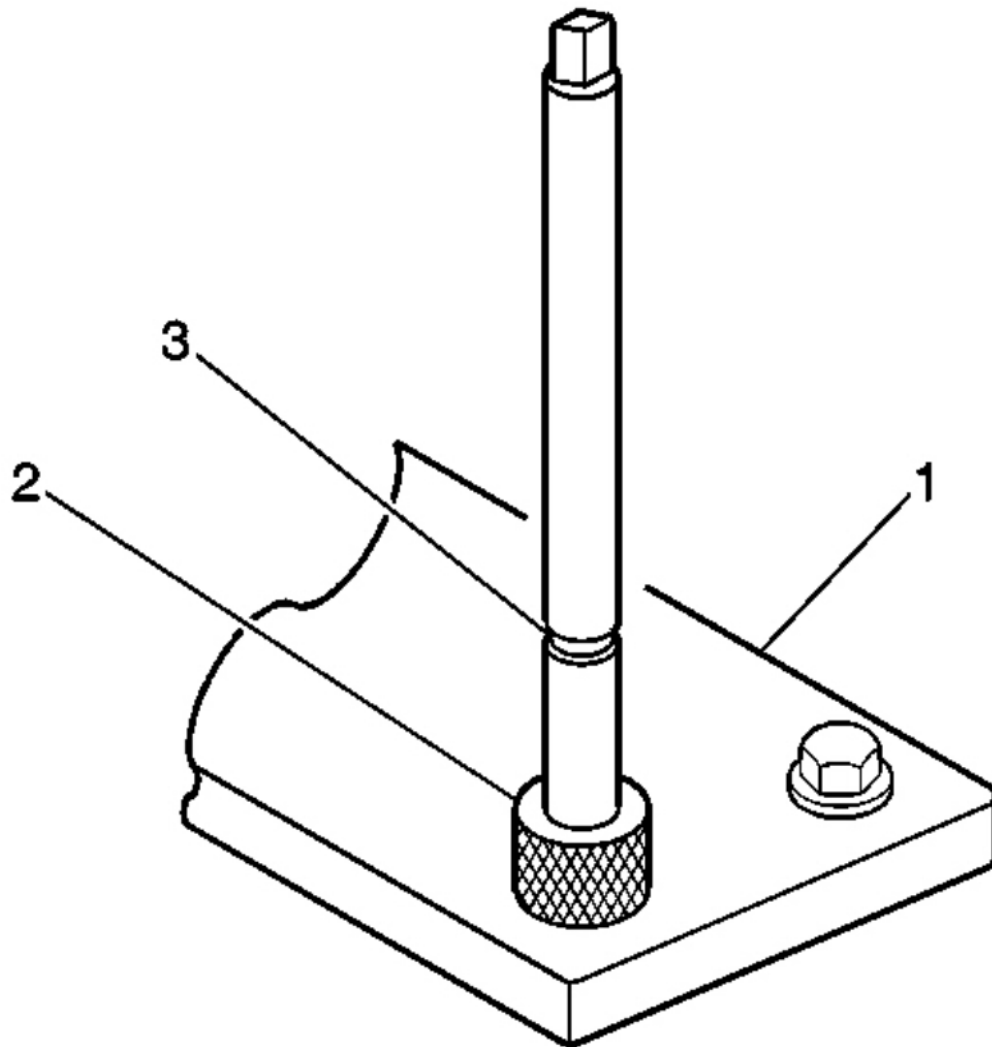


Fig. 100: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

9. In order to tap the new threads for the insert to the proper depth, rotate the tap into the crankshaft main cap bolt hole until the mark (3) on the tap aligns with the top of the drill bushing (2).

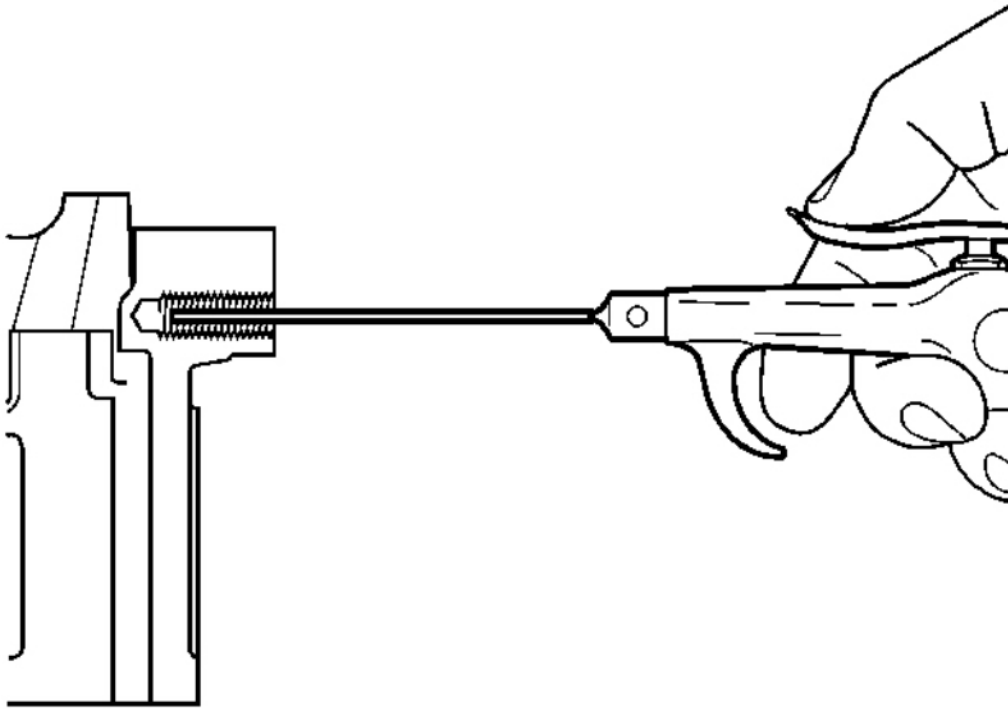


Fig. 101: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

10. Using compressed air, clean out any chips.

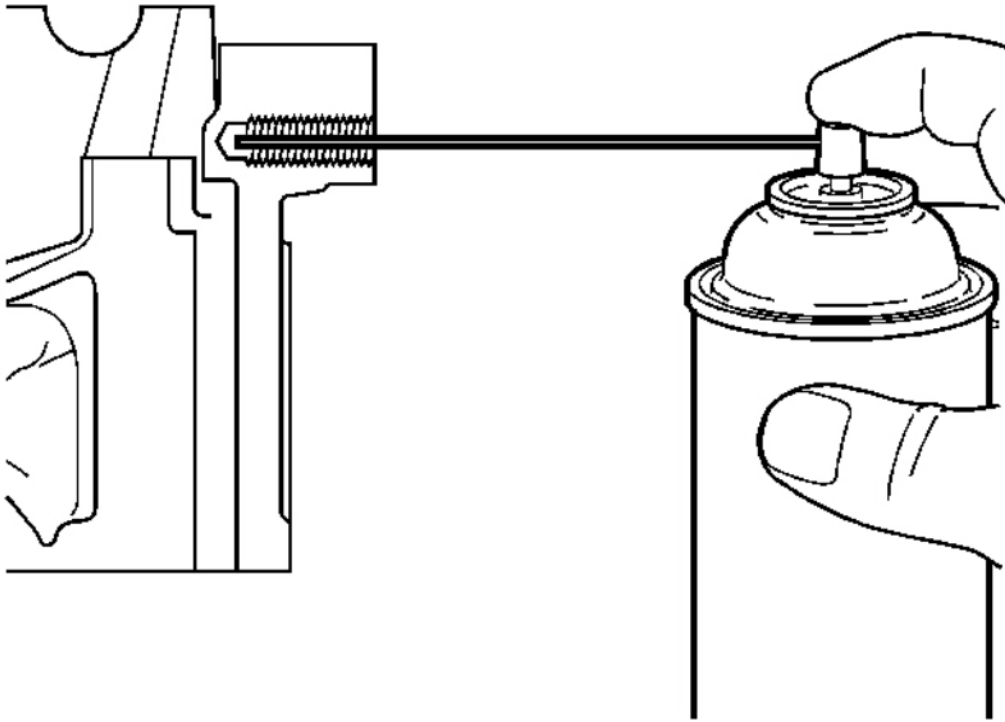


Fig. 102: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

11. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463) or equivalent into the tapped hole.

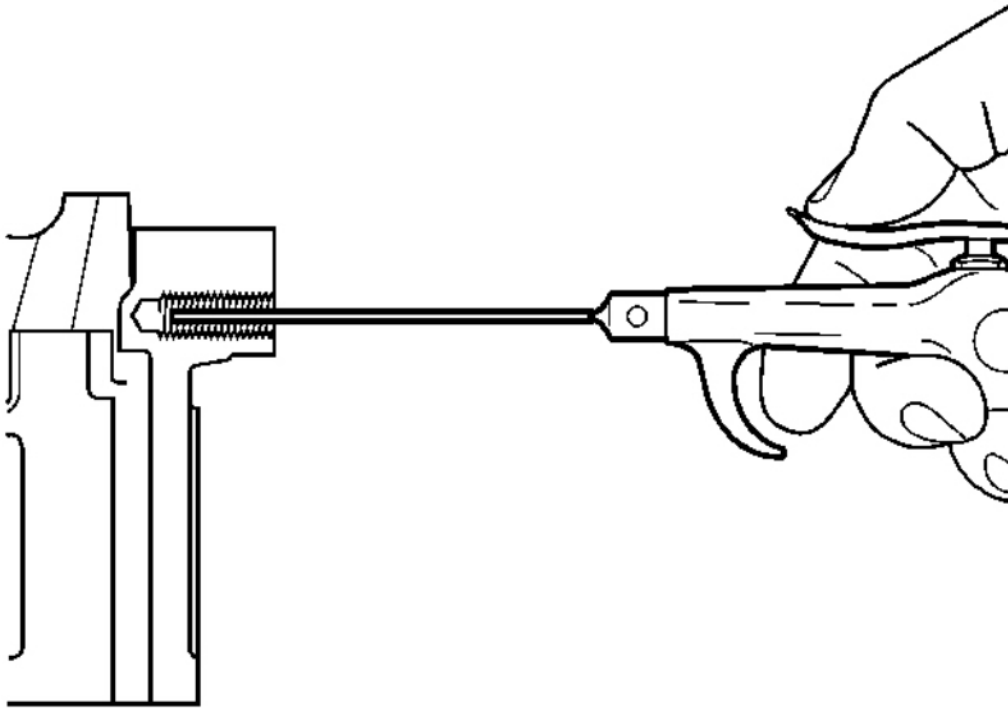


Fig. 103: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: All chips must be removed from the tapped hole prior to insert installation.

12. Using compressed air, clean out any chips.

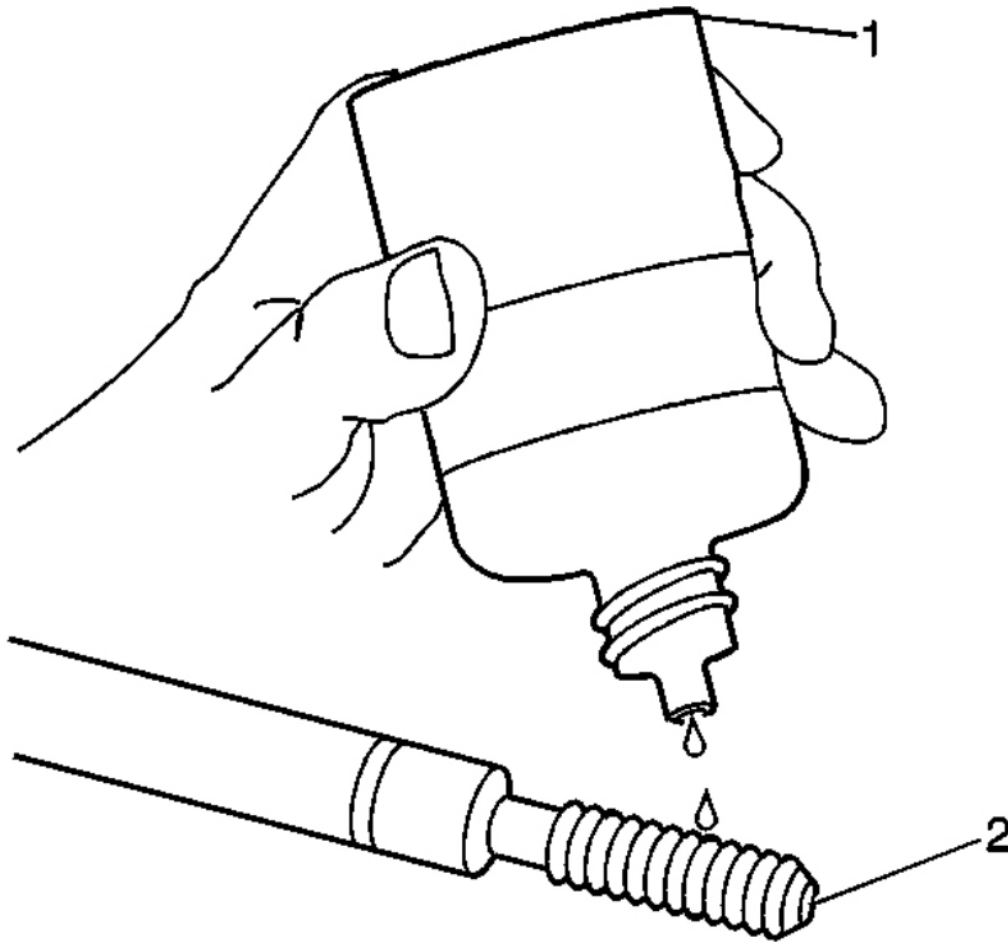


Fig. 104: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not remove the fixture plate, ensure the fixture plate is installed during the installation process of the insert.
- Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

13. Lubricate the threads of the driver installation tool (2) with the driver oil (1) J 42385-110.

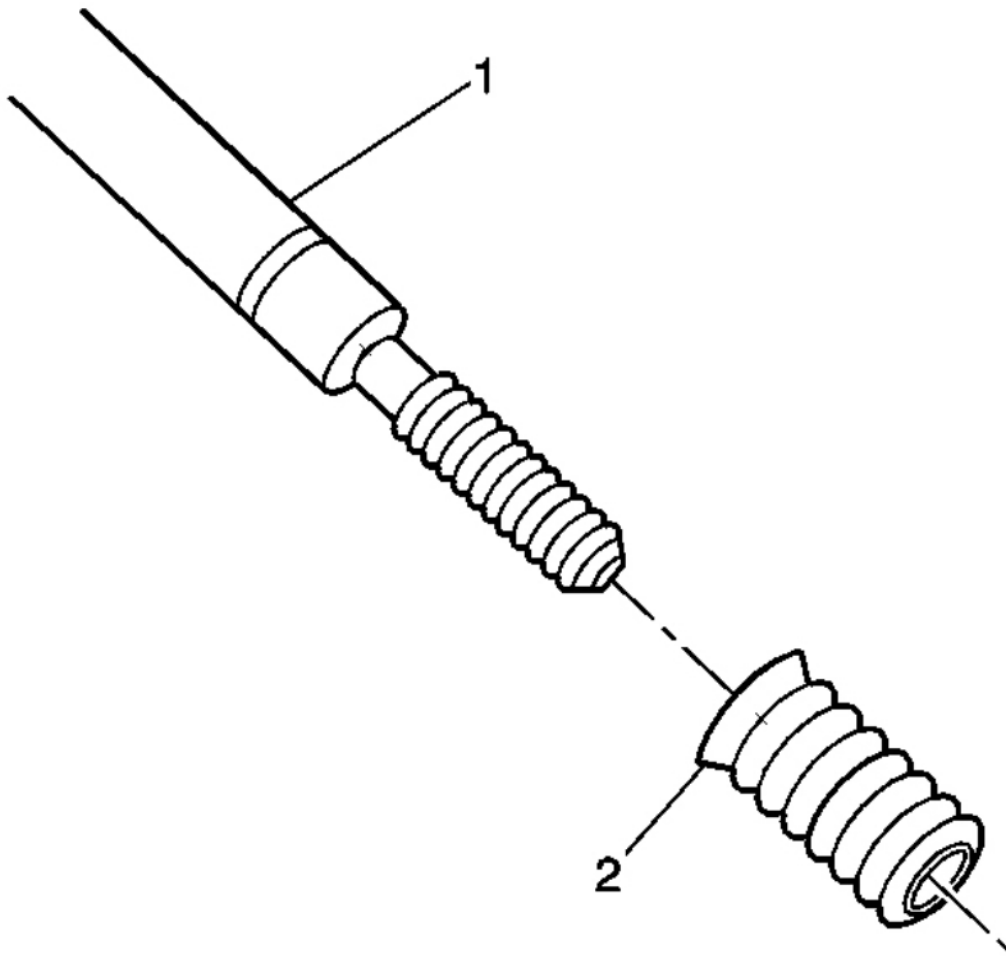


Fig. 105: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

14. Install the insert (2) onto the driver installation tool (1).

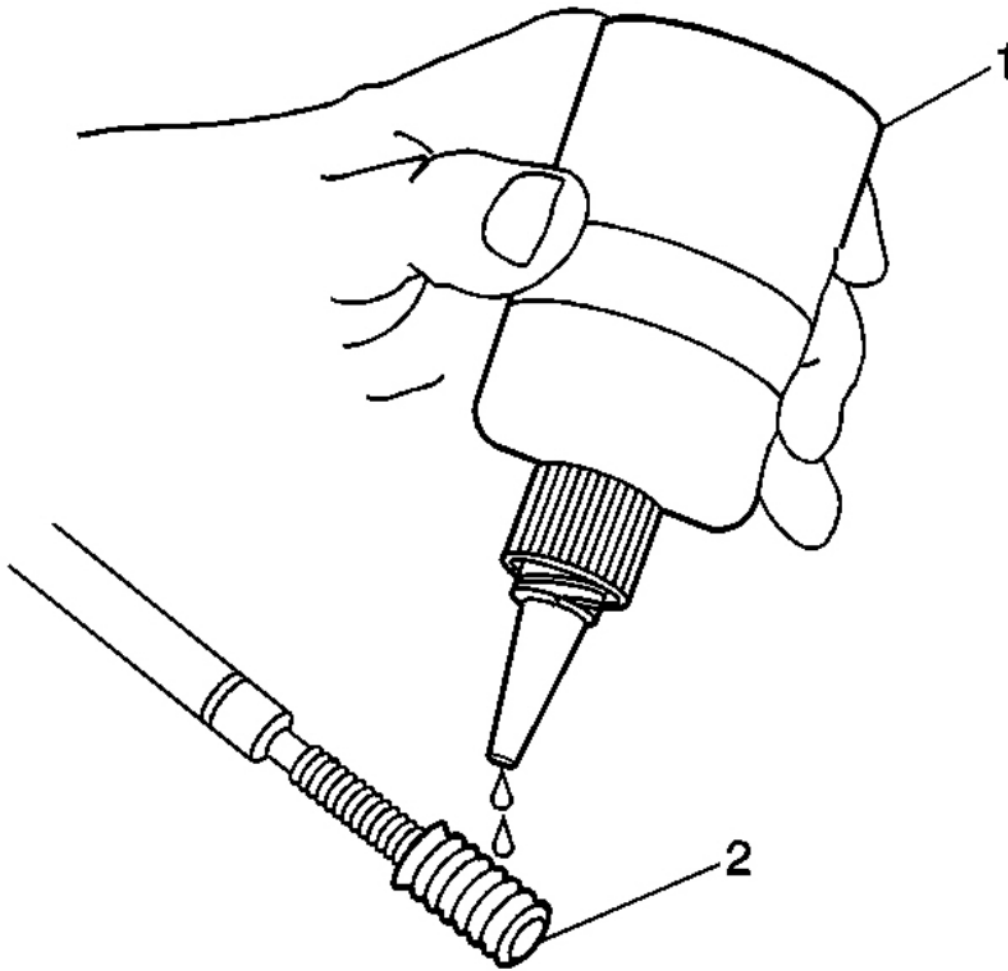


Fig. 106: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

15. Apply threadlock sealant GM P/N 12345493, (Canadian P/N 10953488), J 42385-109, LOCTITE 277®, or equivalent (1) to the insert OD threads (2).

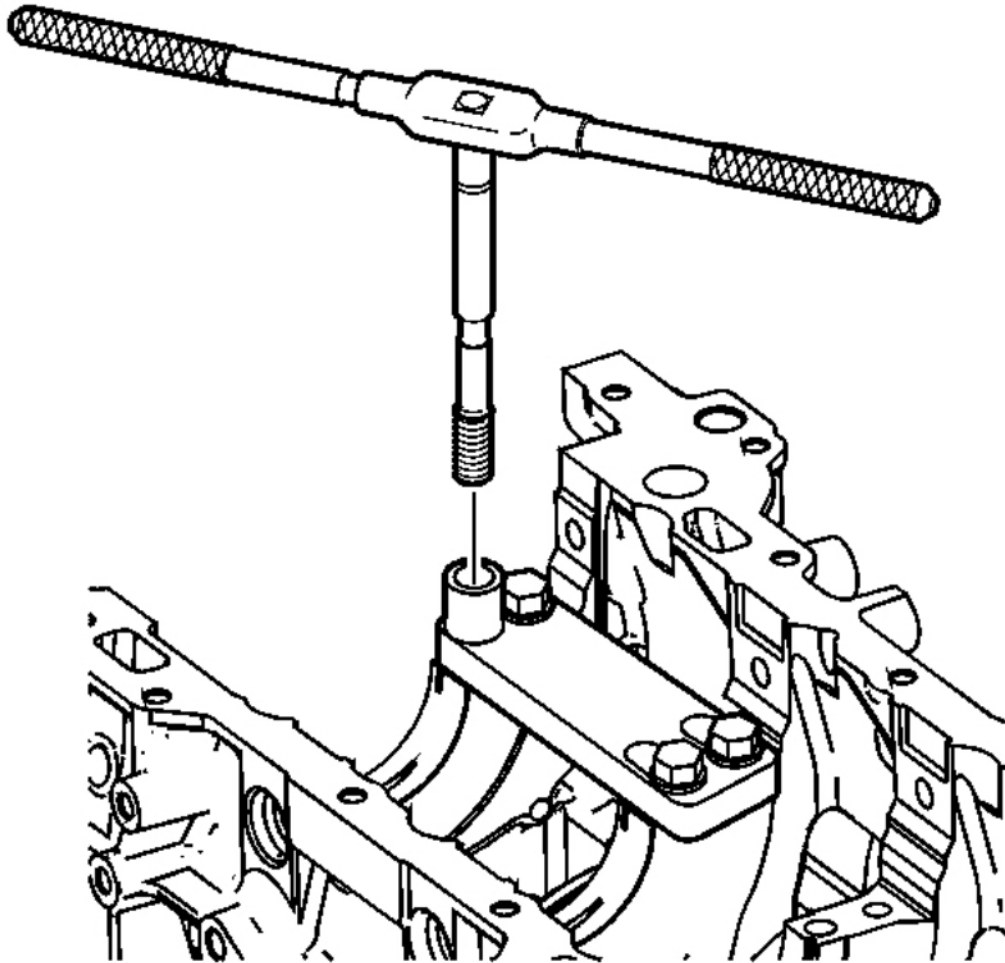


Fig. 107: Installing Insert & Installation Driver - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

16. Install the insert and installation driver into the tapped hole by hand only.
17. Start the insert into the threaded hole.

IMPORTANT: If the insert will not thread down until the flange contacts the counterbored surface remove the insert immediately with a screw extracting tool and inspect the tapped hole for any remaining chips and/or improper tapping.

18. Install the insert until the flange of the insert contacts the counterbored surface.

IMPORTANT: The driver installation tool will tighten up before screwing completely through the insert. This is acceptable. The threads at the bottom of the insert are being formed and the insert is mechanically locking the insert into the base material threads.

19. Continue to rotate the driver installation tool through the insert.

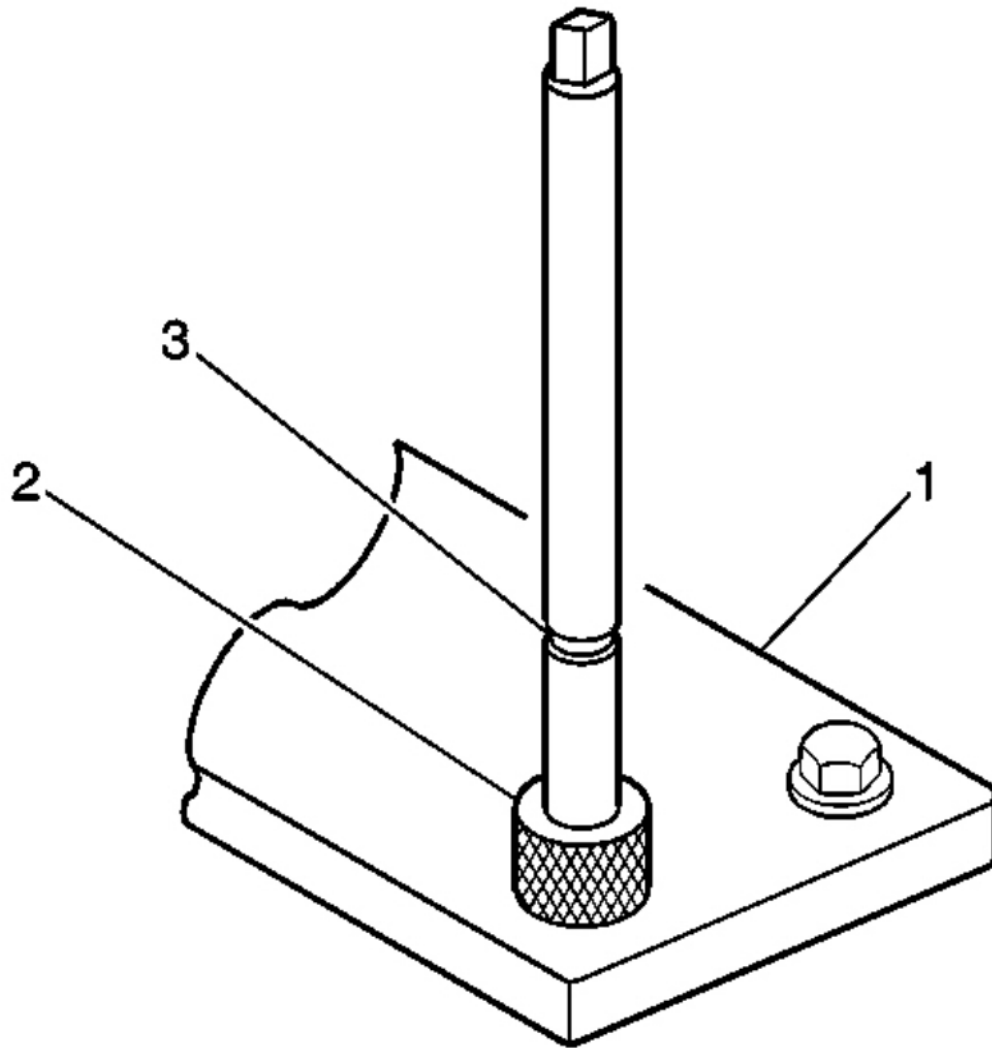


Fig. 108: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

20. Rotate the driver installation tool until the mark (3) on the driver installation tool aligns with the top of the drill bushing (2).
21. Inspect the insert for proper installation into the tapped hole.

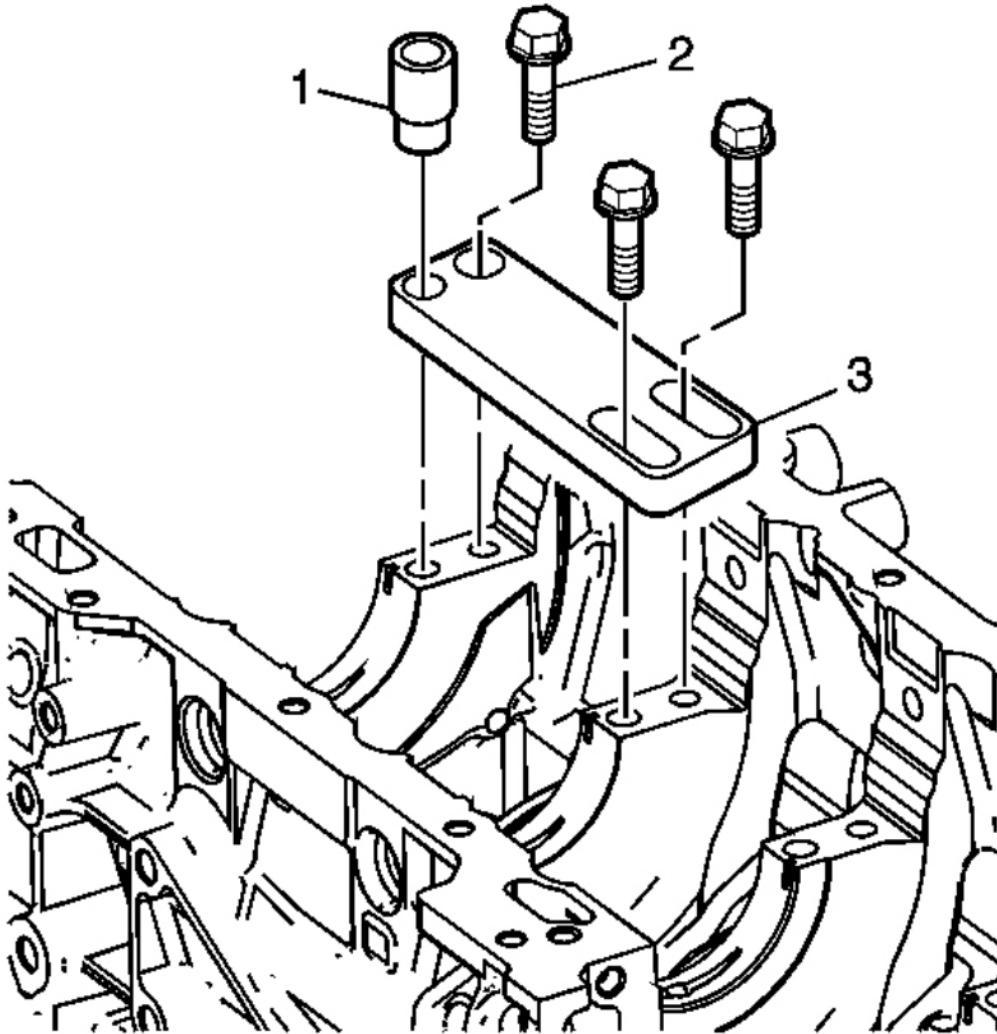


Fig. 109: View Of Fixture Plate & Components - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

22. Remove the fixture plate bolts (2).
23. Remove the fixture plate (3) and bushing (1).

SERVICE PRIOR TO ASSEMBLY

- Dirt will cause premature wear of the rebuilt engine. Clean all the components.

- Use the proper tools to measure the components when checking for excessive wear. Components not within the manufacturer's specification must be repaired or replaced.
- When the components are reinstalled into an engine, return the components to their original location, position, and direction.
- During assembly, lubricate all the moving parts with clean engine oil (unless otherwise specified). This will provide initial lubrication when the engine is first started.

ENGINE BLOCK ASSEMBLE

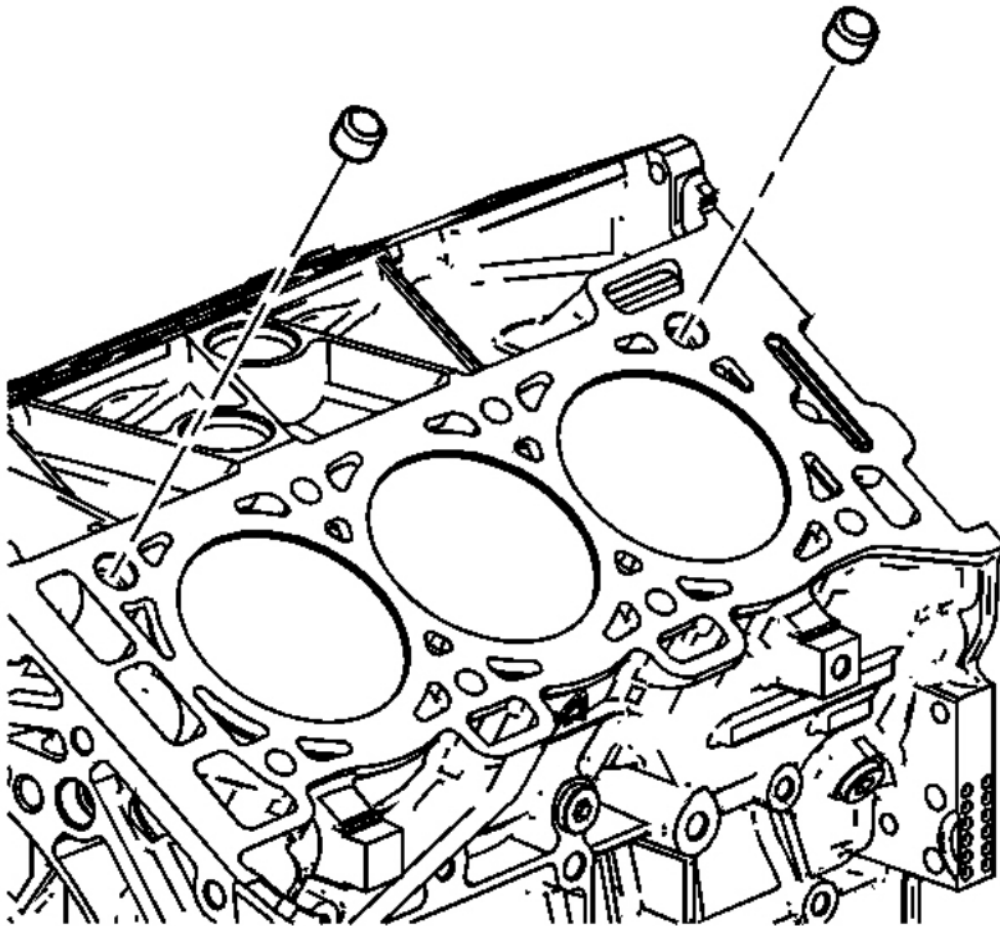


Fig. 110: View Of Cylinder Block-To-Cylinder Head Alignment Dowels
Courtesy of GENERAL MOTORS CORP.

1. Install the cylinder block-to-cylinder head alignment dowels.

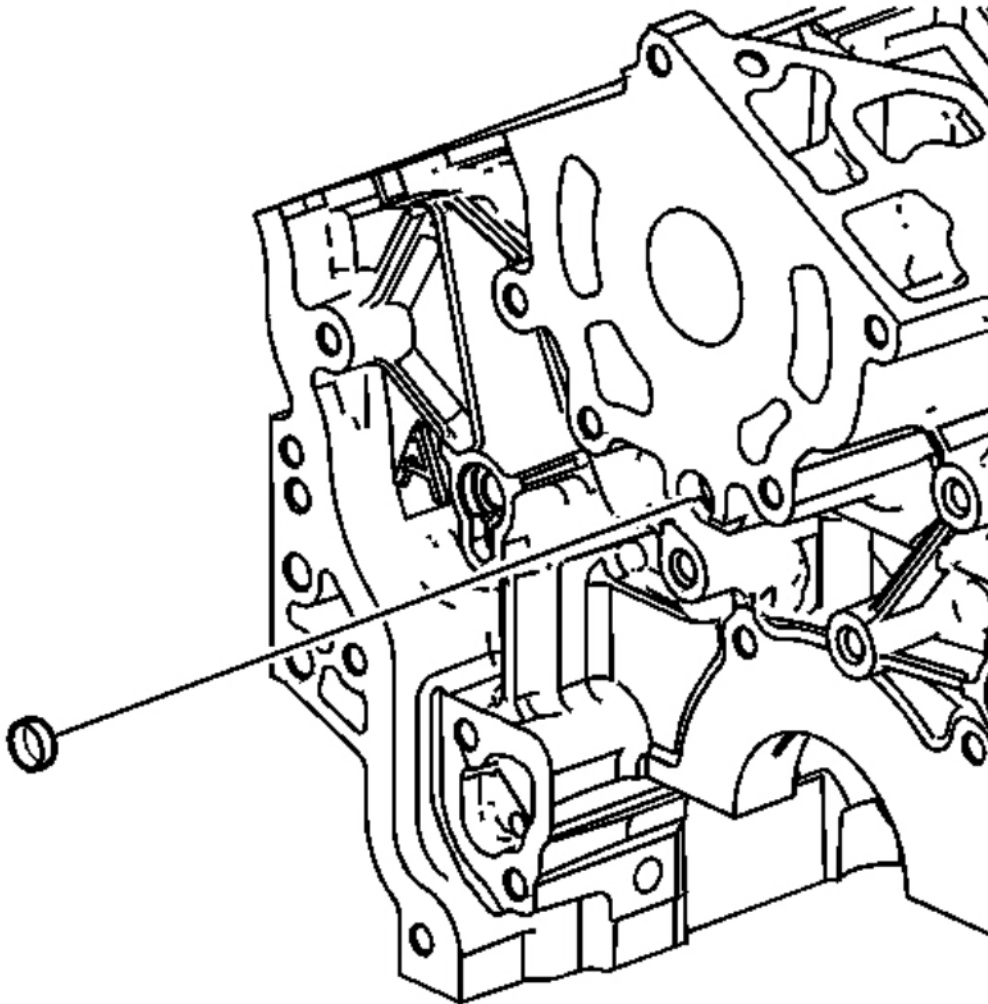


Fig. 111: View Of Front Oil Gallery Expansion Plug
Courtesy of GENERAL MOTORS CORP.

2. Install the NEW front oil gallery expansion plug.
3. Ensure the NEW front oil gallery expansion plug is installed to the proper depth.

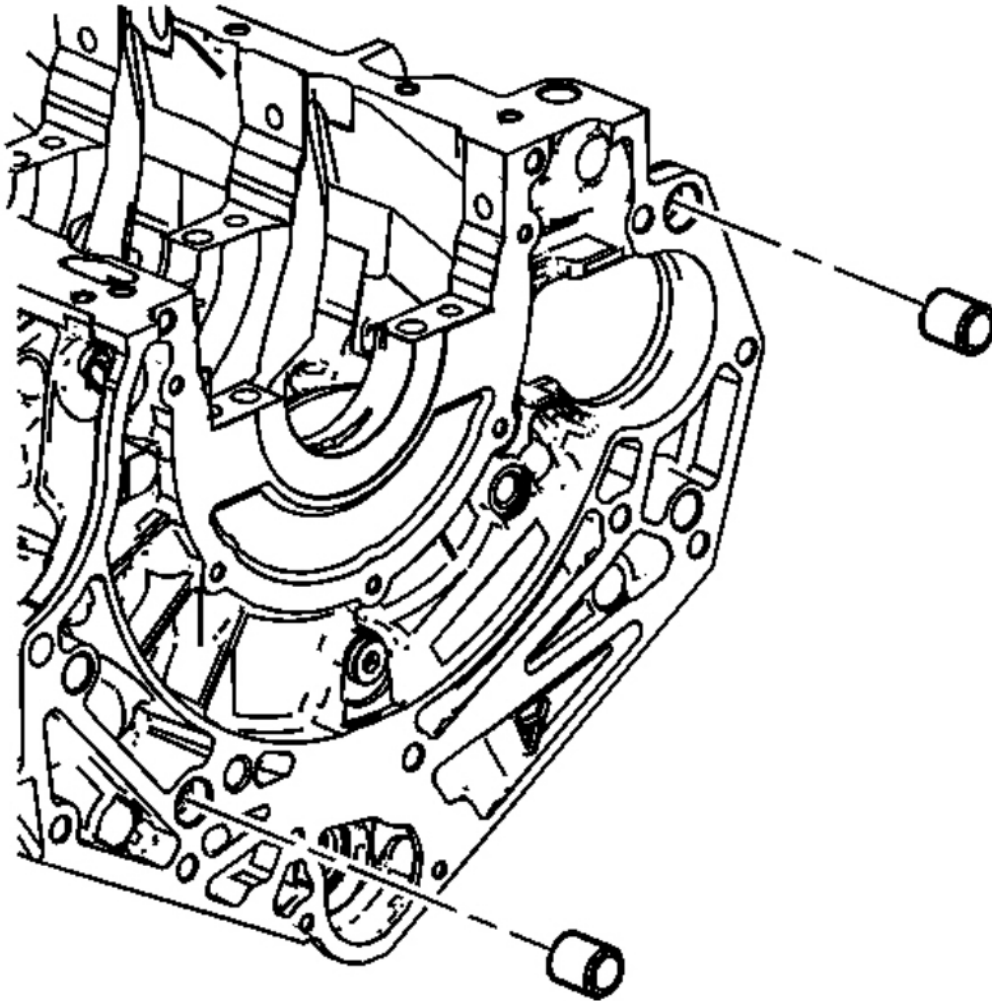


Fig. 112: View Of Cylinder Block-To-Transmission Alignment Dowels
Courtesy of GENERAL MOTORS CORP.

4. Install the cylinder block-to-transmission alignment dowels.

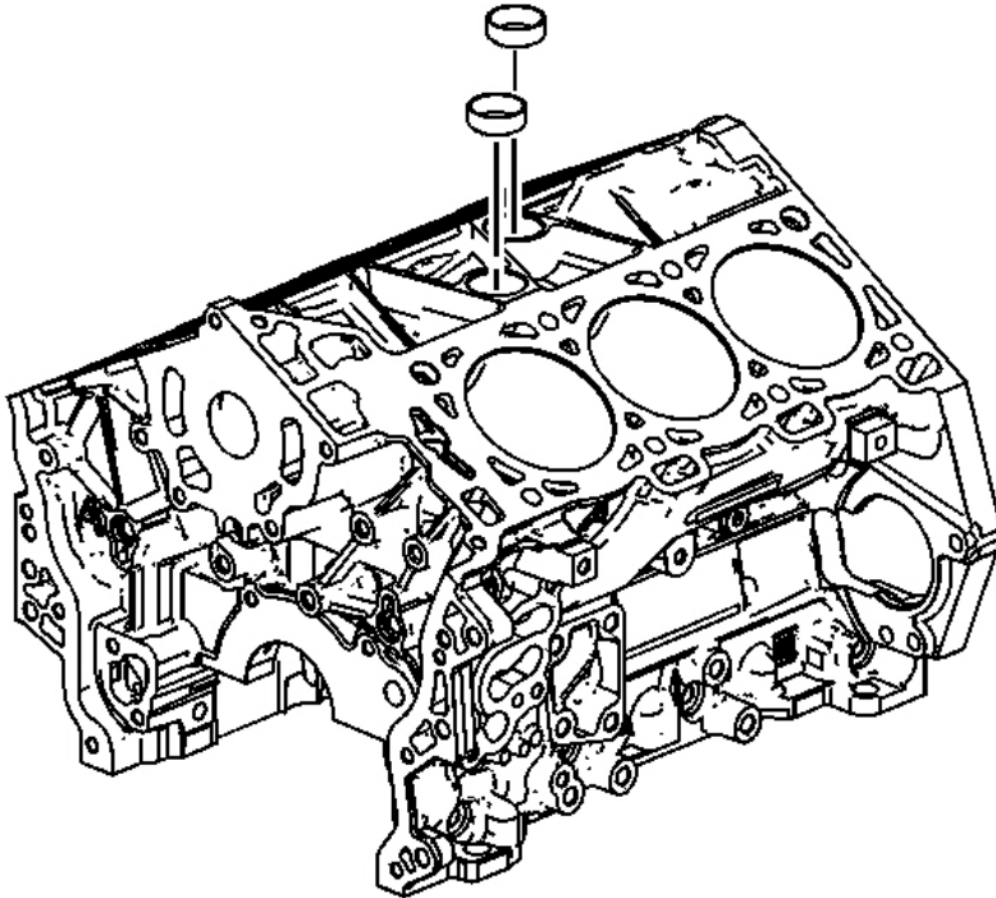


Fig. 113: View Of Coolant Expansion Plugs
Courtesy of GENERAL MOTORS CORP.

5. Apply the RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent on the NEW coolant expansion plugs.
6. Install the NEW coolant expansion plugs.
7. Ensure the NEW coolant expansion plugs are installed to the proper depth.

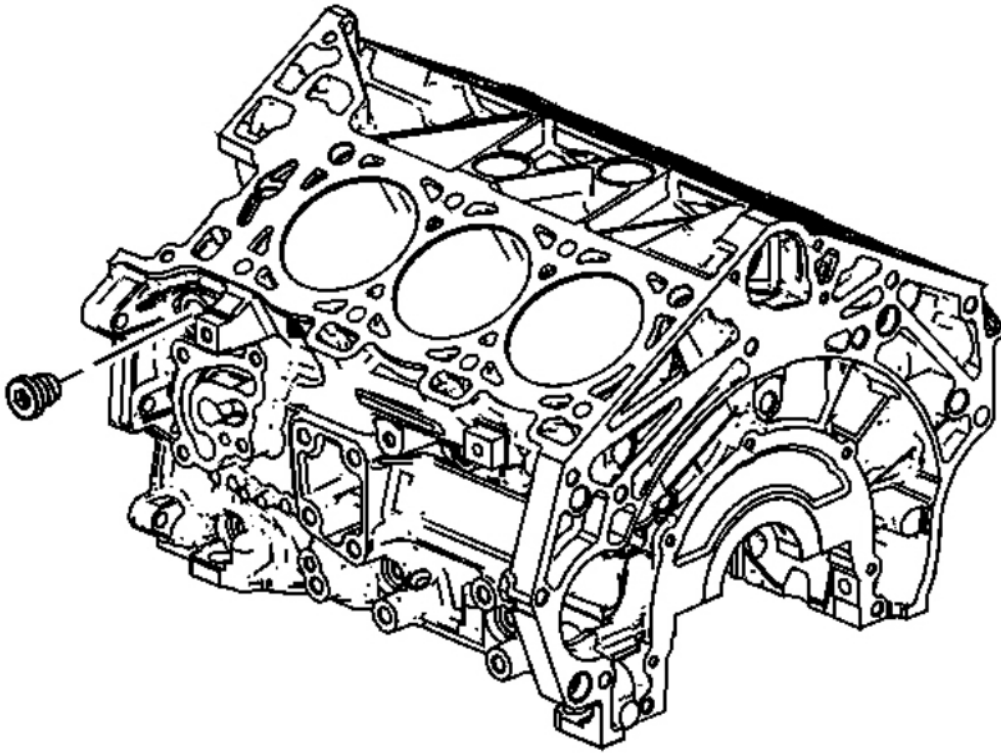


Fig. 114: View Of M20 Left Side Oil Gallery Threaded Plug
Courtesy of GENERAL MOTORS CORP.

8. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M20 left side oil gallery threaded plug.

NOTE: Refer to Fastener Notice in Cautions and Notices.

9. Install the M20 left side oil gallery threaded plug.

Tighten: Tighten the M20 left side oil gallery threaded plug to 31 N.m (23 lb ft).

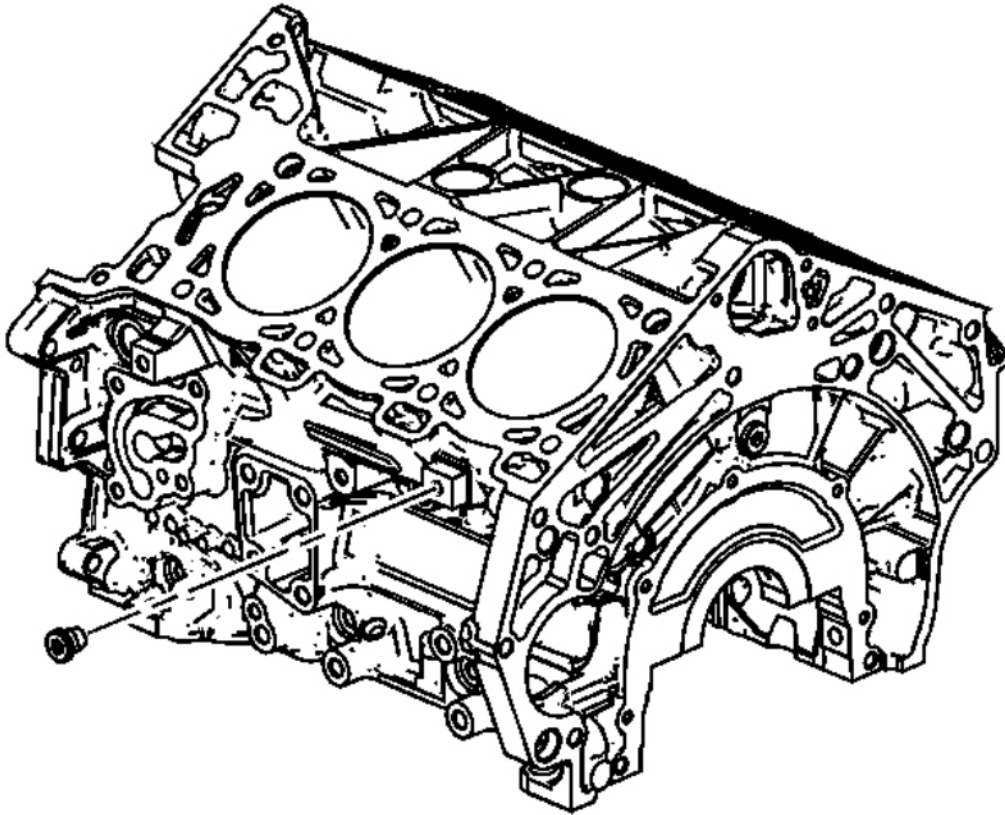


Fig. 115: View Of M14 Left Side Coolant Drain Threaded Plug
Courtesy of GENERAL MOTORS CORP.

10. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 left side coolant drain threaded plug.
11. Install the M14 left side coolant drain threaded plug.

Tighten: Tighten the M14 left side coolant drain threaded plug to 31 N.m (23 lb ft).

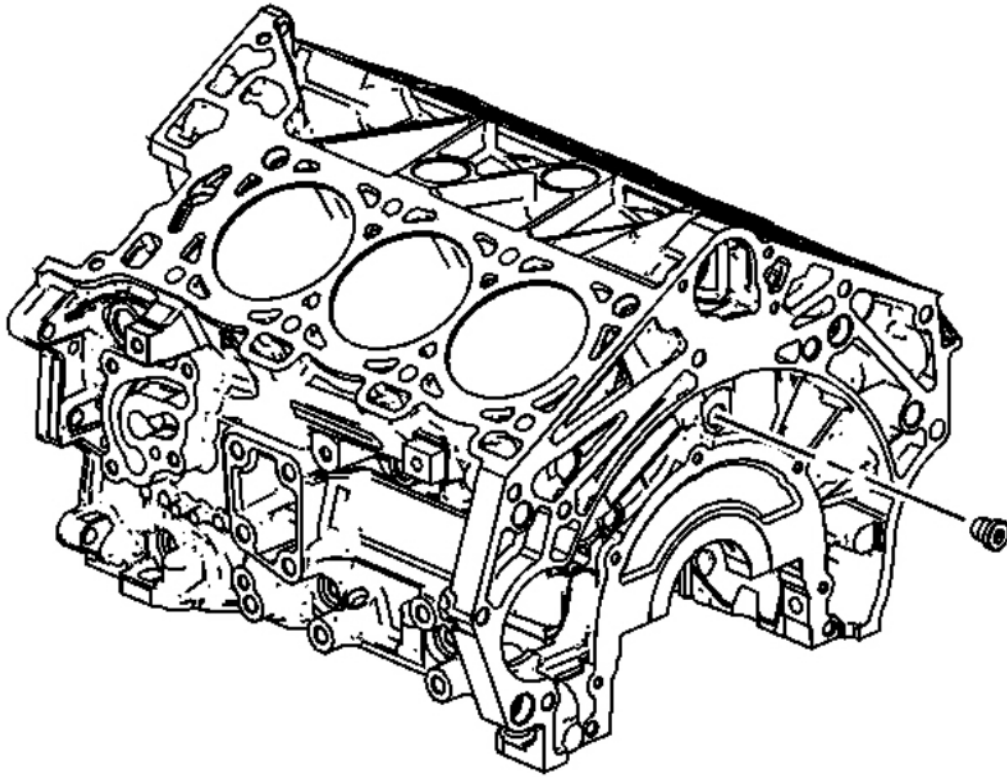


Fig. 116: View Of M14 Rear Oil Gallery Threaded Plug
Courtesy of GENERAL MOTORS CORP.

12. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 rear oil gallery threaded plug.
13. Install the M14 rear oil gallery threaded plug.

Tighten: Tighten the M14 rear oil gallery threaded plug to 31 N.m (23 lb ft).

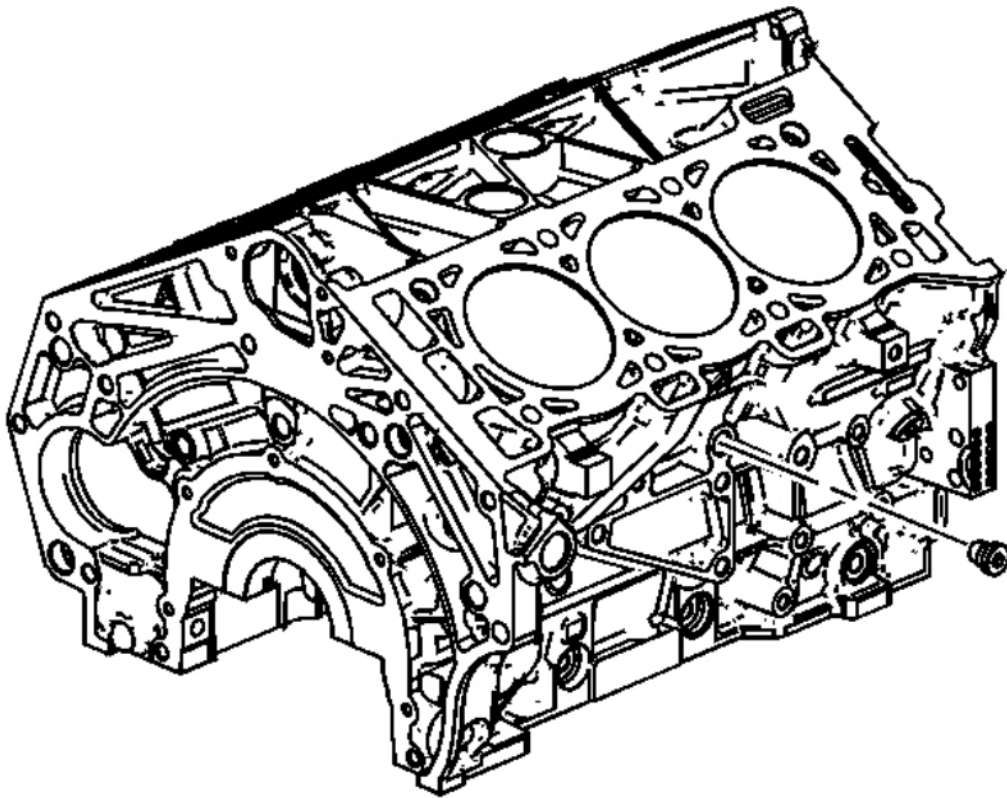


Fig. 117: View Of M14 Right Side Coolant Drain Threaded Plug
Courtesy of GENERAL MOTORS CORP.

14. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 right side coolant drain threaded plug.
15. Install the M14 right side coolant drain threaded plug.

Tighten: Tighten the M14 right side coolant drain threaded plug to 31 N.m (23 lb ft).

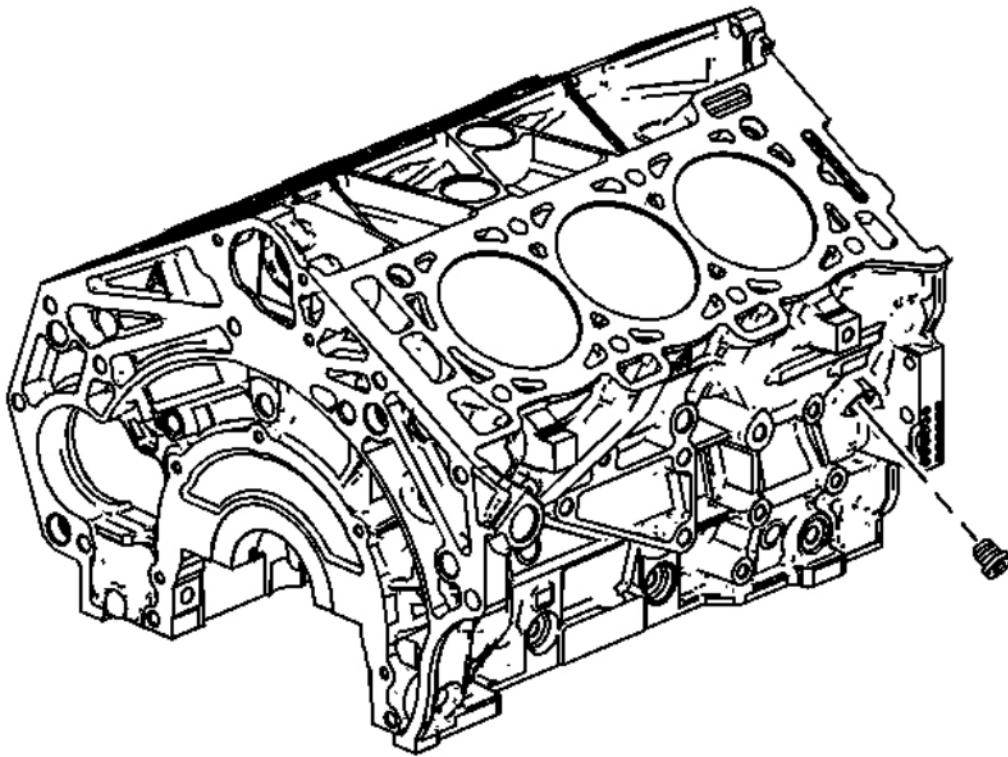


Fig. 118: View Of M14 Right Side Oil Gallery Threaded Plug
Courtesy of GENERAL MOTORS CORP.

16. Apply thread sealant GM P/N 12346004 (Canadian P/N 10953480) or equivalent on the threads of the M14 right side oil gallery threaded plug.
17. Install the M14 right side oil gallery threaded plug.

Tighten: Tighten the M14 right side oil gallery threaded plug to 31 N.m (23 lb ft).

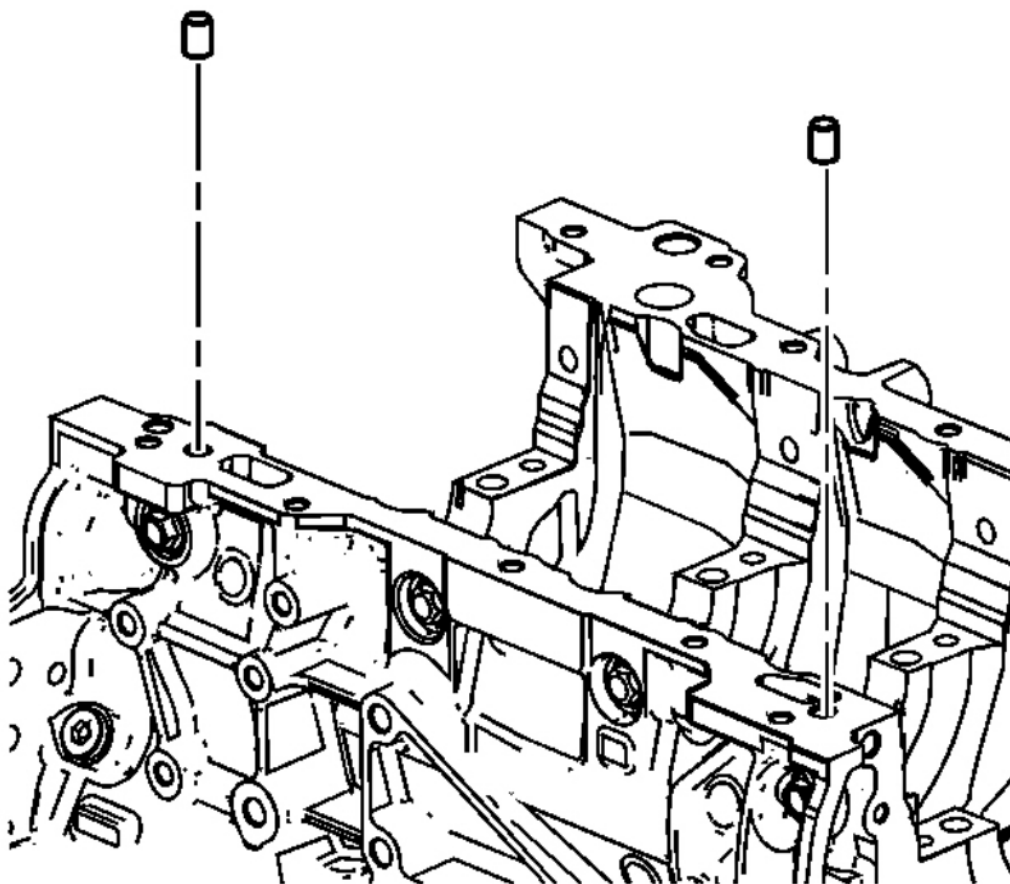


Fig. 119: View Of Cylinder Block-To-Oil Pan Alignment Dowels
Courtesy of GENERAL MOTORS CORP.

18. Install the cylinder block-to-oil pan alignment dowels.

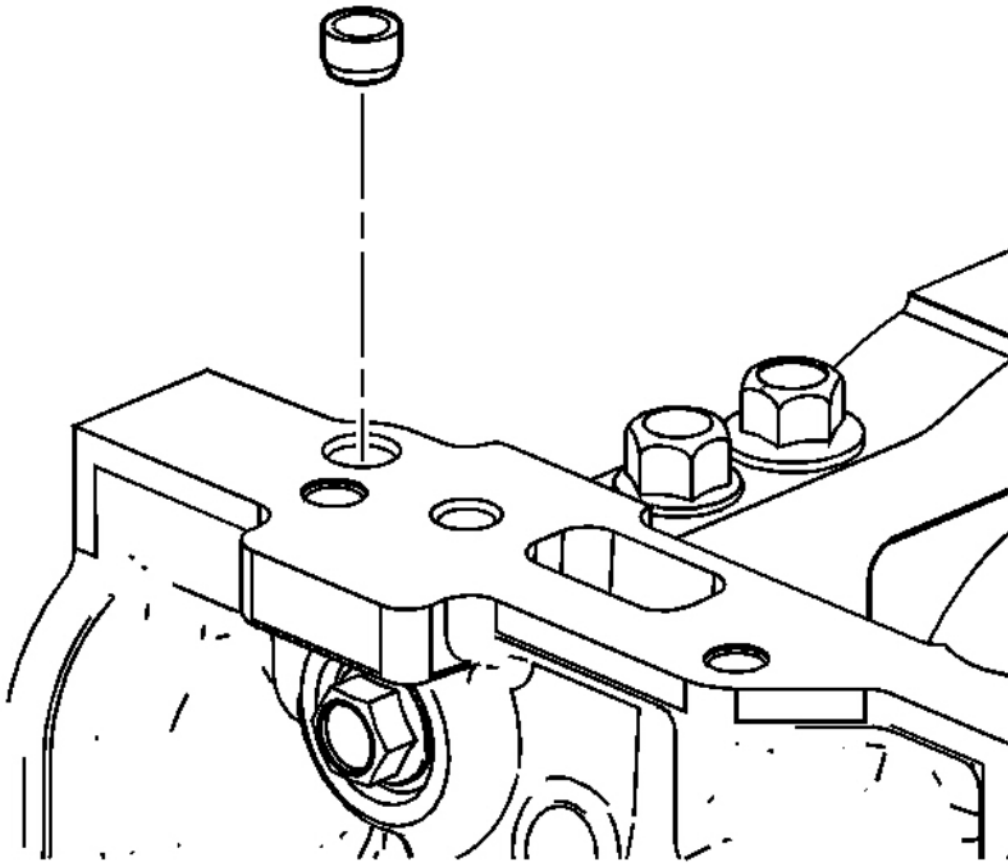


Fig. 120: View Of Right Front Oil Pan Rail Oil Gallery Expansion Plug
Courtesy of GENERAL MOTORS CORP.

19. Install the NEW right front oil pan rail oil gallery expansion plug.
20. Ensure the NEW right front oil pan rail oil gallery expansion plug is installed to the proper depth.

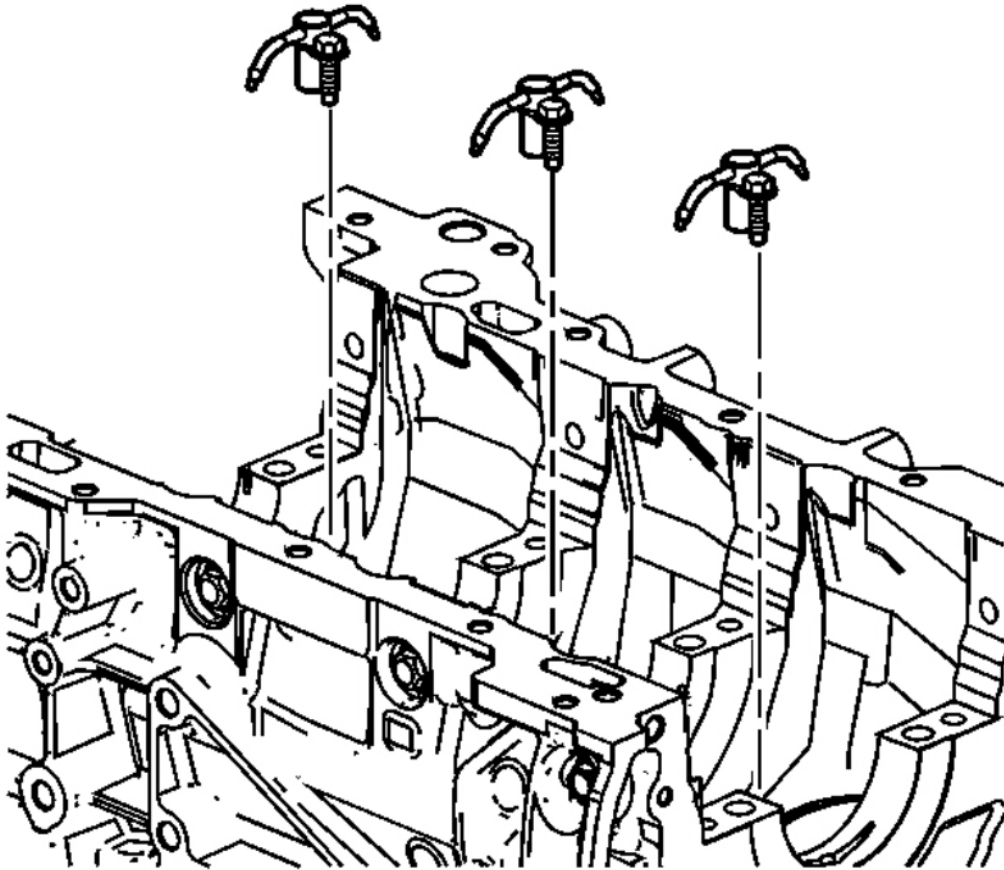


Fig. 121: View Of Oil Jets
Courtesy of GENERAL MOTORS CORP.

21. Install the oil jets.
22. Install the oil jet bolts.

Tighten: Tighten the oil jet bolts to 10 N.m (89 lb in).

CRANKSHAFT AND BEARINGS INSTALLATION

Crankshaft Bearing Installation Procedure

IMPORTANT: If the crankshaft bearings have been used in a running engine, you must replace them with **NEW** crankshaft

bearings for reassembly.

1. Clean the crankcase crank bore with a lint-free cloth.
2. Clean all the oil from the backside of new bearing halves.

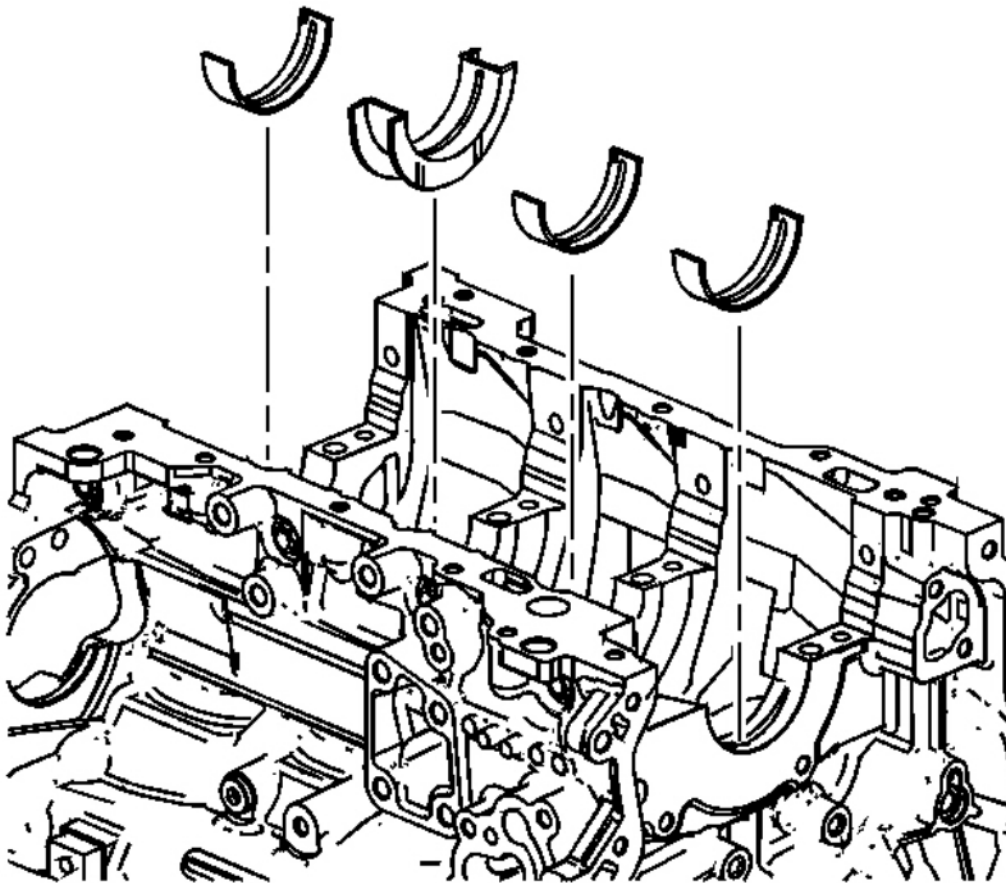


Fig. 122: View Of Upper Crankshaft Bearings
Courtesy of GENERAL MOTORS CORP.

3. Install the new upper crankshaft bearings into position. The thrust bearing belongs in the number 3 journal. Ensure that the upper bearing insert contains the oil transfer hole and groove. Roll the bearing into position so that the lock tang engages the crank slot. The bearing must fit flush with the upper crankcase.

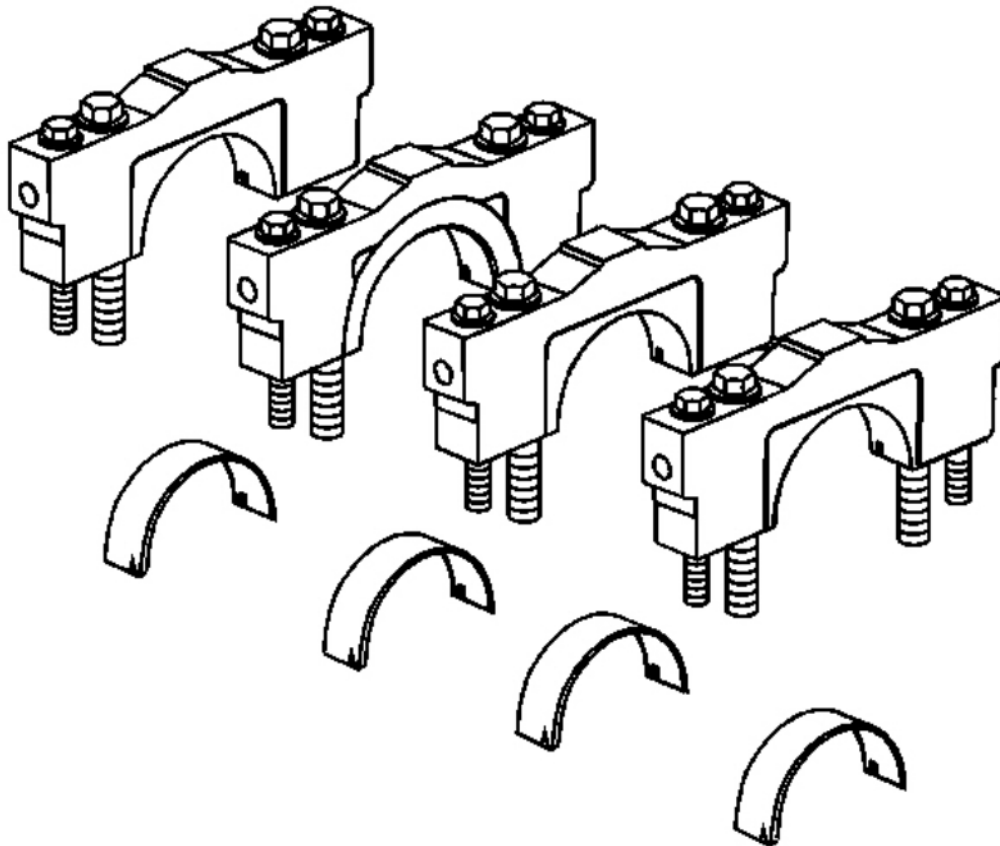


Fig. 123: View Of Lower Crankshaft Bearings & Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

4. Install the new lower crankshaft bearings into position in the main bearing caps. The lower crankshaft bearings are identified by NO grooves or holes. The bearings must fit flush with the crankshaft bearing caps.

Crankshaft Installation Procedure

NOTE: The crankshaft sprocket drive pin must be set to the proper depth. Installing the crankshaft sprocket drive pin too deep can lead to damage to the crankshaft sprocket and extensive engine damage.

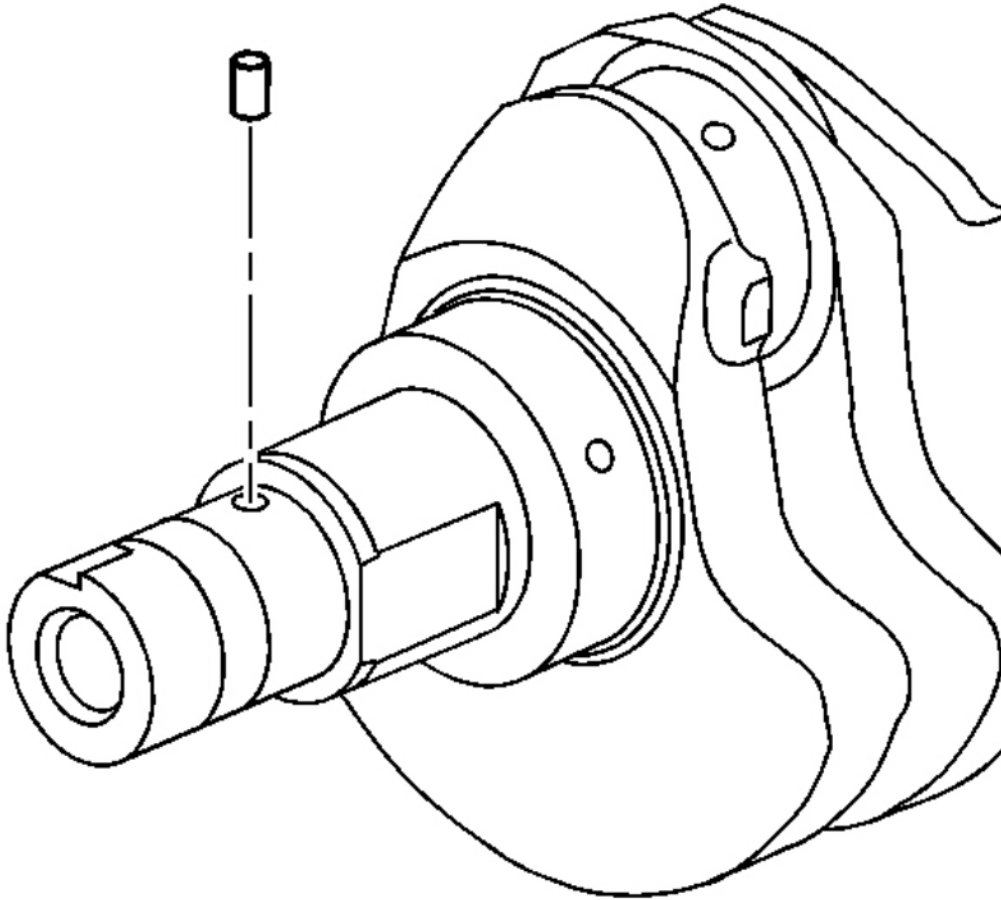


Fig. 124: View Of Crankshaft Sprocket Drive Pin
Courtesy of GENERAL MOTORS CORP.

1. If removed, install the crankshaft sprocket drive pin. Lightly tap the pin in place with a small soft face, bronze/plastic, hammer until it bottoms in the hole.

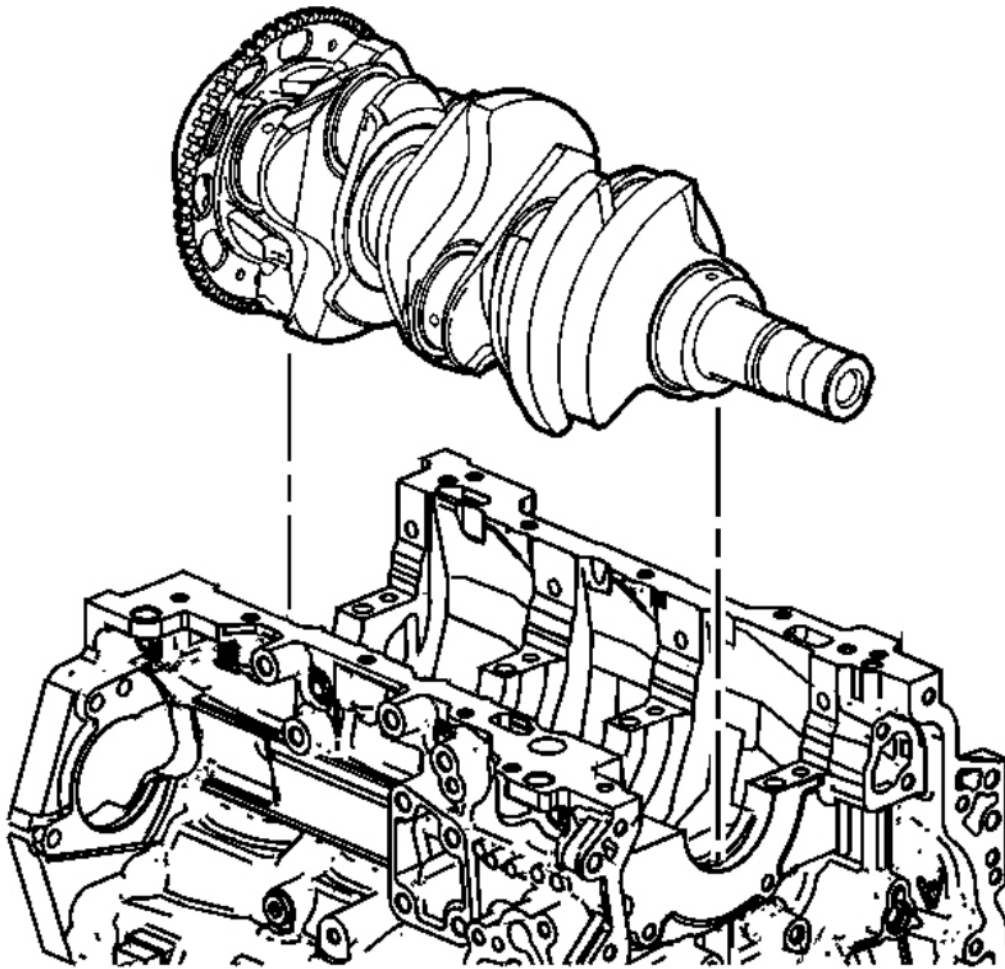


Fig. 125: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

2. Gently lower the crankshaft into position in the cylinder block.

Crankshaft Bearing Clearance Measurement Procedure

Tools Required

- J 6125-1B Slide Hammer Adapter
- J 41818 Crankshaft Bearing Cap Remover

- **J 45059** Angle Meter

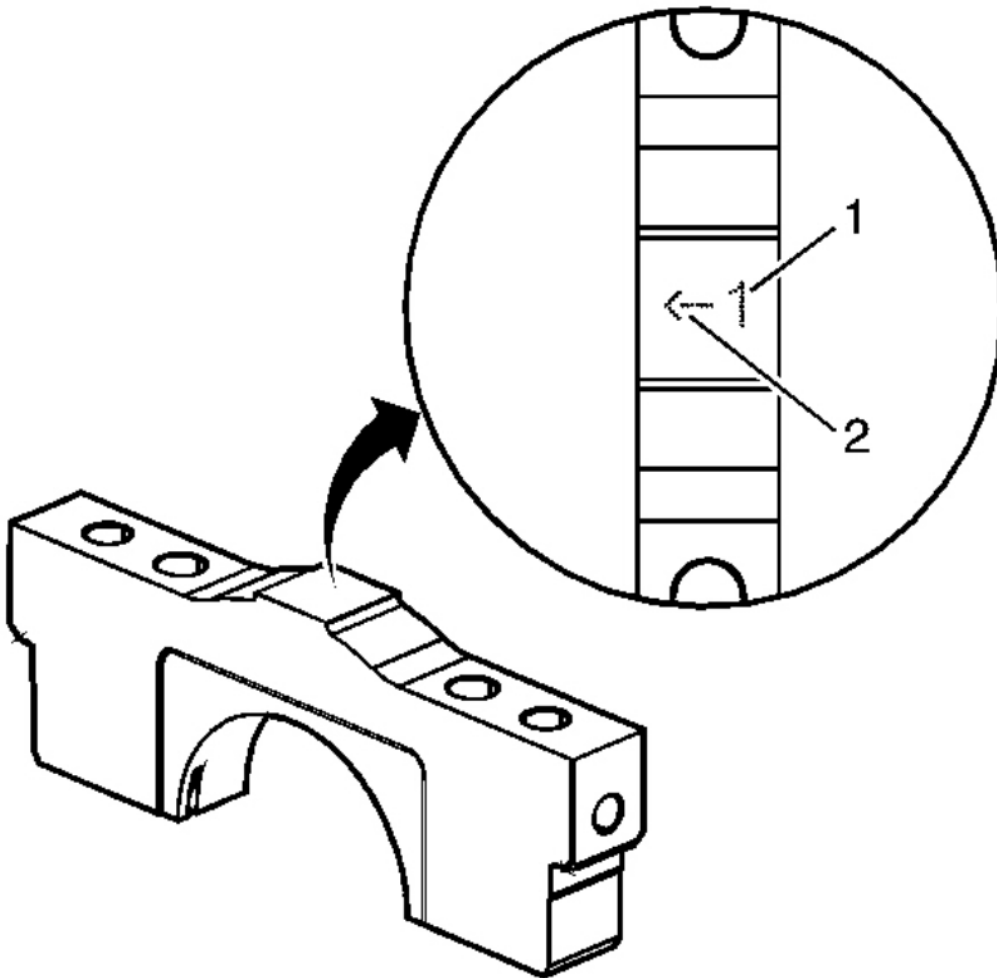


Fig. 126: View Of Main Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

1. Place a length of fresh, room temperature plastic gaging material all the way across all the crankshaft bearing journals.
2. Identify the proper order of the main bearing caps. The main bearing caps are numbered 1 (1) through 4, with the front main bearing cap marked with the number 1. The arrow (2) is to be oriented to the front of the engine.

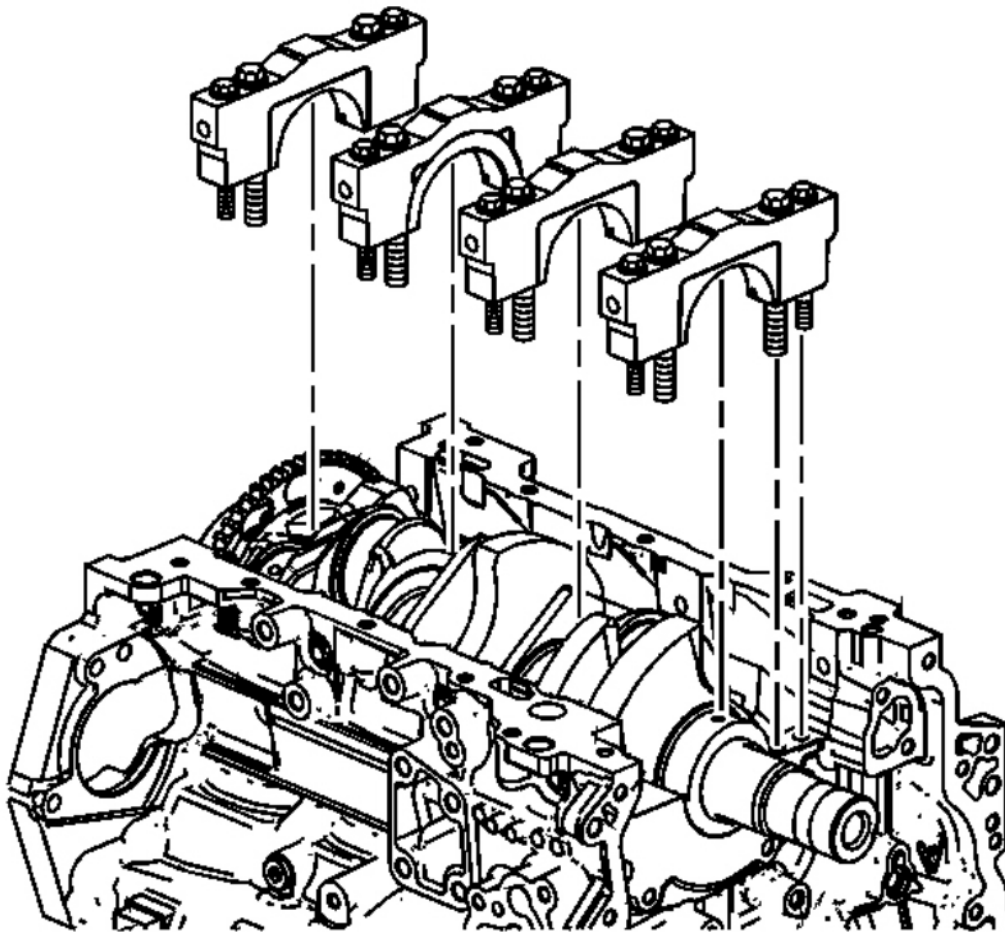


Fig. 127: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft main bearing caps.
4. Loosely install the original inner main cap bolts.
5. Loosely install the original outer main cap bolts.

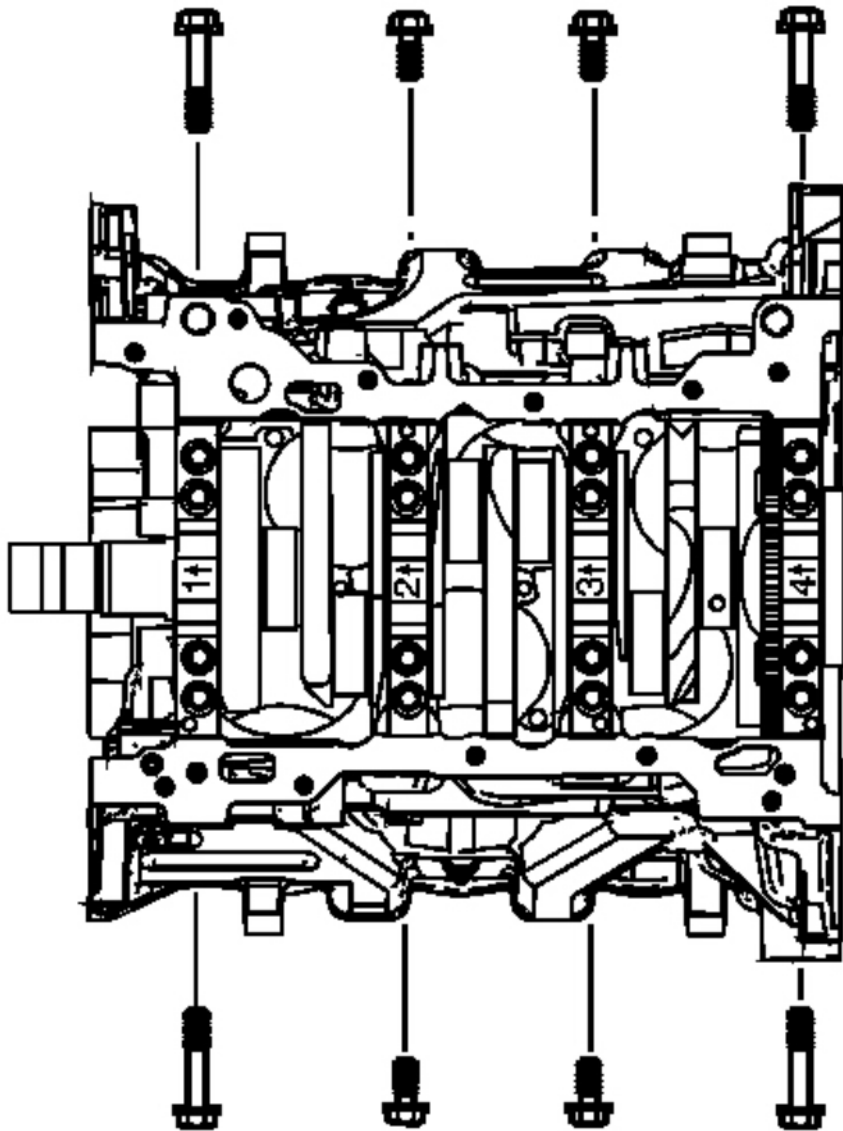


Fig. 128: Identifying Crankshaft Main Bearing Cap Side Bolts
Courtesy of GENERAL MOTORS CORP.

6. Loosely install the original short/inner side main cap bolts.
7. Loosely install the original long/outer side main cap bolts.

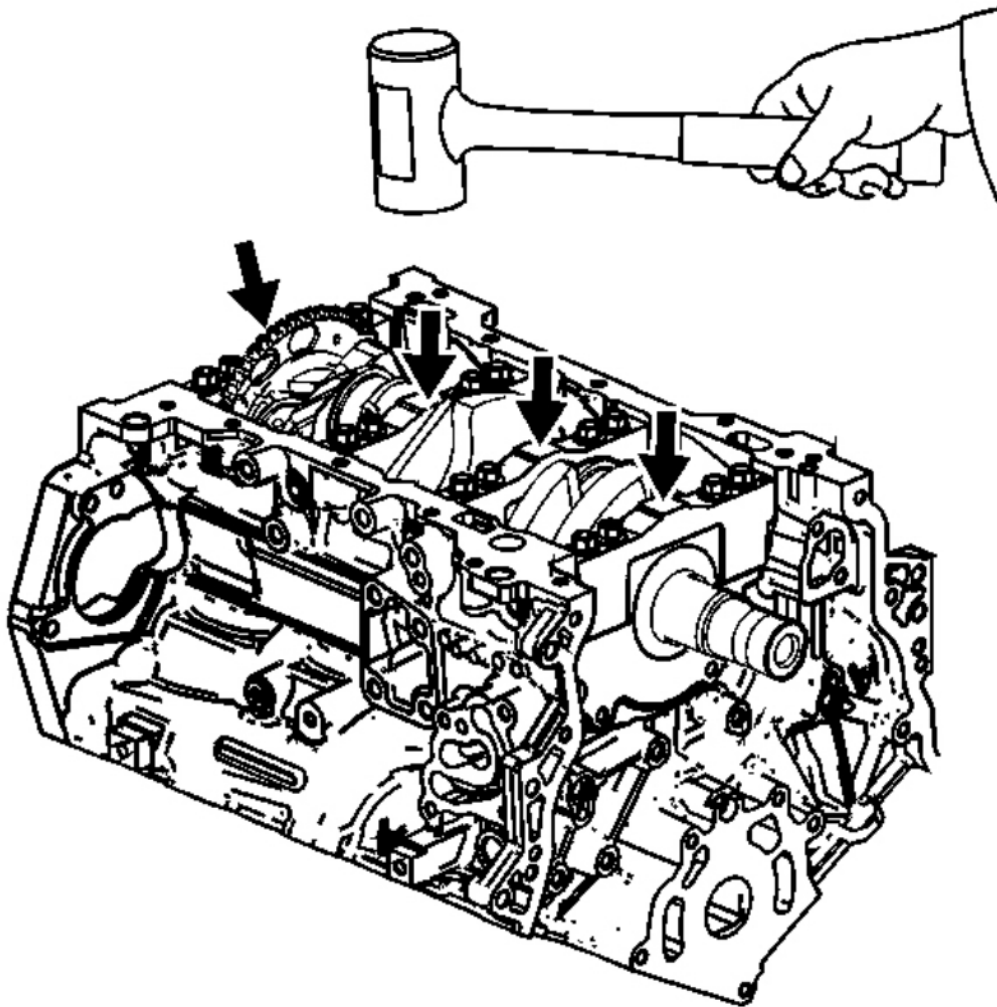


Fig. 129: Tapping Crankshaft Main Bearing Caps With A Soft-Faced Hammer
Courtesy of GENERAL MOTORS CORP.

8. Tap the crankshaft main bearing caps with a soft-faced hammer.
9. Tighten the main caps bolts using the **J 45059** in the following sequence:

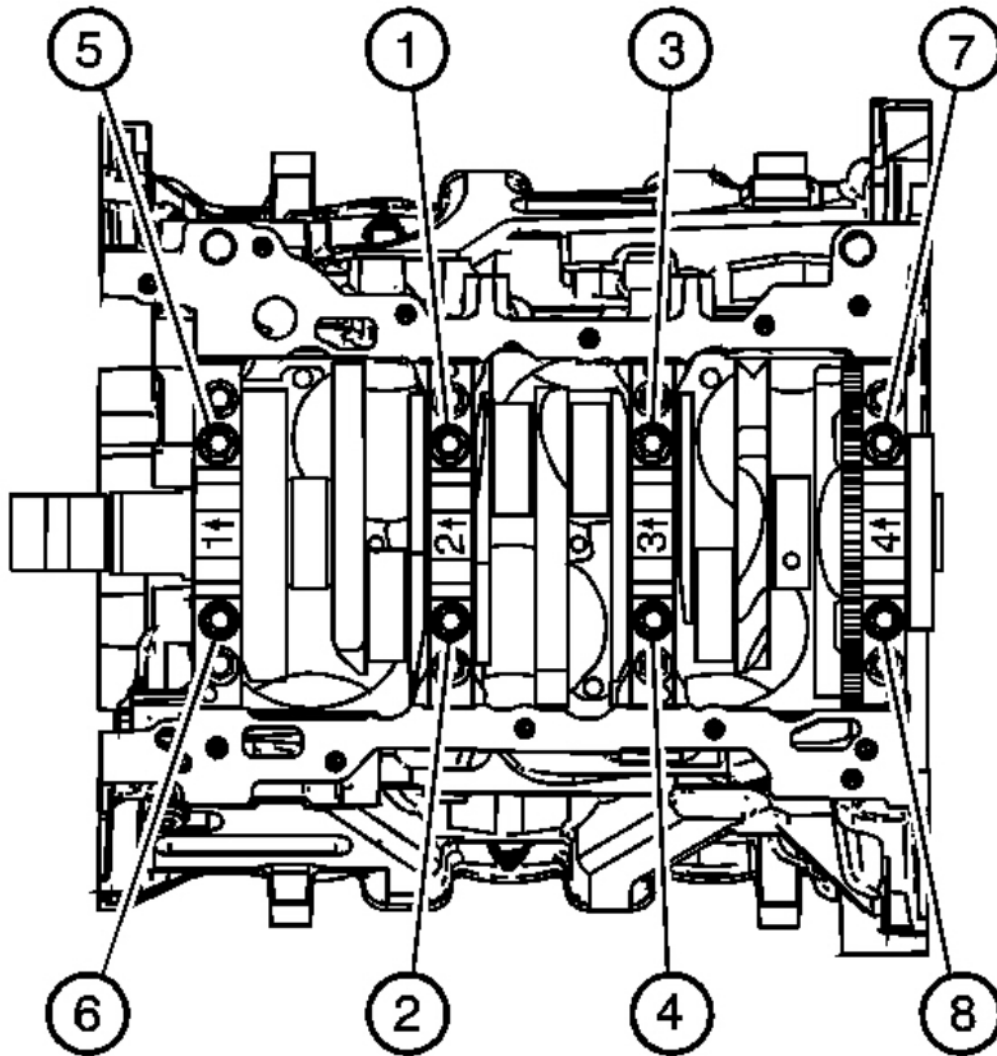


Fig. 130: Tightening Inboard Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

Tighten the inboard bolts (1-8).

Tighten: Tighten the inboard bolts (1-8) to 20 N.m (15 lb ft) plus 80 degrees.

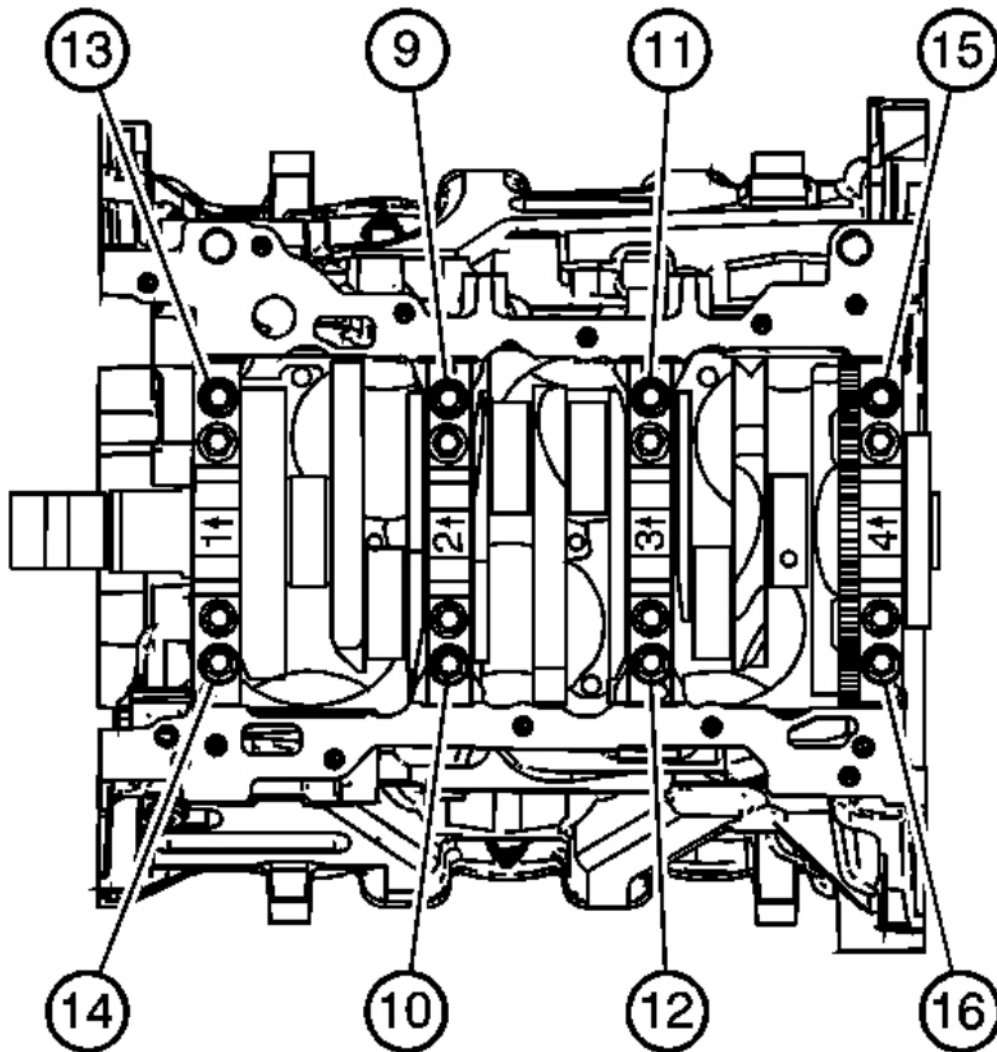


Fig. 131: Tightening Outboard Bolts
Courtesy of GENERAL MOTORS CORP.

10. Tighten the outboard bolts (9-16).

Tighten: Tighten the outboard bolts (9-16) to 15 N.m (11 lb ft) plus 110 degrees.

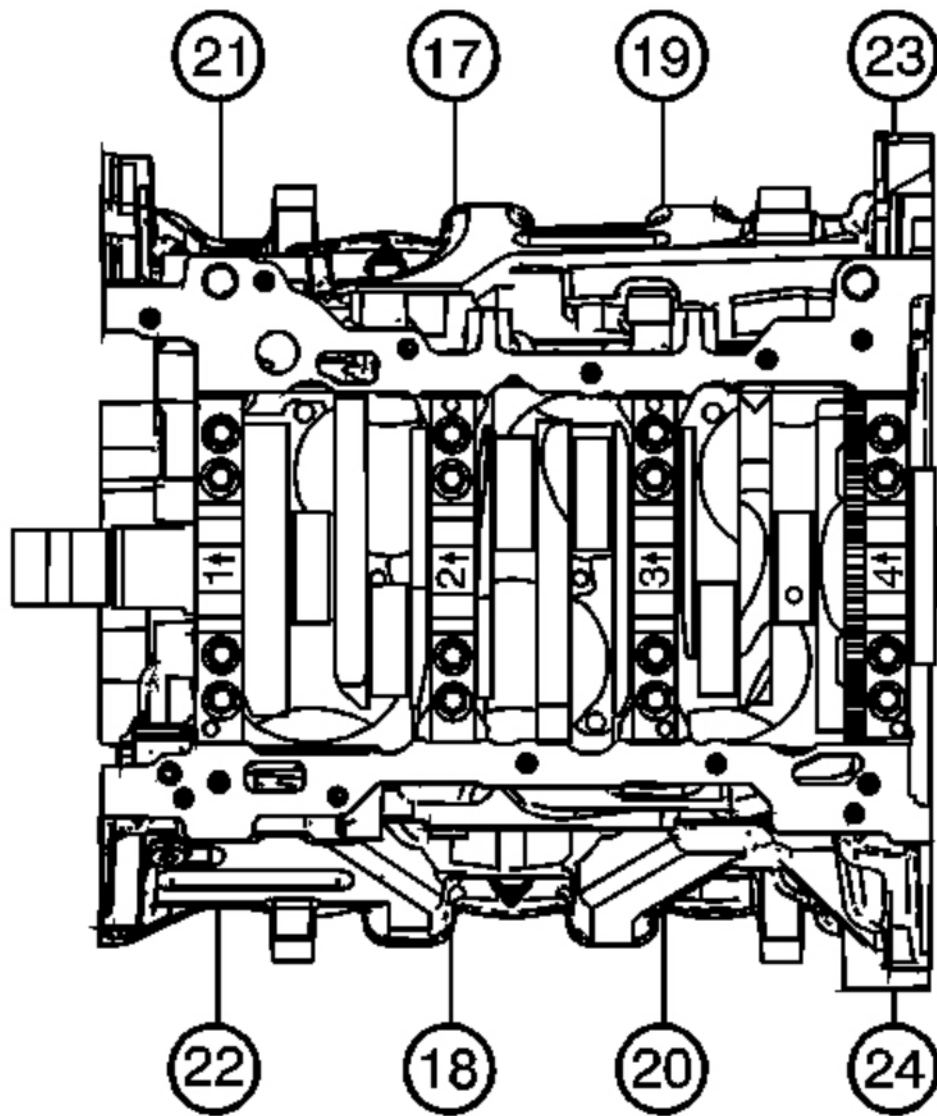


Fig. 132: Tightening Short/Inner & Long/Outer Bolts
Courtesy of GENERAL MOTORS CORP.

11. Tighten the short/inner bolts (17-20).

Tighten: Tighten the short/inner bolts (17-20) to 30 N.m (22 lb ft) plus 60 degrees.

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2004 ENGINE Engine Mechanical - 3.6L (LY7) (Repair Instructions, 4 Of 5) - SRX

12. Tighten the long/outer bolts (21-24).

Tighten: Tighten the long/outer bolts (21-24) to 30 N.m (22 lb ft) plus 60 degrees.

IMPORTANT: Do not rotate the crankshaft.

13. After reaching final torque, allow the assembly to sit for 2 minutes.

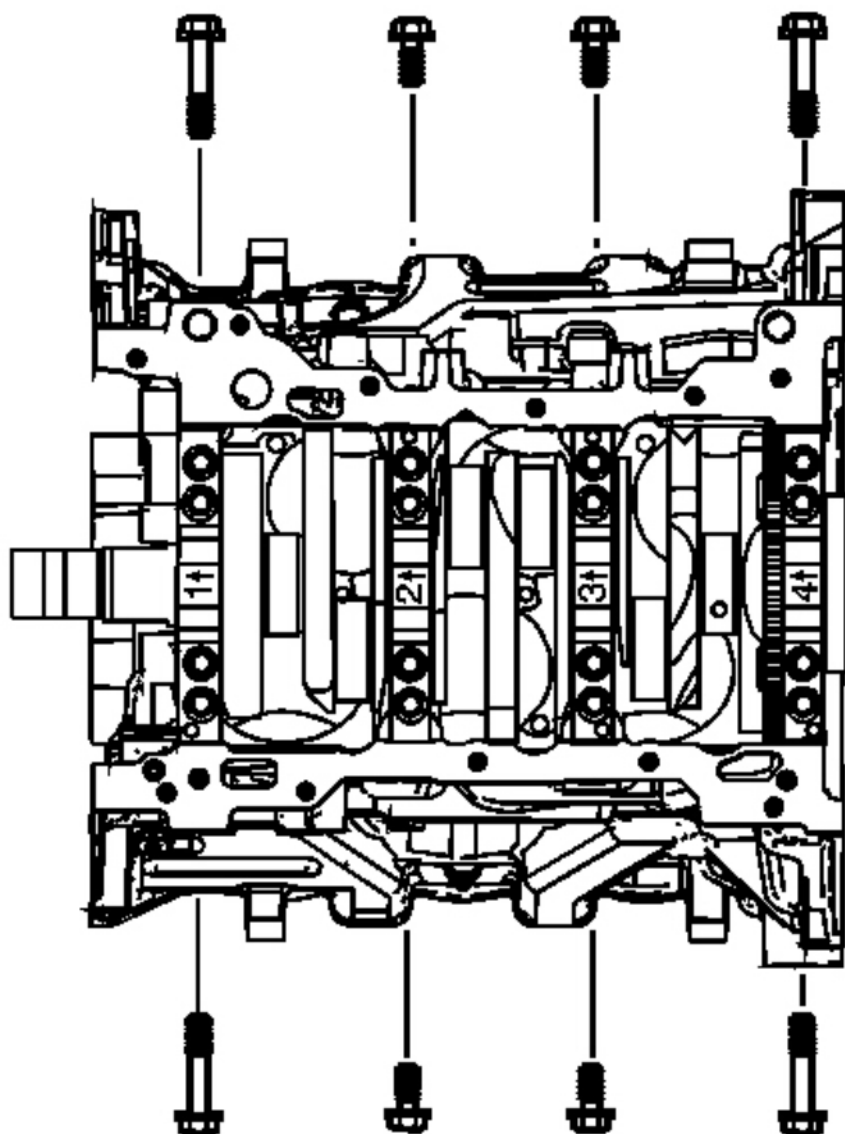


Fig. 133: Identifying Crankshaft Main Bearing Cap Side Bolts
Courtesy of GENERAL MOTORS CORP.

14. Remove the crankshaft bearing cap side bolts.

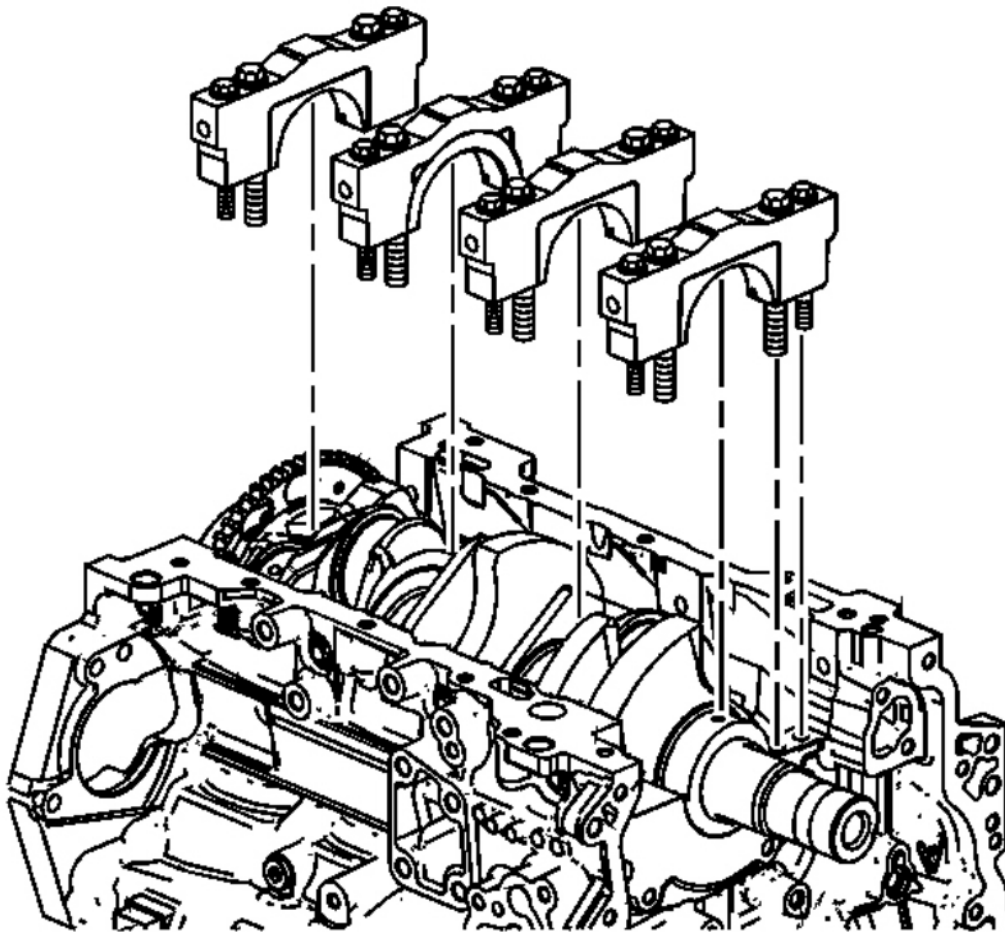


Fig. 134: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

15. Remove the crankshaft bearing cap outer bolts.
16. Remove the crankshaft bearing cap inner bolts.
17. Remove the crankshaft bearing caps using the **J 6125-1B** and **J 41818** .

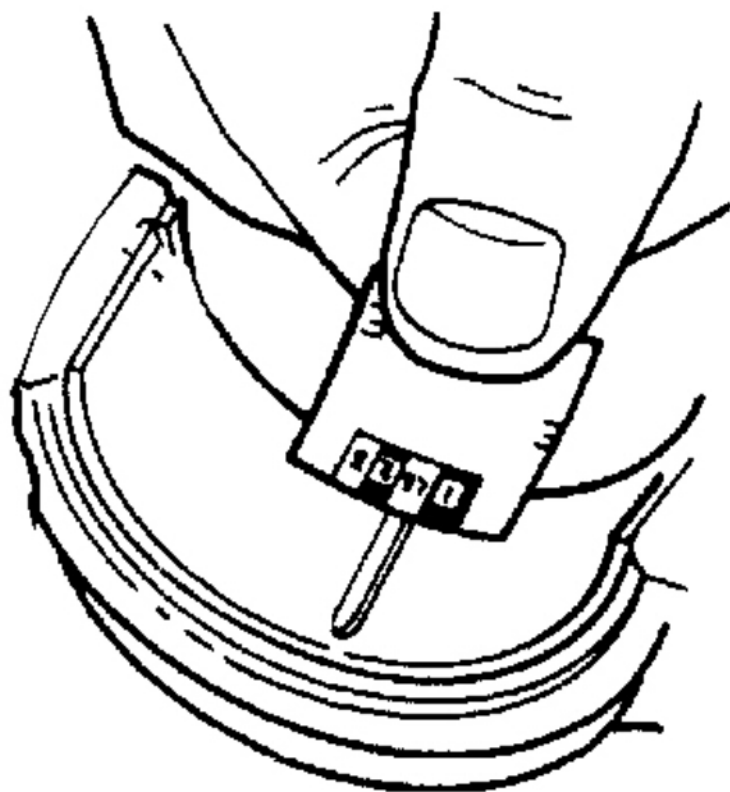


Fig. 135: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

18. Determine the crankshaft bearing clearance by comparing the width of the flattened plastic gaging material at its widest point with the graduation on the gaging material container.

IMPORTANT: The crankshaft bearings CAN be reused after checking the clearance if the bearings have never been used in a running engine.

19. Compare your measurements with the **Engine Mechanical Specifications** . If the new bearings do not provide the proper crankshaft to bearing clearance, inspect the following:
 1. Re-measure the crankshaft journals for the correct specified size and ensure the proper new bearings are being installed. If the crankshaft journals are incorrectly sized,

replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

2. Re-measure the engine block crankshaft bearing bore diameter to ensure proper size. The engine block crankshaft bearing bore is not machinable and the block must be replaced if out of specification.
20. Clean the plastic gaging material from the crankshaft bearing journals with a soft, lint-free cloth.

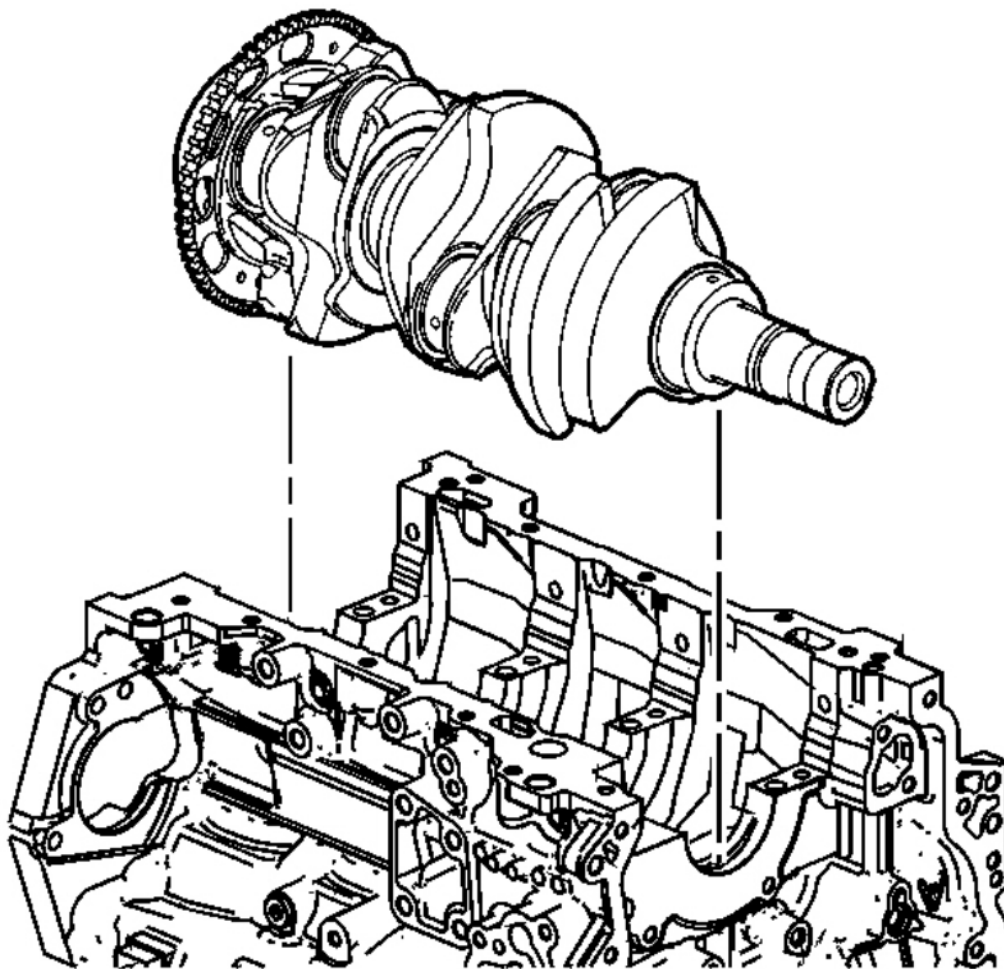


Fig. 136: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

21. Lift the crankshaft out of the cylinder block.

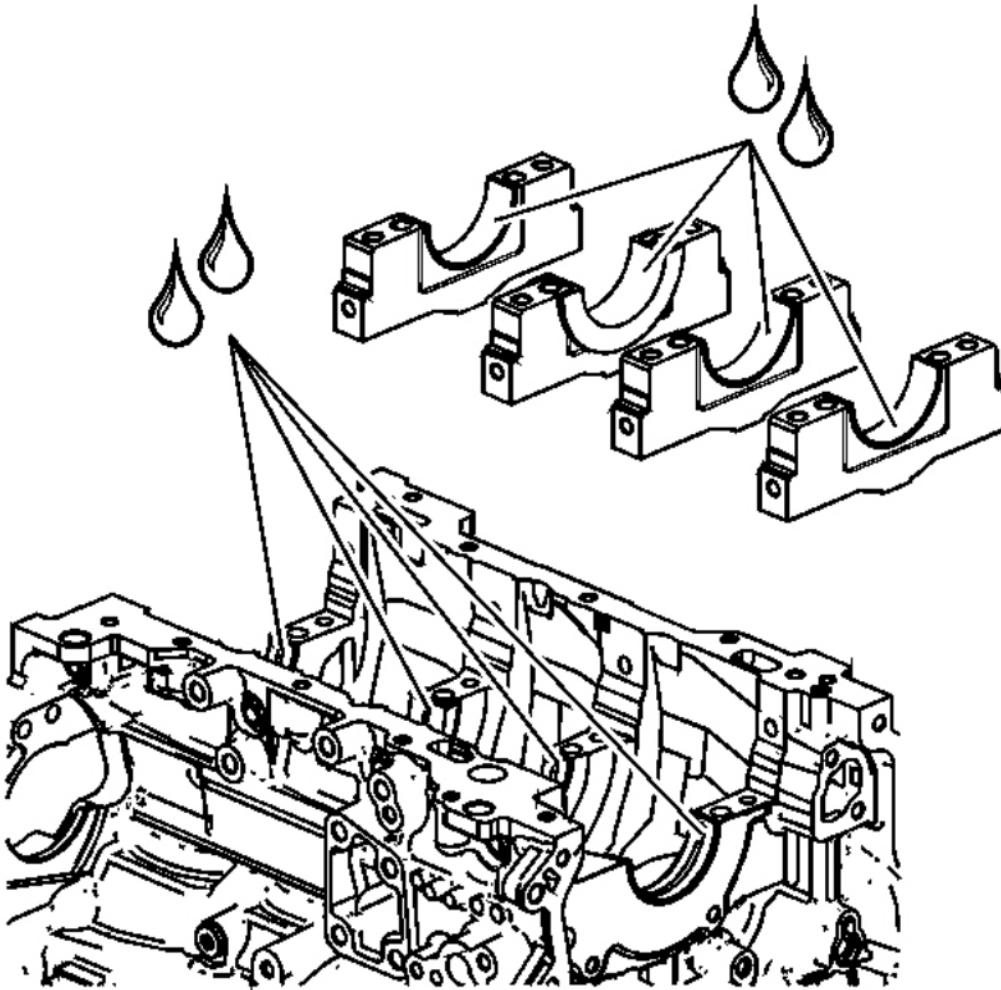


Fig. 137: Lubricating Upper & Lower Bearing Surfaces
Courtesy of GENERAL MOTORS CORP.

22. Apply a liberal amount of crankshaft prelube GM P/N 1052367 (Canadian P/N 992869) or clean engine oil GM P/N 12345501 (Canadian P/N 992704) to the upper and lower bearing surfaces.

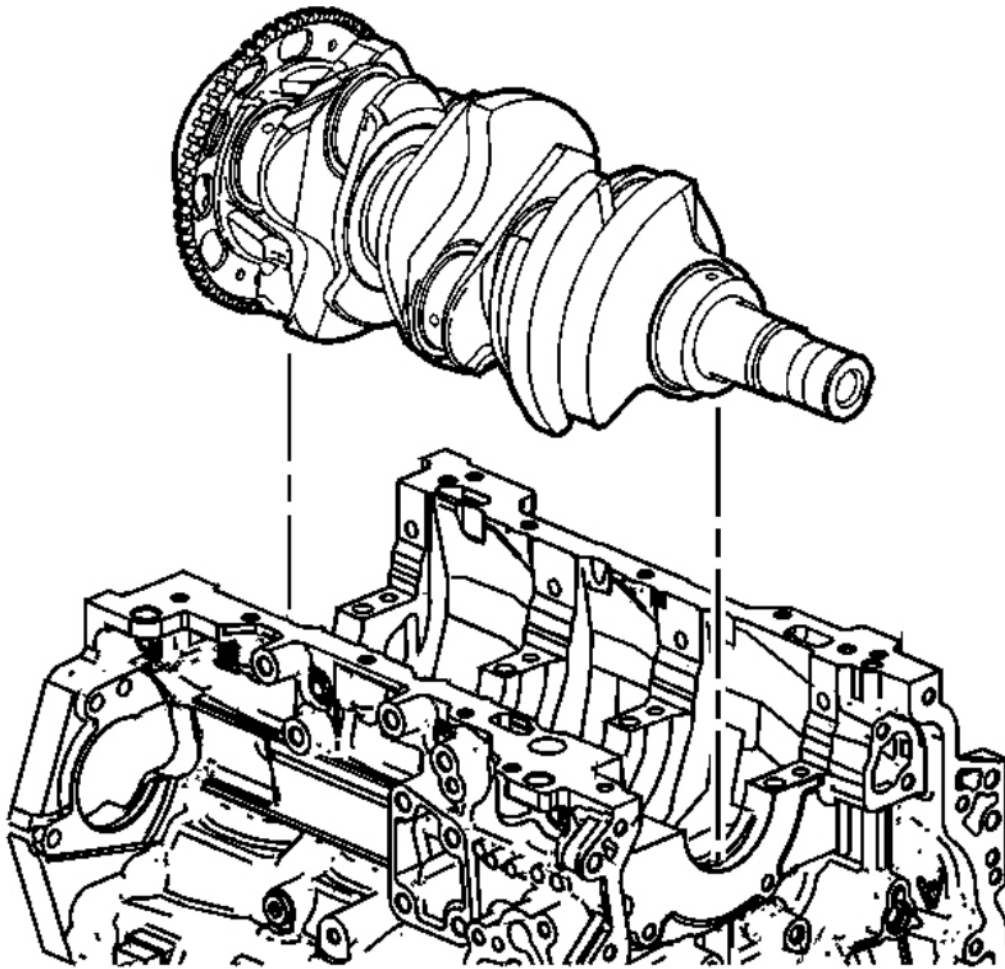


Fig. 138: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

23. Gently lower the crankshaft into position in the cylinder block.

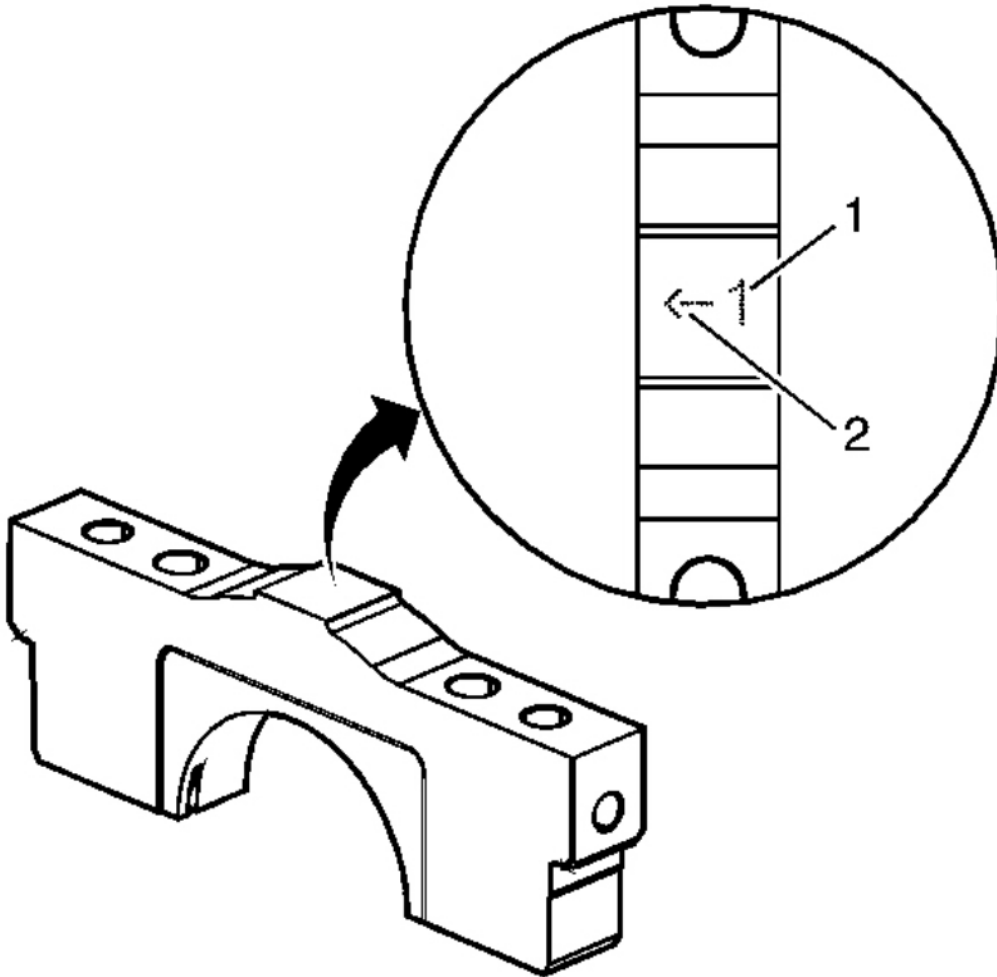


Fig. 139: View Of Main Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

24. Identify the proper order of the main bearing caps. The main bearing caps are numbered 1 (1) through 4, with the front main bearing cap marked with the number 1. The arrow (2) is to be oriented to the front of the engine.

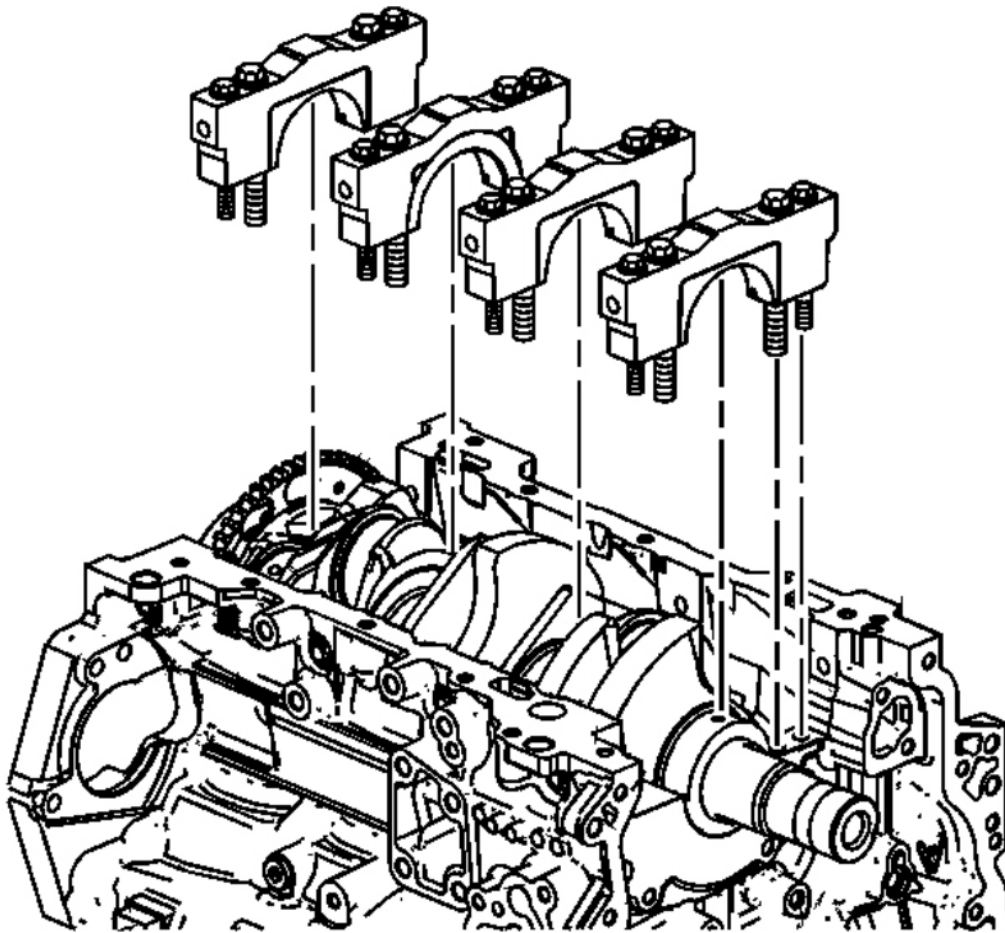


Fig. 140: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

25. Install the crankshaft main bearing caps.
26. Loosely install the original inner main cap bolts.
27. Loosely install the NEW outer main cap bolts.

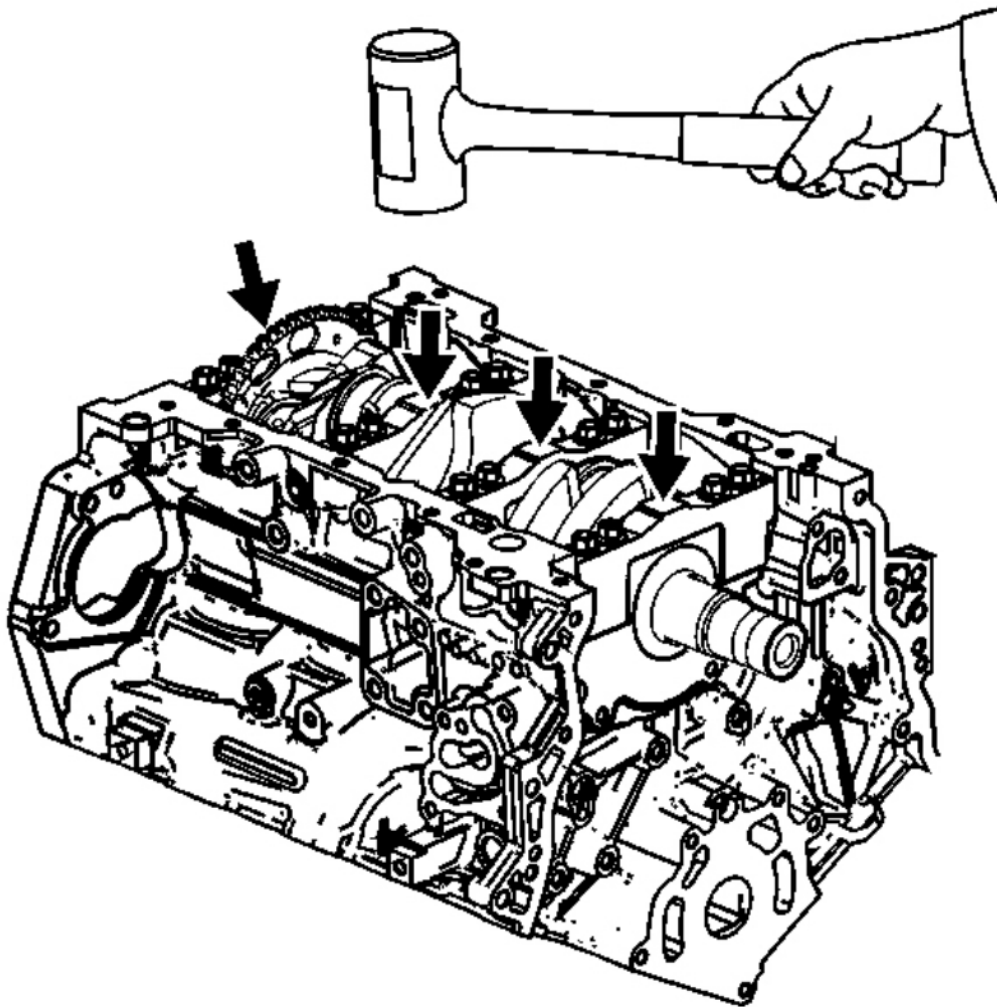


Fig. 141: Tapping Crankshaft Main Bearing Caps With A Soft-Faced Hammer
Courtesy of GENERAL MOTORS CORP.

28. Tap the crankshaft main bearing caps with a soft-faced hammer.

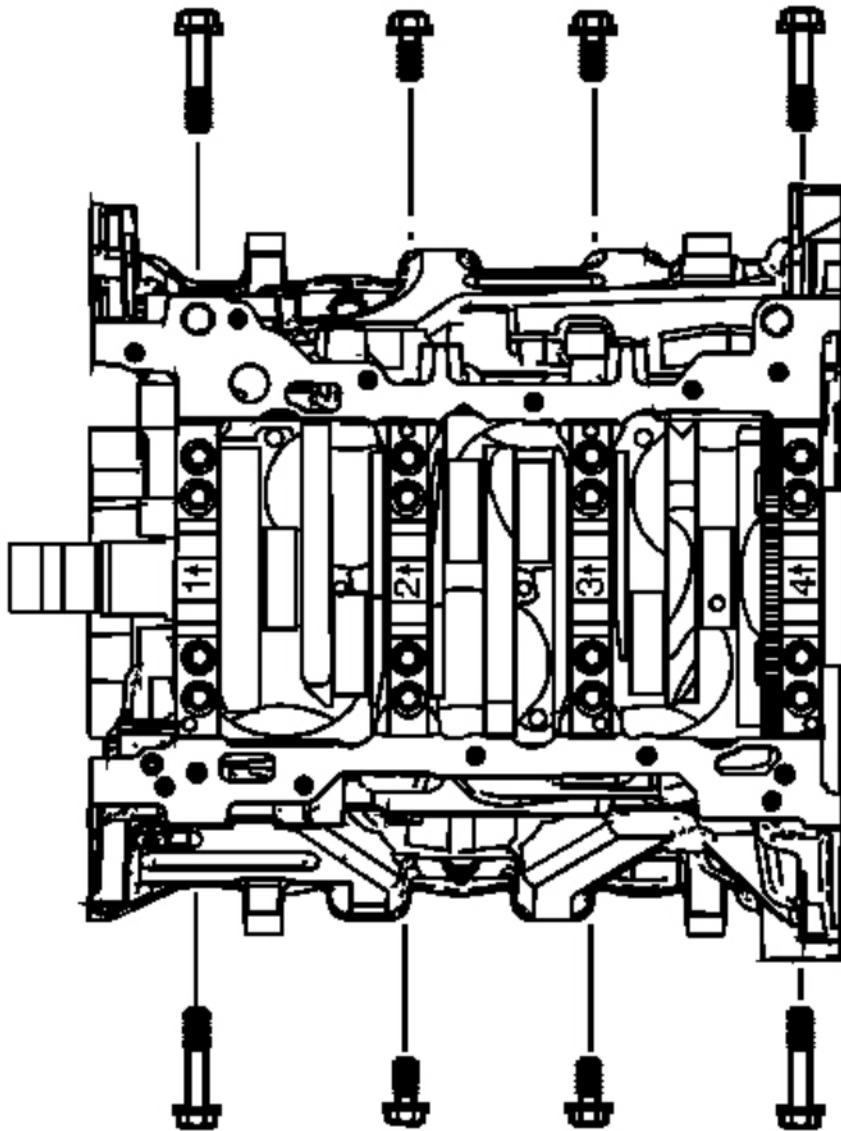


Fig. 142: Identifying Crankshaft Main Bearing Cap Side Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The side main cap bolts originally have a sealant on the flange of the bolt head. **NEW** bolts must be used, if **NEW** bolts are not used, oil can leak from the crankcase past the

bolts.

29. Loosely install the NEW short/inner side main cap bolts.
30. Loosely install the NEW long/outer side main cap bolts.
31. Tighten the main cap bolts using the **J 45059** in the following sequence:

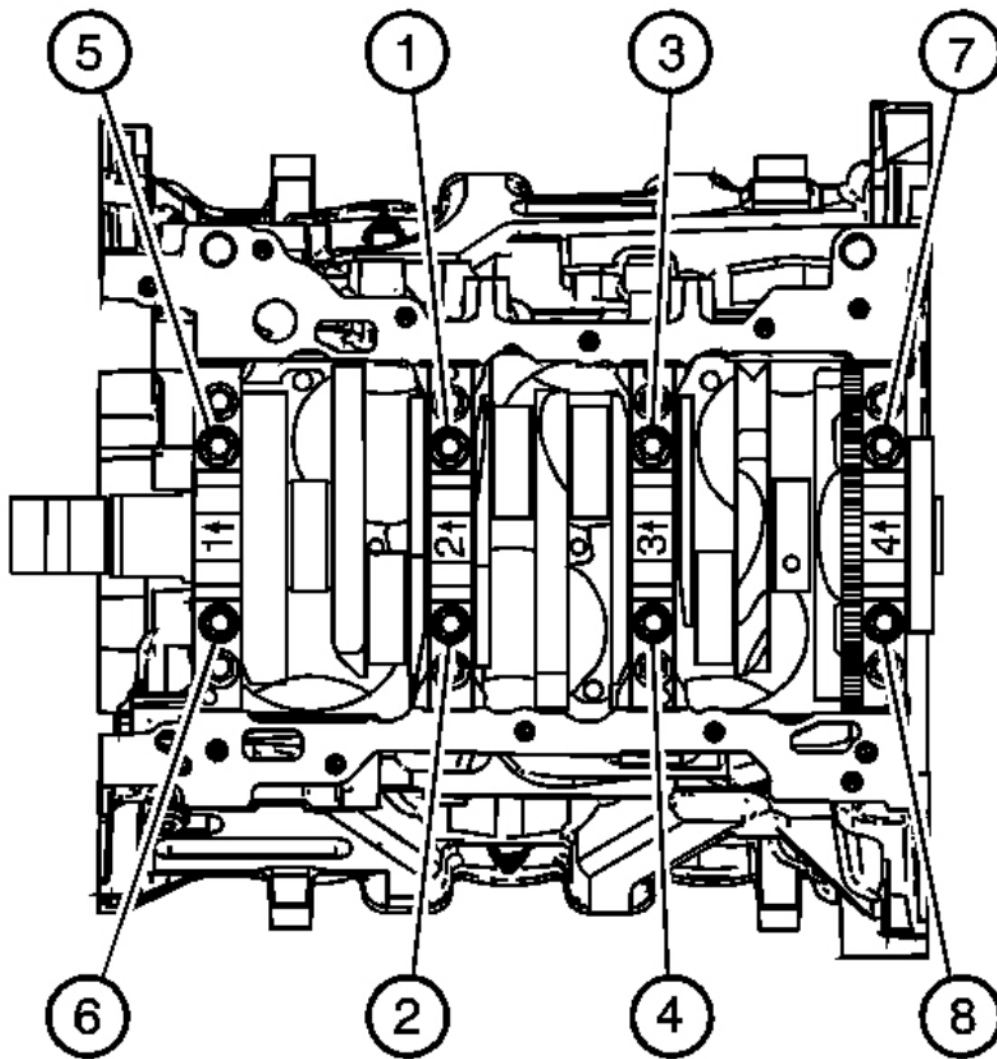


Fig. 143: Tightening Inboard Bolts
Courtesy of GENERAL MOTORS CORP.

Tighten the inboard bolts (1-8).

Tighten: Tighten the inboard bolts (1-8) to 20 N.m (15 lb ft) plus 80 degrees.

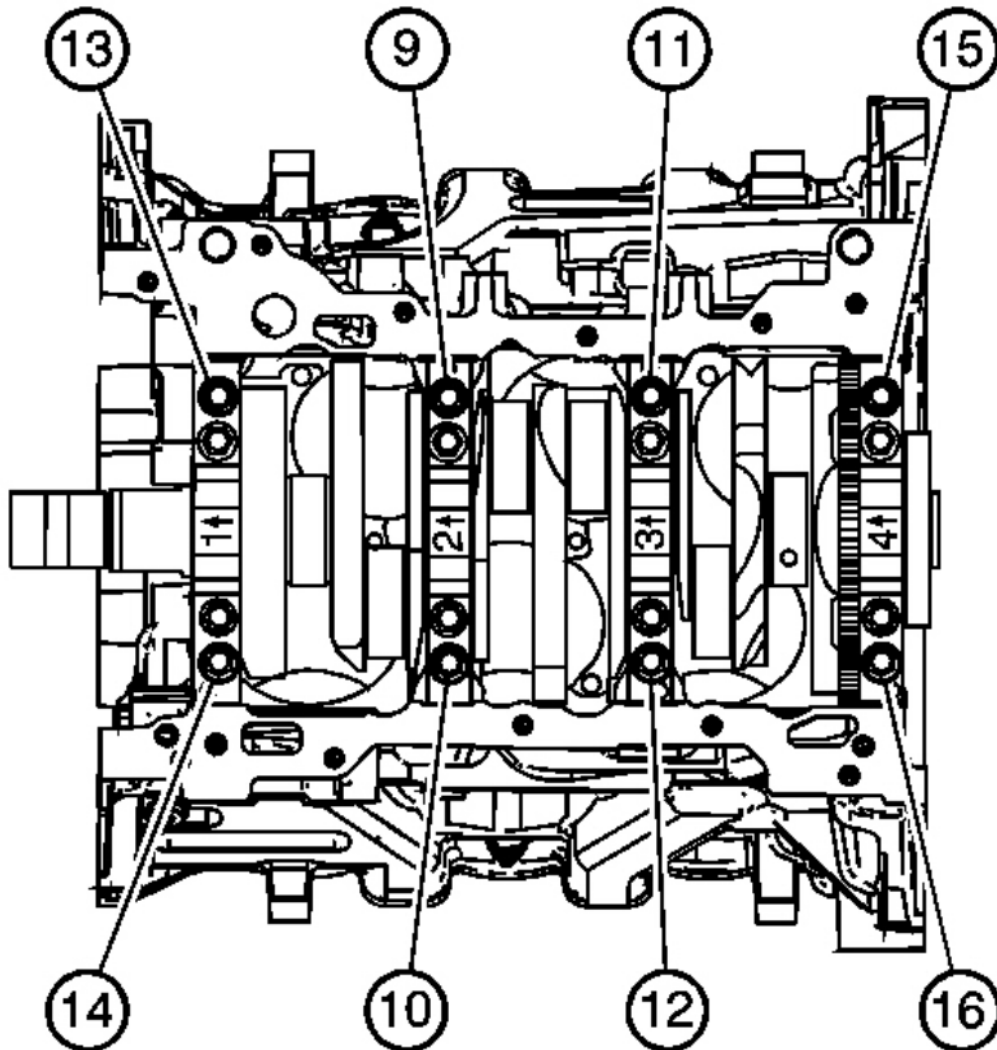


Fig. 144: Tightening Outboard Bolts
Courtesy of GENERAL MOTORS CORP.

32. Tighten the outboard bolts (9-16).

Tighten: Tighten the outboard bolts (9-16) to 15 N.m (11 lb ft) plus 110 degrees.

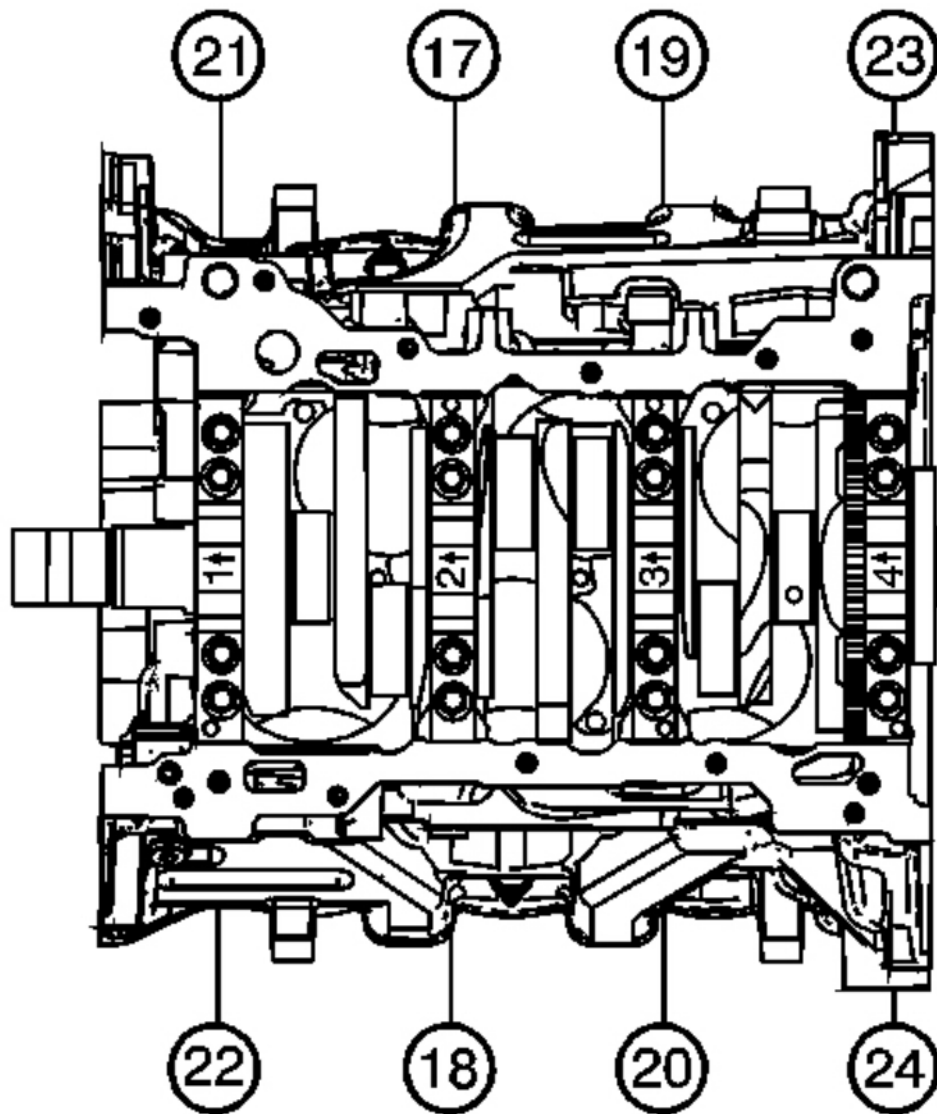


Fig. 145: Tightening Short/Inner & Long/Outer Bolts
Courtesy of GENERAL MOTORS CORP.

33. Tighten the short/inner bolts (17-20).

Tighten: Tighten the short/inner bolts (17-20) to 30 N.m (22 lb ft) plus 60 degrees.

34. Tighten the long/outer bolts (21-24).

Tighten: Tighten the long/outer bolts (21-24) to 30 N.m (22 lb ft) plus 60 degrees.

35. Ensure that the crankshaft turns without binding or noise.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Tools Required

- **EN 46111** Crankshaft Rotation Socket
- **EN 46121** Connecting Rod Guide Pin Set
- **J 8037** Ring Compressor
- **J 43690** Rod Bearing Clearance Checking Tool
- **J 43690-100** Rod Bearing Clearance Checking Tool - Adapter Kit
- **J 45059** Angle Meter

Piston and Connecting Rod Assembly Procedure

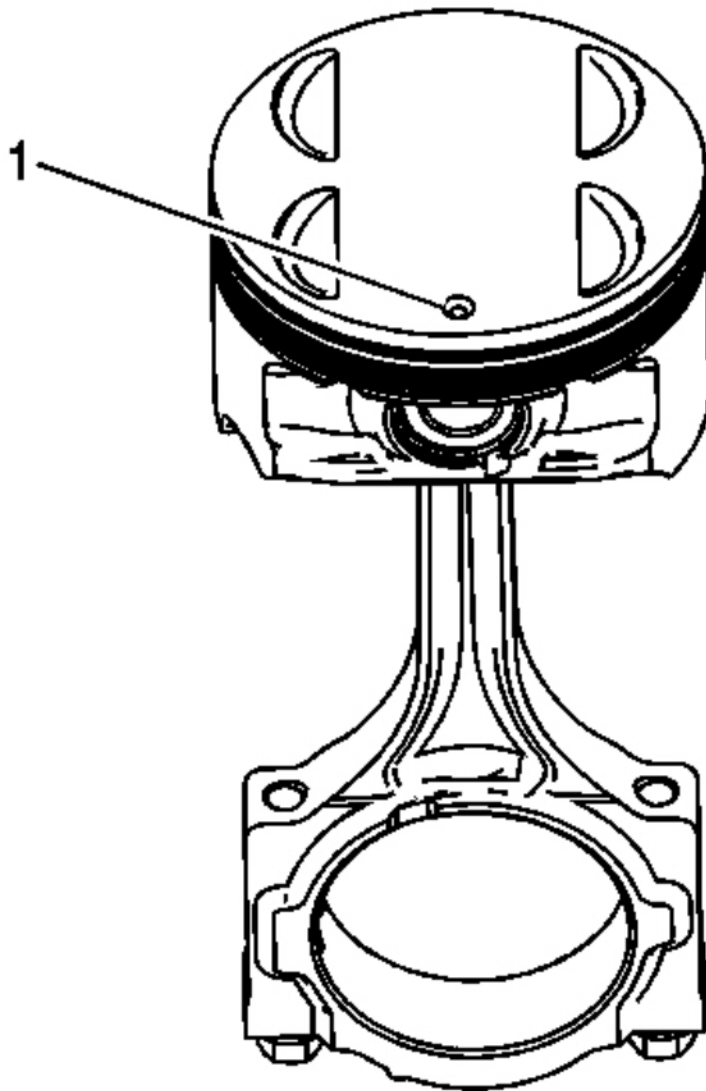


Fig. 146: Locating Piston Orientation Dot
Courtesy of GENERAL MOTORS CORP.

1. Liberally lubricate the cylinder walls, piston rings and piston skirts with engine oil.

IMPORTANT: The piston is directional and must be installed in the engine block in the proper direction.

2. Select the correctly numbered piston/connecting rod assembly for the cylinder. A dot (1) showing proper piston orientation is located on the top of the piston.

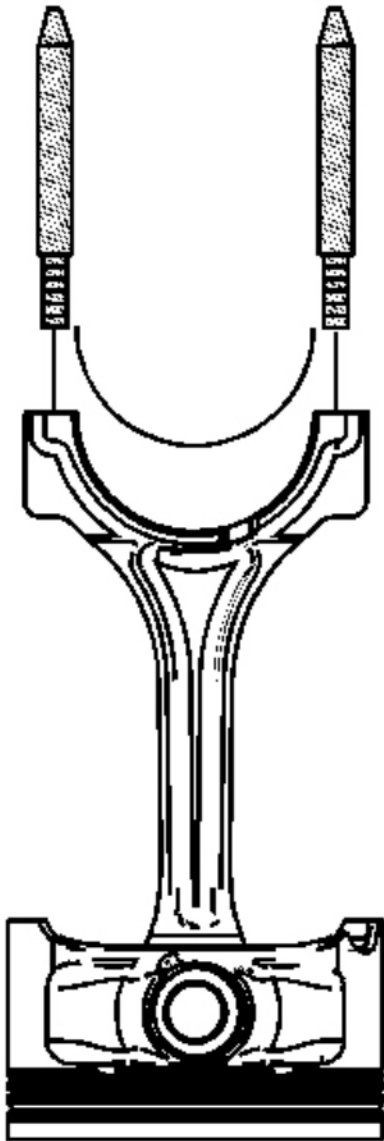


Fig. 147: View Of Piston/Connecting Rod Installation Tool
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the connecting rod bearings have been used in a running engine, you must replace them with NEW connecting rod bearings for reassembly.

3. Install the connecting rod bearing into the connecting rod.
4. Install the **EN 46121** into the connecting rod bolt holes.
5. Compress the piston rings using the **J 8037** or equivalent.

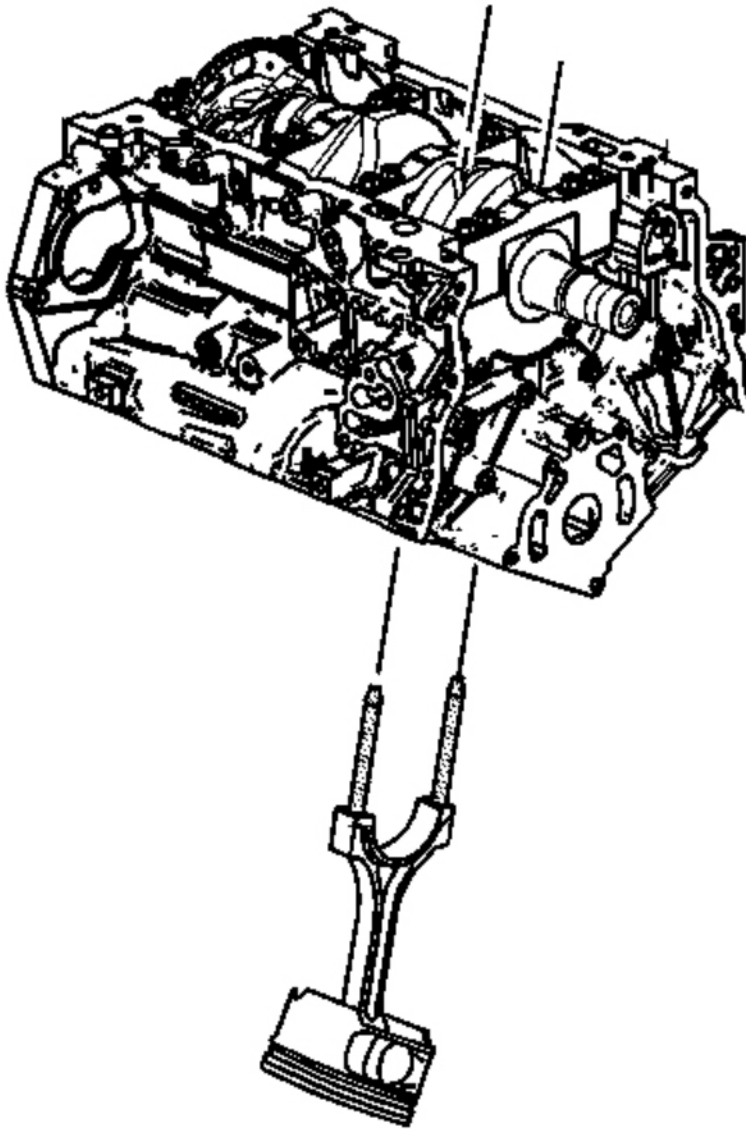


Fig. 148: Installing Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Extreme care must be used when installing the piston and connecting rod in order to be sure the rod does not scrape or nick the cylinder bore, the oil jets, or the crankshaft

surfaces.

6. Using both hands, slowly guide the piston and connecting rod assembly into the cylinder from the top and bottom of the cylinder. DO NOT allow the connecting rod to contact the cylinder wall.
7. When the **J 8037** contacts the deck surface, gently tap the piston into the cylinder using the handle end of a dead-blow hammer. Guide the connecting rod onto the crankshaft bearing journal using the **EN 46121** while gently tapping the piston into the cylinder with a soft-blow hammer.

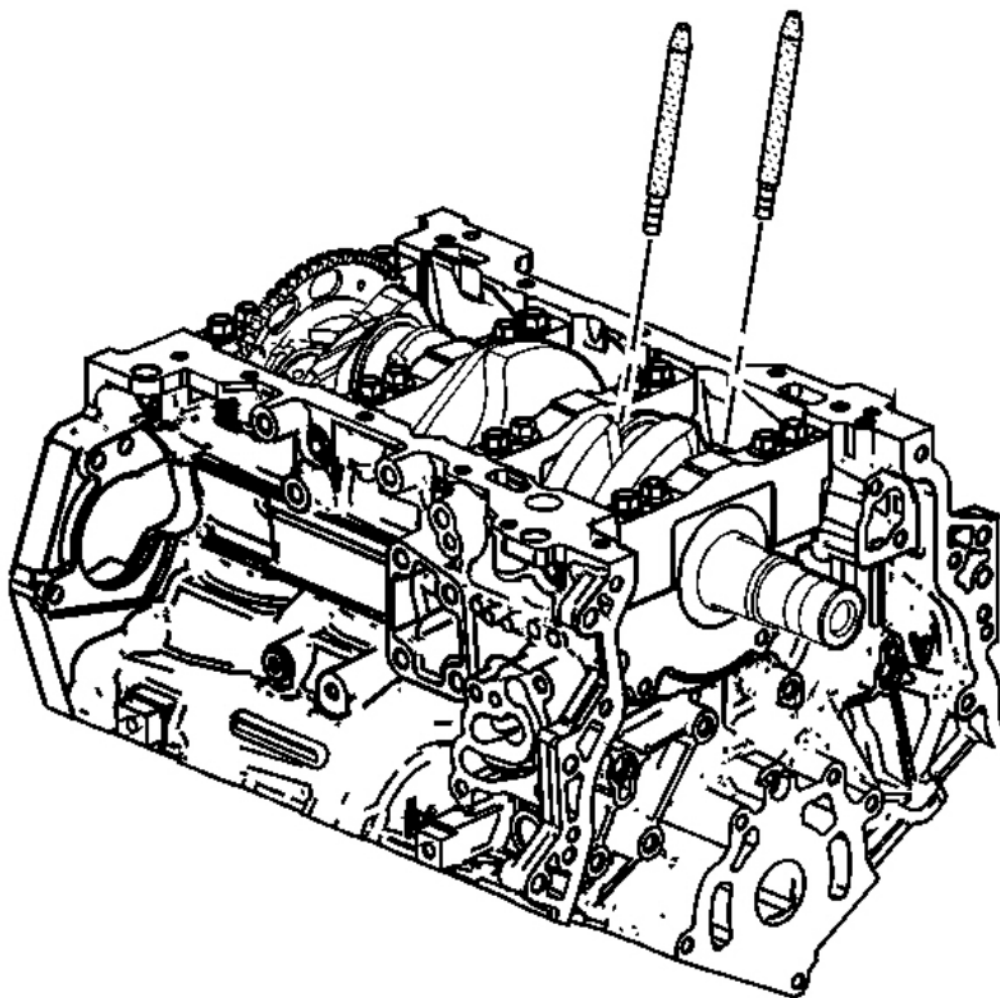


Fig. 149: Removing EN 46121
Courtesy of GENERAL MOTORS CORP.

8. Remove the **EN 46121** from the connecting rod bolt holes.

Connecting Rod Bearing Clearance Measurement Procedure - Using Plastic Gaging

IMPORTANT: Connecting rod bearings that have been run in an engine should NEVER be reused.
Before final assembly it is important to check the clearance of the new connecting rod bearings.

1. Place a length of fresh, room temperature plastic gaging material all the way across the connecting rod bearing journal.
2. Install the connecting rod bearing into the connecting rod cap.

IMPORTANT: The connecting rod is non-directional therefore the connecting rod bearing lock tangs can face inboard or outboard.

3. Install the connecting rod end cap on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

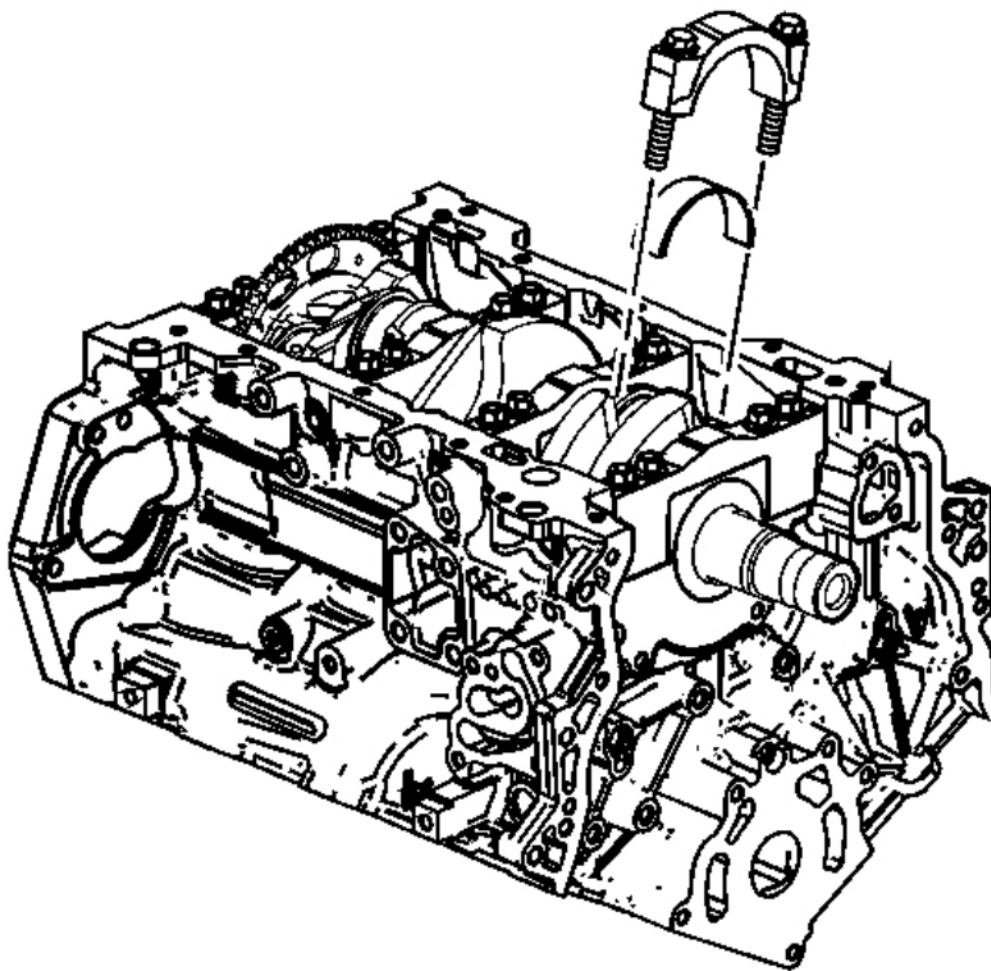


Fig. 150: View Of Connecting Rod Bearing And Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

NOTE: Do not lubricate the NEW connecting rod bolts. The NEW bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are torqued. Improper clamp load can lead to component failure and extensive engine damage.

IMPORTANT: Reuse the old connecting rod bolts ONLY for measuring the connecting rod bearing clearance.

4. Install the connecting rod bolts into the connecting rod cap.

Tighten: Tighten the connecting rod bolts to 30 N.m (22 lb ft).

5. Loosen the connecting rod bolts until the torque reading is zero.
6. Re-tighten the connecting rod bolts.

1. First Pass

Tighten: Tighten the connecting rod bolts to 25 N.m (18 lb ft).

2. Final Pass

Tighten: Tighten the connecting rod bolts an additional 110 degrees using the **J 45059** .

7. Allow the assembly to sit for at least 2 minutes.
8. Remove the connecting rod cap bolts.
9. Remove the connecting rod cap.

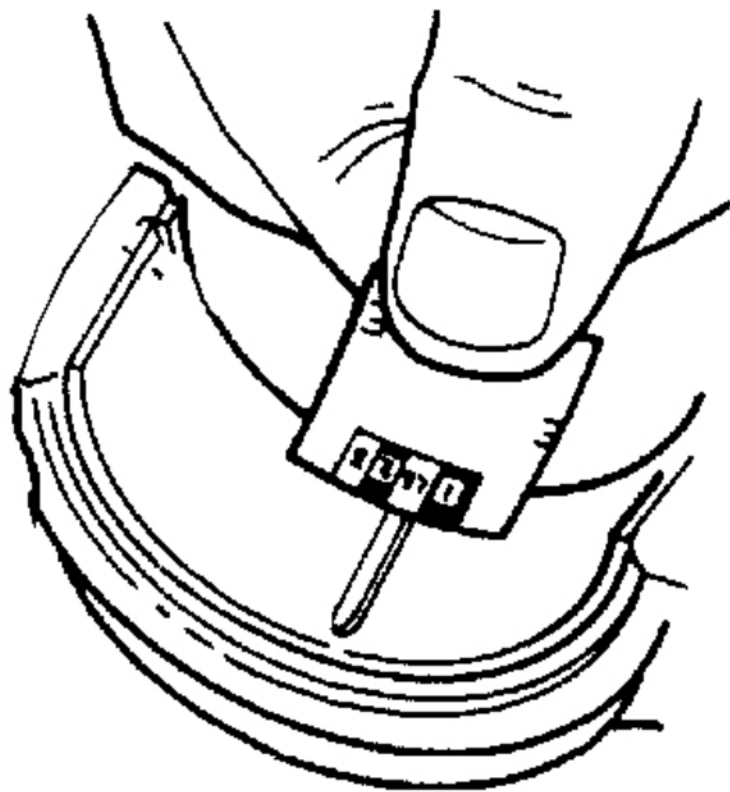


Fig. 151: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

10. Determine the connecting rod bearing clearance by comparing the width of the flattened plastic gaging material at its widest point with the graduation on the gaging material container.
11. Compare your measurements with the engine mechanical specifications. If the new bearings do not provide the proper crankshaft to connecting rod bearing clearance, inspect the following:
 1. Re-measure the crankshaft connecting rod journals for the correct specified size and ensure the proper new bearings are being installed. If the crankshaft connecting rod journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.
 2. Re-measure the connecting rod bearing bore diameter to ensure proper size. The

connecting rod is not machinable and the connecting rod must be replaced if out of specification.

12. Clean the plastic gaging material from the connecting rod bearing journals using a soft lint-free cloth.

Connecting Rod Bearing Clearance Measurement Procedure - Using J 43690 and J 43690-100

The **J 43690** and the **J 43690-100** have been developed as a more accurate method to measure connecting rod bearing clearances. The instructions below provide an overview of tool set-up and usage. For more detailed information, refer to the tool instruction sheets as supplied by the tool manufacturer.

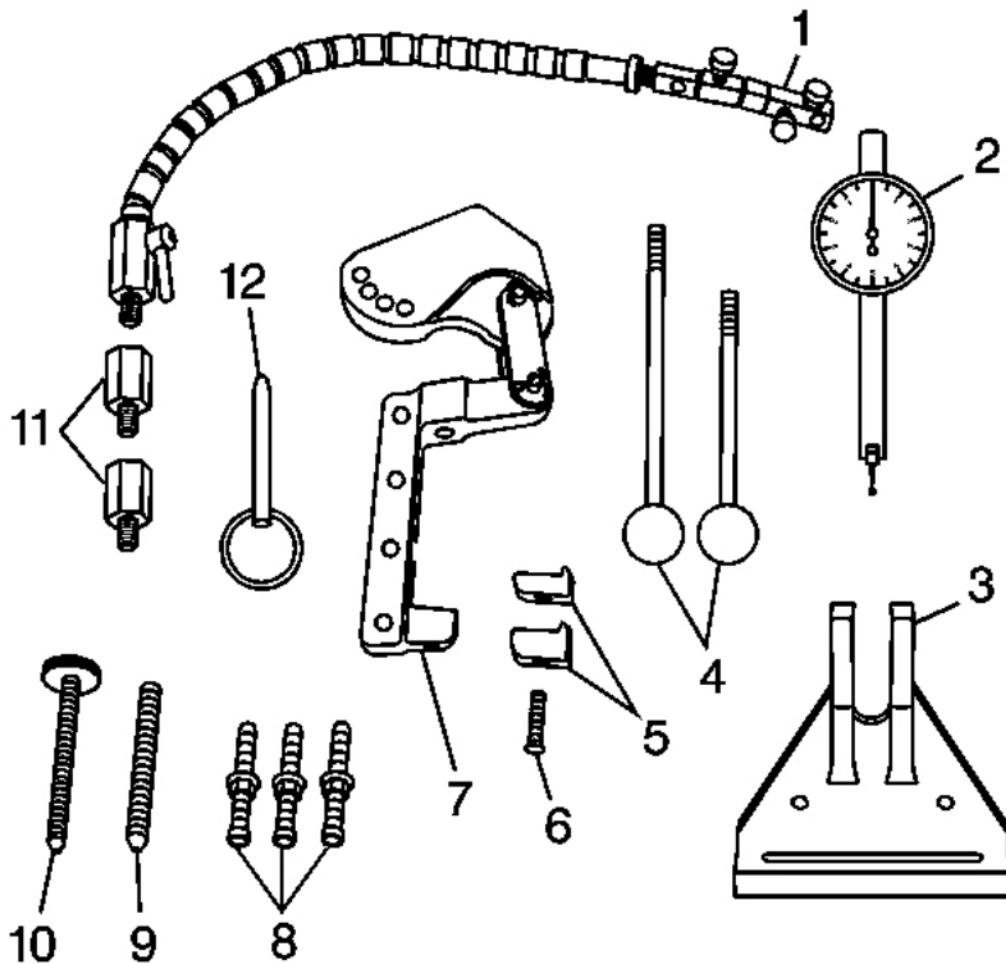


Fig. 152: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

J 43690 Rod Bearing Clearance Checking Tool

- J 43690-20 Swivel Base (1)
- J 43690-19 Dial Indicator (2)
- J 43690-2 Base (3)
- J 43690-5, -6 Handle (4)
- J 43690-10, -11 Foot (5)
- 280307 Screw (6)
- J 43690-1 Pivot Arm Assembly (7)
- J 43690-3, -7, -8 Screws (8)
- 280319 Screw (9)
- 280311 Screw (10)
- J 43690-17, -18 Adapter (11)
- 280310 Pin (12)

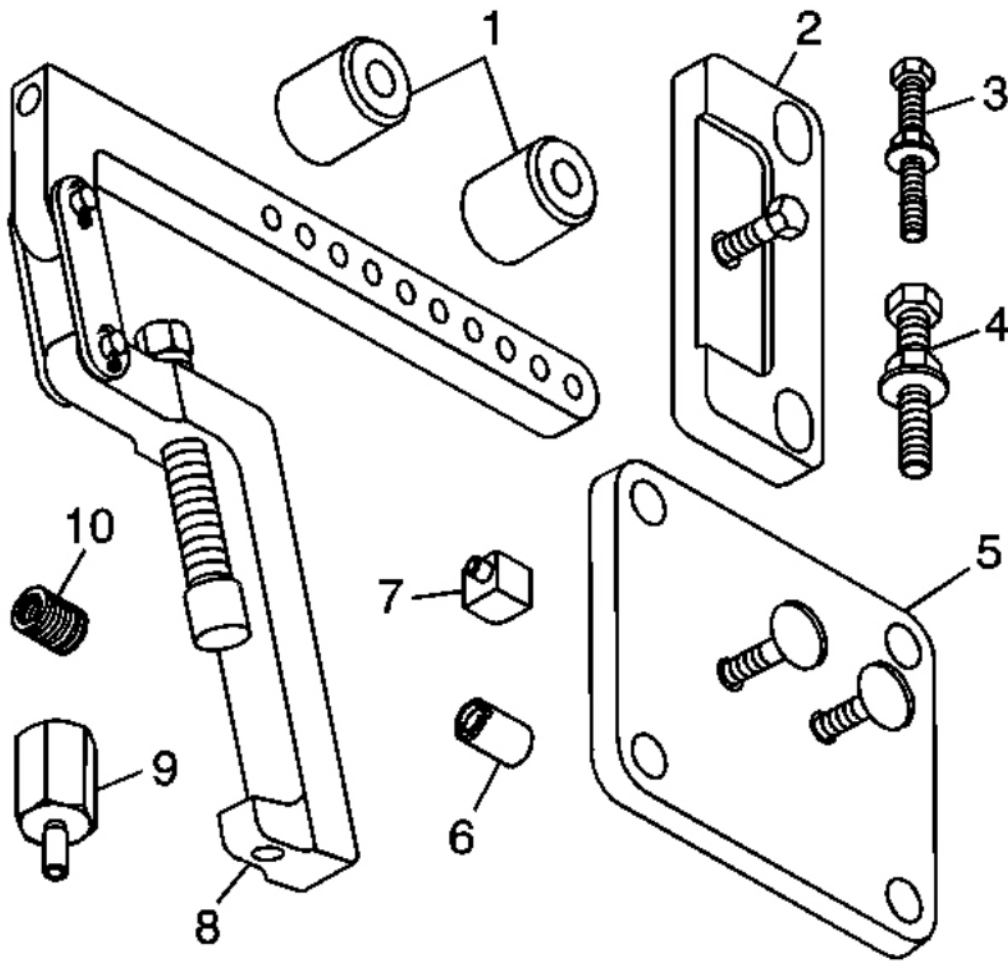


Fig. 153: Identifying Rod Bearing Clearance Tool - Adapter Kit
 Courtesy of GENERAL MOTORS CORP.

J 43690-100 Rod Bearing Clearance Tool - Adapter Kit

- J 43690-104 Spacer (1)
- J 43690-105 Retainer Plate (2)
- 505478 Bolt (3)
- 511341 Bolt (4)
- J 43690-106 Retainer Plate (5)

- J 43690-107 Cap (6)
- J 43690-102 Foot (7)
- J 43690-101 Pivot Arm Assembly (8)
- J 43690-103 Adapter (9)
- 505439 Adapter (10)

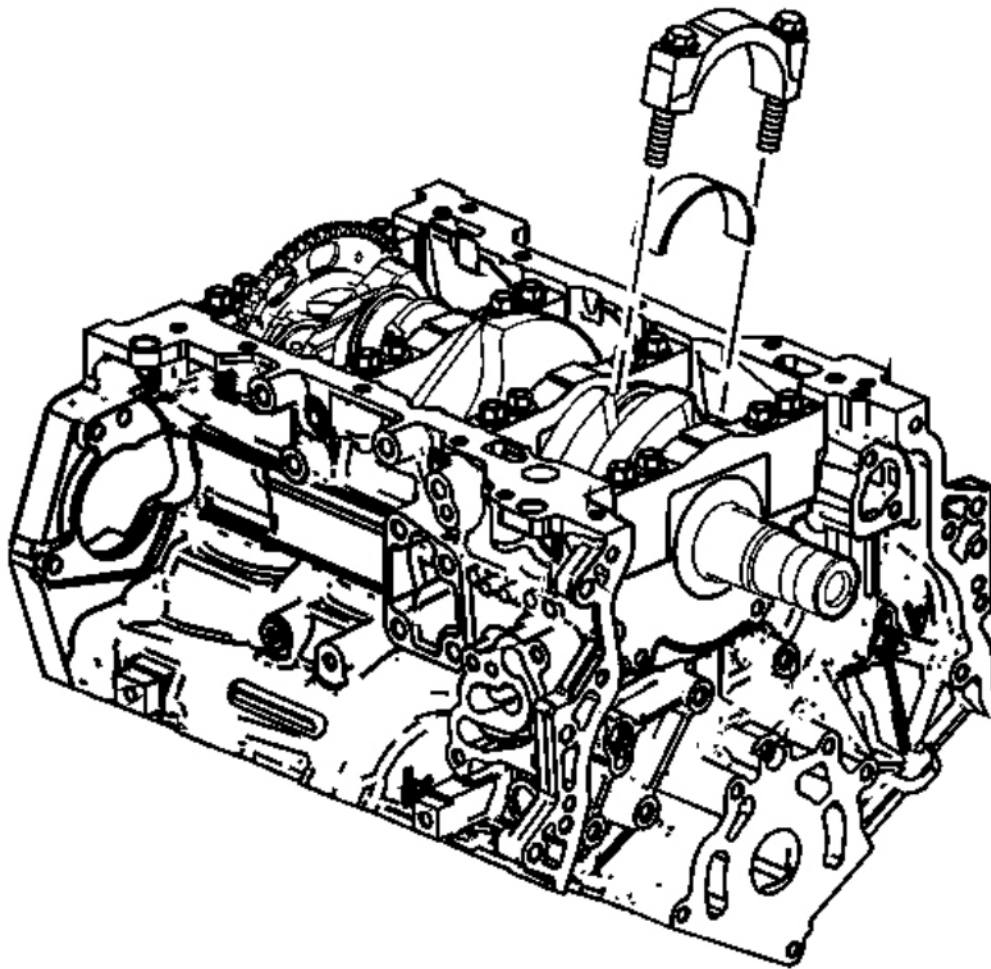


Fig. 154: View Of Connecting Rod Bearing And Cap
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Connecting rod bearings that have been run in an engine should **NEVER** be reused.
Before final assembly it is important to check the clearance of the new connecting rod bearings.

1. Install the connecting rod bearing into the connecting rod cap.

IMPORTANT: The connecting rod is non-directional therefore the connecting rod bearing lock tangs can face inboard or outboard.

2. Install the connecting rod end cap on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

NOTE: Refer to Fastener Notice in Cautions and Notices.

NOTE: Do not lubricate the **NEW** connecting rod bolts. The **NEW** bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the connecting rod bolts are torqued. Improper clamp load can lead to component failure and extensive engine damage.

IMPORTANT: Reuse the old connecting rod bolts **ONLY** for measuring the connecting rod bearing clearance.

3. Install the connecting rod bolts into the connecting rod cap.

Tighten: Tighten the connecting rod bolts to 30 N.m (22 lb ft).

4. Loosen the connecting rod bolts until the torque reading is zero.
5. Re-tighten the connecting rod bolts.

1. First Pass

Tighten: Tighten the connecting rod bolts to 25 N.m (18 lb ft).

2. Final Pass

Tighten: Tighten the connecting rod bolts an additional 110 degrees using the **J 45059**.

6. Rotate the crankshaft until the crankshaft journal and the connecting rod to be measured is in the 12 o'clock position.

IMPORTANT: The crankshaft must be secure with no movement or rotation in order to obtain an accurate reading.

7. Remove the crankshaft main bolts required to install the retainer plate J 43690-105.

IMPORTANT: Do not allow the J 43690-105 retainer plate screw to contact the reluctor ring.

8. Install the J 43690-105 and crankshaft main bolts.
9. Loosen the connecting rod bolts until the torque reading is zero.
10. Re-tighten the connecting rod bolts.
 1. First Pass

Tighten: Tighten the connecting rod bolts to 25 N.m (18 lb ft).

2. Final Pass

Tighten: Tighten the connecting rod bolts an additional 110 degrees using the **J 45059** .

11. During and after installation, ensure each piston is positioned properly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.
12. Repeat these procedures for the remaining piston/connecting rod assemblies using the **EN 46111** in order to rotate the crankshaft.

Connecting Rod Final Assembly Procedure

1. Guide the connecting rod away from the crankshaft connecting rod journal in order to lubricate the crankshaft connecting rod bearing journal.
2. Apply a liberal amount of crankshaft prelube GM P/N 1052367 (Canadian P/N 992869) or clean engine oil GM P/N 12345501 (Canadian P/N 992704) to the crankshaft connecting rod bearing journal.
3. Guide the connecting rod to the crankshaft connecting rod journal.
4. Install the connecting rod end cap on its original connecting rod and ensure the bearing lock tangs are aligned on the same side of the rod.

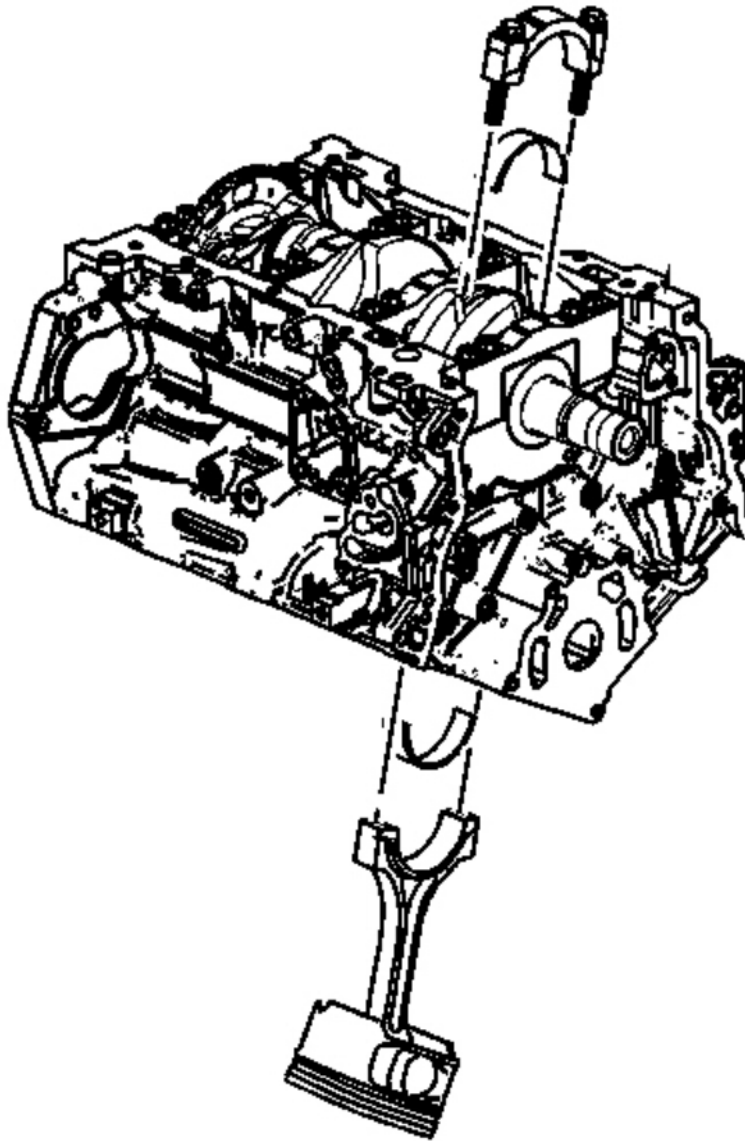


Fig. 155: Installing Connecting Rod
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not lubricate the NEW connecting rod bolts. The NEW bolts have a pre-applied graphite lubricant. Applying lubricant to the connecting rod bolts will effect the clamp load when the

connecting rod bolts are torqued. Improper clamp load can lead to component failure and extensive engine damage.

IMPORTANT: DO NOT reuse the old connecting rod bolts.

5. Install the NEW connecting rod bolts into the connecting rod cap.

Tighten: Tighten the NEW connecting rod bolts to 30 N.m (22 lb ft).

6. Loosen the connecting rod bolts until the torque reading is zero.
7. Re-tighten the connecting rod bolts.

1. First Pass

Tighten: Tighten the connecting rod bolts to 25 N.m (18 lb ft).

2. Final Pass

Tighten: Tighten the connecting rod bolts an additional 110 degrees using the **J 45059** .

8. During and after installation, ensure each piston is positioned properly in the correct cylinder. The locating arrow on the top of each piston (1) must be pointing toward the front of the engine.
9. Repeat these procedures for the remaining piston/connecting rod assemblies using the **EN 46111** in order to rotate the crankshaft.

CRANKSHAFT REAR OIL SEAL AND HOUSING INSTALLATION

Tools Required

- **EN 46109** Guide Pin Set
- EN-47839 Crankshaft Rear Oil Seal Installation Tool
- J-42183 Handle

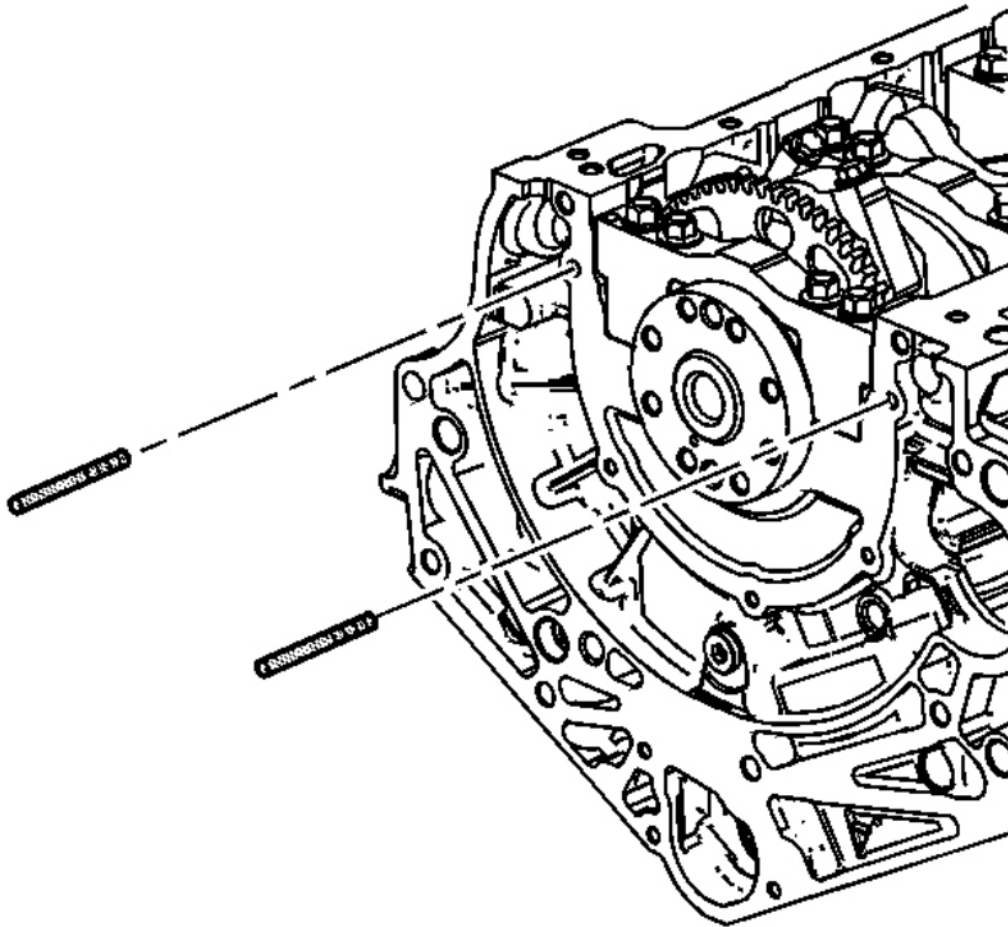


Fig. 156: Installing EN 46109 Guides To Engine Block
Courtesy of GENERAL MOTORS CORP.

1. Install the 6 mm (0.236 in) guides from the **EN 46109** into the 2 crankshaft rear oil seal housing corner bolt holes of the engine block.

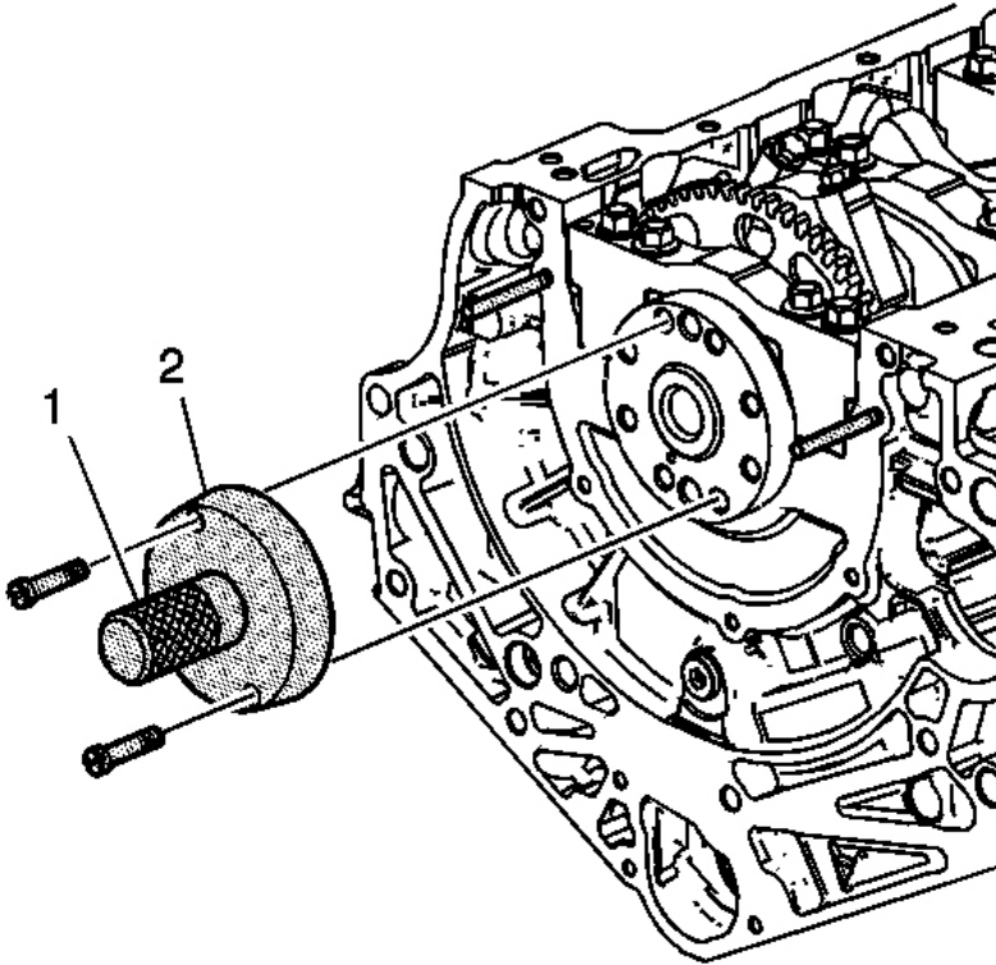


Fig. 157: Installing EN-47839 & J-42183 Onto The Rear Of The Crankshaft Flange
Courtesy of GENERAL MOTORS CORP.

2. Install the EN-47839 with the J-42183 (1, 2) onto the rear of the crankshaft flange.

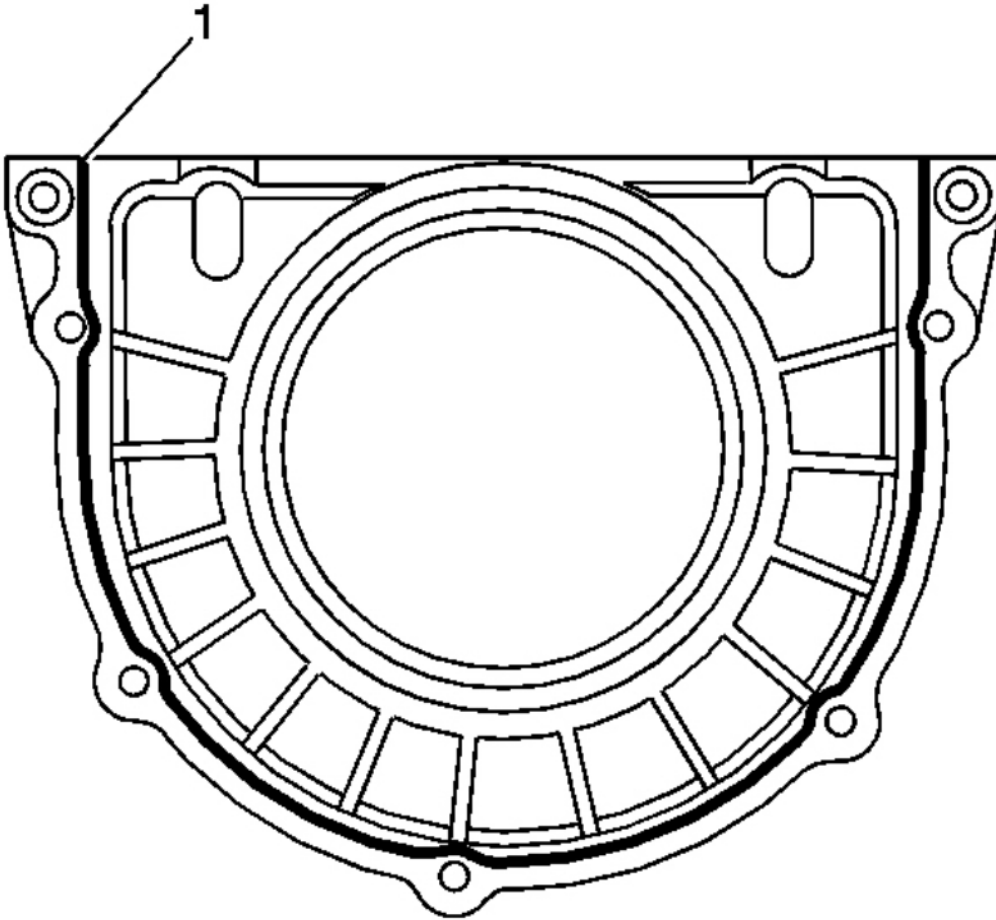


Fig. 158: Applying Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS CORP.

3. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, to the NEW crankshaft rear oil seal housing as shown (1).

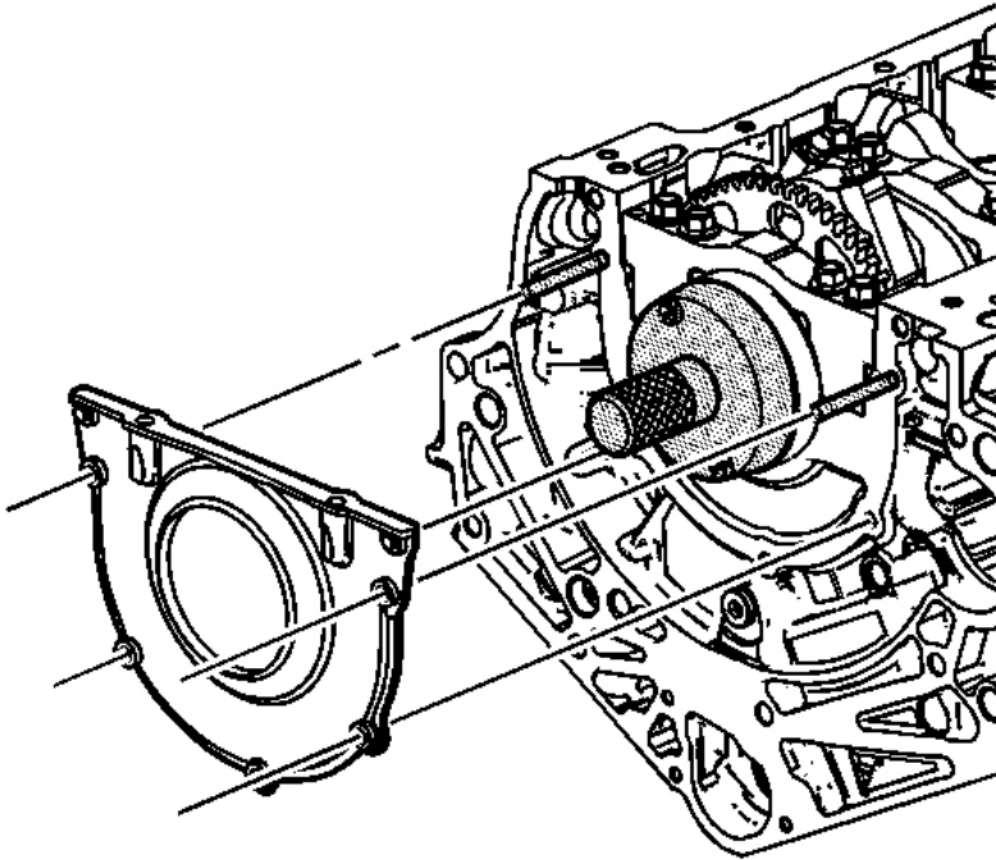


Fig. 159: Installing Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT allow any engine oil on the area where the crankshaft rear oil seal housing is to be installed.

4. Install the crankshaft rear oil seal housing to the engine block.

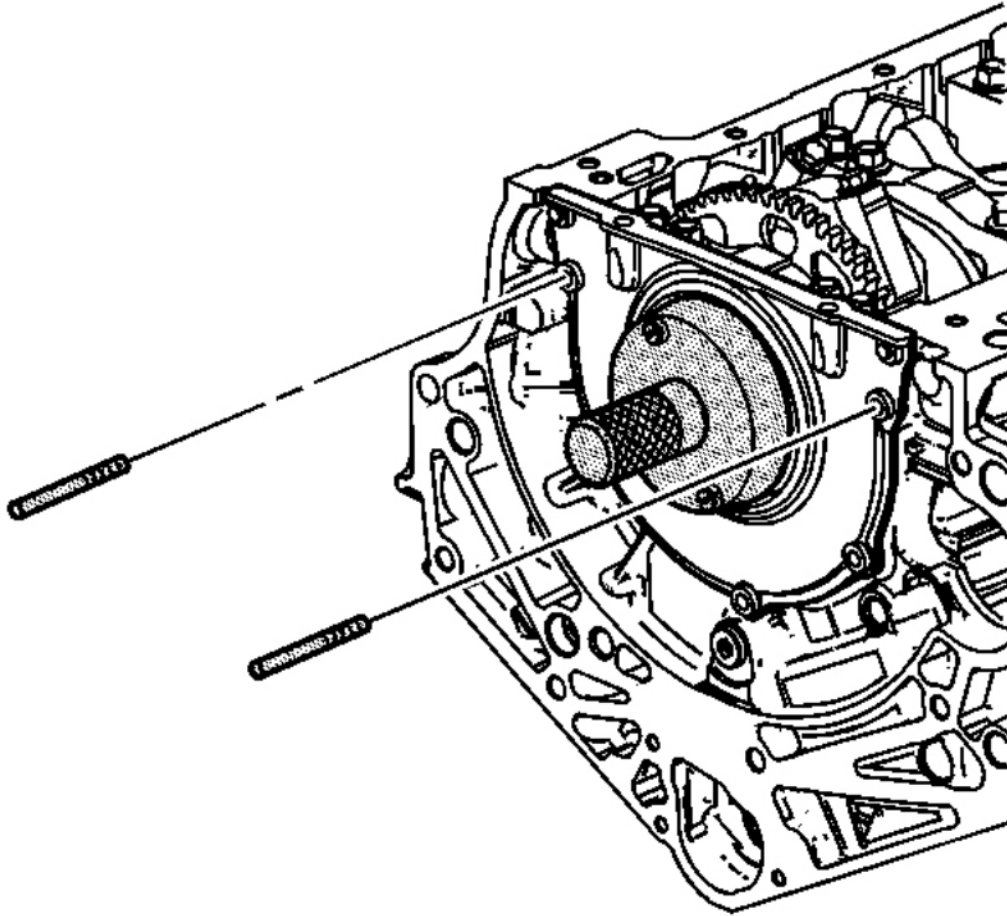


Fig. 160: Removing EN 46109

Courtesy of GENERAL MOTORS CORP.

5. Remove the **EN 46109** 6 mm (0.236 in) guides from the engine block.

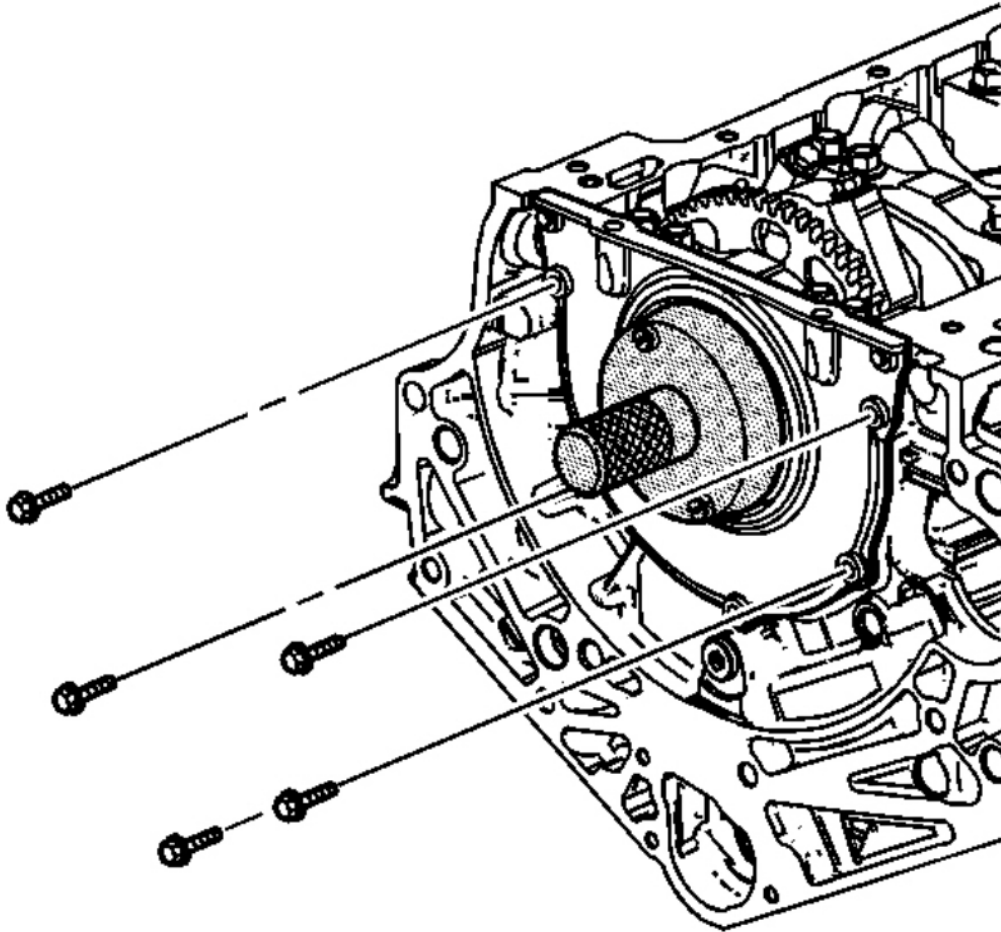


Fig. 161: Installing Crankshaft Rear Oil Seal Housing Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the crankshaft rear oil seal housing bolts.

Tighten: Tighten the crankshaft rear oil seal housing bolts to 10 N.m (89 lb in).

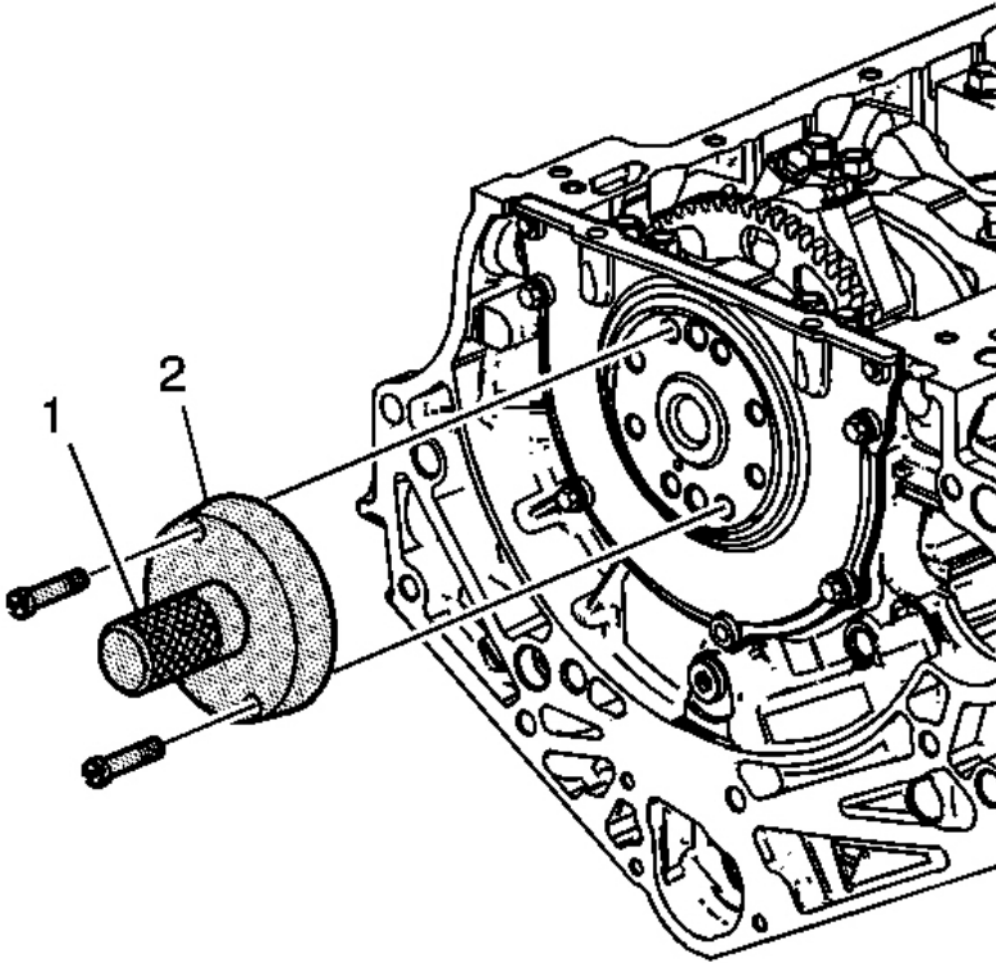


Fig. 162: Removing EN-47839 & J-42183
Courtesy of GENERAL MOTORS CORP.

7. Remove the EN-47839 and J-42183 (1, 2) from the crankshaft flange.

OIL PUMP INSTALLATION

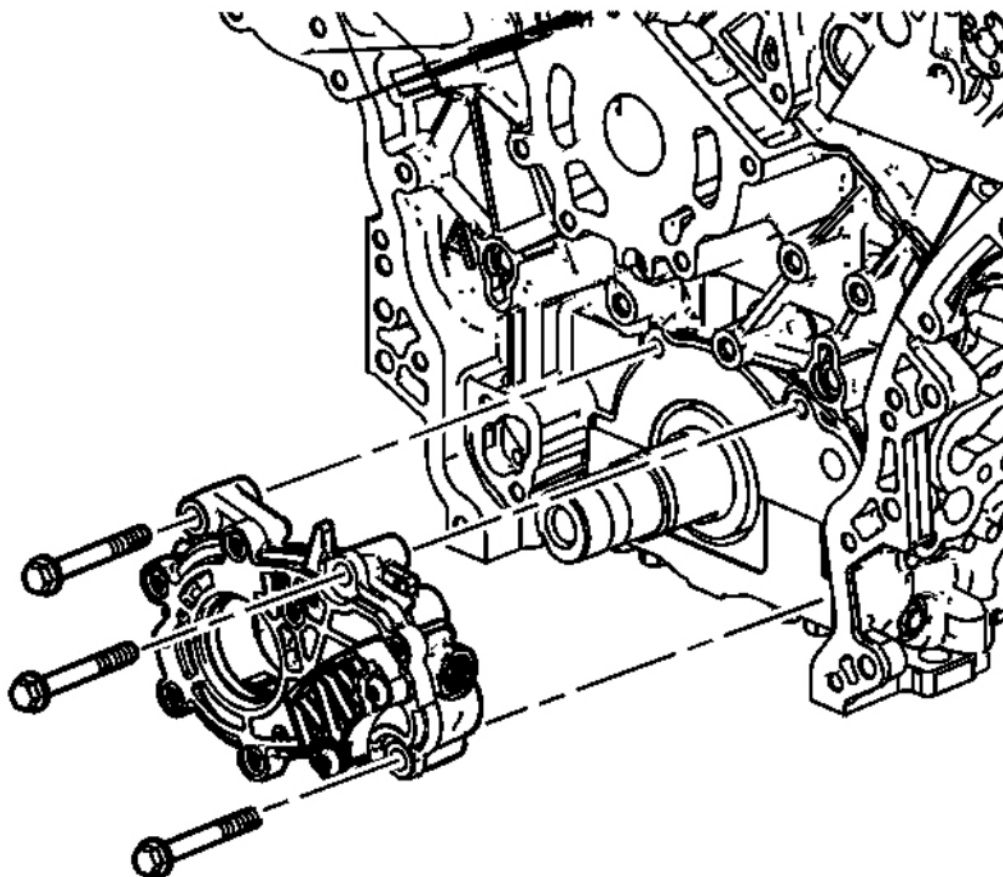


Fig. 163: View Of Oil Pump & Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

1. Align the oil pump gerotor with the crankshaft flats and install the oil pump to the engine block.
2. Align the pump body with the mounting holes in the cylinder block.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the oil pump bolts.

Tighten: Tighten the oil pump bolts to 23 N.m (17 lb ft).

OIL PAN INSTALLATION

Tools Required:

EN 46109 Guide Pin Set

1. Install the 8 mm (0.315 in) guides from the **EN 46109** into the center oil pan rail bolt hole on each side of the engine block.

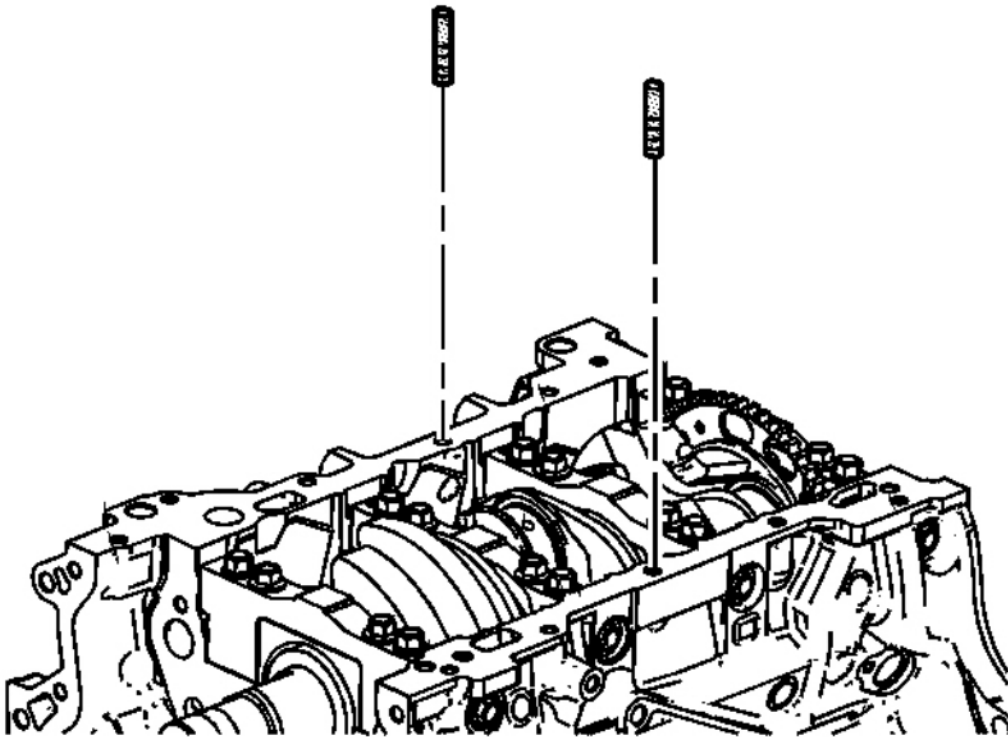


Fig. 164: Installing EN 46109 Guides To Center Oil Pan Rail Bolt Holes
Courtesy of GENERAL MOTORS CORP.

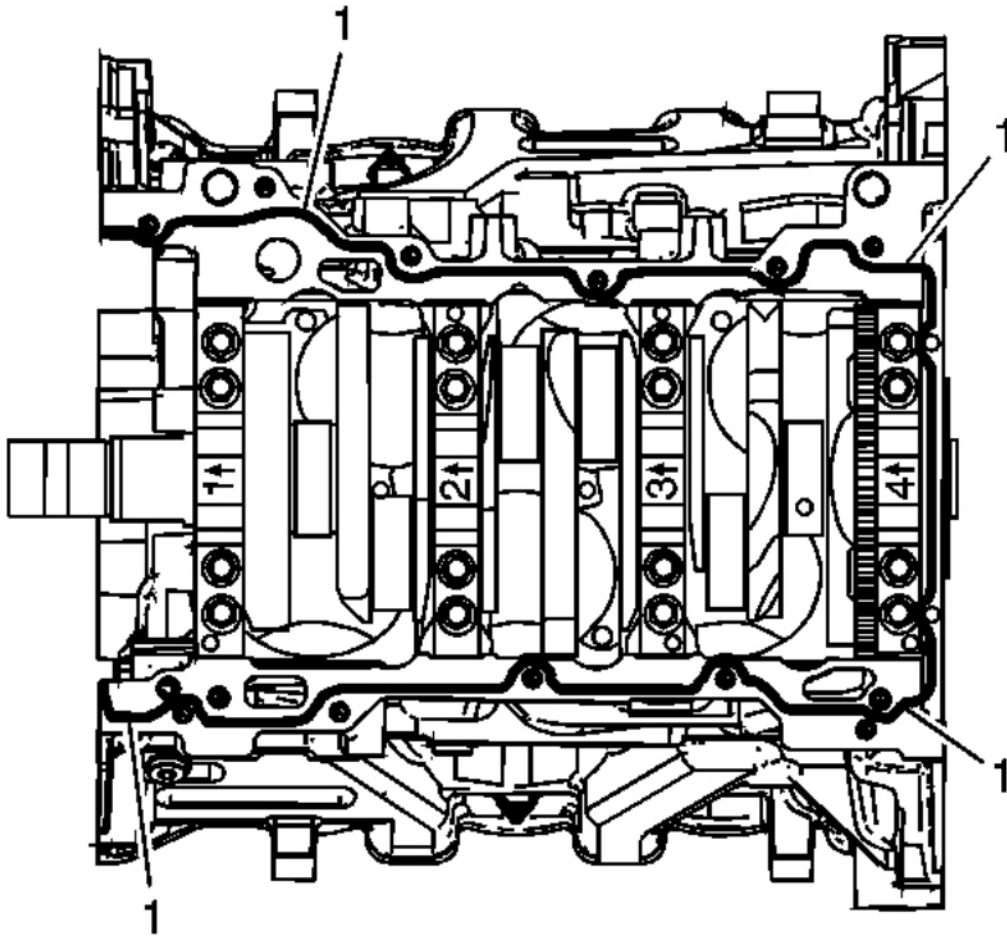


Fig. 165: Applying Sealant On Block Pan Rail & Crankshaft Rear Oil Seal Housing
Courtesy of GENERAL MOTORS CORP.

2. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the block pan rail and the crankshaft rear oil seal housing (1).

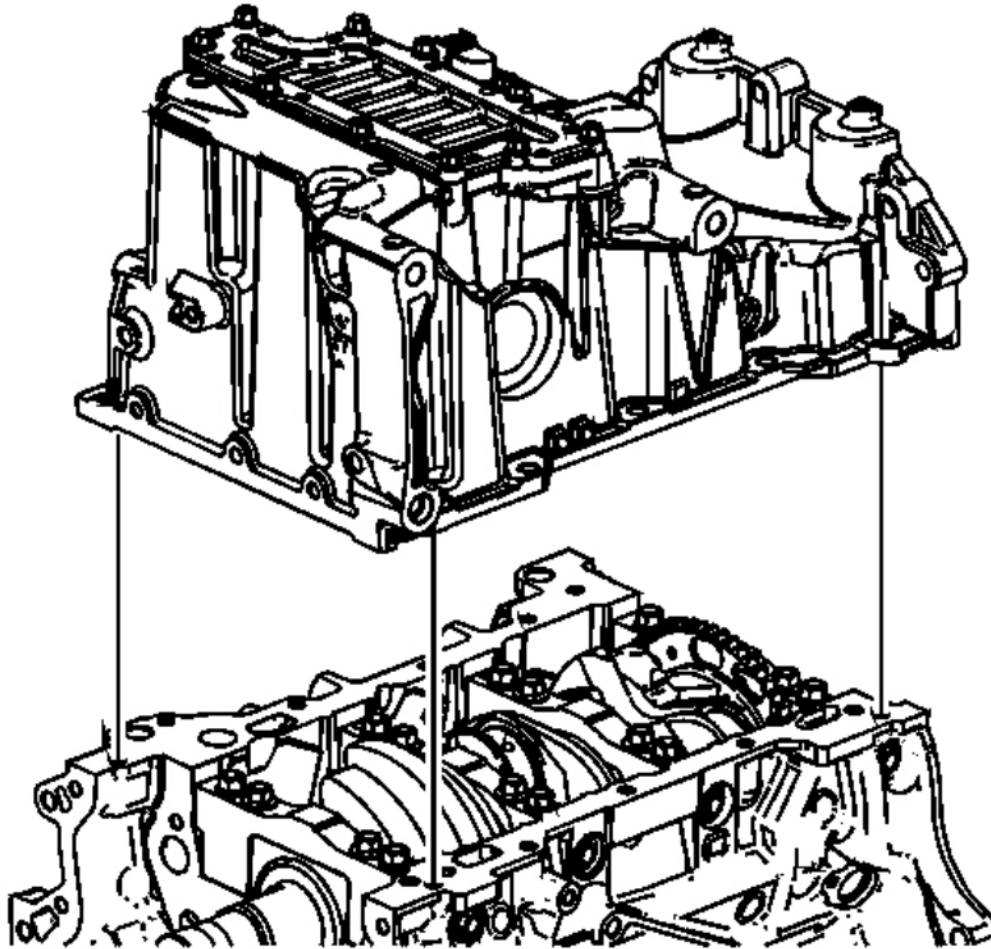


Fig. 166: View Of Oil Pan

Courtesy of GENERAL MOTORS CORP.

3. Position the oil pan onto the block.
4. Remove the **EN 46109** 8 mm (0.315 in) guides from the engine block.

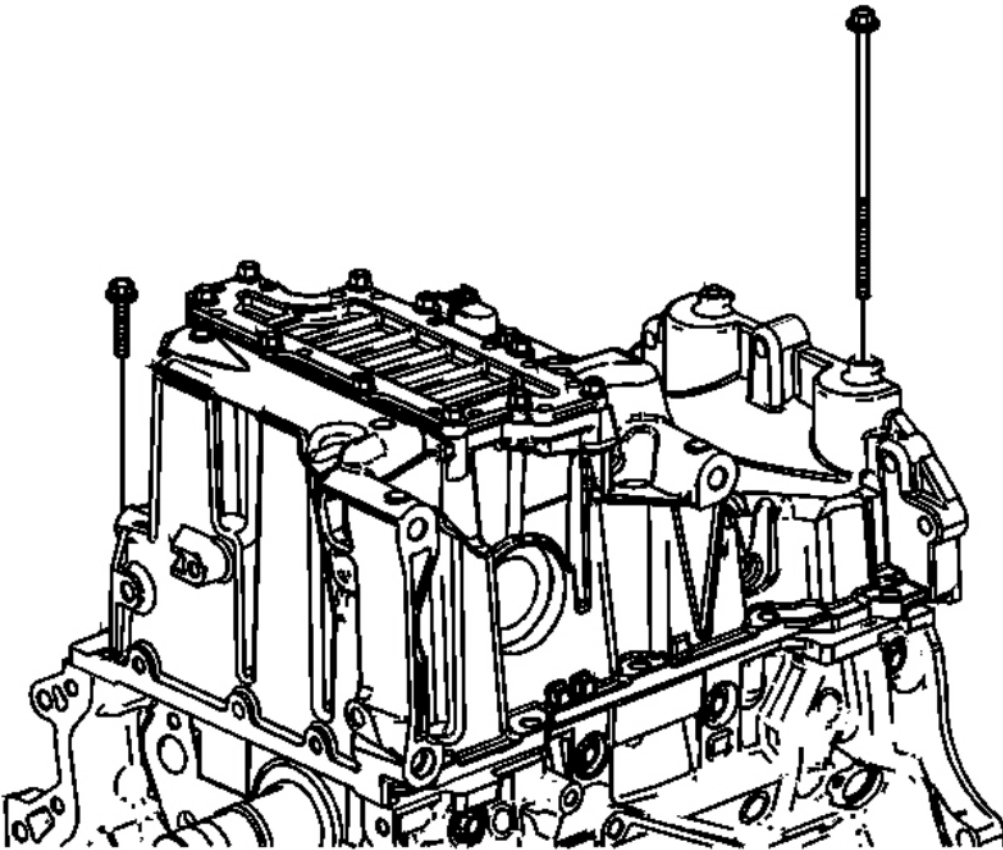


Fig. 167: View Of Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

5. Loosely install the oil pan bolts.

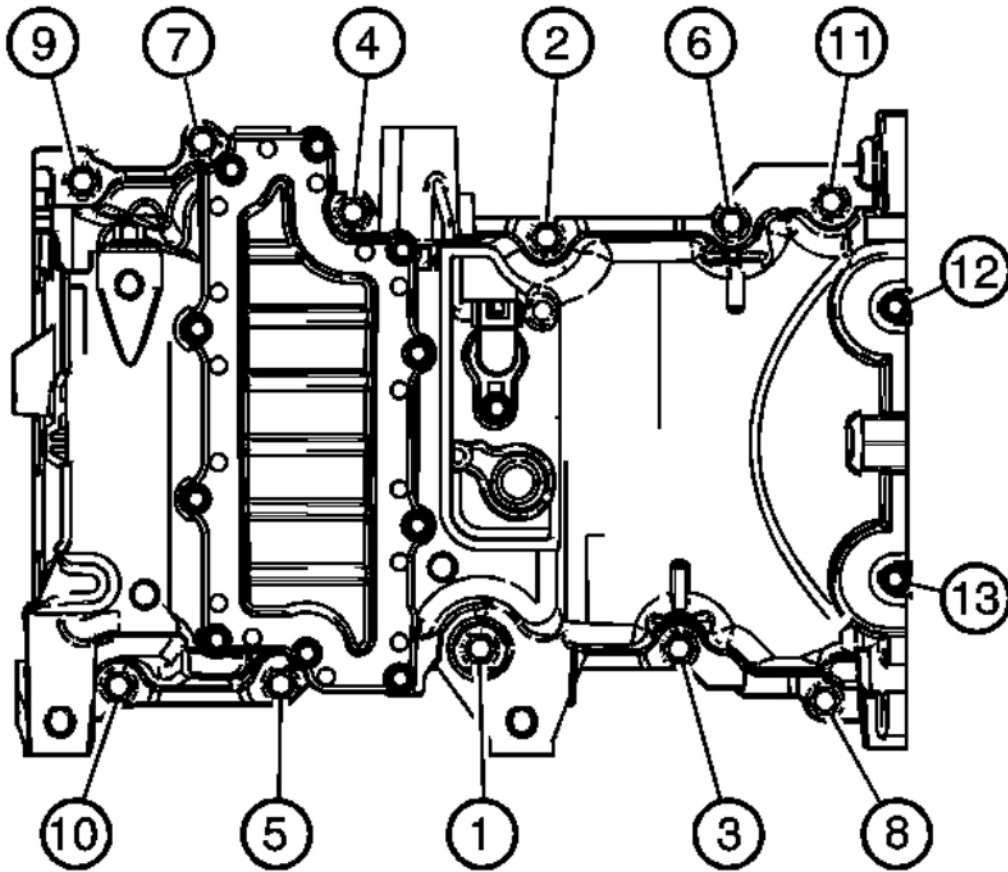


Fig. 168: Tightening Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Tighten the oil pan bolts in sequence shown.

Tighten:

1. Tighten the 8 mm bolts (1-11) to 23 N.m (17 lb ft).
2. Tighten the 6 mm bolts (12, 13) to 10 N.m (89 lb in).

Tools Required

- **EN 46111** Crankshaft Rotation Socket
- **J 45059** Angle Meter

IMPORTANT: Ensure that the crankshaft is in the timing drive assembly position using the EN 46111 .

1. Ensure the cylinder head locating pins are securely mounted in the cylinder block deck face.

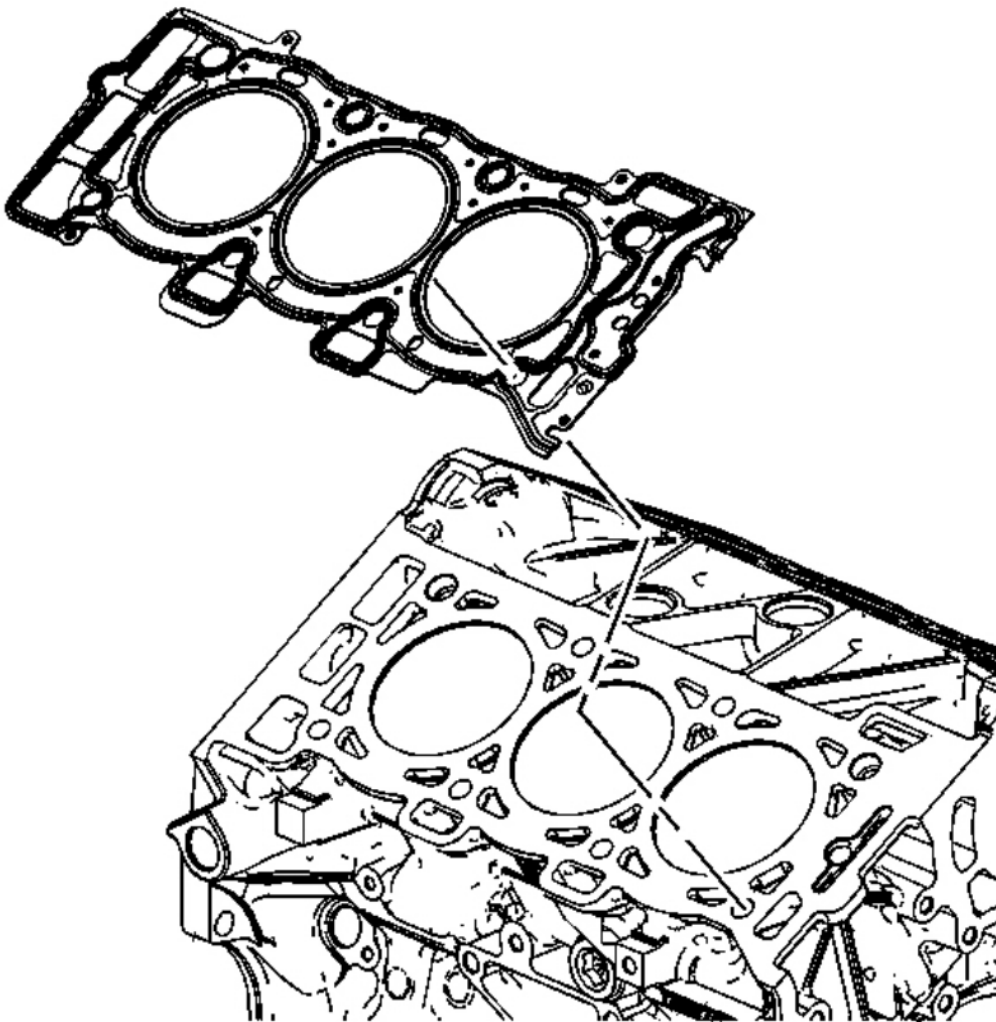


Fig. 169: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW right cylinder head gasket using the deck face locating pins for retention.

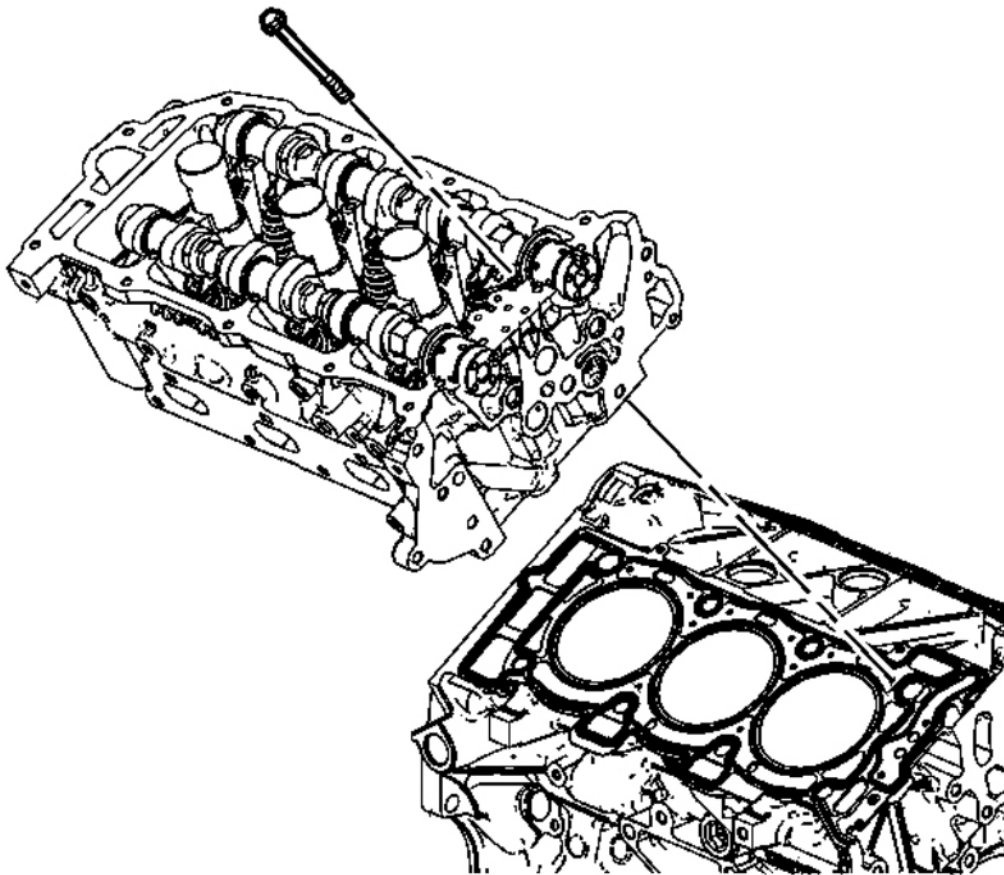


Fig. 170: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Align the right cylinder head with the deck face locating pins.
4. Place the right cylinder head in position on the deck face.

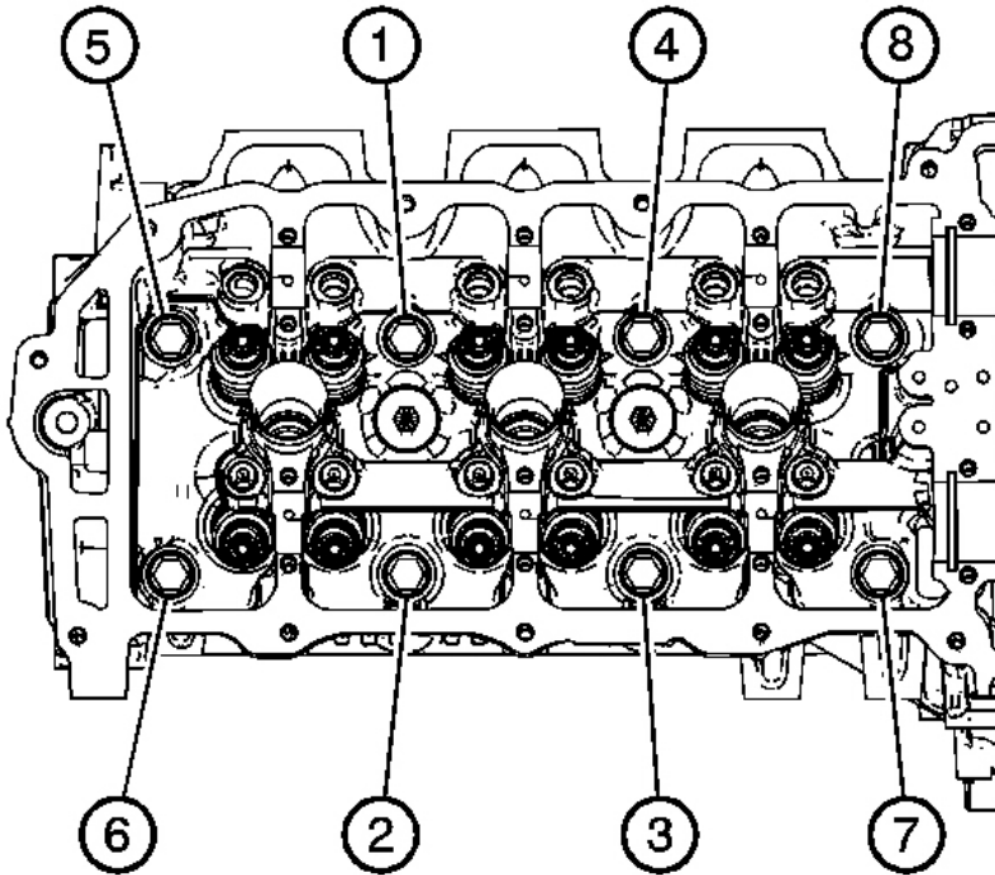


Fig. 171: Installing M11 Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: DO NOT allow oil on the cylinder head bolt bosses.

IMPORTANT: DO NOT reuse the old M11 cylinder head bolts.

5. Install new M11 cylinder head bolts.

Tighten:

1. Tighten the M11 cylinder head bolts a first pass in sequence to 45 N.m (33 lb ft).
2. Tighten the M11 cylinder head bolts a second pass in sequence an additional 120 degrees using the **J 45059** .

VALVE LIFTER INSTALLATION - RIGHT

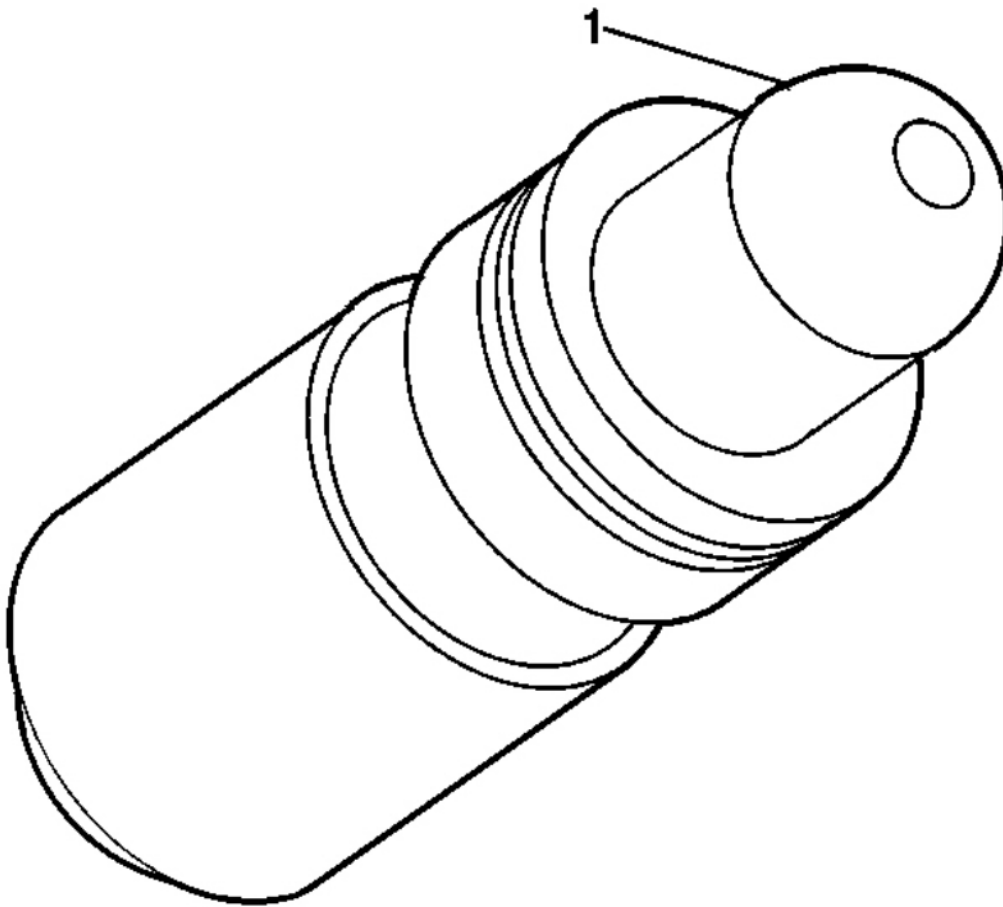


Fig. 172: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.

IMPORTANT: Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.

1. Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil GM P/N 12378006 or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.
2. Lubricate the SHLA bores in the cylinder head with clean engine oil GM P/N 12378006 or equivalent.

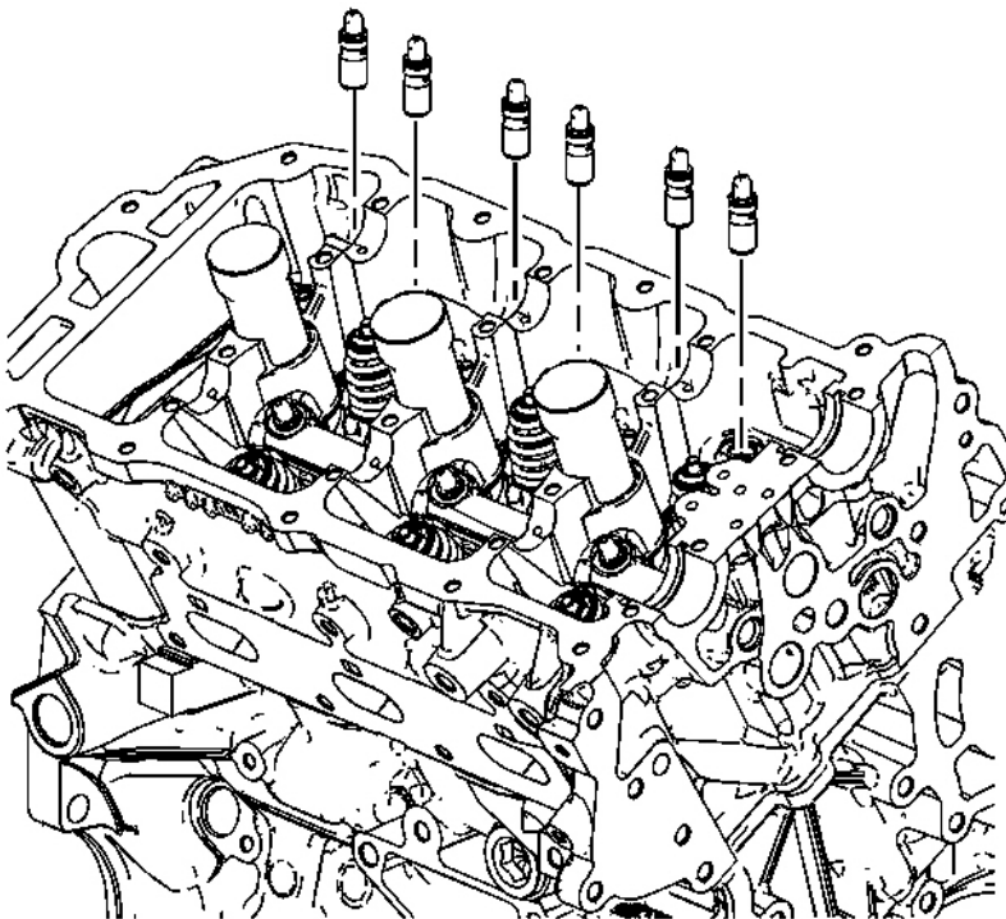


Fig. 173: Identifying Stationary Hydraulic Lash Adjuster (SHLA)
Courtesy of GENERAL MOTORS CORP.

3. Install the SHLAs in the cylinder head.

4. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the SHLA pivot spheres.

VALVE ROCKER ARM INSTALLATION - RIGHT

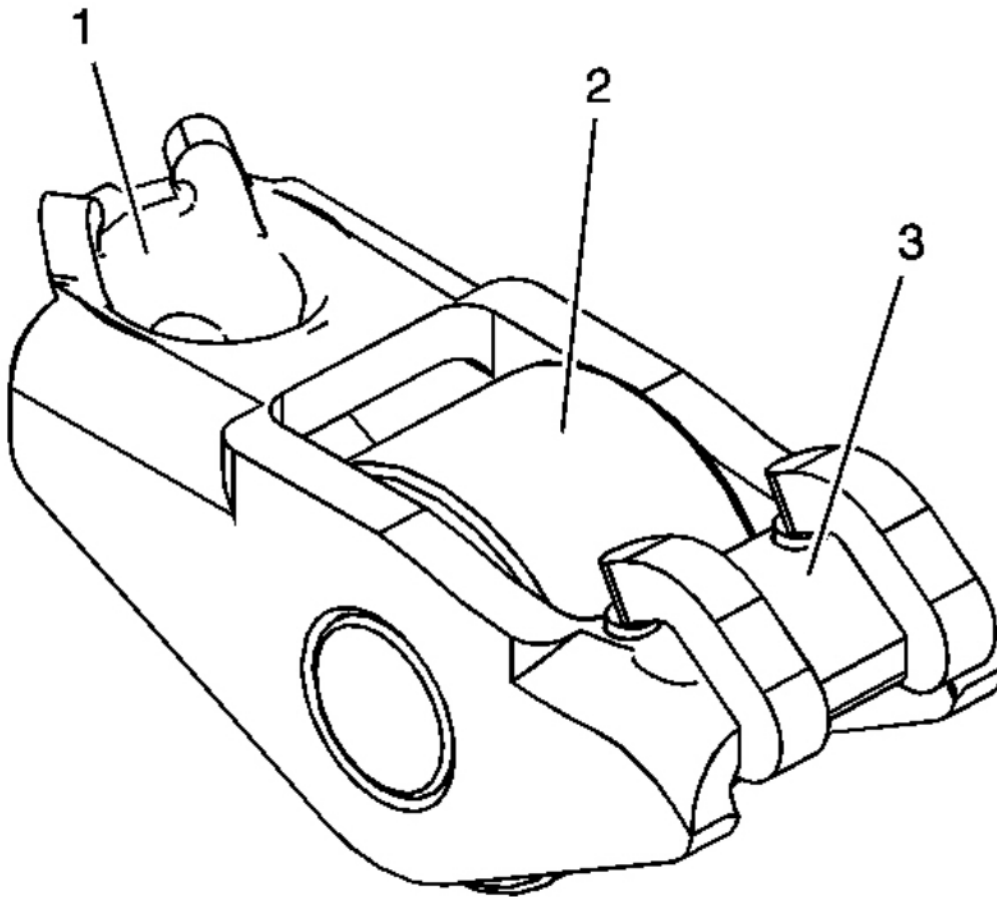


Fig. 174: Identifying Right Valve Rocker Arm Components
Courtesy of GENERAL MOTORS CORP.

1. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the pivot pocket (1), roller (2) and valve slot (3) areas of the camshaft followers.

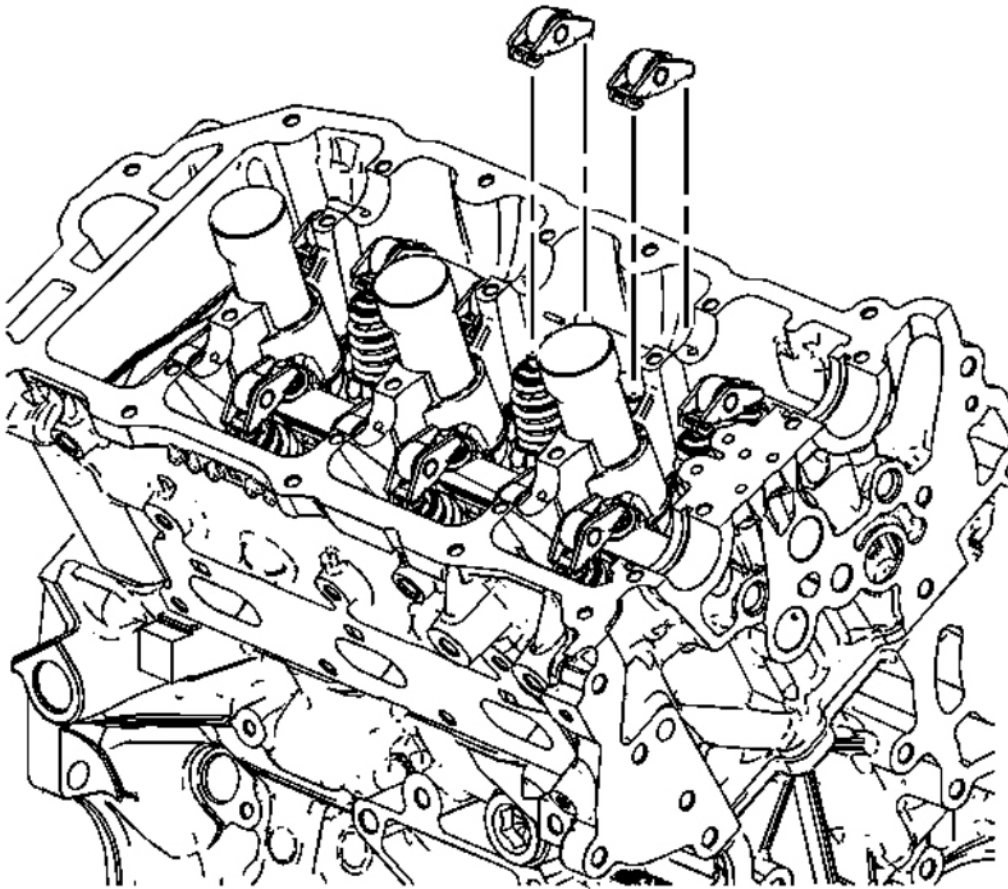


Fig. 175: Identifying Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The follower must be positioned squarely on the valve tip so that the full width of the roller will completely contact the camshaft lobe. If the followers are being reused you must put them back in their original location.

2. Place the camshaft followers in position on the valve tip and stationary hydraulic lash adjuster (SHLA).
3. The rounded head end of the follower goes on the SHLA while the flat end goes on the valve tip.

4. Clean the camshaft journals and carriers with a clean, lint-free cloth.

CAMSHAFT INSTALLATION - RIGHT

Tools Required:

EN 46111 Crankshaft Rotation Socket

1. Ensure that the crankshaft is in the stage one timing drive assembly position using the **EN 46111** . Refer to **Camshaft Timing Drive Chain Alignment Diagram** .

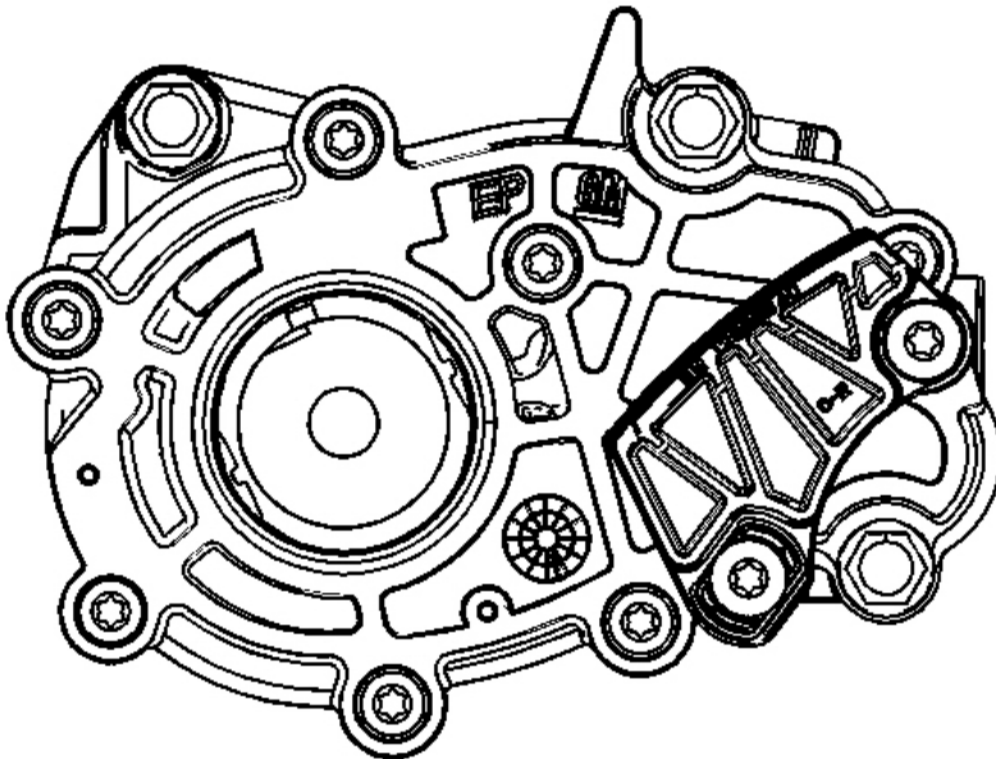


Fig. 176: Identifying Stage One Timing Drive Assembly Position
Courtesy of GENERAL MOTORS CORP.

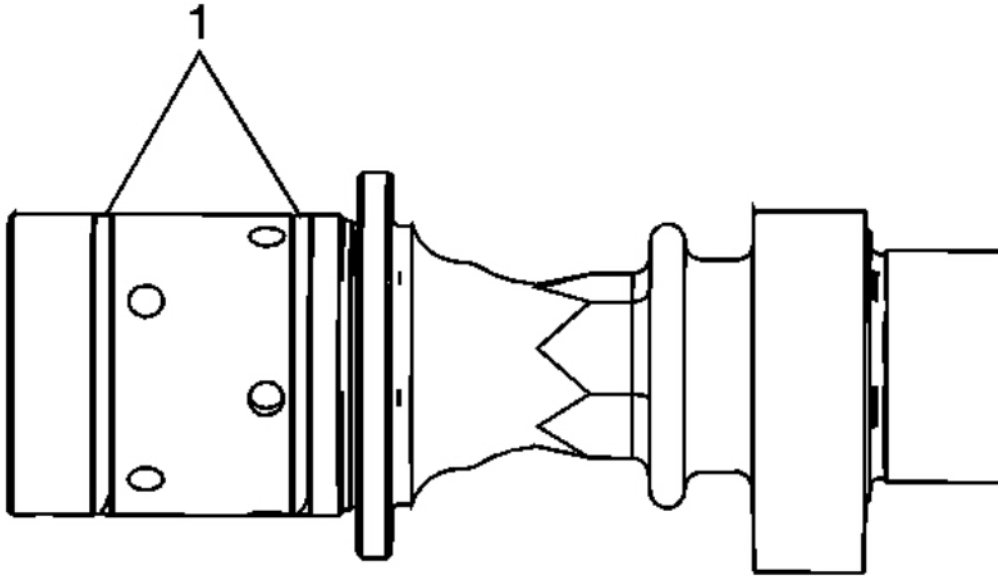


Fig. 177: View Of Camshaft Sealing Rings
Courtesy of GENERAL MOTORS CORP.

2. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves.

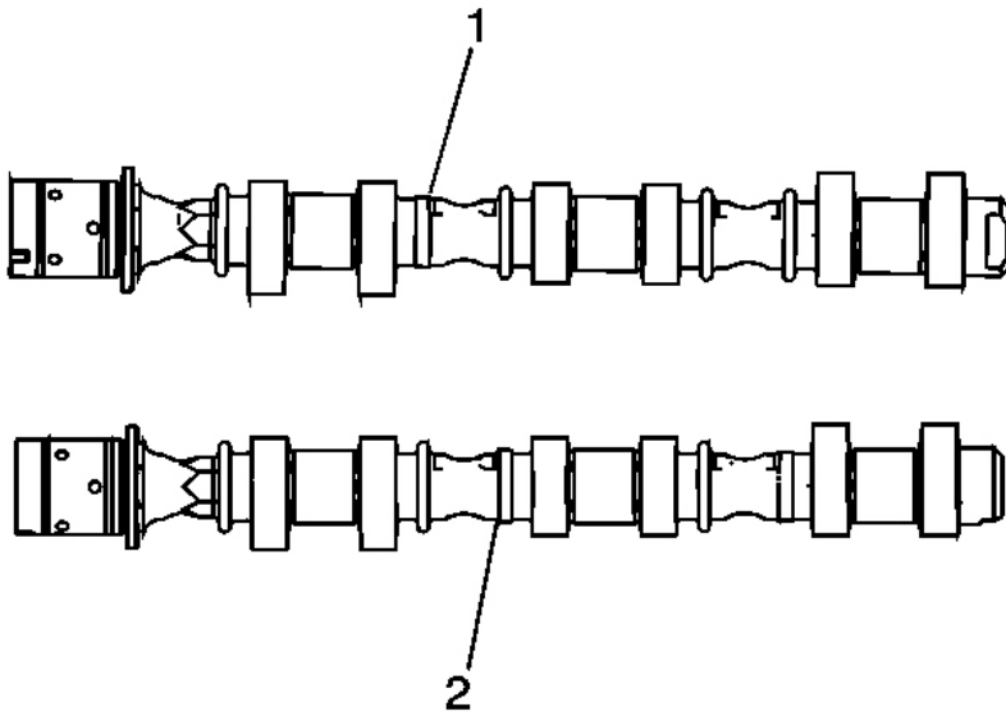


Fig. 178: Checking For Proper Right Camshaft Installation Location
Courtesy of GENERAL MOTORS CORP.

3. Select the proper camshaft for the particular installation location. The ring placement is defined as follows:
 1. The number 2 identification ring for the right exhaust camshaft is machined off (1).
 2. The number 3 identification ring for the right intake camshaft is machined off (2).

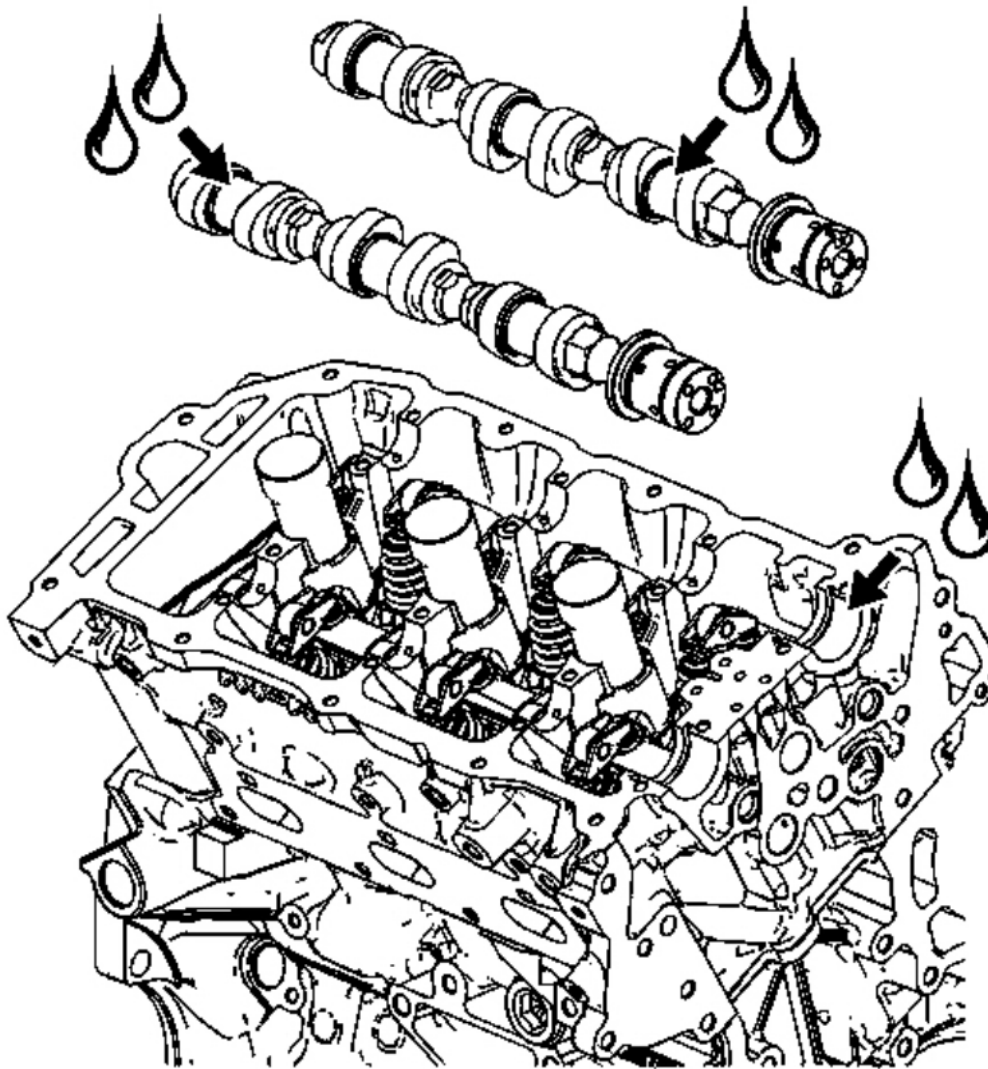


Fig. 179: Lubricating Right Camshaft Journals & Right Cylinder Head Camshaft Carriers

Courtesy of GENERAL MOTORS CORP.

4. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft journals and the right cylinder head camshaft carriers.

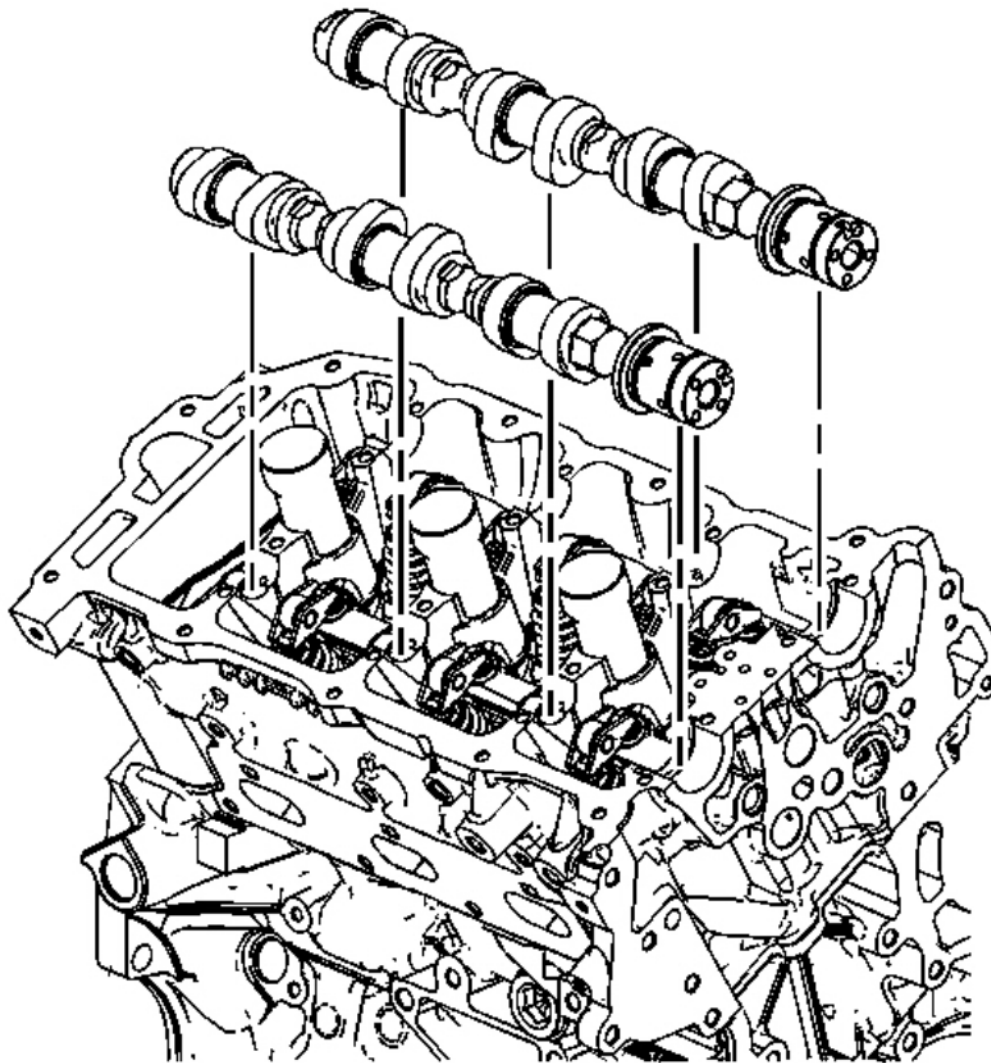


Fig. 180: View Of Right Camshafts
Courtesy of GENERAL MOTORS CORP.

5. Place the right intake and right exhaust camshafts in position in the right cylinder head.

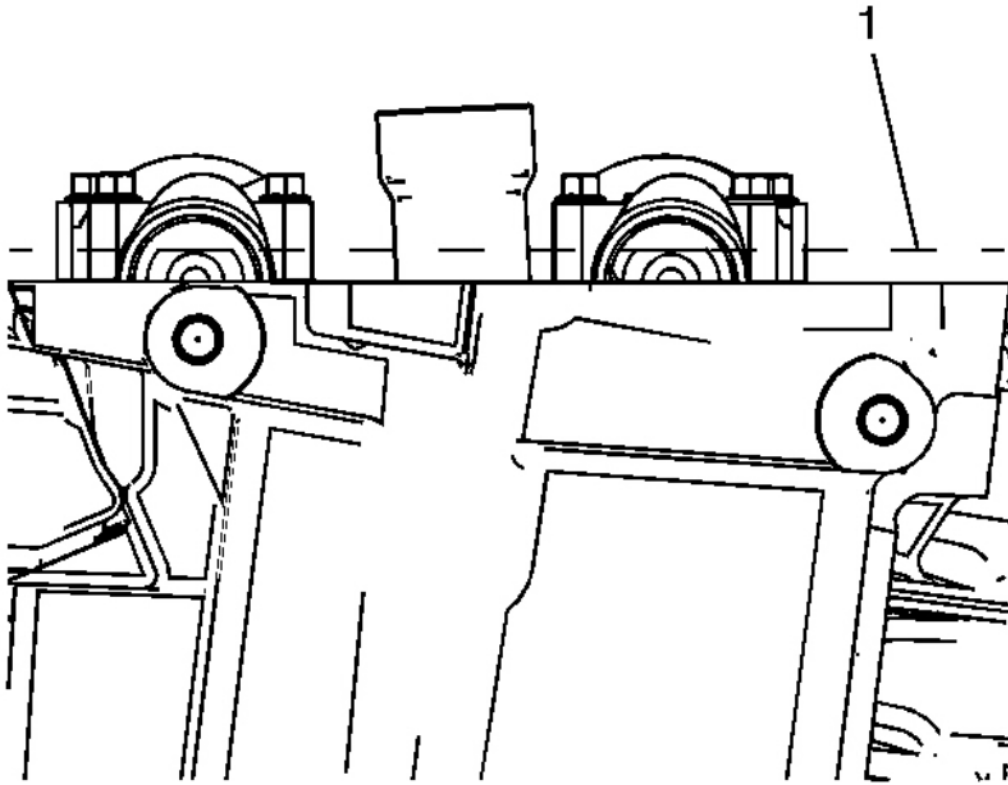


Fig. 181: Positioning Camshaft Lobes Parallel With Right Cylinder Head Camshaft Cover Rail

Courtesy of GENERAL MOTORS CORP.

6. Position the camshaft lobes in a neutral position with the flats on the back of the camshafts up and parallel (1) with the right cylinder head camshaft cover rail.

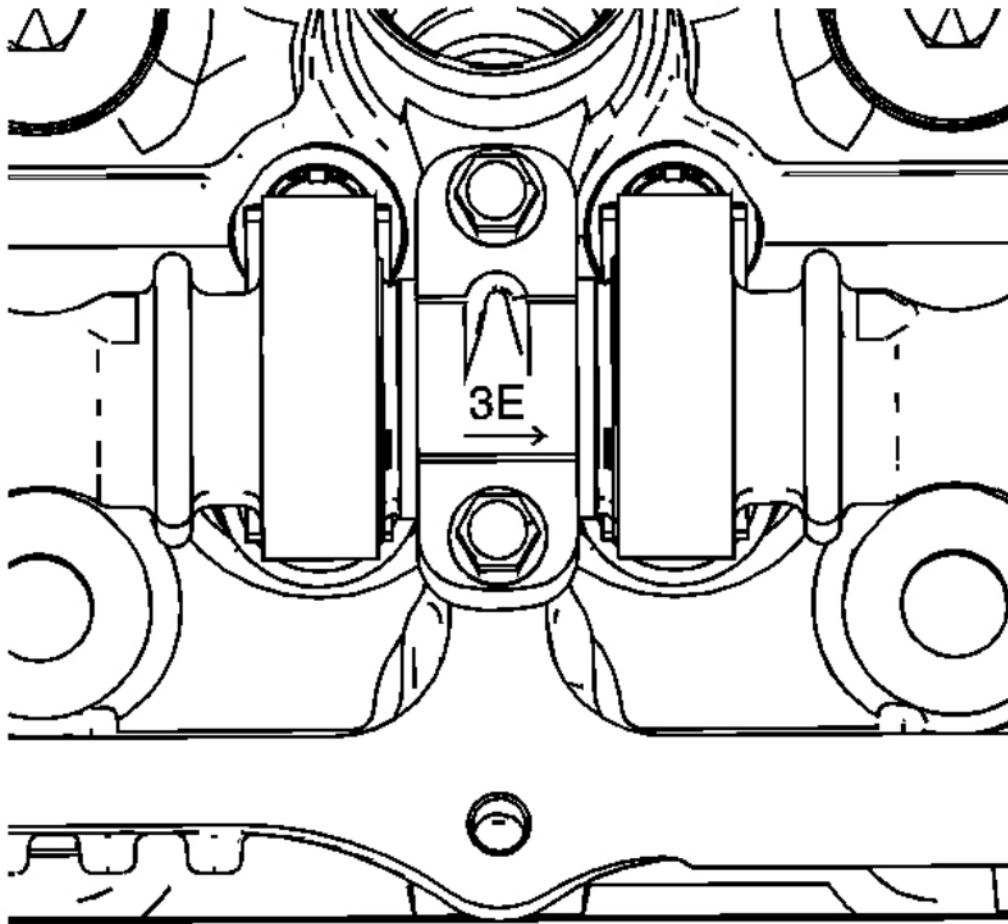


Fig. 182: View Of Right Cylinder Head Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

7. Observe the markings on the right cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number 1, 3, 5 indicates the cylinder position from the front of the engine.
8. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

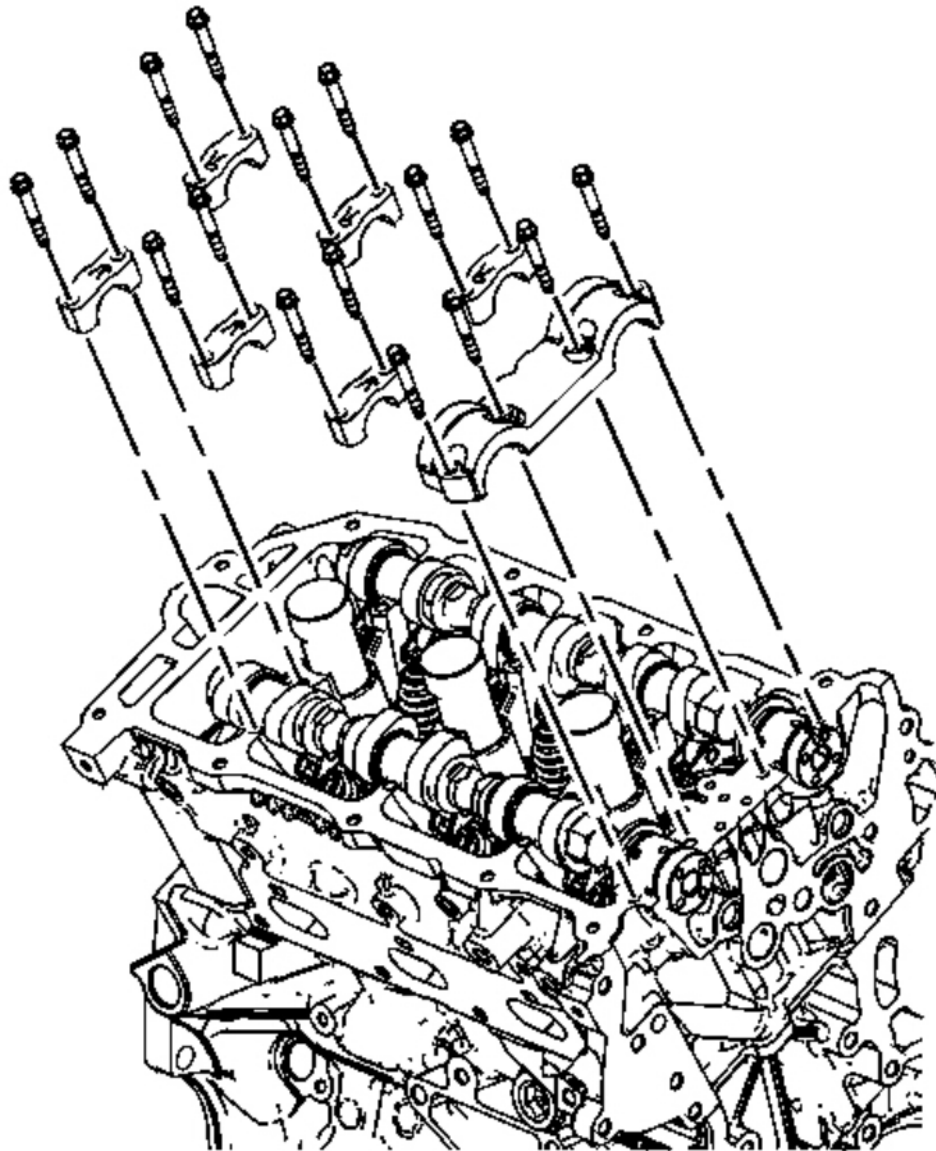


Fig. 183: View Of Right Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

9. Install the camshaft bearing thrust caps in the first journal of the right cylinder head.
10. Install the remaining bearing caps with their orientation mark toward the center of the

cylinder head.

11. Hand start all the camshaft bearing cap bolts.

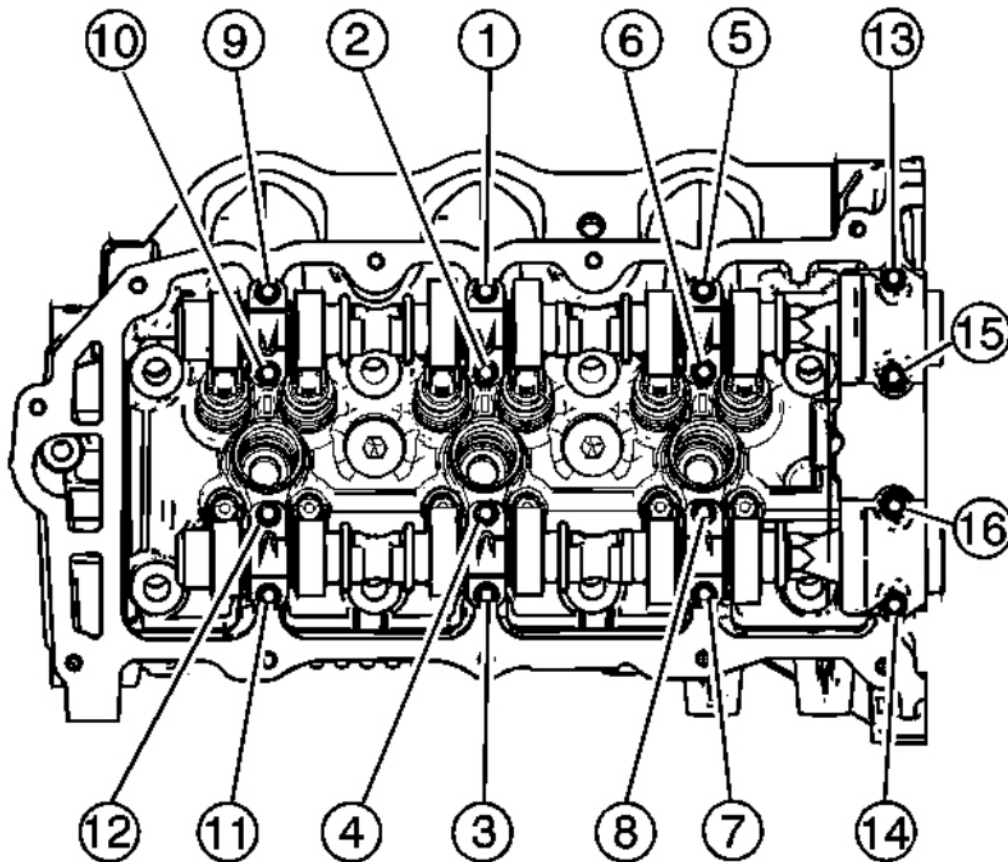


Fig. 184: Installing Right Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

12. Tighten the camshaft bearing cap bolts in the sequence shown.

Tighten: Tighten the camshaft bearing cap bolts in sequence to 10 N.m (89 lb in).

13. Loosen the center intake camshaft bearing cap bolts (1, 2) and the center exhaust camshaft bearing cap bolts (3, 4).

14. Retighten the center camshaft bearing cap bolts (1, 2, 3, 4).

Tighten: Retighten the camshaft bearing cap bolts to 10 N.m (89 lb in).

CYLINDER HEAD INSTALLATION - LEFT

Tools Required

- **EN 46111** Crankshaft Rotation Socket
- **J 45059** Angle Meter

IMPORTANT: Ensure that the crankshaft is in the stage one timing drive assembly position using the EN 46111 .

1. Ensure the cylinder head locating pins are securely mounted in the cylinder block deck face.

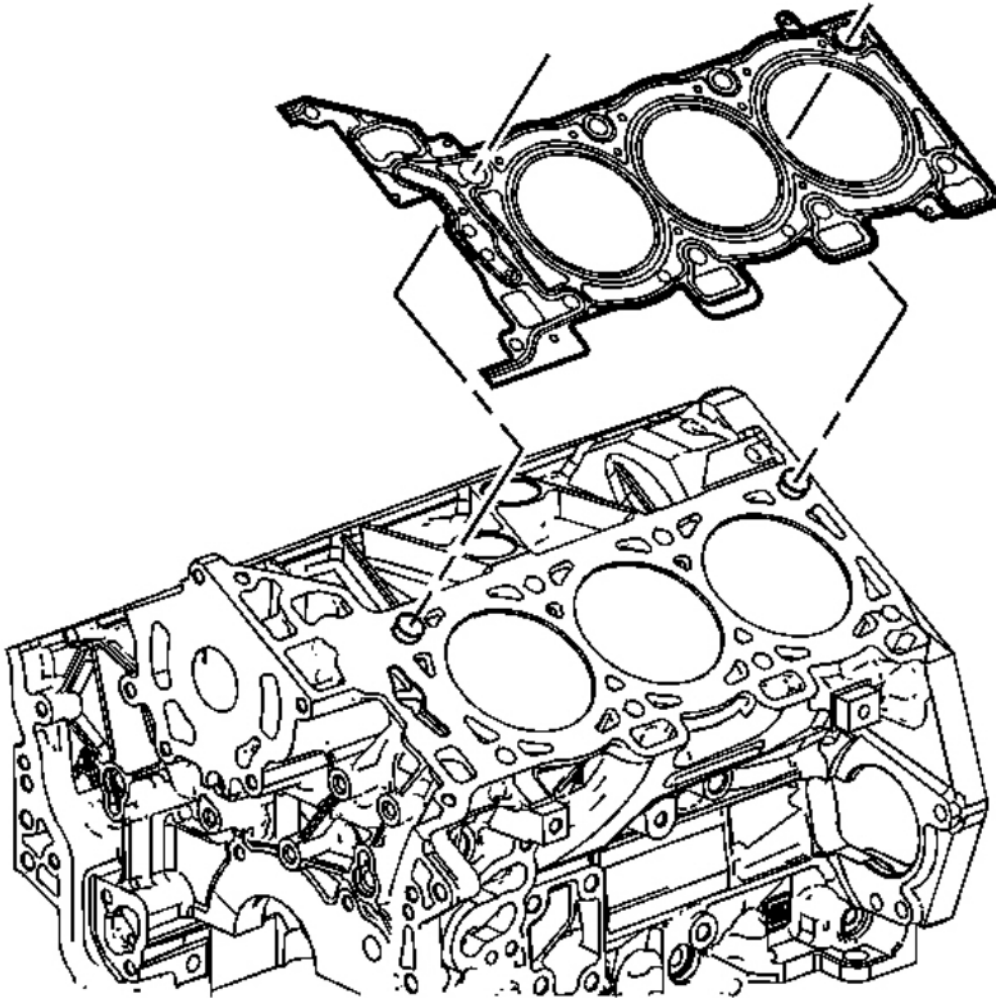


Fig. 185: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install a NEW left cylinder head gasket using the deck face locating pins for retention.

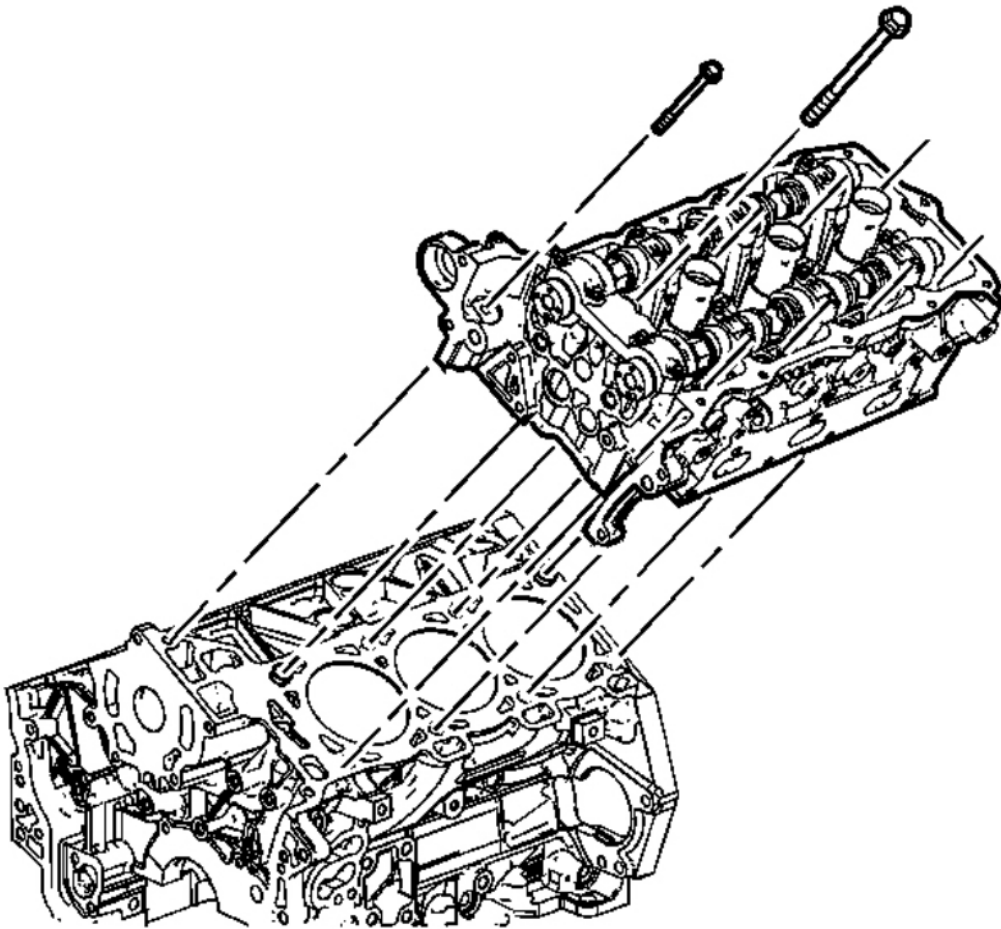


Fig. 186: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

3. Align the left cylinder head with the deck face locating pins.
4. Place the left cylinder head in position on the deck face.

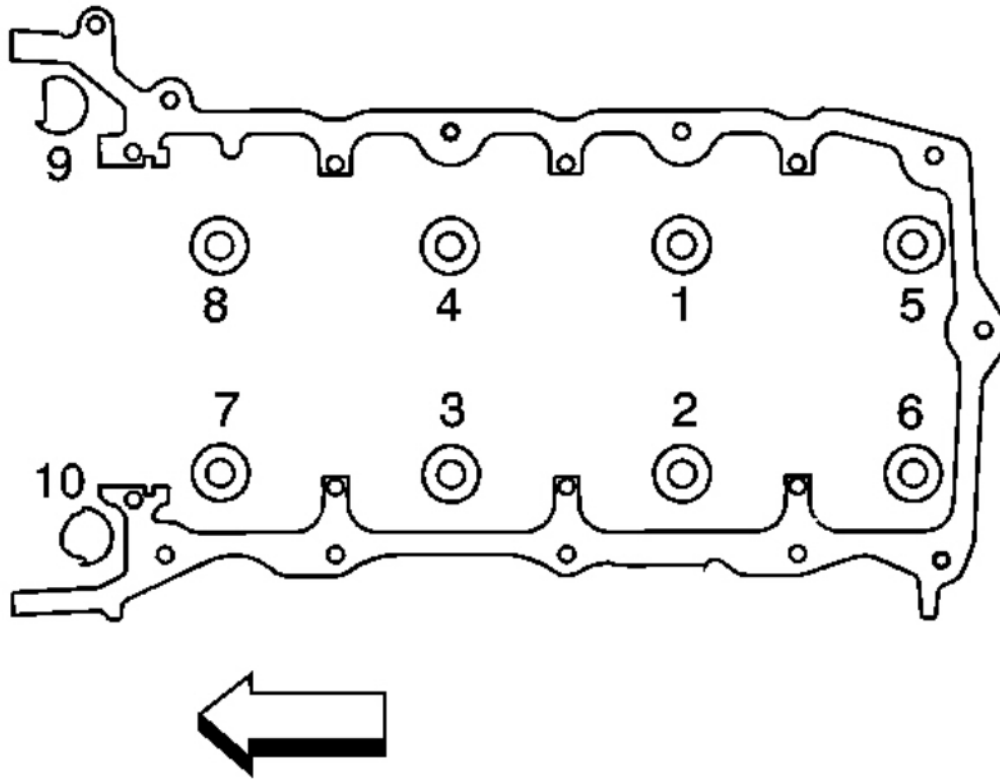


Fig. 187: Installing M11 Left Cylinder Head Bolts

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: DO NOT allow oil on the cylinder head bolt bosses.

IMPORTANT: DO NOT reuse the old M11 cylinder head bolts.

5. Install new M11 cylinder head bolts.

Tighten:

1. Tighten the M11 cylinder head bolts a first pass in sequence to 45 N.m (33 lb ft).
2. Tighten the M11 cylinder head bolts a second pass in sequence an additional 120

degrees using the **J 45059** .

6. Install the 2 front M8 left cylinder head bolts.

Tighten:

1. Tighten the M8 cylinder head bolts a first pass to 15 N.m (11 lb ft).
2. Tighten the M8 cylinder head bolts a second pass in sequence an additional 60 degrees using the **J 45059** .

VALVE LIFTER INSTALLATION - LEFT

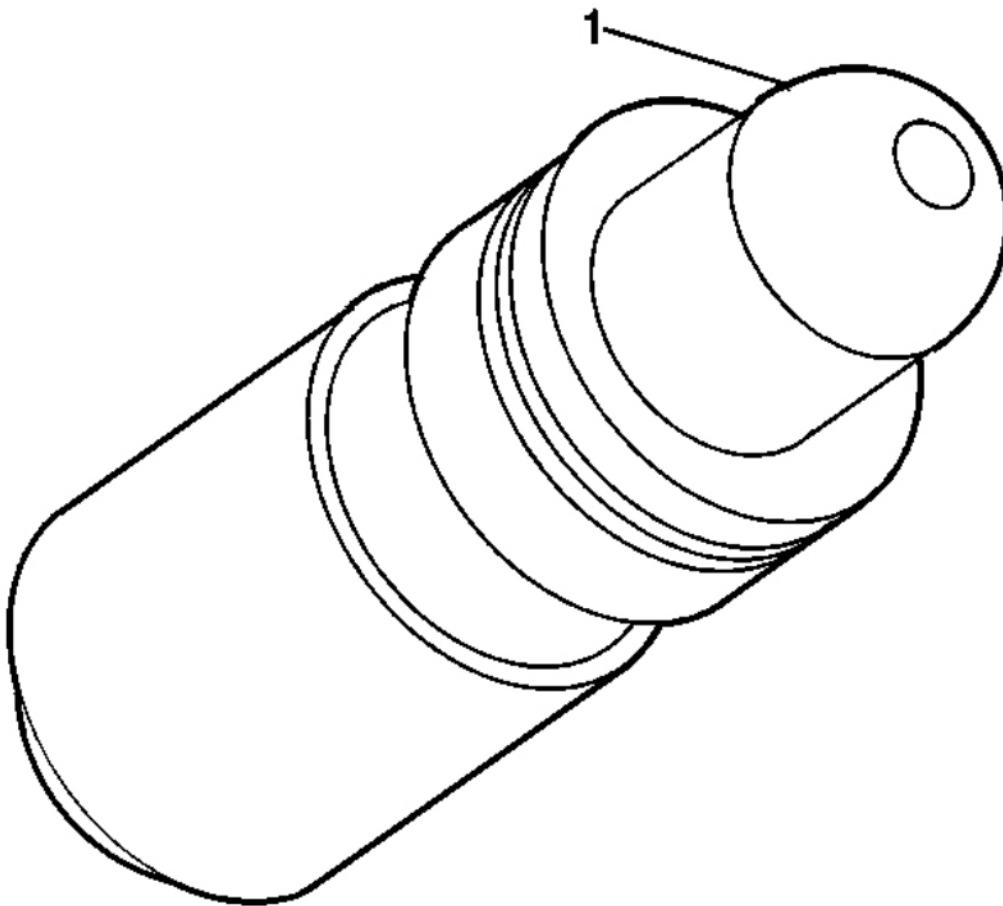


Fig. 188: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not stroke/cycle the stationary hydraulic lash adjuster plunger without oil in the lower pressure chamber.

IMPORTANT: Do not allow the stationary hydraulic lash adjuster to tip over, plunger down, after the oil fill.

1. Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil GM P/N 12378006 or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.
2. Lubricate the SHLA bores in the cylinder head with clean engine oil GM P/N 12378006 or equivalent.

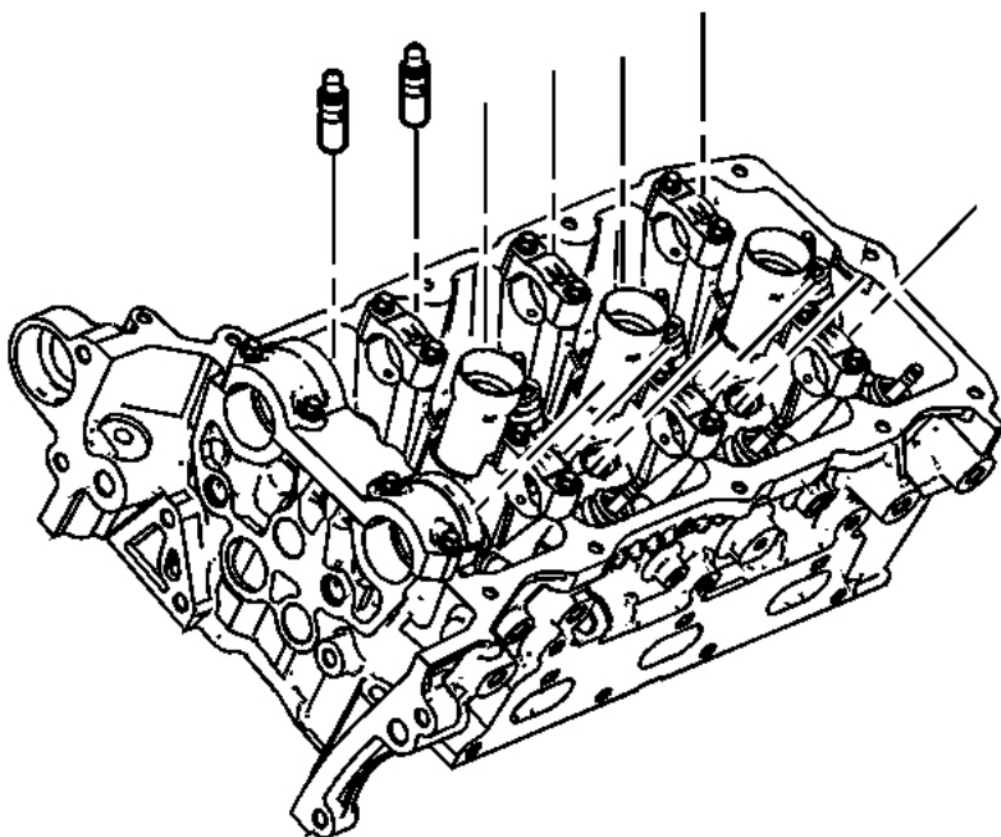


Fig. 189: View Of SHLAs

Courtesy of GENERAL MOTORS CORP.

3. Install the SHLAs in the cylinder head.
4. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the SHLA pivot spheres.

VALVE ROCKER ARM INSTALLATION - LEFT

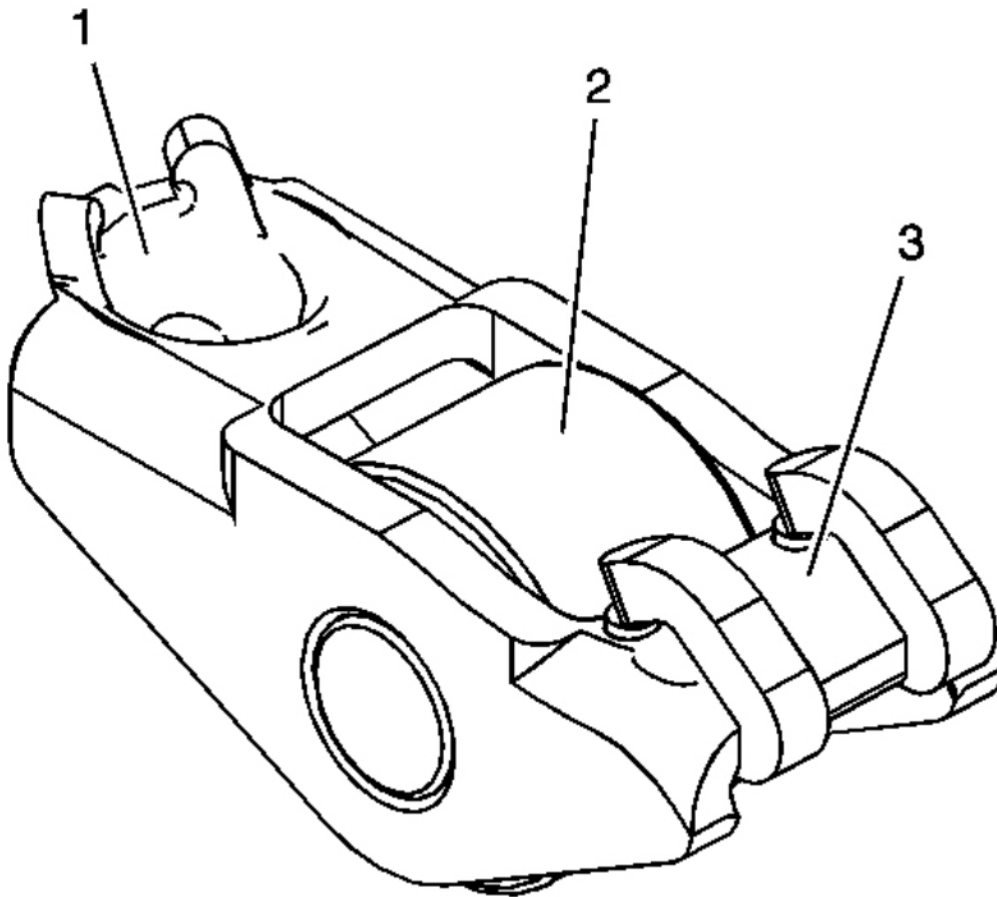


Fig. 190: Identifying Left Valve Rocker Arm Components
Courtesy of GENERAL MOTORS CORP.

1. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the pivot pocket (1), roller (2) and valve slot (3) areas of the camshaft followers.

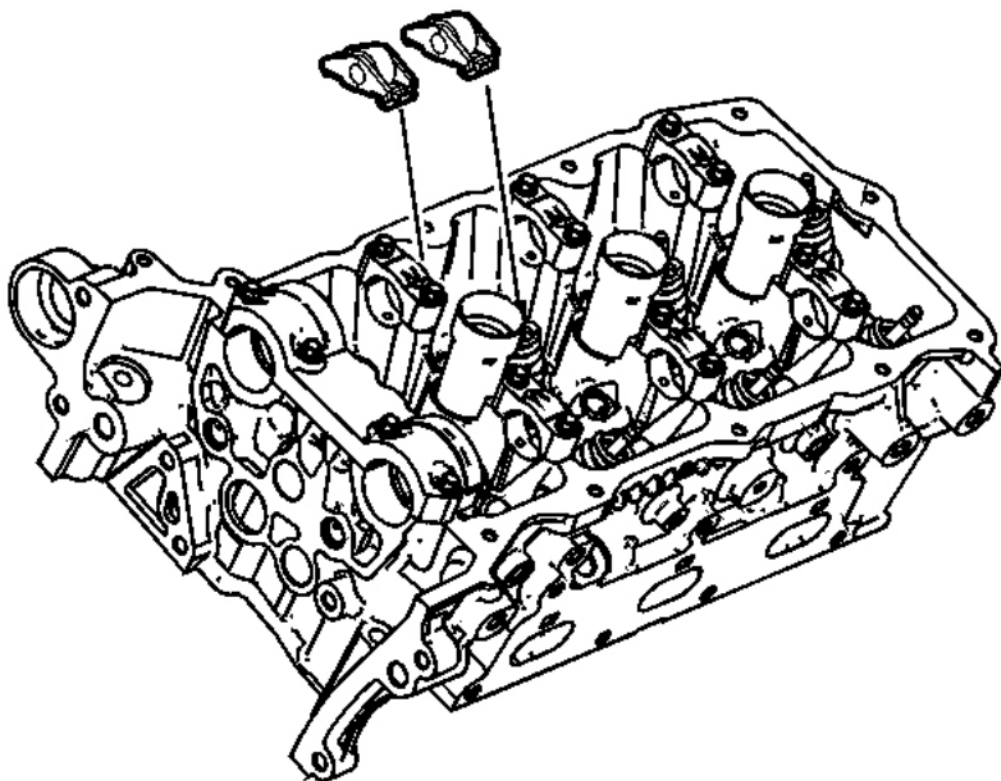


Fig. 191: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The follower must be positioned squarely on the valve tip so that the full width of the roller will completely contact the camshaft lobe. If the followers are being reused you must put them back in their original location.

2. Place the camshaft followers in position on the valve tip and stationary hydraulic lash adjuster (SHLA).
3. The rounded head end of the follower goes on the SHLA while the flat end goes on the valve tip.
4. Clean the camshaft journals and carriers with a clean, lint-free cloth.

Tools Required:

EN 46111 Crankshaft Rotation Socket

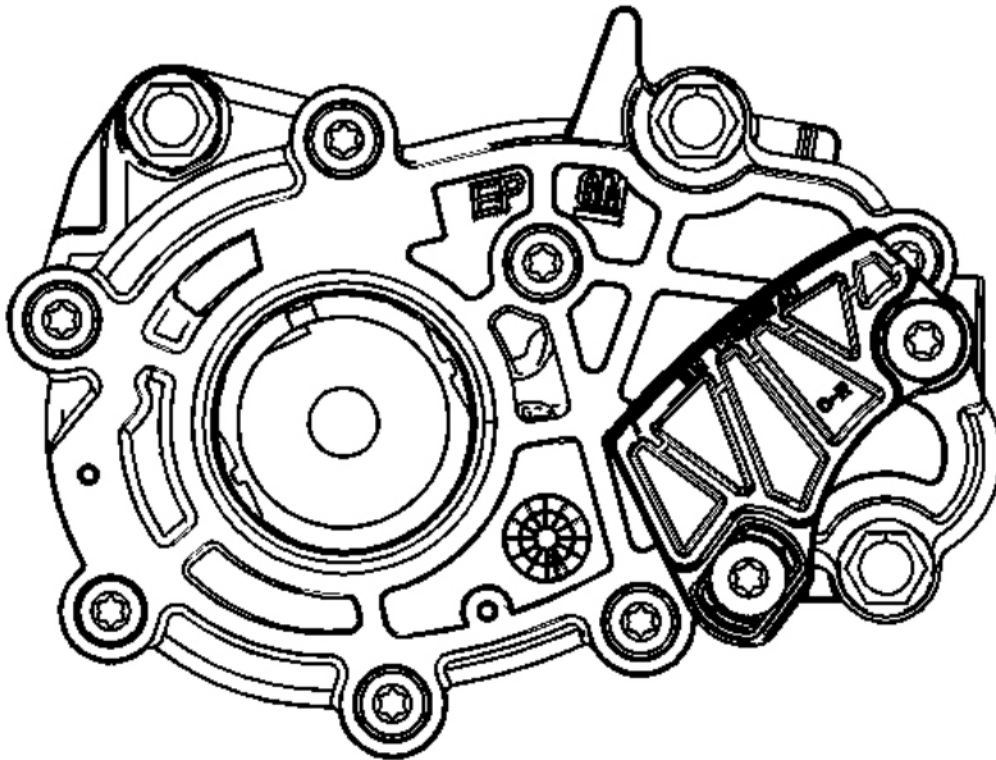


Fig. 192: Identifying Stage One Timing Drive Assembly Position
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the crankshaft is in the stage one timing drive assembly position using the **EN 46111** . Refer to **Camshaft Timing Drive Chain Alignment Diagram** .

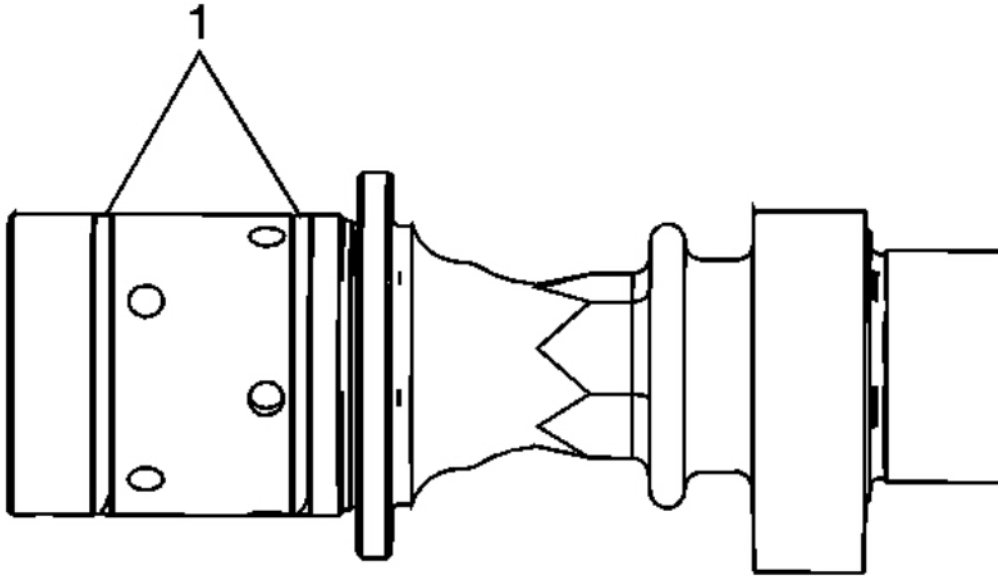


Fig. 193: View Of Camshaft Sealing Rings
Courtesy of GENERAL MOTORS CORP.

2. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves.

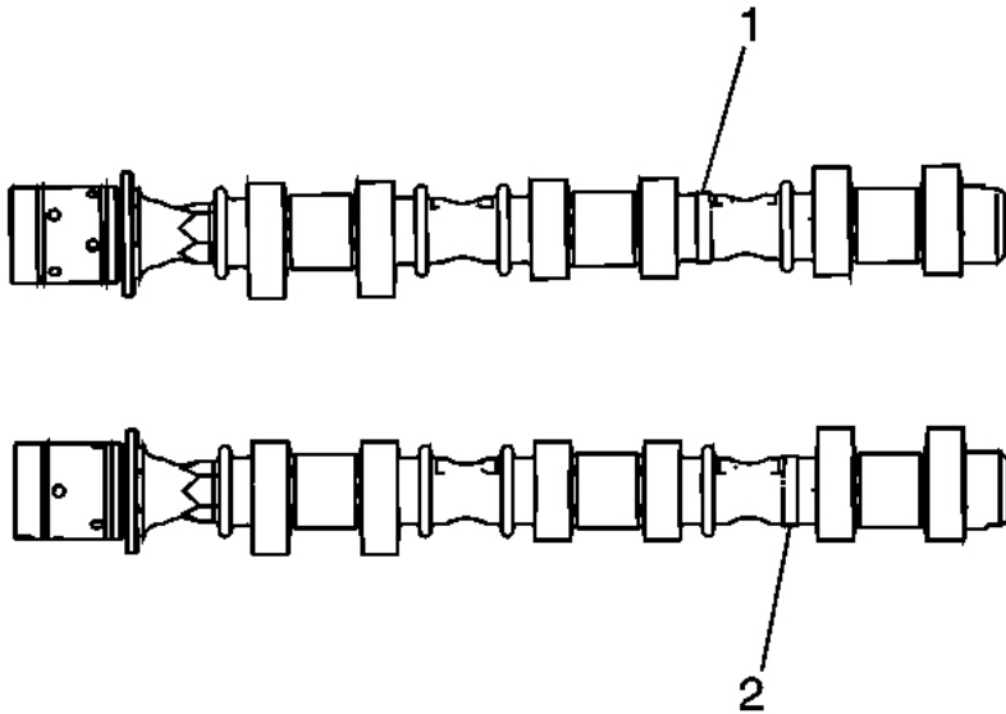


Fig. 194: Checking For Proper Left Camshaft Installation Location
Courtesy of GENERAL MOTORS CORP.

3. Select the proper camshaft for the particular installation location. The ring placement is defined as follows:
 1. The number 4 identification ring for the left intake camshaft is machined off (1).
 2. The number 5 identification ring for the left exhaust camshaft is machined off (2).

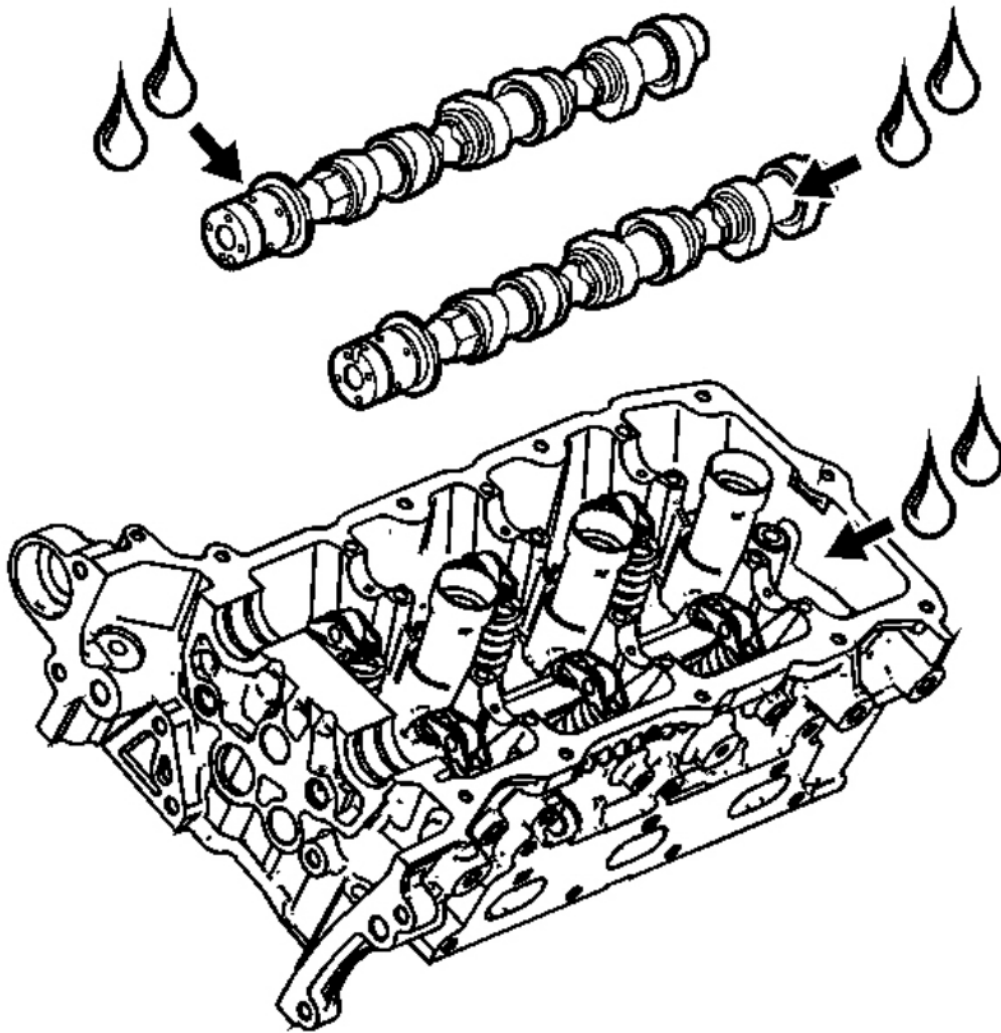


Fig. 195: Lubricating Left Camshaft Journals & Left Cylinder Head Camshaft Carriers

Courtesy of GENERAL MOTORS CORP.

4. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft journals and the left cylinder head camshaft carriers.

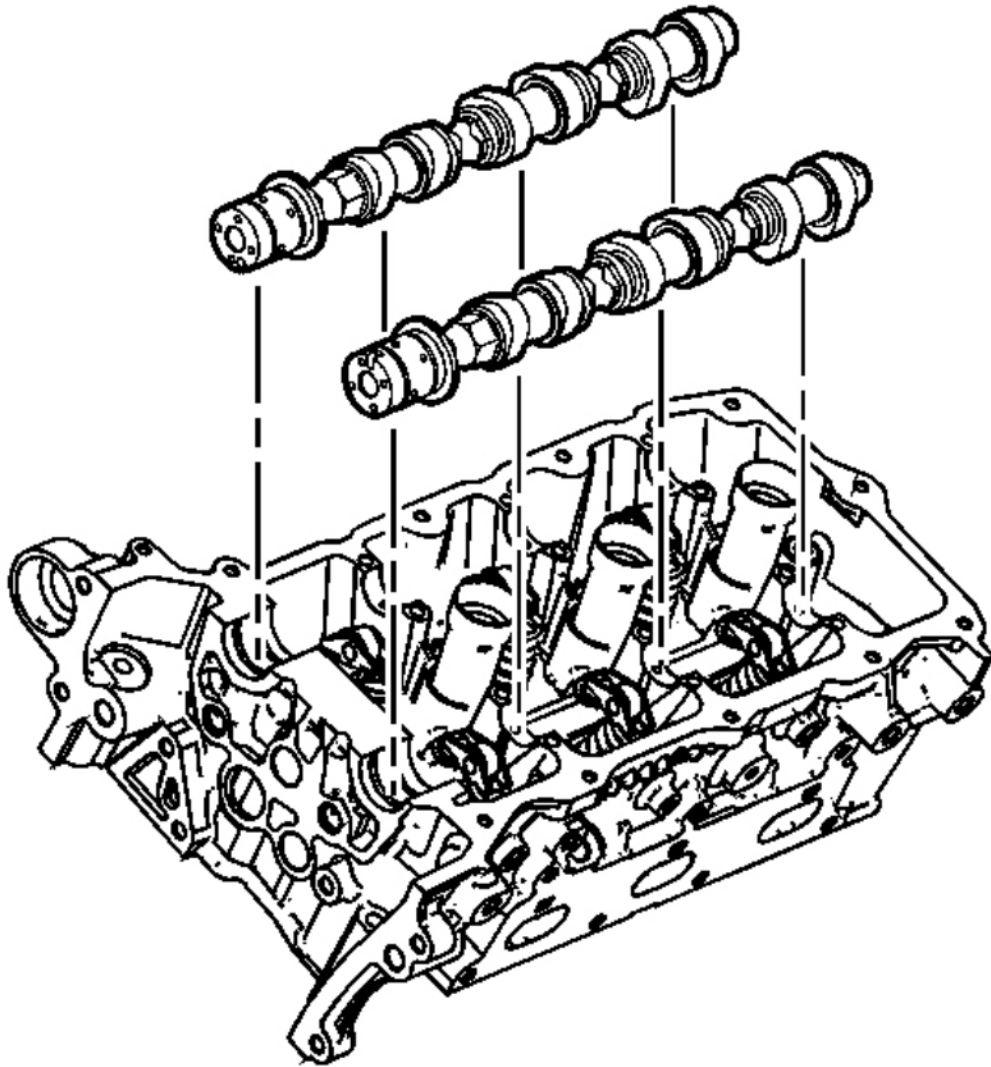


Fig. 196: View Of Left Camshafts
Courtesy of GENERAL MOTORS CORP.

5. Place the left intake and left exhaust camshafts in position in the left cylinder head.

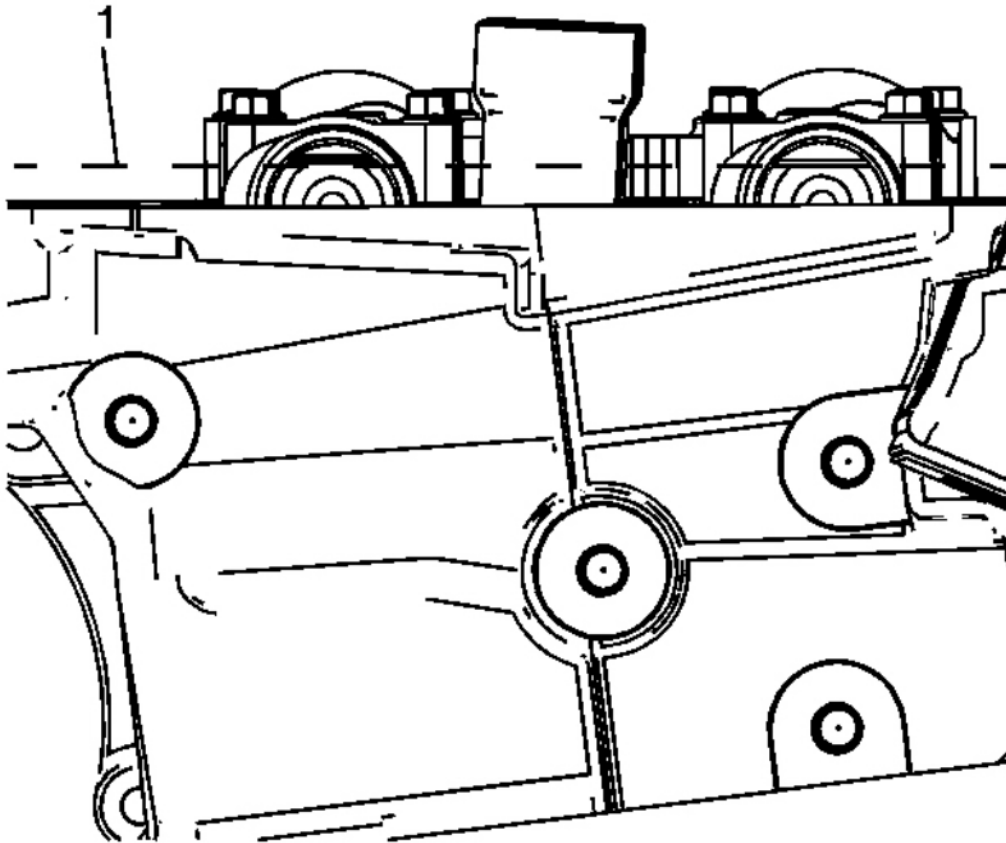


Fig. 197: Positioning Camshaft Lobes Parallel With Left Cylinder Head Camshaft Cover Rail

Courtesy of GENERAL MOTORS CORP.

6. Position the camshaft lobes in a neutral position with the flats on the back of the camshafts up and parallel (1) with the left cylinder head camshaft cover rail.

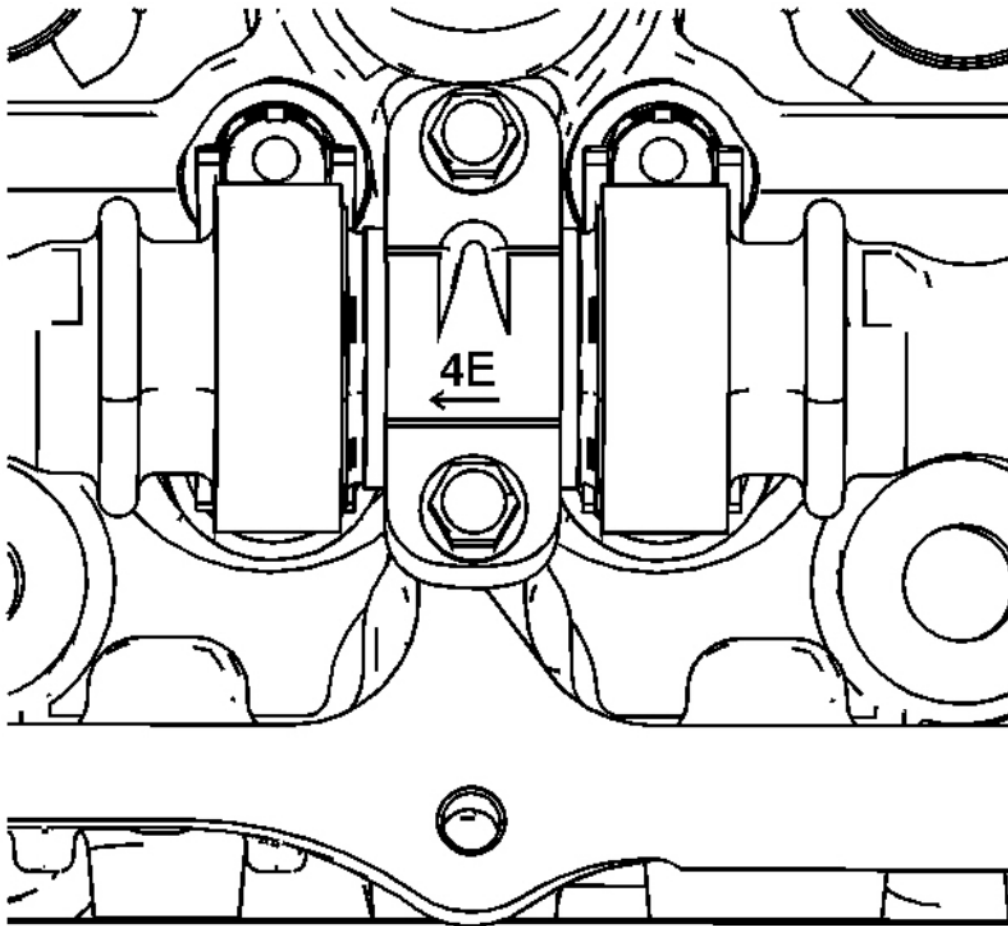


Fig. 198: View Of Left Cylinder Head Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

7. Observe the markings on the left cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.
 - The number 2, 4, 6 indicates the cylinder position from the front of the engine.
8. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

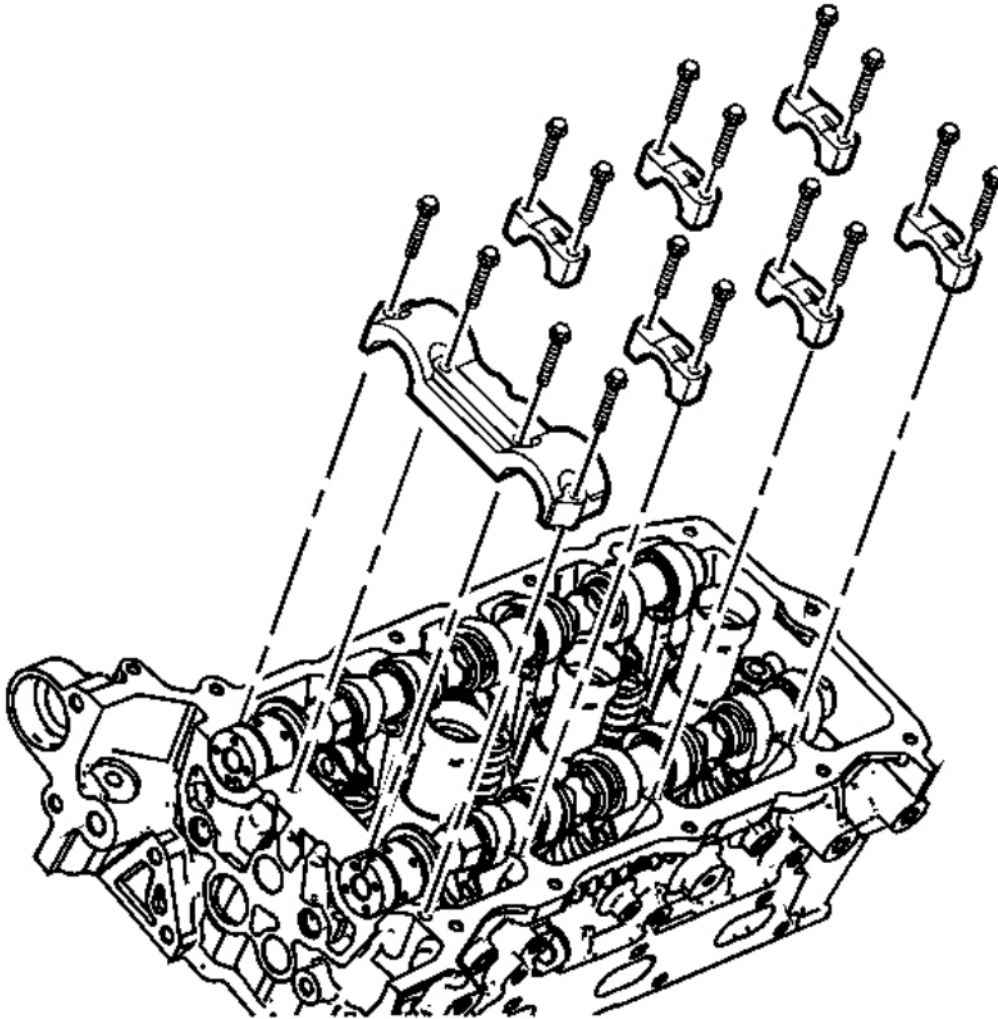


Fig. 199: View Of Left Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

9. Install the camshaft bearing thrust cap in the first journal of the left cylinder head.
10. Install the remaining bearing caps with their orientation mark toward the center of the cylinder head.
11. Hand start all the camshaft bearing cap bolts.

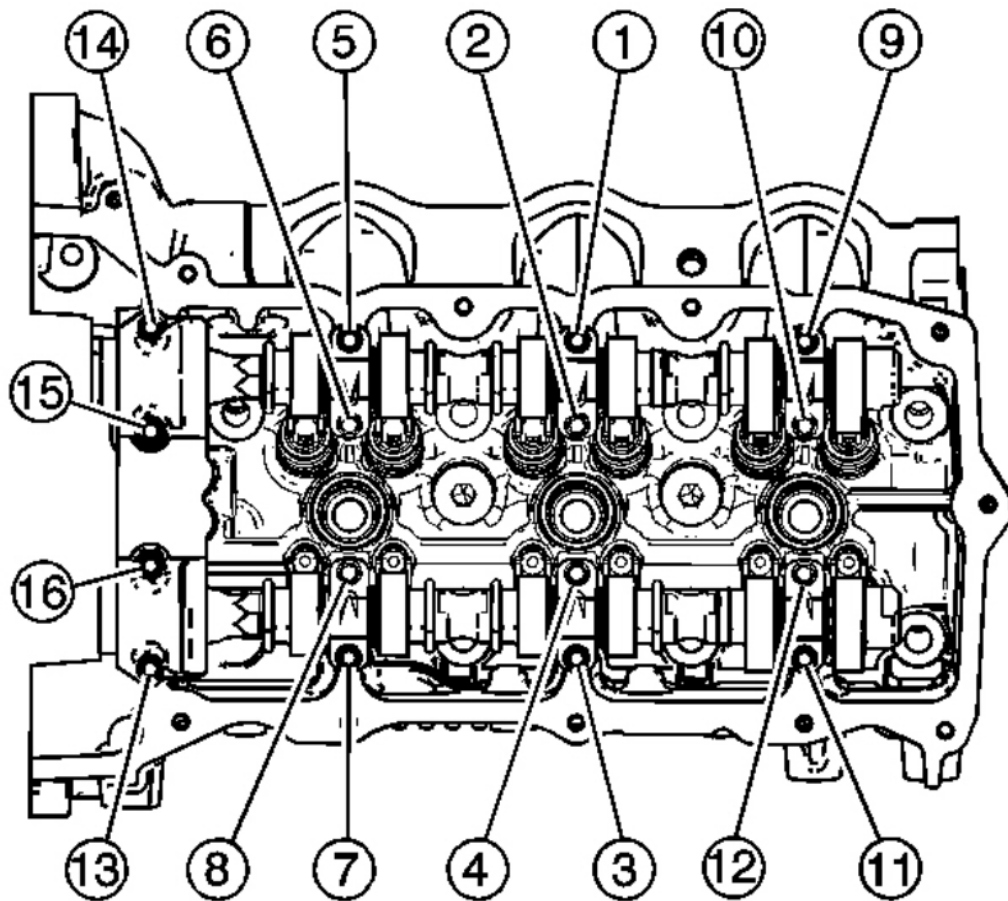


Fig. 200: Installing Left Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

12. Tighten the camshaft bearing cap bolts in the sequence shown.

Tighten: Tighten the camshaft bearing cap bolts in sequence to 10 N.m (89 lb in).

13. Loosen the center intake camshaft bearing cap bolts 1, 2 and the center exhaust camshaft bearing cap bolts 3, 4.
14. Retighten the center camshaft bearing cap bolts 1, 2, 3, 4.

Tighten: Retighten the camshaft bearing cap bolts to 10 N.m (89 lb in).

CAMSHAFT POSITION (CMP) ACTUATOR INSTALLATION - RIGHT INTAKE

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

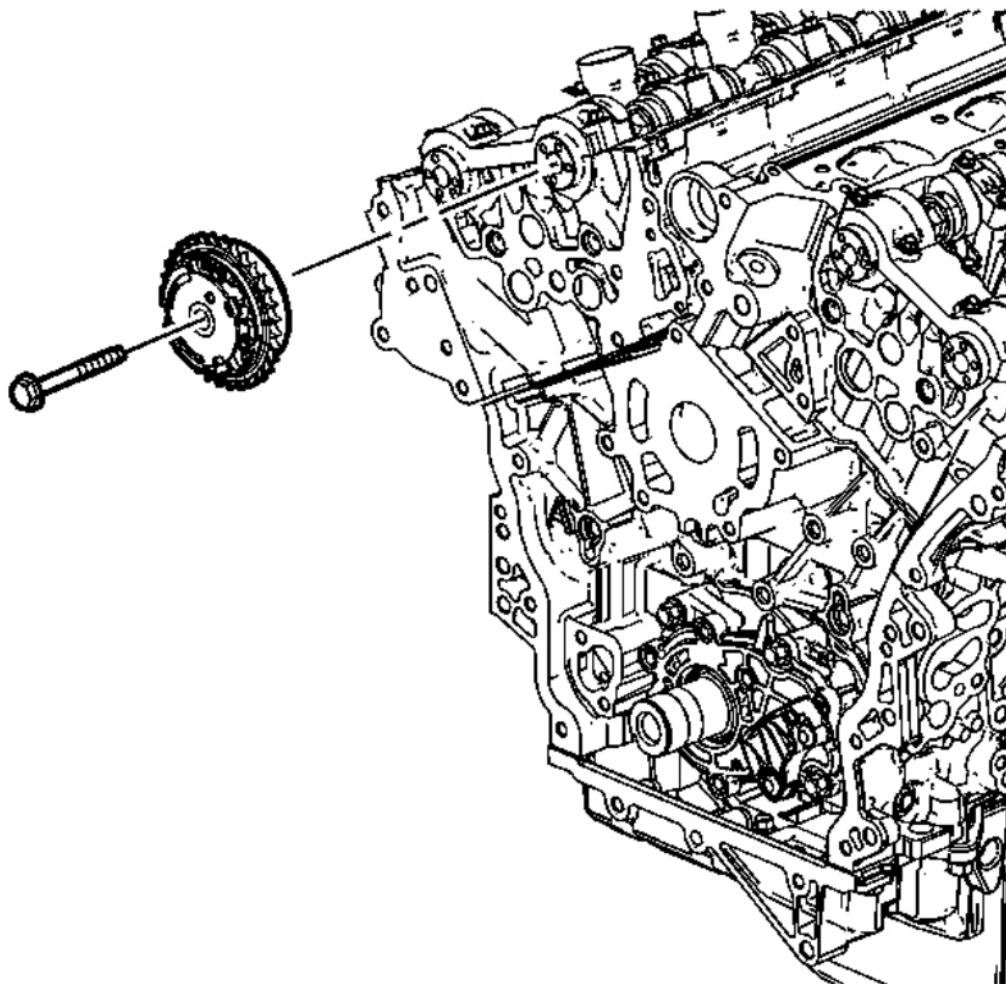


Fig. 201: View Of Camshaft Position (CMP) Actuator - Bank1 Intake

Courtesy of GENERAL MOTORS CORP.

2. Install the right intake camshaft position actuator.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the camshaft position actuator bolt.

Tighten: Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft).

CAMSHAFT POSITION (CMP) ACTUATOR INSTALLATION - RIGHT EXHAUST

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

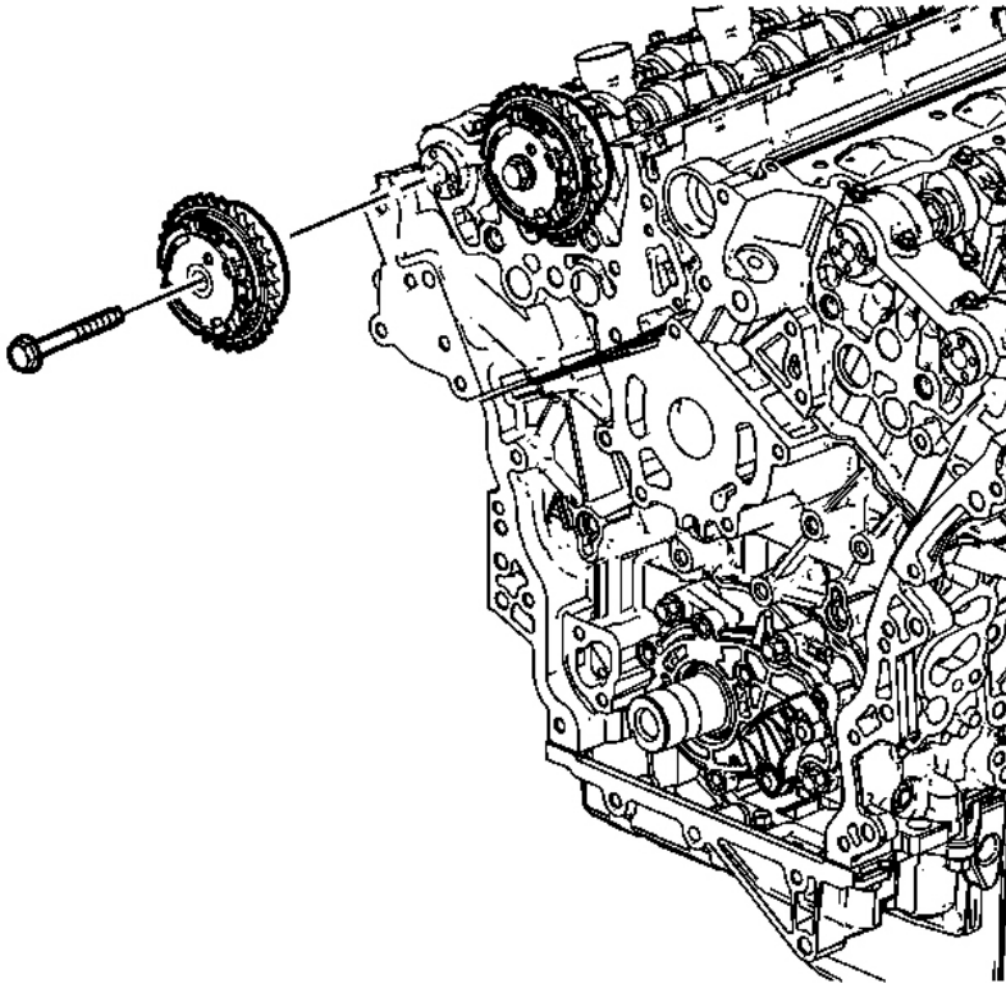


Fig. 202: View Of Right Exhaust Camshaft Position Actuator
Courtesy of GENERAL MOTORS CORP.

2. Install the right exhaust camshaft position actuator.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

3. Install the camshaft position actuator bolt.

Tighten: Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft).

CAMSHAFT POSITION (CMP) ACTUATOR INSTALLATION - LEFT INTAKE

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

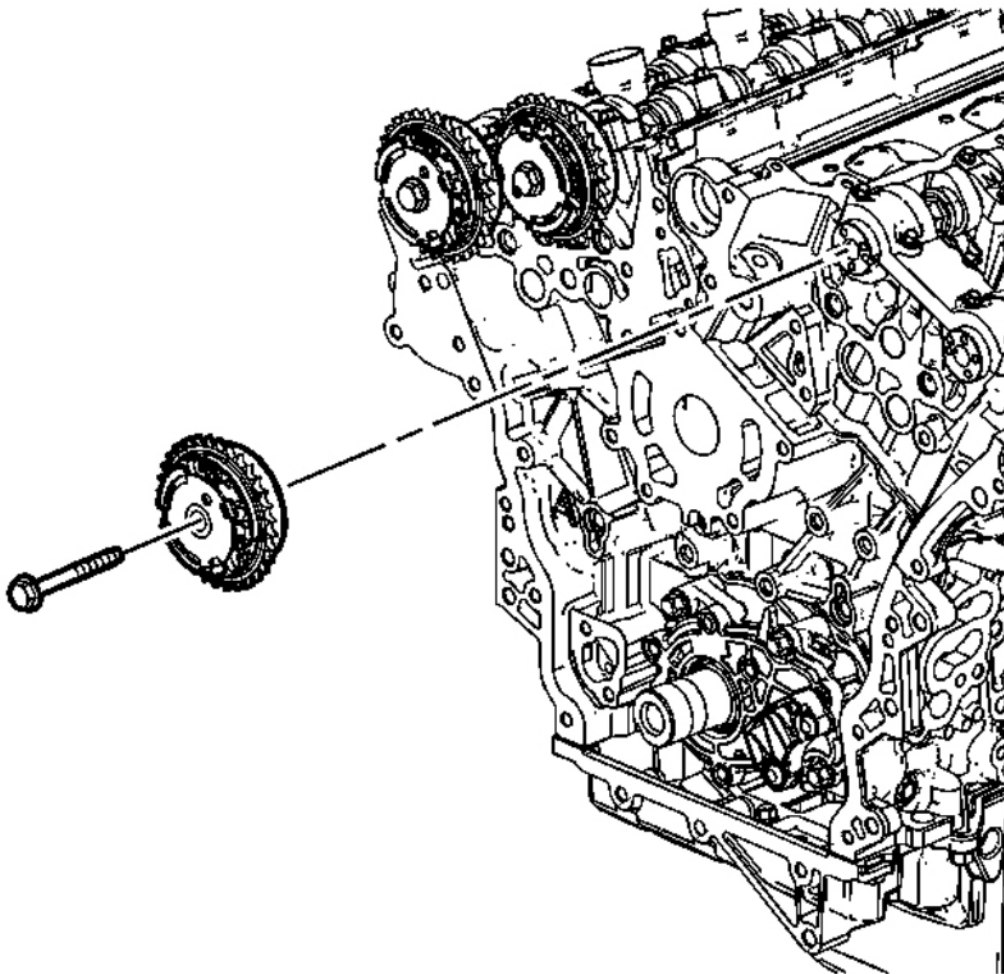


Fig. 203: Removing/Installing Camshaft Position (CMP) Actuator
Courtesy of GENERAL MOTORS CORP.

2. Install the left intake camshaft position actuator.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the camshaft position actuator bolt.

Tighten: Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft).

CAMSHAFT POSITION (CMP) ACTUATOR INSTALLATION - LEFT EXHAUST

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice in Cautions and Notices.

1. Use an open wrench on the hex cast into the camshaft in order to prevent camshaft rotation when tightening the camshaft position actuator bolt.

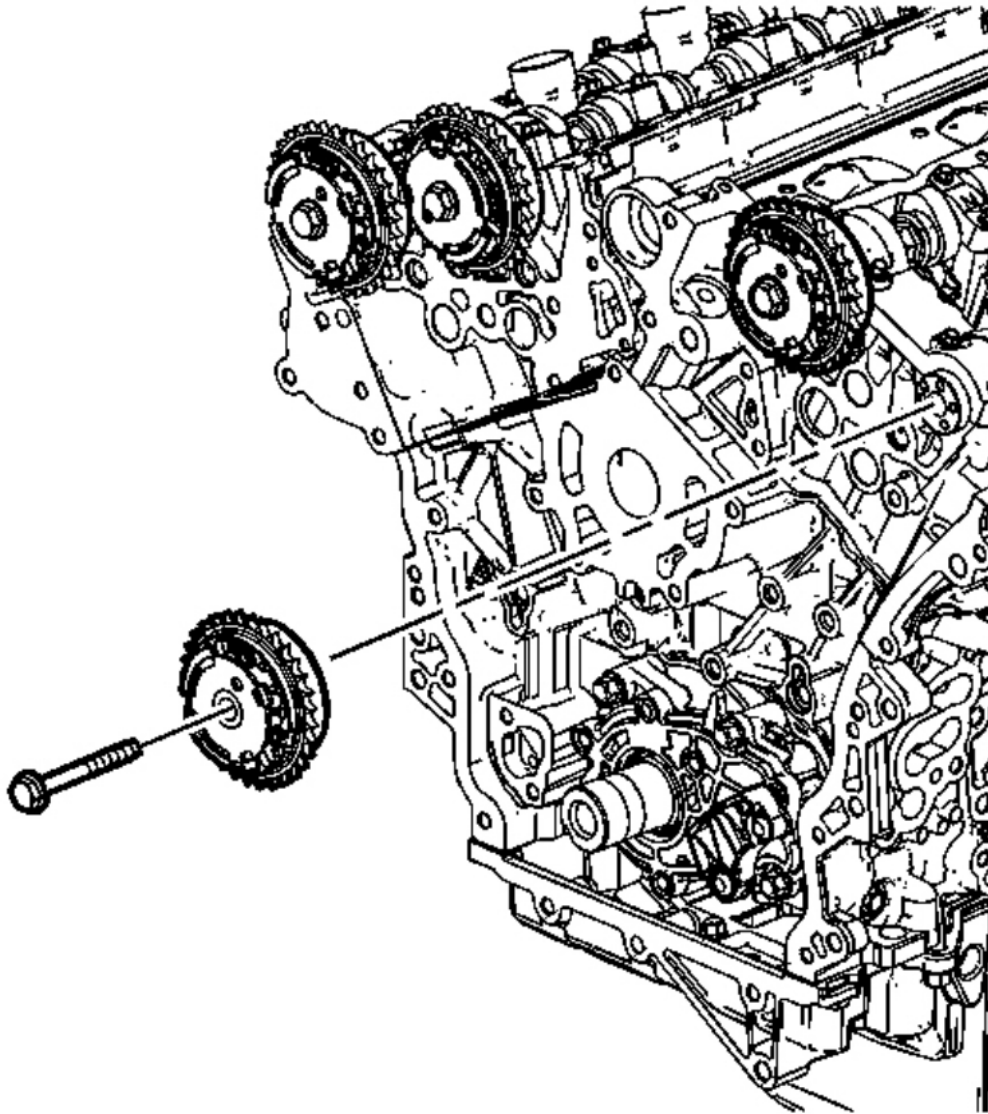


Fig. 204: View Of Camshaft Position (CMP) Actuator - Bank 2 Exhaust
Courtesy of GENERAL MOTORS CORP.

2. Install the left exhaust camshaft position actuator.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the camshaft position actuator bolt.

Tighten: Tighten the camshaft position actuator bolt to 58 N.m (43 lb ft).

CRANKSHAFT SPROCKET INSTALLATION

Tools Required:

EN 46111 Crankshaft Rotation Socket

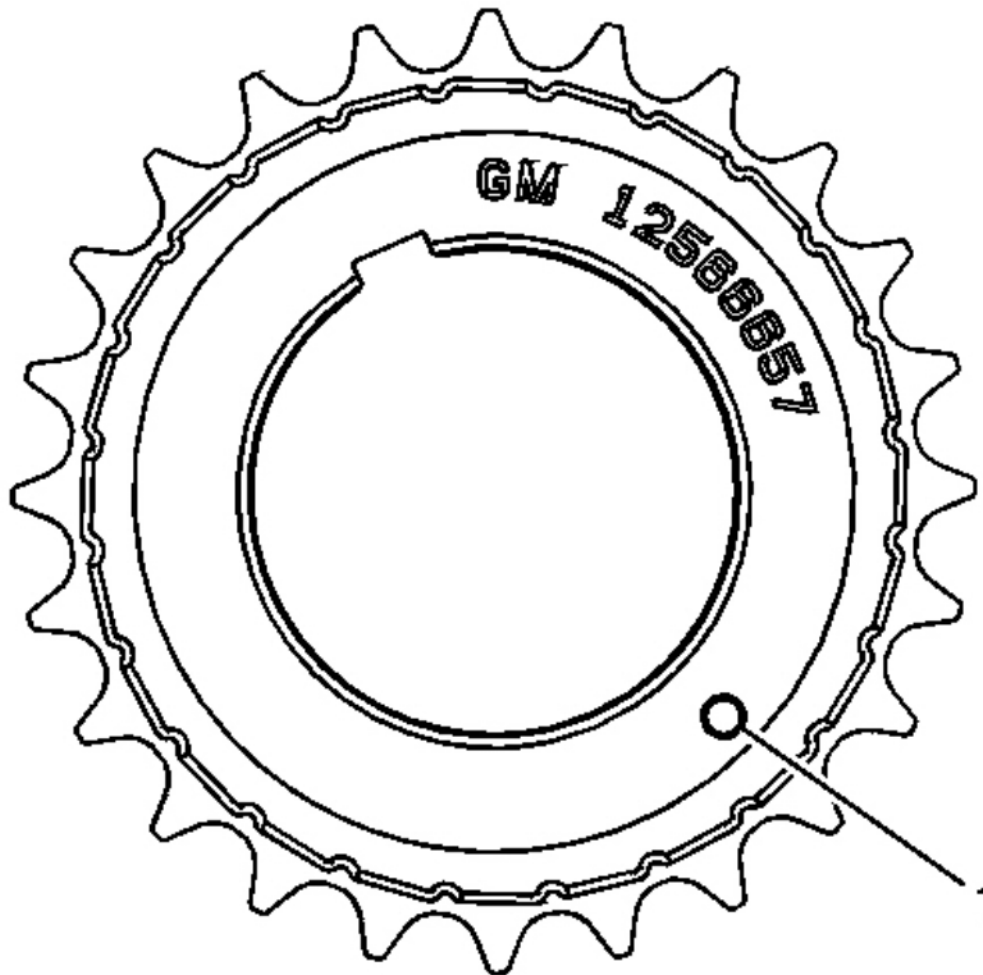


Fig. 205: Locating Crankshaft Sprocket Timing Mark
Courtesy of GENERAL MOTORS CORP.

1. Ensure the crankshaft sprocket is installed with the timing mark (1) visible.

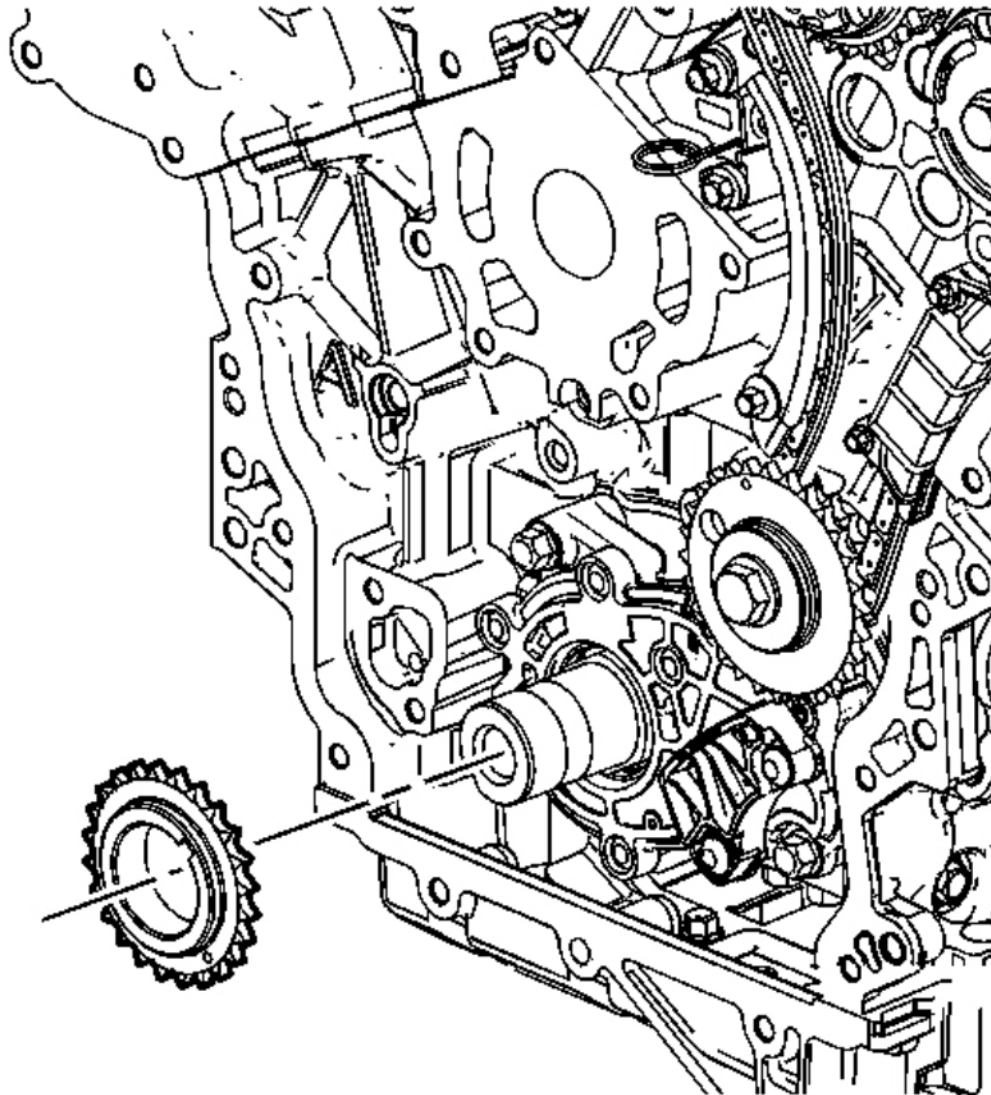


Fig. 206: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

2. Install the crankshaft sprocket on to the nose of the crankshaft.
3. Align the notch in the crankshaft sprocket with the pin in the crankshaft.
4. Slide the crankshaft sprocket on the crankshaft nose until the crankshaft sprocket contacts the step in the crankshaft.

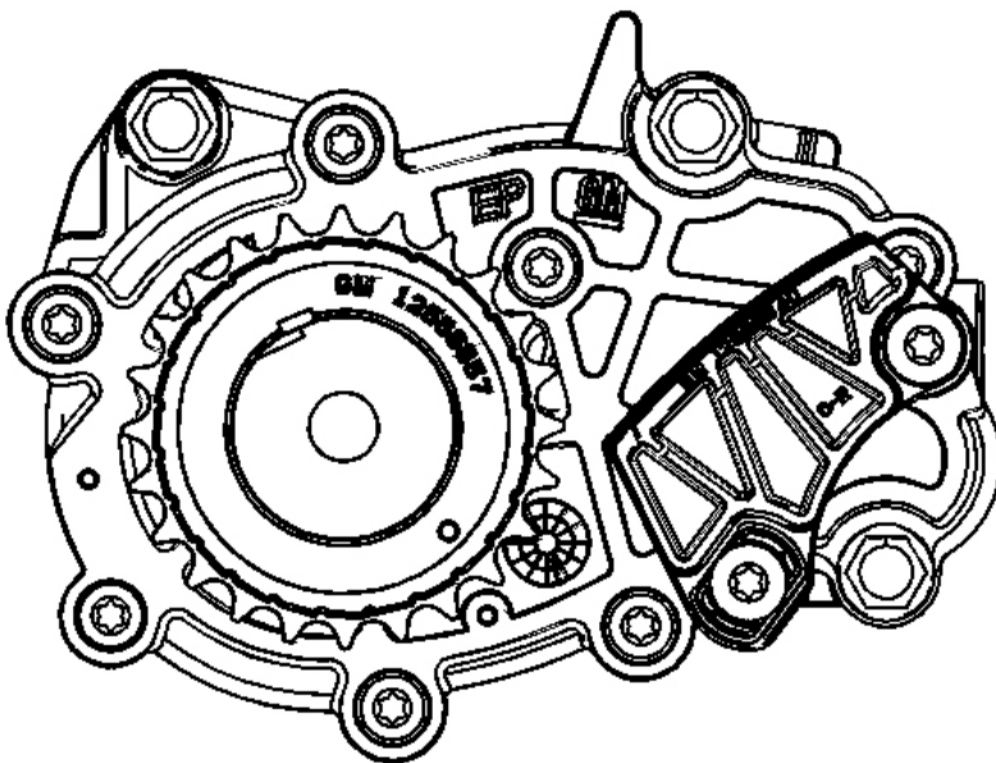


Fig. 207: Aligning Crankshaft Sprocket To Stage One Timing Drive Assembly Position

Courtesy of GENERAL MOTORS CORP.

5. If necessary, align the crankshaft sprocket to the stage one timing drive assembly position using the EN 46111 . Refer to **Camshaft Timing Drive Chain Alignment Diagram - Stage One**.

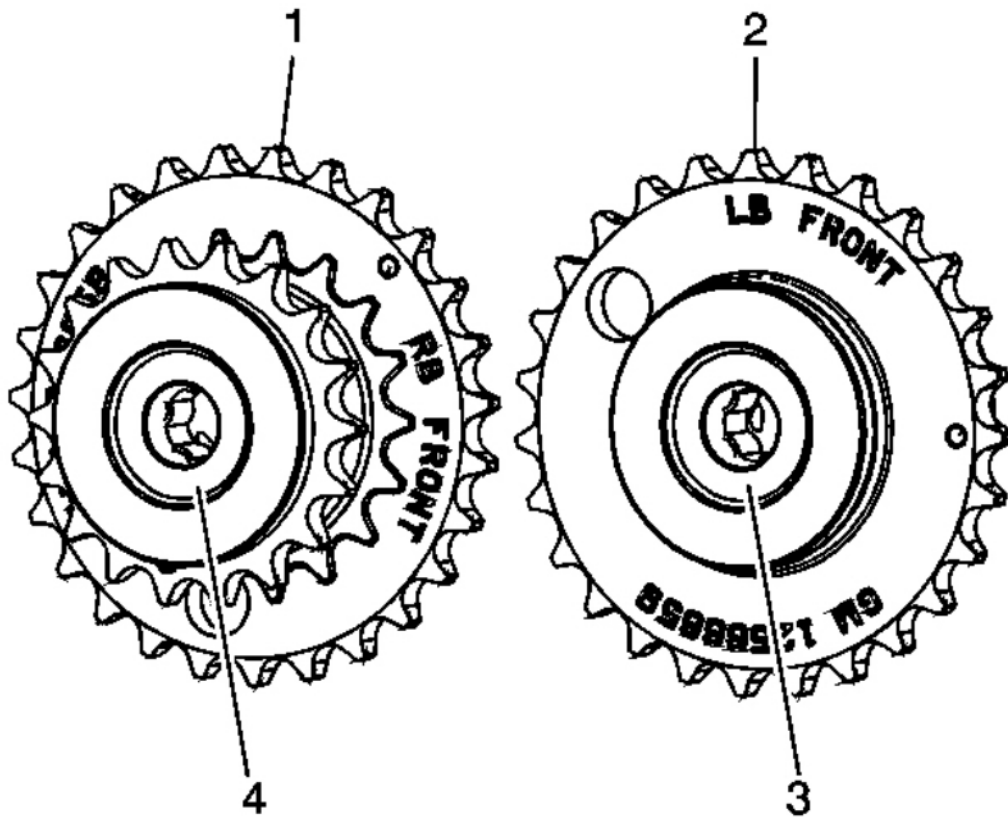


Fig. 208: Identifying Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the left camshaft intermediate drive chain idler (2) is being installed. The recessed hub (3) and the larger sprocket of the left camshaft intermediate drive chain idler is installed outward. The raised hub and the smaller sprocket of the left camshaft intermediate drive chain idler is installed towards the block.

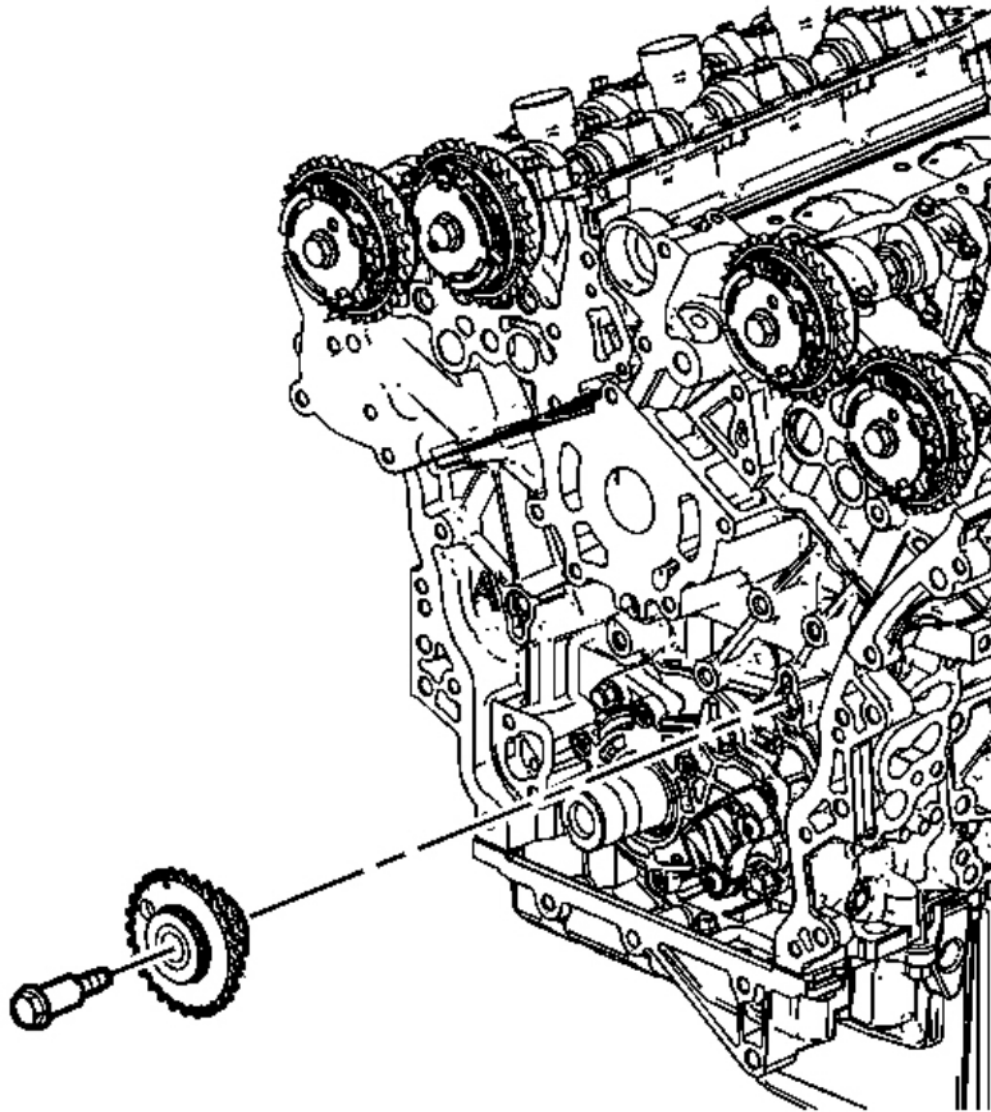


Fig. 209: View Of Left Camshaft Intermediate Drive Chain Idler
Courtesy of GENERAL MOTORS CORP.

2. Place the left camshaft intermediate drive chain idler to the cylinder block.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the camshaft intermediate drive chain idler bolt.

Tighten: Tighten the camshaft intermediate drive chain idler bolt to 58 N.m (43 lb ft).

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT

Tools Required

- EN 46105 Camshaft Holding Tool
- EN 46111 Crankshaft Rotation Socket

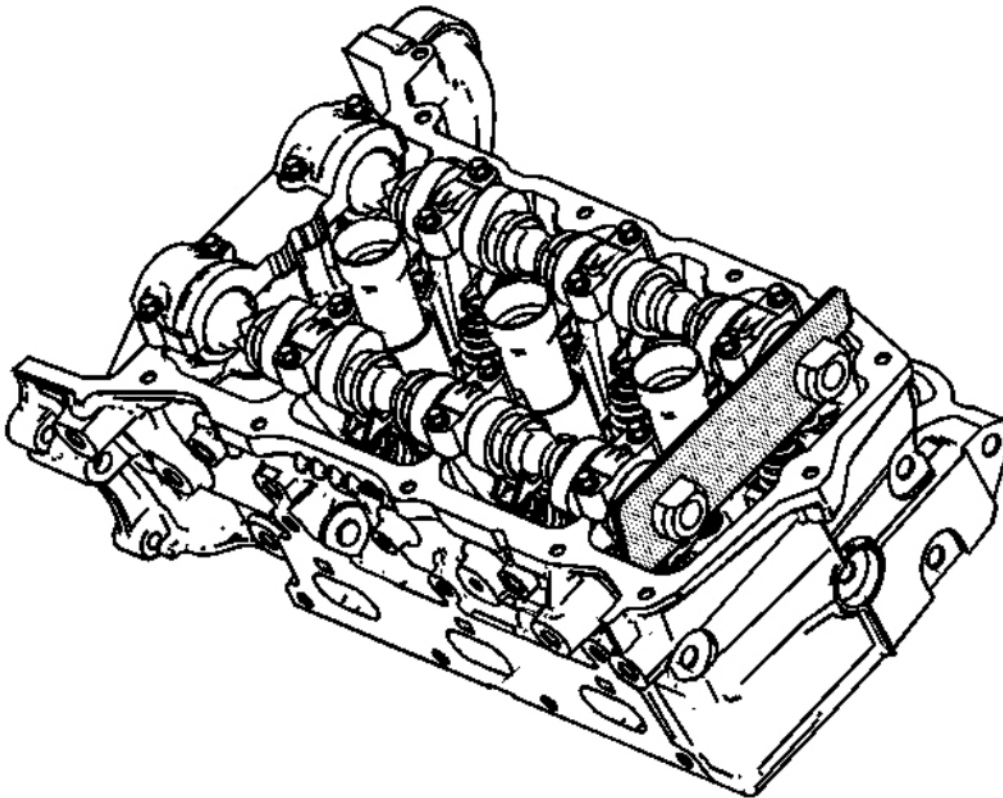


Fig. 210: Installing EN 46105 Onto Rear Of Left Camshafts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: There should be no need to rotate the camshaft more than 10

degrees. Using the hex cast into the camshaft rotate the camshaft in order to install the EN 46105 .

1. Install the EN 46105-1 onto the rear of the left camshafts.

IMPORTANT: All camshafts must be locked in place before installation of any camshaft drive chains.

2. Ensure that the EN 46105-1 is fully seated onto the camshafts.

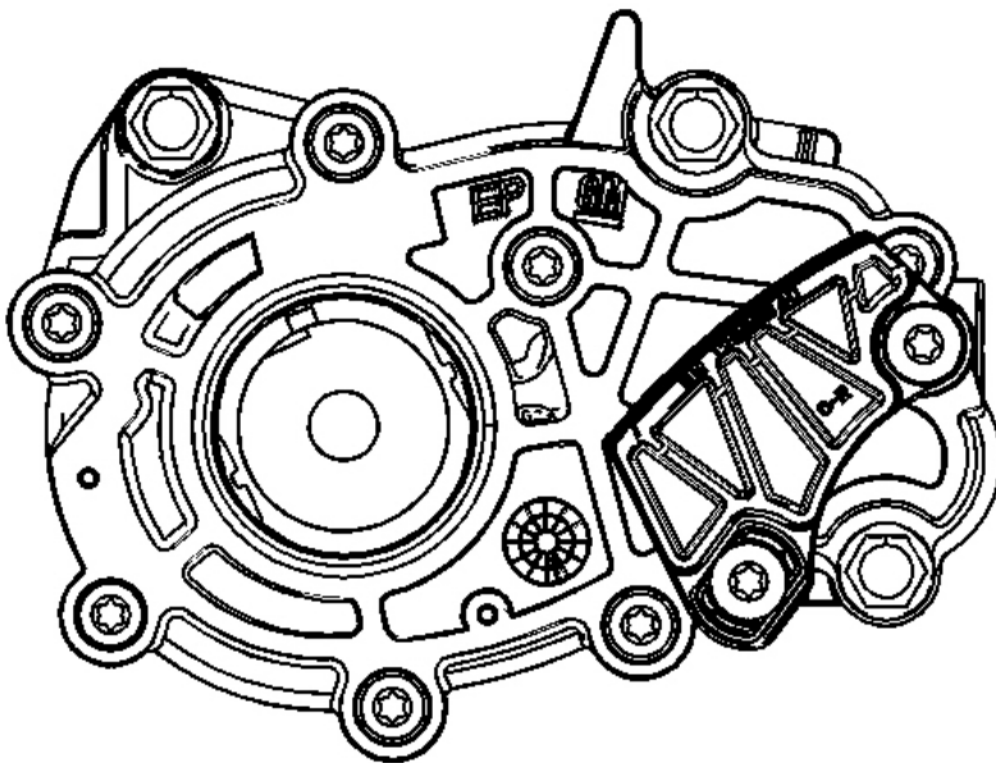


Fig. 211: Identifying Stage One Timing Drive Assembly Position
Courtesy of GENERAL MOTORS CORP.

3. Ensure that the crankshaft is in the stage one timing drive assembly position using the EN 46111 . Refer to Camshaft Timing Drive Chain Alignment Diagram Stage One.

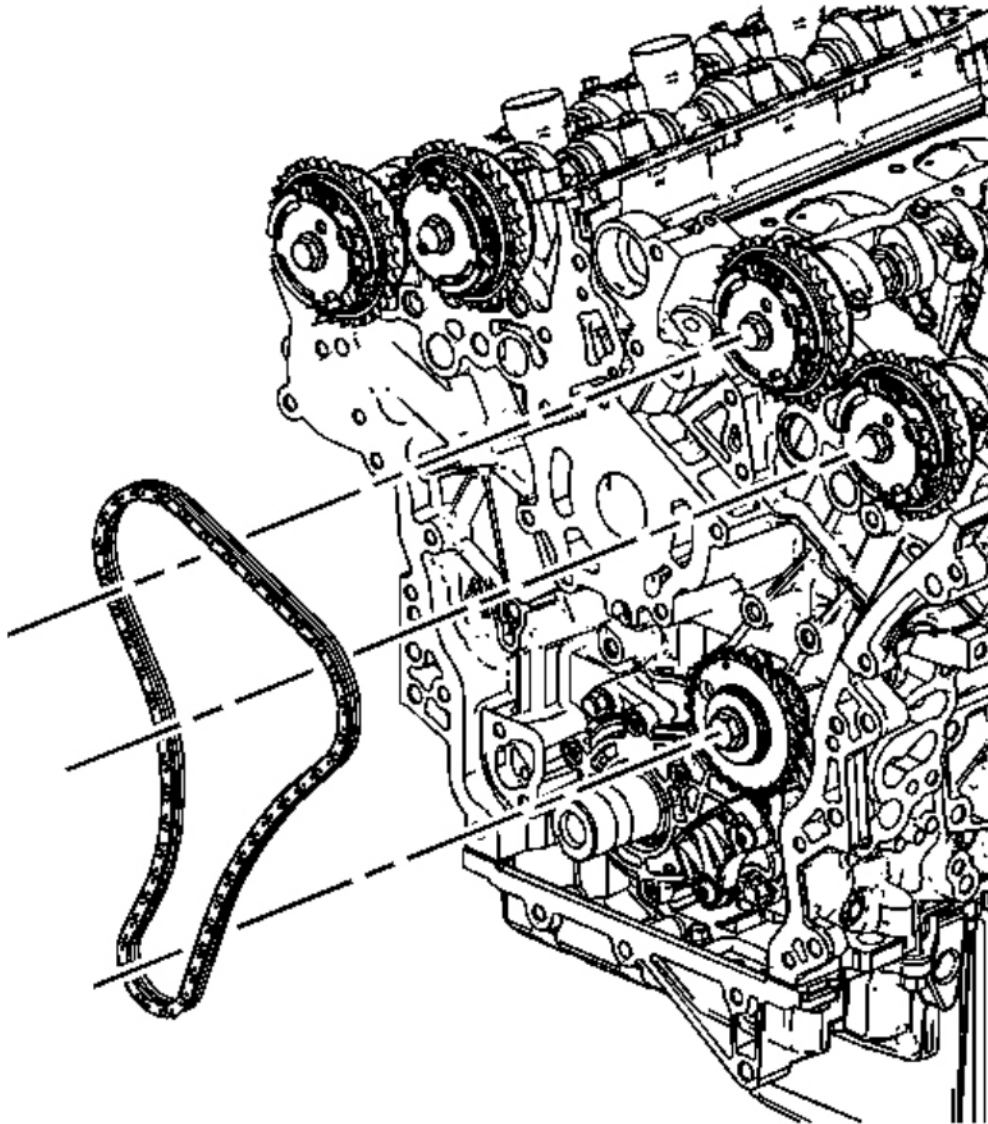


Fig. 212: View Of Left Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

4. Install the left secondary camshaft drive chain.

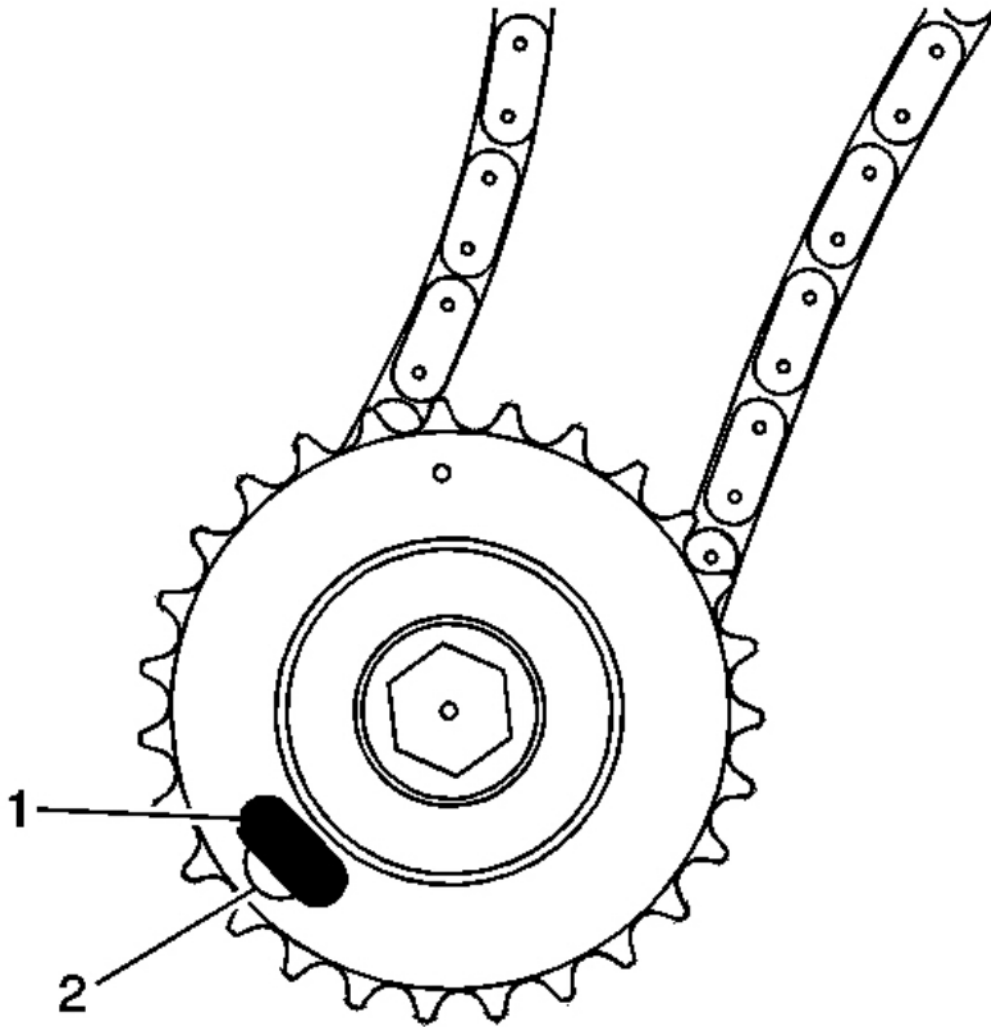


Fig. 213: Locating Timing Camshaft Drive Chain Link & Alignment Access Hole
Courtesy of GENERAL MOTORS CORP.

5. Place the left secondary camshaft drive chain around the inner sprocket of the left camshaft intermediate drive chain idler with the timing camshaft drive chain link (1) aligned to the alignment access hole (2) made in the left camshaft intermediate drive chain idler outer sprocket.

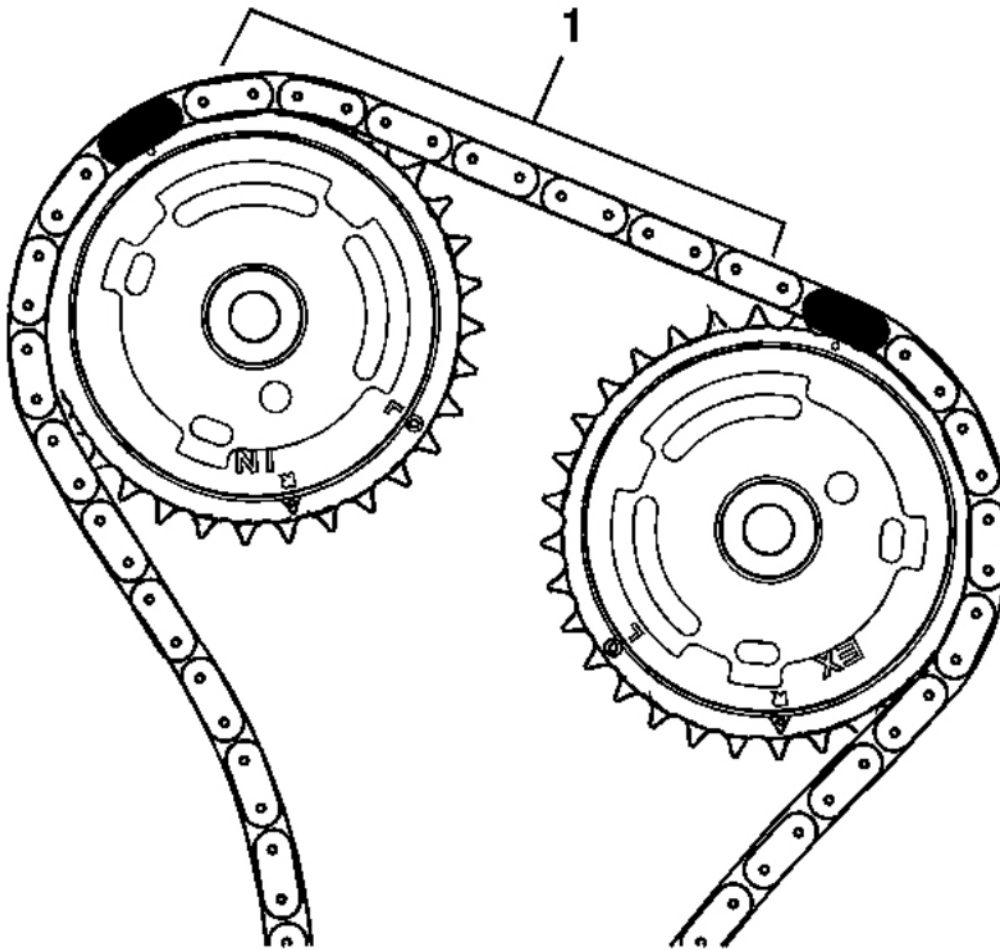


Fig. 214: Identifying 7 Links Between Left Secondary Timing Camshaft Drive Chain Links

Courtesy of GENERAL MOTORS CORP.

6. Wrap the secondary camshaft drive chain around both left actuator drive sprockets.
7. Ensure there are 7 links (1) between the timing camshaft drive chain links for the camshaft position actuator sprockets.

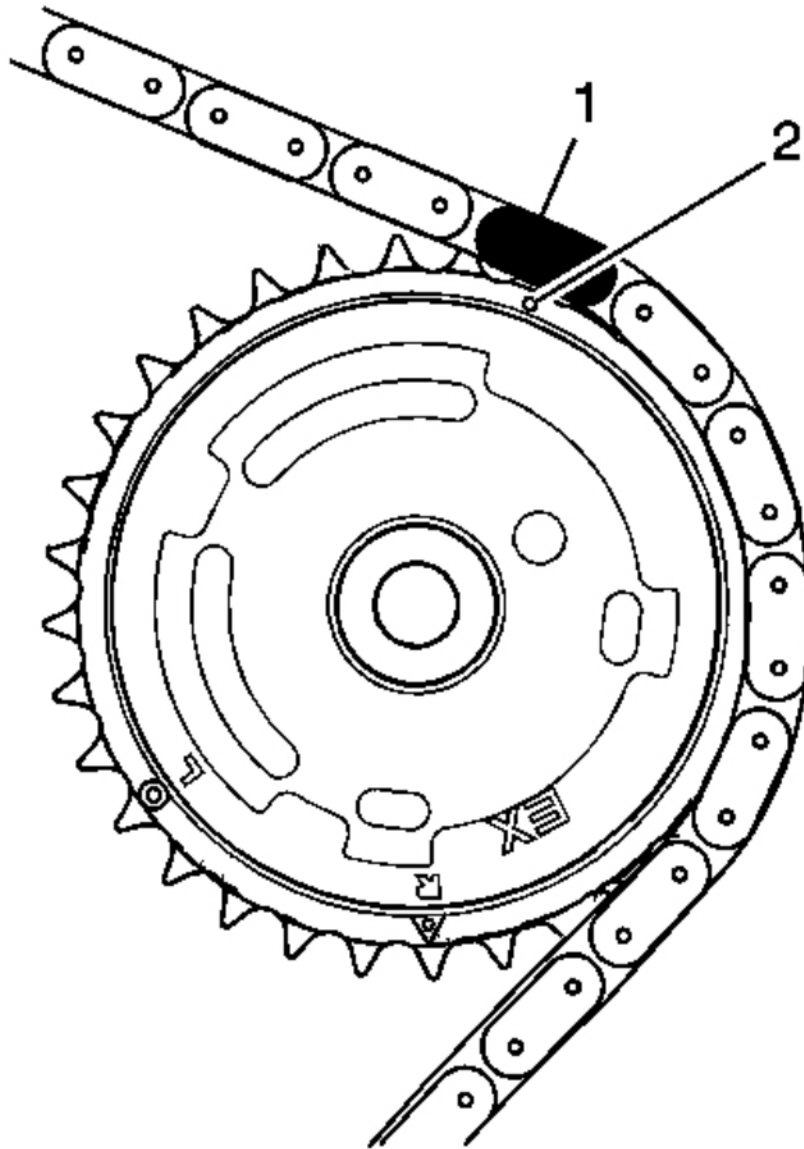


Fig. 215: Aligning Left Exhaust Camshaft Position Actuator Sprocket Alignment Mark With Timing Link

Courtesy of GENERAL MOTORS CORP.

8. Align the left exhaust camshaft position actuator sprocket alignment circle mark (2) with the timing camshaft drive chain link (1).

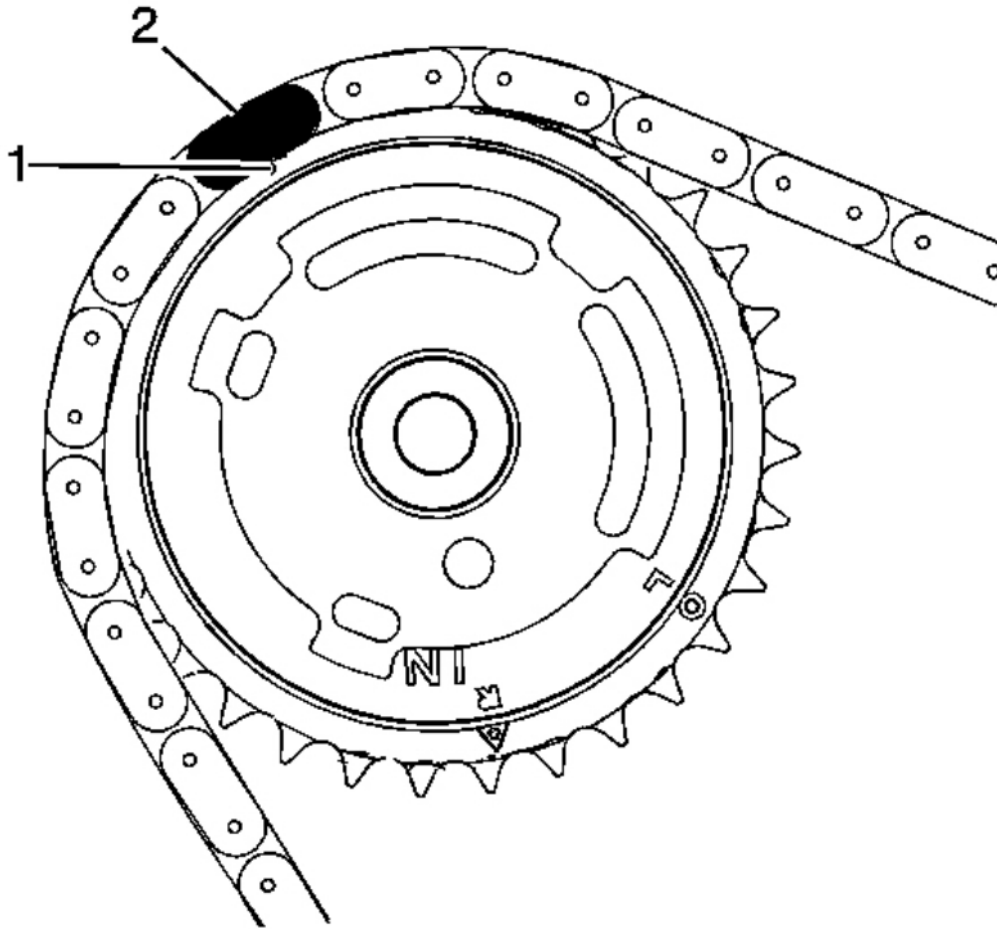


Fig. 216: Aligning Left Intake Camshaft Position Actuator Sprocket Alignment Mark With Timing Link

Courtesy of GENERAL MOTORS CORP.

9. Align the left intake camshaft position actuator sprocket alignment circle mark (1) with the timing camshaft drive chain link (2).

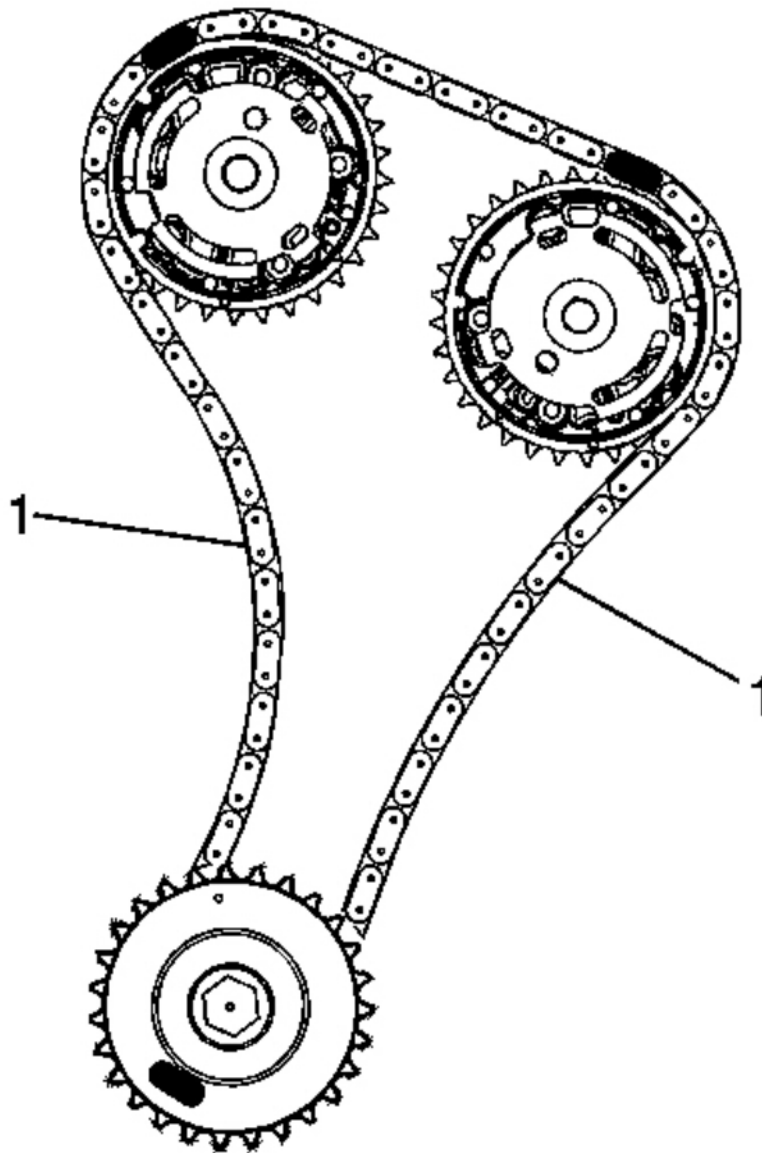


Fig. 217: Identifying 18 Links Between Left Intermediate Timing Camshaft Drive Chain Links

Courtesy of GENERAL MOTORS CORP.

10. There will be 18 links (1) between the left camshaft intermediate drive chain idler timing secondary camshaft drive chain link and each left camshaft position actuator sprocket timing

secondary camshaft drive chain link.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT

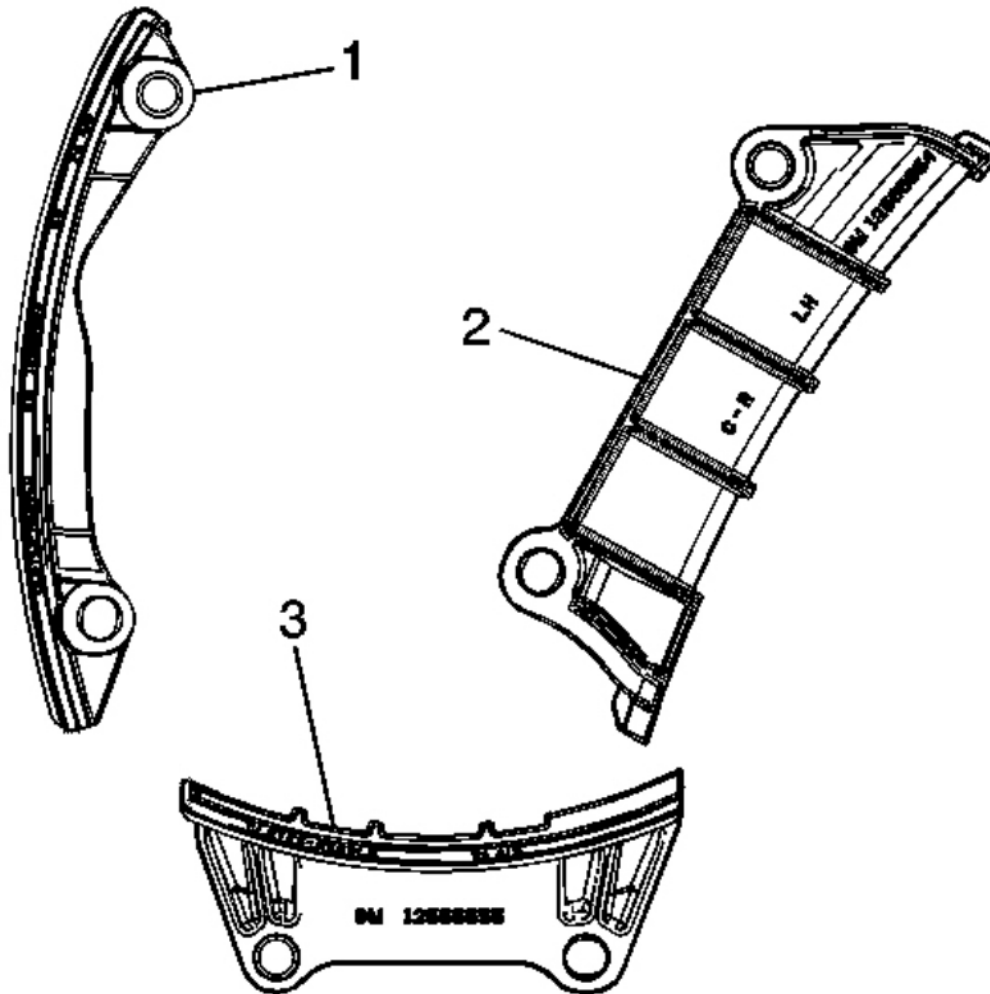


Fig. 218: Identifying Left & Right Secondary Camshaft Drive Chain Guide & Upper Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the left secondary camshaft drive chain guide (2) is being installed.

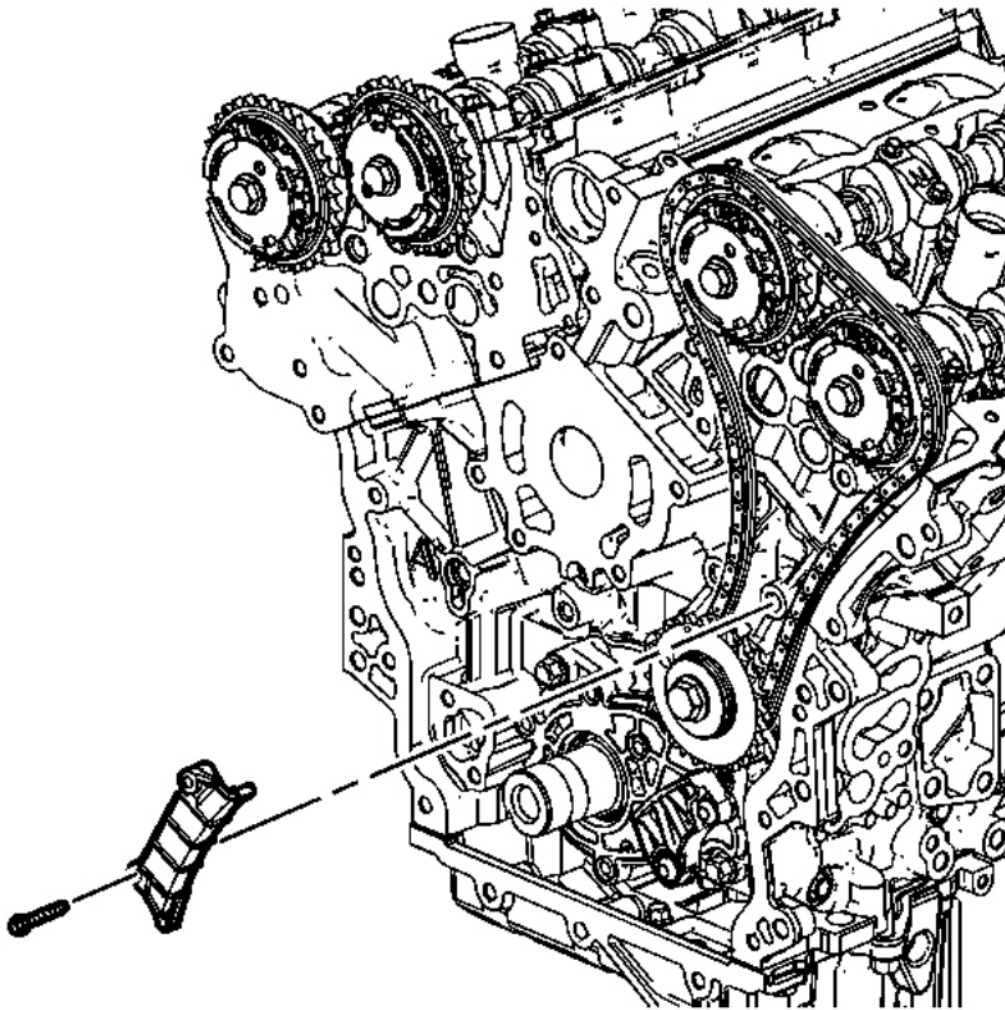


Fig. 219: View Of Left Bank Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

2. Position the left secondary camshaft drive chain guide.

NOTE: Refer to **Fastener Notice** in **Cautions and Notices**.

3. Install the secondary camshaft drive chain guide bolts.

Tighten: Tighten the secondary camshaft drive chain guide bolts to 23 N.m (17 lb ft).

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT

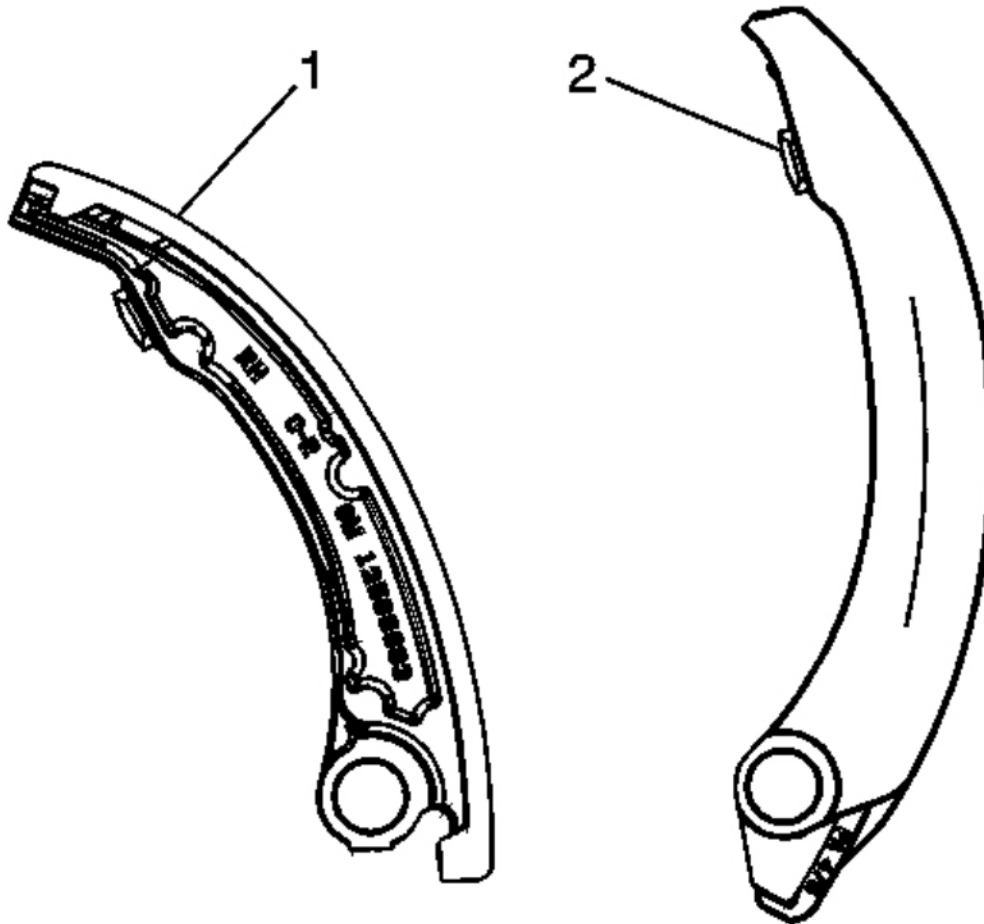


Fig. 220: View Of Secondary Camshaft Drive Chain Shoes
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the left secondary camshaft drive chain shoe (2) is being installed.

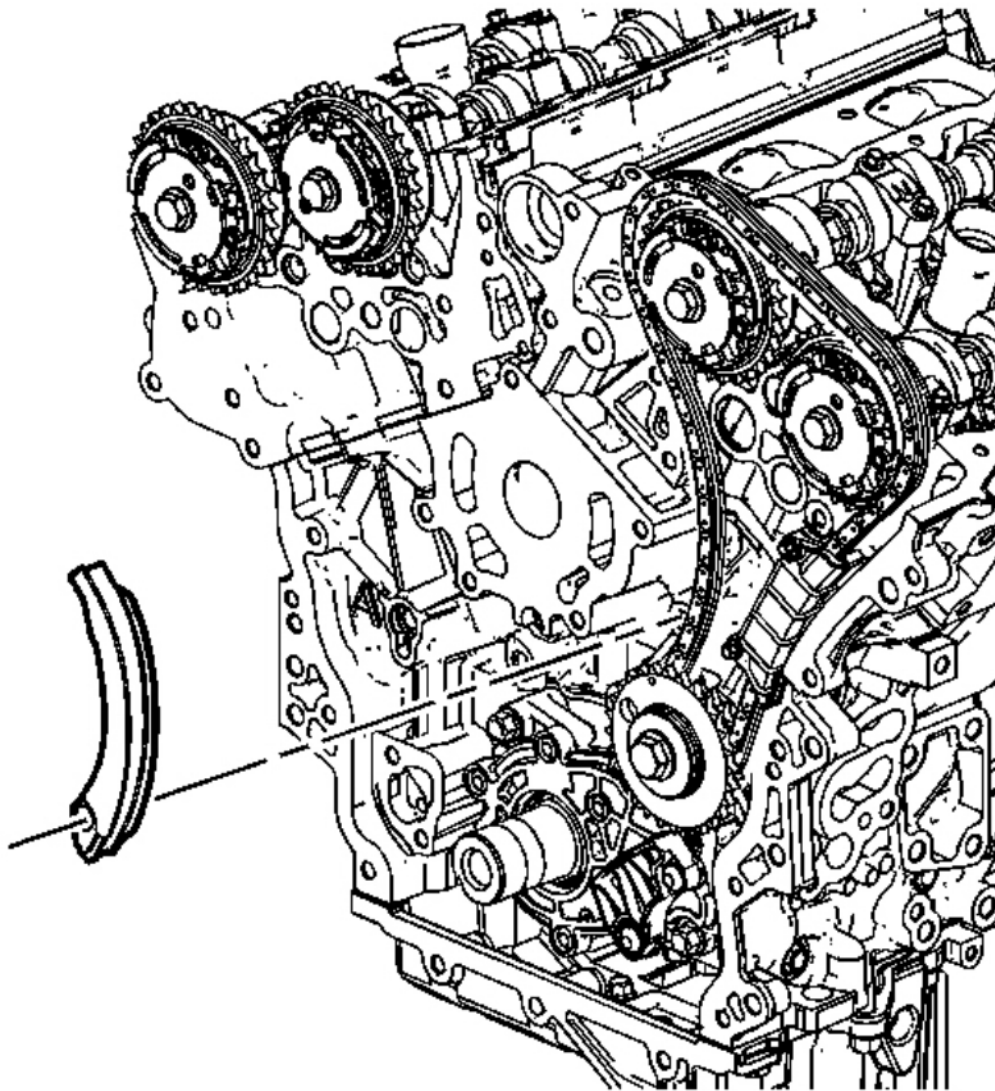


Fig. 221: View Of Left Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Position the left secondary camshaft drive chain shoe.

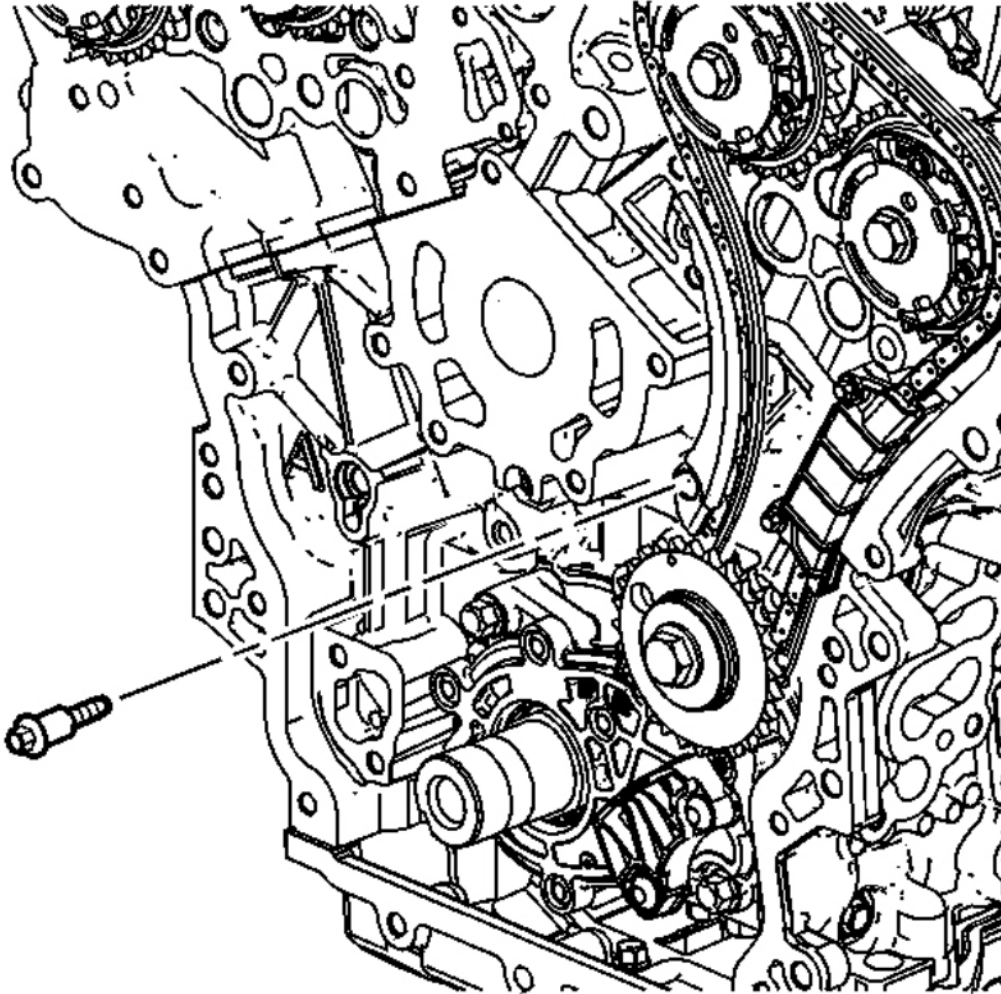


Fig. 222: View Of Left Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the secondary camshaft drive chain shoe bolt.

Tighten: Tighten the secondary camshaft drive chain shoe bolt to 23 N.m (17 lb ft).

Tools Required

- **EN 46112** Tensioner Retraction Pins
- **J 45027** Tensioner Tool

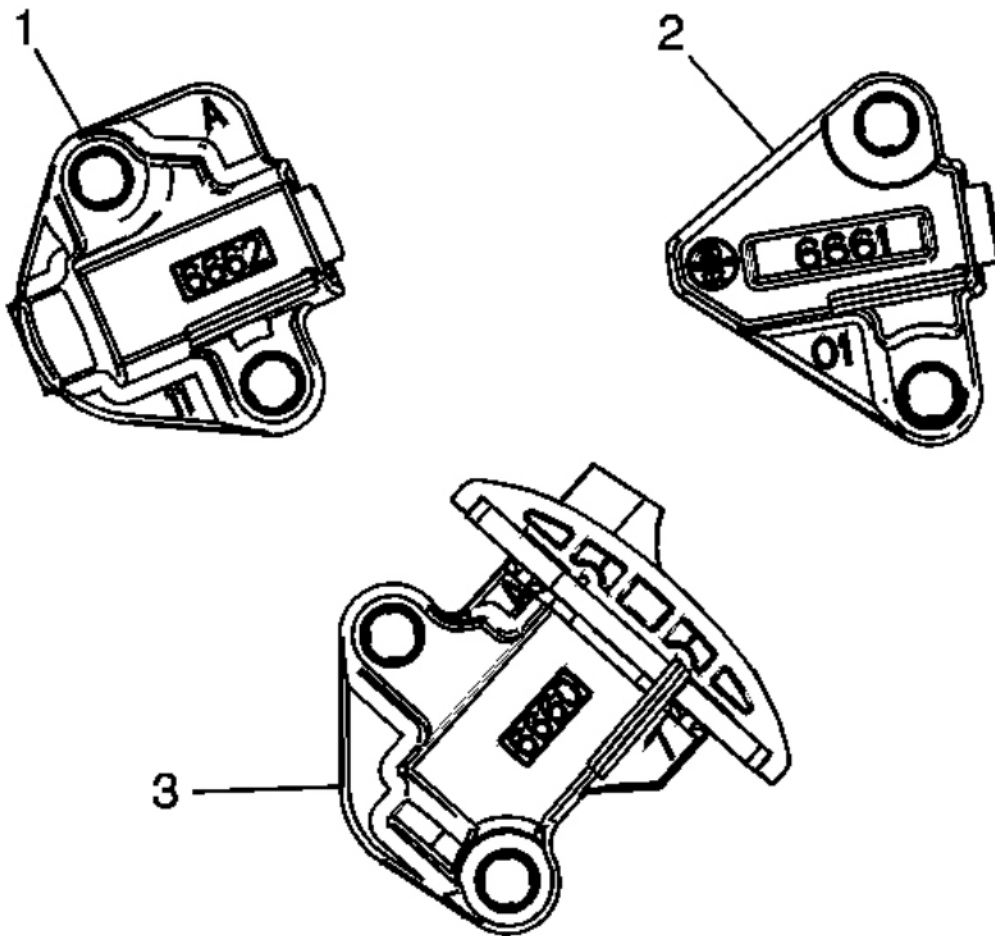


Fig. 223: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the left secondary camshaft drive chain tensioner (2) is being installed.

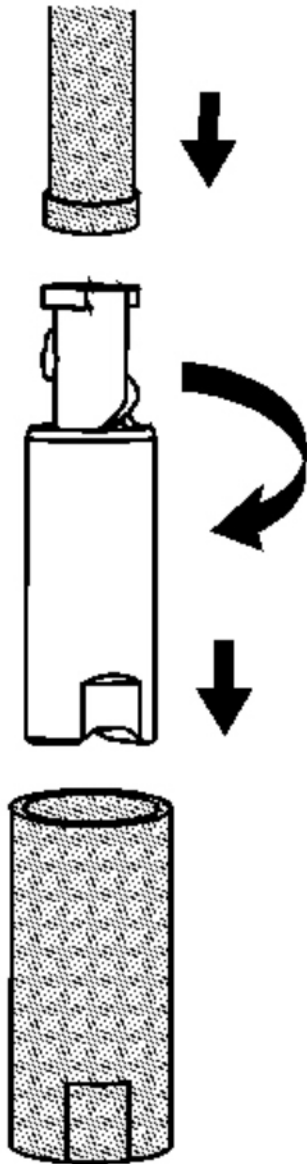


Fig. 224: Resetting Left Secondary Camshaft Drive Chain Tensioner Plunger
Courtesy of GENERAL MOTORS CORP.

2. Using the **J 45027** reset the left secondary camshaft drive chain tensioner plunger.

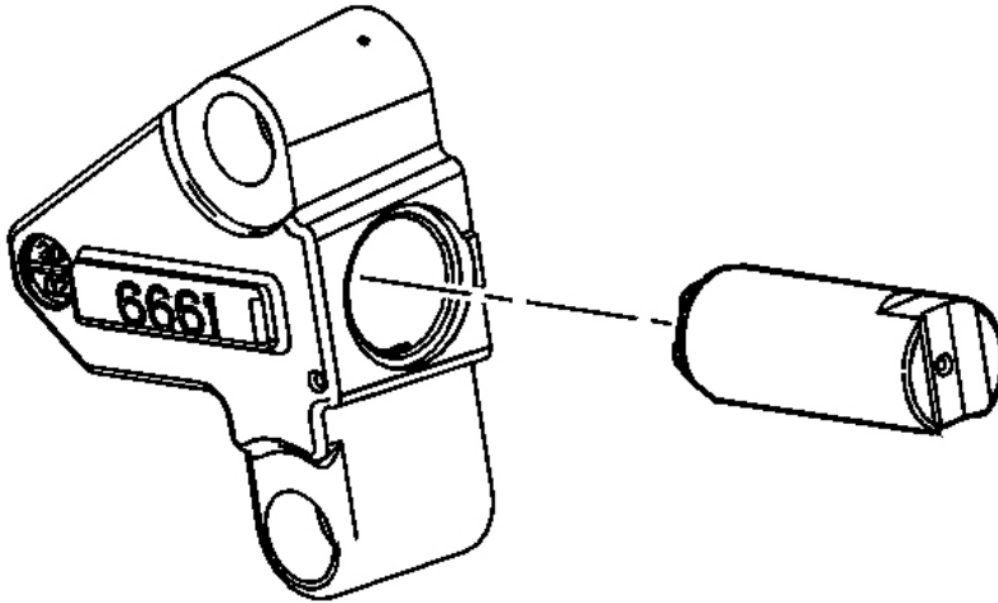


Fig. 225: Installing Plunger Into Left Secondary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

3. Install the plunger into the left secondary camshaft drive chain tensioner body.

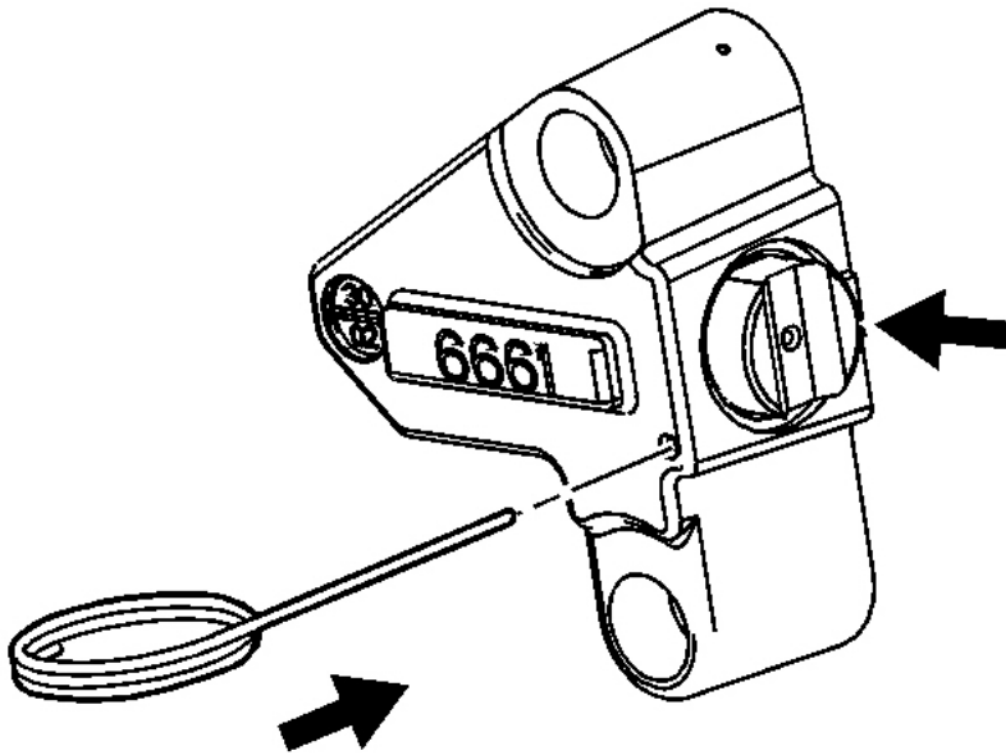


Fig. 226: Inserting EN 46112 Into Left Secondary Camshaft Drive Chain Tensioner Body

Courtesy of GENERAL MOTORS CORP.

4. Compress the plunger into the body and lock the left secondary camshaft drive chain tensioner by inserting the **EN 46112** into the access hole in the side of the left secondary camshaft drive chain tensioner body.
5. Slowly release pressure on the left secondary camshaft drive chain tensioner. The left secondary camshaft drive chain tensioner should remain compressed.

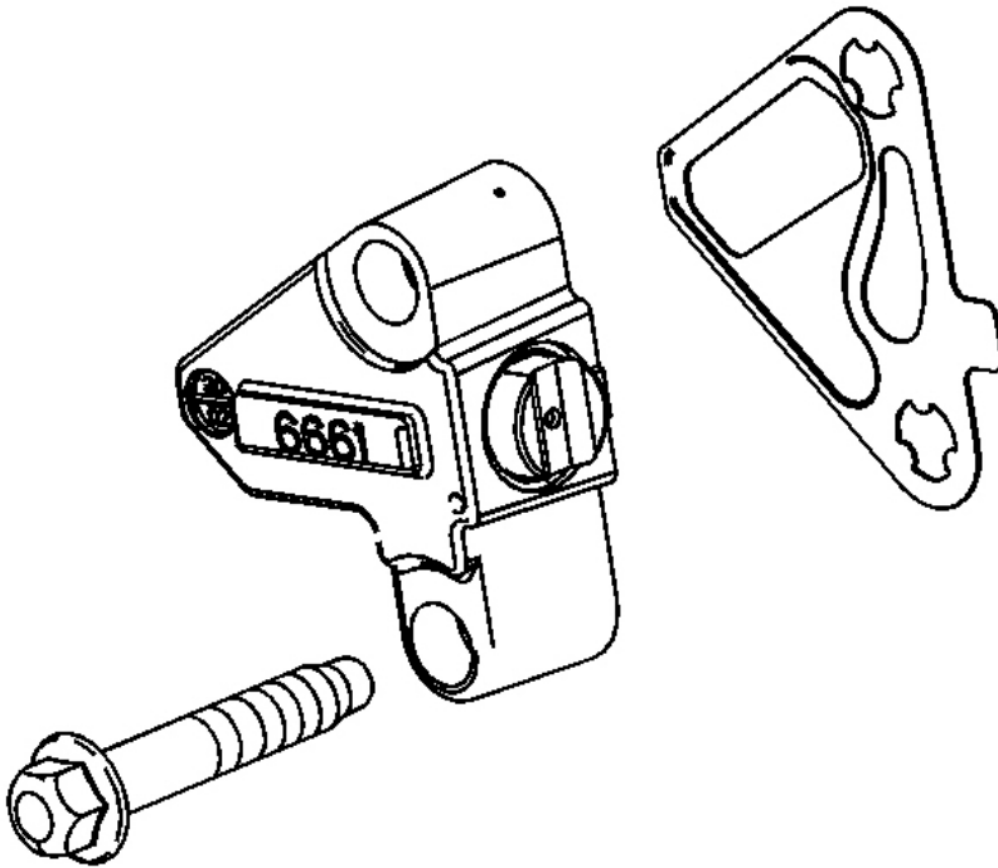


Fig. 227: Identifying Left Secondary Camshaft Drive Chain Tensioner Components
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW left secondary camshaft drive chain tensioner gasket to the left secondary camshaft drive chain tensioner.
7. Install the left secondary camshaft drive chain tensioner bolts through the left secondary camshaft drive chain tensioner and gasket.
8. Ensure the left secondary camshaft drive chain tensioner mounting surface on the left cylinder head does not have any burrs or defects that would degrade the sealing of the NEW left secondary camshaft drive chain tensioner gasket.

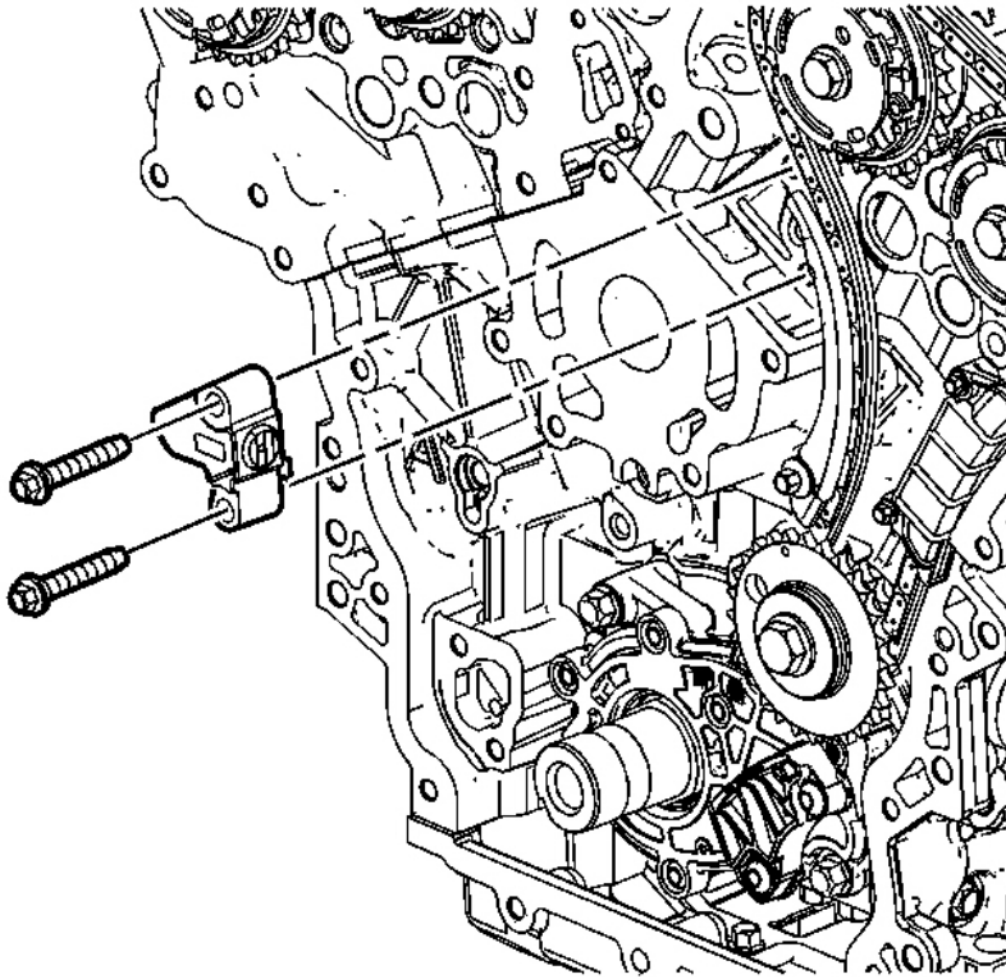


Fig. 228: Location Of Left Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

9. Place the left secondary camshaft drive chain tensioner into position and loosely install the bolts to the block.

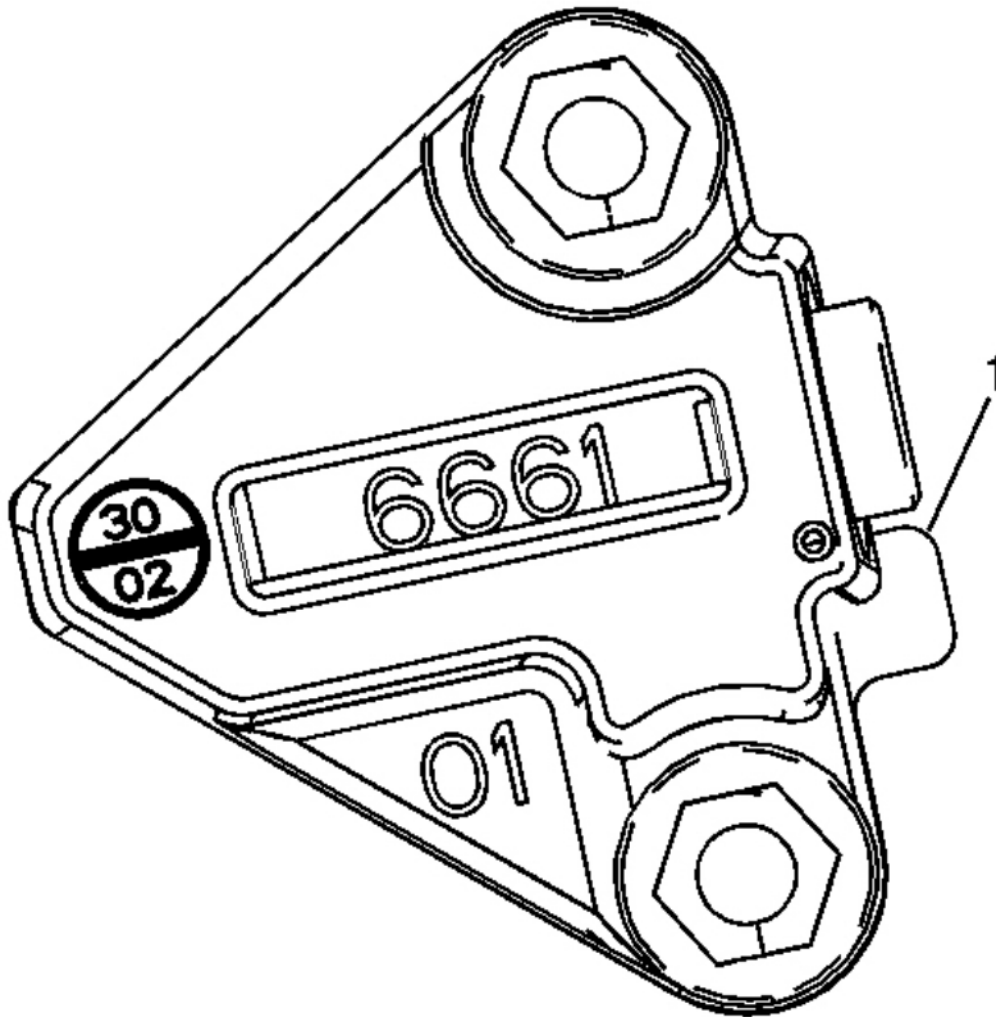


Fig. 229: Locating Left Secondary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Verify the proper placement of the left secondary camshaft drive chain tensioner gasket tab (1).
 1. First Pass

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 3.6L (LY7) (Repair Instructions, 4 Of 5) - SRX

Tighten: Tighten the left secondary camshaft drive chain tensioner bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the left secondary camshaft drive chain tensioner bolts to 23 N.m (17 lb ft).

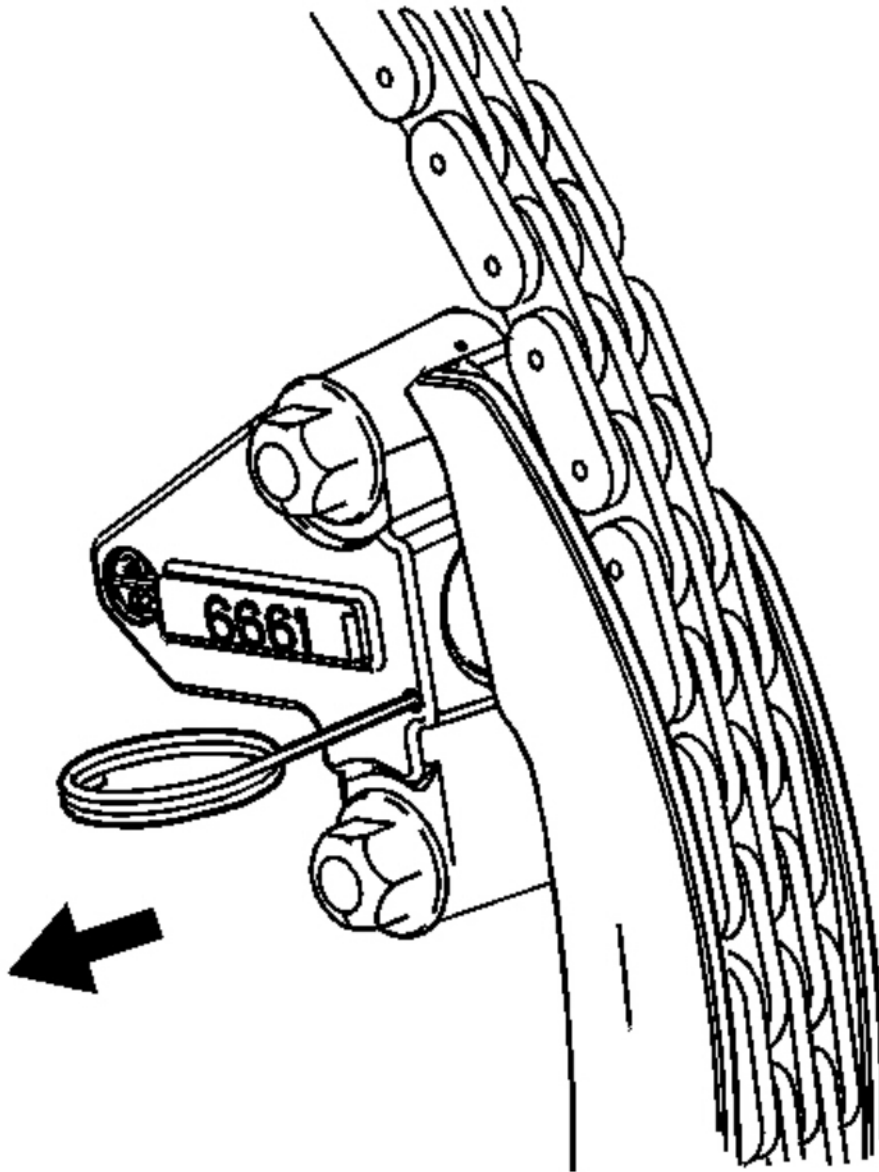


Fig. 230: Removing EN 46112 From Left Secondary Camshaft Drive Chain Tensioner

Courtesy of GENERAL MOTORS CORP.

11. Release the left secondary camshaft drive chain tensioner by pulling out the **EN 46112** and

unlocking the tensioner plunger.

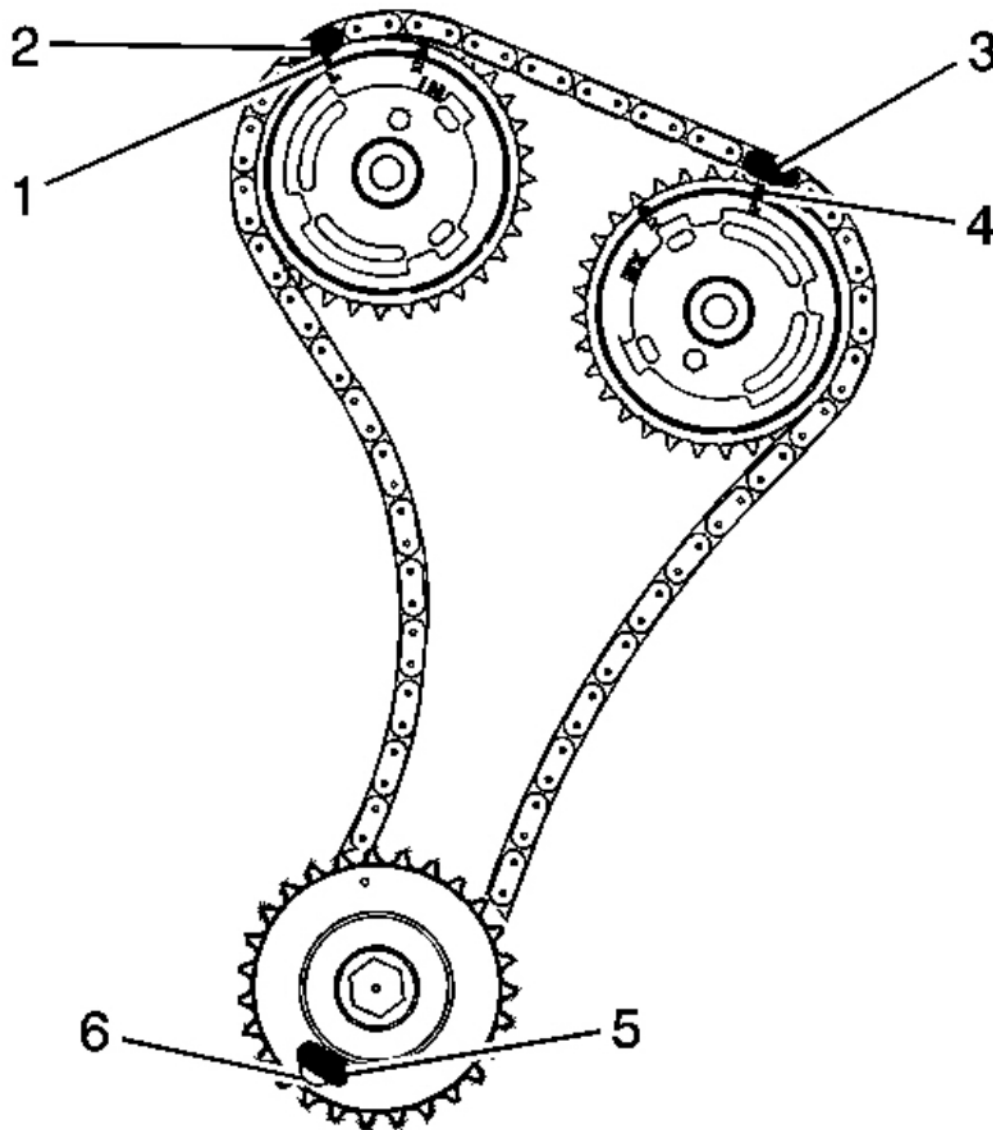


Fig. 231: Locating Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS CORP.

12. Verify the left secondary camshaft drive chain timing mark alignments (1-6) also refer to

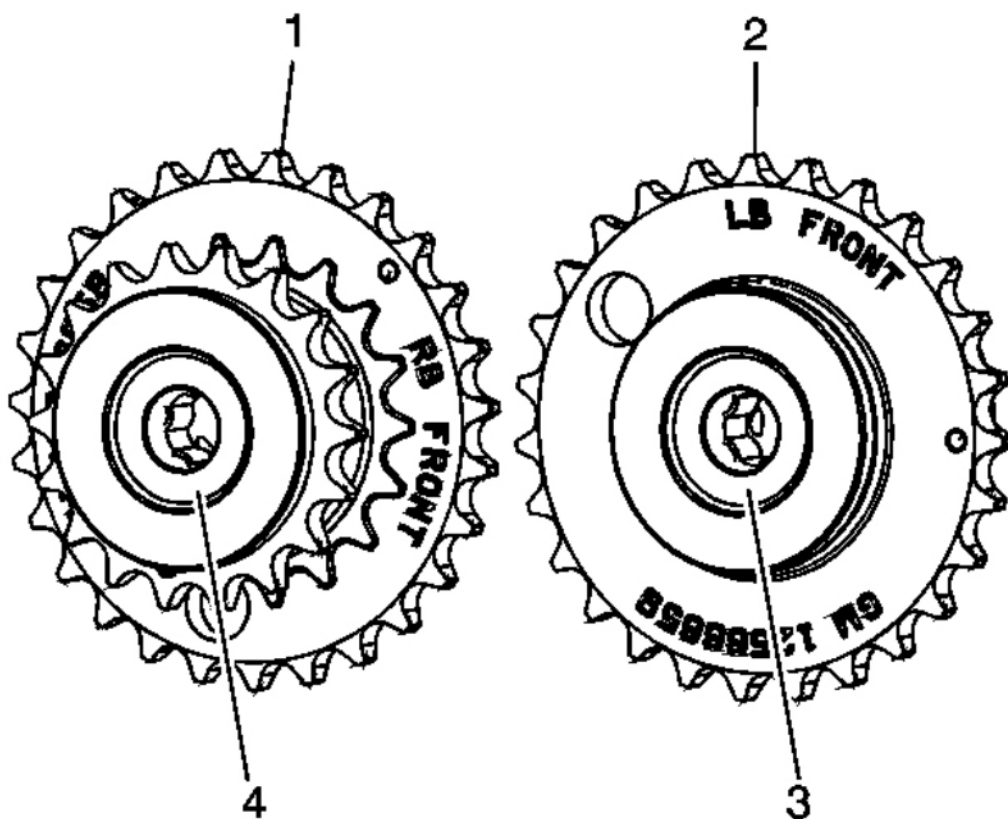
Camshaft Timing Drive Chain Alignment Diagram - Stage One.**CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - RIGHT**

Fig. 232: Identifying Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the right camshaft intermediate drive chain idler (1) is being installed. The recessed hub (4) and the smaller sprocket of the right camshaft intermediate drive chain idler is installed outward. The raised hub and the larger sprocket of the right camshaft intermediate drive chain idler is installed towards the block.

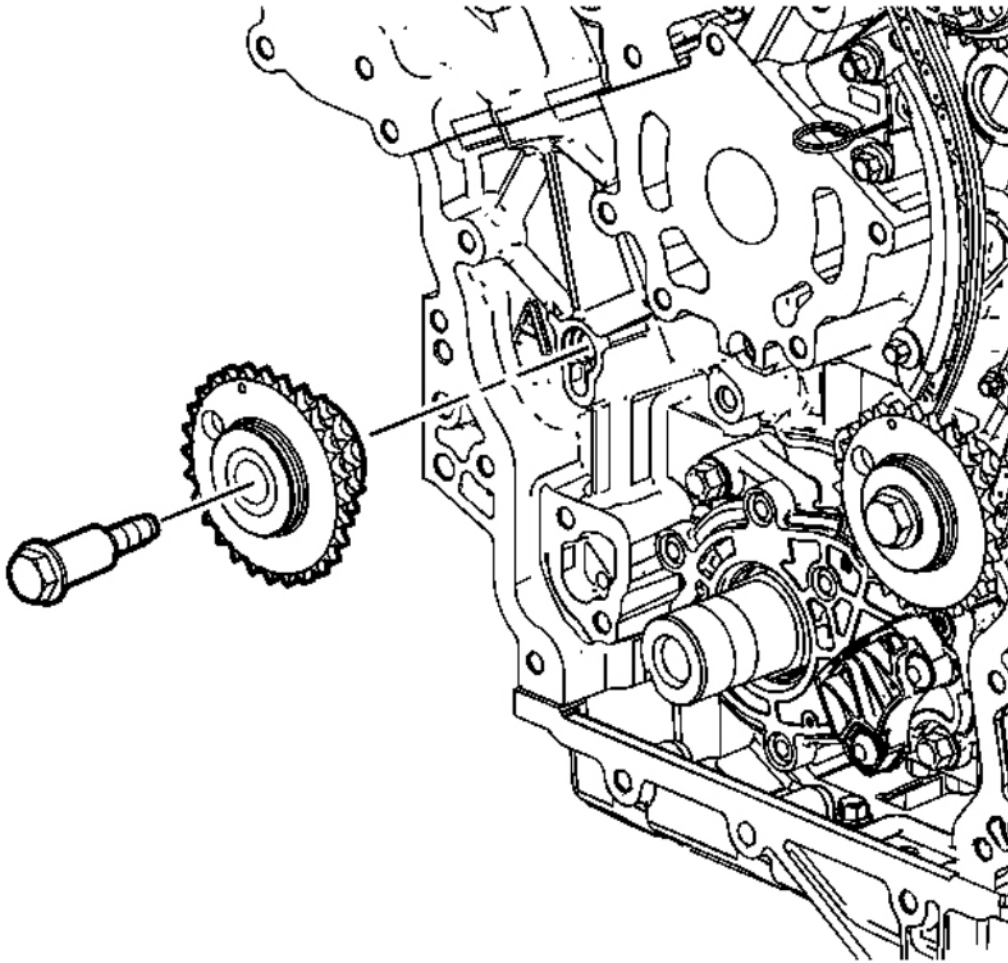


Fig. 233: View Of Right And Left Camshaft Intermediate Drive Chain Idlers
Courtesy of GENERAL MOTORS CORP.

2. Install the right camshaft intermediate drive chain idler.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the camshaft intermediate drive chain idler bolt.

Tighten: Tighten the camshaft intermediate drive chain idler bolt to 58 N.m (43 lb ft).

PRIMARY CAMSHAFT DRIVE CHAIN INSTALLATION

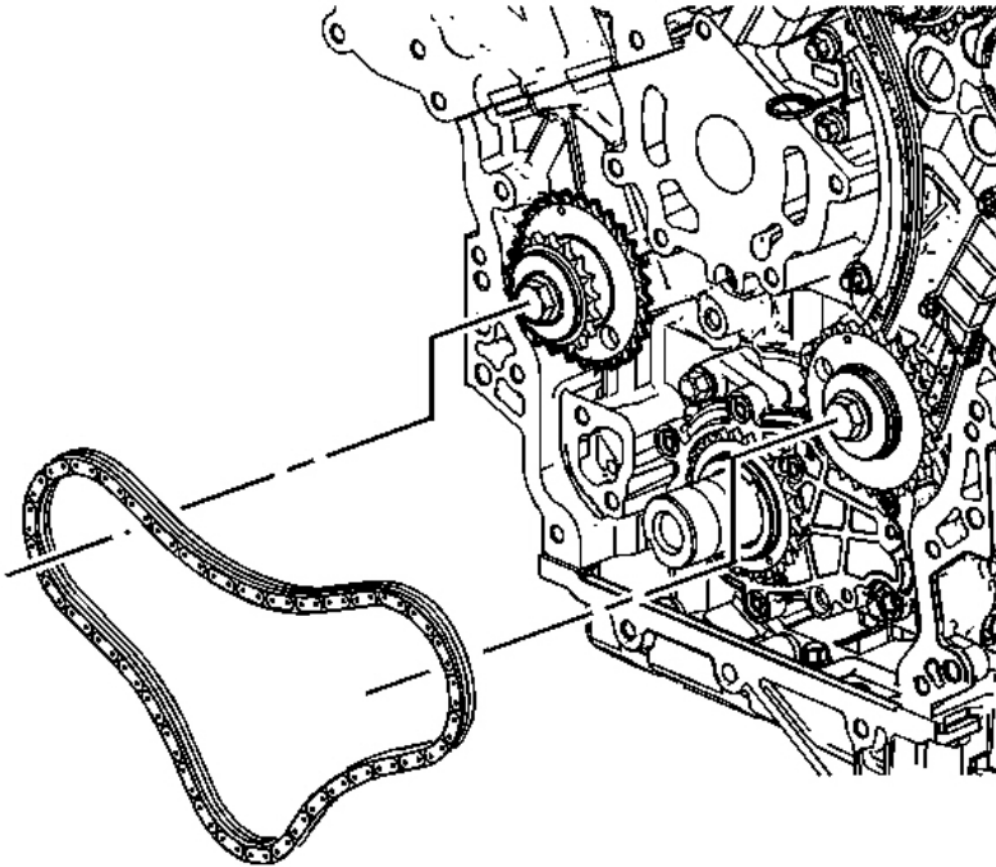


Fig. 234: View Of Primary Camshaft Timing Chain
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure that the crankshaft is in the stage one timing drive assembly position.

1. Install the primary camshaft drive chain.

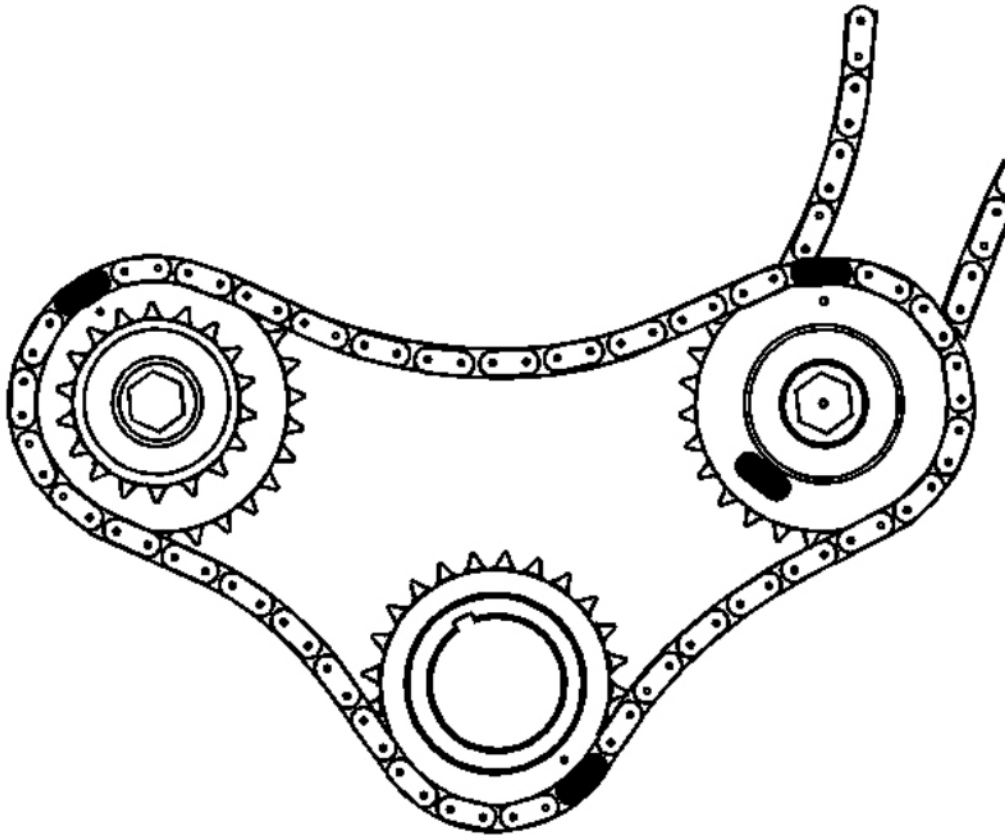


Fig. 235: Wrapping Primary Camshaft Drive Chain Around Sprockets
Courtesy of GENERAL MOTORS CORP.

2. Wrap the primary camshaft drive chain around the large sprockets of each camshaft intermediate drive chain idler and the crankshaft sprocket.

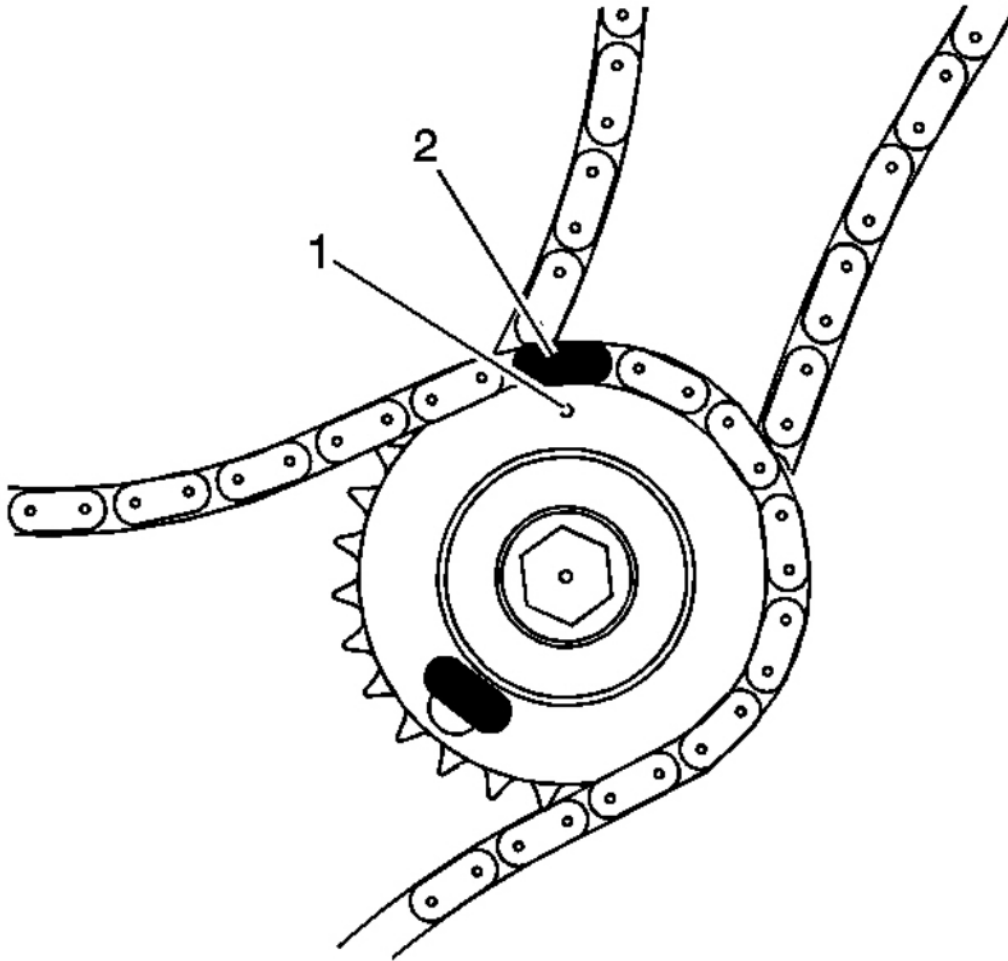


Fig. 236: Aligning Primary Camshaft Drive Chain With Left Drive Chain Idler Timing Mark

Courtesy of GENERAL MOTORS CORP.

3. The left camshaft intermediate drive chain idler timing mark (1) will align with a timing camshaft drive chain link (2).

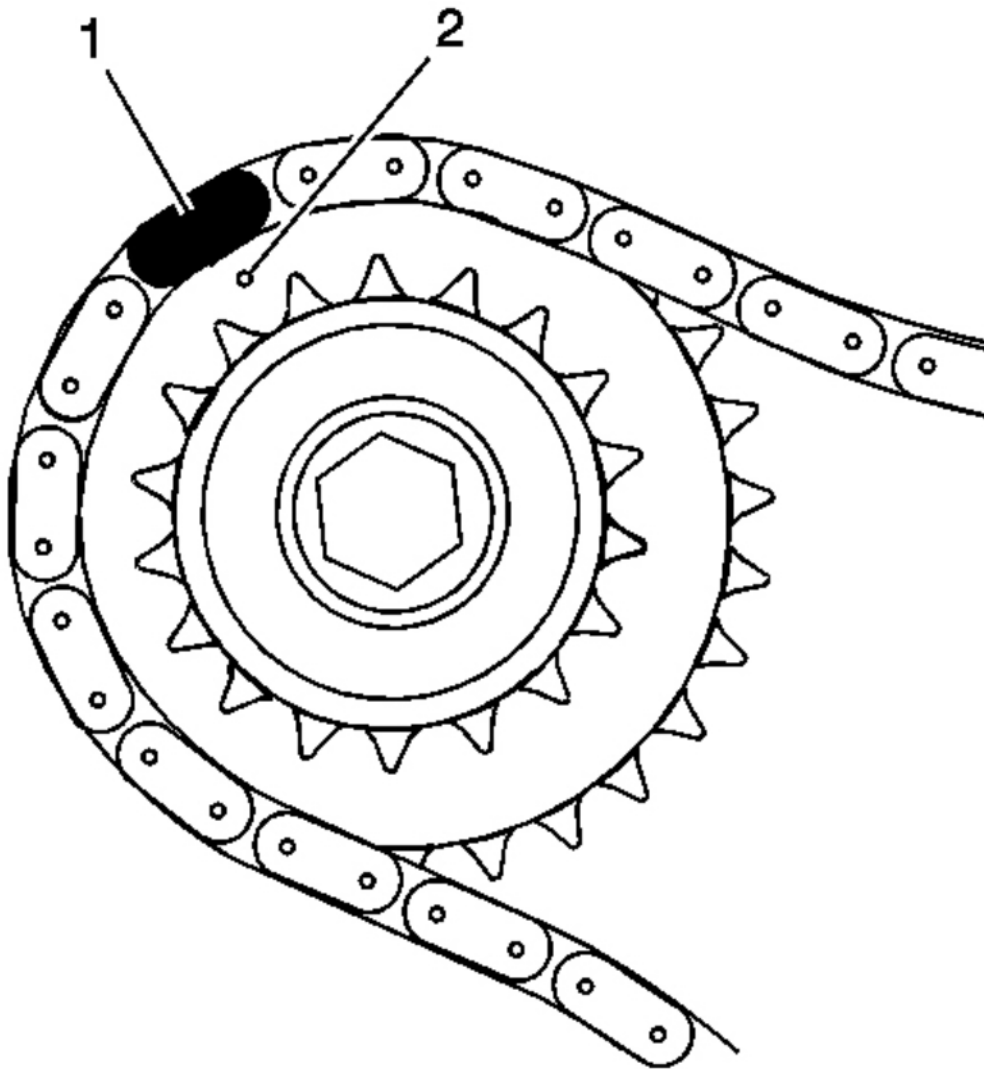


Fig. 237: Aligning Primary Camshaft Drive Chain With Right Drive Chain Idler Timing Mark

Courtesy of GENERAL MOTORS CORP.

4. The right camshaft intermediate drive chain idler timing mark (2) will align with a timing camshaft drive chain link (1).

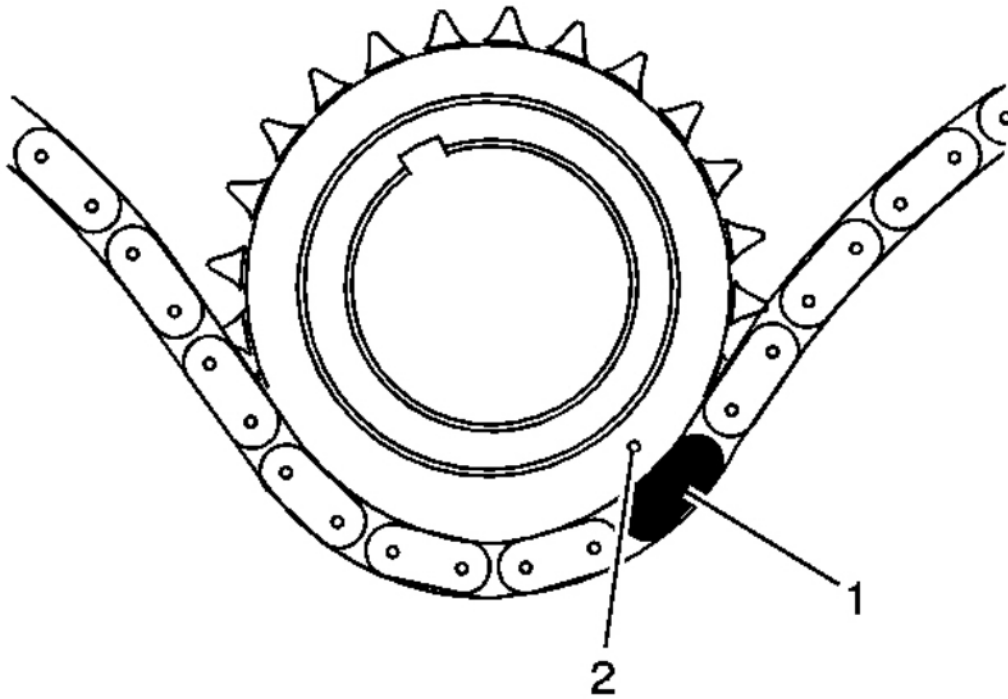


Fig. 238: Aligning Primary Camshaft Drive Chain With Crankshaft Sprocket Timing Mark

Courtesy of GENERAL MOTORS CORP.

5. The crankshaft sprocket timing mark (2) will align with a timing camshaft drive chain link (1).

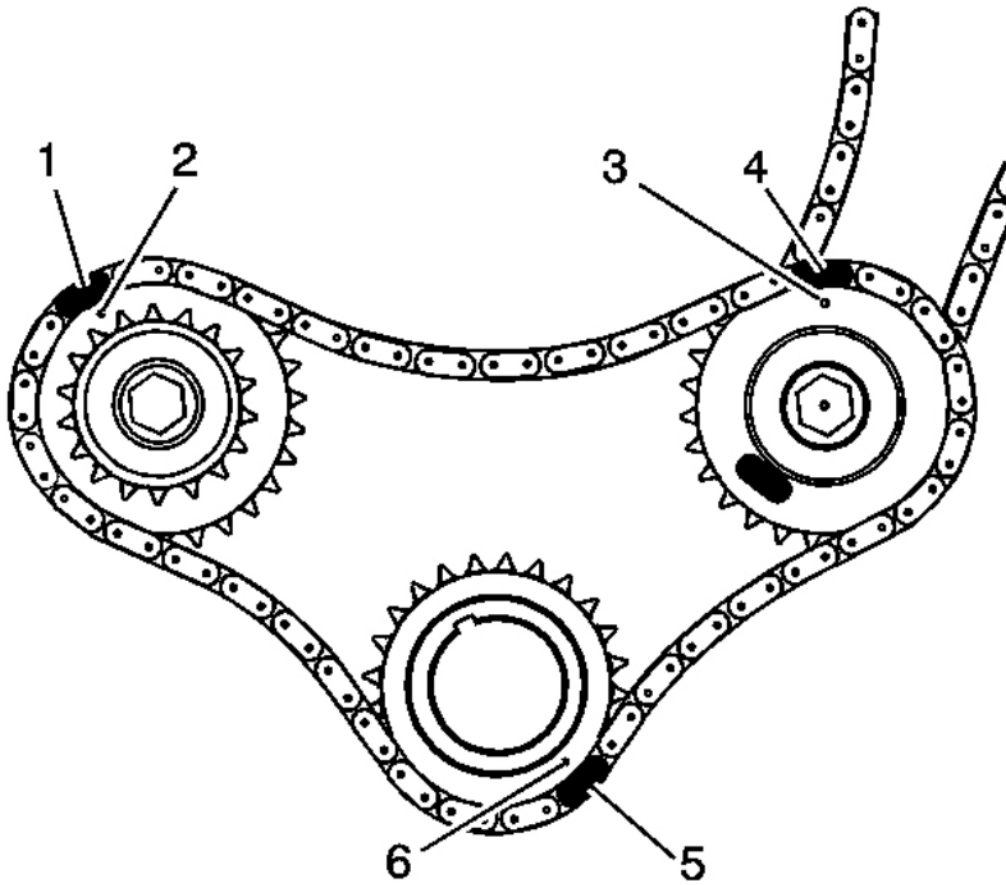


Fig. 239: Ensuring Primary Camshaft Drive Chain Timing Alignment
Courtesy of GENERAL MOTORS CORP.

6. Ensure all the timing marks (2, 3, 6) are properly aligned with the timing camshaft drive chain links (1, 4, 5).

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LOWER

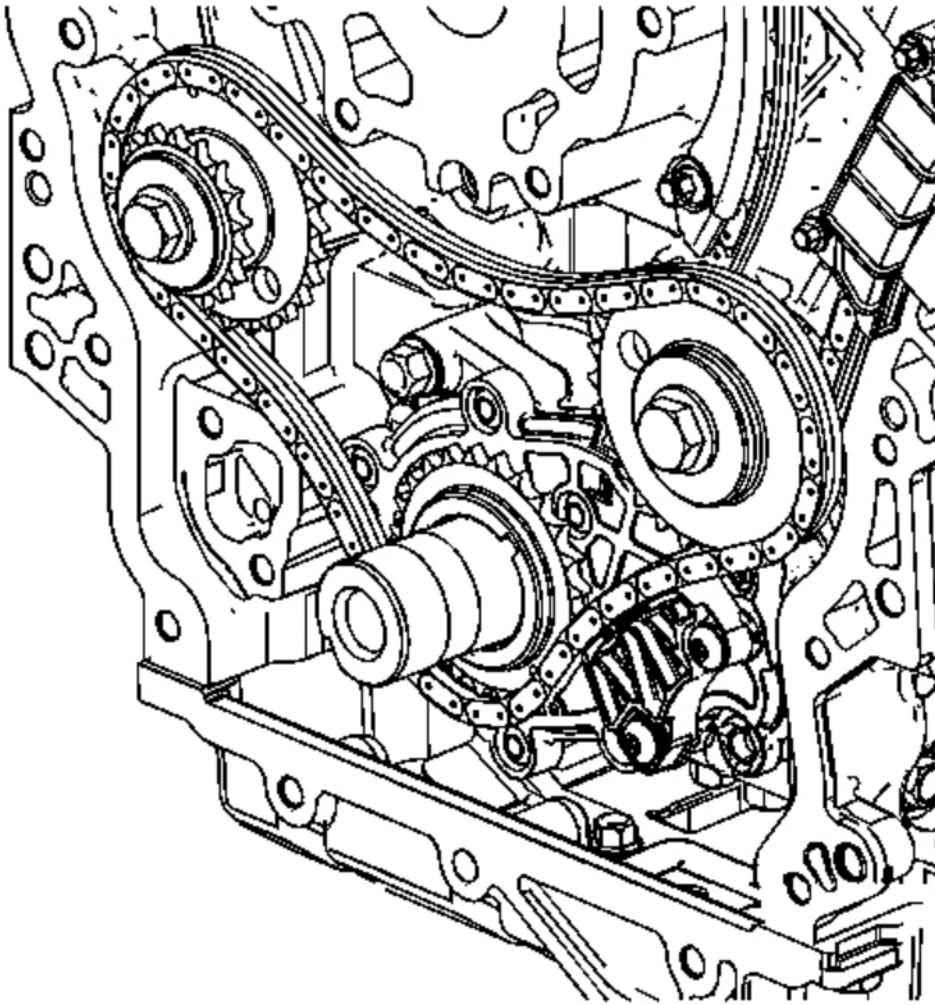


Fig. 240: View Of Lower Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

Do not remove the primary camshaft drive chain lower guide. The primary camshaft drive chain lower guide is not serviceable separately. If the primary camshaft drive chain lower guide must be replaced, the oil pump must be replaced.

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - UPPER

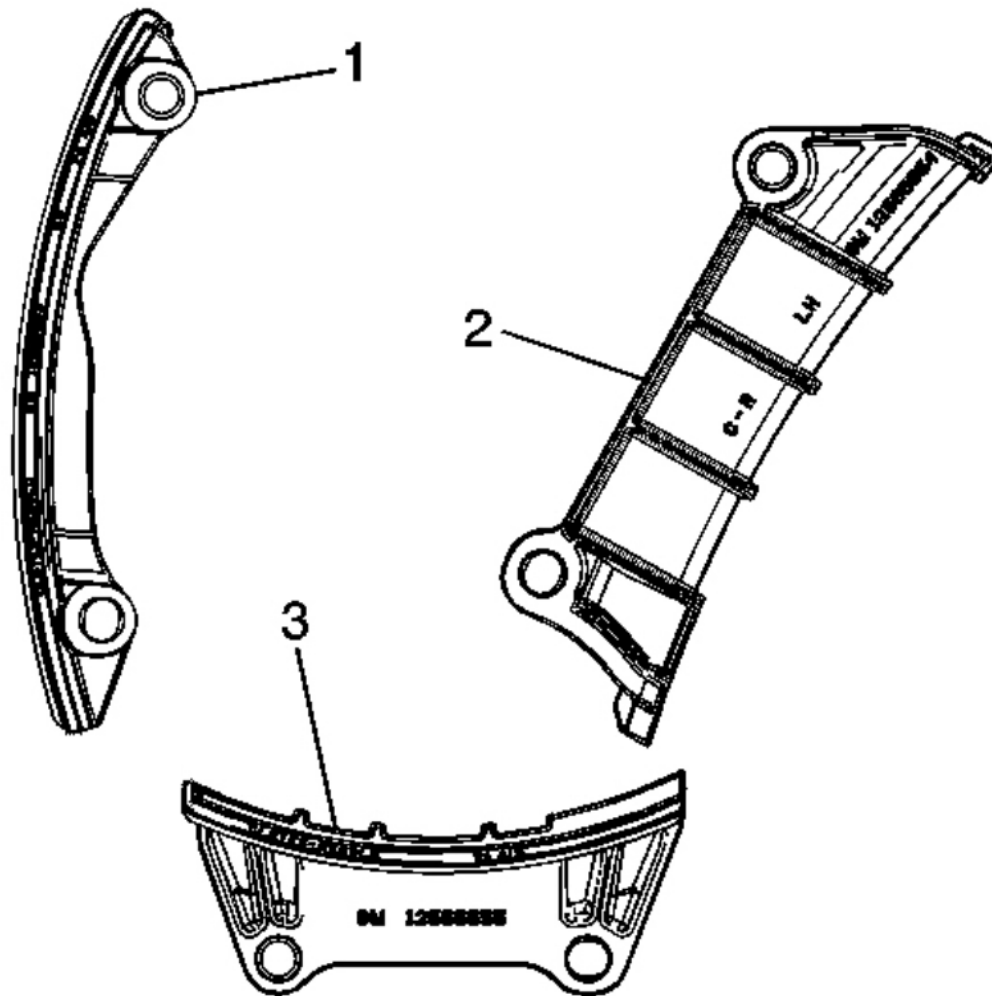


Fig. 241: Identifying Left & Right Secondary Camshaft Drive Chain Guide & Upper Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

1. Ensure the upper primary camshaft drive chain guide (3) is being installed.

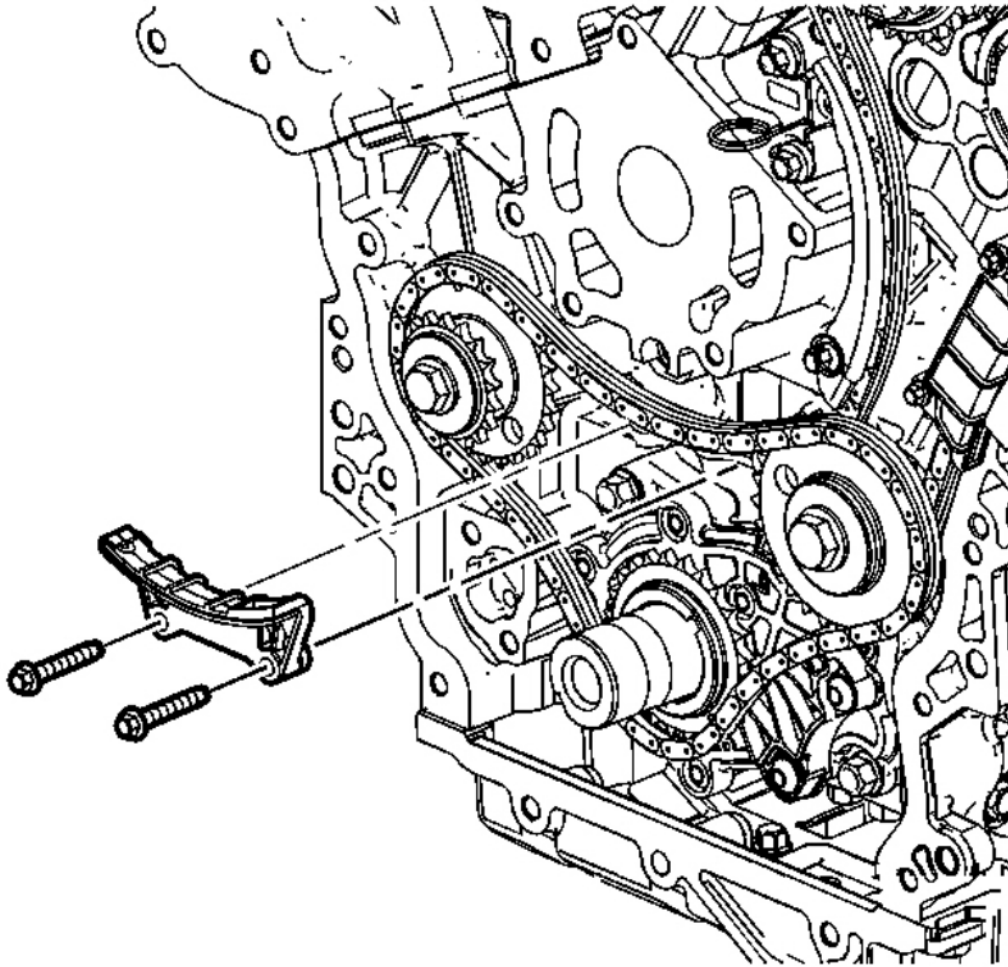


Fig. 242: View Of Upper Primary Camshaft Drive Chain Guides
Courtesy of GENERAL MOTORS CORP.

2. Install the upper primary camshaft drive chain guides.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the upper primary camshaft drive chain guide bolts.

Tighten: Tighten the upper primary camshaft drive chain guide bolts to 23 N.m (17 lb ft).

PRIMARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION**Tools Required**

- **EN 46105** Camshaft Locking Tool
- **EN 46111** Crankshaft Rotation Socket
- **EN 46112** Tensioner Retraction Pins
- **J 45027** Tensioner Tool

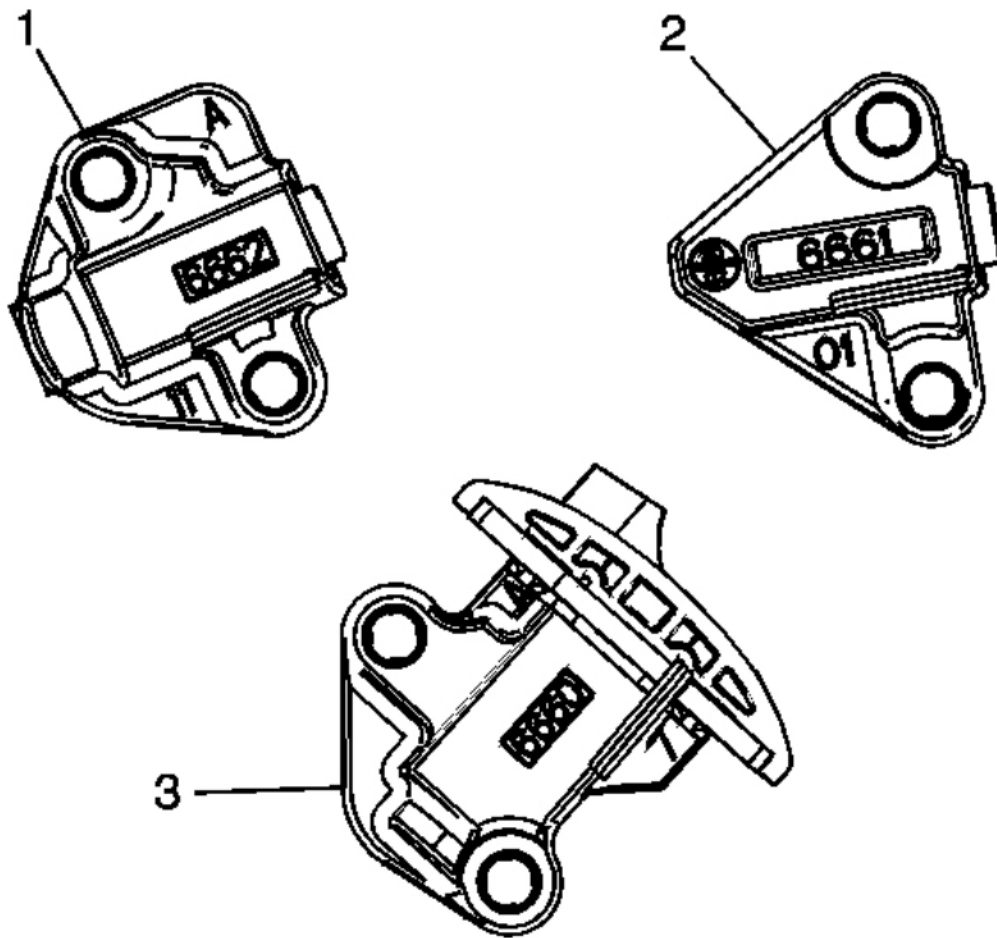


Fig. 243: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner

Courtesy of GENERAL MOTORS CORP.

1. Ensure that the primary camshaft drive chain tensioner (3) is being installed.

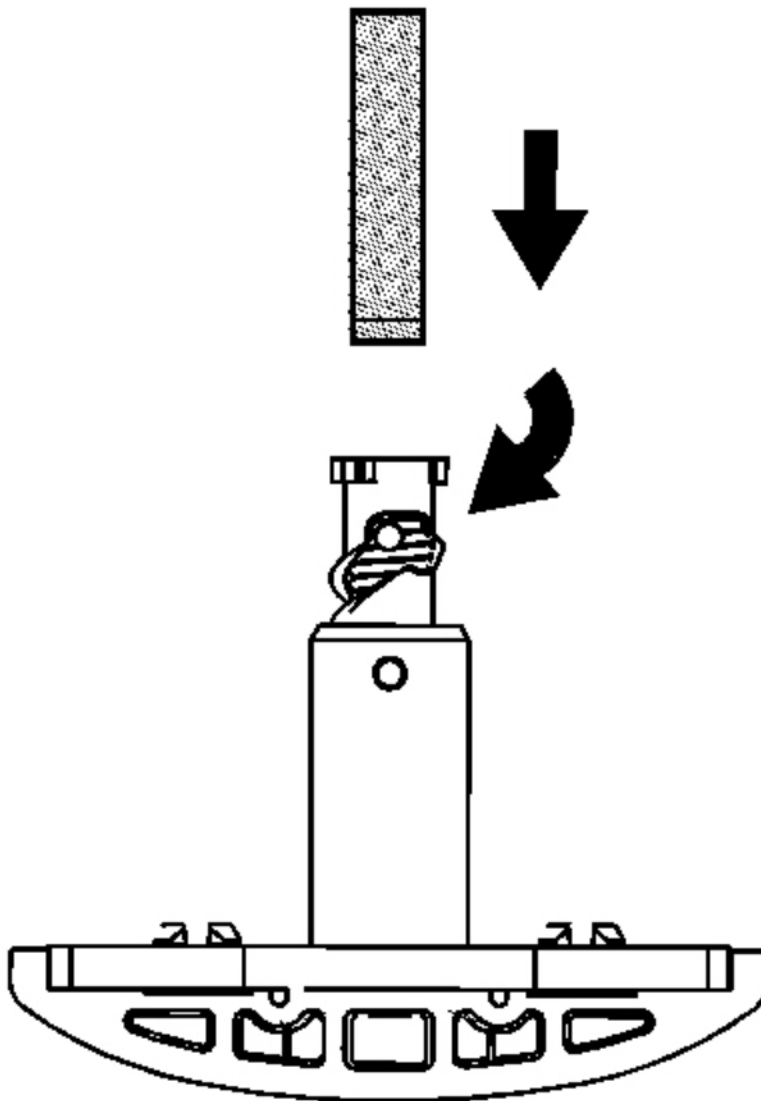


Fig. 244: Resetting Primary Camshaft Drive Chain Tensioner Plunger
Courtesy of GENERAL MOTORS CORP.

2. Using the **J 45027** reset the primary camshaft drive chain tensioner plunger.

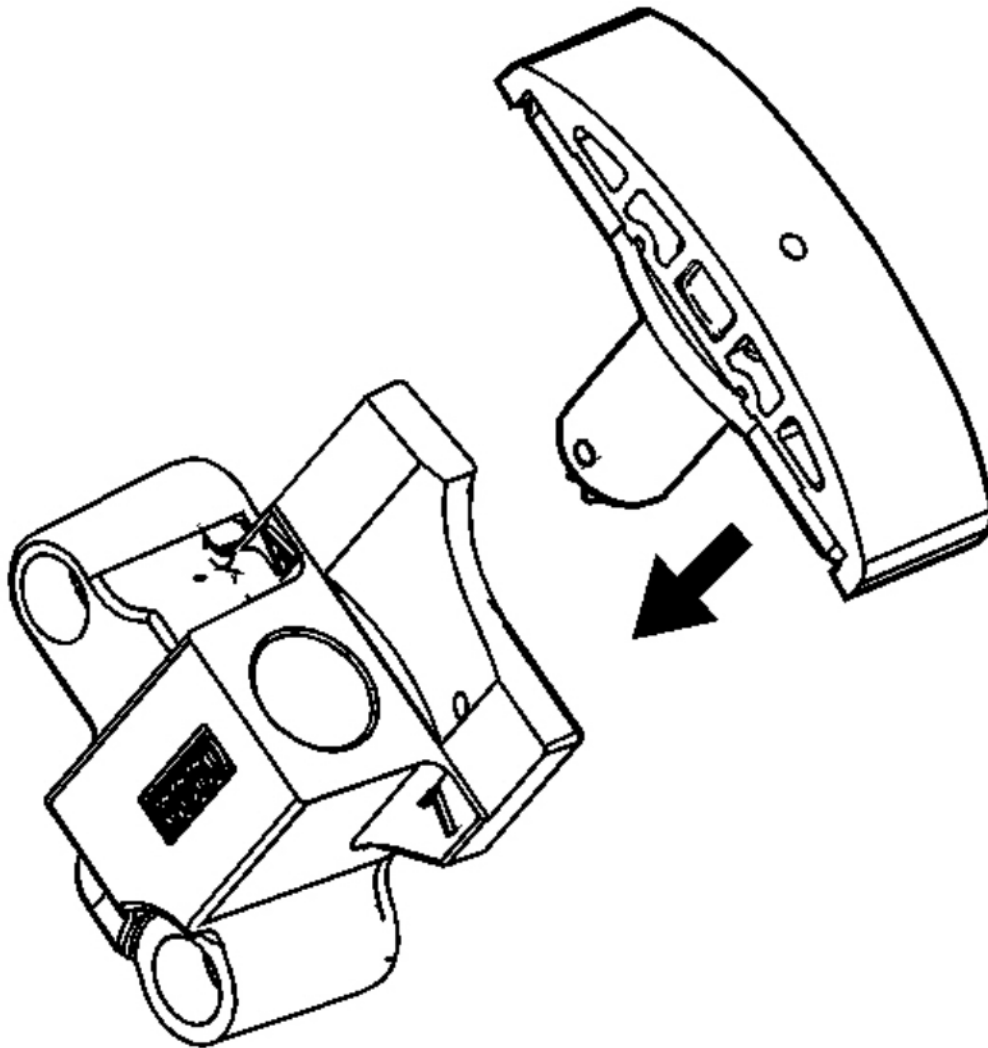


Fig. 245: Installing Plunger Into Primary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

3. Install the plunger into the primary camshaft drive chain tensioner body.

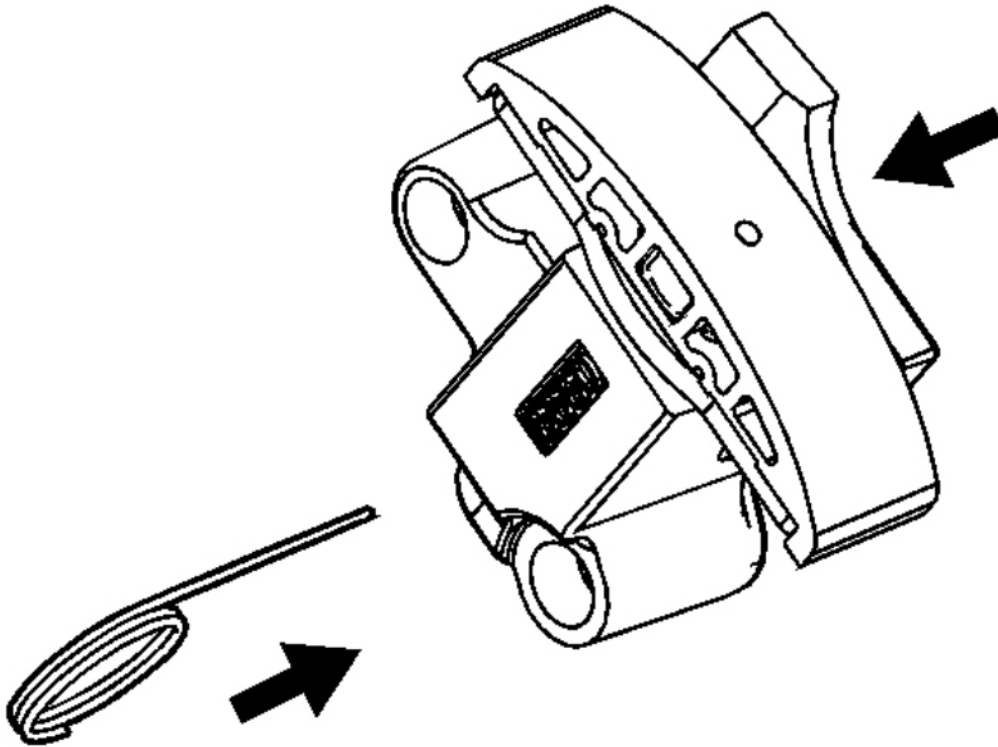


Fig. 246: Inserting EN 46112 Into Primary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

4. Compress the plunger into the body and lock the primary camshaft drive chain tensioner by inserting the **EN 46112** into the access hole in the side of the primary camshaft drive chain tensioner body.
5. Slowly release pressure on the primary camshaft drive chain tensioner. The primary camshaft drive chain tensioner should remain compressed.

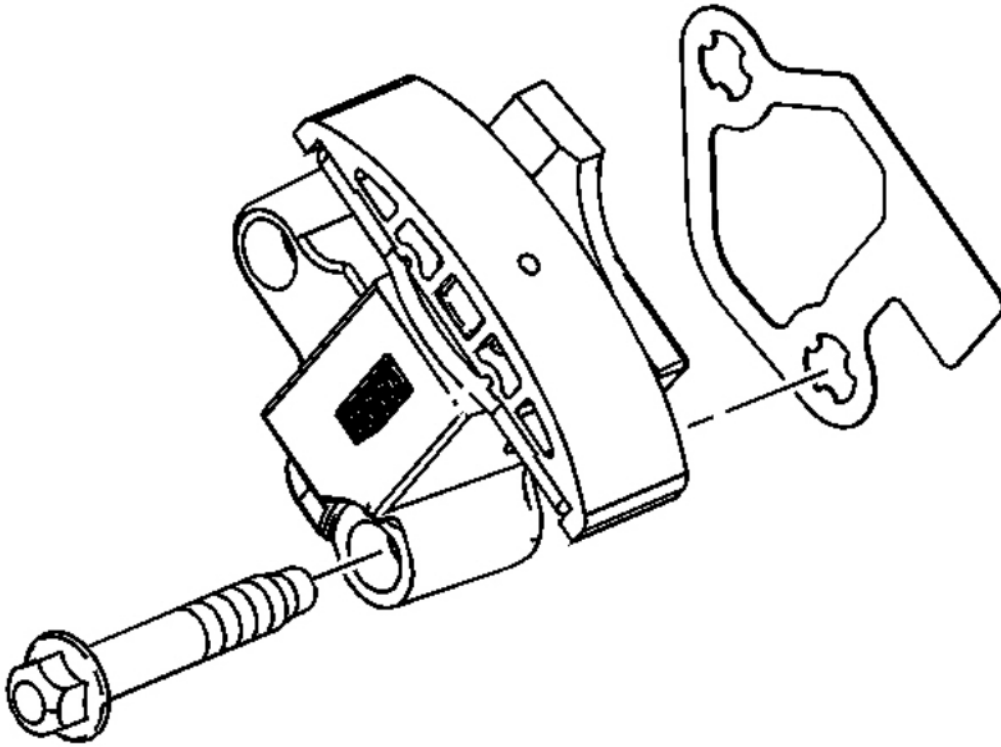


Fig. 247: Identifying Primary Camshaft Drive Chain Tensioner Components
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW primary camshaft drive chain tensioner gasket to the primary camshaft drive chain tensioner.
7. Install the primary camshaft drive chain tensioner bolts through the primary camshaft drive chain tensioner and gasket.
8. Ensure the primary camshaft drive chain tensioner mounting surface on the engine block does not have any burrs or defects that would degrade the sealing of the NEW primary camshaft drive chain tensioner gasket.

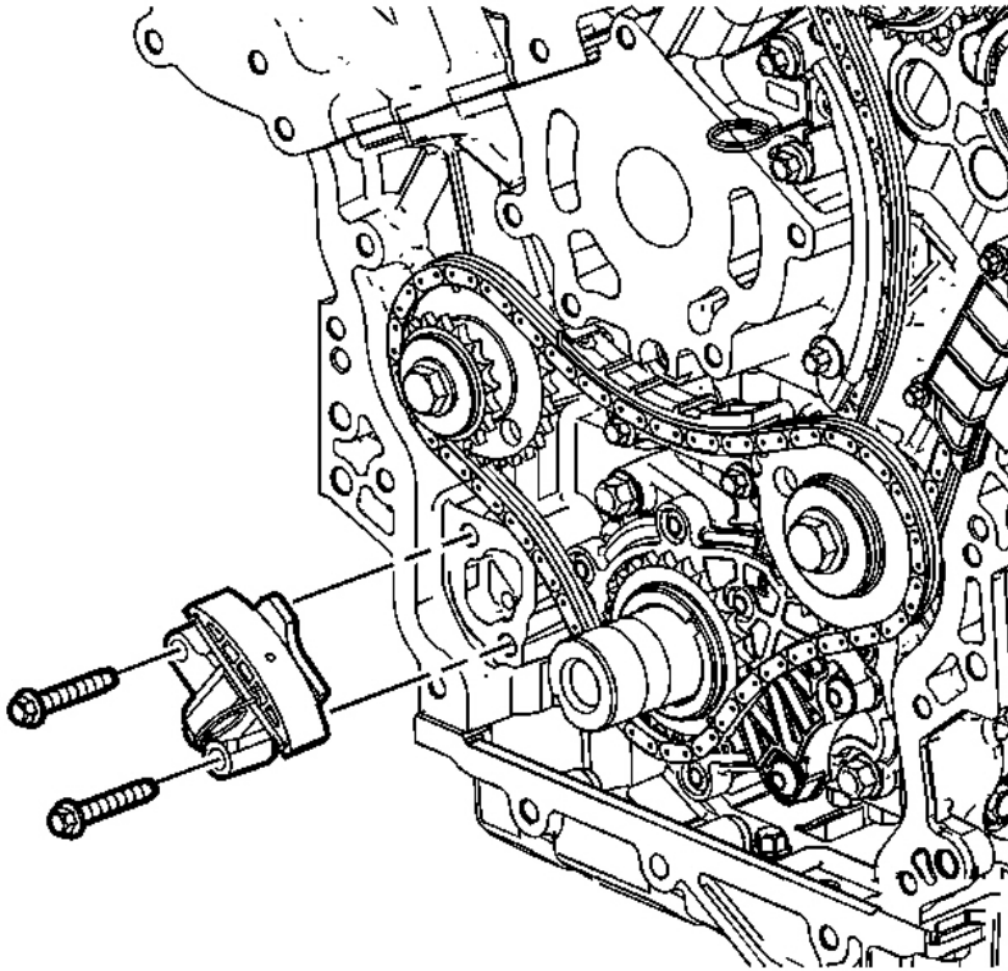


Fig. 248: View Of Primary Camshaft Drive Chain Tensioners
Courtesy of GENERAL MOTORS CORP.

9. Place the primary camshaft drive chain tensioner into position and loosely install the bolts to the block.

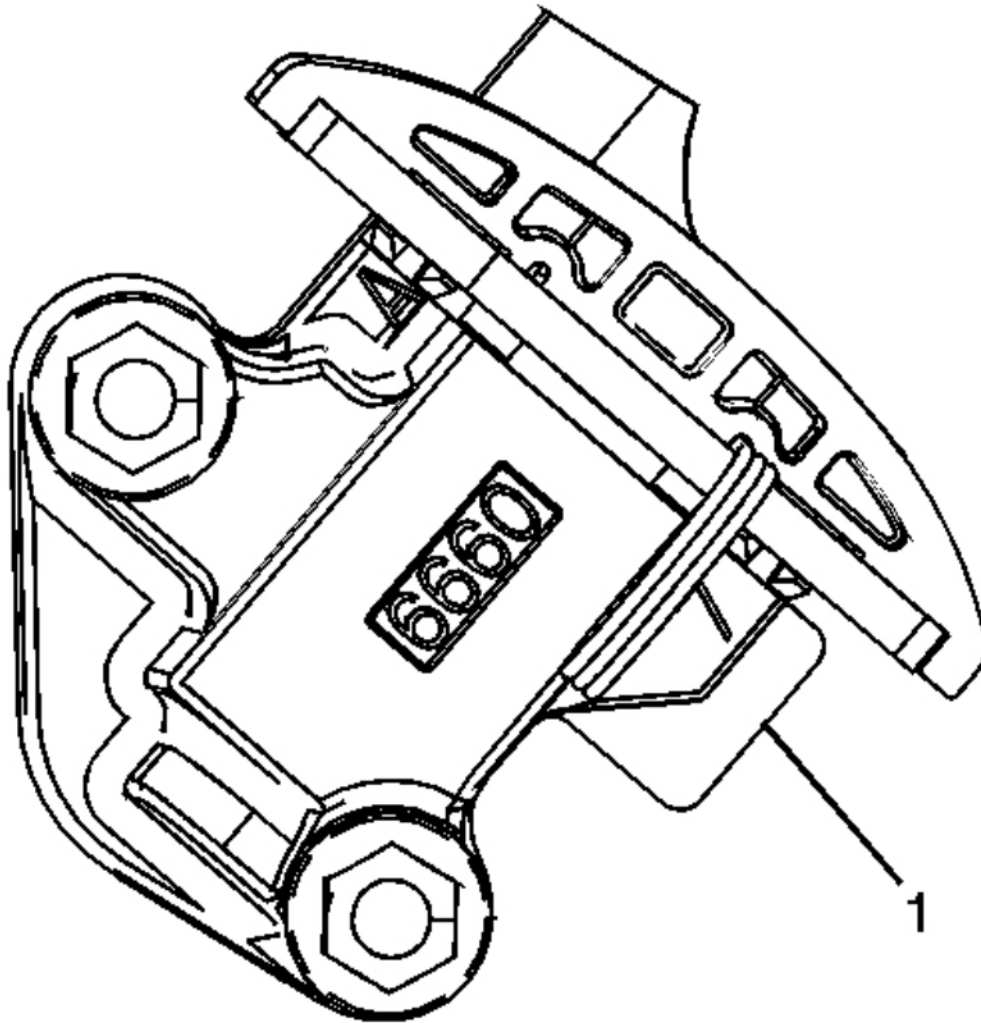


Fig. 249: Locating Primary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Verify the proper placement of the primary camshaft drive chain tensioner gasket tab (1).
 1. First Pass

Tighten: Tighten the primary camshaft drive chain tensioner bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the primary camshaft drive chain tensioner bolts to 23 N.m (17 lb ft).

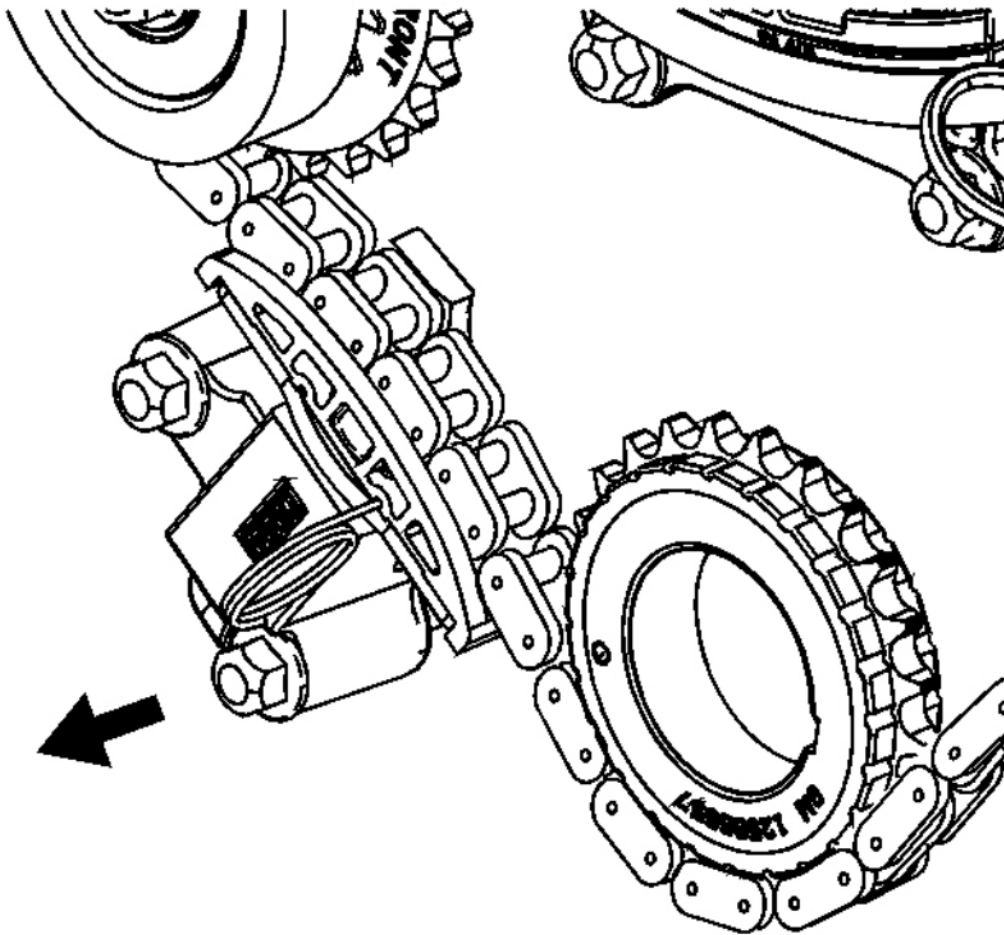


Fig. 250: Removing EN 46112 From Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

11. Release the primary camshaft drive chain tensioner by pulling out the **EN 46112** and unlocking the tensioner plunger.

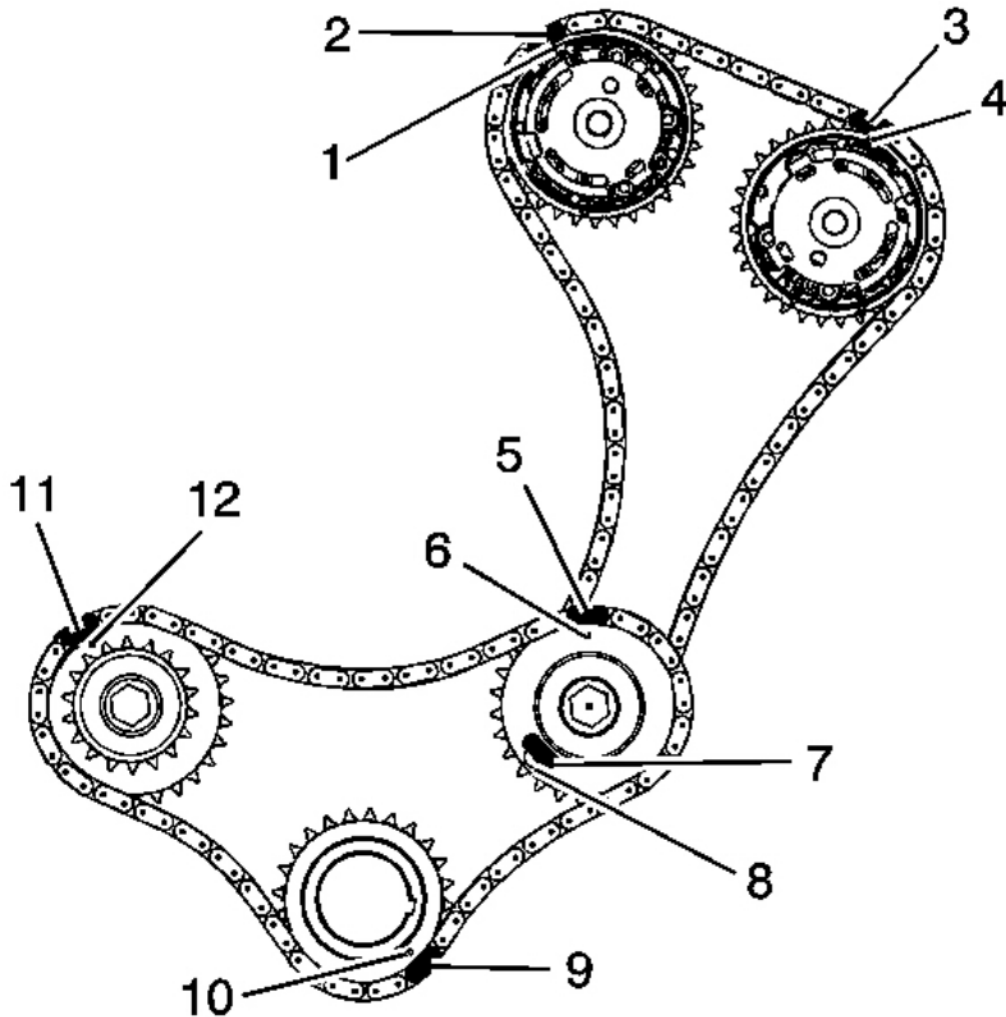


Fig. 251: Aligning Primary & Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS CORP.

12. Verify the primary and left secondary camshaft drive chain timing mark alignments (1-12) also refer to **Camshaft Timing Drive Chain Alignment Diagram** - Stage One.

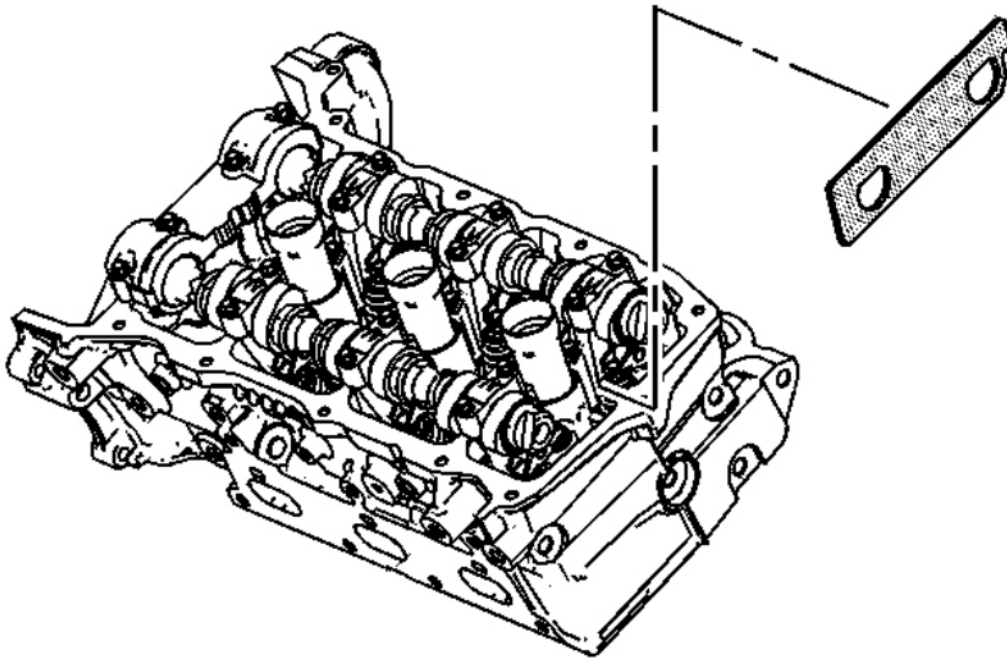


Fig. 252: Removing EN 46105-1 From Rear Of Left camshafts
Courtesy of GENERAL MOTORS CORP.

13. Remove the EN 46105-1 from the rear of the left camshafts.

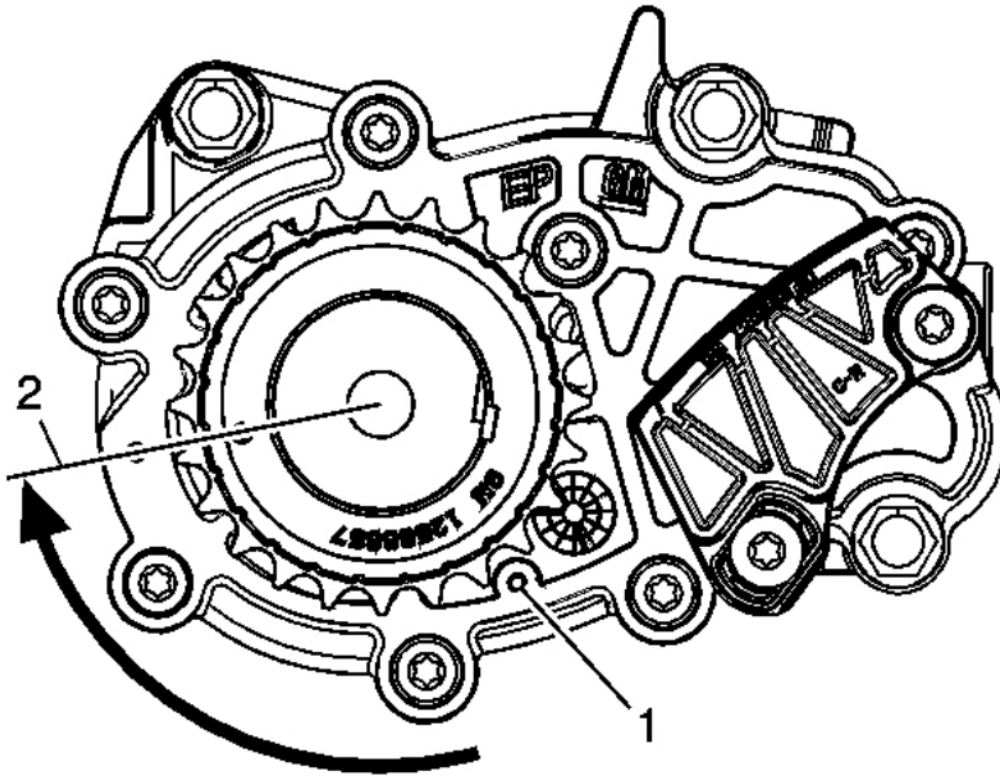


Fig. 253: Rotating Crankshaft To Stage Two Alignment Position
Courtesy of GENERAL MOTORS CORP.

14. Using the **EN 46111** rotate the crankshaft and crankshaft sprocket from the stage one alignment position (1) to the stage two alignment position (2), 115 crankshaft degrees, in order to install the right secondary camshaft drive chain components.

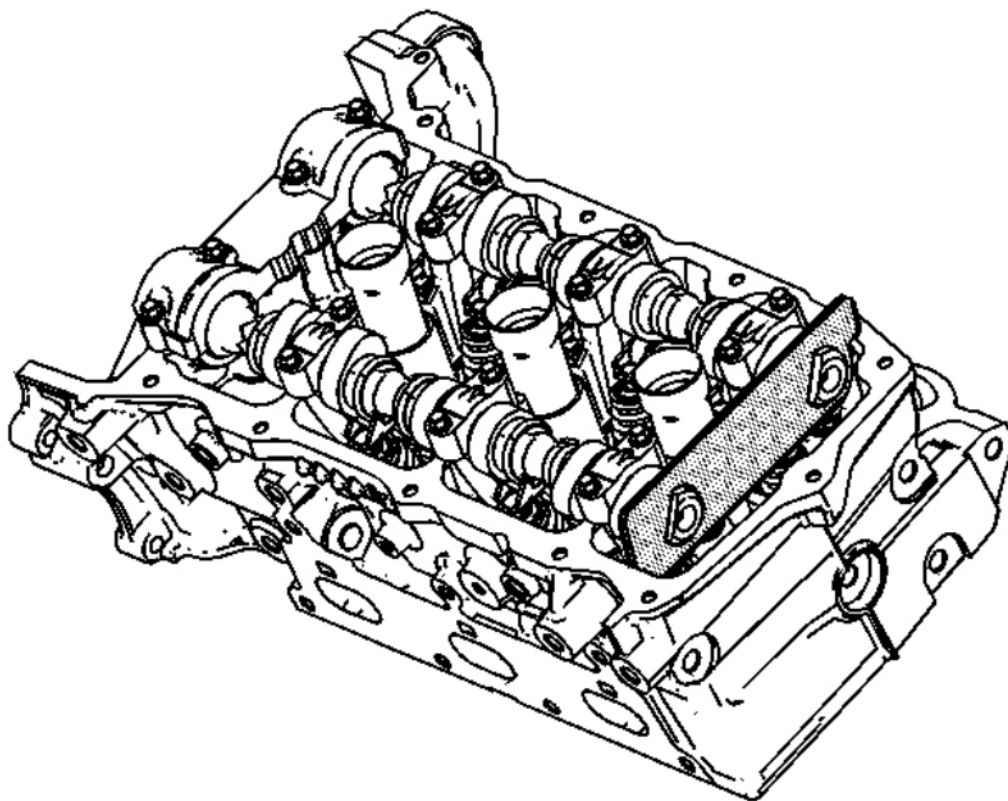


Fig. 254: Installing EN 46105-2 Onto Rear of Left Camshafts
Courtesy of GENERAL MOTORS CORP.

15. Install the EN 46105-2 onto the rear of the left camshafts.

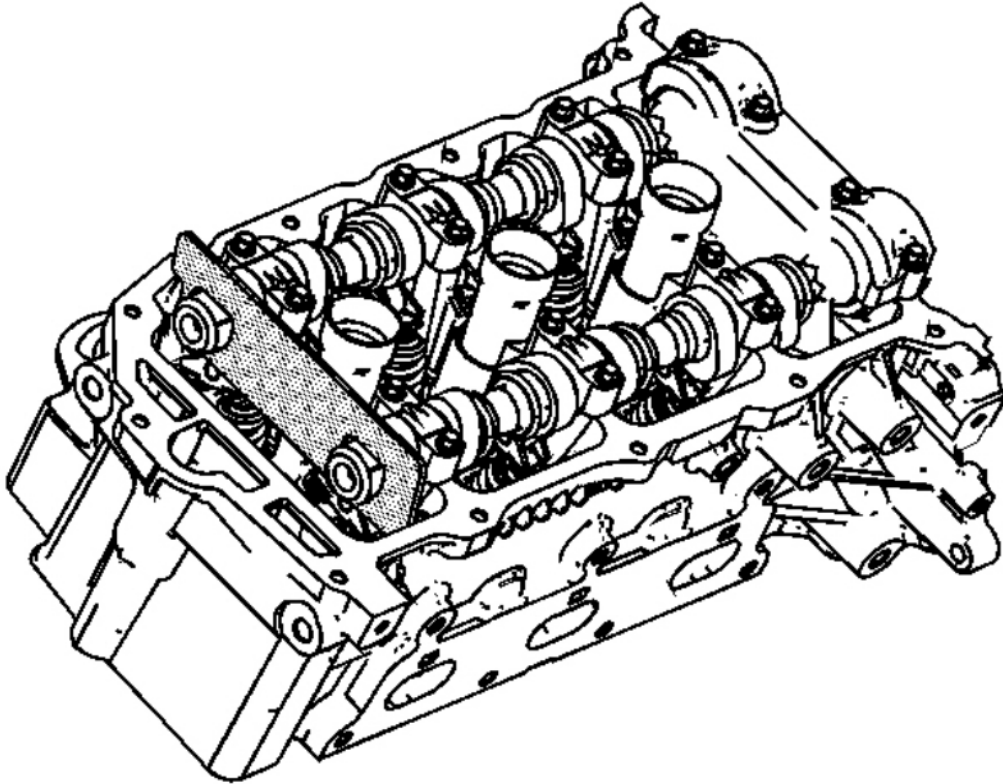


Fig. 255: Installing EN 46105-1 Onto Rear Of Right Camshafts
Courtesy of GENERAL MOTORS CORP.

16. Install the EN 46105-1 onto the rear of the right camshafts.

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT

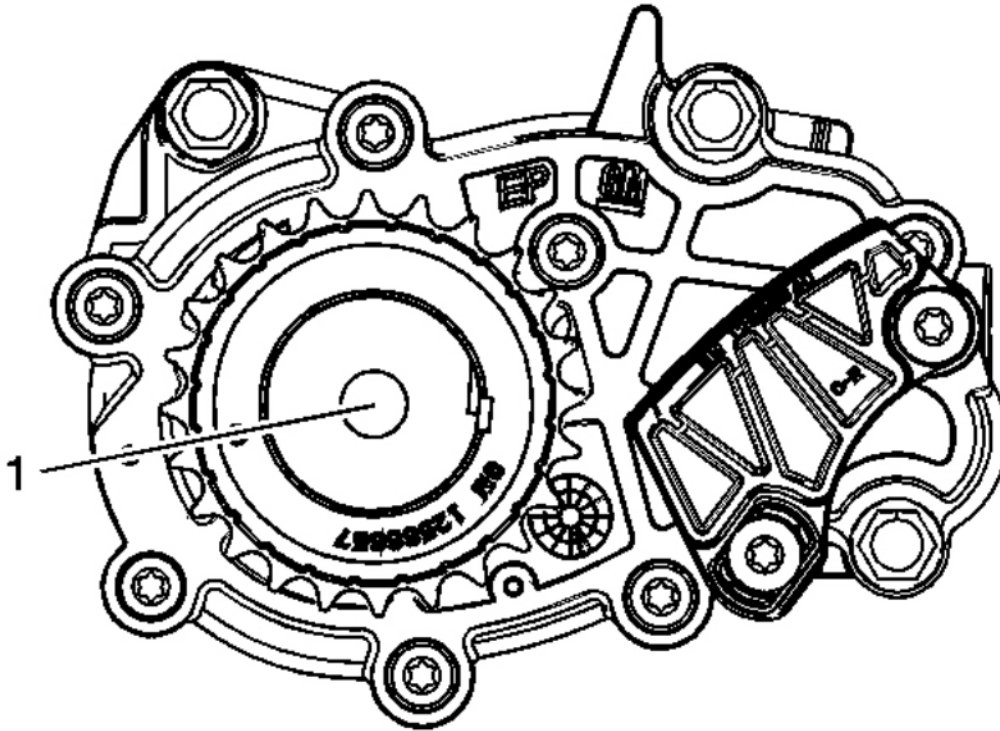


Fig. 256: Ensuring That Crankshaft Is In Stage Two Timing Drive Assembly Position

Courtesy of GENERAL MOTORS CORP.

1. Ensure that the crankshaft is in the stage two timing drive assembly position (1).

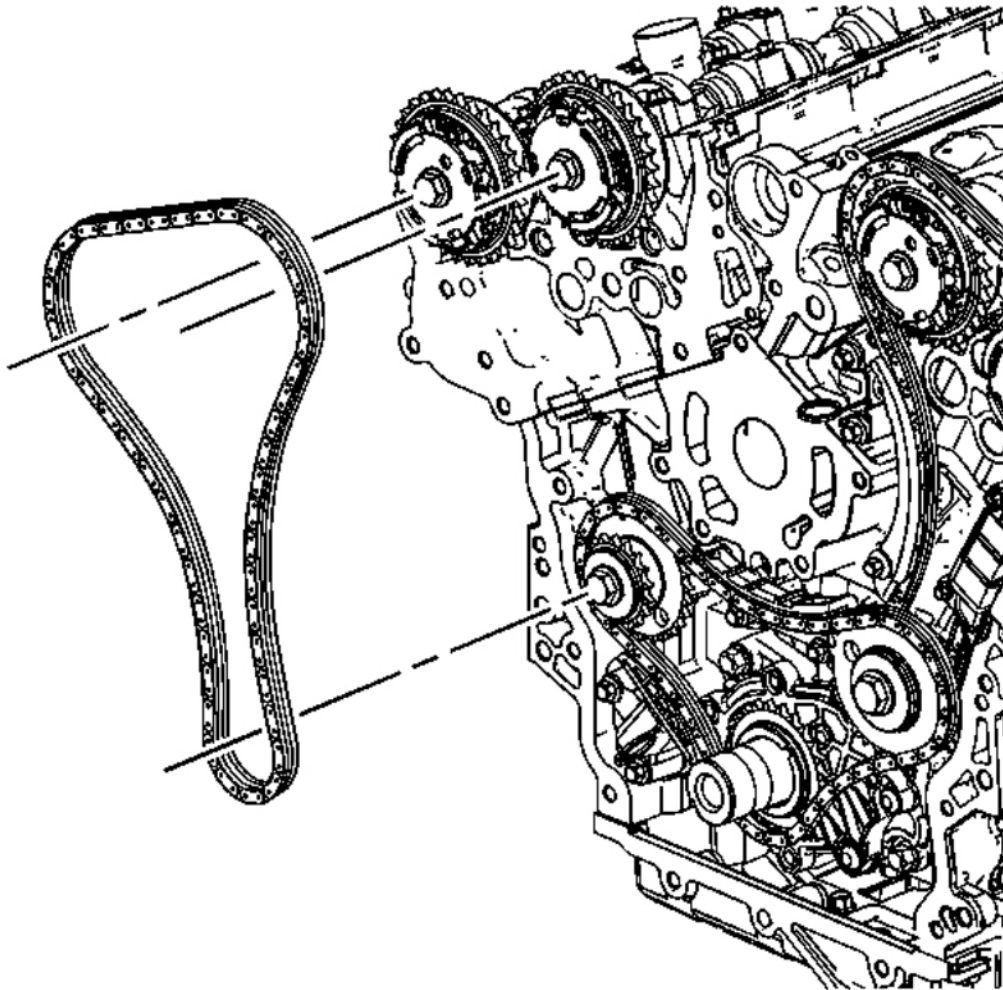


Fig. 257: View Of Right Bank Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

2. Install the right secondary camshaft drive chain.

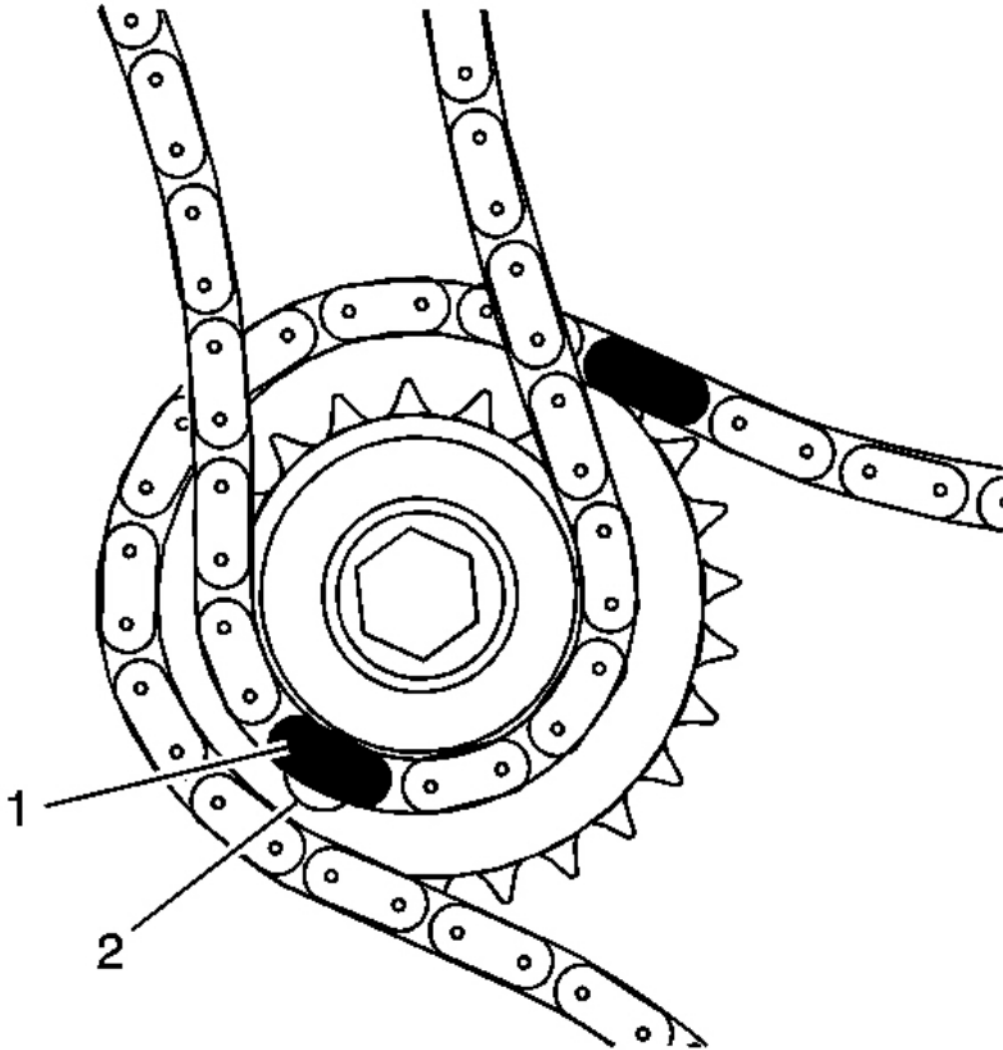


Fig. 258: Aligning Right Secondary Camshaft Drive Chain With Right Camshaft Chain Idler Inner Sprocket

Courtesy of GENERAL MOTORS CORP.

3. Place the secondary camshaft drive chain around the right camshaft intermediate drive chain idler outer sprocket, aligning the timing camshaft drive chain link (1) with the alignment access hole (2) made in the right camshaft intermediate drive chain idler inner sprocket.

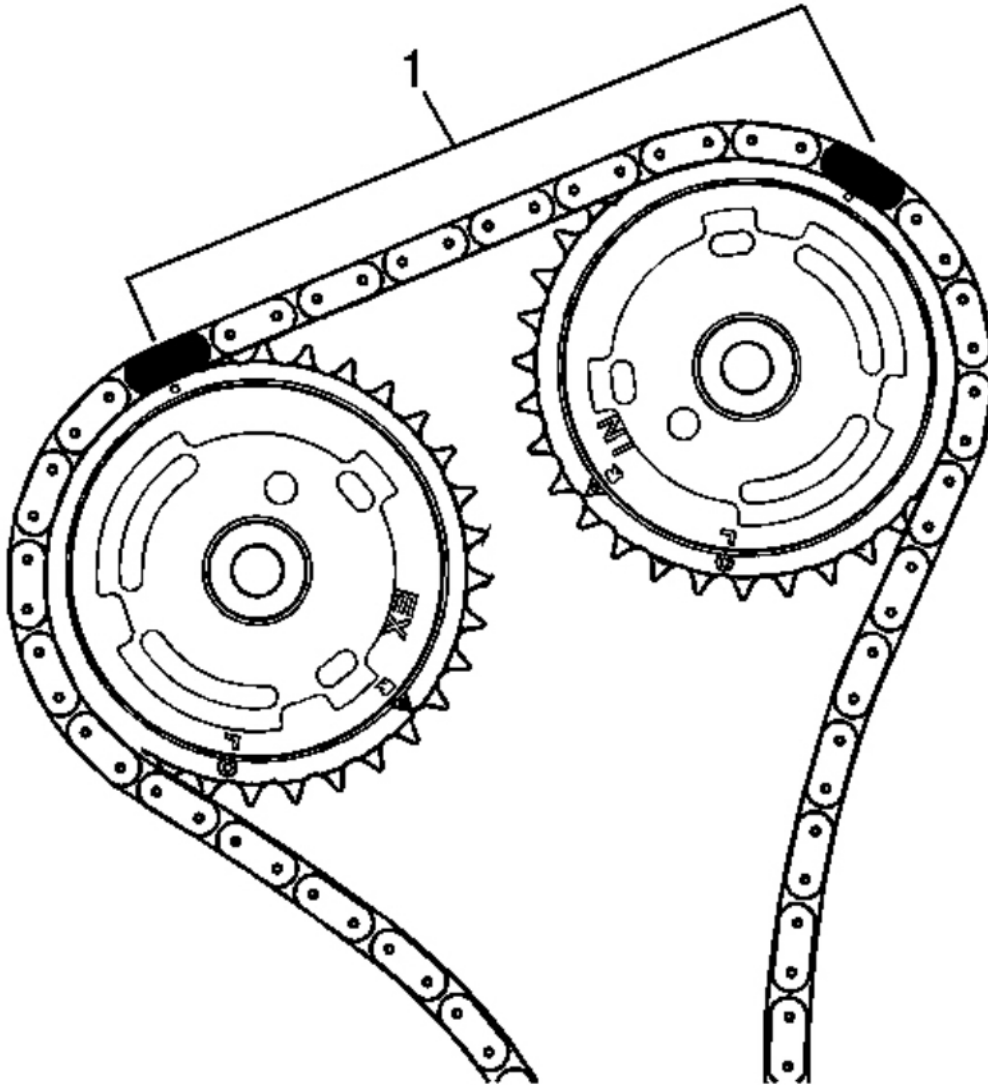


Fig. 259: Identifying 7 Links Between Right Secondary Timing Chain Links
Courtesy of GENERAL MOTORS CORP.

4. Wrap the secondary camshaft drive chain around both right actuator drive sprockets.
5. Ensure there are 7 links (1) between the timing camshaft drive chain links for the camshaft position actuator sprockets.

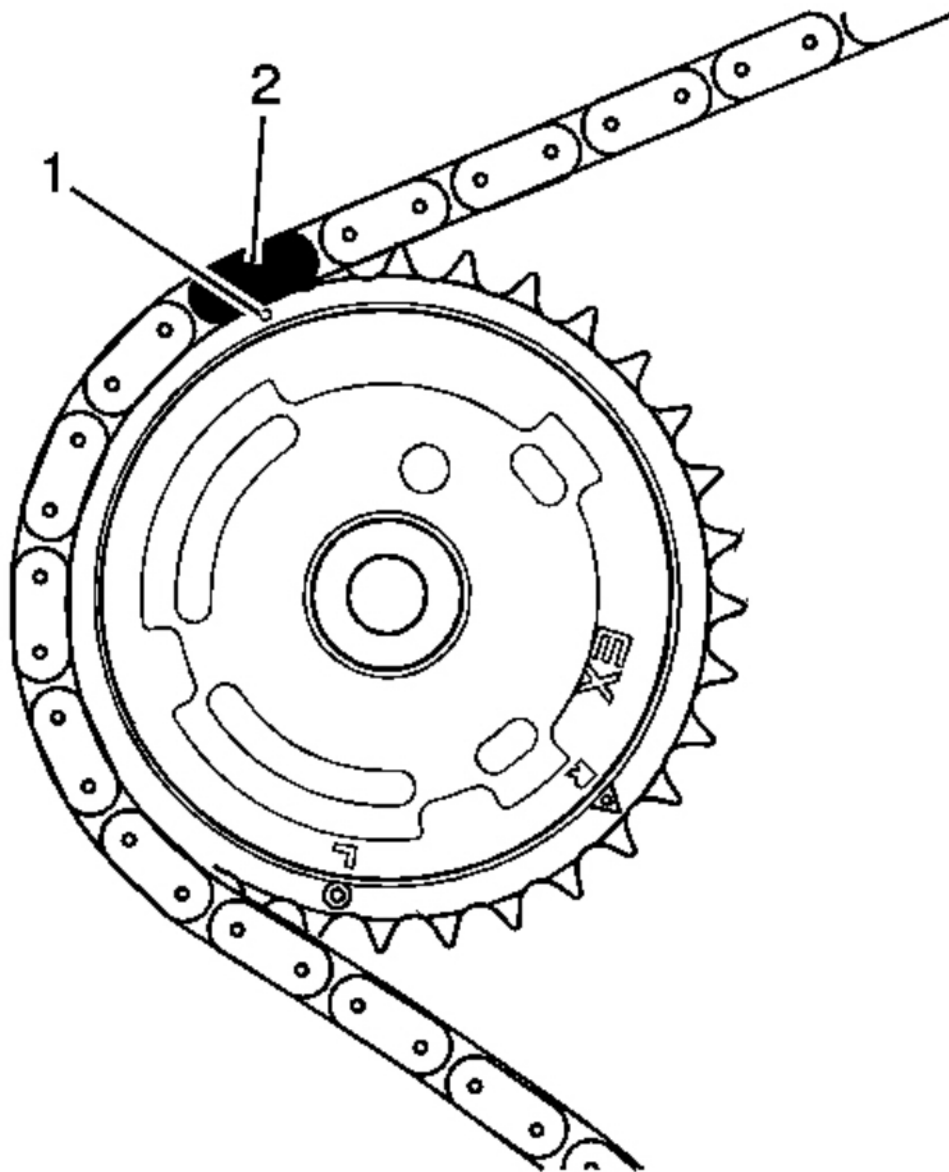


Fig. 260: Aligning Right Exhaust Camshaft Position Actuator Sprocket Alignment Mark With Right Secondary Timing Chain Link
Courtesy of GENERAL MOTORS CORP.

6. Align the right exhaust camshaft position actuator sprocket alignment triangle mark (1) with

the timing camshaft drive chain link (2).

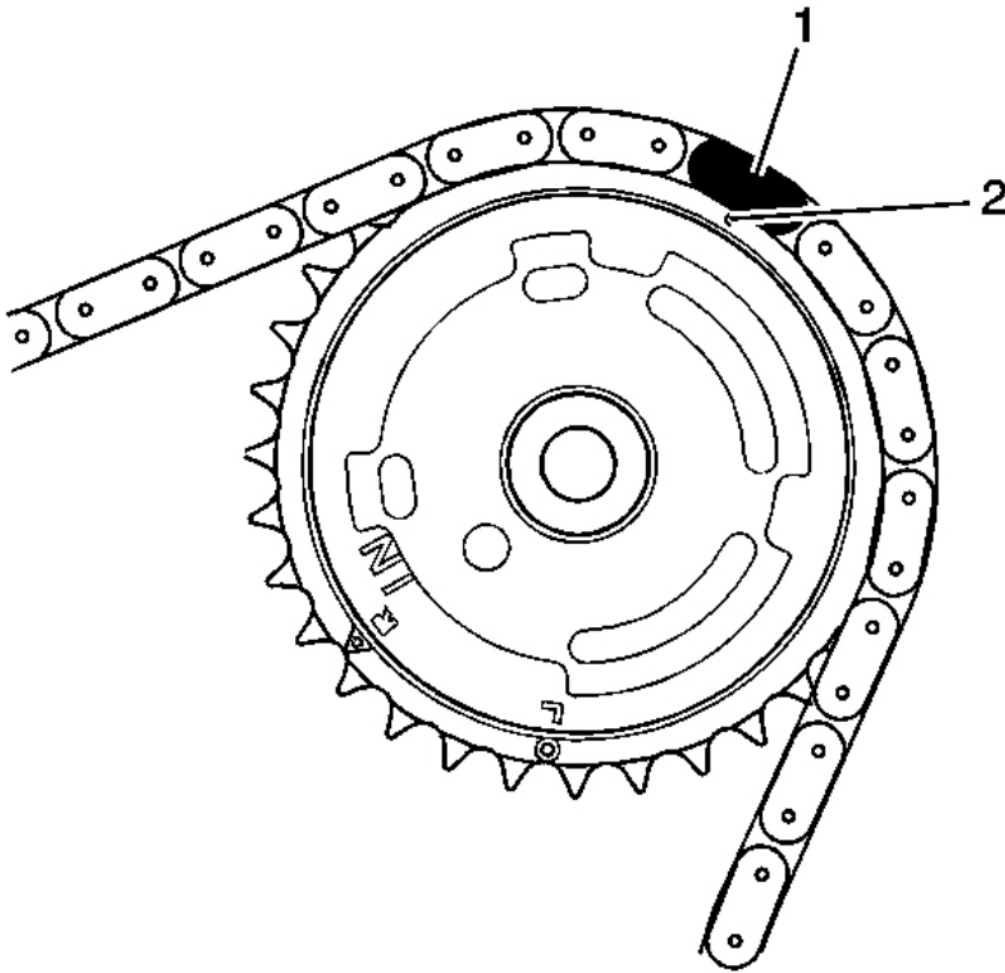


Fig. 261: Aligning Right Intake Camshaft Position Actuator Sprocket Alignment Mark With Right Secondary Timing Chain Link
Courtesy of GENERAL MOTORS CORP.

7. Align the right intake camshaft position actuator sprocket alignment triangle mark (2) with the timing camshaft drive chain link (1).

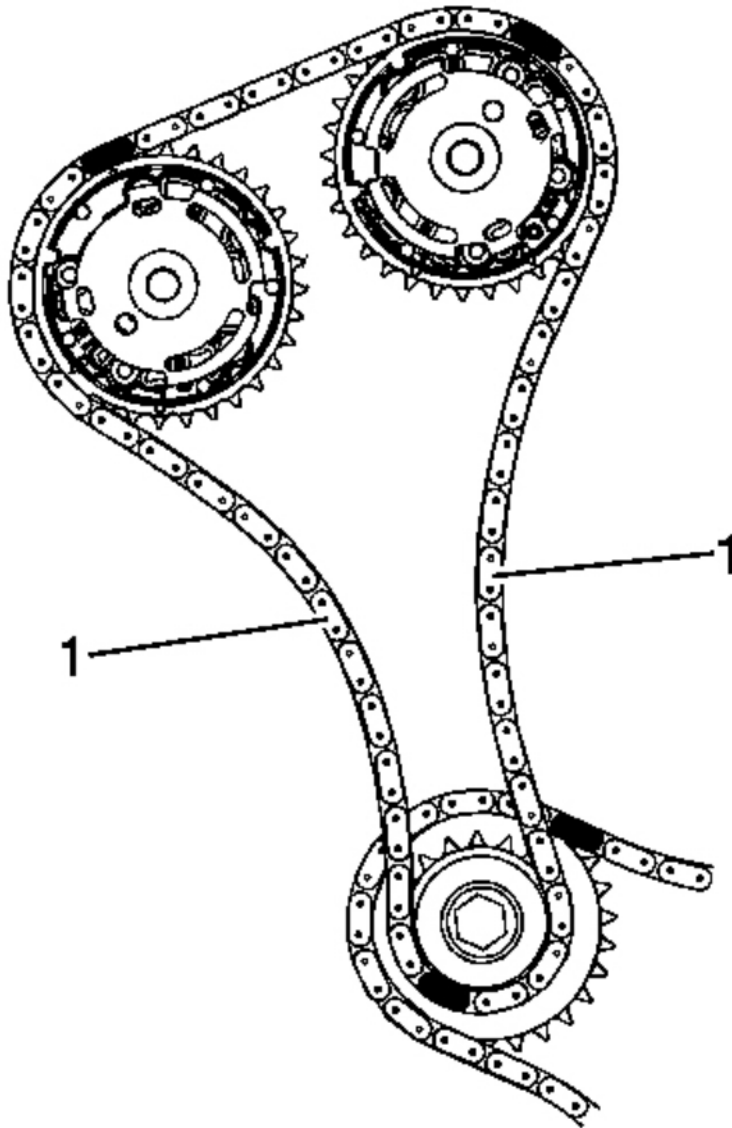


Fig. 262: Identifying 18 Links Between Right Secondary Timing Chain Links
Courtesy of GENERAL MOTORS CORP.

8. There will be 18 links (1) between the right camshaft intermediate drive chain idler timing camshaft drive chain link and each right camshaft position actuator sprocket timing camshaft drive chain link.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT

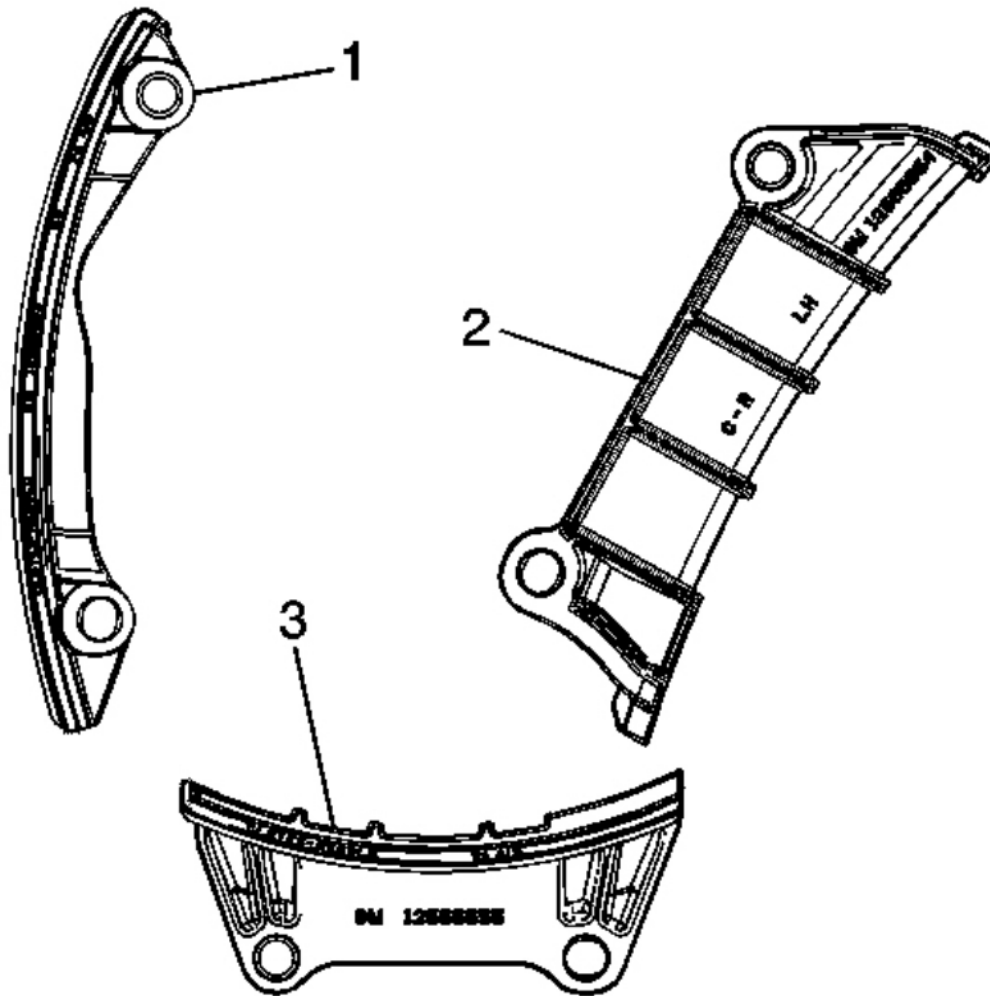


Fig. 263: Identifying Left & Right Secondary Camshaft Drive Chain Guide & Upper Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the right secondary camshaft drive chain guide (1) is being installed.

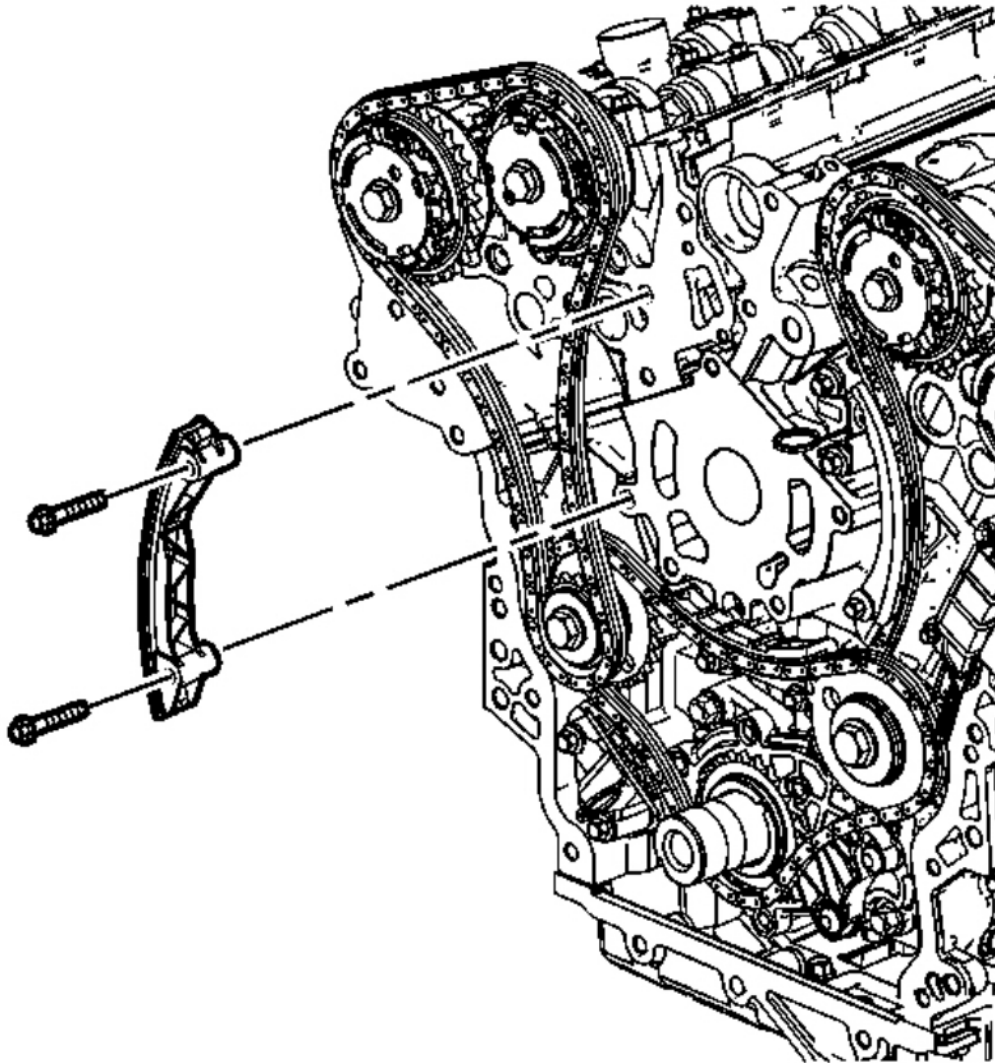


Fig. 264: View Of Right Secondary Camshaft Drive Chain Guide & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Position the right secondary camshaft drive chain guide.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the secondary camshaft drive chain guide bolts.

Tighten: Tighten the secondary camshaft drive chain guide bolts to 23 N.m (17 lb ft).

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT

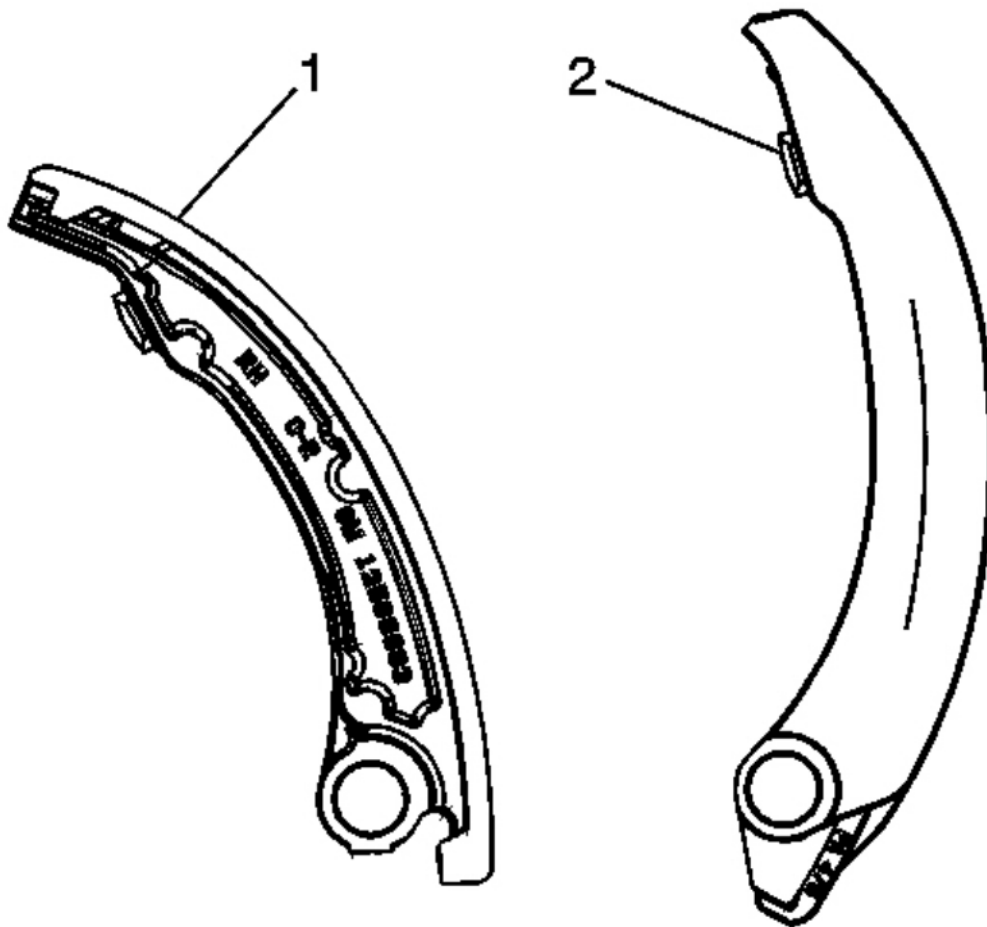


Fig. 265: View Of Secondary Camshaft Drive Chain Shoes
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the right secondary camshaft drive chain shoe (1) is being installed.

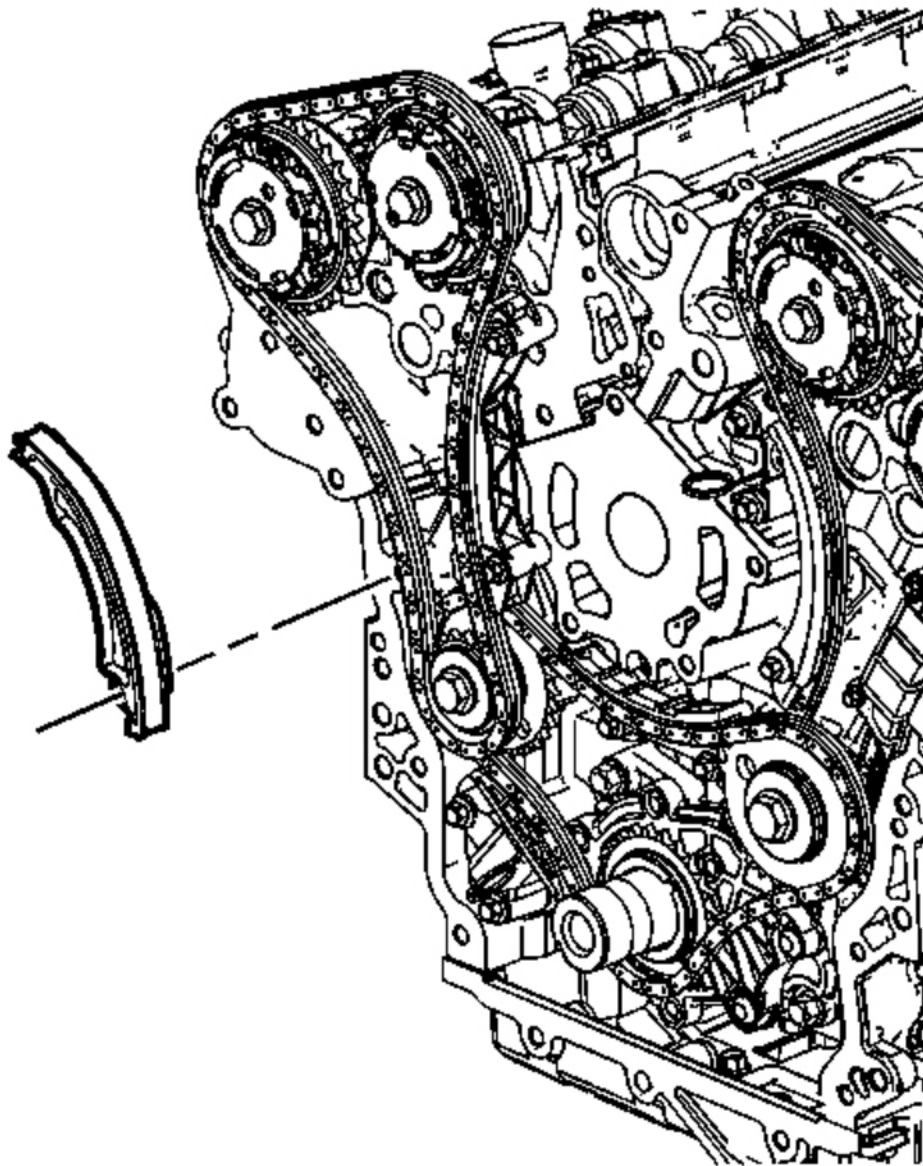


Fig. 266: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Position the right secondary camshaft drive chain shoe.

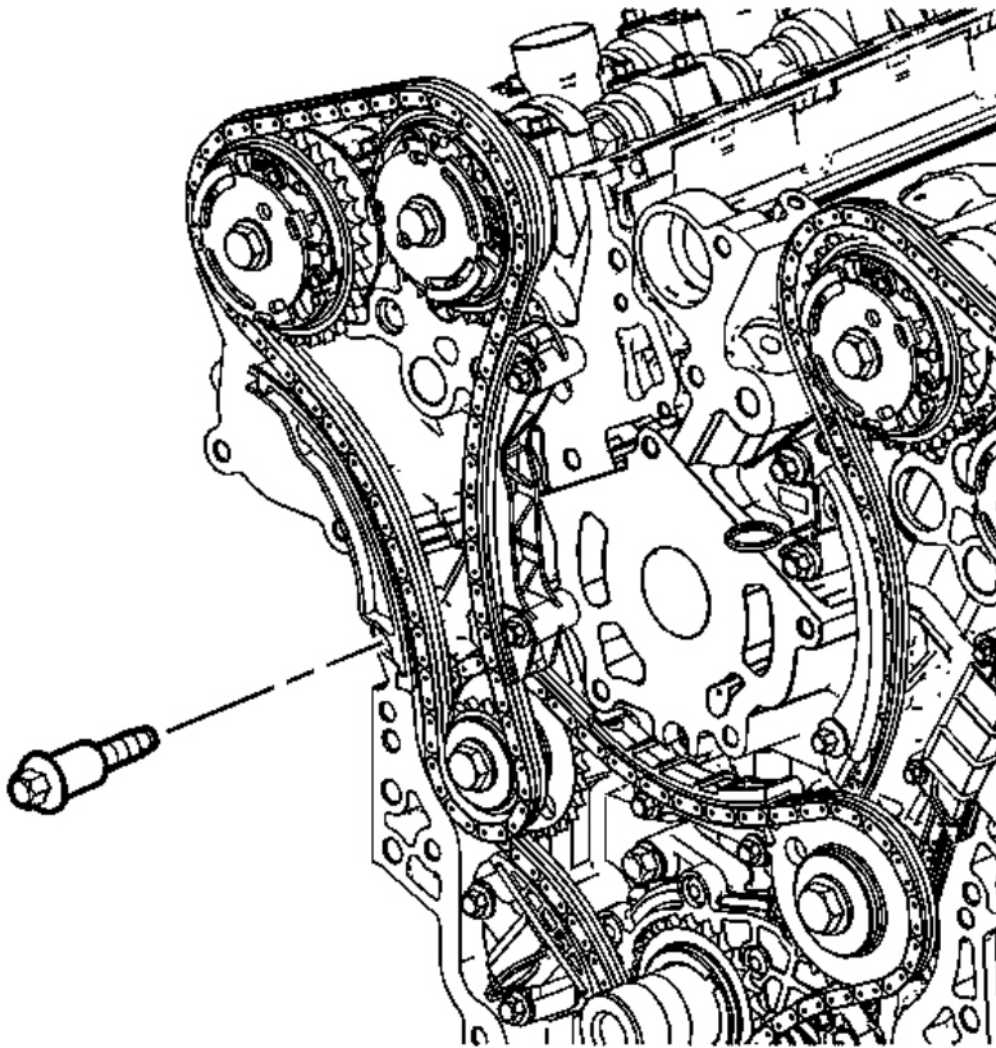


Fig. 267: View Of Right Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the secondary camshaft drive chain shoe bolt.

Tighten: Tighten the secondary camshaft drive chain shoe bolt to 23 N.m (17 lb ft).

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT

Tools Required

- EN 46112 Tensioner Retraction Pins
- J 45027 Tensioner Tool

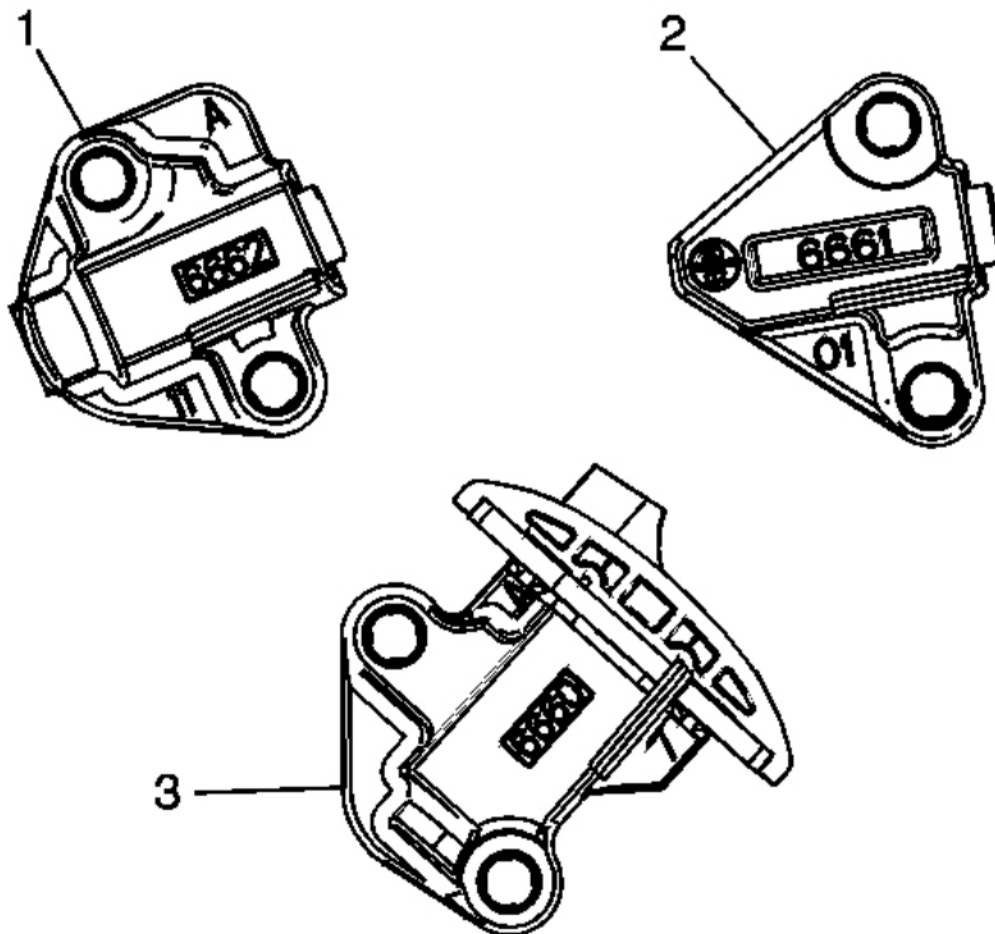


Fig. 268: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the right secondary camshaft drive chain tensioner (1) is being installed.

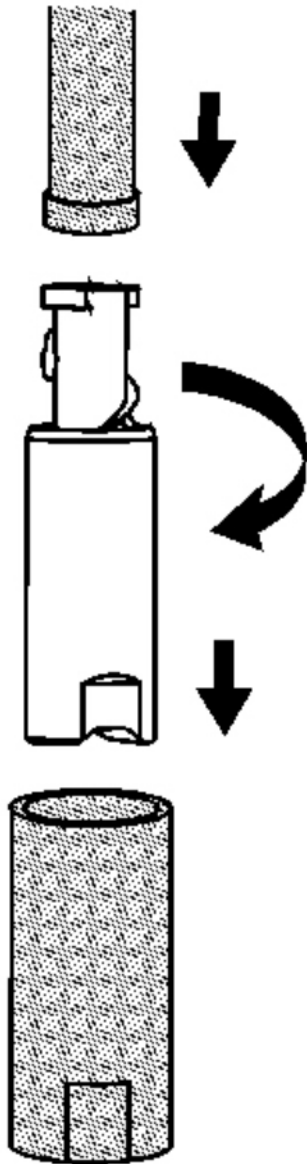


Fig. 269: Resetting Right Secondary Camshaft Drive Chain Tensioner Plunger
Courtesy of GENERAL MOTORS CORP.

2. Using the **J 45027** reset the right secondary camshaft drive chain tensioner plunger.

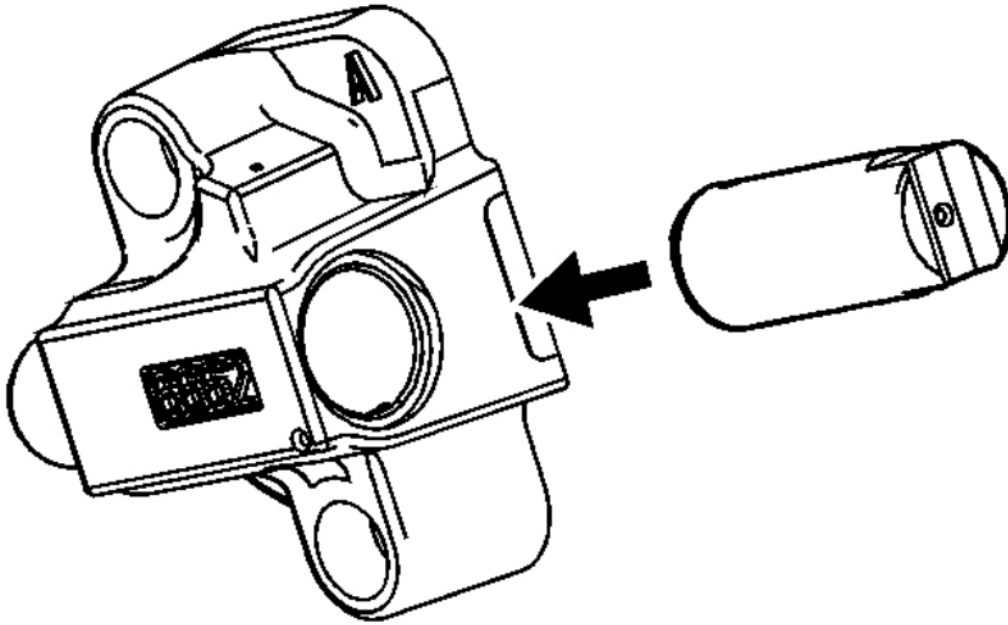


Fig. 270: Installing Plunger Into Right Secondary Camshaft Drive Chain Tensioner Body

Courtesy of GENERAL MOTORS CORP.

3. Install the plunger into the right secondary camshaft drive chain tensioner body.

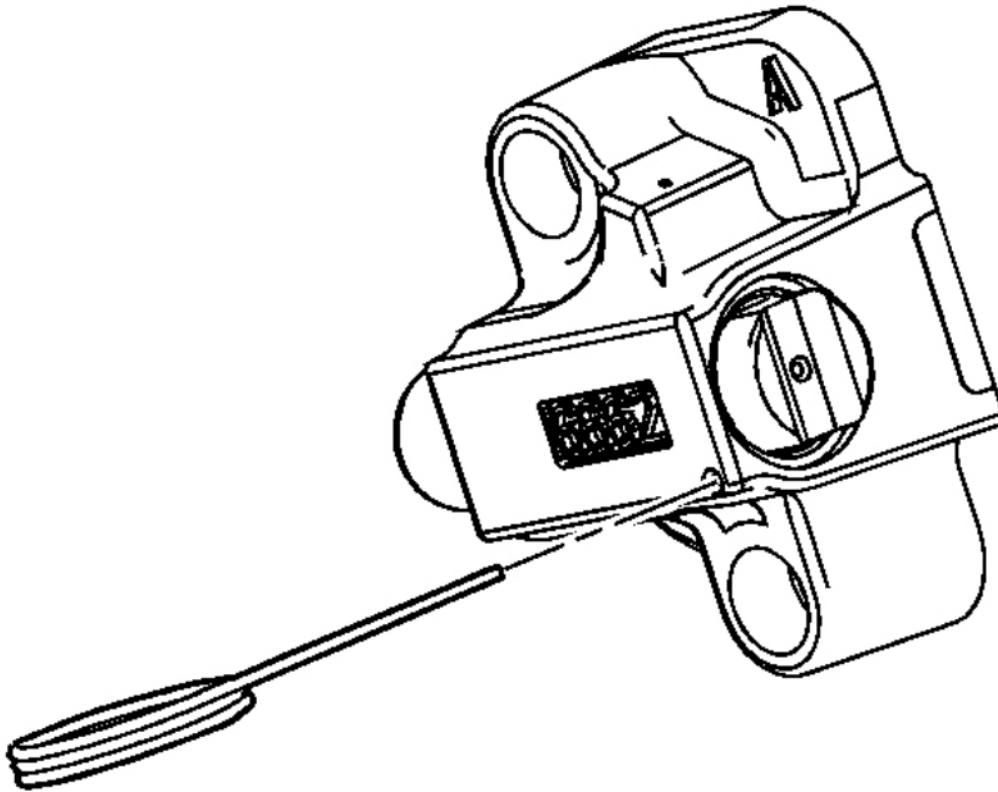


Fig. 271: Inserting EN 46112 Into Right Secondary Camshaft Drive Chain Tensioner Body

Courtesy of GENERAL MOTORS CORP.

4. Compress the plunger into the body and lock the right secondary camshaft drive chain tensioner by inserting the **EN 46112** into the access hole in the side of the right secondary camshaft drive chain tensioner body.
5. Slowly release pressure on the right secondary camshaft drive chain tensioner. The right secondary camshaft drive chain tensioner should remain compressed.

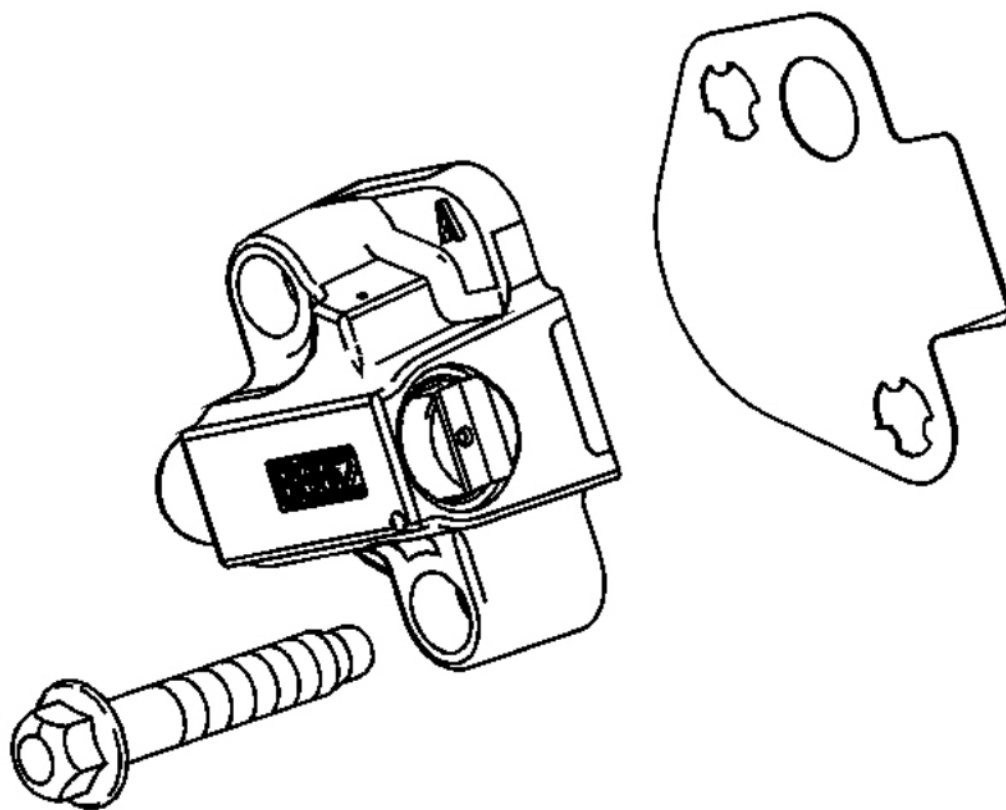


Fig. 272: Identifying Right Secondary Camshaft Drive Chain Tensioner Components
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW right secondary camshaft drive chain tensioner gasket to the right secondary camshaft drive chain tensioner.
7. Install the right secondary camshaft drive chain tensioner bolts through the right secondary camshaft drive chain tensioner and gasket.
8. Ensure the right secondary camshaft drive chain tensioner mounting surface on the right cylinder head does not have any burrs or defects that would degrade the sealing of the NEW right secondary camshaft drive chain tensioner gasket.

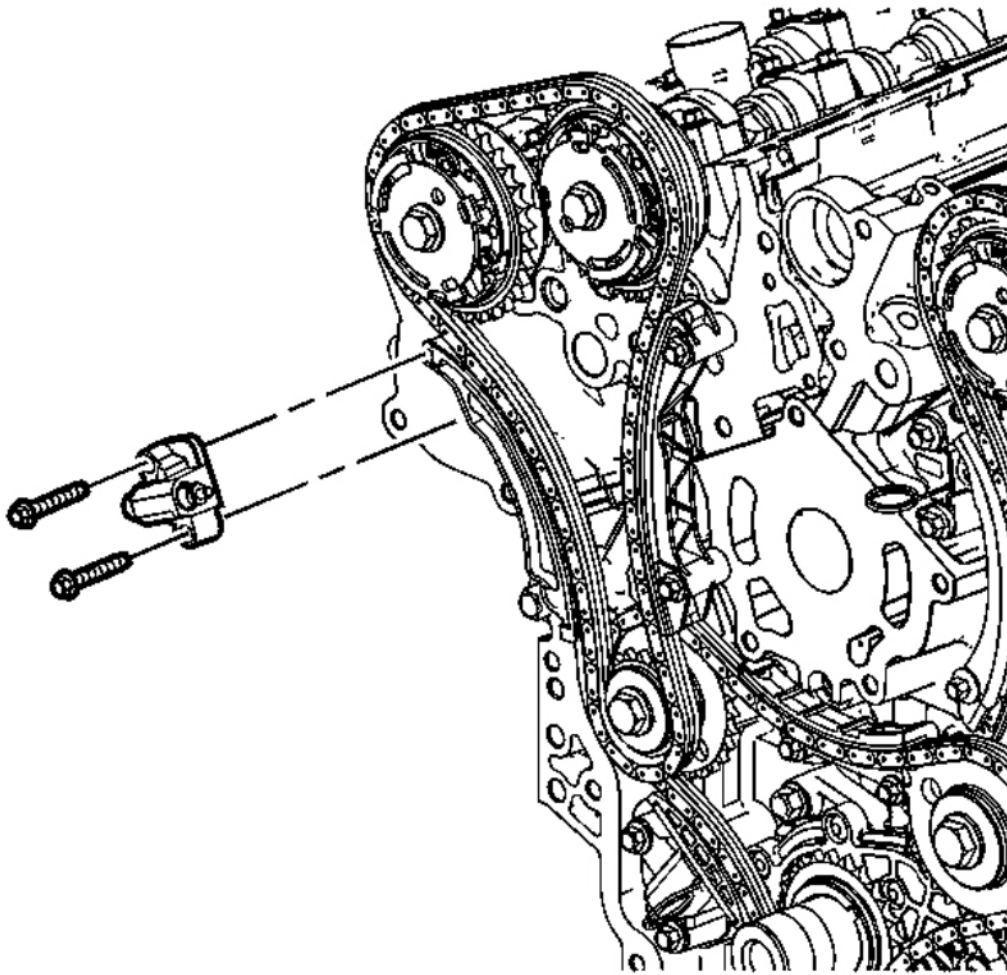


Fig. 273: View Of Right Bank Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

9. Place the right secondary camshaft drive chain tensioner into position and loosely install the bolts to the block.

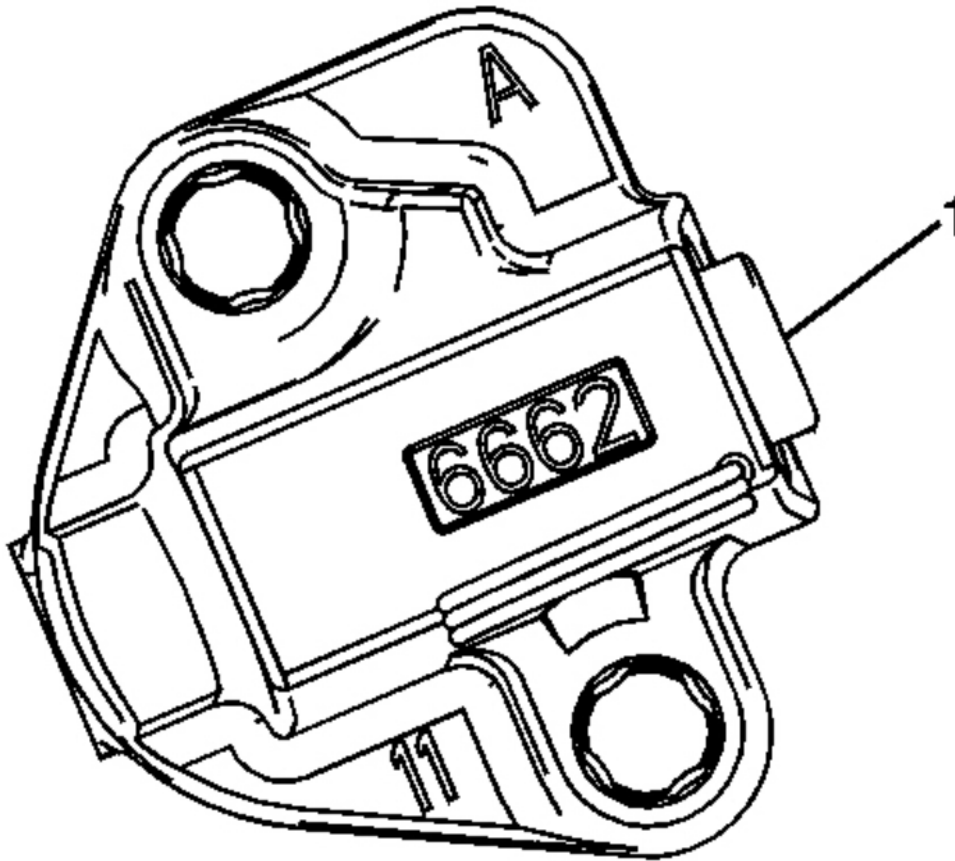


Fig. 274: Locating Right Secondary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

10. Verify the proper placement of the right secondary camshaft drive chain tensioner gasket tab (1).

1. First Pass

Tighten: Tighten the right secondary camshaft drive chain tensioner bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the right secondary camshaft drive chain tensioner bolts to 23 N.m (17 lb ft).

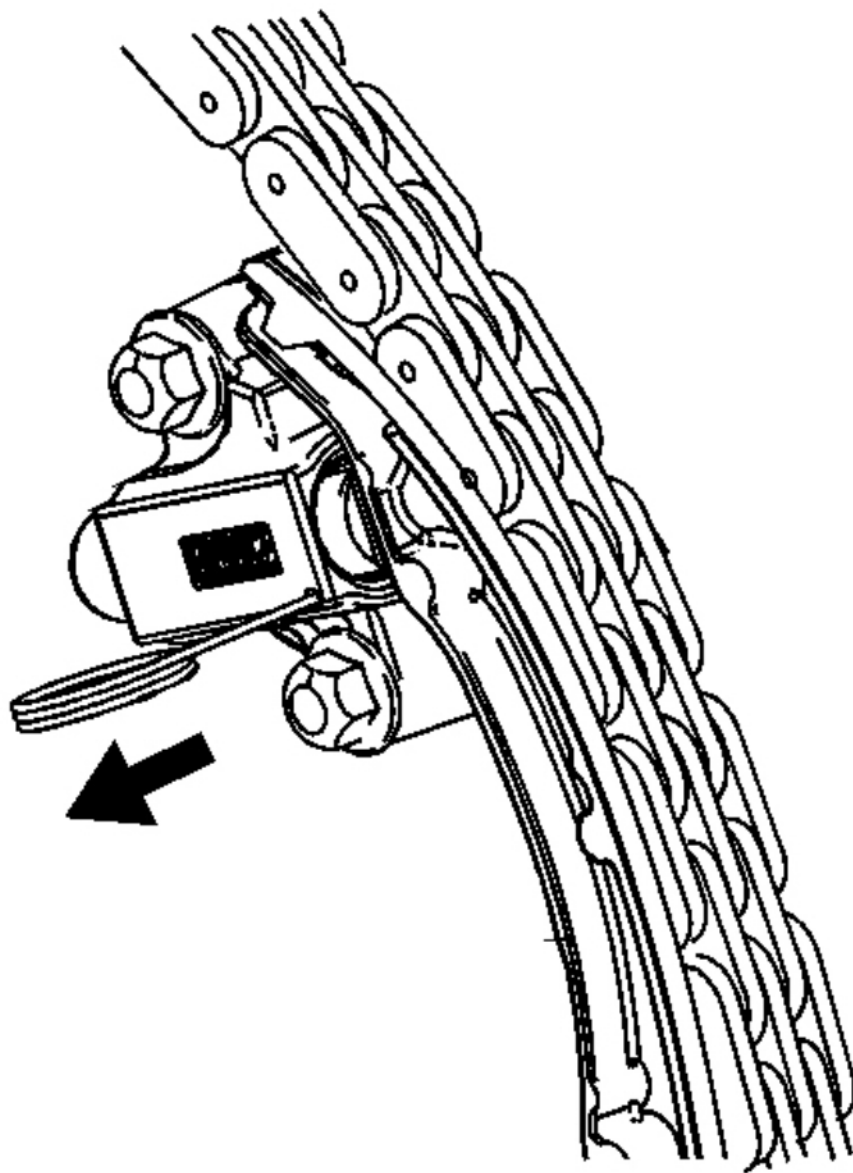


Fig. 275: Removing EN 46112 From Right Secondary Camshaft Drive Chain Tensioner Body

Courtesy of GENERAL MOTORS CORP.

11. Release the right camshaft drive chain tensioner by pulling out the **EN 46112** and unlocking the tensioner plunger.

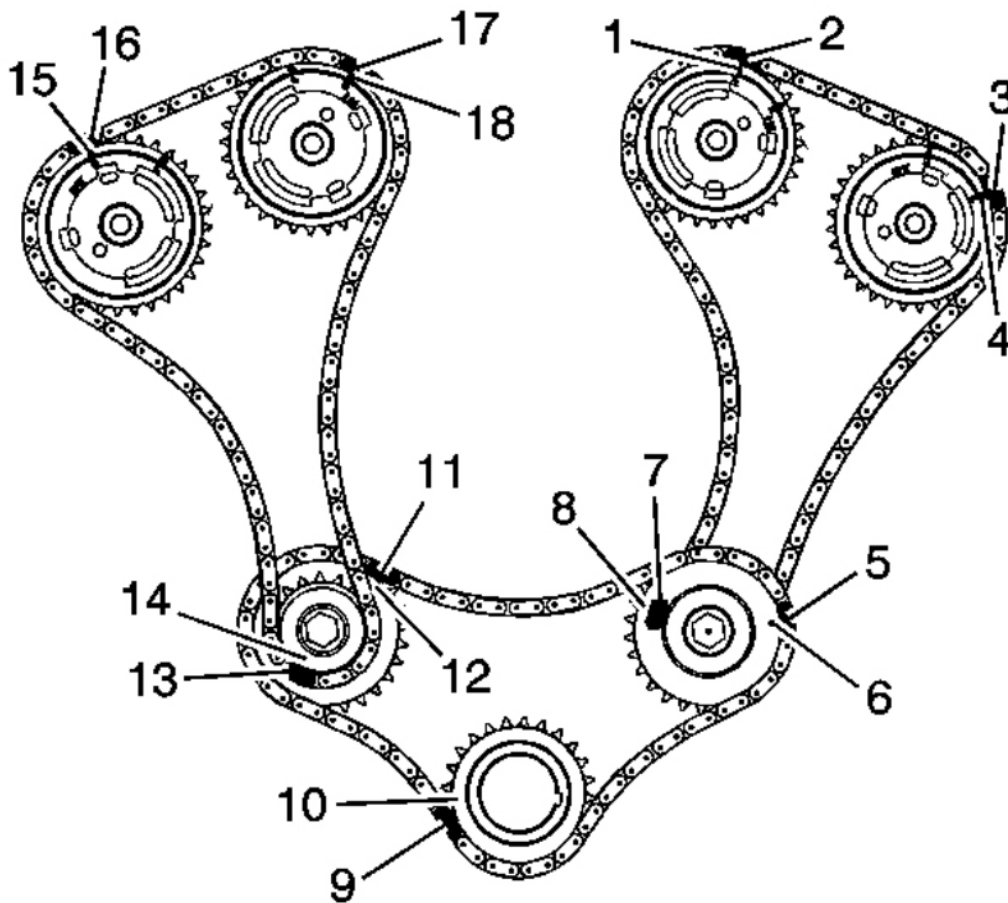


Fig. 276: Identifying Timing Chain Marks And Their Respective Locations On Gears, Sprockets And Actuators

Courtesy of GENERAL MOTORS CORP.

12. Verify all primary and secondary camshaft drive chain timing mark alignments (1-18) also refer to **Camshaft Timing Drive Chain Alignment Diagram** - Stage Two.

ENGINE FRONT COVER INSTALLATION

Tools Required:

EN 46109 Guide Pin Set

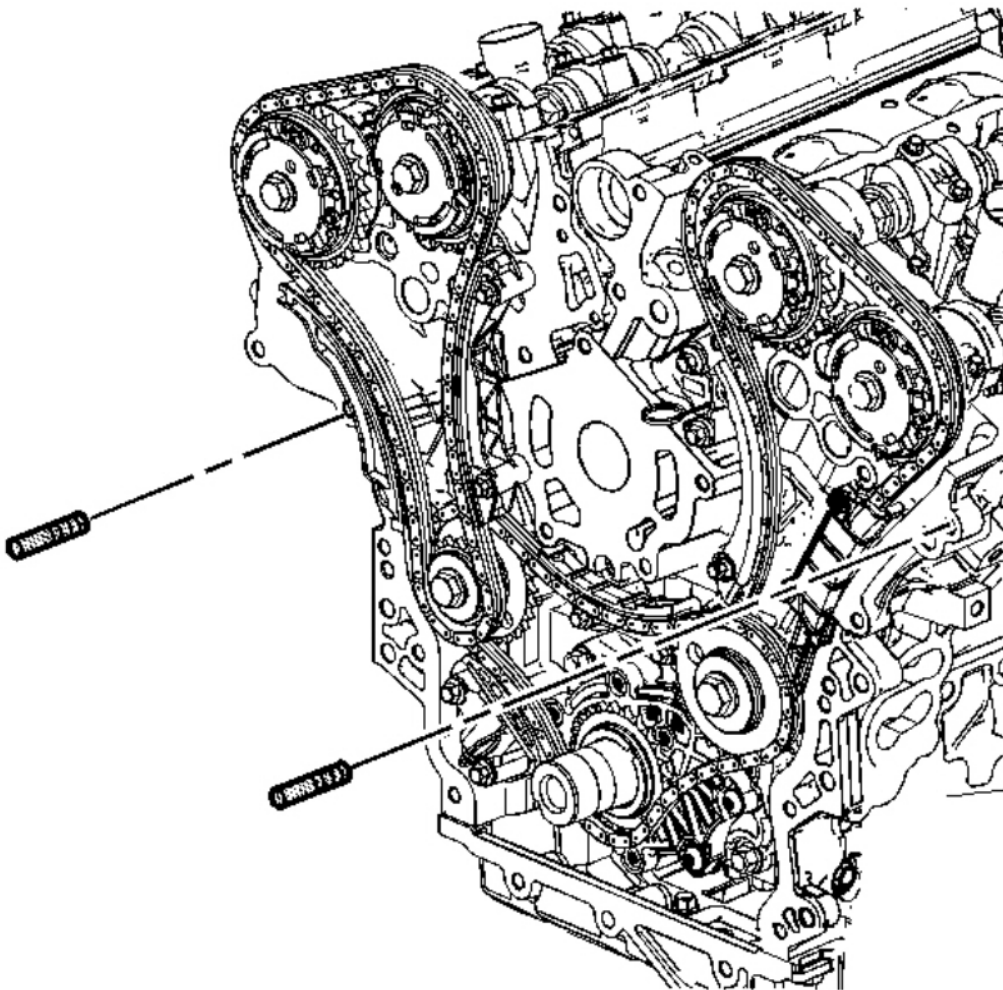


Fig. 277: Installing EN 46109 Into Cylinder Block
Courtesy of GENERAL MOTORS CORP.

1. Install the 8 mm (0.315 in) guide from the **EN 46109** into the cylinder block positions as shown.

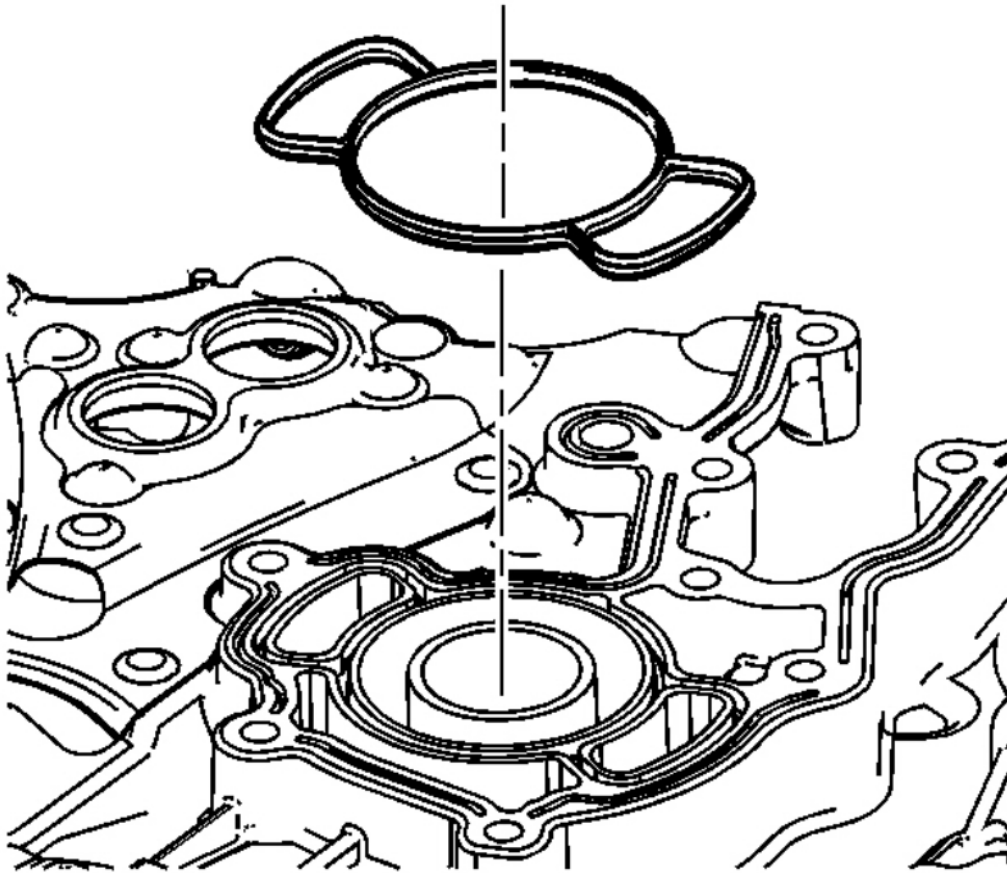


Fig. 278: Installing Engine Front Cover-To-Cylinder Block Seal
Courtesy of GENERAL MOTORS CORP.

2. Install the NEW engine front cover to cylinder block seal.

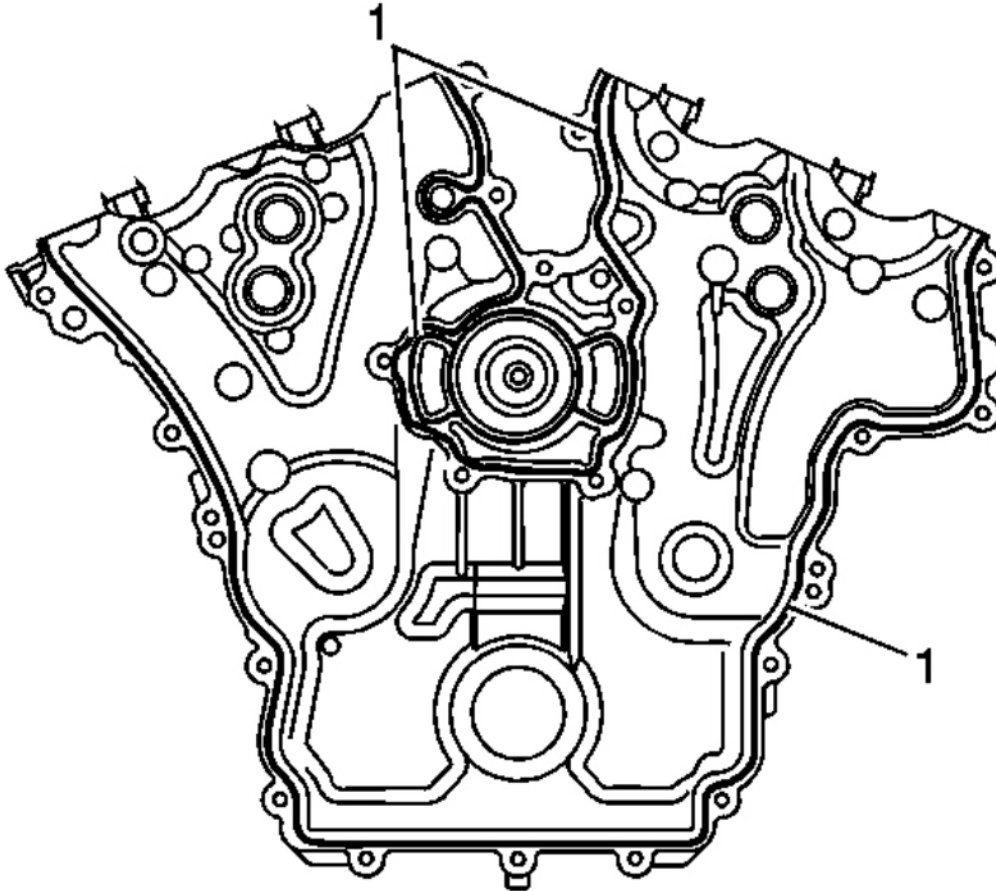


Fig. 279: Applying Sealant On Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

3. Place a 3 mm (0.118 in) bead of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover as shown (1).

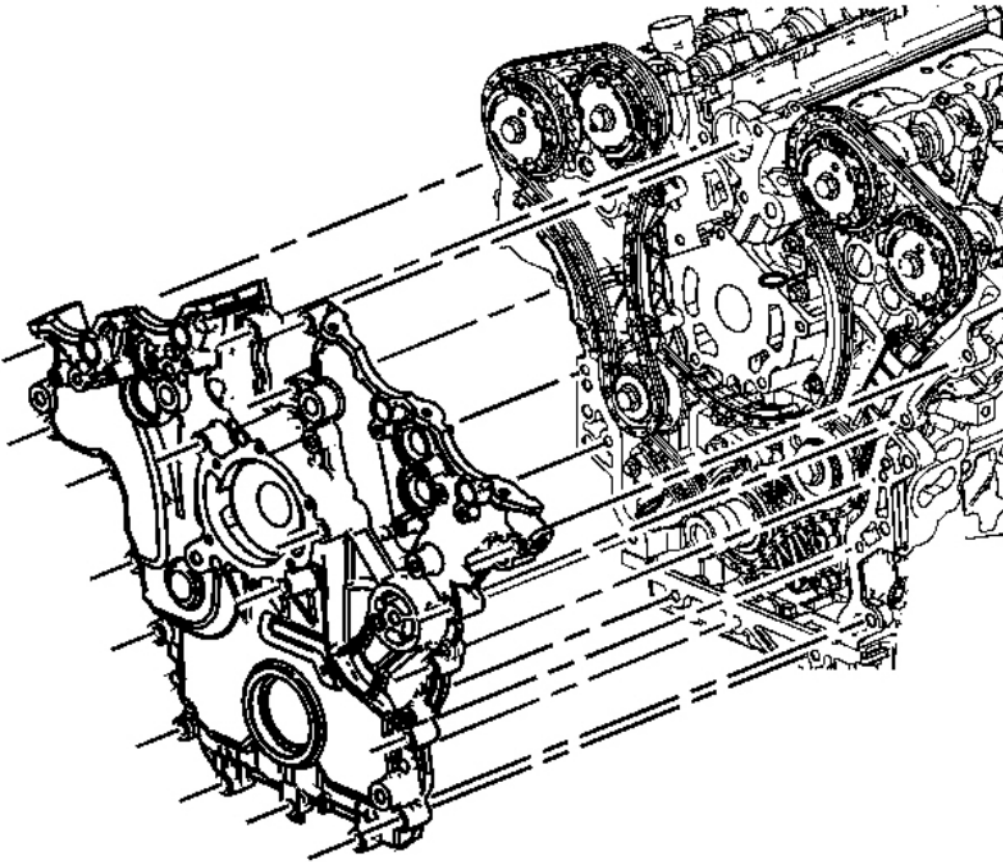


Fig. 280: View Of Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

4. Place the engine front cover onto the **EN 46109** and slide into position.
5. Remove the **EN 46109** from the cylinder block.

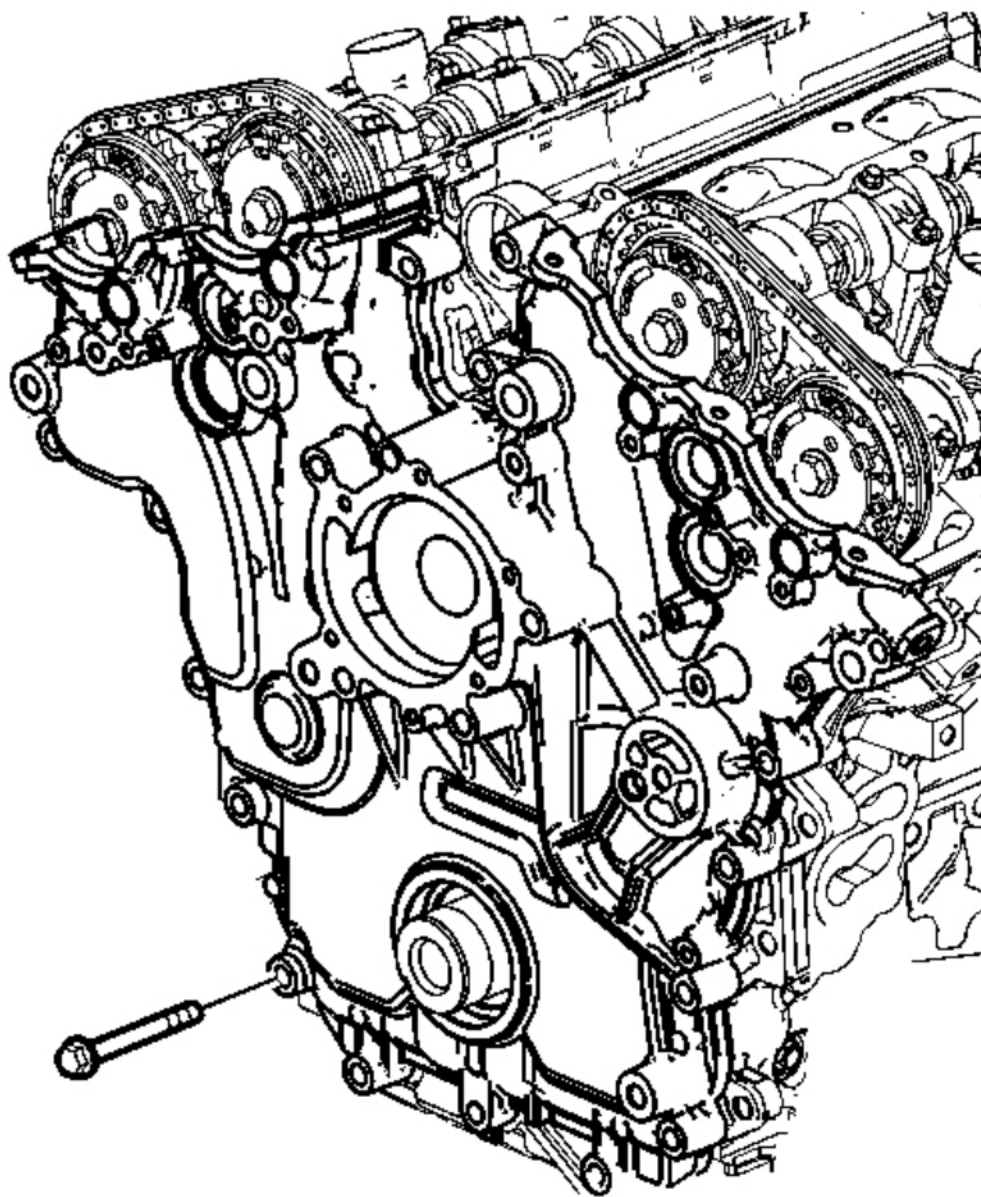


Fig. 281: View Of Engine Front Cover Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Hand start all the engine front cover bolts.

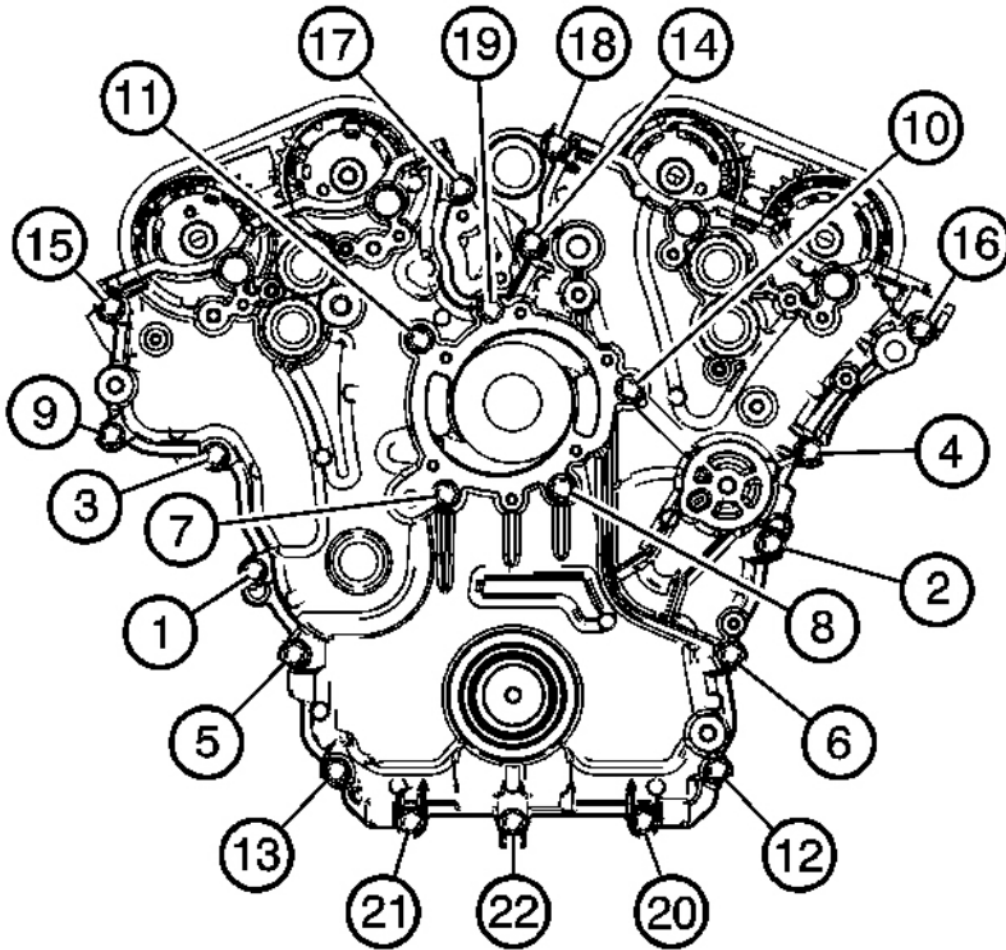


Fig. 282: Tightening Engine Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

7. Tighten the engine front cover bolts in the sequence shown.

Tighten: Tighten the engine front cover bolts in the sequence to 23 N.m (17 lb ft).

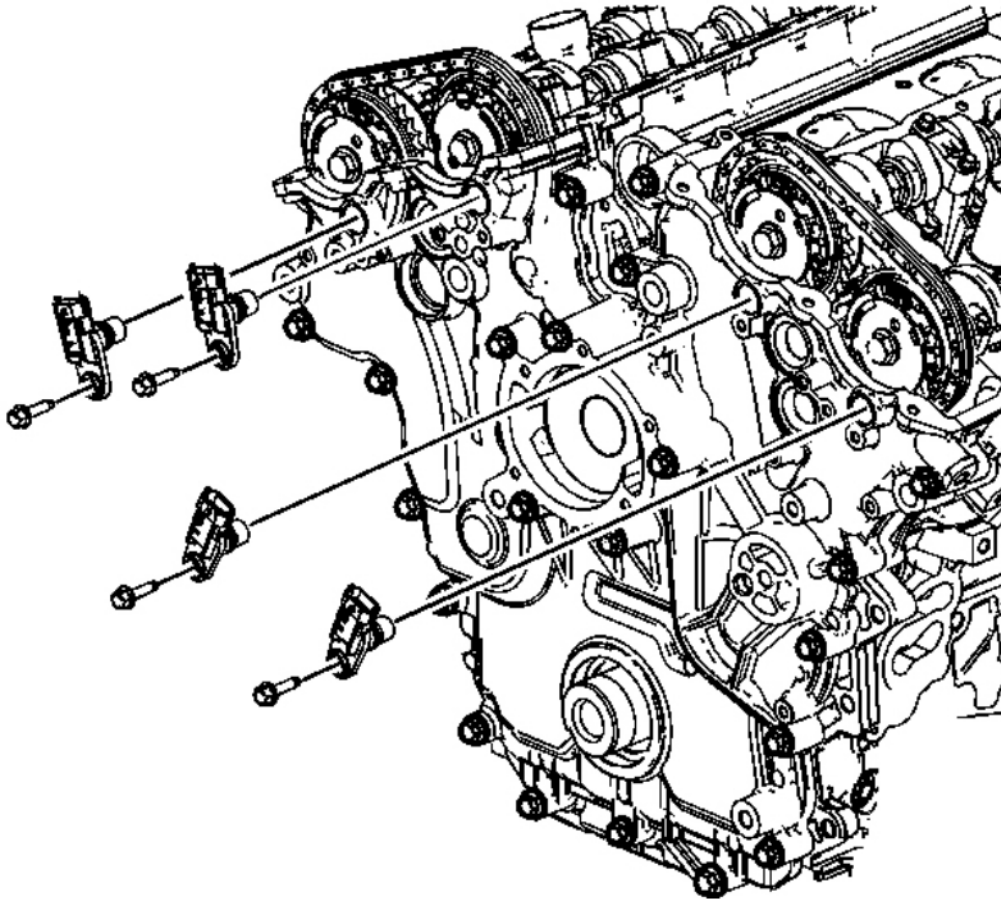


Fig. 283: View Of Camshaft Position Sensors
Courtesy of GENERAL MOTORS CORP.

8. Install NEW O-rings on the camshaft position sensor.
9. Place the camshaft position sensors in position on the front cover.
10. Install the camshaft position sensor bolts.

Tighten: Tighten the camshaft position sensor bolts to 10 N.m (89 lb in).

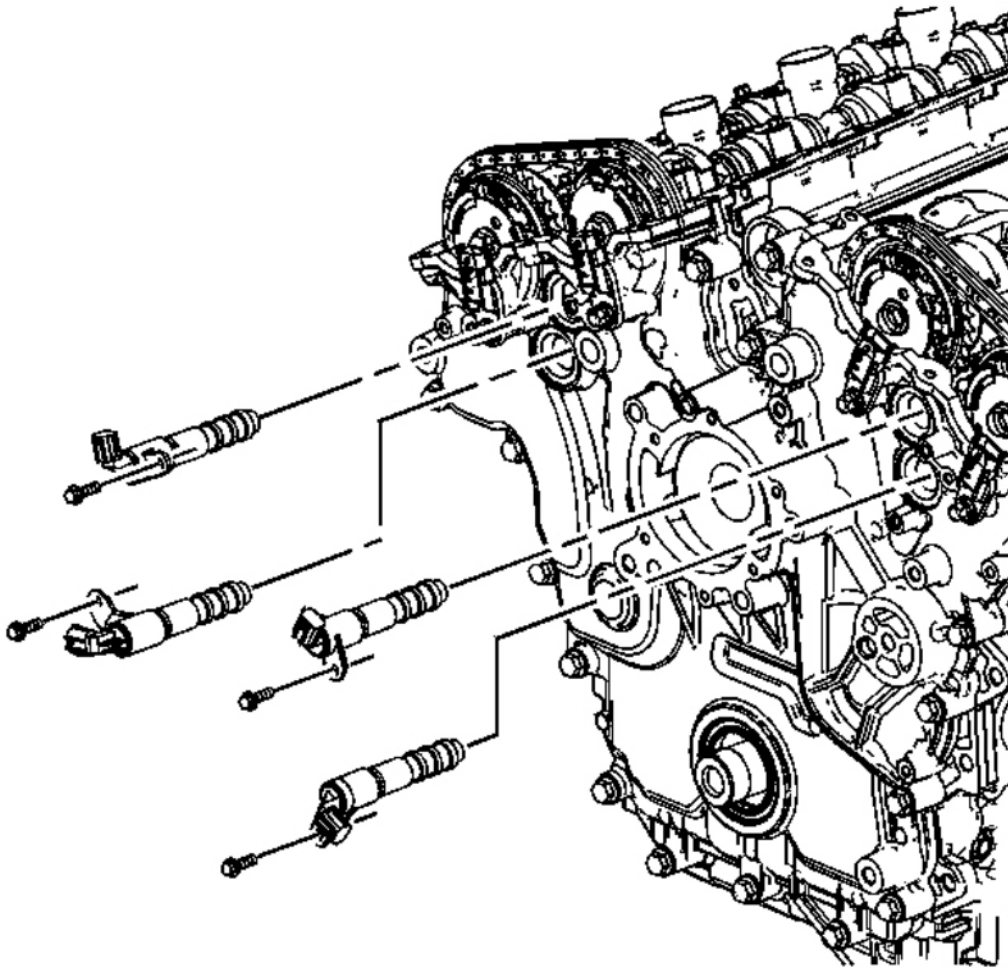


Fig. 284: View Of Camshaft Position Actuator Valves
Courtesy of GENERAL MOTORS CORP.

11. Place the camshaft position actuator valves in position on the front cover.
12. Install the camshaft position actuator valve bolts.

Tighten: Tighten the camshaft position actuator valve bolts to 10 N.m (89 lb in).

WATER PUMP INSTALLATION

Tools Required:

EN 46104 Water Pump Pulley Holding Tool

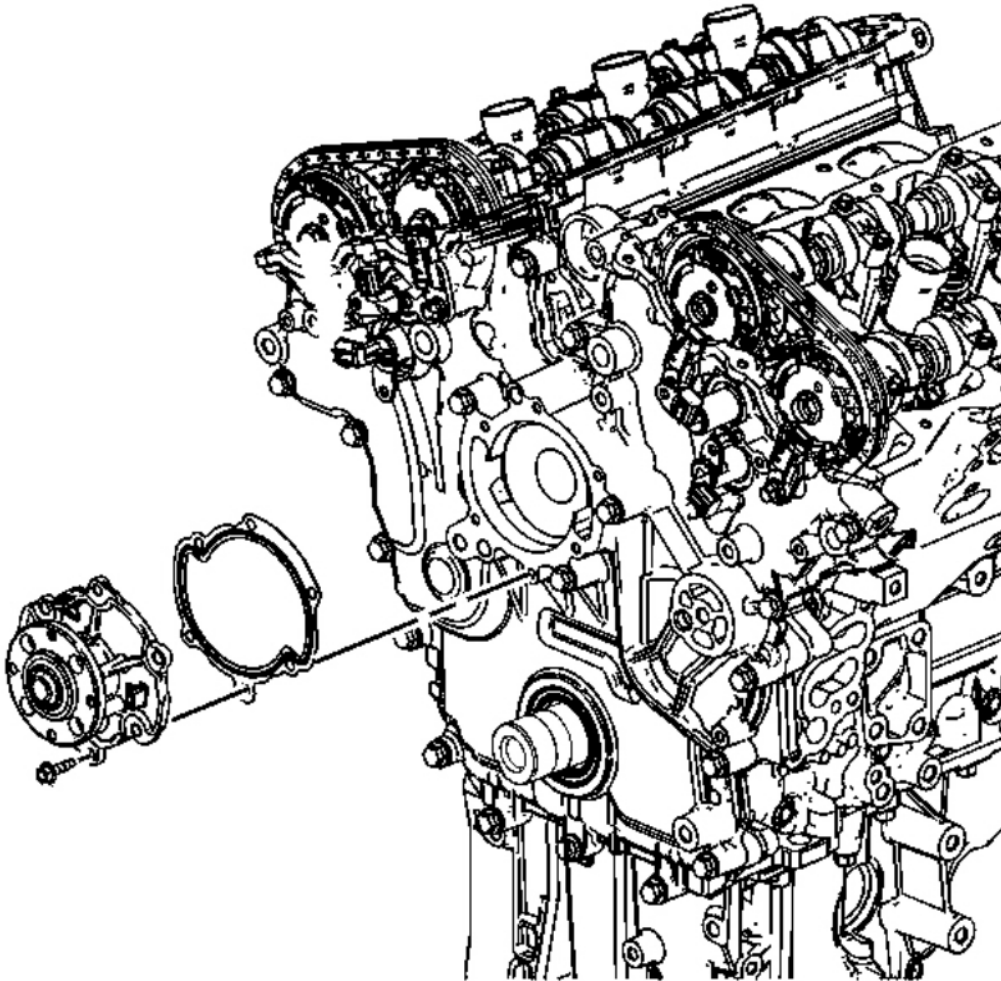


Fig. 285: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the engine front cover and water pump are clear of old gasket material.
2. Place a new water pump gasket on the water pump.
3. Place the water pump in position on the front cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the water pump bolts.

Tighten: Tighten the water pump bolts in the sequence shown to 10 N.m (89 lb in).

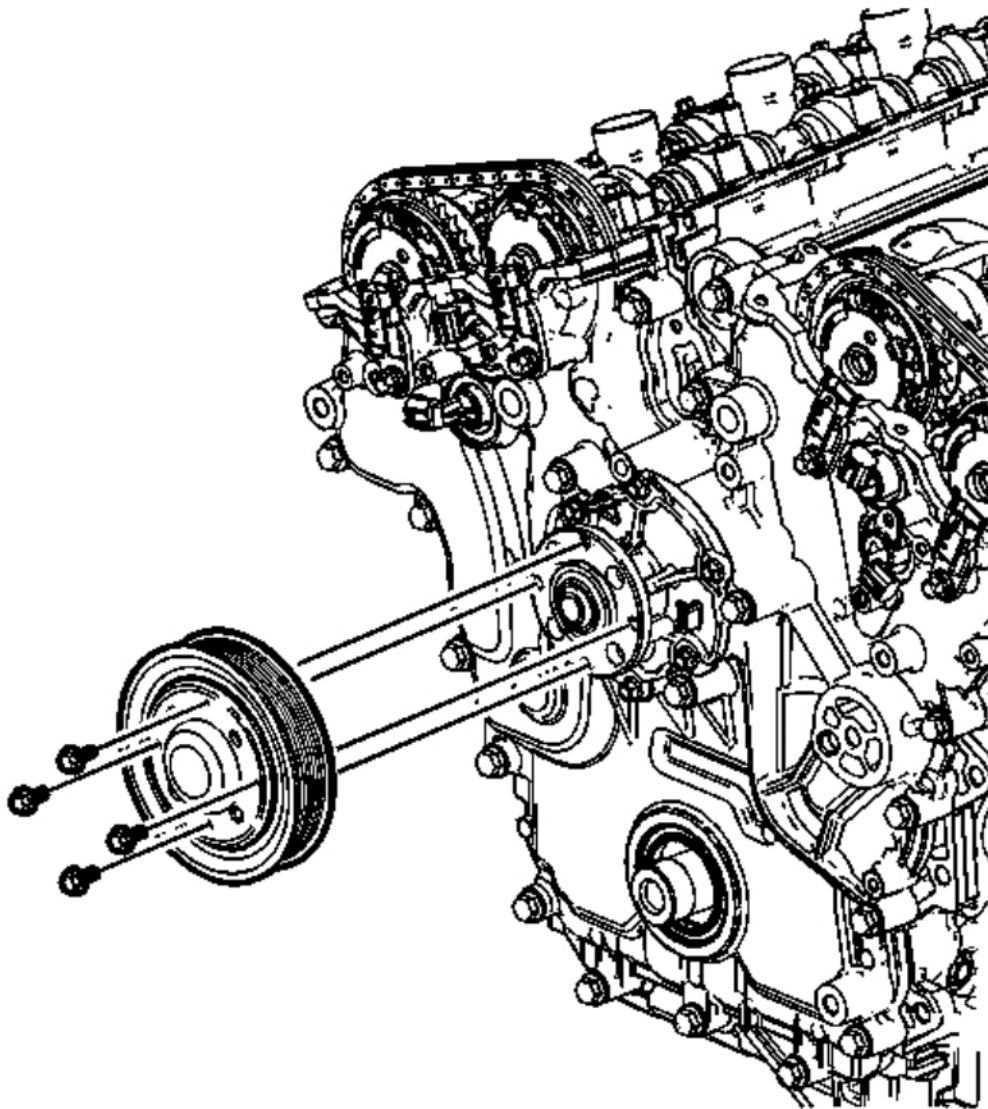


Fig. 286: View Of Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

5. Install the water pump pulley.
6. Loosely install the water pump pulley bolts.

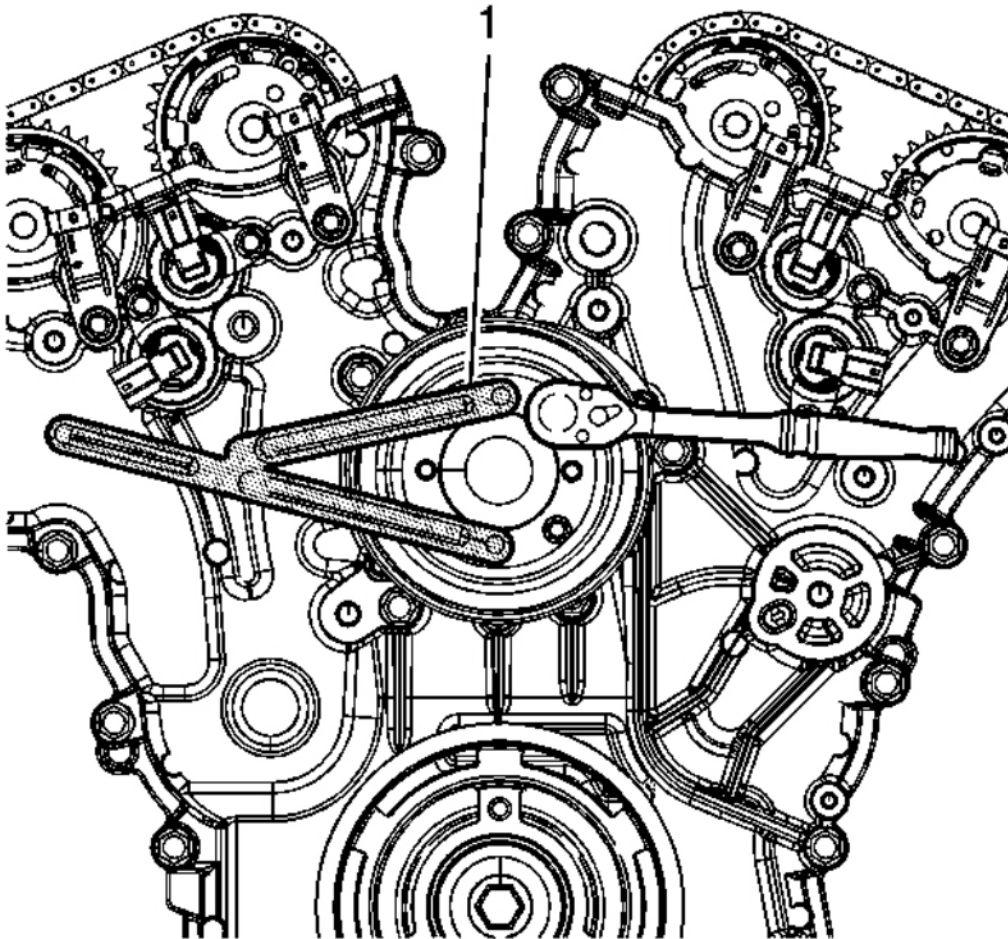


Fig. 287: Installing EN 46104 Onto Water Pump Pulley
Courtesy of GENERAL MOTORS CORP.

7. Install the **EN 46104** (1) onto the water pump pulley.

Tighten: Tighten the water pump pulley bolts to 10 N.m (89 lb in).

Tools Required

- EN 46101 Spark Plug Tube Seal Guide
- EN 46105 Camshaft Locking Tool

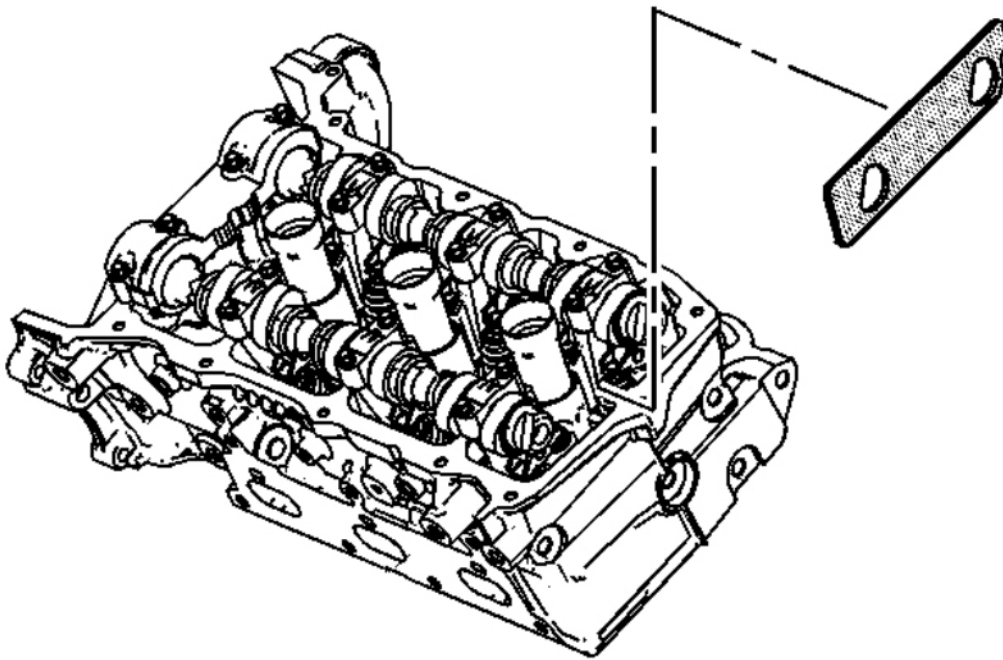


Fig. 288: Removing EN 46105-2 From Left Camshafts
Courtesy of GENERAL MOTORS CORP.

1. Remove the EN 46105-2 from the rear of the left camshafts.

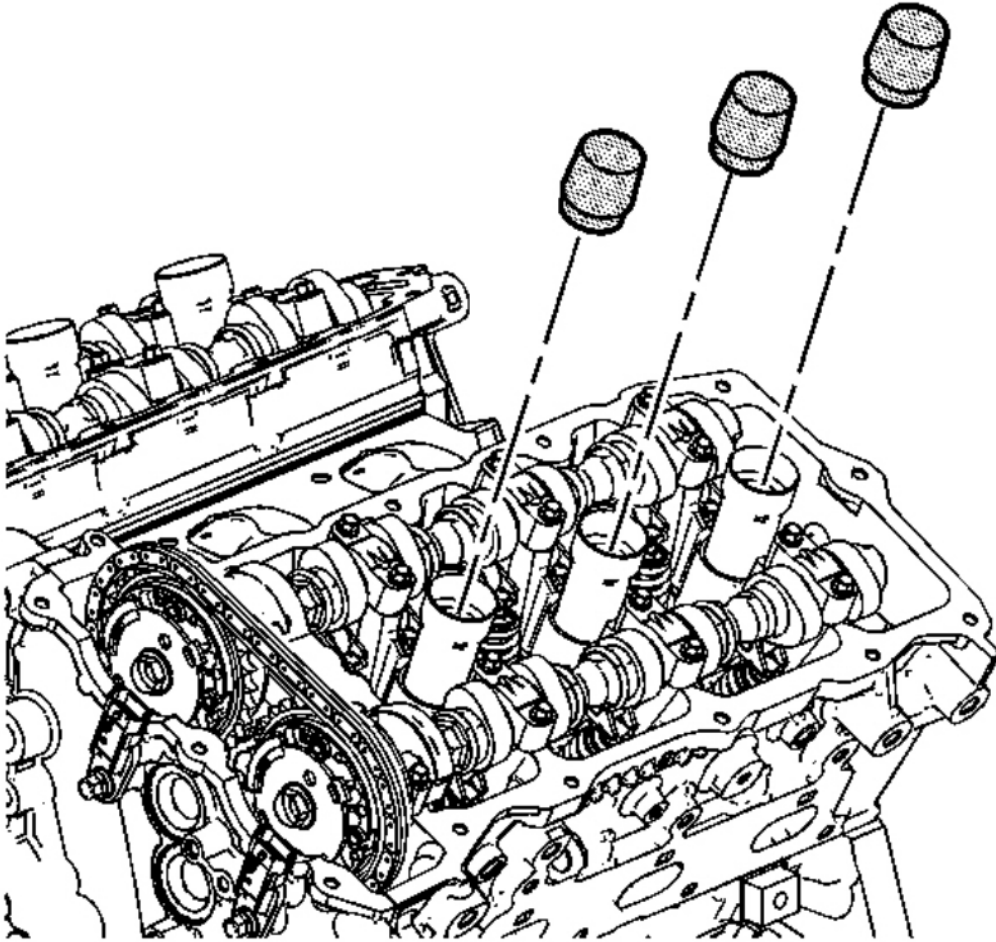


Fig. 289: Installing EN 46101 Onto Spark Plug Tubes Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

2. Install the **EN 46101** onto the spark plug tubes of the left cylinder head.

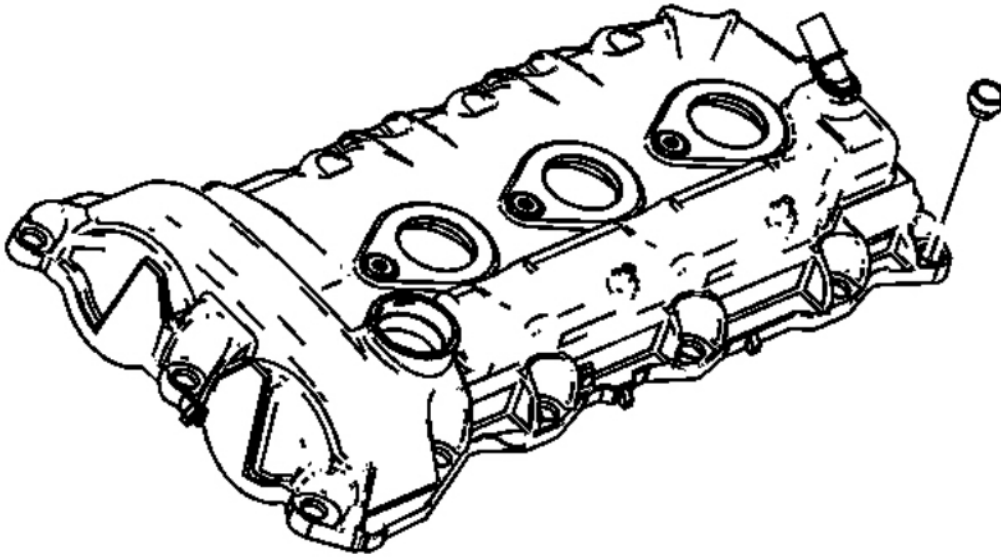


Fig. 290: Identifying Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the camshaft cover bolt grommets prior to installing the camshaft cover bolts.
4. Wipe the camshaft cover sealing surface on the left cylinder head with a clean, lint-free cloth.

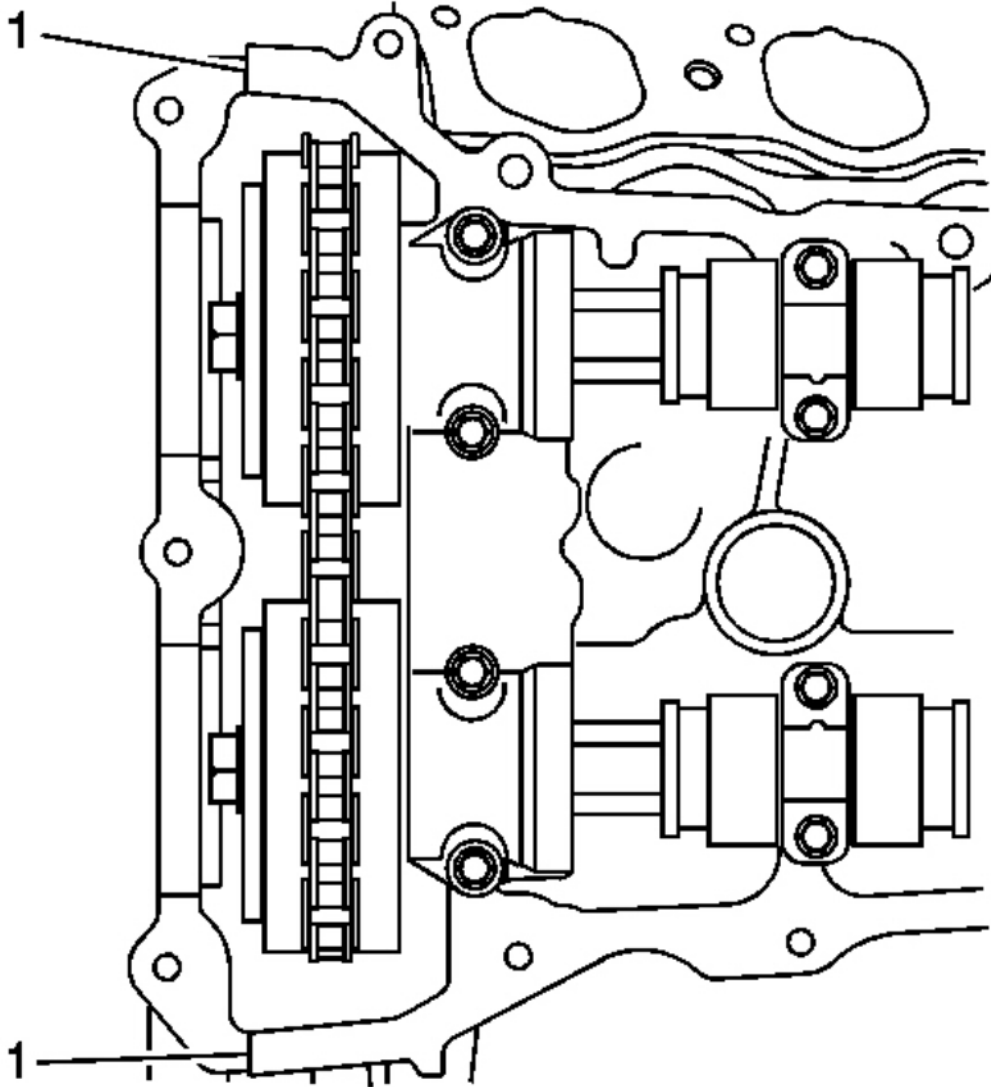


Fig. 291: Applying Sealant Onto Engine Front Cover Split Lines - Left
Courtesy of GENERAL MOTORS CORP.

5. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).

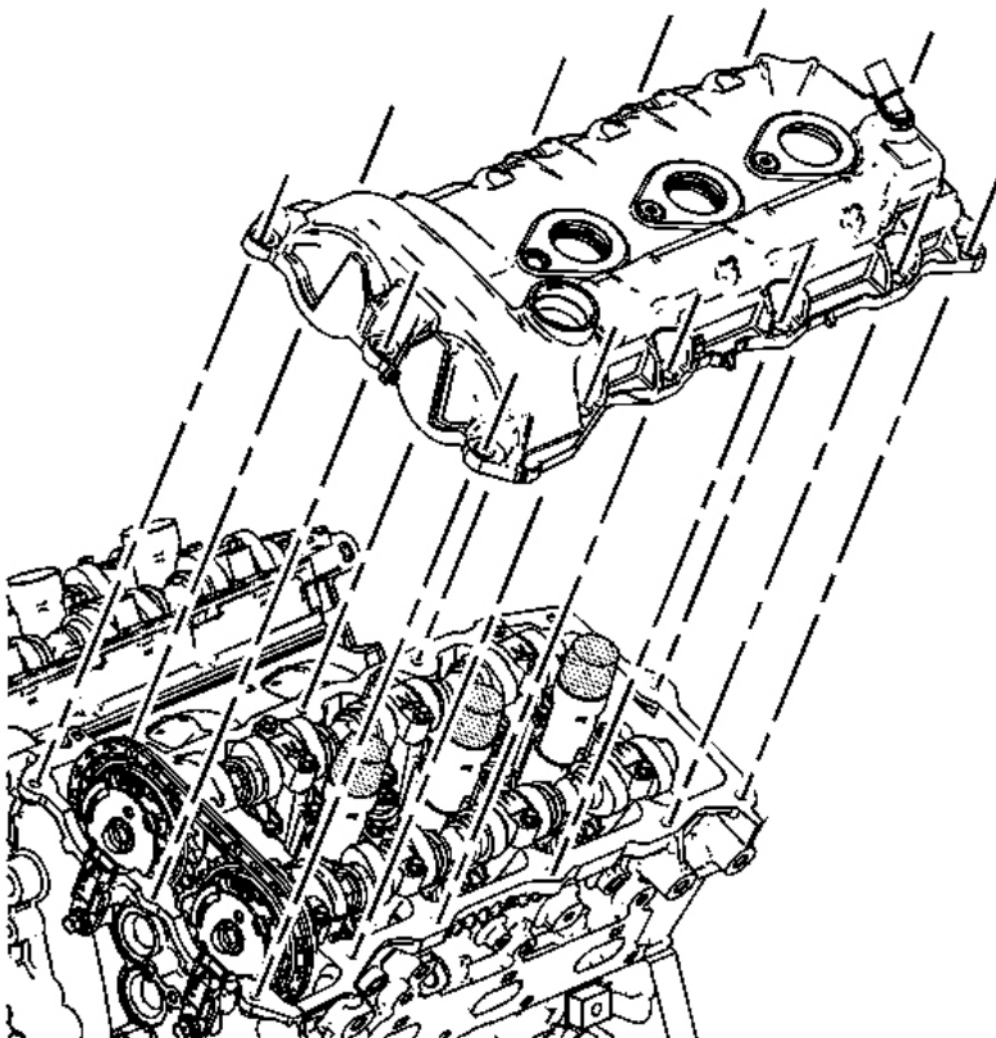


Fig. 292: View Of Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

6. Place the left camshaft cover into position onto the left cylinder head.

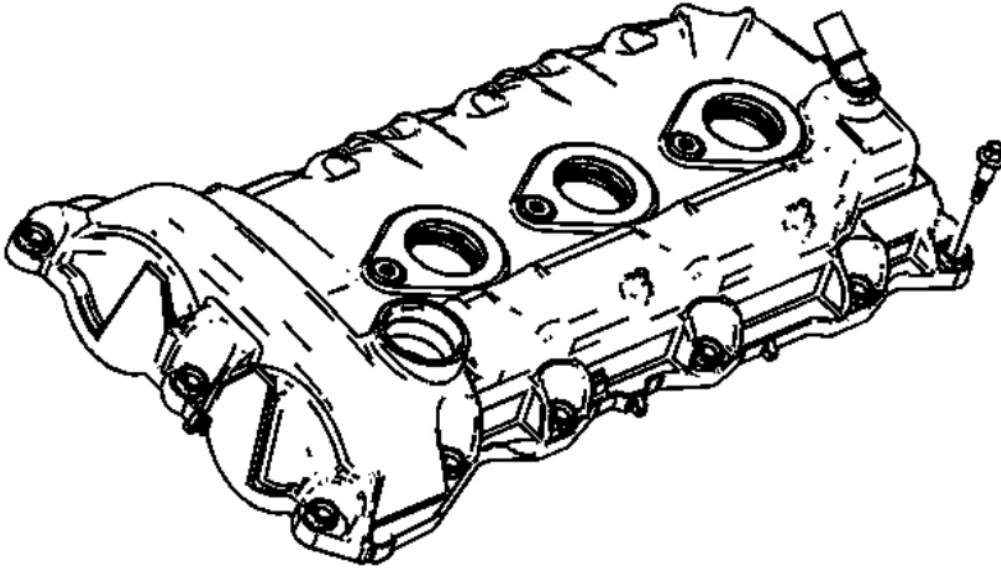


Fig. 293: Installing Left Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosely install the left camshaft cover bolts.

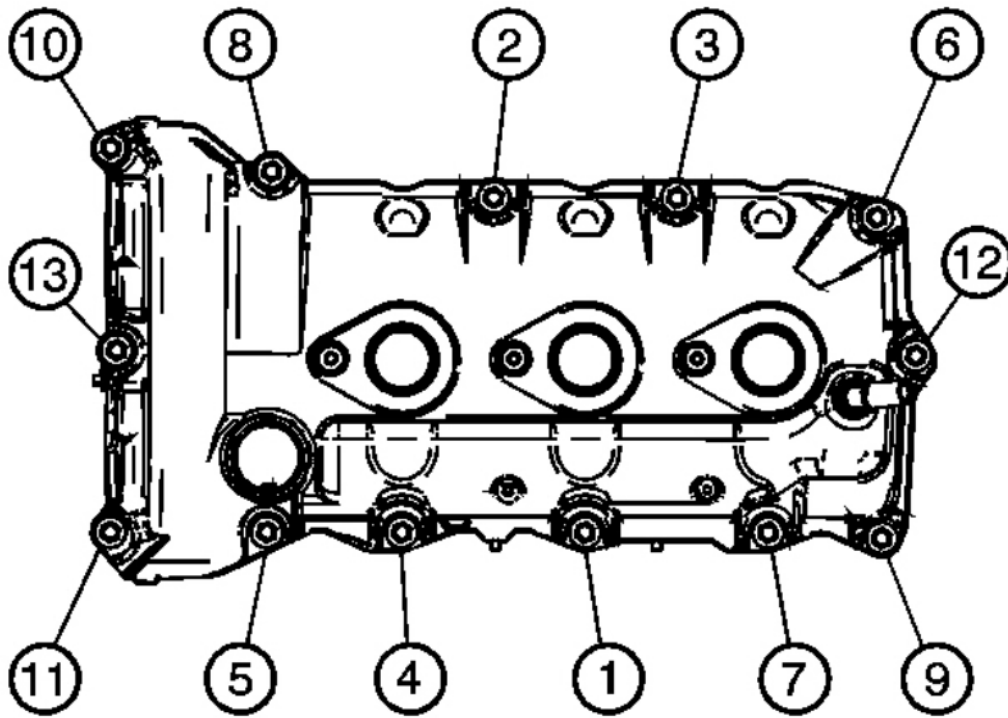


Fig. 294: Tightening Left Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Tighten the left camshaft cover bolts in the sequence shown.

Tighten: Tighten the left camshaft cover bolts in the sequence to 10 N.m (89 lb in).

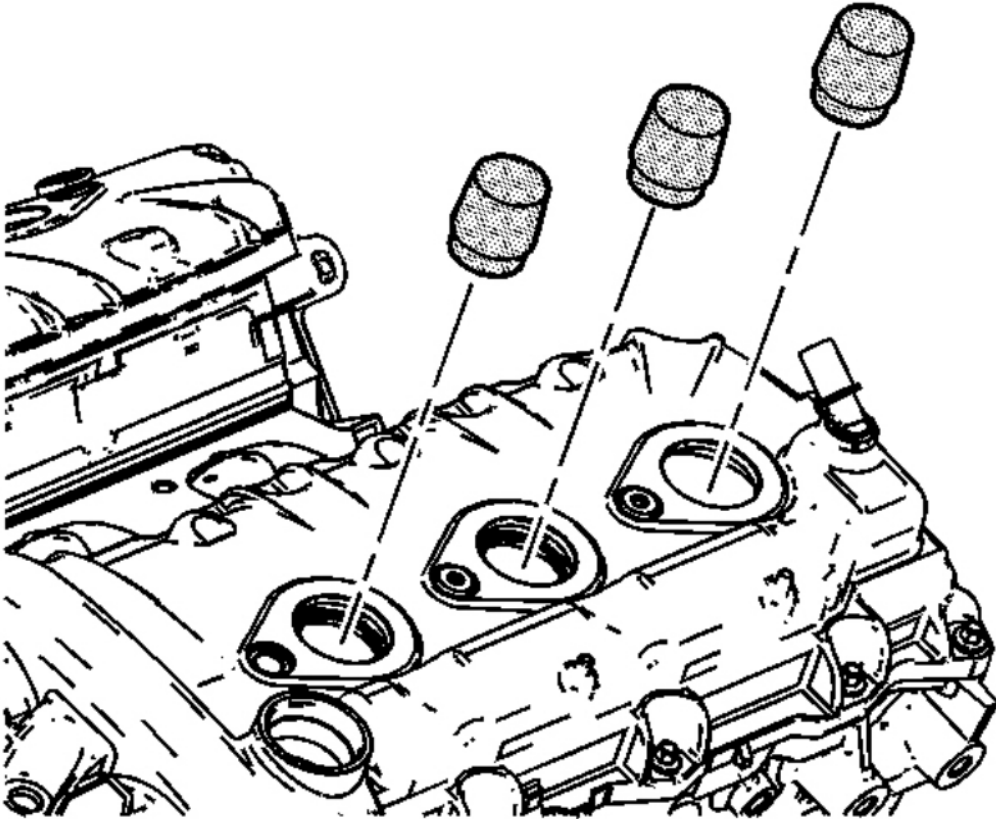


Fig. 295: Removing EN 46101 From Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

9. Remove the EN 46101 from the spark plug tubes of the left cylinder head.

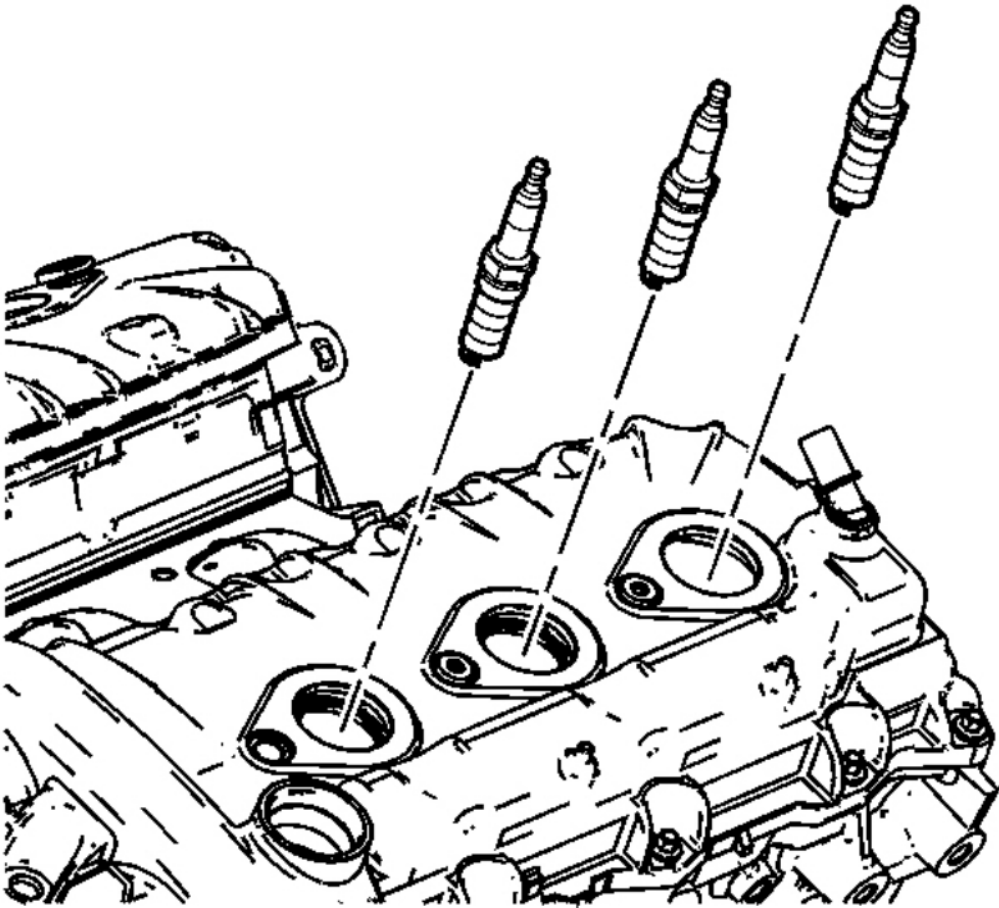


Fig. 296: Installing Spark Plugs Into Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

10. Install the NEW spark plugs into the left cylinder head.

Tighten: Tighten the spark plugs to 20 N.m (15 lb ft).

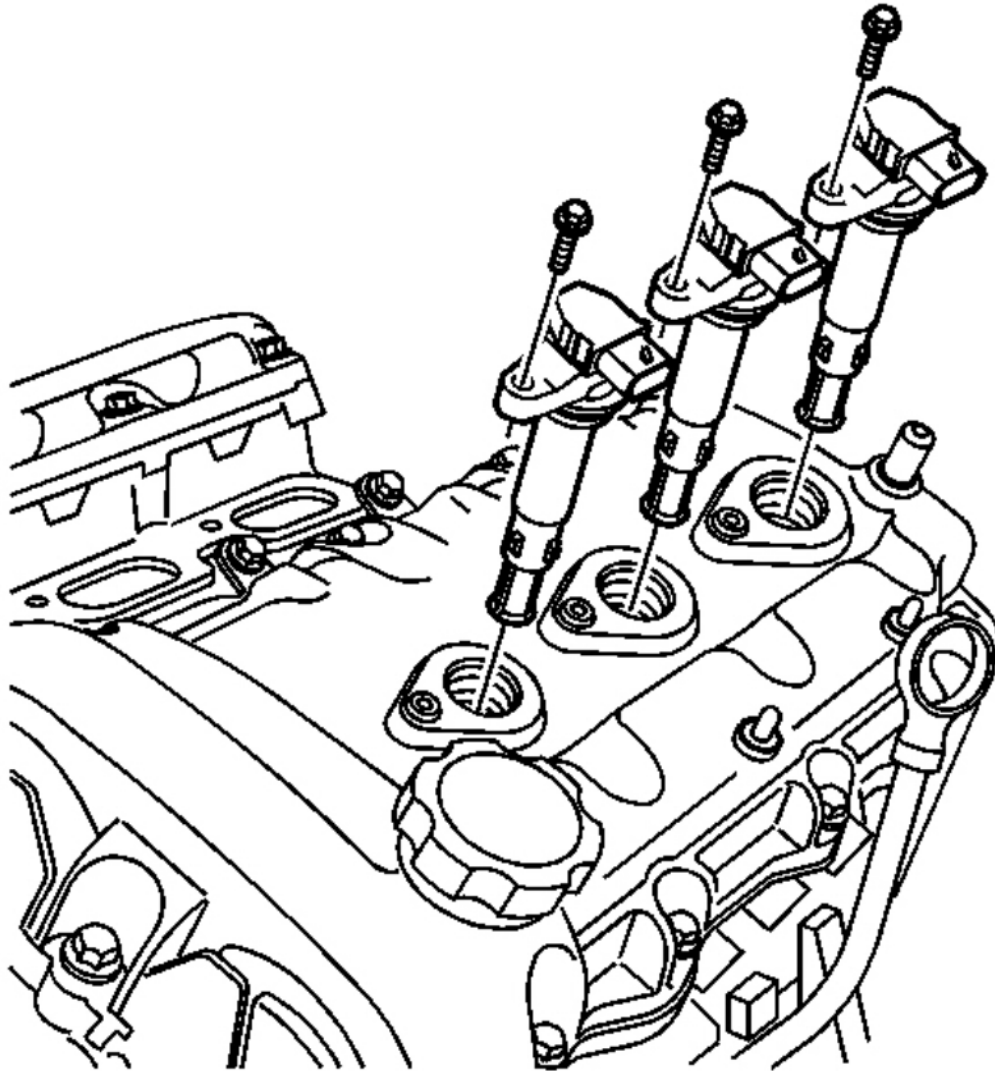


Fig. 297: Identifying Left Cylinder Head Ignition Coils
Courtesy of GENERAL MOTORS CORP.

11. Install each ignition coil through the left camshaft cover into the spark plug tube taking care not to damage the spark plug and/or the seal in the left camshaft cover.
12. Install each ignition coil bolt.

Tighten: Tighten the ignition coil bolt to 10 N.m (89 lb in).

CAMSHAFT COVER INSTALLATION - RIGHT

Tools Required

- **EN 46101** Spark Plug Tube Seal Guide
- **EN 46105** Camshaft Locking Tool

1. Remove the EN 46105-1 from the rear of the right camshafts.

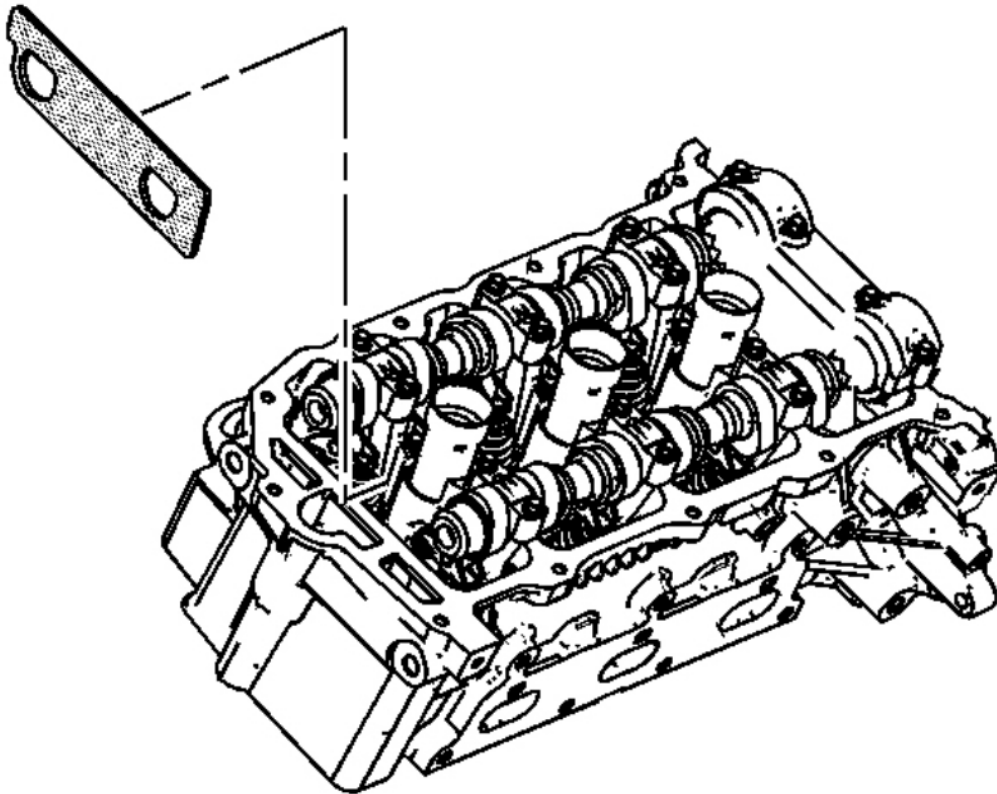


Fig. 298: Removing EN 46105-1 From Right Camshafts
Courtesy of GENERAL MOTORS CORP.

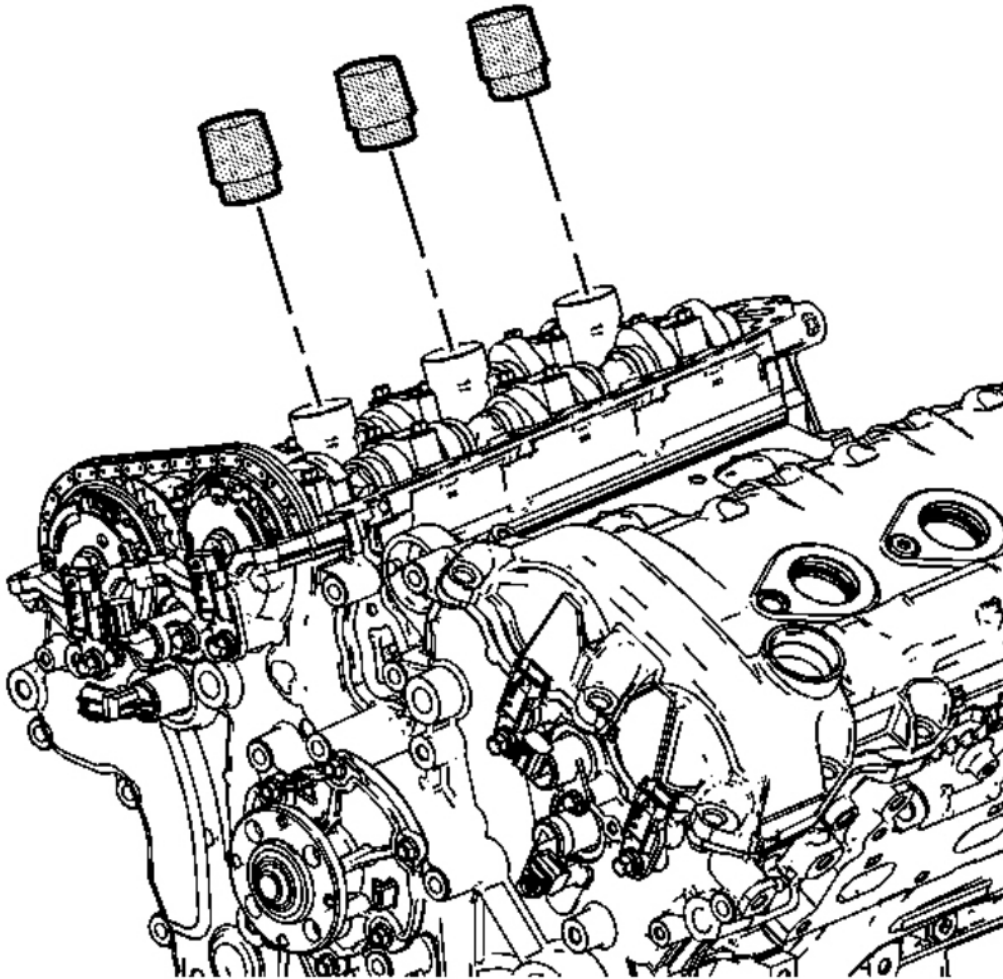


Fig. 299: Installing EN 46101 Onto Spark Plug Tubes Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

2. Install the **EN 46101** onto the spark plug tubes of the right cylinder head.

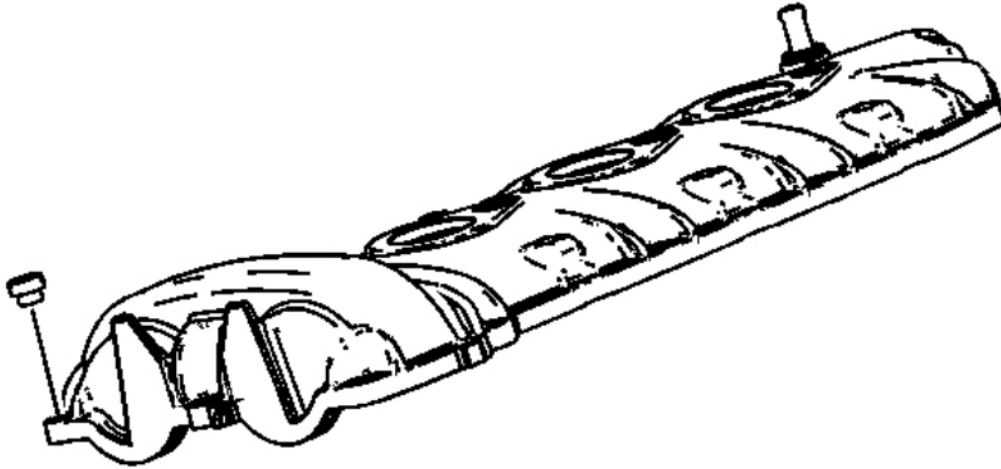


Fig. 300: Identifying Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

3. Install the camshaft cover bolt grommets prior to installing the camshaft cover bolts.
4. Wipe the camshaft cover sealing surface on the right cylinder head with a clean, lint-free cloth.

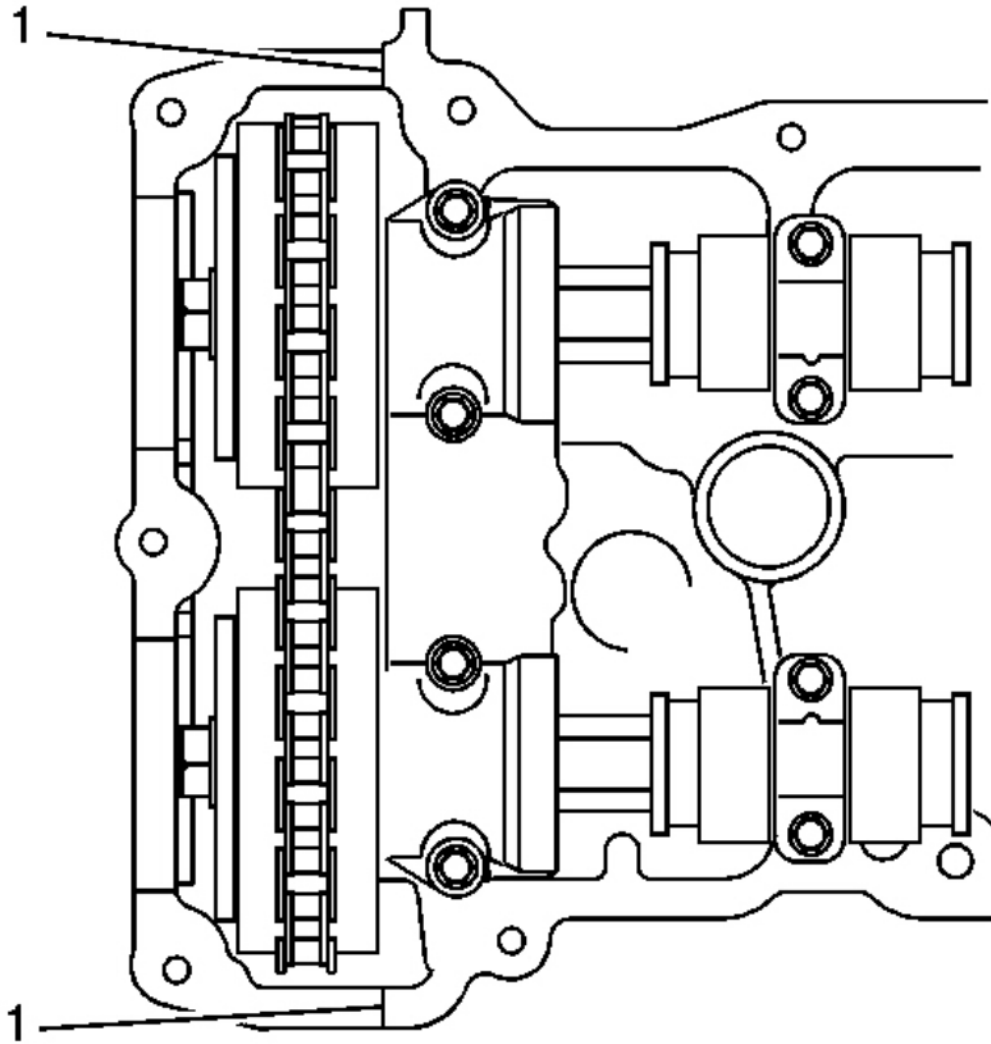


Fig. 301: Applying Sealant Onto Engine Front Cover Split Lines - Right
Courtesy of GENERAL MOTORS CORP.

5. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant, GM P/N 12378521 (Canadian P/N 88901148) or equivalent, on the engine front cover split lines (1).

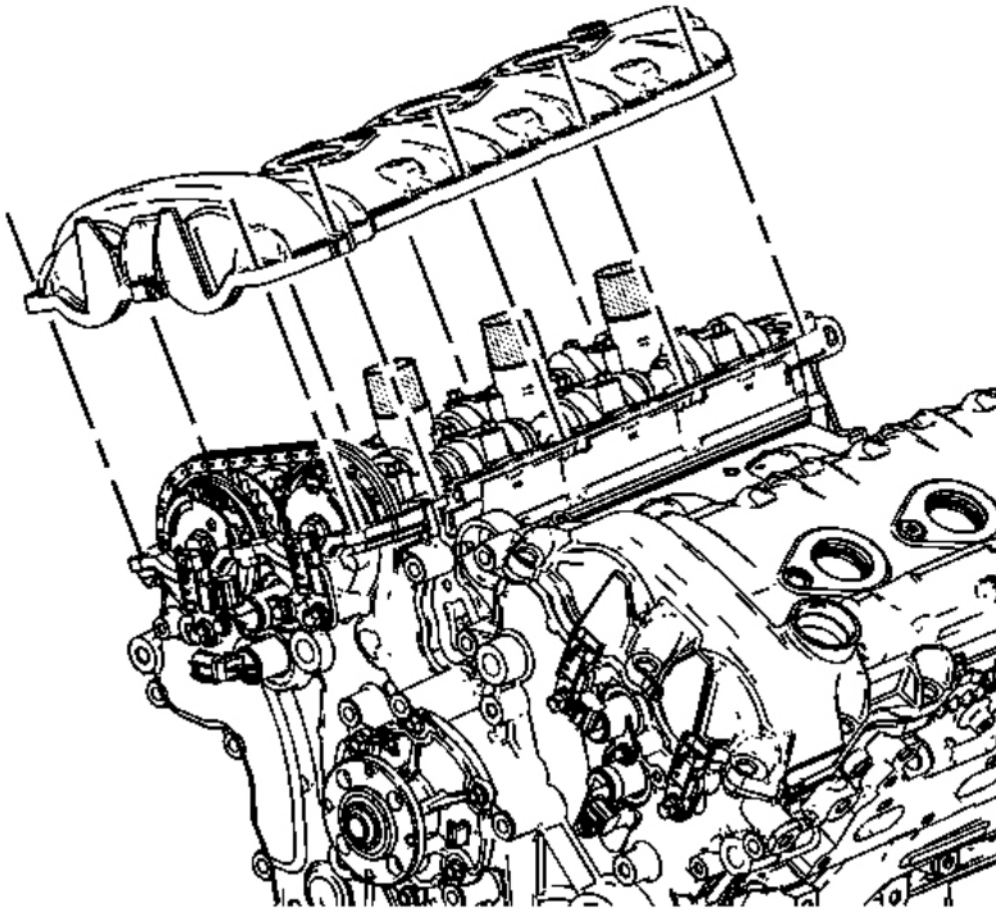


Fig. 302: View Of Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

6. Place the right camshaft cover into position onto the right cylinder head.

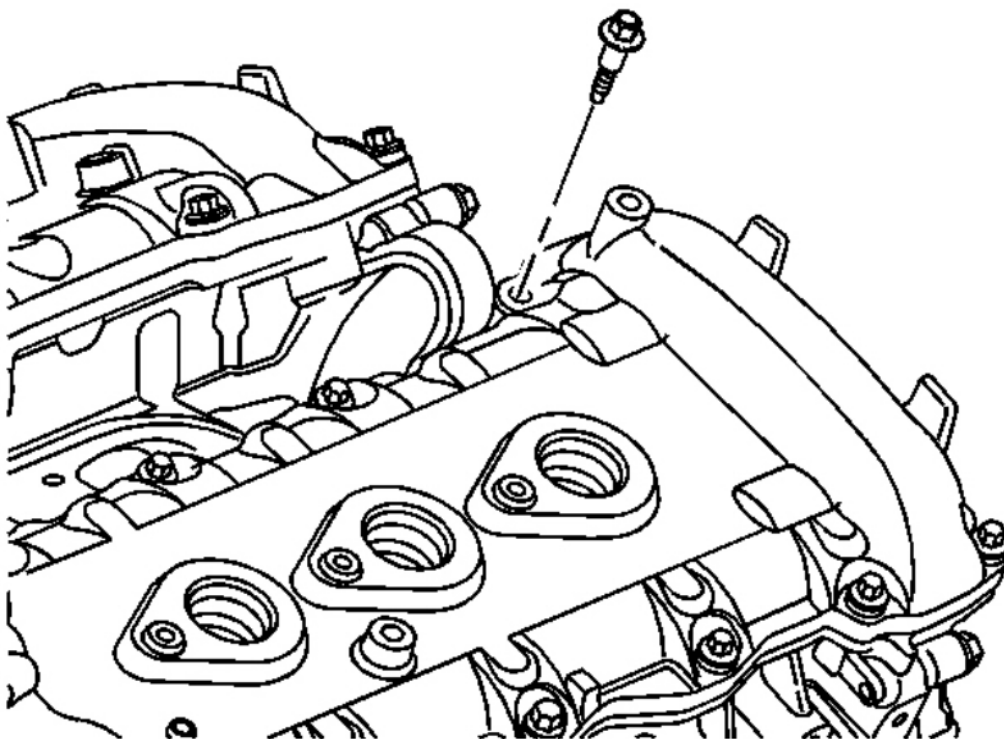


Fig. 303: Installing Right Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosely install the right camshaft cover bolts.

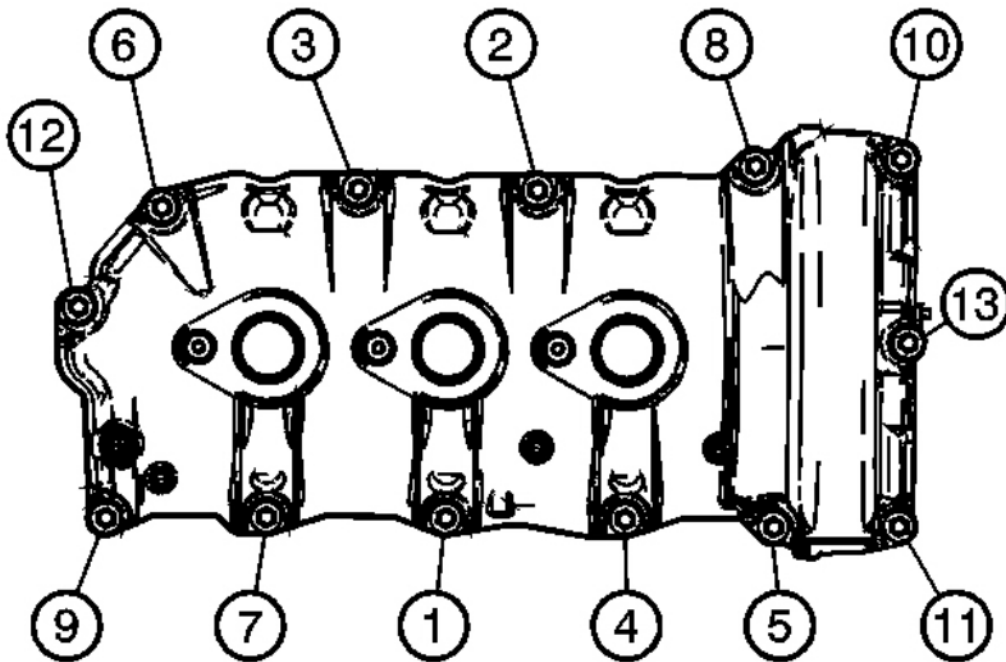


Fig. 304: Tightening Right Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Tighten the right camshaft cover bolts in the sequence shown.

Tighten: Tighten the right camshaft cover bolts in the sequence to 10 N.m (89 lb in).

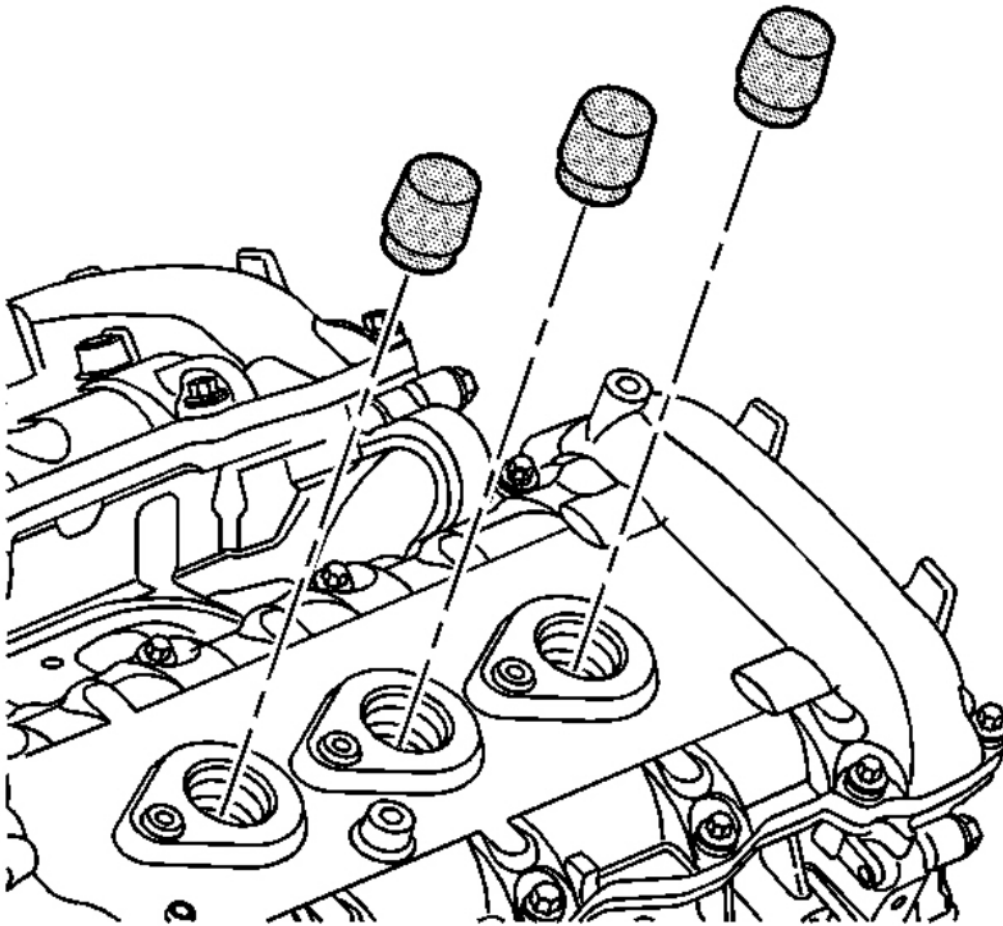


Fig. 305: Removing EN 46101 From Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

9. Remove the **EN 46101** from the spark plug tubes of the right cylinder head.

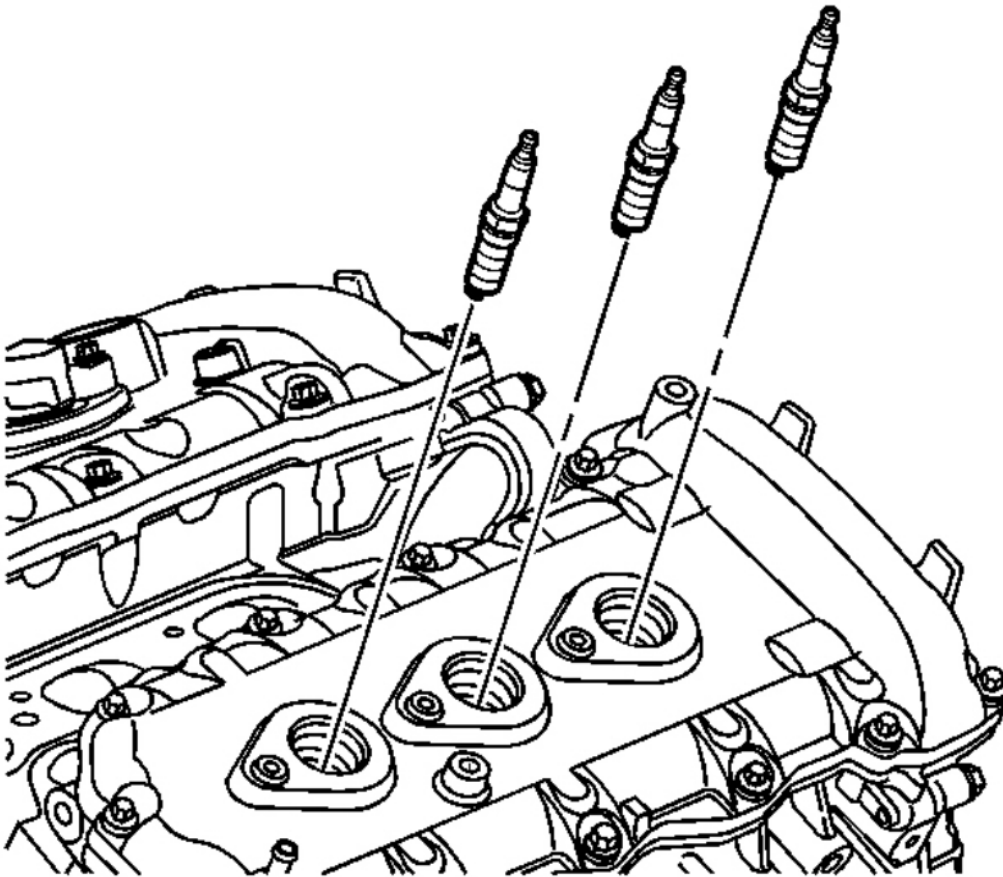


Fig. 306: View Of Spark Plugs

Courtesy of GENERAL MOTORS CORP.

10. Install the NEW spark plugs into the right cylinder head.

Tighten: Tighten the spark plugs to 20 N.m (15 lb ft).

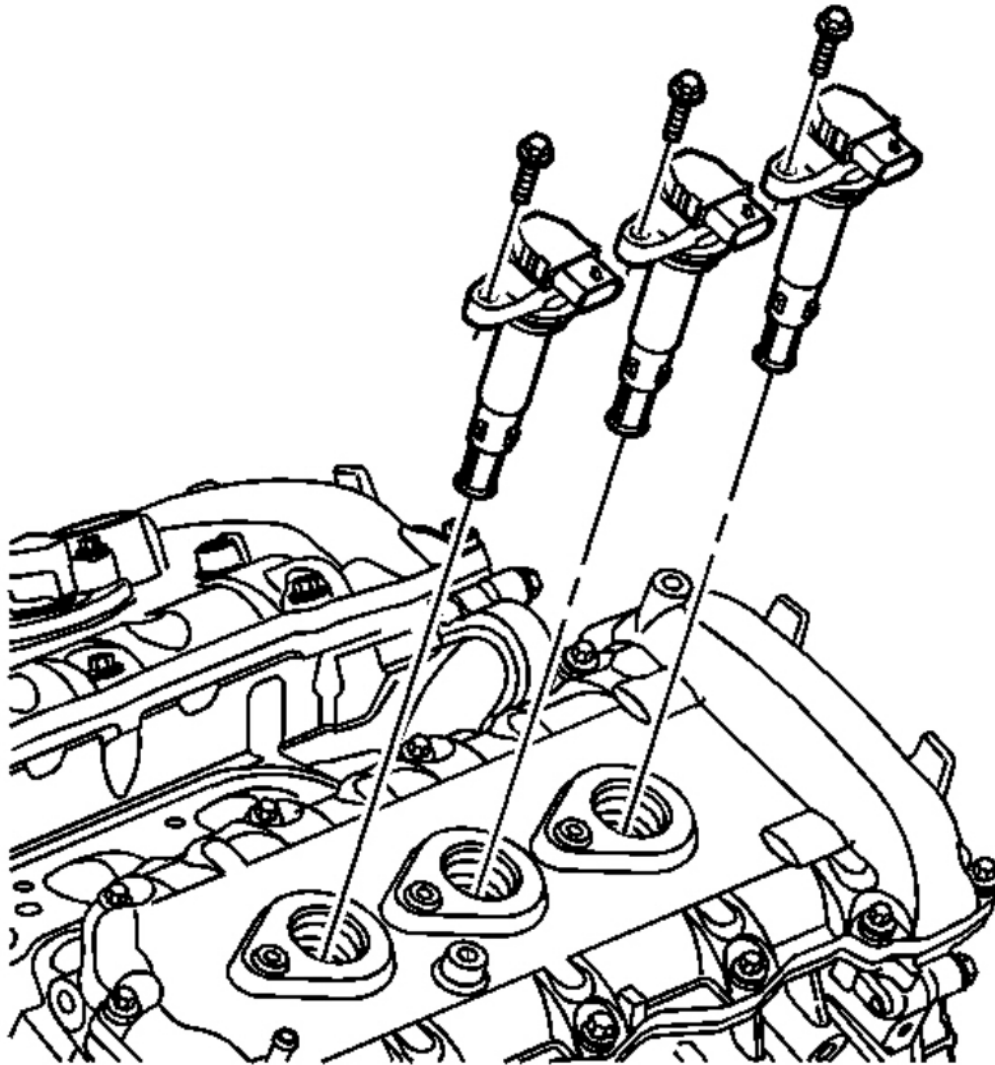


Fig. 307: Ignition Coil View

Courtesy of GENERAL MOTORS CORP.

11. Install each ignition coil through the right camshaft cover into the spark plug tube taking care not to damage the spark plug and/or the seal in the right camshaft cover.
12. Install each ignition coil bolt.

Tighten: Tighten the ignition coil bolt to 10 N.m (89 lb in).

INTAKE MANIFOLD INSTALLATION

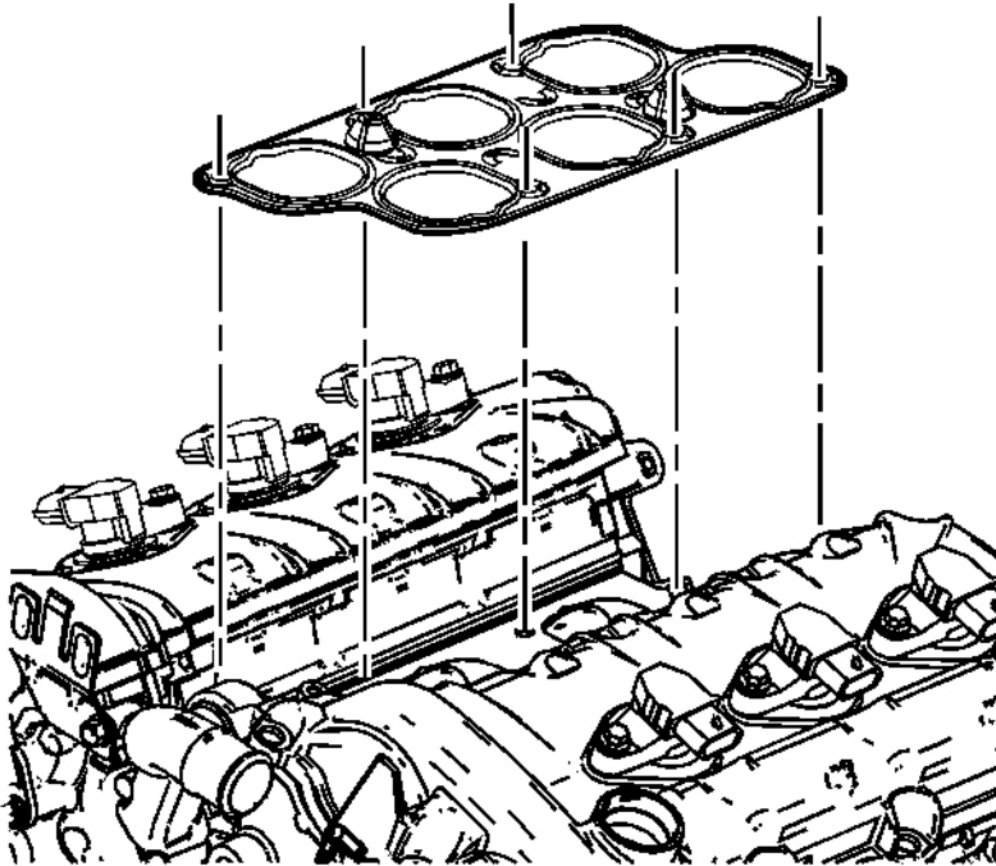


Fig. 308: View Of Lower Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW intake manifold gasket.

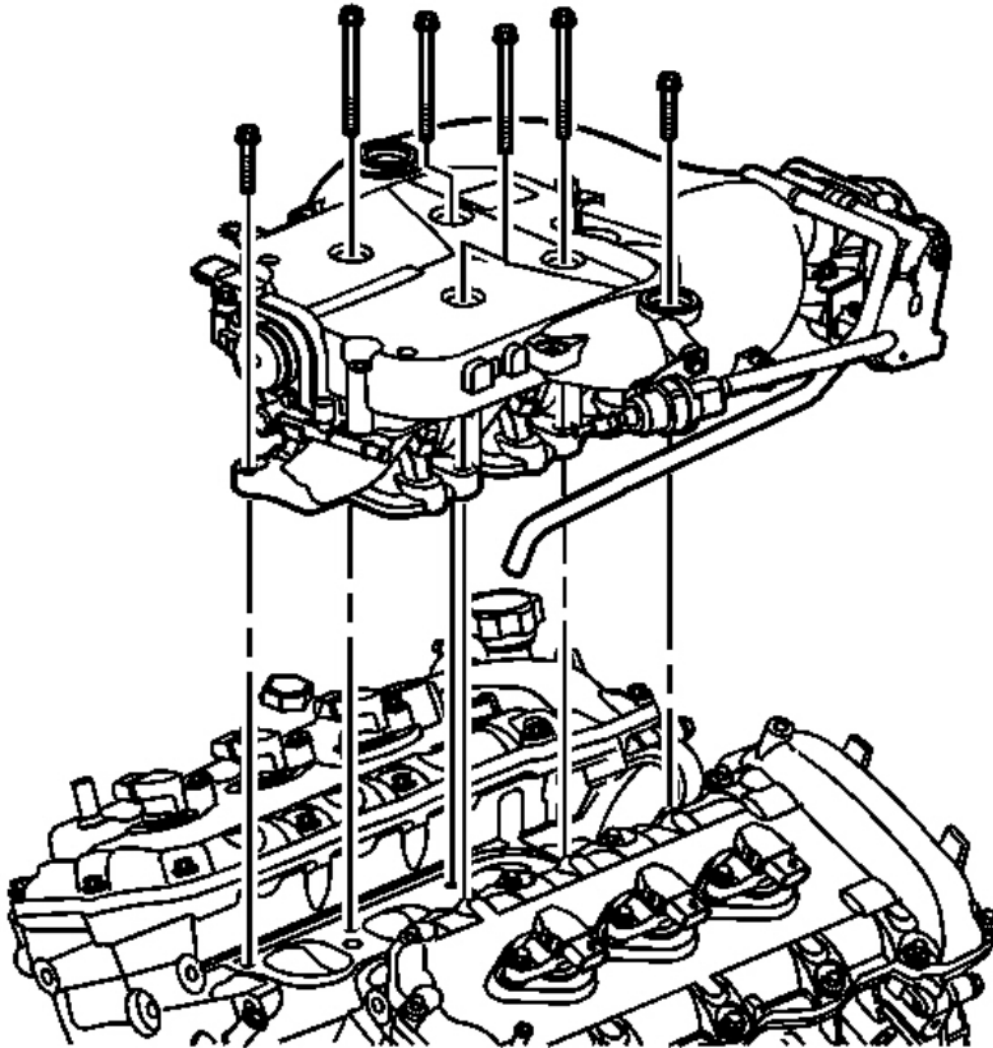


Fig. 309: View Of Intake Manifold Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the intake manifold assembly.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Tighten the intake manifold bolts in a circular pattern

starting from the center and moving outward.

3. Install the intake manifold bolts.

Tighten: Tighten the intake manifold bolts to 23 N.m (17 lb ft).

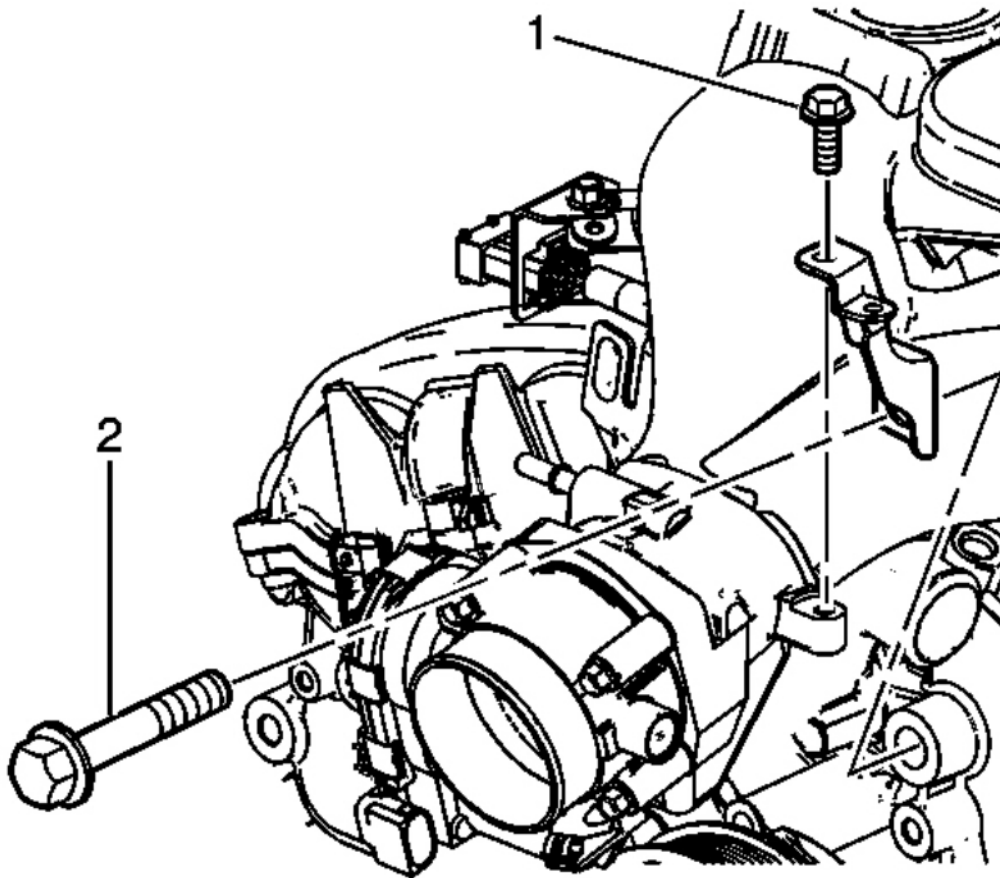


Fig. 310: View Of Intake Manifold Brace & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Place the intake manifold brace to the engine front cover and intake manifold.
5. Loosely install the bolts.
6. First tighten the intake manifold brace bolt (1) to the intake manifold.

Tighten: Tighten the intake manifold brace bolt at the intake manifold to 10 N.m (89 lb in).

7. Finally tighten the intake manifold brace bolt (2) to the engine front cover.

Tighten: Tighten the intake manifold brace bolt to the engine front cover to 65 N.m (48 lb ft).

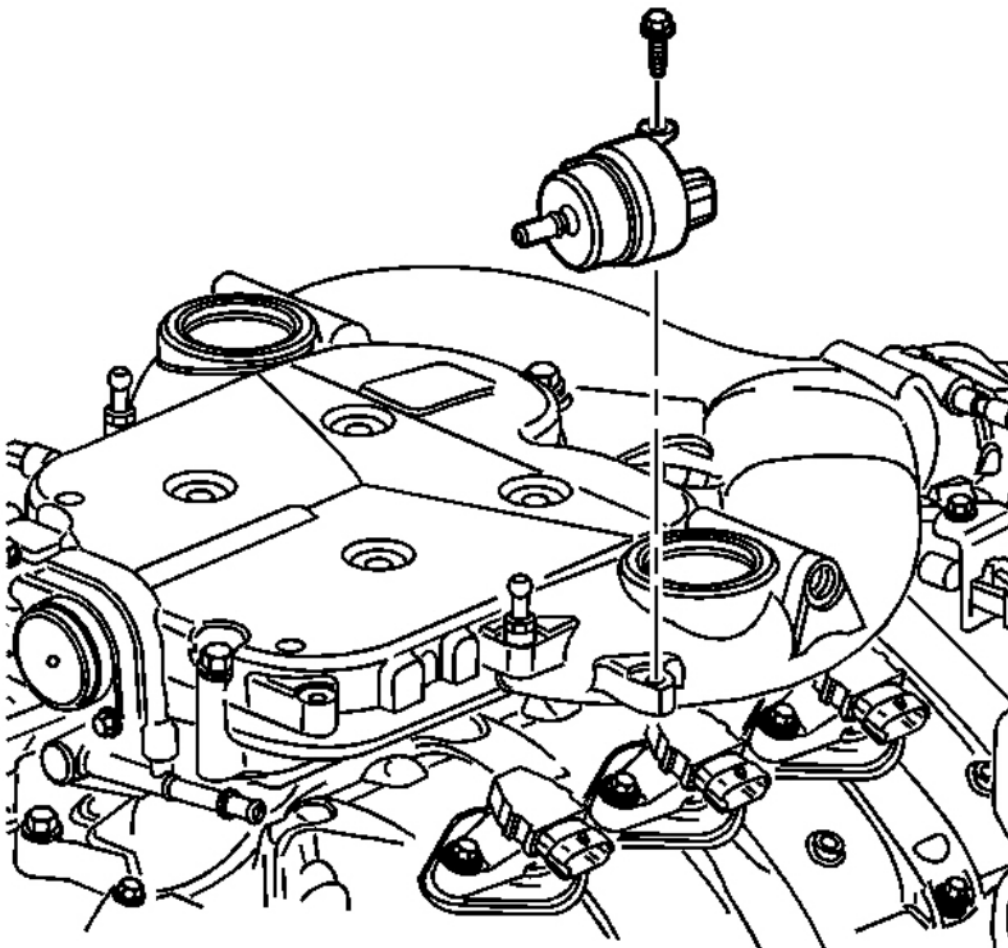


Fig. 311: View Of EVAP Solenoid
Courtesy of GENERAL MOTORS CORP.

8. Install the EVAP solenoid.
9. Install the EVAP solenoid bolt.

Tighten: Tighten the EVAP solenoid bolt to 10 N.m (89 lb in).

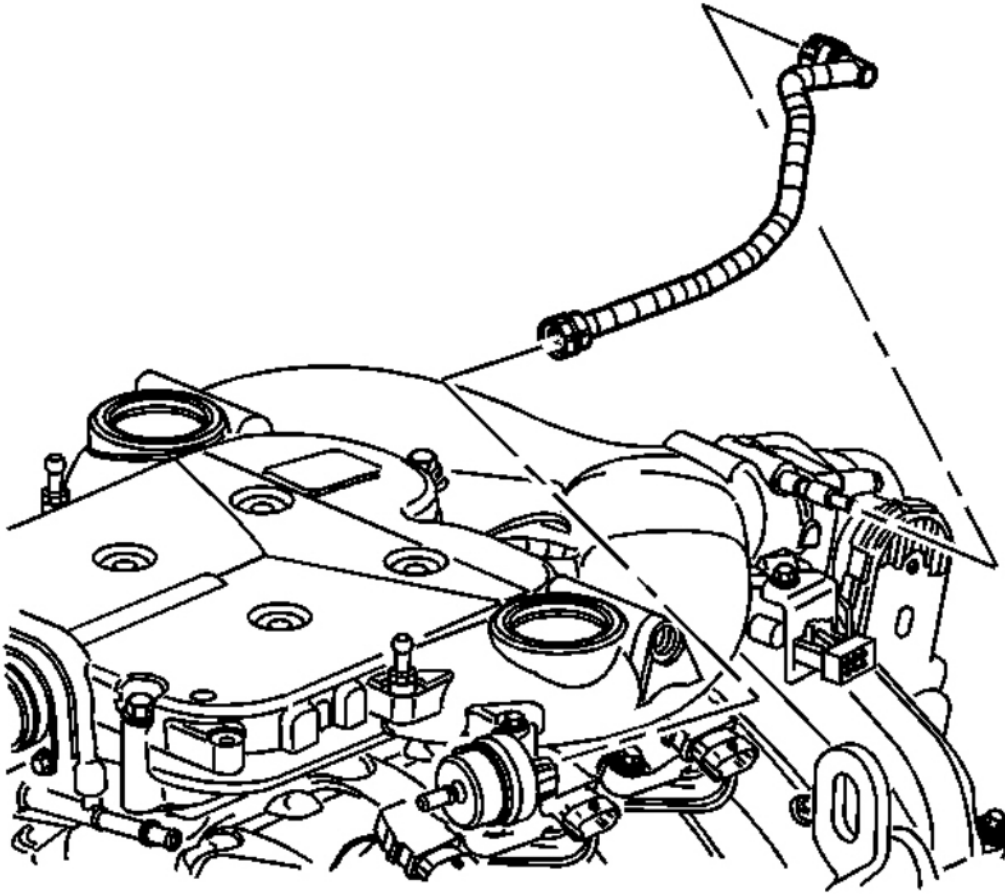


Fig. 312: View Of EVAP Hose
Courtesy of GENERAL MOTORS CORP.

10. Connect the EVAP hose to the upper intake manifold and EVAP solenoid.

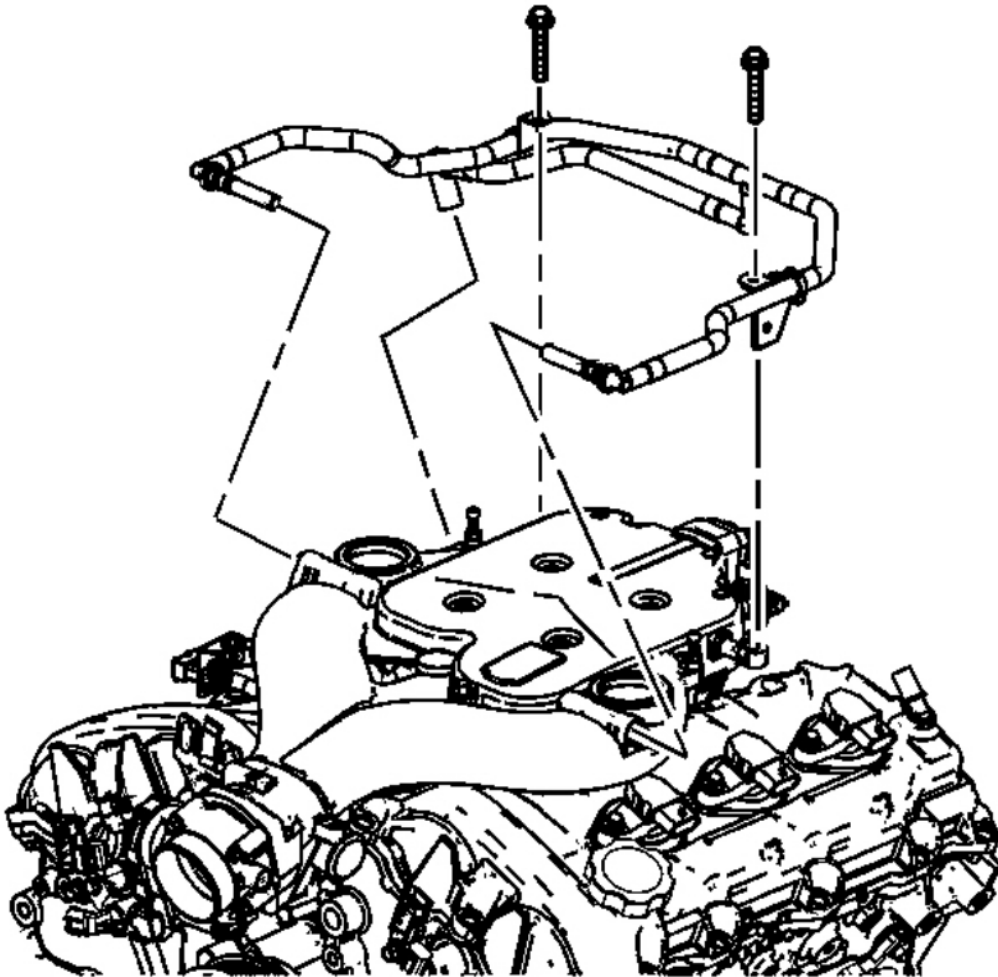


Fig. 313: View Of PCV Dirty Air Tube
Courtesy of GENERAL MOTORS CORP.

11. Connect the PCV tube assembly to the upper intake manifold and the right camshaft cover.
12. Install the PCV tube assembly bracket bolts.

Tighten: Tighten the PCV tube assembly bracket bolts to 10 N.m (89 lb in).

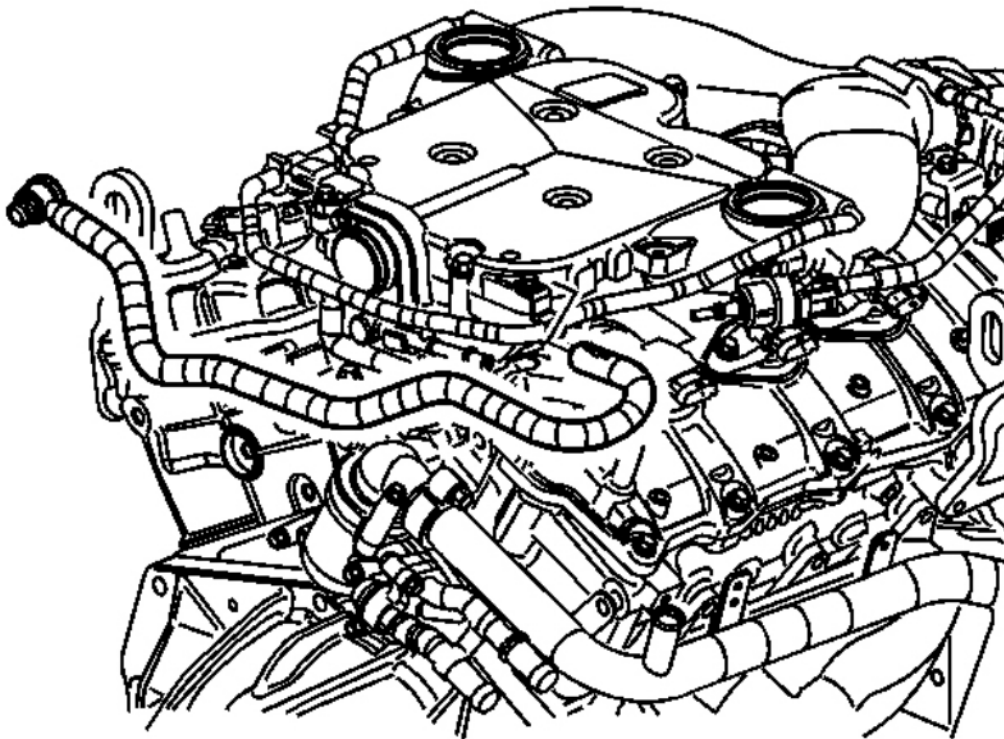


Fig. 314: View Of Brake Booster Hose
Courtesy of GENERAL MOTORS CORP.

13. Install the brake booster hose to the upper intake manifold.

ENGINE FLYWHEEL INSTALLATION

Tools Required

- **EN 46106** Engine Flywheel Holding Tool
- **J 45059** Angle Meter

1. Place the engine flywheel in position on the crankshaft.
2. Install 2 NEW bolts in location at the top and bottom of the engine flywheel bolt pattern allowing the engine flywheel to hang in position.

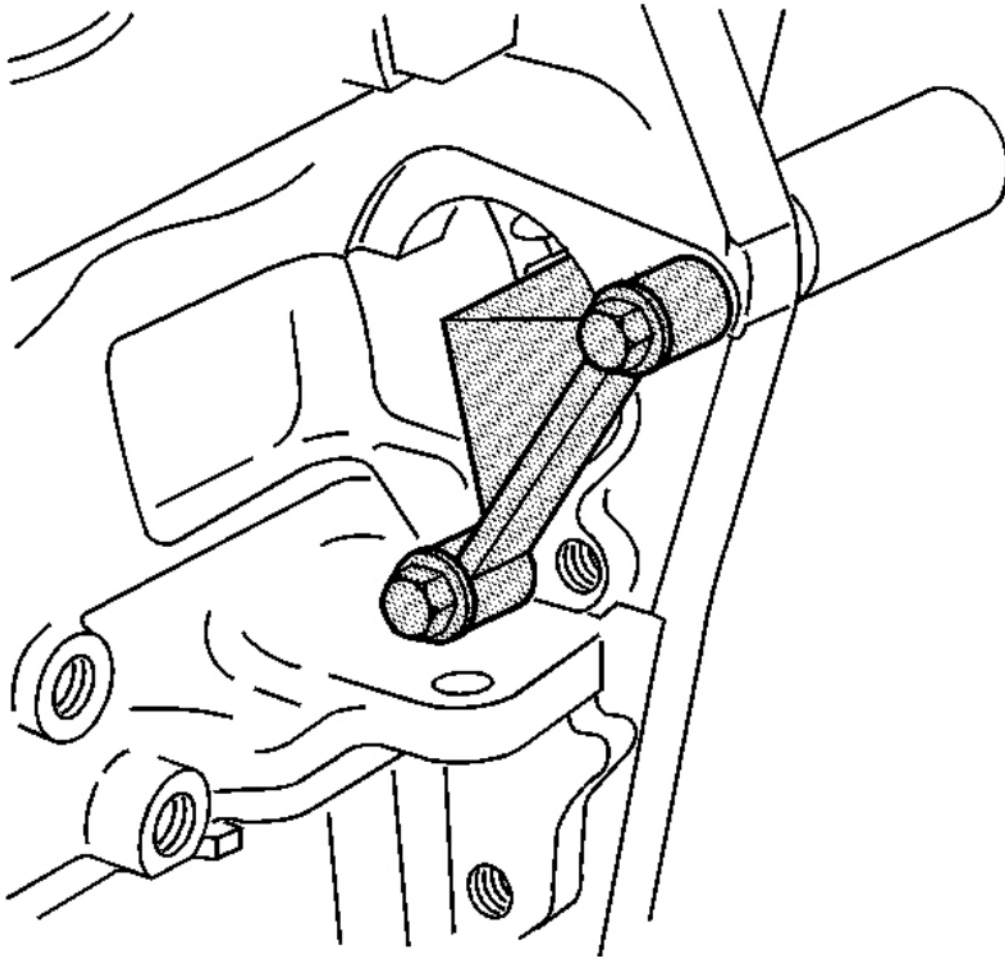


Fig. 315: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

3. Install the EN 46106 .

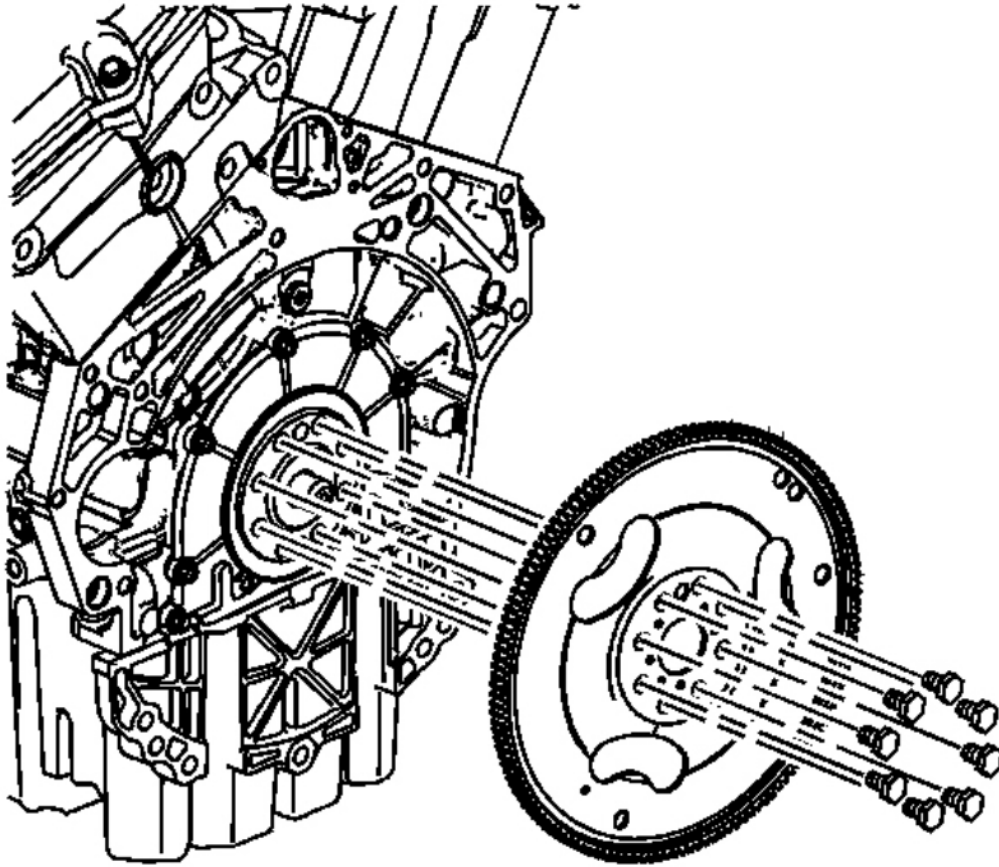


Fig. 316: View Of Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the remaining NEW engine flywheel bolts.

Tighten:

1. Tighten the NEW engine flywheel bolts to 30 N.m (22 lb ft).
2. Tighten the NEW engine flywheel bolts an additional 45 degrees using the **J 45059**.

Tools Required

- **EN 46106** Engine Flywheel Holding Tool
- **J 41998-B** Crankshaft Balancer Installer
- **J 45059** Angle Meter

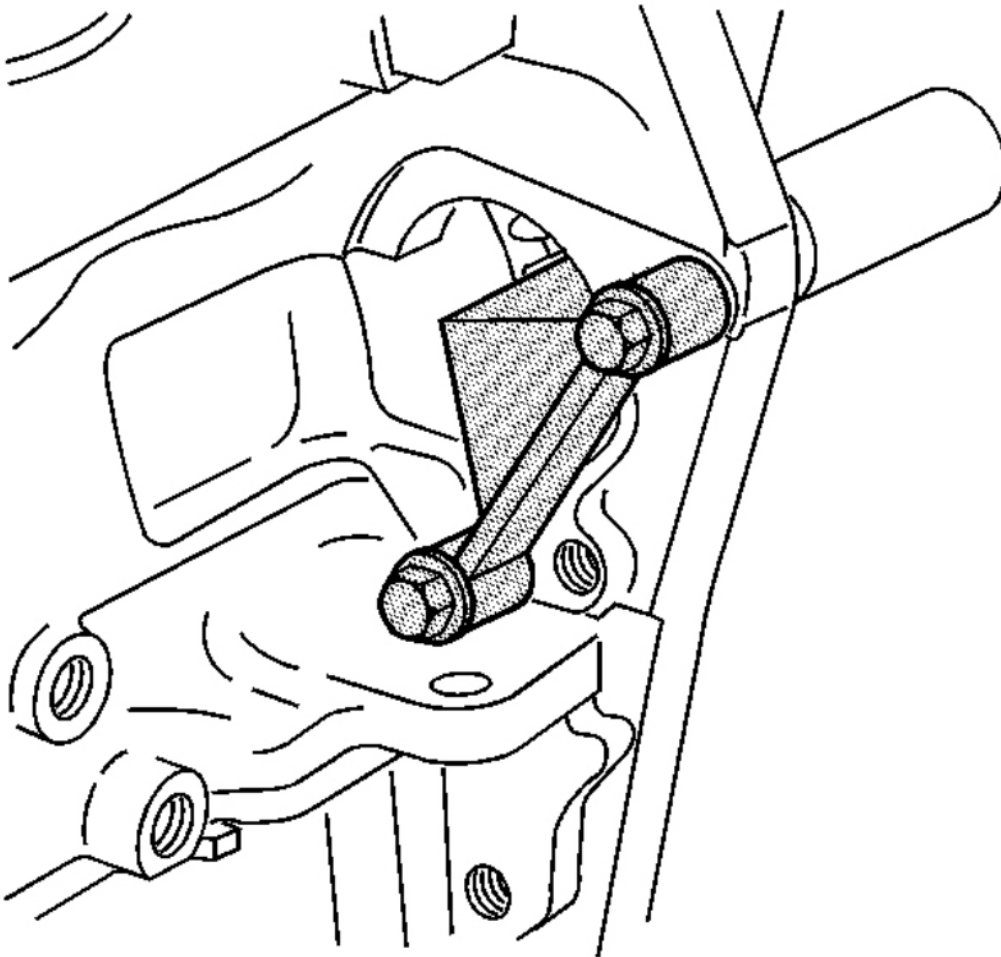


Fig. 317: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

1. The **EN 46106** must be installed onto the flywheel.
2. Use the **J 41998-B** , nut, bearing and washer to install the crankshaft balancer.

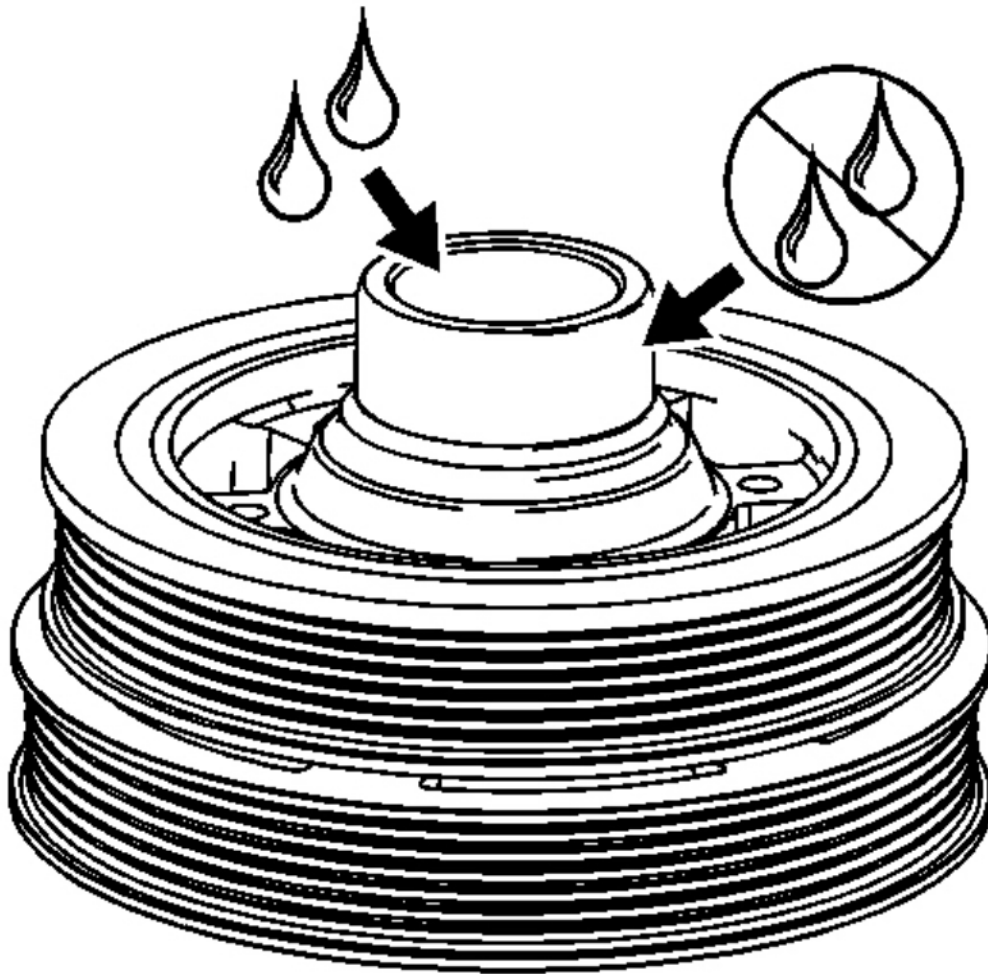


Fig. 318: Lubricating Inside Of Crankshaft Balancer Hub Bore
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

3. Apply lubricant to the inside of the crankshaft balancer hub bore.

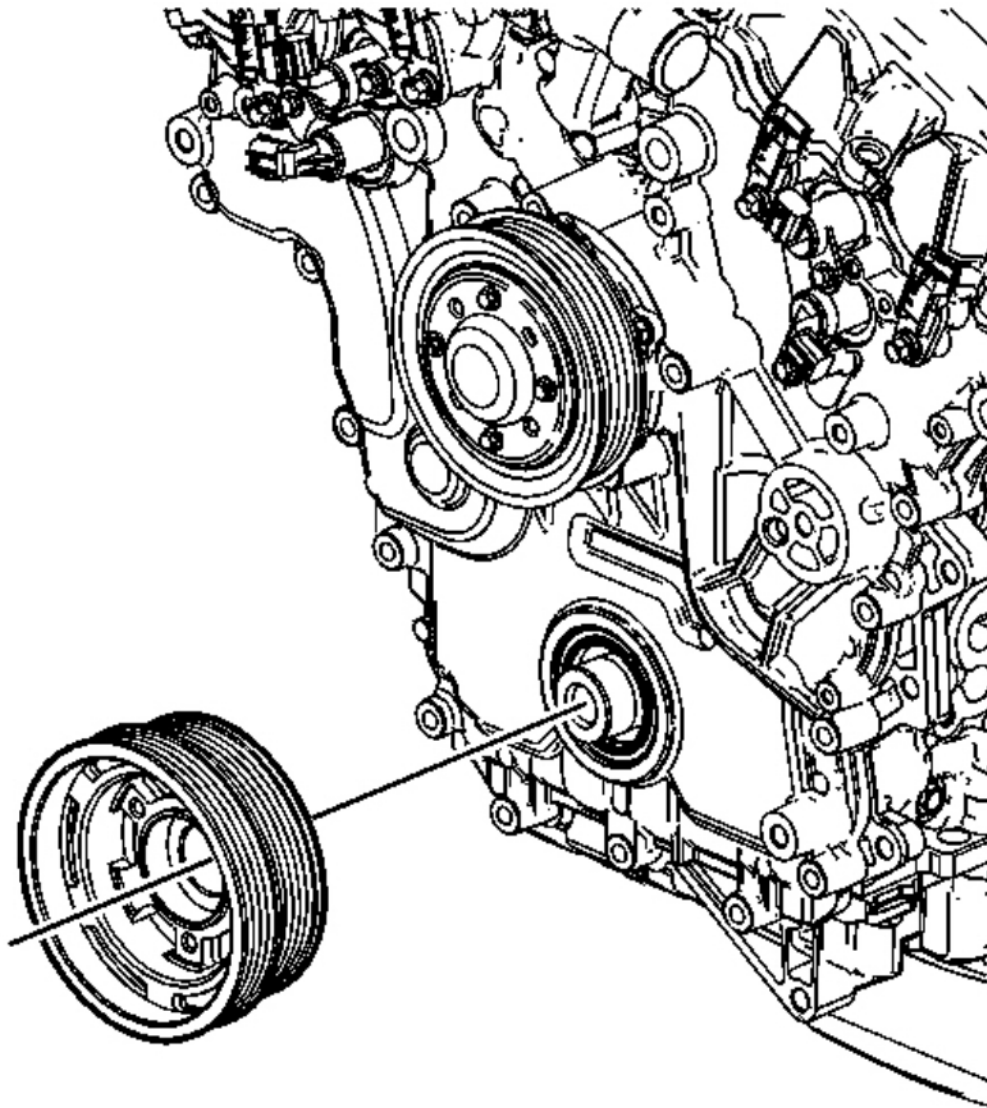


Fig. 319: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

4. Place the crankshaft balancer in position on the crankshaft.

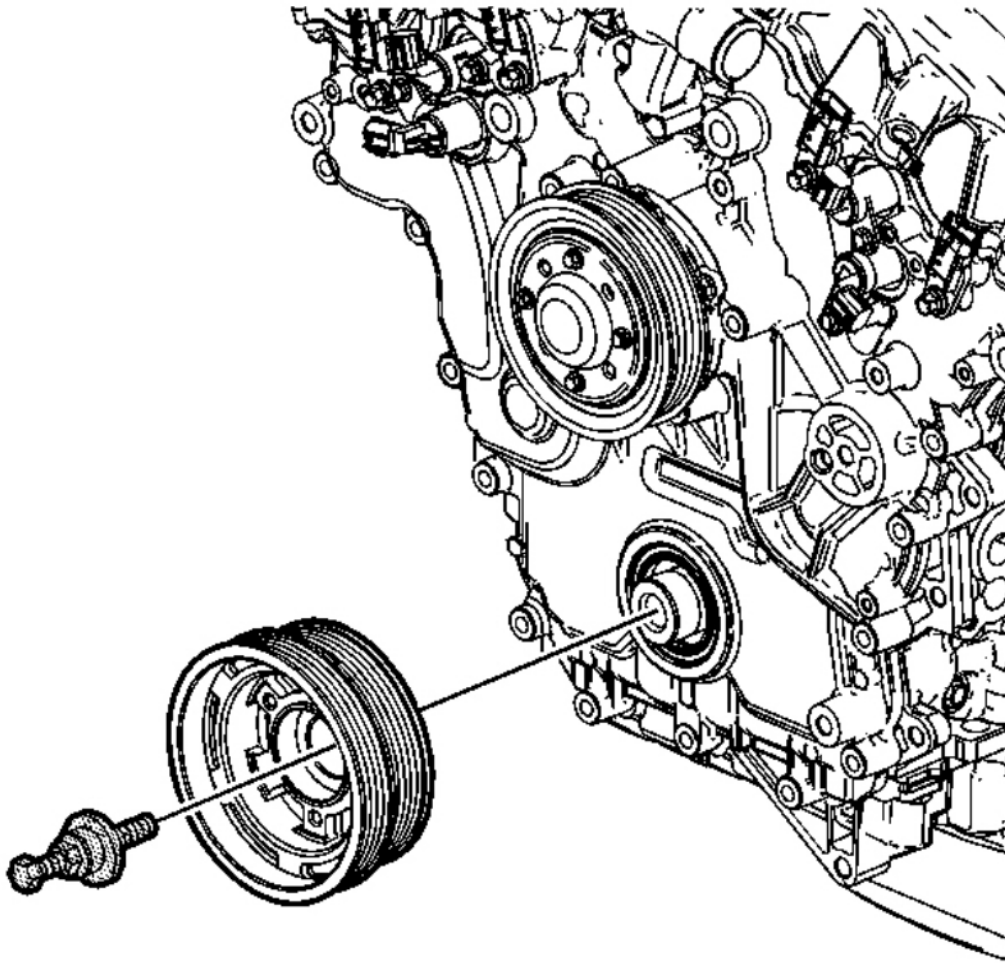


Fig. 320: Installing Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

5. Thread the **J 41998-B** in the crankshaft. Ensure you engage at least 10 threads of the **J 41998-B** before pressing the crankshaft balancer in place.
6. Push the crankshaft balancer into position by tightening the nut on the **J 41998-B** until the large washer bottoms out on the crankshaft end.
7. Remove the **J 41998-B** .

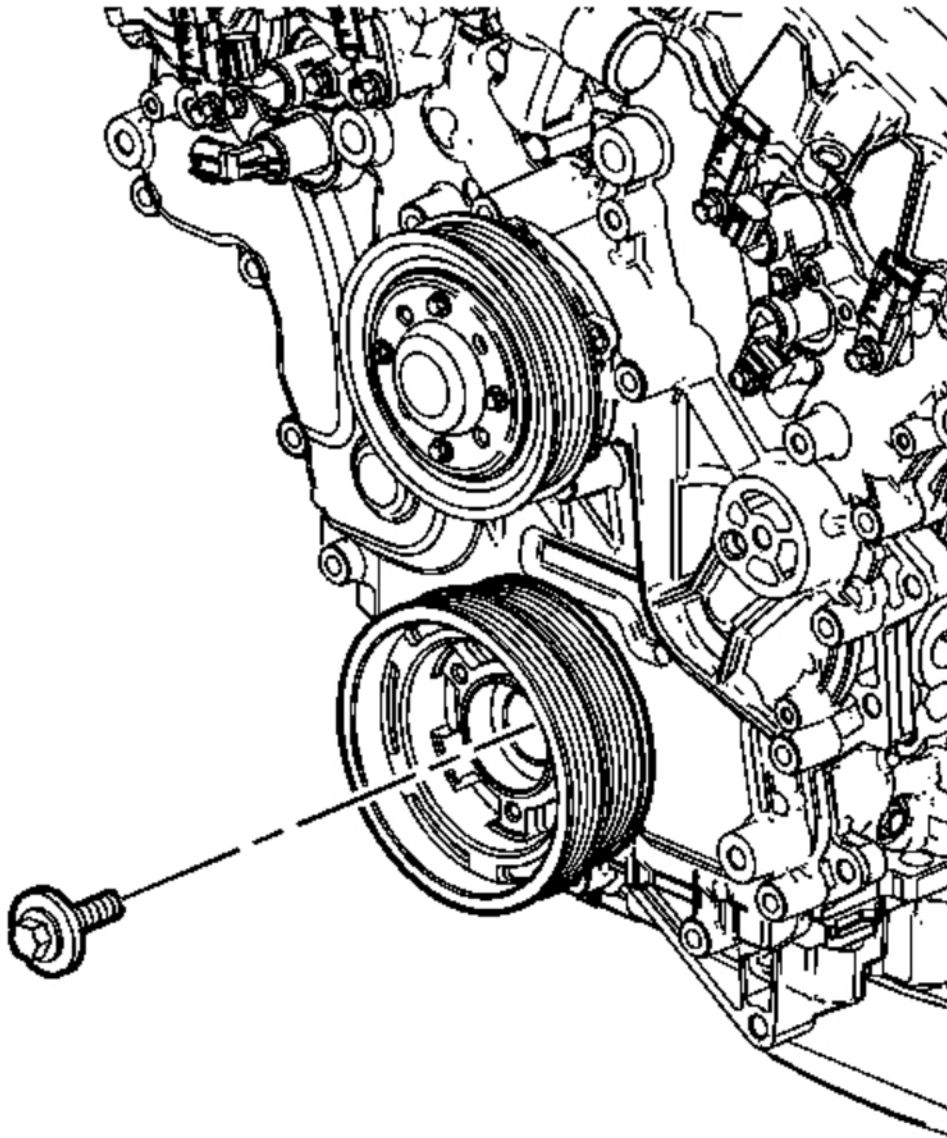


Fig. 321: View Of Crankshaft Balancer & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Install the crankshaft balancer bolt.

NOTE: Refer to Fastener Notice in Cautions and Notices.

9. Tighten the crankshaft balancer bolt.

Tighten:

1. Tighten the crankshaft balancer bolt to 100 N.m (74 lb ft).
2. Tighten the crankshaft balancer bolt an additional 150 degrees using the **J 45059** .

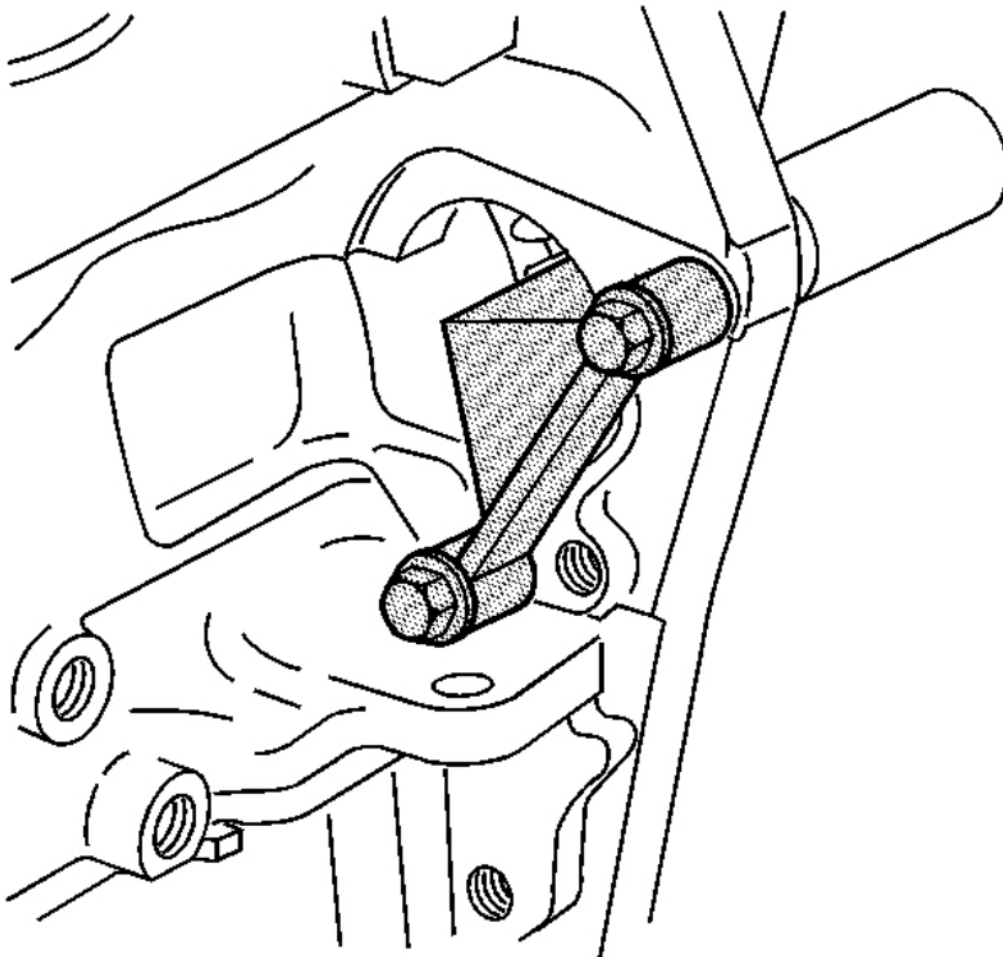


Fig. 322: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

10. Remove the **EN 46106** .

OIL FILTER ADAPTER INSTALLATION

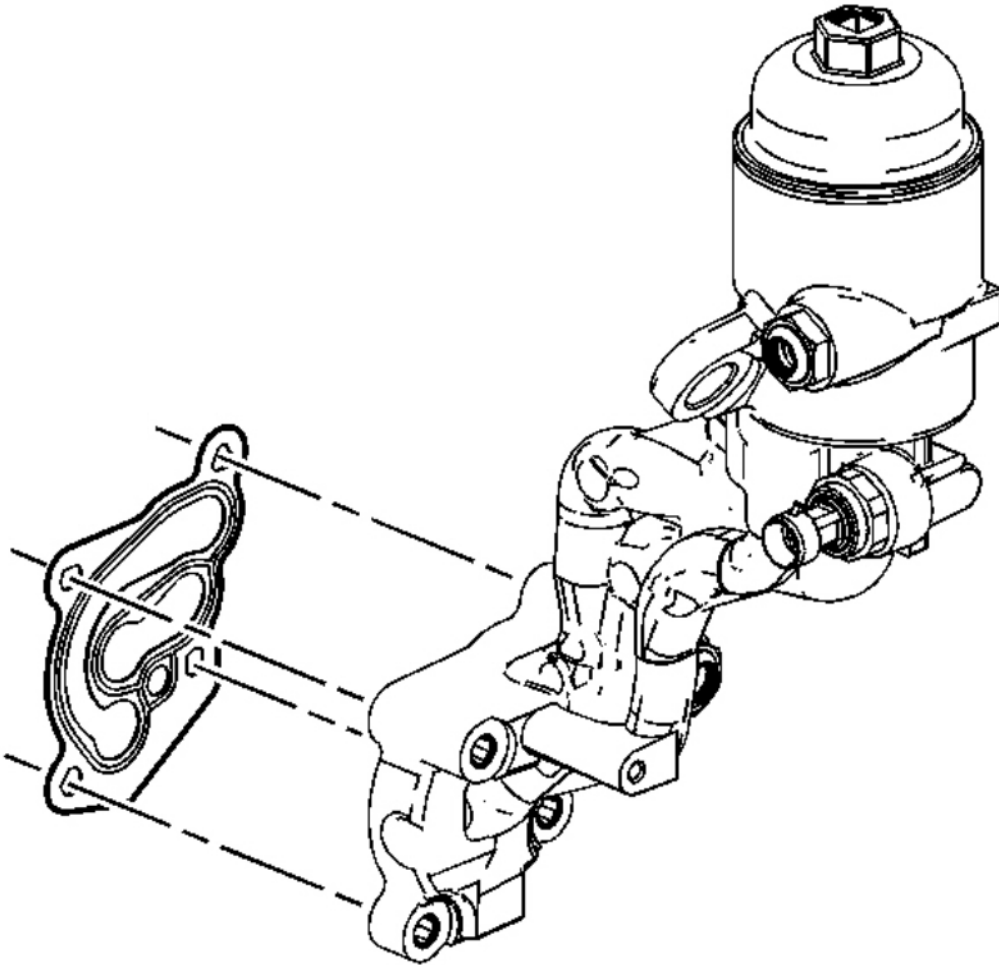


Fig. 323: View Of Oil Filter Adapter & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Position a NEW oil filter adapter gasket onto the oil filter adapter.

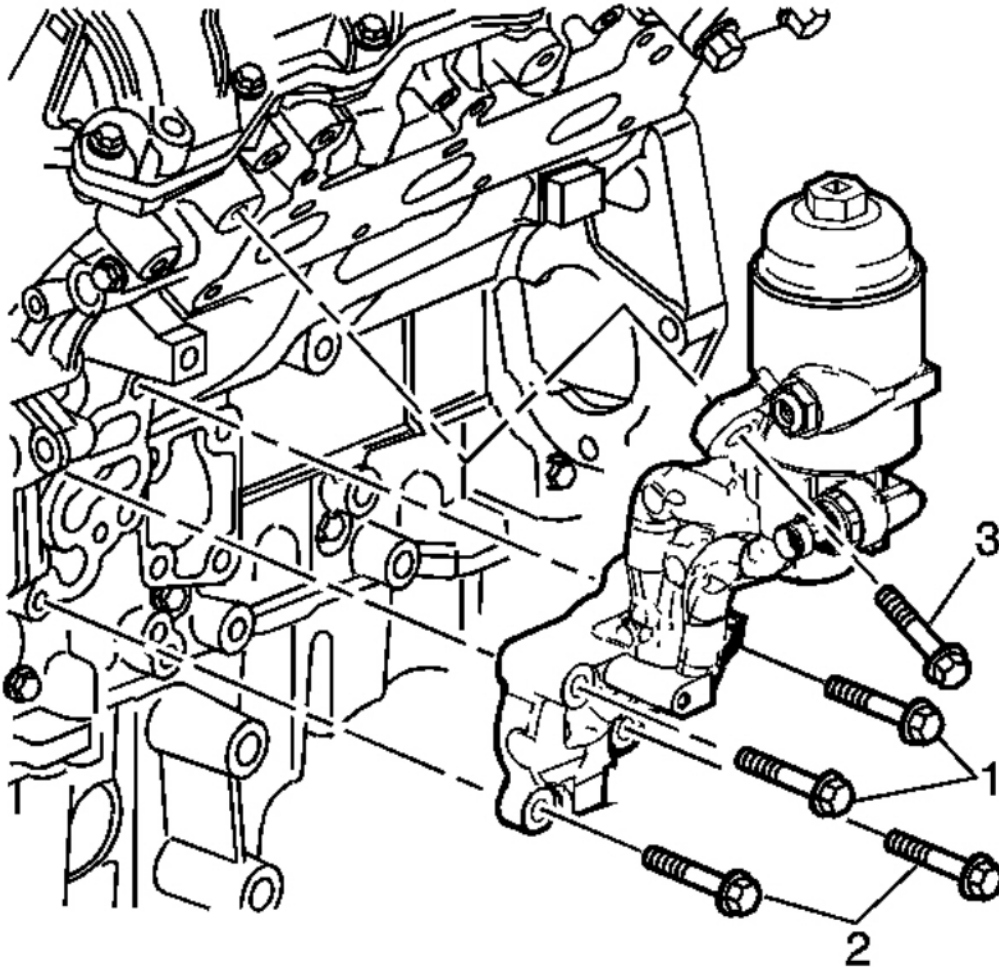


Fig. 324: View Of Oil Filter Adapter & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the oil filter adapter bolts (1, 2) into the oil filter adapter.
3. Loosely tighten the oil filter adapter bolts (1, 2).
4. Install and loosely tighten the oil filter adapter bolt (3) into the oil filter adapter.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Tighten the oil filter adapter bolts (1, 2, 3) into the engine block in the sequence shown.

Tighten: Tighten the oil filter adapter bolts in sequence to 23 N.m (17 lb ft).

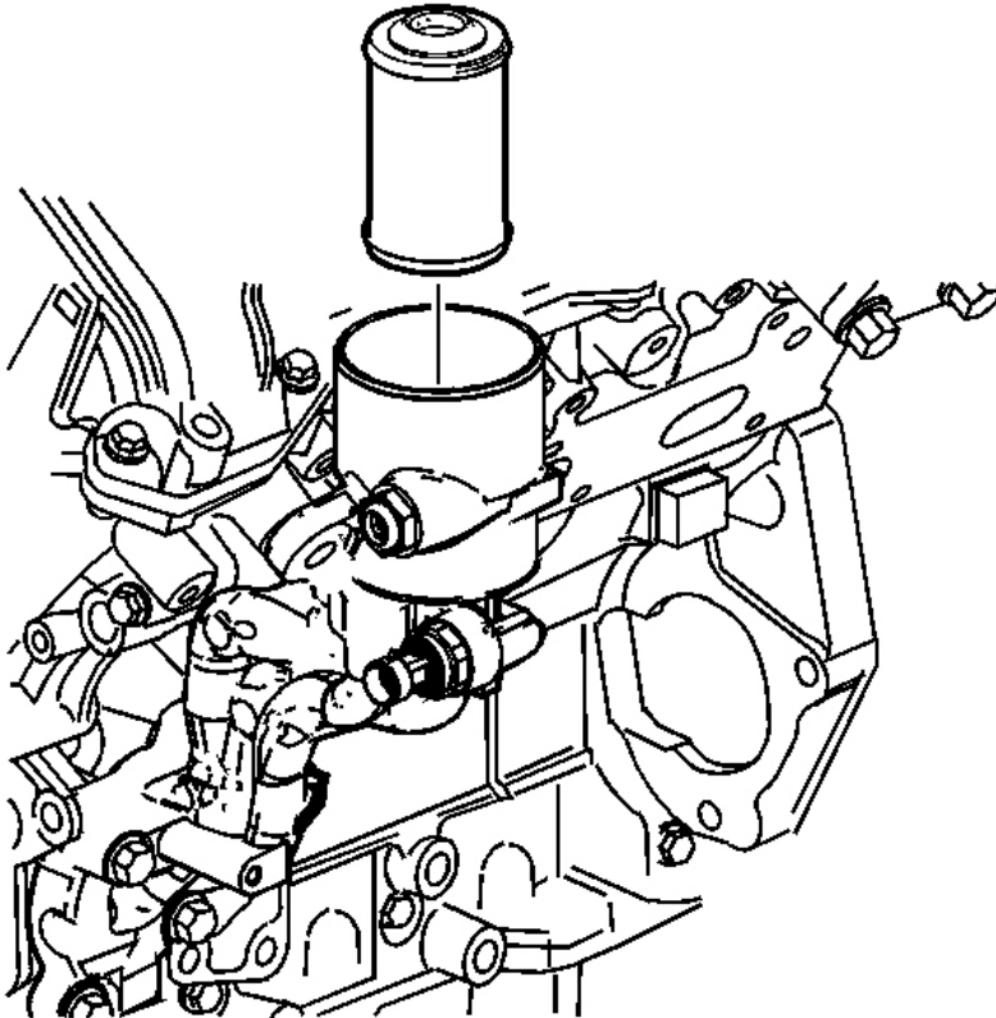


Fig. 325: View Of Oil Filter Cartridge
Courtesy of GENERAL MOTORS CORP.

6. Install a NEW oil filter cartridge.

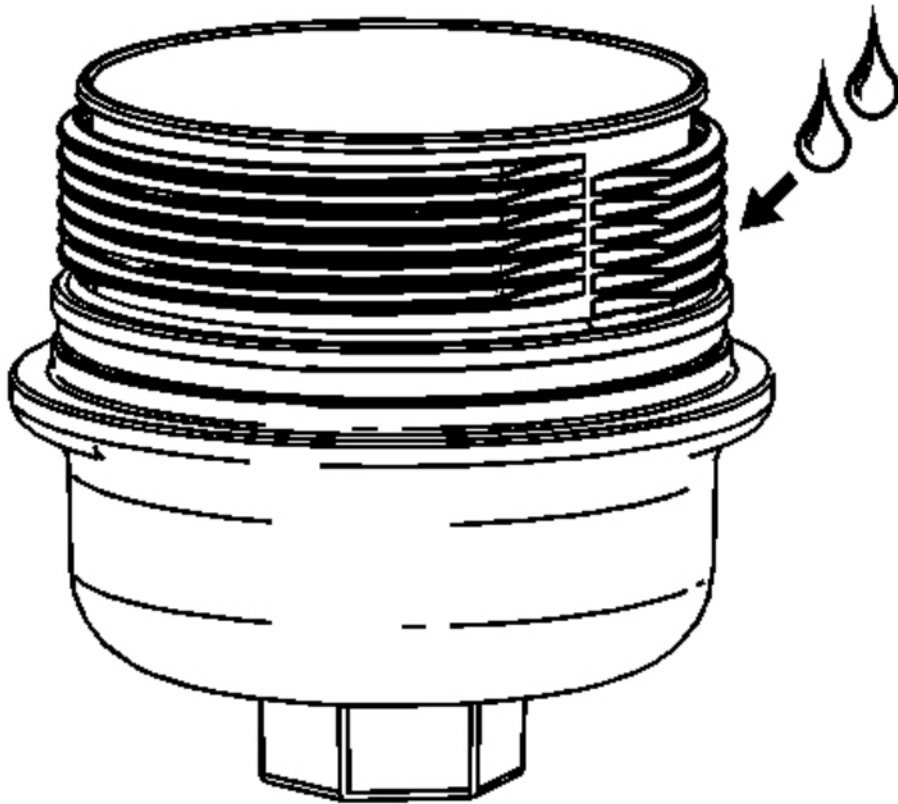


Fig. 326: Lubricating Oil Filter Cap Threads
Courtesy of GENERAL MOTORS CORP.

NOTE: Lubrication must be applied to the threads of the oil filter cap prior to installation. Failure to lubricate the oil filter cap threads can hinder later removal and cause possible oil filter cap damage.

7. Lubricate the oil filter cap threads with clean engine oil.

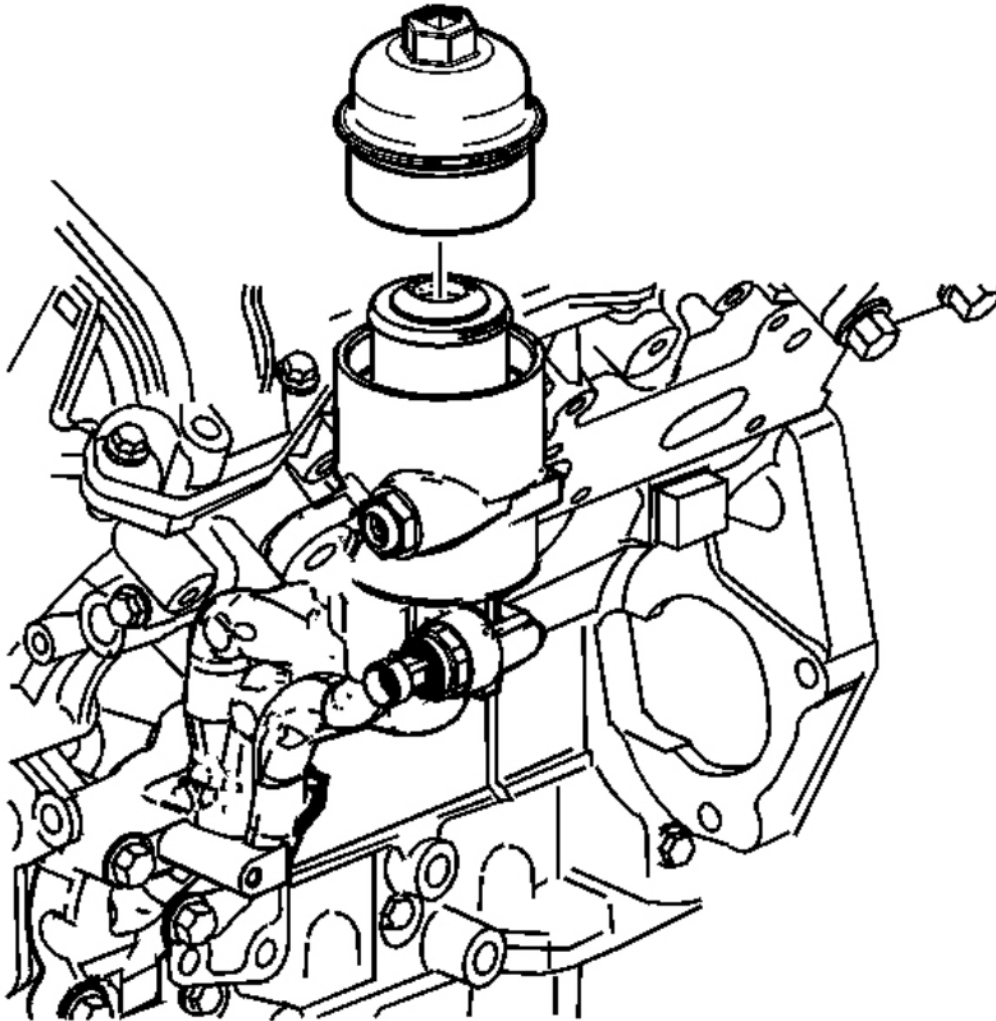


Fig. 327: View Of Oil Filter Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: Proper oil filter cap tightening is mandatory. Failure to tighten the oil filter cap to the proper specification can hinder later removal and cause possible oil filter cap damage.

8. Install the oil filter cap.

Tighten: Tighten the oil filter cap to 25 N.m (18 lb ft).

EXHAUST MANIFOLD INSTALLATION - LEFT

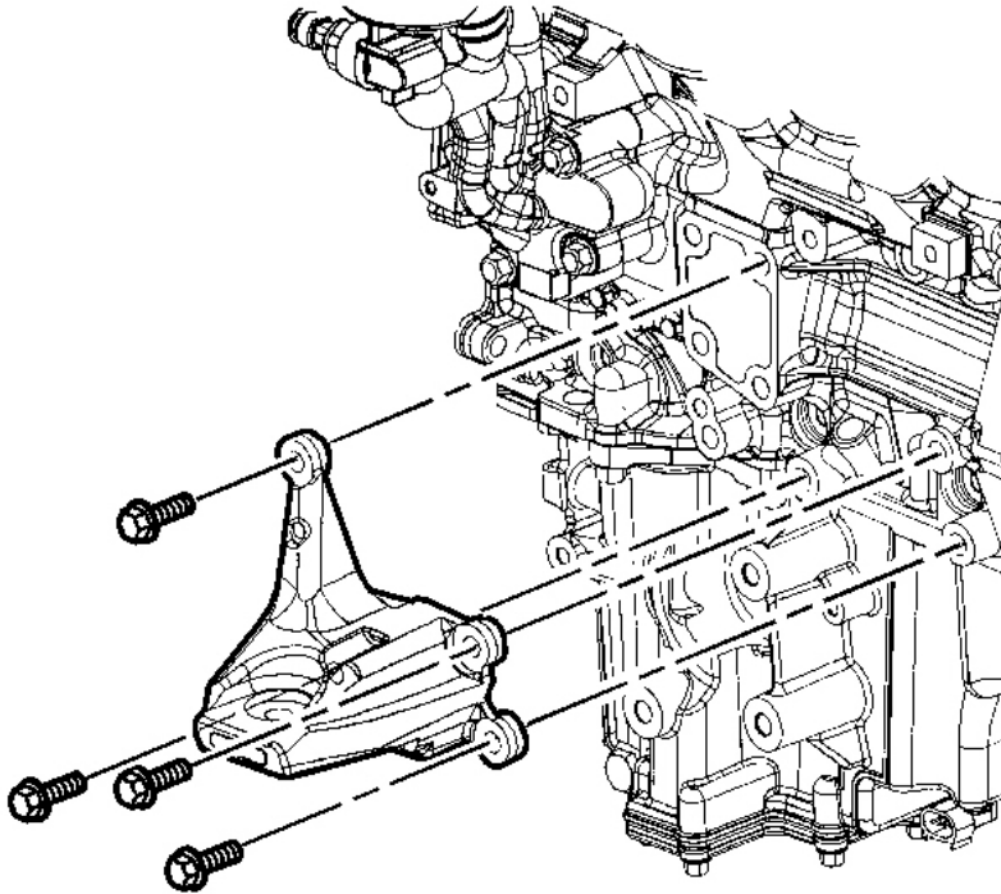


Fig. 328: View Of Left Engine Mount Bracket
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the engine mount bracket bolts.

Tighten: Tighten the engine mount bracket bolts to 60 N.m (44 lb ft).

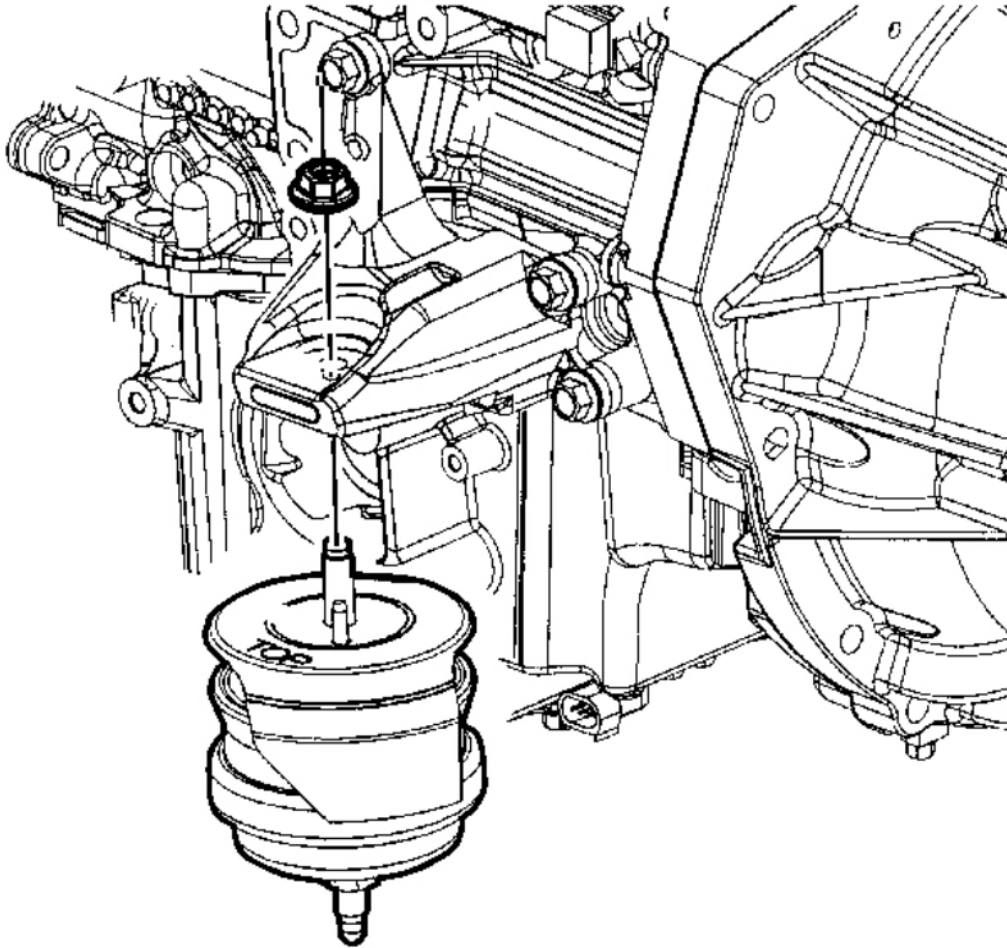


Fig. 329: View Of Left Engine Mount
Courtesy of GENERAL MOTORS CORP.

3. Install the engine mount.
4. Install the engine mount nut.

Tighten: Tighten the engine mount nut to 80 N.m (59 lb ft).

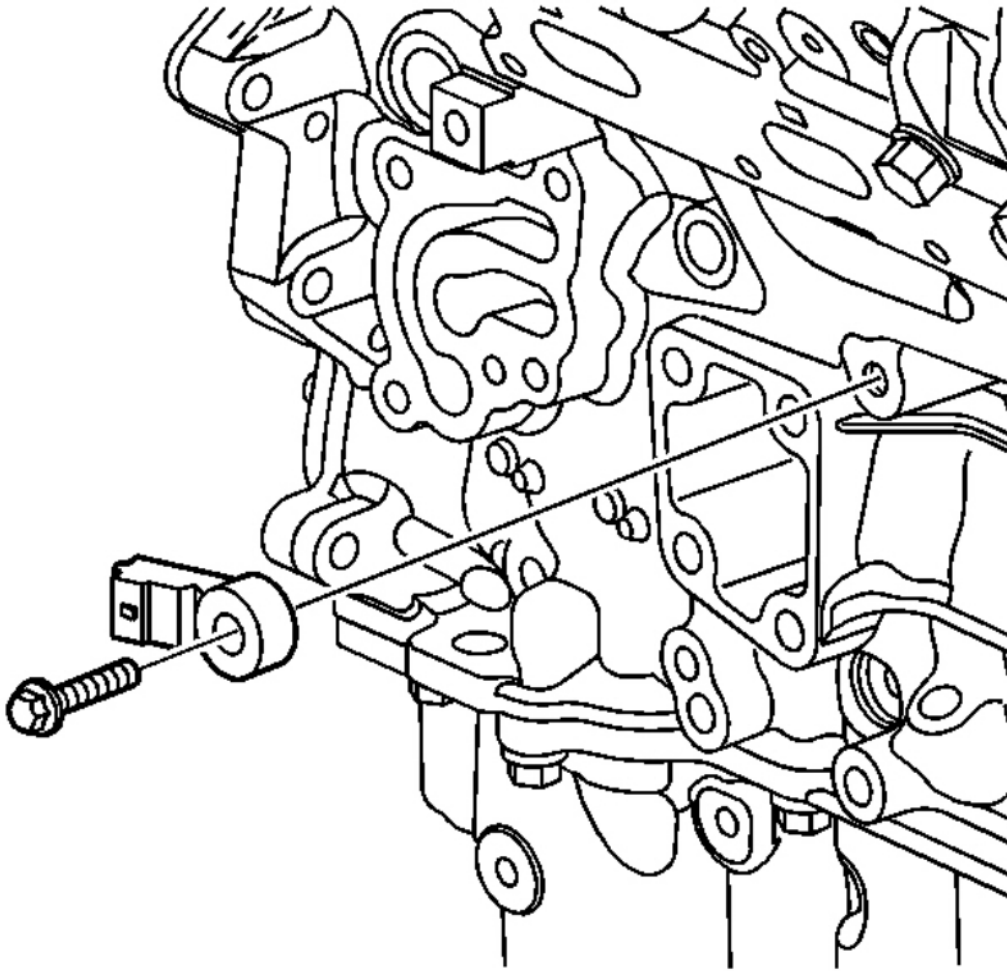


Fig. 330: View Of Left Knock Sensor
Courtesy of GENERAL MOTORS CORP.

5. Position the left knock sensor to the cylinder block as shown.
6. Install the knock sensor bolt.

Tighten: Tighten the knock sensor bolt to 23 N.m (17 lb ft).

7. Ensure proper knock sensor orientation.

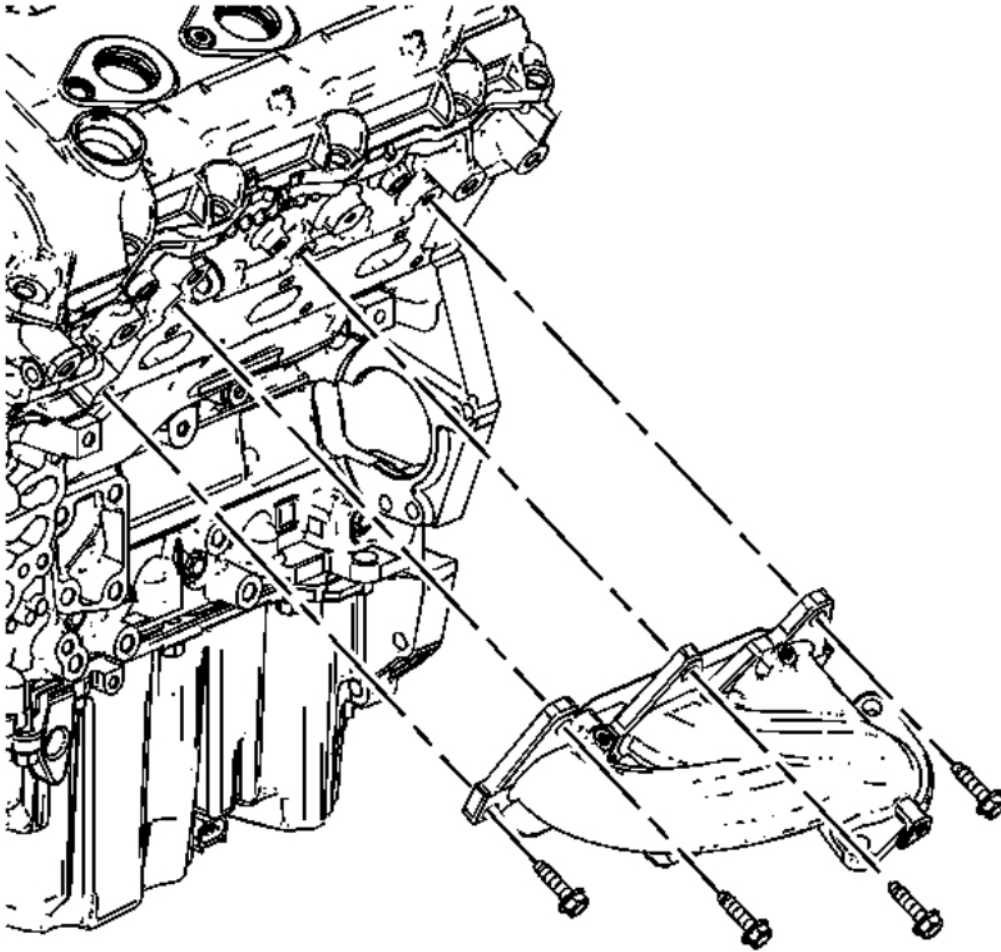


Fig. 331: View Of Left Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

8. Position a NEW exhaust manifold gasket onto the left exhaust manifold.
9. Install the exhaust manifold bolts into the left exhaust manifold.
10. Place the left exhaust manifold, exhaust manifold gasket and bolts as an assembly in position on the left cylinder head.
11. Install the exhaust manifold bolts into the left cylinder head.

Tighten: Tighten the exhaust manifold bolts to 25 N.m (18 lb ft).

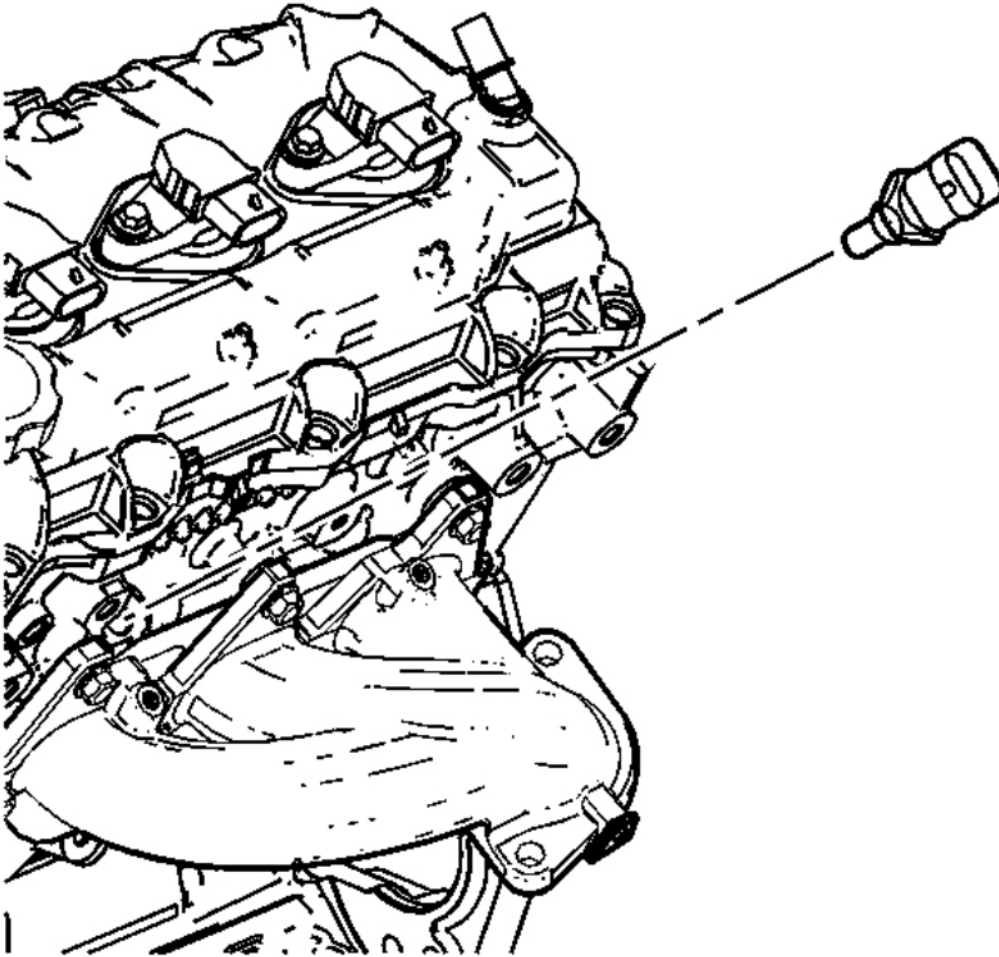


Fig. 332: View Of ECT Sensor
Courtesy of GENERAL MOTORS CORP.

12. Install the engine coolant temperature (ECT) sensor.

Tighten: Tighten the ECT sensor to 22 N.m (16 lb ft).

OIL LEVEL INDICATOR AND TUBE INSTALLATION

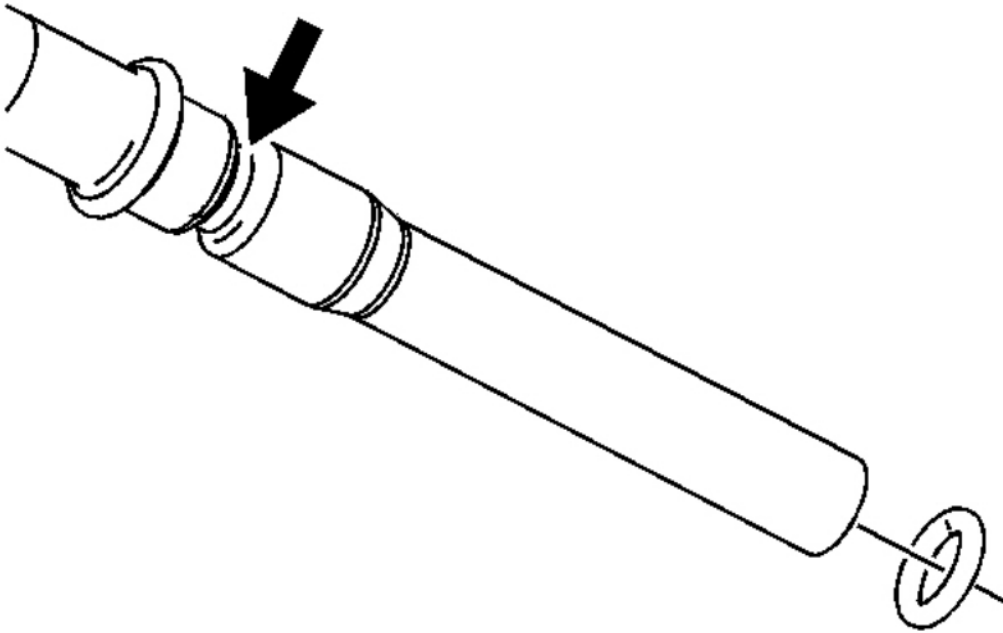


Fig. 333: View Of Oil Level Indicator Tube O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW O-ring on the oil level indicator tube.

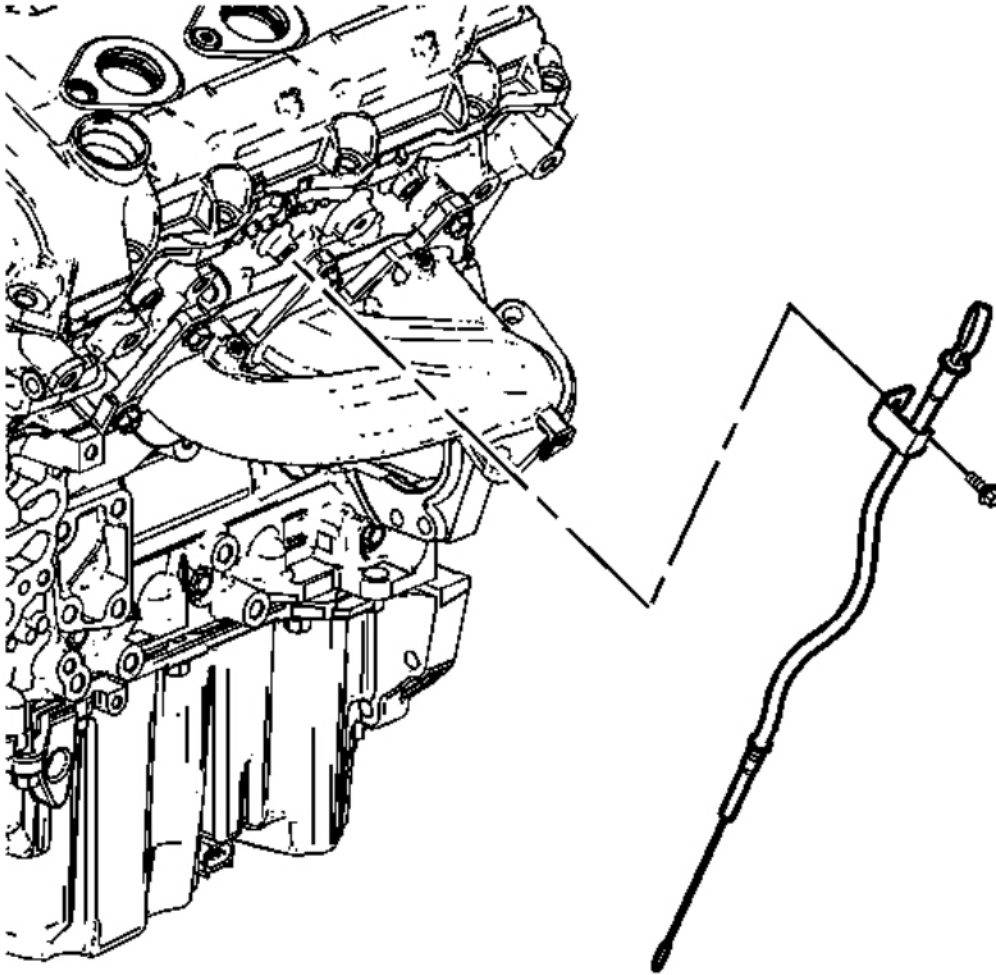


Fig. 334: View Of Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

2. Install the oil level indicator and tube by sliding the tube down through the lower crankcase hole.

NOTE: Refer to **Fastener Notice** in Cautions and Notices.

3. Install the oil level indicator tube bracket bolt.

Tighten: Tighten the oil level indicator tube bracket bolt to 10 N.m (89 lb in).

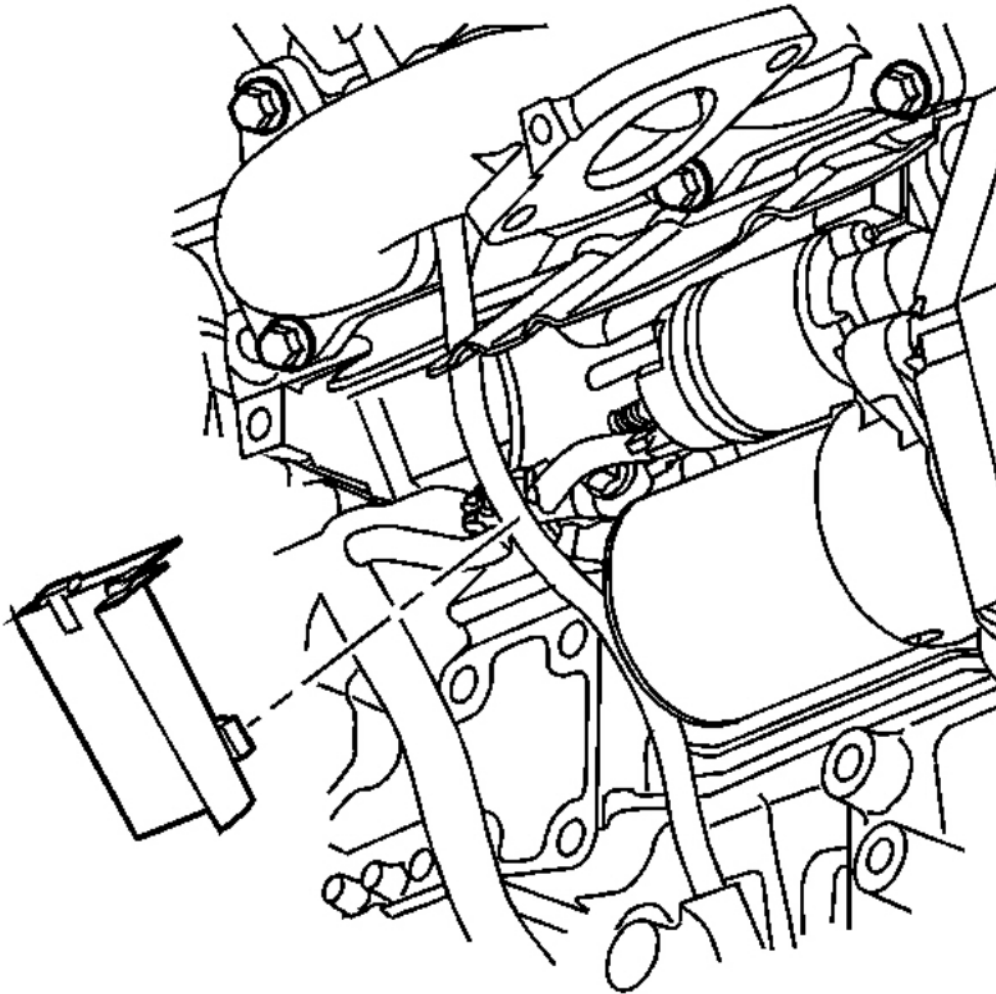


Fig. 335: View Of Left Exhaust Manifold Lower Insulator
Courtesy of GENERAL MOTORS CORP.

4. Install the left exhaust manifold lower insulator onto the oil level indicator tube.

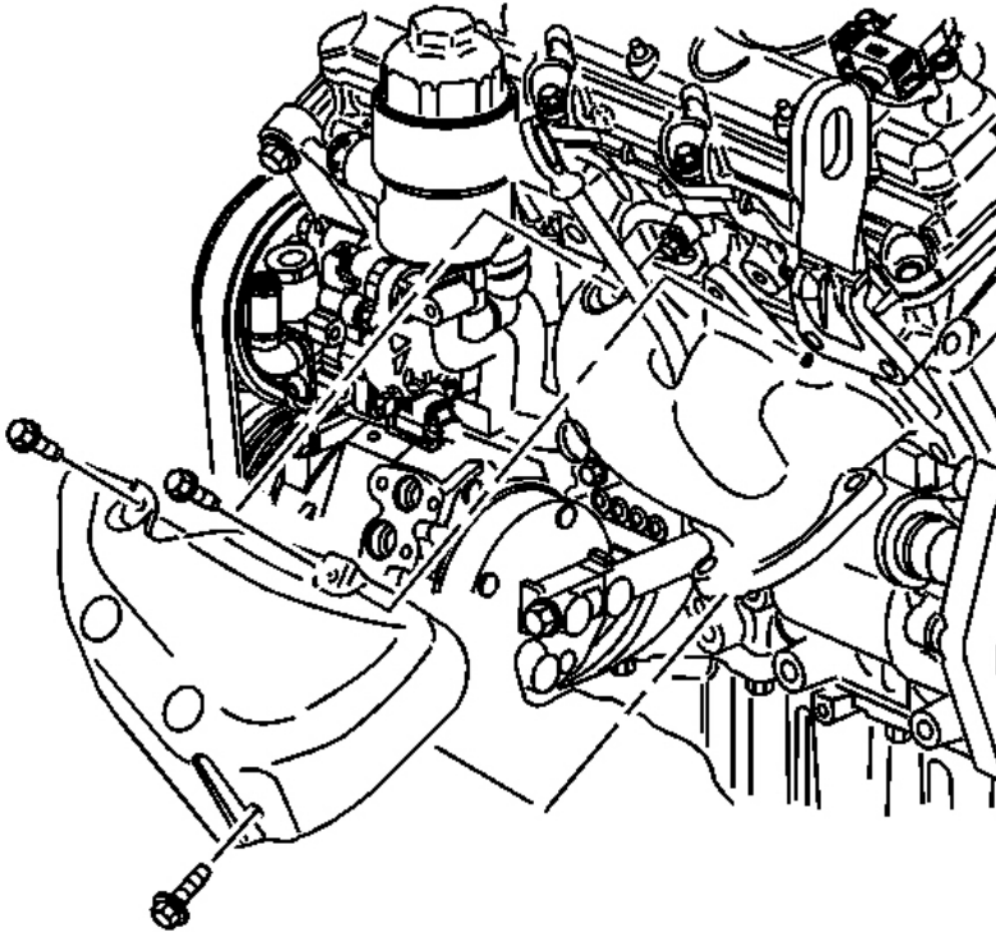


Fig. 336: View Of Left Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

5. Place the left exhaust manifold heat shield in position.
6. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

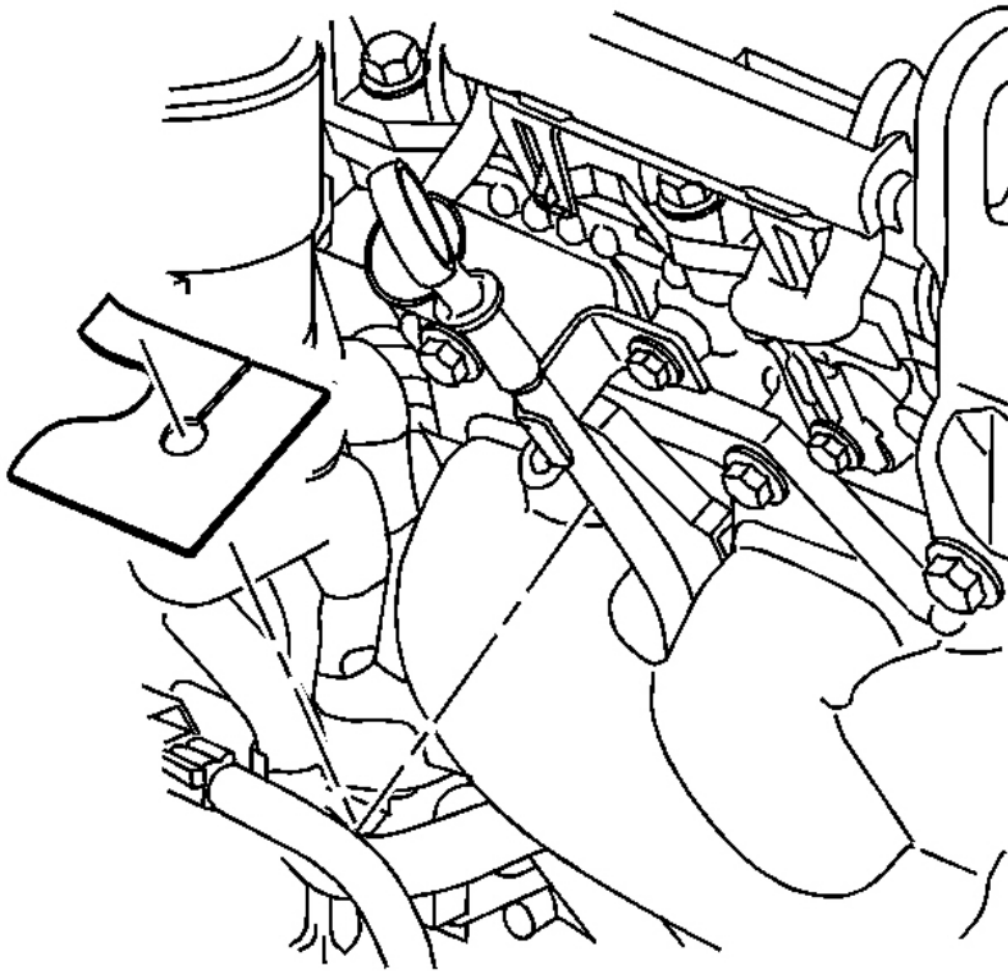


Fig. 337: View Of Left Exhaust Manifold Upper Insulator
Courtesy of GENERAL MOTORS CORP.

7. Install the left exhaust manifold upper insulator onto the oil level indicator tube.

EXHAUST MANIFOLD INSTALLATION - RIGHT (RWD)

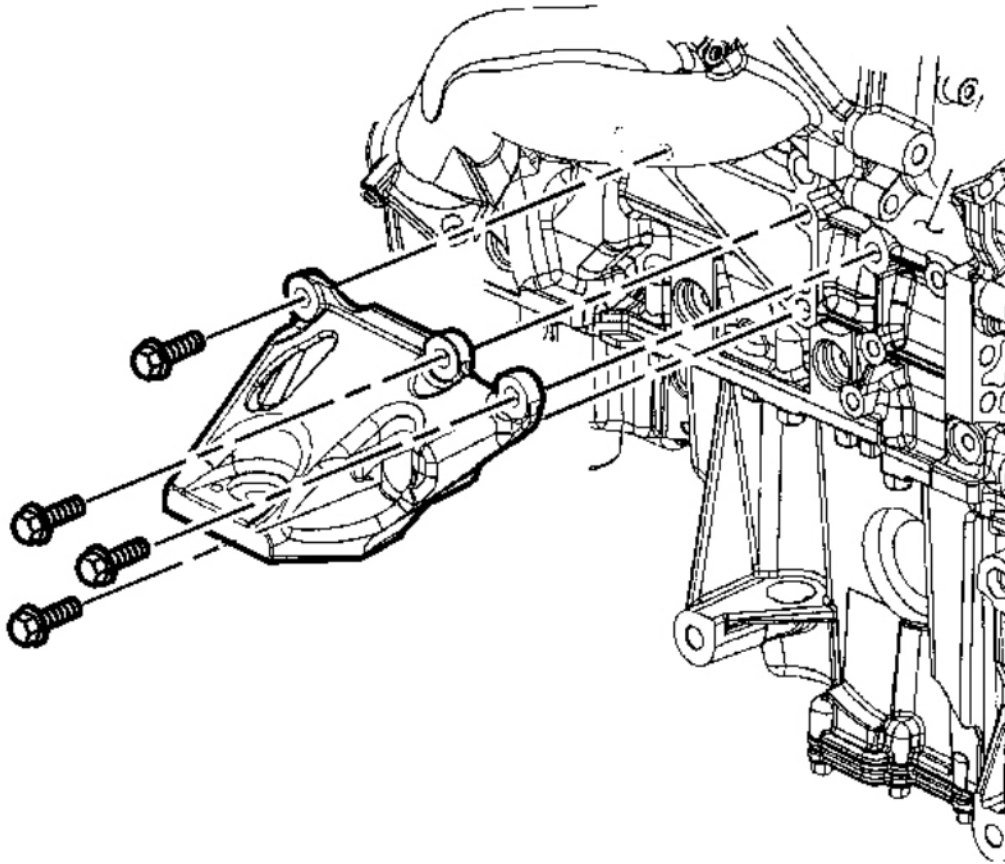


Fig. 338: View Of Right Engine Mount Bracket - RWD
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the engine mount bracket bolts.

Tighten: Tighten the engine mount bracket bolts to 60 N.m (44 lb ft).

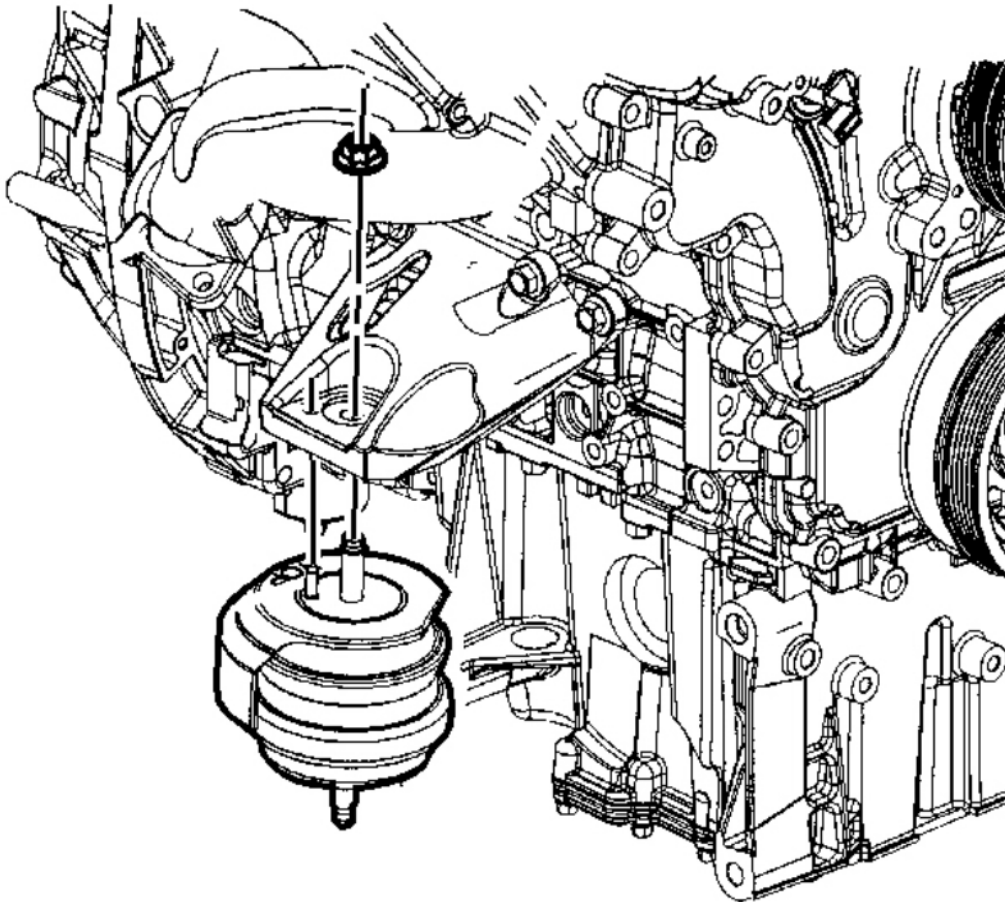


Fig. 339: View Of Right Engine Mount - RWD
Courtesy of GENERAL MOTORS CORP.

3. Install the engine mount.
4. Install the engine mount nut.

Tighten: Tighten the engine mount nut to 80 N.m (59 lb ft).

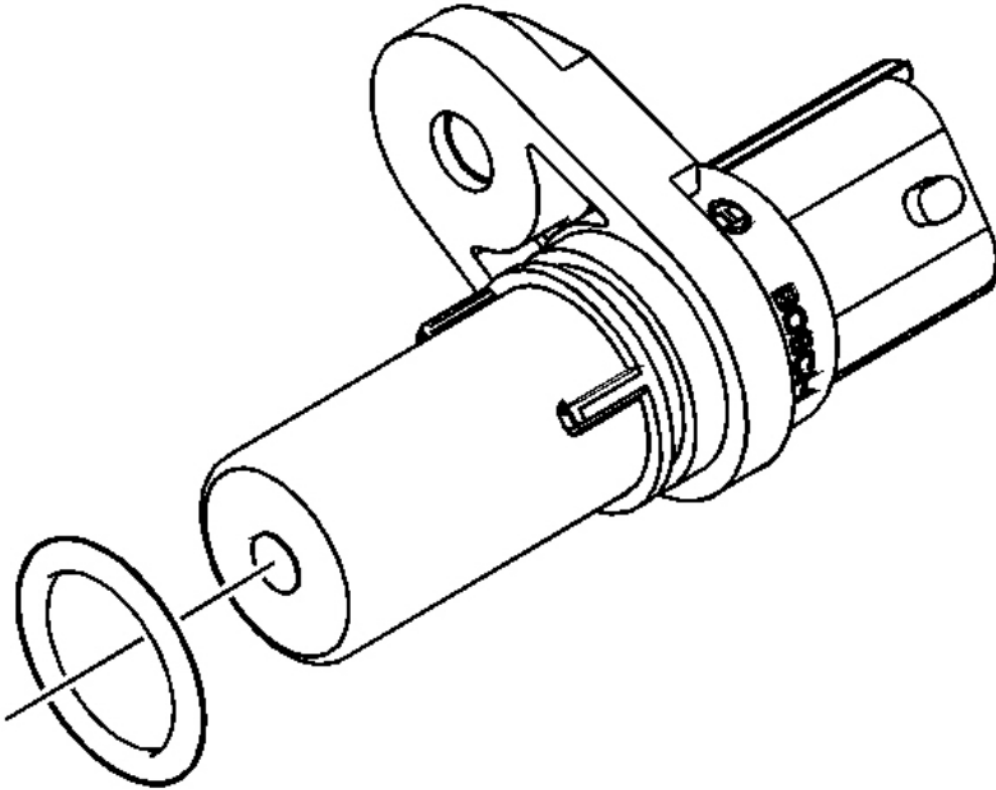


Fig. 340: View Of Crankshaft Position Sensor O-Ring
Courtesy of GENERAL MOTORS CORP.

5. Install the NEW O-ring on the crankshaft position sensor, if damaged.

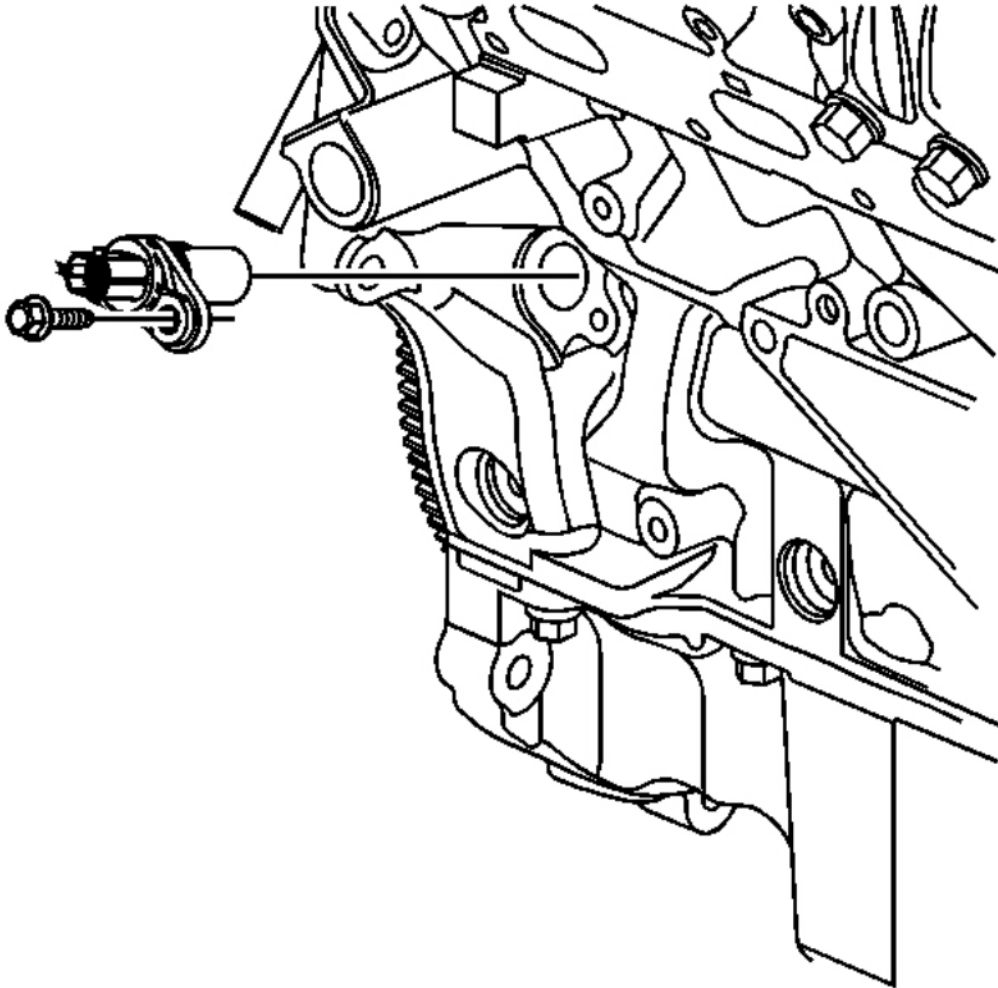


Fig. 341: View Of Crankshaft Position Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Position the crankshaft position sensor into the cylinder block.
7. Install the crankshaft position sensor bolt.

Tighten: Tighten the crankshaft position sensor bolt to 10 N.m (89 lb in).

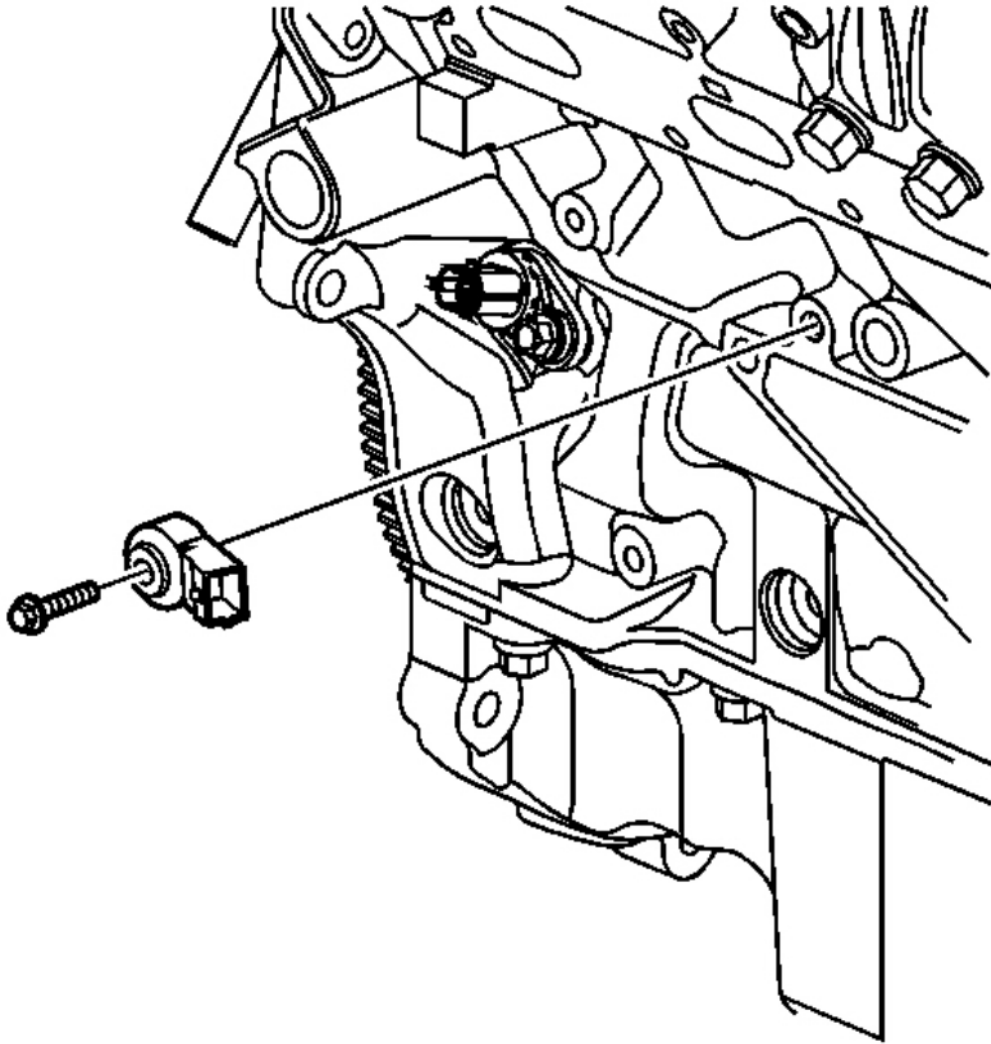


Fig. 342: View Of Right Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Position the right knock sensor to the cylinder block as shown.
9. Install the knock sensor bolt.

Tighten: Tighten the knock sensor bolt to 23 N.m (17 lb ft).

10. Ensure proper knock sensor orientation.

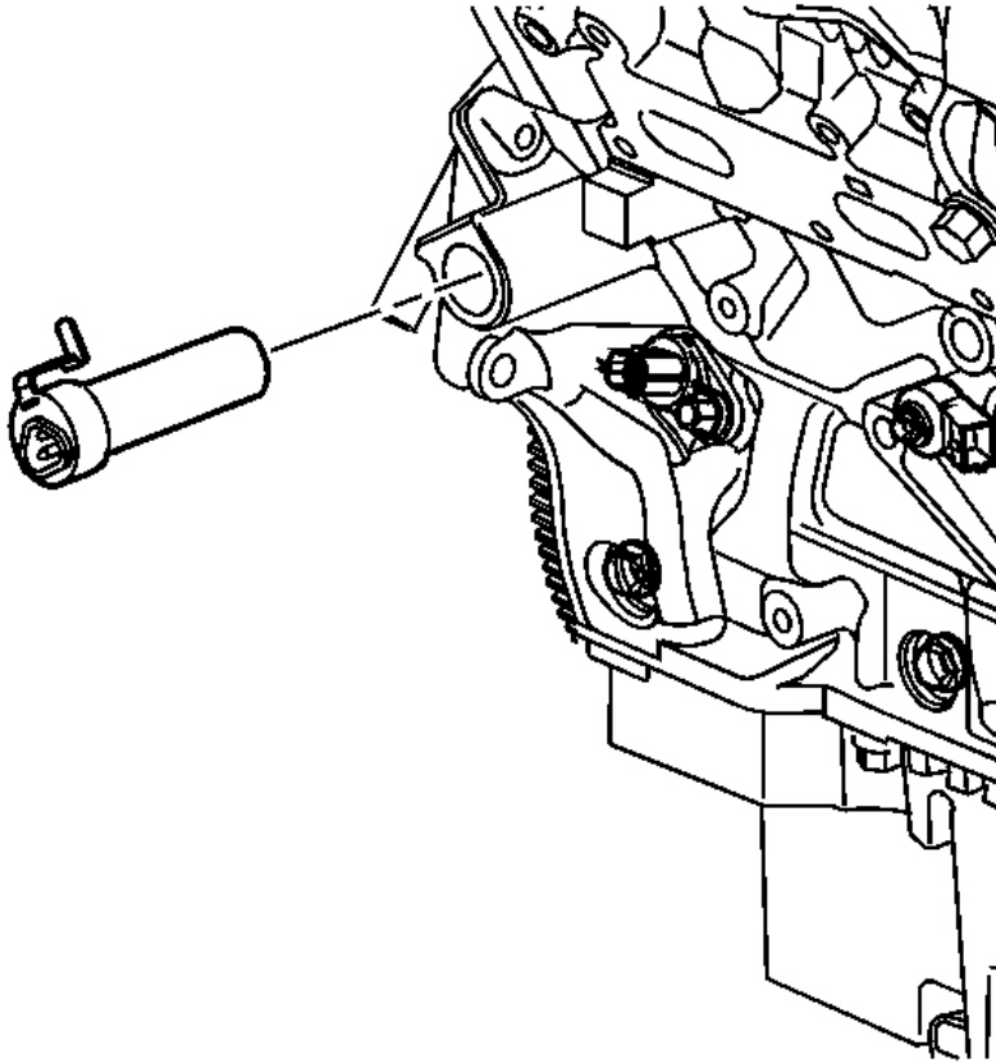


Fig. 343: View Of Block Heater Cartridge
Courtesy of GENERAL MOTORS CORP.

11. Install the block heater cartridge, if equipped.

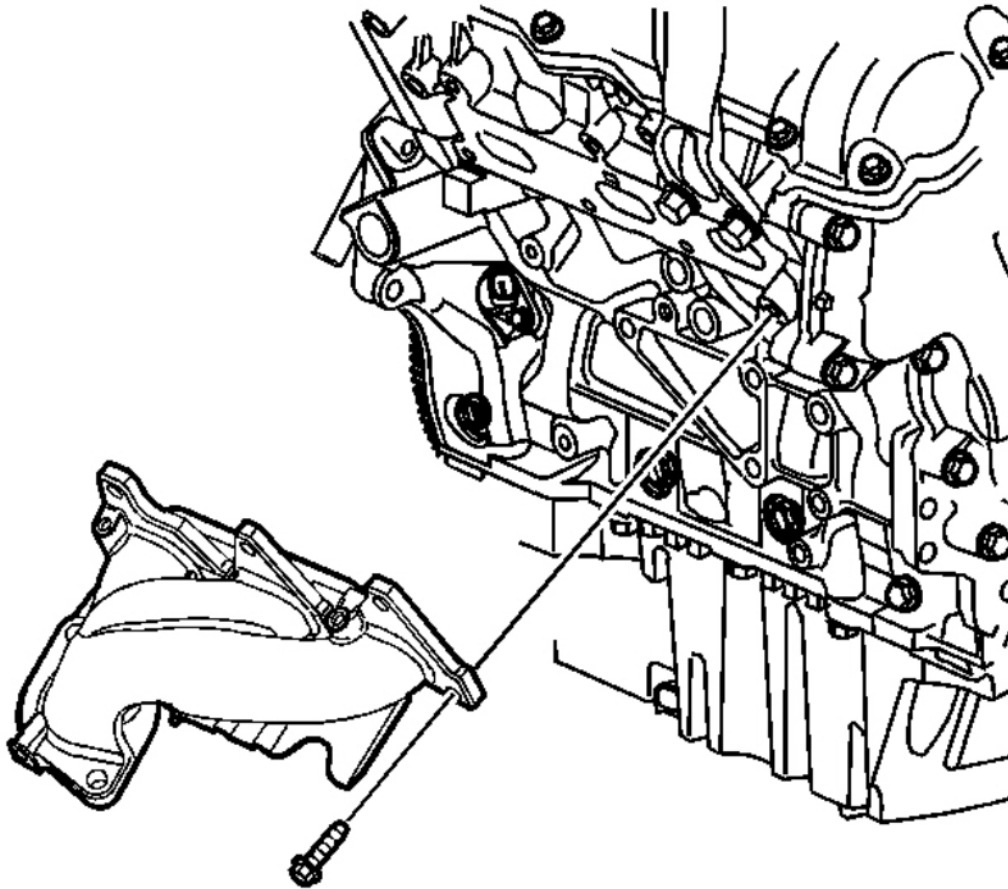


Fig. 344: Removing & Installing Right Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

12. Position a NEW exhaust manifold gasket onto the right exhaust manifold.
13. Install the exhaust manifold bolts into the right exhaust manifold.
14. Place the right exhaust manifold, exhaust manifold gasket and bolts as an assembly in position on the right cylinder head.
15. Install the exhaust manifold bolts into the right cylinder head.

Tighten: Tighten the exhaust manifold bolts to 25 N.m (18 lb ft).

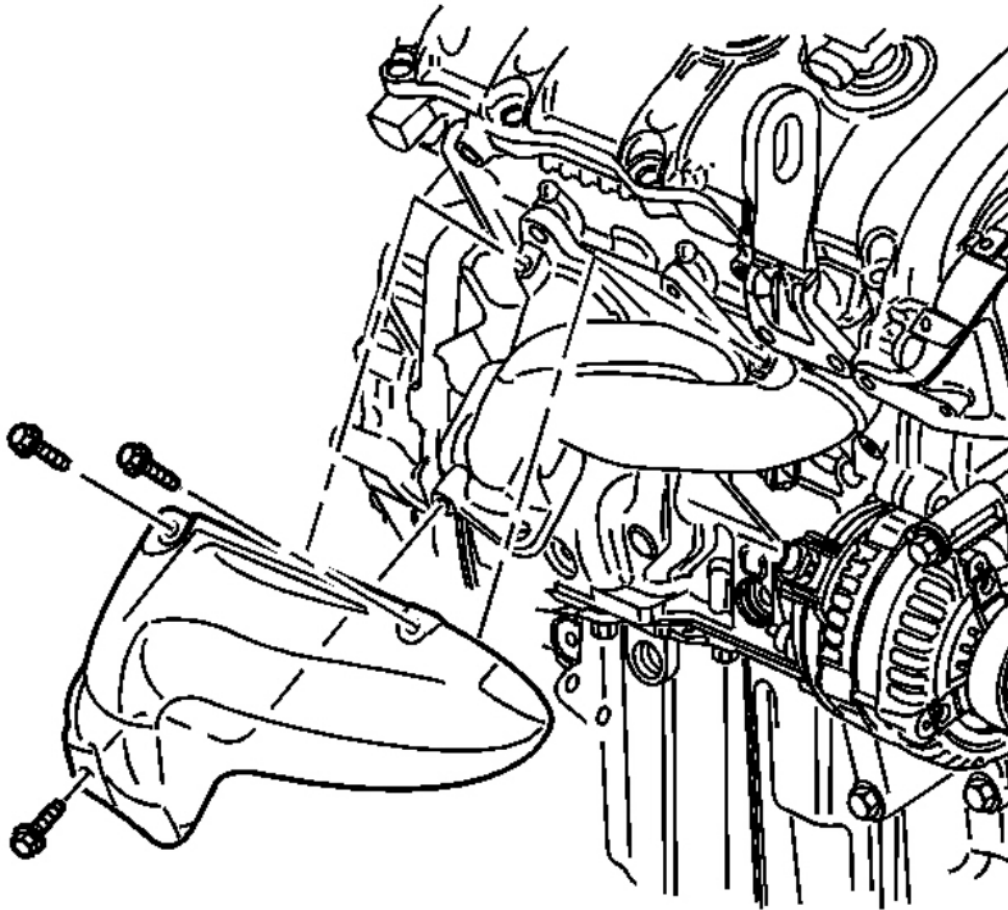


Fig. 345: View Of Right Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

16. Place the right exhaust manifold heat shield in position.
17. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

EXHAUST MANIFOLD INSTALLATION - RIGHT (AWD)

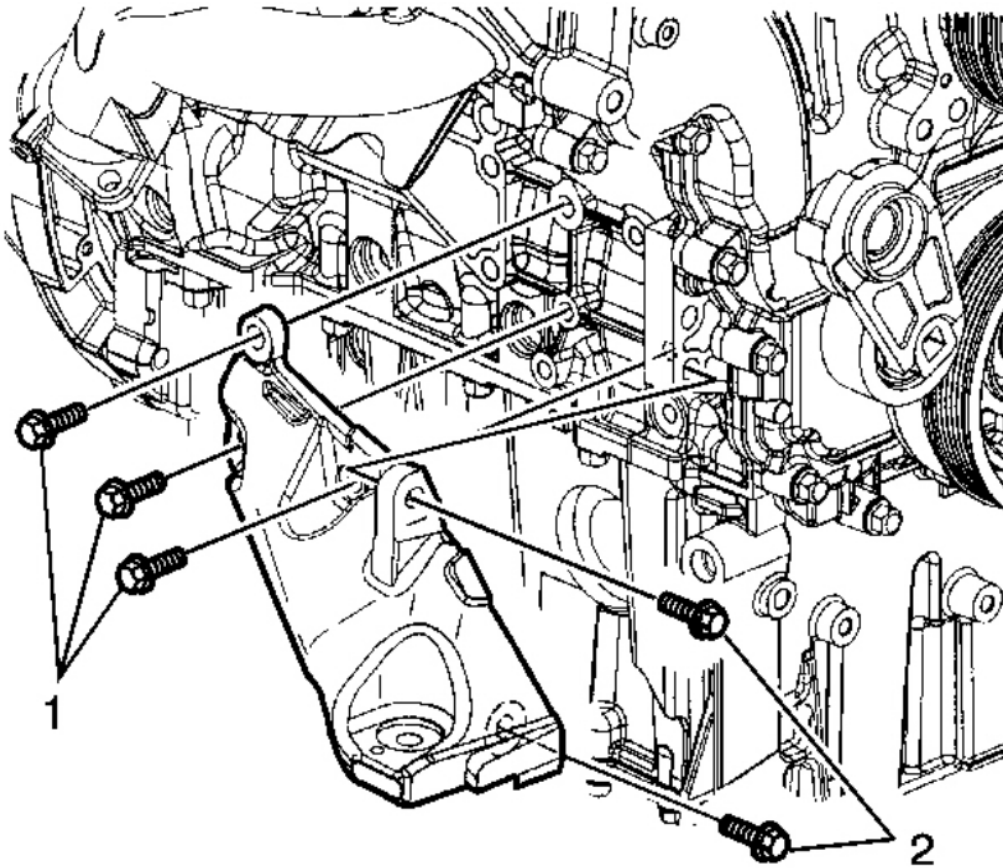


Fig. 346: Installing Right Engine Mount Bracket - AWD
Courtesy of GENERAL MOTORS CORP.

1. Install the engine mount bracket.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the engine mount bracket bolts.

Tighten:

- Tighten the M10 engine mount bracket bolts (1) to 60 N.m (44 lb ft).
- Tighten the M8 engine mount bracket bolts (2) to 38 N.m (28 lb ft).

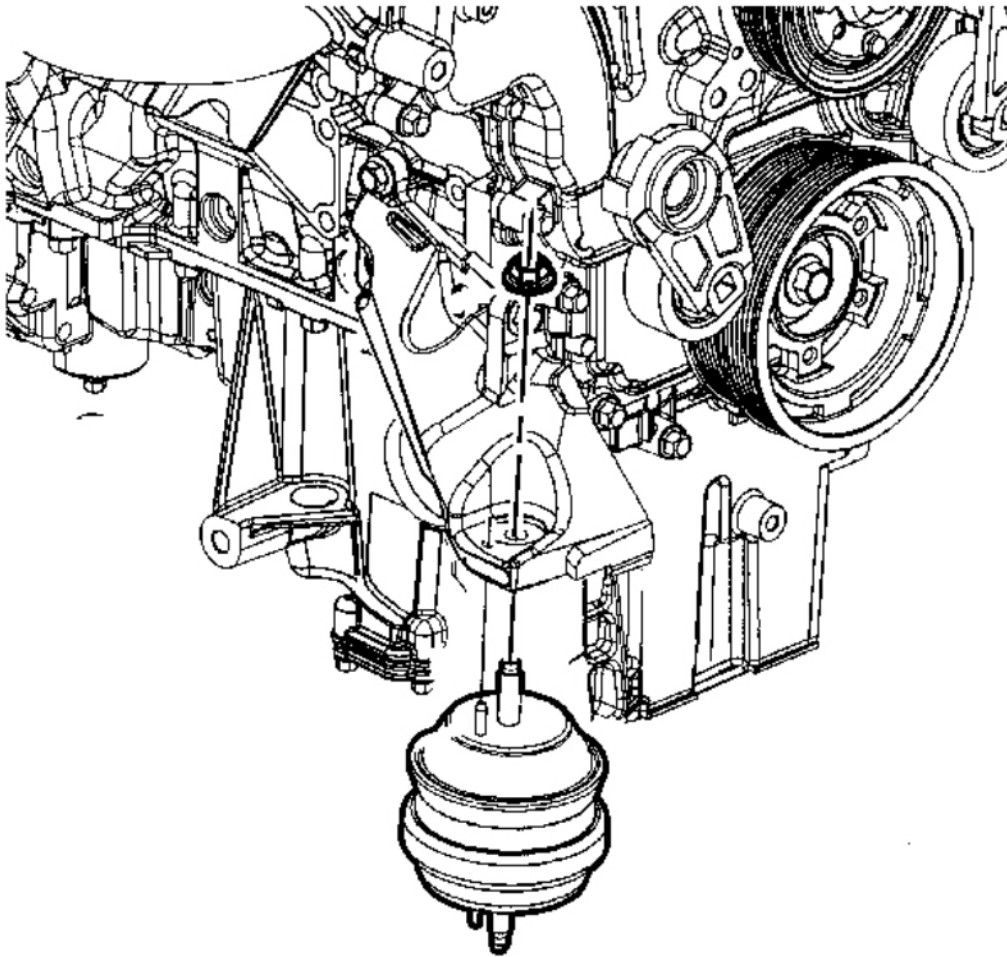


Fig. 347: View Of Right Engine Mount - AWD
Courtesy of GENERAL MOTORS CORP.

3. Install the engine mount.
4. Install the engine mount nut.

Tighten: Tighten the engine mount nut to 80 N.m (59 lb ft).

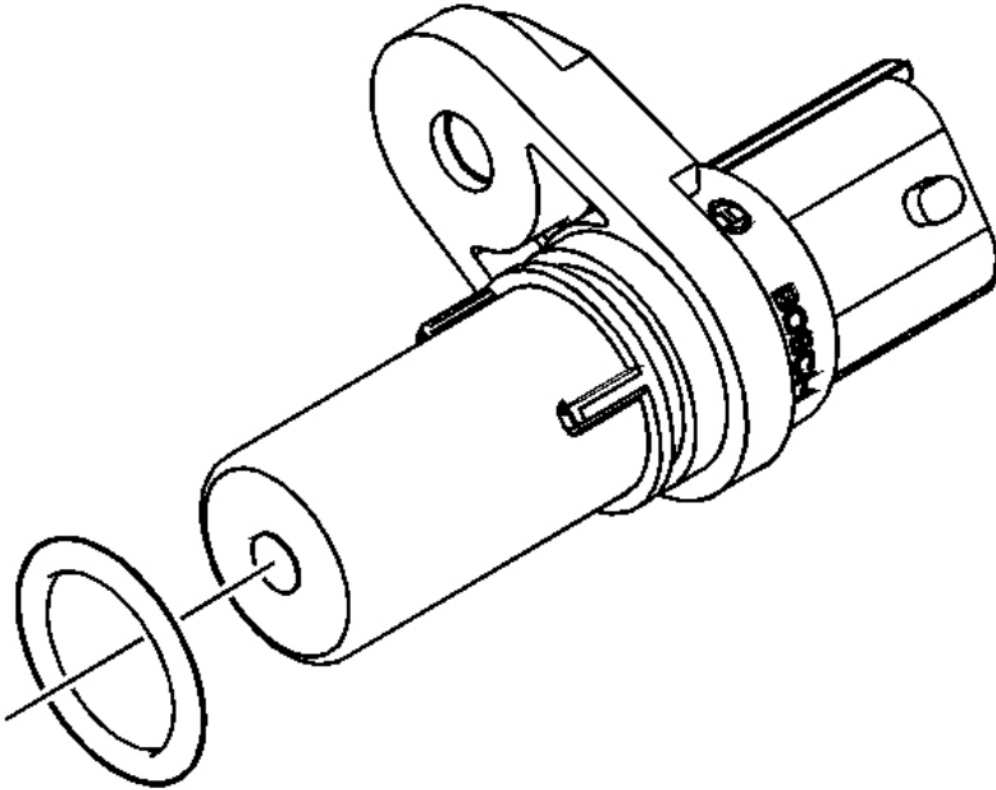


Fig. 348: View Of Crankshaft Position Sensor O-Ring
Courtesy of GENERAL MOTORS CORP.

5. Install the NEW O-ring on the crankshaft position sensor, if damaged.

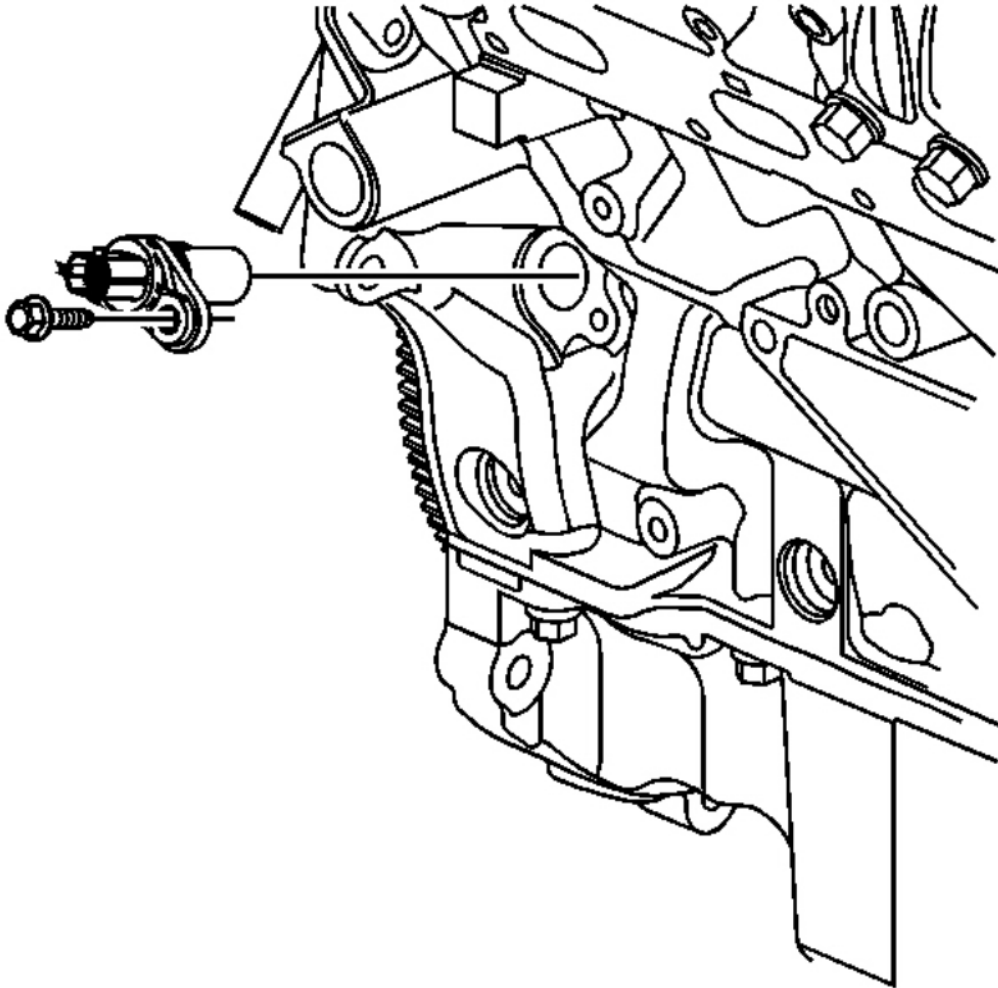


Fig. 349: View Of Crankshaft Position Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Position the crankshaft position sensor into the cylinder block.
7. Install the crankshaft position sensor bolt.

Tighten: Tighten the crankshaft position sensor bolt to 10 N.m (89 lb in).

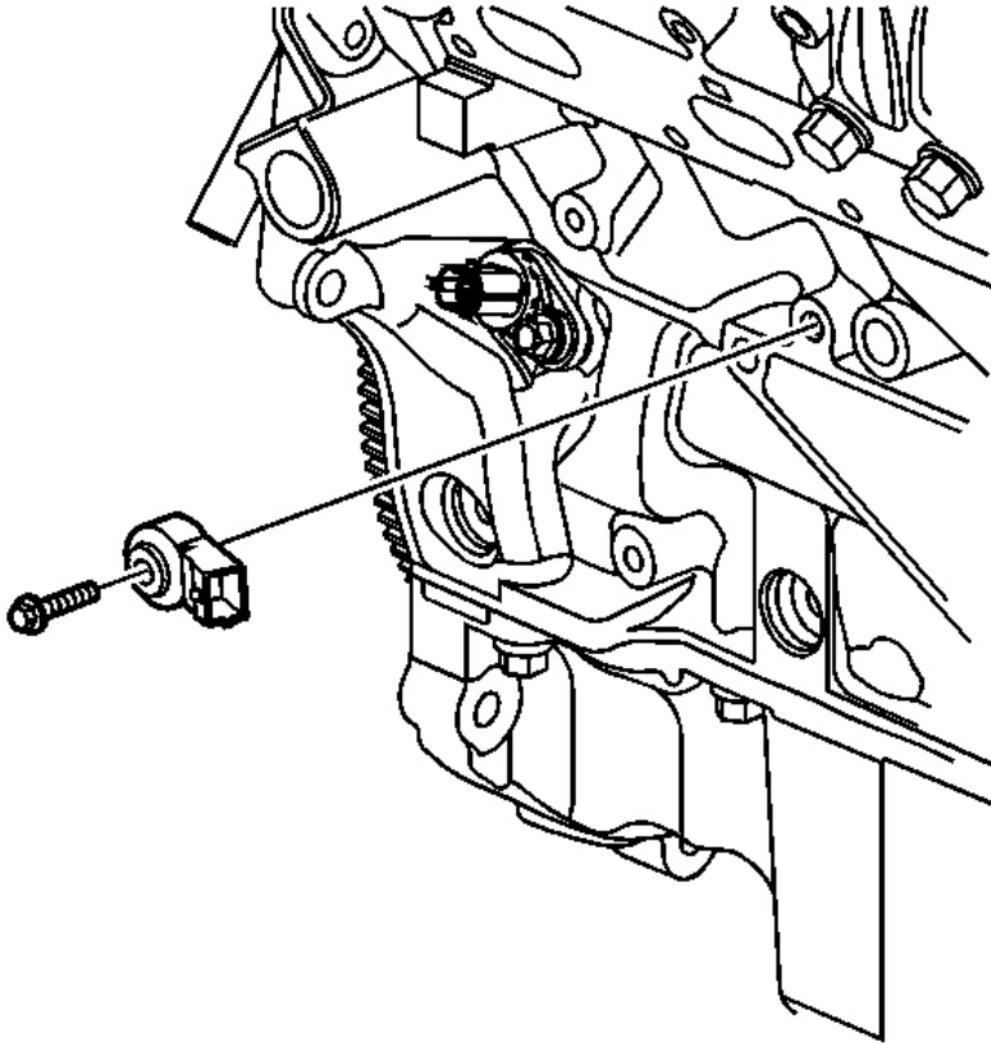


Fig. 350: View Of Right Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Position the right knock sensor to the cylinder block as shown.
9. Install the knock sensor bolt.

Tighten: Tighten the knock sensor bolt to 23 N.m (17 lb ft).

10. Ensure proper knock sensor orientation.

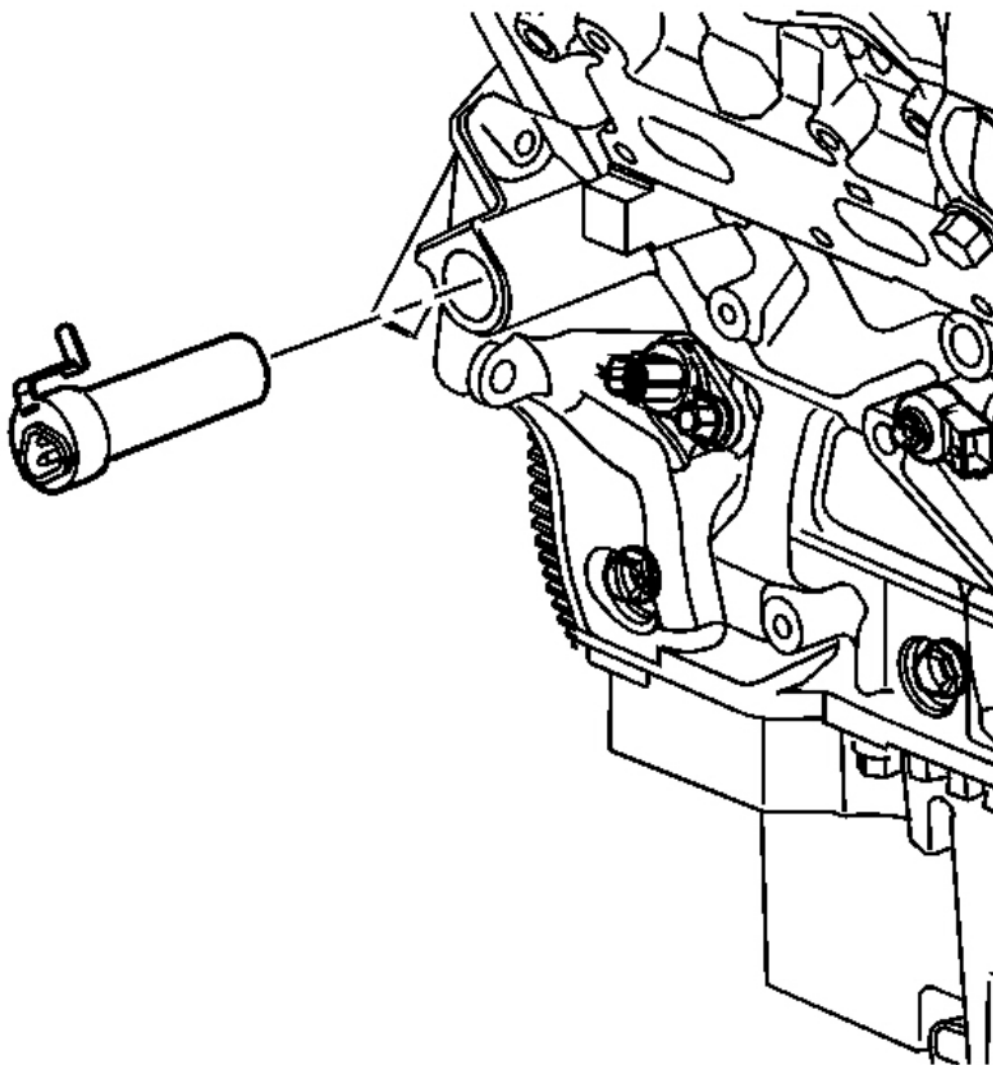


Fig. 351: View Of Block Heater Cartridge
Courtesy of GENERAL MOTORS CORP.

11. Install the block heater cartridge, if equipped.

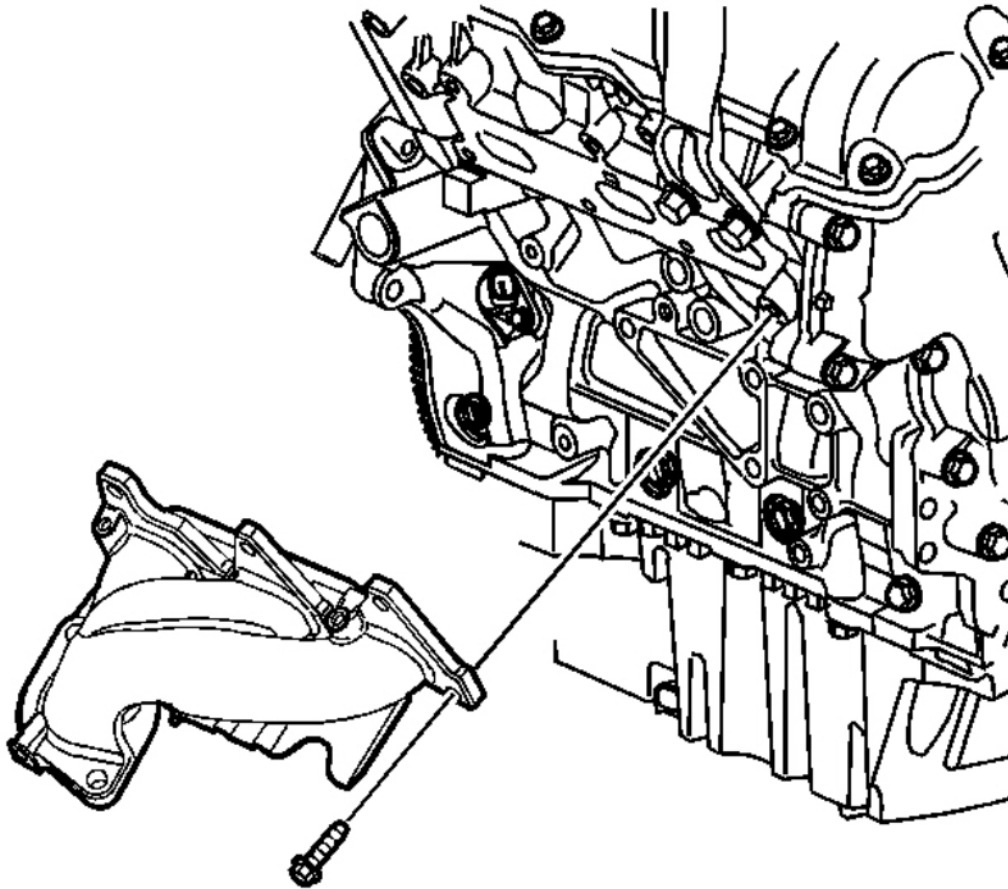


Fig. 352: Removing & Installing Right Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

12. Position a NEW exhaust manifold gasket onto the right exhaust manifold.
13. Install the exhaust manifold bolts into the right exhaust manifold.
14. Place the right exhaust manifold, exhaust manifold gasket and bolts as an assembly in position on the right cylinder head.
15. Install the exhaust manifold bolts into the right cylinder head.

Tighten: Tighten the exhaust manifold bolts to 25 N.m (18 lb ft).

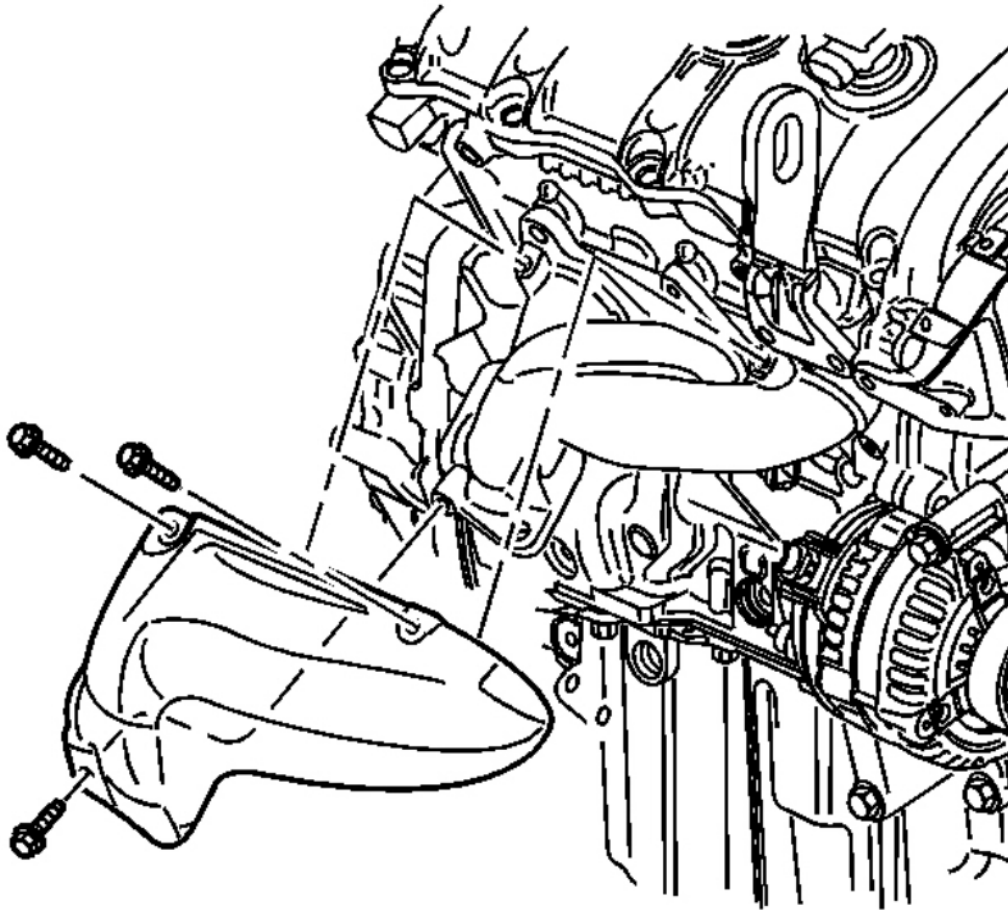


Fig. 353: View Of Right Exhaust Manifold Heat Shield
Courtesy of GENERAL MOTORS CORP.

16. Place the right exhaust manifold heat shield in position.
17. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).