

2008 ENGINE

Engine Mechanical - 3.6L - LaCrosse

OFF-VEHICLE REPAIR INSTRUCTIONS (CONT.)

CRANKSHAFT AND BEARING INSTALLATION

Crankshaft Bearing Installation Procedure

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

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

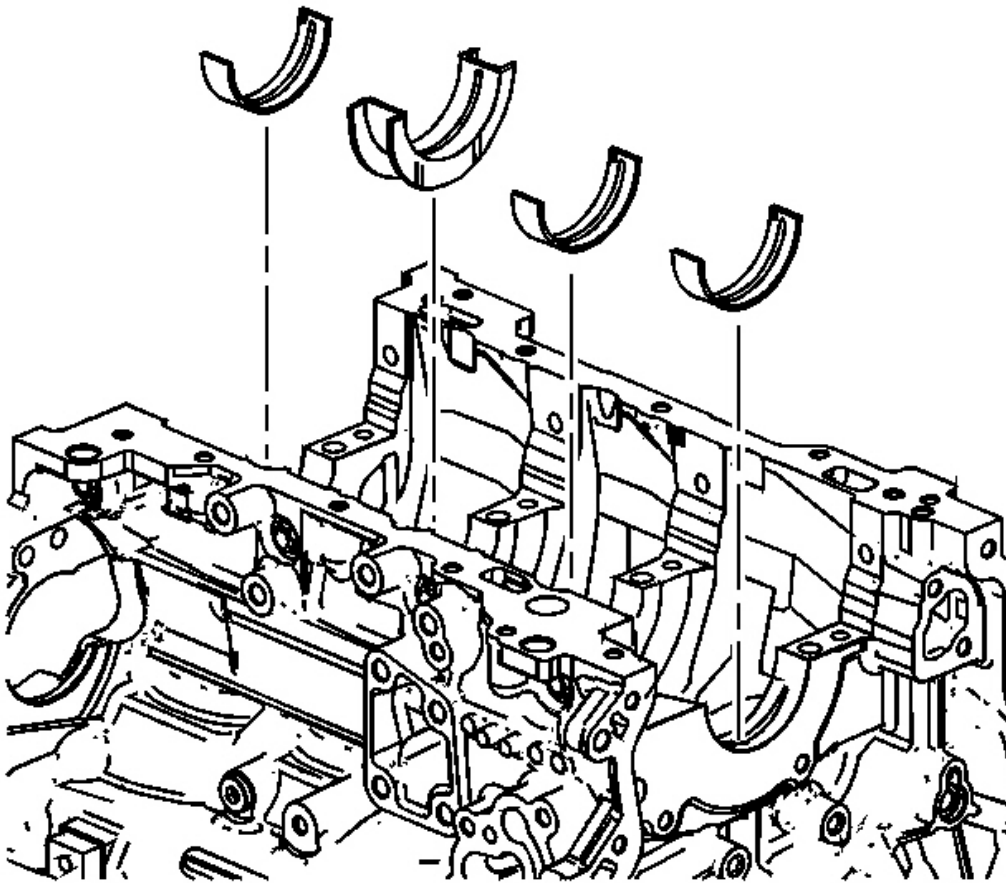


Fig. 1: Locating Upper Crankshaft Bearings
Courtesy of GENERAL MOTORS CORP.

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

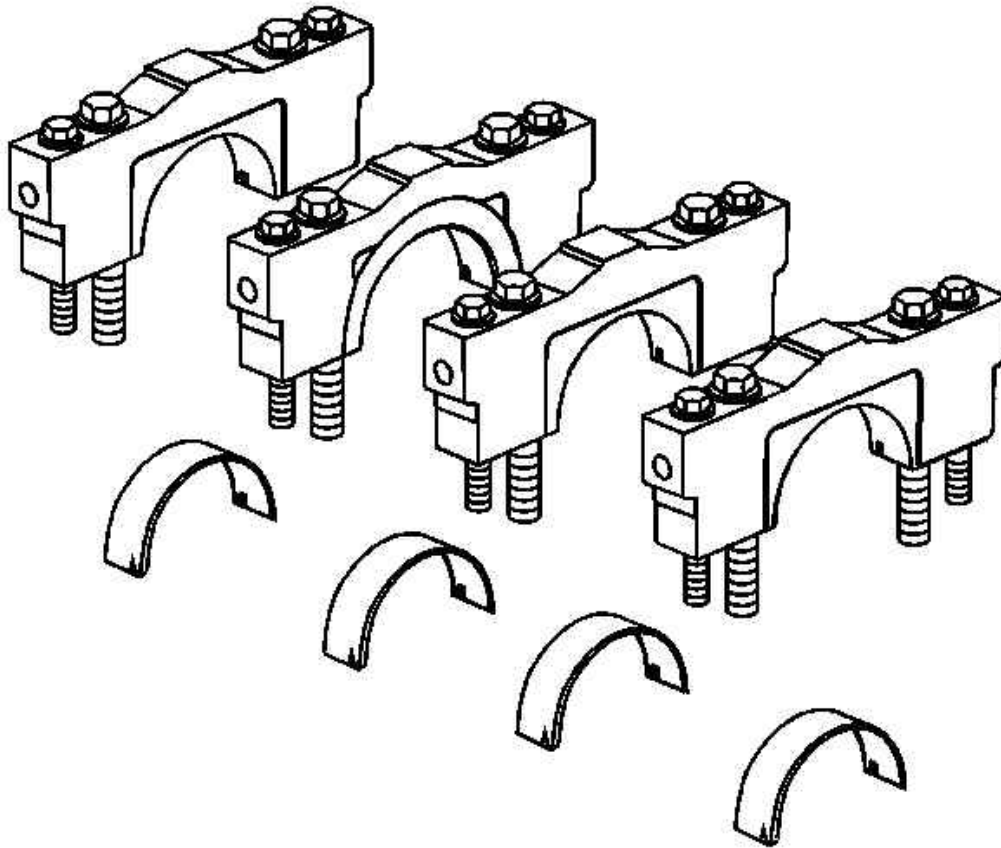


Fig. 2: Identifying Crankshaft Lower Bearing Halves & Crankshaft Bearing Caps

Courtesy of GENERAL MOTORS CORP.

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

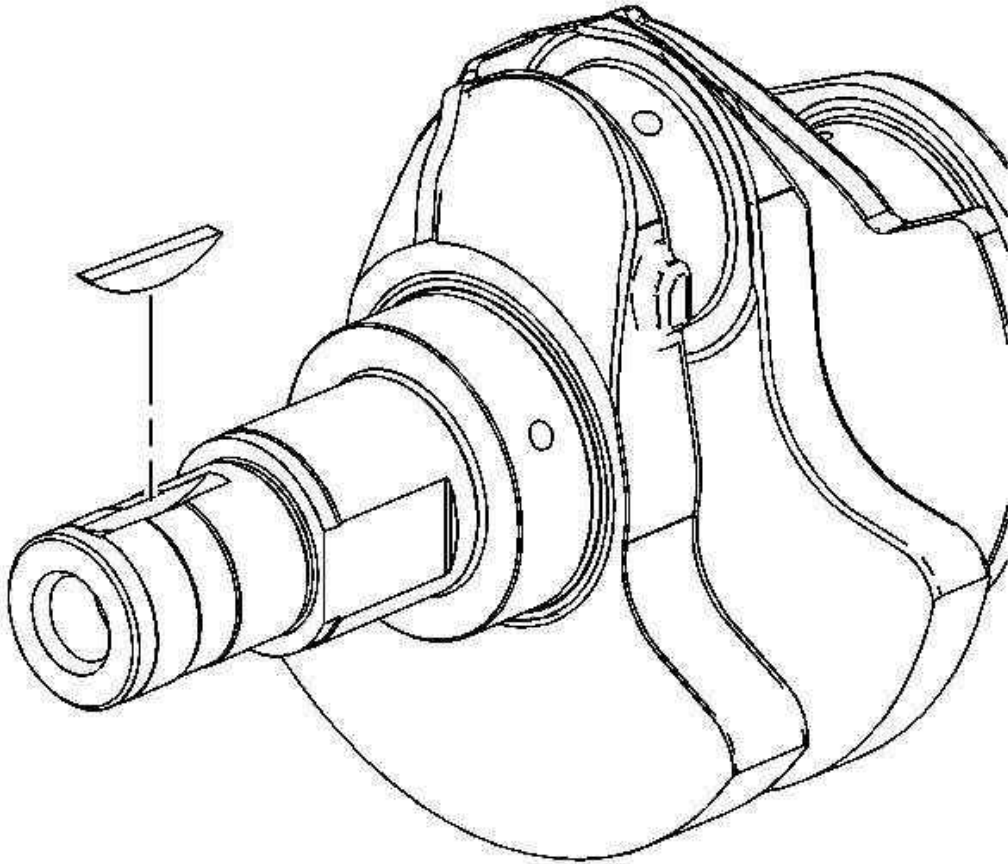


Fig. 3: Locating Crankshaft Sprocket Drive Pin
Courtesy of GENERAL MOTORS CORP.

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

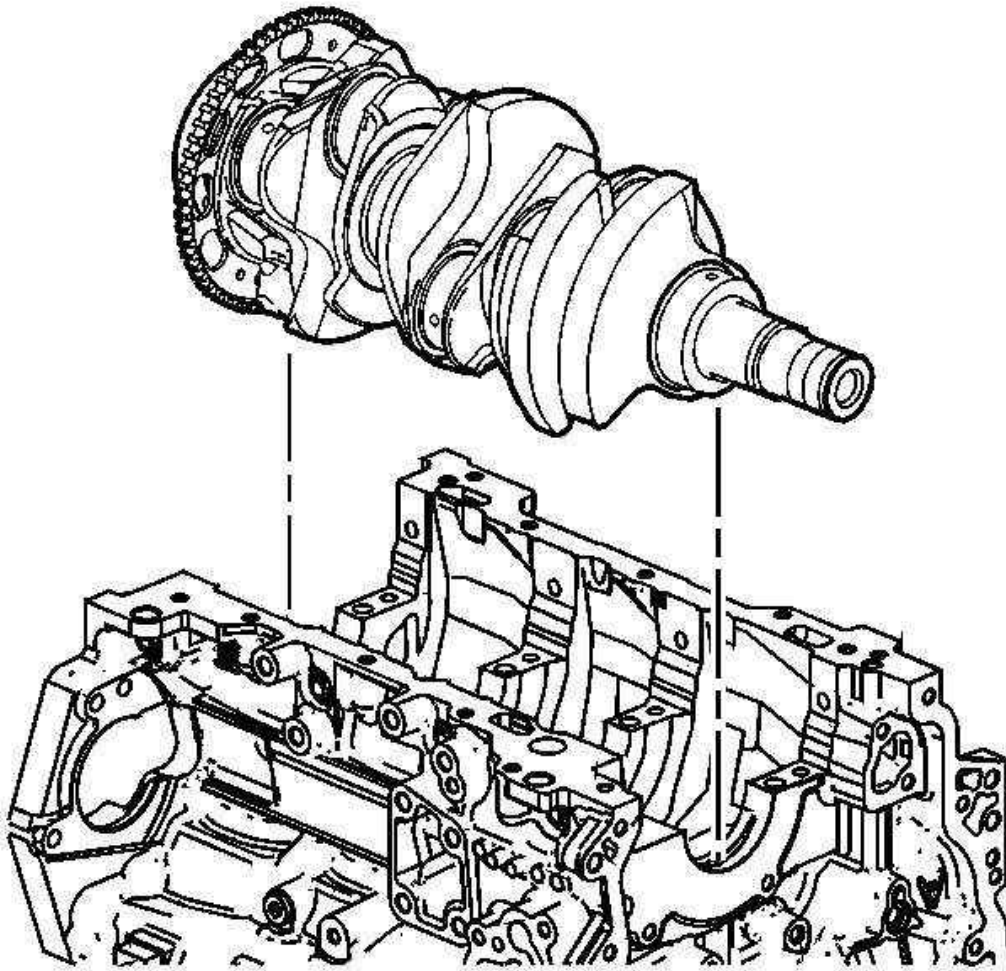


Fig. 4: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

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

Crankshaft Bearing Clearance Measurement Procedure

Tools Required

- **J 6125-1B** Slide Hammer Adapter. See **Special Tools** .
- **J 41818** Crankshaft Bearing Cap Remover. See **Special Tools** .

- **J 45059** Angle Meter

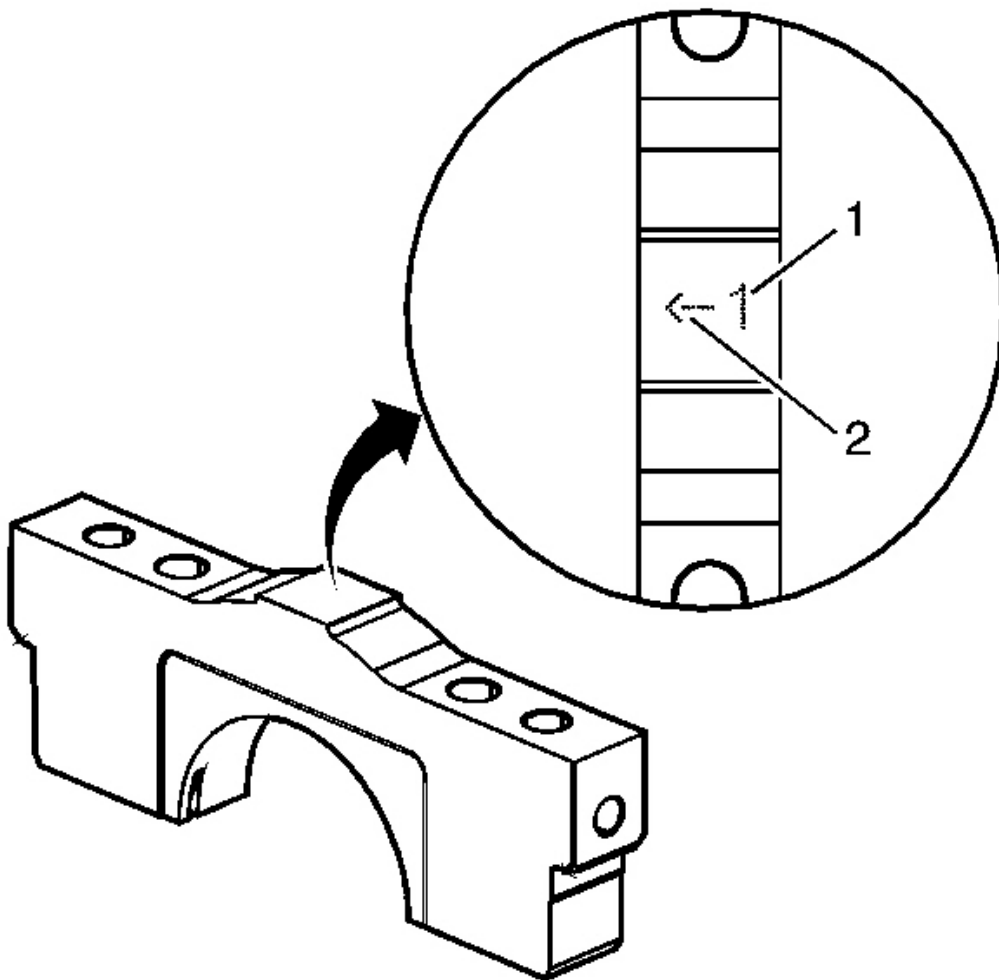


Fig. 5: Identifying Front Main Bearing Cap
Courtesy of GENERAL MOTORS CORP.

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

number 1. The arrow (2) is to be oriented to the front of the engine.

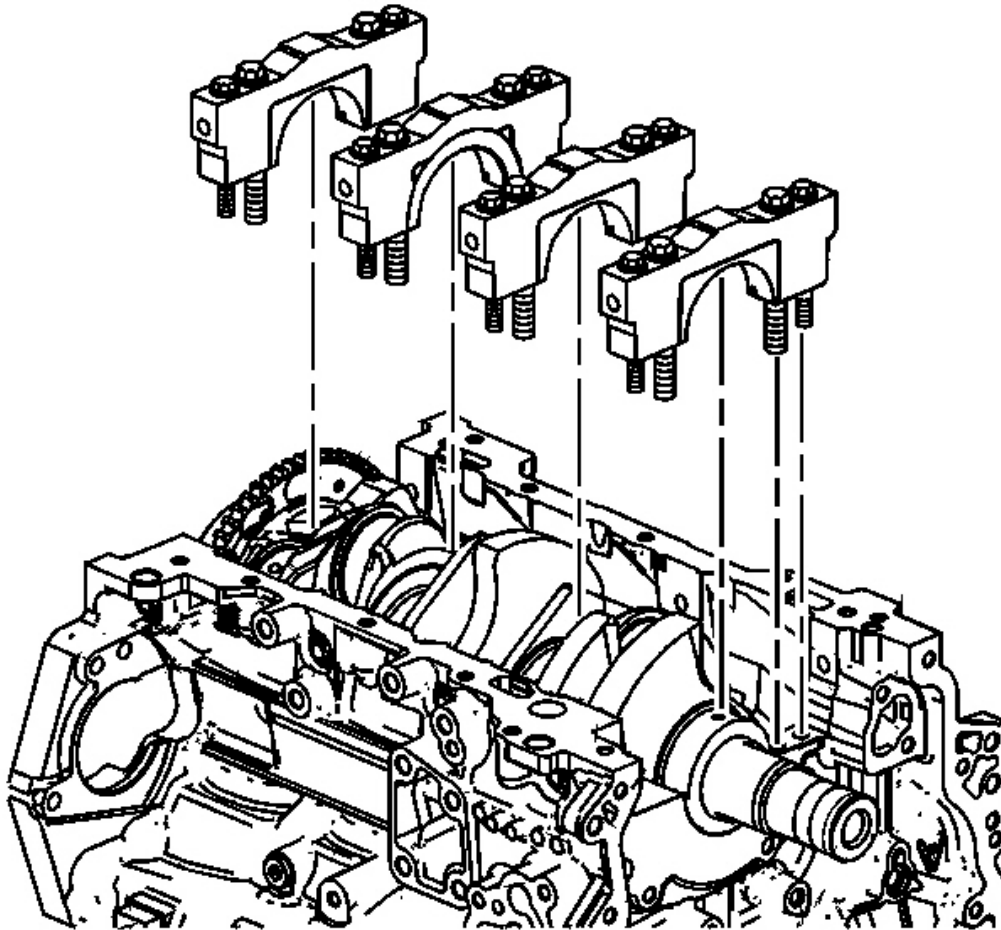


Fig. 6: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

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

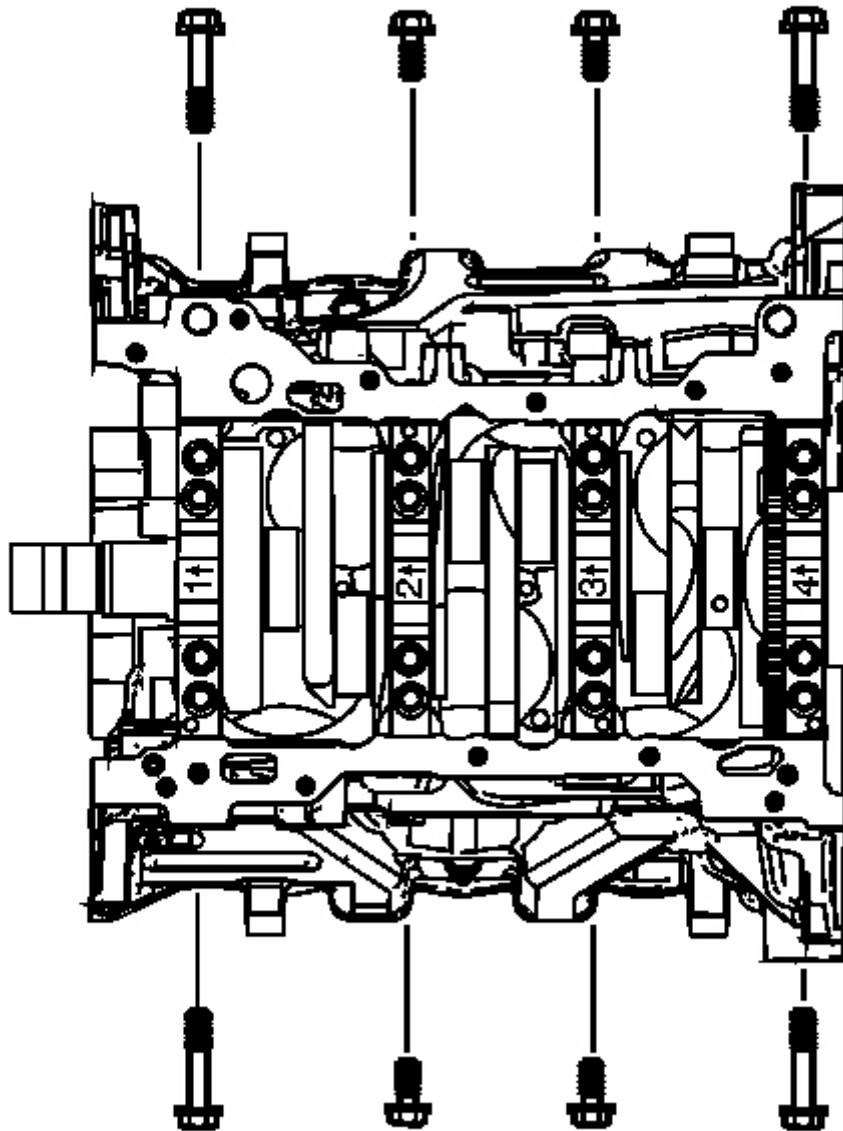


Fig. 7: Identifying Crankshaft Main Bearing Cap Side Bolts
Courtesy of GENERAL MOTORS CORP.

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

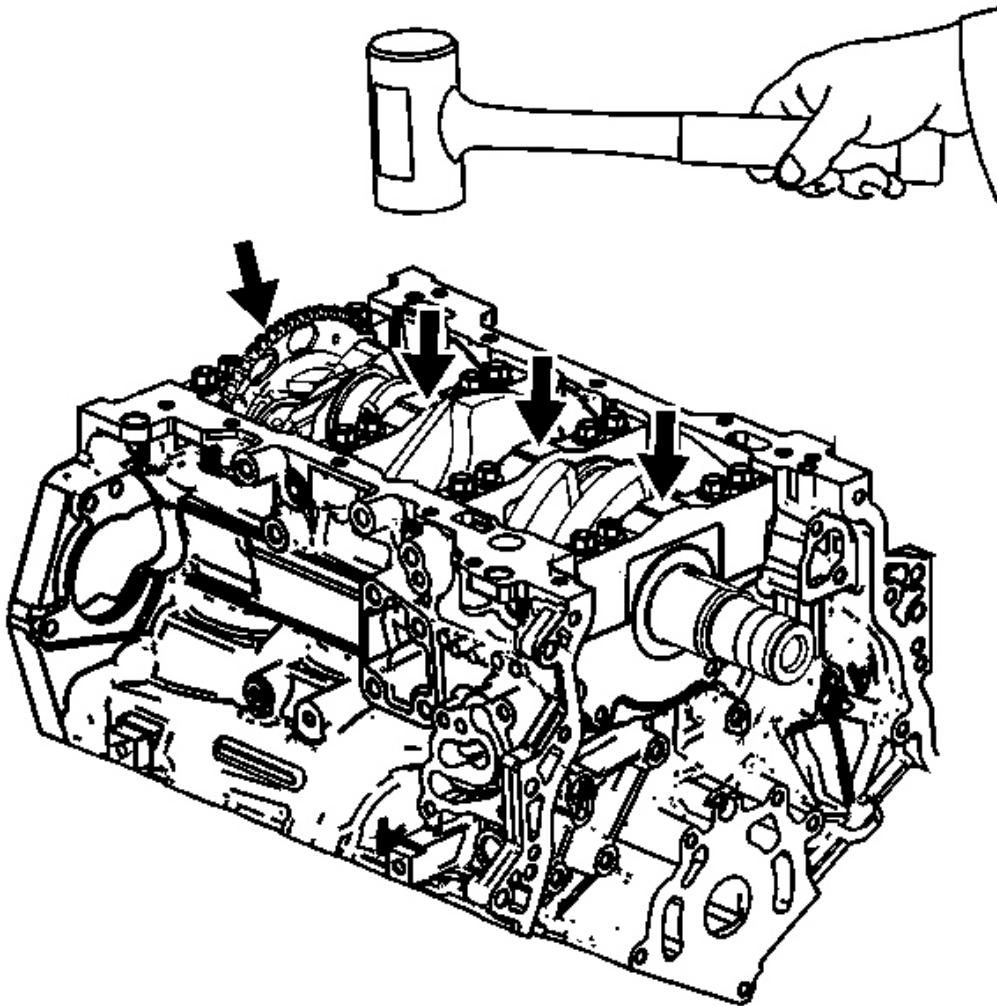


Fig. 8: Tapping Crankshaft Main Bearing Caps With Hammer
Courtesy of GENERAL MOTORS CORP.

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

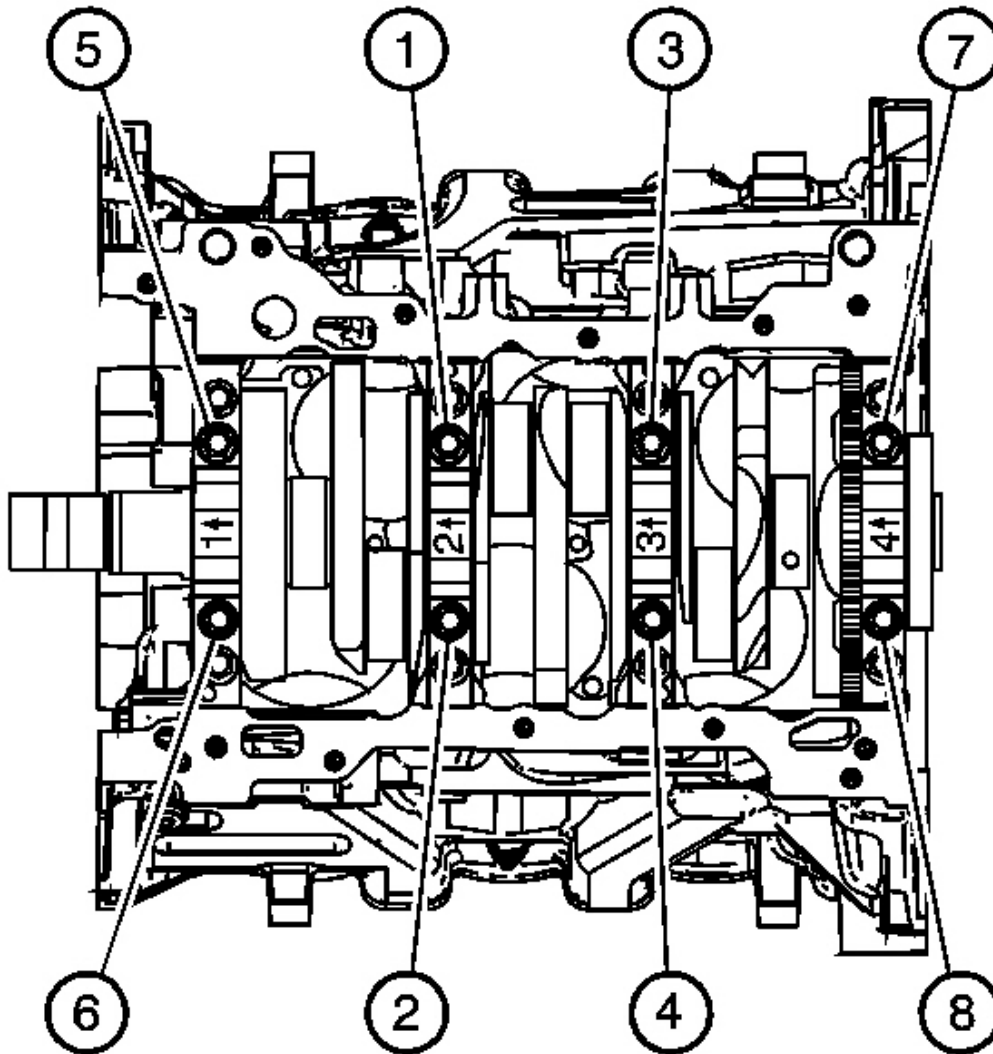


Fig. 9: Identifying Crankshaft Main Bearing Inboard Bolt Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

10. Tighten the inboard bolts (1-8).

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

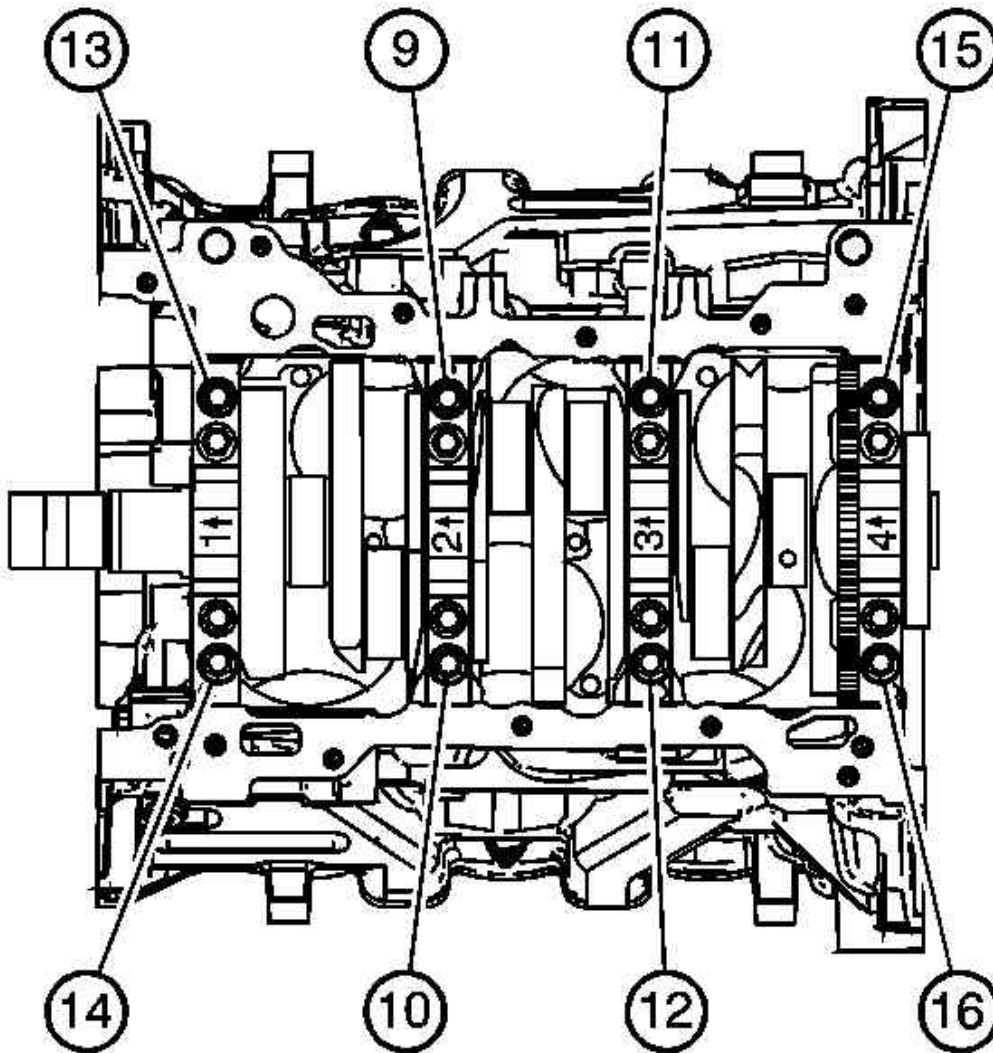


Fig. 10: Identifying Outboard Crankshaft Main Bearing Bolt Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

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

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

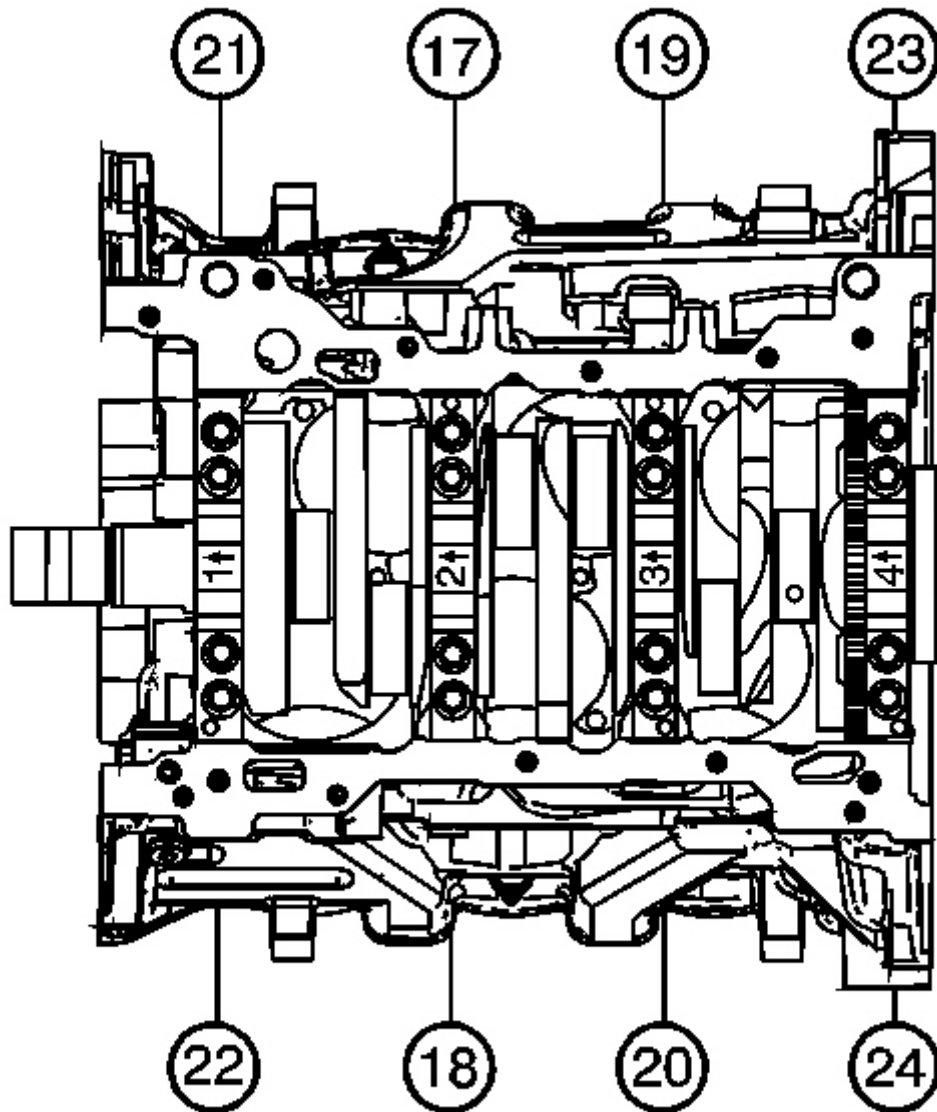


Fig. 11: Identifying Short/Inner Bolts & Long/Outer Bolts Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

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

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

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

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

IMPORTANT: Do not rotate the crankshaft.

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

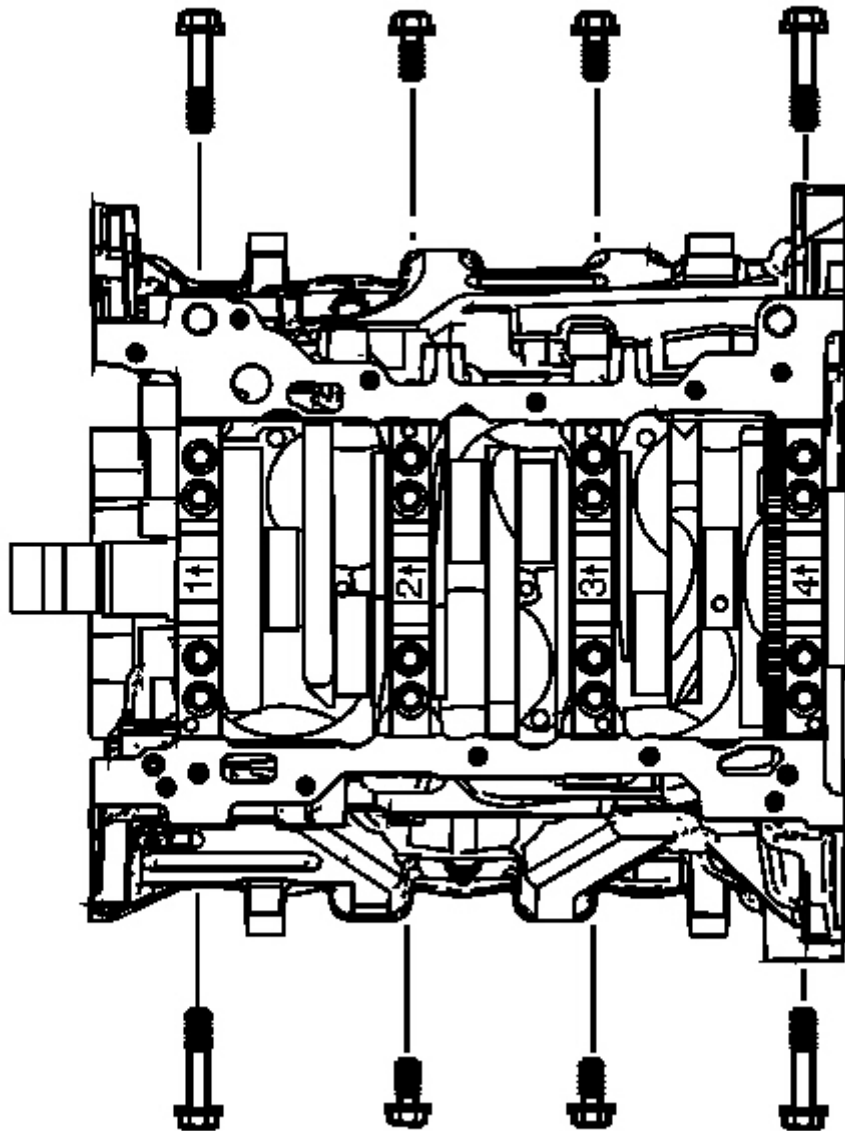


Fig. 12: Identifying Crankshaft Main Bearing Cap Side Bolts
Courtesy of GENERAL MOTORS CORP.

15. Remove the crankshaft bearing cap side bolts.

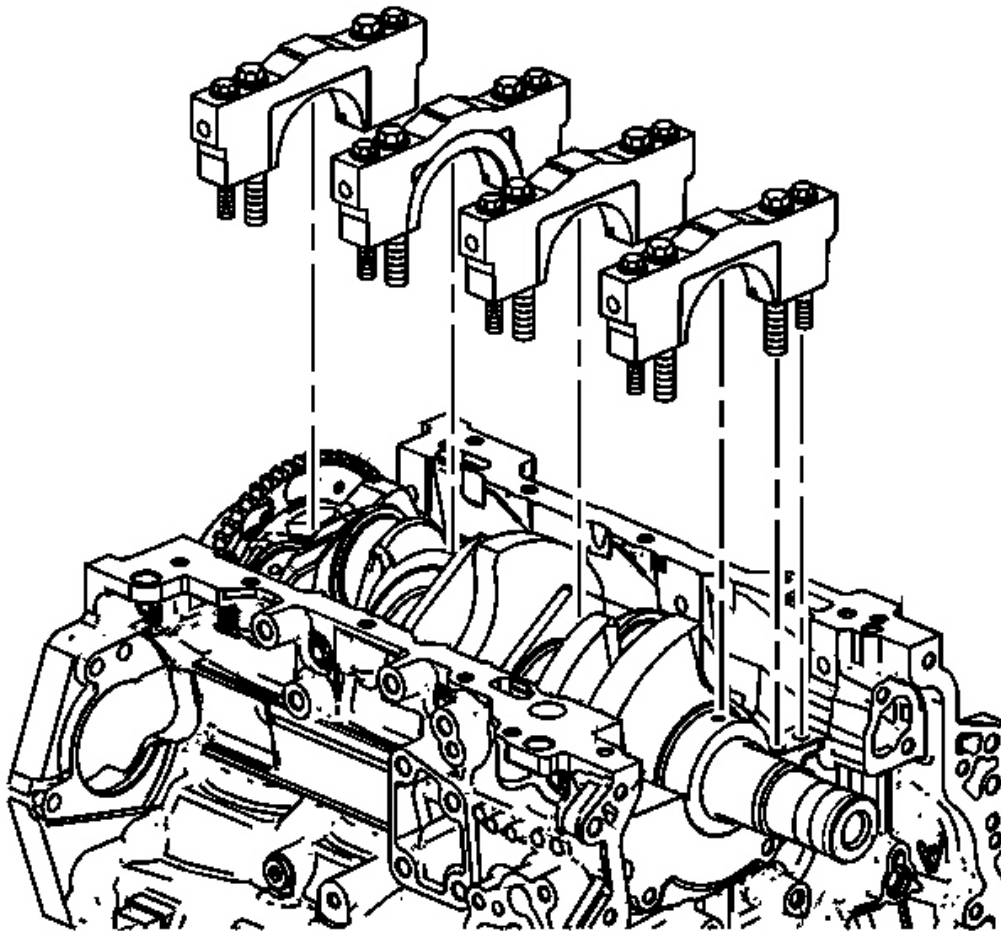


Fig. 13: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

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

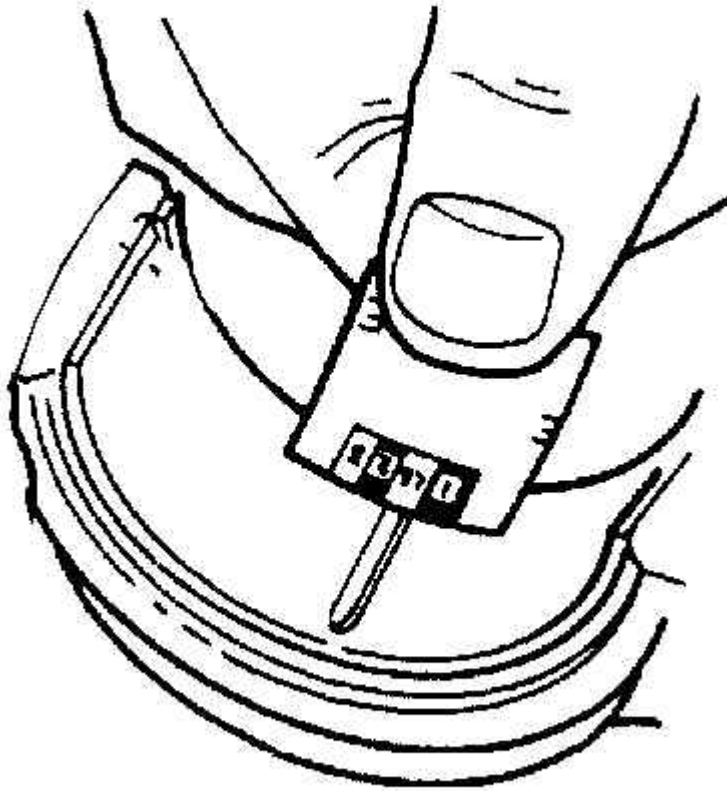


Fig. 14: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

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

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

20. Compare your measurements with the **Engine Mechanical Specifications** . If the new bearings do not provide the proper crankshaft to bearing clearance,

inspect the following:

1. Re-measure the crankshaft journals for the correct specified size and ensure the proper new bearings are being installed. If the crankshaft journals are incorrectly sized, replace or regrind the crankshaft. Crankshaft machining is permitted and undersized bearings are available.
 2. Re-measure the engine block crankshaft bearing bore diameter to ensure proper size. The engine block crankshaft bearing bore is not machinable and the block must be replaced if out of specification.
21. Clean the plastic gaging material from the crankshaft bearing journals with a soft, lint-free cloth.

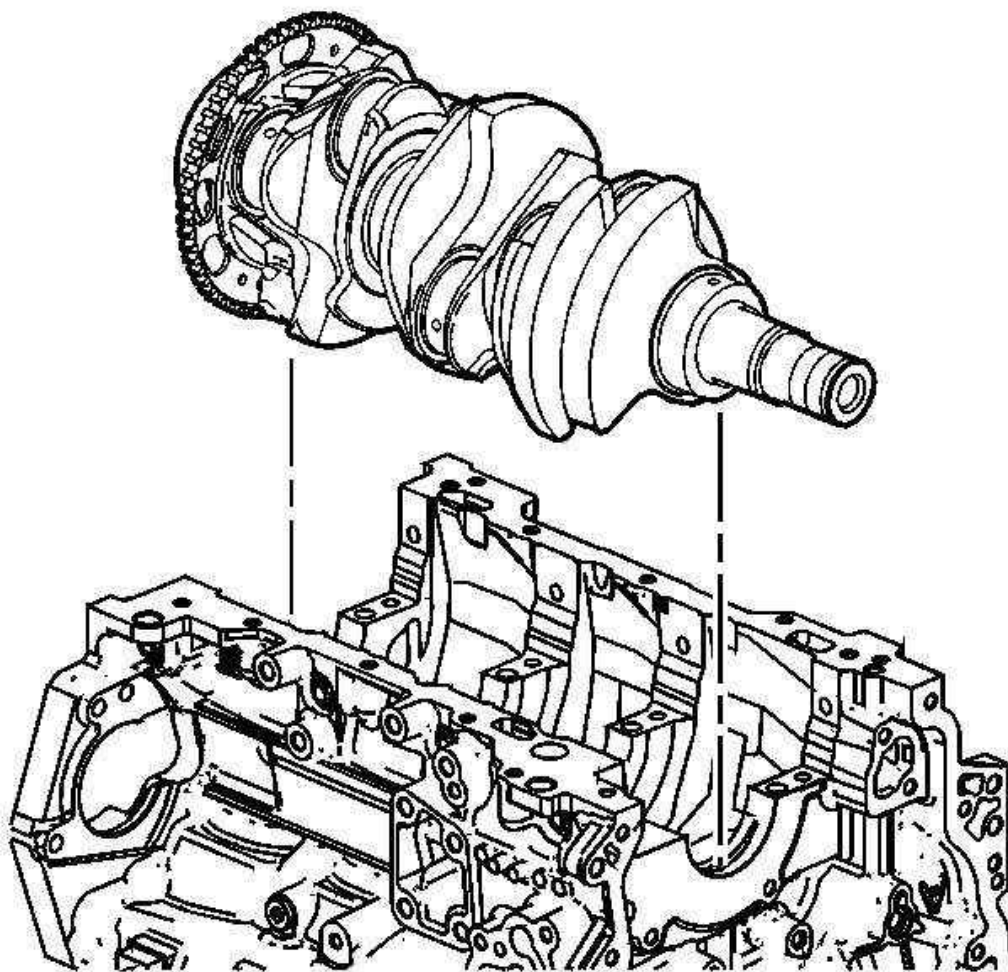


Fig. 15: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

22. Lift the crankshaft out of the cylinder block.

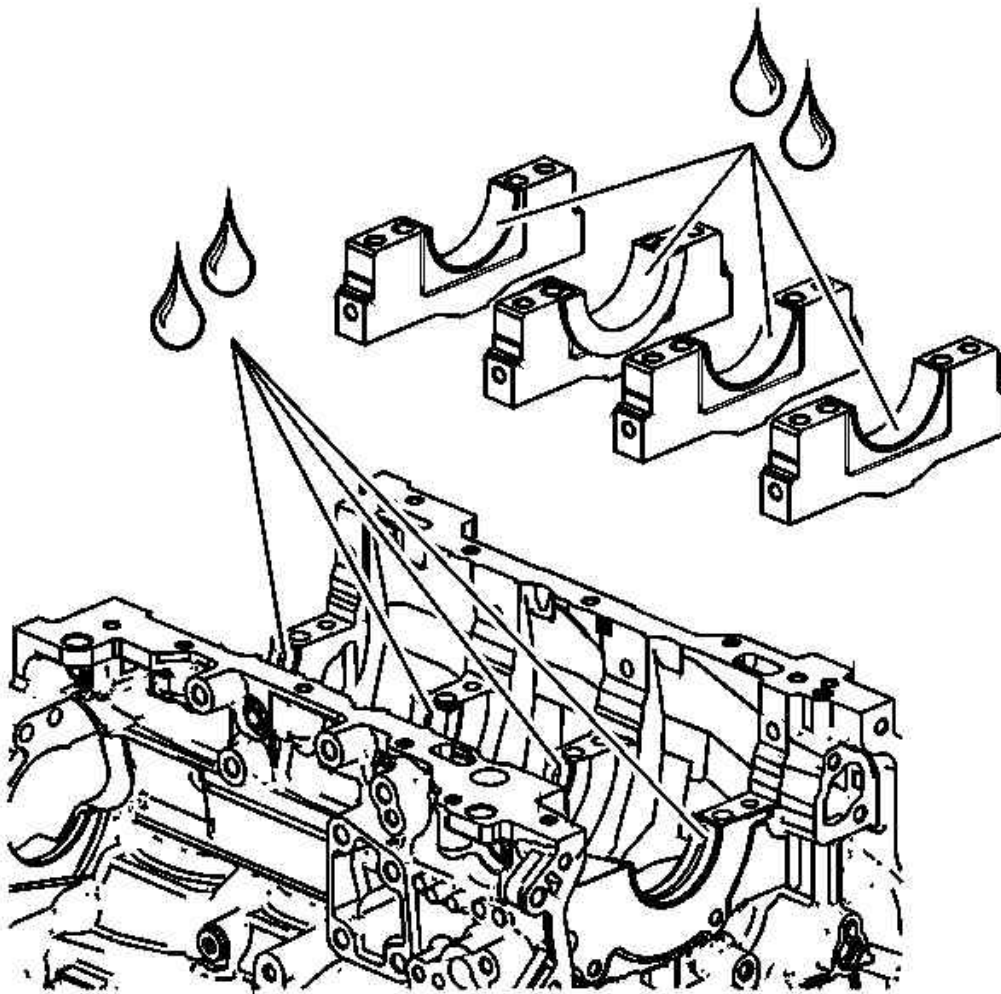


Fig. 16: Lubricating Upper & Lower Bearing Surfaces
Courtesy of GENERAL MOTORS CORP.

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

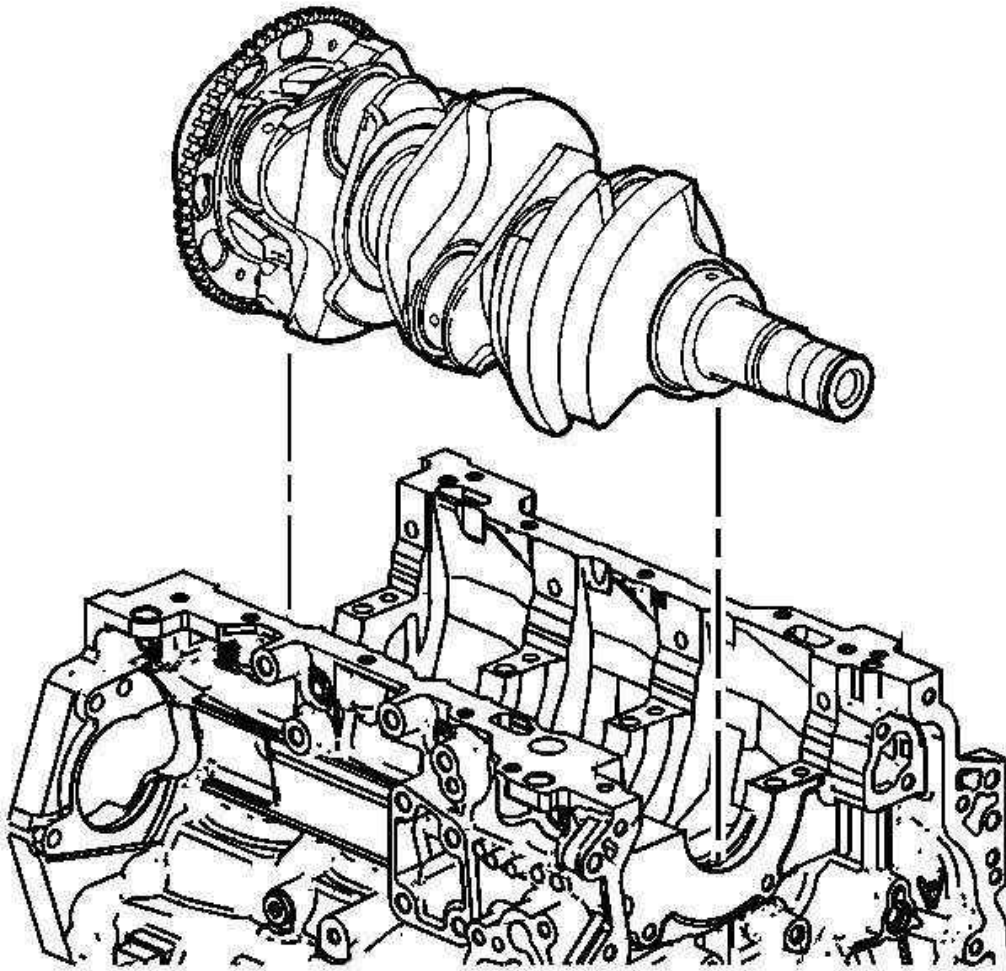


Fig. 17: View Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

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

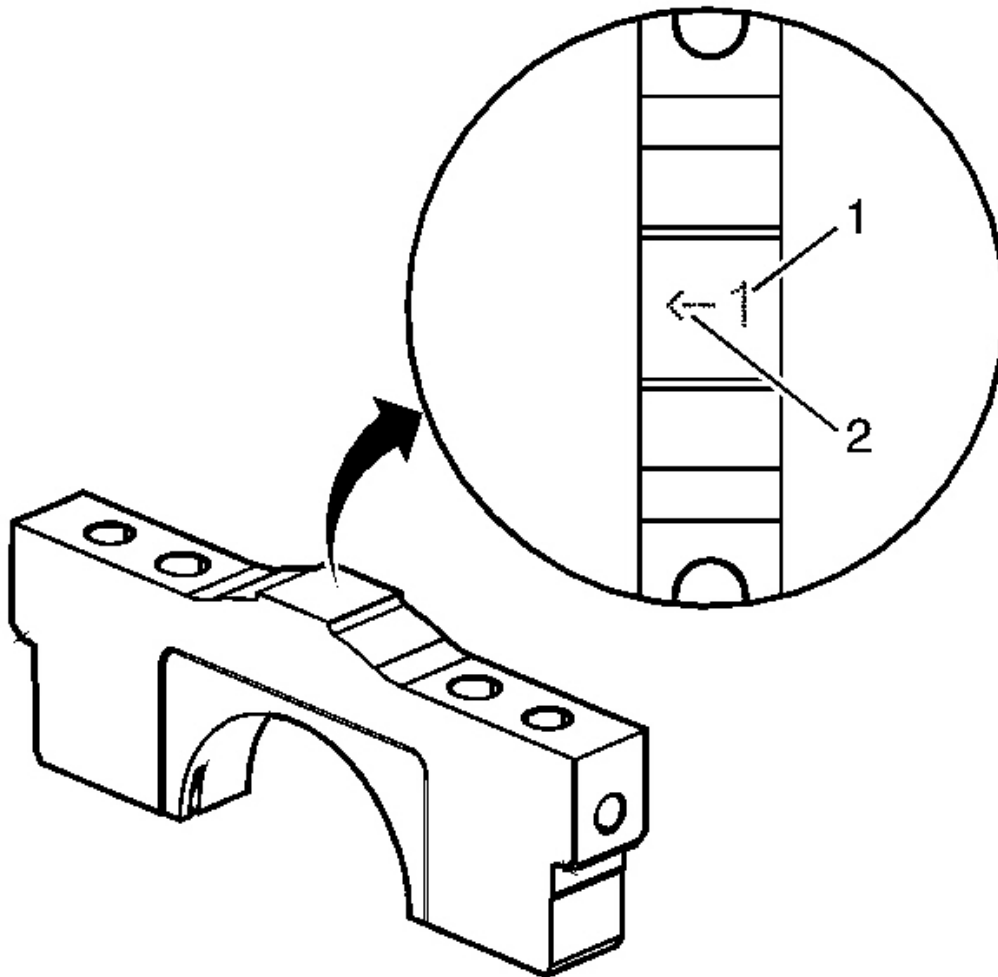


Fig. 18: Identifying Front Main Bearing Cap
Courtesy of GENERAL MOTORS CORP.

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

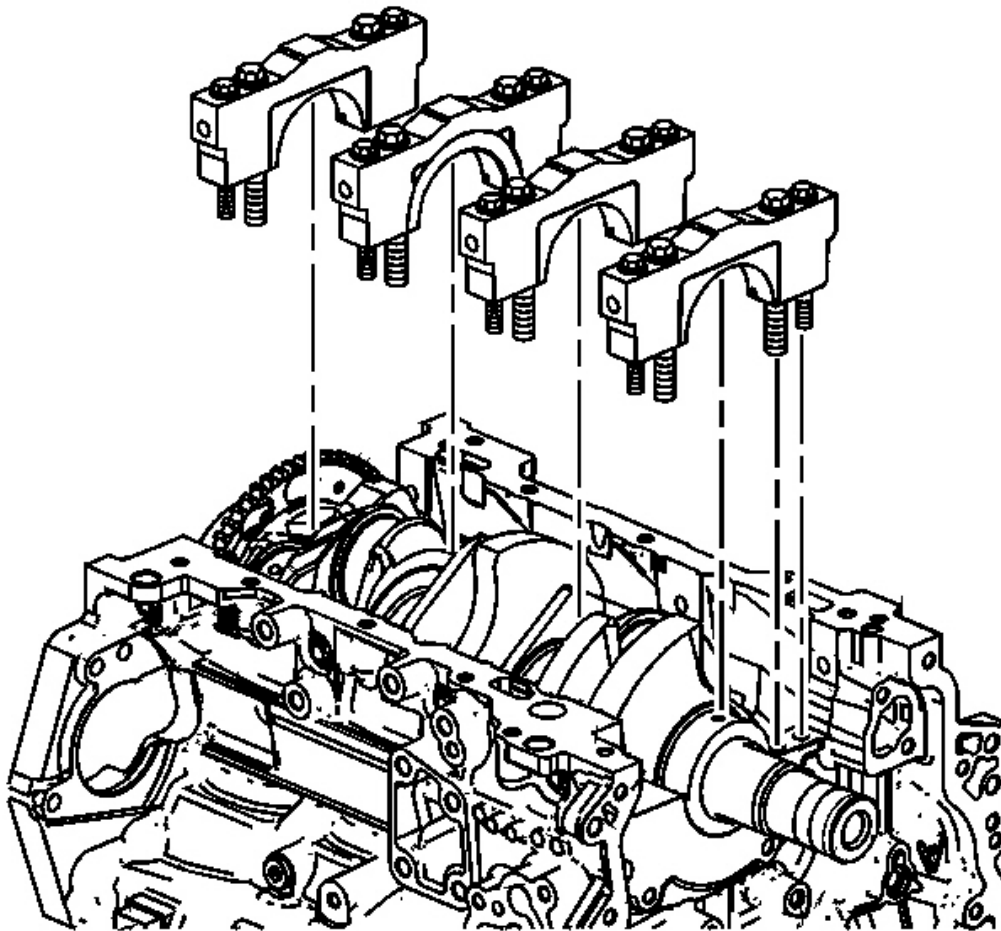


Fig. 19: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

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

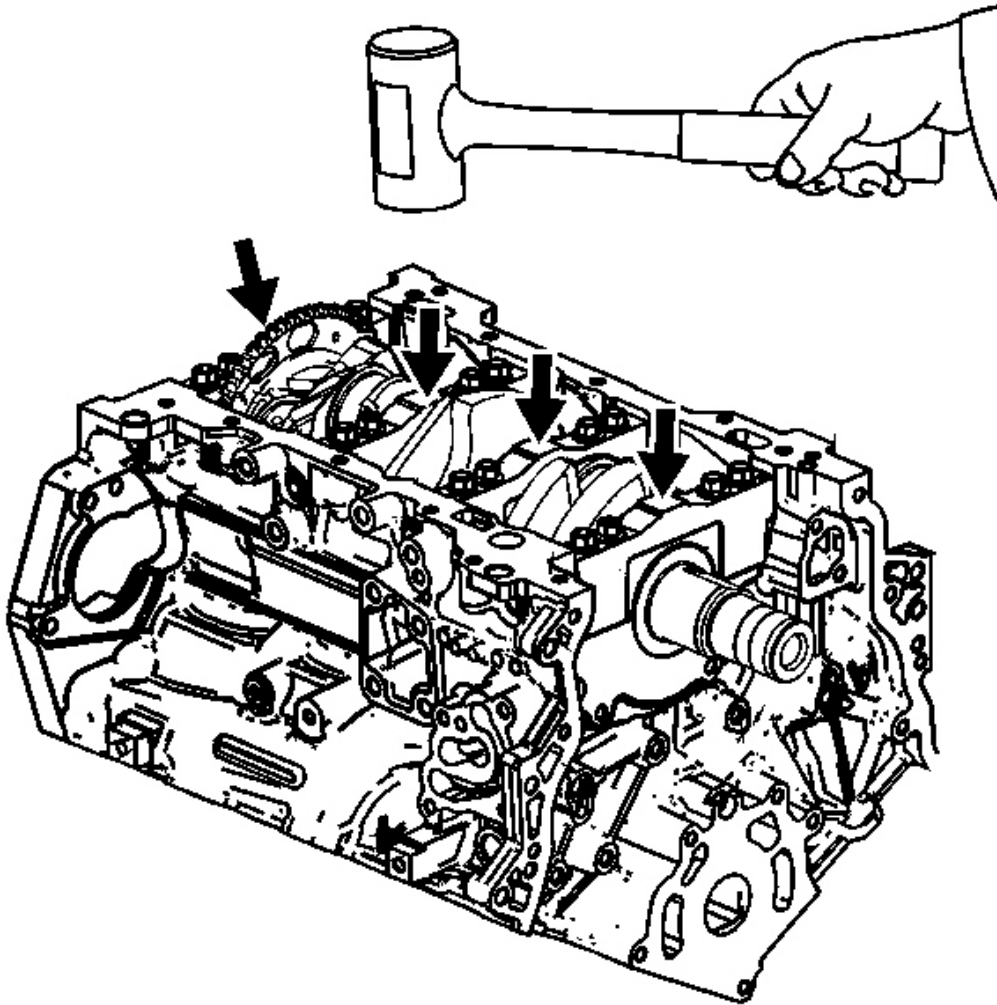


Fig. 20: Tapping Crankshaft Main Bearing Caps With Hammer
Courtesy of GENERAL MOTORS CORP.

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

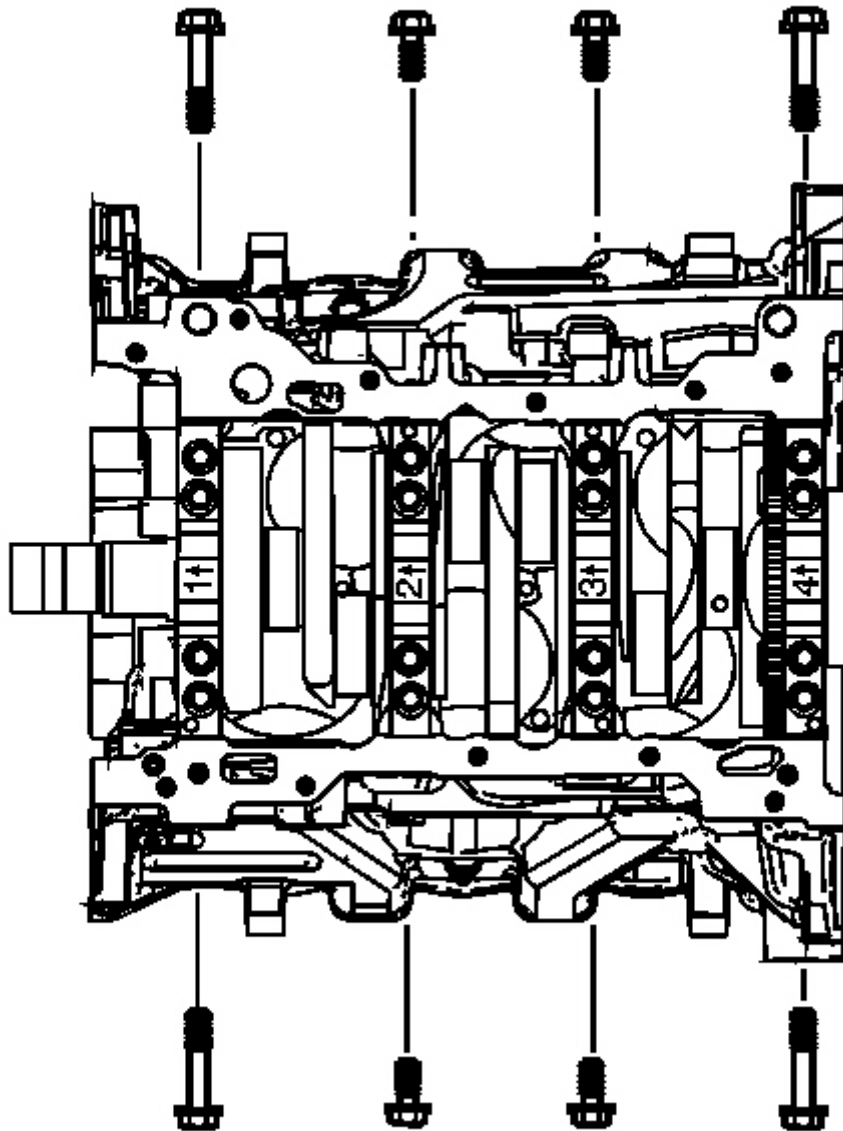


Fig. 21: Identifying Crankshaft Main Bearing Cap Side Bolts
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The side main cap bolts originally have a sealant on the flange of the bolt head. **NEW** bolts must be

used. If NEW bolts are not used, oil can leak from the crankcase past the bolts.

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

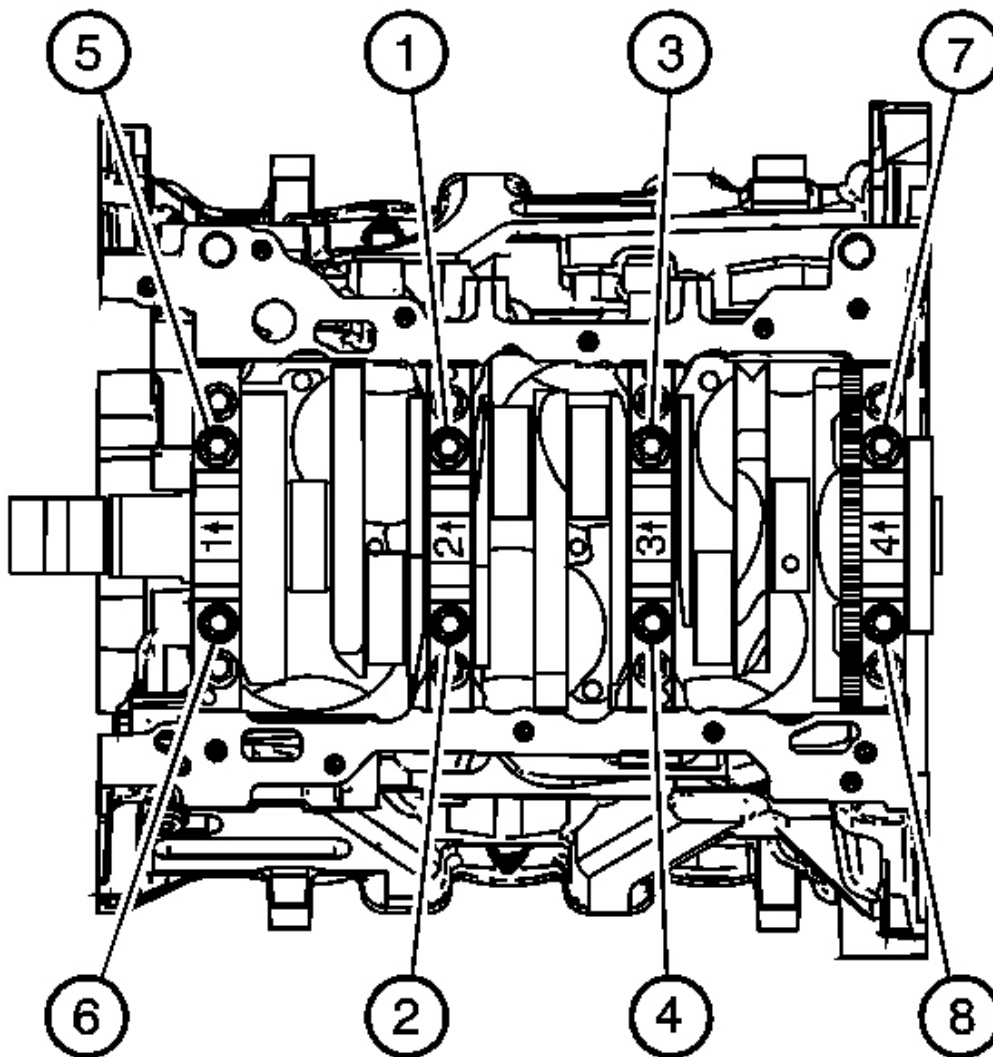


Fig. 22: Identifying Crankshaft Main Bearing Inboard Bolt Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

Tighten the inboard bolts (1-8).

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

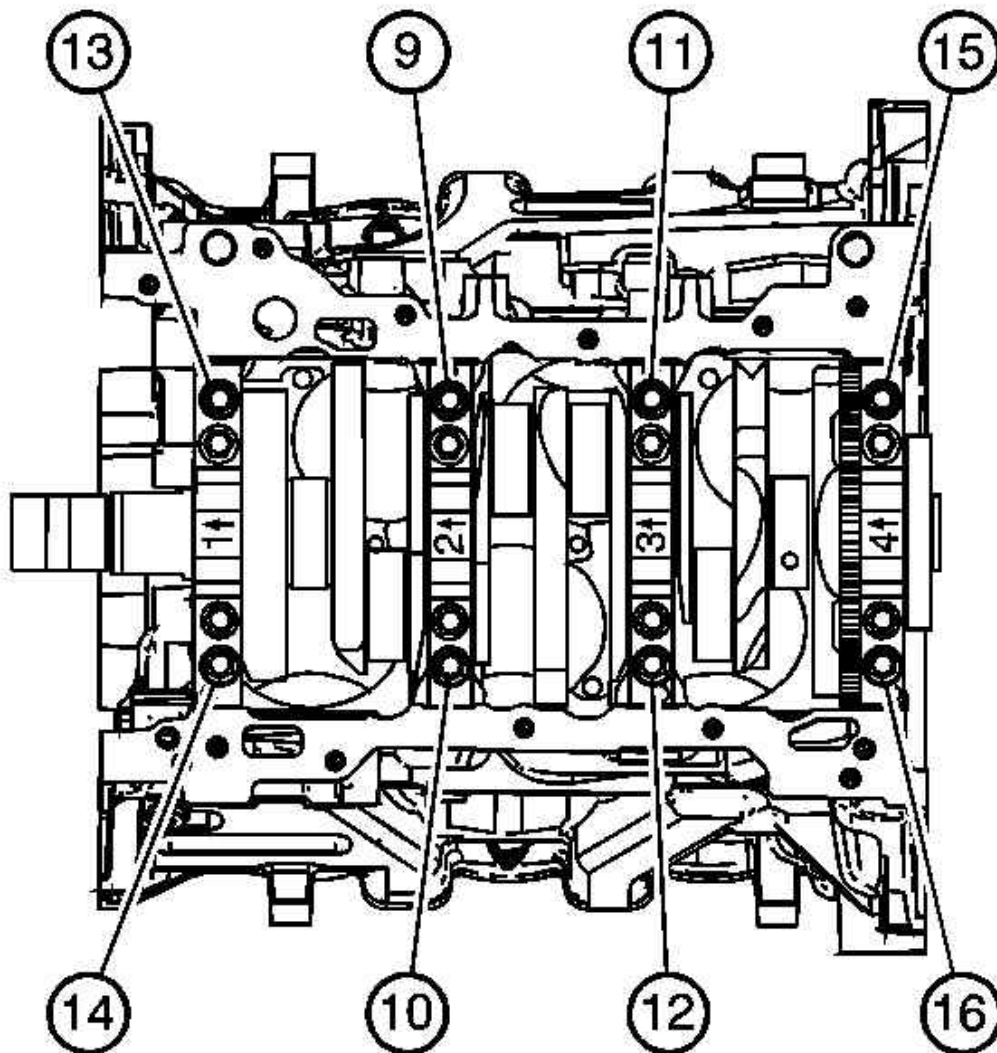


Fig. 23: Identifying Outboard Crankshaft Main Bearing Bolt Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

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

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

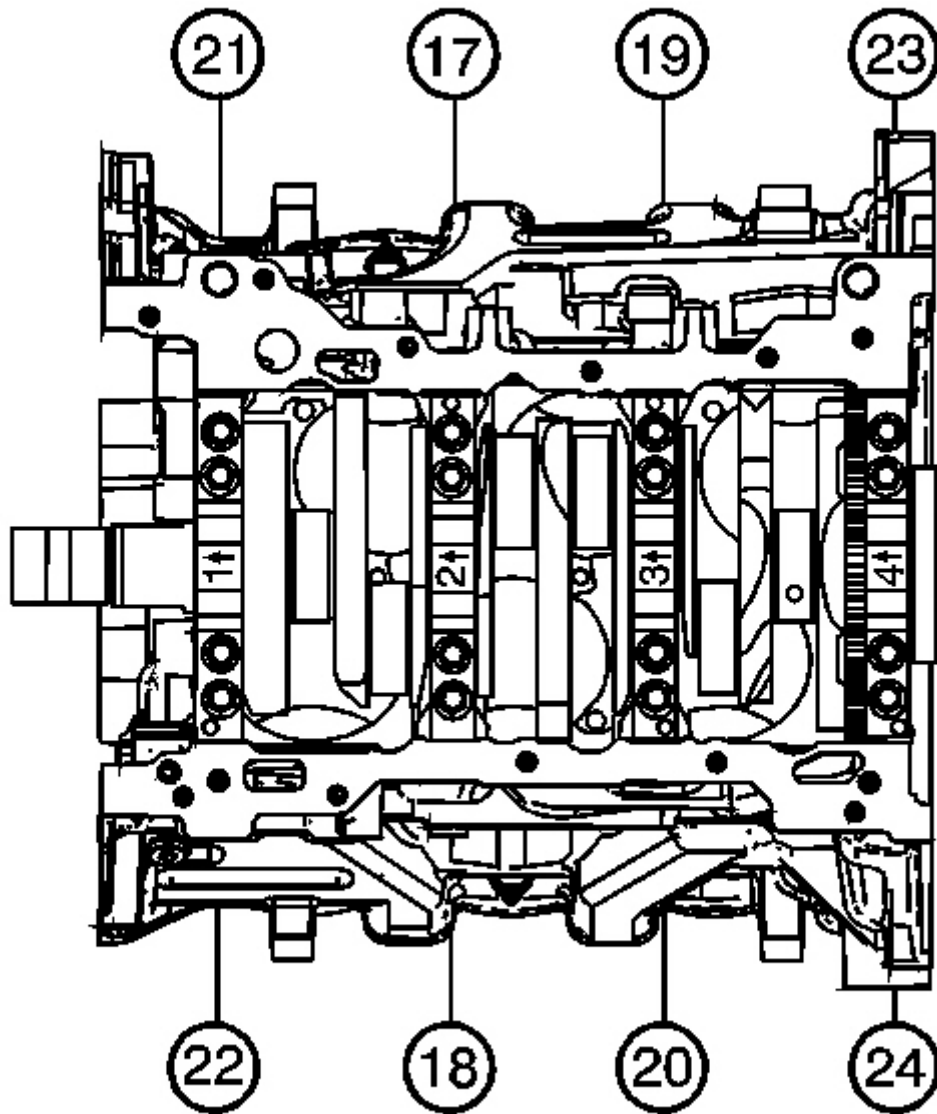


Fig. 24: Identifying Short/Inner Bolts & Long/Outer Bolts Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

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

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

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

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

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

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Tools Required

- **EN 46121** Connecting Rod Guide Pin Set. See **Special Tools** .
- **EN-48589** Crankshaft Rotation Socket. See **Special Tools** .
- **J 8037** Ring Compressor. See **Special Tools** .
- **J 43690** Rod Bearing Clearance Checking Tool. See **Special Tools** .
- **J 43690-100** Rod Bearing Clearance Checking Tool - Adapter Kit. See **Special Tools** .
- **J 45059** Angle Meter

Piston and Connecting Rod Assembly Procedure

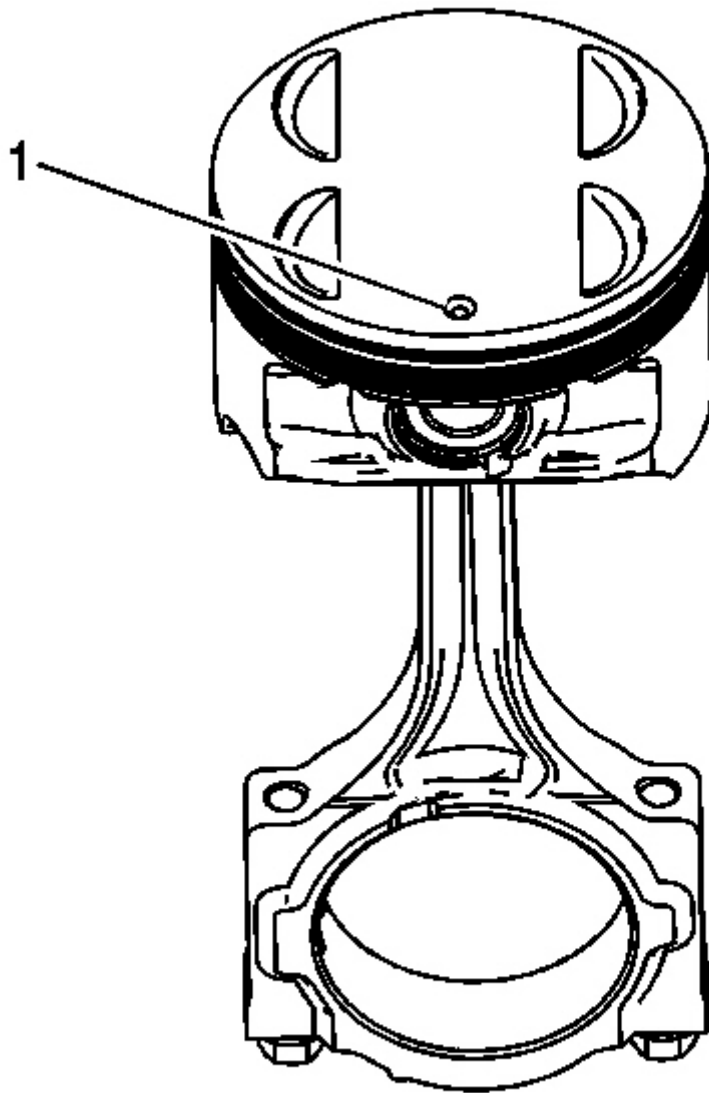


Fig. 25: Identifying Proper Piston Orientation With Dot On Piston
Courtesy of GENERAL MOTORS CORP.

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

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

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

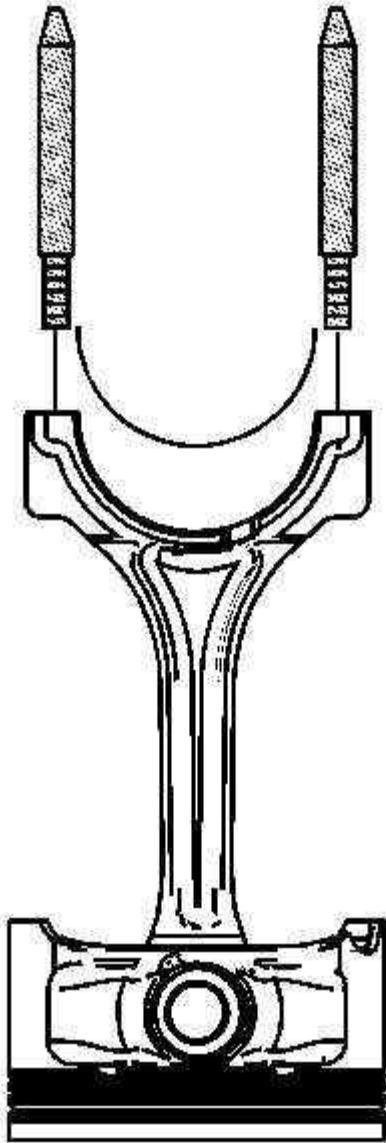


Fig. 26: View Of Piston/Connecting Rod Installation Tool
Courtesy of GENERAL MOTORS CORP.

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

connecting rod bearings for reassembly.

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

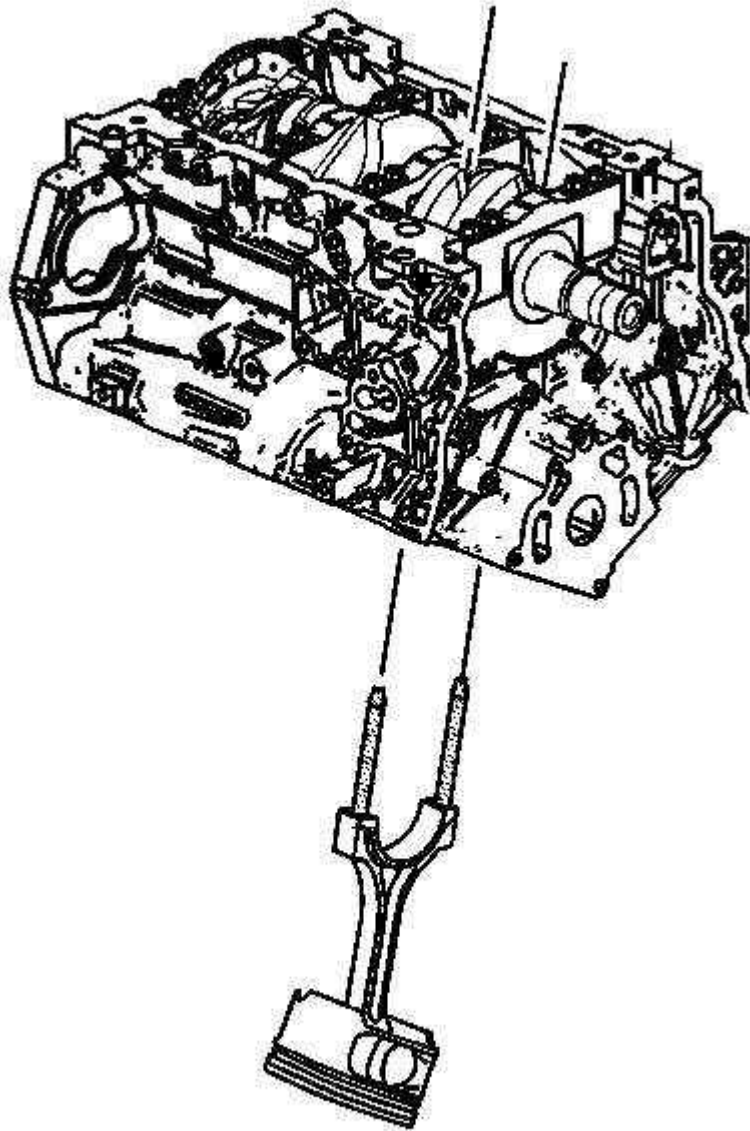


Fig. 27: View Of Connecting Rod And Piston Assembly
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Extreme care must be used when installing the piston and connecting rod in order to be sure the

rod does not scrape or nick the cylinder bore, the oil jets, or the crankshaft surfaces.

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

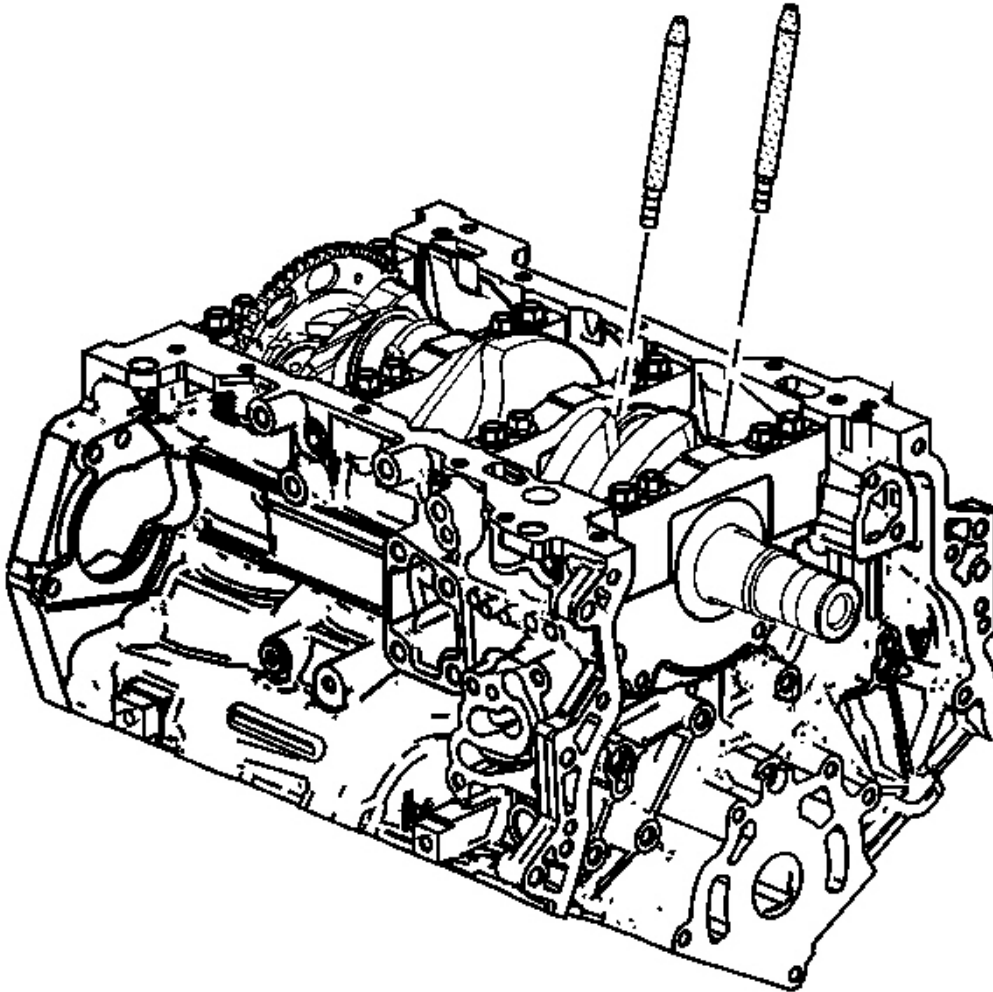


Fig. 28: Identifying Special Tools - EN 46121
Courtesy of GENERAL MOTORS CORP.

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

Connecting Rod Bearing Clearance Measurement Procedure - Using Plastic Gaging

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

clearance of the new connecting rod bearings.

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

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

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

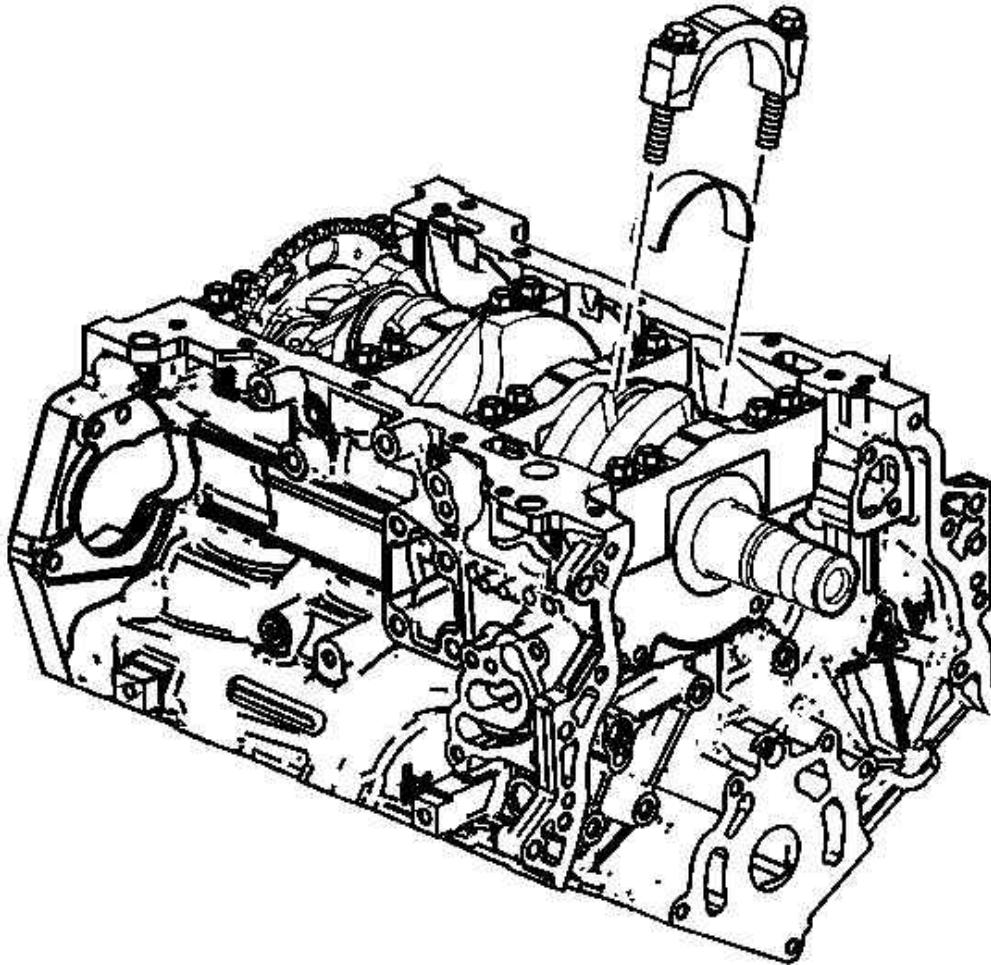


Fig. 29: View Of Connecting Rod Bearing And Cap
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

torqued. Improper clamp load can lead to component failure and extensive engine damage.

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

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

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

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

1. First Pass

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

2. Final Pass

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

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

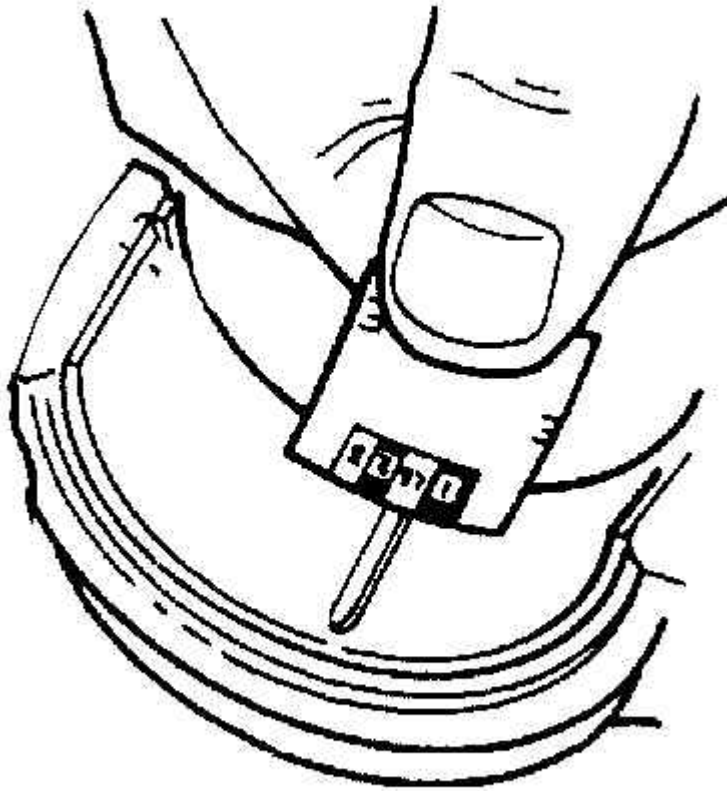


Fig. 30: Measuring Plastigage
Courtesy of GENERAL MOTORS CORP.

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

reground the crankshaft. Crankshaft machining is permitted and undersized bearings are available.

2. Re-measure the connecting rod bearing bore diameter to ensure proper size. The connecting rod is not machinable and the connecting rod must be replaced if out of specification.
12. Clean the plastic gaging material from the connecting rod bearing journals using a soft lint-free cloth.

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

The **J 43690** and the **J 43690-100** have been developed as a more accurate method to measure connecting rod bearing clearances. See **Special Tools** . 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.

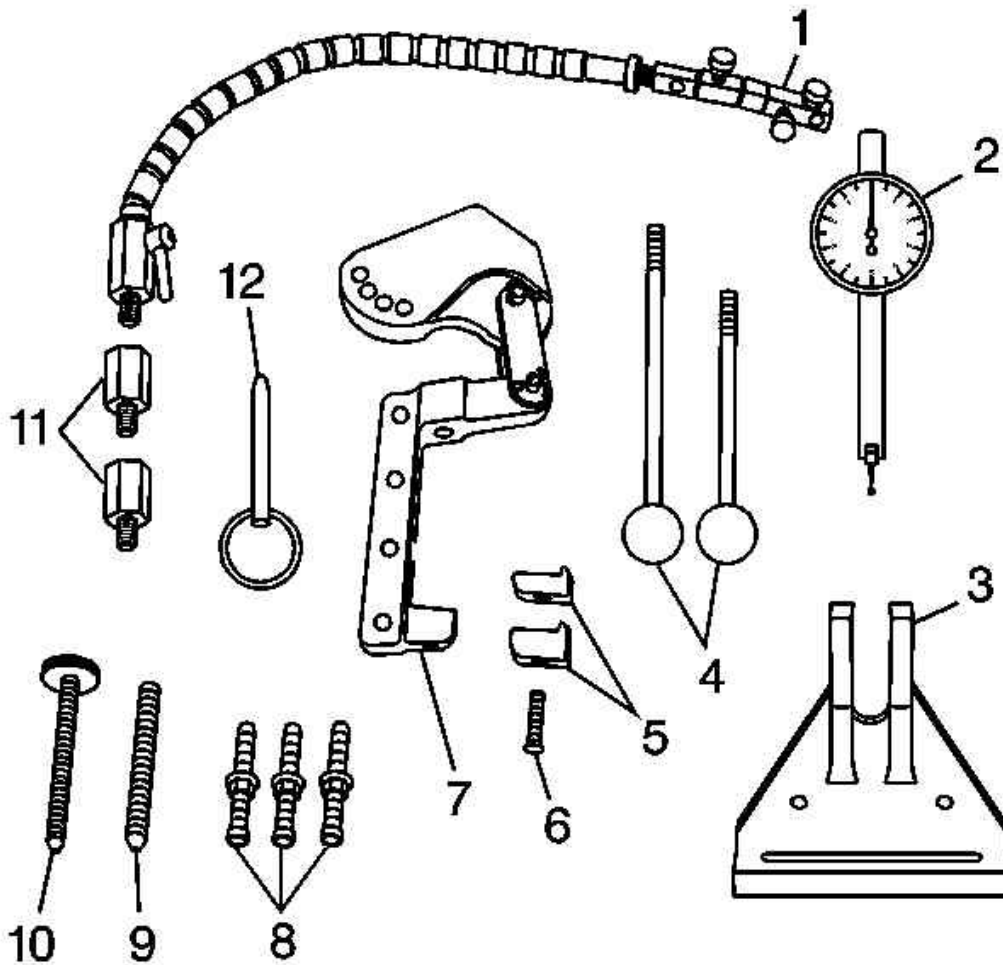


Fig. 31: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

J 43690 Rod Bearing Clearance Checking Tool. See **Special Tools** .

- J 43690-20 Swivel Base (1)
- J 43690-19 Dial Indicator (2)
- J 43690-2 Base (3)
- J 43690-5, -6 Handle (4)

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2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

- 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)

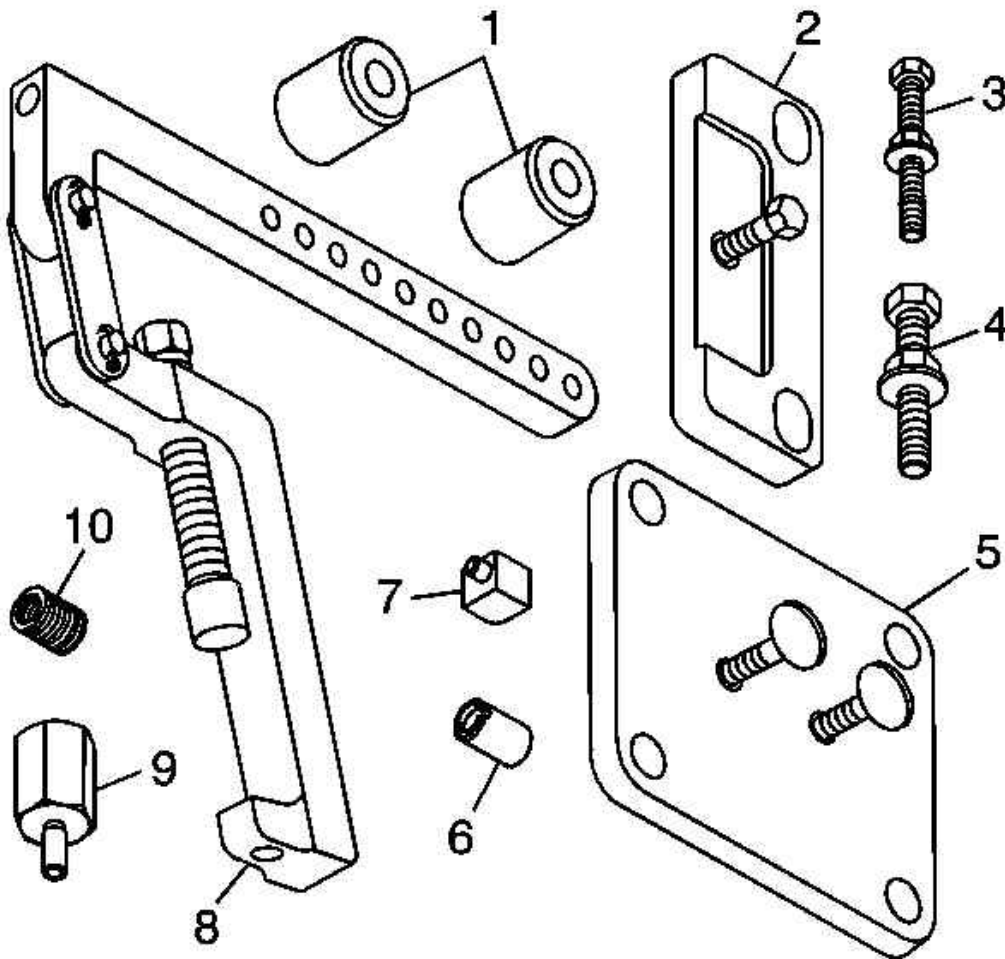


Fig. 32: Identifying Rod Bearing Clearance Tool - Adapter Kit
Courtesy of GENERAL MOTORS CORP.

J 43690-100 Rod Bearing Clearance Tool - Adapter Kit. See **Special Tools** .

- 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)

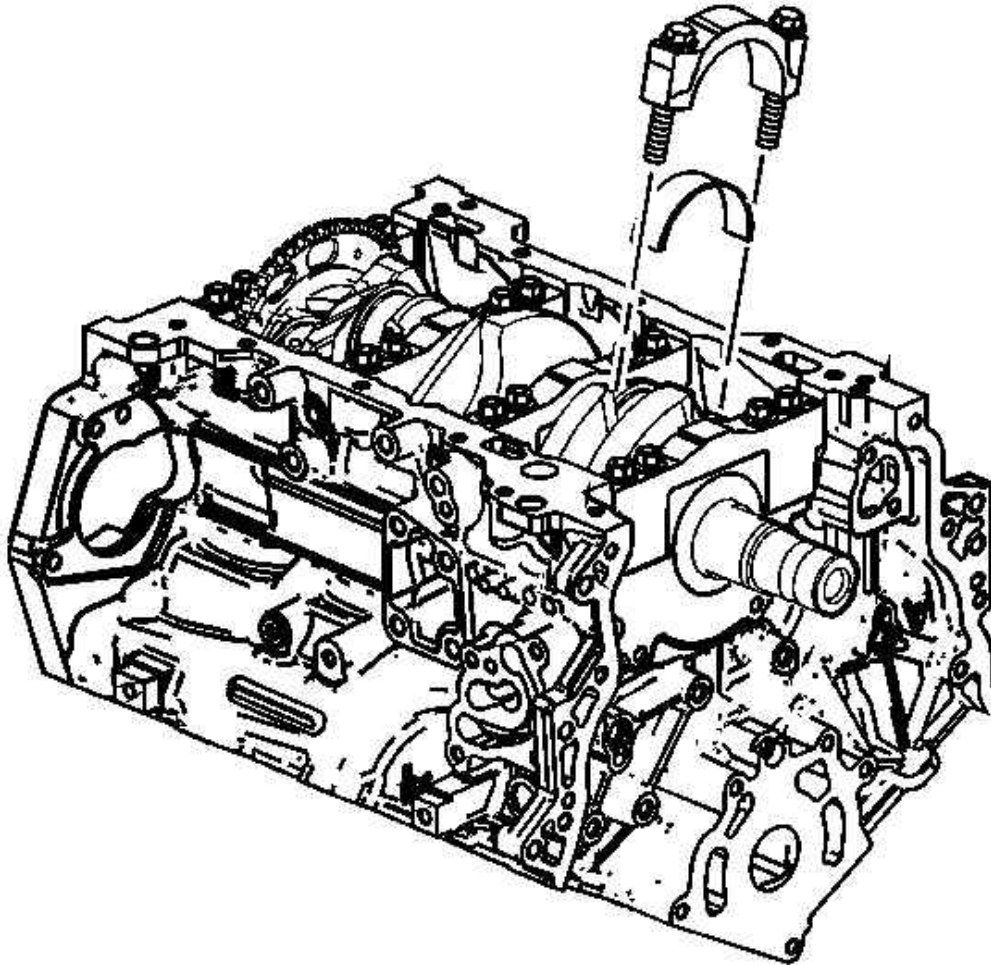


Fig. 33: View Of Connecting Rod Bearing And Cap
Courtesy of GENERAL MOTORS CORP.

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

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

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

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

NOTE: Refer to Fastener Notice .

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

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

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

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

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

1. First Pass

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

2. Final Pass

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

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

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

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

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

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

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

2. Final Pass

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

11. During and after installation, ensure each piston is positioned properly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.
12. Repeat these procedures for the remaining piston/connecting rod assemblies using the **EN-48589** in order to rotate the crankshaft. See **Special Tools** .

Connecting Rod Final Assembly Procedure

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

bearing lock tangs are aligned on the same side of the rod.

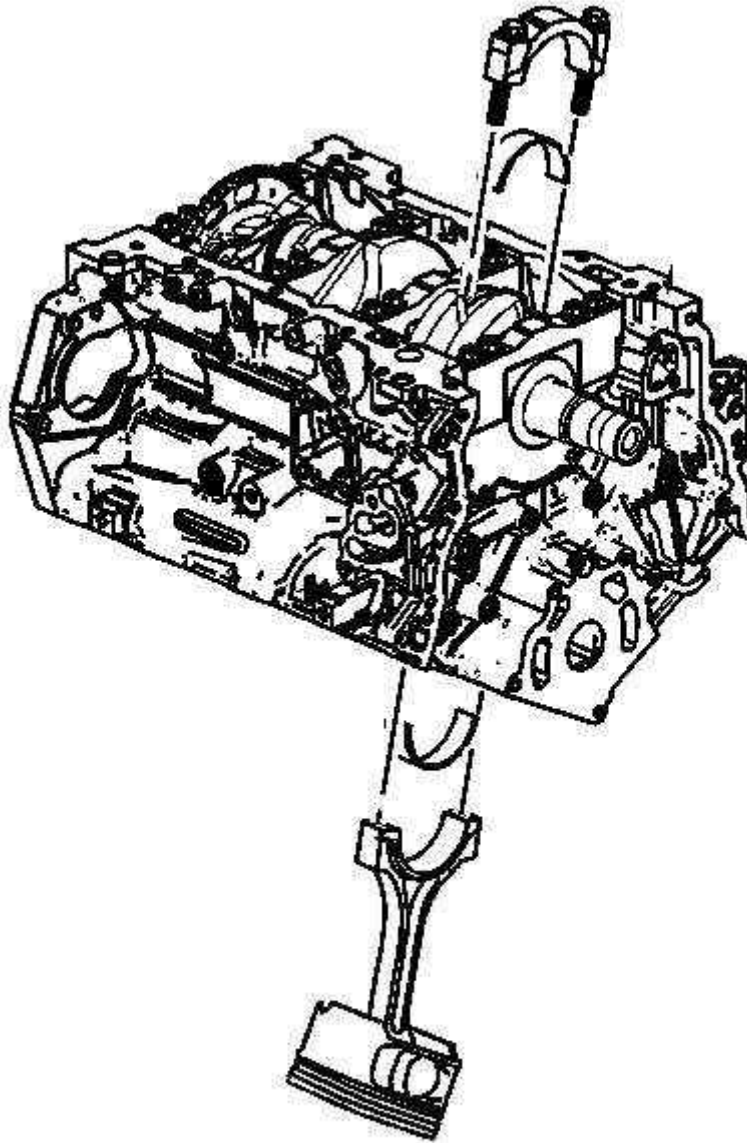


Fig. 34: Identifying Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

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

IMPORTANT: DO NOT reuse the old connecting rod bolts.

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

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

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

1. First Pass

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

2. Final Pass

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

8. During and after installation, ensure each piston is positioned properly in the correct cylinder. The locating arrow on the top of each piston must be pointing toward the front of the engine.
9. Repeat these procedures for the remaining piston/connecting rod assemblies using the **EN-48589** in order to rotate the crankshaft. See **Special Tools** .

CRANKSHAFT REAR OIL SEAL AND HOUSING INSTALLATION

Tools Required

- **EN 46109** Guide Pin Set. See **Special Tools** .
- **EN-47839** Crankshaft Rear Oil Seal Installation Tool. See **Special Tools** .

- **J 42183** Handle. See **Special Tools** .

Installation

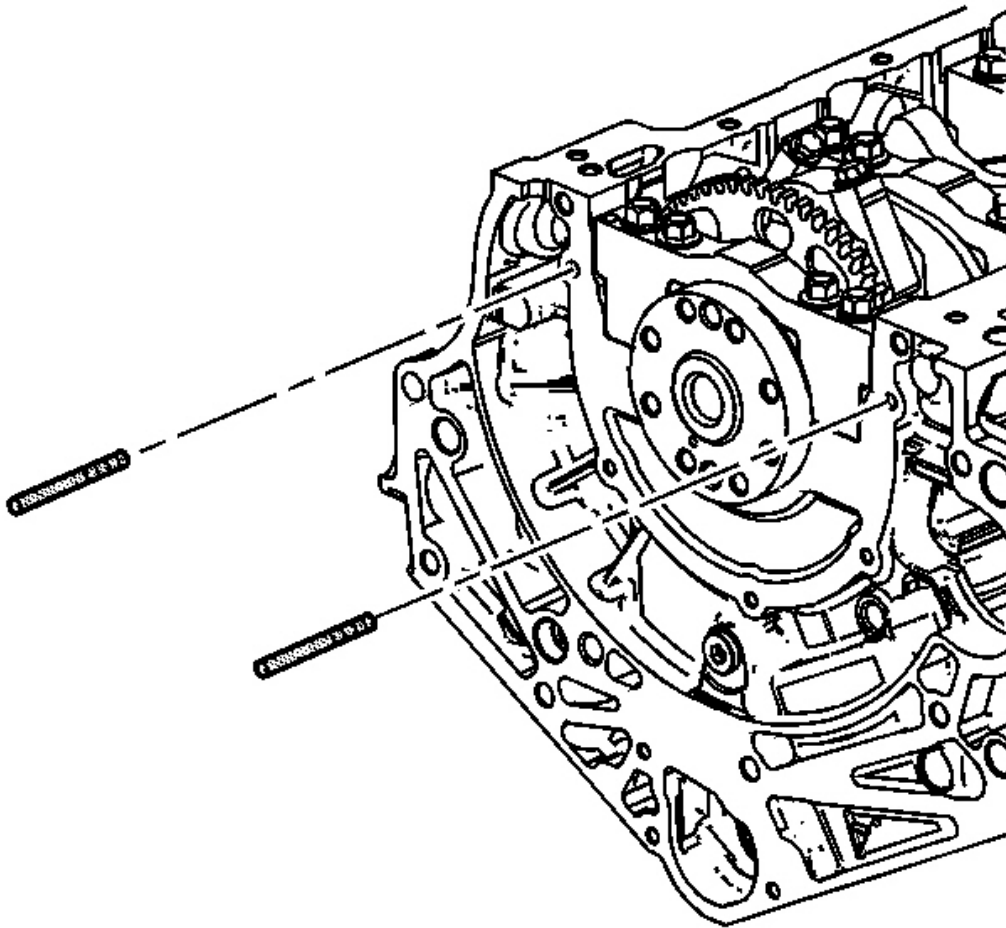


Fig. 35: View Of EN 46109
Courtesy of GENERAL MOTORS CORP.

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

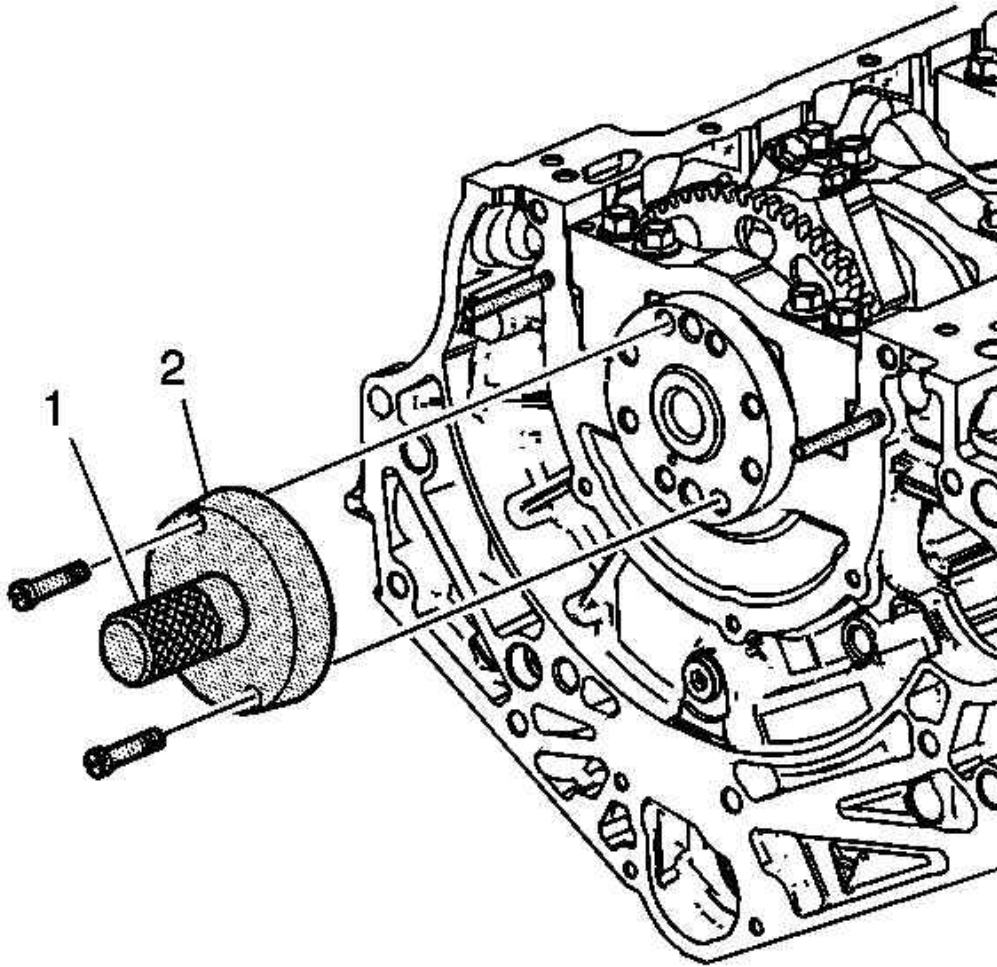


Fig. 36: Identifying Special Tools EN-47839 & J-42183
Courtesy of GENERAL MOTORS CORP.

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

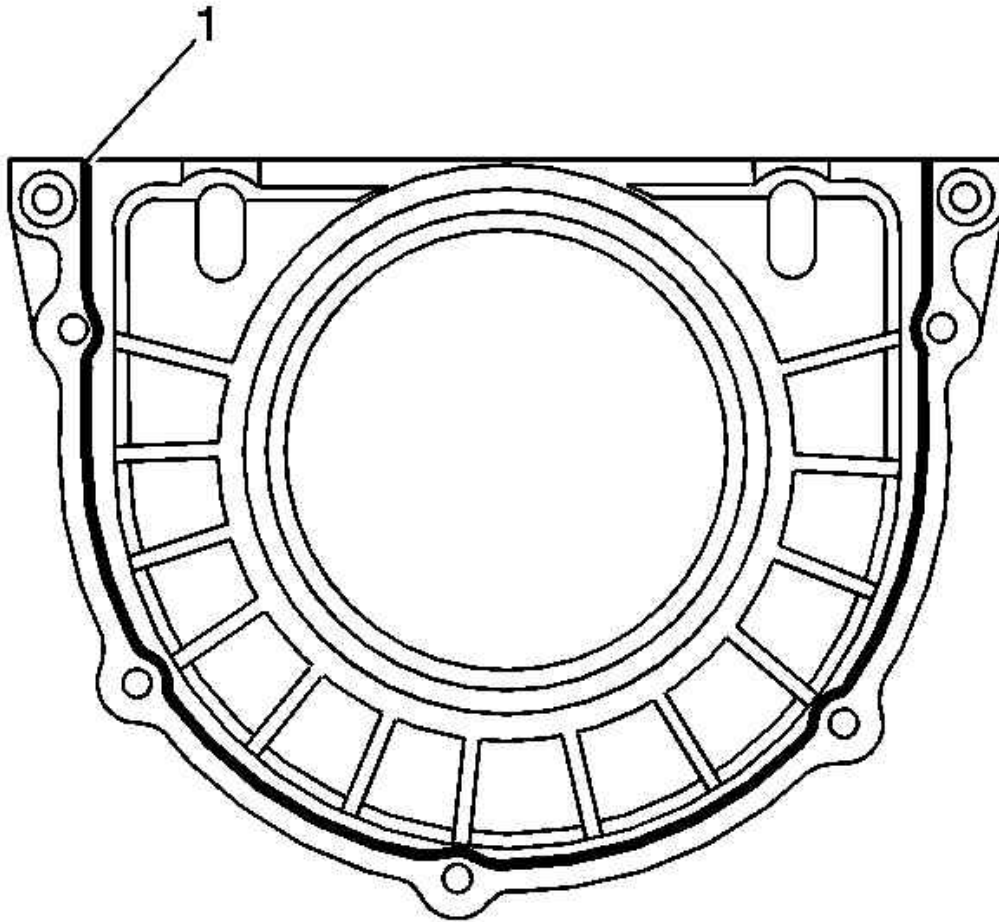


Fig. 37: Identifying Sealant Application Area On Crankshaft Rear Oil Seal Housing

Courtesy of GENERAL MOTORS CORP.

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

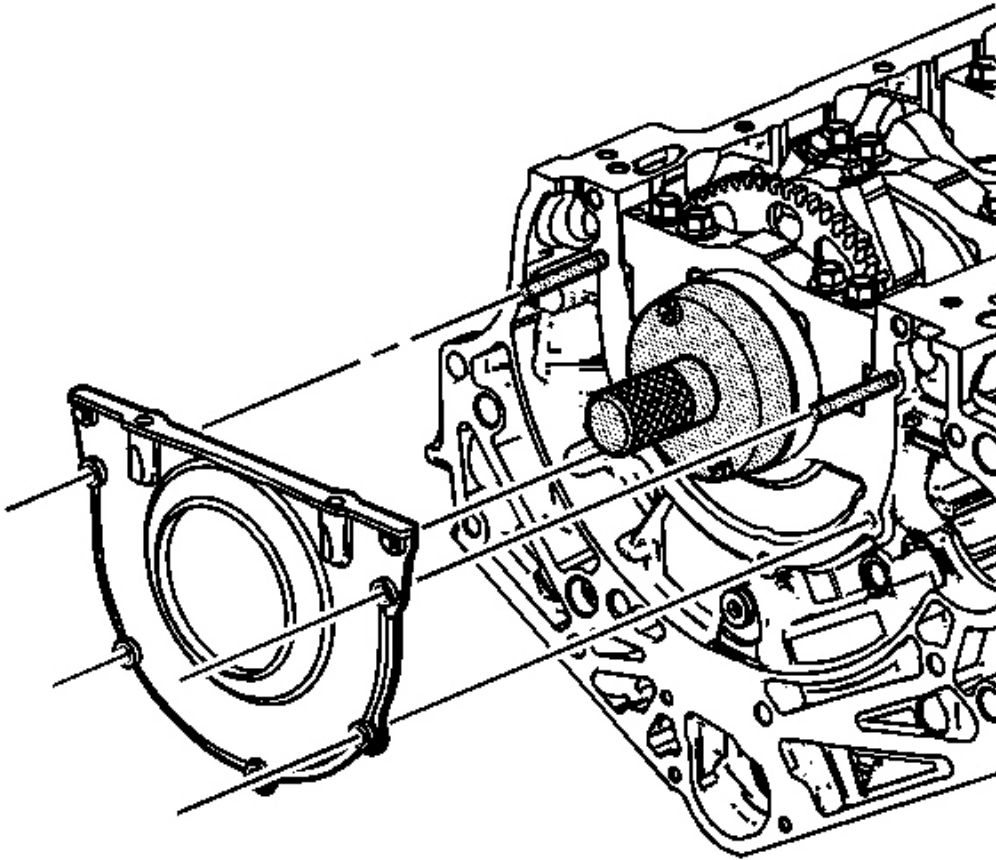


Fig. 38: View of Crankshaft Rear Oil Seal Housing Assembly
Courtesy of GENERAL MOTORS CORP.

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

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

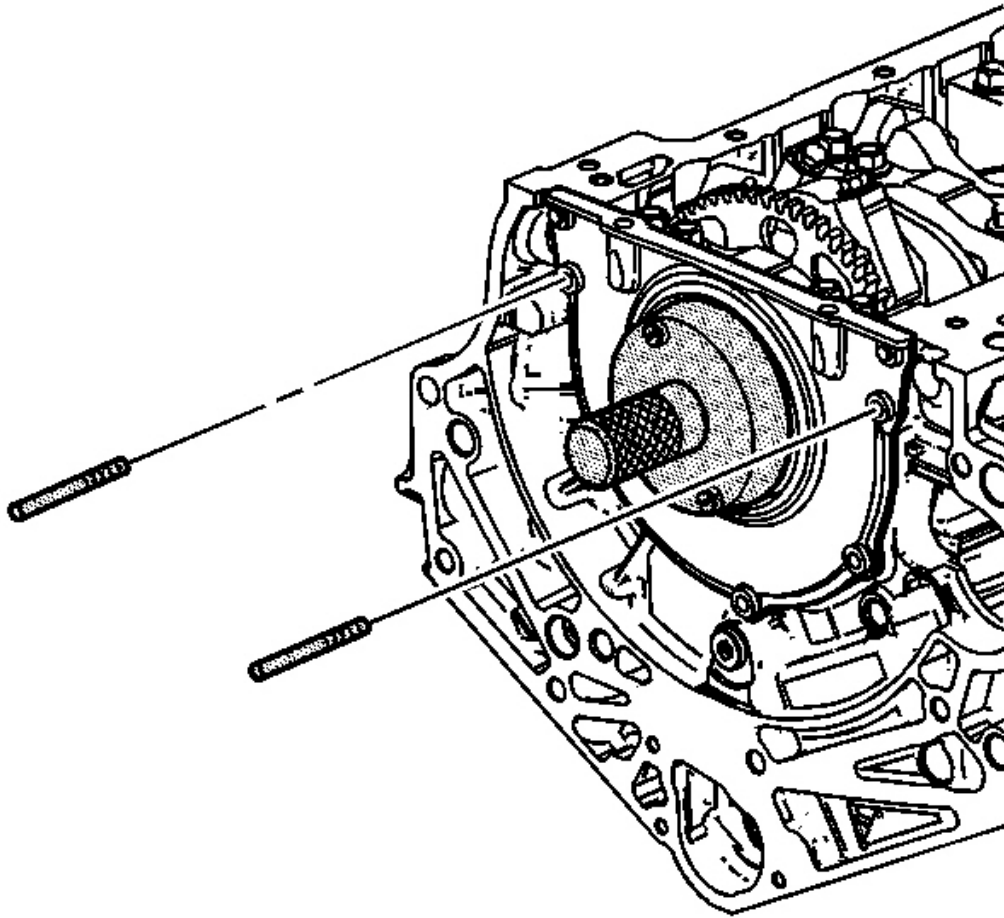


Fig. 39: Identifying Special Tool - EN 46109
Courtesy of GENERAL MOTORS CORP.

5. Remove the **EN 46109** 6 mm (0. See **Special Tools** .236 in) guides from the engine block.

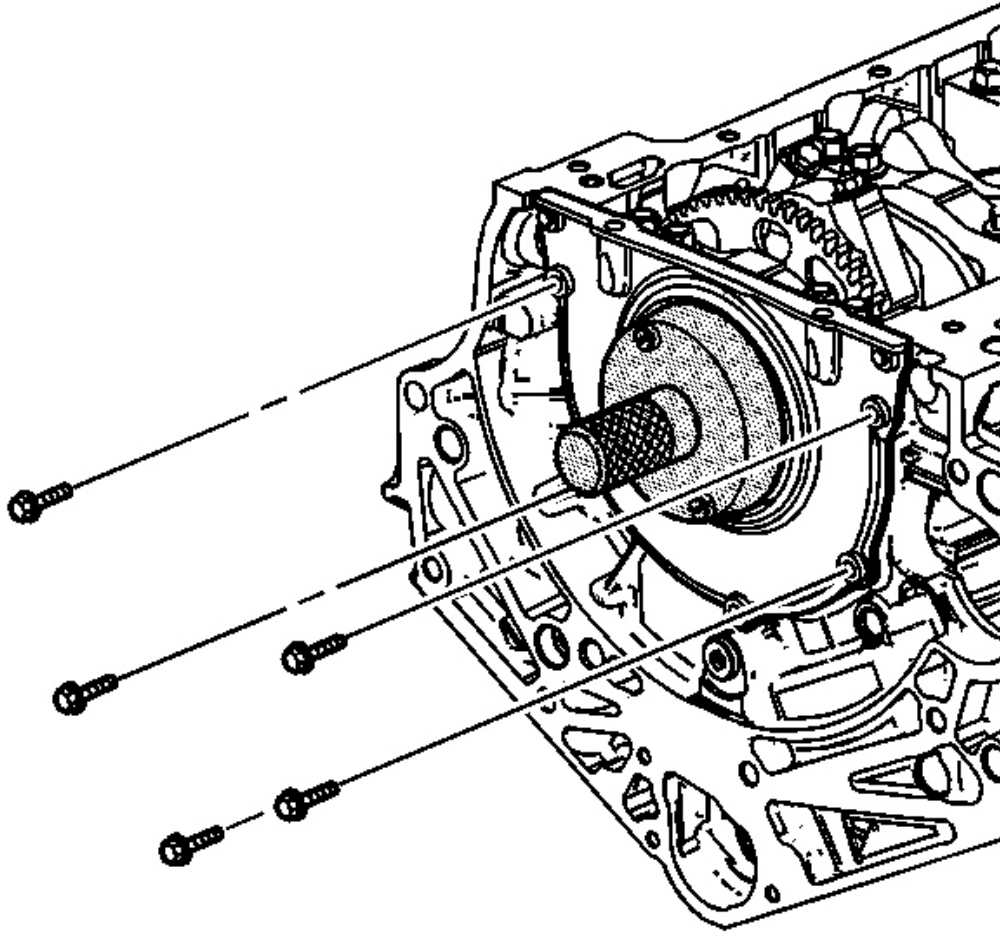


Fig. 40: Locating Crankshaft Rear Oil Seal Housing Bolts
Courtesy of GENERAL MOTORS CORP.

6. Install the crankshaft rear oil seal housing bolts.

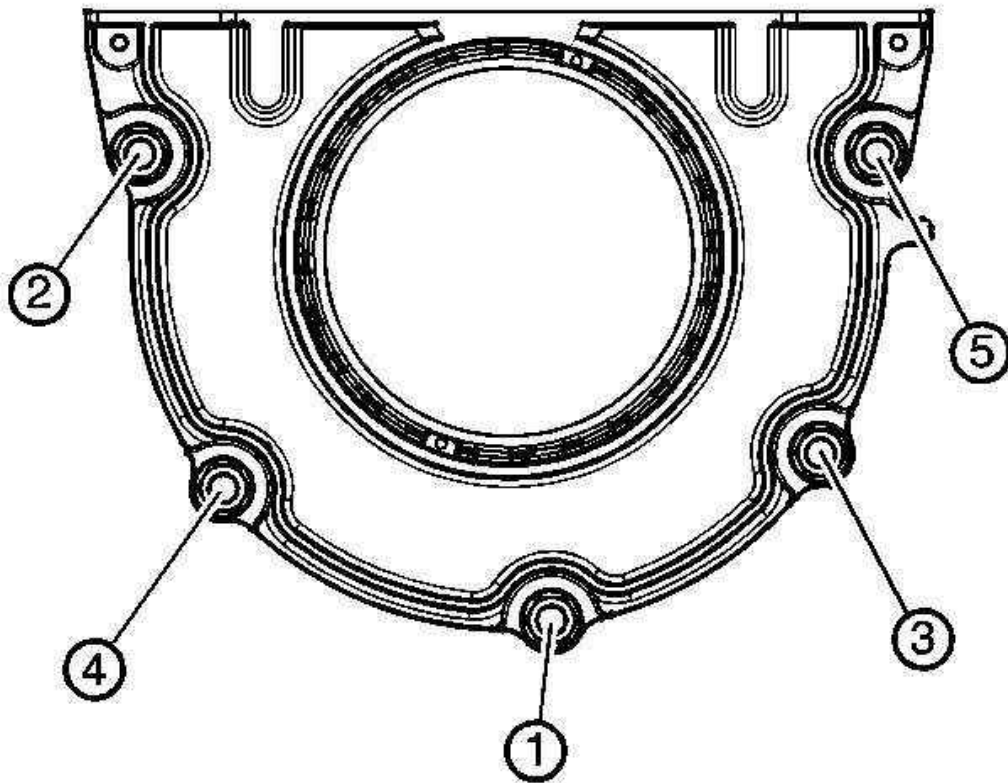


Fig. 41: Identifying Crankshaft Rear Oil Seal Housing Bolts Tightening Sequence

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

7. Tighten the crankshaft rear oil seal housing bolts in sequence shown.

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

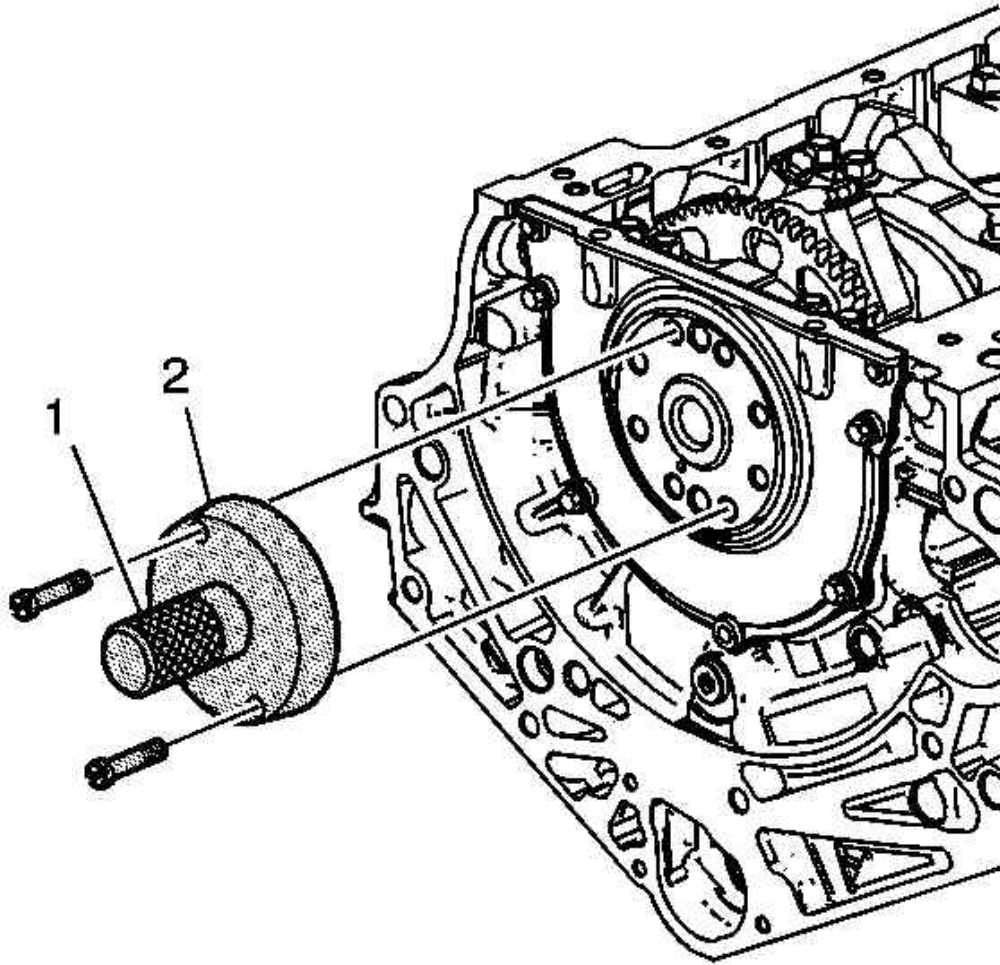


Fig. 42: Identifying Special Tools EN-47839 & J-42183
Courtesy of GENERAL MOTORS CORP.

8. Remove the **EN-47839** and **J 42183** (1, 2) from the crankshaft flange. See **Special Tools** .

OIL PUMP INSTALLATION

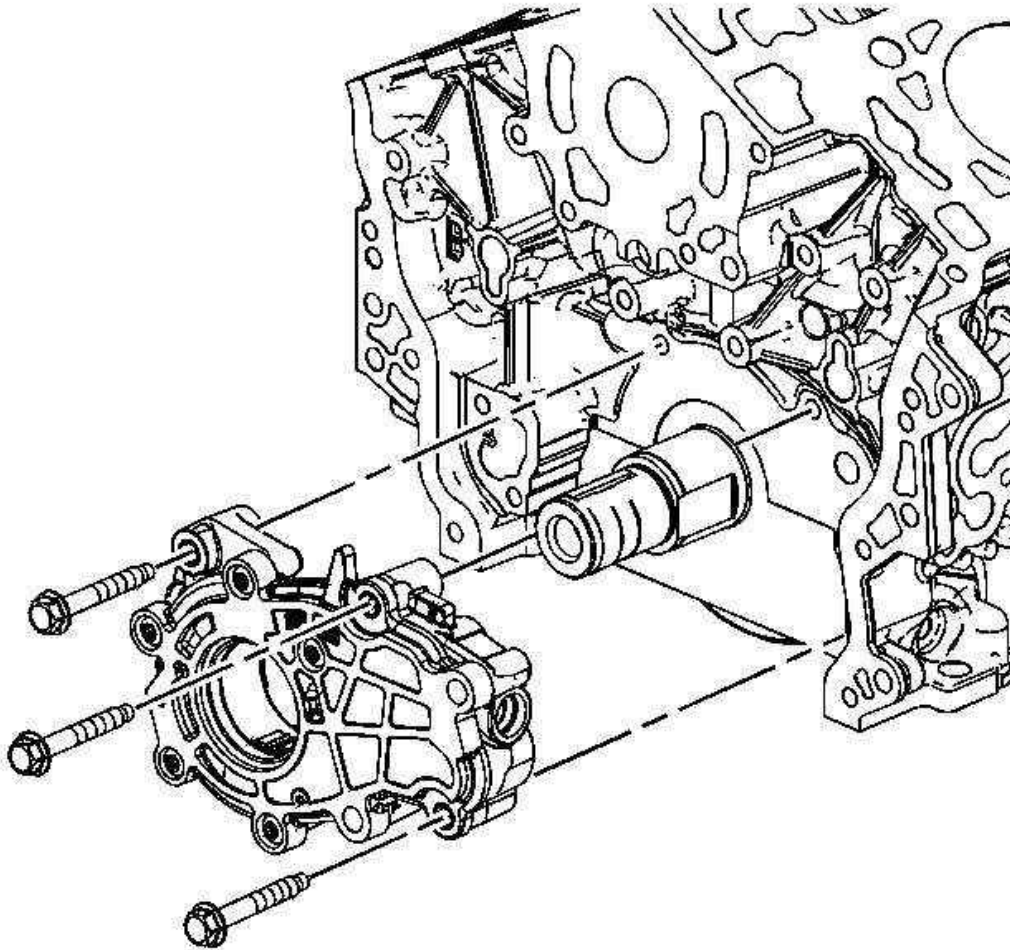


Fig. 43: View Of Oil Pump Generator Aligned With Crankshaft Flats
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

3. Install the oil pump bolts.

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

OIL PAN INSTALLATION

Tools Required

EN 46109 Guide Pin Set. See **Special Tools** .

Installation Procedure

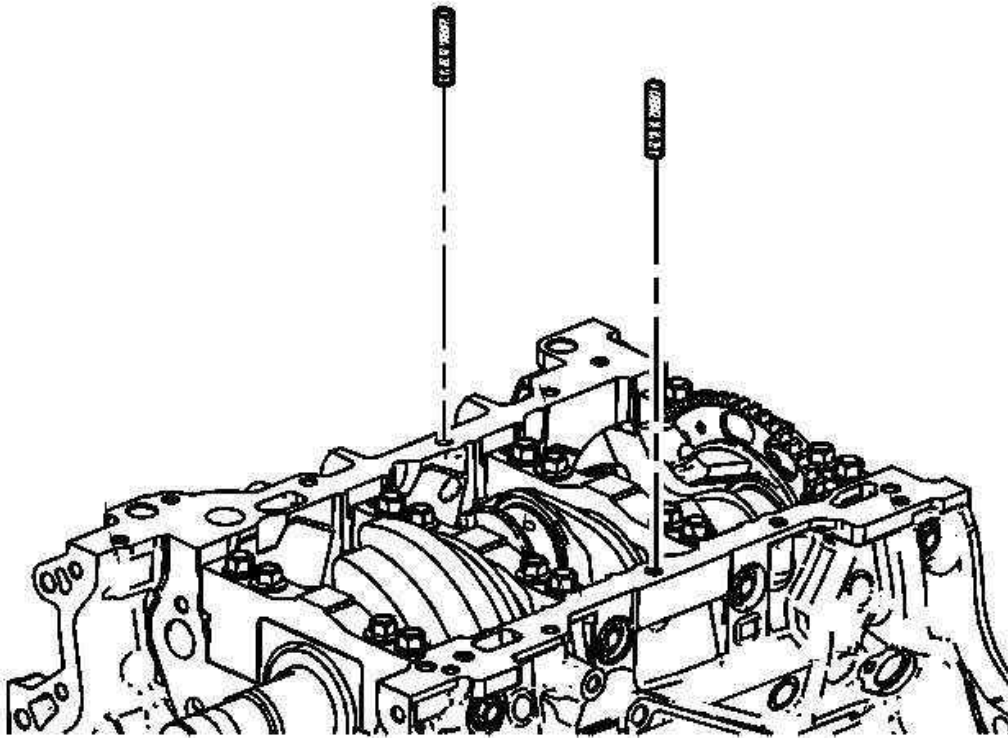


Fig. 44: Identifying EN 46109 Guides
Courtesy of GENERAL MOTORS CORP.

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

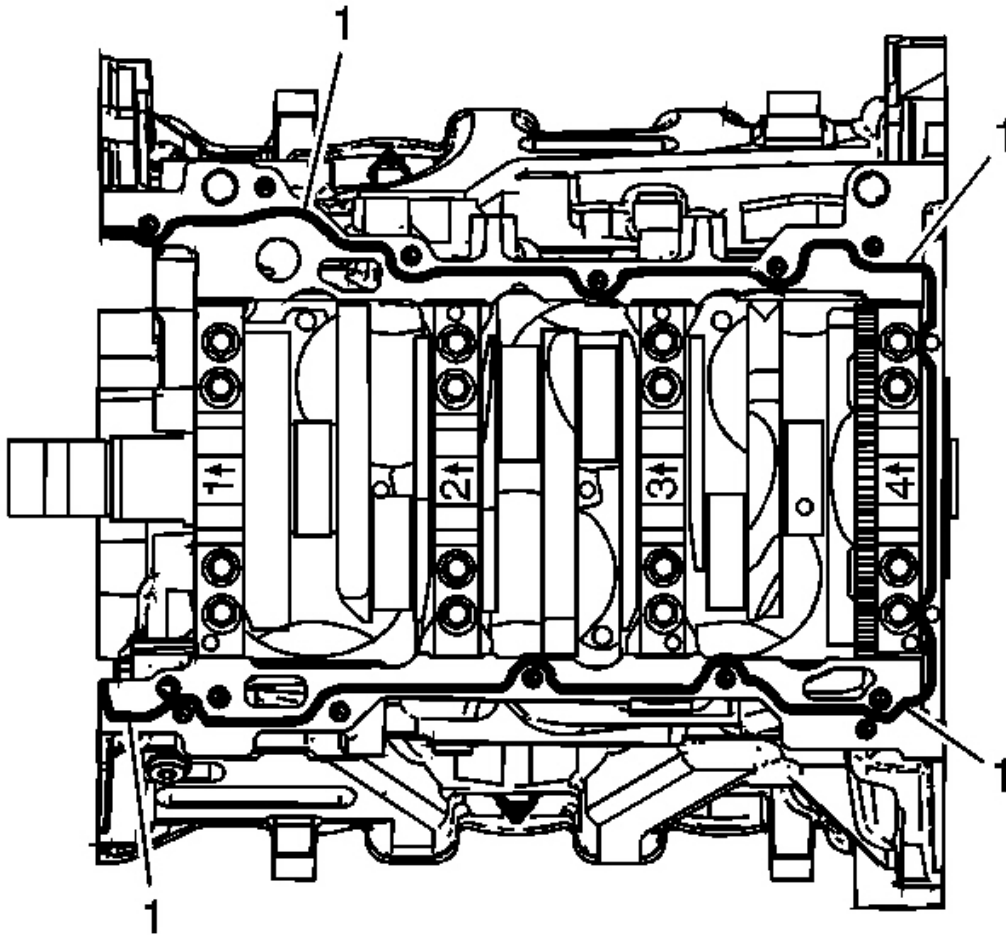


Fig. 45: Applying Sealant On Block Pan Rail & Crankshaft Rear Oil Seal Housing

Courtesy of GENERAL MOTORS CORP.

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

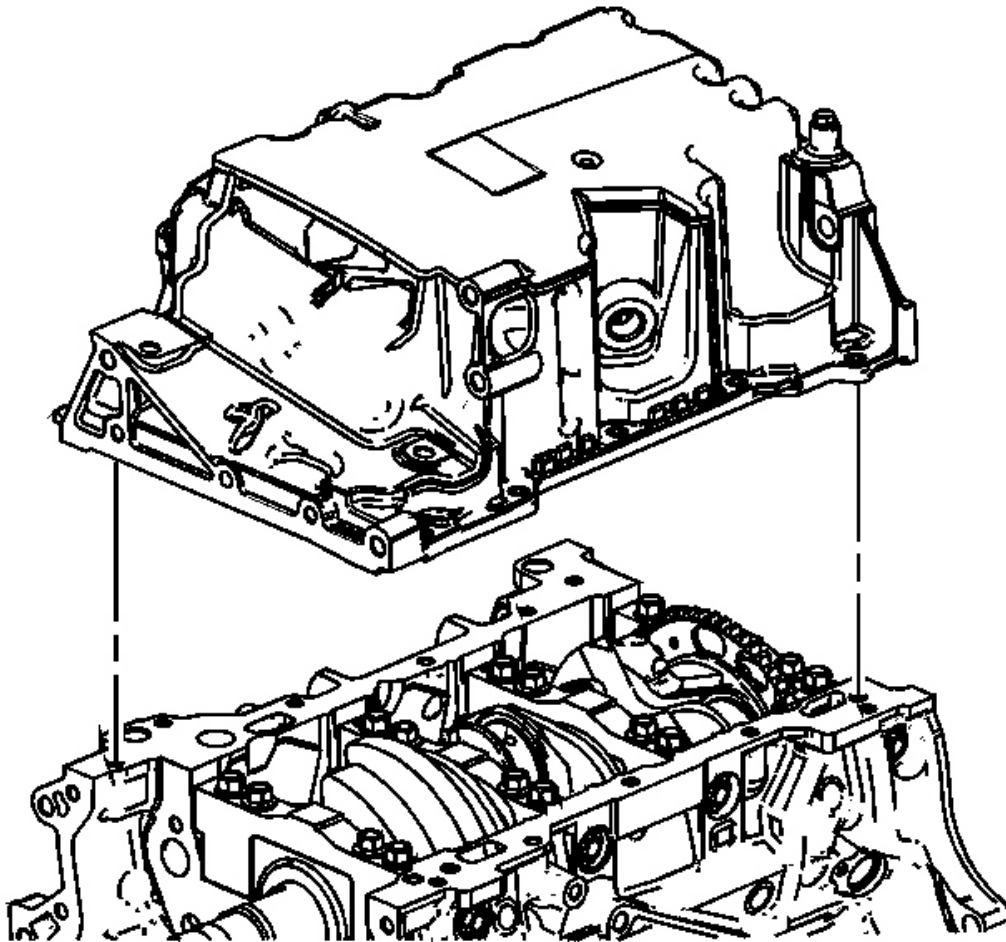


Fig. 46: Positioning Oil Pan Onto Block
Courtesy of GENERAL MOTORS CORP.

3. Position the oil pan onto the block.
4. Remove the **EN 46109** 8 mm (0. See **Special Tools** .315 in) guides from the engine block.

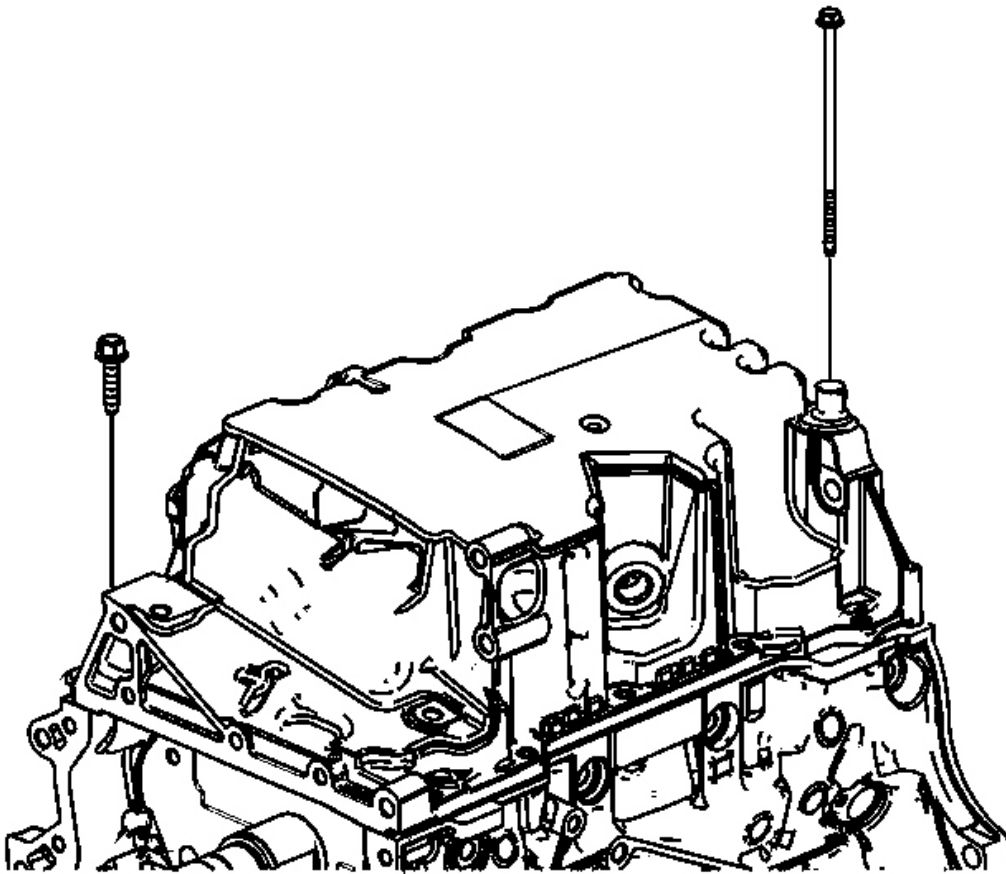


Fig. 47: Loosely Installing Oil Pan Bolts
Courtesy of GENERAL MOTORS CORP.

5. Loosely install the oil pan bolts.

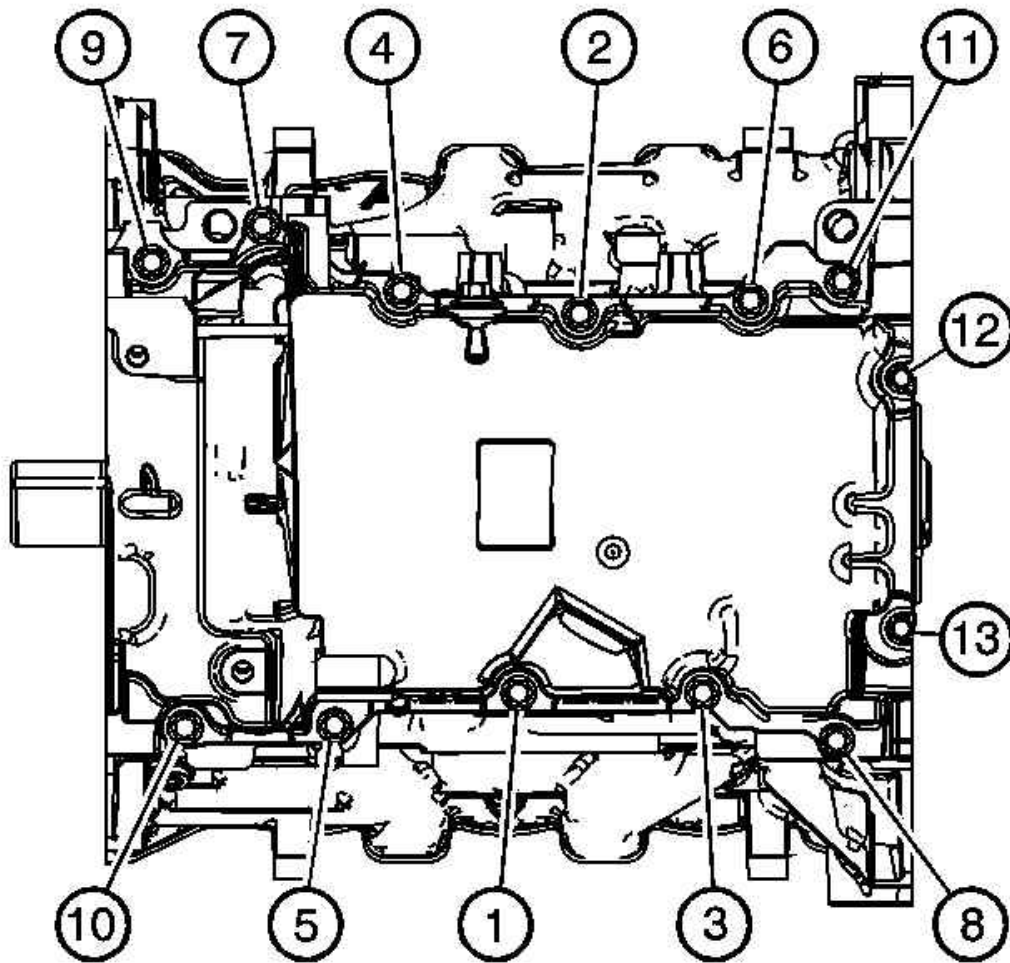


Fig. 48: Identifying Oil Pan Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

6. Tighten the oil pan bolts in sequence shown.

Tighten:

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

CYLINDER HEAD INSTALLATION - RIGHT SIDE

Tools Required

J 45059 Angle Meter

Installation Procedure

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

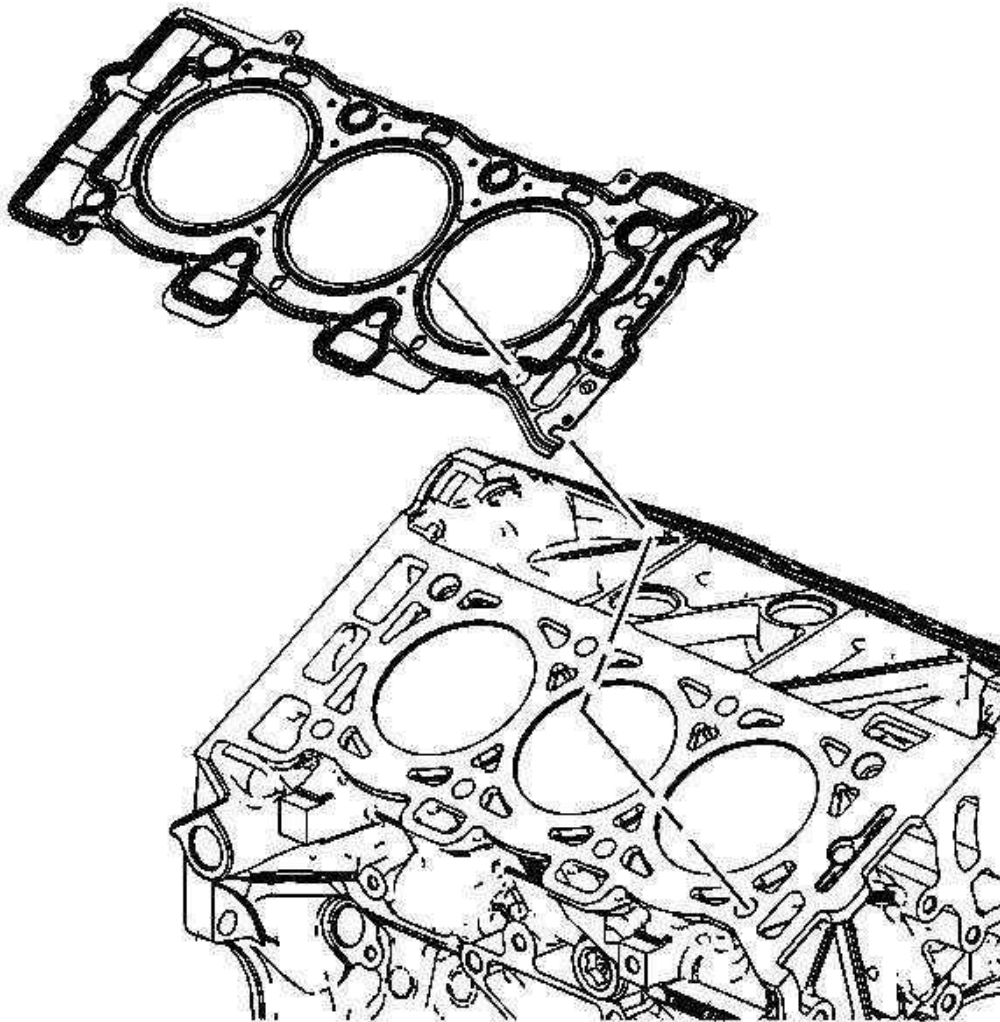


Fig. 49: View Of Right Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

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

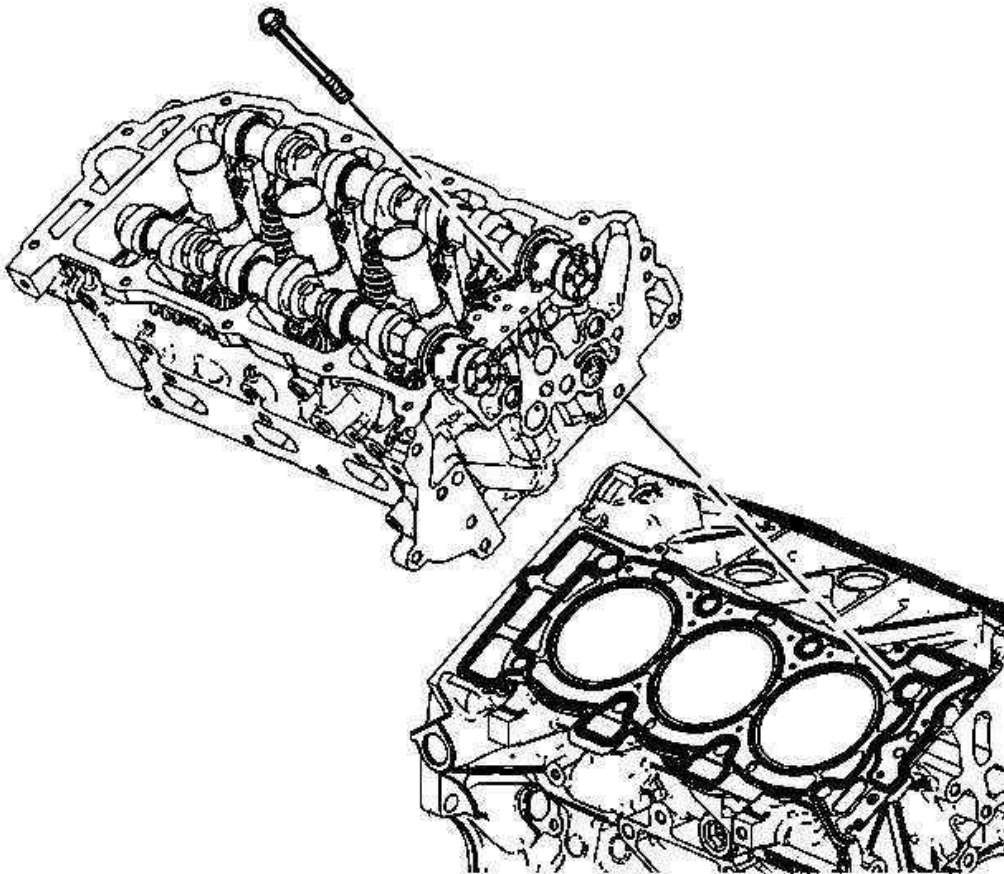


Fig. 50: View Of Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

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

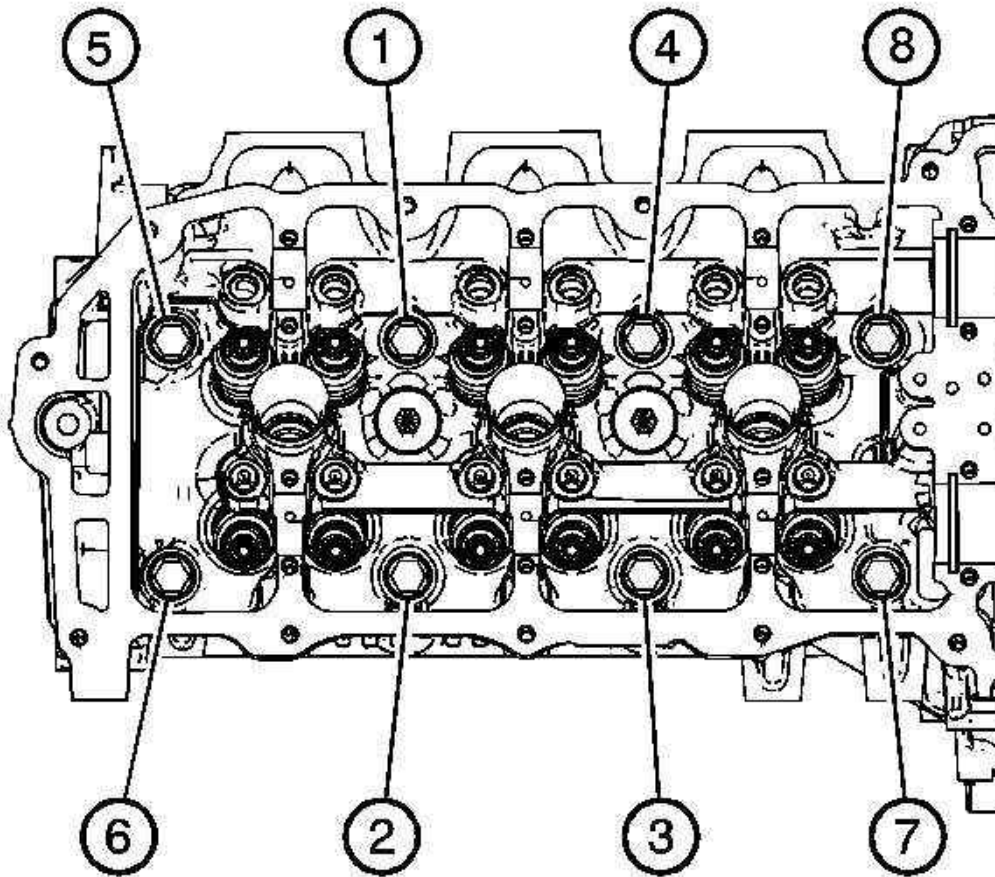


Fig. 51: Identifying M11 Cylinder Head Bolts Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

5. Install new M11 cylinder head bolts.

Tighten:

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

VALVE LIFTER INSTALLATION - RIGHT SIDE

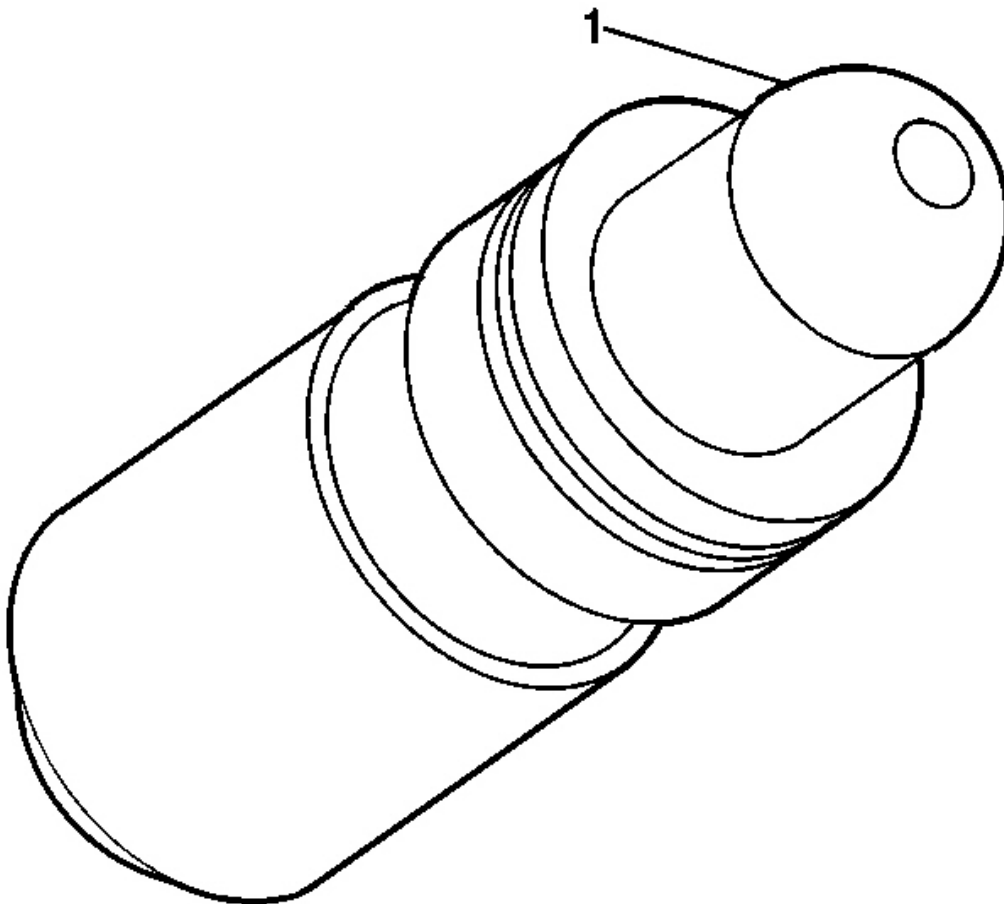


Fig. 52: View Of Valve Lifter
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not stroke/cycle the stationary hydraulic lash

adjuster plunger without oil in the lower pressure chamber.

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

1. Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.
2. Lubricate the SHLA bores in the cylinder head with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent.

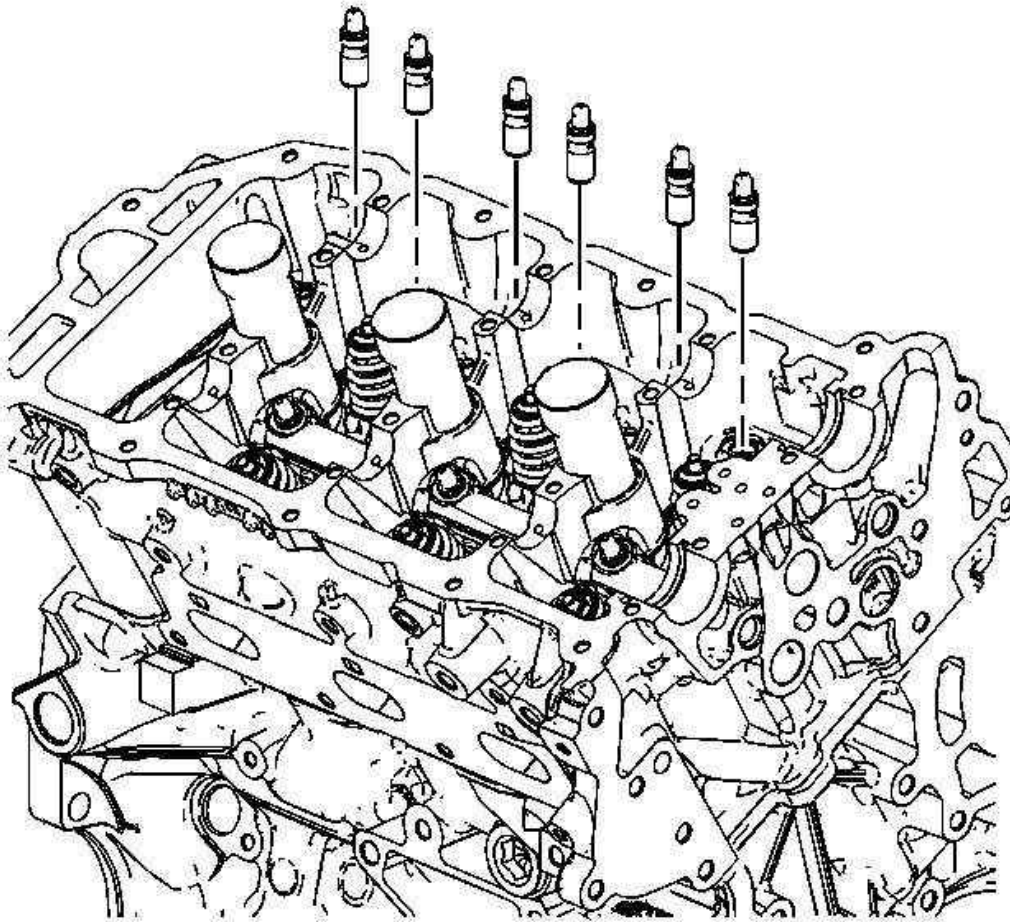


Fig. 53: Identifying Stationary Hydraulic Lash Adjuster (SHLA)
Courtesy of GENERAL MOTORS CORP.

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

VALVE ROCKER ARM INSTALLATION - RIGHT SIDE

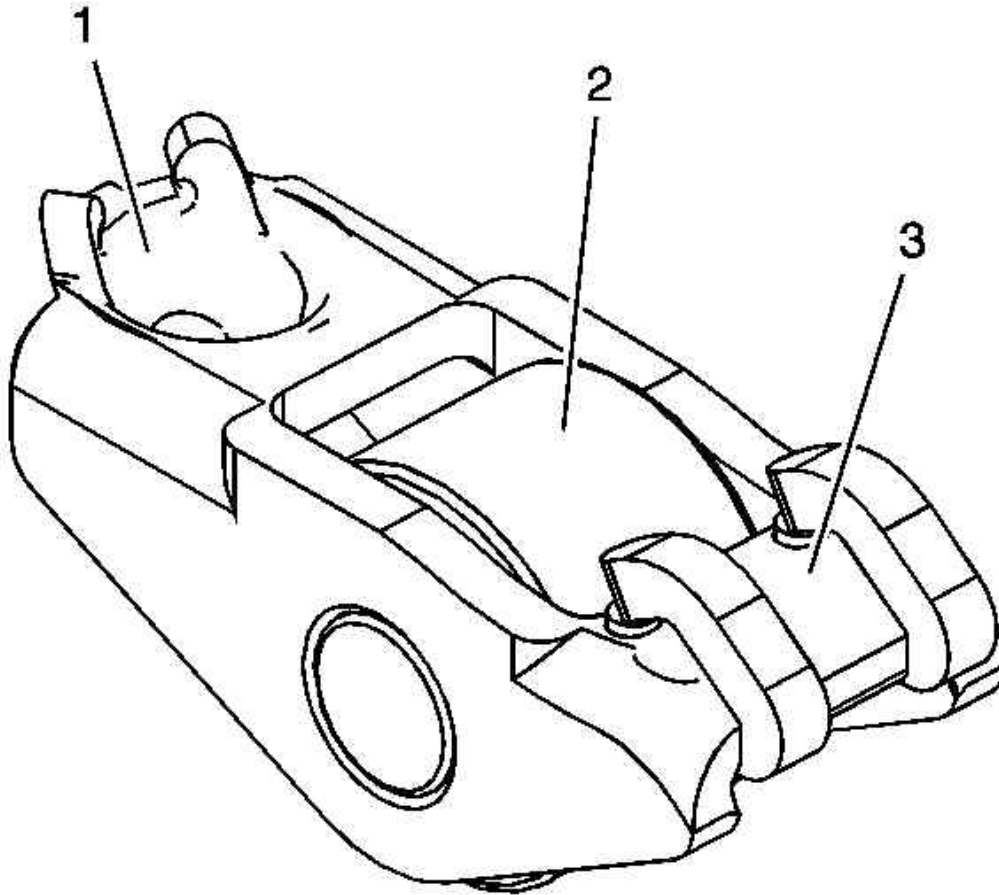


Fig. 54: Identifying Valve Rocker Arm Lubrication Areas
Courtesy of GENERAL MOTORS CORP.

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

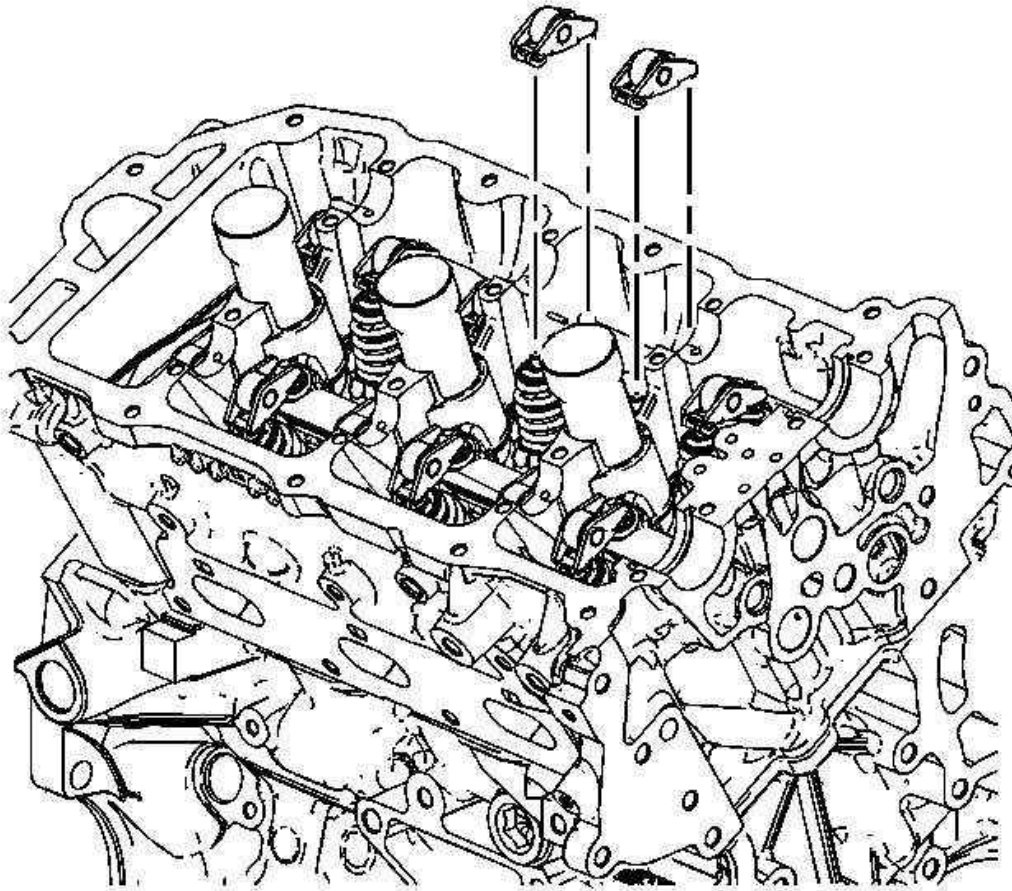


Fig. 55: Identifying Valve Rocker Arms
Courtesy of GENERAL MOTORS CORP.

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

2. Place the camshaft followers in position on the valve tip and stationary hydraulic lash adjuster (SHLA).

3. The rounded head end of the follower goes on the SHLA while the flat end goes on the valve tip.
4. Clean the camshaft journals and carriers with a clean, lint-free cloth.

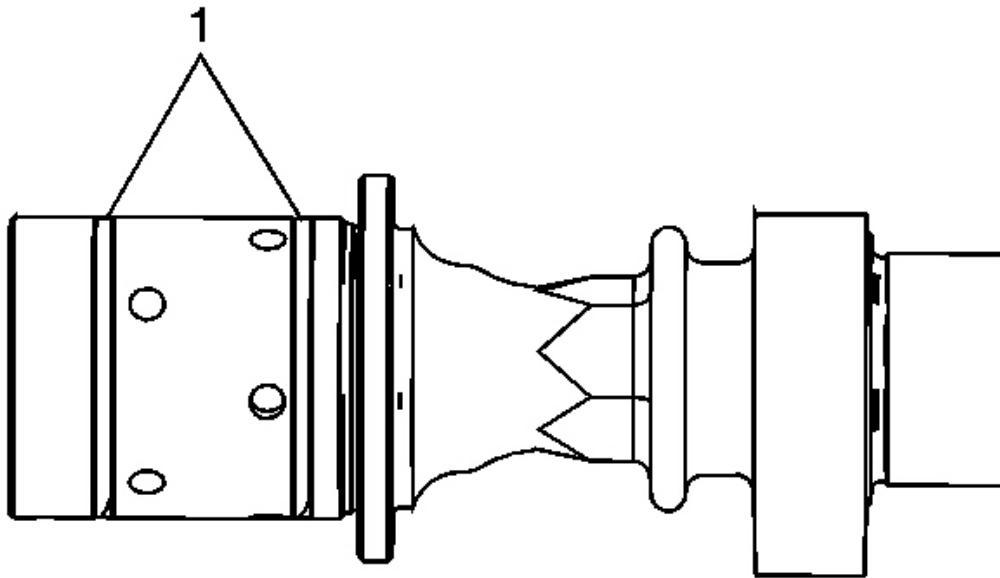
CAMSHAFT INSTALLATION - RIGHT SIDE

Fig. 56: Locating Camshaft Sealing Rings In Camshaft Grooves
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves. Camshaft sealing rings must be in place below the surface of the camshaft journal in order to avoid being pinched between the cylinder head and the camshaft caps.

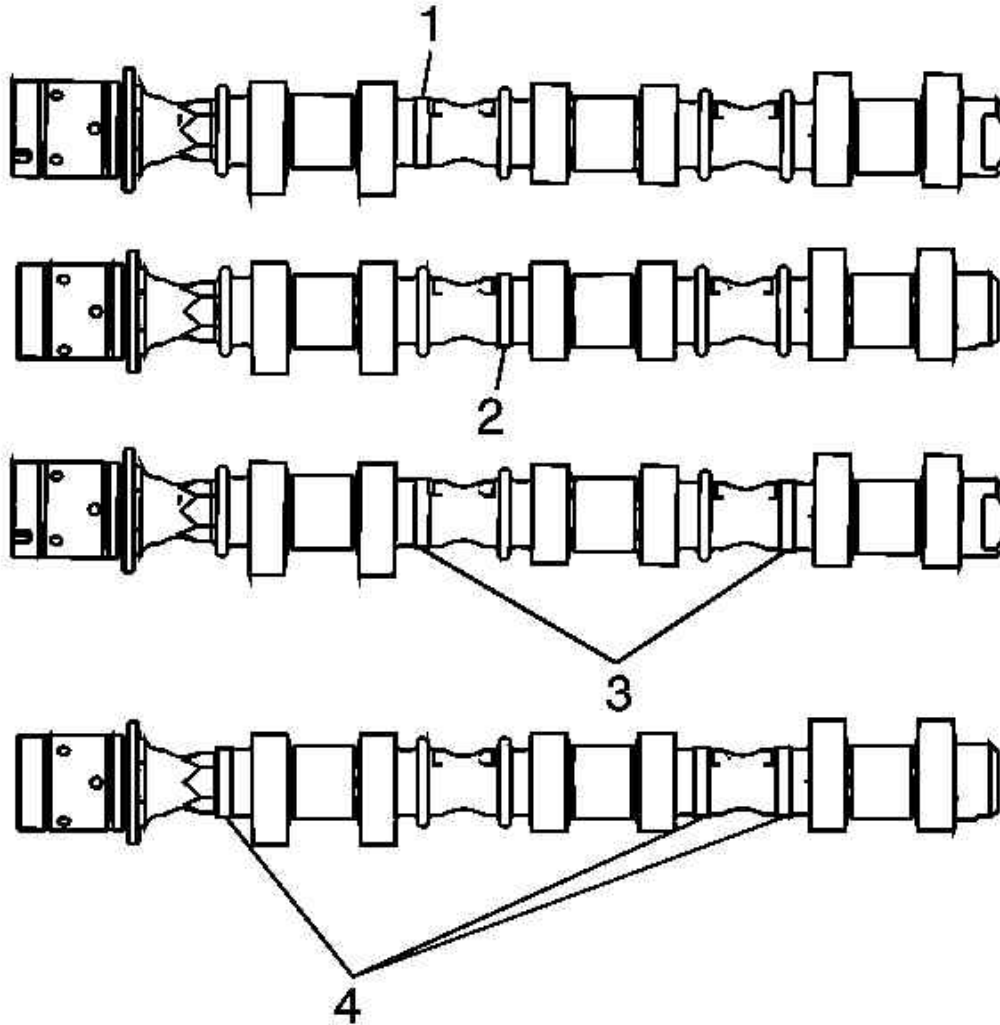


Fig. 57: Identifying Camshaft Identification Rings
Courtesy of GENERAL MOTORS CORP.

2. Select the proper camshaft for the particular installation location. The ring placement is defined as follows:
 1. The number 2 identification ring for the right exhaust camshaft is machined off (1) - Third Design, Camshaft Timing Drive System.
 2. The number 3 identification ring for the right intake camshaft is machined

2008 Buick LaCrosse CXL
2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

off (2) - Third Design and Fourth, except High Output, Camshaft Timing Drive System.

3. The number 2 and 5 identification rings for the right intake camshaft is machined off (3) - Fourth Design, Camshaft Timing Drive System.
4. The number 1, 4 and 5 identification rings for the right exhaust camshaft is machined off (4) - Fourth Design High Output, Camshaft Timing Drive System.

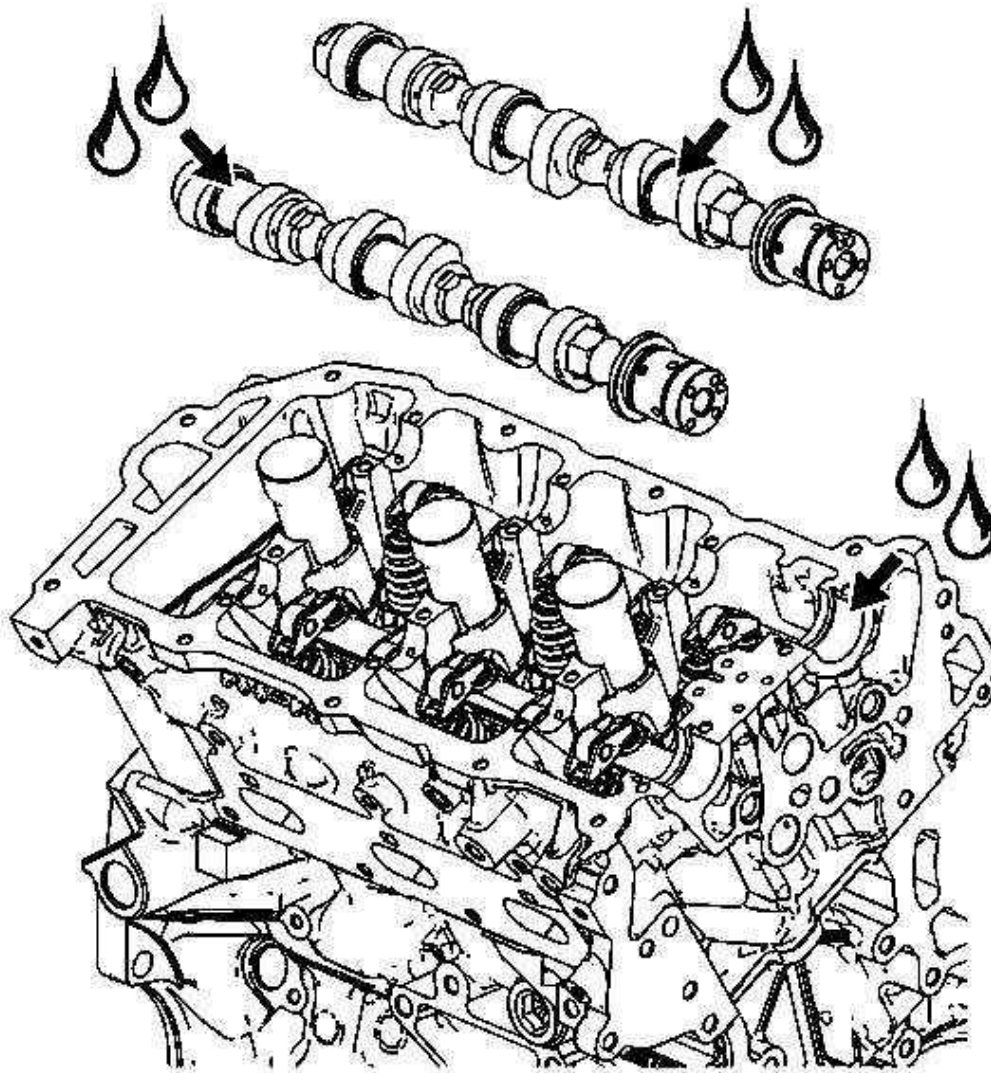


Fig. 58: Applying Lubricant To Camshaft Journals & Cylinder Head
Courtesy of GENERAL MOTORS CORP.

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

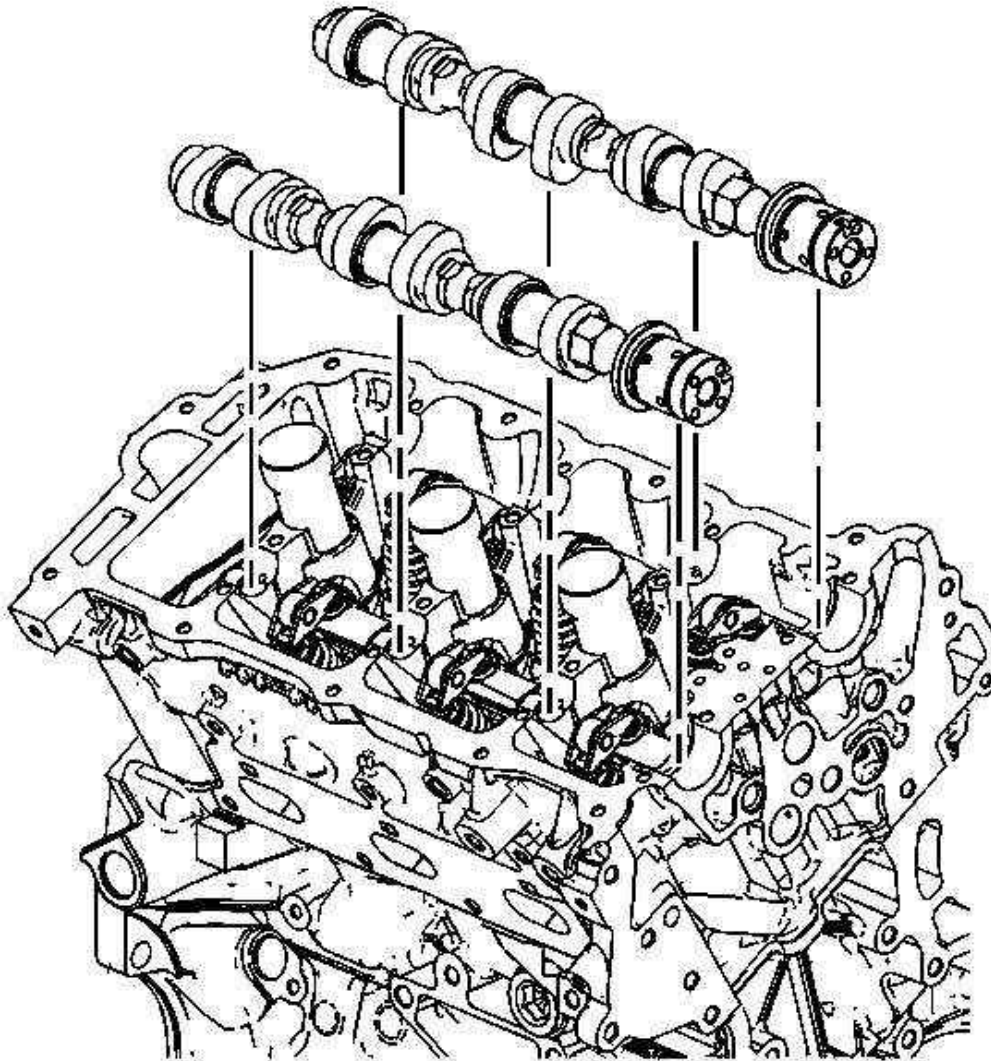


Fig. 59: View Of Right Camshafts
Courtesy of GENERAL MOTORS CORP.

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

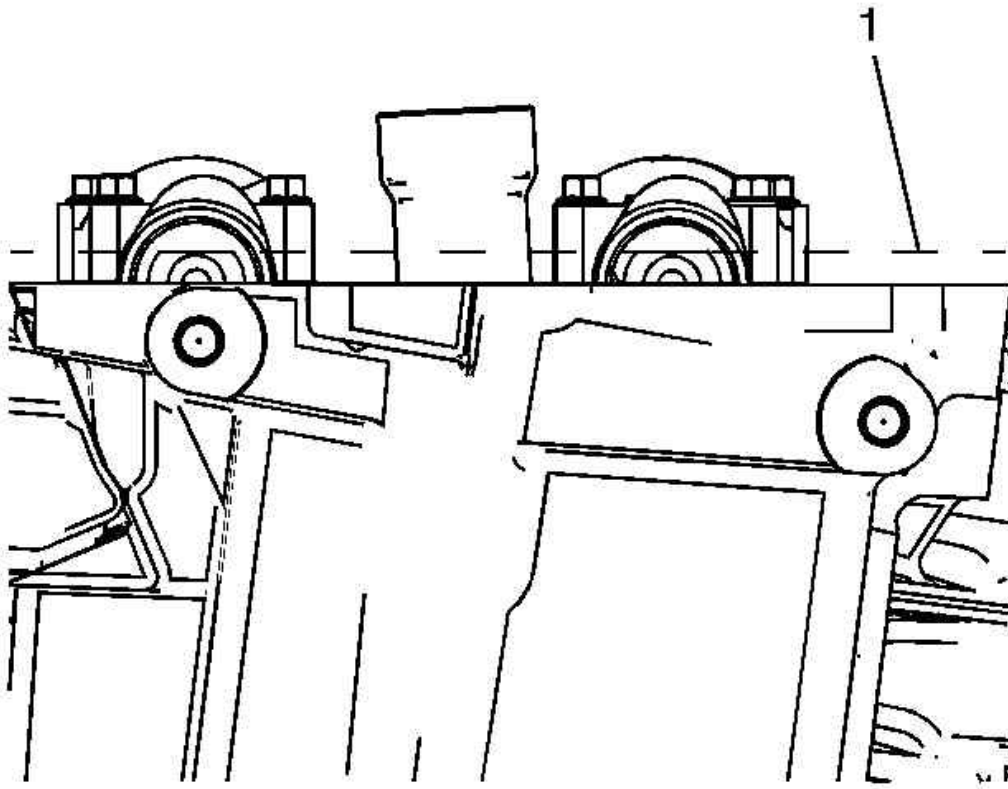


Fig. 60: Identifying Camshaft Neutral (Low Tension) Position
Courtesy of GENERAL MOTORS CORP.

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

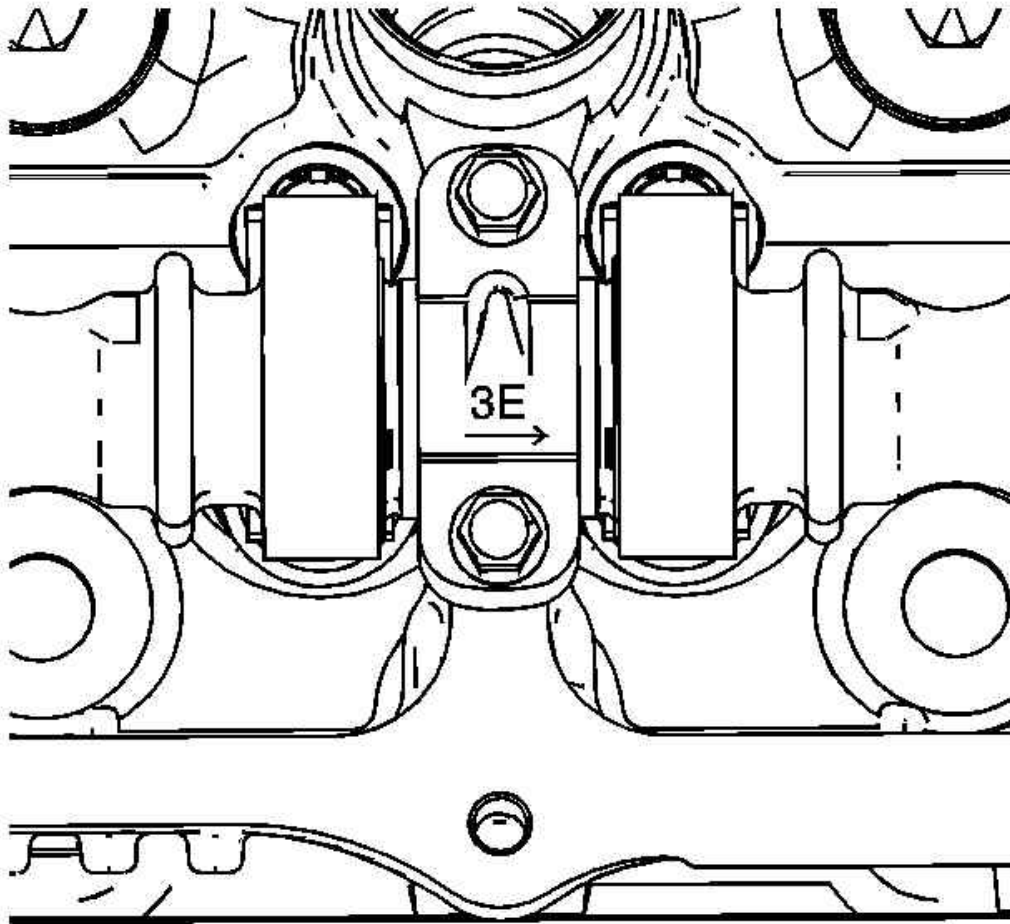


Fig. 61: Identifying Markings On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

6. Observe the markings on the right cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.

- The number 1, 3, 5 indicates the cylinder position from the front of the engine.
7. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

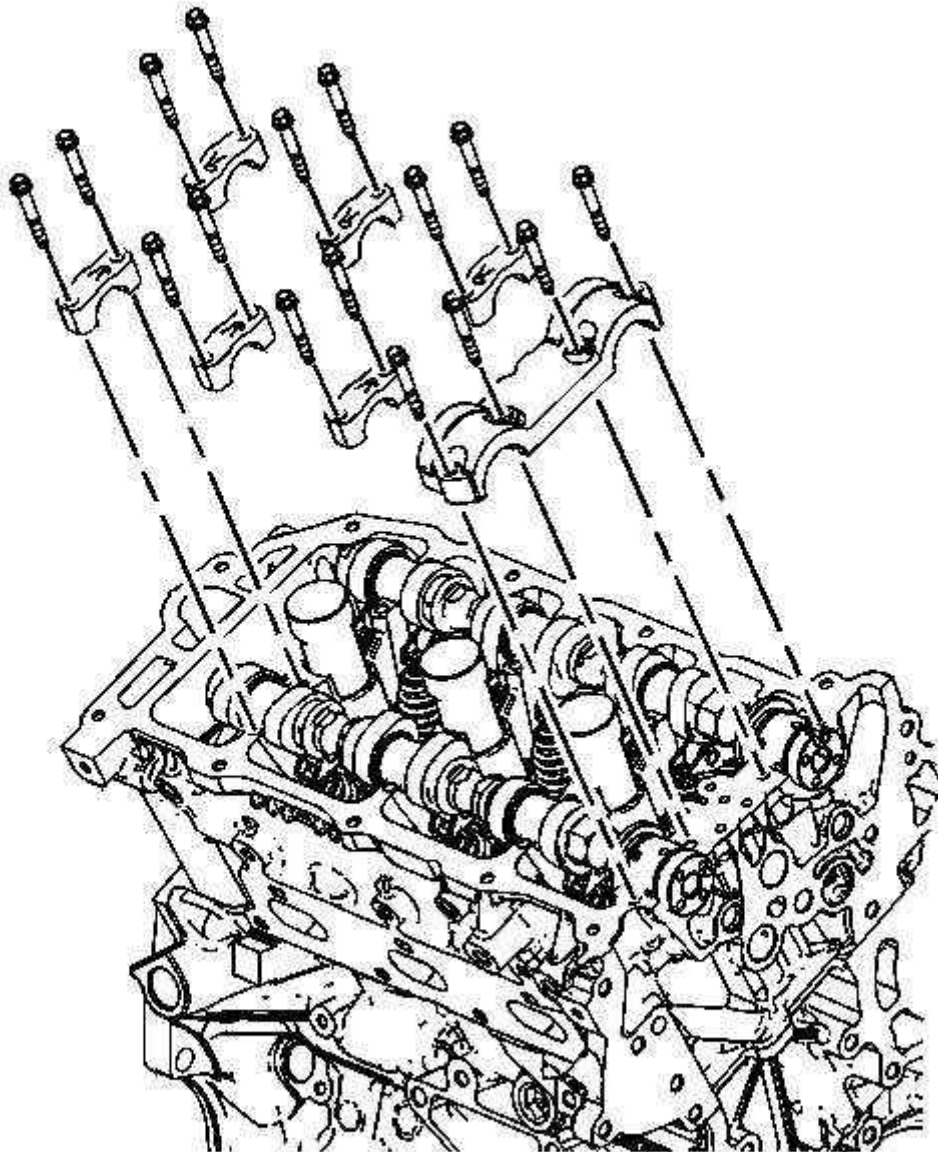


Fig. 62: View Of Camshaft Bearing Caps & Bolts
Courtesy of GENERAL MOTORS CORP.

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

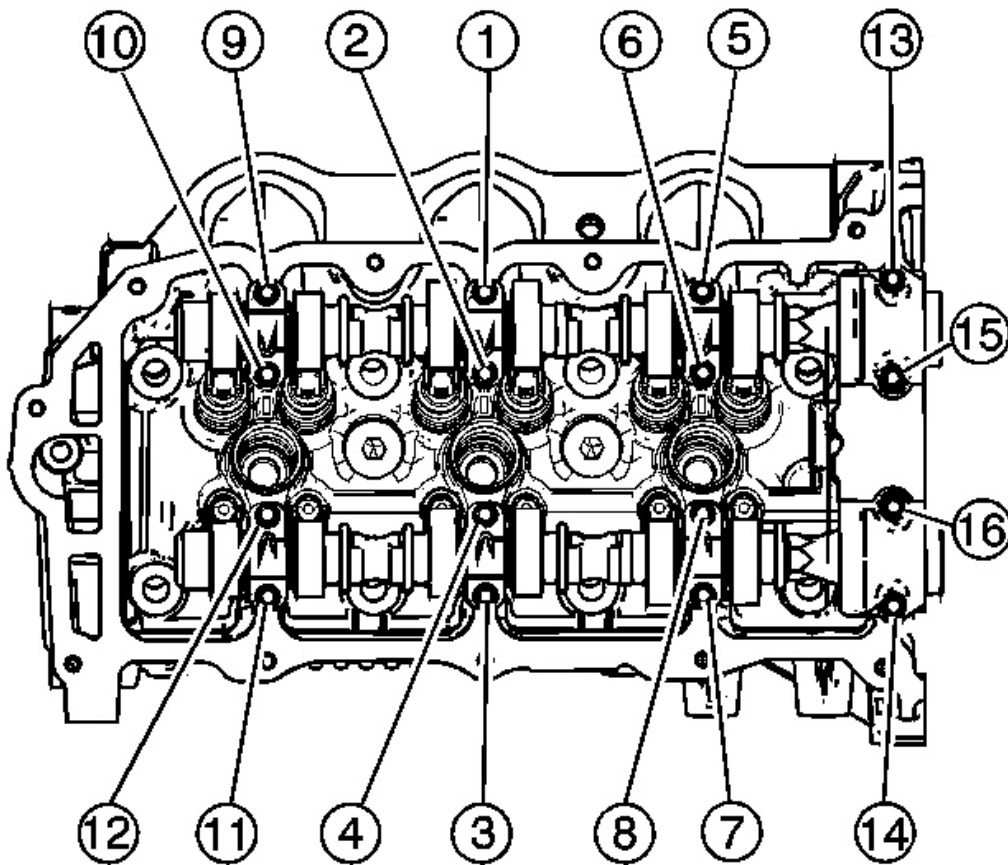


Fig. 63: Identifying Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

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

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

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

CYLINDER HEAD INSTALLATION - LEFT SIDE

Tools Required

J 45059 Angle Meter

Installation Procedure

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

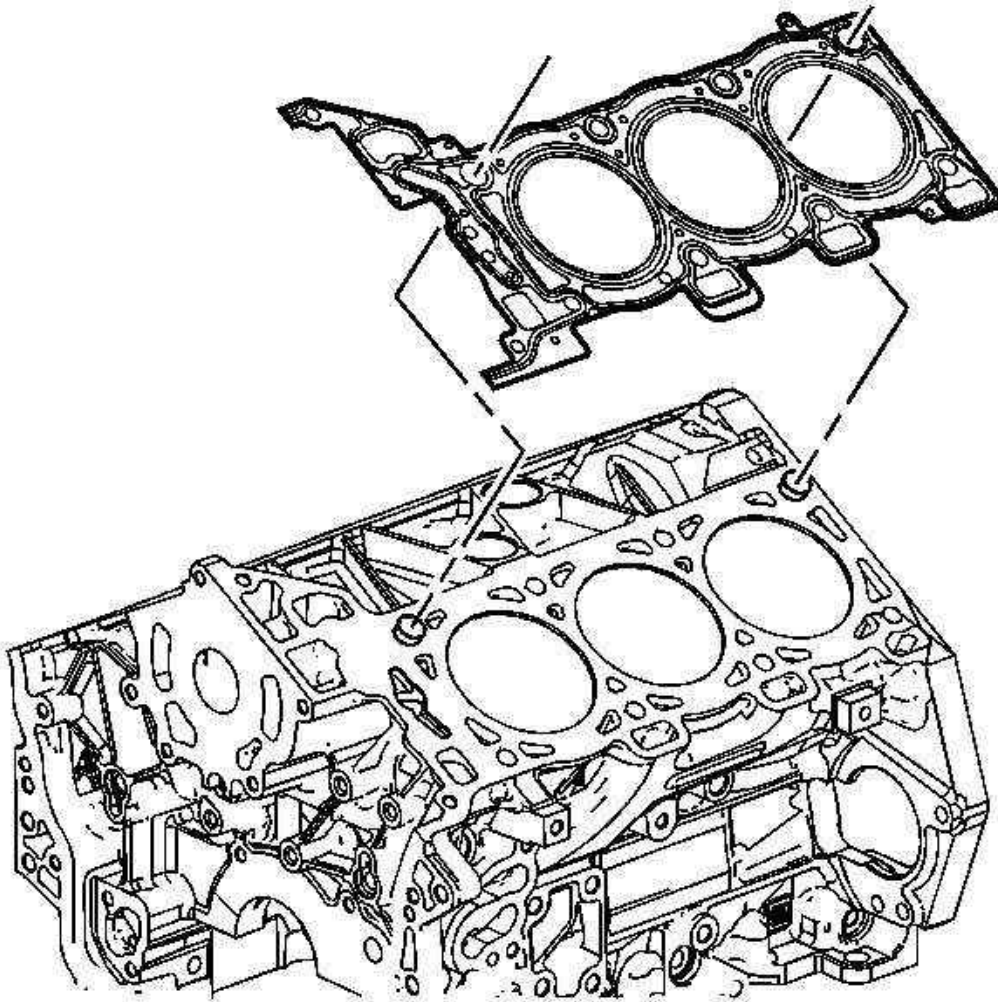


Fig. 64: View Of Left Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

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

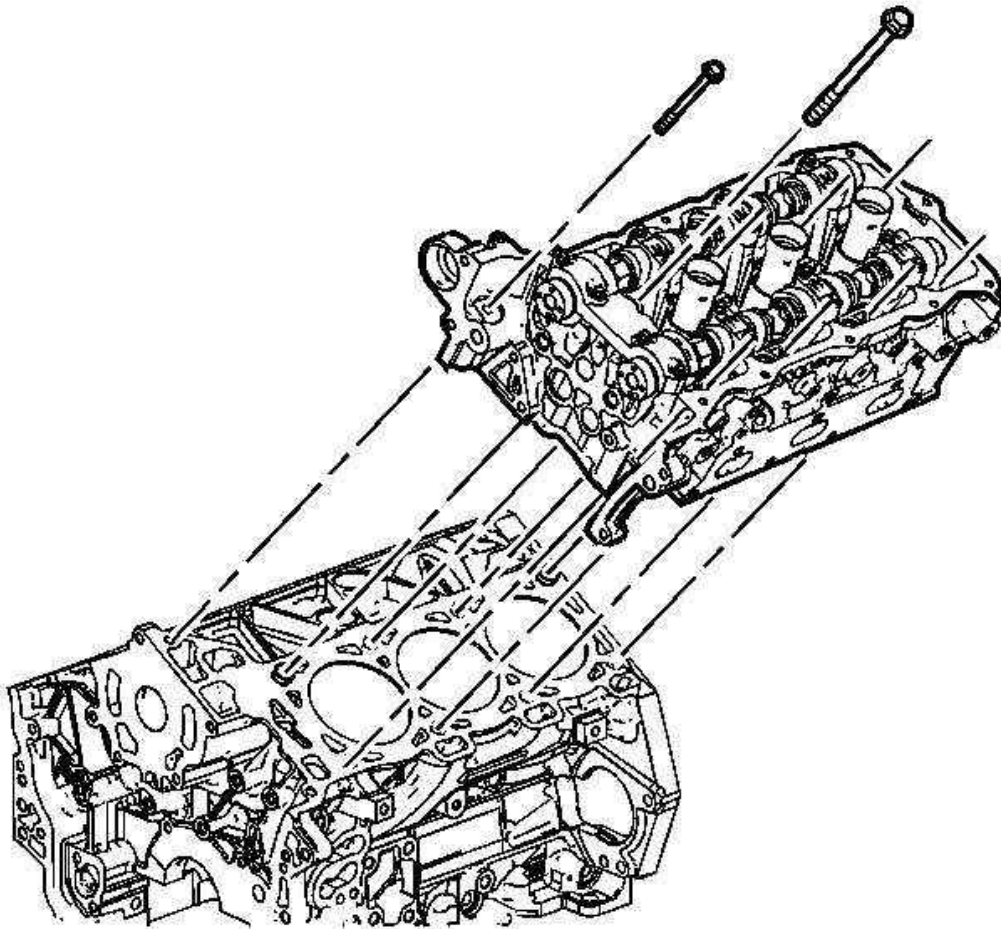


Fig. 65: View Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

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

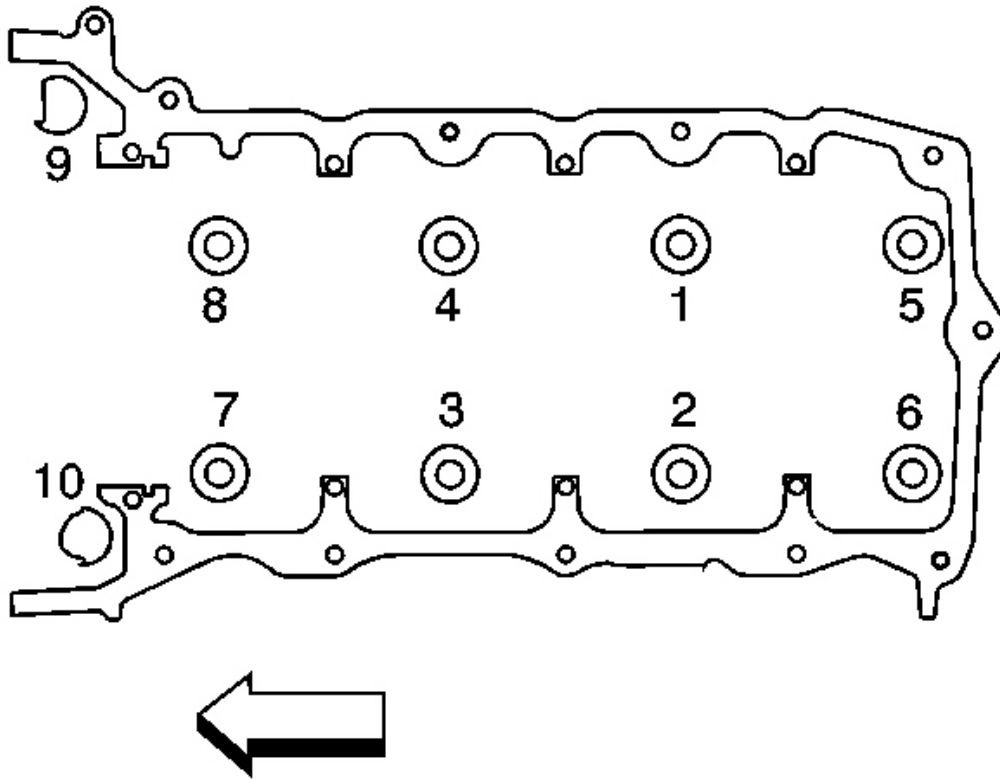


Fig. 66: View Of M11 Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

5. Install new M11 cylinder head bolts.

Tighten:

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

2. Tighten the M11 cylinder head bolts a second pass in sequence an additional 120 degrees using the **J 45059** .
6. Install the 2 front M8 left cylinder head bolts.

Tighten:

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

VALVE LIFTER INSTALLATION - LEFT SIDE

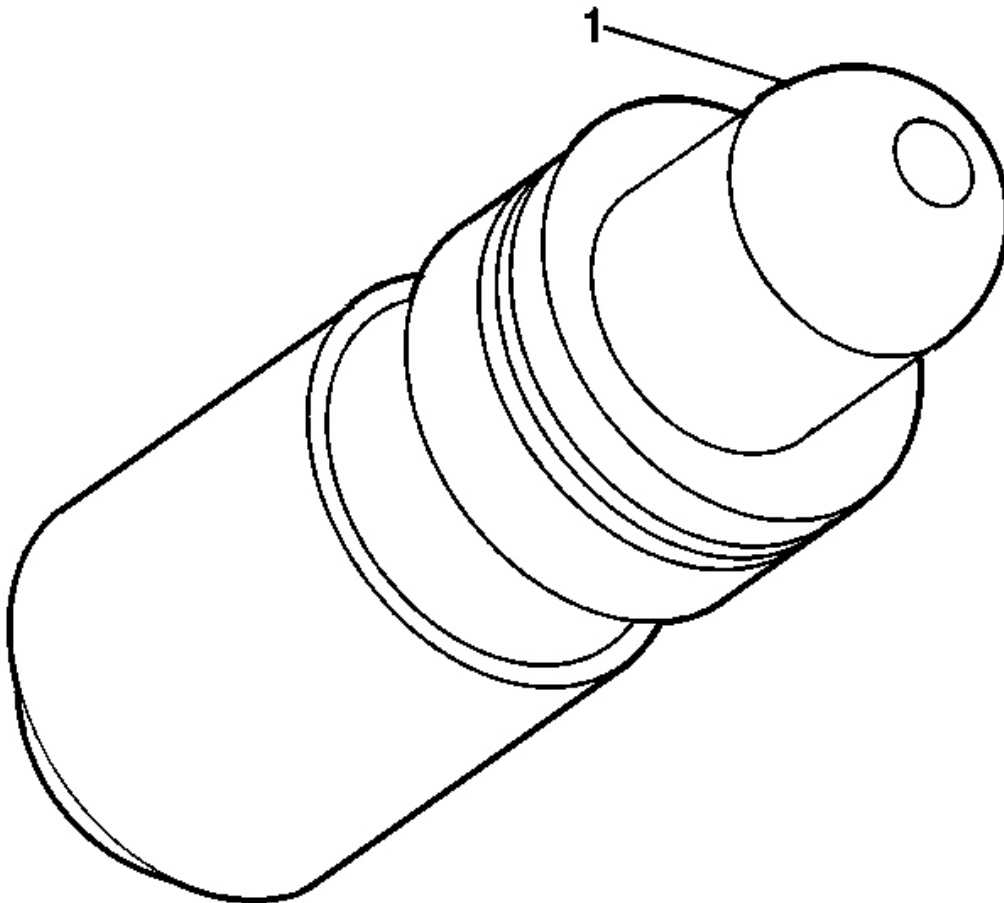


Fig. 67: View Of Valve Lifter

Courtesy of GENERAL MOTORS CORP.

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

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

1. Fill the stationary hydraulic lash adjuster (SHLA) with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent. Take precautions to prevent scratching the pivot sphere area (1) of the SHLA.
2. Lubricate the SHLA bores in the cylinder head with clean engine oil GM P/N 12345610 (Canadian P/N 993193) or equivalent.

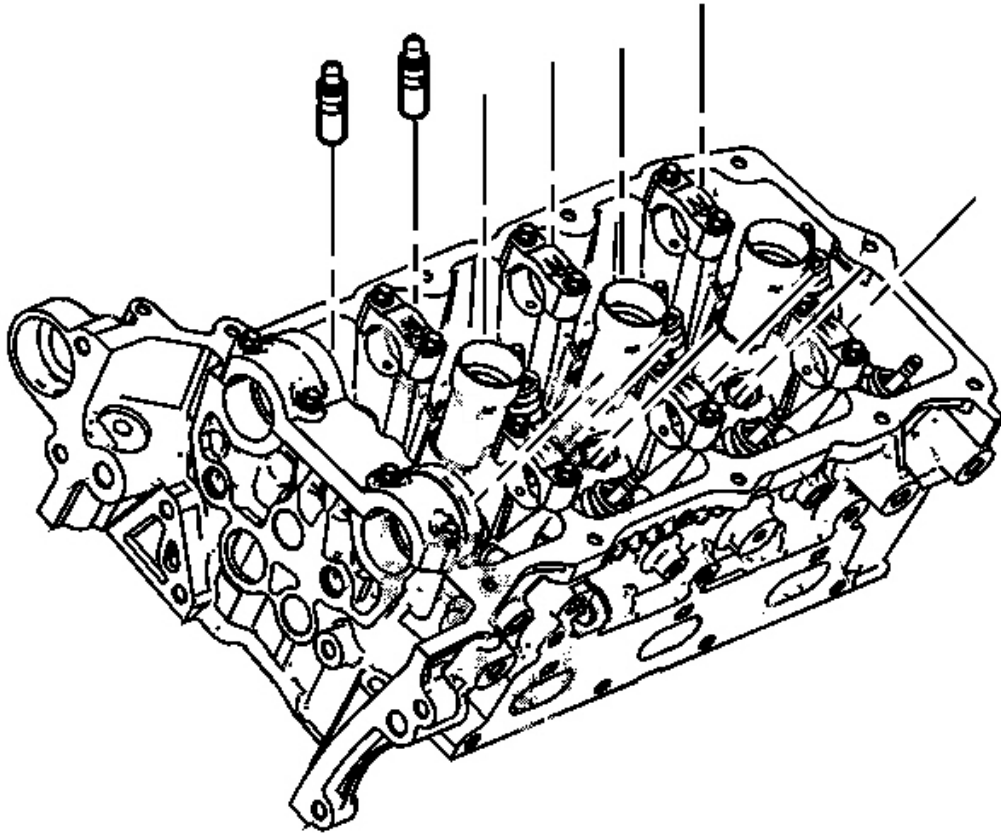


Fig. 68: View Of Stationary Hydraulic Lash Adjuster (SHLAs)
Courtesy of GENERAL MOTORS CORP.

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

VALVE ROCKER ARM INSTALLATION - LEFT SIDE

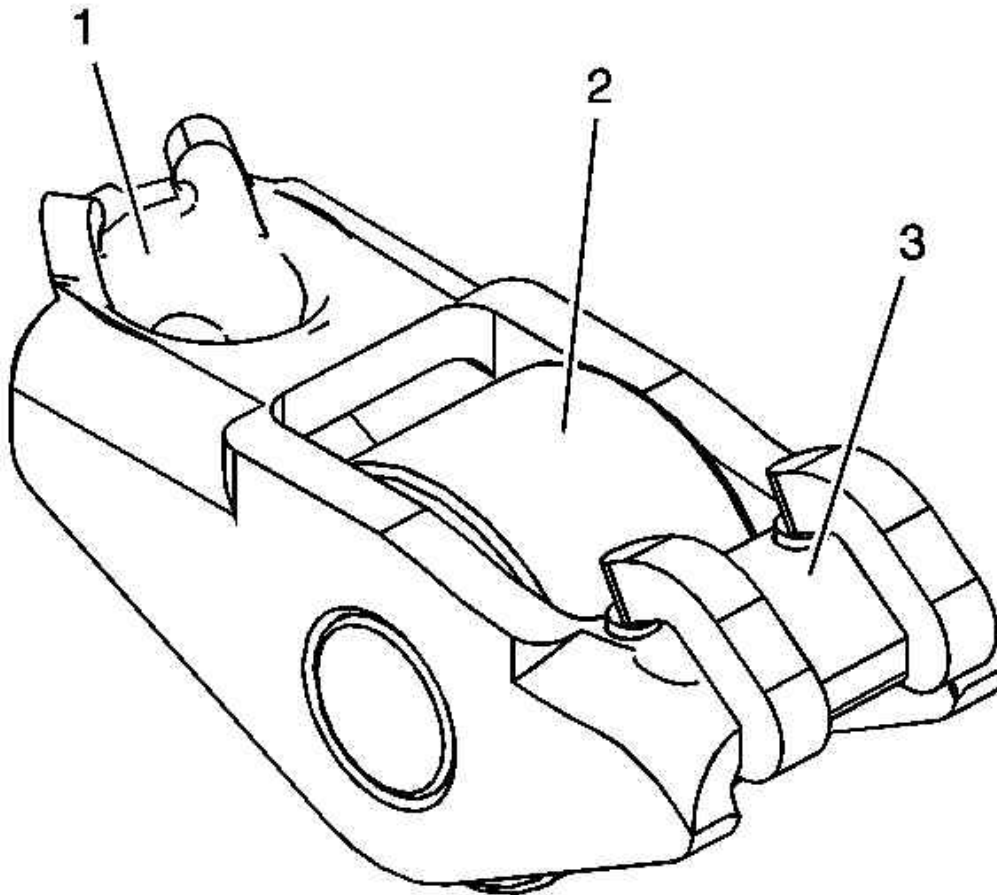


Fig. 69: Identifying Valve Rocker Arm Lubrication Areas
Courtesy of GENERAL MOTORS CORP.

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

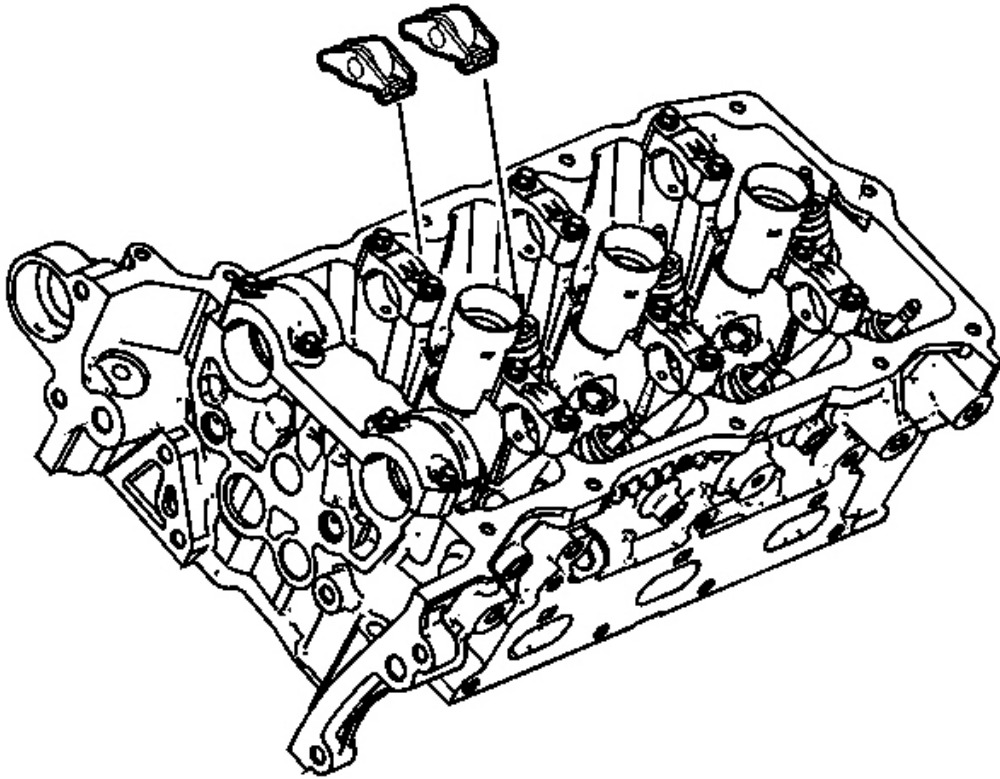


Fig. 70: View Of Valve Rocker Arm
Courtesy of GENERAL MOTORS CORP.

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

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

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

CAMSHAFT INSTALLATION - LEFT SIDE

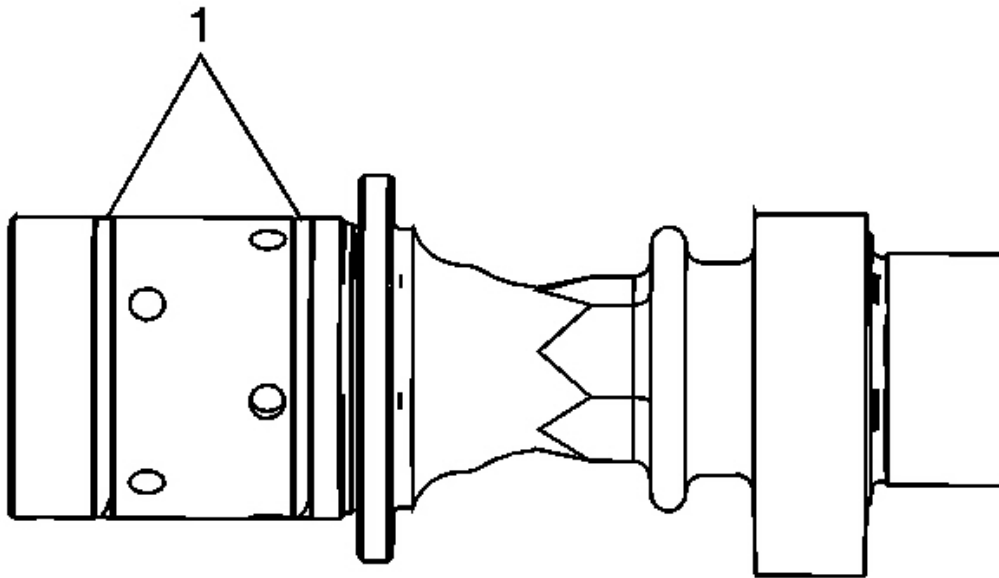


Fig. 71: Locating Camshaft Sealing Rings In Camshaft Grooves
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the camshaft sealing rings (1) are in place in the camshaft grooves. Camshaft sealing rings must be in place below the surface of the camshaft journal in order to avoid being pinched between the cylinder head and the camshaft caps.

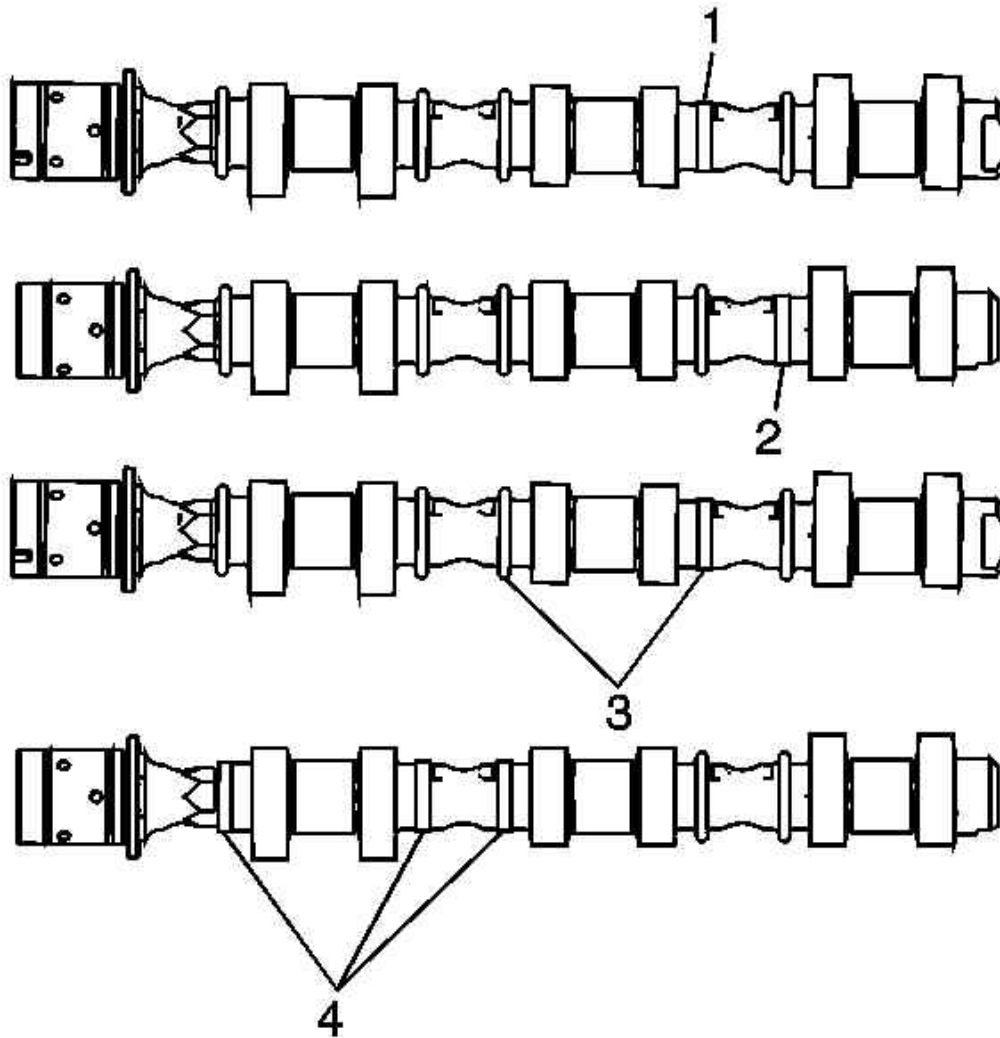


Fig. 72: Identifying Camshaft Ring Placement
Courtesy of GENERAL MOTORS CORP.

2. Select the proper camshaft for the particular installation location. The ring placement is defined as follows:
 1. The number 4 identification ring for the left intake camshaft is machined off (1) - Third Design, Camshaft Timing Drive System.
 2. The number 5 identification ring for the left exhaust camshaft is machined

off (2) - Third Design and Fourth, except High Output, Camshaft Timing Drive System.

3. The number 3 and 4 identification rings for the left intake camshaft is machined off (3) - Fourth Design, Camshaft Timing Drive System.
4. The number 1, 2 and 3 identification rings for the left exhaust camshaft is machined off (4) - Fourth Design High Output, Camshaft Timing Drive System.

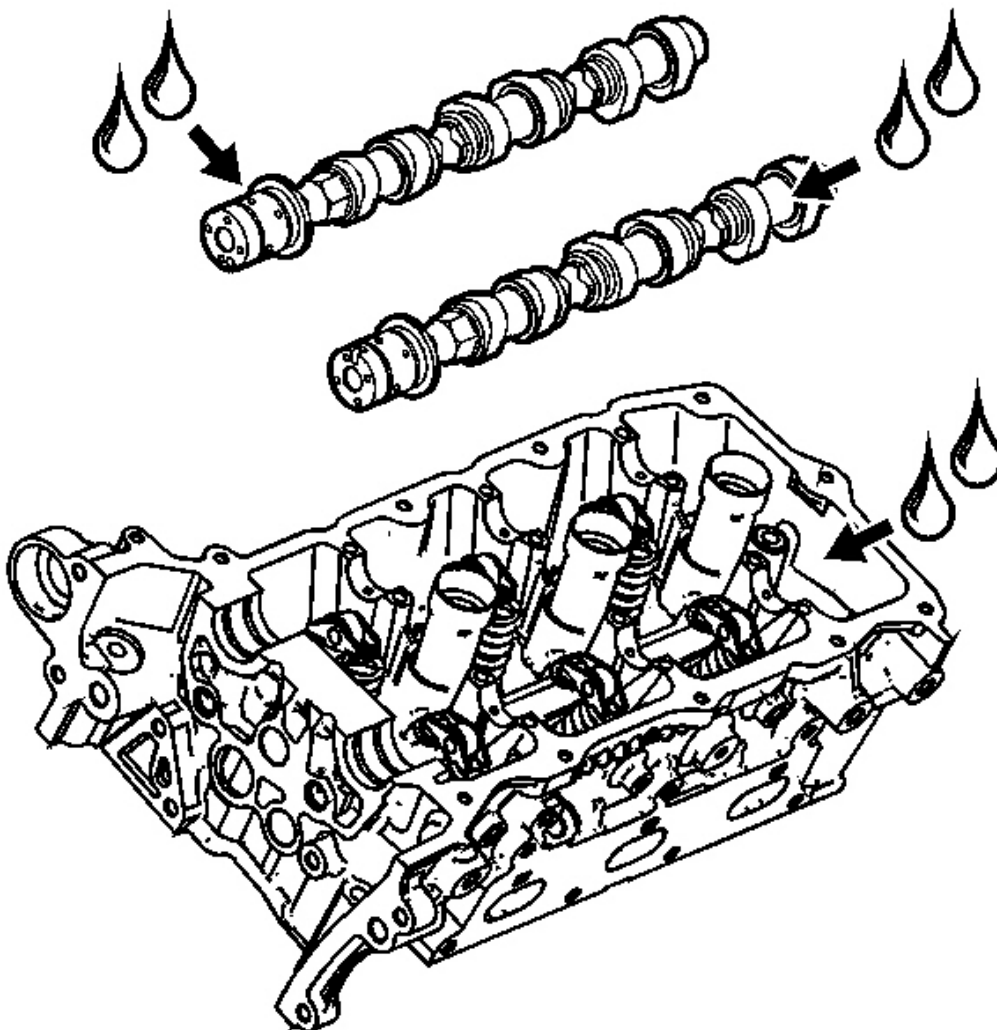


Fig. 73: Lubricating Camshaft Journals & Left Cylinder Head Camshaft Carriers

Courtesy of GENERAL MOTORS CORP.

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

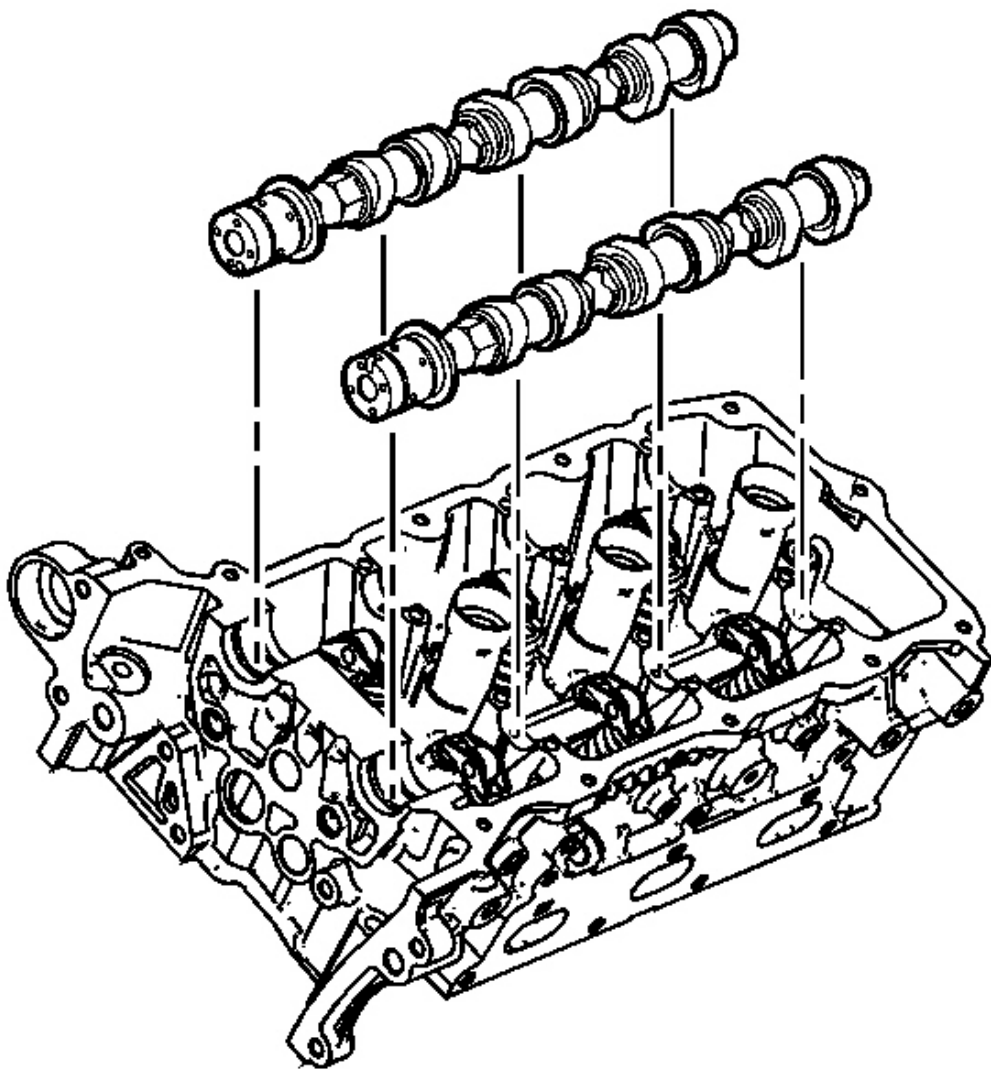


Fig. 74: View Of Left Camshafts
Courtesy of GENERAL MOTORS CORP.

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

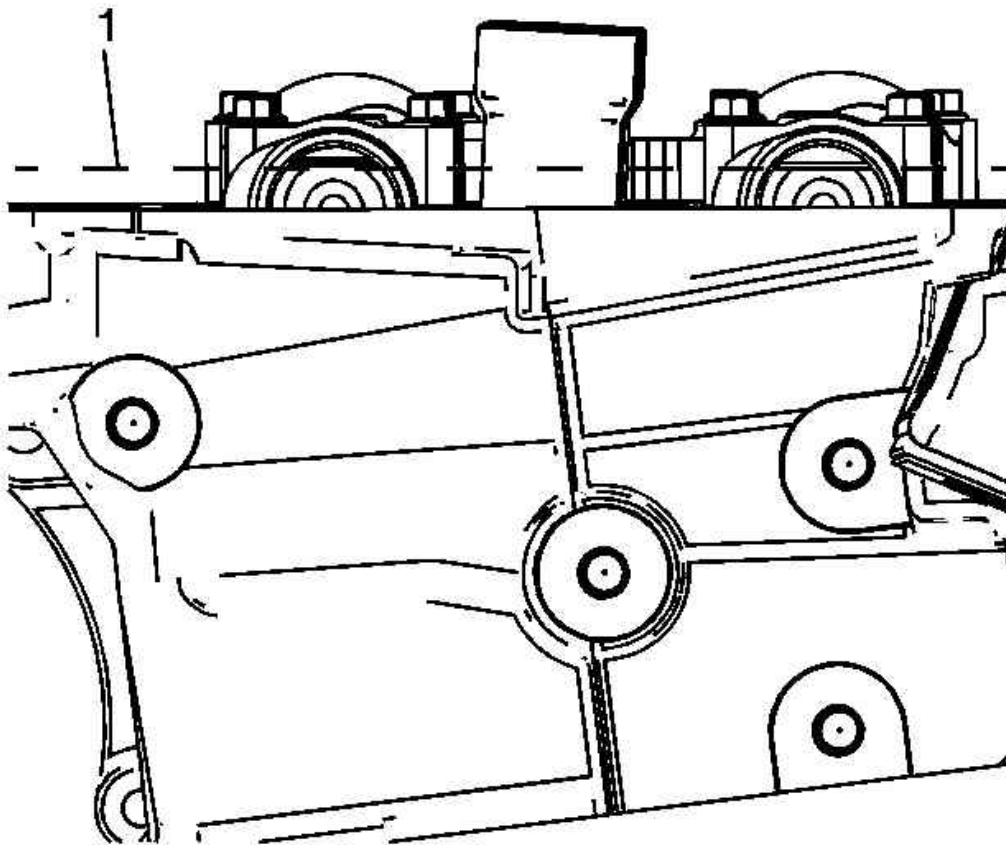


Fig. 75: View Of Camshaft Flats Parallel With Camshaft Cover Rail
Courtesy of GENERAL MOTORS CORP.

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

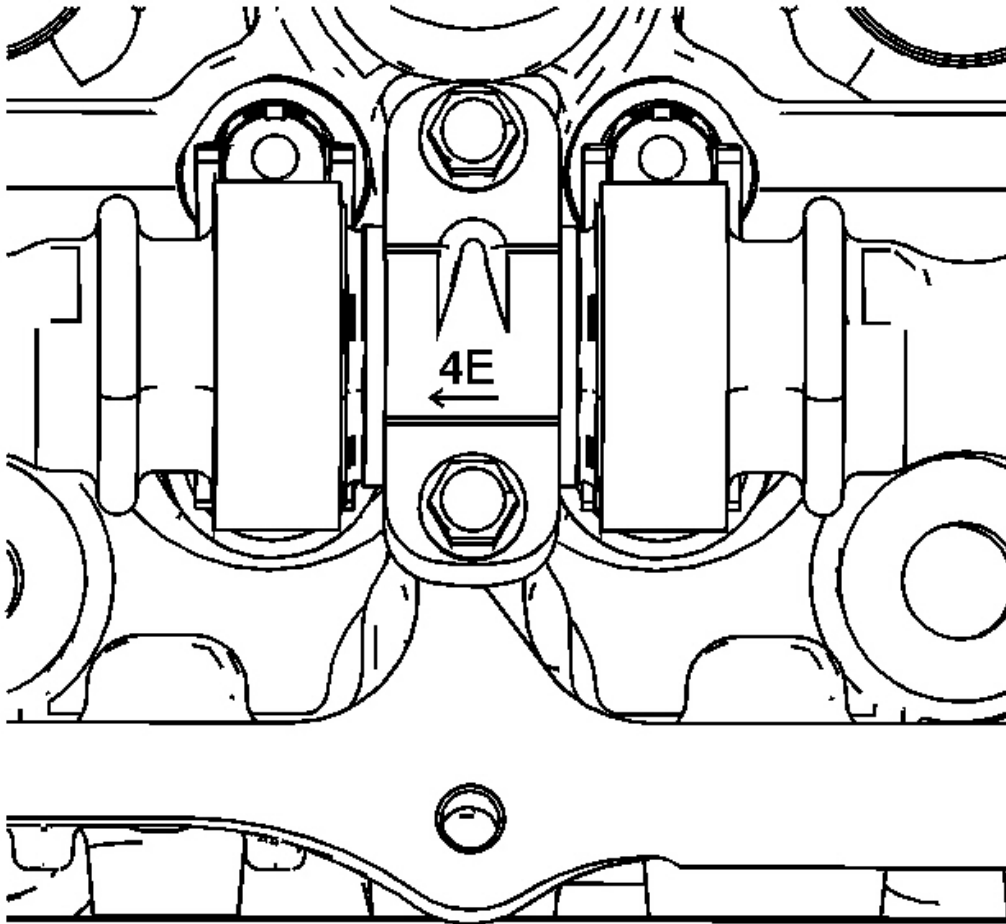


Fig. 76: Identifying Markings On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

6. Observe the markings on the left cylinder head camshaft bearing caps. Each bearing cap is marked in order to identify its location. The markings have the following meanings:
 - The raised feature must always be oriented toward the center of the cylinder head.
 - The I indicates the intake camshaft.
 - The E indicates the exhaust camshaft.

- The number 2, 4, 6 indicates the cylinder position from the front of the engine.
7. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

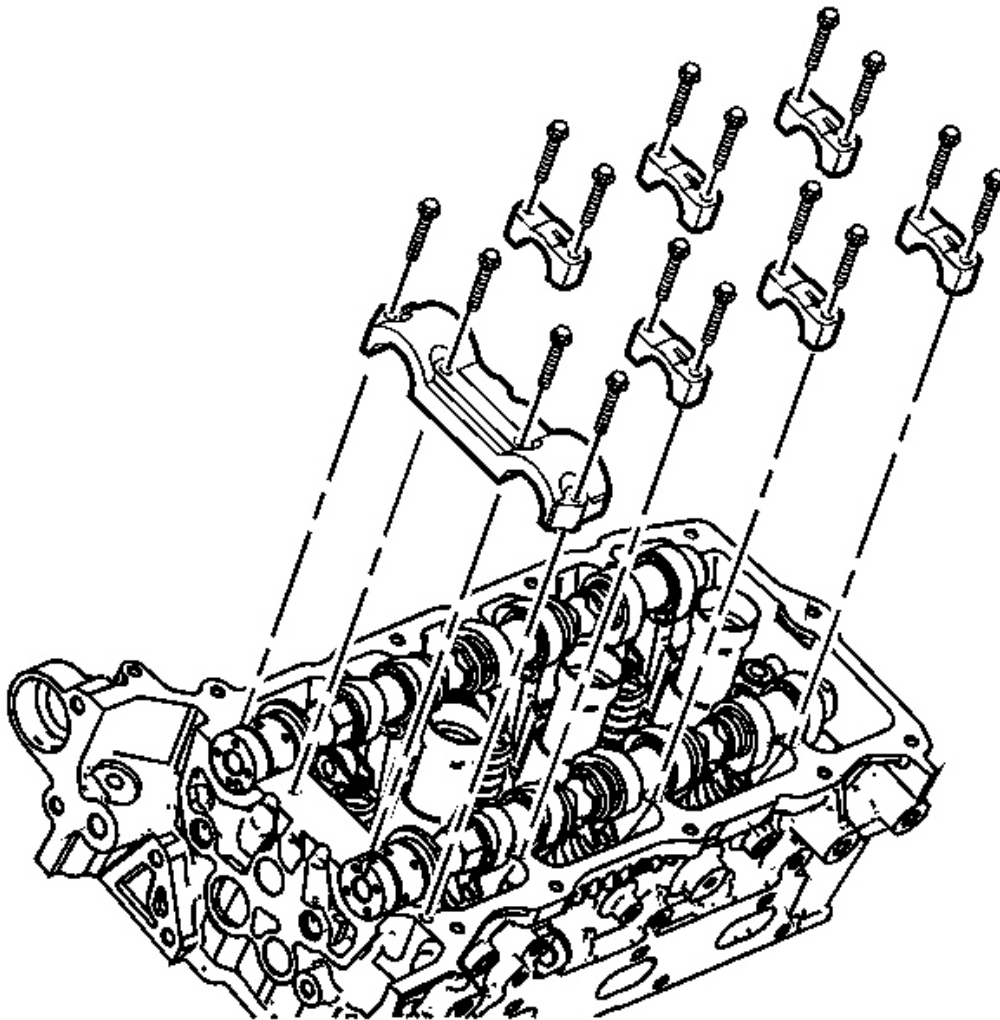


Fig. 77: Locating Camshaft Bearing Cap & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the camshaft bearing thrust cap in the first journal of the left cylinder

head.

9. Install the remaining bearing caps with their orientation mark toward the center of the cylinder head.
10. Hand start all the camshaft bearing cap bolts.

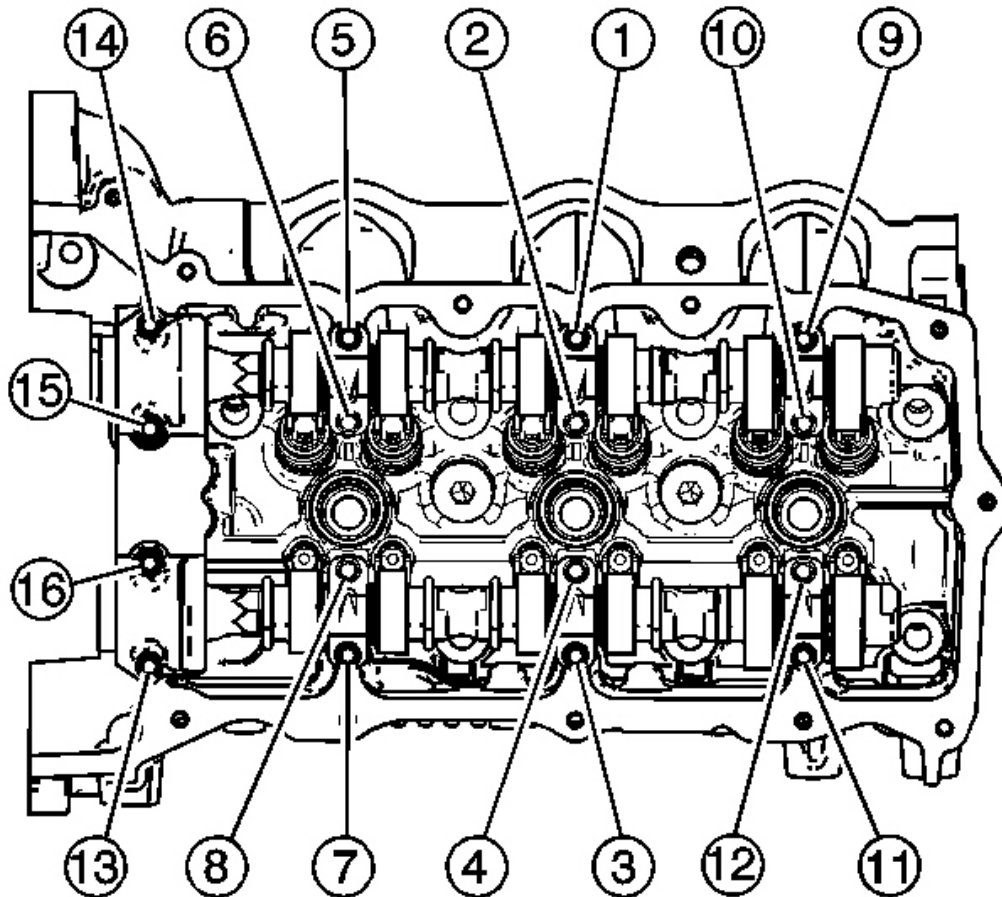


Fig. 78: Identifying Camshaft Bearing Cap Bolts Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

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

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

CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE (FOURTH DESIGN)

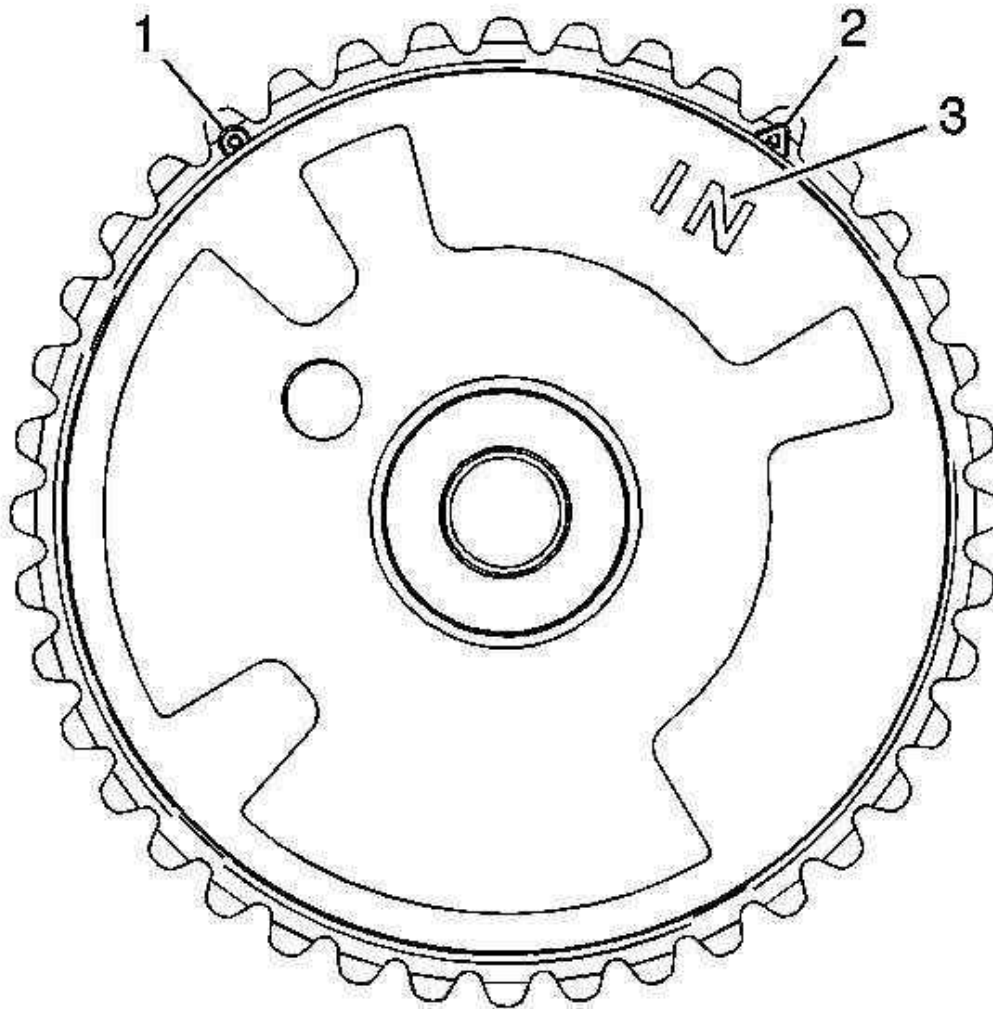


Fig. 79: View Of Camshaft Position Actuator Markings
Courtesy of GENERAL MOTORS CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "IN" marking (3). The marking is for an intake camshaft position actuator.

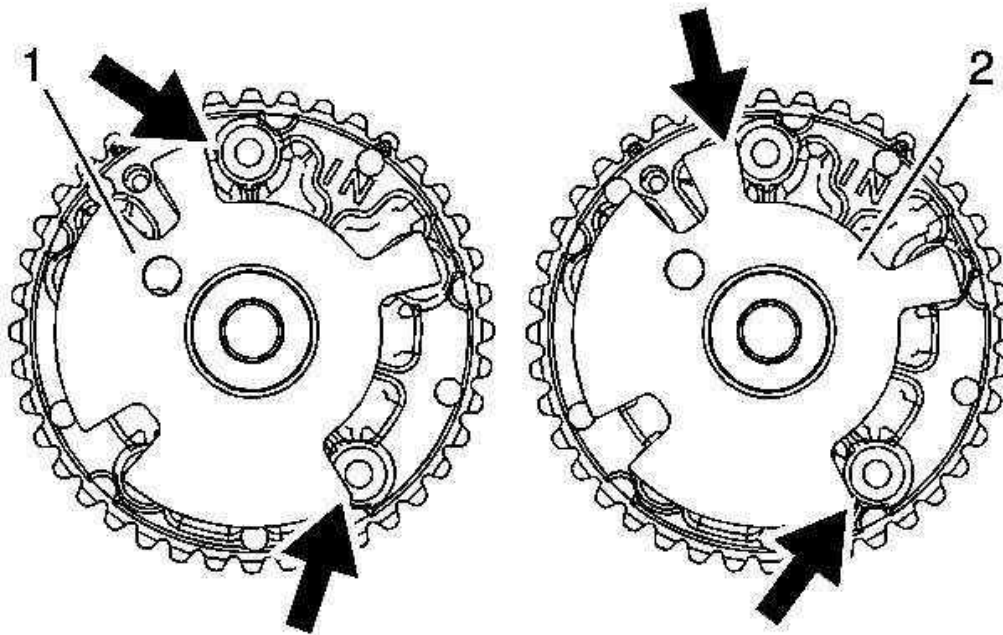


Fig. 80: View Of Right Intake Camshaft Position Actuator & Left Intake Camshaft Position Actuator

Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the 4th design right intake camshaft position actuator (1) is indexed in a different position compared to the 4th design left intake camshaft position actuator (2).

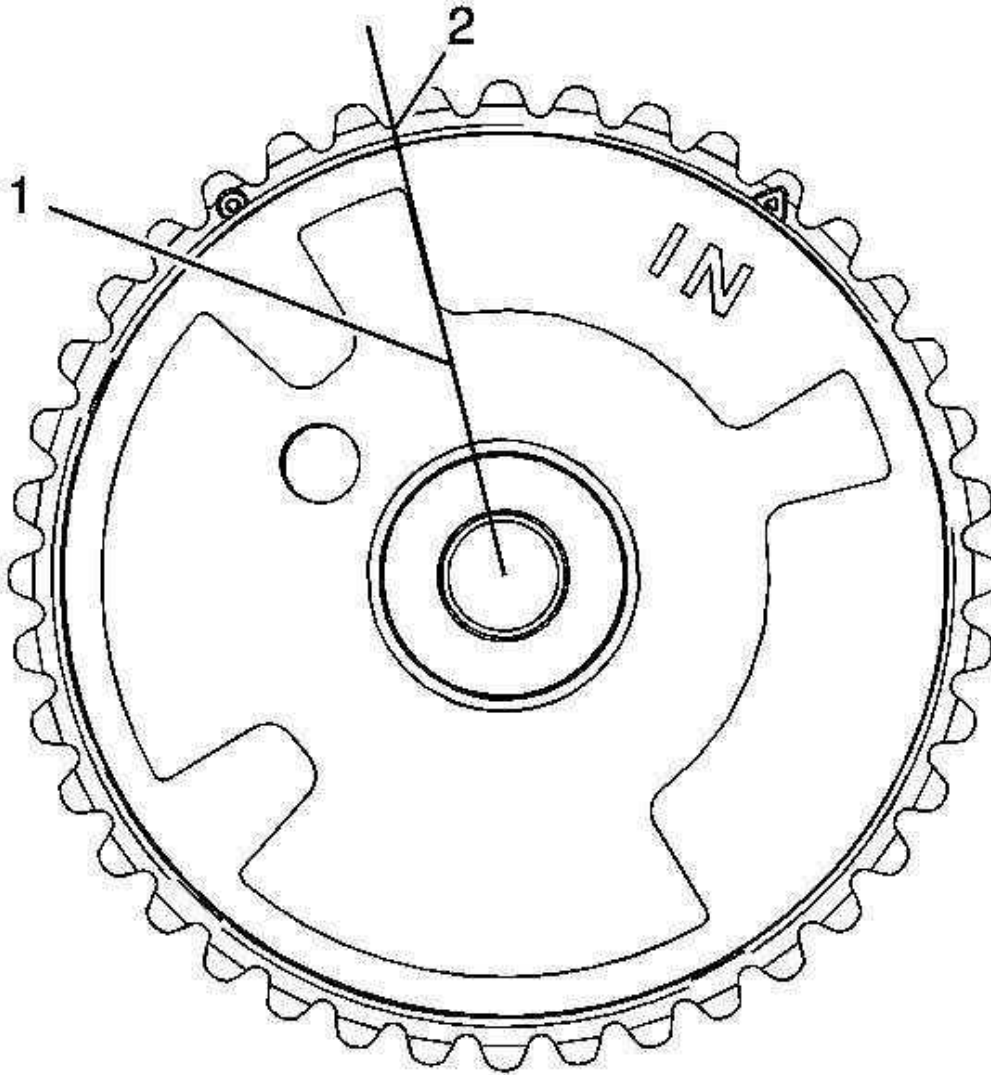


Fig. 81: View Of Reluctor Wheel & Valley
Courtesy of GENERAL MOTORS CORP.

3. On the right intake camshaft actuator the edge of the reluctor wheel (1) lines up with the valley (2) of the sprocket tooth.

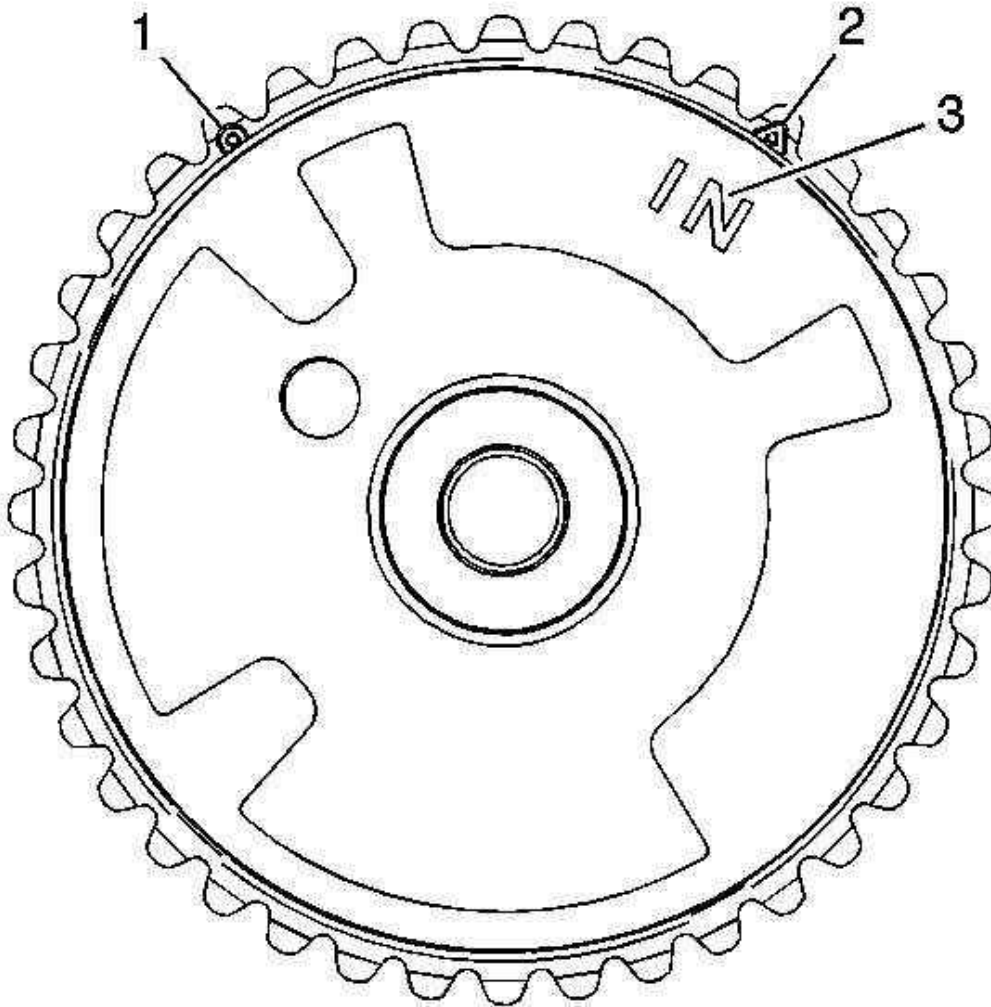


Fig. 82: View Of Camshaft Position Actuator Markings
Courtesy of GENERAL MOTORS CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2). The triangle marking is for alignment to the highlighted timing chain link on the right side of the engine.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice .

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

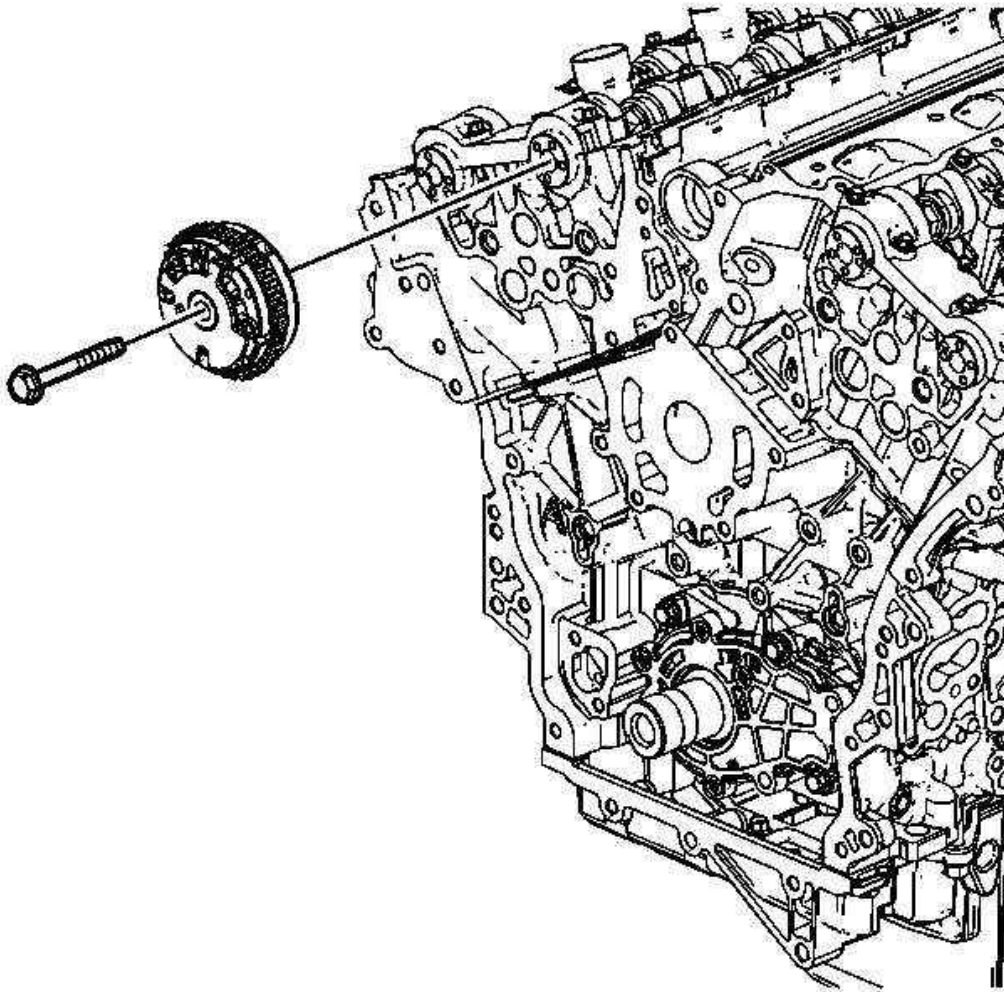


Fig. 83: Identifying Intake Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install the right intake camshaft position actuator.

NOTE: Refer to Fastener Notice .

7. Install the camshaft position actuator bolt.

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

CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE EXHAUST (FOURTH DESIGN)

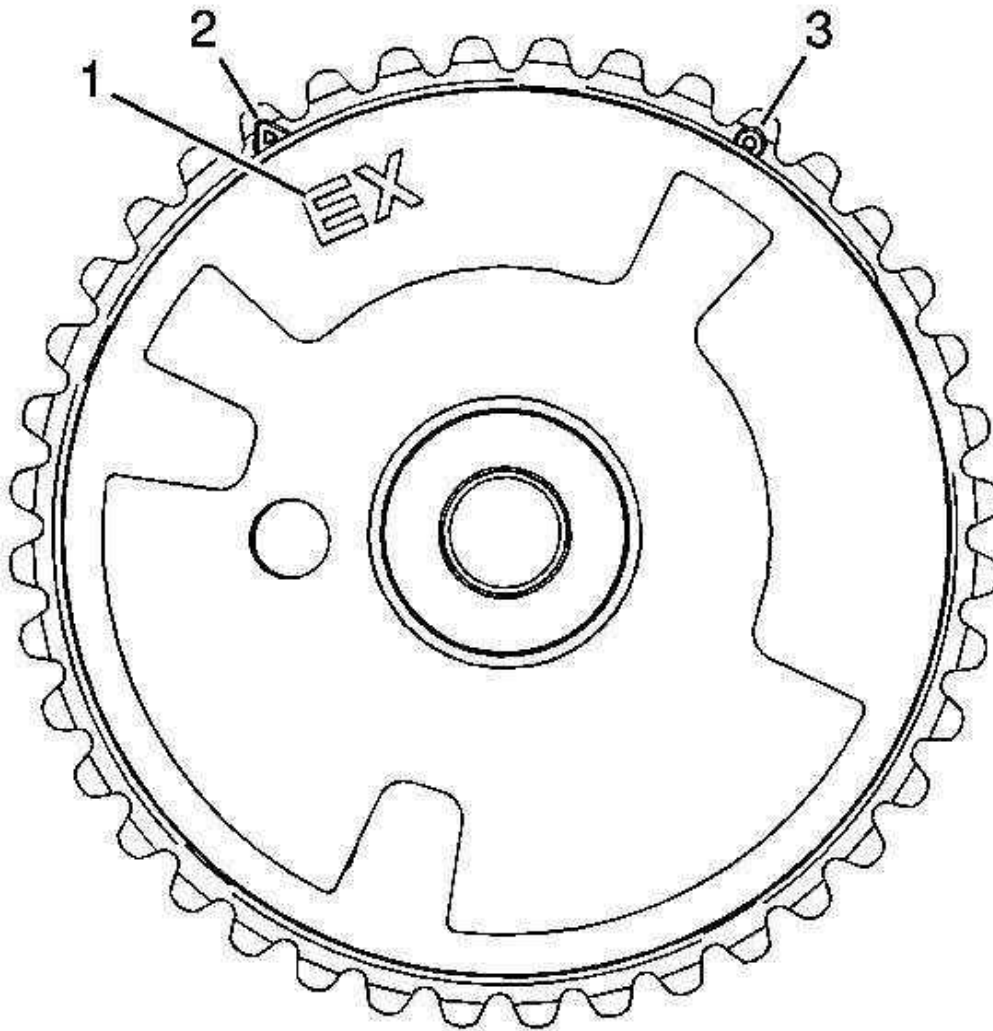


Fig. 84: View Of EX Marking, Triangle & Circle Marking
Courtesy of GENERAL MOTORS CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "EX" marking (1). The marking is for an exhaust camshaft position actuator.
2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the triangle marking (2). The marking is for alignment to the highlighted timing chain link on the right side of the engine.

NOTE: **Refer to Torque Reaction Against Timing Drive Chain Notice .**

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

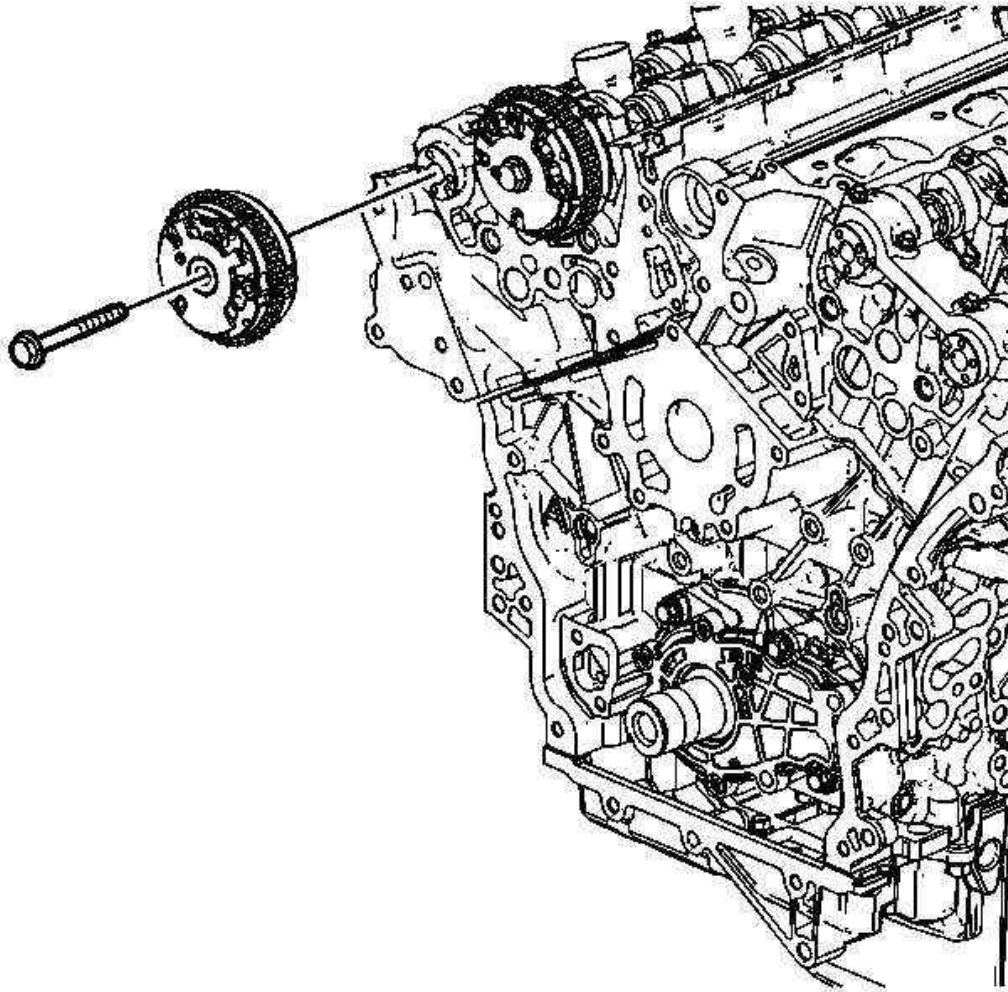


Fig. 85: Identifying Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Install the right exhaust camshaft position actuator.

NOTE: Refer to Fastener Notice .

5. Install the camshaft position actuator bolt.

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

CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE INTAKE (FOURTH DESIGN)

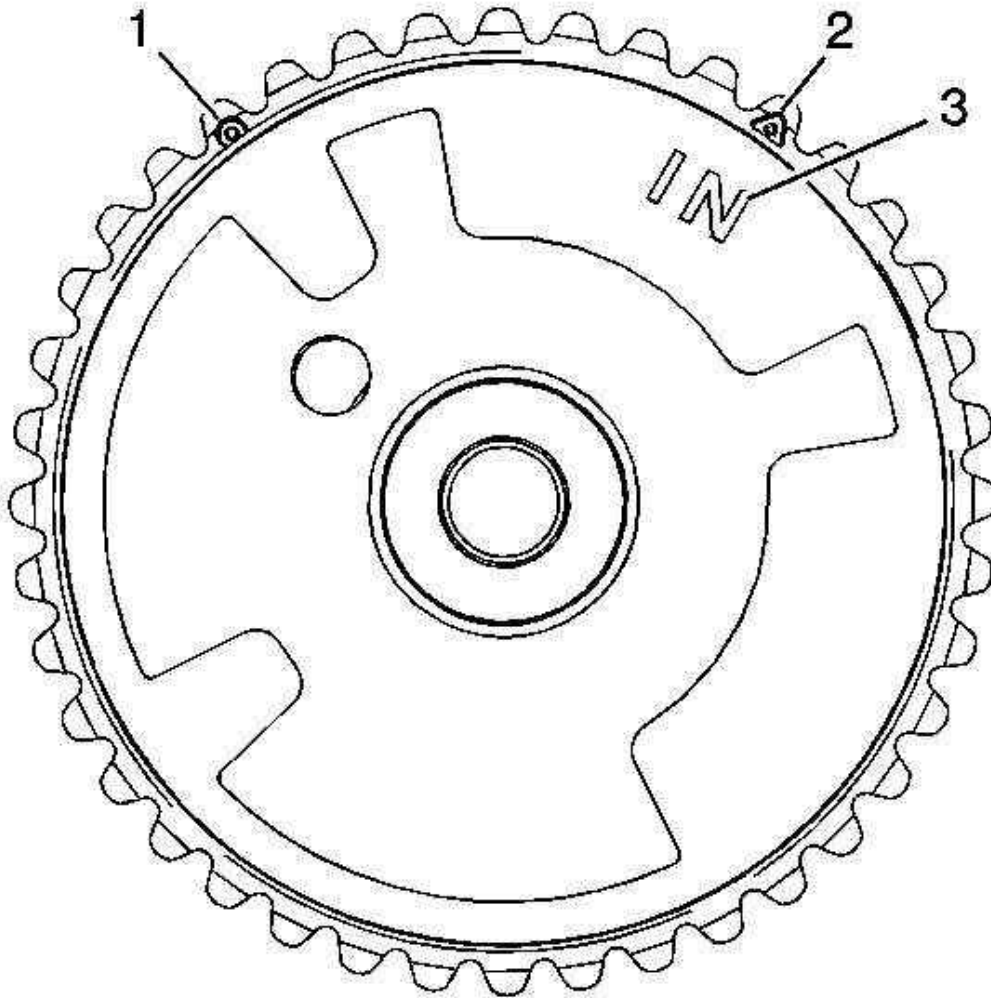


Fig. 86: Identifying Camshaft Position Actuator Marks
Courtesy of GENERAL MOTORS CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "IN" marking (3). The marking is for an intake camshaft position actuator.

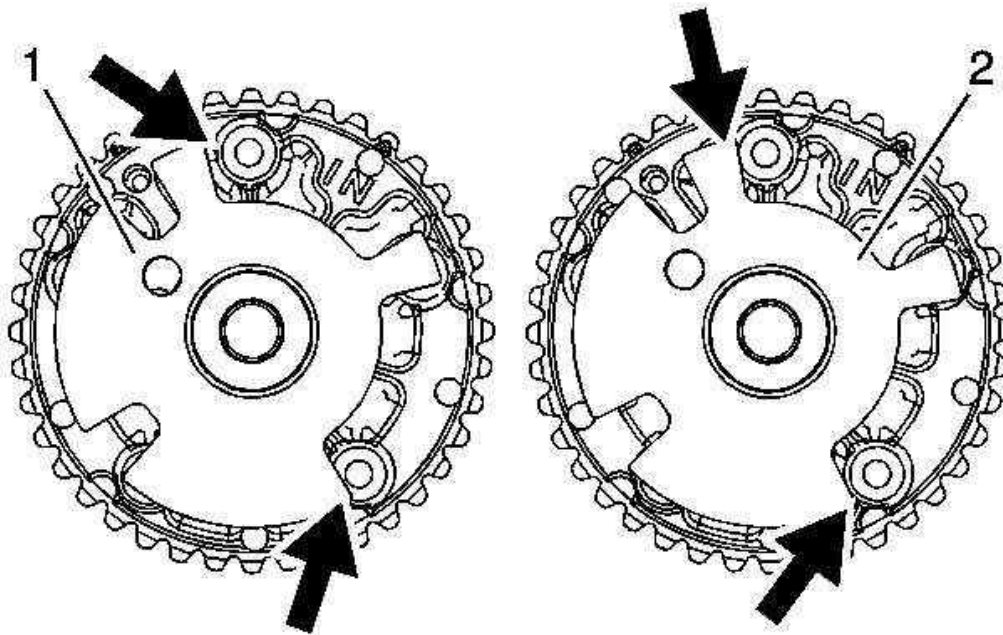


Fig. 87: View Of Left Intake Camshaft Position Actuator & Left Intake Camshaft Position Actuator

Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure the proper camshaft position actuator is installed in the correct position. Failure to install the proper camshaft position actuator can effect engine performance and set an engine code.

2. Ensure the proper camshaft position actuator is being installed. The reluctor wheel on the 4th design right intake camshaft position actuator (1) is indexed in a different position compared to the 4th design left intake camshaft position actuator (2).

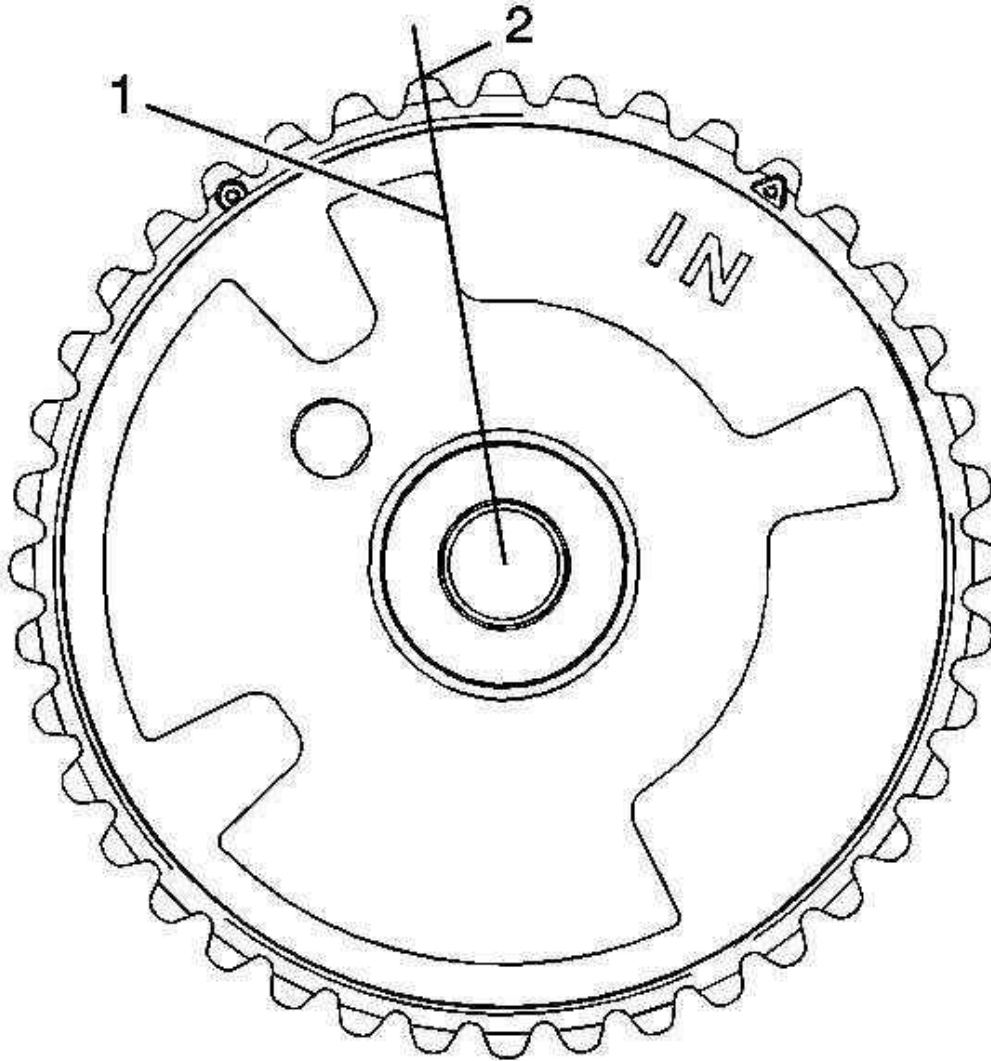


Fig. 88: View Of Reluctor Wheel Lines Up With Peak
Courtesy of GENERAL MOTORS CORP.

3. On the left intake camshaft actuator the edge of the reluctor wheel (1) lines up with the peak (2) of the sprocket tooth.

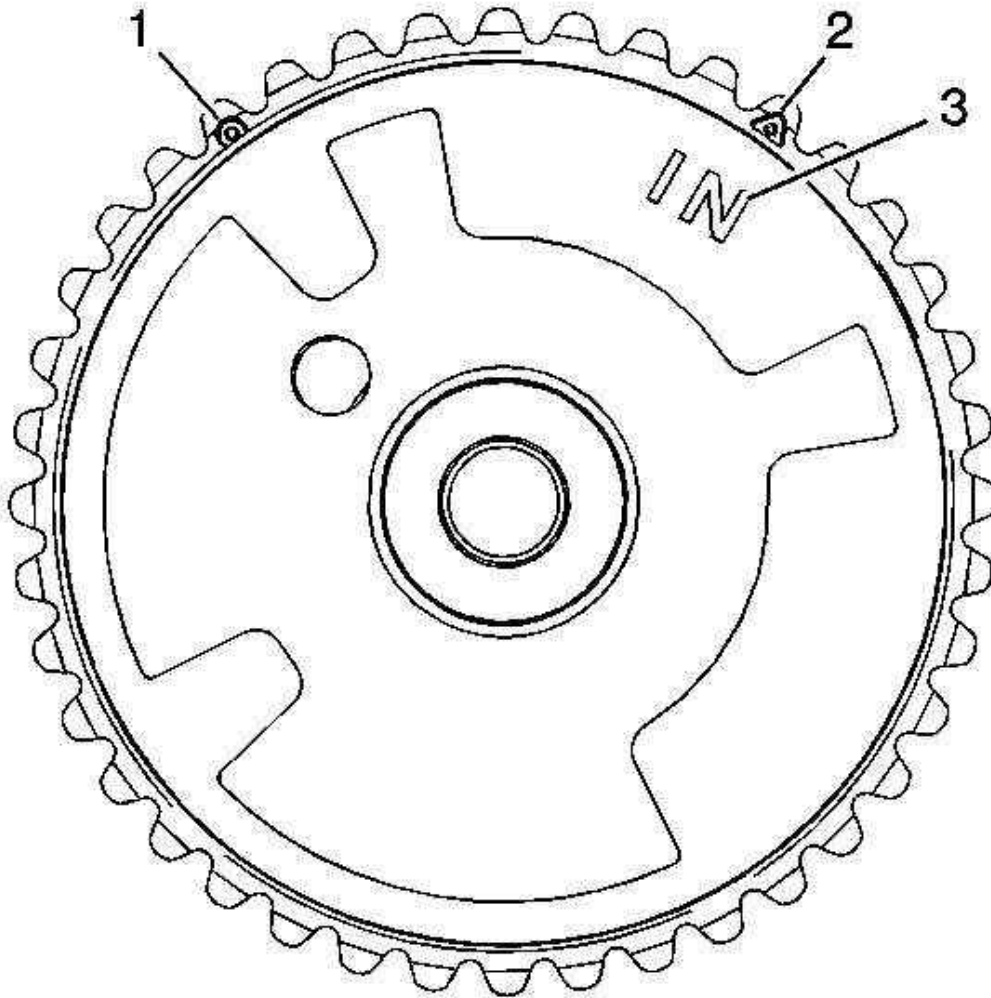


Fig. 89: Identifying Camshaft Position Actuator Marks
Courtesy of GENERAL MOTORS CORP.

4. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (1). The circle marking is for alignment to the highlighted timing chain link on the left side of the engine.

NOTE: Refer to Torque Reaction Against Timing Drive Chain Notice .

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

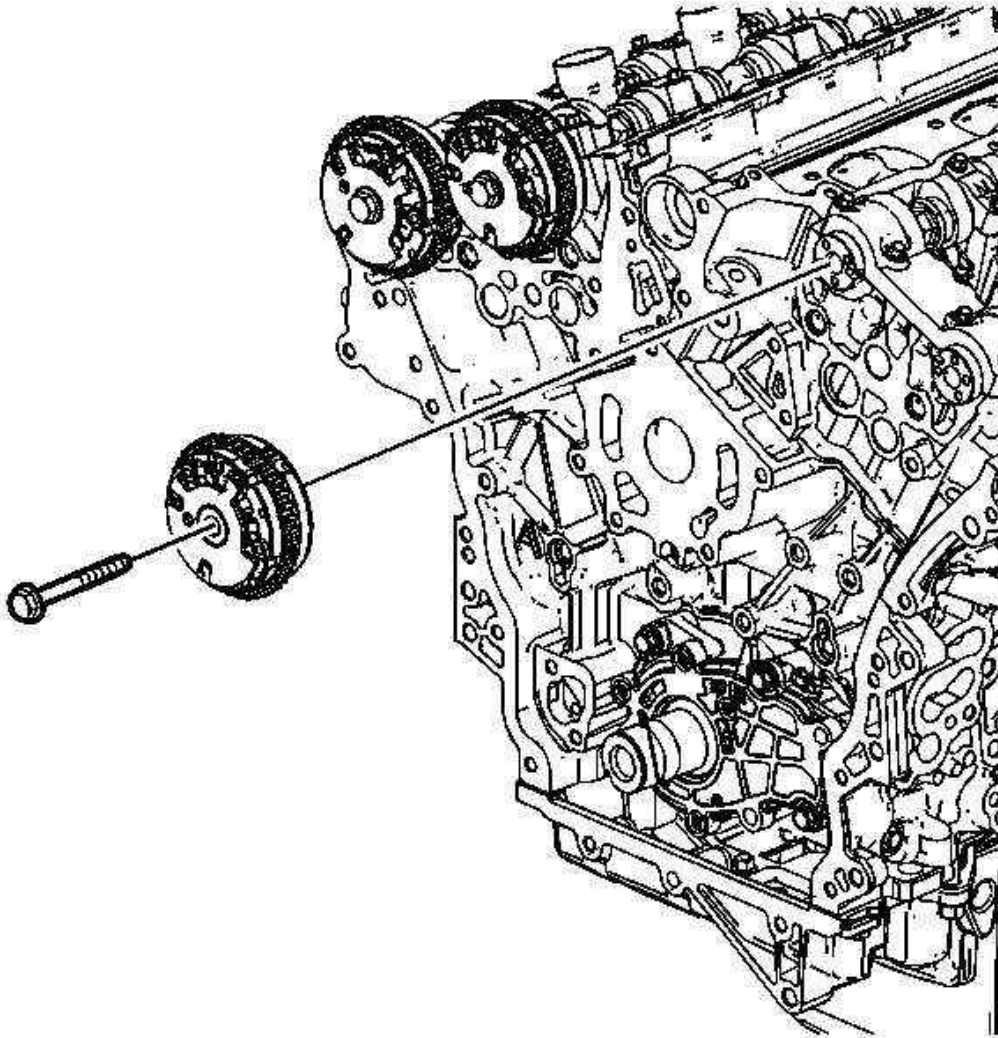


Fig. 90: View Of Camshaft Position Actuator Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install the left intake camshaft position actuator.

NOTE: Refer to Fastener Notice .

7. Install the camshaft position actuator bolt.

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

CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE EXHAUST (FOURTH DESIGN)

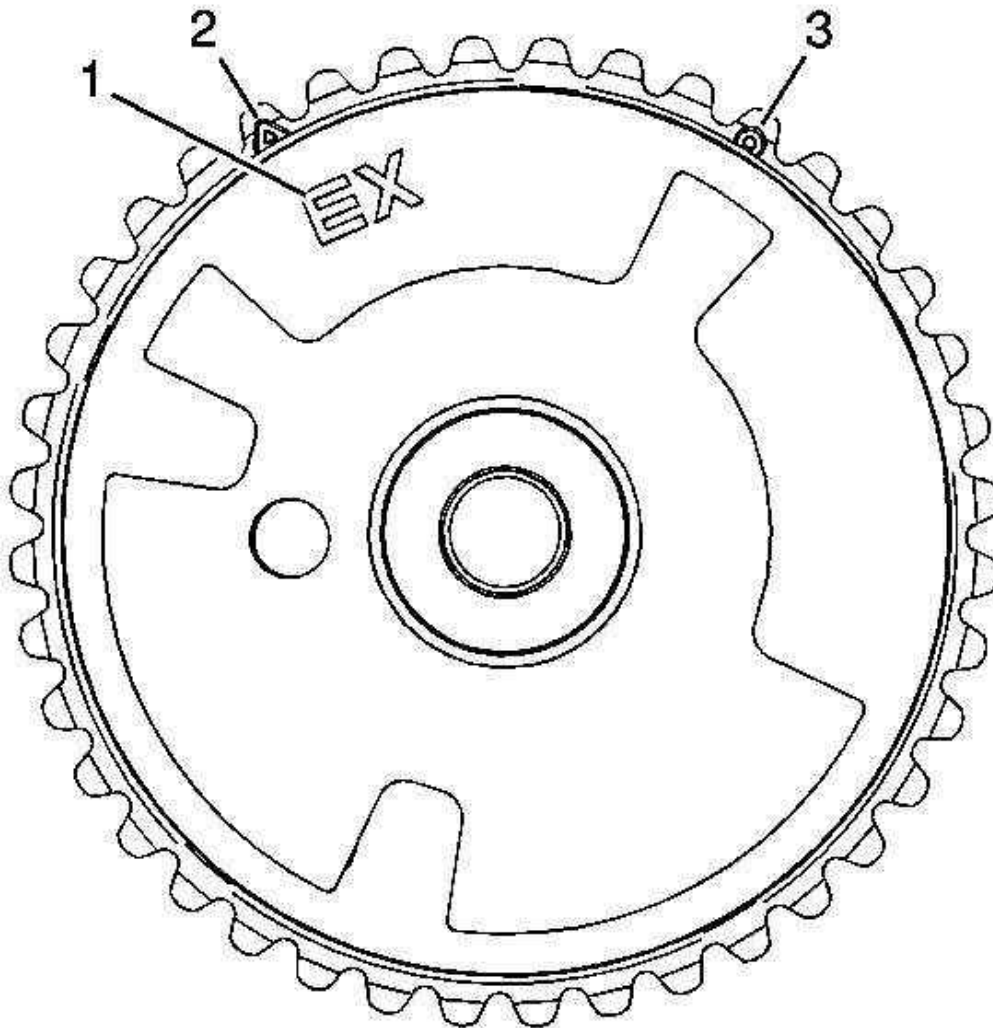


Fig. 91: View Of EX Marking, Triangle & Circle Marking
Courtesy of GENERAL MOTORS CORP.

1. Ensure the proper camshaft position actuator is installed. Observe the body of the camshaft position actuator for the "EX" marking (1). The marking is for an exhaust camshaft position actuator.
2. Ensure the proper timing mark is used. Observe the outer ring of the camshaft position actuator for the circle marking (3). The marking is for alignment to the highlighted timing chain link on the left side of the engine.

NOTE: **Refer to Torque Reaction Against Timing Drive Chain Notice .**

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

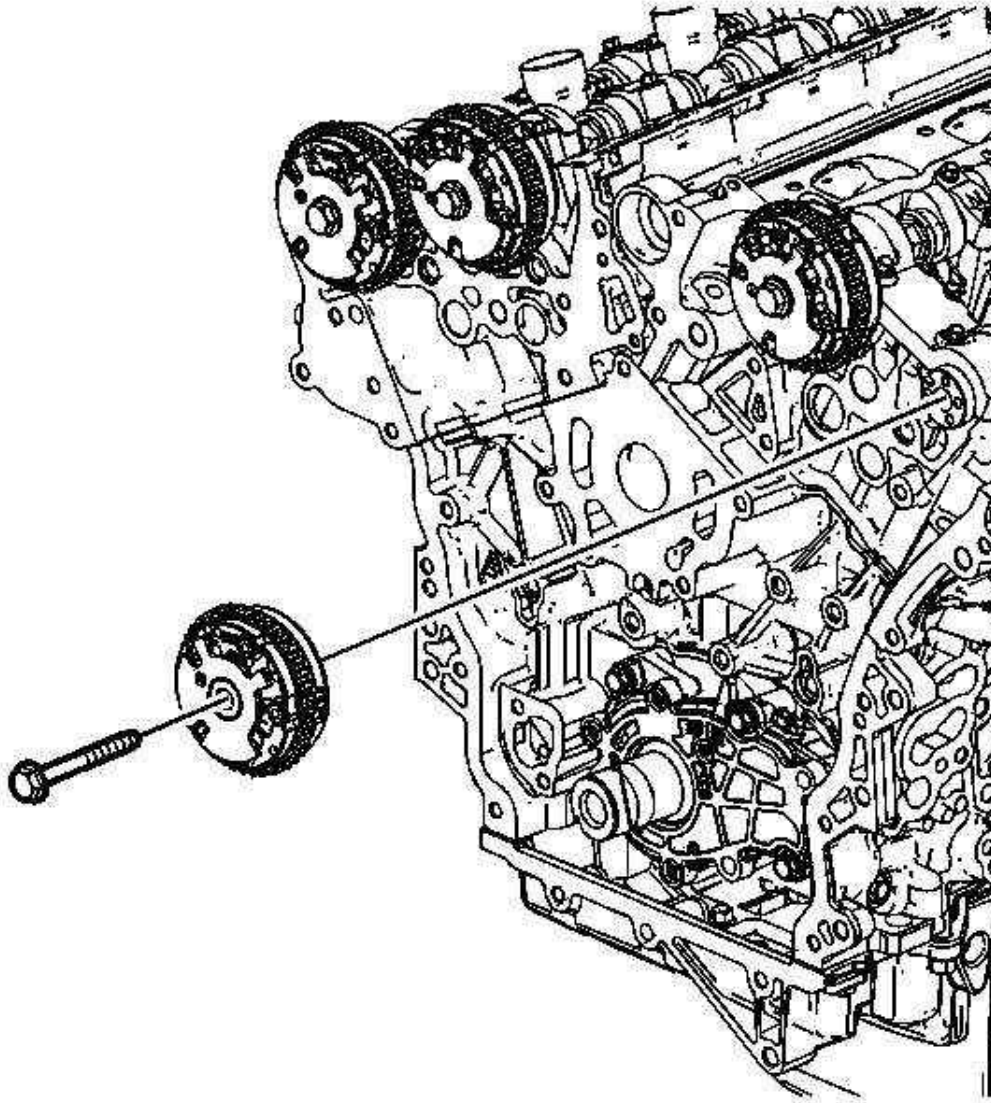


Fig. 92: Locating Exhaust Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Install the left exhaust camshaft position actuator.

NOTE: Refer to Fastener Notice .

2008 Buick LaCrosse CXL
2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

5. Install the camshaft position actuator bolt.

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

CRANKSHAFT SPROCKET INSTALLATION (FOURTH DESIGN)

Tools Required

EN-48589 Crankshaft Rotation Socket. See **Special Tools** .

Installation Procedure

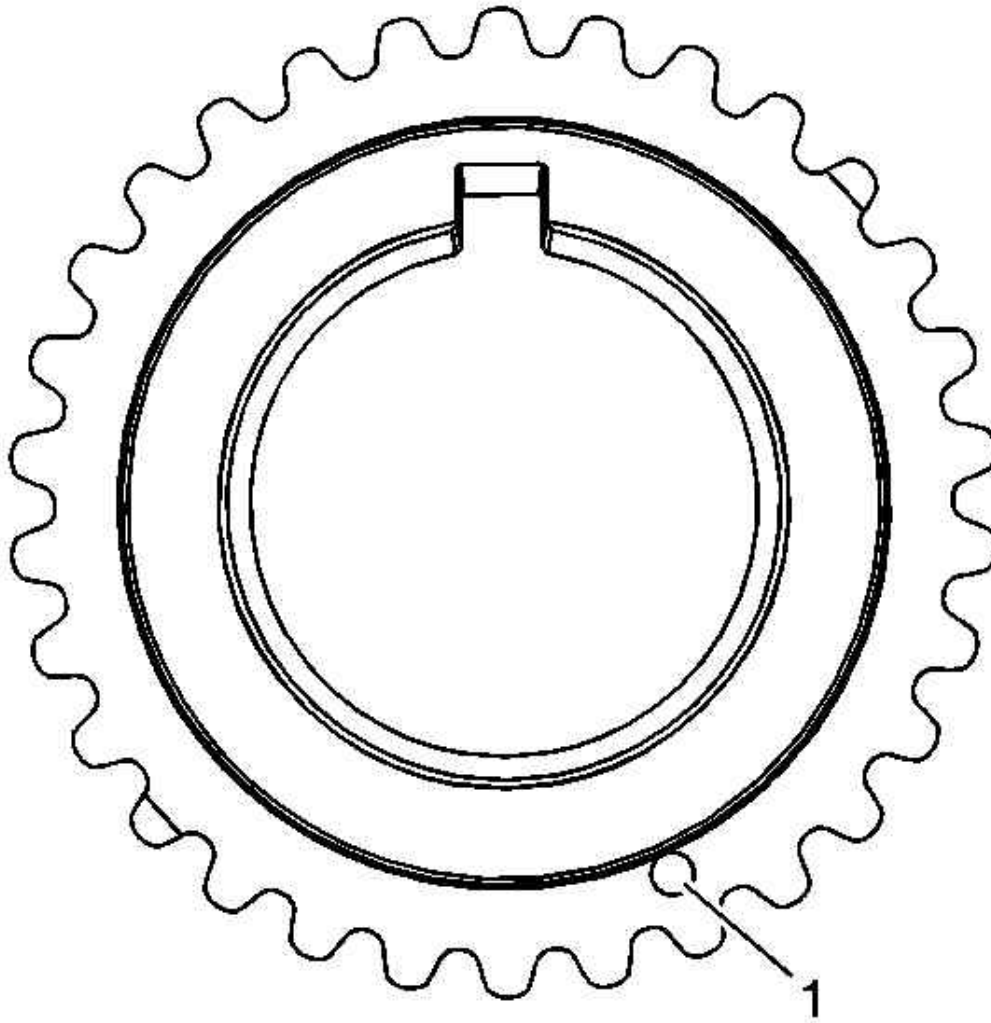


Fig. 93: Identifying Crankshaft Sprocket Timing Mark
Courtesy of GENERAL MOTORS CORP.

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

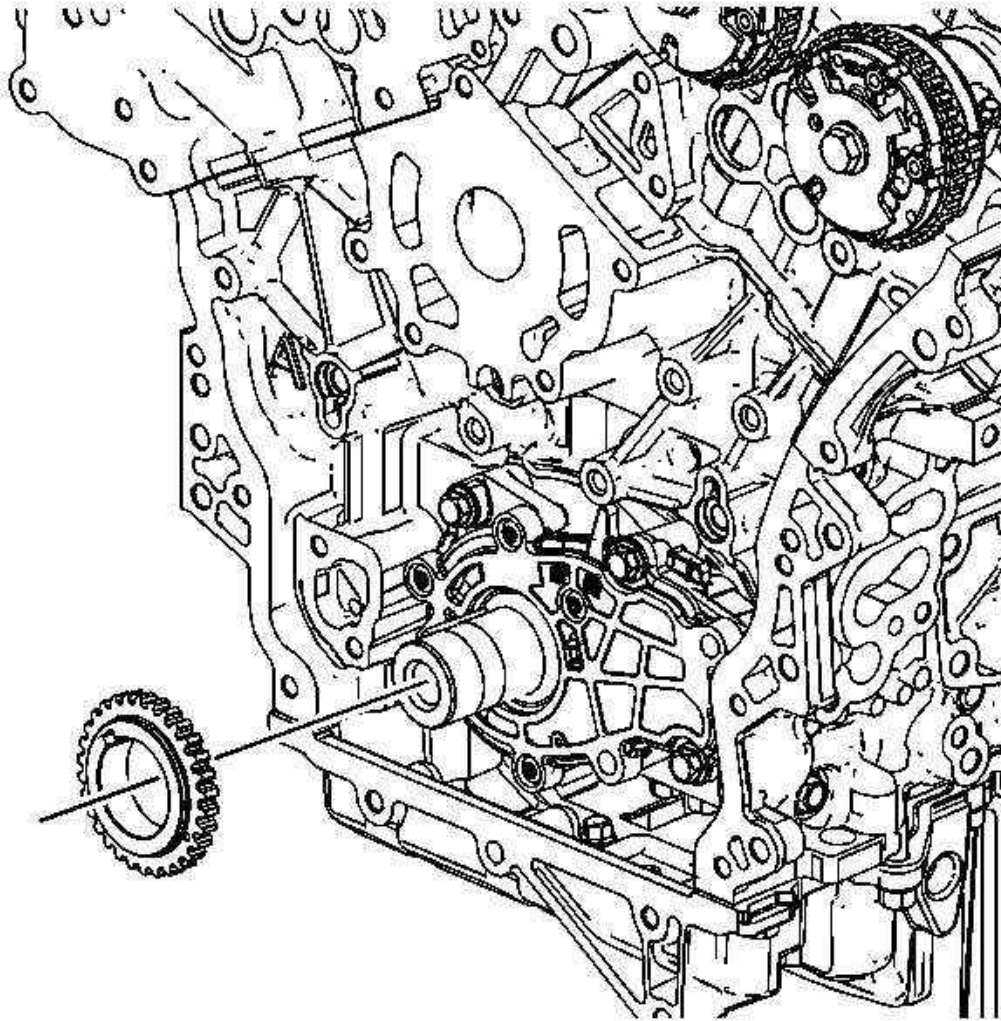


Fig. 94: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

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

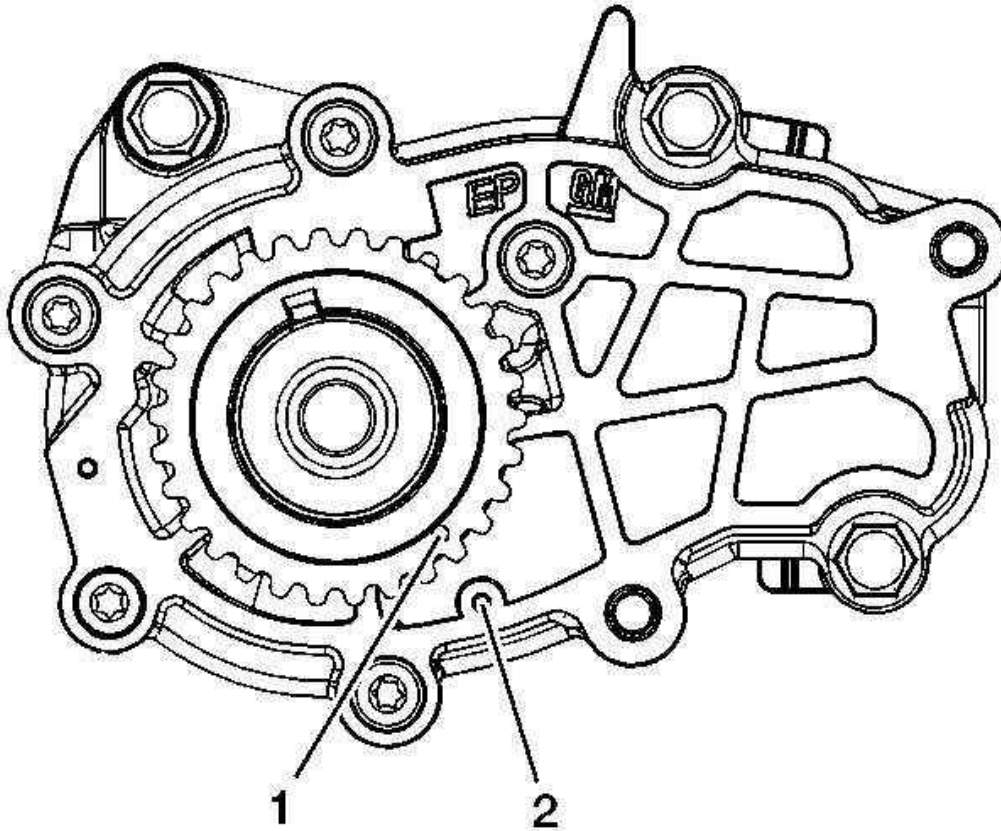


Fig. 95: View Of Stage One Timing Mark On Oil Pump Cover & Sprocket Timing Mark

Courtesy of GENERAL MOTORS CORP.

5. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1) aligned to the stage one timing mark on the oil pump cover (2) using the EN-48589 . See **Special Tools** . Refer to **Camshaft Timing Drive Chain Alignment Diagram (Third Design)** or **Camshaft Timing Drive Chain Alignment Diagram (Fourth Design)** - Stage One.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - LEFT SIDE (FOURTH DESIGN)

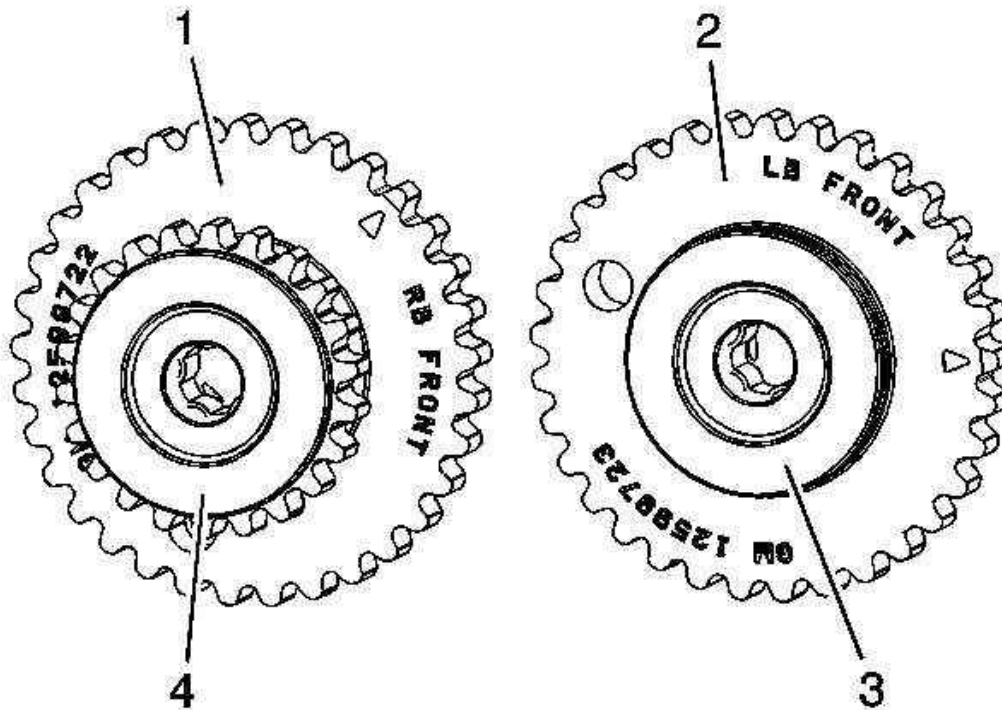


Fig. 96: View Of Camshaft Intermediate Drive Chain Idler - Left Side (Fourth Design)

Courtesy of GENERAL MOTORS CORP.

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

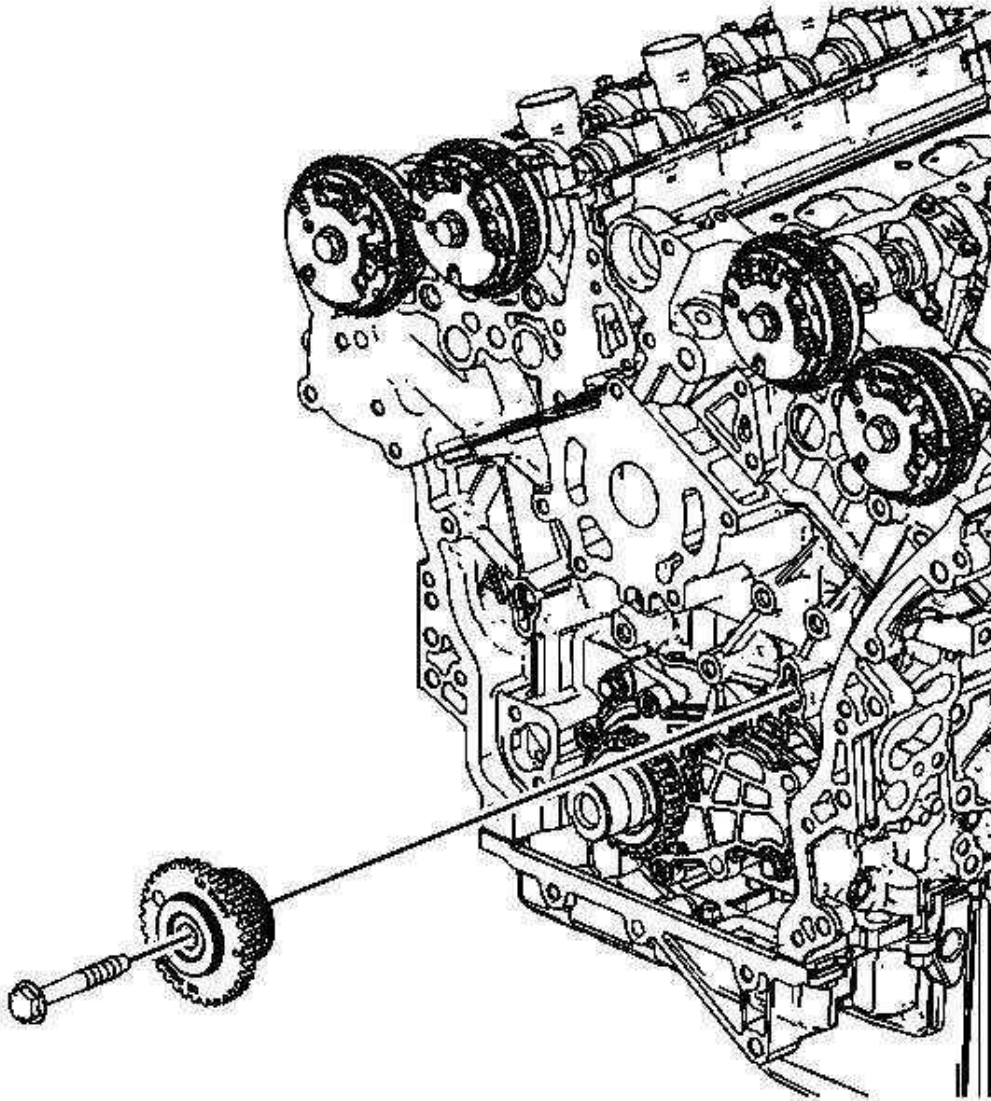


Fig. 97: View Of Camshaft Intermediate Drive Chain Idler & Bolt
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

3. Install the camshaft intermediate drive chain idler bolt.

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

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - LEFT SIDE (FOURTH DESIGN)

Tools Required

- **EN 46105** Camshaft Locking Tool. See Special Tools .
- **EN-48589** Crankshaft Rotation Socket. See Special Tools .

Installation

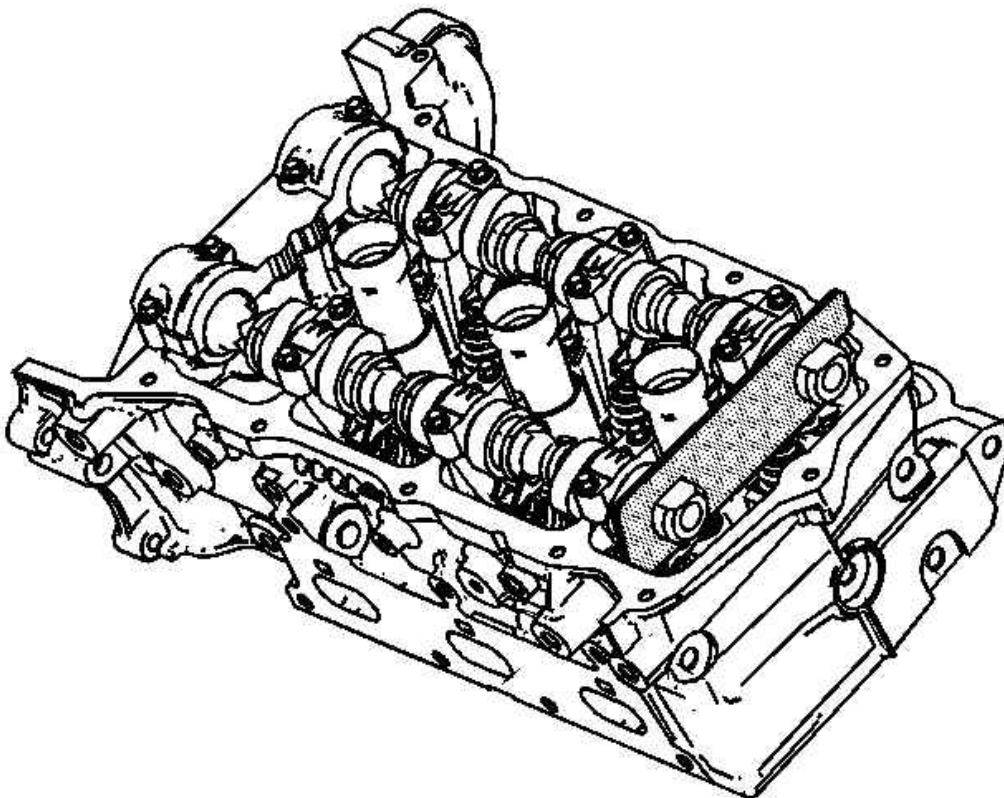


Fig. 98: Identifying Special Tools - EN 46105-1

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: There should be no need to rotate the camshaft more than 10 degrees. Using the hex cast into the camshaft rotate the camshaft in order to install the EN 46105 . See Special Tools .

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

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

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

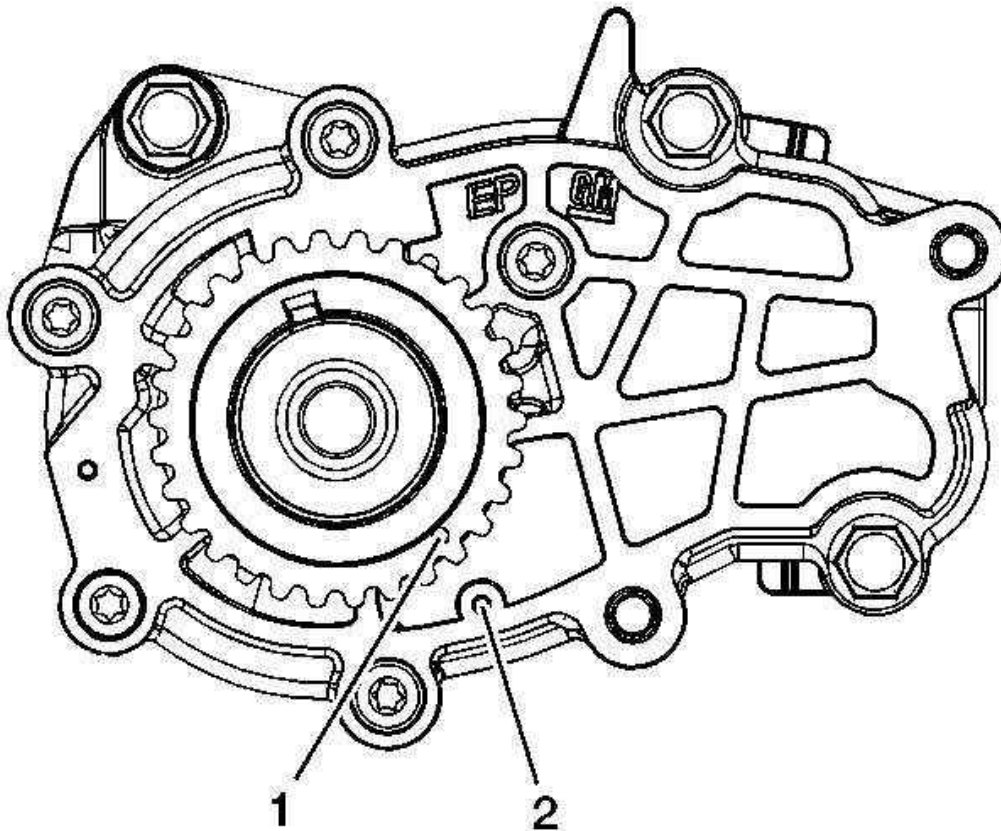


Fig. 99: View Of Stage One Timing Mark On Oil Pump Cover & Sprocket Timing Mark

Courtesy of GENERAL MOTORS CORP.

3. Ensure the crankshaft is in the stage one timing position with the crankshaft sprocket timing mark (1) aligned to the stage one timing mark on the oil pump cover (2) using the EN-48589 . See **Special Tools** . Refer to **Camshaft Timing Drive Chain Alignment Diagram (Third Design)** or **Camshaft Timing Drive Chain Alignment Diagram (Fourth Design)** - Stage One.

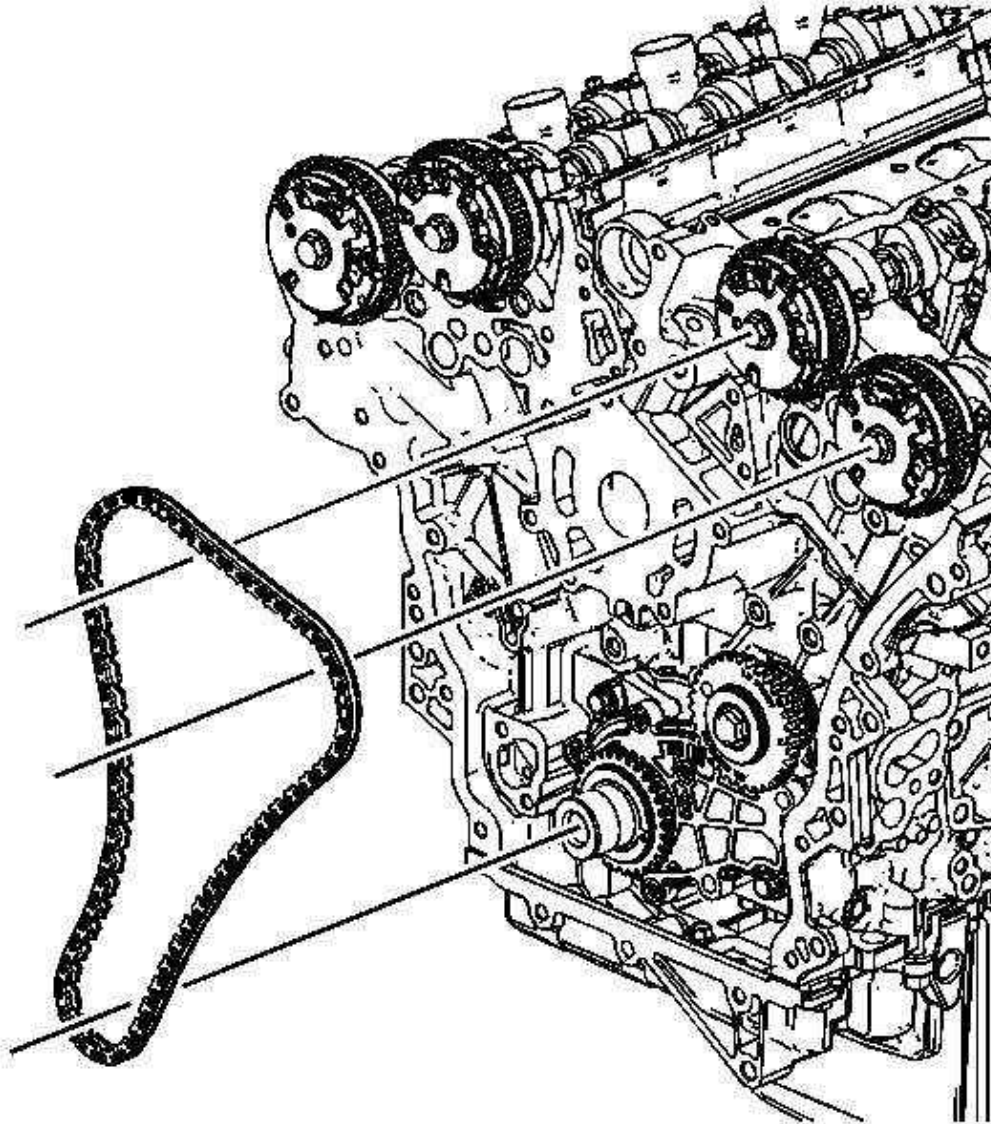


Fig. 100: Identifying Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

4. Install the left secondary camshaft drive chain.

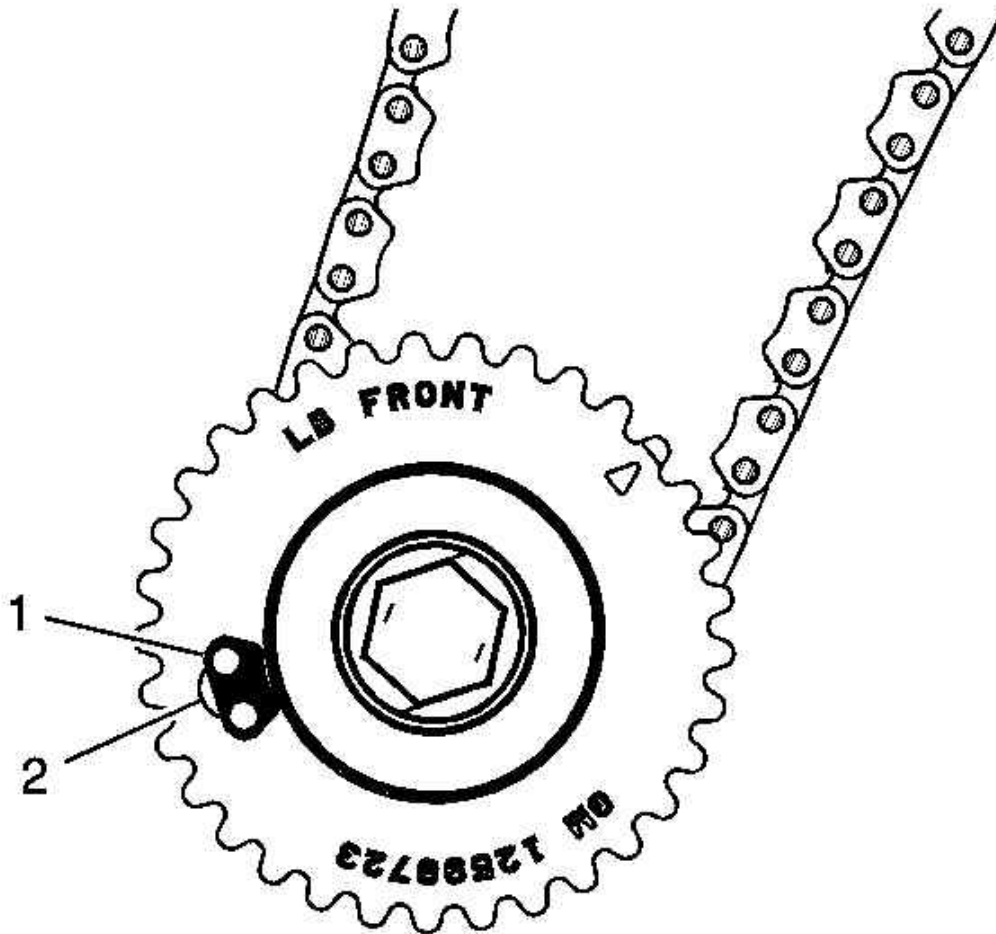


Fig. 101: View Of Timing Camshaft Drive Chain Link & Alignment Access Hole

Courtesy of GENERAL MOTORS CORP.

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

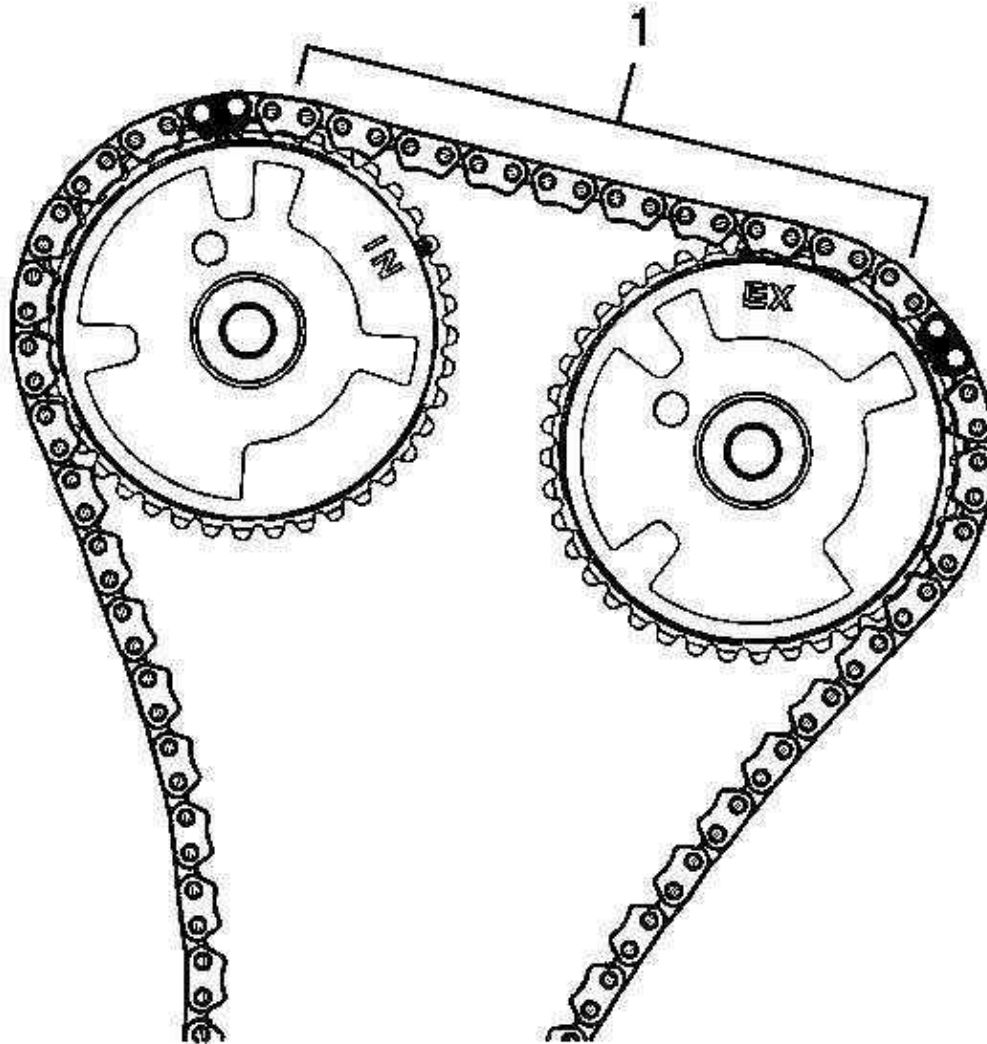


Fig. 102: View Of Camshaft Drive Chain Links
Courtesy of GENERAL MOTORS CORP.

6. Wrap the secondary camshaft drive chain around both left actuator drive sprockets.
7. Ensure there are 10 links (1) between the timing camshaft drive chain links for the camshaft position actuator sprockets.

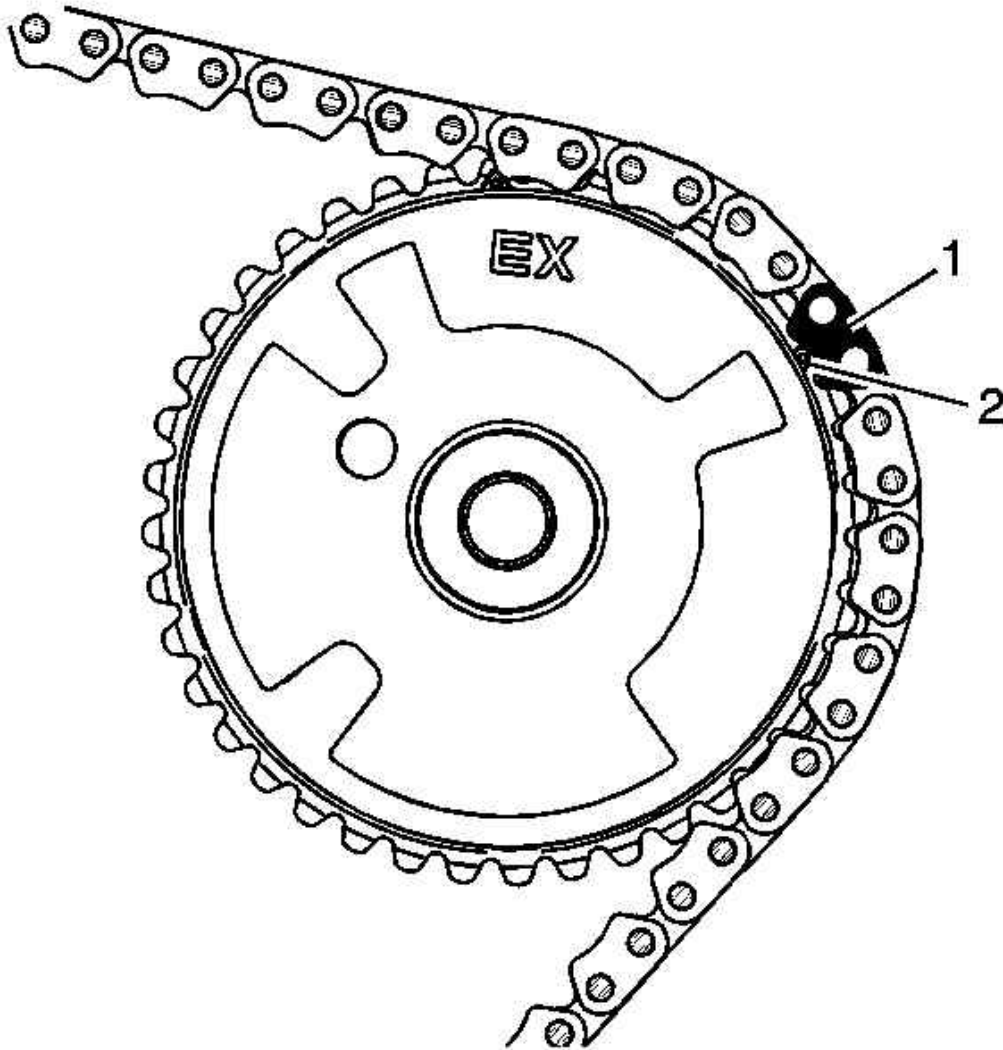


Fig. 103: View Of Exhaust Camshaft & Timing Chain Marks
Courtesy of GENERAL MOTORS CORP.

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

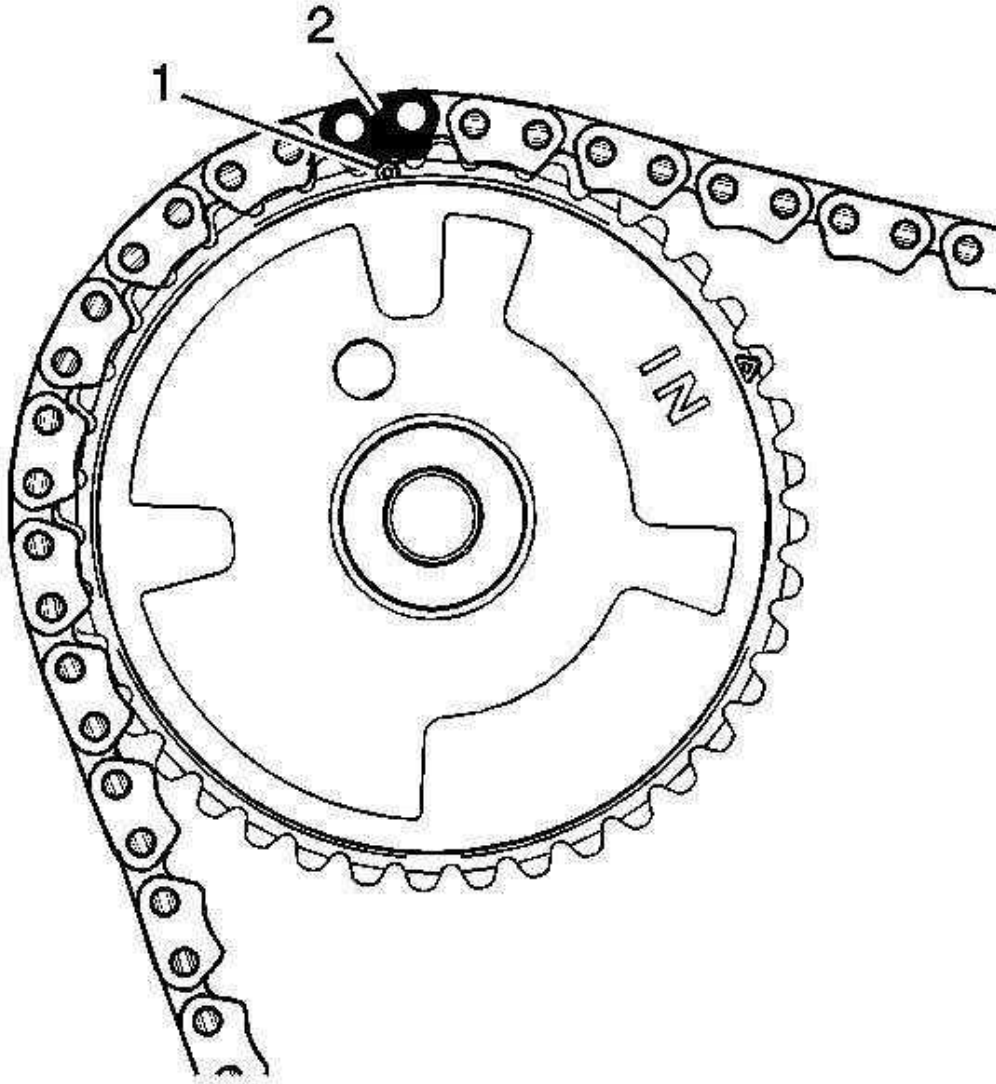


Fig. 104: View Of Intake Camshaft & Timing Chain Marks
Courtesy of GENERAL MOTORS CORP.

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

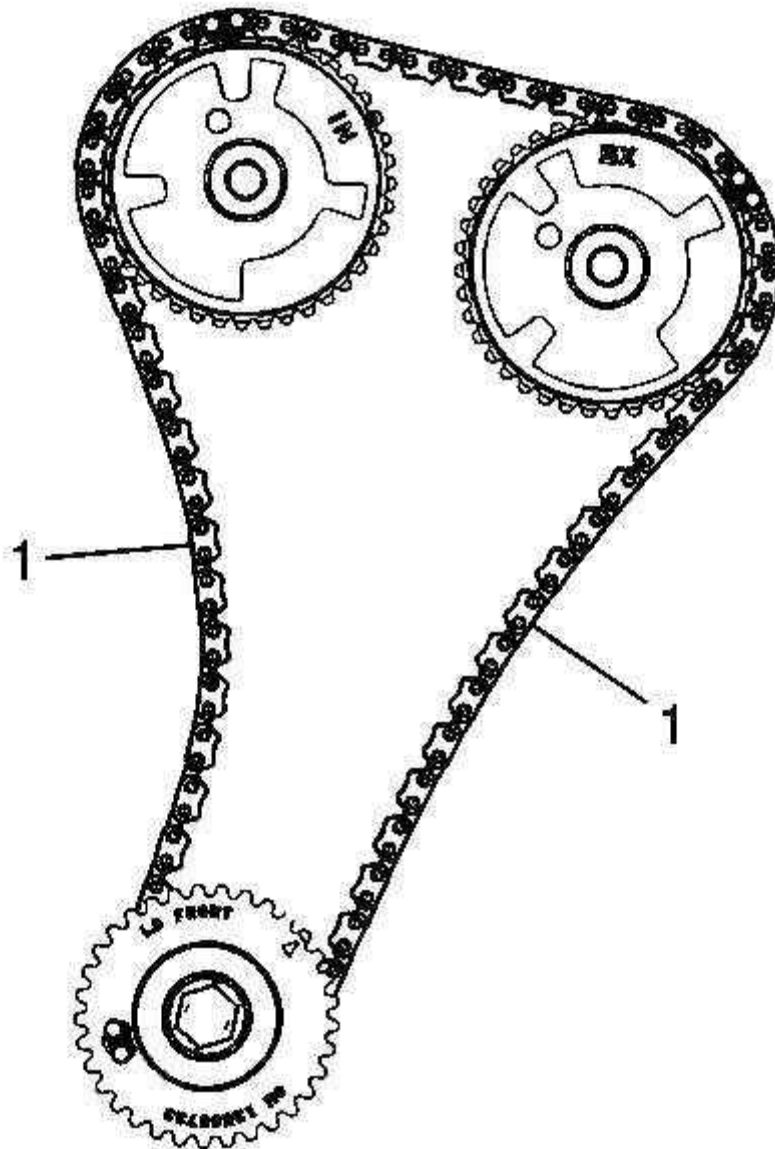


Fig. 105: View of Timing Chain
Courtesy of GENERAL MOTORS CORP.

10. There will be 22 links (1) between the left camshaft intermediate drive chain idler timing secondary camshaft drive chain link and each left camshaft

position actuator sprocket timing secondary camshaft drive chain link.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LEFT SIDE (FOURTH DESIGN)

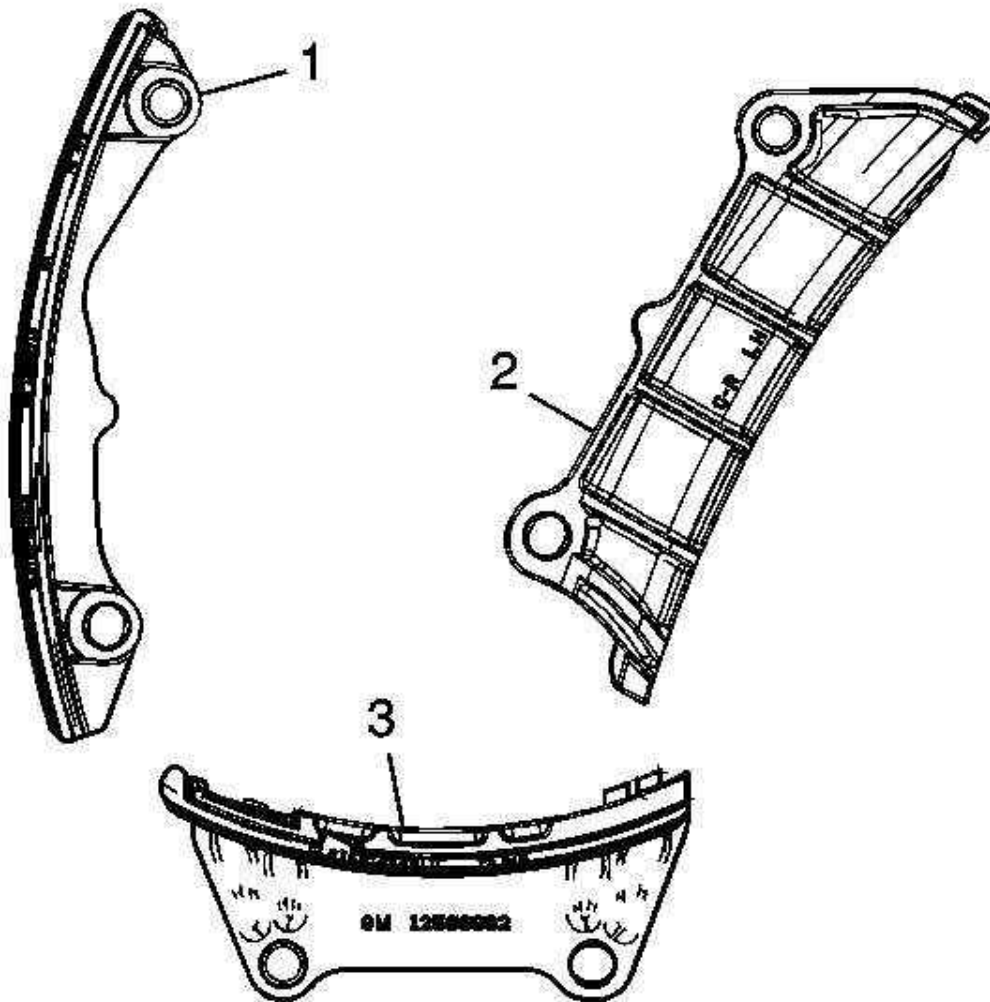


Fig. 106: View Of Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

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

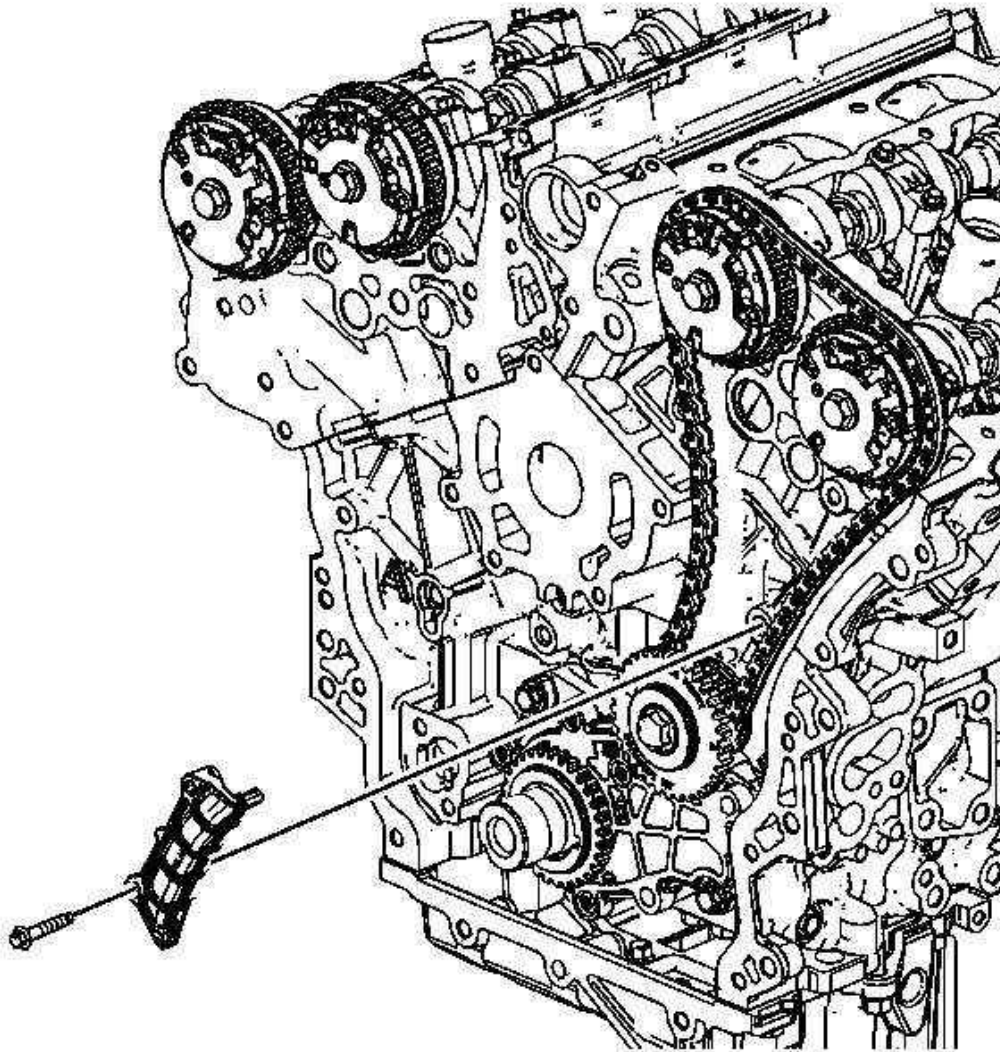


Fig. 107: View Of Secondary Camshaft Drive Chain Guide Bolts
Courtesy of GENERAL MOTORS CORP.

2. Position the left secondary camshaft drive chain guide.

NOTE: Refer to **Fastener Notice** .

3. Install the secondary camshaft drive chain guide bolts.

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

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT SIDE (FOURTH DESIGN)

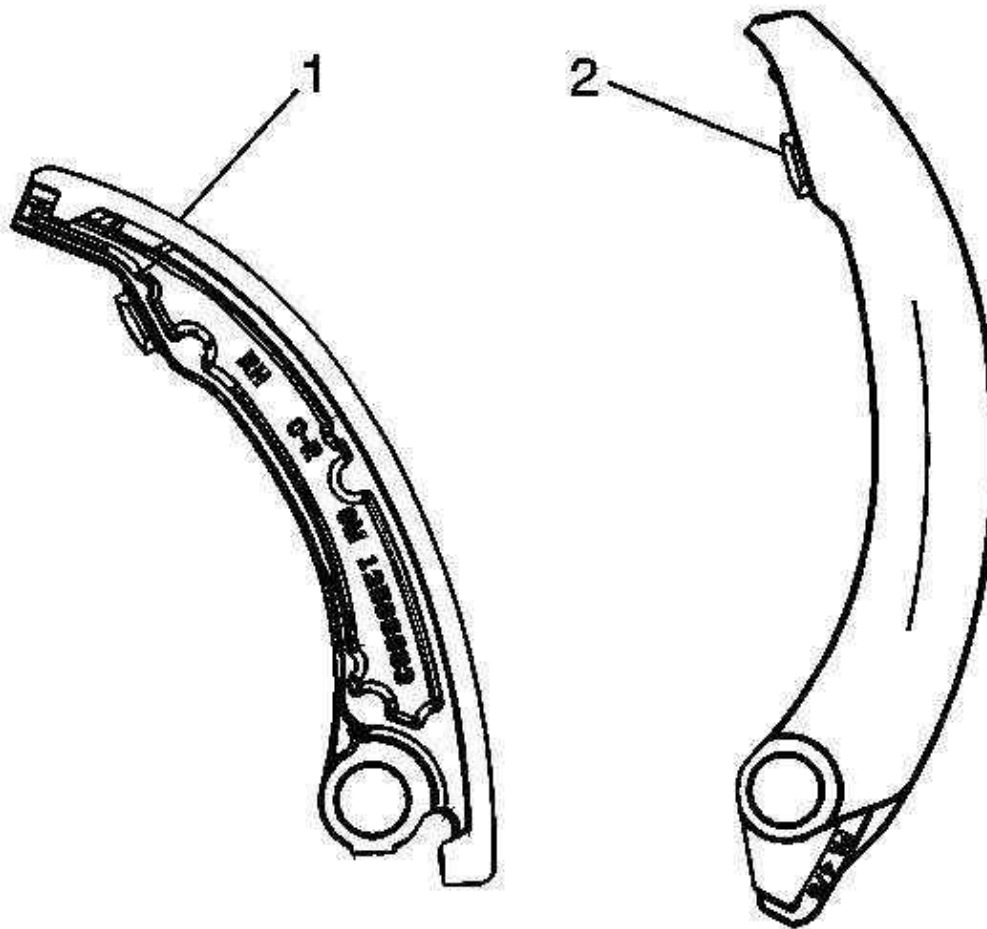


Fig. 108: View Of Left Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

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

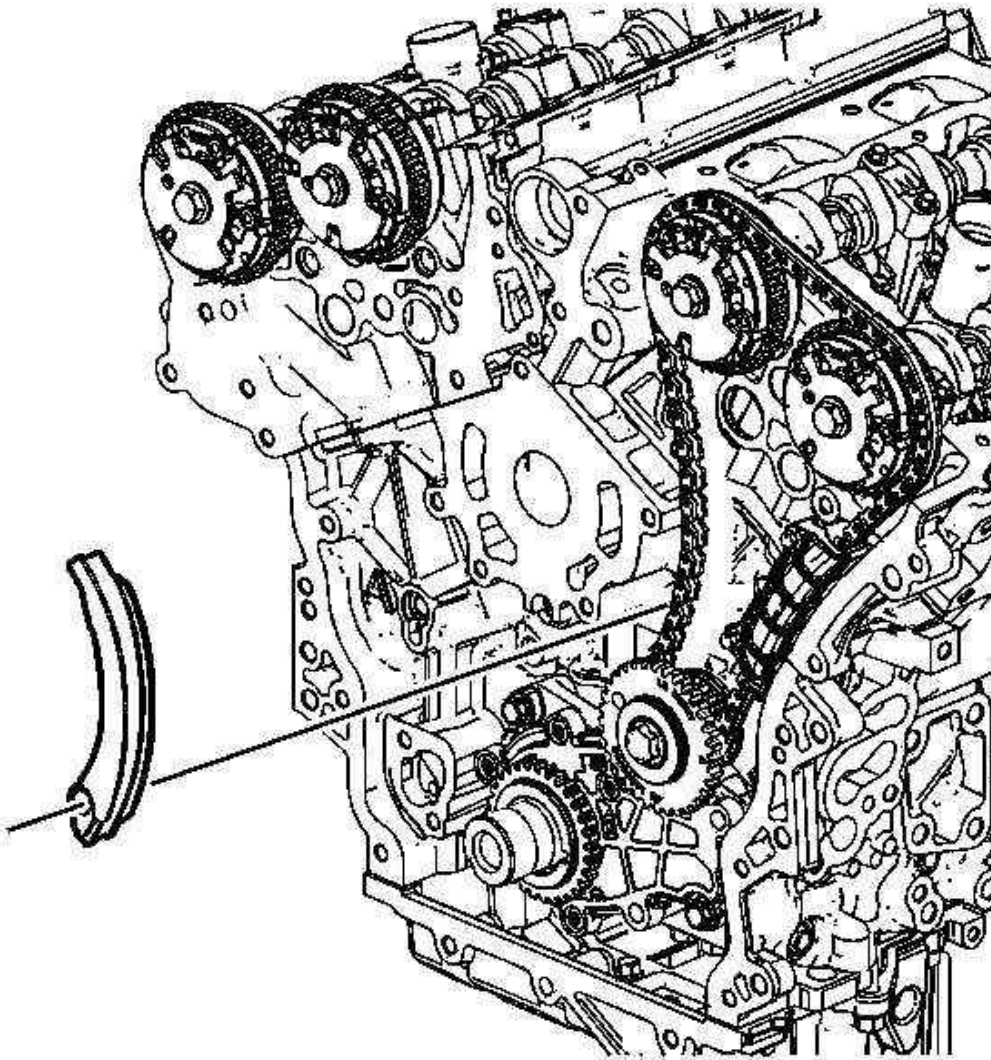


Fig. 109: View Of Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Position the left secondary camshaft drive chain shoe.

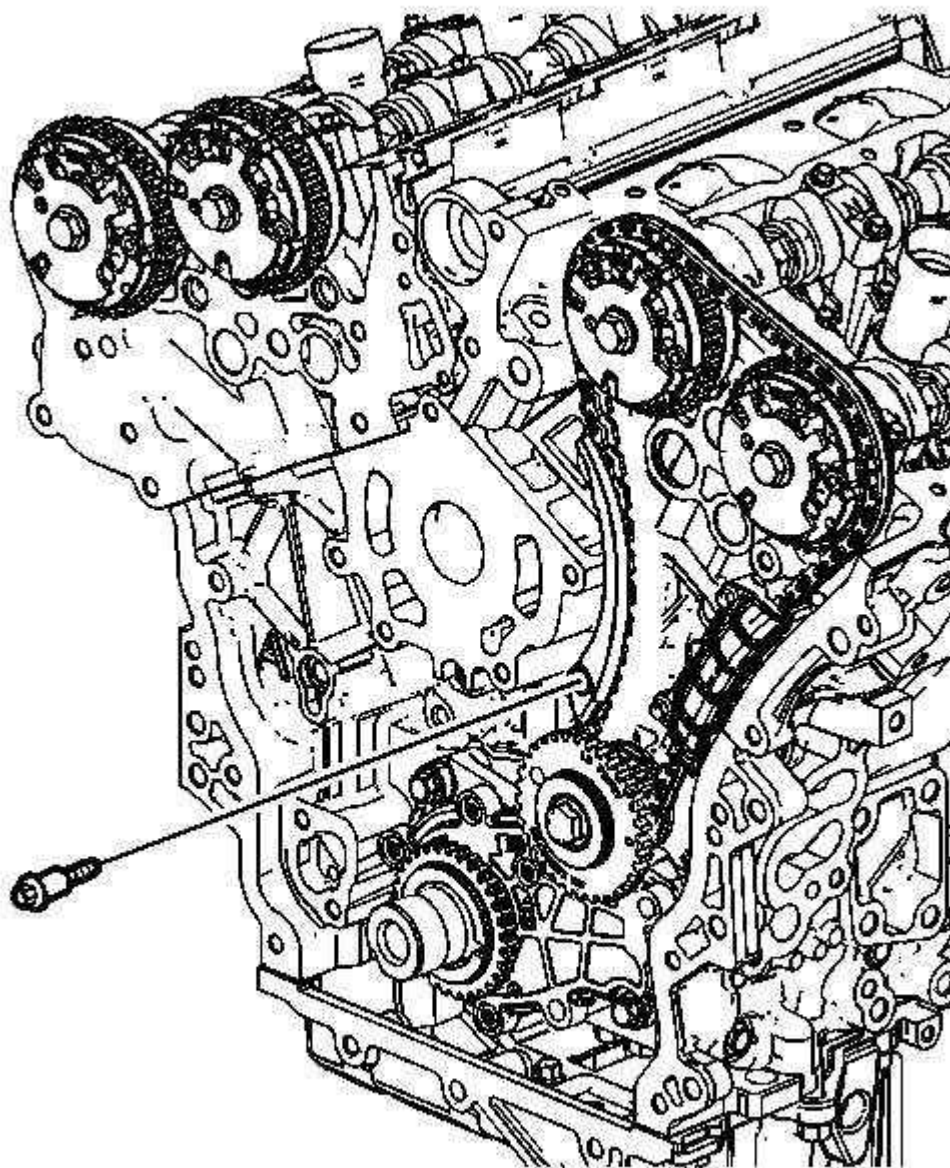


Fig. 110: Identifying Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

3. Install the secondary camshaft drive chain shoe bolt.

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

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - LEFT SIDE (FOURTH DESIGN)

Tools Required

- **EN 46112** Tensioner Retraction Pins. See **Special Tools** .
- **J 45027** Tensioner Tool. See **Special Tools** .

Installation

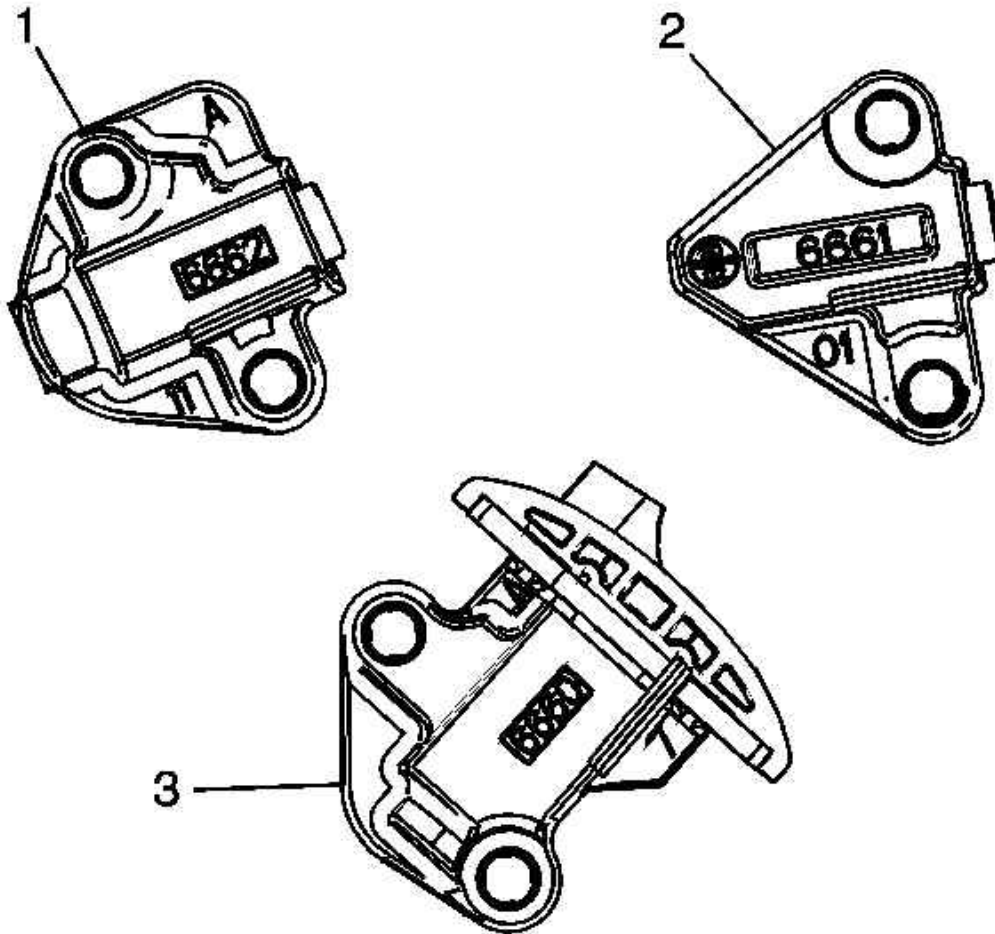


Fig. 111: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

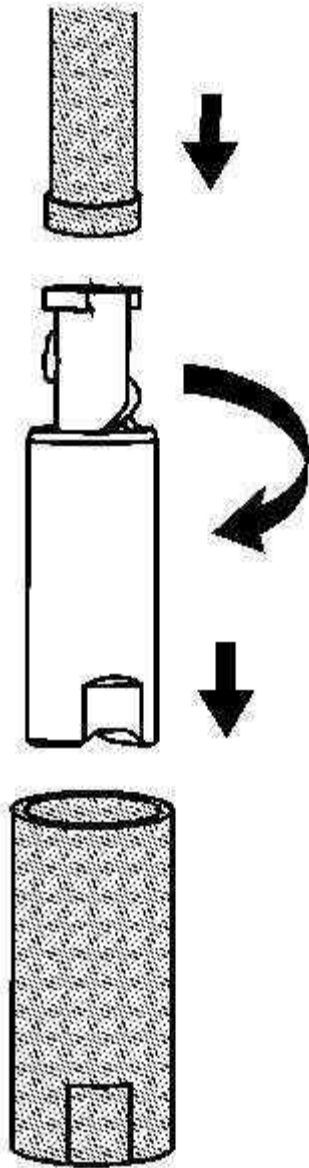


Fig. 112: Resetting Left Secondary Camshaft Drive Chain Tensioner Plunger With J 45027
Courtesy of GENERAL MOTORS CORP.

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

plunger. See **Special Tools** .

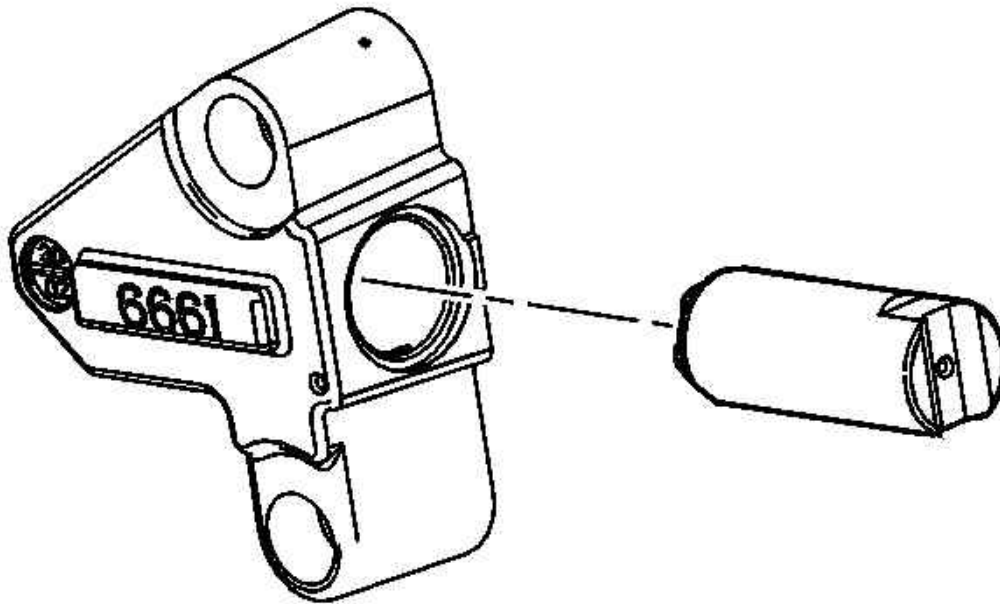


Fig. 113: View Of Plunger & Left Secondary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

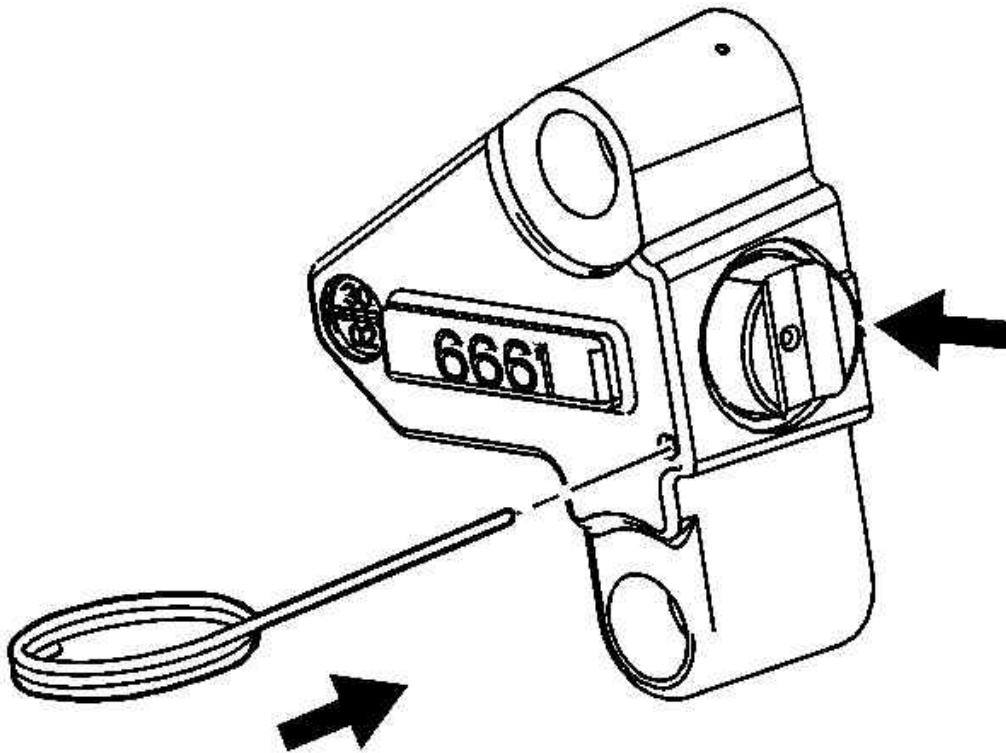


Fig. 114: Locking Left Secondary Camshaft Drive Chain Tensioner Plunger Into Body

Courtesy of GENERAL MOTORS CORP.

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

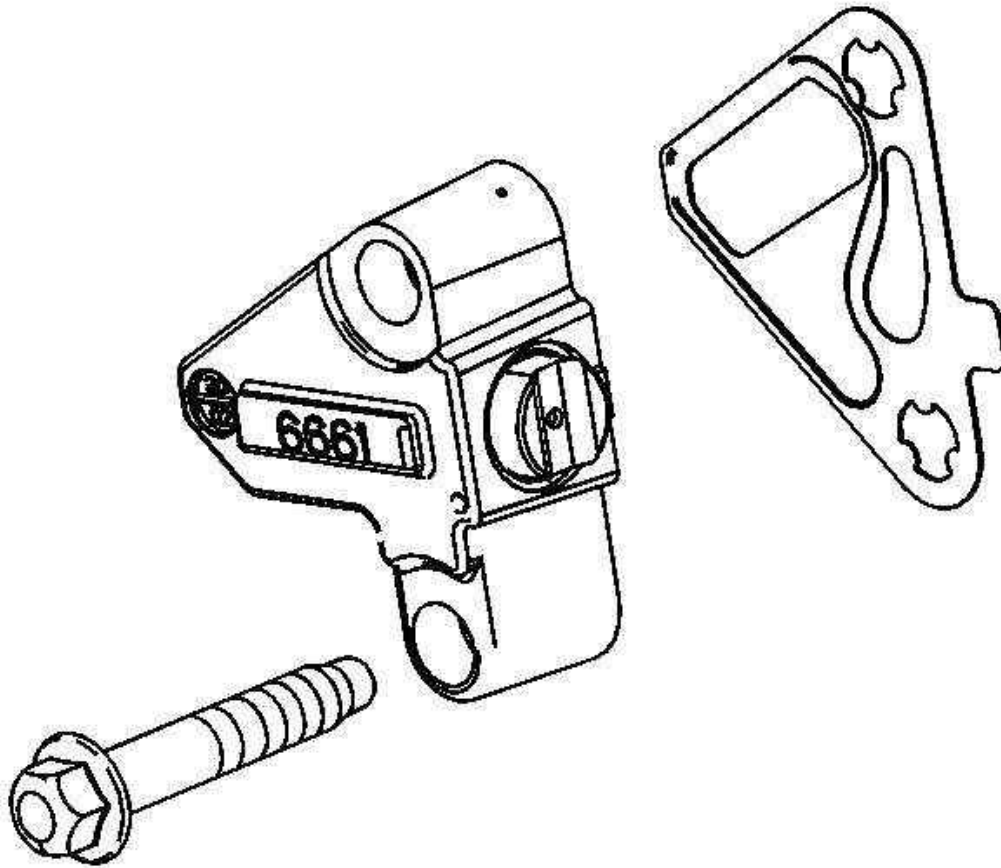


Fig. 115: Identifying Left Secondary Camshaft Drive Chain Tensioner Gasket

Courtesy of GENERAL MOTORS CORP.

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

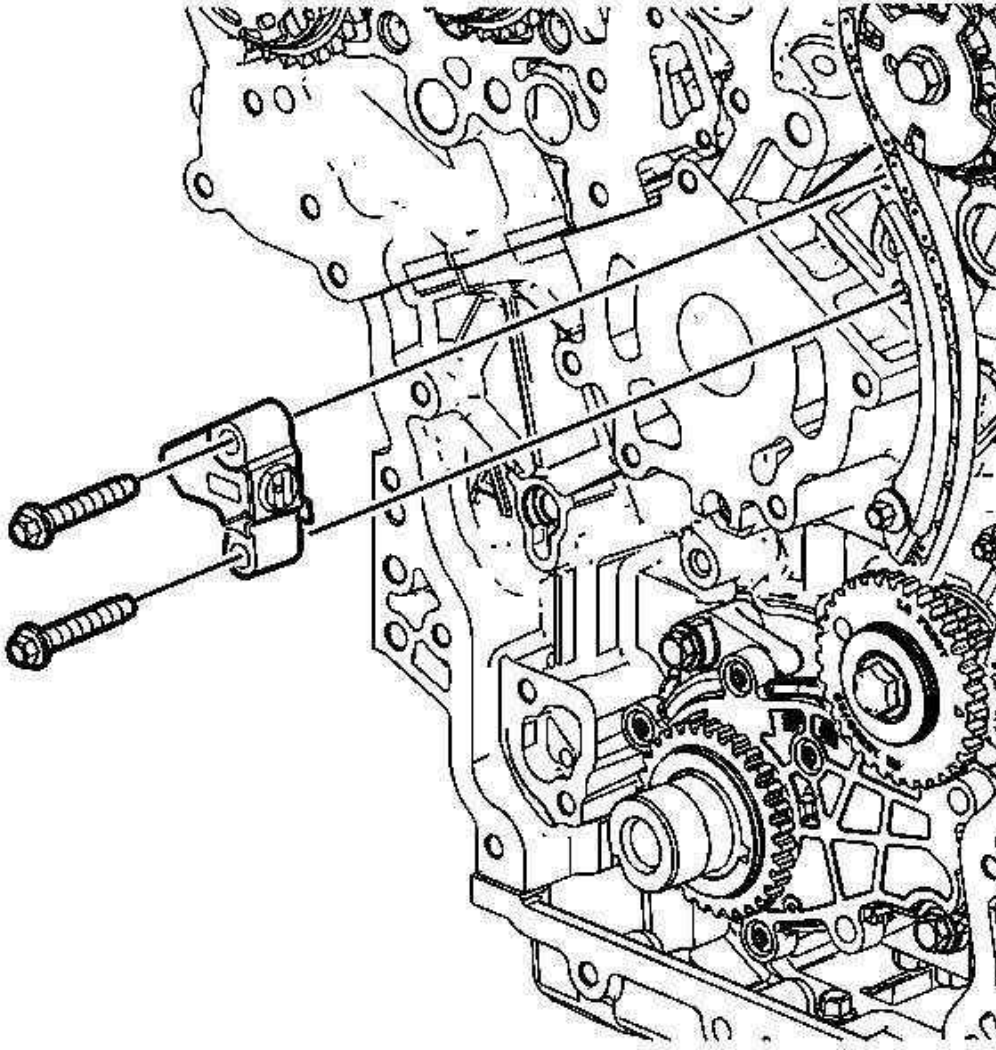


Fig. 116: View Of Secondary Camshaft Drive Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

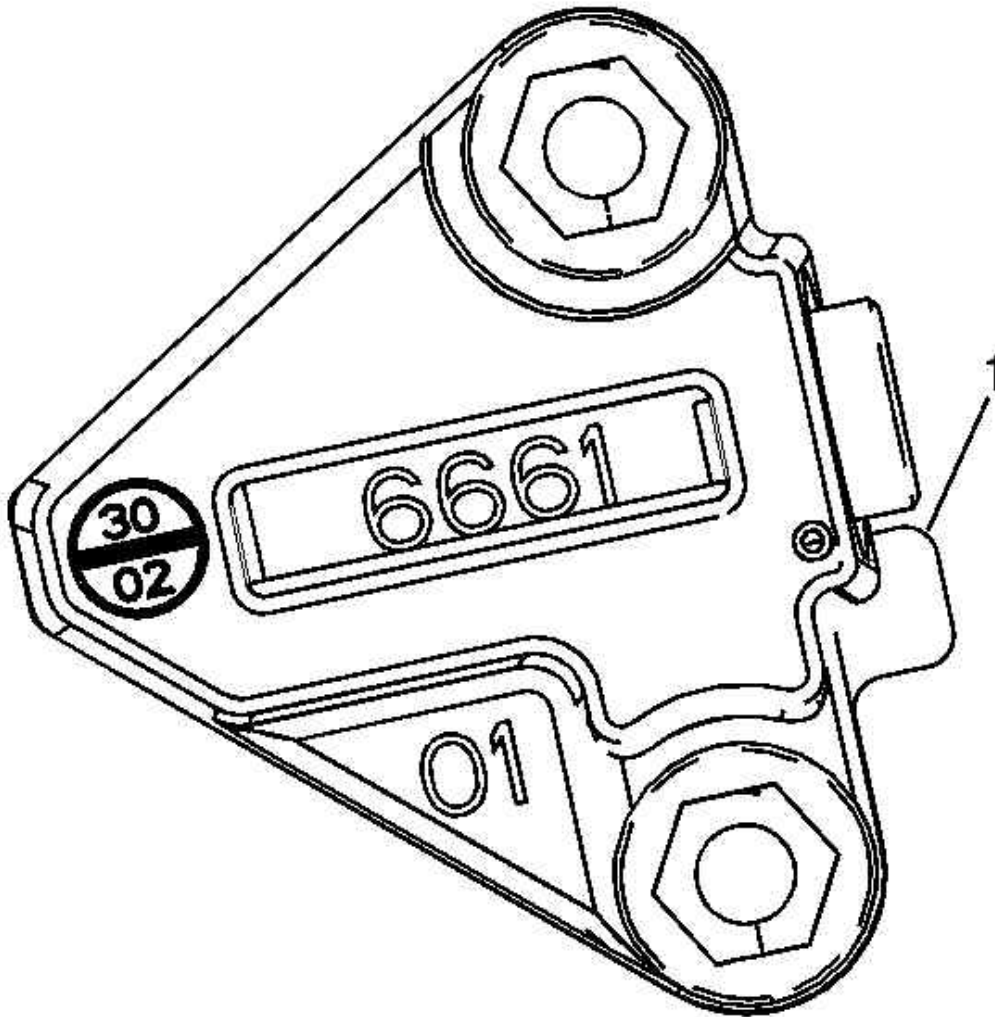


Fig. 117: Locating Left Secondary Camshaft Drive Chain Tensioner Gasket Tab

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

1. First Pass

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

2. Final Pass

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

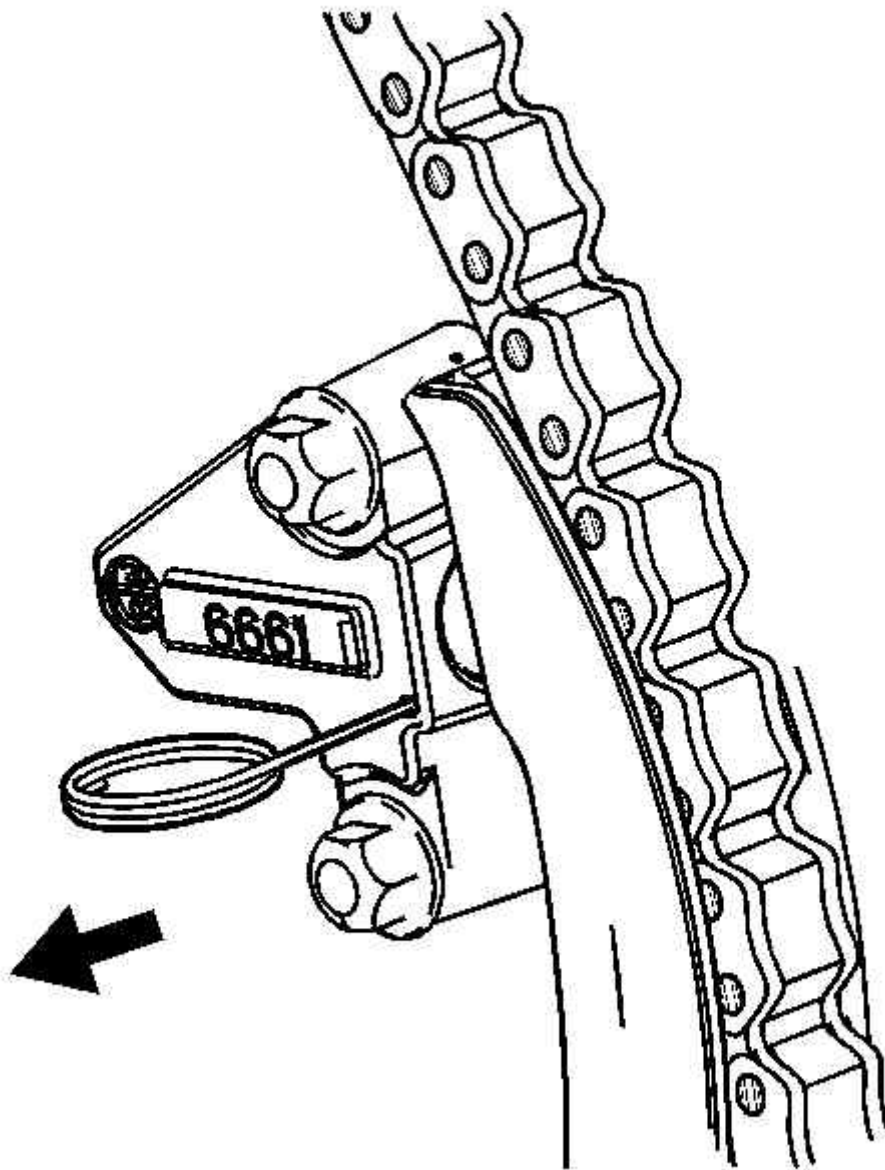


Fig. 118: View Of Left Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

11. Release the left secondary camshaft drive chain tensioner by pulling out the EN 46112 and unlocking the tensioner plunger. See **Special Tools** .

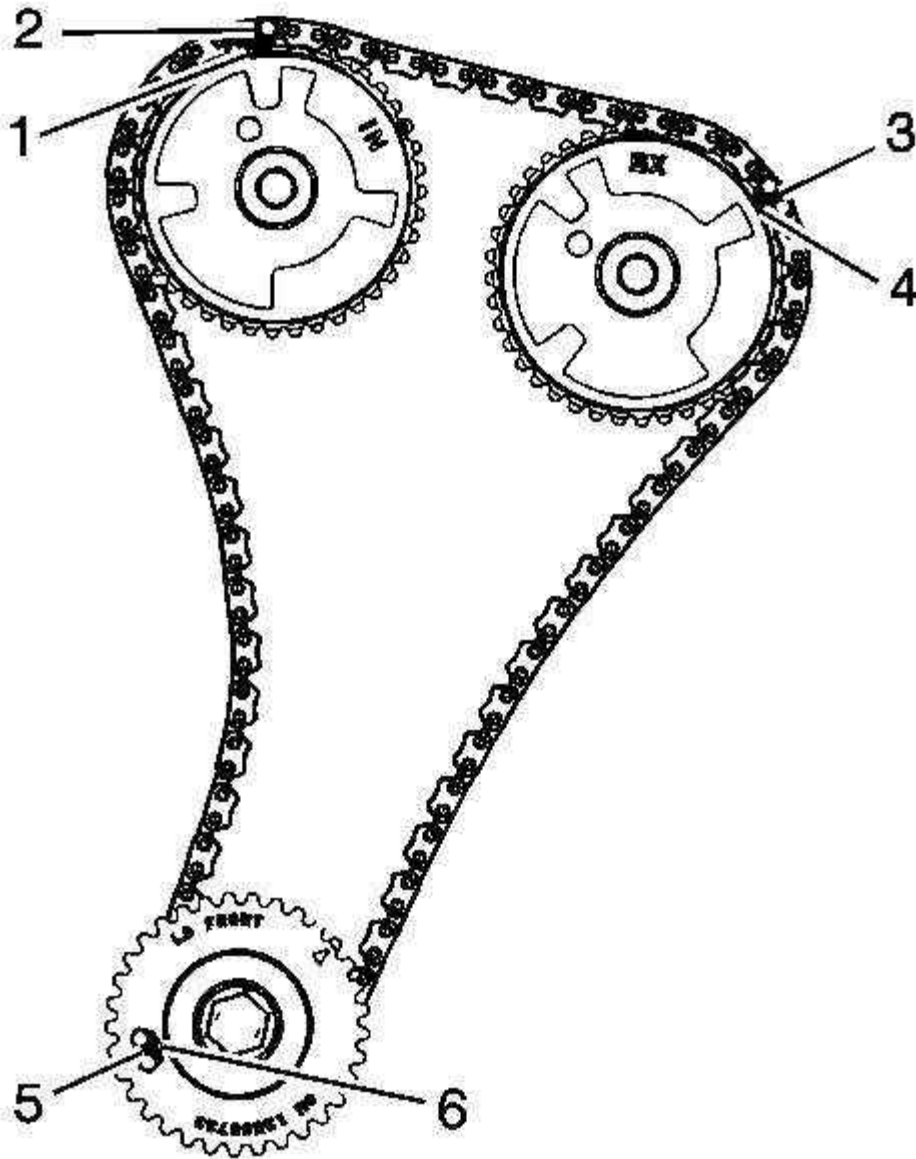


Fig. 119: View Of Left Secondary Camshaft Drive Chain Timing Mark
Courtesy of GENERAL MOTORS CORP.

12. Verify the left secondary camshaft drive chain timing mark alignments (1-6). Also refer to **Camshaft Timing Drive Chain Alignment Diagram (Third**

Design) or **Camshaft Timing Drive Chain Alignment Diagram (Fourth Design)** - Stage One.

CAMSHAFT INTERMEDIATE DRIVE CHAIN IDLER INSTALLATION - RIGHT SIDE (FOURTH DESIGN)

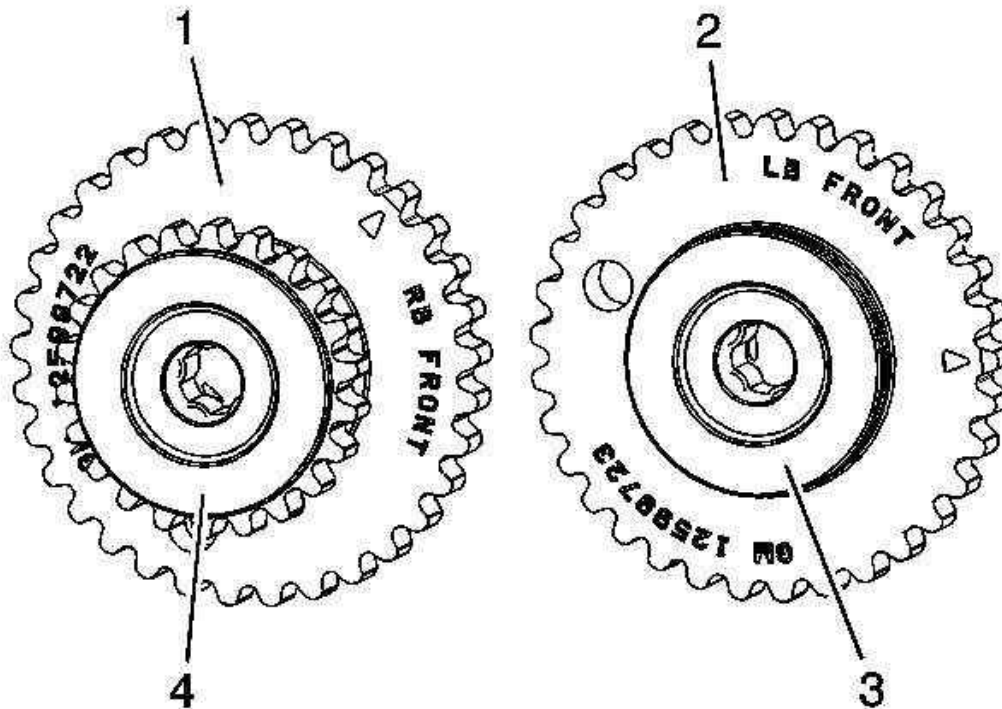


Fig. 120: View Of Camshaft Intermediate Drive Chain Idler - Left Side (Fourth Design)

Courtesy of GENERAL MOTORS CORP.

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

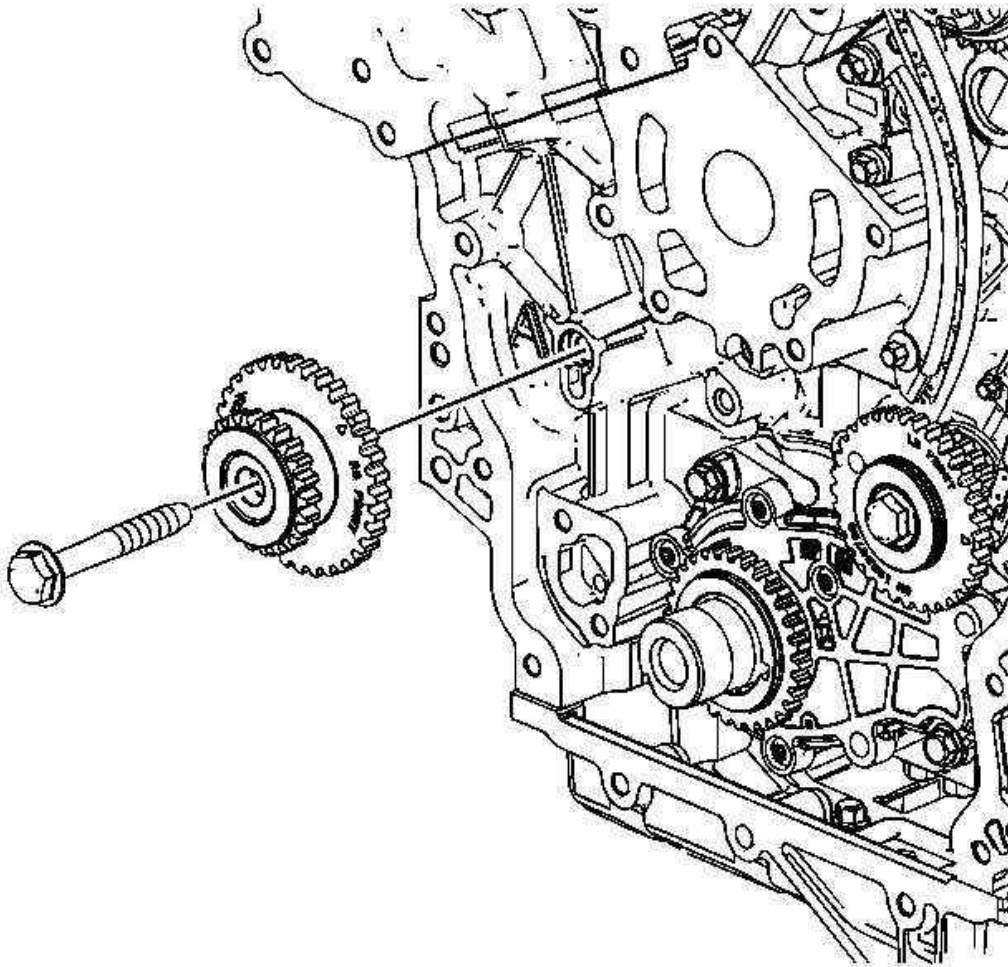


Fig. 121: Identifying Camshaft Intermediate Drive Chain Idler & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Install the right camshaft intermediate drive chain idler.

NOTE: Refer to Fastener Notice .

3. Install the camshaft intermediate drive chain idler bolt.

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

PRIMARY CAMSHAFT DRIVE CHAIN INSTALLATION (FOURTH DESIGN)

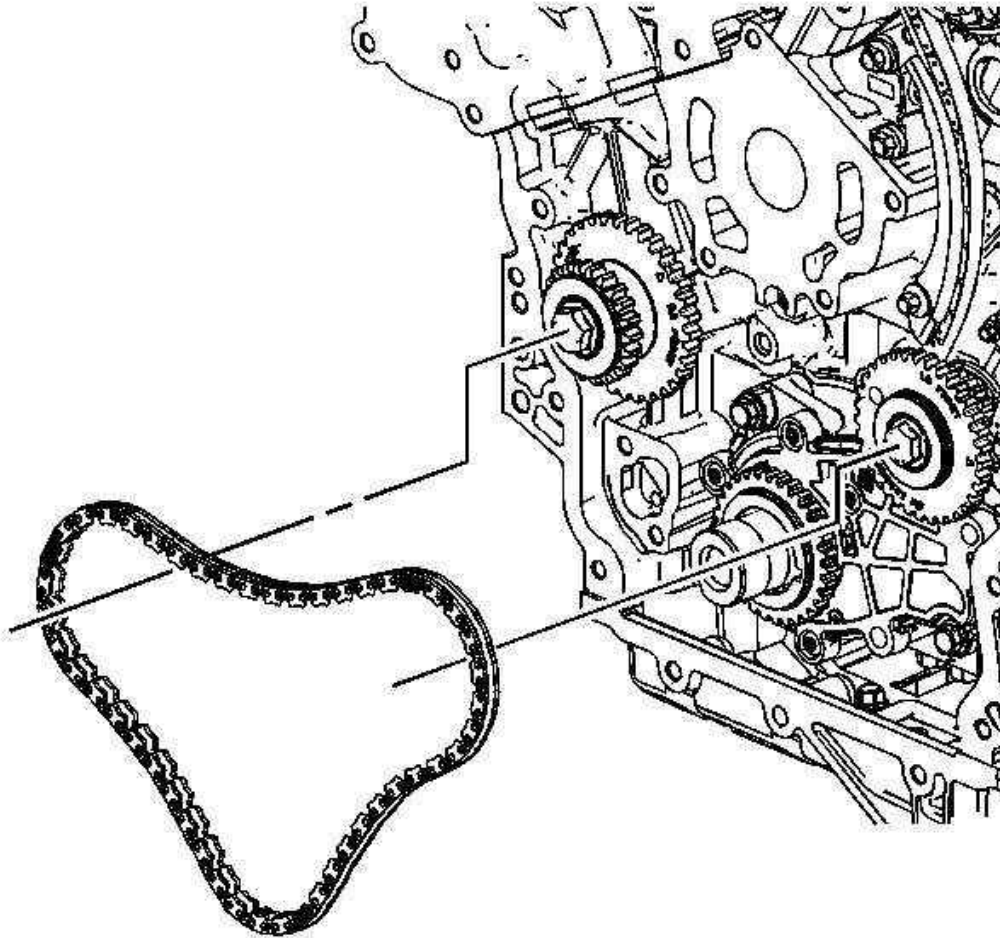


Fig. 122: Identifying Primary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

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

1. Install the primary camshaft drive chain.

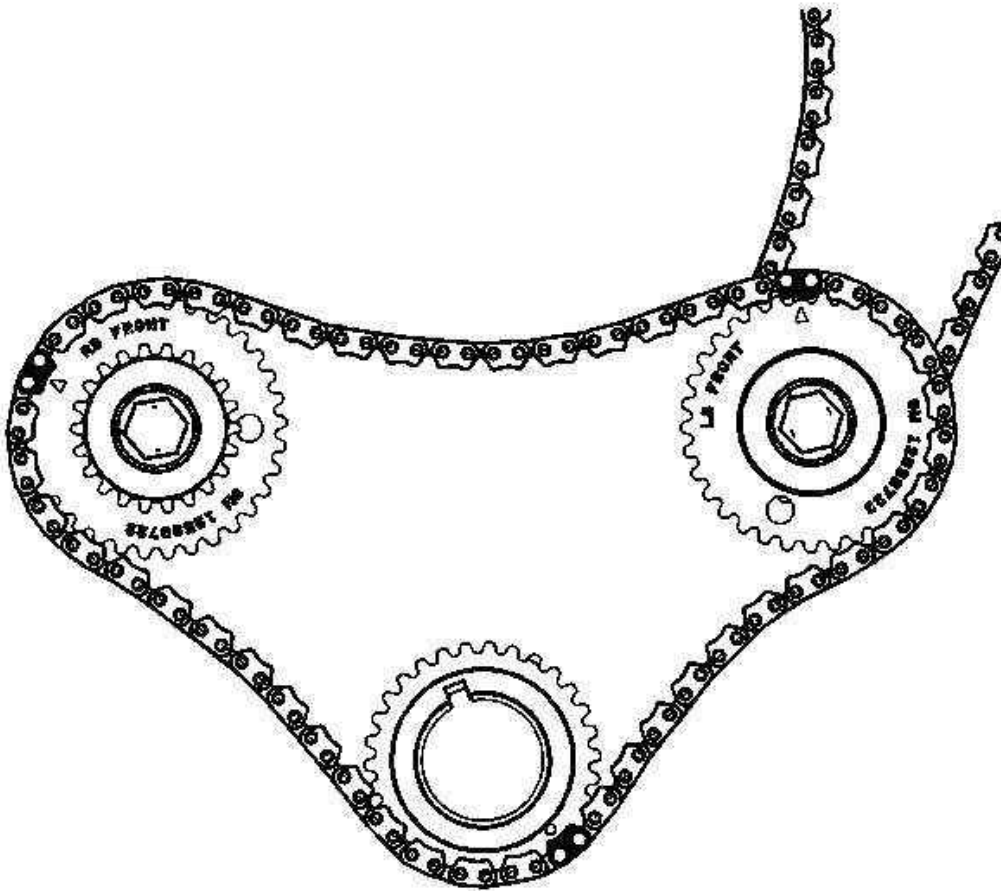


Fig. 123: View Of Primary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

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

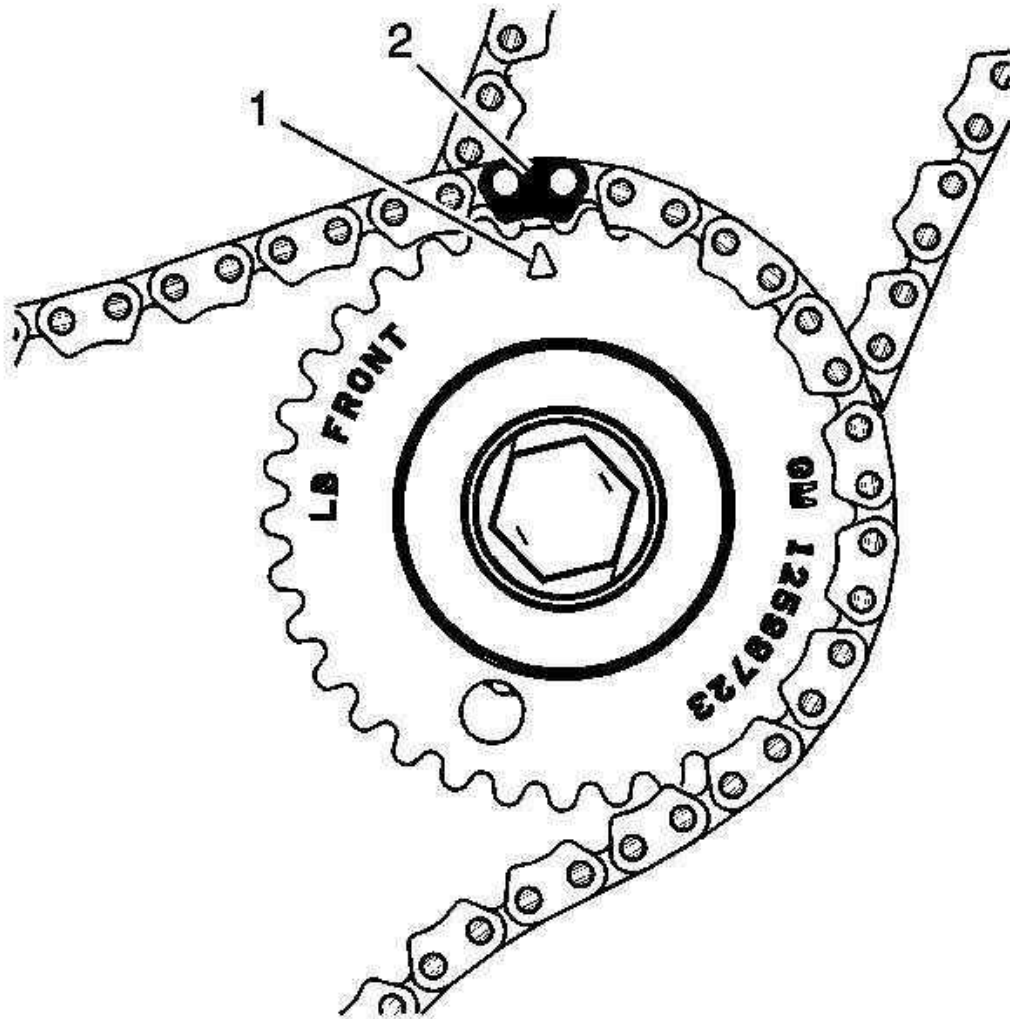


Fig. 124: View Of Camshaft Timing Marks
Courtesy of GENERAL MOTORS CORP.

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

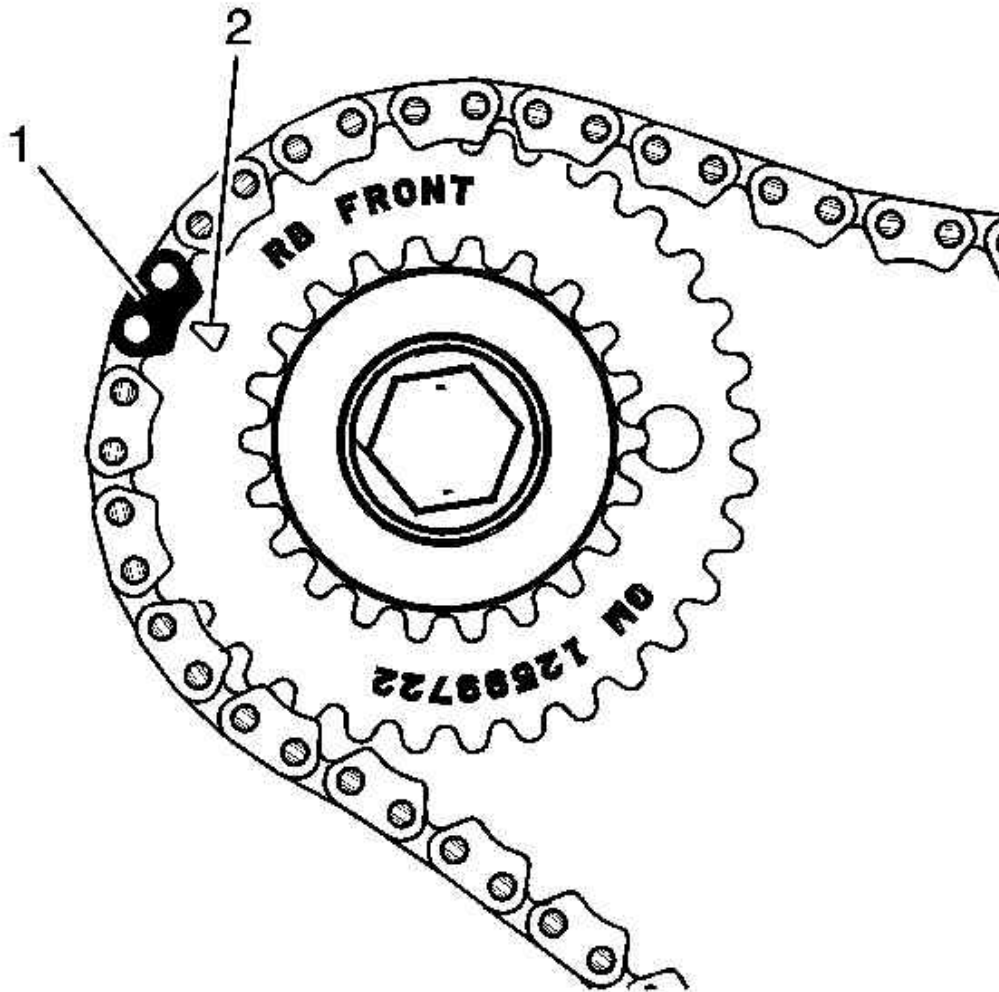


Fig. 125: View Of Right Camshaft Timing Marks
Courtesy of GENERAL MOTORS CORP.

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

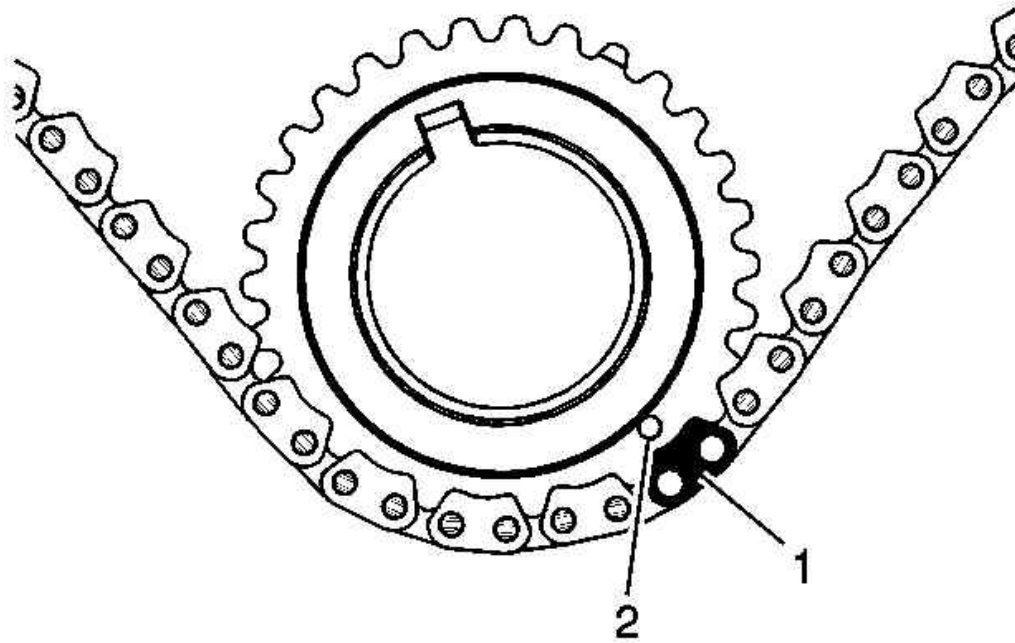


Fig. 126: View Of Crankshaft Sprocket Timing Mark & Timing Chain Link

Courtesy of GENERAL MOTORS CORP.

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

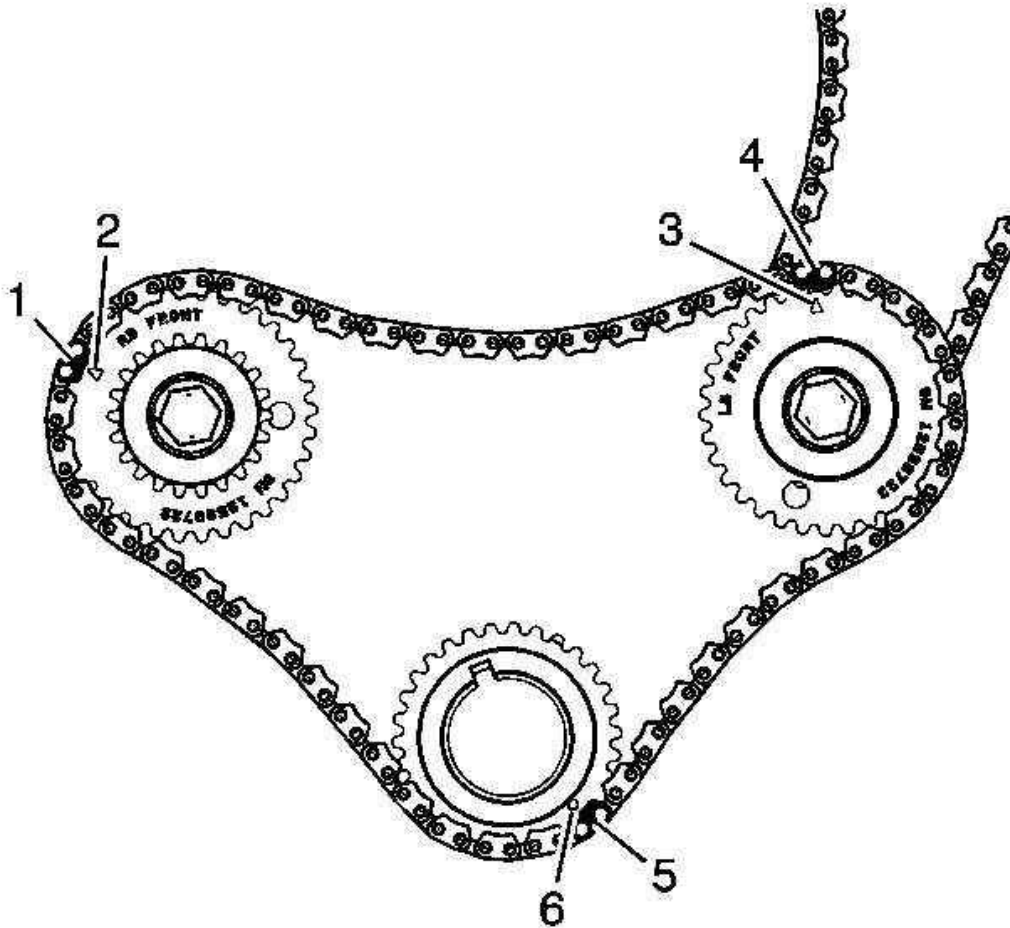


Fig. 127: View Of Timing Marks And Drive Chain Links
Courtesy of GENERAL MOTORS CORP.

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

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - LOWER (FOURTH DESIGN)

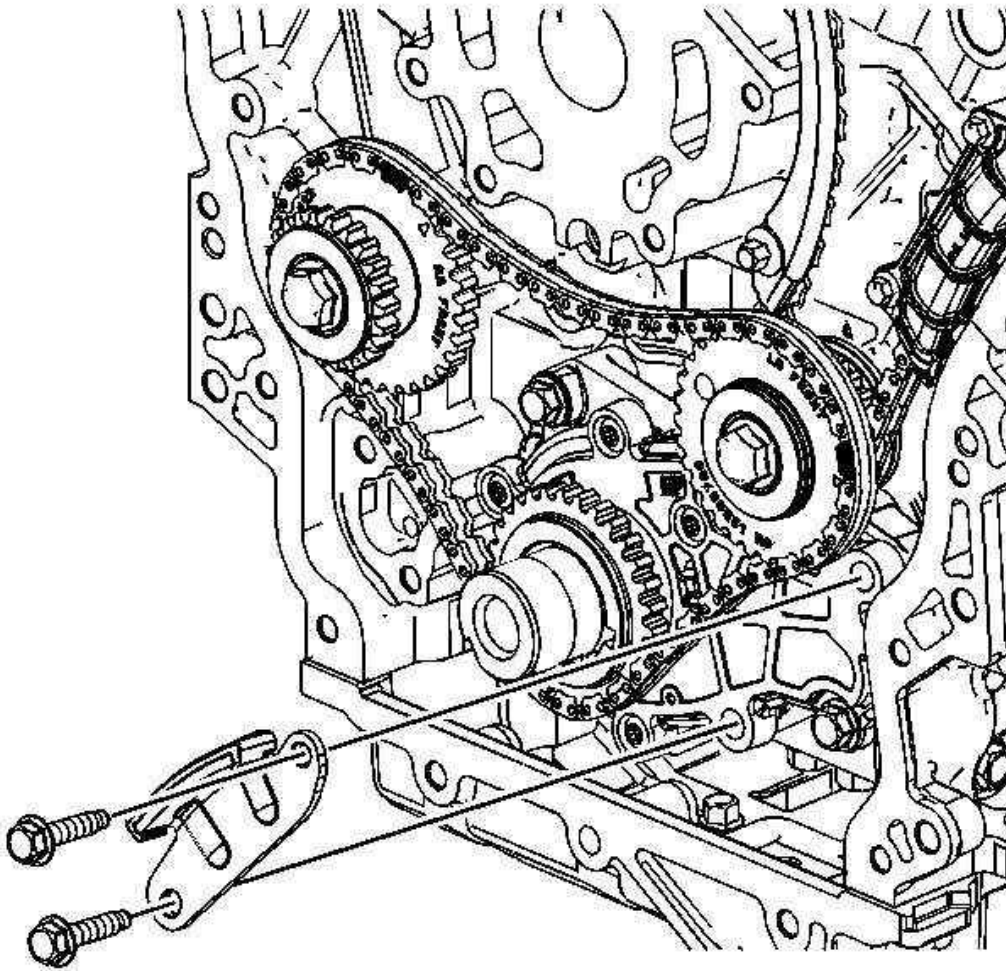


Fig. 128: View Of Primary Camshaft Drive Chain Lower Guide Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position the primary camshaft drive chain lower guide to the oil pump.

NOTE: Refer to Fastener Notice .

2. Install the primary camshaft drive chain lower guide bolts.

Tighten: Tighten the primary camshaft drive chain lower guide bolts to 23

N.m (17 lb ft).

PRIMARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - UPPER (FOURTH DESIGN)

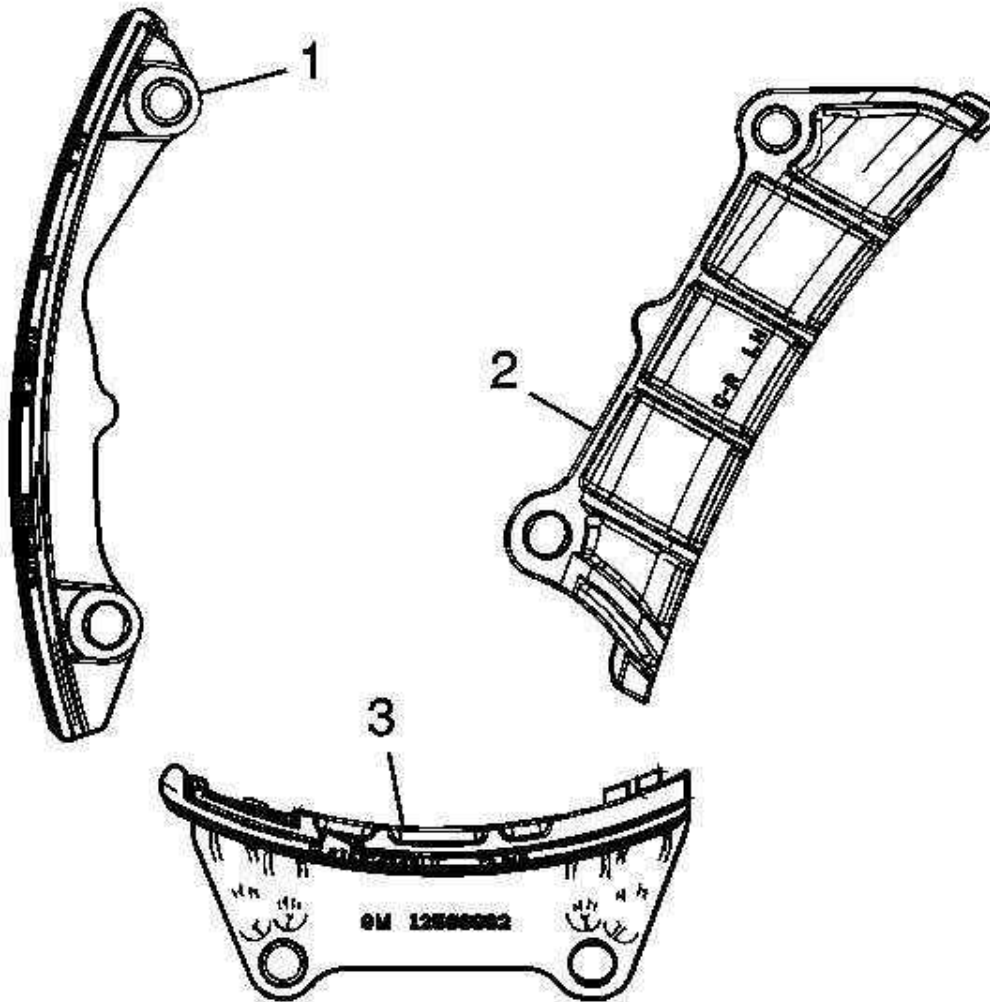


Fig. 129: View Of Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

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

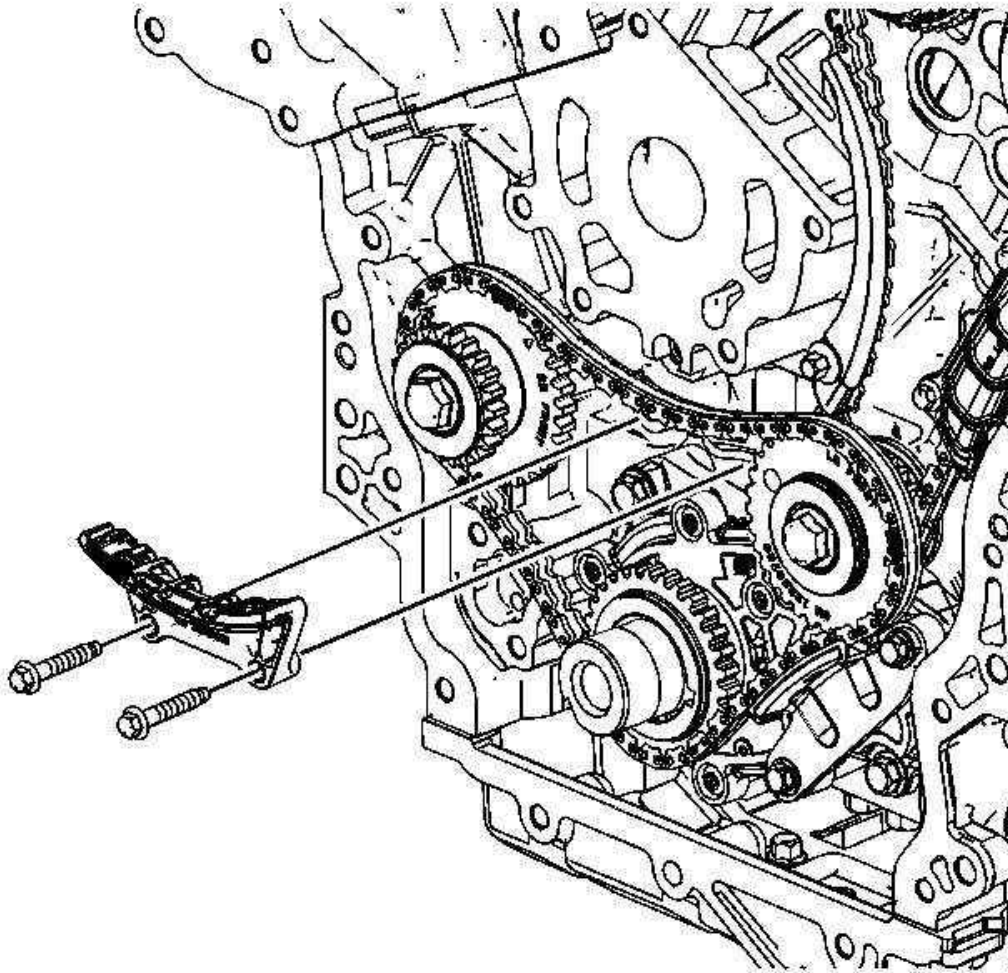


Fig. 130: Identifying Primary Camshaft Drive Chain Upper Guide & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the upper primary camshaft drive chain guides.

NOTE: Refer to Fastener Notice .

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

Tighten: Tighten the upper primary camshaft drive chain guide bolts to 23

N.m (17 lb ft).

PRIMARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION (FOURTH DESIGN)

Tools Required

- **EN 46105** Camshaft Locking Tool. See **Special Tools** .
- **EN 46112** Tensioner Retraction Pins. See **Special Tools** .
- **EN-48383** Camshaft Retaining Tools
- **EN-48589** Crankshaft Rotation Socket. See **Special Tools** .
- **J 45027** Tensioner Tool. See **Special Tools** .

Installation

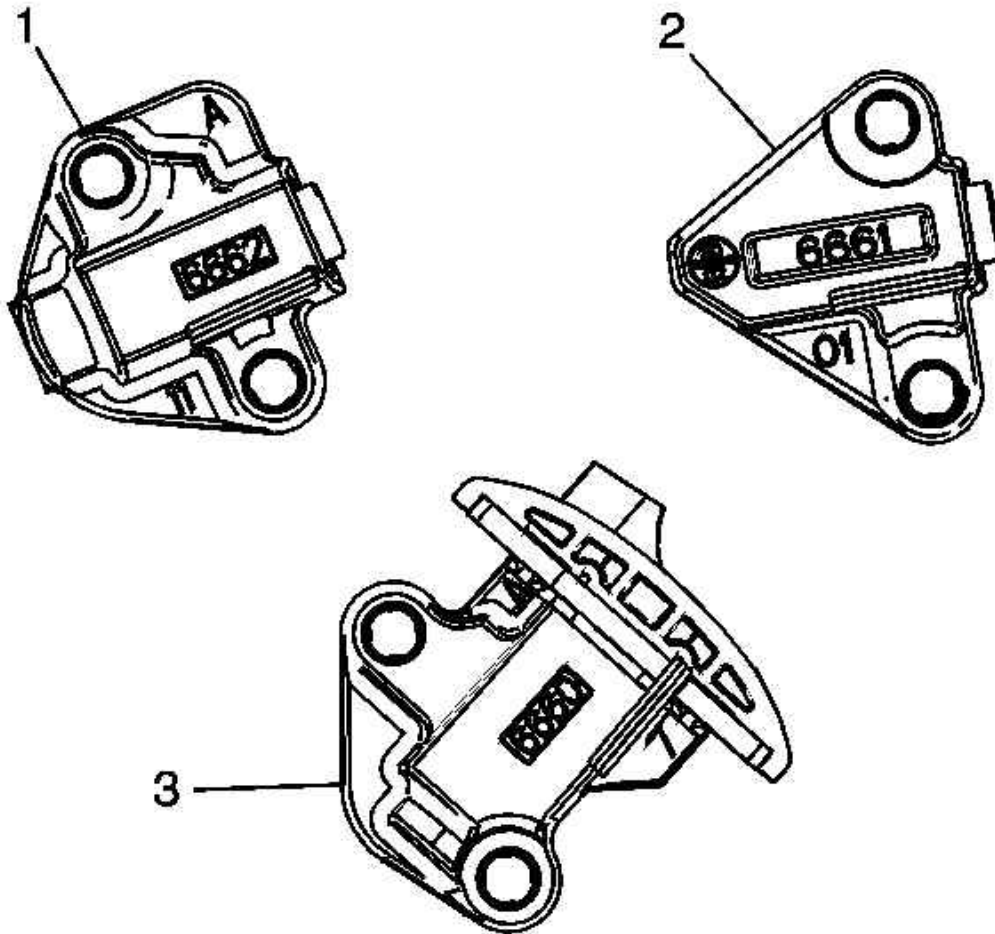


Fig. 131: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

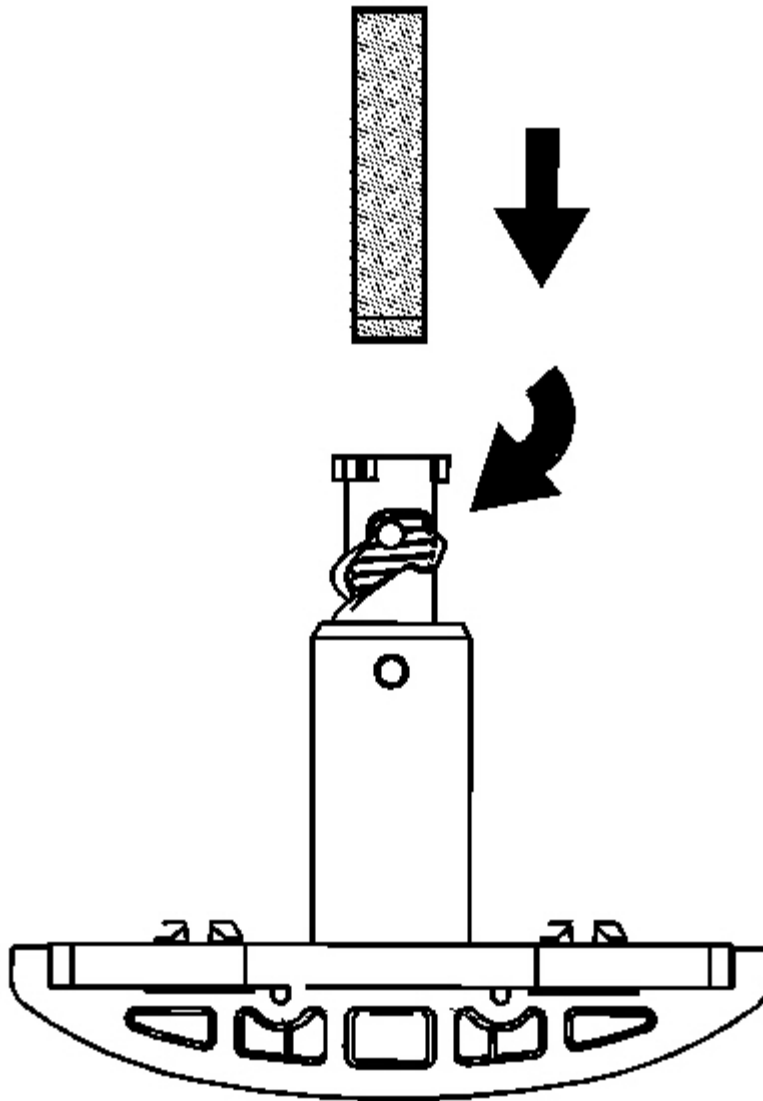


Fig. 132: View Of Primary Camshaft Drive Chain Tensioner Plunger & J 45027

Courtesy of GENERAL MOTORS CORP.

2. Using the **J 45027** , reset the primary camshaft drive chain tensioner plunger. See **Special Tools** .

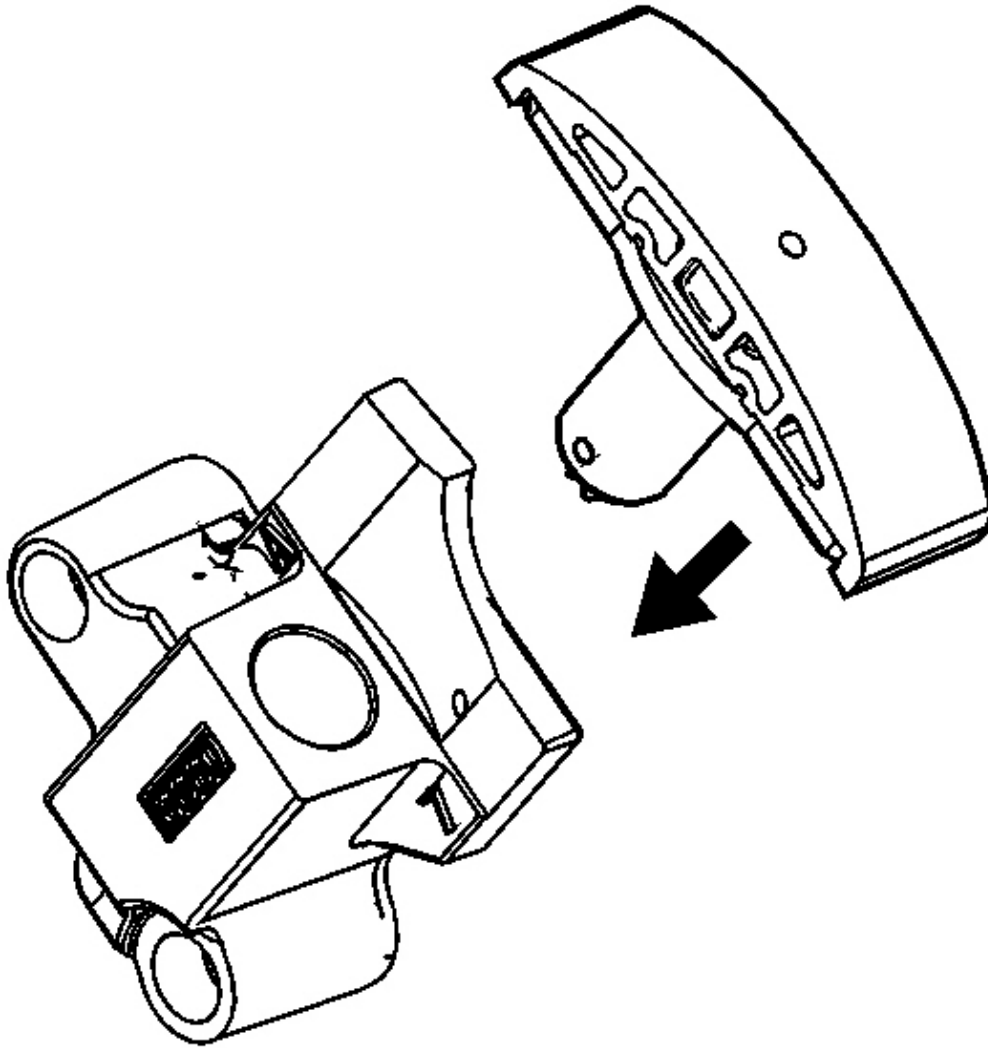


Fig. 133: View Of Plunger & Primary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

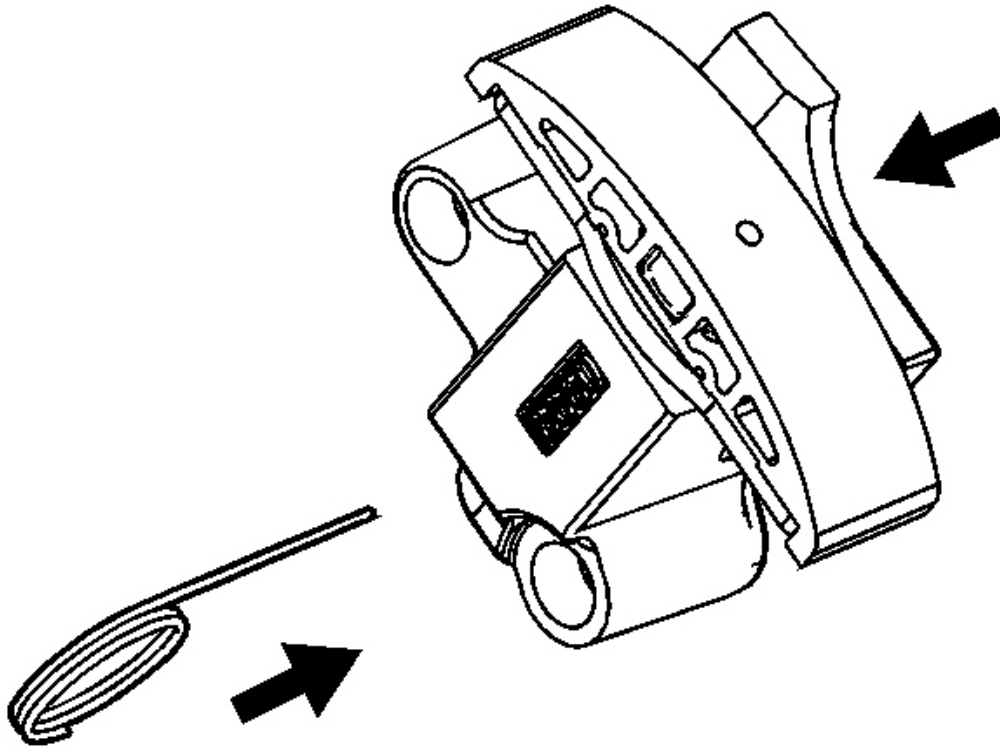


Fig. 134: Locking Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

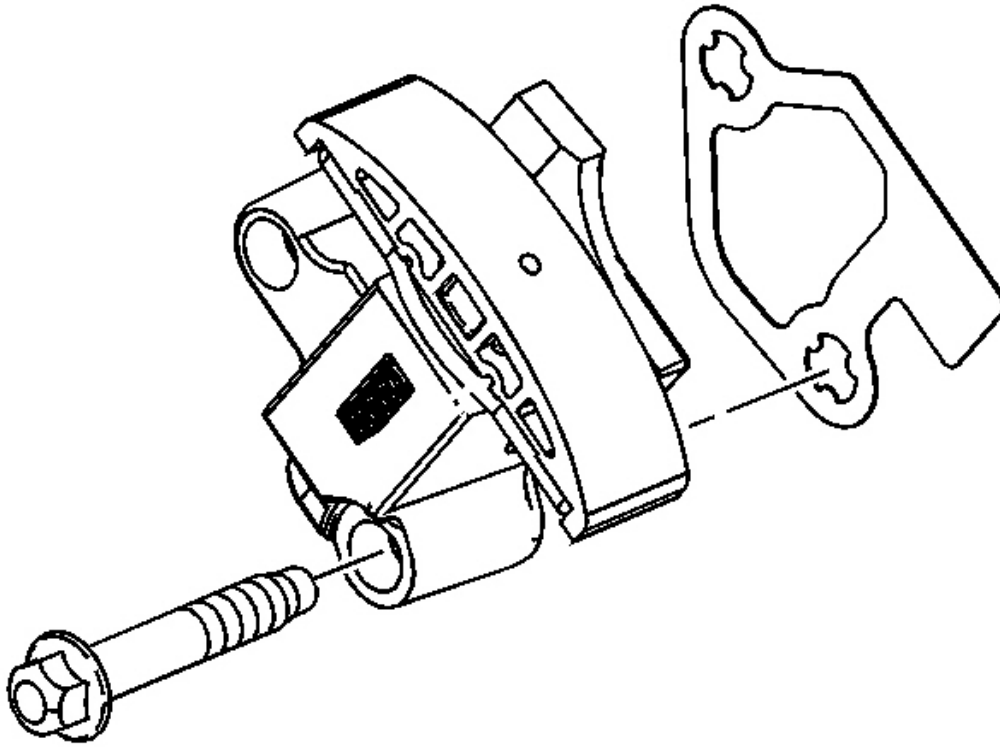


Fig. 135: Identifying Primary Camshaft Drive Chain Tensioner Gasket
Courtesy of GENERAL MOTORS CORP.

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

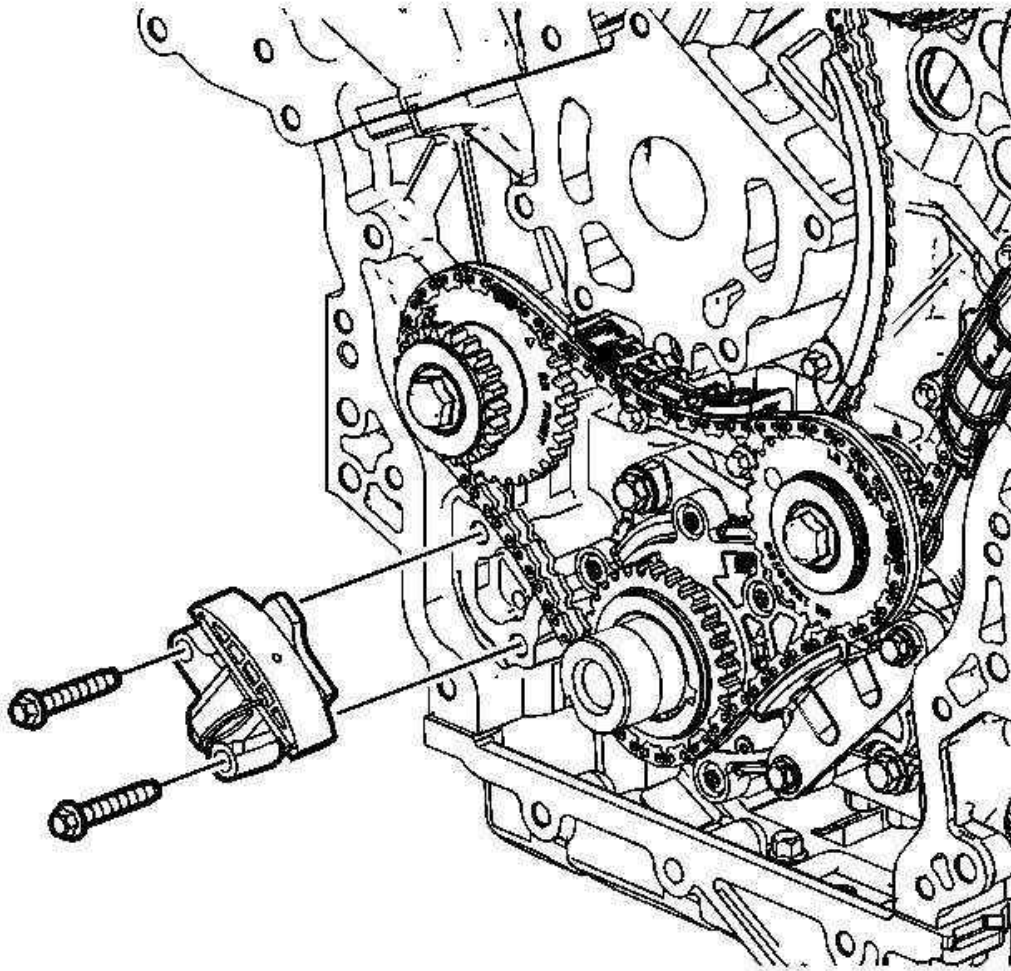


Fig. 136: View Of Primary Camshaft Drive Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

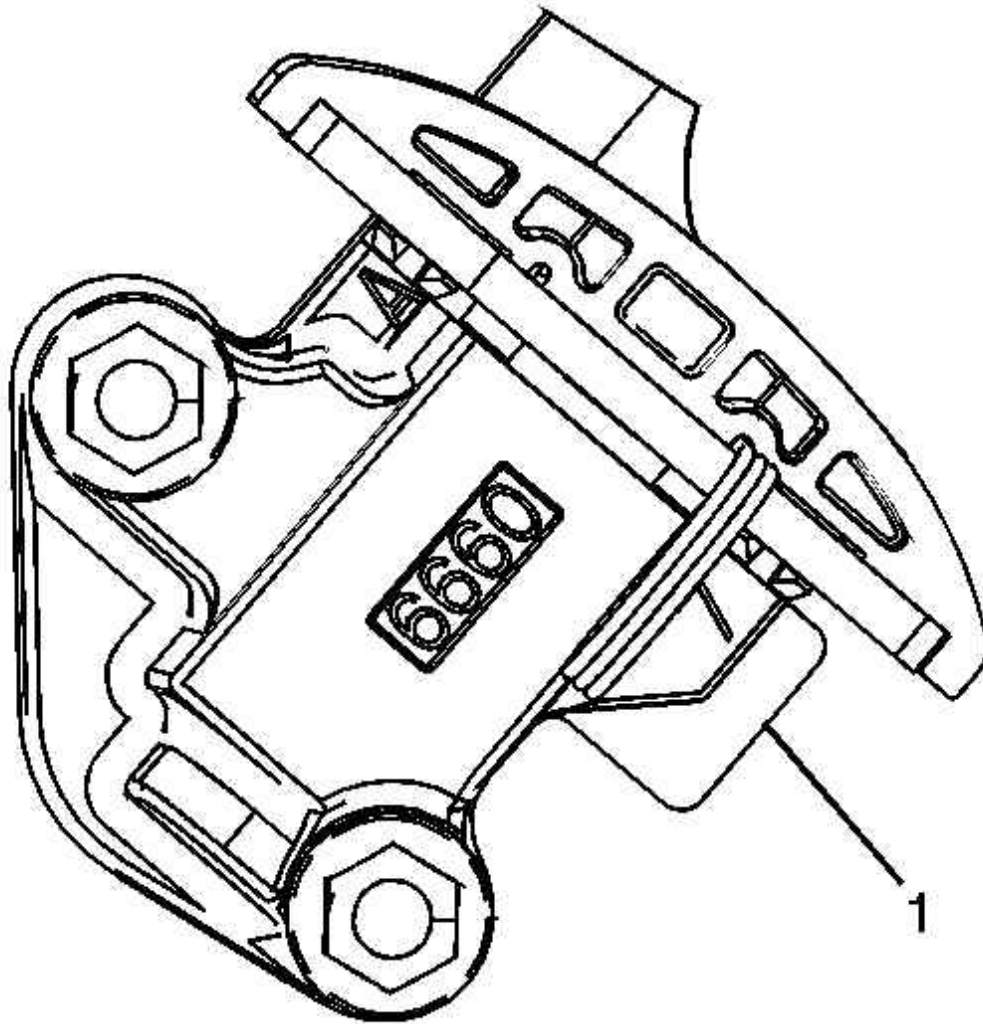


Fig. 137: Locating Primary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

1. First Pass

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

2. Final Pass

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

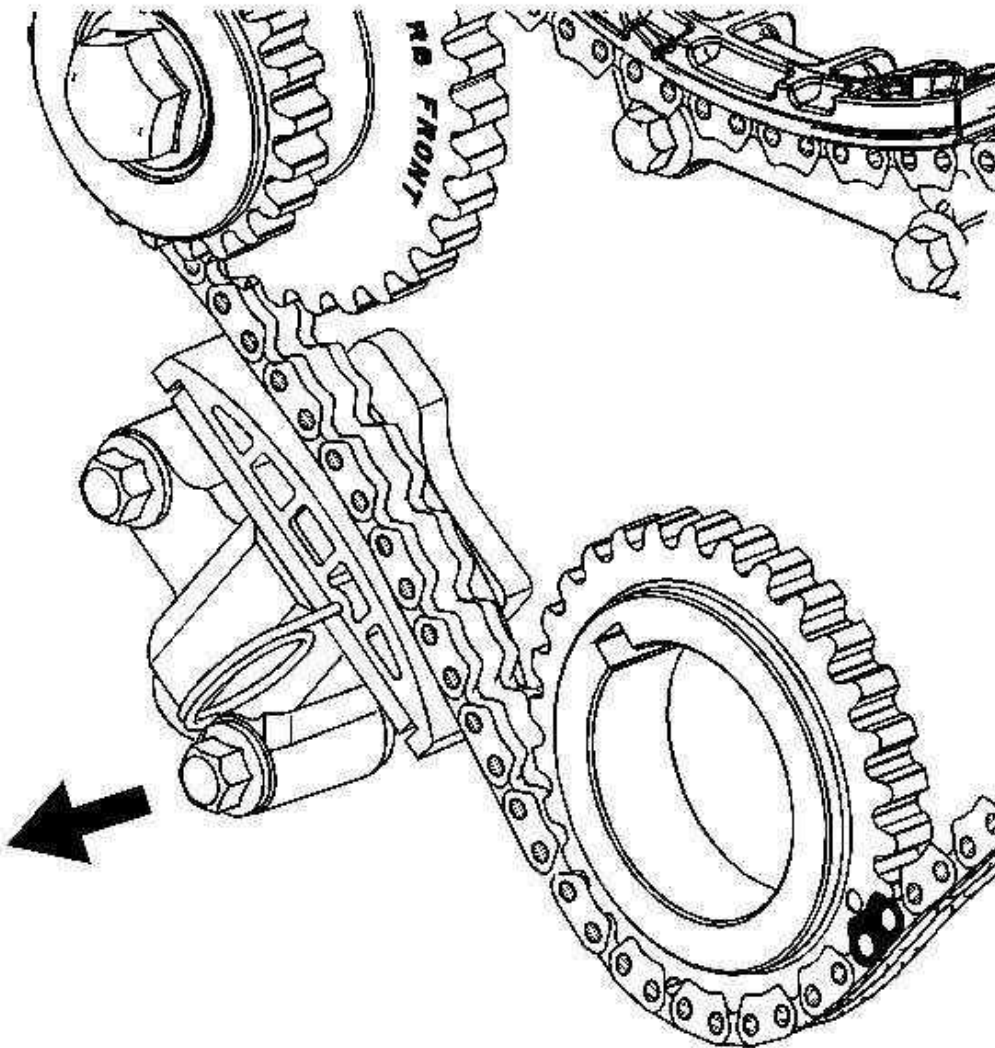


Fig. 138: View Of Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

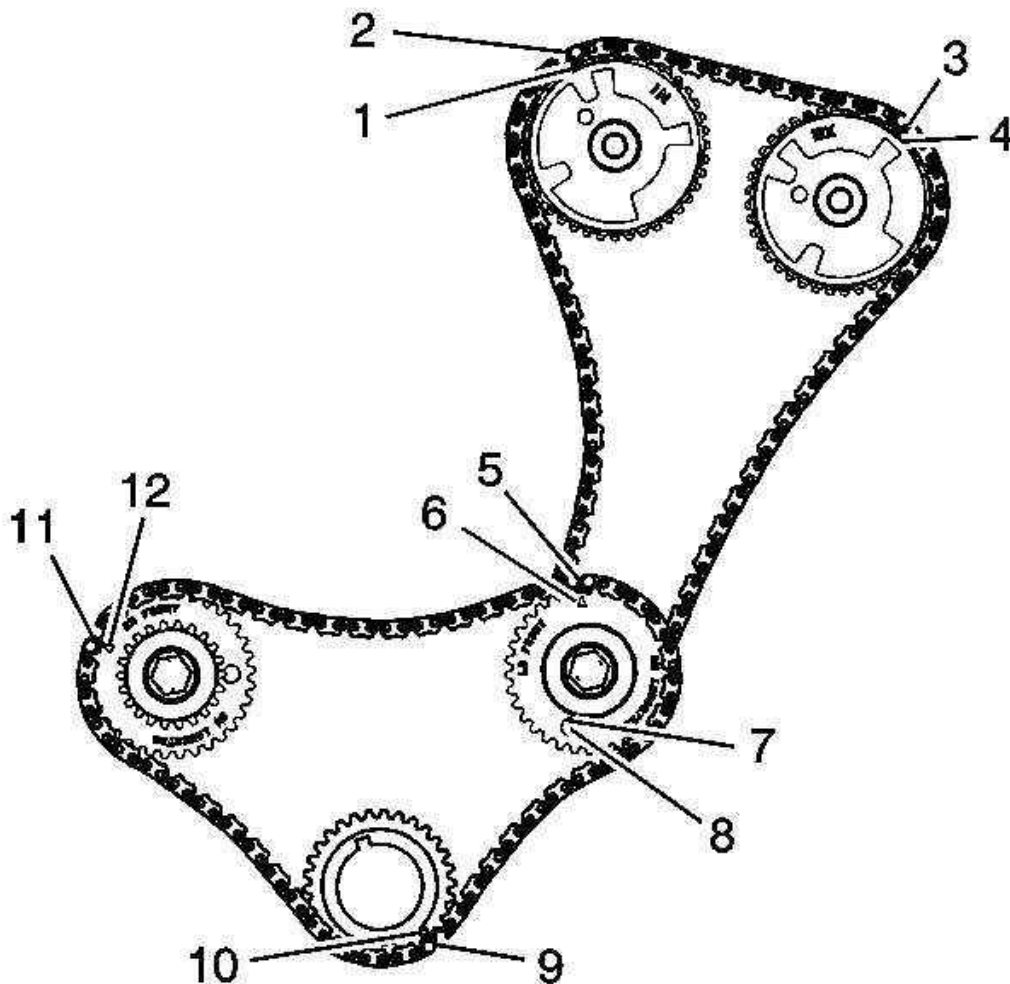


Fig. 139: View Of Left Secondary Camshaft Drive Chain Timing Marks
Courtesy of GENERAL MOTORS CORP.

12. Verify the primary and left secondary camshaft drive chain timing mark

alignments (1-12). Also refer to Camshaft Timing Drive Chain Alignment Diagram (Third Design) or Camshaft Timing Drive Chain Alignment Diagram (Fourth Design) - Stage One.

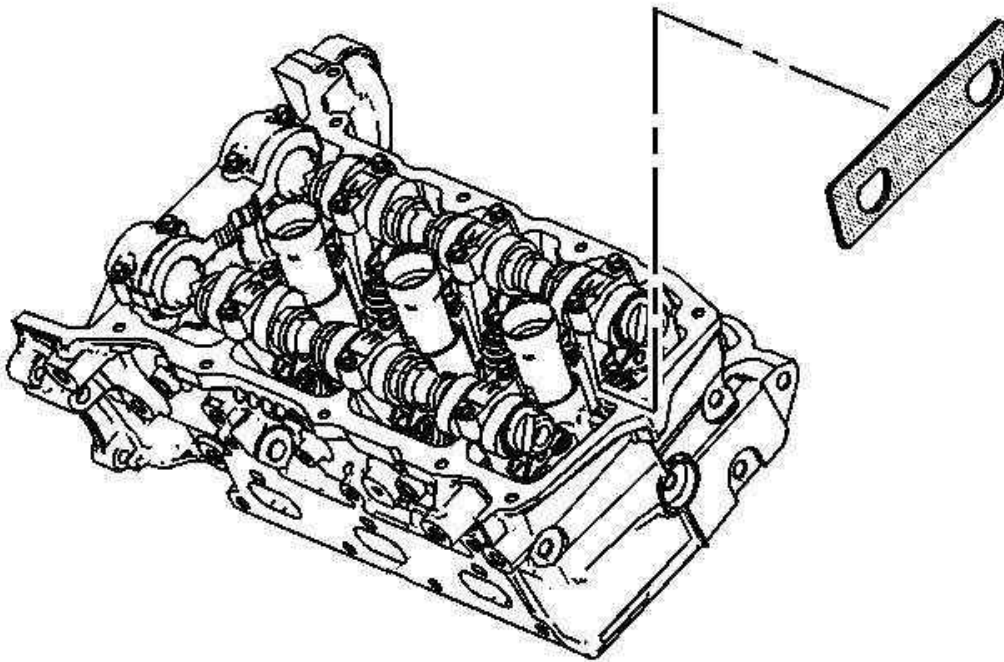


Fig. 140: Identifying Special Tools - EN 46105-1
Courtesy of GENERAL MOTORS CORP.

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

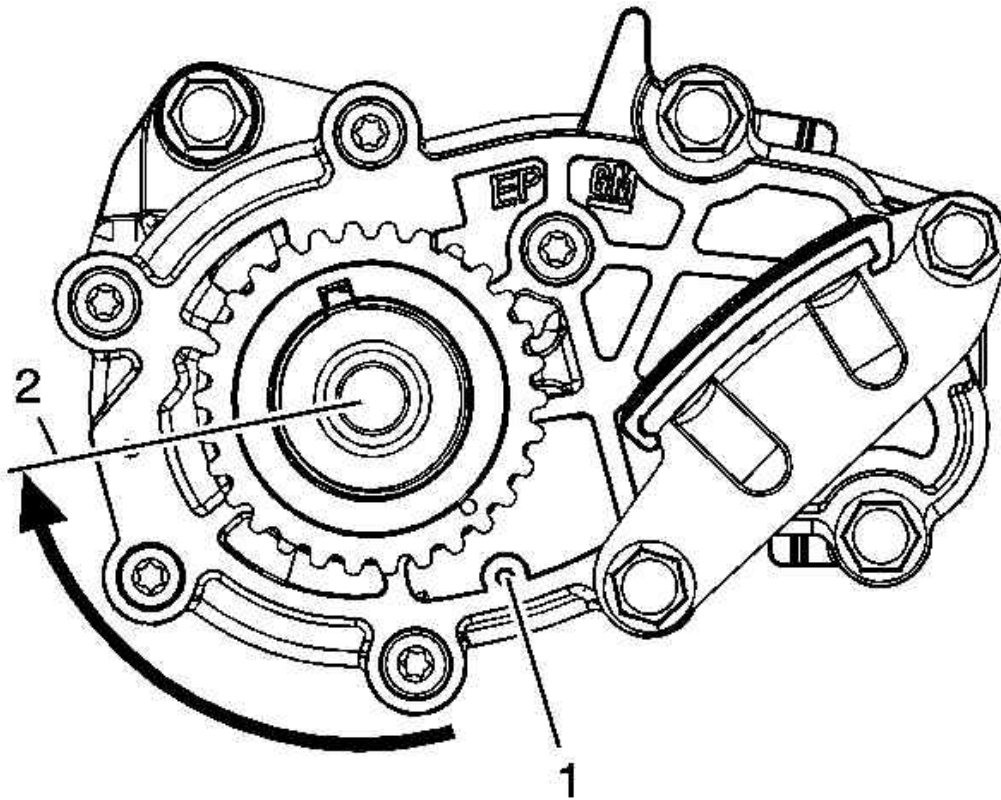


Fig. 141: View Of Stage 1 & Stage 2 Alignment Positions
Courtesy of GENERAL MOTORS CORP.

14. Using the **EN-48589** , rotate the crankshaft and crankshaft sprocket from the stage 1 alignment position (1) to the stage 2 alignment position (2), 115 crankshaft degrees, in order to install the right secondary camshaft drive chain components. See **Special Tools** .

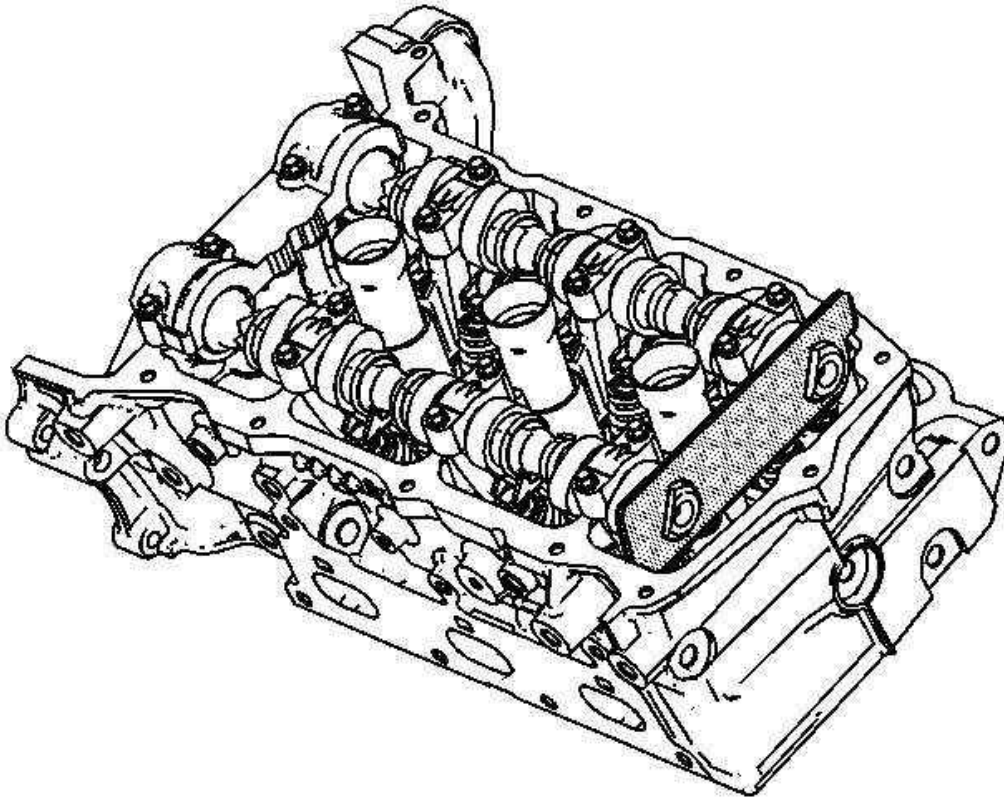


Fig. 142: EN 46105-2 Installed To Left Camshafts
Courtesy of GENERAL MOTORS CORP.

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

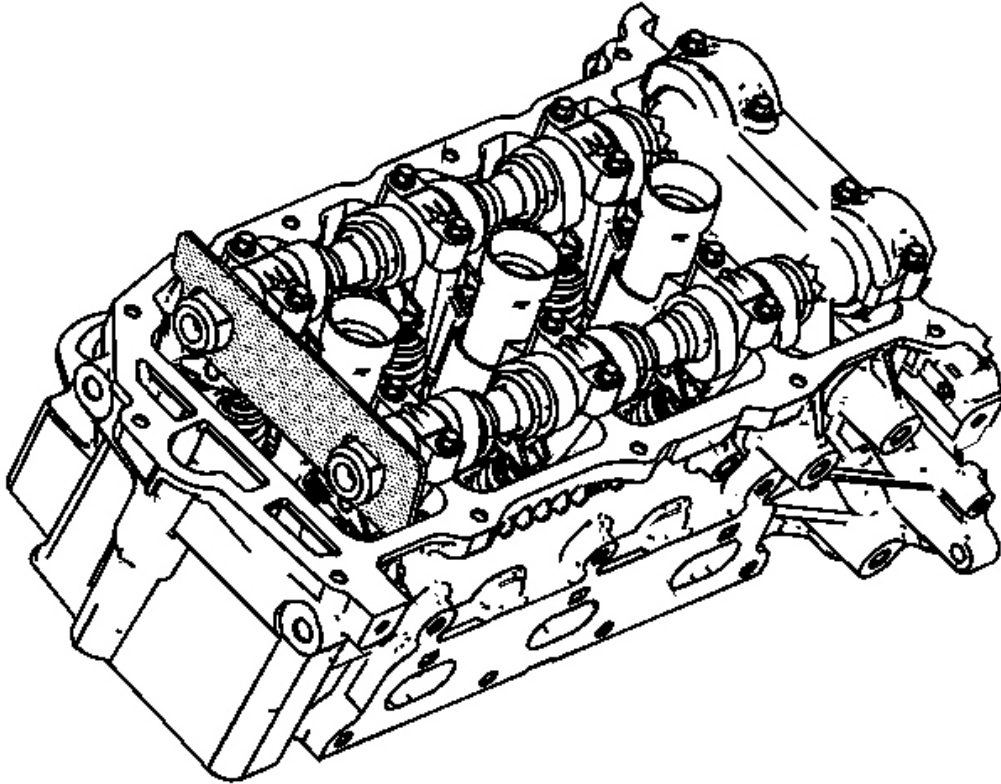


Fig. 143: EN 46105-1 Installed To Right Camshafts
Courtesy of GENERAL MOTORS CORP.

16. Install the EN 48383-3 onto the rear of the right camshafts.

SECONDARY CAMSHAFT DRIVE CHAIN INSTALLATION - RIGHT SIDE (FOURTH DESIGN)

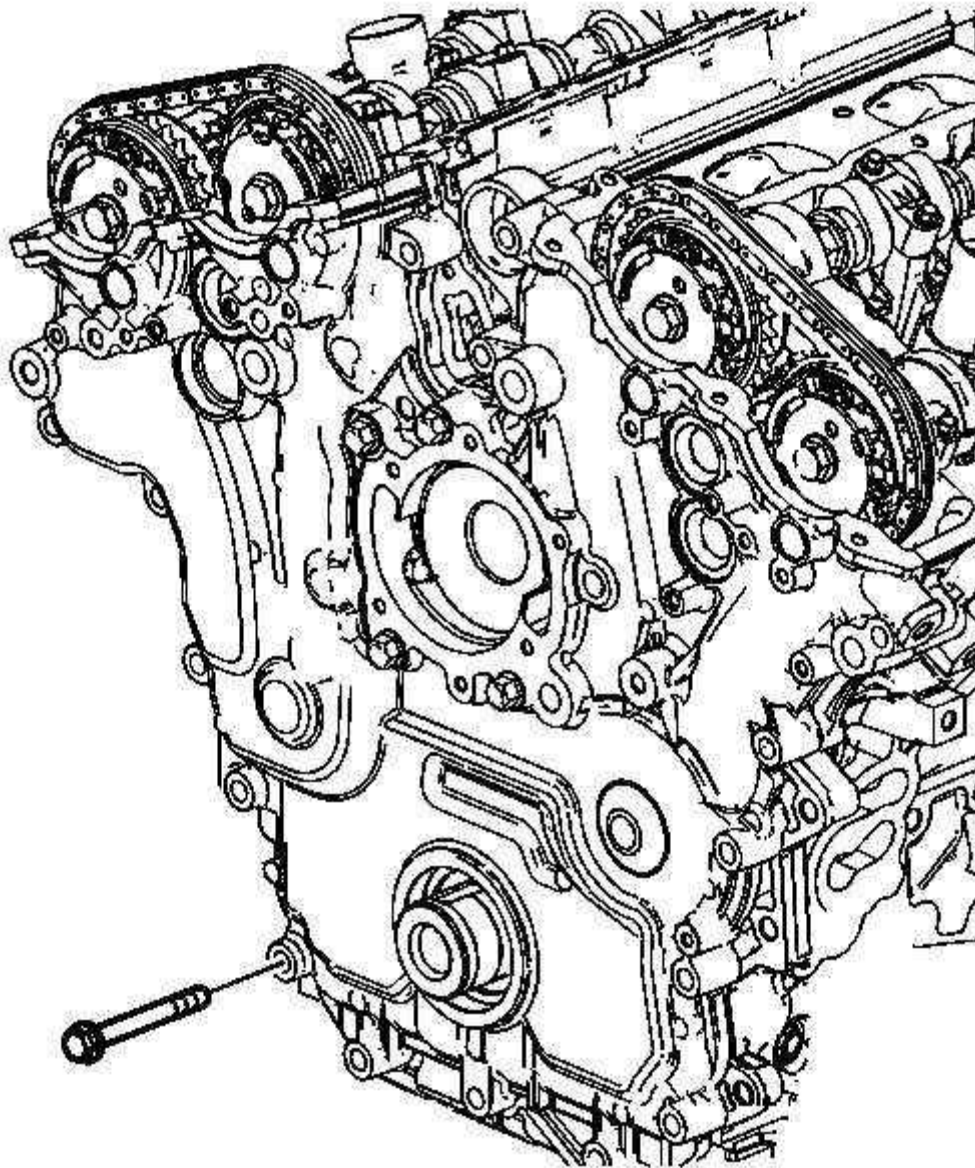


Fig. 144: View Of Drive Chain Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Ensure that the crankshaft is in the stage 2 timing drive assembly position (1).

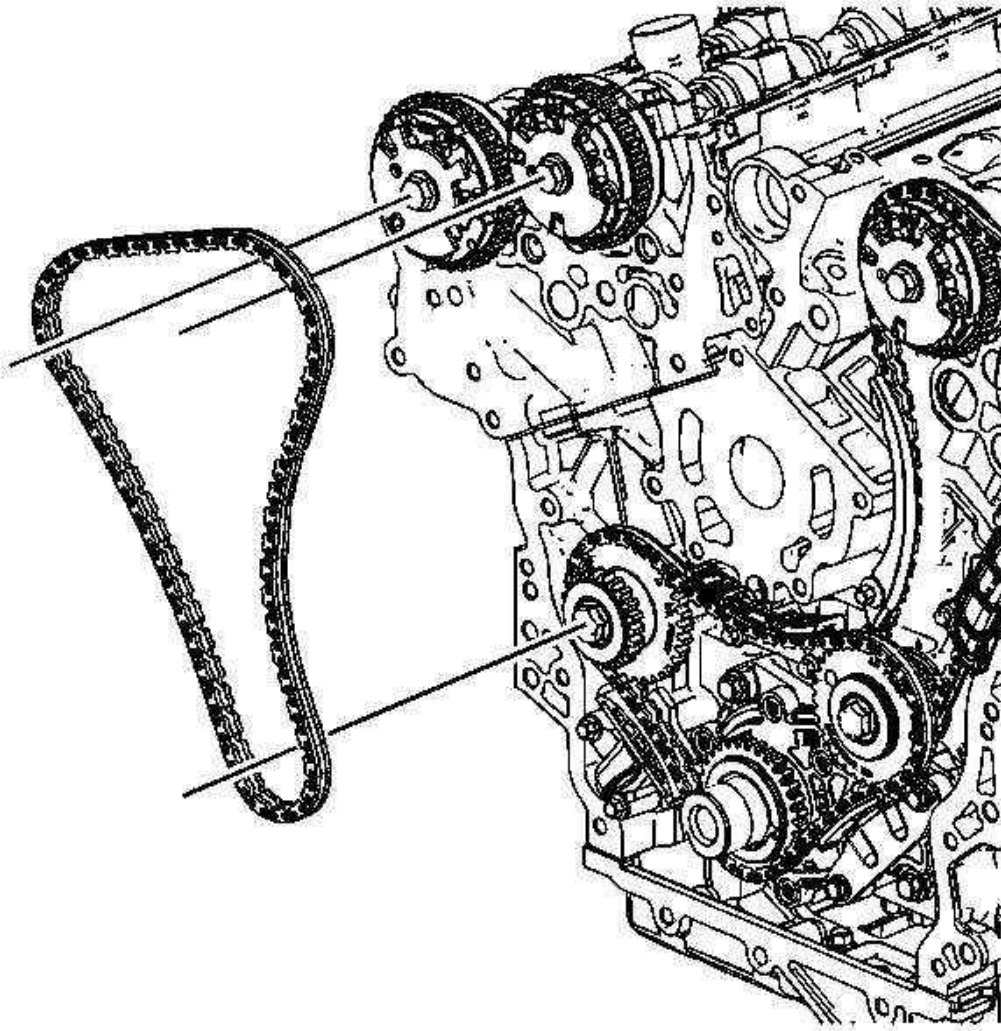


Fig. 145: View Of Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

2. Install the right secondary camshaft drive chain.

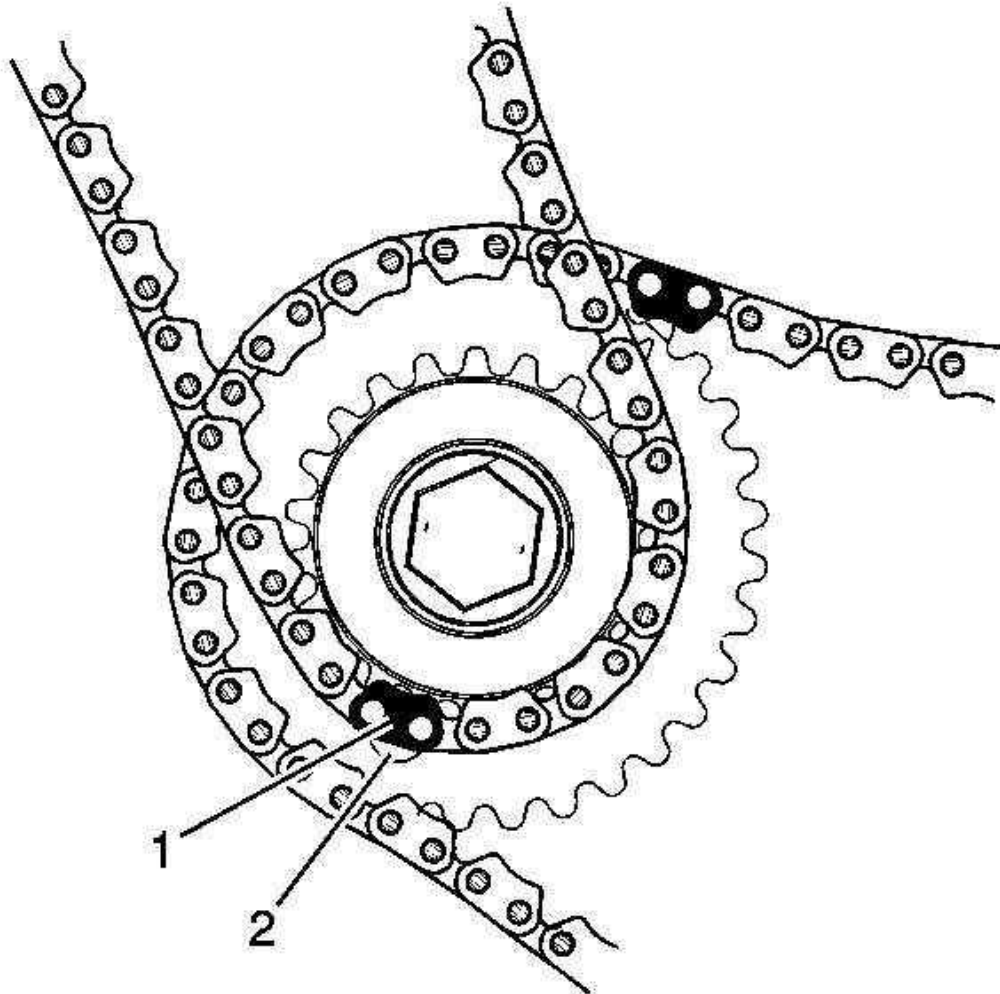


Fig. 146: View Of Timing Camshaft Drive Chain Link And Alignment Access Hole

Courtesy of GENERAL MOTORS CORP.

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

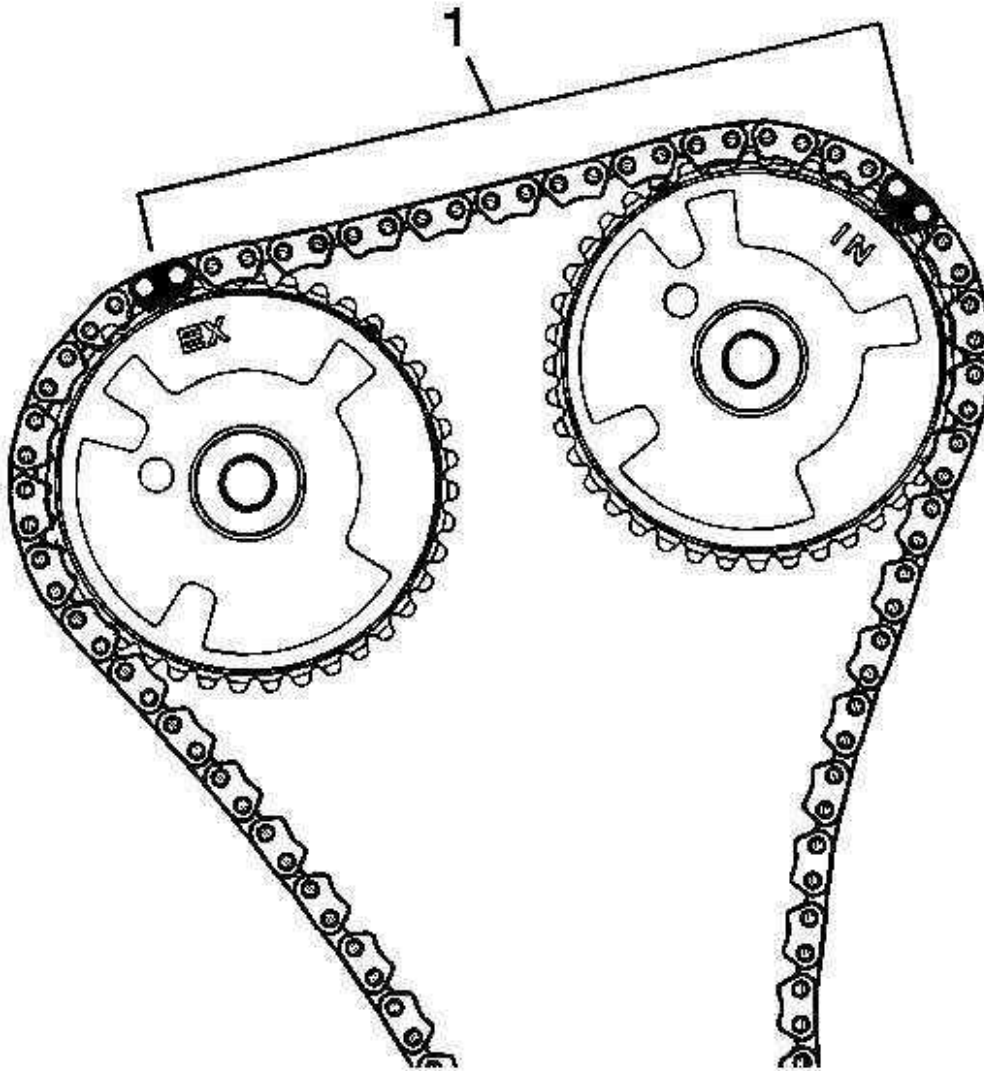


Fig. 147: View Of Links

Courtesy of GENERAL MOTORS CORP.

4. Wrap the secondary camshaft drive chain around both right actuator drive sprockets.
5. Ensure there are 10 links (1) between the timing camshaft drive chain links for the camshaft position actuator sprockets.

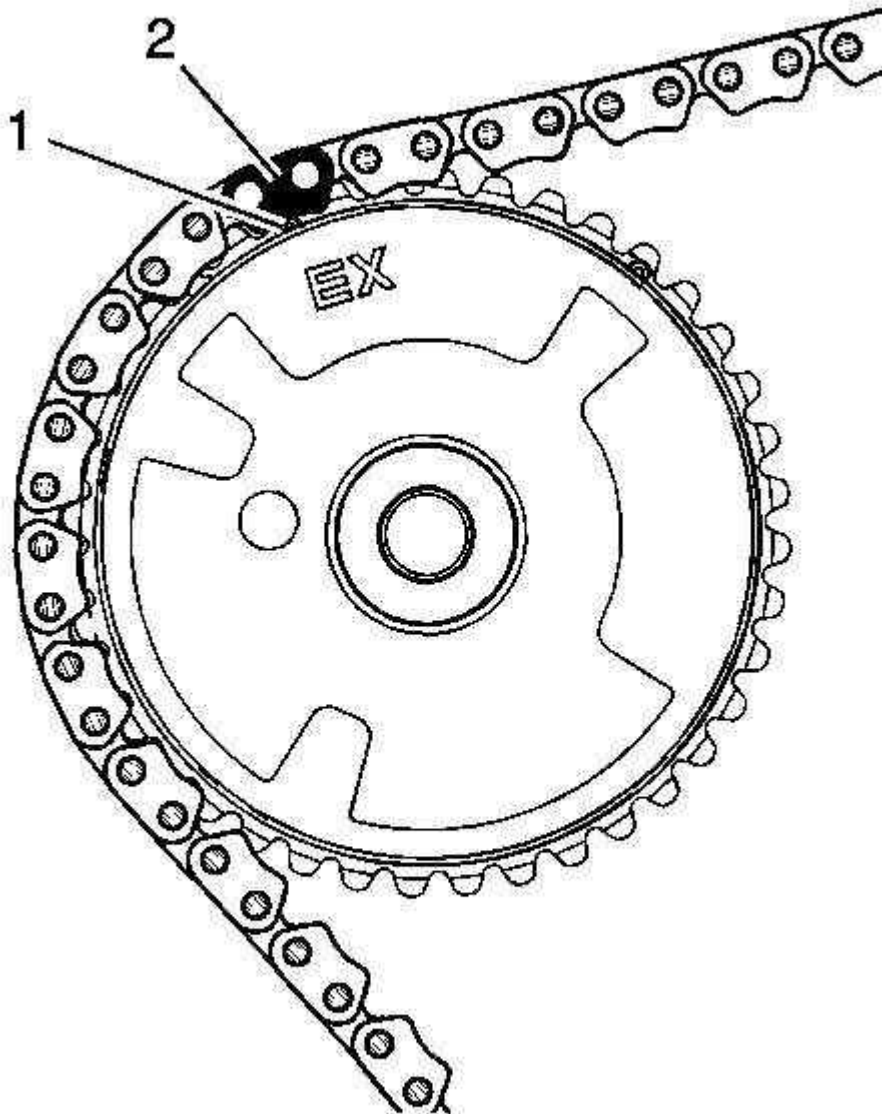


Fig. 148: View Of Camshaft Marks
Courtesy of GENERAL MOTORS CORP.

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

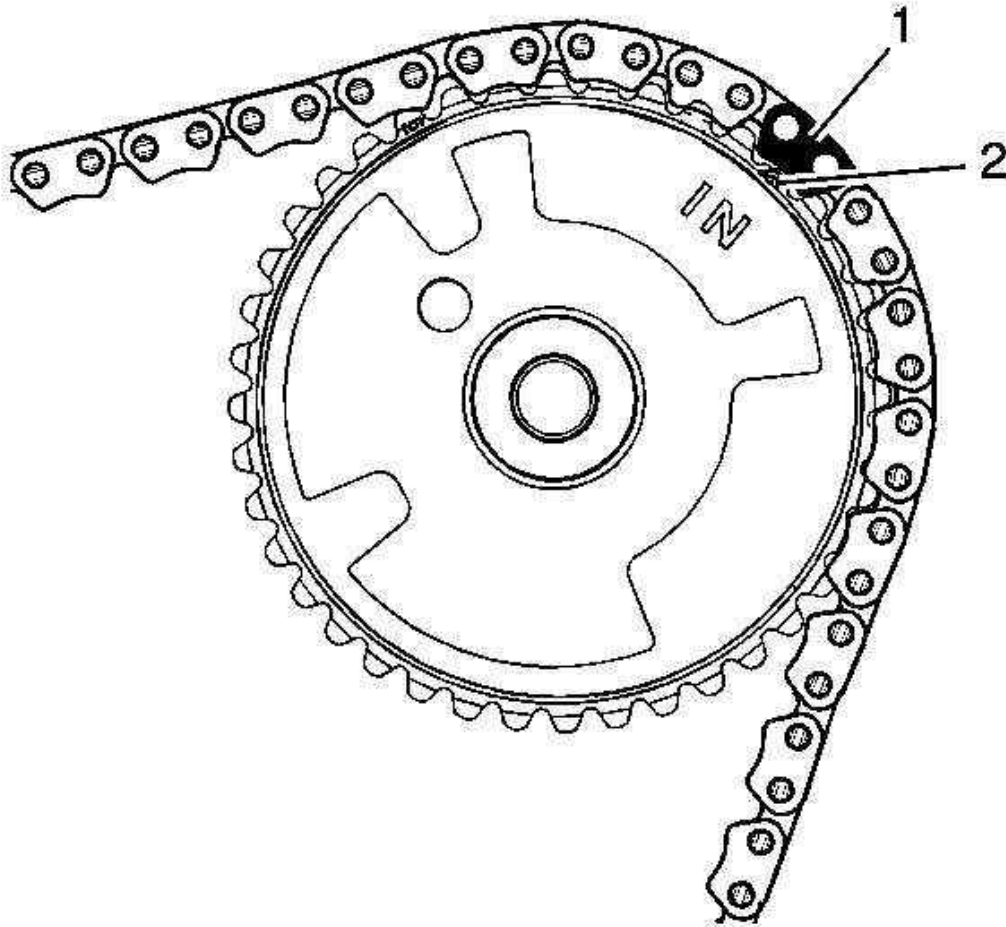


Fig. 149: View Of Right Intake Camshaft Position Actuator Sprocket Alignment Triangle Mark

Courtesy of GENERAL MOTORS CORP.

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

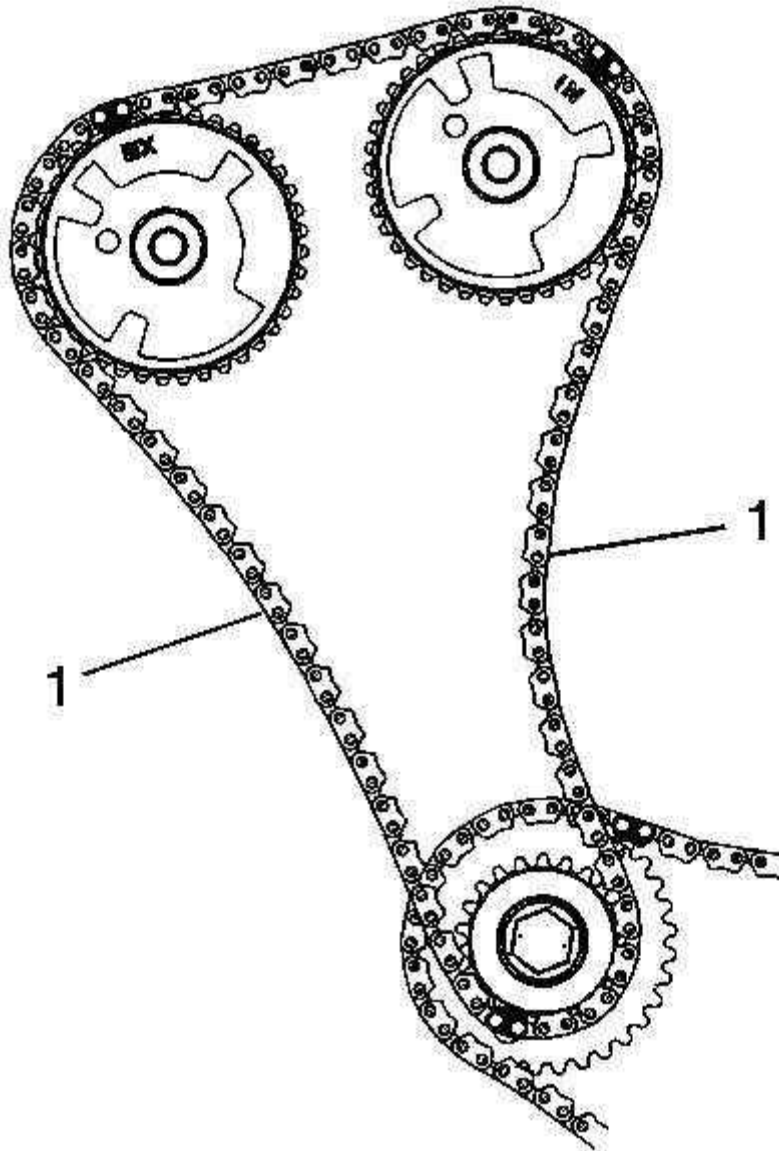


Fig. 150: View Of Links

Courtesy of GENERAL MOTORS CORP.

8. There will be 22 links (1) between the right camshaft intermediate drive chain idler timing camshaft drive chain link and each right camshaft position actuator

sprocket timing camshaft drive chain link.

SECONDARY CAMSHAFT DRIVE CHAIN GUIDE INSTALLATION - RIGHT SIDE (FOURTH DESIGN)

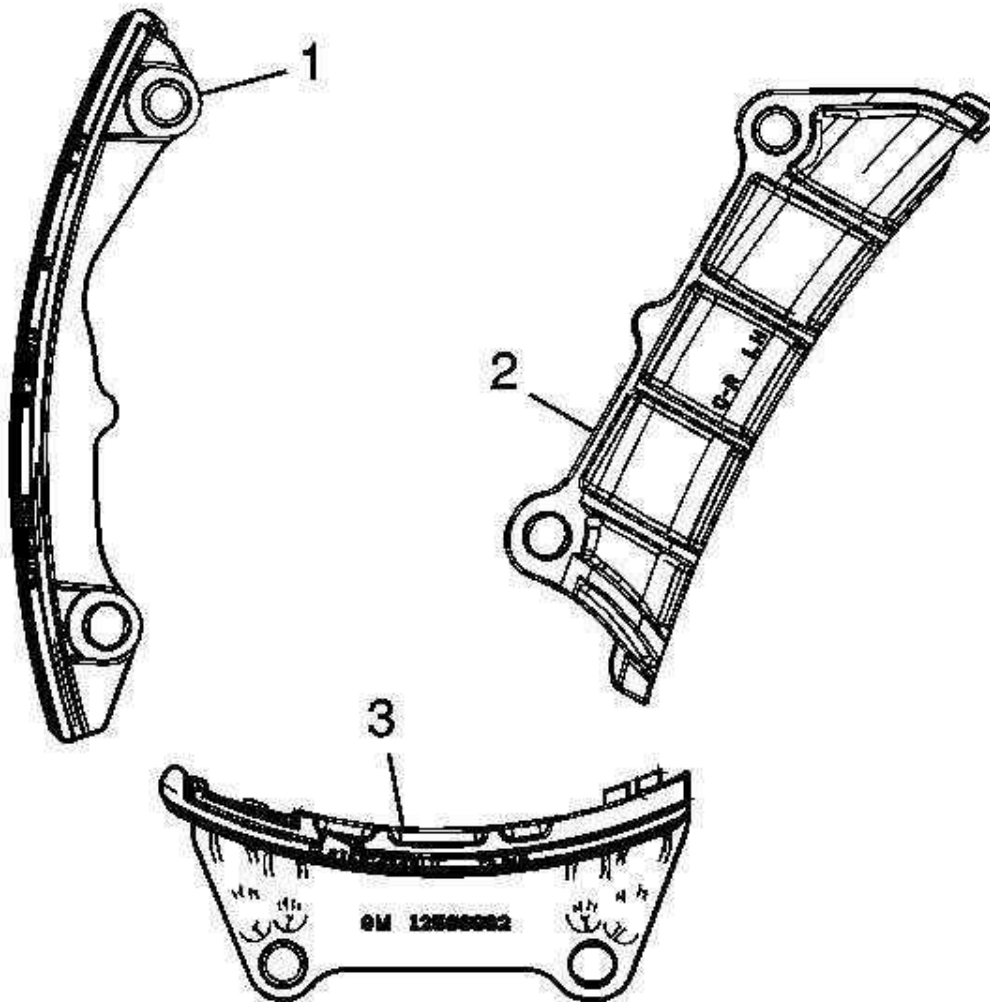


Fig. 151: View Of Secondary Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

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

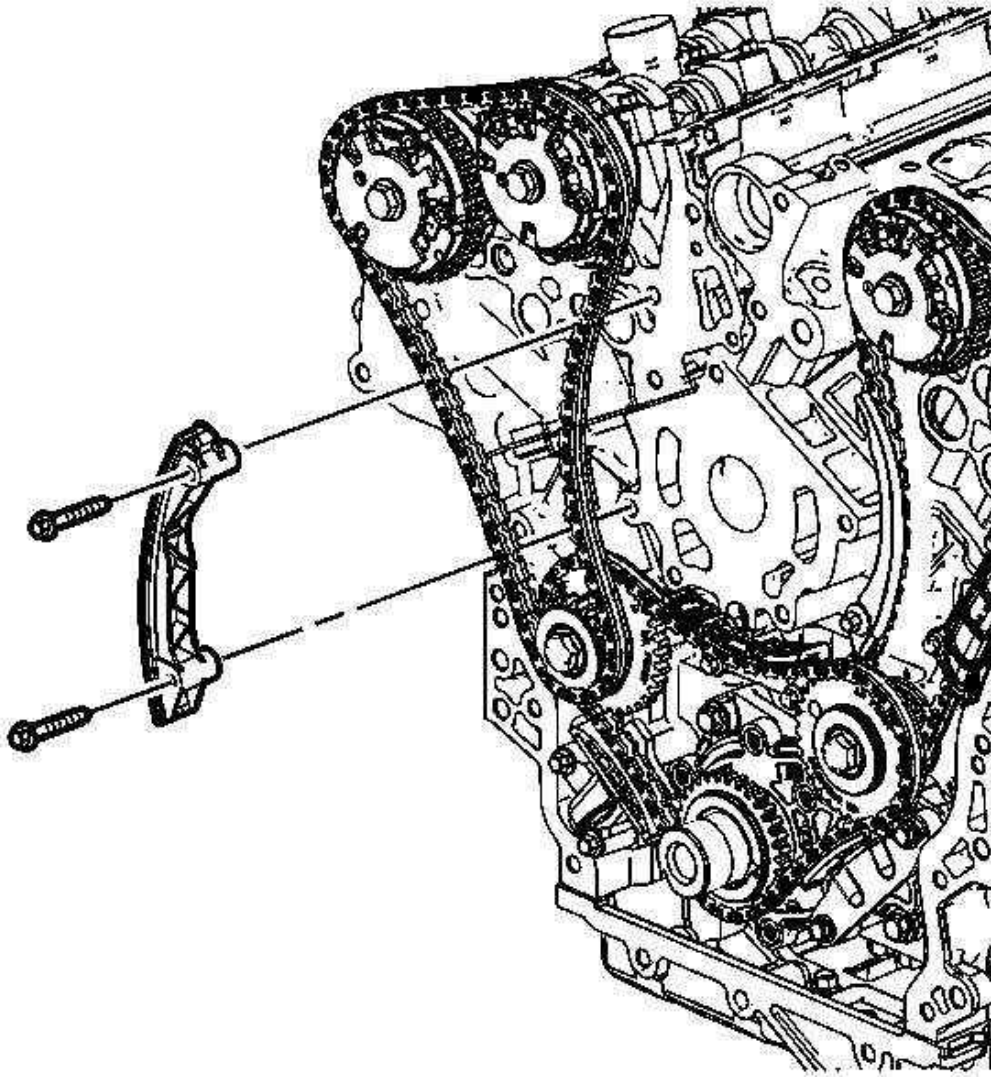


Fig. 152: Identifying Secondary Camshaft Drive Chain Guide And Bolts
Courtesy of GENERAL MOTORS CORP.

2. Position the right secondary camshaft drive chain guide.

NOTE: Refer to Fastener Notice .

3. Install the secondary camshaft drive chain guide bolts.

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

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE (FOURTH DESIGN)

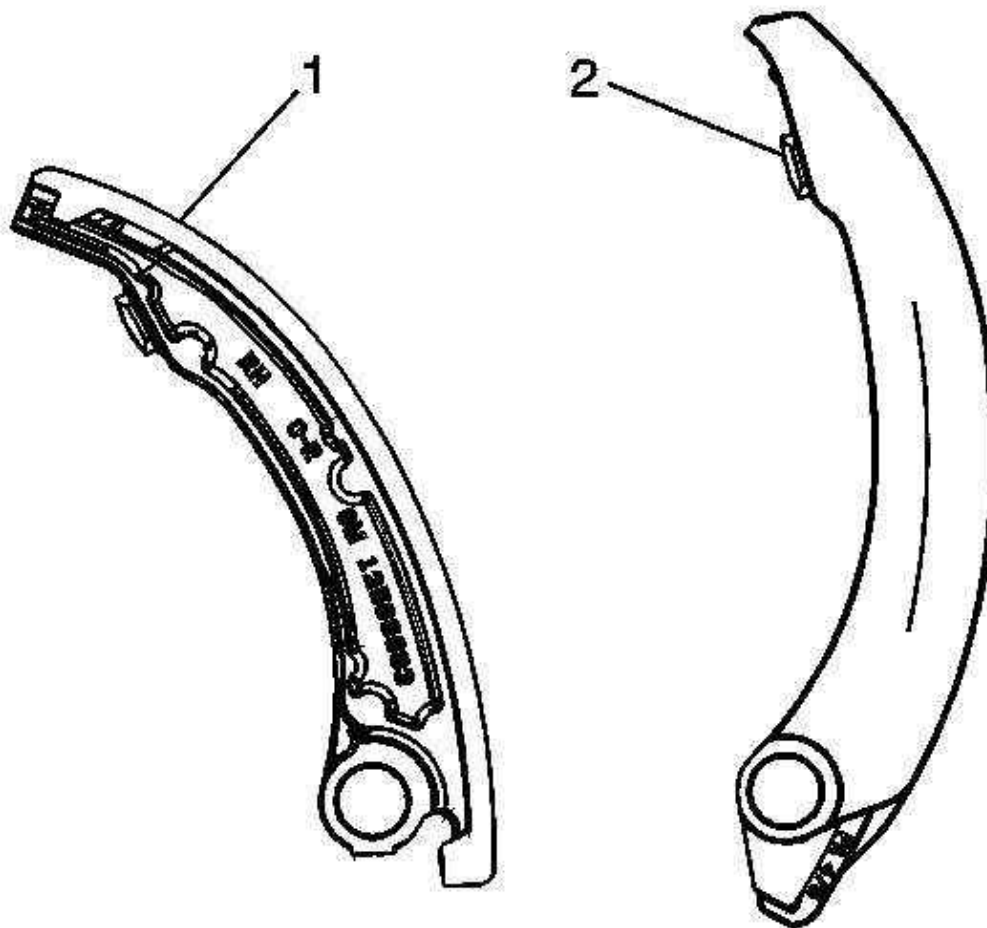


Fig. 153: View Of Left Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

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

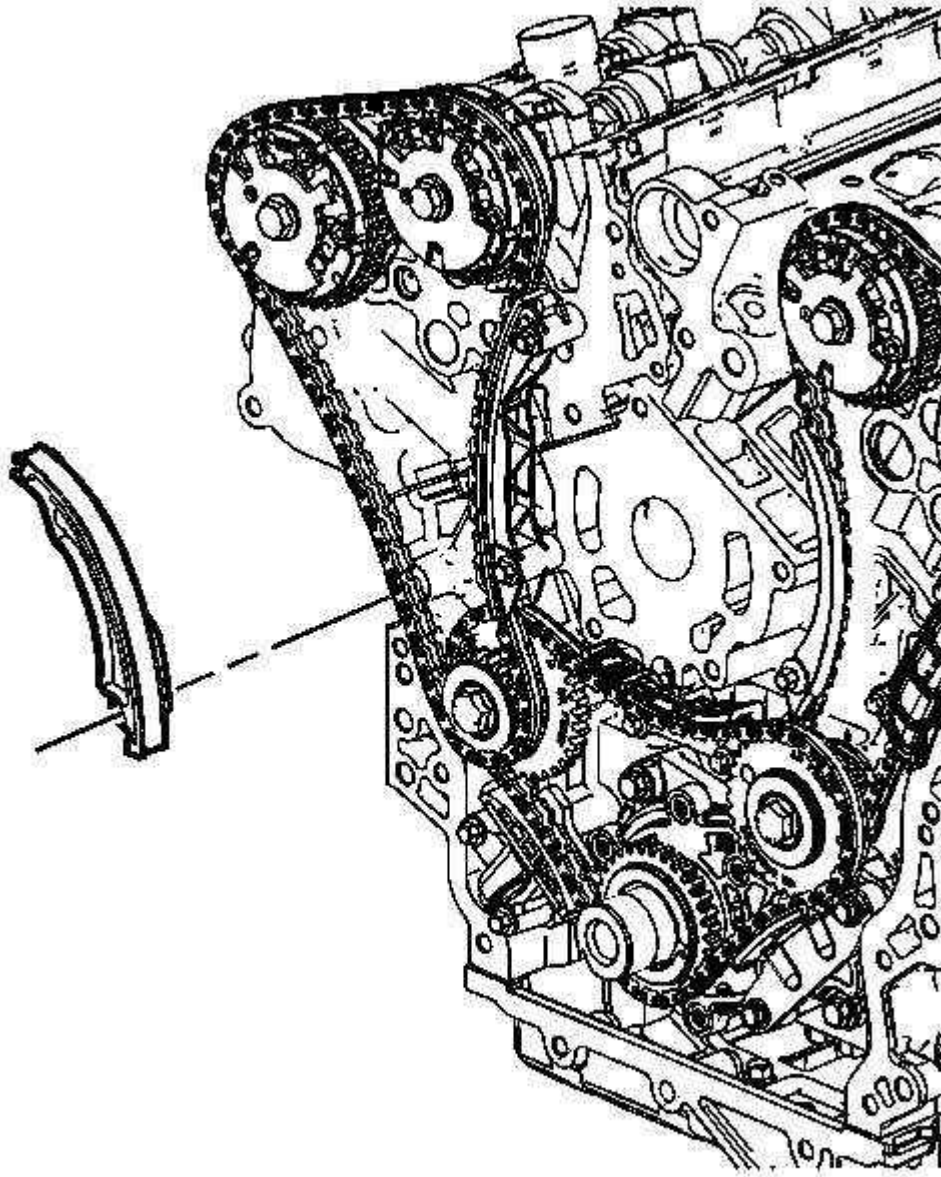


Fig. 154: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Position the right secondary camshaft drive chain shoe.

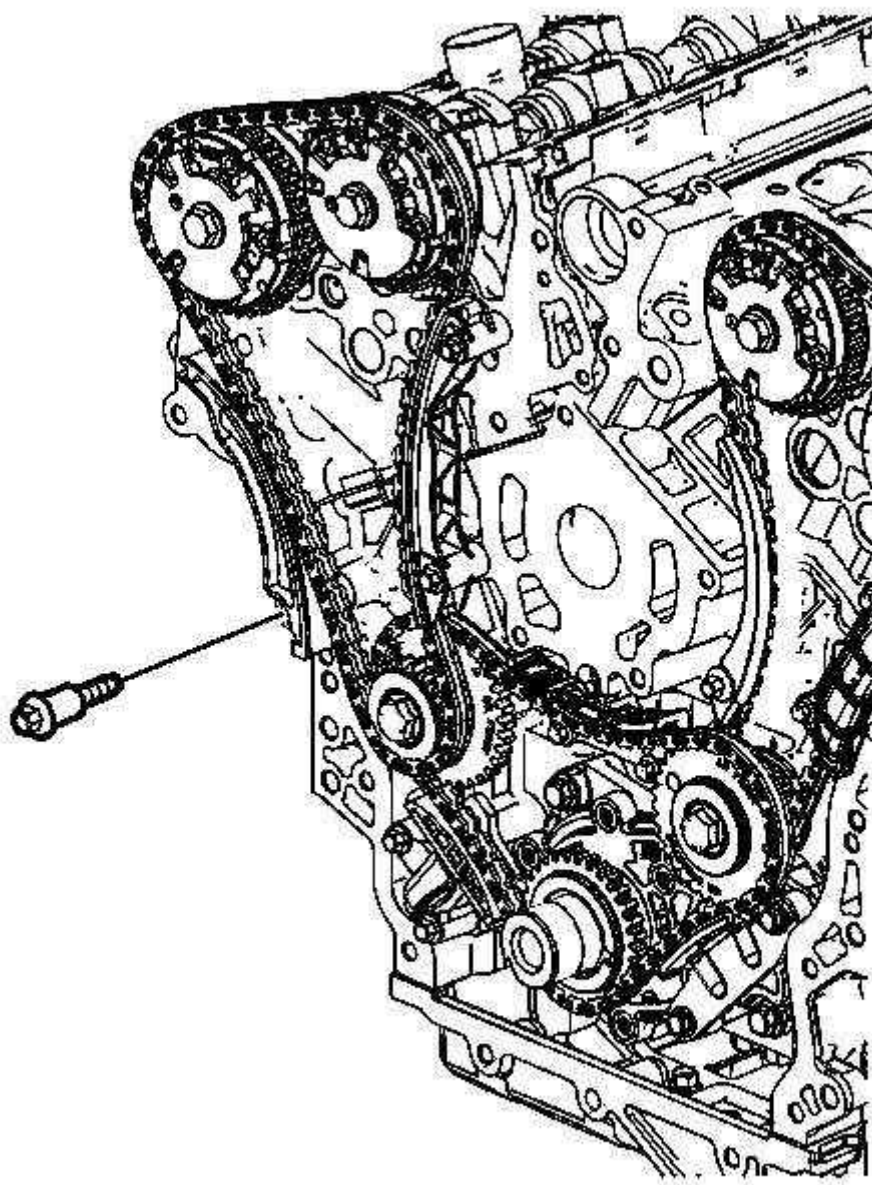


Fig. 155: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

3. Install the secondary camshaft drive chain shoe bolt.

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

SECONDARY CAMSHAFT DRIVE CHAIN TENSIONER INSTALLATION - RIGHT SIDE (FOURTH DESIGN)

Tools Required

- **EN 46112** Tensioner Retraction Pins. See Special Tools .
- **J 45027** Tensioner Tool. See Special Tools .

Installation

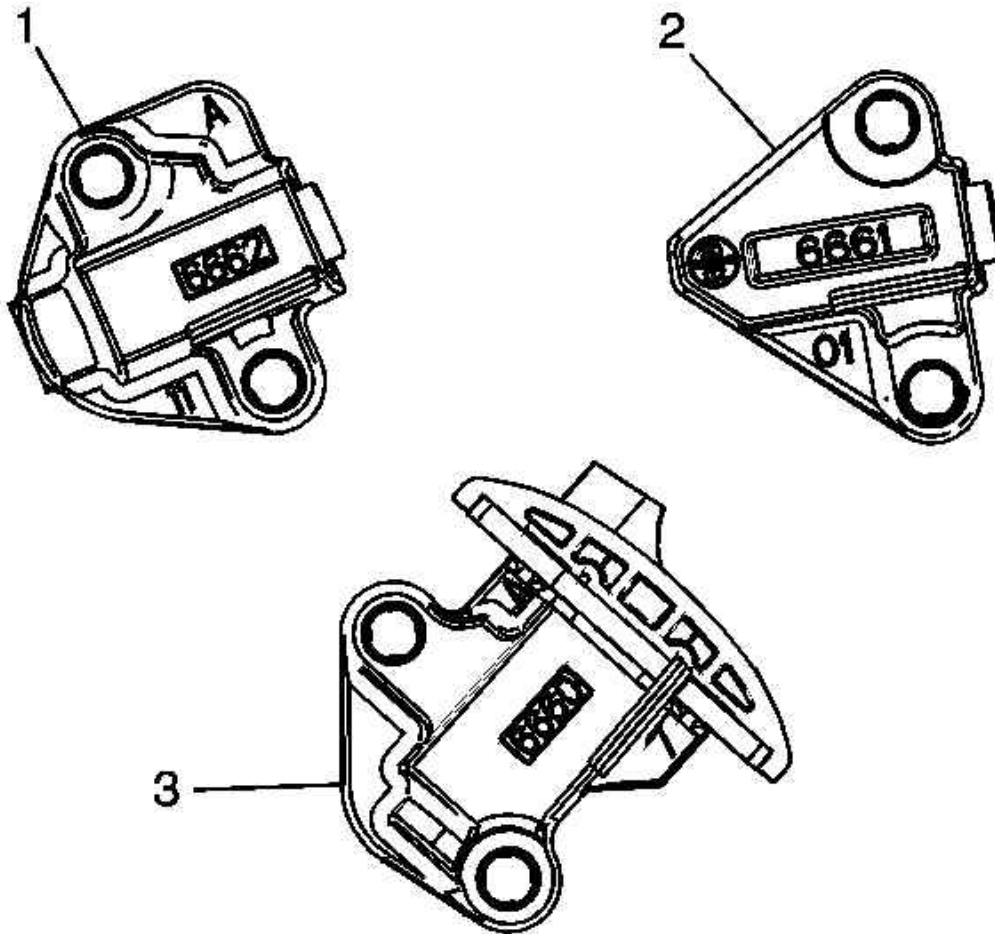


Fig. 156: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

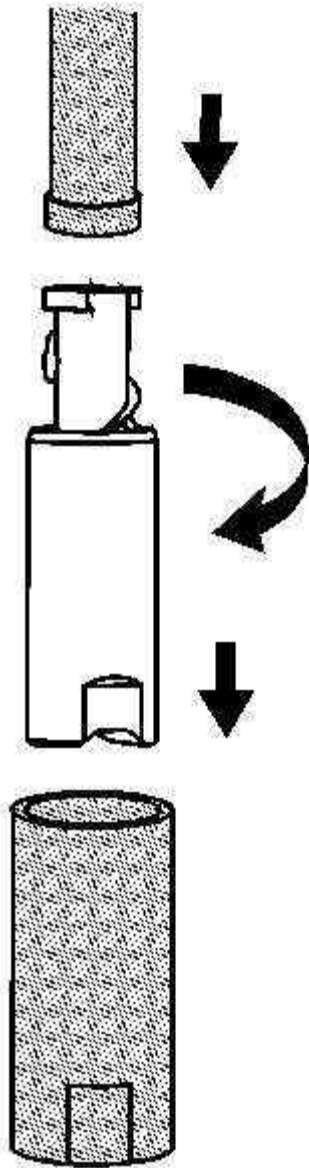


Fig. 157: Resetting Left Secondary Camshaft Drive Chain Tensioner Plunger With J 45027
Courtesy of GENERAL MOTORS CORP.

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

plunger. See **Special Tools** .

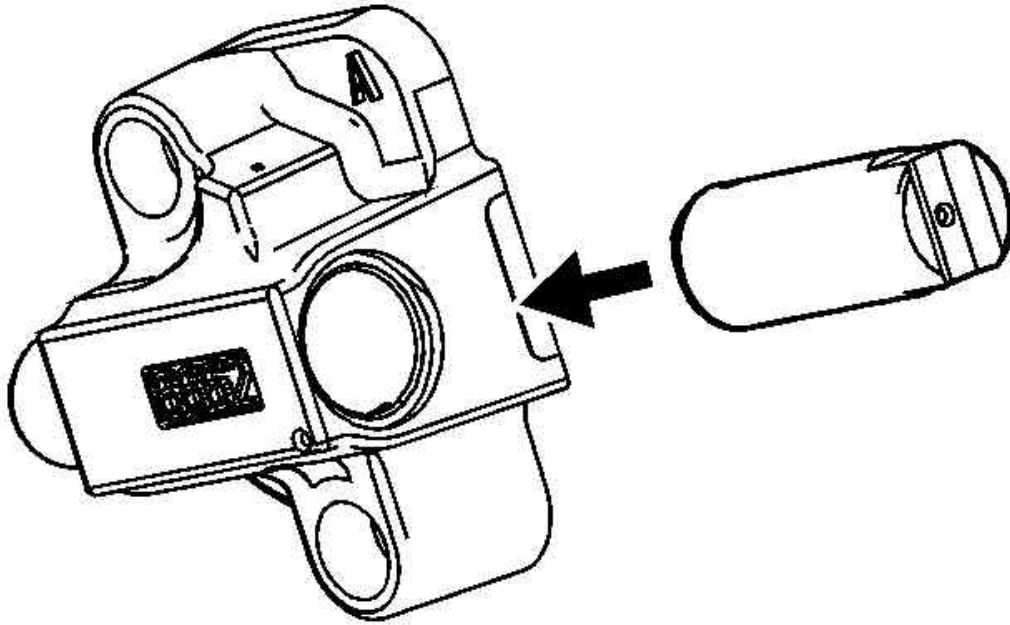


Fig. 158: View Of Plunger & Right Secondary Camshaft Drive Chain Tensioner Body

Courtesy of GENERAL MOTORS CORP.

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

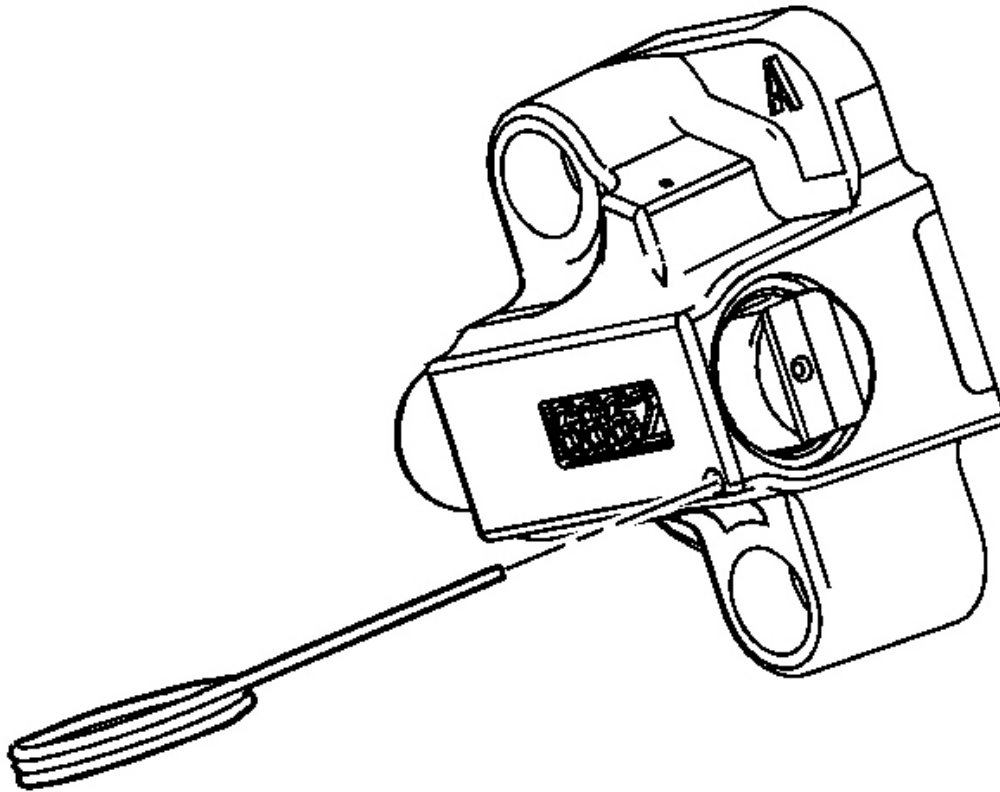


Fig. 159: Locking Plunger Of Right Secondary Camshaft Drive Chain Tensioner

Courtesy of GENERAL MOTORS CORP.

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

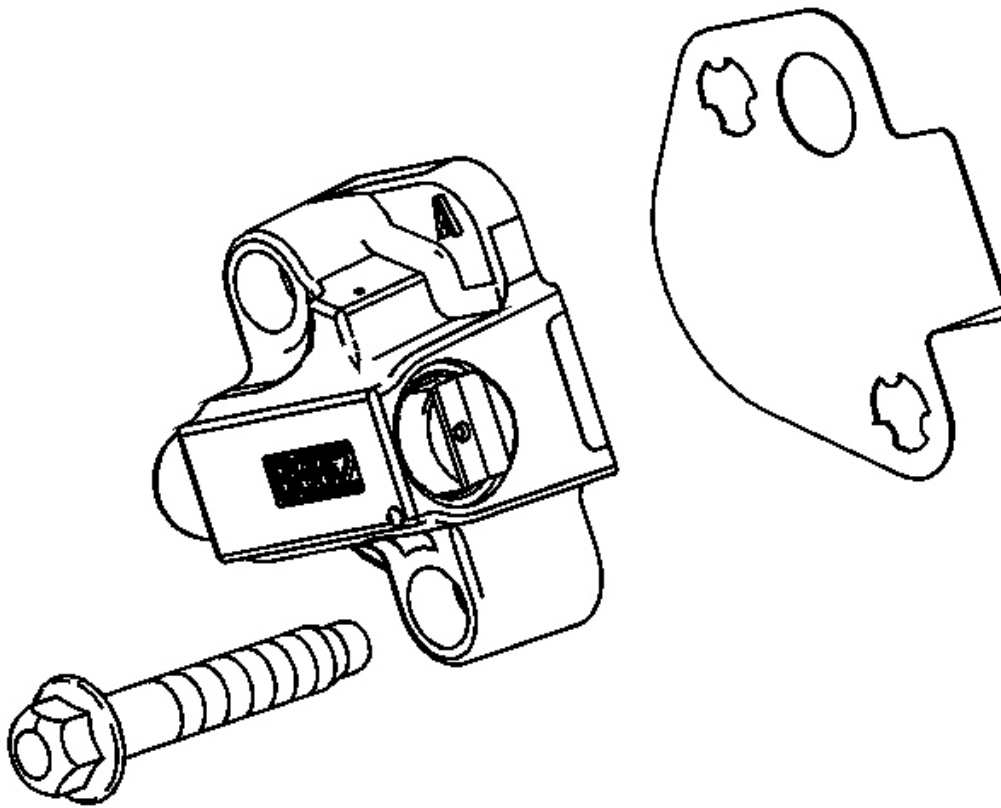


Fig. 160: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket

Courtesy of GENERAL MOTORS CORP.

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

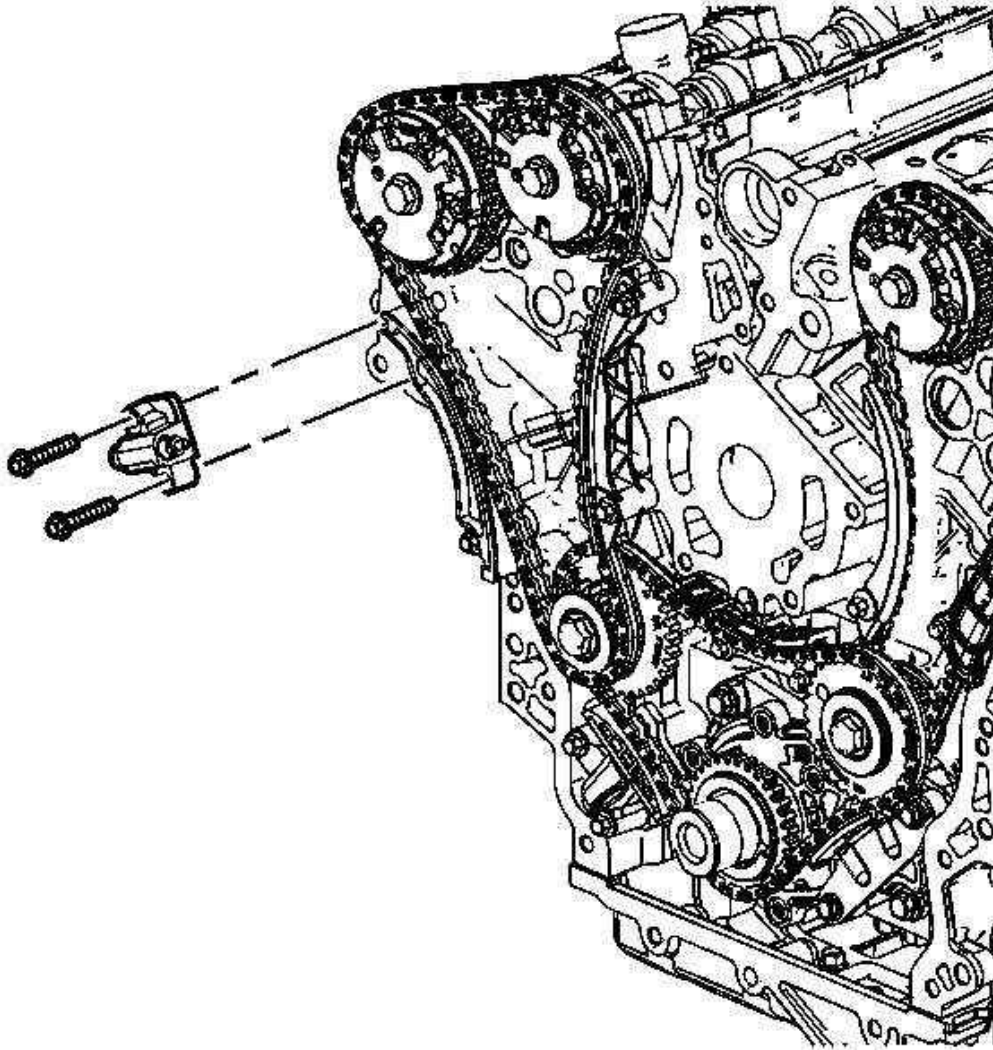


Fig. 161: View Of Secondary Camshaft Drive Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

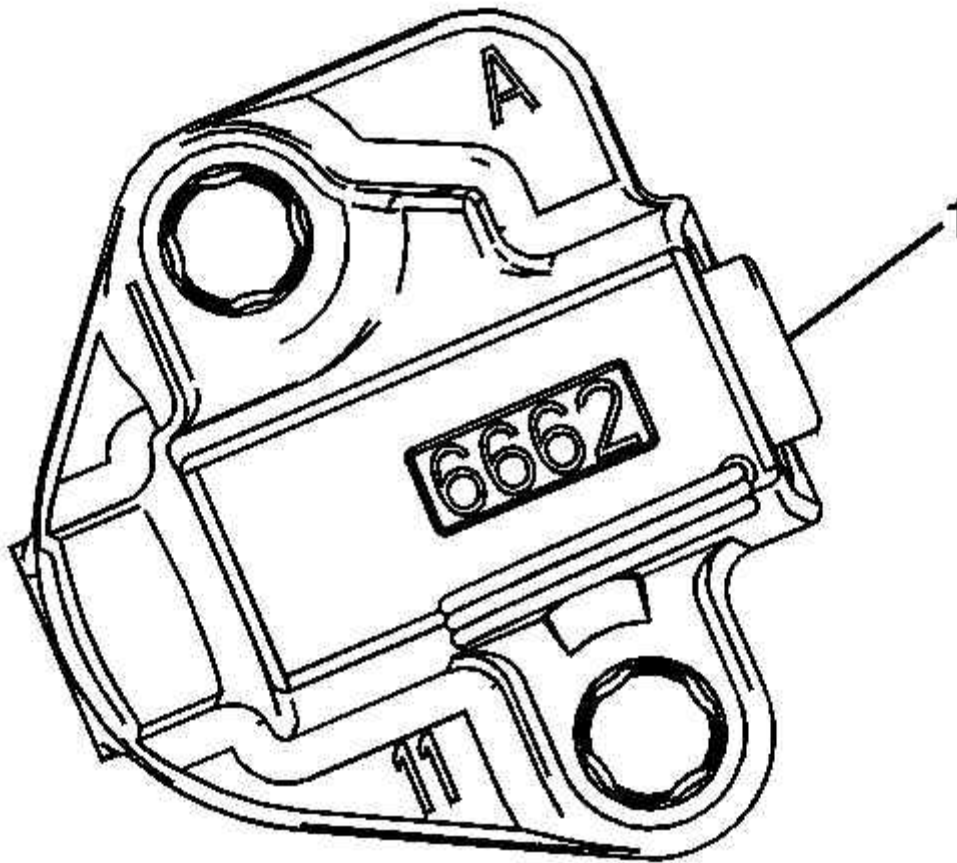


Fig. 162: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket Tab

Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

1. First Pass

Tighten: Tighten the right secondary camshaft drive chain tensioner bolts

2008 Buick LaCrosse CXL
2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

to 5 N.m (44 lb in).

2. Final Pass

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

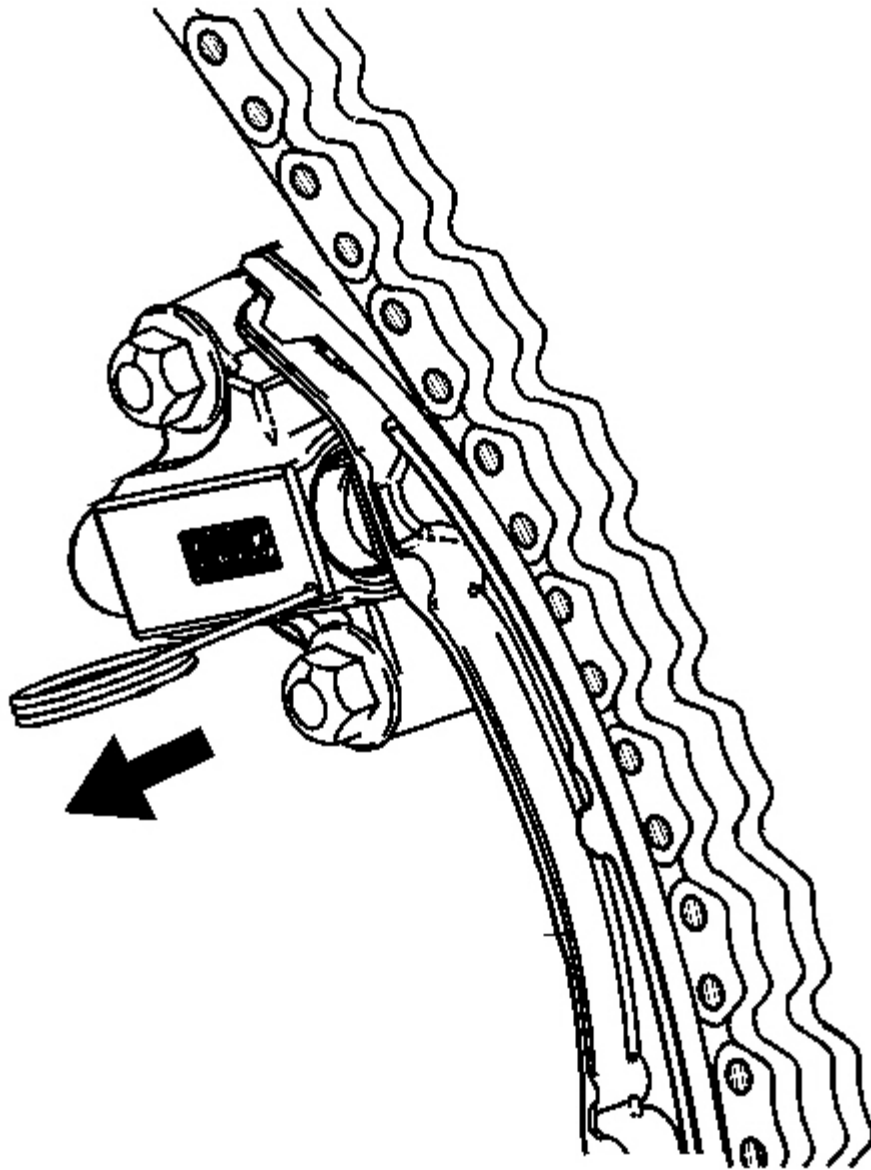


Fig. 163: Identifying Right Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

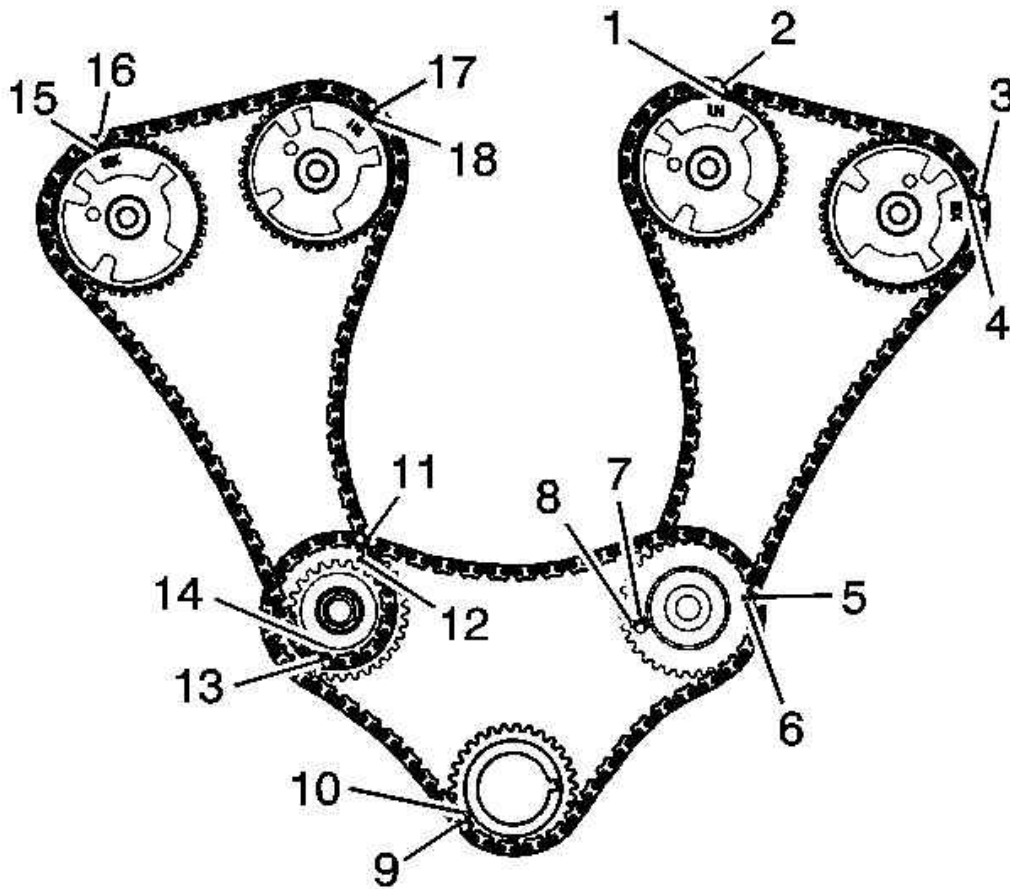


Fig. 164: View Of Camshaft Drive Chain Timing Mark Alignments
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure that all timing chain tensioners are completely released. A timing chain tensioner that is not properly released can lead to serious engine damage.

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

ENGINE FRONT COVER INSTALLATION (FOURTH DESIGN)

Tools Required

EN 46109 Guide Pins. See Special Tools .

Installation Procedure

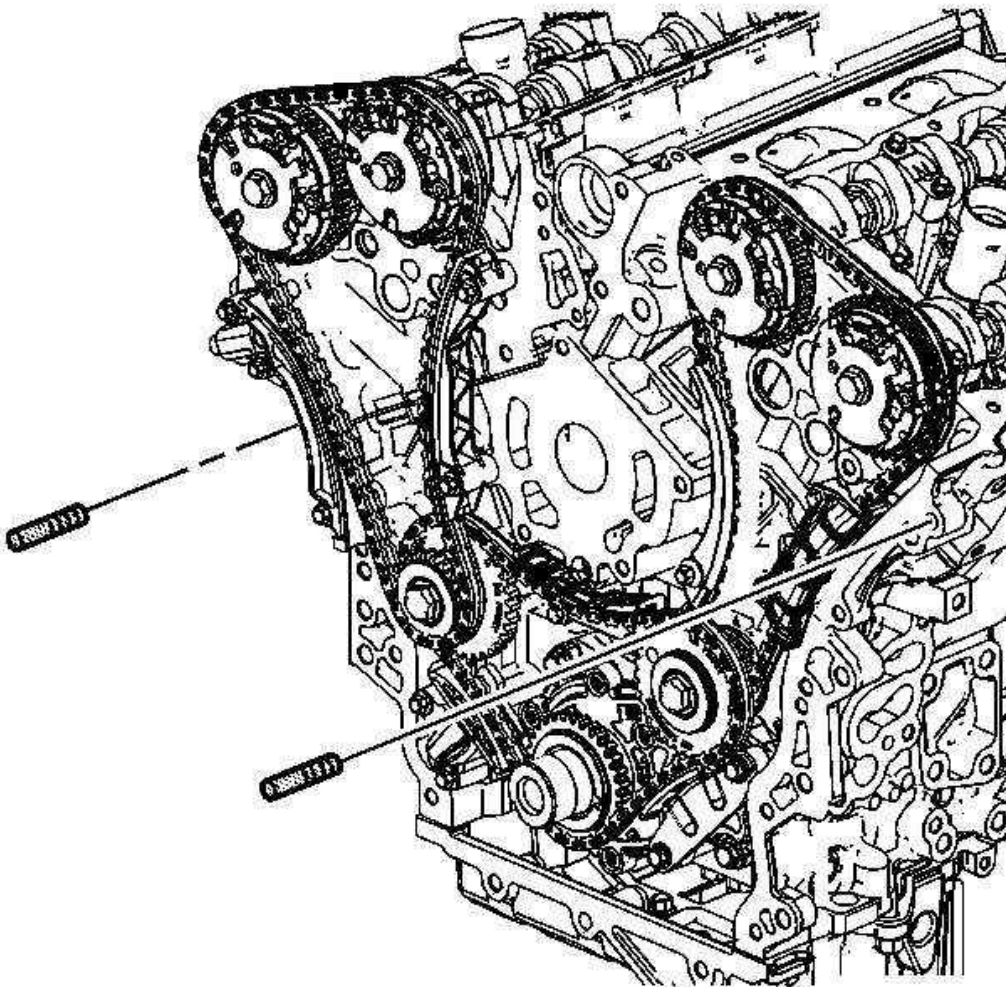


Fig. 165: Identifying Cylinder Block Guide Studs
Courtesy of GENERAL MOTORS CORP.

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

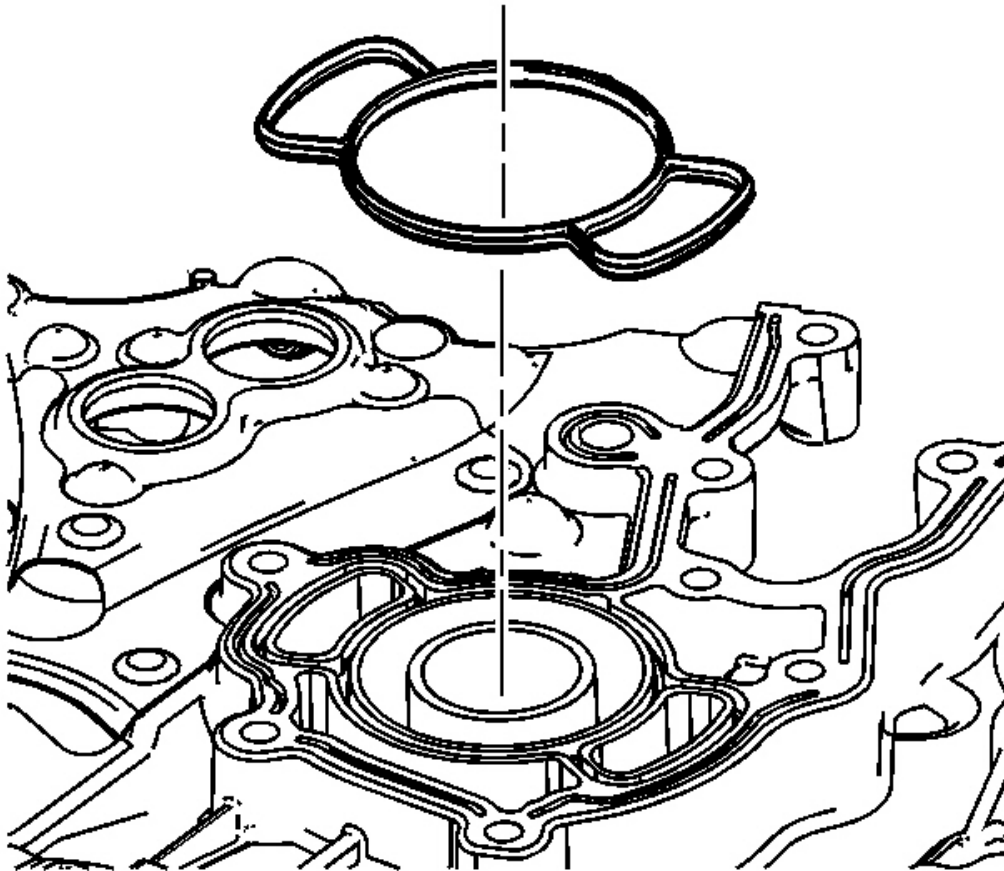


Fig. 166: Identifying Water Pump Seal
Courtesy of GENERAL MOTORS CORP.

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

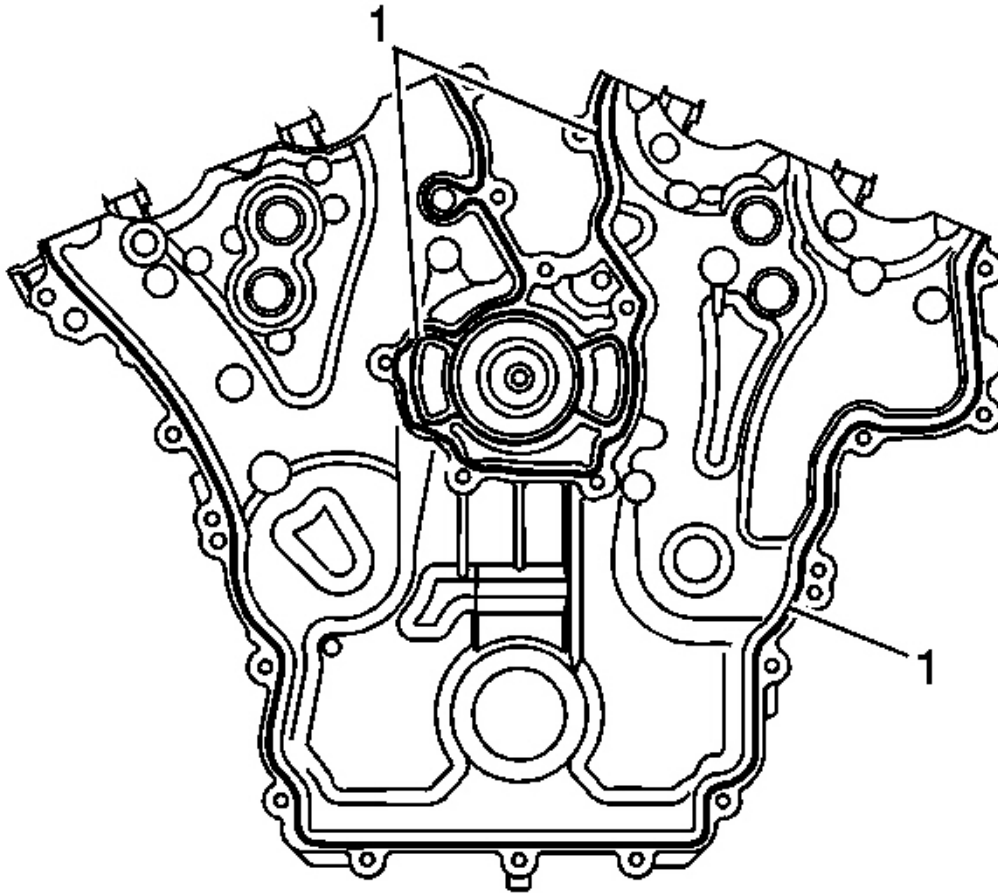


Fig. 167: Applying Sealant To Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

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

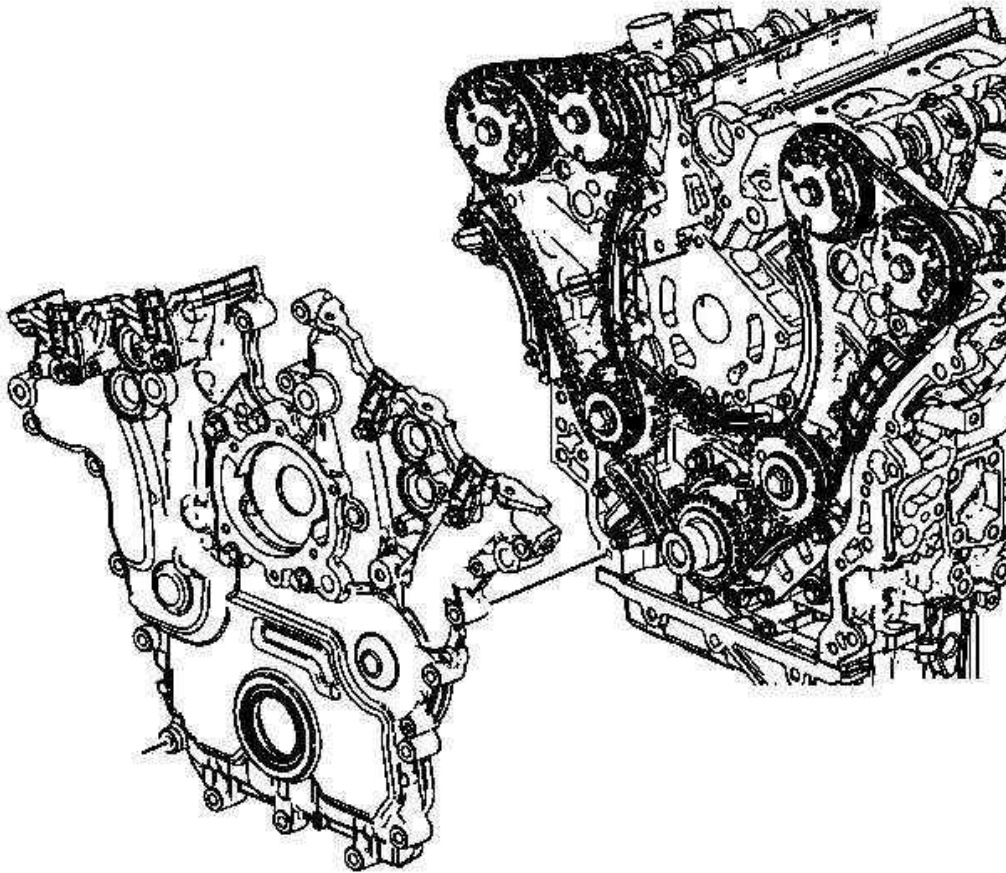


Fig. 168: Identifying Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

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

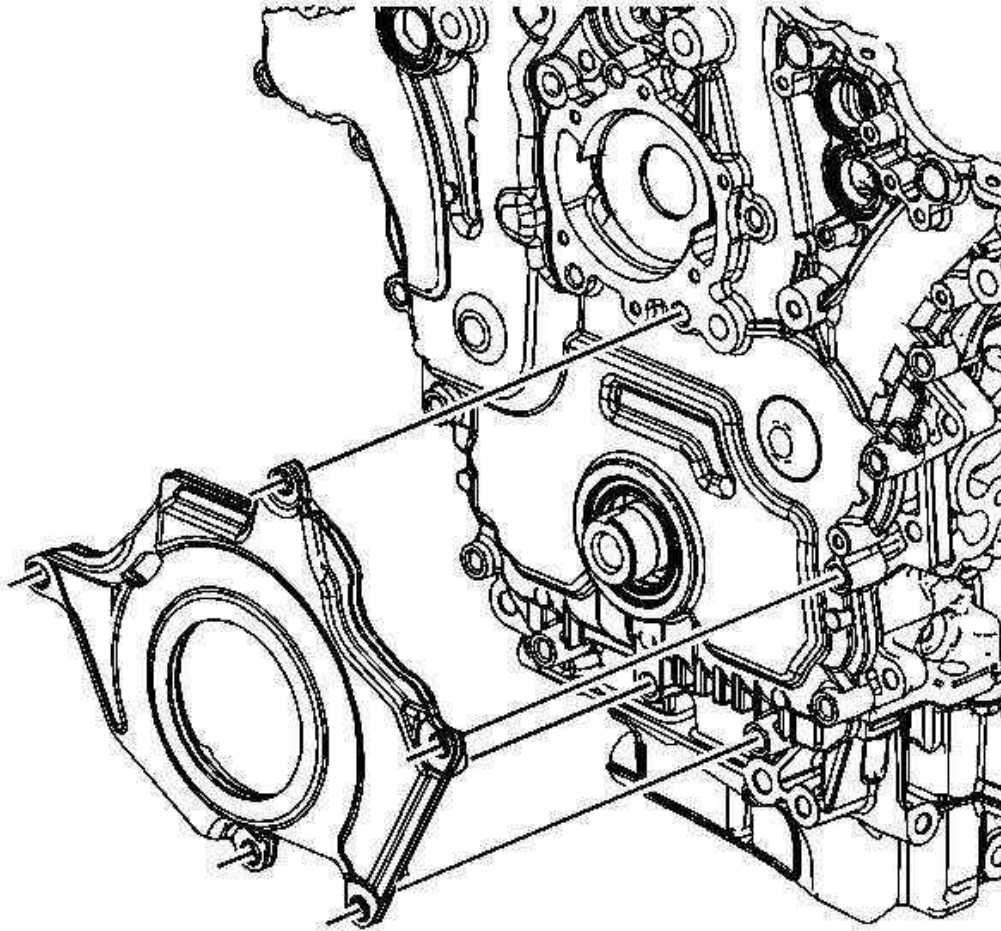


Fig. 169: View Of Engine Front Cover Deadener
Courtesy of GENERAL MOTORS CORP.

6. Install the engine front cover deadener.

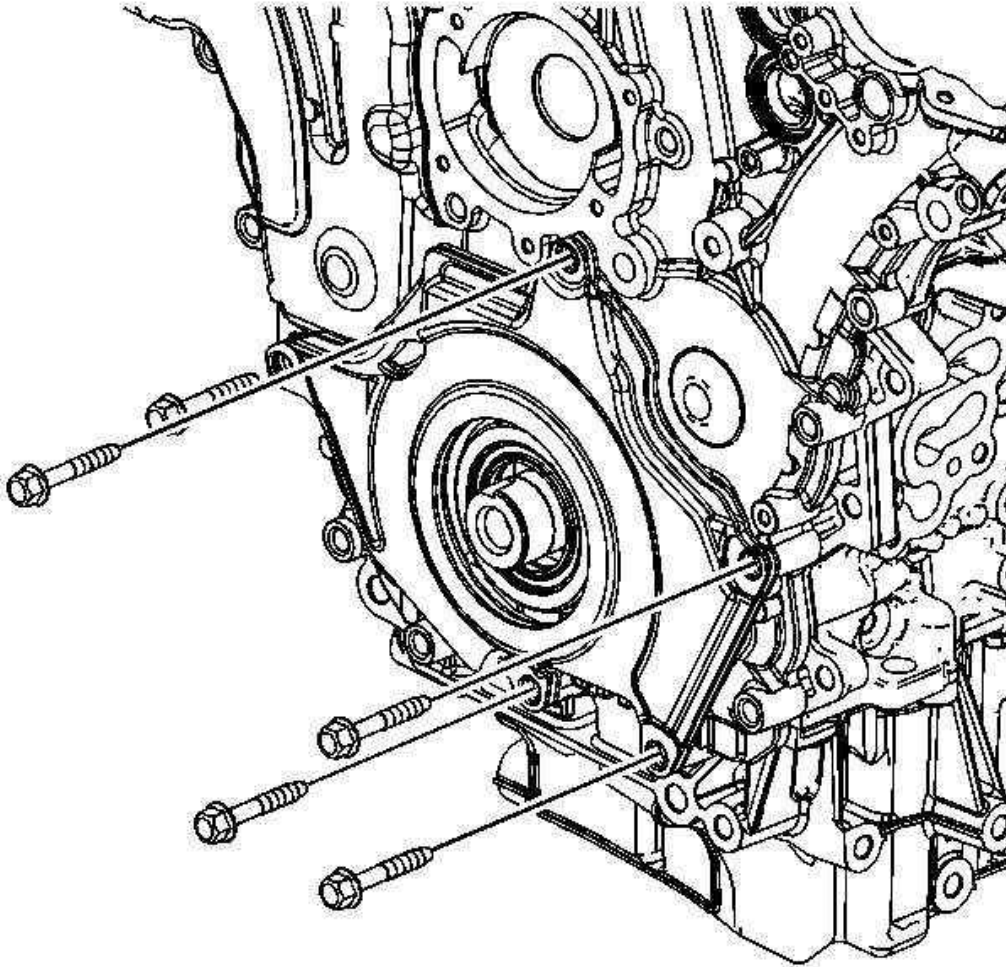


Fig. 170: Identifying Engine Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice

7. Loosely install the engine front cover bolts to hold the engine front cover deadener into position.

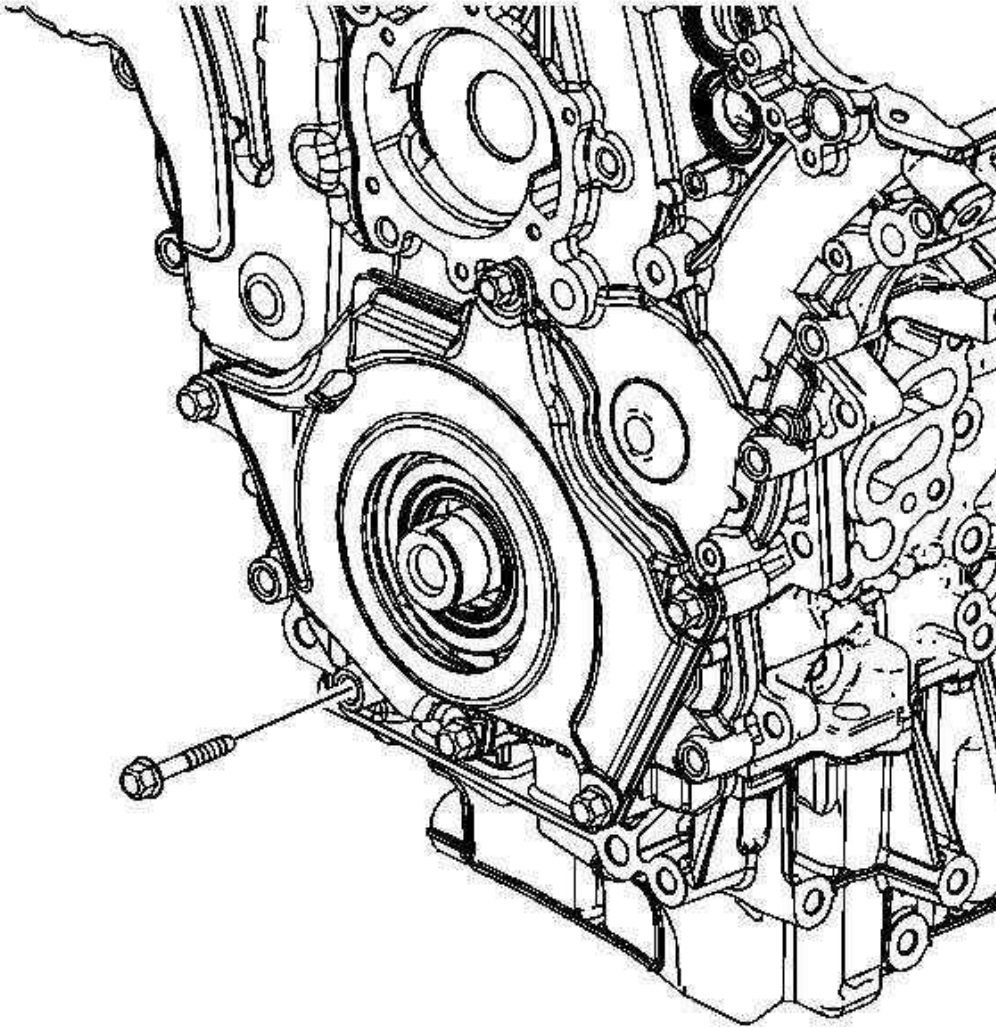


Fig. 171: Identifying Remaining Engine Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

8. Loosely install the remaining engine front cover bolts.

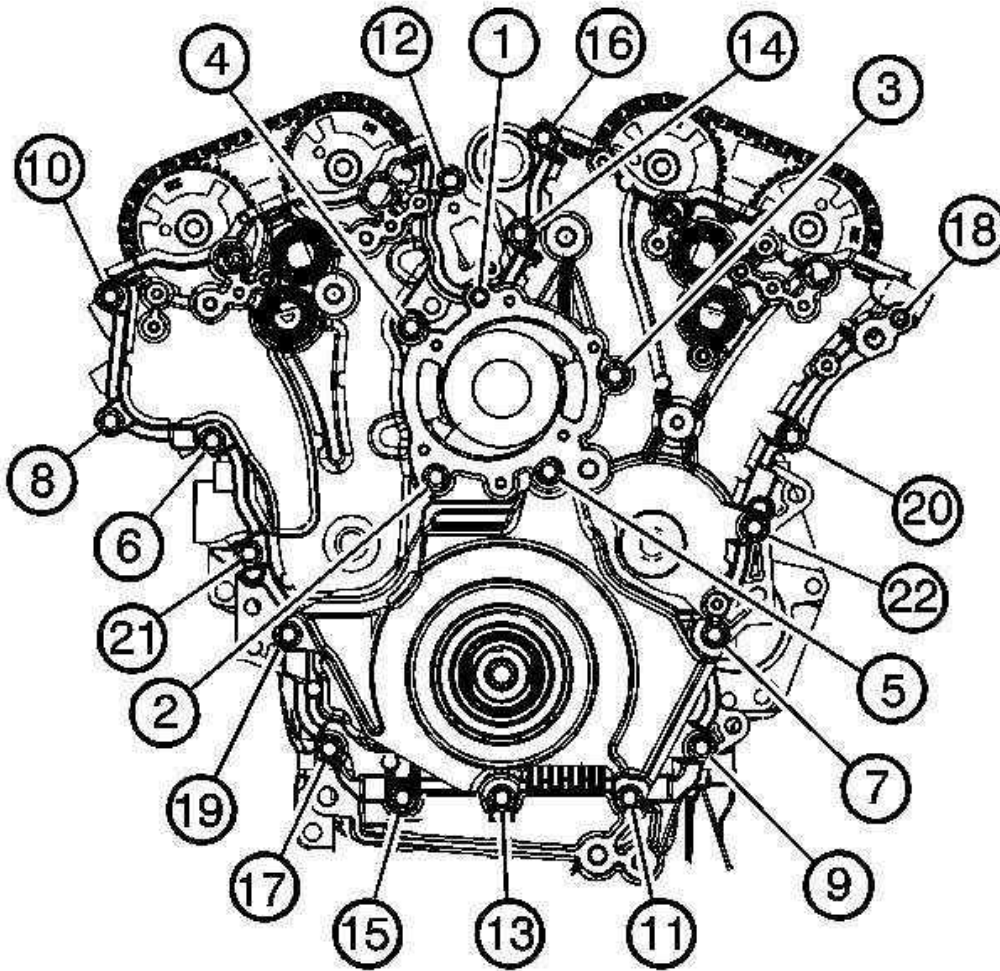


Fig. 172: Identifying Engine Front Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

9. Tighten the engine front cover bolts in the sequence shown (1-22).

Tighten:

1. Tighten the engine front cover bolts a first pass in sequence to 20 N.m (14 lb ft).
2. Tighten the engine front cover bolts a second pass in sequence an additional 60 degrees.

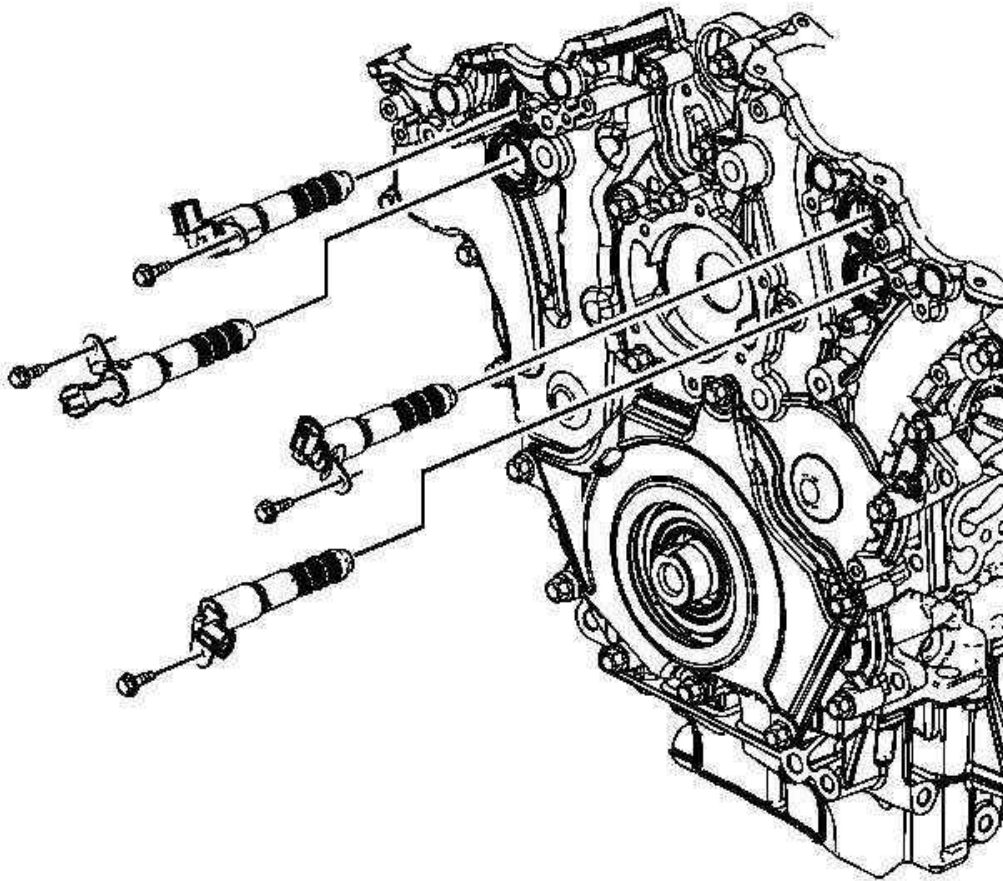


Fig. 173: Identifying Camshaft Position Actuator Valves & Bolts
Courtesy of GENERAL MOTORS CORP.

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

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

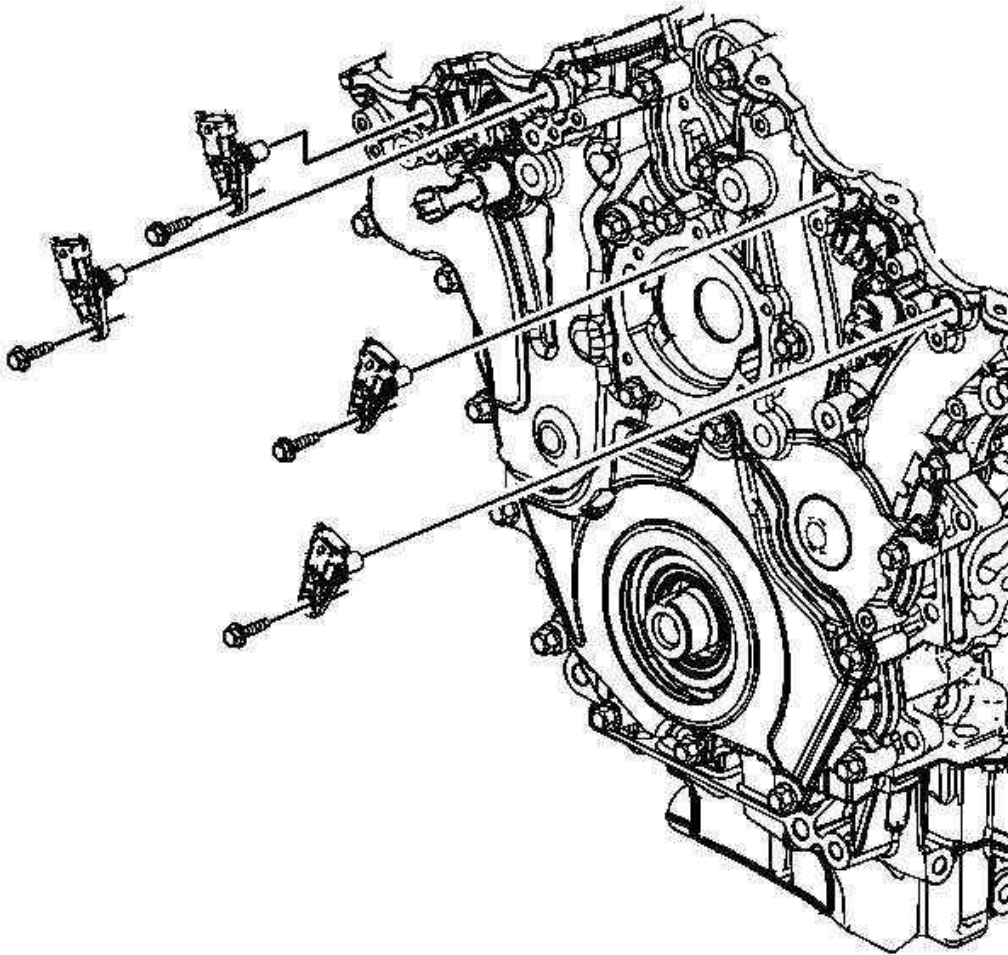


Fig. 174: Identifying Camshaft Position Sensors & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install NEW O-rings on the camshaft position sensor.
13. Place the camshaft position sensors in position on the front cover.
14. Install the camshaft position sensor bolts.

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

WATER PUMP INSTALLATION

Tools Required

EN 46104 Water Pump Pulley Holding Tool

Installation Procedure

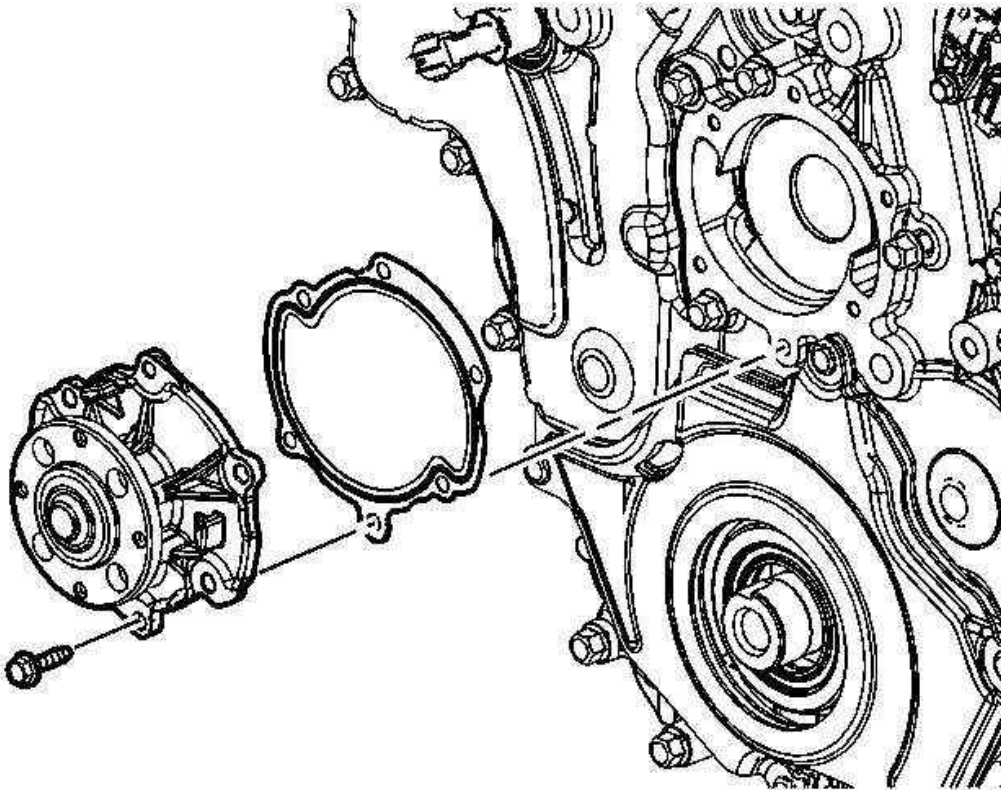


Fig. 175: View Of Water Pump, Gasket & Bolt
Courtesy of GENERAL MOTORS CORP.

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

NOTE: Refer to Fastener Notice .

4. Install the water pump bolts.

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

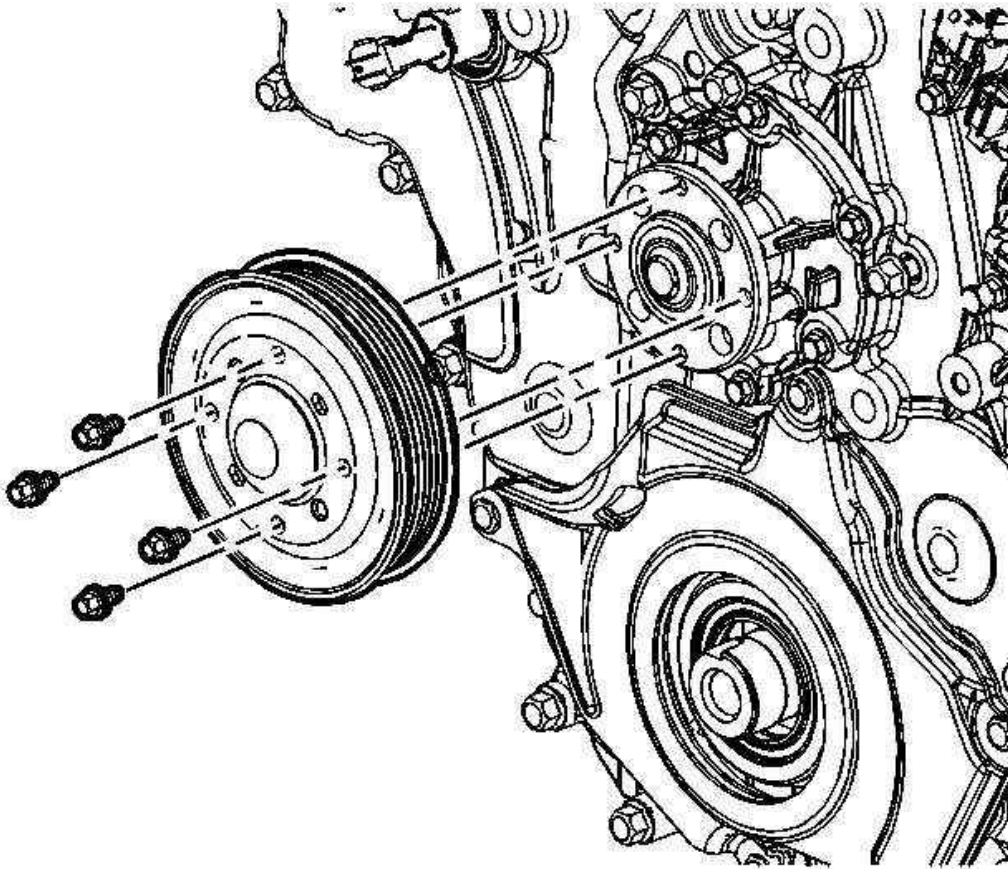


Fig. 176: View Of Water Pump Pulley & Bolts
Courtesy of GENERAL MOTORS CORP.

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

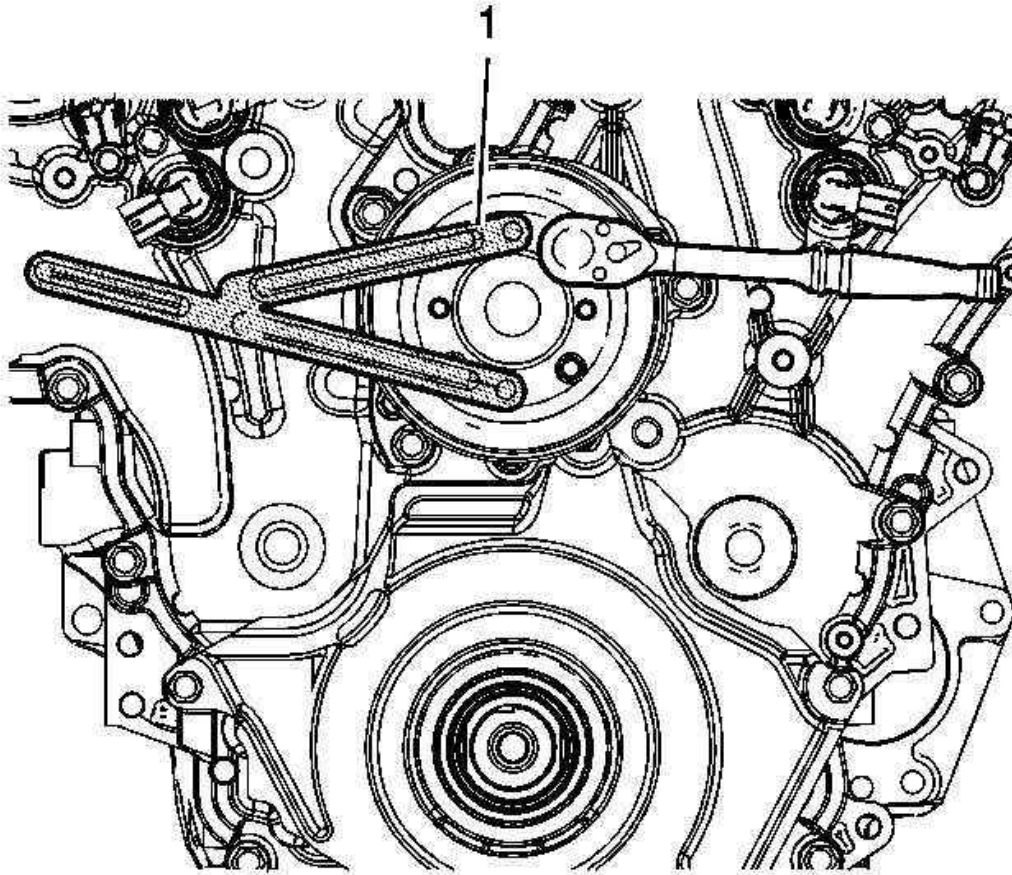


Fig. 177: Identifying Special Tool - EN 46104
Courtesy of GENERAL MOTORS CORP.

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

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

CAMSHAFT COVER INSTALLATION - LEFT SIDE

Tools Required

- **EN 46101** Spark Plug Tube Seal Guide. See **Special Tools** .
- **EN 46105** Camshaft Locking Tool. See **Special Tools** .

Installation

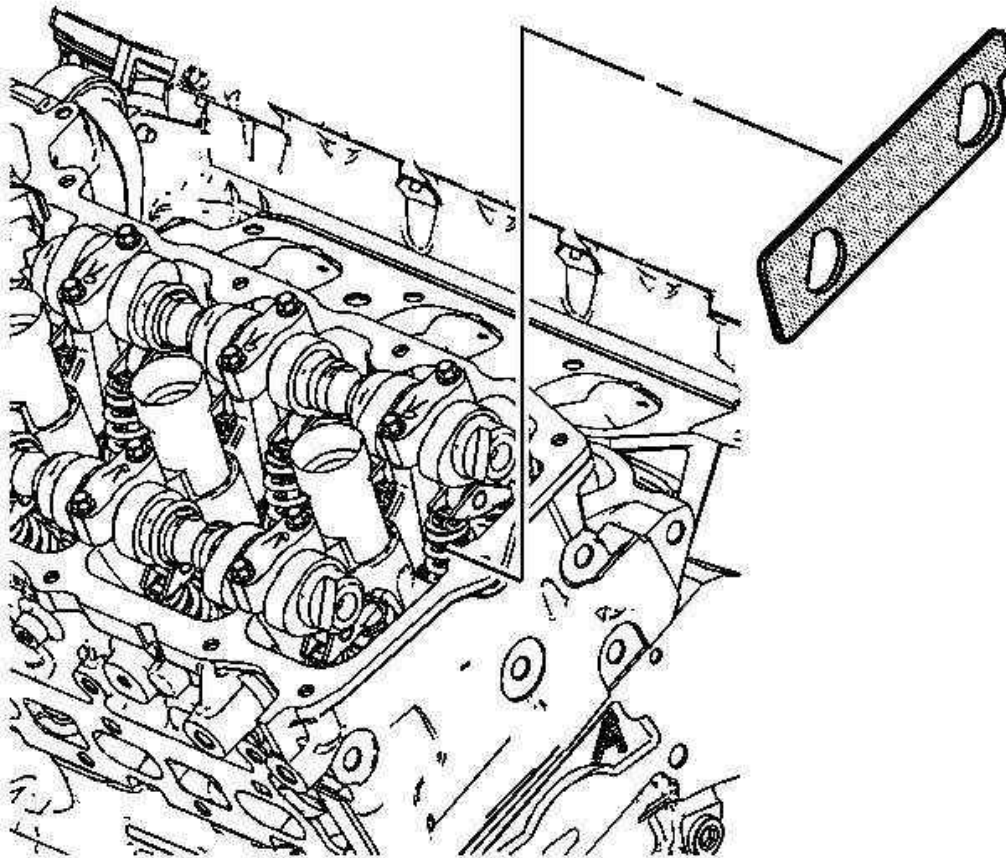


Fig. 178: Identifying EN 46105-2 & Camshaft
Courtesy of GENERAL MOTORS CORP.

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

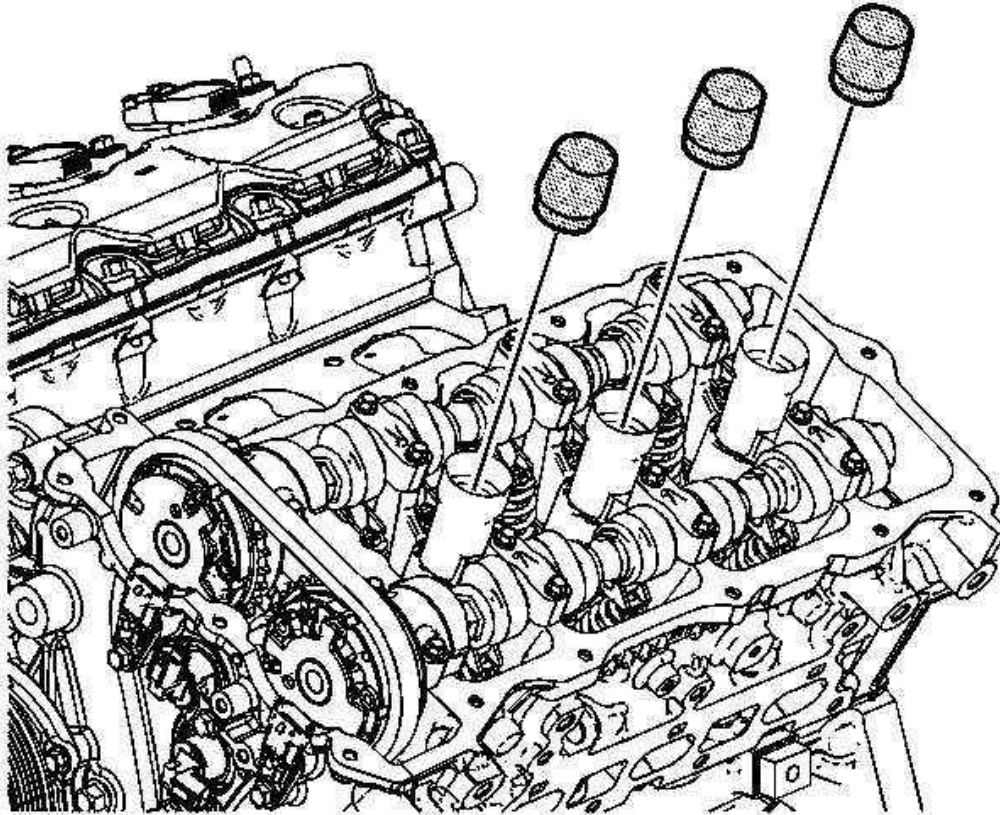


Fig. 179: Identifying Spark Plug Tubes
Courtesy of GENERAL MOTORS CORP.

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

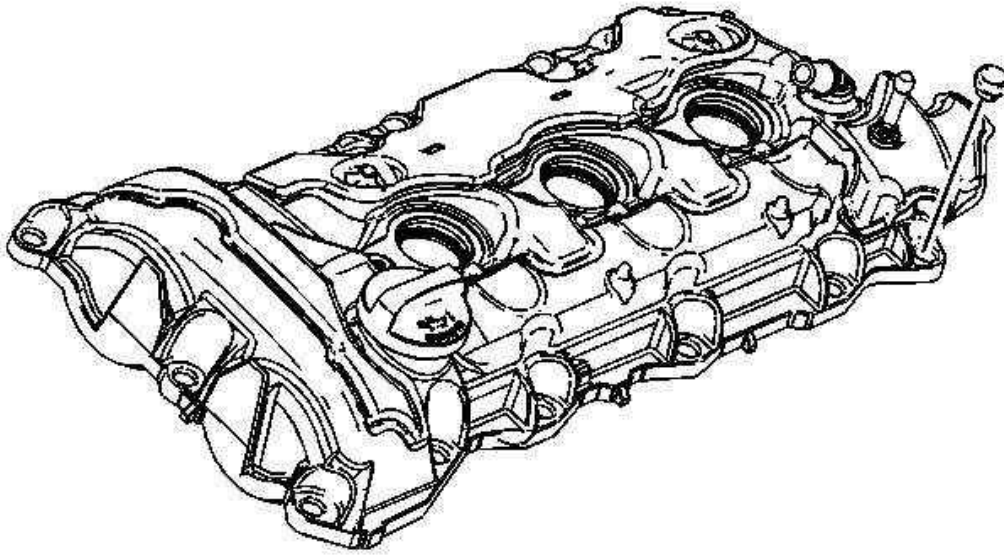


Fig. 180: View Of Camshaft Cover & Bolt Insulator
Courtesy of GENERAL MOTORS CORP.

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

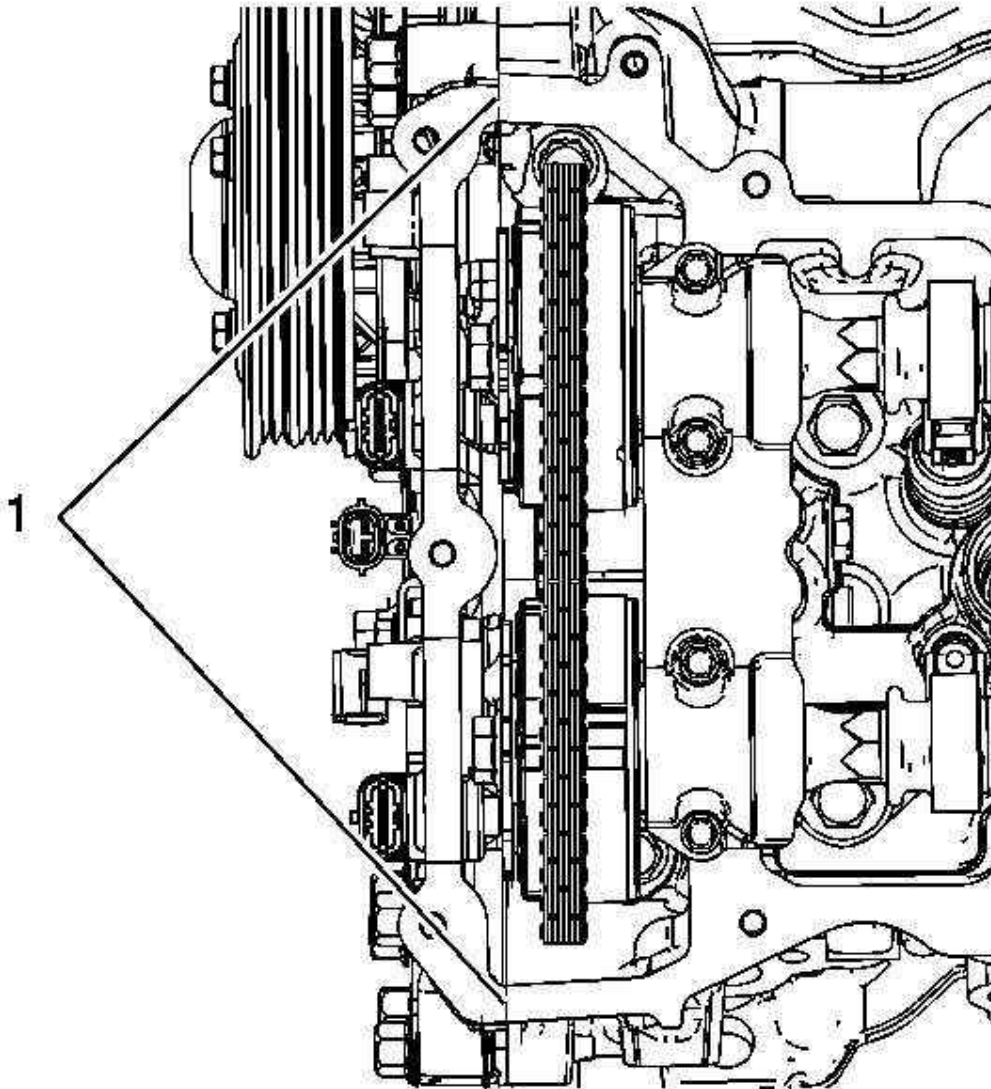


Fig. 181: Locating Engine Front Cover Split Lines
Courtesy of GENERAL MOTORS CORP.

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

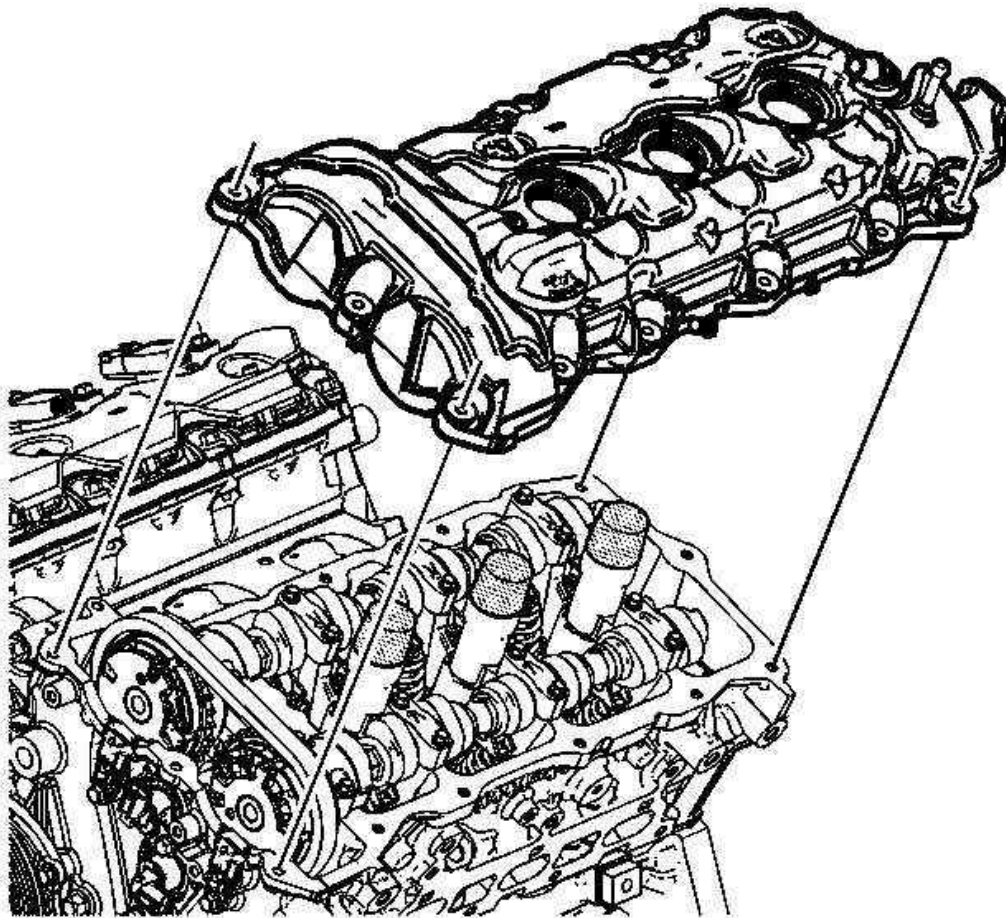


Fig. 182: View Of Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

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

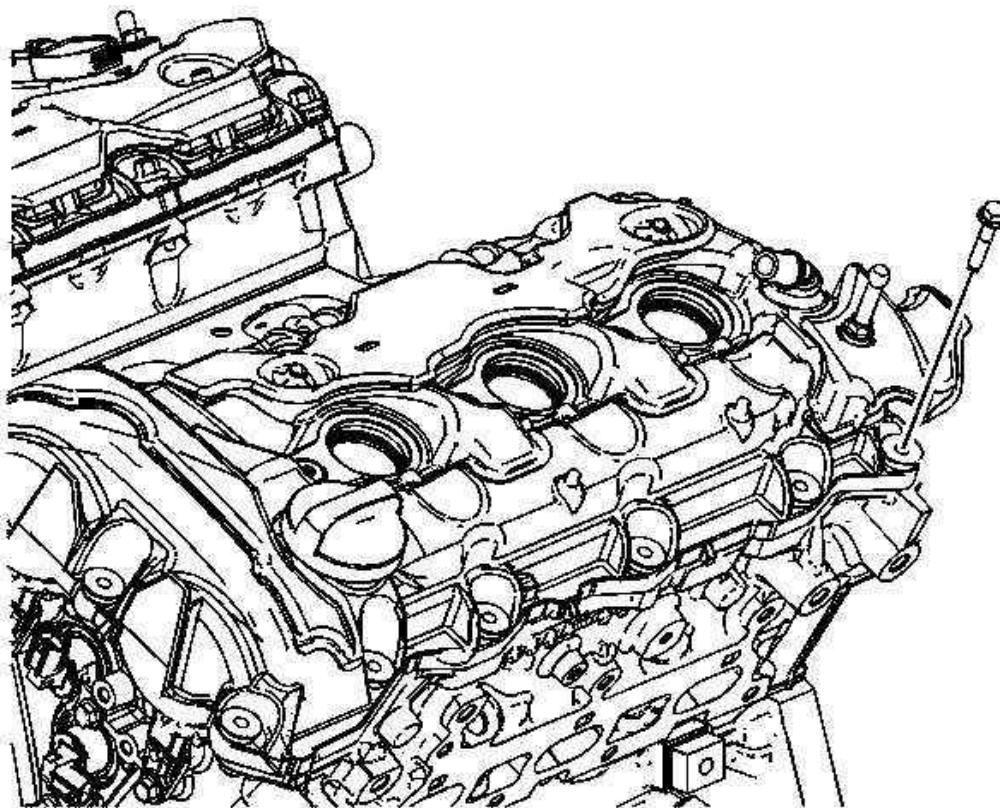


Fig. 183: Locating Left Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosely install the left camshaft cover bolts.

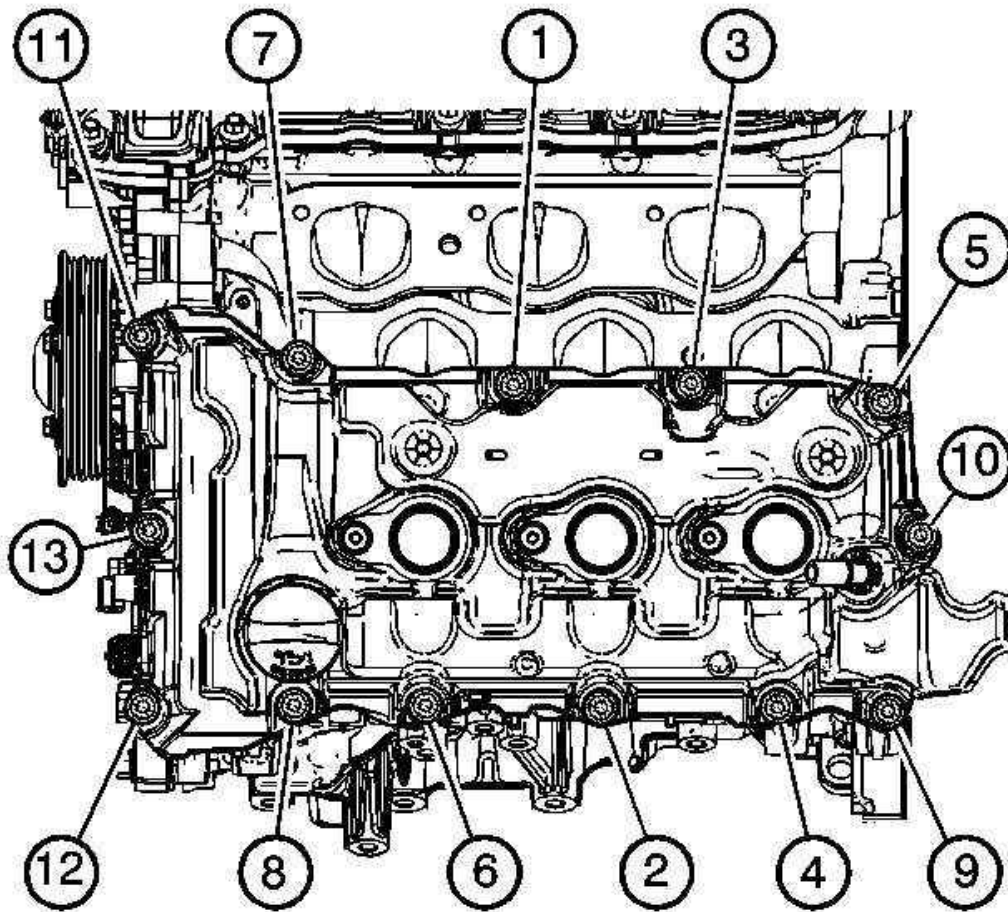


Fig. 184: Identifying Left Camshaft Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

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

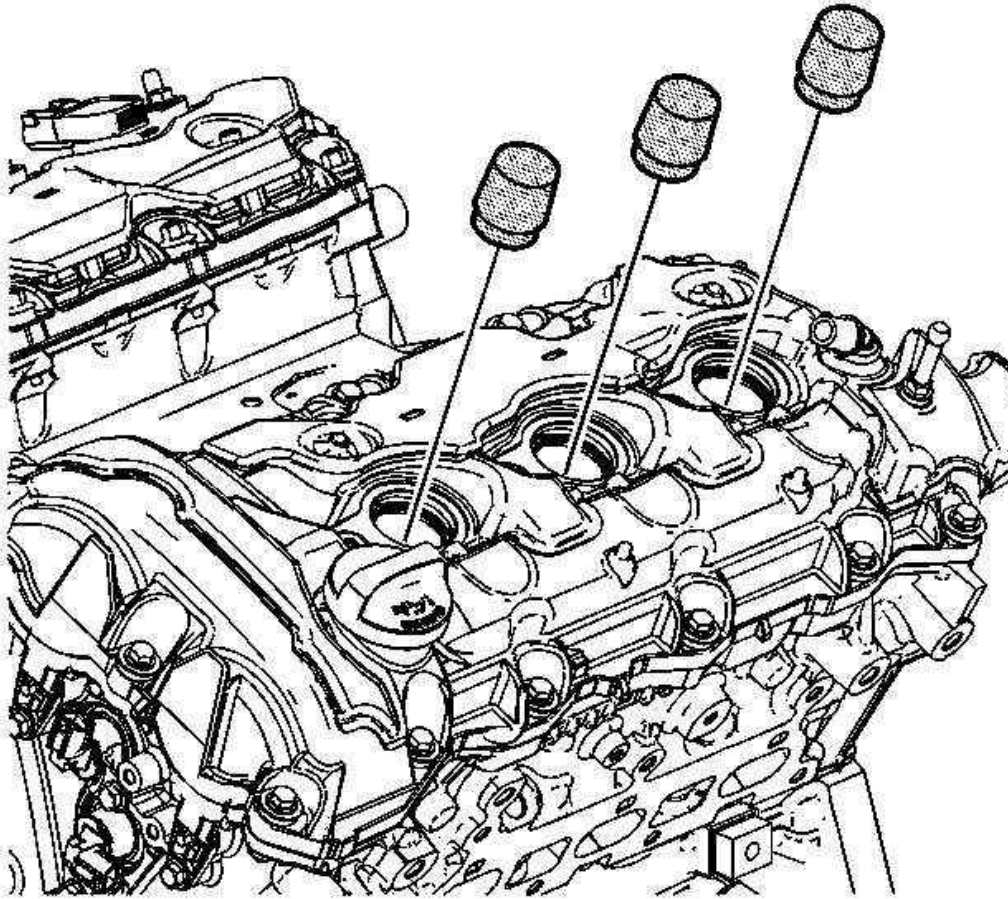


Fig. 185: Identifying Spark Plug Tubes
Courtesy of GENERAL MOTORS CORP.

9. Remove the **EN 46101** from the spark plug tubes of the left cylinder head. See **Special Tools** .

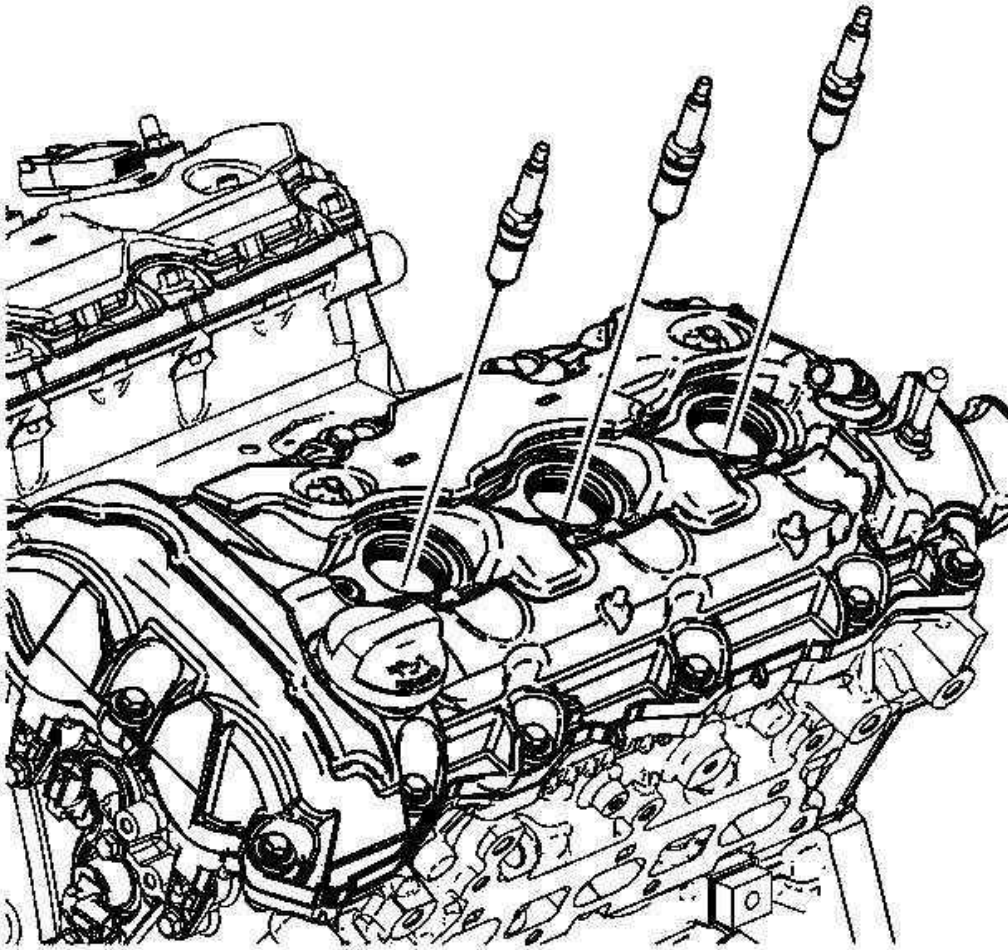


Fig. 186: Identifying Spark Plugs
Courtesy of GENERAL MOTORS CORP.

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

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

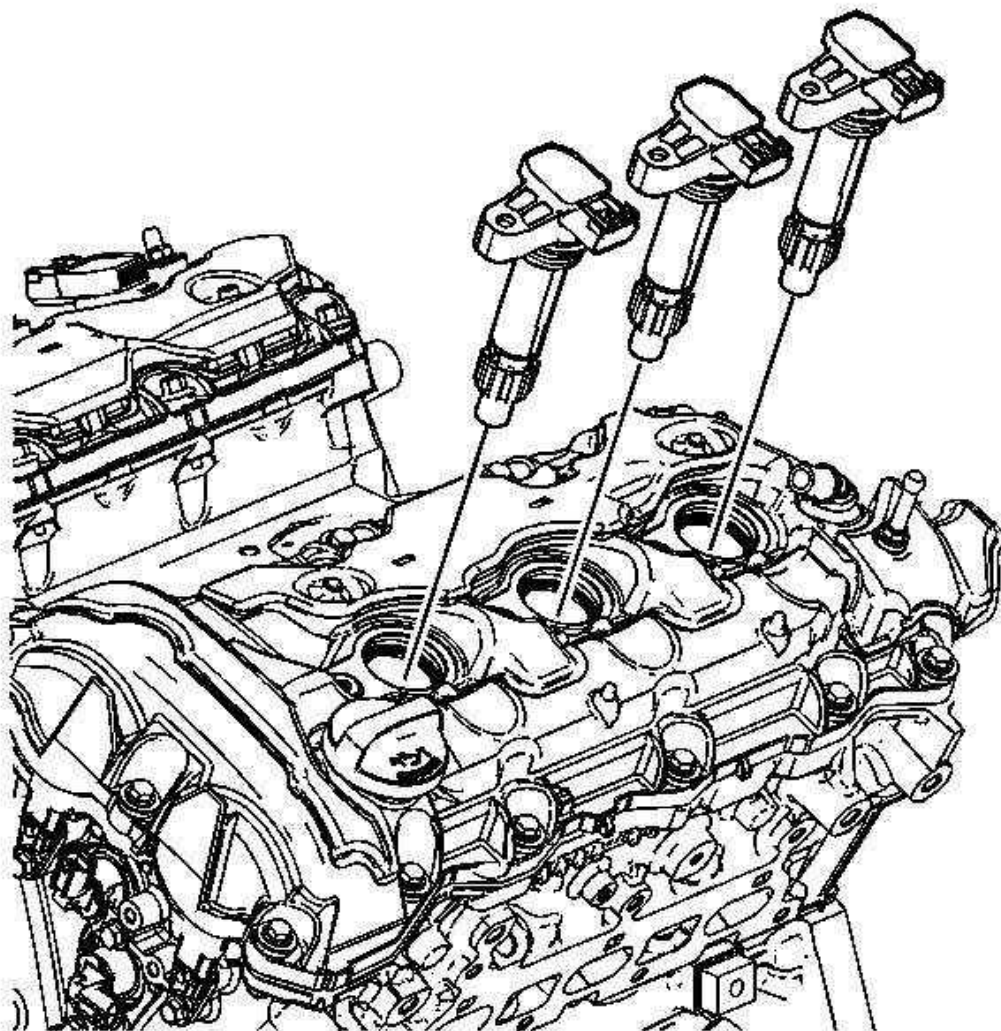


Fig. 187: View Of Ignition Coils
Courtesy of GENERAL MOTORS CORP.

11. Install the ignition coils.

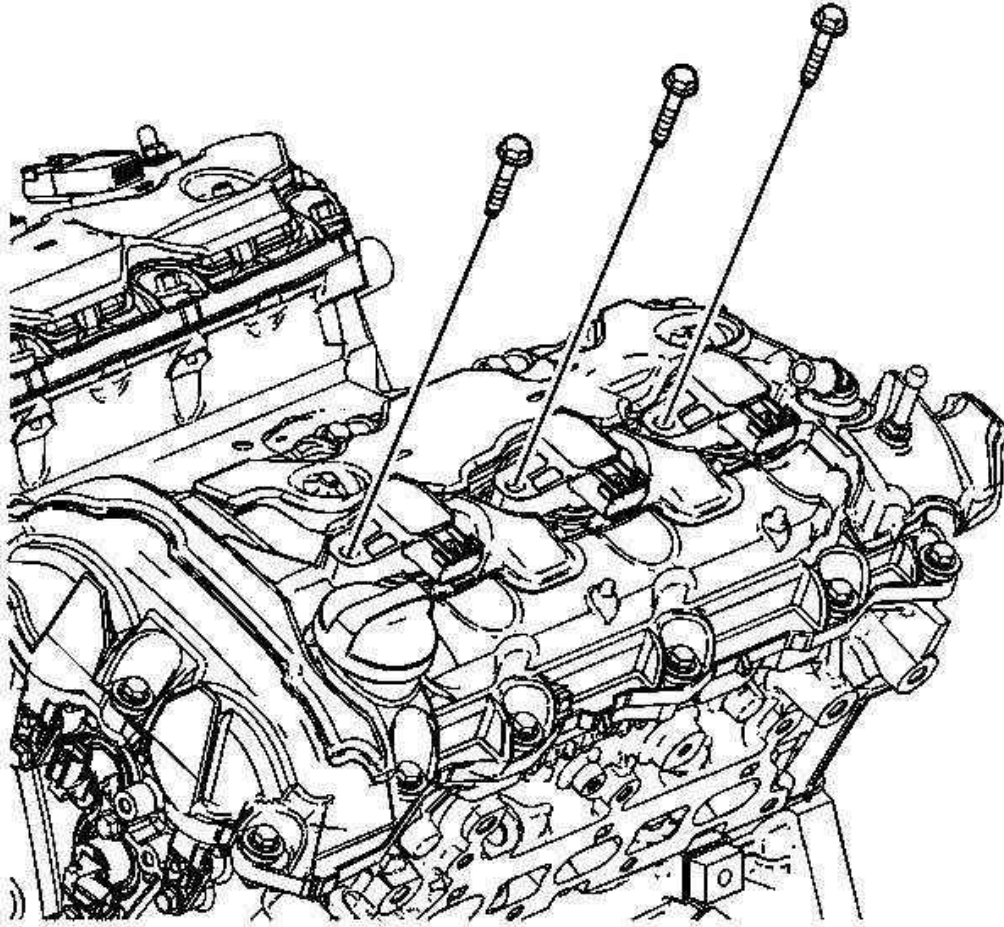


Fig. 188: Identifying Ignition Coil Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the ignition coil bolts.

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

CAMSHAFT COVER INSTALLATION - RIGHT SIDE

Tools Required

- EN 46101 Spark Plug Tube Seal Guide. See **Special Tools** .

- **EN-48383** Camshaft Retaining Tools

Installation

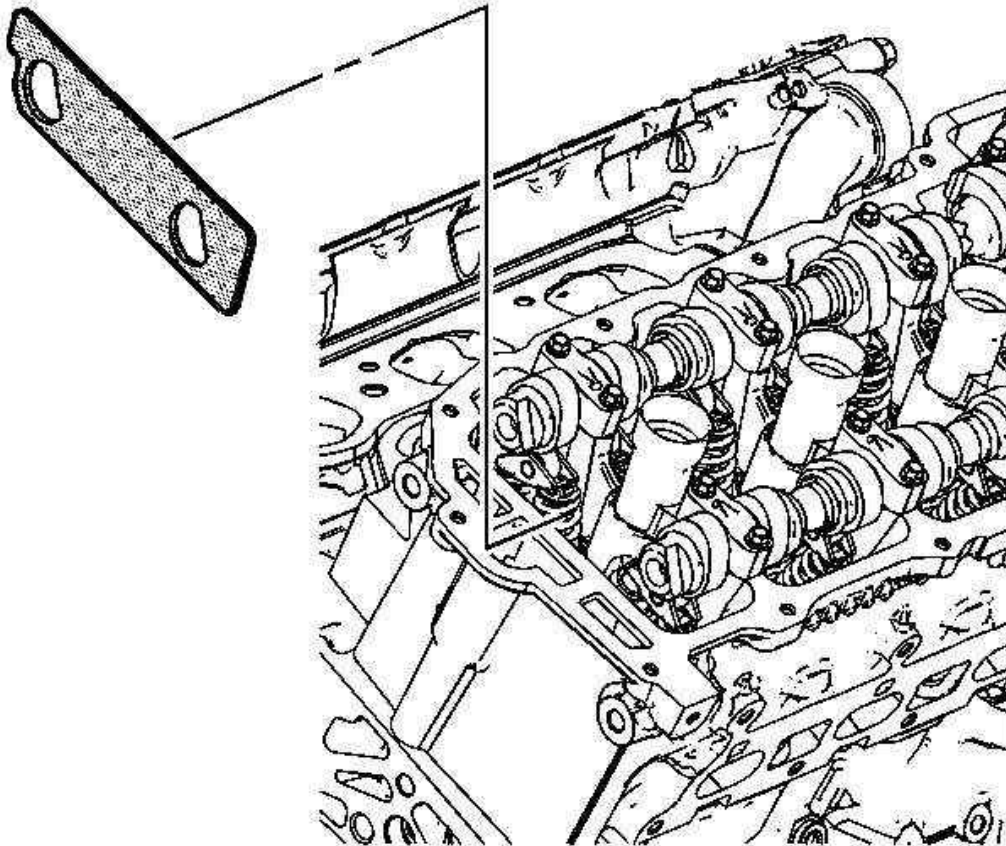


Fig. 189: Identifying EN 46105-1
Courtesy of GENERAL MOTORS CORP.

1. Remove the EN 48383-3 from the rear of the right camshafts.

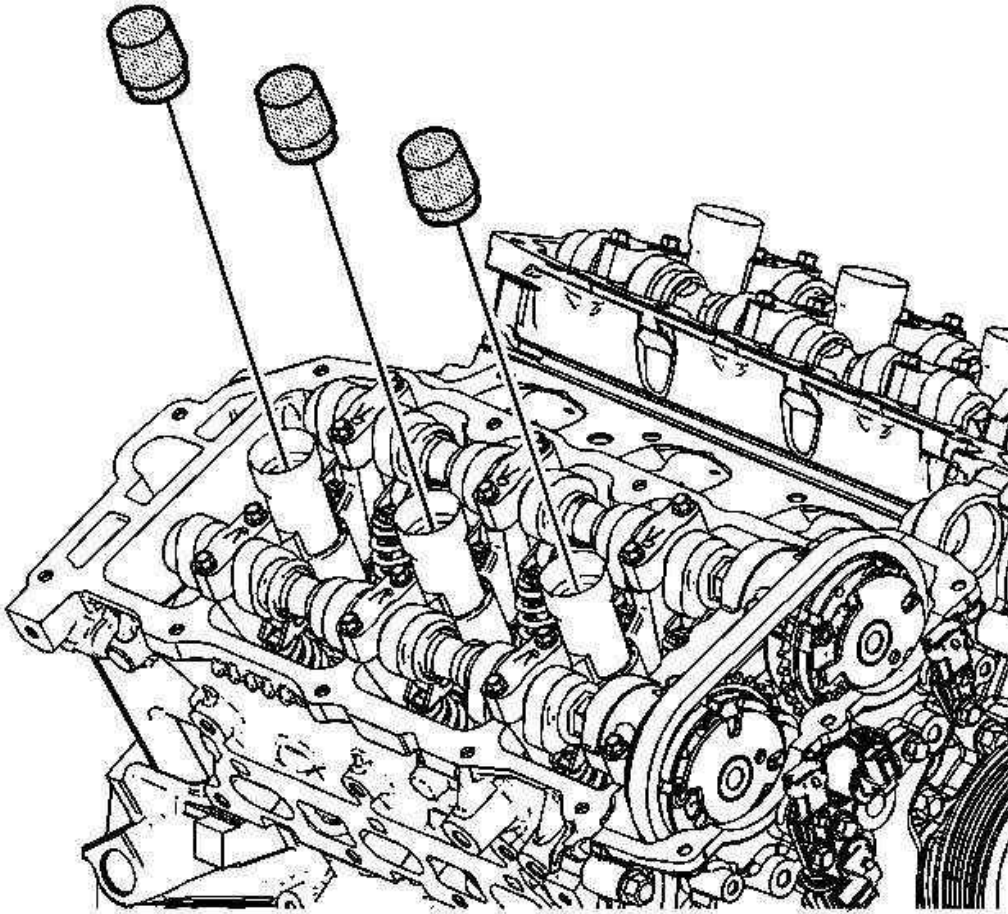


Fig. 190: Identifying Spark Plug Tubes
Courtesy of GENERAL MOTORS CORP.

2. Install the **EN 46101** onto the spark plug tubes of the right cylinder head. See **Special Tools** .

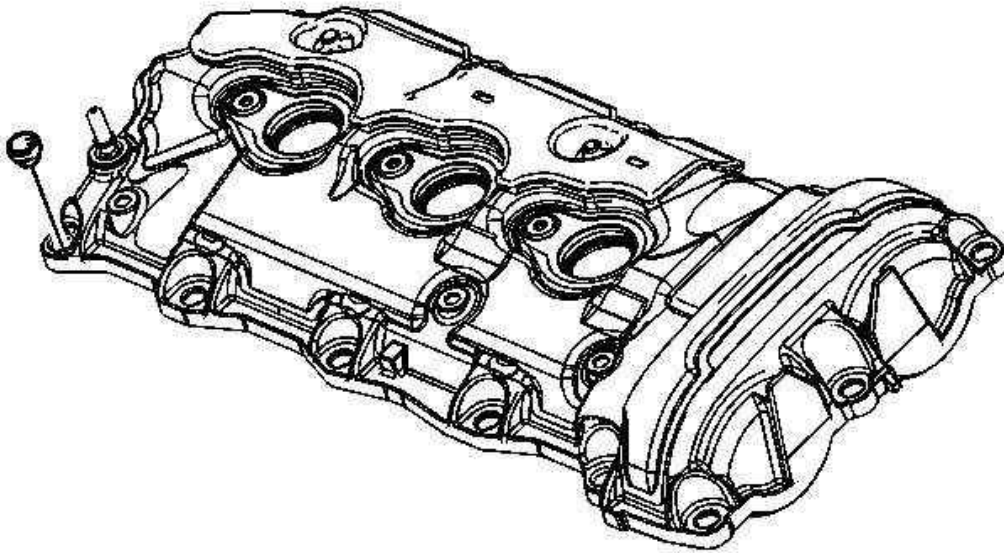


Fig. 191: View Of Right Camshaft Cover Bolt Grommets
Courtesy of GENERAL MOTORS CORP.

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

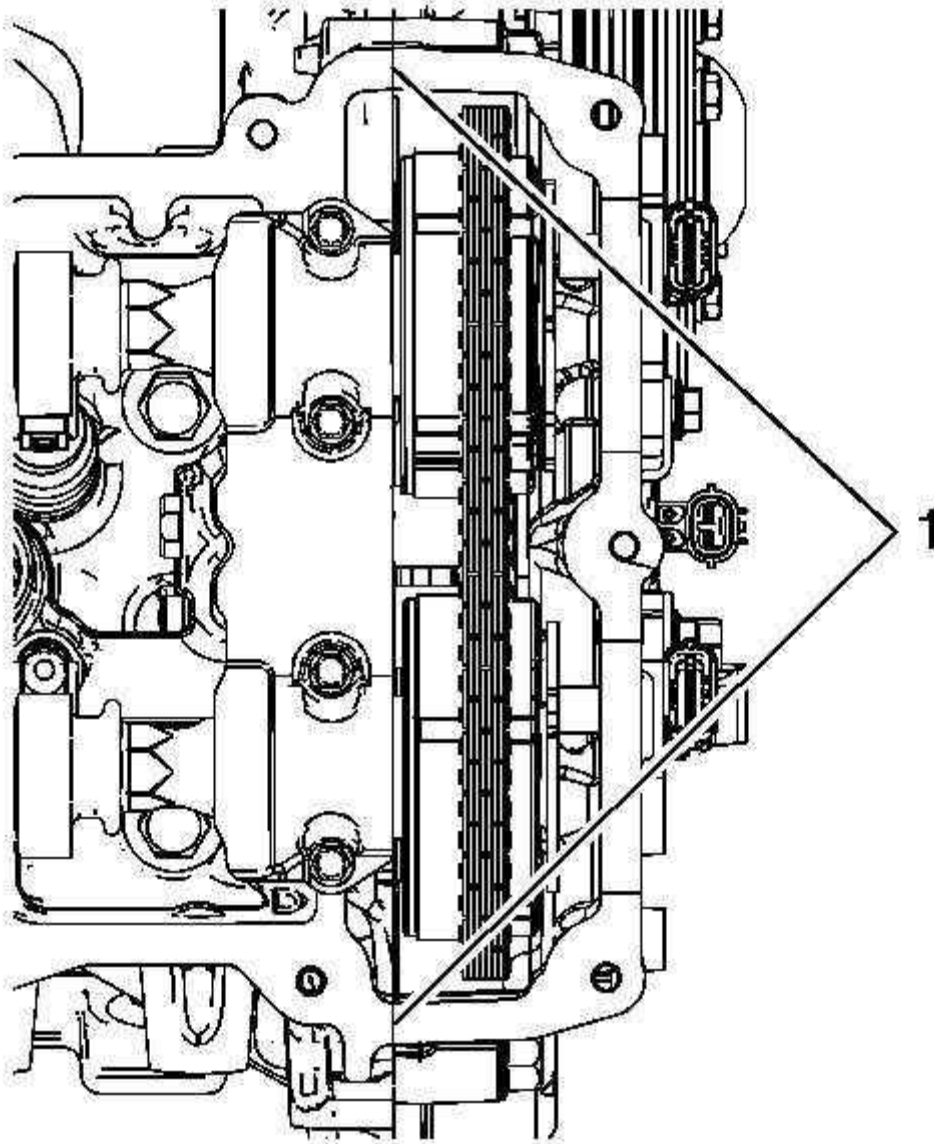


Fig. 192: Identifying Engine Front Cover Split Lines
Courtesy of GENERAL MOTORS CORP.

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

the engine front cover split lines (1).

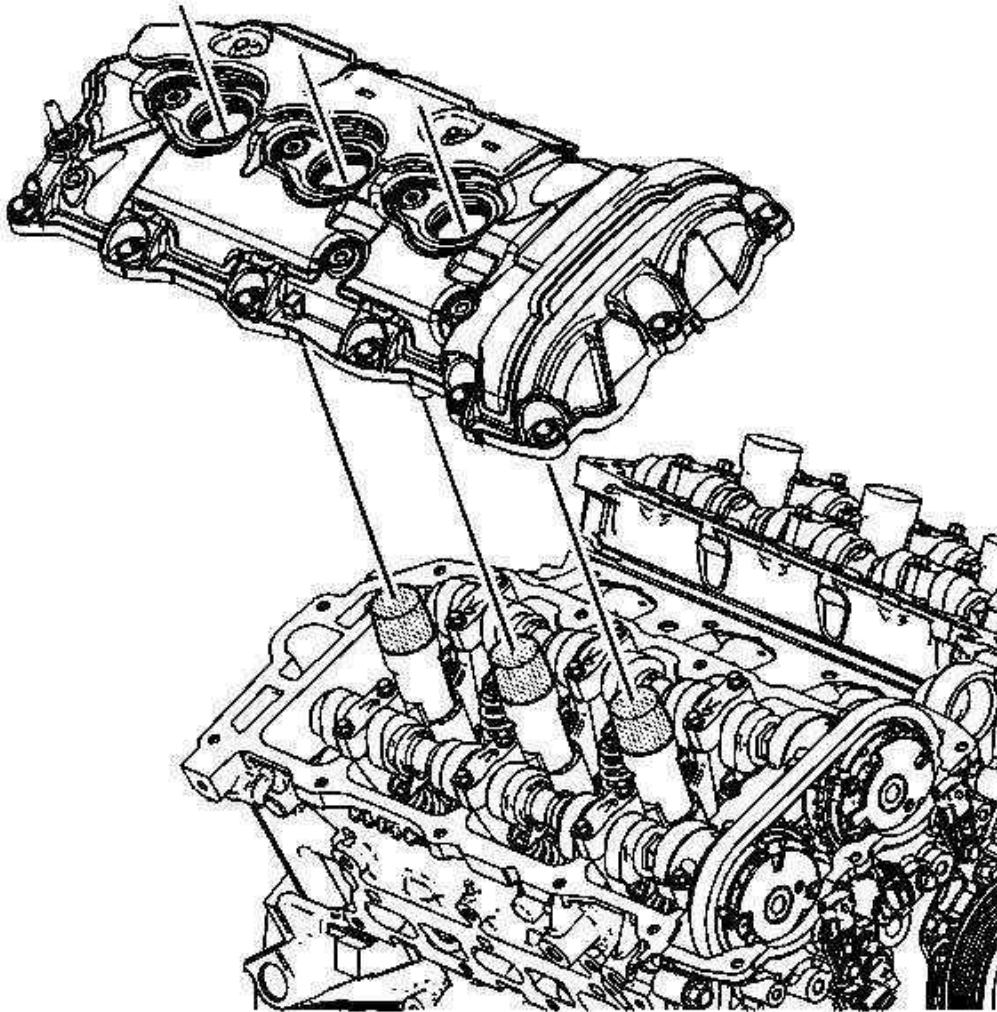


Fig. 193: View Of Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

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

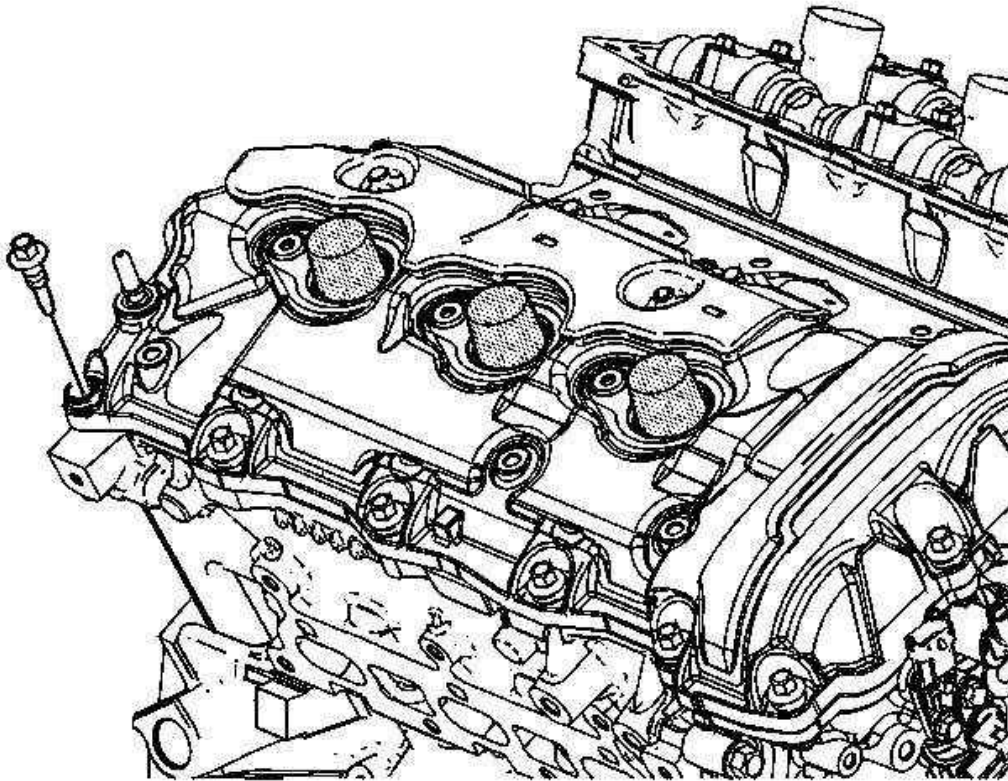


Fig. 194: Locating Right Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosely install the right camshaft cover bolts.

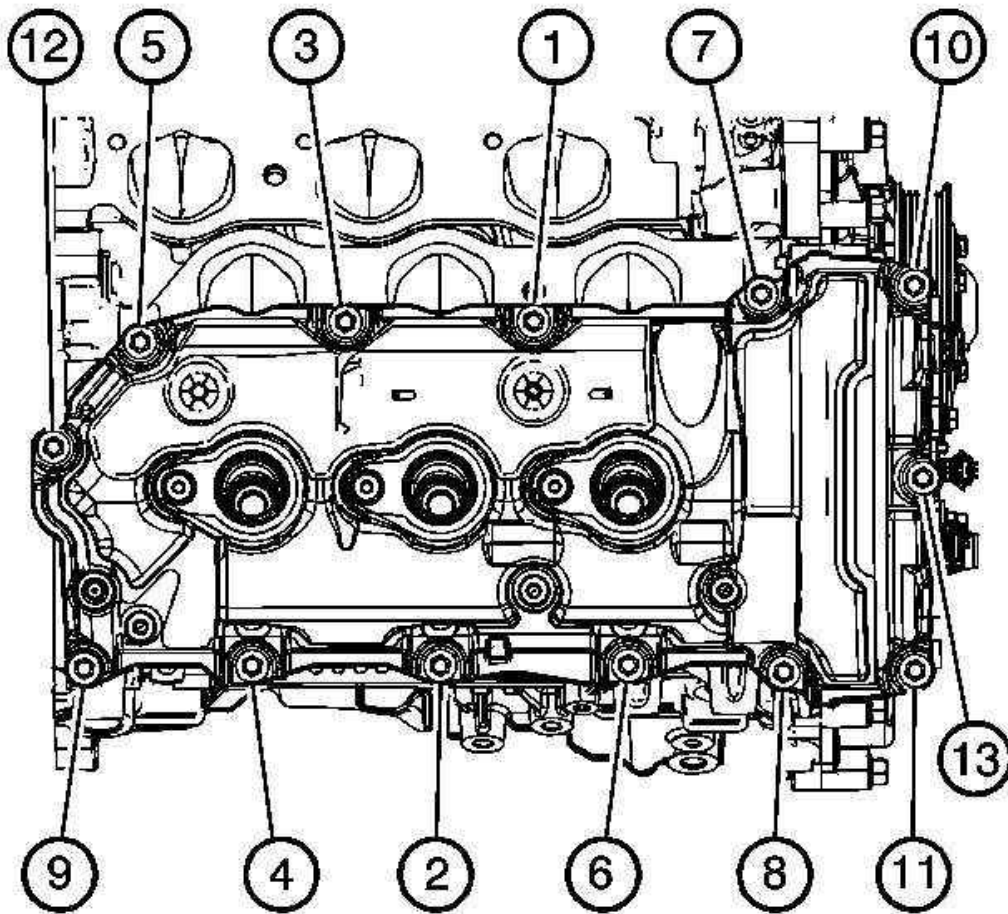


Fig. 195: Identifying Right Camshaft Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

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

Tighten:

1. Tighten the right camshaft cover bolts in the sequence to 10 N.m (89 lb in).
2. Tighten the right camshaft cover bolts a second pass in the sequence to 10

N.m (89 lb in).

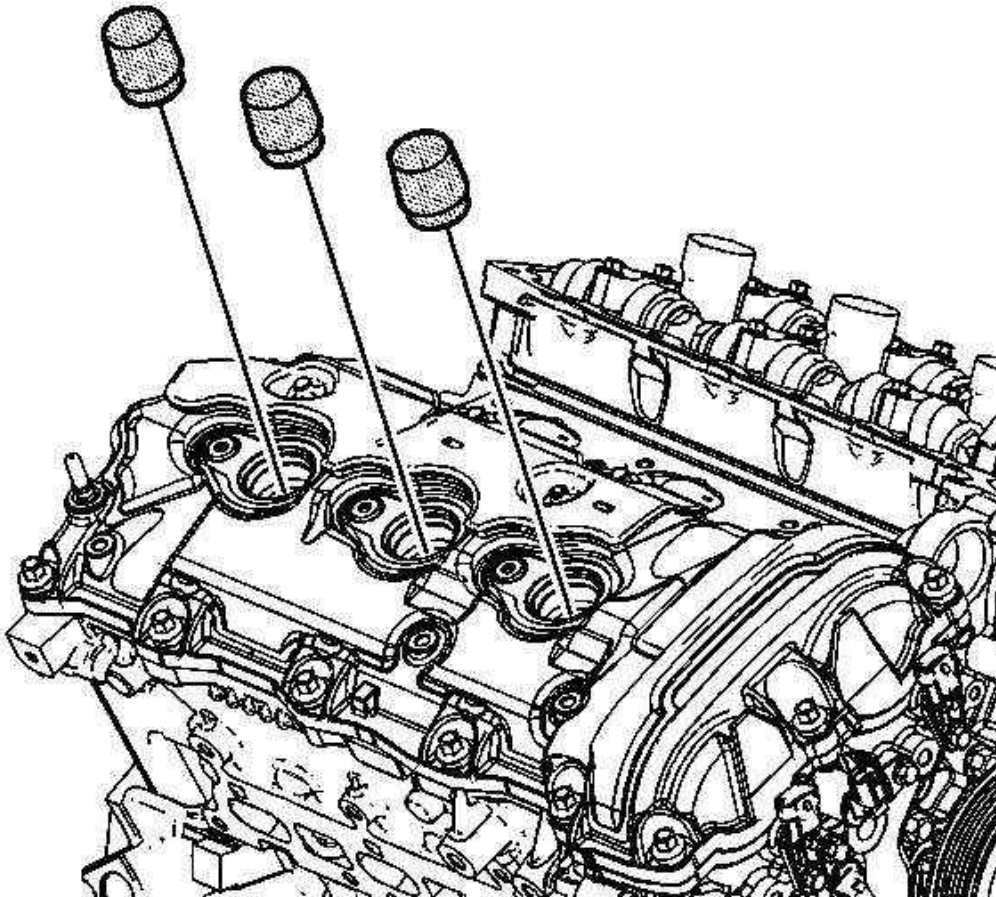


Fig. 196: View Of Spark Plug Tubes
Courtesy of GENERAL MOTORS CORP.

9. Remove the **EN 46101** from the spark plug tubes of the right cylinder head.
See **Special Tools** .

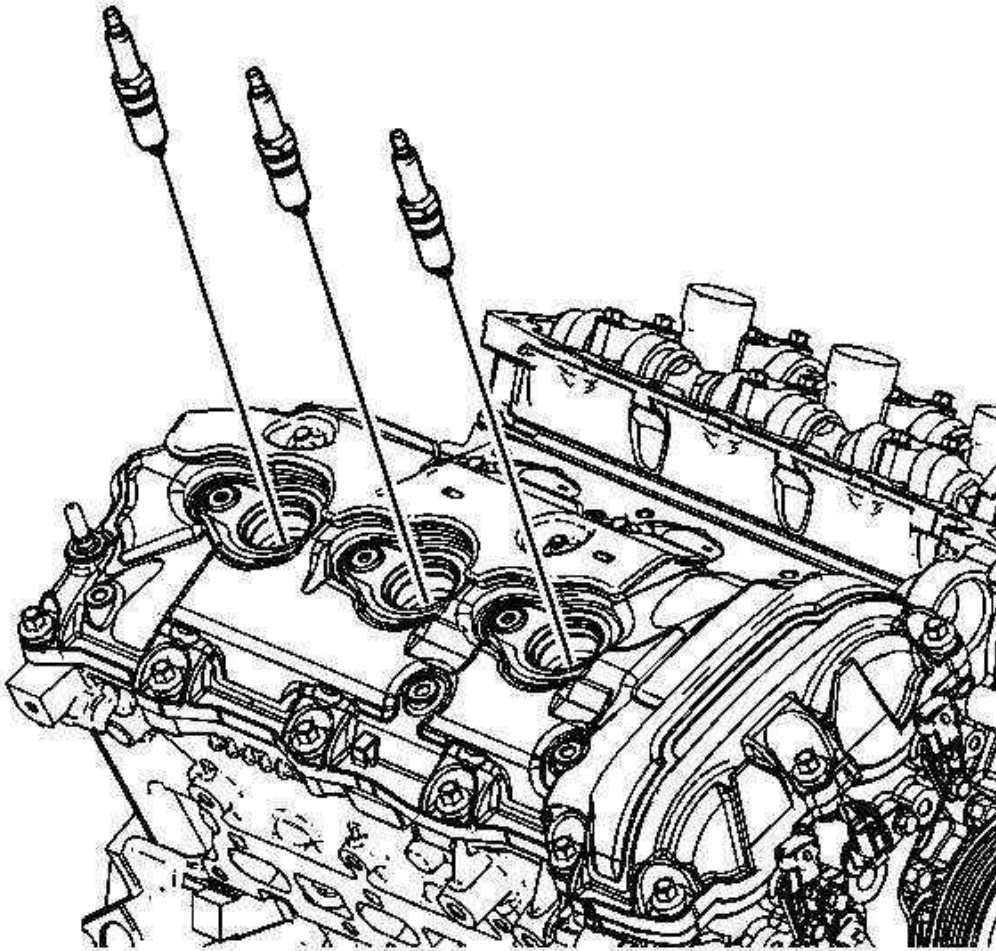


Fig. 197: View Of Spark Plugs
Courtesy of GENERAL MOTORS CORP.

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

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

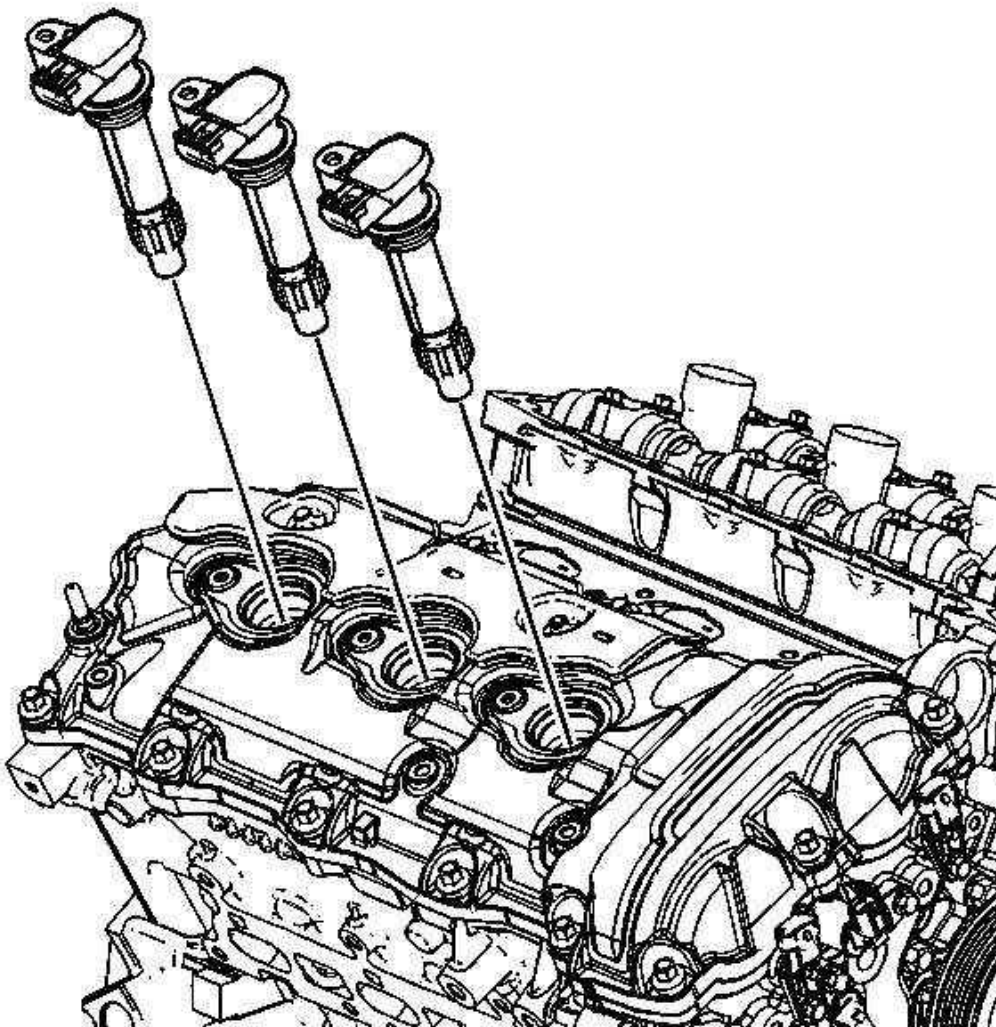


Fig. 198: View Of Ignition Coils
Courtesy of GENERAL MOTORS CORP.

11. Install the ignition coils.

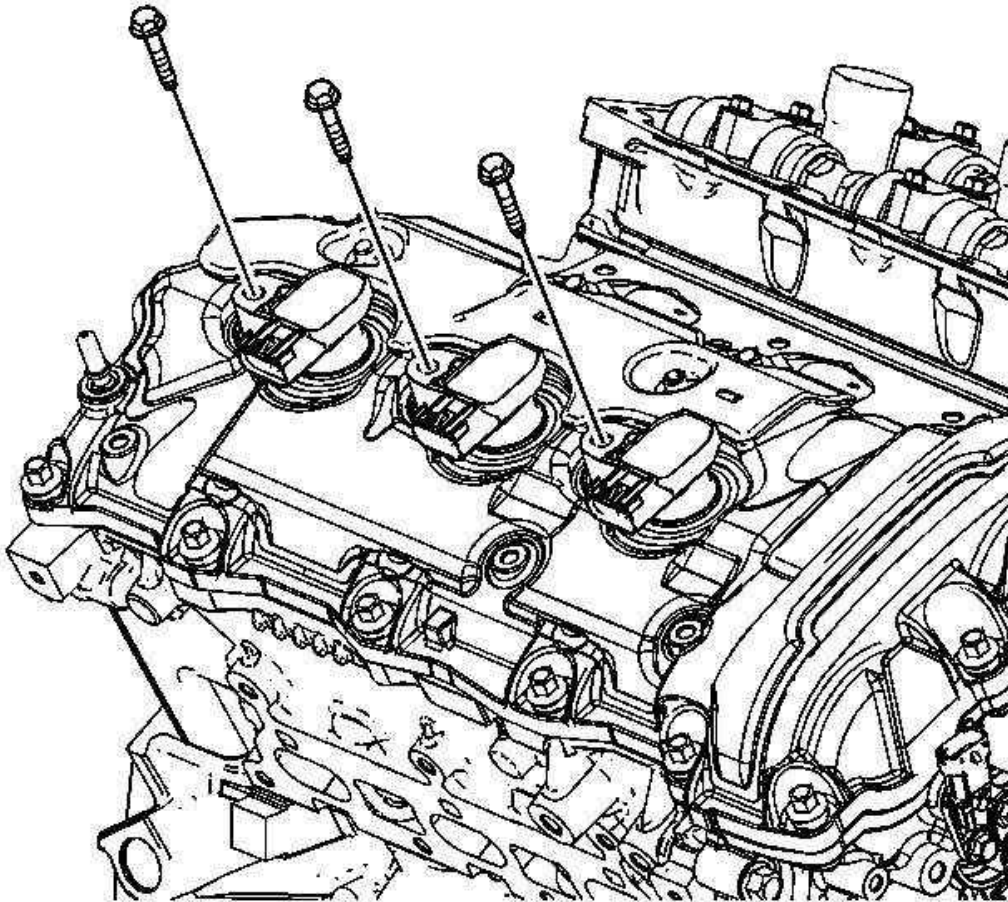


Fig. 199: Identifying Ignition Coil Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the ignition coil bolts.

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

INTAKE MANIFOLD INSTALLATION

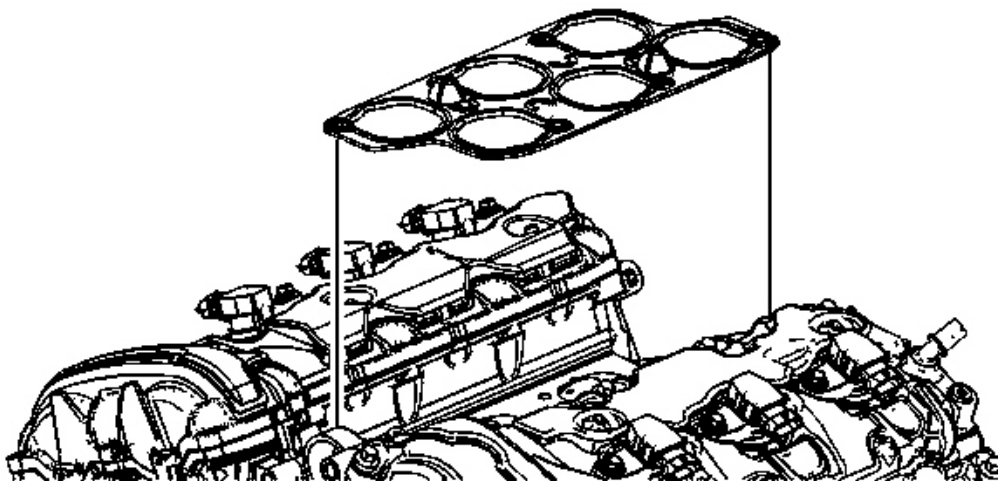


Fig. 200: View Of Lower Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW lower intake manifold gasket.

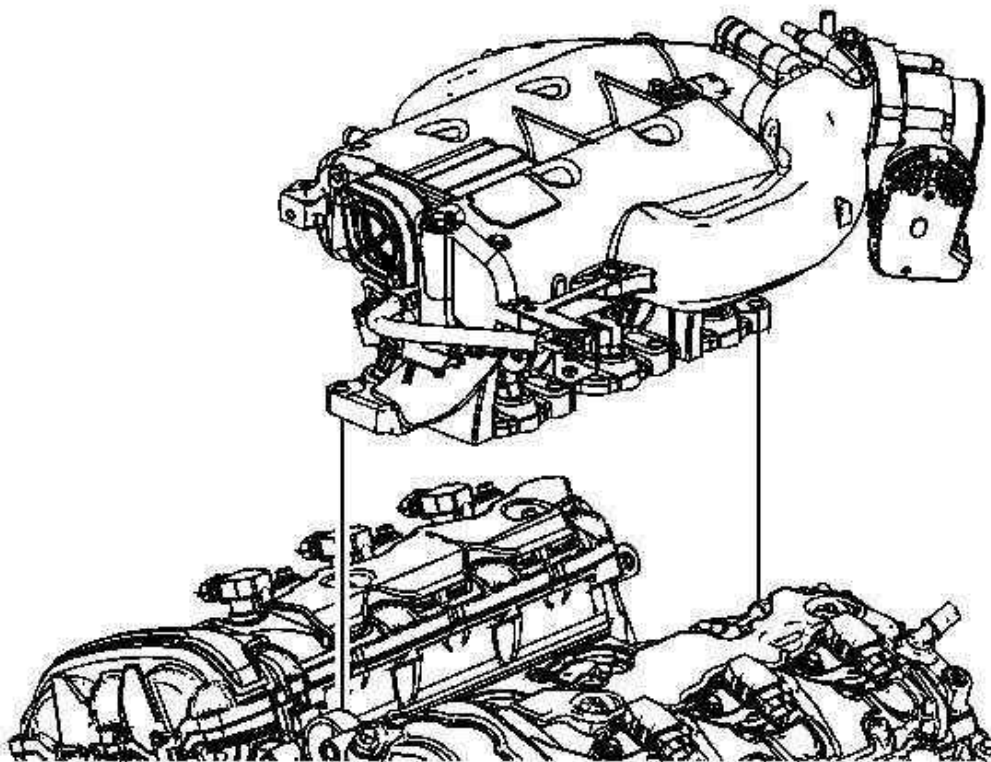


Fig. 201: View Of Intake Manifold
Courtesy of GENERAL MOTORS CORP.

2. Install the intake manifold assembly.

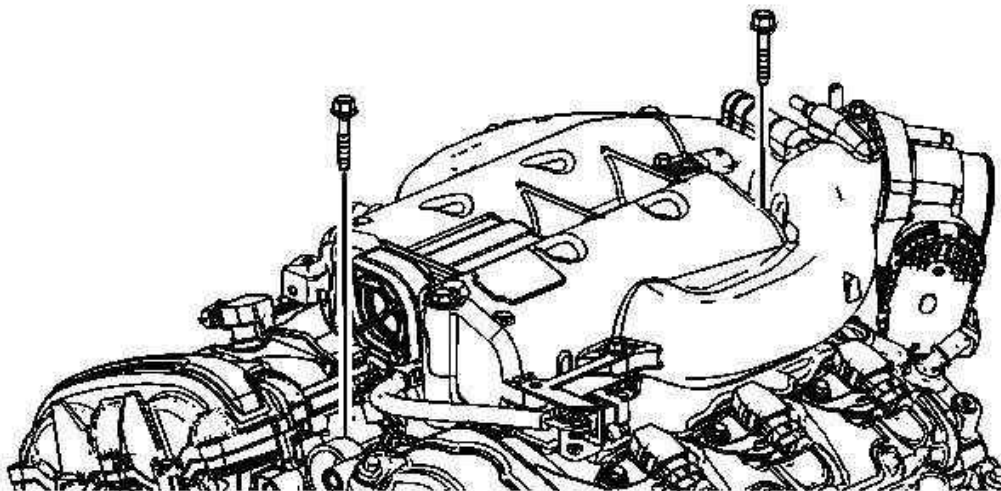


Fig. 202: Identifying Intake Manifold Short Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the intake manifold short bolts.

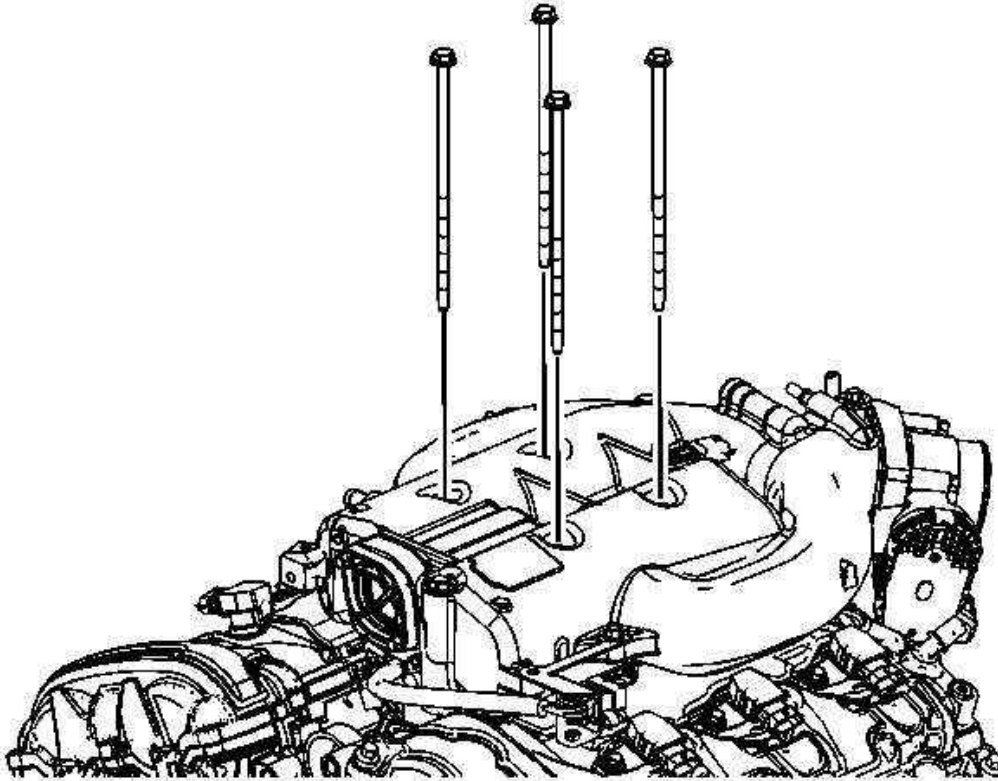


Fig. 203: Identifying Intake Manifold Long Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Install the intake manifold long bolts.

Tighten: Tighten the intake manifold bolts to 23 N.m (17 lb ft).

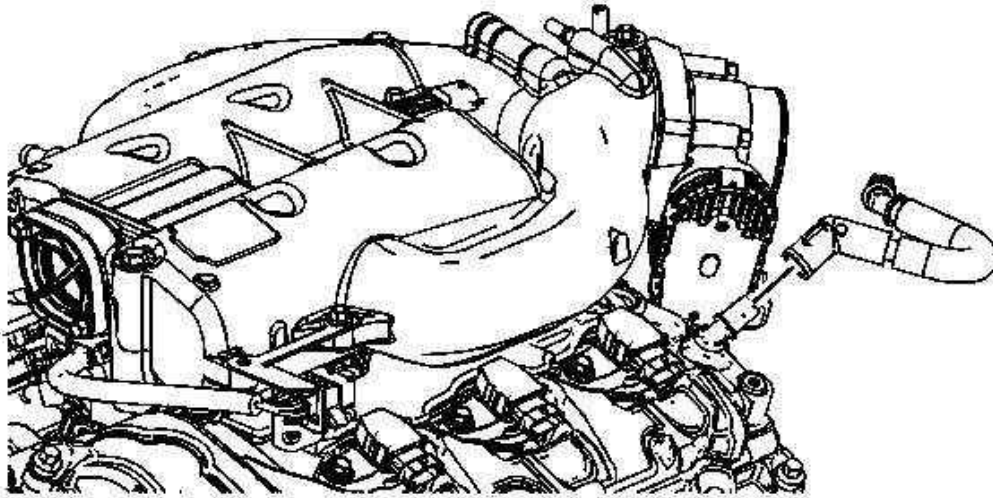


Fig. 204: Identifying Fresh Air PCV Hose
Courtesy of GENERAL MOTORS CORP.

5. Install and connect the fresh air positive crankcase ventilation (PCV) hose to the left camshaft cover fitting.

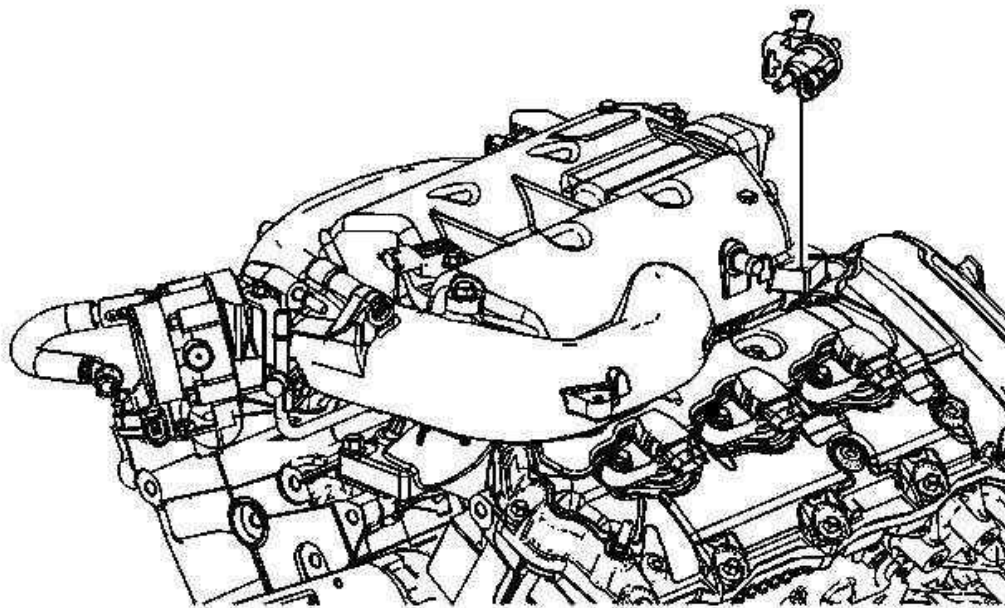


Fig. 205: View Of EVAP Solenoid
Courtesy of GENERAL MOTORS CORP.

6. Install the evaporative emissions (EVAP) solenoid.

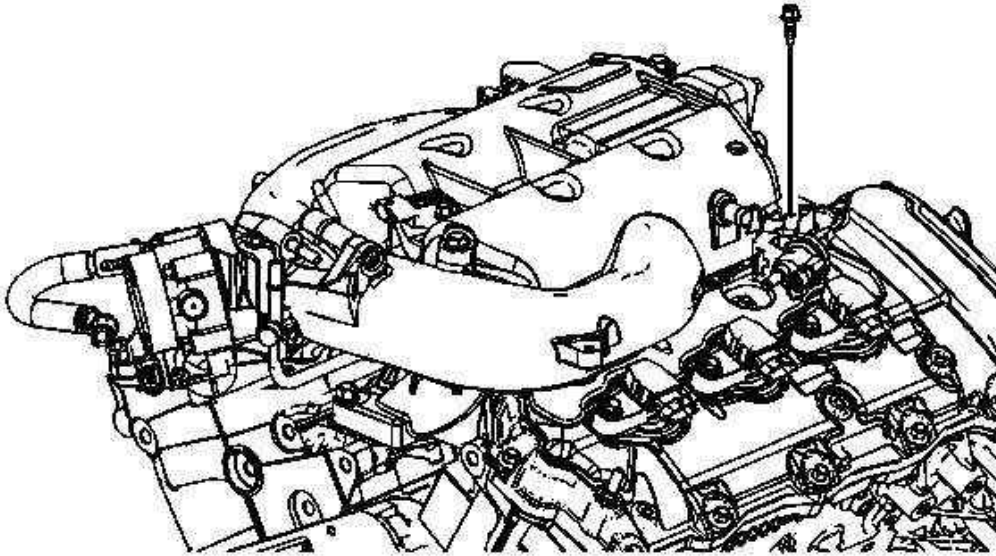


Fig. 206: Identifying EVAP Solenoid Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the EVAP solenoid bolt.

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

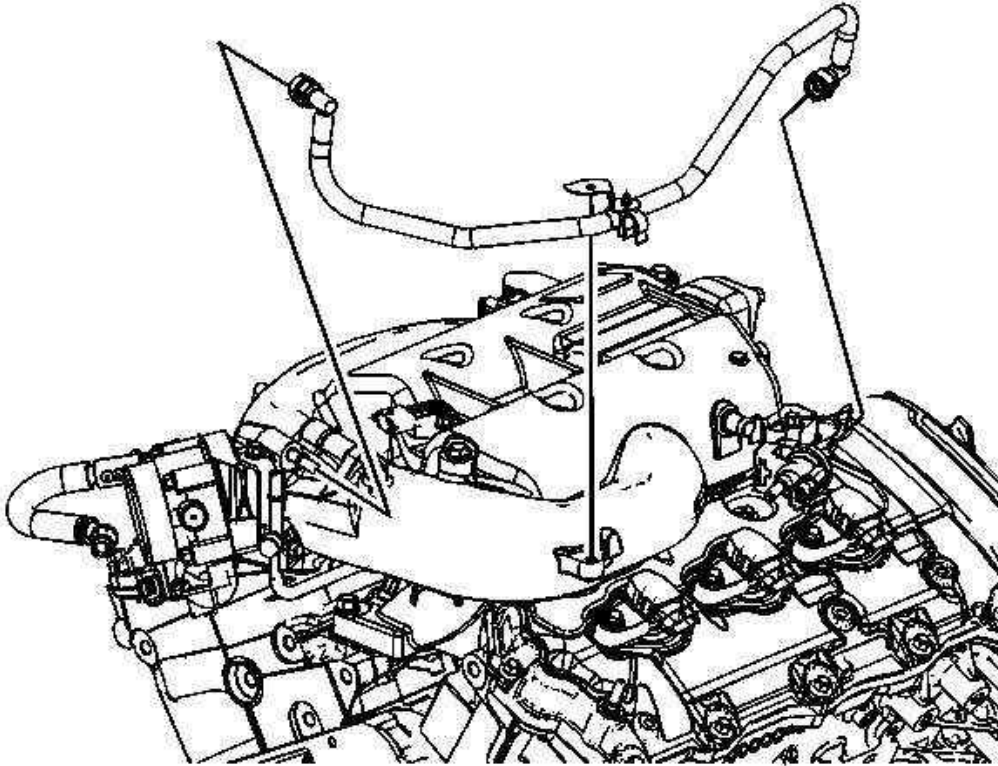


Fig. 207: Identifying Intake Manifold-To-Solenoid EVAP Hose
Courtesy of GENERAL MOTORS CORP.

8. Install and connect the intake manifold-to-solenoid EVAP hose to the intake manifold and to the EVAP solenoid.

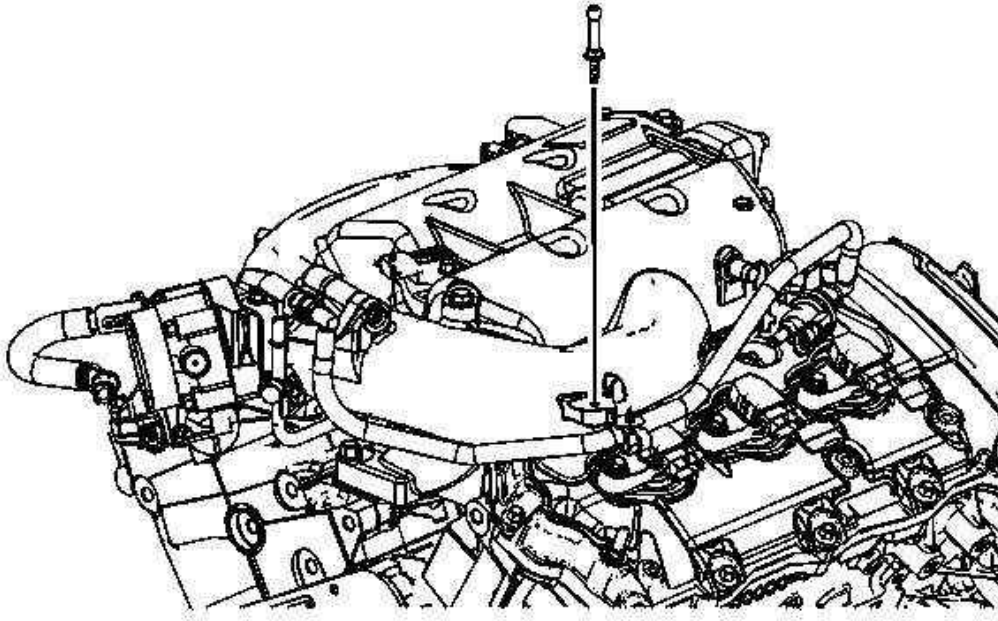


Fig. 208: Identifying Intake Manifold-To-Solenoid EVAP Hose Bracket Ballstud Bolt

Courtesy of GENERAL MOTORS CORP.

9. Install the intake manifold-to-solenoid EVAP hose bracket ballstud bolt to the intake manifold.

Tighten: Tighten the intake manifold-to-solenoid EVAP hose bracket bolt to 10 N.m (89 lb in).

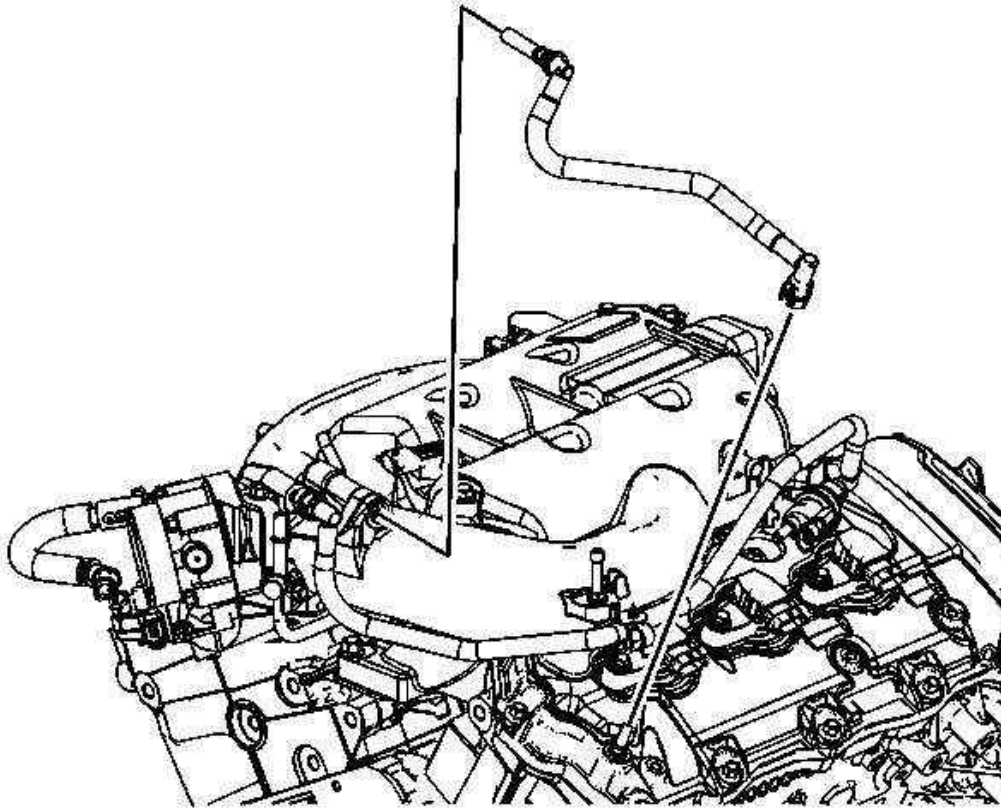


Fig. 209: Identifying Dirty Air Positive Crankcase Ventilation (PCV) Hose
Courtesy of GENERAL MOTORS CORP.

10. Install and connect the dirty air PCV hose to the intake manifold and to the right camshaft cover fitting.

ENGINE FLYWHEEL INSTALLATION

Tools Required

- **EN 46106** Engine Flywheel Holding Tool. See **Special Tools** .
- **J 45059** Angle Meter

Installation

1. Place the engine flywheel in position on the crankshaft.
2. Install 2 NEW bolts in location at the top and bottom of the engine flywheel bolt pattern allowing the engine flywheel to hang in position.

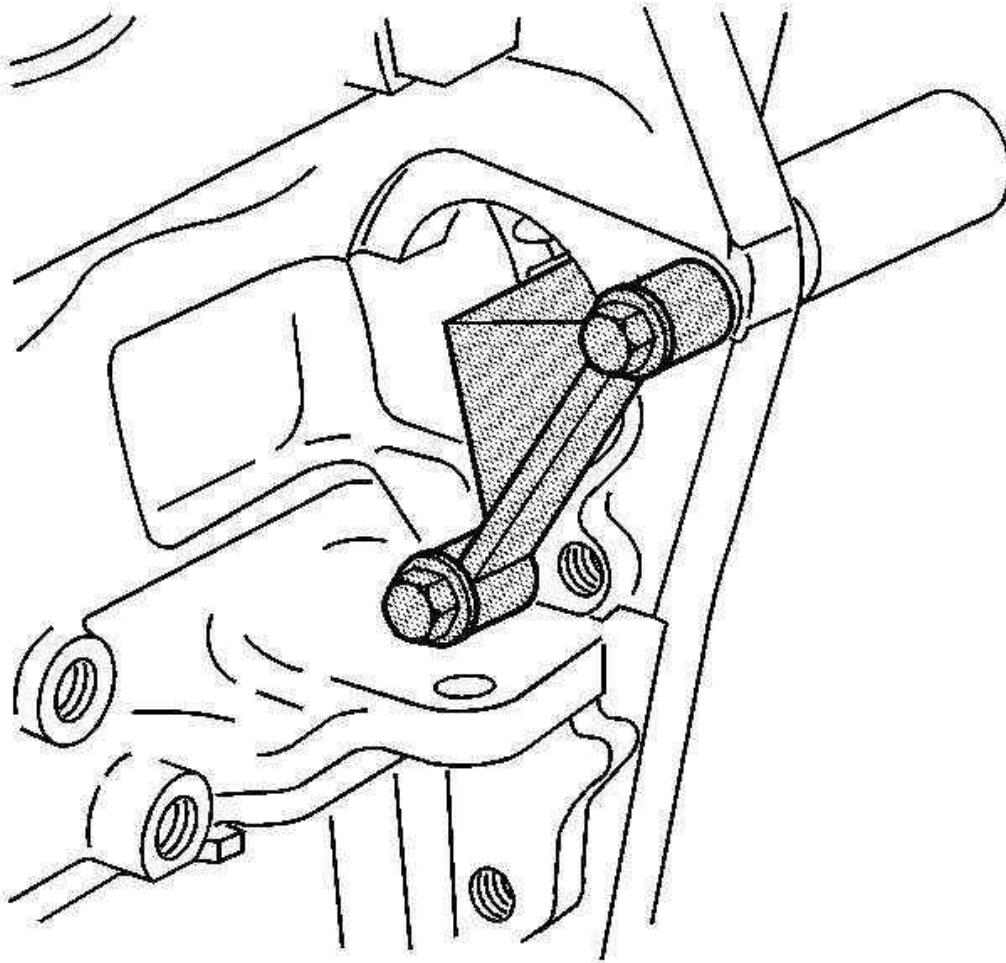


Fig. 210: View Of Special Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

3. Install the **EN 46106** . See Special Tools .

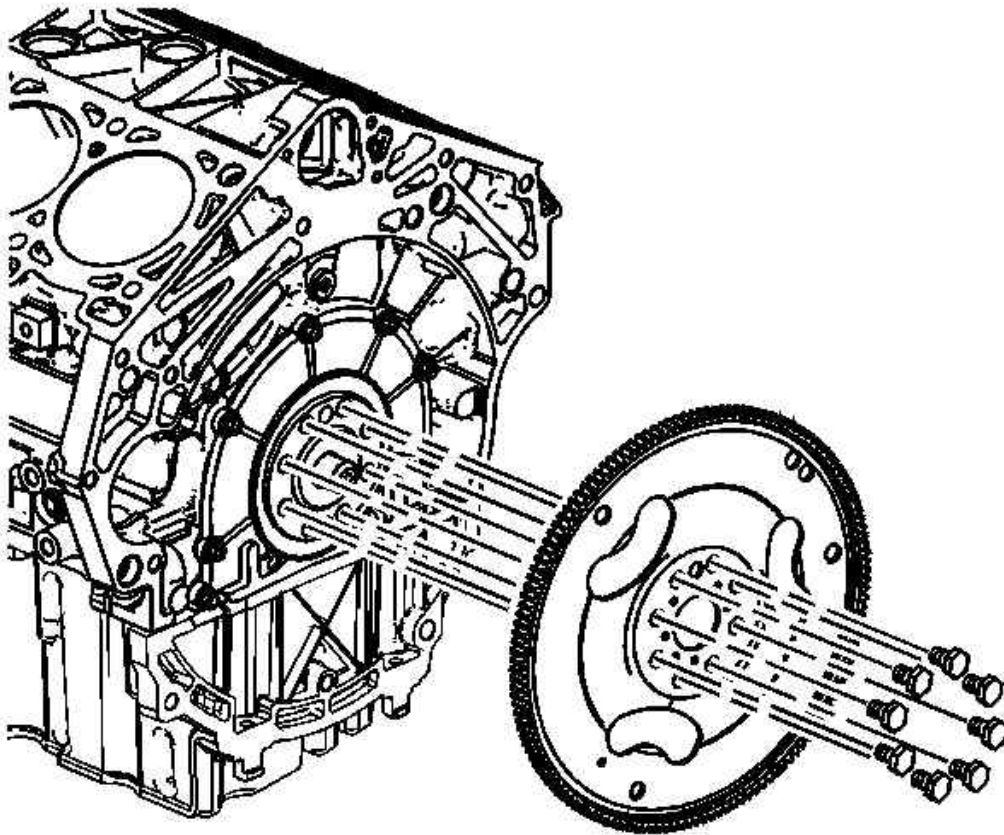


Fig. 211: Identifying Engine Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

4. Install the remaining NEW engine flywheel bolts.

Tighten:

1. Tighten the NEW engine flywheel bolts to 30 N.m (22 lb ft).
2. Tighten the NEW engine flywheel bolts an additional 45 degrees using the J 45059 .

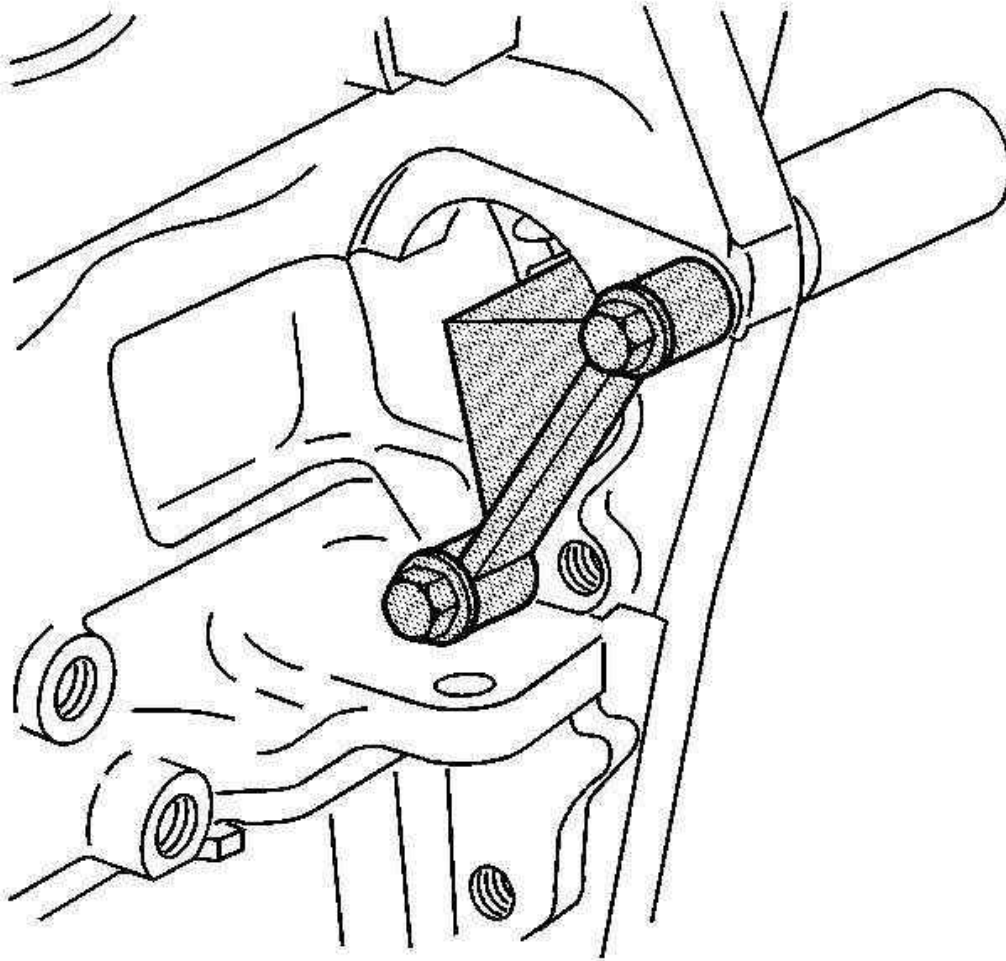


Fig. 212: View Of Special Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

5. Remove the **EN 46106** . See **Special Tools** .

CRANKSHAFT BALANCER INSTALLATION

Tools Required

- **EN 46106** Engine Flywheel Holding Tool. See **Special Tools** .
- **J 41998-B** Crankshaft Balancer Installer. See **Special Tools** .

- **J 45059** Angle Meter

Installation

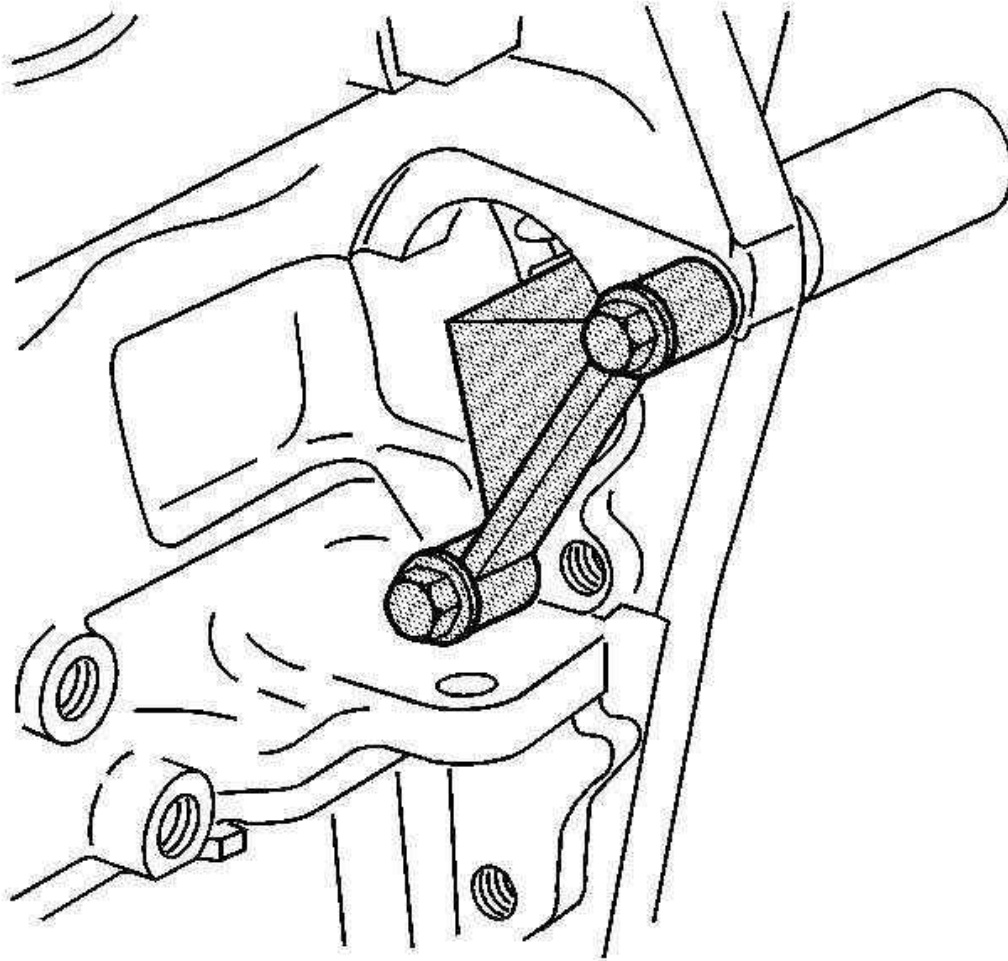


Fig. 213: View Of Special Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

1. The **EN 46106** must be installed onto the flywheel. See **Special Tools** .
2. Use the **J 41998-B** , nut, bearing and washer to install the crankshaft balancer. See **Special Tools** .

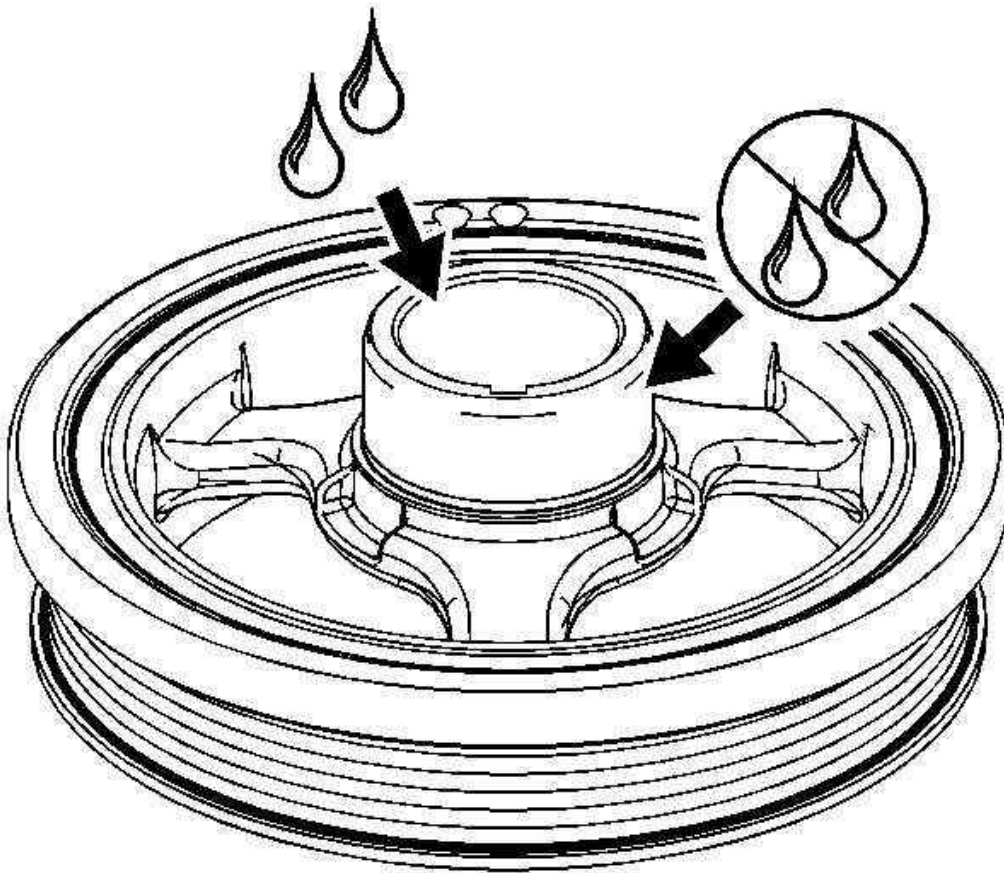


Fig. 214: Lubricating Inside Of Crankshaft Balancer Hub Bore
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Do not lubricate the crankshaft front oil seal or crankshaft balancer sealing surfaces. The crankshaft balancer is installed into a dry seal.

3. Apply lubricant to the inside of the crankshaft balancer hub bore.

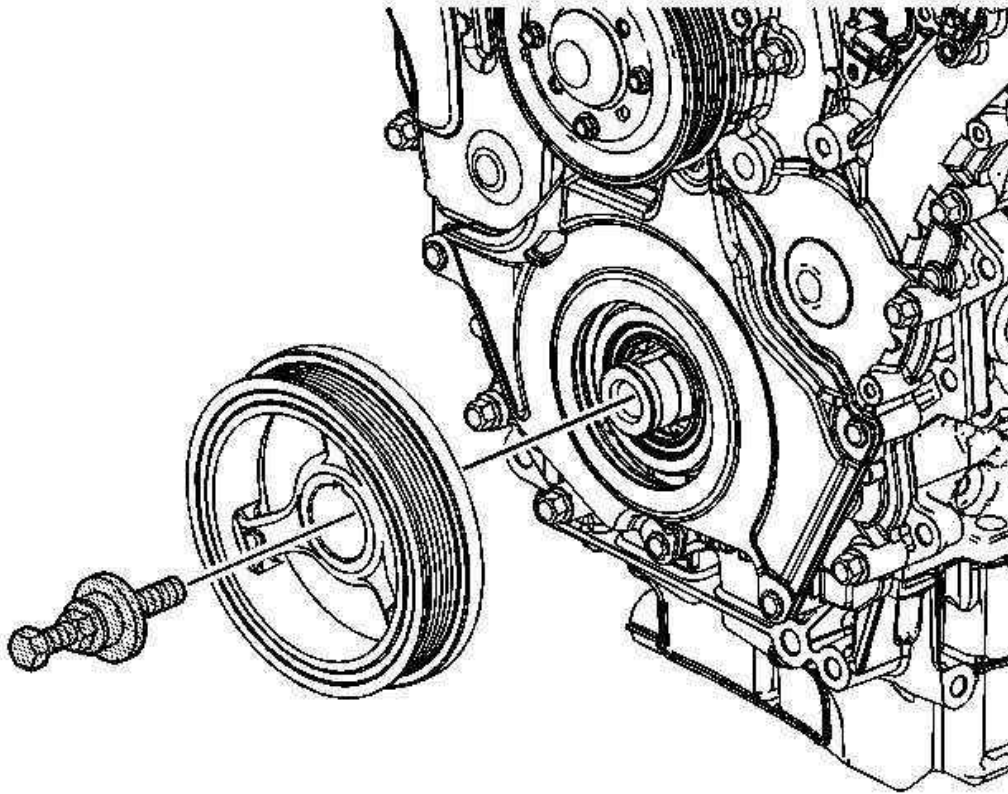


Fig. 215: View Of Crankshaft Balancer & Bolt
Courtesy of GENERAL MOTORS CORP.

4. Place the crankshaft balancer in position on the crankshaft.
5. Thread the **J 41998-B** in the crankshaft. See **Special Tools** . Ensure you engage at least 10 threads of the **J 41998-B** before pressing the crankshaft balancer in place. See **Special Tools** .
6. Push the crankshaft balancer into position by tightening the nut on the **J 41998-B** until the large washer bottoms out on the crankshaft end. See **Special Tools** .
7. Remove the **J 41998-B** . See **Special Tools** .

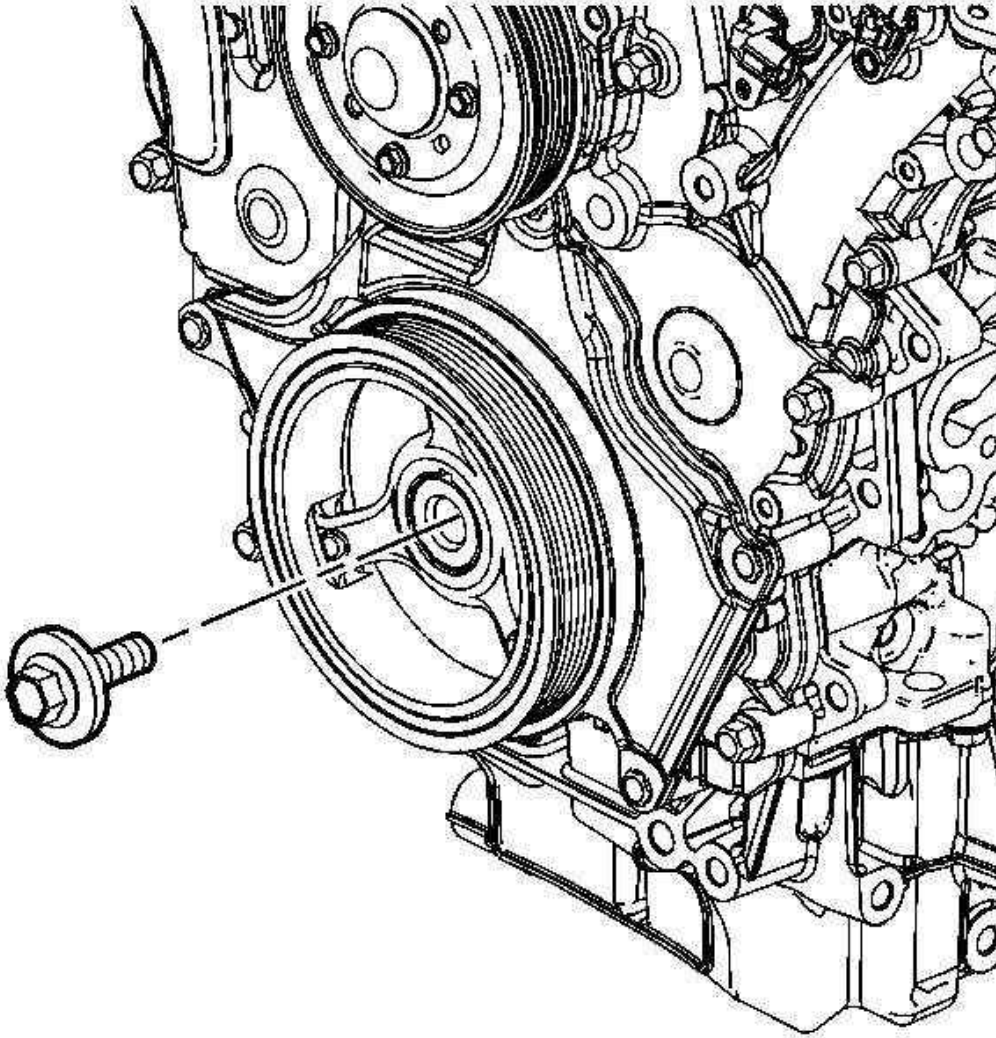


Fig. 216: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

8. Install the crankshaft balancer bolt.

NOTE: Refer to Fastener Notice .

9. Tighten the crankshaft balancer bolt.

Tighten:

1. Tighten the crankshaft balancer bolt to 100 N.m (74 lb ft).
2. Tighten the crankshaft balancer bolt an additional 150 degrees using the **J 45059** .

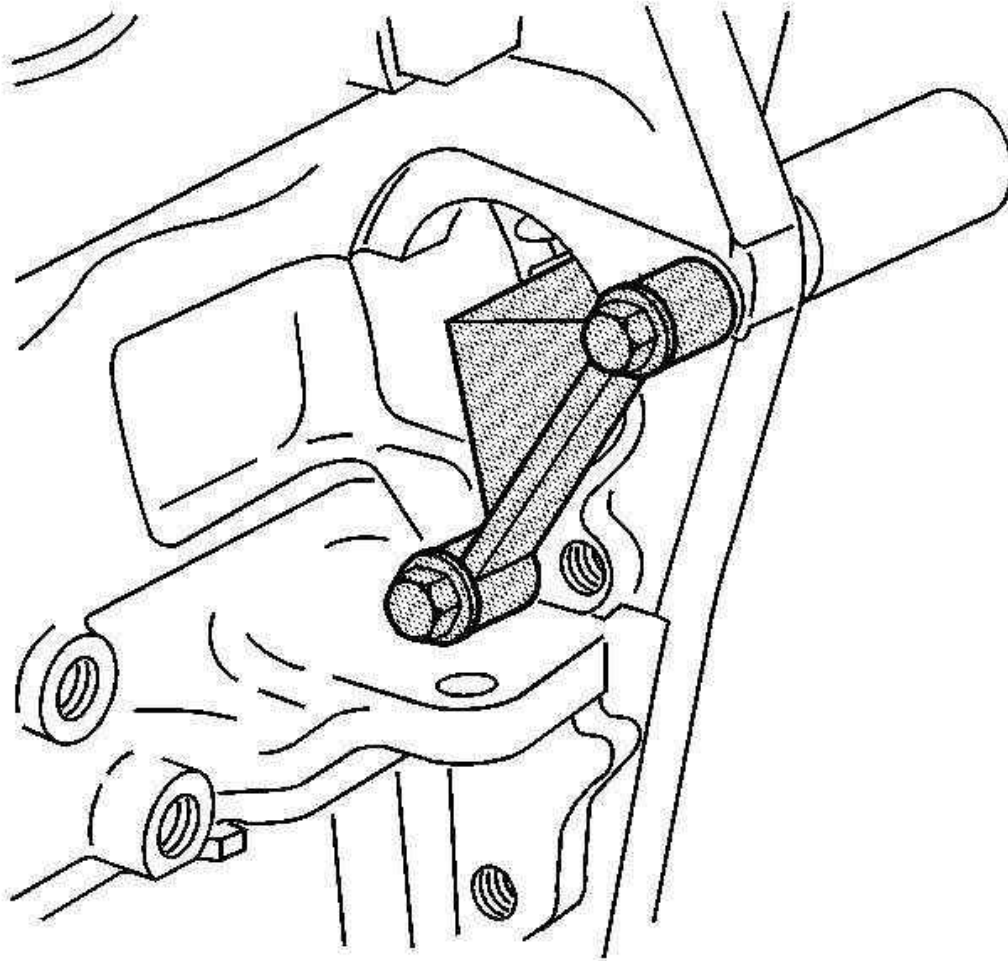


Fig. 217: View Of Special Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

10. Remove the **EN 46106** . See **Special Tools** .

OIL FILTER ADAPTER INSTALLATION

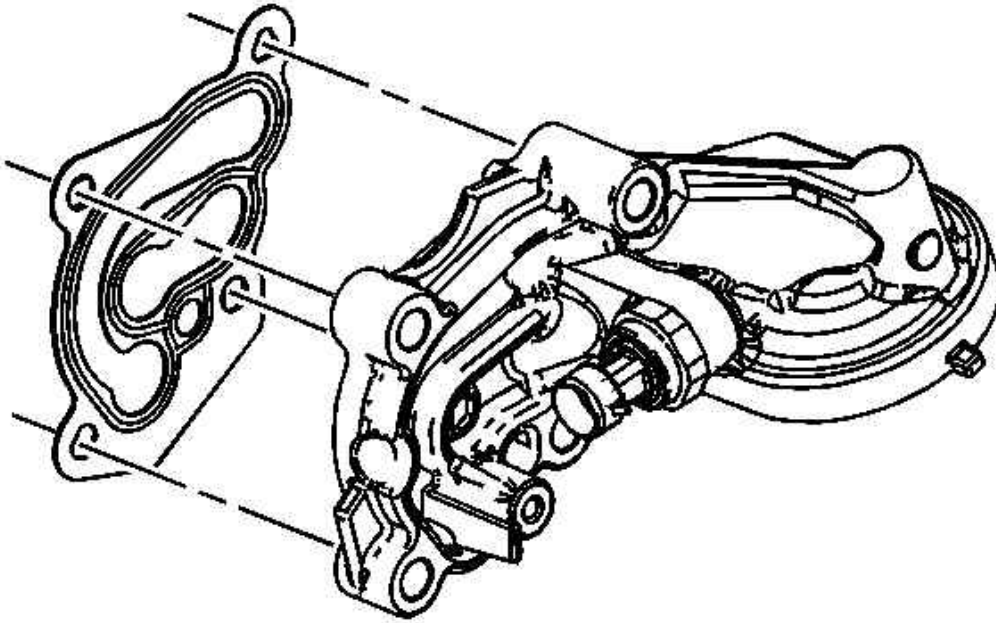


Fig. 218: View Of Oil Filter Adapter Gasket
Courtesy of GENERAL MOTORS CORP.

1. Position a NEW oil filter adapter gasket onto the oil filter adapter.

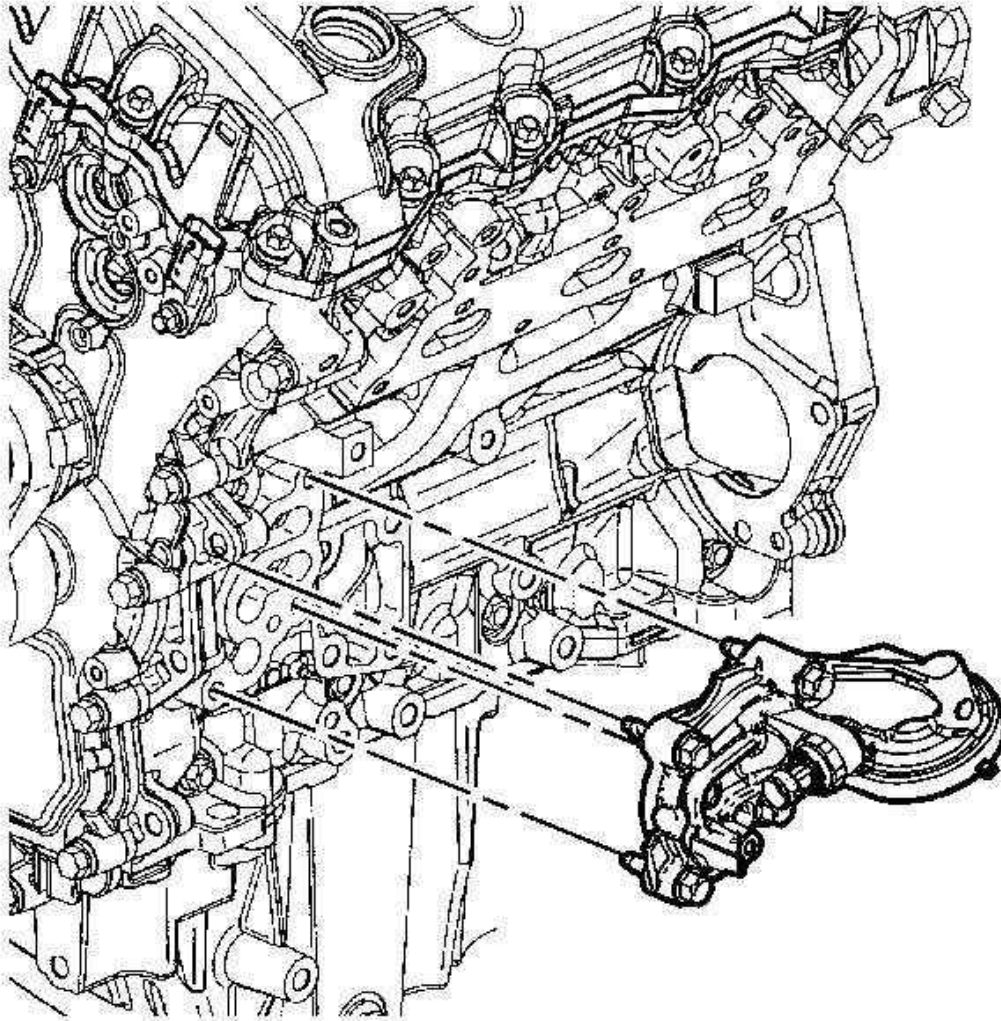


Fig. 219: Identifying Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

2. Install the oil filter adapter bolts into the oil filter adapter.
3. Install the oil filter adapter.
4. Tighten the oil filter adapter bolts into the engine block.

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

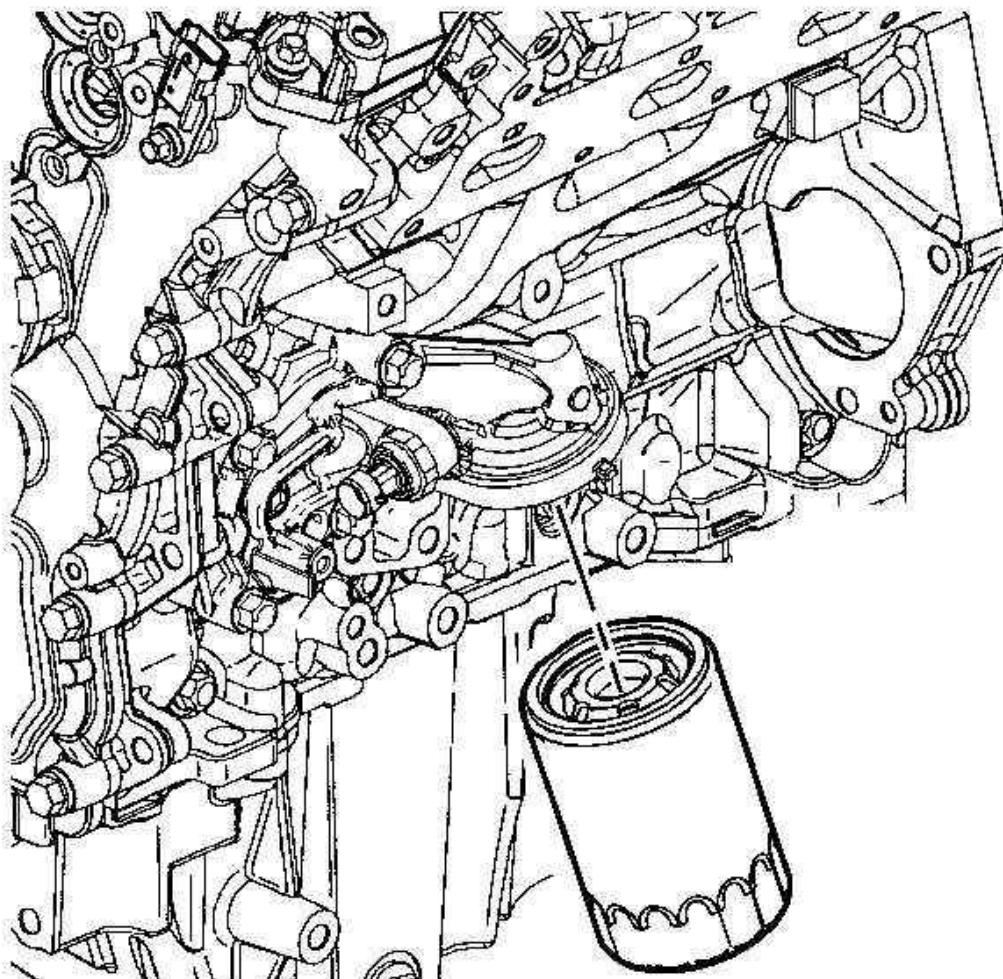


Fig. 220: View Of Oil Filter
Courtesy of GENERAL MOTORS CORP.

5. Install a NEW oil filter.

EXHAUST MANIFOLD INSTALLATION - LEFT SIDE

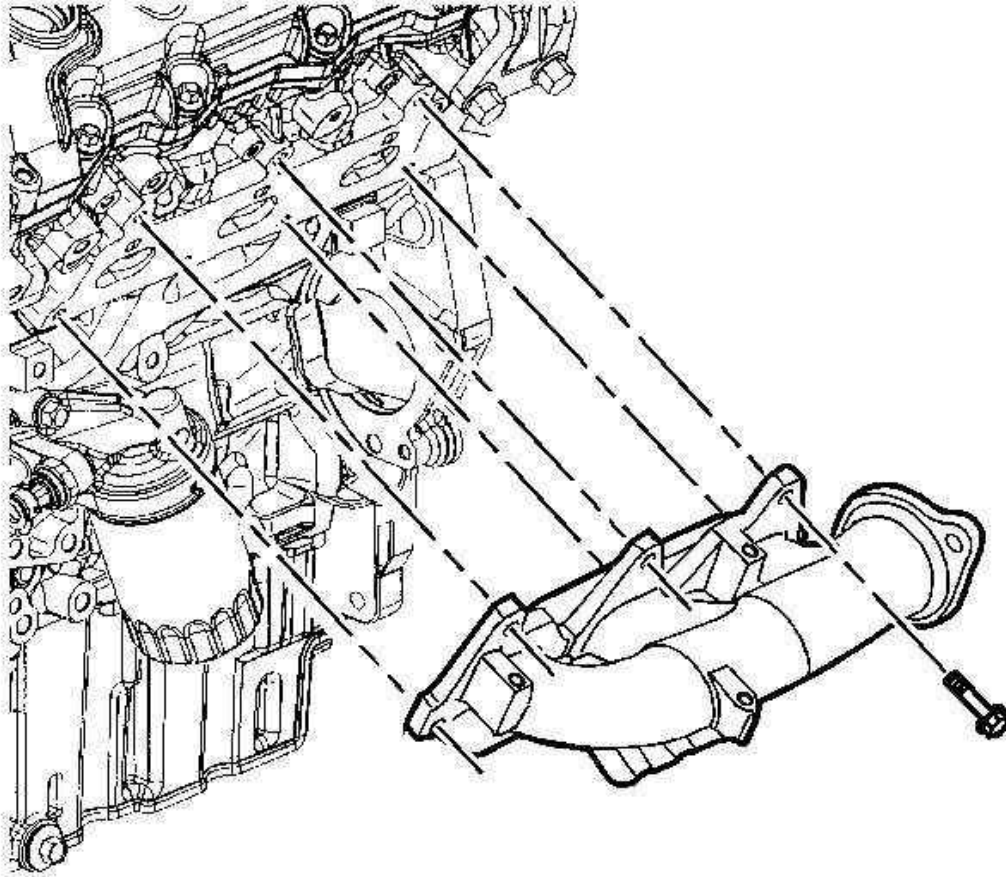


Fig. 221: Identifying Exhaust Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

1. Position a NEW exhaust manifold gasket onto the left exhaust manifold.
2. Install the exhaust manifold bolts into the left exhaust manifold.
3. Place the left exhaust manifold, exhaust manifold gasket and bolts as an assembly in position on the left cylinder head.

NOTE: Refer to Fastener Notice .

4. Install the exhaust manifold bolts into the left cylinder head.

Tighten: Tighten the exhaust manifold bolts to 25 N.m (18 lb ft).

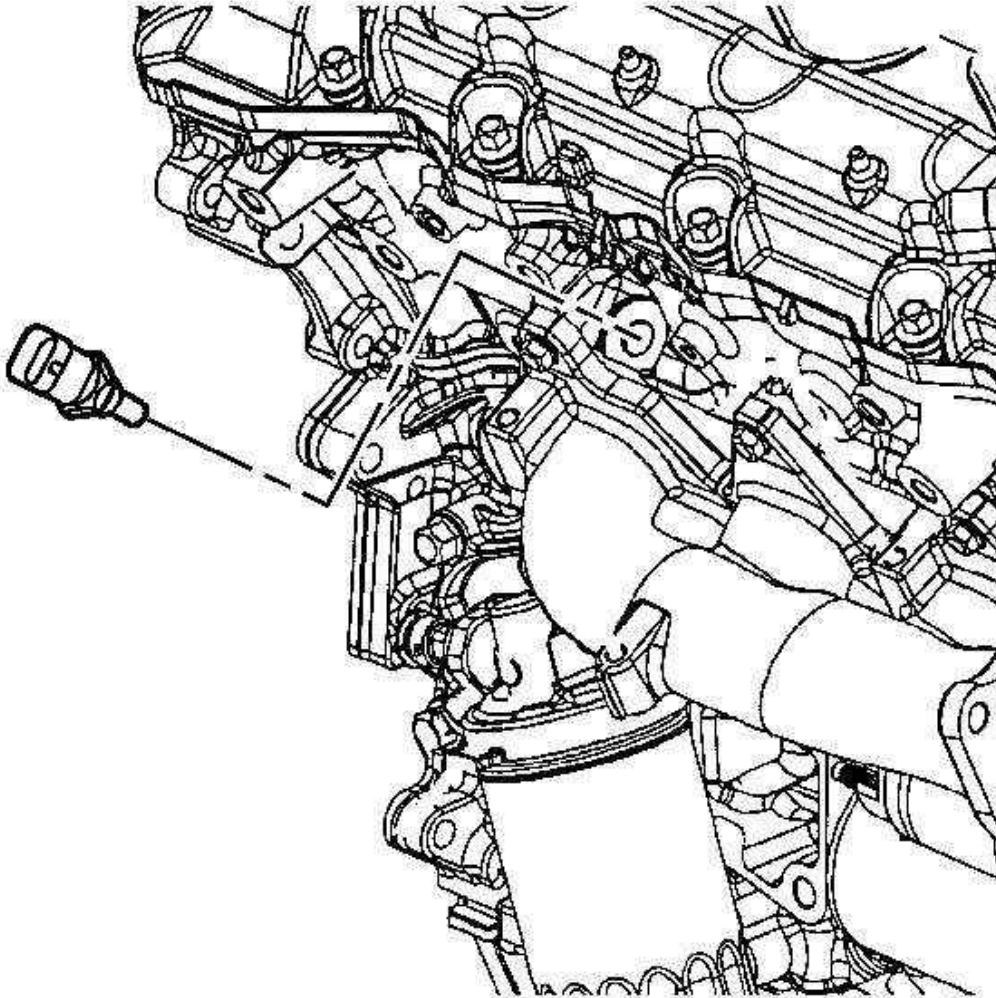


Fig. 222: Identifying Engine Coolant Temperature (ECT) Sensor
Courtesy of GENERAL MOTORS CORP.

5. Install the engine coolant temperature (ECT) sensor.

Tighten: Tighten the ECT sensor to 22 N.m (16 lb ft).

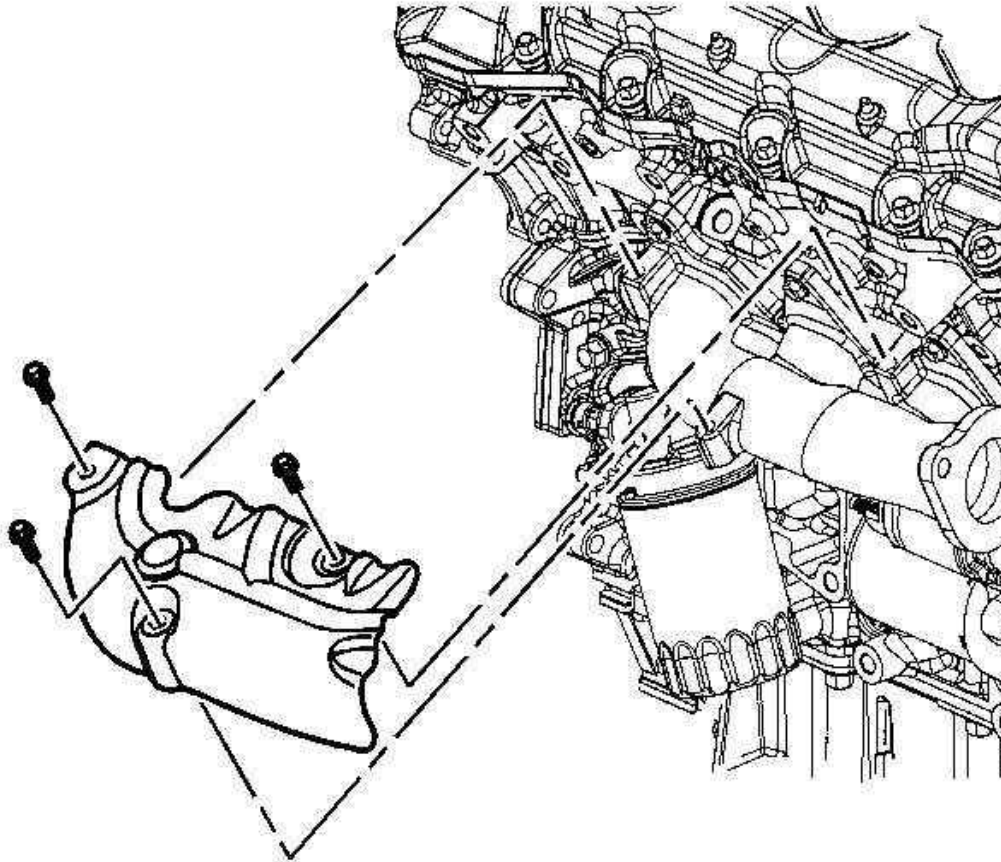


Fig. 223: Identifying Left Exhaust Manifold Heat Shield Bolts
Courtesy of GENERAL MOTORS CORP.

6. Place the left exhaust manifold heat shield in position.
7. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

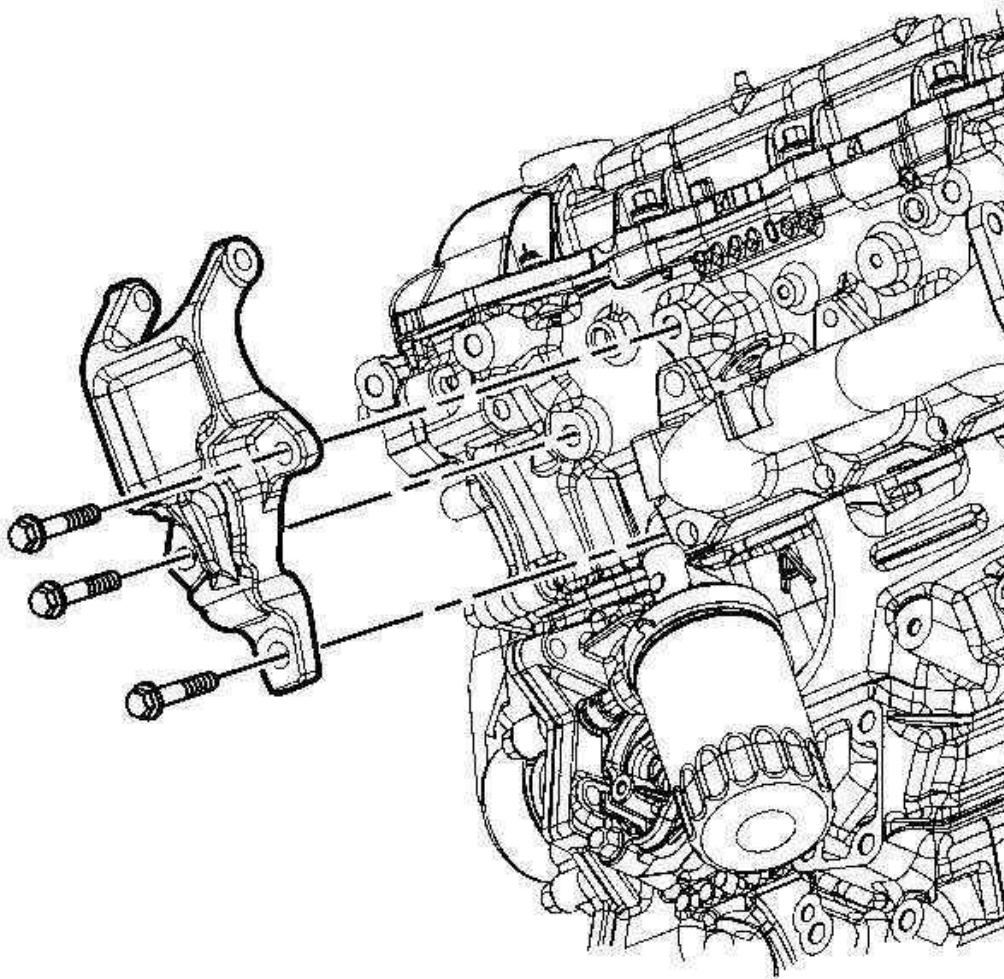


Fig. 224: View Of Left Torque Strut Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the left torque strut bracket.
9. Install the left torque strut bracket bolts.

Tighten: Tighten the left torque strut bracket bolts to 50 N.m (37 lb ft).

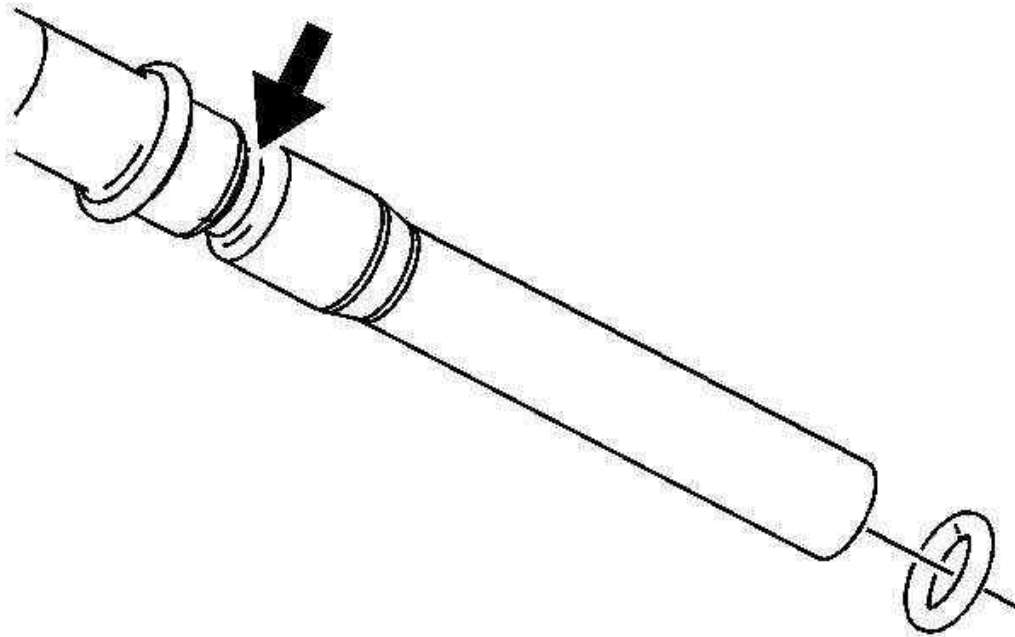


Fig. 225: View Of Oil Level Indicator Tube O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW O-ring on the oil level indicator tube.

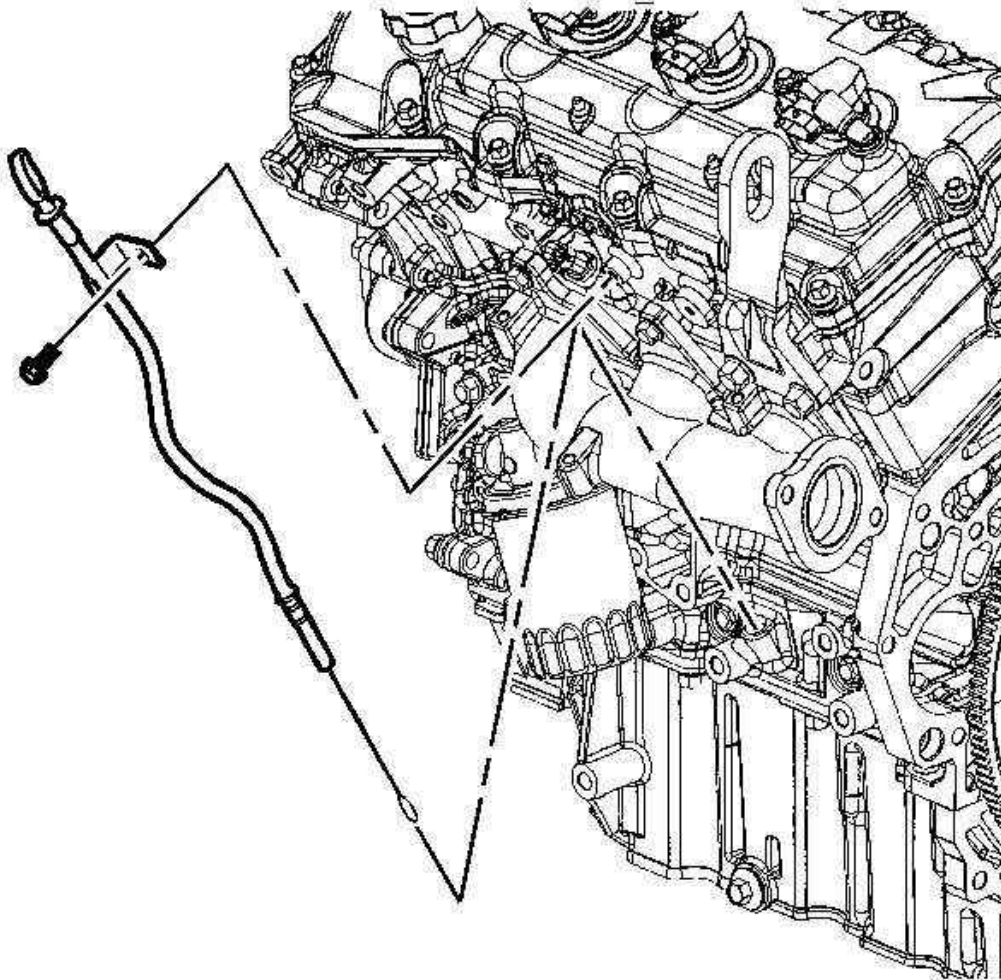


Fig. 226: Identifying Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

2. Install the oil level indicator and tube by sliding the tube down through the lower crankcase hole.

NOTE: Refer to Fastener Notice .

3. Install the oil level indicator tube bracket bolt.

Tighten: Tighten the oil level indicator tube bracket bolt to 10 N.m (89 lb in).

EXHAUST MANIFOLD INSTALLATION - RIGHT SIDE

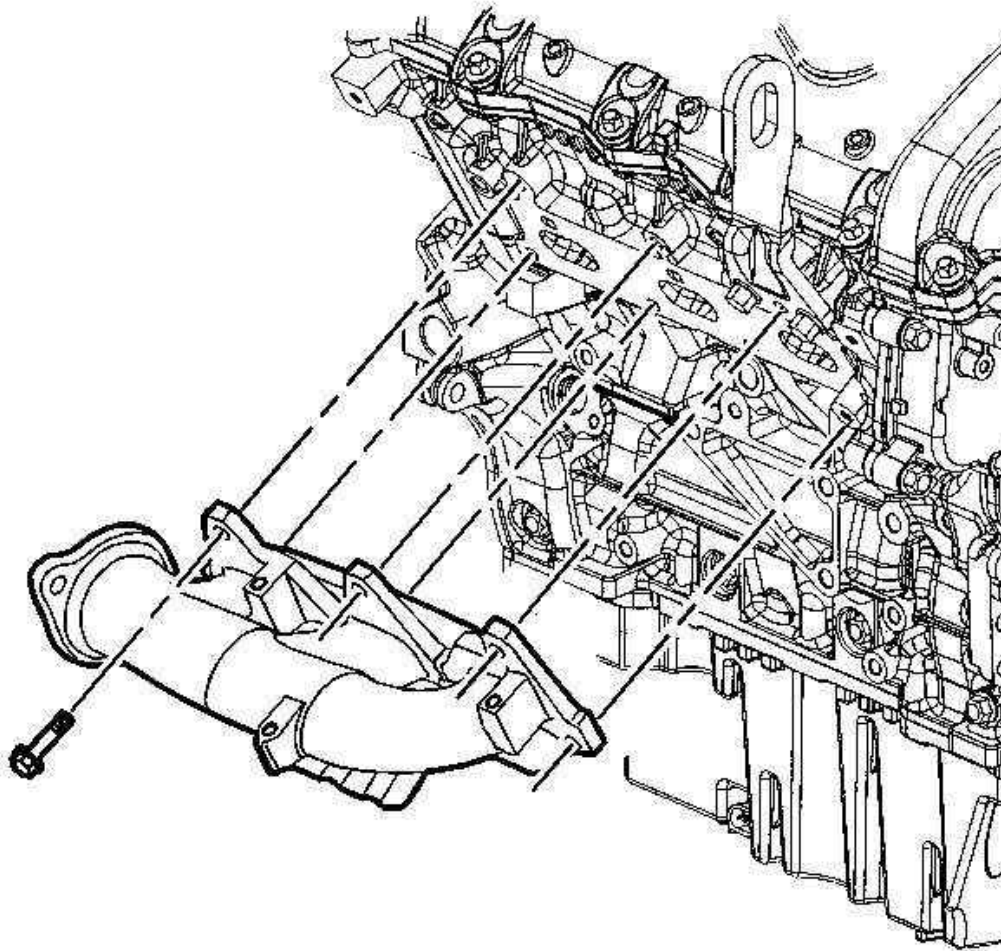


Fig. 227: Identifying Exhaust Manifold Bolts To Right Cylinder Head
Courtesy of GENERAL MOTORS CORP.

1. Position a NEW exhaust manifold gasket onto the right exhaust manifold.
2. Install the exhaust manifold bolts into the right exhaust manifold.
3. Place the right exhaust manifold, exhaust manifold gasket and bolts as an

assembly in position on the right cylinder head.

NOTE: Refer to Fastener Notice .

4. Install the exhaust manifold bolts into the right cylinder head.

Tighten: Tighten the exhaust manifold bolts to 25 N.m (18 lb ft).

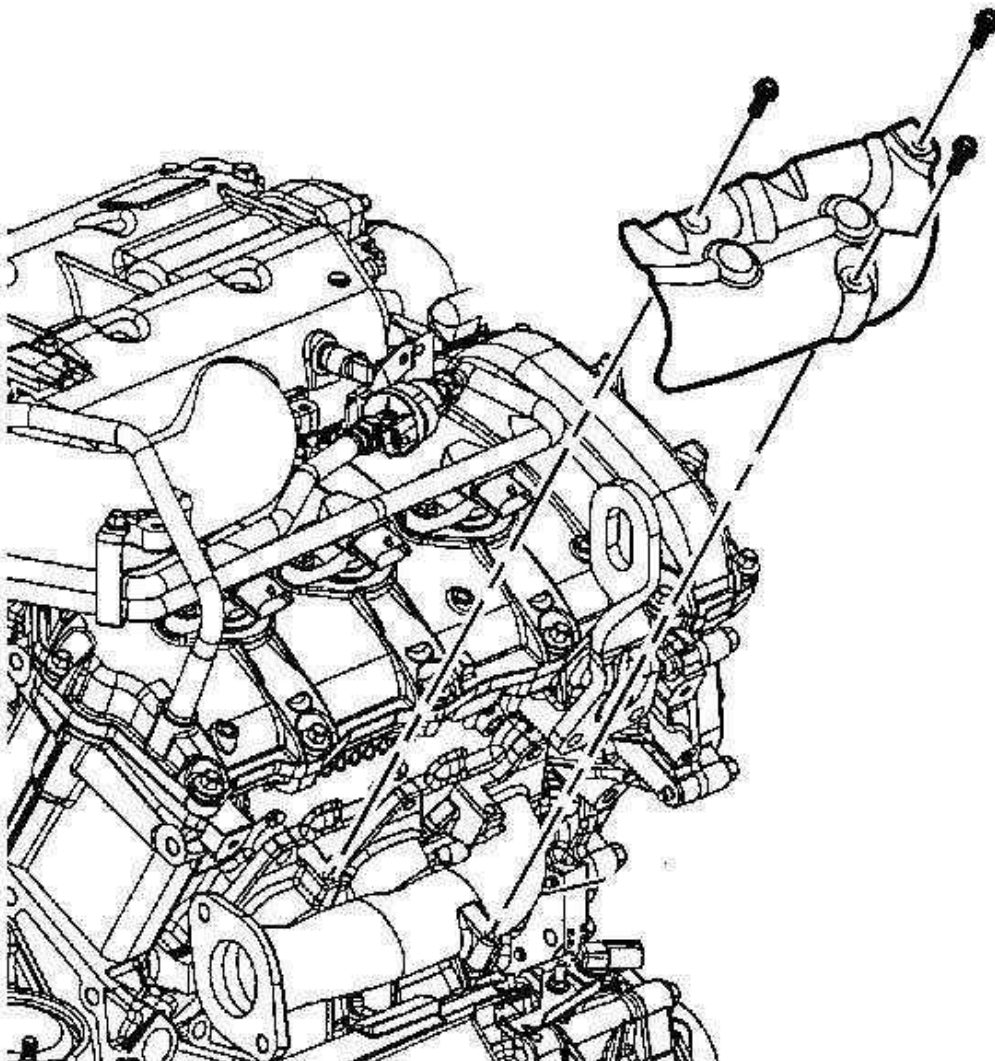


Fig. 228: View Of Right Exhaust Manifold Heat Shield & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Place the right exhaust manifold heat shield in position.
6. Install the exhaust manifold heat shield bolts.

Tighten: Tighten the exhaust manifold heat shield bolts to 10 N.m (89 lb in).

ENGINE COOLANT THERMOSTAT HOUSING INSTALLATION

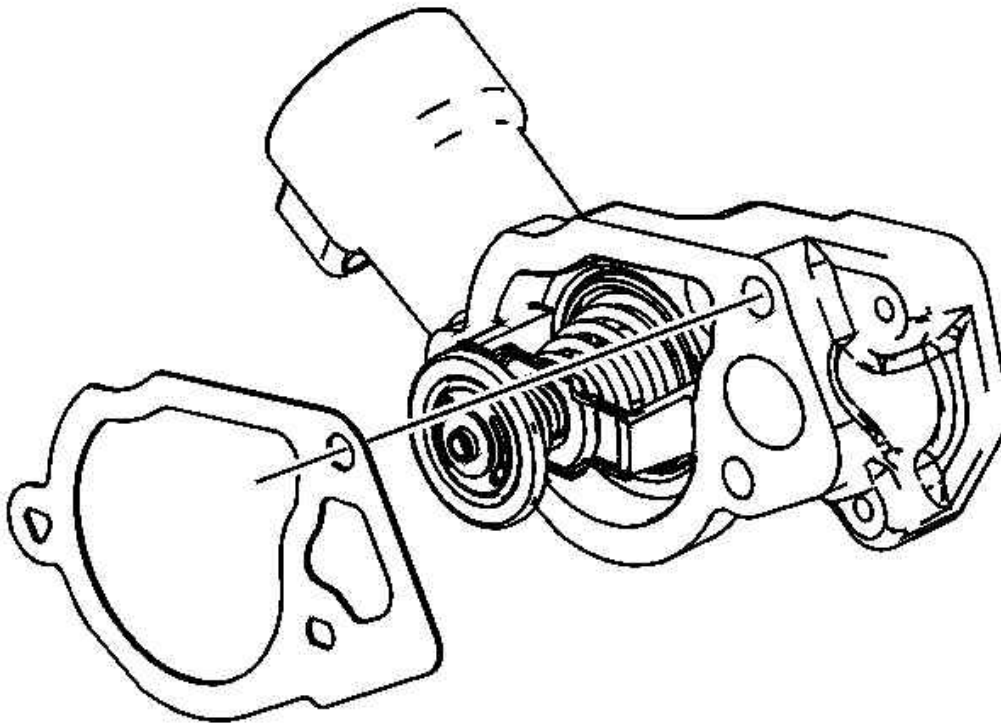


Fig. 229: View Of Thermostat Housing Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket onto the thermostat housing.

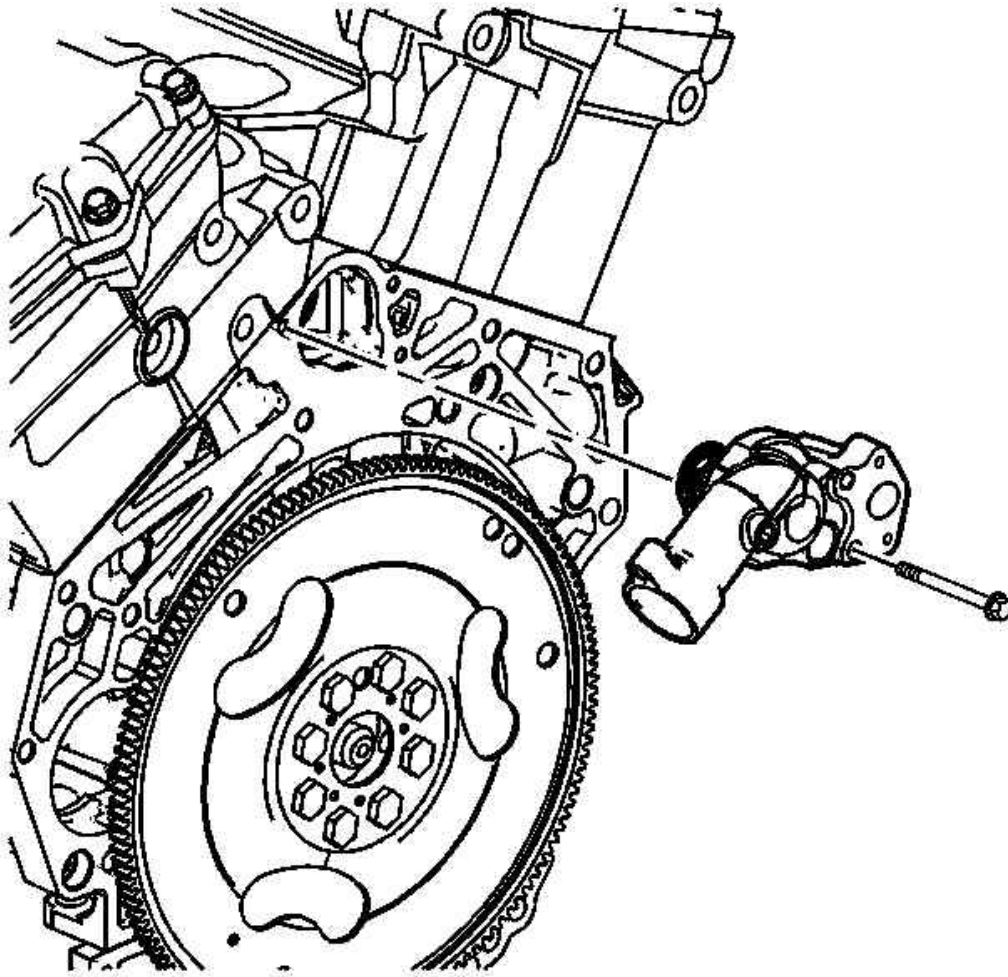


Fig. 230: View Of Thermostat Housing & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the thermostat housing.

NOTE: Refer to Fastener Notice .

3. Install the thermostat housing bolts.

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

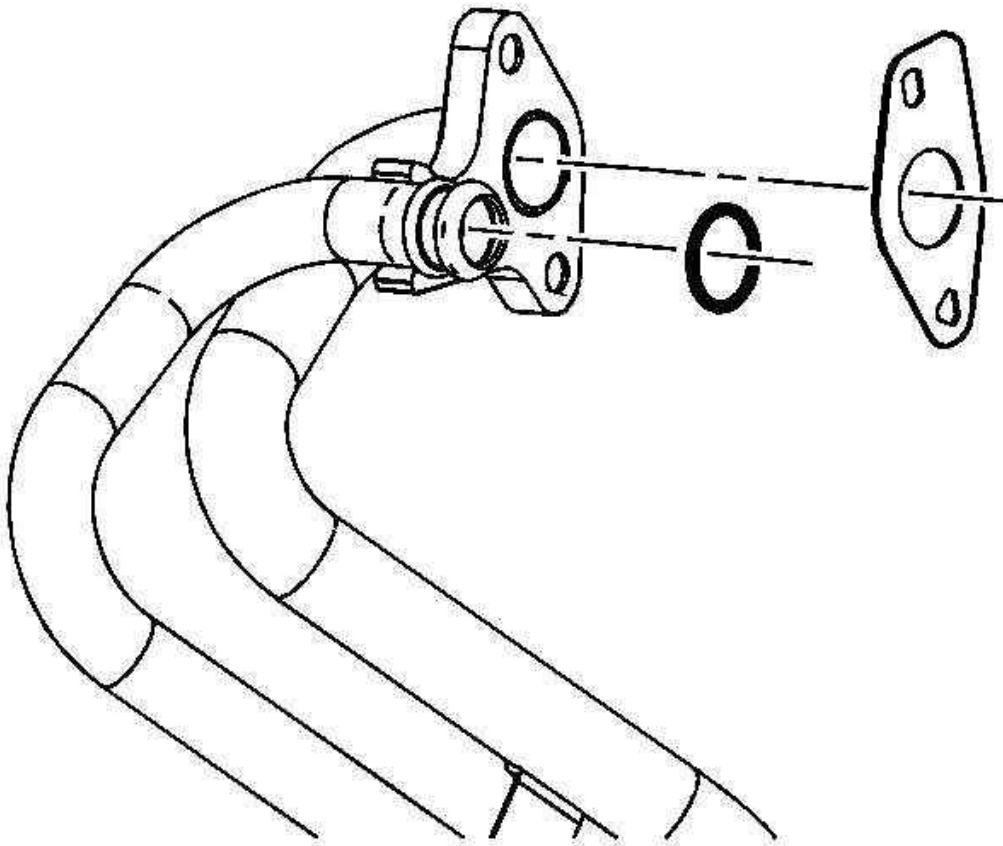


Fig. 231: Identifying Heater Inlet/Outlet Pipe Gasket & O-Ring
Courtesy of GENERAL MOTORS CORP.

4. Install a NEW gasket and O-ring onto the heater inlet/outlet pipe assembly.

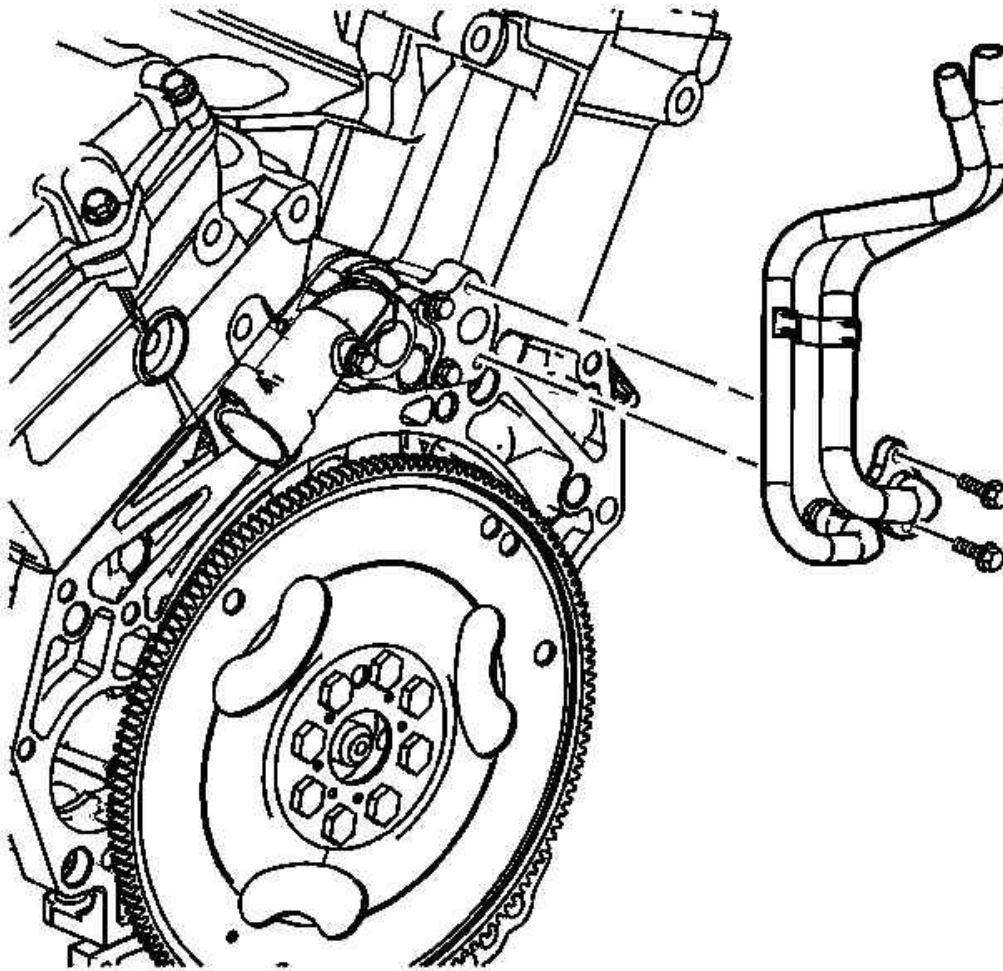


Fig. 232: View Of Heater Inlet/Outlet Pipe Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the heater inlet/outlet pipe assembly.
6. Install the heater inlet/outlet pipe assembly bolts.

Tighten: Tighten the heater inlet/outlet pipe assembly bolts to 10 N.m (89 lb in).

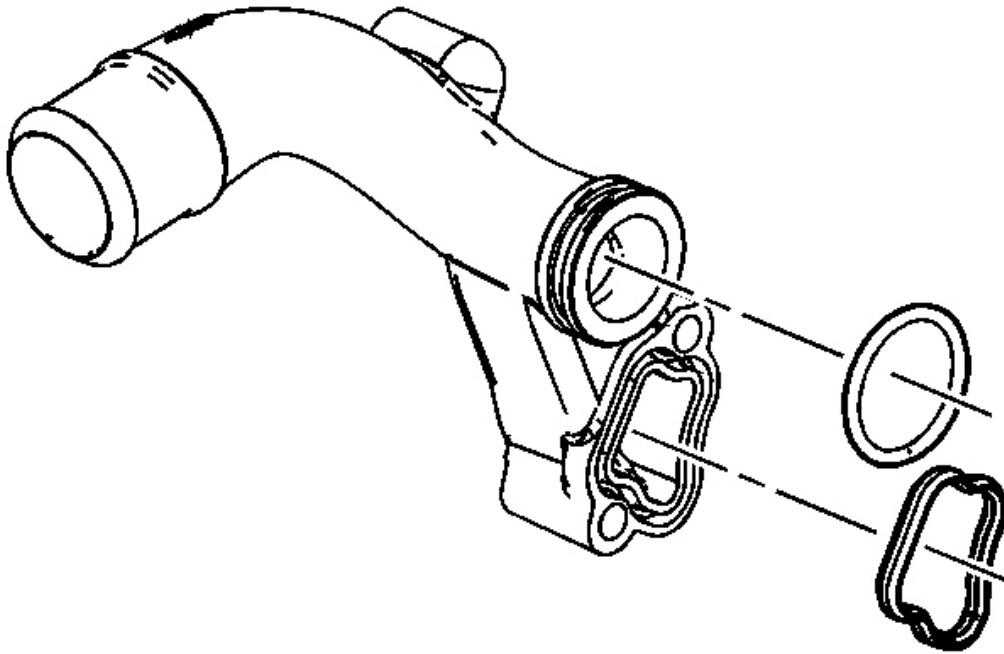


Fig. 233: Identifying Water Outlet Gasket & O-Ring
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket and O-ring onto the water outlet.

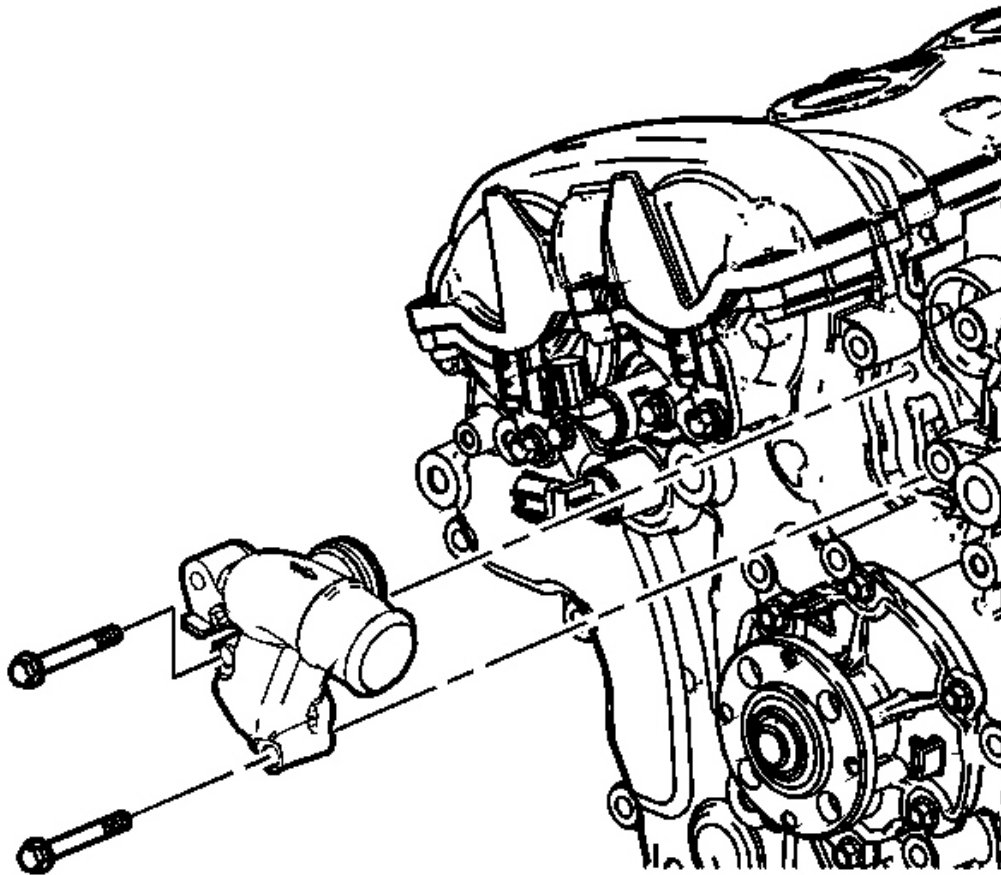


Fig. 234: Locating Water Outlet Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the water outlet.

NOTE: Refer to Fastener Notice .

3. Install the water outlet bolts.

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

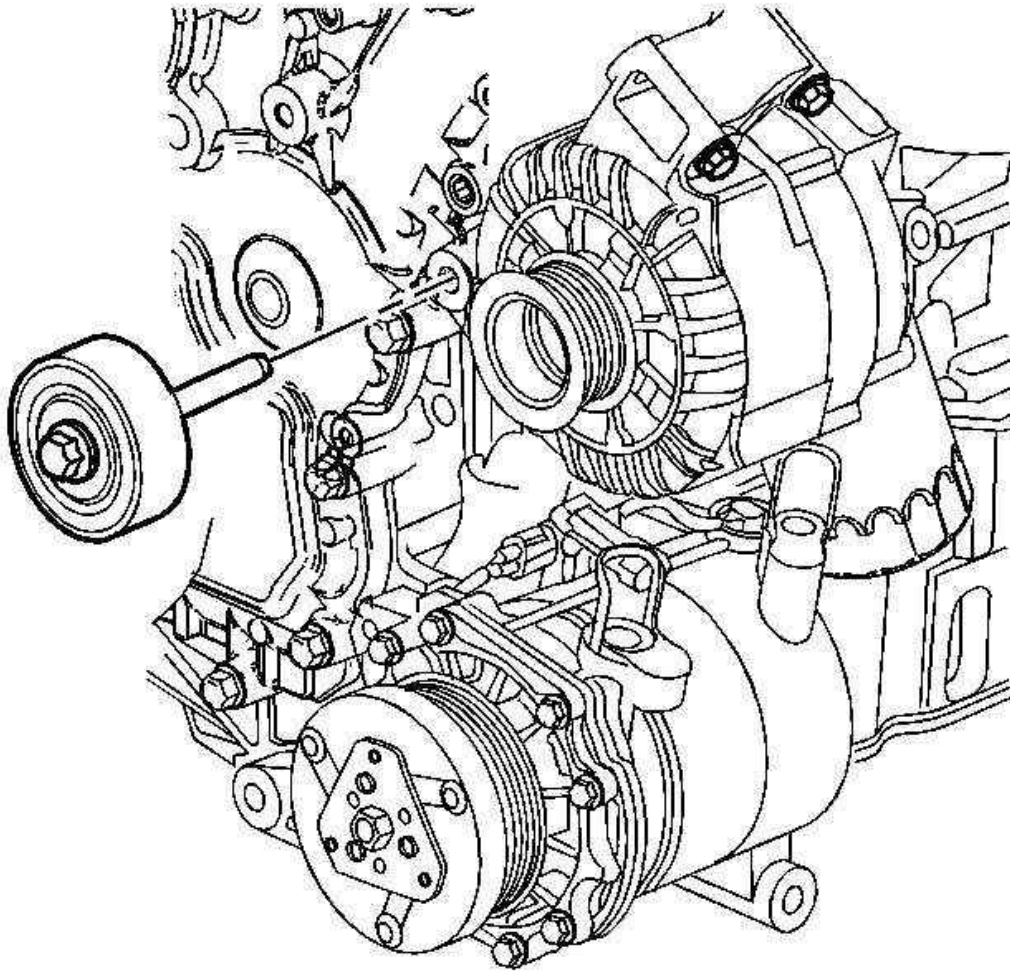


Fig. 235: Identifying Drive Belt Idler Pulley
Courtesy of GENERAL MOTORS CORP.

1. Place the drive belt idler pulley and bolt in position through the generator mounting hole and into the engine front cover.

NOTE: Refer to Fastener Notice .

2. Install the drive belt idler pulley bolt.

Tighten: Tighten the drive belt idler pulley bolt to 50 N.m (37 lb ft).

3. Tighten the generator bolts.

Tighten: Tighten the generator bolts to 50 N.m (37 lb ft).

DRIVE BELT TENSIONER INSTALLATION

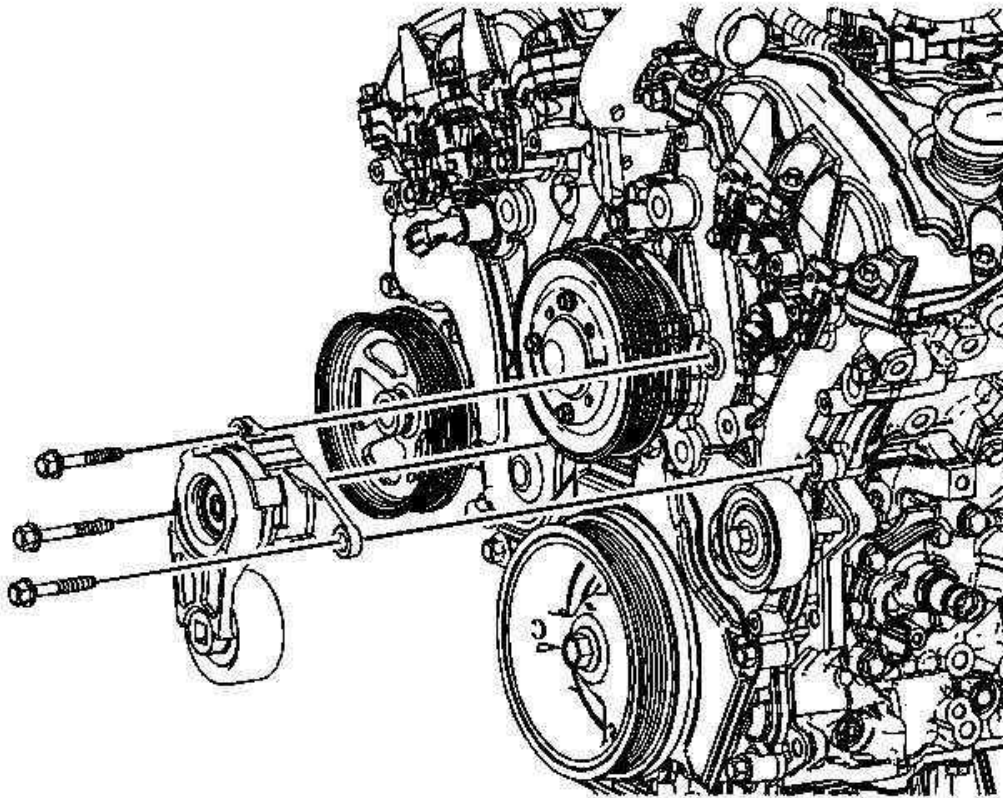


Fig. 236: View Of Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

1. Place the left drive belt tensioner assembly in position to the engine front cover.

NOTE: Refer to Fastener Notice .

2008 Buick LaCrosse CXL
2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

2. Install the left drive belt tensioner bracket bolts.

Tighten: Tighten the left drive belt tensioner bracket bolts to 23 N.m (17 lb ft).

ENGINE PRELUBING

Tools Required

- **J 42907** Oil Pressure Tester. See **Special Tools** .
- **J 45299** Engine Preluber. See **Special Tools** .

Prelube Procedure

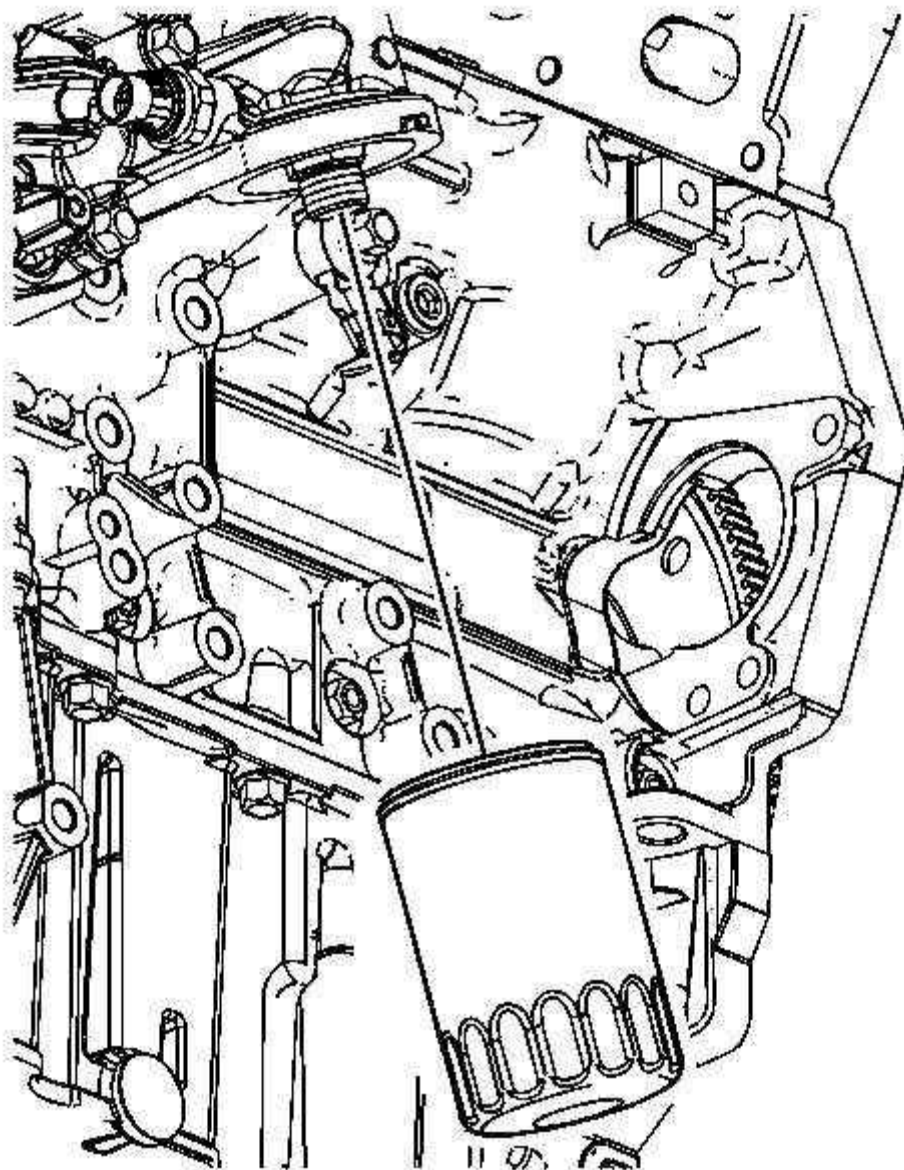


Fig. 237: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil filter.

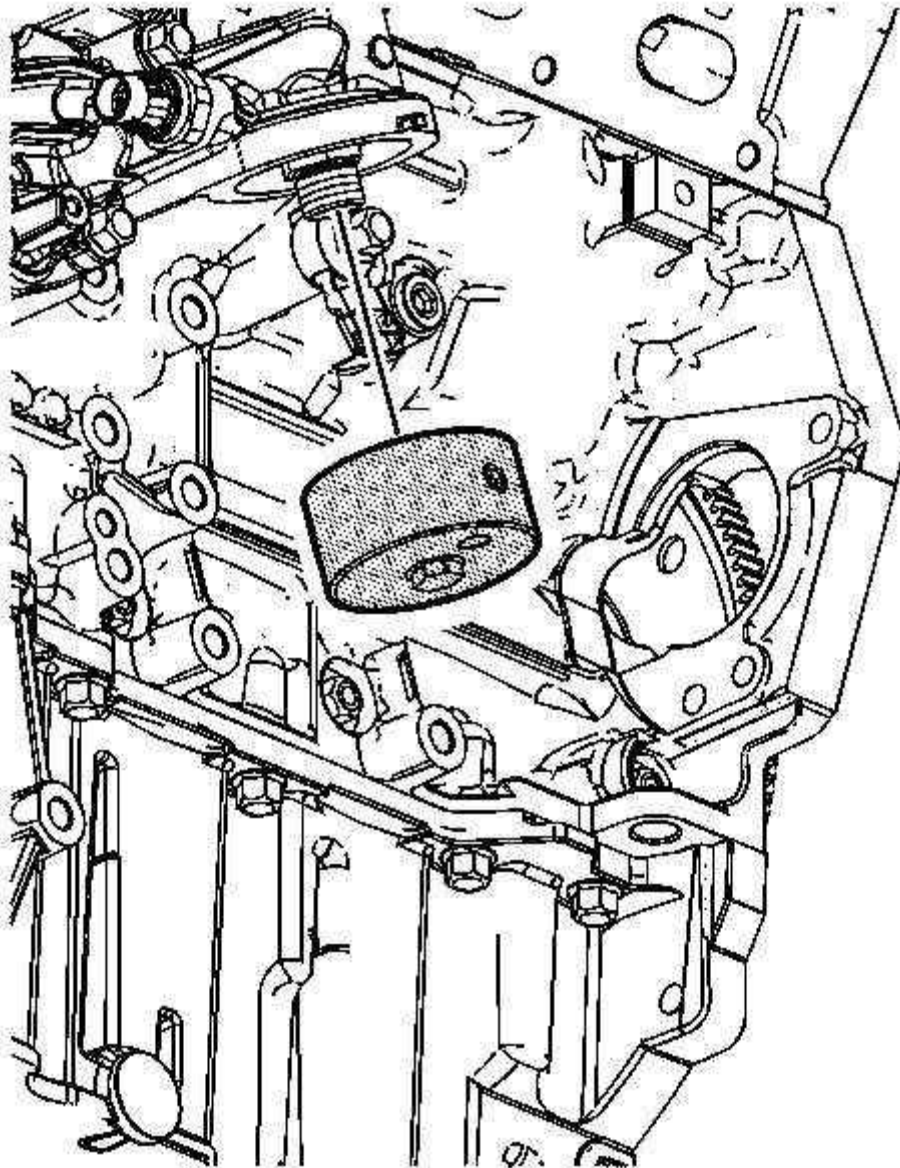


Fig. 238: View Of Engine Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

2. Install the **J 42907** onto the oil filter adapter. See **Special Tools** .

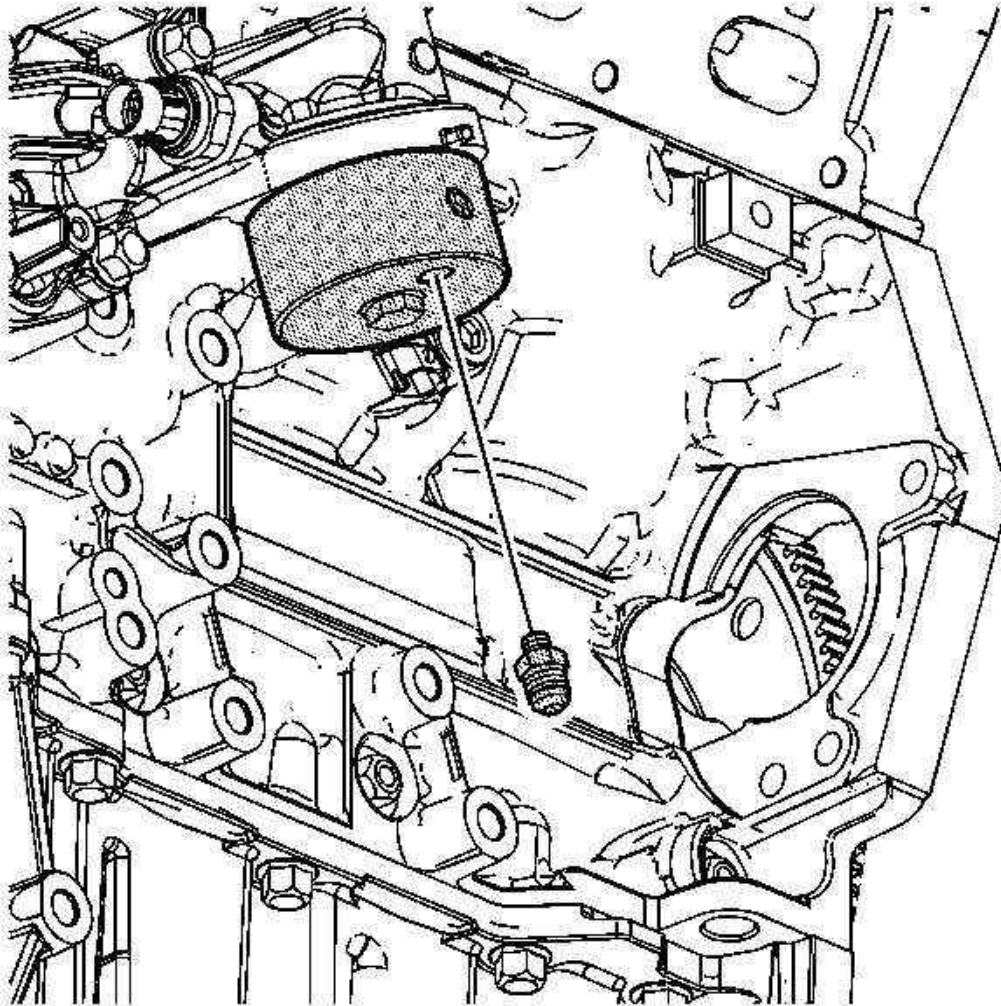


Fig. 239: View Of Engine Oil Filter Adapter & NPT Fitting
Courtesy of GENERAL MOTORS CORP.

3. Install the 1/8 NPT fitting from the **J 45299** into the port on the **J 42907** . See **Special Tools** .

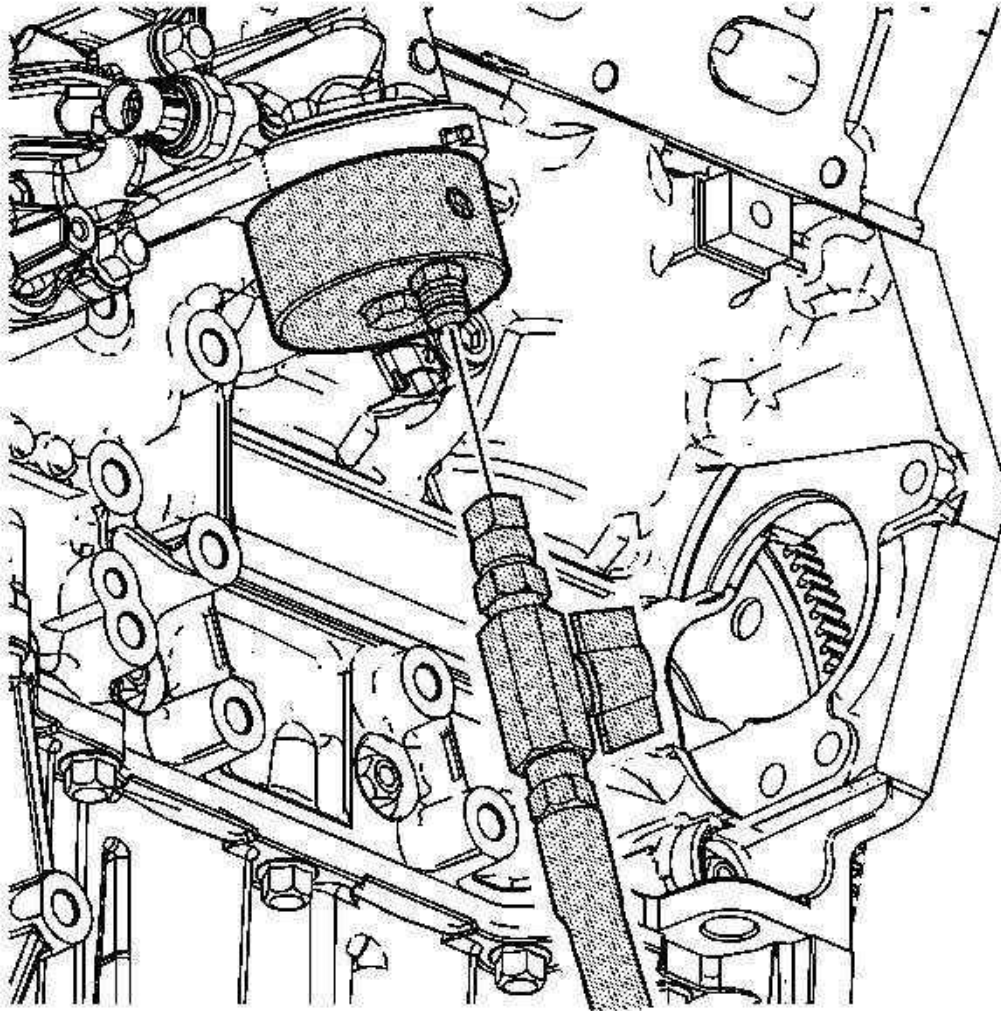


Fig. 240: View Of Engine Preluber Flexible Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the **J 45299** flexible hose to the fitting. See **Special Tools** .

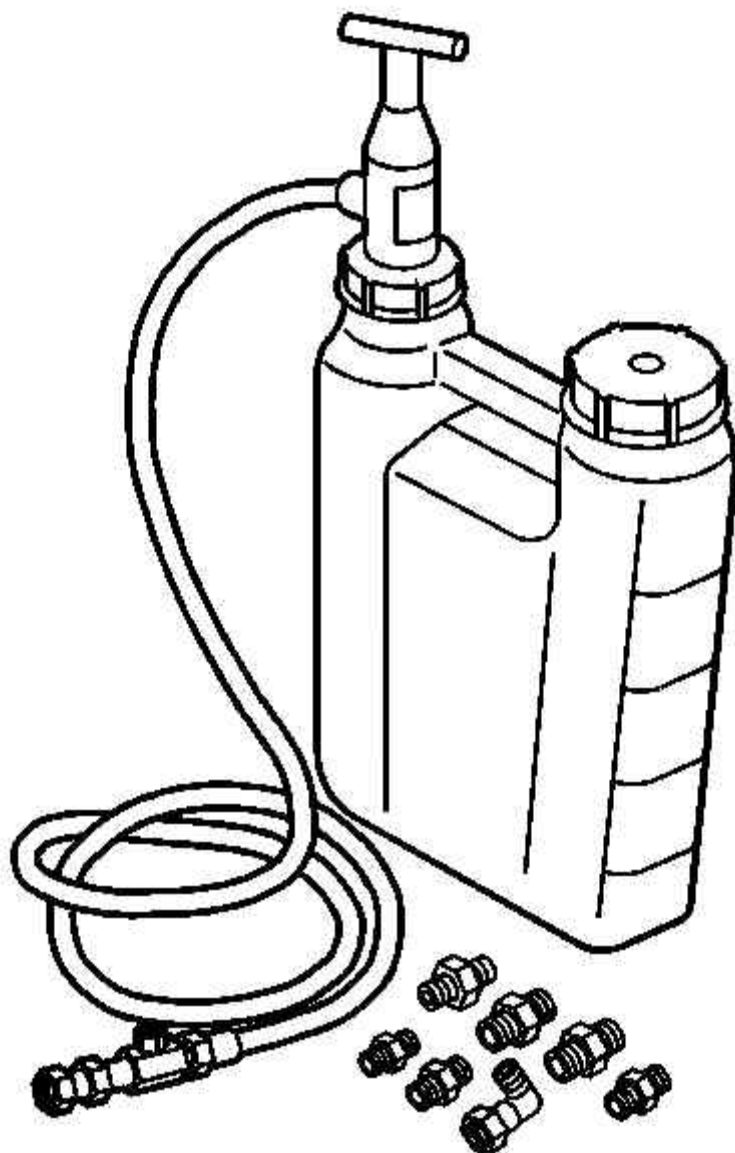


Fig. 241: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

5. Open the valve of the J 45299 . See **Special Tools** .

IMPORTANT: A constant and continuous flow of clean engine oil is required in order to properly prime the engine. Use the approved engine oil as specified in the owner's manual.

6. Pump the handle of the **J 45299** in order to flow a minimum of 1-1. See **Special Tools** .9 liters (1-2 quarts) of fresh clean engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
7. Close the valve of the **J 45299** . See **Special Tools** .

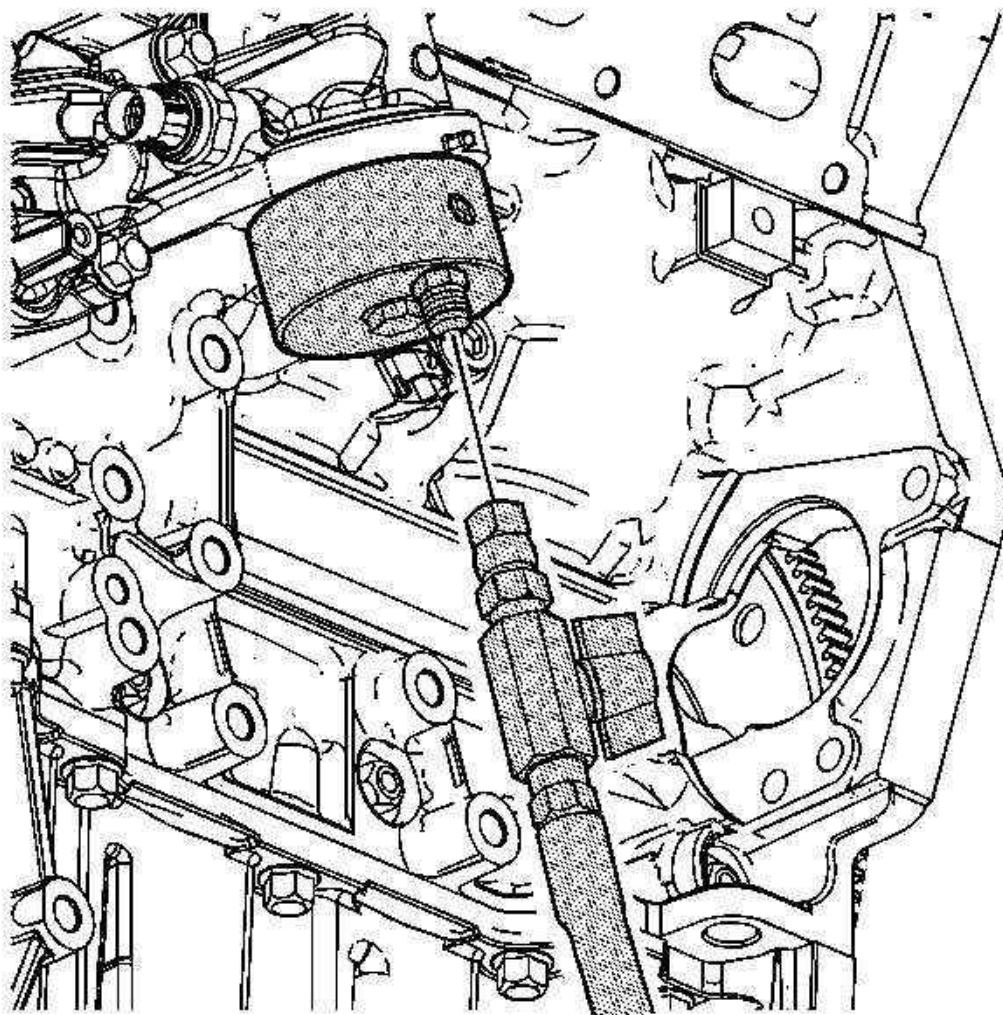


Fig. 242: View Of Engine Preluber Flexible Hose
Courtesy of GENERAL MOTORS CORP.

8. Remove the **J 45299** flexible hose. See **Special Tools** .

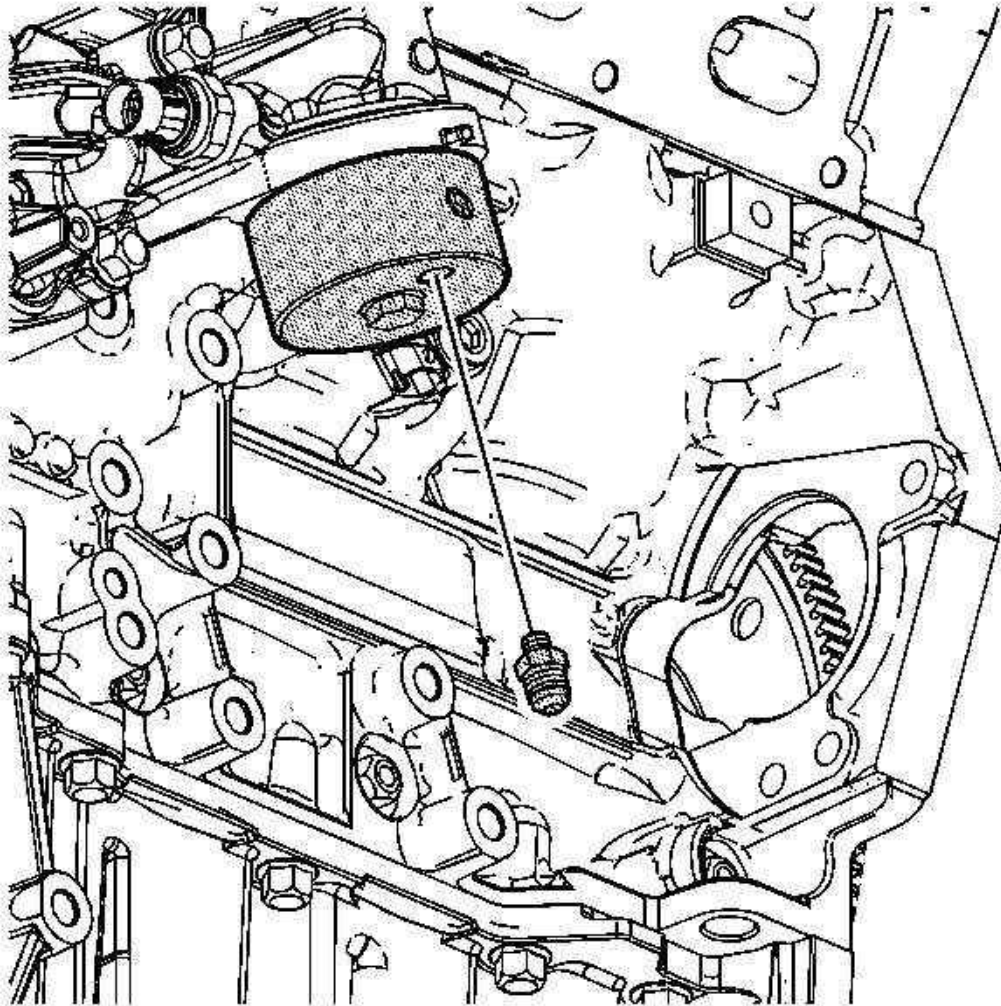


Fig. 243: View Of Engine Oil Filter Adapter & NPT Fitting
Courtesy of GENERAL MOTORS CORP.

9. Remove the fitting from the J 42907 . See **Special Tools** .

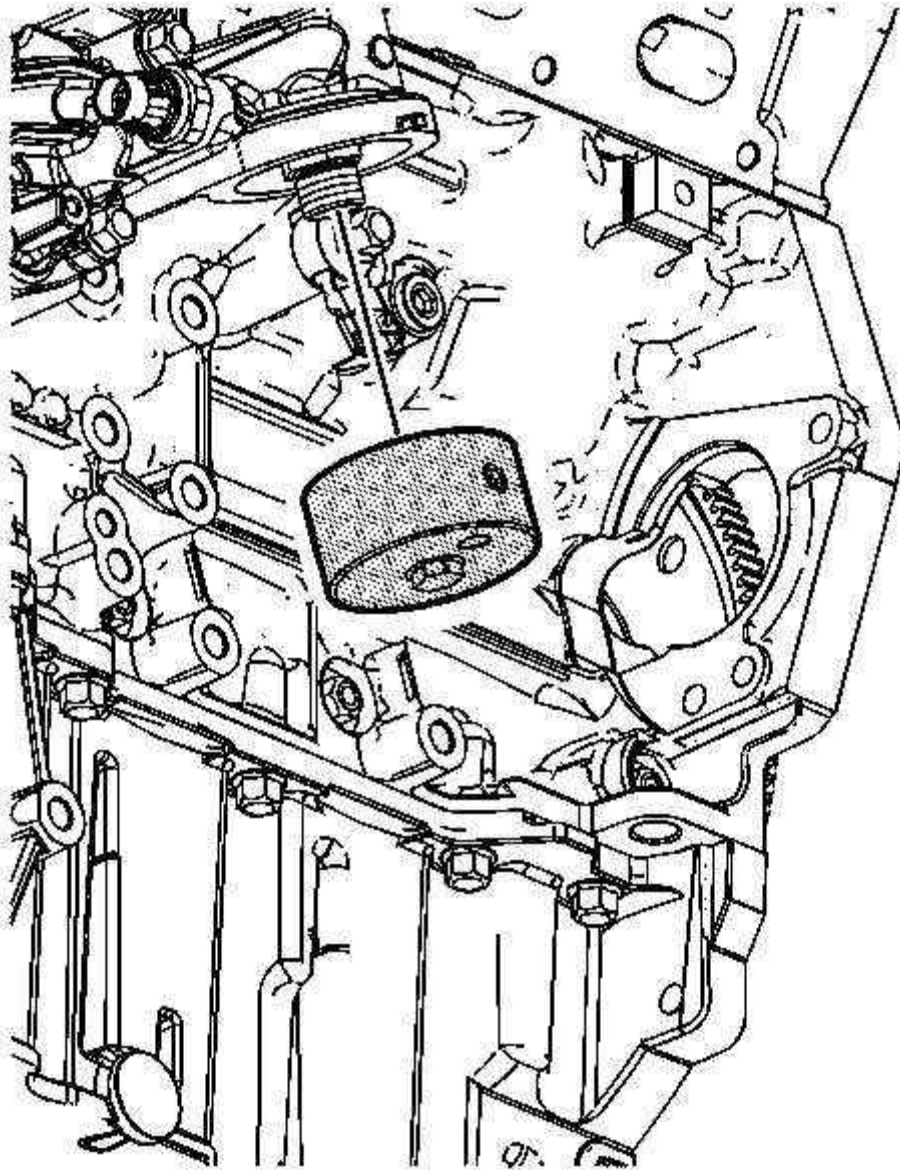


Fig. 244: View Of Engine Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

10. Remove the **J 42907** from the oil filter adapter. See **Special Tools** .
11. Ensure the NEW oil filter is filled with clean fresh engine oil.

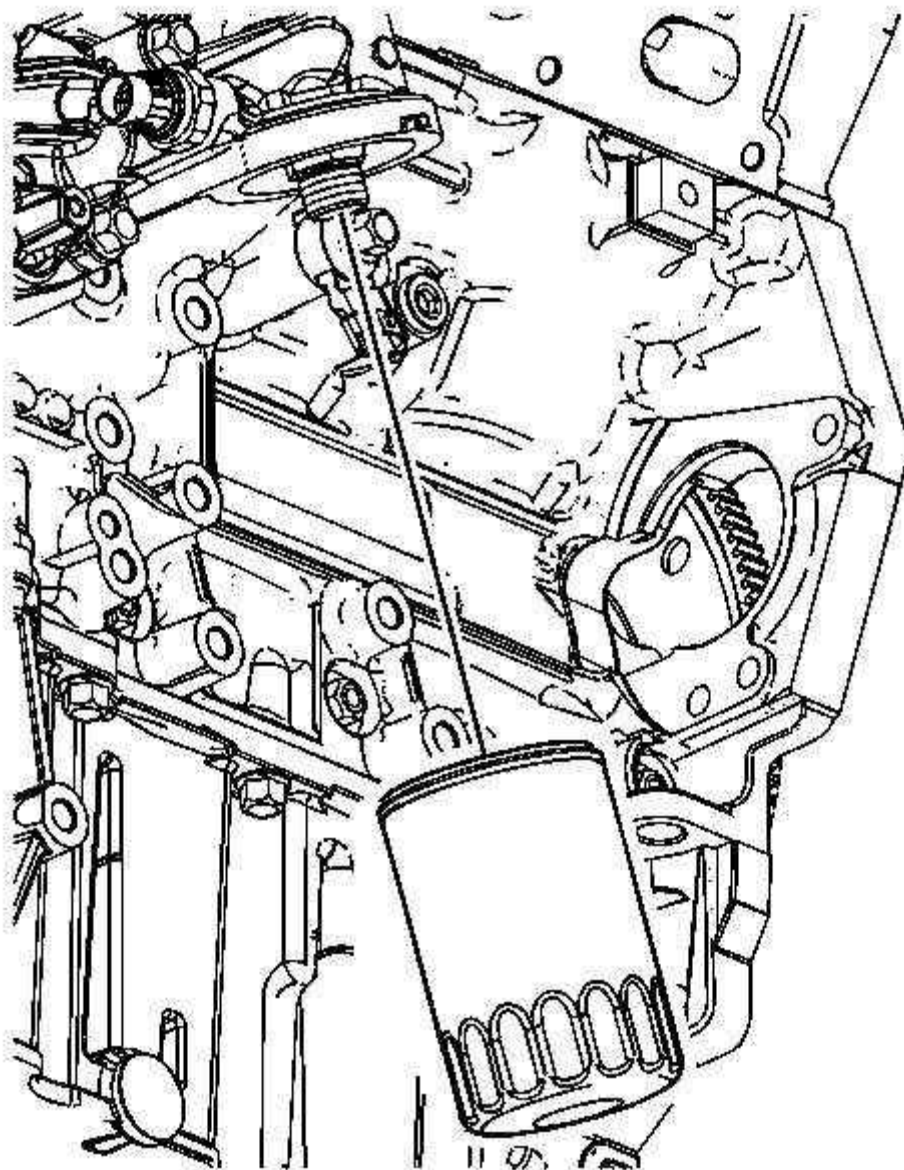


Fig. 245: View Of Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice .

2008 Buick LaCrosse CXL

2008 ENGINE Engine Mechanical - 3.6L - LaCrosse

12. Install the NEW oil filter.

Tighten: Tighten the oil filter to 32 N.m (24 lb ft).