

2010 ENGINE

Engine Mechanical - 2.8L, 3.0L, 3.2L, or 3.6L - Repair Instructions - Off Vehicle - Equinox & Terrain

CAMSHAFT INSTALLATION - LEFT SIDE

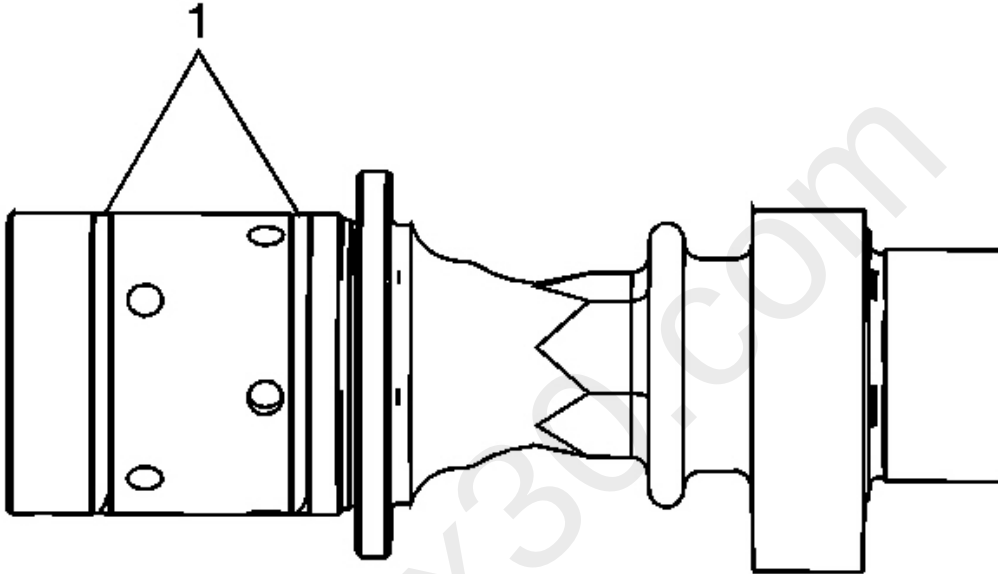


Fig. 1: Locating Camshaft Sealing Rings In Camshaft Grooves
Courtesy of GENERAL MOTORS CORP.

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.

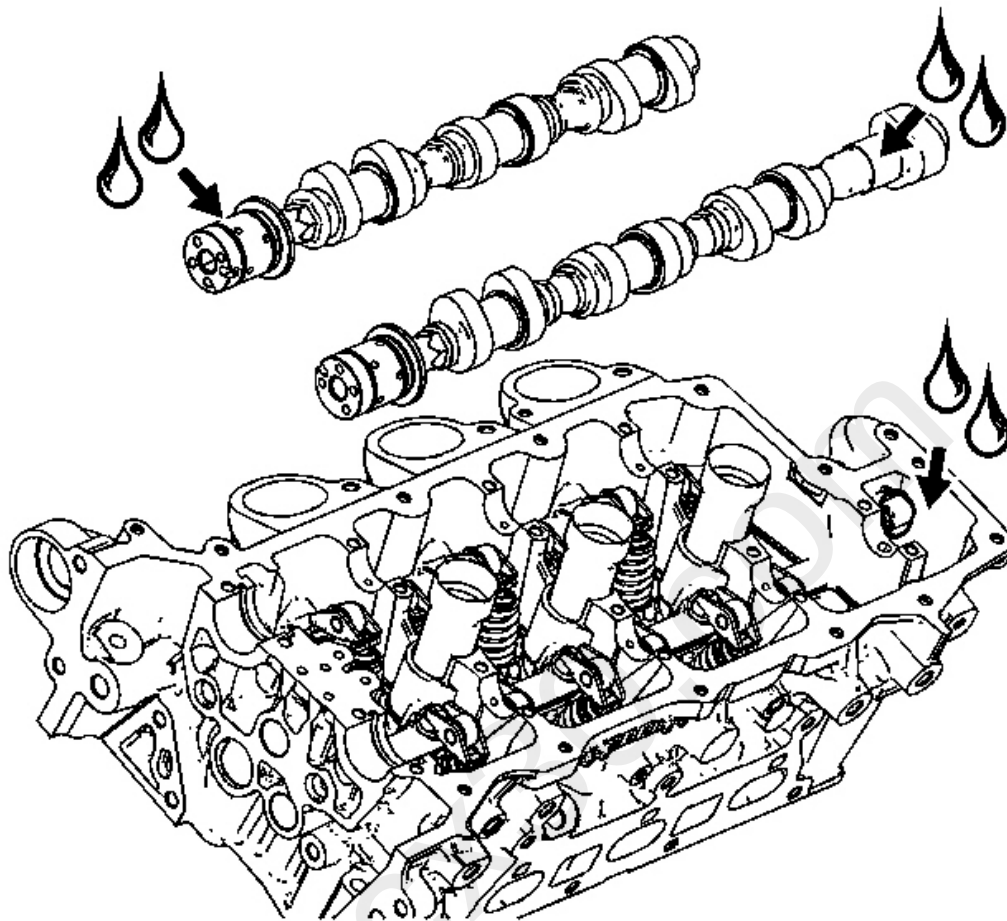


Fig. 2: Lubricating Camshaft Journals
Courtesy of GENERAL MOTORS CORP.

2. 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.

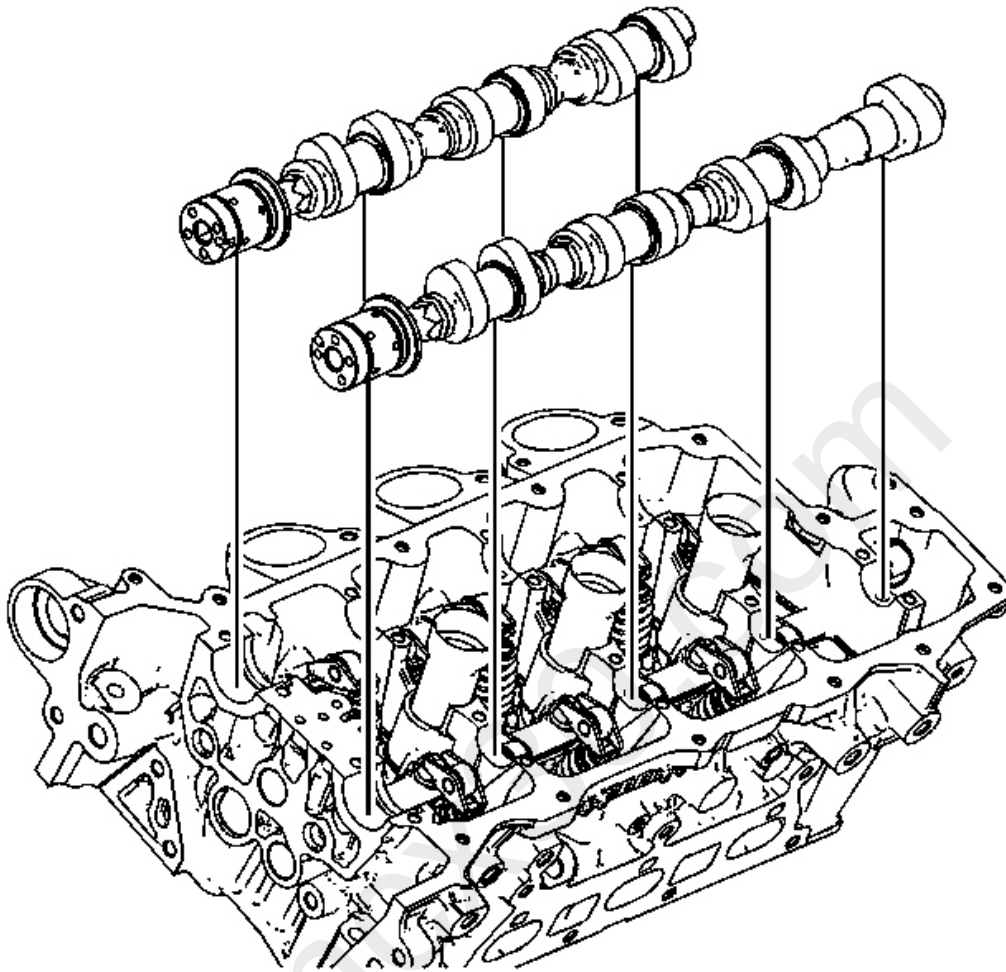


Fig. 3: Removing/Installing Camshafts
Courtesy of GENERAL MOTORS CORP.

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

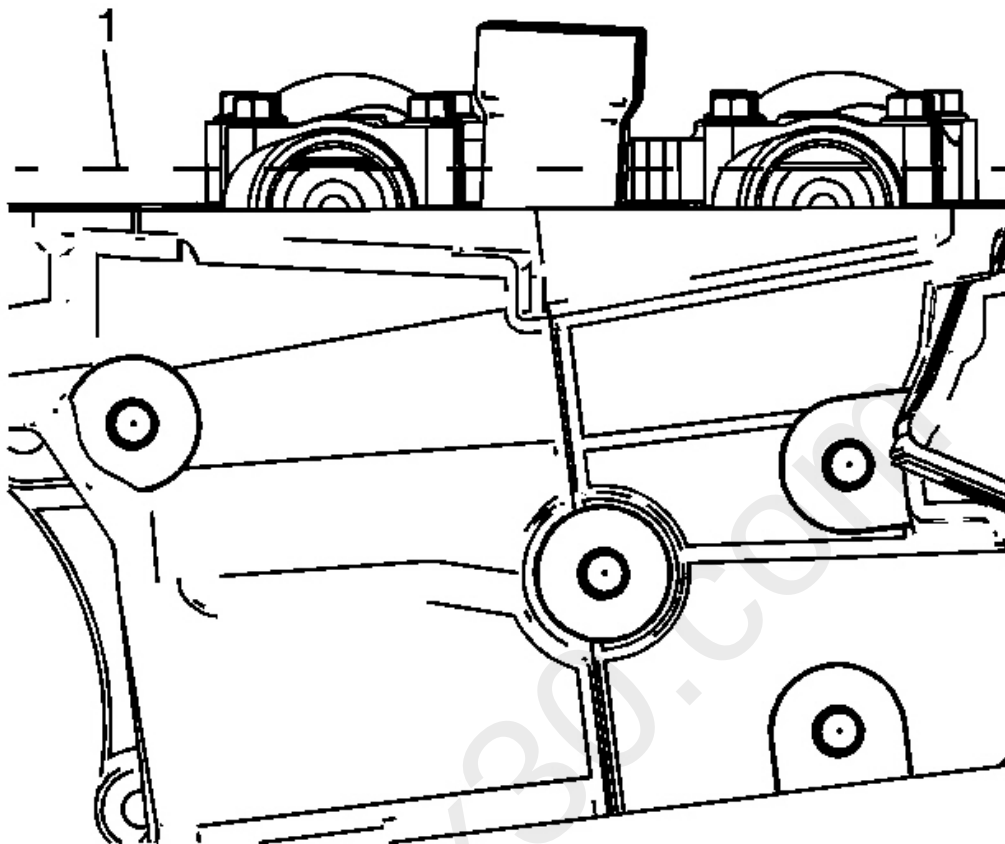


Fig. 4: Camshaft Flats Parallel With Camshaft Cover Rail
Courtesy of GENERAL MOTORS CORP.

4. 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.

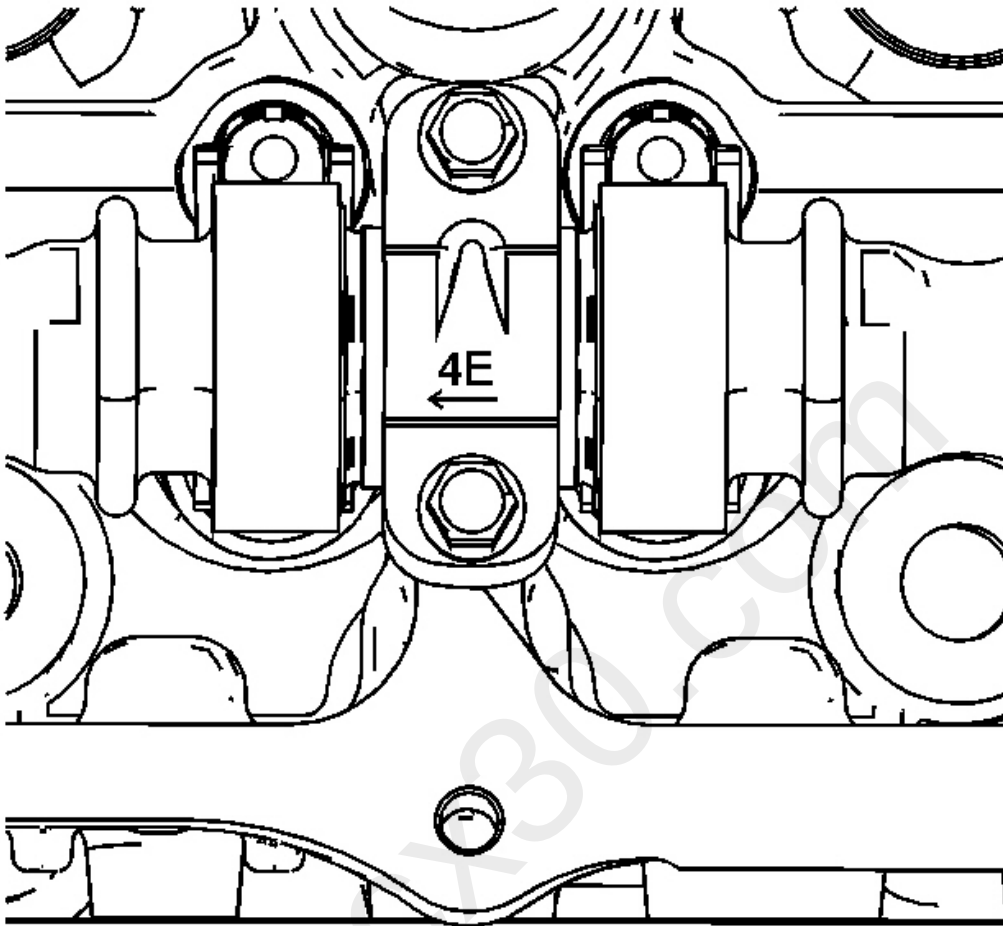


Fig. 5: Identifying Markings On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

5. 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.
6. Apply a liberal amount of lubricant GM P/N 12345501 (Canadian P/N 992704) or equivalent to the camshaft bearing caps.

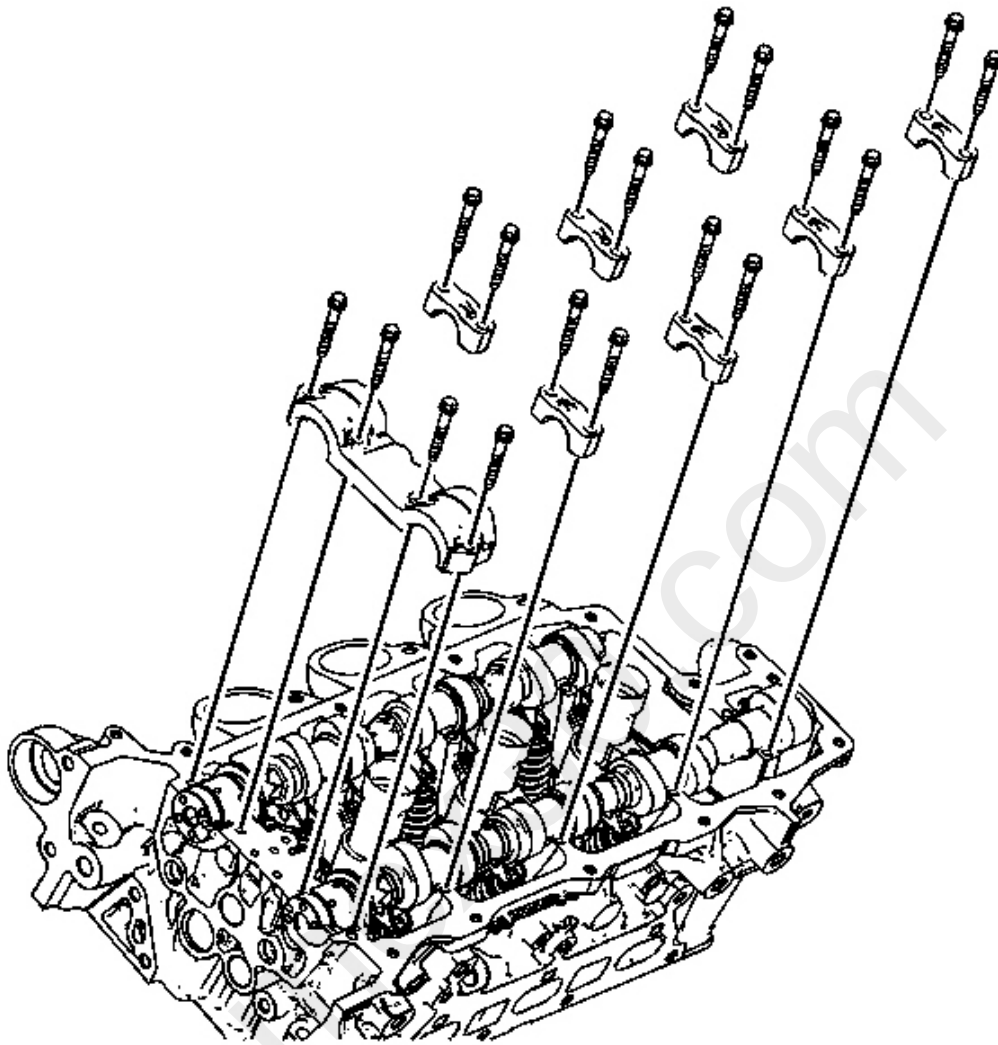


Fig. 6: Removing/Installing Camshaft Bearing Thrust Caps
Courtesy of GENERAL MOTORS CORP.

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

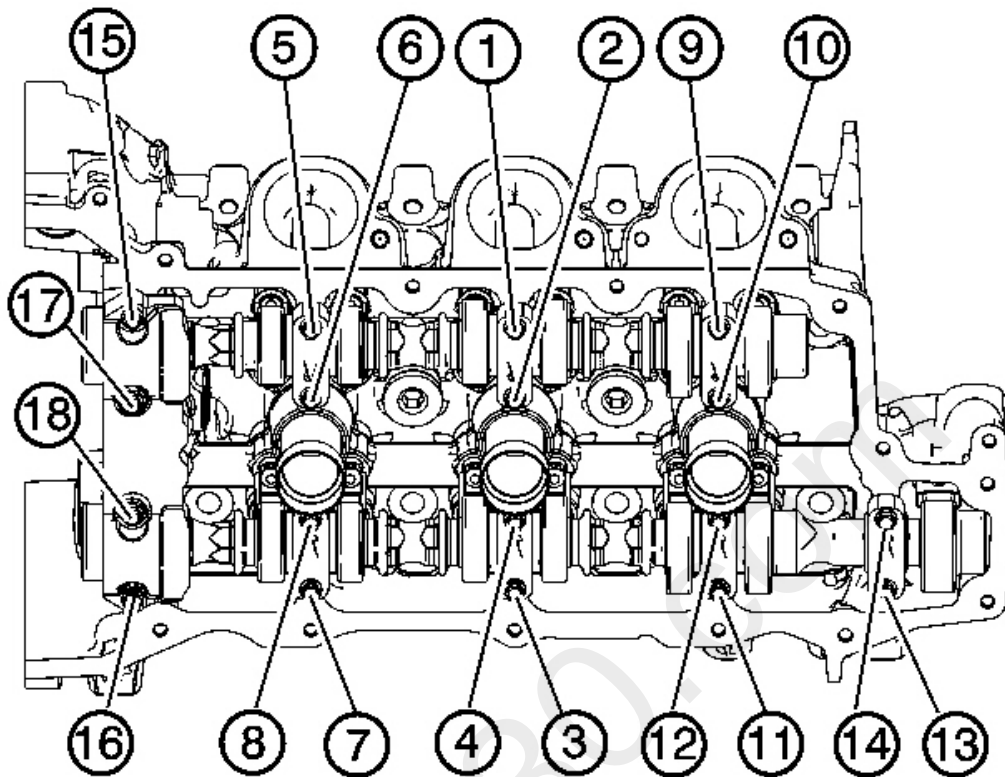


Fig. 7: Identifying Camshaft Bearing Cap Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

10. Tighten the camshaft bearing cap bolts in the sequence shown and tighten to 10 N.m (89 lb in).
11. Loosen the center intake camshaft bearing cap bolts 1, 2 and the center exhaust camshaft bearing cap bolts 3, 4.
12. Retighten the center camshaft bearing cap bolts 1, 2, 3, 4 and retighten the camshaft bearing cap bolts to 10 N.m (89 lb in).

FUEL PUMP INSTALLATION (LF1 OR LFW)

SPECIAL TOOLS

EN 48896: HP Fuel Pump Installation Alignment Gauge

For equivalent regional tools, refer to **Special Tools** .

INSTALLATION

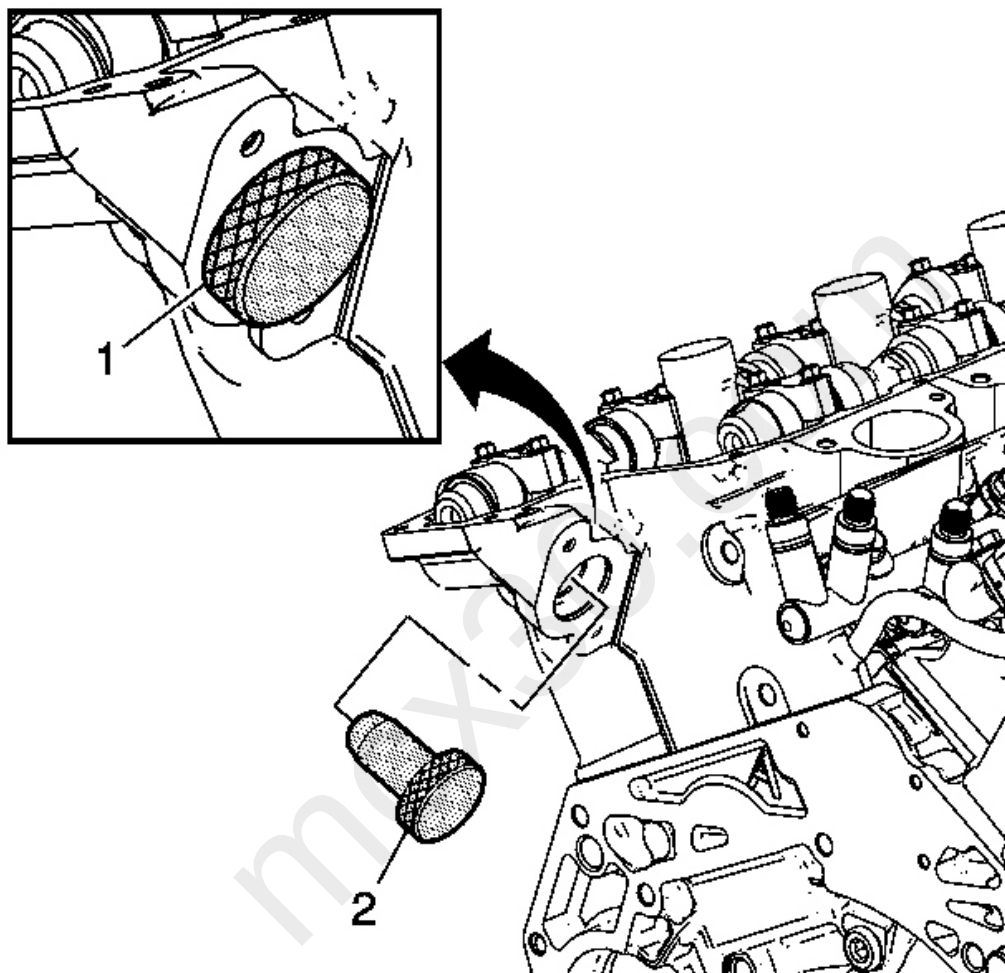


Fig. 8: Alignment Gauge

Courtesy of GENERAL MOTORS CORP.

NOTE: The camshaft must be in the base circle position before the high pressure fuel pump is installed.

1. Use the **EN 48896**: alignment gauge (2) to ensure that the camshaft lobe is in the base circle position. At base circle position, the tool will be flush with the head (1).

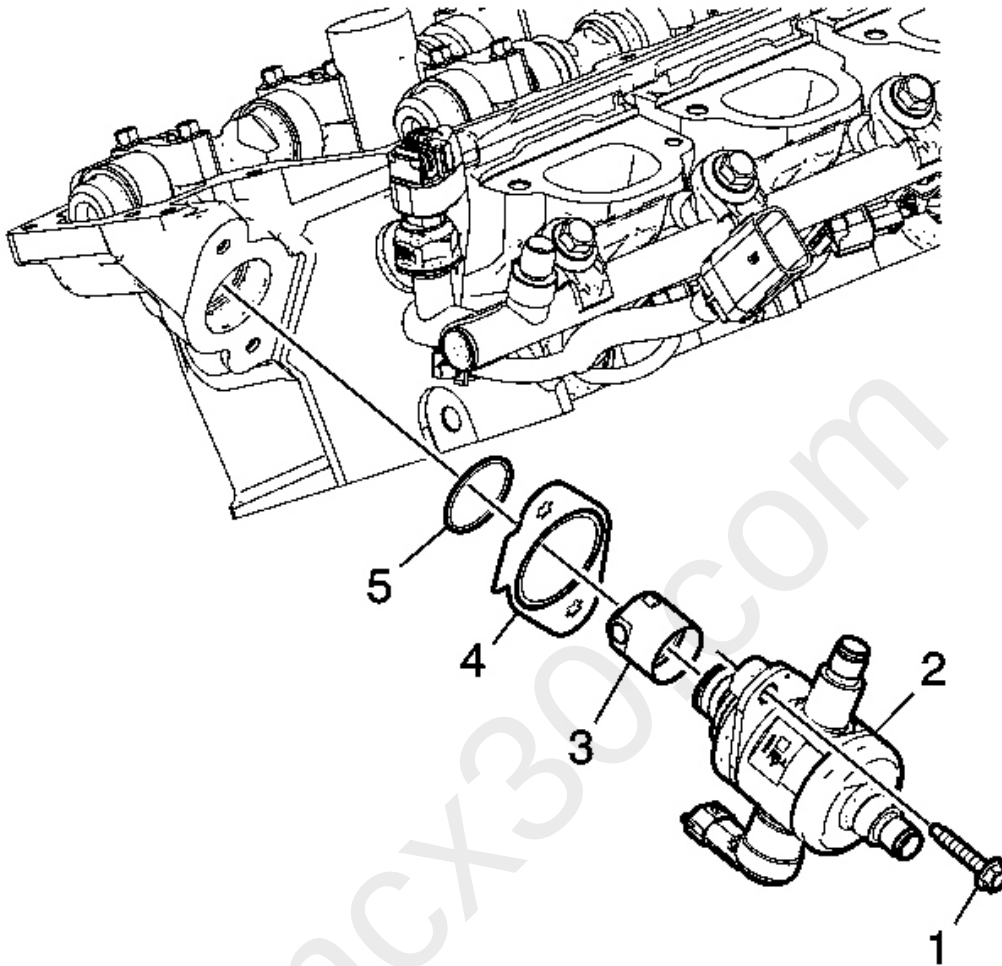


Fig. 9: High Pressure Fuel Pump Components
Courtesy of GENERAL MOTORS CORP.

2. Lubricate the high pressure fuel pump cylinder head bore with 5W30 engine oil.

NOTE: Ensure that the high pressure fuel pump roller lifter is oriented properly, the camshaft is at base circle and the number 1 piston is at top dead center (TDC) on the exhaust stroke.

3. Lubricate the high pressure fuel pump roller lifter with 5W30 engine oil and install into the cylinder head bore.
4. Install a NEW high pressure fuel pressure fuel pump gasket (4).
5. Install a NEW high pressure fuel pump O-ring (5).

NOTE: Ensure the plastic bolt retainers are installed in the high pressure fuel pump mounting holes before installing.

6. Install the valve lifter follower (3).
7. Install the high pressure fuel pump (2).

CAUTION: Refer to Fastener Caution .

CAUTION: Alternately hand-tighten the fuel pump bolts one turn at a time until the pump is fully seated. Trying to draw down the pump without even side-to-side tightening may result in pump plunger damage.

8. Start and hand-tighten the NEW high pressure fuel pump bolts (1) evenly and tighten the high pressure fuel pump bolts to 15 N.m (11 lb ft).

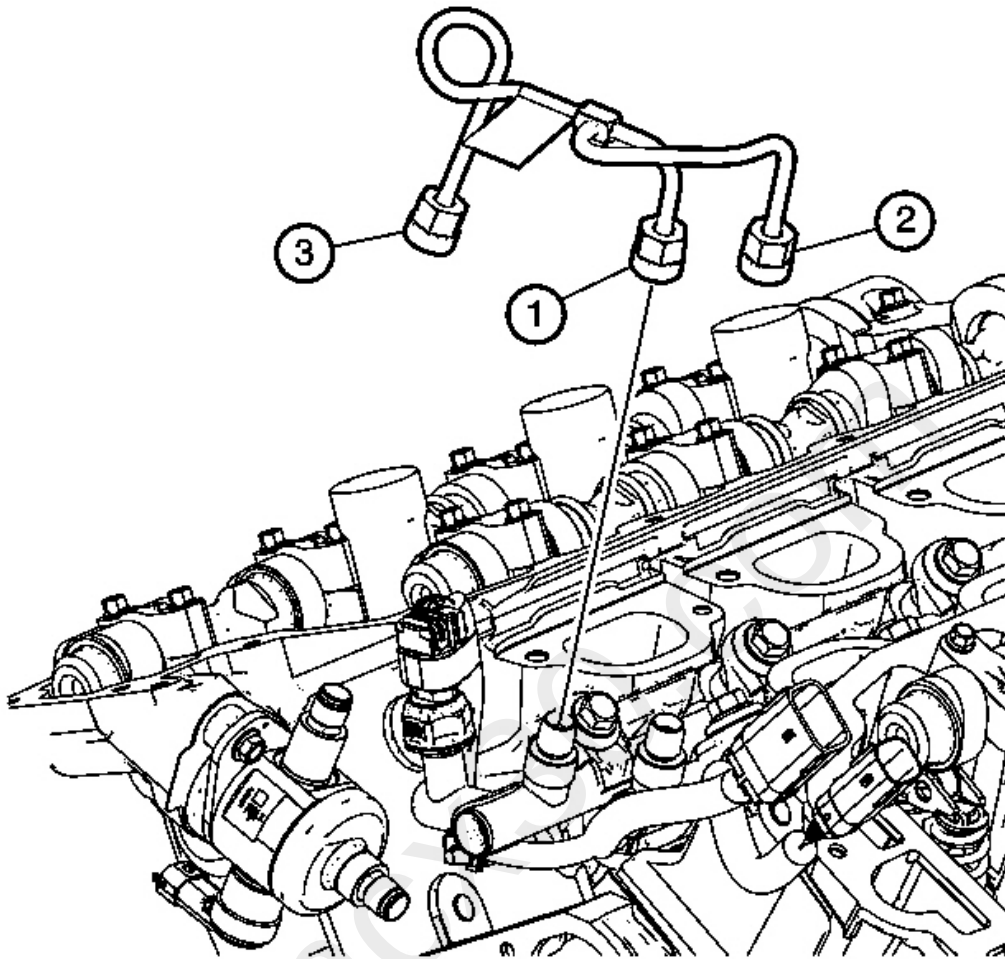


Fig. 10: Fuel Rail Crossover Pipe Components
Courtesy of GENERAL MOTORS CORP.

NOTE:

- **DO NOT** reuse the high pressure fuel rail crossover pipe.
- The tightening order and torque are critical to proper fuel system fit and function. Be sure to follow installation and tightening steps exactly.

9. Install the NEW high pressure LH to RH fuel rail crossover pipe by starting all three fuel crossover pipe fitting nuts (1), (2) and (3) to finger-tight only.
10. Tighten the fuel rail crossover pipe fittings to 30 N.m (22 lb ft) in the following order: (1) Left Fuel Rail, (2) Right Fuel Rail, then (3) Fuel Pump.

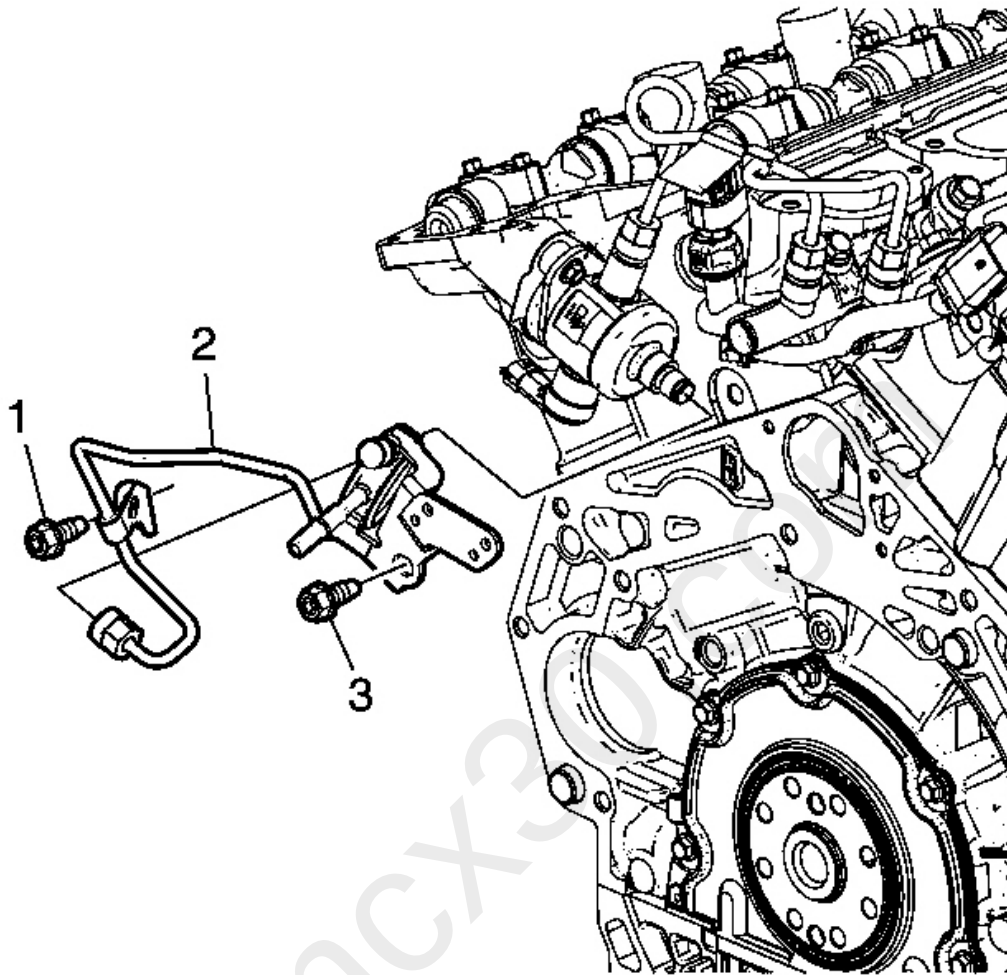


Fig. 11: Fuel Feed Pipe Components
Courtesy of GENERAL MOTORS CORP.

11. Install the NEW fuel feed pipe (2) by installing the fuel line nut to the fuel pump finger-tight.
12. Install the right fuel feed pipe bolt finger tight (3).
13. Install the left fuel feed pipe bolt finger tight (1).
14. Tighten the left fuel feed pipe bolt (1) to 10 N.m (89 lb in).
15. Tighten the right fuel feed pipe bolt (3) to 10 N.m (89 lb in).
16. Tighten the fuel feed pipe fitting nut to 30 N.m (22 lb ft).
17. Install the fuel rail wiring connectors to the fuel feed pipe bracket.

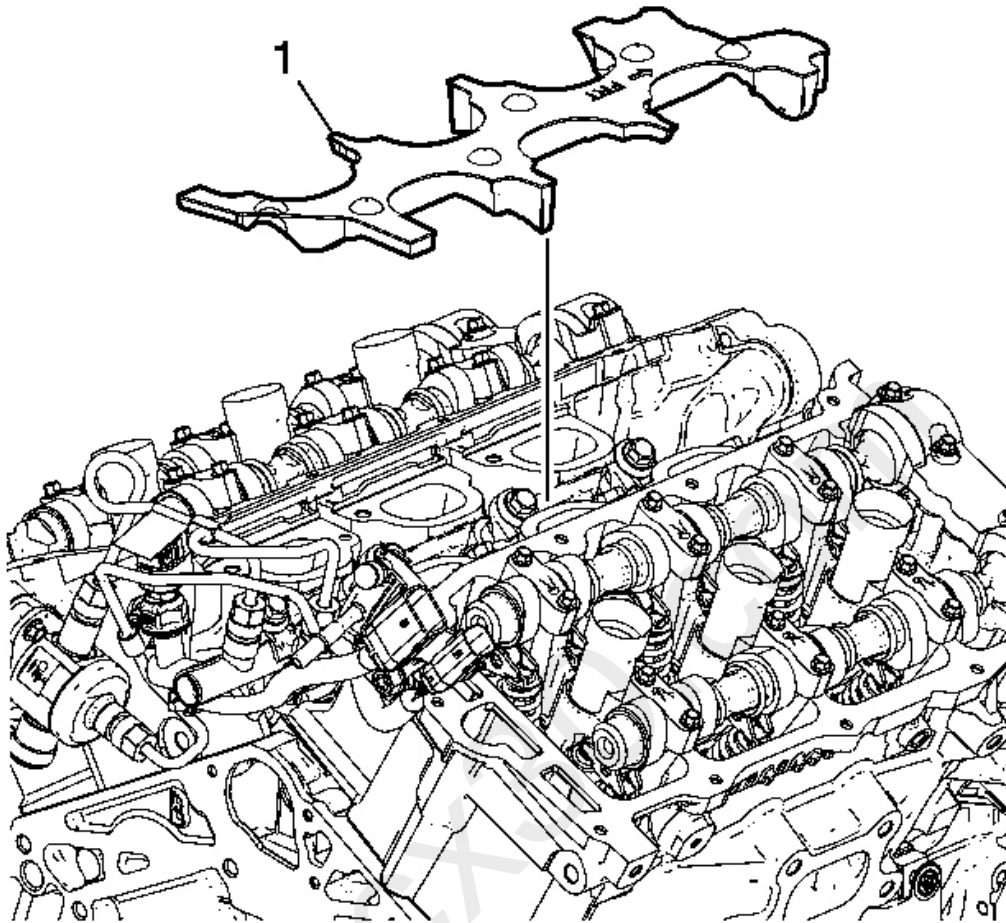


Fig. 12: Fuel Rail Noise Shield
Courtesy of GENERAL MOTORS CORP.

18. Install the fuel rail noise shield (1).

CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE INTAKE

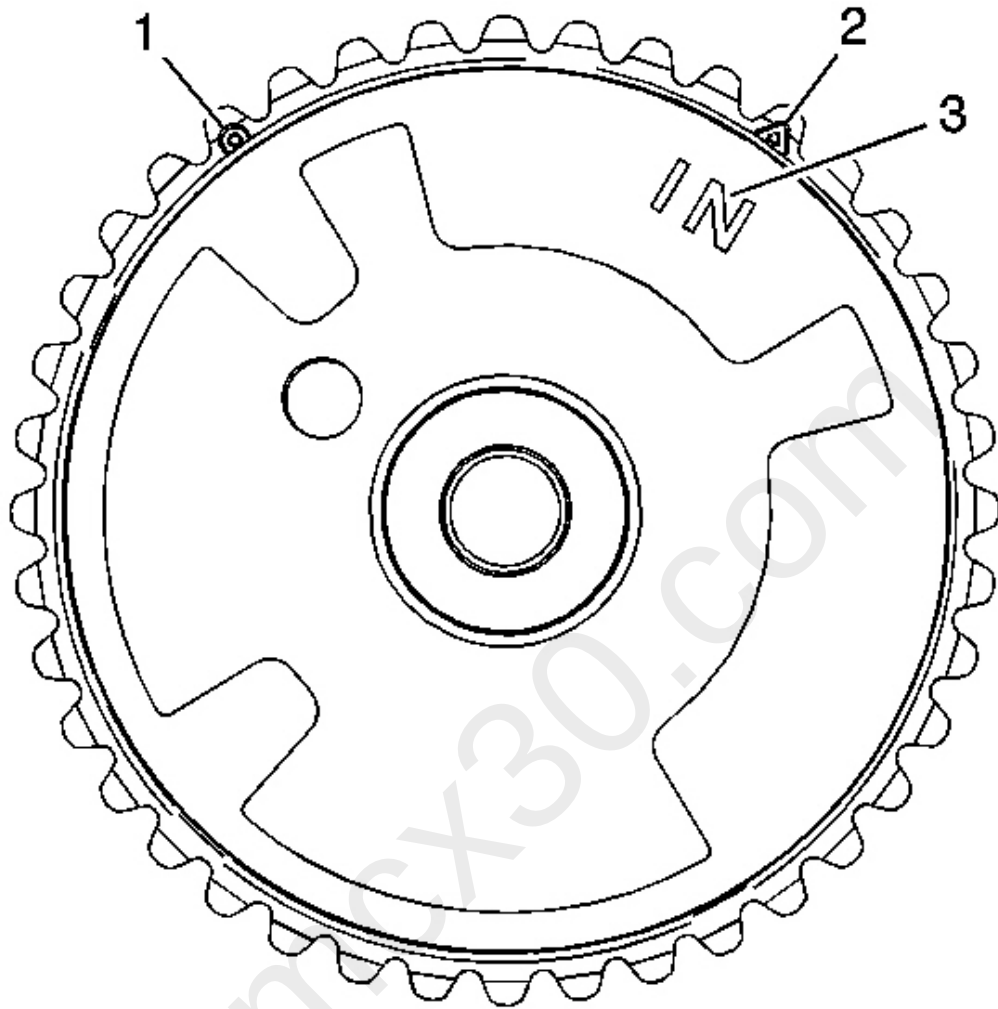


Fig. 13: View Of Camshaft Position Actuator Markings
Courtesy of GENERAL MOTORS CORP.

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.

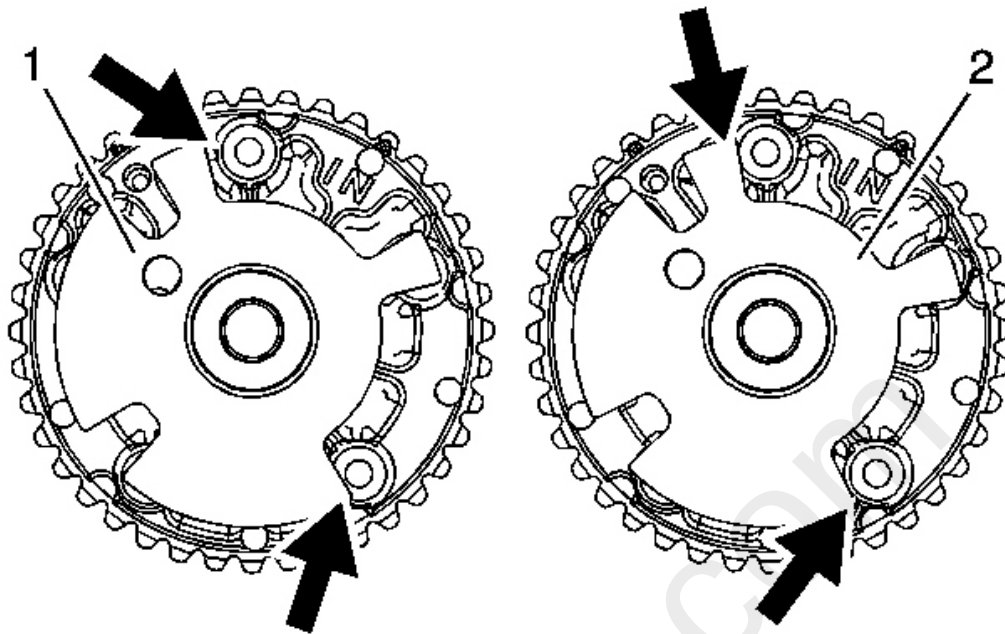


Fig. 14: View Of Right Intake Camshaft Position Actuator & Left Intake Camshaft Position Actuator

Courtesy of GENERAL MOTORS CORP.

CAUTION: 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 right intake camshaft position actuator (1) is indexed in a different position compared to the left intake camshaft position actuator (2).

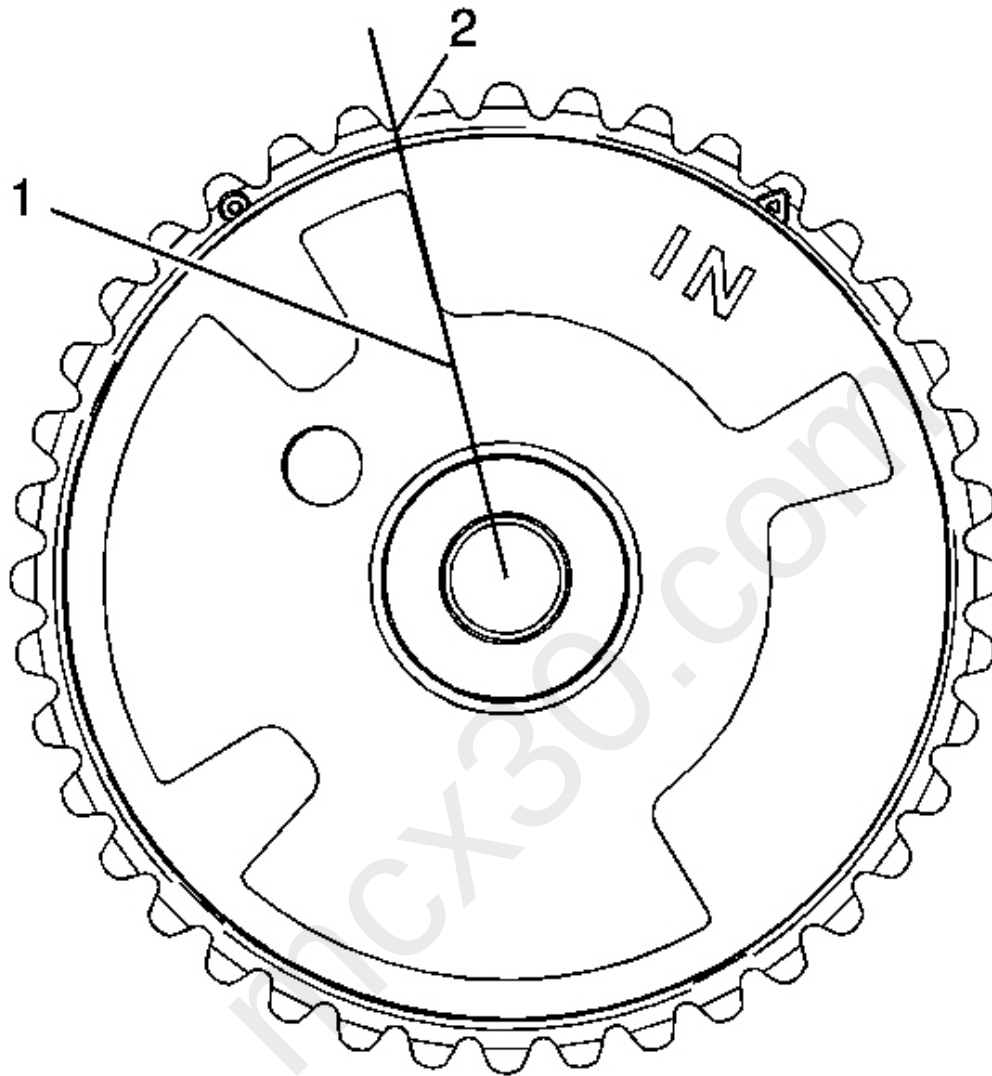


Fig. 15: View Of Reluctor Wheel & Valley
Courtesy of GENERAL MOTORS CORP.

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

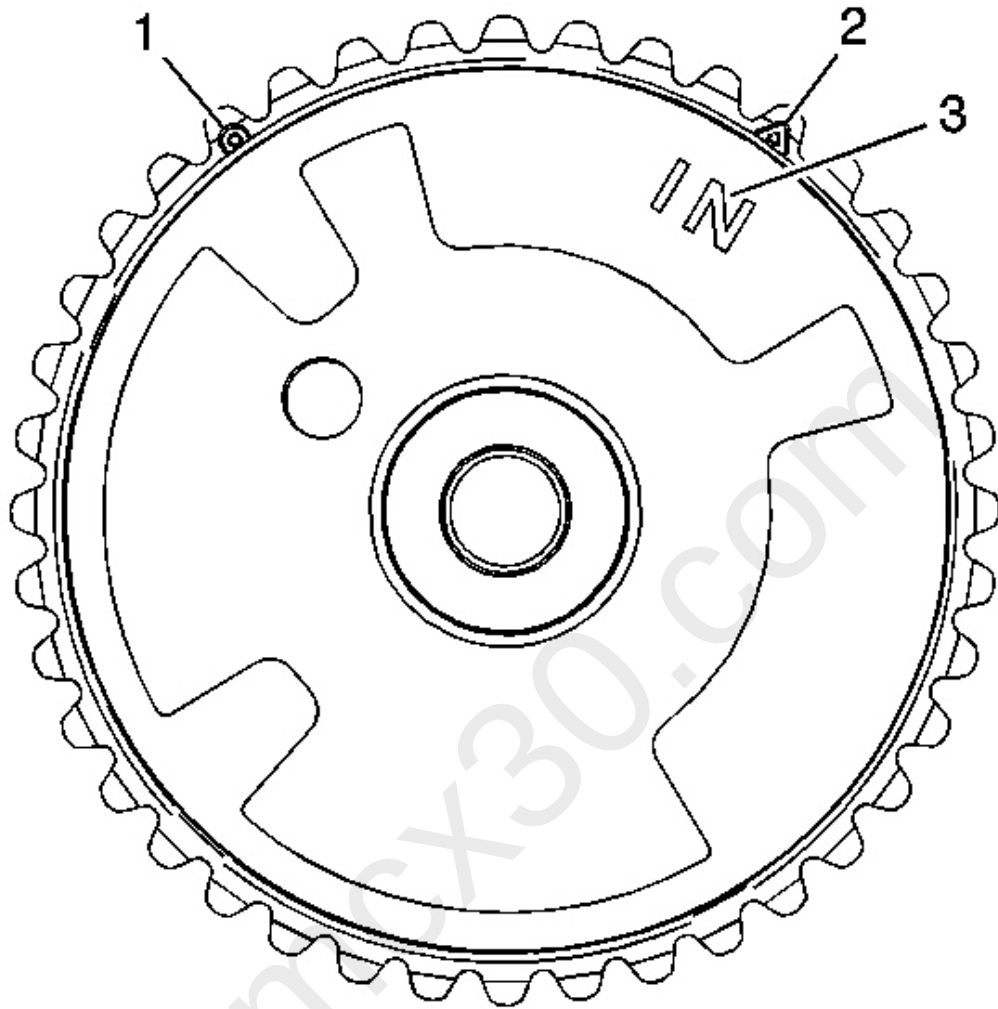


Fig. 16: View Of Camshaft Position Actuator Markings
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Torque Reaction Against Timing Drive Chain Caution .

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.

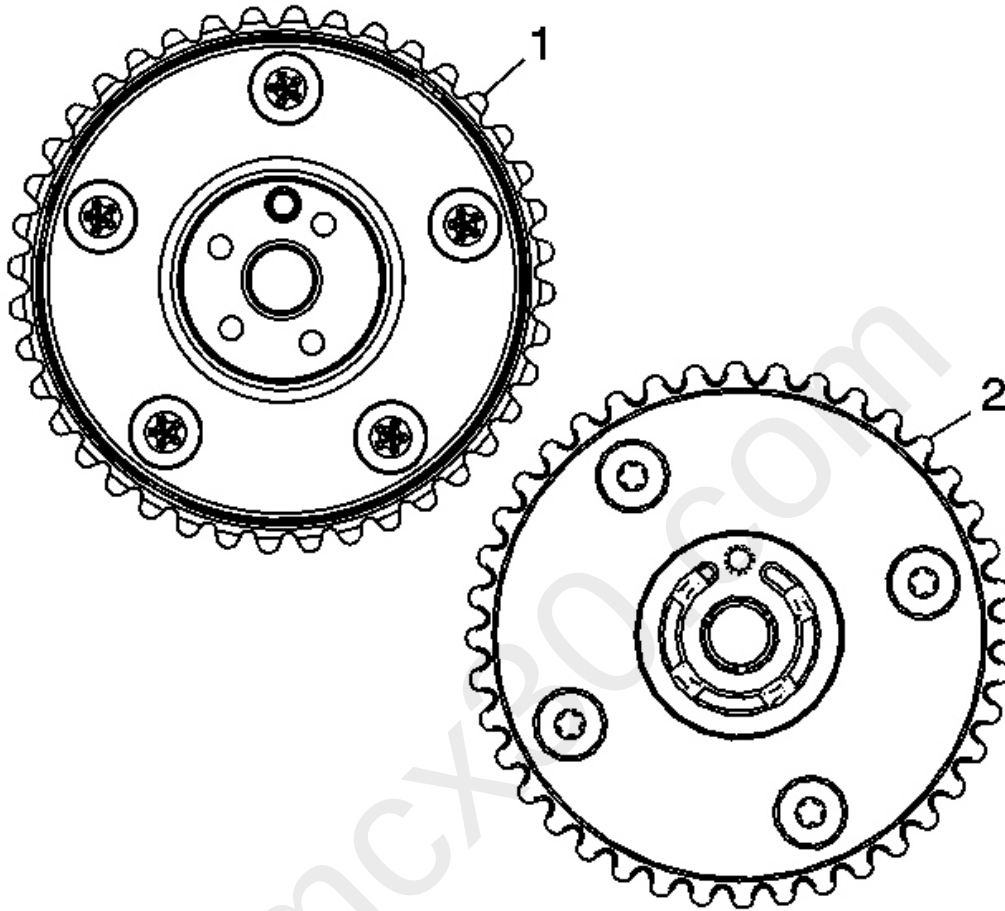


Fig. 17: Identifying Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

NOTE: The camshaft position actuator will vary depending on application.

NOTE: Camshaft thrust washers must be installed on all 2010 applications when servicing the camshaft position actuators. Do not install washers on 2009 applications if they are not already present.

6. Ensure the proper camshaft thrust washer is used. Use a 1.6 mm (0.063 in) thrust washer on applications that have 5 attaching screws on the back side of the camshaft position actuator (1). Use a 1.1 mm (0.043 in) thick thrust washer with yellow speckles on applications that have 4 attaching screws on the back side of the camshaft position actuator (2).

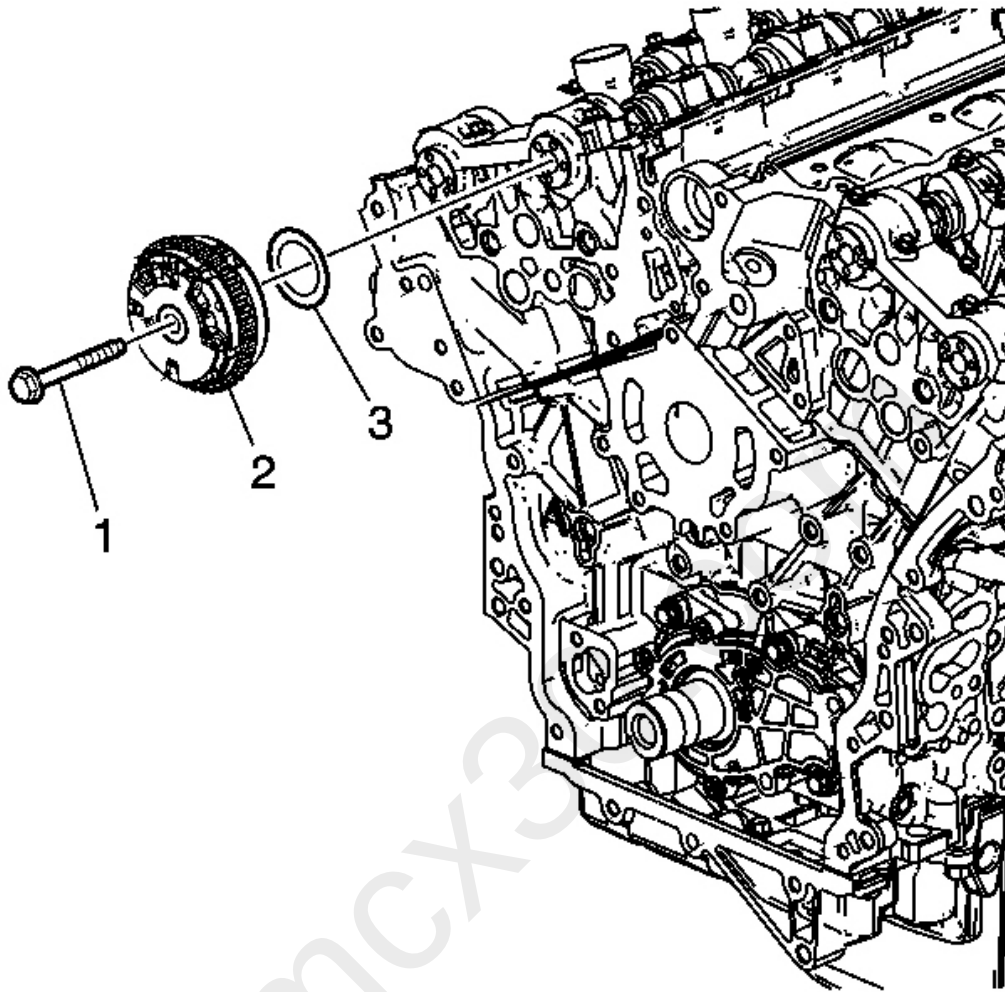


Fig. 18: View Of Intake Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the thrust washer if applicable (3).
8. Install the right intake camshaft position actuator (2).

CAUTION: Refer to Fastener Caution .

9. Install the camshaft position actuator bolt (1) and tighten to 58 N.m (43 lb ft).

CAMSHAFT POSITION ACTUATOR INSTALLATION - RIGHT SIDE EXHAUST

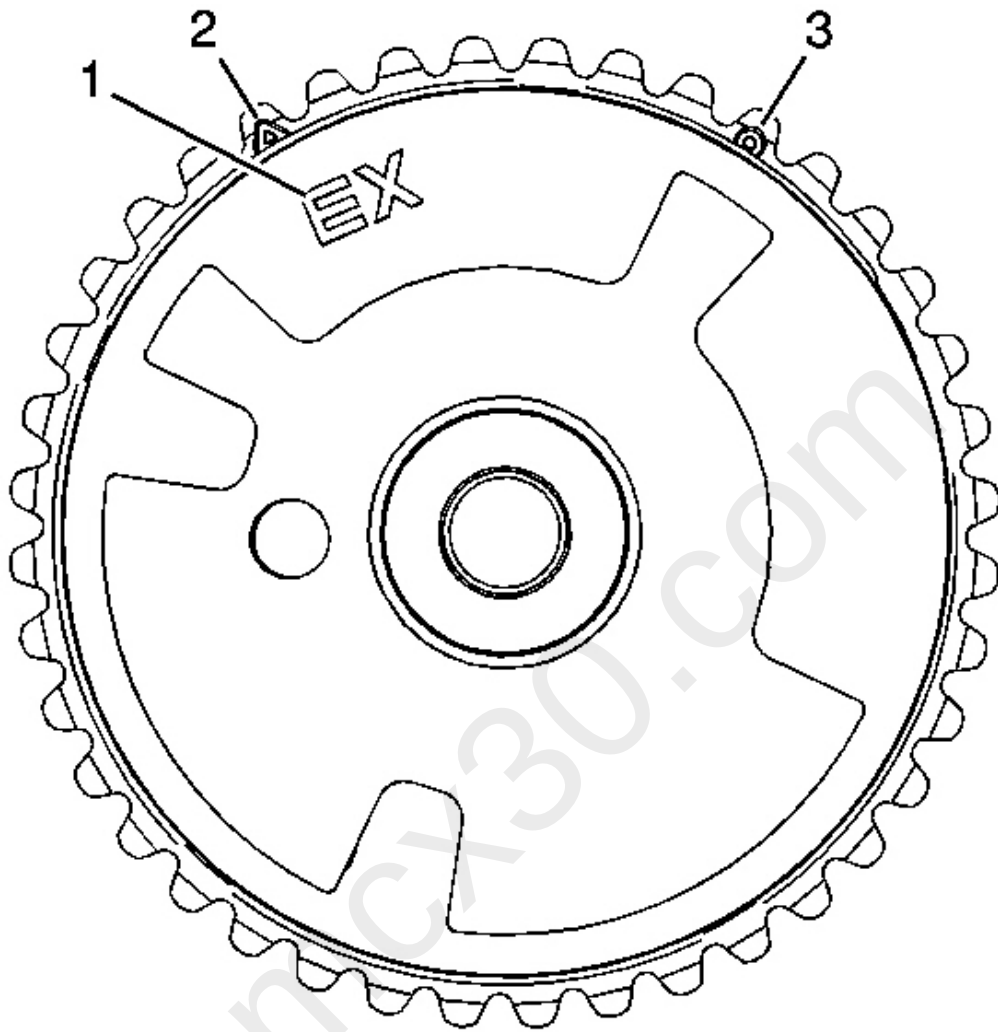


Fig. 19: View Of EX Marking, Triangle & Circle Marking
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Torque Reaction Against Timing Drive Chain Caution .

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.

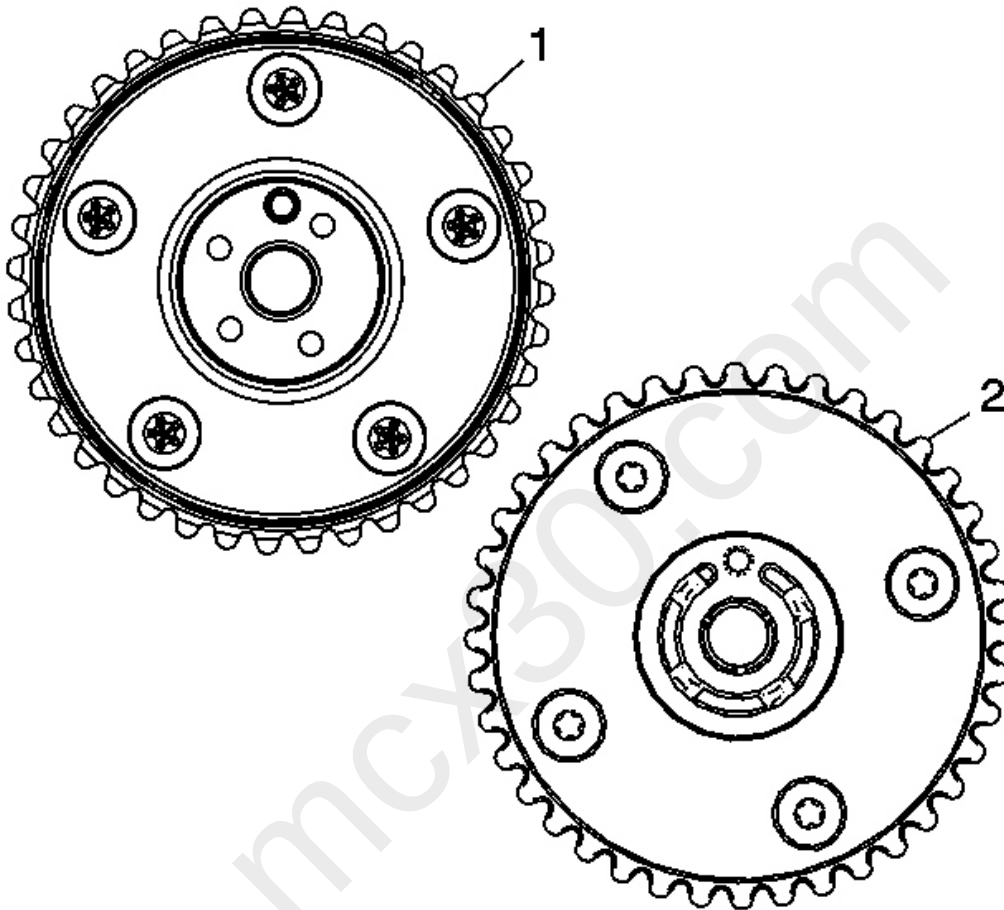


Fig. 20: Identifying Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

NOTE: The camshaft position actuator will vary depending on application.

NOTE: Camshaft thrust washers must be installed on all 2010 applications when servicing the camshaft position actuators. Do not install washers on 2009 applications if they are not already present.

4. Ensure the proper camshaft thrust washer is used. Use a 1.6 mm (0.063 in) thrust washer on applications

that have 5 attaching screws on the back side of the camshaft position actuator (1). Use a 1.1 mm (0.043 in) thick thrust washer with yellow speckles on applications that have 4 attaching screws on the back side of the camshaft position actuator (2).

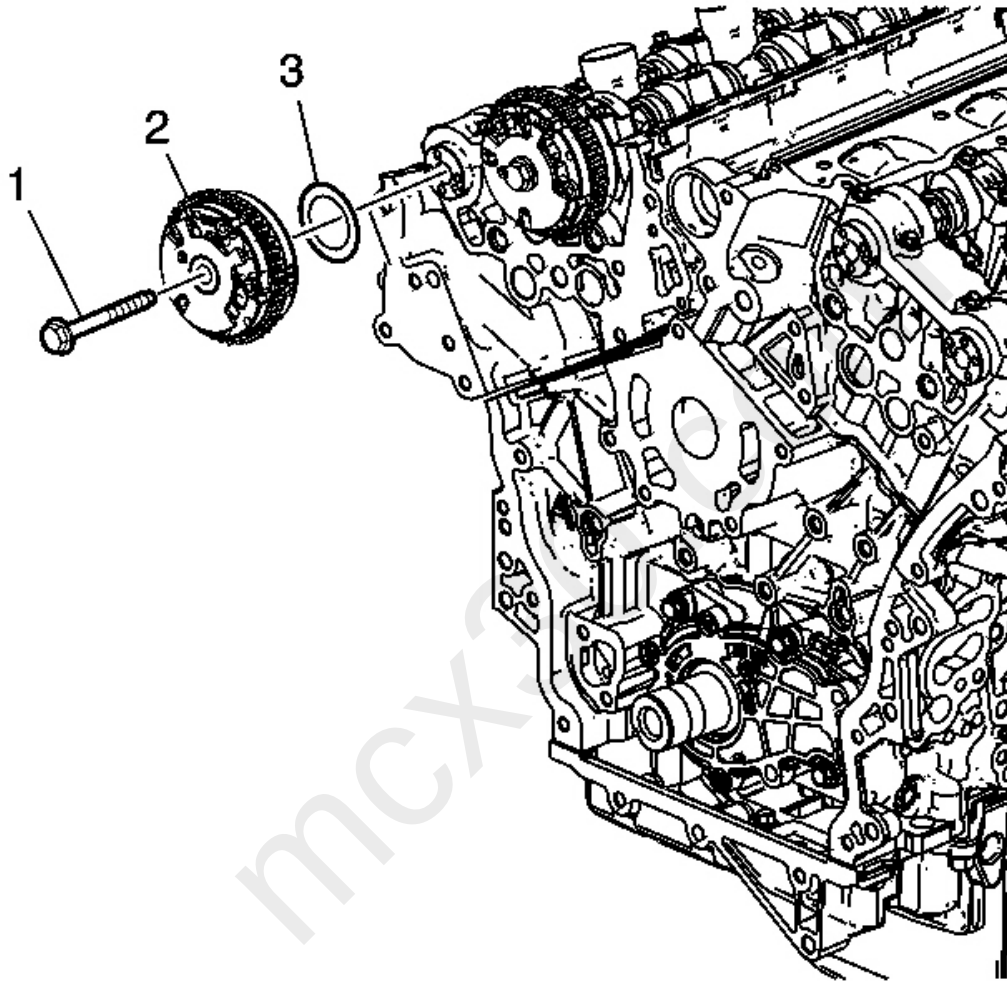


Fig. 21: Identifying Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the thrust washer if applicable (3).
6. Install the right exhaust camshaft position actuator (2).

CAUTION: Refer to Fastener Caution .

7. Install the camshaft position actuator bolt (1) and tighten to 58 N.m (43 lb ft).

CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE INTAKE

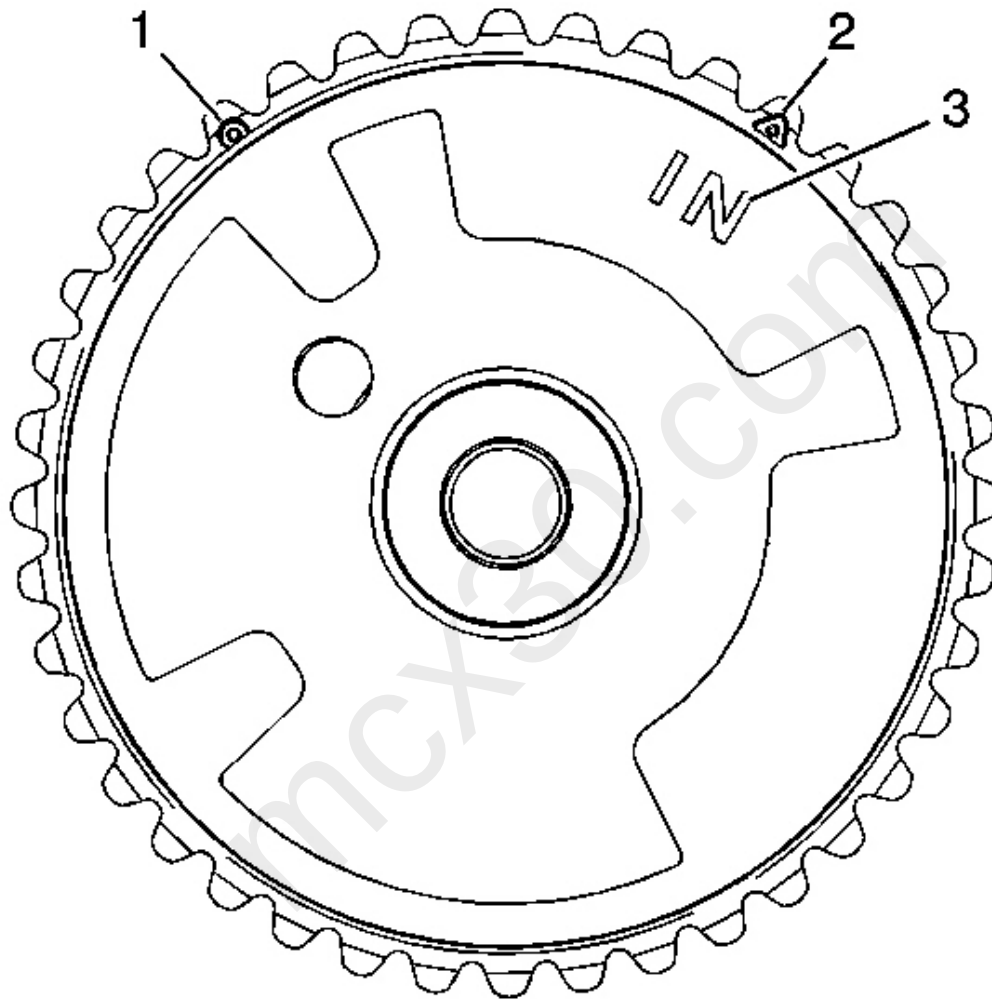


Fig. 22: Identifying Camshaft Position Actuator Marks
Courtesy of GENERAL MOTORS CORP.

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.

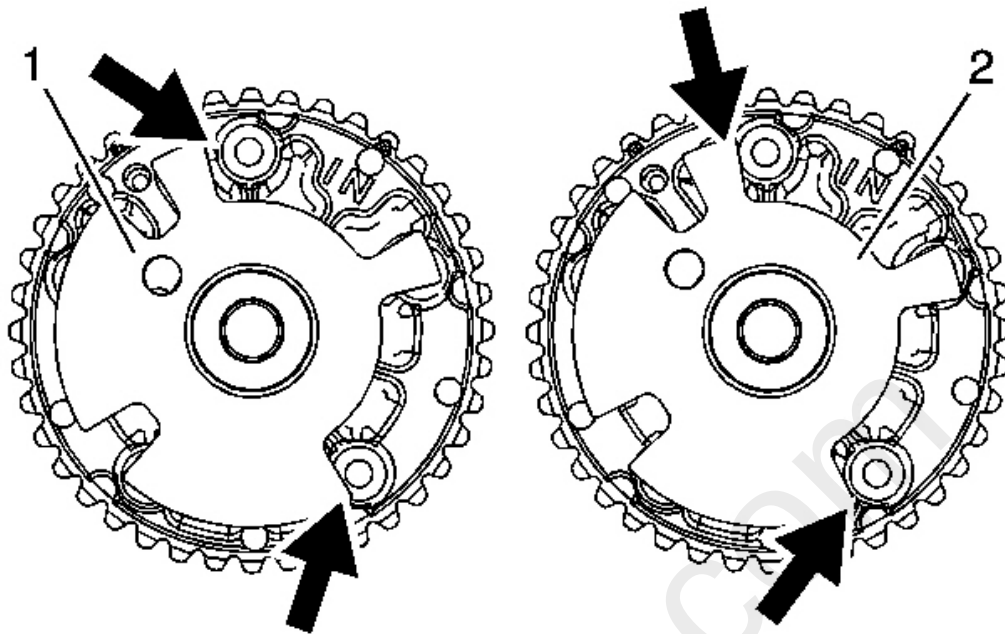


Fig. 23: View Of Right Intake Camshaft Position Actuator & Left Intake Camshaft Position Actuator

Courtesy of GENERAL MOTORS CORP.

CAUTION: 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 right intake camshaft position actuator (1) is indexed in a different position compared to the left intake camshaft position actuator (2).

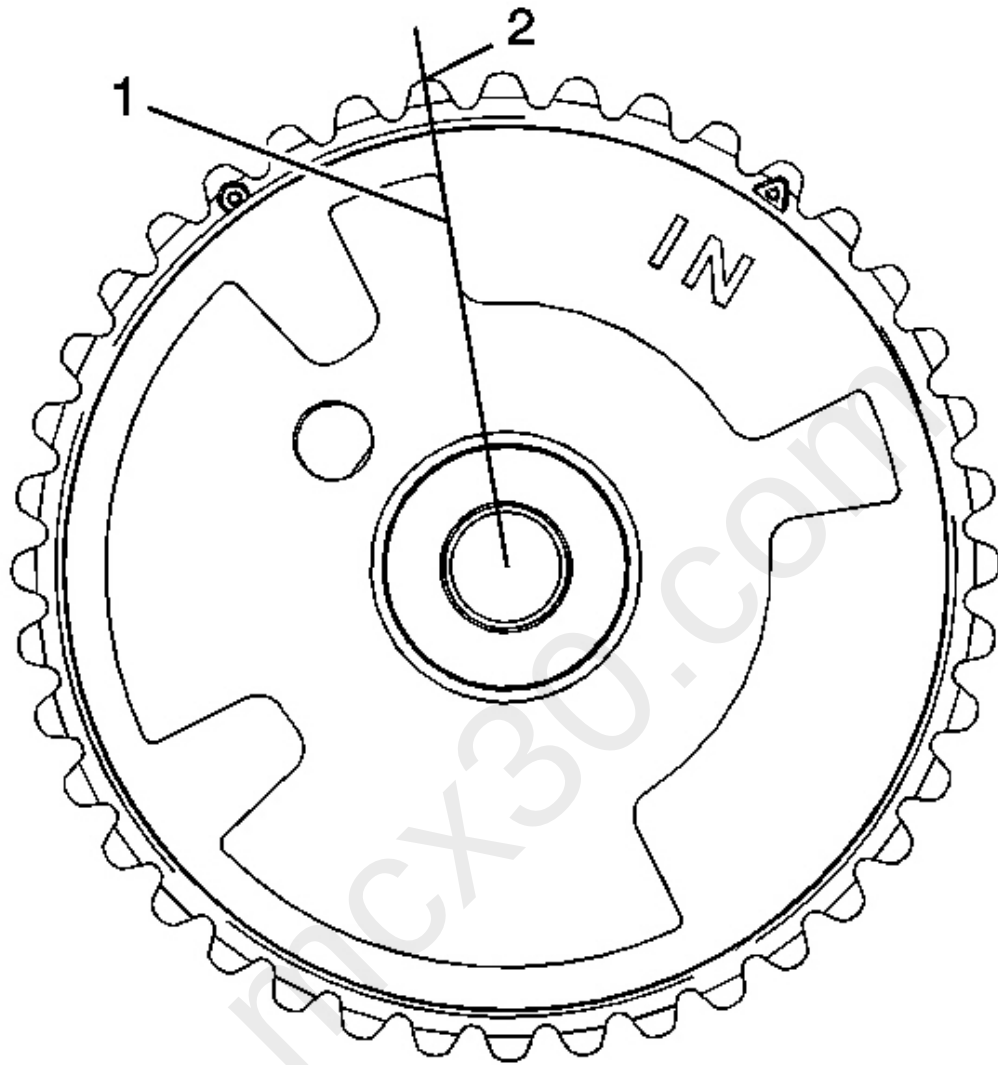


Fig. 24: Aligning Reluctor Wheel With Peak
Courtesy of GENERAL MOTORS CORP.

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

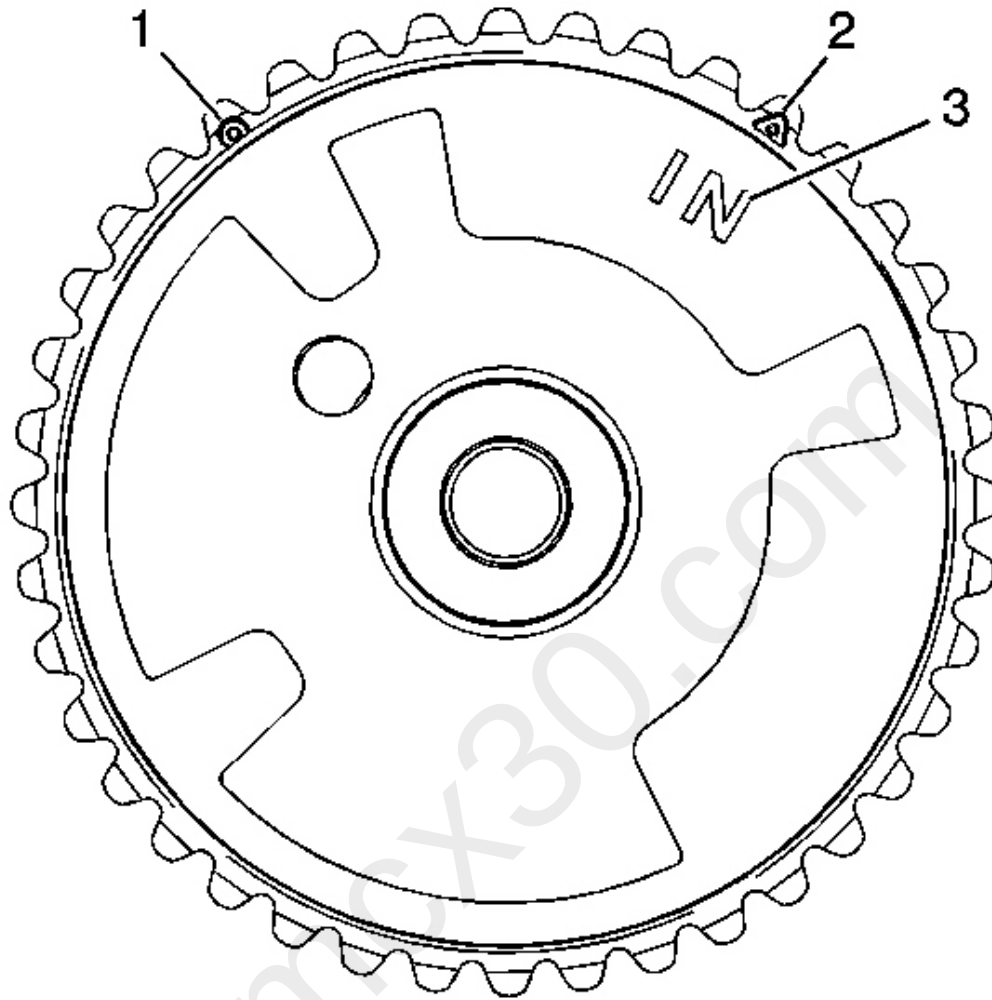


Fig. 25: Identifying Camshaft Position Actuator Marks
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Torque Reaction Against Timing Drive Chain Caution .

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.

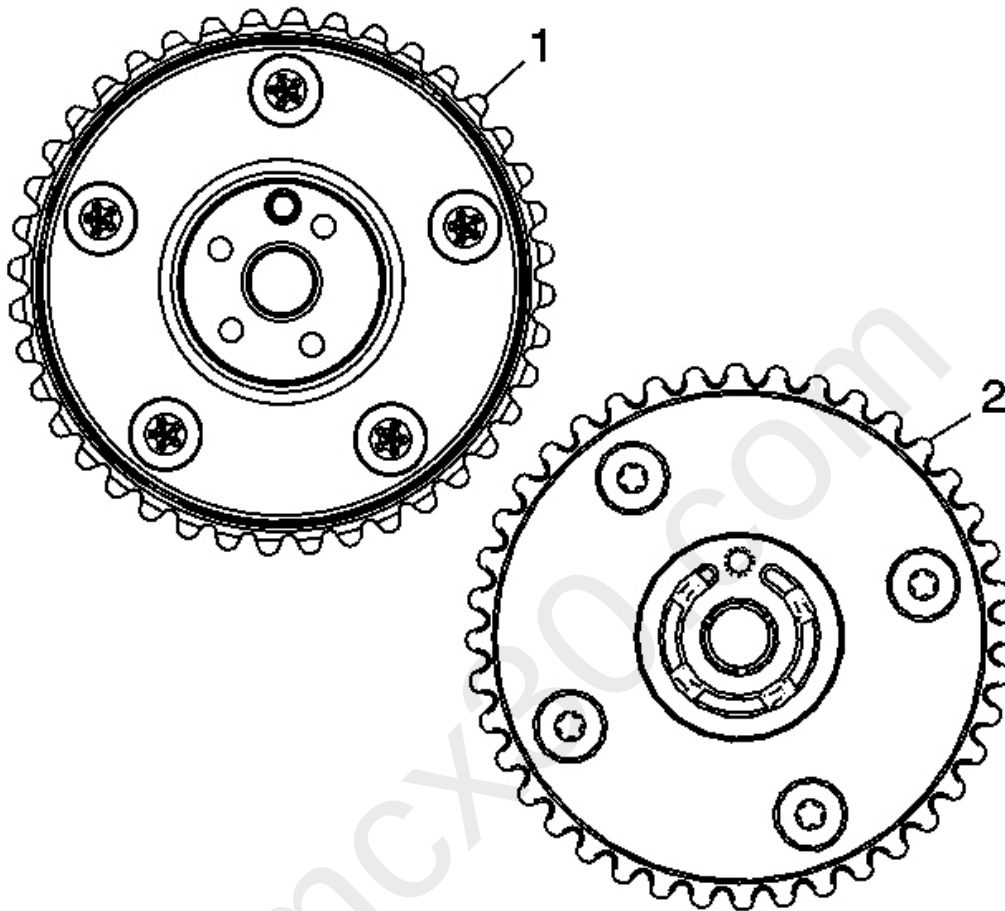


Fig. 26: Identifying Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

NOTE: The camshaft position actuator will vary depending on application.

NOTE: Camshaft thrust washers must be installed on all 2010 applications when servicing the camshaft position actuators. Do not install washers on 2009 applications if they are not already present.

6. Ensure the proper camshaft thrust washer is used. Use a 1.6 mm (0.063 in) thrust washer on applications that have 5 attaching screws on the back side of the camshaft position actuator (1). Use a 1.1 mm (0.043 in) thick thrust washer with yellow speckles on applications that have 4 attaching screws on the back side of the camshaft position actuator (2).

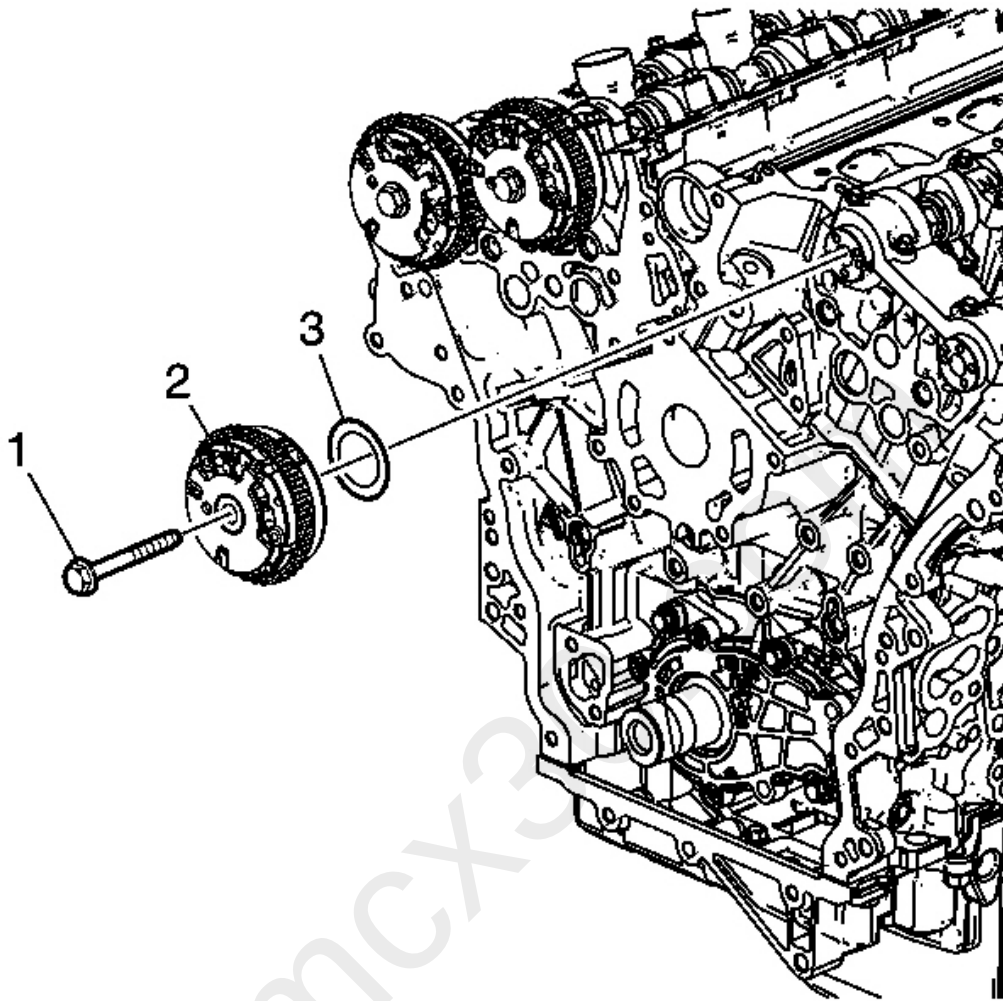


Fig. 27: View Of Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

7. Install the thrust washer if applicable (3).
8. Install the left intake camshaft position actuator (2).

CAUTION: Refer to Fastener Caution .

9. Install the camshaft position actuator bolt (1) and tighten to 58 N.m (43 lb ft).

CAMSHAFT POSITION ACTUATOR INSTALLATION - LEFT SIDE EXHAUST

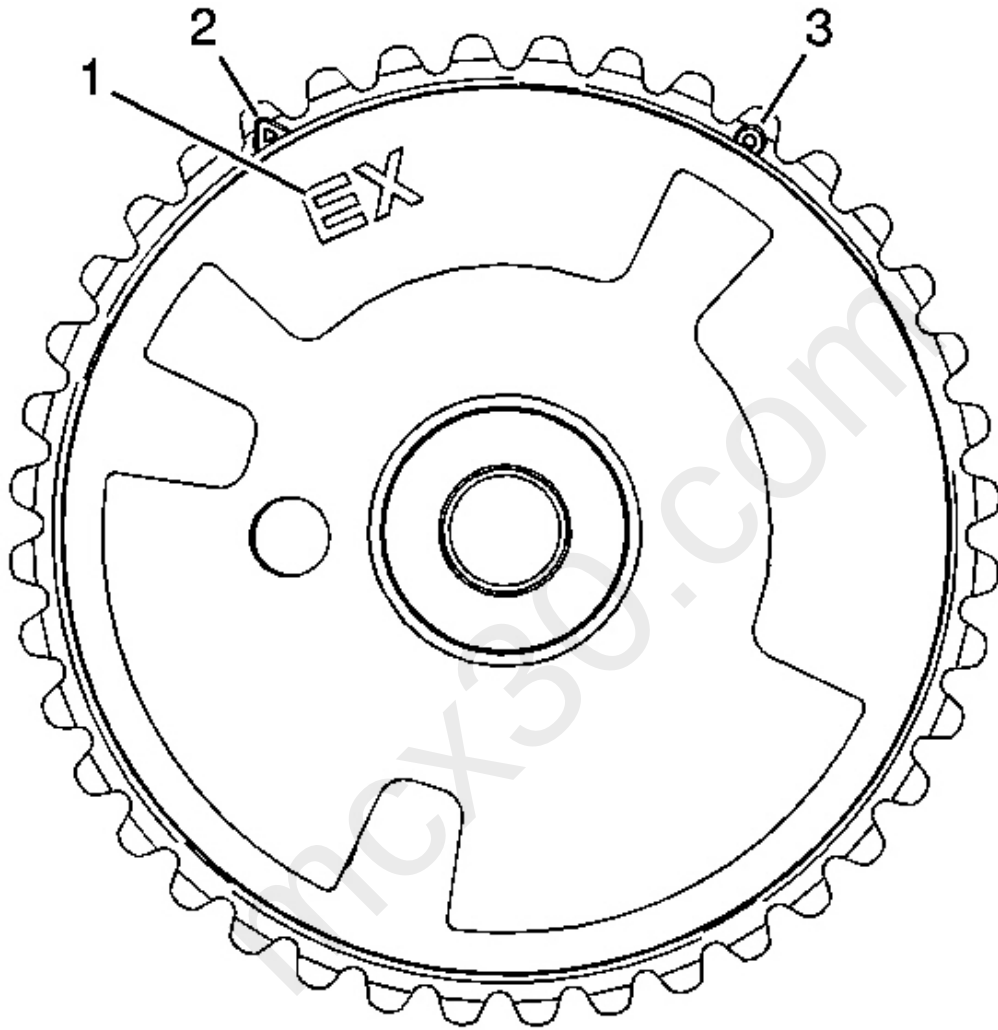


Fig. 28: View Of EX Marking, Triangle & Circle Marking
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Torque Reaction Against Timing Drive Chain Caution .

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.

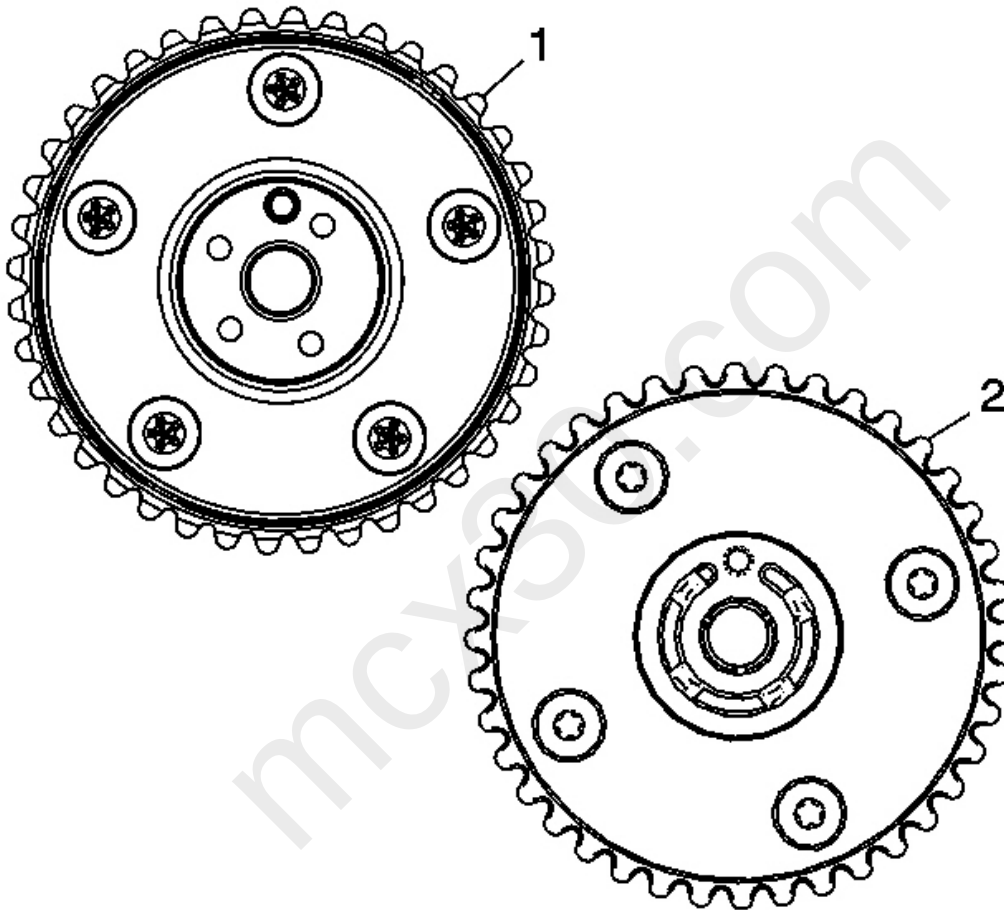


Fig. 29: Identifying Camshaft Position Actuators
Courtesy of GENERAL MOTORS CORP.

NOTE: The camshaft position actuator will vary depending on application.

NOTE: Camshaft thrust washers must be installed on all 2010 applications when servicing the camshaft position actuators. Do not install washers on 2009 applications if they are not already present.

4. Ensure the proper camshaft thrust washer is used. Use a 1.6 mm (0.063 in) thrust washer on applications that have 5 attaching screws on the back side of the camshaft position actuator (1). Use a 1.1 mm (0.043 in) thick thrust washer with yellow speckles on applications that have 4 attaching screws on the back side of the camshaft position actuator (2).

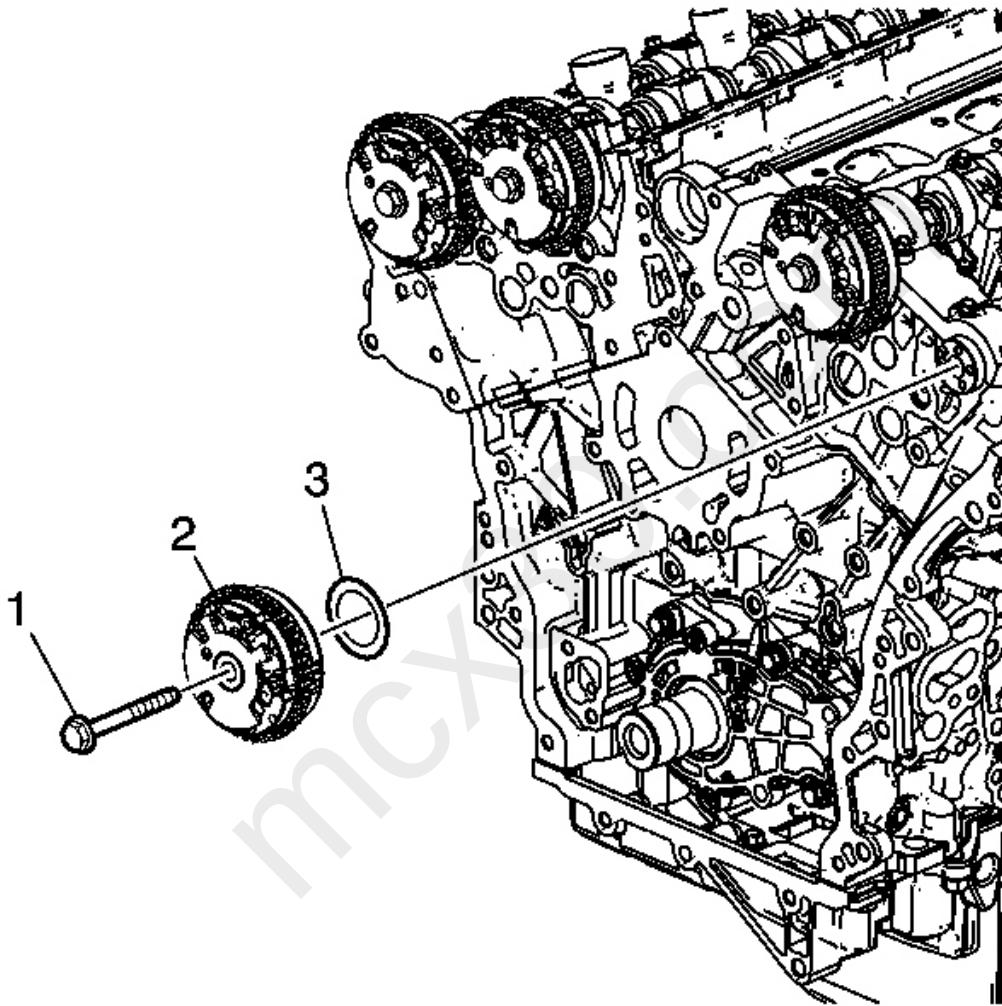


Fig. 30: View Of Exhaust Camshaft Position Actuator & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Install the thrust washer if applicable (3).
6. Install the left exhaust camshaft position actuator (2).

CAUTION: Refer to Fastener Caution .

7. Install the camshaft position actuator bolt (1) and tighten to 58 N.m (43 lb ft).

CRANKSHAFT SPROCKET INSTALLATION

SPECIAL TOOLS

EN-48589: Crankshaft Rotation Socket

For equivalent regional tools, refer to **Special Tools** .

INSTALLATION

mcx30.com

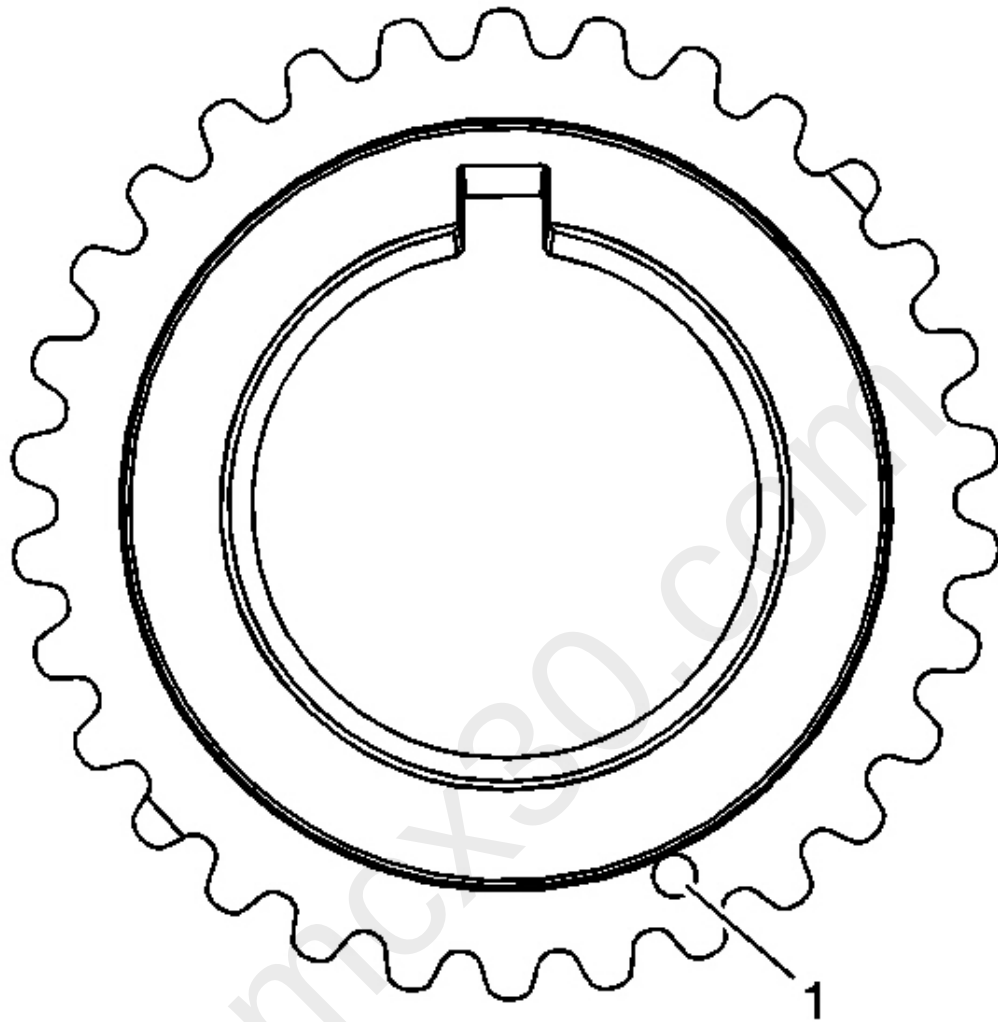


Fig. 31: Identifying Crankshaft Sprocket Timing Mark
Courtesy of GENERAL MOTORS CORP.

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

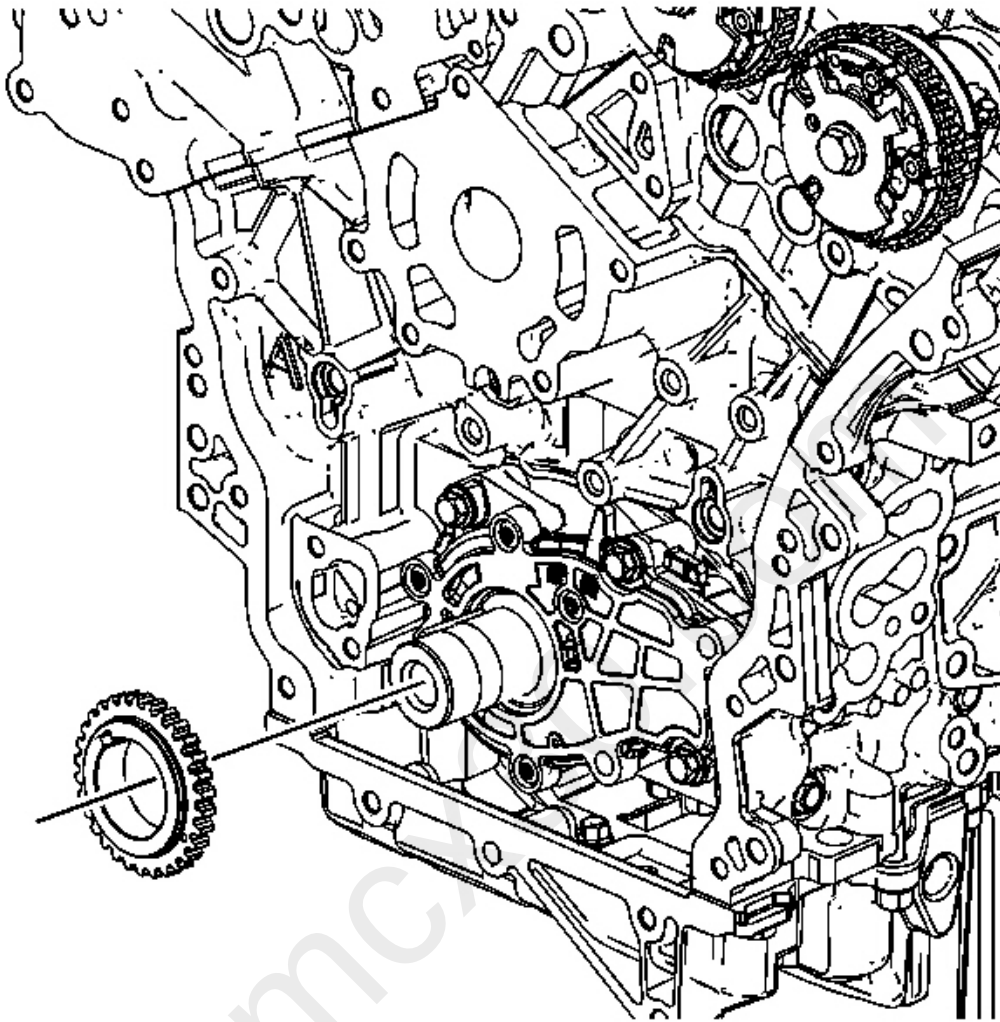


Fig. 32: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

2. Install the crankshaft sprocket onto 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.

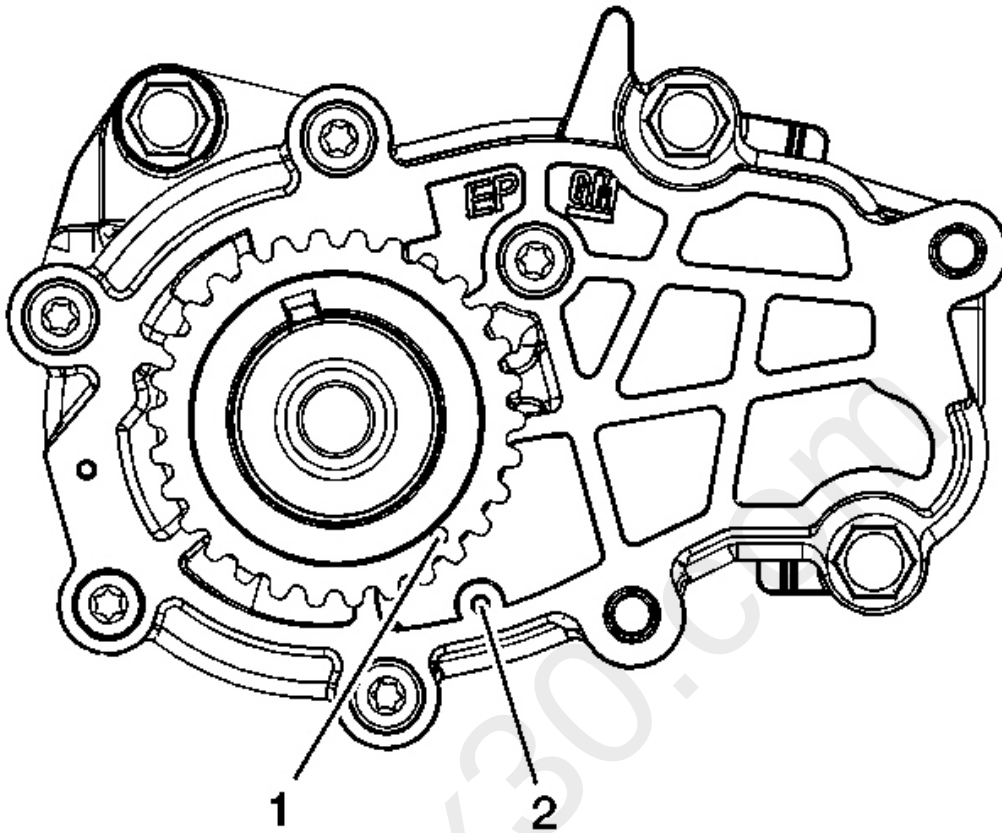


Fig. 33: View Of Stage One Timing Mark On Oil Pump Cover & Sprocket Timing Mark
Courtesy of GENERAL MOTORS CORP.

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**: socket. Refer to **Timing Chain Alignment Diagram** .

TIMING CHAIN IDLER SPROCKET INSTALLATION - LEFT SIDE

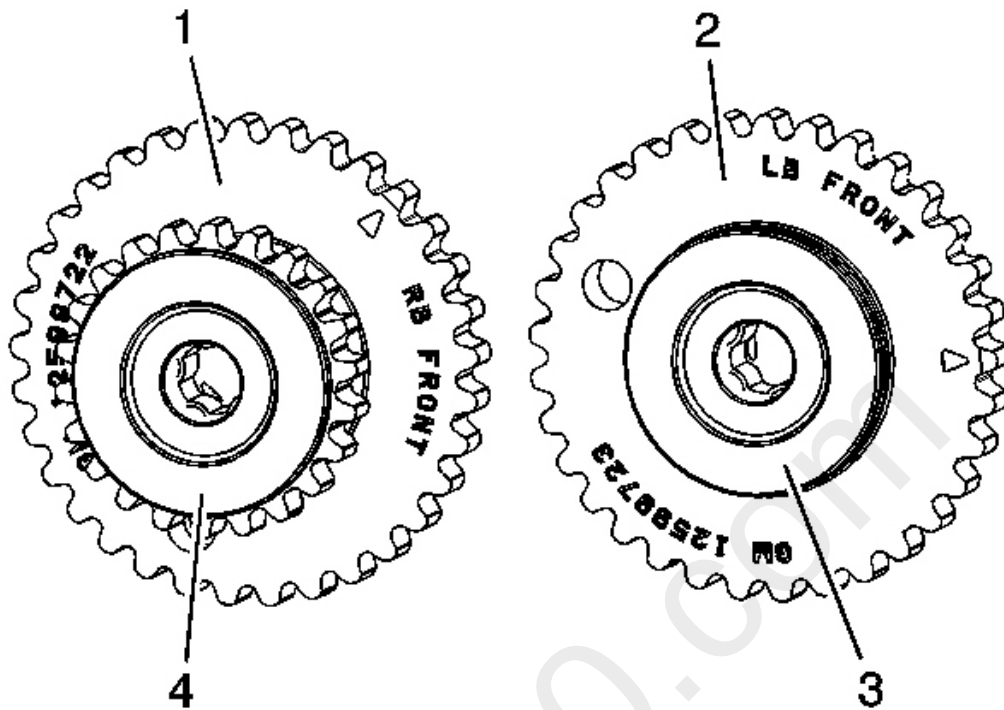


Fig. 34: View Of Camshaft Intermediate Drive Chain Idler - Left Side (Fourth Design)
Courtesy of GENERAL MOTORS CORP.

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.

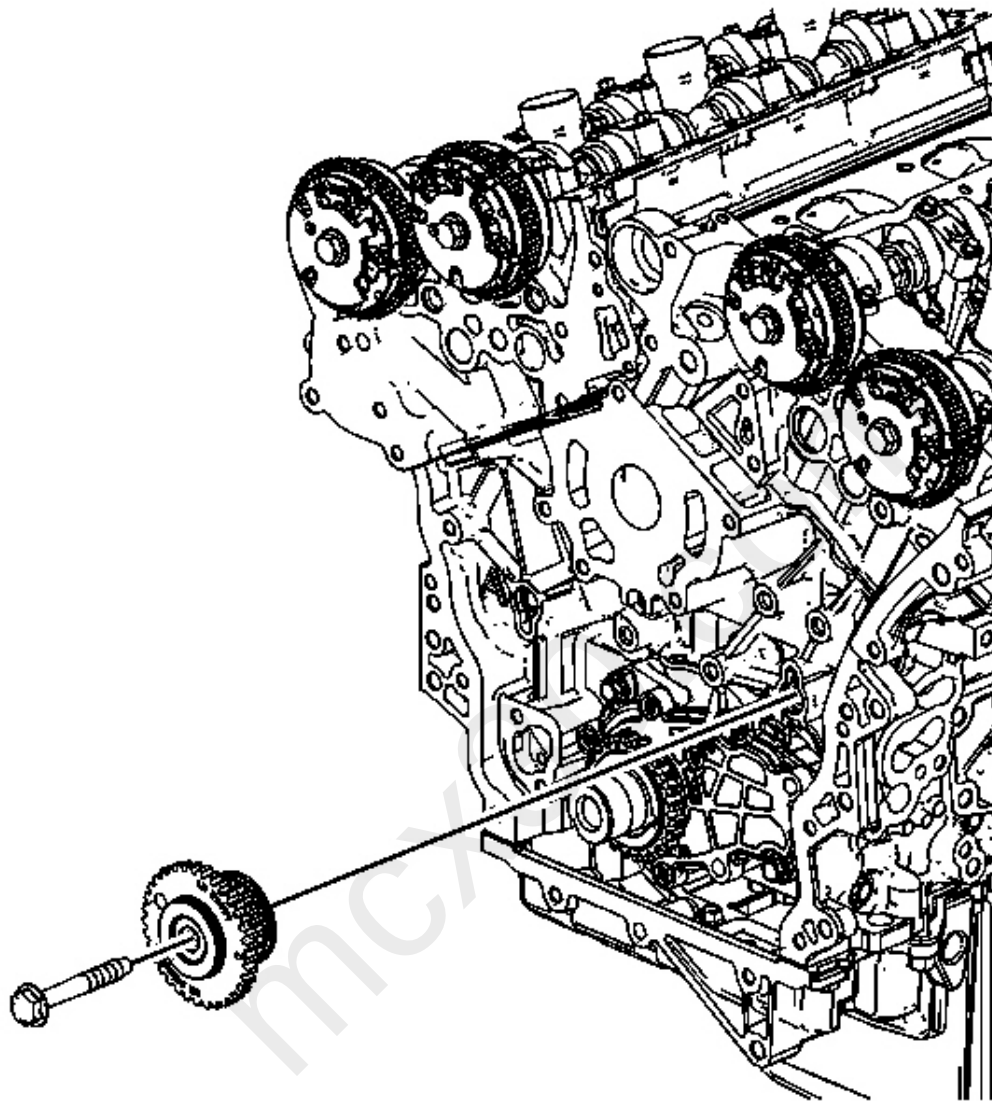


Fig. 35: View Of Camshaft Intermediate Drive Chain Idler & Bolt
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

3. Install the camshaft intermediate drive chain idler bolt and tighten to 58 N.m (43 lb ft).

SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION - LEFT SIDE

Special Tools

- **EN 48383:** Camshaft Retaining Tools
- **EN 48589:** Crankshaft Rotation Socket

For equivalent regional tools, refer to **Special Tools** .

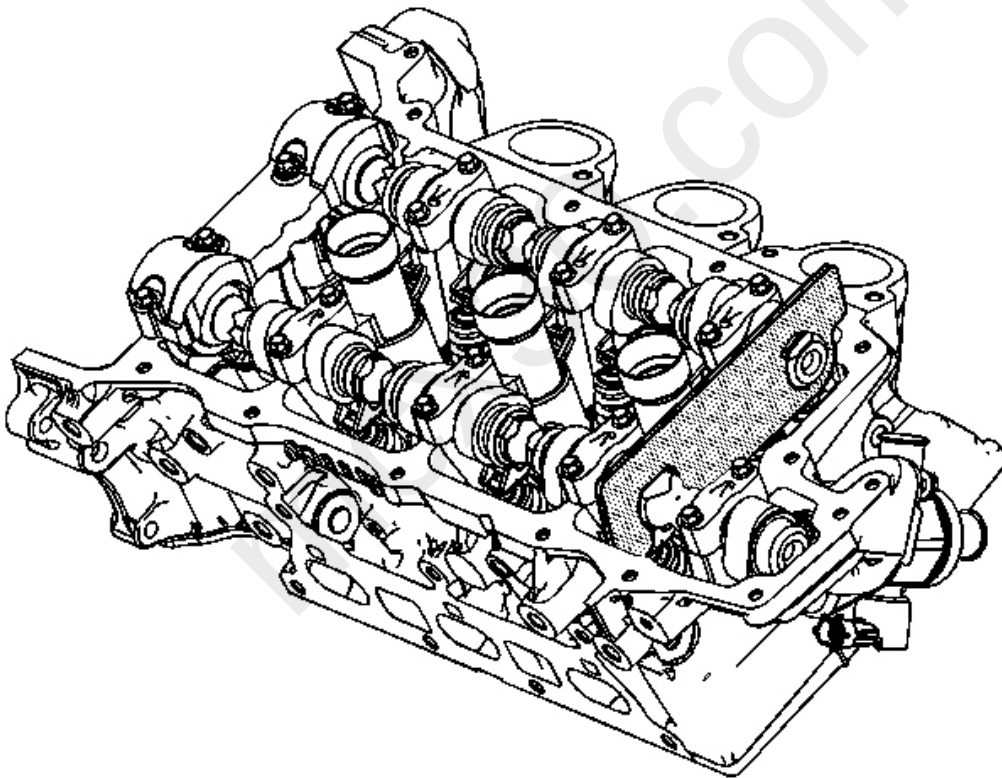


Fig. 36: View Of Camshafts & EN 48383-1
Courtesy of GENERAL MOTORS CORP.

NOTE: 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 48383: tools.

1. Install the EN 48383-1 onto the rear of the left camshafts.

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

2. Ensure that the EN 48383-1 is fully seated onto the camshafts.

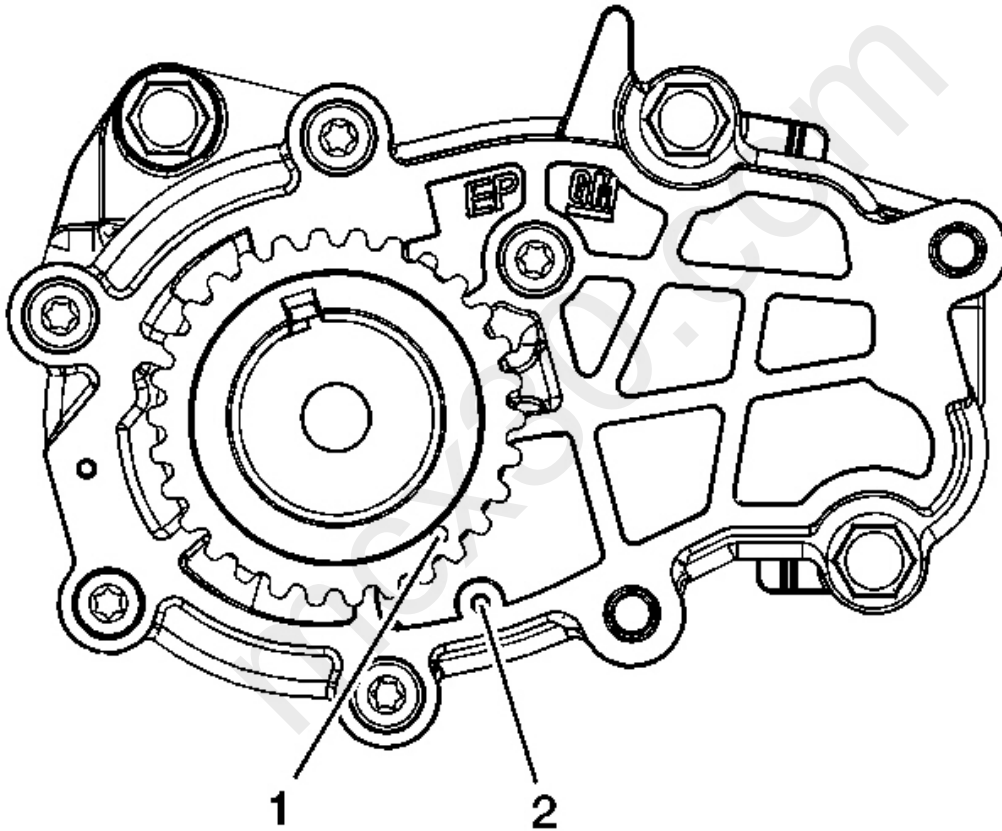


Fig. 37: View Of Crankshaft Sprocket Timing Mark & Oil Pump Cover
Courtesy of GENERAL MOTORS CORP.

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: socket. Refer to **Timing Chain Alignment Diagram**.

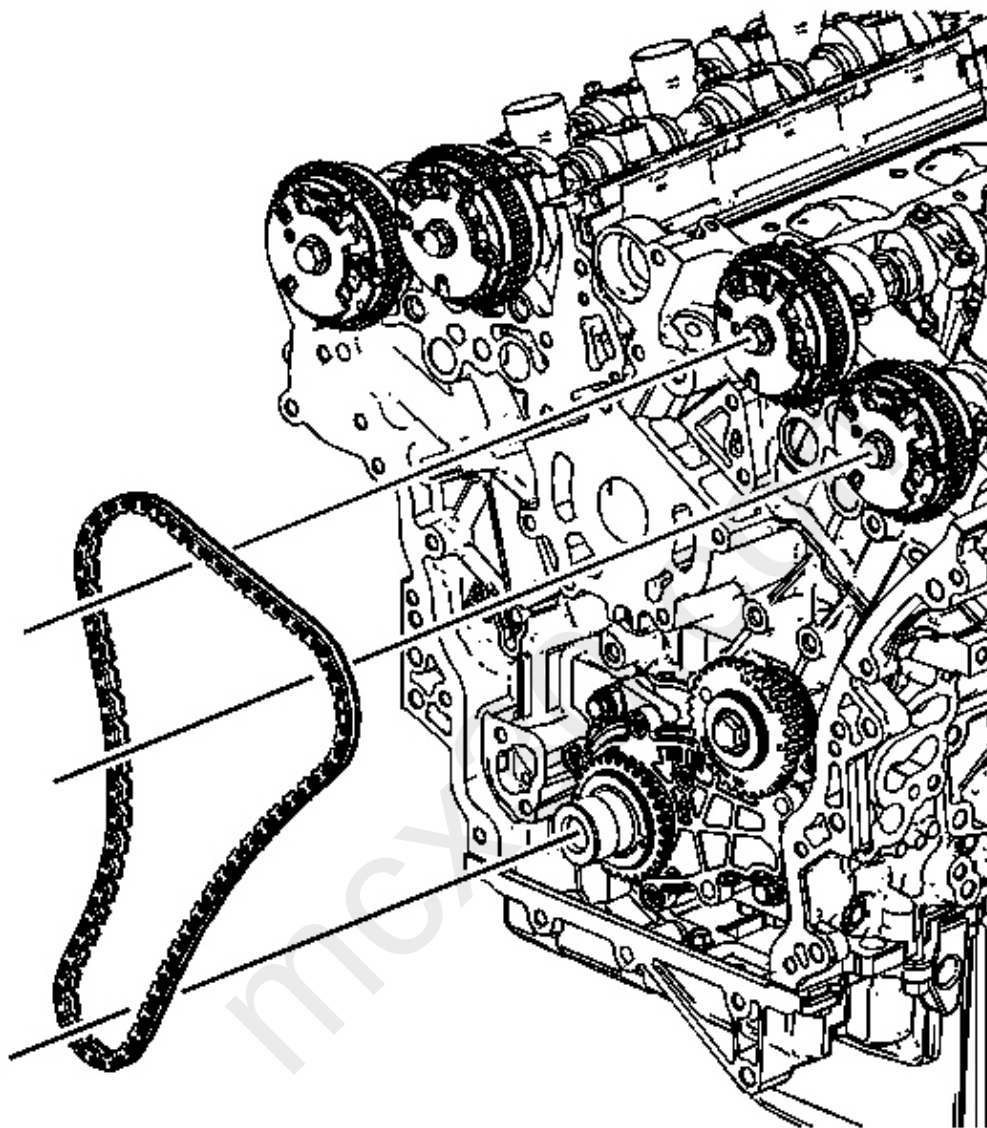


Fig. 38: View Of Left Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

4. Install the left secondary camshaft drive chain.

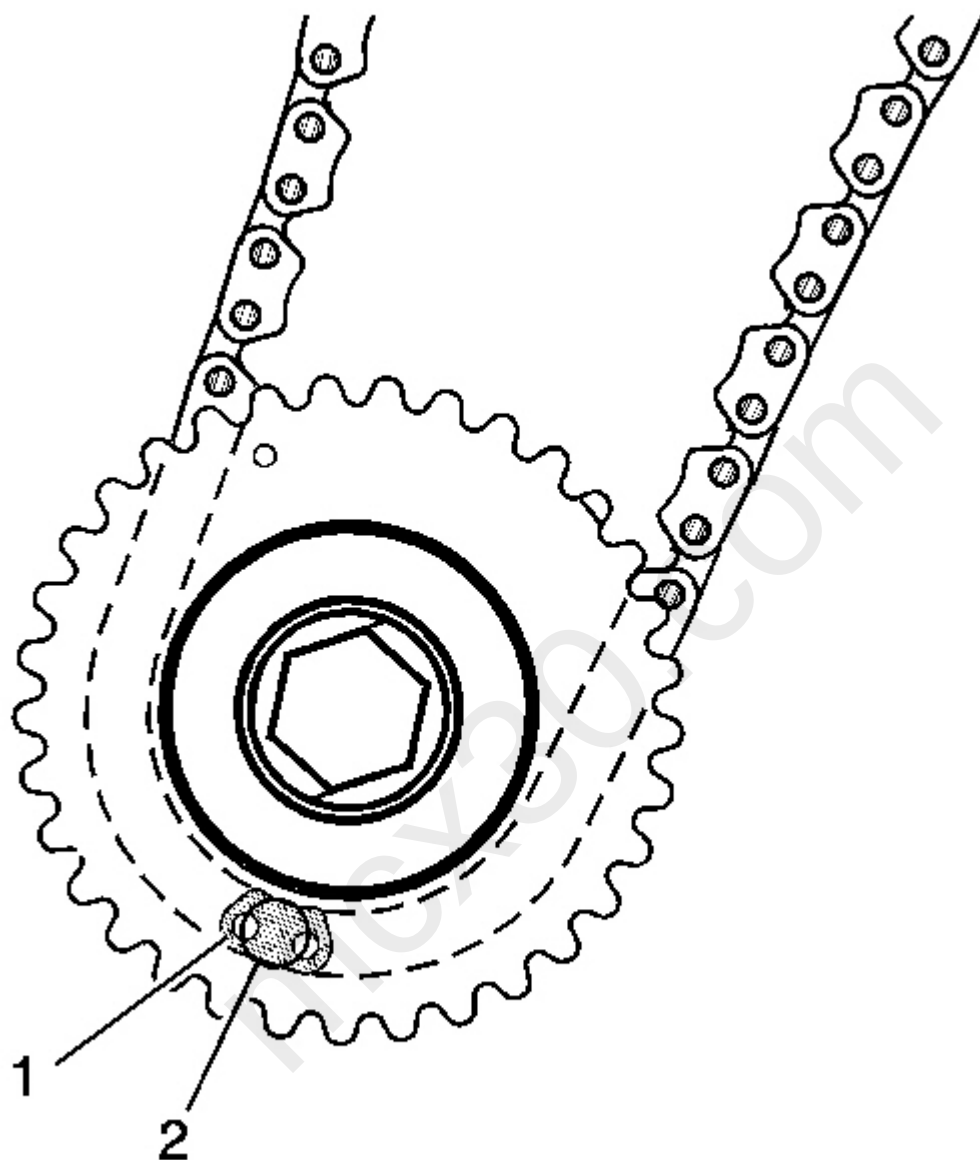


Fig. 39: View Of Timing Camshaft Drive Chain Link & Alignment Access Hole
Courtesy of GENERAL MOTORS CORP.

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.

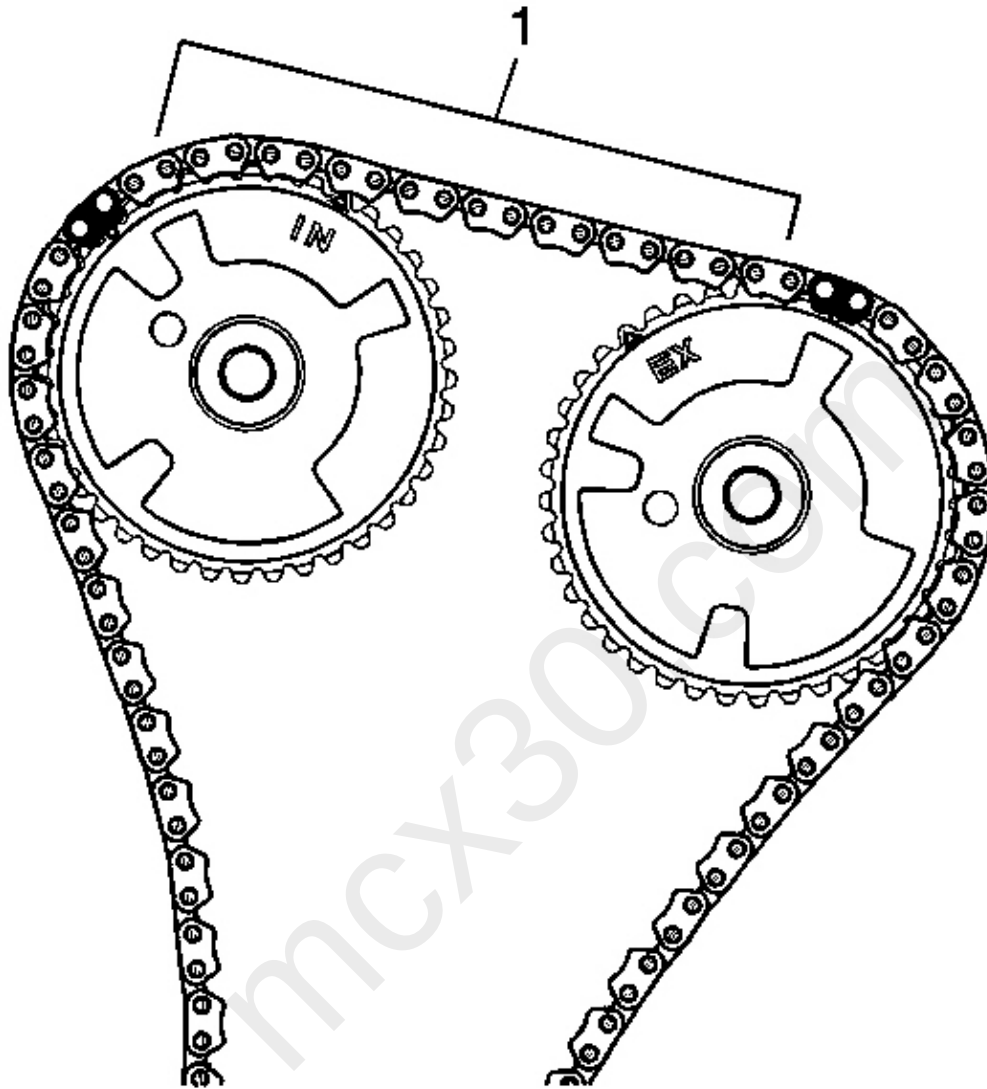


Fig. 40: View Of Camshaft Drive Chain Links
Courtesy of GENERAL MOTORS CORP.

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.

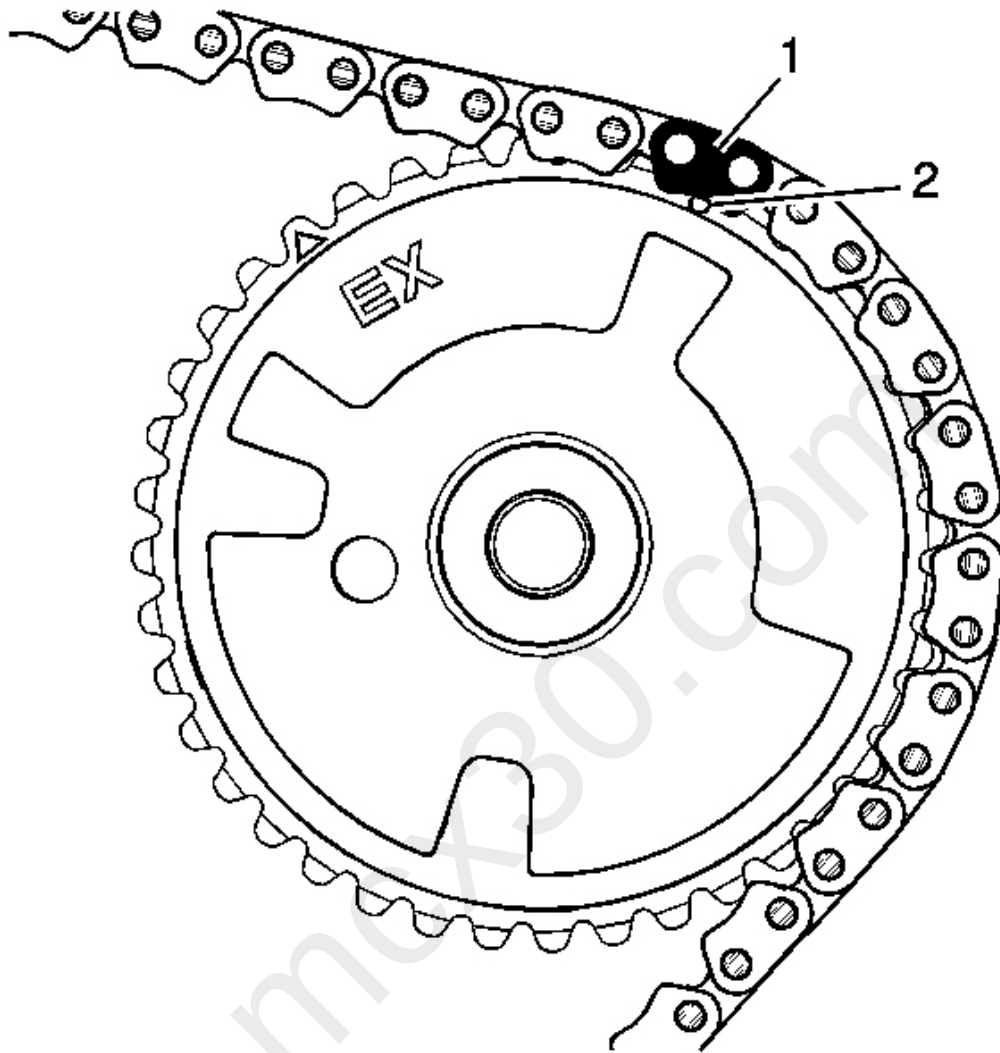


Fig. 41: View Of Exhaust Camshaft Marks
Courtesy of GENERAL MOTORS CORP.

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

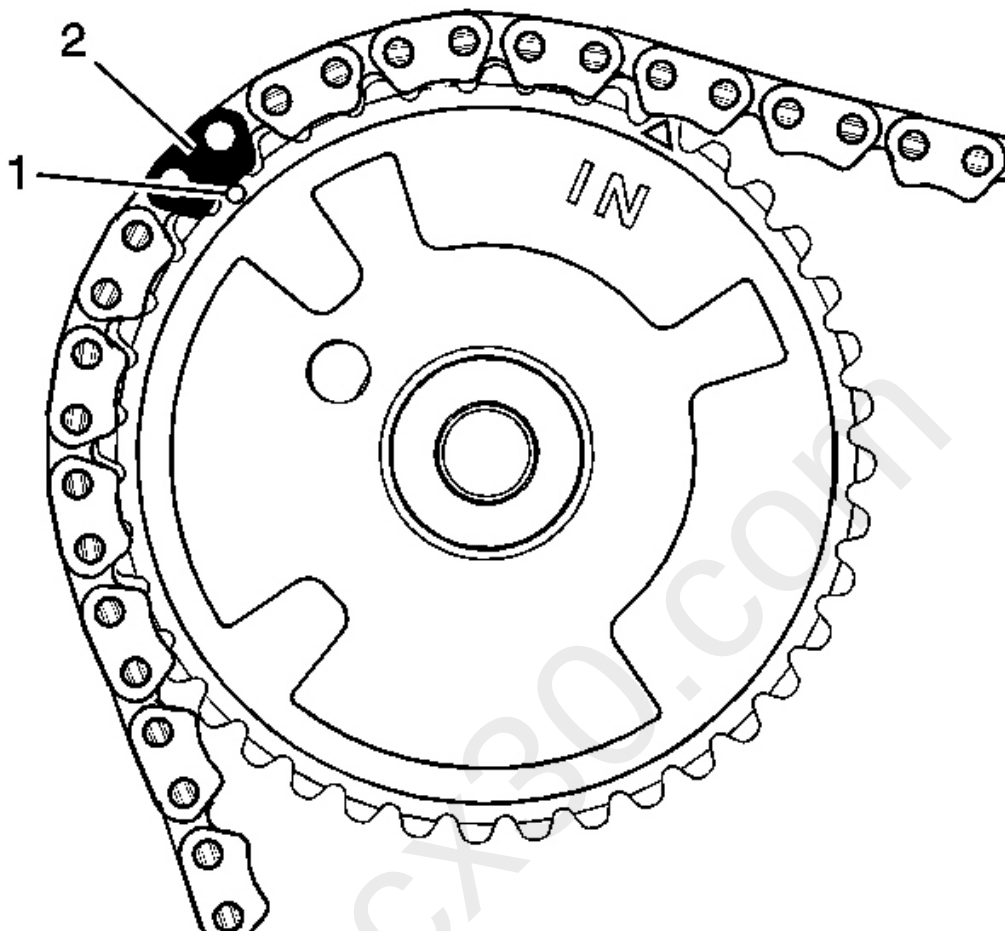


Fig. 42: View Of Intake Camshaft Marks
Courtesy of GENERAL MOTORS CORP.

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

SECONDARY TIMING CHAIN GUIDE INSTALLATION - LEFT SIDE

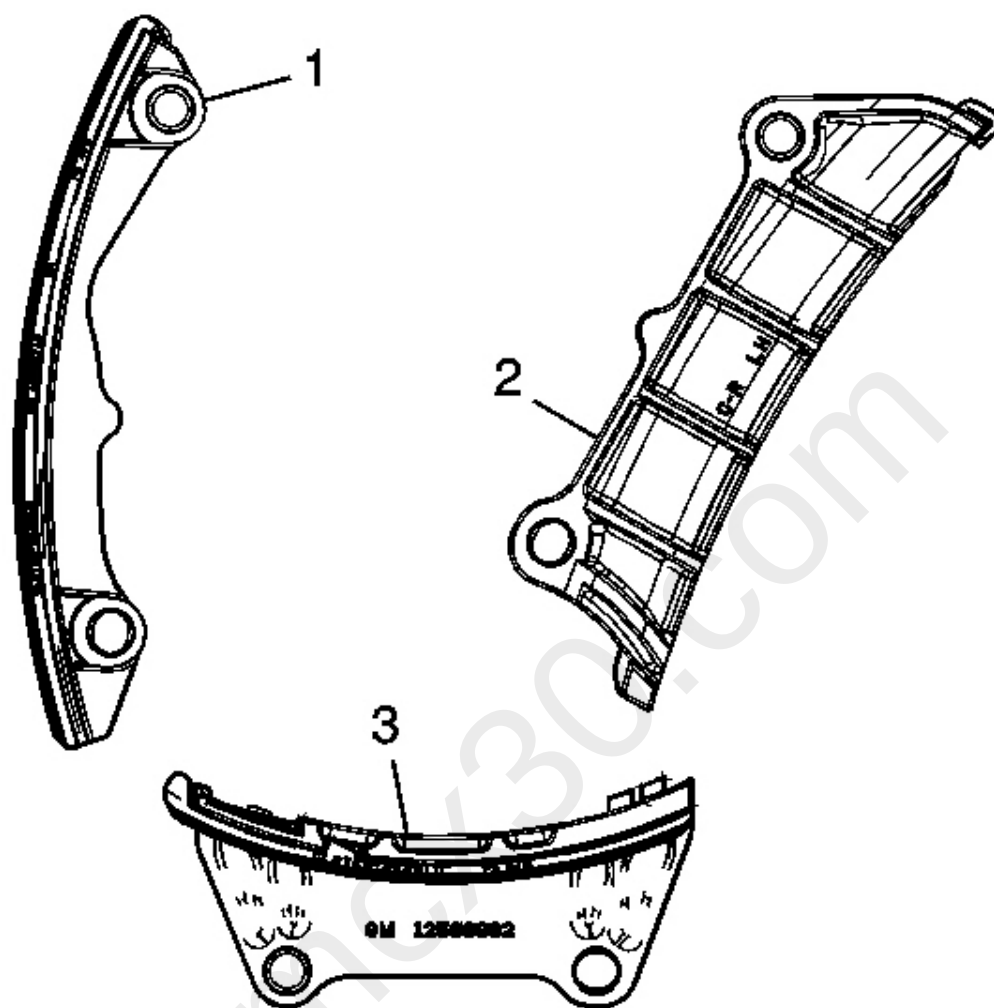


Fig. 43: View Of Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

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

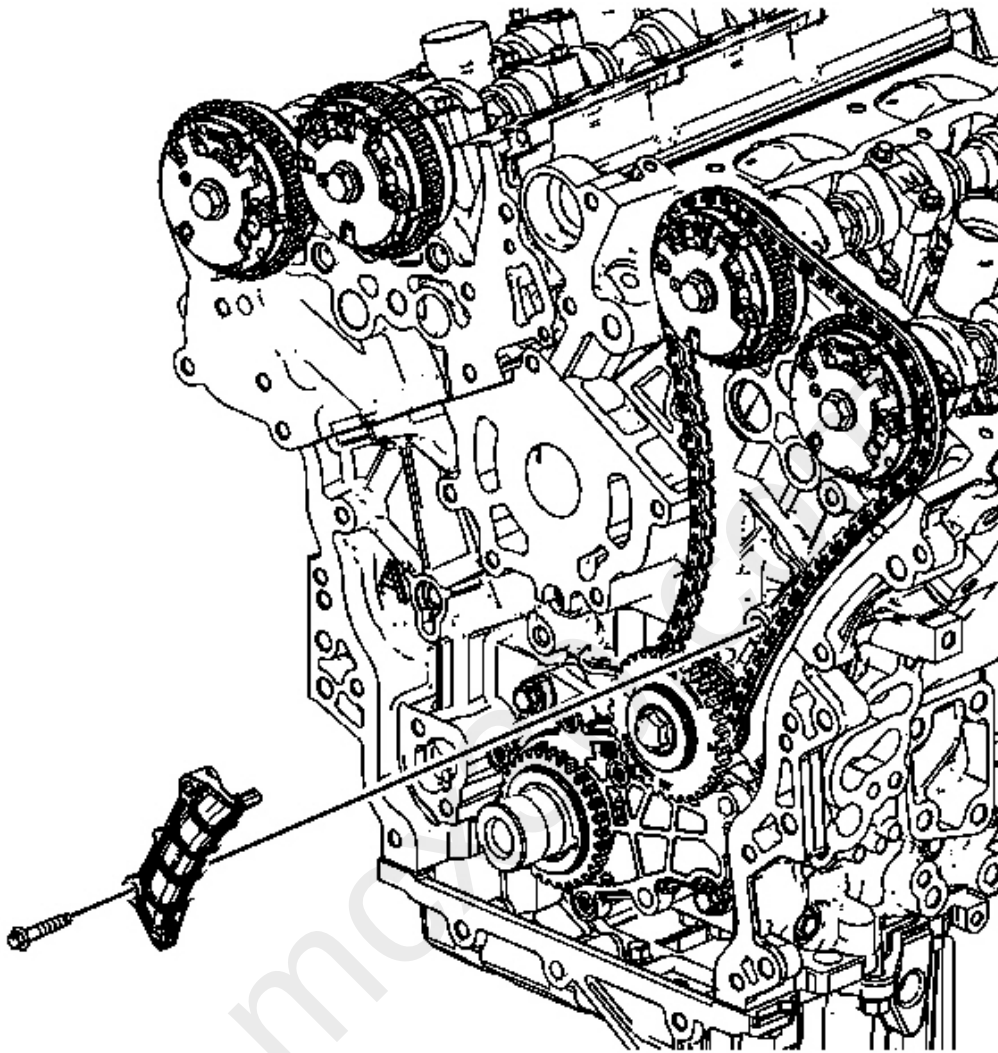


Fig. 44: View Of Secondary Camshaft Drive Chain Guide Bolt
Courtesy of GENERAL MOTORS CORP.

2. Position the left secondary camshaft drive chain guide.

CAUTION: Refer to Fastener Caution .

3. Install the secondary camshaft drive chain guide bolts and tighten to 25 N.m (18 lb ft).

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - LEFT SIDE

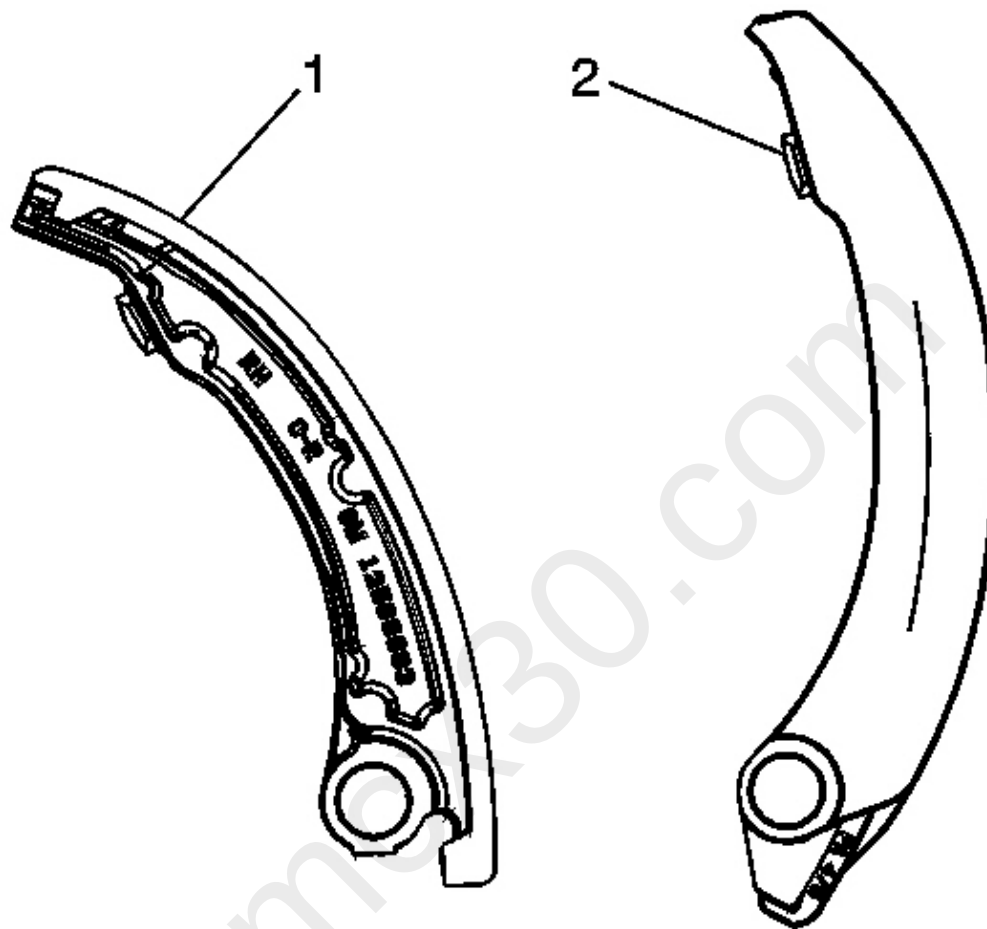


Fig. 45: Identifying Correct Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

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

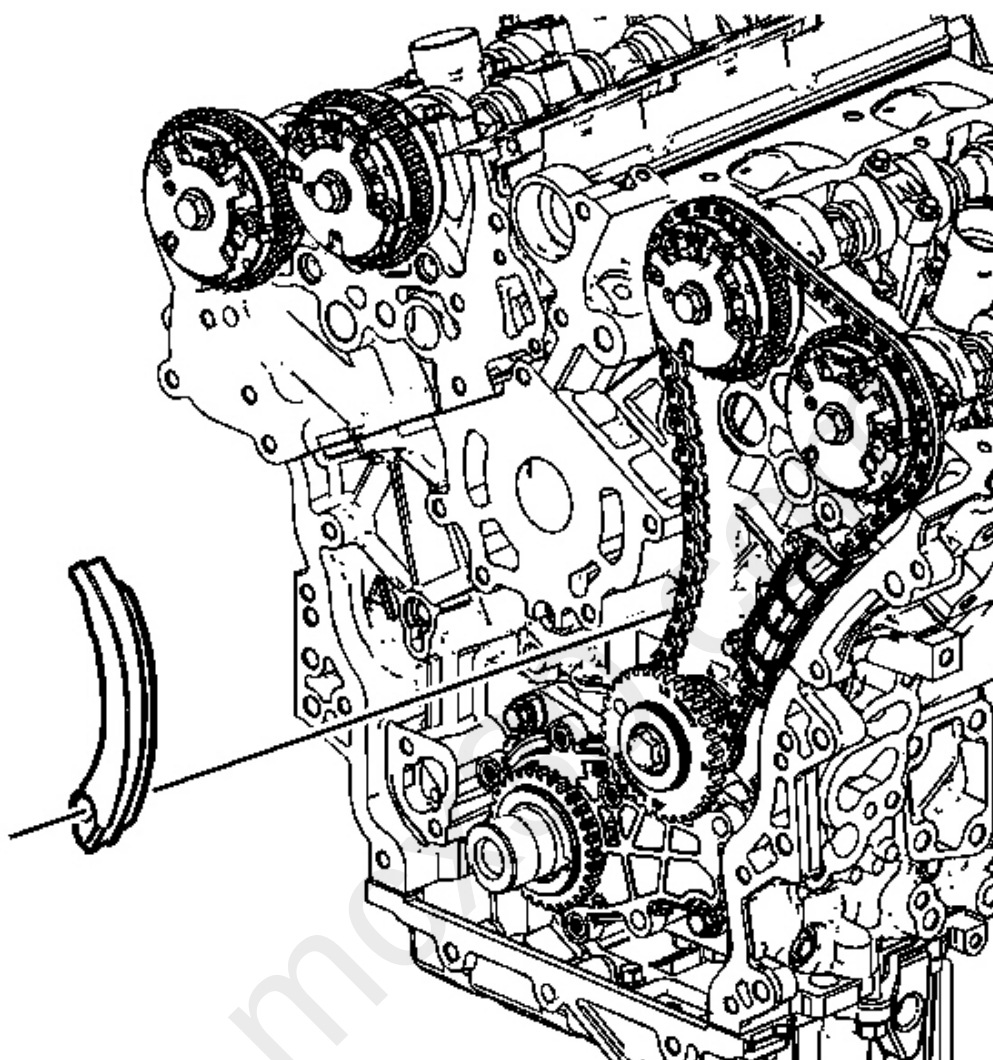


Fig. 46: View Of Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Position the left secondary camshaft drive chain shoe.

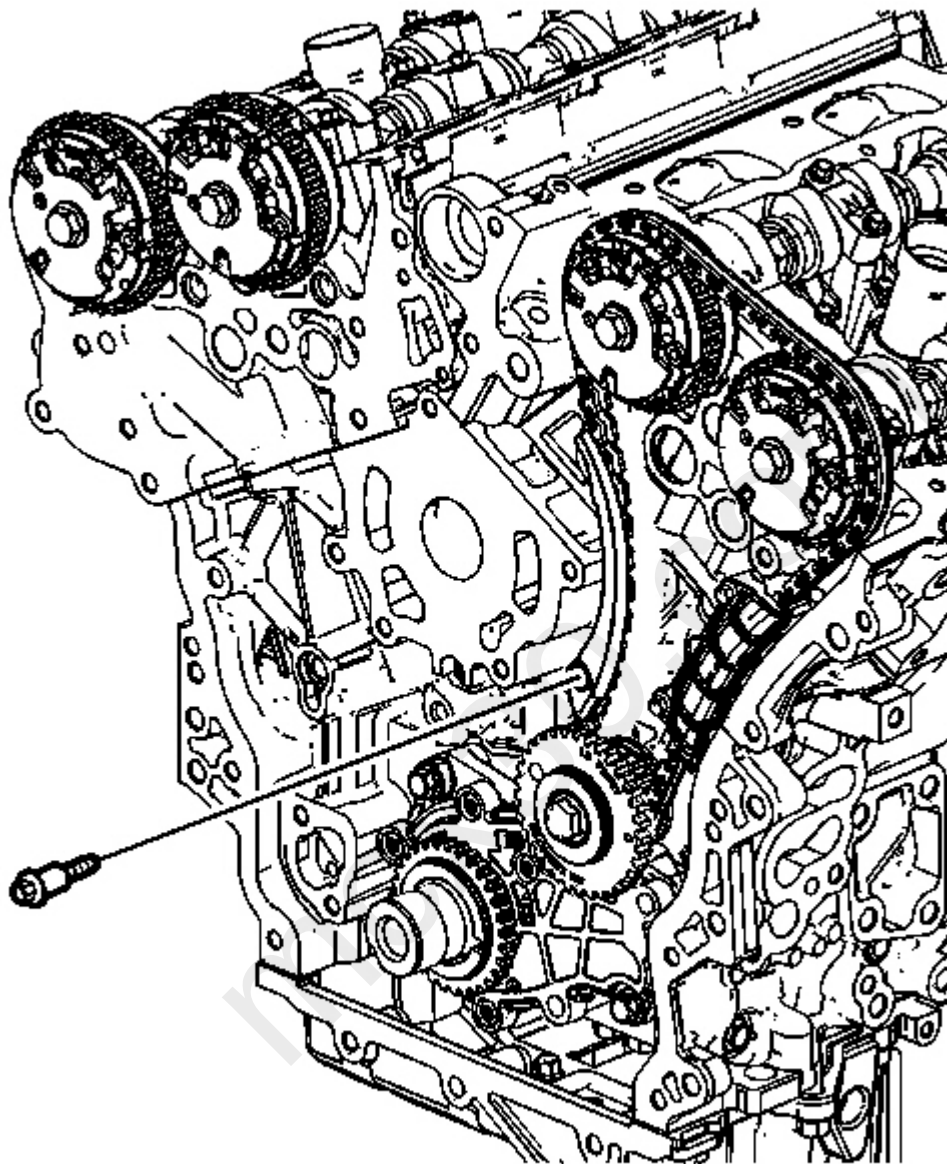


Fig. 47: View Of Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the secondary camshaft drive chain shoe bolt and tighten to 25 N.m (18 lb ft).

SECONDARY TIMING CHAIN TENSIONER INSTALLATION - LEFT SIDE

Special Tools

- EN 45027: Tensioner Tool
- EN 46112: Tensioner Retraction Pins

For equivalent regional tools, refer to Special Tools .

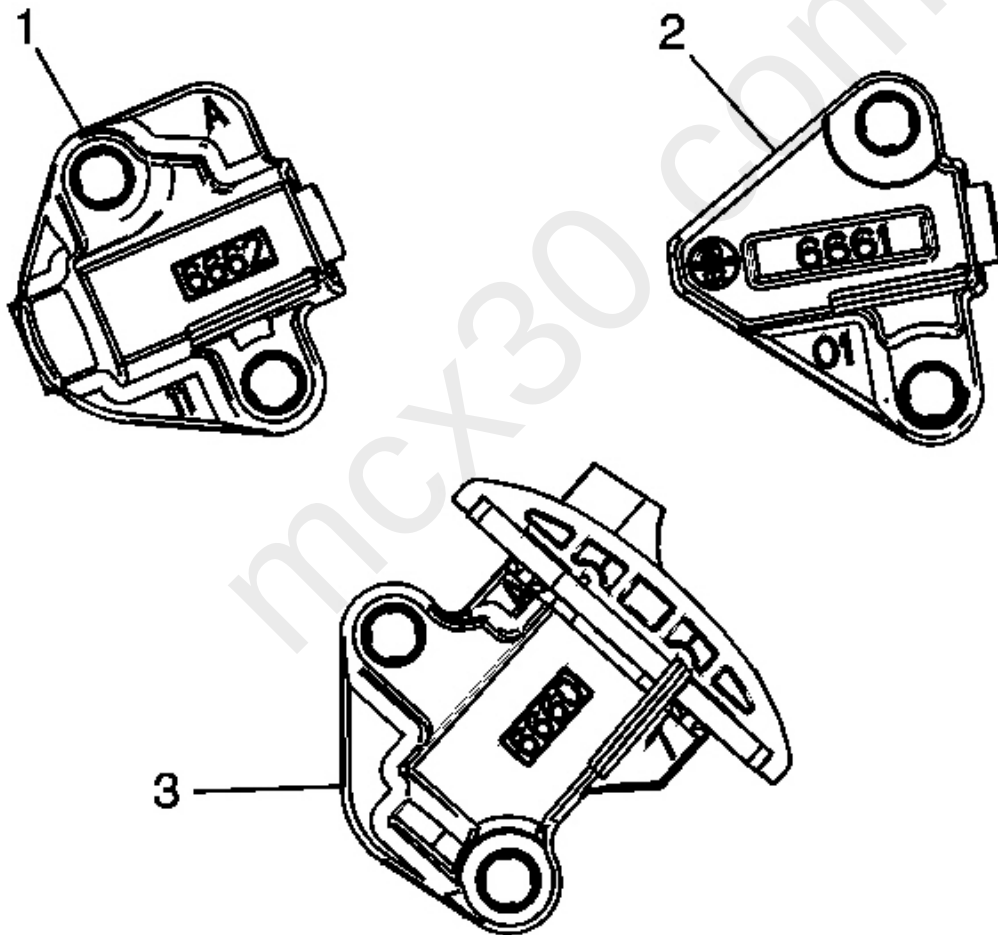


Fig. 48: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner

Courtesy of GENERAL MOTORS CORP.

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

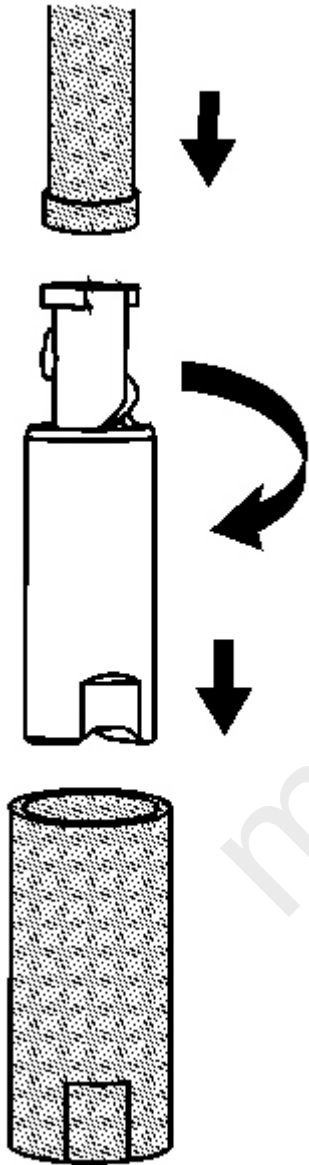


Fig. 49: Resetting Left Secondary Camshaft Drive Chain Tensioner Plunger
Courtesy of GENERAL MOTORS CORP.

2. Using the **EN 45027:** tool, reset the left secondary camshaft drive chain tensioner plunger.

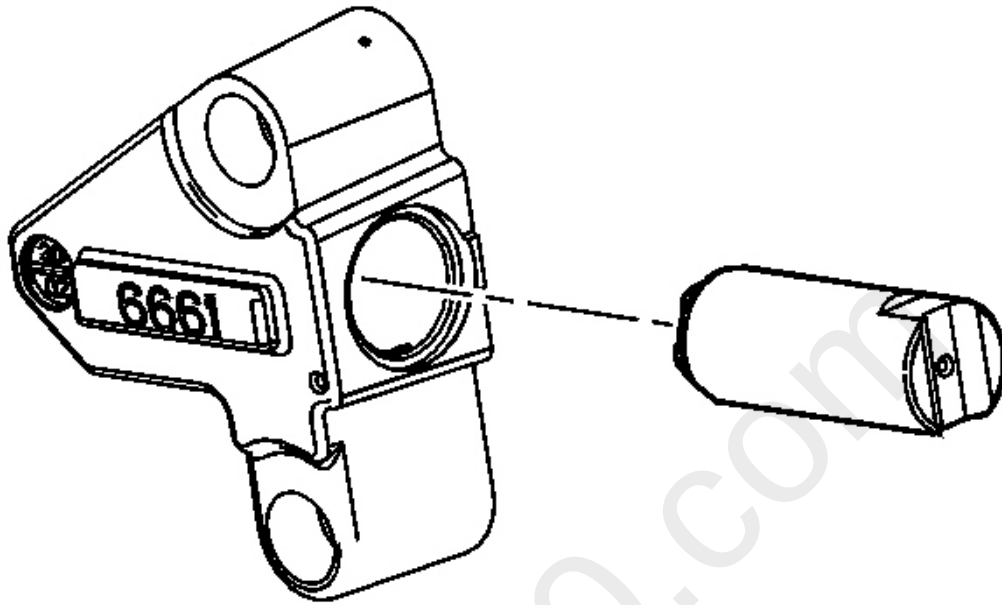


Fig. 50: Installing Plunger Into Left Secondary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

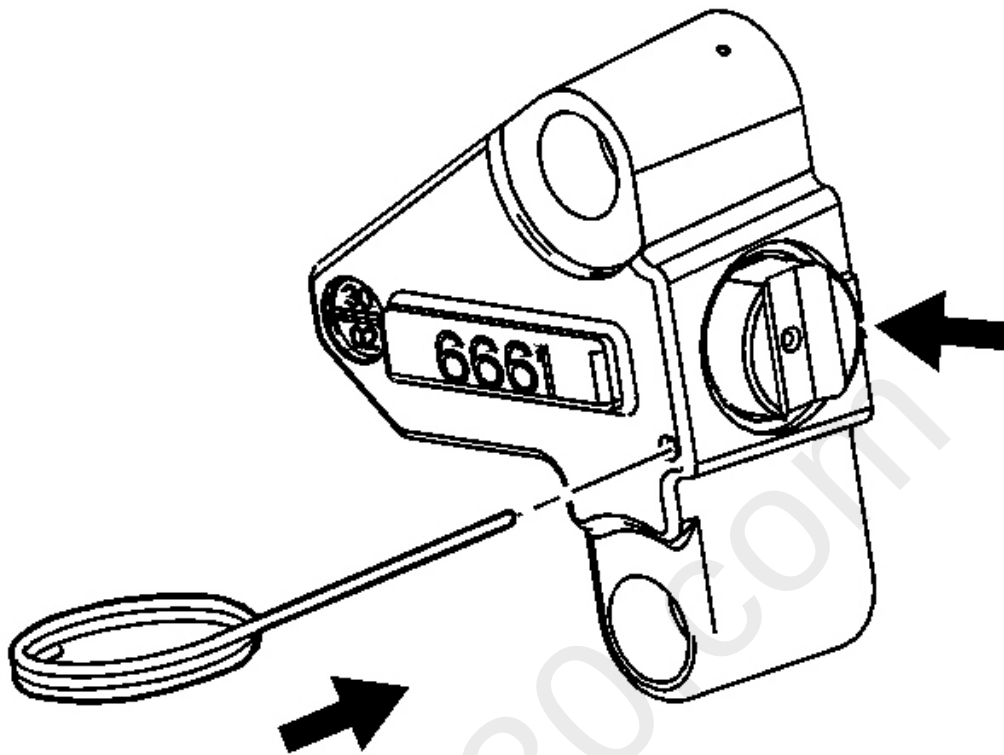


Fig. 51: Inserting EN 46112 Into Access Hole In Side Of Left Secondary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

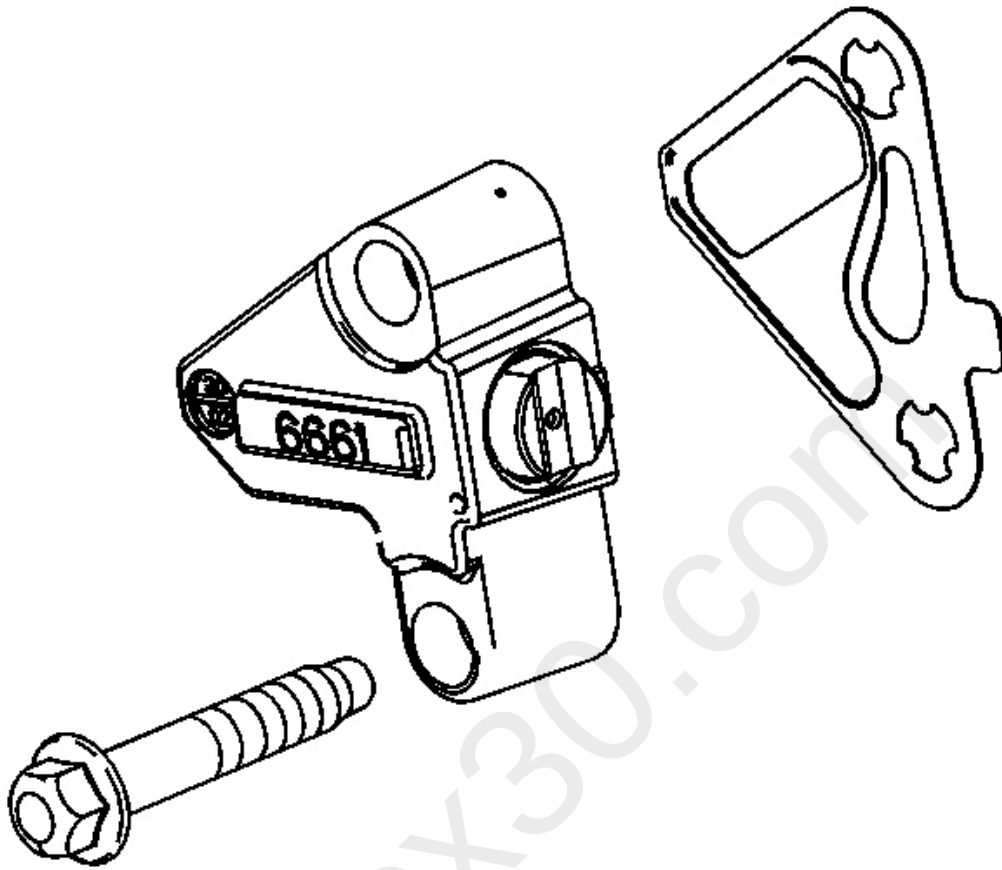


Fig. 52: View Of Left Secondary Camshaft Drive Chain Tensioner Gasket
Courtesy of GENERAL MOTORS CORP.

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.

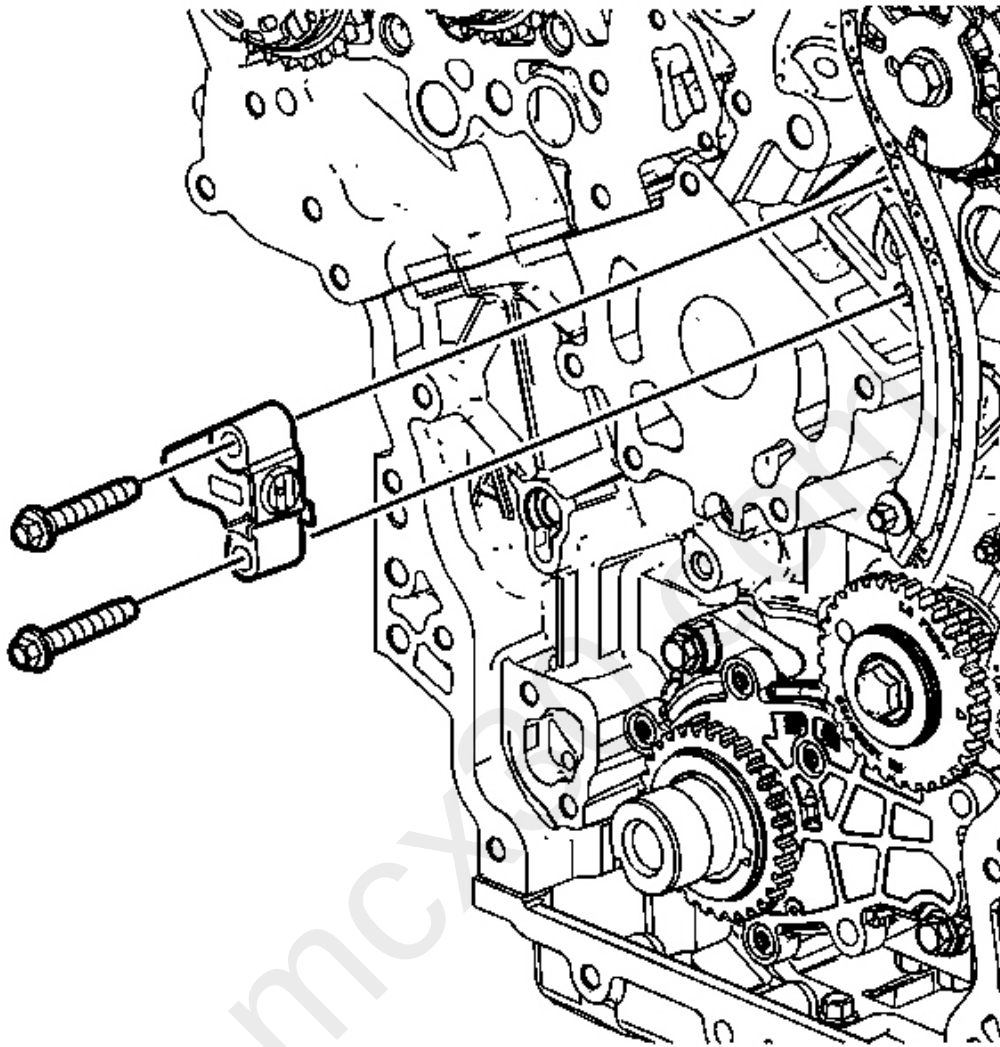


Fig. 53: View Of Secondary Camshaft Drive Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

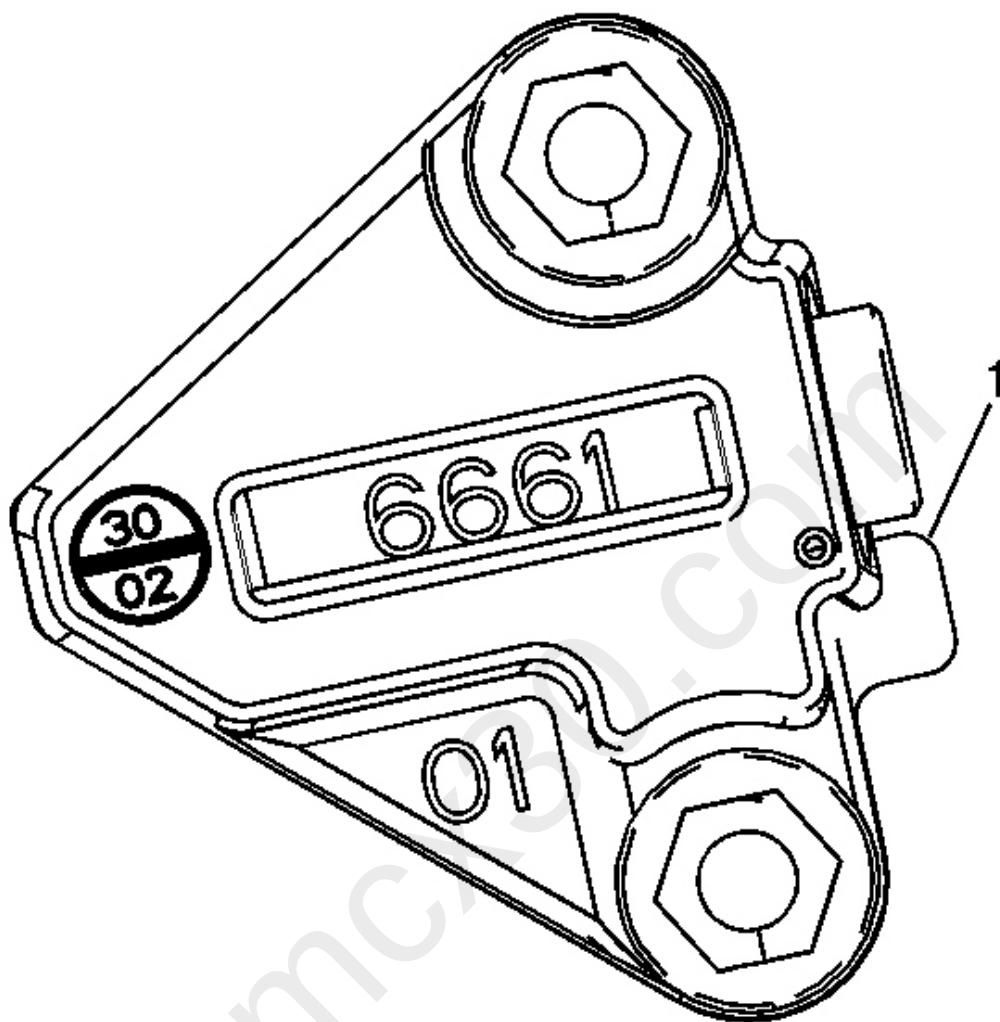


Fig. 54: Locating Left Secondary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

1. First Pass

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

2. Final Pass

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

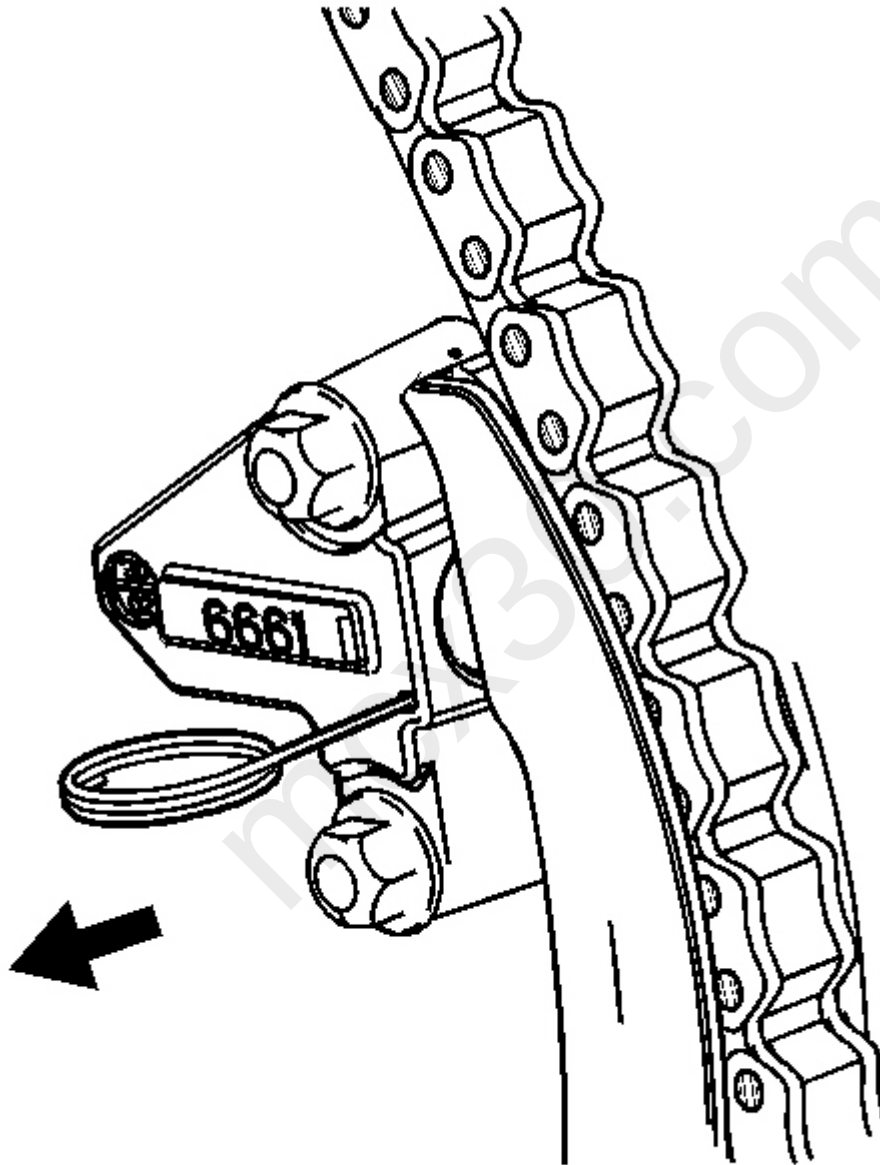


Fig. 55: View Of Left Secondary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

11. Release the left secondary camshaft drive chain tensioner by pulling out the **EN 46112**: pins and unlocking the tensioner plunger.
12. Verify the left secondary camshaft drive chain timing mark alignments by referring to **Timing Chain Alignment Diagram** - Stage One.

TIMING CHAIN IDLER SPROCKET INSTALLATION - RIGHT SIDE

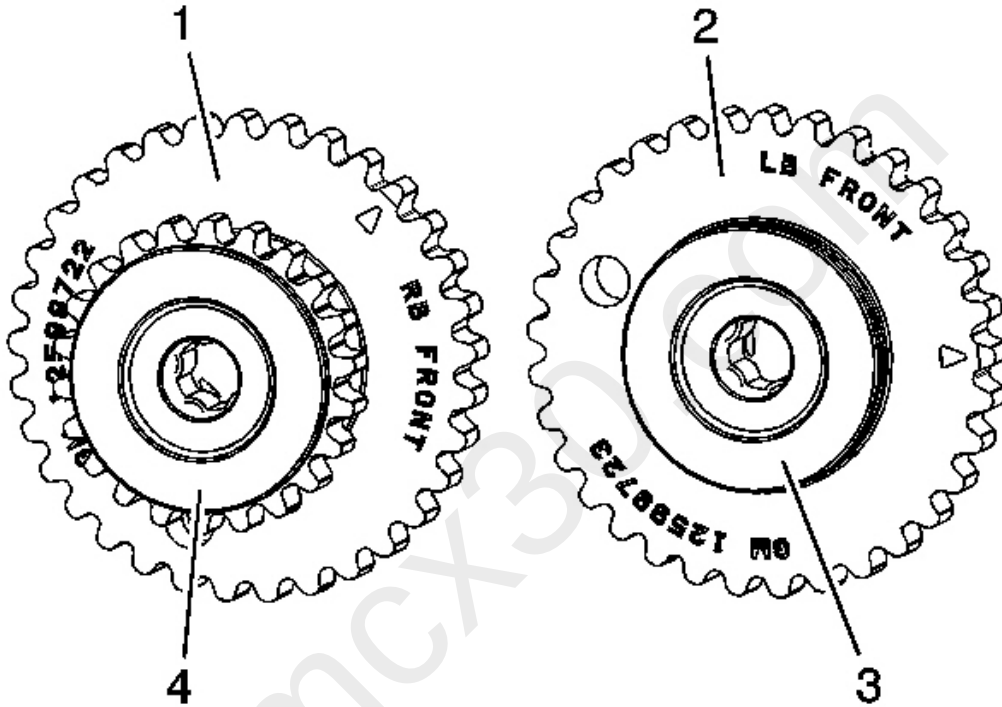


Fig. 56: View Of Camshaft Intermediate Drive Chain Idler - Left Side (Fourth Design)
Courtesy of GENERAL MOTORS CORP.

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.

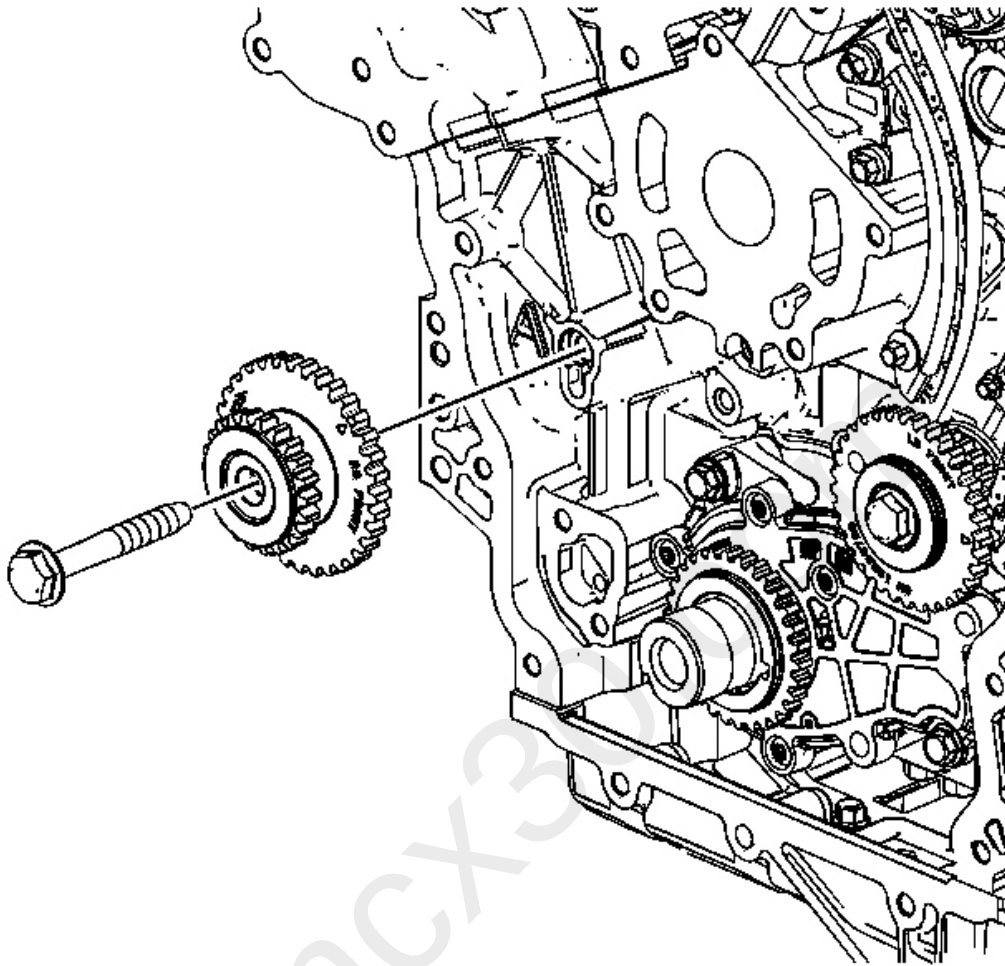


Fig. 57: View Of Right Camshaft Intermediate Drive Chain Idler & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Install the right camshaft intermediate drive chain idler.

CAUTION: Refer to Fastener Caution .

3. Install the camshaft intermediate drive chain idler bolt and tighten to 58 N.m (43 lb ft).

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION

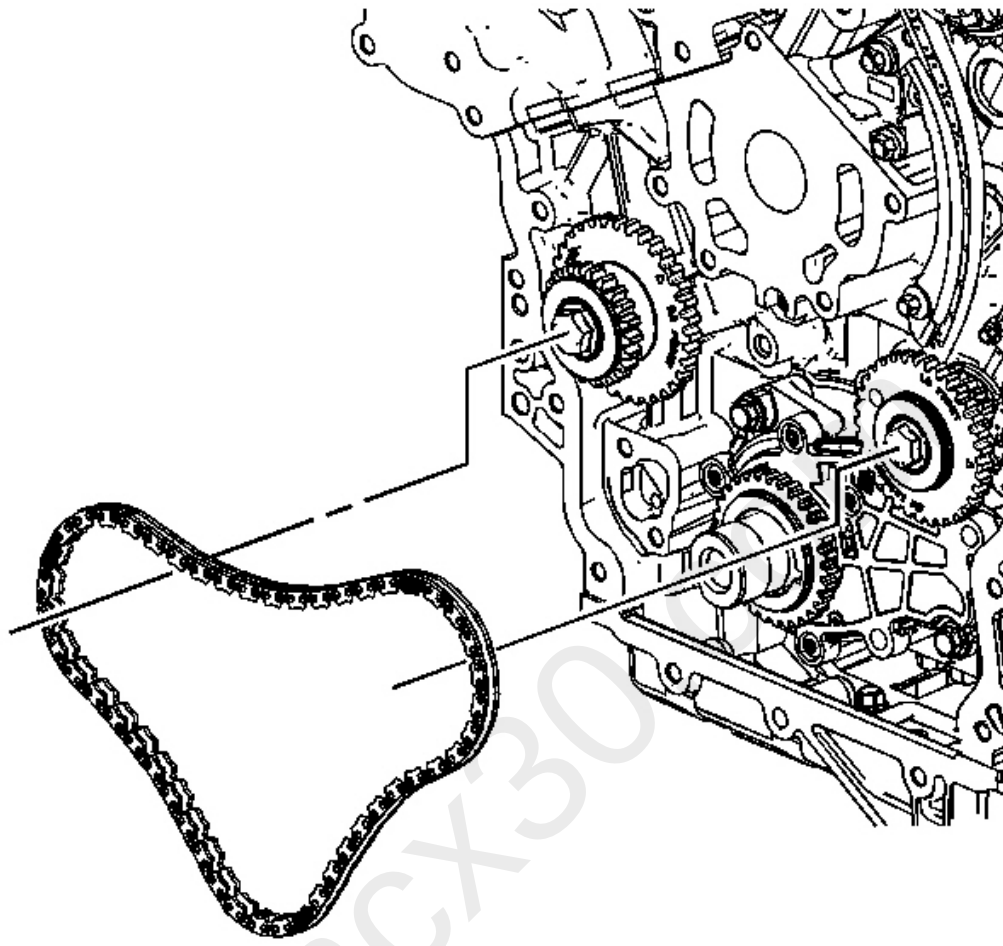


Fig. 58: View Of Primary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

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

1. Install the primary camshaft drive chain.

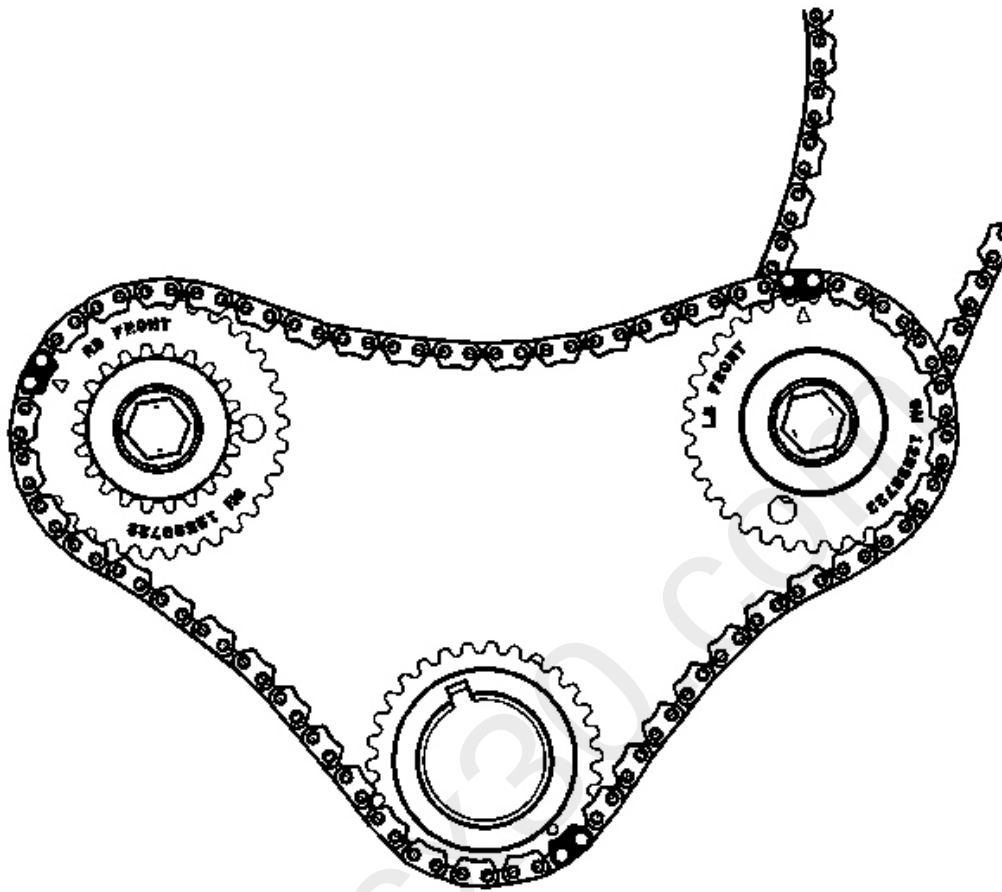


Fig. 59: View Of Primary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

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

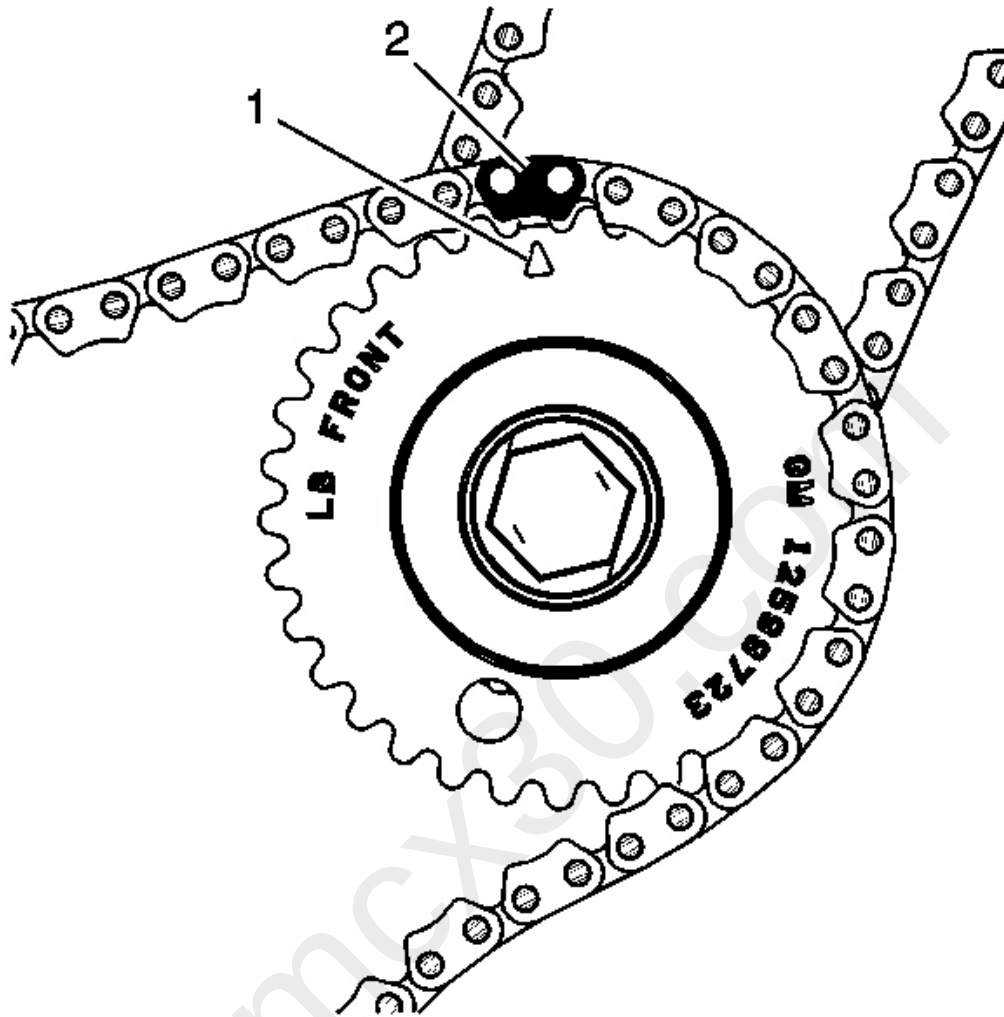


Fig. 60: View Of Camshaft Timing Marks
Courtesy of GENERAL MOTORS CORP.

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

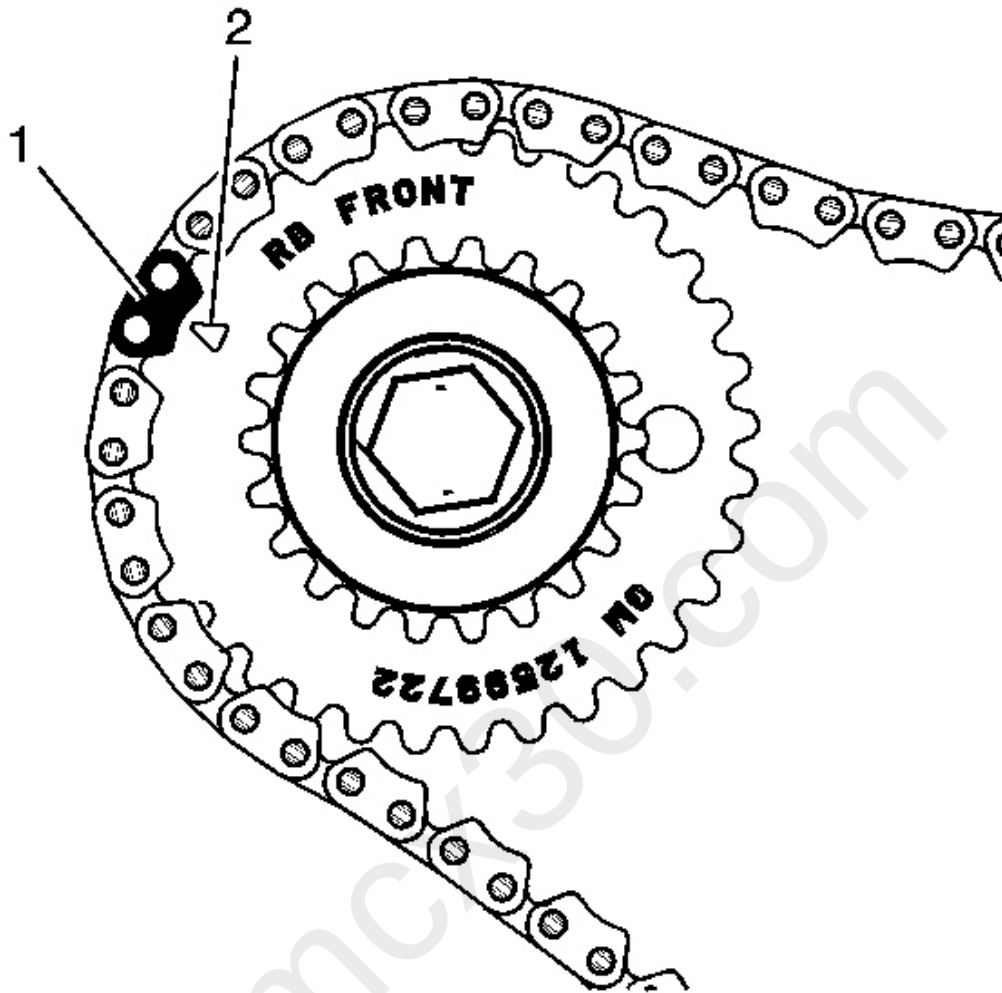


Fig. 61: View Of Right Camshaft Timing Marks
Courtesy of GENERAL MOTORS CORP.

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

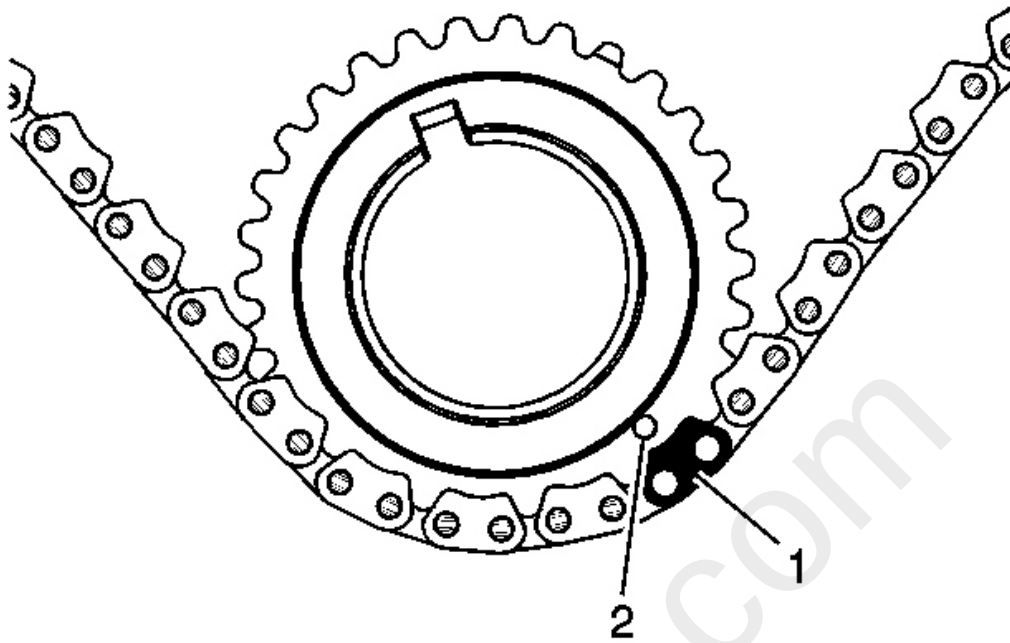


Fig. 62: View Of Crankshaft Sprocket Timing Mark & Timing Chain Link
Courtesy of GENERAL MOTORS CORP.

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

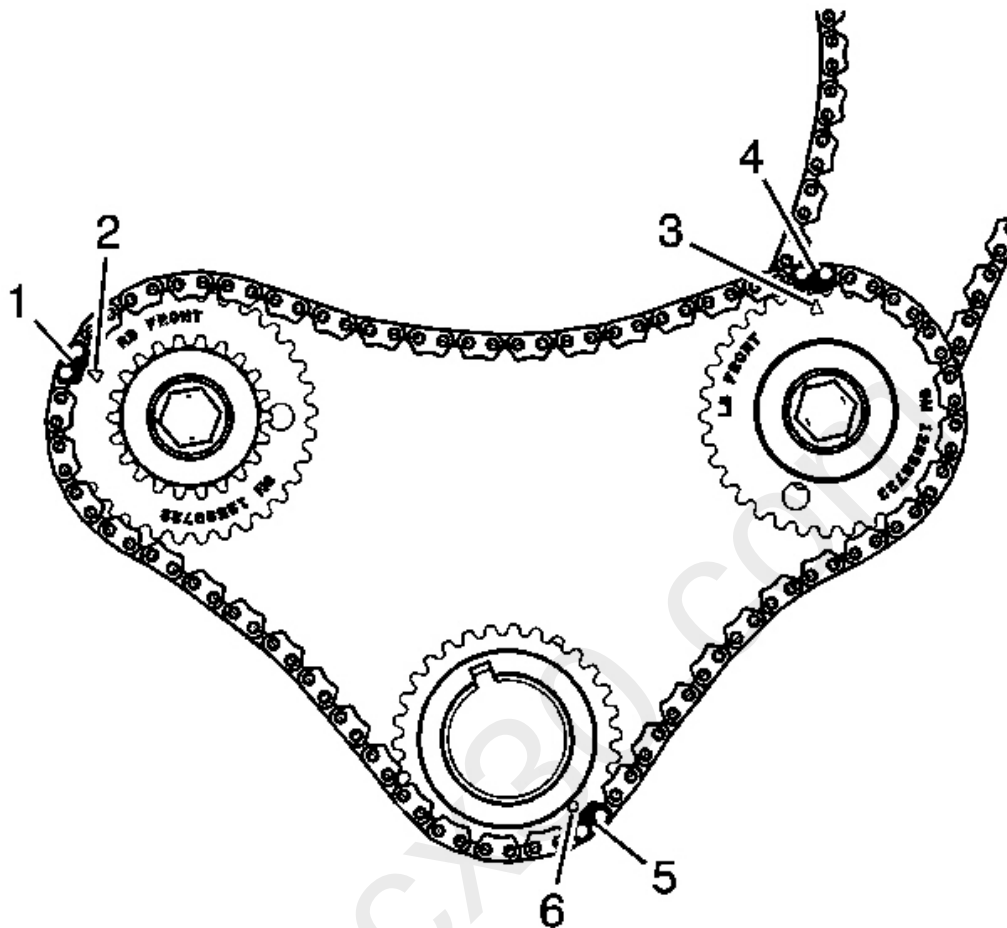


Fig. 63: Identifying Timing Marks & Drive Chain Links
Courtesy of GENERAL MOTORS CORP.

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

PRIMARY TIMING CHAIN GUIDE INSTALLATION - LOWER

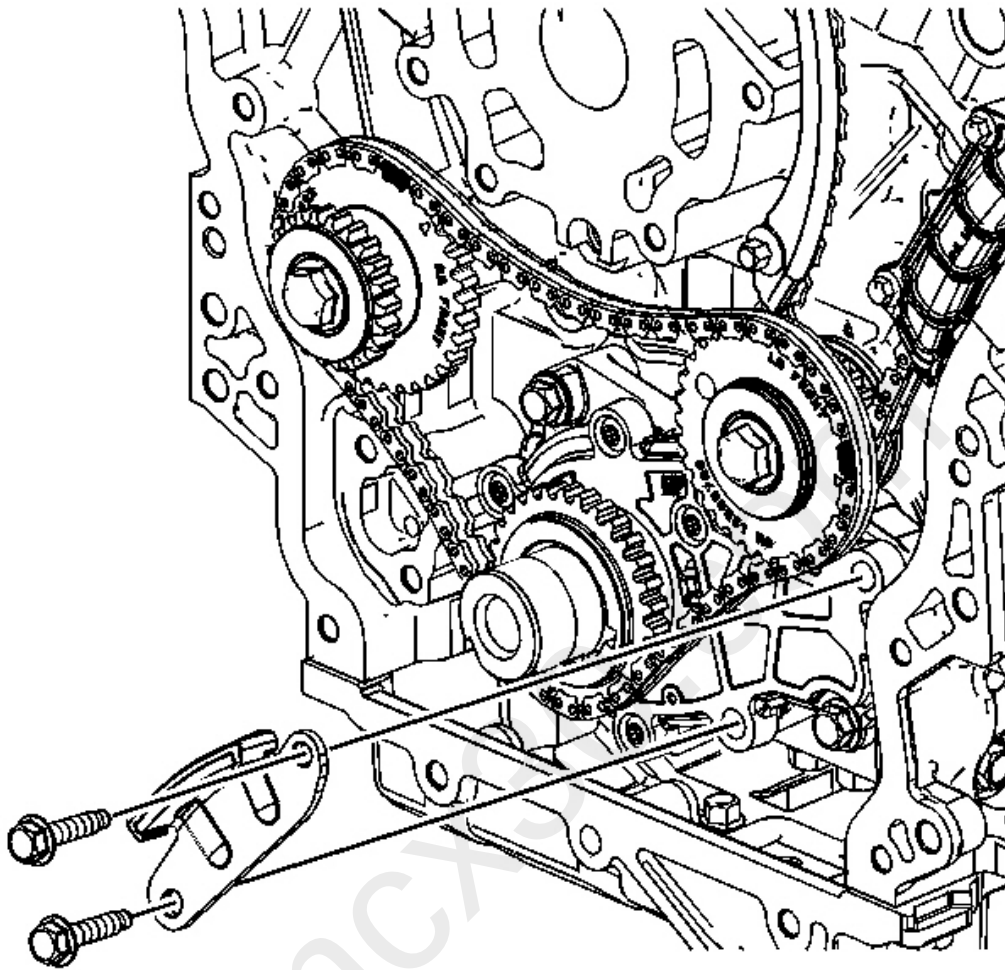


Fig. 64: View Of Primary Camshaft Drive Chain Lower Guide Bolts
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

2. Install the primary camshaft drive chain lower guide bolts and tighten to 25 N.m (18 lb ft).

PRIMARY TIMING CHAIN GUIDE INSTALLATION - UPPER

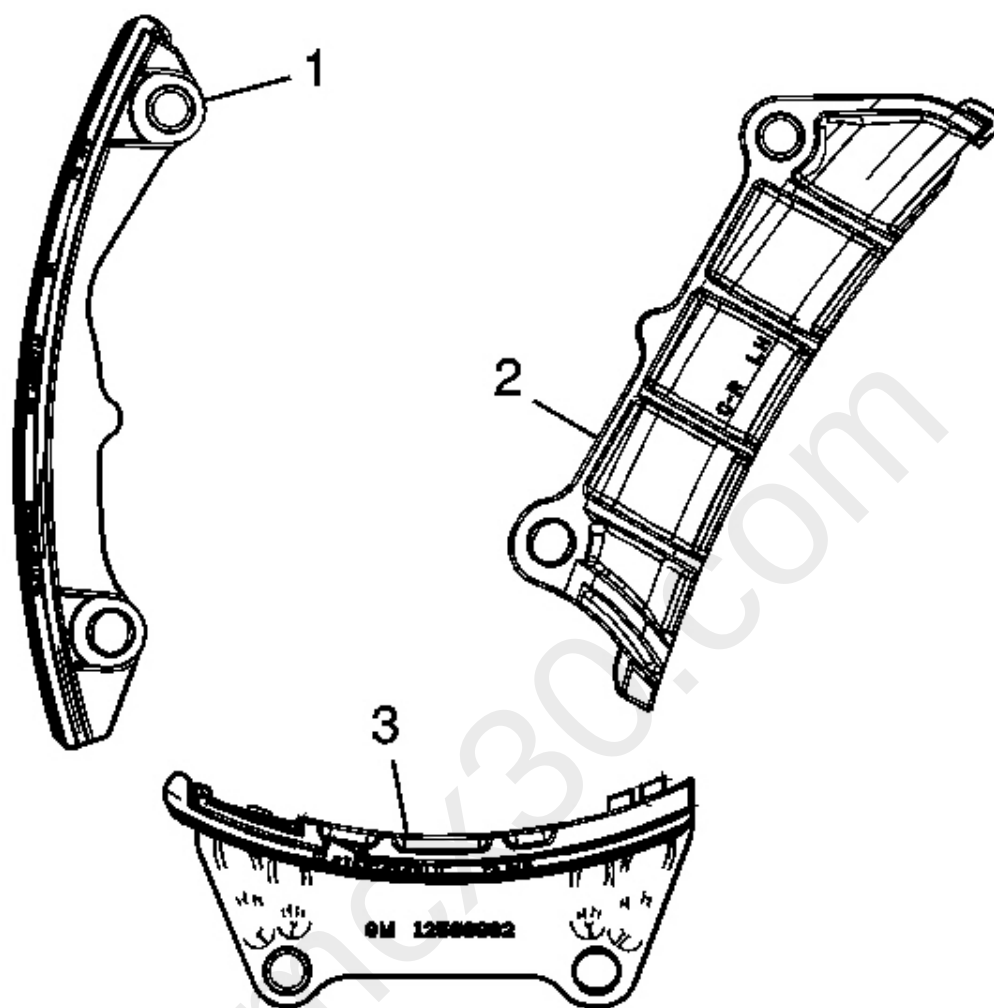


Fig. 65: View Of Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

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

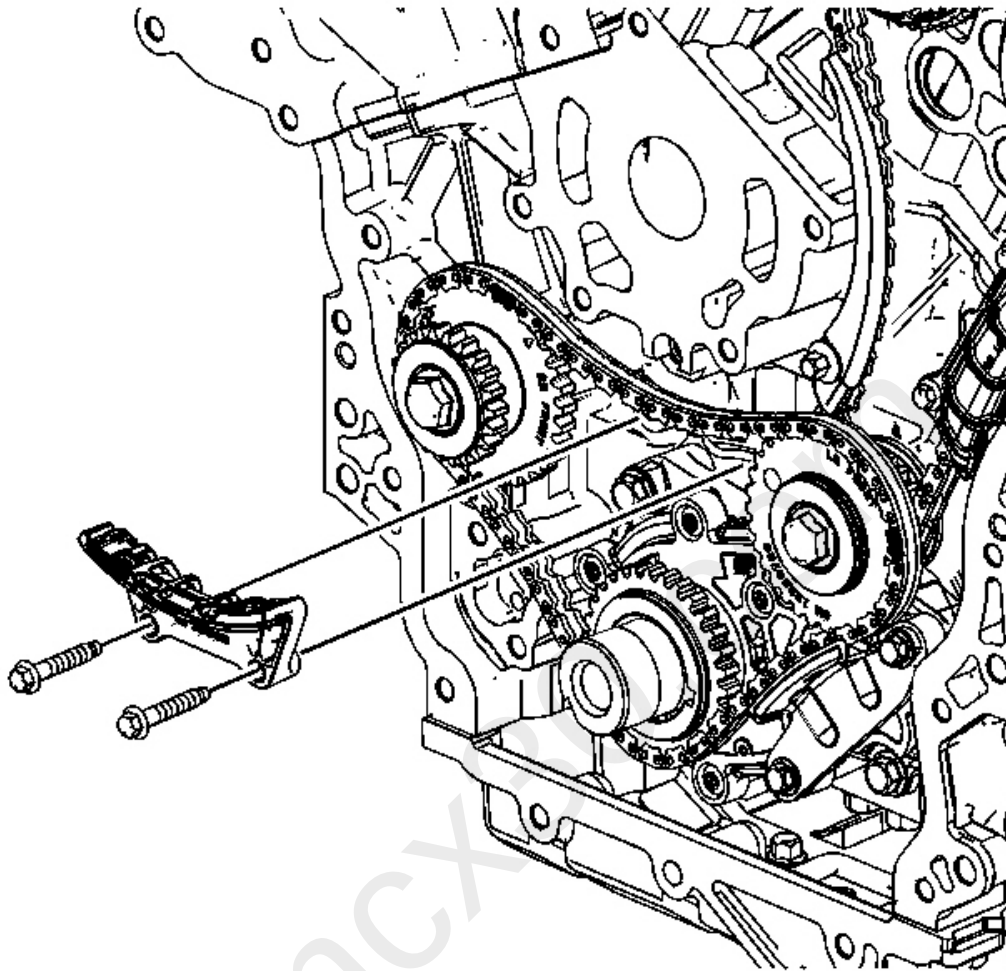


Fig. 66: View Of Primary Camshaft Drive Chain Upper Guide & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the upper primary camshaft drive chain guides.

CAUTION: Refer to Fastener Caution .

3. Install the upper primary camshaft drive chain guide bolts and tighten to 25 N.m (18 lb ft).

PRIMARY CAMSHAFT INTERMEDIATE DRIVE CHAIN TENSIONER INSTALLATION

Special Tools

- **EN-45027:** Tensioner Tool
- **EN-46112:** Tensioner Retraction Pins
- **EN-48383:** Camshaft Retaining Tools
- **EN-48589:** Crankshaft Rotation Socket

For equivalent regional tools, refer to **Special Tools** .

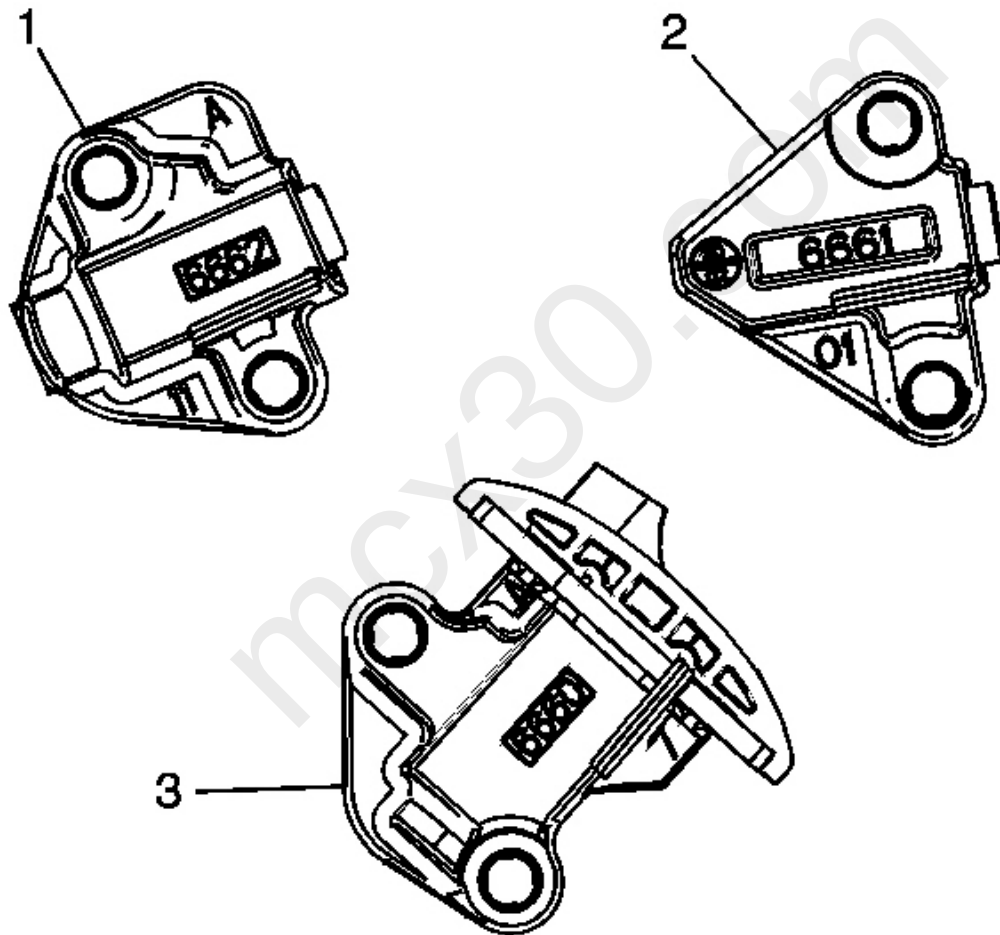


Fig. 67: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

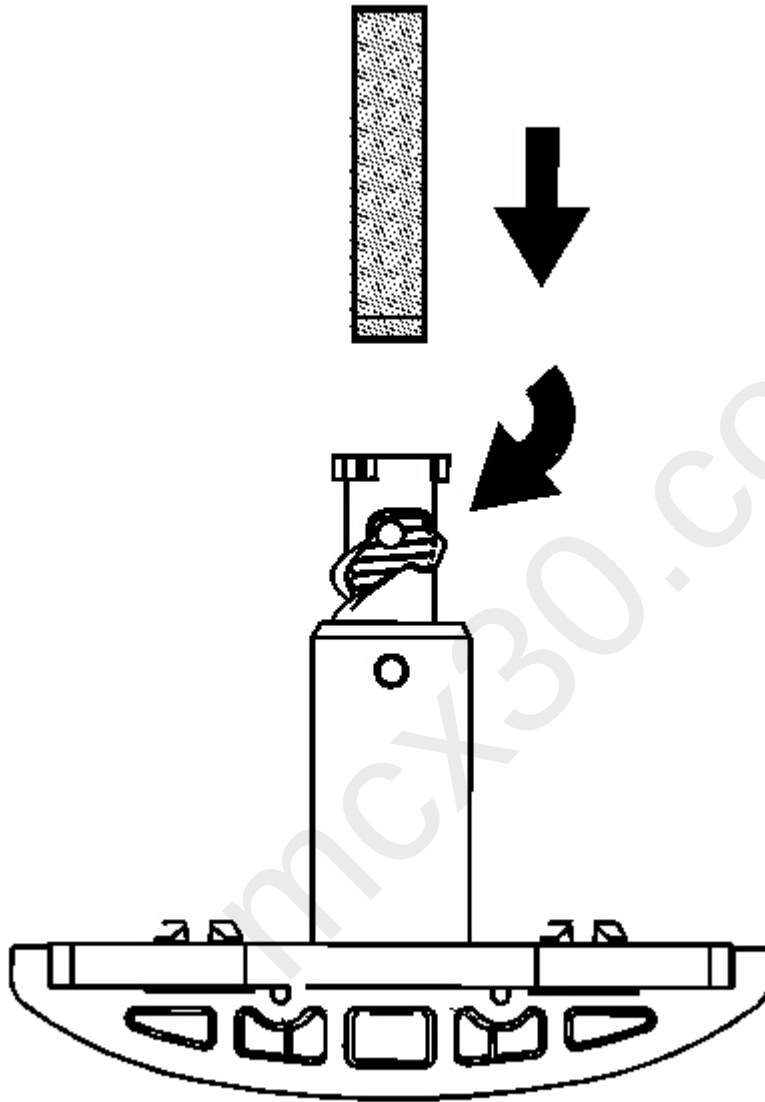


Fig. 68: View Of Primary Camshaft Drive Chain Tensioner Plunger & J 45027
Courtesy of GENERAL MOTORS CORP.

2. Using the **EN-45027**: tool, reset the primary camshaft drive chain tensioner plunger.

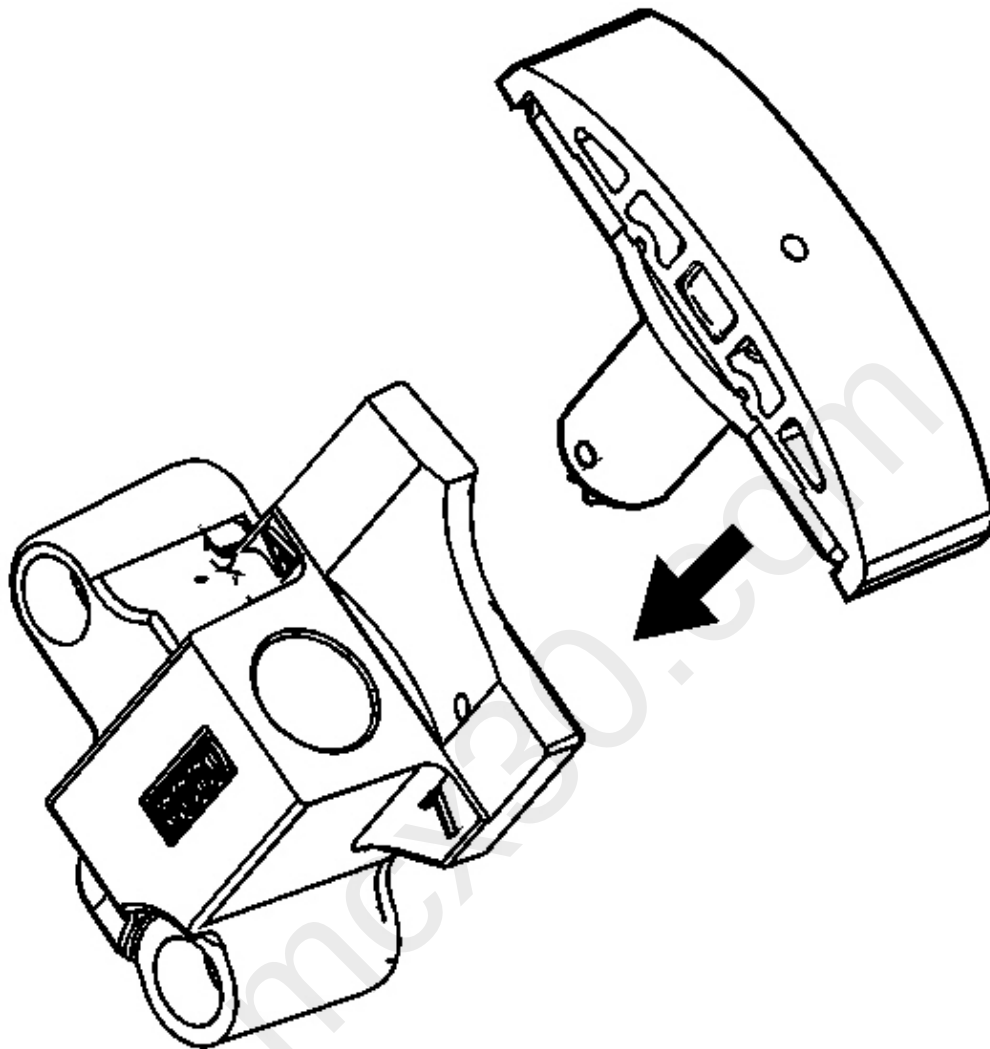


Fig. 69: Installing Plunger Into Primary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

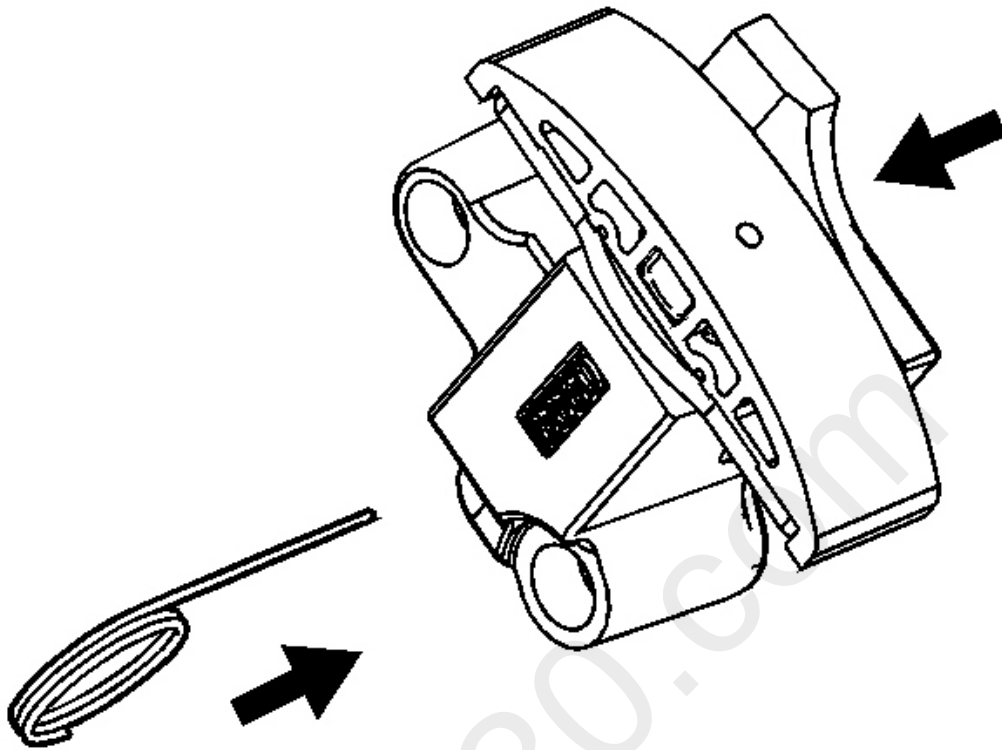


Fig. 70: Inserting EN 46112 Into Primary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

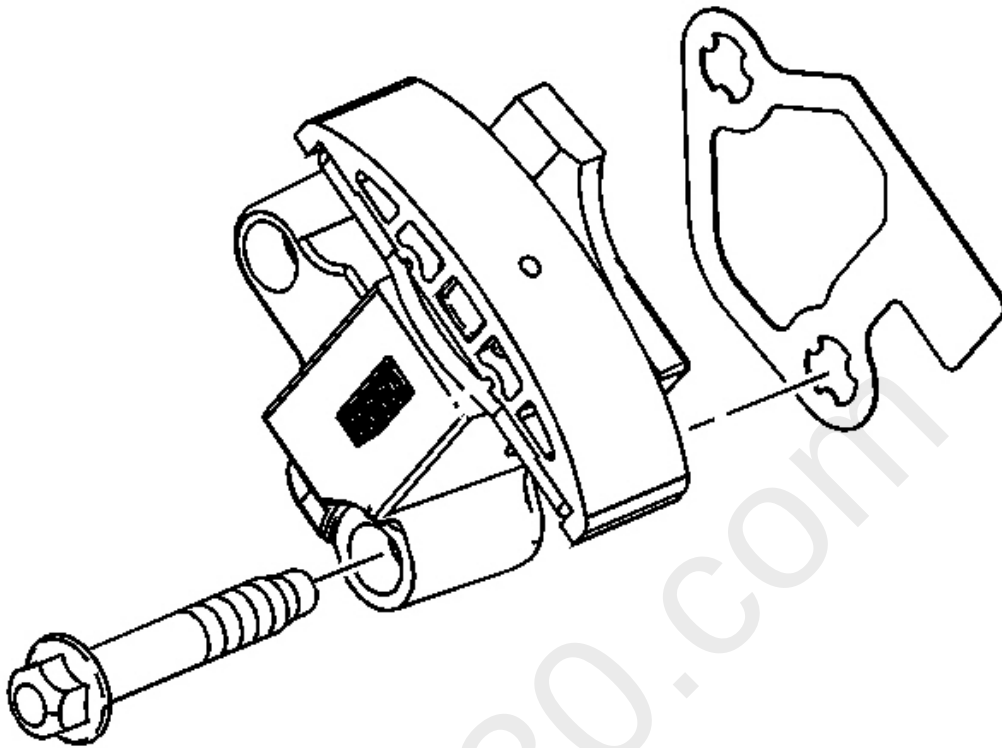


Fig. 71: View Of Primary Camshaft Drive Chain Tensioner Gasket
Courtesy of GENERAL MOTORS CORP.

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.

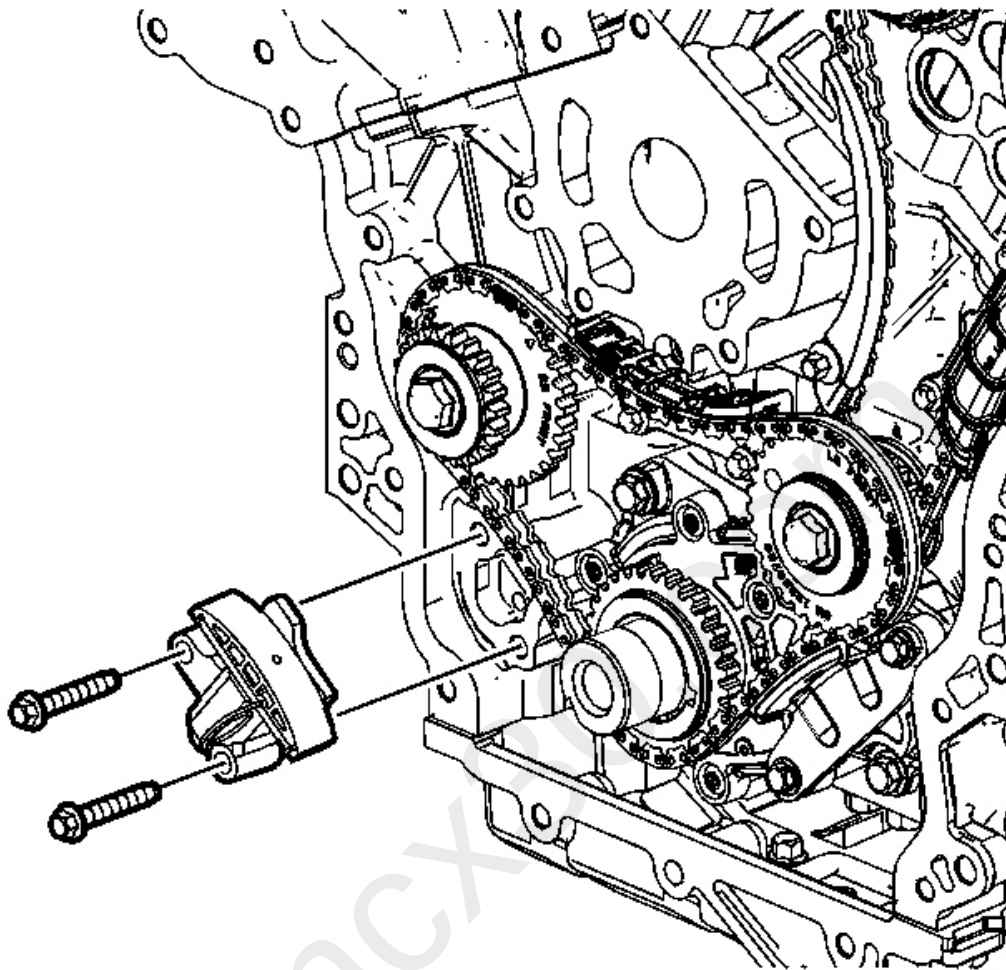


Fig. 72: View Of Primary Camshaft Drive Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

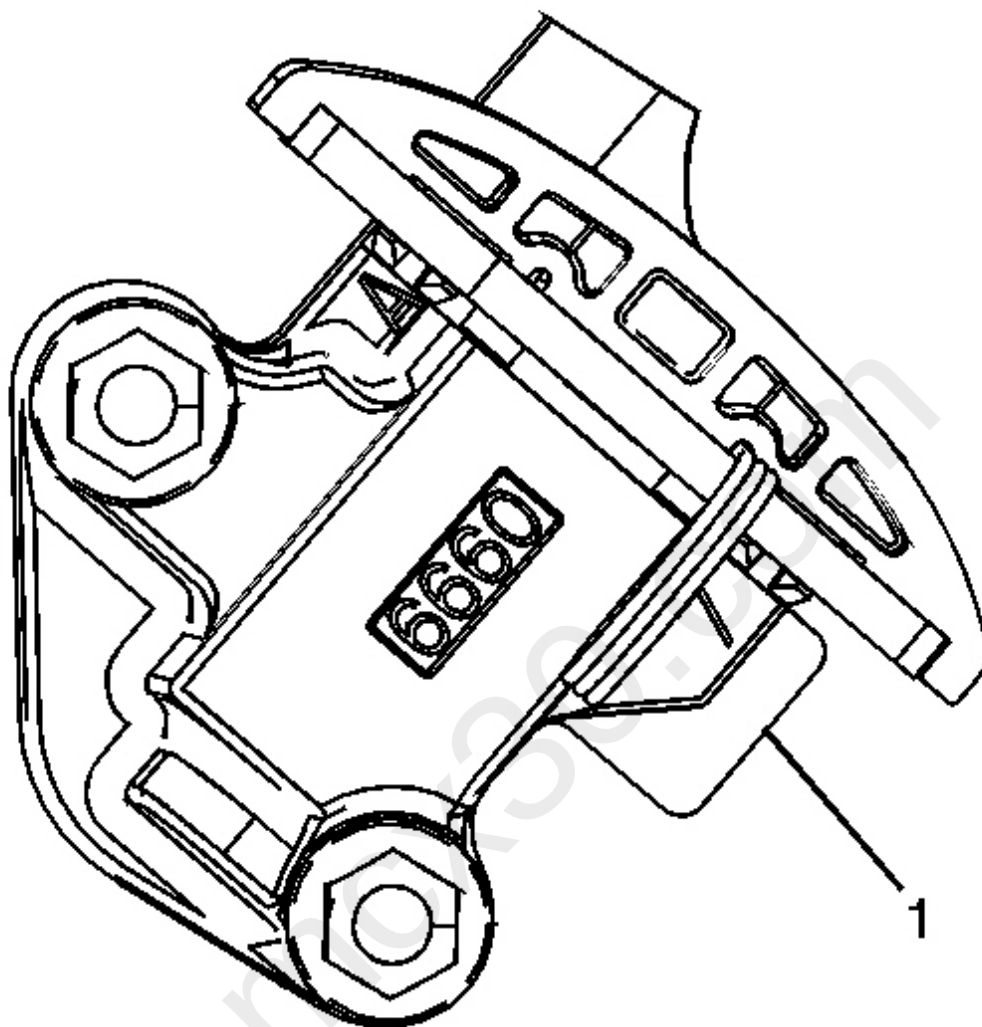


Fig. 73: Locating Primary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

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

2. Final Pass

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

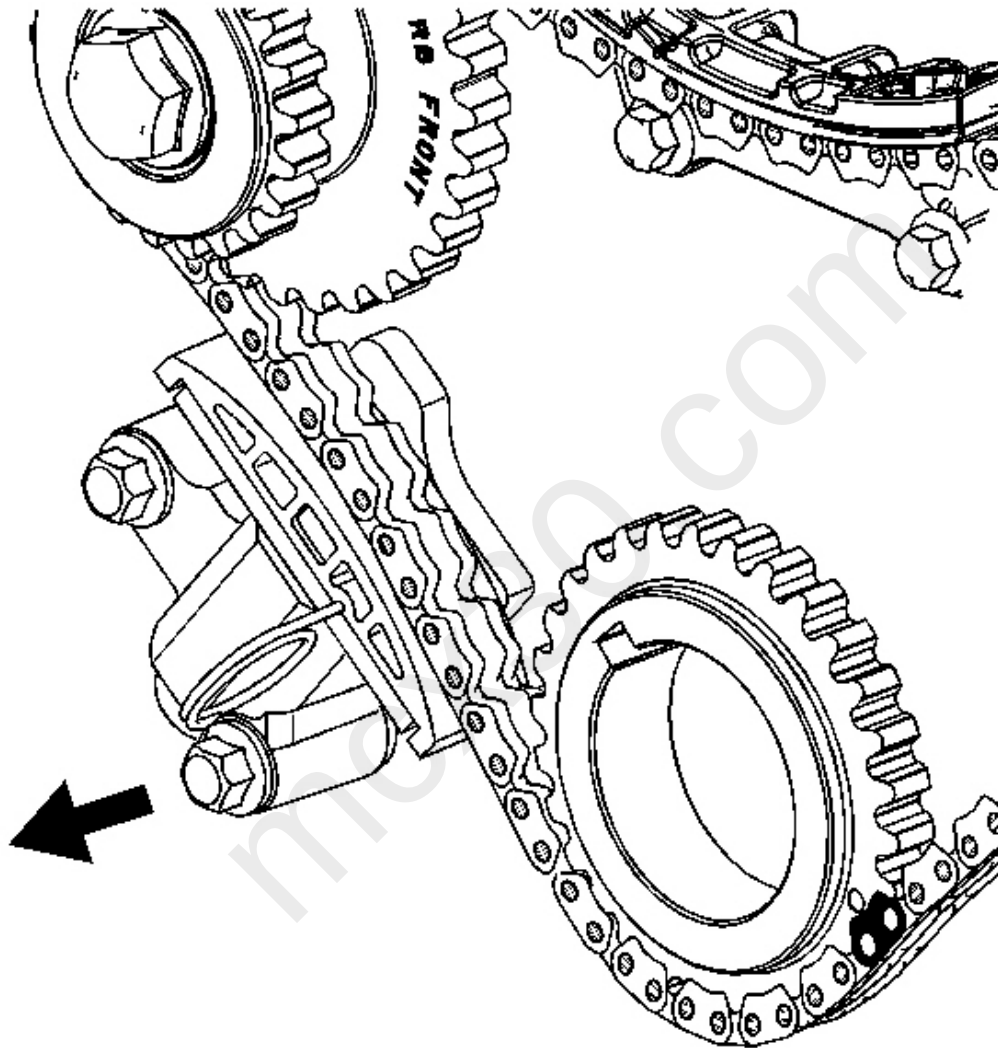


Fig. 74: View Of Primary Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

11. Release the primary camshaft drive chain tensioner by pulling out the **EN-46112** pins and unlocking the tensioner plunger.
12. Verify the primary and left secondary camshaft drive chain timing mark alignments. Refer to **Timing**

Chain Alignment Diagram - Stage One.

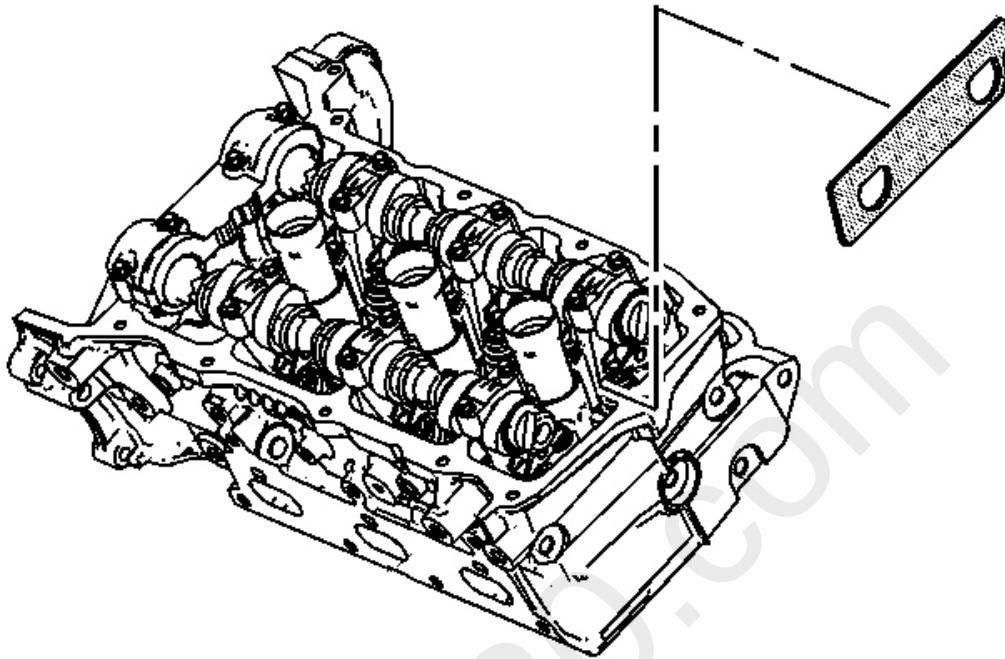


Fig. 75: Removing Special Tool
Courtesy of GENERAL MOTORS CORP.

13. Remove the EN 48383-1 from the rear of the left camshafts.

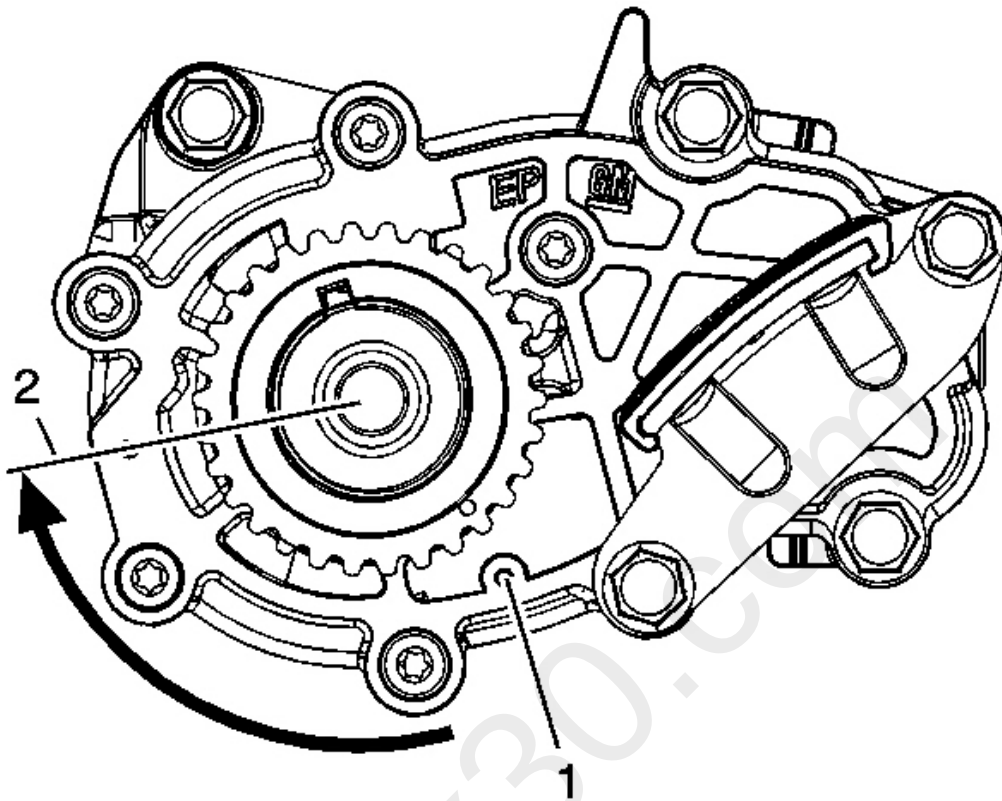


Fig. 76: View Of Stage 1 & Stage 2 Alignment Positions
Courtesy of GENERAL MOTORS CORP.

14. Using the **EN-48589:** socket, 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.

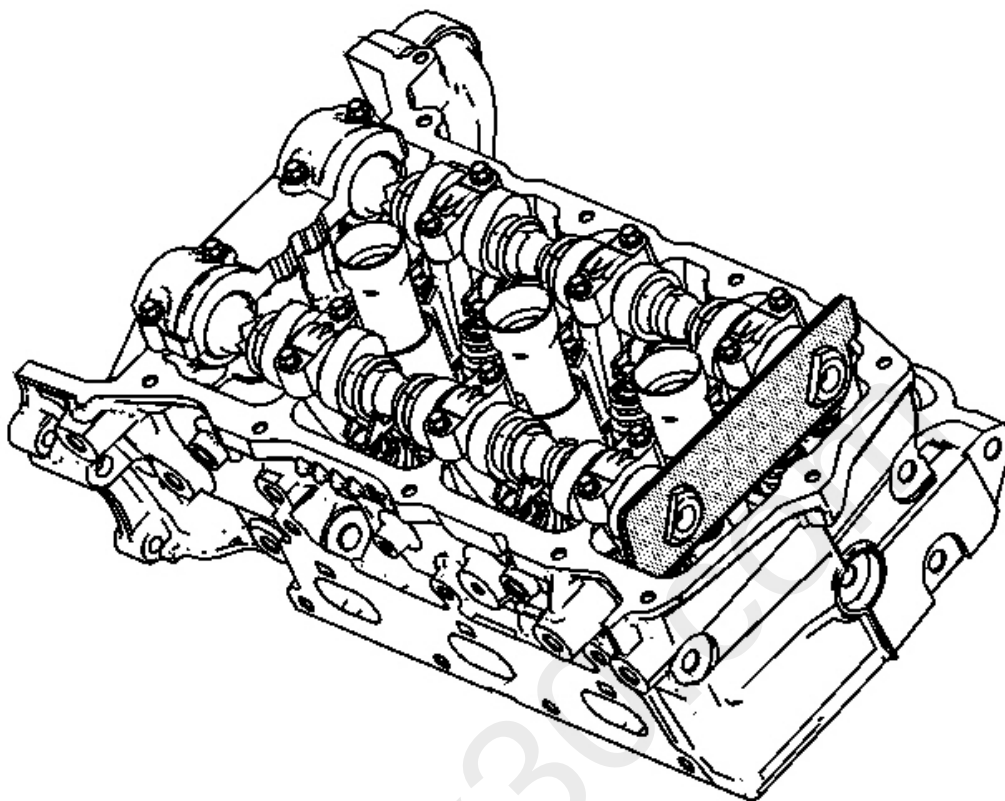


Fig. 77: EN 46105-2 Installed To Left Camshafts
Courtesy of GENERAL MOTORS CORP.

15. Install the EN 48383-2 onto the rear of the left camshafts.

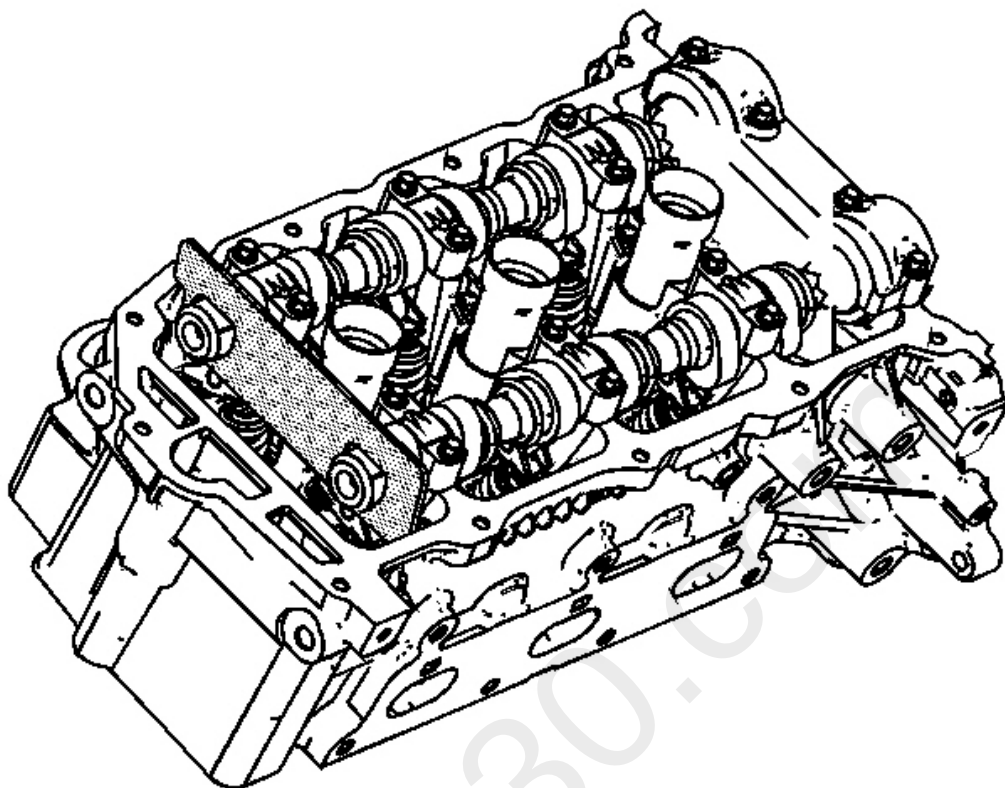


Fig. 78: EN 46105-1 Installed To Right Camshafts
Courtesy of GENERAL MOTORS CORP.

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

SECONDARY CAMSHAFT INTERMEDIATE DRIVE CHAIN INSTALLATION - RIGHT SIDE

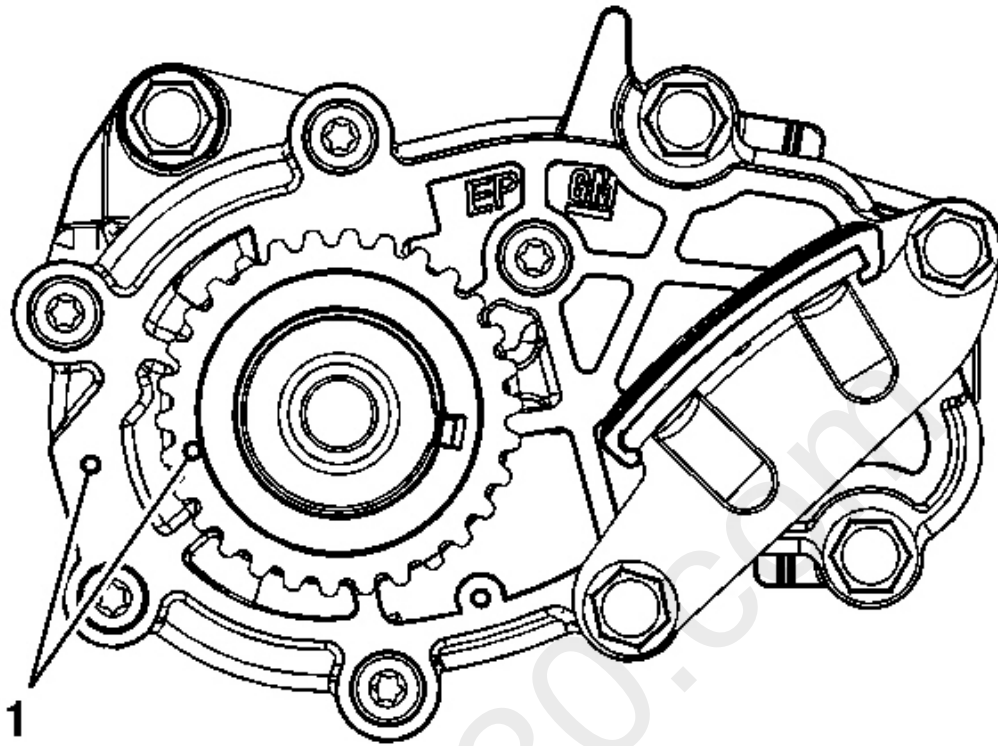


Fig. 79: View Of Crankshaft In Stage 2 Timing Drive Assembly Position
Courtesy of GENERAL MOTORS CORP.

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

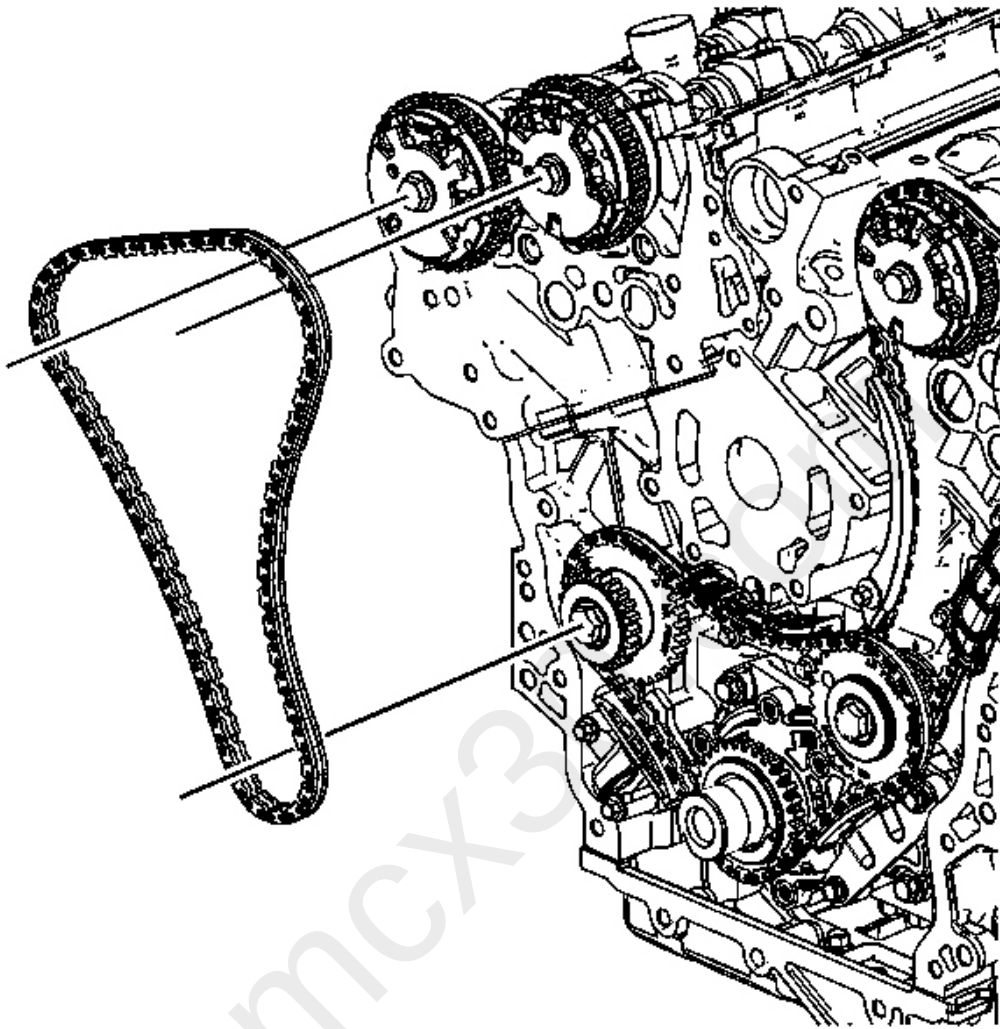


Fig. 80: View Of Secondary Camshaft Drive Chain
Courtesy of GENERAL MOTORS CORP.

2. Install the right secondary camshaft drive chain.

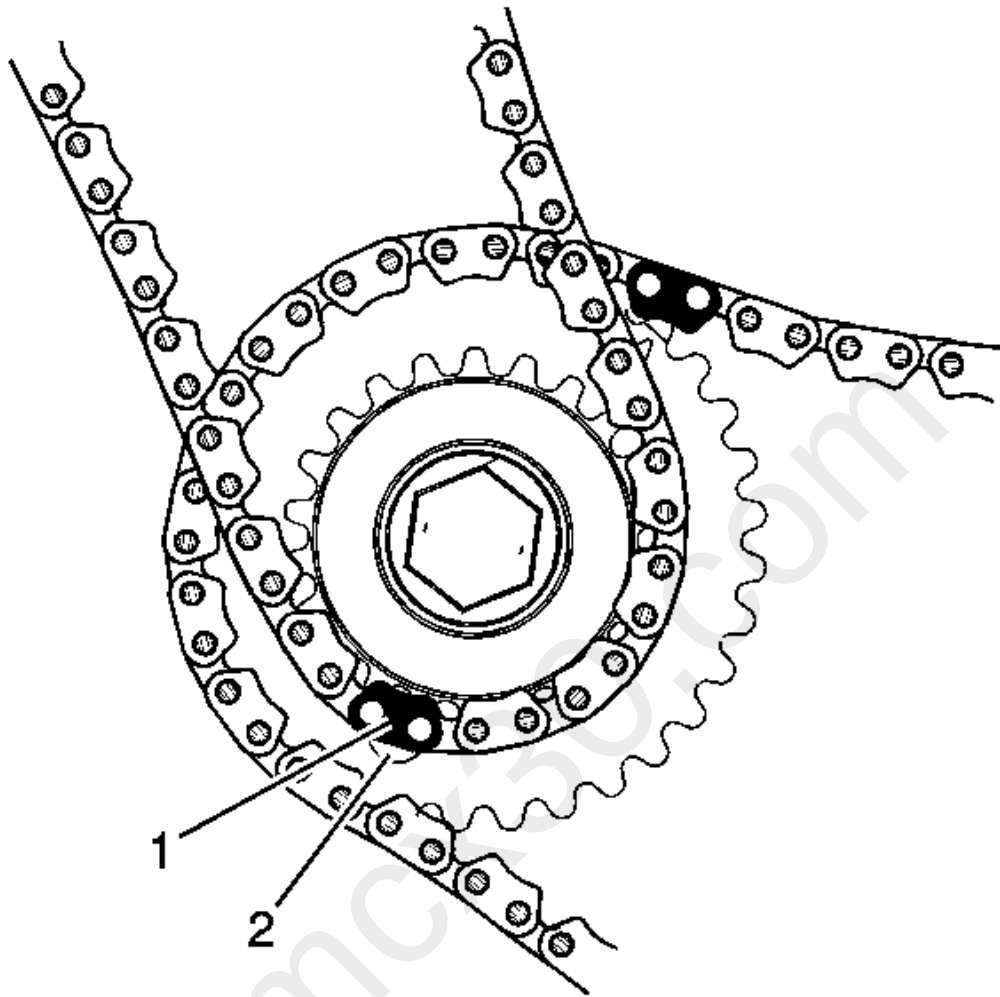


Fig. 81: View Of Timing Camshaft Drive Chain Link & Alignment Access Hole
Courtesy of GENERAL MOTORS CORP.

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.

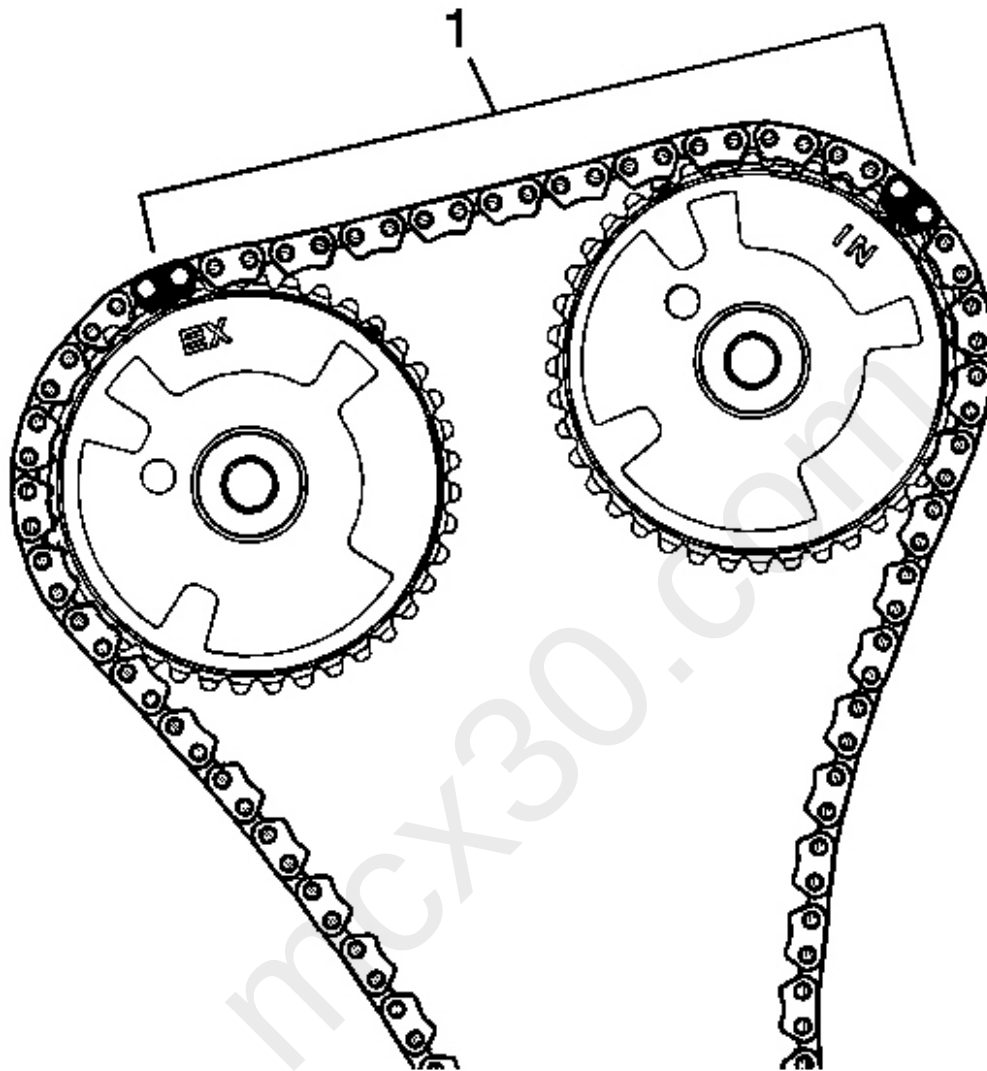


Fig. 82: View Of Links

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.

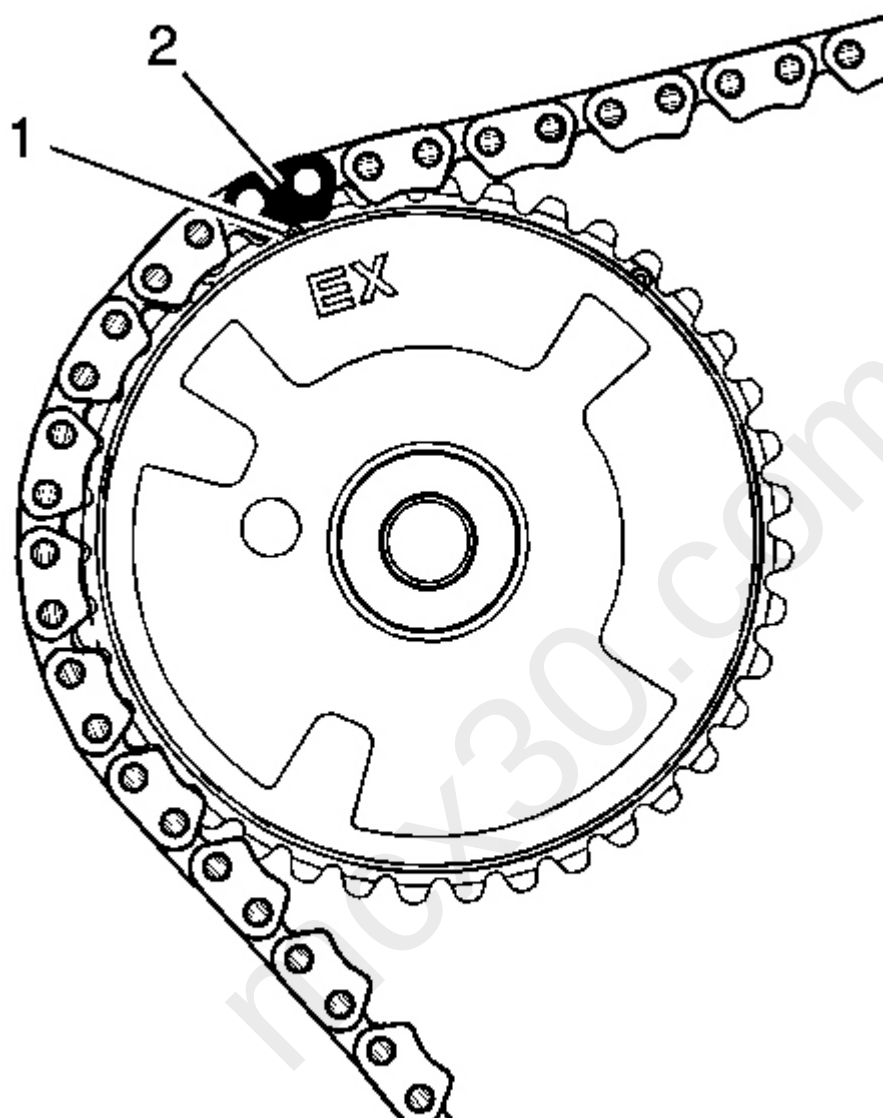


Fig. 83: View Of Camshaft Marks
Courtesy of GENERAL MOTORS CORP.

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

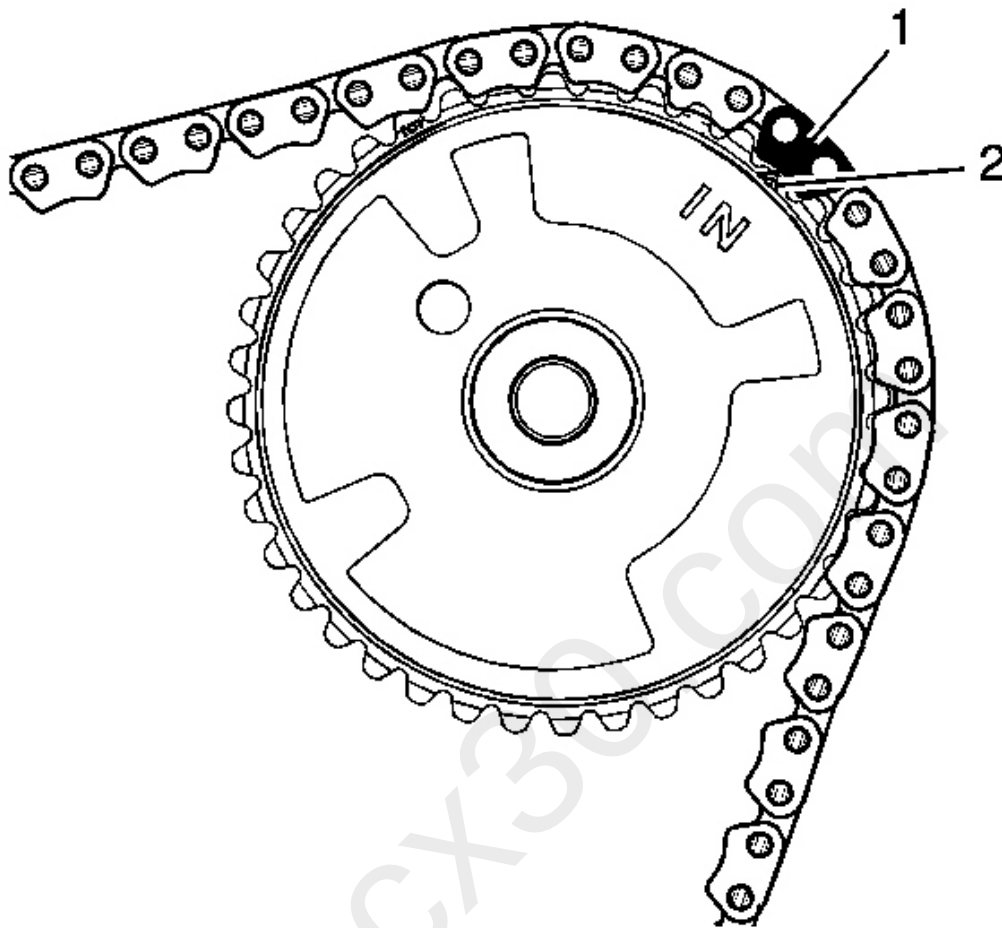


Fig. 84: View Of Right Intake Camshaft Position Actuator Sprocket Alignment Triangle Mark
Courtesy of GENERAL MOTORS CORP.

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

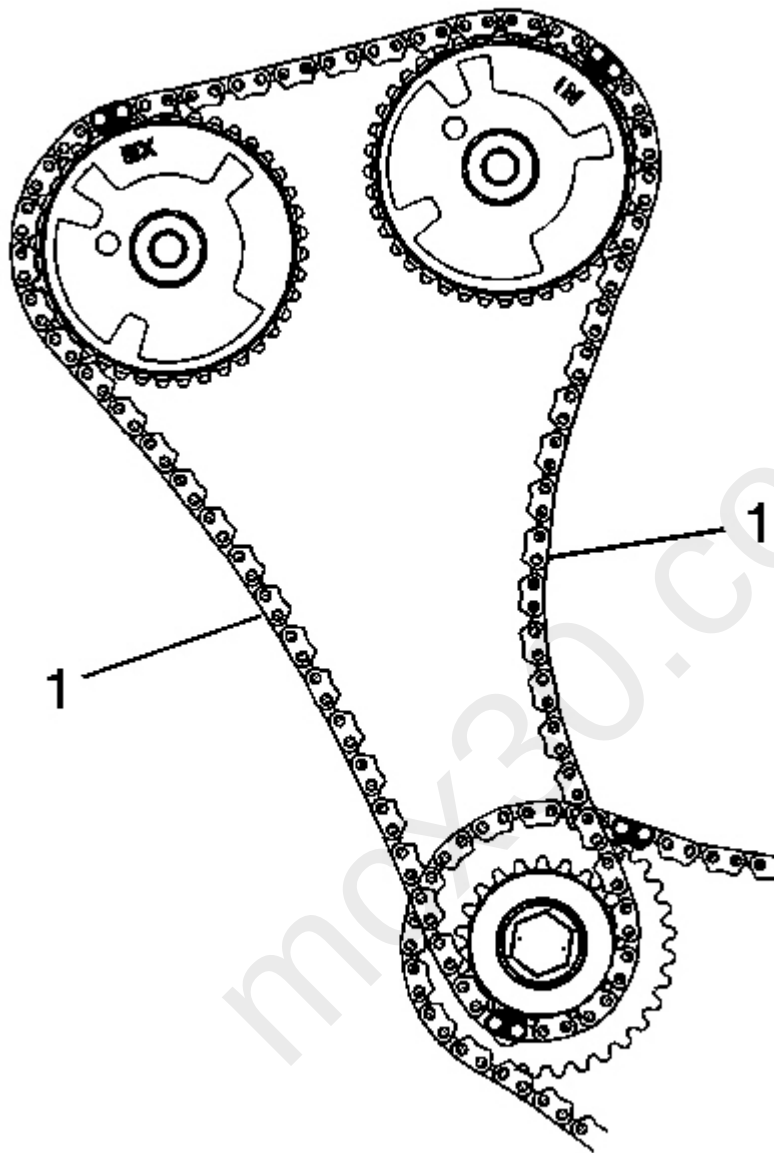


Fig. 85: Identifying Correct Number Of Links Between Points
 Courtesy of GENERAL MOTORS CORP.

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 TIMING CHAIN GUIDE INSTALLATION - RIGHT SIDE

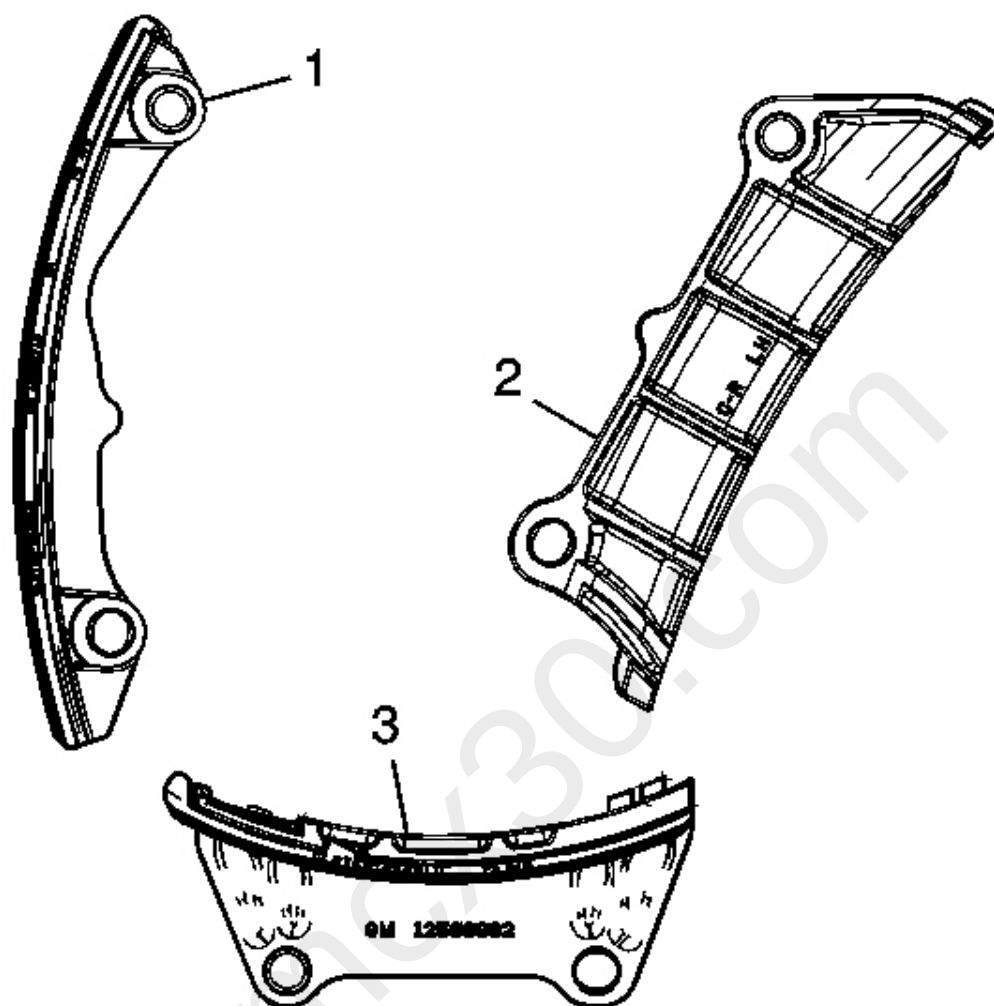


Fig. 86: View Of Camshaft Drive Chain Guide
Courtesy of GENERAL MOTORS CORP.

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

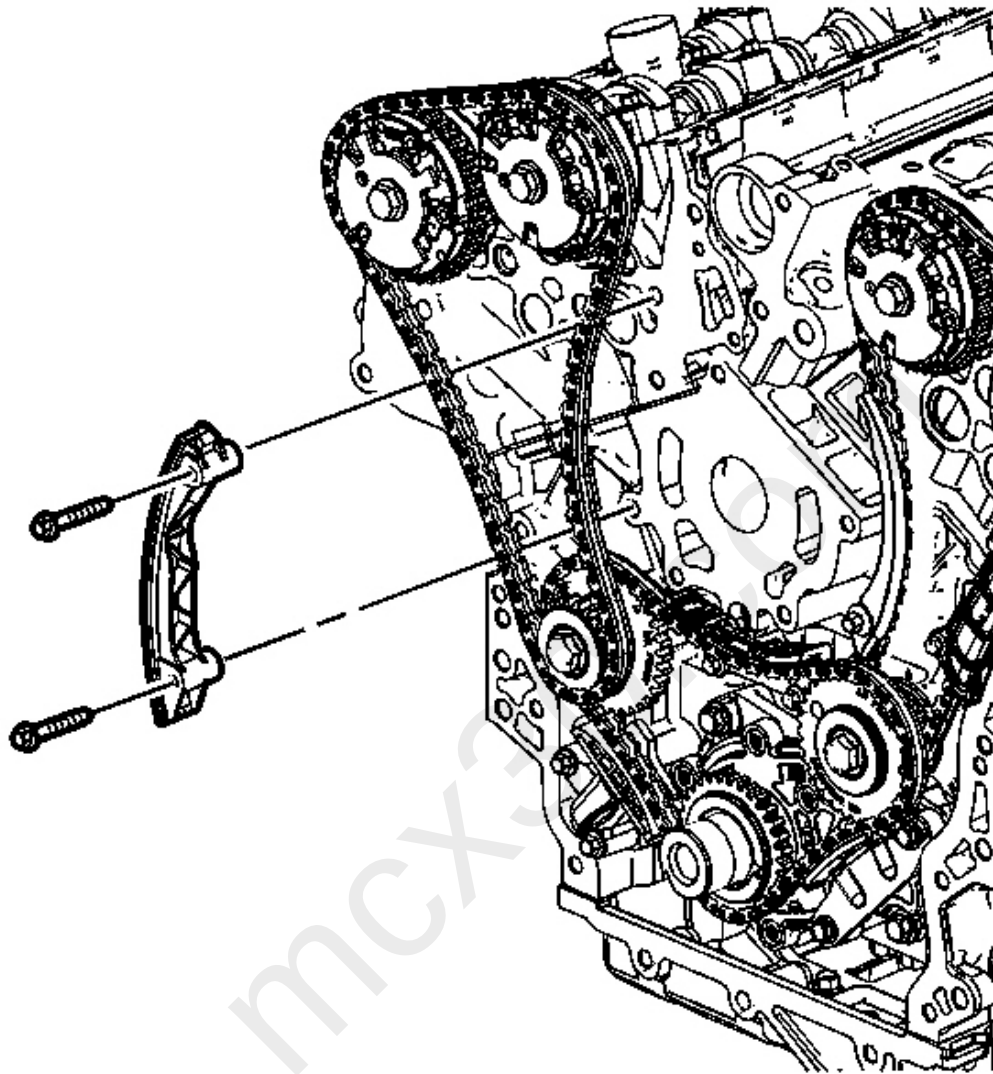


Fig. 87: View Of Right Secondary Camshaft Drive Chain Guide & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Position the right secondary camshaft drive chain guide.

CAUTION: Refer to Fastener Caution .

3. Install the secondary camshaft drive chain guide bolts and tighten to 25 N.m (18 lb ft).

SECONDARY CAMSHAFT DRIVE CHAIN SHOE INSTALLATION - RIGHT SIDE

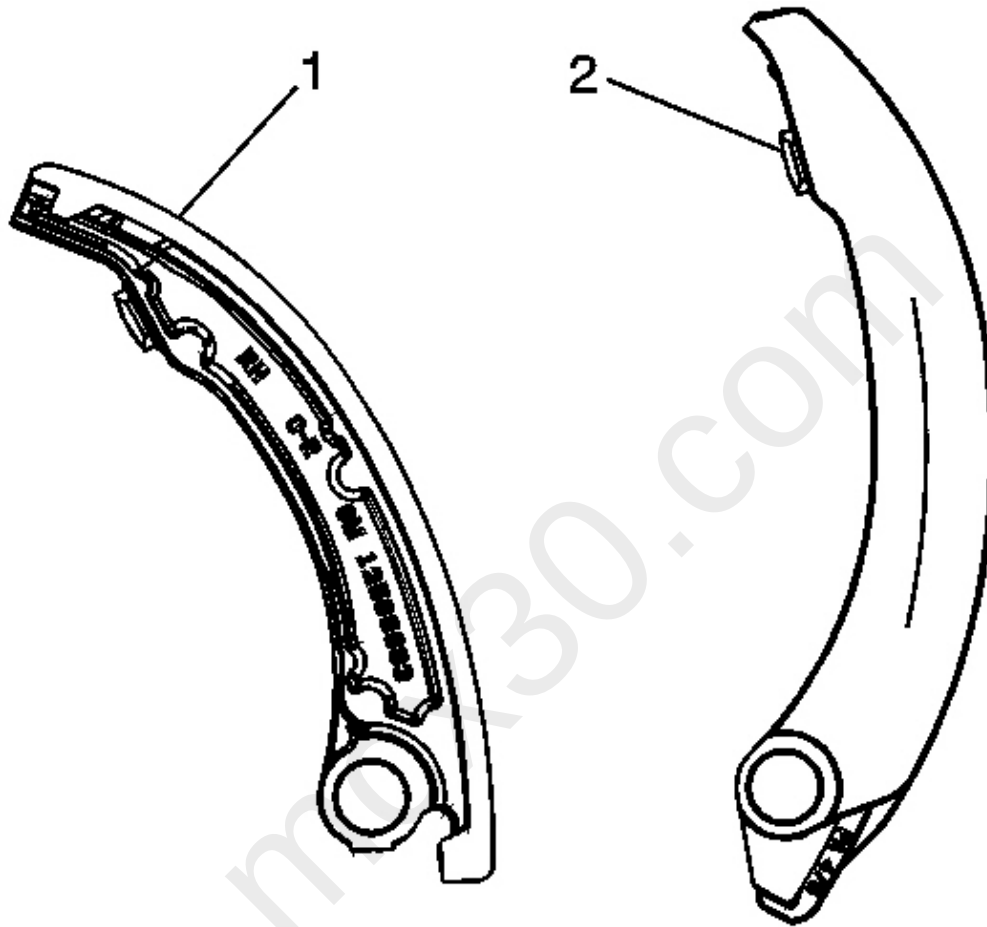


Fig. 88: Identifying Correct Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

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

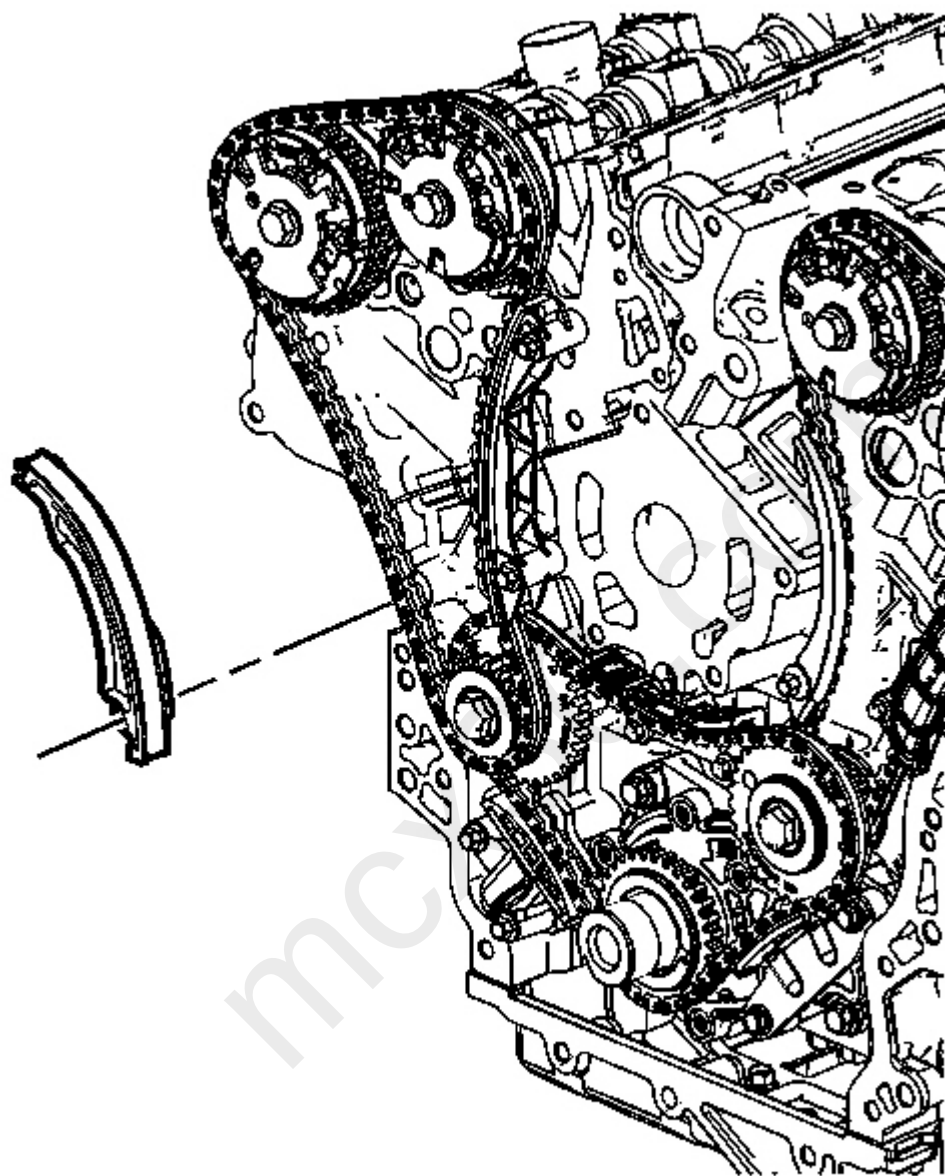


Fig. 89: View Of Right Secondary Camshaft Drive Chain Shoe
Courtesy of GENERAL MOTORS CORP.

2. Position the right secondary camshaft drive chain shoe.

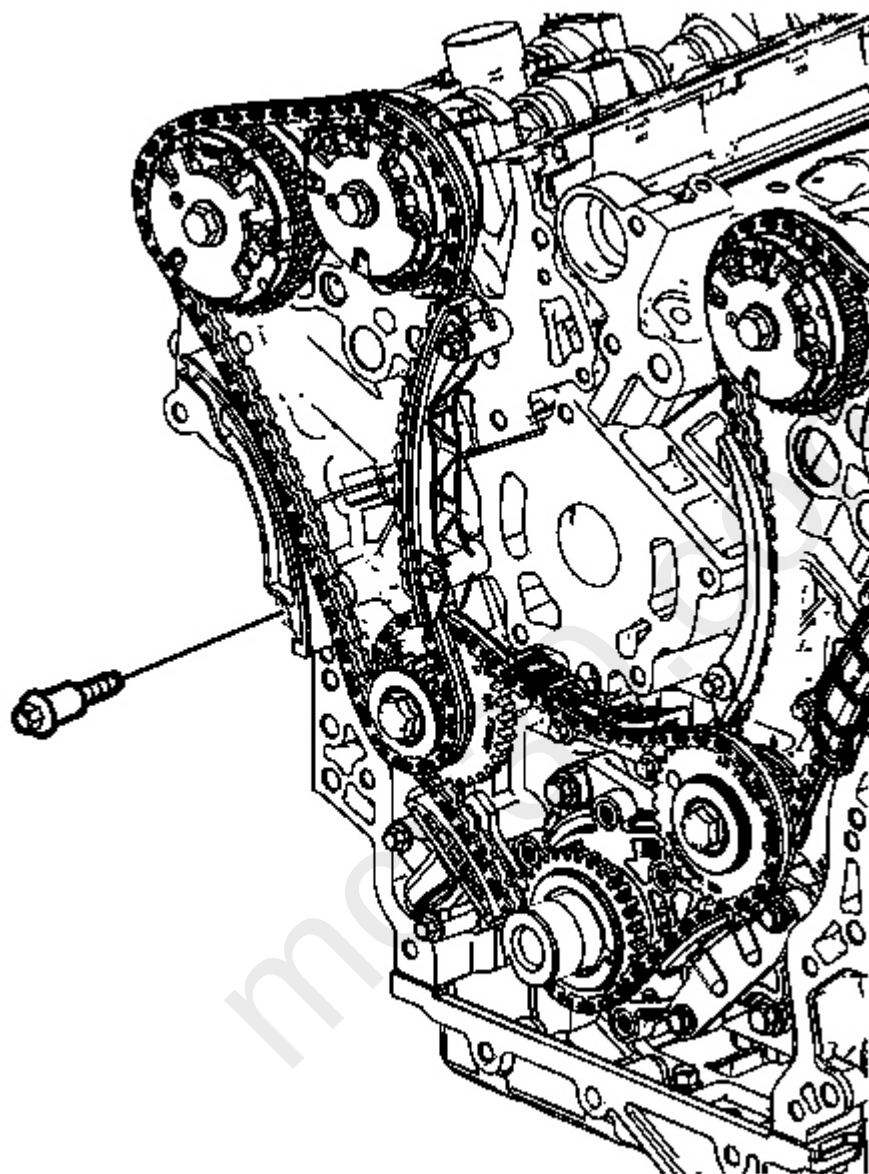


Fig. 90: View Of Right Secondary Camshaft Drive Chain Shoe Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the secondary camshaft drive chain shoe bolt and tighten to 25 N.m (18 lb ft).

SECONDARY TIMING CHAIN TENSIONER INSTALLATION - RIGHT SIDE

Special Tools

- EN 45027: Tensioner Tool
- EN 46112: Tensioner Retraction Pins

For equivalent regional tools, refer to Special Tools .

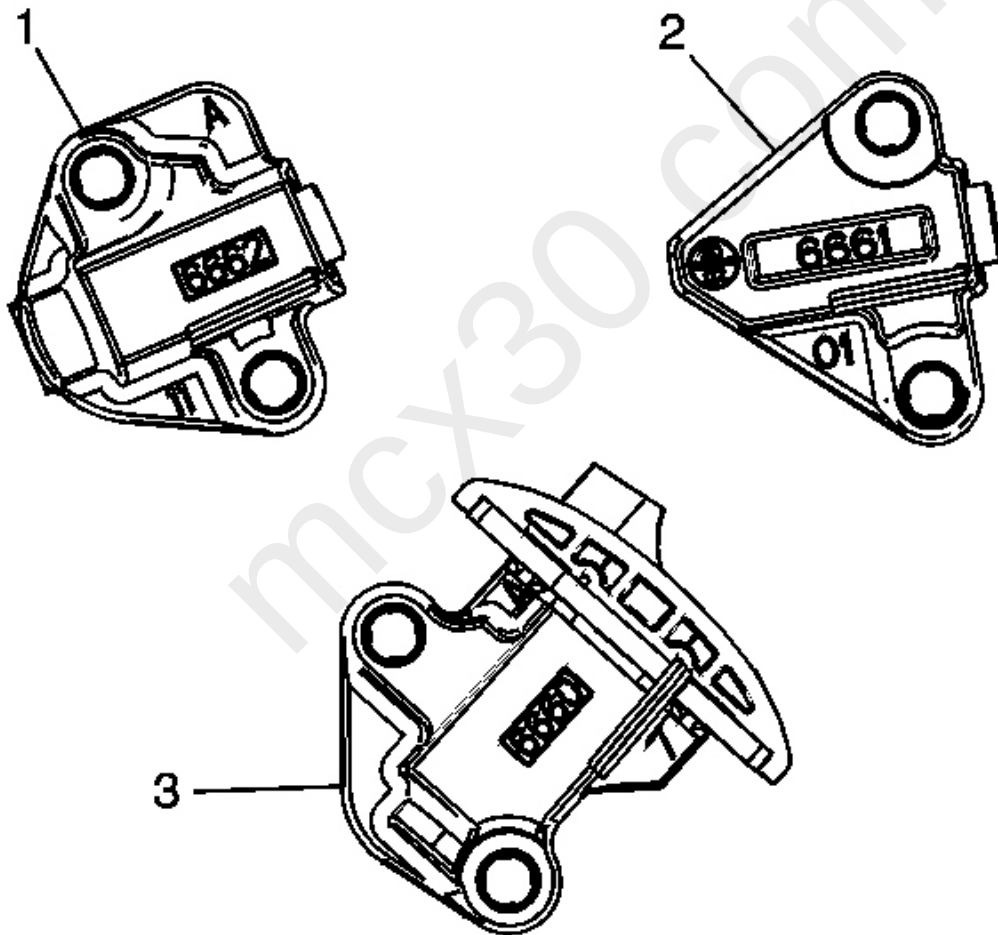


Fig. 91: Identifying Left & Right Secondary Camshaft Drive Chain Tensioner & Primary Camshaft Drive Chain Tensioner

Courtesy of GENERAL MOTORS CORP.

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

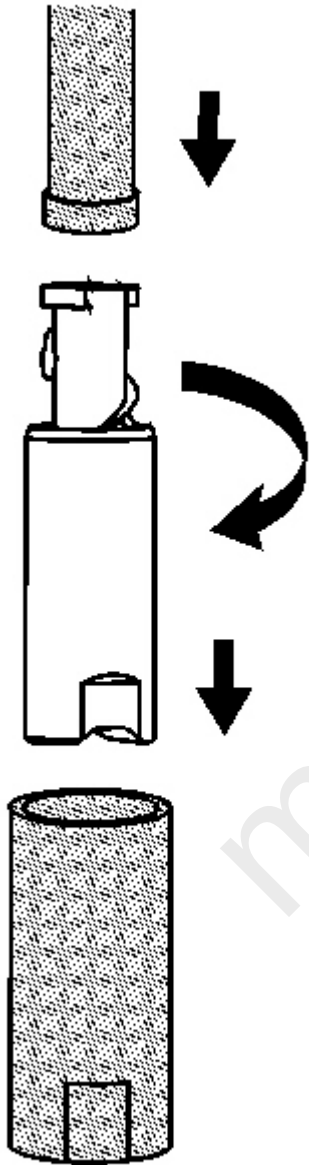


Fig. 92: Resetting Left Secondary Camshaft Drive Chain Tensioner Plunger
Courtesy of GENERAL MOTORS CORP.

2. Using the **EN 45027**: tool, reset the right secondary camshaft drive chain tensioner plunger.

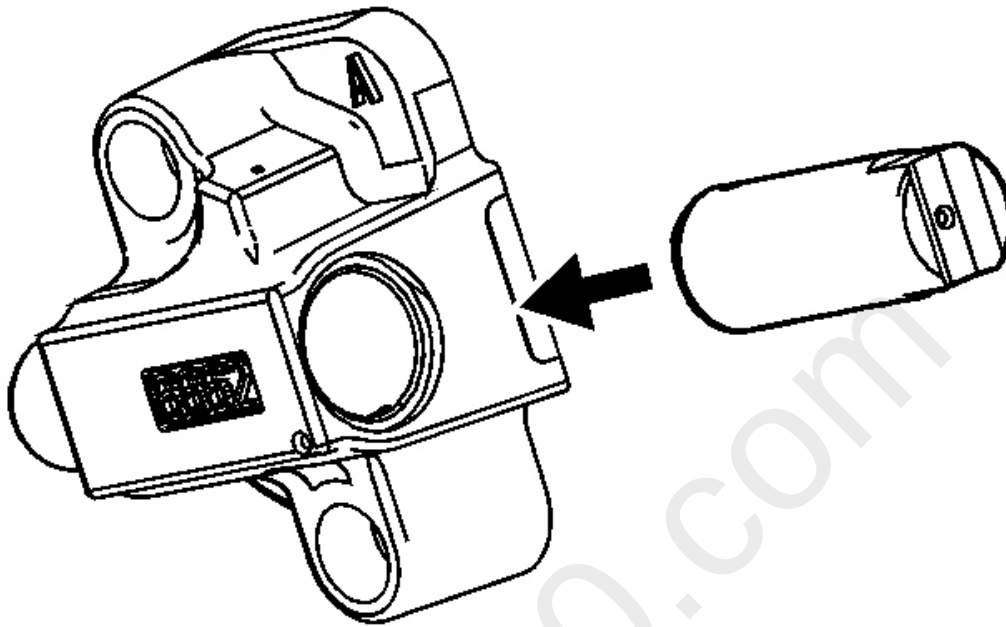


Fig. 93: Installing Plunger Into Right Secondary Camshaft Drive Chain Tensioner Body
Courtesy of GENERAL MOTORS CORP.

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

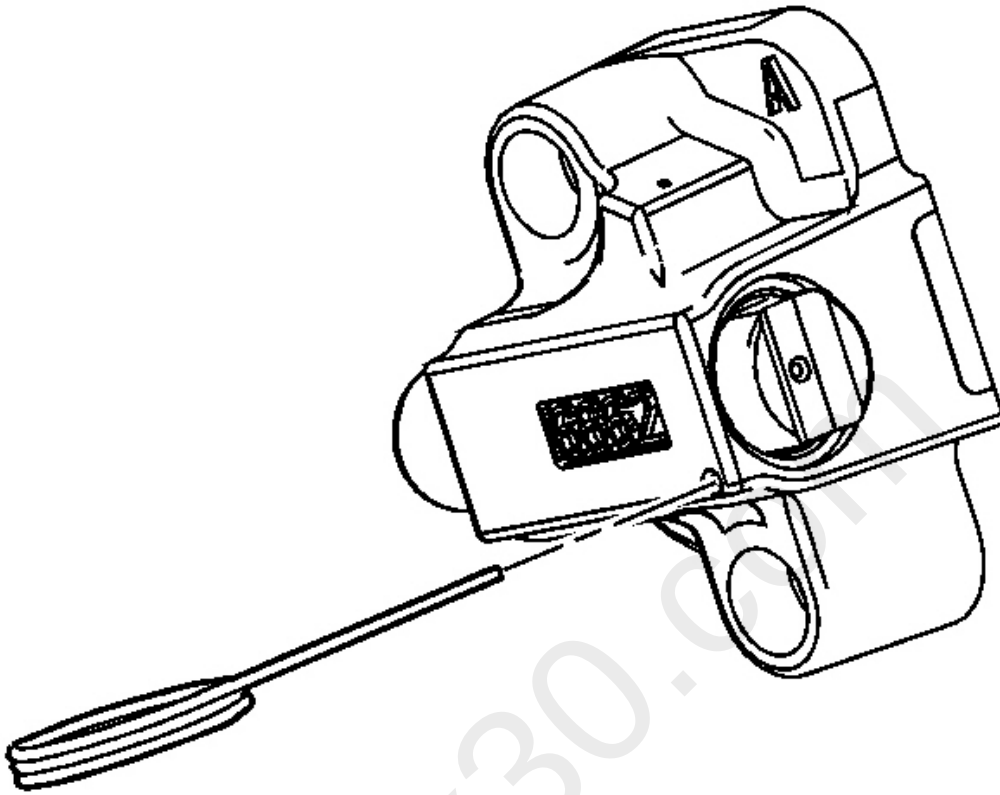


Fig. 94: Identifying EN 46112
Courtesy of GENERAL MOTORS CORP.

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

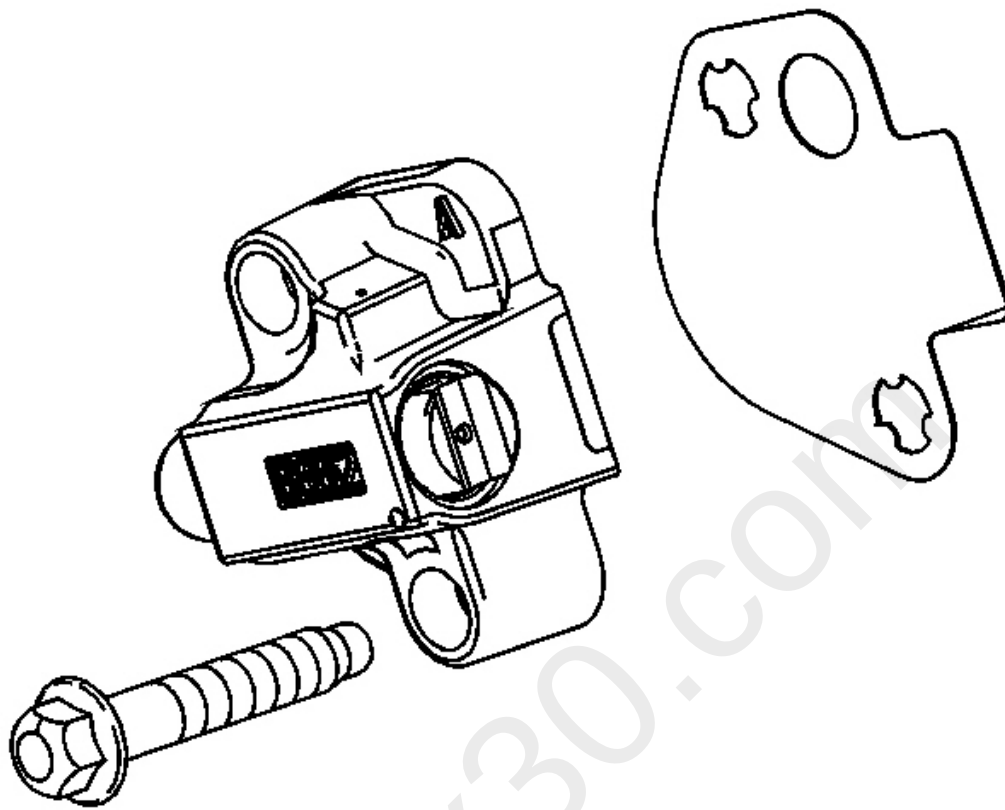


Fig. 95: View Of Right Secondary Camshaft Drive Chain Tensioner Gasket
Courtesy of GENERAL MOTORS CORP.

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.

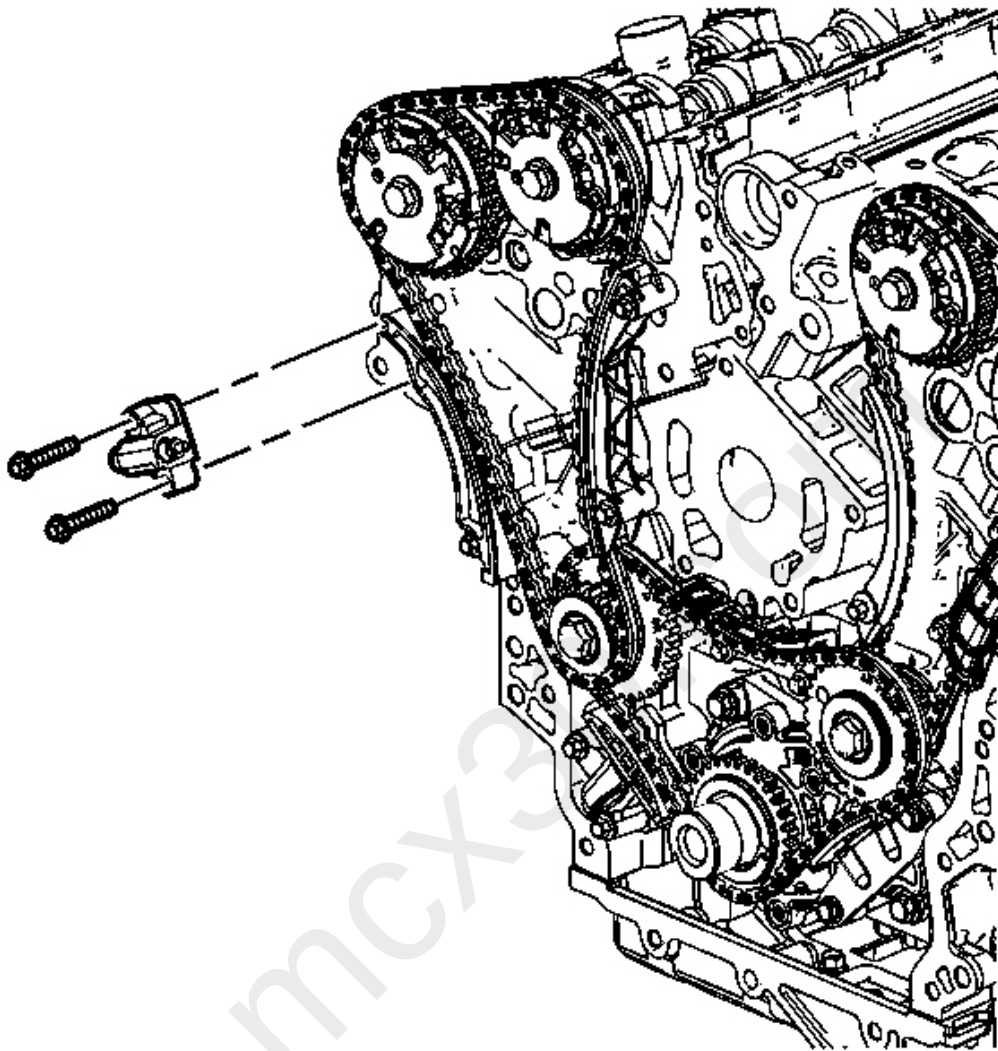


Fig. 96: View Of Secondary Camshaft Drive Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

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

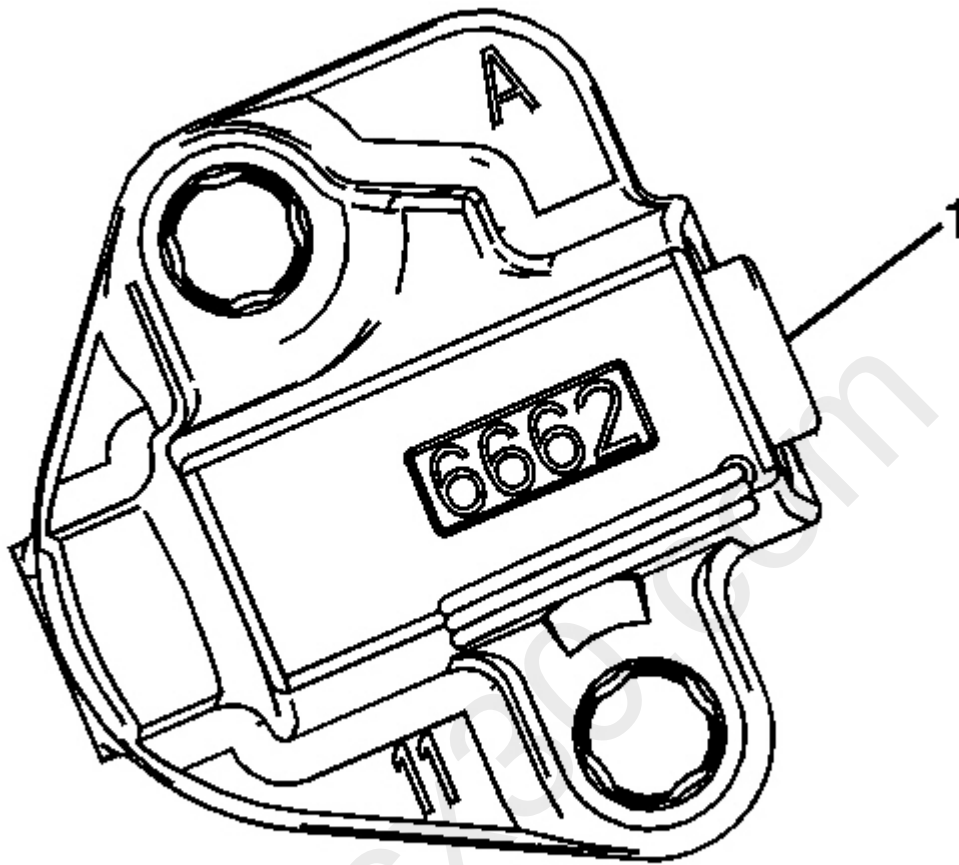


Fig. 97: Identifying Right Secondary Camshaft Drive Chain Tensioner Gasket Tab
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

1. First Pass

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

2. Final Pass

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

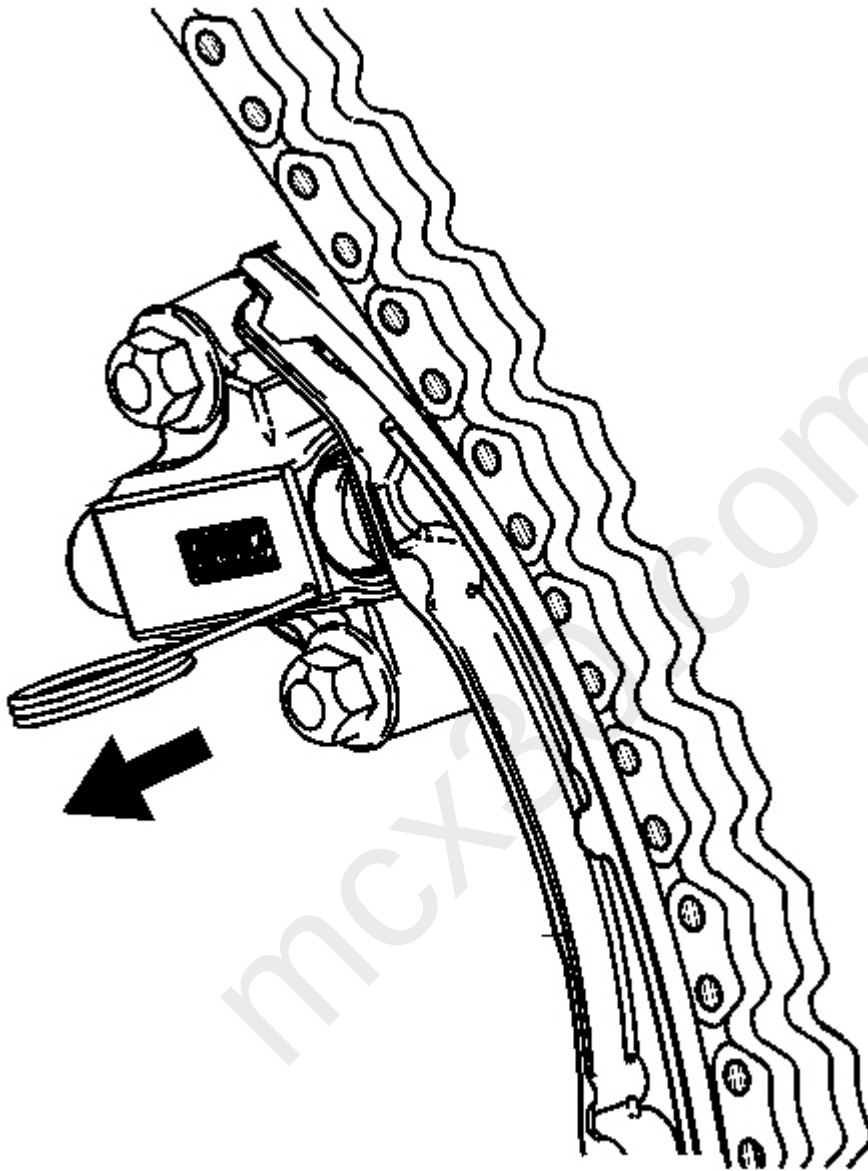


Fig. 98: Releasing Right Camshaft Drive Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: 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. Refer to **Timing Chain Alignment Diagram** - Stage Two.

ENGINE FRONT COVER INSTALLATION

SPECIAL TOOLS

EN 46109: Guide Pins

For equivalent regional tools, refer to **Special Tools** .

INSTALLATION

mcx30.com

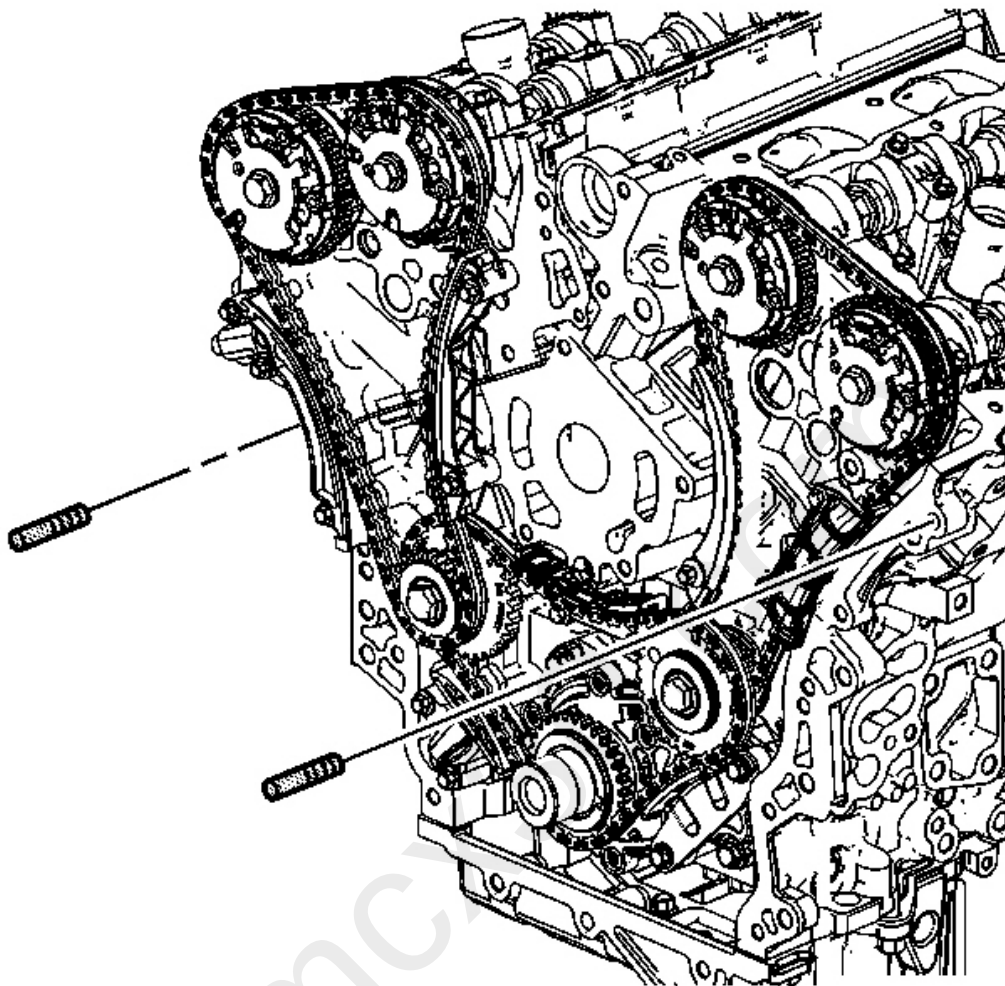


Fig. 99: View Of Front Cover Guides
Courtesy of GENERAL MOTORS CORP.

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

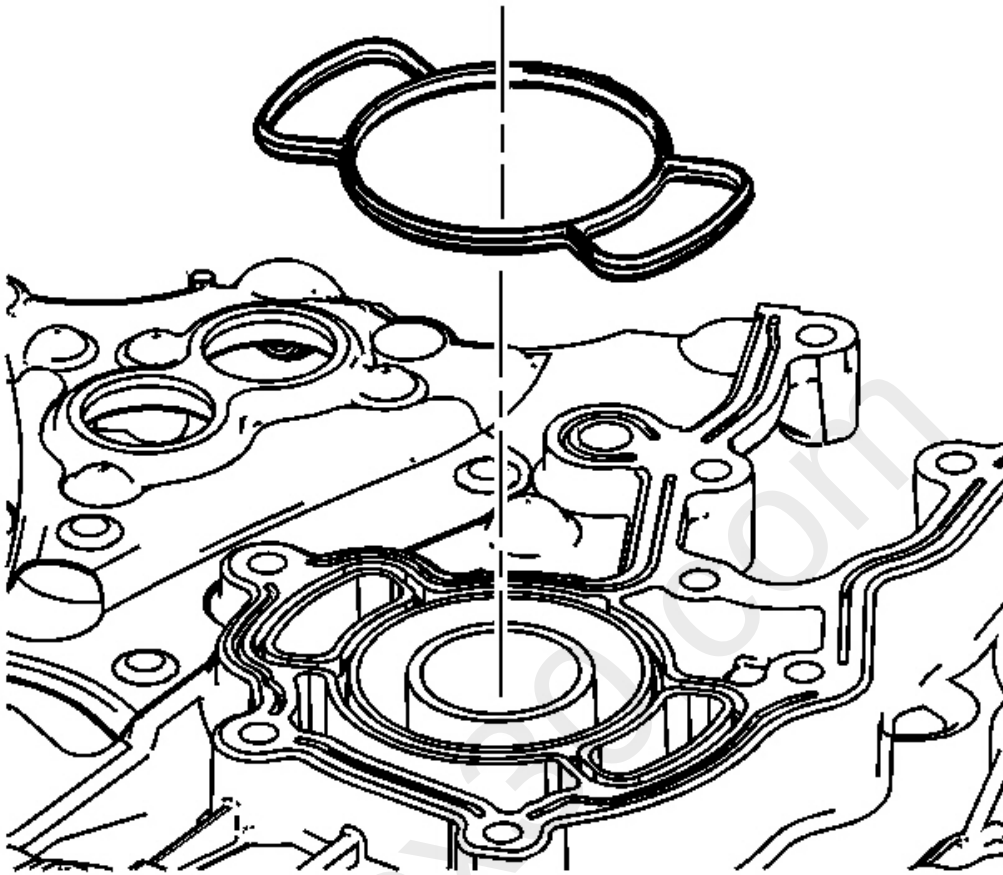


Fig. 100: View Of Water Pump Seal
Courtesy of GENERAL MOTORS CORP.

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

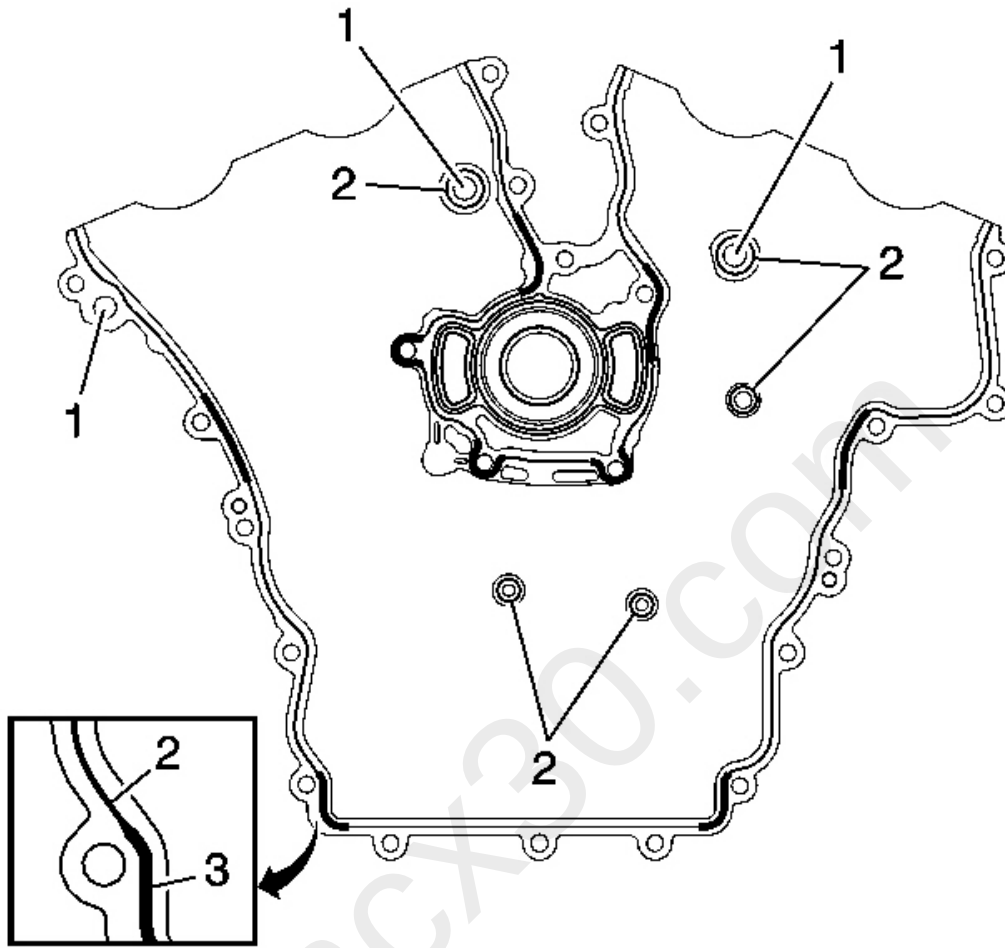


Fig. 101: Applying Sealant

Courtesy of GENERAL MOTORS CORP.

NOTE: No RTV sealant should be visible in the M12 bolt holes (1) upon final assembly of front cover to engine.

3. Apply 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 (2). Apply a 5 mm (0.197 in) bead of RTV sealant on the engine front cover as shown (3).

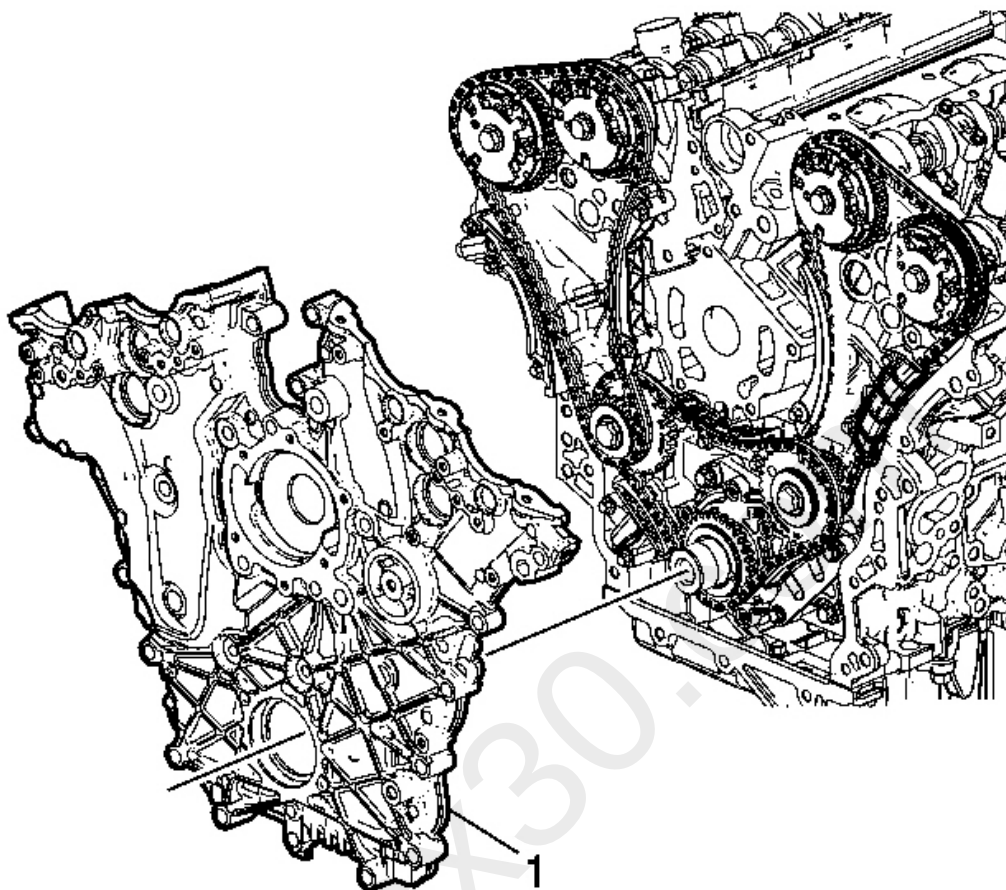


Fig. 102: Engine Front Cover
Courtesy of GENERAL MOTORS CORP.

4. Place the engine front cover (1) onto the **EN 46109:** pins and slide into position.
5. Remove the **EN 46109:** pins from the cylinder block.
6. Hand start all the engine front cover bolts.

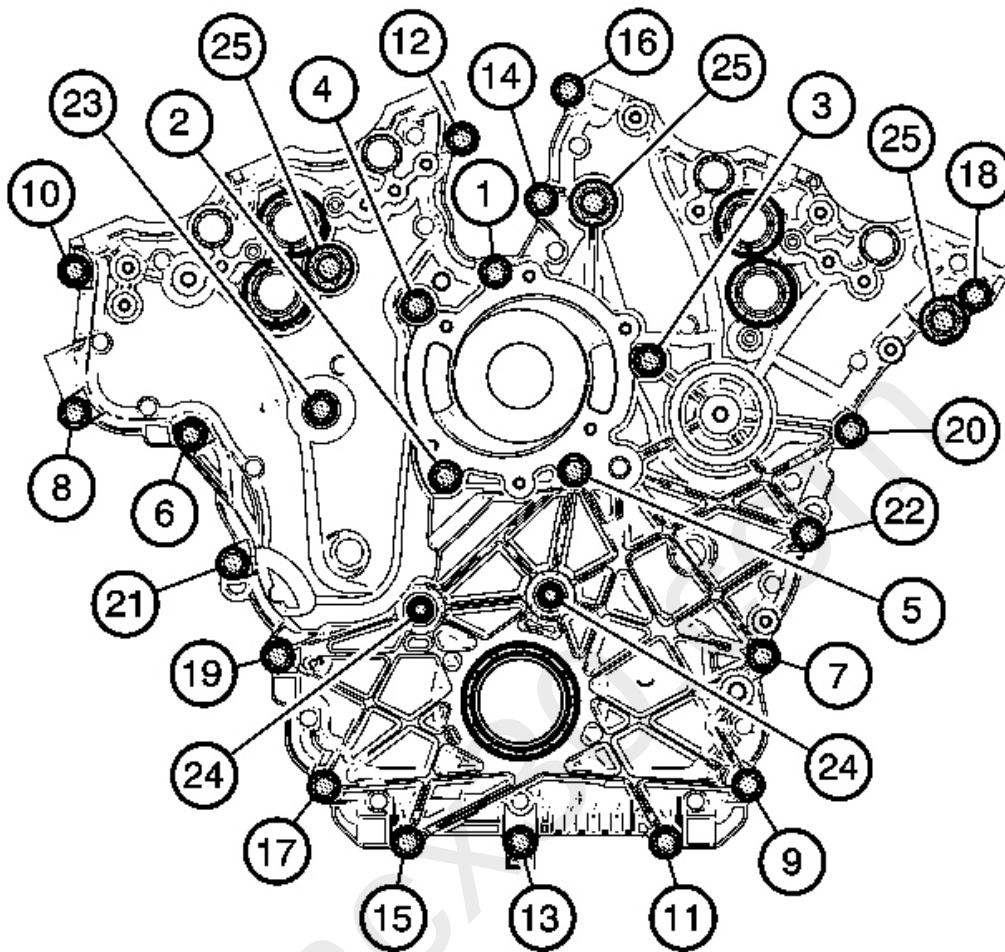


Fig. 103: Identifying Engine Front Cover Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

NOTE: Engine front cover bolts in the number (25) location are model dependent and may not apply.

7. Tighten the engine front cover bolts (1-23) in the sequence shown to 20 N.m (14 lb ft).
 1. Tighten the engine front cover bolts (1-23) a second pass in sequence to 20 N.m (14 lb ft) .
 2. Tighten the engine front cover bolts (1-23) a third pass in sequence an additional 60 degrees .

3. Tighten the engine front cover bolts (24) to 15 N.m (11 lb ft) .
4. Tighten the engine front cover bolts (25) to 65 N.m (48 lb ft) .

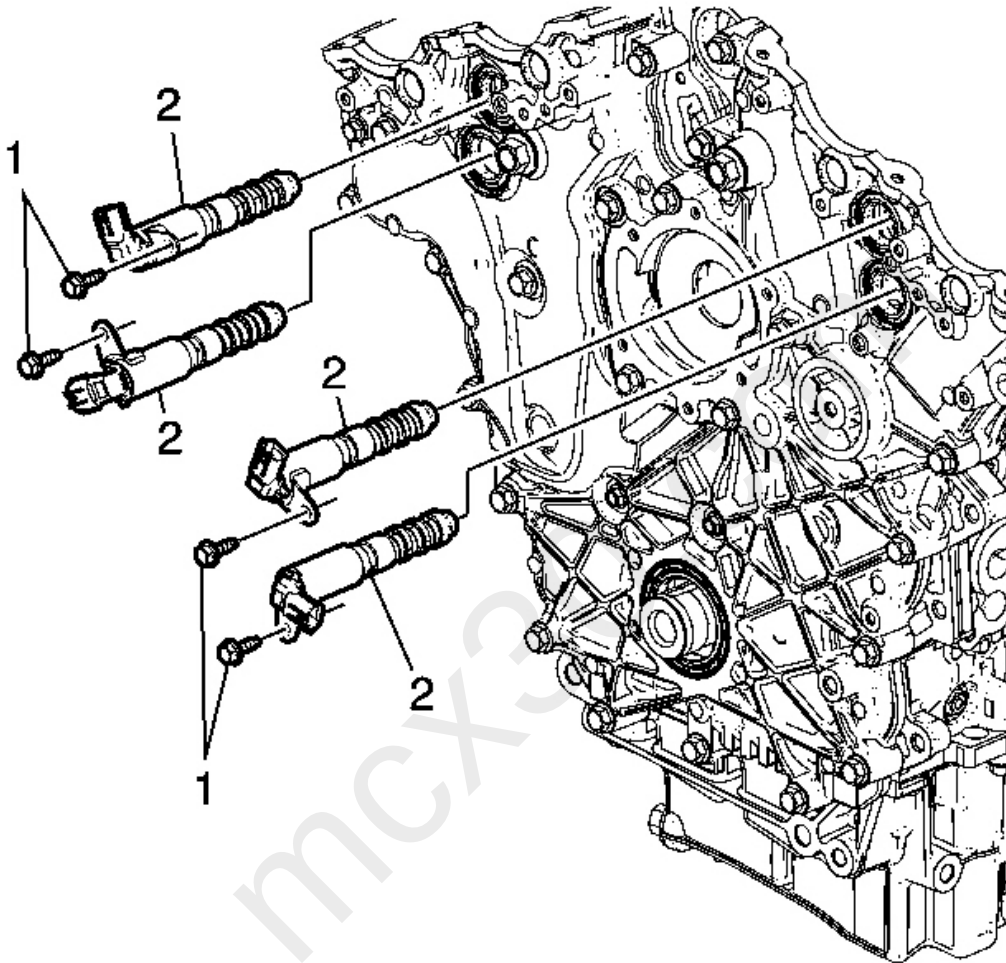


Fig. 104: Placing Camshaft Position Actuator Valves
Courtesy of GENERAL MOTORS CORP.

8. Place the camshaft position actuator valves (2) in position on the front cover.
9. Install the camshaft position actuator valve bolts (1) and tighten to 10 N.m (89 lb in).

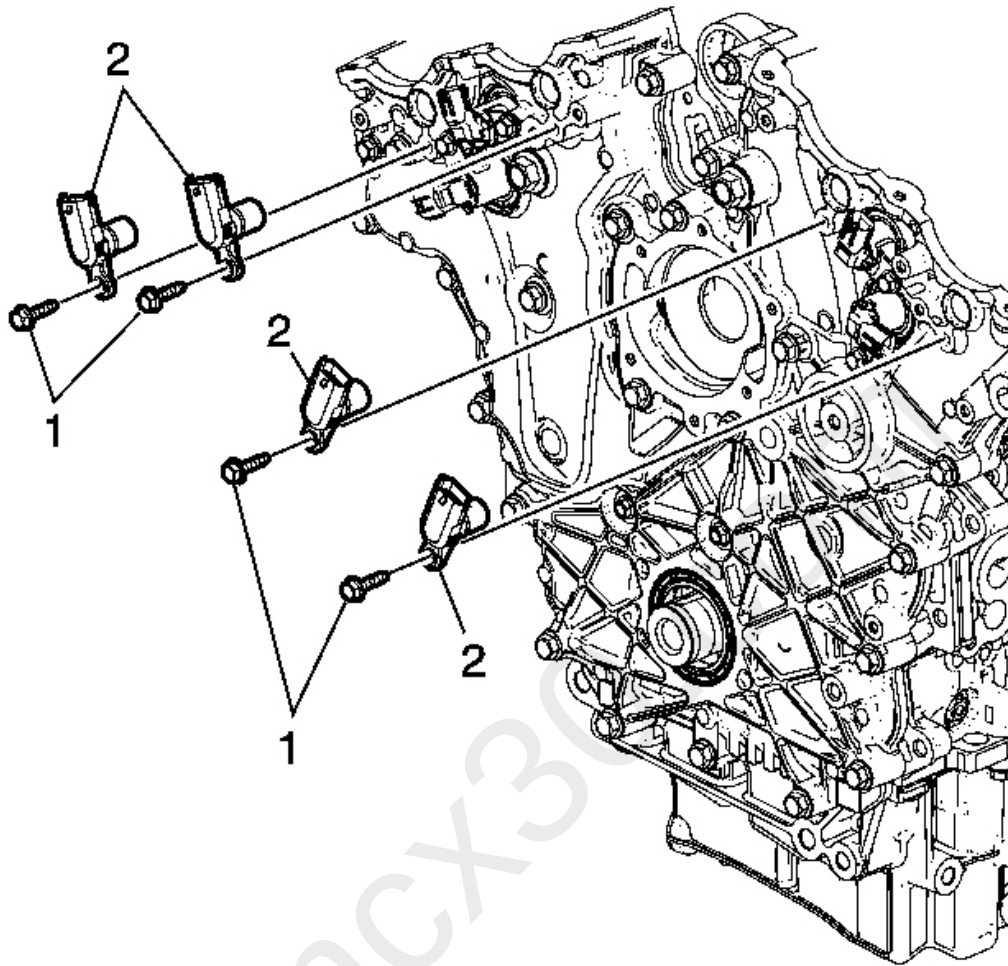


Fig. 105: Placing Camshaft Position Sensors
Courtesy of GENERAL MOTORS CORP.

10. Install NEW O-rings on the camshaft position sensor.
11. Place the camshaft position sensors (2) in position on the front cover.
12. Install the camshaft position sensor bolts (1) and tighten to 10 N.m (89 lb in).

WATER PUMP INSTALLATION

SPECIAL TOOLS

EN 46104: Water Pump Pulley Holding Tool

For equivalent regional tools, refer to **Special Tools** .

INSTALLATION

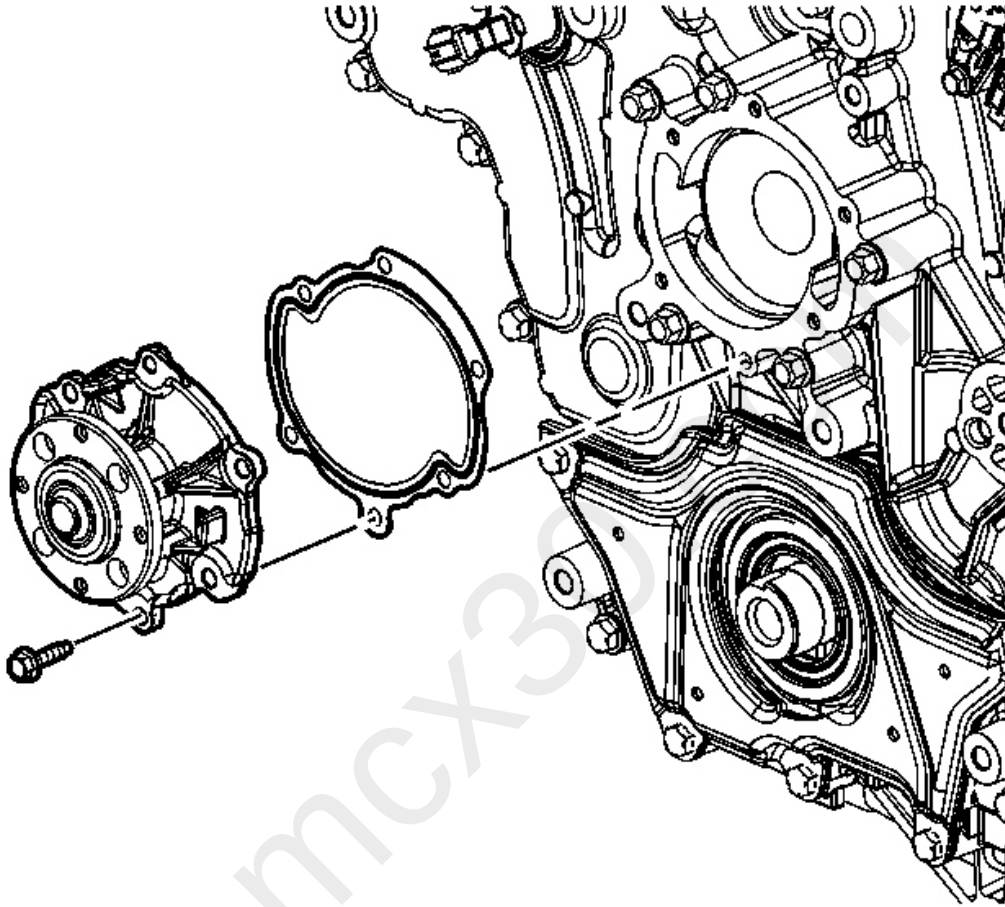


Fig. 106: View Of Water Pump Bolts
Courtesy of GENERAL MOTORS CORP.

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.

CAUTION: Refer to Fastener Caution .

4. Install the water pump bolts and tighten to 10 N.m (89 lb in).

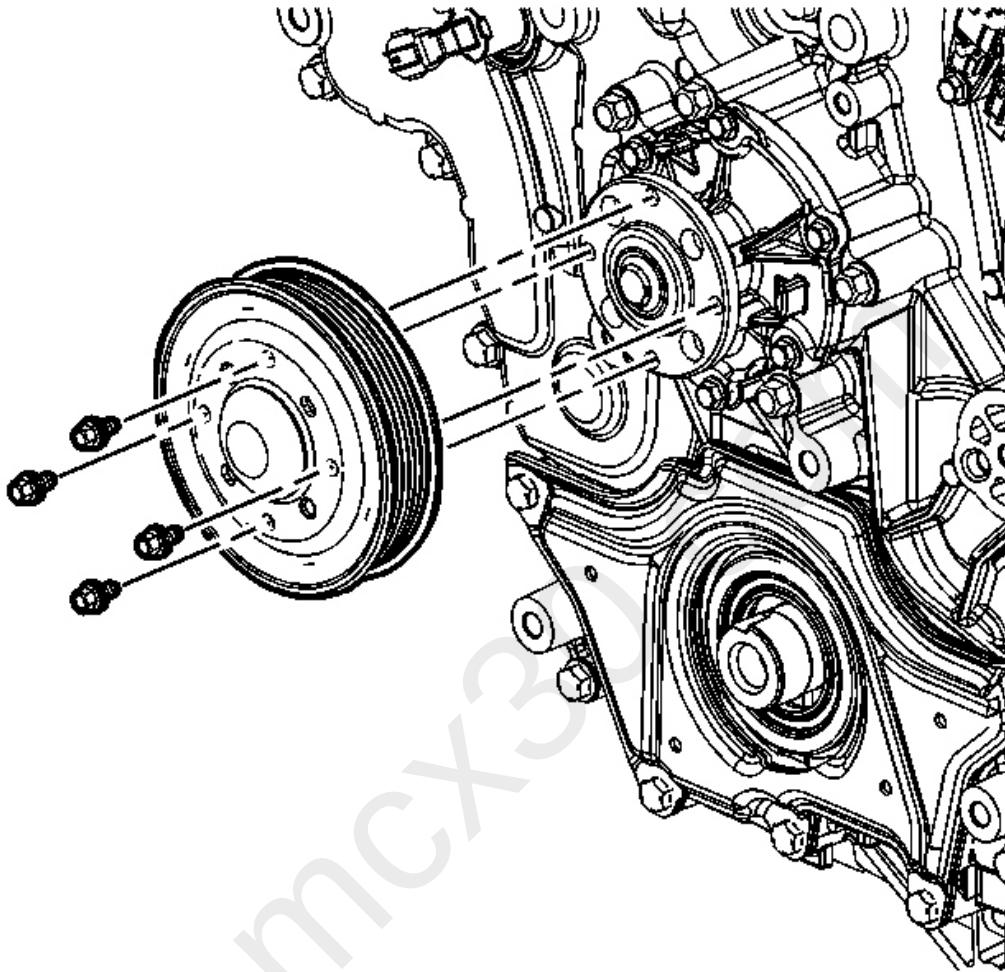


Fig. 107: View Of Water Pump Pulley Bolts
Courtesy of GENERAL MOTORS CORP.

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

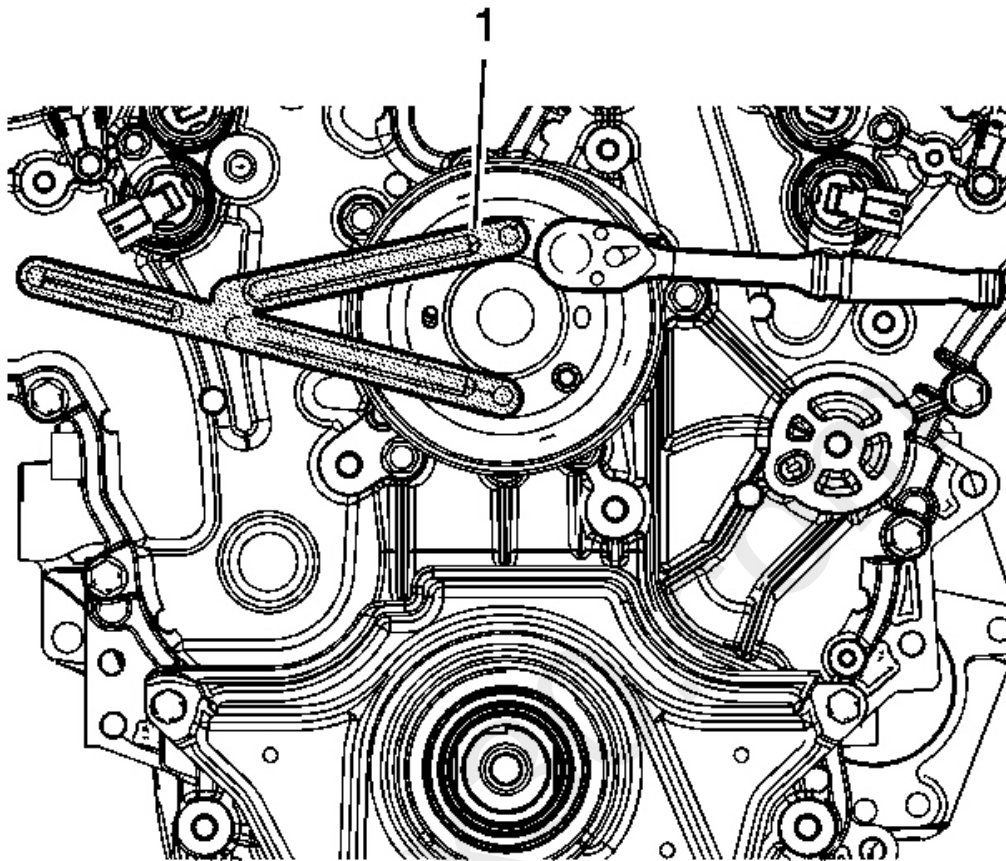


Fig. 108: View Of EN 46104
Courtesy of GENERAL MOTORS CORP.

7. Install the **EN 46104**: tool (1) onto the water pump pulley and tighten the water pump pulley bolts to 10 N.m (89 lb in)

CAMSHAFT COVER INSTALLATION - LEFT SIDE

Special Tools

- **EN 46101**: Spark Plug Tube Seal Guide
- **EN-48383**: Camshaft Retaining Tools

For equivalent regional tools, refer to **Special Tools** .

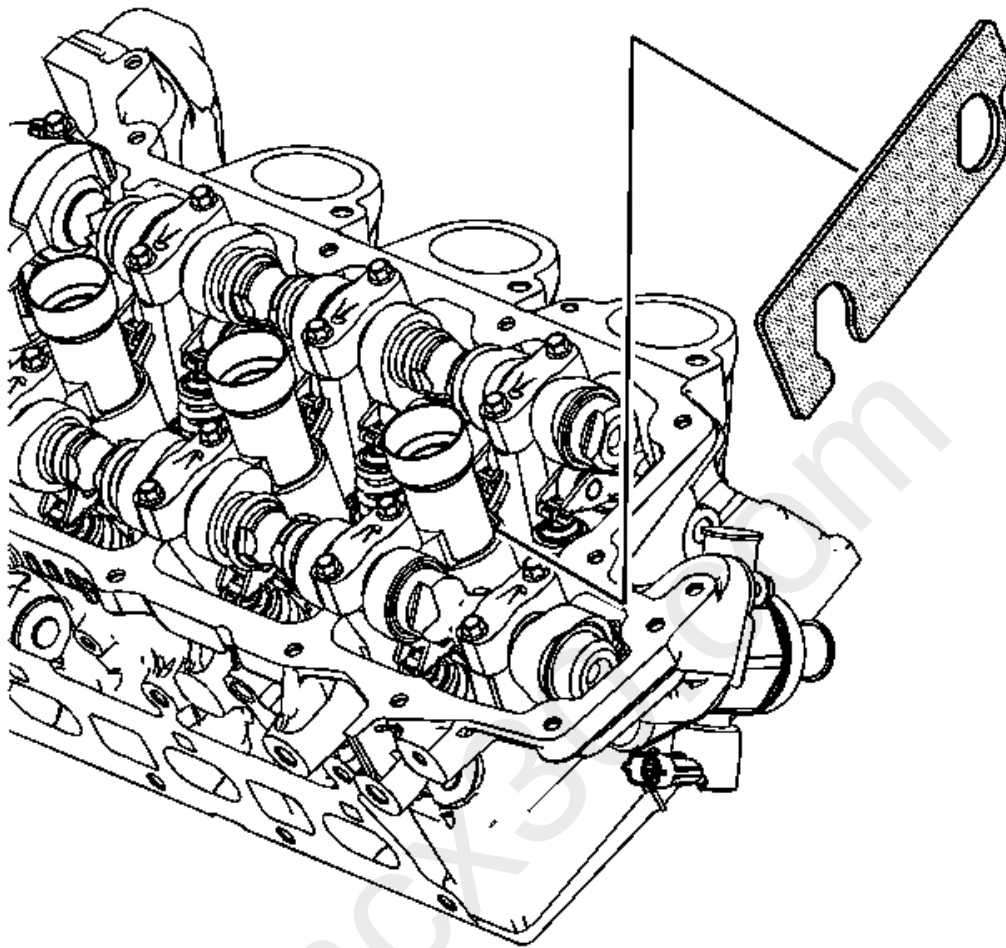


Fig. 109: View Of EN 48383-2 & Camshaft
Courtesy of GENERAL MOTORS CORP.

1. Remove the EN 48383-2 from the rear of the left camshafts.

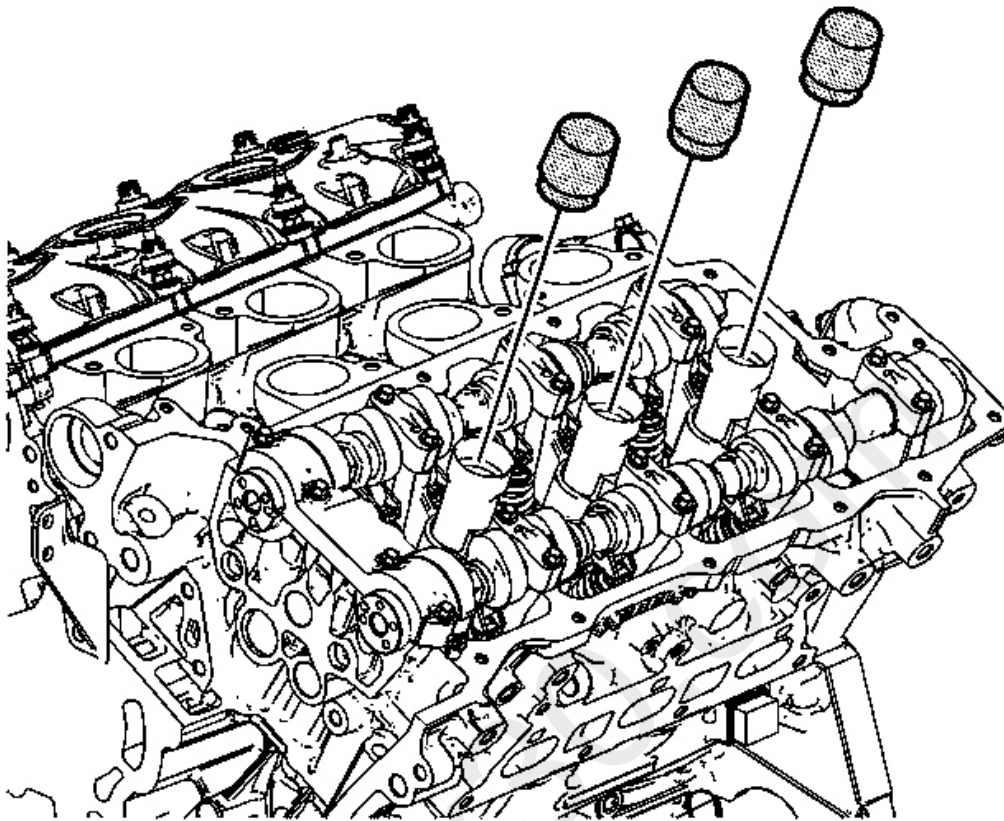


Fig. 110: Removing/Installing EN 46101 Onto Spark Plug Tubes Of Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

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

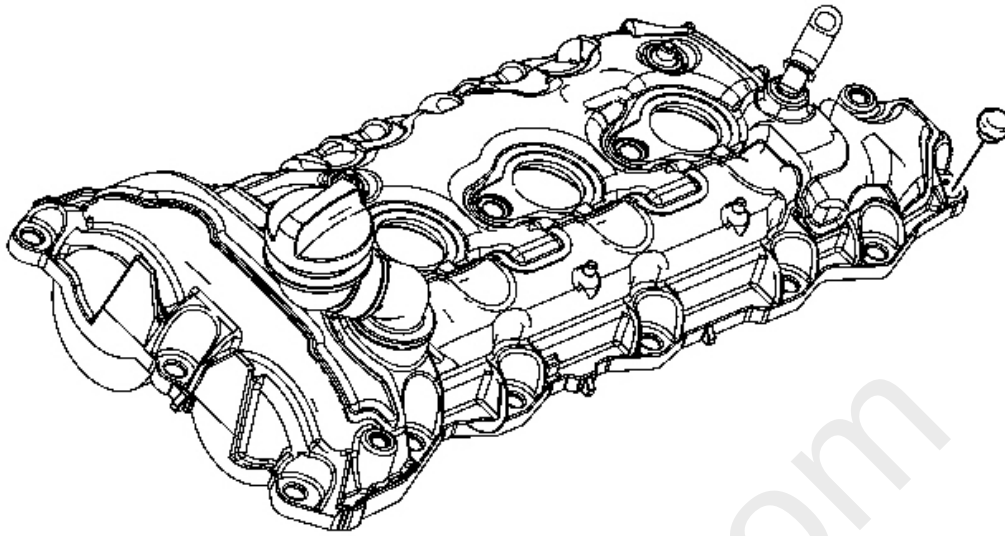


Fig. 111: View of Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

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

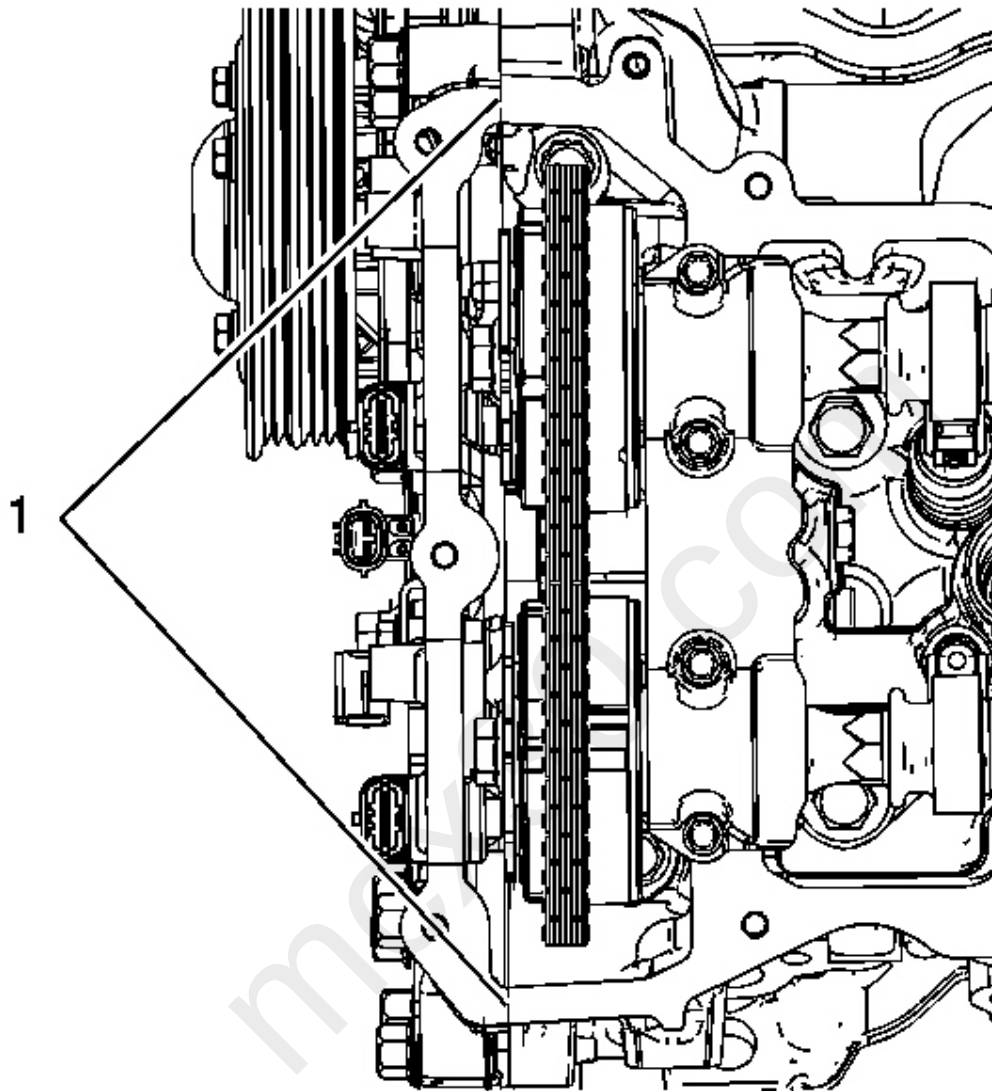


Fig. 112: Locating Engine Front Cover Split Lines
Courtesy of GENERAL MOTORS CORP.

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).

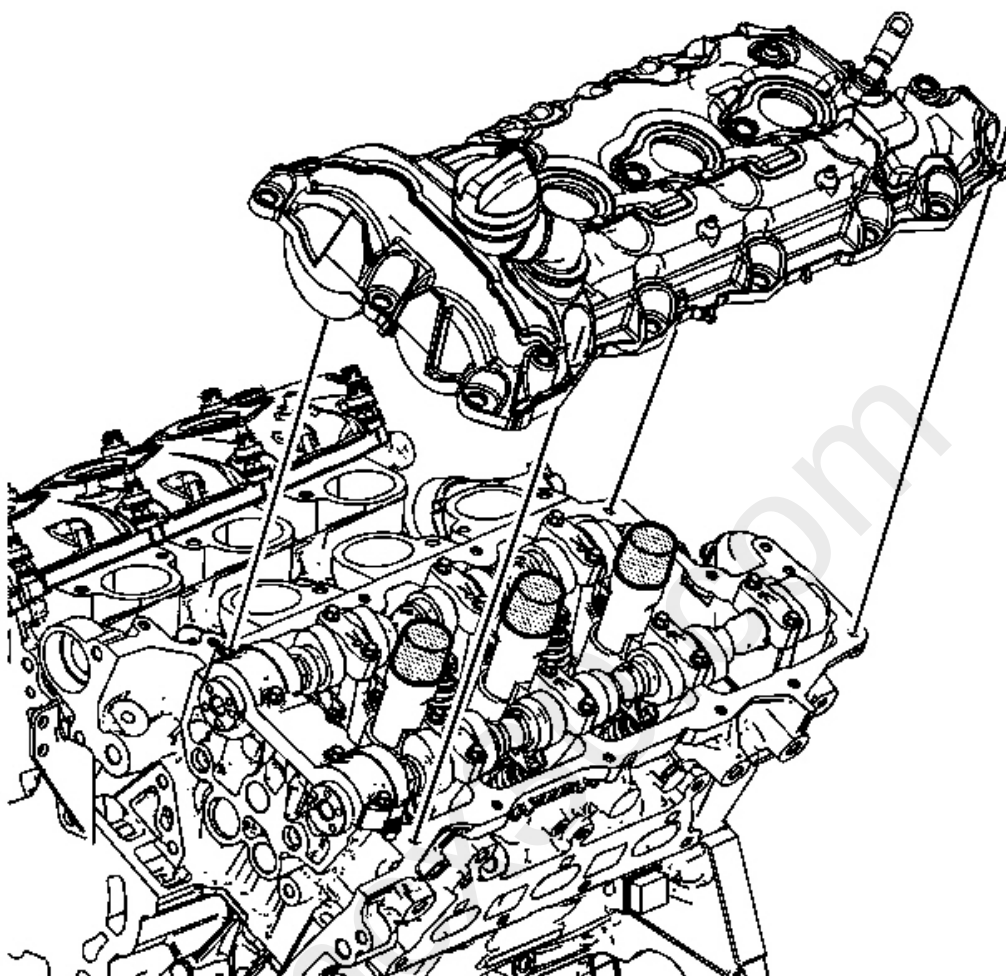


Fig. 113: Removing/Installing Left Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

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

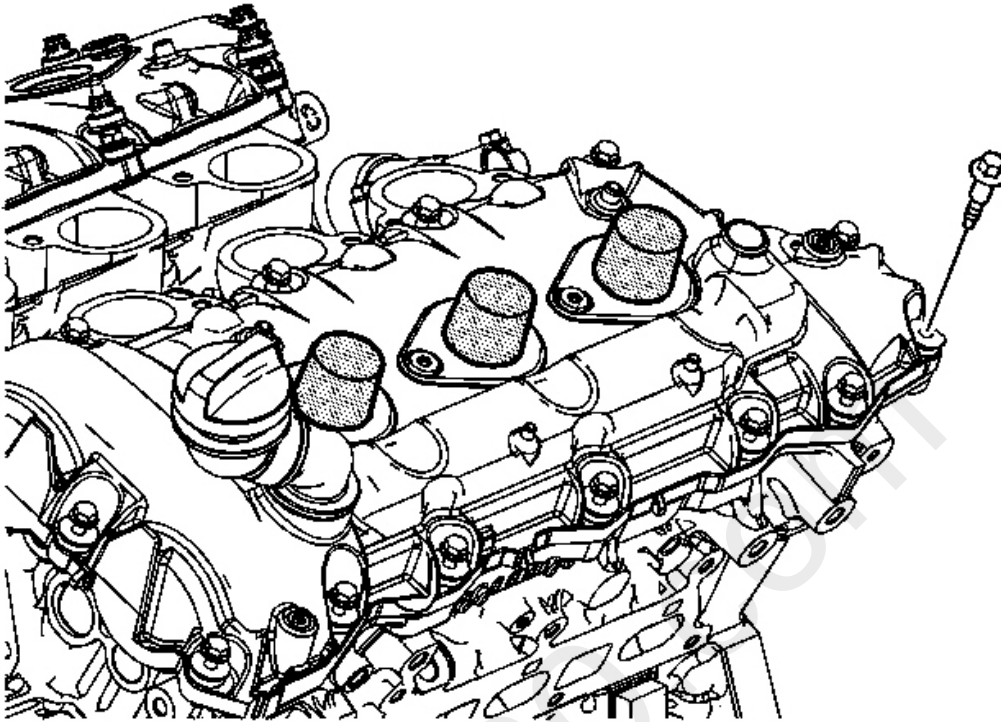


Fig. 114: Removing/Installing Left Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

7. Loosely install the left camshaft cover bolts.

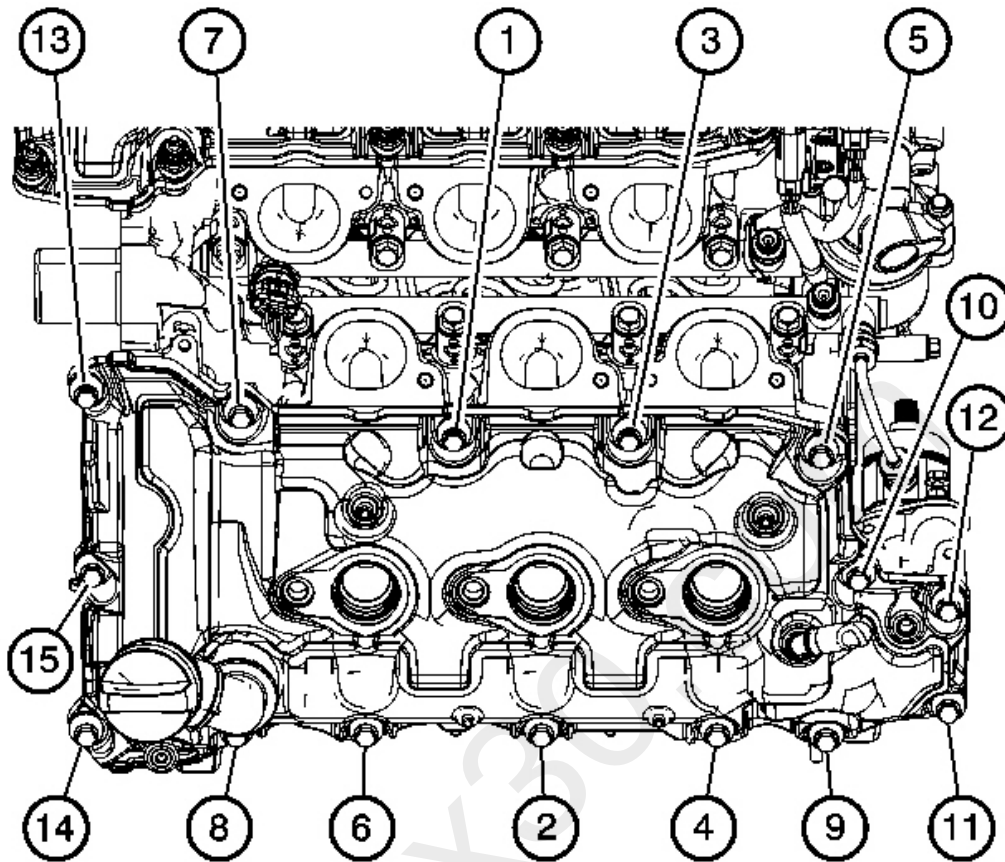


Fig. 115: Identifying Left Camshaft Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

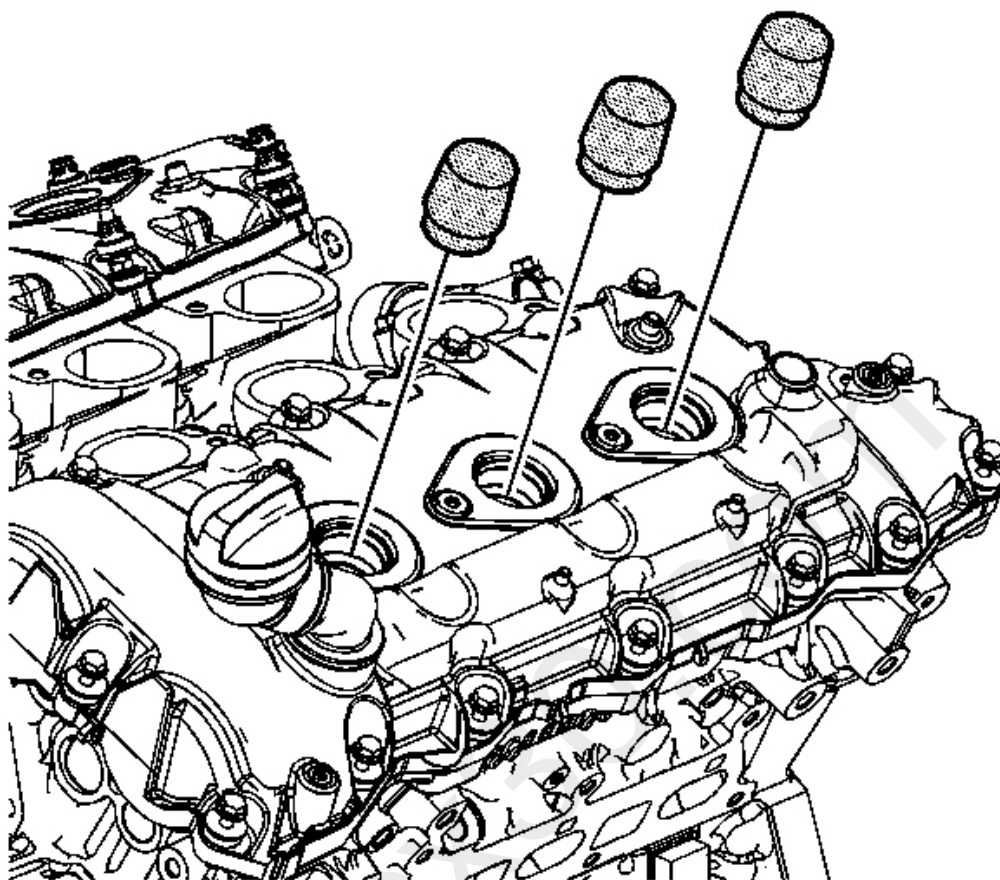


Fig. 116: View of Spark Plug Tubes & Cylinder Head
Courtesy of GENERAL MOTORS CORP.

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

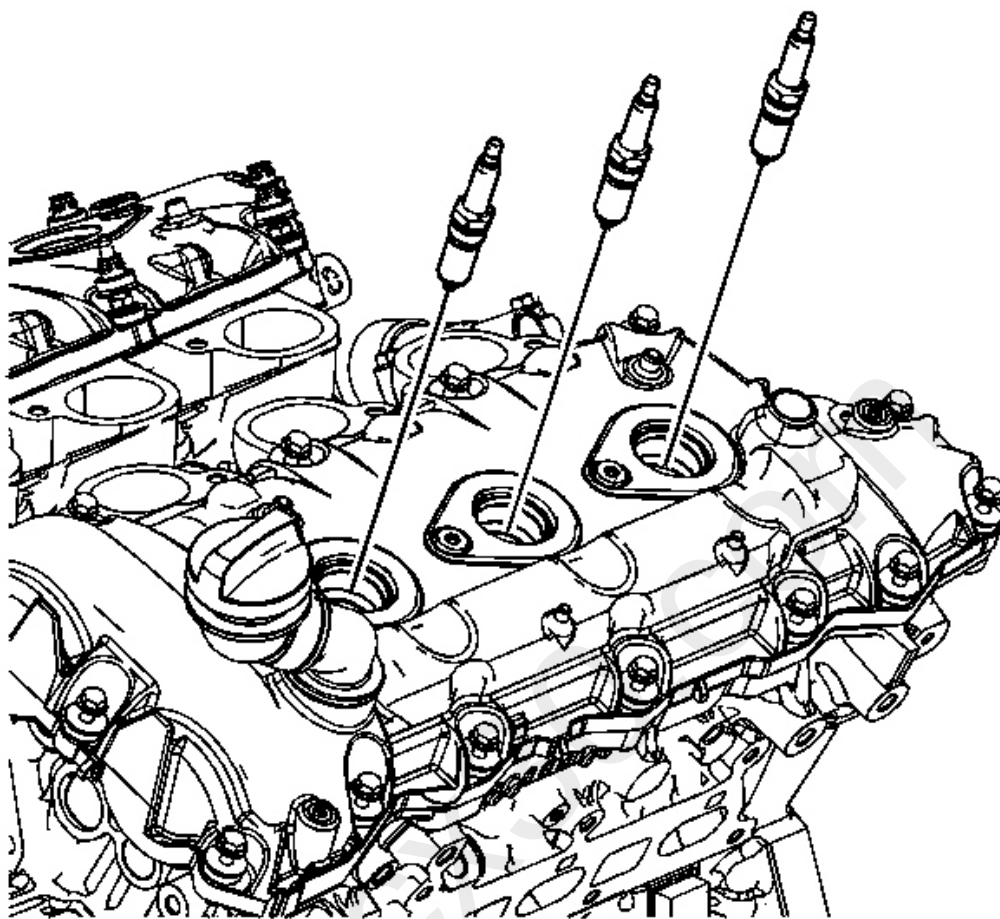


Fig. 117: Removing/Installing Spark Plugs Into Left Cylinder Head
Courtesy of GENERAL MOTORS CORP.

10. Install the NEW spark plugs into the left cylinder head and tighten to 18 N.m (13 lb ft)..

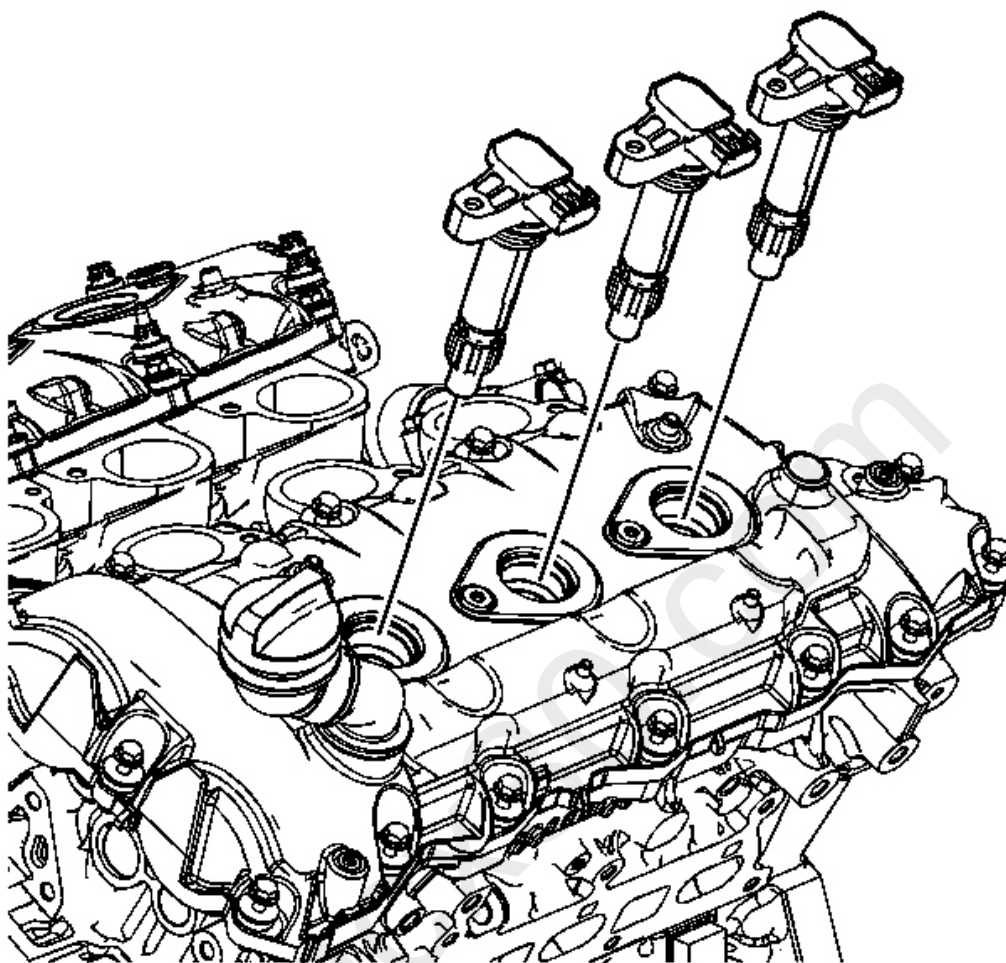


Fig. 118: Removing/Installing Ignition Coils
Courtesy of GENERAL MOTORS CORP.

11. Install the ignition coils.

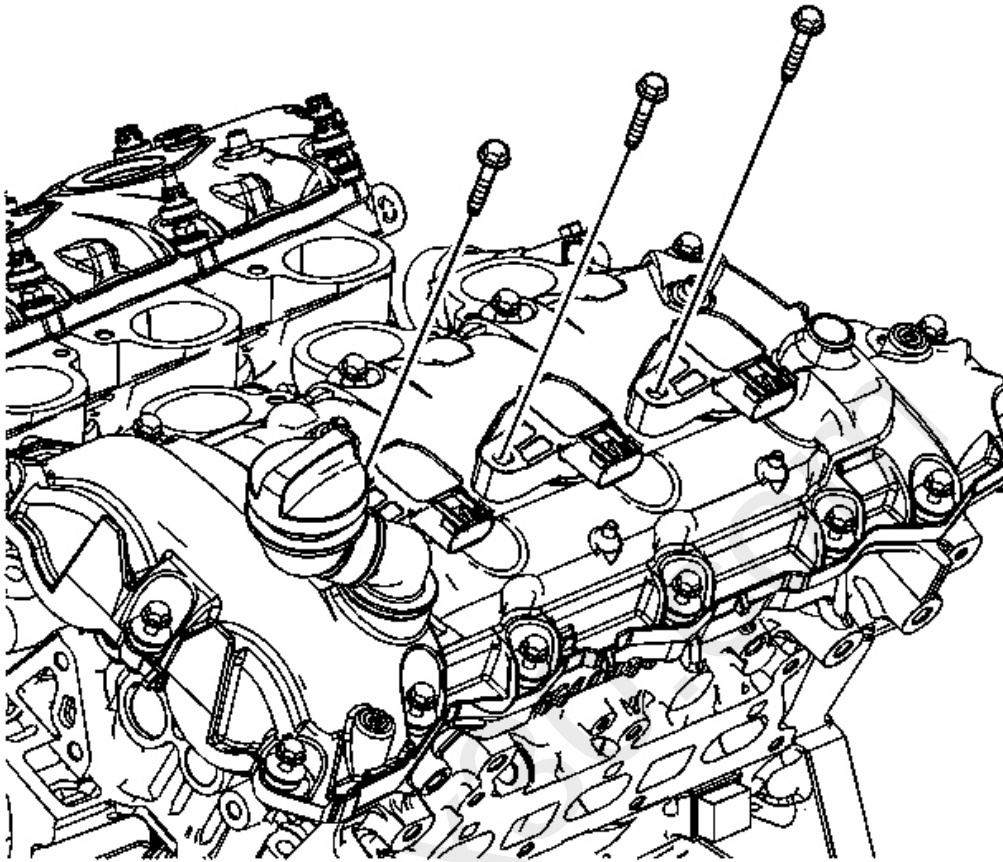


Fig. 119: Removing/Installing Ignition Coil Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the ignition coil bolts and tighten to 10 N.m (89 lb in).

CAMSHAFT COVER INSTALLATION - RIGHT SIDE

SPECIAL TOOLS

EN-46101: Spark Plug Tube Seal Guide

For equivalent regional tools, refer to **Special Tools** .

INSTALLATION

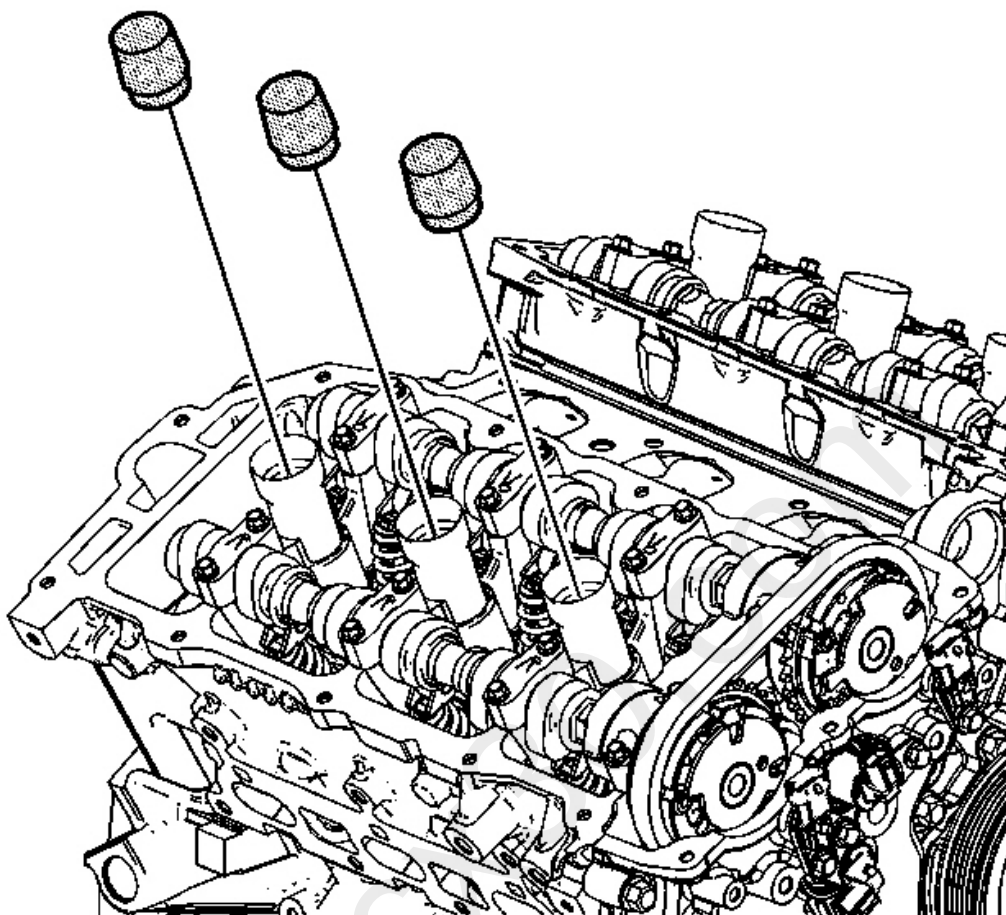


Fig. 120: Installing EN 46101 Into Spark Plug Tubes
Courtesy of GENERAL MOTORS CORP.

1. Install the **EN-46101**: guide onto the spark plug tubes of the right cylinder head.

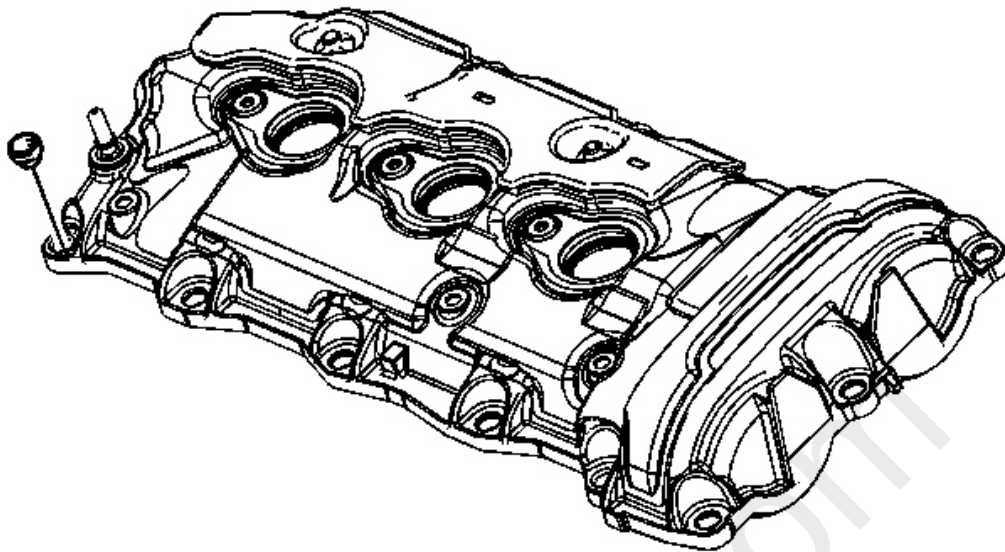


Fig. 121: View Of Right Camshaft Cover Bolt Grommets
Courtesy of GENERAL MOTORS CORP.

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

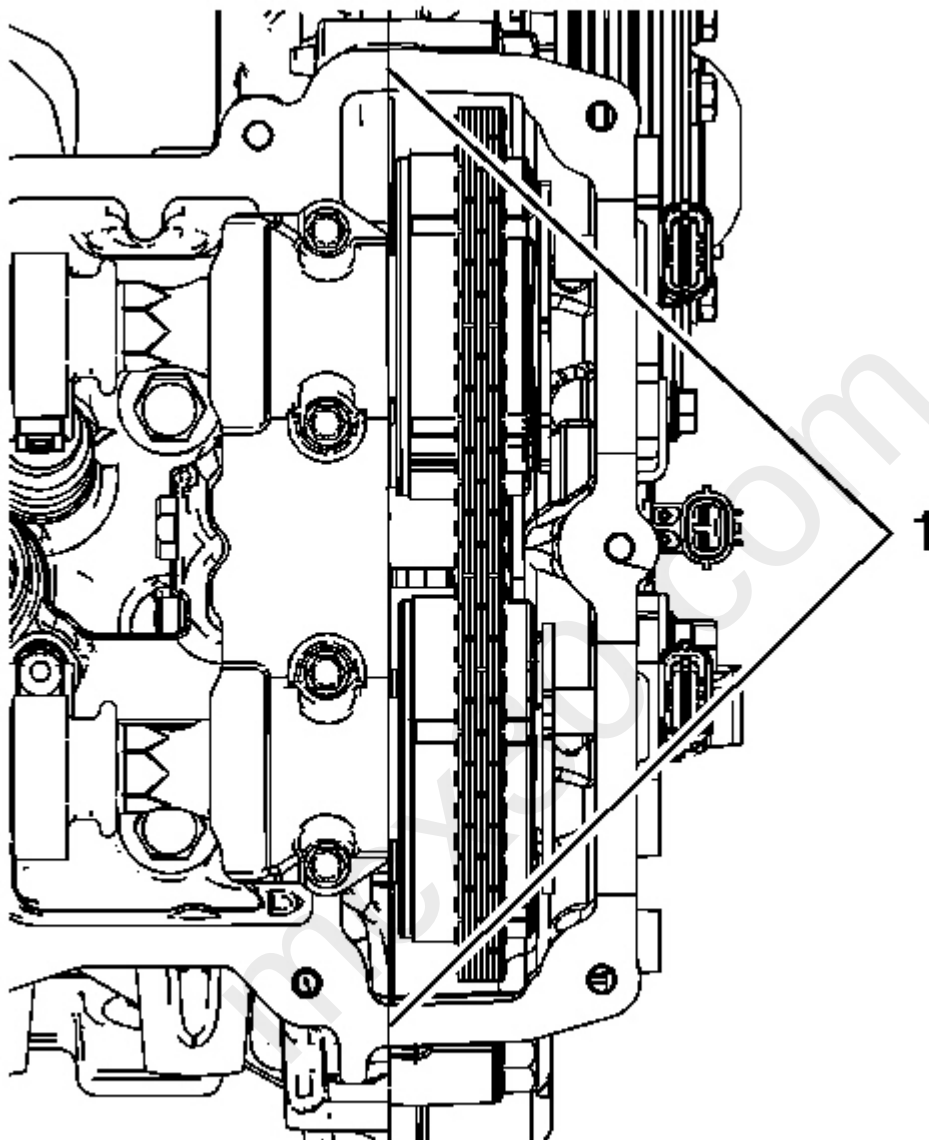


Fig. 122: Identifying Engine Front Cover Split Lines
Courtesy of GENERAL MOTORS CORP.

4. Place a bead 8 mm (0.3150 in) in diameter by 4 mm (0.1575 in) in height of RTV sealant on the engine front cover split lines (1). Refer to **Adhesives, Fluids, Lubricants, and Sealers** for recommended sealant.

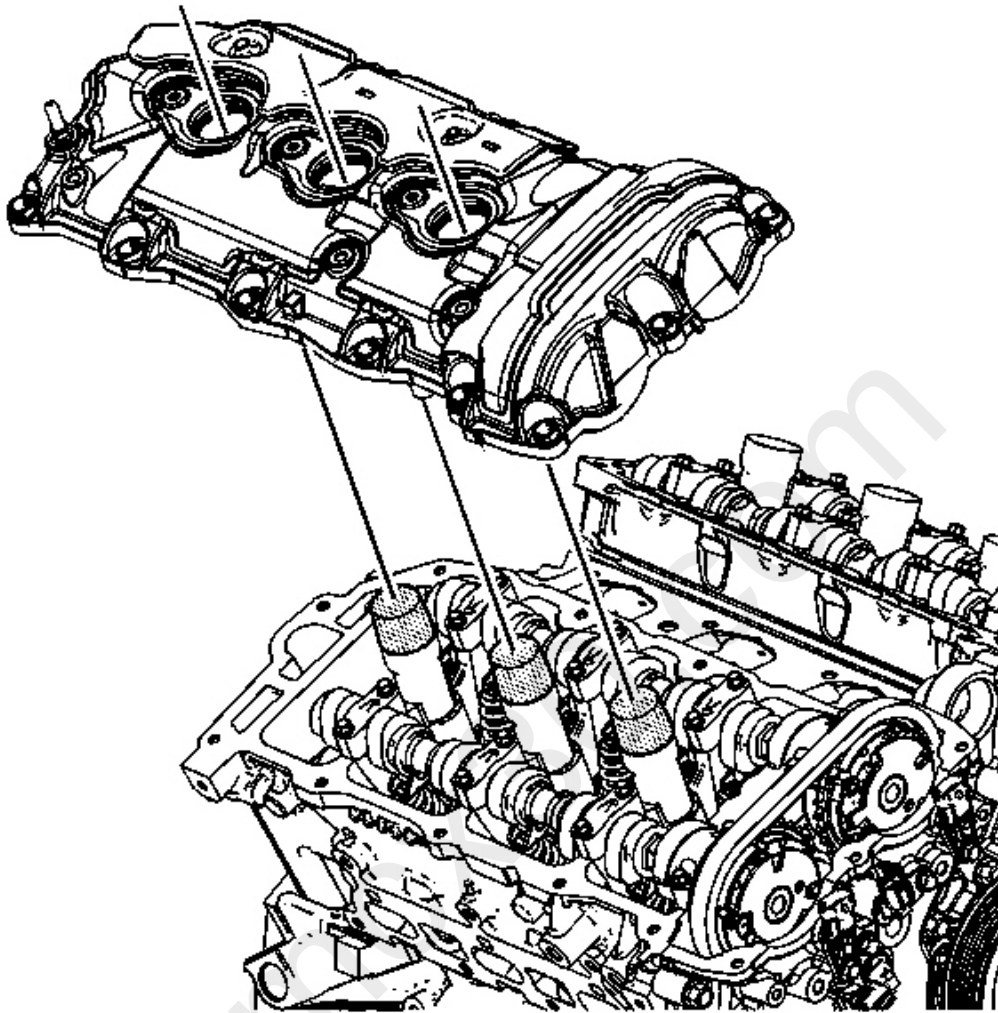


Fig. 123: View Of Right Camshaft Cover
Courtesy of GENERAL MOTORS CORP.

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

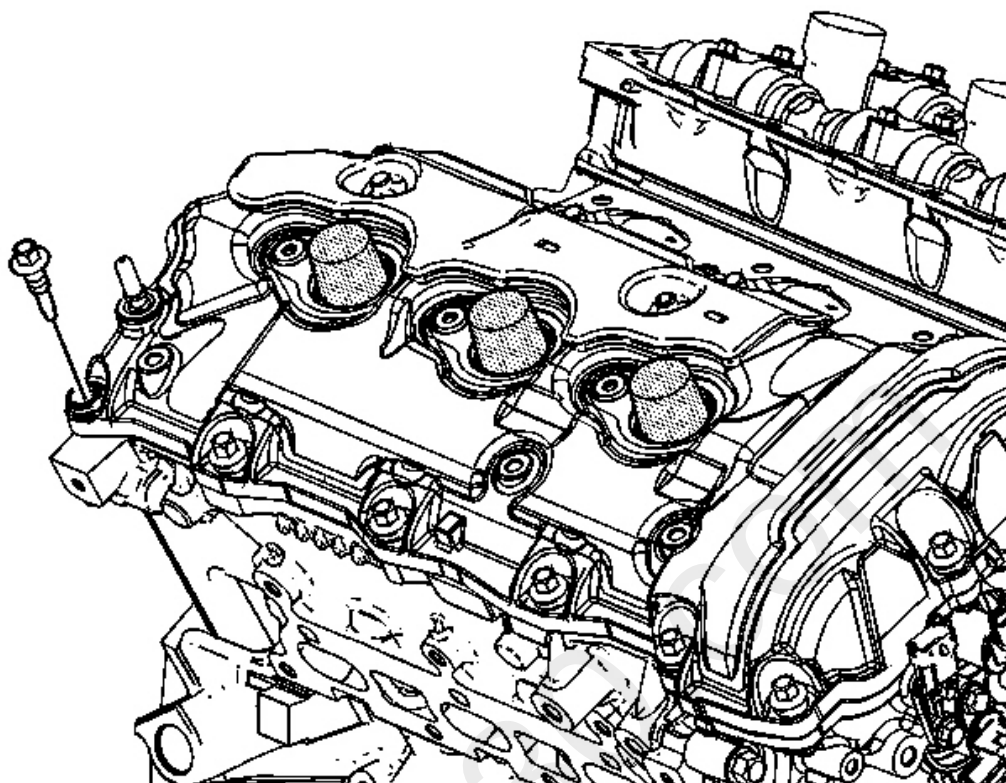


Fig. 124: View Of Right Camshaft Cover Bolts
Courtesy of GENERAL MOTORS CORP.

6. Loosely install the right camshaft cover bolts.

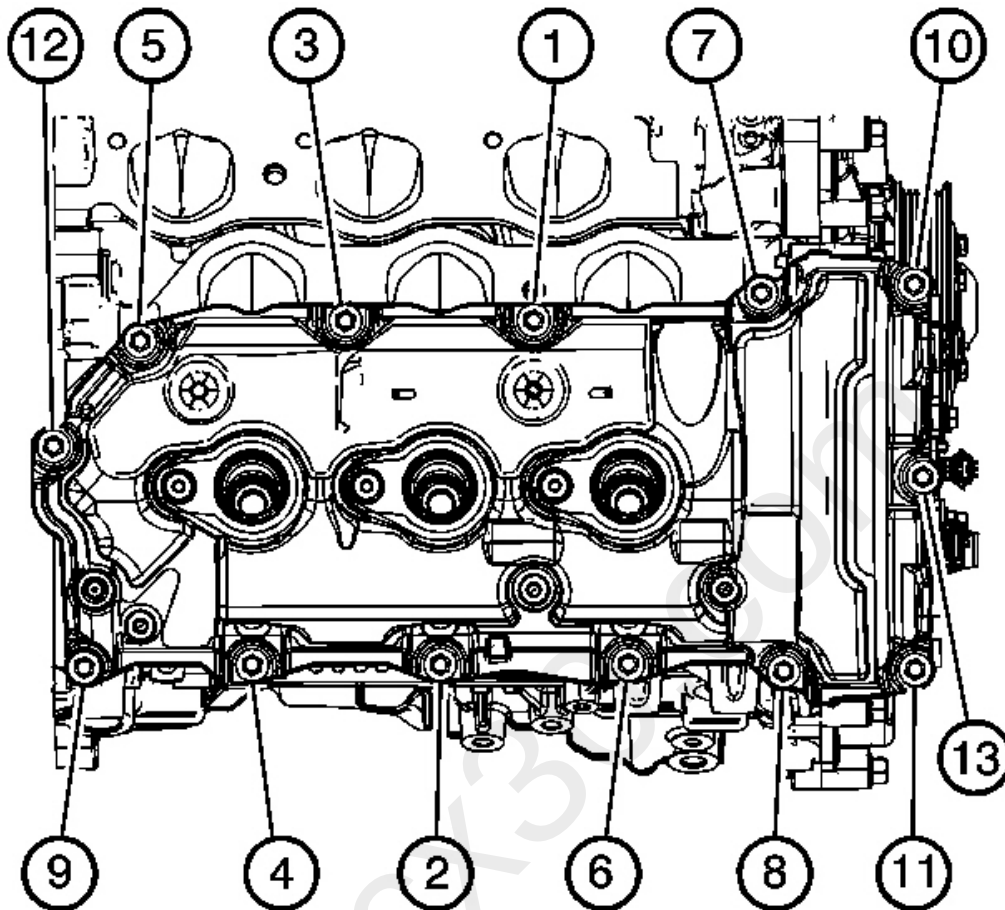


Fig. 125: Identifying Right Camshaft Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

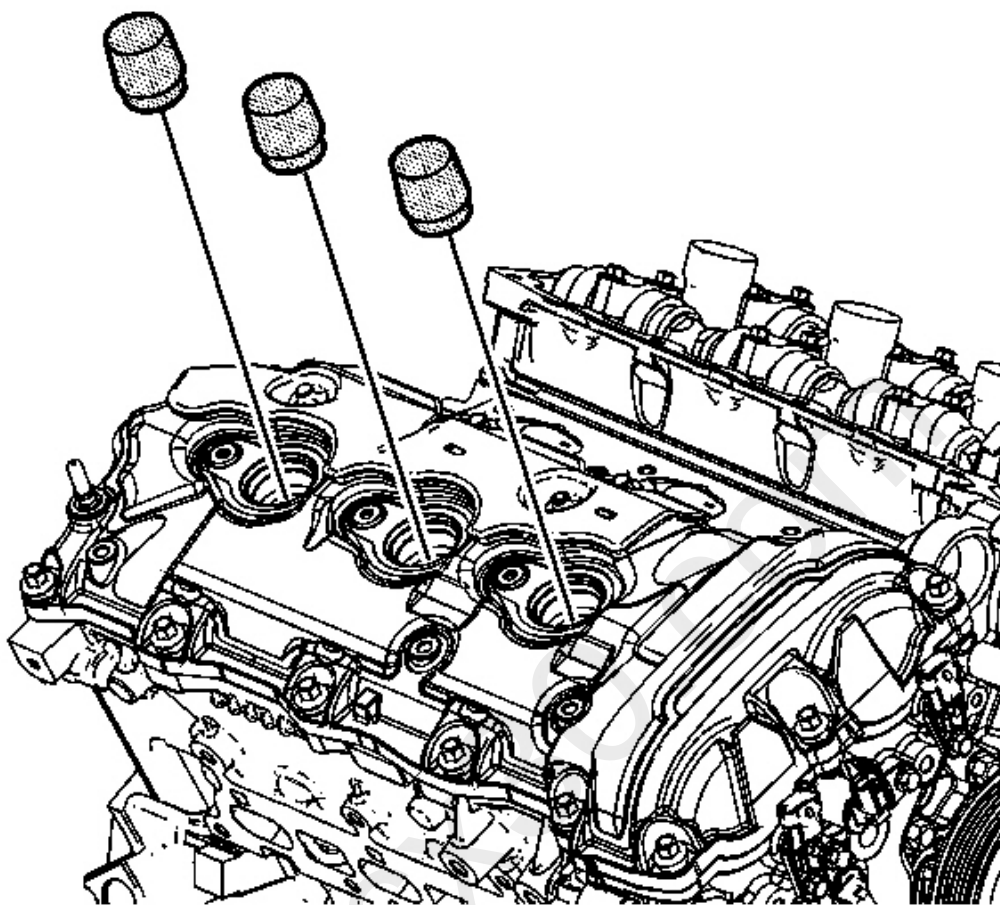


Fig. 126: View Of Spark Plug Tubes
Courtesy of GENERAL MOTORS CORP.

8. Remove the **EN-46101**: guide from the spark plug tubes of the right cylinder head.

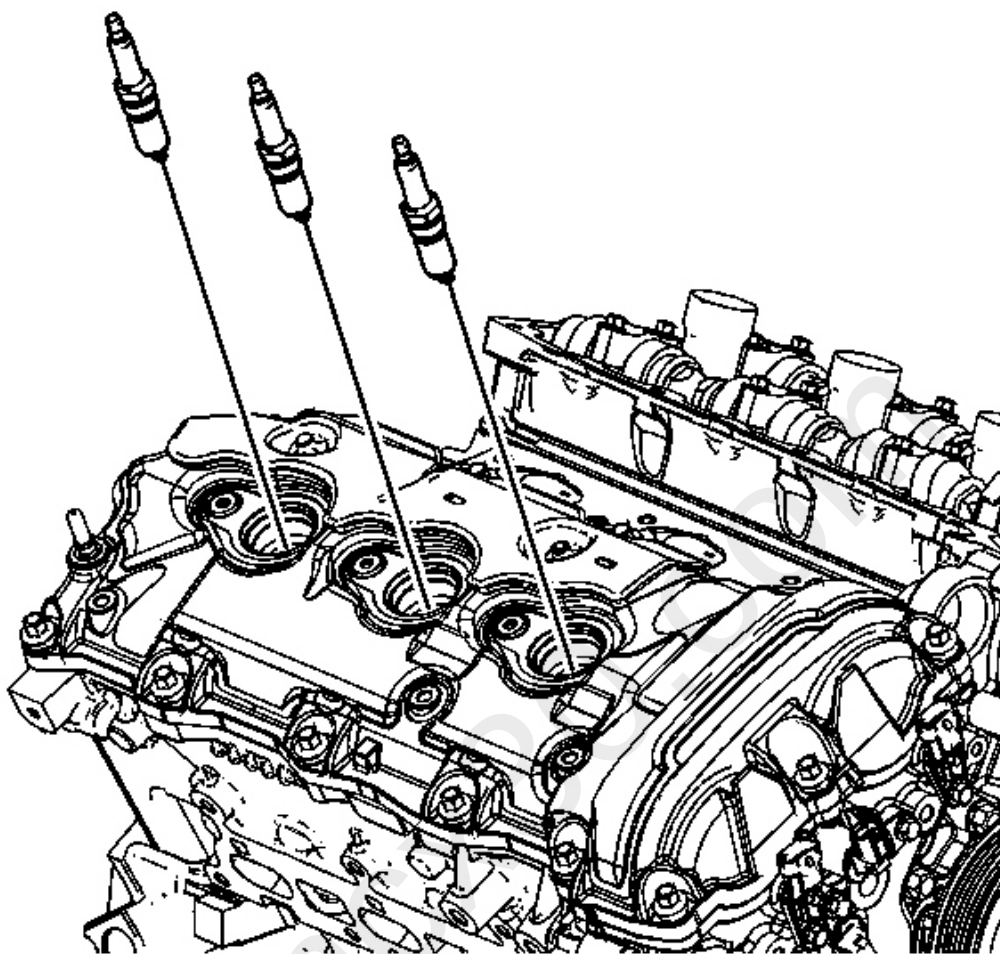


Fig. 127: View Of Spark Plugs

Courtesy of GENERAL MOTORS CORP.

9. Install the NEW spark plugs into the right cylinder head and tighten to 18 N.m (13 lb ft).

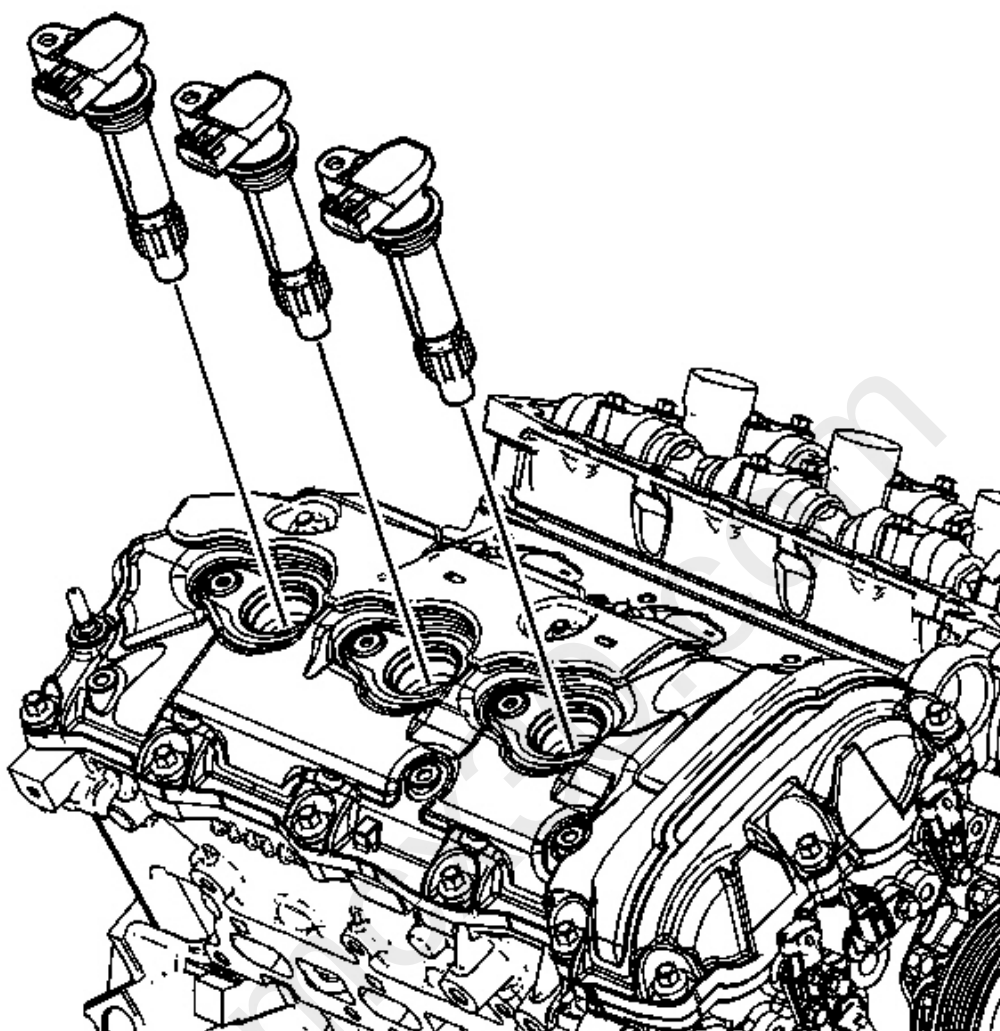


Fig. 128: View Of Ignition Coils
Courtesy of GENERAL MOTORS CORP.

10. Install the ignition coils.

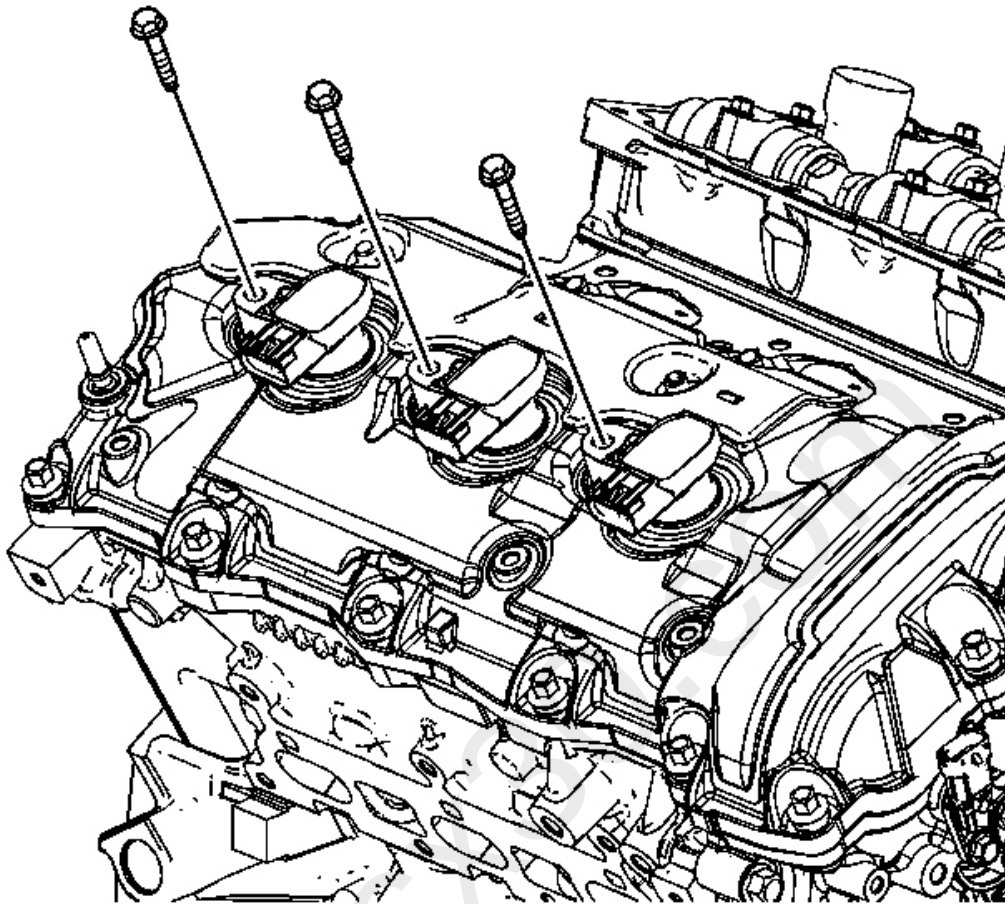


Fig. 129: View Of Ignition Coil Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the ignition coil bolts and tighten to 10 N.m (89 lb in).

INTAKE MANIFOLD INSTALLATION (LF1 OR LFW)

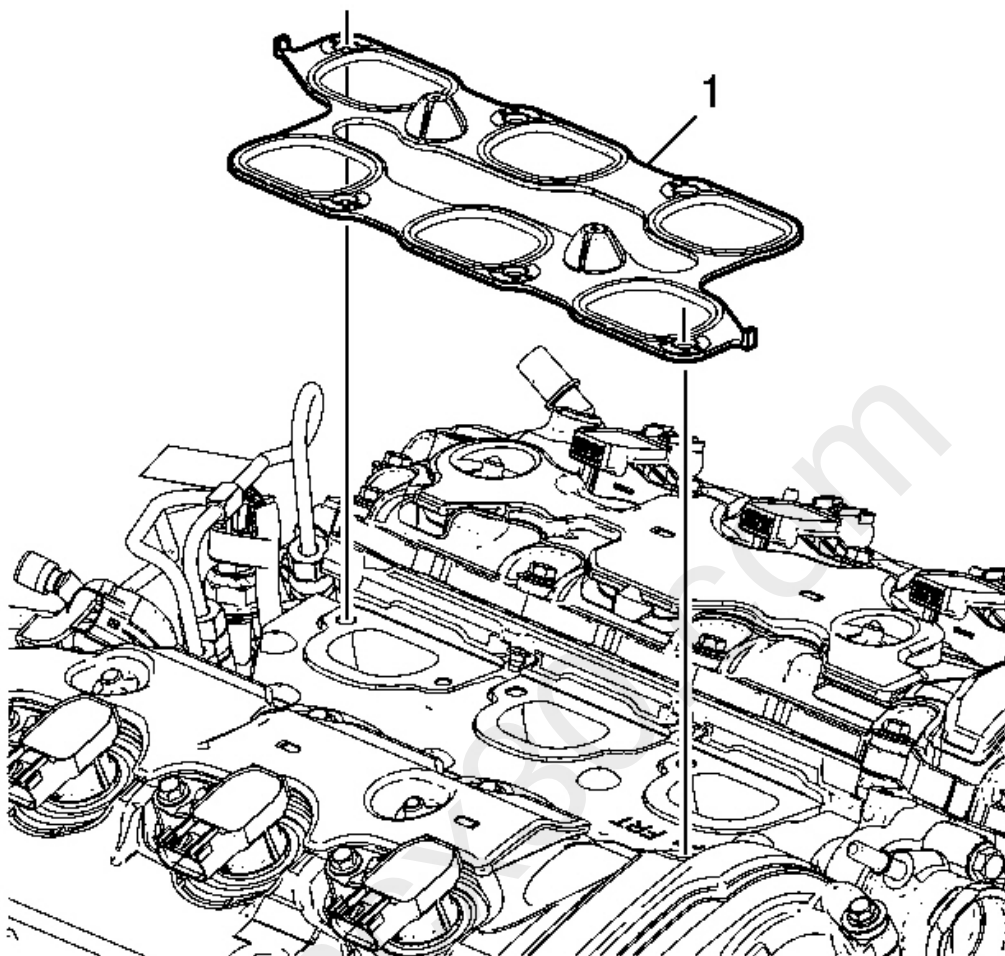


Fig. 130: Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW intake manifold gasket (1).

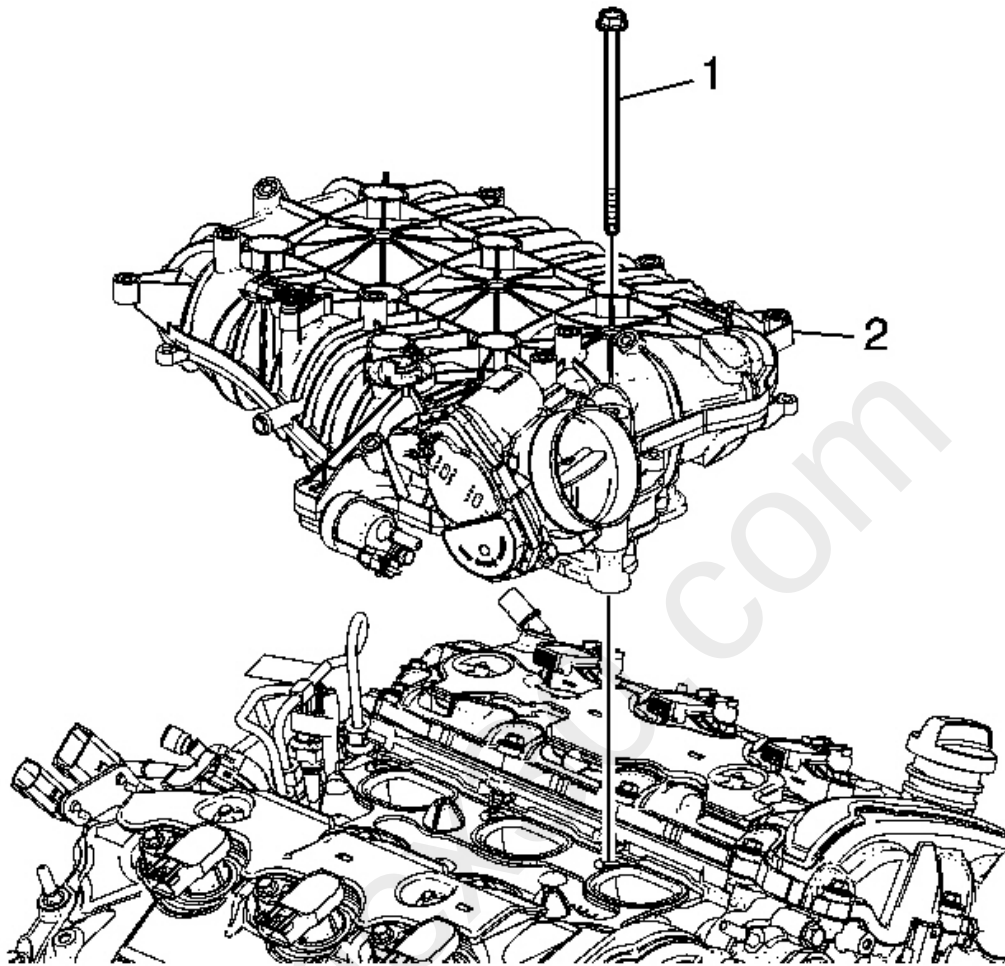


Fig. 131: Intake Manifold Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the intake manifold assembly (2).
3. Install the intake manifold bolts (1).

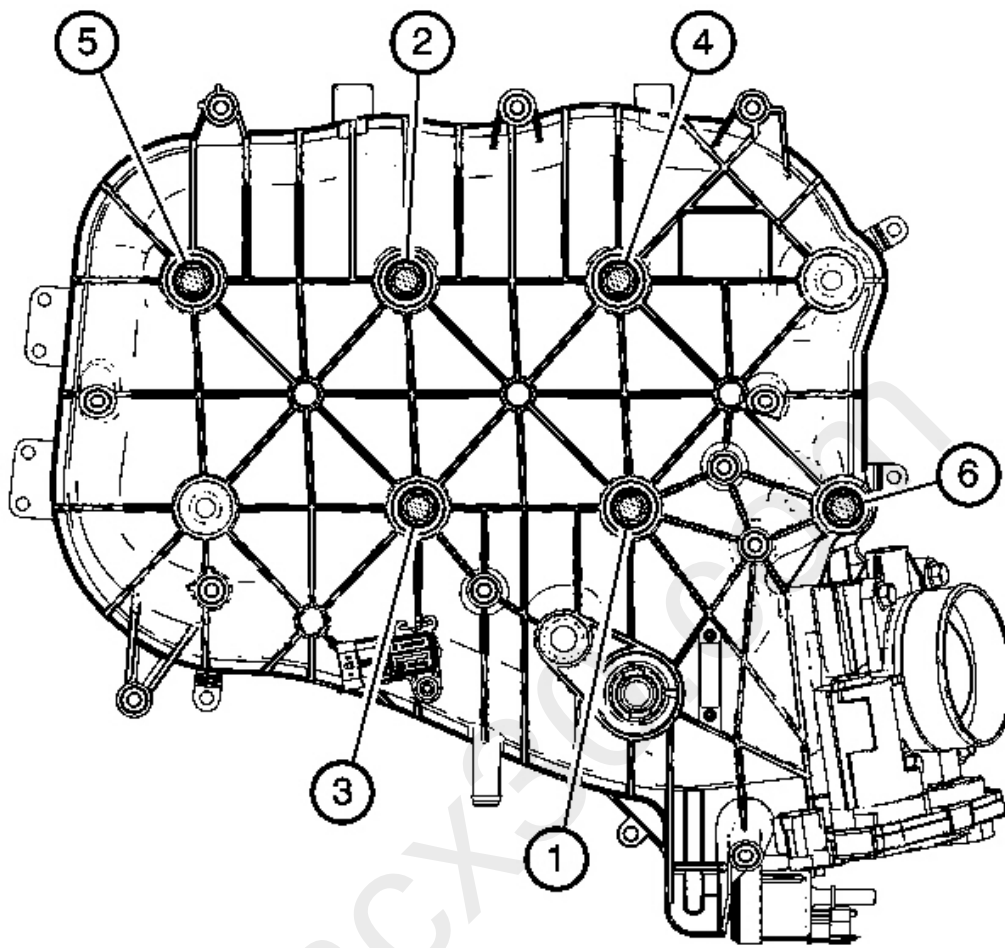


Fig. 132: Identifying Intake Manifold Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Tighten the intake manifold bolts in the sequence shown.
5. Tighten the intake manifold bolts in sequence to 25 N.m (18 lb ft).
6. Tighten the intake manifold bolts a second pass in sequence to 25 N.m (18 lb ft).

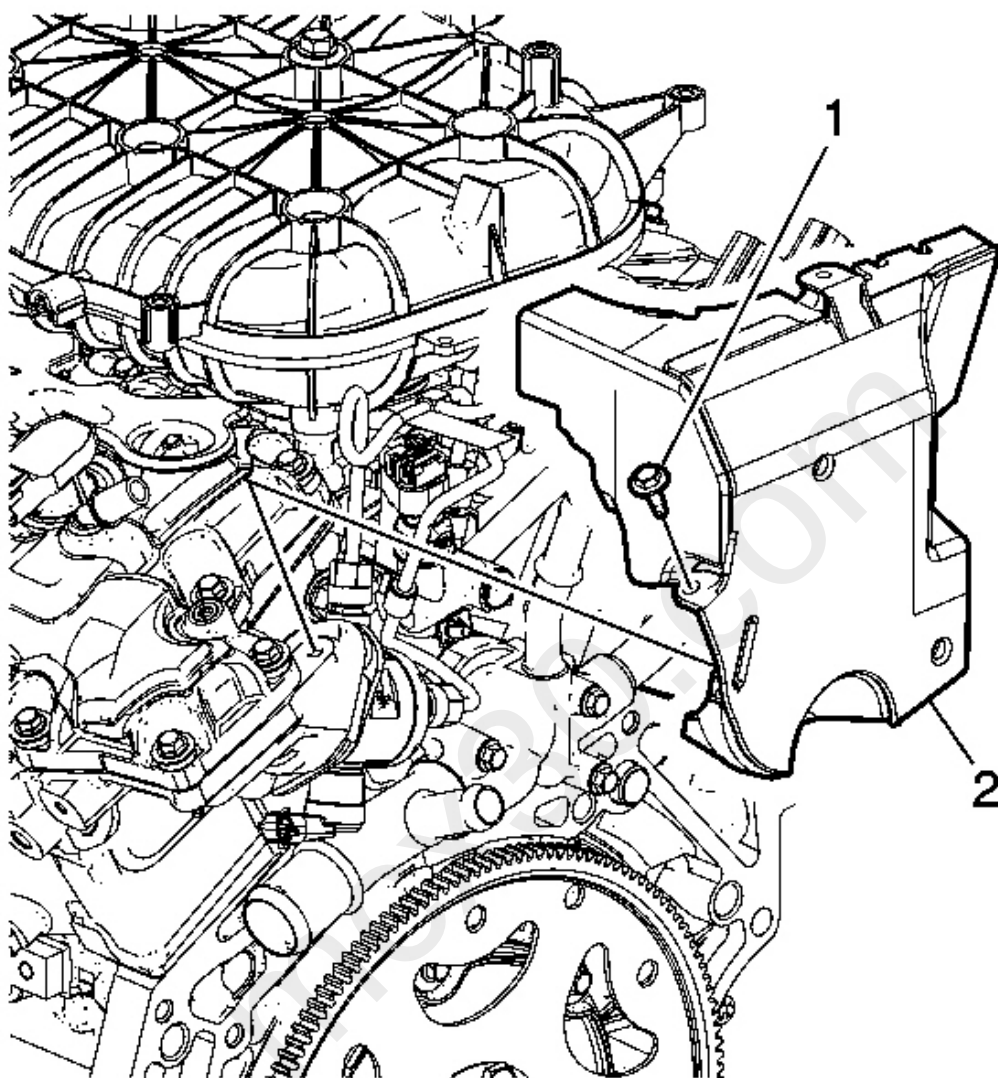


Fig. 133: Fuel Pump Cover

Courtesy of GENERAL MOTORS CORP.

7. Install the fuel pump cover (2).
8. Install the fuel pump cover bolt (1) and tighten to 10 N.m (89 lb in).

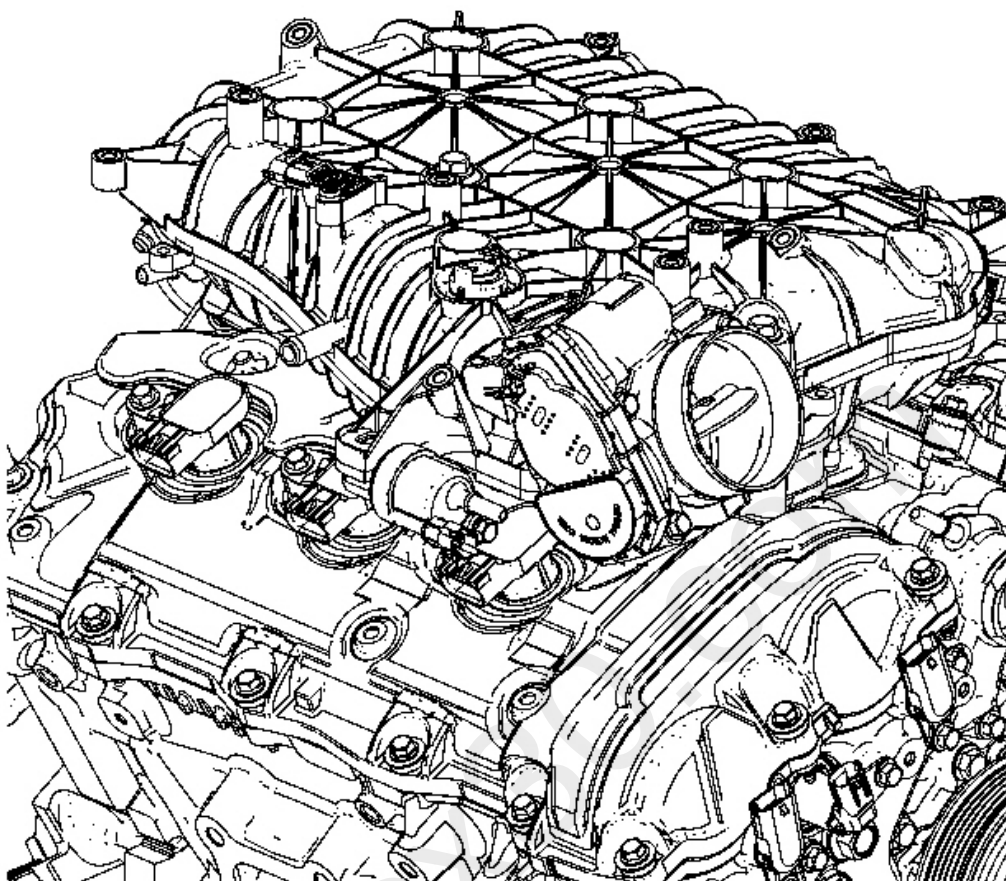


Fig. 134: Upper Intake Manifold & EVAP Solenoid
Courtesy of GENERAL MOTORS CORP.

9. Connect the evaporative (EVAP) hose to the upper intake manifold and EVAP solenoid.

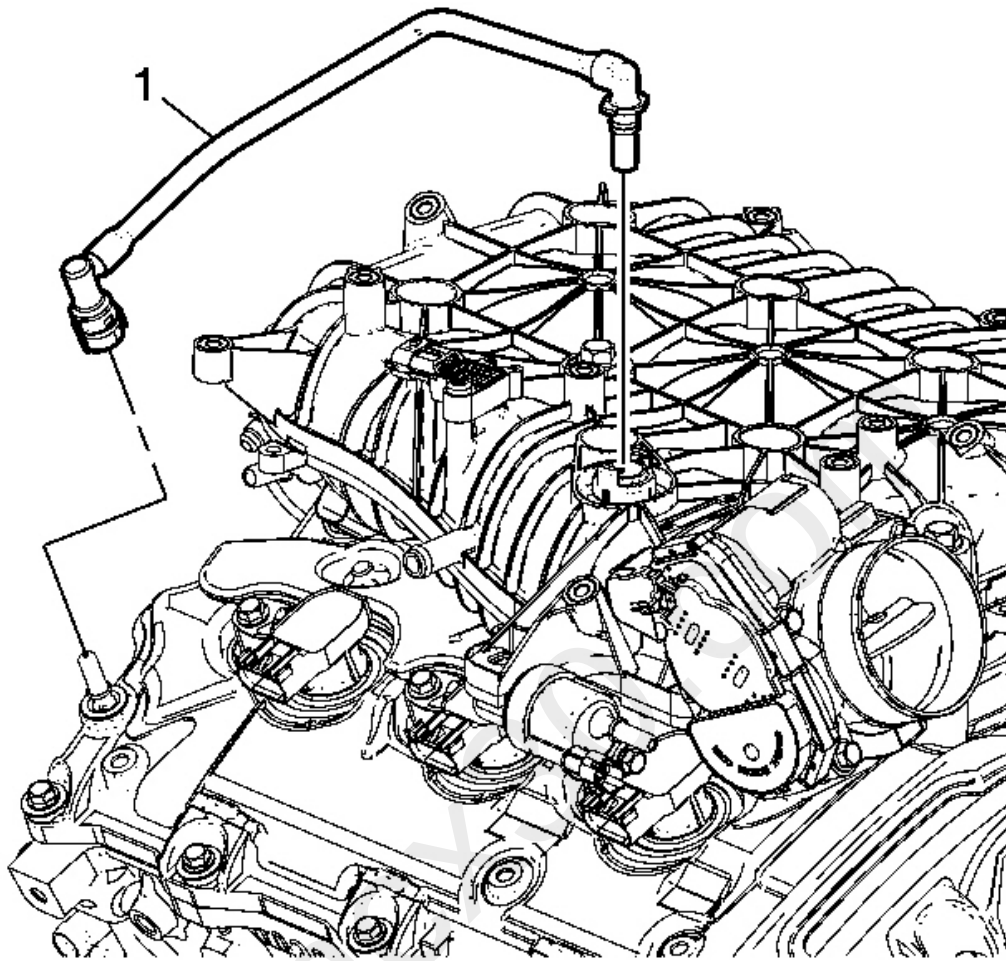


Fig. 135: Positive Crankcase Ventilation (PCV) Tube Assembly
Courtesy of GENERAL MOTORS CORP.

10. Connect the positive crankcase ventilation (PCV) tube assembly (1) to the upper intake manifold and the right camshaft cover.

ENGINE FLYWHEEL INSTALLATION

Special Tools

- **EN 45059:** Angle Meter
- **EN 46106:** Engine Flywheel Holding Tool

For equivalent regional tools, refer to **Special Tools**

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.

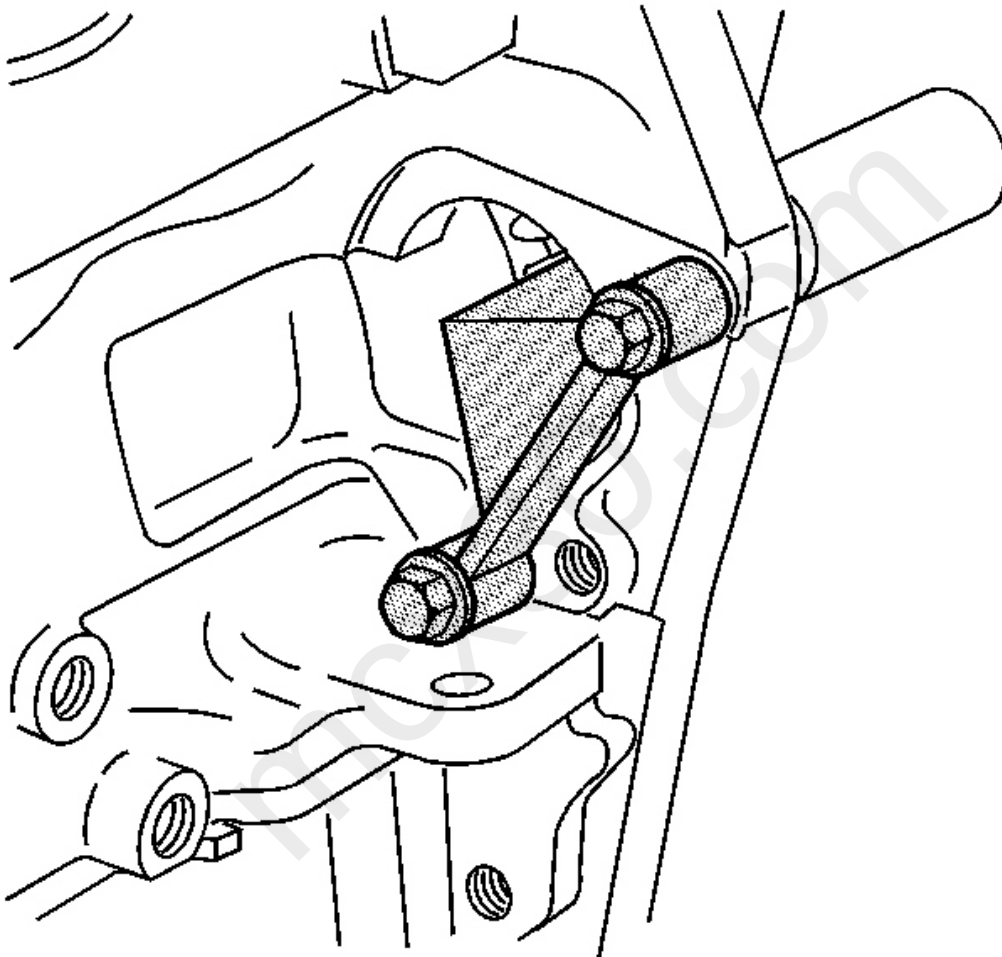


Fig. 136: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

3. Install the **EN 46106**: tool.

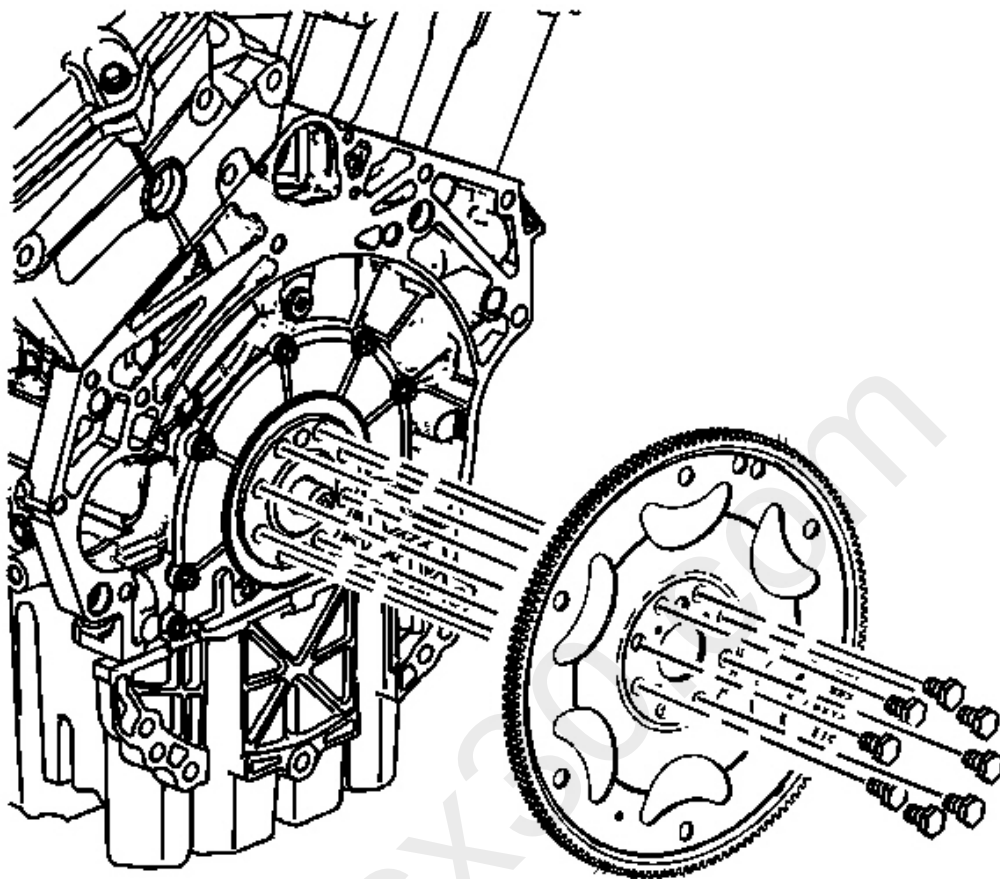


Fig. 137: View Of Engine Flywheel Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

4. Install the remaining NEW engine flywheel bolts.
 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 **EN 45059:** meter .

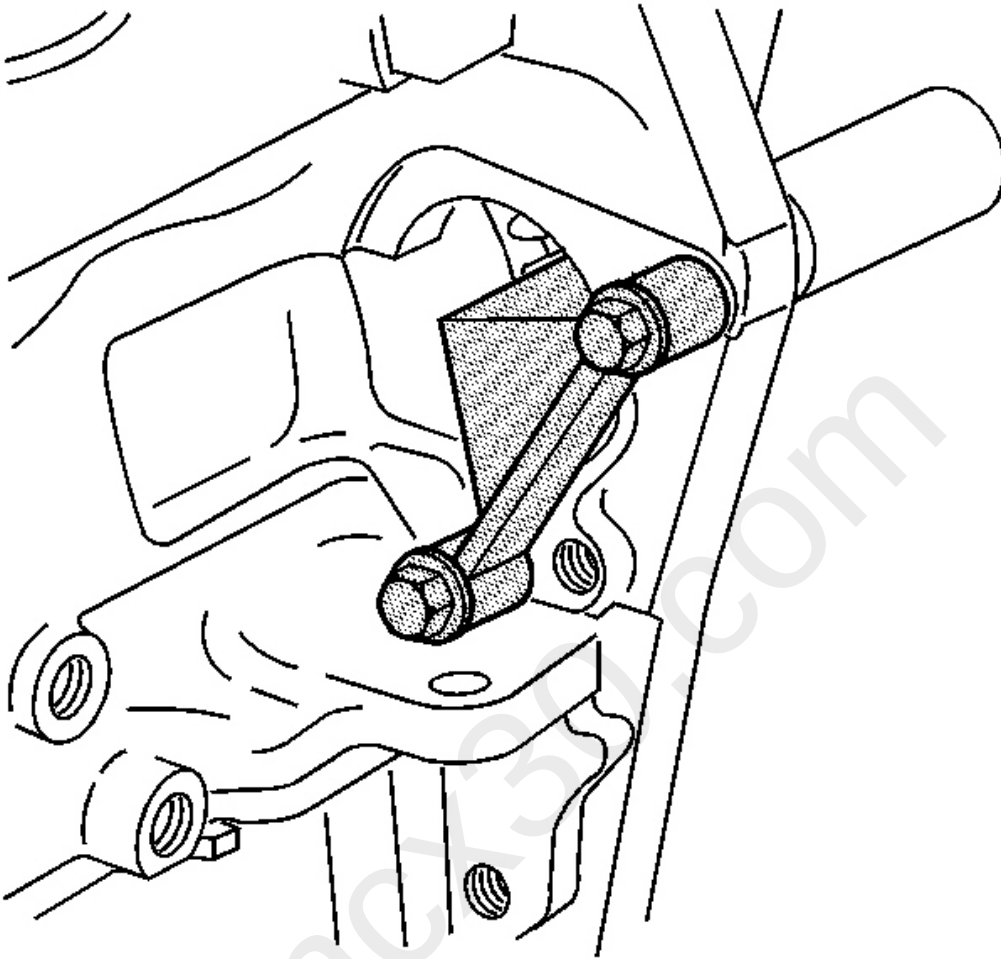


Fig. 138: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

5. Remove the **EN 46106**: tool.

CRANKSHAFT BALANCER INSTALLATION

Special Tools

- **EN 41998-B**: Crankshaft Balancer Installer
- **EN 45059**: Angle Meter
- **EN 46106**: Engine Flywheel Holding Tool

For equivalent regional tools, refer to **Special Tools** .

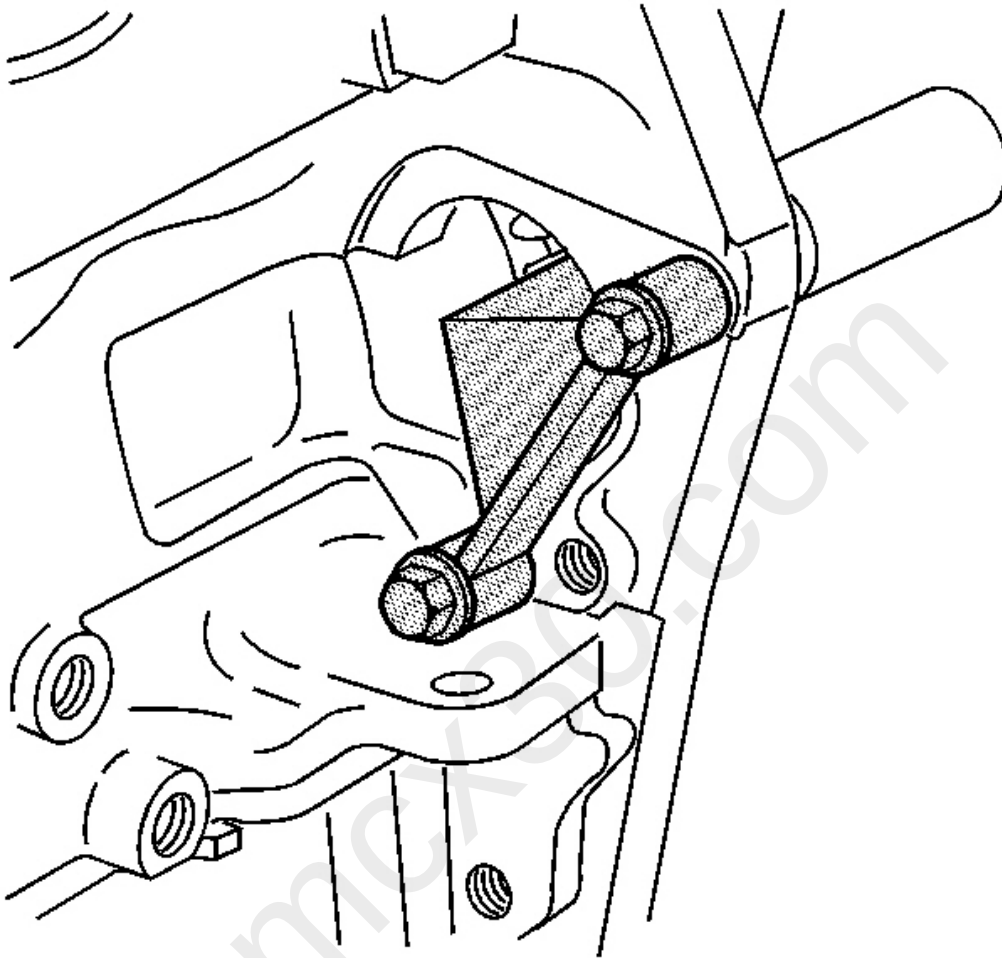


Fig. 139: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

1. The **EN 46106**: tool must be installed onto the flywheel.
2. Use the **EN 41998-B**: installer, nut, bearing and washer to install the crankshaft balancer.

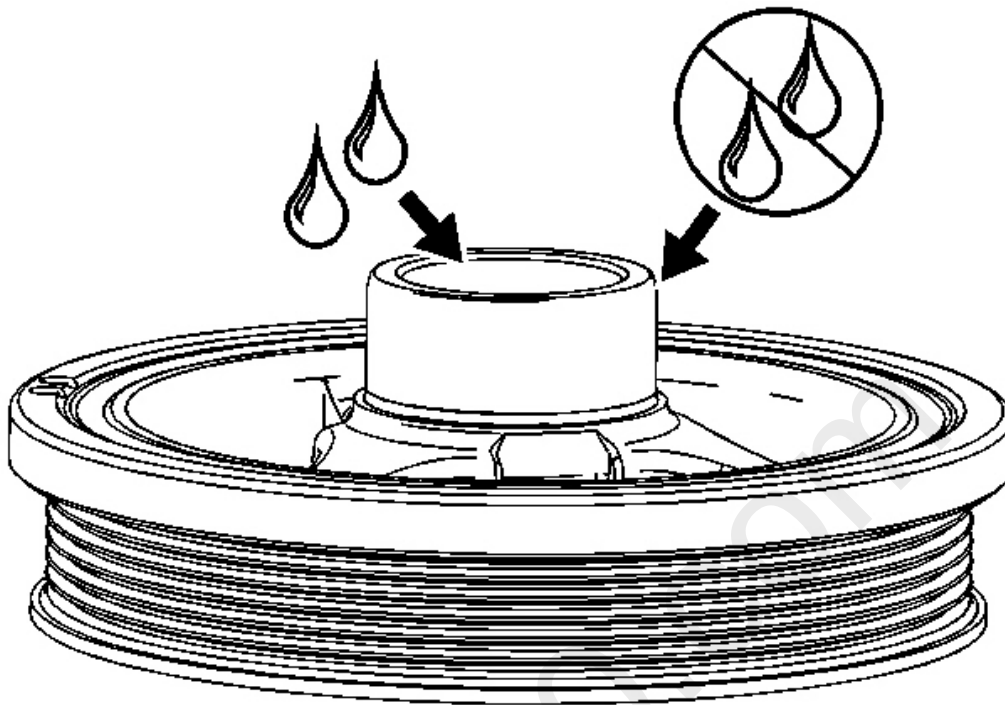


Fig. 140: Identifying Lubrication & Non-Lubrication Areas On Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

NOTE: 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.

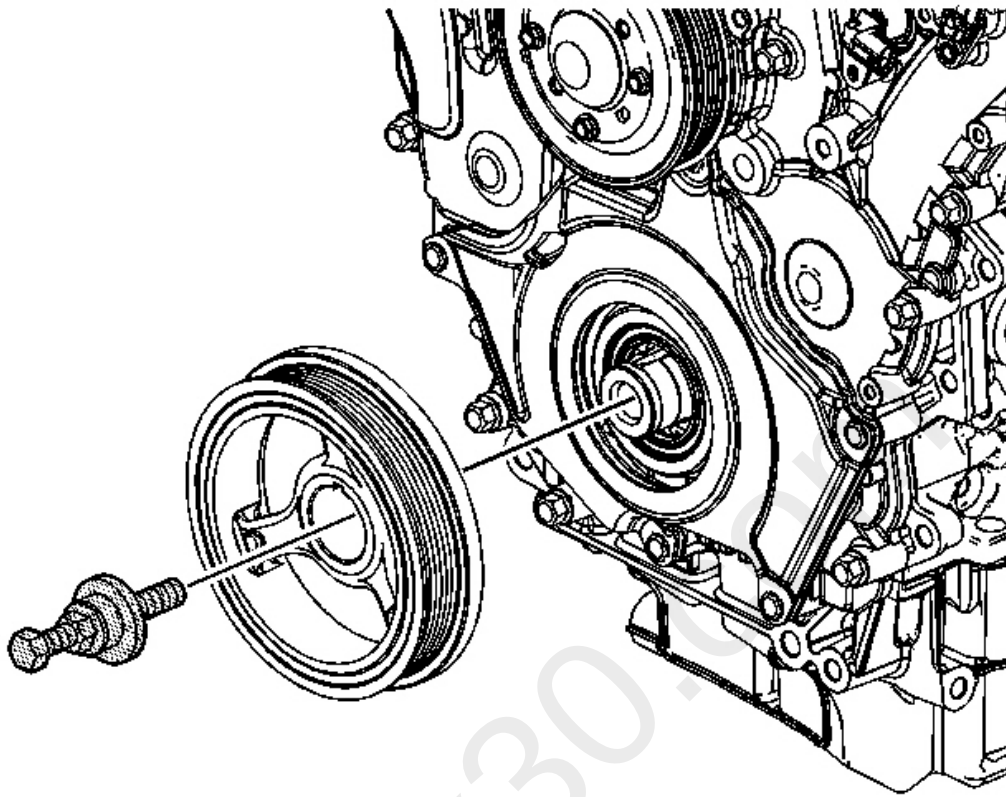


Fig. 141: View Of Crankshaft Balancer & Bolt
Courtesy of GENERAL MOTORS CORP.

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

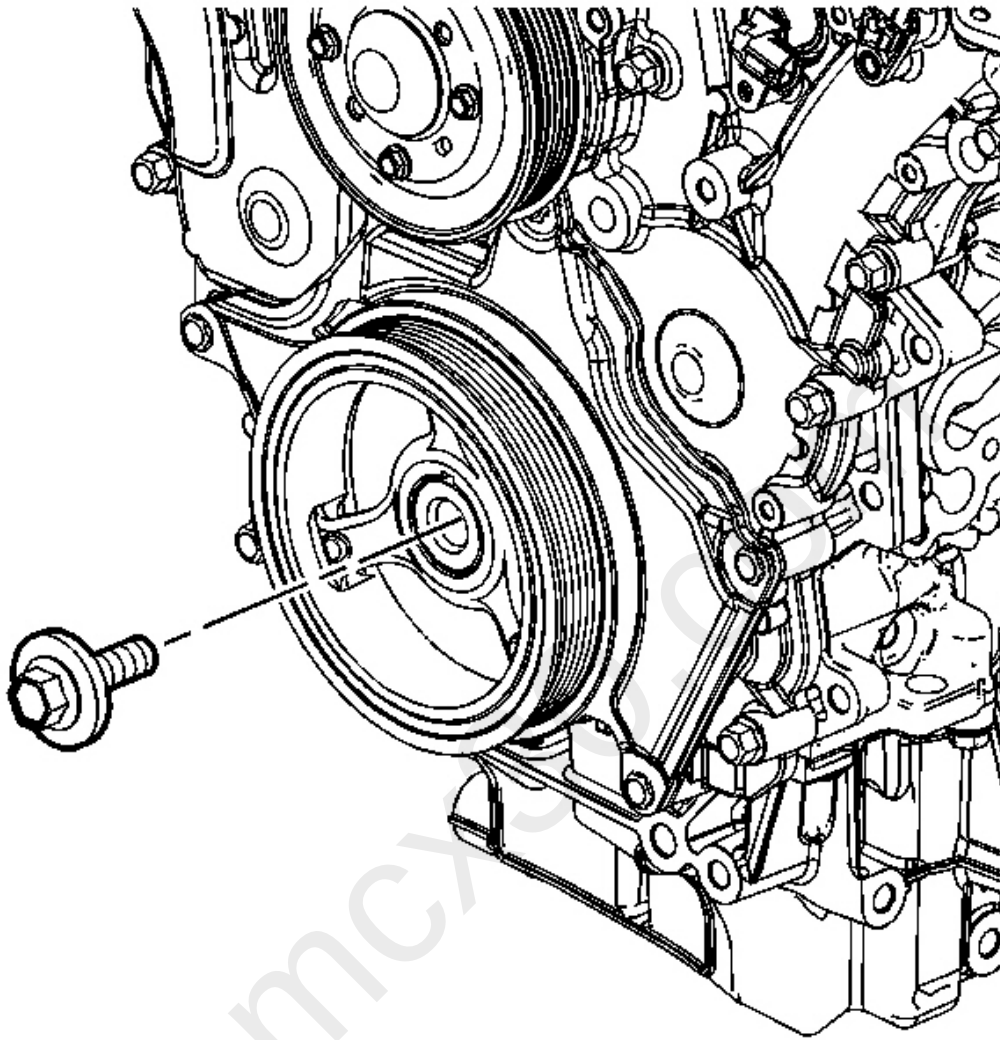


Fig. 142: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

8. Install the NEW crankshaft balancer bolt.

CAUTION: Refer to Fastener Caution .

9. Tighten the crankshaft balancer bolt.
 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 **EN 45059:** meter .

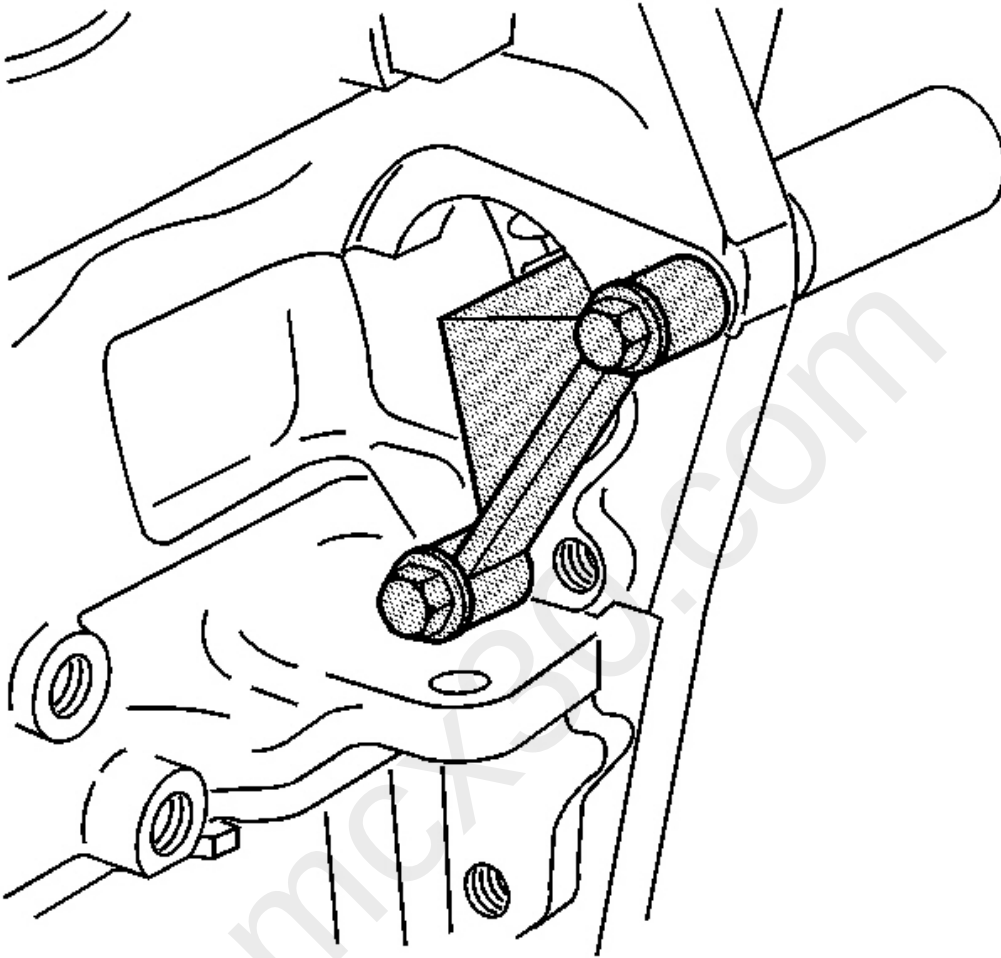


Fig. 143: View Of Tool EN 46106
Courtesy of GENERAL MOTORS CORP.

10. Remove the **EN 46106:** tool.

OIL FILTER ADAPTER INSTALLATION

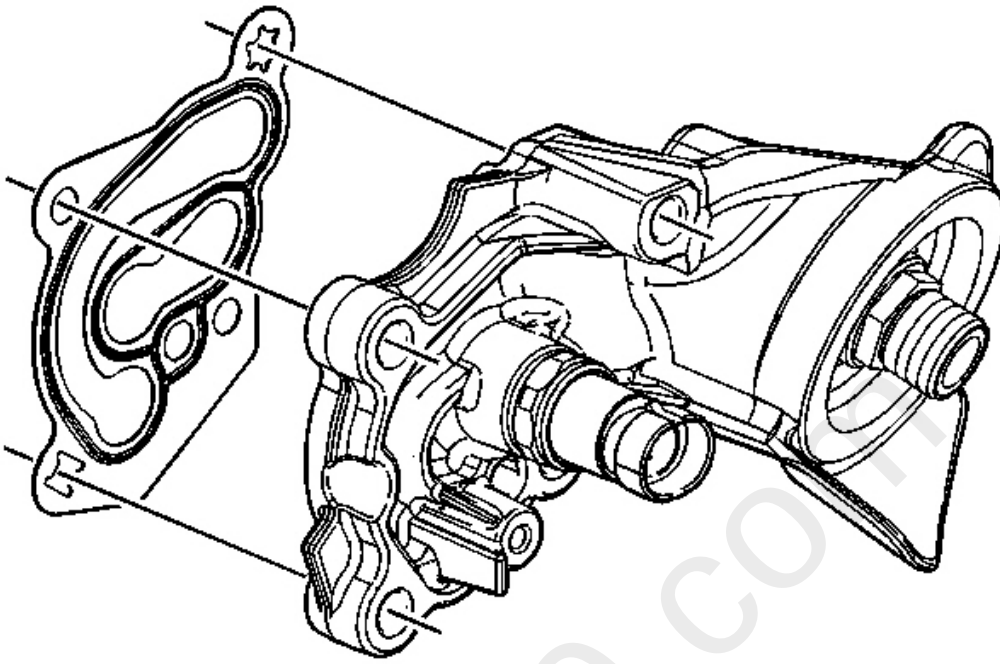


Fig. 144: View Of Oil Filter Adapter & Gasket
Courtesy of GENERAL MOTORS CORP.

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

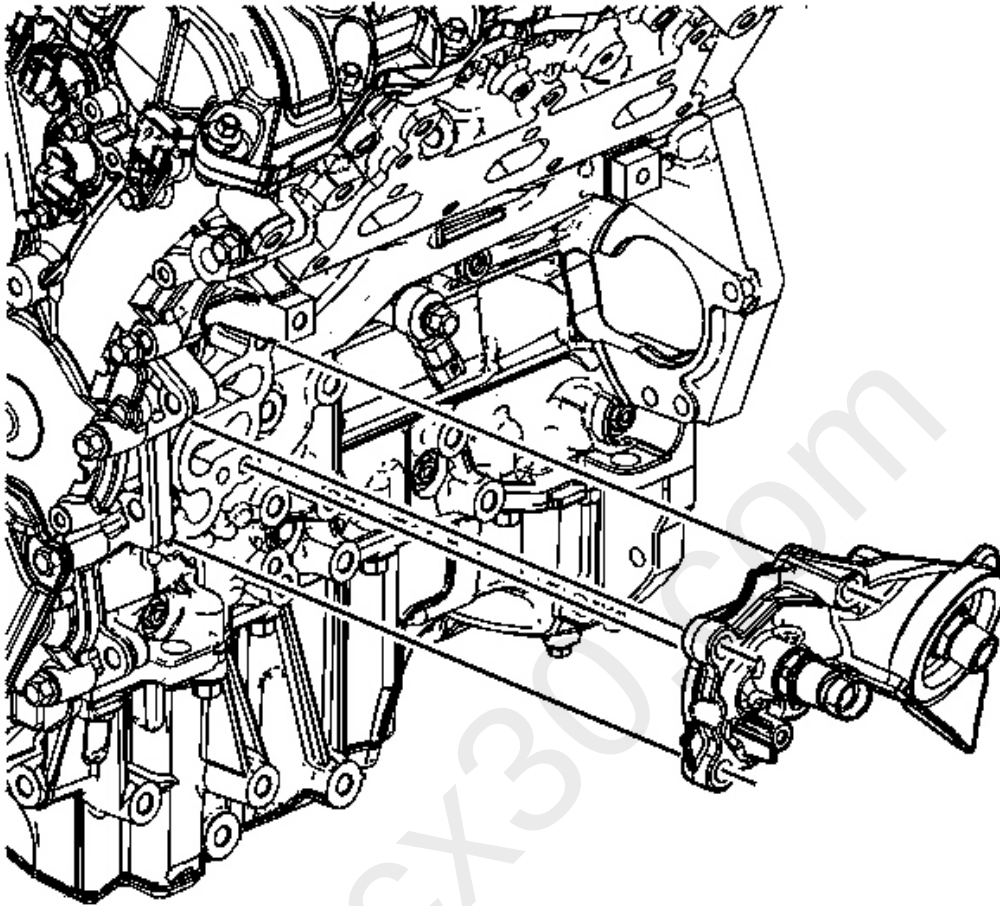


Fig. 145: Removing/Installing Oil Filter Adapter
Courtesy of GENERAL MOTORS CORP.

2. Place the oil filter adapter into position.

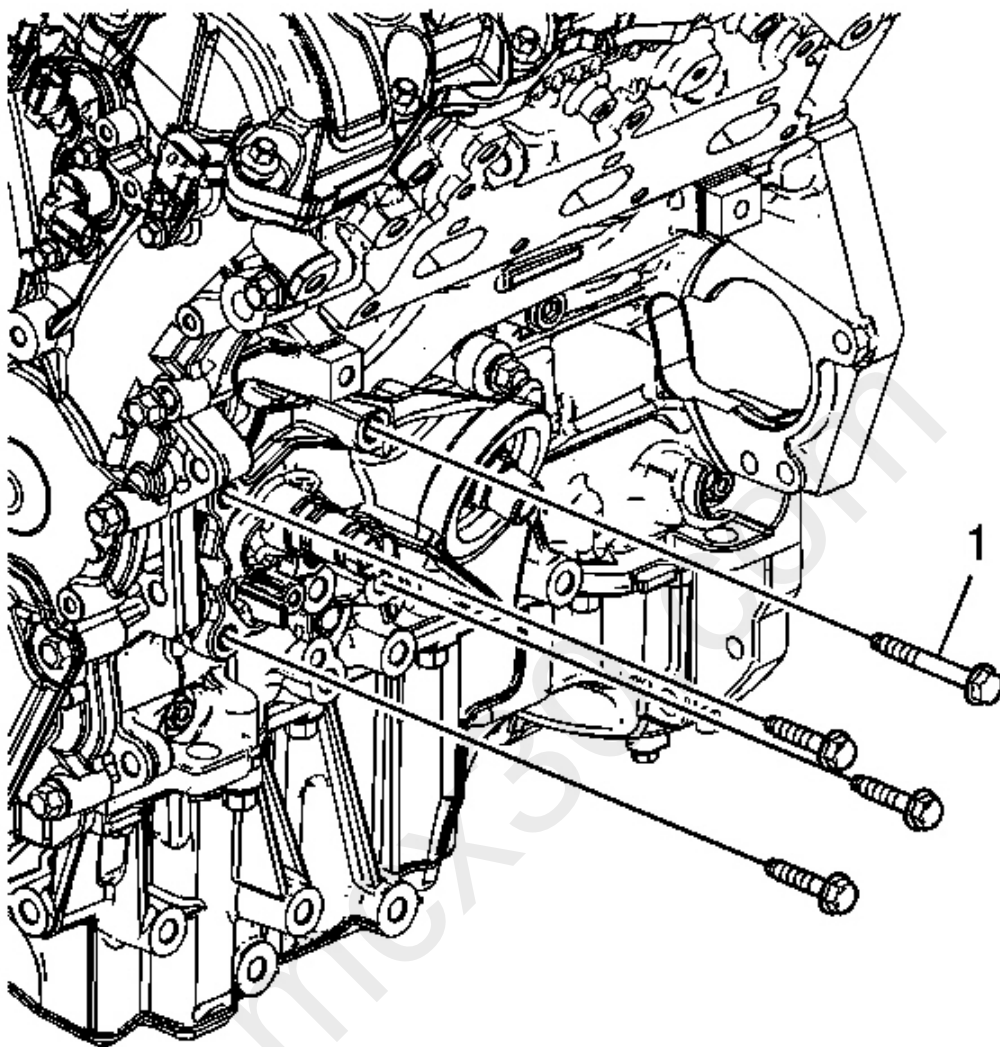


Fig. 146: Identifying Oil Filter Adapter Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the oil filter adapter bolts. Ensure the longer bolts (1) is installed in the upper rear position and tighten the oil filter adapter bolts to 25 N.m (18 lb ft).

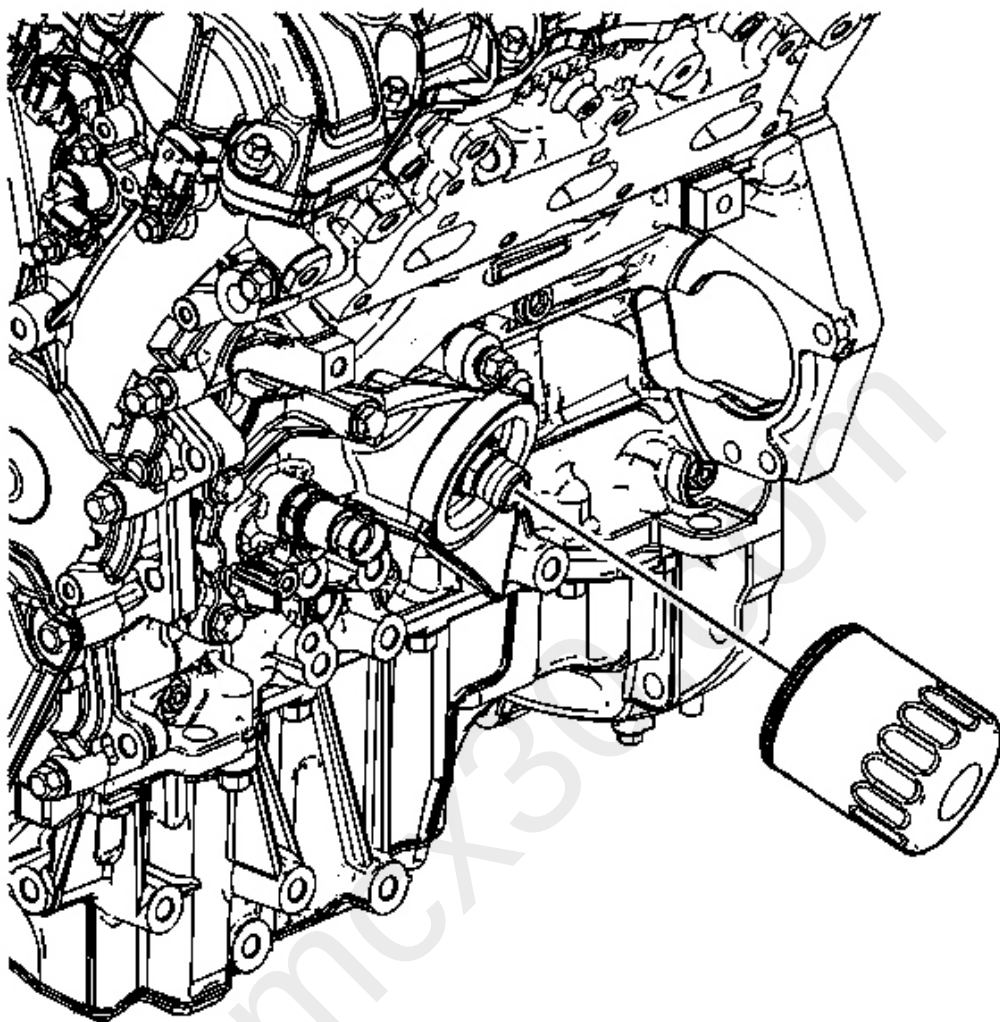


Fig. 147: Removing/Installing Oil Filter
Courtesy of GENERAL MOTORS CORP.

4. Install a NEW oil filter.

OIL LEVEL INDICATOR AND TUBE INSTALLATION (LF1 OR LFW)

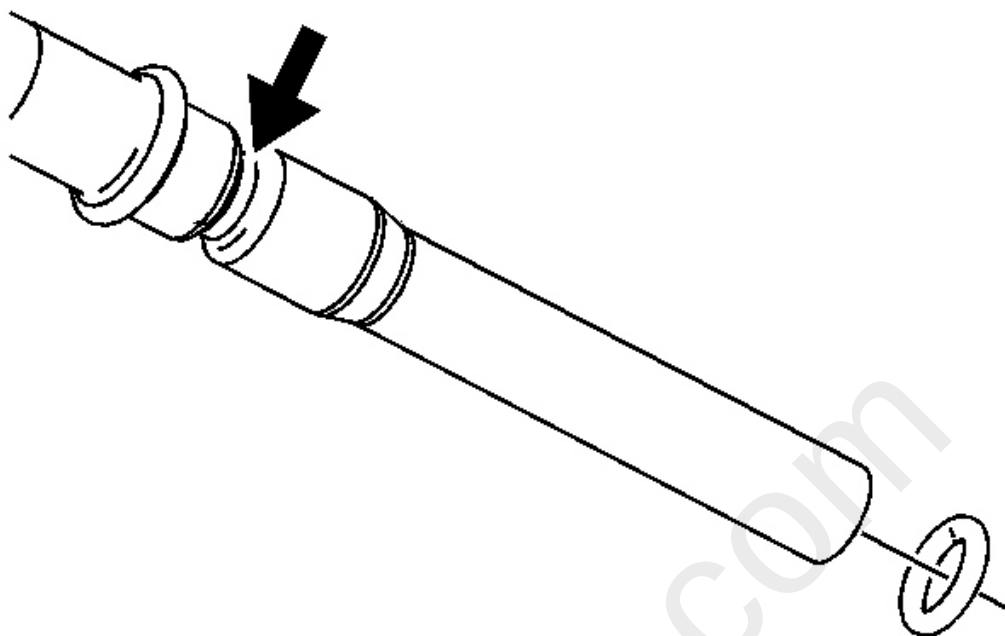


Fig. 148: View Of Oil Level Indicator Tube O-Ring
Courtesy of GENERAL MOTORS CORP.

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

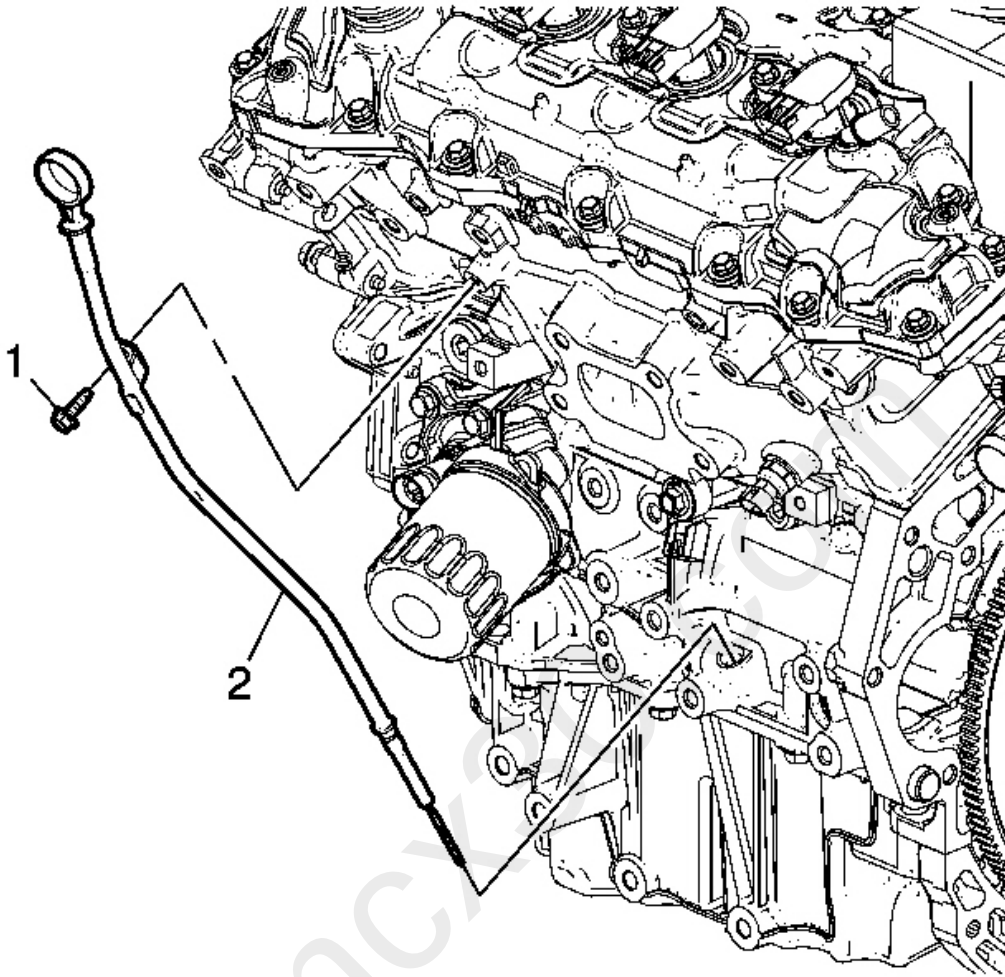


Fig. 149: Oil Level Indicator & Tube
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

3. Install the oil level indicator tube bracket bolt (1) and tighten to 10 N.m (89 lb in).

ENGINE COOLANT THERMOSTAT HOUSING INSTALLATION

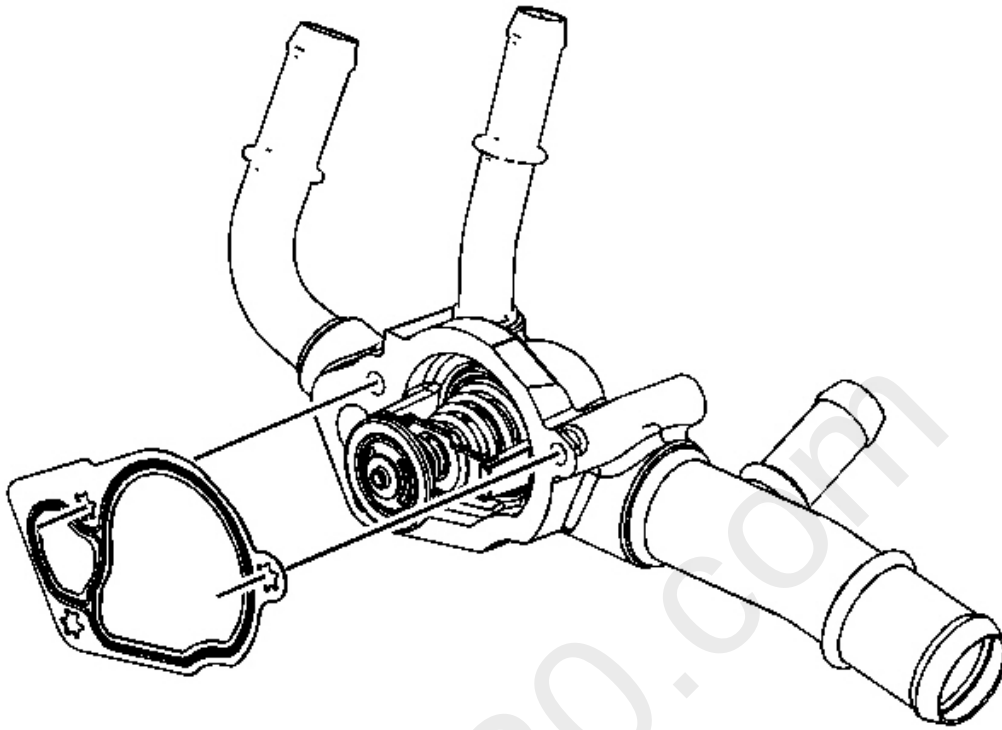


Fig. 150: View Of Thermostat Housing Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install a NEW gasket onto the thermostat housing.

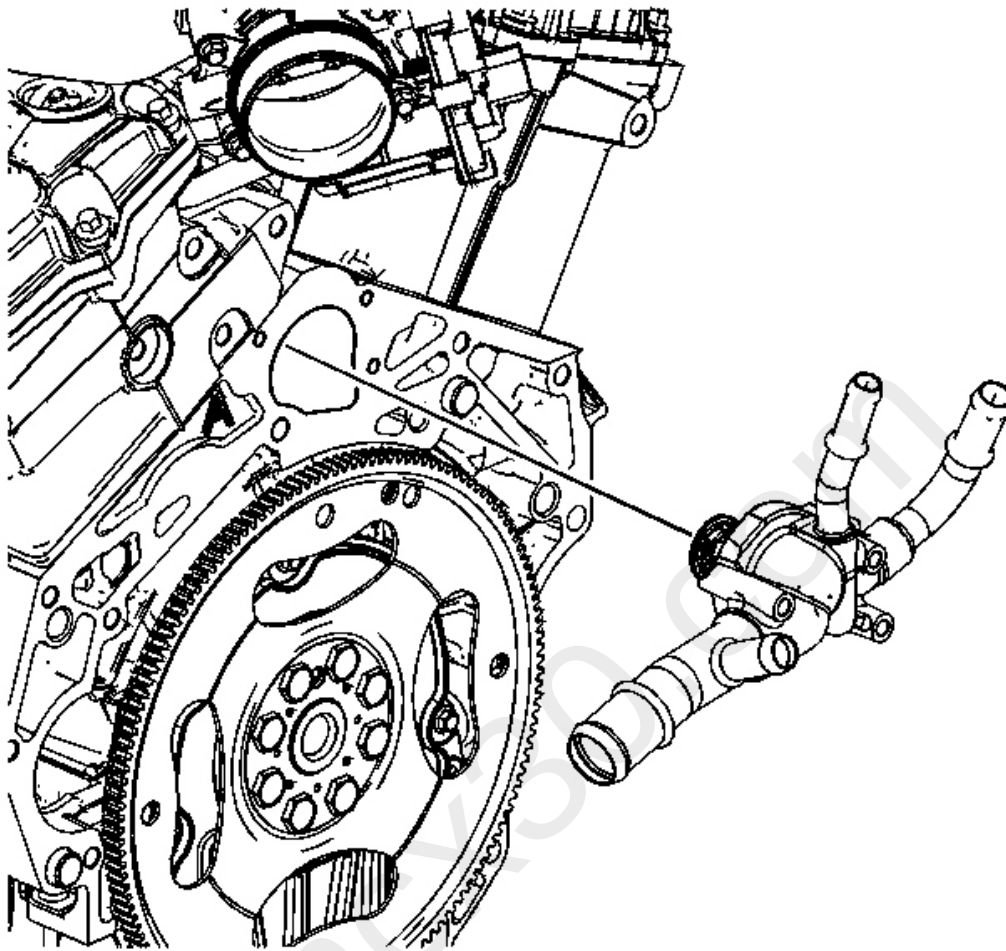


Fig. 151: View Of Thermostat Housing
Courtesy of GENERAL MOTORS CORP.

2. Install the thermostat housing.

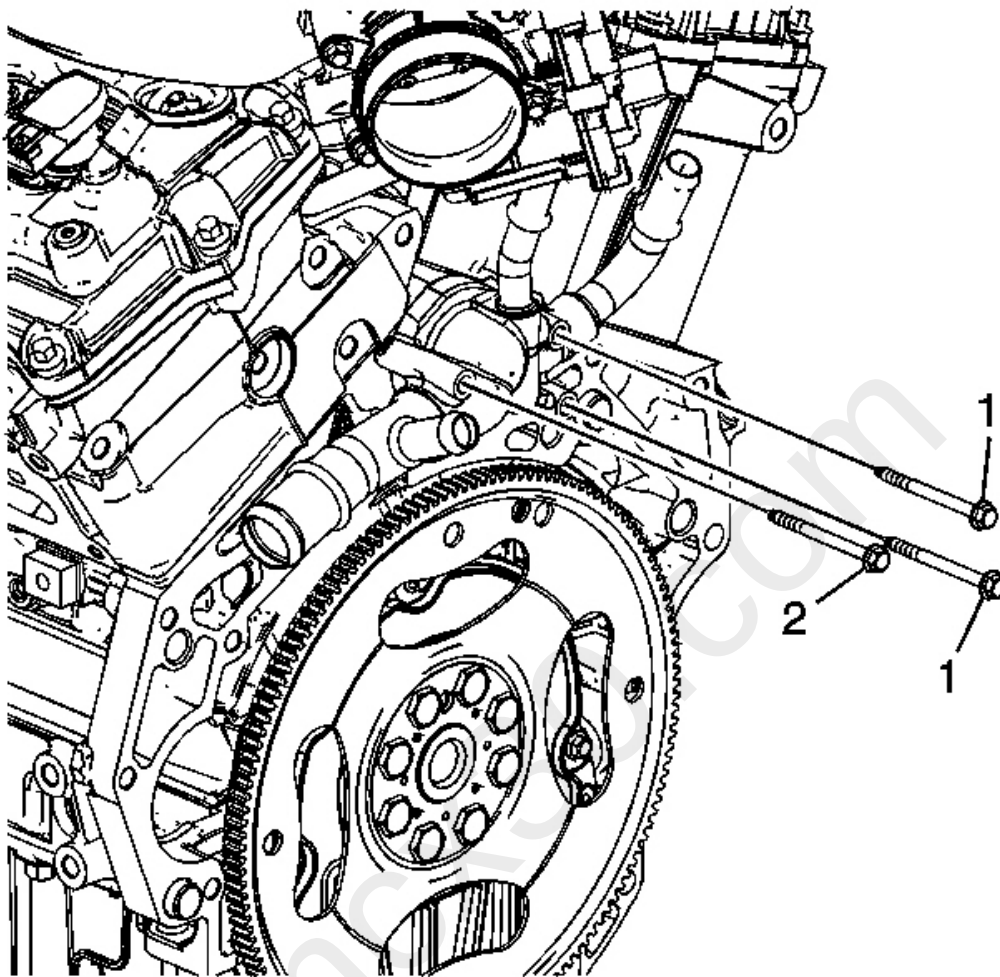


Fig. 152: Identifying Thermostat Housing Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the thermostat housing bolts. Ensure to install the short bolts (1) and the long bolt (2) in the proper position and tighten to 10 N.m (89 lb in).

WATER OUTLET INSTALLATION

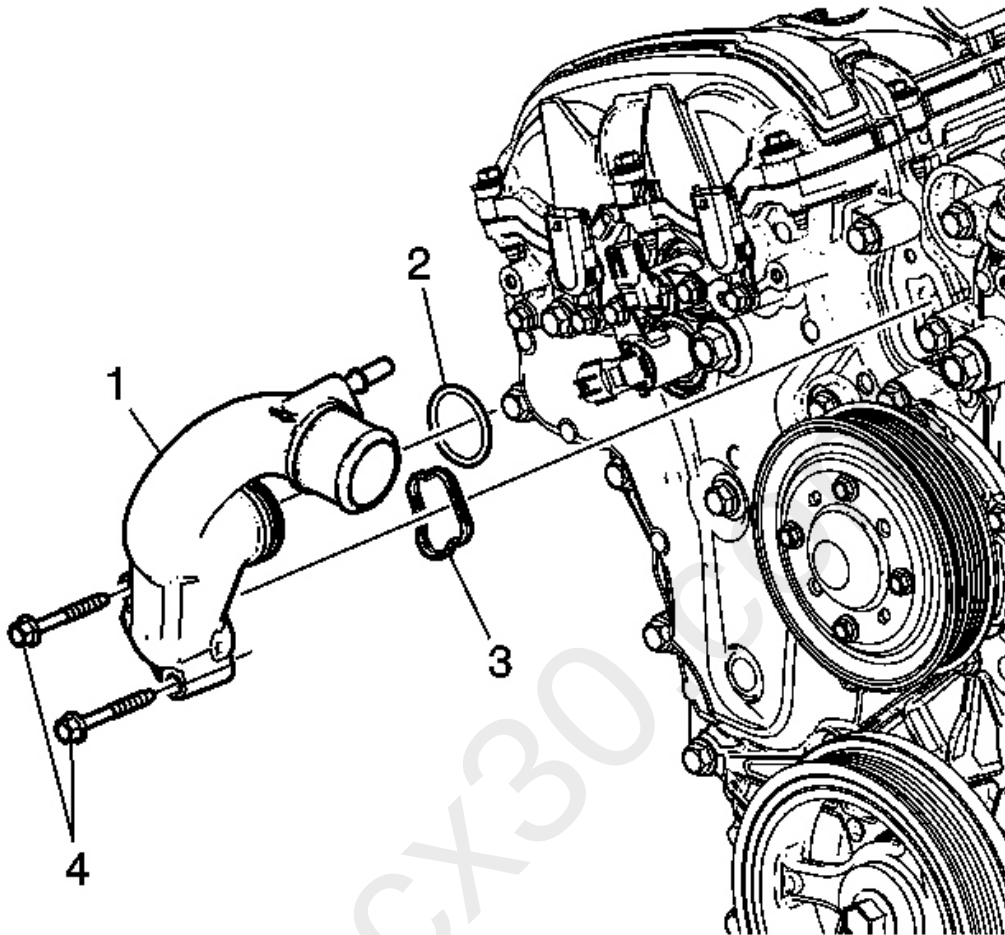


Fig. 153: Water Outlet Components
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW water outlet seals (2) and (3).
2. Install the water outlet (1).
3. Install the water outlet bolts (4).

DRIVE BELT TENSIONER INSTALLATION

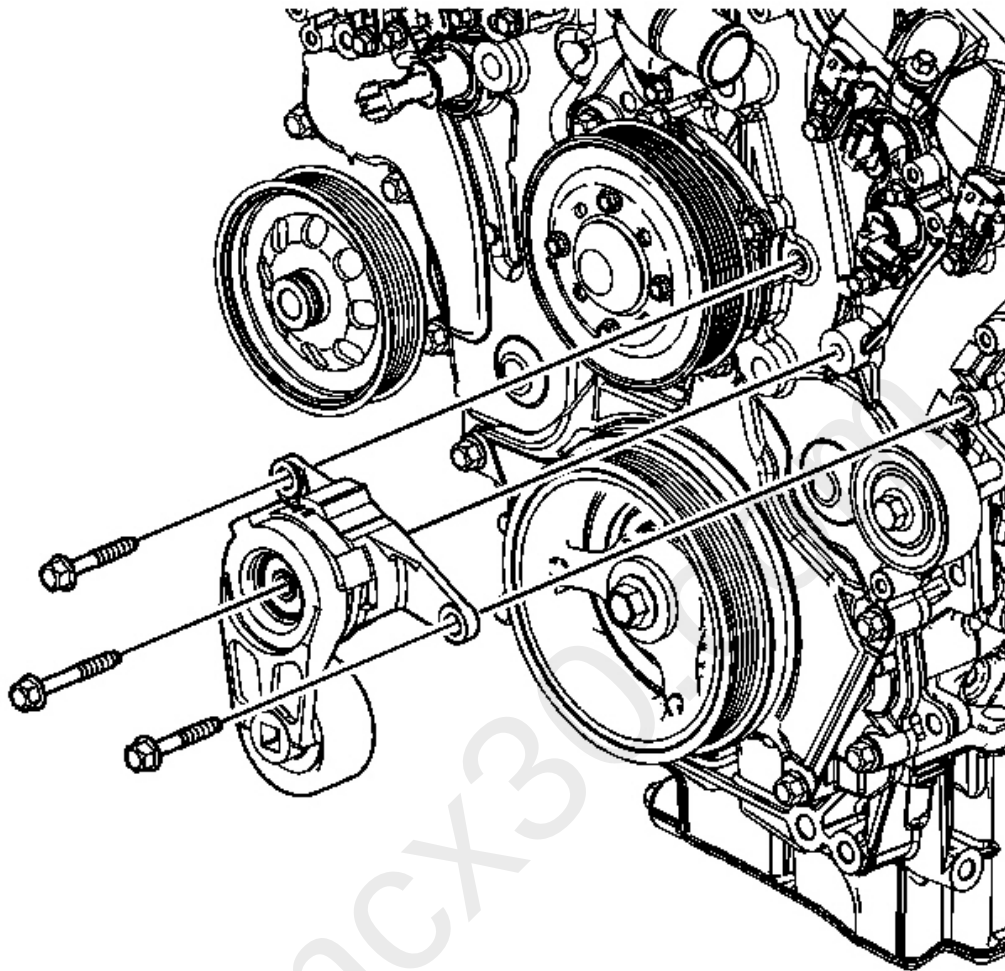


Fig. 154: View Of Left Drive Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

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

CAUTION: Refer to Fastener Caution .

2. Install the left drive belt tensioner bracket bolts and tighten to 25 N.m (18 lb ft).

ENGINE PRELUBING

Special Tools

- **EN 21867-6:** Oil Pressure Adapter Fitting
- **EN 45299:** Engine Preluber

For equivalent regional tools, refer to **Special Tools**

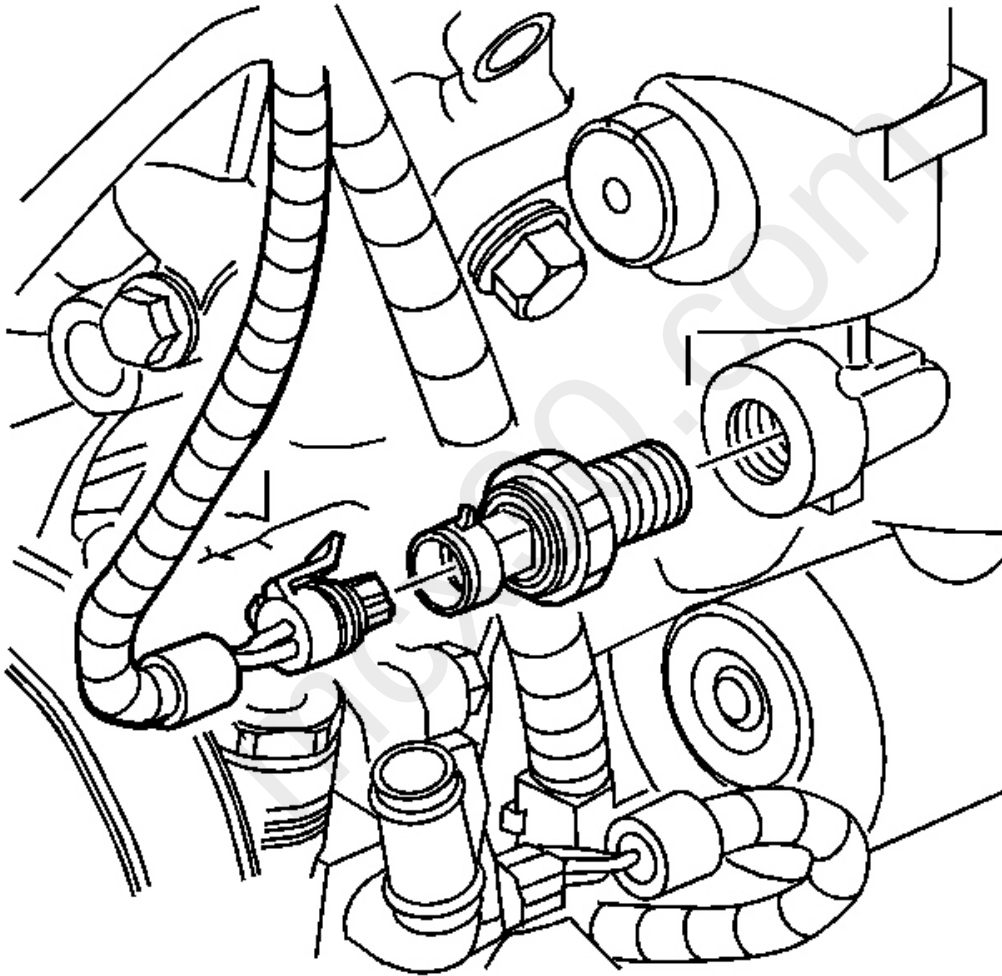


Fig. 155: View Of Oil Pressure Sending Unit
Courtesy of GENERAL MOTORS CORP.

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

1. Remove the oil filter cap.
2. Install the NEW oil filter cartridge.
3. Lubricate the threads of the oil filter cap with clean engine oil.

CAUTION: Refer to Fastener Caution .

4. Install the oil filter cap and tighten to 25 N.m (18 lb ft).
5. Remove the oil pressure sending unit from the oil filter adapter.
6. Install the **EN 21867-6**: fitting.

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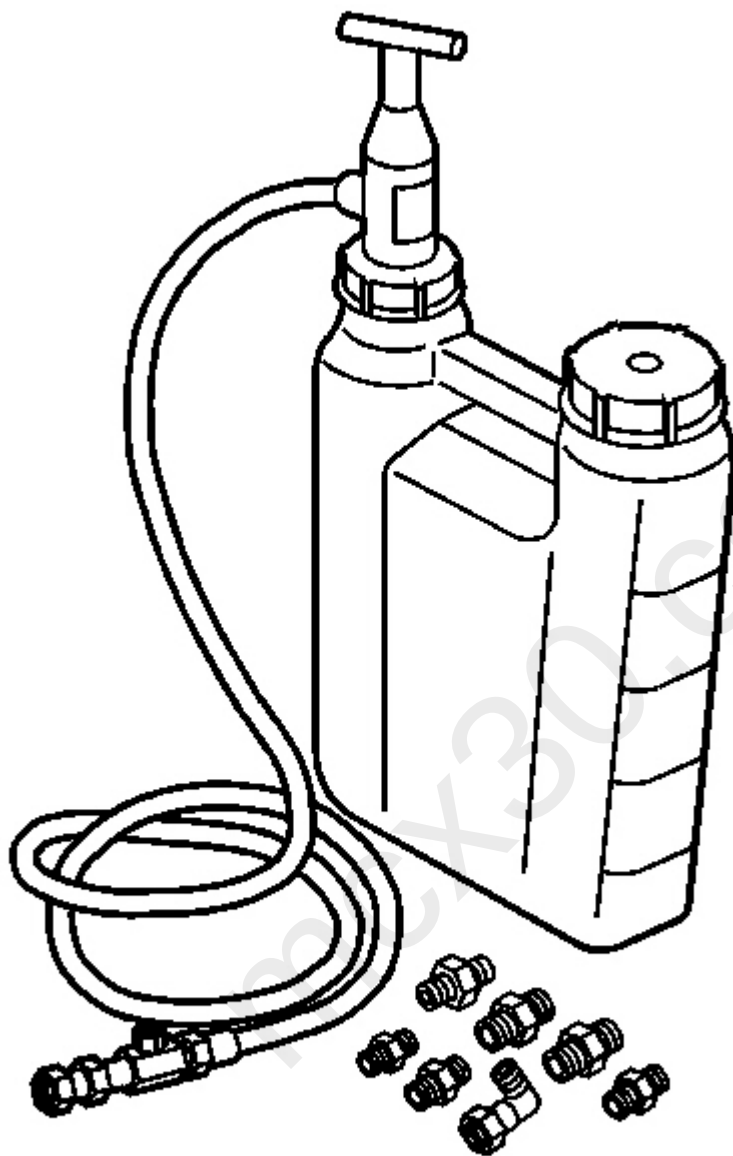


Fig. 156: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

7. Install the flexible hose to the adapter and open the valve.
8. Pump the handle on the **EN 45299**: preluber in order to flow a minimum of 1-1.9 liters (1-2 quarts) of engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
9. Close the valve and remove the flexible hose and adapter from the engine.

10. Install the oil pressure sending unit and tighten to 20 N.m (15 lb ft).
11. Top-off the engine oil to the proper level.

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