

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 4.6L (LH2) (Repair Instructions, 4 Of 5) - SRX

2004 ENGINE

Engine Mechanical - 4.6L (LH2) (Repair Instructions, 4 Of 5) - SRX

REPAIR INSTRUCTIONS

WATER PUMP CLEANING AND INSPECTION

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.**

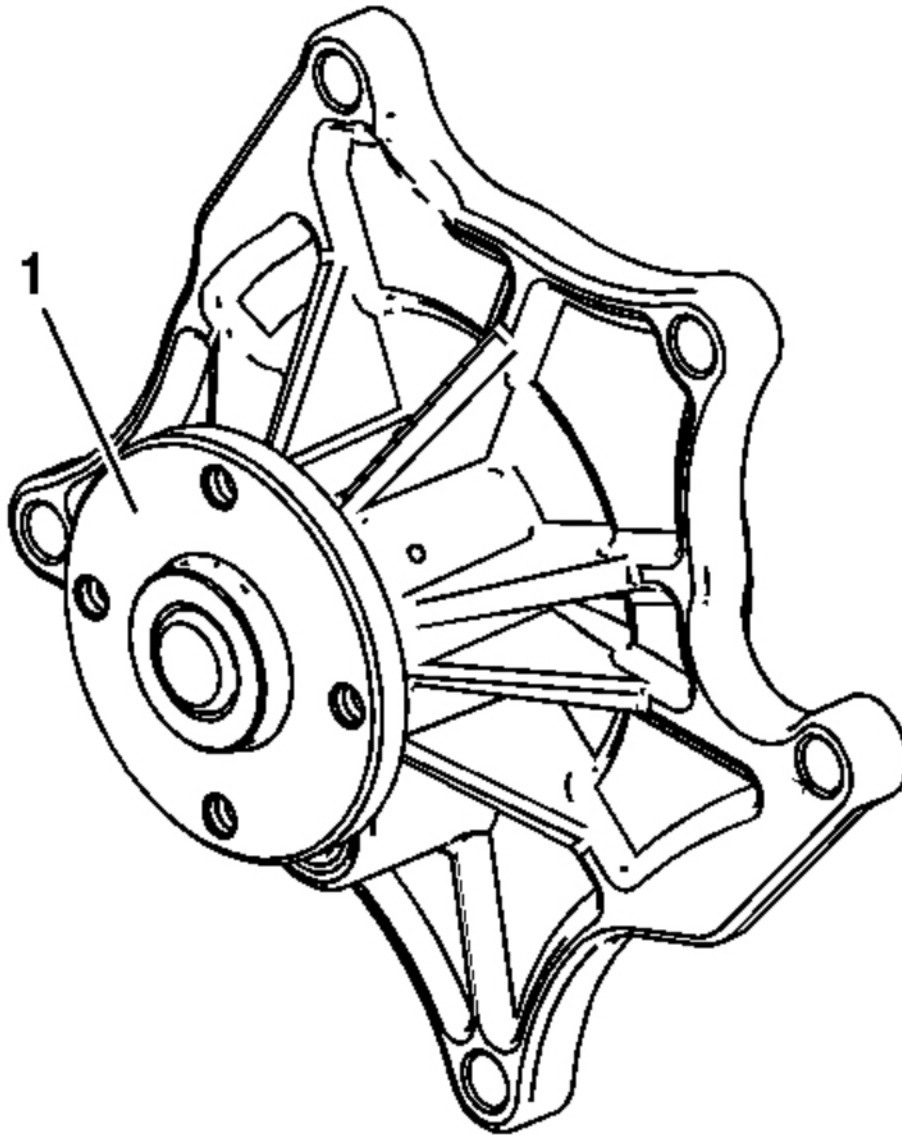


Fig. 1: Locating Water Pump Hub
Courtesy of GENERAL MOTORS CORP.

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 "lumpy" when turned, replace the water pump.

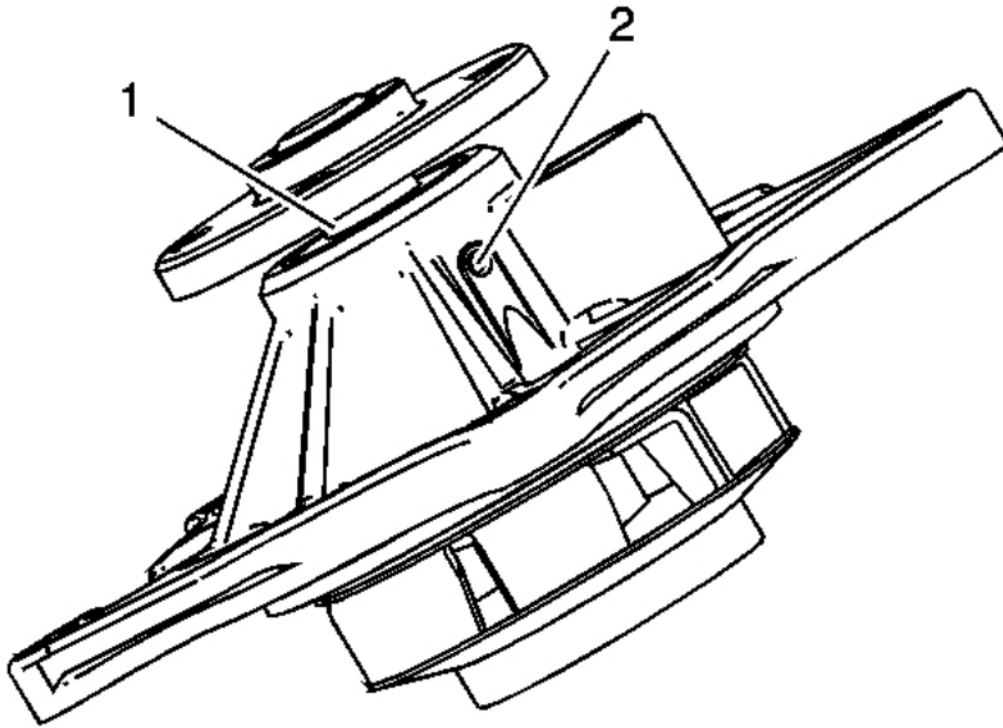


Fig. 2: Locating Water Pump Shaft & Weep Hole
Courtesy of GENERAL MOTORS CORP.

2. 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.

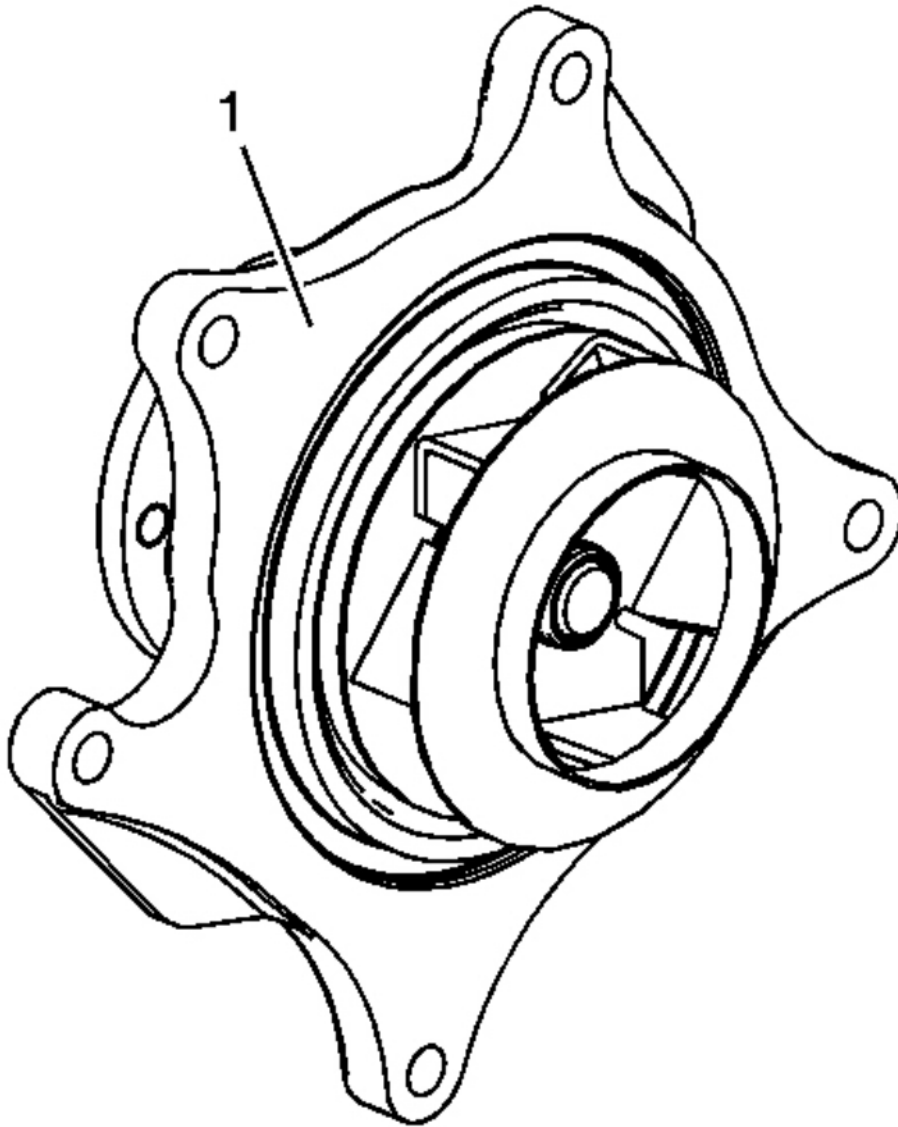


Fig. 3: Identifying Water Pump Sealing Surface
Courtesy of GENERAL MOTORS CORP.

3. Examine the water pump sealing surface (1) for imperfections. If imperfections cannot be repaired, replace the water pump.

ENGINE FRONT COVER ASSEMBLE

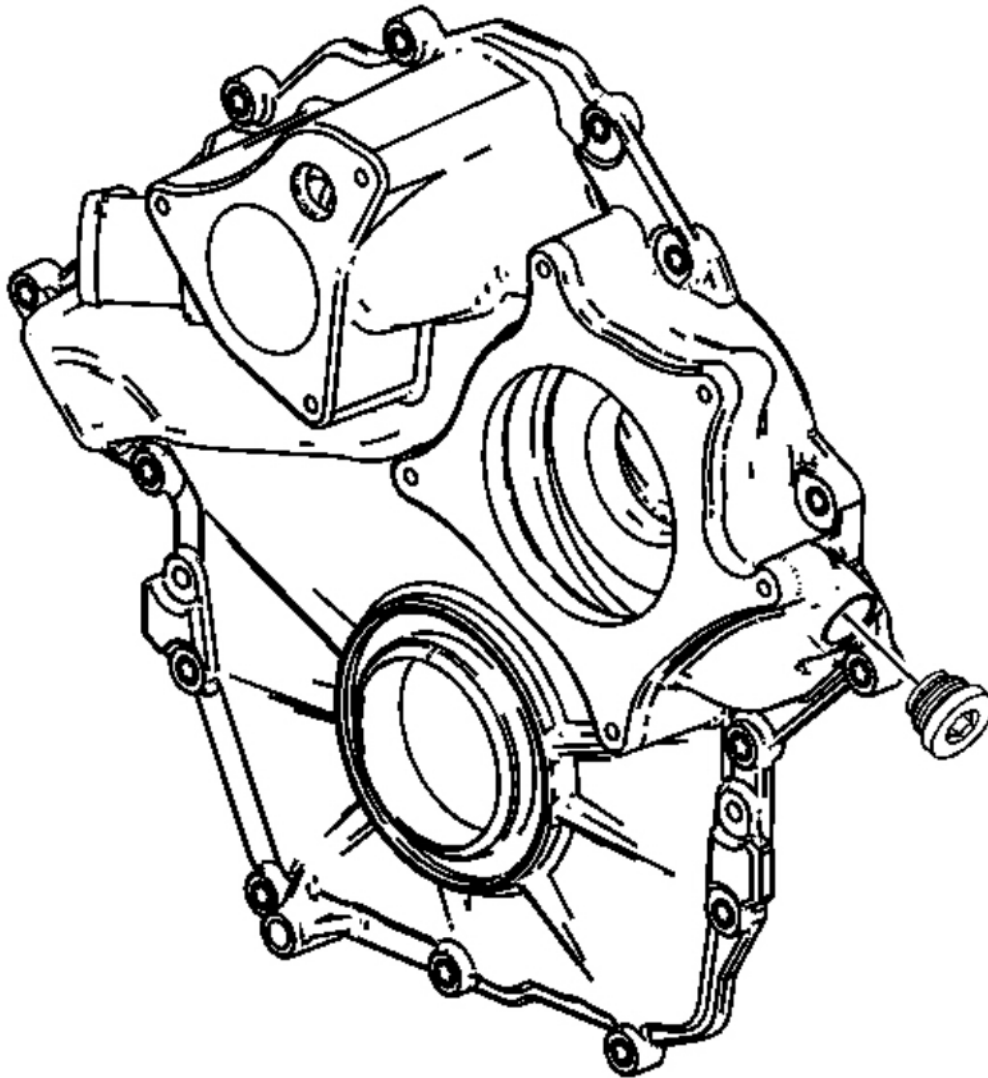


Fig. 4: View Of Engine Front Cover Fitting
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the engine front cover fitting.

Tighten: Tighten the engine front cover fitting to 25 N.m (18 lb ft).

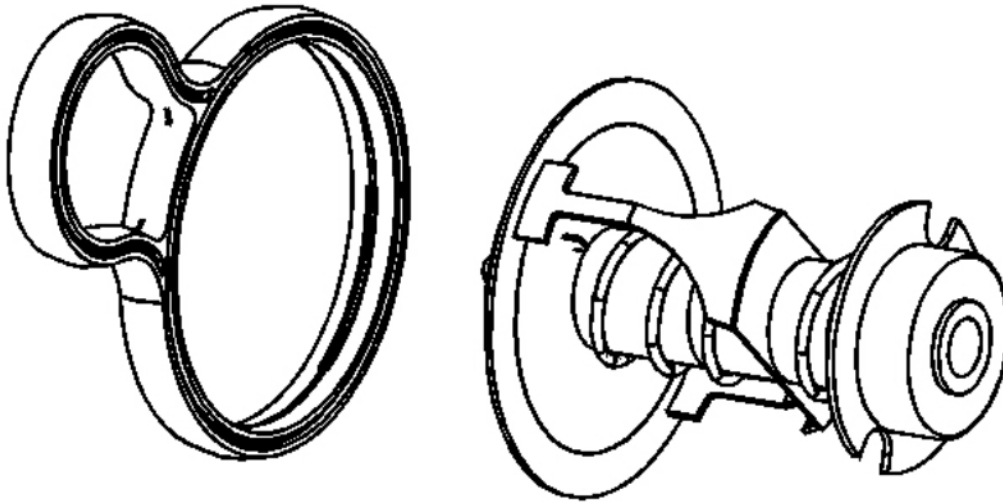


Fig. 5: View Of Thermostat Gasket
Courtesy of GENERAL MOTORS CORP.

2. Install the NEW thermostat gasket onto the thermostat.

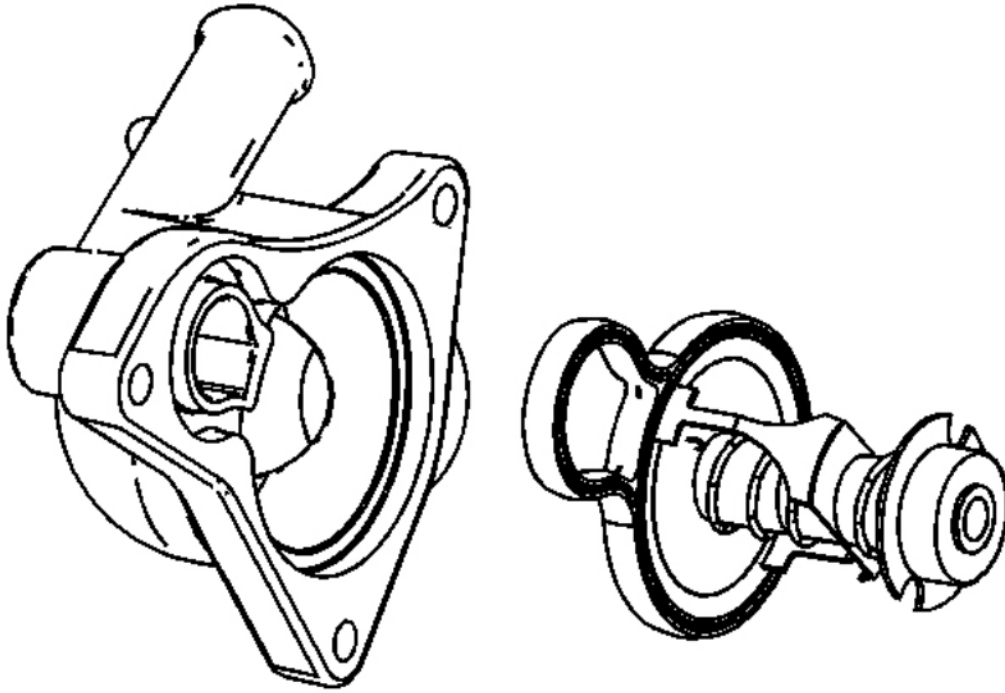


Fig. 6: View Of Thermostat

Courtesy of GENERAL MOTORS CORP.

3. Install the thermostat and gasket into the thermostat housing.

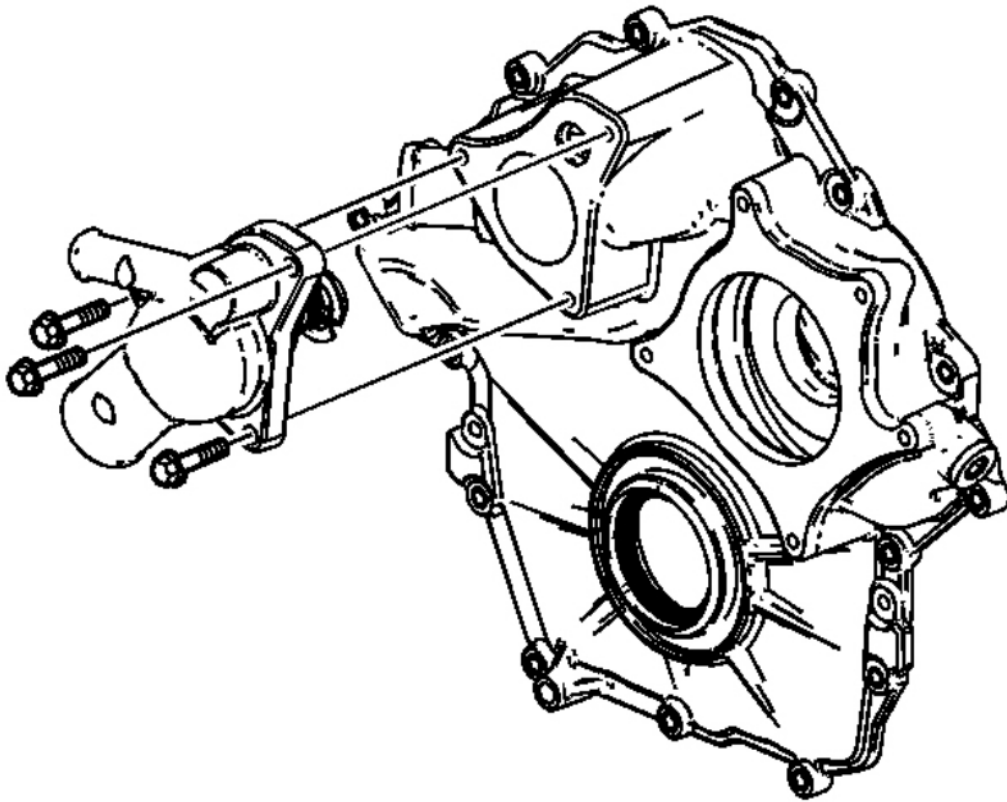


Fig. 7: View Of Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

4. Install the thermostat housing.
5. Install the thermostat housing bolts.

Tighten: Tighten the thermostat housing bolts to 10 N.m (89 lb in).

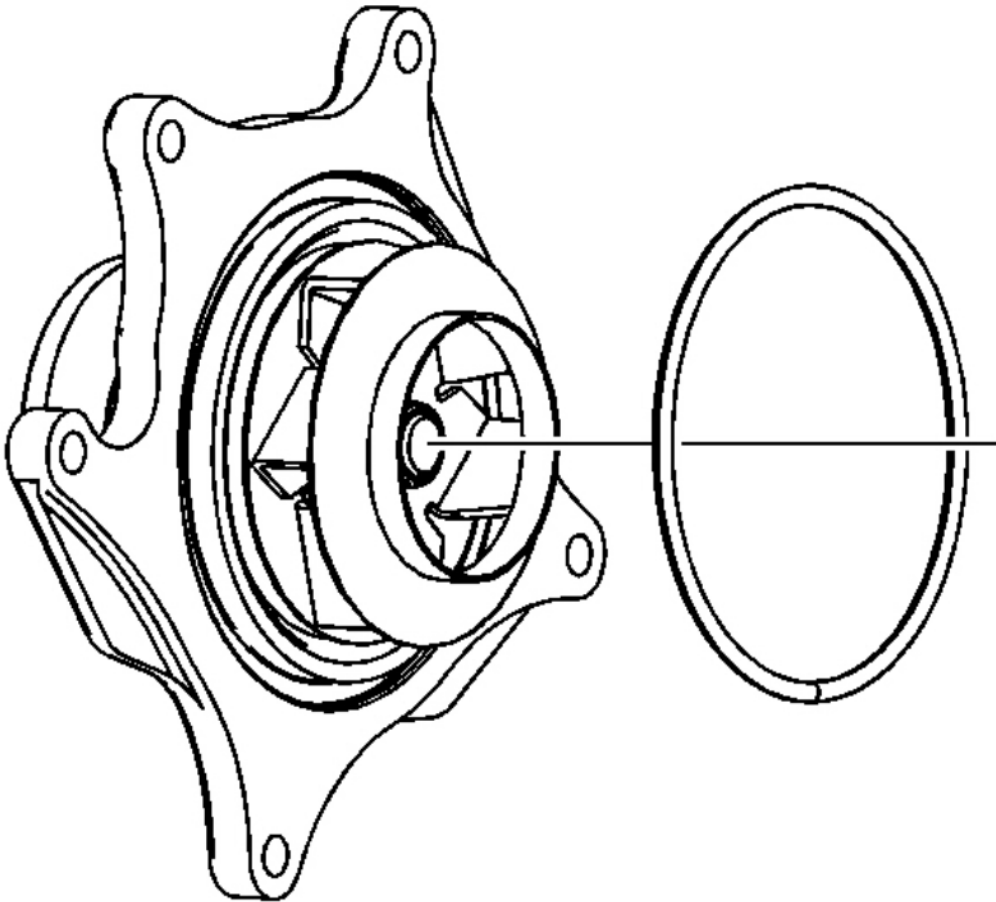


Fig. 8: View Of Water Pump O-Ring
Courtesy of GENERAL MOTORS CORP.

6. Install the NEW water pump O-ring.

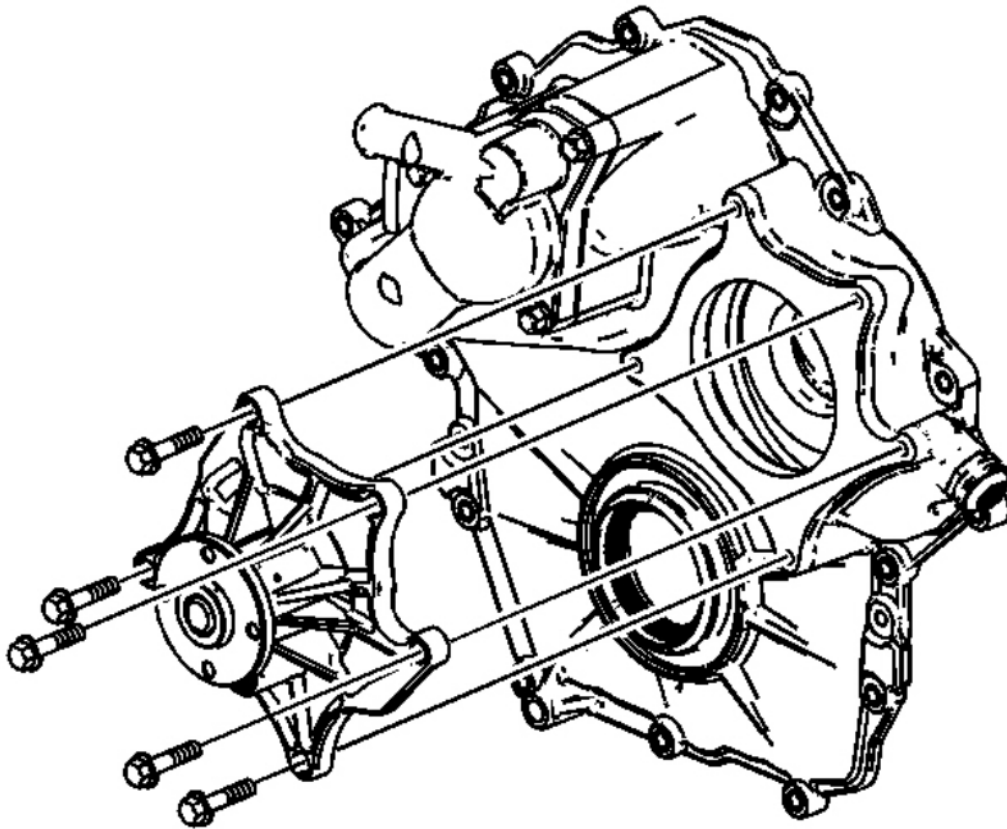


Fig. 9: View Of Water Pump
Courtesy of GENERAL MOTORS CORP.

7. Install the water pump.
8. Install the water pump bolts.

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

CAMSHAFT COVER DISASSEMBLE

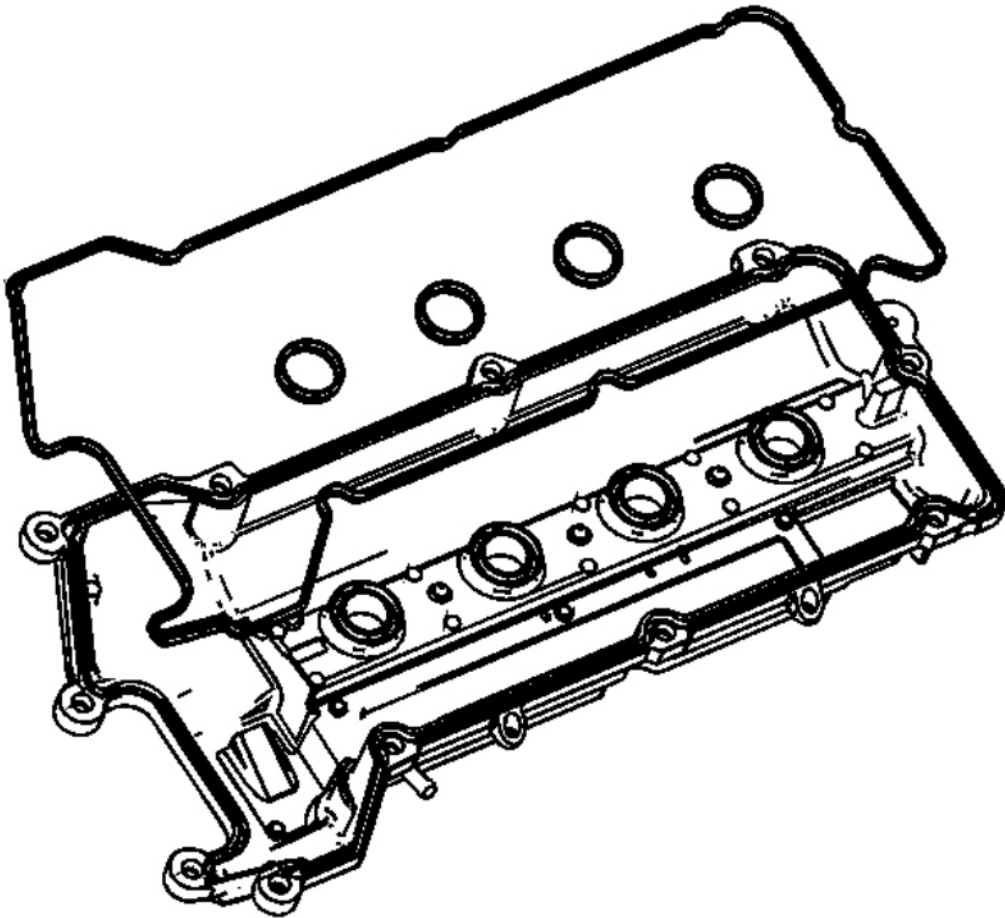


Fig. 10: View Of Left Camshaft Cover Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the left camshaft cover gasket and discard.
2. Remove the left spark plug port seals and discard.

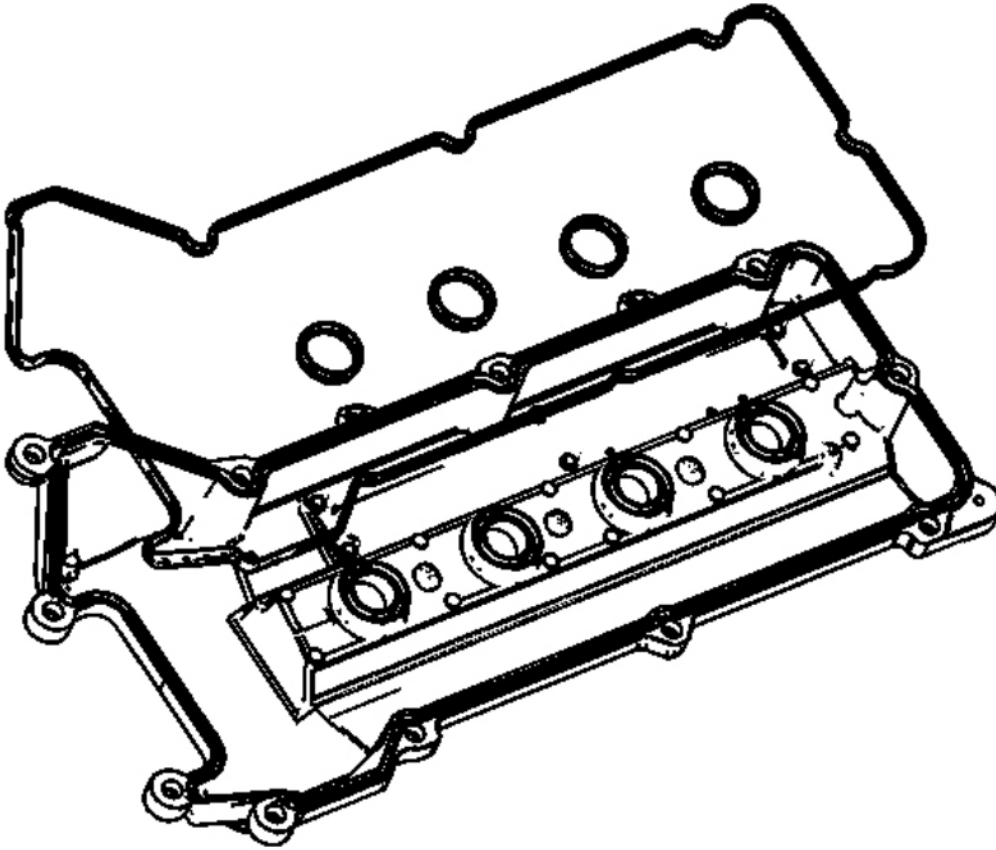


Fig. 11: View Of Right Camshaft Cover Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the right camshaft cover gasket and discard.
4. Remove the right spark plug port seals and discard.

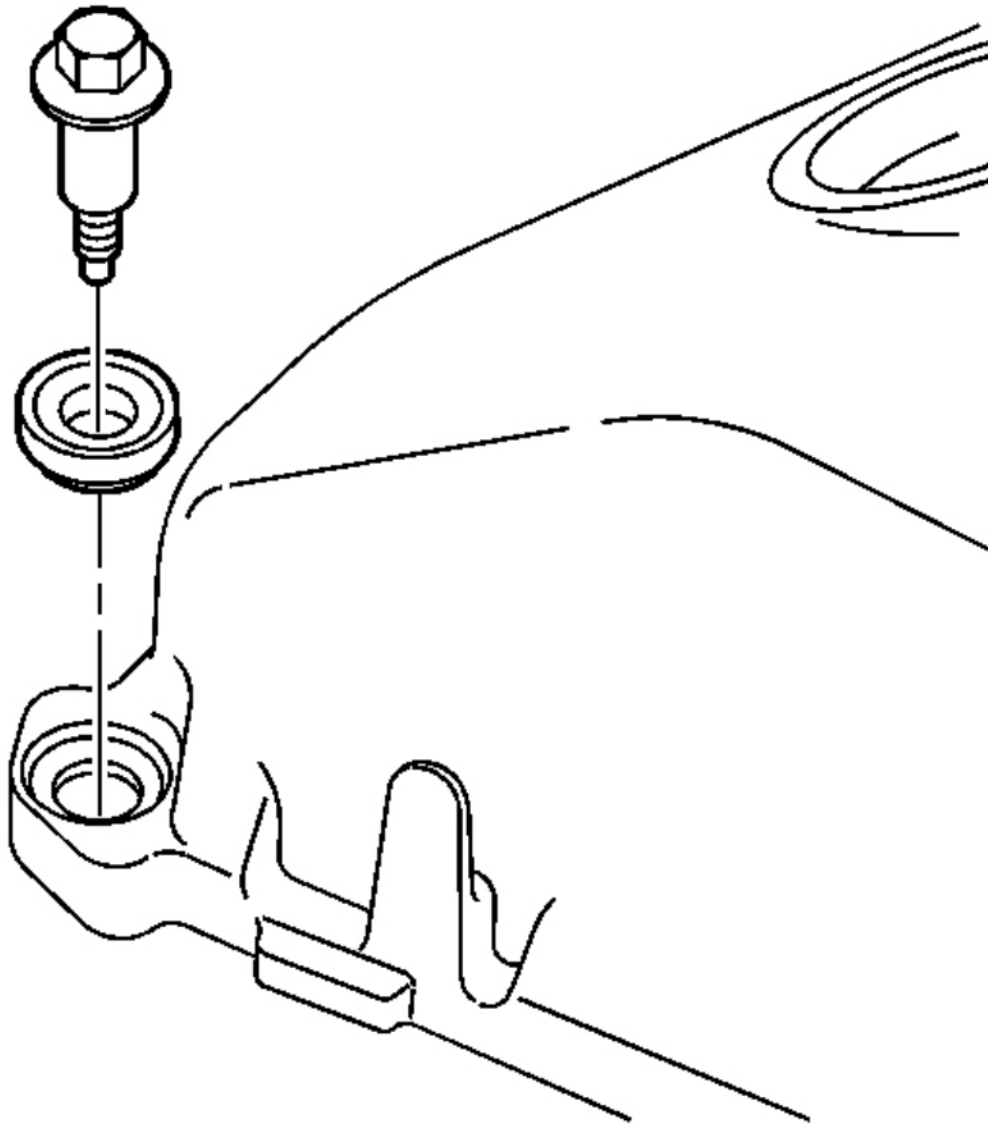


Fig. 12: View Of Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the camshaft cover bolts.
6. Remove the camshaft cover bolt grommets.

Cleaning Procedure

1. Clean the camshaft cover in solvent.

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

2. Dry the camshaft cover with compressed air.

Inspection Procedure

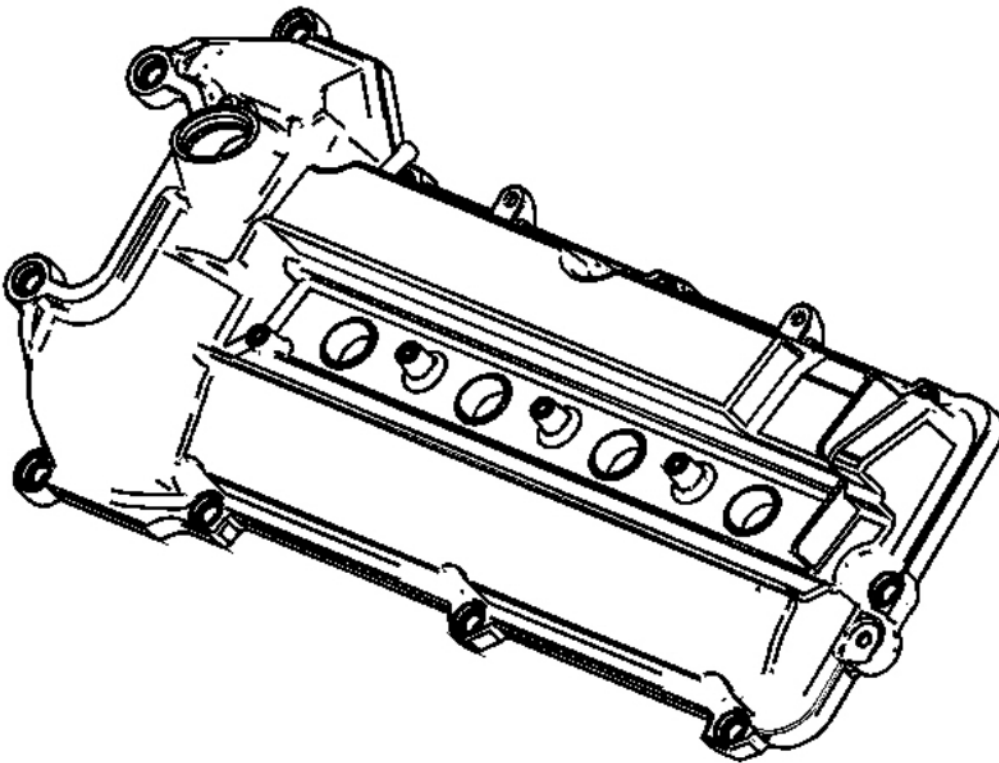


Fig. 13: Inspecting Exterior Of Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

1. Inspect the exterior of the left camshaft cover for the following:
 - Dents or damage

A dented or damaged cover may:

- Leak oil
- Effect crankcase ventilation
- Interfere with the camshafts
- Interfere with the ignition coil sealing
- Allow water, condensation, or debris to enter the engine
- Damaged threads for the ignition coils or ground straps
- Damaged camshaft cover bolt holes
- Damaged threads for the oil fill cap
- Damaged PCV tube fitting
- Damaged holes for the wiring harness retainers

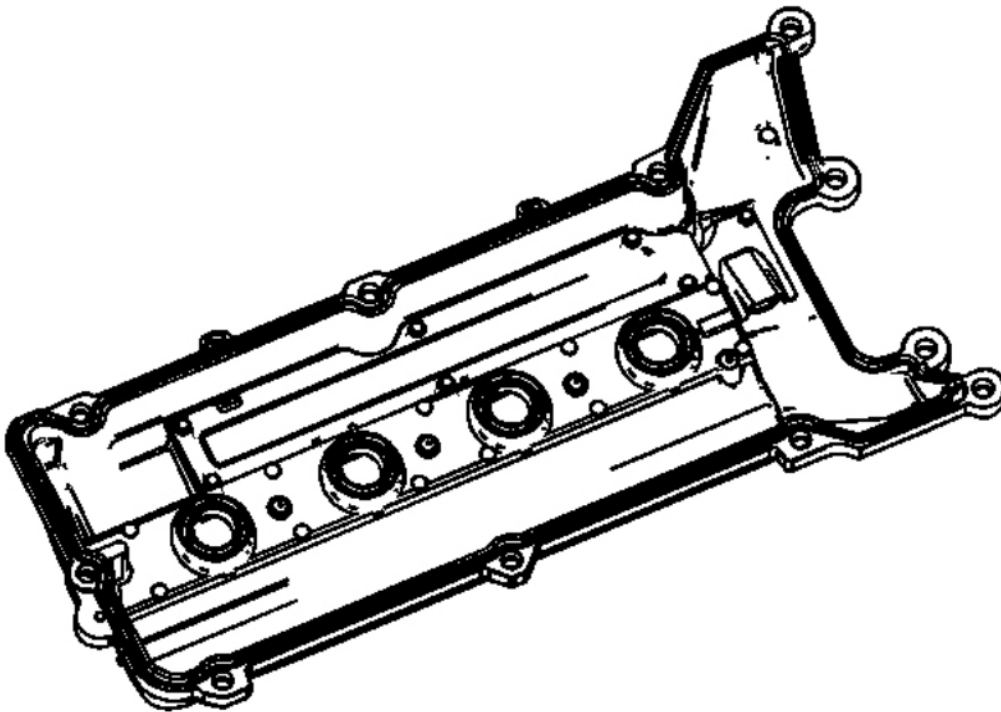


Fig. 14: Inspecting Interior Of Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

2. Inspect the interior of the left camshaft cover for the following:

- Damaged, loose or missing baffle
- Damaged, loose or missing baffle fasteners
- Restrictions to the ventilation system passages
- Damaged or warped seal groove for the camshaft cover seal and/or spark plug port seals

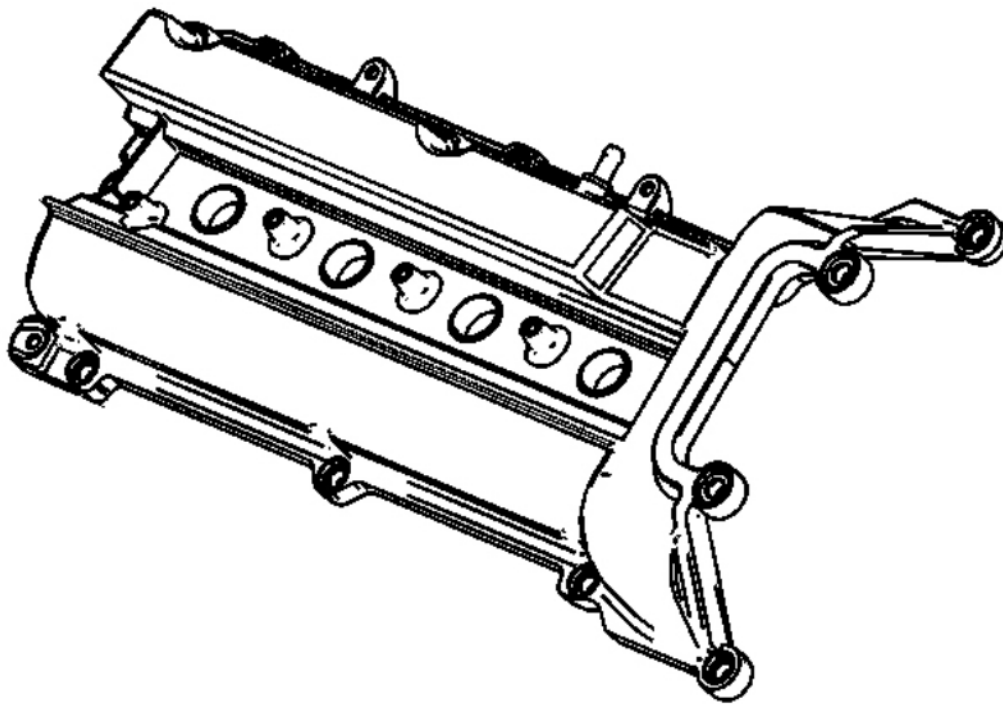


Fig. 15: Inspecting Exterior Of Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

3. Inspect the exterior of the right camshaft cover for the following:

- Dents or damage

A dented or damaged cover may:

- Leak oil

- Effect crankcase ventilation
- Interfere with the camshafts
- Interfere with ignition coil sealing
- Allow water, condensation or debris to enter the engine
- Damaged threads for the ignition coils or ground straps
- Damaged camshaft cover bolt holes
- Damaged PCV tube orifice fitting
- Damaged holes for the wiring harness retainers

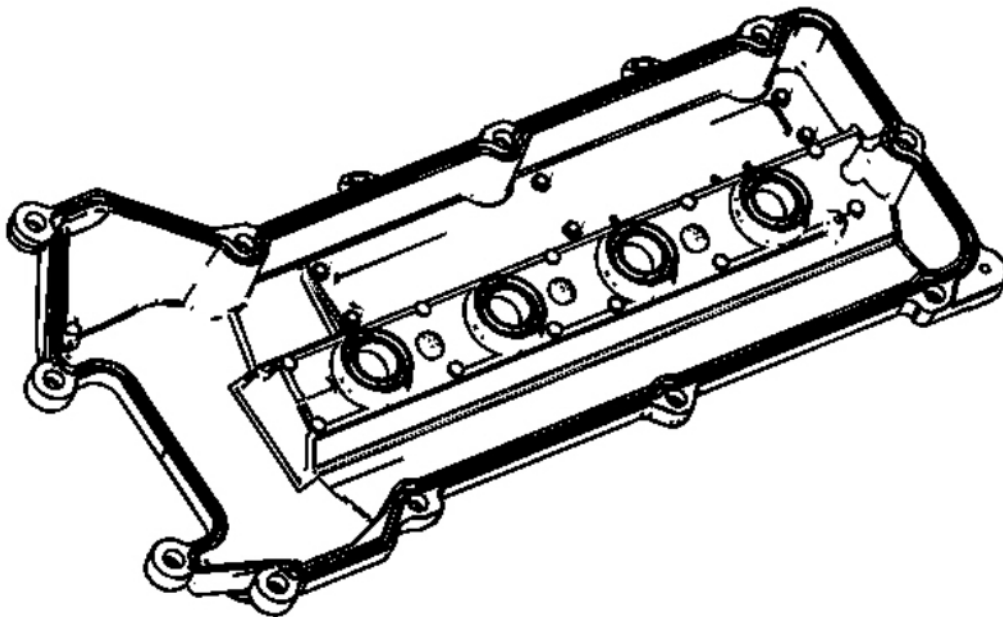


Fig. 16: Inspecting Interior Of Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

4. Inspect the interior of the right camshaft cover for the following:
 - Damaged, loose or missing baffle
 - Damaged, loose or missing baffle fasteners
 - Restrictions to the ventilation system passages
 - Damaged or warped seal groove for the camshaft cover seal and/or spark plug port

seals

5. Inspect the following related camshaft cover components for damage:
 - Oil fill cap
 - PCV clean air tube
 - PCV dirty air tube
 - Camshaft cover bolts and grommets
 - Ground straps and bolts
 - Ignition coil bracket assembly and wiring harness
6. Repair or replace the camshaft cover and/or components as necessary.

CAMSHAFT COVER ASSEMBLE

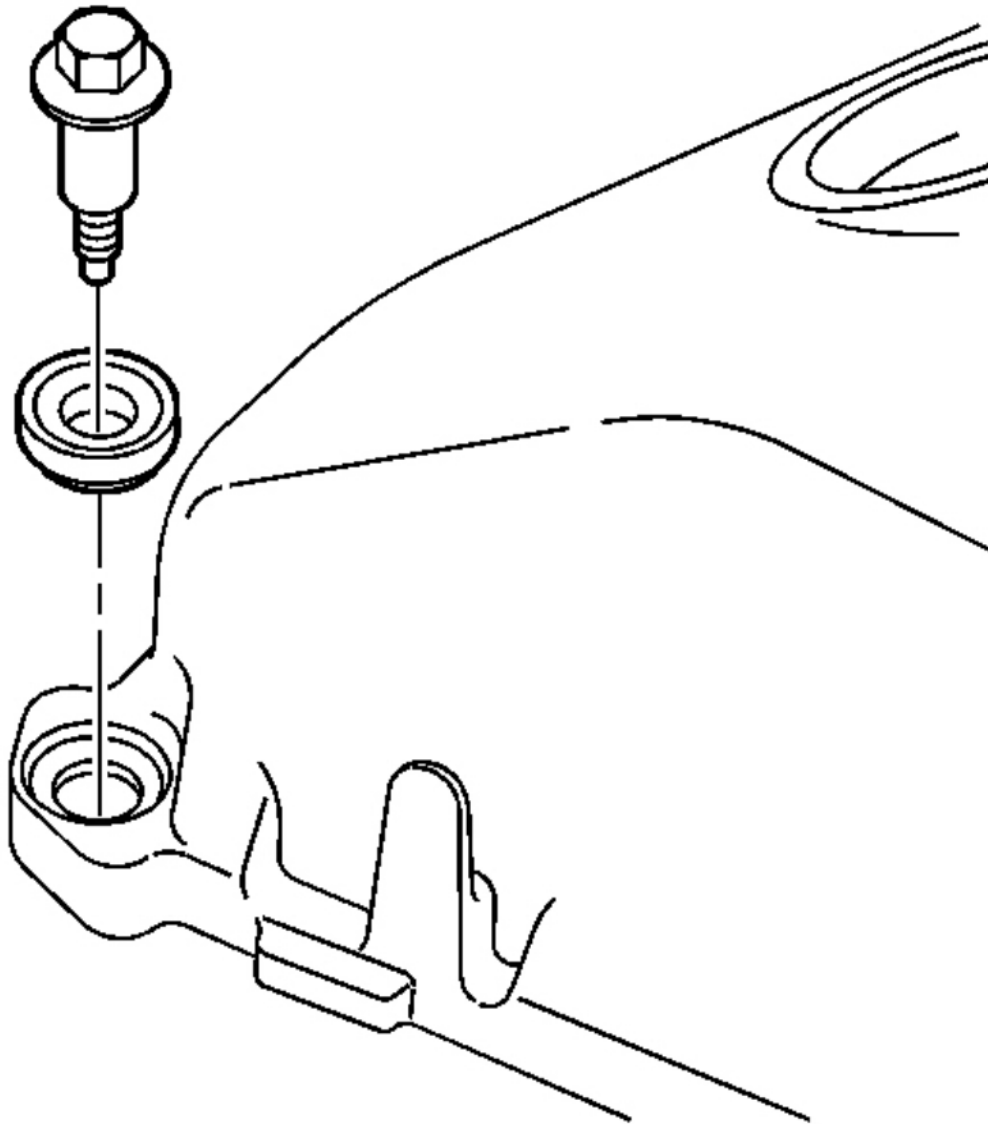


Fig. 17: View Of Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the camshaft cover bolt grommets.
2. Install the camshaft cover bolts.

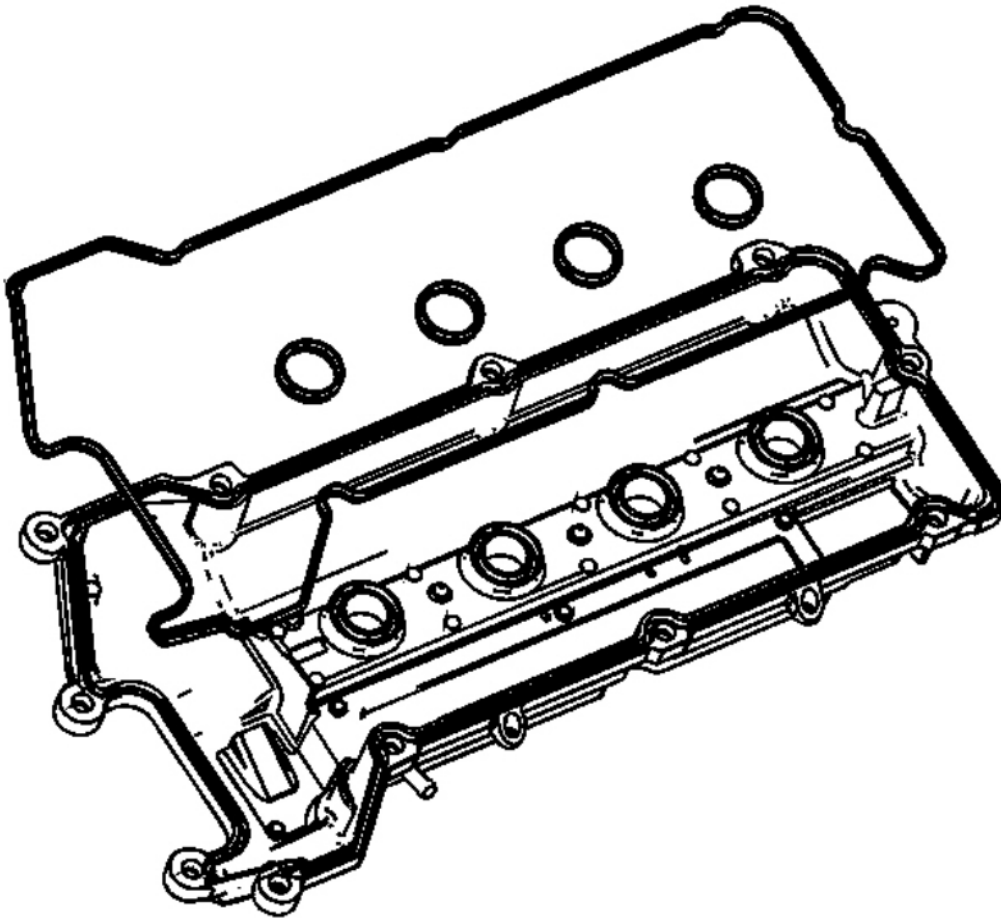


Fig. 18: View Of Left Camshaft Cover Gasket
Courtesy of GENERAL MOTORS CORP.

3. Install the NEW left camshaft cover gasket.
4. Install the NEW left spark plug port seals.

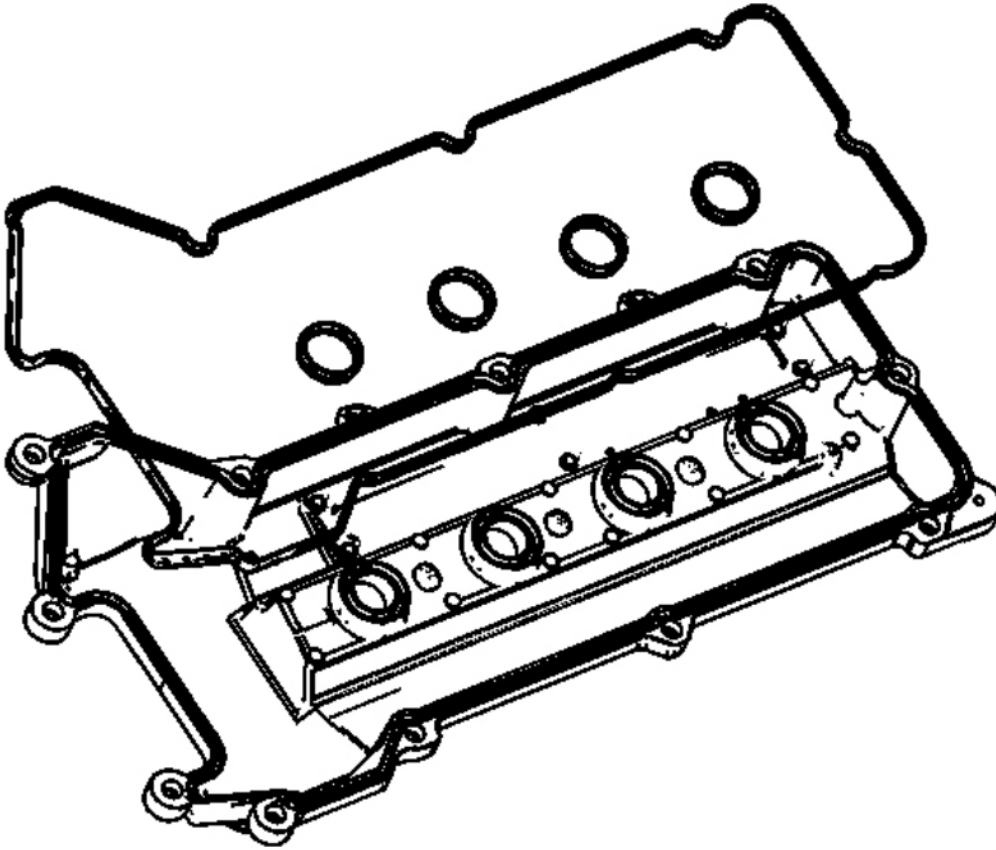


Fig. 19: View Of Right Camshaft Cover Gasket
Courtesy of GENERAL MOTORS CORP.

5. Install the NEW right camshaft cover gasket.
6. Install the NEW right spark plug port seals.

INTAKE MANIFOLD DISASSEMBLE

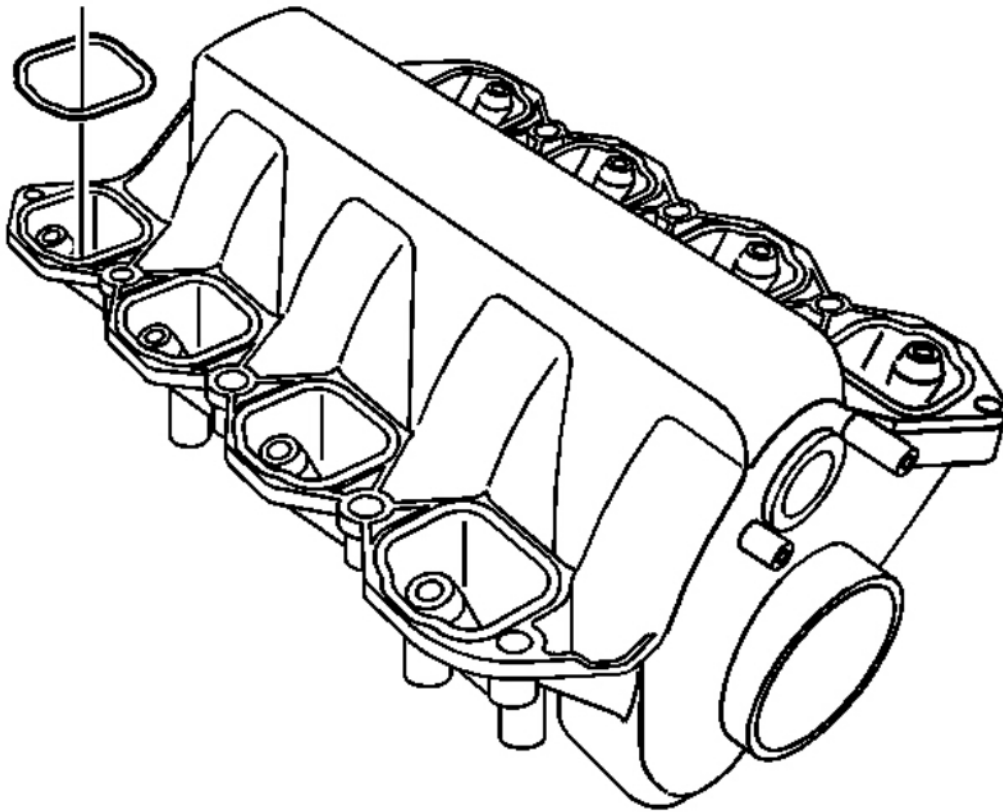


Fig. 20: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not reuse the intake manifold-to-cylinder head sealing gaskets.

1. Remove and discard the intake manifold-to-cylinder head gaskets.

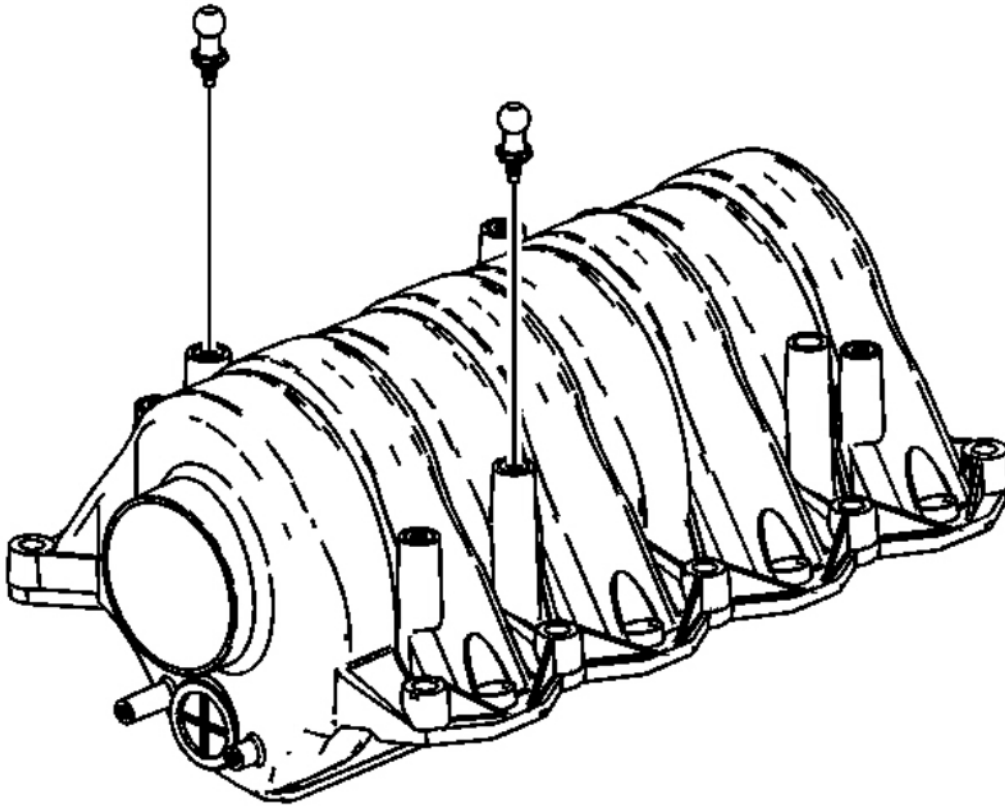


Fig. 21: View Of Sight Shield Retainer Ball Studs
Courtesy of GENERAL MOTORS CORP.

2. Remove the sight shield retainer ball studs.

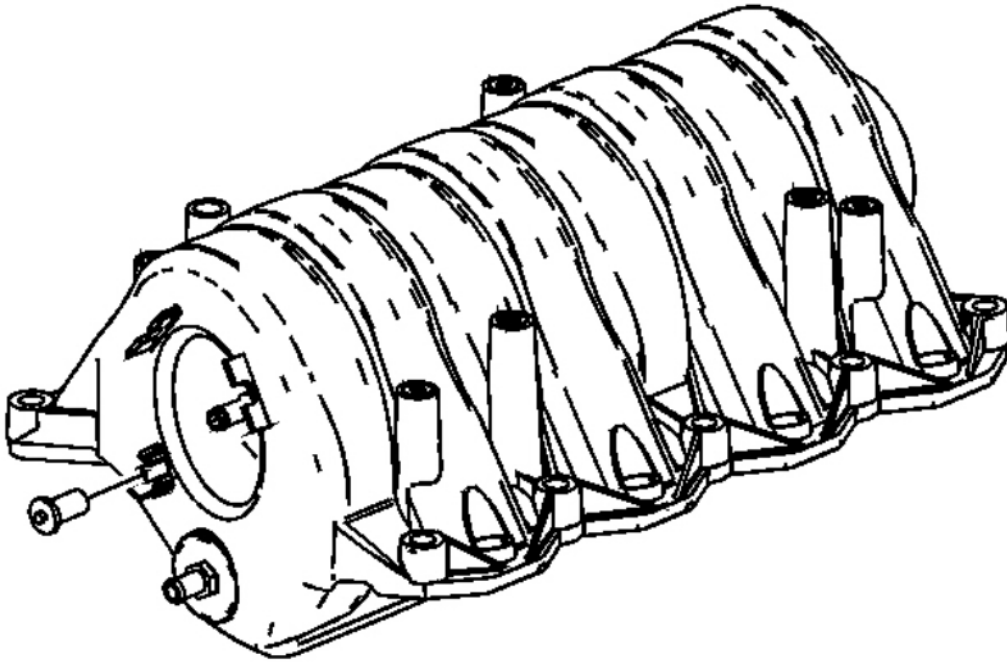


Fig. 22: View Of Manifold Vacuum Source Cap
Courtesy of GENERAL MOTORS CORP.

3. Remove the manifold vacuum source cap.

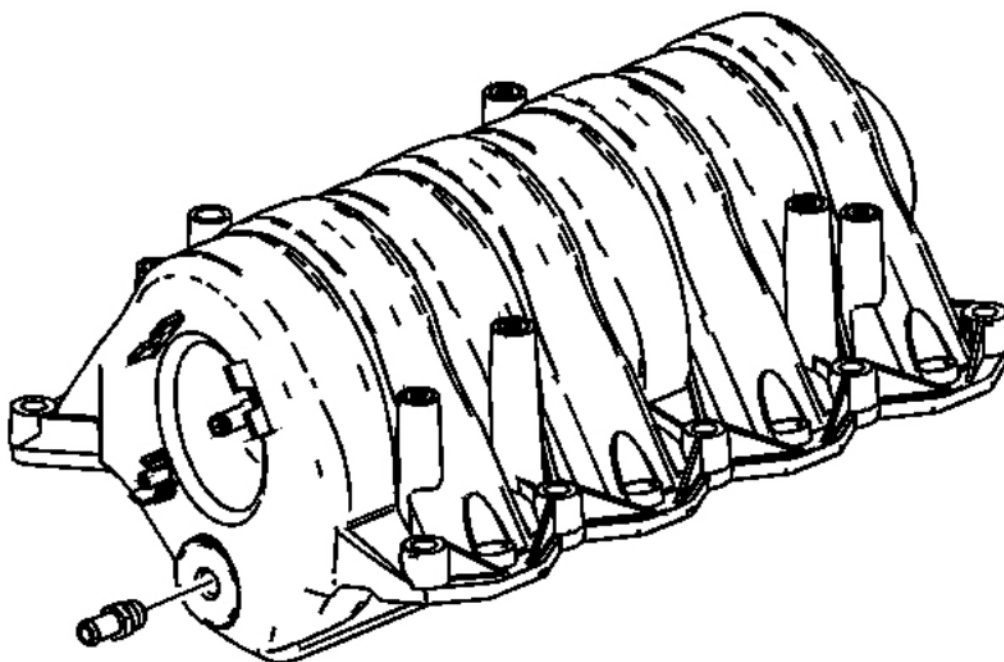


Fig. 23: View Of Vacuum Boost Fitting
Courtesy of GENERAL MOTORS CORP.

4. Remove the vacuum boost fitting.

INTAKE MANIFOLD CLEANING AND INSPECTION

Cleaning Procedure

IMPORTANT: Do not reuse the intake manifold-to-cylinder head sealing gaskets.

1. Remove any remaining gasket and/or gasket material from the intake manifold.
2. Clean the following intake manifold areas in solvent.
 - Intake manifold gasket grooves
 - Intake manifold passages
 - PCV vacuum hose passage
 - Vacuum hose fitting passage

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

3. Dry the intake manifold with compressed air.

Inspection Procedure

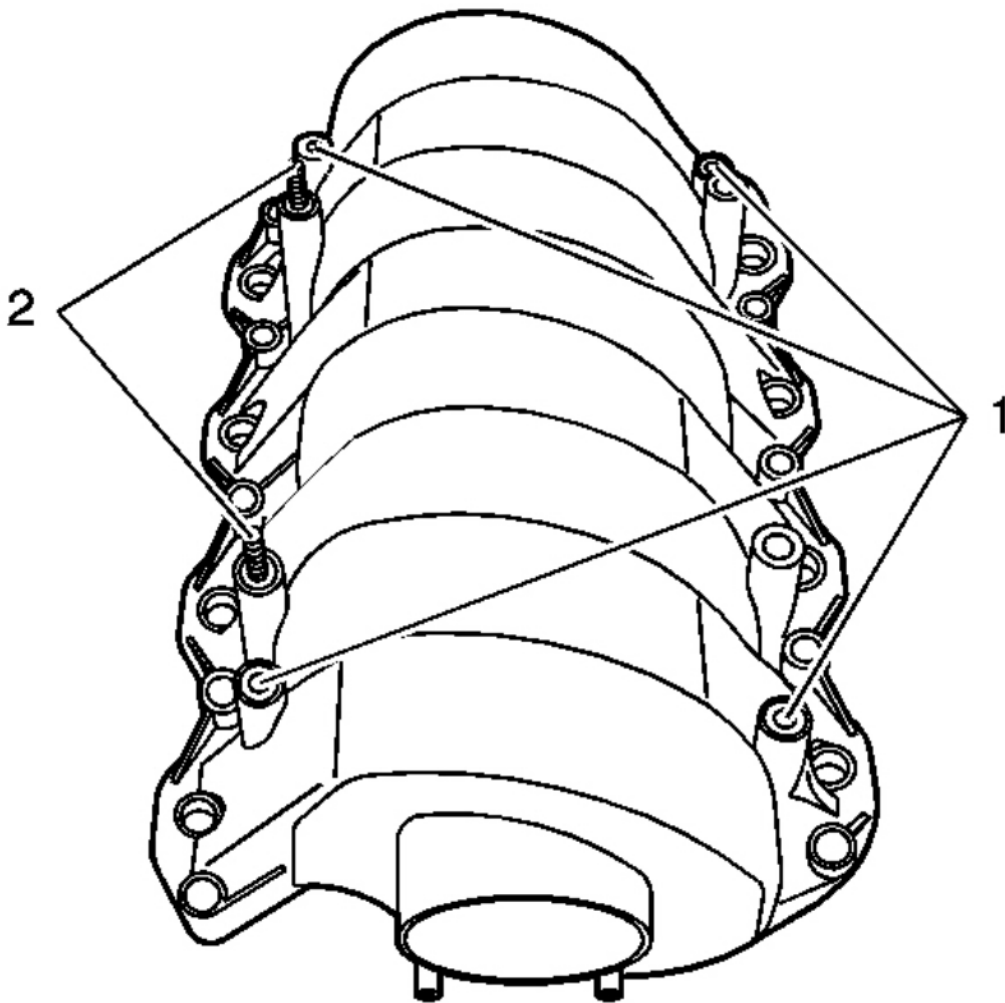


Fig. 24: Inspecting Intake Manifold For Damage To Fuel Rail Mounting Inserts & Studs

Courtesy of GENERAL MOTORS CORP.

1. Inspect the intake manifold for the following conditions:

- Damage to the fuel rail mounting inserts (1)
- Damage to the studs (2)

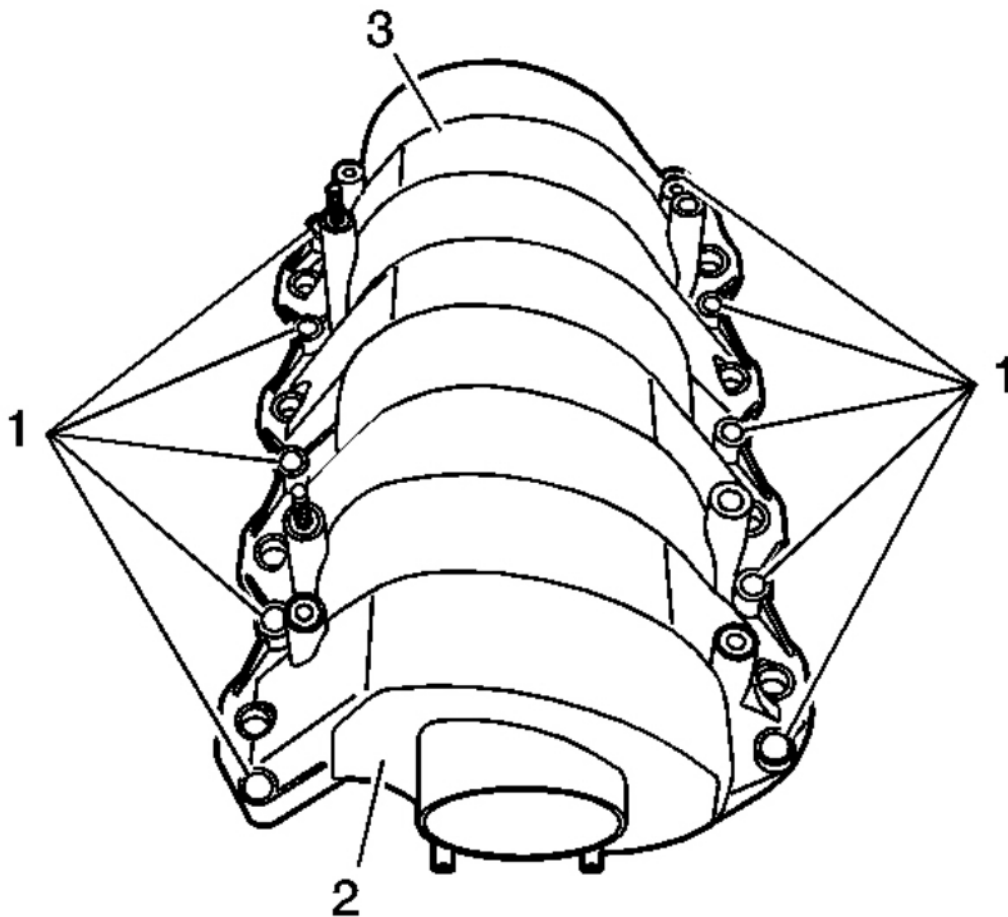


Fig. 25: Inspecting Intake Manifold For Cracks & Damage To Bolt Bosses
Courtesy of GENERAL MOTORS CORP.

2. Inspect the intake manifold for the following conditions:

- Damage to the intake manifold bolt bosses (1)
- Damage or cracks to the composite intake manifold assembly (2)
- Damage in areas between the intake runners (3)

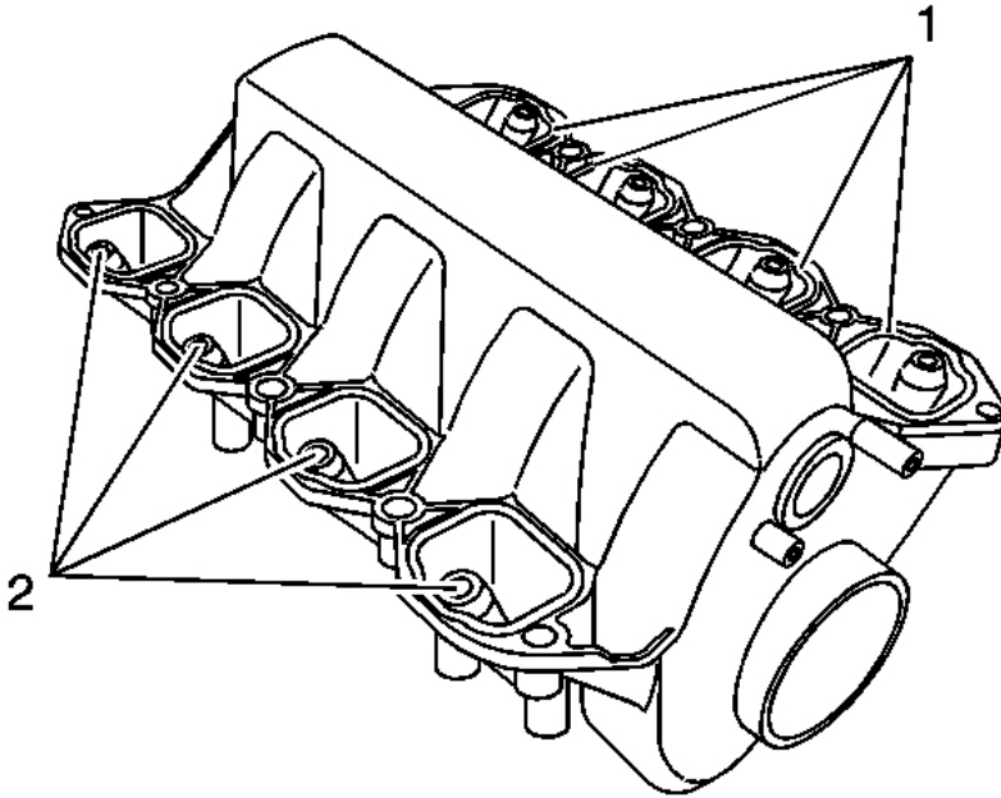


Fig. 26: Inspecting Intake Manifold For Damage To Sealing Surfaces & Fuel Injector Bores

Courtesy of GENERAL MOTORS CORP.

3. Inspect the intake manifold for the following conditions:
 - Damage, gouges or cracks to the intake manifold sealing surfaces and grooves (1)
 - Damage or excessive scoring to the fuel injector bores (2)

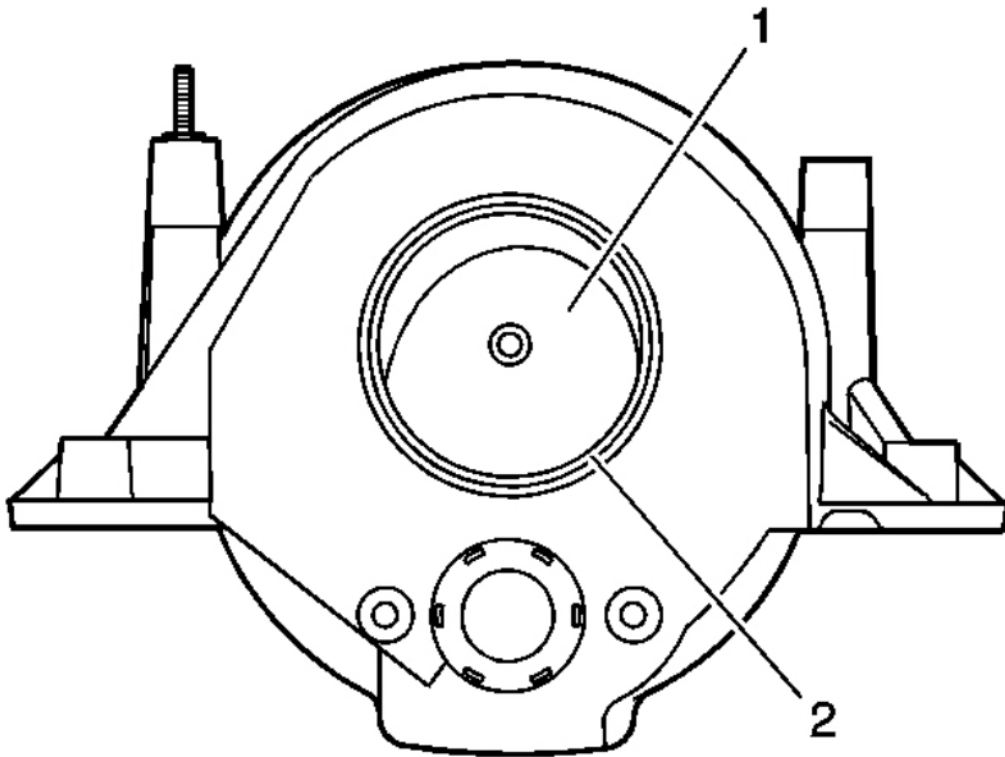


Fig. 27: Inspecting Front Intake Manifold For Damage To Passage & Plenum Duct Neck

Courtesy of GENERAL MOTORS CORP.

4. Inspect the front of the intake manifold for the following conditions:
 - Damage, debris or restrictions to the intake manifold passage (1)
 - Damage to the plenum duct neck (2)

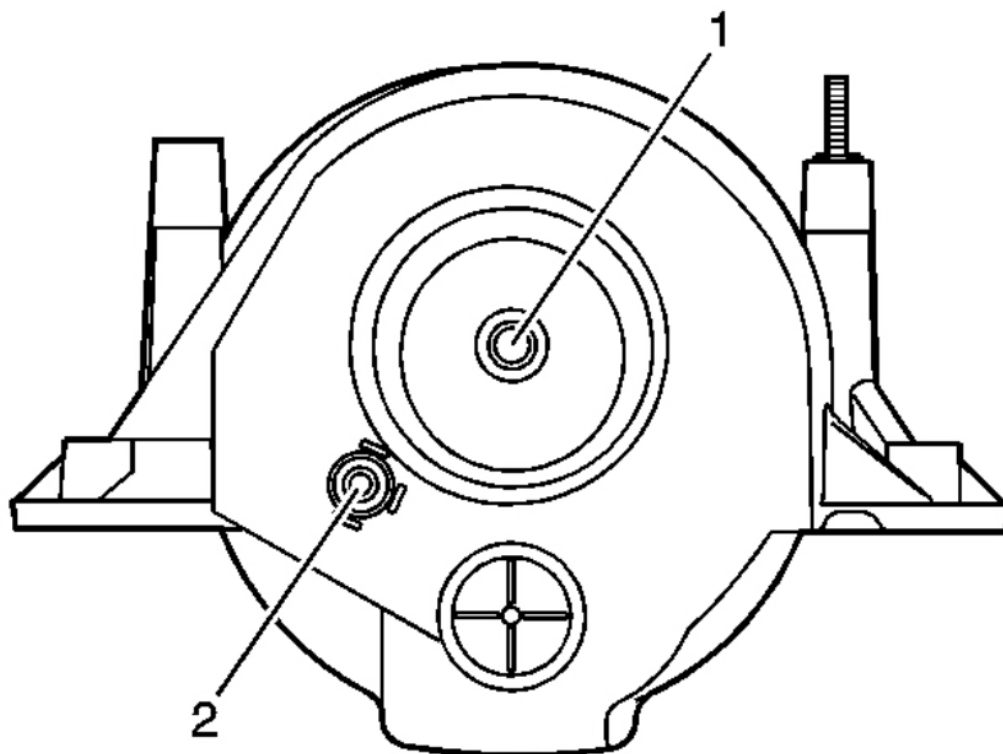


Fig. 28: Inspecting Intake Manifold For Damage To PCV System Hose & Vacuum Ports

Courtesy of GENERAL MOTORS CORP.

5. Inspect the intake manifold for the following conditions:
 - Damage, debris or restrictions to the PCV system hose port (1)
 - Damage, debris or restrictions to the vacuum port (2)
6. Inspect the intake manifold cylinder head deck for warpage.
 1. Locate a straight edge across the intake manifold cylinder head deck surface.
 2. Insert a feeler gage between the intake manifold and the straight edge. An intake manifold with warpage in excess of 0.25 mm per 25 mm (0.010 in per 1.00 in) must be replaced.
7. Repair or replace the intake manifold as necessary.

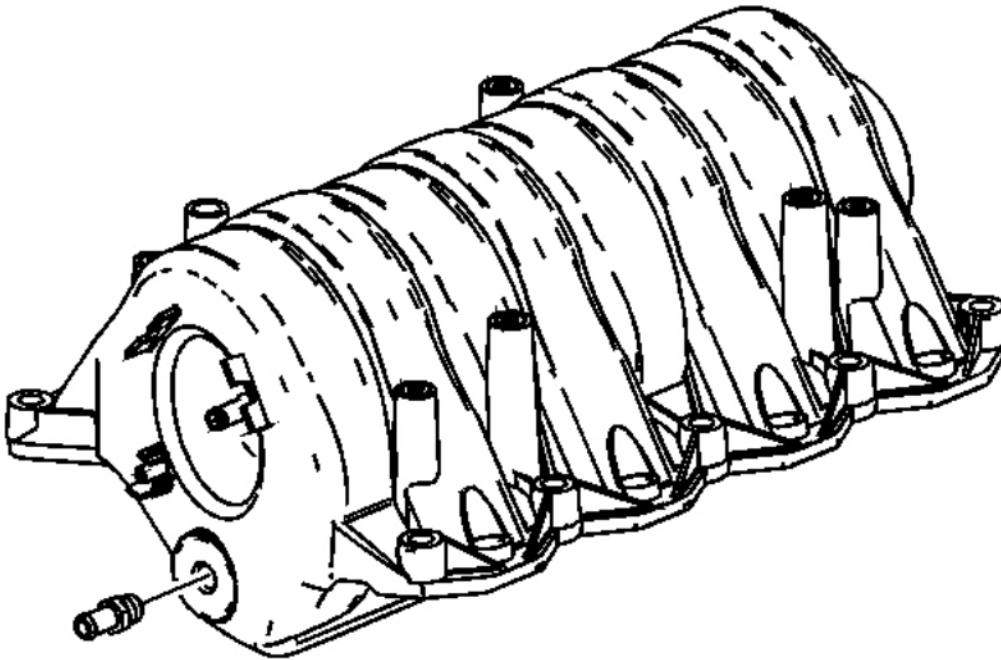


Fig. 29: View Of Vacuum Boost Fitting
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the vacuum boost fitting.

Tighten: Tighten the vacuum boost fitting to 2 N.m (18 lb in).

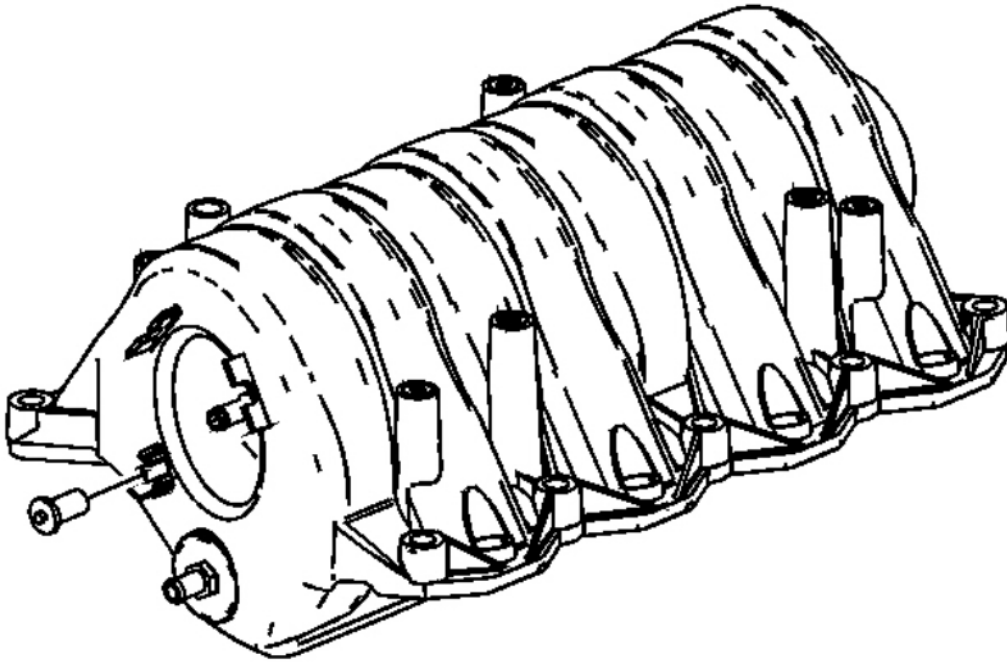


Fig. 30: View Of Manifold Vacuum Source Cap
Courtesy of GENERAL MOTORS CORP.

2. Install the manifold vacuum source cap.

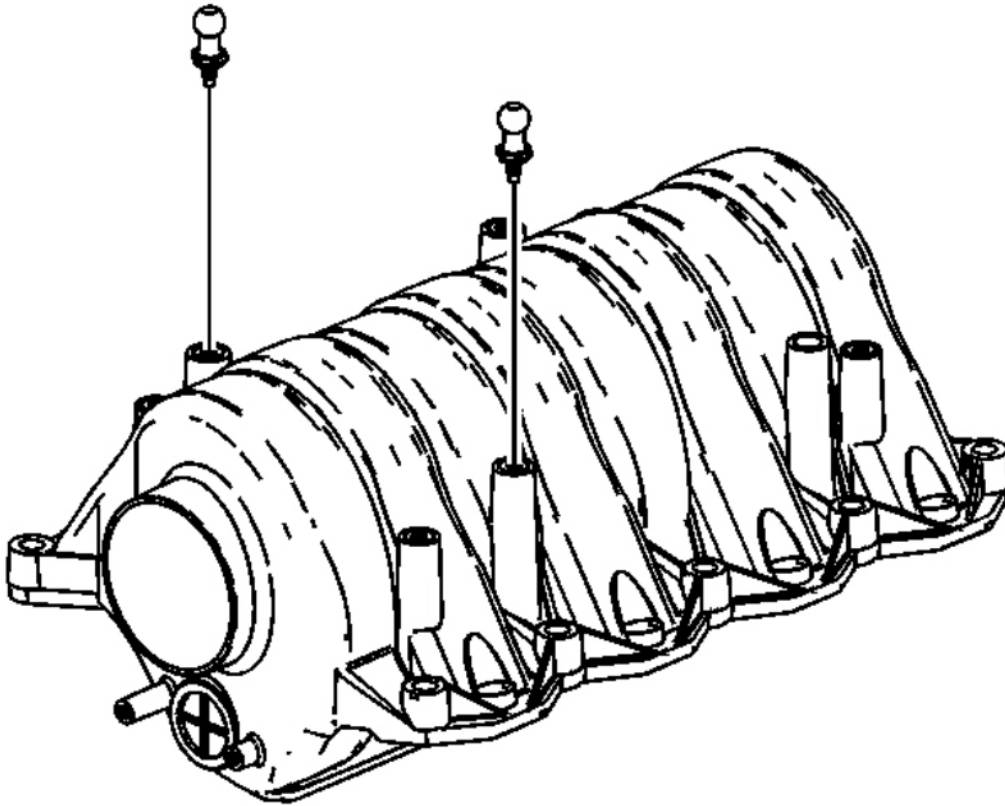


Fig. 31: View Of Sight Shield Retainer Ball Studs
Courtesy of GENERAL MOTORS CORP.

3. Install the sight shield retainer ball studs.

Tighten: Tighten the sight shield retainer ball studs to 7 N.m (62 lb in).

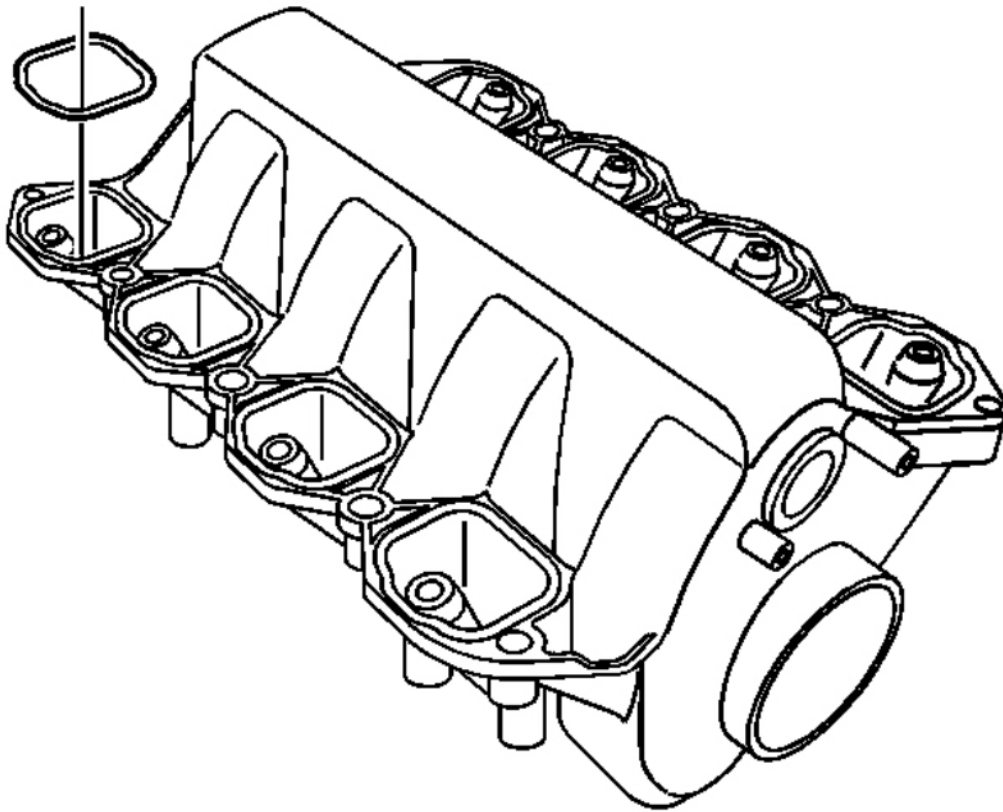


Fig. 32: View Of Intake Manifold-To-Cylinder Head Gaskets
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not reuse the intake manifold-to-cylinder head sealing gaskets.

4. Install NEW intake manifold-to-cylinder head gaskets.

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

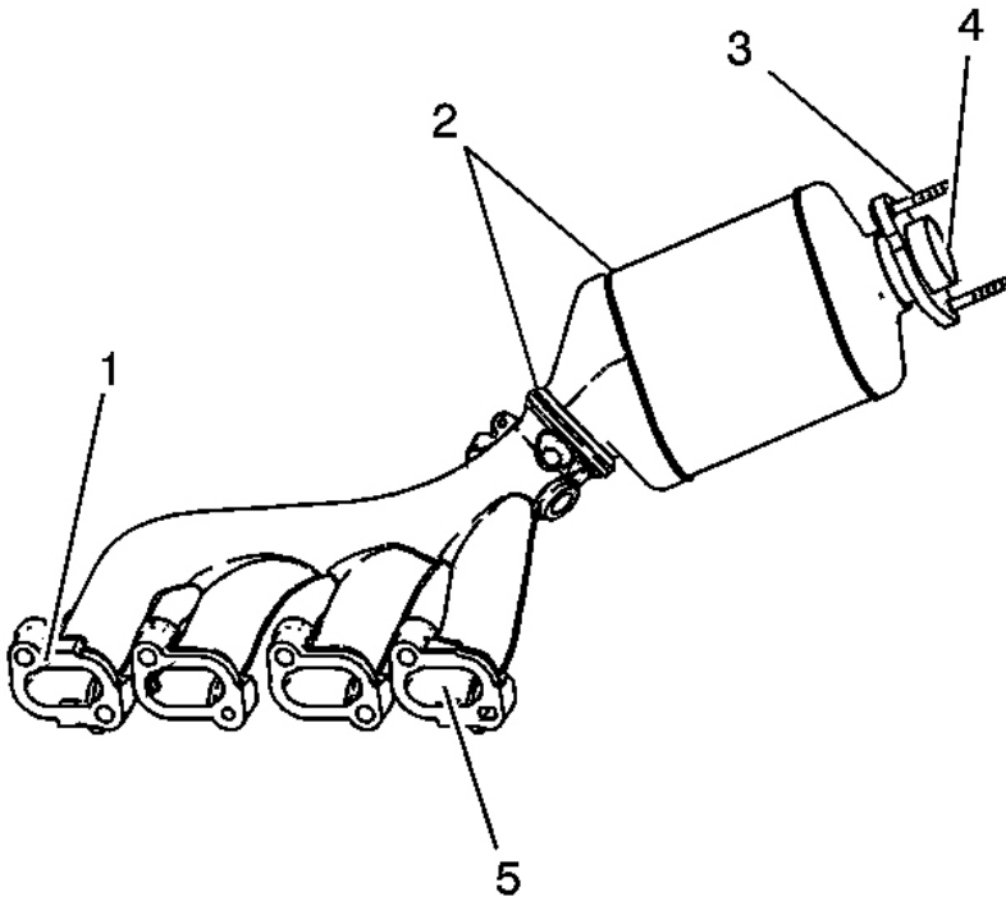


Fig. 33: Inspecting Left Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Inspect the left exhaust manifold and converter assembly for the following:
 - Damage to the exhaust sealing area (1)
 - Damage or broken welds (2)
 - Damage to the exhaust pipe mounting studs (3)

- Damage to the exhaust pipe flange (4)
- Damage or restrictions to the exhaust passages (5)

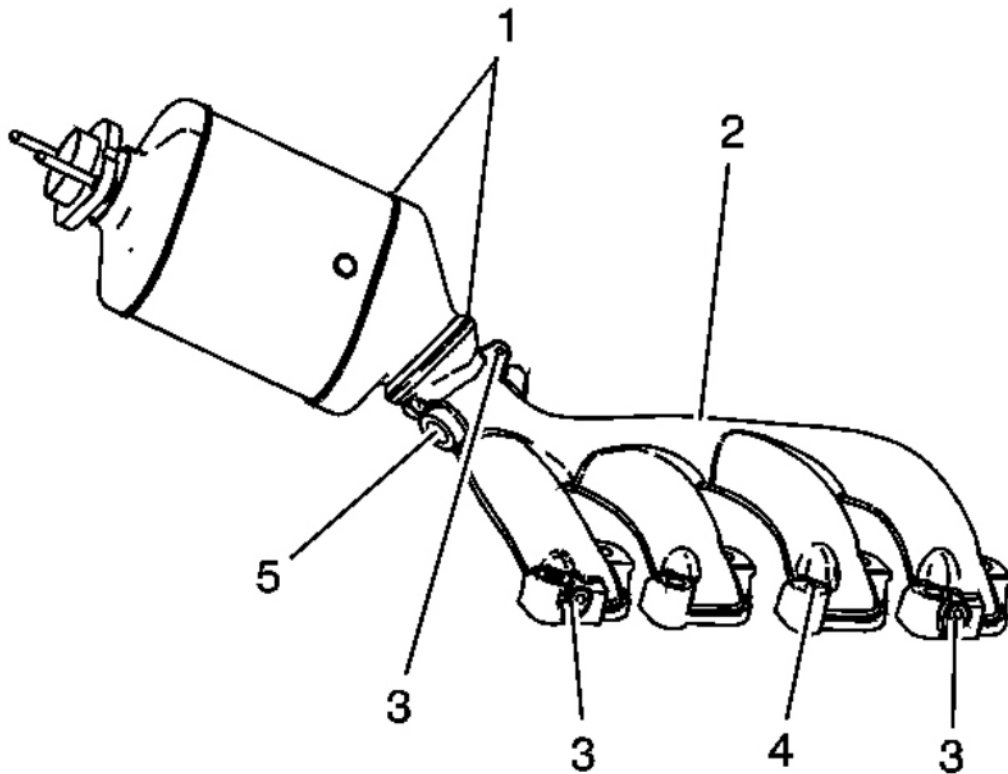


Fig. 34: Inspecting Left Exhaust Manifold & Converter Assembly
 Courtesy of GENERAL MOTORS CORP.

2. Inspect the left exhaust manifold and converter assembly for the following:
 - Damage or broken welds (1)
 - Damage or excessive corrosion to the exterior (2)
 - Damage to the heat shield mounting hole threads (3)
 - Damage to the exhaust manifold mounting holes (4)
 - Damage to the oxygen sensor threaded hole (5)
3. Repair or replace the exhaust manifold and/or converter as necessary.

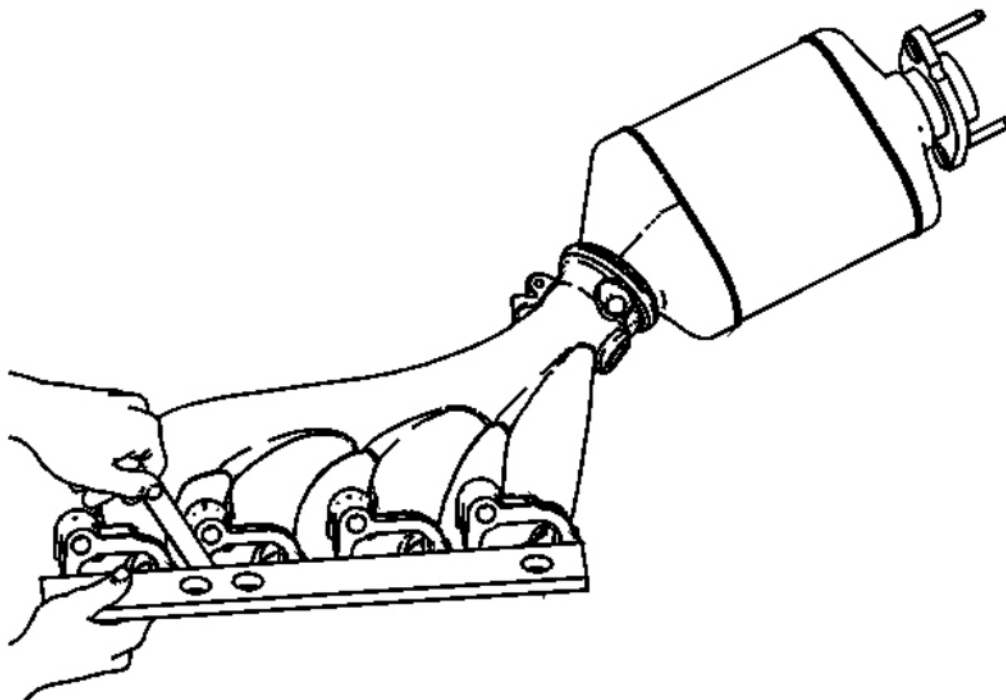


Fig. 35: Measuring Alignment Of Left Exhaust Manifold Flanges
Courtesy of GENERAL MOTORS CORP.

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) out of alignment.
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

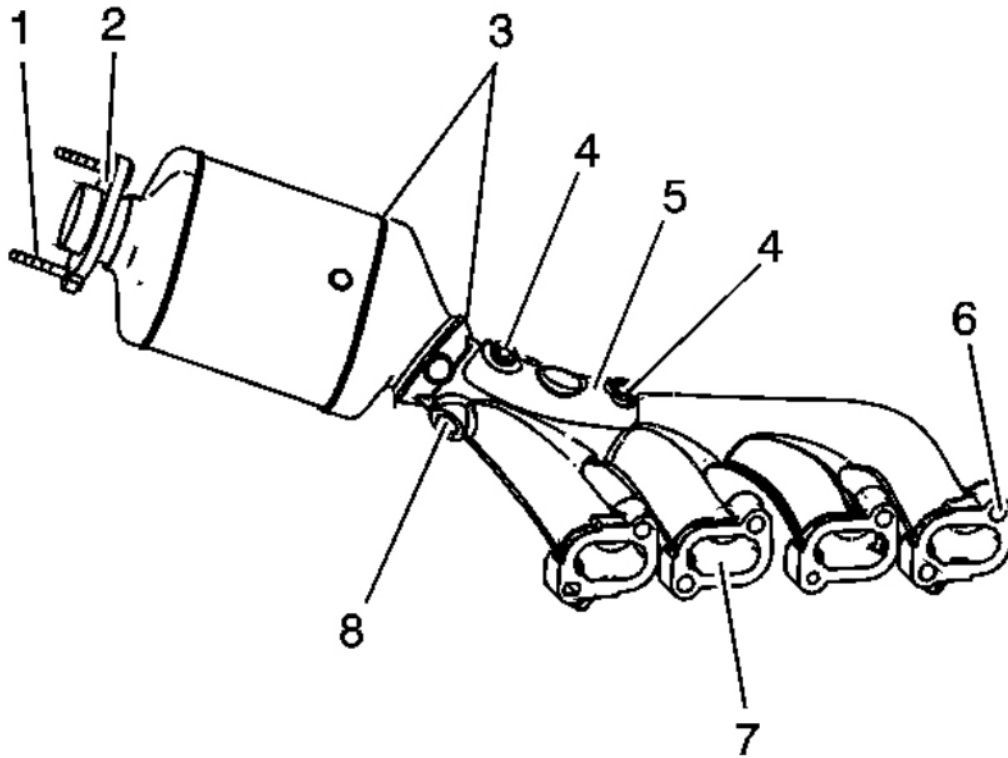


Fig. 36: Inspecting Right Exhaust Manifold
Courtesy of GENERAL MOTORS CORP.

1. Inspect the right exhaust manifold and converter assembly for the following:
 - Damage to the exhaust pipe mounting studs (1)
 - Damage to the exhaust pipe flange (2)
 - Damage or broken welds (3)
 - Damage, loose or missing heat shield rivets (4)
 - Damage, loose, missing heat shield (5)
 - Damage to the exhaust sealing area (6)
 - Damage or restrictions to the exhaust passages (7)

- Damage to the oxygen sensor threaded hole (8)

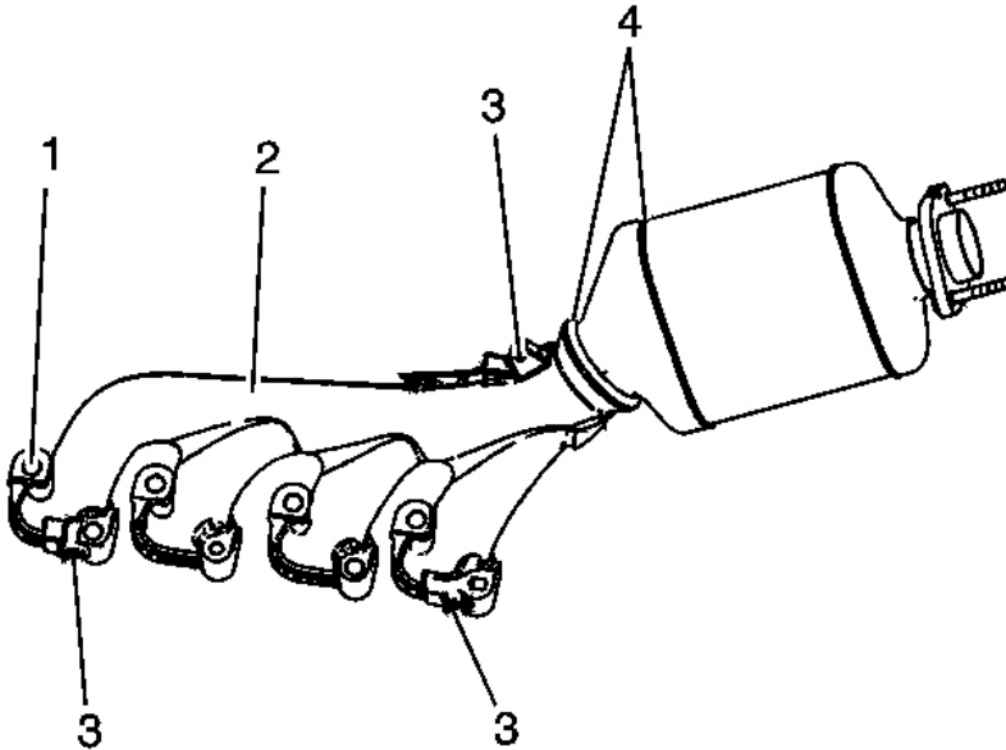


Fig. 37: Inspecting Right Exhaust Manifold & Converter Assembly
Courtesy of GENERAL MOTORS CORP.

2. Inspect the right exhaust manifold and converter assembly for the following:
 - Damage to the exhaust manifold mounting holes (1)
 - Damage or excessive corrosion to the exterior (2)
 - Damage to the heat shield mounting hole threads (3)
 - Damage or broken welds (4)
3. Repair or replace the exhaust manifold and converter assembly as necessary.

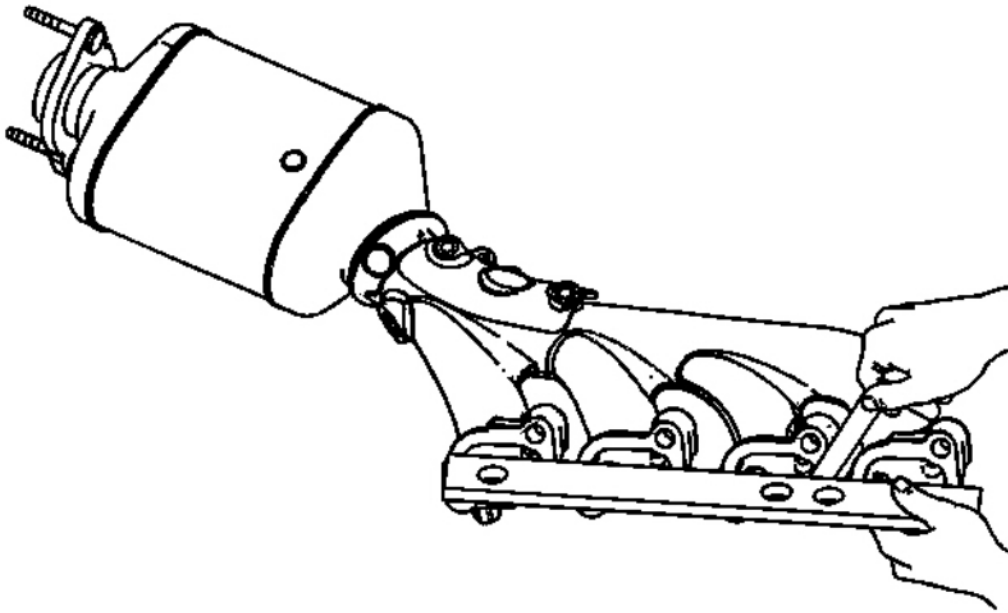


Fig. 38: Measuring Alignment Of Right Exhaust Manifold Flanges
Courtesy of GENERAL MOTORS CORP.

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) out of alignment.
5. If the surface flatness is not within specifications, the exhaust manifold is warped and must be replaced.

WATER OUTLET HOUSING DISASSEMBLE

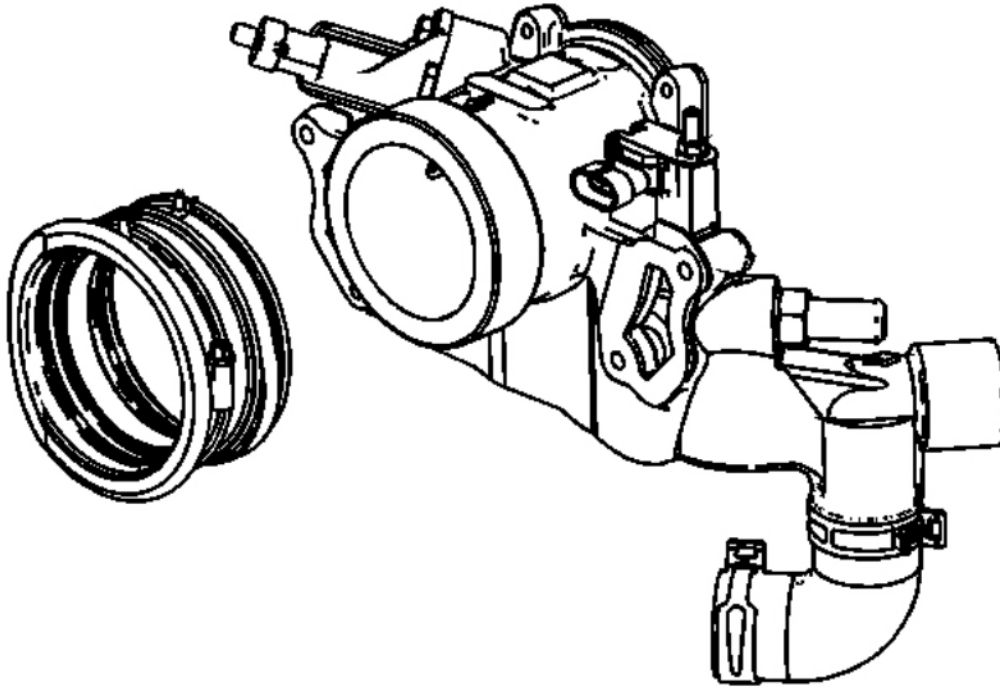


Fig. 39: View Of Intake Manifold Plenum Duct
Courtesy of GENERAL MOTORS CORP.

1. Loosen the intake manifold plenum duct clamp.
2. Remove the intake manifold plenum duct.

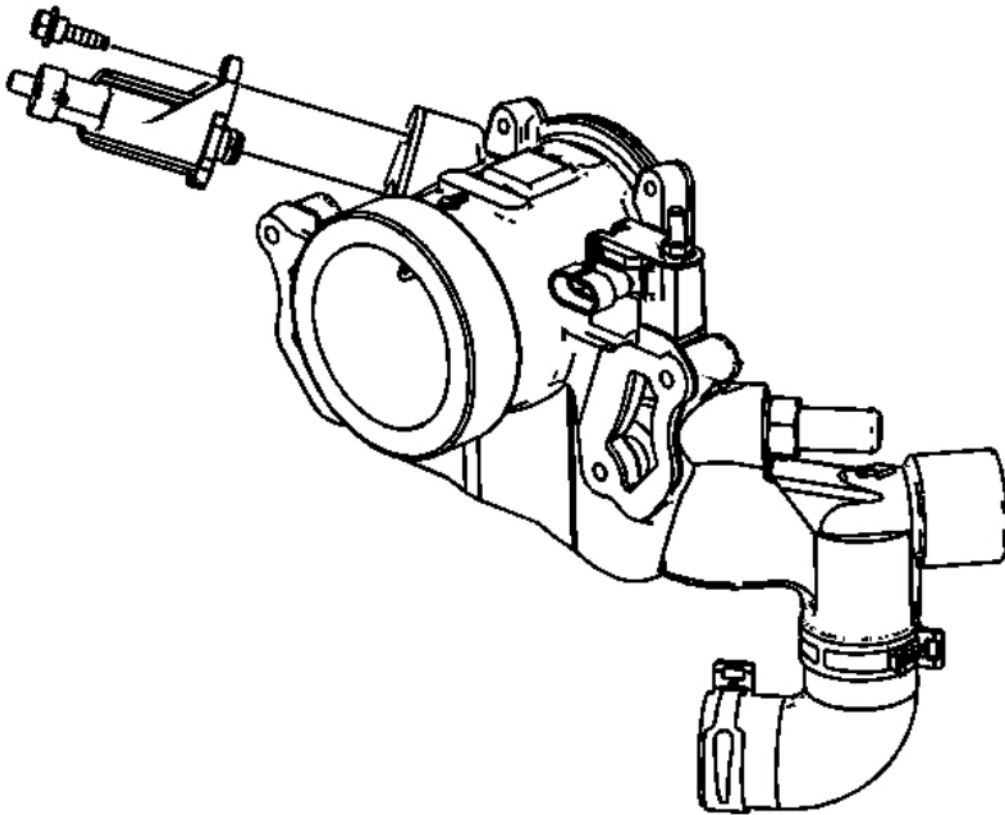


Fig. 40: View Of EVAP Purge Valve
Courtesy of GENERAL MOTORS CORP.

3. Remove the evaporative emission (EVAP) purge valve bolt.
4. Remove the EVAP purge valve.

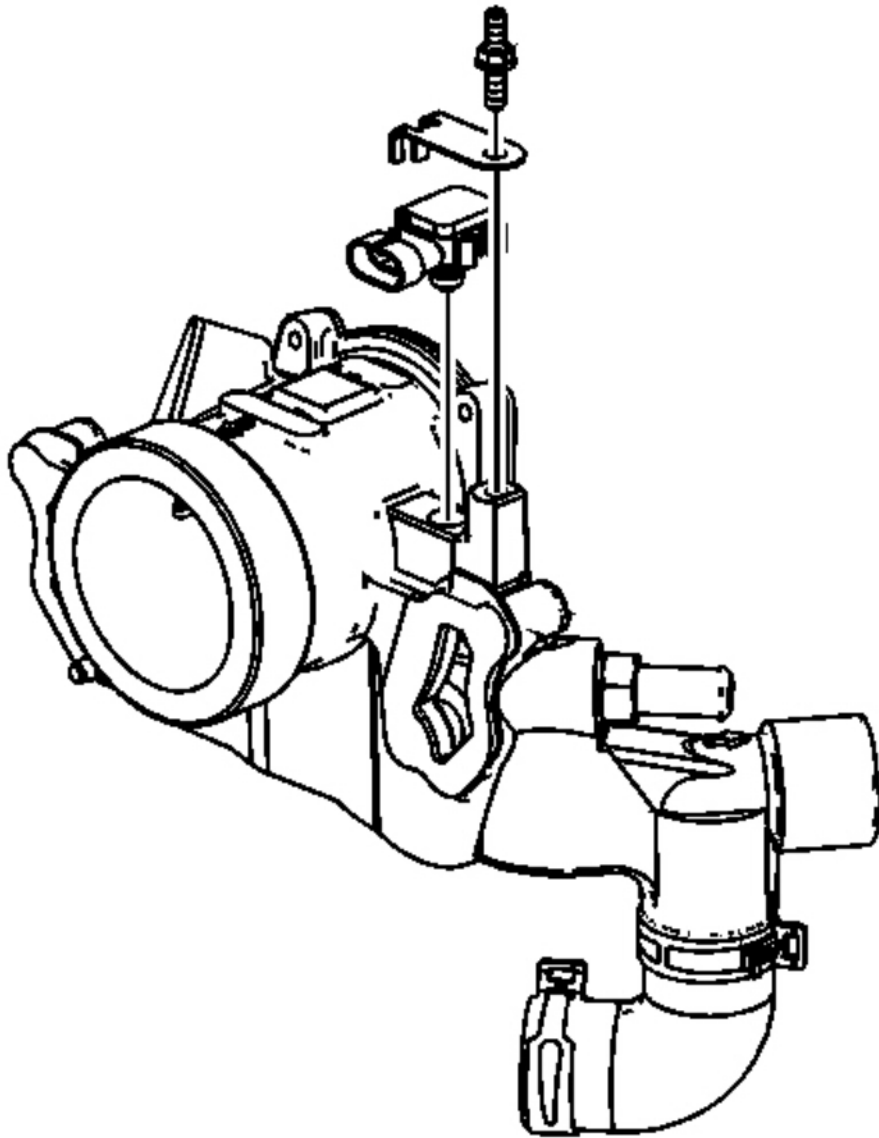


Fig. 41: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

5. Remove the manifold absolute pressure (MAP) sensor bolt.
6. Remove the MAP sensor.

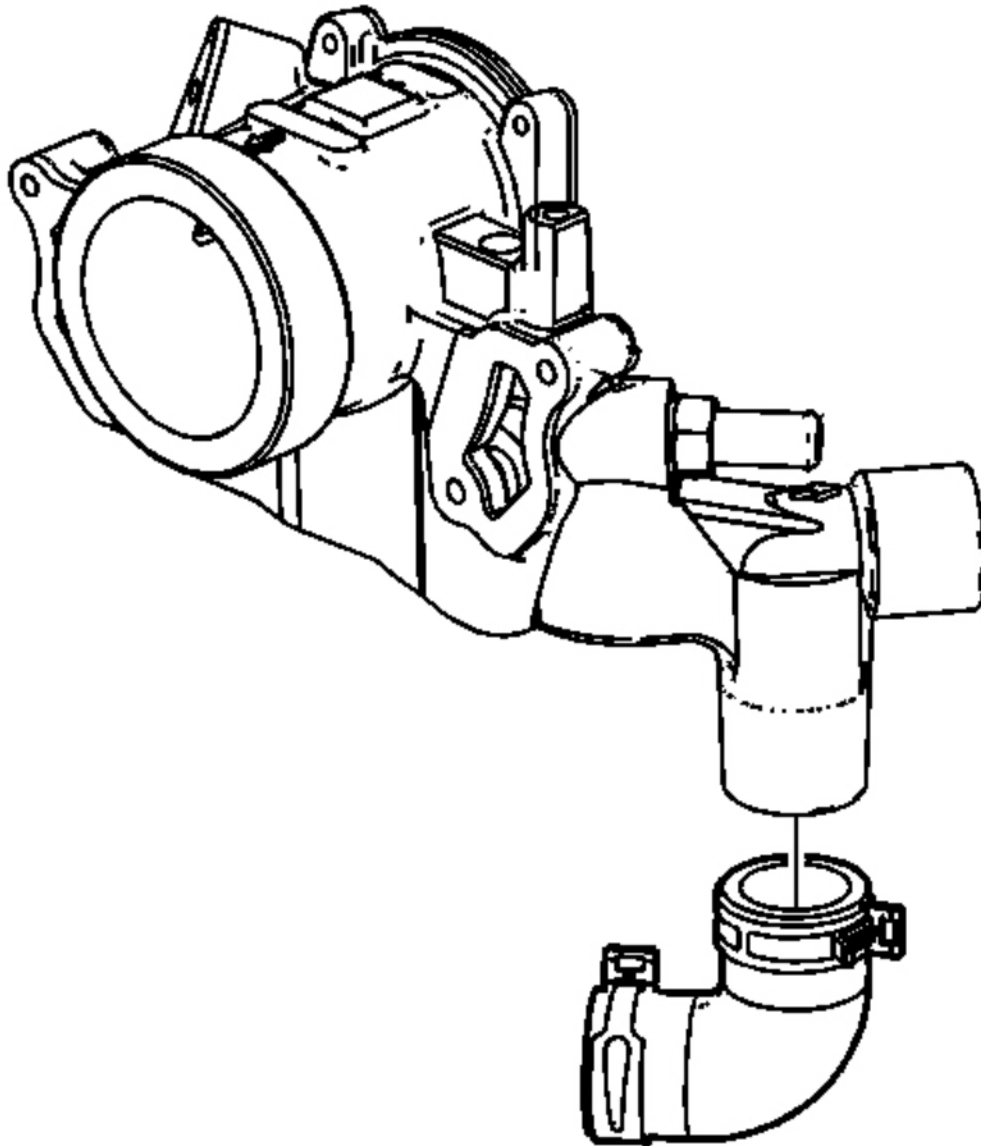


Fig. 42: View Of Bypass Hose
Courtesy of GENERAL MOTORS CORP.

7. Remove the bypass hose clamp.
8. Remove and discard the bypass hose.

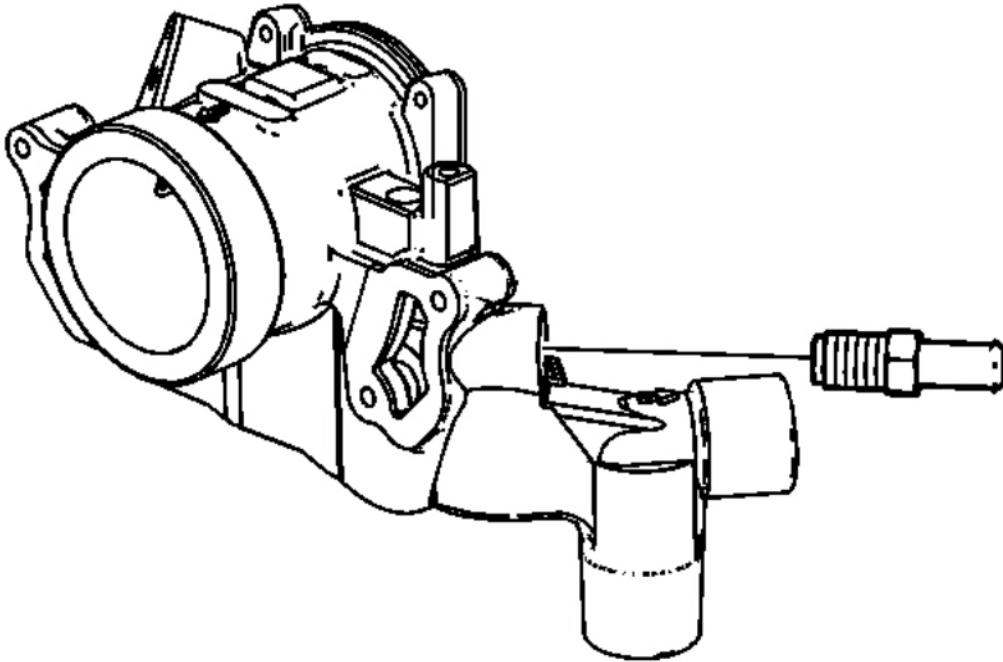


Fig. 43: View Of Heater Hose Fitting
Courtesy of GENERAL MOTORS CORP.

9. Remove the heater hose fitting.

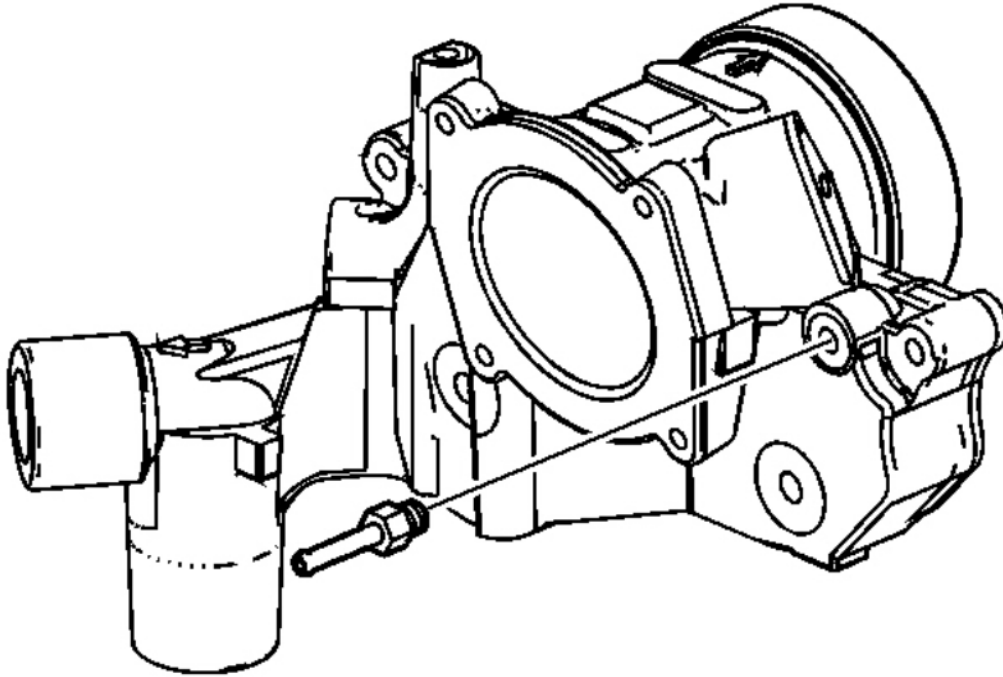


Fig. 44: View Of Engine Coolant Air Bleed Fitting
Courtesy of GENERAL MOTORS CORP.

10. Remove the engine coolant air bleed fitting.
11. Remove the EVAP purge valve and MAP sensor O-rings and discard.

WATER OUTLET HOUSING CLEANING AND INSPECTION

Cleaning Procedure

1. Clean the water outlet housing with solvent.

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

2. Dry the water outlet housing with compressed air.

Inspection Procedure

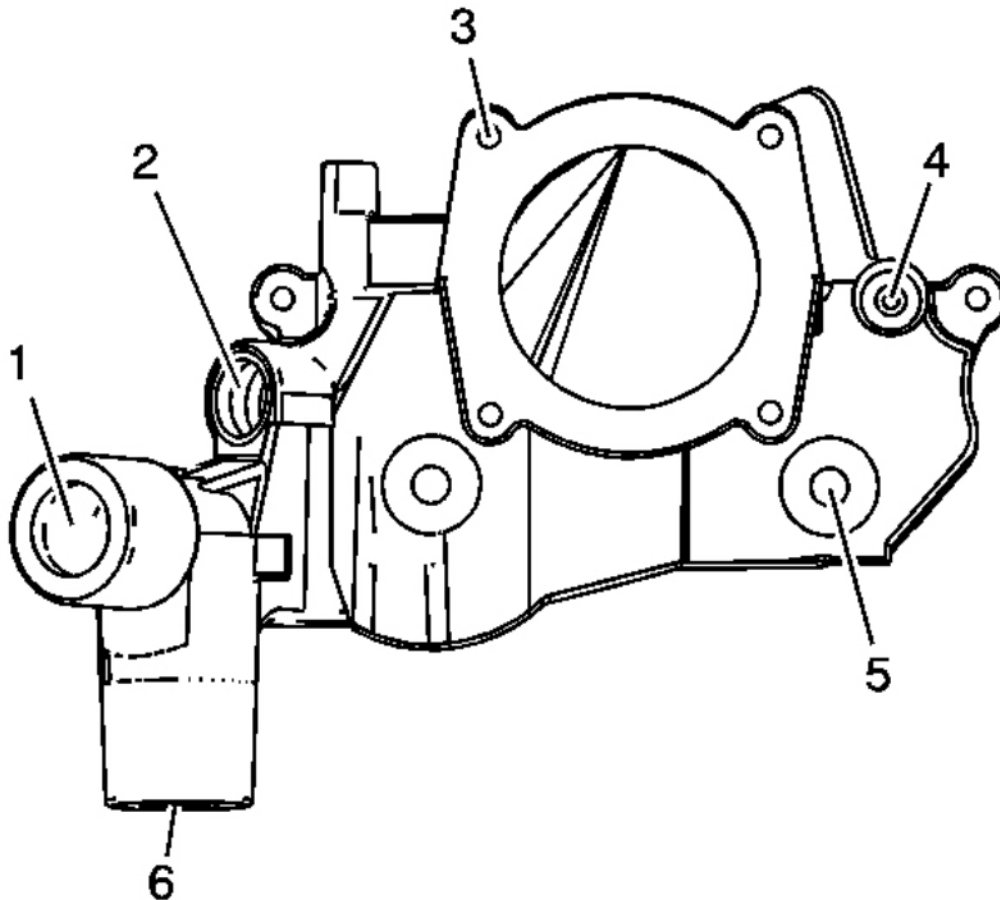


Fig. 45: Inspecting Front Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

1. Inspect the front of the water outlet housing for the following:
 - Damage or restrictions to the radiator hose connection (1)
 - Damage to the threads for the heater hose fitting (2)
 - Damage to the threads for the throttle body bolts (3)
 - Damage to the threads for the engine coolant air bleed fitting (4)
 - Damage to the water outlet housing-to-cylinder head mounting holes (5)
 - Damage or restrictions to the bypass hose connection (6)

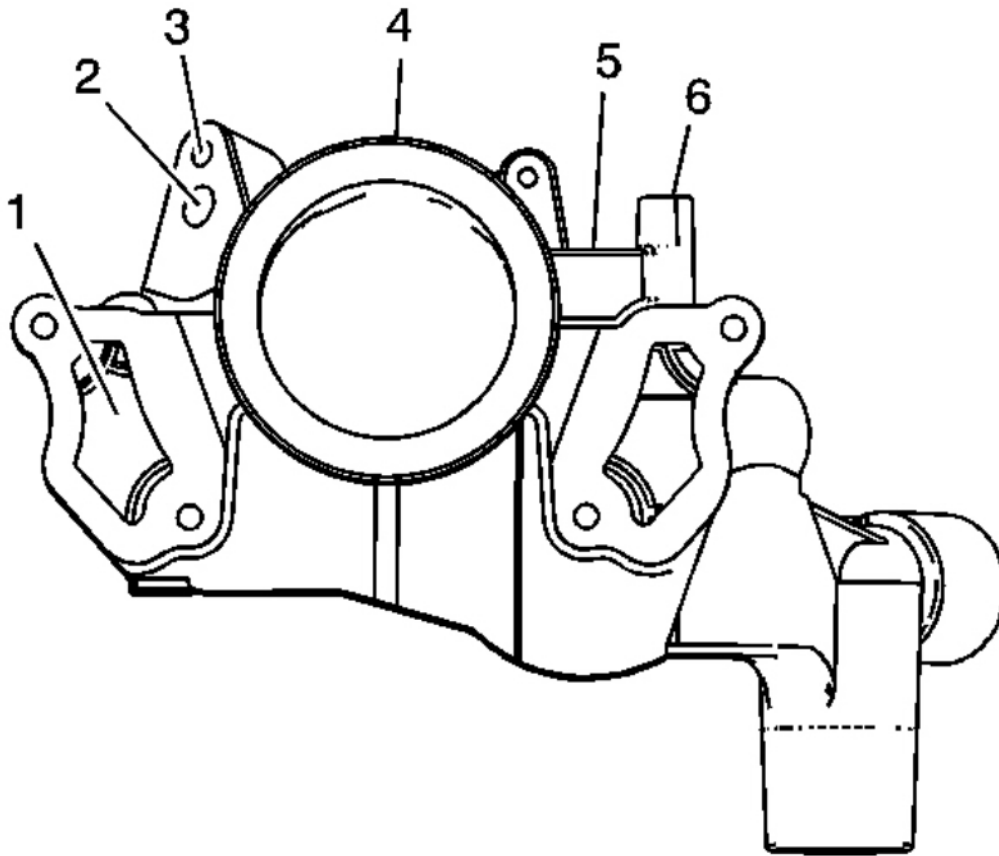


Fig. 46: Inspecting Rear Of Water Outlet Housing
Courtesy of GENERAL MOTORS CORP.

2. Inspect the rear of the water outlet housing for the following:
 - Damage, blockage or excessive corrosion to the engine coolant passages (1)
 - Damage or restrictions to the EVAP purge solenoid port (2)
 - Damage to the threads for the EVAP purge solenoid bolt (3)
 - Damage to the sealing surface for the intake manifold duct (4)
 - Damage or restrictions to the MAP sensor port (5)
 - Damage to the threads for the MAP sensor bolt (6)
3. Repair or replace the water outlet housing as necessary.

WATER OUTLET HOUSING ASSEMBLE

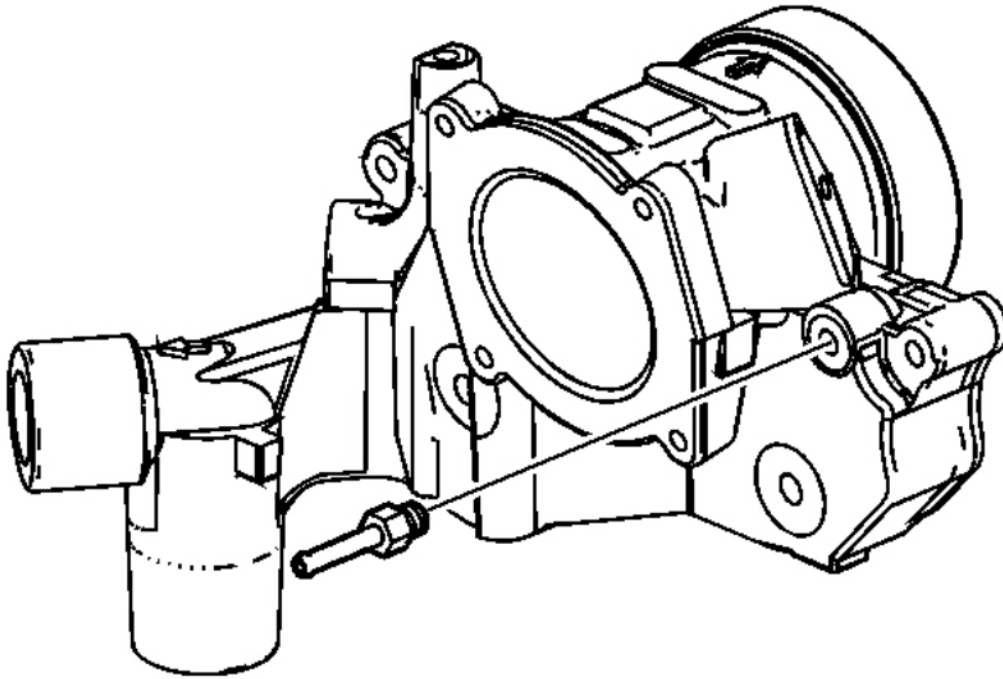


Fig. 47: View Of Engine Coolant Air Bleed Fitting
Courtesy of GENERAL MOTORS CORP.

1. Install NEW O-rings on the EVAP purge valve and MAP sensor.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the coolant fitting.

Tighten: Tighten the engine coolant air bleed fitting to 10 N.m (89 lb in).

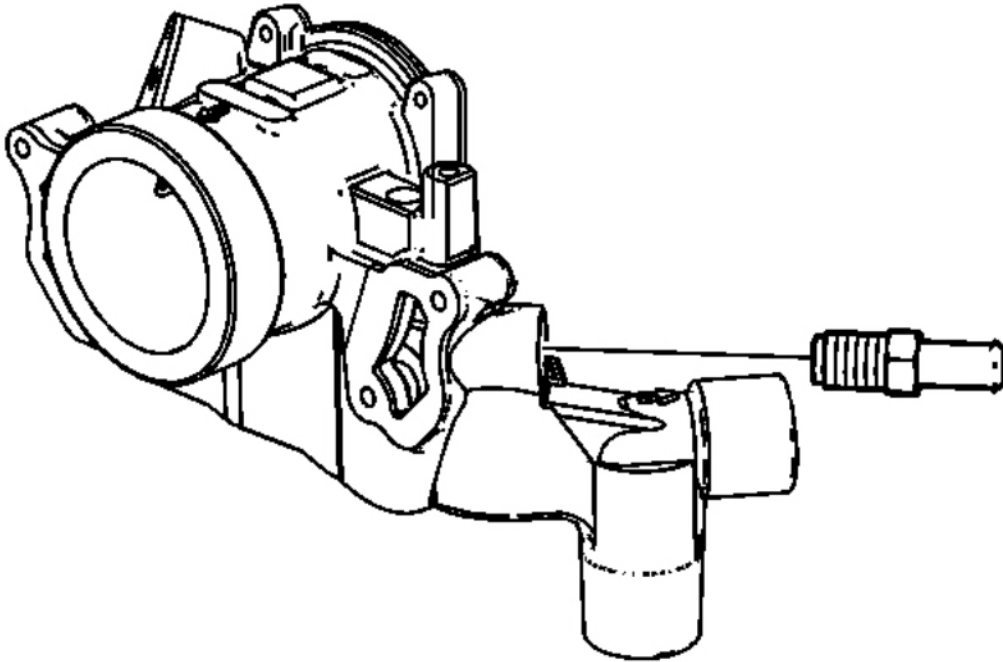


Fig. 48: View Of Heater Hose Fitting
Courtesy of GENERAL MOTORS CORP.

3. Install the heater hose fitting.

Tighten: Tighten the heater hose fitting to 45 N.m (33 lb ft).

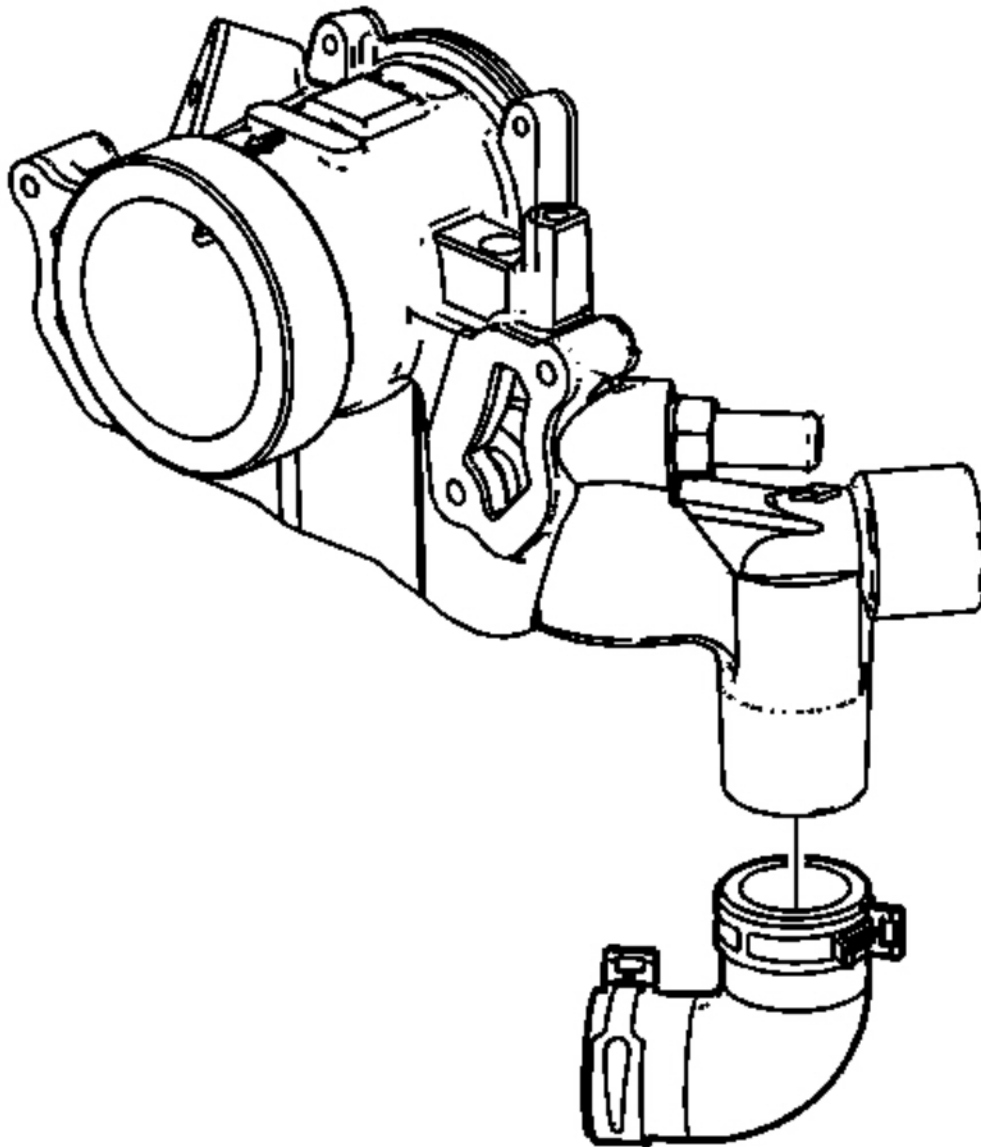


Fig. 49: View Of Bypass Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the NEW bypass hose.
5. Position the bypass hose clamp.

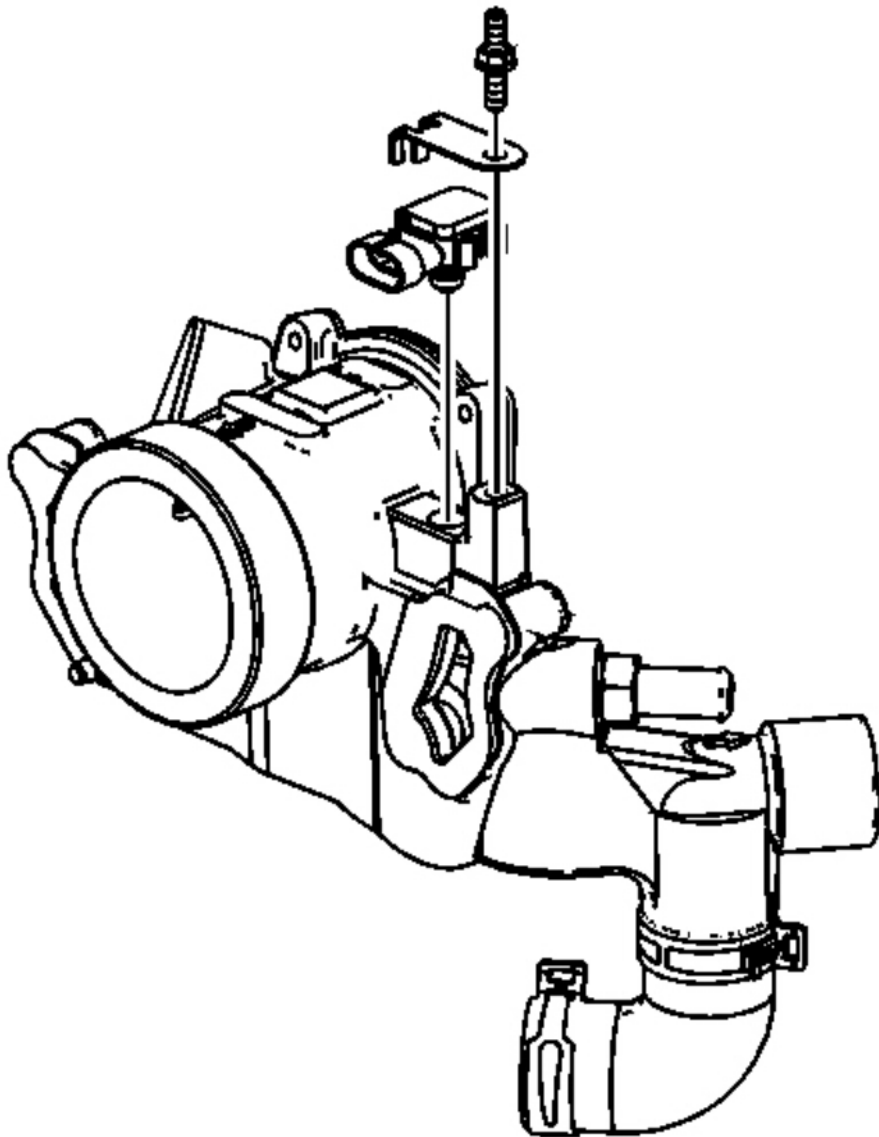


Fig. 50: View Of MAP Sensor
Courtesy of GENERAL MOTORS CORP.

6. Install the MAP sensor.
7. Install the MAP sensor bolt.

Tighten: Tighten the MAP sensor bolt to 10 N.m (89 lb in).

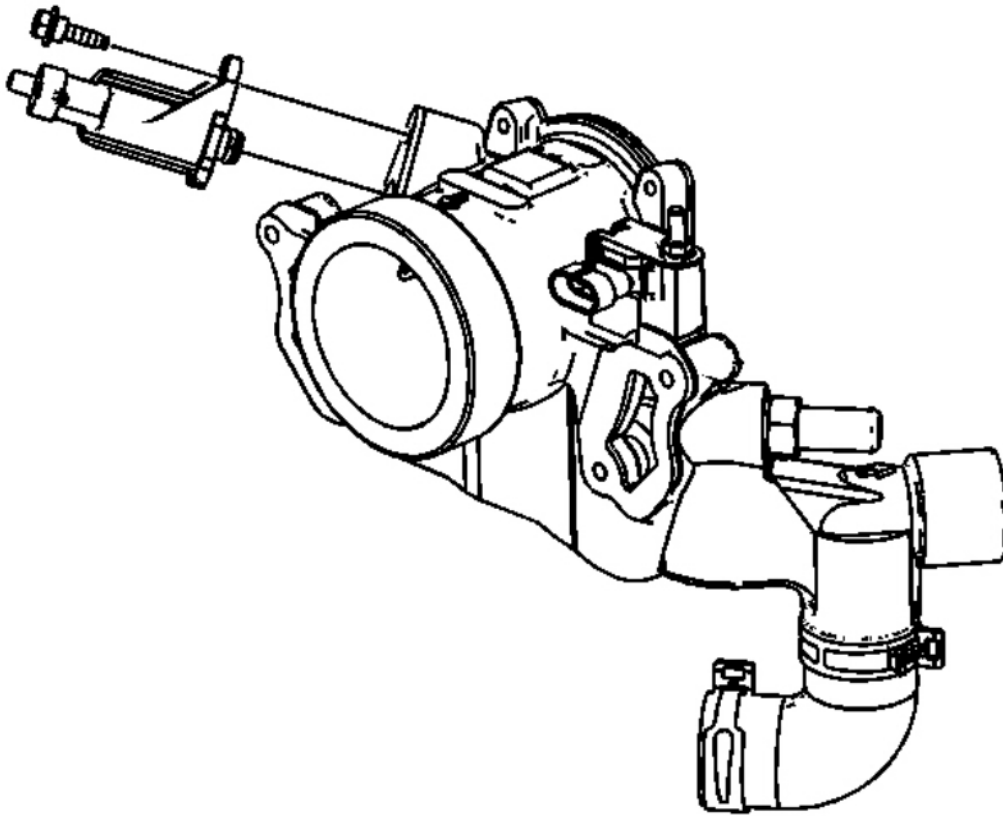


Fig. 51: View Of EVAP Purge Valve
Courtesy of GENERAL MOTORS CORP.

8. Install the EVAP purge valve.
9. Install the EVAP purge valve bolt.

Tighten: Tighten the EVAP purge valve bolt to 10 N.m (89 lb in).

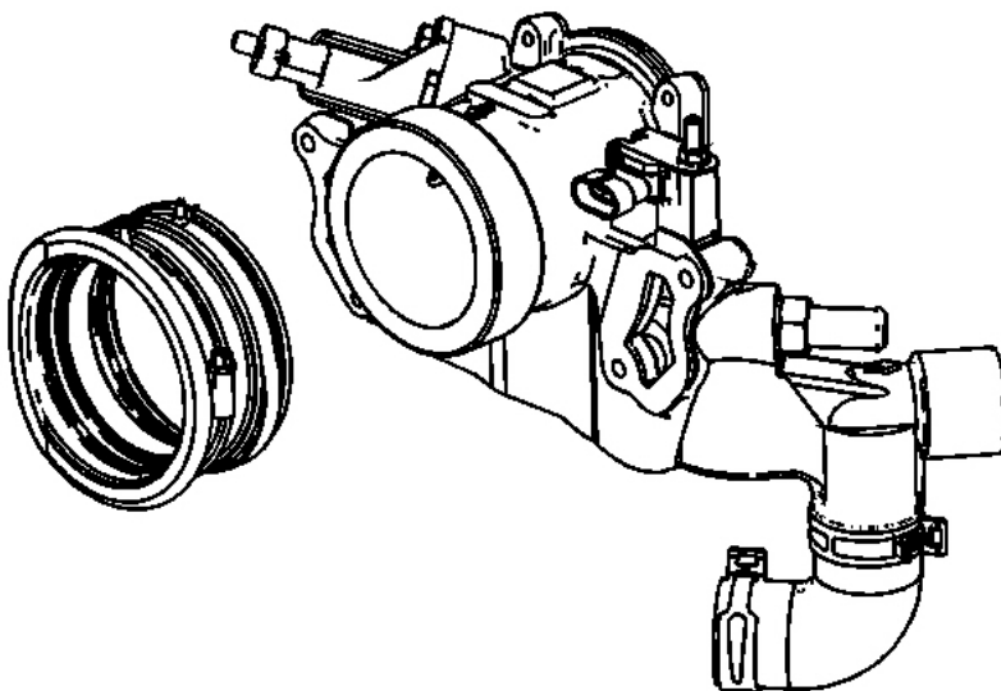


Fig. 52: View Of Intake Manifold Plenum Duct
Courtesy of GENERAL MOTORS CORP.

10. Install the intake manifold plenum duct.
11. Tighten the intake manifold plenum duct clamp.

Tighten: Tighten the intake manifold plenum duct clamp to 2.25 N.m (20 lb in).

THREAD REPAIR

Tools Required

- **J 42385-2000** Thread Insert Kit
- **J 42385-2030** M11 x 2.0 Cylinder Head Bolt - Northstar/Premium V8 Thread Repair 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.

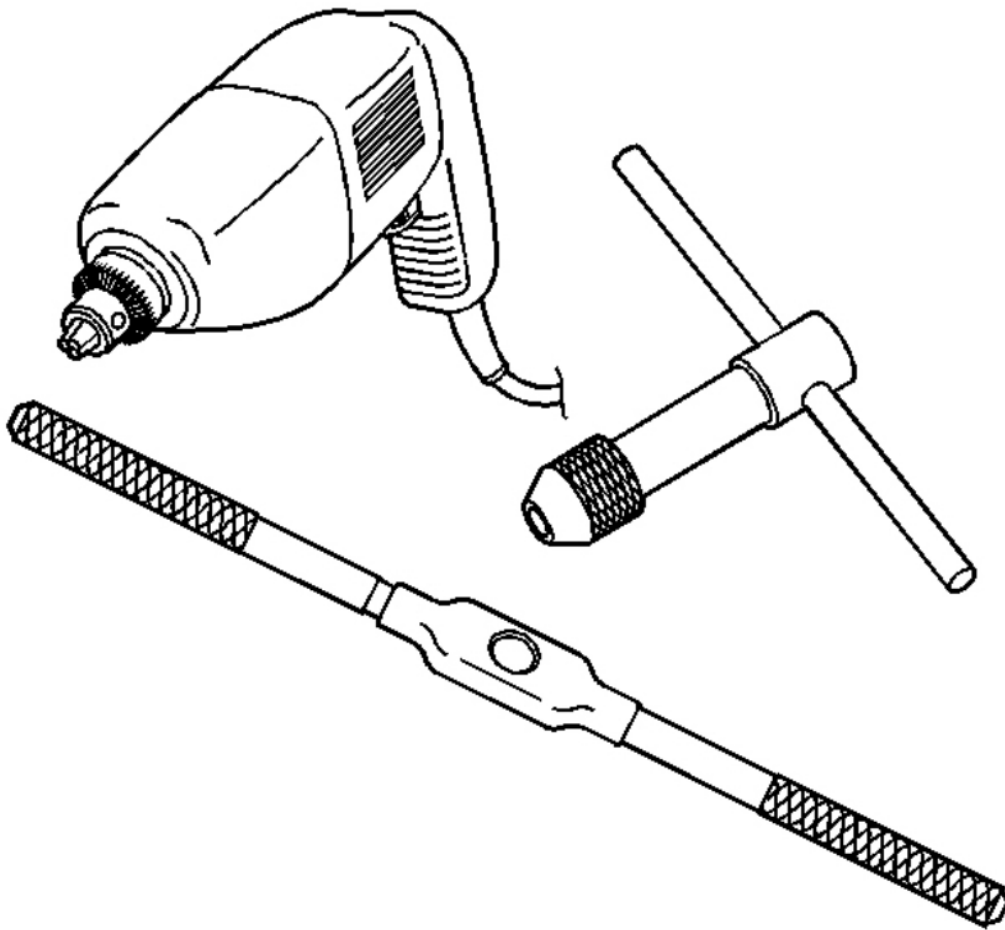


Fig. 53: View Of J 42385-400 Tool Kit
Courtesy of GENERAL MOTORS CORP.

The drill bit and counter bore tool from the tool kit **J 42385-2000** and **J 42385-2030** 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.

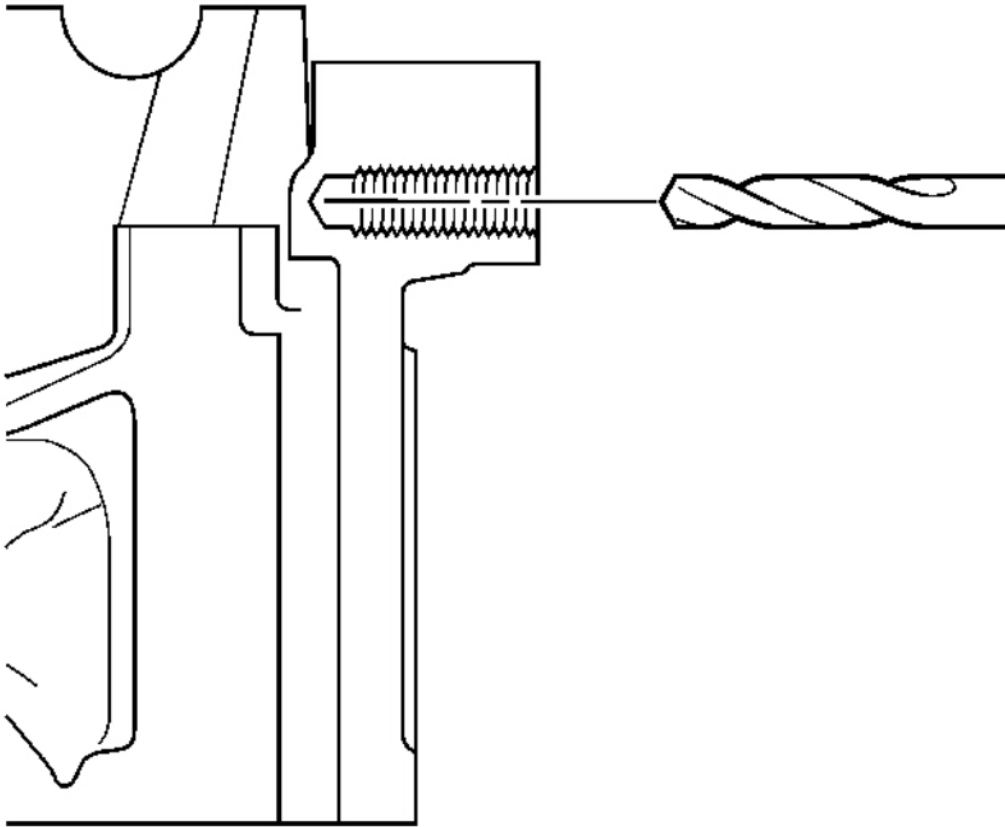


Fig. 54: Drilled Hole Centerline
Courtesy of GENERAL MOTORS CORP.

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

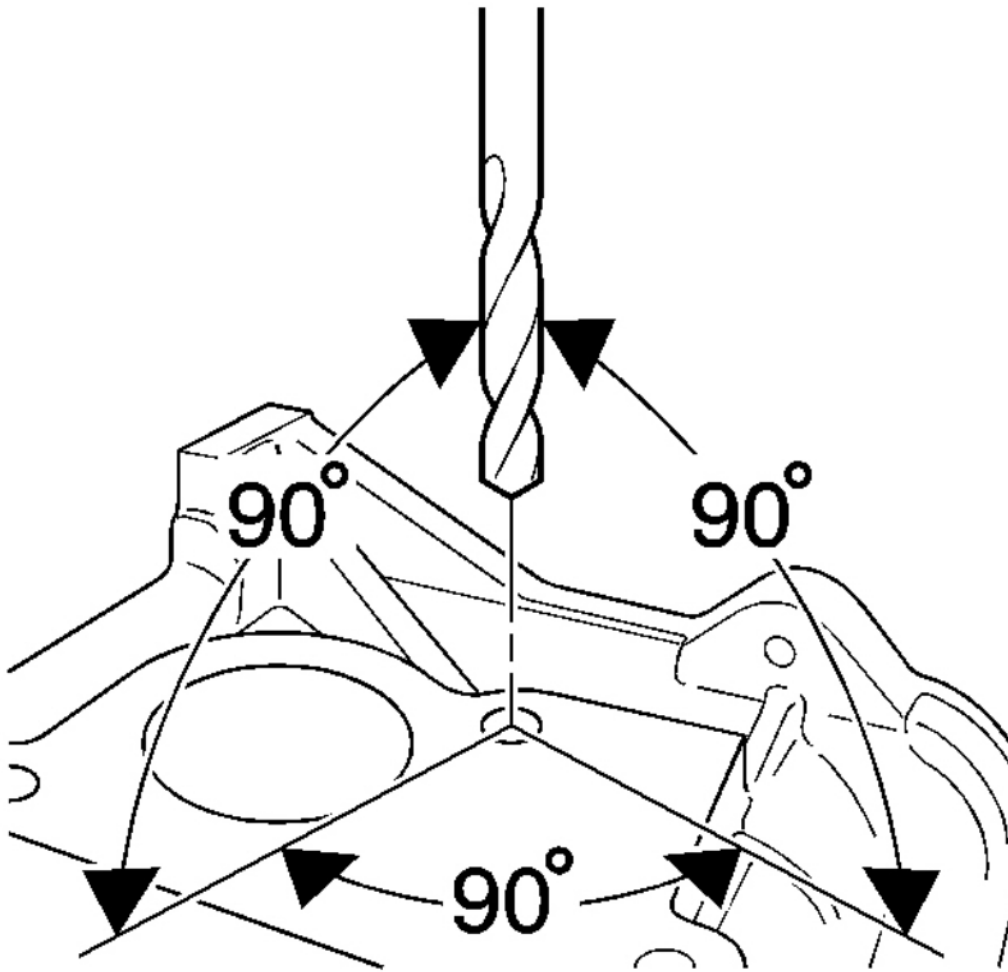


Fig. 55: Identifying Proper Drilling Angle
Courtesy of GENERAL MOTORS CORP.

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

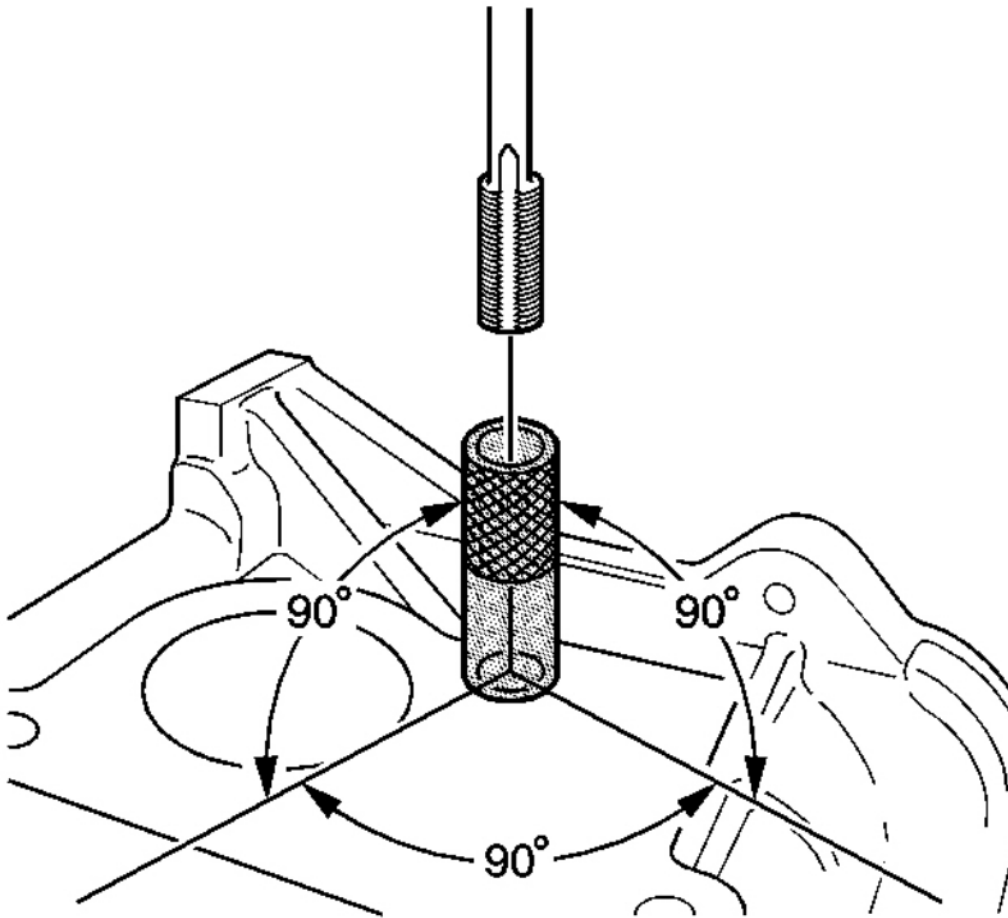


Fig. 56: View Of Tapping Guide
Courtesy of GENERAL MOTORS CORP.

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

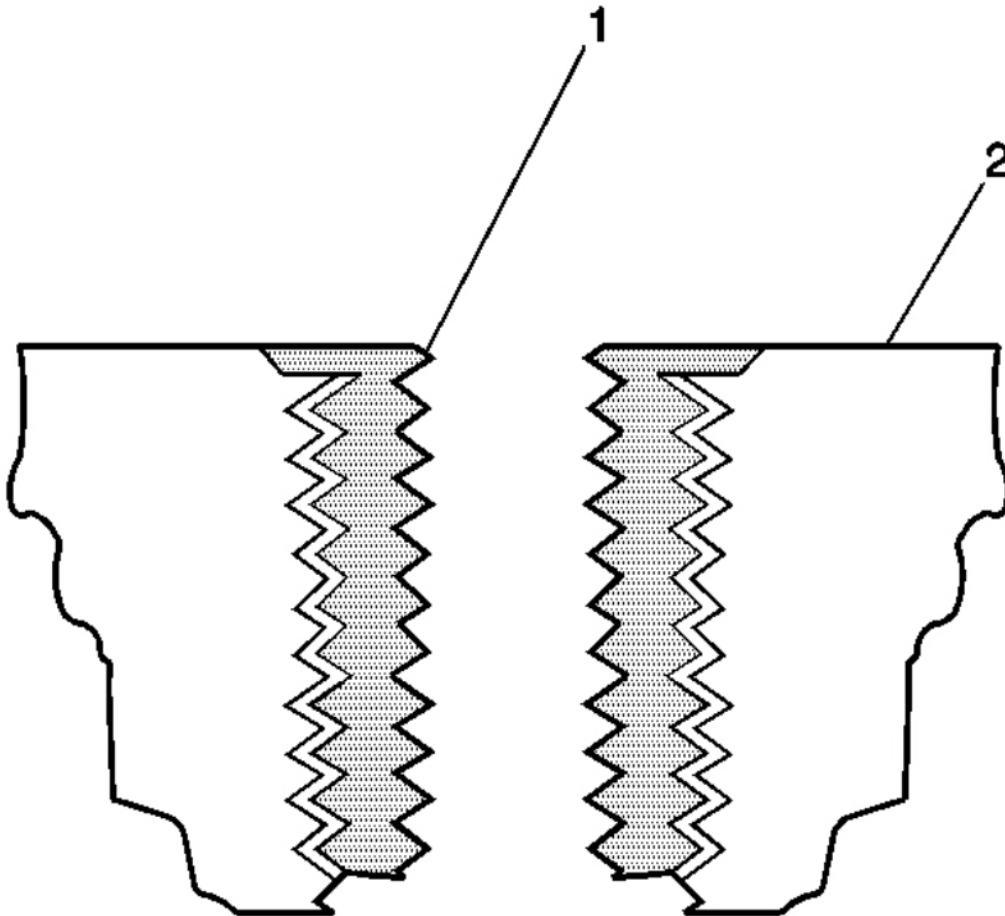


Fig. 57: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

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.

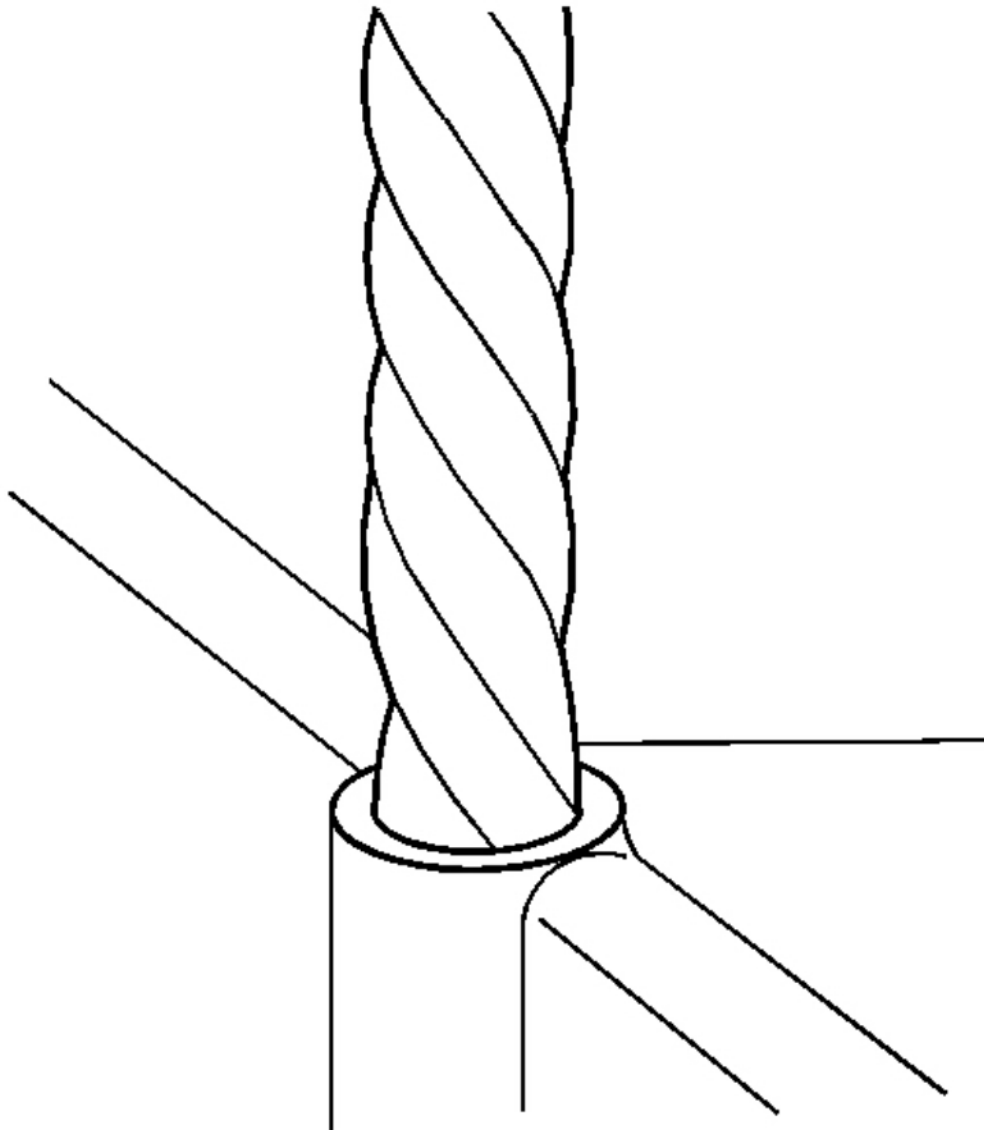


Fig. 58: Drilling Out Threads Of Damaged Hole
Courtesy of GENERAL MOTORS CORP.

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.

- 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).

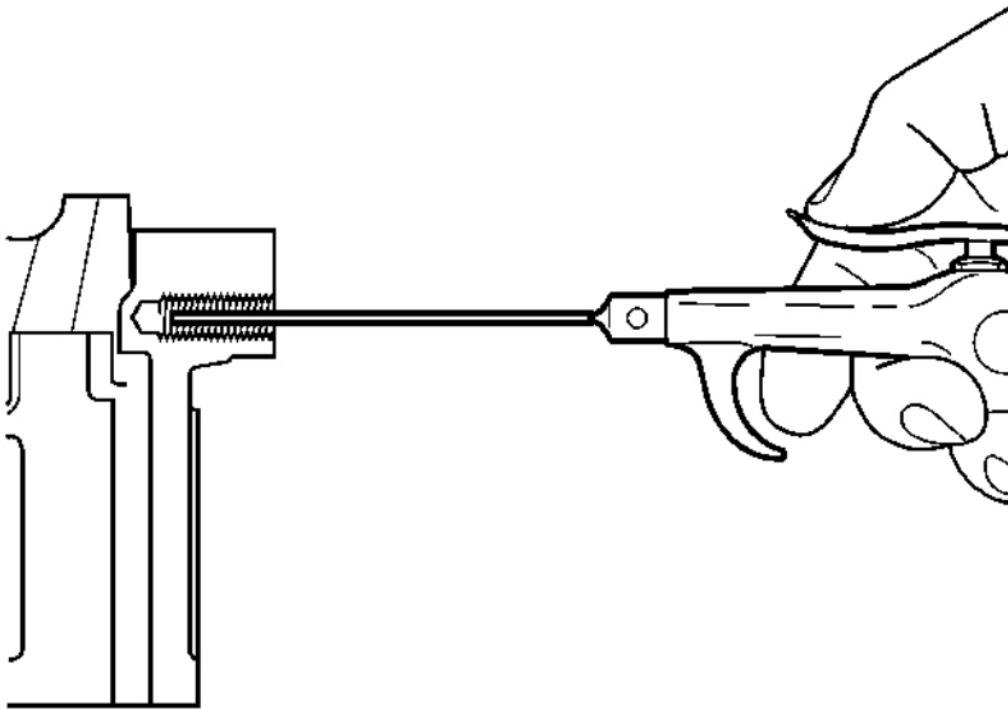


Fig. 59: Cleaning Out Metal Chips

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.

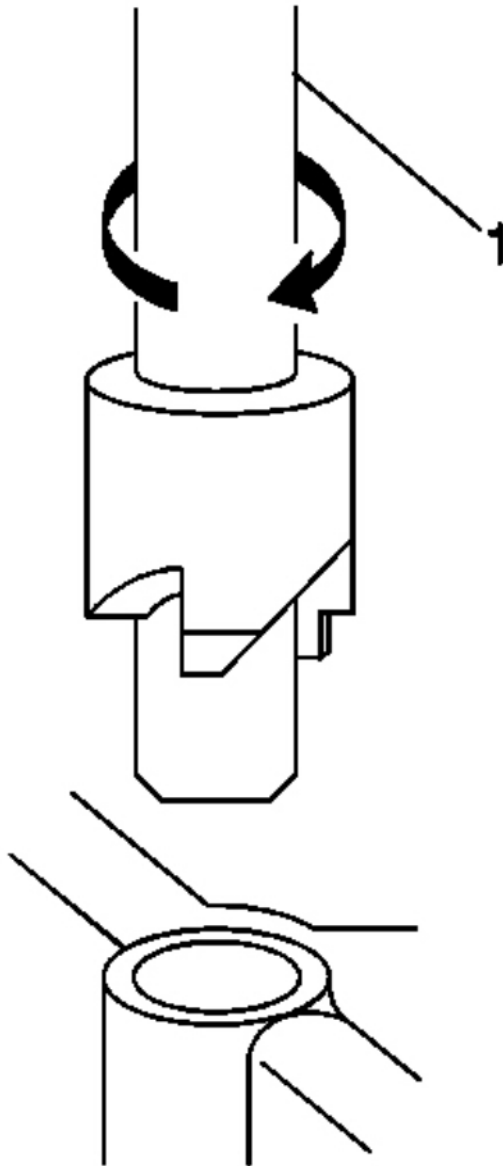


Fig. 60: View Of Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

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).

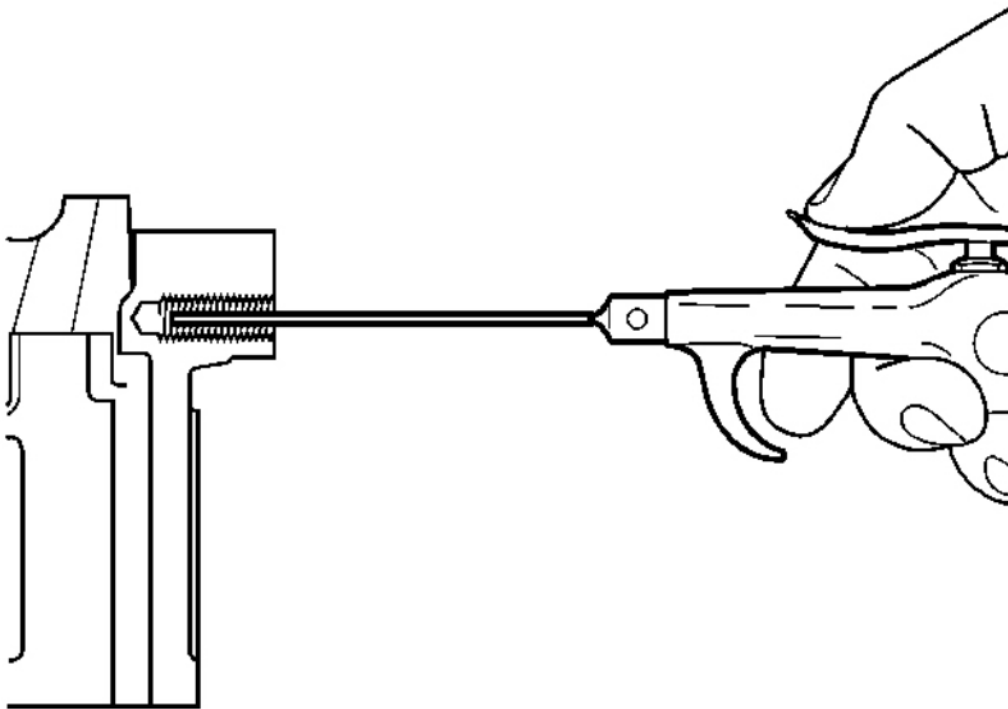


Fig. 61: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

4. Using compressed air, clean out any chips.

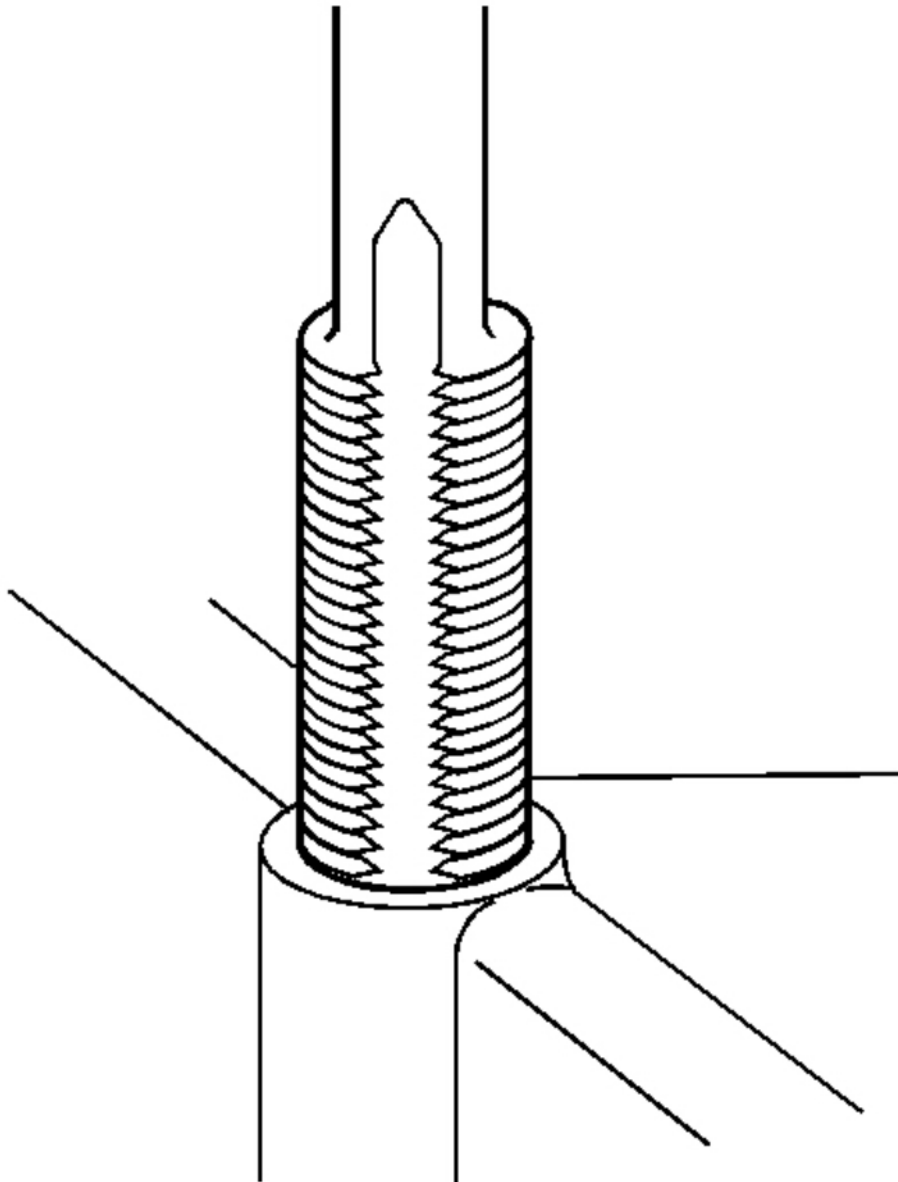


Fig. 62: Tapping Threads Of Drilled Hole
Courtesy of GENERAL MOTORS CORP.

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.
 - 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).

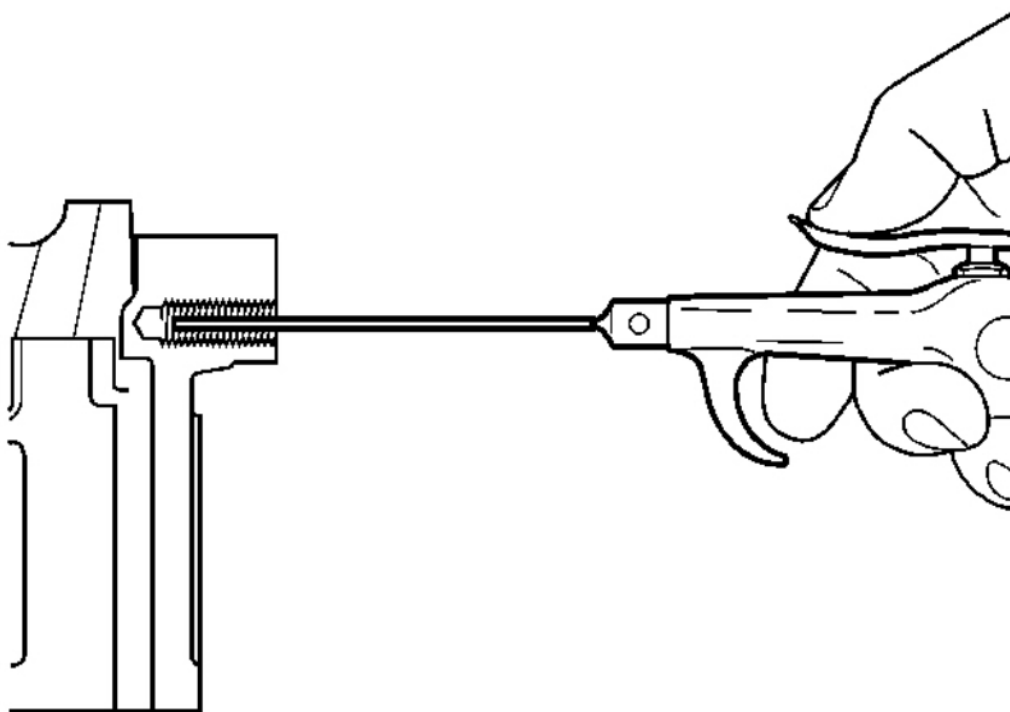


Fig. 63: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

6. Using compressed air, clean out any chips.

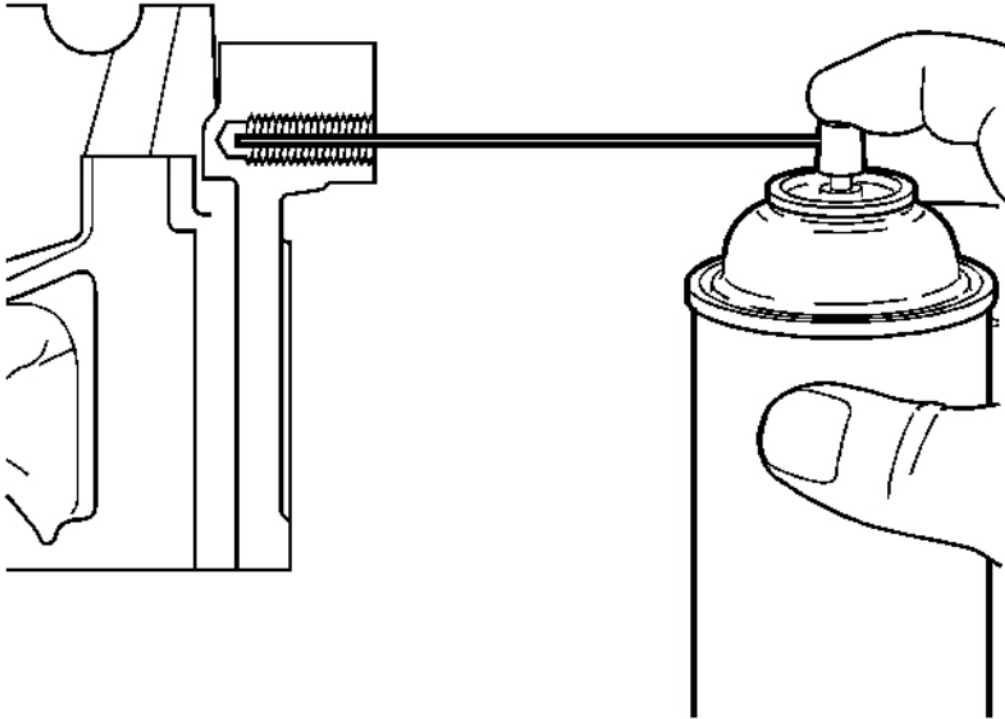


Fig. 64: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

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

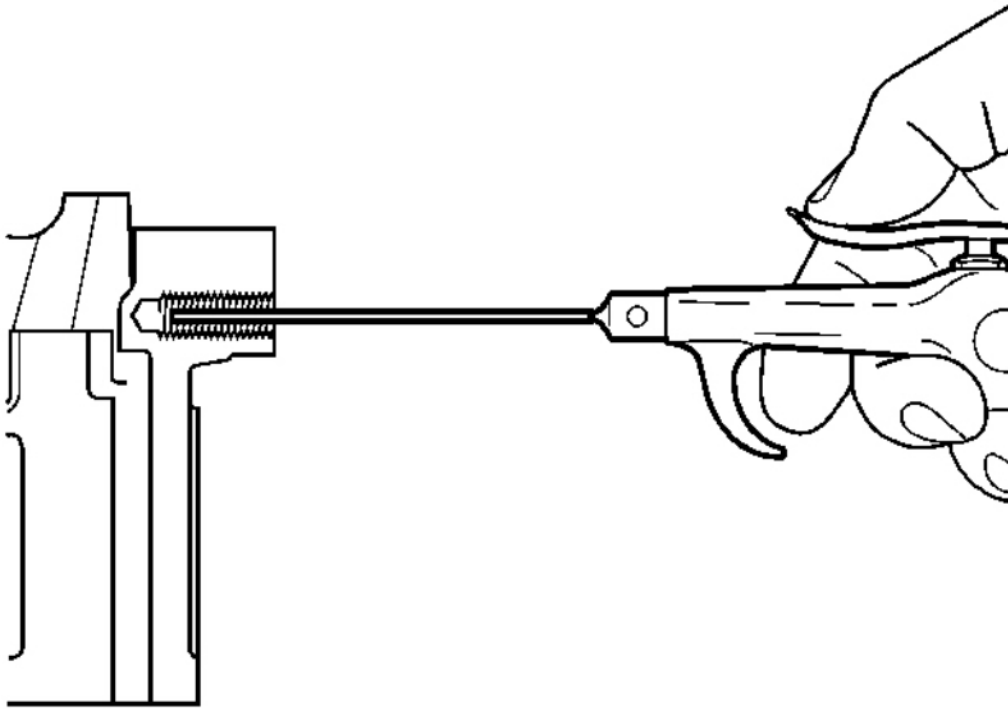


Fig. 65: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

8. Using compressed air, clean out any chips.

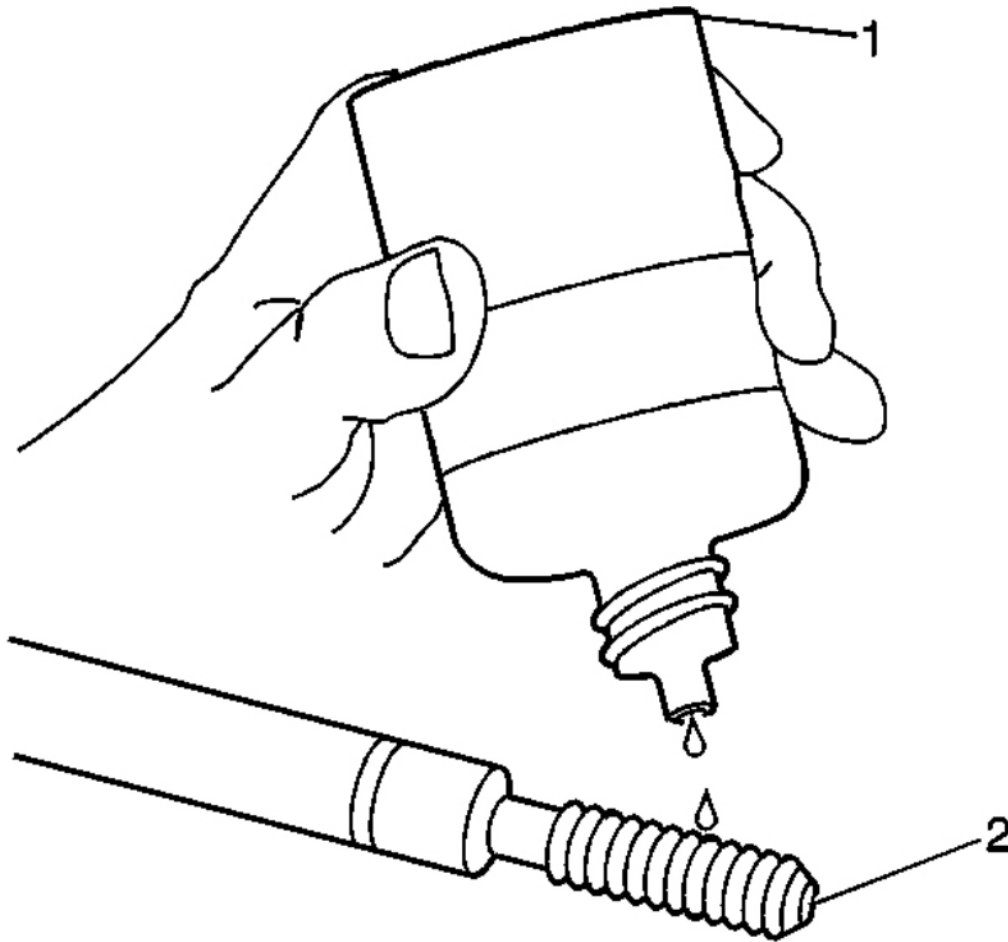


Fig. 66: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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 J 42385-110 (1).

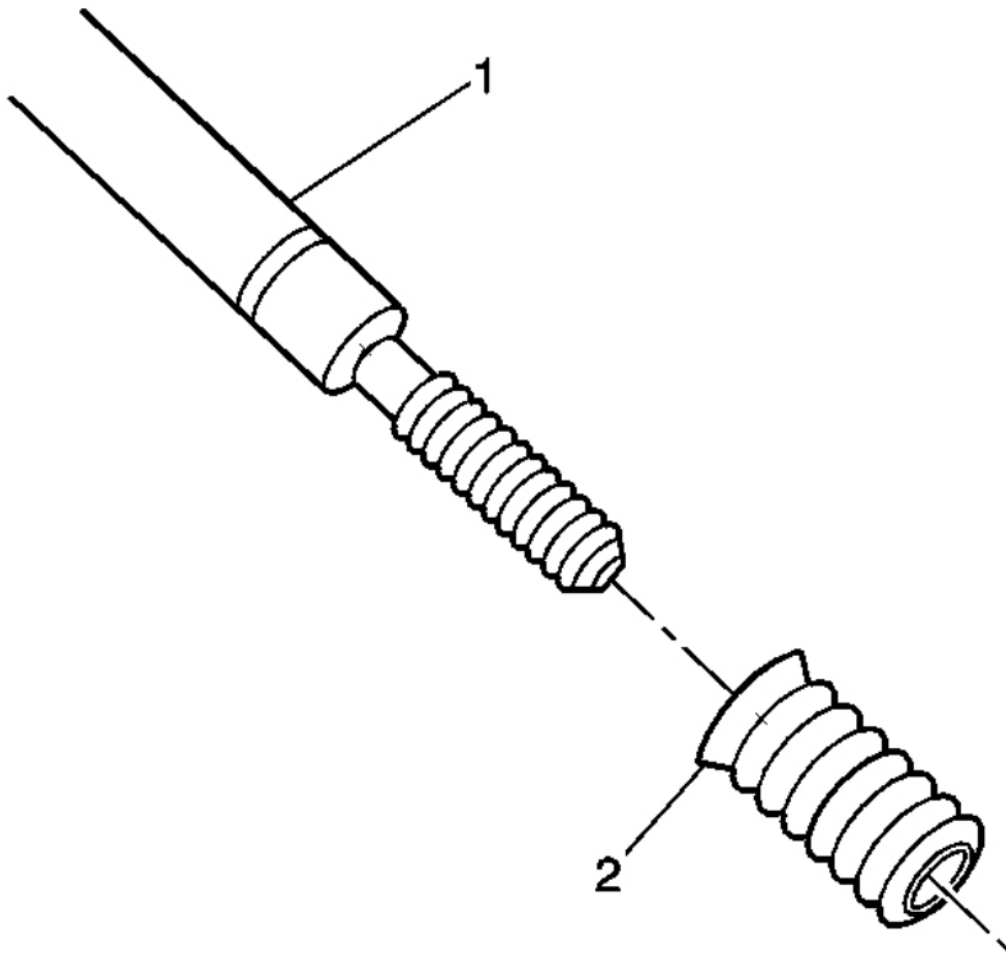


Fig. 67: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

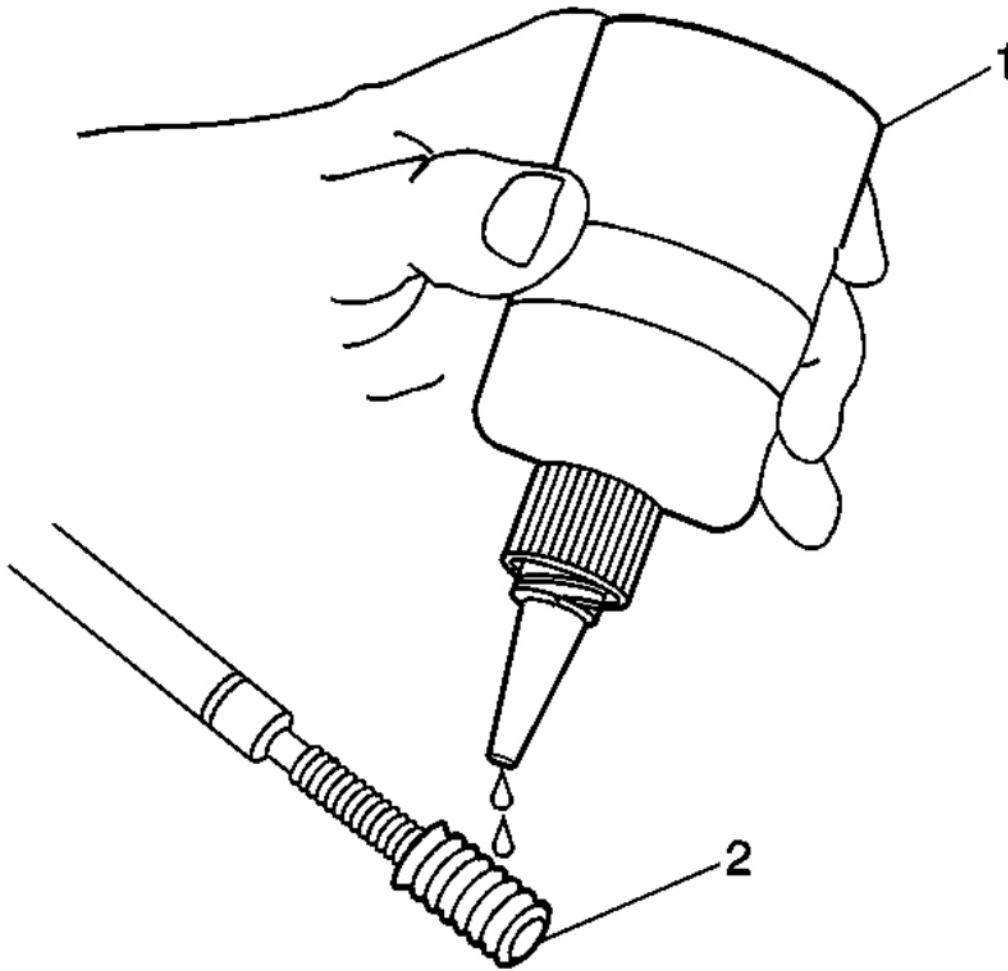


Fig. 68: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

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).

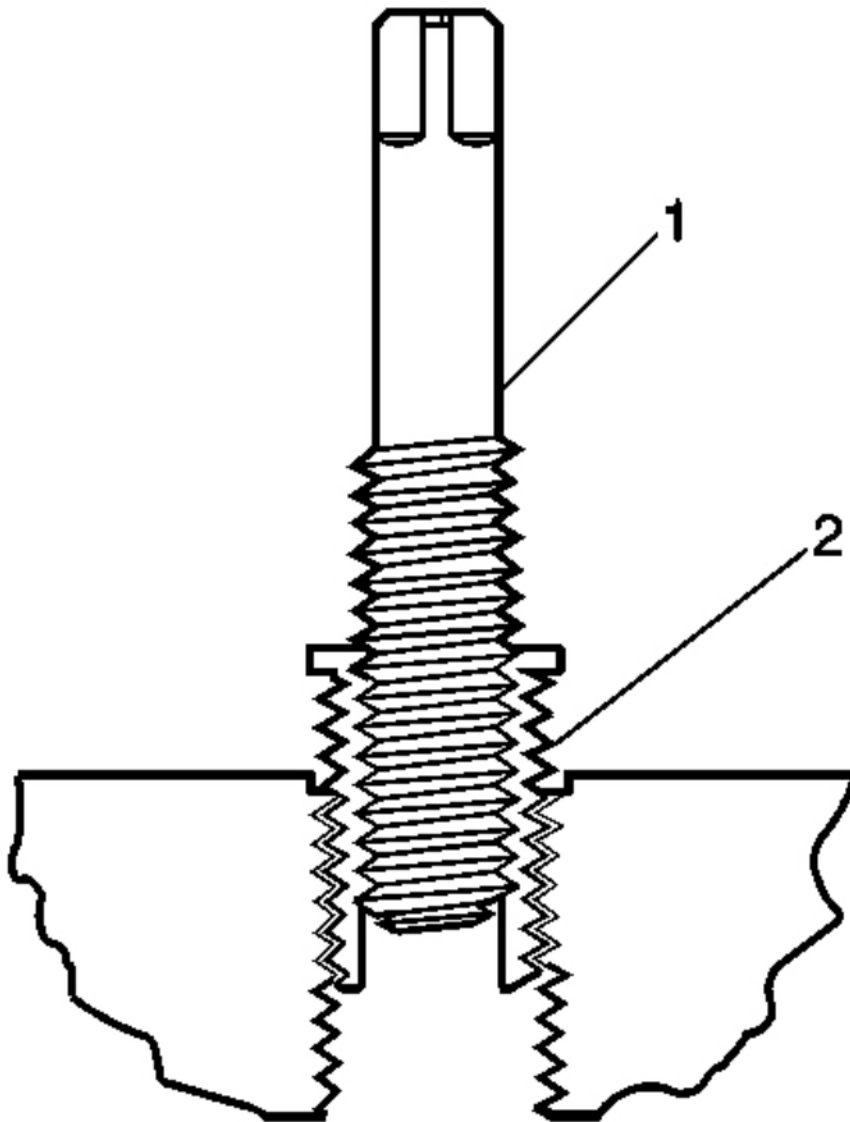


Fig. 69: Installing Insert Into Tapped Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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

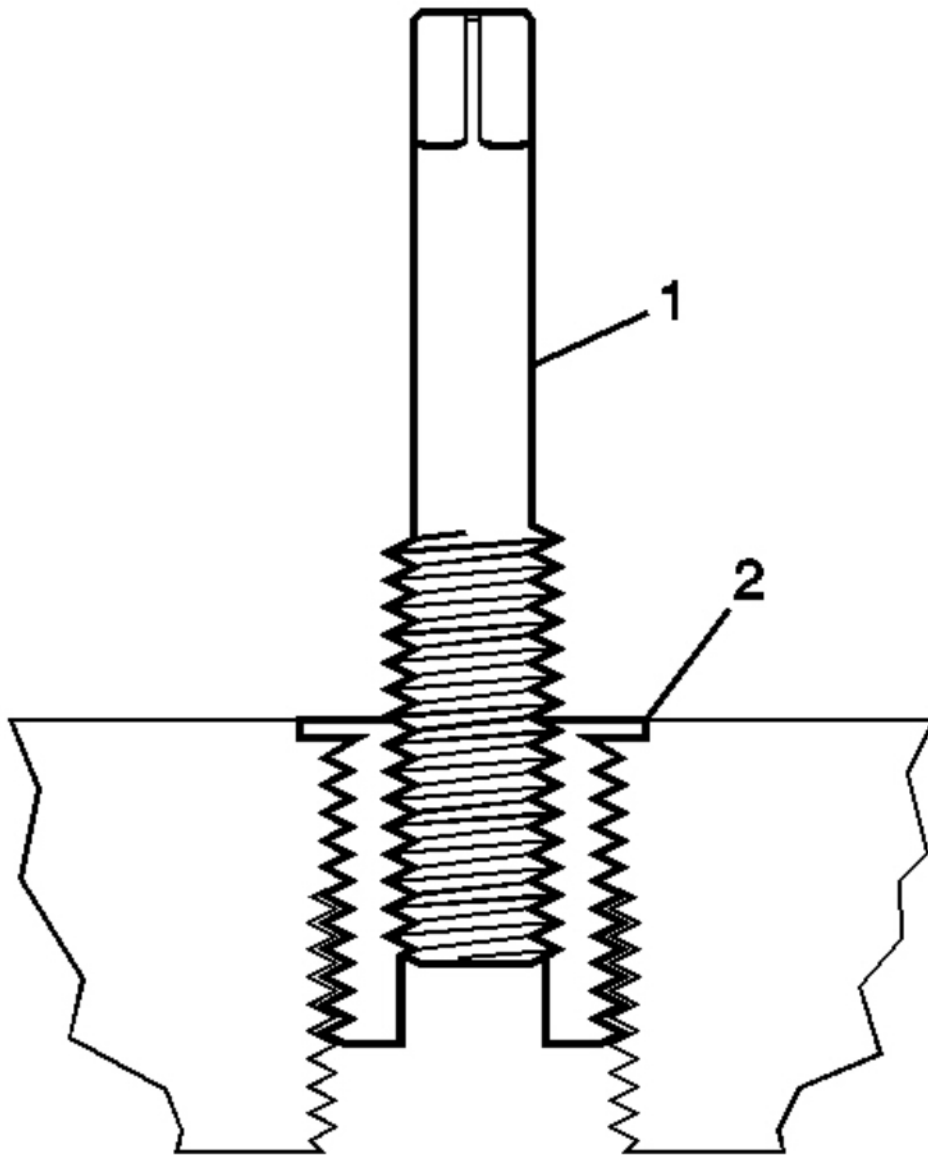


Fig. 70: Installing Insert - Standard Thread
Courtesy of GENERAL MOTORS CORP.

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.

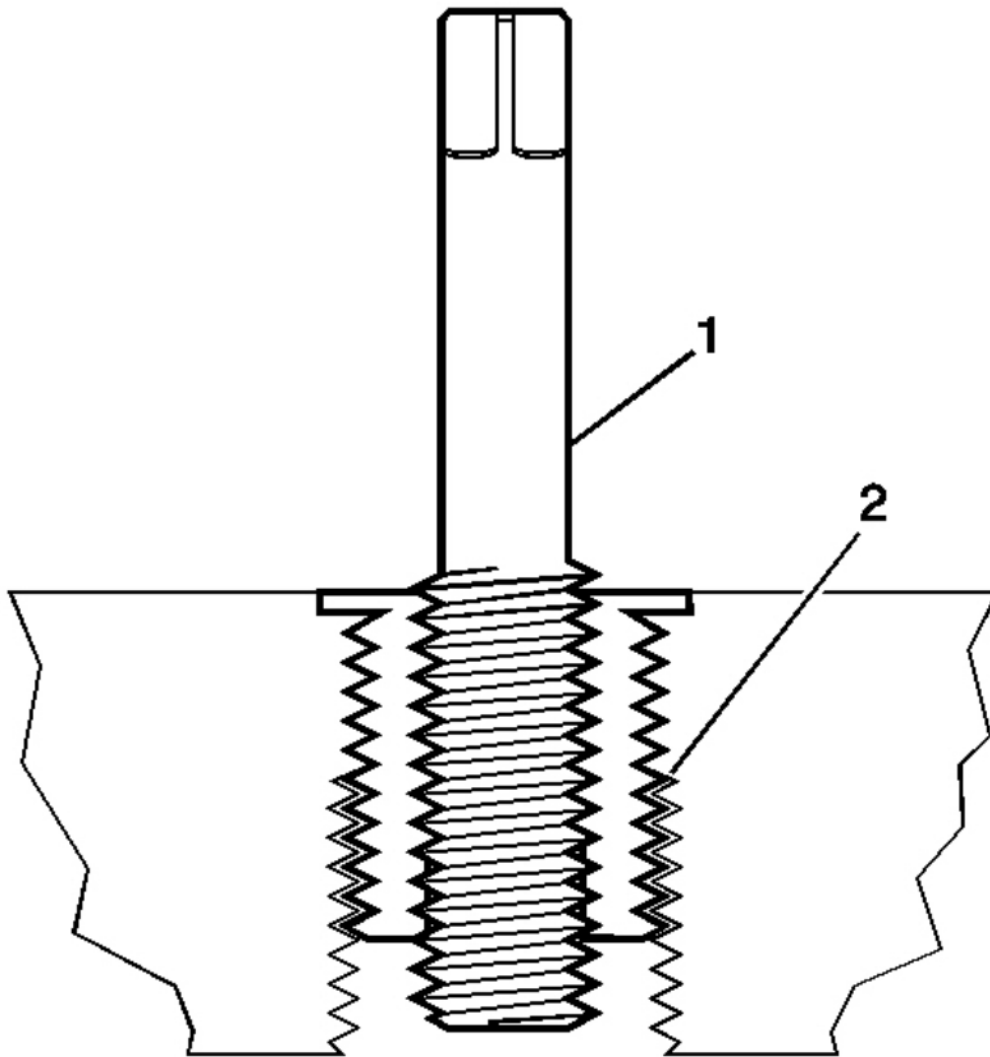


Fig. 71: View Insert And Tool - Standard Thread
Courtesy of GENERAL MOTORS CORP.

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).

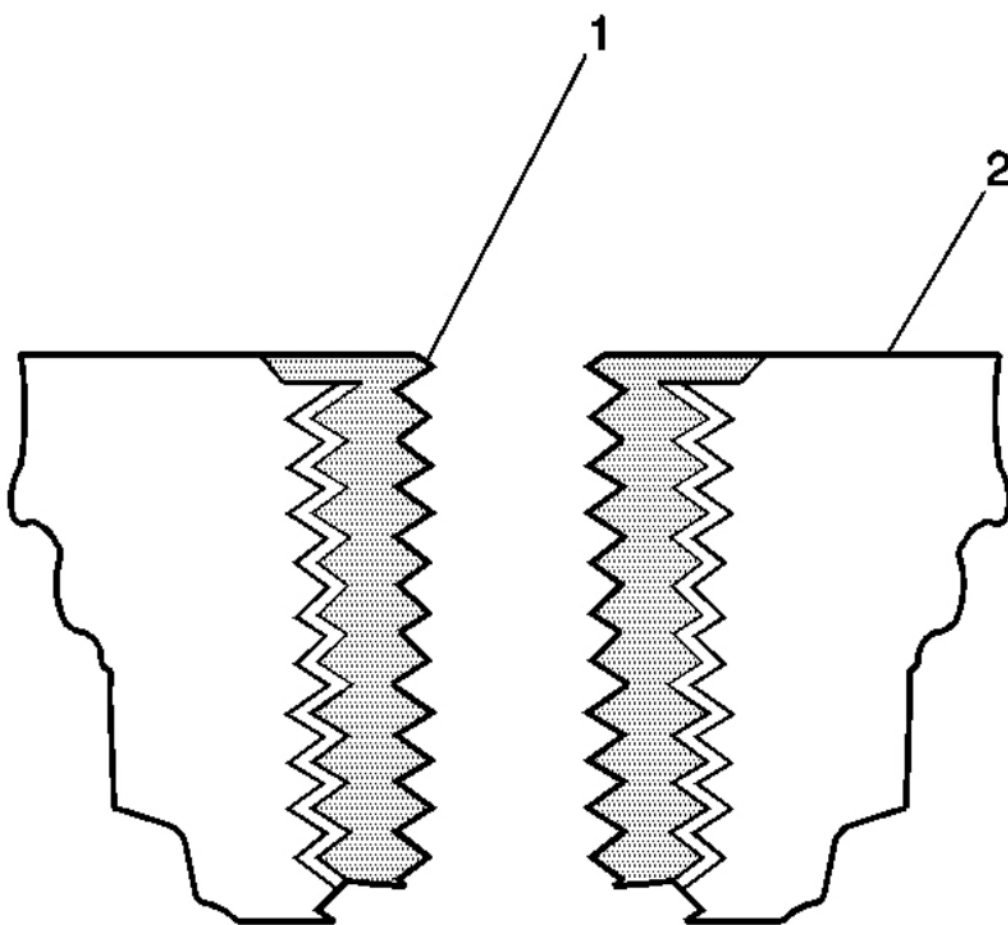


Fig. 72: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

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).

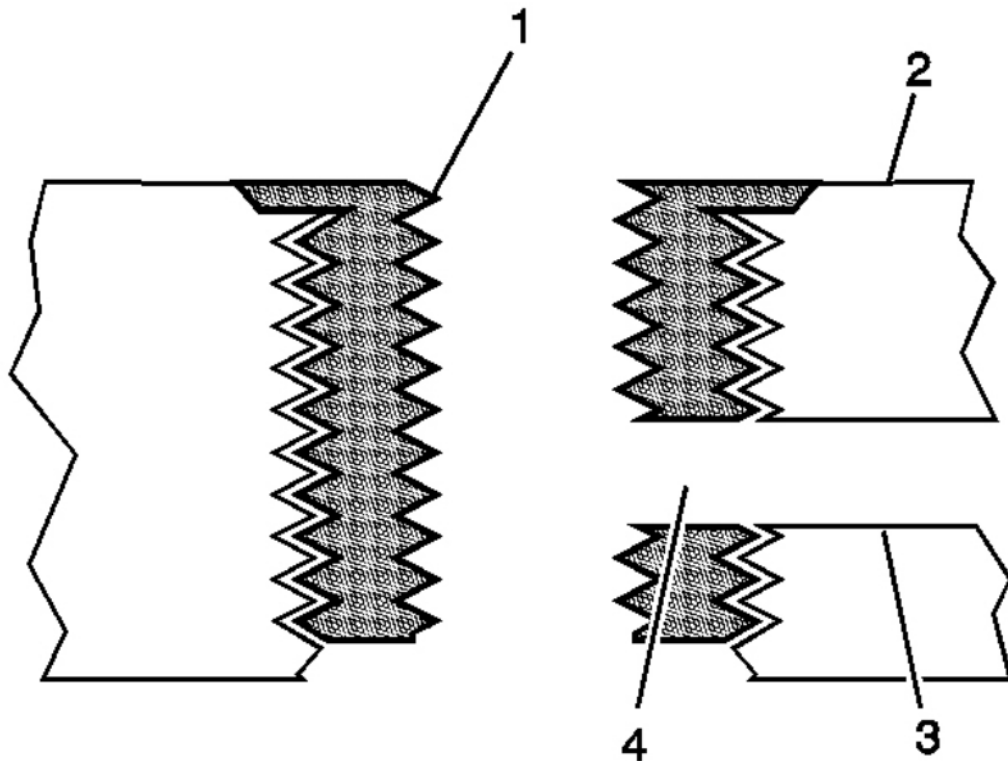


Fig. 73: View Of Restricted Engine Coolant Passages - Standard Thread Repair
Courtesy of GENERAL MOTORS CORP.

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

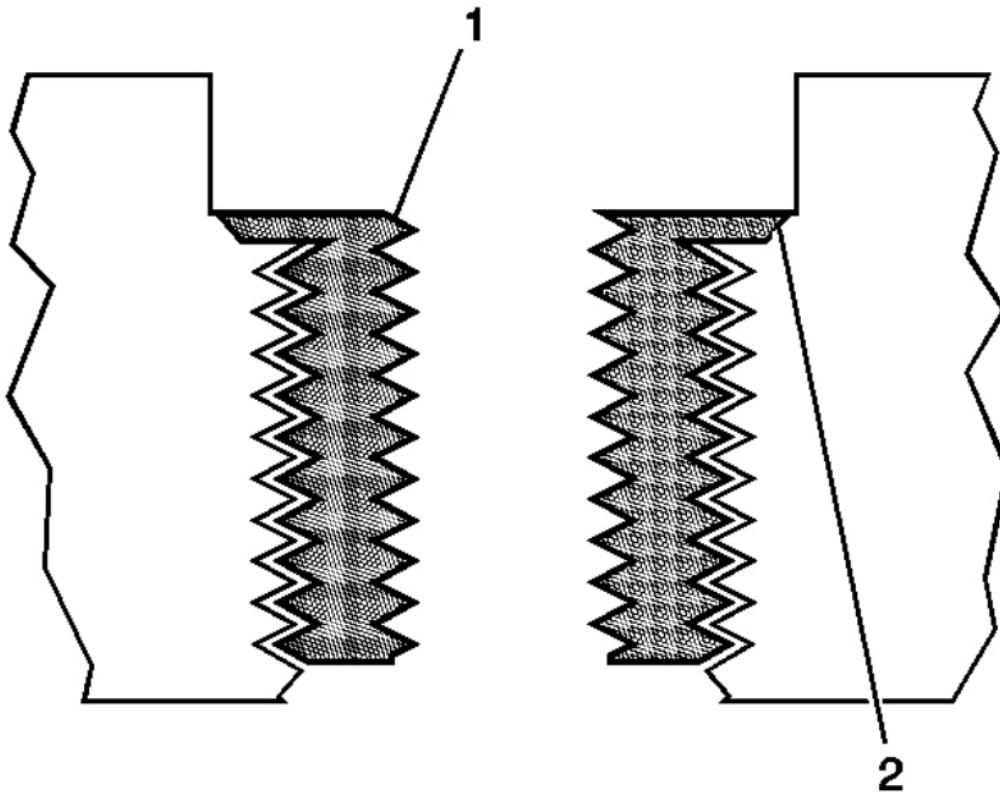


Fig. 74: Inspecting Insert For Proper Installation - Recessed Thread
 Courtesy of GENERAL MOTORS CORP.

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.

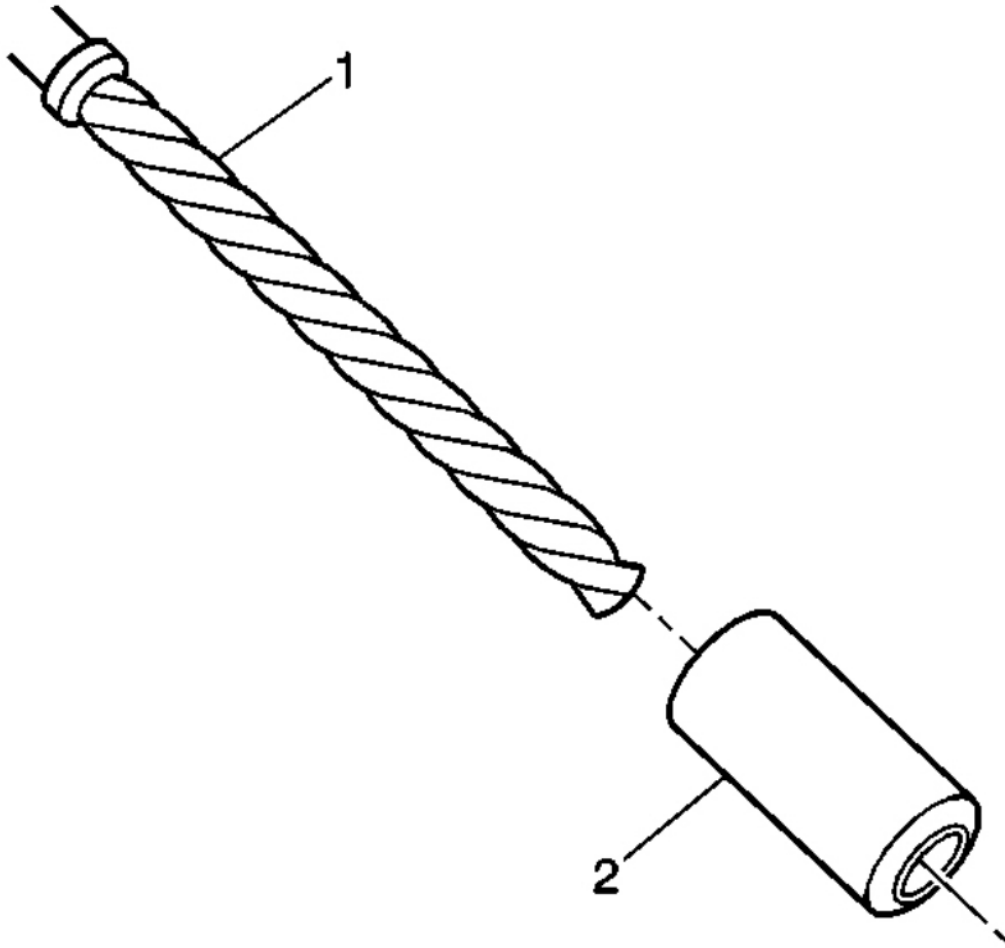


Fig. 75: View Of Stop Collar & Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

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

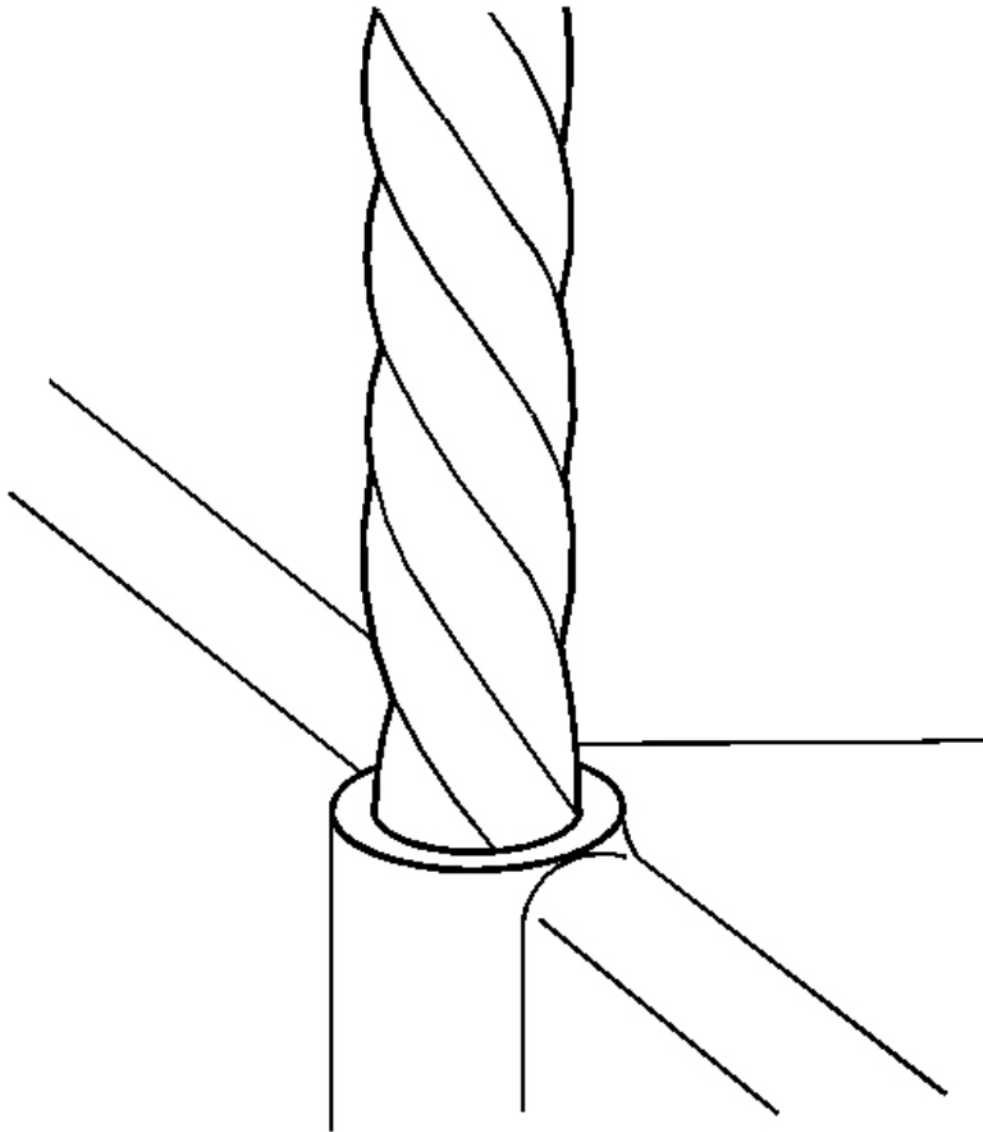


Fig. 76: Drilling Out Threads Of Damaged Hole

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.

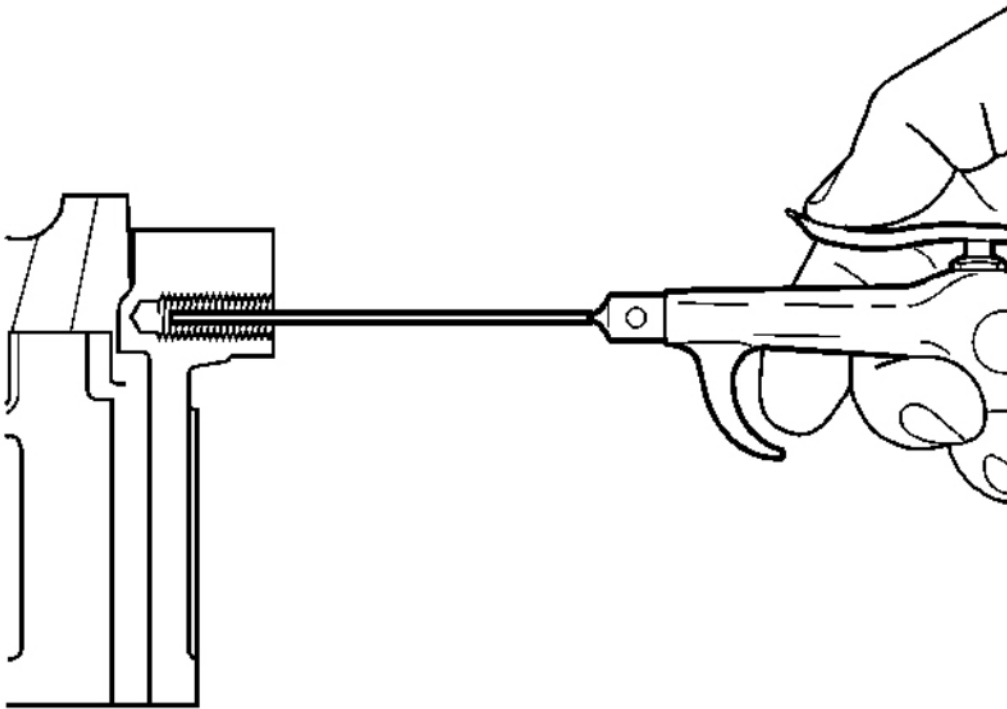


Fig. 77: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

3. Using compressed air, clean out any chips.

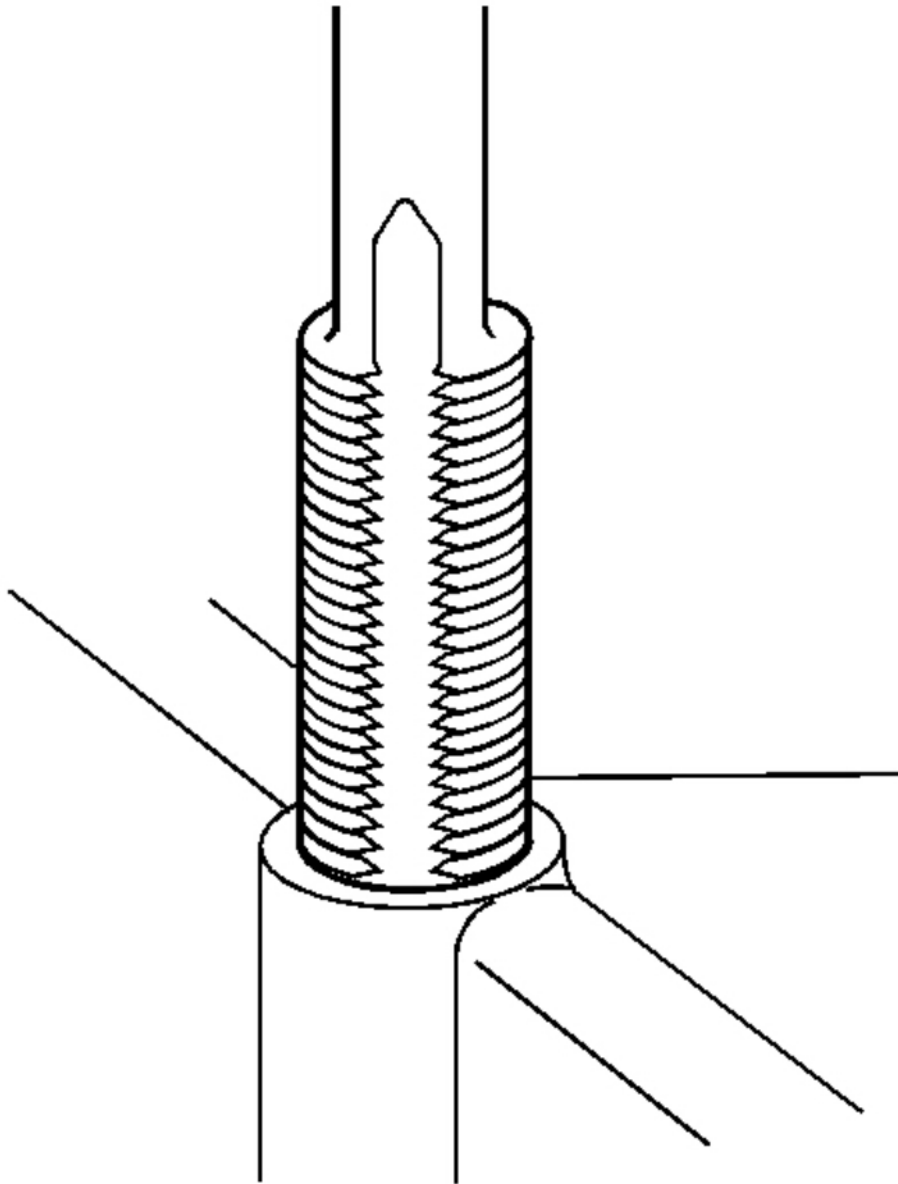


Fig. 78: Tapping Threads Of Drilled Hole
Courtesy of GENERAL MOTORS CORP.

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.

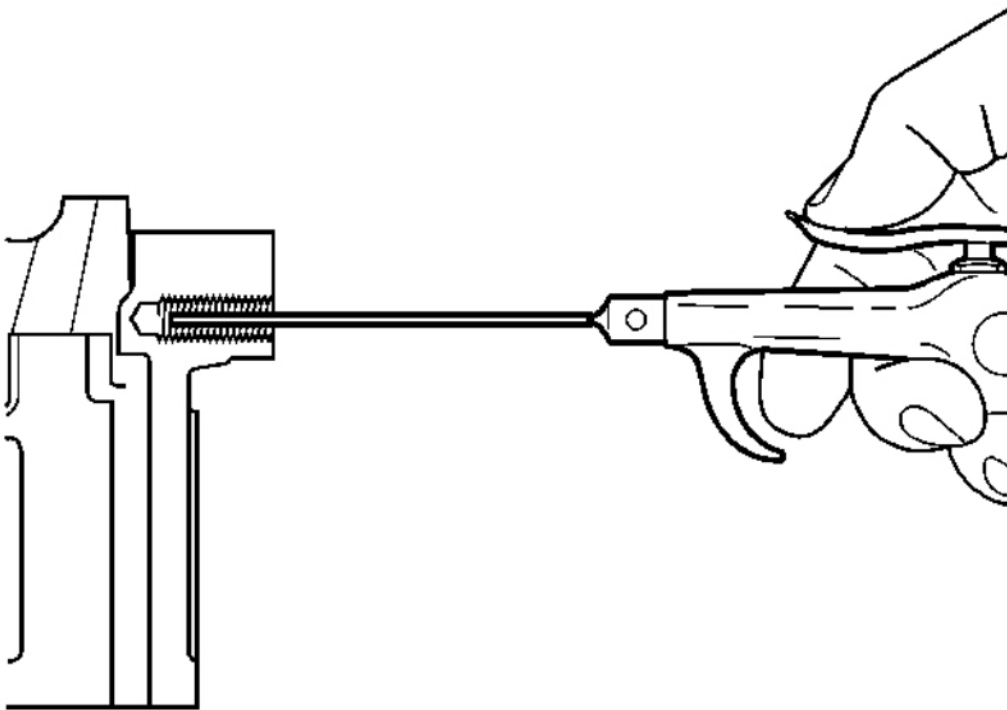


Fig. 79: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

5. Using compressed air, clean out any chips.

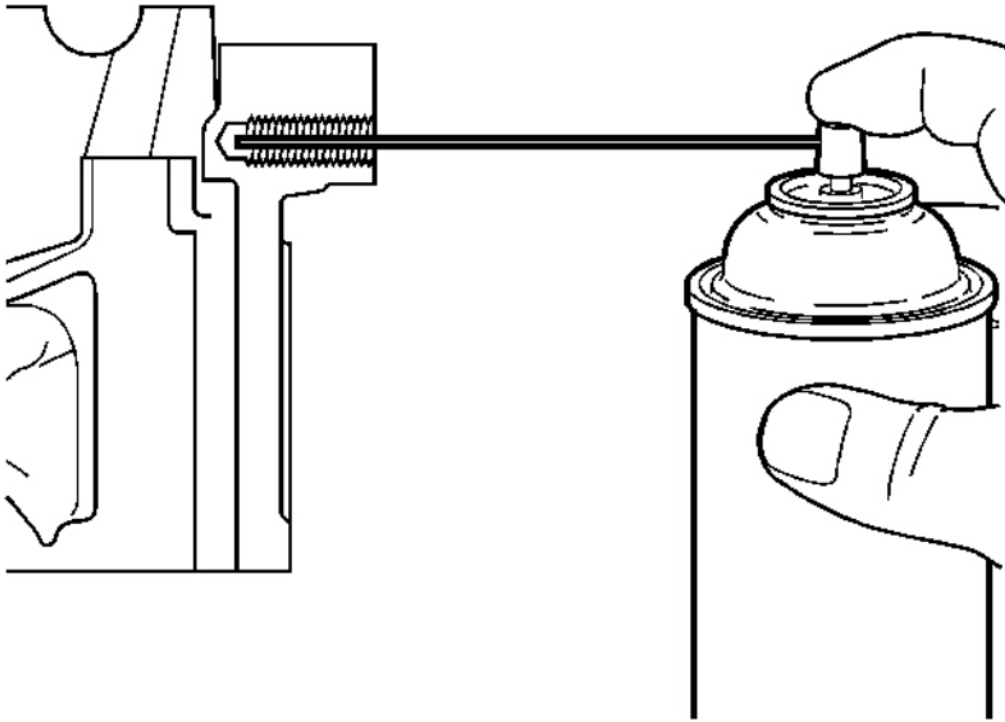


Fig. 80: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

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

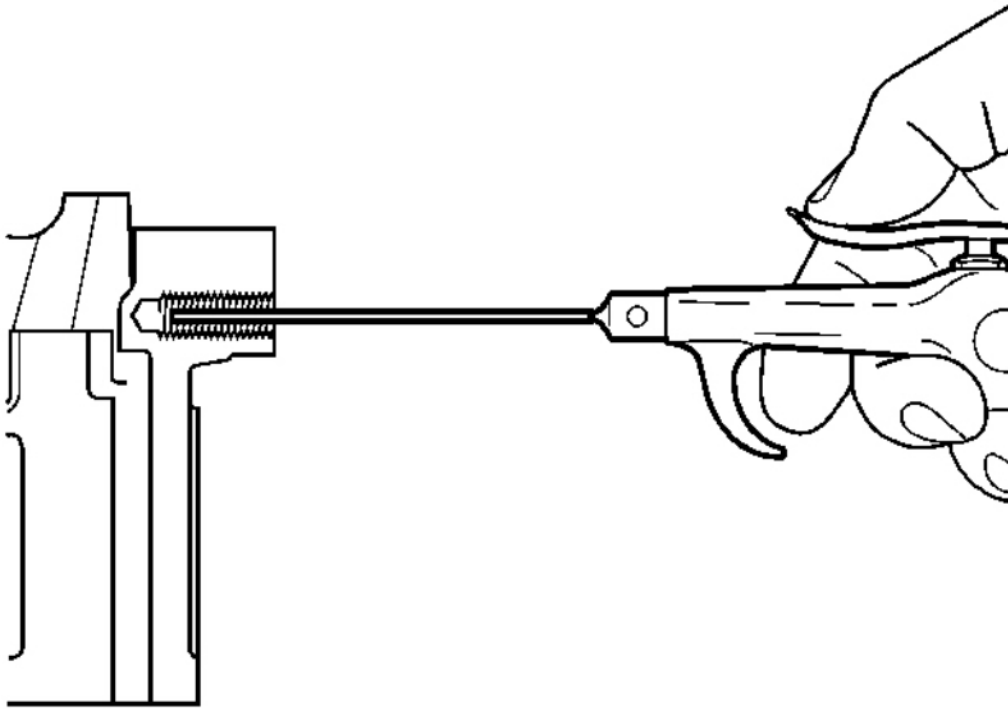


Fig. 81: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

7. Using compressed air, clean out any chips.

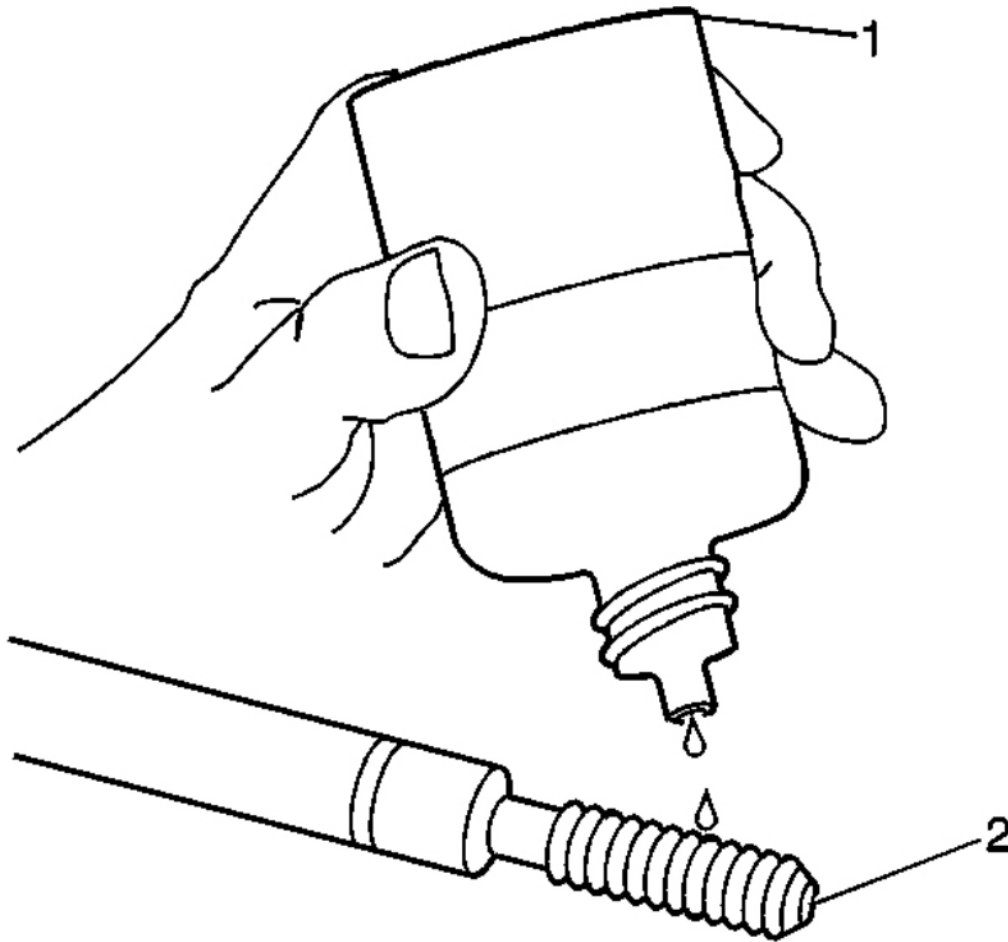


Fig. 82: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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

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

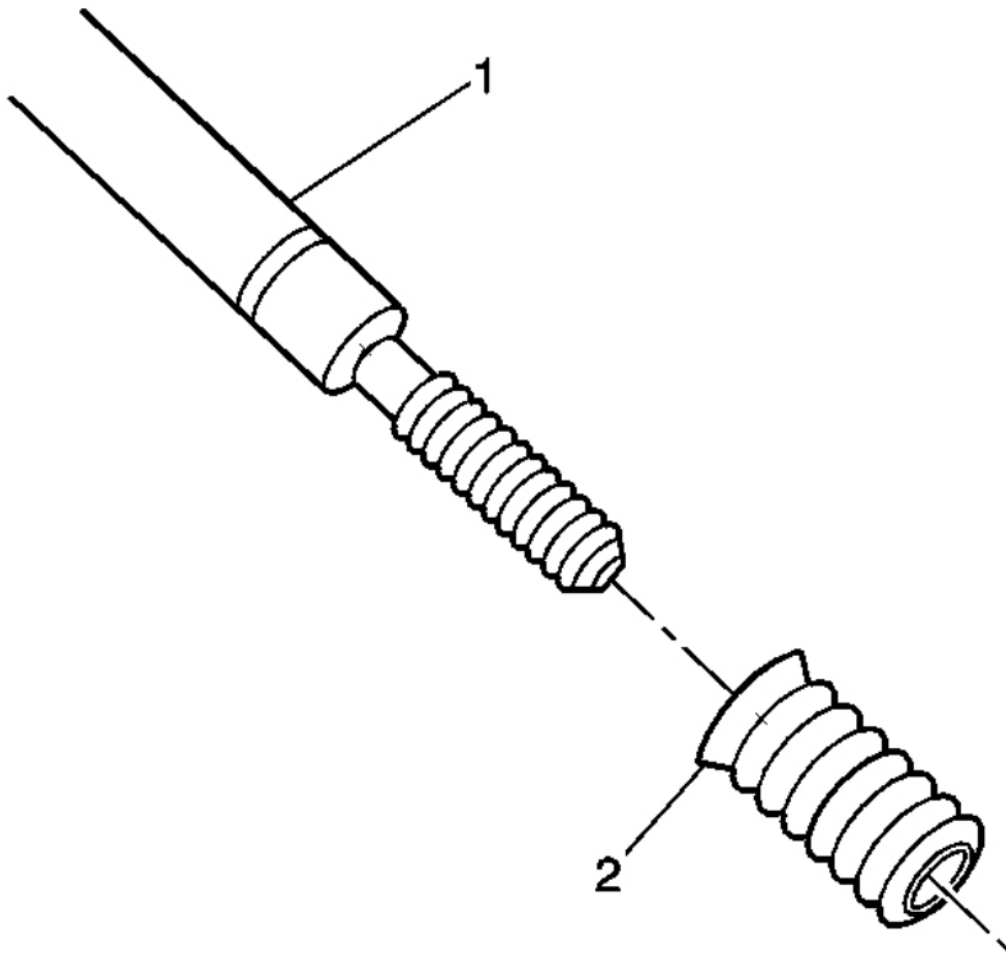


Fig. 83: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

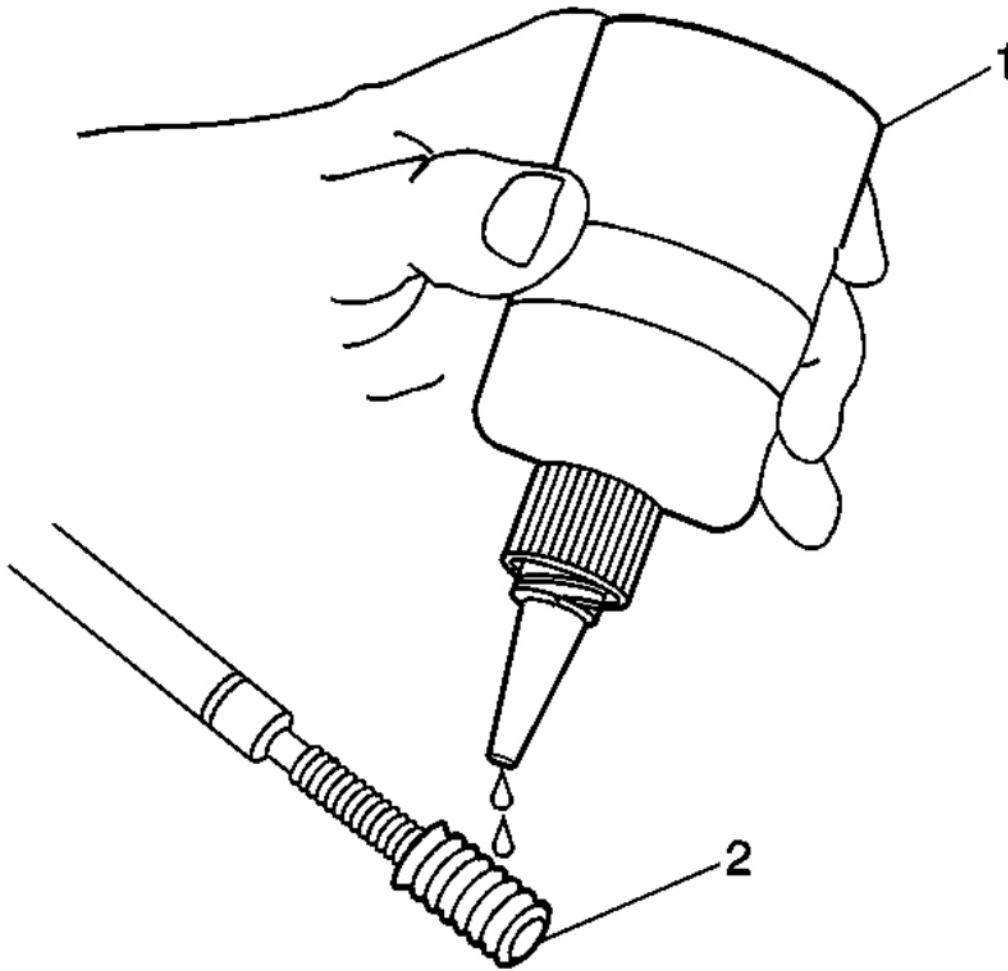


Fig. 84: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

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).

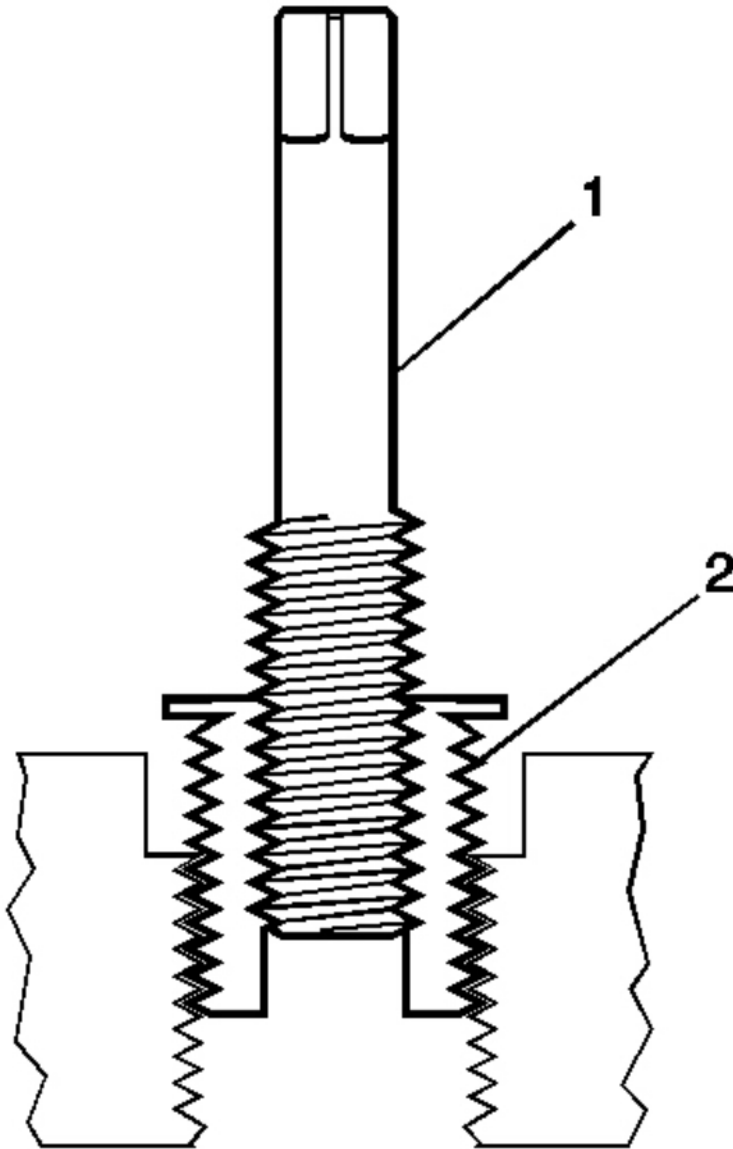


Fig. 85: Installing Insert - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

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

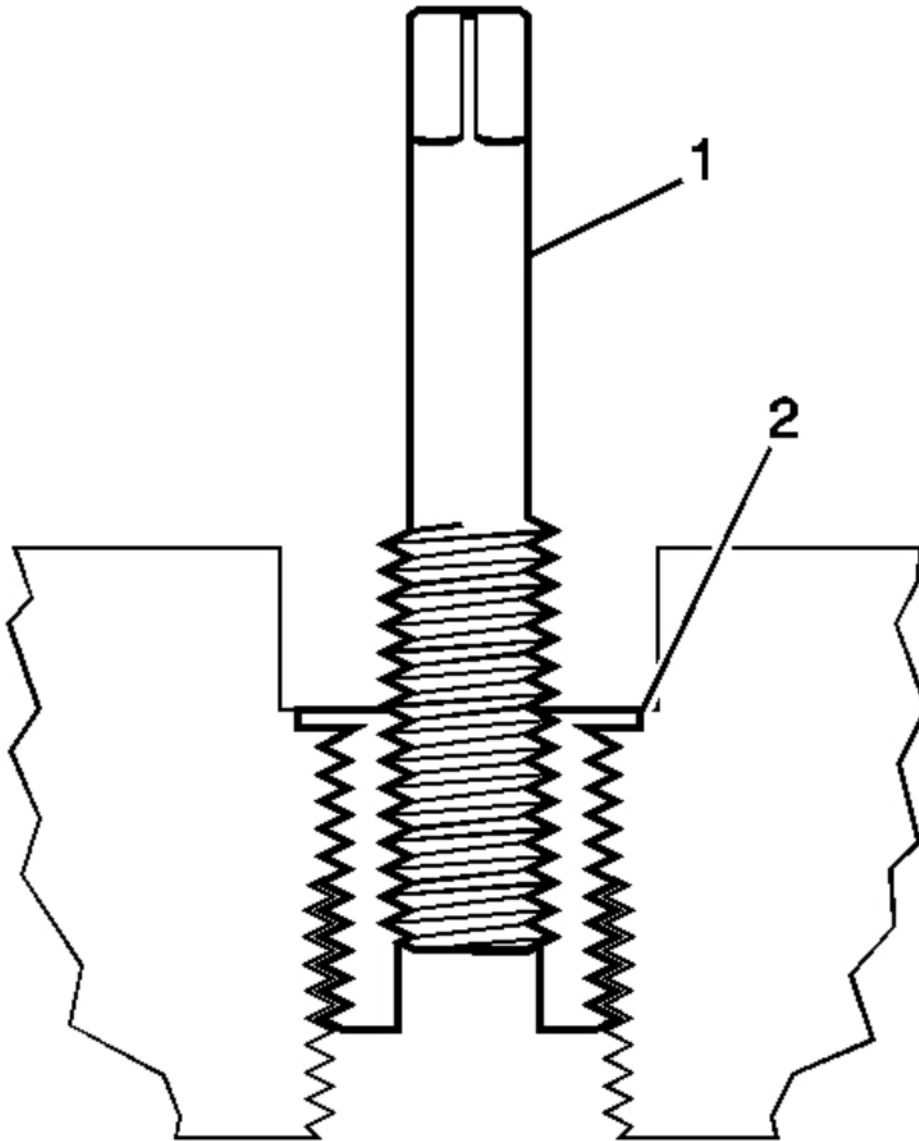


Fig. 86: View Of Installed Insert - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

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.

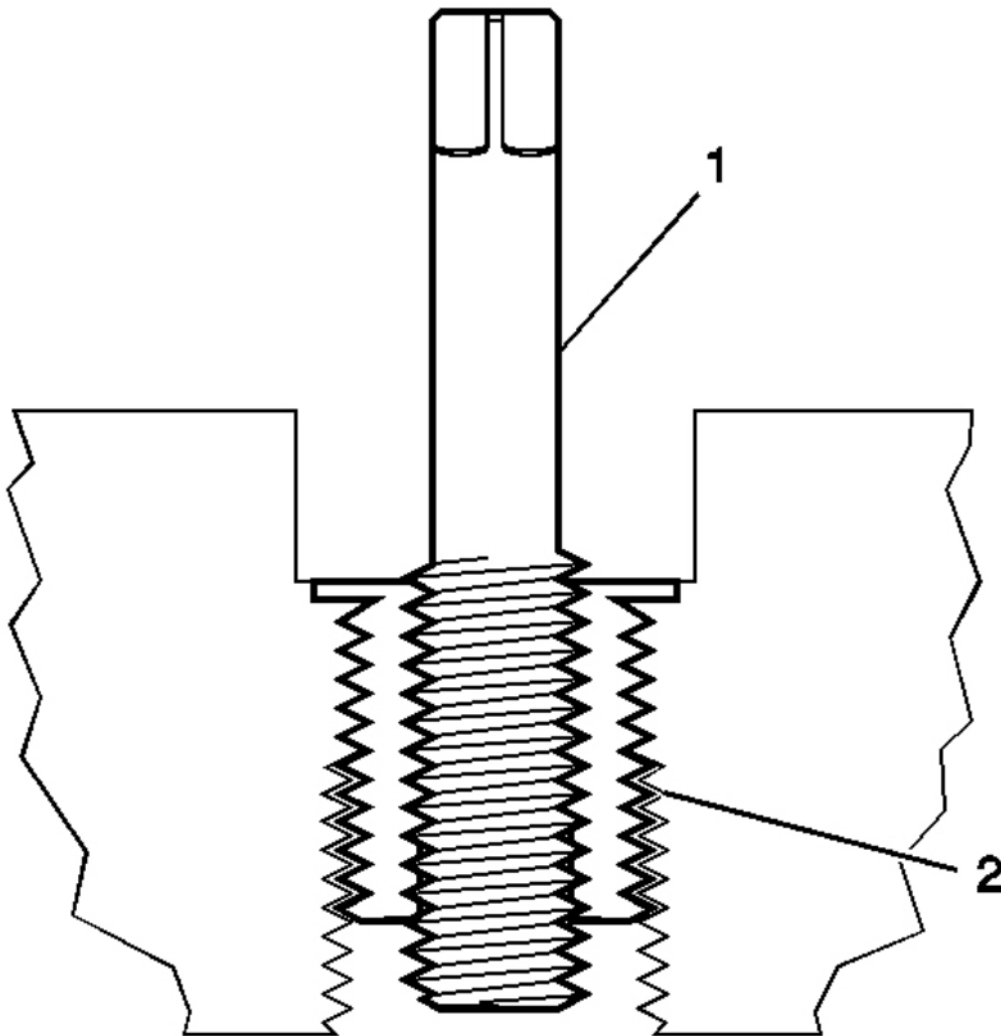


Fig. 87: Installed Insert - Recessed Thread Repair
Courtesy of GENERAL MOTORS CORP.

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).

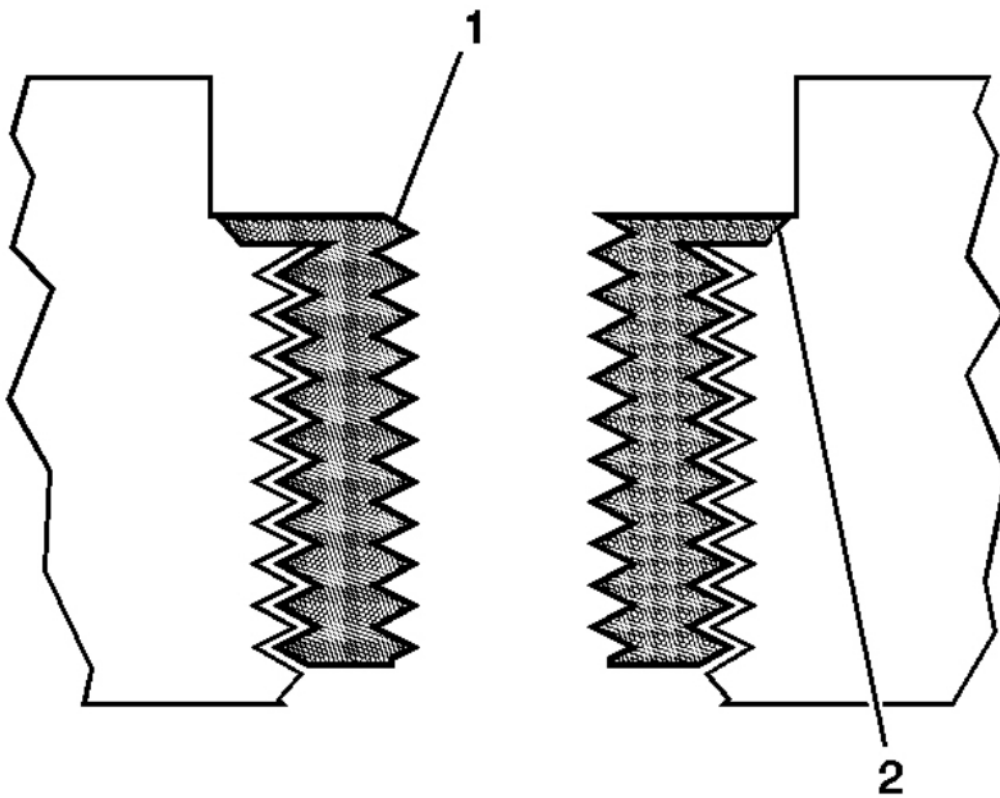


Fig. 88: Inspecting Insert For Proper Installation - Recessed Thread
Courtesy of GENERAL MOTORS CORP.

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

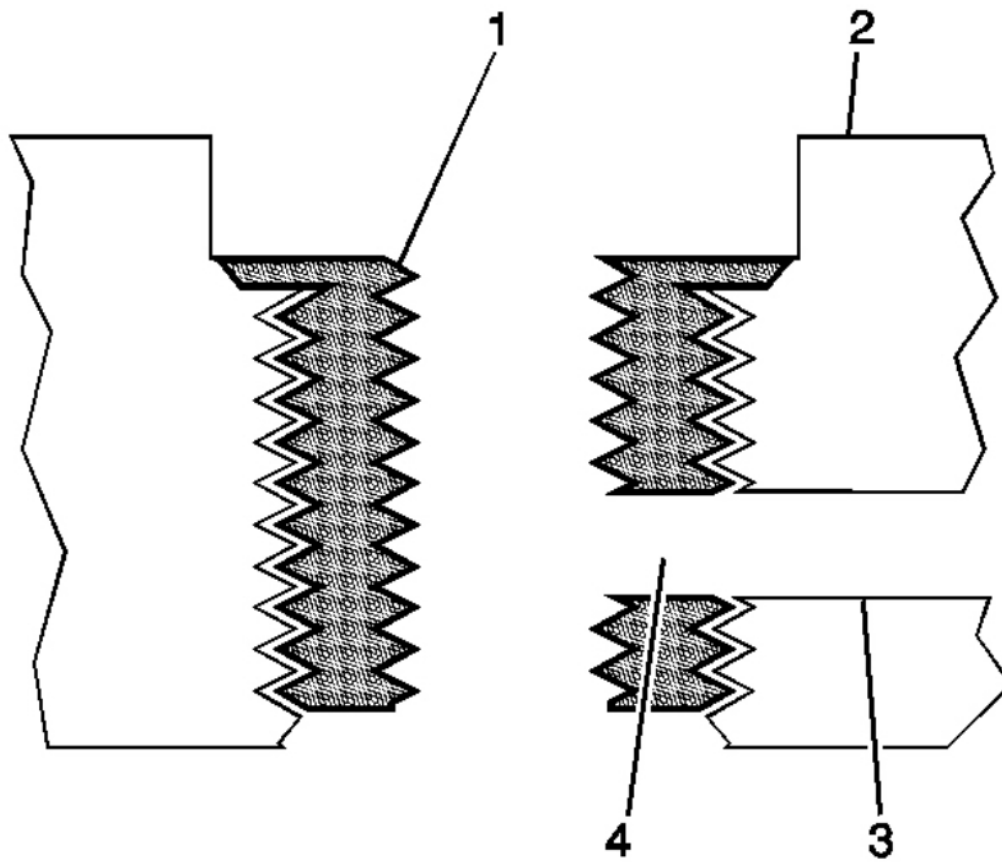


Fig. 89: View Of Restricted Engine Coolant Passage - Recessed Thread Repair
Courtesy of GENERAL MOTORS CORP.

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.

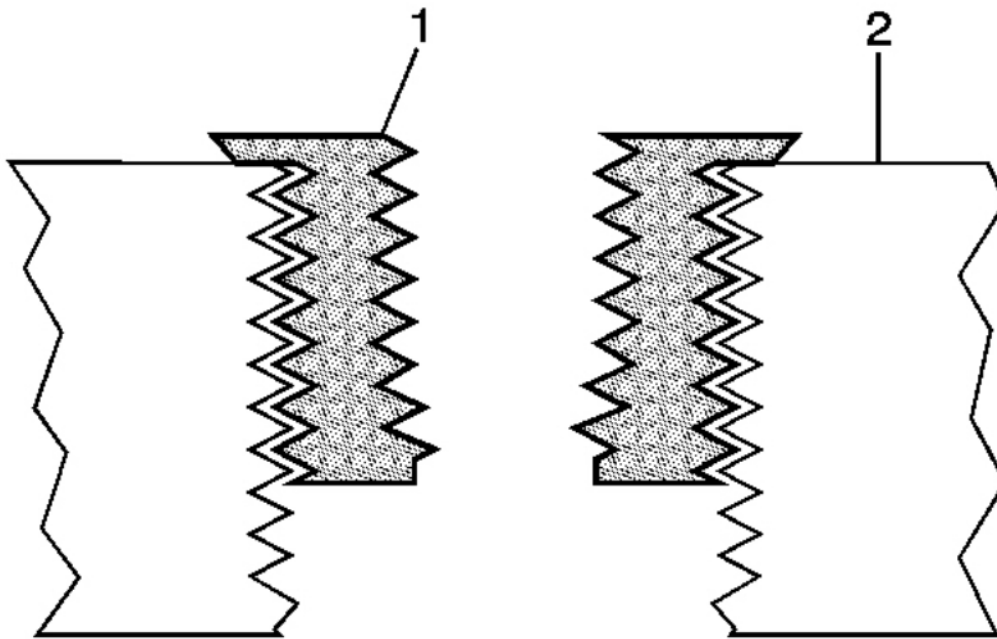


Fig. 90: Inspecting Insert For Proper Installation - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

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.

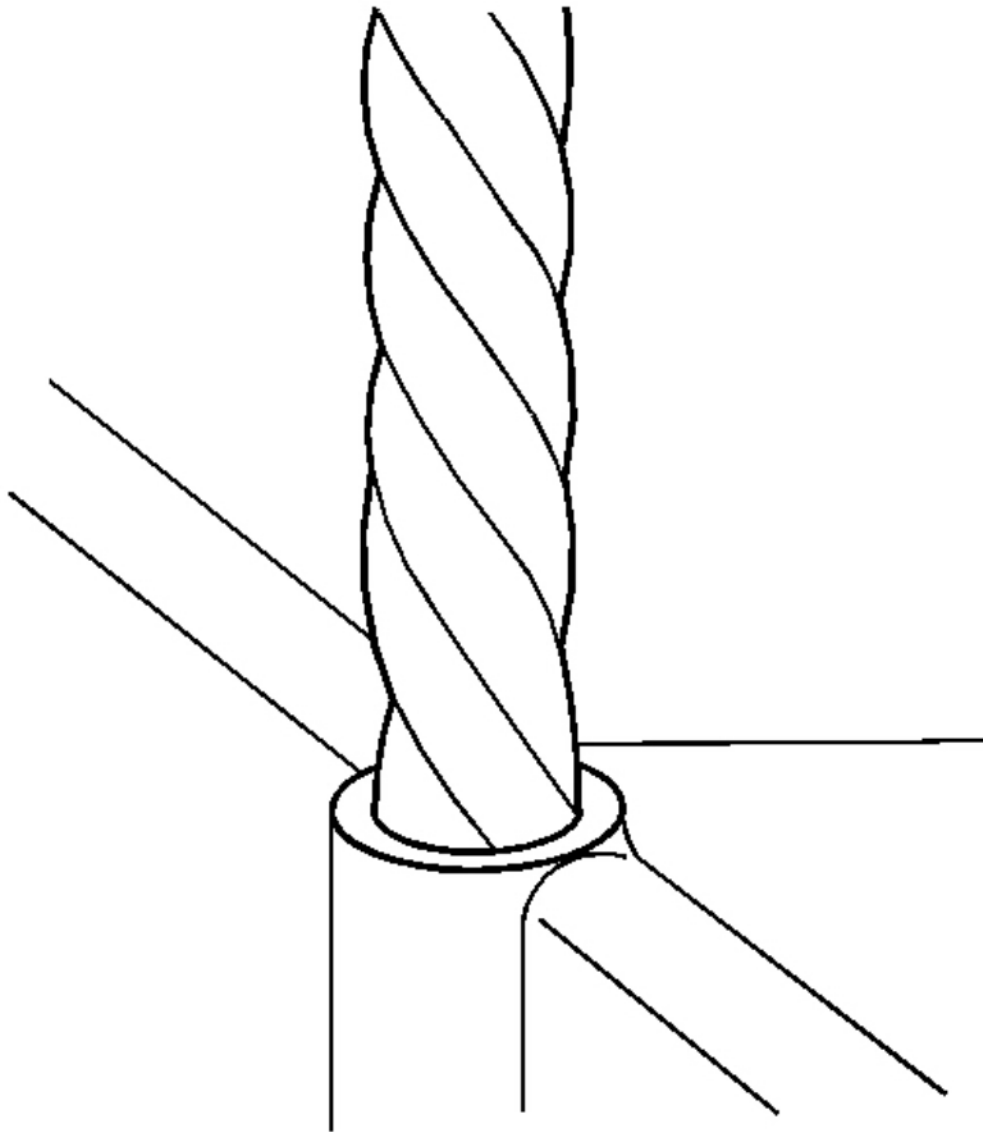


Fig. 91: Drilling Out Threads Of Damaged Hole
Courtesy of GENERAL MOTORS CORP.

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.

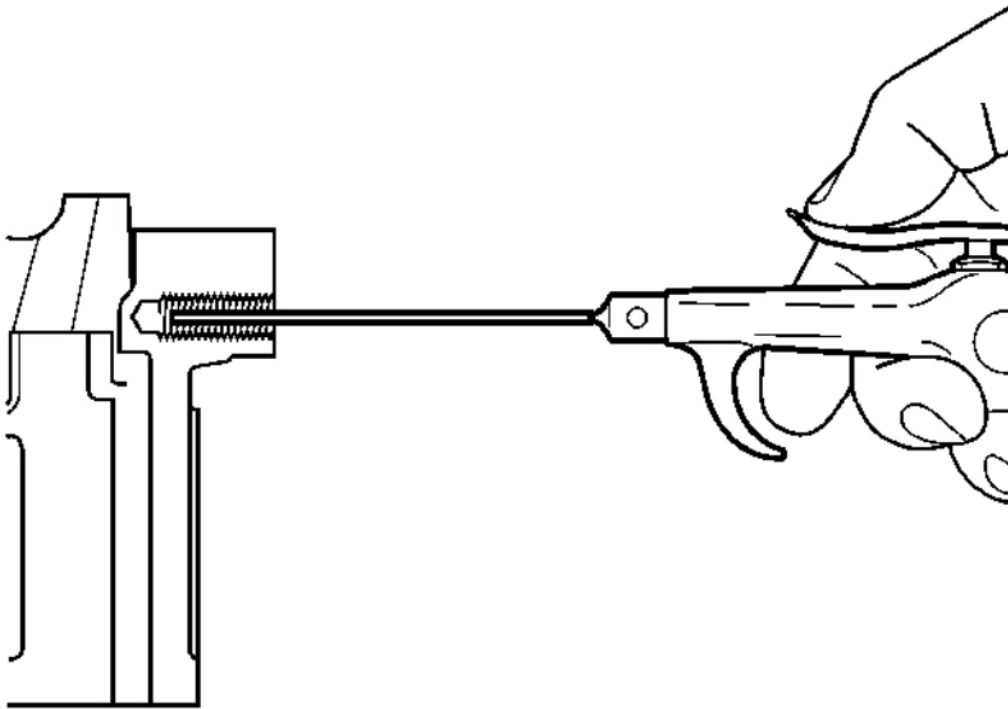


Fig. 92: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

2. Using compressed air, clean out any chips.

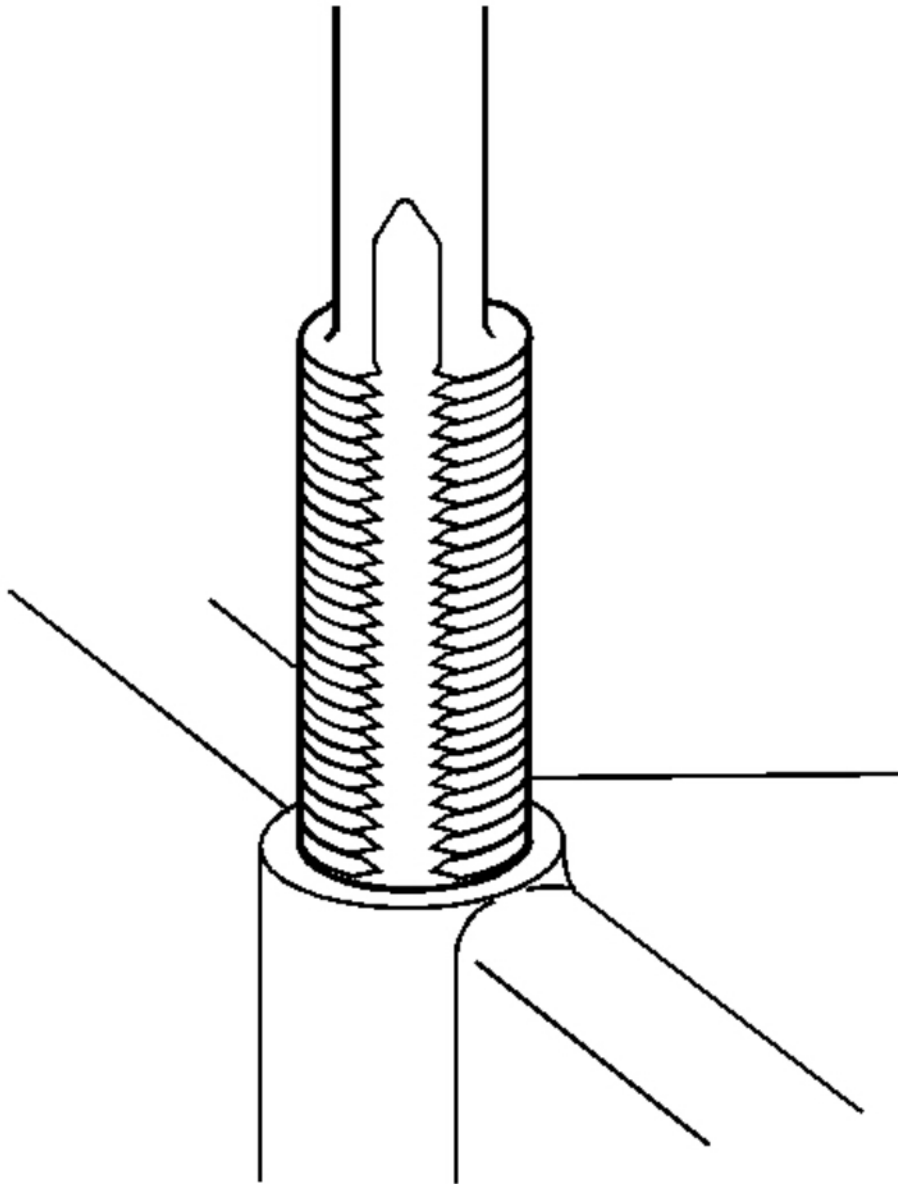


Fig. 93: Tapping Threads Of Drilled Hole
Courtesy of GENERAL MOTORS CORP.

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.

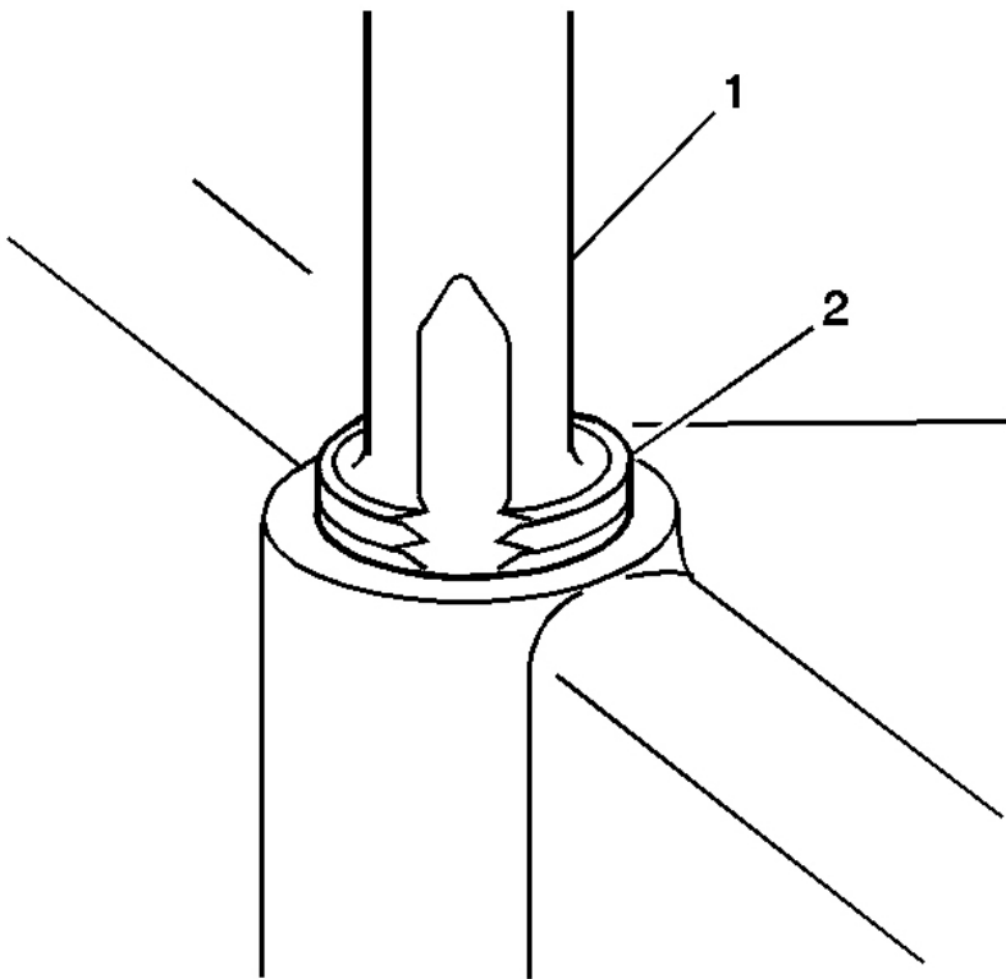


Fig. 94: View Of Proper Tapping Distance - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

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

base material.

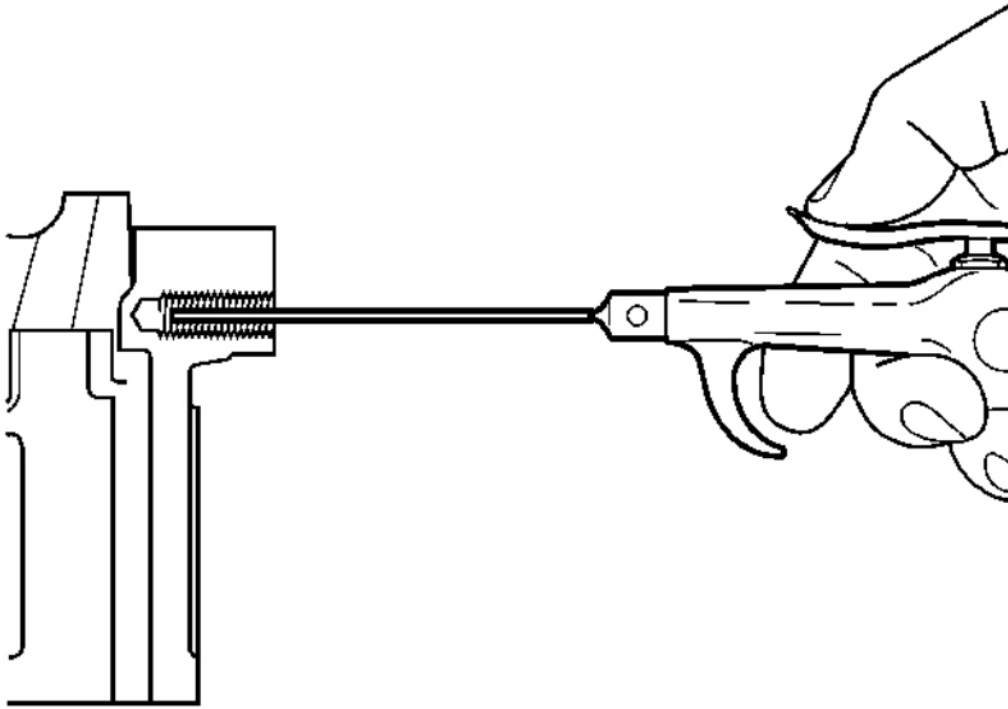


Fig. 95: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

5. Using compressed air, clean out any chips.

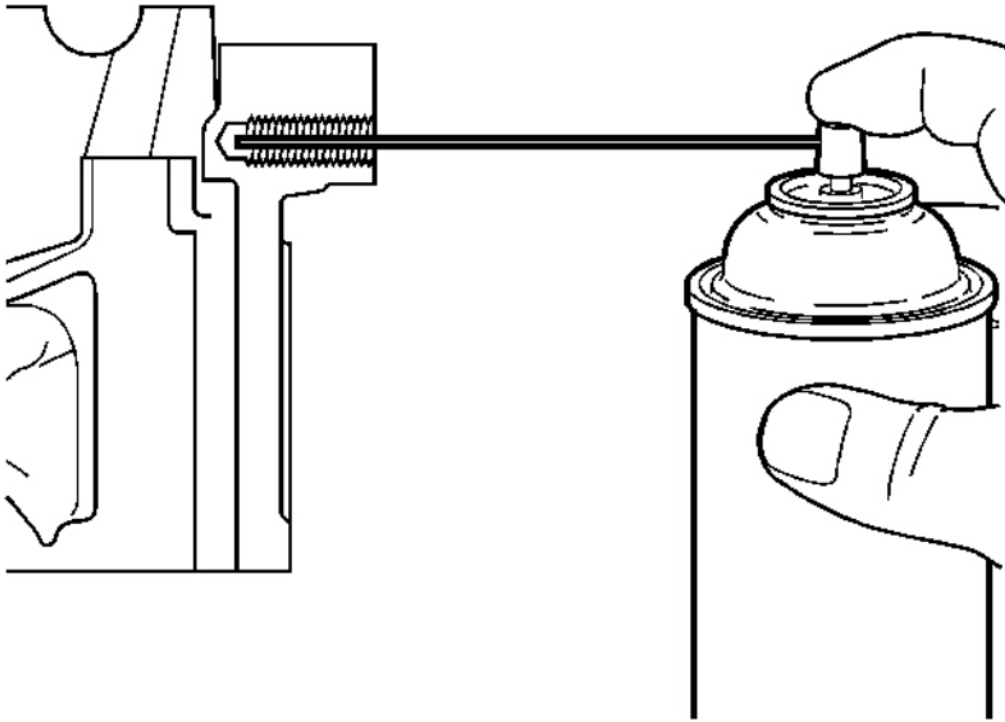


Fig. 96: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

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

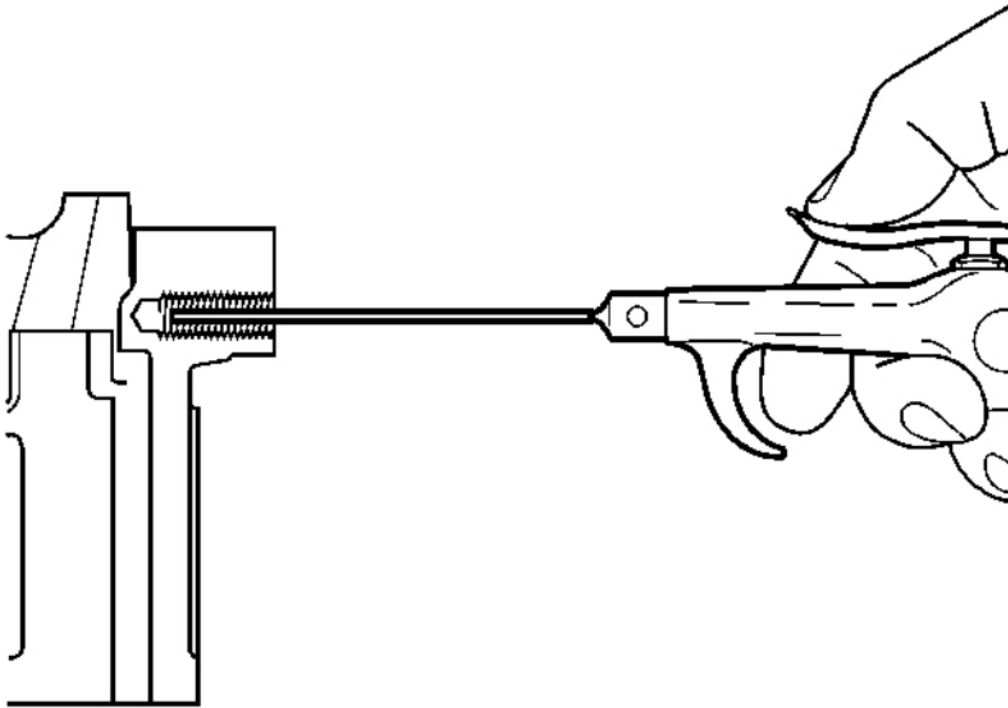


Fig. 97: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

7. Using compressed air, clean out any chips.

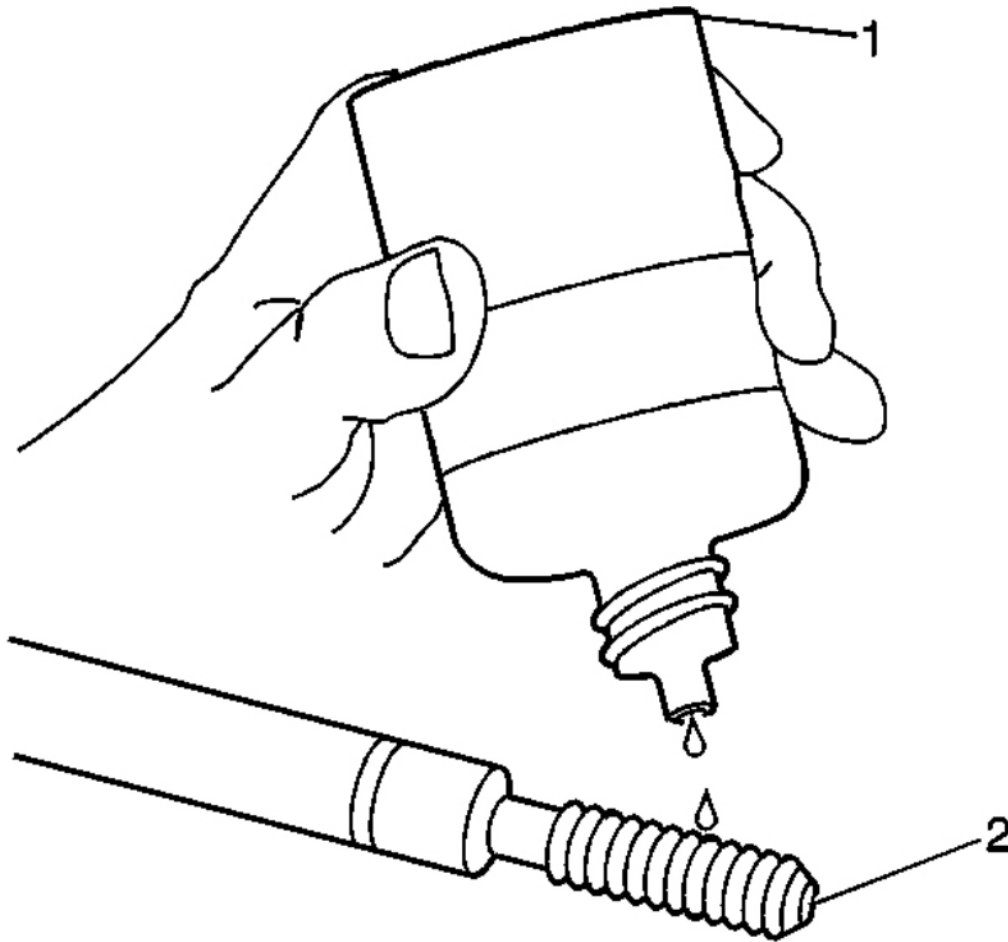


Fig. 98: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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

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

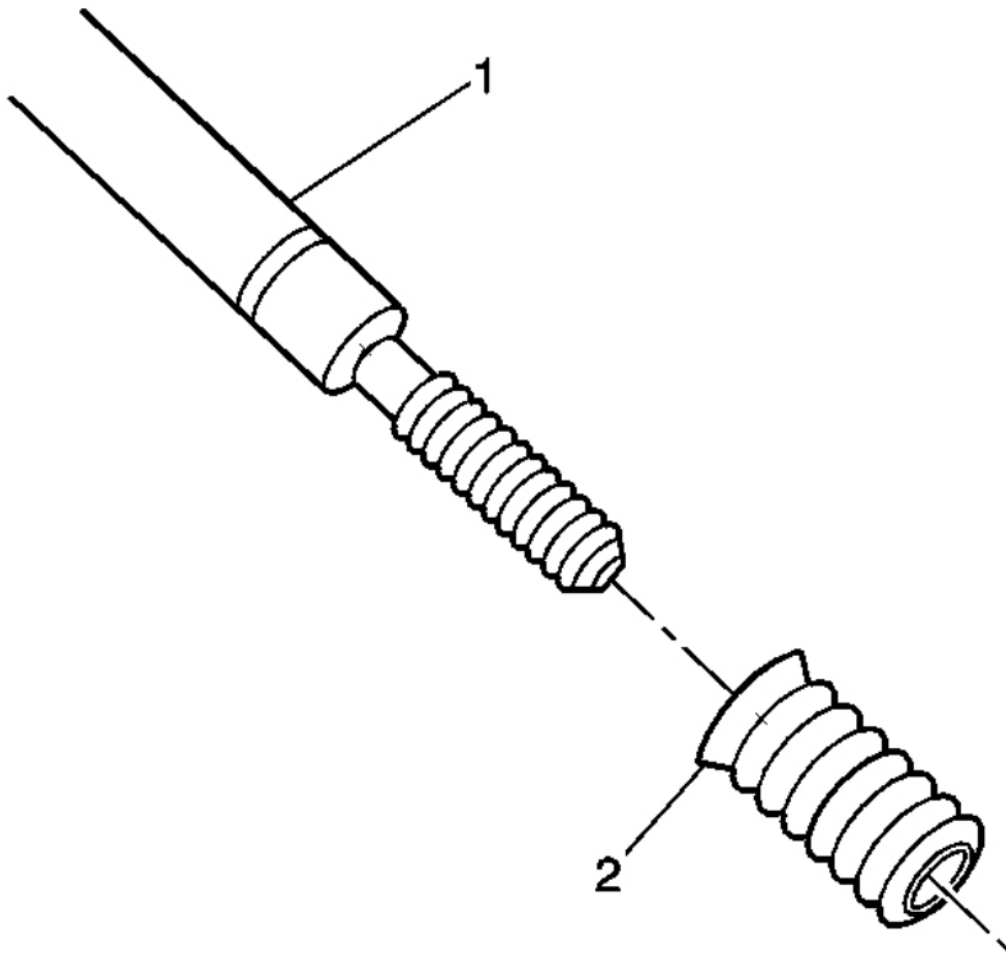


Fig. 99: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

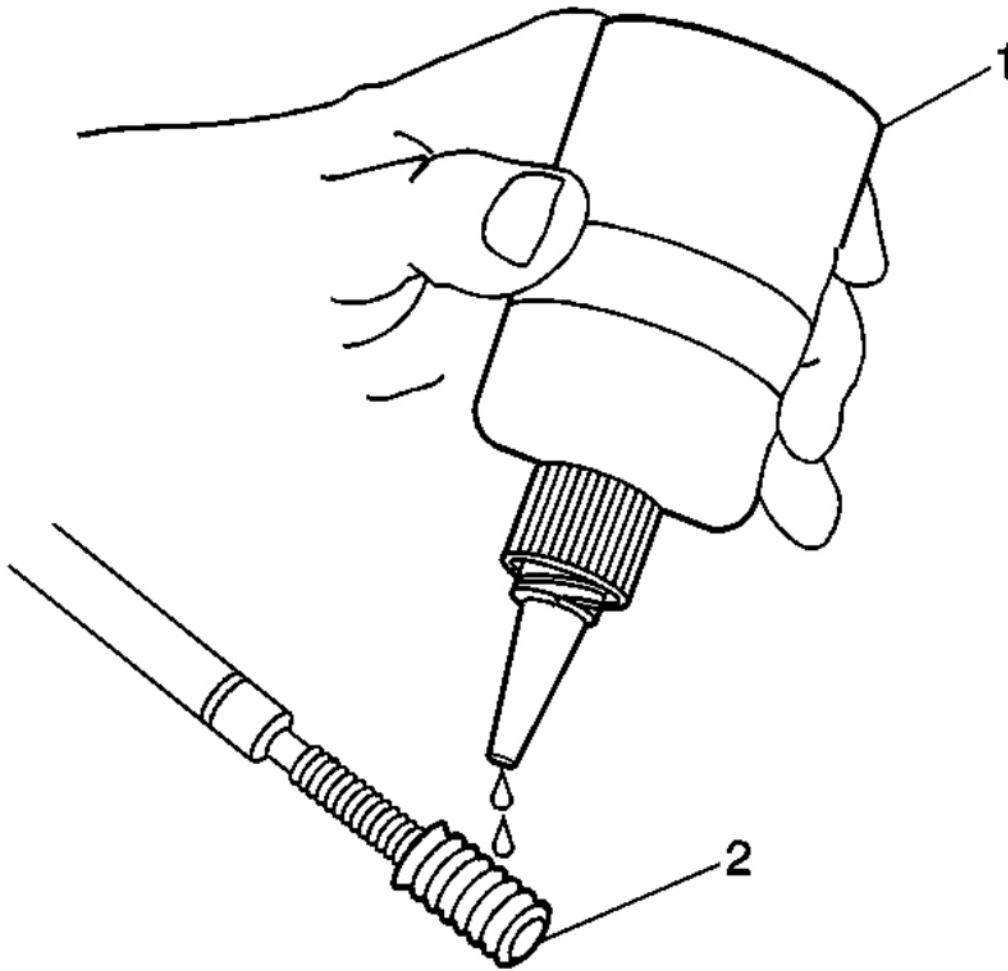


Fig. 100: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

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).

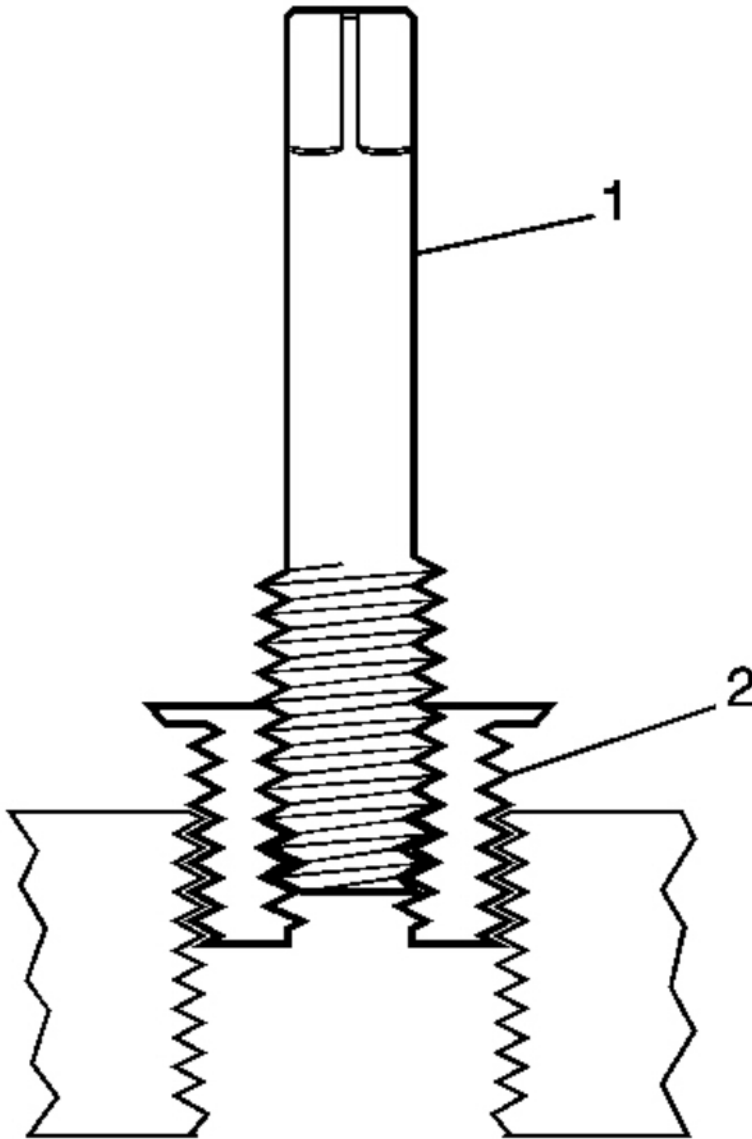


Fig. 101: Installing Insert - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

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

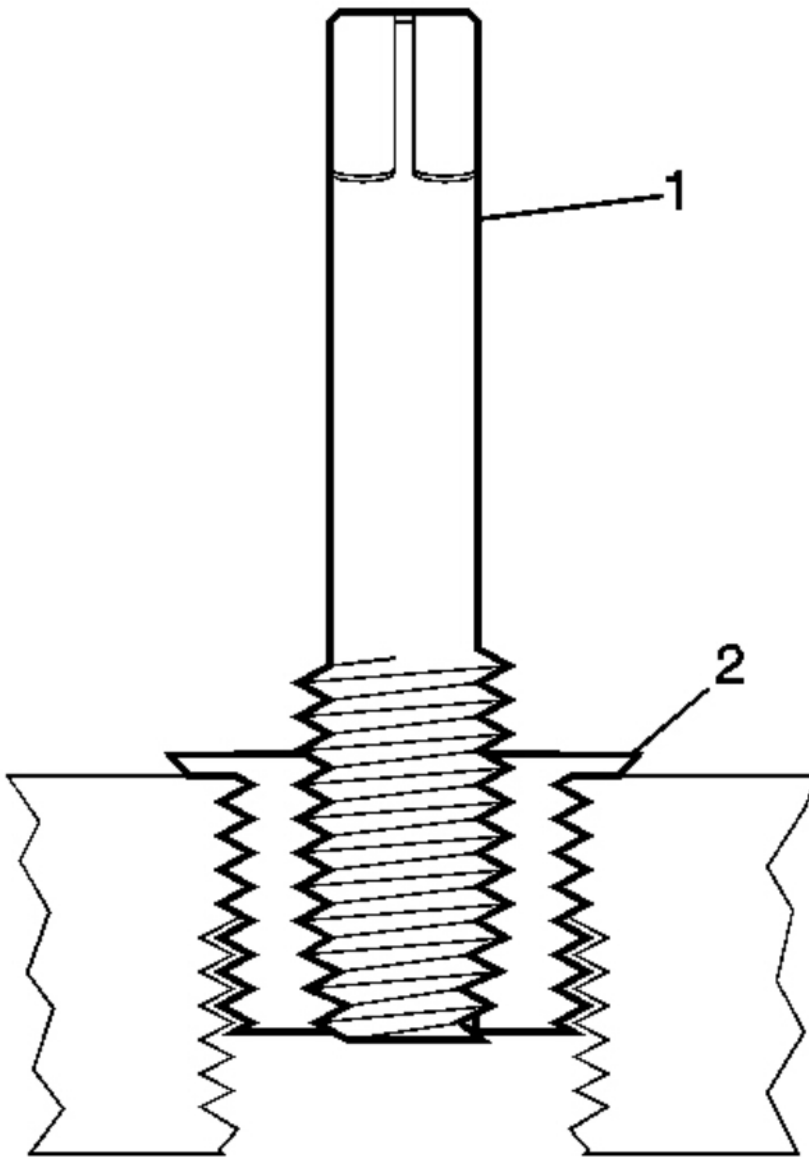


Fig. 102: Installing Insert - Tapered Pipe Thread Repair
Courtesy of GENERAL MOTORS CORP.

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.

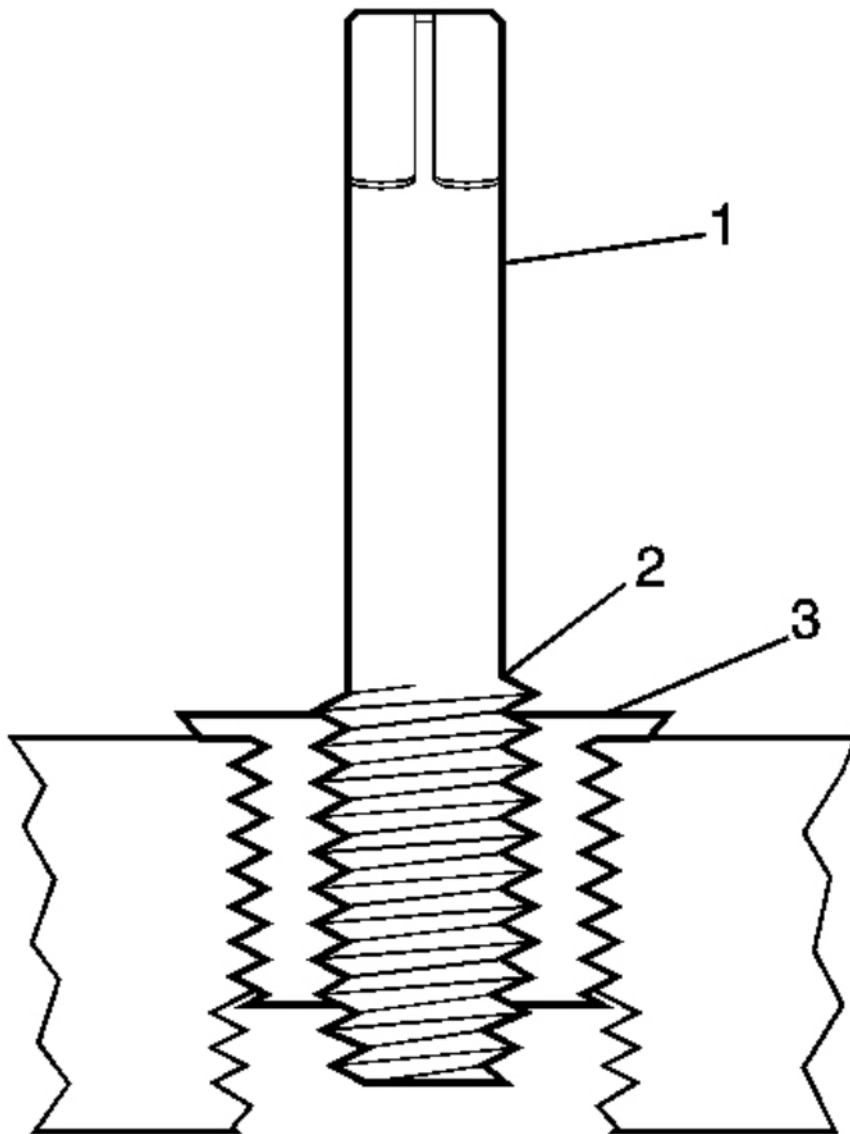


Fig. 103: Installed Insert - Tapered Pipe Thread Repair

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).

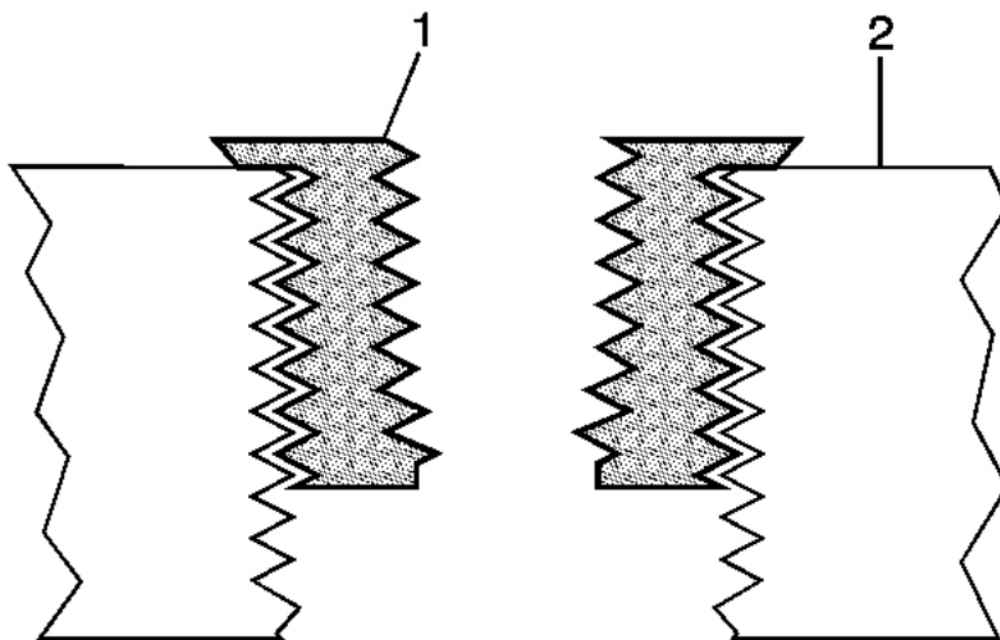


Fig. 104: Inspecting Insert For Proper Installation - Tapered Thread
Courtesy of GENERAL MOTORS CORP.

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

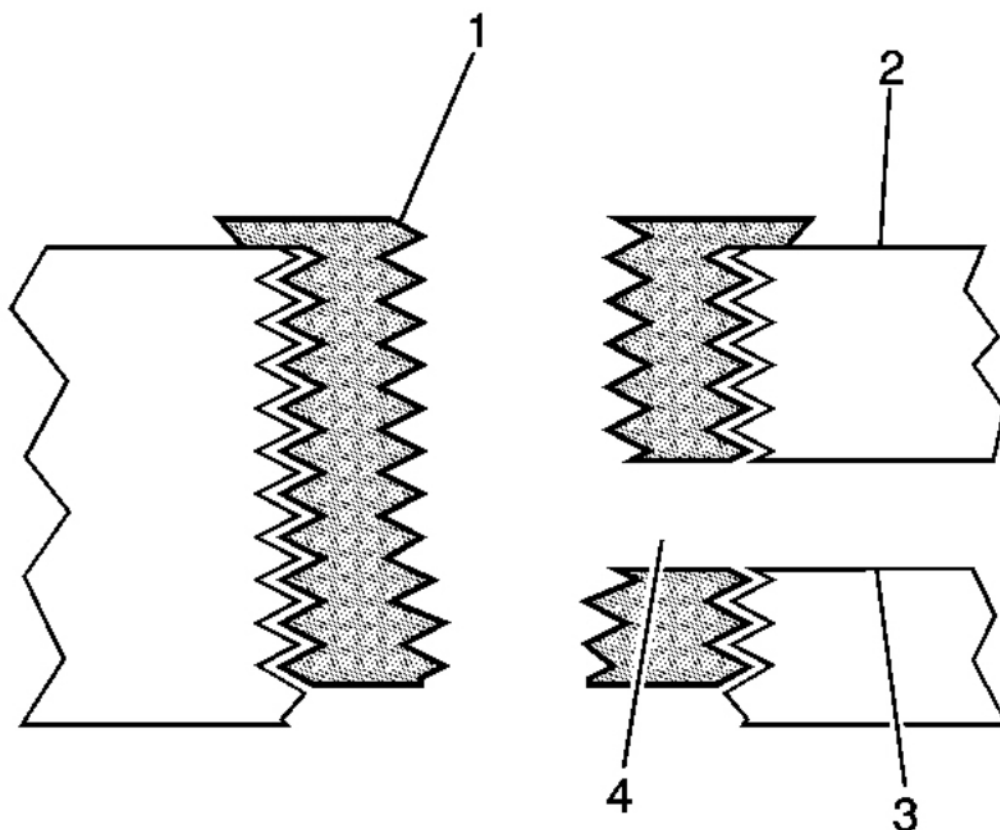


Fig. 105: View Of Restricted Engine Coolant Passages - Tapered Pipe Thread Repair
Courtesy of GENERAL MOTORS CORP.

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 42385-2030 M11 x 2.0 Cylinder Head Bolt - Northstar/Premium V8 Thread Insert Kit

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 4.6L (LH2) (Repair Instructions, 4 Of 5) - SRX

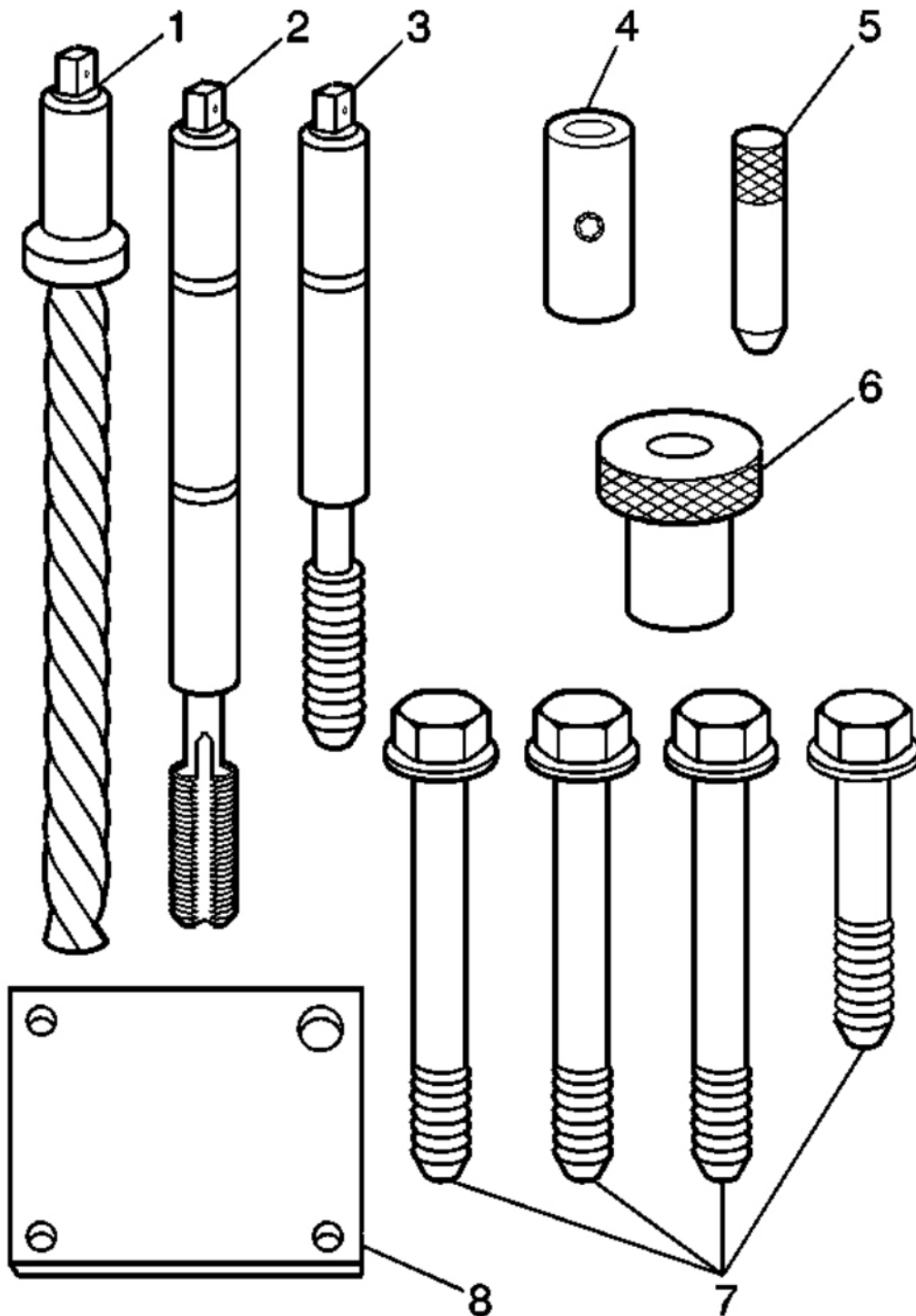


Fig. 106: Identifying Thread Repair Kit Components
Courtesy of GENERAL MOTORS CORP.

The cylinder head bolt hole thread repair kit **J 42385-2030** components consist of the following:

- Drill (1) J 42385-2031
- Tap (2) J 42385-2032
- Installation driver (3) J 42385-2033
- Stop collar (4) for inboard holes J 42385-2034
- Alignment pin (5) J 42385-303
- Bushing (6) J 42385-302
- Bolts (7) J 42385-2035 and J 42385-2036
- Fixture plate (8) J 42385-301

NOTE: **Ensure the cylinder head bolts, tools and inserts that are being used are the proper pitch or engine damage will occur. The thread pitch on the M11 cylinder head bolts and the engine block cylinder head bolt holes have been revised. In order to install the proper pitch insert it is important to identify which thread pitch is being used. Cylinder head bolts with a pitch of 1.5 mm have a thread length of about 48 mm (1.890 in) long. Cylinder head bolts with a pitch of 2.0 mm have a thread length of about 67 mm (2.638 in) long.**

IMPORTANT:

- **Cylinder head bolt holes with a pitch of 2.0 mm (0.08 in) use the tooling from the J 42385-2030 . Cylinder head bolt holes with a pitch of 1.5 mm (5.90 in) use the tooling from the J 42385-2000 .**
- **Verify the depth of the cylinder head bolt hole and the pitch of the cylinder head bolt threads. Measure the depth from the deck surface of the block to the bottom of the cylinder head hole. All cylinder head holes should use only one of the bushings. Never use both bushings to repair a block.**

With M11 bolts with a 1.5 mm pitch:

- Use the bushing J 42385-2022 for inboard holes that measure 73 mm (2.874 in) deep and outboard holes that measure 89.5 mm (3.524 in) deep.

- Use the bushing J 42385-302 for inboard holes that measure 80 mm (3.150 in) deep and outboard holes that measure 96.5 mm (3.799 in) deep.

With M11 bolts with 2.0 mm pitch:

Use the bushing J 42385-302 for inboard holes that measure 73 mm (2.874 in) deep and outboard holes that measure 89.5 mm (3.524 in) deep.

Inboard Bolt Holes

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.

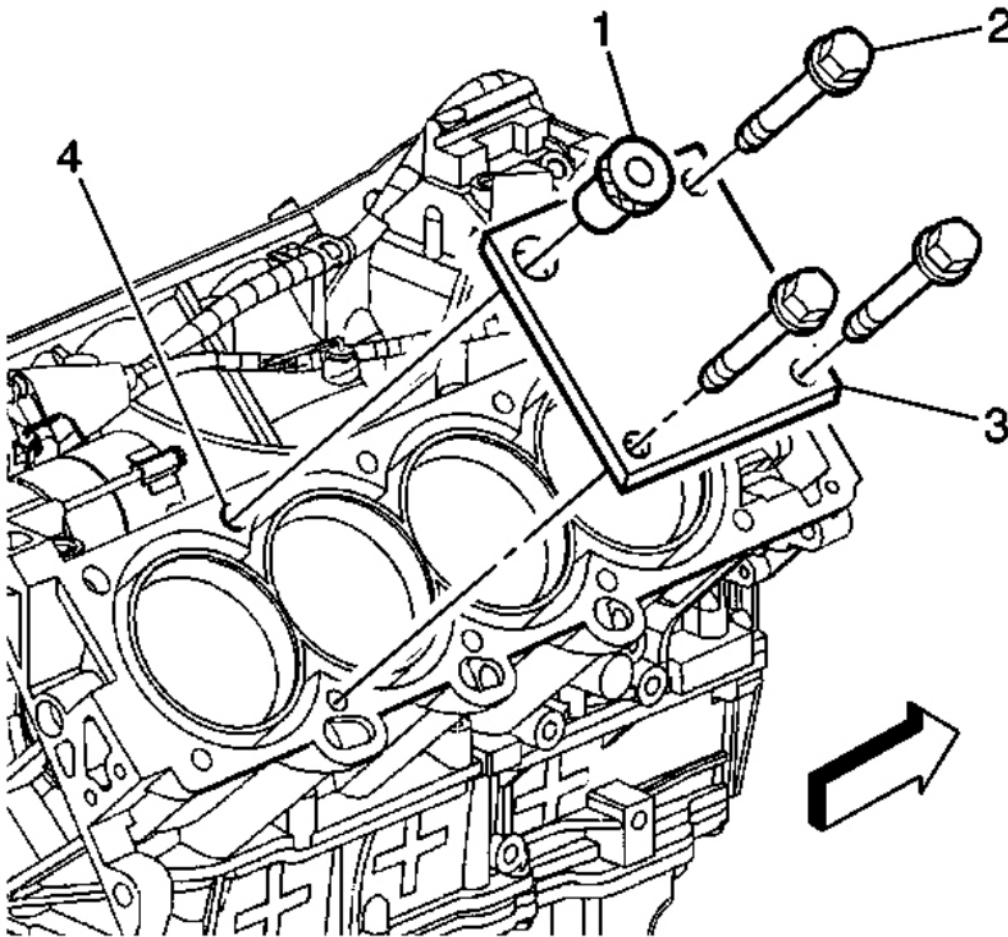


Fig. 107: View Of Fixture Plate & Components - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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

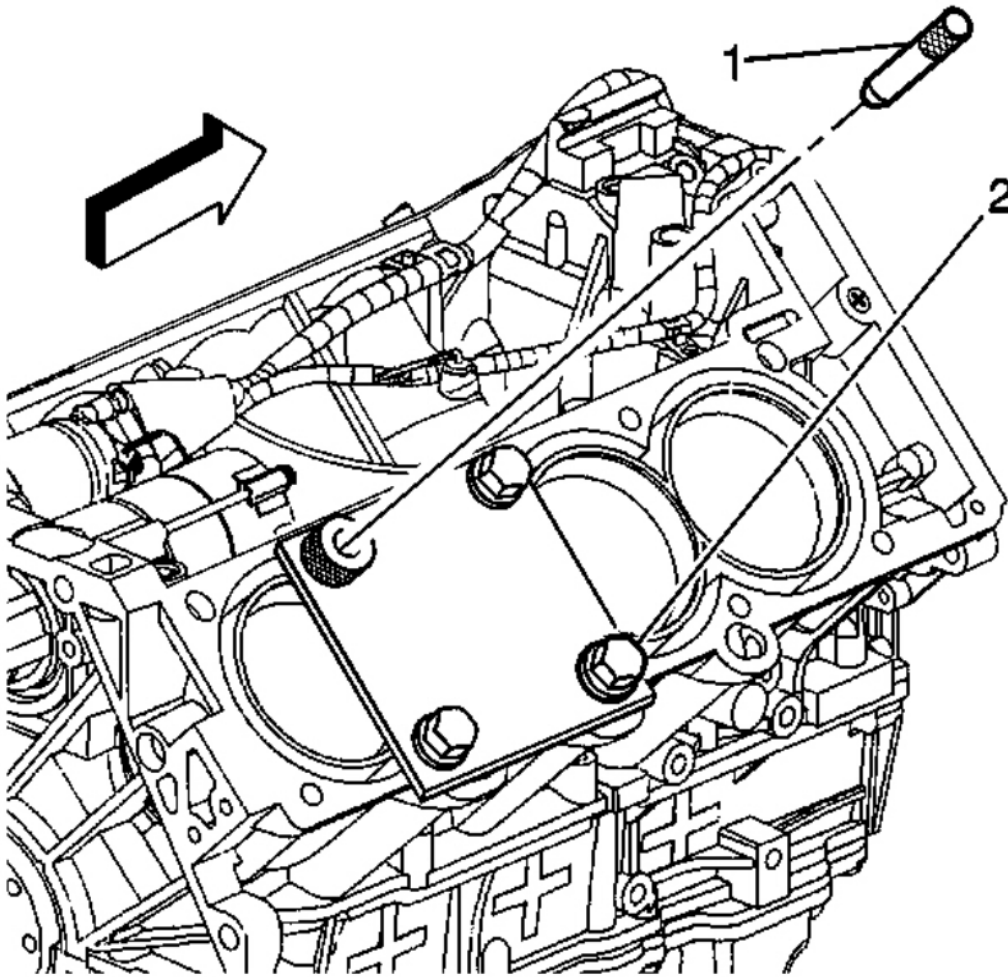


Fig. 108: Positioning Alignment Pin - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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.

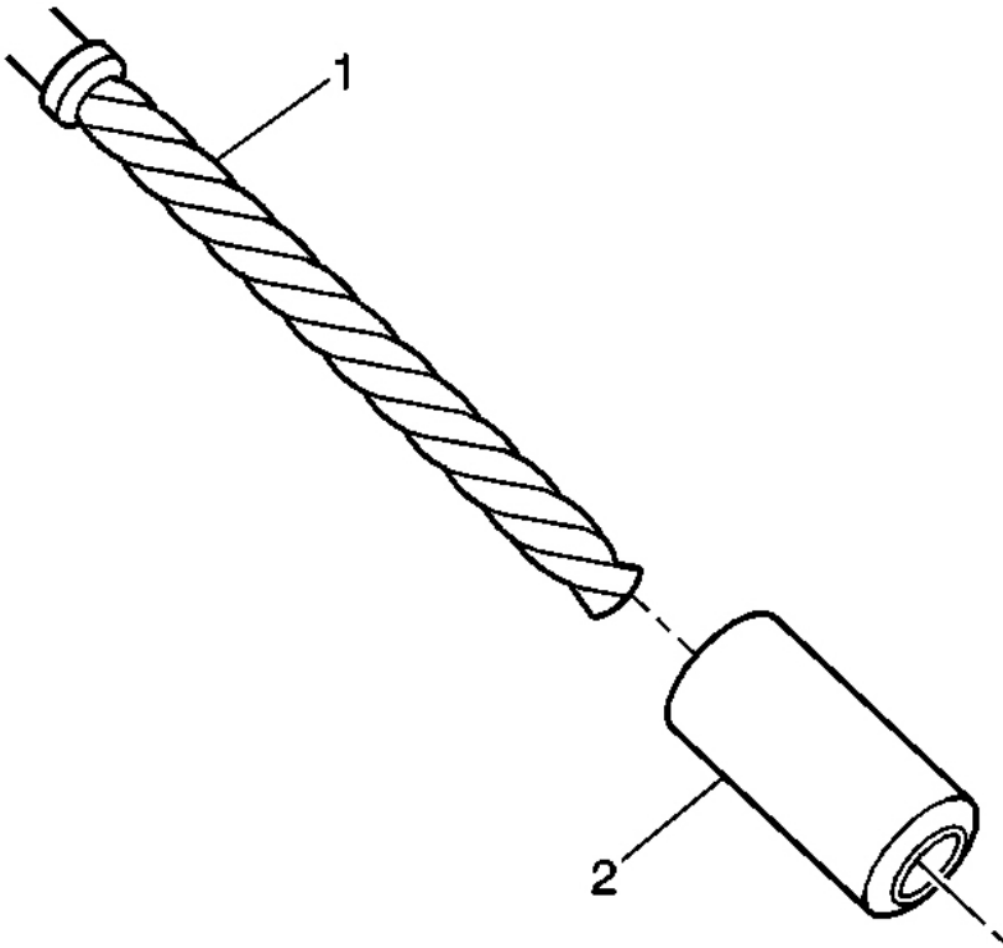


Fig. 109: View Of Stop Collar & Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

6. Install the stop collar (2) onto the drill (1).

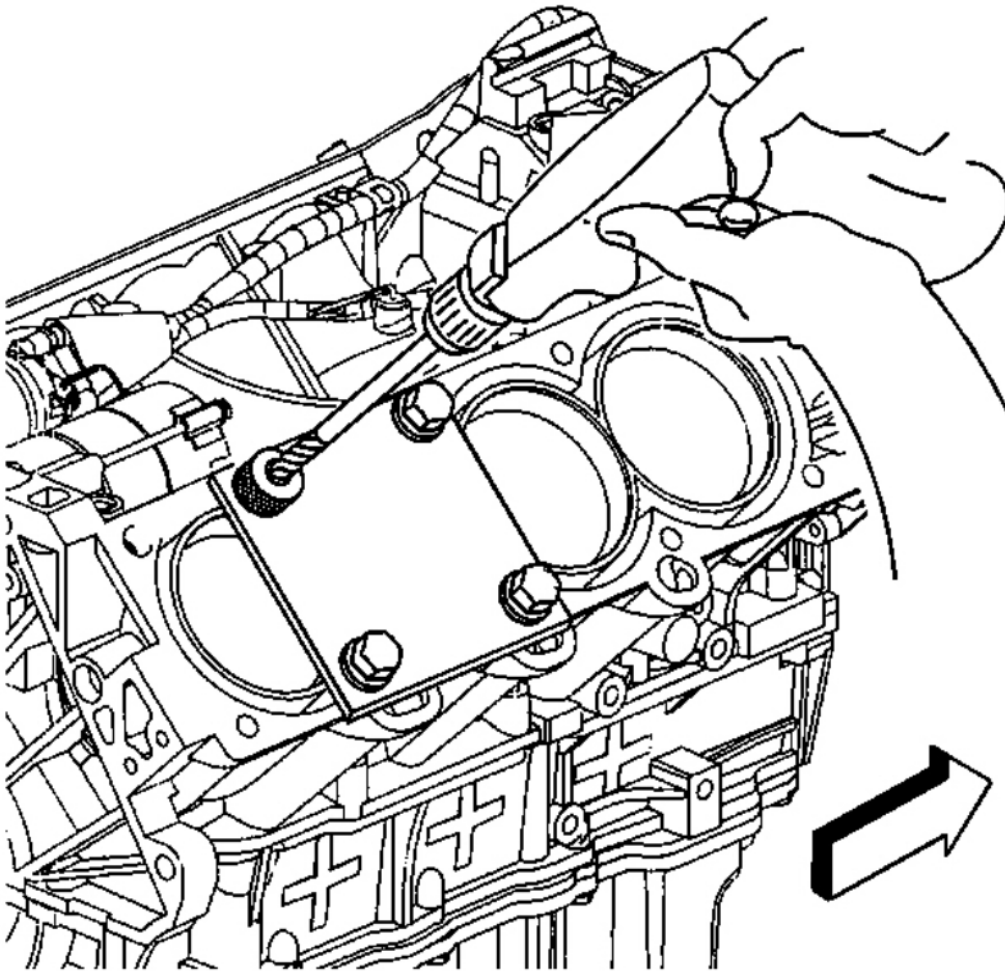


Fig. 110: Drilling Out Threads Of Damaged Hole - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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 hole until the stop collar contacts the top of the drill bushing.

7. Drill out the threads of the damaged hole.

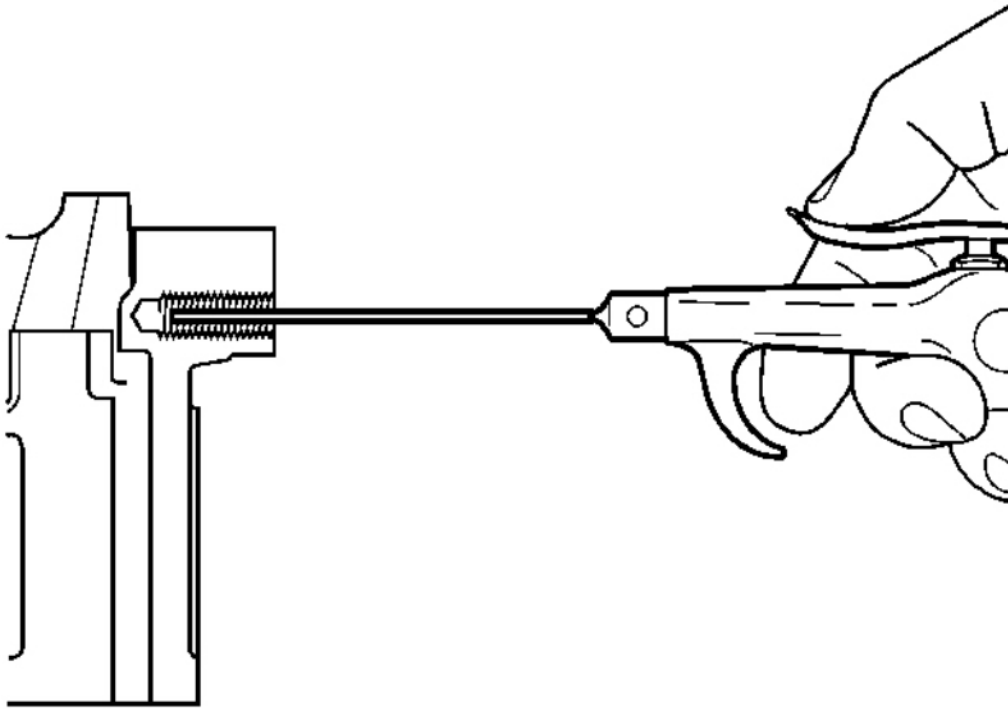


Fig. 111: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

8. Using compressed air, clean out any chips.

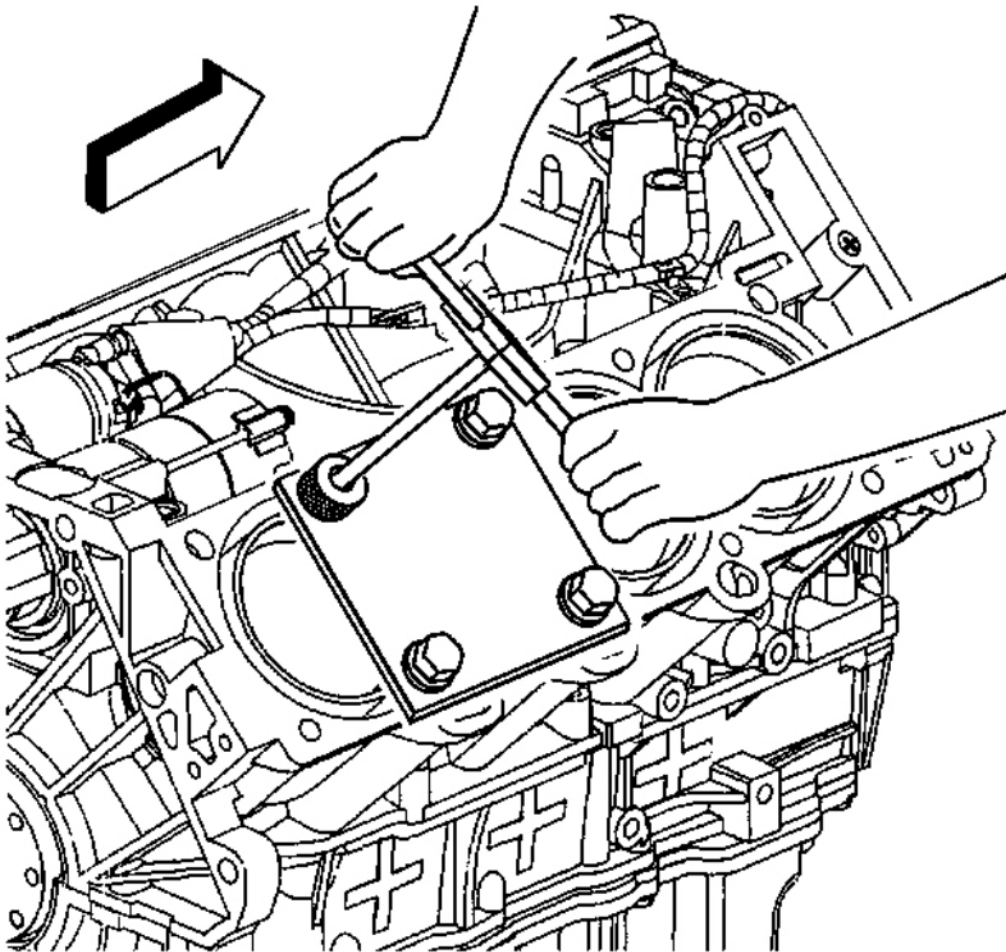


Fig. 112: Tapping Threads Using Tapping Wrench - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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.

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

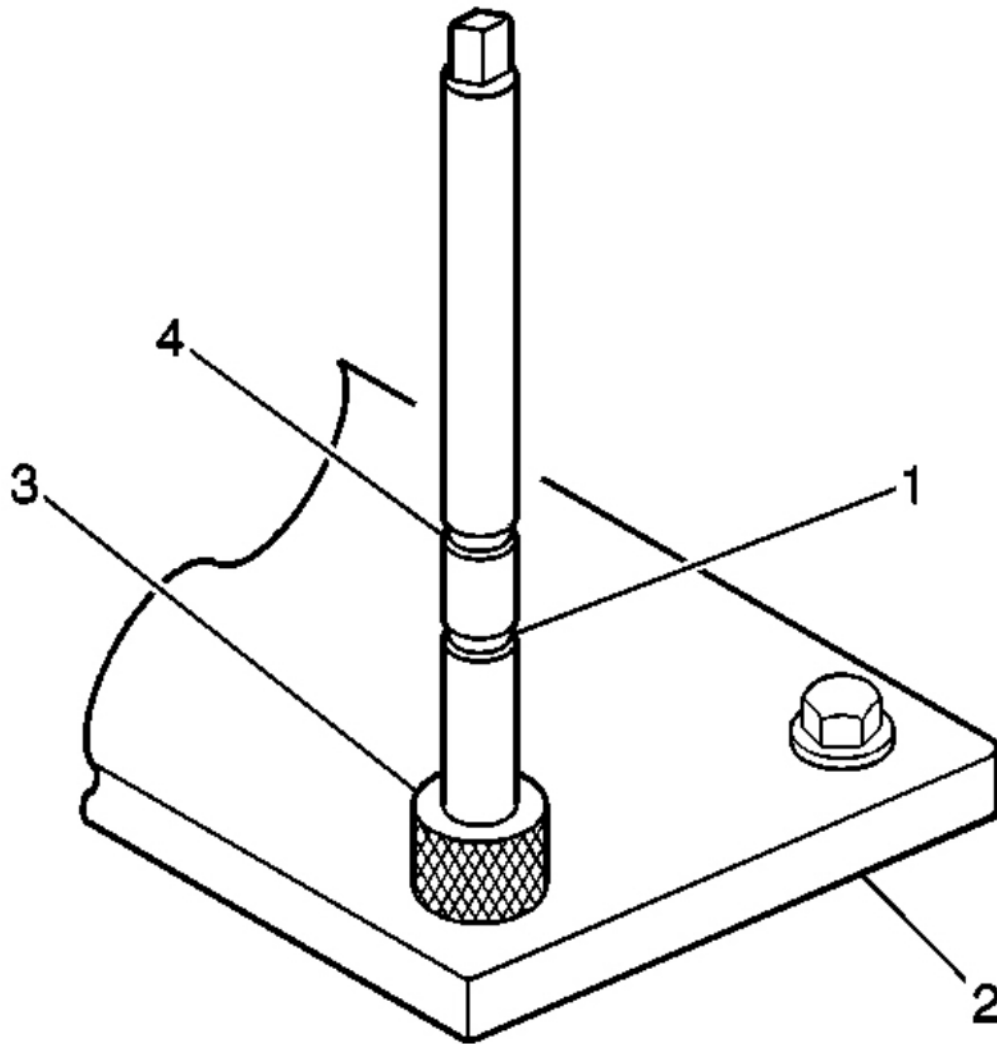


Fig. 113: View Of Tap Upper & Lower Marks, Fixture Plate & Bushing
Courtesy of GENERAL MOTORS CORP.

10. 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 first mark (1) on the tap aligns with the top of the drill bushing (3).

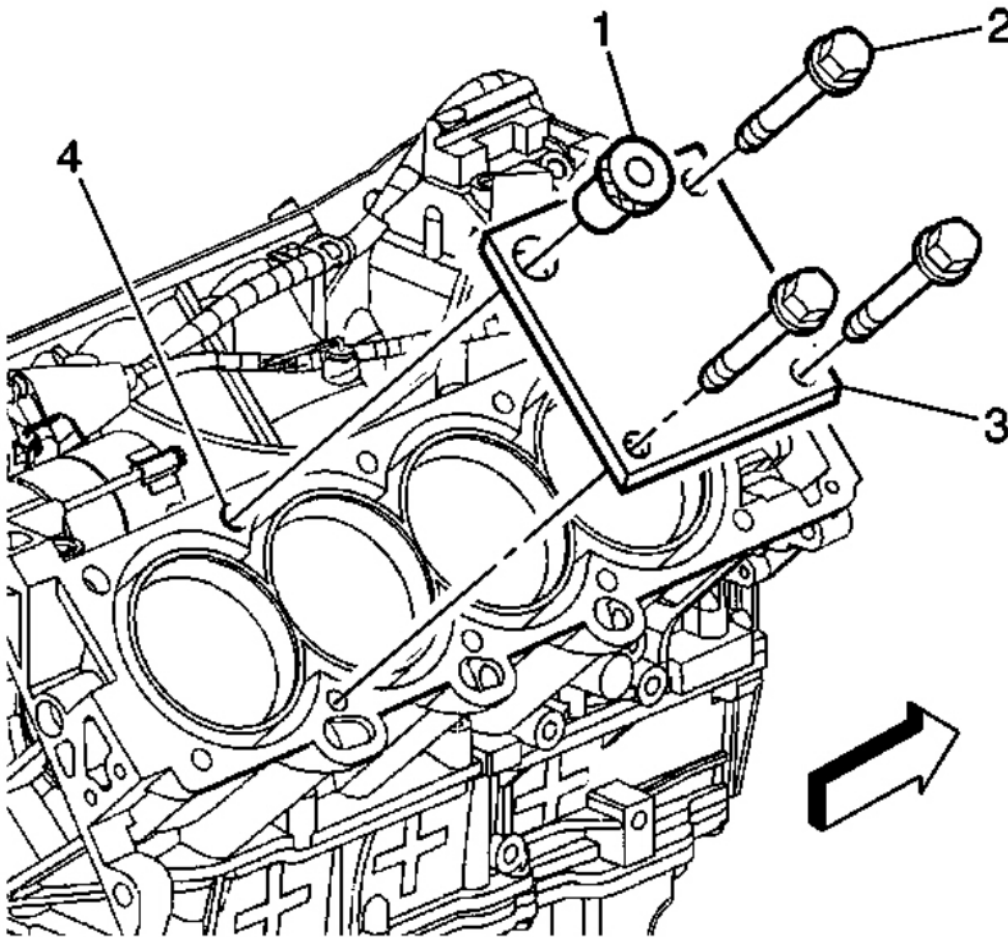


Fig. 114: View Of Fixture Plate & Components - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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

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

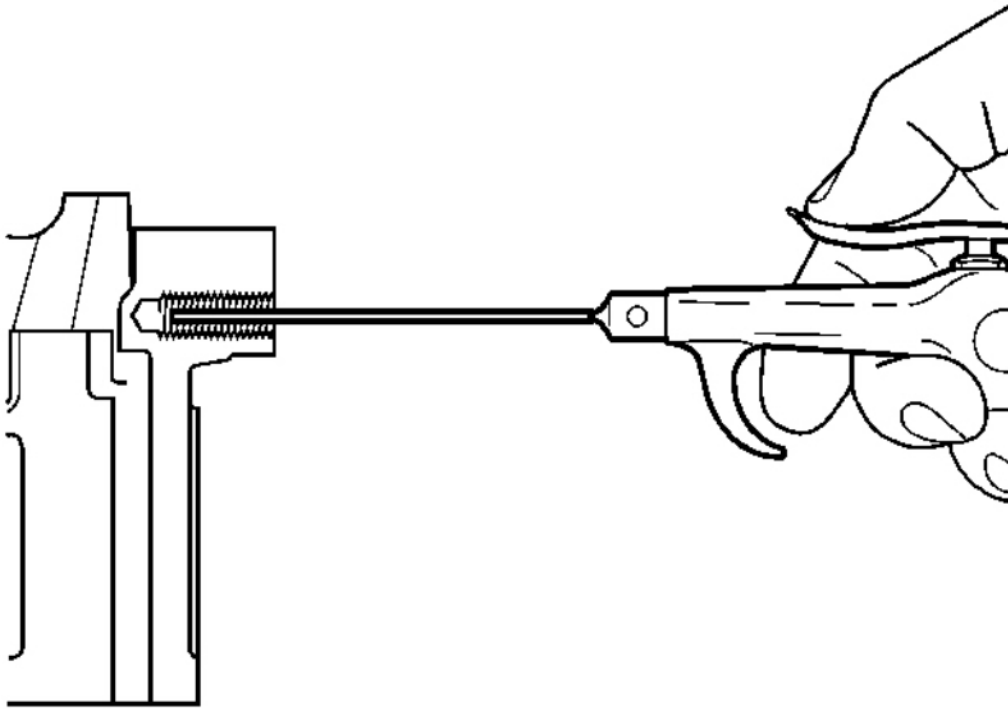


Fig. 115: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

13. Using compressed air, clean out any chips.

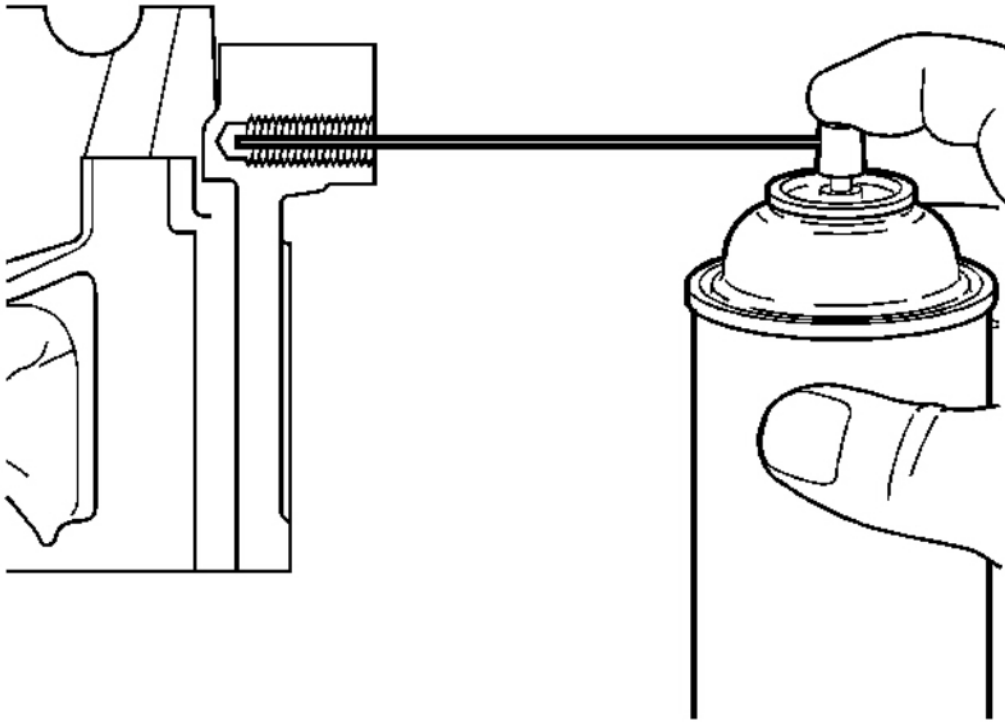


Fig. 116: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

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

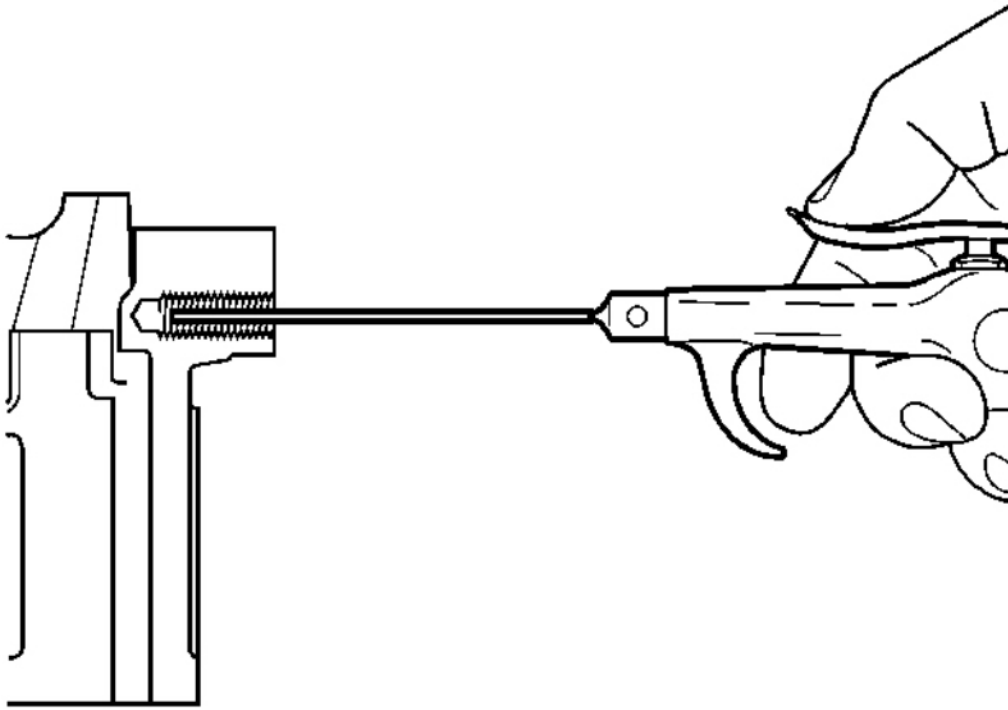


Fig. 117: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

15. Using compressed air, clean out any chips.

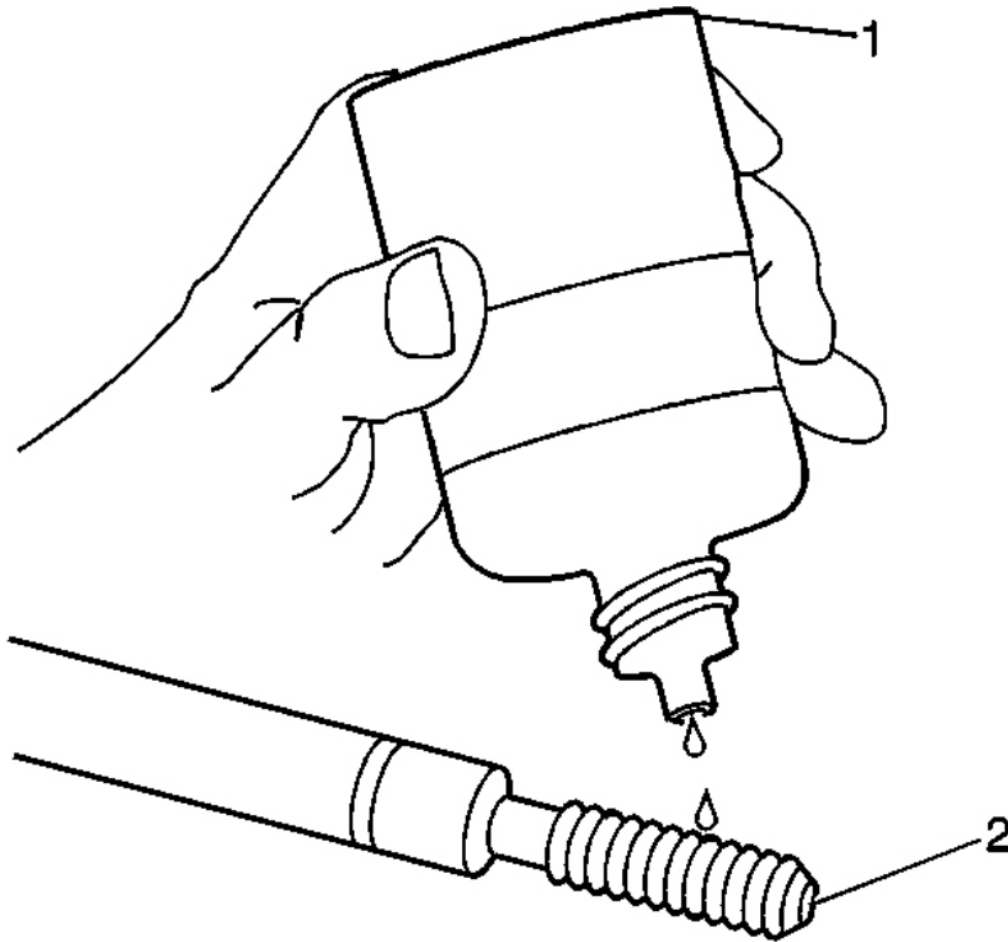


Fig. 118: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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

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

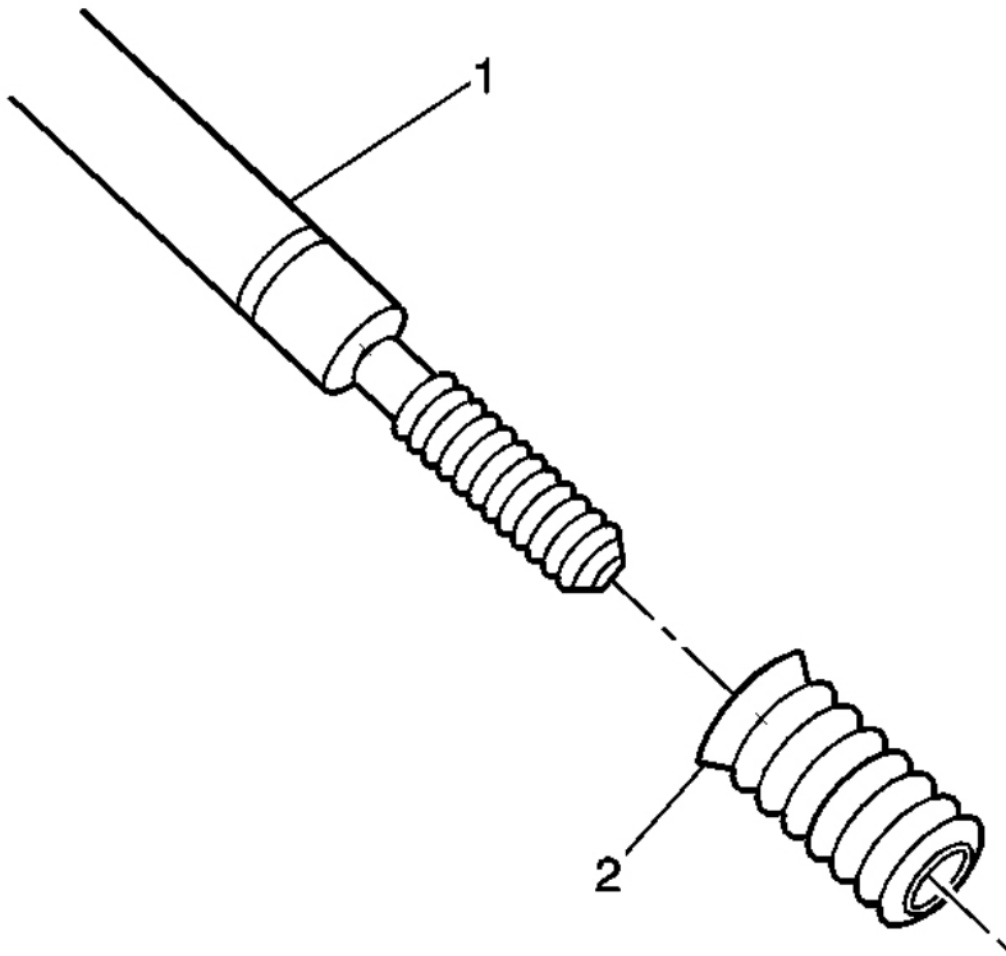


Fig. 119: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

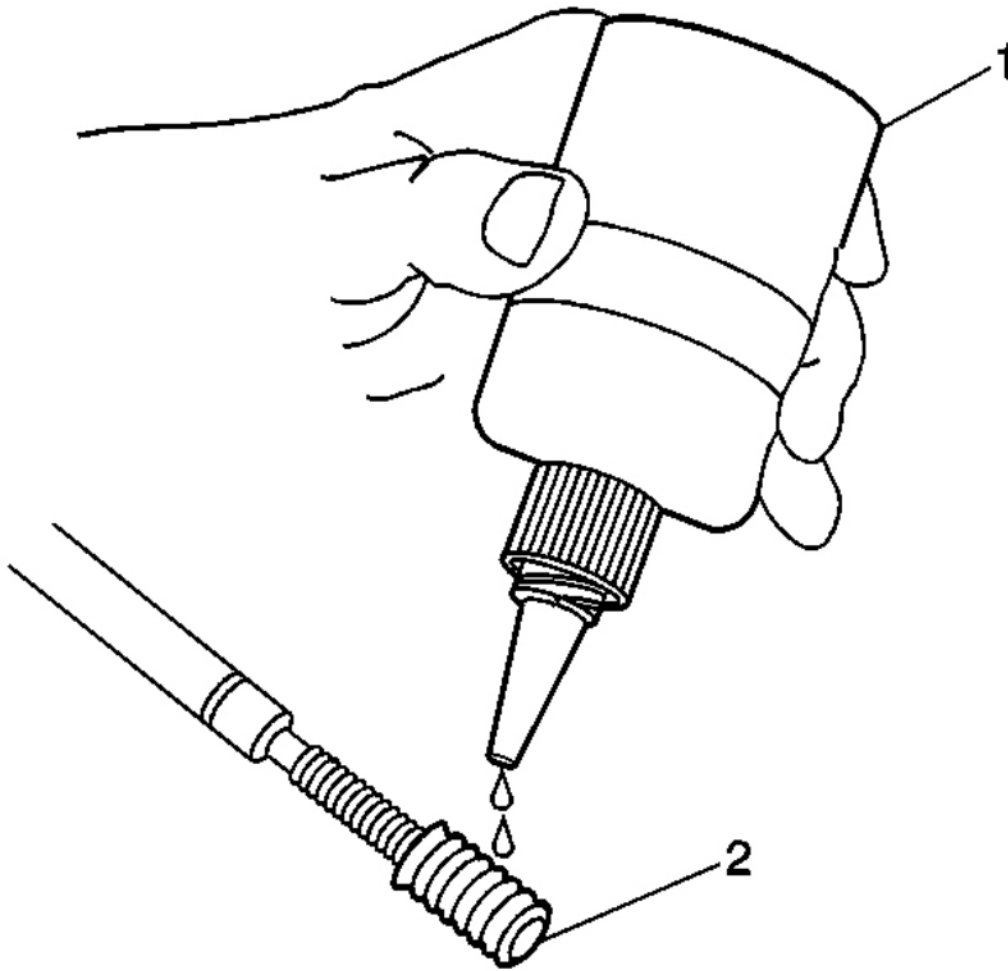


Fig. 120: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

18. 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).

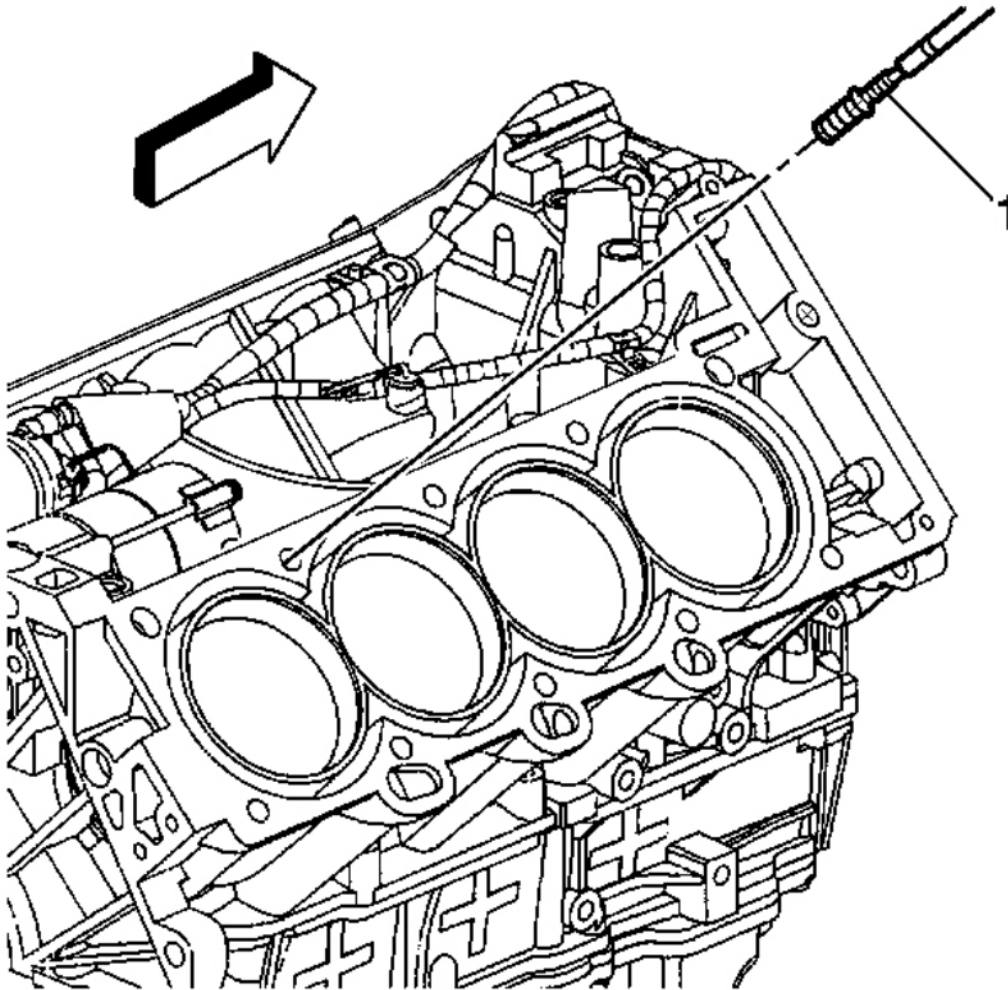


Fig. 121: Installing Insert & Installation Driver - Inboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

19. Install the insert and installation driver (1) into the tapped hole by hand only.
20. 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.

21. 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.

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

23. Inspect the insert for proper installation into the tapped hole.

Outboard Bolt Holes

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.

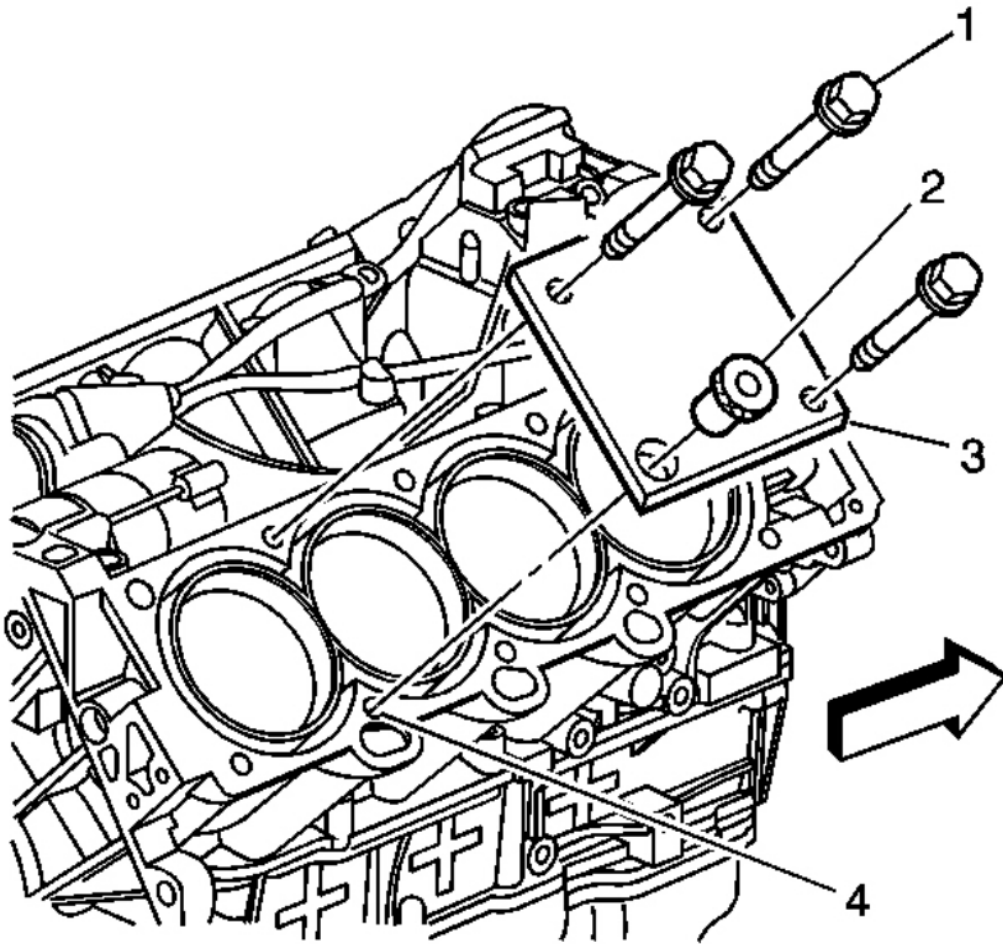


Fig. 122: View Of Fixture Plate & Components - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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

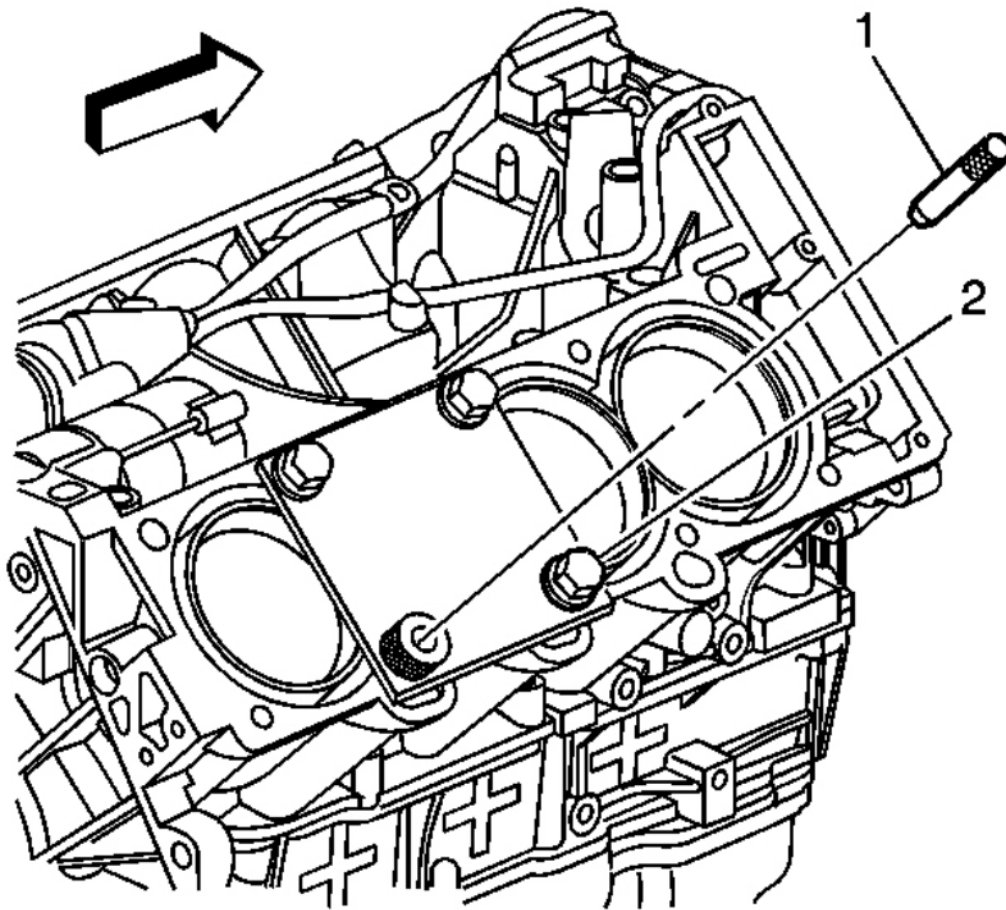


Fig. 123: Positioning Alignment Pin - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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.

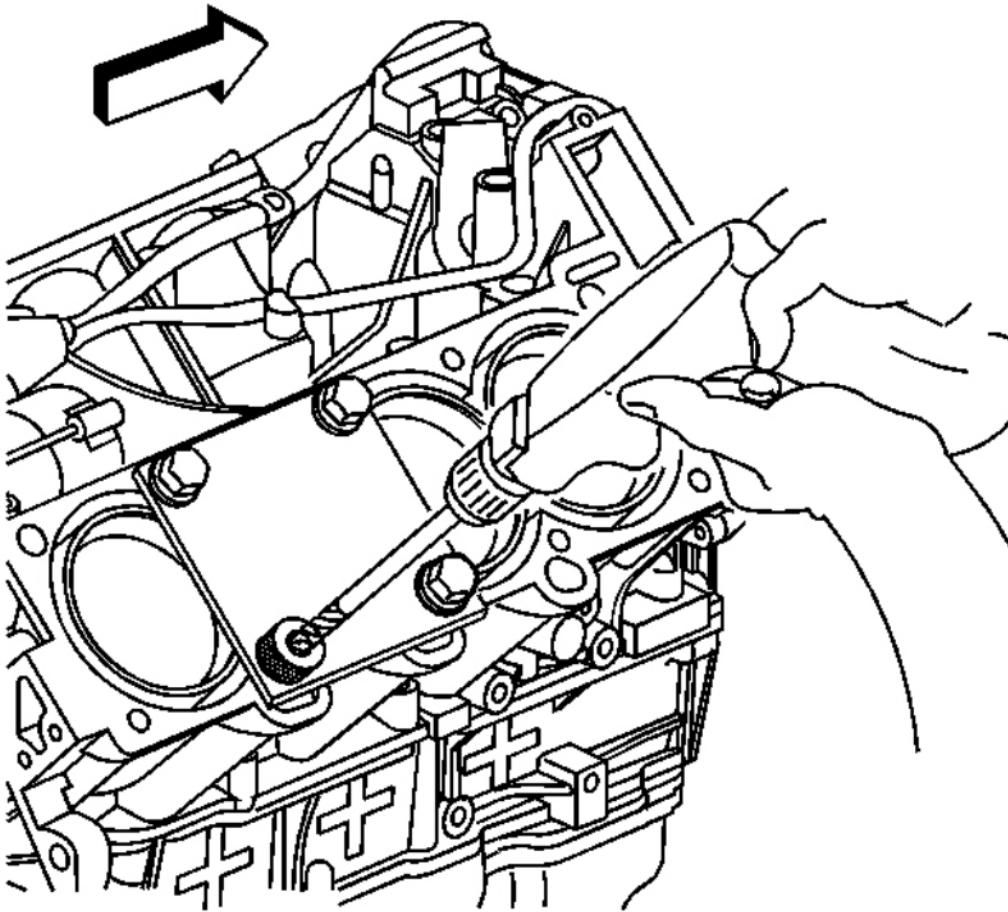


Fig. 124: Drilling Out Threads Of Damaged Hole - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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 hole until the stop collar contacts the top of the drill bushing.

6. Drill out the threads of the damaged hole.

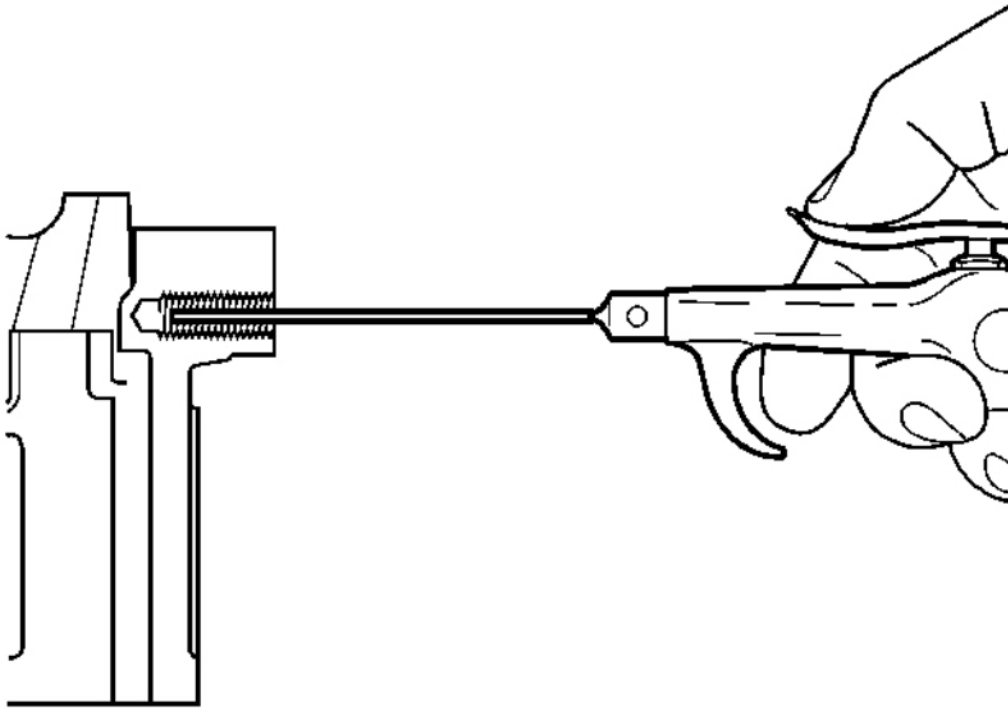


Fig. 125: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

7. Using compressed air, clean out any chips.

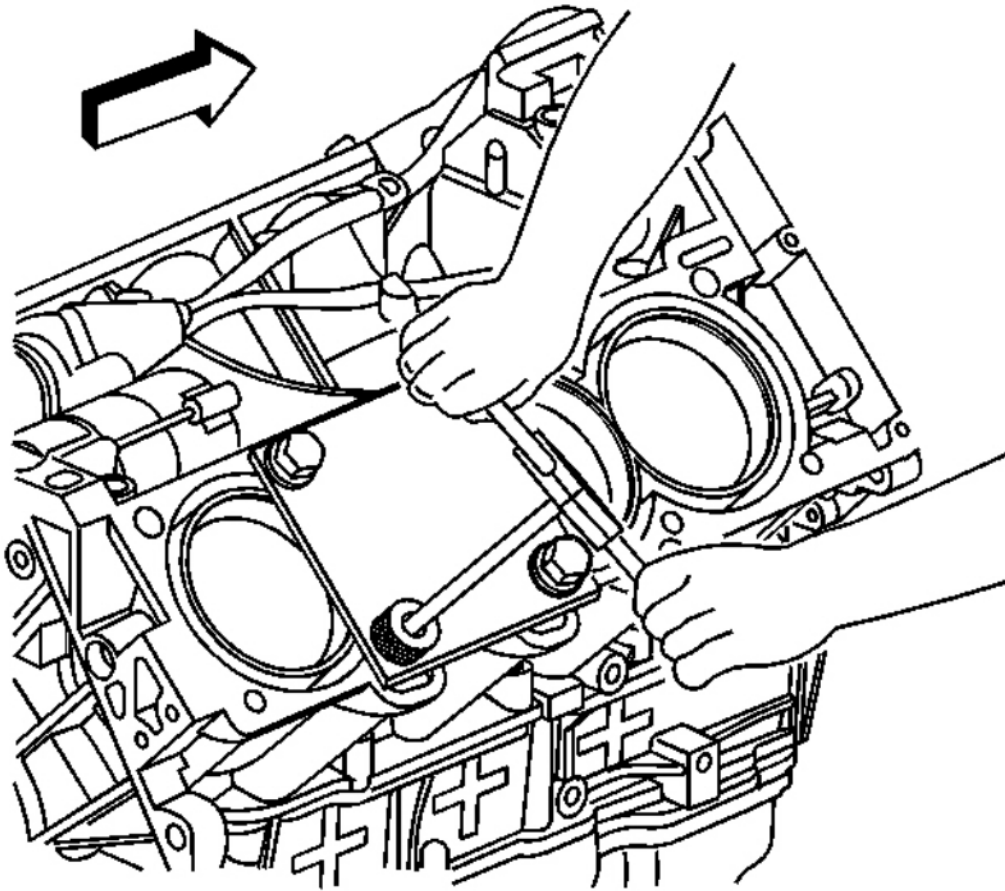


Fig. 126: Tapping Threads Using Tapping Wrench - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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.

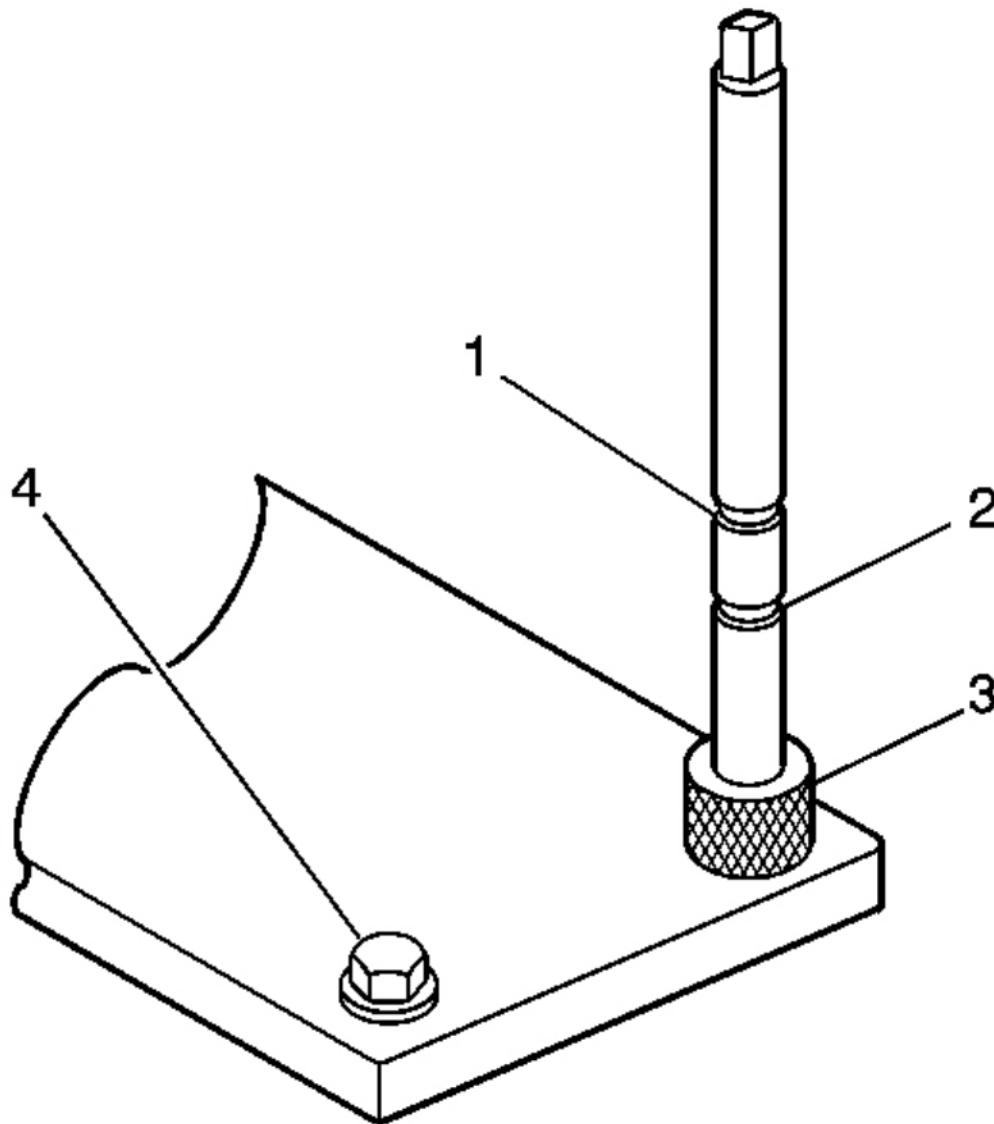


Fig. 127: Rotating Tap Into Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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 second mark (1) on the tap aligns with the top of the drill bushing (3).

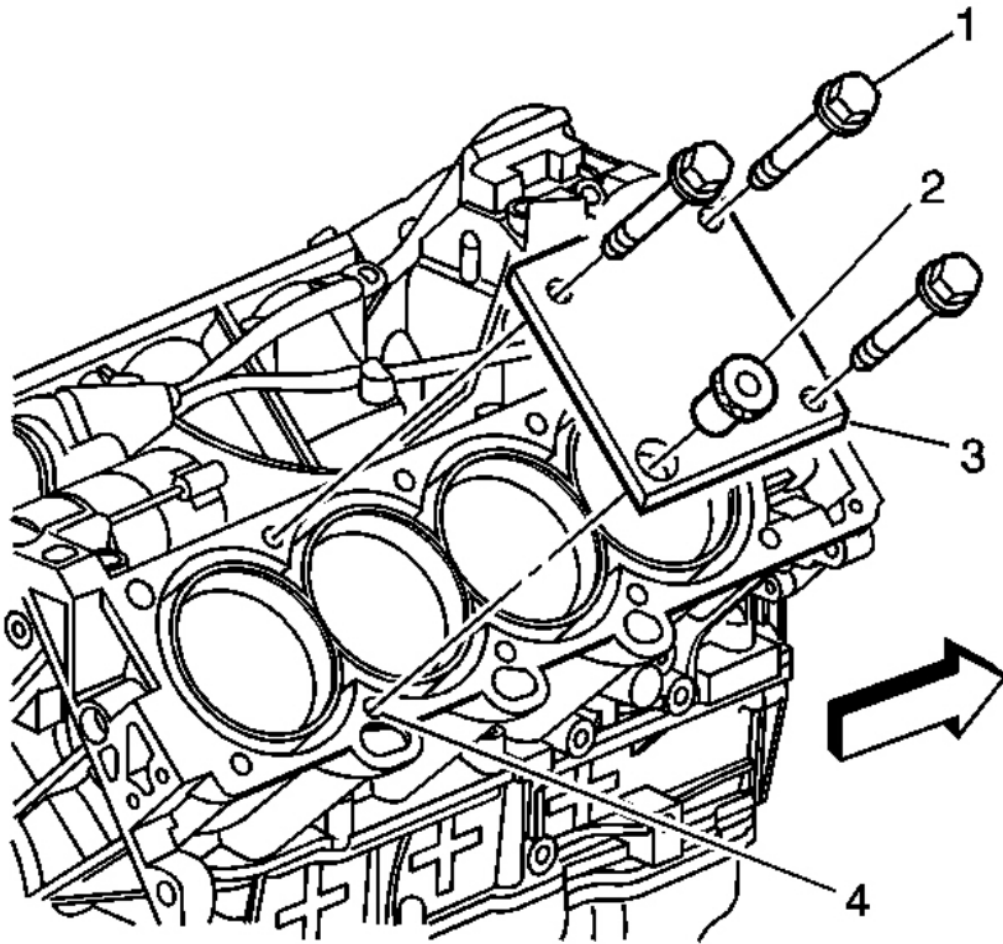


Fig. 128: View Of Fixture Plate & Components - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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

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

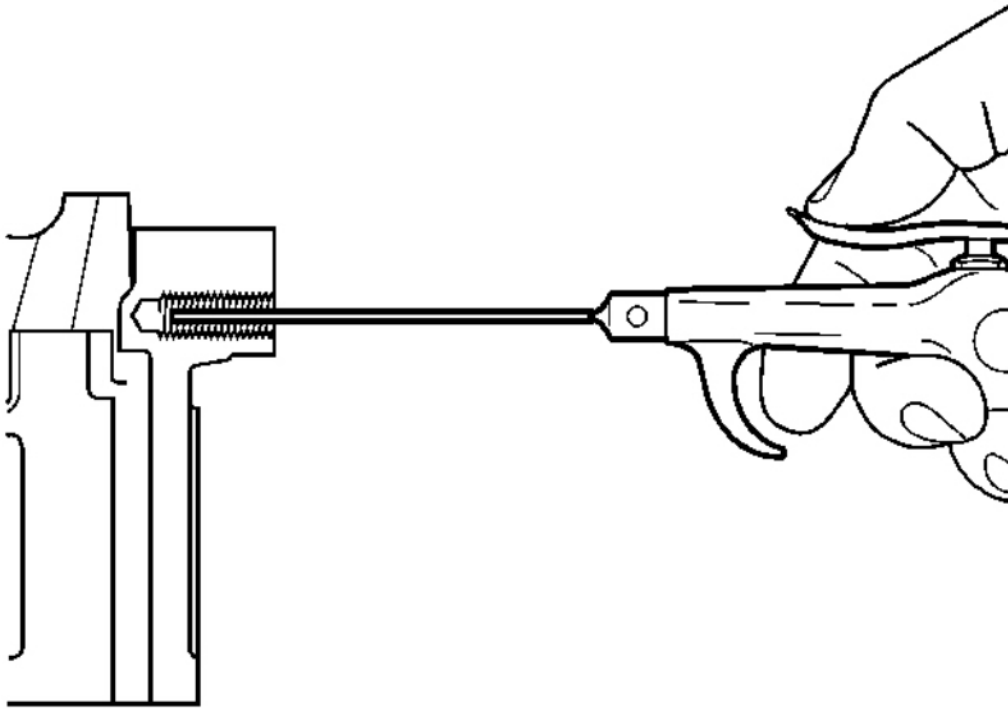


Fig. 129: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

12. Using compressed air, clean out any chips.

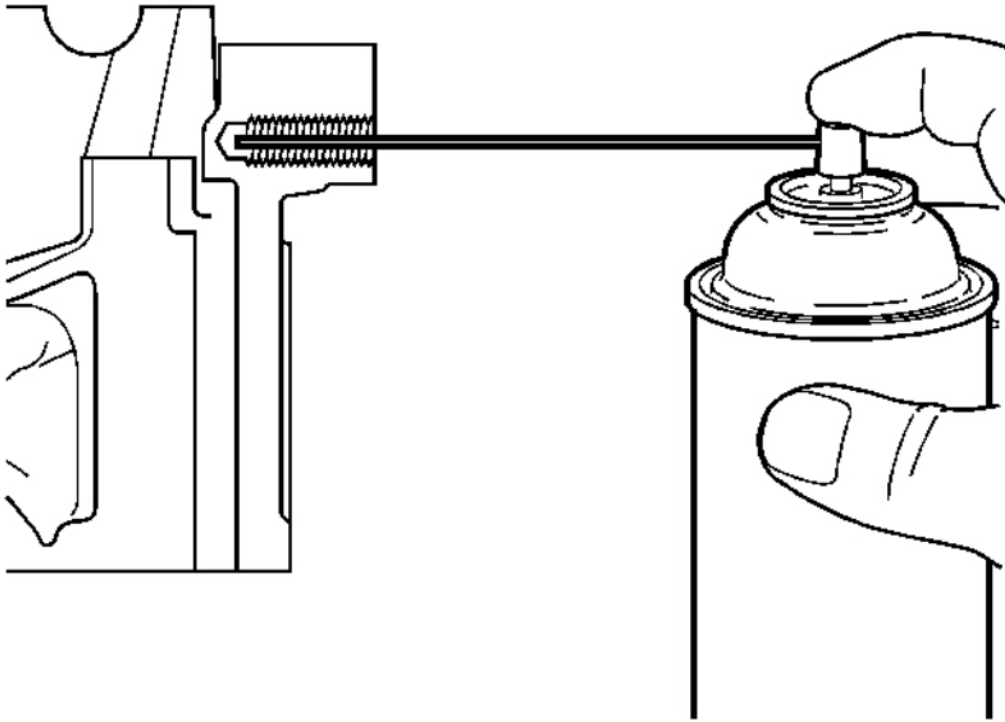


Fig. 130: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

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

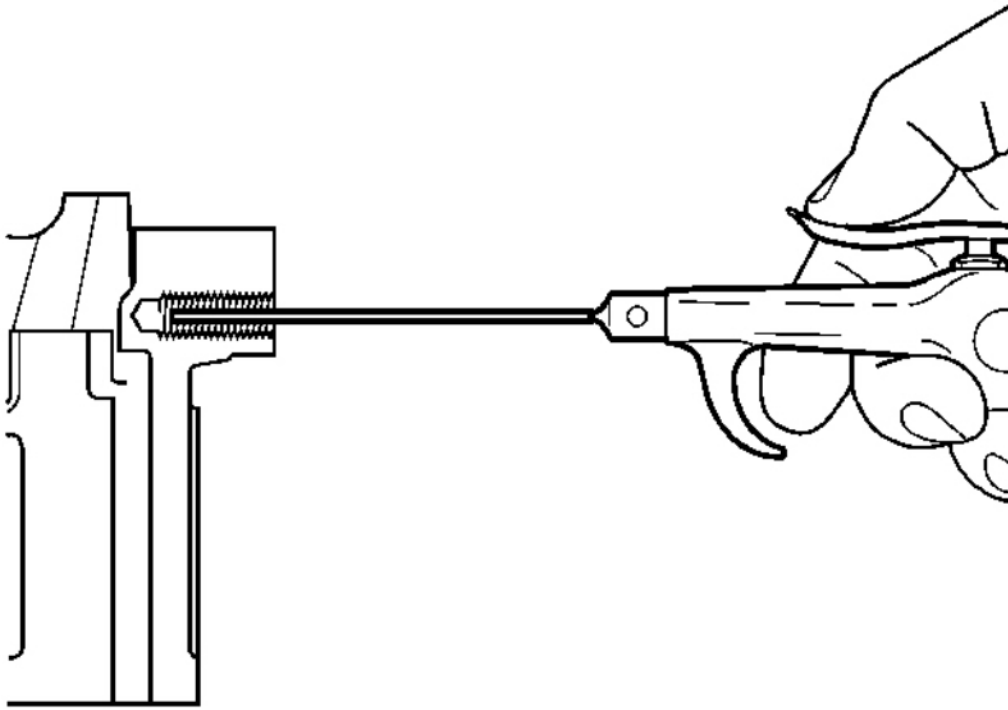


Fig. 131: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

14. Using compressed air, clean out any chips.

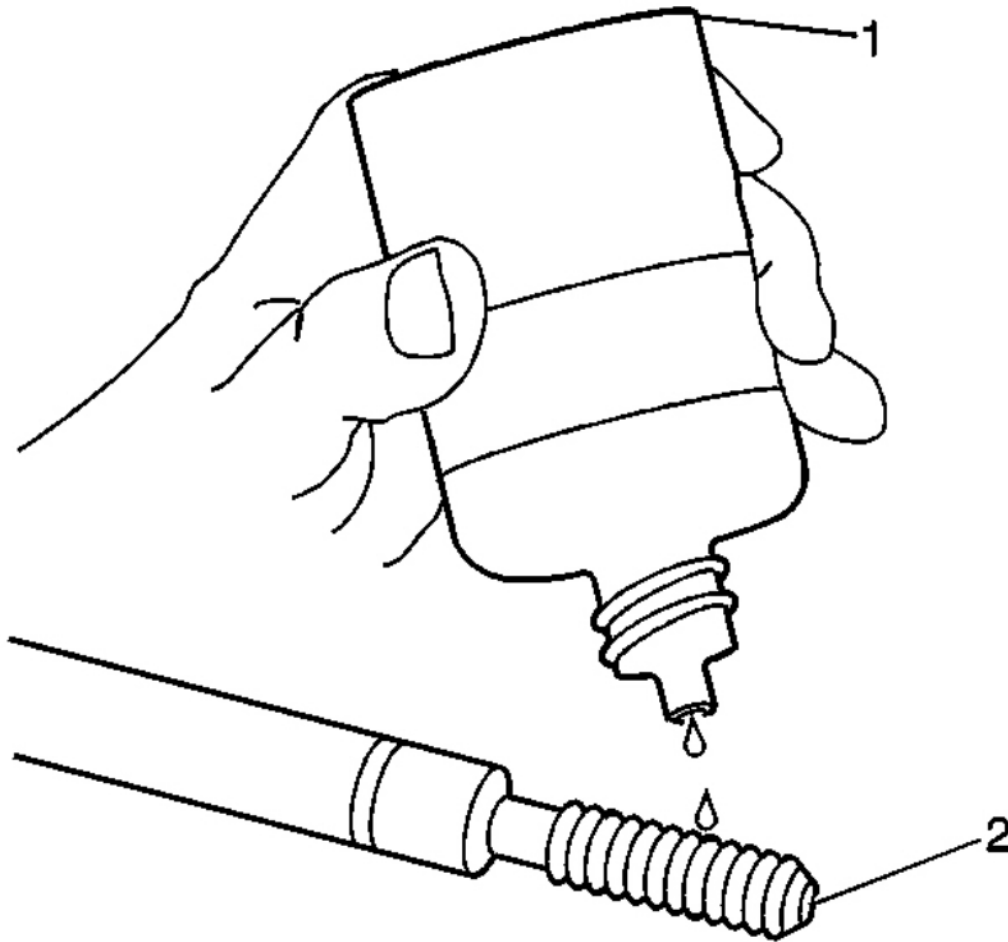


Fig. 132: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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

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

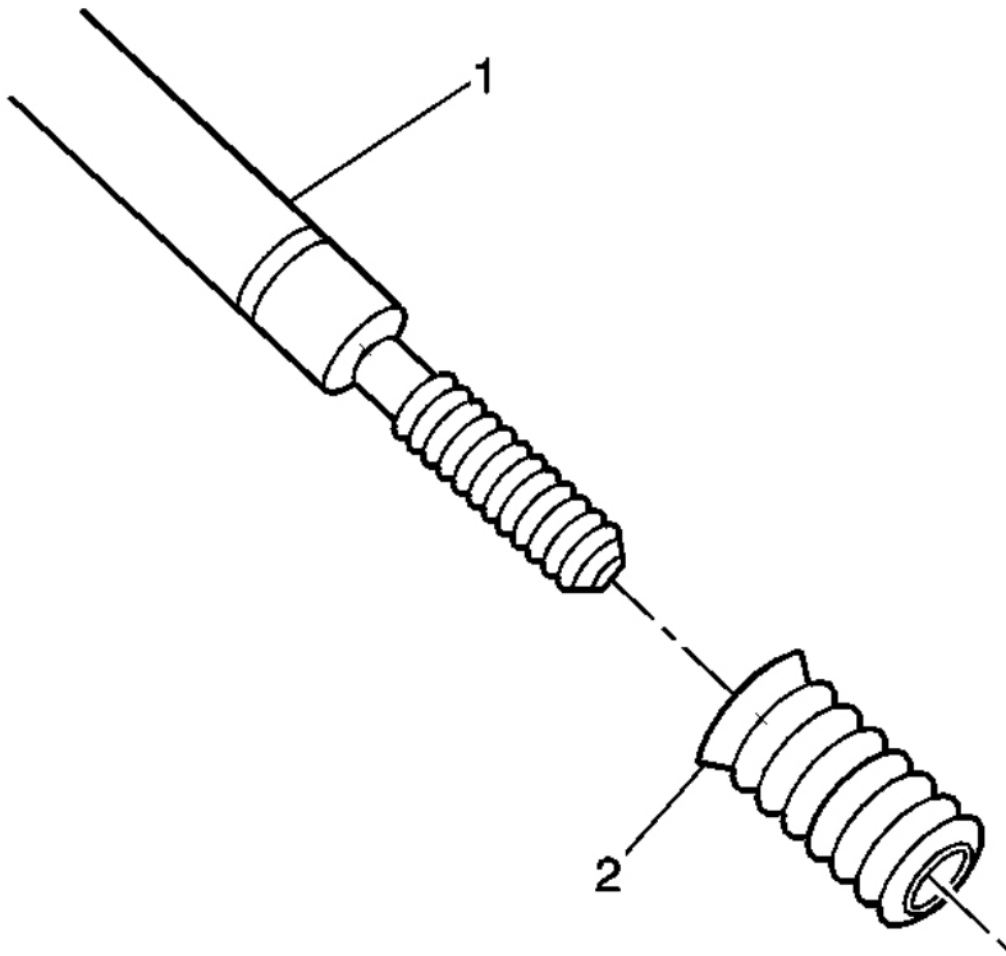


Fig. 133: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

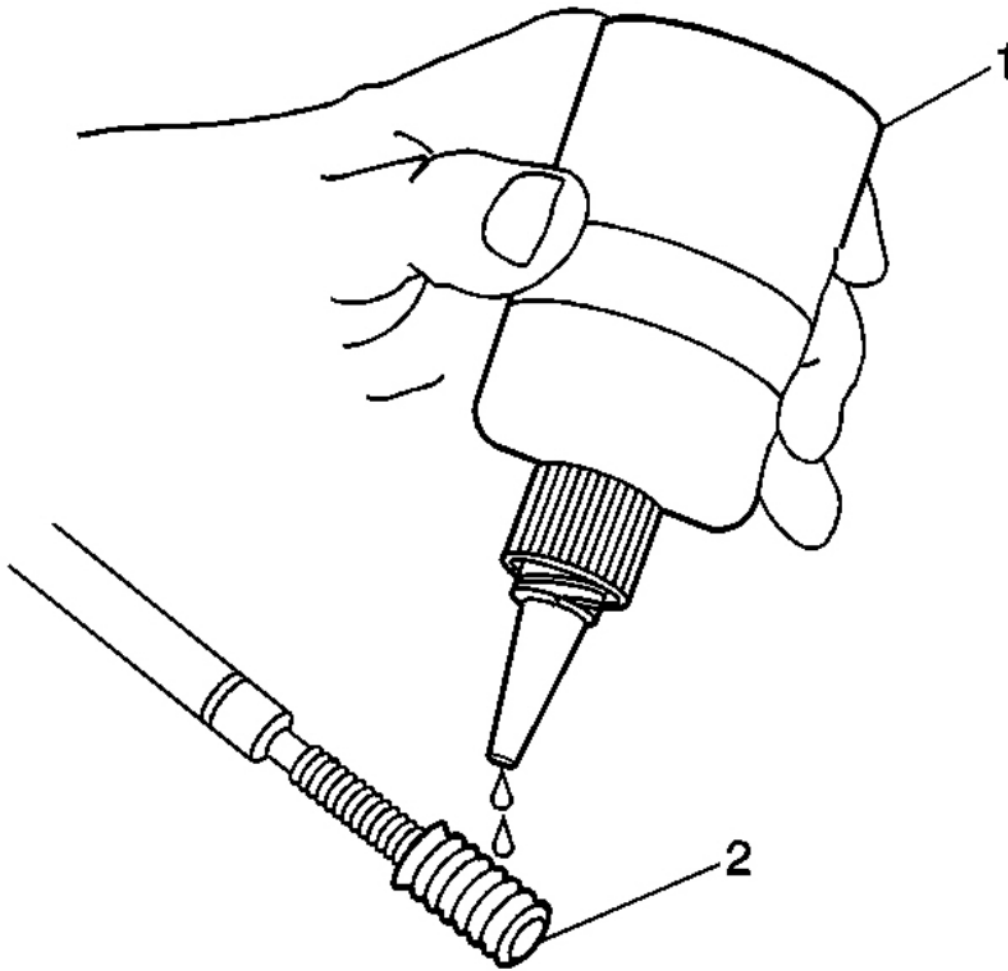


Fig. 134: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

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).

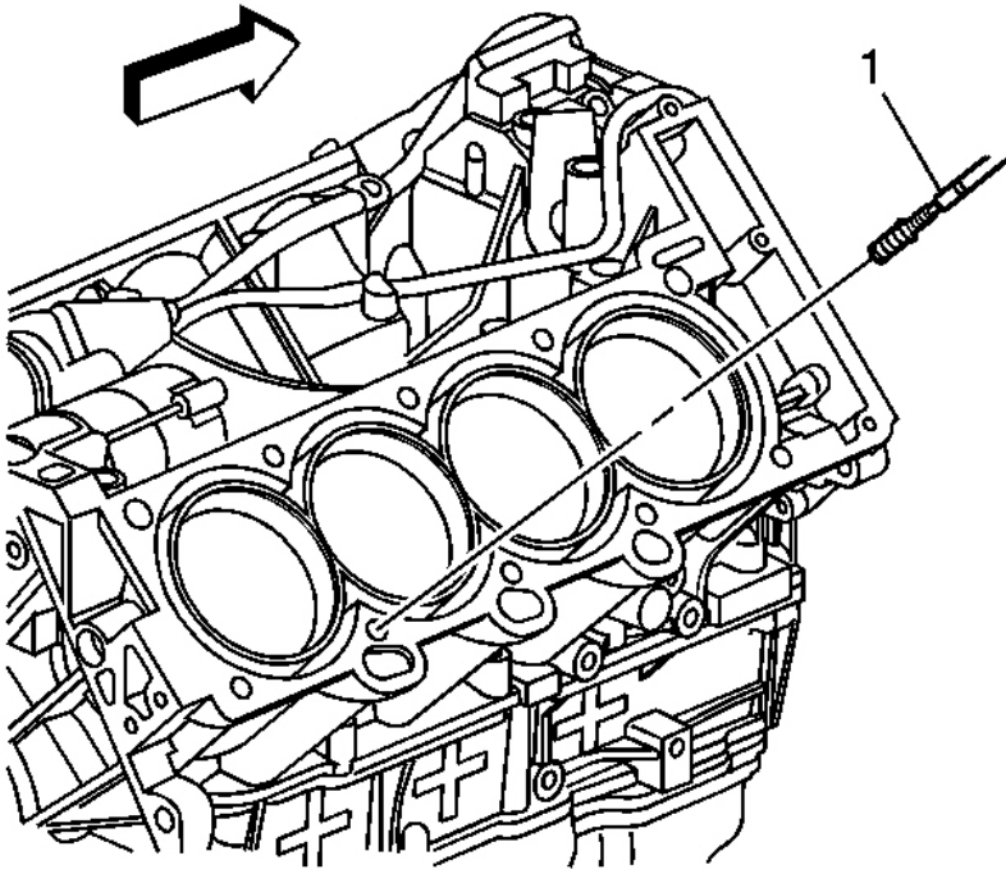


Fig. 135: Installing Insert & Installation Driver - Outboard Bolt Holes
Courtesy of GENERAL MOTORS CORP.

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.
22. Inspect the insert for proper installation into the tapped hole.

Crankshaft Main Bolt Hole Thread Repair

Tools Required:

J 42385-2000 Thread Insert Kit

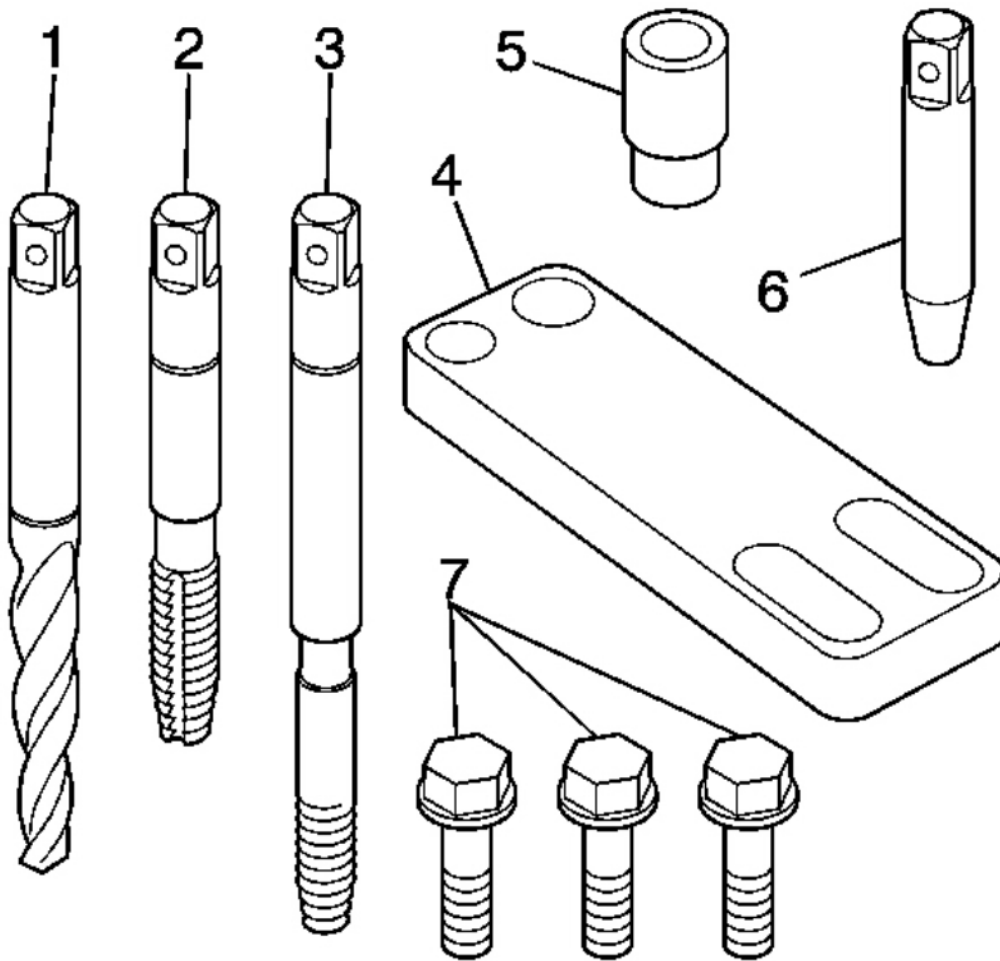


Fig. 136: View Of Thread Insert Kit
Courtesy of GENERAL MOTORS CORP.

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 kit **J 42385-2000** components consist of the

following:

- Drill (1) J 42385-511
- Tap (2) J 42385-512
- Installation driver (3) J 42385-513
- Fixture plate (4) J 42385-306
- Bushing (5) J 42385-307
- Alignment pin (6) J 42385-308
- Bolts (7) J 42385-510

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.

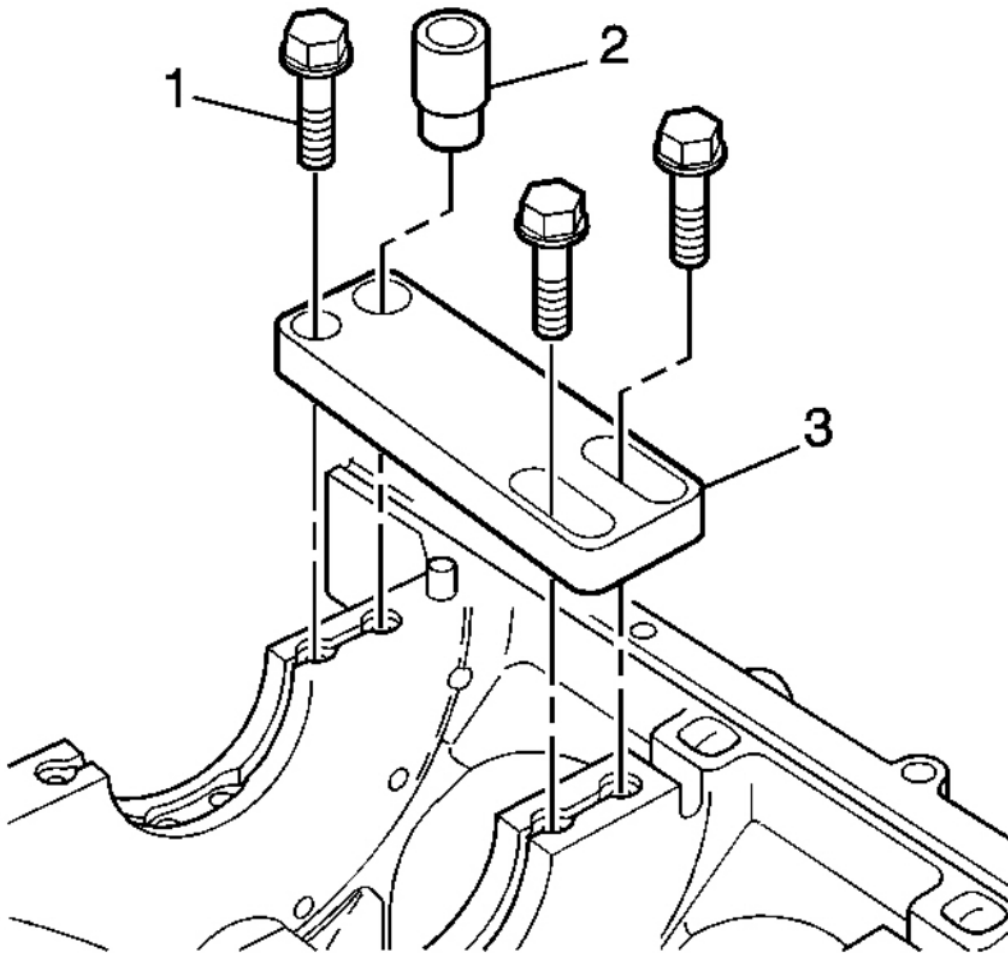


Fig. 137: View Of Fixture Plate & Components - Crankshaft Main Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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.

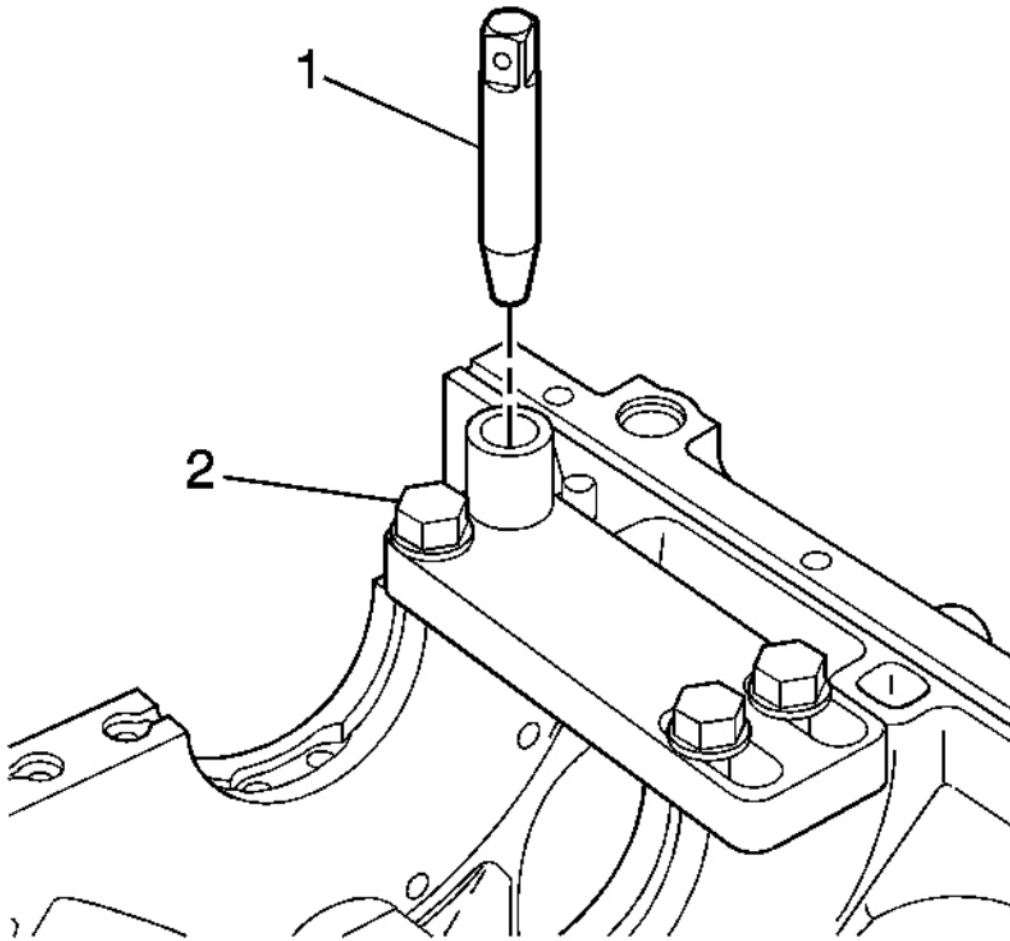


Fig. 138: Positioning Alignment Pin - Crankshaft Main Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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.

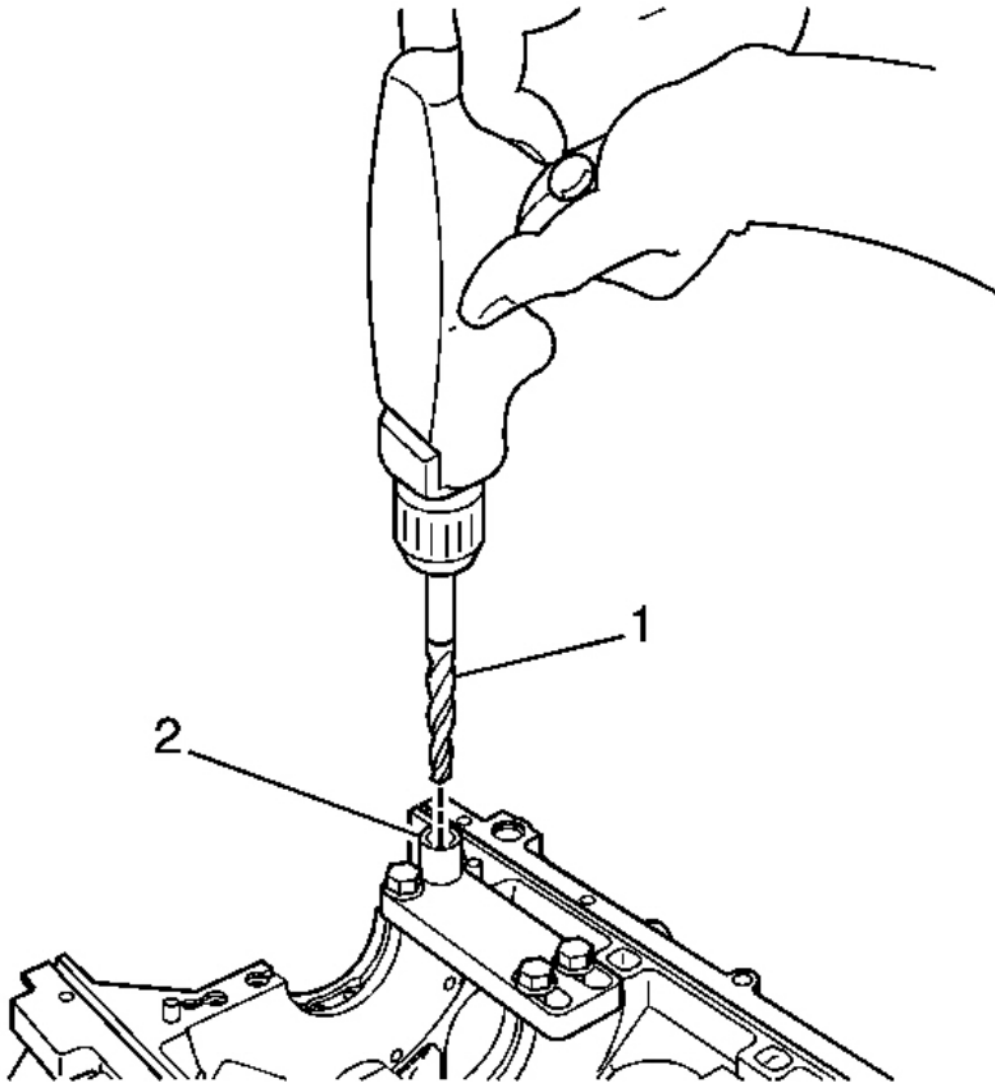


Fig. 139: Drilling Out Threads Of Damaged Hole - Crankshaft Main Bolt Hole
Courtesy of GENERAL MOTORS CORP.

- 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 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.

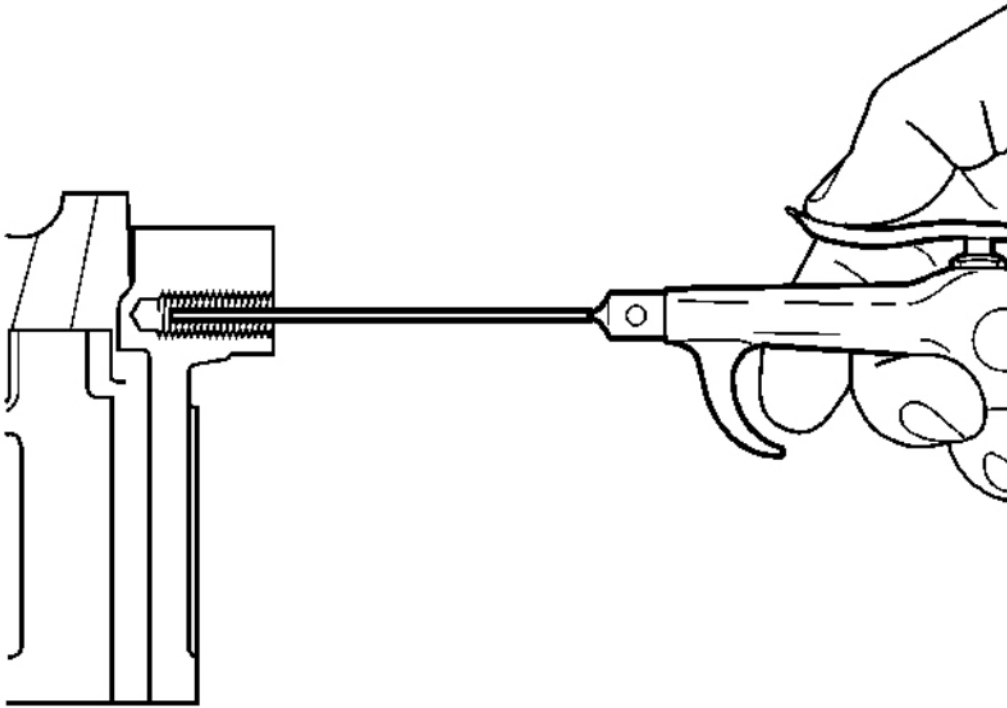


Fig. 140: Cleaning Out Metal Chips

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.

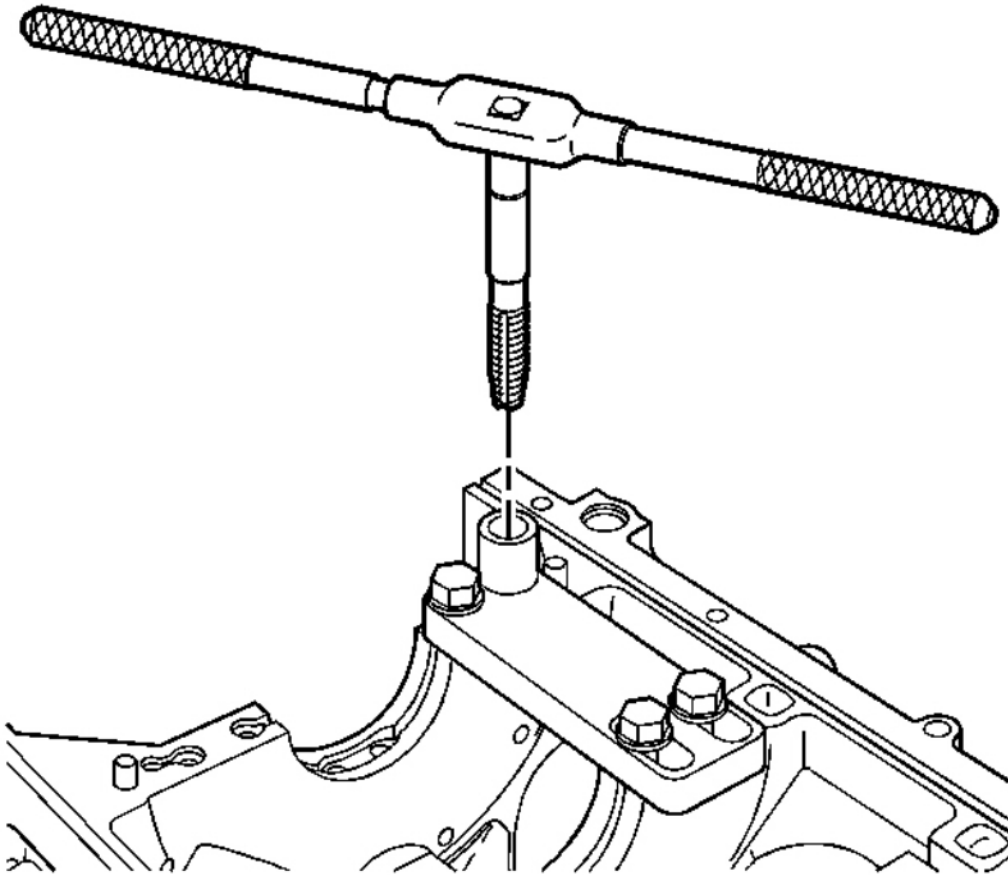


Fig. 141: Tapping Threads Using Tapping Wrench - Crankshaft Main Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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.

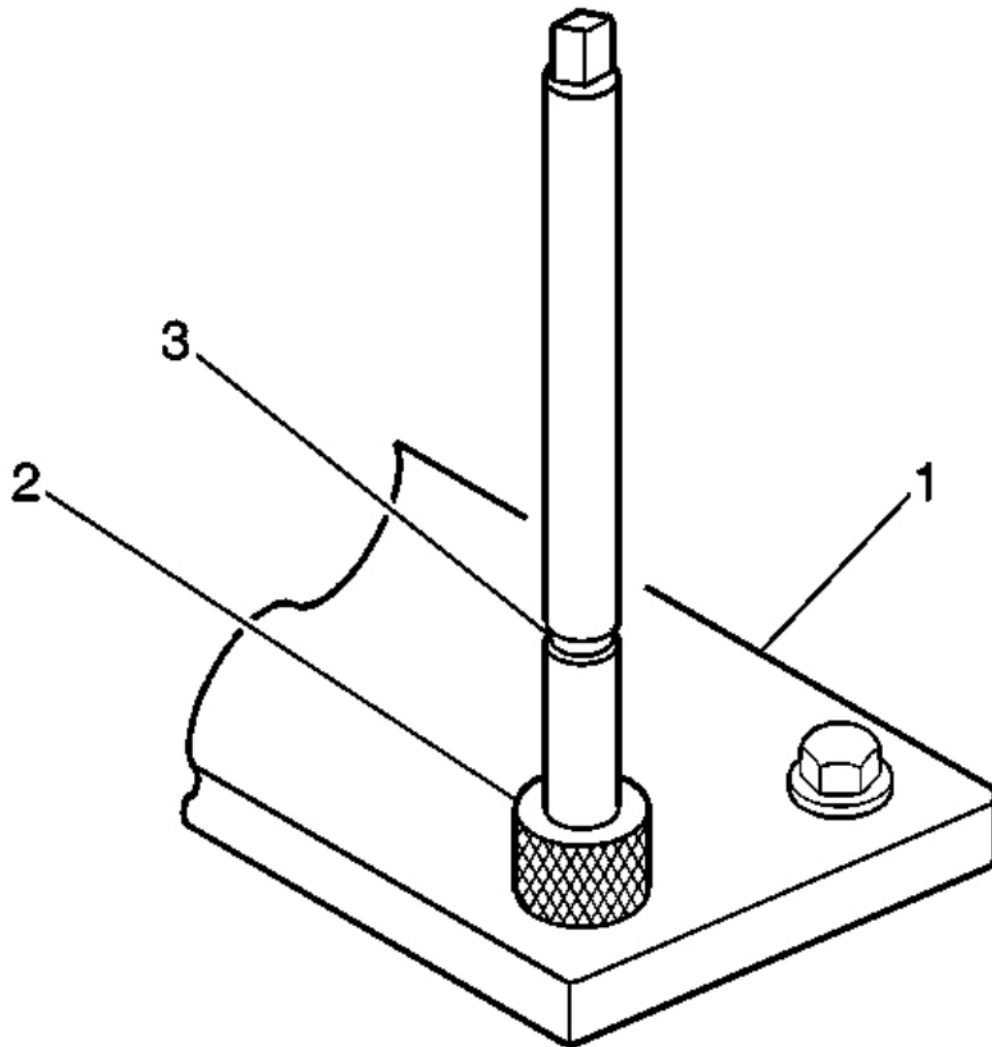


Fig. 142: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

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).

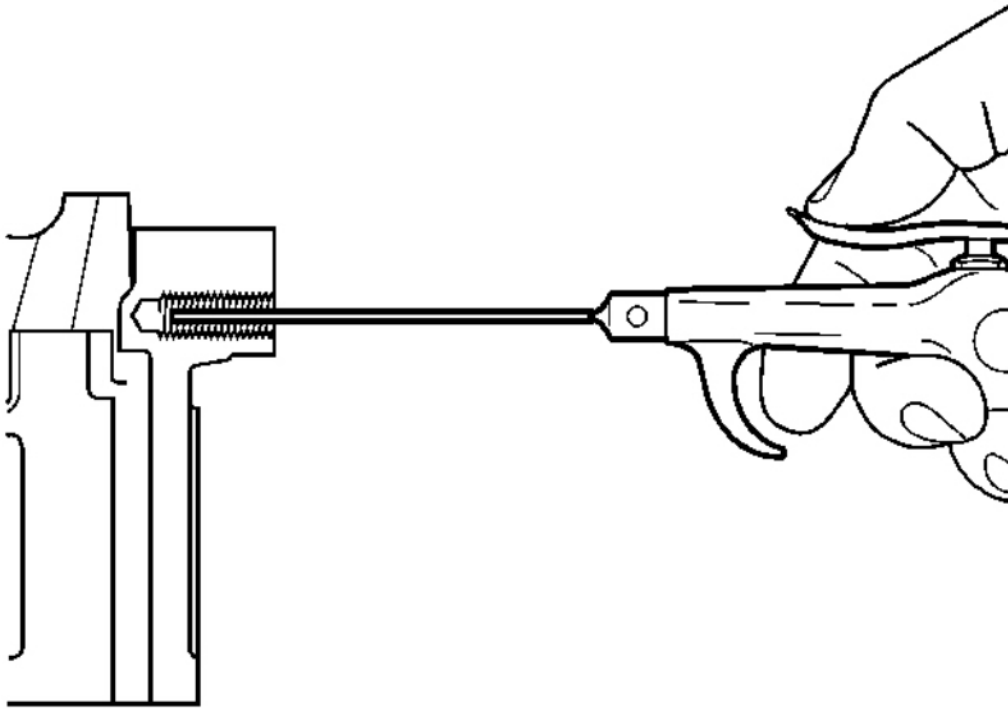


Fig. 143: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

10. Using compressed air, clean out any chips.

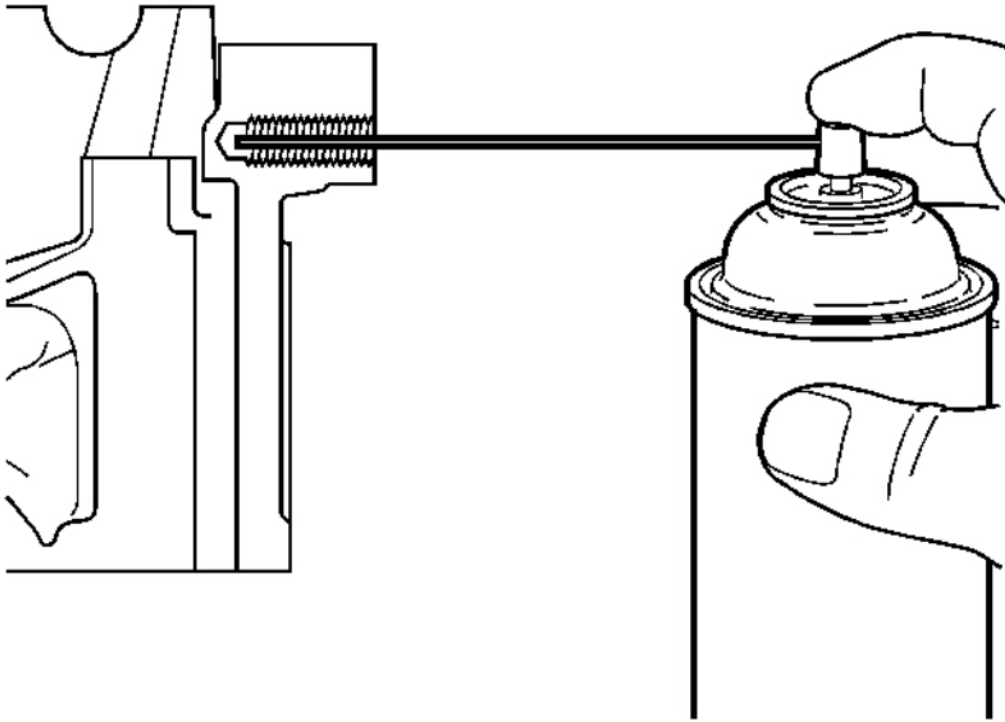


Fig. 144: Spraying Cleaner Into Tapped Hole
Courtesy of GENERAL MOTORS CORP.

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

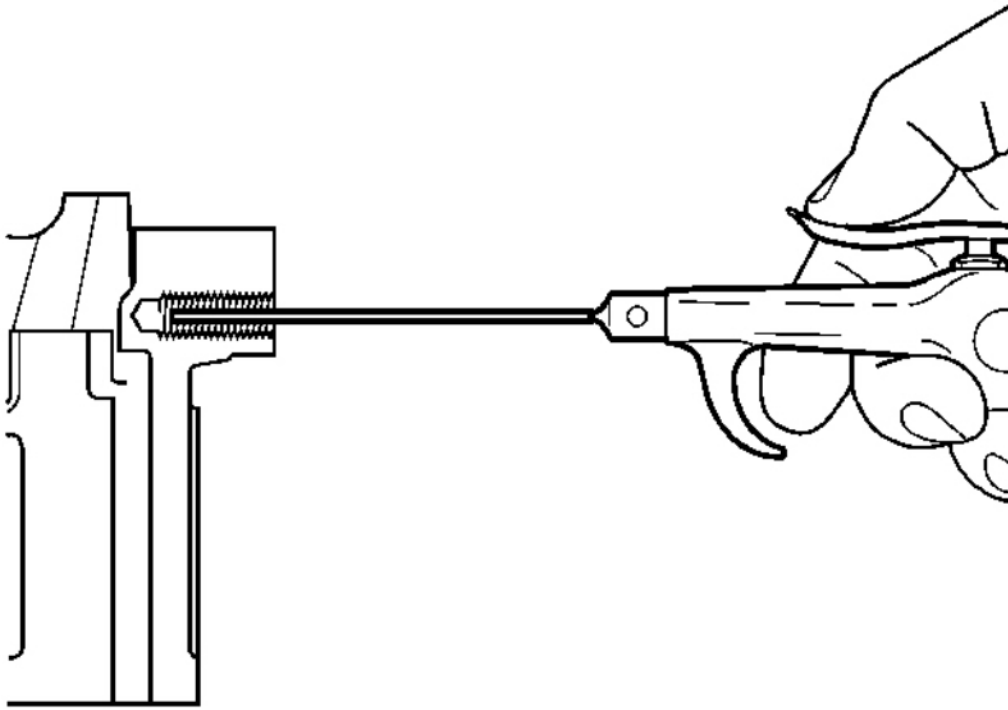


Fig. 145: Cleaning Out Metal Chips
Courtesy of GENERAL MOTORS CORP.

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

12. Using compressed air, clean out any chips.

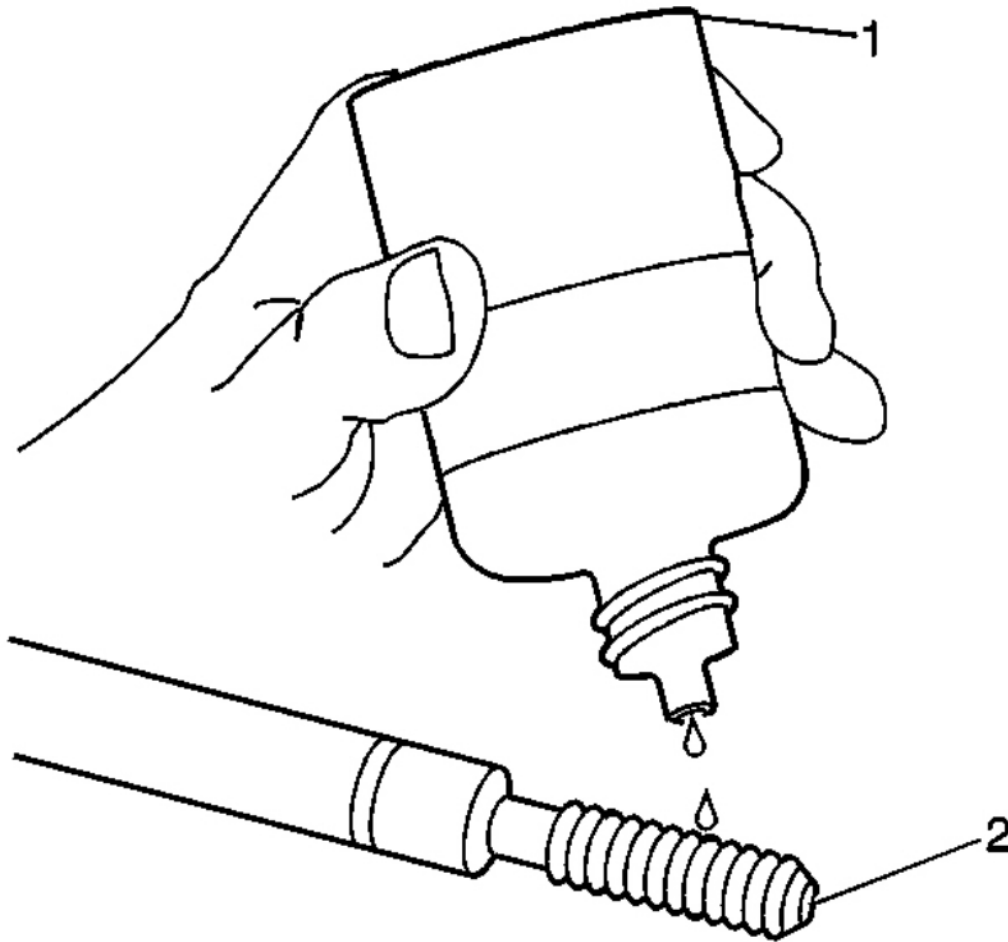


Fig. 146: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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 OD of the insert.

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

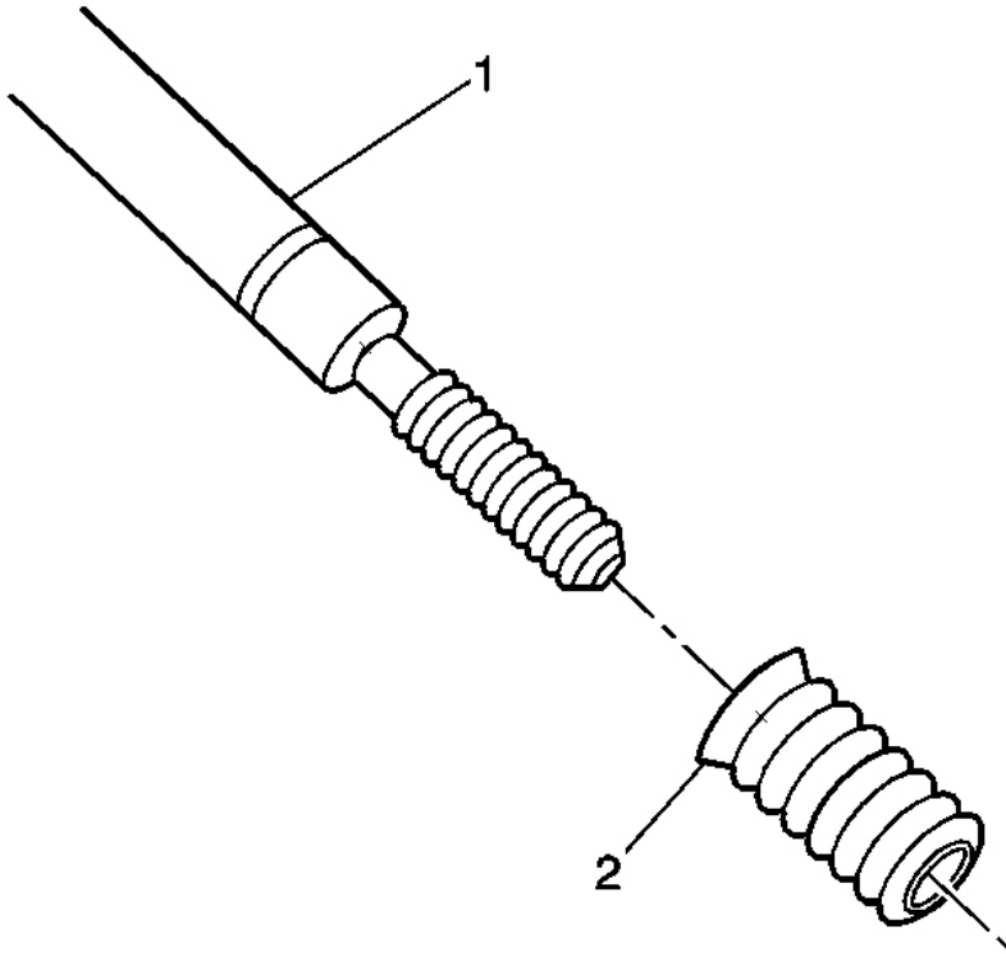


Fig. 147: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

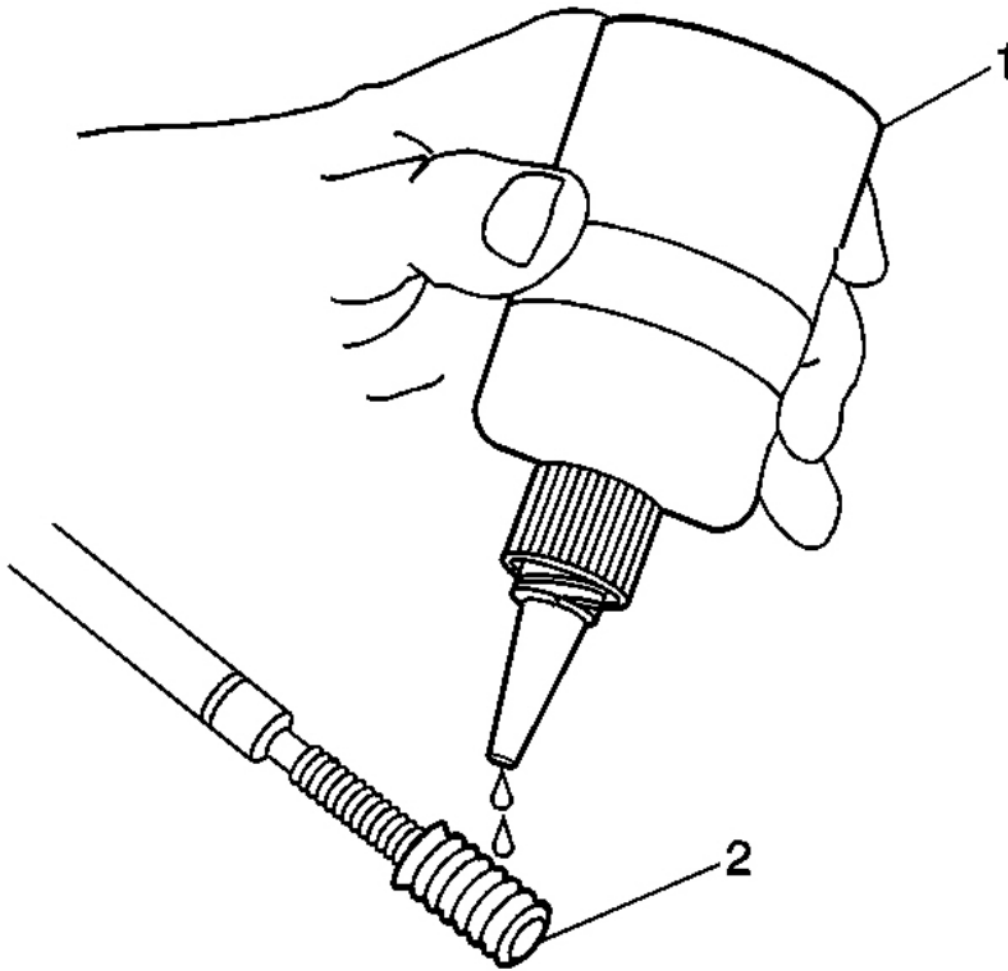


Fig. 148: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

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).

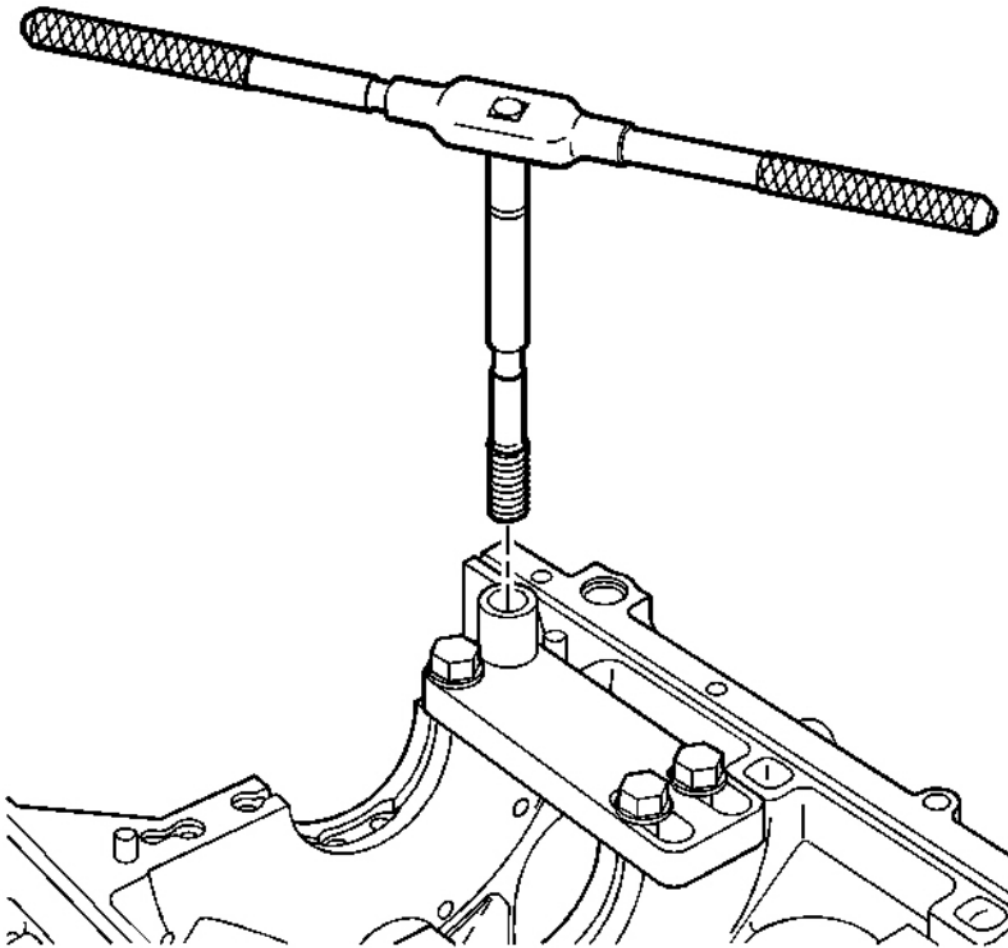


Fig. 149: Installing Insert & Installation Driver - Crankshaft Main Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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.

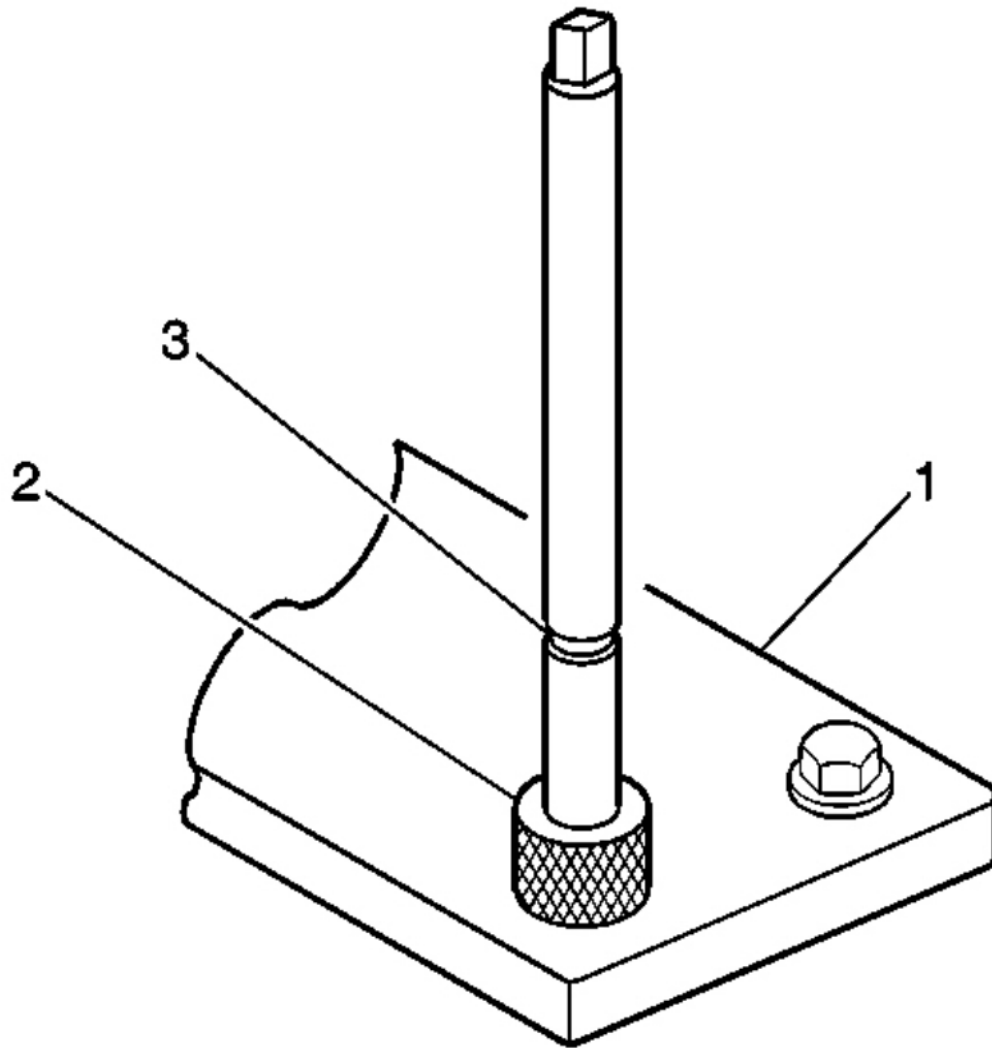


Fig. 150: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

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.

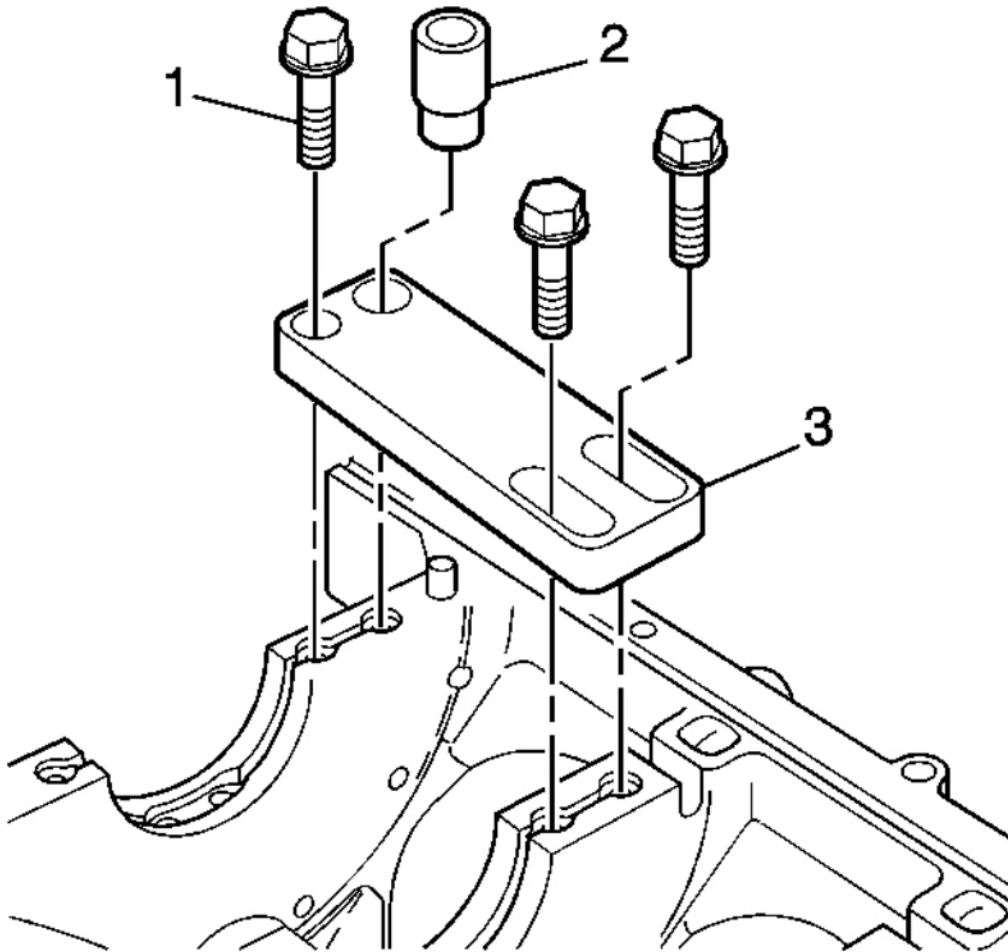


Fig. 151: View Of Fixture Plate & Components - Crankshaft Main Bolt Hole
Courtesy of GENERAL MOTORS CORP.

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

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.

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- 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 PRELUBING

Tools Required:

J 45299 Engine Preluber

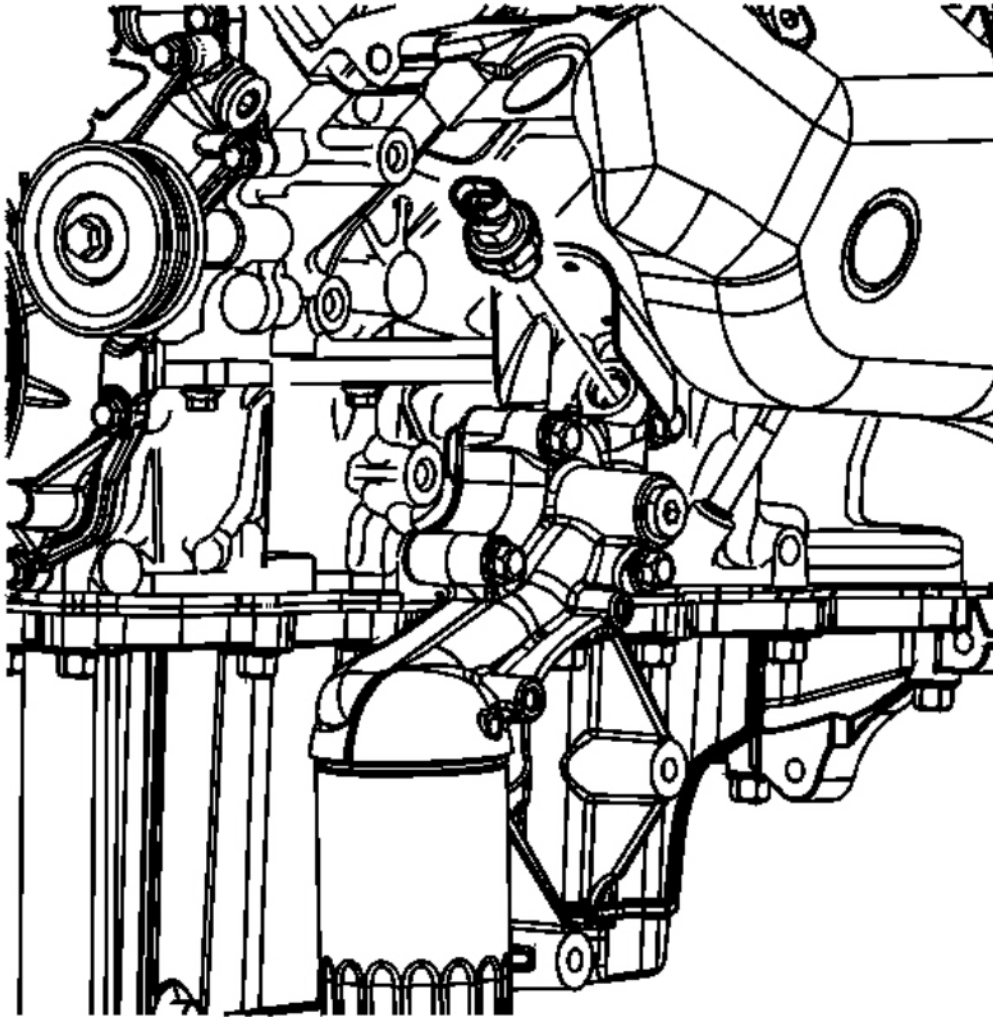


Fig. 152: View Of Oil Pressure Sending Unit
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A constant and continuous flow of clean engine oil is required in order to properly prime the engine. Be sure to use an approved engine oil as specified in the owners manual.

1. Remove the engine oil filter, fill with clean engine oil.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the oil filter.

Tighten: Tighten the oil filter 3/4 to 1 full turn, after the oil filter gasket contacts the oil filter mounting surface.

3. Locate and remove the oil pressure sending unit.
4. Install the 3/8-18 adapter P/N 11628.

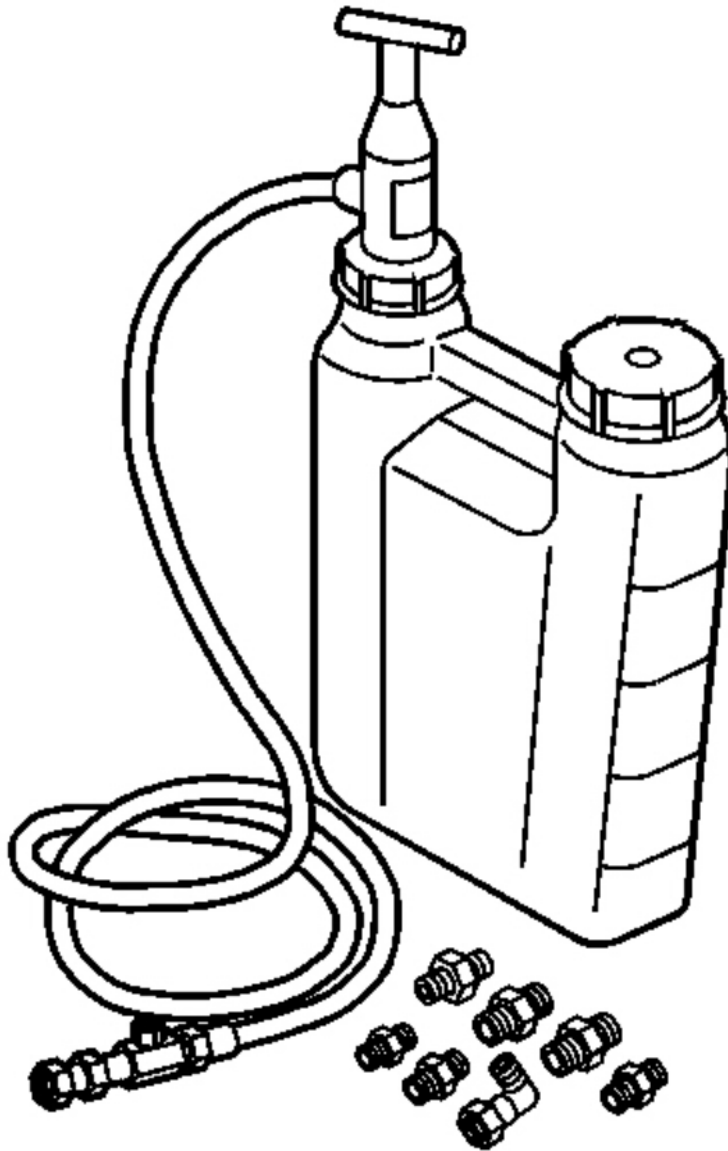


Fig. 153: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

5. Install the flexible hose to the adapter and open the valve.
6. Pump the handle on the **J 45299** in order to flow a minimum of 1-1.9 liters (1-2 quarts) of

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engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.

7. Close the valve and remove the flexible hose and adapter from the engine.
8. Install the oil pressure sending unit.

Tighten: Tighten the oil pressure sending unit to 16 N.m (12 lb ft).

9. Top-off the engine oil to the proper level.

CRANKSHAFT AND BEARINGS INSTALLATION

Crankshaft Bearing Installation Procedure

Tools Required:

J 45059 Angle Meter

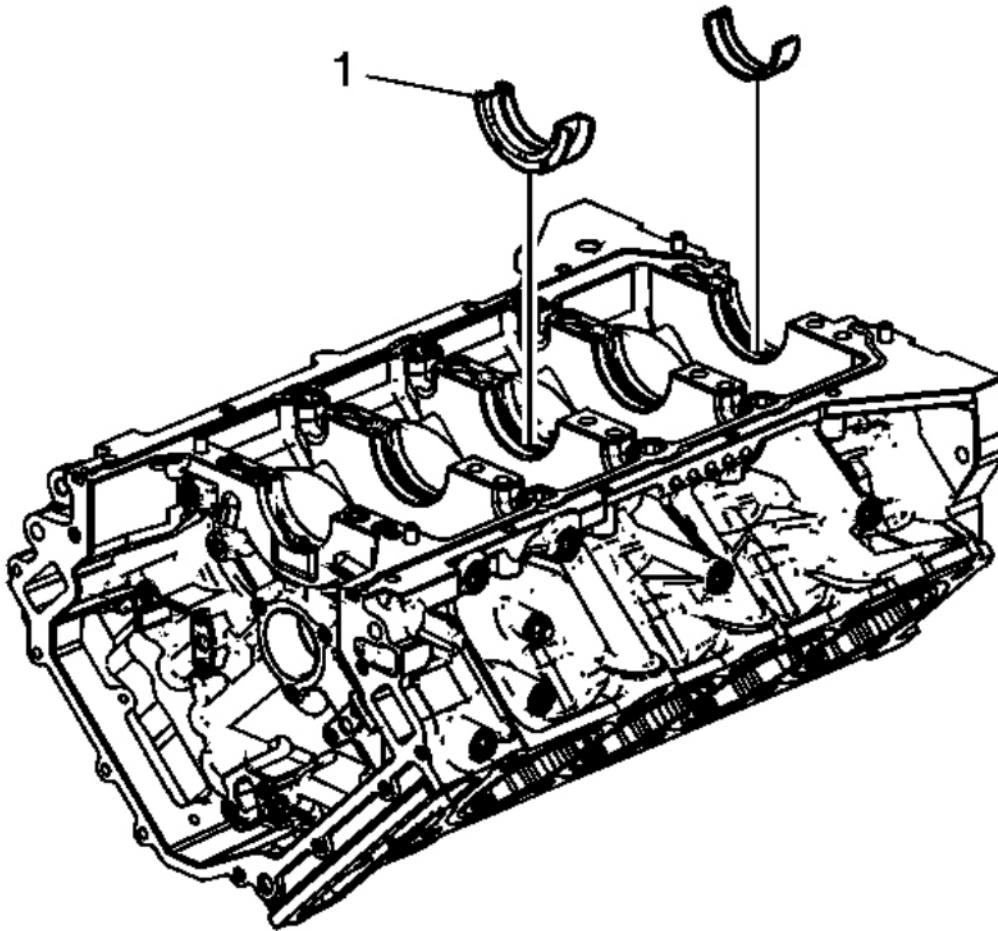


Fig. 154: View Of Thrust Bearing
Courtesy of GENERAL MOTORS CORP.

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 upper and lower crankcase crank bore with a lint-free cloth.
2. Clean all the oil from the backside of new bearing halves.
3. Install new upper crankshaft bearings into position. The thrust bearing (1) belongs in the number three journal. Be sure 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.

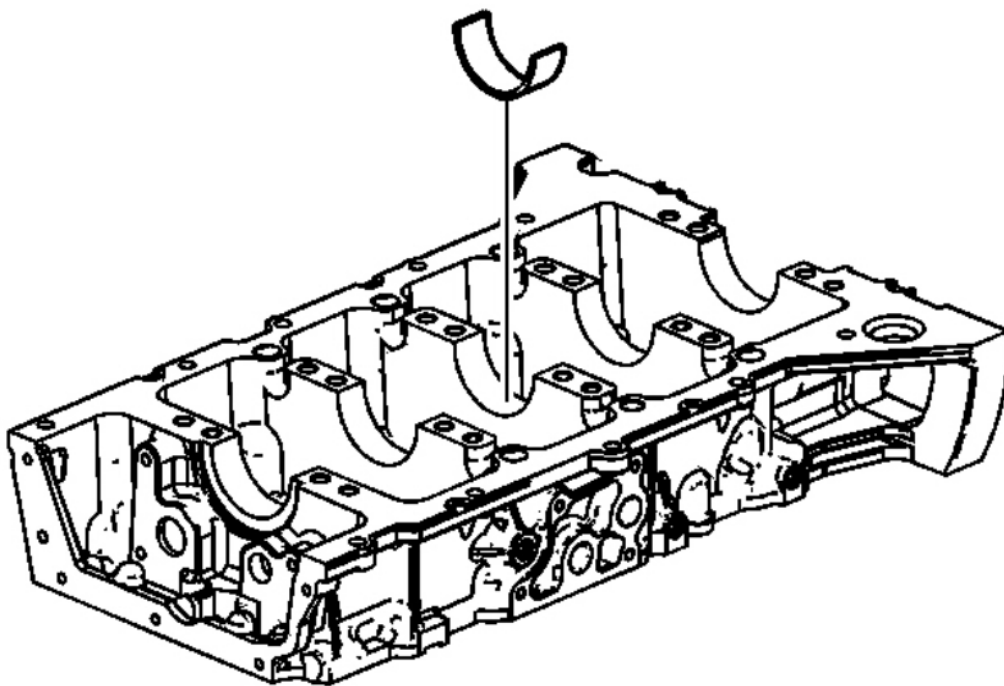


Fig. 155: View Of Lower Crankshaft Bearing
Courtesy of GENERAL MOTORS CORP.

4. Install new lower crankshaft bearings into position in the lower crankcase. The lower crankcase crankshaft bearings are identified by NO grooves or holes. The bearings must fit flush with the lower crankcase.
5. Apply a liberal amount of GM crankshaft prelube GM P/N 1052367, (Canadian P/N 992869), or engine oil to the upper and lower bearing surfaces.

Crankshaft Installation Procedure

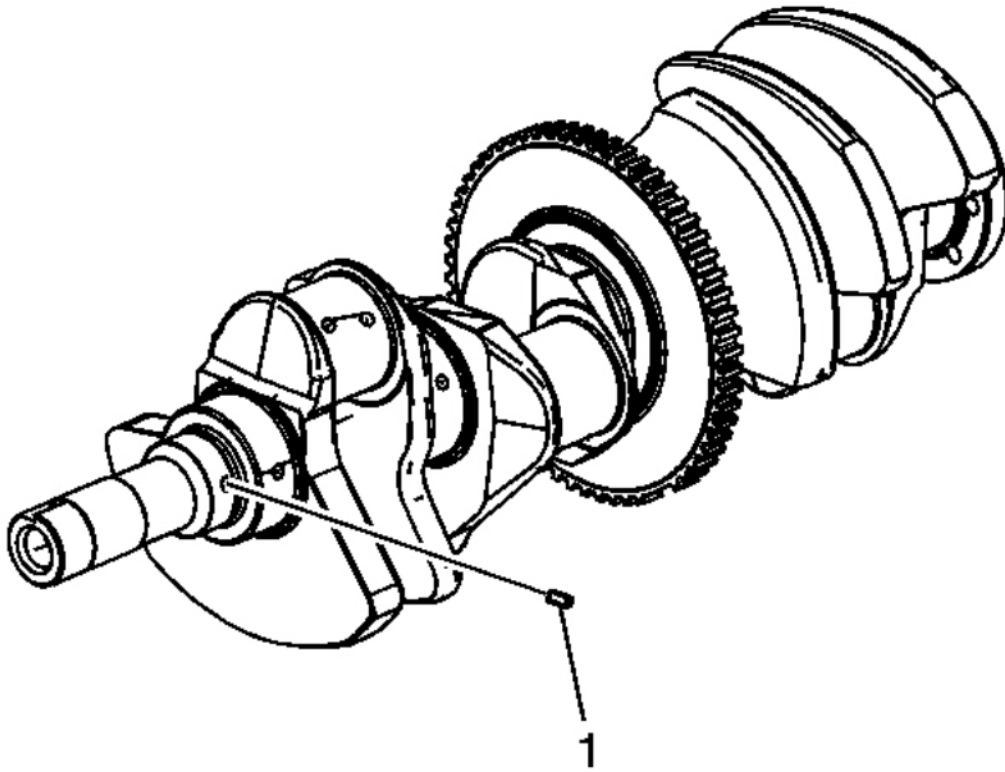


Fig. 156: Identifying Crankshaft Sprocket Drive Pin
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW crankshaft sprocket drive pin (1), if removed due to damage.

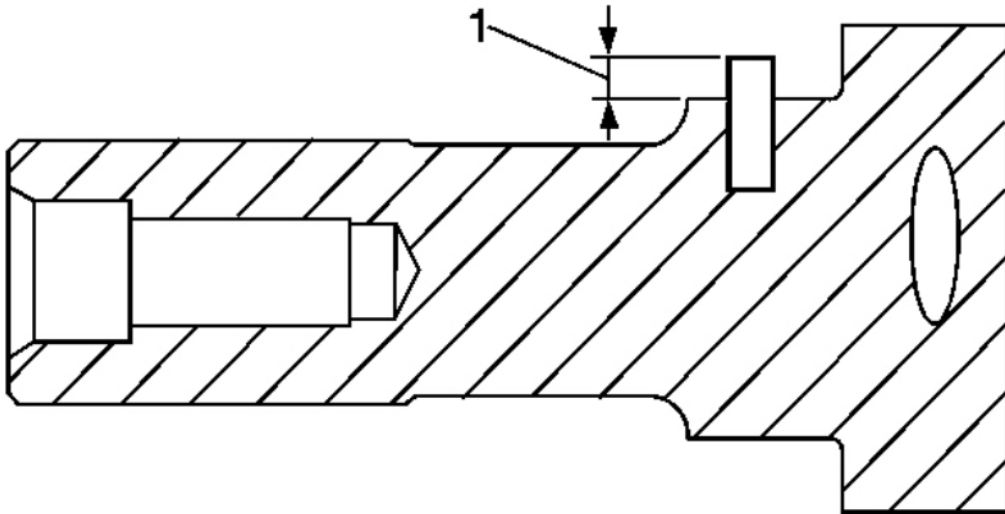


Fig. 157: Ensuring Proper Pin Height
Courtesy of GENERAL MOTORS CORP.

2. Ensure pin height (1) is 1.75-3.25 mm (0.0689-0.1280 in).

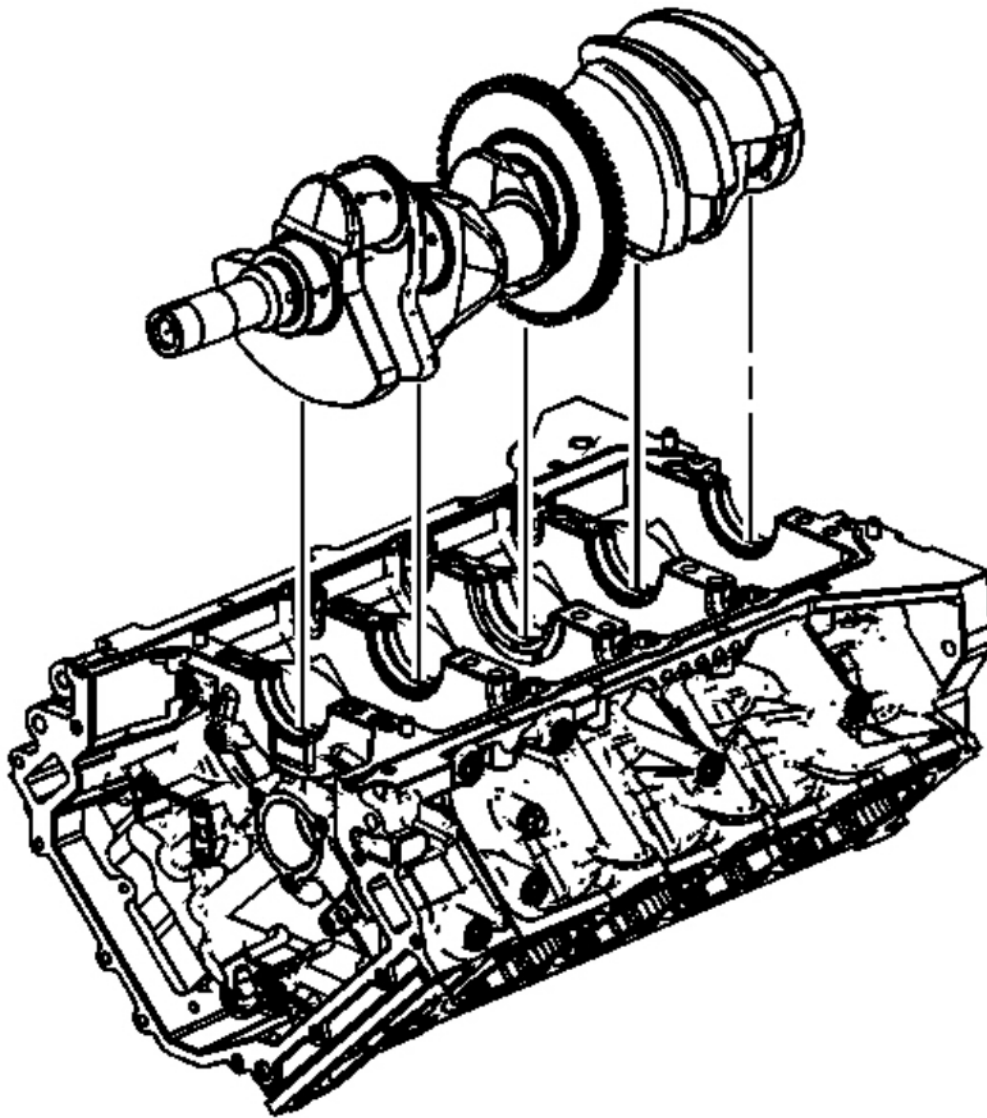


Fig. 158: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

3. Gently lower the crankshaft into position in the cylinder block.
4. Ensure the crankshaft turns without binding or noise.

1. Place a length of fresh, room temperature plastic gaging material all the way across all the crankshaft bearing journals.

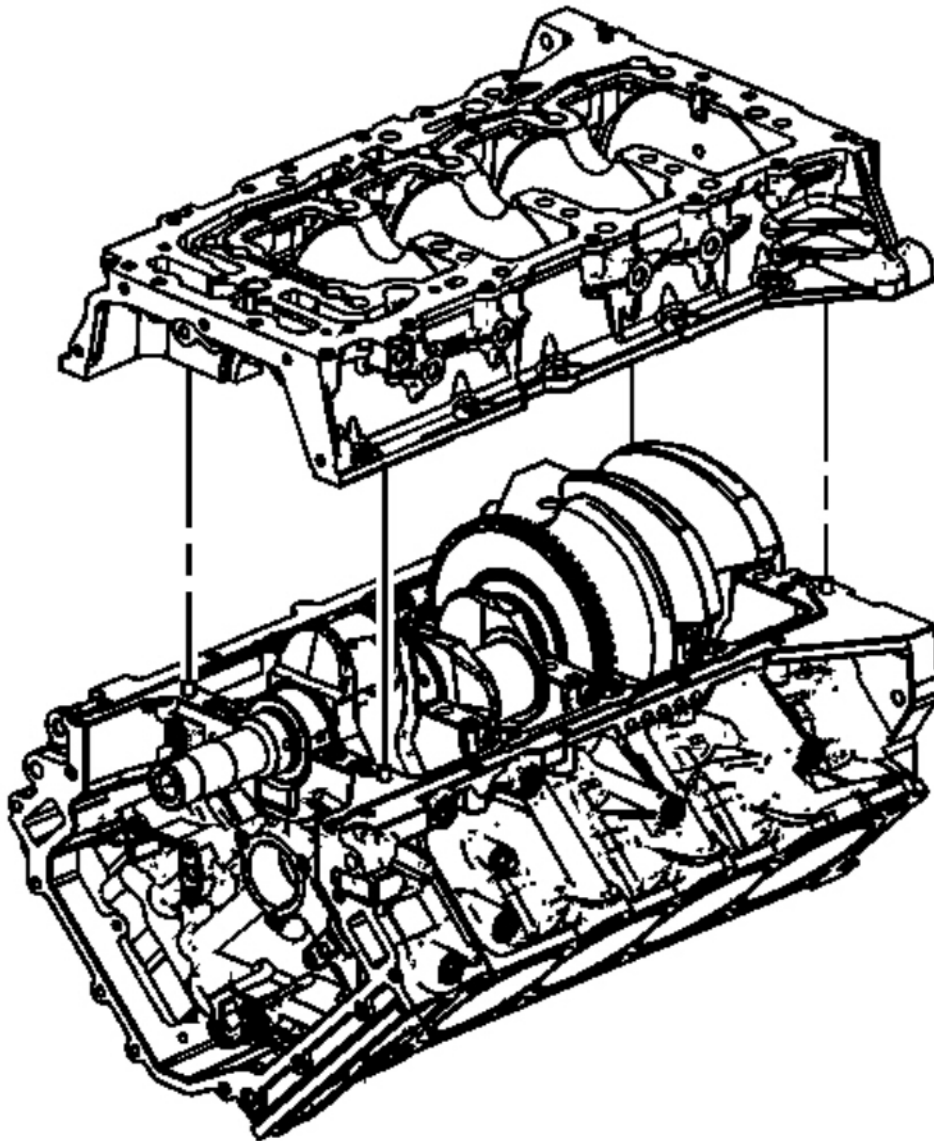


Fig. 159: View Of Lower Crankcase
Courtesy of GENERAL MOTORS CORP.

2. Align the lower crankcase with the dowel pins in the upper crankcase.
3. Install the lower crankcase onto the upper crankcase slowly until feeling a positive stop.
4. Inspect the upper-to-lower crankcase joint in order to make sure the lower crankcase is fully seated on the cylinder block.

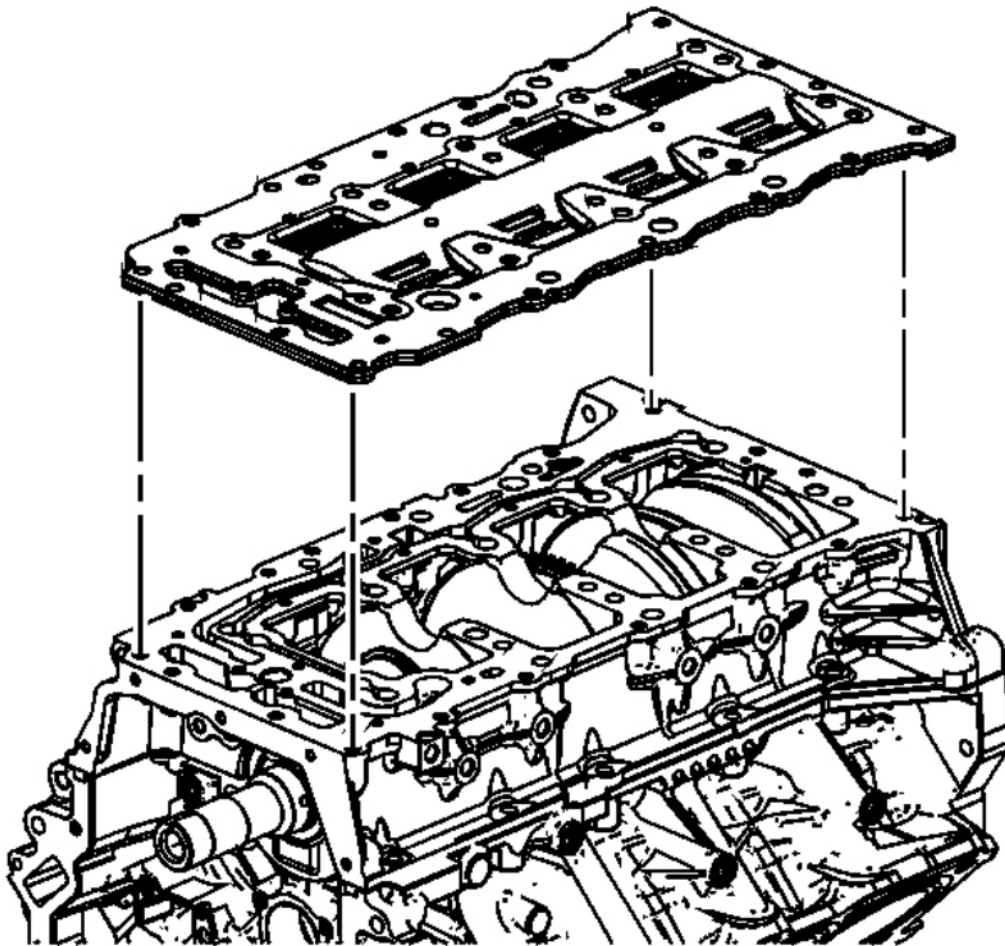


Fig. 160: View Of Oil Manifold & Oil Scraper Plate Assembly
Courtesy of GENERAL MOTORS CORP.

5. Install the old oil manifold and oil scraper plate assembly.

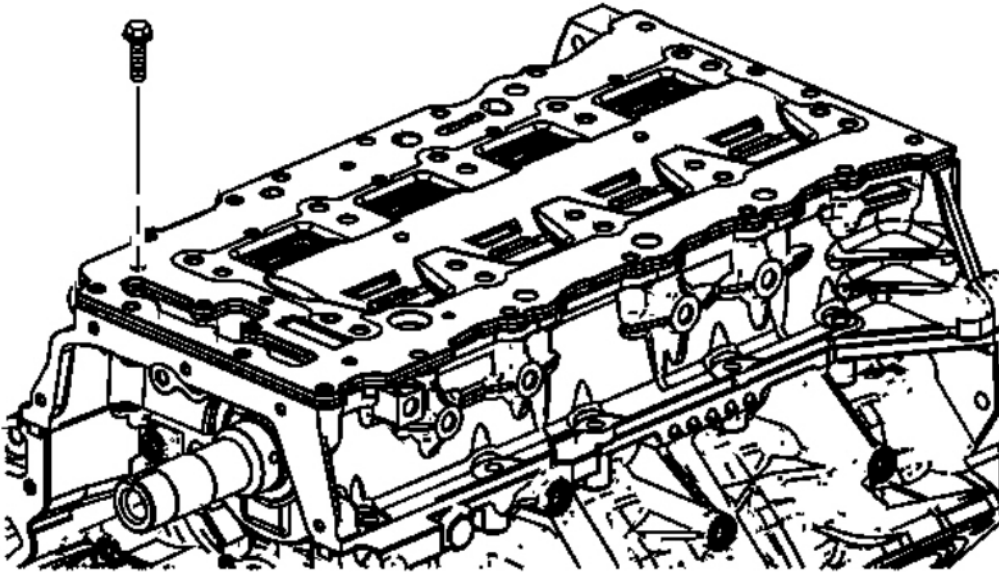


Fig. 161: View Of Oil Manifold Plate Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

6. Install the oil manifold plate bolts.

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

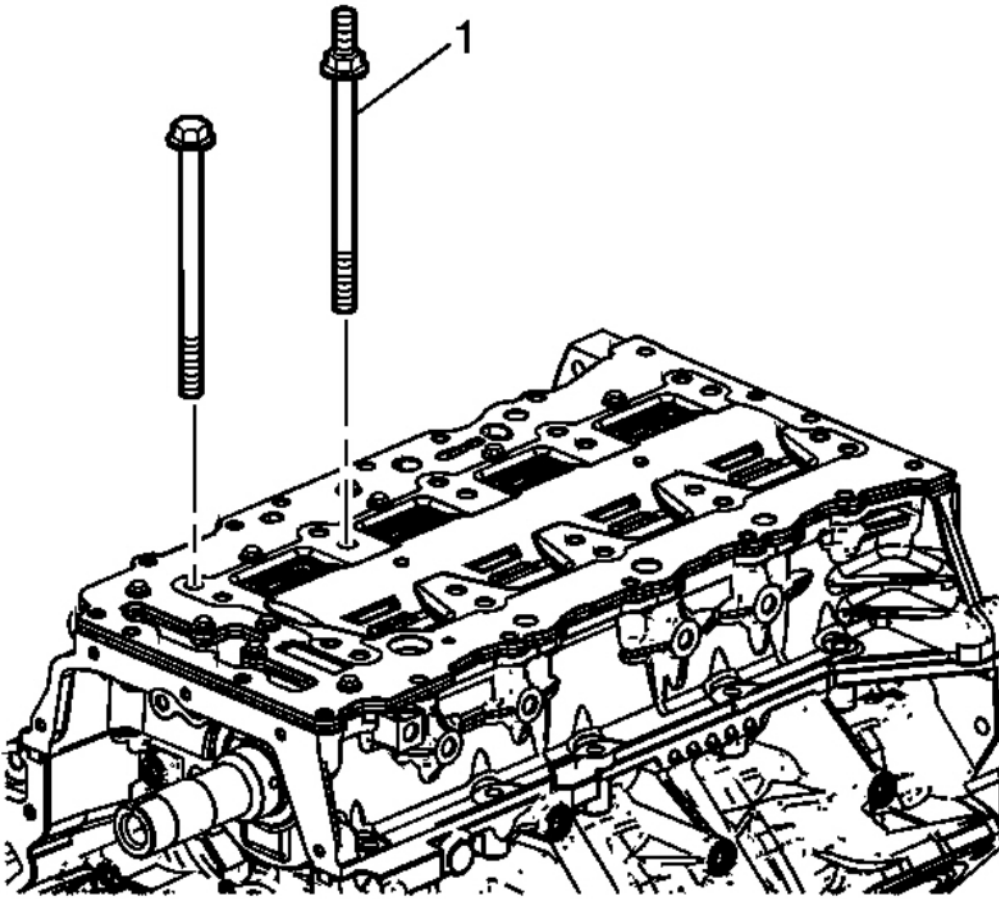


Fig. 162: View Of Main Bearing Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosely install the main bearing bolts. The single stud-end bolt (1) used to attach the oil pump pipe and screen assembly support bracket is installed in the inboard position in the second set of main bearing bolts from the front and left bank side of the engine.

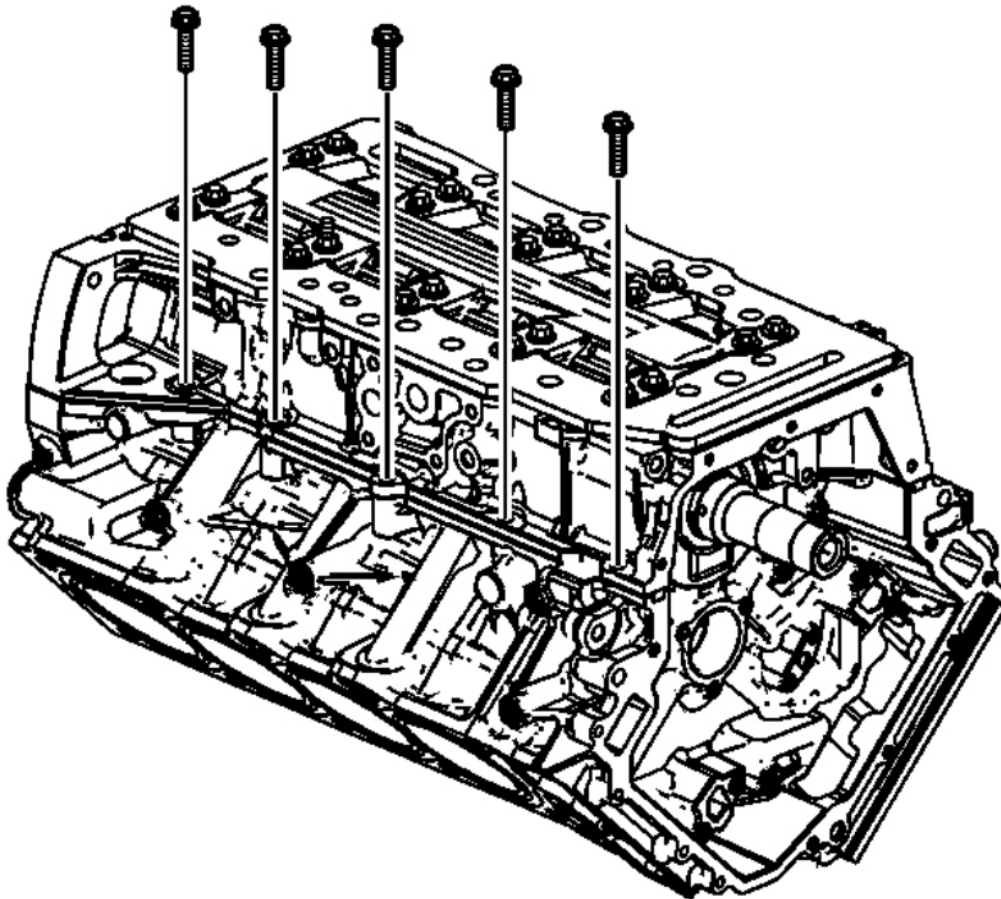


Fig. 163: View Of Lower Left Crankcase Perimeter Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the left side upper-to-lower crankcase perimeter bolts.

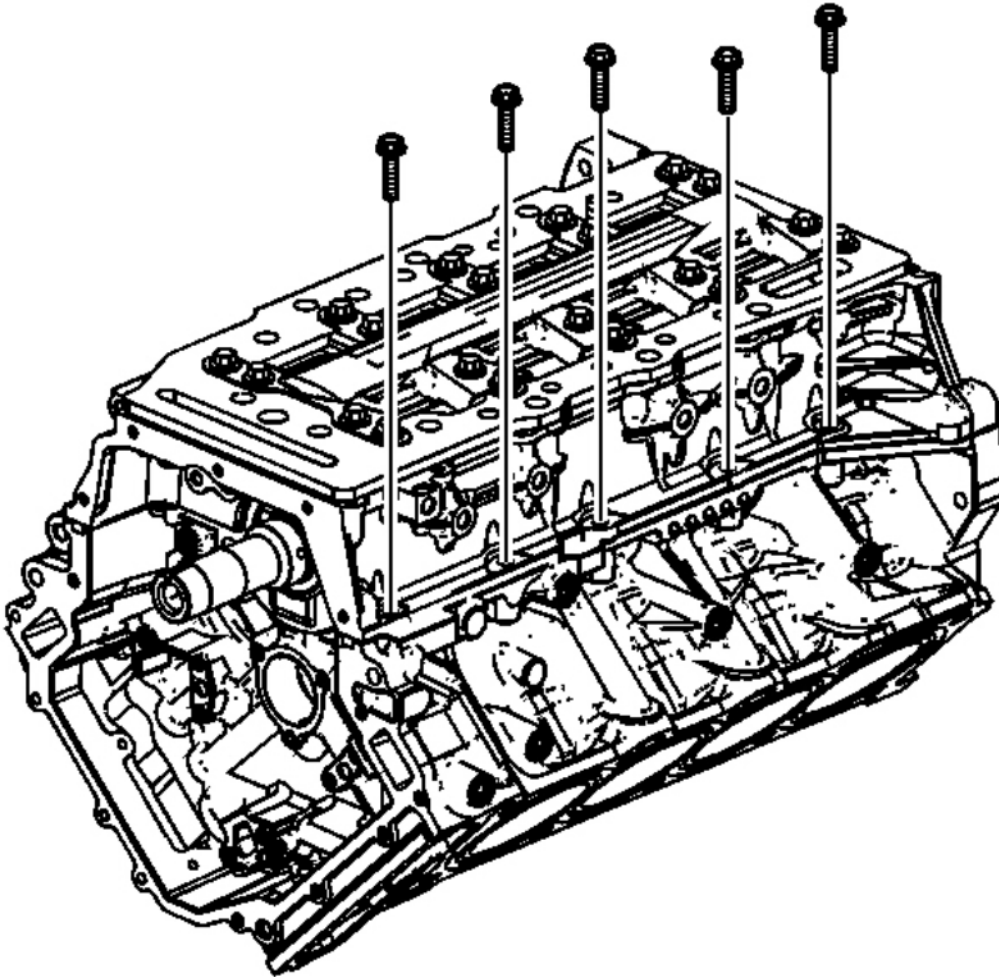


Fig. 164: View Of Right Upper-To-Lower Crankcase Perimeter Bolts
Courtesy of GENERAL MOTORS CORP.

9. Install the right side upper-to-lower crankcase perimeter bolts.

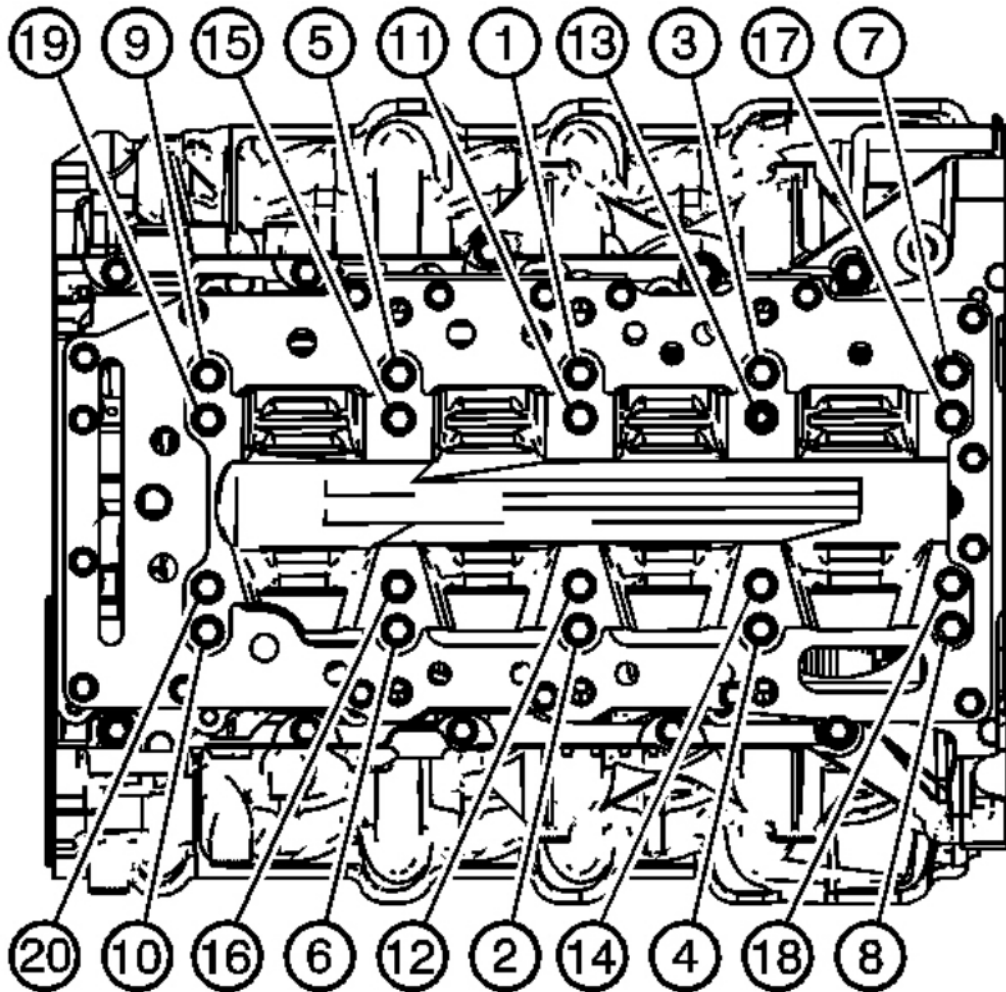


Fig. 165: Tightening Lower Crankcase Bolts
Courtesy of GENERAL MOTORS CORP.

10. Tighten the lower crankcase bolts in proper sequence.
 1. First Pass

Tighten: Tighten the lower crankcase bearing bolts (1-20) to 20 N.m (15 lb ft) in the proper sequence.

2. Final Pass

Tighten: Tighten the lower crankcase bolts (1-20) an additional 65 degrees in the proper sequence using the **J 45059** .

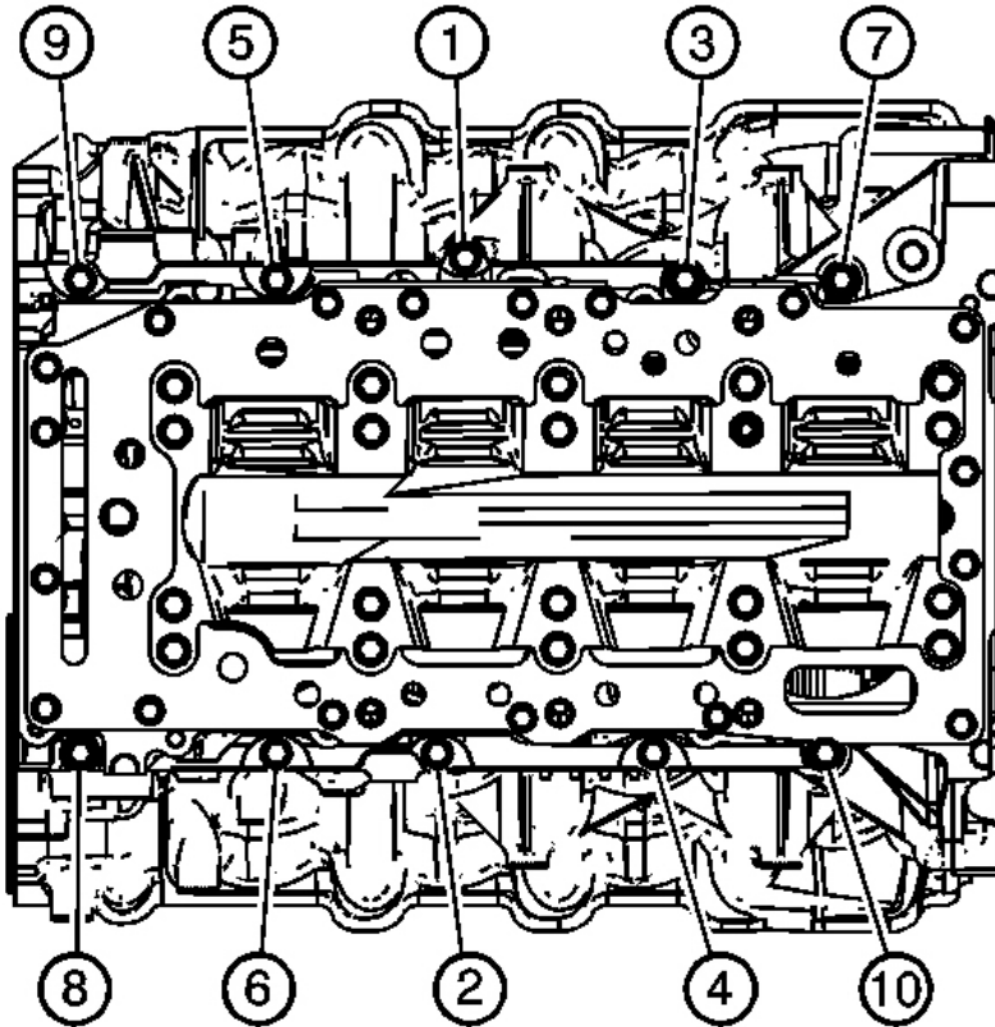


Fig. 166: Tightening Upper-To-Lower Crankcase Perimeter Bolts
Courtesy of GENERAL MOTORS CORP.

11. Tighten the upper-to-lower crankcase perimeter bolts (1-8).

Tighten: Tighten the upper-to-lower crankcase perimeter bolts (1-8) to 30 N.m (22 lb ft).

12. Allow the assembly to sit for at least 2 minutes.

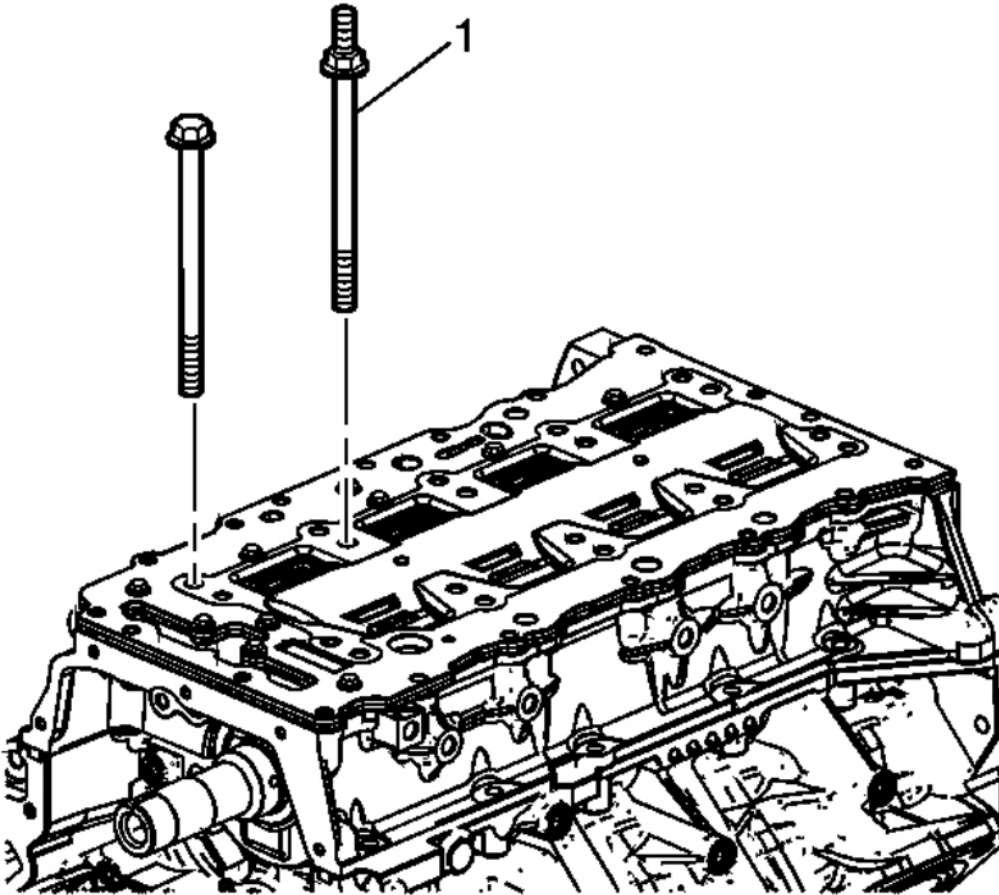


Fig. 167: View Of Main Bearing Bolts
Courtesy of GENERAL MOTORS CORP.

13. Remove the main bearing bolts (1).

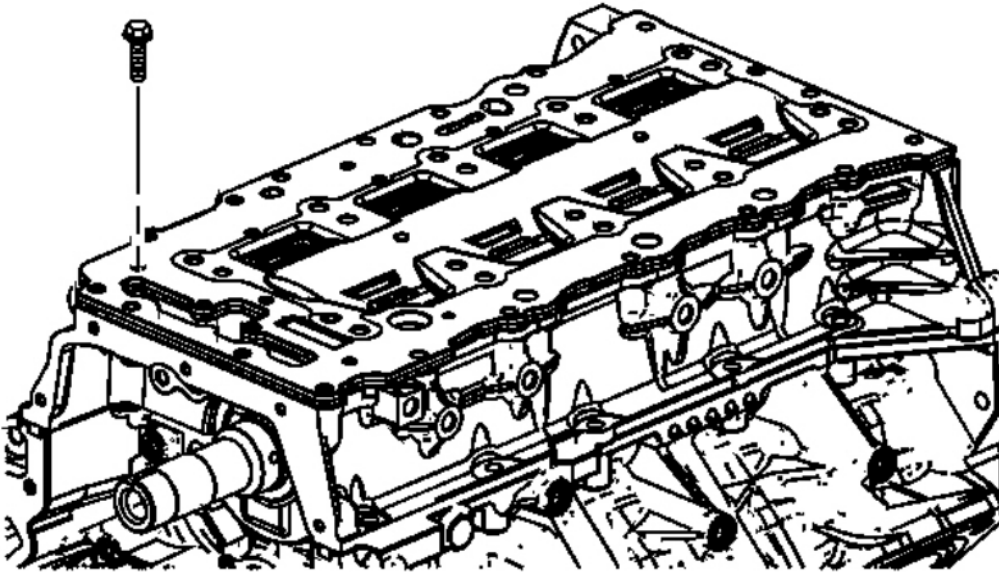


Fig. 168: View Of Oil Manifold Plate Bolts
Courtesy of GENERAL MOTORS CORP.

14. Remove the oil manifold plate bolts.

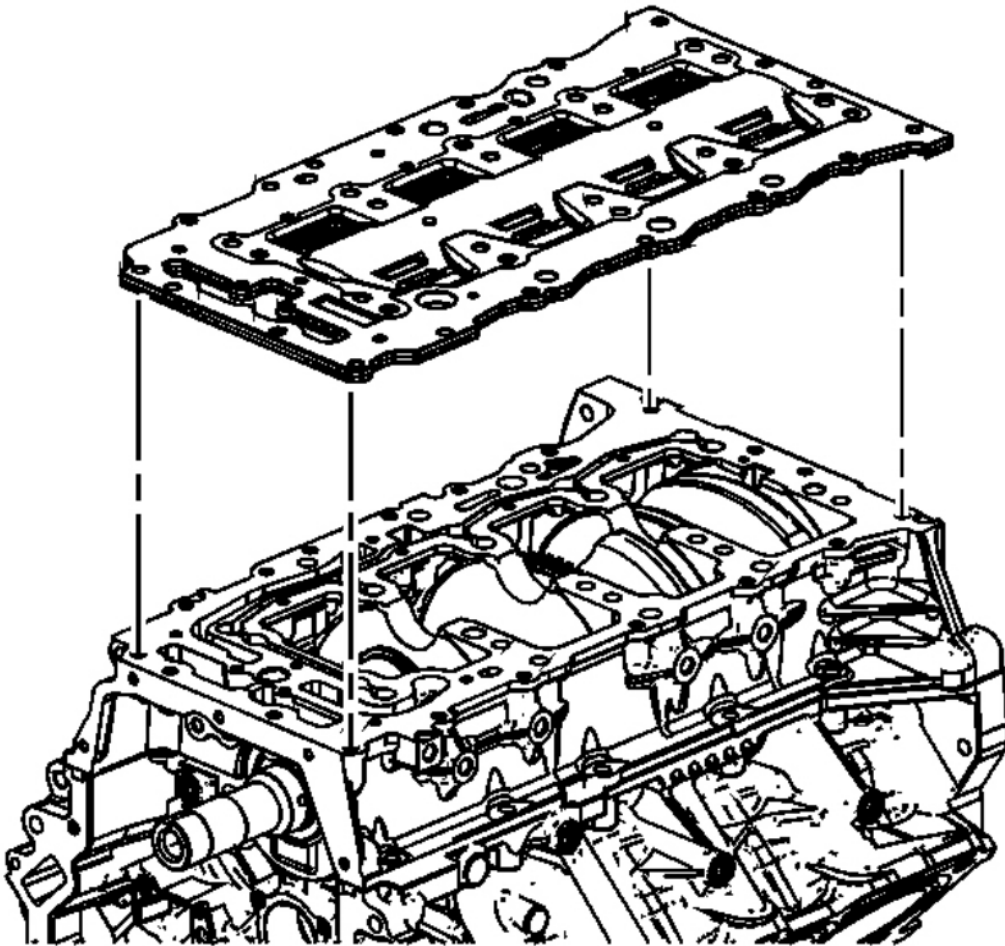


Fig. 169: View Of Oil Manifold & Oil Scraper Plate Assembly
Courtesy of GENERAL MOTORS CORP.

15. Remove the old oil manifold and oil scraper plate assembly.

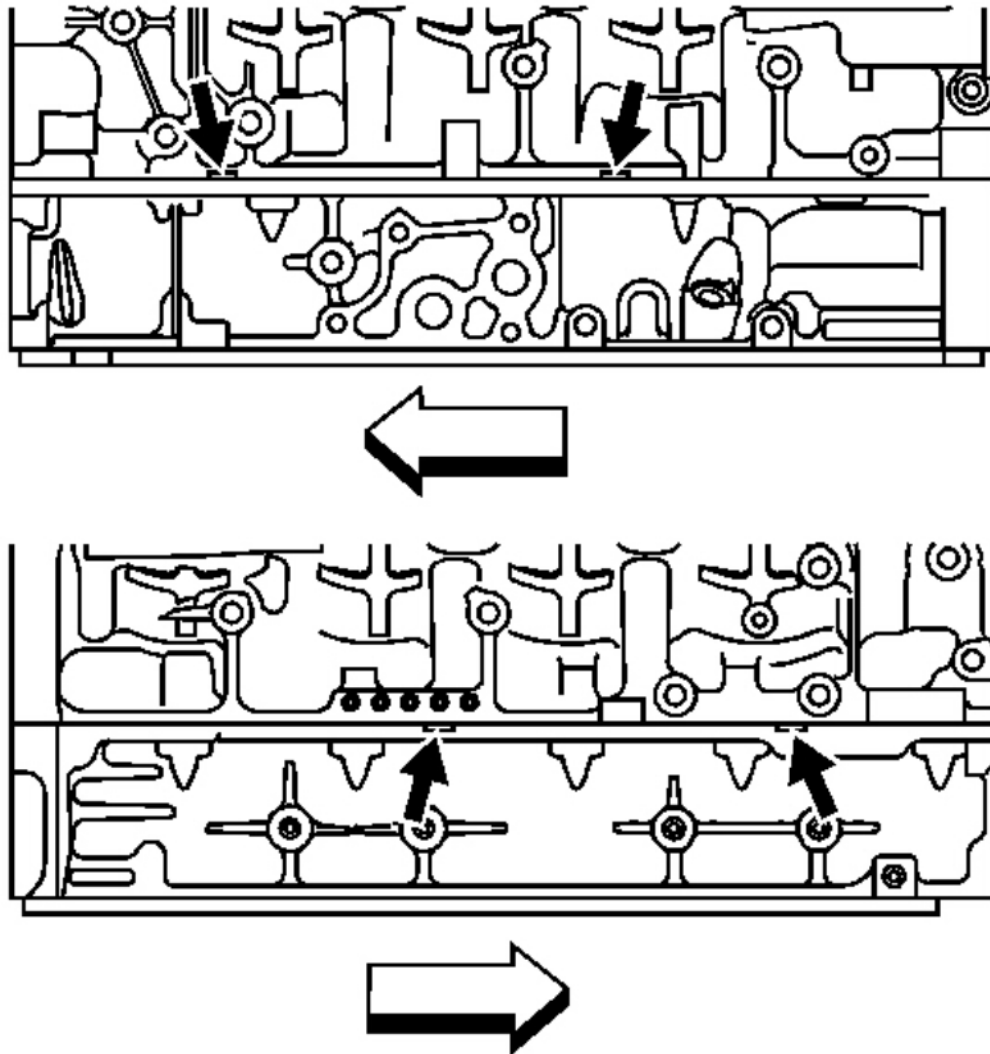


Fig. 170: Separating Crankcase Halves
Courtesy of GENERAL MOTORS CORP.

NOTE: Use a plastic pry tool when prying case halves apart to prevent damage to the Upper and Lower Crankcase surface. Do not continue to push the pry tool in the crankcase as the Upper and Lower Crankcase halves separate. This may damage the sealing surface.

16. Working on either side of the lower crankcase, separate the crankcase halves by alternately prying in the grooves provided until the lower crankcase is free of the dowel pins.

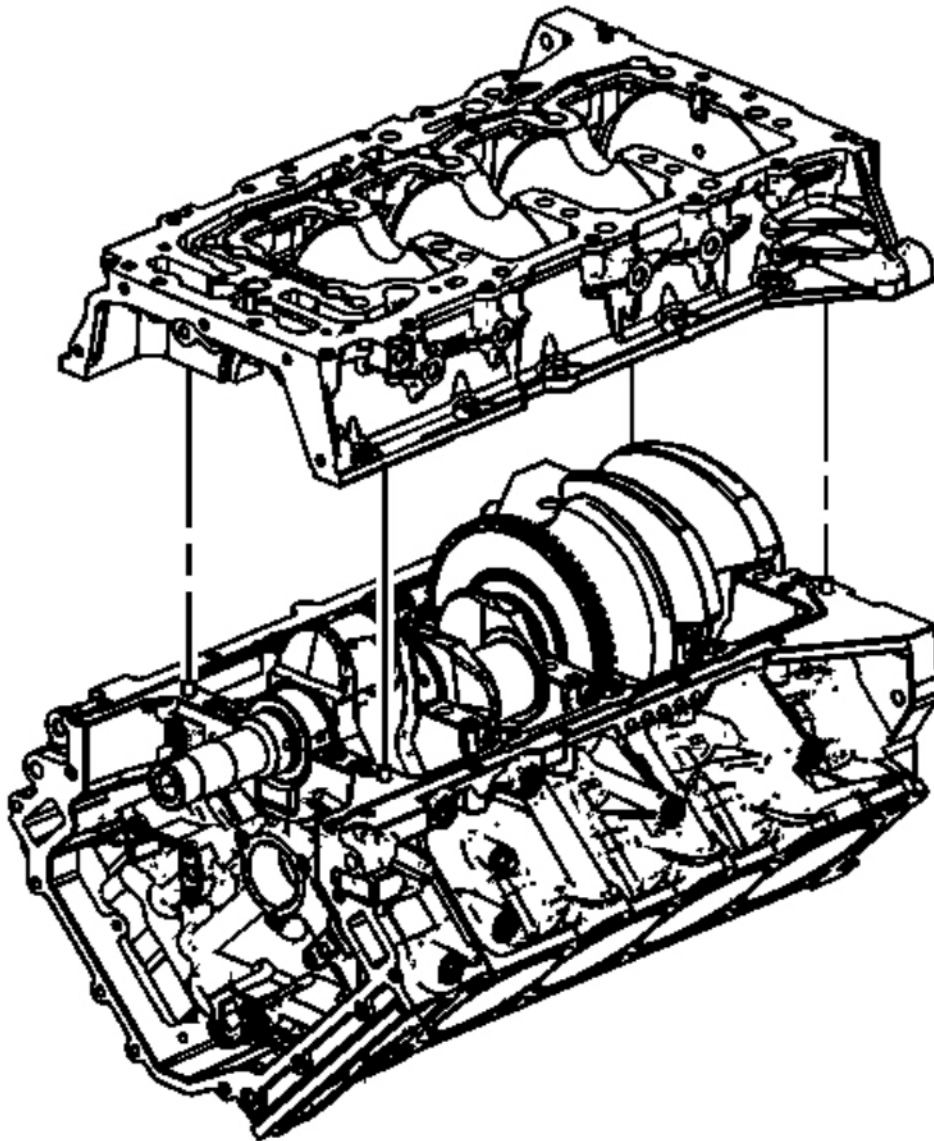


Fig. 171: View Of Lower Crankcase
Courtesy of GENERAL MOTORS CORP.

17. Remove the lower crankcase.

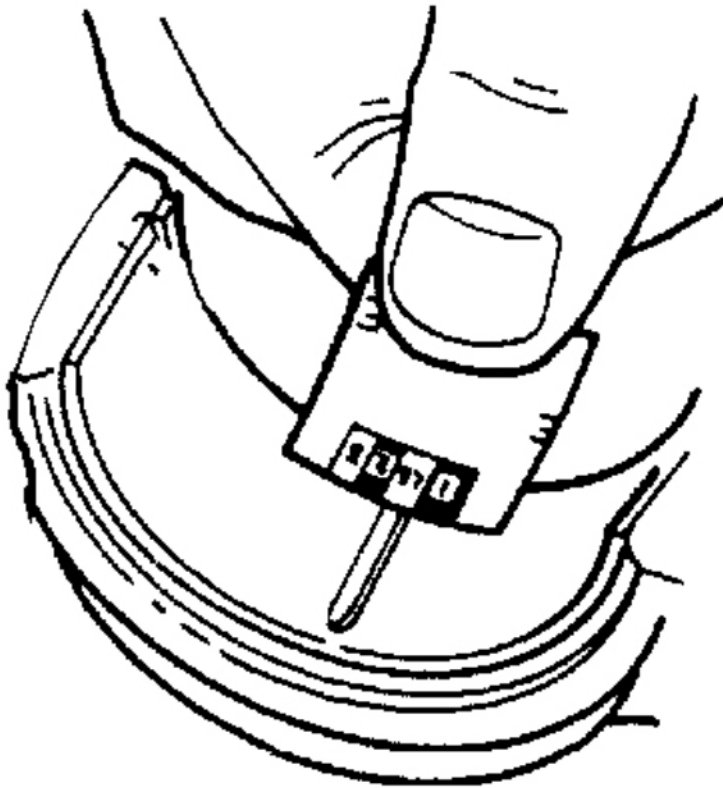


Fig. 172: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

18. Determine the main bearing clearance by comparing the width of the flattened plastic gaging material at its widest point with the graduation on the gaging material container.
19. Compare your measurements with the engine mechanical specifications. If the new bearings do not provide the proper crankshaft to bearing clearance, re-measure the crankshaft journals for the correct specified size and check to make sure you have the correct new bearings. If the crankshaft journals are incorrectly sized, replace the crankshaft. No crankshaft machining is permitted and undersized bearings are not available.
20. Clean the plastic gaging material from the crankshaft bearings and/or crankshaft bearing journals using a soft lint-free cloth.

21. Coat the upper crankshaft bearings and crankshaft main bearing journals with GM crankshaft prelube GM P/N 1052367, (Canadian P/N 992869), or equivalent.

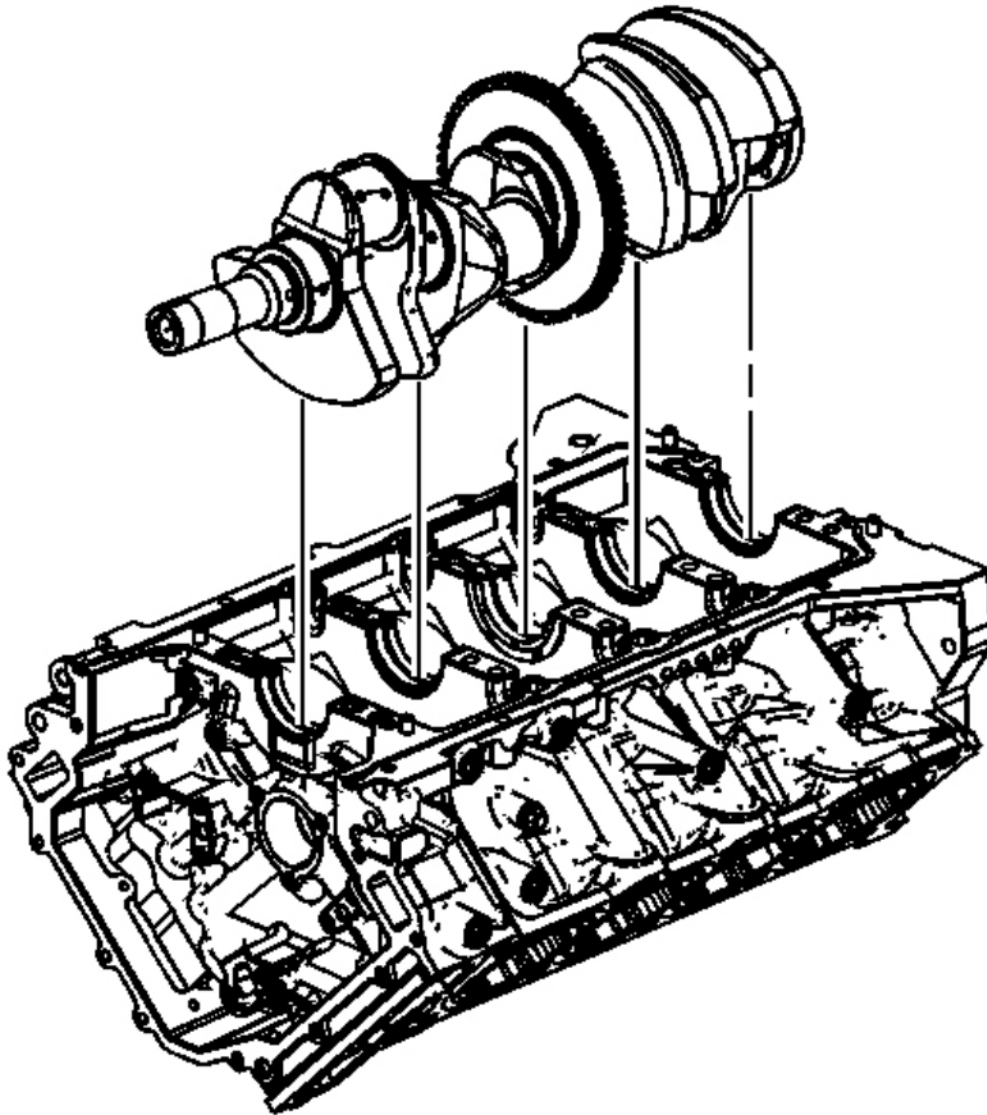


Fig. 173: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

22. Reinstall the crankshaft into position in the cylinder block.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Tools Required

- **EN 46121** Connecting Rod Guide Pin Set
- **J 8037** Ring Compressor
- **J 39946** Crankshaft Socket - 4.0L and 4.6L
- **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

1. Rotate the crankshaft using the **J 39946** in order to align the crankshaft connecting rod journal being serviced to BDC.
2. Liberally lubricate the cylinder walls, piston rings and piston skirts with clean engine oil.

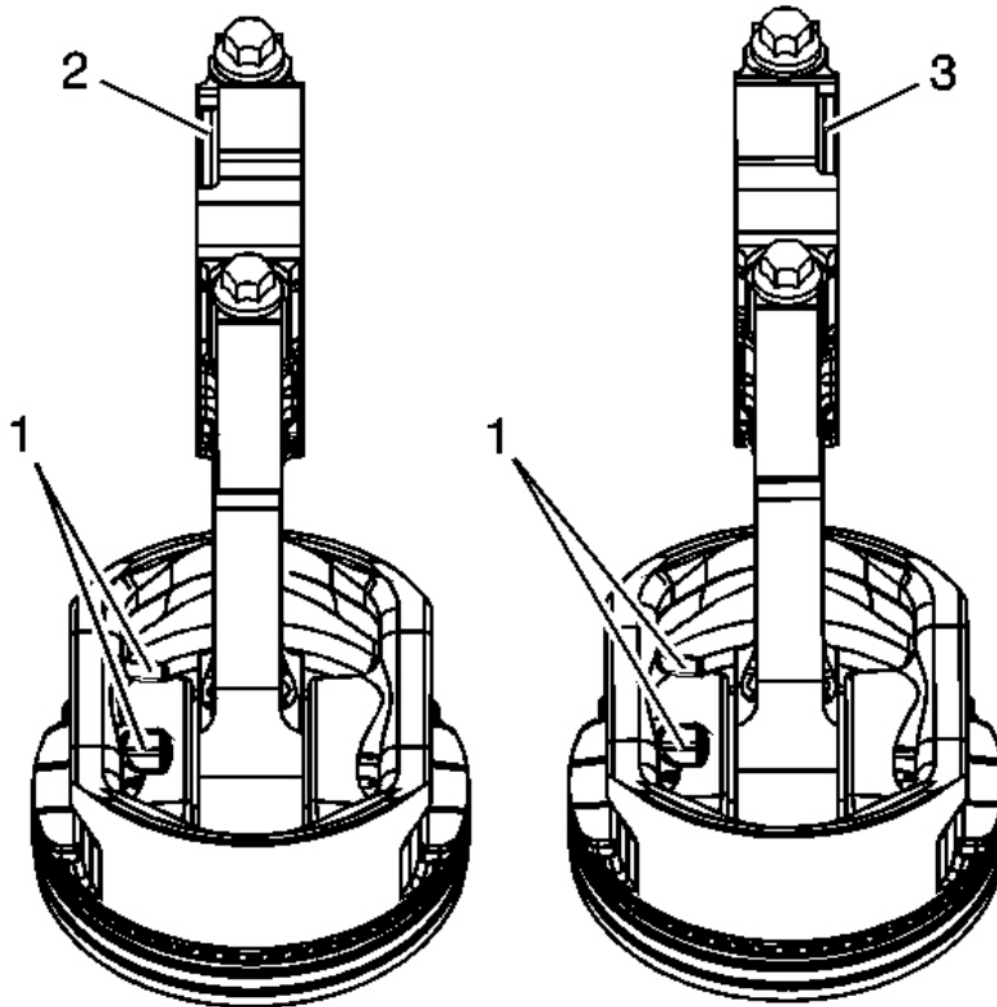


Fig. 174: Locating Piston & Connecting Rod Alignment Markings
Courtesy of GENERAL MOTORS CORP.

3. Select the correctly numbered piston/connecting rod assembly for the cylinder. Indication features showing proper piston orientation are located on the bottom of the piston and connecting rod. Ensure the connecting rod bearing tang notches in the connecting rod bearing bore are aligned to the same side.
 - The locator lugs (1) on the bottom of the piston are oriented towards the front of engine.

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- The notch (2) on the left piston assembly connecting rod cap is oriented towards the front of the engine. The piston locator lugs (1) and the connecting rod cap notch (2) in the same orientation.
- The notch (3) on the right piston assembly connecting rod cap is oriented towards the rear of the engine. The piston locator lugs (1) and the connecting rod cap notch (3) in the opposing orientation.

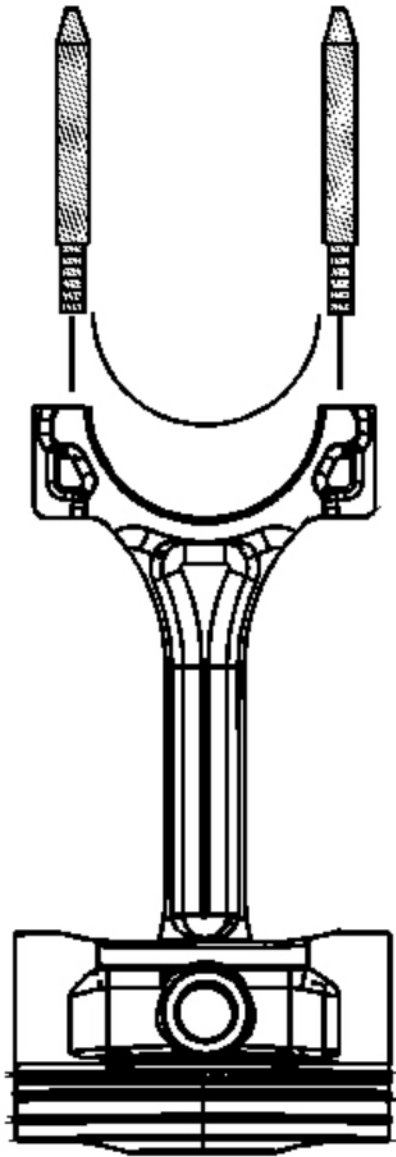


Fig. 175: Installing EN 46121

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Connecting rod bearings that have been used in a running engine, must be replaced with NEW connecting rod bearings

for reassembly.

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

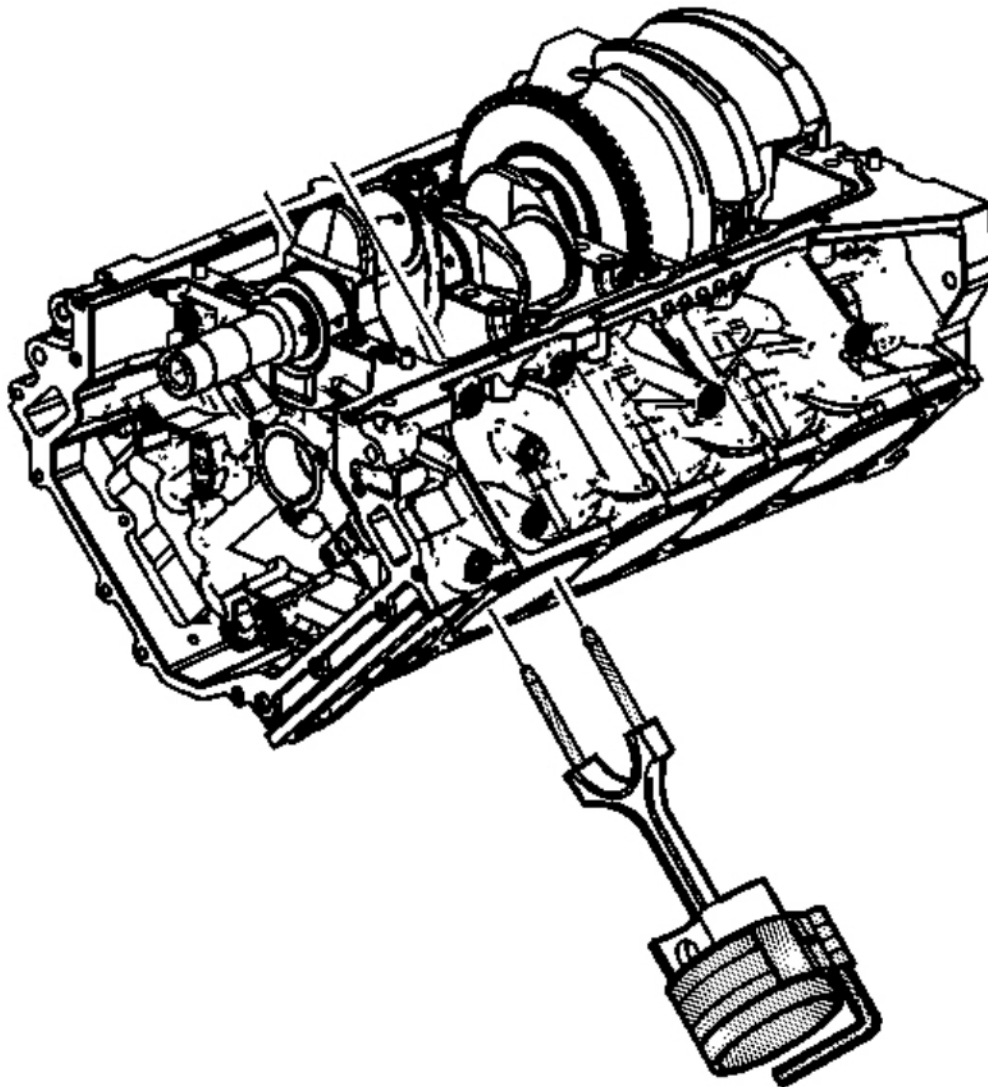


Fig. 176: Installing Piston

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Extreme care must be exercised when installing the piston and connecting rod in order to ensure the connecting rod does not scrape or nick the cylinder bore or the crankshaft journal surfaces.

7. 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.
8. 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 tapping the piston into the cylinder.

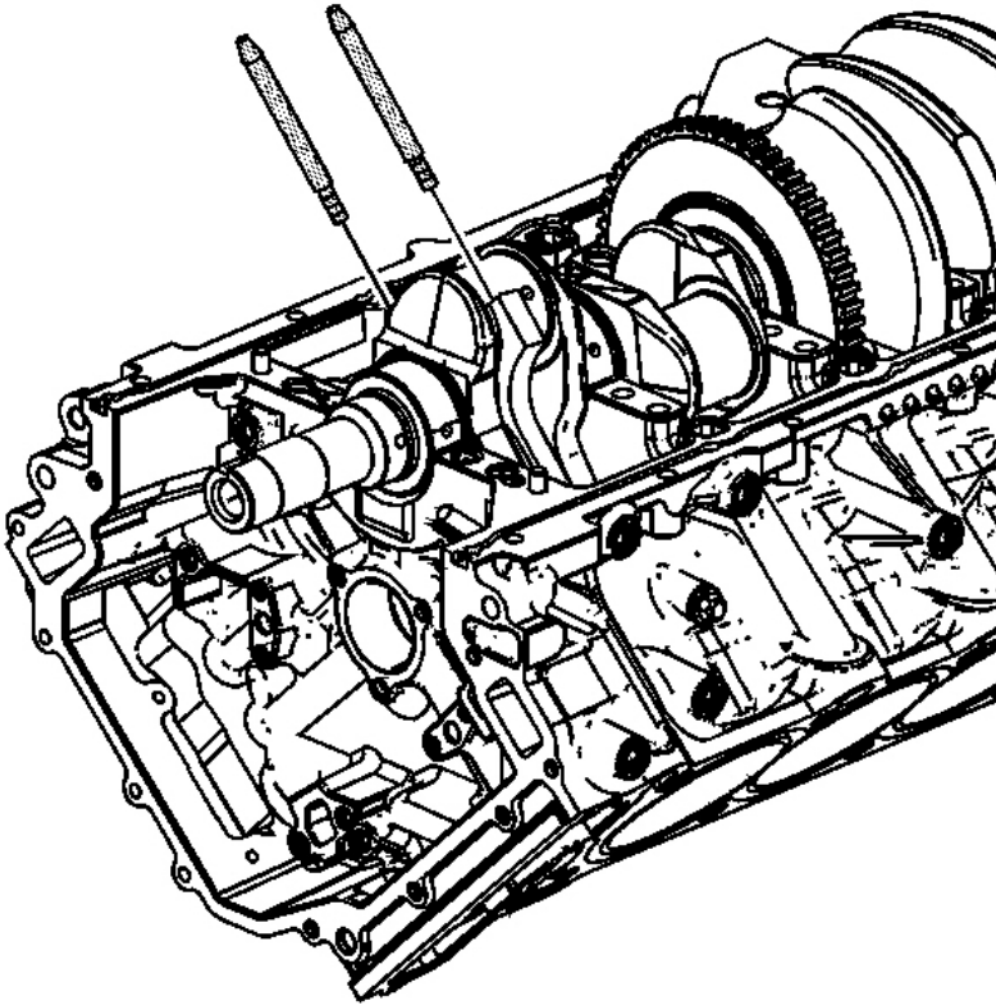


Fig. 177: Removing EN 46121
Courtesy of GENERAL MOTORS CORP.

9. 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 used in a running engine, must be replaced with **NEW** connecting rod bearings for reassembly.

1. Before final assembly it is important to check the clearance of the new connecting rod bearings.
2. Place a length of fresh, room temperature plastic gaging material all the way across the entire connecting rod bearing journal.

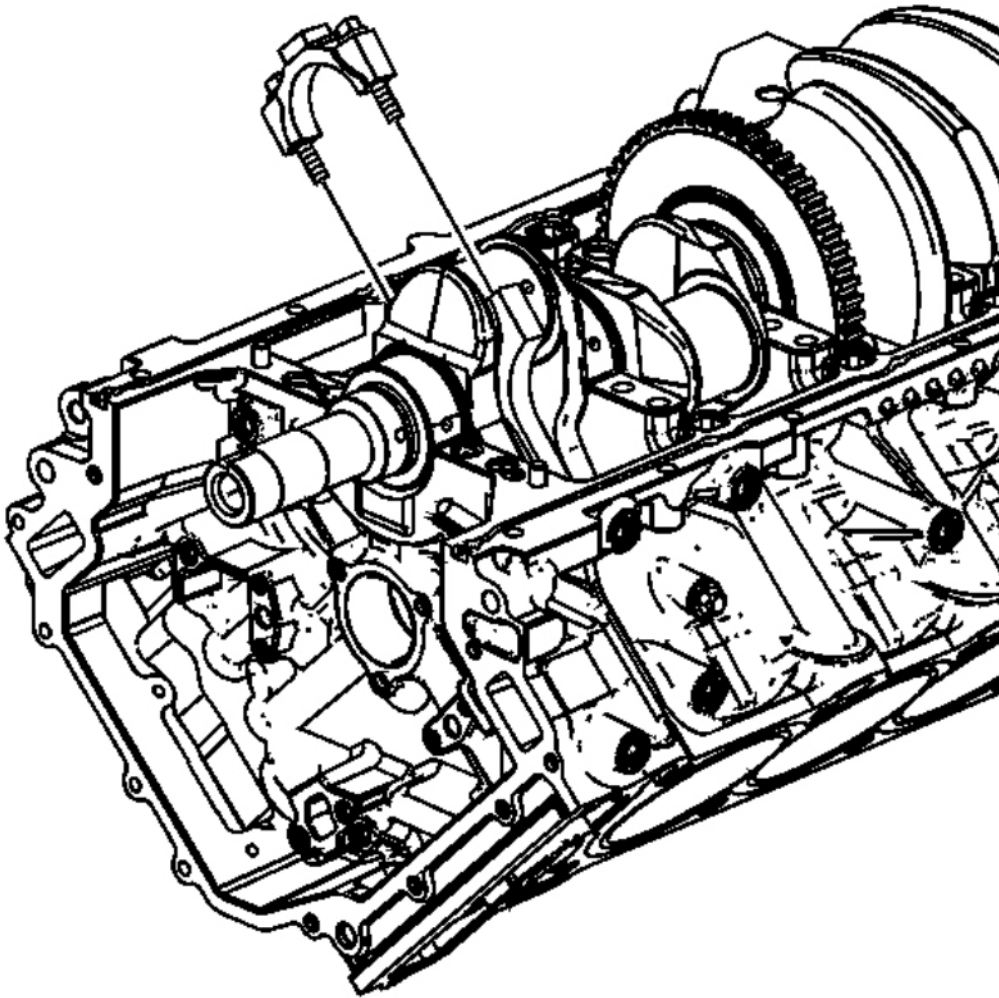


Fig. 178: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

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

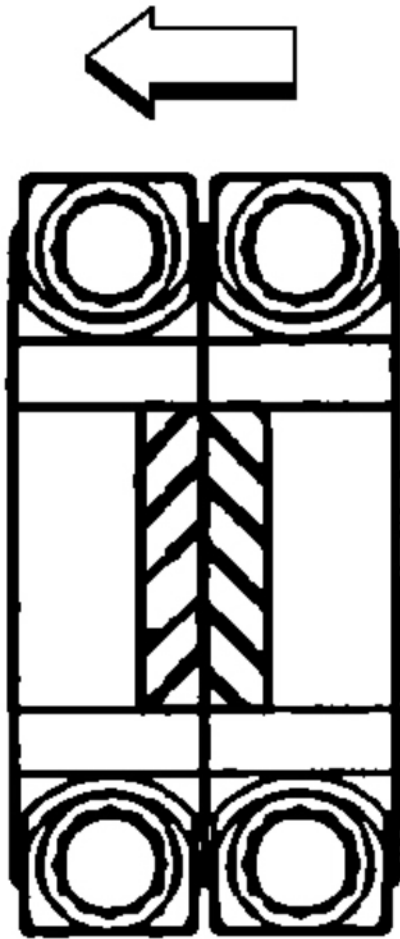


Fig. 179: View Of Paired Connecting Rod Bearing Cap Notches
Courtesy of GENERAL MOTORS CORP.

4. When properly installed, the connecting rod bearing cap notches should be paired, as shown, on the crankpin.

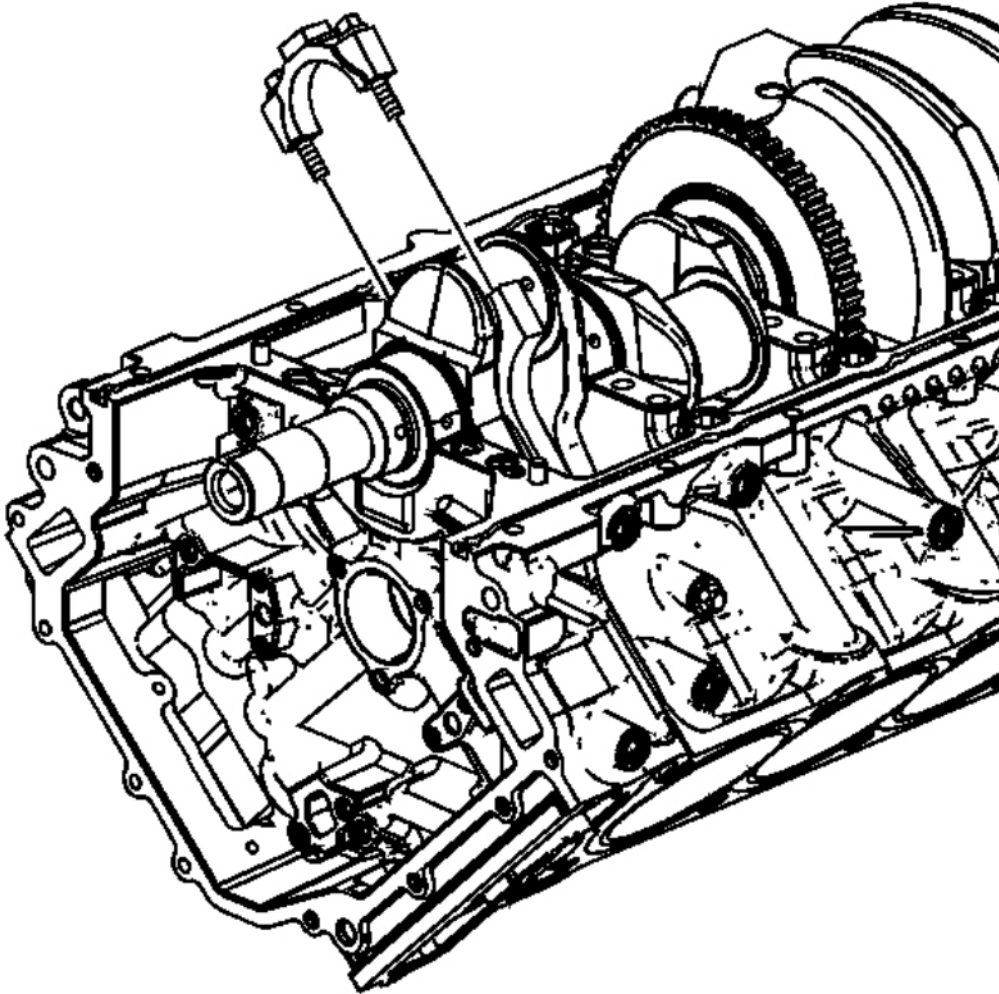


Fig. 180: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

5. Lubricate connecting rod bolts with engine oil and install in the connecting rod.

Tighten: Tighten the 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. Allow the assembly to sit for at least 2 minutes.

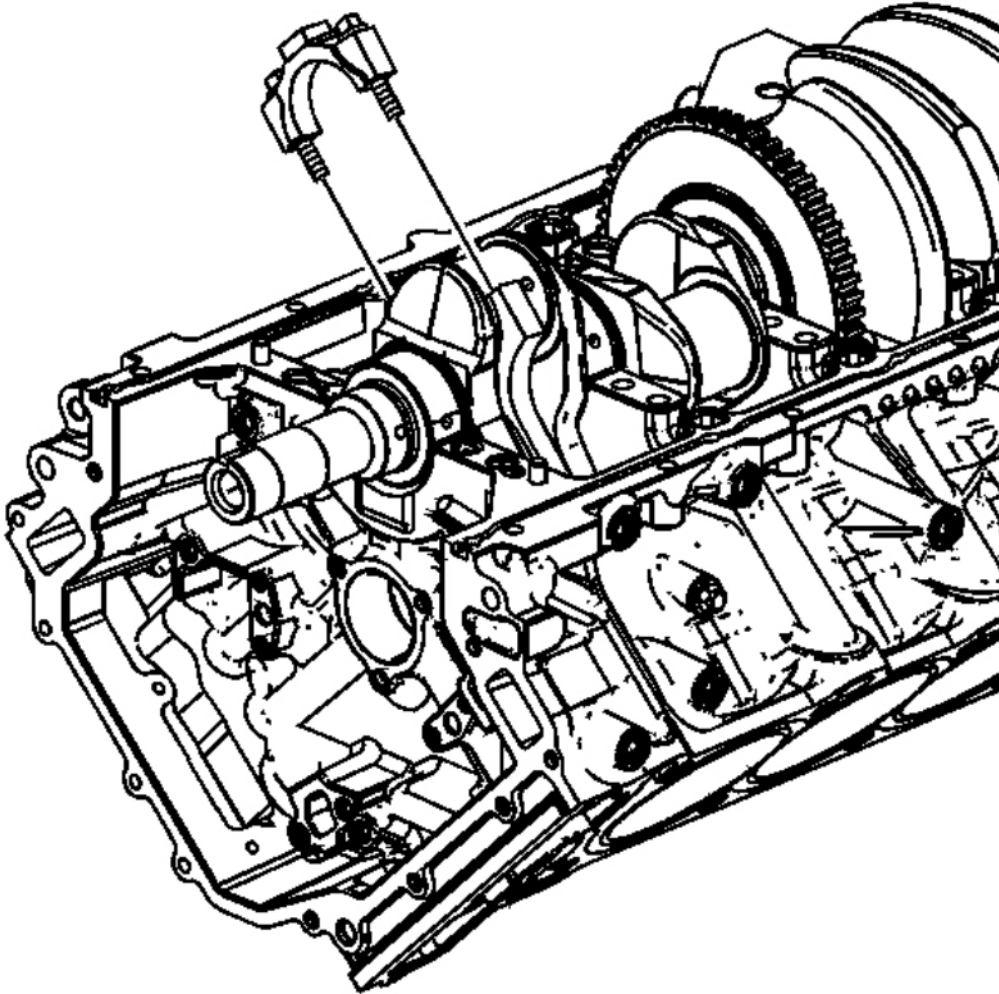


Fig. 181: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

9. Remove the connecting rod cap bolts.
10. Remove the connecting rod cap.

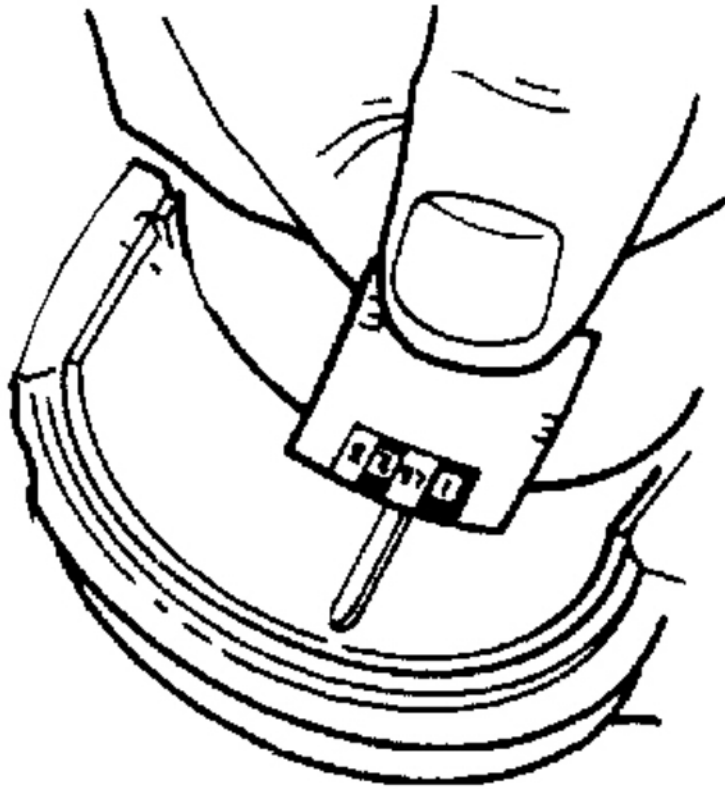


Fig. 182: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

11. 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 gauging material container.
12. Compare the measurements with the engine mechanical specifications. Refer to **Engine Mechanical Specifications** .
13. If the new bearings do not provide the proper crankshaft to bearing clearance, re-measure the crankshaft journals for the correct specified size and check to make sure you have the correct new bearings. If the crankshaft journals are incorrectly sized, replace the crankshaft. No crankshaft machining is permitted and undersized bearings are not available.
14. Clean the plastic gaging material from the connecting rod bearing and crankshaft connecting rod bearing journal using a soft lint-free cloth.

Connecting Rod 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.

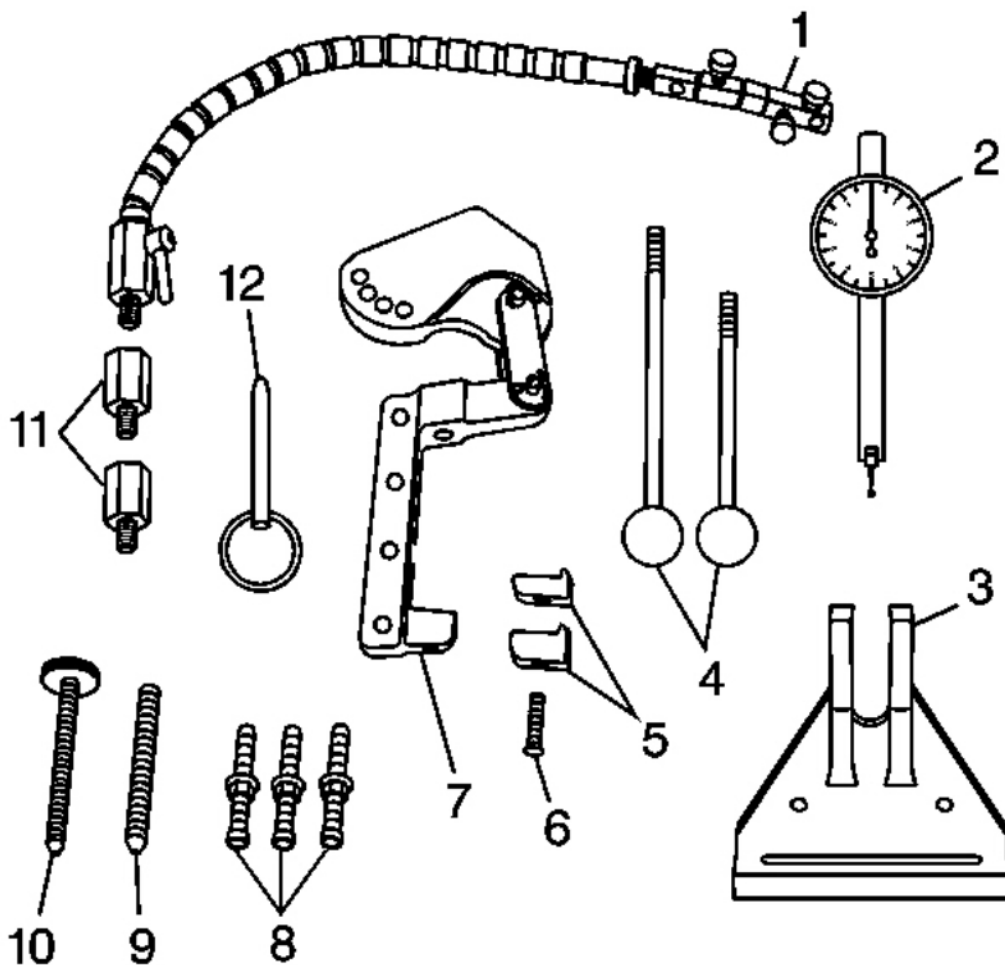


Fig. 183: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

J 43690 Rod Bearing Clearance Checking Tool

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 4.6L (LH2) (Repair Instructions, 4 Of 5) - SRX

- 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)

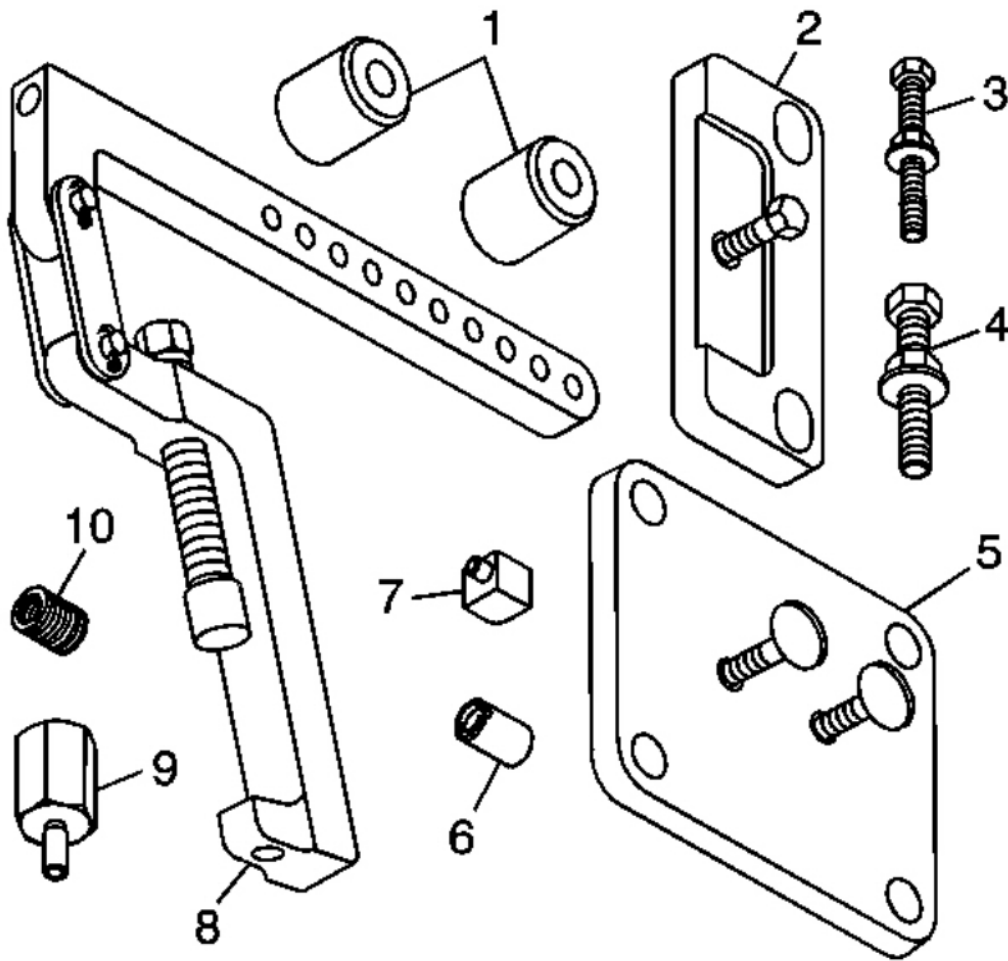


Fig. 184: Identifying Rod Bearing Clearance Tool - Adapter Kit
 Courtesy of GENERAL MOTORS CORP.

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)

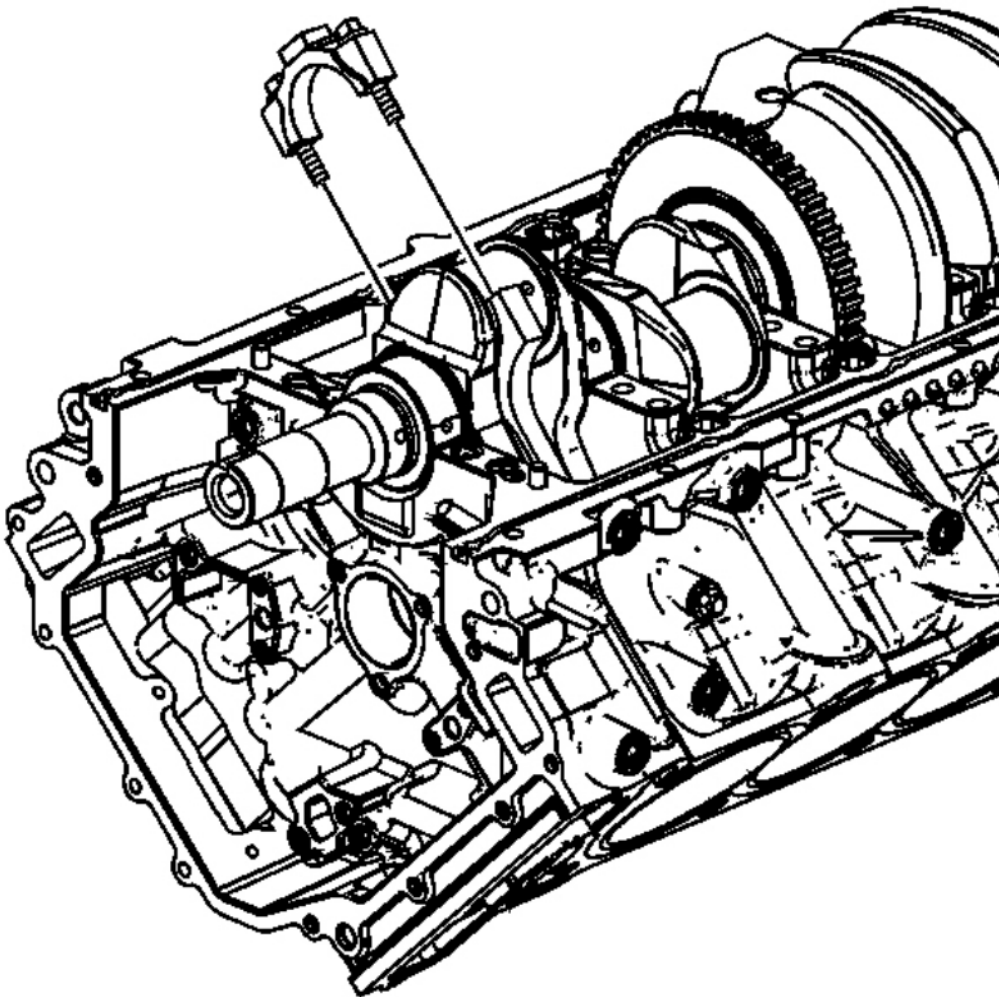


Fig. 185: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

1. Install the connecting rod end cap on its original connecting rod making sure the bearing lock tangs are aligned on the same side of the rod.

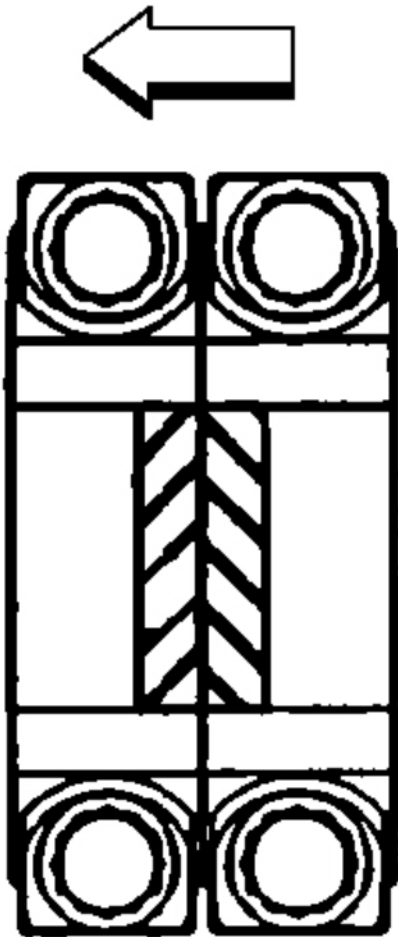


Fig. 186: View Of Paired Connecting Rod Bearing Cap Notches
Courtesy of GENERAL MOTORS CORP.

2. When properly installed, the connecting rod bearing cap notches should be paired, as shown, on the crankpin.

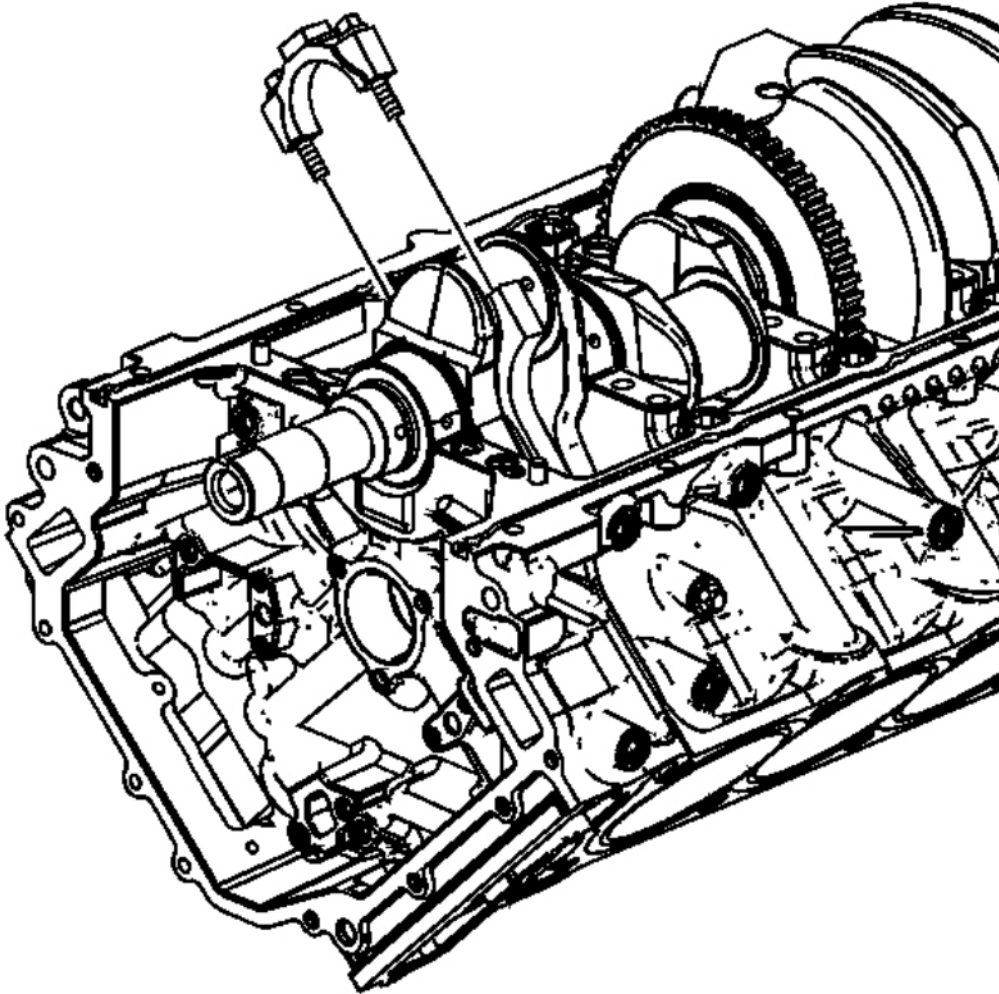


Fig. 187: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

3. Lubricate connecting rod bolts with engine oil and install in the connecting rod.

2004 Cadillac SRX

2004 ENGINE Engine Mechanical - 4.6L (LH2) (Repair Instructions, 4 Of 5) - SRX

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** .

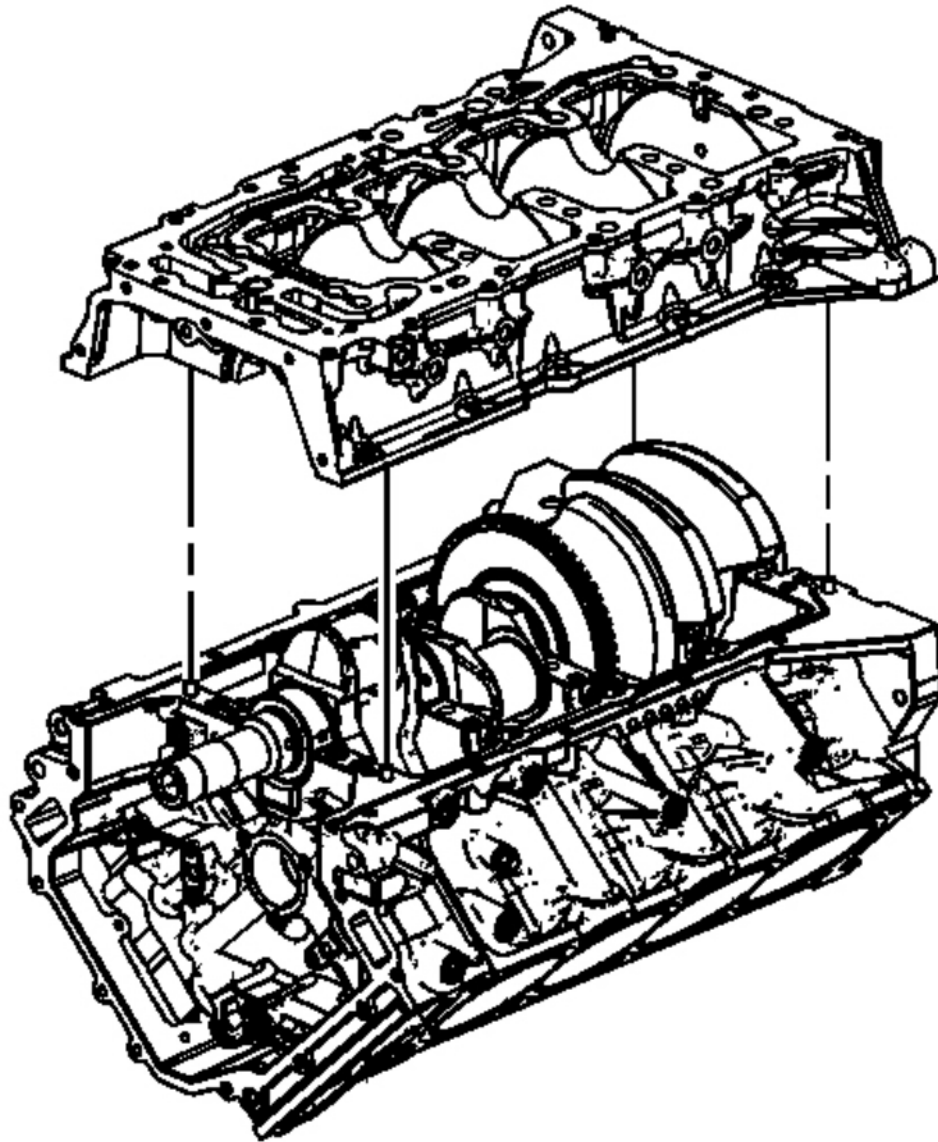


Fig. 188: View Of Lower Crankcase
Courtesy of GENERAL MOTORS CORP.

6. Align the lower crankcase with the dowel pins in the upper crankcase.
7. Install the lower crankcase onto the upper crankcase slowly until feeling a positive stop.

8. Inspect the upper-to-lower crankcase joint in order to make sure the lower crankcase is fully seated on the cylinder block.

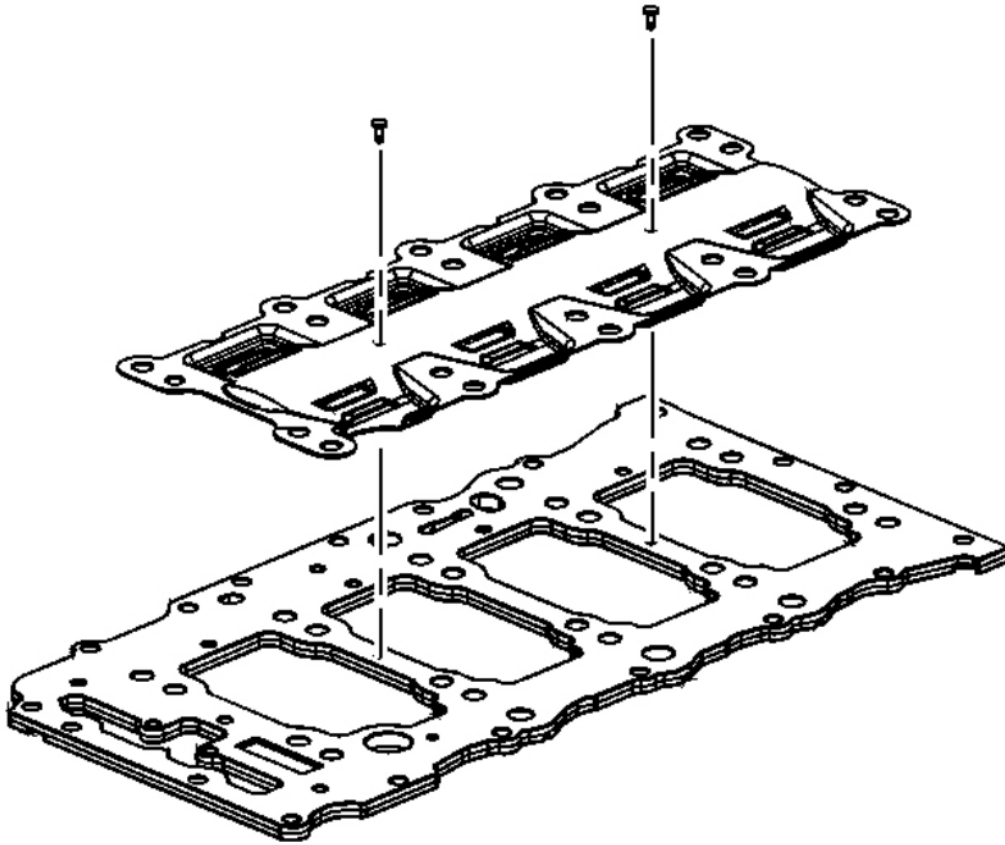


Fig. 189: View Of Oil Scraper Plate & Oil Manifold Plate
Courtesy of GENERAL MOTORS CORP.

9. In order to gain access for the **J 43690** and the **J 43690-100** remove the oil scraper plate from the old oil manifold plate, if fastened into place.

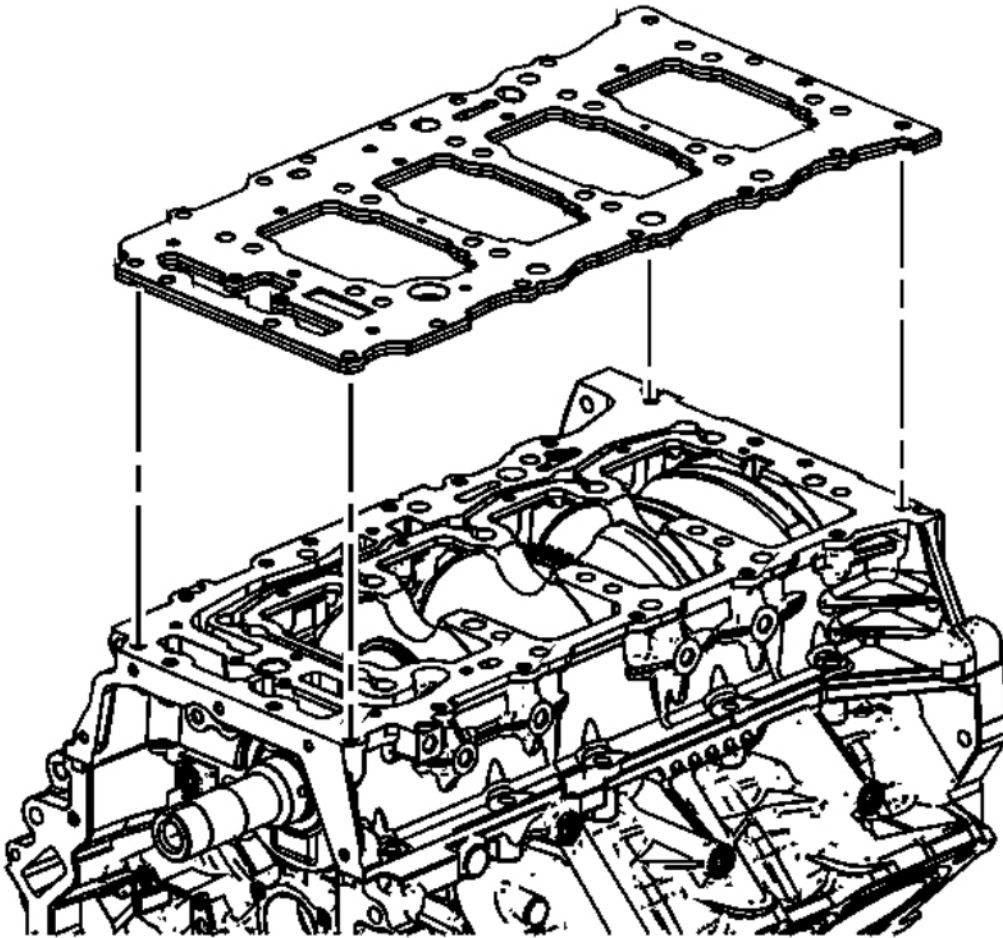


Fig. 190: View Of Oil Manifold Plate
Courtesy of GENERAL MOTORS CORP.

10. Install the old oil manifold plate.

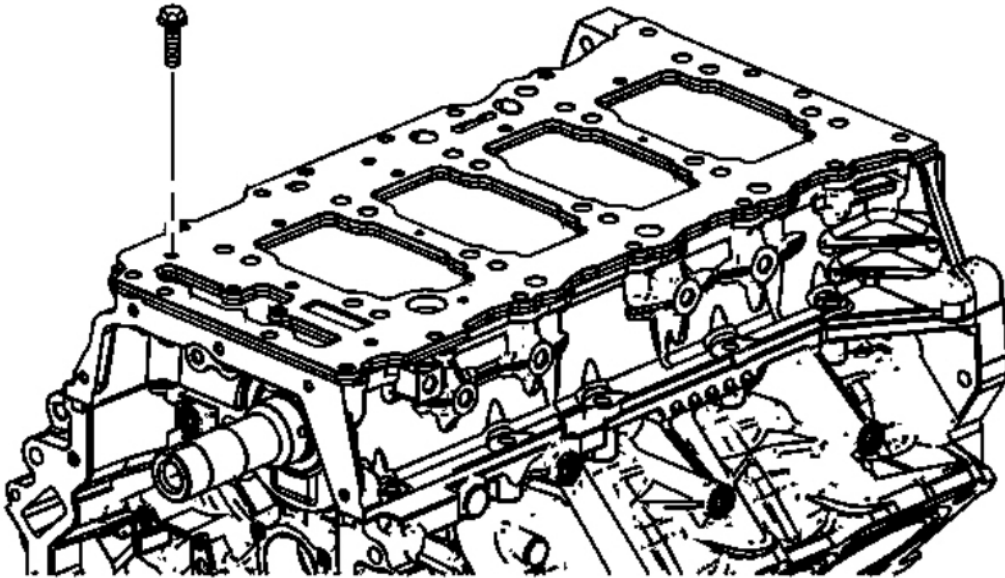


Fig. 191: View Of Oil Manifold Plate Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the old oil manifold plate bolts.

Tighten: Tighten the old oil manifold plate bolts to 10 N.m (89 lb in).

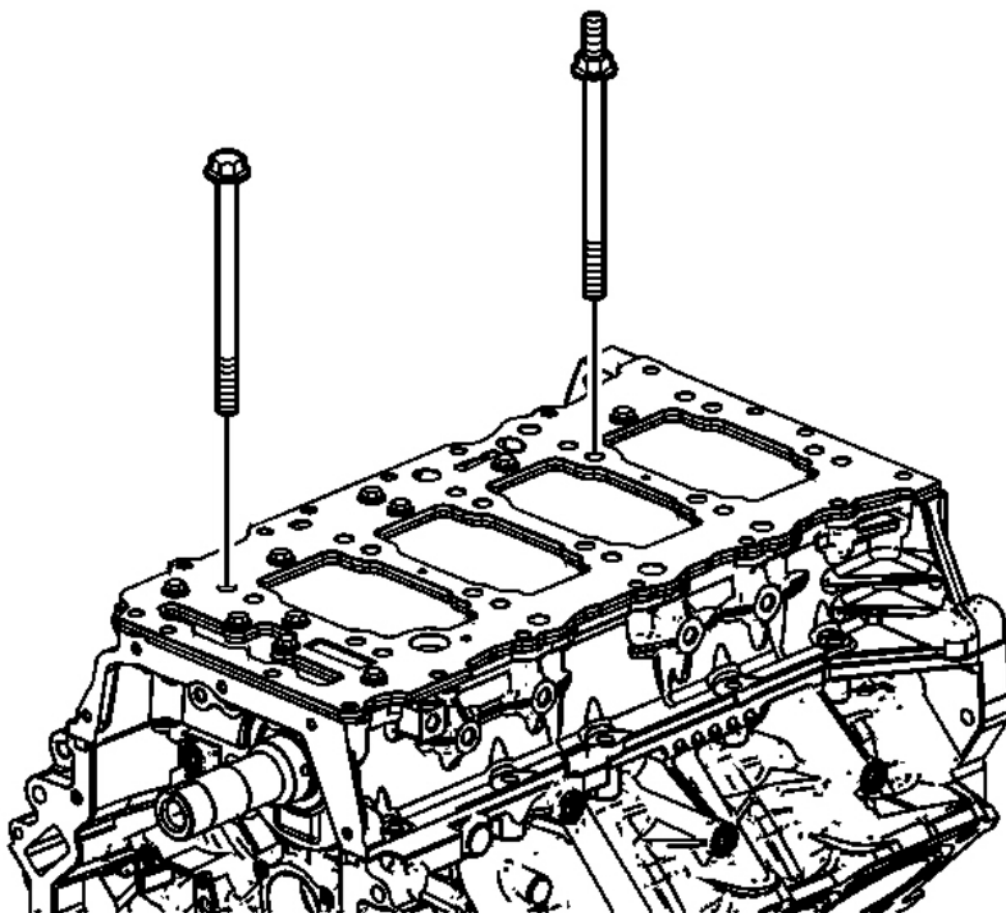


Fig. 192: View Of Lower Crankcase Main Bearing Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the lower crankcase main bearing bolts.

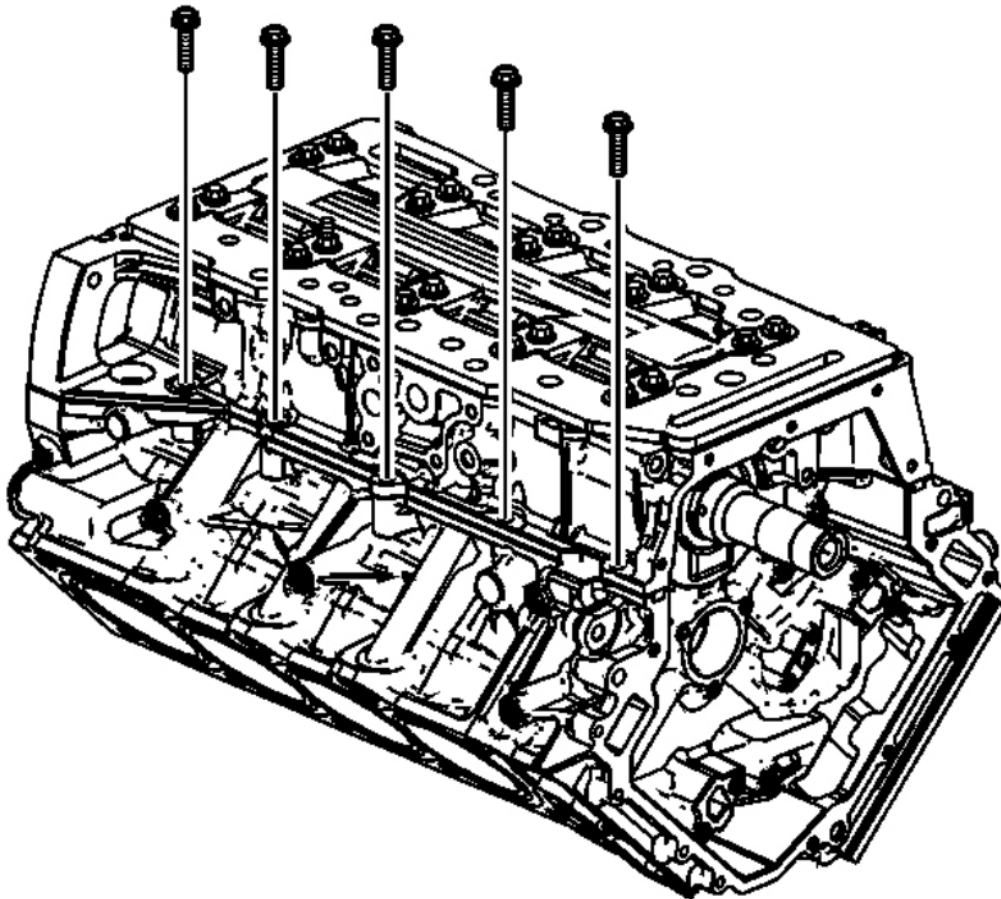


Fig. 193: View Of Lower Left Crankcase Perimeter Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the left side upper-to-lower crankcase perimeter bolts.

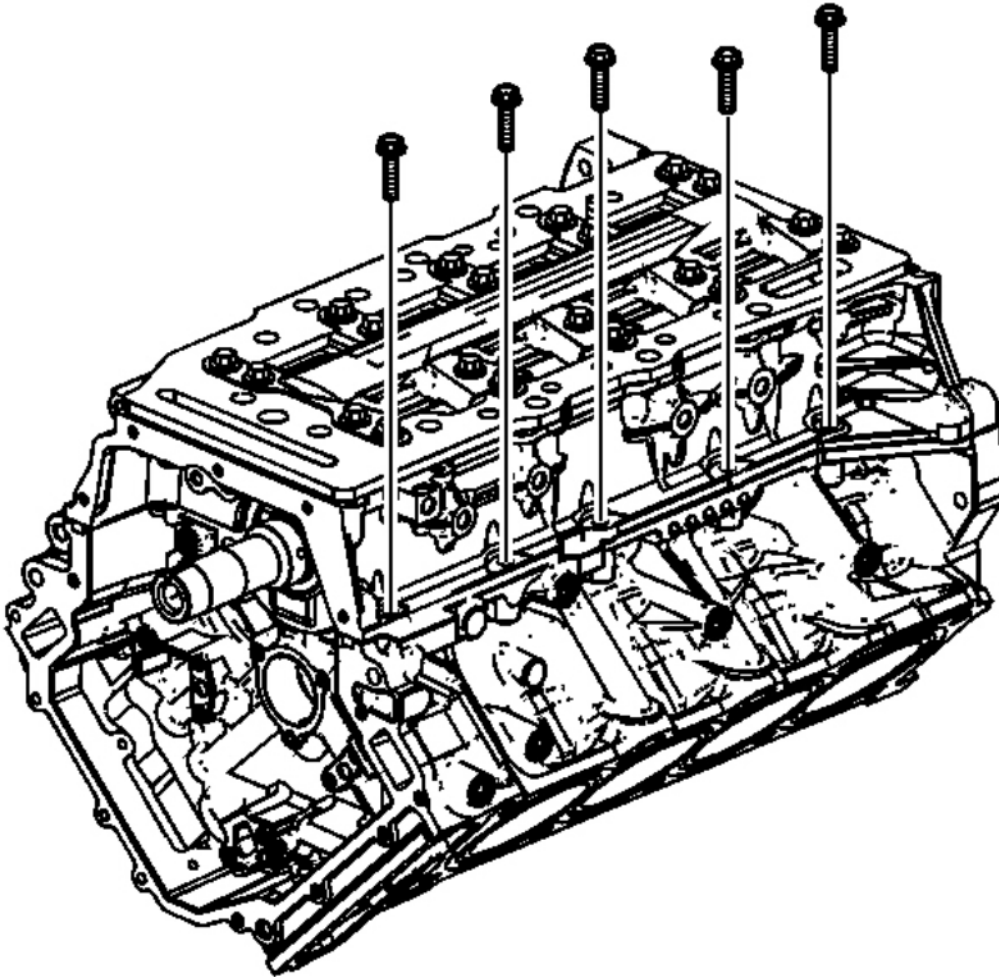


Fig. 194: View Of Right Upper-To-Lower Crankcase Perimeter Bolts
Courtesy of GENERAL MOTORS CORP.

14. Install the right side upper-to-lower crankcase perimeter bolts.

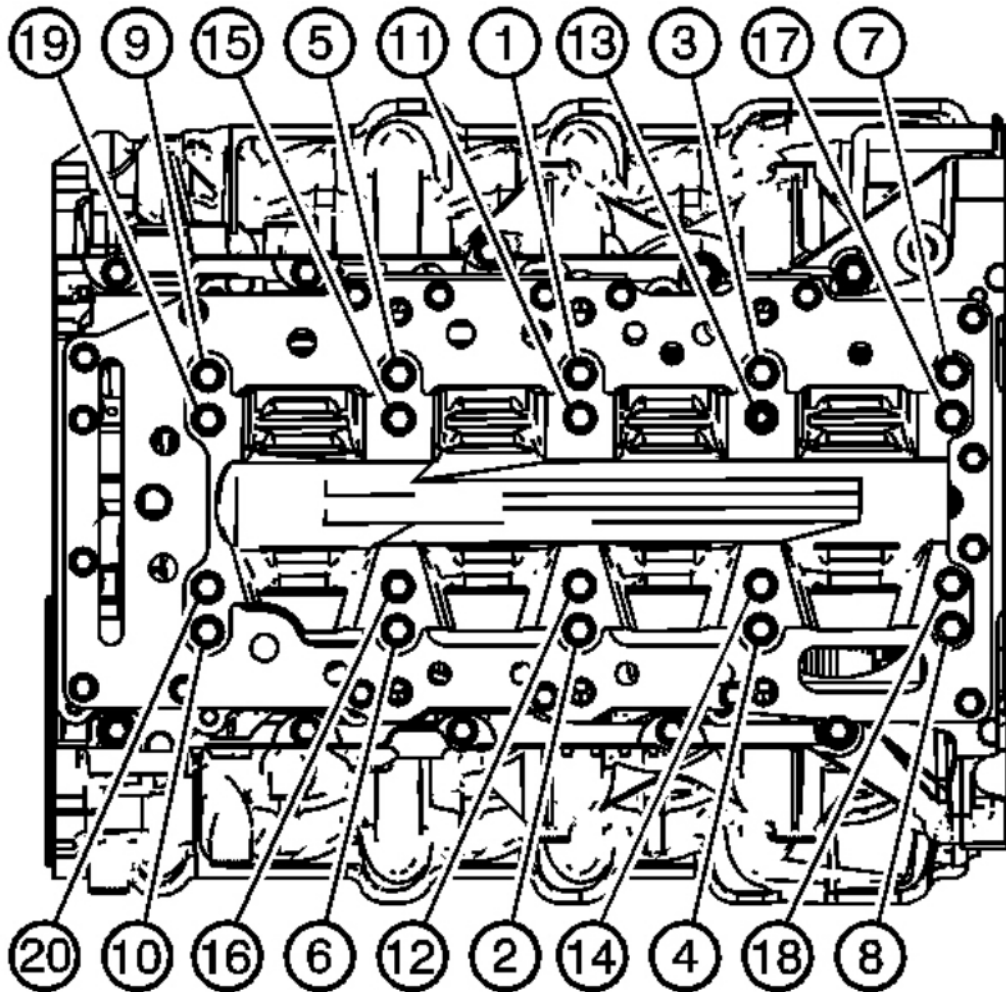


Fig. 195: Tightening Lower Crankcase Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the lower crankcase main bearing bolts.

1. First Pass

Tighten: Tighten the lower crankcase main bearing bolts (1-20) to 20 N.m (15 lb ft) in the proper sequence.

2. Final Pass

Tighten: Tighten the lower crankcase main bearing bolts (1-20) an additional 65 degrees in the proper sequence using the **J 45059** .

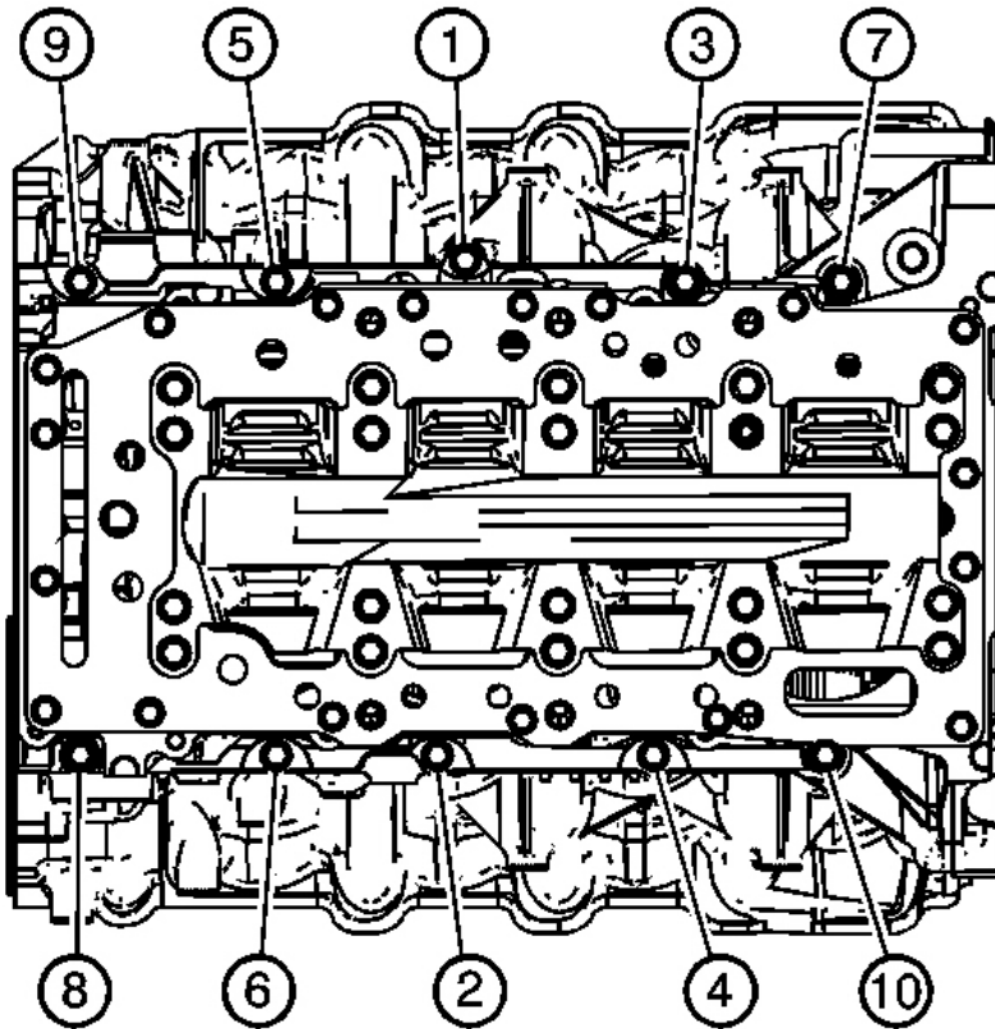


Fig. 196: Tightening Upper-To-Lower Crankcase Perimeter Bolts
Courtesy of GENERAL MOTORS CORP.

16. Tighten the upper-to-lower crankcase perimeter bolts (1-10).

Tighten: Tighten the upper-to-lower crankcase perimeter bolts (1-10) to 30 N.m (22 lb ft) in the proper sequence.

17. Using the **J 39946** 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.

18. Remove the crankshaft main bolts required to install the retainer plate J 43690-105.
19. Install the J 43690-105 retainer plate and crankshaft main bolts. Refer to **Lower Crankcase Installation** for tightening specifications.

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

20. Tighten the J 43690-105 retainer plate screw until snug in order to secure the crankshaft movement.
21. Install the foot and bolt to the J 43690-101 pivot arm assembly. Tighten the bolt until snug.
22. Install the J 43690-101 pivot arm assembly onto the connecting rod and tighten the screw securely.
23. Install the base and bolt to the oil pan rail.
24. Align the center of the base with the screw of the J 43690-101 pivot arm assembly. Tighten the bolt until snug.
25. Align the link of the J 43690-101 pivot arm assembly on a plane equal to that of the connecting rod beam.
26. Insert the pin to the base and J 43690-101 pivot arm assembly.
27. Select the adapter as required and install to the swivel base. Tighten until snug.
28. Install the swivel base to the oil pan rail.

IMPORTANT: The clamp of the swivel base and the shaft of the indicator should be free of oil or other debris. A loose or improperly clamped indicator may indicate incorrect readings.

29. Install the indicator to the swivel base. Tighten the clamp of the base until snug.

IMPORTANT: The tip of the indicator should be positioned above and NOT in contact with the end of the connecting rod.

30. Adjust the swivel base as required and position the indicator tip slightly above the

connecting rod cap. Lock the swivel base in position by rotating the locking lever.

31. Rotate the fine adjustment knobs on the dial indicator end of the swivel base in order to position the tip of the indicator in contact with the connecting rod.
32. Lightly actuate the handle of the pivot arm assembly, multiple times in both directions, to ensure the oil film is removed from the connecting rod.
33. Load the handle in the forward position and zero the dial indicator. Load the handle multiple times in both directions and record the readings.
34. Refer to **Fastener Tightening Specifications** for proper clearances.
35. Remove the J 43690-105 retainer plate.
36. Install the crankshaft main bolts. Refer to **Lower Crankcase Installation** for tightening specifications.
37. Reposition the tools and repeat steps 2-21 for all other connecting rods.
38. If clearances do not meet specifications, replace components as required.
39. Remove the lower crankcase when the procedure is complete.

Connecting Rod Final Assembly Procedure

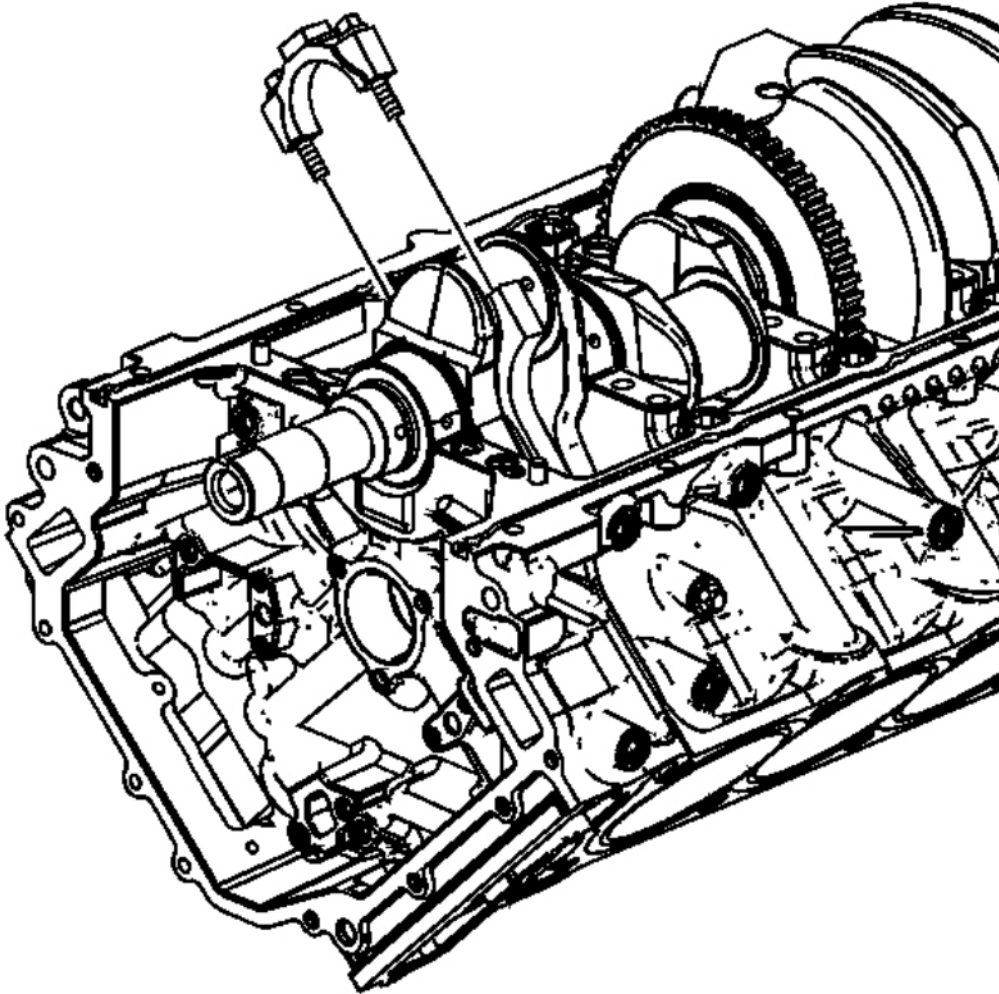


Fig. 197: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

1. Remove the connecting rod bolts.
2. Remove the connecting rod cap.

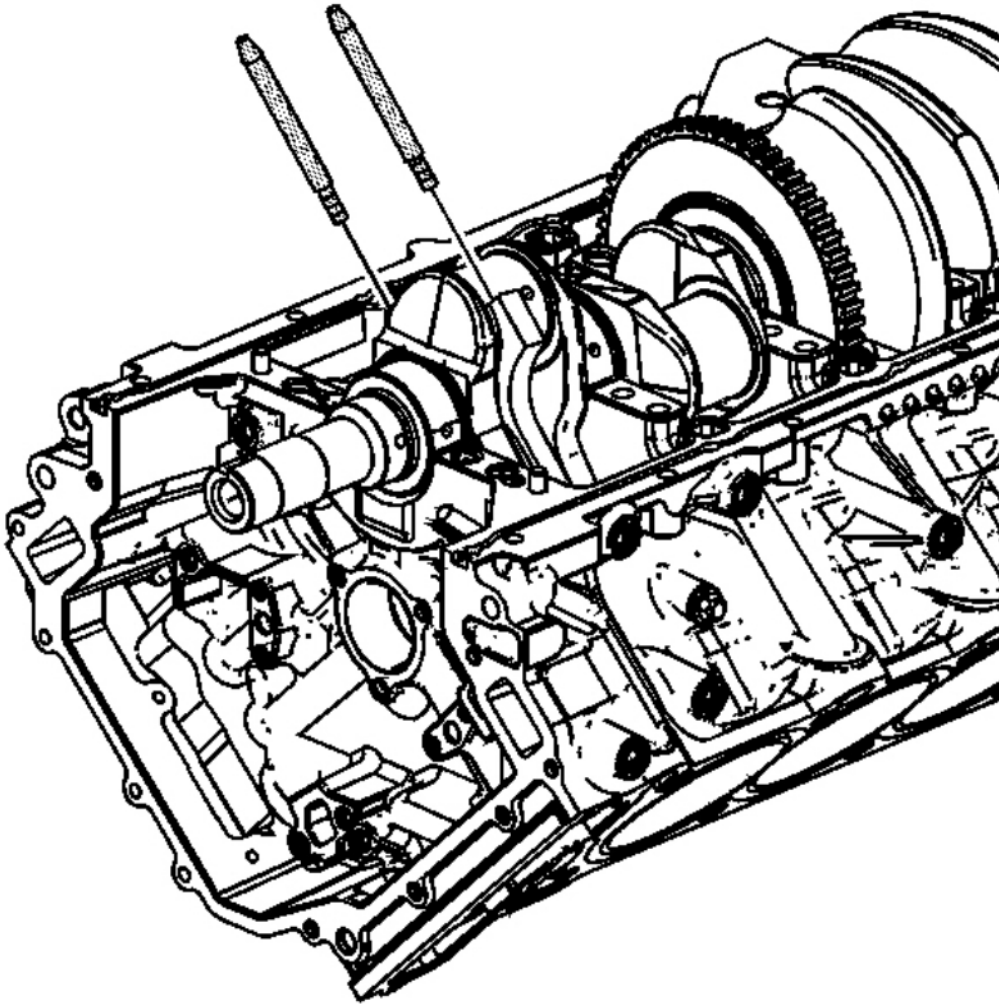


Fig. 198: View Of EN 46121

Courtesy of GENERAL MOTORS CORP.

3. Install the **EN 46121** into the connecting rod bolt holes.
4. Back the connecting rod away from the crankshaft in order to allow for lubricant application.
5. Coat the crankshaft connecting rod bearing journal and installed connecting rod bearings with GM crankshaft prelube GM P/N 1052367, (Canadian P/N 992869), or equivalent.
6. Guide the connecting rod onto the crankshaft connecting rod bearing journal.

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

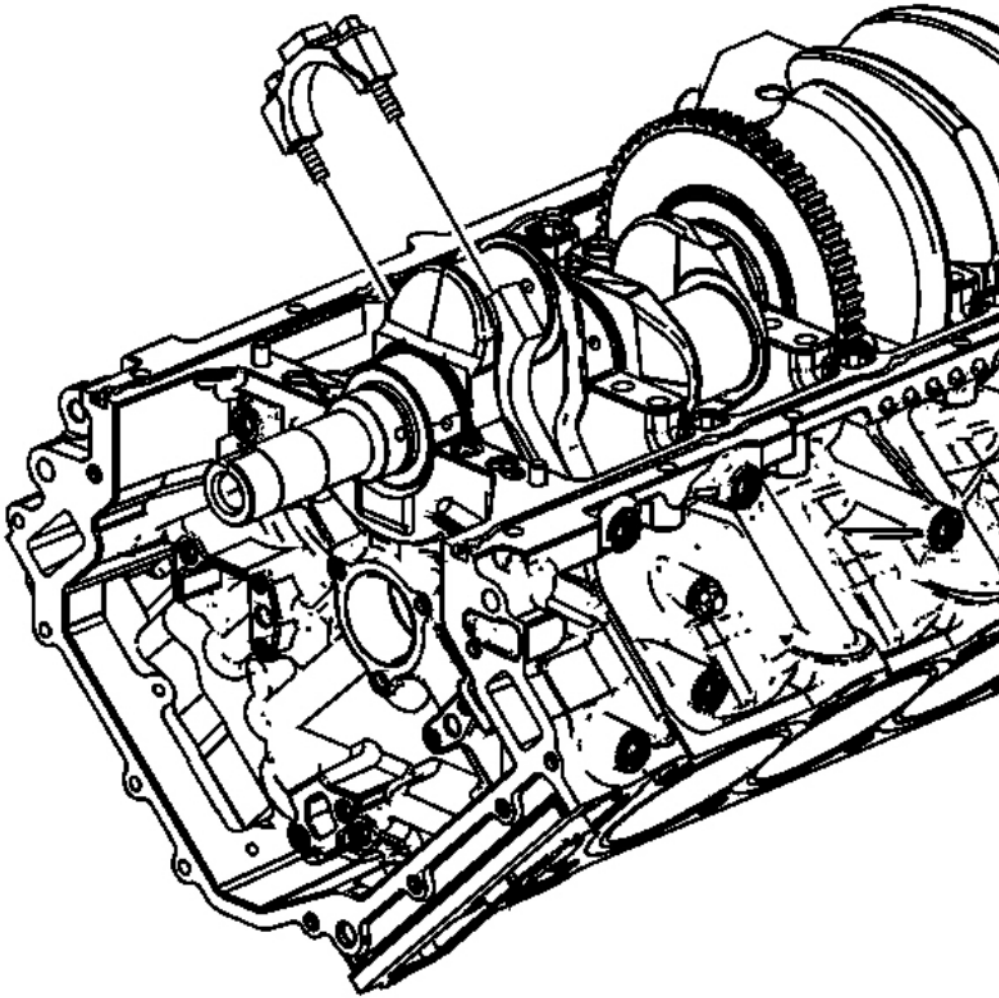


Fig. 199: View Of Connecting Rod Cap
Courtesy of GENERAL MOTORS CORP.

8. Install the connecting rod end cap on its original connecting rod making sure the bearing lock tangs are aligned on the same side of the rod.

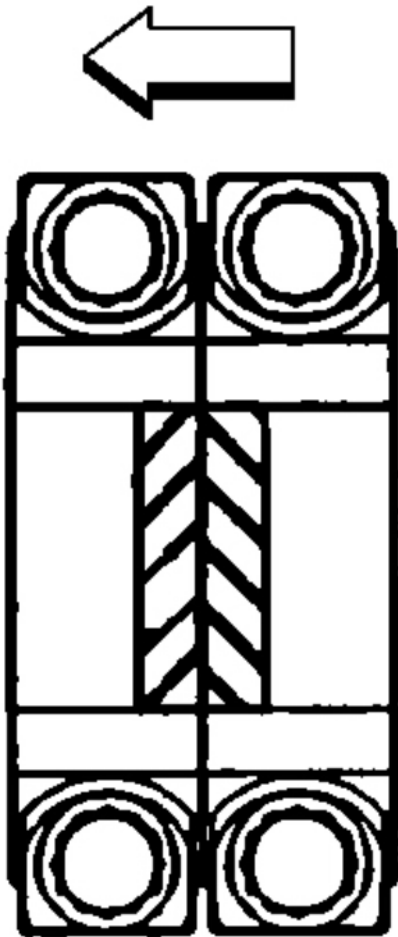


Fig. 200: View Of Paired Connecting Rod Bearing Cap Notches
Courtesy of GENERAL MOTORS CORP.

9. When properly installed, the connecting rod bearing cap notches should be paired, as shown, on the crankpin.

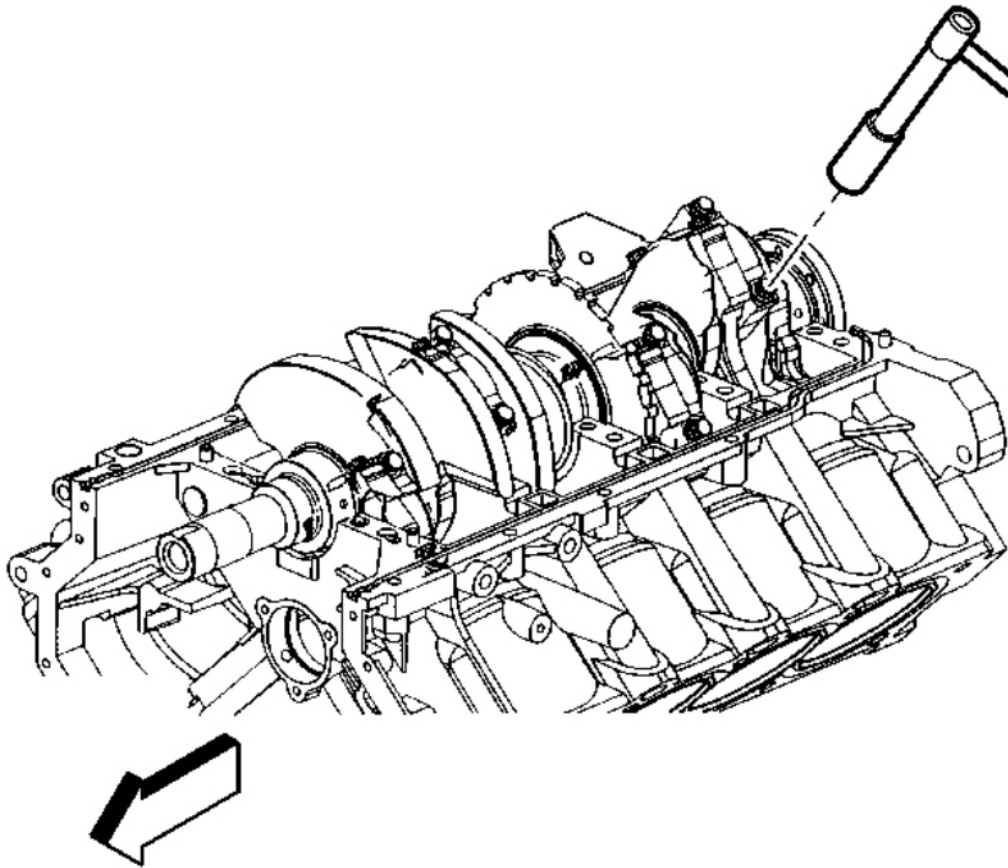


Fig. 201: Loosening Connecting Rod Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: DO NOT reuse the old connecting rod bolts.

10. Lubricate the NEW connecting rod bolts with engine oil and install in the connecting rod.

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

11. Loosen the connecting rod bolts until the torque reading is zero.
12. 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** .

13. During and after installation, ensure each piston is positioned properly in the correct cylinder.
14. Repeat these procedures for the piston/connecting rod assembly that is using the common crankshaft connecting rod journal.
15. Measure the connecting rod side clearance between the 2 connecting rods that share the common crankshaft connecting rod journal.
16. Compare the measurements with the engine mechanical specifications. Refer to **Engine Mechanical Specifications** .
17. If the connecting rods do not provide the proper crankshaft side clearance inspect for the following conditions:
 - If the clearance is too tight, ensure the connecting rods are not binding and can slide parallel to the crankpin. Re-measure the connecting rod widths for the correct specified size. If the connecting rods are incorrectly sized, replace the connecting rods.
 - If the clearance is too loose, re-measure the connecting rod widths for the correct specified size. If the connecting rods are incorrectly sized, replace the connecting rods.
18. Repeat these procedures for the remaining piston/connecting rod assemblies using the **J 39946** in order to rotate the crankshaft.

LOWER CRANKCASE INSTALLATION

Tools Required

- **J 39946** Crankshaft Socket - 4.0L and 4.6L
- **J 45059** Angle Meter

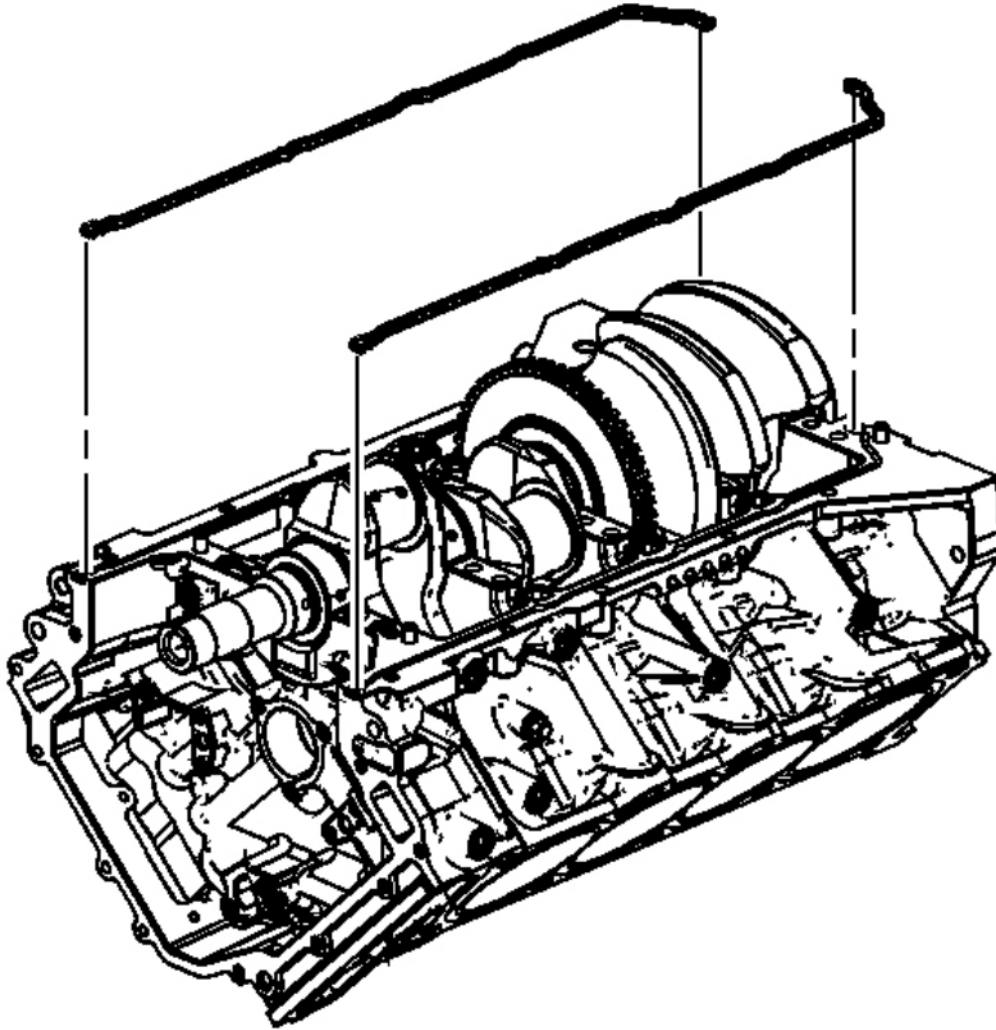


Fig. 202: View Of Upper-To-Lower Crankcase Seal
Courtesy of GENERAL MOTORS CORP.

1. Wipe all sealing surfaces clean with a dry, lint-free cloth.
2. Work the NEW upper-to-lower crankcase seal into its groove starting at both ends and working the seal towards the center. The seal must not be torn, nicked or out of the groove over its entire length on both sides of the crankcase.

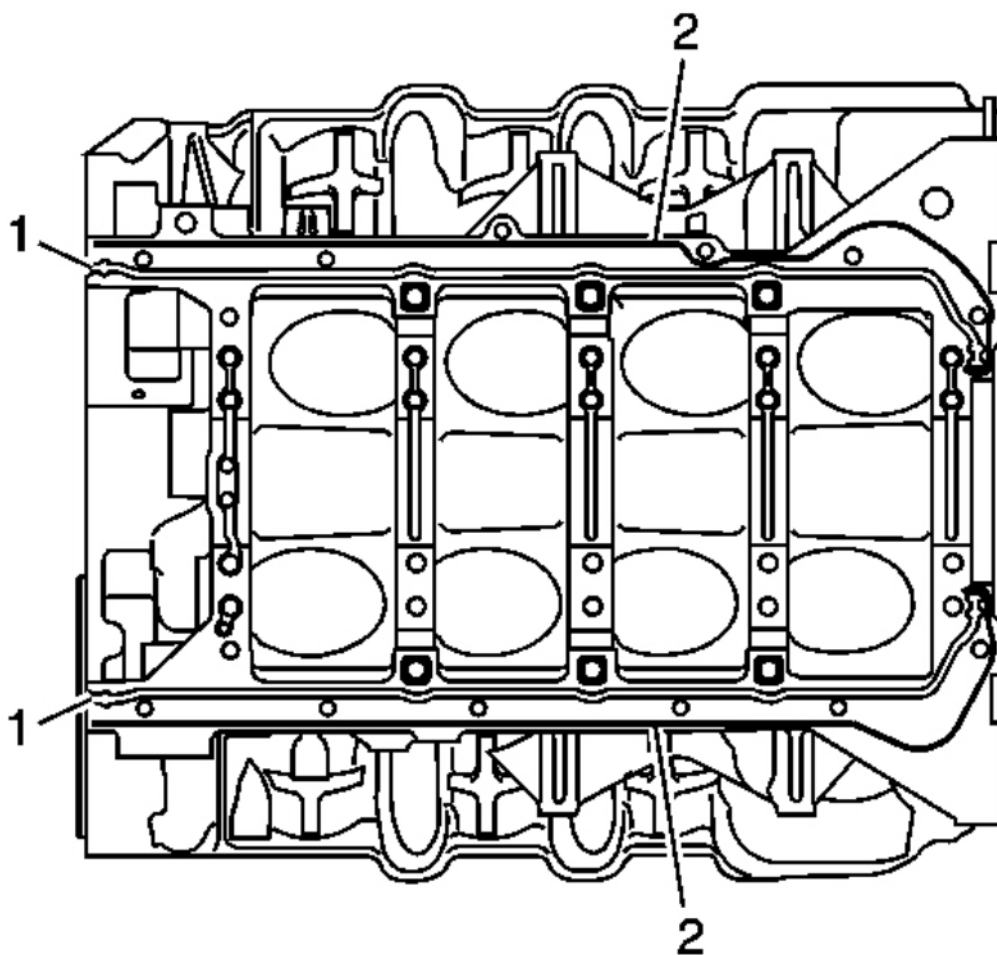


Fig. 203: Applying Adhesive To Upper Crankcase
Courtesy of GENERAL MOTORS CORP.

3. Apply a thin bead (2) of Gasket Maker, GM P/N 1052942, (Canadian P/N 10953466), or equivalent, to the upper crankcase. The bead should run parallel to the silicone seal (1) and through the centerline of the bolt holes but not through the bolt holes. Starting from the front of the block, the bead should be about 1 mm (0.039 in) thick until the first bolt hole. Expand to 2.5-3 mm (0.098-0.118 in) thick from the first to the third bolt hole. After the third bolt hole the bead should be reduced to 1 mm (0.039 in) until running off the end of the crankcase. Do not continue the bead all the way to the rear crankshaft seal.

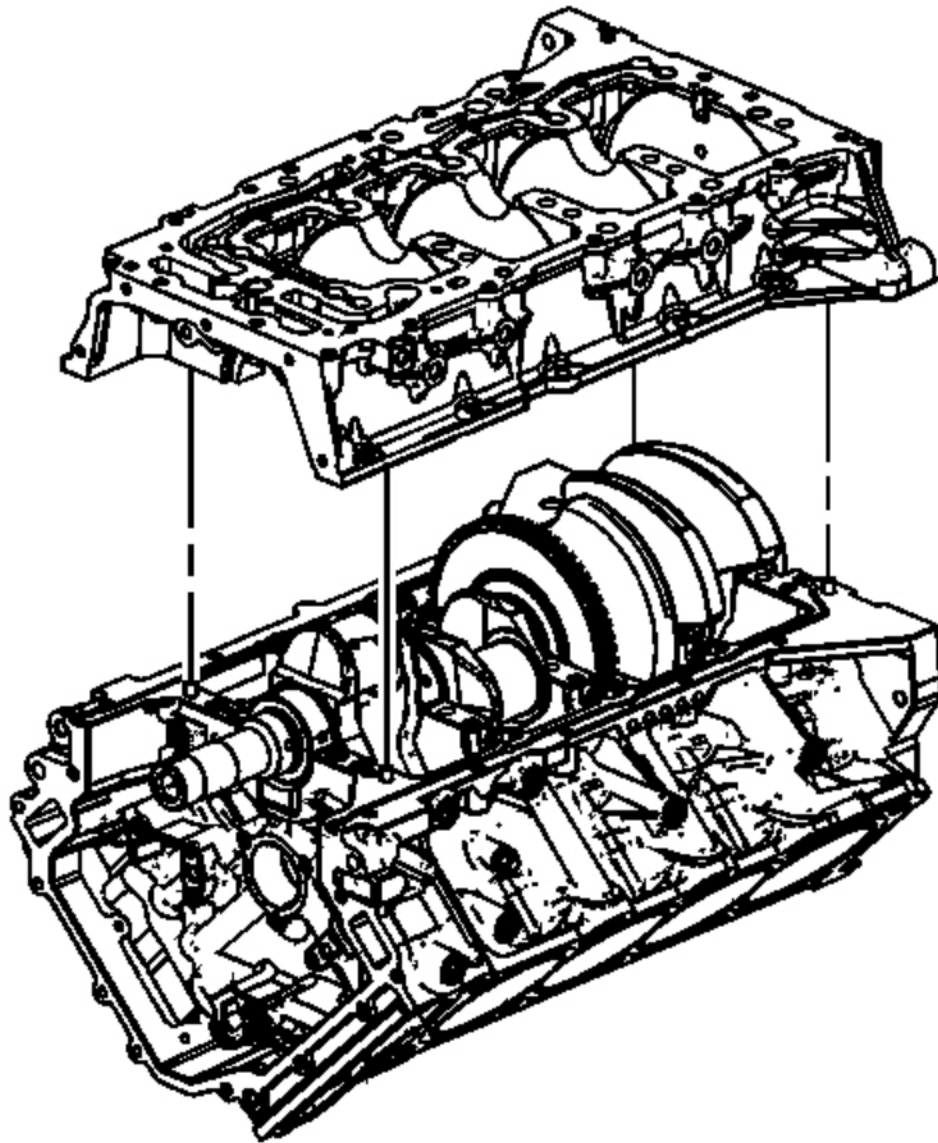


Fig. 204: View Of Lower Crankcase
Courtesy of GENERAL MOTORS CORP.

4. Align the lower crankcase with the dowel pins in the upper crankcase.
5. Install the lower crankcase onto the upper crankcase slowly until feeling a positive stop.

6. Inspect the upper-to-lower crankcase joint in order to make sure the lower crankcase is fully seated on the cylinder block.

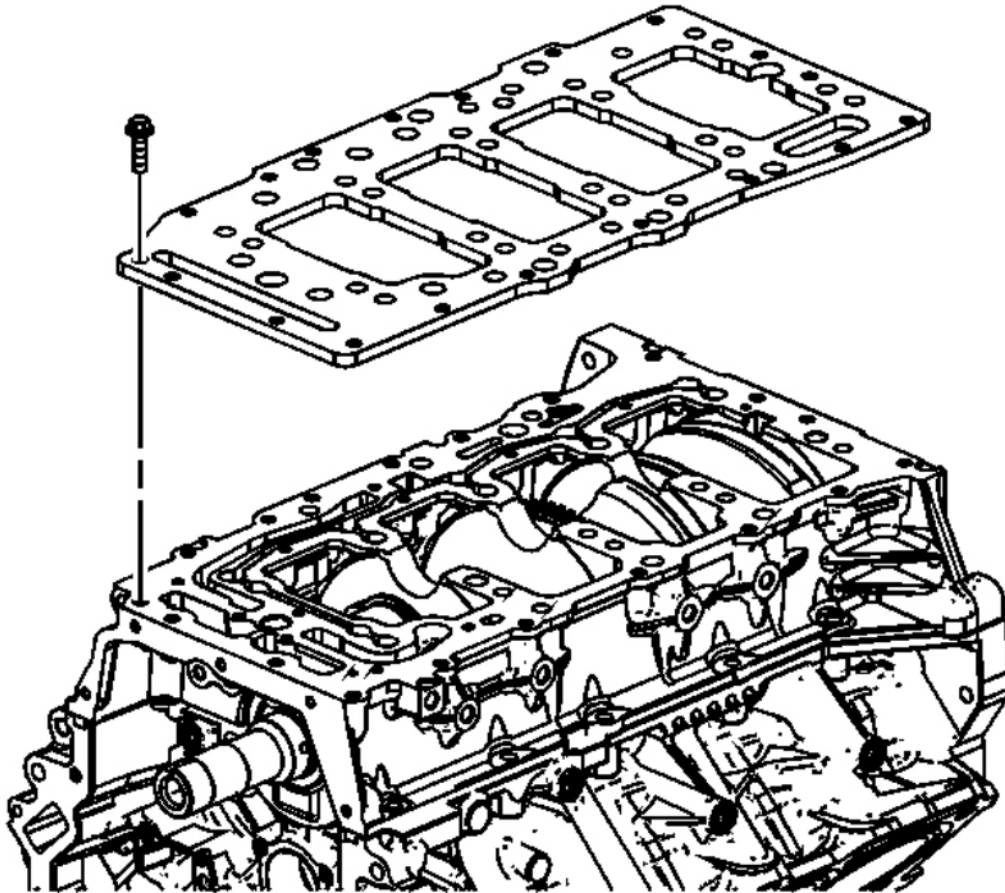


Fig. 205: View Of Oil Manifold Plate
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW oil manifold plate.

NOTE: Refer to Fastener Notice in Cautions and Notices.

8. Install the oil manifold plate bolts.

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

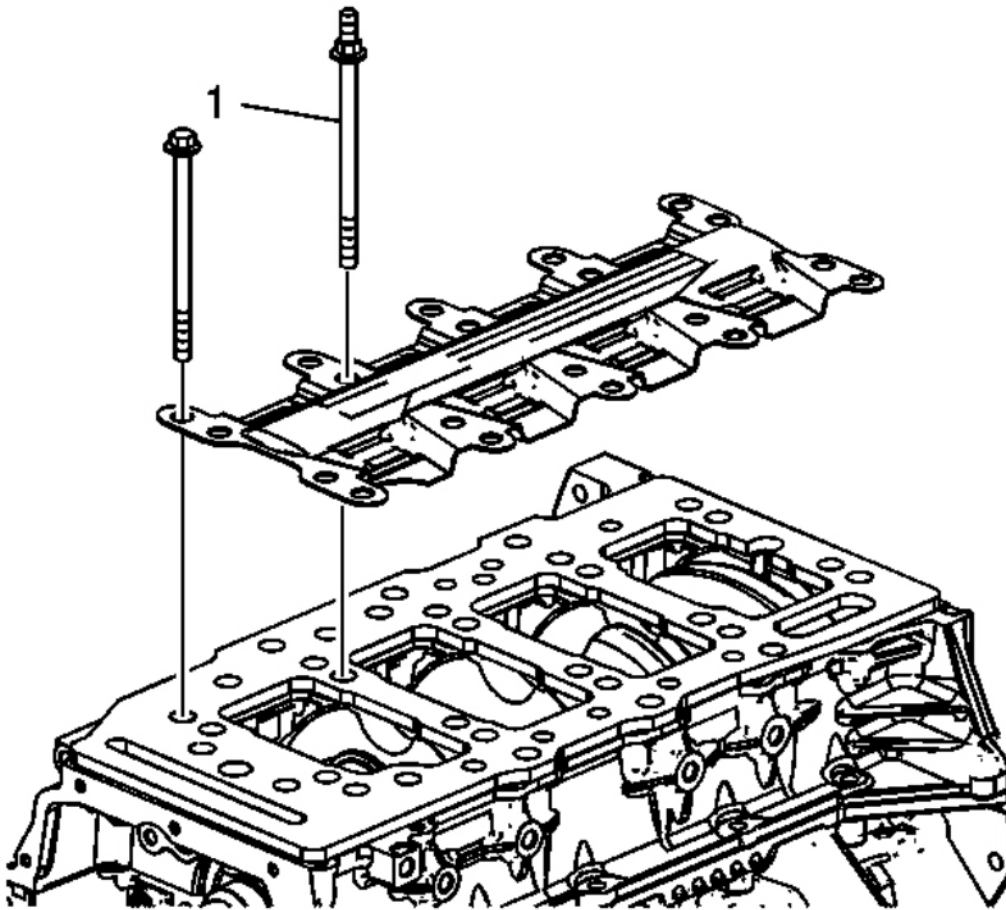


Fig. 206: View Of Main Bearing Single Stud-Head Bolt
Courtesy of GENERAL MOTORS CORP.

9. Place the crankshaft oil scraper in position on the oil manifold. Align the holes with the main bearing bolt holes.
10. Install the main bearing bolts. The single stud-head bolt (1) used for oil pump pick-up mounting goes, in the inboard position of the third set of main bearing bolts from the front of the engine.

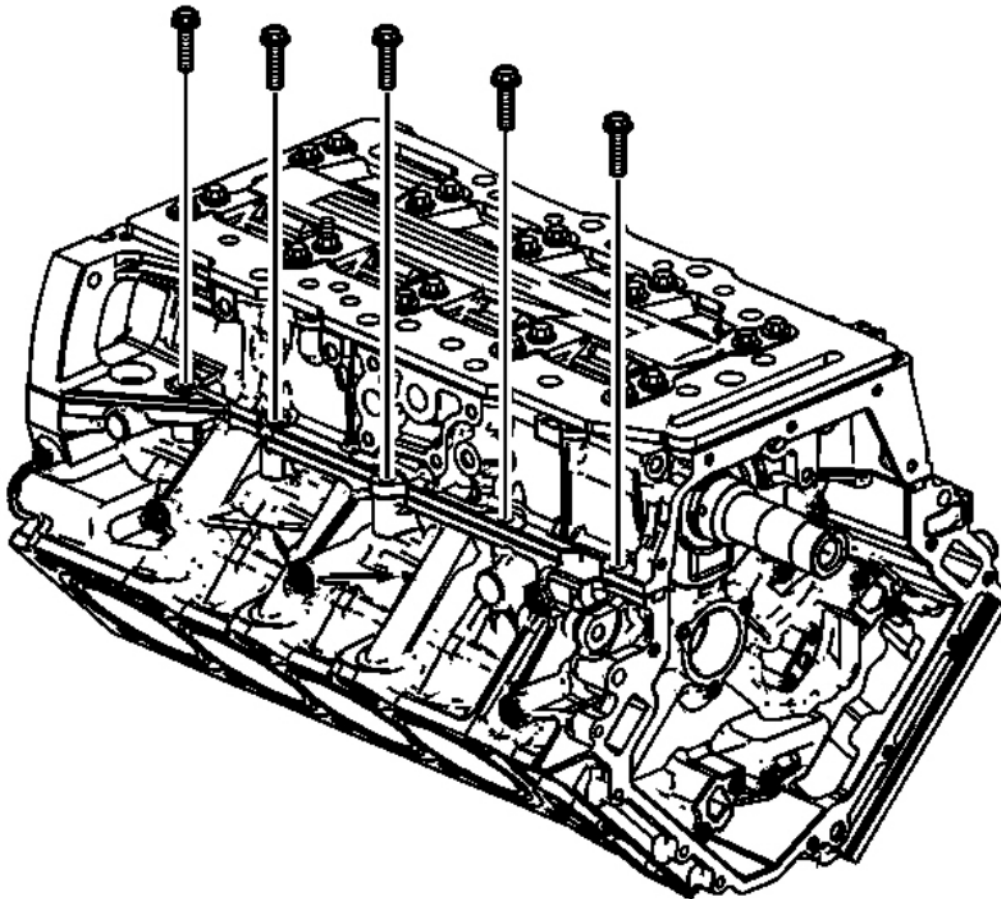


Fig. 207: View Of Lower Left Crankcase Perimeter Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the left side upper-to-lower crankcase perimeter bolts.

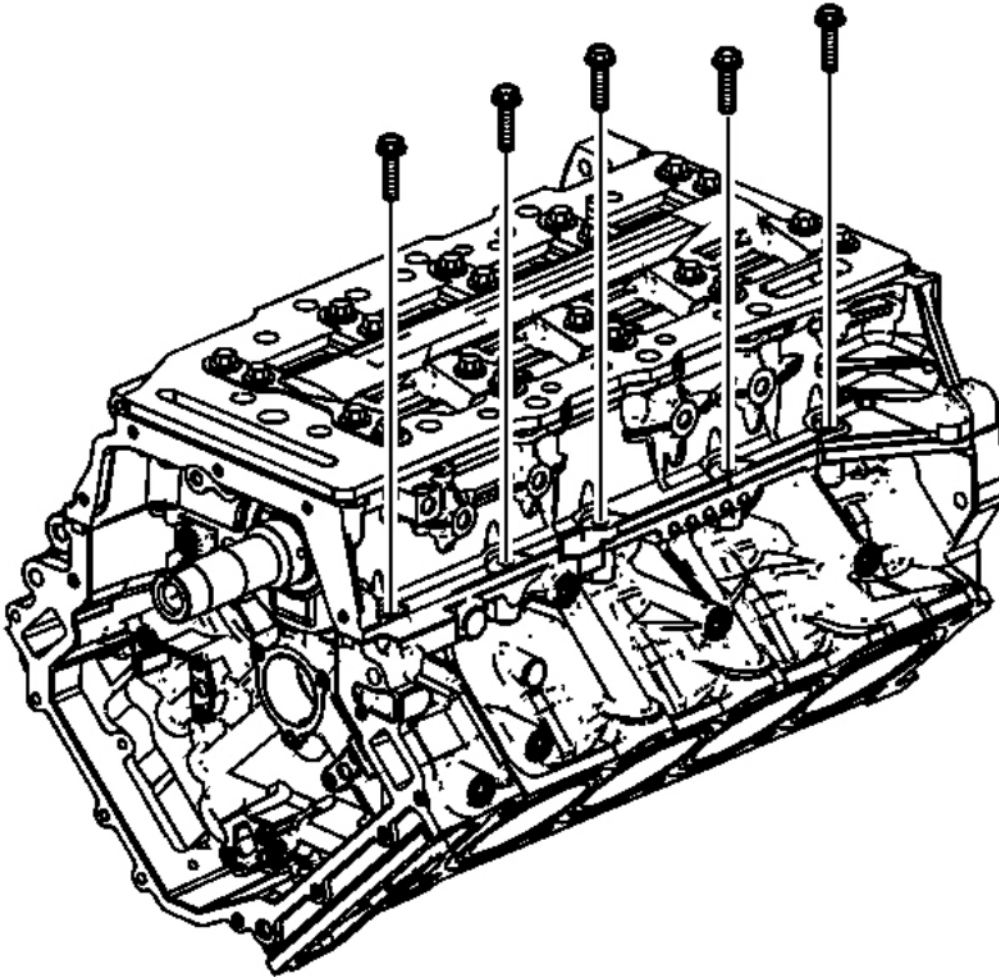


Fig. 208: View Of Right Upper-To-Lower Crankcase Perimeter Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the right side upper-to-lower crankcase perimeter bolts.

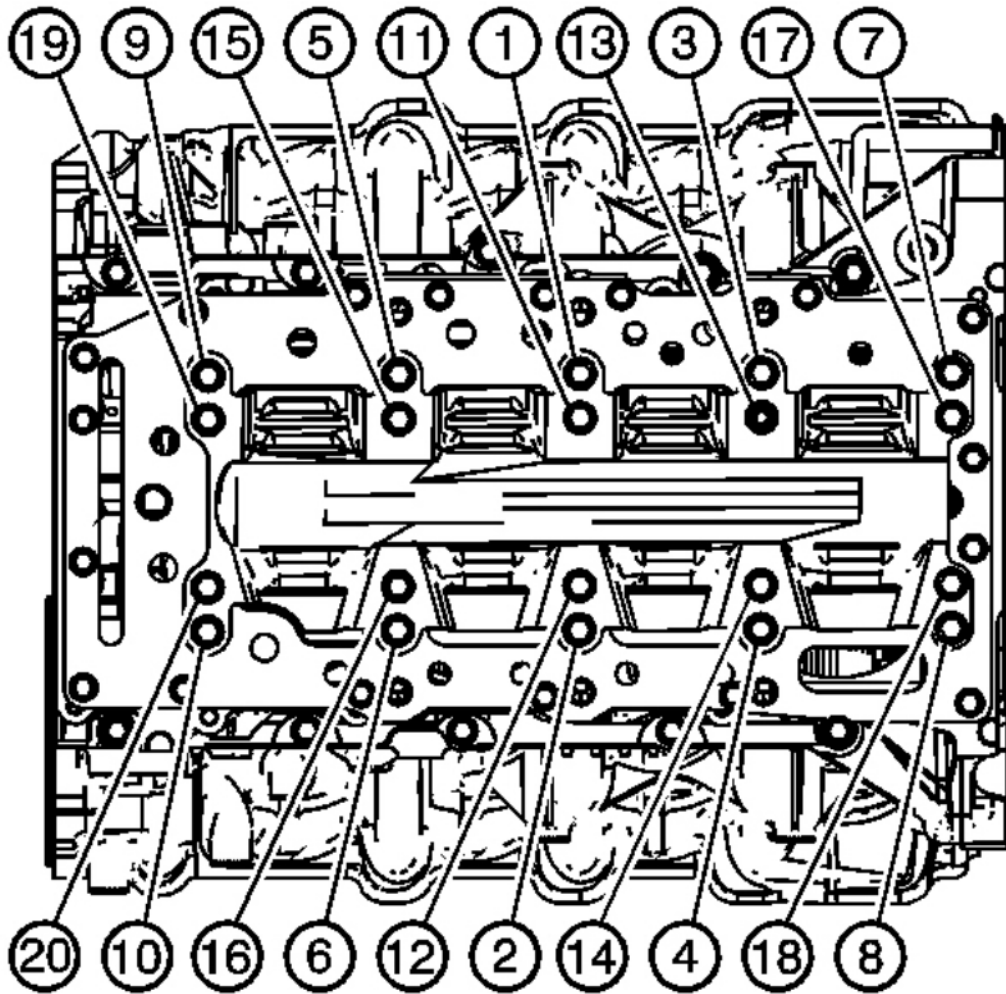


Fig. 209: Tightening Lower Crankcase Bolts
Courtesy of GENERAL MOTORS CORP.

13. Install the lower crankcase bolts.

1. First Pass

Tighten: Tighten the lower crankcase bolts (1-20) to 20 N.m (15 lb ft) in the proper sequence.

2. Final Pass

Tighten: Tighten the lower crankcase bolts (1-20) an additional 65 degrees in the proper sequence using the **J 45059** .

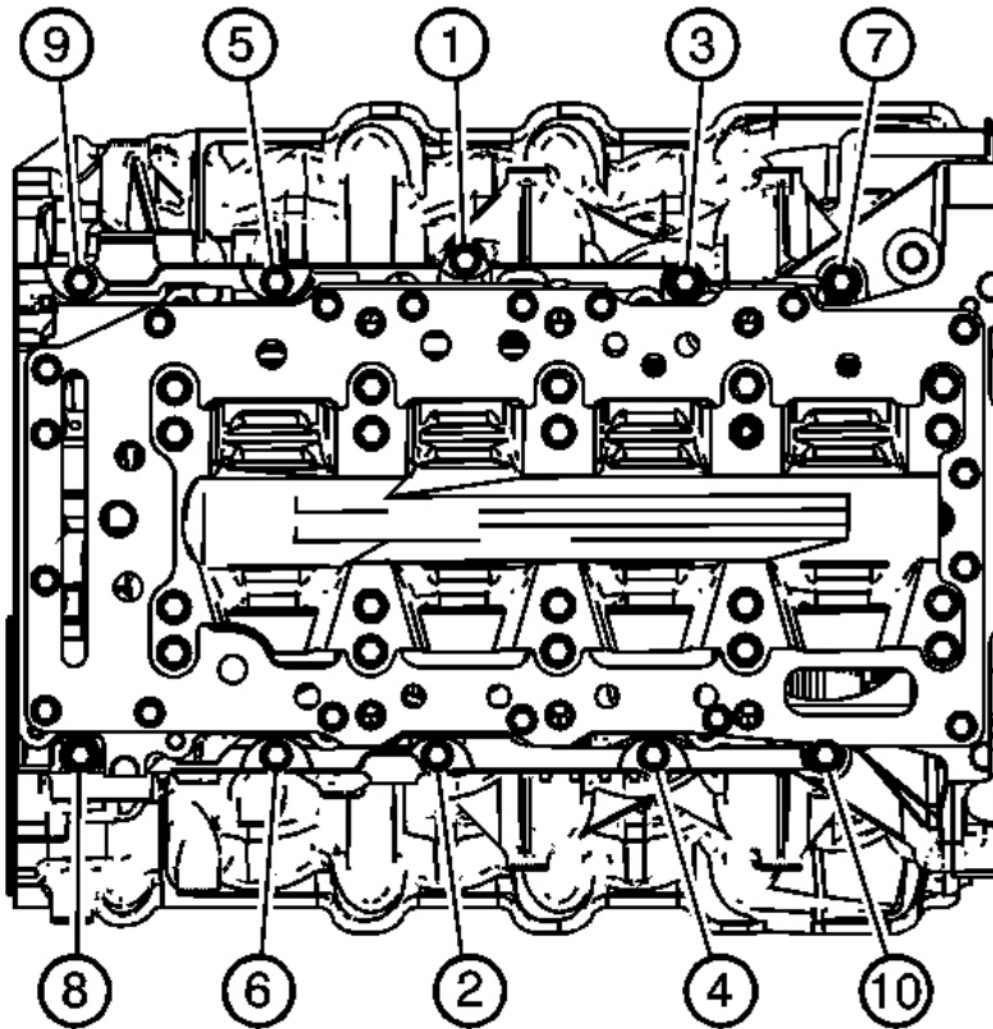


Fig. 210: Tightening Upper-To-Lower Crankcase Perimeter Bolts
Courtesy of GENERAL MOTORS CORP.

14. Tighten the upper-to-lower crankcase perimeter bolts (1-8).

Tighten: Tighten the upper-to-lower crankcase perimeter bolts (1-8) to 30 N.m (22 lb ft) in the proper sequence.

15. Using the **J 39946** rotate the crankshaft until the number one piston is at top dead center (TDC) and the crankshaft key way is approximately at the 7 o'clock position.

OIL PUMP PIPE AND SCREEN ASSEMBLY INSTALLATION

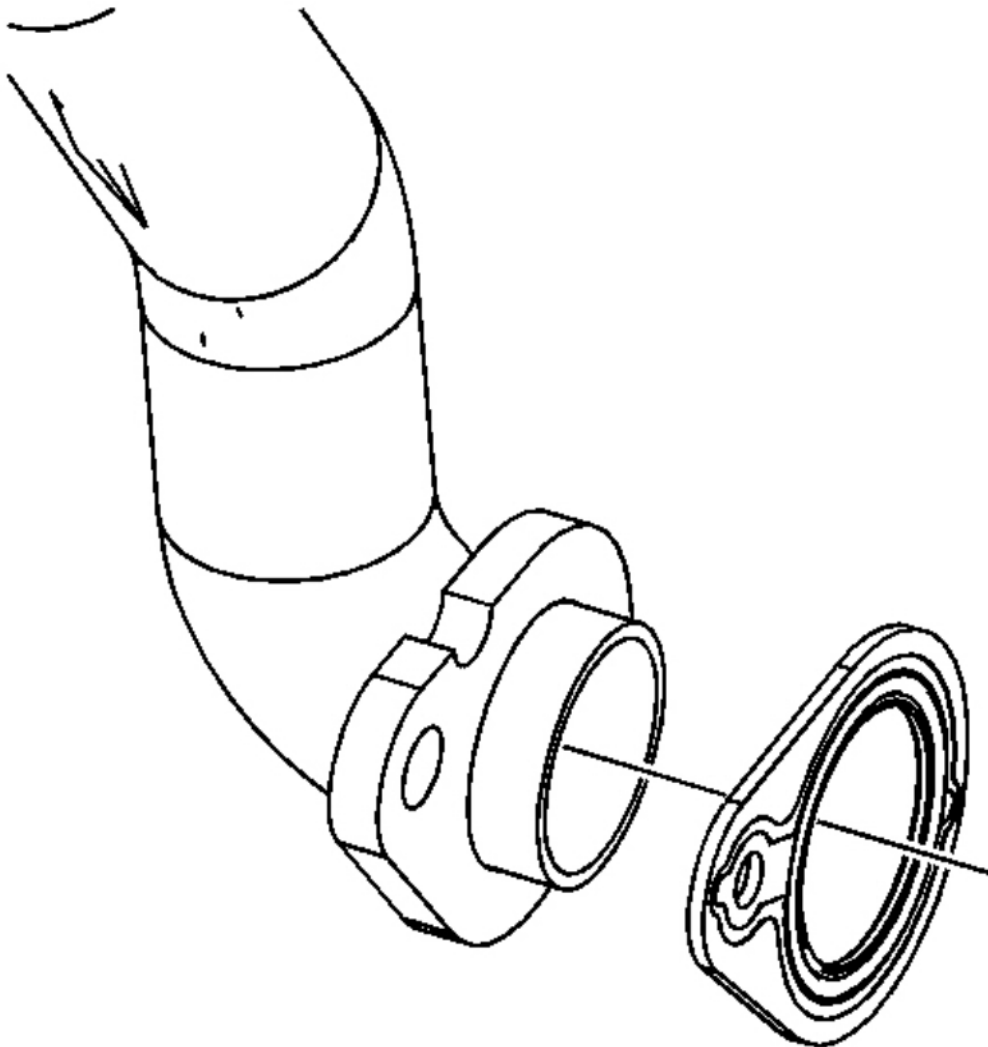


Fig. 211: View Of Oil Pump Pipe Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install NEW oil pump pipe gasket on oil pump pipe.

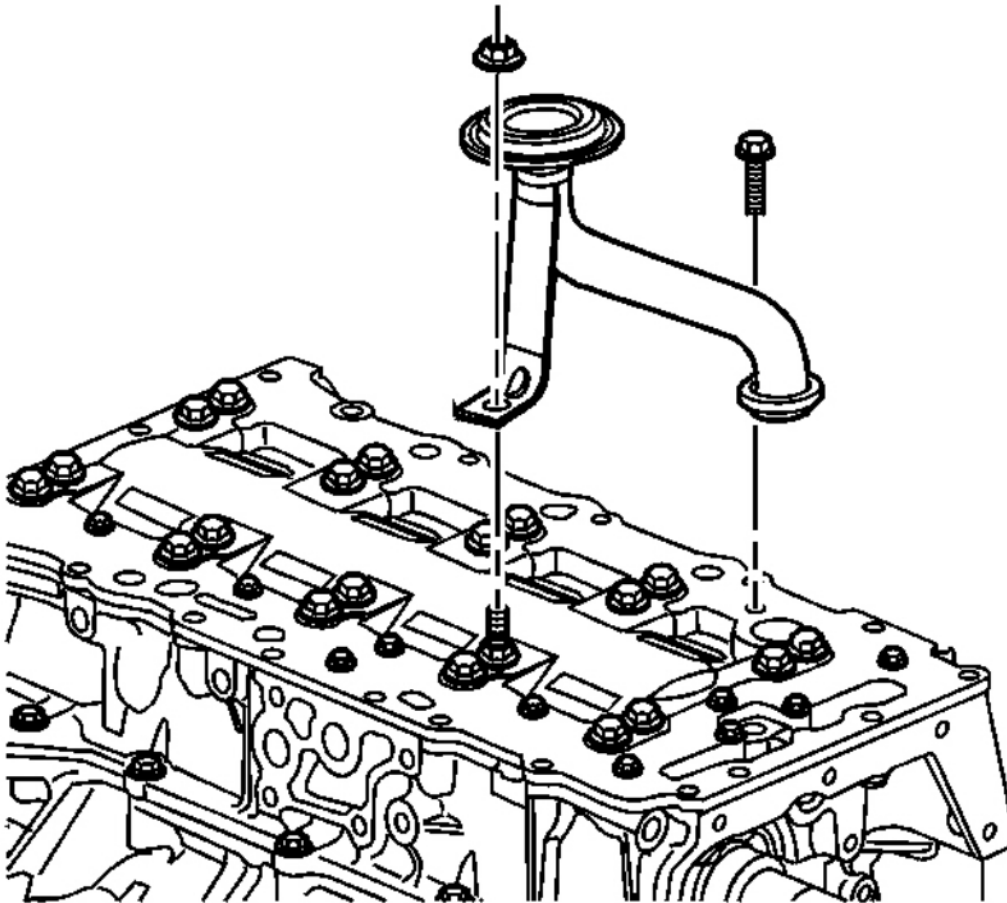


Fig. 212: View Of Oil Pump Pipe
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the oil pump pick-up retaining bolt and nut.

Tighten:

- Tighten the oil pump pick-up tube nut to 24 N.m (18 lb ft).
- Tighten the oil pump pick-up tube bolt to 10 N.m (89 lb in).

OIL PAN INSTALLATION

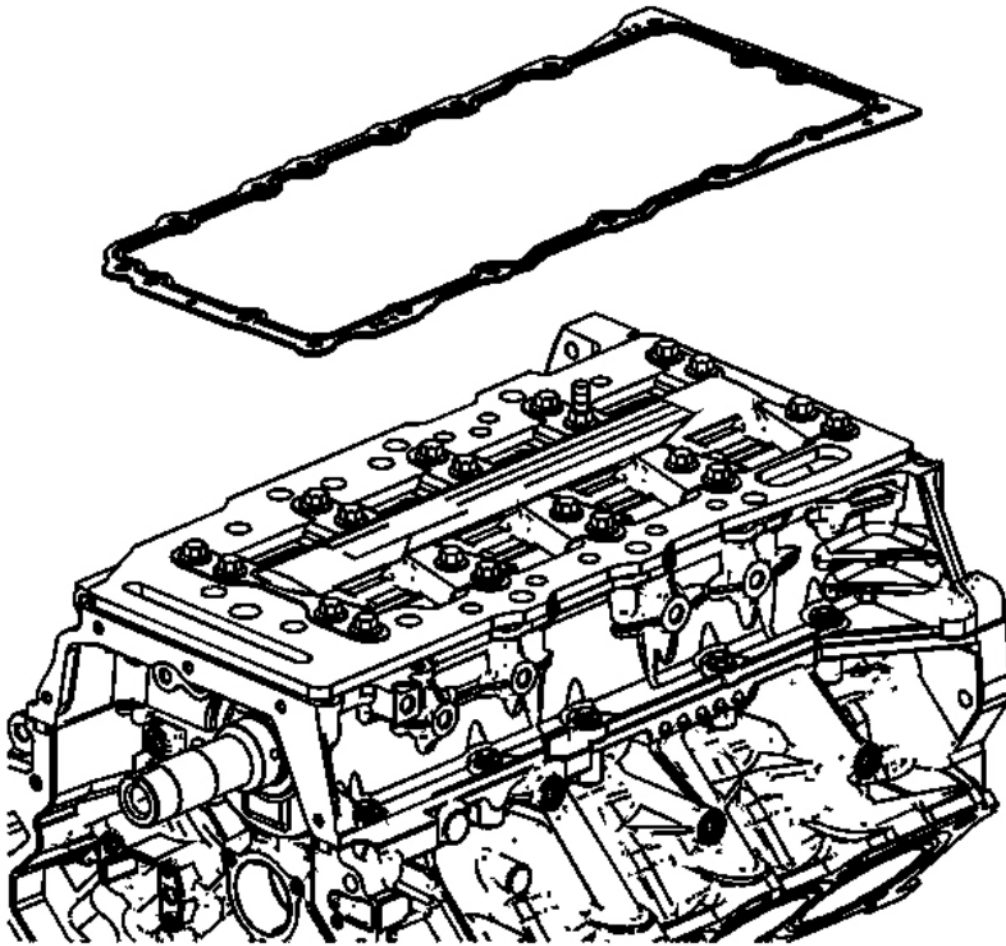


Fig. 213: View Of Oil Pan Gasket
Courtesy of GENERAL MOTORS CORP.

1. Place a NEW oil pan gasket in place on the oil manifold plate.

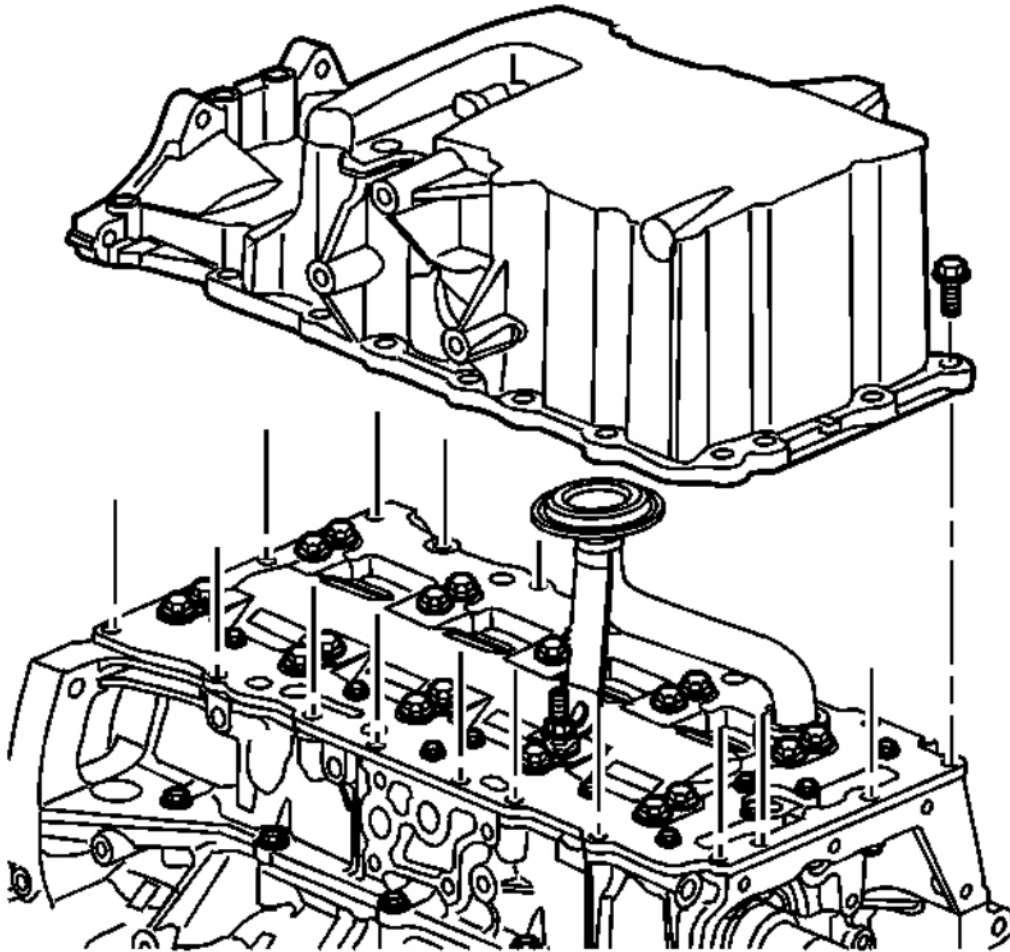


Fig. 214: View Of Oil Pan

Courtesy of GENERAL MOTORS CORP.

2. Position the oil pan onto the lower crankcase.

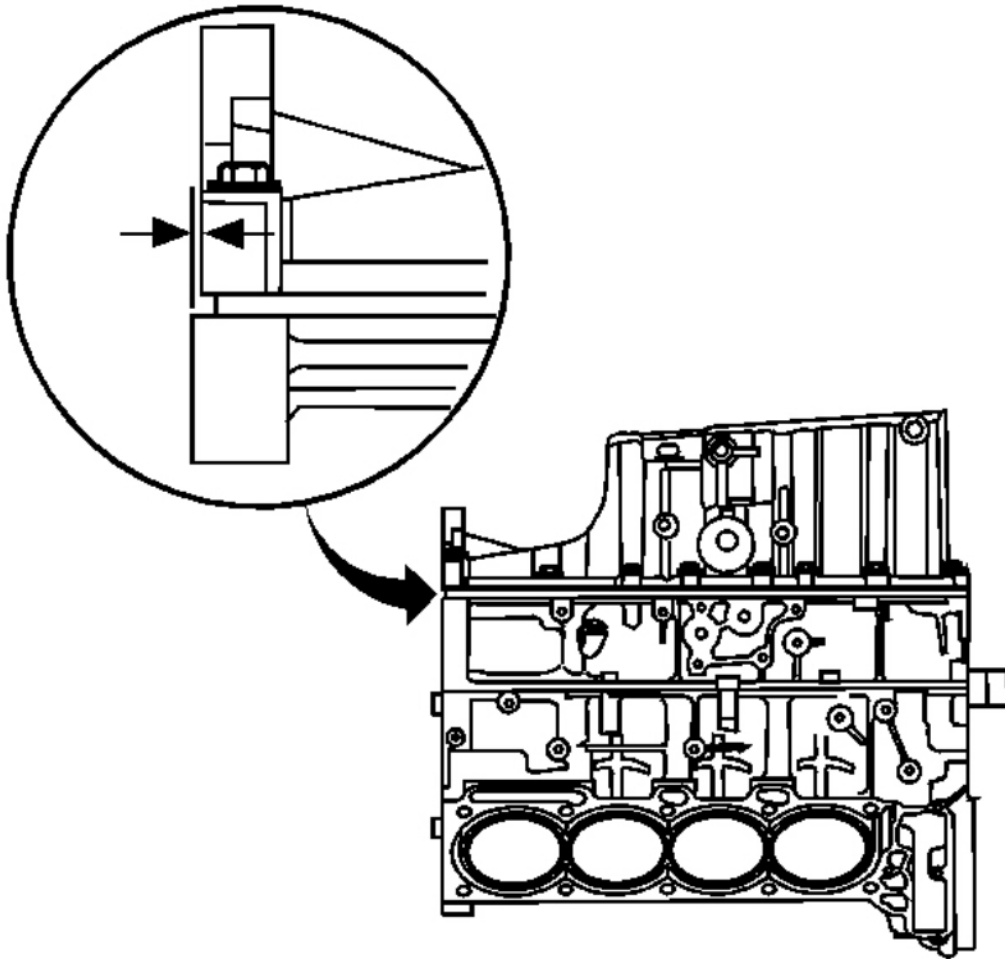


Fig. 215: View Of Proper Oil Pan Seating
Courtesy of GENERAL MOTORS CORP.

3. The oil pan must be held flush to 0.50 mm (0.020 in) forward of the rear face of the engine block.

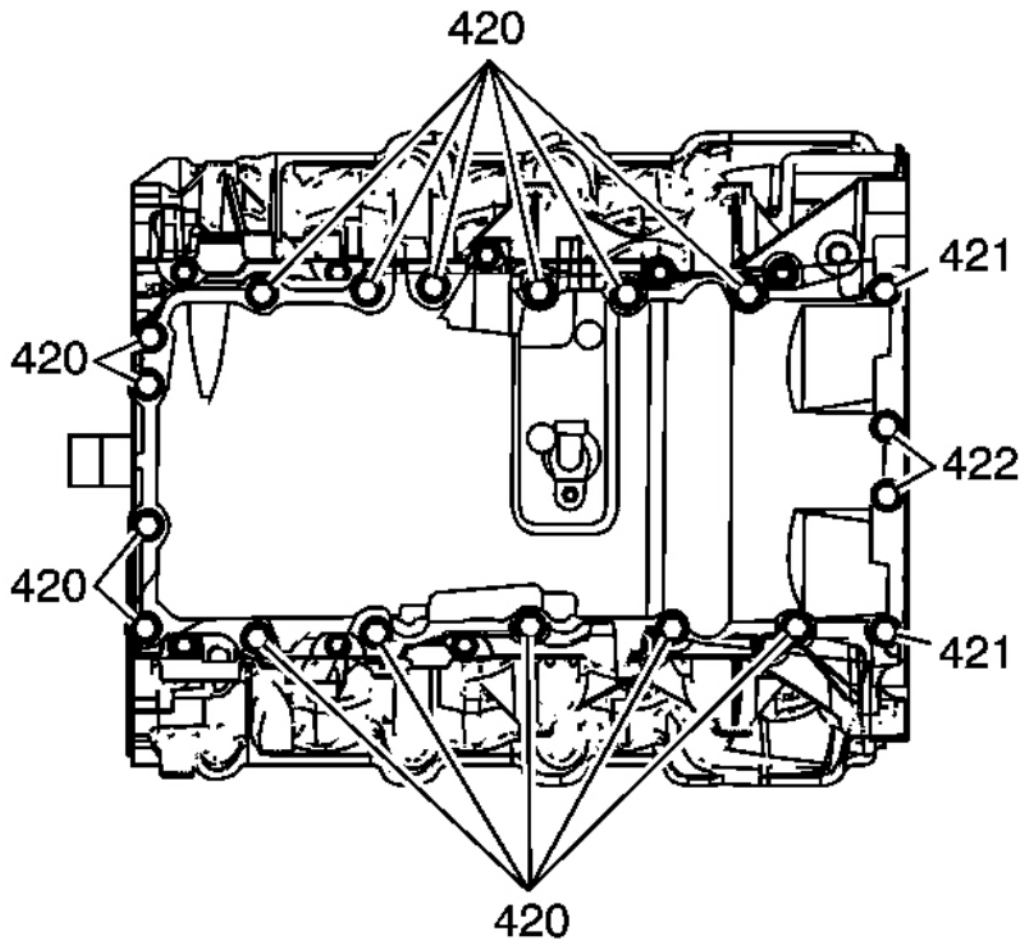


Fig. 216: Locating Oil Pan Fasteners
Courtesy of GENERAL MOTORS CORP.

4. Place oil pan fasteners in location as shown:
 - Short length bolt (420)
 - Medium length bolt (421)
 - Long length bolt (422)

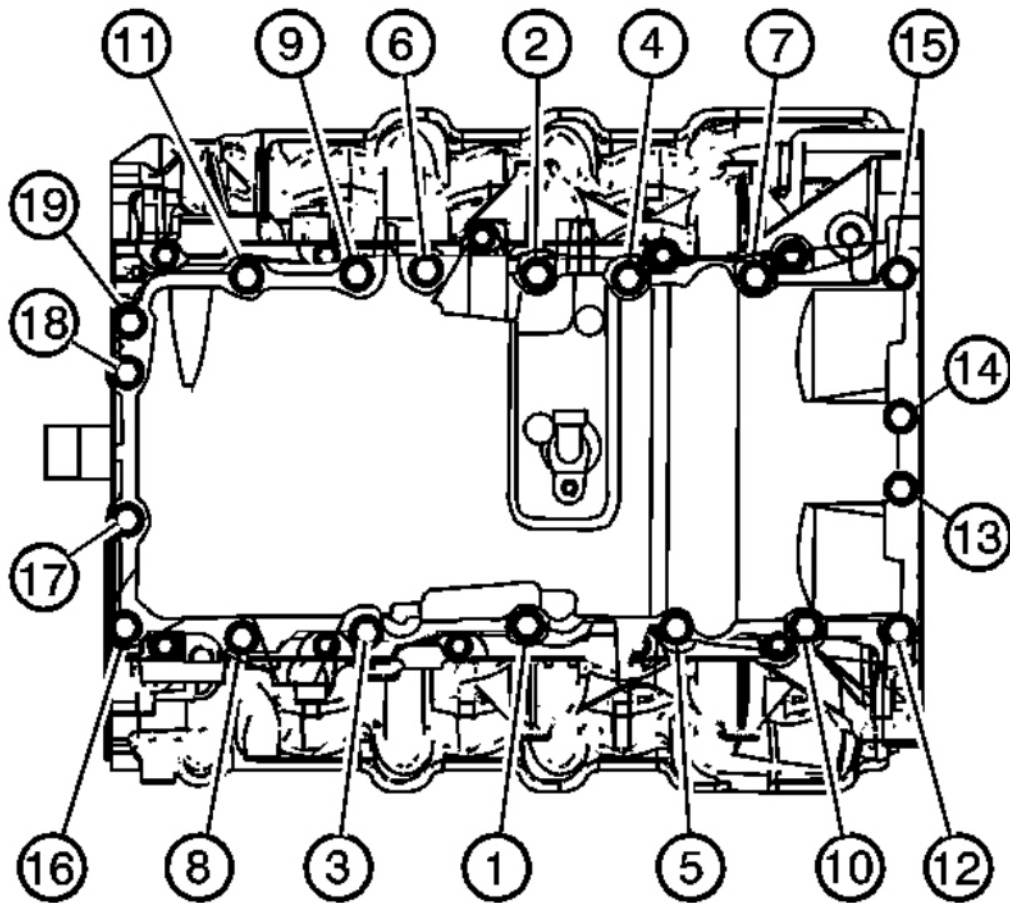


Fig. 217: Tightening Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the oil pan bolts.

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

6. Install the oil drain plug.

Tighten: Tighten the oil drain plug to 20 N.m (15 lb ft).

7. Rotate the engine so that the engine valley is facing upward.

CYLINDER HEAD INSTALLATION - LEFT

Tools Required:

J 45059 Angle Meter

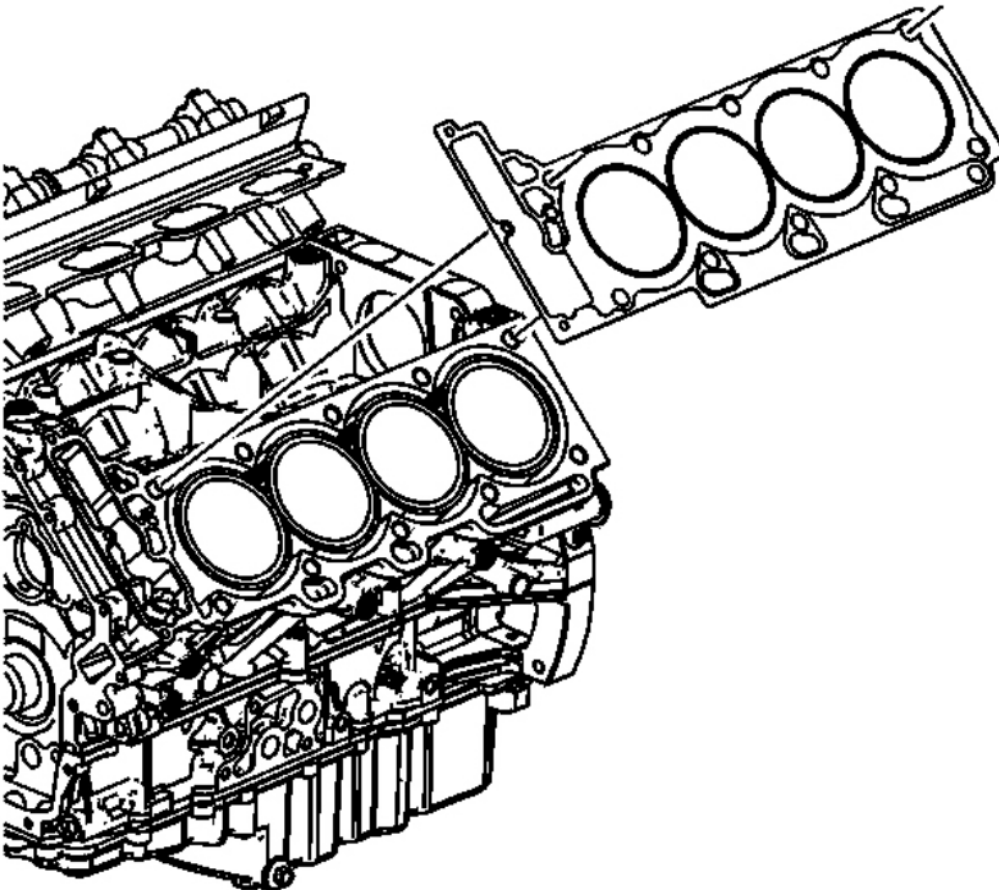


Fig. 218: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

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

IMPORTANT: Failure to remove all the old thread sealant material from the cylinder block could cause false torque readings.

2. Ensure any old thread sealant material is removed from the cylinder head bolt holes in the cylinder block.
3. Install a new left cylinder head gasket using the deck face locating pins for retention.

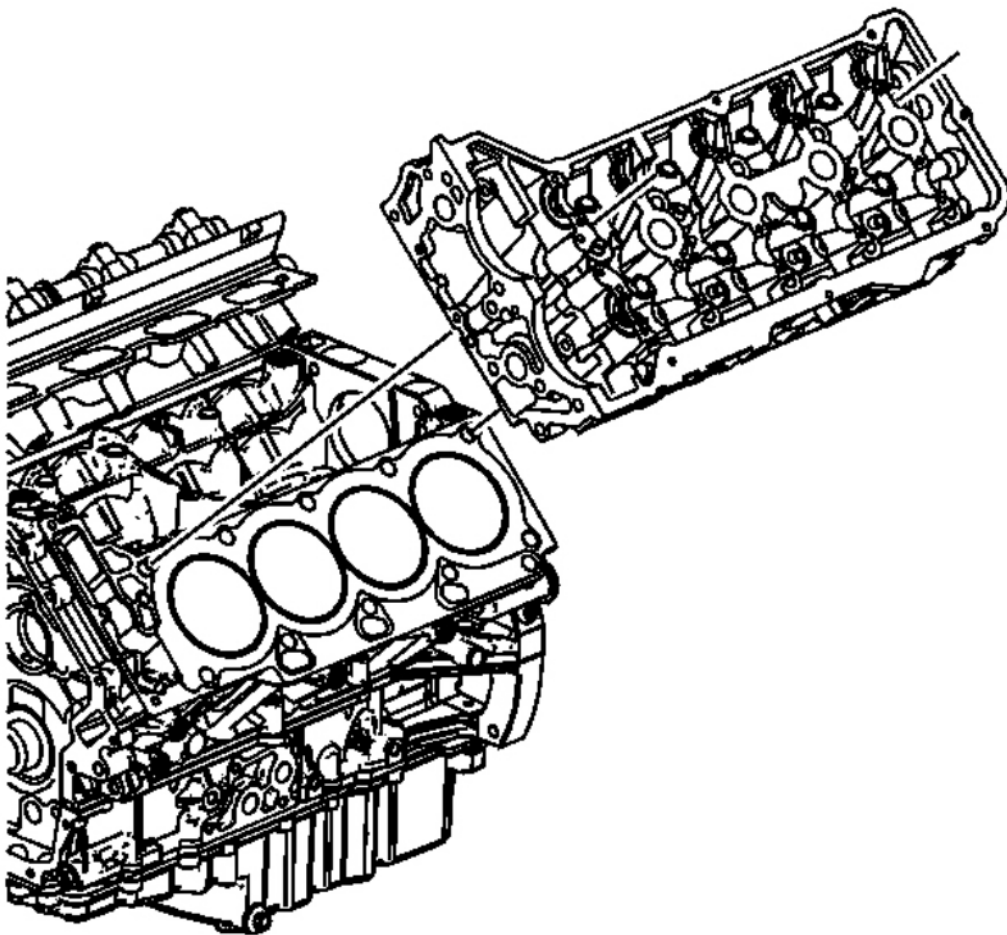


Fig. 219: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

4. Align the cylinder head with the deck face locating pins.

5. Place the cylinder head in position on the deck face.

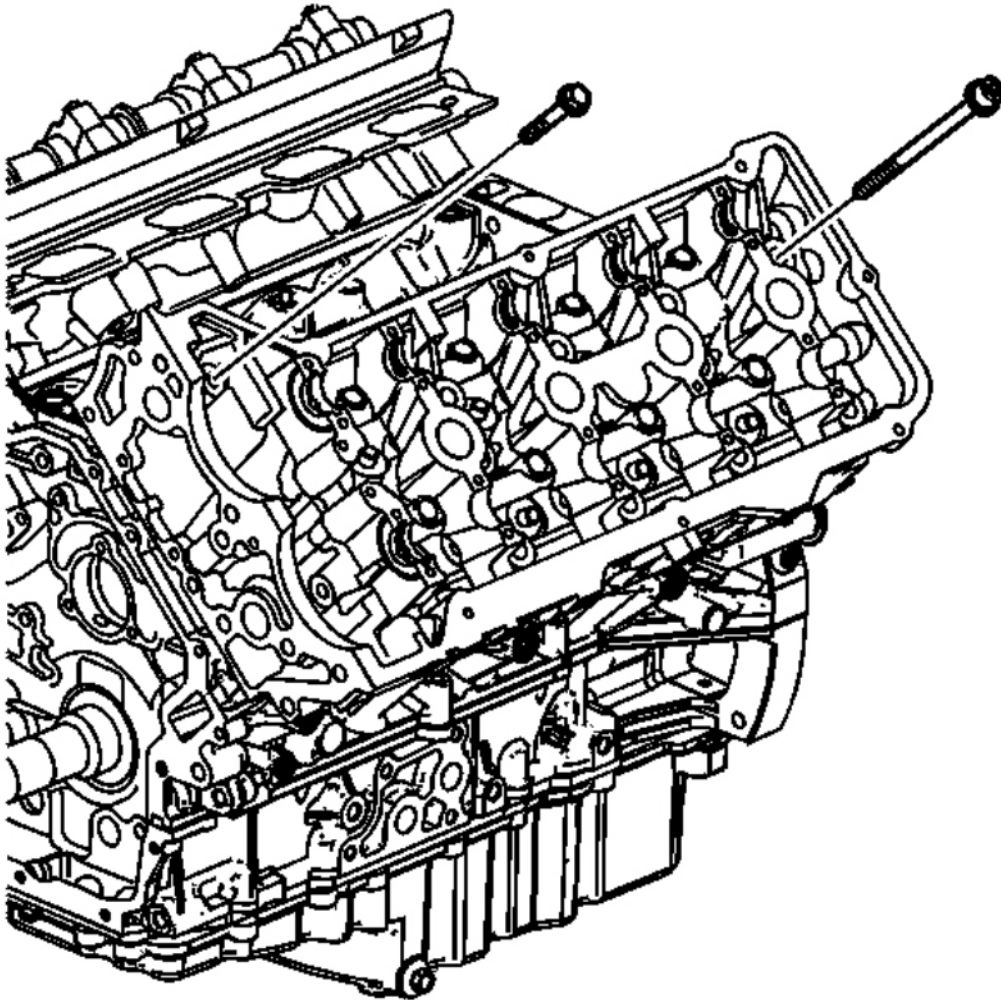


Fig. 220: View Of M11 & M6 Left Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

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

6. Install new M11 cylinder head bolts in the cylinder head.
7. Install the M6 cylinder head bolts at the front of the cylinder head.

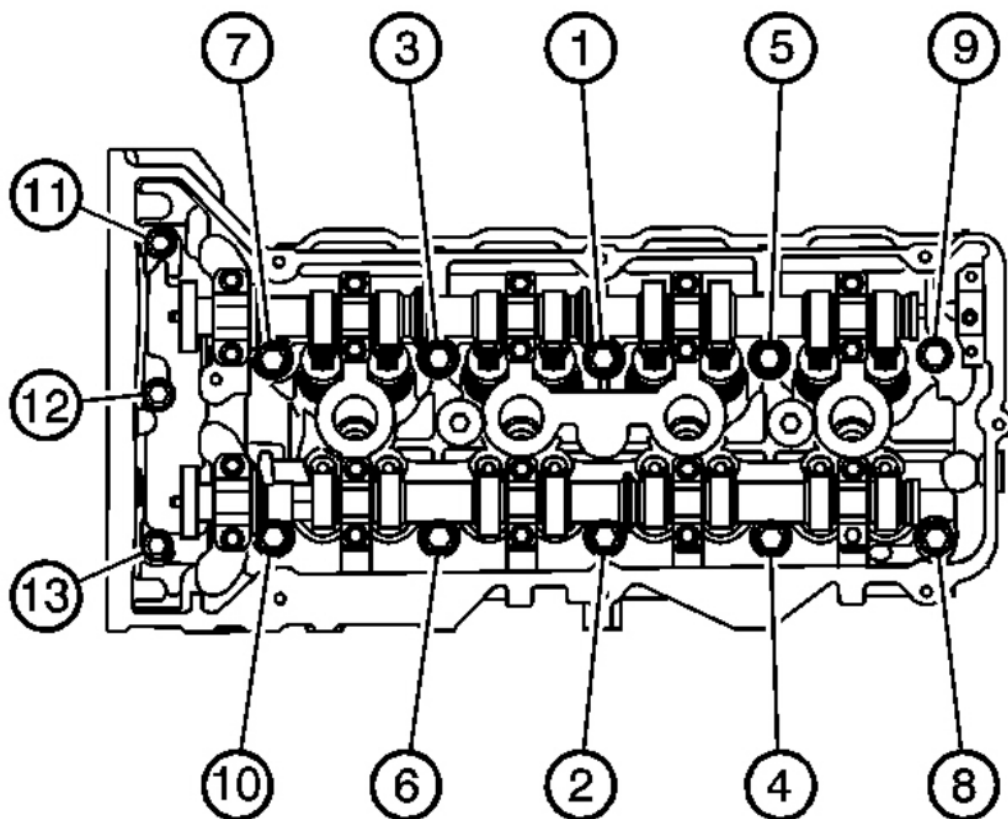


Fig. 221: Tightening Left Cylinder Head Bolts

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

NOTE: Ensure the cylinder head bolts that are being used are the proper pitch or engine damage will occur. The thread pitch on the M11 cylinder head bolts and the engine block cylinder head bolt holes have been revised. In order to prevent engine damage it is important to identify which thread pitch is being used. Cylinder head bolts with a pitch of 1.5 mm have a thread length of about 48 mm (1.890 in) long. Cylinder head bolts with a pitch of 2.0 mm have a thread length of about 67 mm (2.638 in) long.

8. Tighten the left cylinder head bolts in the sequence shown.

1. First Pass

Tighten: Tighten the left cylinder head M11 cylinder head bolts to 30 N.m (22 lb ft) in the sequence shown.

2. Second Pass

Tighten: Using the **J 45059** , tighten the left cylinder head M11 cylinder head bolts an additional 60 degrees in the sequence shown.

3. Third Pass

Tighten: Repeat the sequence turning each bolt another 60 degrees.

4. Final Pass

Tighten: Repeat the sequence again turning each bolt a final 60 degrees, total 180 degrees.

9. Tighten the M6 bolts at the front of the cylinder head.

Tighten: Tighten the M6 cylinder head bolts to 12 N.m (106 lb in).

VALVE LIFTER INSTALLATION - LEFT

Tools Required:

J 39946 Crankshaft Socket - 4.0L and 4.6L

1. Ensure the crankshaft is in the TDC position for the number one cylinder using the **J 39946** .

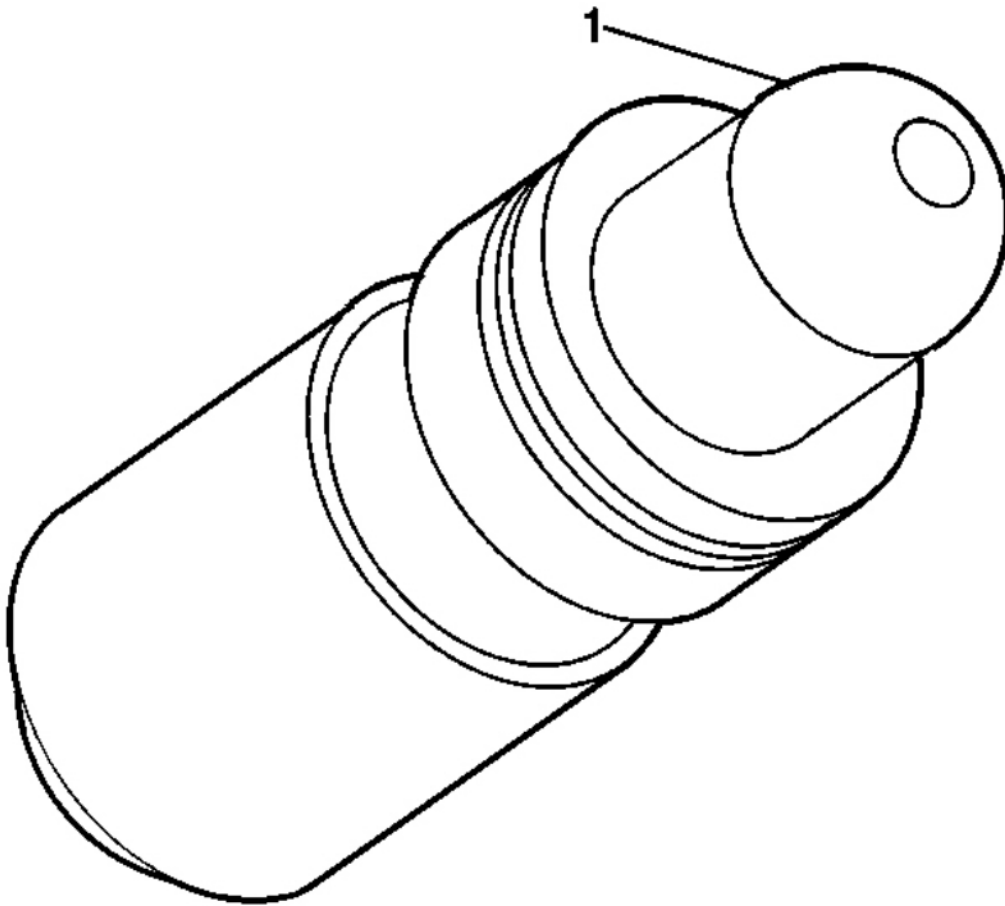


Fig. 222: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Valve Lifter Priming Notice in Cautions and Notices.

2. 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.
3. Lubricate the SHLA bores of the cylinder head with clean engine oil GM P/N 12378006 or equivalent.

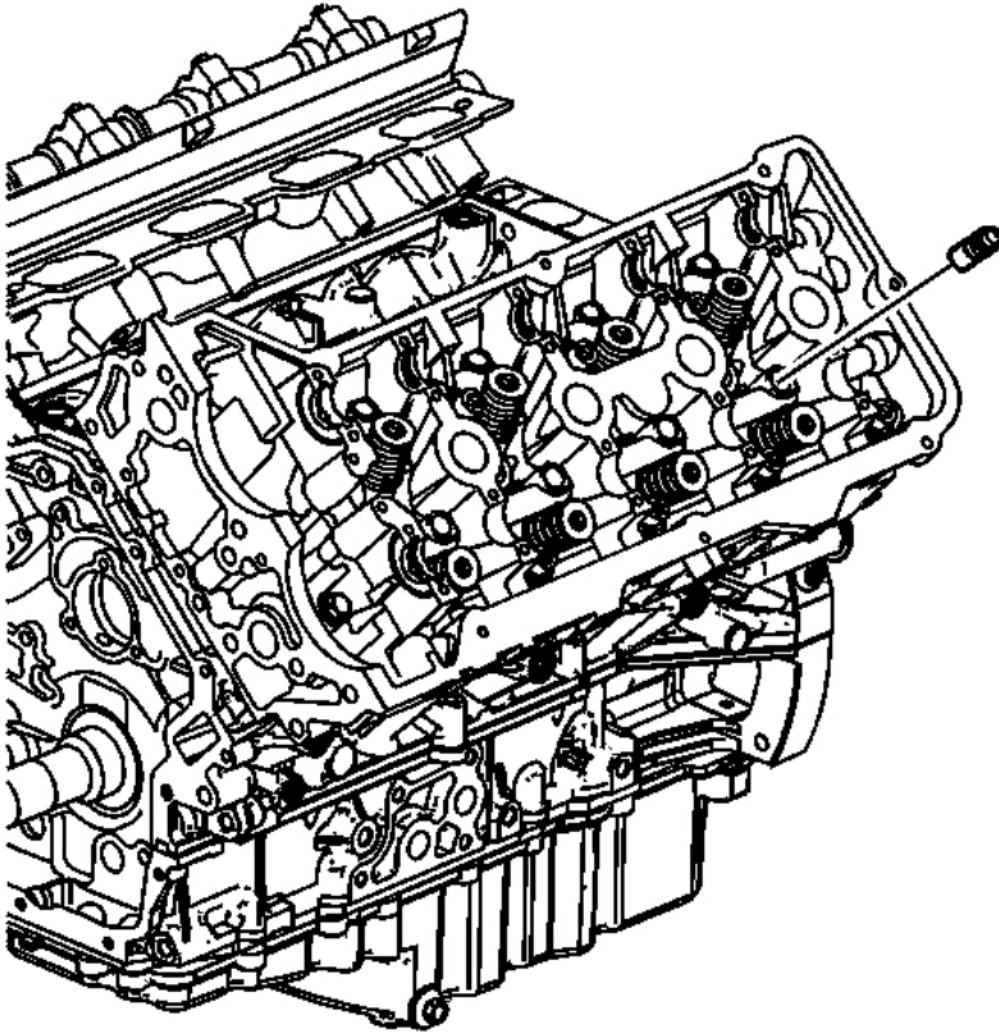


Fig. 223: View Of Left SHLAs
Courtesy of GENERAL MOTORS CORP.

4. Install the SHLAs.
5. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the SHLA sphere.

VALVE ROCKER ARM INSTALLATION - LEFT

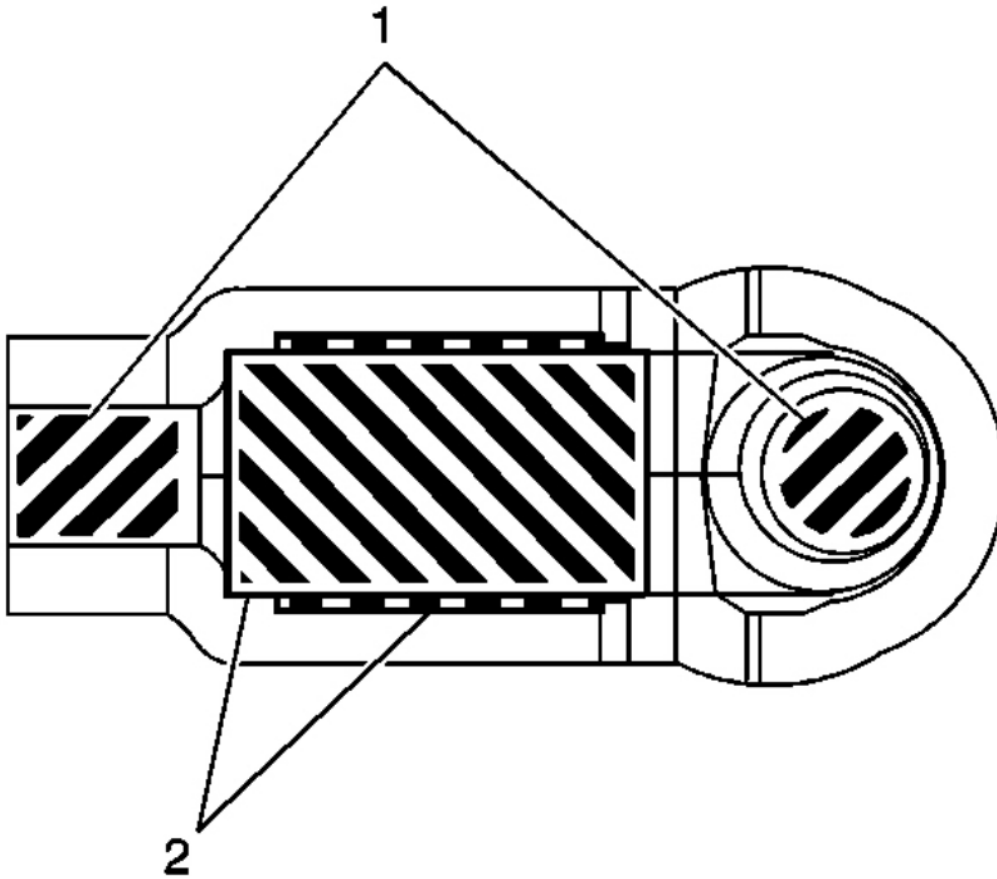


Fig. 224: Identifying Roller Pivot Pocket (2) & Valve Slot Areas (1) Of Camshaft Followers

Courtesy of GENERAL MOTORS CORP.

1. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the roller (2), pivot pocket and valve slot areas (1) of the camshaft followers.

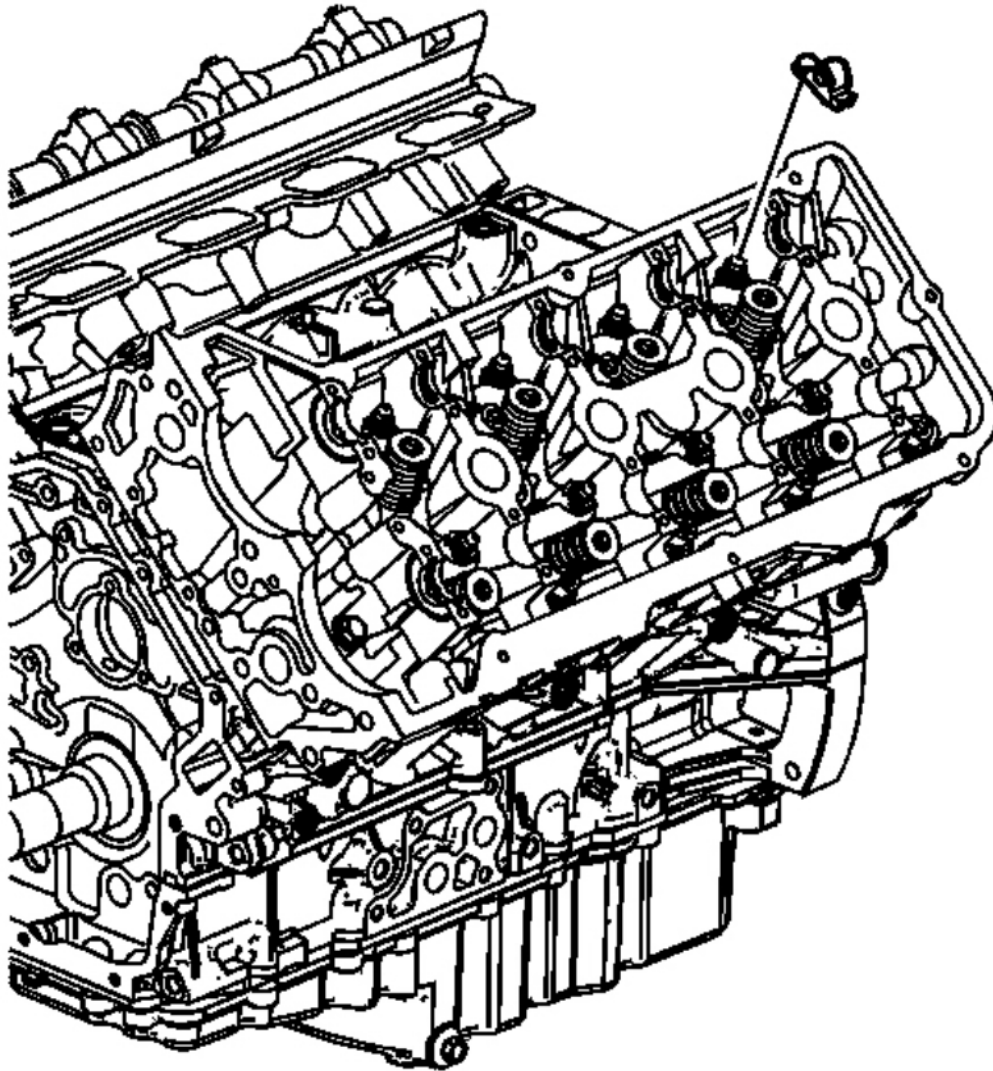


Fig. 225: View Of Left Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

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 SHLA. The rounded head of the follower goes on the SHLA while the flat end goes on the valve tip.

CAMSHAFT INSTALLATION - LEFT EXHAUST

Tools Required:

J 45059 Angle Meter

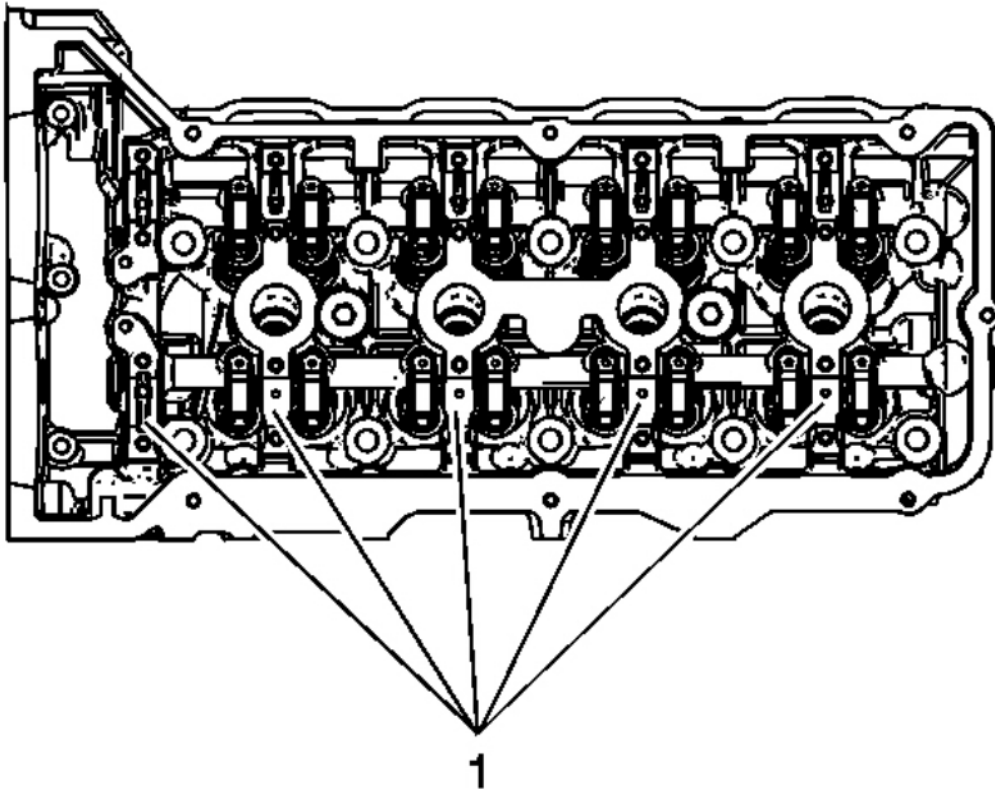


Fig. 226: Locating Left Exhaust Camshaft Bearing Journals
Courtesy of GENERAL MOTORS CORP.

1. Clean the camshaft journals, camshaft and the camshaft caps with a clean, lint-free cloth.
2. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft bearing journals (1).

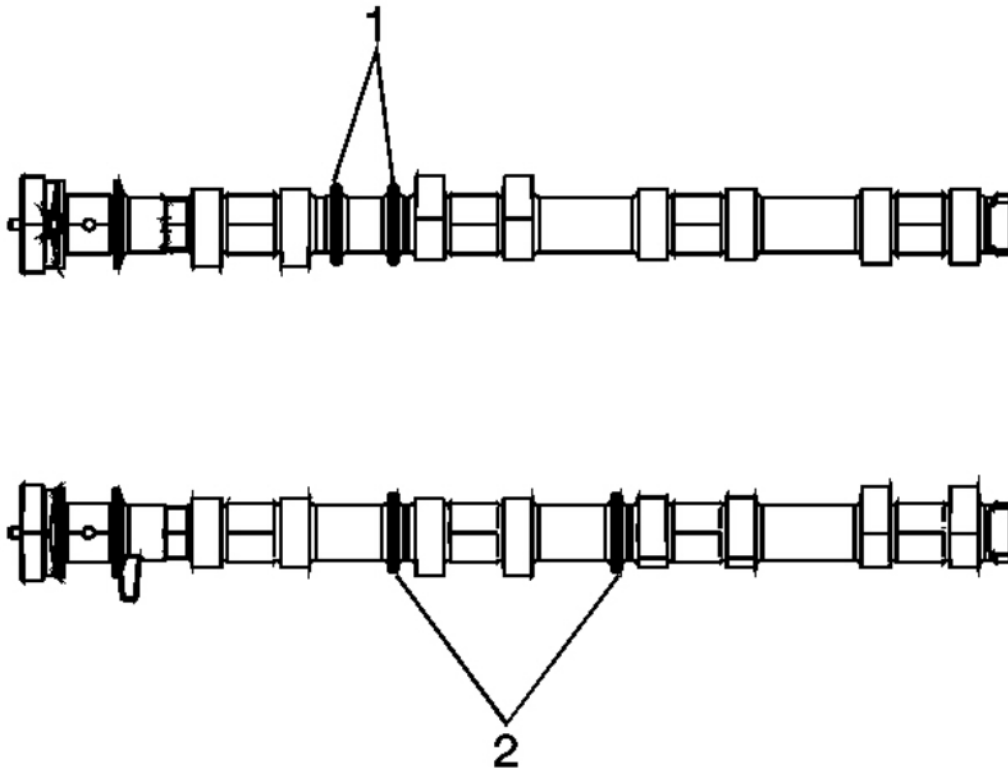


Fig. 227: Locating Left Camshaft Identifying Rings
Courtesy of GENERAL MOTORS CORP.

3. Select the proper camshaft by the identifying rings cast into the left exhaust camshaft (2).

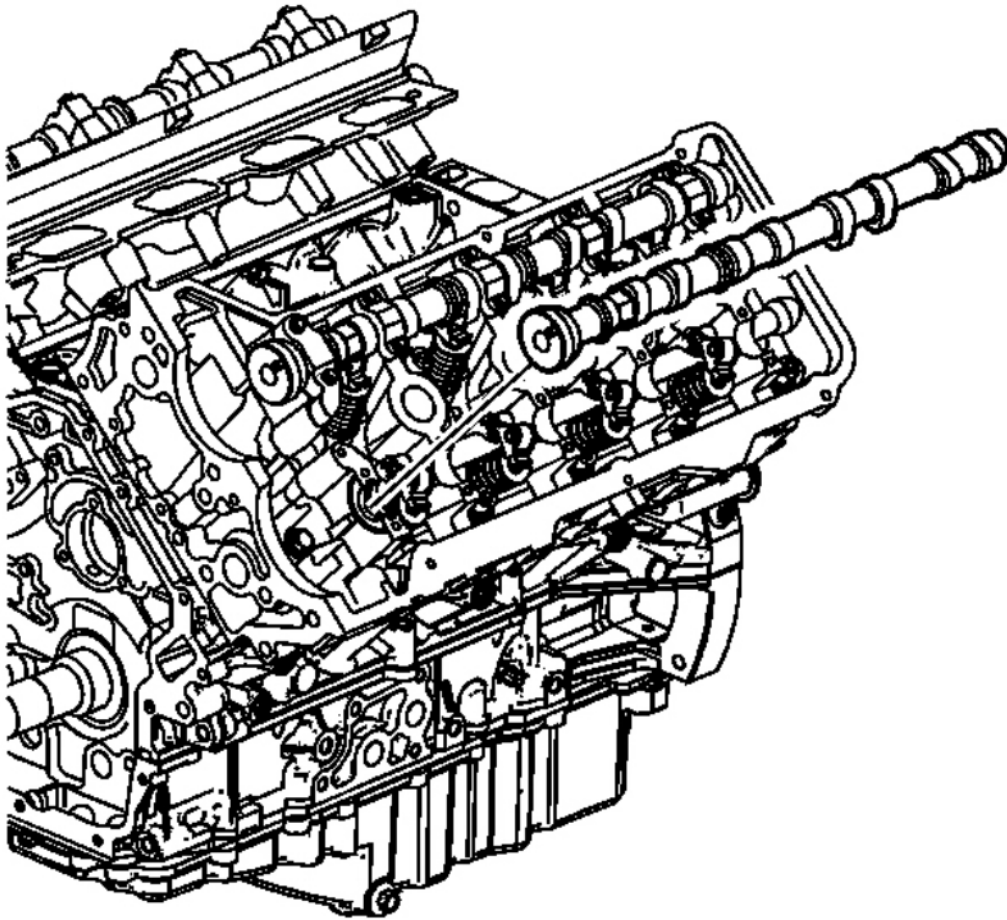


Fig. 228: View Of Left Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft lobes and the camshaft journals.

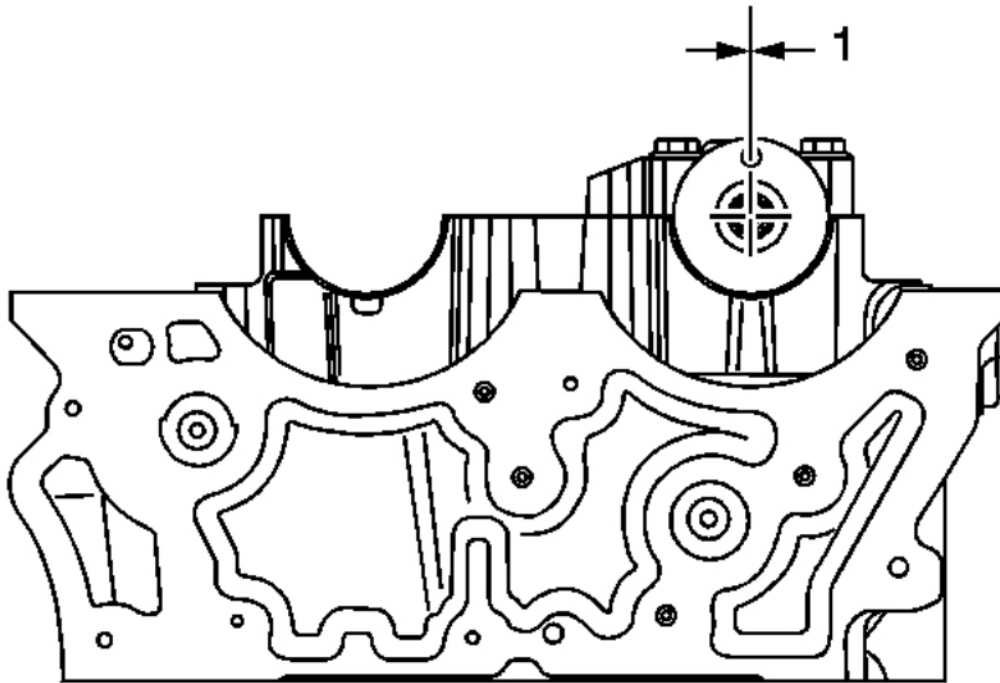


Fig. 229: Aligning Left Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

5. Place the camshaft in the camshaft journals with the camshaft sprocket drive pins near the top of their rotation (1) and the camshaft lobes in a neutral position. The camshaft can be identified by a stamping near the rear journal. For example: L-EXH is defined as Left Bank Exhaust.

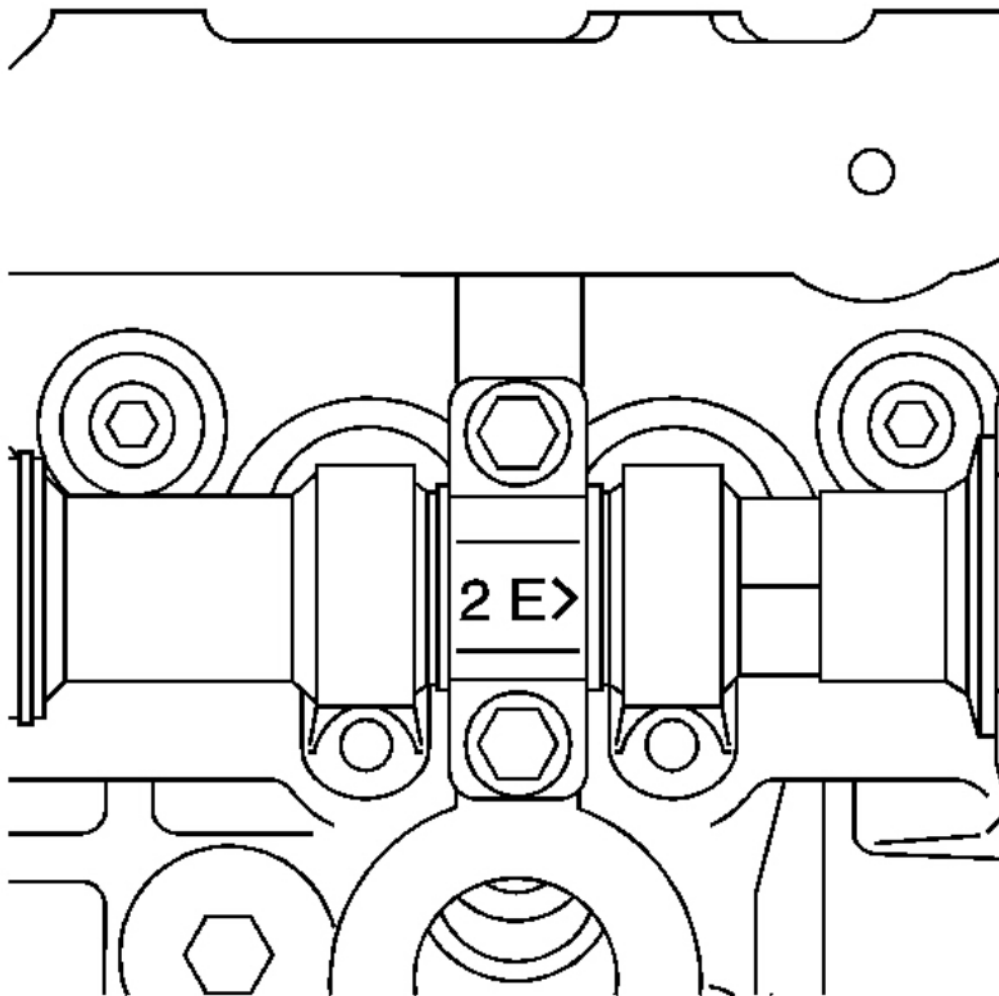


Fig. 230: View Of Exhaust Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

6. Observe the markings on the camshaft bearing caps. Each camshaft bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The arrow should point toward the front of the engine.
 - The number indicates the position from the front of the engine.
 - The "E" indicates the exhaust camshaft.
7. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the left exhaust

camshaft bearing cap journals.

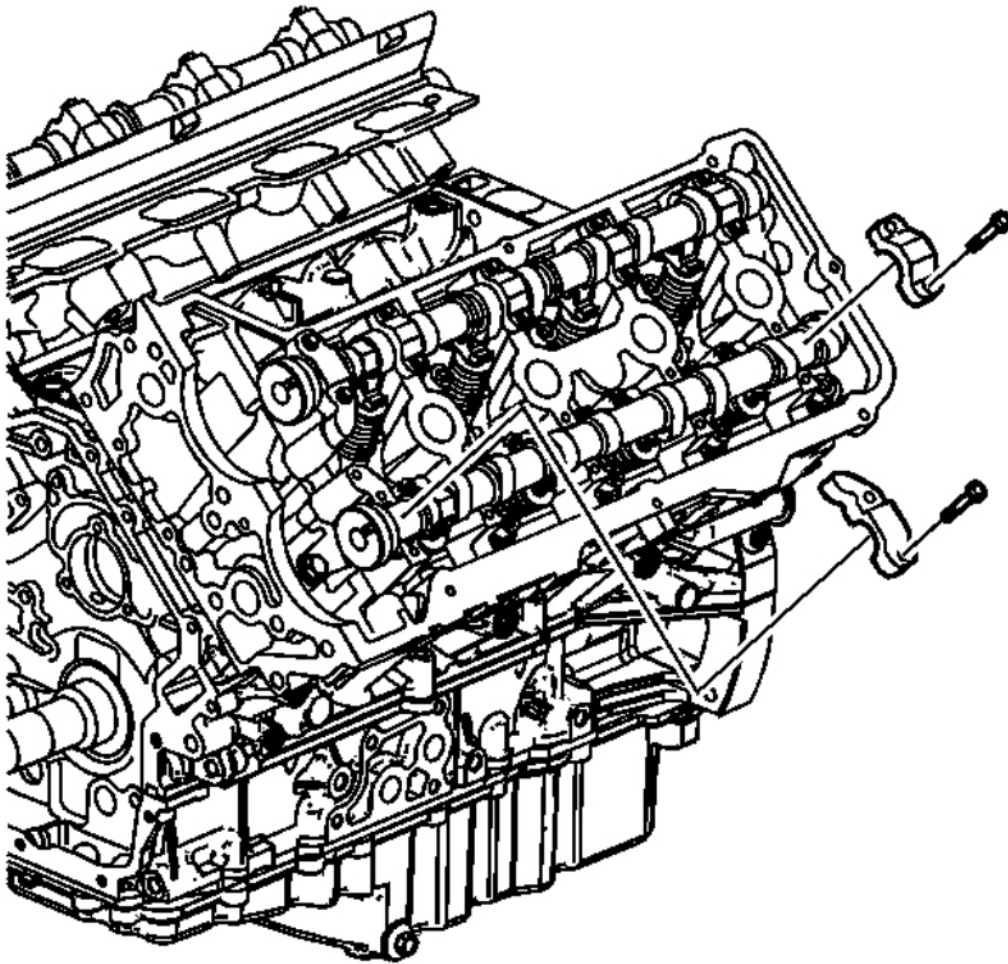


Fig. 231: View Of Left Exhaust Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

8. Install the left exhaust camshaft bearing caps according to the identifications marks.
9. Hand start all the left exhaust camshaft bearing cap bolts.

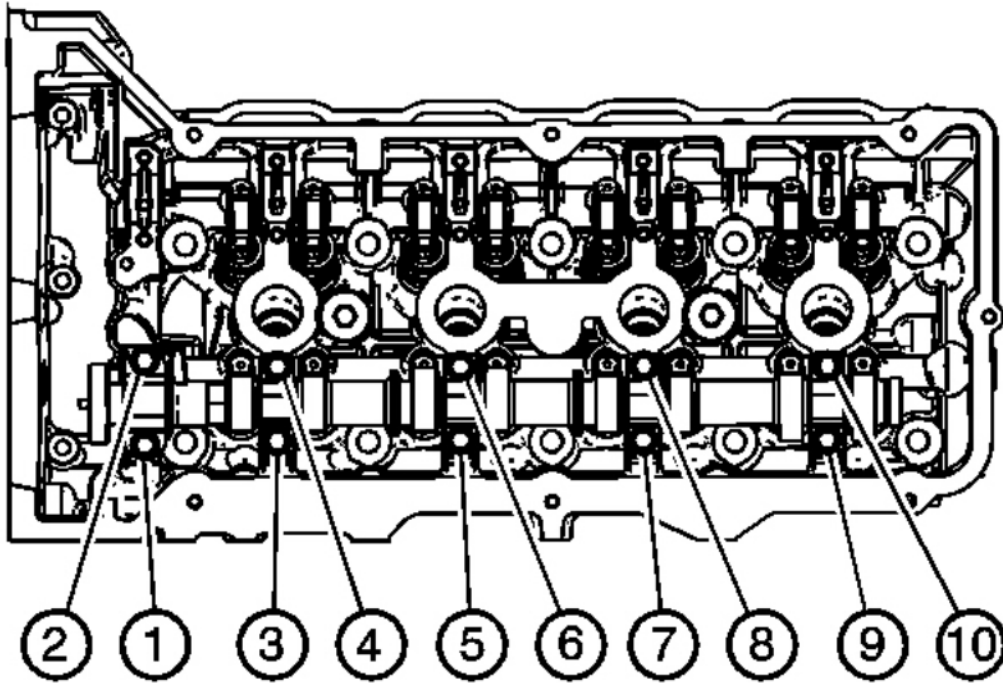


Fig. 232: Tightening Left Cylinder Head Exhaust Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

10. Install the left cylinder head exhaust camshaft bearing cap bolts.

1. First Pass

Tighten: Tighten the camshaft bearing cap bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the camshaft bearing cap bolts an additional 30 degrees using the **J 45059** .

CAMSHAFT INSTALLATION - LEFT INTAKE

Tools Required:

J 45059 Angle Meter

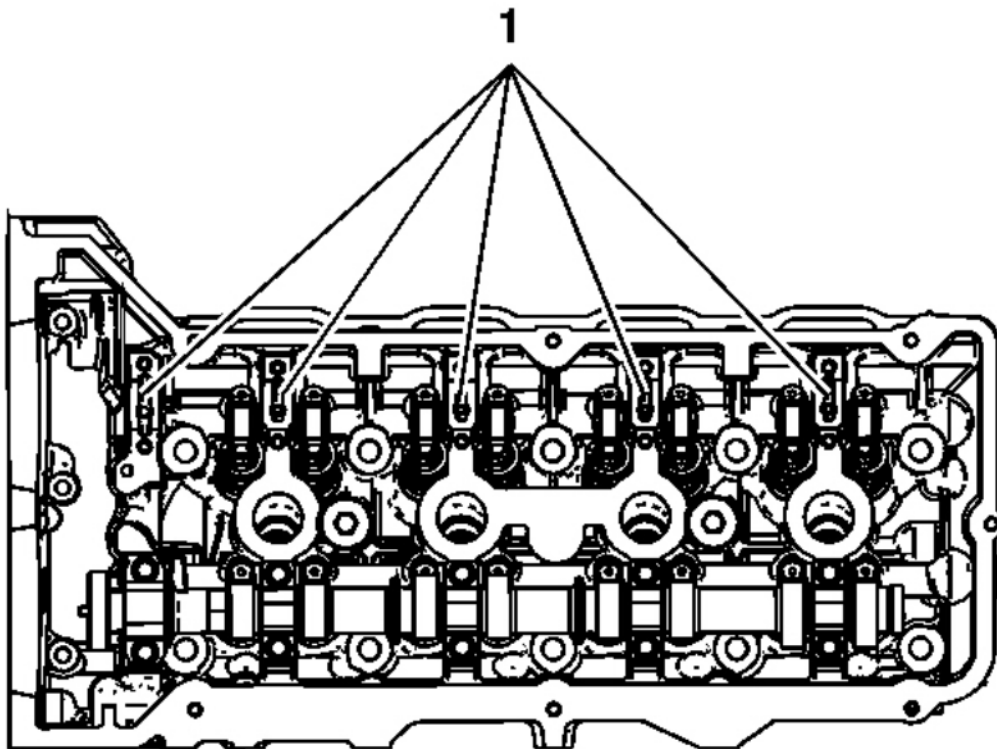


Fig. 233: Locating Left Intake Camshaft Bearing Journals
Courtesy of GENERAL MOTORS CORP.

1. Clean the camshaft journals, camshaft and the camshaft caps with a clean, lint-free cloth.
2. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft bearing journals (1).

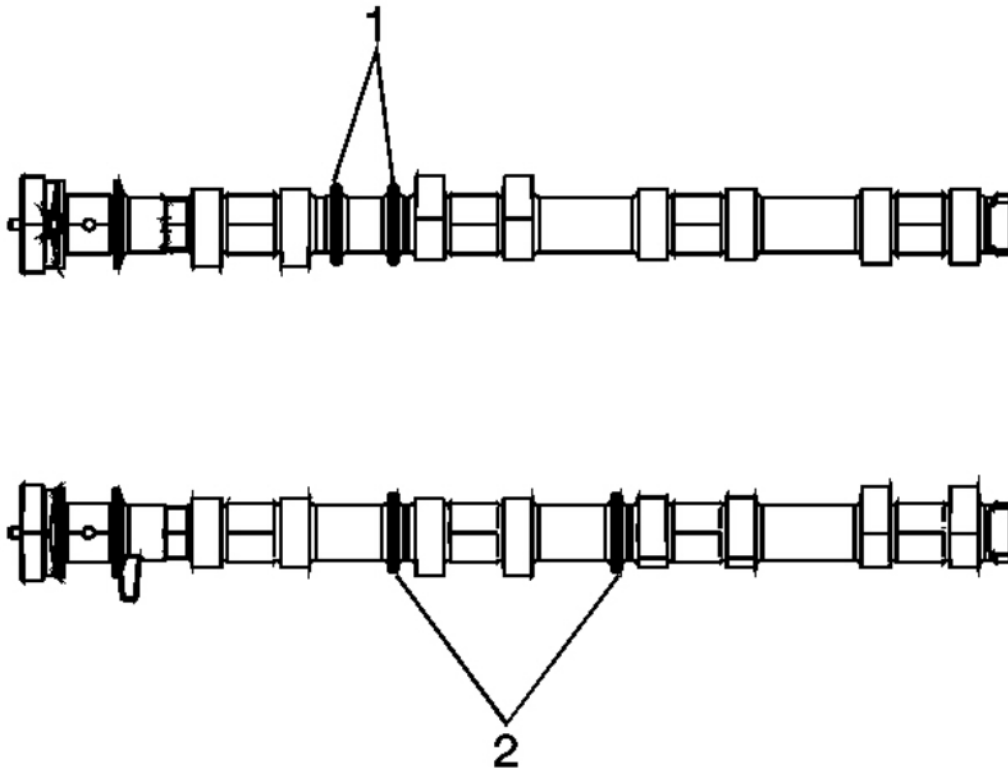


Fig. 234: Locating Left Camshaft Identifying Rings
Courtesy of GENERAL MOTORS CORP.

3. Select the proper camshaft by the identifying rings cast into the left intake camshaft (1).

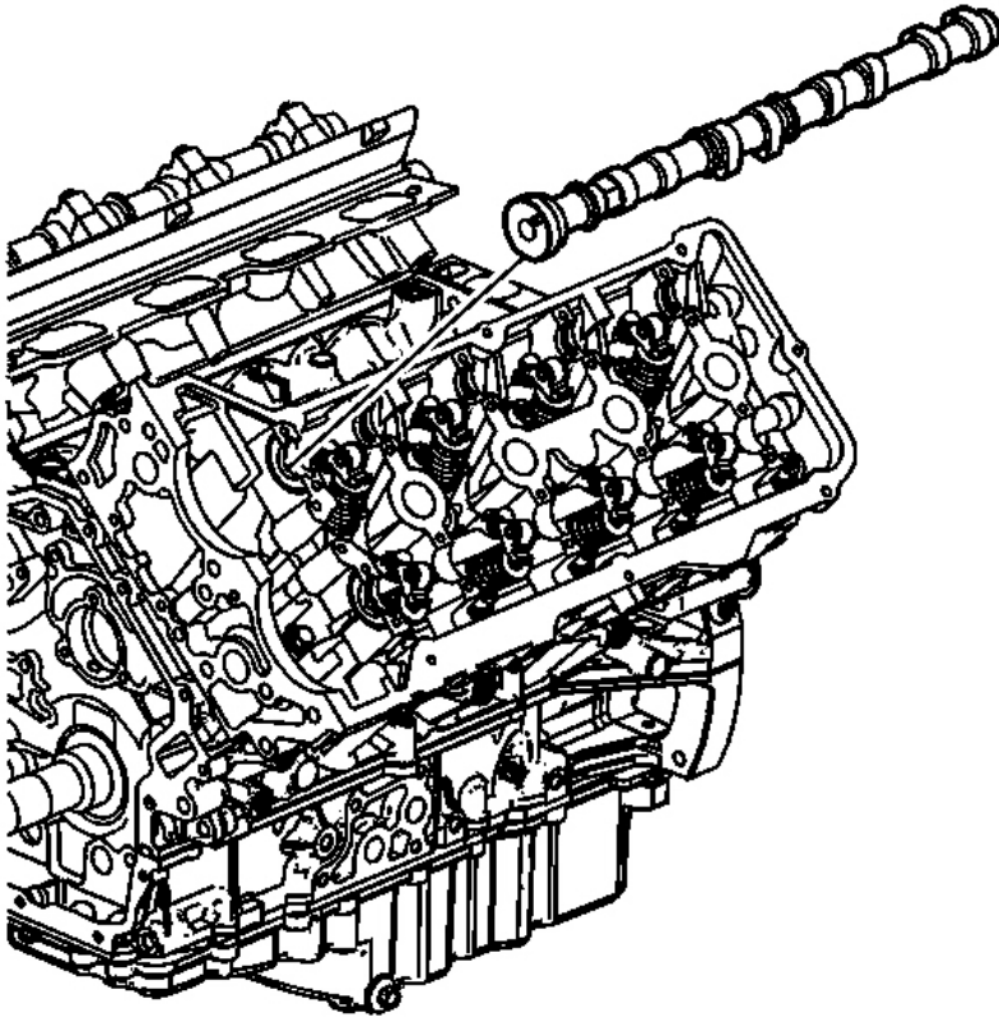


Fig. 235: View Of Left Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft lobes and the camshaft journals.

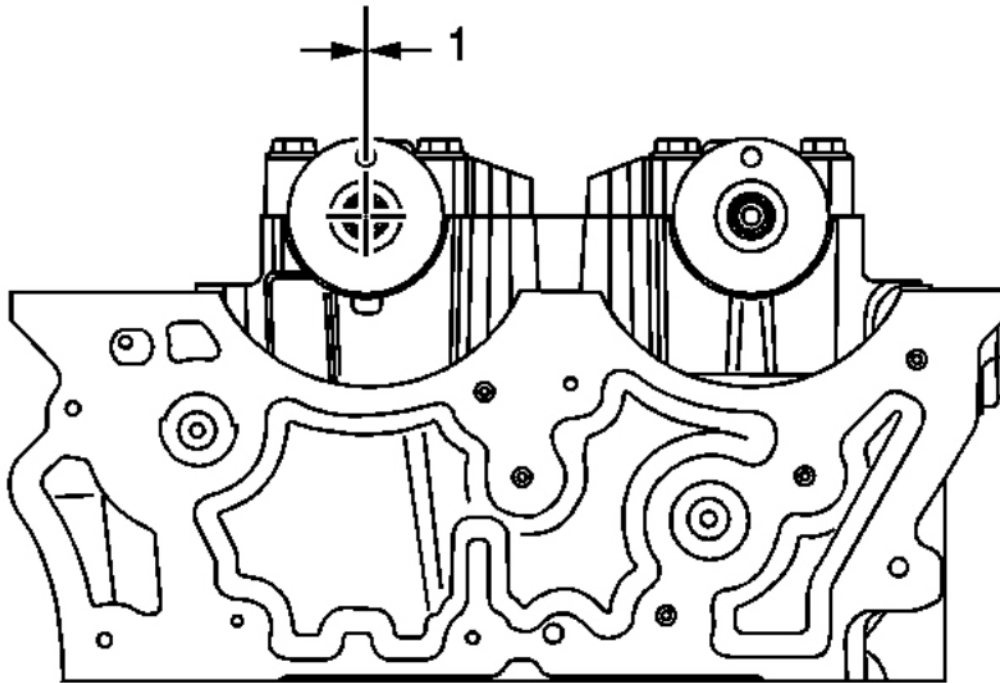


Fig. 236: Aligning Left Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

5. Place the camshaft in the camshaft journals with the camshaft sprocket drive pins near the top of their rotation (1) and the camshaft lobes in a neutral position. The camshaft can be identified by a stamping near the rear journal. For example: L-INT is defined as Left Bank Intake.

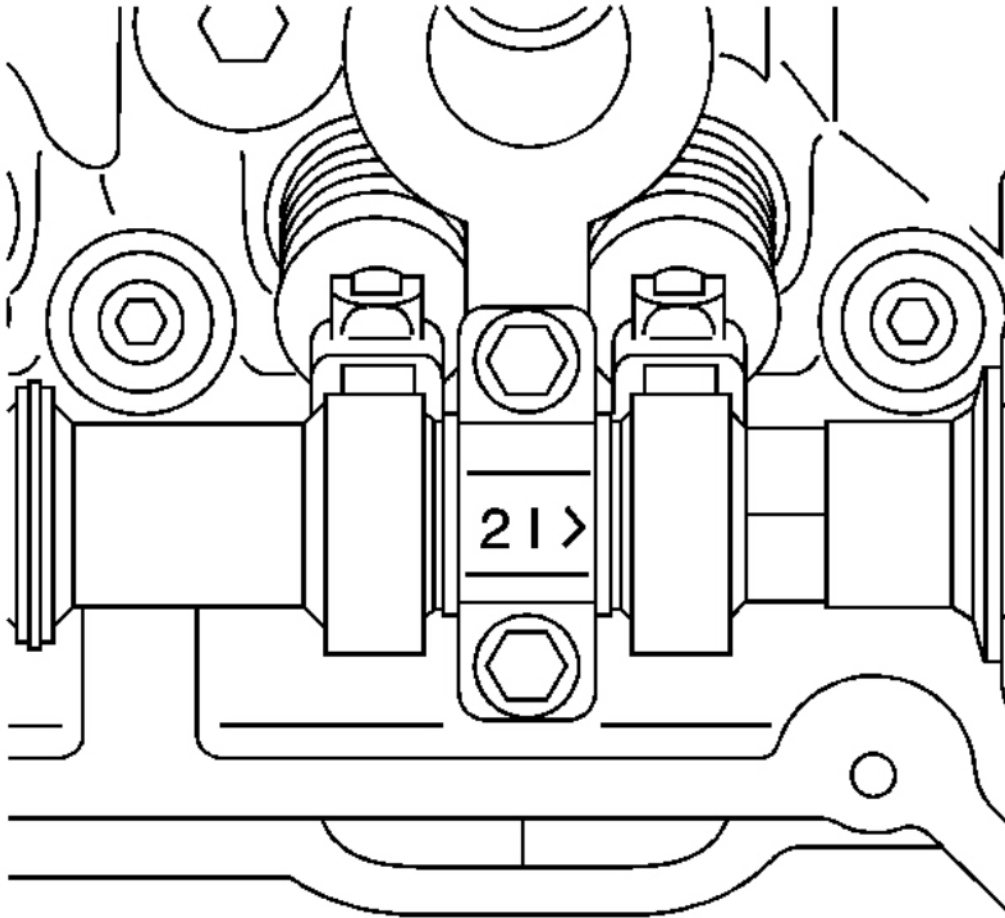


Fig. 237: View Of Left Intake Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

6. Observe the markings on the camshaft bearing caps. Each camshaft bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The arrow should point toward the front of the engine.
 - The number indicates the position from the front of the engine.
 - The "I" indicates the intake camshaft.
7. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the left intake camshaft bearing cap journals.

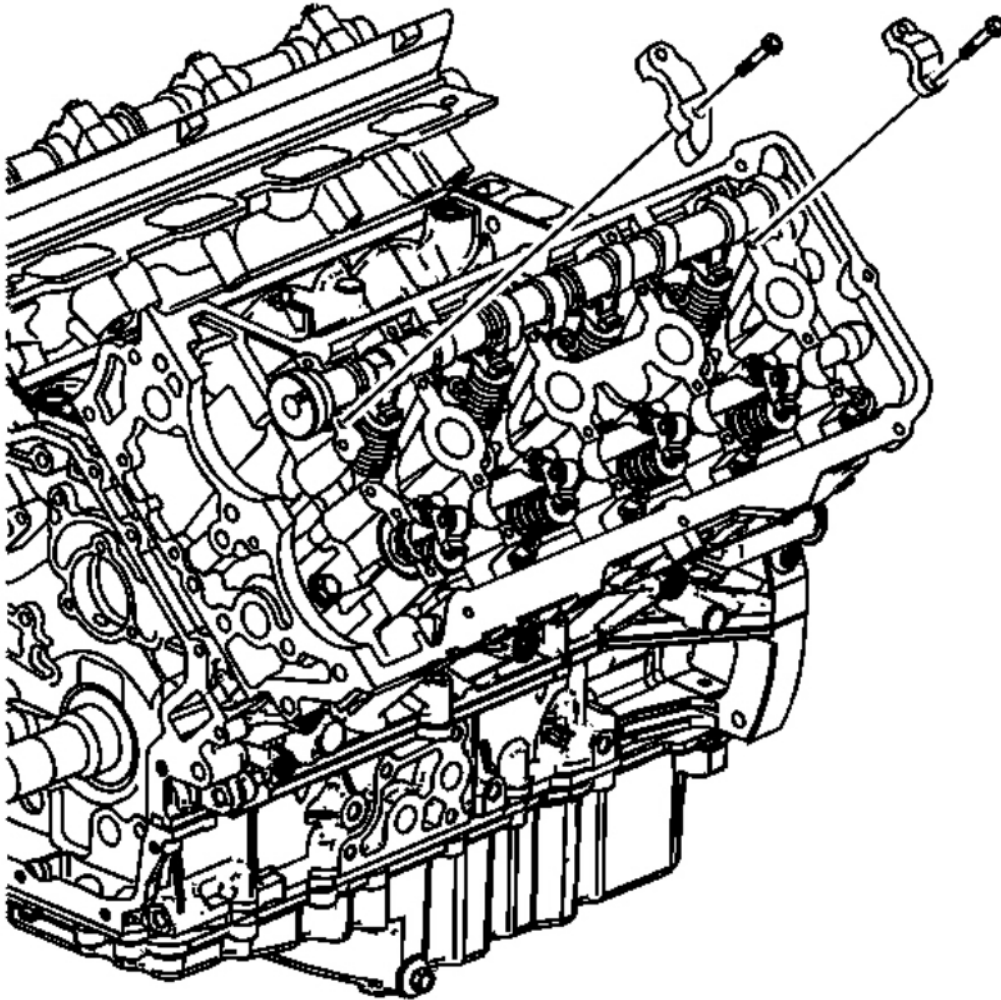


Fig. 238: View Of Left Intake Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

8. Install the left intake camshaft bearing caps according to the identifications marks.
9. Hand start all the left intake camshaft bearing cap bolts.

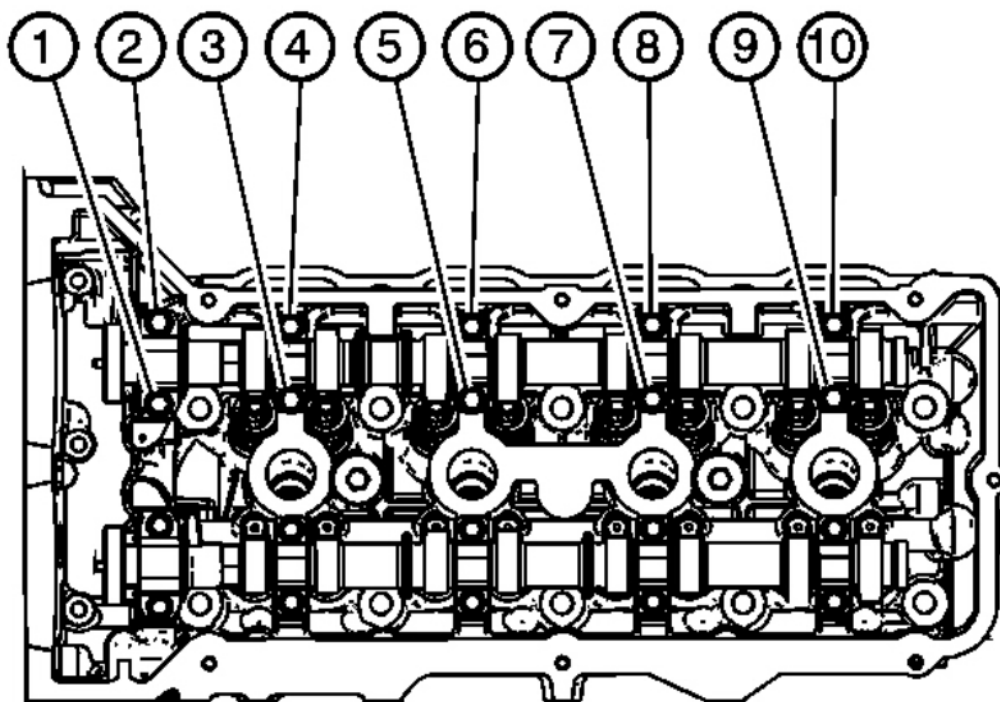


Fig. 239: Tightening Left Cylinder Head Intake Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

10. Install the left cylinder head intake camshaft bearing cap bolts.

1. First Pass

Tighten: Tighten the camshaft bearing cap bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the camshaft bearing cap bolts an additional 30 degrees using the **J 45059** .

CYLINDER HEAD INSTALLATION - RIGHT

Tools Required:

J 45059 Angle Meter

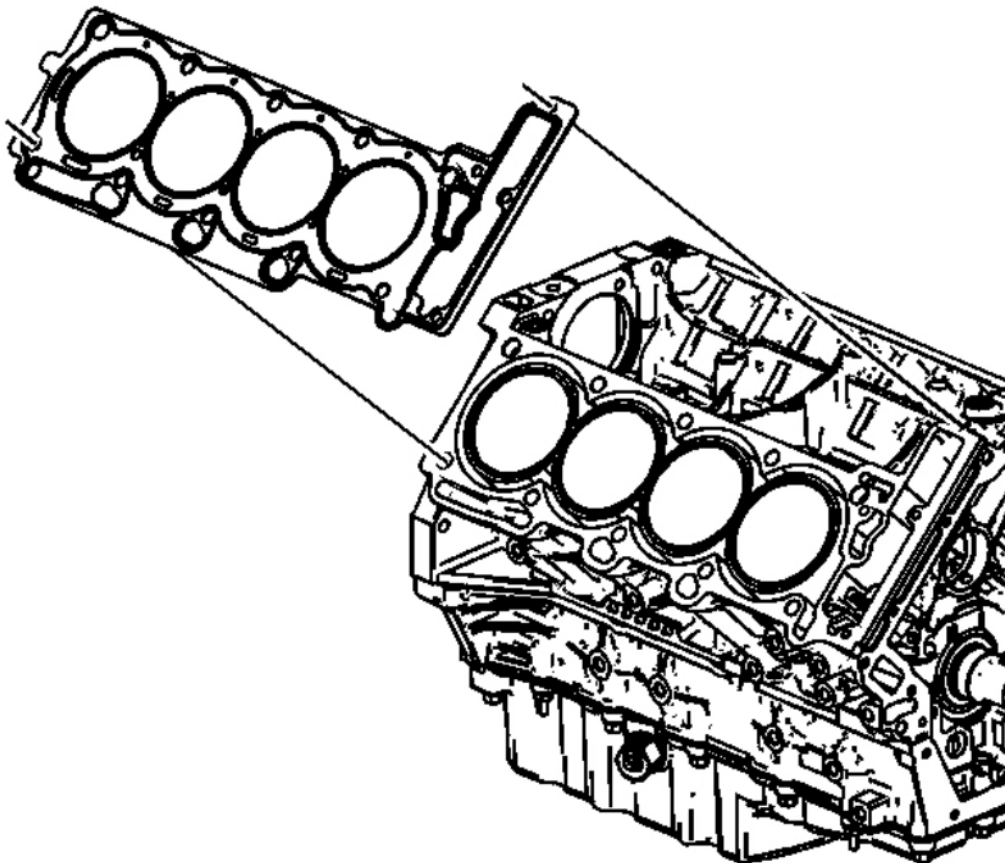


Fig. 240: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

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

IMPORTANT: Failure to remove all the old thread sealant material from the cylinder block could cause false torque readings.

2. Ensure any old thread sealant material is removed from the cylinder head bolt holes in the cylinder block.
3. Install a new right cylinder head gasket using the deck face locating pins for retention.

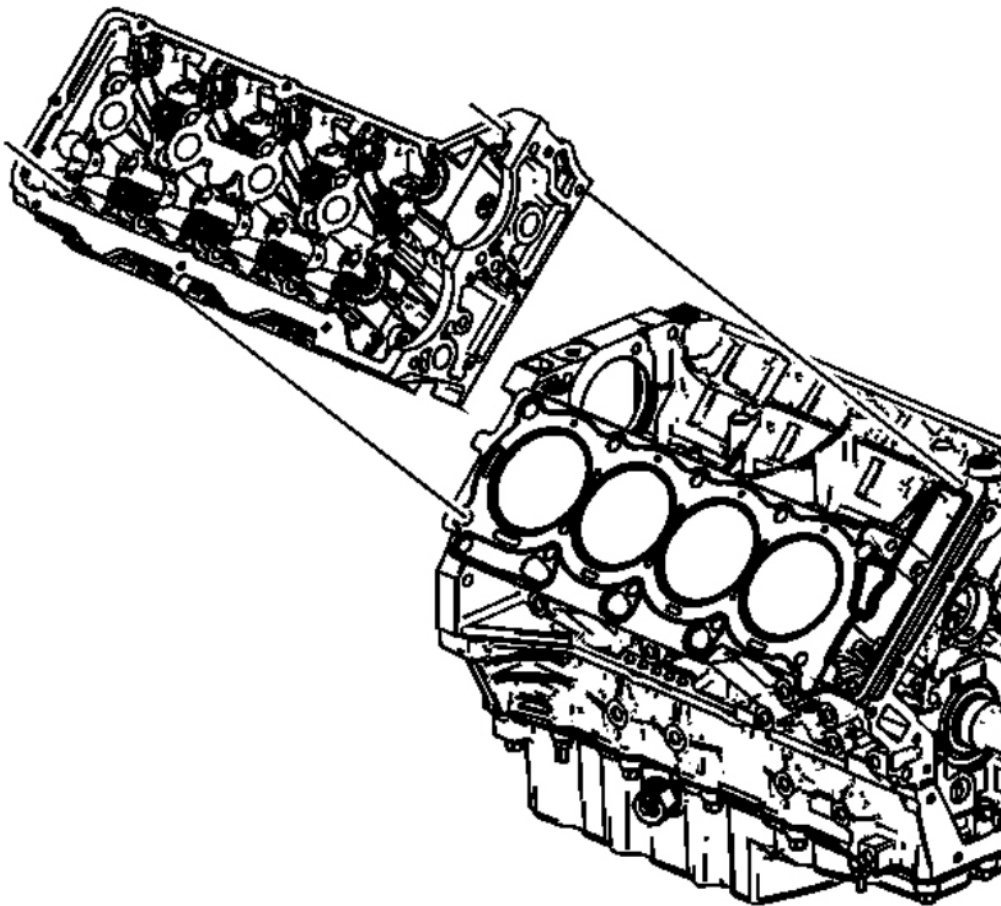


Fig. 241: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

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

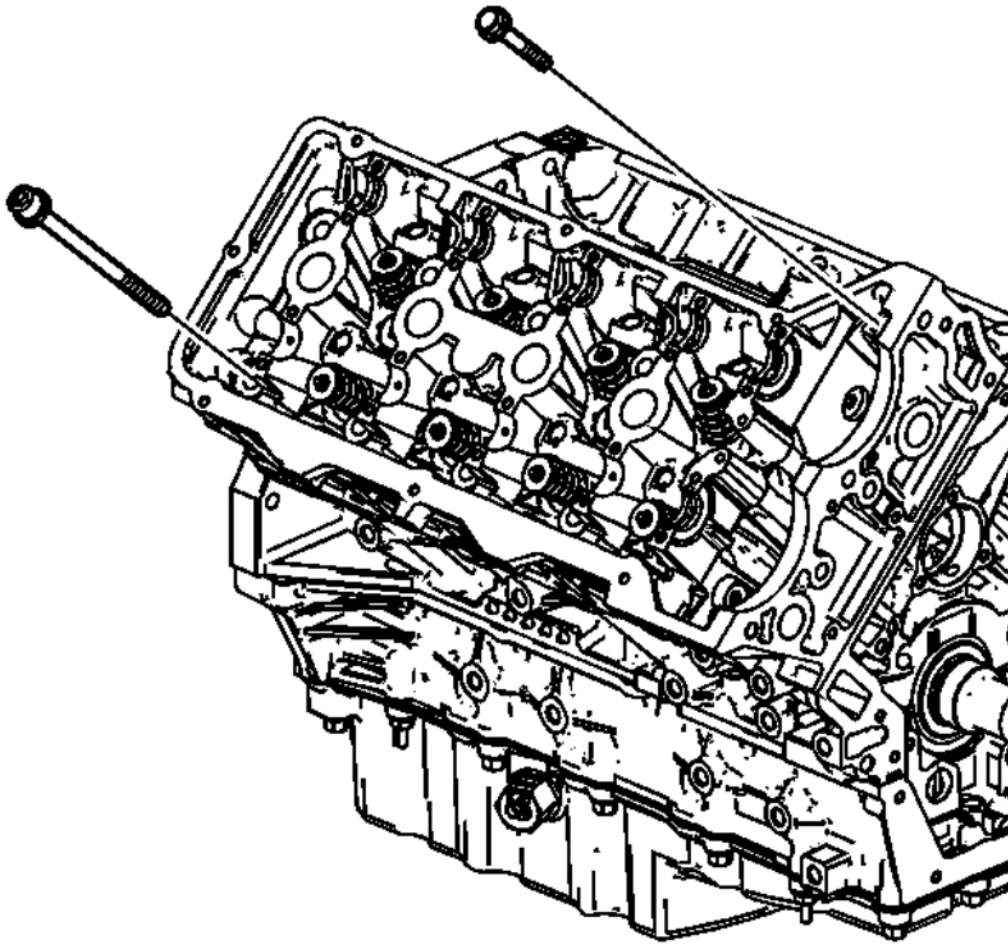


Fig. 242: View Of M11 & M6 Right Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

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

6. Install new M11 cylinder head bolts in the cylinder head.
7. Install the M6 cylinder head bolts at the front of the cylinder head.

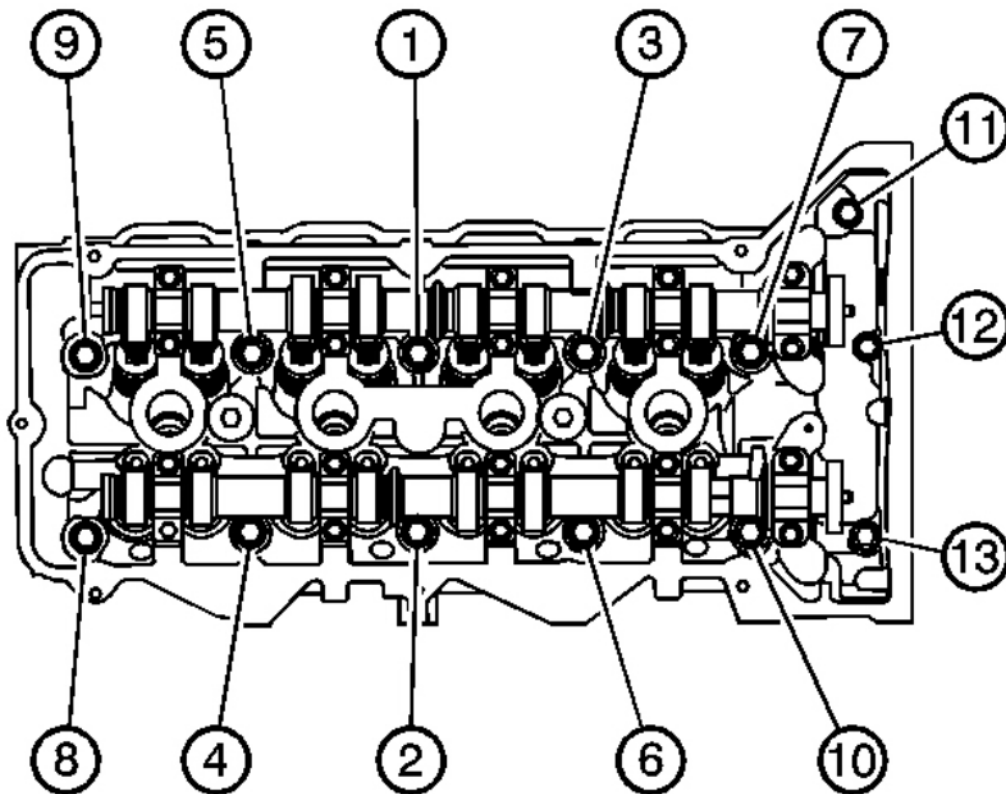


Fig. 243: Tightening Right Cylinder Head Bolts

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

NOTE: Ensure the cylinder head bolts that are being used are the proper pitch or engine damage will occur. The thread pitch on the M11 cylinder head bolts and the engine block cylinder head bolt holes have been revised. In order to prevent engine damage it is important to identify which thread pitch is being used. Cylinder head bolts with a pitch of 1.5 mm have a thread length of about 48 mm (1.890 in) long. Cylinder head bolts with a pitch of 2.0 mm have a thread length of about 67 mm (2.638 in) long.

8. Tighten the right cylinder head bolts in the sequence shown.

1. First Pass

Tighten: Tighten the right cylinder head M11 cylinder head bolts to 30 N.m (22 lb ft) in the sequence shown.

2. Second Pass

Tighten: Using the **J 45059** , tighten the right cylinder head M11 cylinder head bolts an additional 60 degrees in the sequence shown.

3. Third Pass

Tighten: Repeat the sequence turning each bolt another 60 degrees.

4. Final Pass

Tighten: Repeat the sequence again turning each bolt a final 60 degrees, total 180 degrees.

9. Tighten the M6 bolts at the front of the cylinder head.

Tighten: Tighten the M6 cylinder head bolts to 12 N.m (106 lb in).

VALVE LIFTER INSTALLATION - RIGHT

Tools Required:

J 39946 Crankshaft Socket - 4.0 L and 4.6 L

1. Ensure the crankshaft is in the TDC position for the number one cylinder using the **J 39946** .

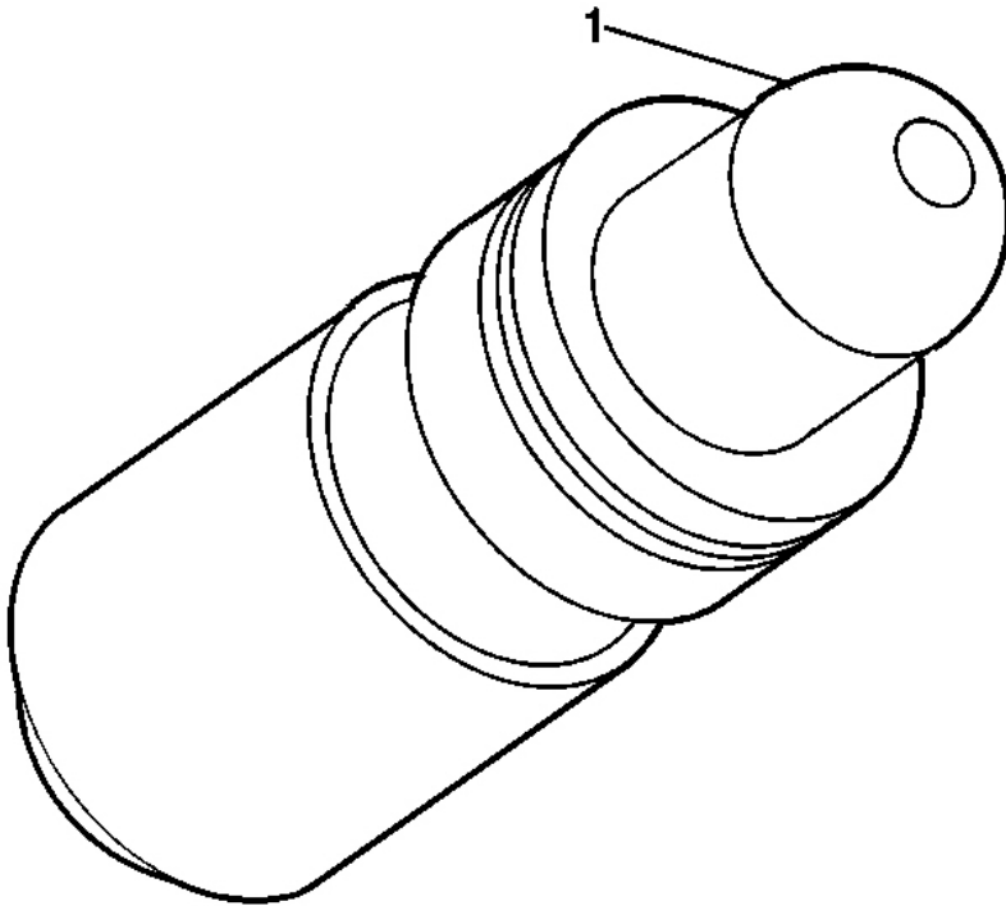


Fig. 244: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Valve Lifter Priming Notice in Cautions and Notices.

2. 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.
3. Lubricate the SHLA bores of the cylinder head with clean engine oil GM P/N 12378006 or equivalent.

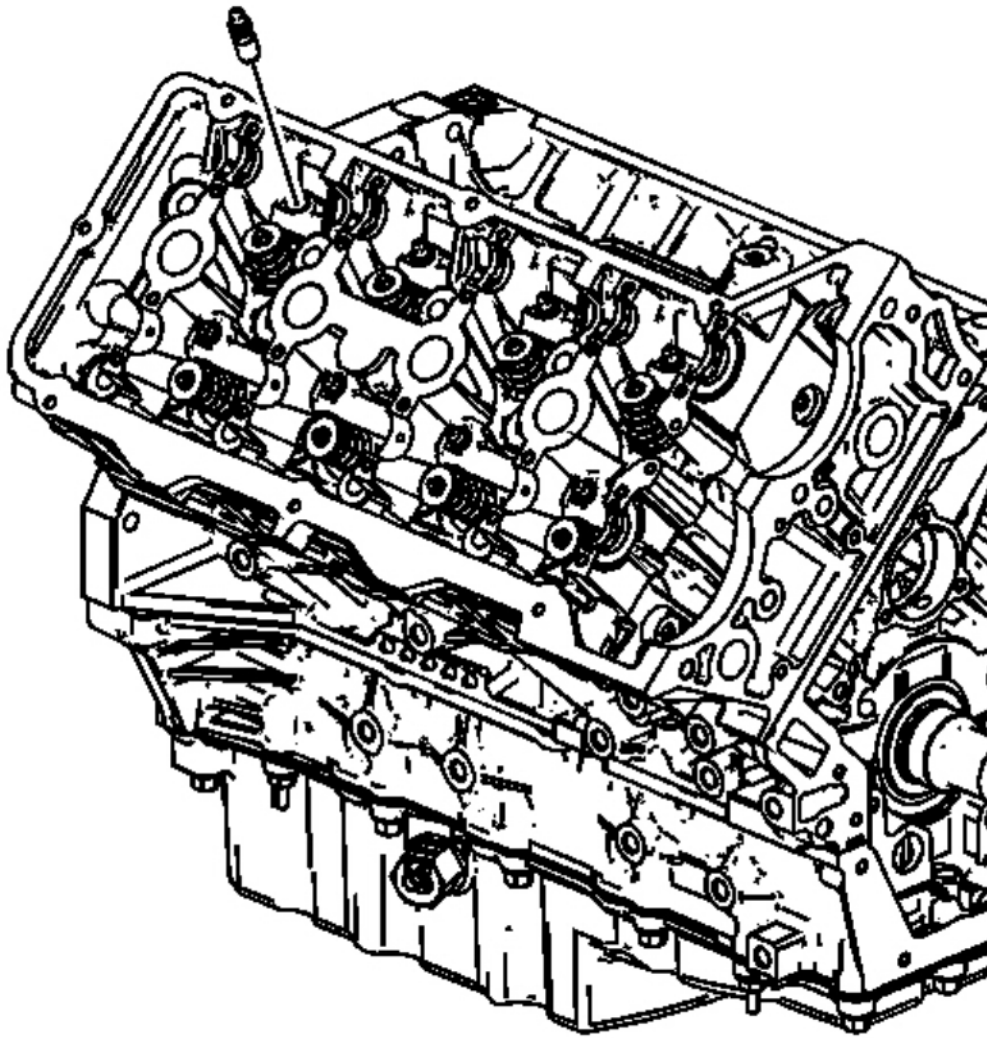


Fig. 245: View Of Right SHLAs
Courtesy of GENERAL MOTORS CORP.

4. Install the SHLAs.
5. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the SHLA sphere.

VALVE ROCKER ARM INSTALLATION - RIGHT

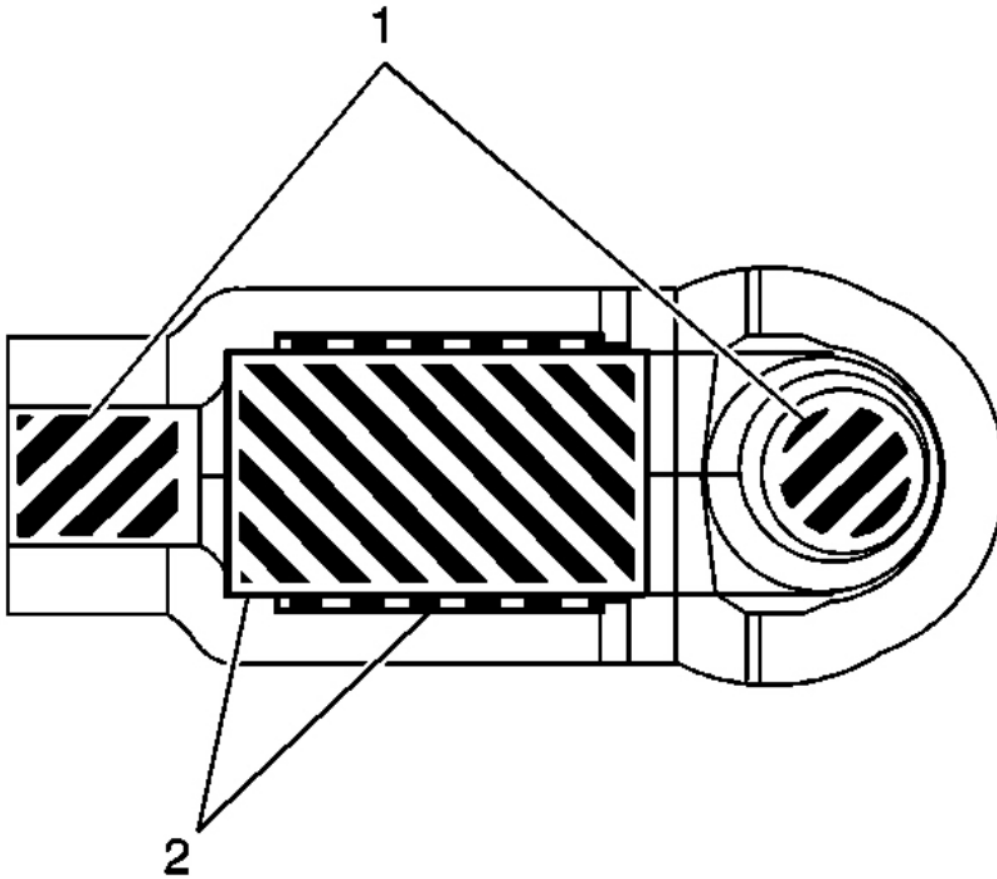


Fig. 246: Identifying Roller Pivot Pocket (2) & Valve Slot Areas (1) Of Camshaft Followers

Courtesy of GENERAL MOTORS CORP.

1. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the roller (2), pivot pocket and valve slot areas (1) of the camshaft followers.

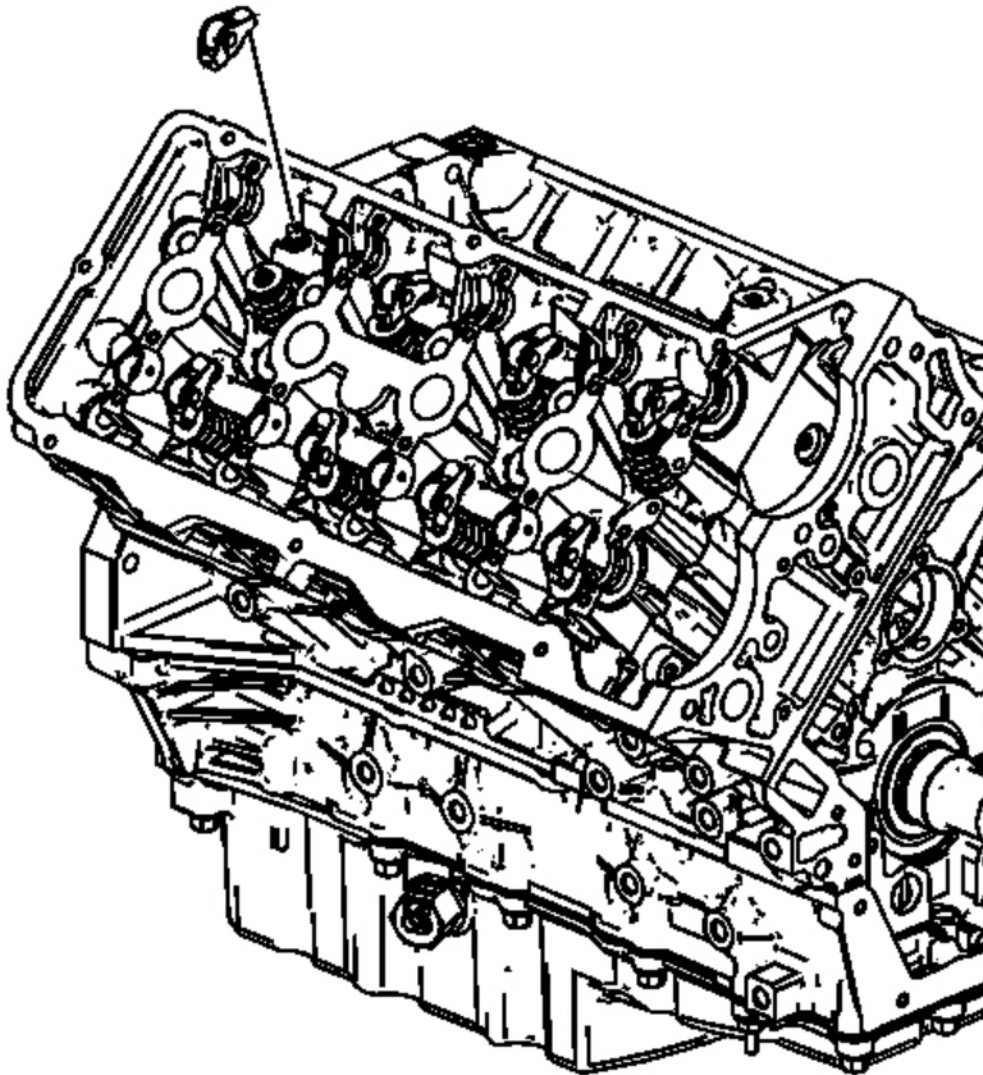


Fig. 247: View Of Right Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

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 SHLA. The rounded head of the follower goes on the SHLA while the flat end goes on the valve tip.

CAMSHAFT INSTALLATION - RIGHT EXHAUST

Tools Required:

J 45059 Angle Meter

1. Clean the camshaft journals, camshaft and the camshaft caps with a clean, lint-free cloth.

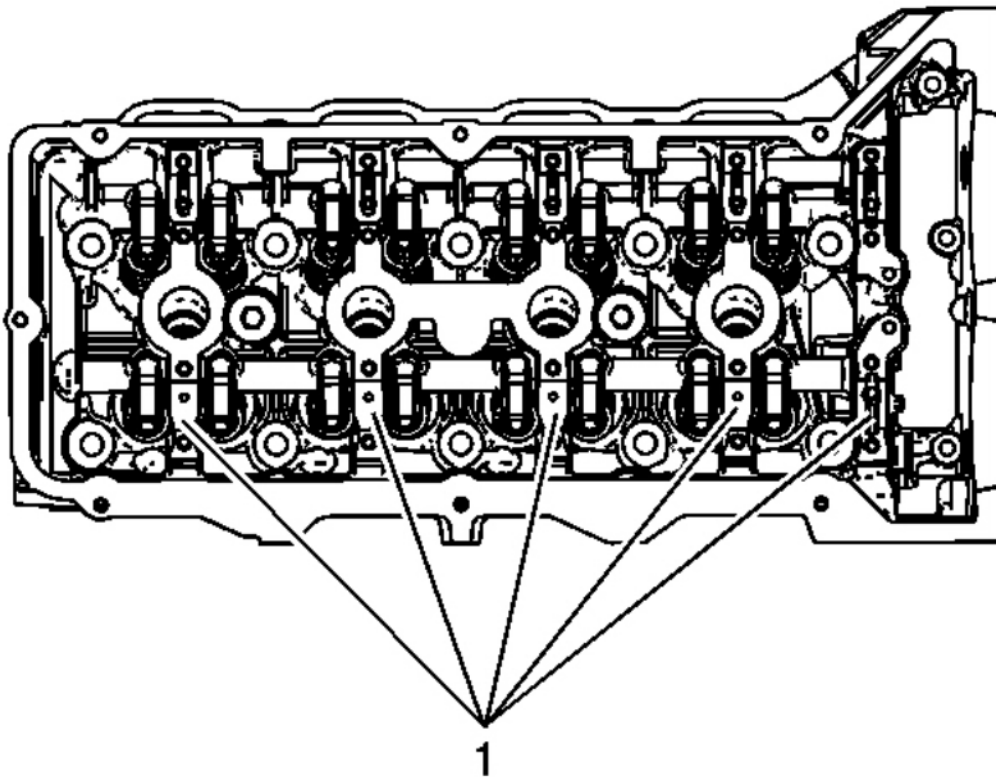


Fig. 248: Locating Right Exhaust Camshaft Bearing Journals
Courtesy of GENERAL MOTORS CORP.

2. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft bearing journals (1).

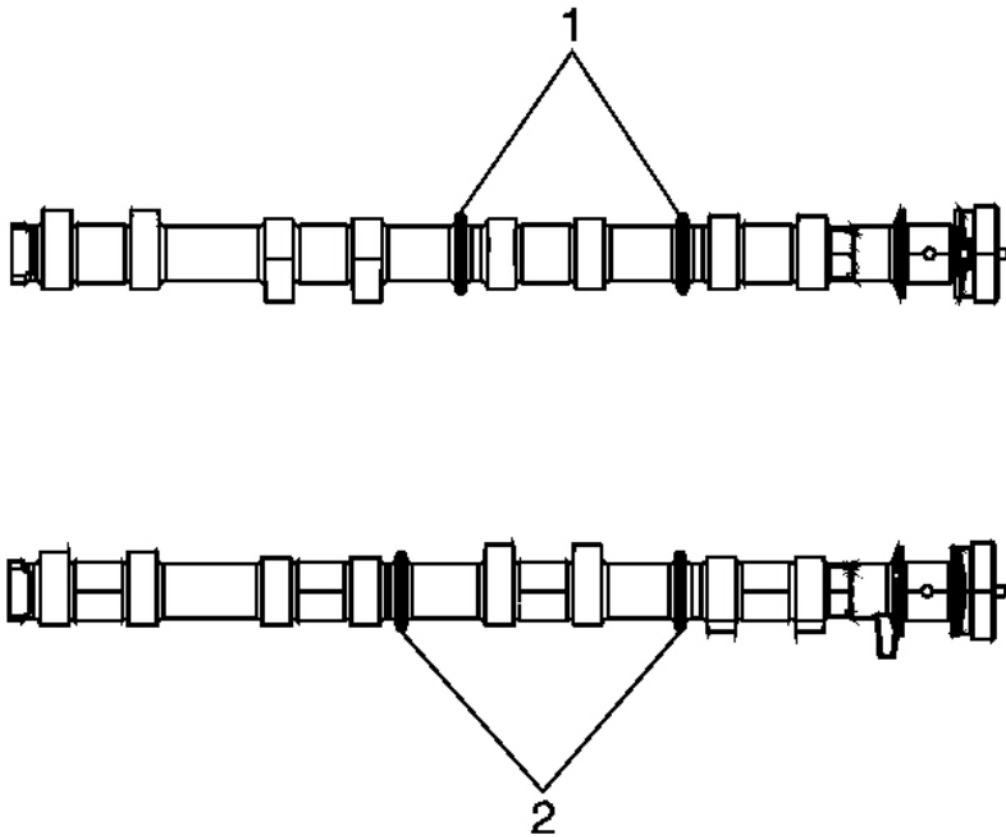


Fig. 249: Locating Right Camshaft Identifying Rings
Courtesy of GENERAL MOTORS CORP.

3. Select the proper camshaft by the identifying rings cast into the right exhaust camshaft (2).

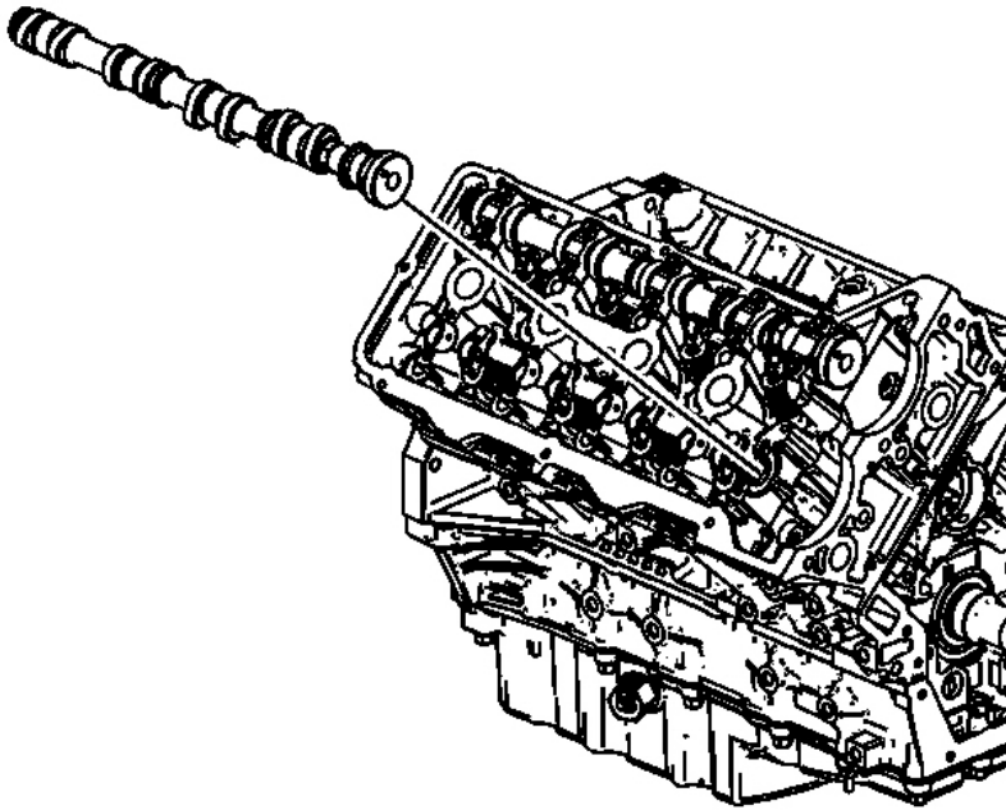


Fig. 250: View Of Right Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft lobes and the camshaft journals.

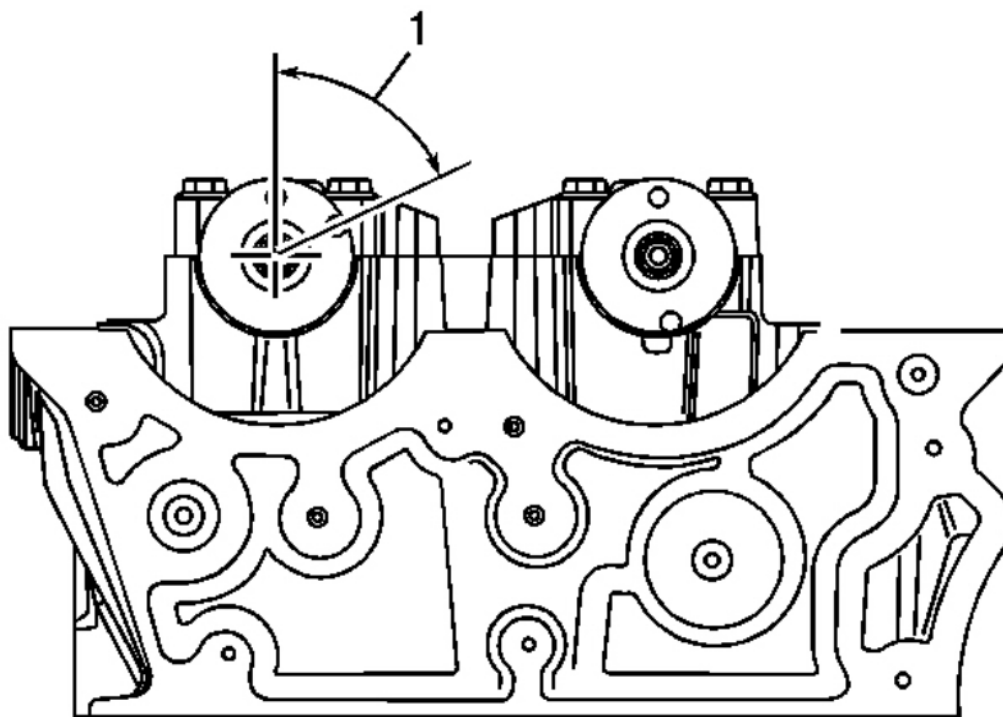


Fig. 251: Aligning Right Exhaust Camshaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

5. Place the camshaft in the camshaft journals with the camshaft sprocket drive pins near the 45 to 60 degree location (1), clockwise from the top of their rotation and the camshaft lobes in a neutral position. The camshaft can be identified by a stamping near the rear journal. For example: R-EXH is defined as Right Bank Exhaust.

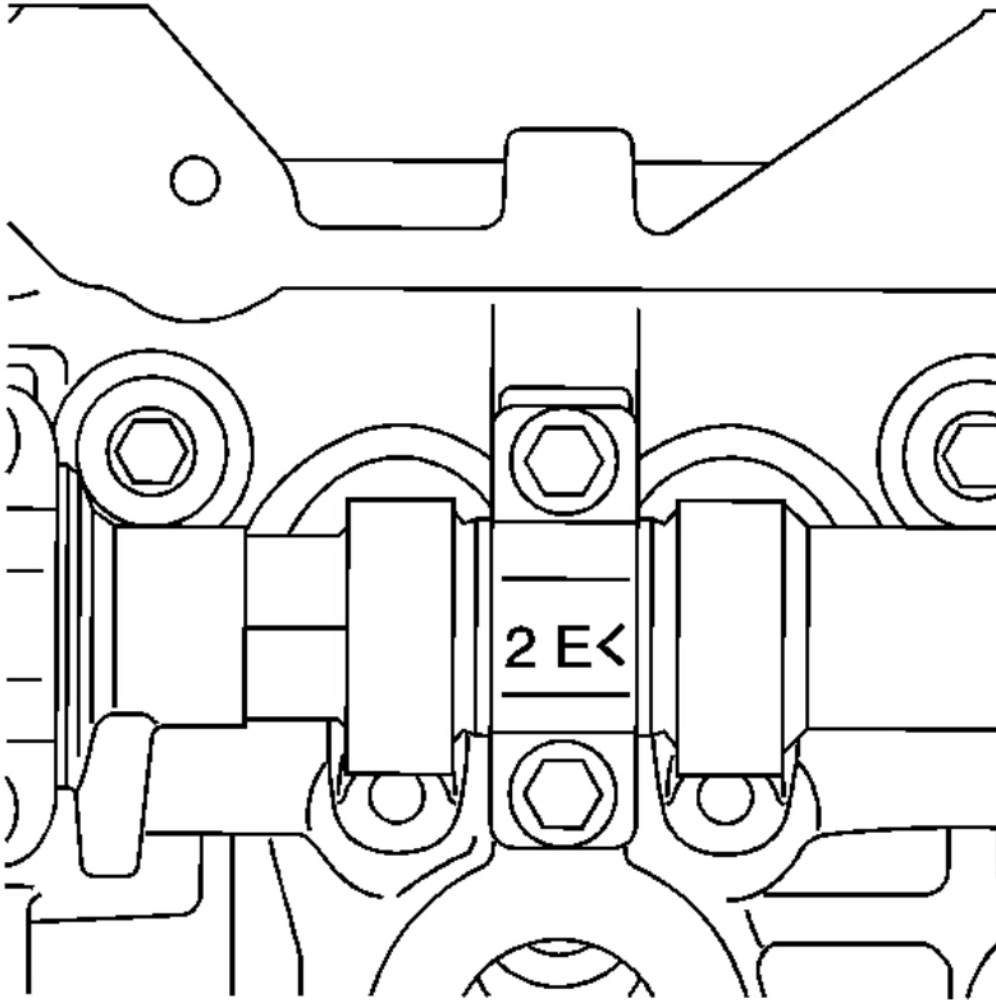


Fig. 252: View Of Right Exhaust Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

6. Observe the markings on the camshaft bearing caps. Each camshaft bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The arrow should point toward the front of the engine.
 - The number indicates the position from the front of the engine.
 - The "E" indicates the exhaust camshaft.
7. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the right exhaust

camshaft bearing cap journals.

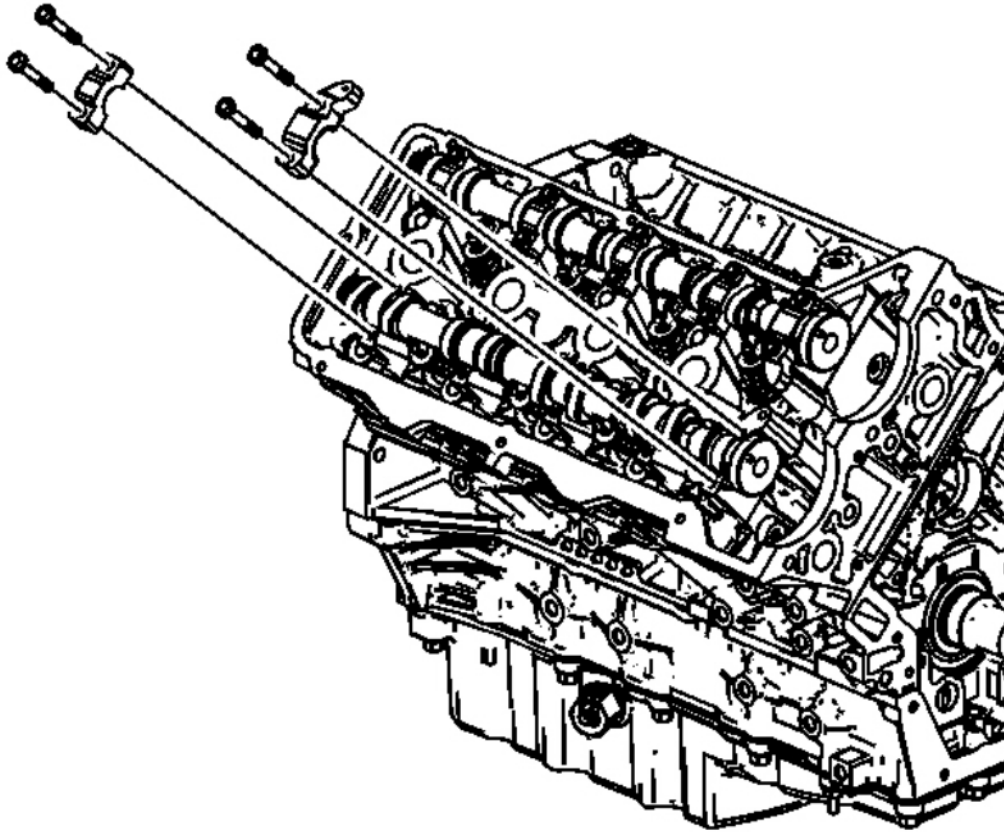


Fig. 253: View Of Right Exhaust Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

8. Install the right exhaust camshaft bearing caps according to the identifications marks.
9. Hand start all the right exhaust camshaft bearing cap bolts.

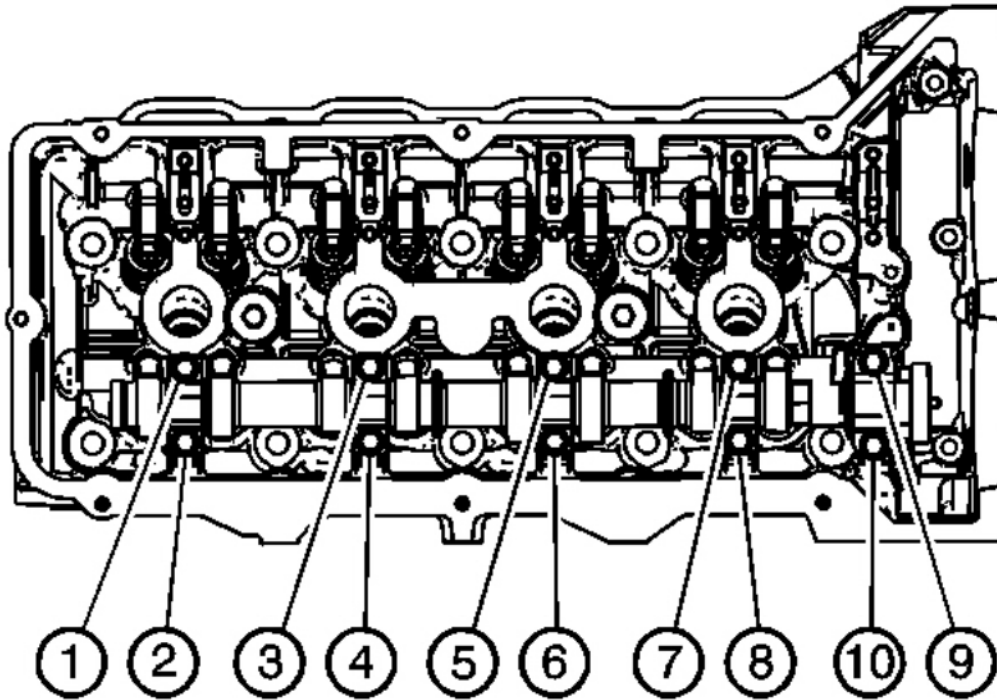


Fig. 254: Tightening Right Cylinder Head Exhaust Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

10. Install the right cylinder head exhaust camshaft bearing cap bolts.

1. First Pass

Tighten: Tighten the camshaft bearing cap bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the camshaft bearing cap bolts an additional 30 degrees using the **J 45059** .

CAMSHAFT INSTALLATION - RIGHT INTAKE

Tools Required:

J 45059 Angle Meter

1. Clean the camshaft journals, camshaft and the camshaft caps with a clean, lint-free cloth.

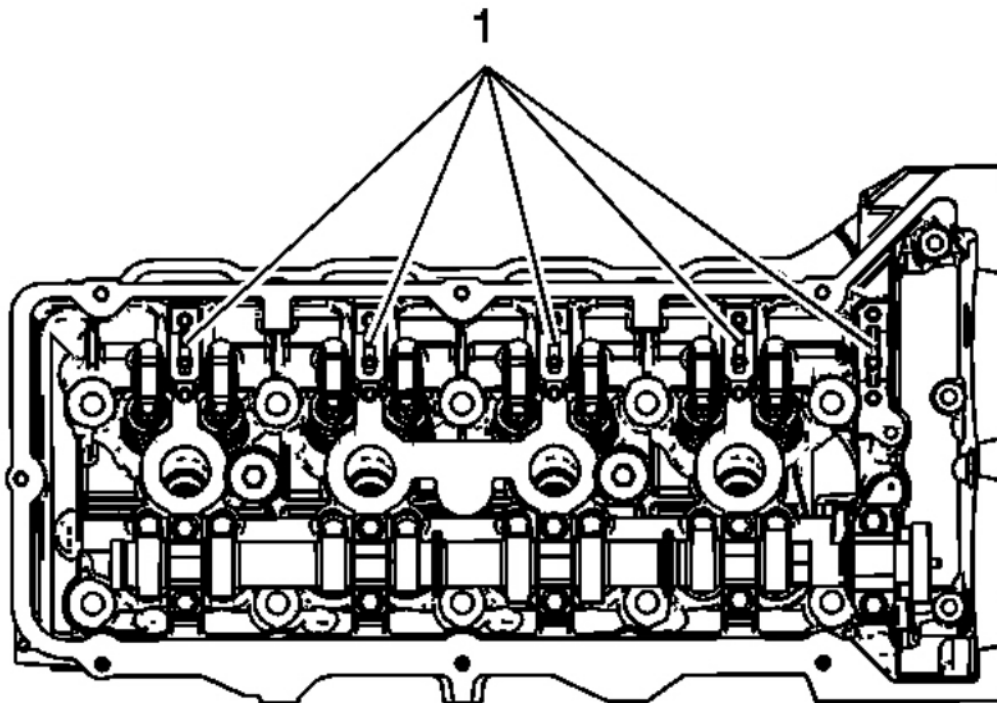


Fig. 255: Locating Right Intake Camshaft Bearing Journals
Courtesy of GENERAL MOTORS CORP.

2. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft bearing journals (1).

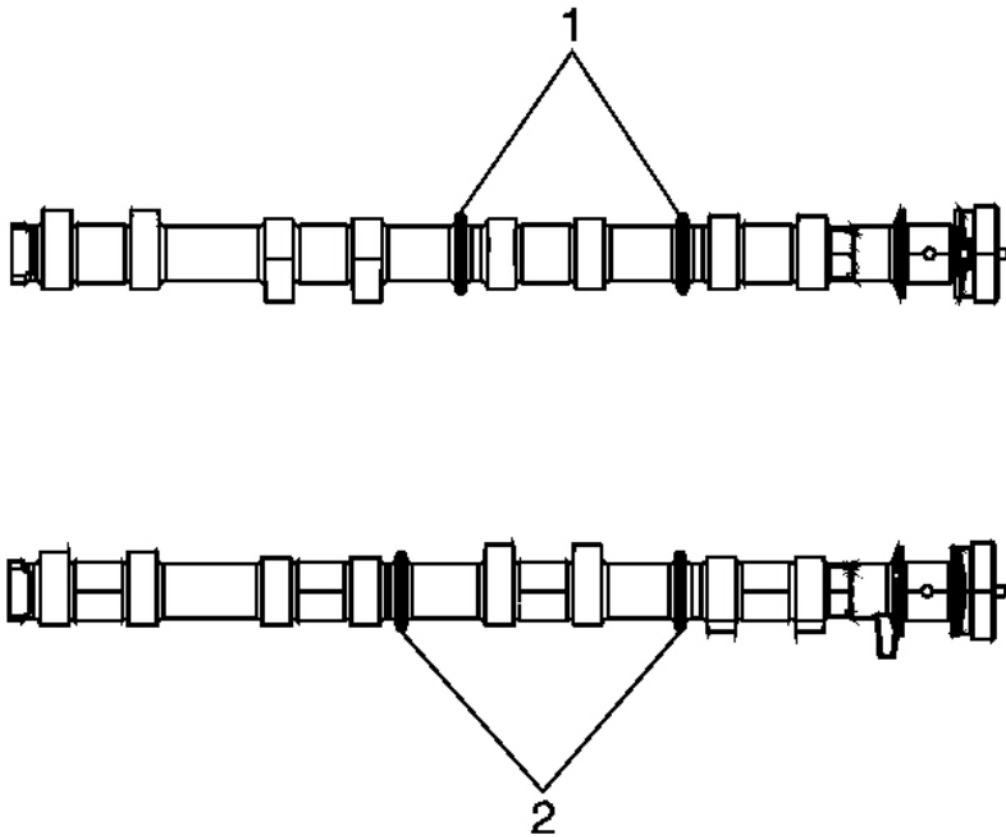


Fig. 256: Locating Right Camshaft Identifying Rings
Courtesy of GENERAL MOTORS CORP.

3. Select the proper camshaft by the identifying rings cast into the right intake camshaft (1).

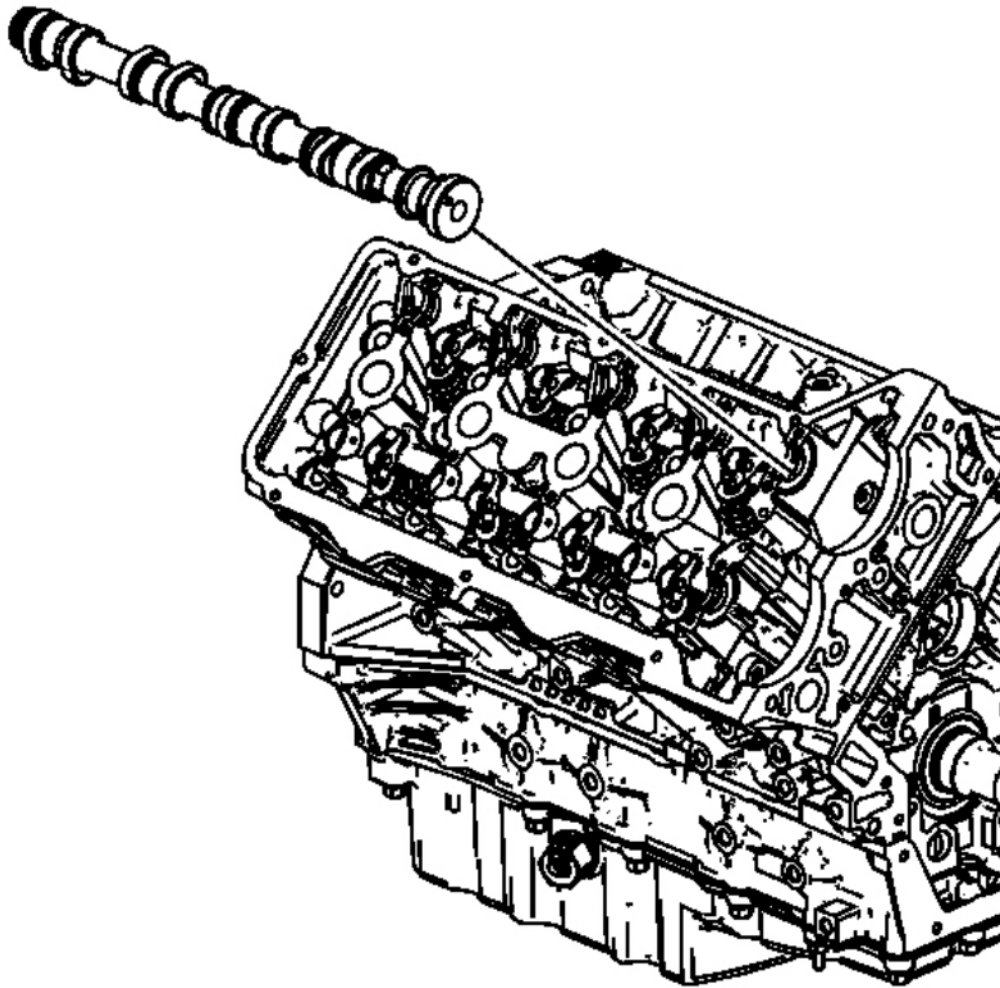


Fig. 257: View Of Right Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the camshaft lobes and the camshaft journals.

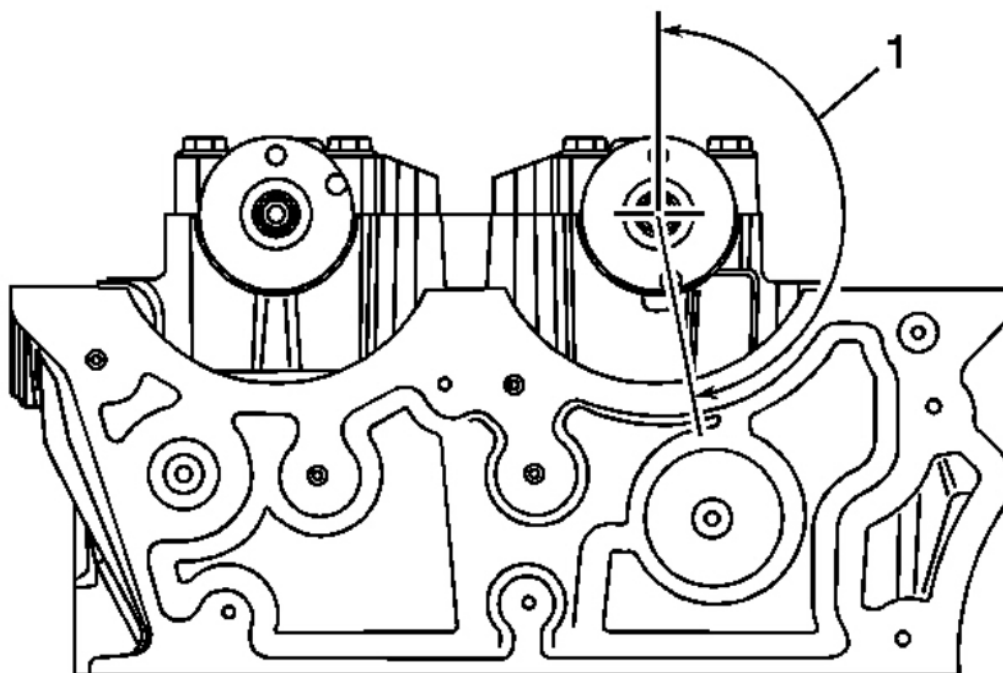


Fig. 258: Aligning Right Intake Camshaft
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

5. Place the camshaft in the camshaft carriers with the camshaft sprocket drive pins near the 45 to 60 degree location (1), clockwise from the top of their rotation and the camshaft lobes in a neutral position. The camshafts can be identified by a stamping near the rear journal. For example: L-EXH is defined as Left Bank Exhaust.

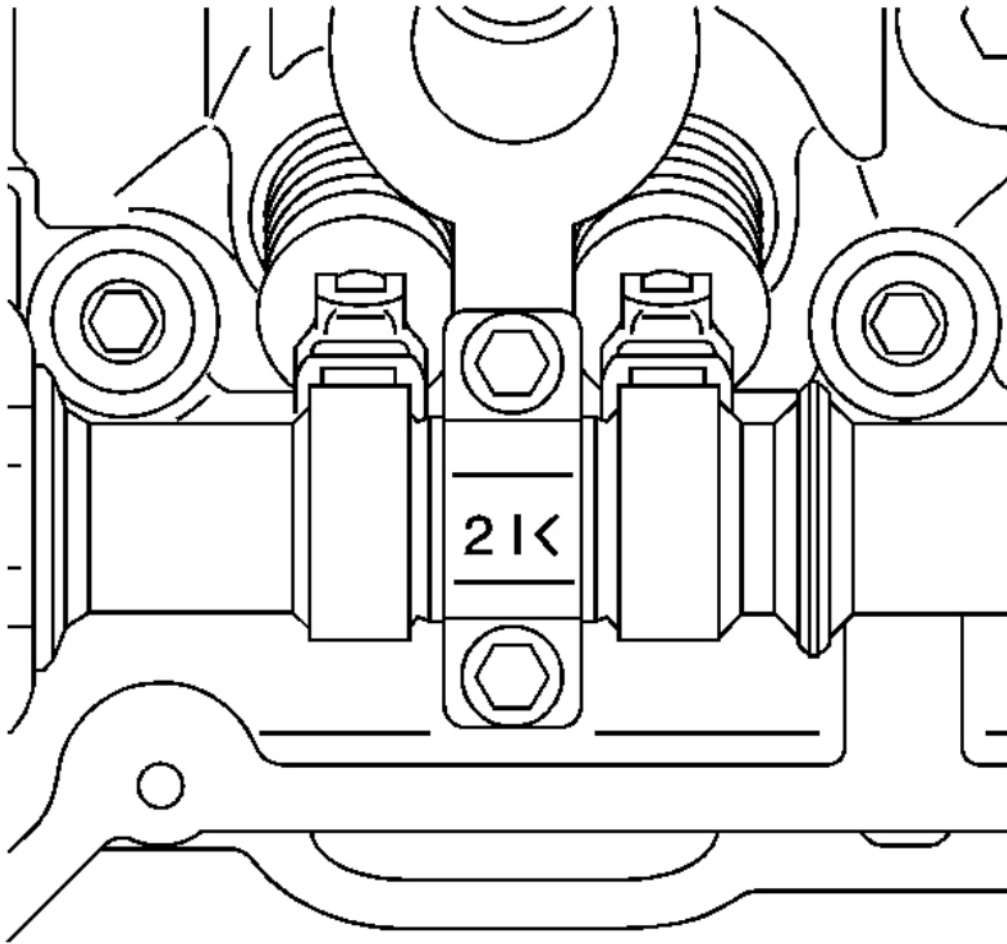


Fig. 259: View Of Right Intake Camshaft Bearing Cap Markings
Courtesy of GENERAL MOTORS CORP.

6. Observe the markings on the camshaft bearing caps. Each camshaft bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The arrow should point toward the front of the engine.
 - The number indicates the position from the front of the engine.
 - The "I" indicates the intake camshaft.
7. Apply a liberal amount of lubricant GM P/N 12345001 or equivalent to the right intake camshaft bearing cap journals.

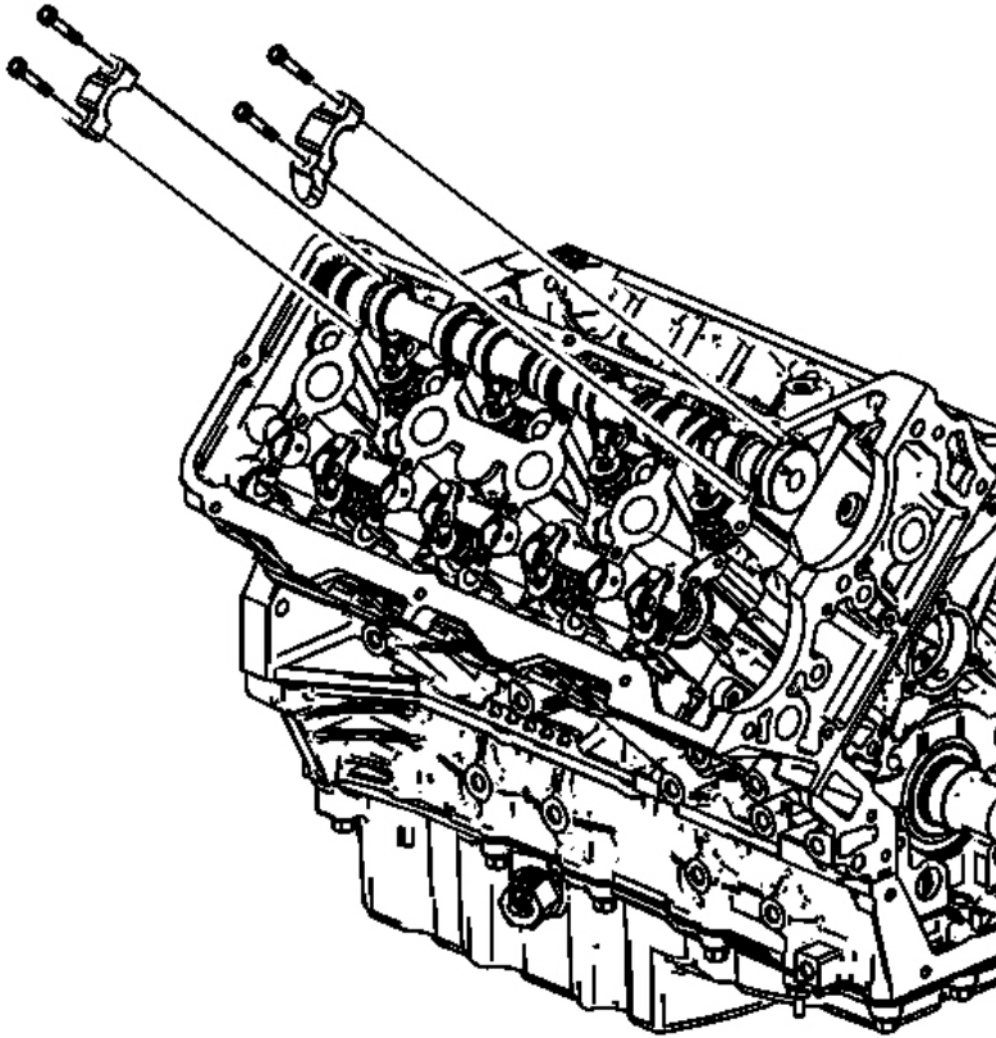


Fig. 260: View Of Right Intake Camshaft Bearing Caps
Courtesy of GENERAL MOTORS CORP.

8. Install the right intake camshaft bearing caps according to the identifications marks.
9. Hand start all the right intake camshaft bearing cap bolts.

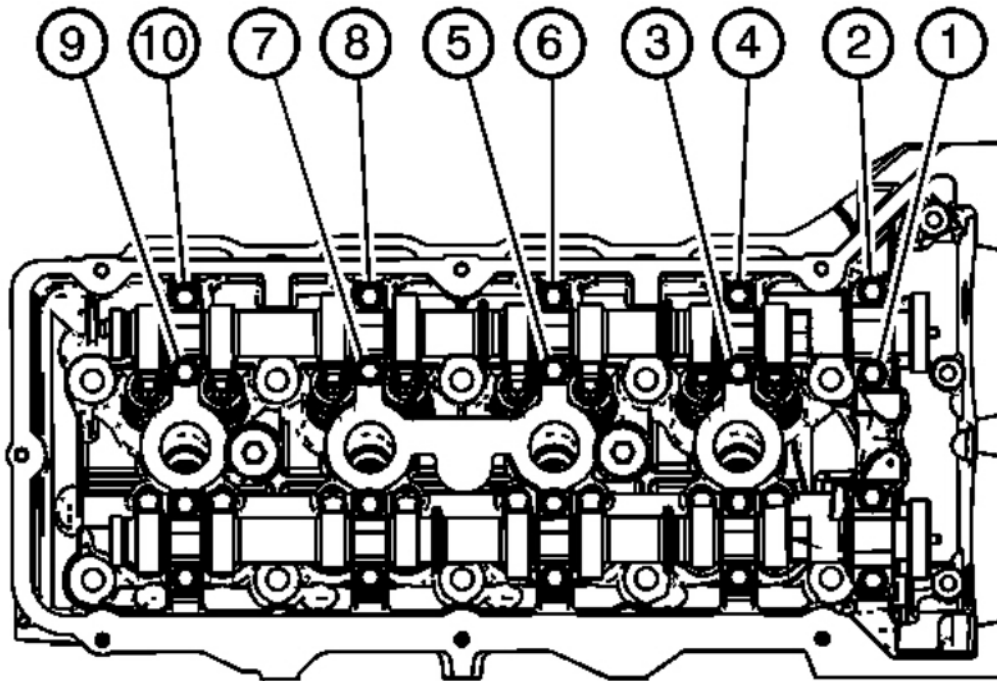


Fig. 261: Tightening Right Cylinder Head Intake Camshaft Bearing Cap Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

IMPORTANT: Ensure each valve rocker arm is properly aligned to the valve tip, the valve lifter and the camshaft lobe. Inspect the alignment prior to and after the camshaft caps are tightened to specifications.

10. Install the right cylinder head intake camshaft bearing cap bolts.

1. First Pass

Tighten: Tighten the camshaft bearing cap bolts to 5 N.m (44 lb in).

2. Final Pass

Tighten: Tighten the camshaft bearing cap bolts an additional 30 degrees using the **J 45059** .

CAMSHAFT INTERMEDIATE DRIVE SHAFT INSTALLATION

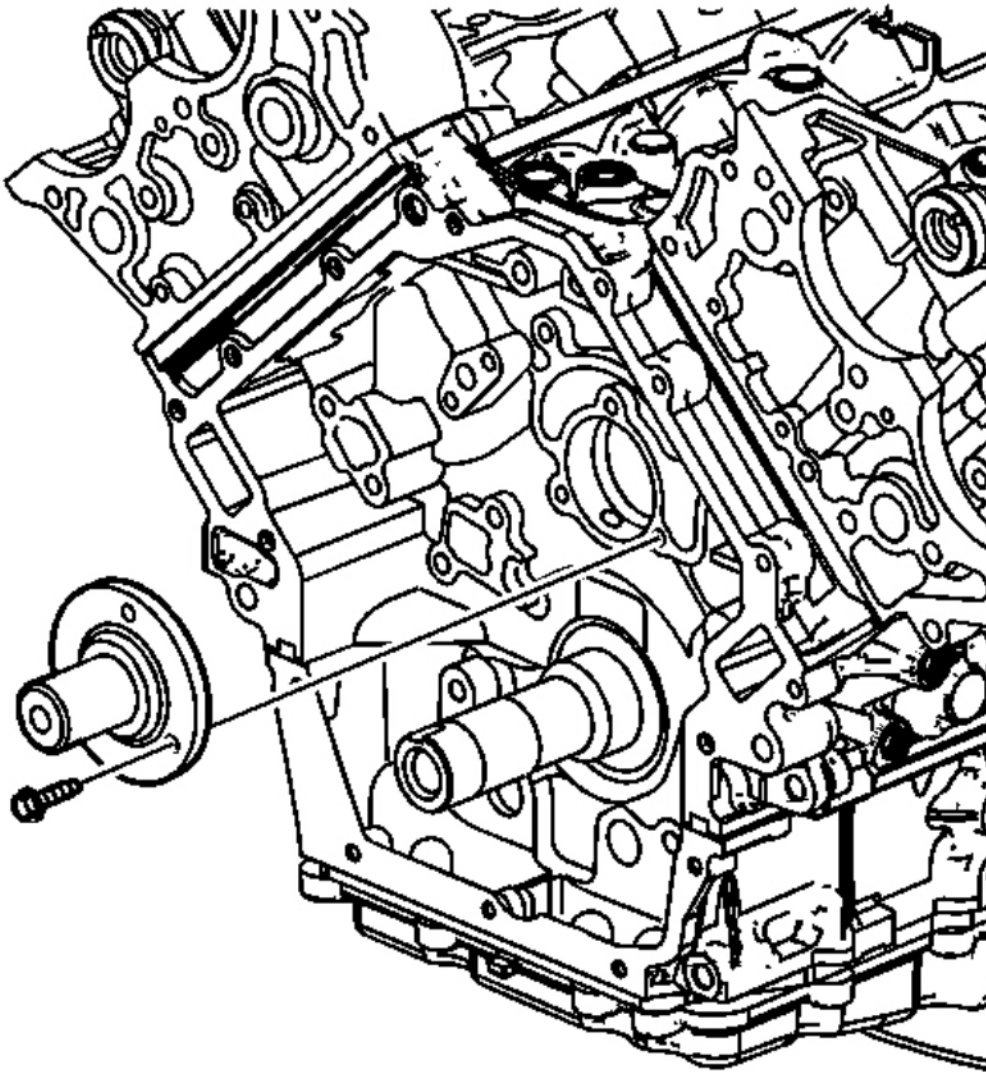


Fig. 262: View Of Intermediate Sprocket Shaft & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

Install the intermediate sprocket shaft and the retaining bolts.

Tighten: Tighten the intermediate sprocket shaft bolts to 10 N.m (89 lb in).

PRIMARY CAMSHAFT DRIVE CHAIN INSTALLATION

Tools Required:

J 39946 Crankshaft Socket - 4.0L and 4.6L

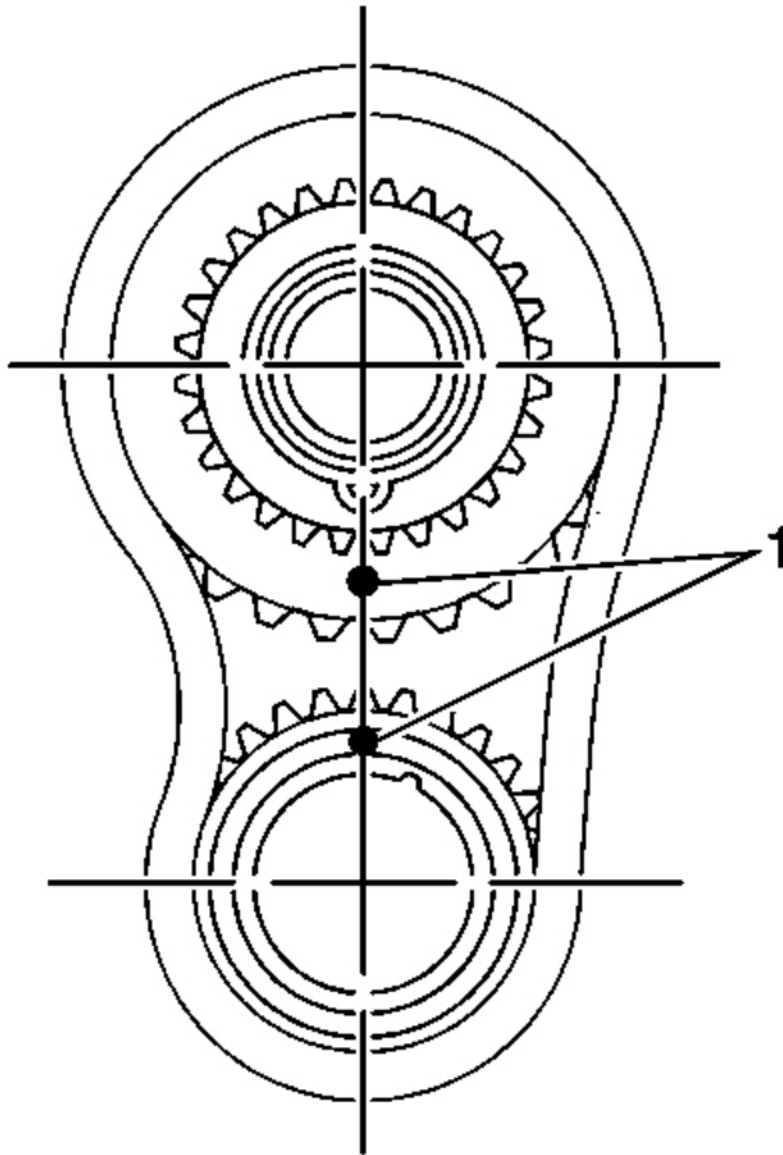


Fig. 263: Aligning Primary Camshaft Drive Chain & Shaft Sprocket Timing Marks
Courtesy of GENERAL MOTORS CORP.

1. Install the primary camshaft drive chain on the camshaft intermediate drive shaft sprocket and crankshaft sprocket.

2. Align the timing marks (1) of the camshaft intermediate drive shaft sprocket and crankshaft sprocket. Ensure the marks are aligned vertically.

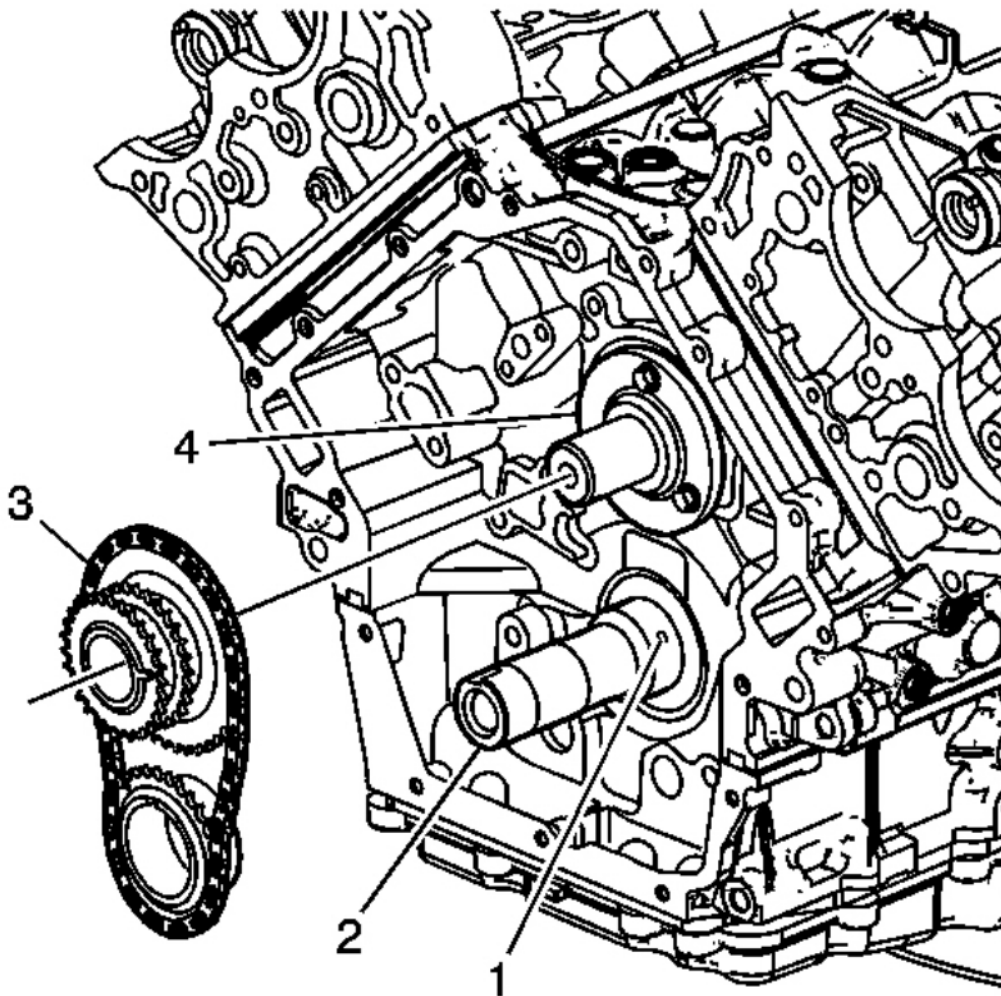


Fig. 264: View Of Primary Camshaft Drive Chain, Intermediate Drive Shaft Sprocket & Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

3. Ensure the number one piston is at Top Dead Center (TDC) and the crankshaft pin (1) is approximately at the one o'clock position using the J 39946 .
4. Install the primary camshaft drive chain, camshaft intermediate drive shaft sprocket and

crankshaft sprocket as an assembly (3) onto the camshaft intermediate drive shaft (4) and the crankshaft (2).

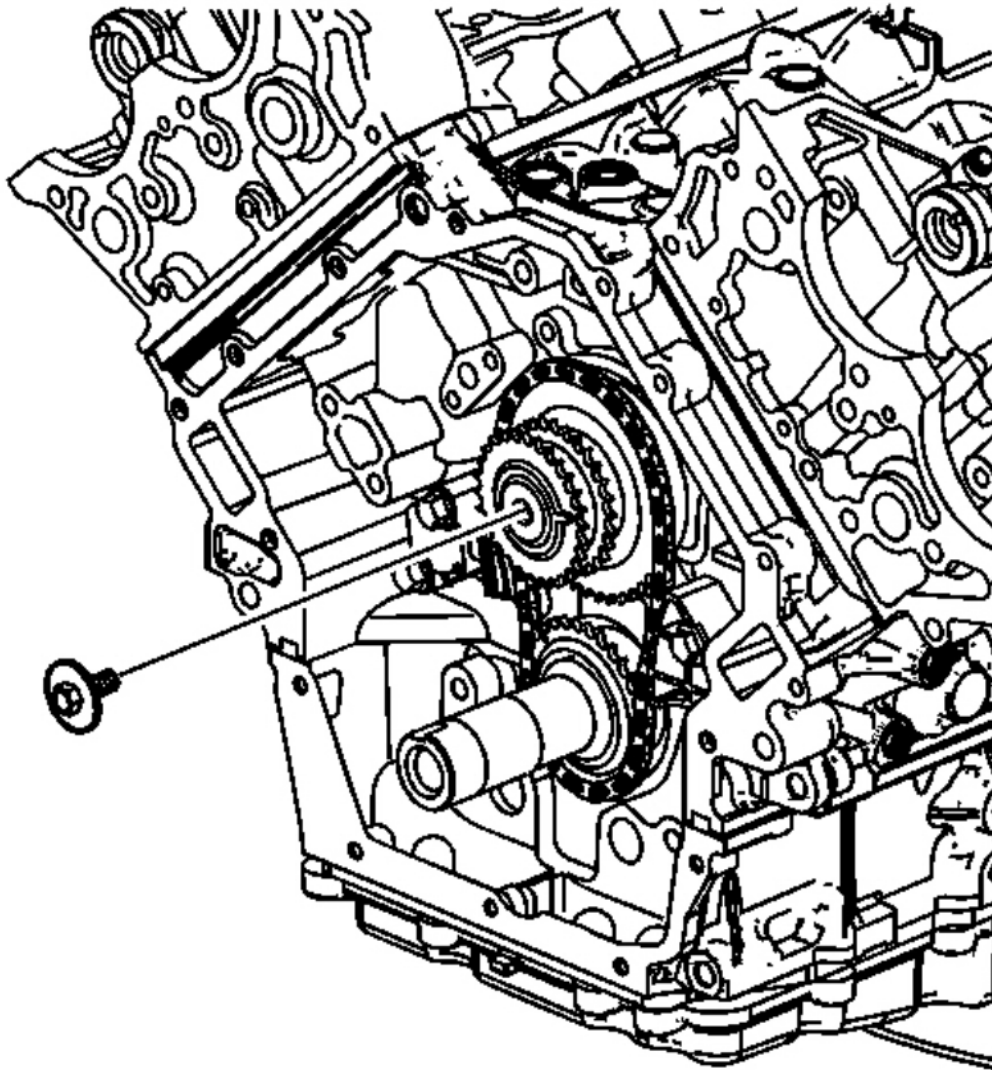


Fig. 265: View Of Camshaft Intermediate Sprocket Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the camshaft intermediate drive shaft sprocket bolt.

Tighten: Tighten the camshaft intermediate drive shaft sprocket bolt to 60 N.m (44 lb ft).

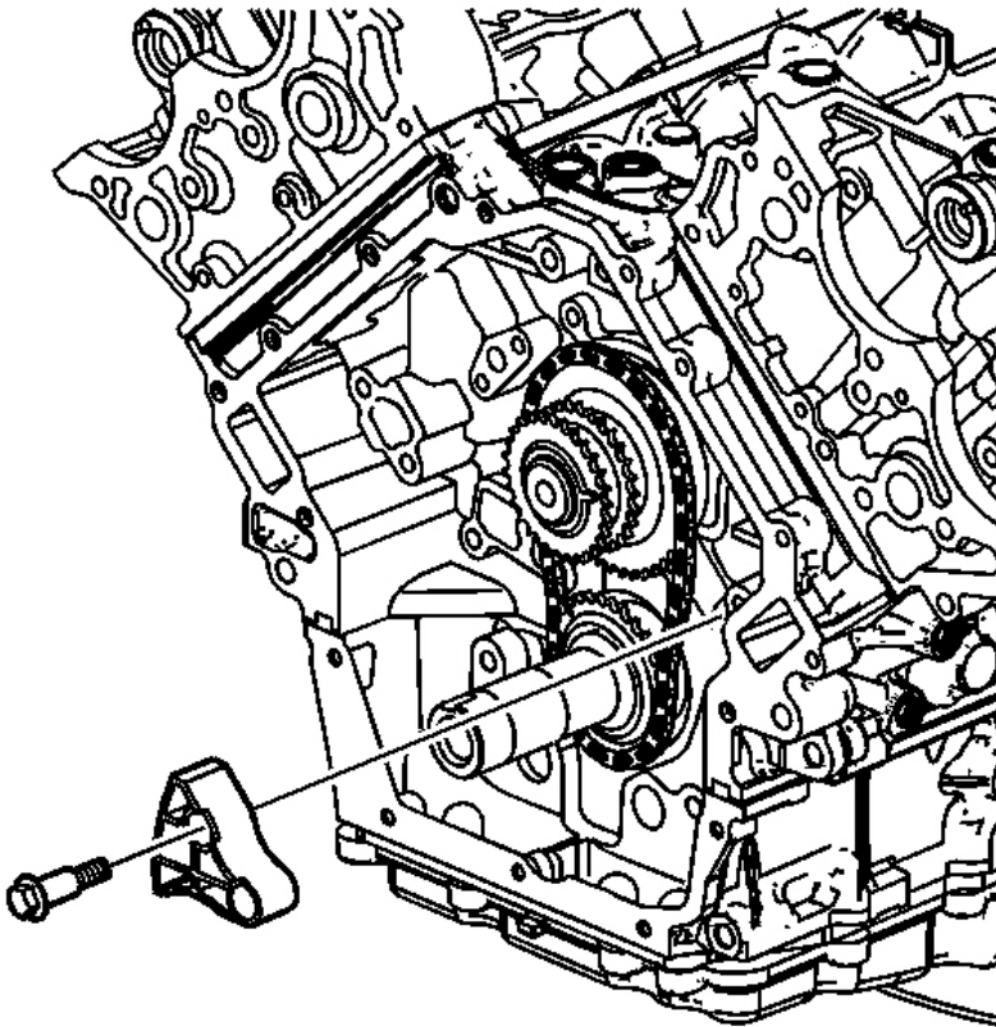


Fig. 266: View Of Primary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

6. Install the primary camshaft drive chain guide.
7. Install the primary camshaft drive chain guide bolts.

Tighten: Tighten the primary camshaft drive chain guide bolts to 25 N.m (18 lb ft).

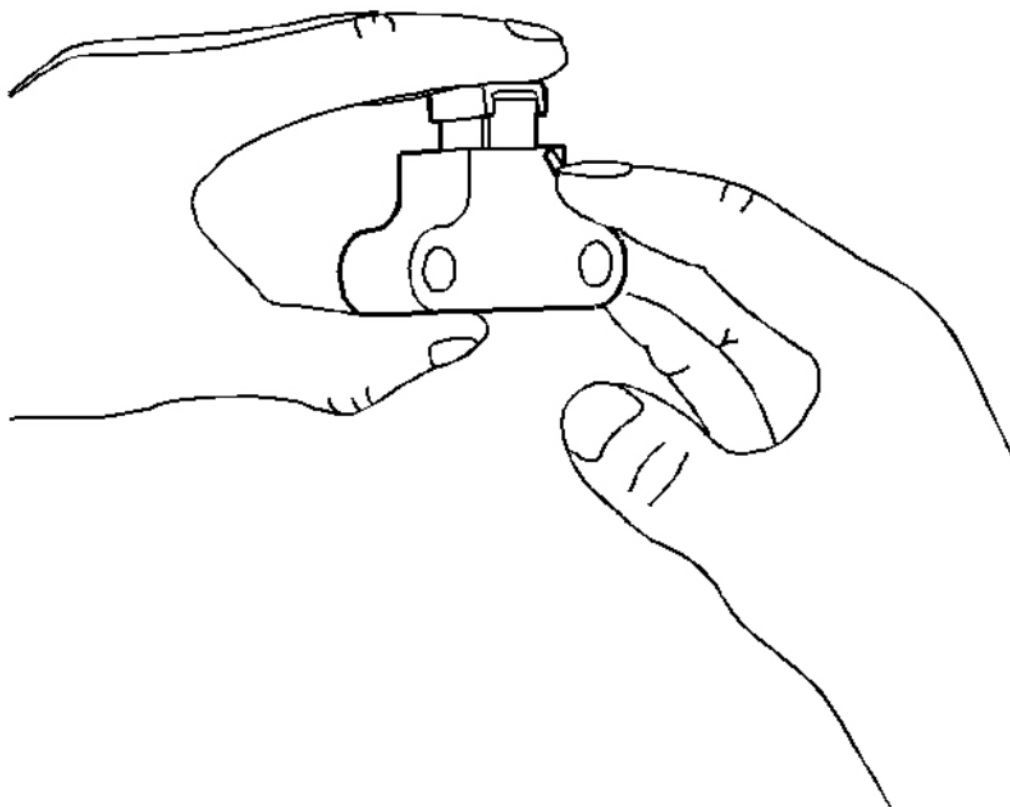


Fig. 267: Collapsing Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

8. Collapse the primary camshaft drive chain tensioner using the following procedure:
 1. Rotate the ratchet release lever counterclockwise and hold.
 2. Collapse the primary camshaft drive chain tensioner shoe and hold.
 3. Release the ratchet lever and slowly release the pressure on the shoe.
9. When the ratchet lever moves to the first detent a click should be heard and felt. Insert a pin through the hole in the release lever in order to lock the primary camshaft drive chain tensioner shoe in the collapsed position.

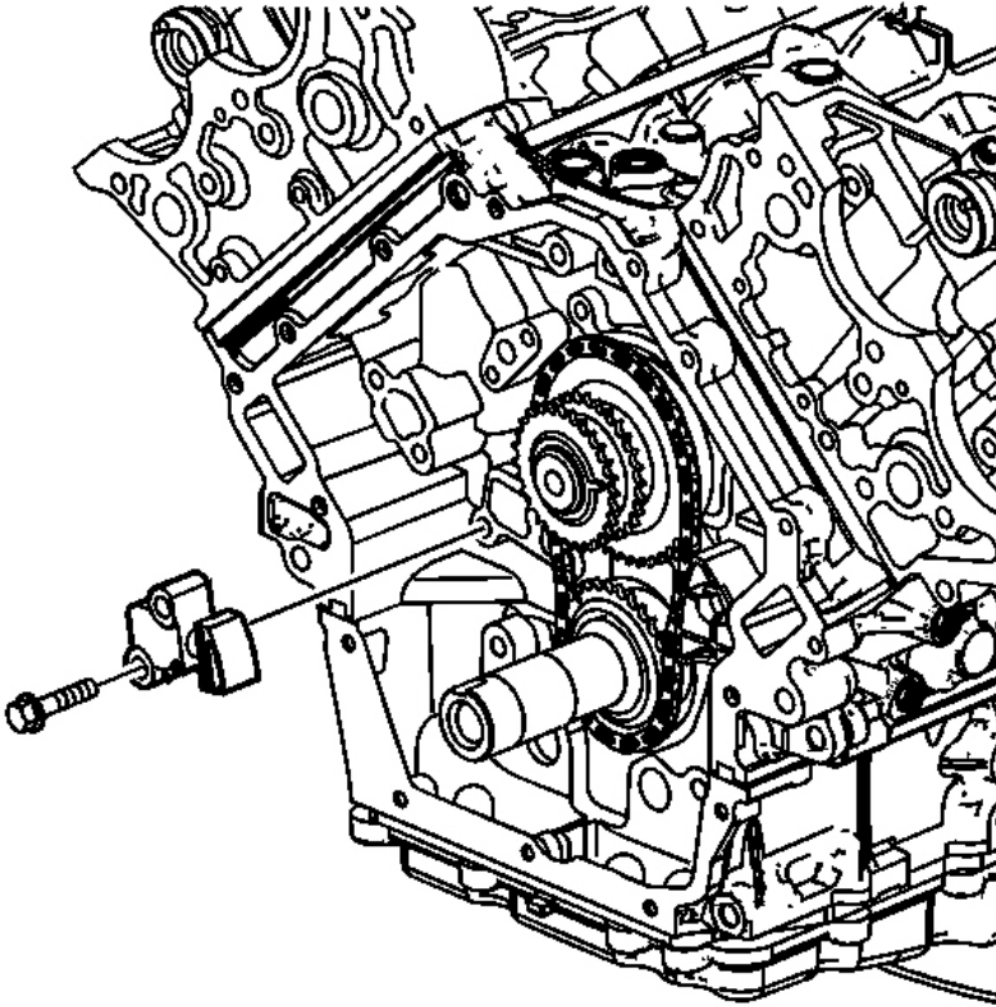


Fig. 268: View Of Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the primary camshaft drive chain tensioner release lever is facing out.

10. Install the primary camshaft drive chain tensioner.
11. Install the primary camshaft drive chain tensioner bolts.

Tighten: Tighten the primary camshaft drive chain tensioner bolts to 25 N.m (18 lb ft).

12. Remove the pin in the release lever locking the primary camshaft drive chain tensioner.

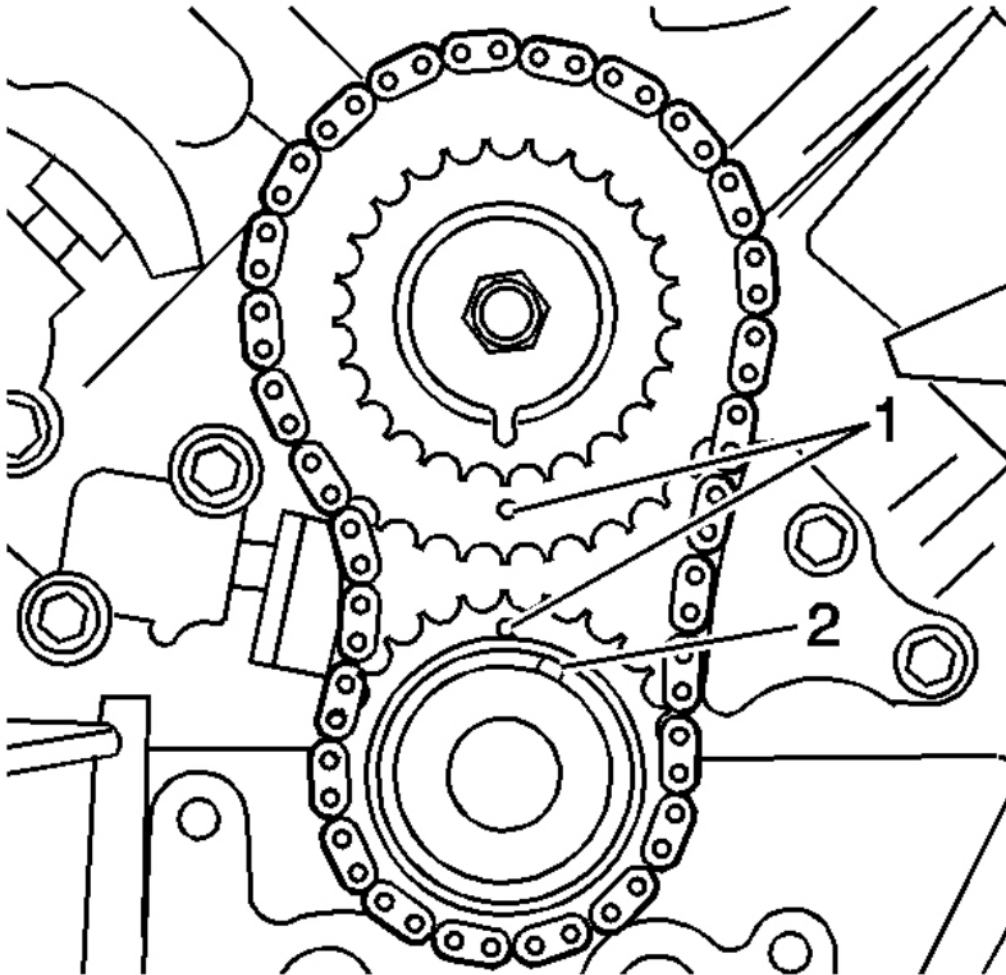


Fig. 269: Ensuring Vertical Timing Mark Alignment
Courtesy of GENERAL MOTORS CORP.

13. Ensure the timing marks (1) are aligned vertically.

OIL OUTLET TUBE INSTALLATION

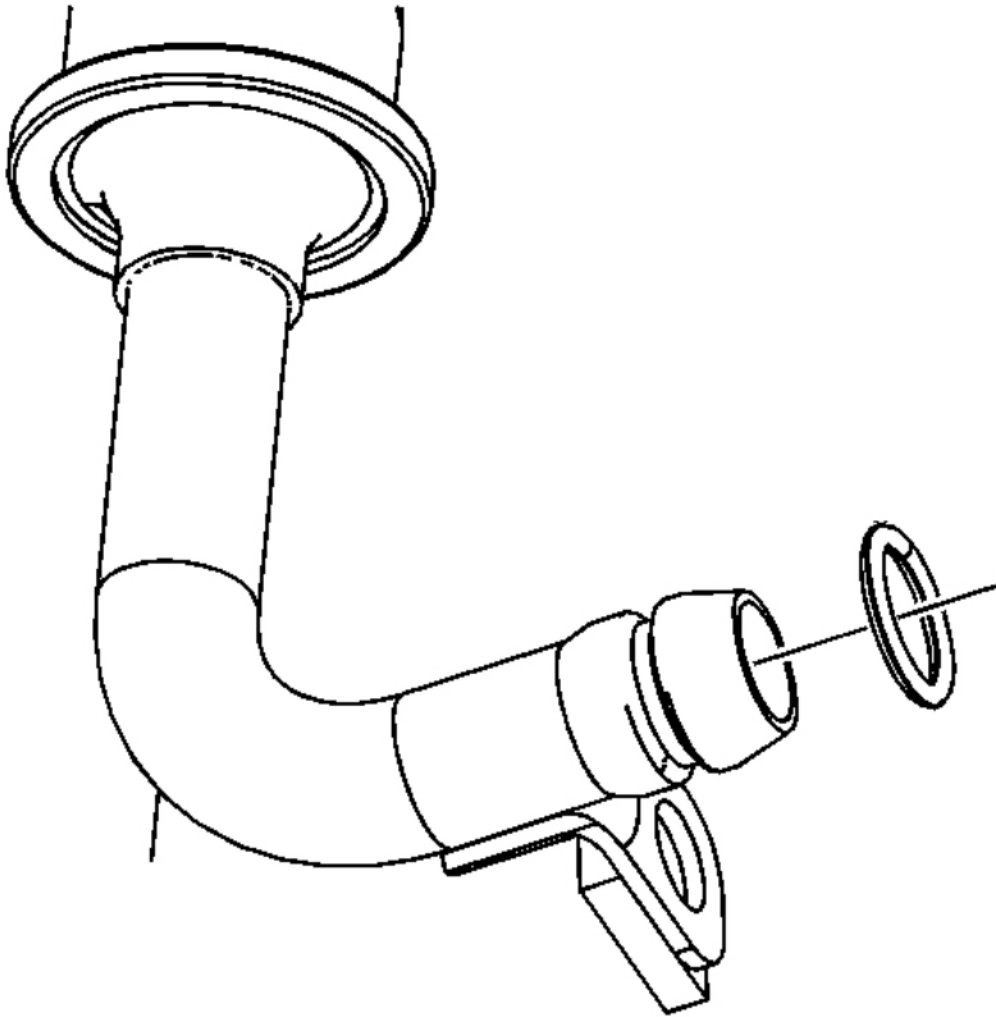


Fig. 270: View Of Oil Outlet Tube O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW O-ring on the oil outlet tube.
2. Apply lubricant to the O-ring.

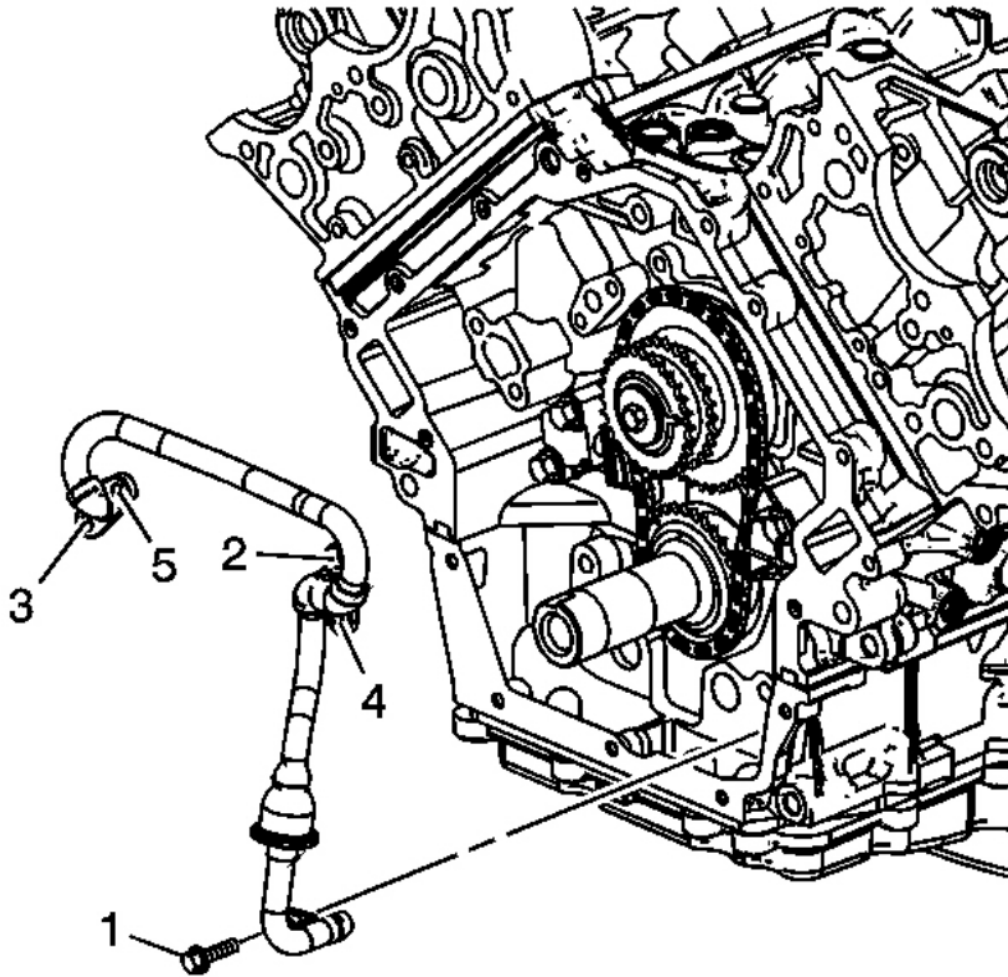


Fig. 271: View Of Oil Outlet Tube Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the oil outlet tube.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the oil outlet tube bolts (1-5).

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

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT

Tools Required:

EN 46328 Camshaft Holding Tool

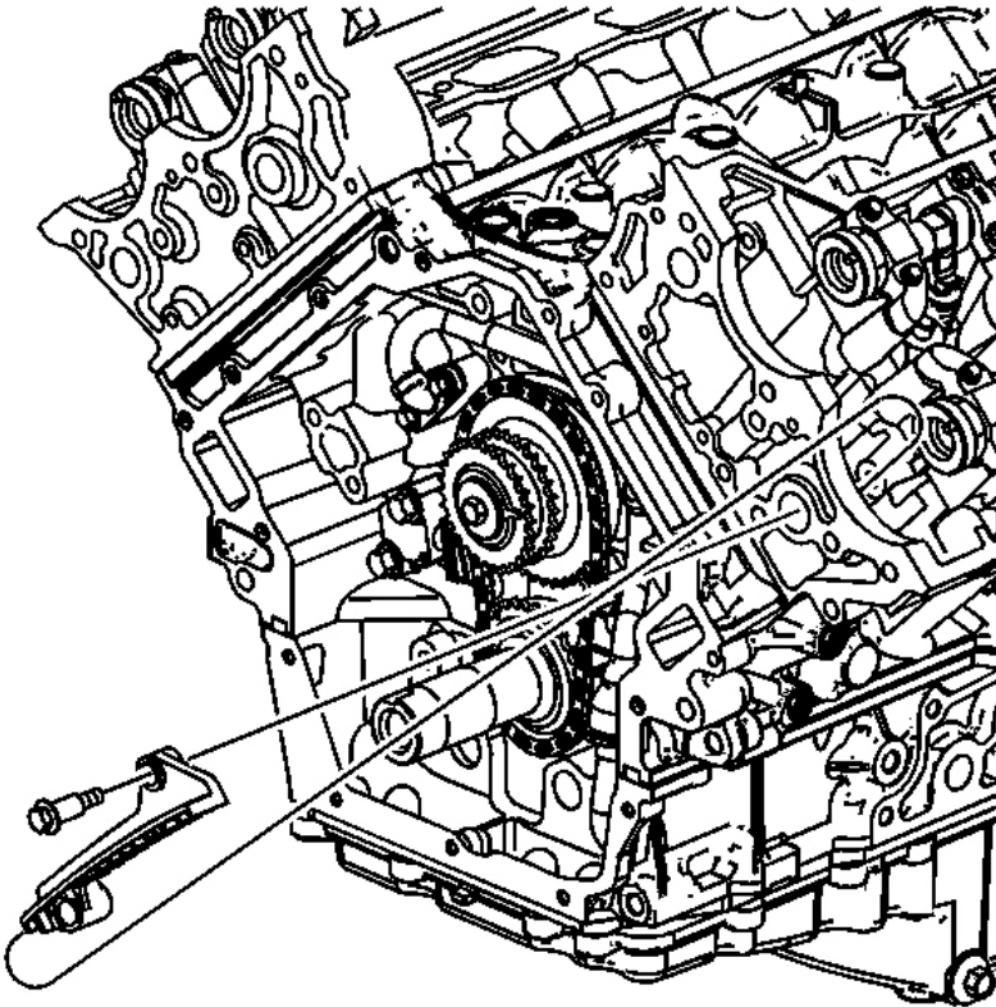


Fig. 272: View Of Left Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

1. Install the left secondary camshaft drive chain guide.

2. Loosely install the lower left secondary camshaft drive chain guide bolt.

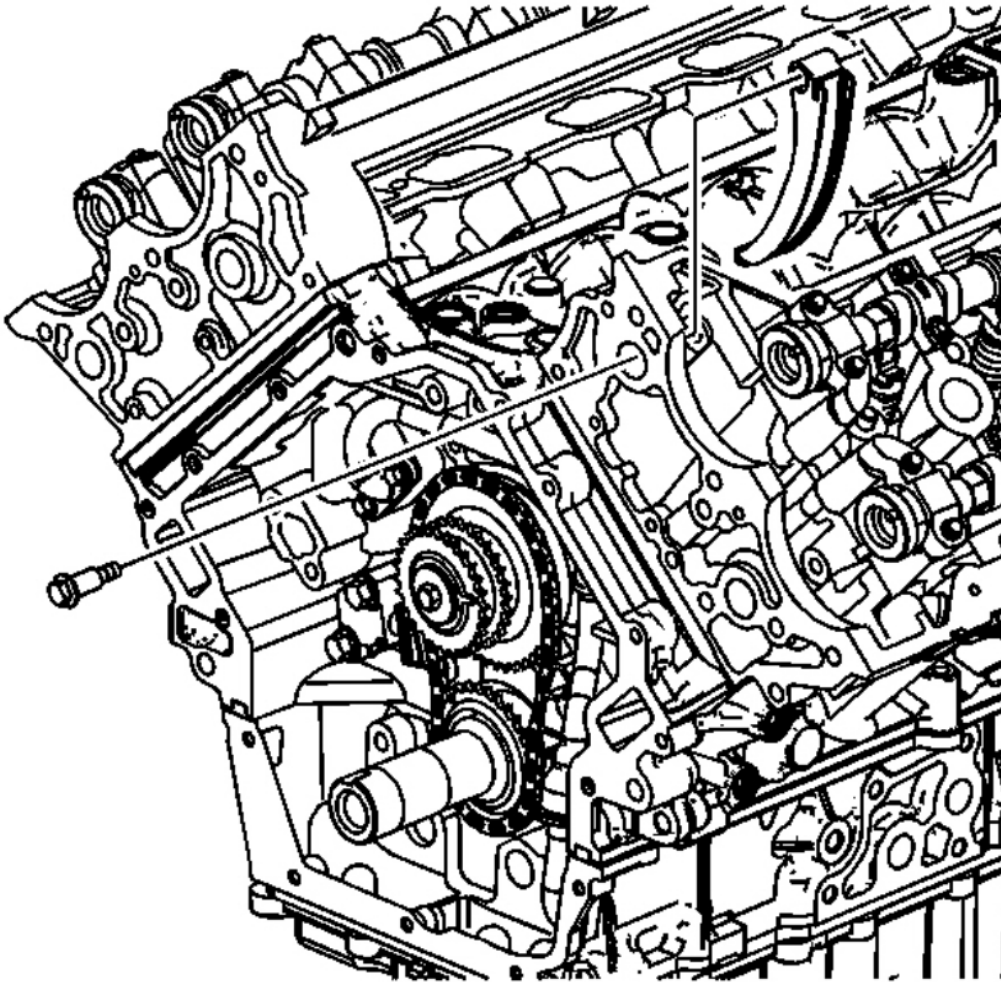


Fig. 273: View Of Left Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

3. Install the left secondary camshaft drive chain shoe.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the left secondary camshaft drive chain shoe bolt.

Tighten: Tighten the left secondary camshaft drive chain shoe bolt to 25 N.m (18 lb ft).

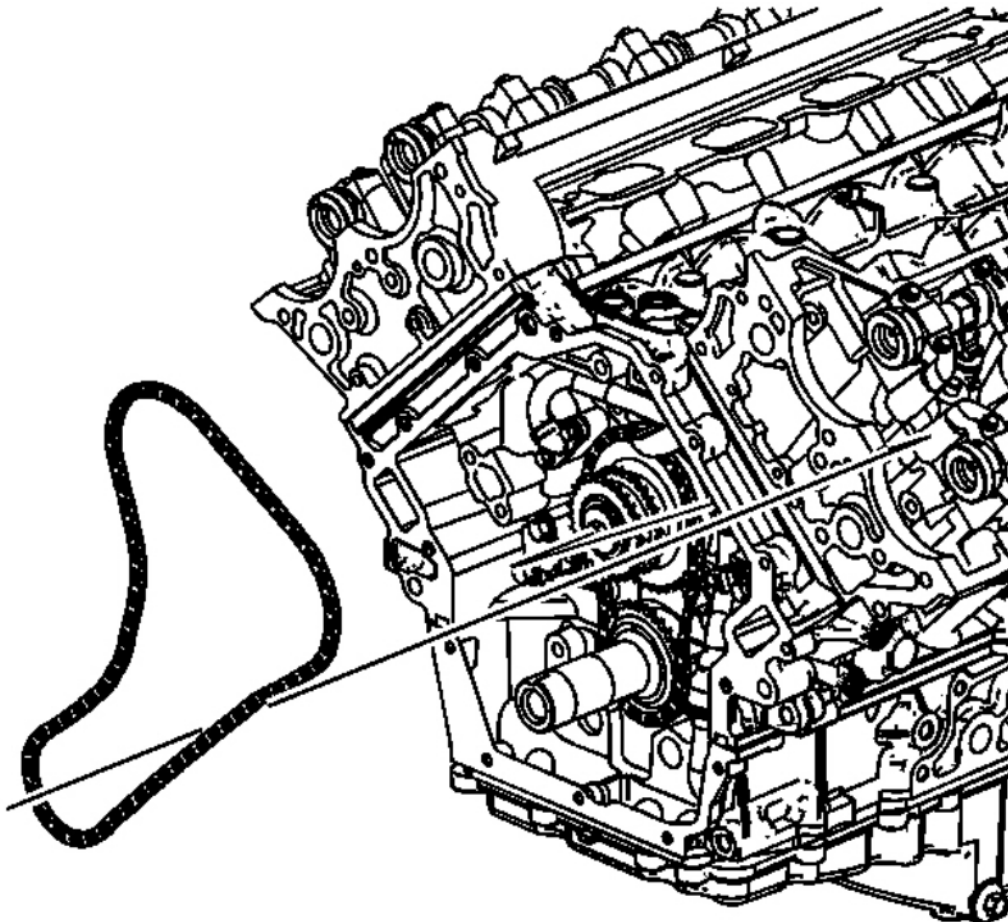


Fig. 274: View Of Left Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

5. Install the left secondary camshaft drive chain by sliding the chain down through the left cylinder head and placing the chain on the end of the camshafts.
6. Route the left secondary camshaft drive chain around the inner row of the intermediate drive chain sprocket teeth.

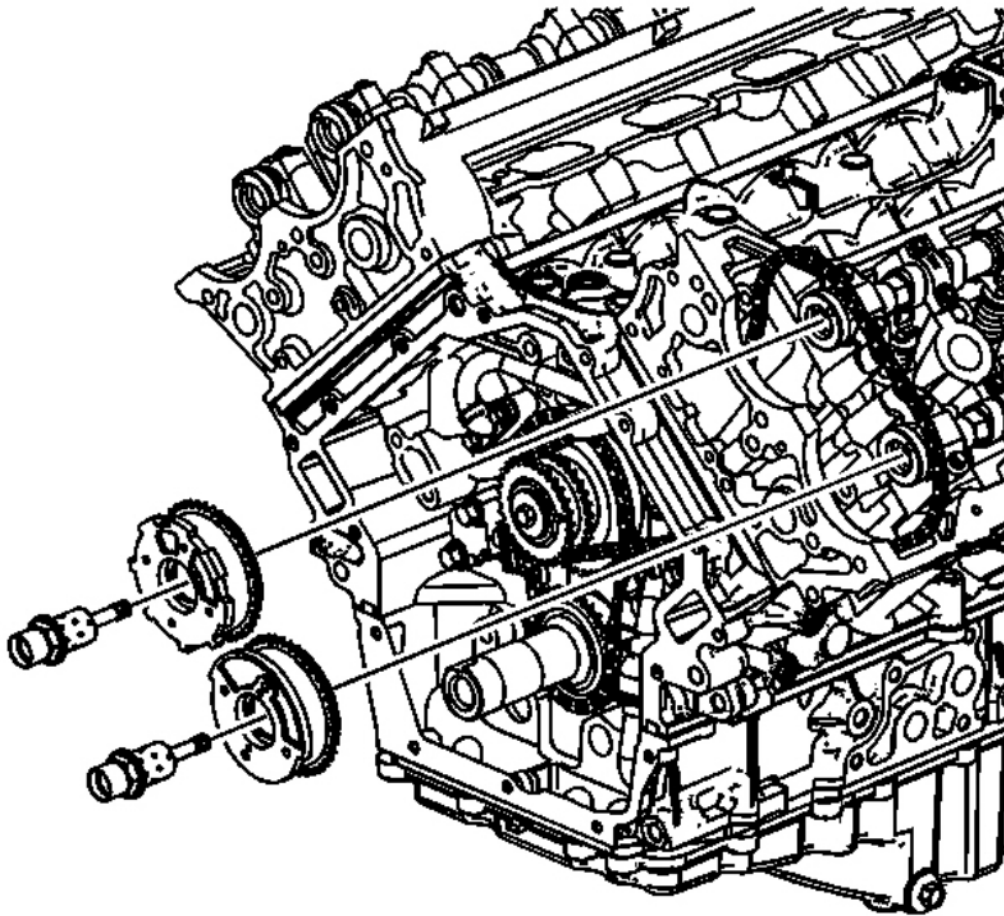


Fig. 275: View Of Left Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

7. Install the left intake and exhaust camshaft position actuators into the left secondary camshaft drive chain.

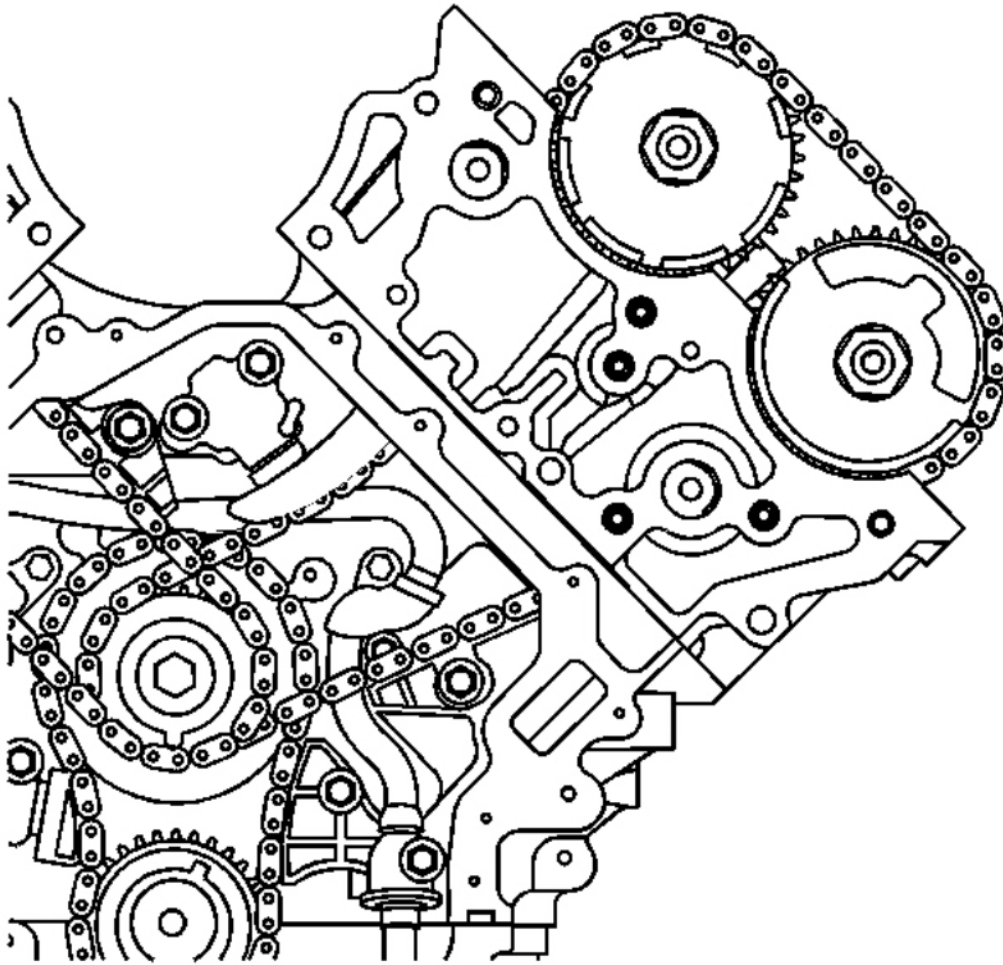


Fig. 276: View Of Left Camshaft Sprockets
Courtesy of GENERAL MOTORS CORP.

8. Install the left intake and exhaust camshaft sprockets onto the camshafts. The camshaft sprocket notch marked "LI" which indicates left intake, engages the intake camshaft pin and the camshaft sprocket notch marked "LE" which indicates left exhaust, engages the exhaust camshaft pin.

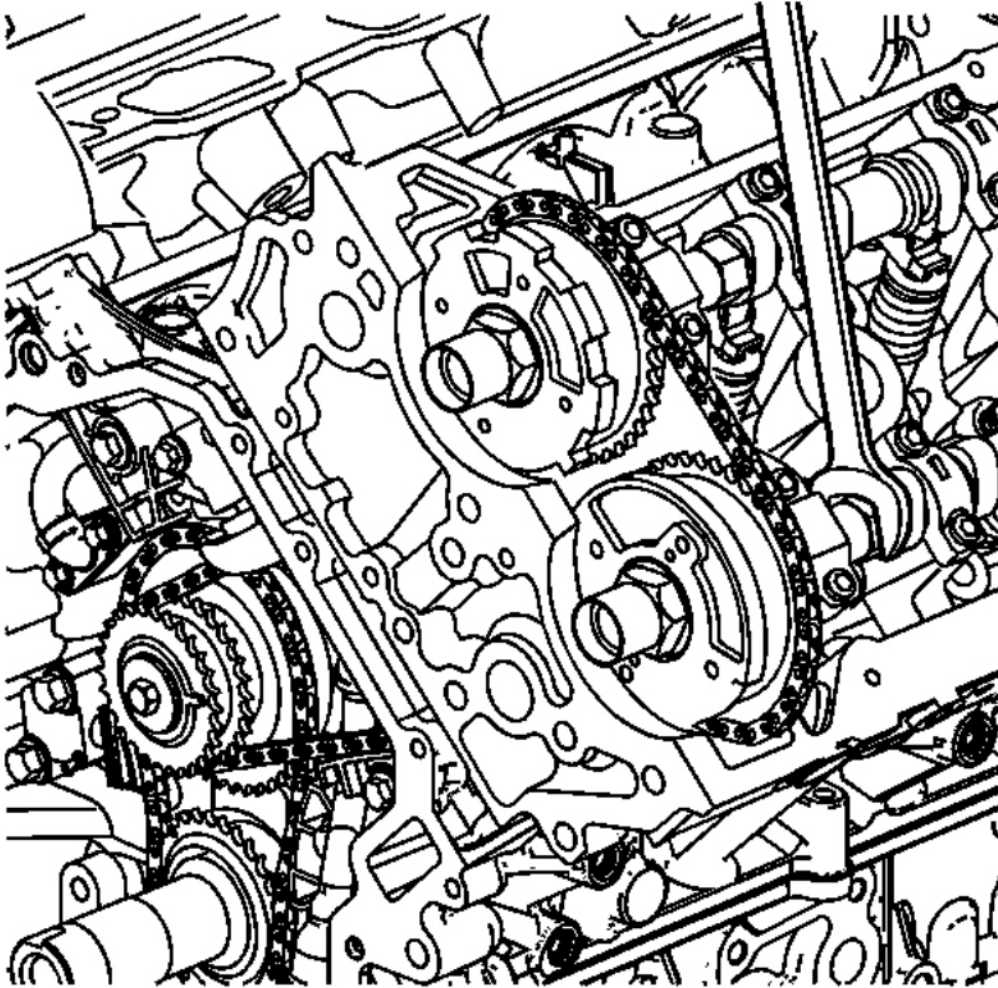


Fig. 277: Aligning Left Sprocket Notch To Camshaft Pin
Courtesy of GENERAL MOTORS CORP.

9. If necessary, use an open wrench on the hex cast near the front of each camshaft to help align the sprocket notch to the camshaft pin.
10. Loosely install the left intake and exhaust camshaft position actuator oil control valves.

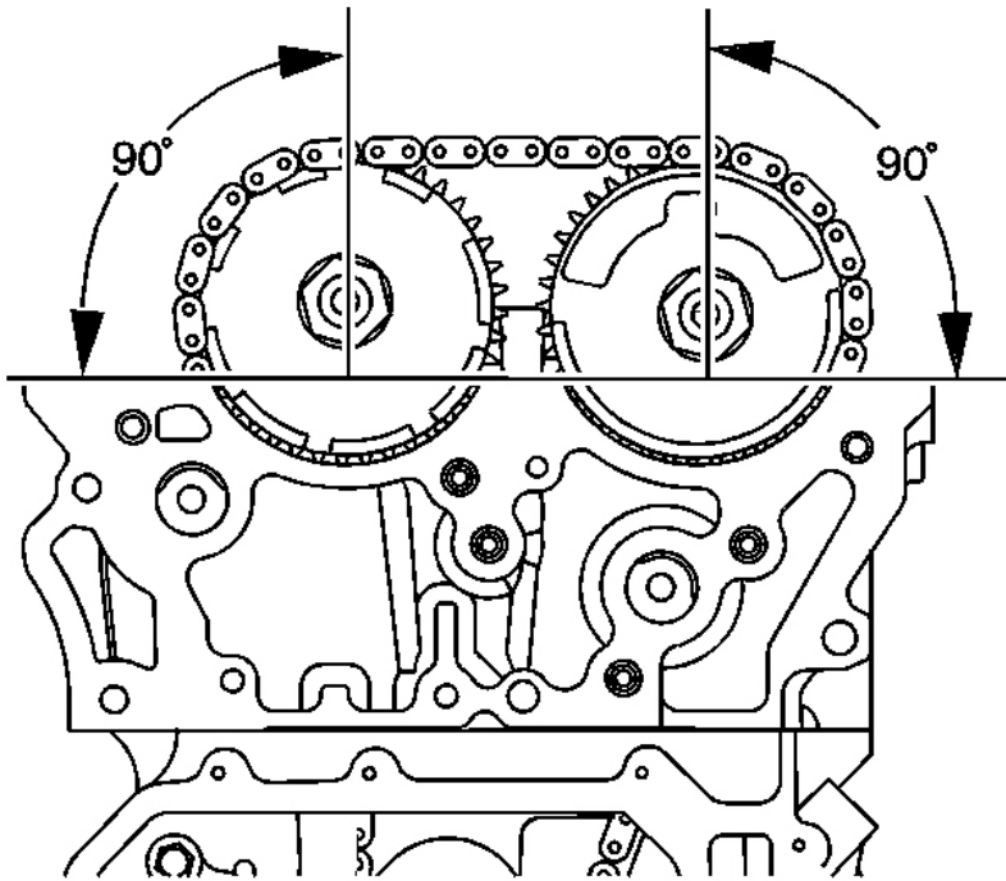


Fig. 278: Ensuring Proper Alignment Of Left Camshaft Sprocket Notches & Pins
Courtesy of GENERAL MOTORS CORP.

11. Ensure the perpendicular alignment of the left intake and exhaust camshaft sprocket notches and camshaft pins to the cylinder head.

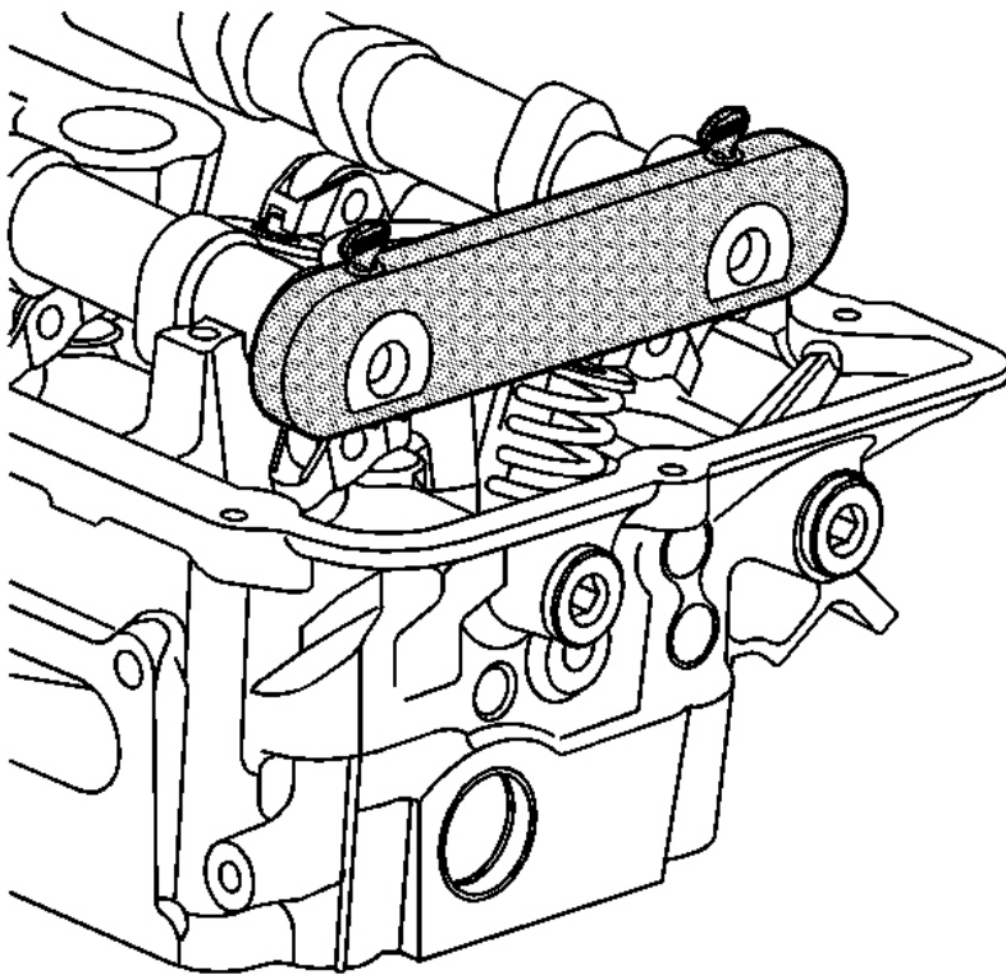


Fig. 279: View Of EN 46328 - Left
Courtesy of GENERAL MOTORS CORP.

12. Install the **EN 46328** to the left cylinder head camshafts.

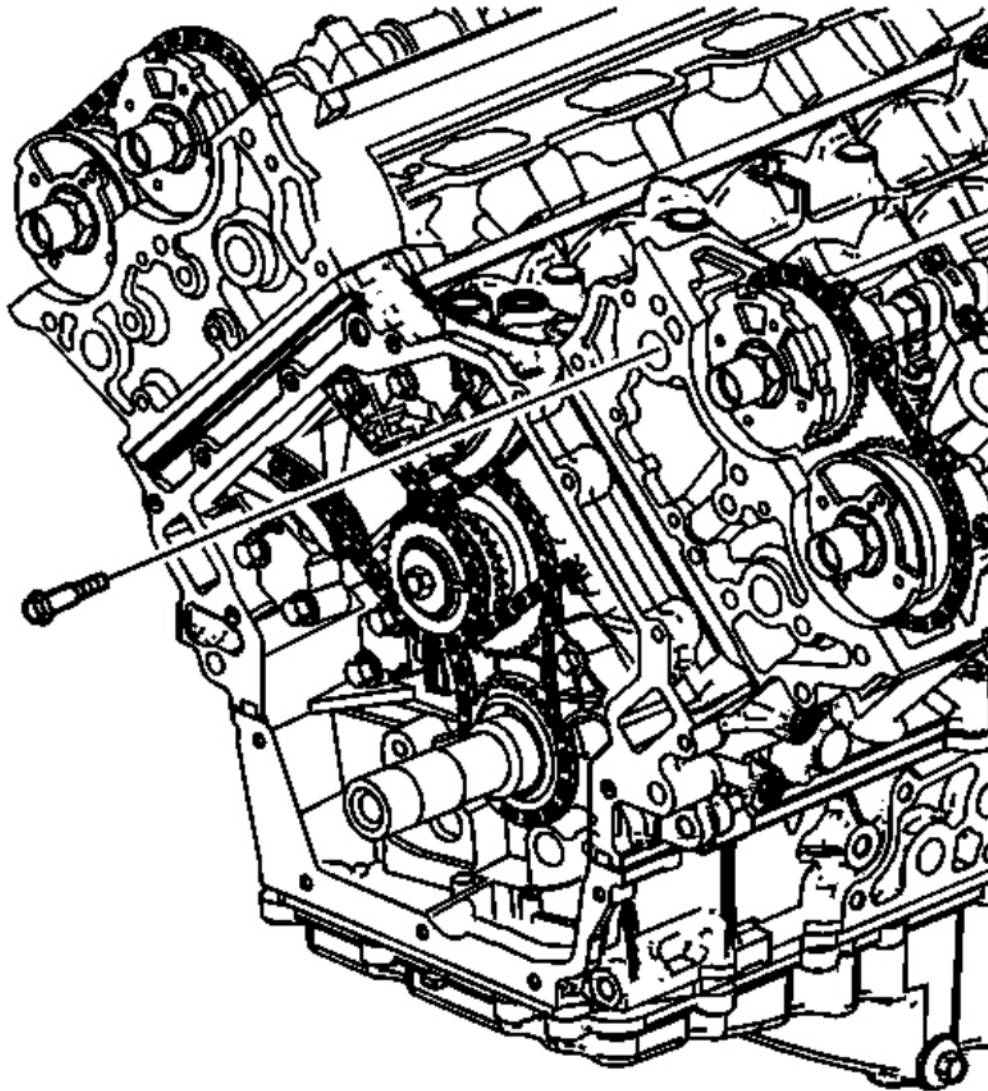


Fig. 280: View Of Upper Left Secondary Camshaft Drive Chain Guide Bolt
Courtesy of GENERAL MOTORS CORP.

13. Install the upper left secondary camshaft drive chain guide bolt.

Tighten: Tighten BOTH the upper and lower left secondary camshaft drive chain guide bolts to 25 N.m (18 lb ft).

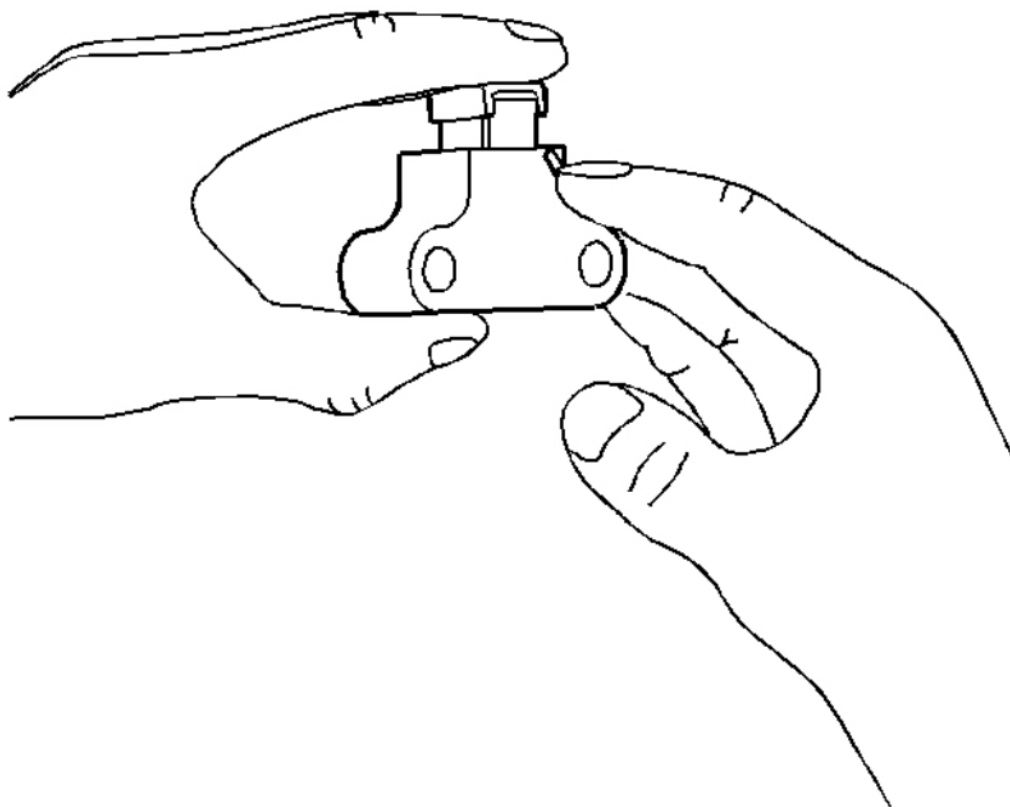


Fig. 281: Collapsing Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

14. Collapse the left secondary camshaft drive chain tensioner using the following procedure:
 1. Rotate the ratchet release lever counterclockwise and hold.
 2. Collapse the left secondary camshaft drive chain tensioner shoe and hold.
 3. Release the ratchet lever and slowly release the pressure on the shoe.
15. When the ratchet lever moves to the first detent a click should be heard and felt. Insert a pin through the hole in the release lever in order to lock the left secondary camshaft drive chain tensioner shoe in the collapsed position.

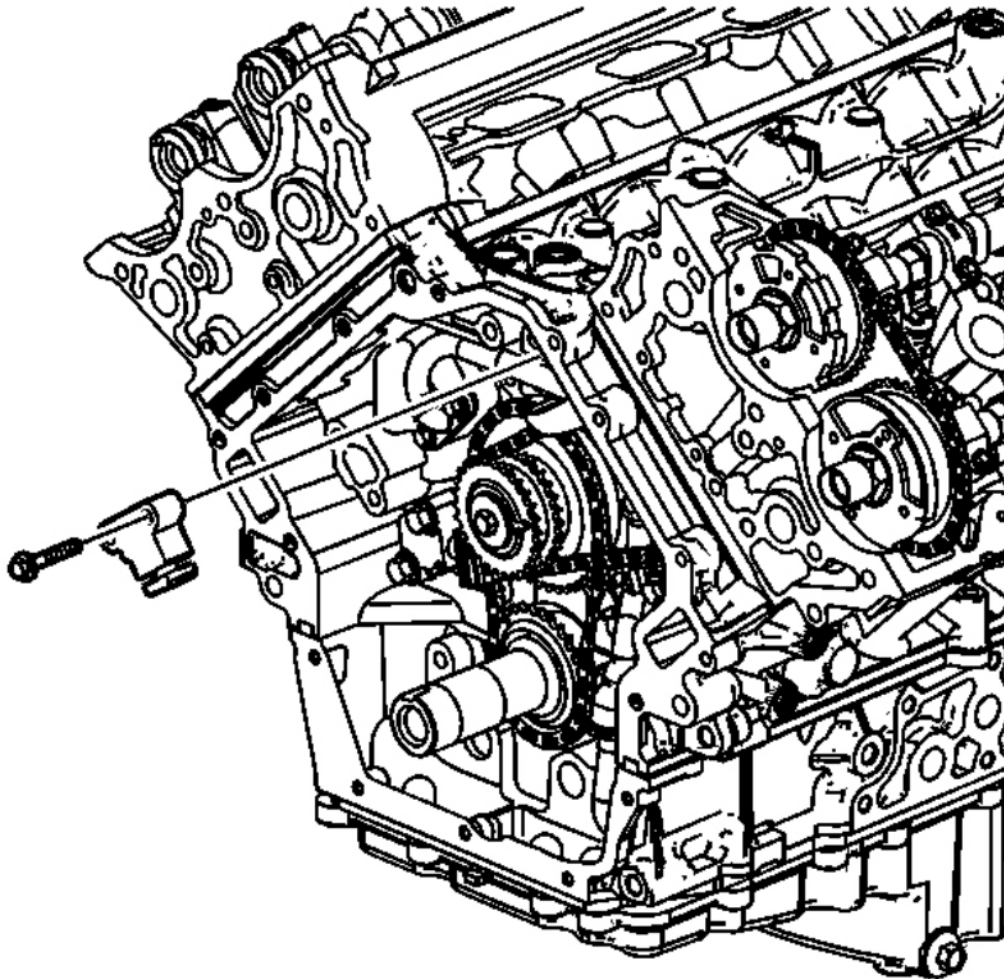


Fig. 282: View Of Left Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the left secondary camshaft drive chain tensioner release lever is facing out.

16. Install the left secondary camshaft drive chain tensioner.
17. Install the left secondary camshaft drive chain tensioner bolts.

Tighten: Tighten the left secondary camshaft drive chain tensioner bolts to 25 N.m (18 lb

ft).

18. Remove pin from left secondary camshaft drive chain tensioner lever.

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT

Tools Required:

EN 46328 Camshaft Holding Tool

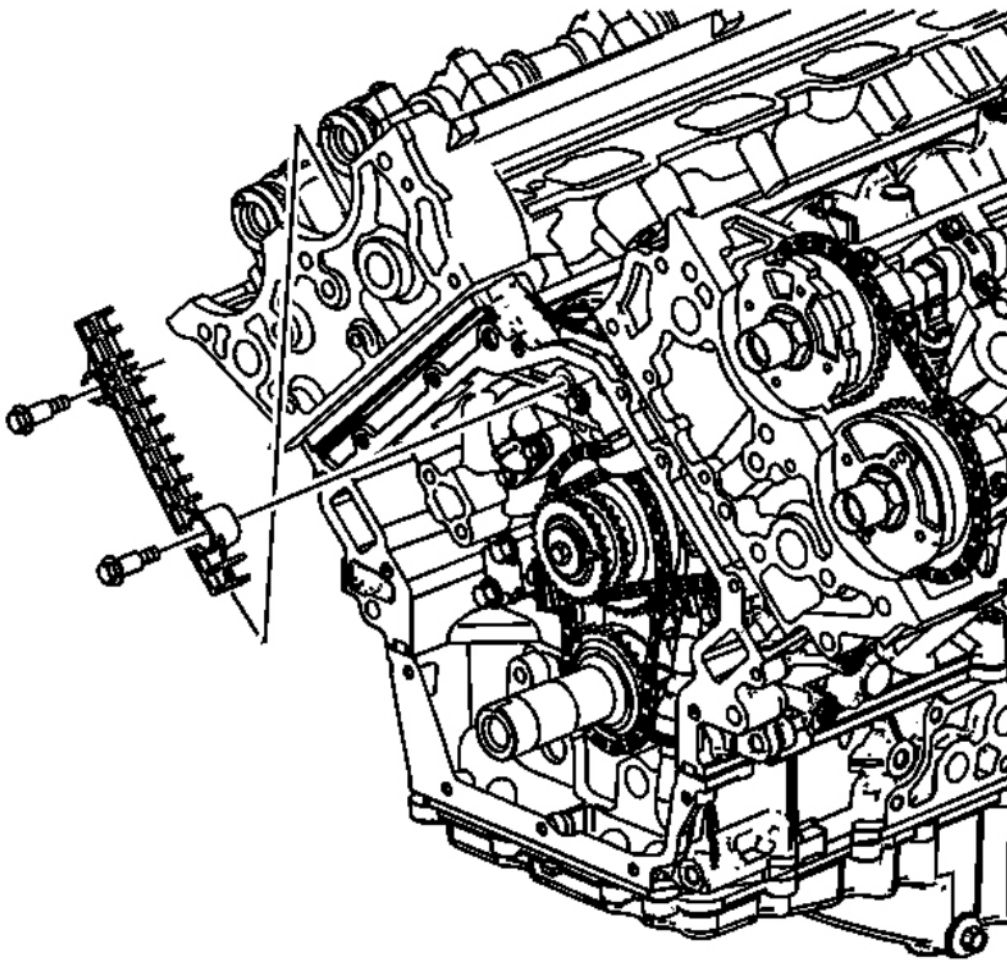


Fig. 283: View Of Right Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

1. Install the right secondary camshaft drive chain guide.
2. Loosely install the lower right secondary camshaft drive chain guide bolt.

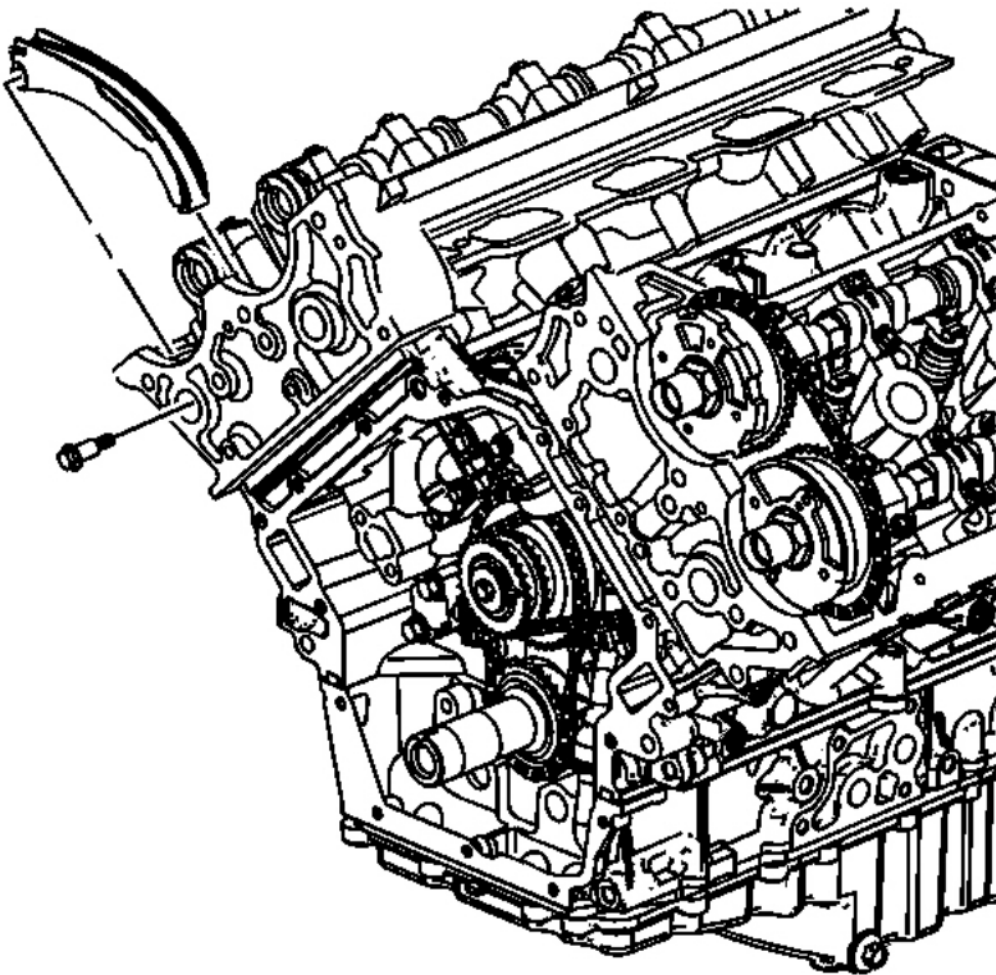


Fig. 284: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

3. Install the right secondary camshaft drive chain shoe.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the right secondary camshaft drive chain shoe bolt.

Tighten: Tighten the right secondary camshaft drive chain shoe bolt to 25 N.m (18 lb ft).

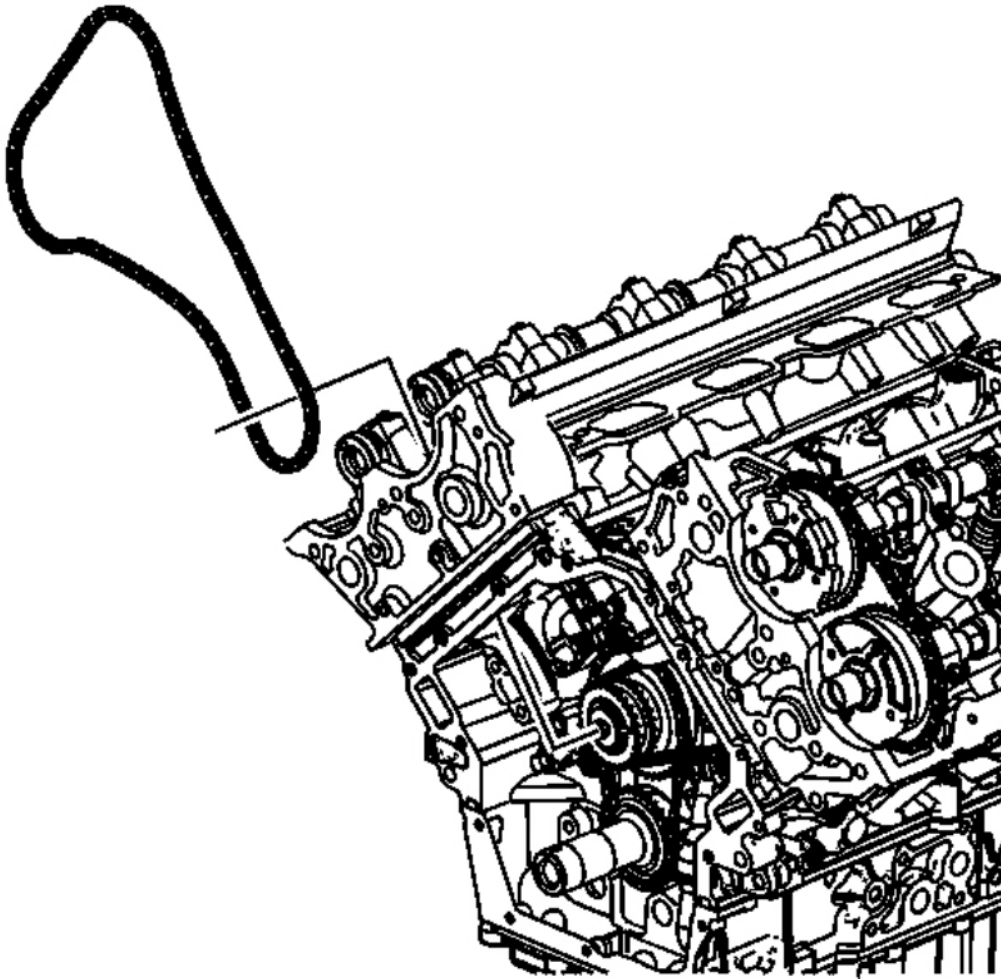


Fig. 285: View Of Right Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

5. Install the right secondary camshaft drive chain by sliding the chain down through the right cylinder head and placing the chain on the end of the camshafts.
6. Route the right secondary camshaft drive chain around the outer row of the intermediate drive chain sprocket teeth.

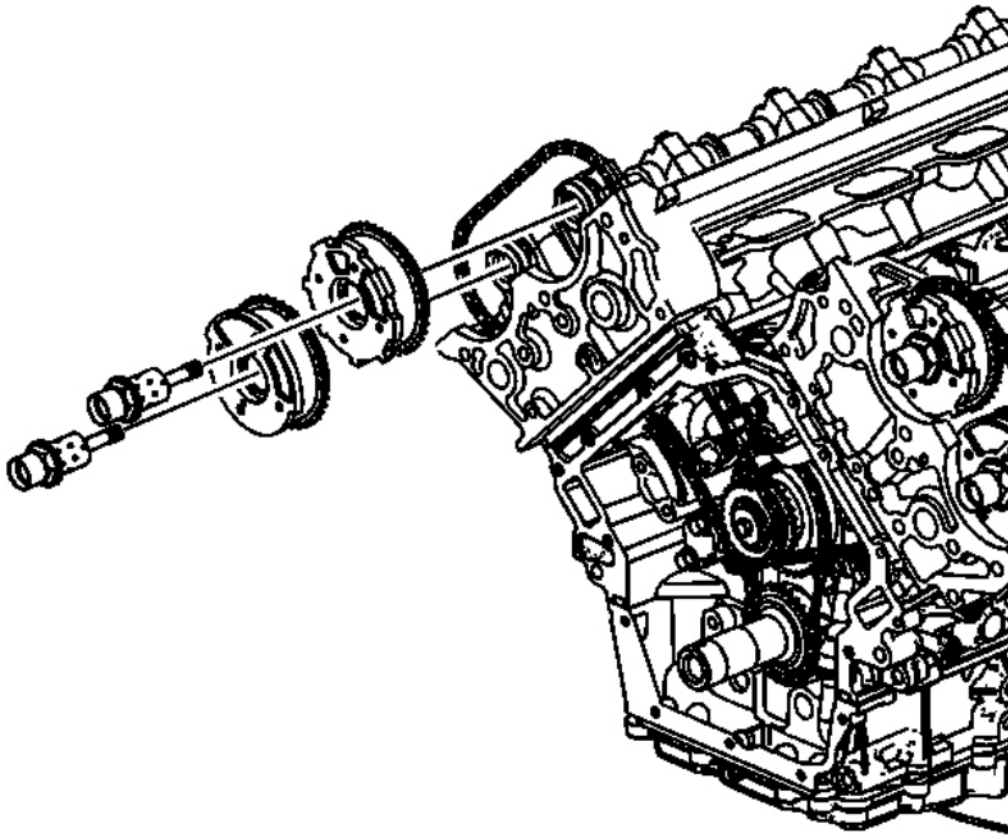


Fig. 286: View Of Right Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

7. Install the right intake and exhaust camshaft position actuators into the right secondary camshaft drive chain.

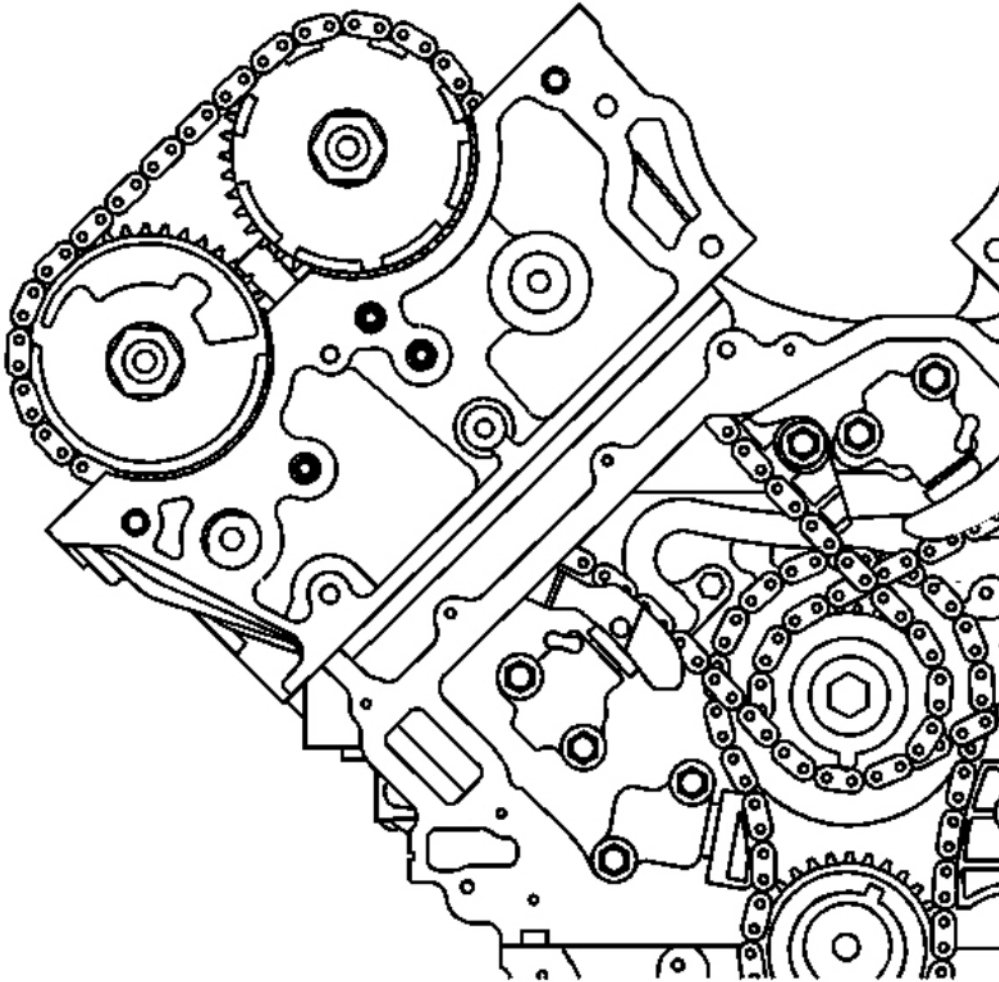


Fig. 287: Installing Right Camshaft Actuators
Courtesy of GENERAL MOTORS CORP.

8. Install the right intake and exhaust camshafts onto the camshafts. The camshaft sprocket notch marked "RI" which indicates right intake, engages the intake camshaft pin and the camshaft sprocket notch marked "RE" which indicates right exhaust, engages the exhaust camshaft pin.

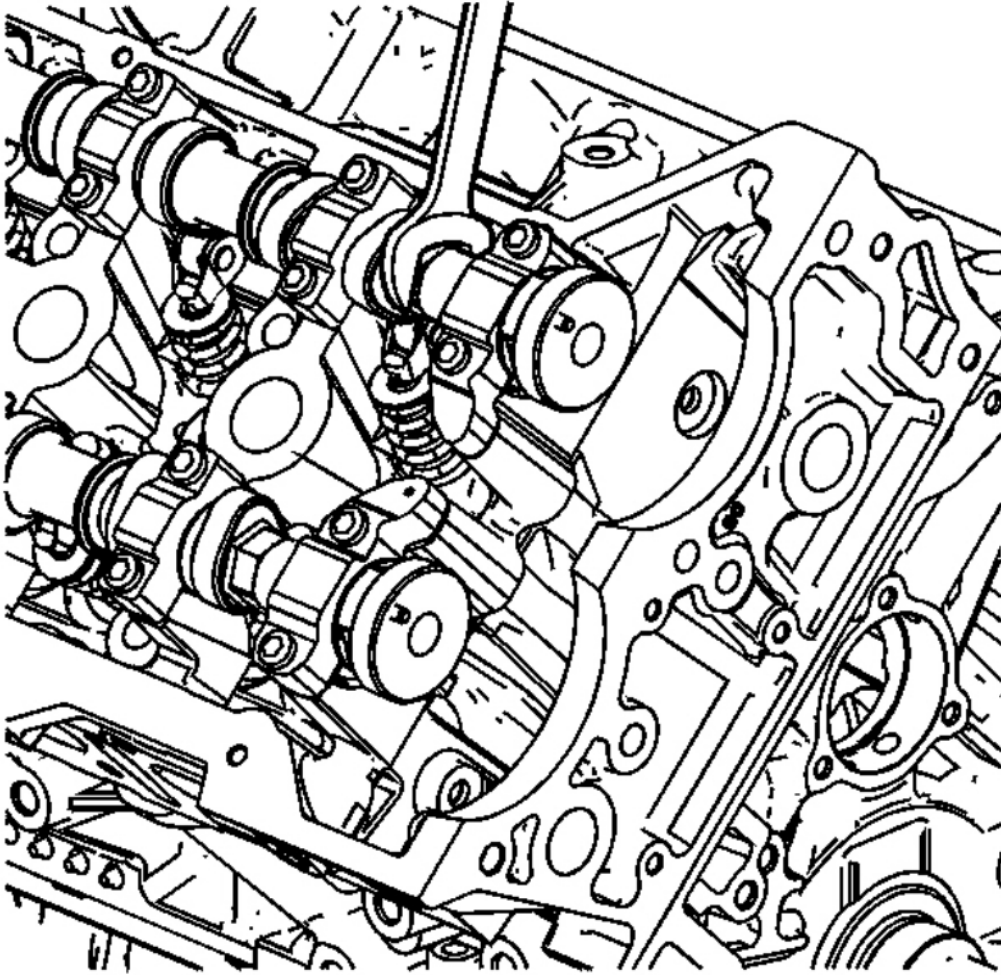


Fig. 288: Aligning Right Sprocket Notch To Camshaft Pin
Courtesy of GENERAL MOTORS CORP.

9. If necessary, use an open wrench on the hex cast near the front of each camshaft to help align the sprocket notch to the camshaft pin.
10. Loosely install the right intake and exhaust camshaft position actuator oil control valves.

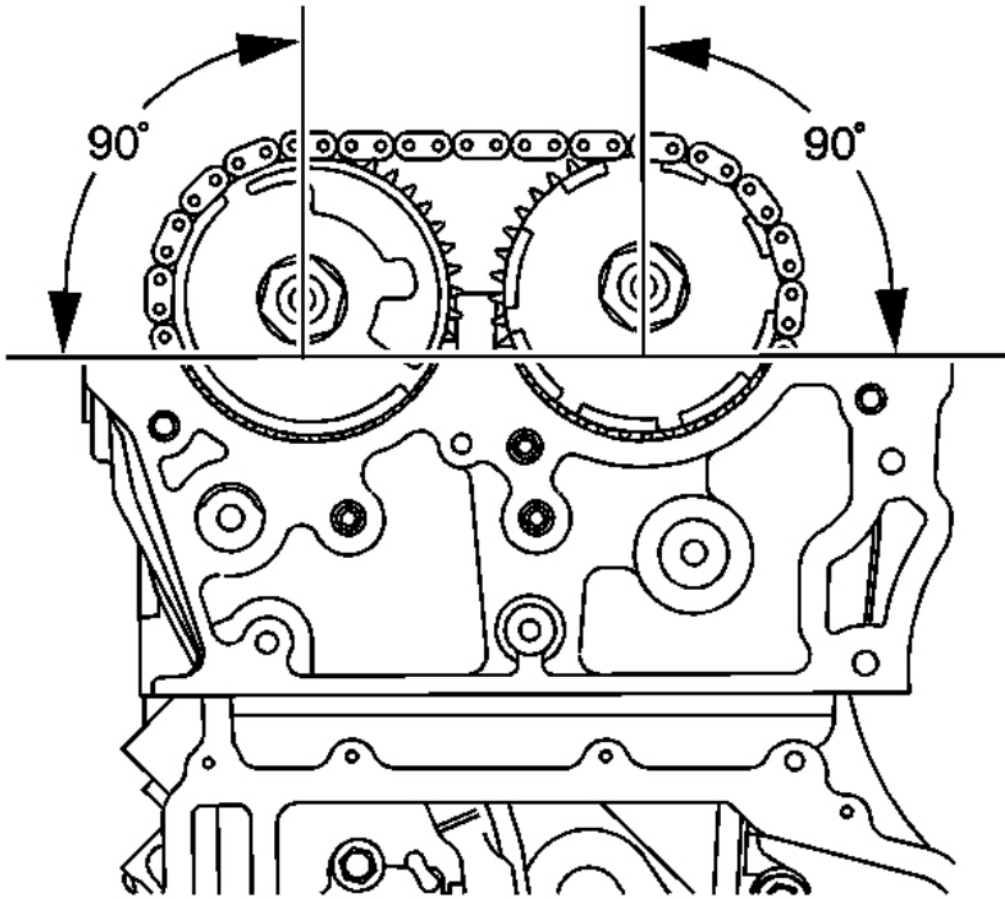


Fig. 289: Ensuring Proper Alignment Of Right Camshaft Sprocket Notches & Pins
Courtesy of GENERAL MOTORS CORP.

11. Ensure the perpendicular alignment of the right intake and exhaust camshaft sprocket notches and camshaft pins to the cylinder head.

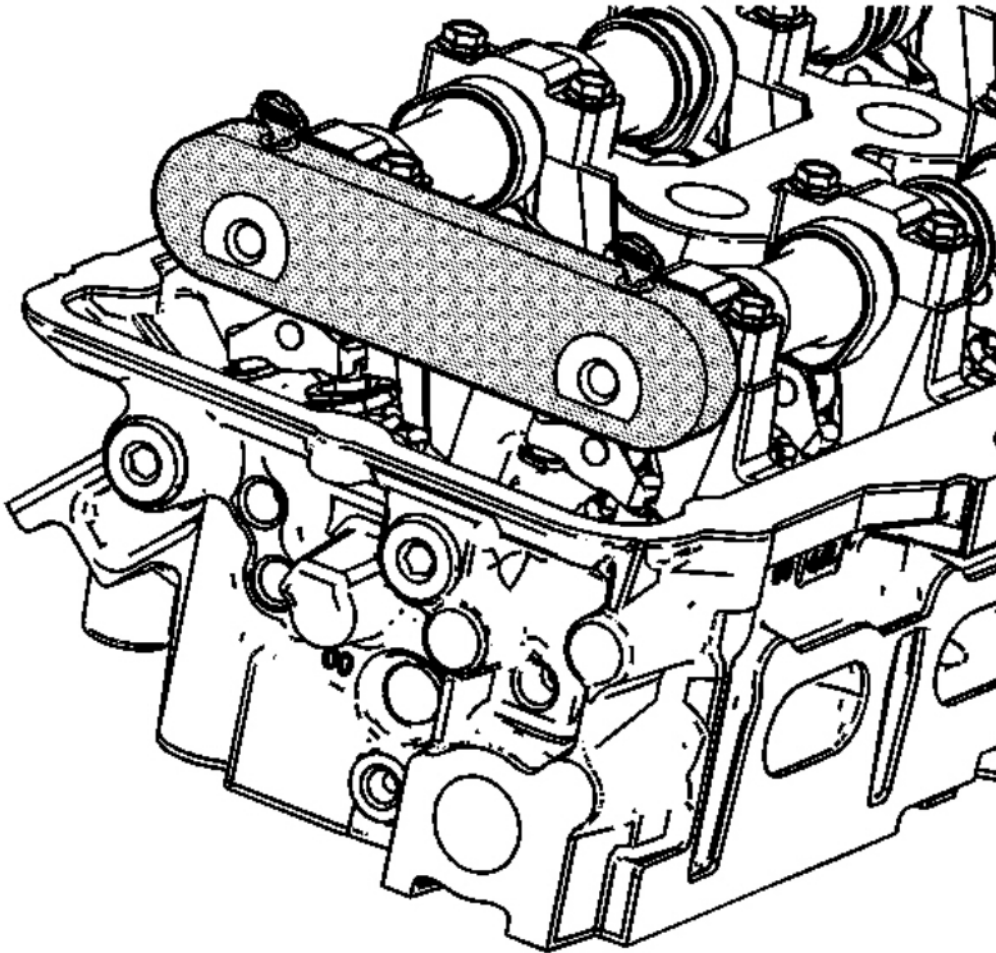


Fig. 290: View Of EN 46328 - Right
Courtesy of GENERAL MOTORS CORP.

12. Install the EN 46328 to the right cylinder head camshafts.

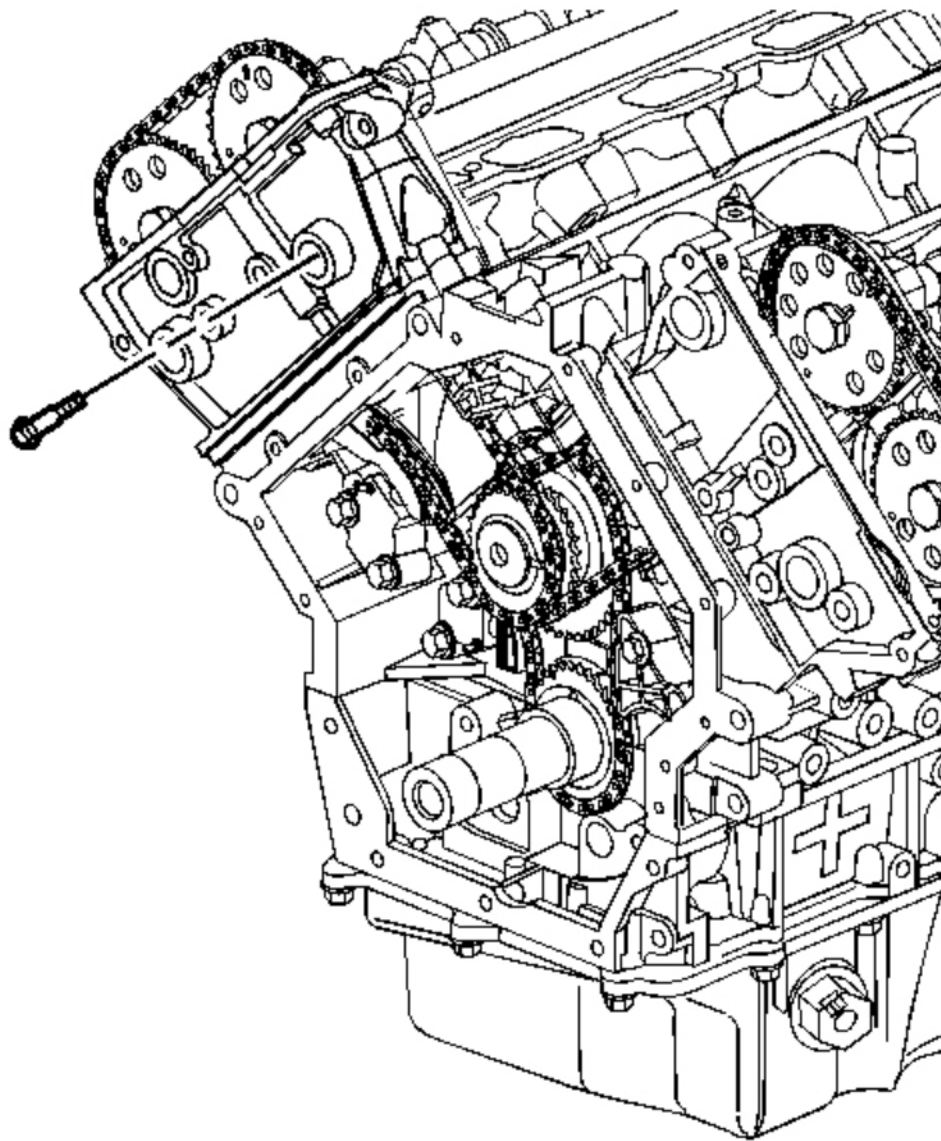


Fig. 291: View Of Upper Right Secondary Camshaft Drive Chain Guide Bolt
Courtesy of GENERAL MOTORS CORP.

13. Install the upper right secondary camshaft drive chain guide bolt.

Tighten: Tighten BOTH the upper and lower right secondary camshaft drive chain guide

bolts to 25 N.m (18 lb ft).

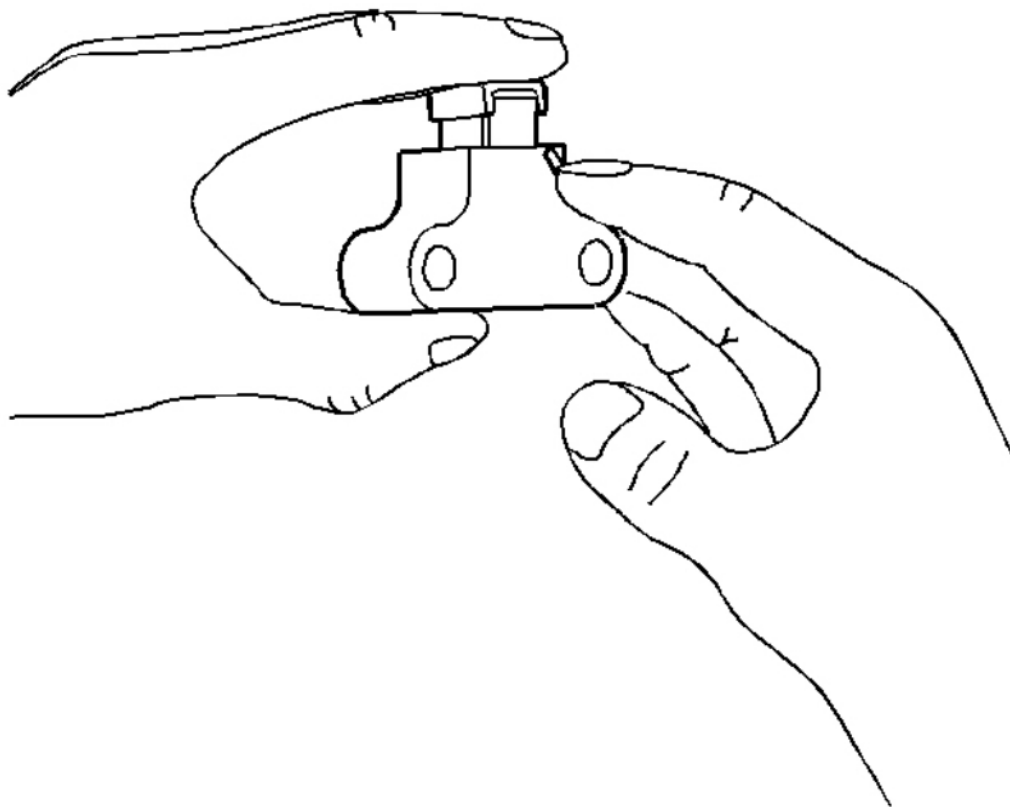


Fig. 292: Collapsing Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

14. Collapse the right secondary camshaft drive chain tensioner using the following procedure:
 1. Rotate the ratchet release lever counter-clockwise and hold.
 2. Collapse the right secondary camshaft drive chain tensioner shoe and hold.
 3. Release the ratchet lever and slowly release the pressure on the shoe.
15. When the ratchet lever moves to the first detent a click should be heard and felt. Insert a pin through the hole in the release lever in order to lock the right secondary camshaft drive chain tensioner shoe in the collapsed position.

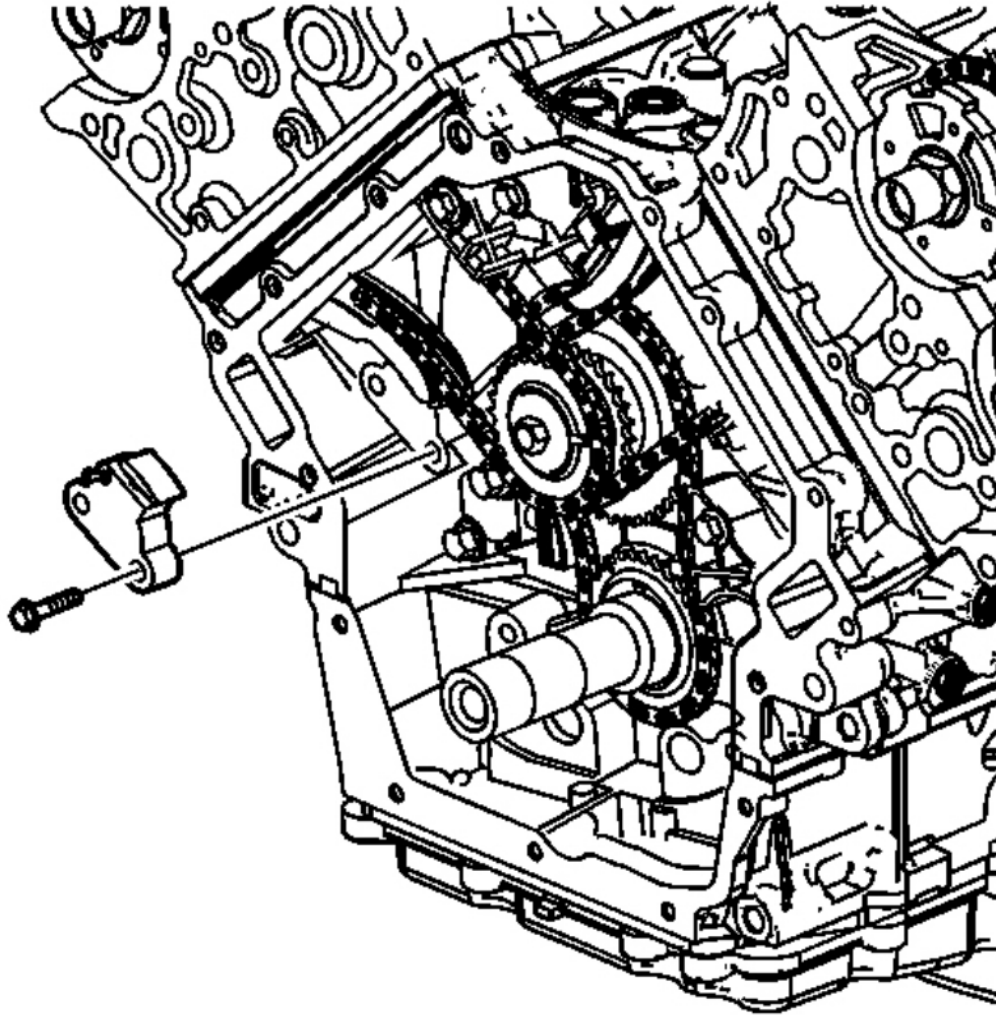


Fig. 293: View Of Right Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Ensure the right secondary camshaft drive chain tensioner release lever is facing out.

16. Install the right secondary camshaft drive chain tensioner.
17. Install the right secondary camshaft drive chain tensioner bolts.

Tighten: Tighten the right secondary camshaft drive chain tensioner bolts to 25 N.m (18 lb ft).

18. Remove pin from right secondary camshaft drive chain tensioner lever.

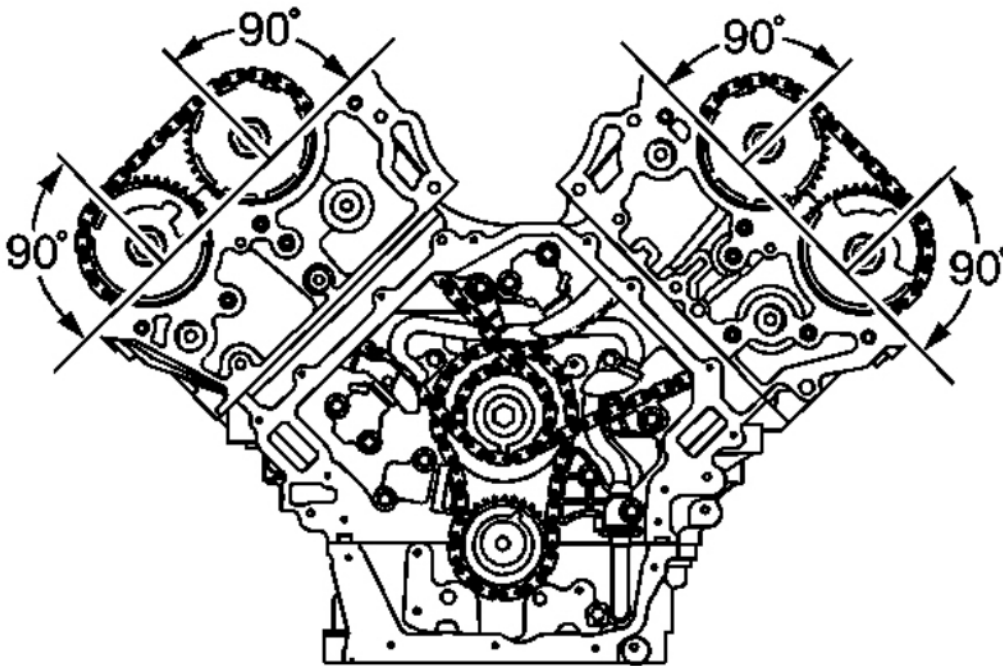


Fig. 294: Ensuring Correct Alignment Of All Secondary Timing Components
Courtesy of GENERAL MOTORS CORP.

19. Ensure the correct alignment of all secondary timing components.

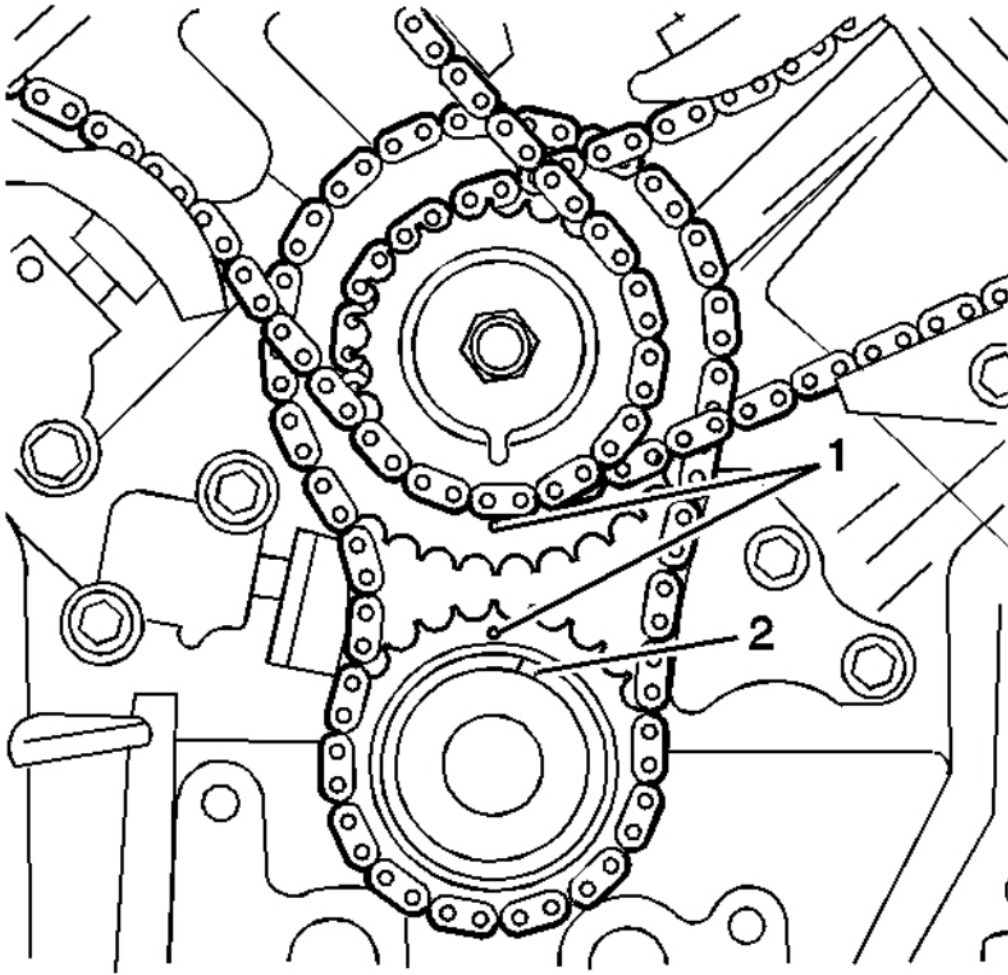


Fig. 295: Identifying Primary Timing Gear Alignment Marks
Courtesy of GENERAL MOTORS CORP.

20. Ensure the correct alignment of all primary timing components (1, 2).

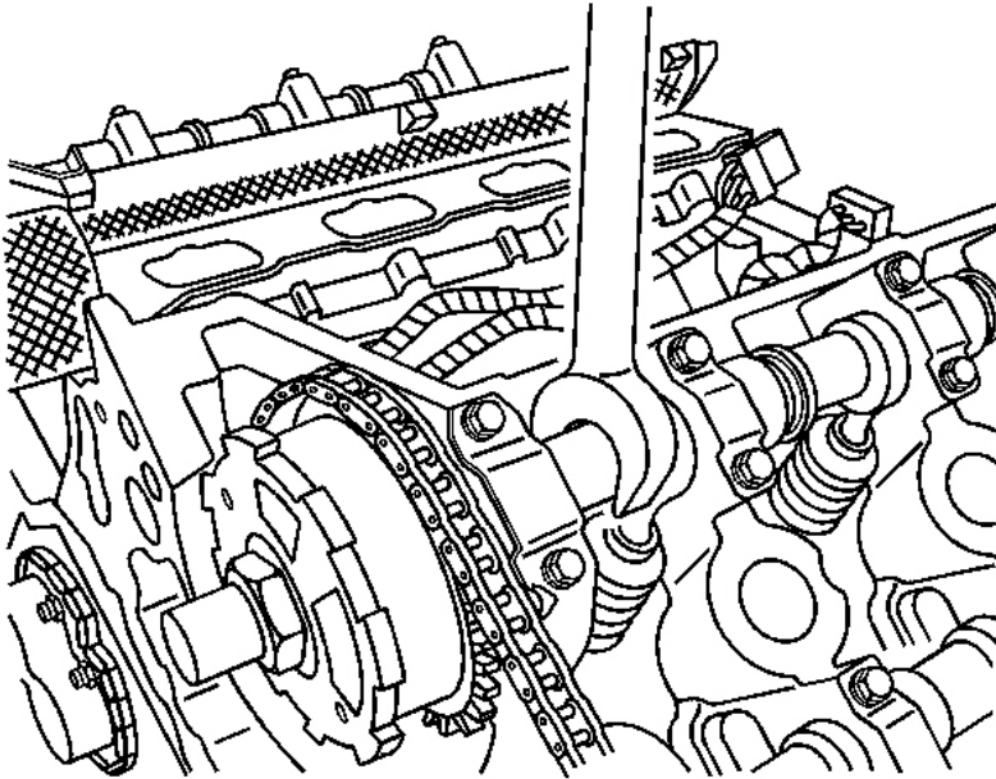


Fig. 296: Holding Camshaft
Courtesy of GENERAL MOTORS CORP.

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

21. Use an open end wrench on the hex cast into the left intake camshaft, in order to prevent the camshaft from rotating, when tightening the camshaft position actuator oil control valve on the left intake camshaft.
22. Tighten the camshaft position actuator oil control valve on the left intake camshaft.

Tighten: Tighten the camshaft position actuator oil control valve to 120 N.m (90 lb ft).

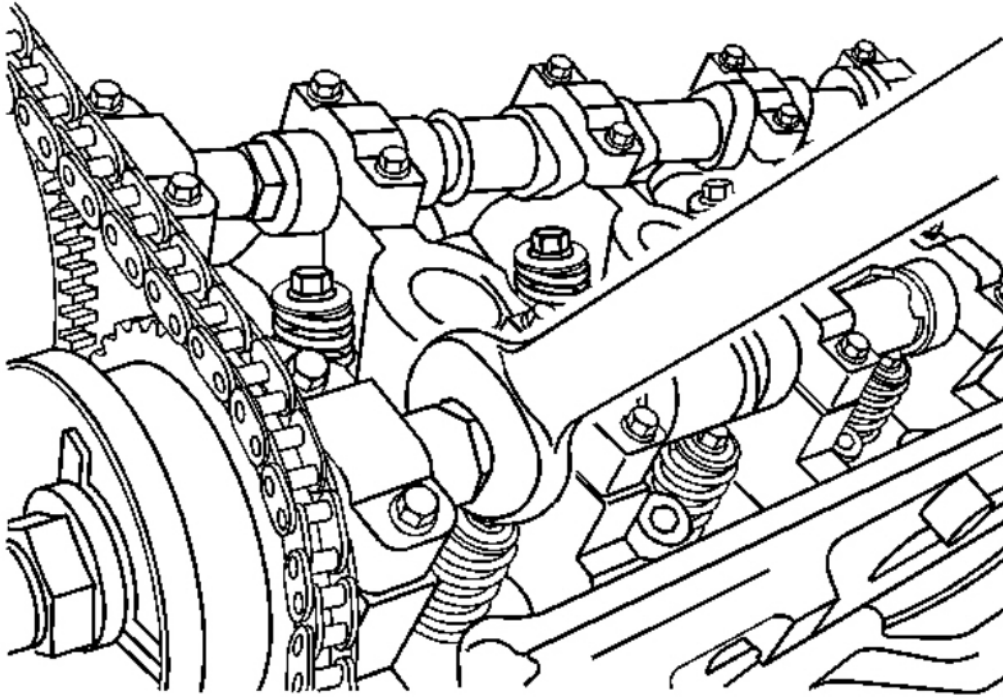


Fig. 297: Holding Camshaft In Position
Courtesy of GENERAL MOTORS CORP.

23. Use an open end wrench on the hex cast into the left exhaust camshaft, in order to prevent the camshaft from rotating, when tightening the camshaft position oil actuator control valve on the left exhaust camshaft.
24. Tighten the camshaft position oil actuator control valve on the left exhaust camshaft.

Tighten: Tighten the camshaft position actuator oil control valve to 120 N.m (90 lb ft).

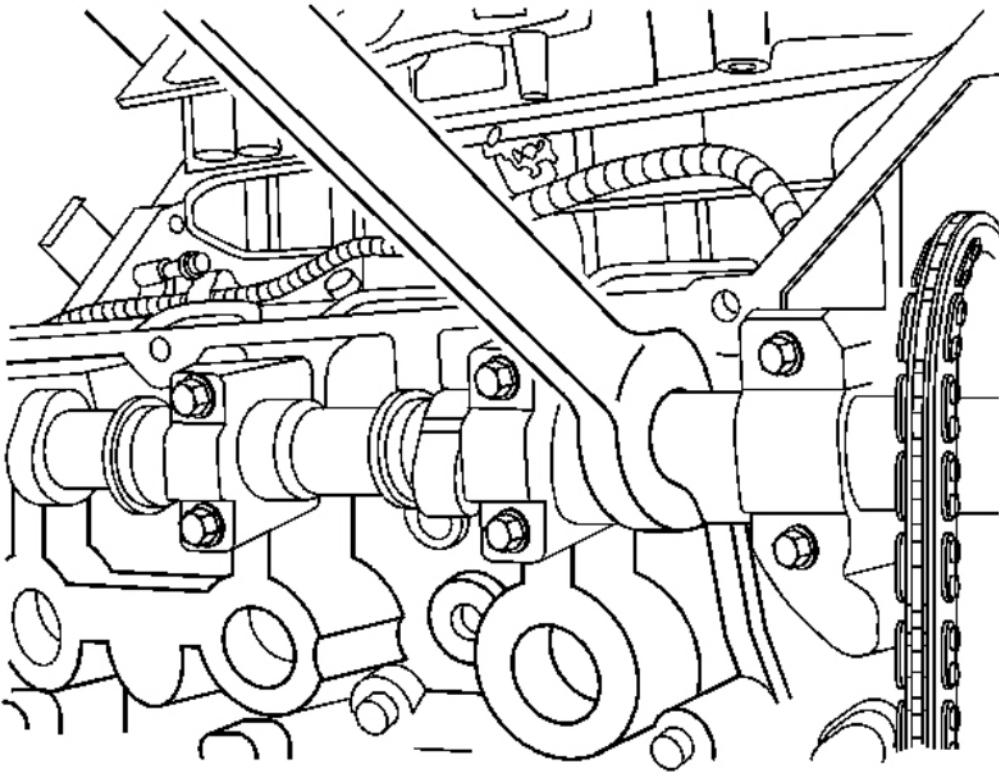


Fig. 298: Holding Camshaft In Position
Courtesy of GENERAL MOTORS CORP.

25. Use an open end wrench on the hex cast into the right intake camshaft, in order to prevent the camshaft from rotating, when tightening the camshaft position actuator oil control valve on the right intake camshaft.
26. Tighten the camshaft position actuator oil control valve on the right intake camshaft.

Tighten: Tighten the camshaft position actuator oil control valve to 120 N.m (90 lb ft).

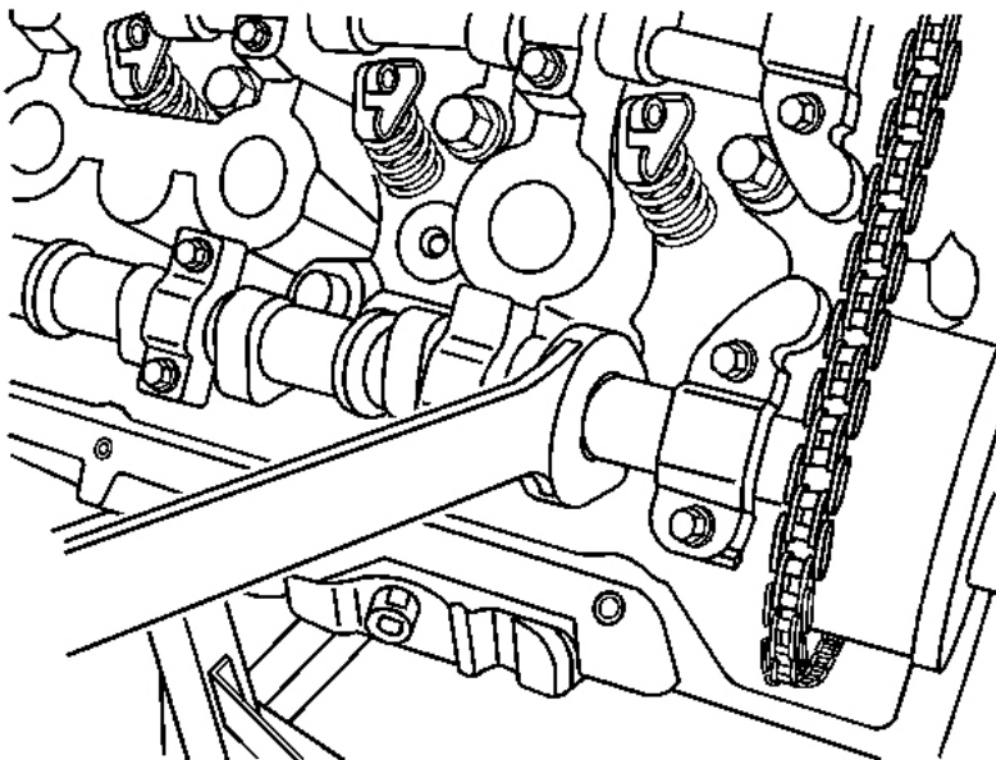


Fig. 299: Preventing Camshaft Rotation
Courtesy of GENERAL MOTORS CORP.

27. Use an open end wrench on the hex cast into the right exhaust camshaft, in order to prevent the camshaft from rotating, when tightening the camshaft position actuator oil control valve on the right exhaust camshaft.
28. Tighten the camshaft position actuator oil control valve on the right exhaust camshaft.

Tighten: Tighten the camshaft position actuator oil control valve to 120 N.m (90 lb ft).

OIL PUMP INSTALLATION

Tools Required:

J 45059 Torque Angle Meter

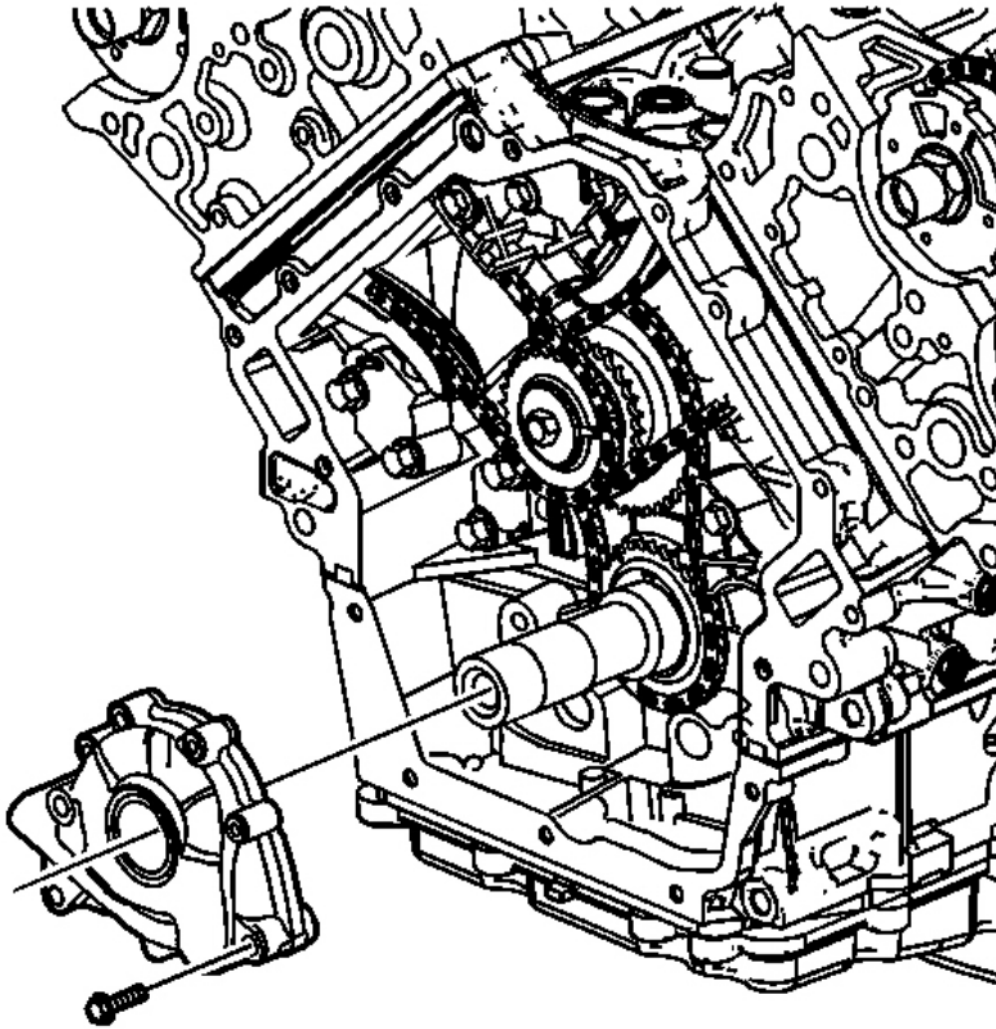


Fig. 300: View Of Oil Pump

Courtesy of GENERAL MOTORS CORP.

1. Install the oil pump drive spacer into the oil pump so that the drive flat engages the pump rotor.
2. Position the oil pump on the crankshaft.
3. Install the retaining bolts.

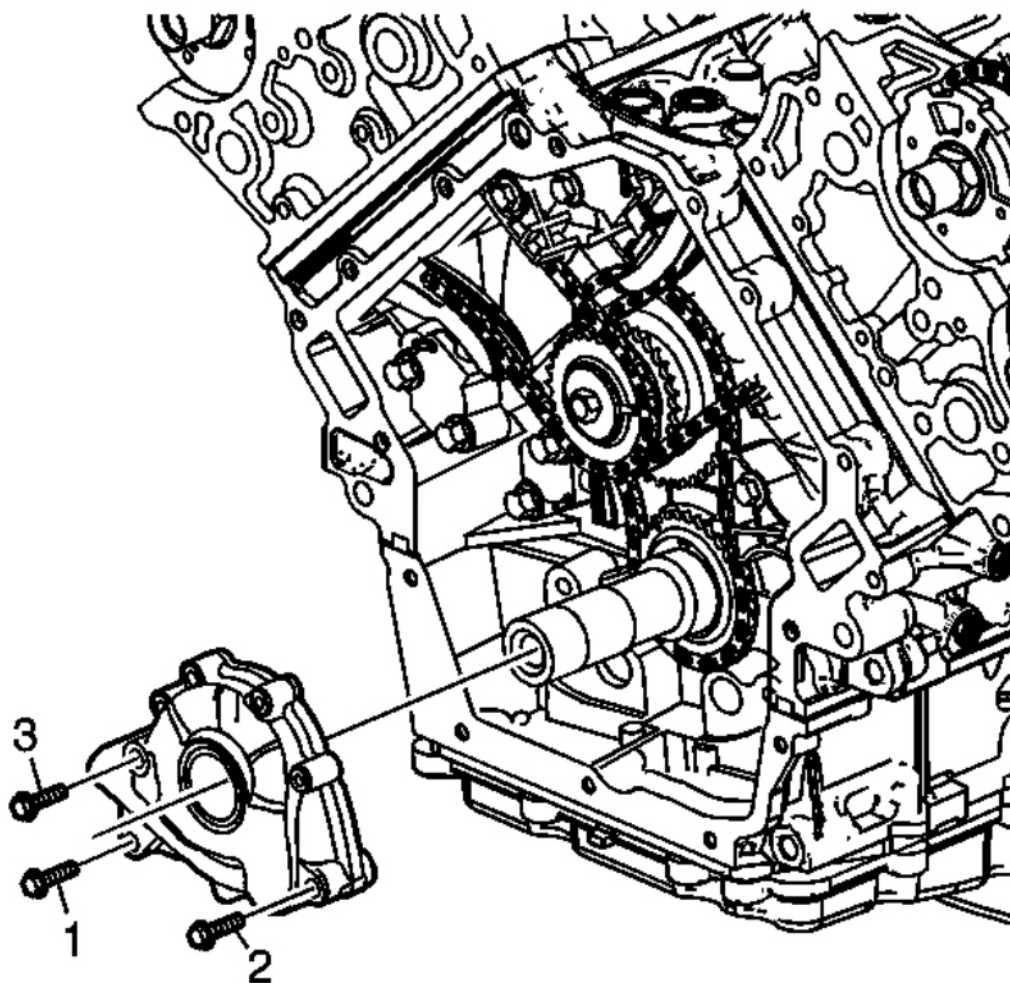


Fig. 301: View Of Oil Pump Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Apply upward pressure on the pump while tightening the three retaining bolts. Tighten the bolts in the sequence (1, 2, 3) shown.
 1. First Pass

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

2. Final Pass

Tighten: Tighten the oil pump mounting bolts in sequence an additional 35 degrees using the **J 45059** .

ENGINE FRONT COVER INSTALLATION

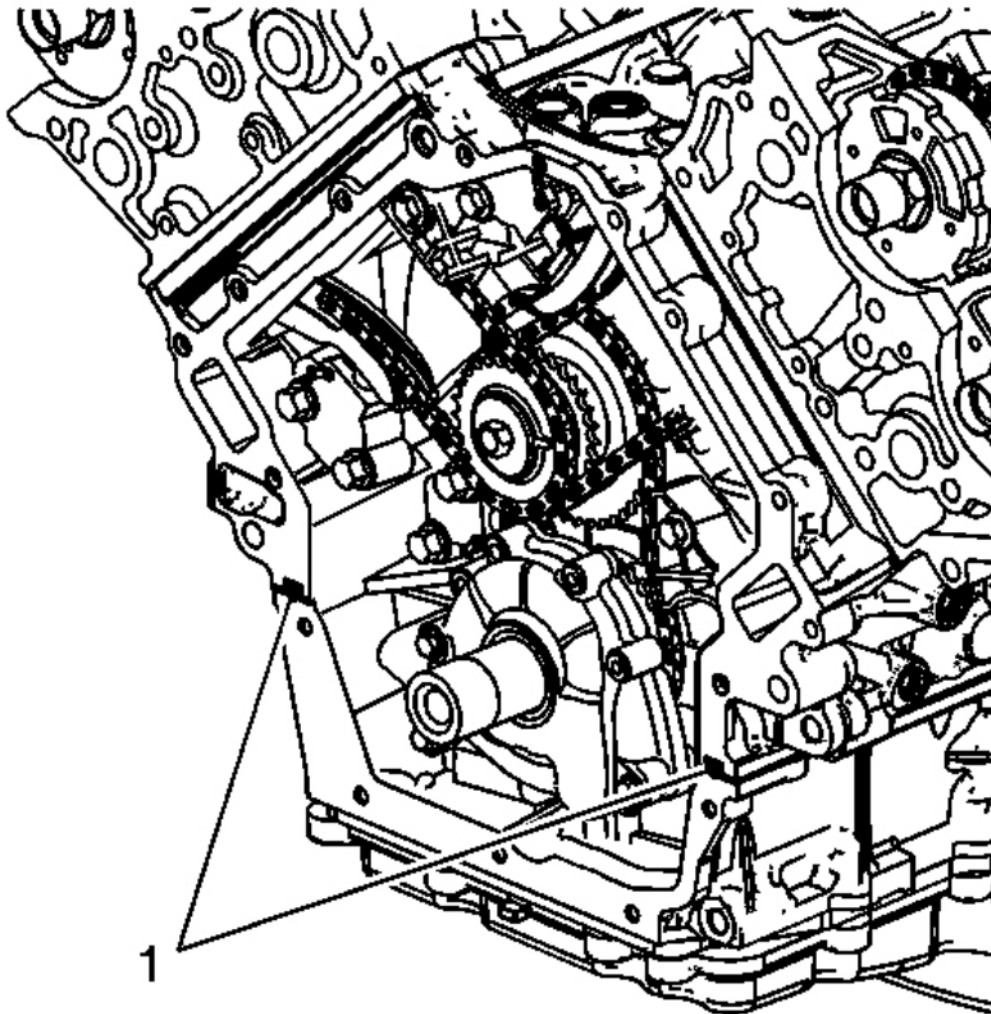


Fig. 302: Applying Sealant At Split Line Of Crankcases & Top Of Block Face
Courtesy of GENERAL MOTORS CORP.

1. Place a small amount of sealant GM P/N 12578521 (Canadian P/N 88901148) or equivalent at the split line of the upper and lower crankcases (2) and at the top of the block face (1).

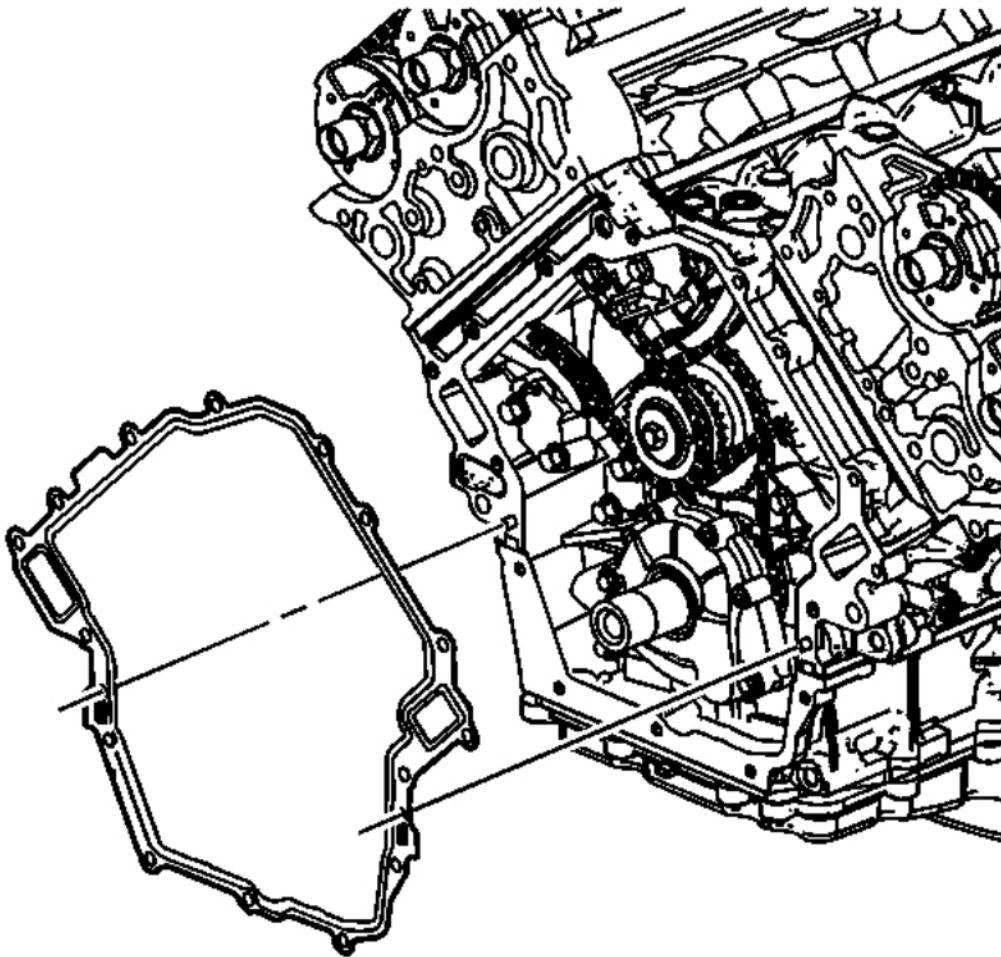


Fig. 303: View Of Engine Front Cover Gasket
Courtesy of GENERAL MOTORS CORP.

2. Place the NEW engine front cover gasket over the crankcase dowel pins.

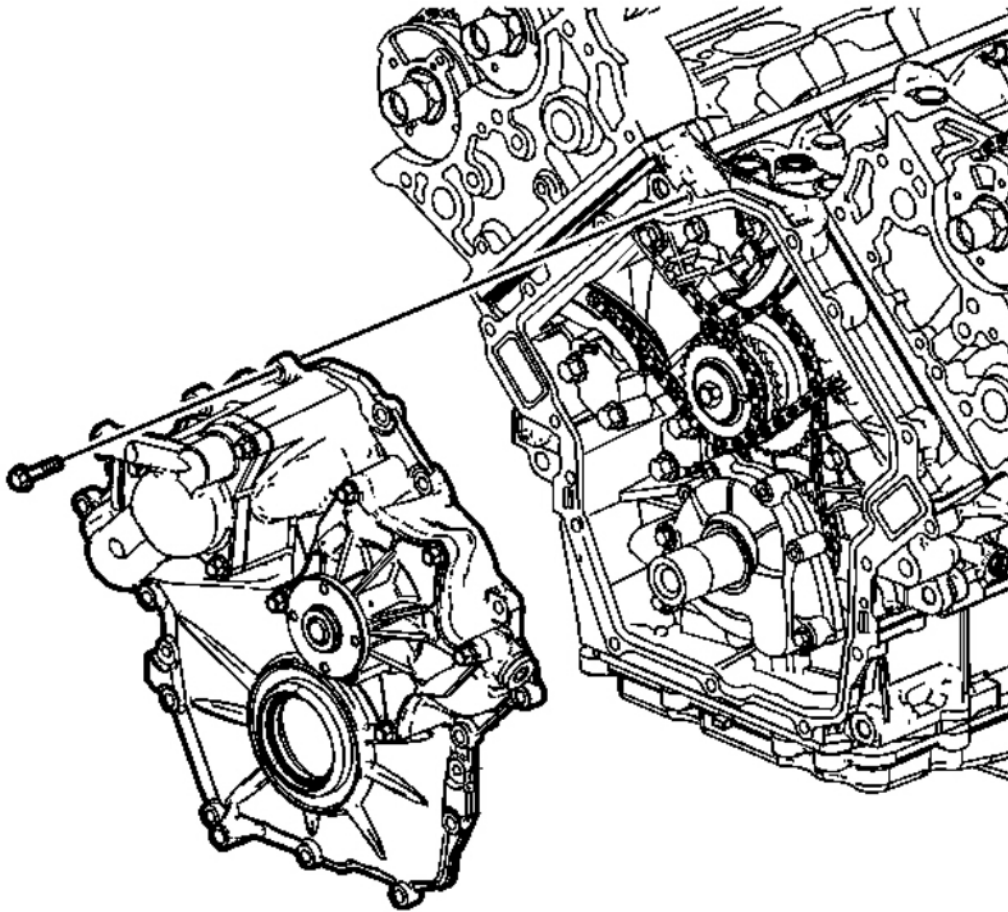


Fig. 304: View Of Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

3. Place the engine front cover in position on the crankcase.
4. Apply the thread locking compound GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the engine front cover bolts.
5. Install the engine front cover bolts.

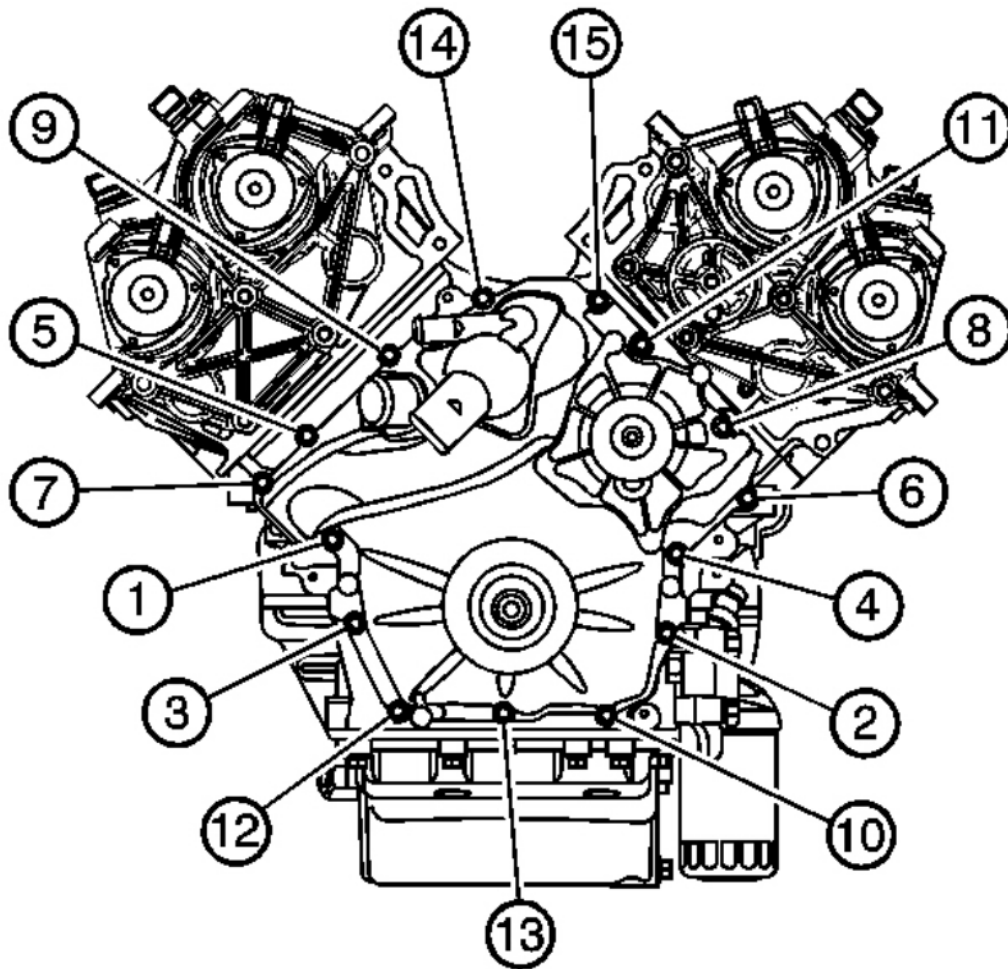


Fig. 305: Tightening Engine Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

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

Tighten: Tighten the engine front cover bolts in proper sequence to 15 N.m (11 lb ft).

CAMSHAFT POSITION (CMP) ACTUATOR HOUSING INSTALLATION - LEFT

Tools Required:

EN 46109 Guide Pin Set

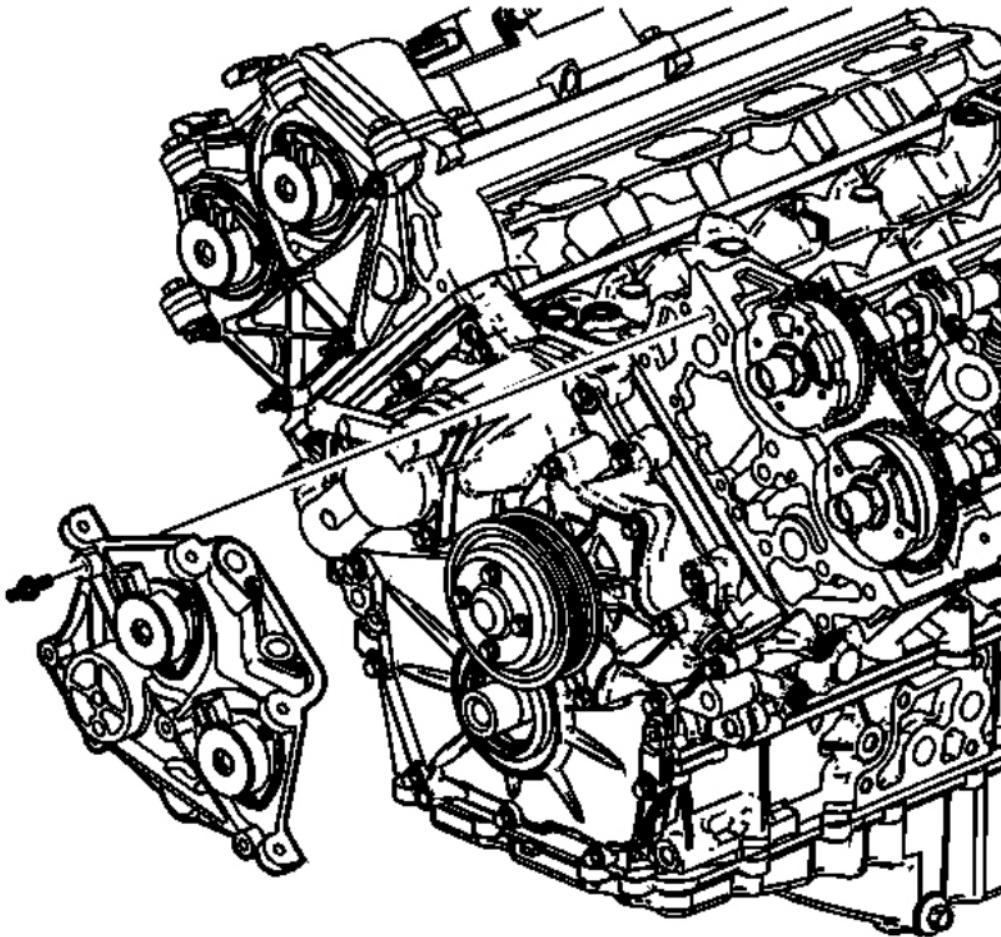


Fig. 306: View Of Left Camshaft Position Actuator Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the left camshaft position actuator housing.

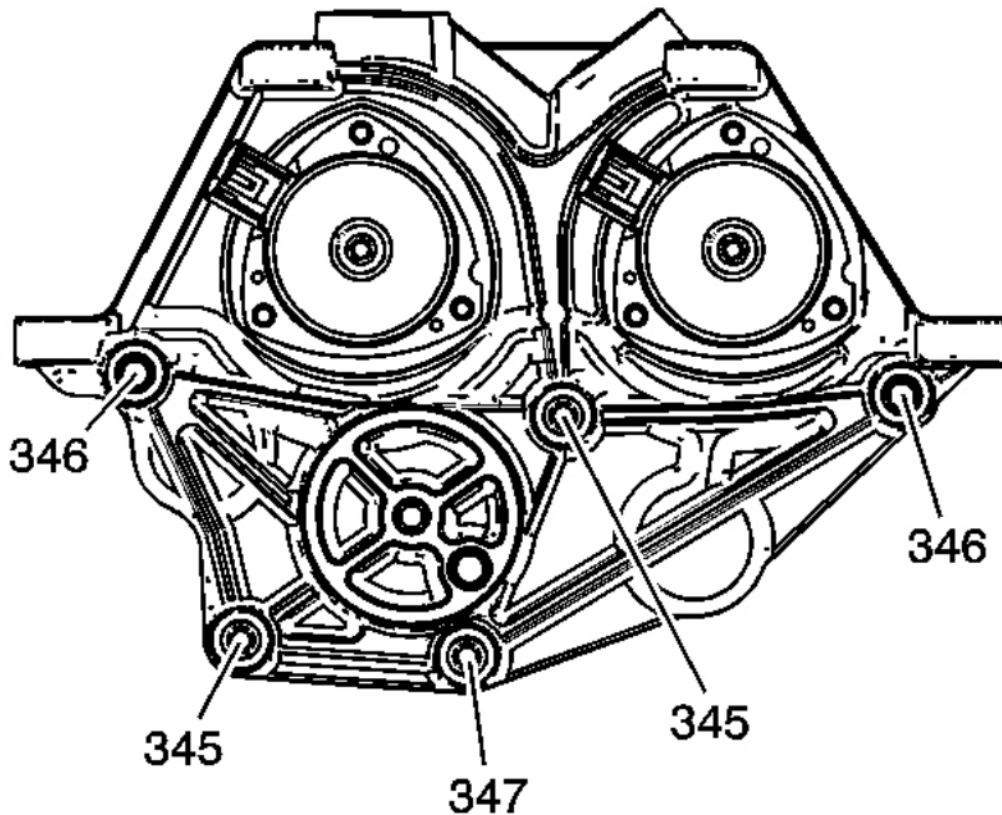


Fig. 307: Locating Left Camshaft Position Actuator Housing Bolts & Studs
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the left camshaft position actuator housing bolt (347), short studs (345) and long studs (346).

Tighten: Tighten the left camshaft position actuator housing bolts and studs to 10 N.m (89 lb in).

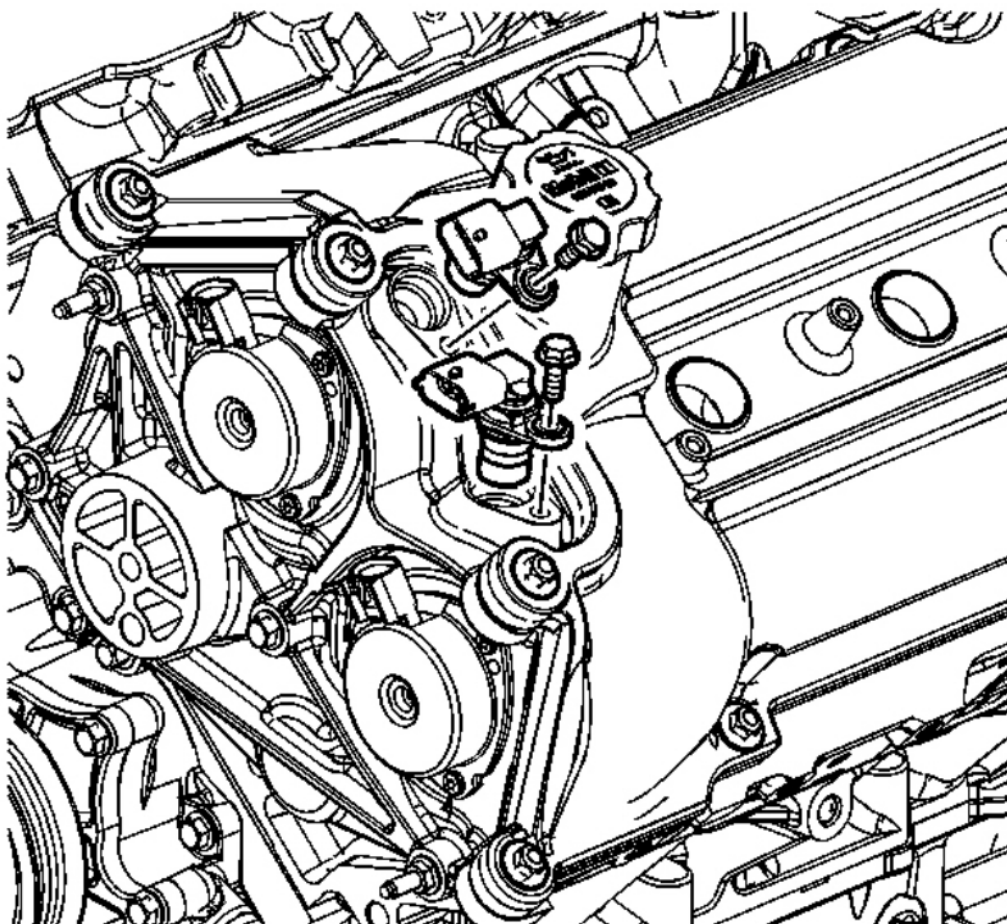


Fig. 308: View Of Left Intake Camshaft Sensor & Left Exhaust Camshaft Sensor
Courtesy of GENERAL MOTORS CORP.

3. Install the left camshaft position sensors.
4. Install the left camshaft position sensor bolts.

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

Camshaft Position Actuator Magnet Alignment

1. If the camshaft position actuator magnet has been removed or is being replaced the camshaft position actuator magnet will need to be resealed to the camshaft position actuator housing and realigned to the camshaft position actuator oil control valve.

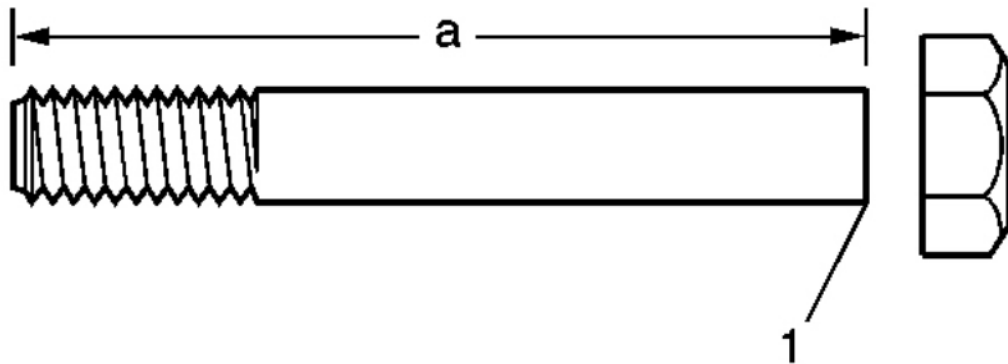


Fig. 309: Creating Loading Pins
Courtesy of GENERAL MOTORS CORP.

2. Use the 2 6 mm (0.236 in) pins, EN 46109-1, from the **EN 46109** or make 2 loading pins from 2 6 mm (0.236 in) bolts at least 75 mm (3.00 in) long (a) with the hex head removed (1).

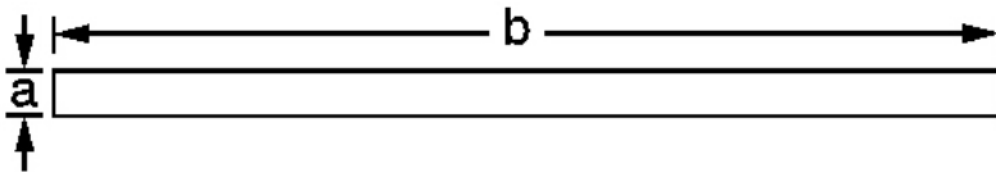


Fig. 310: Making Alignment Pin
Courtesy of GENERAL MOTORS CORP.

3. Make an alignment pin from 15/64 inch drill rod (a) with a diameter of 5.954 mm (0.2344 in) and at least 75 mm (3.00 in) long (b).

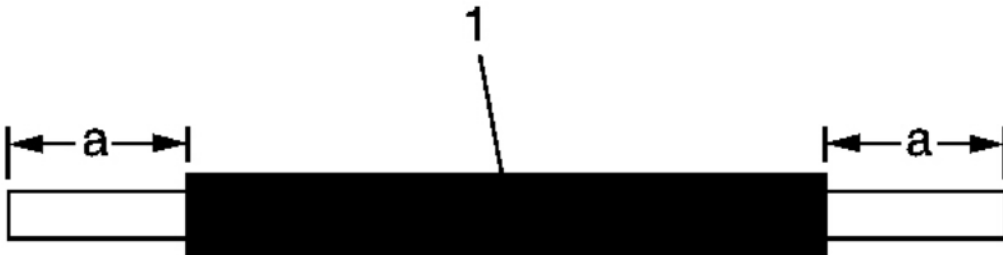


Fig. 311: Creating A Stop On Alignment Pin
Courtesy of GENERAL MOTORS CORP.

4. To verify proper insertion distance create a stop (1) on the alignment pin by placing tape or shrink tubing 13 mm (0.5118 in) from the end (a) that will be inserted through the camshaft position actuator magnet.

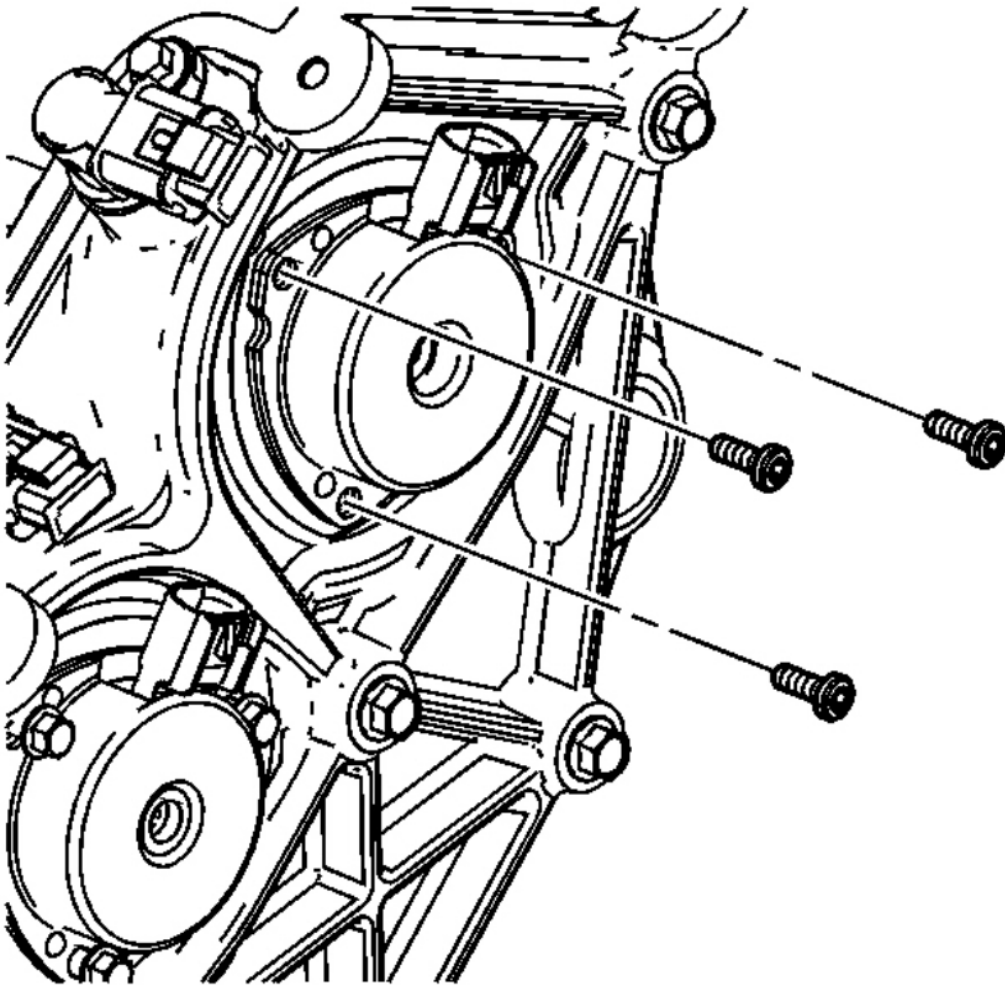


Fig. 312: View Of Camshaft Position Actuator Magnet Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the camshaft position actuator magnet bolts.

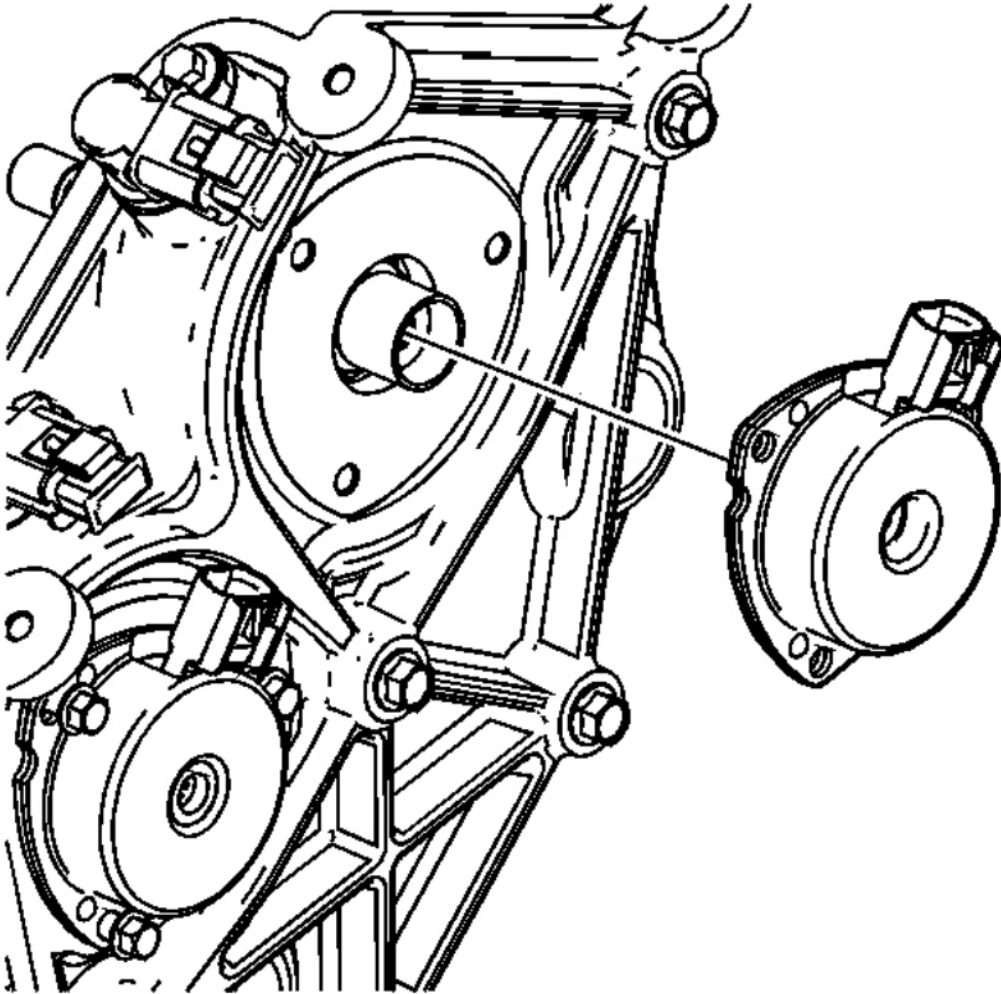


Fig. 313: View Of Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

6. Remove the camshaft position actuator magnet.

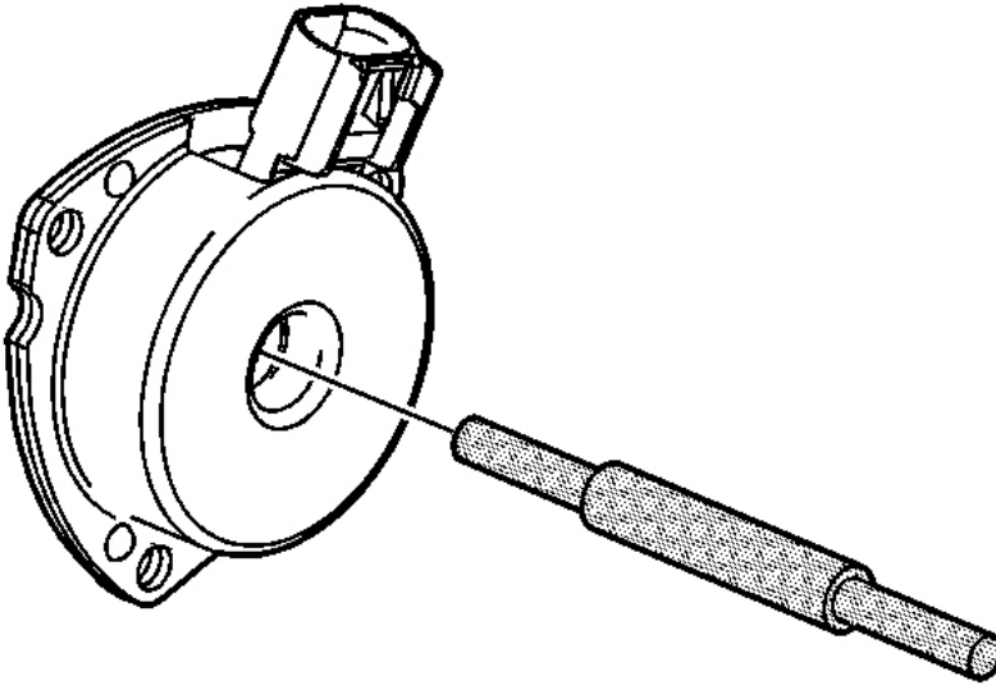


Fig. 314: Verifying That Alignment Pin Will Pass Through Camshaft Position Actuator Magnet Alignment Hole
Courtesy of GENERAL MOTORS CORP.

7. Verify that the alignment pin will pass through the camshaft position actuator magnet alignment hole.

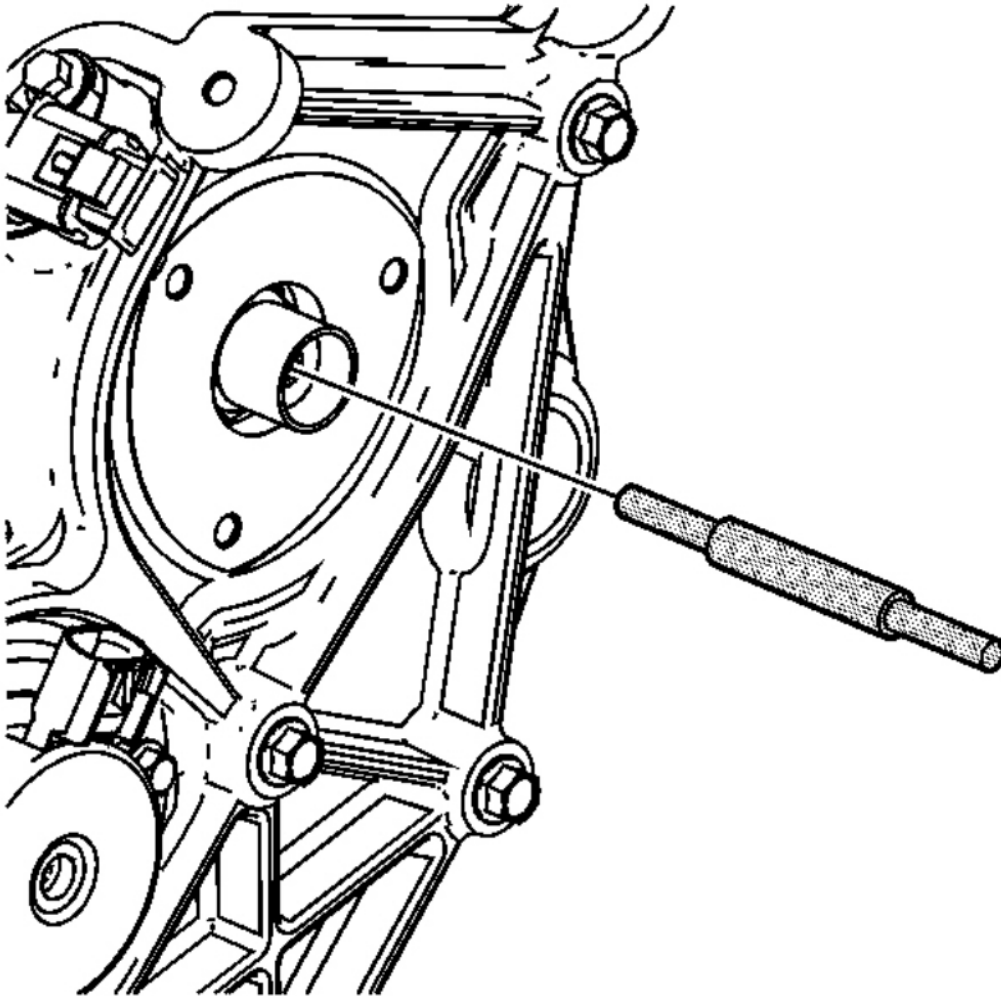


Fig. 315: Verifying That Alignment Pin Will Pass Through Camshaft Position Actuator Oil Control Valve Alignment Hole
Courtesy of GENERAL MOTORS CORP.

8. Verify that the alignment pin will fit into the alignment hole in the camshaft position actuator oil control valve.

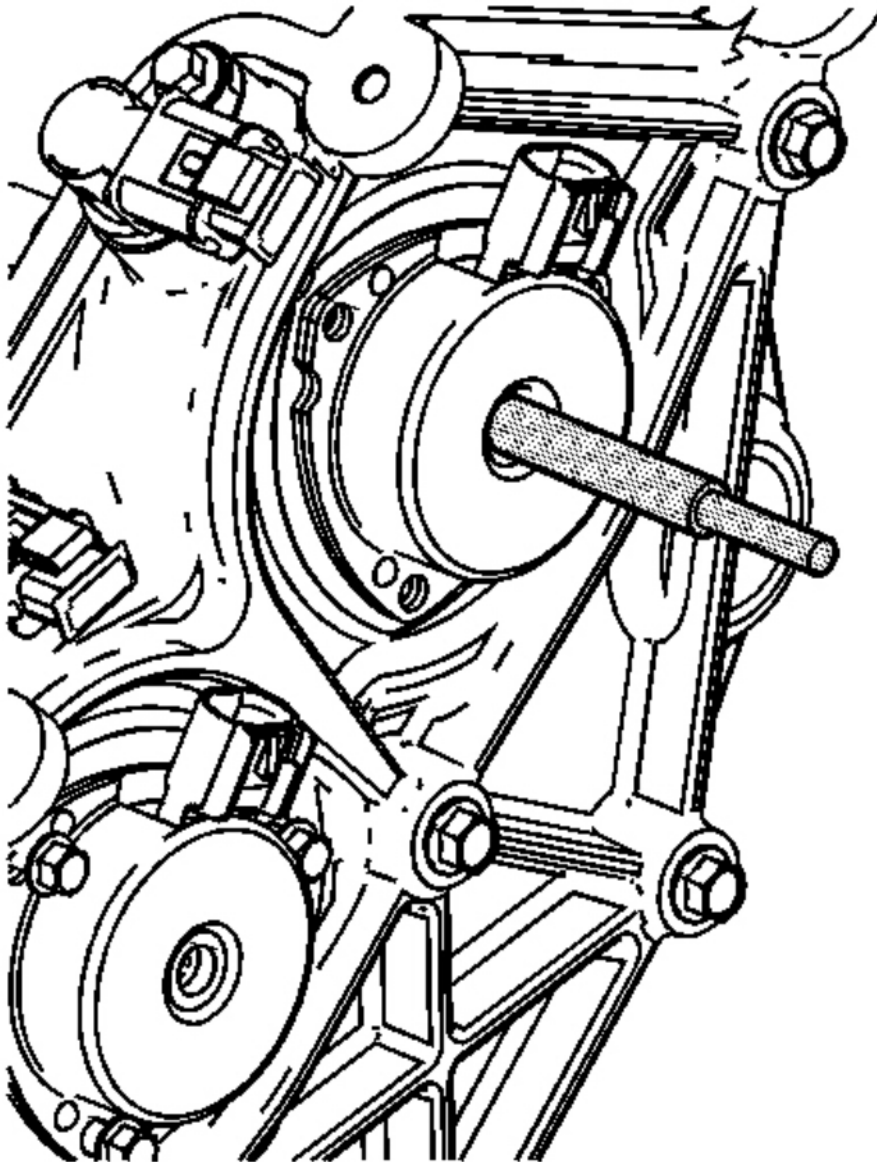


Fig. 316: Verifying Alignment Pin Stop Distance
Courtesy of GENERAL MOTORS CORP.

9. Place the camshaft position actuator magnet into place and verify the alignment pin will insert through the camshaft position actuator magnet and into the camshaft position actuator

oil control valve to verify alignment pin stop distance.

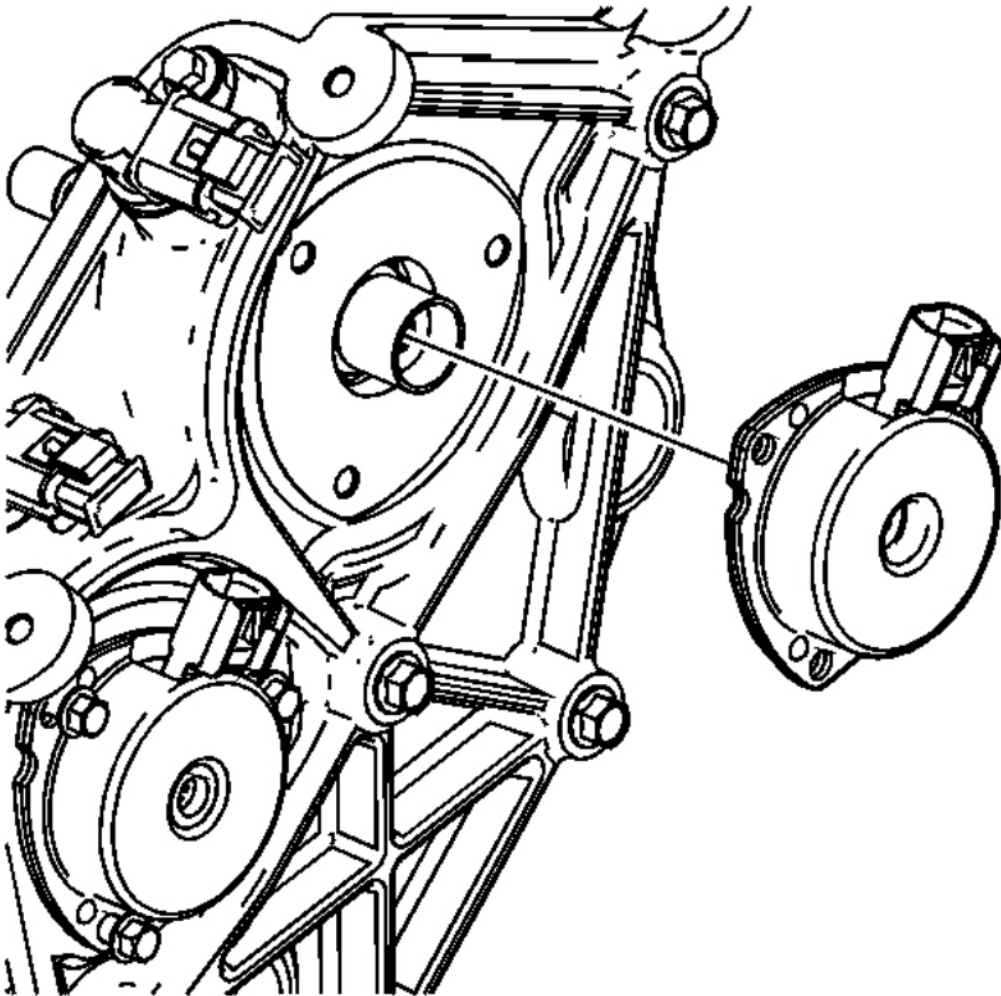


Fig. 317: View Of Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

10. Remove the camshaft position actuator magnet.

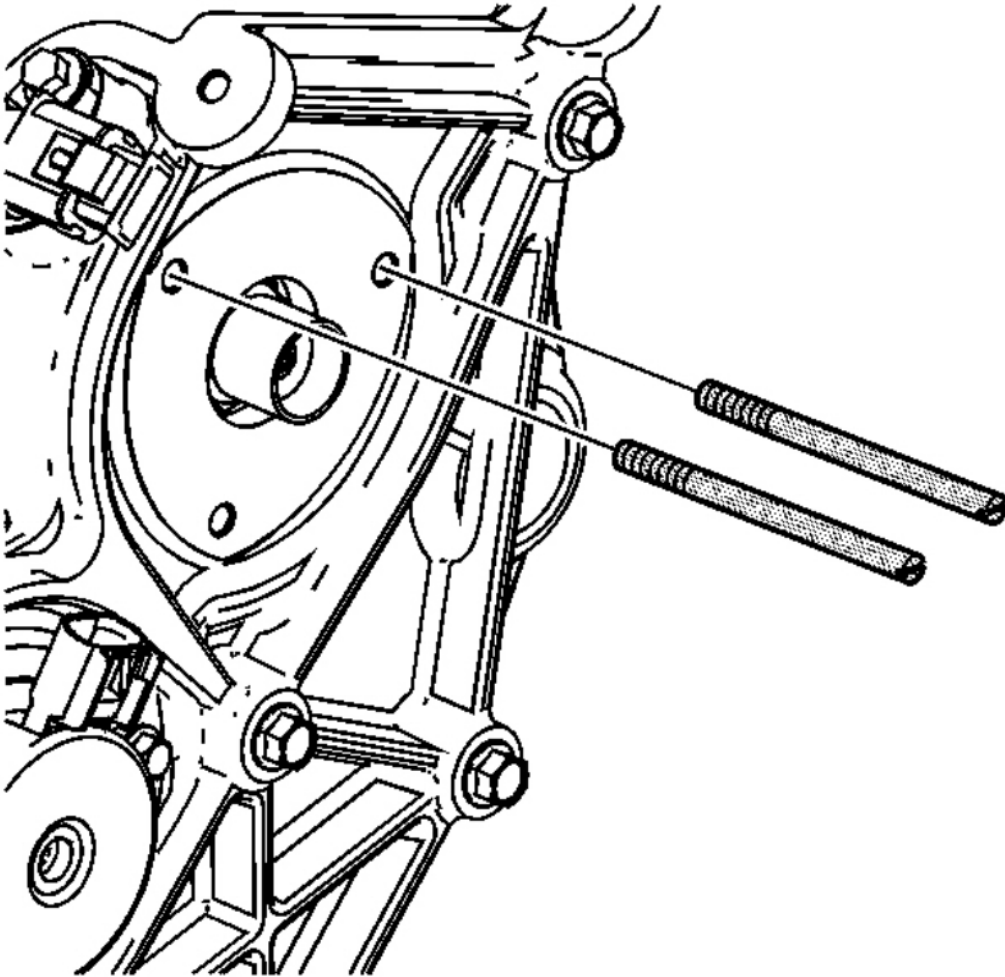


Fig. 318: Installing Loading Pins
Courtesy of GENERAL MOTORS CORP.

11. Install the 2 6 mm (0.236 in) loading pins in 2 of the camshaft position actuator magnet bolt holes in the camshaft position actuator housing.

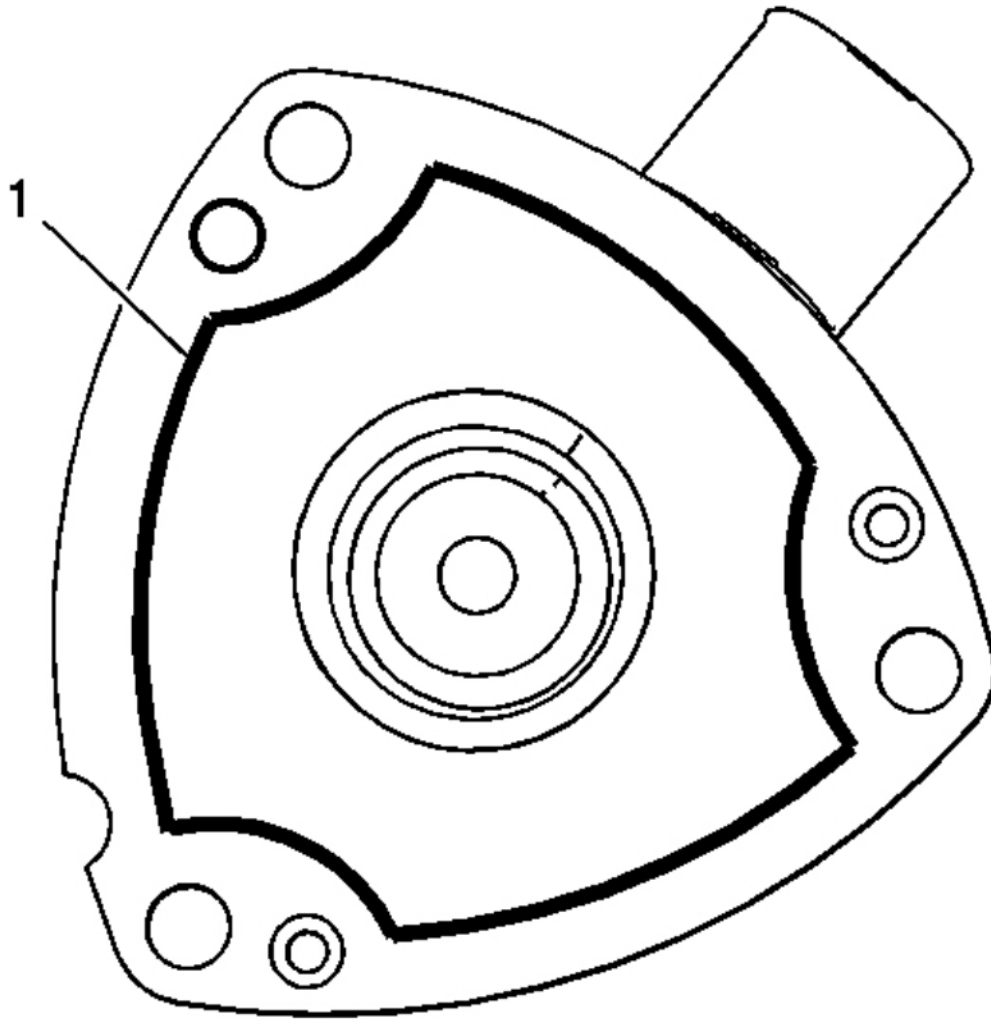


Fig. 319: Applying Sealant Around Flange Of Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

12. Apply a 2 mm (0.079 in) bead (1) of RTV sealant GM P/N 12378521 or equivalent around the flange of the camshaft position actuator magnet as shown.

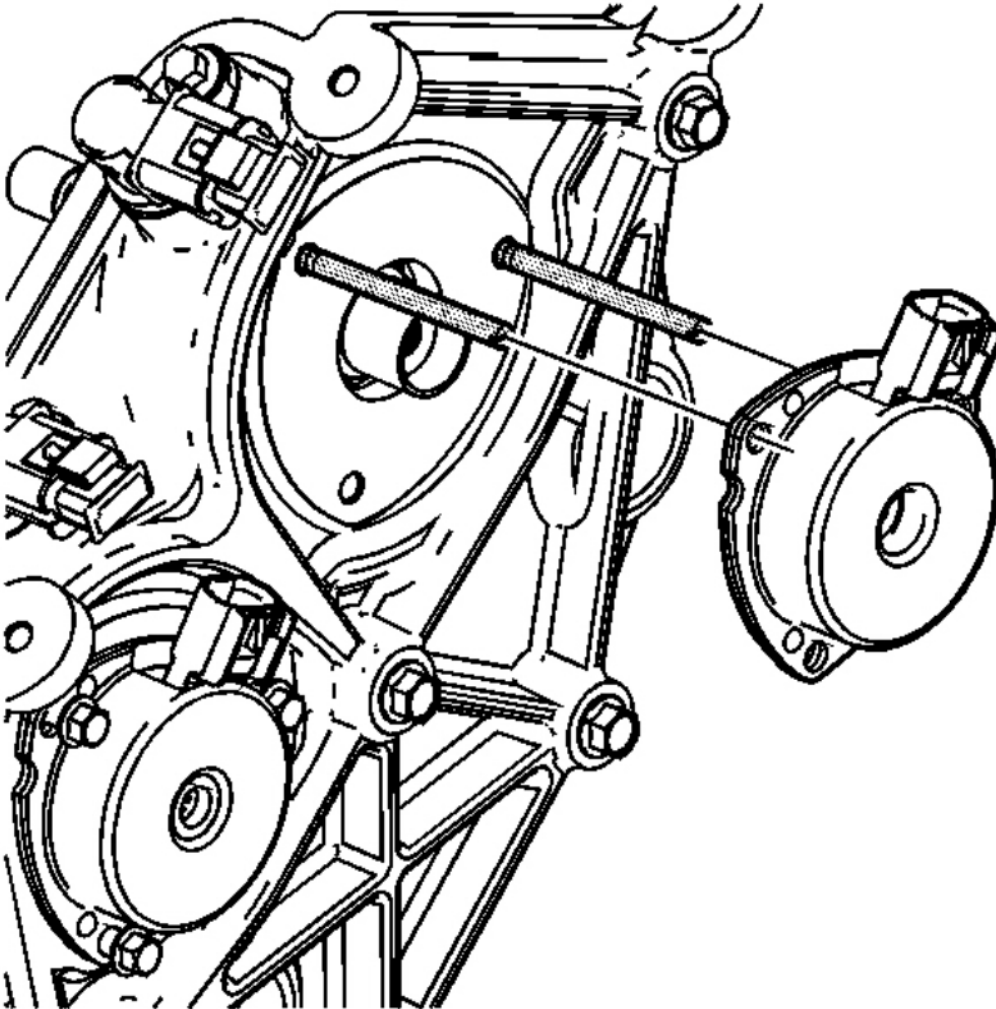


Fig. 320: Sliding Camshaft Position Actuator Magnet Over Loading Pins
Courtesy of GENERAL MOTORS CORP.

13. Slide the camshaft position actuator magnet over the 6 mm (0.236 in) loading pins.

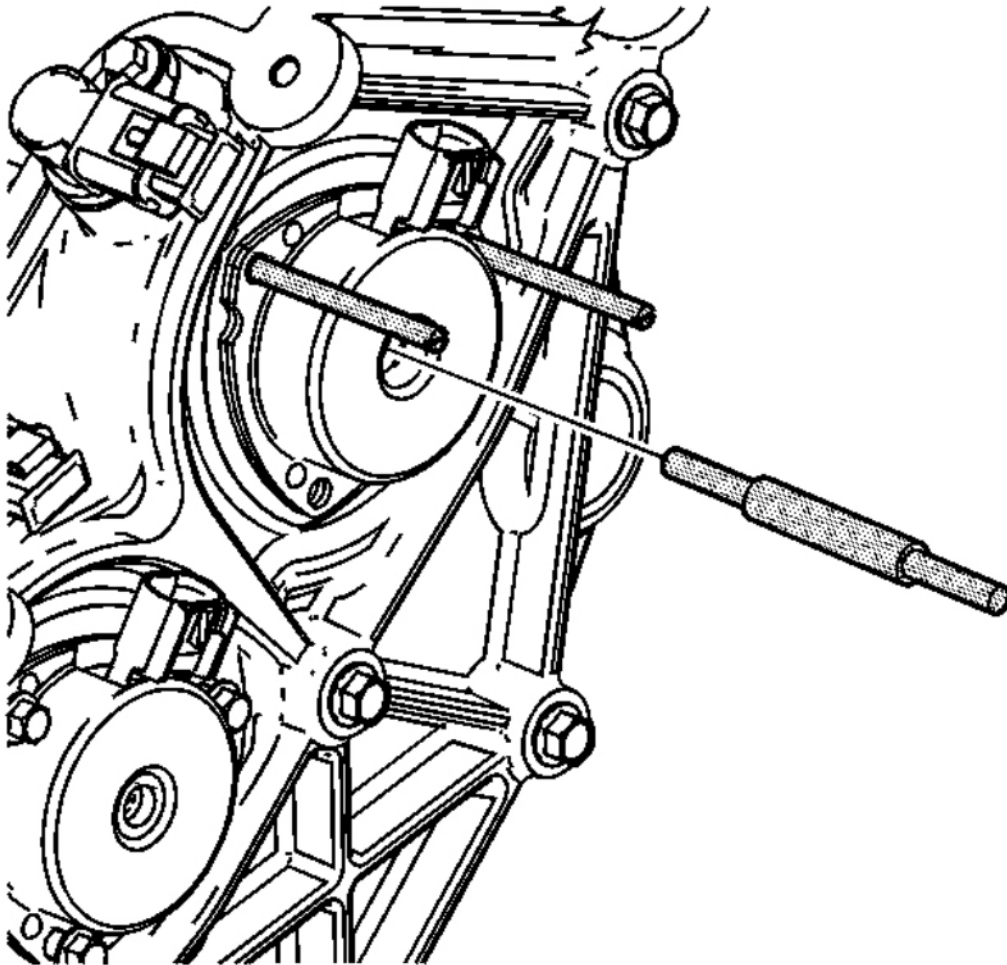


Fig. 321: Aligning Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

14. In order to align the camshaft position actuator magnet to the camshaft position actuator oil control valve, install the alignment pin through the camshaft position actuator magnet and into the camshaft position actuator oil control valve alignment hole.

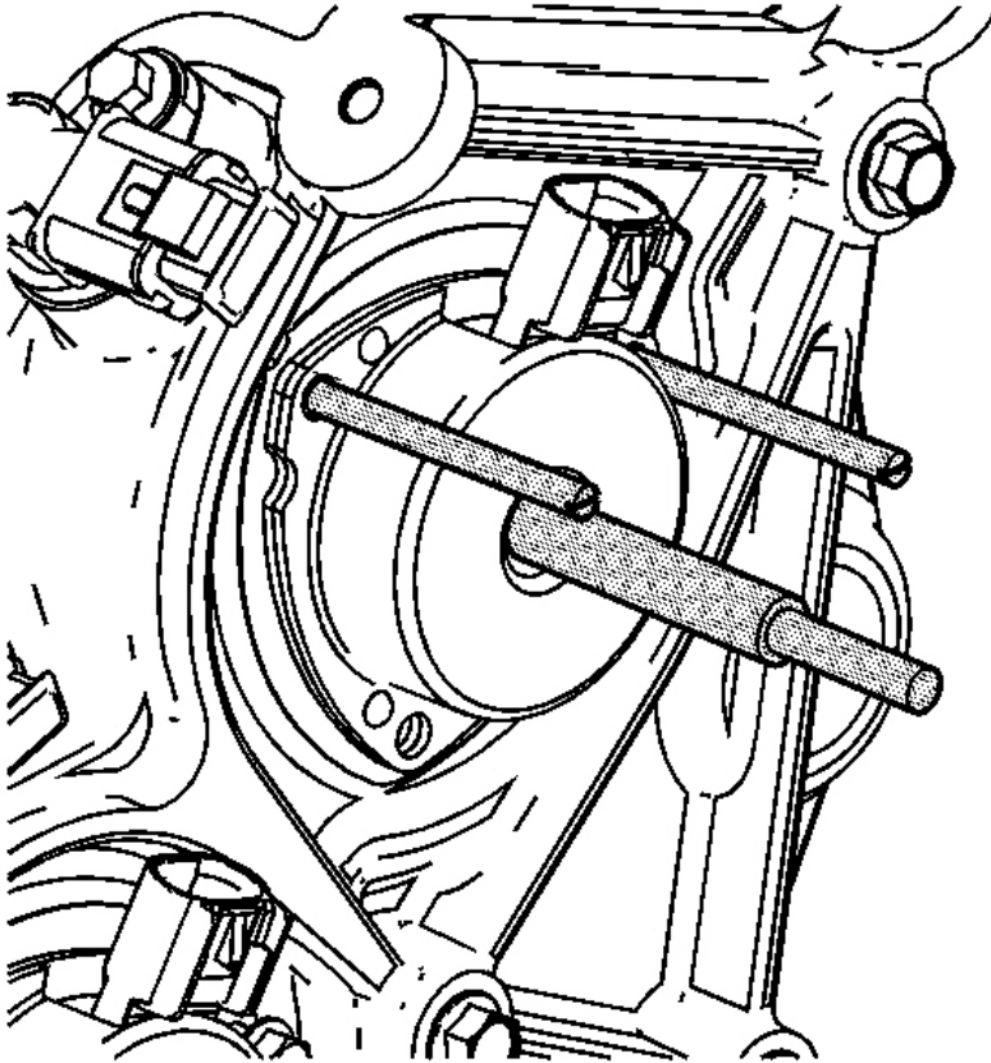


Fig. 322: Inserting Alignment Pin

Courtesy of GENERAL MOTORS CORP.

15. Verify that the alignment pin has been inserted into the camshaft position actuator oil control valve alignment hole by observing the stop has reached the hole in the camshaft position actuator magnet.

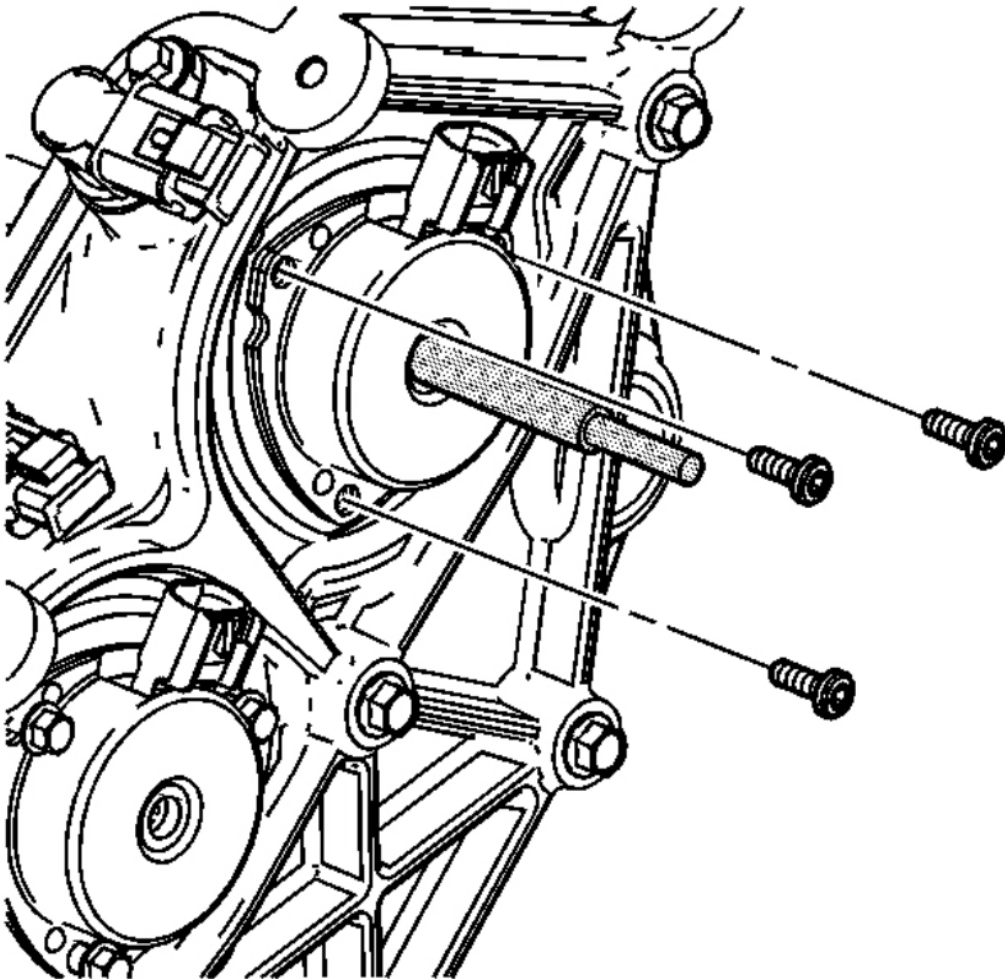


Fig. 323: Installing Camshaft Position Actuator Magnet Bolts
Courtesy of GENERAL MOTORS CORP.

16. With the alignment pin still installed, remove the loading pins and install the camshaft position actuator magnet bolts.

Tighten: Tighten the camshaft position actuator magnet bolts to 8 N.m (71 lb in).

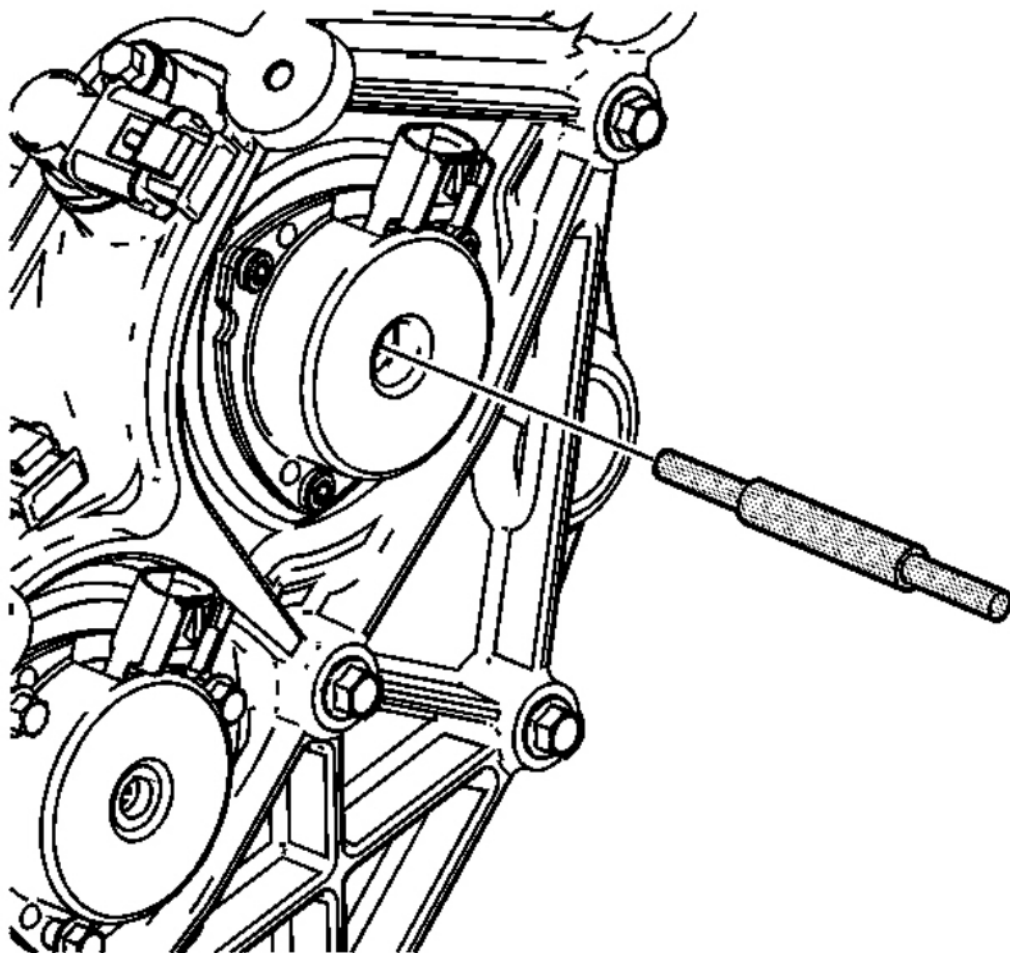


Fig. 324: Removing Alignment Pin
Courtesy of GENERAL MOTORS CORP.

17. Remove the alignment pin.

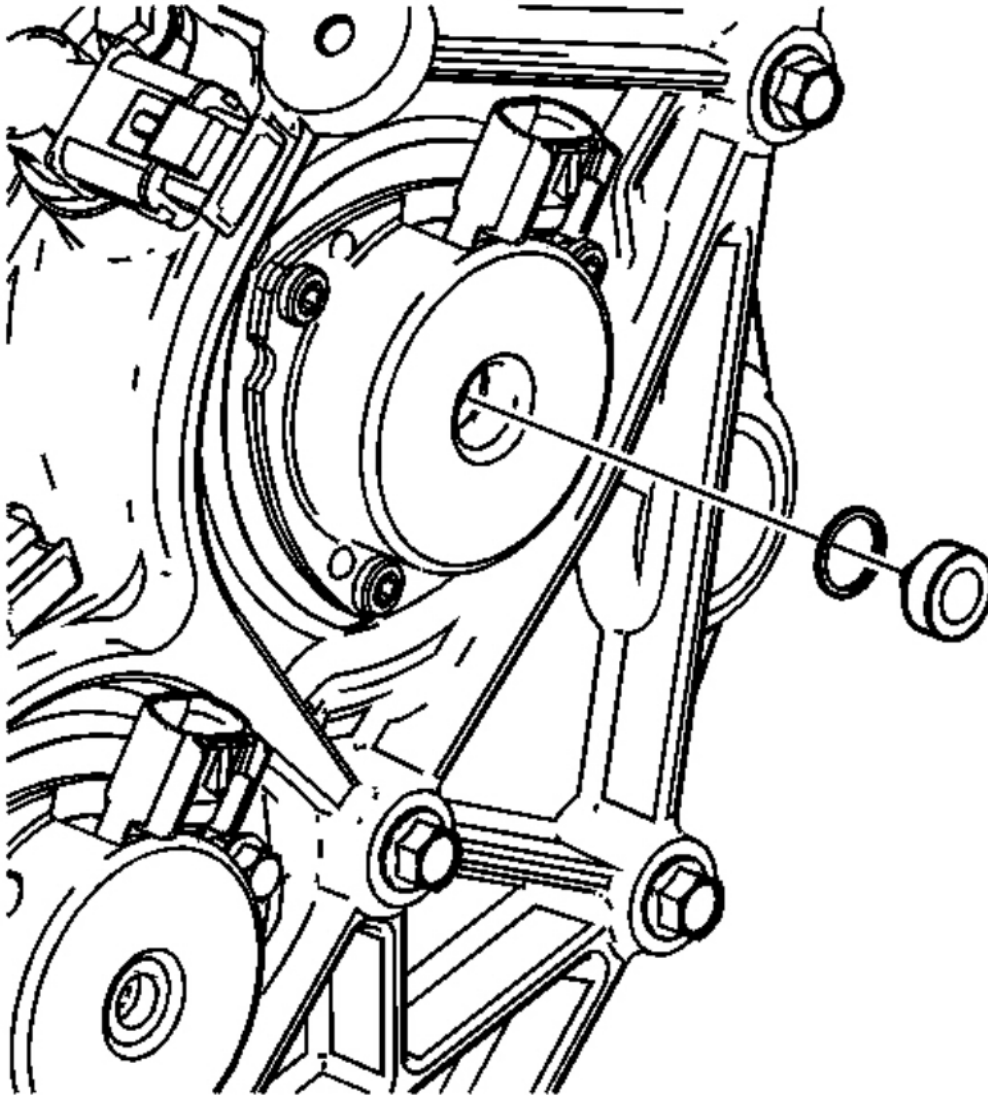


Fig. 325: View Of Camshaft Position Actuator Magnet Plug
Courtesy of GENERAL MOTORS CORP.

18. Install a NEW camshaft position actuator magnet plug.
19. Repeat steps 10 through 18 for any remaining camshaft position actuator magnets that have been removed.

CAMSHAFT COVER INSTALLATION - LEFT

Tools Required:

EN 46328 Camshaft Holding Tool

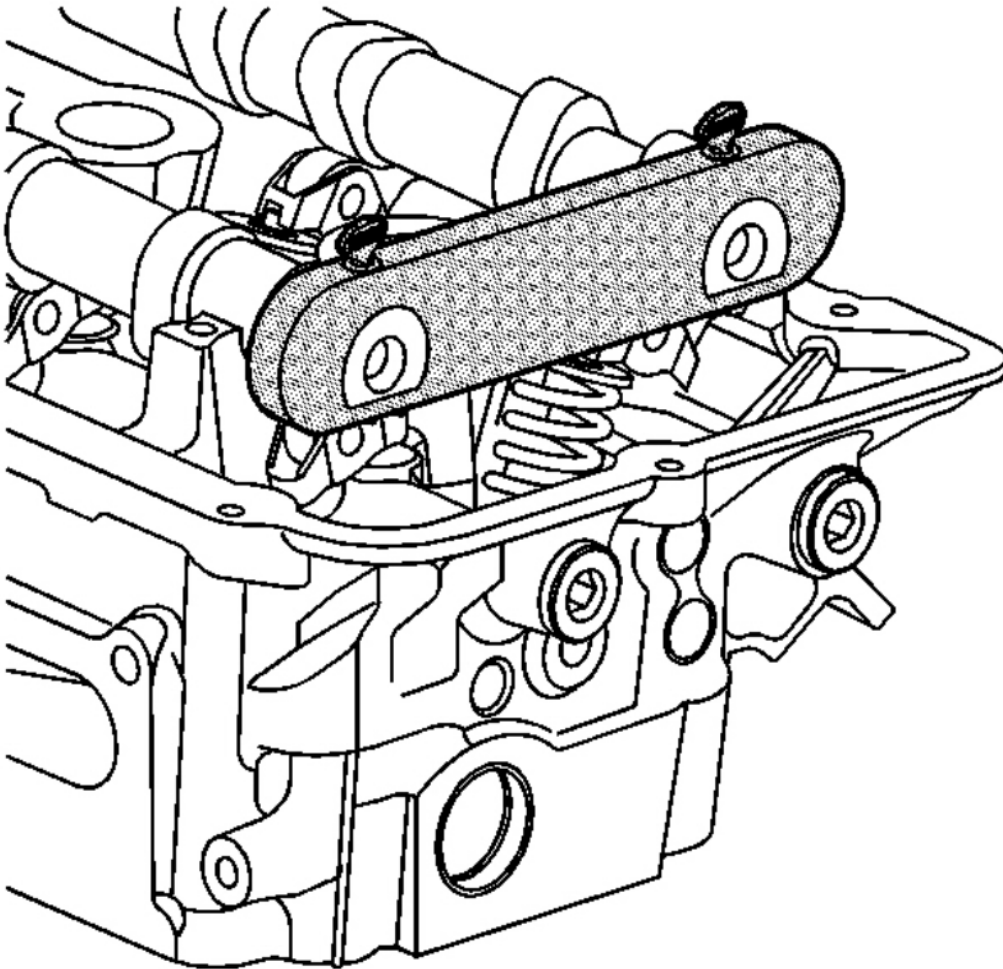


Fig. 326: View Of EN 46328 - Left
Courtesy of GENERAL MOTORS CORP.

1. Remove the **EN 46328** from the left camshafts.

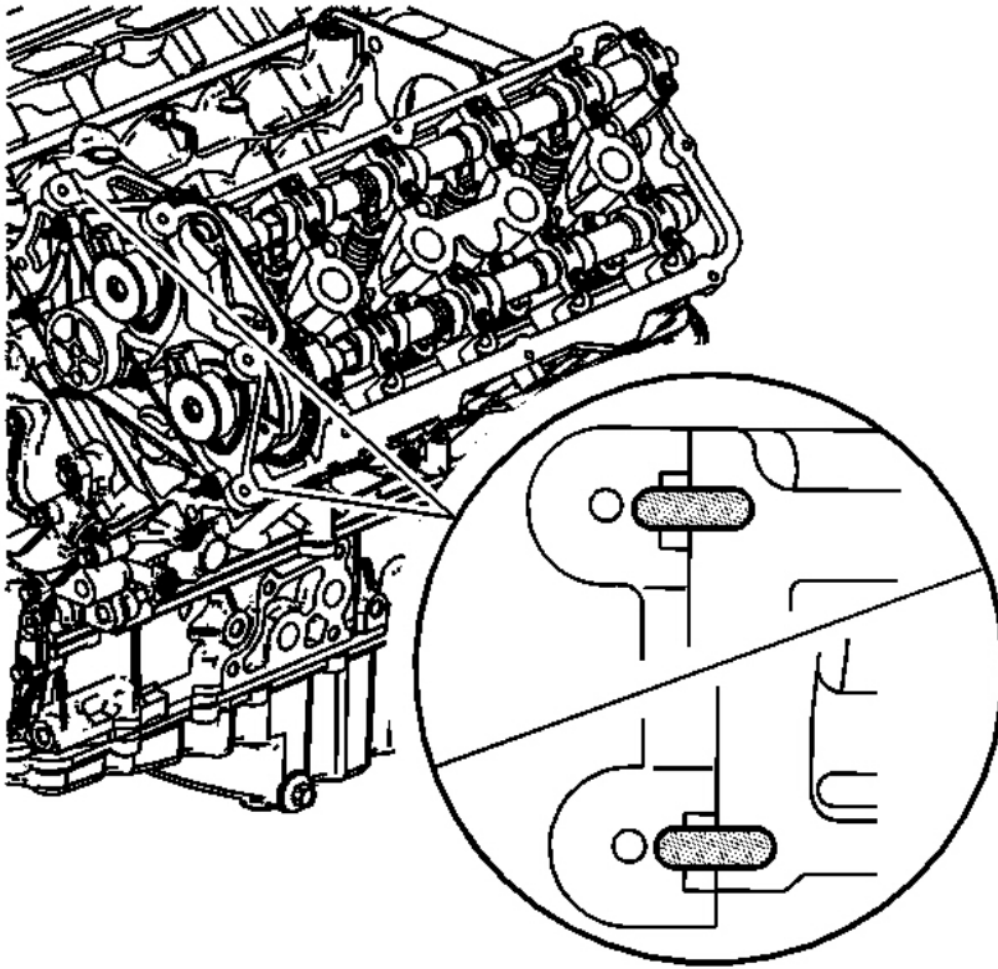


Fig. 327: Applying Sealant At Split Line Of Left Cylinder Head & Camshaft Position Actuator Housings

Courtesy of GENERAL MOTORS CORP.

2. Place a small amount of sealant GM P/N 12345739 (Canadian P/N 10953541) or equivalent at the split line of the left cylinder head and the left camshaft position actuator housings.

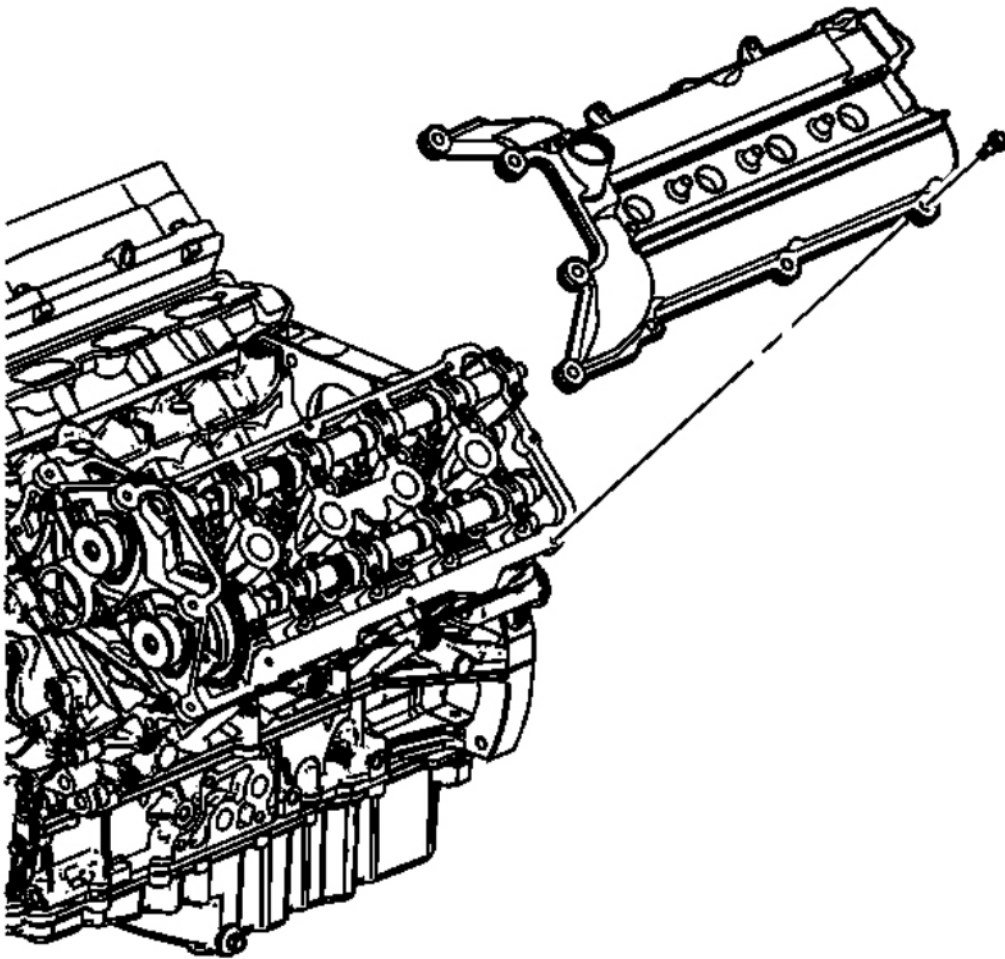


Fig. 328: View Of Left Camshaft Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Be careful to prevent the exposed section of the camshaft cover seal from being damaged by the edge of the cylinder head casting.

3. Install the left camshaft cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the left camshaft cover bolts.

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

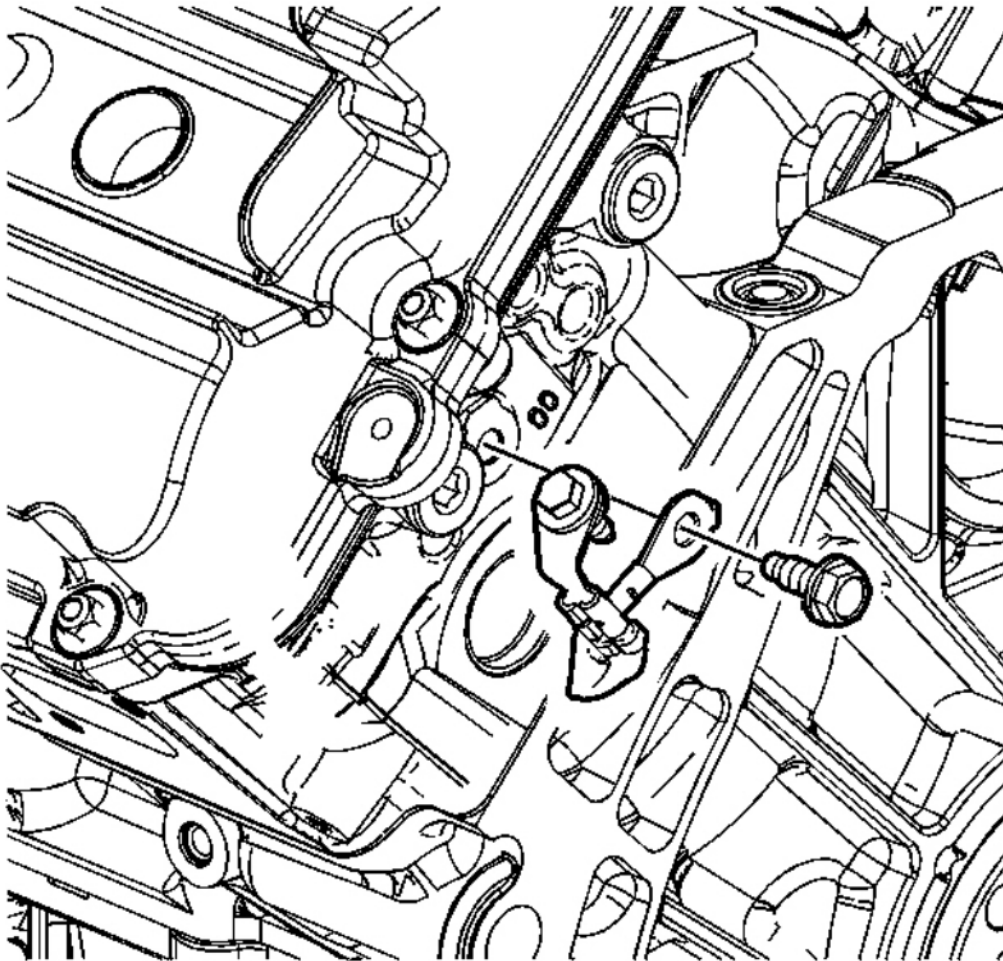


Fig. 329: View Of Left Camshaft Cover Ground Strap & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the bolts connecting the left camshaft cover ground strap to the left cylinder head and the left camshaft cover.

Tighten: Tighten the left ground strap bolts to 10 N.m (89 lb in).

IGNITION MODULE INSTALLATION - LEFT

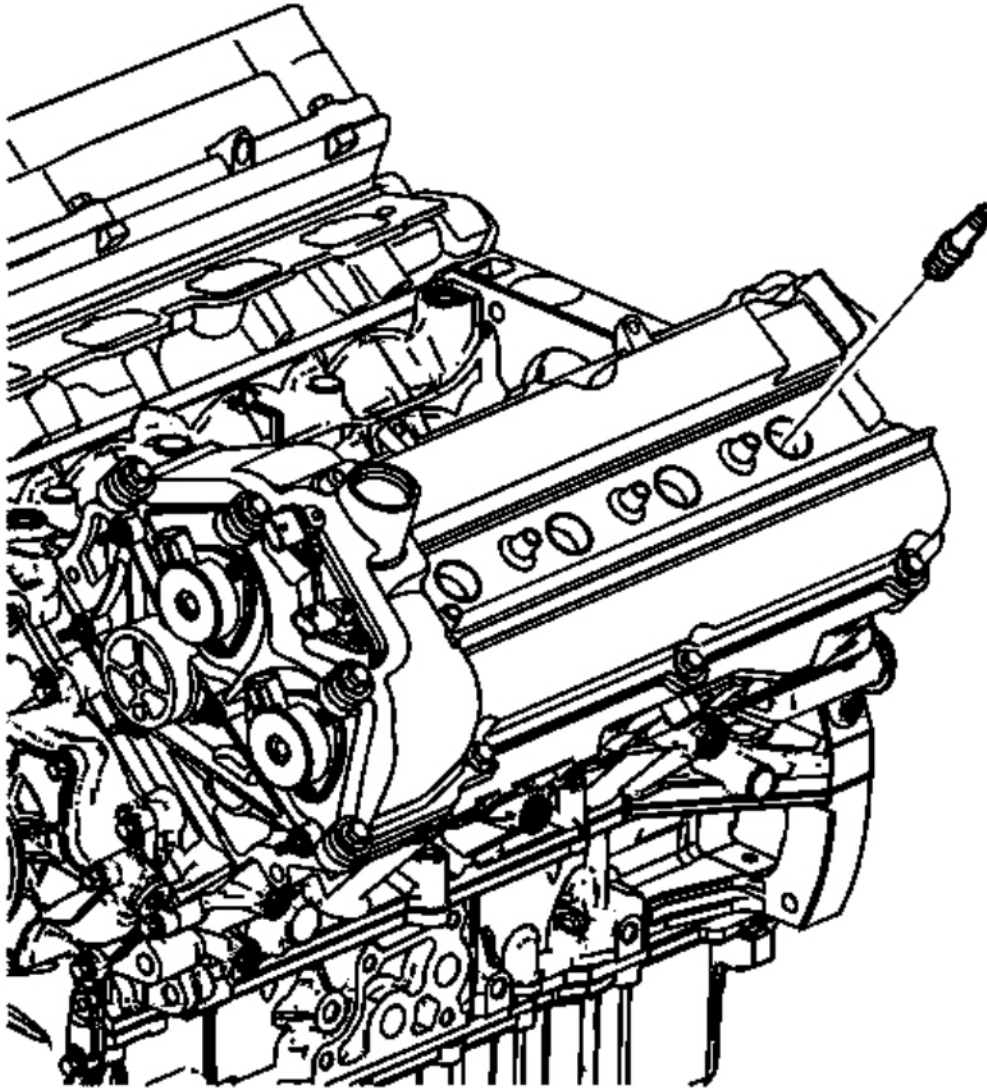


Fig. 330: View Of Left Spark Plug
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the left spark plugs.

Tighten: Tighten the spark plugs to 15 N.m (11 lb ft).

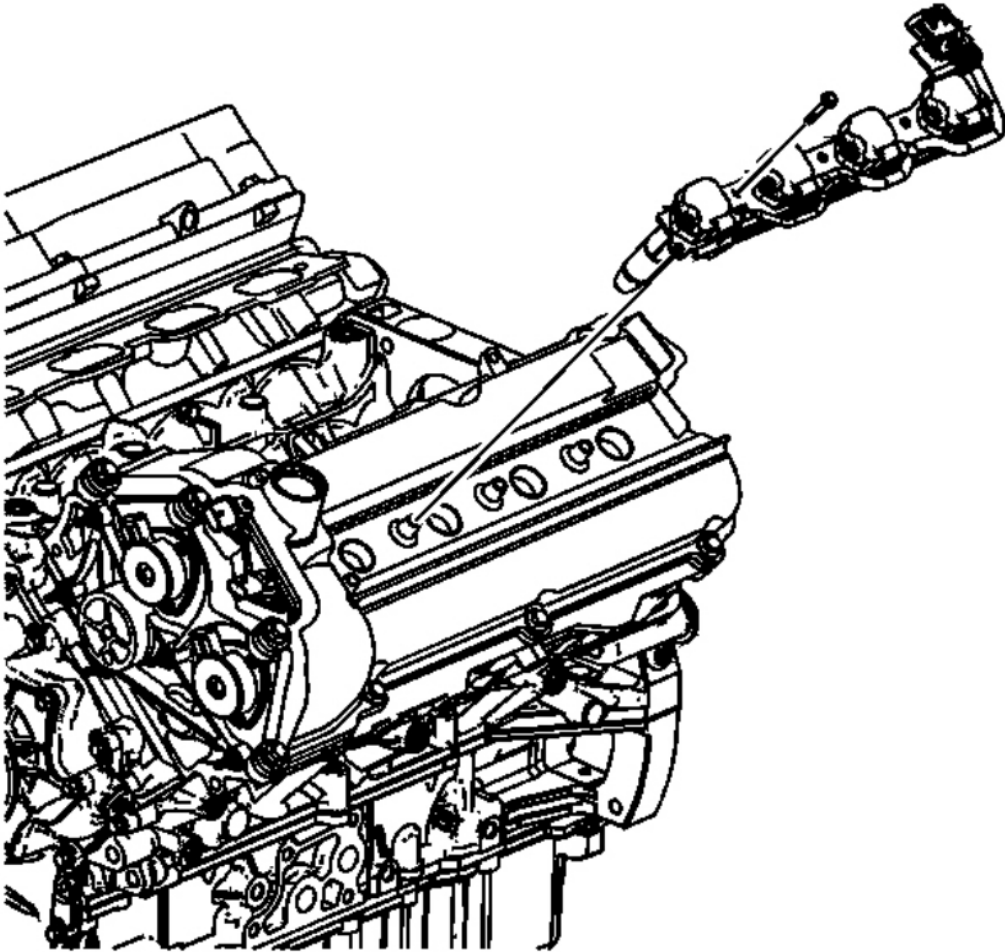


Fig. 331: View Of Left Ignition Coil Assembly, Bolts & Ball Studs
Courtesy of GENERAL MOTORS CORP.

2. Carefully, install the left ignition coil assembly.
3. Install the left ignition coil assembly bolts.

Tighten: Tighten the left ignition cassette bolts to 10 N.m (89 lb in).

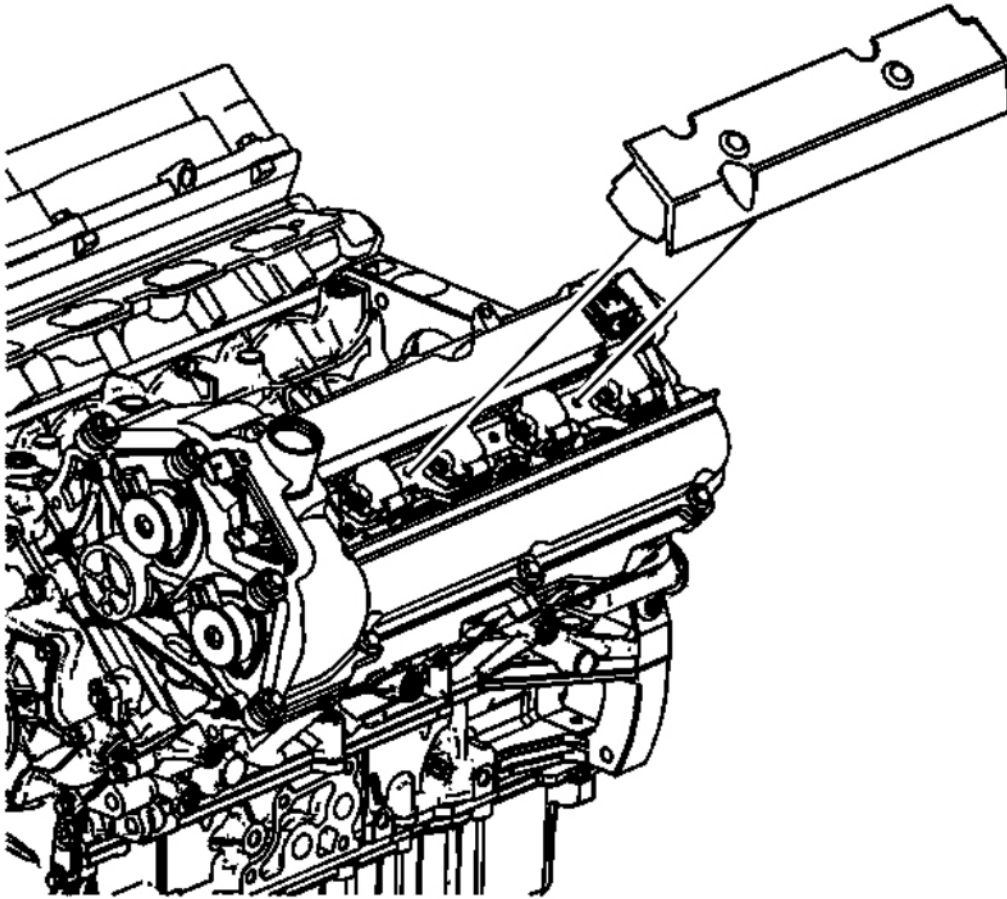


Fig. 332: View Of Left Ignition Coil Assembly Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the left ignition coil assembly cover.

CAMSHAFT POSITION (CMP) ACTUATOR HOUSING INSTALLATION - RIGHT

Tools Required:

EN 46109 Guide Pin Set

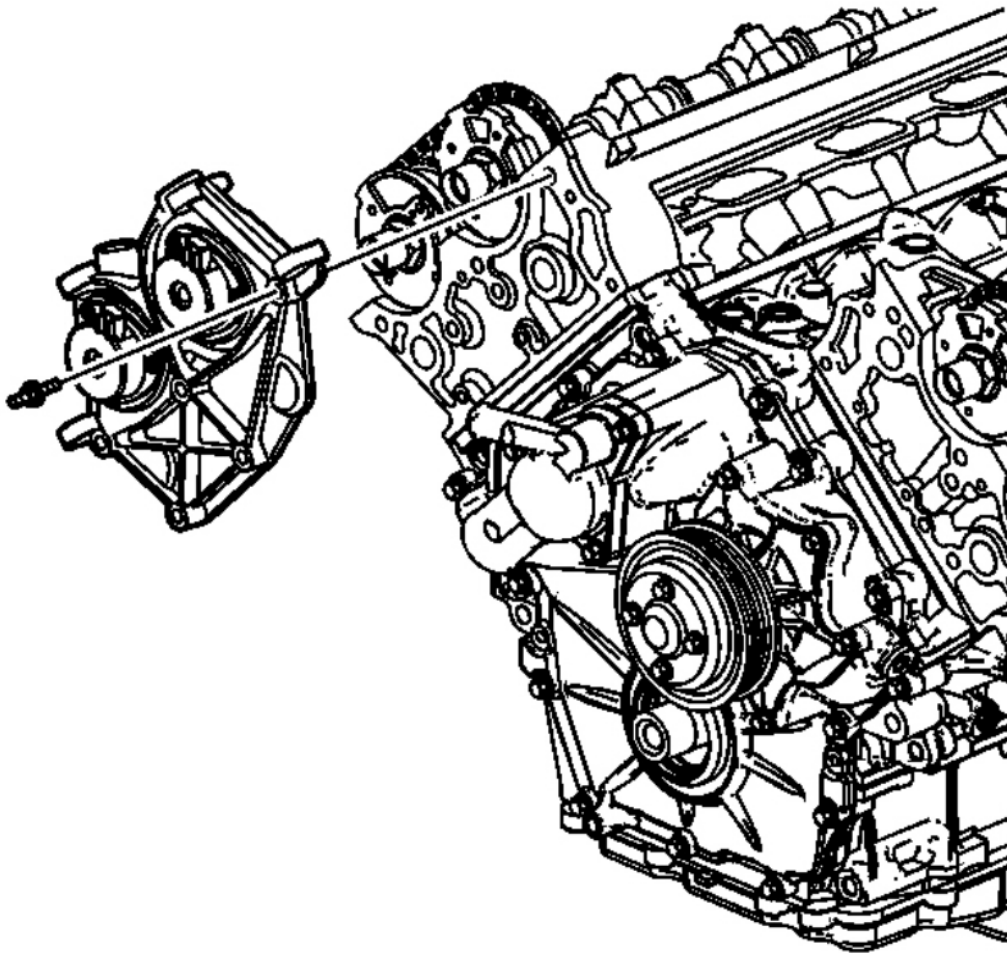


Fig. 333: View Of Right Camshaft Position Actuator Housing
Courtesy of GENERAL MOTORS CORP.

1. Install the right camshaft position actuator housing.

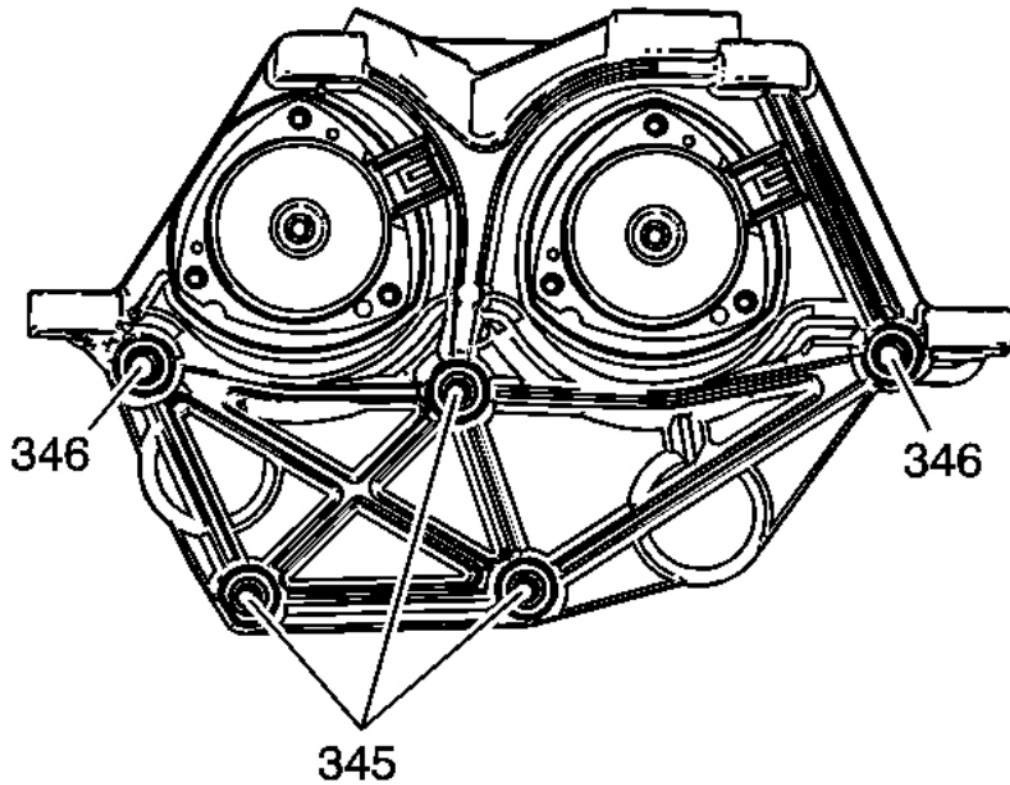


Fig. 334: Locating Right Camshaft Position Actuator Housing Studs
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the right camshaft position actuator housing short studs (345) and long studs (346).

Tighten: Tighten the right camshaft position actuator housing studs to 10 N.m (89 lb in).

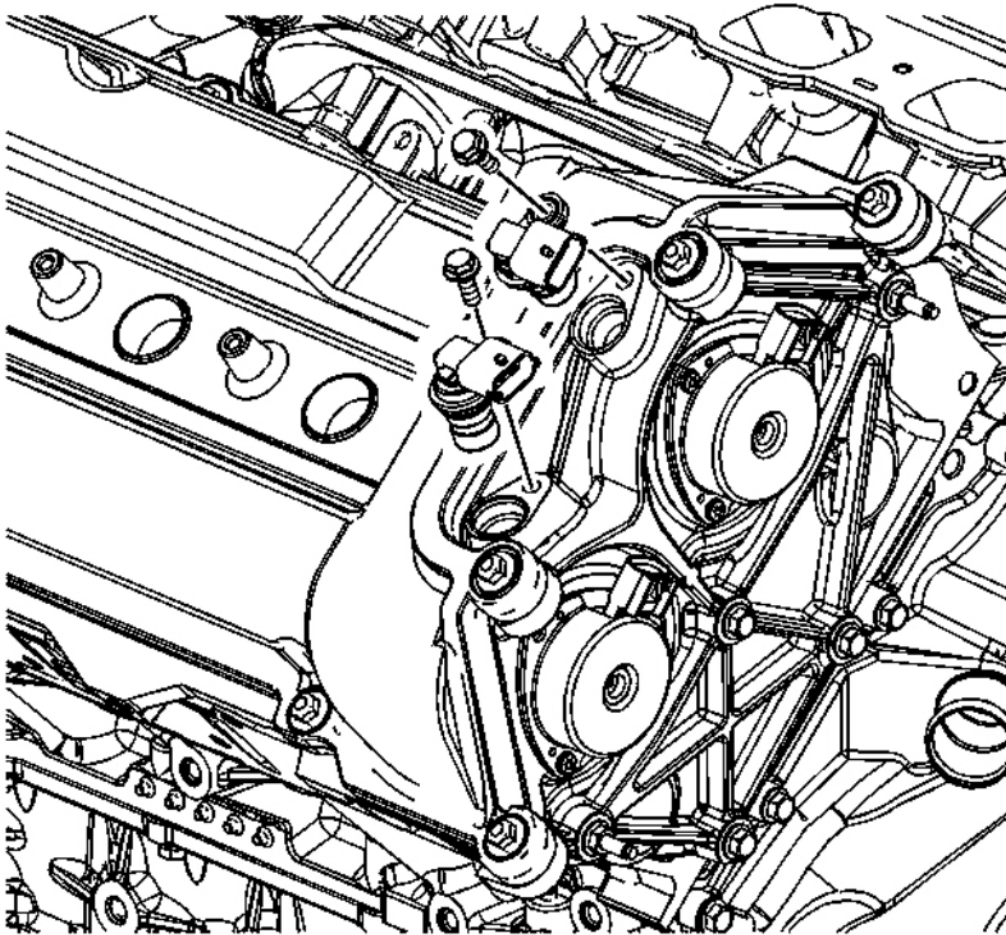


Fig. 335: View Of Right Intake Camshaft Sensor & Right Exhaust Camshaft Sensor
Courtesy of GENERAL MOTORS CORP.

3. Install the right camshaft position sensors.
4. Install the right camshaft position sensor bolts.

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

Camshaft Position Actuator Magnet Alignment

1. If the camshaft position actuator magnet has been removed or is being replaced the camshaft position actuator magnet will need to be resealed to the camshaft position actuator housing

and realigned to the camshaft position actuator oil control valve.

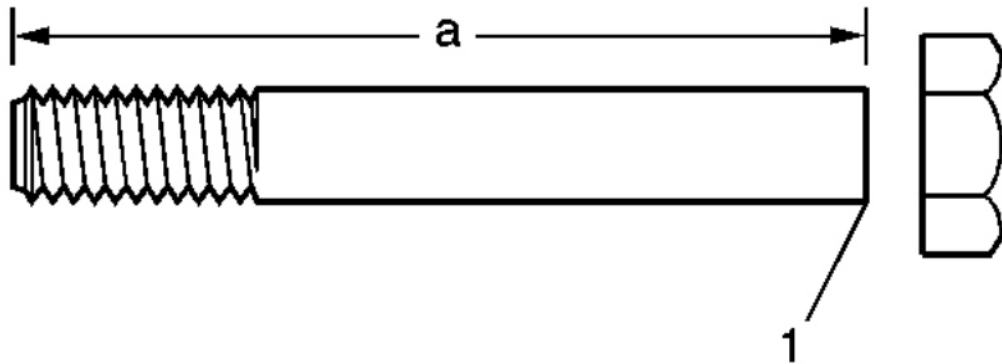


Fig. 336: Creating Loading Pins

Courtesy of GENERAL MOTORS CORP.

2. Use the 2 6 mm (0.236 in) pins, EN 46109-1, from the **EN 46109** or make 2 loading pins from 2 6 mm (0.236 in) bolts at least 75 mm (3.00 in) long (a) with the hex head removed (1).

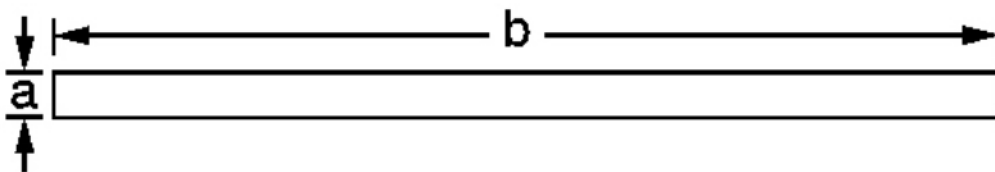


Fig. 337: Making Alignment Pin

Courtesy of GENERAL MOTORS CORP.

3. Make an alignment pin from 15/64 inch drill rod (a) with a diameter of 5.954 mm (0.2344 in) and at least 75 mm (3.00 in) long (b).

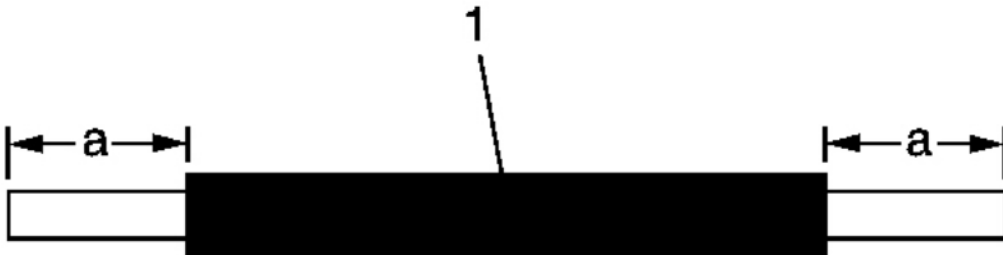


Fig. 338: Creating A Stop On Alignment Pin
Courtesy of GENERAL MOTORS CORP.

4. To verify proper insertion distance create a stop (1) on the alignment pin by placing tape or shrink tubing 13 mm (0.5118 in) from the end (a) that will be inserted through the camshaft position actuator magnet.

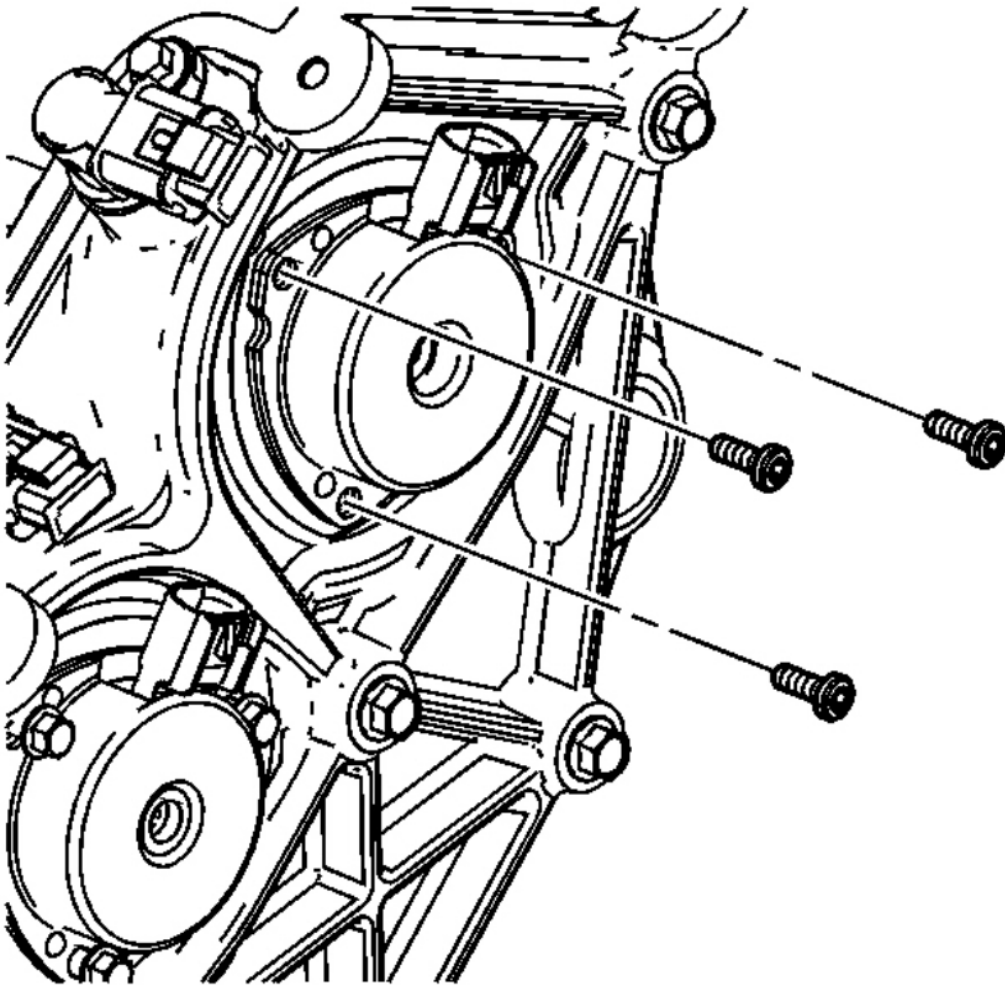


Fig. 339: View Of Camshaft Position Actuator Magnet Bolts
Courtesy of GENERAL MOTORS CORP.

5. Remove the camshaft position actuator magnet bolts.

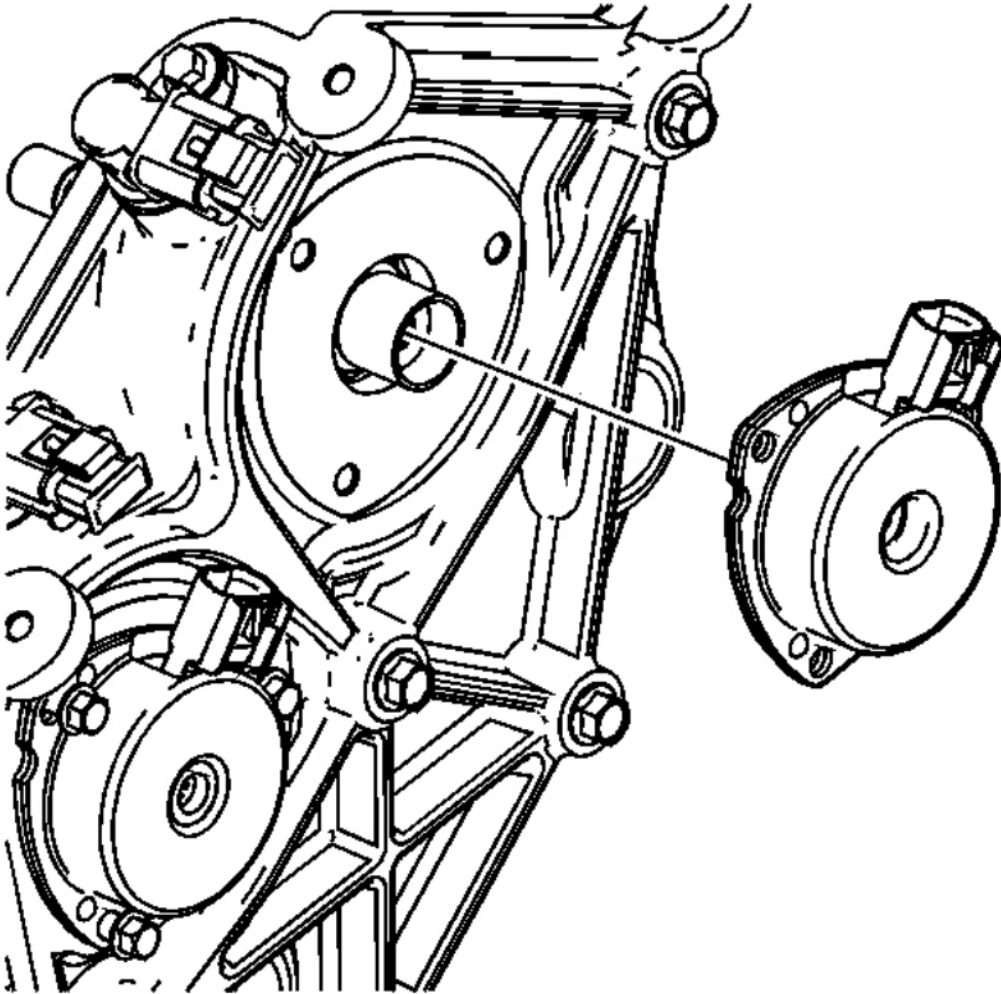


Fig. 340: View Of Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

6. Remove the camshaft position actuator magnet.

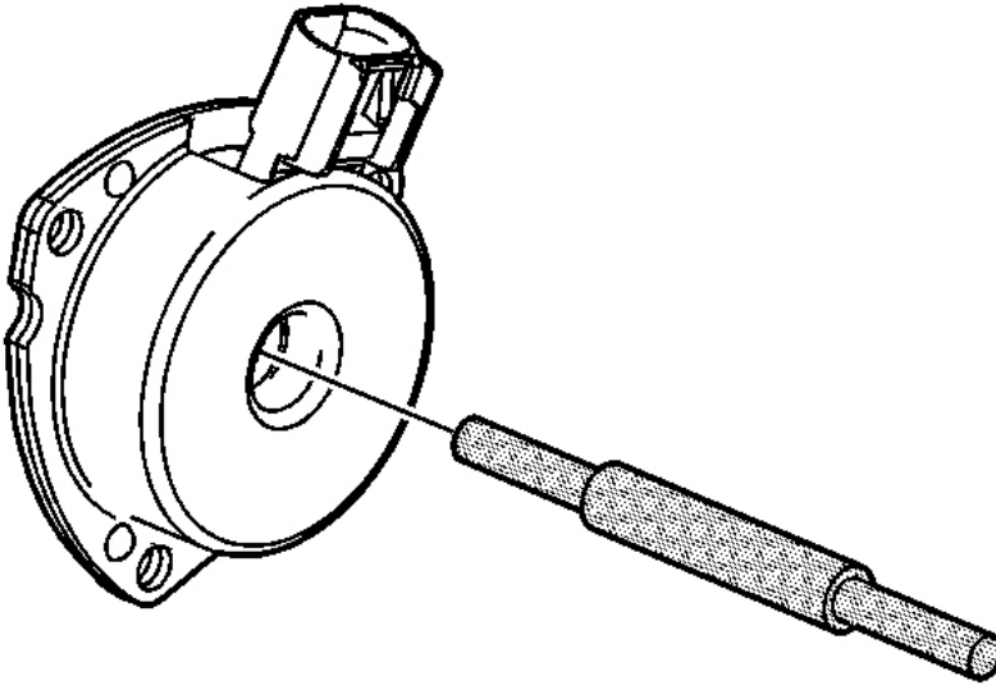


Fig. 341: Verifying That Alignment Pin Will Pass Through Camshaft Position Actuator Magnet Alignment Hole
Courtesy of GENERAL MOTORS CORP.

7. Verify that the alignment pin will pass through the camshaft position actuator magnet alignment hole.

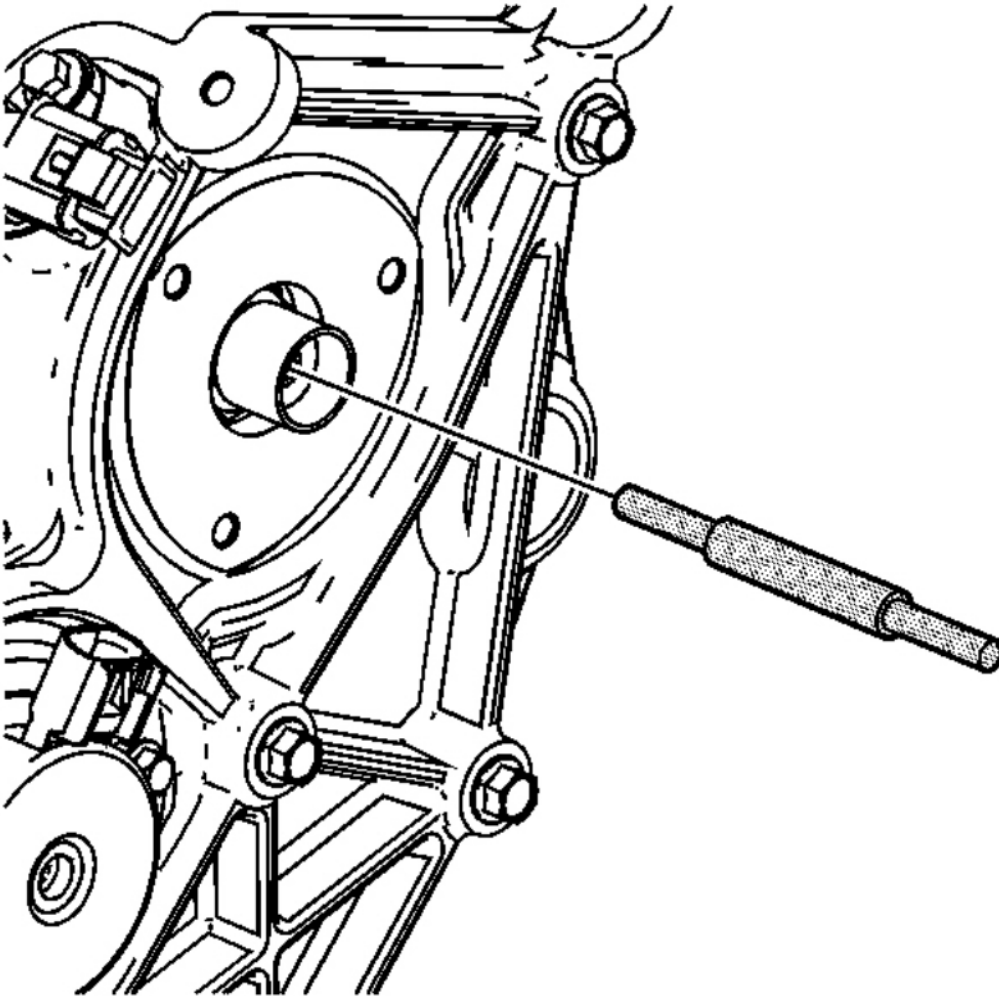


Fig. 342: Verifying That Alignment Pin Will Pass Through Camshaft Position Actuator Oil Control Valve Alignment Hole
Courtesy of GENERAL MOTORS CORP.

8. Verify that the alignment pin will fit into the alignment hole in the camshaft position actuator oil control valve.

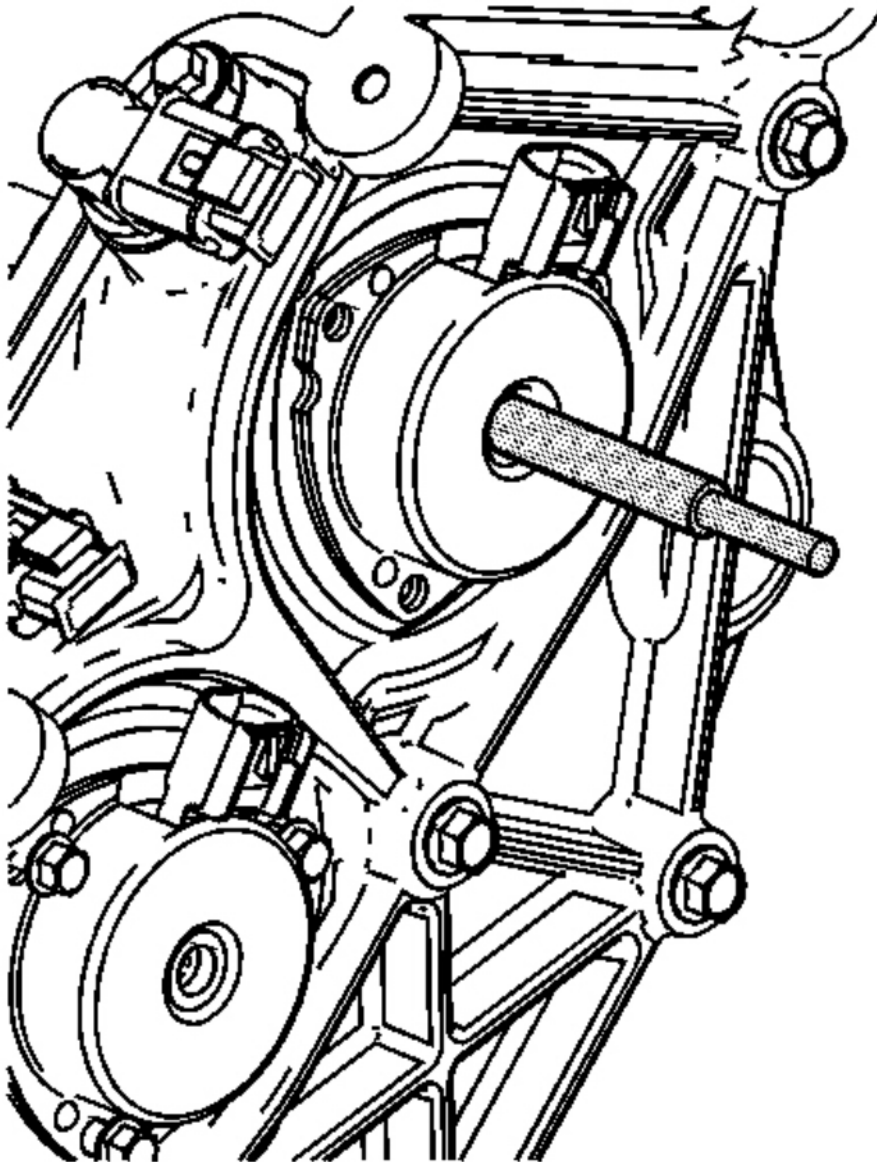


Fig. 343: Verifying Alignment Pin Stop Distance
Courtesy of GENERAL MOTORS CORP.

9. Place the camshaft position actuator magnet into place and verify the alignment pin will insert through the camshaft position actuator magnet and into the camshaft position actuator

oil control valve to verify alignment pin stop distance.

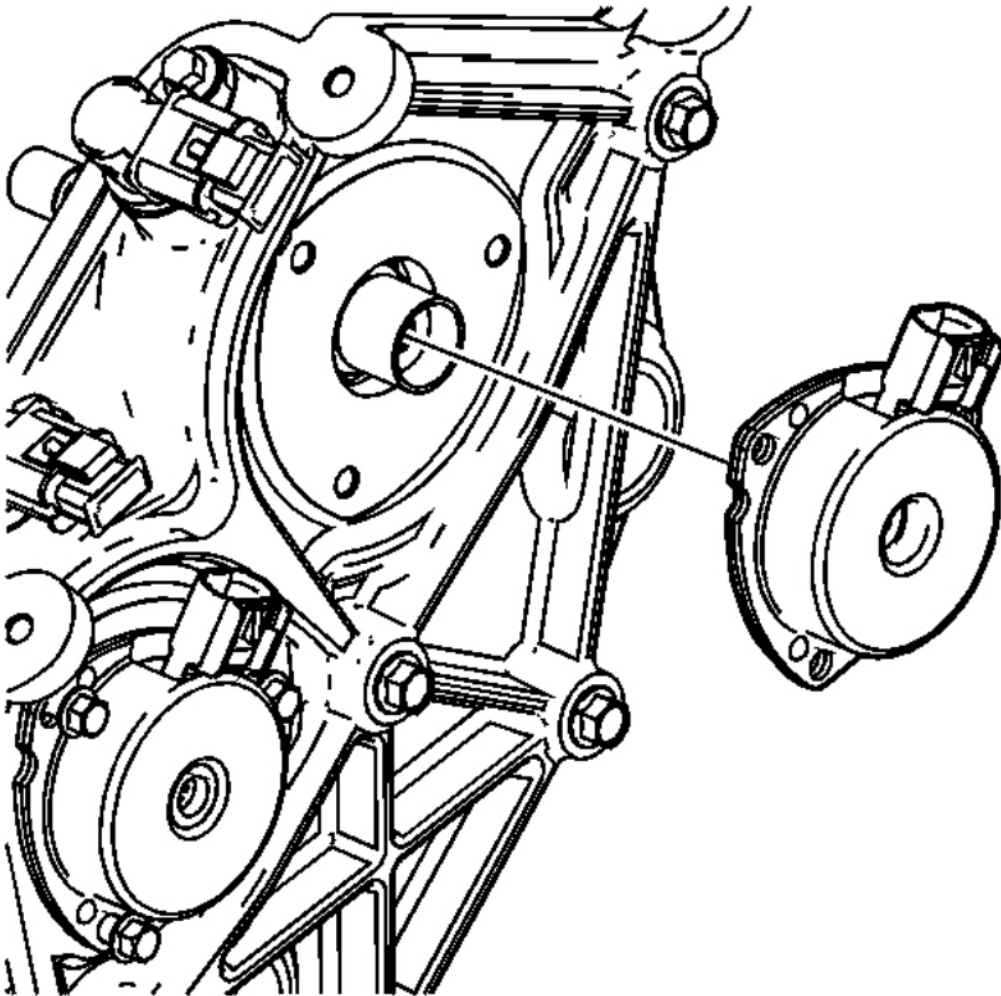


Fig. 344: View Of Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

10. Remove the camshaft position actuator magnet.

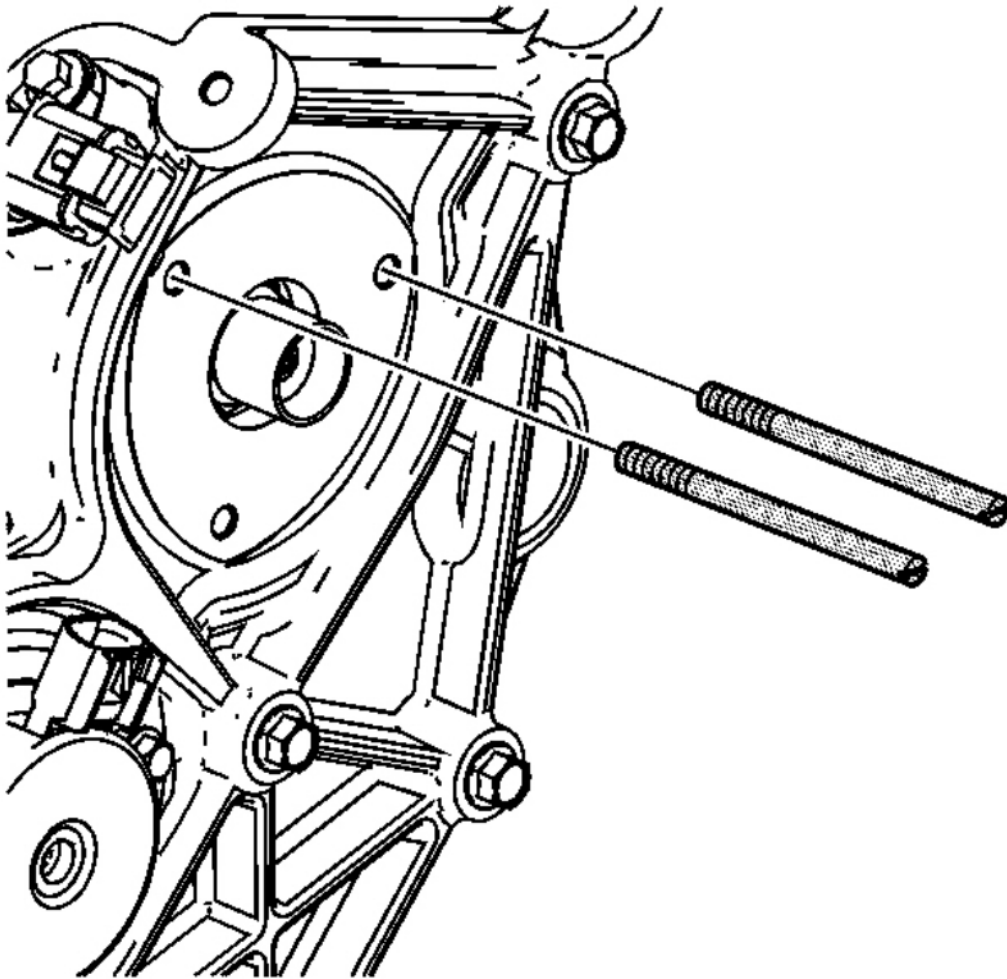


Fig. 345: Installing Loading Pins
Courtesy of GENERAL MOTORS CORP.

11. Install the 2 6 mm (0.236 in) loading pins in 2 of the camshaft position actuator magnet bolt holes in the camshaft position actuator housing.

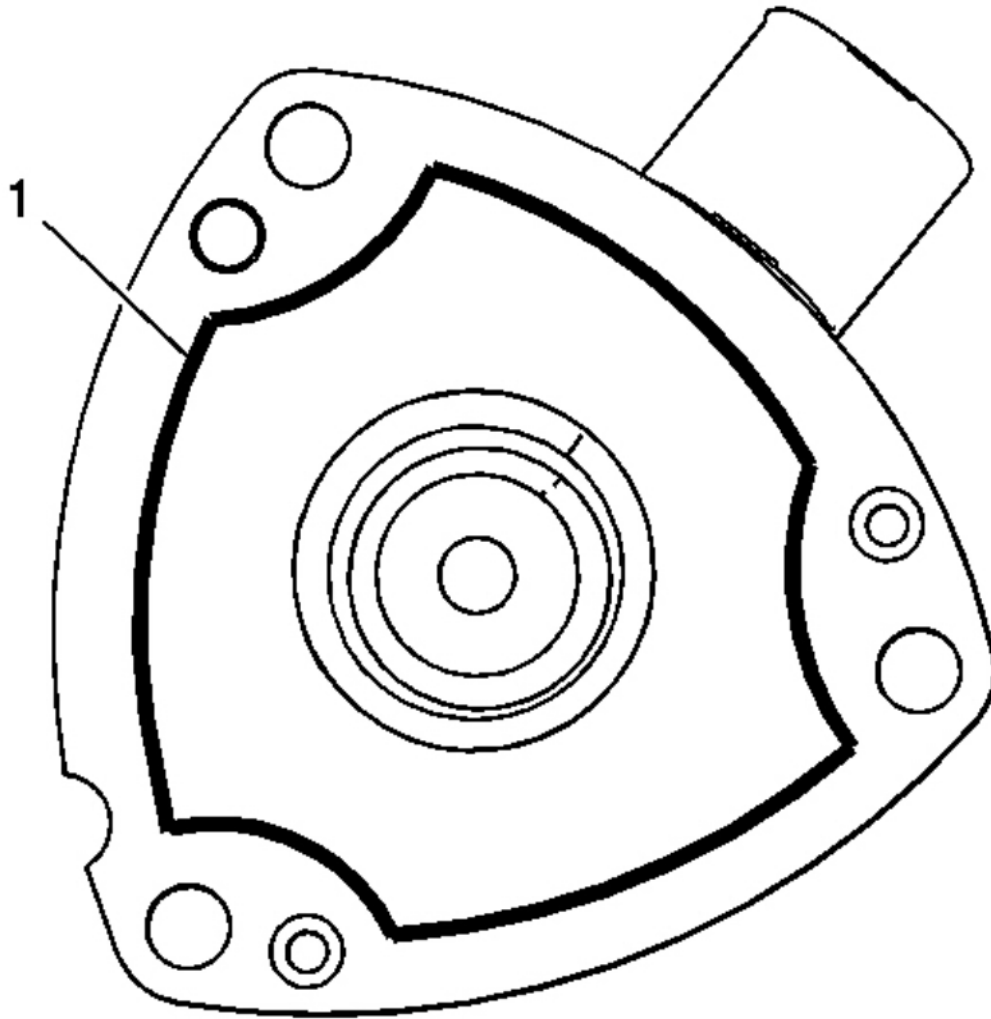


Fig. 346: Applying Sealant Around Flange Of Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

12. Apply a 2 mm (0.079 in) bead (1) of RTV sealant GM P/N 12378521 or equivalent around the flange of the camshaft position actuator magnet as shown.

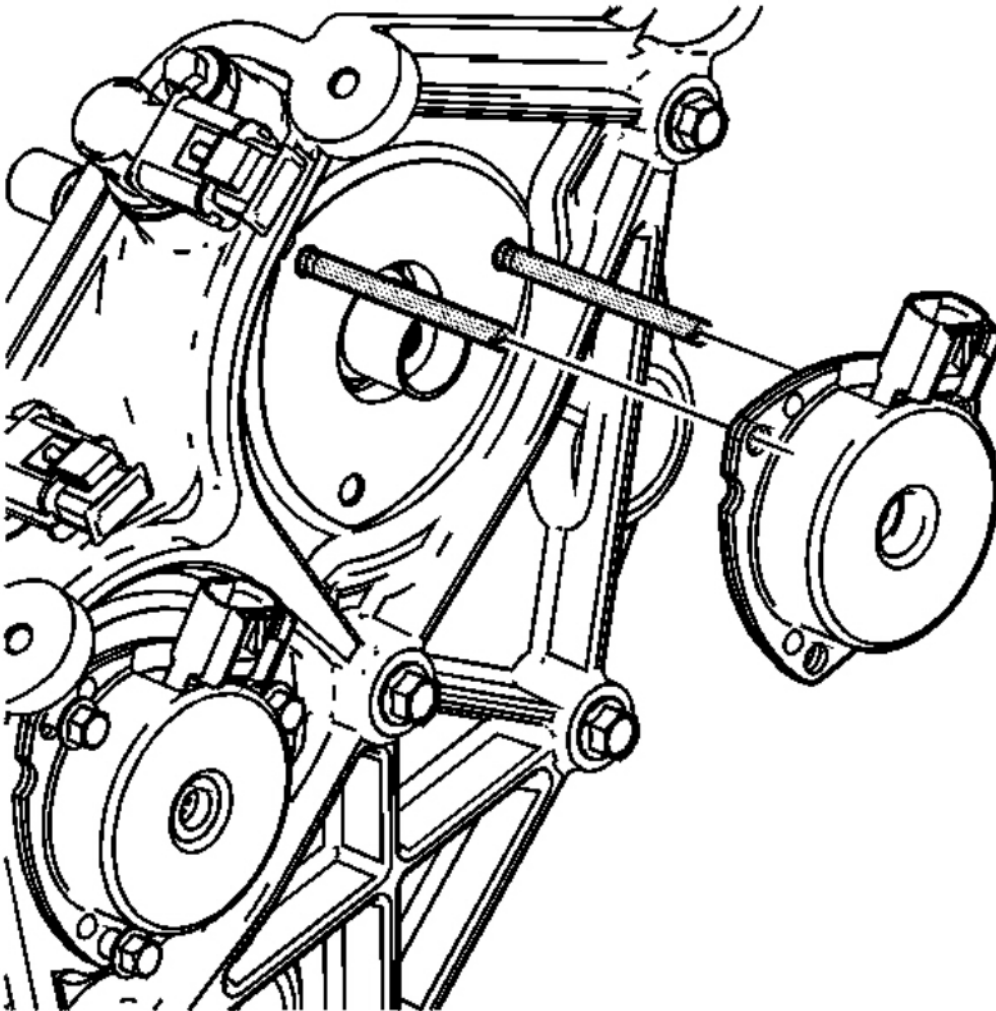


Fig. 347: Sliding Camshaft Position Actuator Magnet Over Loading Pins
Courtesy of GENERAL MOTORS CORP.

13. Slide the camshaft position actuator magnet over the 6 mm (0.236 in) loading pins.

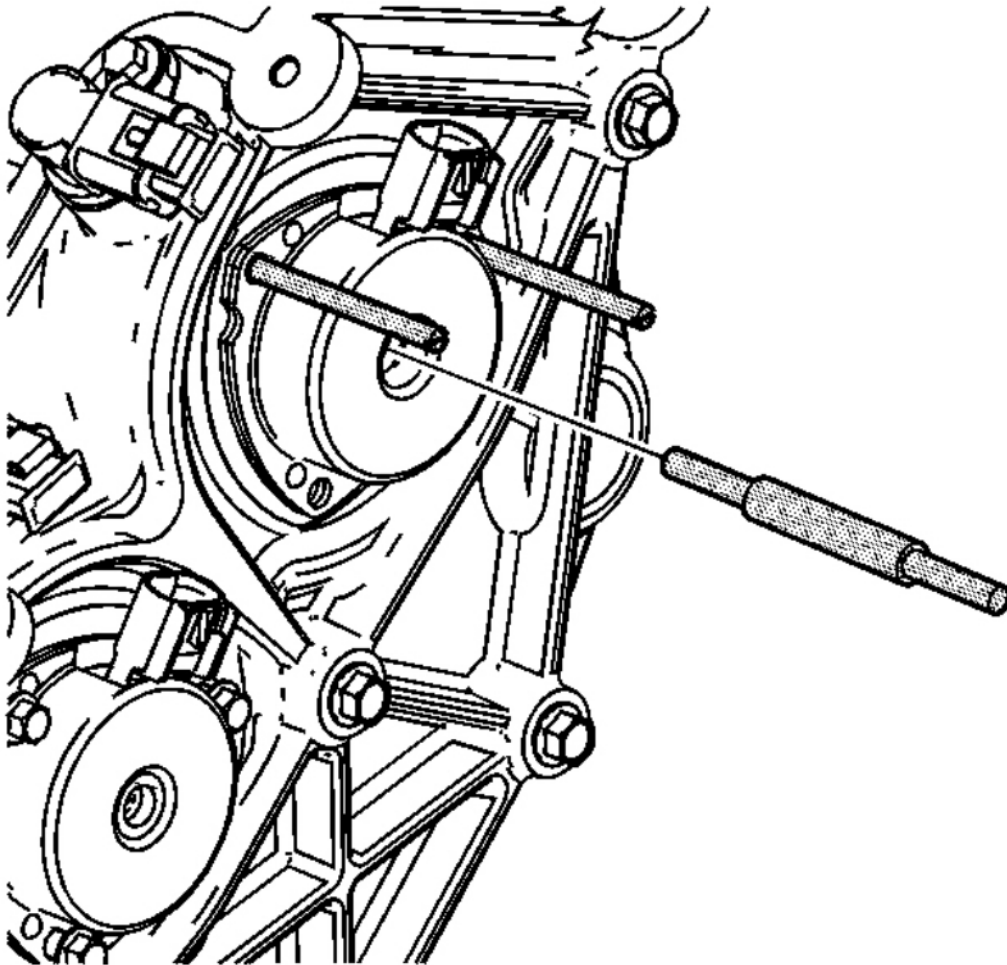


Fig. 348: Aligning Camshaft Position Actuator Magnet
Courtesy of GENERAL MOTORS CORP.

14. In order to align the camshaft position actuator magnet to the camshaft position actuator oil control valve, install the alignment pin through the camshaft position actuator magnet and into the camshaft position actuator oil control valve alignment hole.

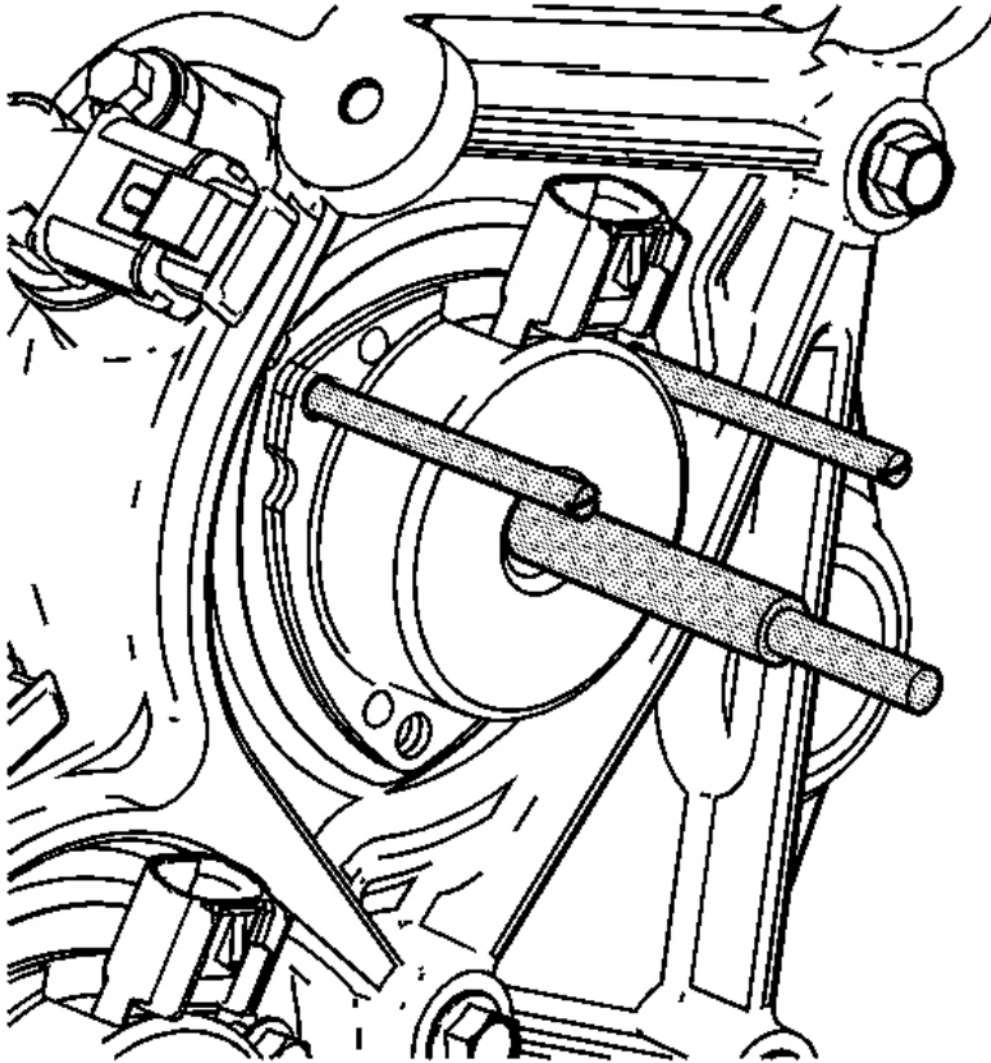


Fig. 349: Inserting Alignment Pin

Courtesy of GENERAL MOTORS CORP.

15. Verify that the alignment pin has been inserted into the camshaft position actuator oil control valve alignment hole by observing the stop has reached the hole in the camshaft position actuator magnet.

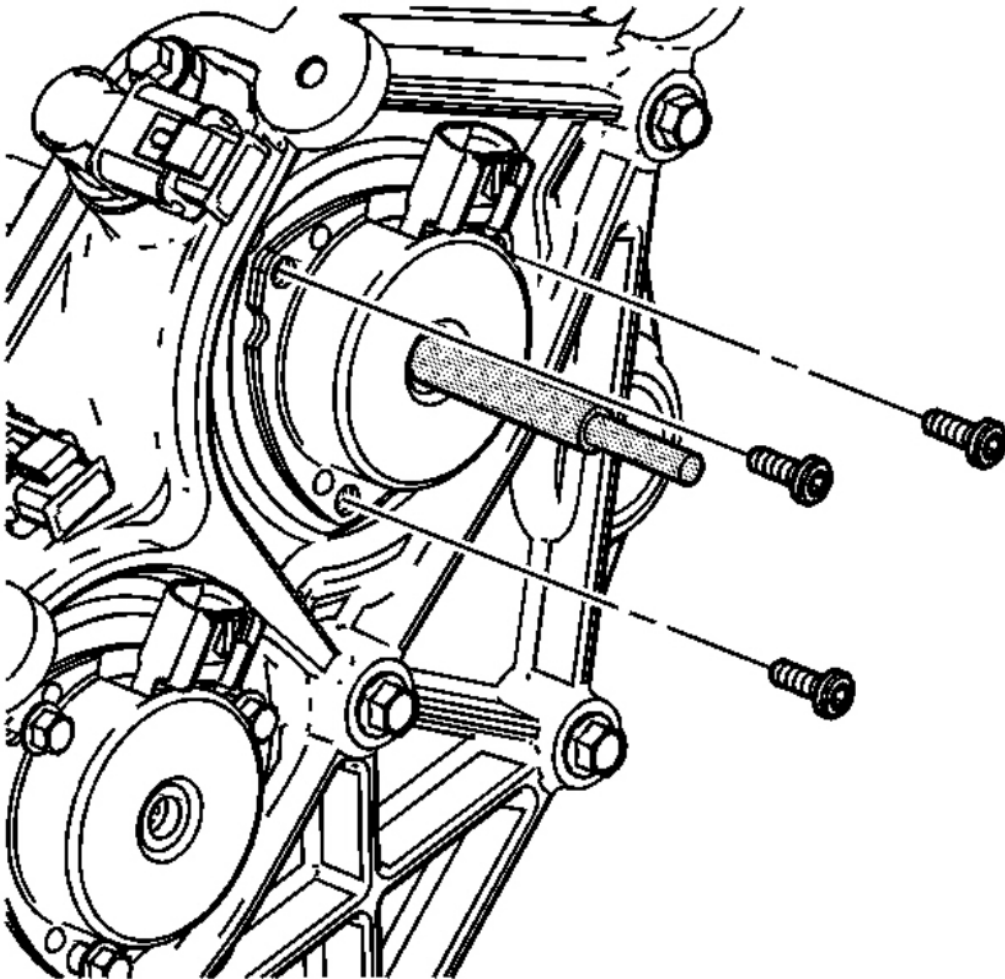


Fig. 350: Installing Camshaft Position Actuator Magnet Bolts
Courtesy of GENERAL MOTORS CORP.

16. With the alignment pin still installed, remove the loading pins and install the camshaft position actuator magnet bolts.

Tighten: Tighten the camshaft position actuator magnet bolts to 8 N.m (71 lb in).

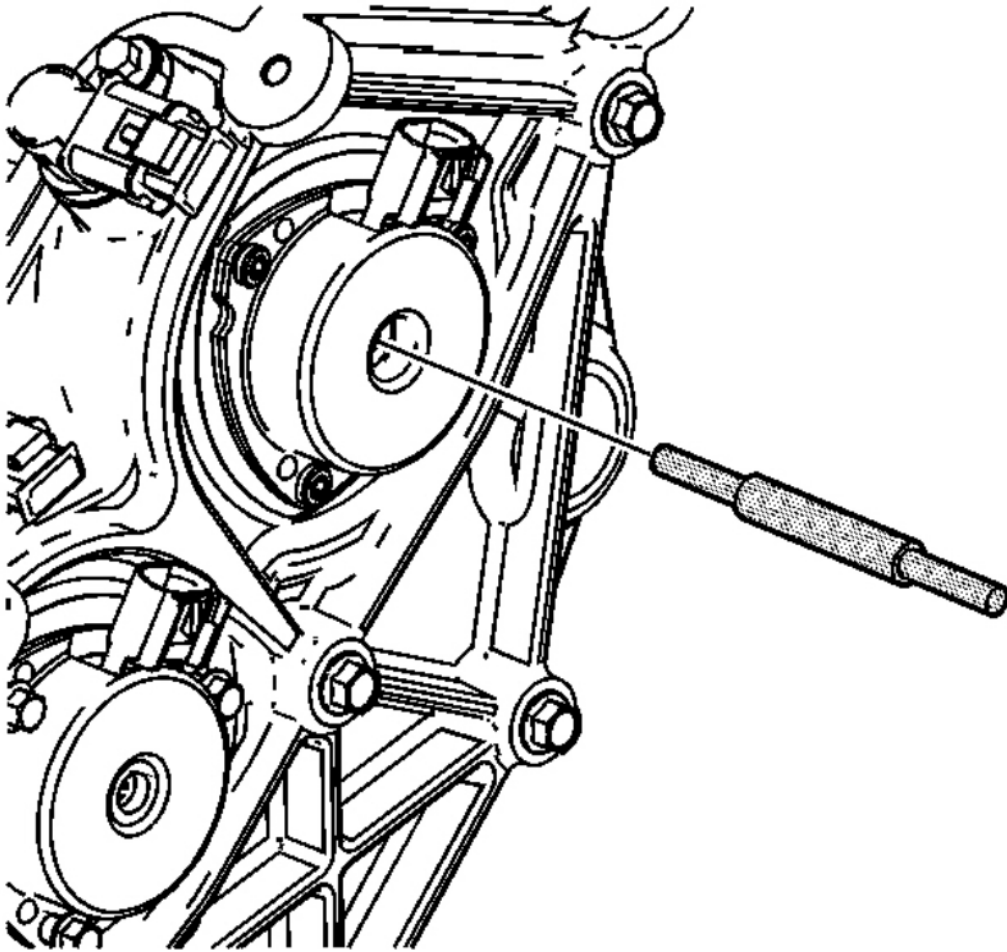


Fig. 351: Removing Alignment Pin
Courtesy of GENERAL MOTORS CORP.

17. Remove the alignment pin.

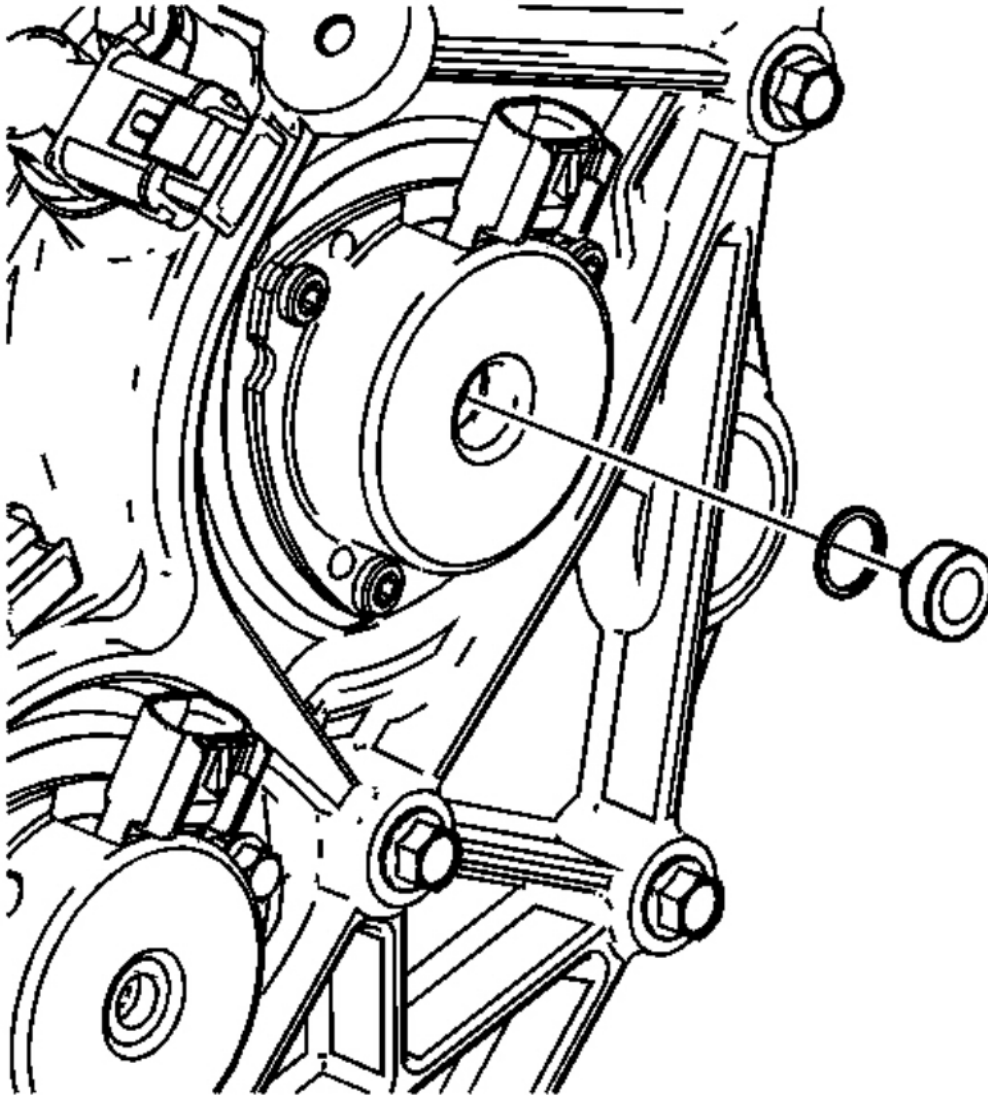


Fig. 352: View Of Camshaft Position Actuator Magnet Plug
Courtesy of GENERAL MOTORS CORP.

18. Install a NEW camshaft position actuator magnet plug.
19. Repeat steps 10 through 18 for any remaining camshaft position actuator magnets that have been removed.

CAMSHAFT COVER INSTALLATION - RIGHT

Tools Required:

EN 46328 Camshaft Holding Tool

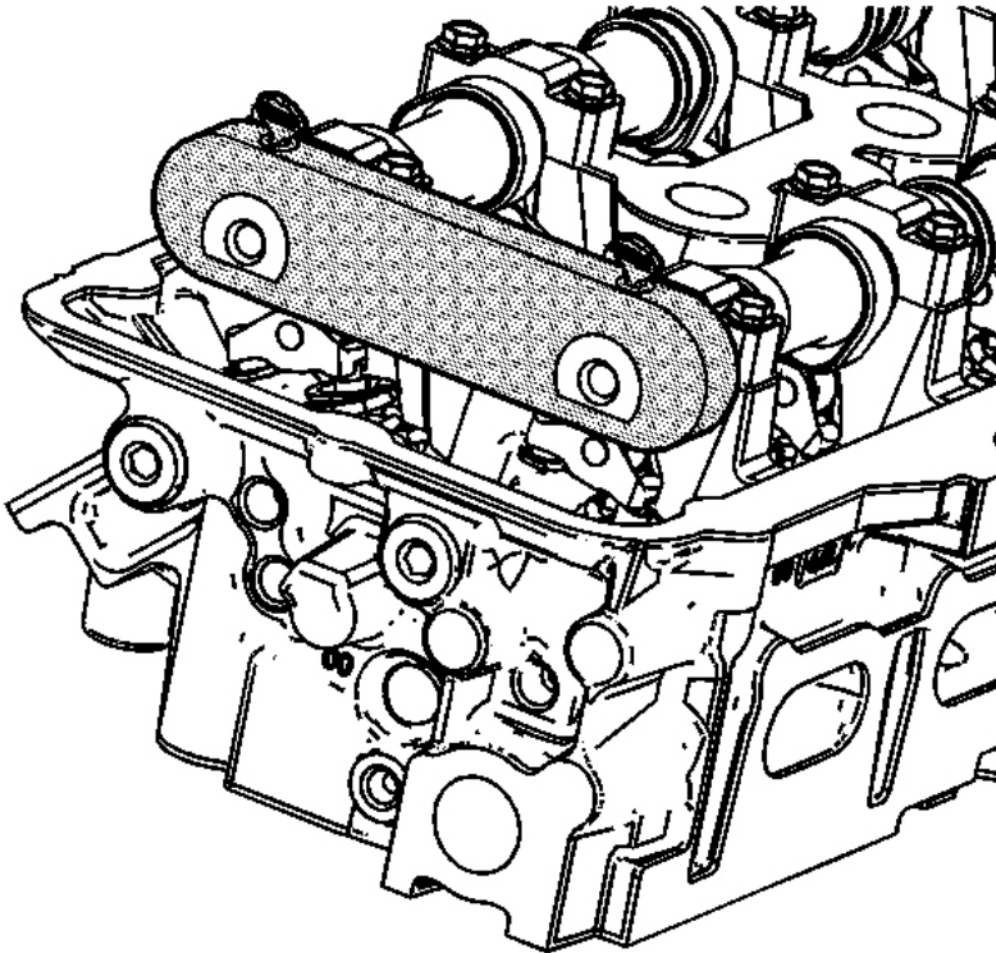


Fig. 353: View Of EN 46328 - Right
Courtesy of GENERAL MOTORS CORP.

1. Remove the **EN 46328** from the right camshafts.

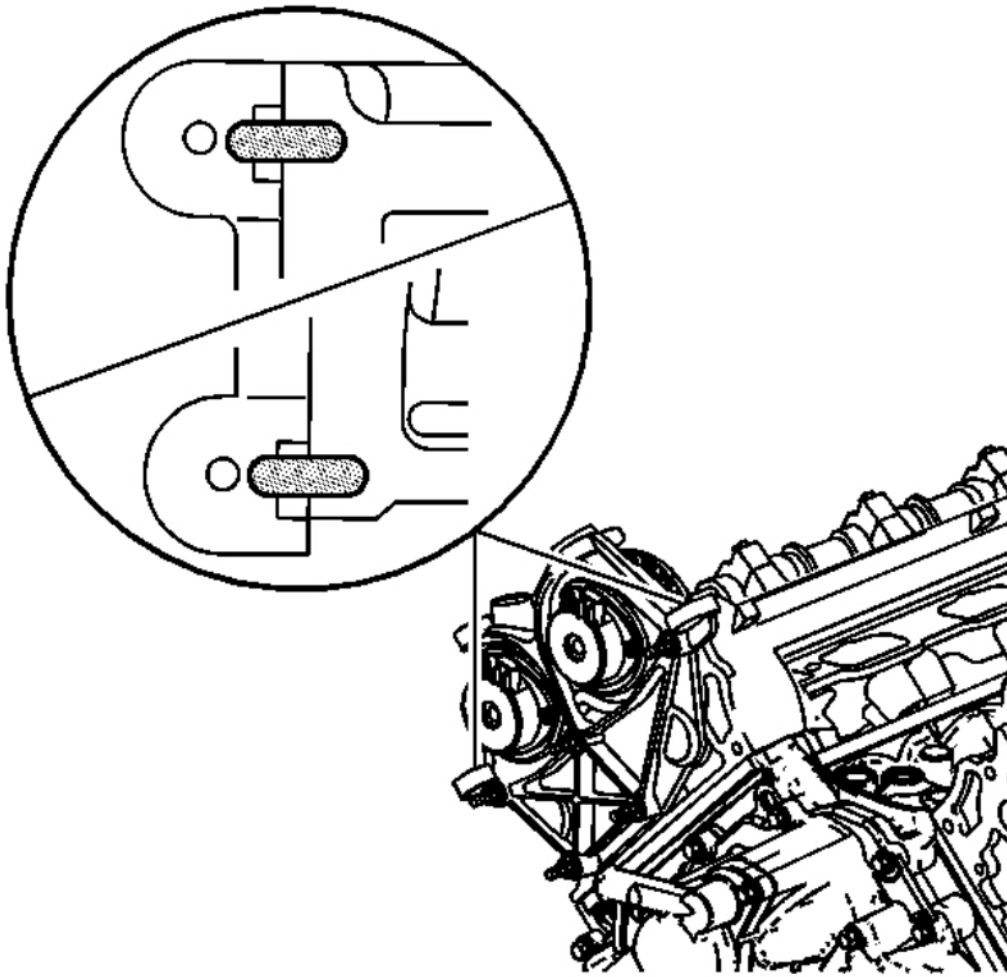


Fig. 354: Applying Sealant At Split Line Of Right Cylinder Head & CMP Actuator Housings

Courtesy of GENERAL MOTORS CORP.

2. Place a small amount of sealant GM P/N 12345739 (Canadian P/N 10953541) or equivalent at the split line of the right cylinder head and the right camshaft position actuator housings.

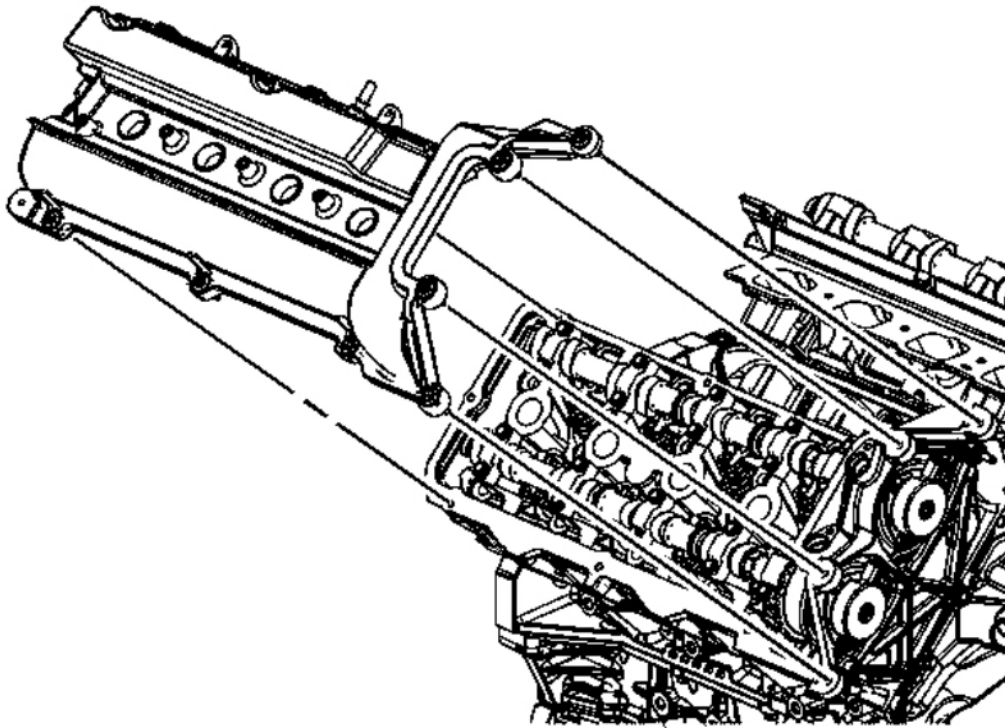


Fig. 355: View Of Right Camshaft Cover & Bolts

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Be careful to prevent the exposed section of the camshaft cover seal from being damaged by the edge of the cylinder head casting.

3. Install the right camshaft cover.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the right camshaft cover bolts.

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

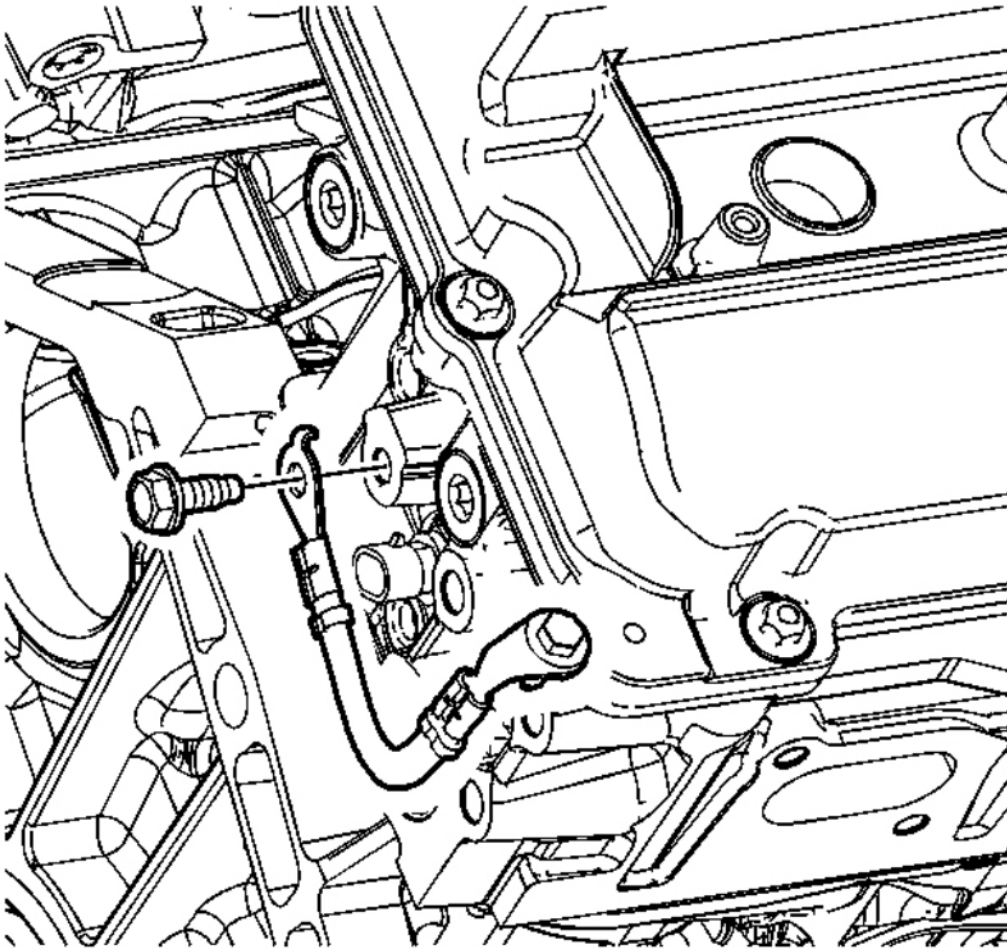


Fig. 356: View Of Ground Strap, Right Camshaft Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the bolts connecting the right camshaft cover ground strap to the right cylinder head and the right camshaft cover.

Tighten: Tighten the right ground strap bolts to 25 N.m (18 lb ft).

IGNITION MODULE INSTALLATION - RIGHT

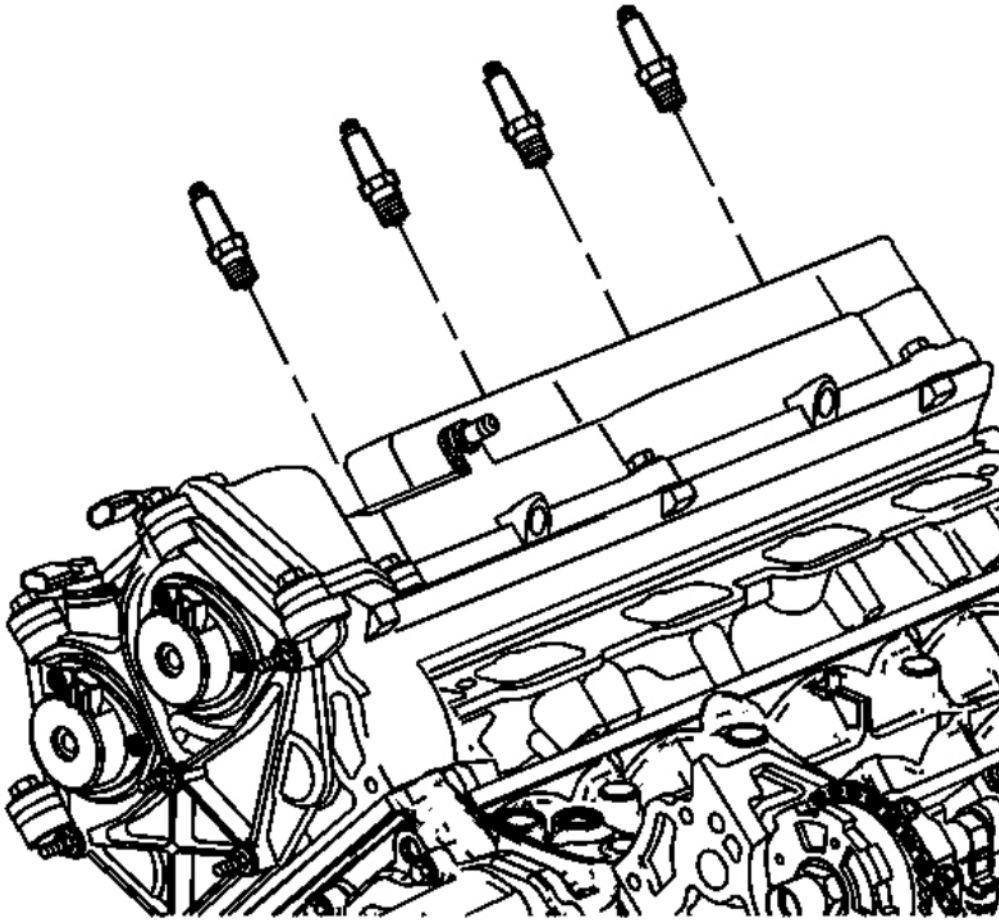


Fig. 357: View Of Right Spark Plugs
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the right spark plugs.

Tighten: Tighten the spark plugs to 15 N.m (11 lb ft).

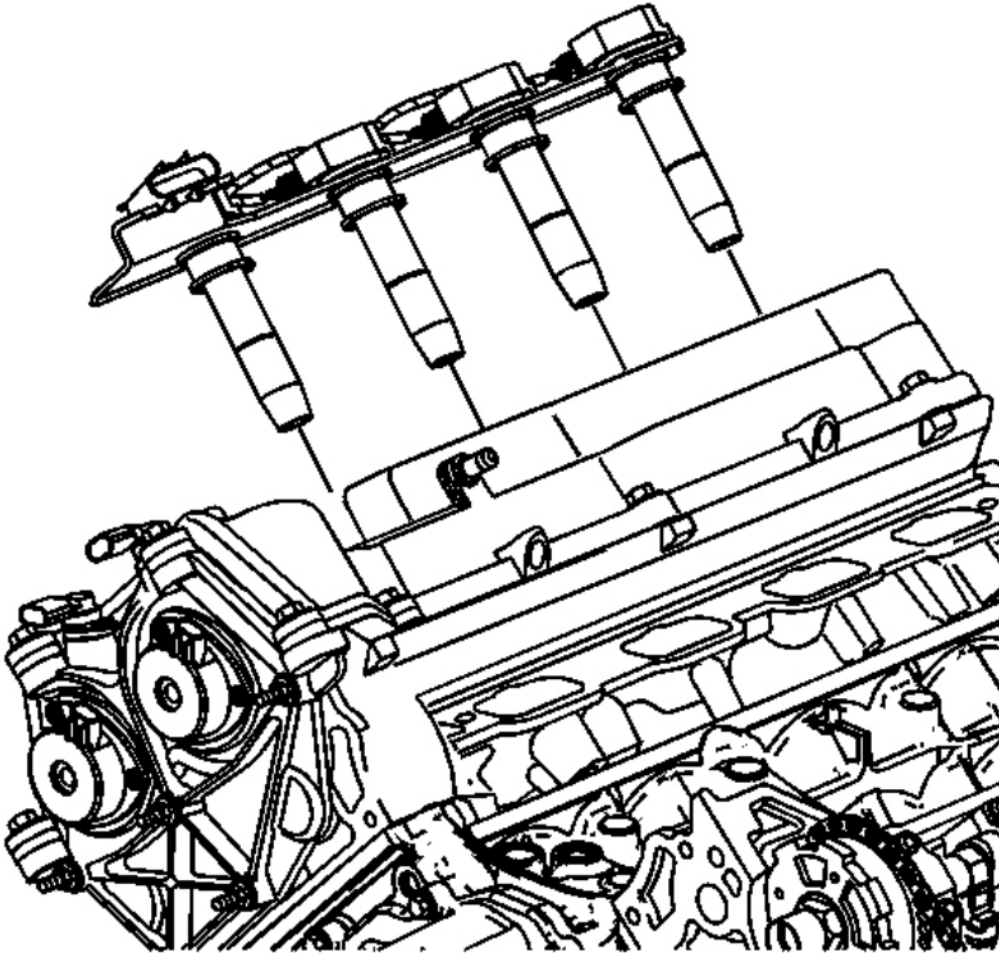


Fig. 358: View Of Ignition Coils
Courtesy of GENERAL MOTORS CORP.

2. Carefully, install the right ignition coil assembly.

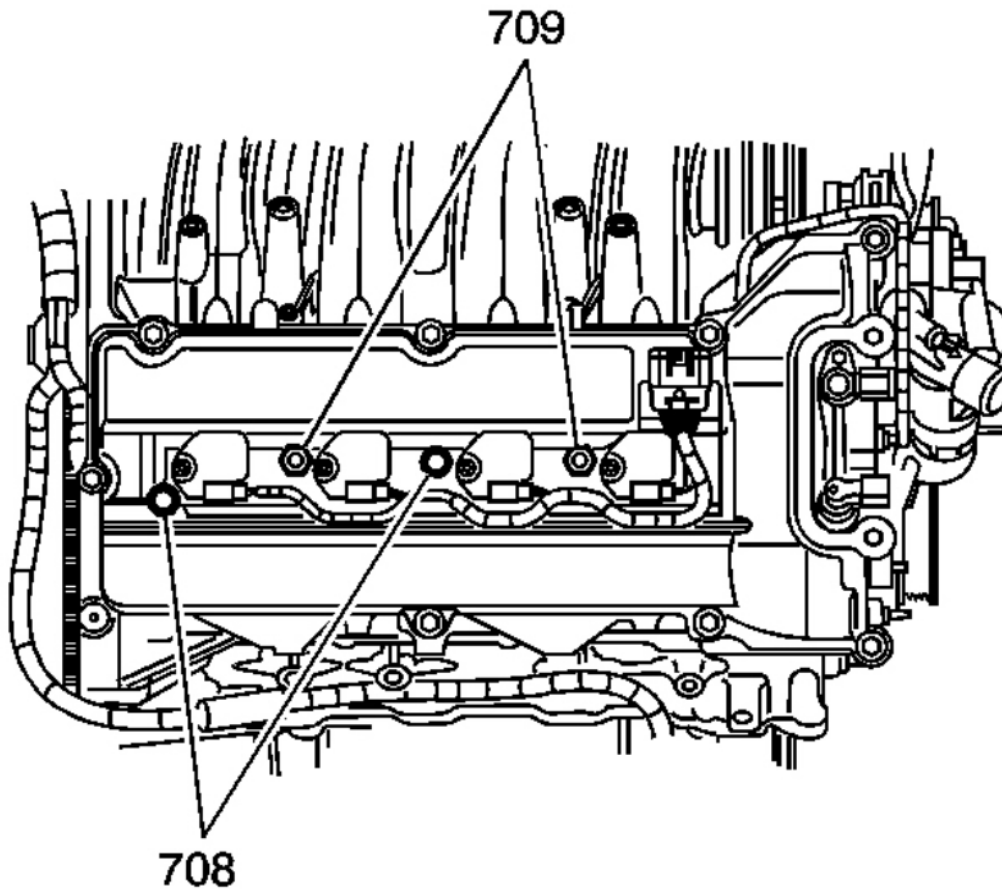


Fig. 359: Locating Ignition Coil Assembly Bolts & Ball Studs
Courtesy of GENERAL MOTORS CORP.

3. Install the ignition coil assembly bolts (708) and ball studs (709).

Tighten: Tighten the right ignition cassette bolts and ball studs to 10 N.m (89 lb in).

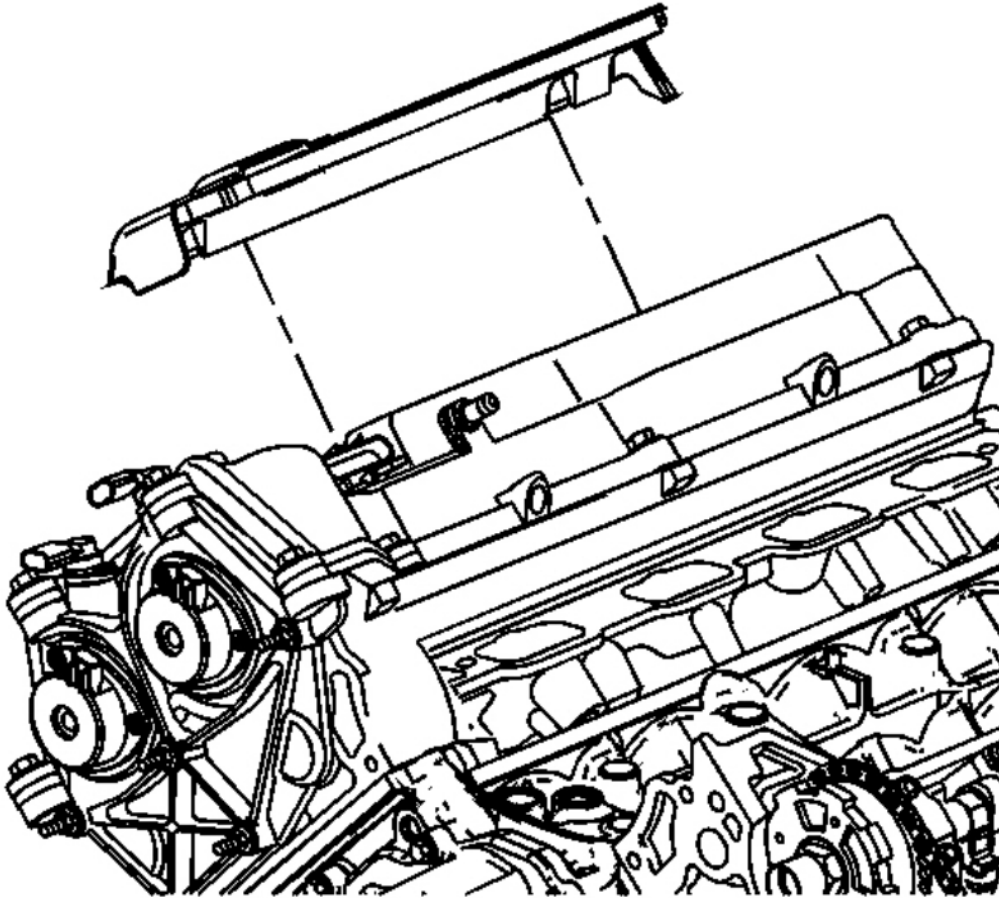


Fig. 360: View Of Right Ignition Coil Assembly Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the right ignition coil assembly cover.

OIL FILTER ADAPTER INSTALLATION (WITHOUT OIL COOLER)

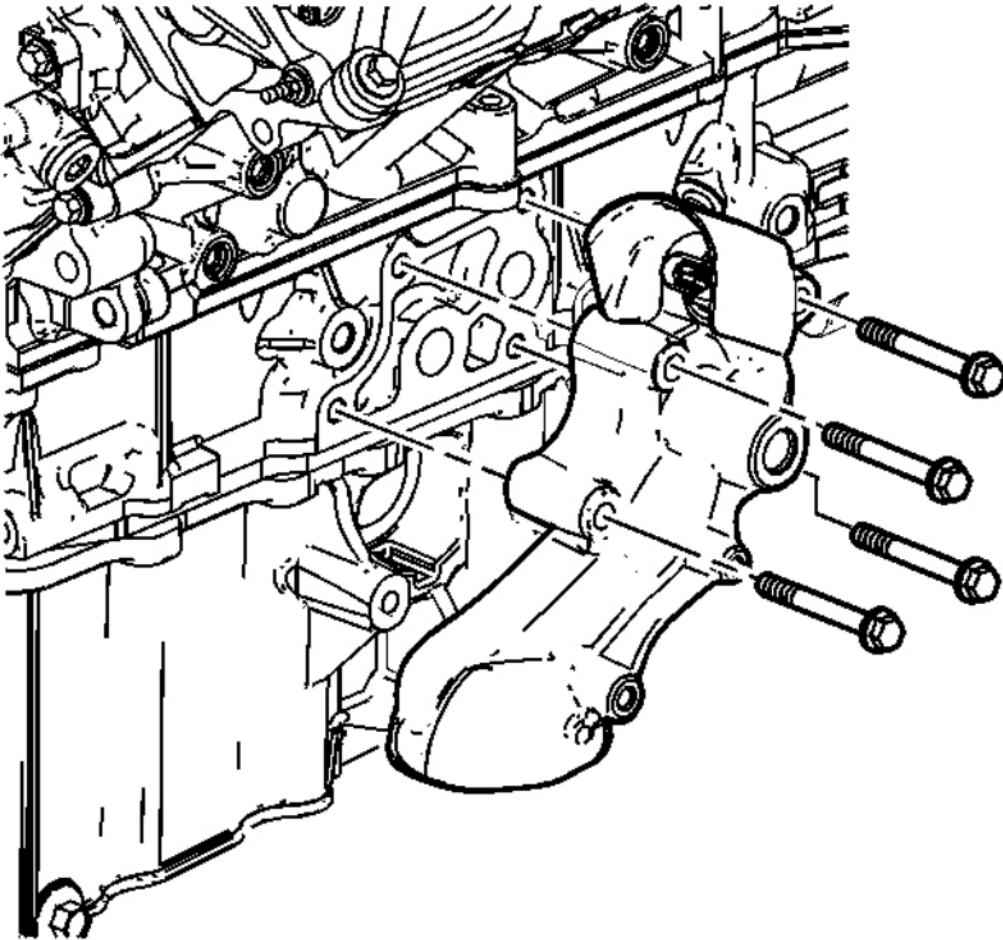


Fig. 361: View Of Oil Filter Adapter - w/o Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket to the oil filter adapter.
2. Position the oil filter adapter on the crankcase.

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

3. Install the oil filter adapter bolts.

Tighten: Tighten the oil filter adapter bolts to 16 N.m (12 lb ft).

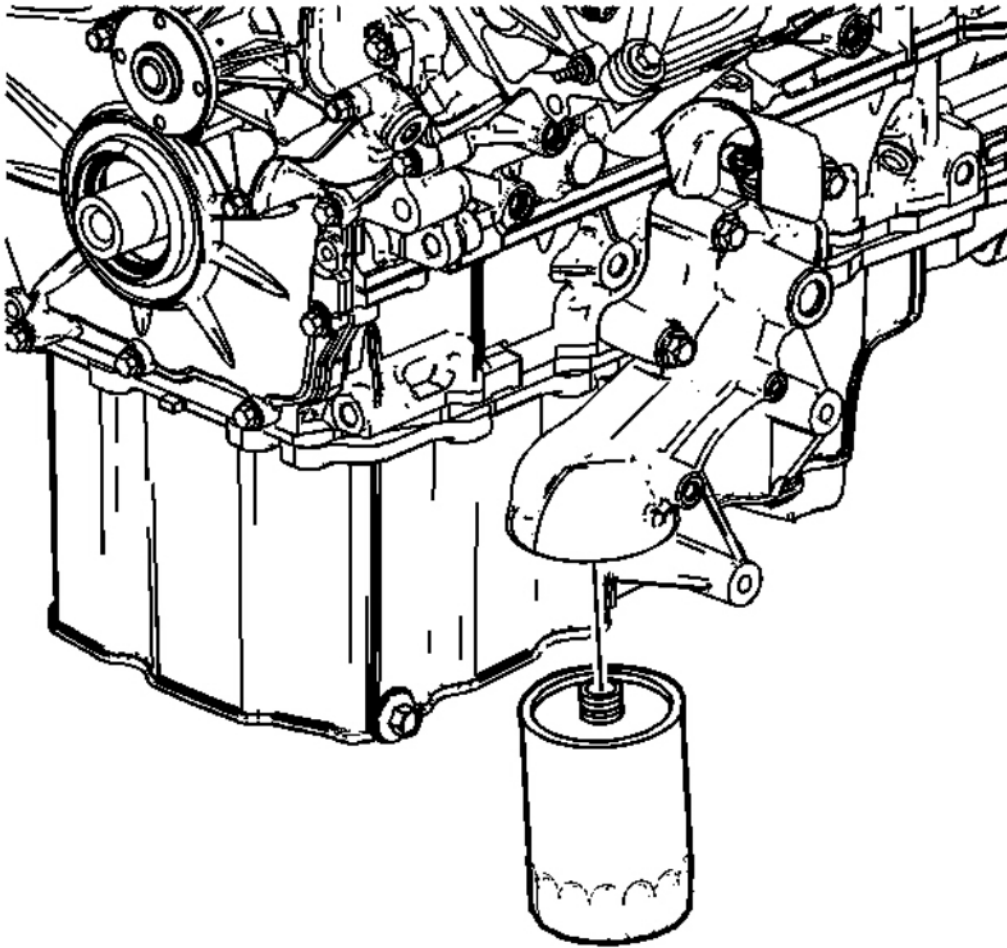


Fig. 362: View Of Oil Filter - w/o Oil Cooler
Courtesy of GENERAL MOTORS CORP.

4. Fill the oil filter with oil.
5. Install the oil filter.

Tighten: Tighten the oil filter to 32 N.m (24 lb ft).

OIL FILTER ADAPTER INSTALLATION (WITH OIL COOLER)

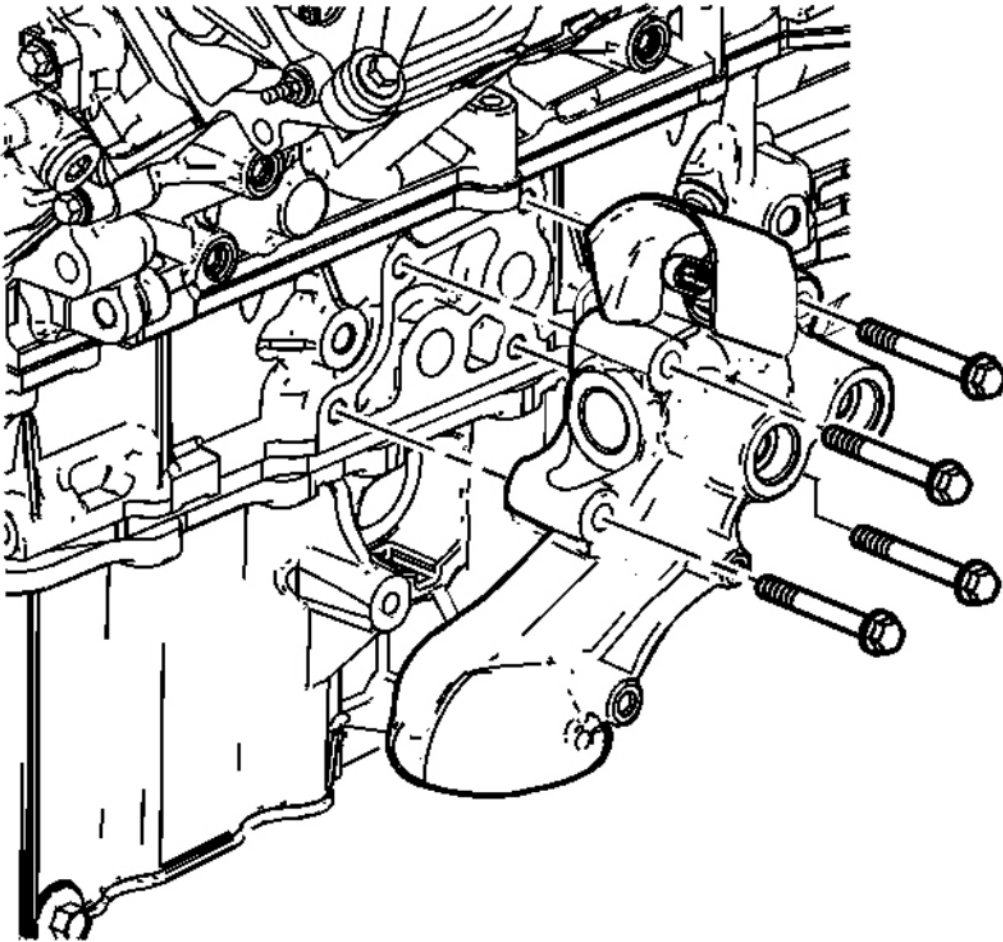


Fig. 363: View Of Oil Filter Adapter - w/Oil Cooler
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket to the oil filter adapter.
2. Position the oil filter adapter on the crankcase.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the oil filter adapter bolts.

Tighten: Tighten the oil filter adapter bolts to 16 N.m (12 lb ft).

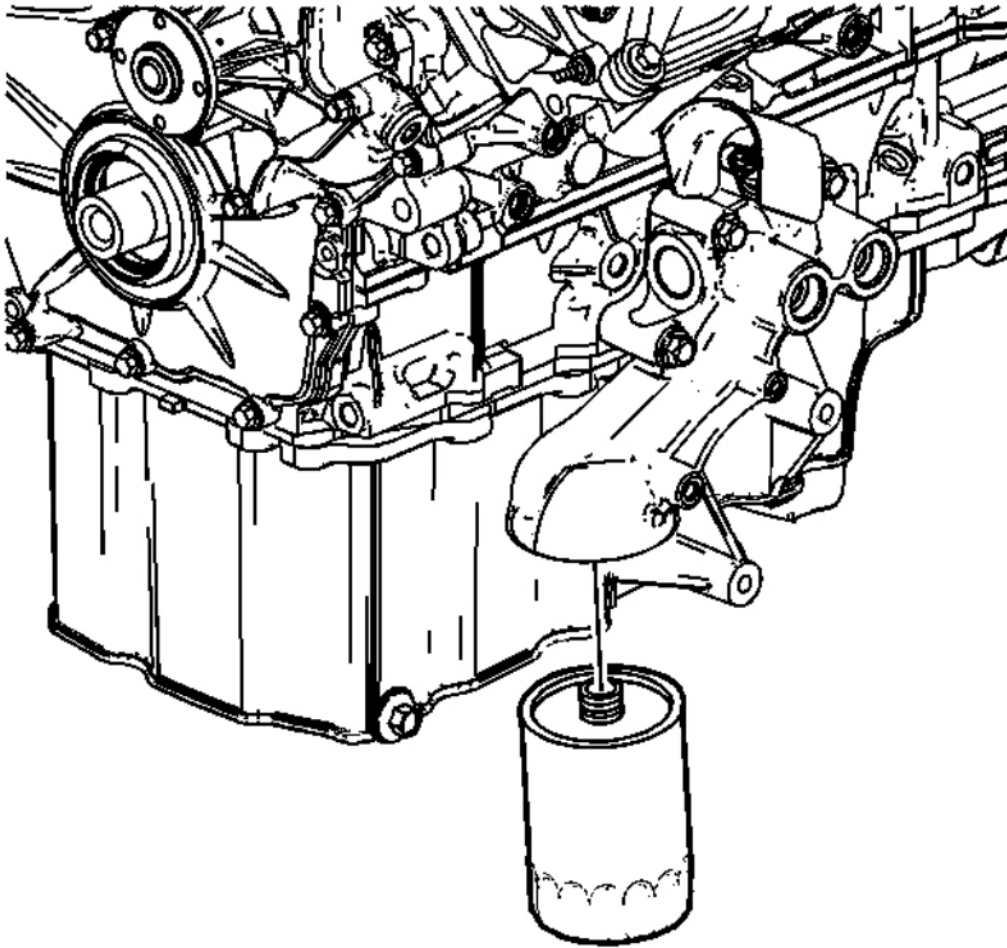


Fig. 364: View Of Oil Filter - w/Oil Cooler
Courtesy of GENERAL MOTORS CORP.

4. Fill the oil filter with oil.
5. Install the oil filter.

Tighten: Tighten the oil filter to 32 N.m (24 lb ft).

OIL LEVEL INDICATOR AND TUBE INSTALLATION

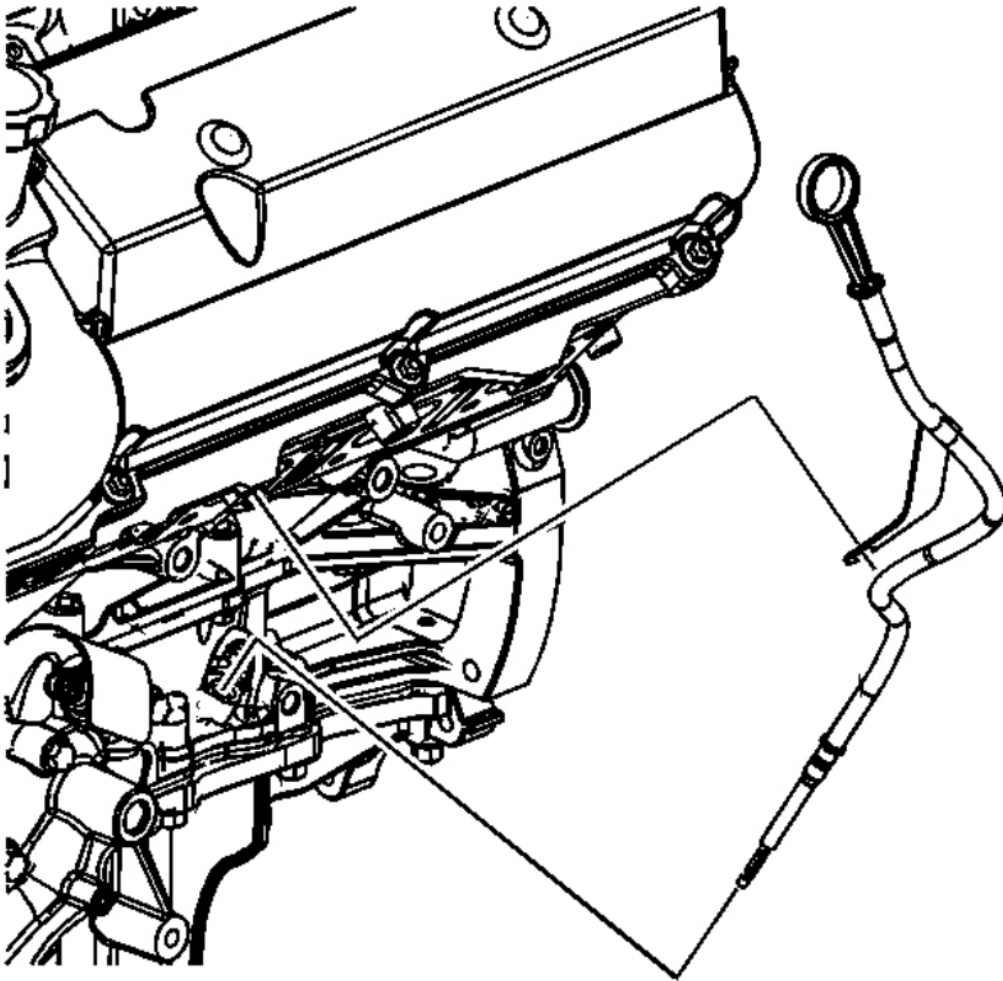


Fig. 365: View Of Oil Level Indicator Tube
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW O-ring on the oil level indicator tube.
2. Install the oil level indicator tube.

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

3. Install the oil level indicator tube nut.

Tighten: Tighten the oil level indicator tube nut to 10 N.m (89 lb in).

CRANKSHAFT REAR OIL SEAL INSTALLATION

Tools Required:

J 45930 Crankshaft Rear Oil Seal Installer

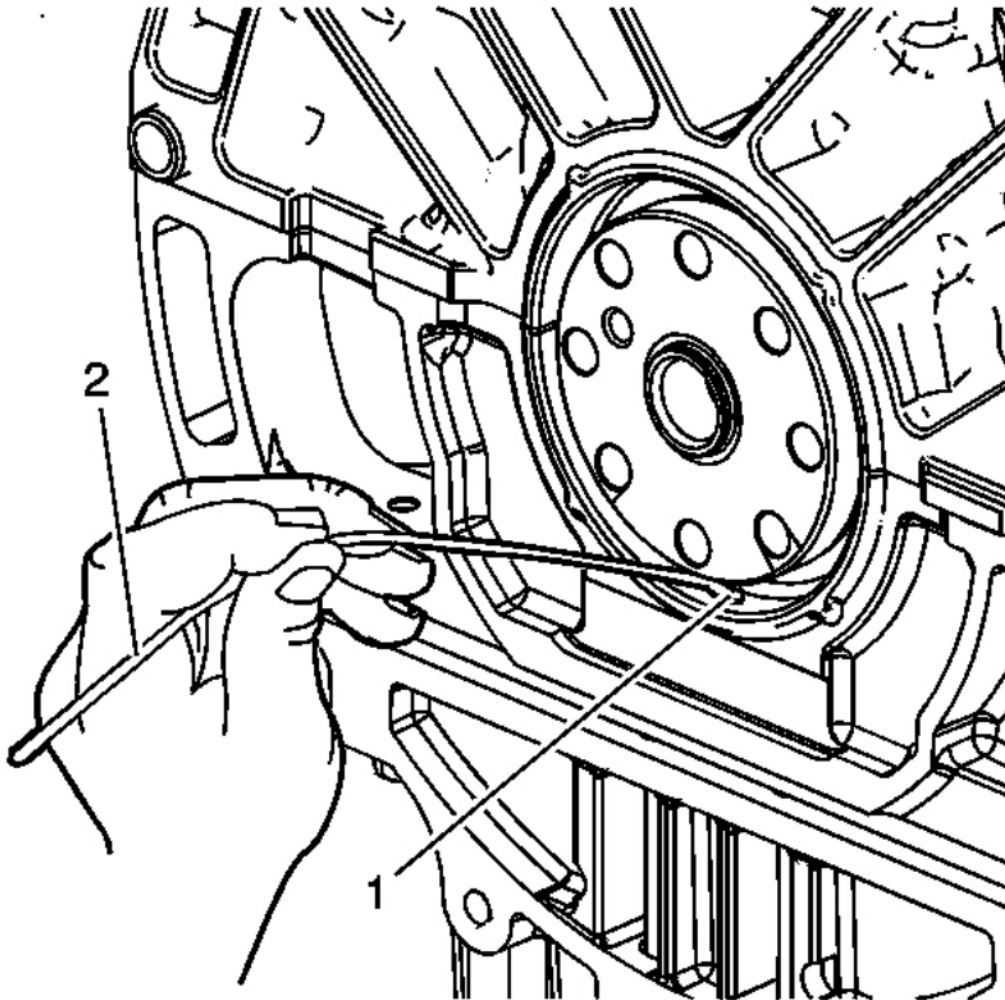


Fig. 366: Cleaning Debris From Crankshaft Rear Oil Seal Drain
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Crankshaft rear oil seal and engine flywheel installation

requires adequate space for installation. If the engine stand does not allow suitable space to use the J 45930 install the crankshaft rear oil seal and engine flywheel with the engine properly supported on the floor or on a bench.

IMPORTANT: Make sure the drain is clear before installing the new crankshaft rear oil seal. Failure to clear the drain could cause the crankshaft rear oil seal to leak.

1. Clean any debris from the crankshaft rear oil seal drain (1) using wire or an unbound plastic tie-wrap (2).
2. Place a small amount of Gasket Maker, GM P/N 1052942, (Canadian P/N 10953466), or equivalent, at the crankcase split line across the end of the upper/lower crankcase seal.
3. Coat the outer diameter of the cylinder block crankshaft rear oil seal area with clean engine oil GM P/N 12345501, (Canadian P/N 992704), or equivalent.

IMPORTANT: DO NOT allow any engine oil on the area where the crankshaft rear oil seal is to be pressed onto the crankshaft. The green coating pre-applied to the inner diameter of the crankshaft rear oil seal must not be contaminated.

4. Wipe the outer diameter of the flywheel flange clean with a lint-free cloth.

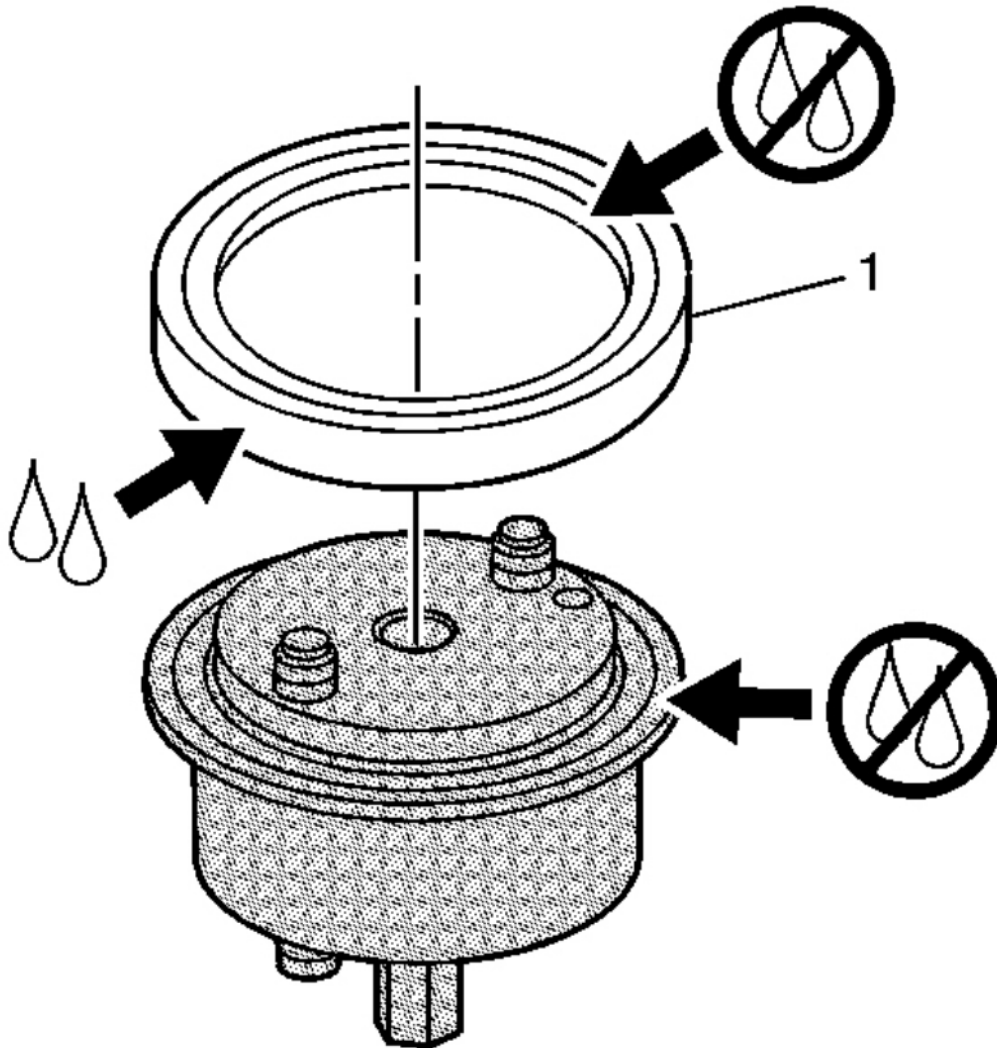


Fig. 367: Lubricating Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: DO NOT put any engine oil on the green coating pre-applied to the inner diameter of the crankshaft rear oil seal. This coating is a sealant that must not be contaminated.

5. Lubricate the outer rubber surface (1) of the crankshaft rear oil seal with clean engine oil

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GM P/N 12345501, (Canadian P/N 992704), or equivalent.

6. Install the proper sized bolts into the **J 45930** that match the threads in the crankshaft flange.

IMPORTANT: It is not necessary to completely unthread the center bolt and separate the two pieces of the J 45930 .

7. Adjust the center bolt of the **J 45930** until the center hub protrudes approximately one-half inch beyond the outer plate.

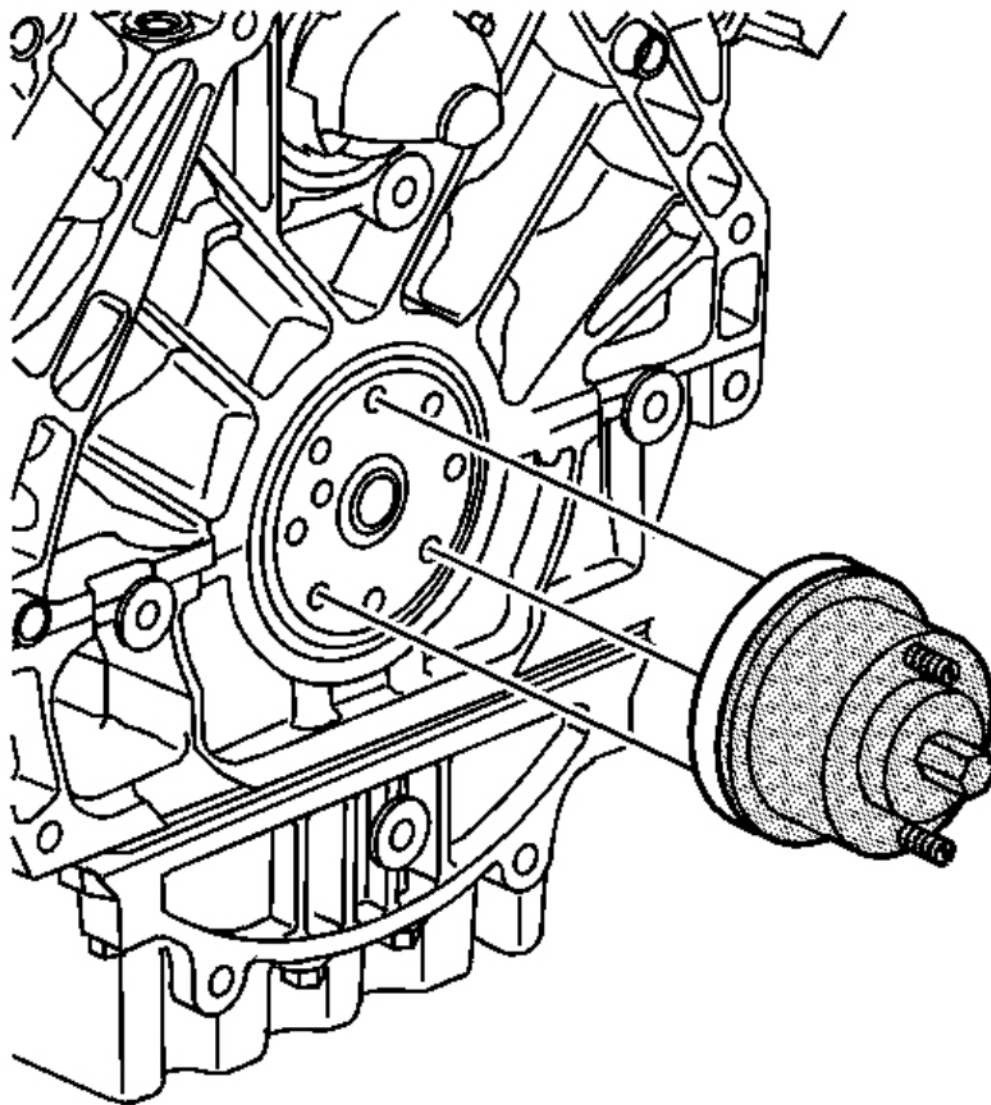


Fig. 368: Installing J 45930

Courtesy of GENERAL MOTORS CORP.

8. Install the **J 45930** to the rear of the crankshaft.

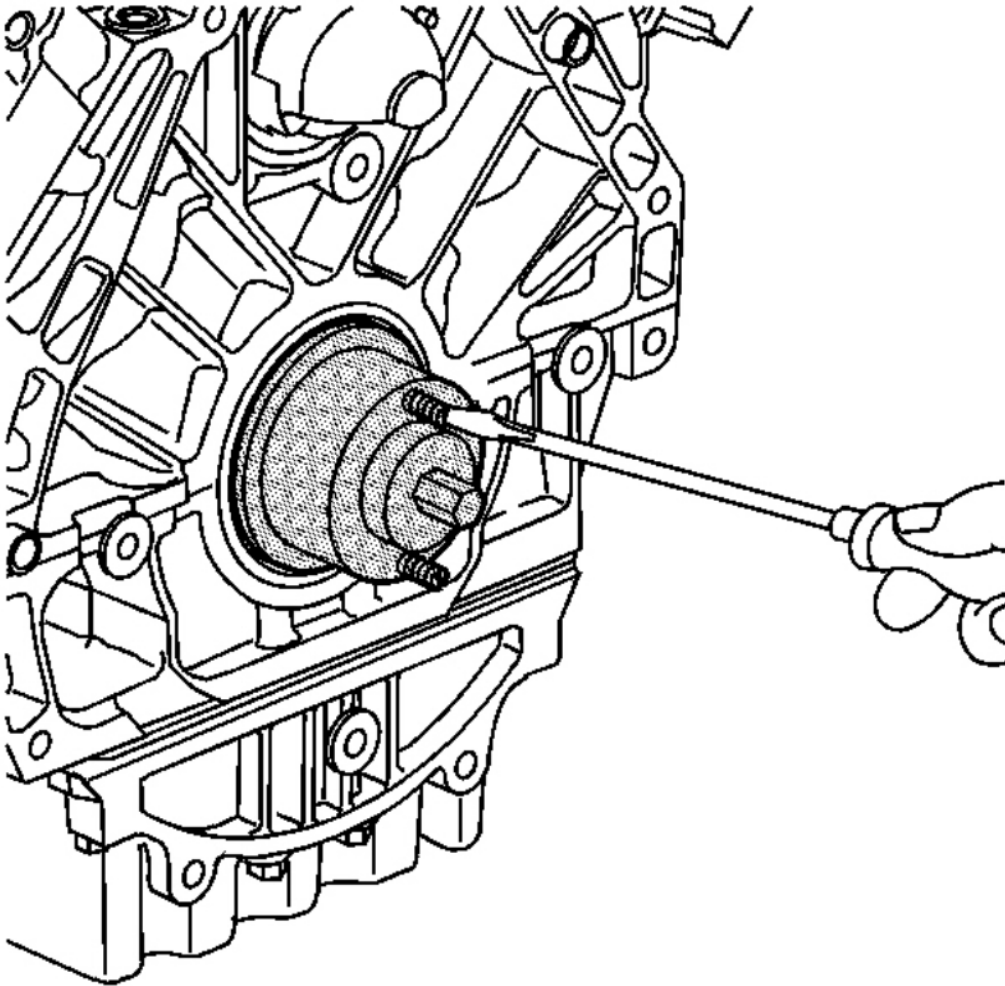


Fig. 369: Adjusting Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

9. Thread the mounting bolts into the crankshaft flange.
10. Tighten the mounting bolts until the **J 45930** is firmly mounted on the crankshaft.

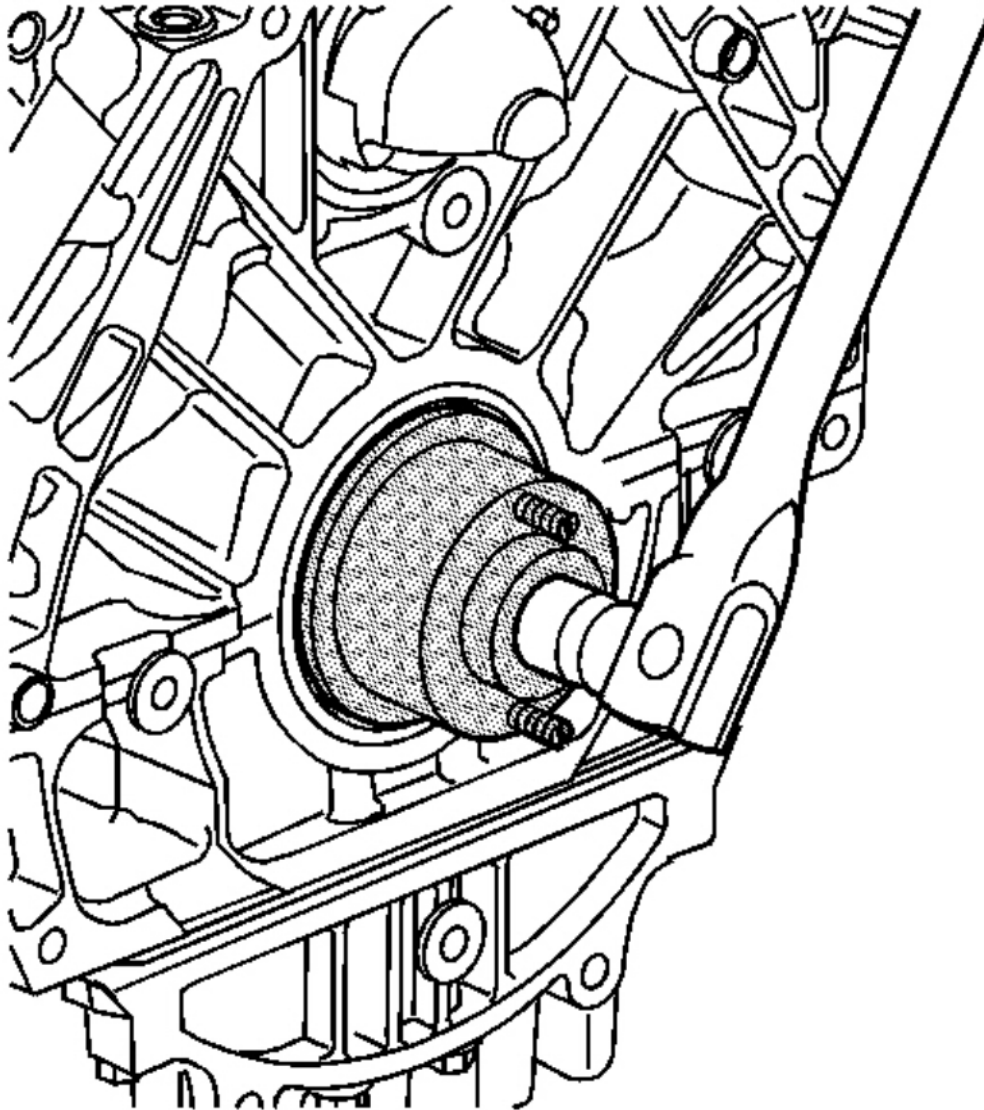


Fig. 370: Installing Crankshaft Rear Oil Seal
Courtesy of GENERAL MOTORS CORP.

11. Install the crankshaft rear oil seal by tightening the center bolt until the **J 45930** bottoms against the crankcase.
12. Loosen the center bolt to release pressure on the crankcase.

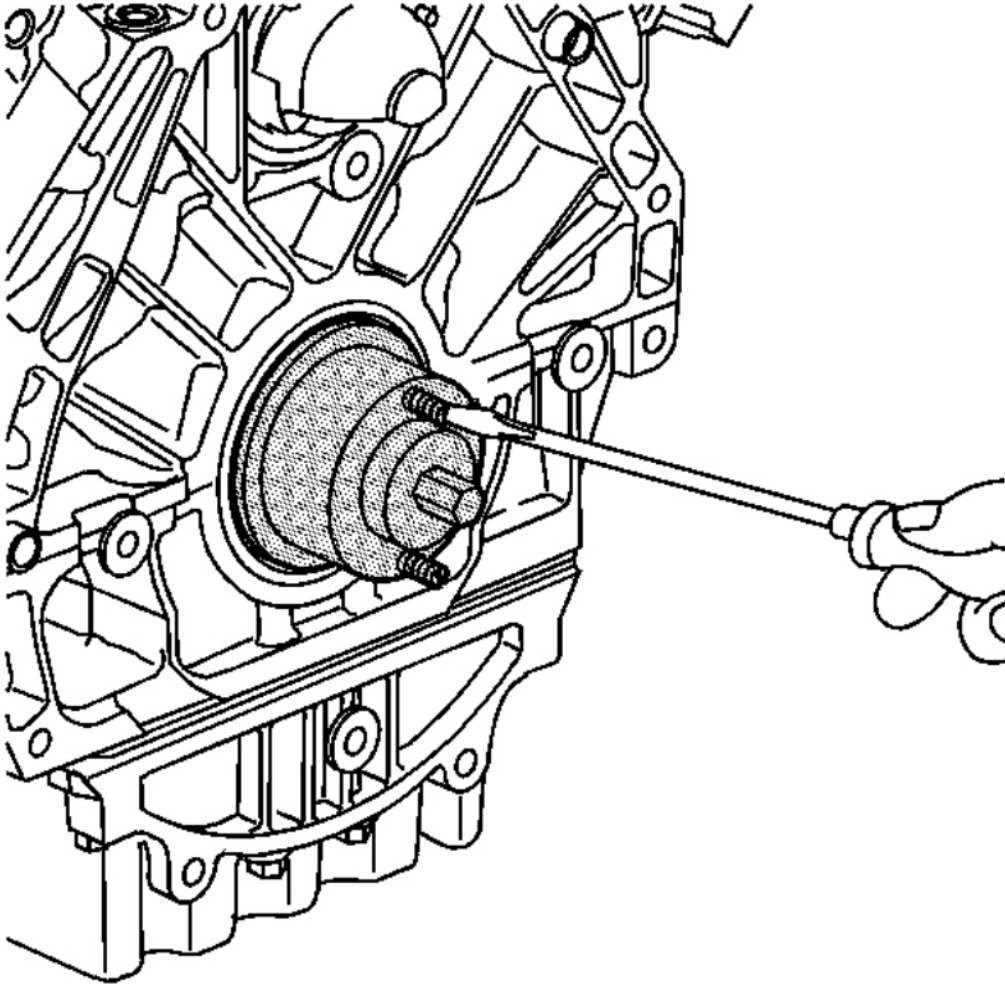


Fig. 371: Adjusting Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

13. Loosen the mounting bolts.
14. Remove the **J 45930** from the crankshaft flange.
15. Inspect to ensure the installation depth is equal around the crankshaft rear oil seal's circumference. If the depth is not equal reinstall the **J 45930** and repeat the installation procedures.

Tools Required

- **J 45059** Torque Angle Meter
 - **EN 46326** Flywheel Holding Tool
1. Apply sealant, GM P/N 12346004 (Canadian P/N 10953480) or equivalent, to the engine flywheel retaining bolts.

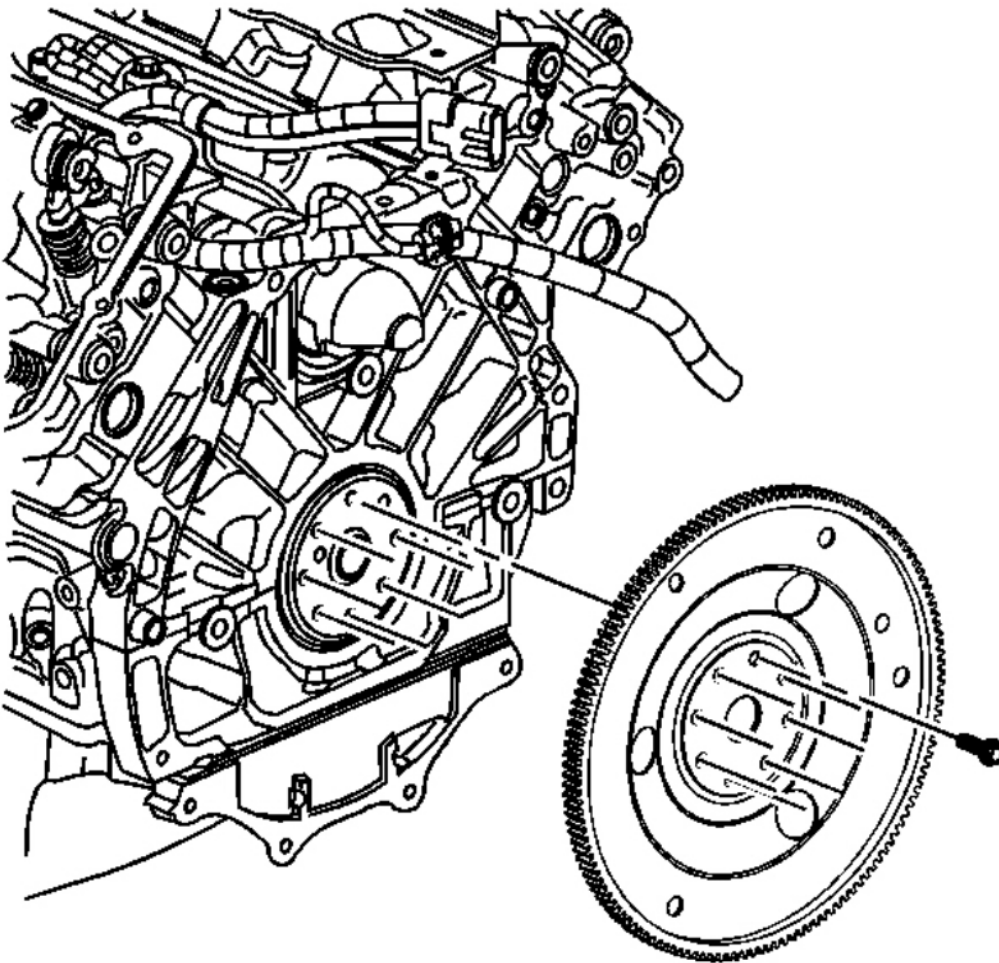


Fig. 372: View Of Engine Flywheel
Courtesy of GENERAL MOTORS CORP.

2. Place the engine flywheel in position on the crankshaft.
3. Slip one bolt into the engine flywheel washer.
4. Install the washer and bolt in a location at the top of its rotation allowing the engine flywheel to hang in position.

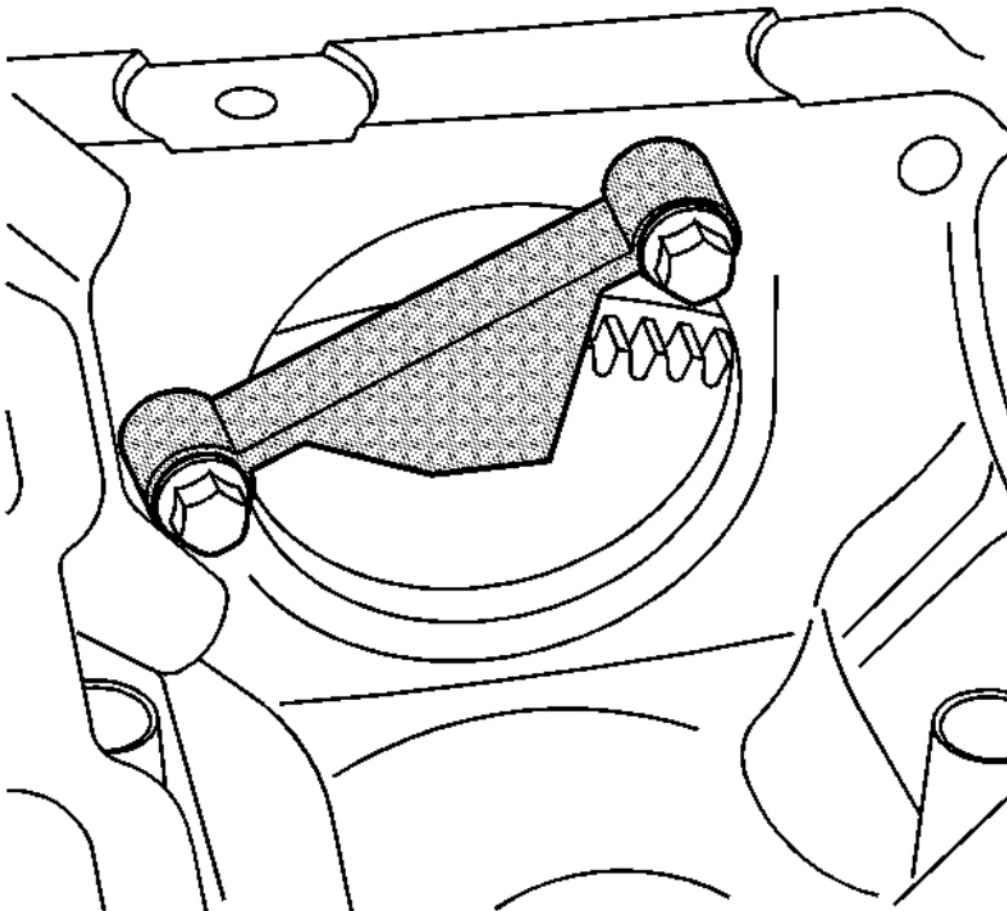


Fig. 373: View Of Flywheel Holder
Courtesy of GENERAL MOTORS CORP.

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

5. Install the remaining engine flywheel bolts.
 1. Install the **EN 46326** to the engine block.

2. First Pass

Tighten: Tighten the engine flywheel retaining bolts to 15 N.m (11 lb ft).

3. Final Pass

Tighten: Tighten the engine flywheel retaining bolts an additional 50 degrees using the **J 45059** .

CRANKSHAFT BALANCER INSTALLATION

Tools Required

- **J 41998-B** Crankshaft Balancer Installer
- **J 45059** Angle Meter
- **EN 46326** Flywheel Holding Tool

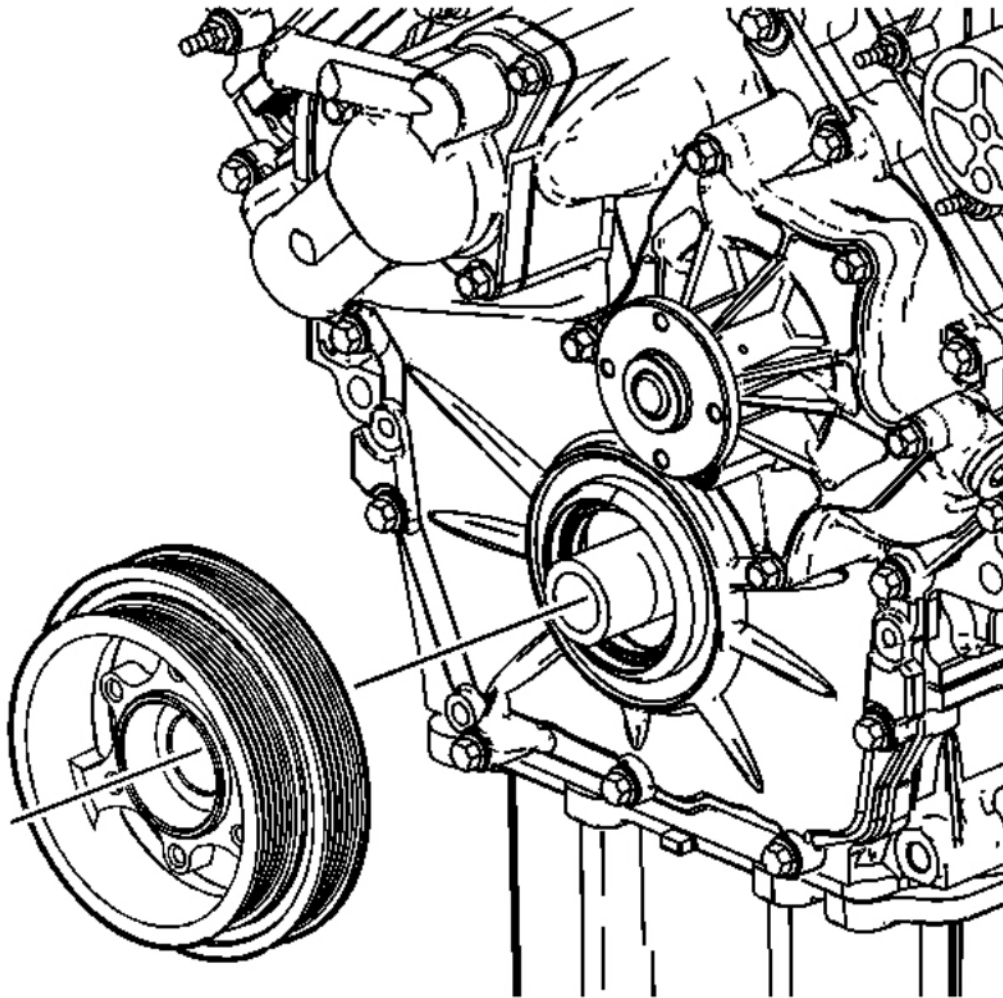


Fig. 374: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

1. Position the crankshaft balancer on the nose of the crankshaft.

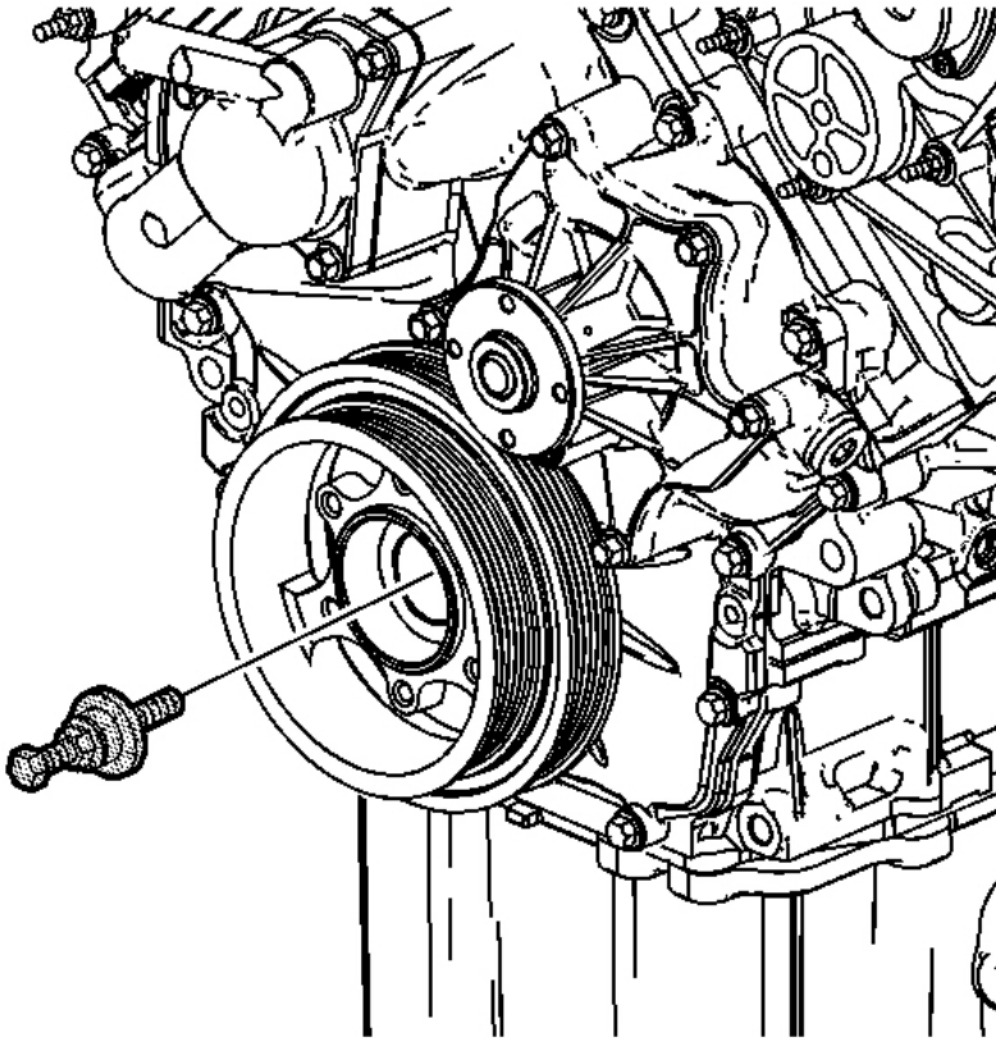


Fig. 375: View Of J 41998-B
Courtesy of GENERAL MOTORS CORP.

2. Press the crankshaft balancer in place using the **J 41998-B** .

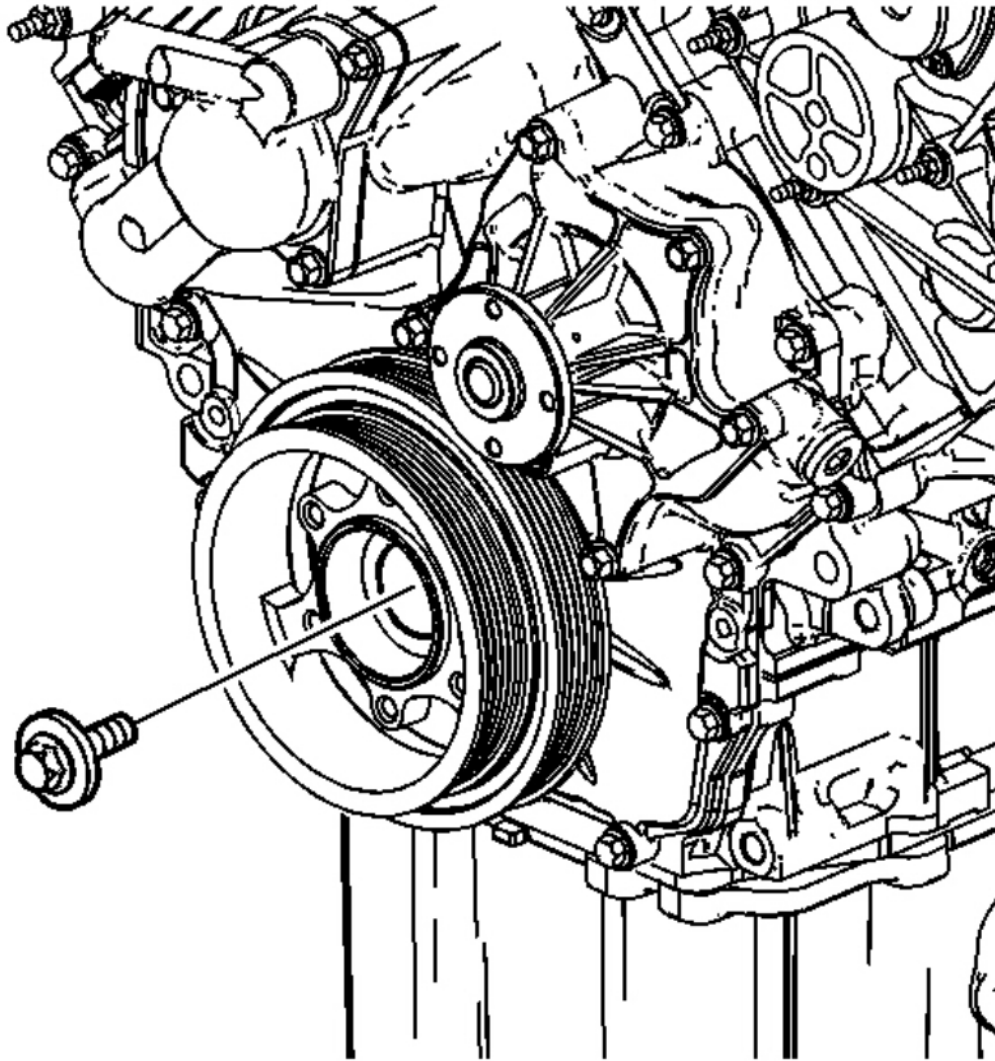


Fig. 376: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

3. Clean the crankshaft balancer bolt threads.
4. Apply engine oil to the crankshaft balancer bolt threads.

NOTE: Refer to Fastener Notice in Cautions and Notices.

5. Install the crankshaft balancer bolt.

1. First Pass

Tighten: Tighten the crankshaft balancer bolt to 50 N.m (37 lb ft).

2. Final Pass

Tighten: Tighten the crankshaft balancer bolt an additional 120 degrees using the **J 45059** .

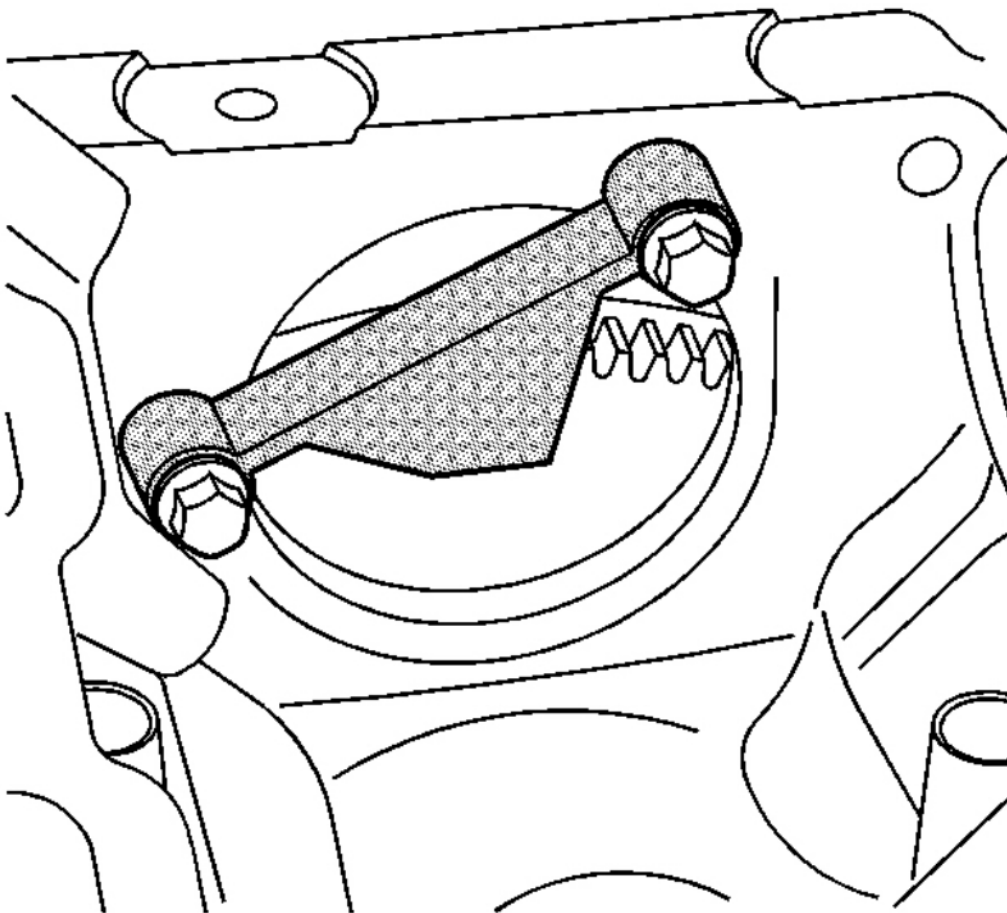


Fig. 377: View Of Flywheel Holder
Courtesy of GENERAL MOTORS CORP.

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6. Remove the **EN 46326** from the engine block.