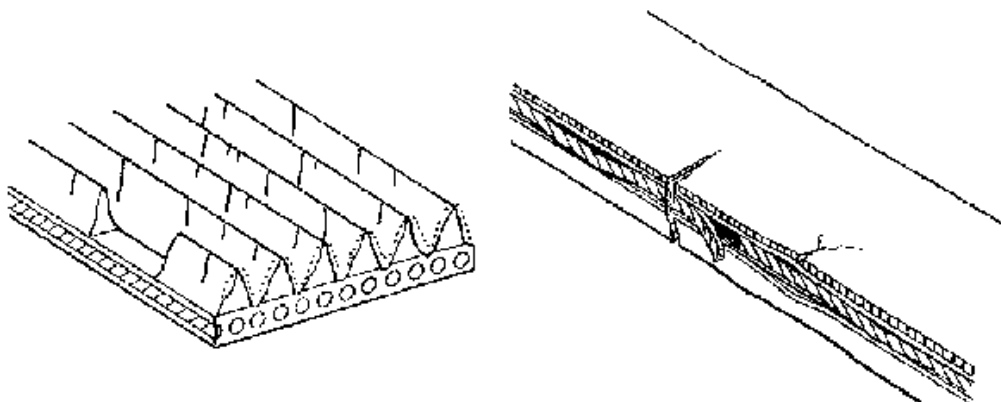


2010 ENGINE**Engine Mechanical - 1.8L (LAY) - Repair Instructions - On Vehicle - Vibe****DRIVE BELT REPLACEMENT****ON-VEHICLE INSPECTION****Fig. 1: Inspecting Drive Belt****Courtesy of GENERAL MOTORS CORP.**

1. Inspect the V-ribbed belt for wear, cracks or other signs of damage.

If any of the following defects is found, replace the V-ribbed belt.

- The belt is cracked.
- The belt is worn out to the extent that wires are exposed.
- The belt has chunks missing from the ribbed grooves.

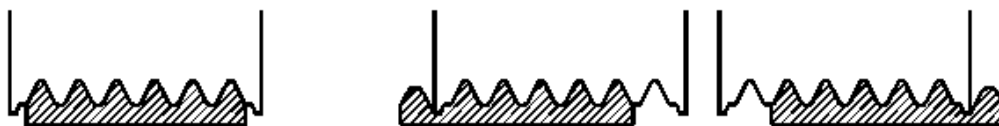
**CORRECT****INCORRECT**

Fig. 2: Ensuring Belt Fits Properly In Ribbed Grooves
Courtesy of GENERAL MOTORS CORP.

NOTE: Check by hand to confirm that the belt has not slipped out of the grooves on the bottom to the pulley. If it has slipped out, replace the V-ribbed belt. Install a new V-ribbed belt correctly.

2. Check that the belt fits properly in the ribbed grooves.

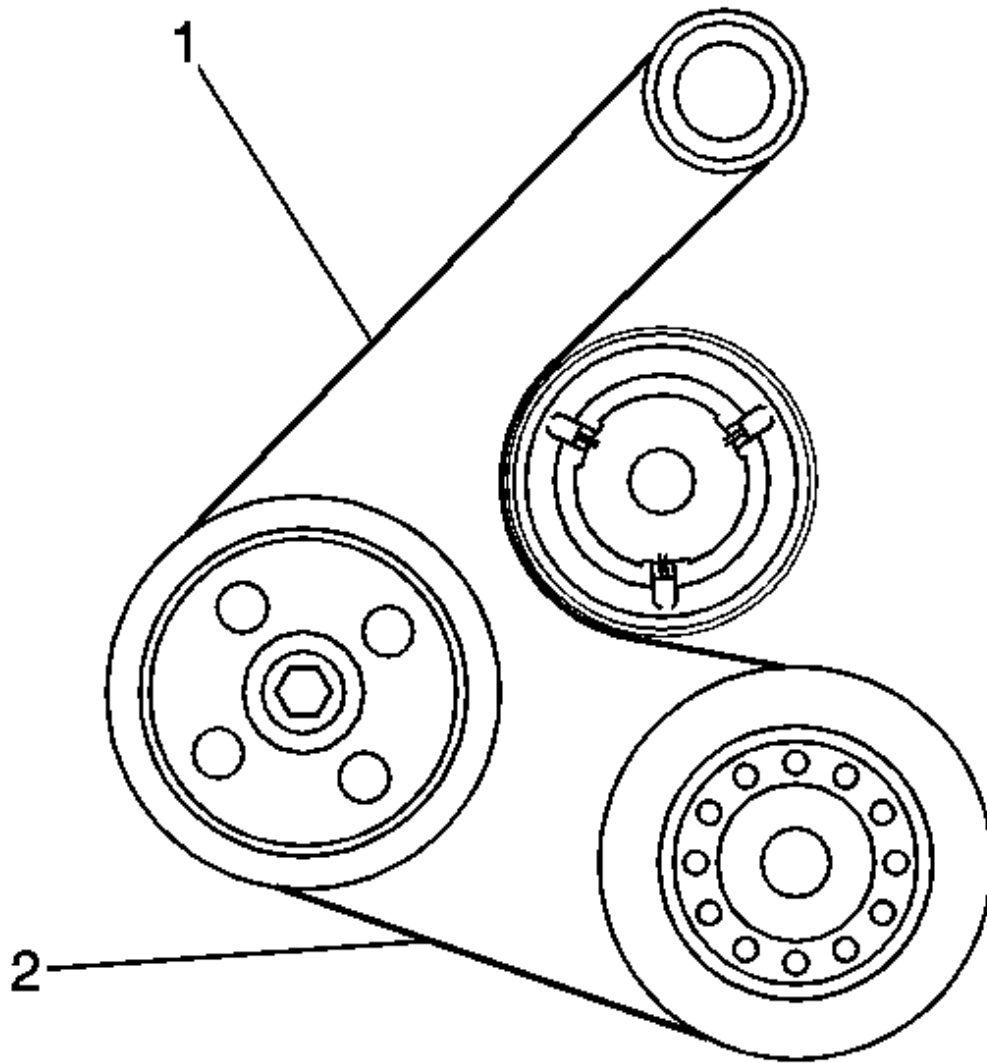


Fig. 3: Checking Belt Deflection & Tension (Air Conditioning)
Courtesy of GENERAL MOTORS CORP.

3. On vehicles equipped with air conditioning, check the belt deflection and tension in positions shown (1, 2).

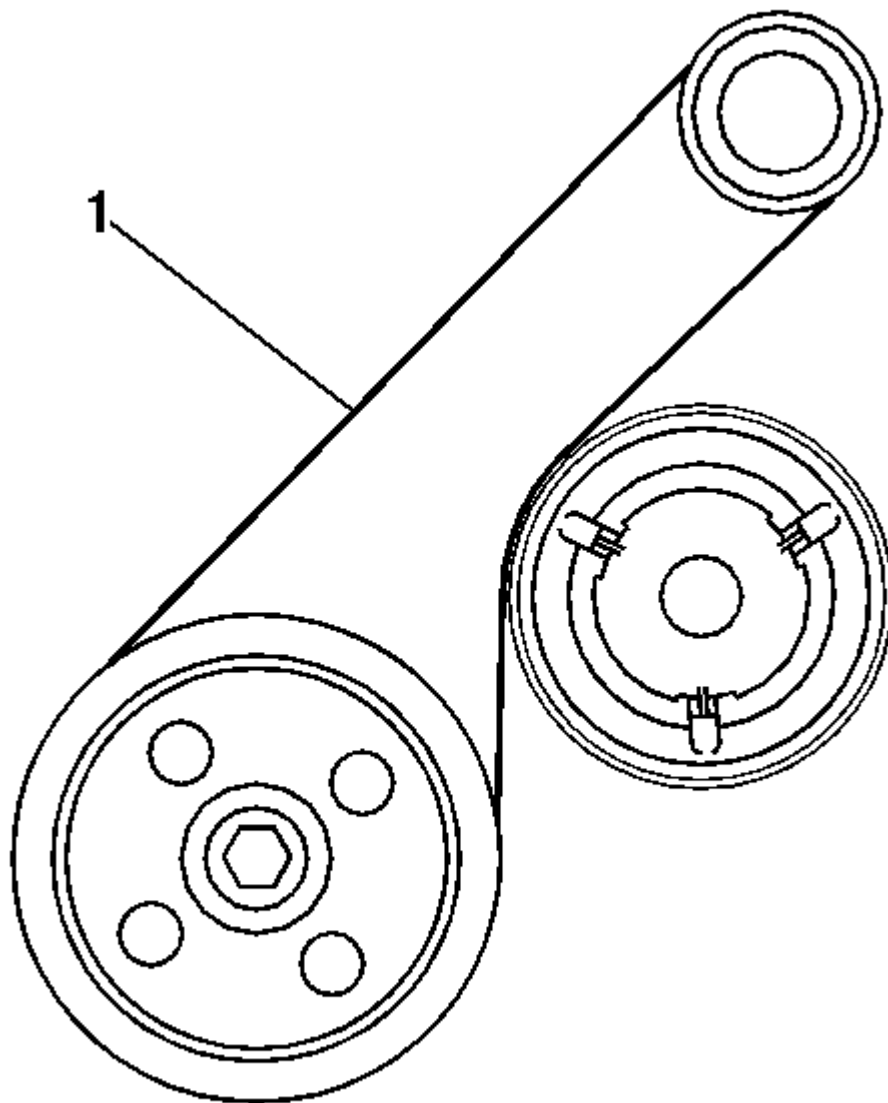


Fig. 4: Checking Belt Deflection & Tension (Non-Air Conditioning)
Courtesy of GENERAL MOTORS CORP.

4. On vehicles without air conditioning, check the belt deflection and tension in position shown (1).
5. If the belt deflection is not as specified, adjust it. Refer to **Engine Mechanical Specifications** .
 - When inspecting the belt deflection, apply 98 N (10 kgf) tensile force to it.
 - After installing a new belt, run the engine for approximately 5 minutes and then re-adjust the tension to (new belt) specifications.

- Check the V-ribbed belt deflection and tension at the specified point.
- V-ribbed belt tension and deflection should be checked after 2 revolutions of the engine.
- V-ribbed belt tension and deflection should be checked at TDC crank angle and cold condition.
- When adjusting a belt, adjust its deflection and tension to the intermediate values of the specification.
- When reinstalling a belt which has been used for over 5 minutes, adjust its deflection and tension to the used belt specification.
- When using a belt tension gauge, confirm its accuracy by using a master gauge first.

REMOVAL PROCEDURE

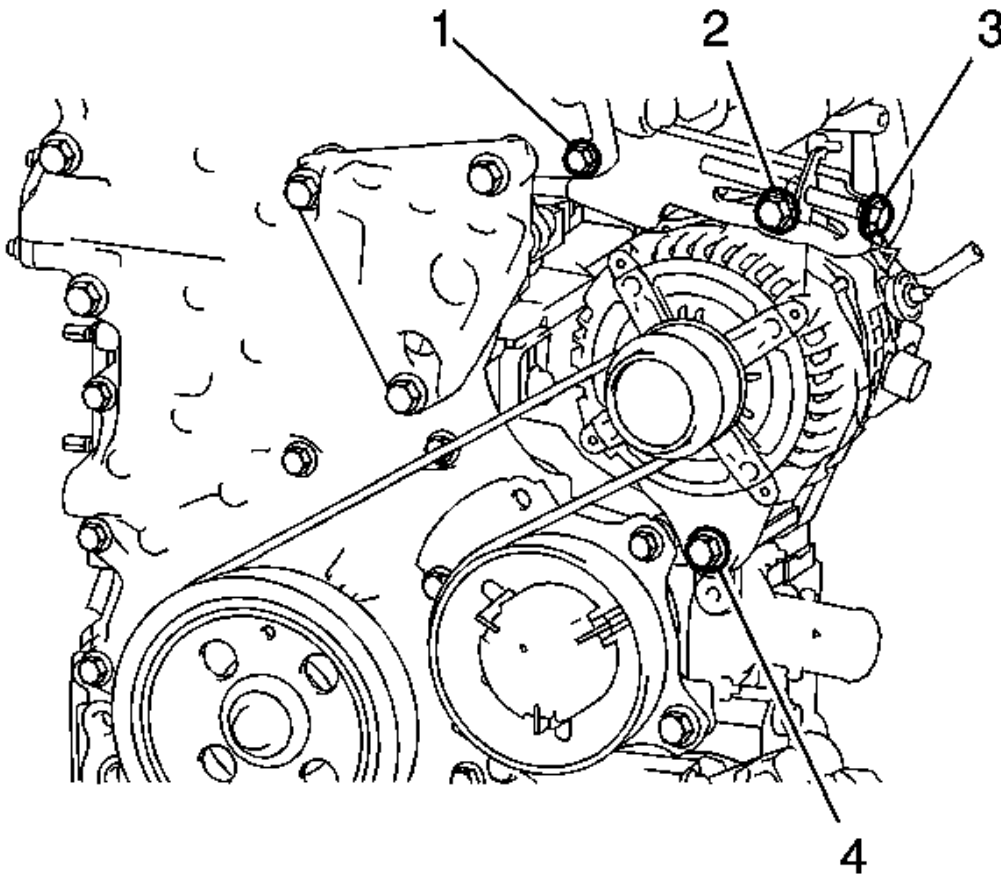


Fig. 5: View Of Attachment Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine cover. Refer to **Engine Mount Replacement**.
2. Remove the engine under cover RH.
3. Remove the V-ribbed belt.
 1. Loosen bolts (2, 4).
 2. Loosen bolt (3) then remove the V-ribbed belt.

INSTALLATION PROCEDURE

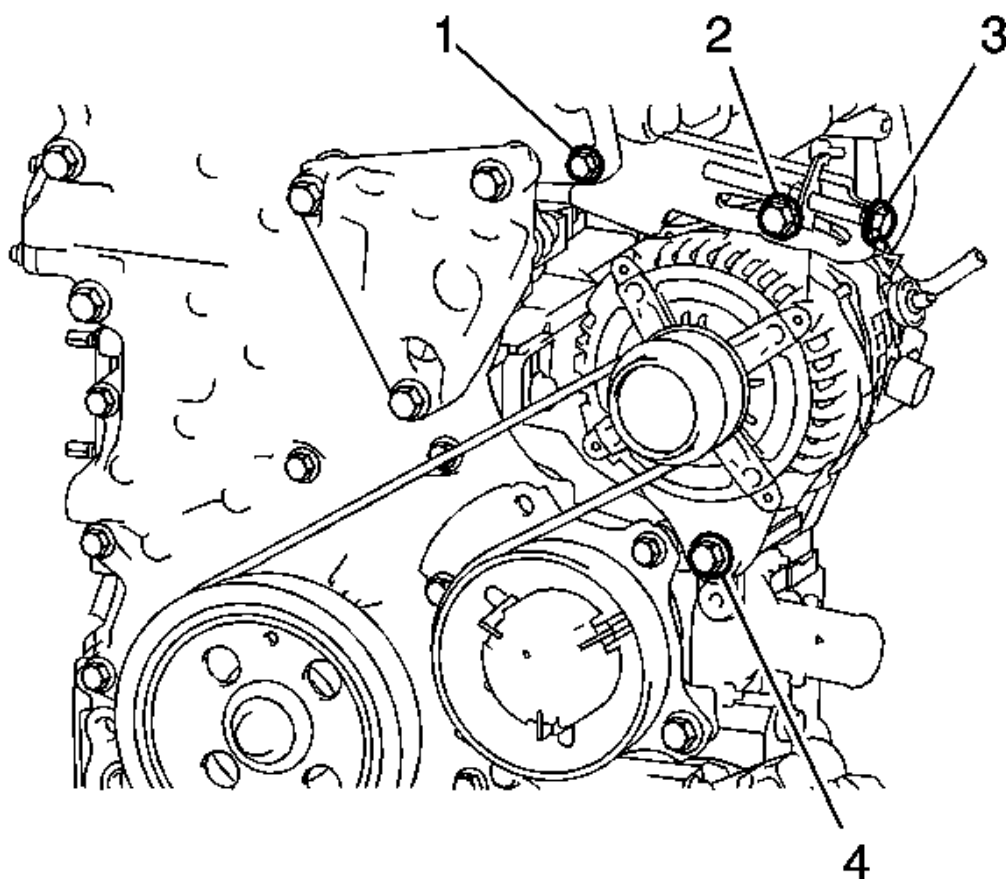


Fig. 6: View Of Attachment Bolts
Courtesy of GENERAL MOTORS CORP.

1. Install the V-ribbed belt

CAUTION: Refer to **Fastener Caution** .

2. Adjust the V-ribbed belt
 1. Turn bolt 3 to adjust the tension of the V-ribbed belt.
 2. Install bolts 2 and 4 and tighten.
 - Bolt 2 to 19 N.m (14 lb ft).
 - Bolt 4 to 43 N.m (32 lb ft).
3. Inspect the V-ribbed belt.
4. Install the engine under cover RH.
5. Install the engine cover. Refer to **Engine Mount Replacement**.

ENGINE COVER REPLACEMENT

REMOVAL PROCEDURE

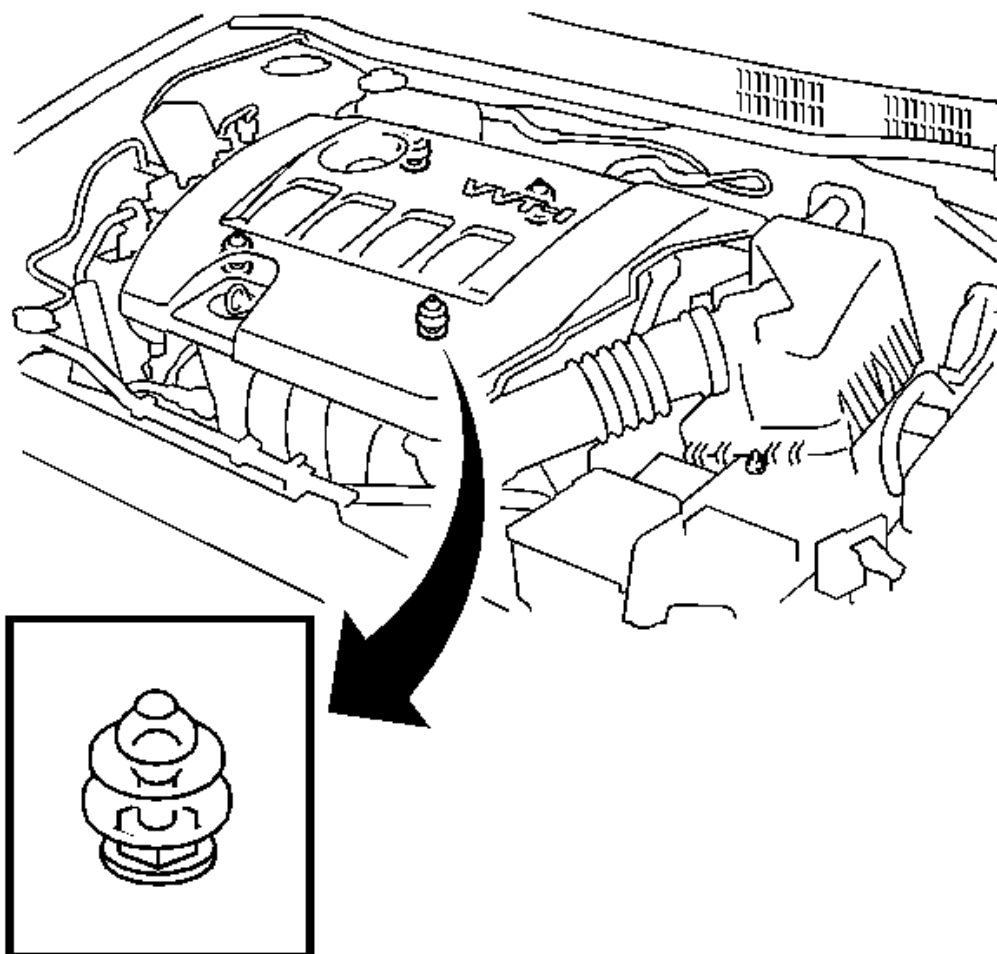


Fig. 7: View Of Engine Cover Clips
Courtesy of GENERAL MOTORS CORP.

NOTE: Attempting to disengage both front and rear clips at the same time may cause the cover to break.

1. Hold the rear of the cover and raise it to disengage the two fasteners on the rear of the cover. Continue to raise the cover to disengage the two fasteners on the front of the cover.
2. Remove the engine cover.

INSTALLATION PROCEDURE

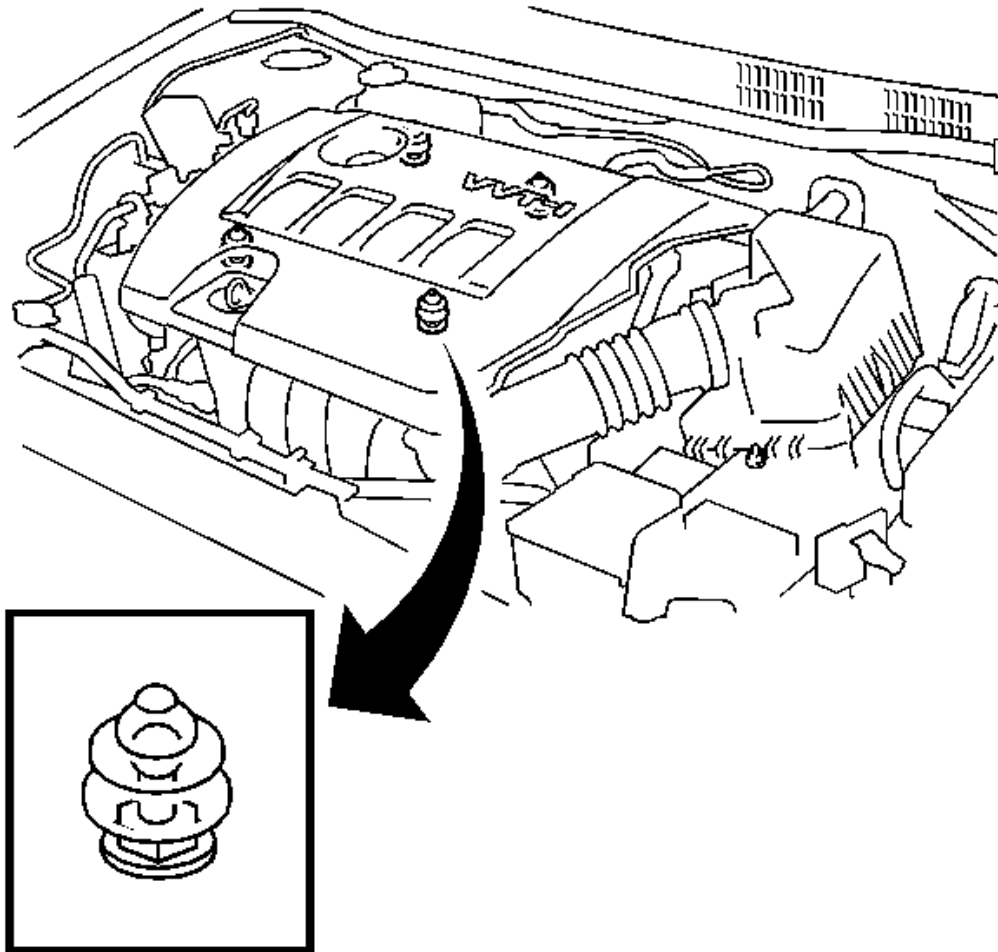


Fig. 8: View Of Engine Cover Clips
Courtesy of GENERAL MOTORS CORP.

1. Position The engine cover and engage the two front fasteners.
2. Engage the two fasteners on the rear of the cover.

ENGINE SUPPORT FIXTURE

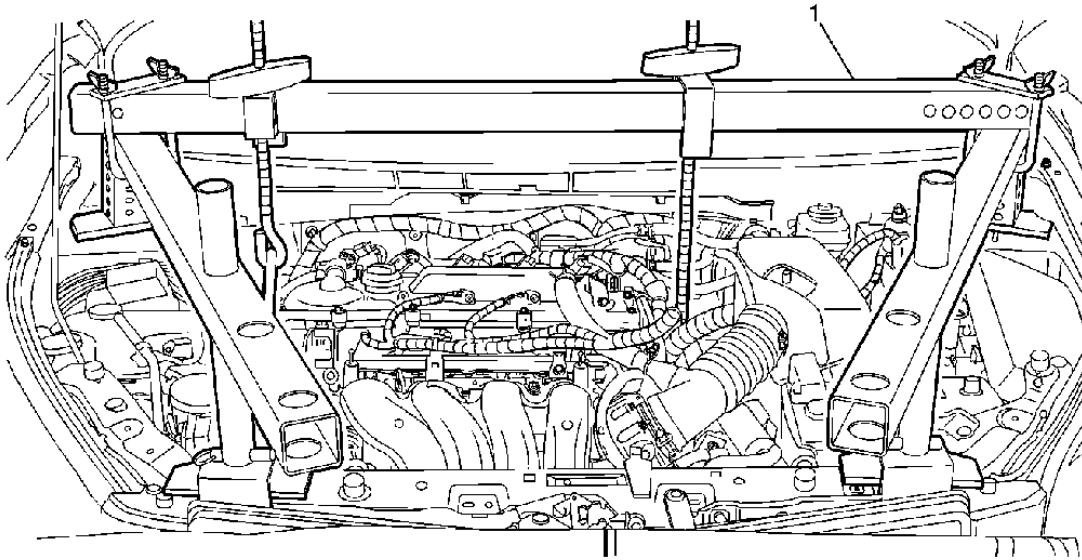


Fig. 9: View Of Engine Support Fixture
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Engine Support Fixture. Tip: As shown in the illustration. Special Tools • J-28467-B: Universal Engine Support Fixture • J-28467-4: Engine Support Bracket • J-36462-A: Engine Support Adapter Leg Set • J-36857: Engine Lift Bracket

ENGINE MOUNT INSPECTION

NOTE: It is the design intent of the torque axis mounting systems to allow more engine movement than other mounting systems. Do not replace any torque axis mounts for excessive engine movement. Replace them if damage exists on the mount or rubber.

1. Raise the engine enough to apply slight tension on the engine mount.
2. Replace the engine mount if any of the following conditions exist:
 - The hard rubber surface is covered with heat cracks.
 - The rubber split through the center.
3. Lower the engine.

4. Check the engine mount fastener torque.

ENGINE MOUNT REPLACEMENT

REMOVAL PROCEDURE

WARNING: Refer to Battery Disconnect Warning .

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .
2. Raise and properly support the engine. Refer to Engine Support Fixture.

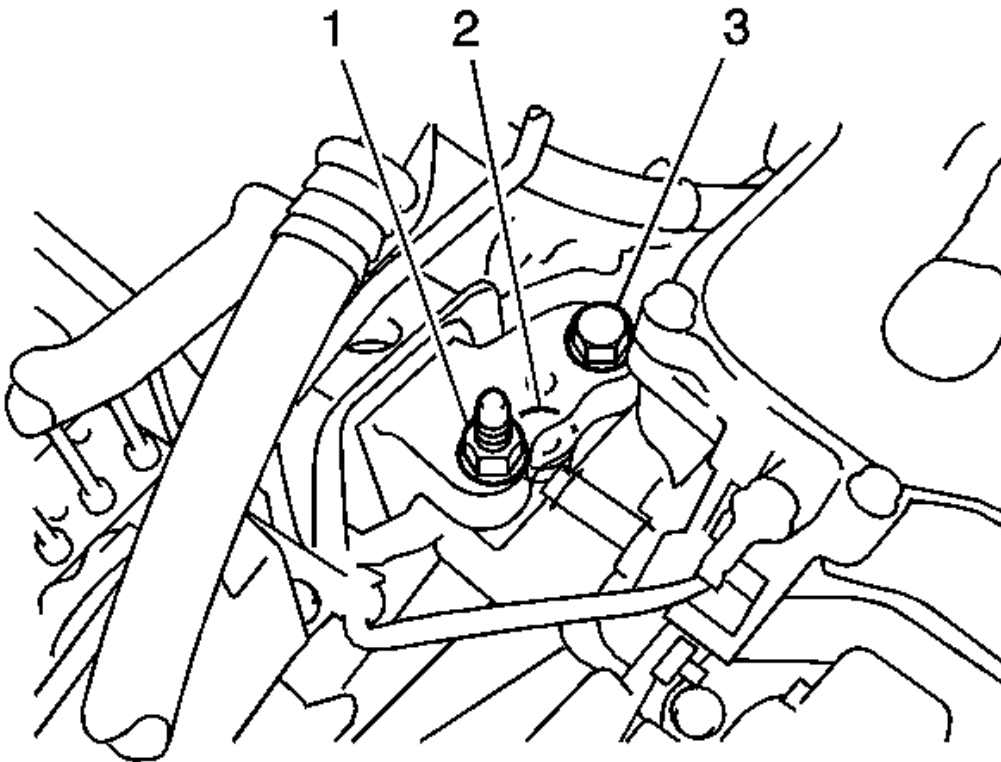


Fig. 10: Identifying Engine Mounting Insulator Bolts - Right Side
Courtesy of GENERAL MOTORS CORP.

3. Remove the bolt and 2 nuts (1, 2), and separate the engine mounting insulator RH.

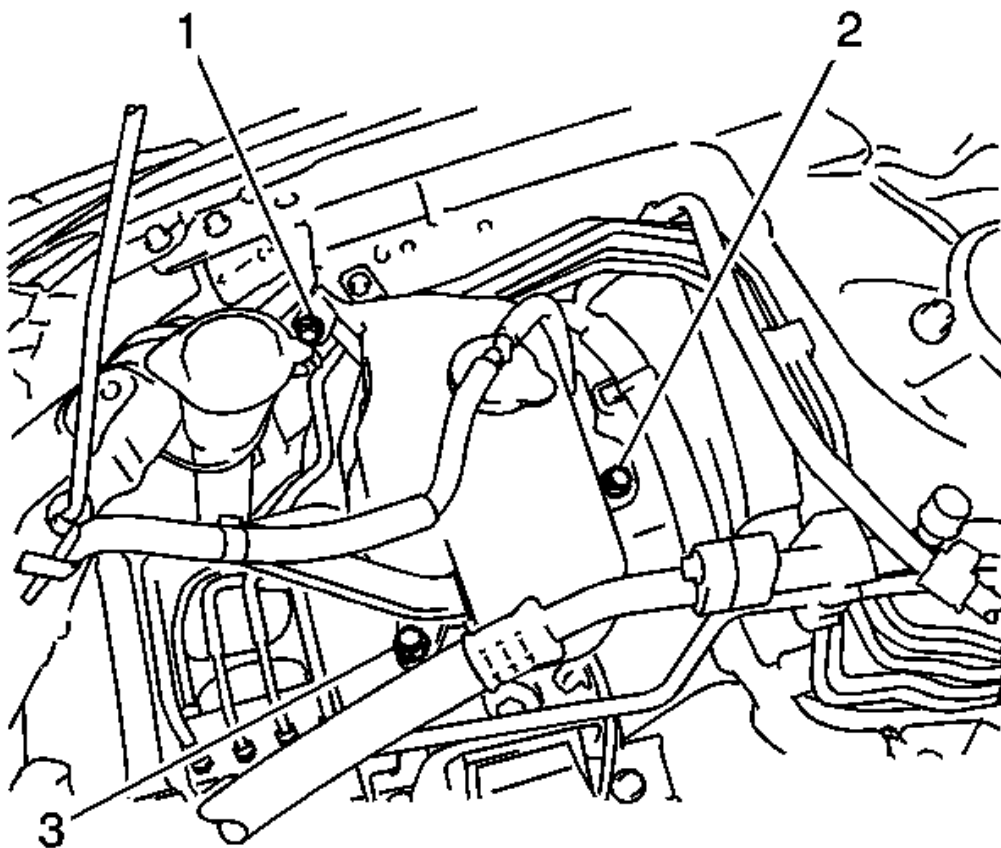


Fig. 11: Identifying Radiator Reserve Tank Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the 3 bolts (1-3) and radiator reserve tank.

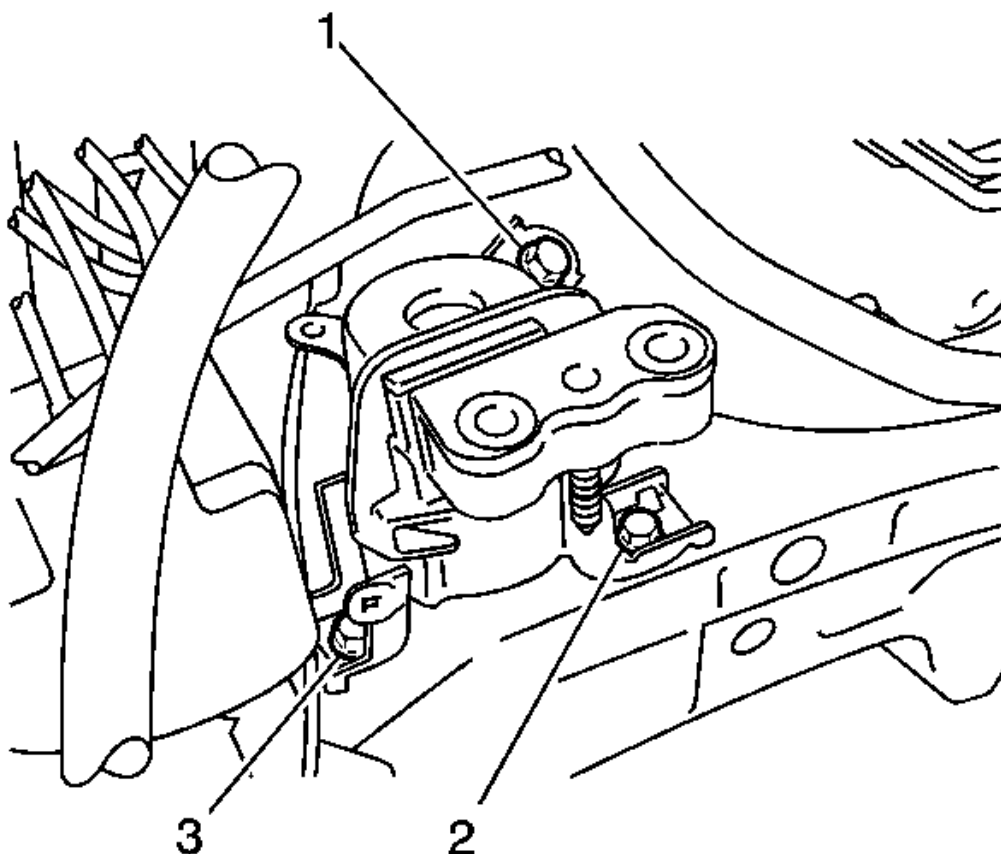


Fig. 12: View Of Engine Mounting Insulator Bolts - Right Side
Courtesy of GENERAL MOTORS CORP.

NOTE: Perform this procedure only when replacement of the engine mounting insulator is necessary.

5. Remove the 3 bolts (1-3) and engine mounting insulator RH.

INSTALLATION PROCEDURE

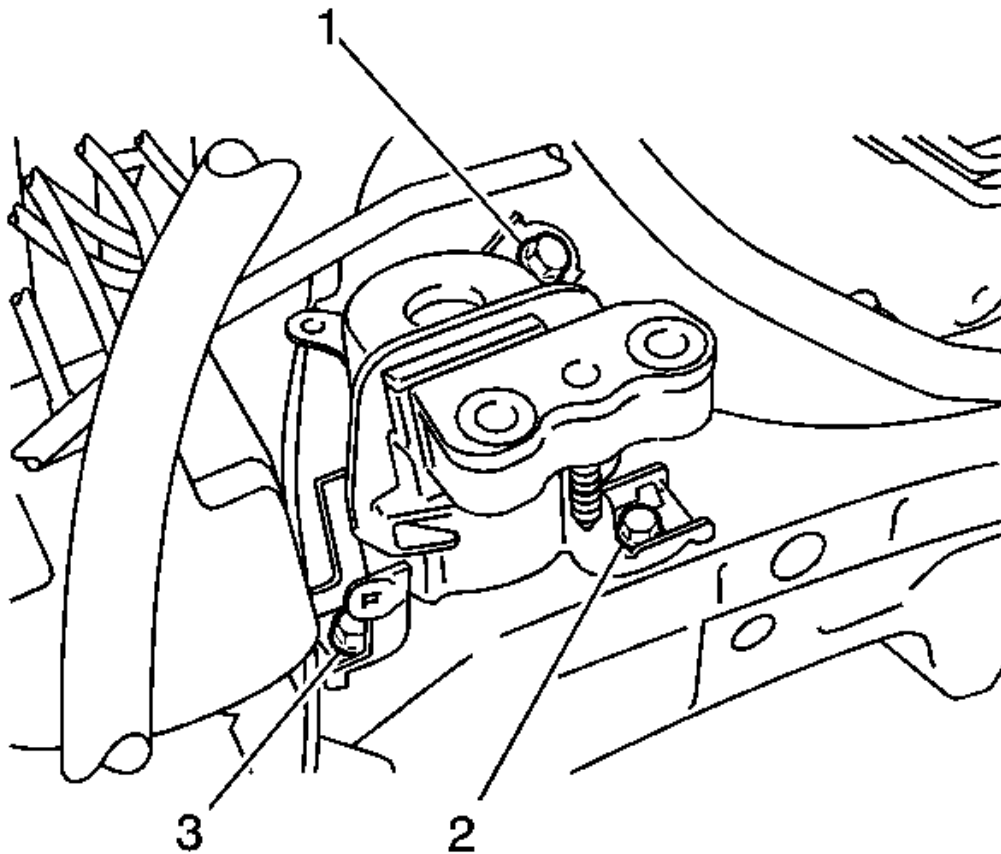


Fig. 13: View Of Engine Mounting Insulator Bolts - Right Side
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine mounting insulator RH with the 3 bolts (1-3).

Tighten: Tighten the bolts to 52 N.m (38 lb ft).

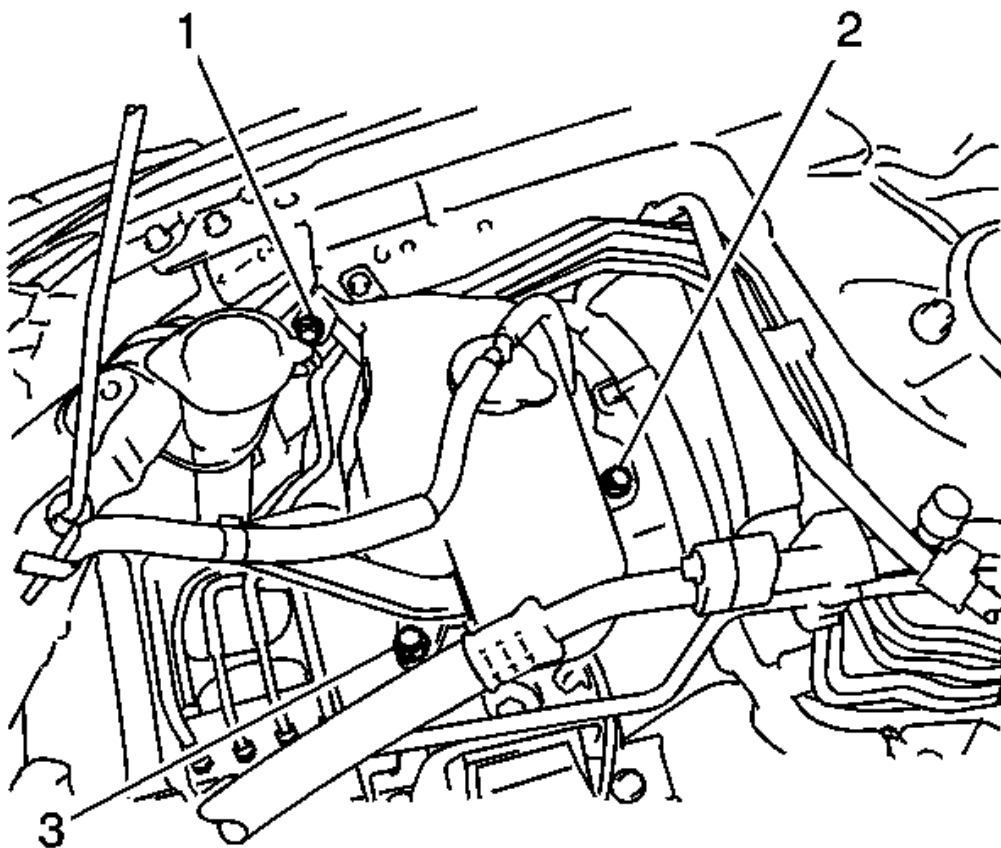


Fig. 14: Identifying Radiator Reserve Tank Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the radiator reserve tank with the 3 bolts (1-3).

Tighten: Tighten the bolts to 7.0 N.m (62 lb in).

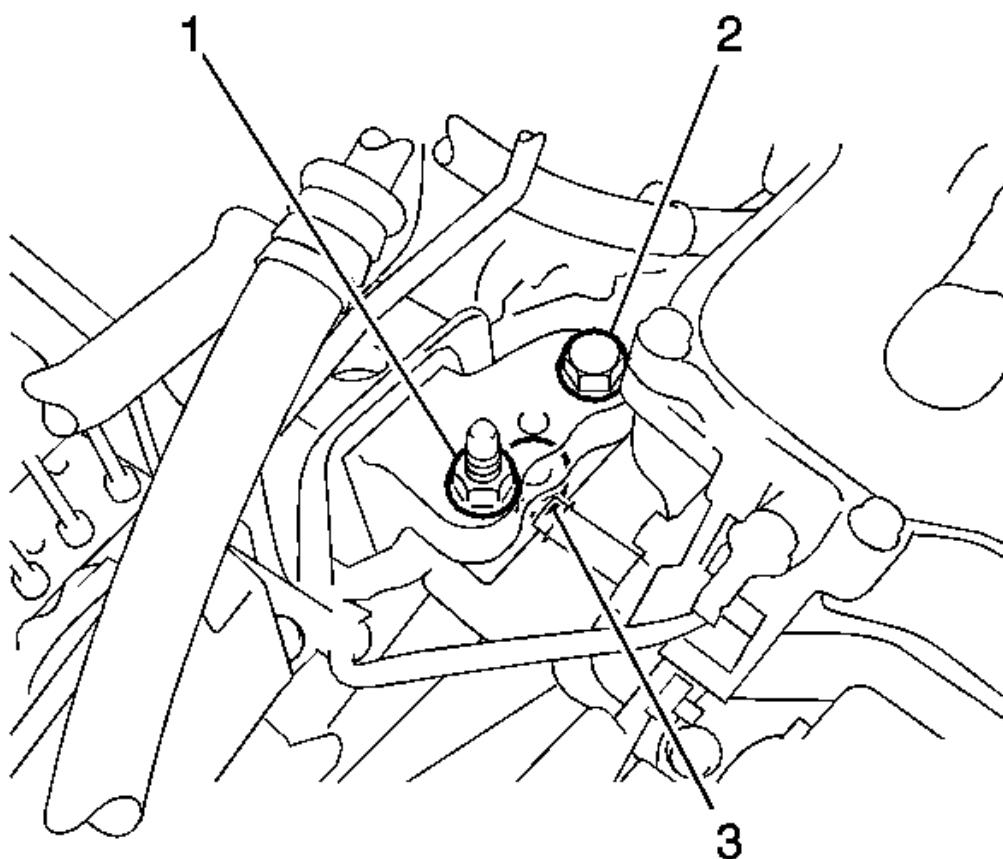


Fig. 15: Identifying Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the engine mounting insulator RH with the bolt and 2 nuts.

Tighten:

- Tighten the nut 1 to 95 N.m (70 lb ft)
 - Tighten the nut 2 to 52 N.m (38 lb ft)
 - Tighten the bolt 3 to 95 N.m (70 lb ft)
4. Remove the engine support fixture.
 5. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .

OIL LEVEL INDICATOR TUBE REPLACEMENT

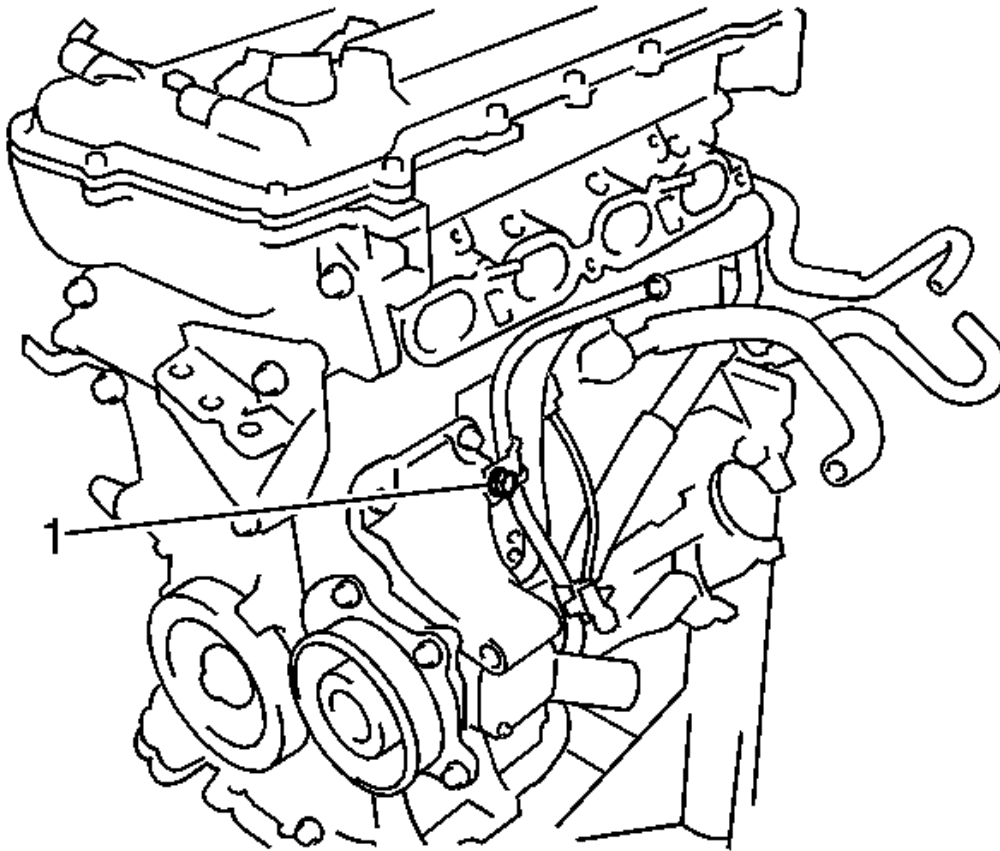
REMOVAL PROCEDURE

Fig. 16: Identifying Guide Tube Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil level indicator from the guide tube.
2. Remove the guide tube bolt (1) from the cylinder block.
3. Remove the guide tube from the cylinder block.

INSTALLATION PROCEDURE

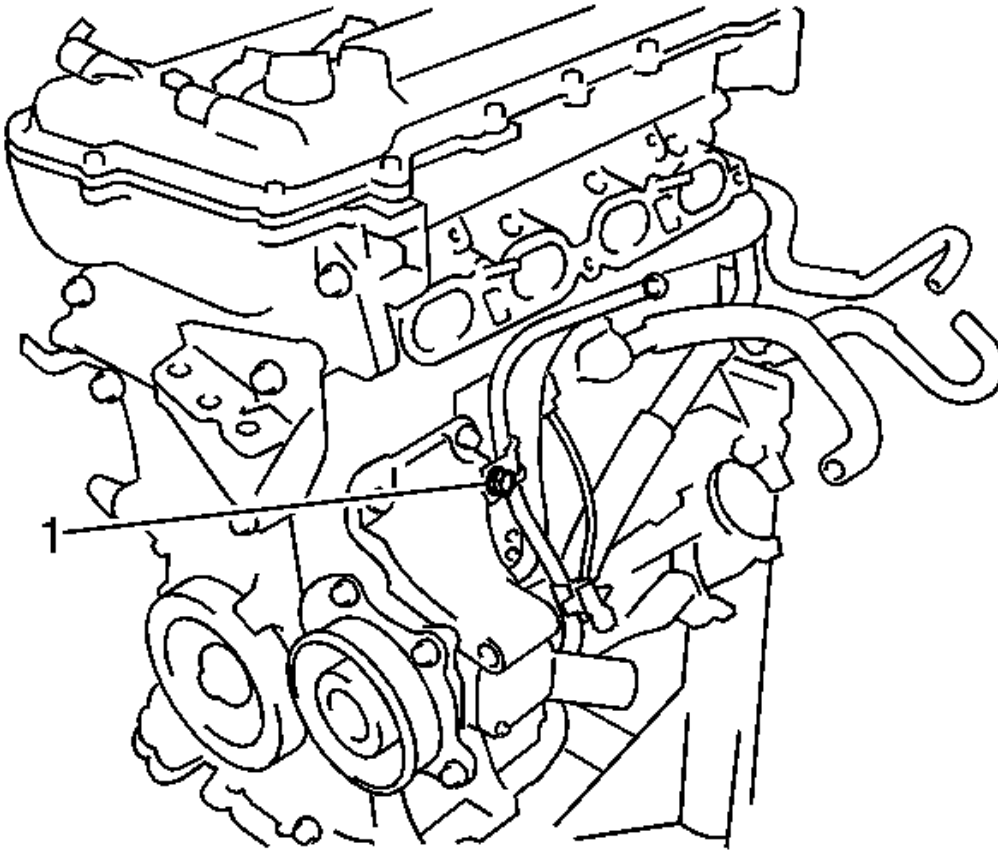


Fig. 17: Identifying Guide Tube Bolt
Courtesy of GENERAL MOTORS CORP.

1. Use new engine oil in order to coat the new guide tube seal.

CAUTION: Refer to Fastener Caution .

2. Install the new guide tube seal (1) to the guide tube. Secure the guide tube to the cylinder block using one bolt and tighten to 14 N.m (10 lb ft).
3. Install the oil level indicator to the guide tube.

ENGINE BLOCK HEATER REPLACEMENT (AUTOMATIC TRANSMISSION)

REMOVAL PROCEDURE

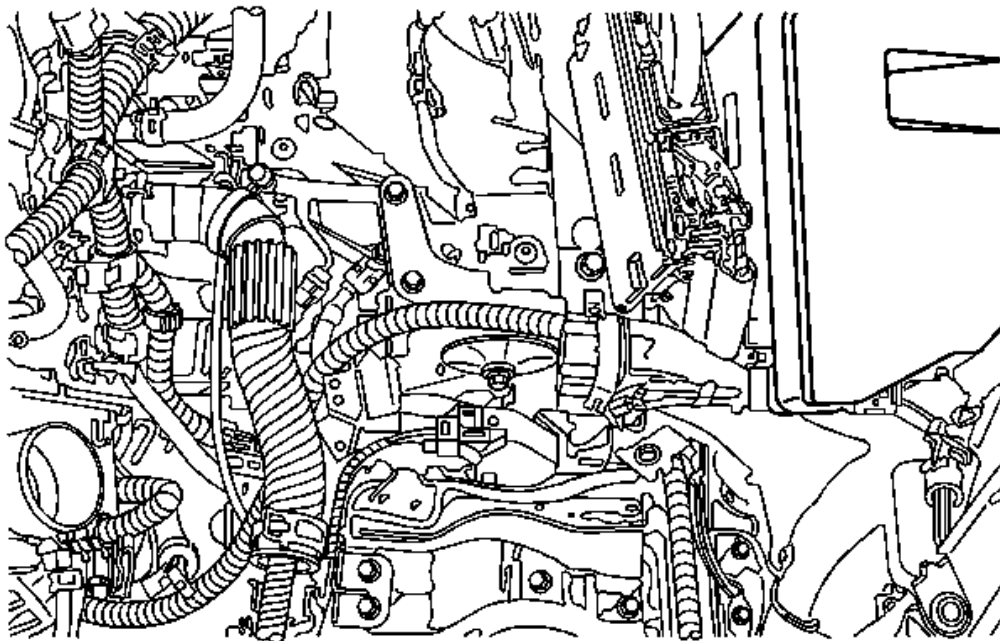


Fig. 18: Identifying Engine Block Heater Harness Plug Bundle
Courtesy of GENERAL MOTORS CORP.

1. Unclip the engine block heater harness plug bundle from the resonator attachment flange.

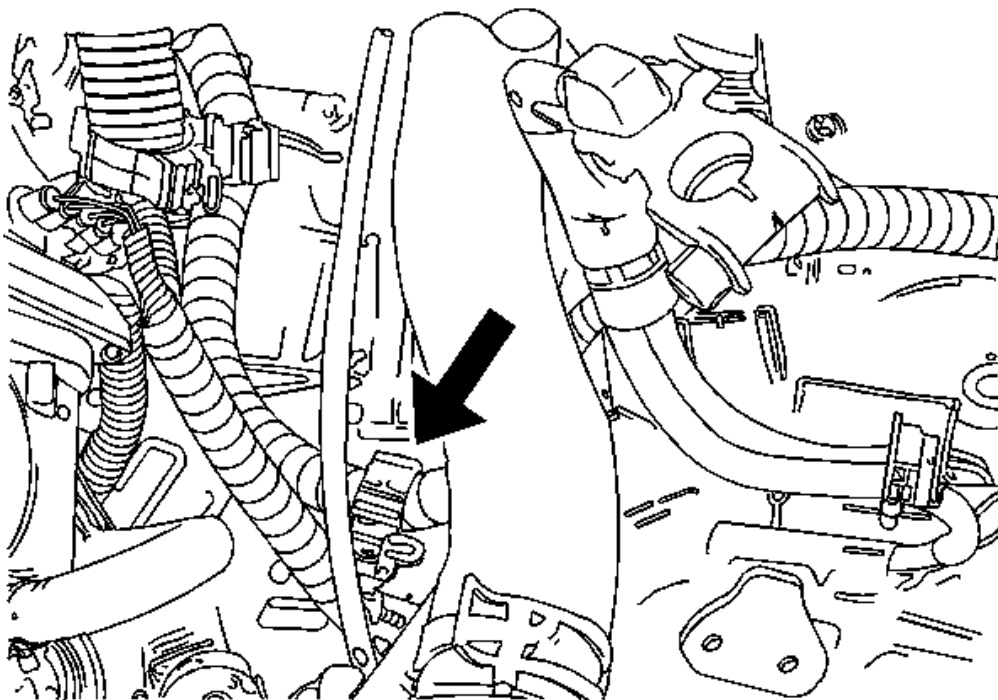


Fig. 19: Identifying Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

2. Detach the engine block heater harness retainer from the neutral safety switch harness.

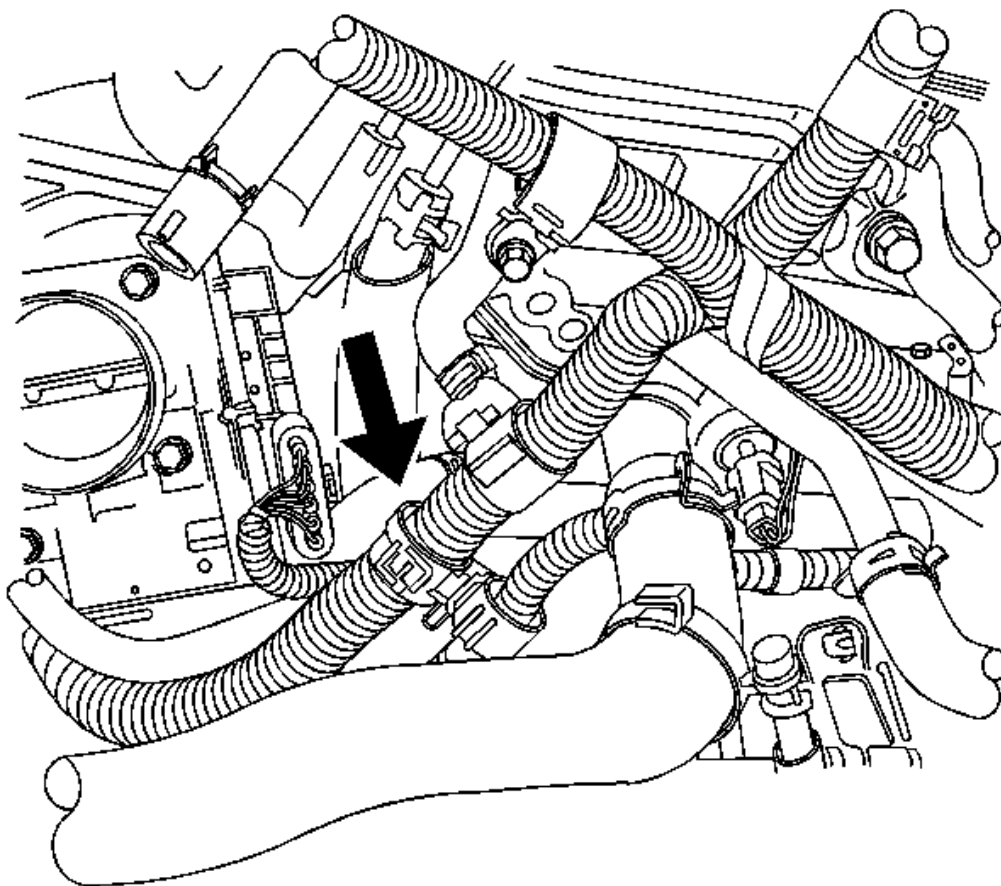


Fig. 20: View Of Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

3. Detach the engine block heater harness retainer from the engine harness.

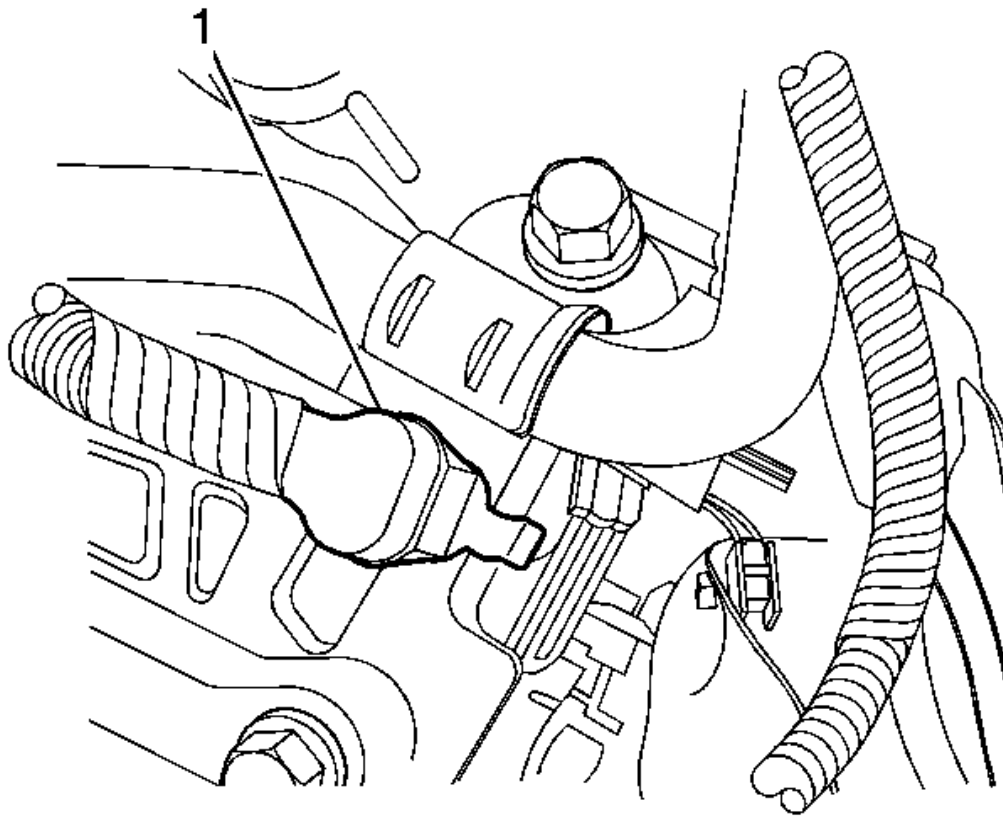


Fig. 21: Locating Engine Block Heater Element Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Disengage the engine block heater element (1) retaining clip from the engine block and remove the engine block heater assembly.

INSTALLATION PROCEDURE

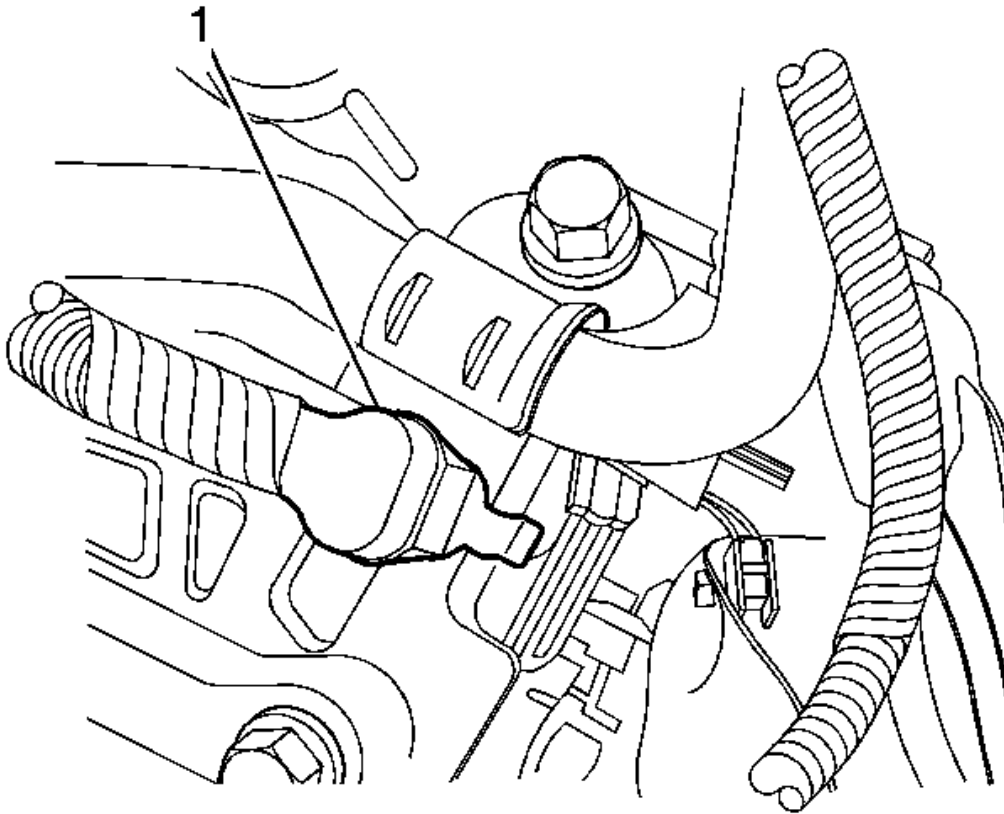


Fig. 22: Locating Engine Block Heater Element Retaining Clip
Courtesy of GENERAL MOTORS CORP.

NOTE: Visually inspect that the engine block heater harness plug is fully seated onto the element. Ensure the heating element is fully inserted into the engine block and the retaining clip is engaged. An audible click will be heard when clip is locked in position.

1. Completely insert the engine block heater element (1) into the engine block cavity in the nine o'clock position.

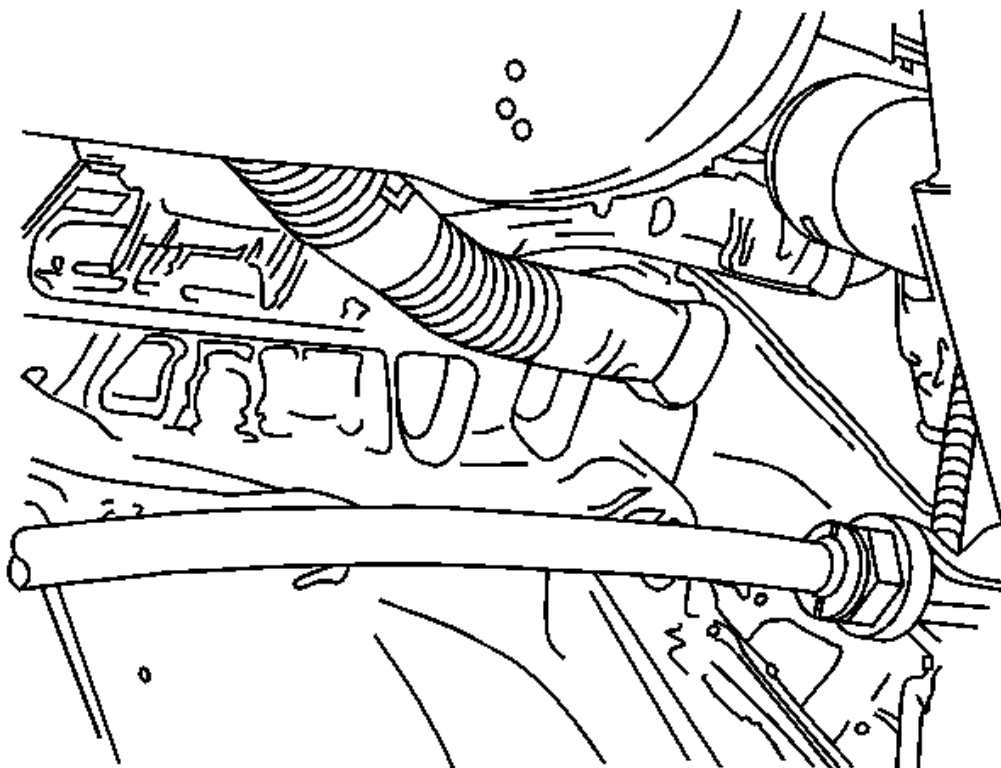


Fig. 23: Routing Engine Block Heater Harness
Courtesy of GENERAL MOTORS CORP.

2. Route the engine block heater harness towards the front of the engine.

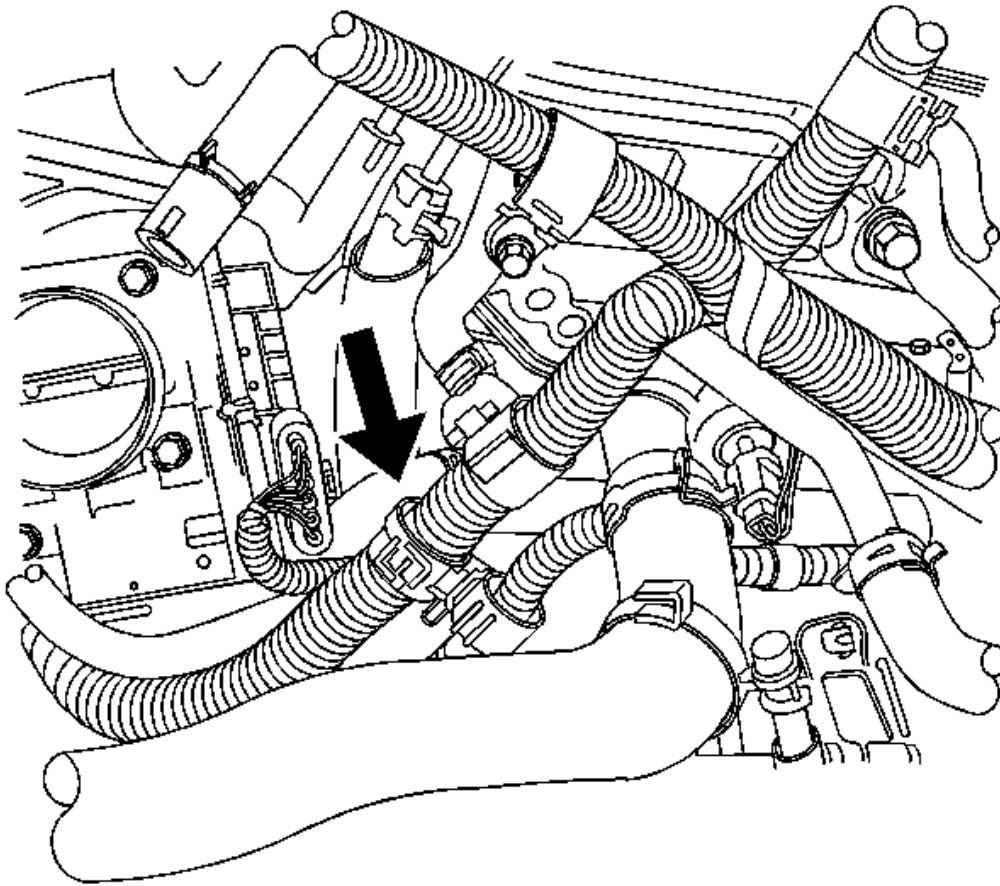


Fig. 24: View Of Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

NOTE: Locate the retaining clip close to the throttle body branch. Ensure the engine block heater harness clip is fully attached to the conduit of the engine harness. An audible click will be heard when fully seated.

3. Attach the engine block heater harness clip, nearest the heating element, between the engine main wiring harness bracket and the throttle body branch.

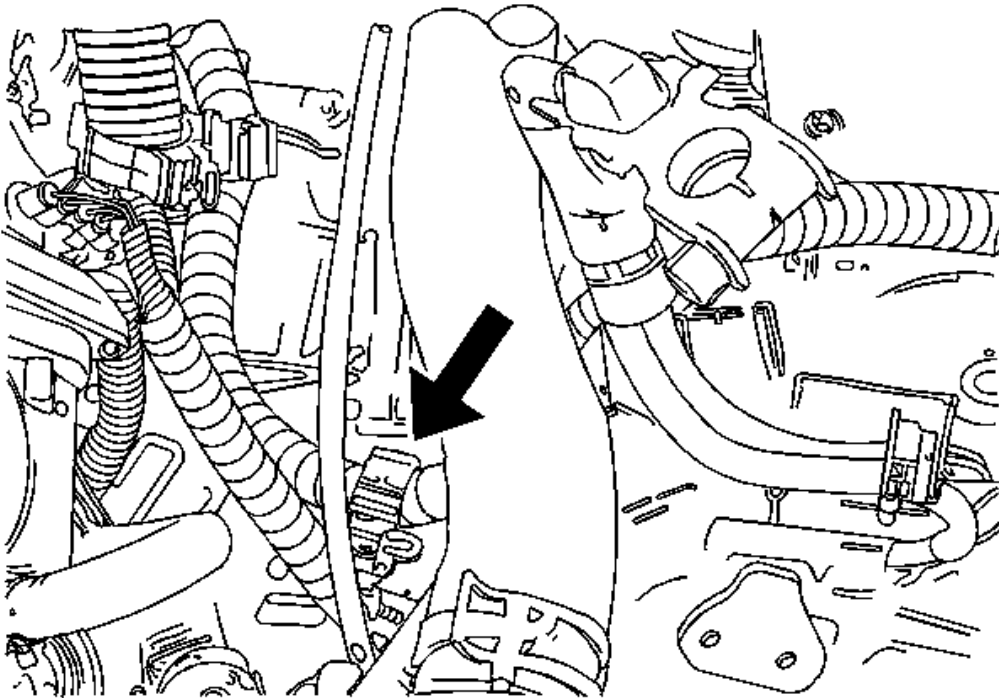


Fig. 25: Identifying Engine Block Heater Harness Retainer

Courtesy of GENERAL MOTORS CORP.

4. Route the engine block heater harness downward towards the bottom of the engine.
5. Route the engine block heater harness below the transmission shift cable.

NOTE: **Ensure the engine block heater harness clip is fully attached to the conduit of the neutral safety switch harness. An audible click will be heard when fully seated.**

6. Attach the engine block heater harness retaining clip to the neutral safety switch harness branch bracket.
7. Route the engine block heater harness over the battery harness protector and away from the air cleaner.

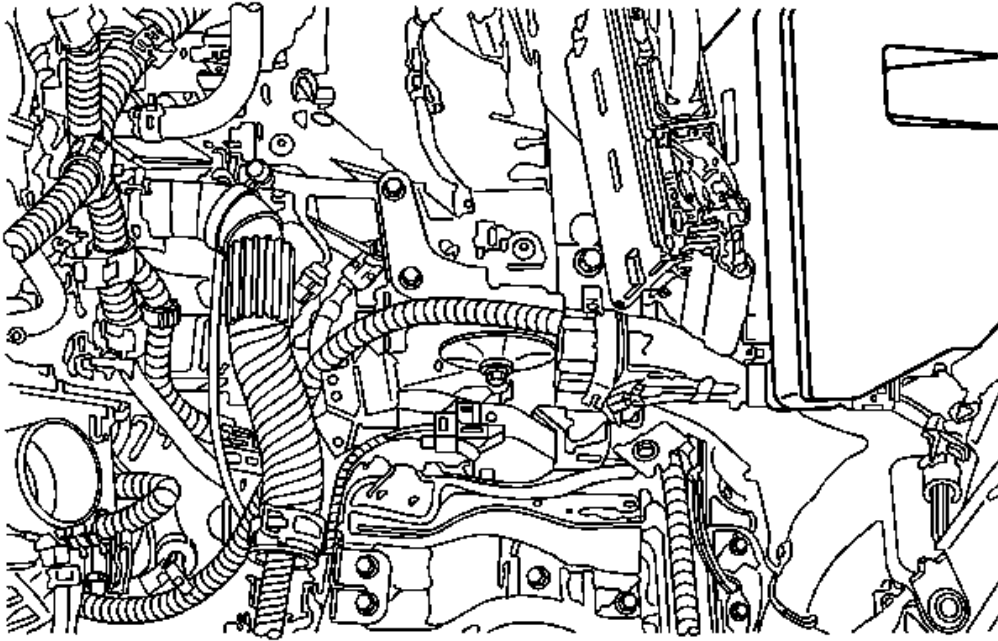


Fig. 26: Identifying Engine Block Heater Harness Plug Bundle
Courtesy of GENERAL MOTORS CORP.

8. Route the engine block heater harness under the air inlet. Then bring the harness upward along the air inlet towards the fender.

NOTE: When installation is completed, ensure the engine block heater harness plug bundle is stowed between the resonator and the fender.

9. Clip the engine block heater harness plug bundle to the resonator attachment flange close to the neck.

ENGINE BLOCK HEATER REPLACEMENT (MANUAL TRANSMISSION)

REMOVAL PROCEDURE

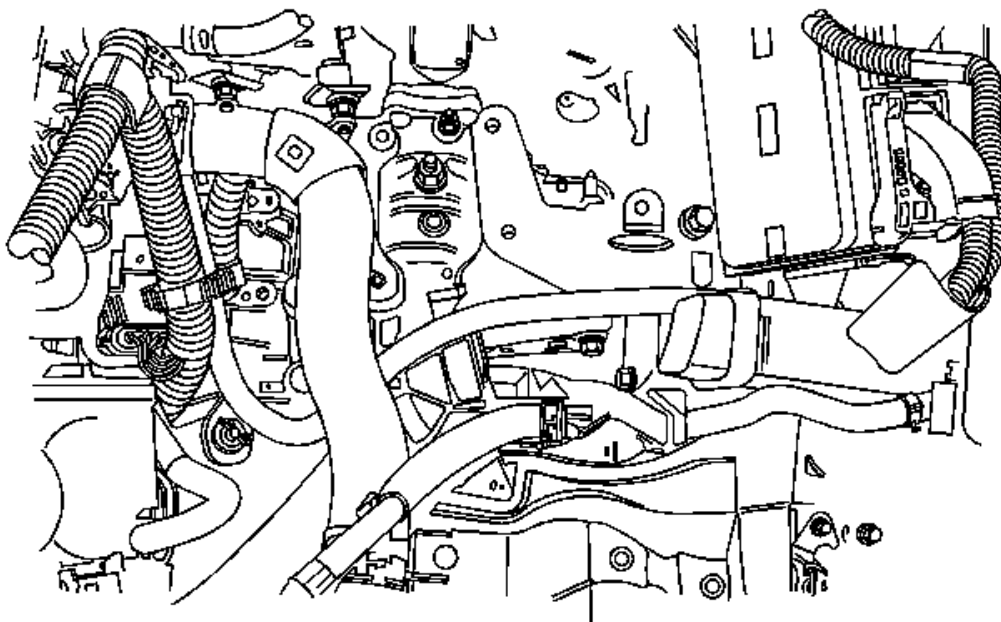


Fig. 27: View Of Engine Block Heater Harness Plug Bundle
Courtesy of GENERAL MOTORS CORP.

1. Unclip the engine block heater harness plug bundle from the resonator attachment flange.

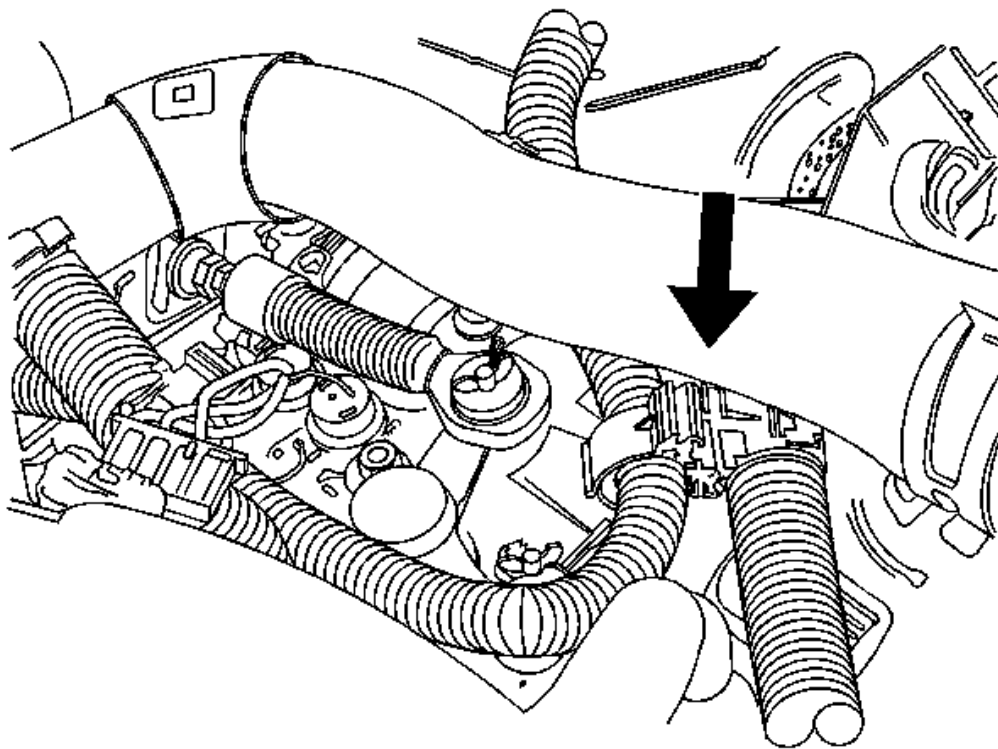


Fig. 28: View Of Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

2. Detach the engine block heater harness retainer from the battery harness.

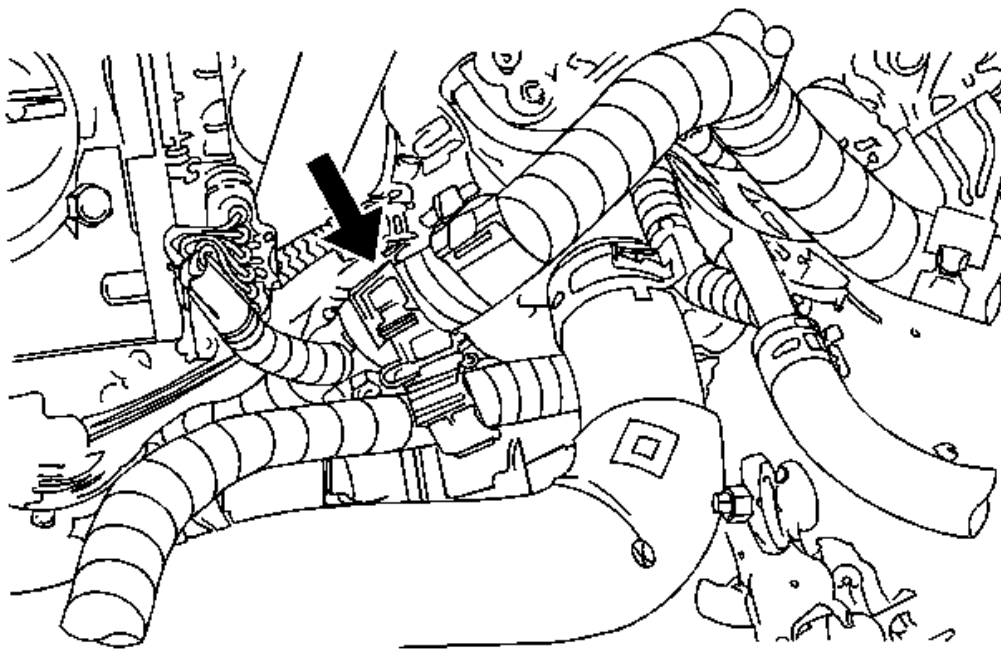


Fig. 29: Locating Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

3. Detach the engine block heater harness retainer from the engine harness.

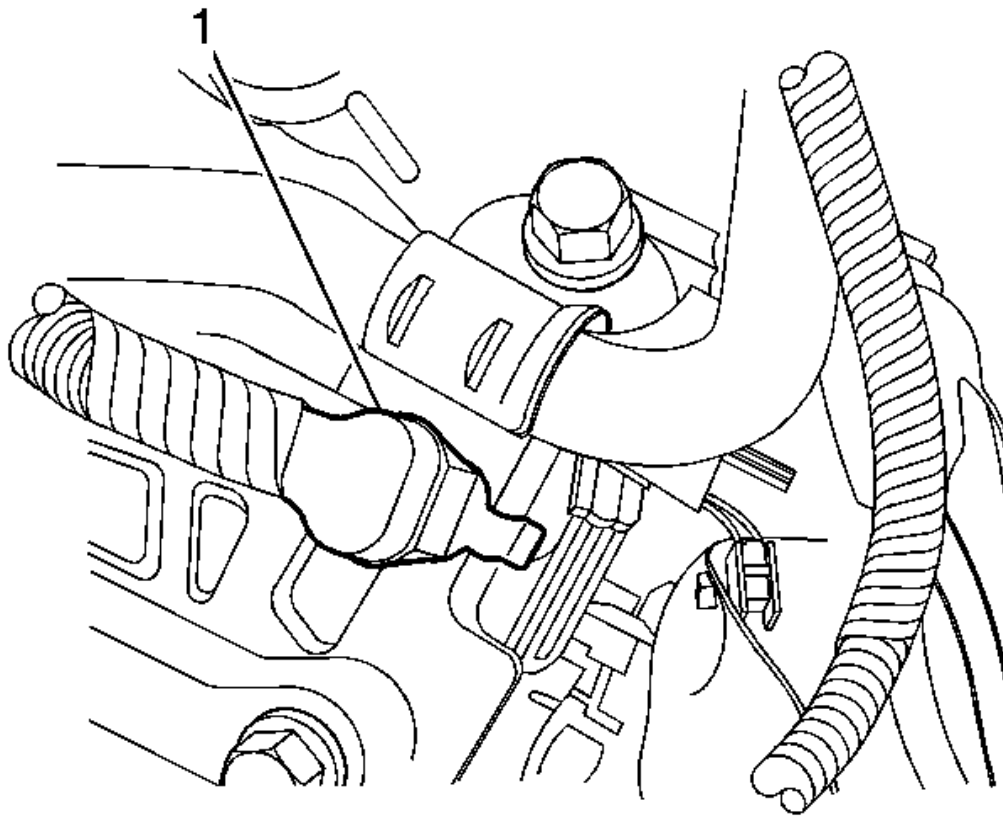


Fig. 30: Locating Engine Block Heater Element Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Disengage the engine block heater element (1) retaining clip from the engine block and remove the engine block heater assembly.

INSTALLATION PROCEDURE

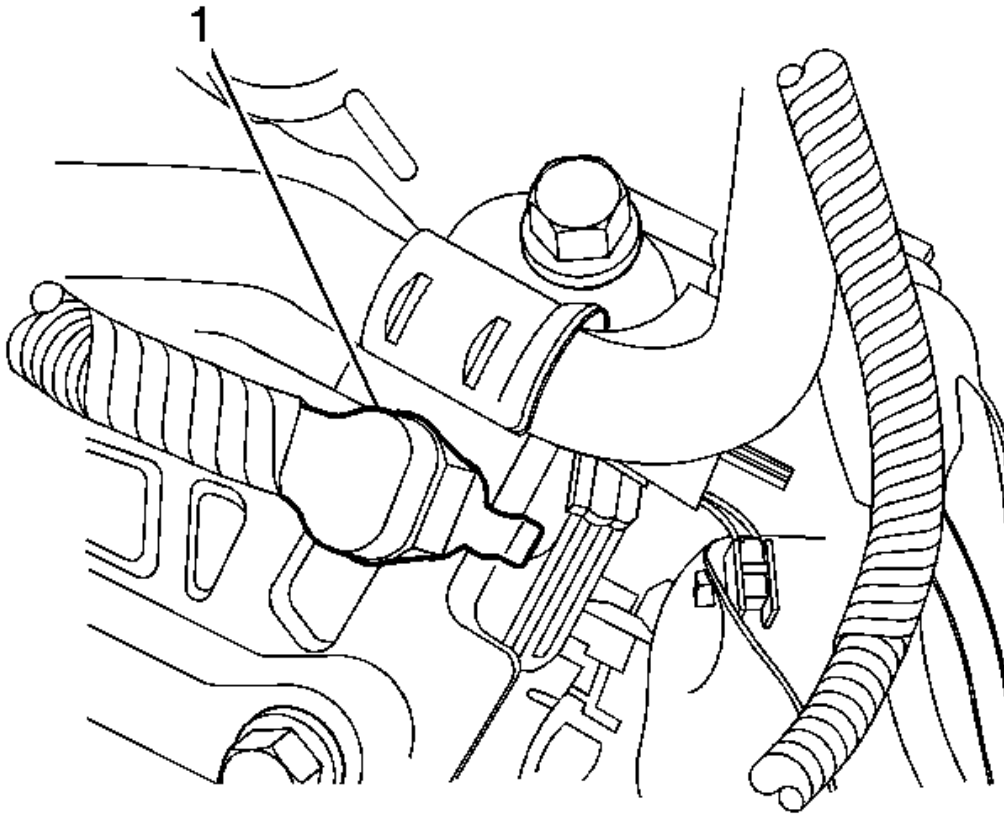


Fig. 31: Locating Engine Block Heater Element Retaining Clip
Courtesy of GENERAL MOTORS CORP.

NOTE: Visually inspect that the engine block heater harness plug is fully seated onto the element. Ensure the heating element is fully inserted into the engine block and the retaining clip is engaged. An audible click will be heard when clip is locked in position.

1. Completely insert the engine block heater element (1) into the engine block cavity in the nine o'clock position.

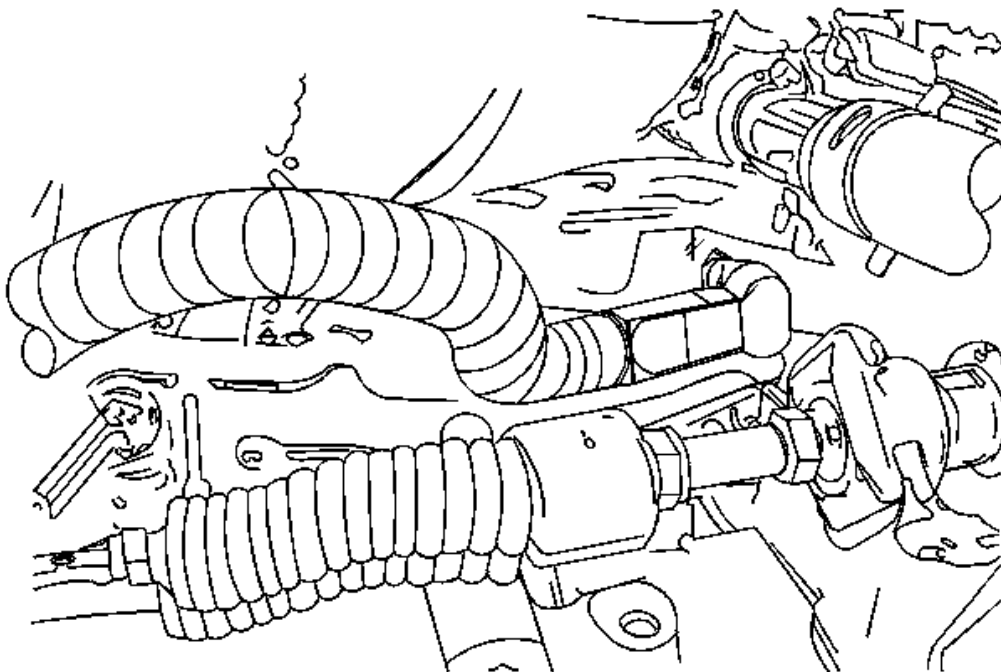


Fig. 32: Routing Of Engine Block Heater Harness
Courtesy of GENERAL MOTORS CORP.

2. Route the engine block heater harness towards the front of the engine.

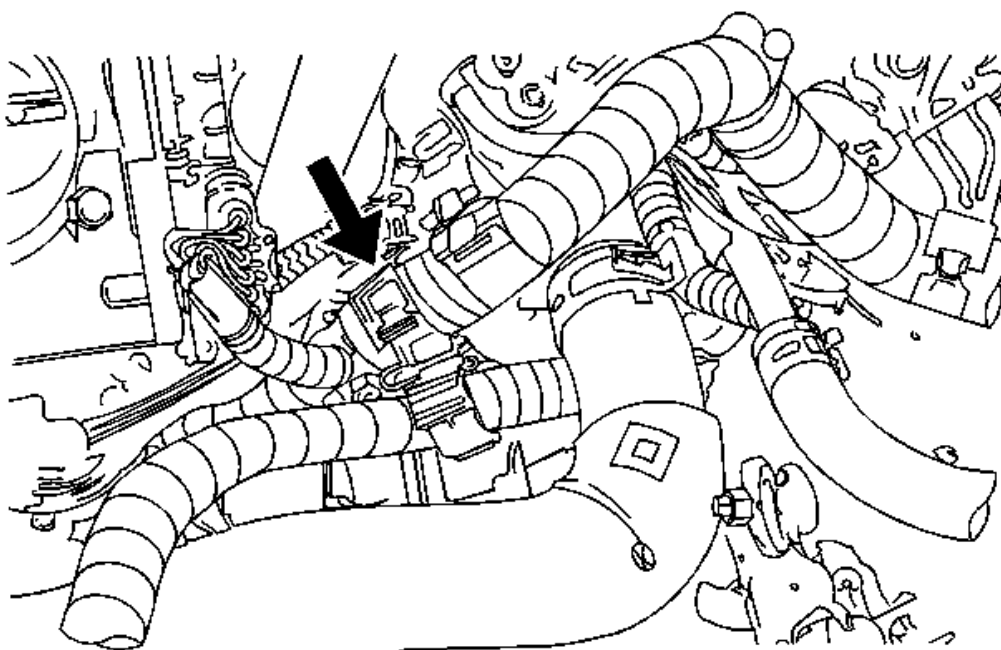


Fig. 33: Locating Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

NOTE: Locate the retaining clip close to the throttle body branch. Ensure the engine block heater harness clip is fully attached to the conduit of the engine harness. An audible click will be heard when fully seated.

3. Attach the engine block heater harness clip, nearest the heating element, between the engine main wiring harness bracket and the throttle body branch.

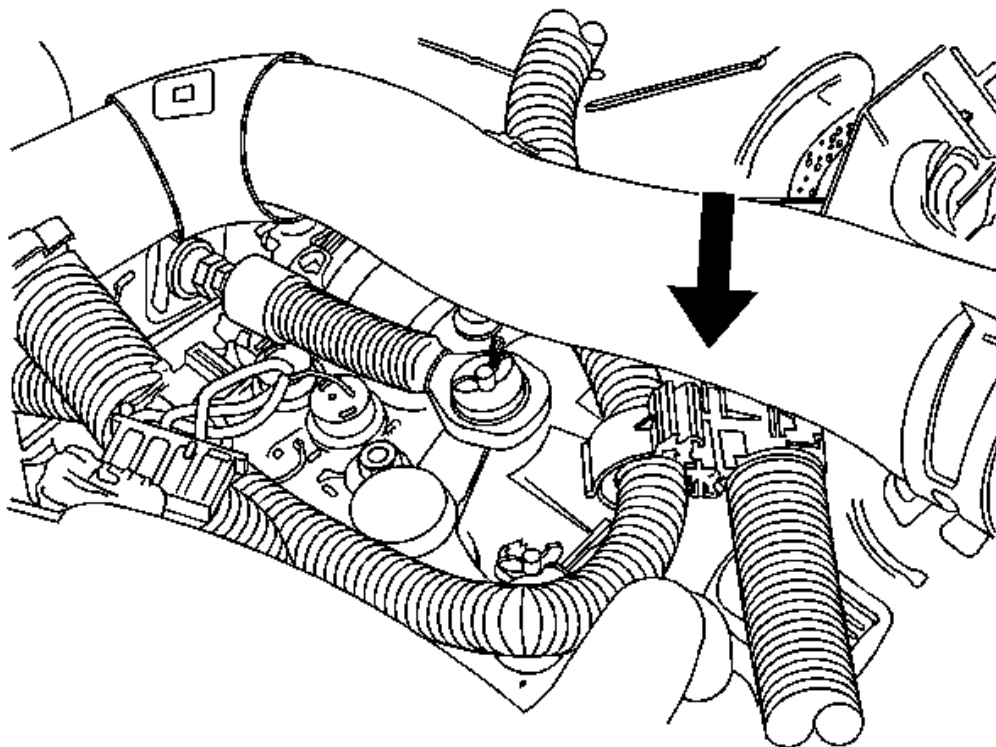


Fig. 34: View Of Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

4. Route the engine block heater harness under the heater hose.

NOTE: **Ensure the engine block heater harness clip is fully attached to the conduit of the battery harness. An audible click will be heard when fully seated.**

5. Route the engine block heater harness below the battery tray bracket and along the battery harness.
6. Rotate the clip downwards away from the radiator hose to prevent contact.

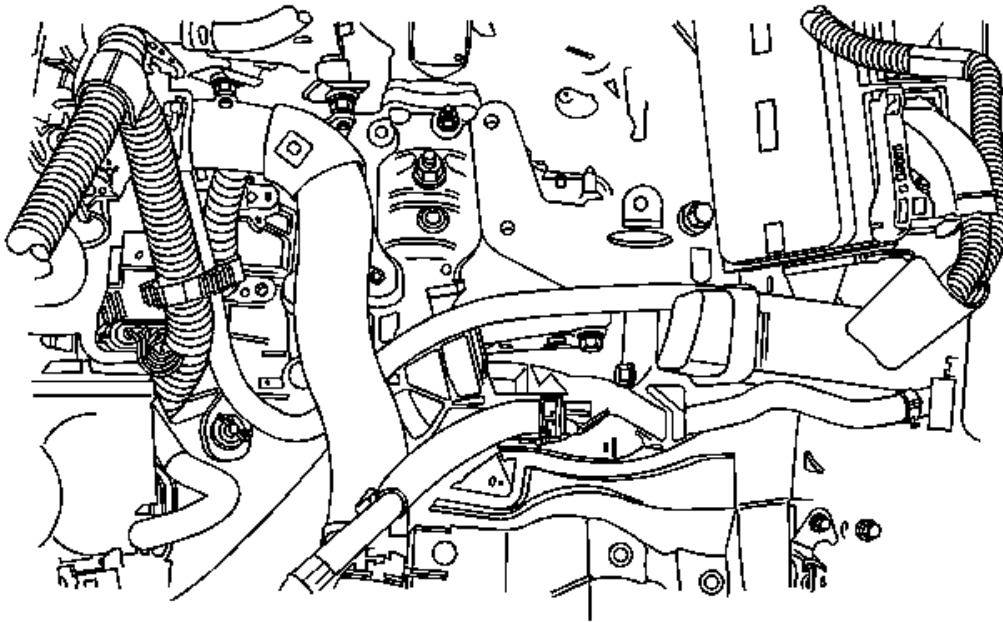


Fig. 35: View Of Engine Block Heater Harness Plug Bundle
Courtesy of GENERAL MOTORS CORP.

7. Route the engine block heater harness over the battery harness protector and away from the air cleaner.
8. Route the engine block heater harness under the air inlet. Then bring the harness upward along the air inlet.

NOTE: When installation is completed, ensure the engine block heater harness plug bundle is stowed between the resonator and the fender.

9. Clip the engine block heater harness plug bundle to the resonator attachment flange close to the neck.

INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

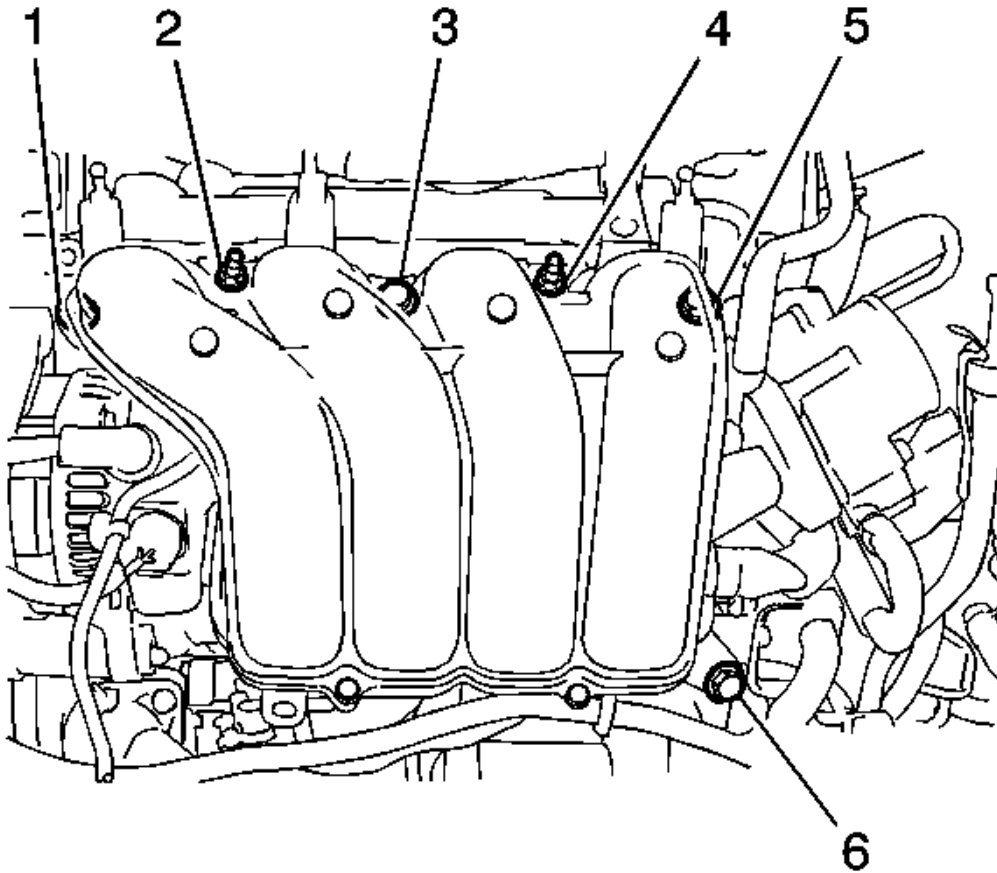


Fig. 36: Identifying Intake Manifold Bolts
 Courtesy of GENERAL MOTORS CORP.

1. Drain the engine coolant. Refer to Cooling System Draining and Filling .
2. Remove the engine cover. Refer to Engine Cover Replacement.
3. Remove the air cleaner assembly with hose.
4. Remove the throttle body assembly. Refer to Throttle Body Assembly Replacement .
5. Remove the bolt and wire harness bracket.
6. Disconnect the 3 hoses.
7. Remove the 4 bolts (1, 3, 5, 6), 2 nuts (2, 4), intake manifold support and intake manifold.

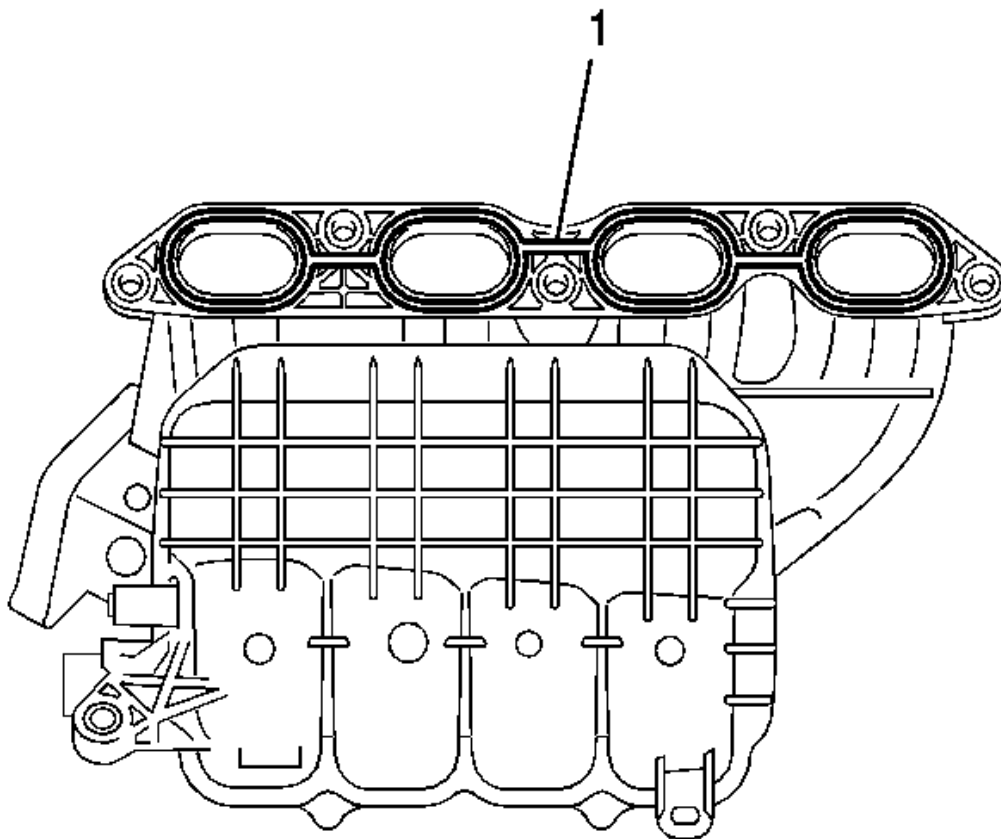


Fig. 37: View Of Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

8. Remove the gasket (1) from the intake manifold.
9. Using a TORX® socket E6, remove the 2 stud bolts from the intake manifold.

INSTALLATION PROCEDURE

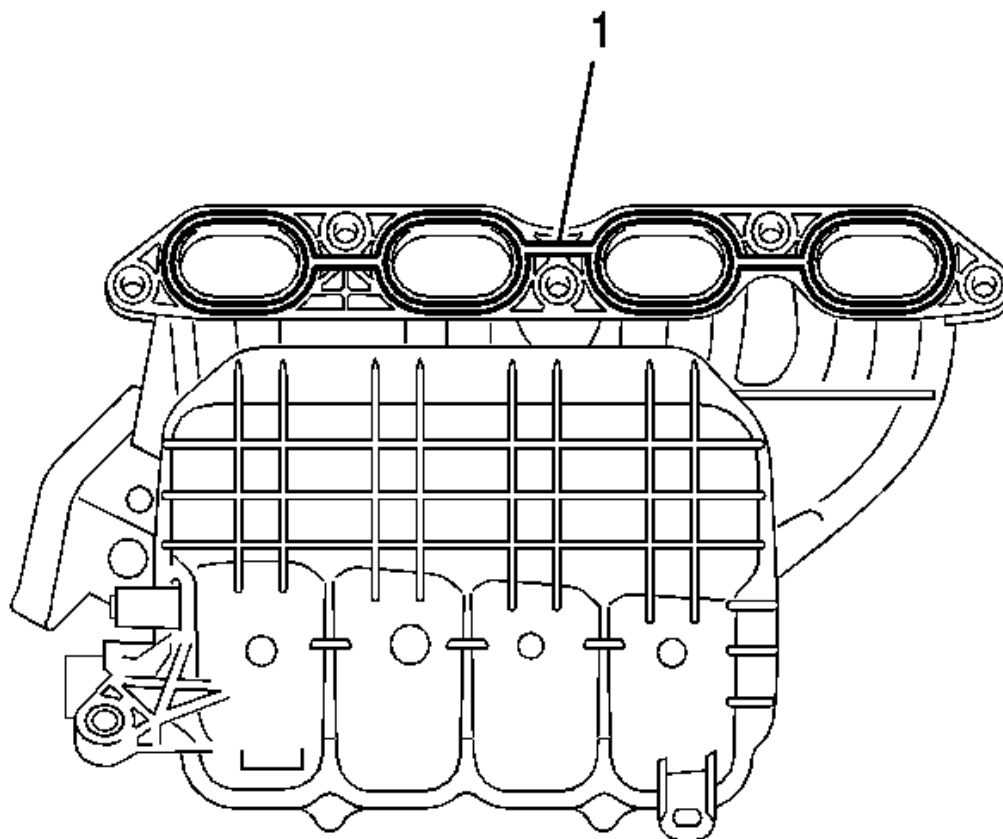


Fig. 38: View Of Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to **Fastener Caution** .

1. Using a TORX® socket E6, install the 2 stud bolts to the intake manifold and tighten to 5.0 N.m (44 lb in).
2. Connect the bracket with the bolt and tighten to 10 N.m (8 lb ft).
3. Install a new gasket (1) into the intake manifold.

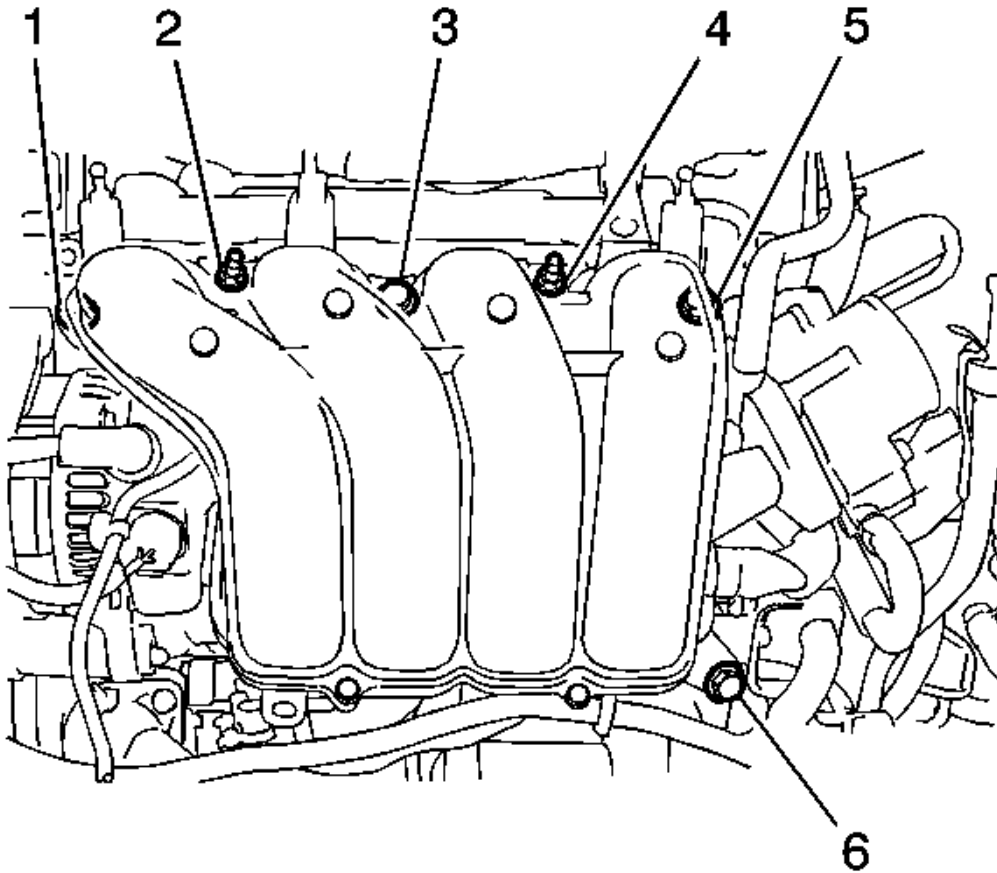


Fig. 39: Identifying Intake Manifold Bolts
Courtesy of GENERAL MOTORS CORP.

4. Install the intake manifold and intake manifold support with the 4 bolts (1, 3, 5, 6) and 2 nuts (2, 4) and tighten to 28 N.m (21 lb ft).
5. Connect the 3 hoses.
6. Connect the wire harness bracket with the bolt and tighten to 10 N.m (8 lb ft).
7. Install the throttle body assembly. Refer to **Throttle Body Assembly Replacement**
8. Install the air cleaner assembly with hose.
9. Install the engine cover. Refer to **Engine Cover Replacement**.
10. Add the engine coolant. Refer to **Cooling System Draining and Filling**
11. Inspect for coolant leak.

INTAKE CAMSHAFT AND VALVE LIFTER REPLACEMENT

REMOVAL PROCEDURE

1. Remove the engine assembly with transaxle. Refer to **Engine Replacement**.
2. Install the engine stand.
3. Remove the intake manifold. Refer to **Intake Manifold Removal**.
4. Remove the fuel tube assembly.
5. Remove the fuel delivery pipe assembly.
6. Remove the fuel injector assembly.
7. Remove the ignition coil assembly.
8. Remove the oil level dipstick sub-assembly. Refer to **Oil Level Indicator Tube Replacement**.
9. Remove the exhaust manifold. Refer to **Exhaust Manifold Removal**.
10. Remove the ventilation hose.
11. Remove the water by-pass hoses.
12. Remove the water by-pass pipe.
13. Remove the inlet water hose.
14. Remove the inlet water.
15. Remove the thermostat.
16. Remove the radio setting condenser.
17. Remove the cylinder head cover assembly. Refer to **Camshaft Cover Removal**.
18. Set the No. 1 cylinder to TDC/compression.
19. Remove the crankshaft pulley.
20. Remove the chain tensioner assembly. Refer to **Timing Chain Tensioner Removal**.
21. Remove the timing chain cover assembly. Refer to **Timing Chain Housing Removal**.
22. Remove the timing chain cover oil seal.
23. Remove the chain tensioner slipper.
24. Remove the timing gear chain vibration damper.
25. Remove the chain assembly.
26. Remove the oil pumpchain vibration damper.

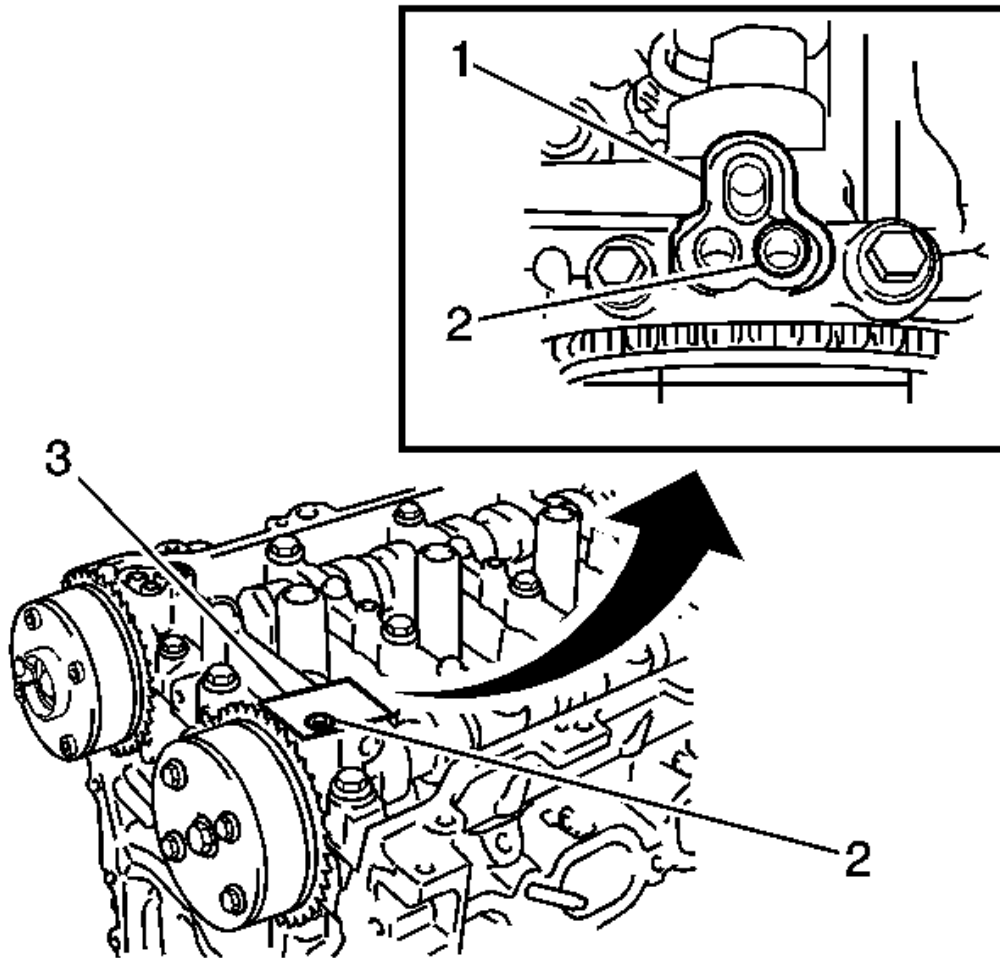


Fig. 40: Identifying Camshaft Timing Gear Assembly
 Courtesy of GENERAL MOTORS CORP.

27. Inspect the camshaft timing gear assembly.
28. Check the lock of the camshaft timing gear.

NOTE: Be sure to cover the oil hole completely because air leaks due to insufficient sealing will prevent the lock pin from being released.

29. After cleaning and degreasing the VVT oil hole on the intake side of the camshaft bearing cap, completely seal the oil hole with adhesive tape (3) or equivalent as shown in the illustration to prevent air from leaking.
30. Prick a hole (2) in the tape covering the oil hole as shown.

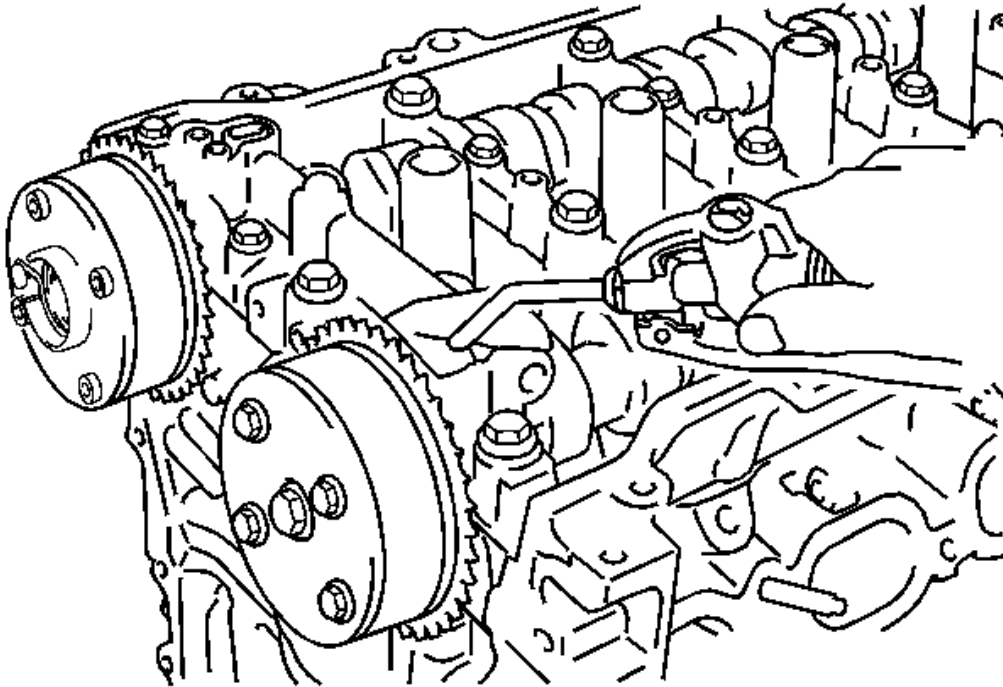


Fig. 41: Releasing Lock Pin

Courtesy of GENERAL MOTORS CORP.

NOTE:

- If air leaks out, reattach the adhesive tape.
- Cover the oil hole with a shop rag or piece of cloth when applying air pressure to prevent oil from spraying.

31. Apply approximately 150 kPa (22 psi) of air pressure to the hole to release the lock pin.

NOTE:

Depending on the air pressure applied, the camshaft timing gear assembly may turn in the advanced direction without assistance by hand.

32. Forcibly turn the camshaft timing gear assembly in the advanced direction (counterclockwise).

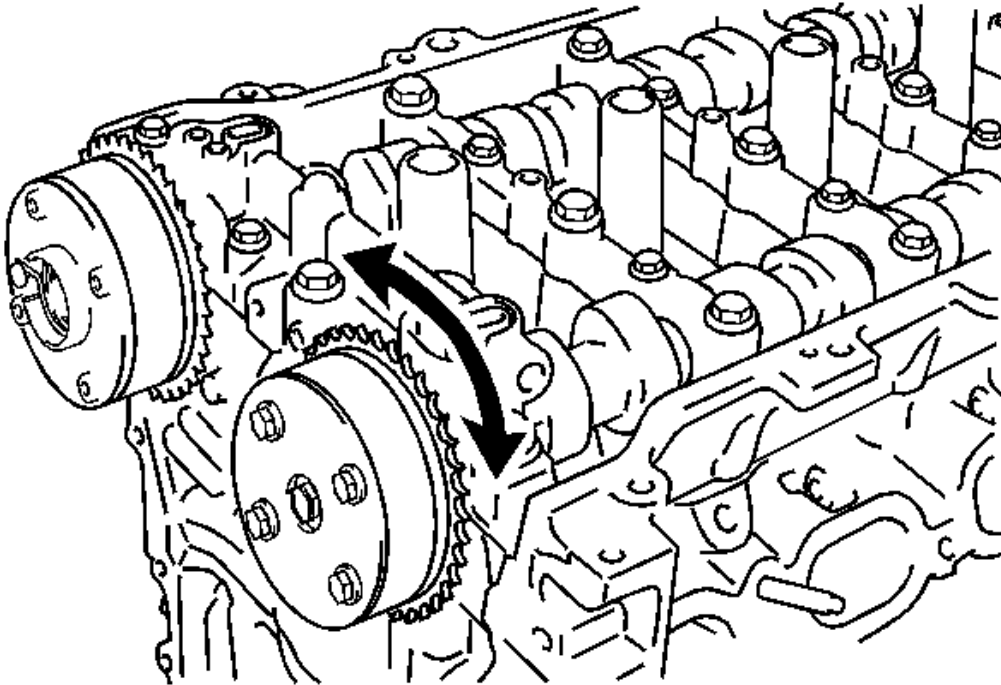


Fig. 42: Turning Camshaft Timing Gear Assembly
Courtesy of GENERAL MOTORS CORP.

33. Turn the camshaft timing gear assembly within its movable range (26.5-28.5 degrees) 2 or 3 times without turning it to the most retarded position. Make sure that the camshaft timing gear assembly turns smoothly.
34. Remove the adhesive tape from the camshaft bearing cap.
35. Inspect the camshaft timing exhaust gear assembly.
36. Check the lock of the camshaft timing exhaust gear.

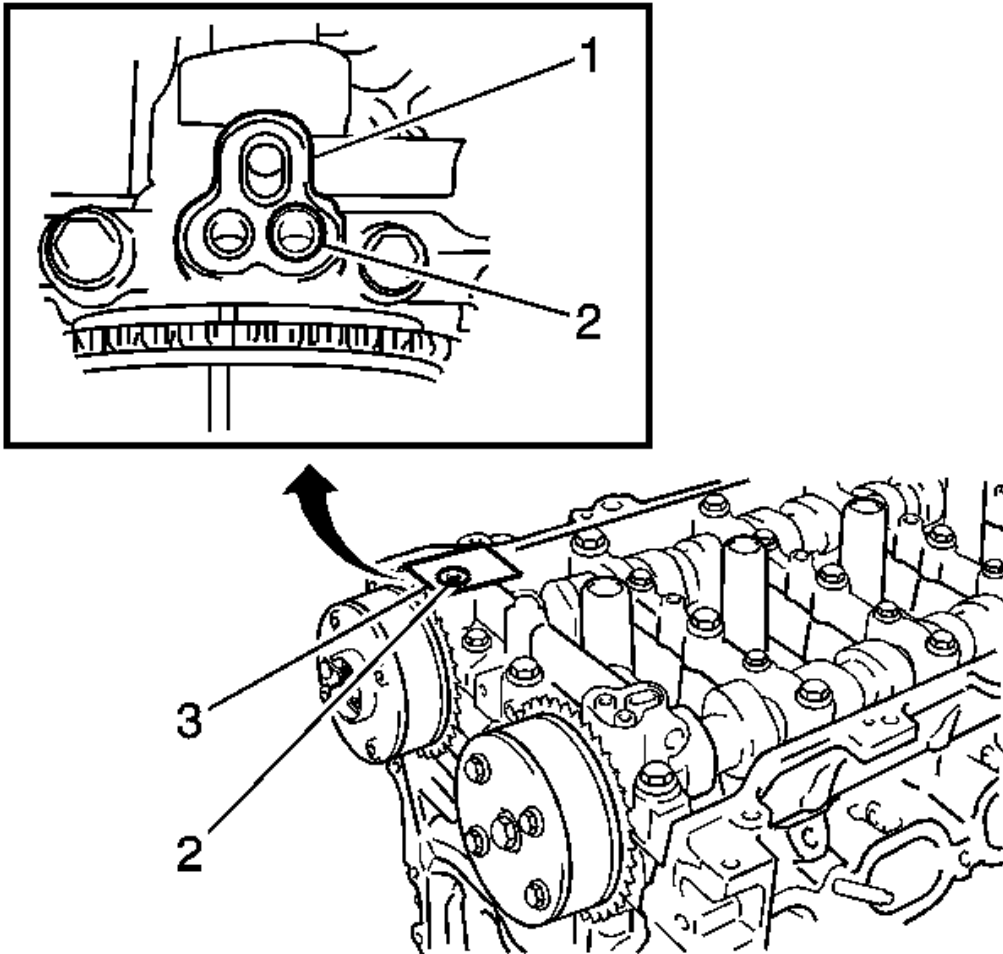


Fig. 43: Sealing Oil Hole

Courtesy of GENERAL MOTORS CORP.

NOTE: Be sure to cover the oil hole completely because air leaks due to insufficient sealing will prevent the lock pin from being released.

37. After cleaning and degreasing the VVT oil hole on the exhaust side of the camshaft bearing cap, completely seal the oil hole with adhesive tape (3) or equivalent as shown in the illustration to prevent air from leaking.
38. Prick a hole (2) in the tape covering the oil hole as shown.

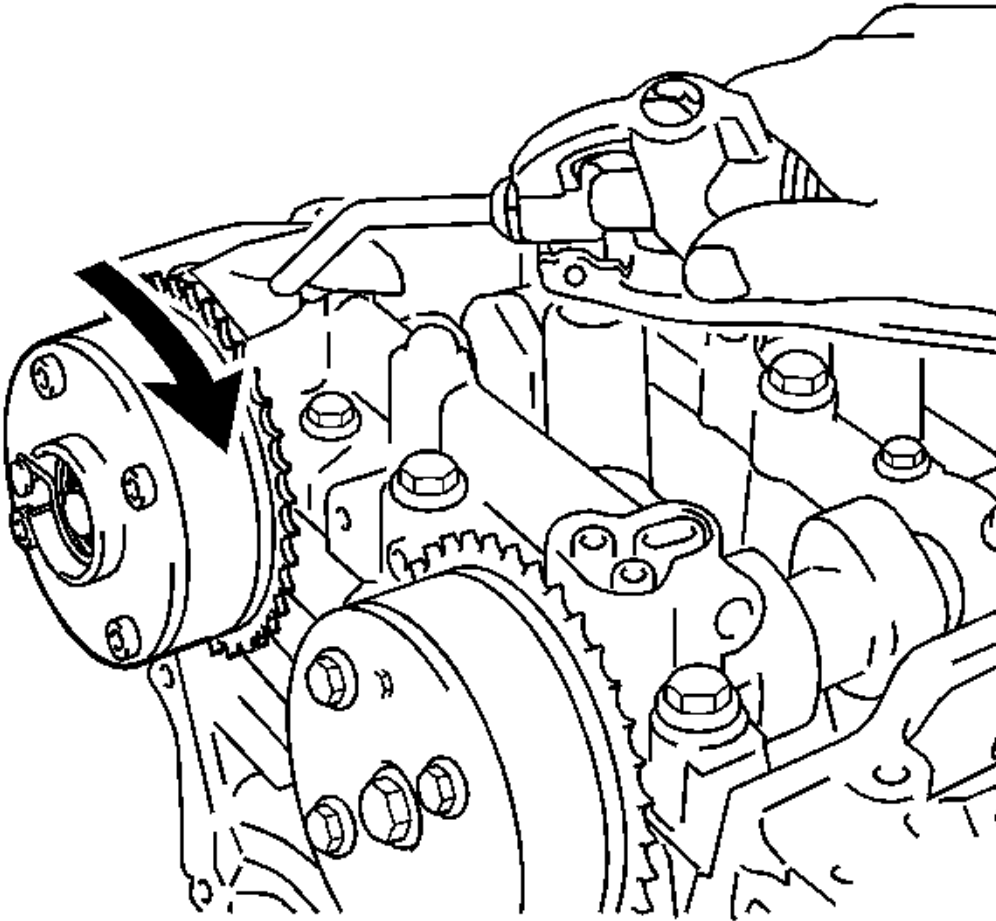


Fig. 44: Releasing Lock Pin

Courtesy of GENERAL MOTORS CORP.

NOTE:

- If air leaks out, reattach the adhesive tape.
- Cover the oil hole with a shop rag or piece of cloth when applying air pressure to prevent oil from spraying.

39. Apply approximately 200 kPa (28 psi) of air pressure to the hole to release the lock pin.

NOTE:

Be sure to keep the camshaft timing exhaust gear in the retard direction using a screwdriver. If the gear is released, it will return to the most advanced position automatically due to force from the spring.

40. Using a screwdriver with its tip wrapped with tape, forcibly turn the camshaft timing exhaust gear in the retard direction (clockwise).

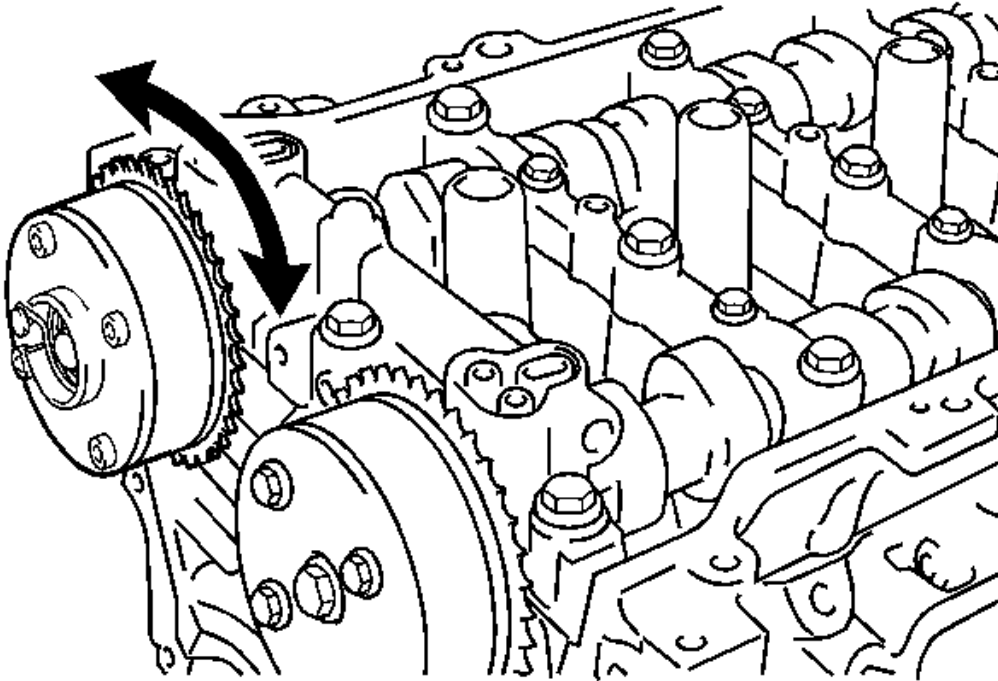


Fig. 45: Turning Camshaft Timing Exhaust Gear
Courtesy of GENERAL MOTORS CORP.

41. Using a screwdriver with its tip wrapped with tape, turn the camshaft timing exhaust gear within its movable range (19 to 21 degrees) 2 or 3 times without turning it to the most advanced position. Make sure that the camshaft timing exhaust gear turns smoothly.
42. Remove the adhesive tape from the camshaft bearing cap.

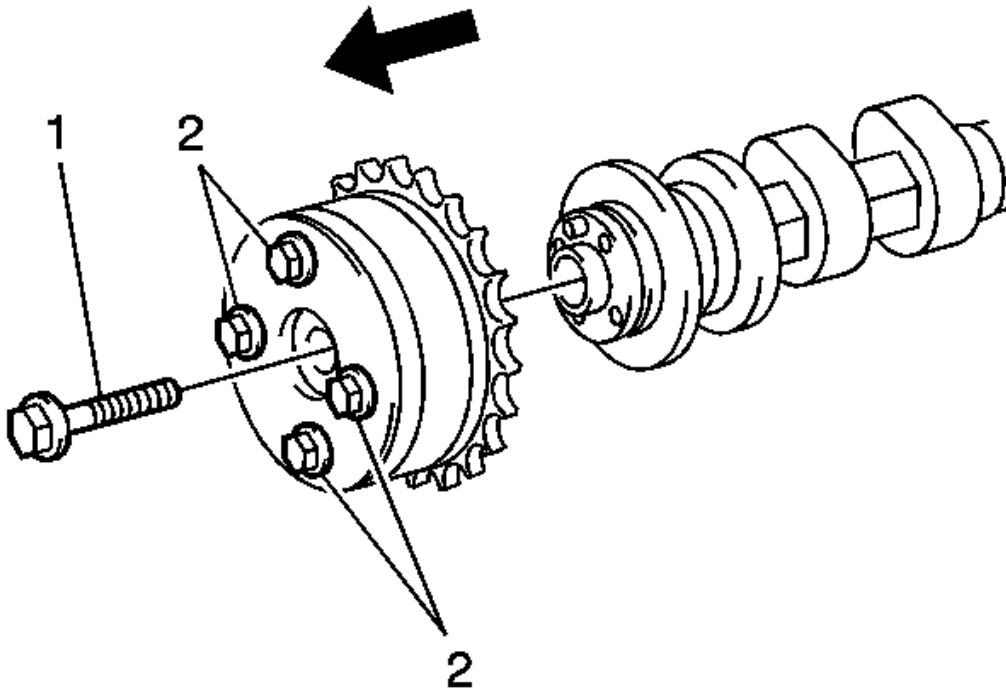


Fig. 46: View Of Camshaft Timing Gear & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Before removing the camshaft timing gear, make sure that the lock pin has been released.
- Be sure not to remove the other 4 bolts (2).
- Keep the camshaft timing gear assembly horizontal while removing it from the camshaft.

43. Remove the flange bolt (1) while holding the hexagonal portion of the camshaft, and then remove the camshaft timing gear assembly.

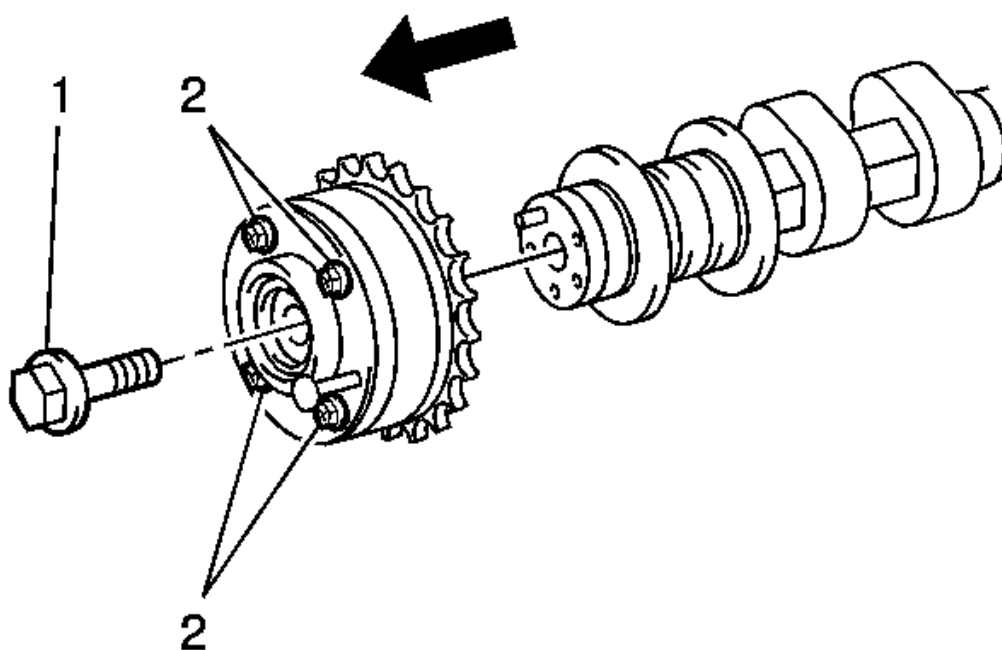


Fig. 47: View Of Camshaft Timing Gear & Bolts
 Courtesy of GENERAL MOTORS CORP.

NOTE:

- Be sure not to remove the other 4 bolts (2).
- Keep the camshaft timing exhaust gear assembly horizontal while removing it from the camshaft.

44. Remove the flange bolt (1) while holding the hexagonal portion of the camshaft, and then remove the camshaft timing exhaust gear assembly.

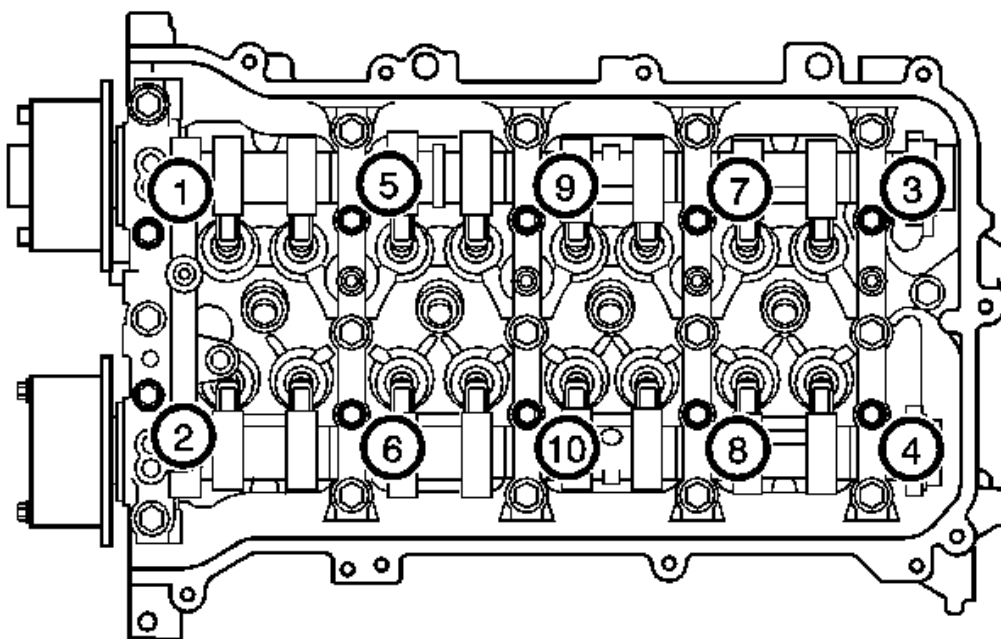


Fig. 48: Identifying Bearing Cap Bolt Removal/Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

45. Remove camshaft bearing cap-Uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.

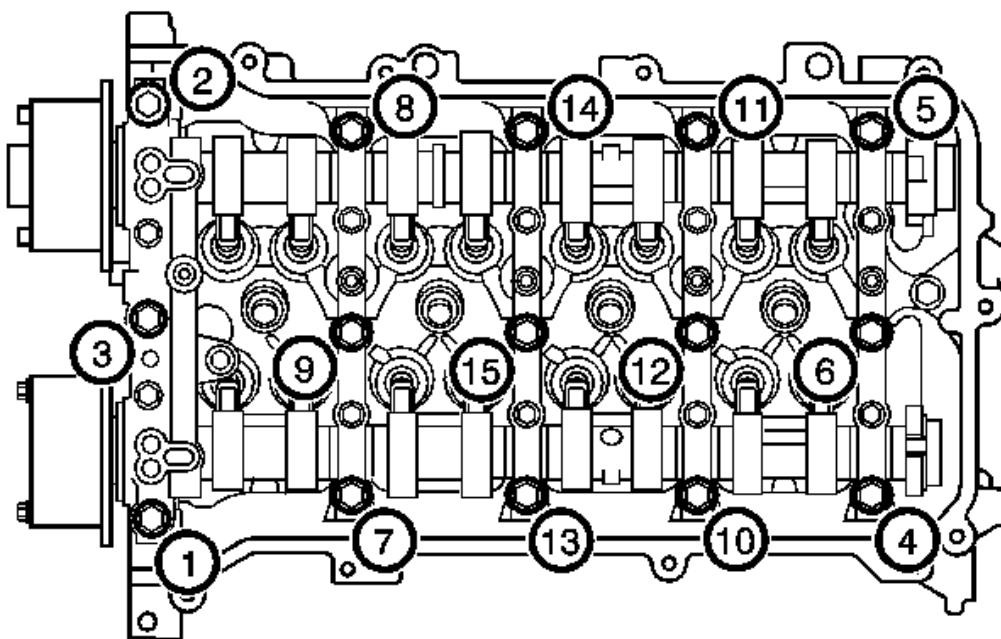


Fig. 49: Identifying Camshaft Bearing Cap Bolt Removal/Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Uniformly loosen the bolts while keeping the camshaft level.

46. Uniformly loosen and remove the 15 bearing cap bolts in the sequence shown in the illustration.

NOTE: Arrange the removed parts in the correct order.

47. Remove the 5 bearing caps.

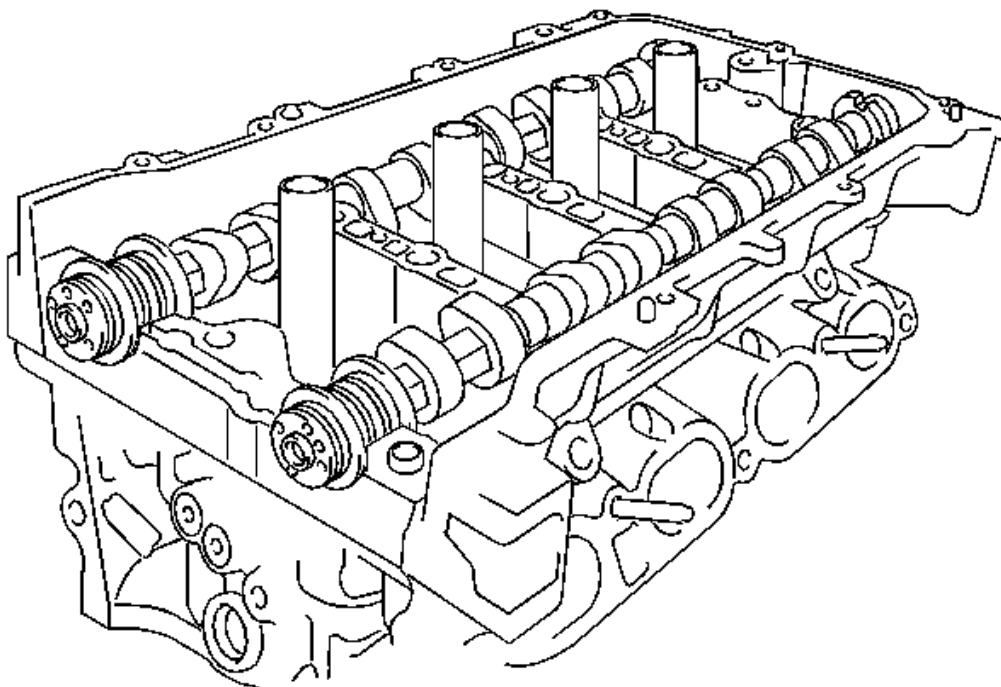


Fig. 50: View Of Cylinder Head & Camshafts
Courtesy of GENERAL MOTORS CORP.

48. Remove the intake camshaft.

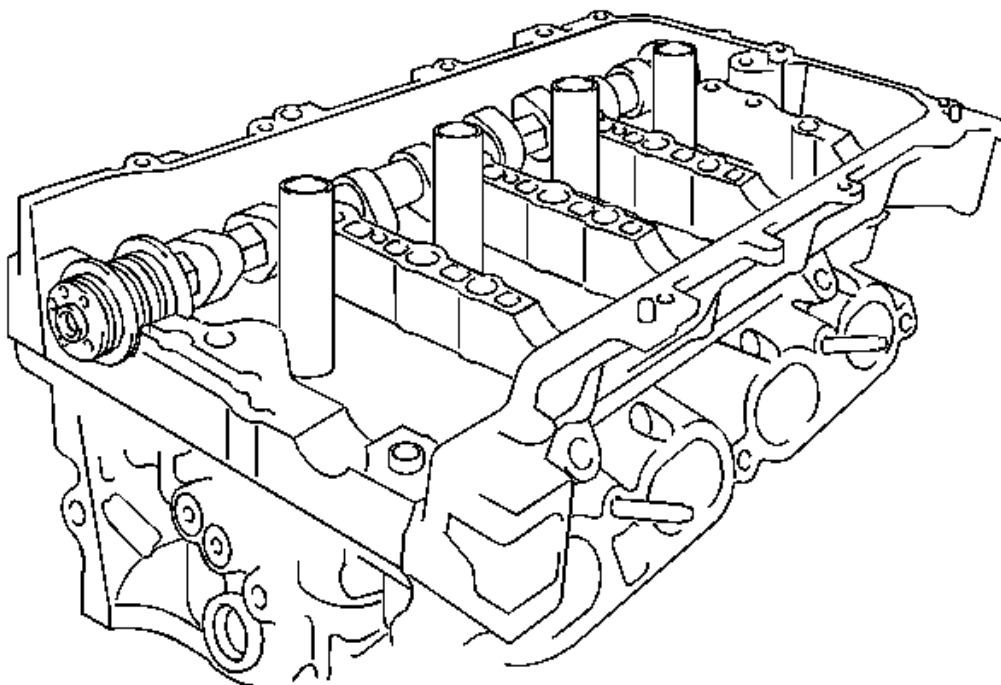


Fig. 51: View Of Camshaft
Courtesy of GENERAL MOTORS CORP.

49. Remove the exhaust camshaft.
50. Remove the valve rocker arm subassembly.
51. Remove the valve lash adjuster assembly.

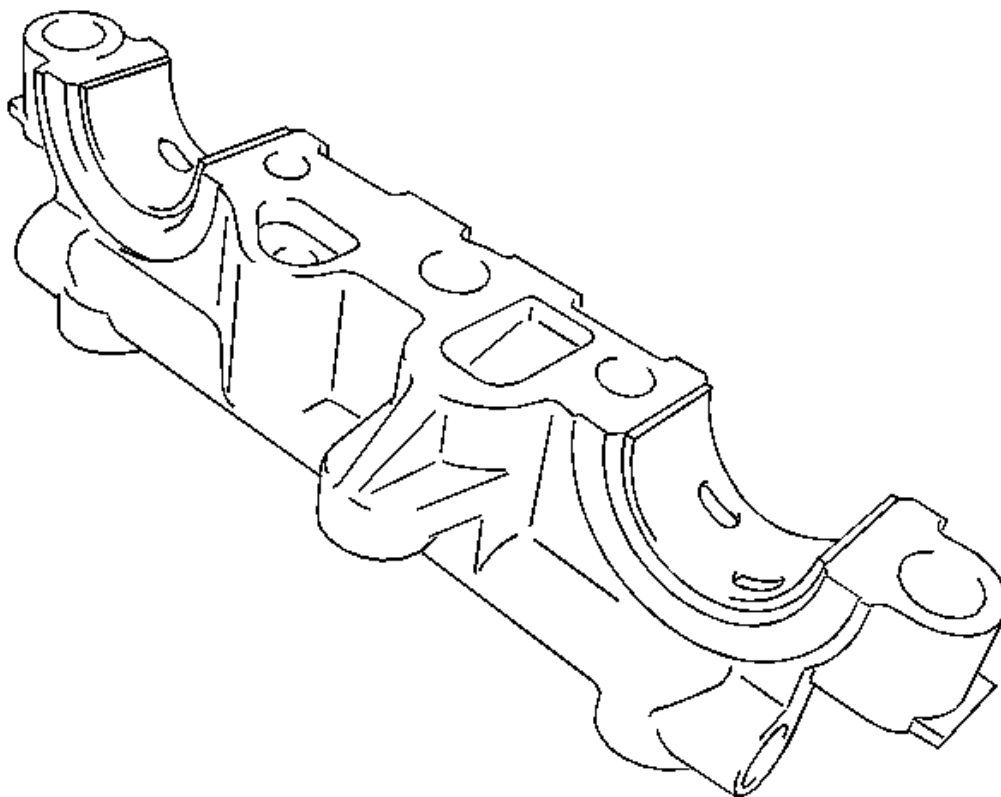


Fig. 52: View Of Camshaft Bearings
Courtesy of GENERAL MOTORS CORP.

52. Remove the 2 camshaft bearings from the cap.

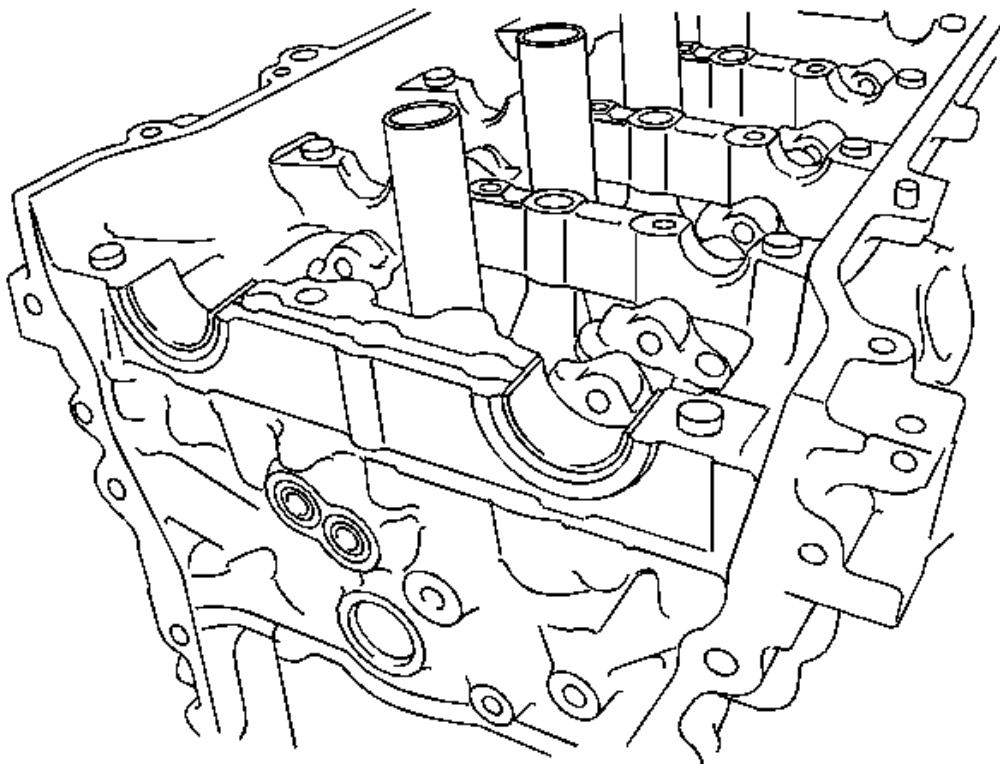


Fig. 53: Identifying Camshaft Bearings
Courtesy of GENERAL MOTORS CORP.

53. Remove the 2 camshaft bearings from the cylinder head.

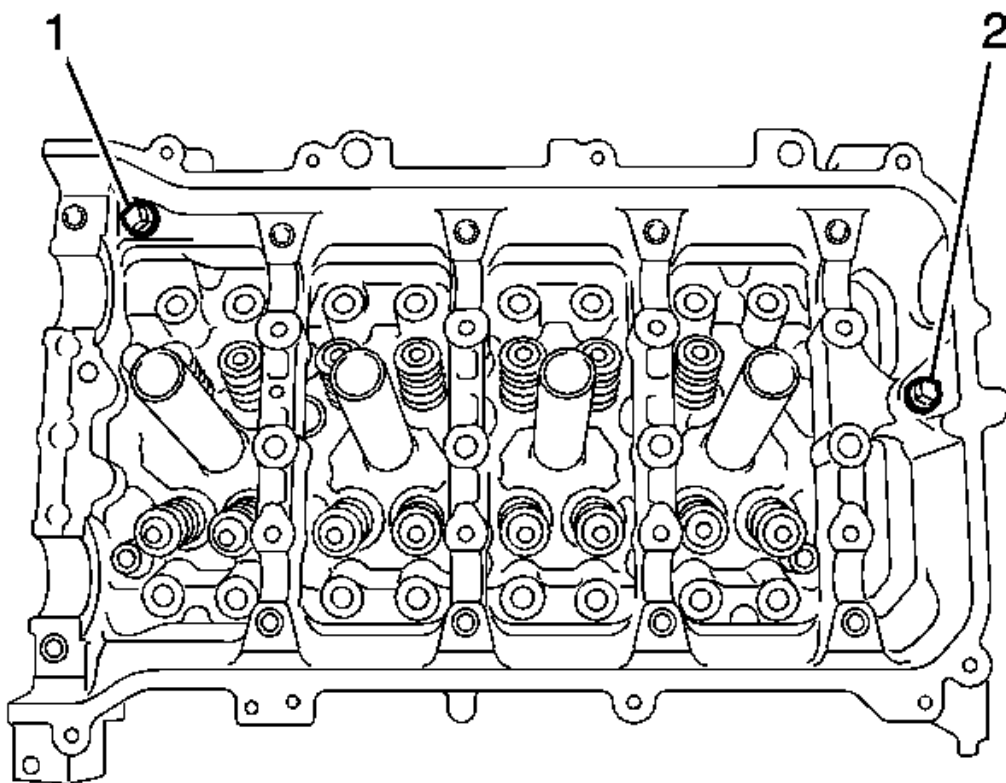


Fig. 54: Identifying 2 Bolts

Courtesy of GENERAL MOTORS CORP.

54. Remove the 2 bolts (1, 2).

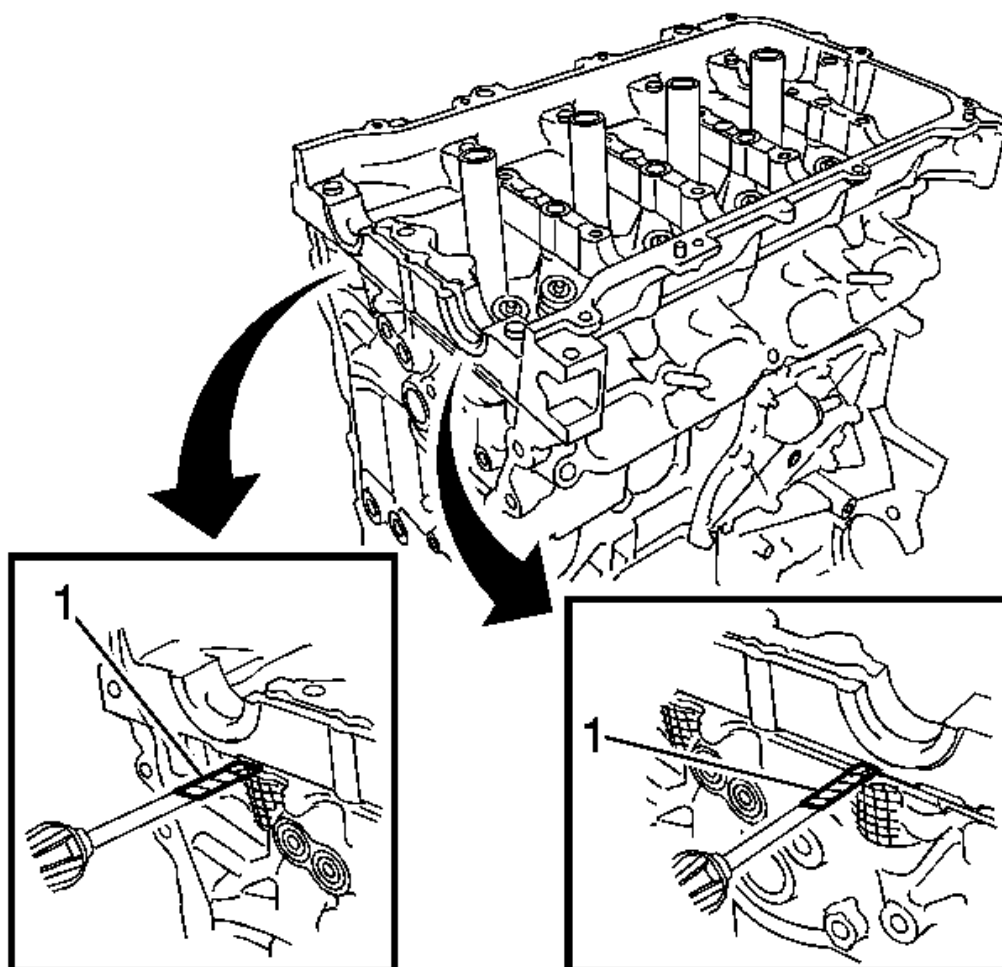


Fig. 55: View Of Camshaft Housing Assembly
Courtesy of GENERAL MOTORS CORP.

55. Remove the camshaft housing assembly by prying between the cylinder head and camshaft housing with a screwdriver (1).

NOTE: **Tape the screwdriver tip before use.**

56. Inspect the valve rocker arm assembly.
57. Inspect the valve lash adjuster assembly.
58. Clean the camshaft housing and cylinder head.

INSTALLATION PROCEDURE

1. Install the valve lash adjuster assembly.
2. Install the valve rocker arm assembly.
3. Install the 2 camshaft bearings after cleaning both surfaces of the bearings.

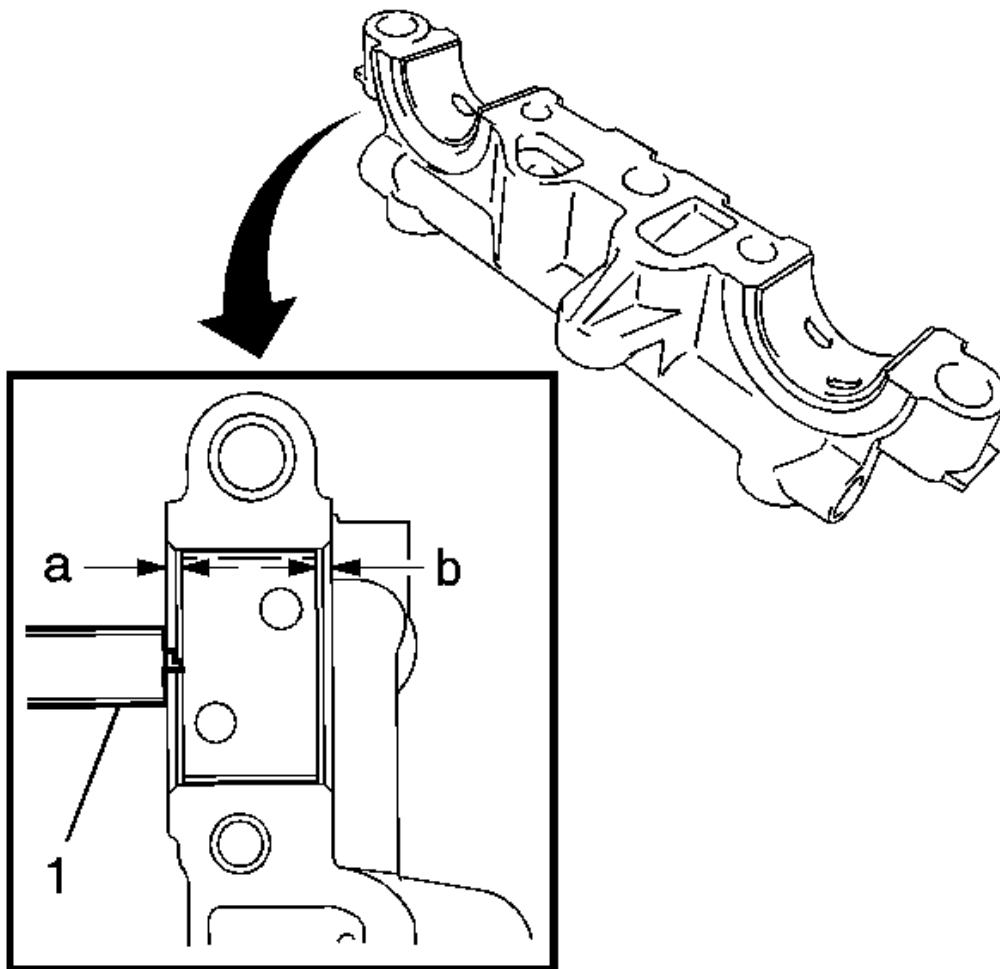


Fig. 56: Measuring Distance Between Bearing Cap Edge & Camshaft Bearing Edge
 Courtesy of GENERAL MOTORS CORP.

NOTE: Position the bearings to the center of the bearing cap by measuring dimensions A and B.

4. Using vernier calipers (1), measure the distance between the bearing cap edge and the camshaft bearing edge.

Specification: Dimension (A-B): 0.7 mm (0.0276 in) or less

5. Clean both surfaces of the bearings.
6. Install the 2 camshaft bearings.

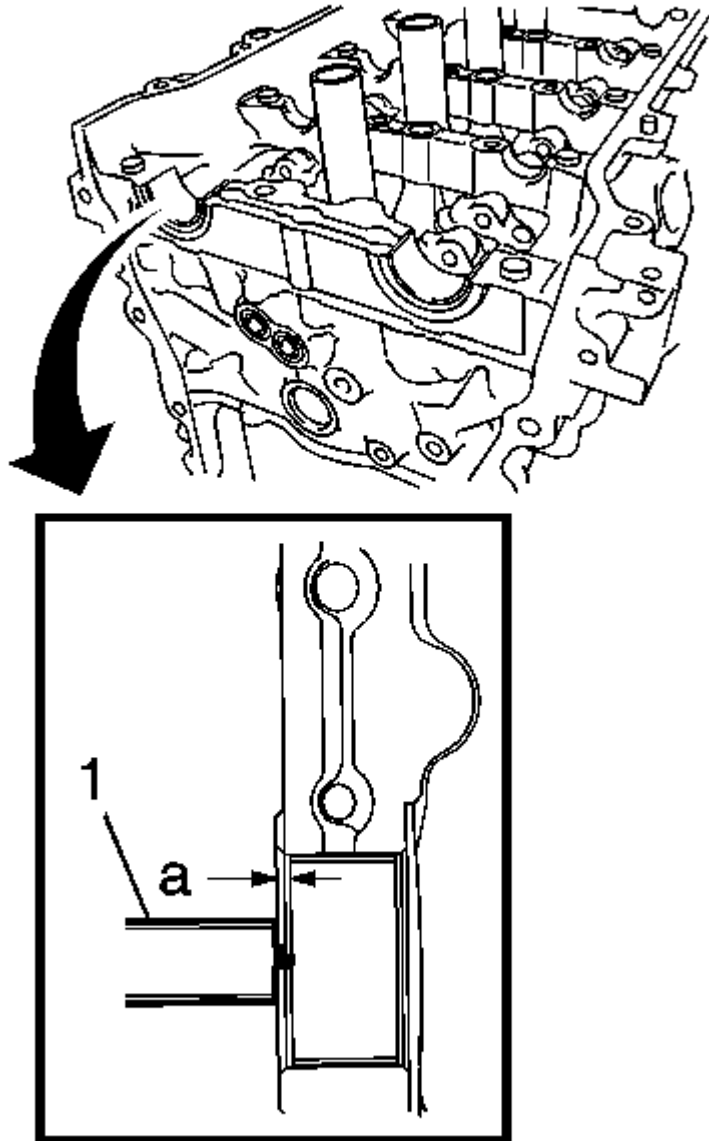


Fig. 57: Measuring Distance Between Bearing Cap Edge & Camshaft Bearing Edge
 Courtesy of GENERAL MOTORS CORP.

NOTE: Position the bearings to the center of the bearing cap by measuring dimension A.

7. Using vernier calipers (1), measure the distance between the bearing cap edge and the camshaft bearing edge.

Specification: Dimension (A): 1.05-1.75 mm (0.0413-0.0689 in.)

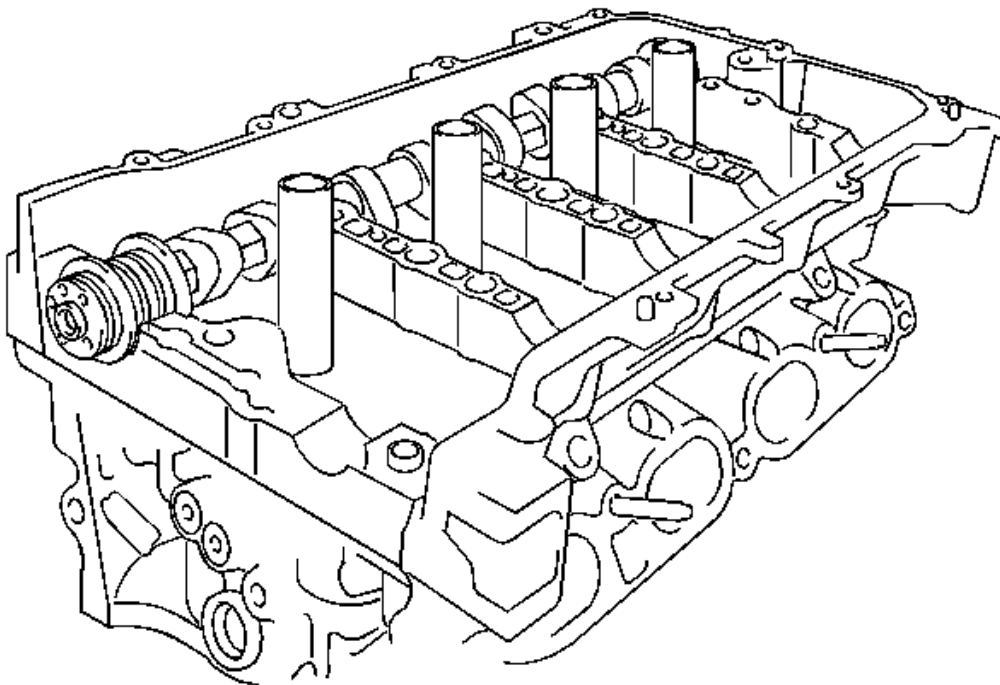


Fig. 58: View Of Camshaft
Courtesy of GENERAL MOTORS CORP.

8. Clean the camshaft journals.
9. Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.
10. Install the exhaust camshaft to the camshaft housing.

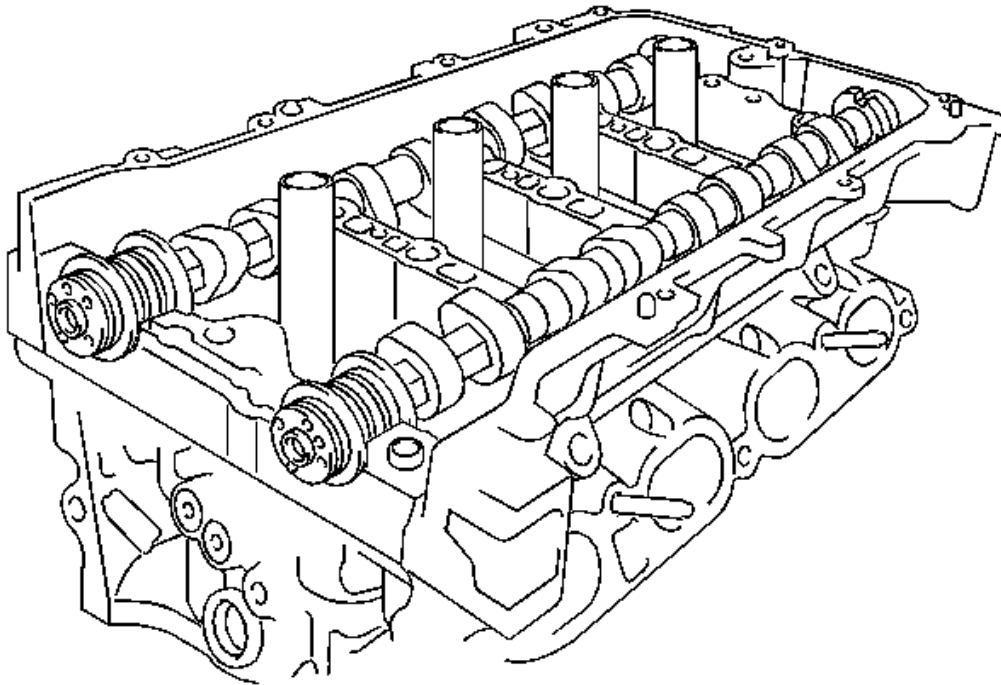


Fig. 59: View Of Cylinder Head & Camshafts
Courtesy of GENERAL MOTORS CORP.

11. Clean the camshaft journals.
12. Apply engine oil to the camshaft journals, camshaft housings and bearing caps.
13. Install the intake camshaft to the camshaft housing.

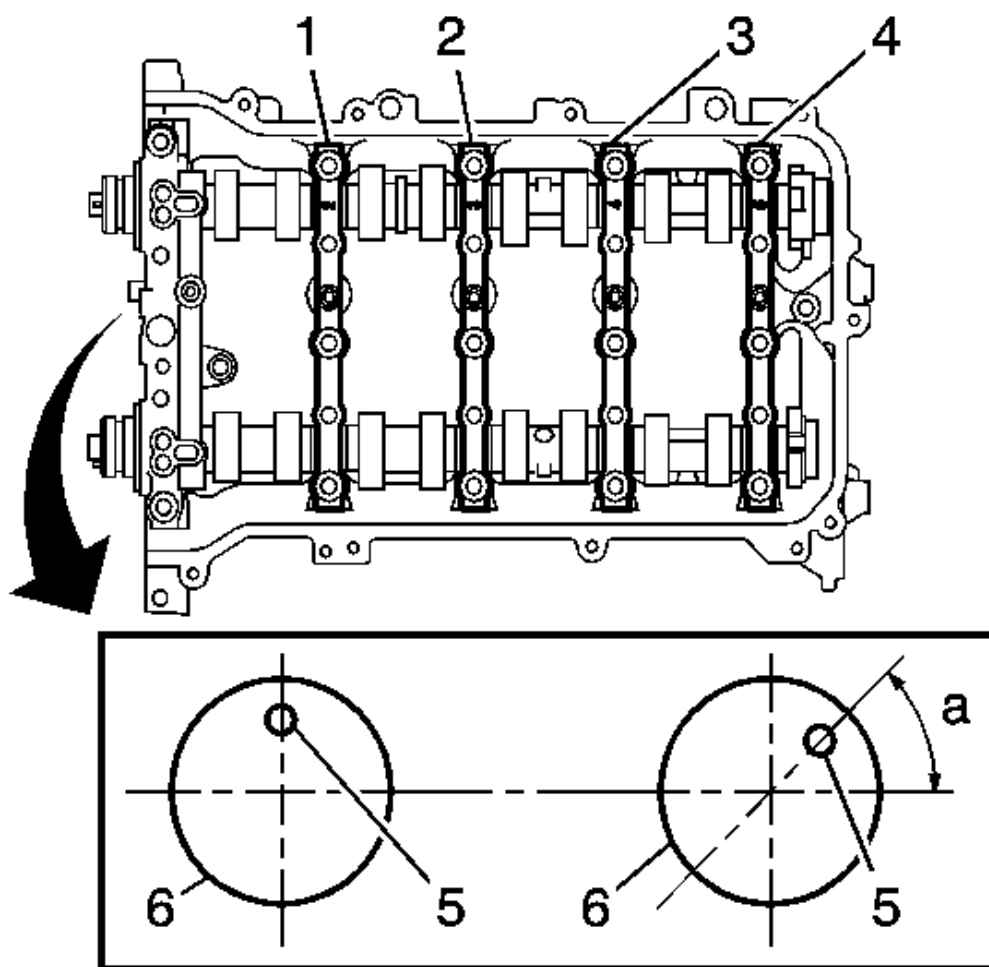


Fig. 60: Positioning Knock Pins Of Camshafts
Courtesy of GENERAL MOTORS CORP.

NOTE: Make sure that the knock pin (5) of the camshafts (6) are positioned as shown in the illustration.

14. Ensure the marks and numbers on the camshaft bearing caps (1-4) and place them in each proper position and direction.

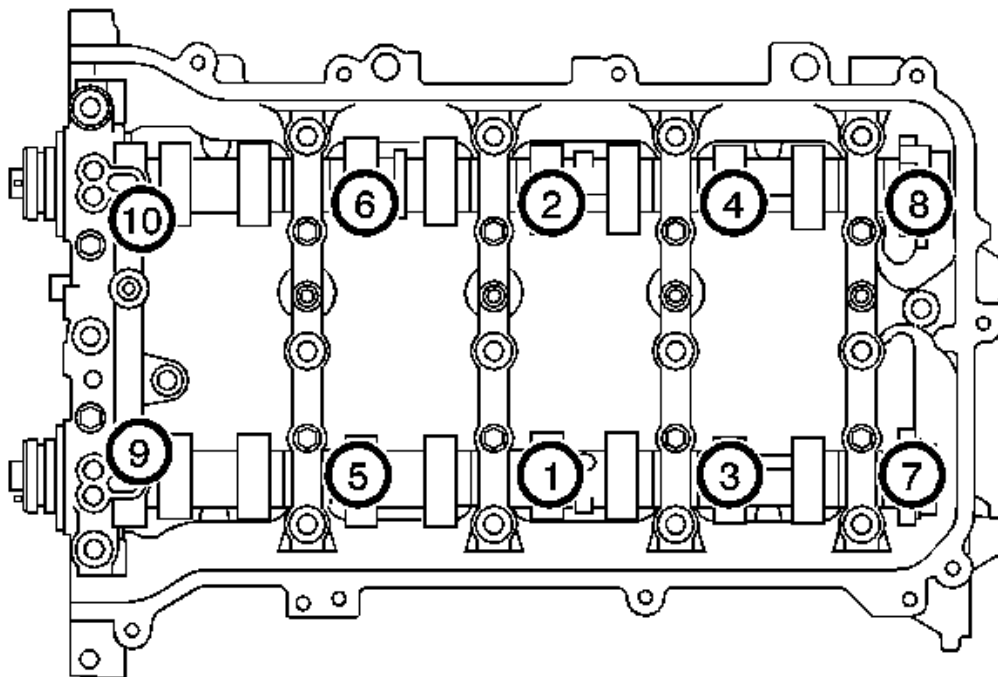


Fig. 61: Identifying Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

15. Install the 10 bolts in the order shown and tighten to 16 N.m (12 lb ft).

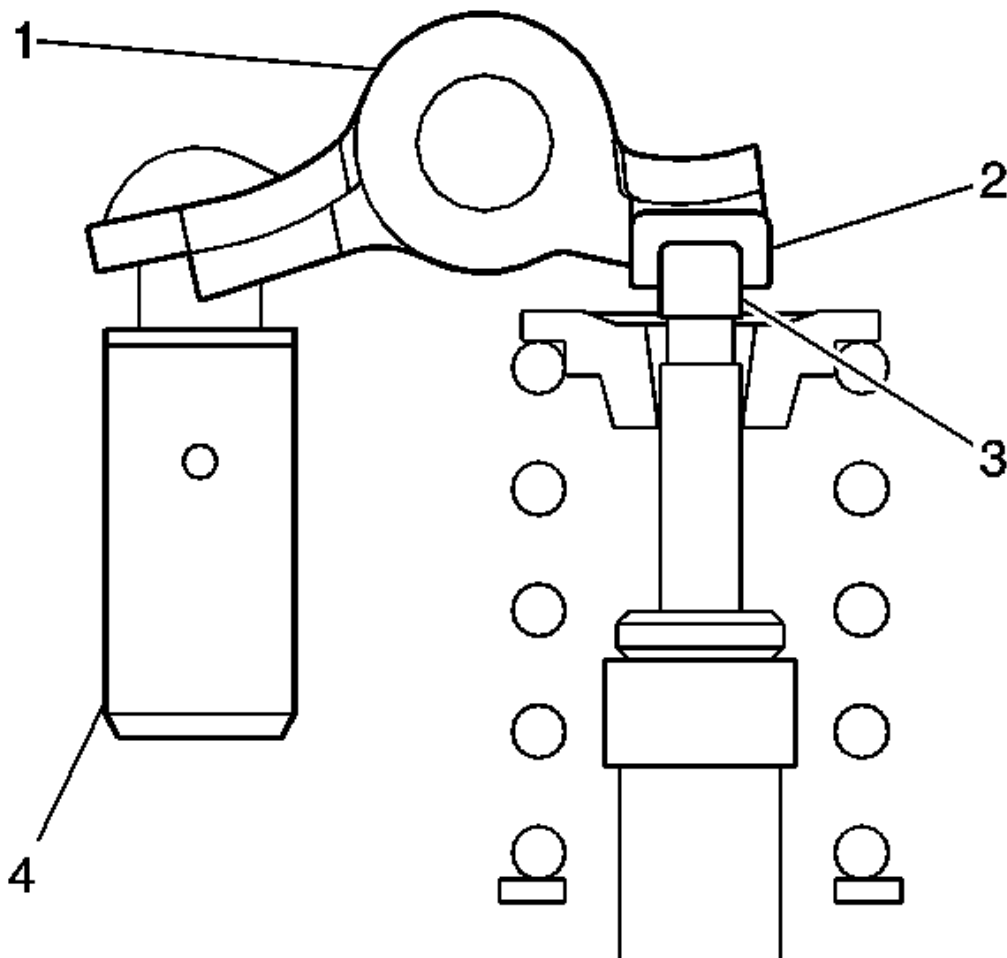


Fig. 62: View Of Correct Rocker Arm Installation
Courtesy of GENERAL MOTORS CORP.

16. Install the camshaft housing sub-assembly.
17. Make sure that the valve rocker arm (1) is installed as shown in the illustration.

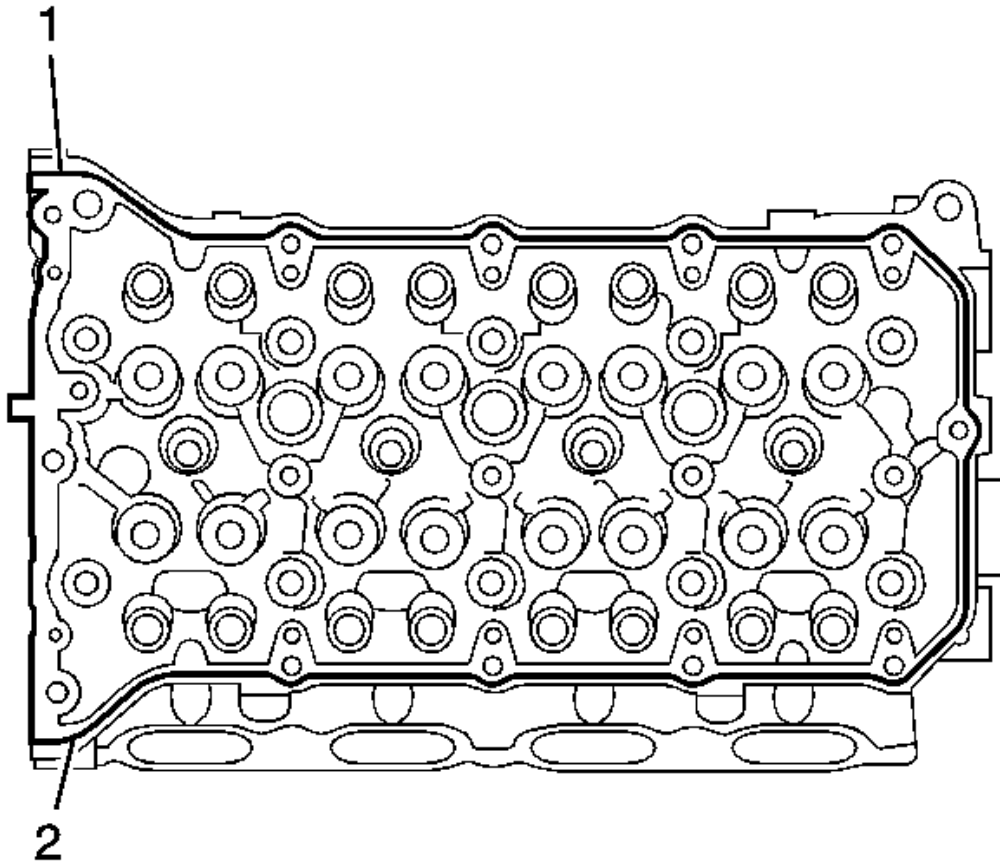


Fig. 63: Applying Adhesive To Cylinder Head
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Remove any oil from the contact surface.
- Install the camshaft housing assembly within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after installing.

18. Apply a continuous bead of sealant (1), diameter: 3.5-4.0 mm (0.138-0.158 in), as shown in the illustration, Three Bond 1217B, or equivalent, GM part number 12378521 (Canadian part number 88901148).

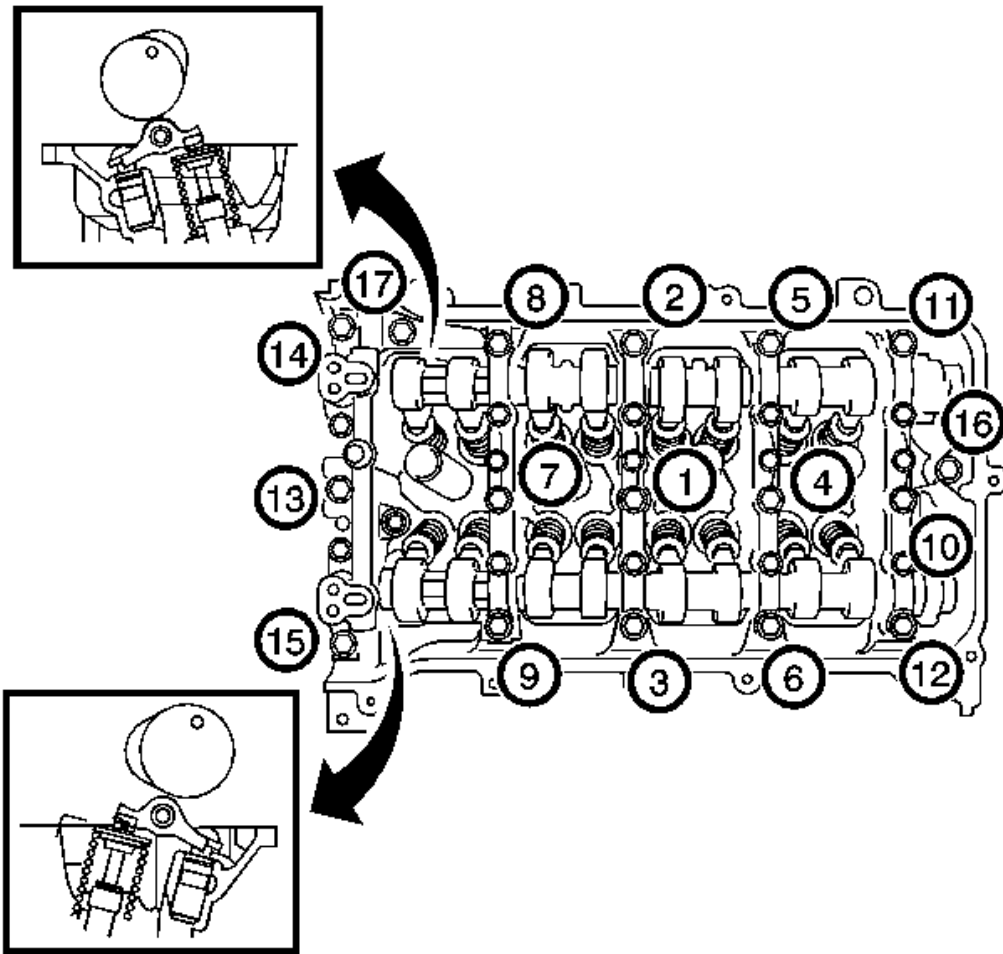


Fig. 64: Identifying Camshaft Housing Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

19. Set the intake camshaft and the exhaust camshaft.

NOTE:

- After installing the camshaft housing, make sure that the cam lobes are positioned as shown.
- If any of the bolts are loosened during installation, remove the camshaft housing, clean the installation surfaces, and reapply seal packing.
- If the camshaft housing is removed because any of the bolts are loosened during installation, make sure that the previously applied seal packing does not enter any oil passages.

- After installing the camshaft housing, wipe off any seal packing that seeped out from between the housing and the cylinder head.

20. Install the camshaft housing and tighten the 17 bolts in the order shown and tighten to 27 N.m (20 lb ft).

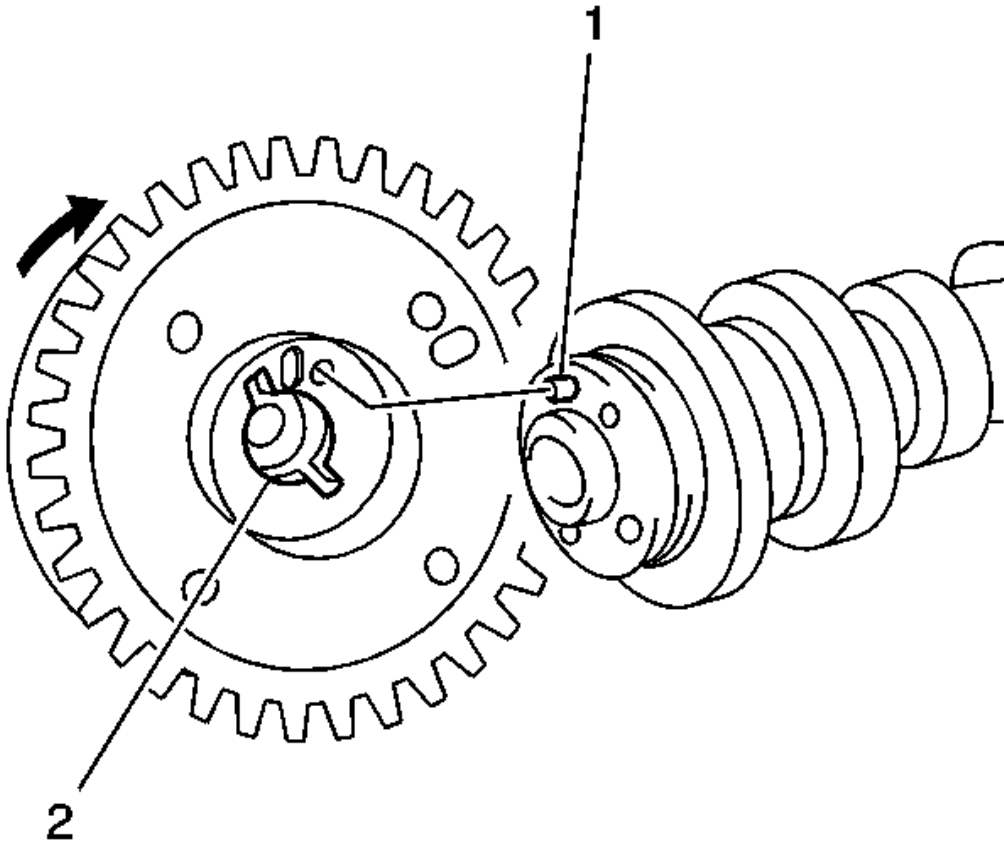


Fig. 65: View Of Camshaft Timing Gear Assembly
Courtesy of GENERAL MOTORS CORP.

21. Install the camshaft timing gear assembly.
22. Check that the knock pin (1) is installed on the camshaft.

NOTE: Do not forcefully push in the camshaft timing gear assembly. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing gear assembly.

23. Put the camshaft timing gear and camshaft together with the straight pin and key groove misaligned, as

shown in the illustration.

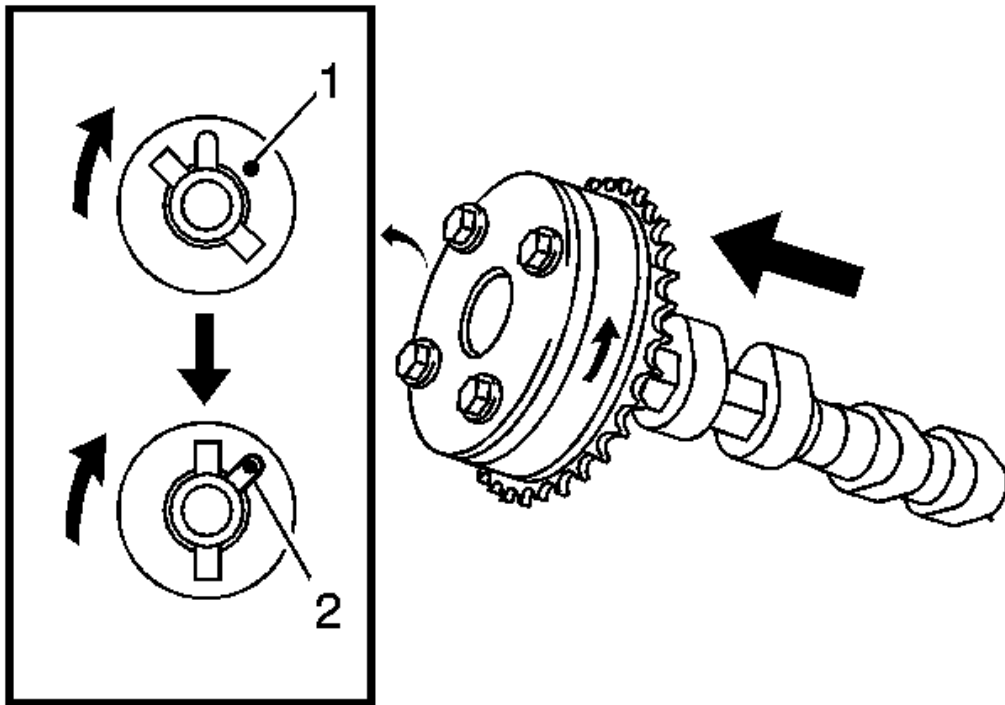


Fig. 66: Turning Camshaft Gear
Courtesy of GENERAL MOTORS CORP.

NOTE:

Do not turn the camshaft timing gear in the retard direction (clockwise).

24. Turn the camshaft timing gear as shown in the illustration while pushing it gently against the camshaft. Push further at the position where the pin (1) fits into the groove (2).

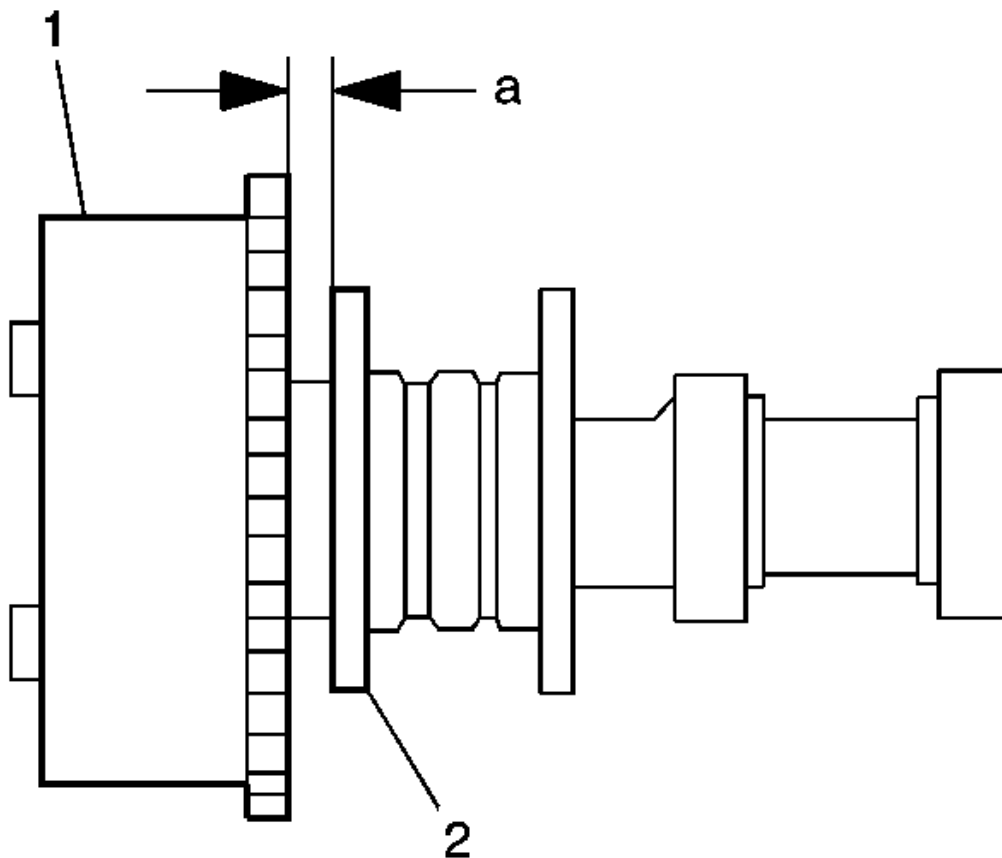


Fig. 67: Identifying Clearance Between Gear & Camshaft
Courtesy of GENERAL MOTORS CORP.

25. Measure the clearance between the gear (1) and the camshaft (2).

Specification: Clearance: 0.1-0.4 mm (0.004-0.016 in.)

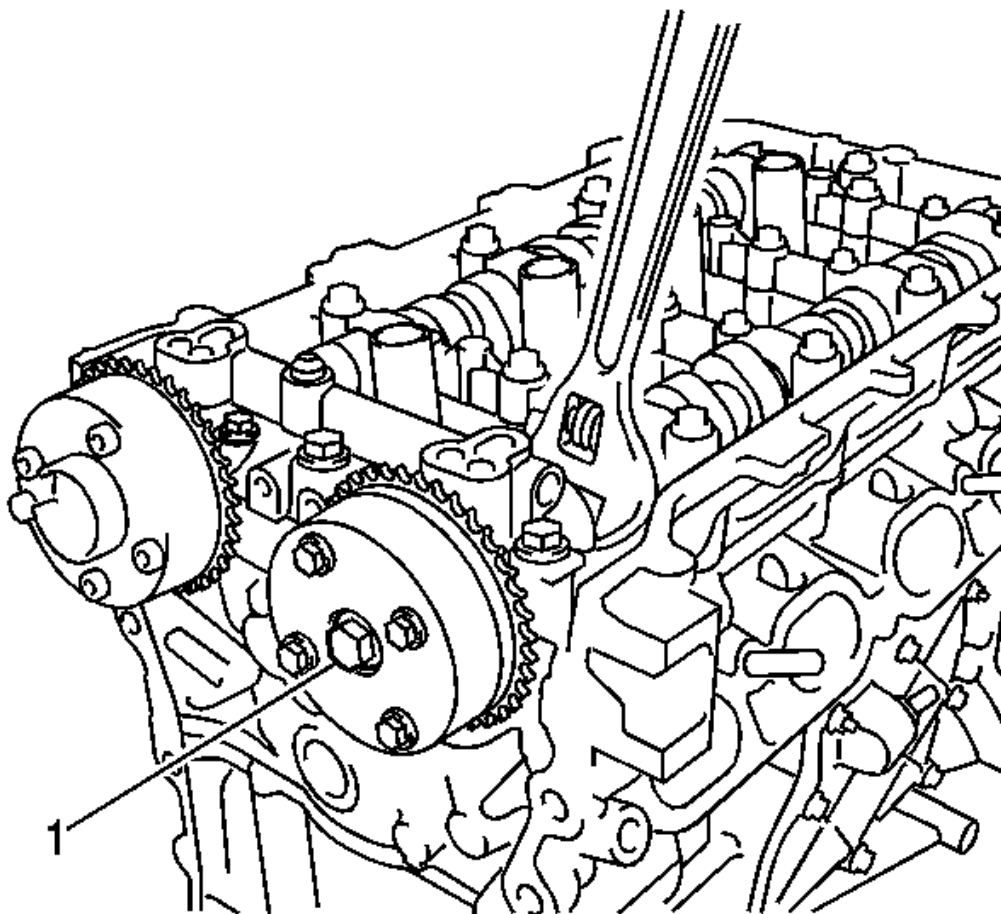


Fig. 68: Tightening Camshaft Timing Gear Flange Bolt
Courtesy of GENERAL MOTORS CORP.

26. Install the flange bolt (1) with the camshaft timing gear fixed in place and tighten to 54 N.m (40 lb ft).

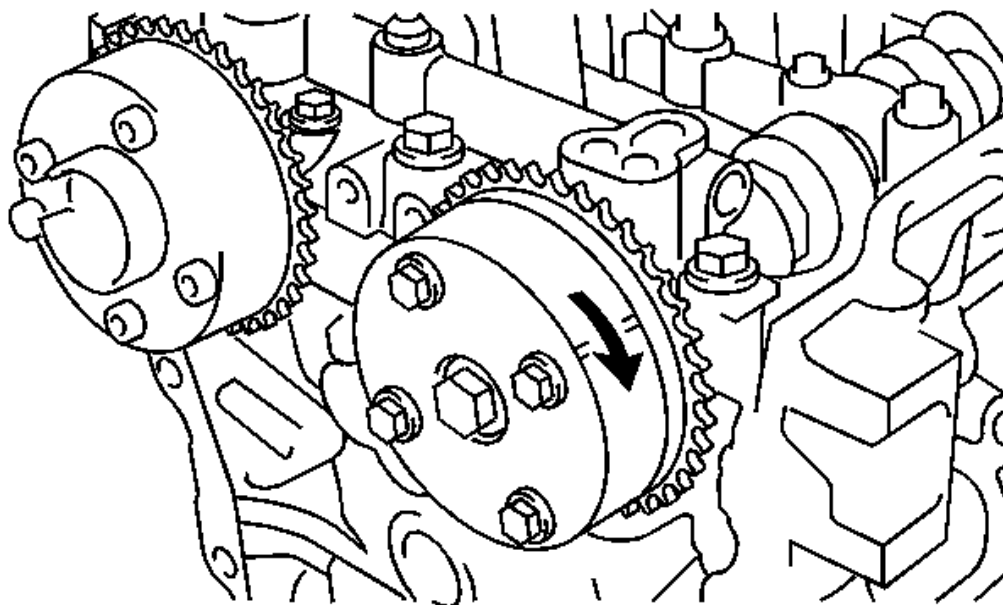


Fig. 69: Checking Camshaft Timing Gear Movement
Courtesy of GENERAL MOTORS CORP.

27. Check that the camshaft timing gear can move in the retard direction (clockwise) and is locked in the most retarded position.
28. Install the camshaft timing exhaust gear assembly.
29. Check that the knock pin is installed on the camshaft.

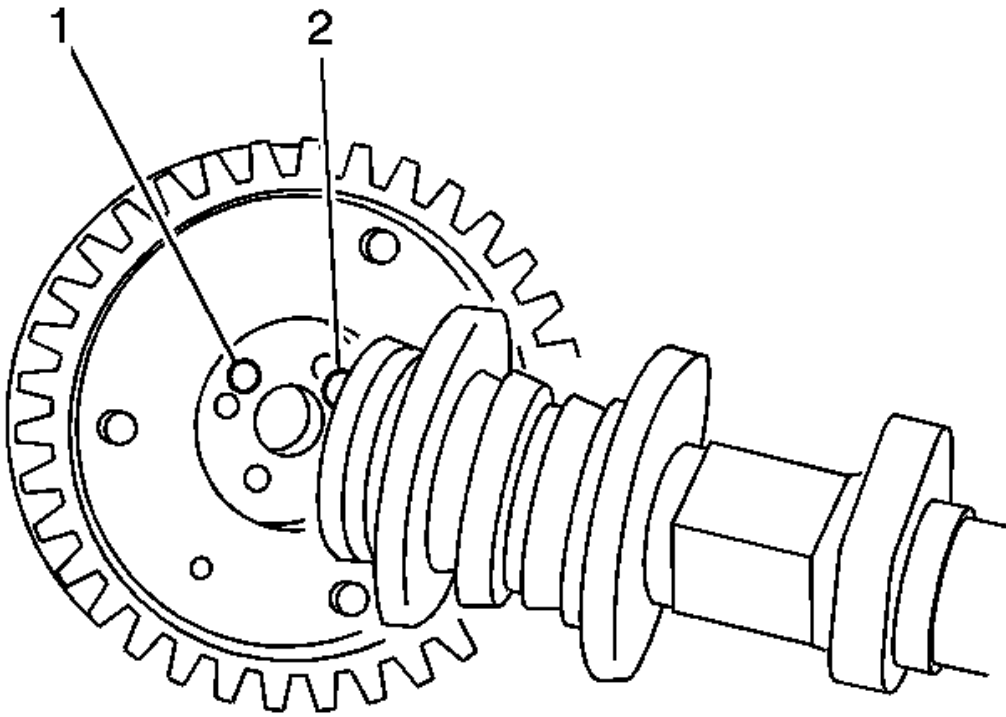


Fig. 70: View Of Camshaft Timing Exhaust Gear & Camshaft
 Courtesy of GENERAL MOTORS CORP.

30. Put the camshaft timing exhaust gear and camshaft together by aligning the key groove (1) and straight pin (2).

NOTE: Be sure not to turn the camshaft timing exhaust gear in the retard direction (clockwise).

31. Lightly press the gear against the camshaft, and turn the gear. Push further at the position where the pin enters the groove.
32. Check that there is no clearance between the gear flange and the camshaft.

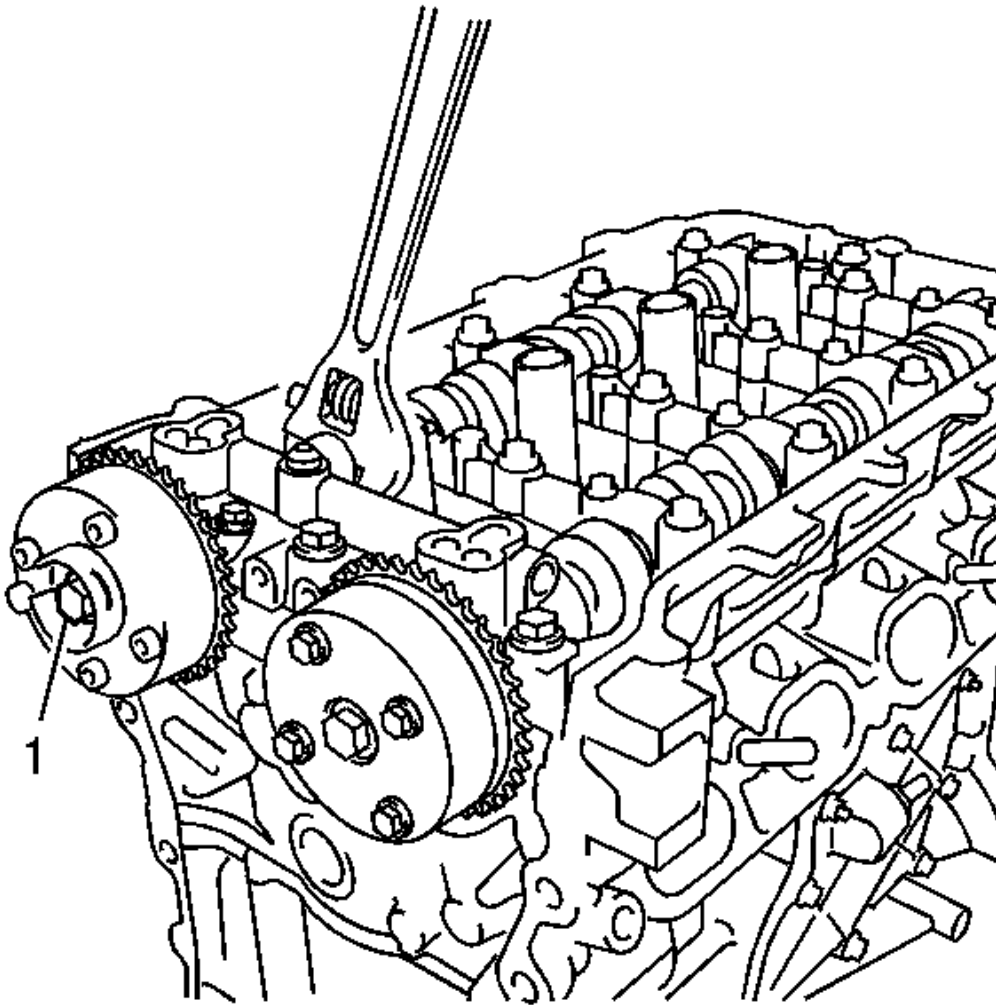


Fig. 71: Tightening Flange Bolt
Courtesy of GENERAL MOTORS CORP.

33. Install the flange bolt (1) with the camshaft timing exhaust gear fixed and tighten to 54 N.m (40 lb ft).
34. Make sure that the camshaft timing exhaust gear is locked.
35. Install the timing gear chain vibration damper.
36. Install the oil pump chain vibration damper.
37. Install the chain assembly.
38. Install the chain tensioner slipper.
39. Install the timing chain cover oil seal.

40. Install the timing chain cover assembly. Refer to **Timing Chain Housing Installation** .
41. Install the crankshaft pulley.
42. Install the chain tensioner assembly. Refer to **Timing Chain Tensioner Installation** .
43. Install the cylinder head cover assembly. Refer to **Camshaft Cover Installation** .
44. Install the radio setting condenser.
45. Install the thermostat.
46. Install the inlet water.
47. Install the inlet water hose.
48. Install the water by-pass hoses.
49. Install the water by-pass pipe.
50. Install the ventilation hose.
51. Install the exhaust manifold. Refer to **Exhaust Manifold Installation** .
52. Install the oil level dipstick sub-assembly. Refer to **Oil Level Indicator Tube Replacement**.
53. Install the ignition coil assembly.
54. Install the fuel injector assembly.
55. Install the delivery pipe spacer.
56. Install the fuel delivery pipe assembly.
57. Install the fuel tube assembly.
58. Install the intake manifold. Refer to **Intake Manifold Installation** .
59. Remove the engine stand.
60. Install the engine assembly with transaxle. Refer to **Engine Replacement**.

EXHAUST CAMSHAFT AND VALVE LIFTER REPLACEMENT

REMOVAL PROCEDURE

1. Remove the engine assembly with transaxle. Refer to **Engine Replacement**.
2. Install the engine stand.
3. Remove the intake manifold. Refer to **Intake Manifold Removal** .
4. Remove the fuel tube assembly.
5. Remove the fuel delivery pipe assembly.
6. Remove the fuel injector assembly.
7. Remove the ignition coil assembly.
8. Remove the oil level dipstick sub-assembly. Refer to **Oil Level Indicator Tube Replacement**.
9. Remove the exhaust manifold. Refer to **Exhaust Manifold Removal** .
10. Remove the ventilation hose.
11. Remove the water by-pass hoses.
12. Remove the water by-pass pipe.
13. Remove the inlet water hose.

14. Remove the inlet water.
15. Remove the thermostat.
16. Remove the radio setting condenser.
17. Remove the cylinder head cover assembly. Refer to **Camshaft Cover Removal** .
18. Set the No. 1 cylinder to TDC/compression.
19. Remove the crankshaft pulley.
20. Remove the chain tensioner assembly. Refer to **Timing Chain Tensioner Removal** .
21. Remove the timing chain cover assembly. Refer to **Timing Chain Housing Removal**
22. Remove the timing chain cover oil seal.
23. Remove the chain tensioner slipper.
24. Remove the timing gear chain vibration damper.
25. Remove the chain assembly.
26. Remove the oil pump chain vibration damper.

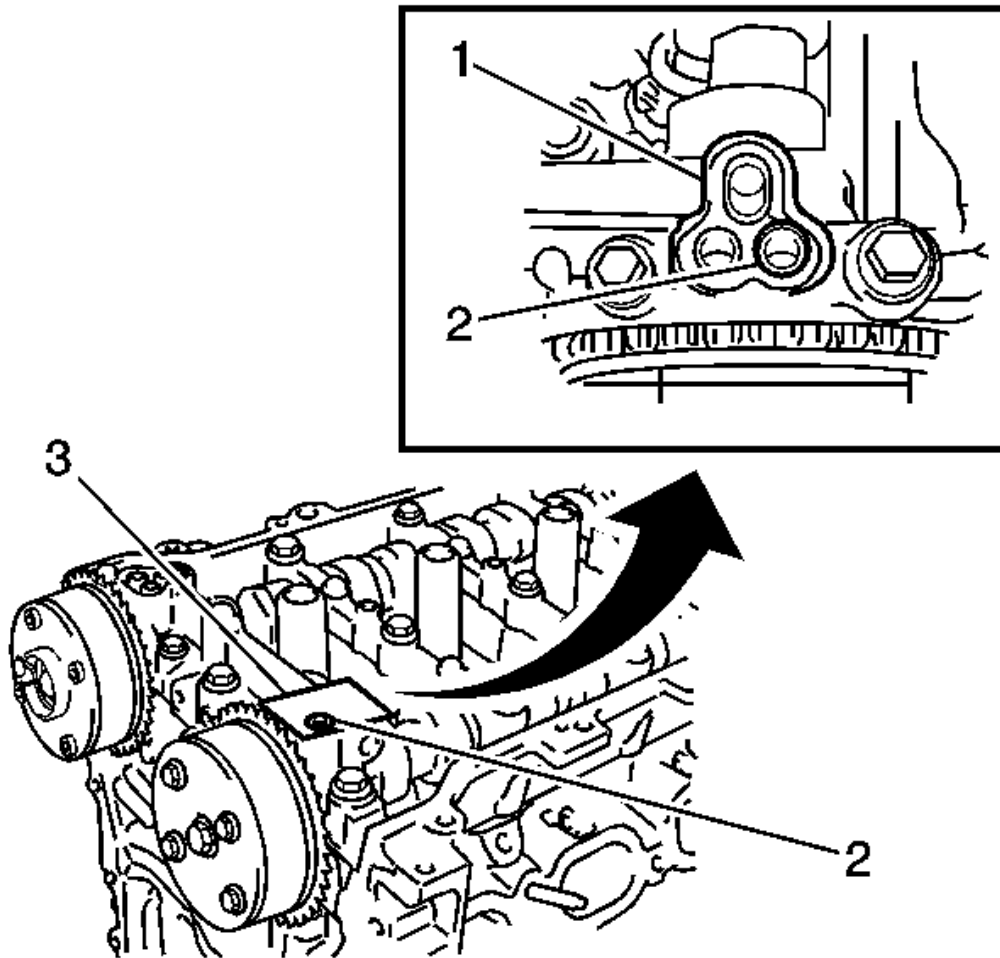


Fig. 72: Identifying Camshaft Timing Gear Assembly
 Courtesy of GENERAL MOTORS CORP.

27. Inspect the camshaft timing gear assembly.
28. Check the lock of the camshaft timing gear.

NOTE: Be sure to cover the oil hole completely because air leaks due to insufficient sealing will prevent the lock pin from being released.

29. After cleaning and degreasing the VVT oil hole on the intake side of the camshaft bearing cap, completely seal the oil hole with adhesive tape (3) or equivalent as shown in the illustration to prevent air from leaking.
30. Prick a hole (2) in the tape covering the oil hole as shown.

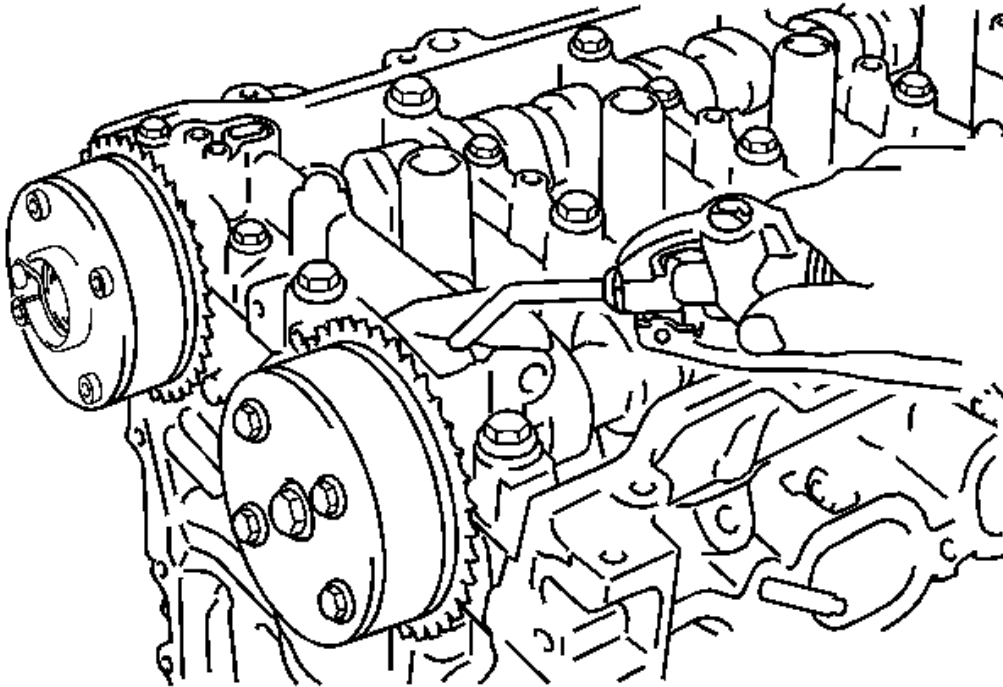


Fig. 73: Releasing Lock Pin

Courtesy of GENERAL MOTORS CORP.

NOTE:

- If air leaks out, reattach the adhesive tape.
- Cover the oil hole with a shop rag or piece of cloth when applying air pressure to prevent oil from spraying.

31. Apply approximately 150 kPa (22 psi) of air pressure to the hole to release the lock pin.

NOTE:

Depending on the air pressure applied, the camshaft timing gear assembly may turn in the advanced direction without assistance by hand.

32. Forcibly turn the camshaft timing gear assembly in the advanced direction (counterclockwise).

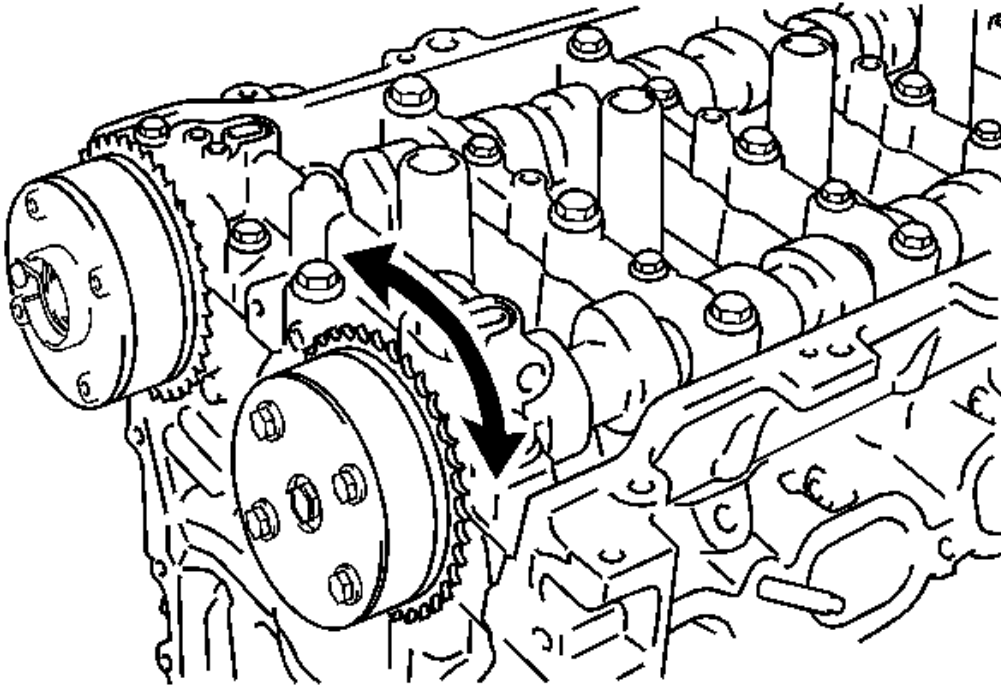


Fig. 74: Turning Camshaft Timing Gear Assembly
Courtesy of GENERAL MOTORS CORP.

33. Turn the camshaft timing gear assembly within its movable range (26.5-28.5 degrees) 2 or 3 times without turning it to the most retarded position. Make sure that the camshaft timing gear assembly turns smoothly.
34. Remove the adhesive tape from the camshaft bearing cap.
35. Inspect the camshaft timing exhaust gear assembly.
36. Check the lock of the camshaft timing exhaust gear.

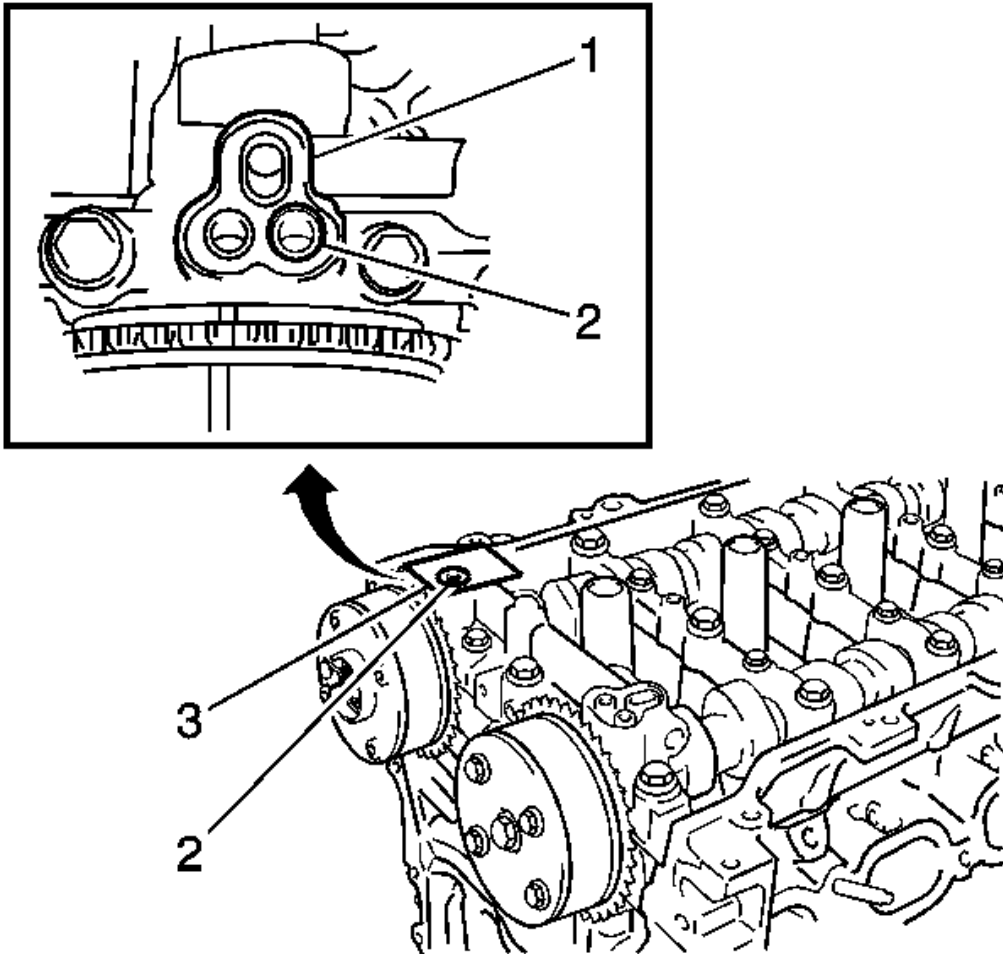


Fig. 75: Sealing Oil Hole

Courtesy of GENERAL MOTORS CORP.

NOTE: Be sure to cover the oil hole completely because air leaks due to insufficient sealing will prevent the lock pin from being released.

37. After cleaning and degreasing the VVT oil hole on the exhaust side of the camshaft bearing cap, completely seal the oil hole with adhesive tape (3) or equivalent as shown in the illustration to prevent air from leaking.
38. Prick a hole (2) in the tape covering the oil hole as shown.

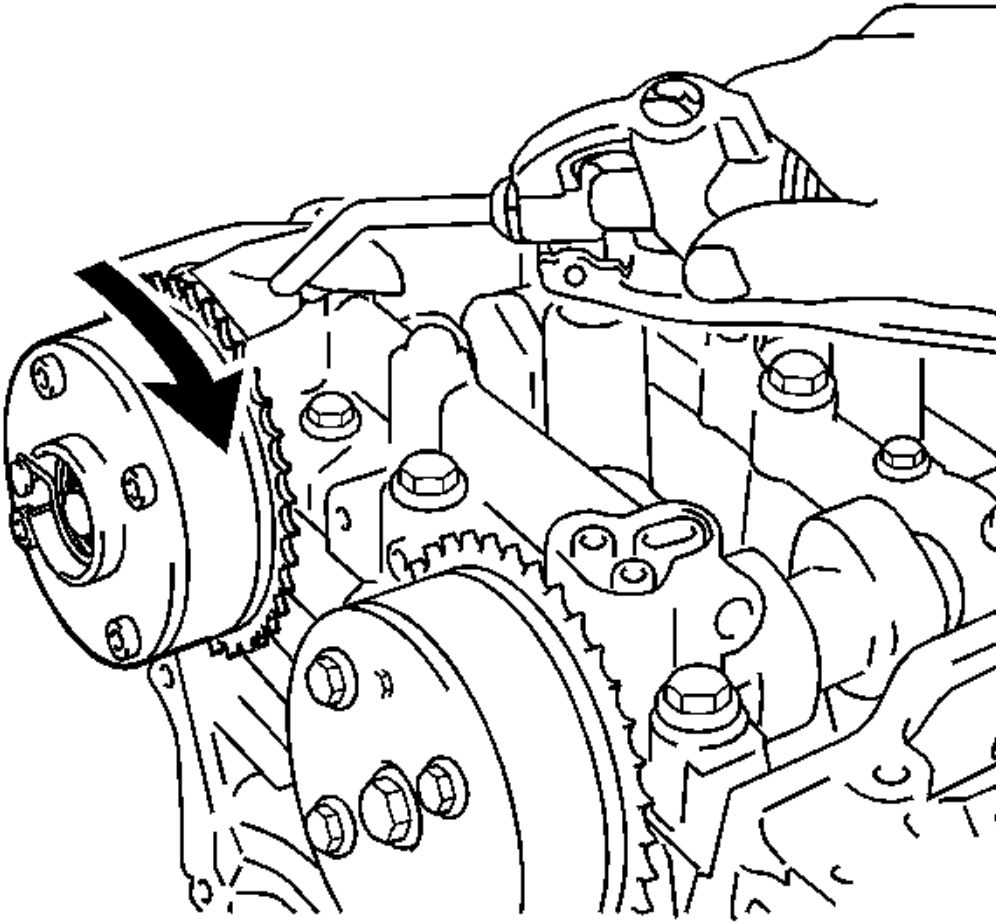


Fig. 76: Releasing Lock Pin

Courtesy of GENERAL MOTORS CORP.

NOTE:

- If air leaks out, reattach the adhesive tape.
- Cover the oil hole with a shop rag or piece of cloth when applying air pressure to prevent oil from spraying.

39. Apply approximately 200 kPa (28 psi) of air pressure to the hole to release the lock pin.

NOTE:

Be sure to keep the camshaft timing exhaust gear in the retard direction using a screwdriver. If the gear is released, it will return to the most advanced position automatically due to force from the spring.

40. Using a screwdriver with its tip wrapped with tape, forcibly turn the camshaft timing exhaust gear in the retard direction (clockwise).

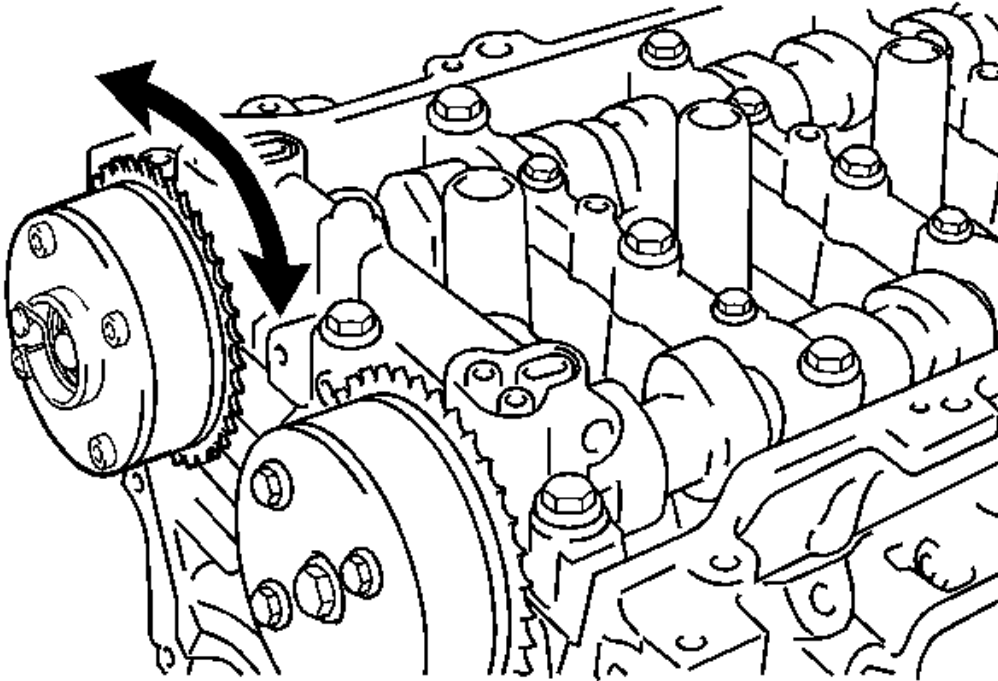


Fig. 77: Turning Camshaft Timing Exhaust Gear
Courtesy of GENERAL MOTORS CORP.

41. Using a screwdriver with its tip wrapped with tape, turn the camshaft timing exhaust gear within its movable range (19 to 21 degrees) 2 or 3 times without turning it to the most advanced position. Make sure that the camshaft timing exhaust gear turns smoothly.
42. Remove the adhesive tape from the camshaft bearing cap.

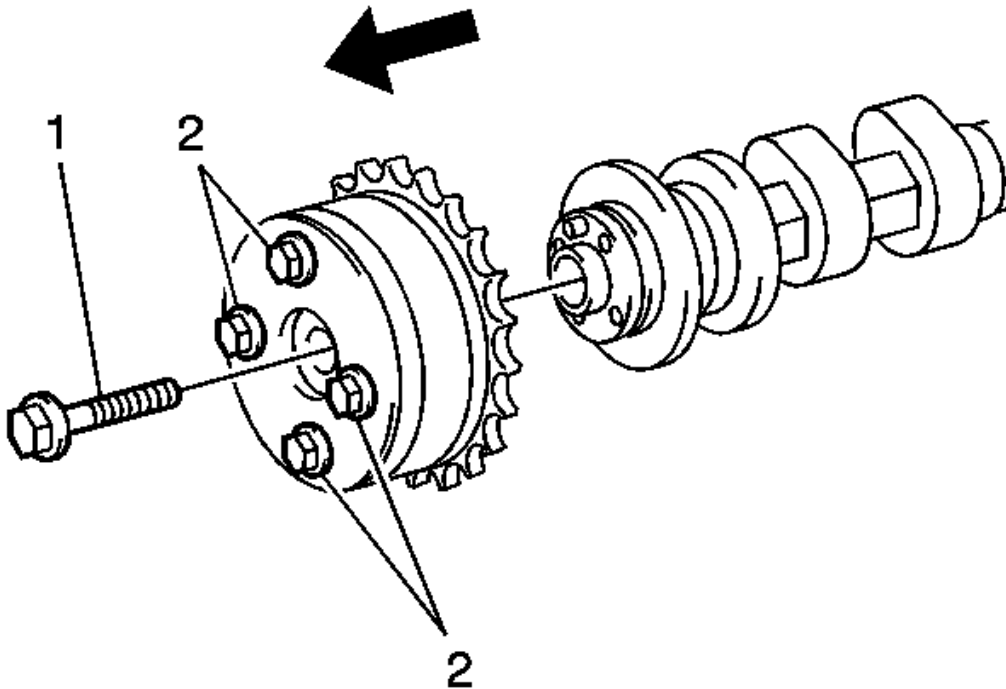


Fig. 78: View Of Camshaft Timing Gear & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Before removing the camshaft timing gear, make sure that the lock pin has been released.
- Be sure not to remove the other 4 bolts (2).
- Keep the camshaft timing gear assembly horizontal while removing it from the camshaft.

43. Remove the flange bolt (1) while holding the hexagonal portion of the camshaft, and then remove the camshaft timing gear assembly.

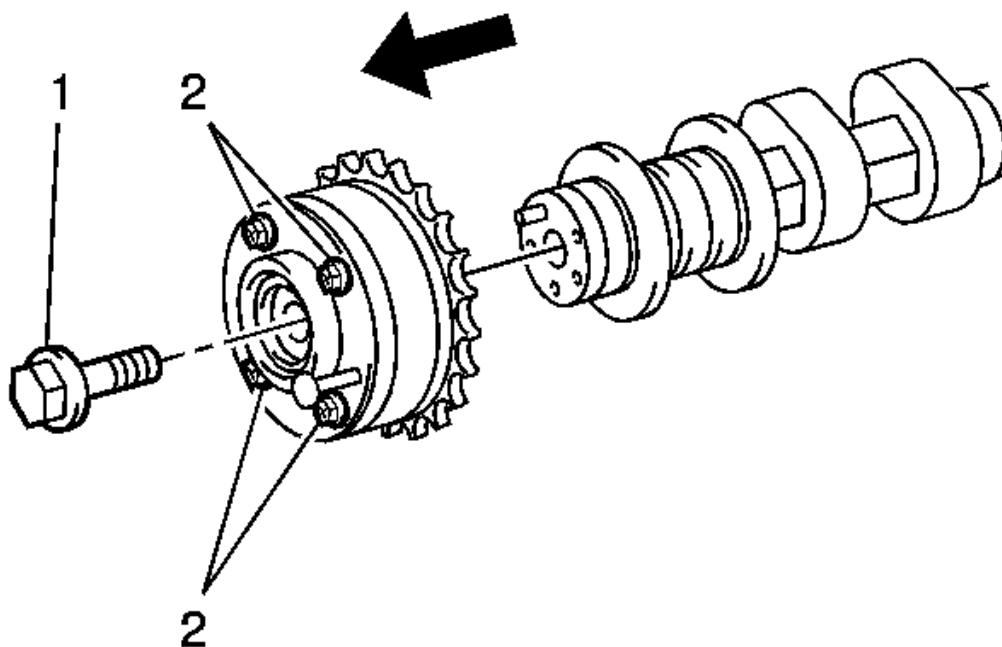


Fig. 79: View Of Camshaft Timing Gear & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Be sure not to remove the other 4 bolts (2).
- Keep the camshaft timing exhaust gear assembly horizontal while removing it from the camshaft.

44. Remove the flange bolt (1) while holding the hexagonal portion of the camshaft, and then remove the camshaft timing exhaust gear assembly.

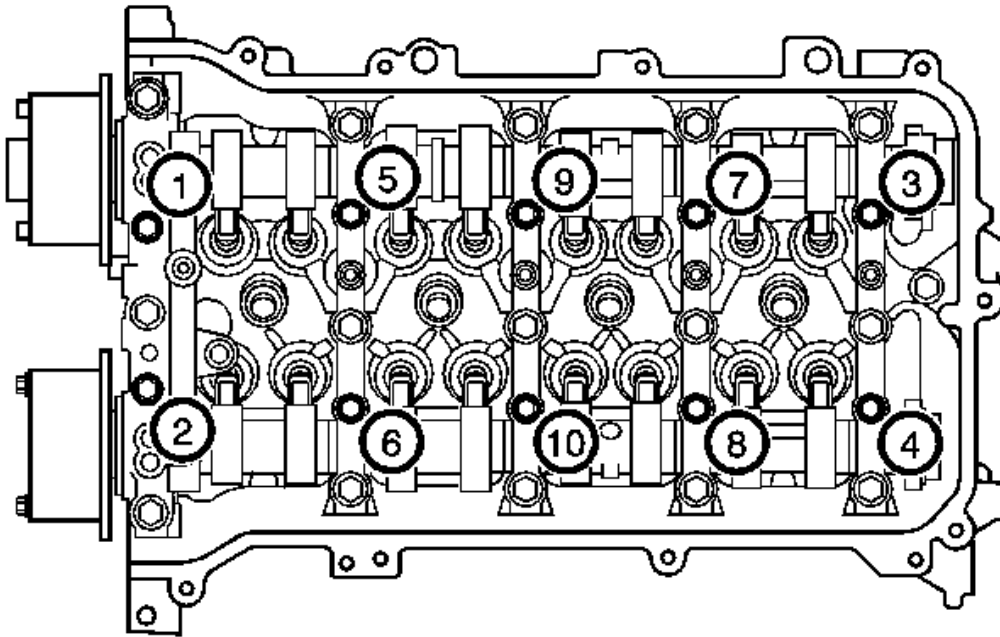


Fig. 80: Identifying Bearing Cap Bolt Removal/Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

45. Remove camshaft bearing cap-Uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.

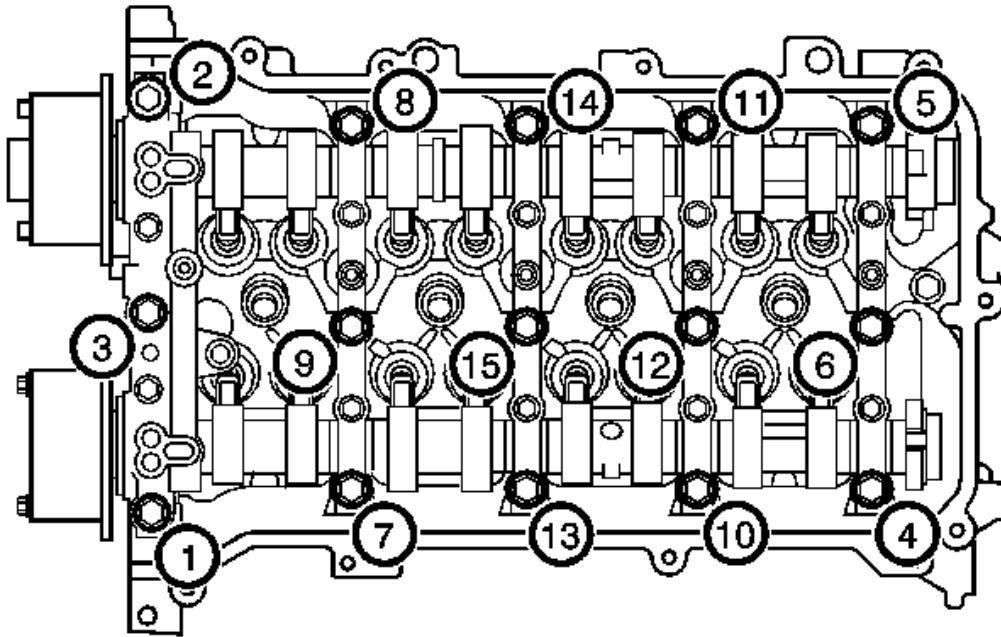


Fig. 81: Identifying Camshaft Bearing Cap Bolt Removal/Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Uniformly loosen the bolts while keeping the camshaft level.

46. Uniformly loosen and remove the 15 bearing cap bolts in the sequence shown in the illustration.

NOTE: Arrange the removed parts in the correct order.

47. Remove the 5 bearing caps.

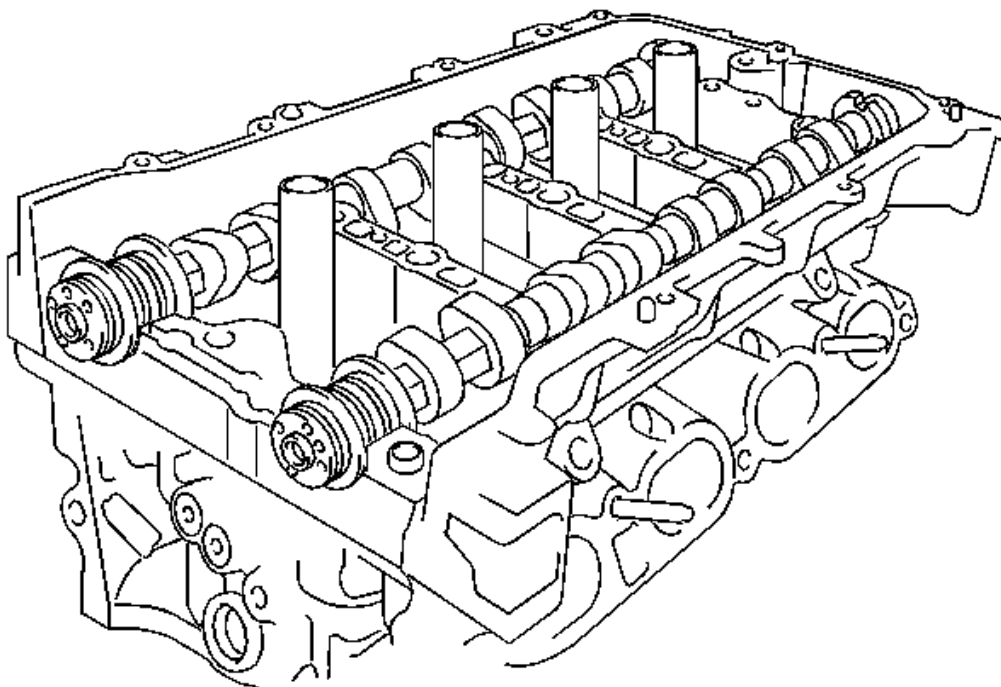


Fig. 82: View Of Cylinder Head & Camshafts
Courtesy of GENERAL MOTORS CORP.

48. Remove the intake camshaft.

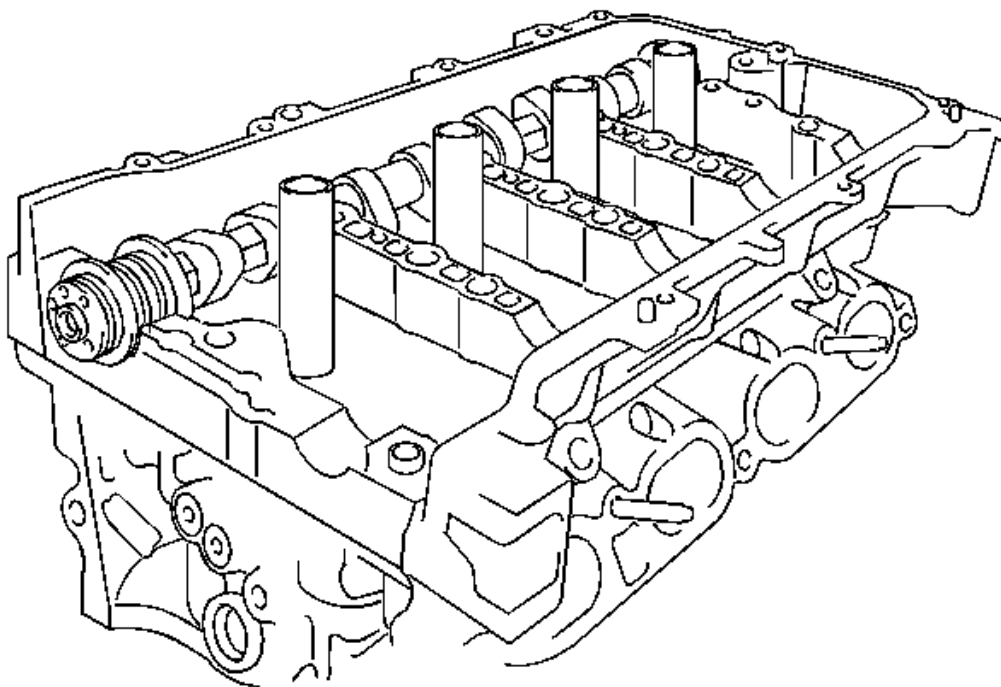


Fig. 83: View Of Camshaft

Courtesy of GENERAL MOTORS CORP.

49. Remove the exhaust camshaft.
50. Remove the valve rocker arm subassembly.
51. Remove the valve lash adjuster assembly.

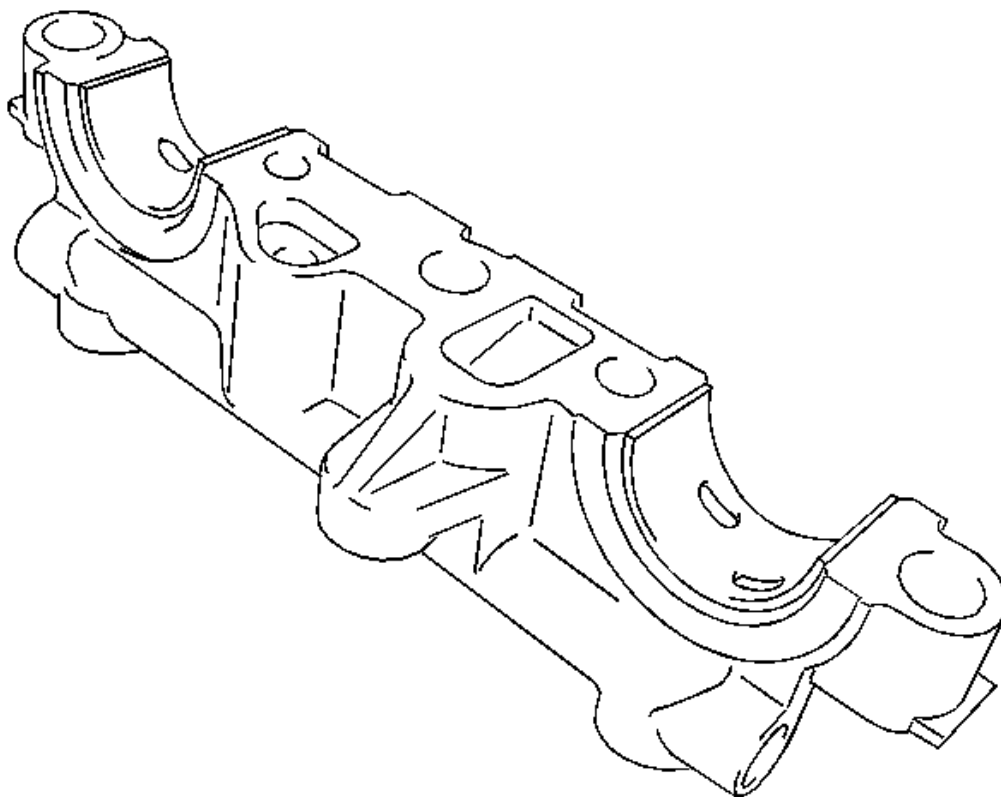


Fig. 84: View Of Camshaft Bearings
Courtesy of GENERAL MOTORS CORP.

52. Remove the 2 camshaft bearings from the cap.

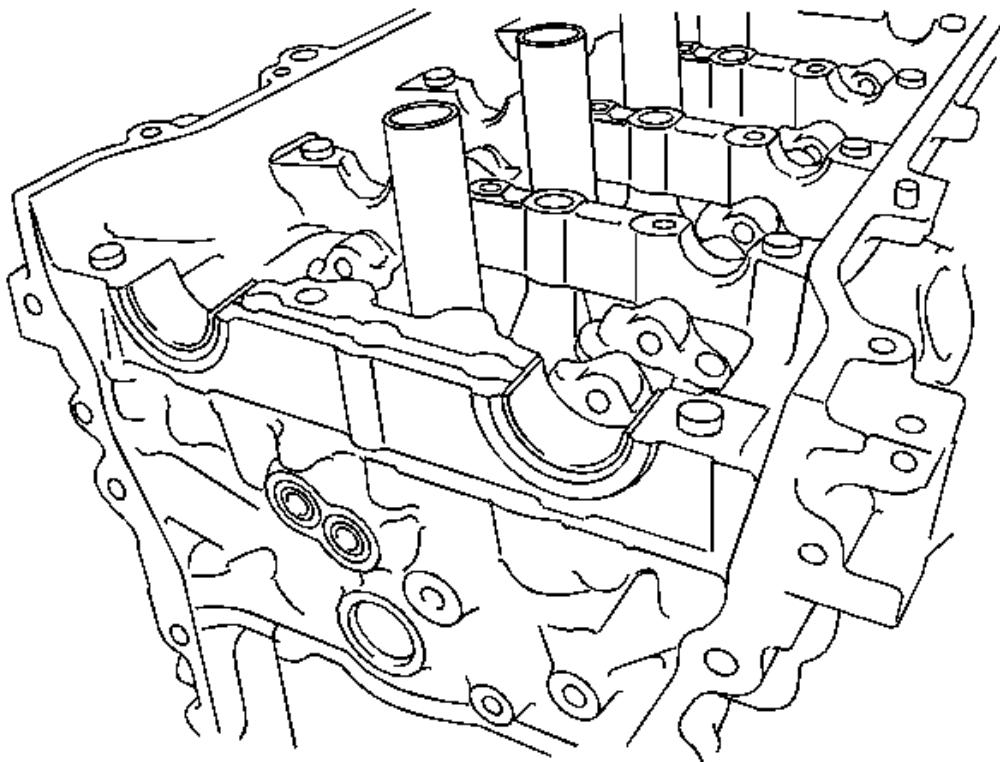


Fig. 85: Identifying Camshaft Bearings
Courtesy of GENERAL MOTORS CORP.

53. Remove the 2 camshaft bearings from the cylinder head.

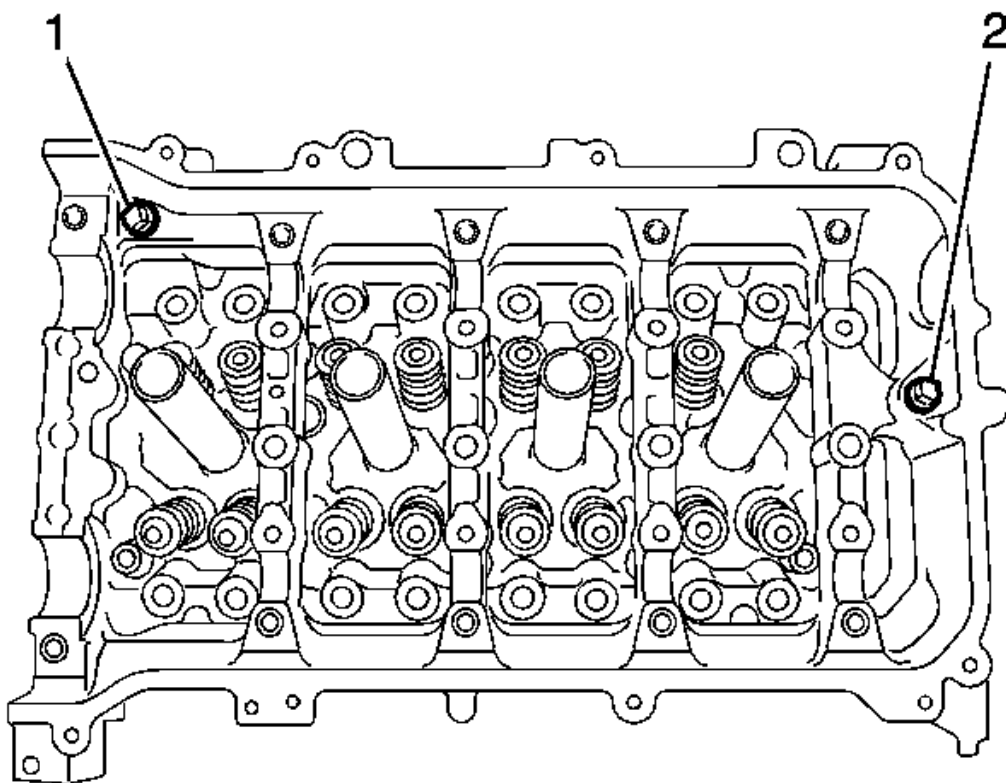


Fig. 86: Identifying 2 Bolts
Courtesy of GENERAL MOTORS CORP.

54. Remove the 2 bolts (1, 2).

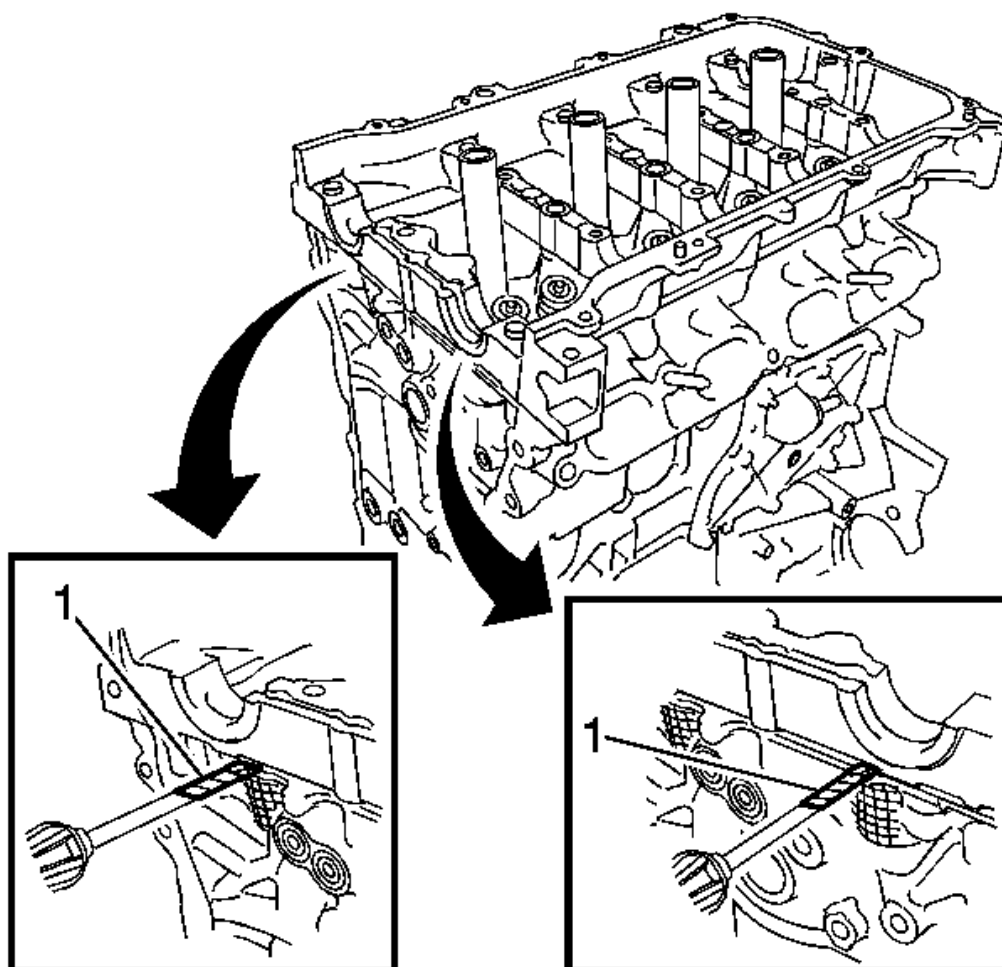


Fig. 87: View Of Camshaft Housing Assembly
Courtesy of GENERAL MOTORS CORP.

55. Remove the camshaft housing assembly by prying between the cylinder head and camshaft housing with a screwdriver (1).

NOTE: **Tape the screwdriver tip before use.**

56. Inspect the valve rocker arm assembly.
57. Inspect the valve lash adjuster assembly.
58. Clean the camshaft housing and cylinder head.

INSTALLATION PROCEDURE

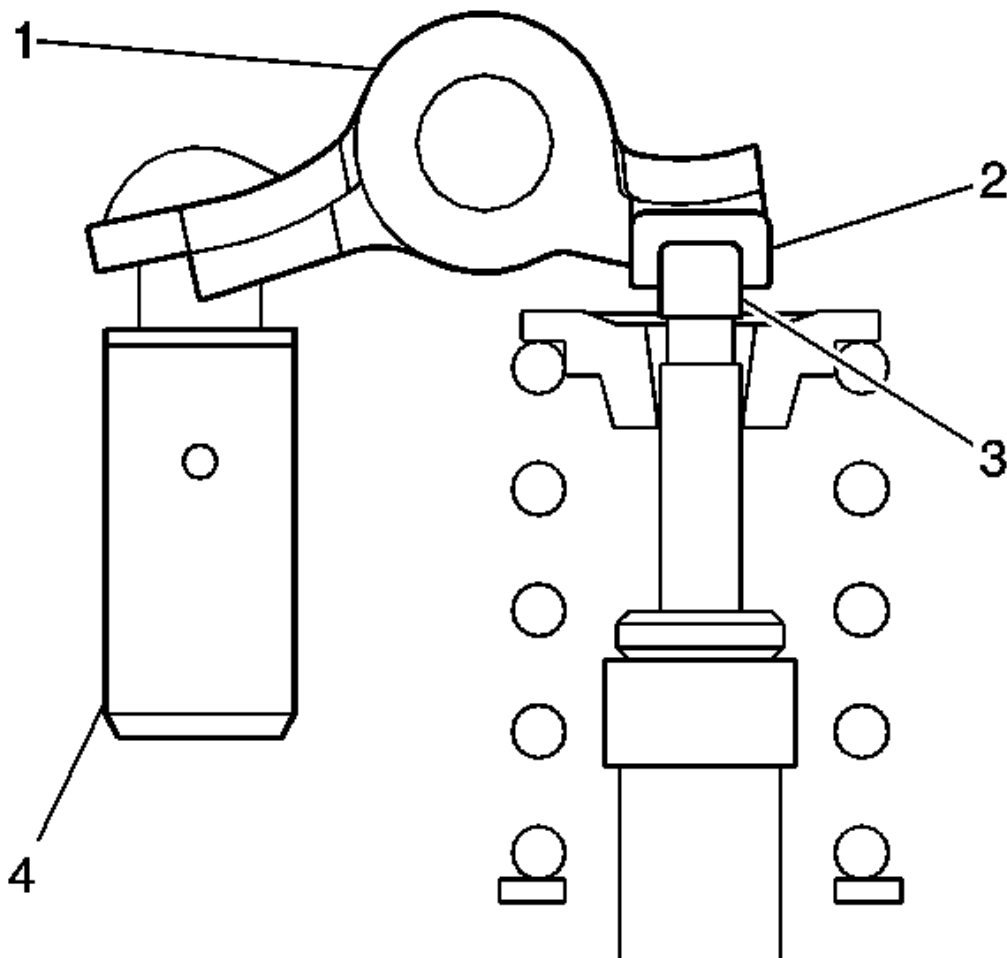


Fig. 88: View Of Correct Rocker Arm Installation
Courtesy of GENERAL MOTORS CORP.

1. Install the valve lash adjuster assembly (2).
2. Install the valve rocker arm assembly (1).
3. Install the 2 camshaft bearings after cleaning both surfaces of the bearings.

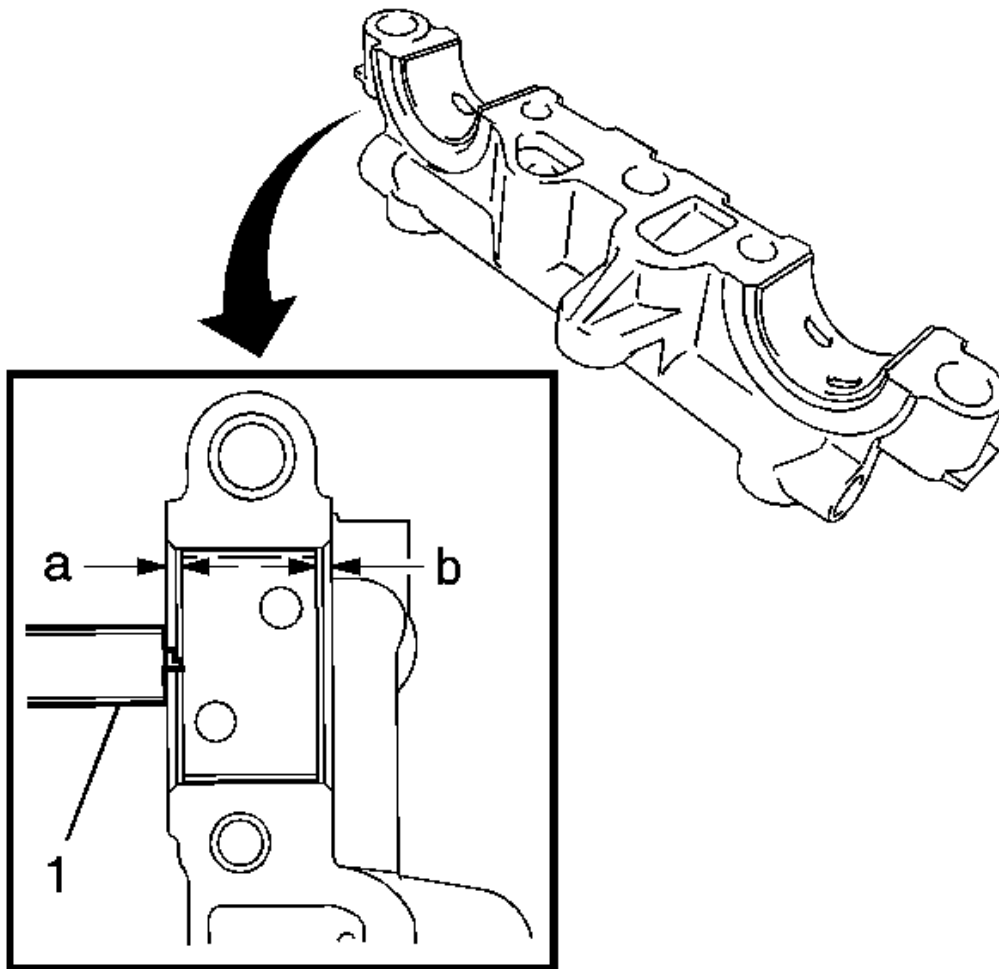


Fig. 89: Measuring Distance Between Bearing Cap Edge & Camshaft Bearing Edge
Courtesy of GENERAL MOTORS CORP.

NOTE: Position the bearings to the center of the bearing cap by measuring dimensions A and B.

4. Using vernier calipers (1), measure the distance between the bearing cap edge and the camshaft bearing edge.

Specification: Dimension (A-B): 0.7 mm (0.0276 in) or less

5. Clean both surfaces of the bearings.
6. Install the 2 camshaft bearings.

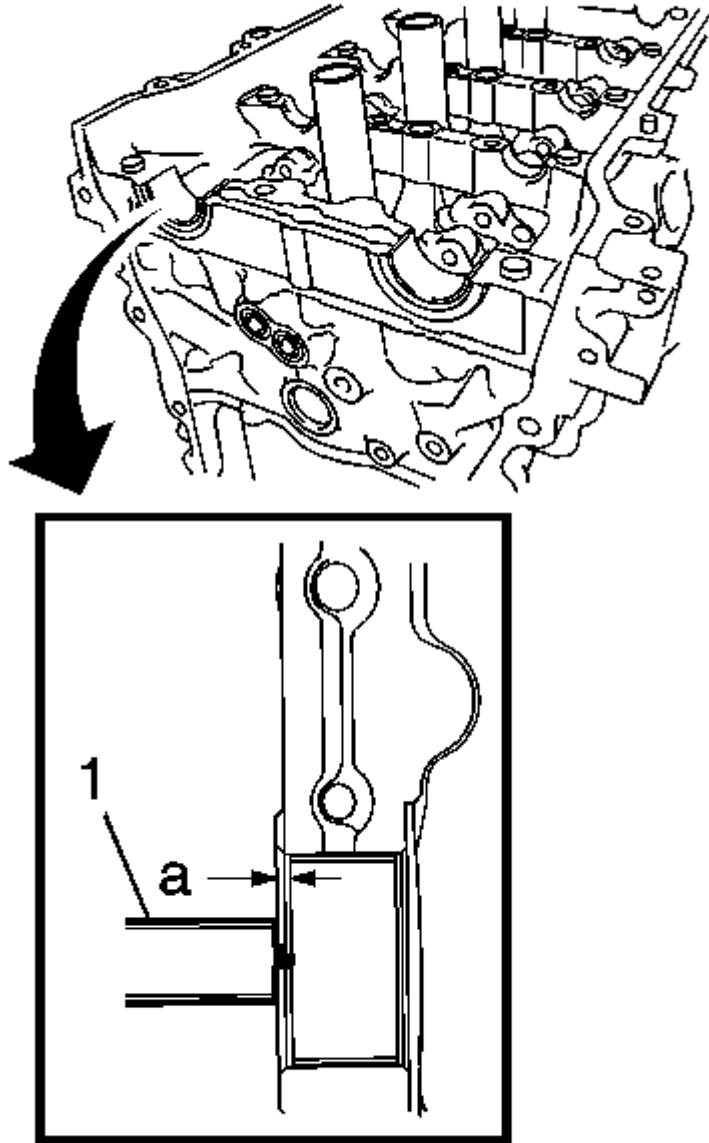


Fig. 90: Measuring Distance Between Bearing Cap Edge & Camshaft Bearing Edge
Courtesy of GENERAL MOTORS CORP.

NOTE: Position the bearings to the center of the bearing cap by measuring dimension A.

7. Using vernier calipers (1), measure the distance between the bearing cap edge and the camshaft bearing

edge.

Specification: Dimension (A): 1.05-1.75 mm (0.0413-0.0689 in.)

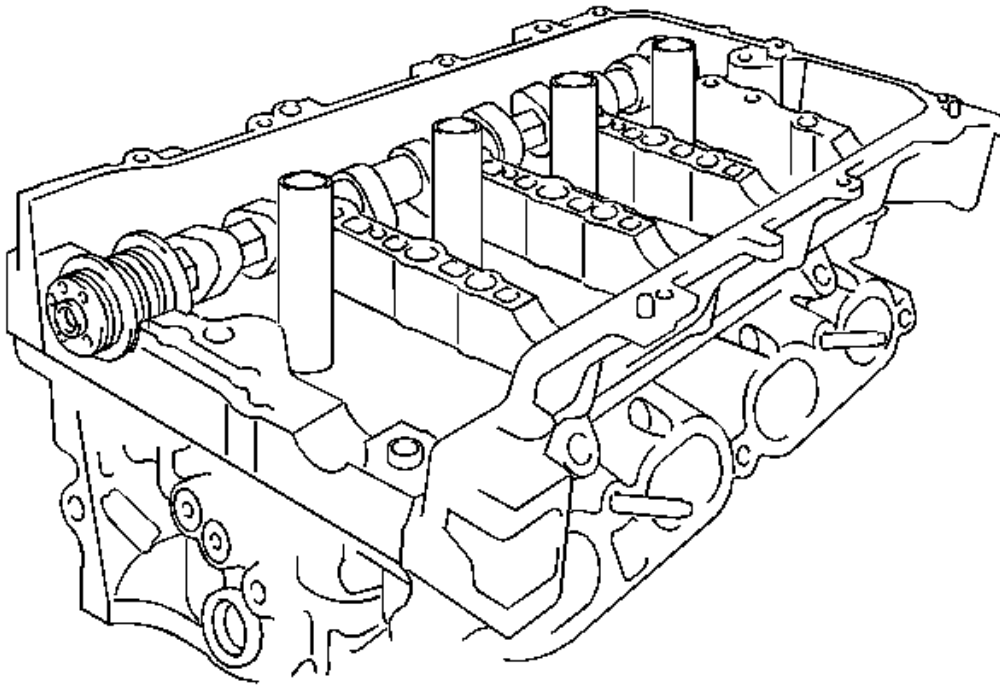


Fig. 91: View Of Camshaft
Courtesy of GENERAL MOTORS CORP.

8. Clean the camshaft journals.
9. Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.
10. Install the exhaust camshaft to the camshaft housing.

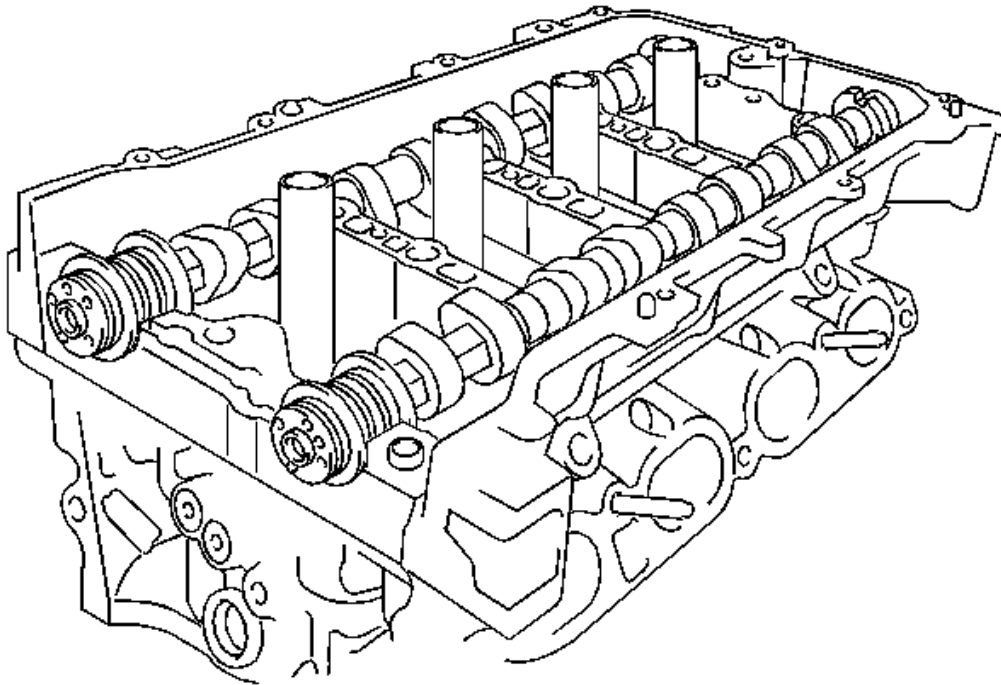


Fig. 92: View Of Cylinder Head & Camshafts
Courtesy of GENERAL MOTORS CORP.

11. Clean the camshaft journals.
12. Apply engine oil to the camshaft journals, camshaft housings and bearing caps.
13. Install the intake camshaft to the camshaft housing.

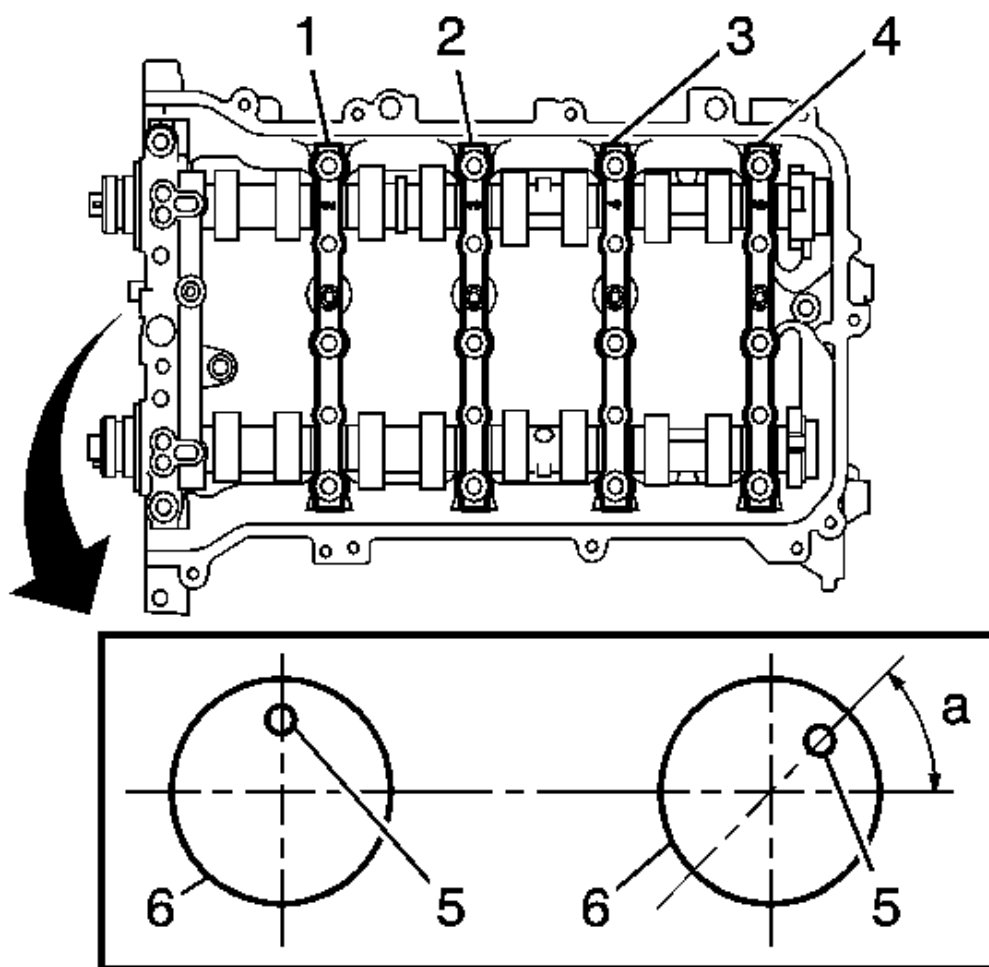


Fig. 93: Positioning Knock Pins Of Camshafts
Courtesy of GENERAL MOTORS CORP.

NOTE: Make sure that the knock pin (5) of the camshafts (6) are positioned as shown in the illustration.

14. Ensure the marks and numbers on the camshaft bearing caps (1-4) and place them in each proper position and direction.

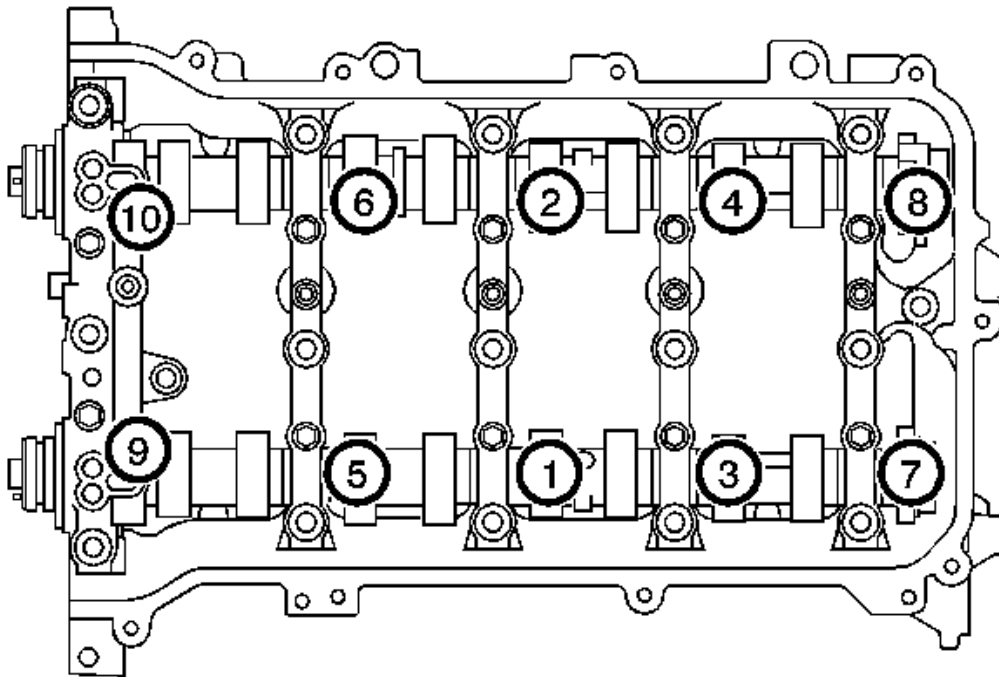


Fig. 94: Identifying Camshaft Bearing Cap Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

15. Install the 10 bolts in the order shown and tighten to 16 N.m (12 lb ft).

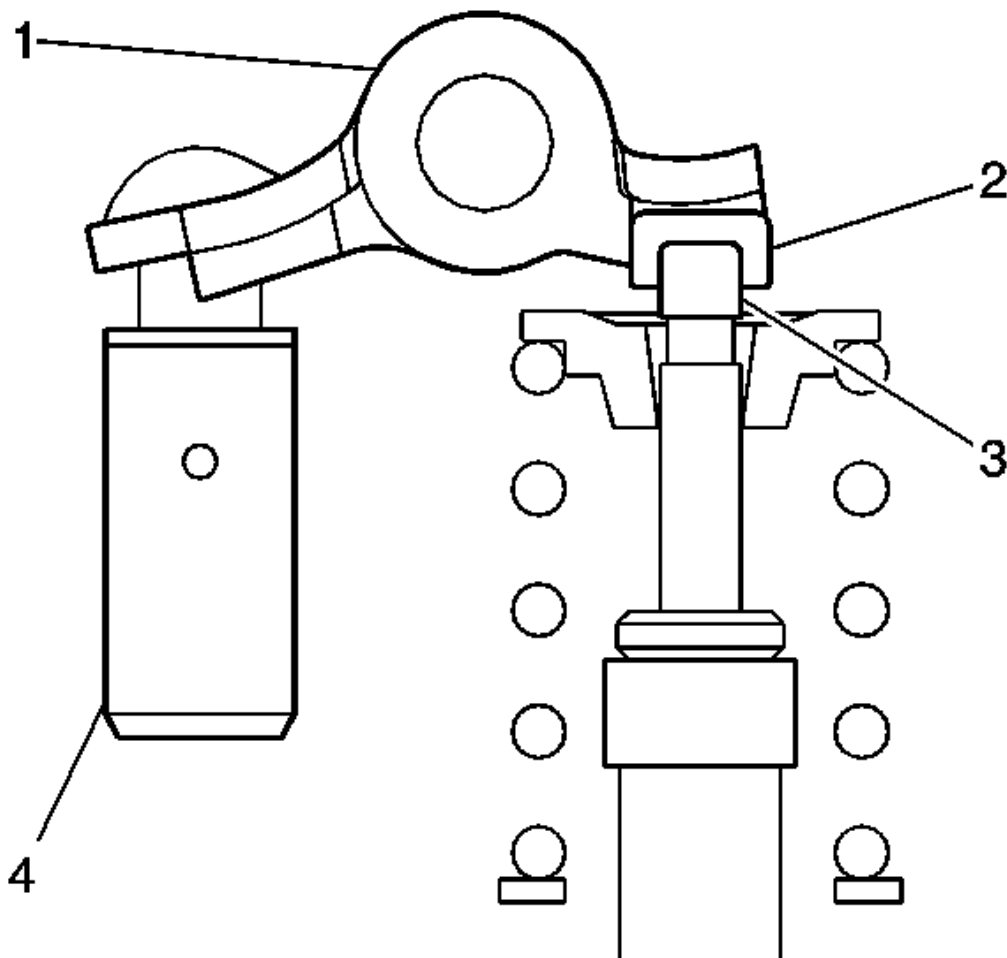


Fig. 95: View Of Correct Rocker Arm Installation
Courtesy of GENERAL MOTORS CORP.

16. Install the camshaft housing sub-assembly.
17. Make sure that the valve rocker arm (1) is installed as shown in the illustration.

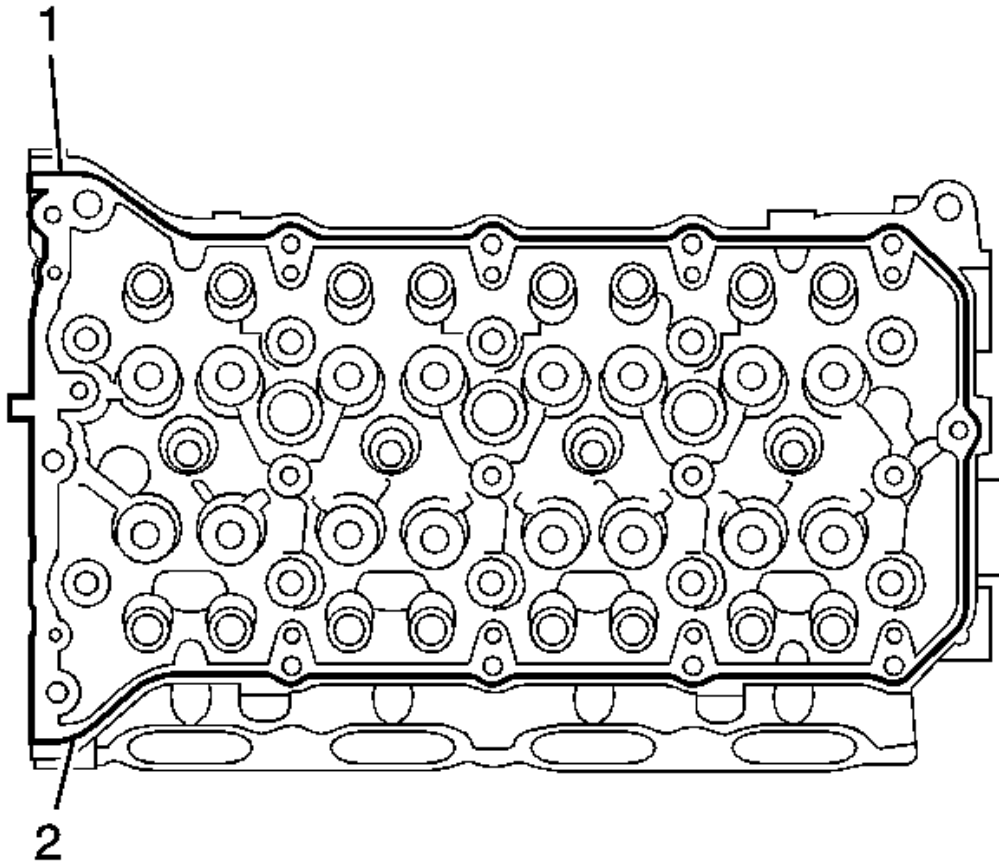


Fig. 96: Applying Adhesive To Cylinder Head
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Remove any oil from the contact surface.
- Install the camshaft housing assembly within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after installing.

18. Apply a continuous bead of sealant (1), diameter: 3.5-4.0 mm (0.138-0.158 in), as shown in the illustration, Three Bond 1217B, or equivalent, GM part number 12378521 (Canadian part number 88901148).

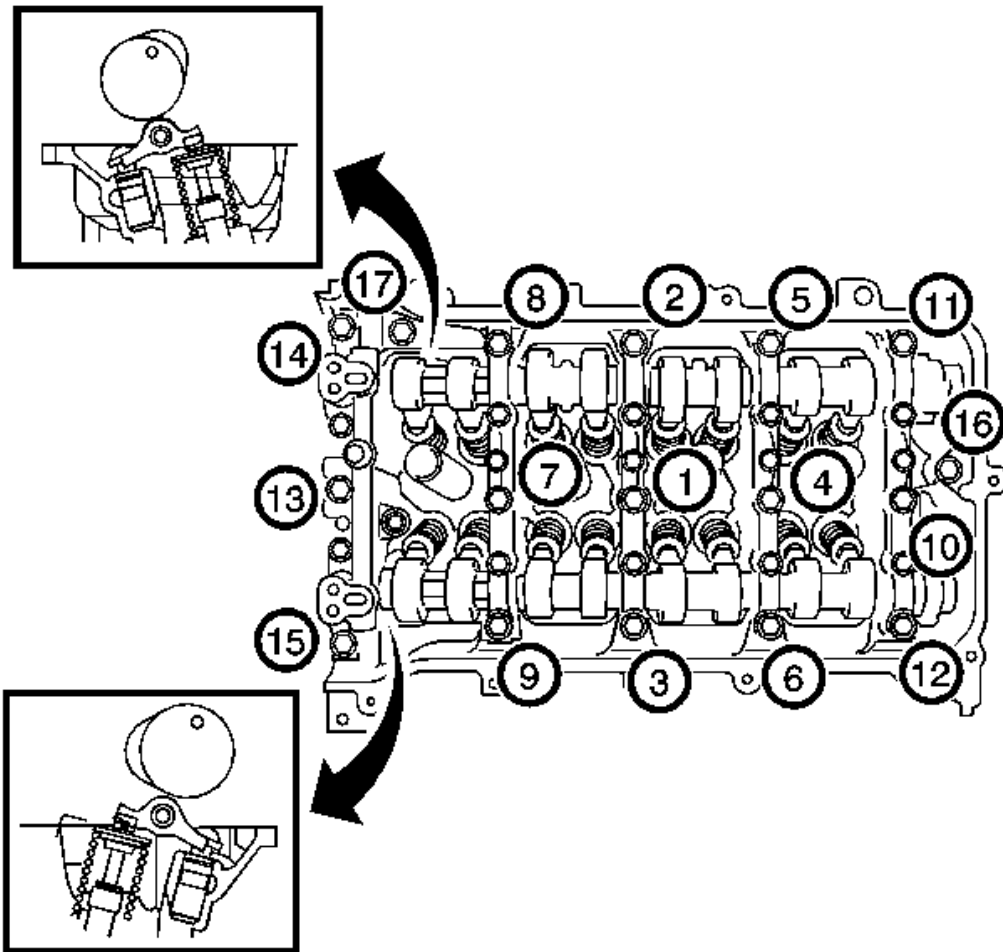


Fig. 97: Identifying Camshaft Housing Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

19. Set the intake camshaft and the exhaust camshaft.

NOTE:

- After installing the camshaft housing, make sure that the cam lobes are positioned as shown.
- If any of the bolts are loosened during installation, remove the camshaft housing, clean the installation surfaces, and reapply seal packing.
- If the camshaft housing is removed because any of the bolts are loosened during installation, make sure that the previously applied seal packing does not enter any oil passages.

- After installing the camshaft housing, wipe off any seal packing that seeped out from between the housing and the cylinder head.

20. Install the camshaft housing and tighten the 17 bolts in the order shown and tighten to 27 N.m (20 lb ft).

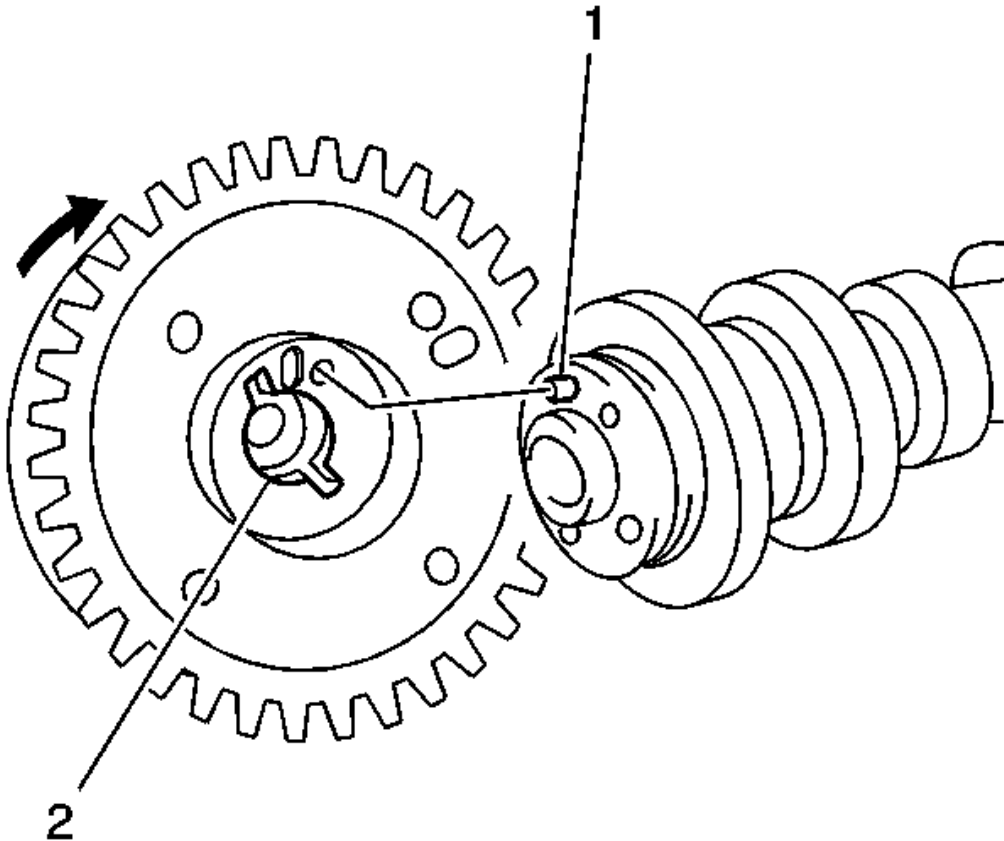


Fig. 98: View Of Camshaft Timing Gear Assembly
Courtesy of GENERAL MOTORS CORP.

21. Install camshaft timing gear assembly.
22. Check that the knock pin (1) is installed on the camshaft.

NOTE: Do not forcefully push in the camshaft timing gear assembly. This may cause the camshaft knock pin tip to damage the installation surface of the camshaft timing gear assembly.

23. Put the camshaft timing gear and camshaft together with the straight pin and key groove misaligned, as

shown in the illustration.

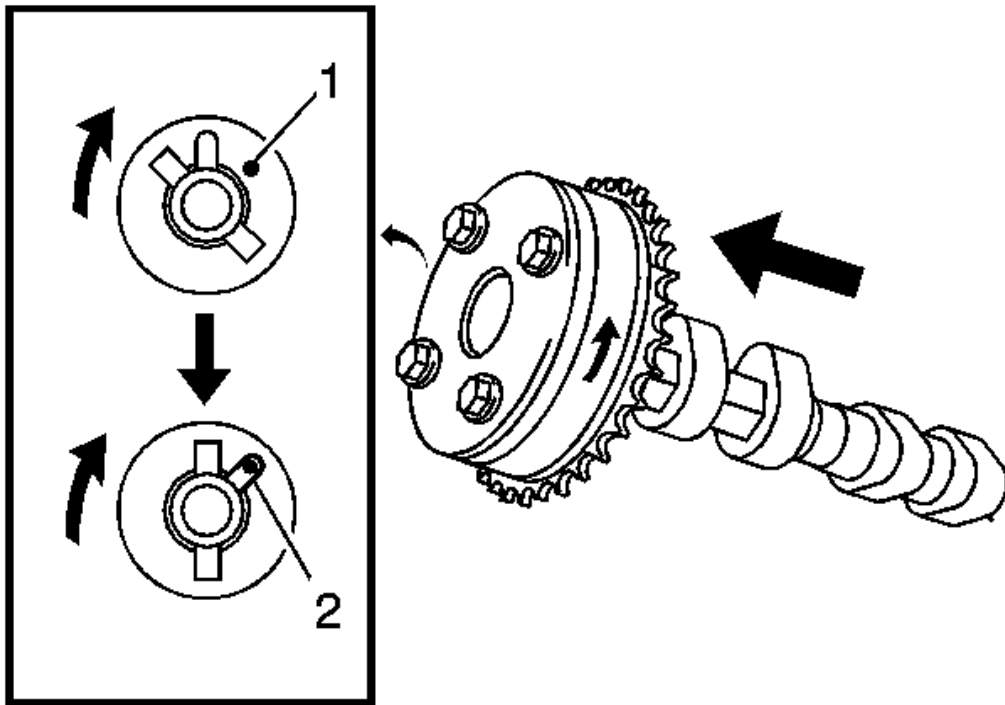


Fig. 99: Turning Camshaft Gear
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not turn the camshaft timing gear in the retard direction (clockwise).

24. Turn the camshaft timing gear as shown in the illustration while pushing it gently against the camshaft. Push further at the position where the pin (1) fits into the groove (2).

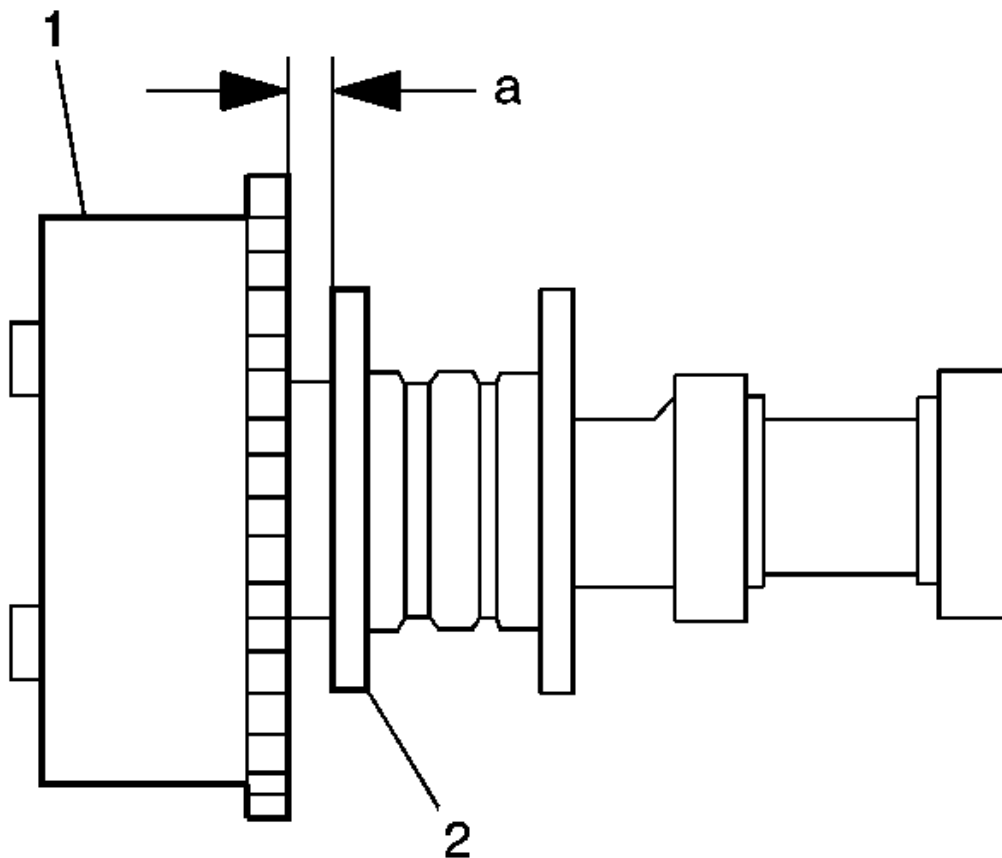


Fig. 100: Identifying Clearance Between Gear & Camshaft
Courtesy of GENERAL MOTORS CORP.

25. Measure the clearance between the gear (1) and the camshaft (2).

Specification: Clearance: 0.1-0.4 mm (0.004-0.016 in.)

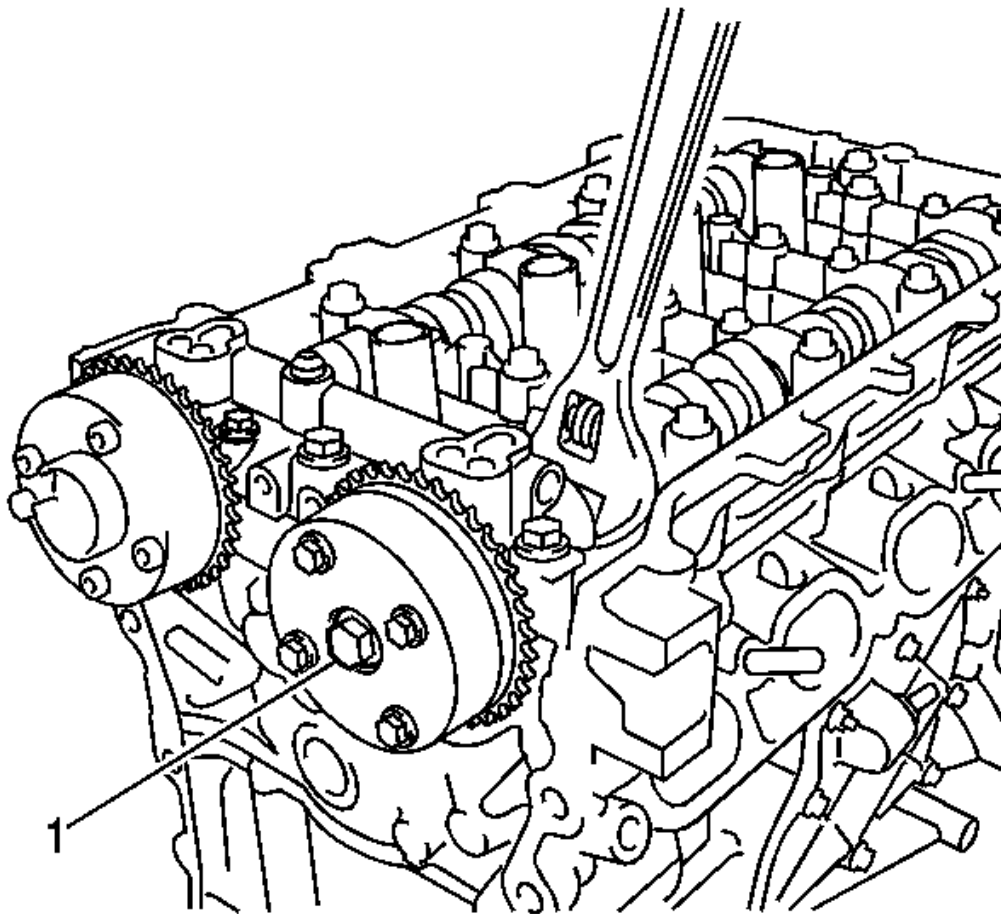


Fig. 101: Tightening Camshaft Timing Gear Flange Bolt
Courtesy of GENERAL MOTORS CORP.

26. Install the flange bolt (1) with the camshaft timing gear fixed in place and tighten to 54 N.m (40 lb ft).

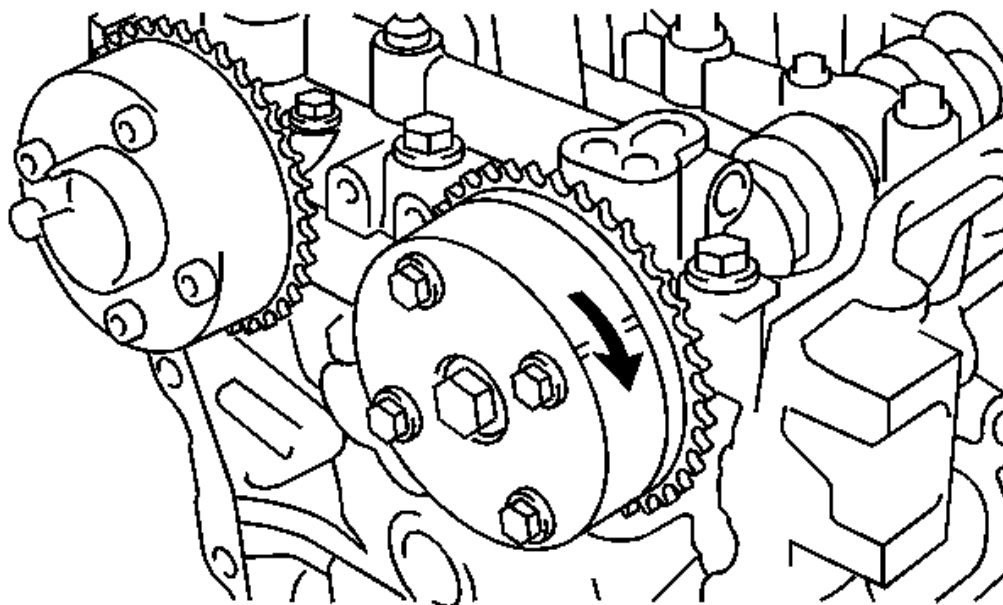


Fig. 102: Checking Camshaft Timing Gear Movement
Courtesy of GENERAL MOTORS CORP.

27. Check that the camshaft timing gear can move in the retard direction (clockwise) and is locked in the most retarded position.
28. Install the camshaft timing exhaust gear assembly.
29. Check that the knock pin is installed on the camshaft.

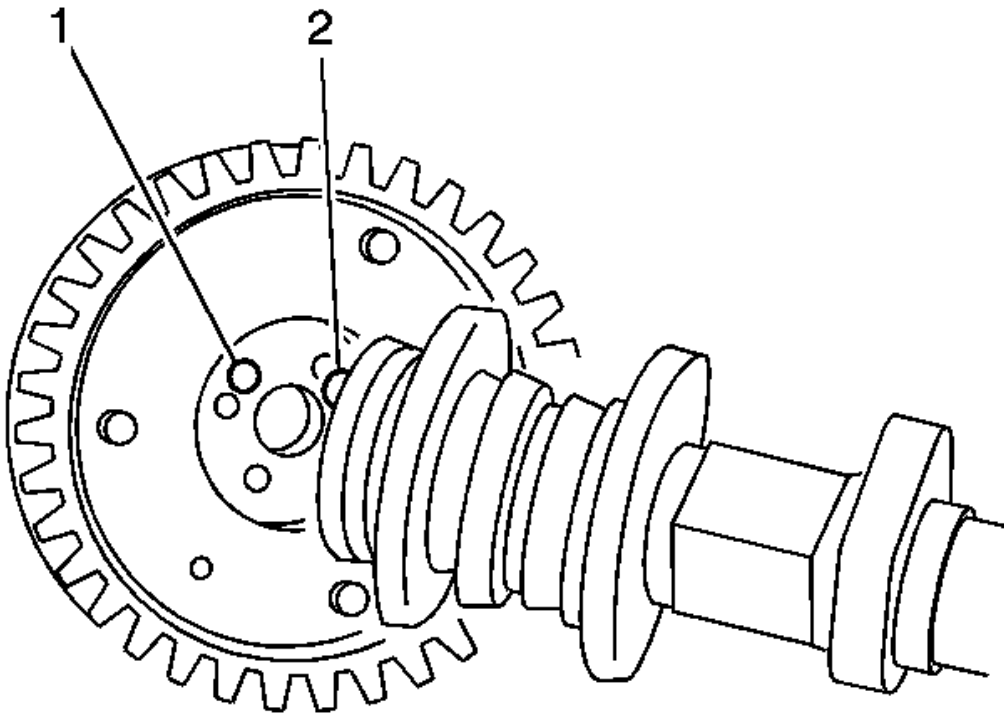


Fig. 103: View Of Camshaft Timing Exhaust Gear & Camshaft
Courtesy of GENERAL MOTORS CORP.

30. Put the camshaft timing exhaust gear and camshaft together by aligning the key groove (1) and straight pin (2).

NOTE: Be sure not to turn the camshaft timing exhaust gear in the retard direction (clockwise).

31. Lightly press the gear against the camshaft, and turn the gear. Push further at the position where the pin enters the groove.
32. Check that there is no clearance between the gear flange and the camshaft.

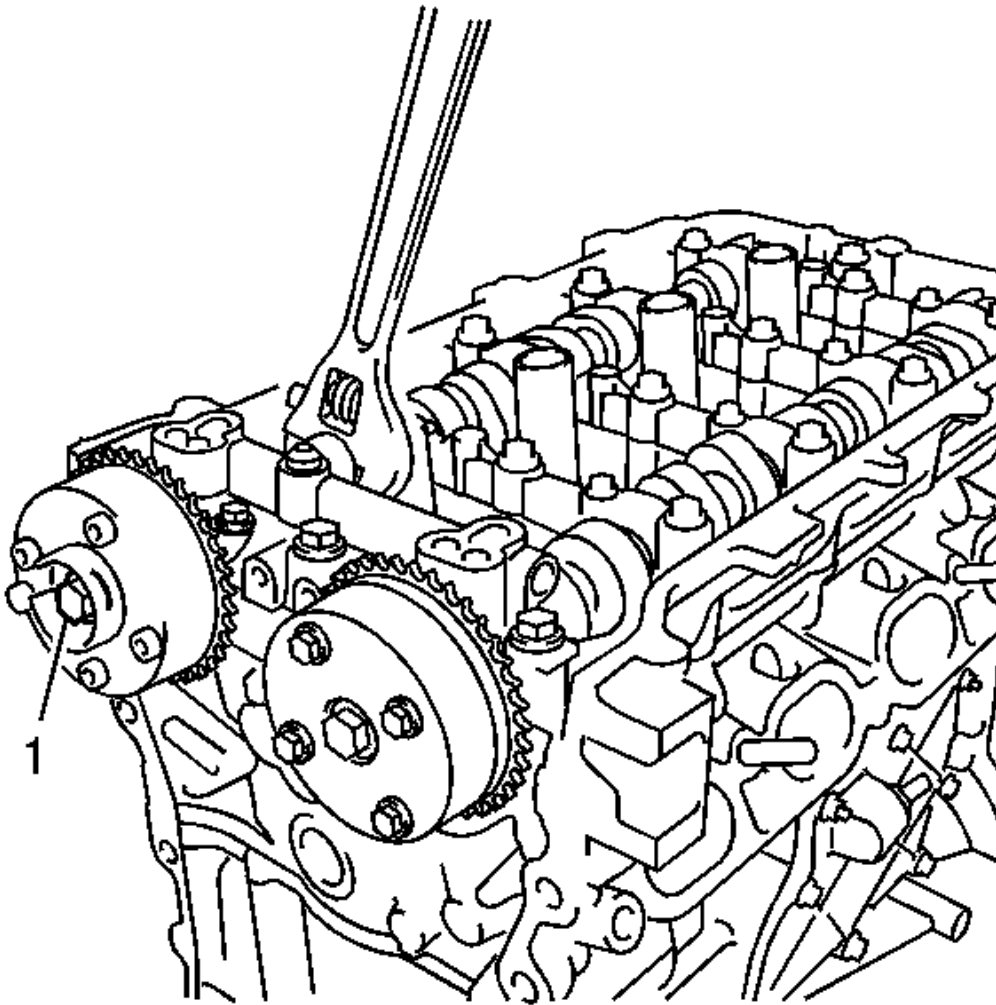


Fig. 104: Tightening Flange Bolt
Courtesy of GENERAL MOTORS CORP.

33. Install the flange bolt (1) with the camshaft timing exhaust gear fixed and tighten to 54 N.m (40 lb ft).
34. Make sure that the camshaft timing exhaust gear is locked.
35. Install the timing gear chain vibration damper.
36. Install the oil pump chain vibration damper.
37. Install the chain assembly.
38. Install the chain tensioner slipper.
39. Install the timing chain cover oil seal.

40. Install the timing chain cover assembly. Refer to **Timing Chain Housing Installation** .
41. Install the crankshaft pulley.
42. Install the chain tensioner assembly. Refer to **Timing Chain Tensioner Installation** .
43. Install the cylinder head cover assembly. Refer to **Camshaft Cover Installation** .
44. Install the radio setting condenser.
45. Install the thermostat.
46. Install the inlet water.
47. Install the inlet water hose.
48. Install the water by-pass pipe.
49. Install the water by-pass hoses.
50. Install the ventilation hose.
51. Install the exhaust manifold. Refer to **Exhaust Manifold Installation** .
52. Install the oil level dipstick sub-assembly. Refer to **Oil Level Indicator Tube Replacement**.
53. Install the ignition coil assembly.
54. Install the fuel injector assembly.
55. Install the delivery pipe spacer.
56. Install the fuel delivery pipe assembly.
57. Install the fuel tube assembly.
58. Install the intake manifold. Refer to **Intake Manifold Installation** .
59. Remove the engine stand.
60. Install the engine assembly with transaxle. Refer to **Engine Replacement**.

CRANKSHAFT FRONT OIL SEAL REPLACEMENT

Special Tools

- **J-8614-A:** Pinion Flange Holder and Remover
- **J-21052-4:** Crankshaft End Protector
- **J-41665-A:** Crankshaft Balancer and Sprocket Installer
- **J-41998-A:** Crankshaft Balancer Installer

REMOVAL PROCEDURE

1. Remove the front wheel RH.
2. Remove the engine under cover RH.
3. Remove the engine cover. Refer to **Engine Cover Replacement**.
4. Remove the V-ribbed belt. Refer to **Drive Belt Replacement**.

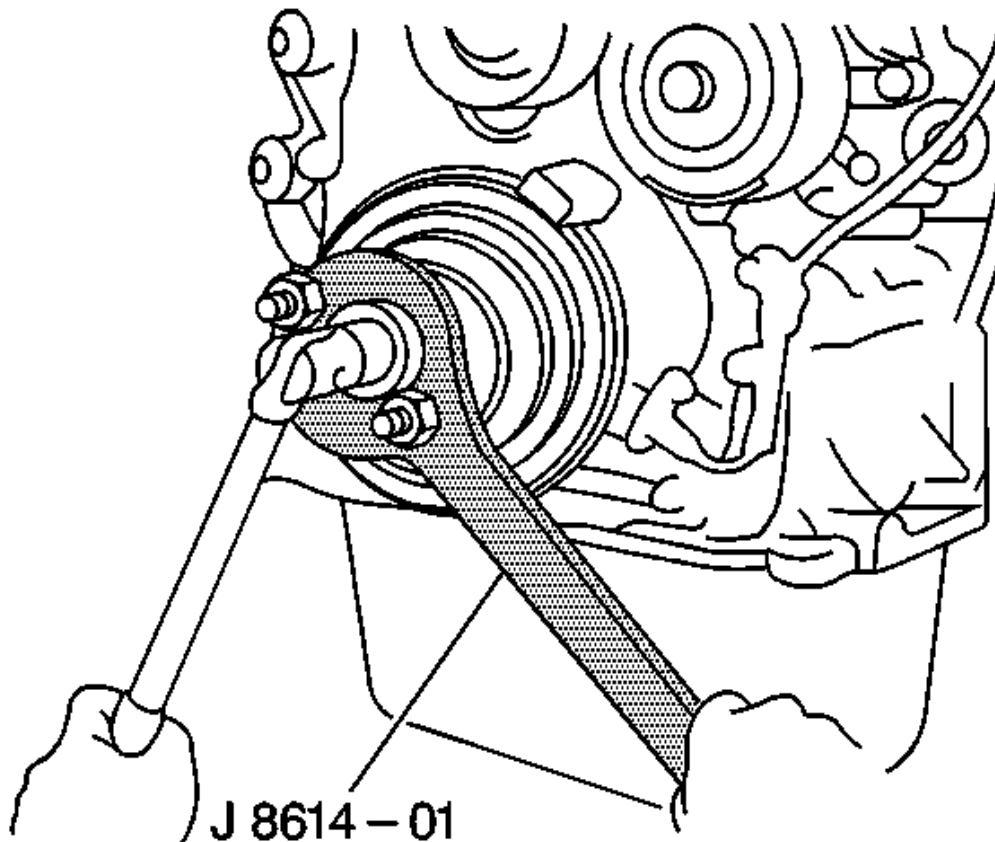


Fig. 105: Removing/ Installing Crankshaft Pulley Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft pulley.
6. Using the **J-8614-A**: holder and remover, hold the pulley in place, loosen and remove the pulley bolt.

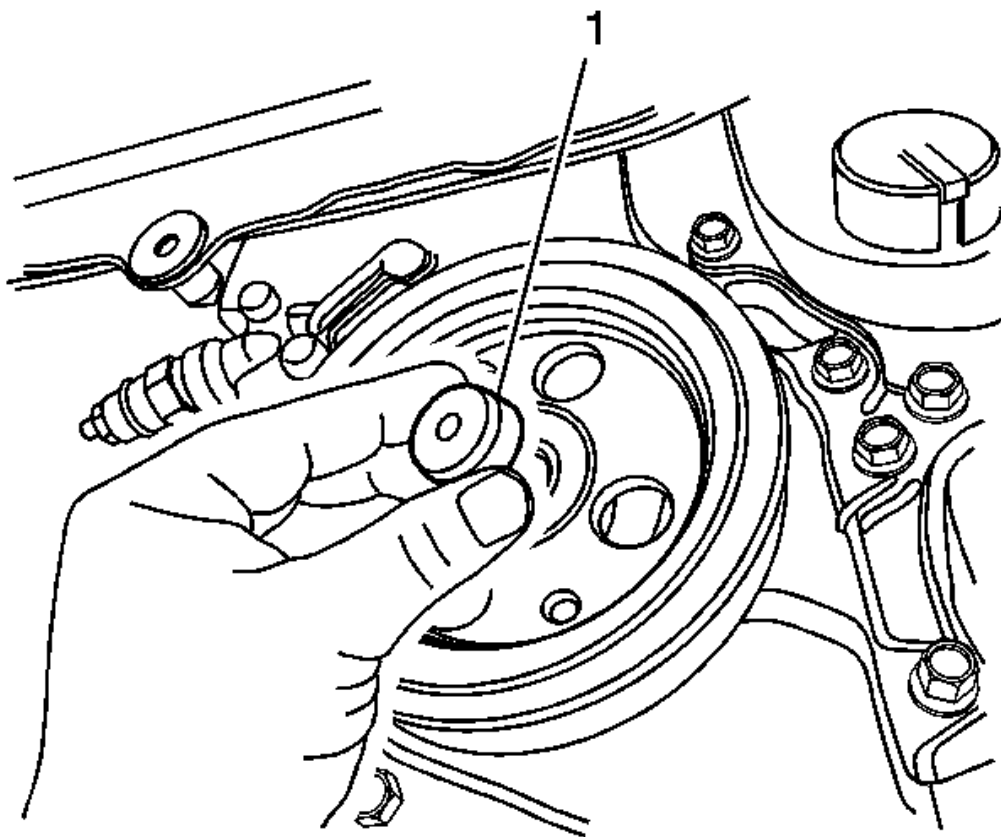


Fig. 106: Placing Crankshaft End Protector
Courtesy of GENERAL MOTORS CORP.

7. Place the **J-21052-4**: protector (1) on the end of the crankshaft

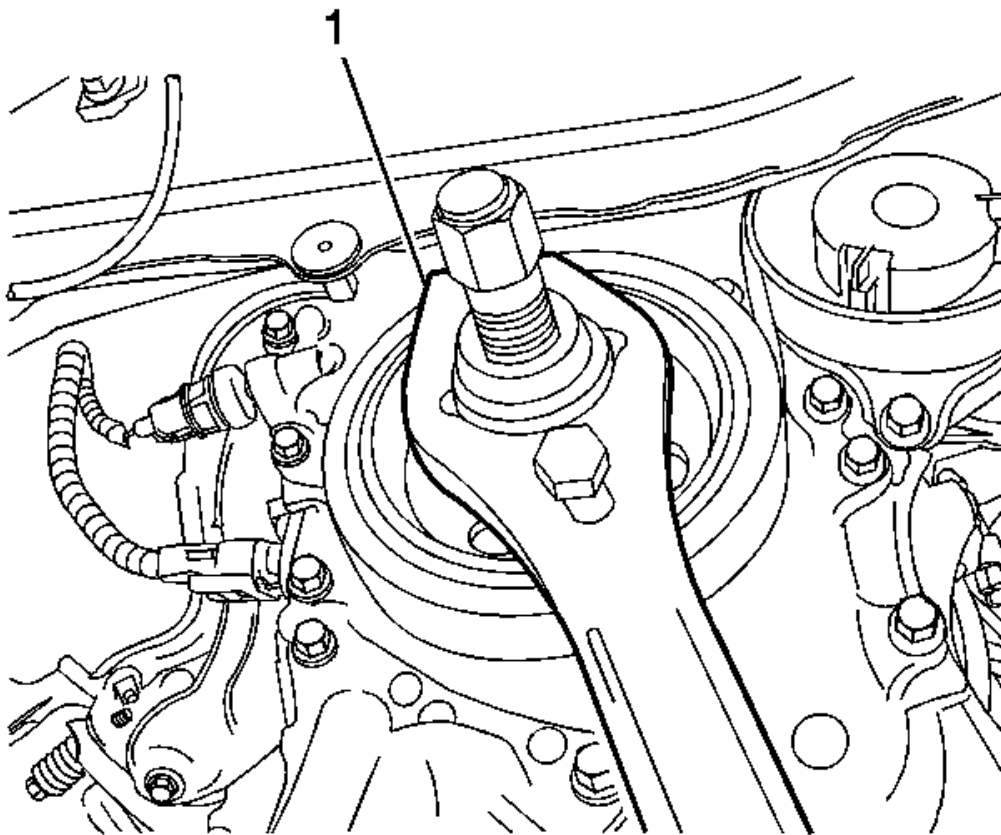


Fig. 107: Removing Crankshaft Pulley
Courtesy of GENERAL MOTORS CORP.

8. Using the **J-8614-A**: holder and remover (1), remove the crankshaft pulley.
9. Remove the timing chain cover oil seal.

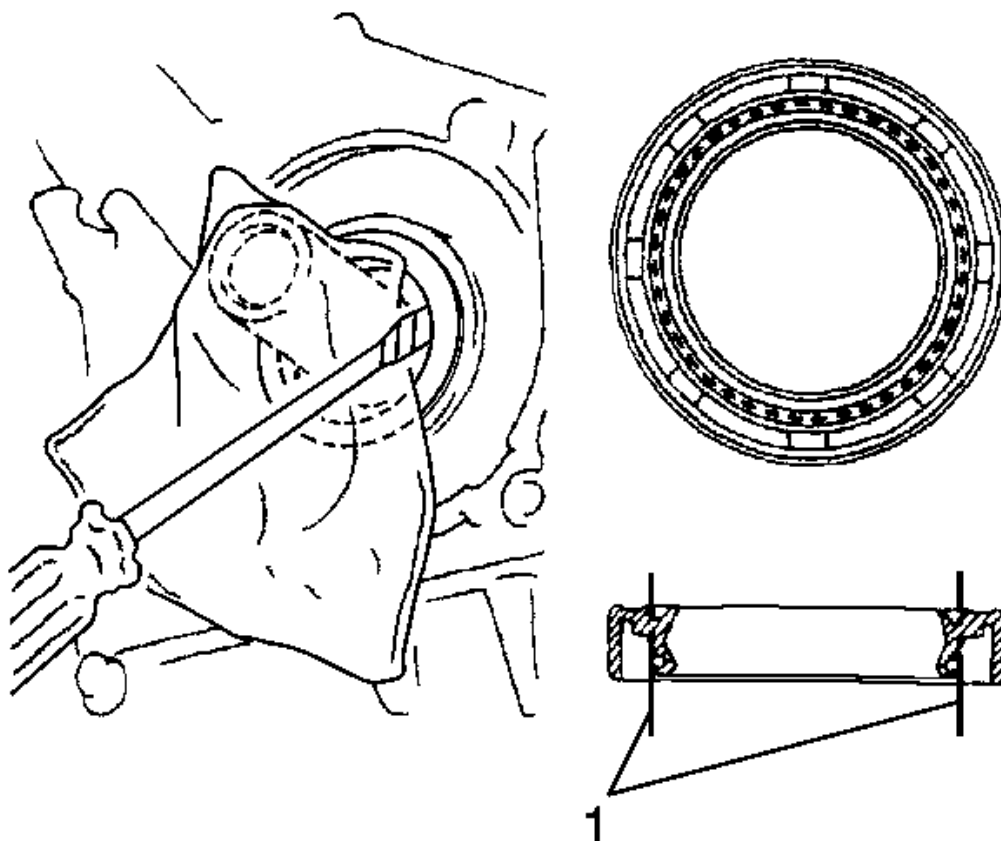


Fig. 108: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: After removing, check the crankshaft for nicks or burrs. Smooth the surface with 400-grit sandpaper.

10. Using a knife, cut off the lip (1) of the oil seal.
11. Using a screwdriver with its tip wrapped with tape, pry out the oil seal.

INSTALLATION PROCEDURE

1. Install the timing chain cover oil seal.
2. Apply MP grease to the lip of a new oil seal.

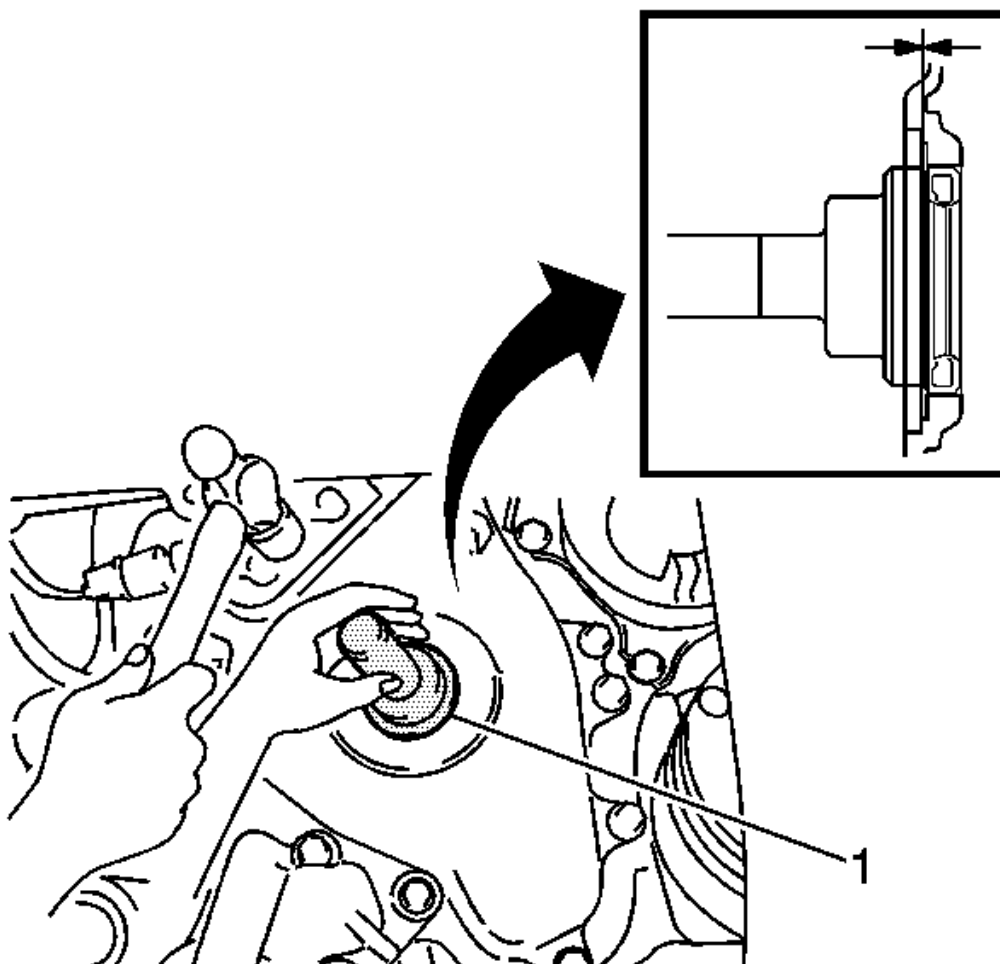


Fig. 109: Tapping In Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Wipe off extra grease from the crankshaft.

3. Using **J-41998-A**: installer (1) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
4. Align the pulley set key with the key groove of the pulley.

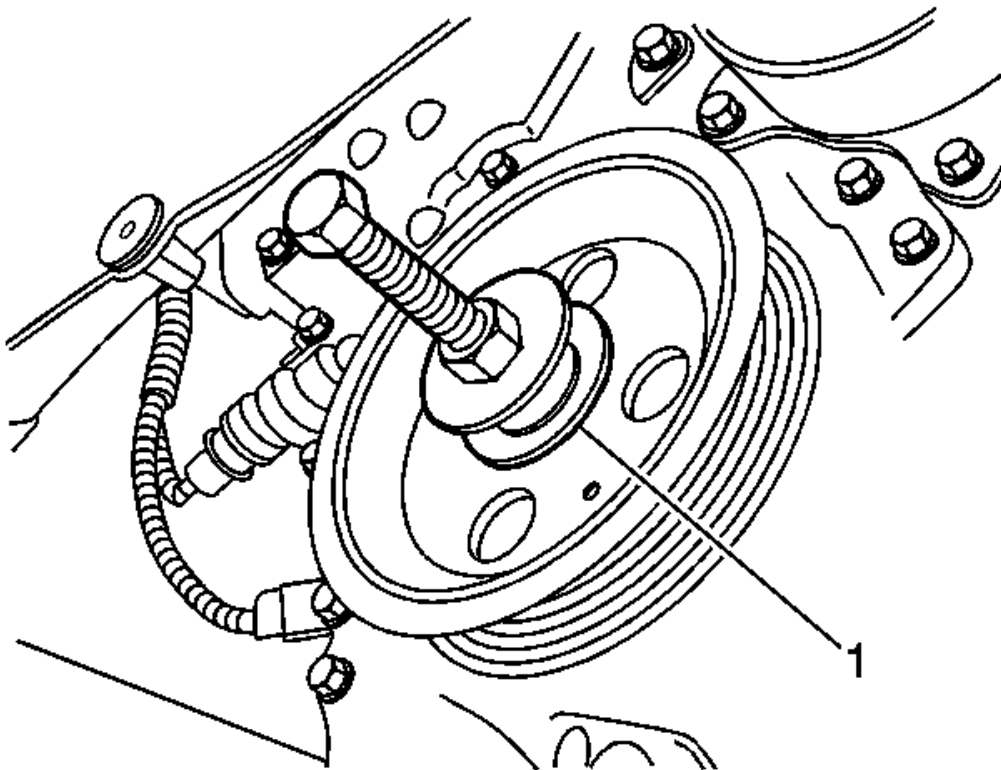


Fig. 110: Pushing Crankshaft Pulley On
Courtesy of GENERAL MOTORS CORP.

5. Using the **J-41665-1**: installer (1), push the pulley onto the crankshaft.

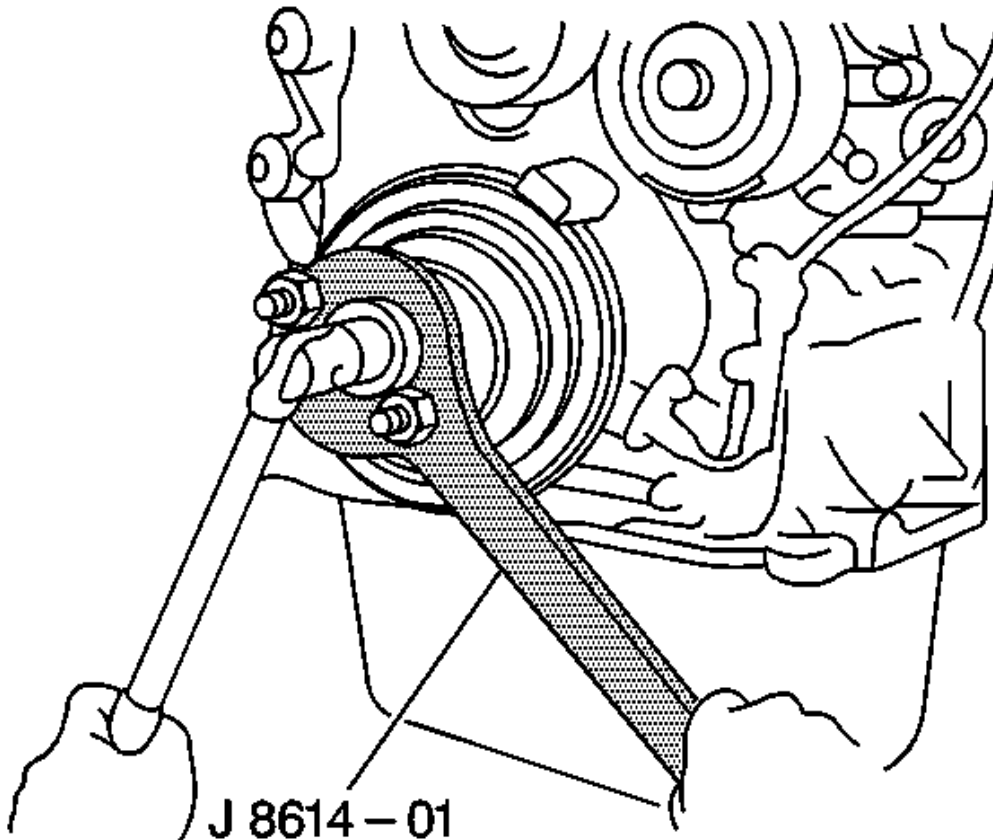


Fig. 111: Removing/ Installing Crankshaft Pulley Retaining Bolt
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

6. Using the **J-8614-A**: holder and remover, hold the pulley in place and tighten the bolt to 190 N.m (140 lb ft).
7. Install the V-ribbed belt. Refer to Drive Belt Replacement.
8. Add the engine oil.
9. Inspect for engine oil leaks.
10. Install the engine cover. Refer to Engine Cover Replacement.
11. Install the engine under cover RH.
12. Install the front wheel RH.

CAMSHAFT COVER REPLACEMENT

REMOVAL PROCEDURE

1. Remove the engine cover. Refer to Engine Cover Replacement.

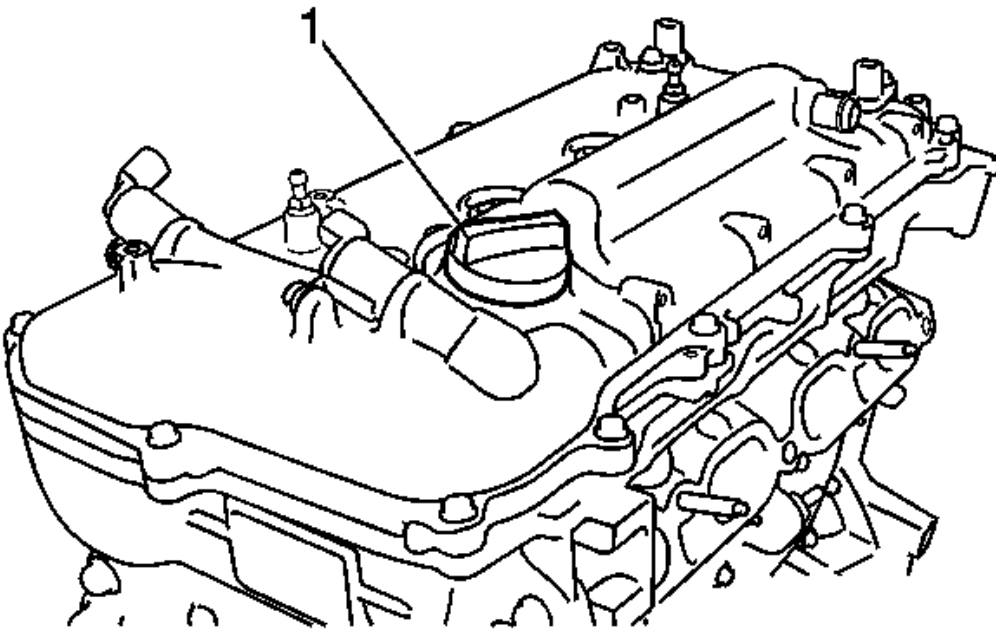


Fig. 112: Identifying Oil Filler Cap
Courtesy of GENERAL MOTORS CORP.

2. Remove the oil filler cap (1).

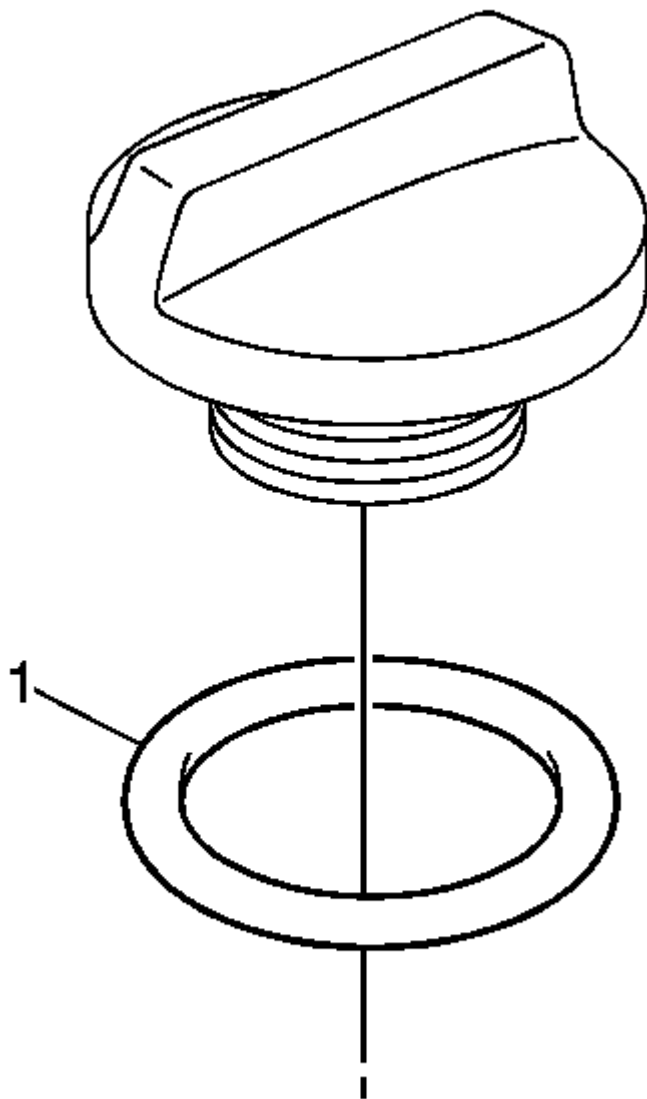


Fig. 113: View Of Oil Filler Cap Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil filler cap gasket (1).

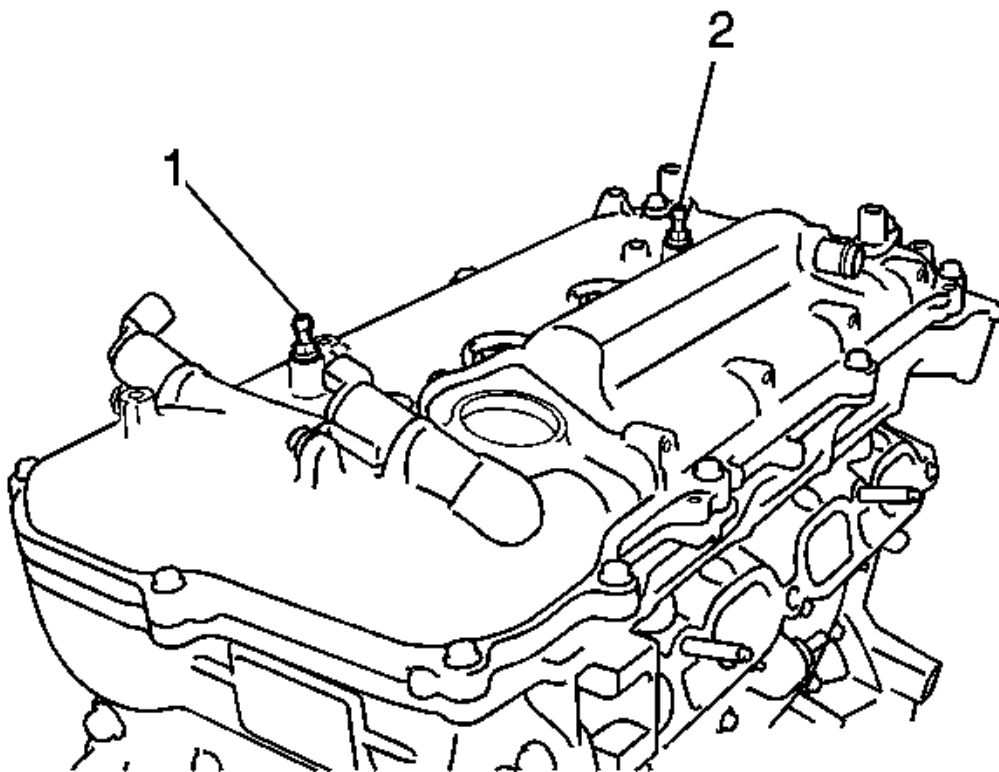


Fig. 114: View Of Engine Cover Joints
Courtesy of GENERAL MOTORS CORP.

4. Remove the 2 engine cover joints (1, 2).

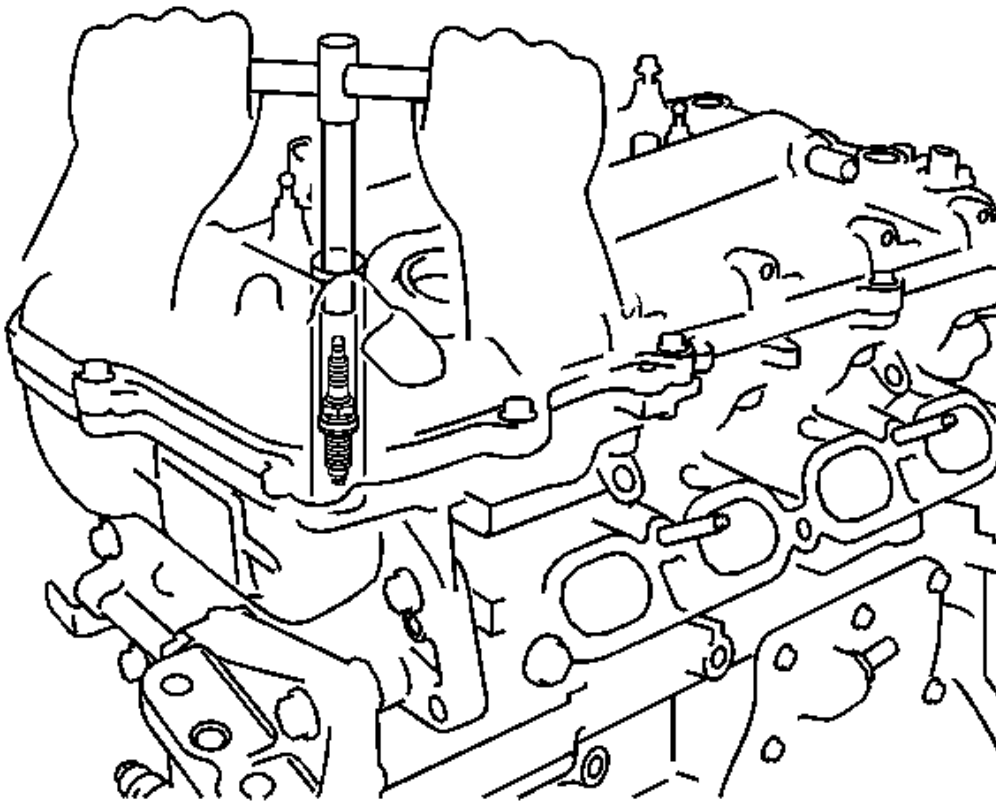


Fig. 115: Removing/Installing Spark Plug
Courtesy of GENERAL MOTORS CORP.

5. Remove the ignition coils.
6. Using a 14 mm spark plug wrench, remove the 4 spark plugs.

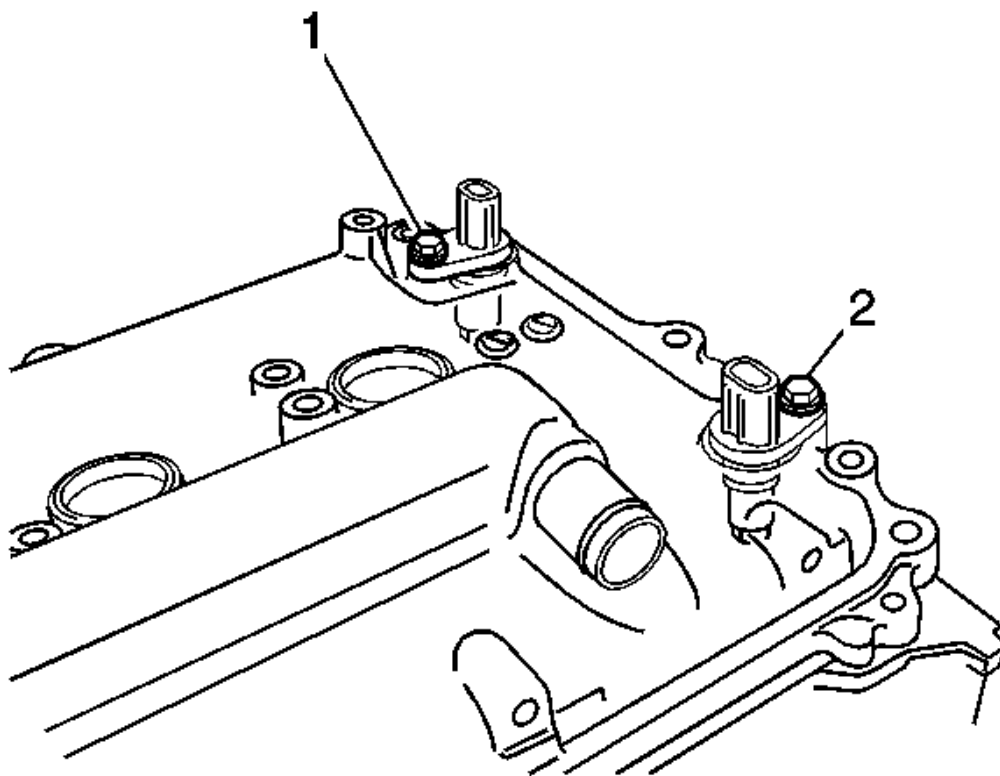


Fig. 116: Identifying Camshaft Position Sensors
Courtesy of GENERAL MOTORS CORP.

7. Remove the 2 bolts (1, 2) and 2 camshaft position sensors.

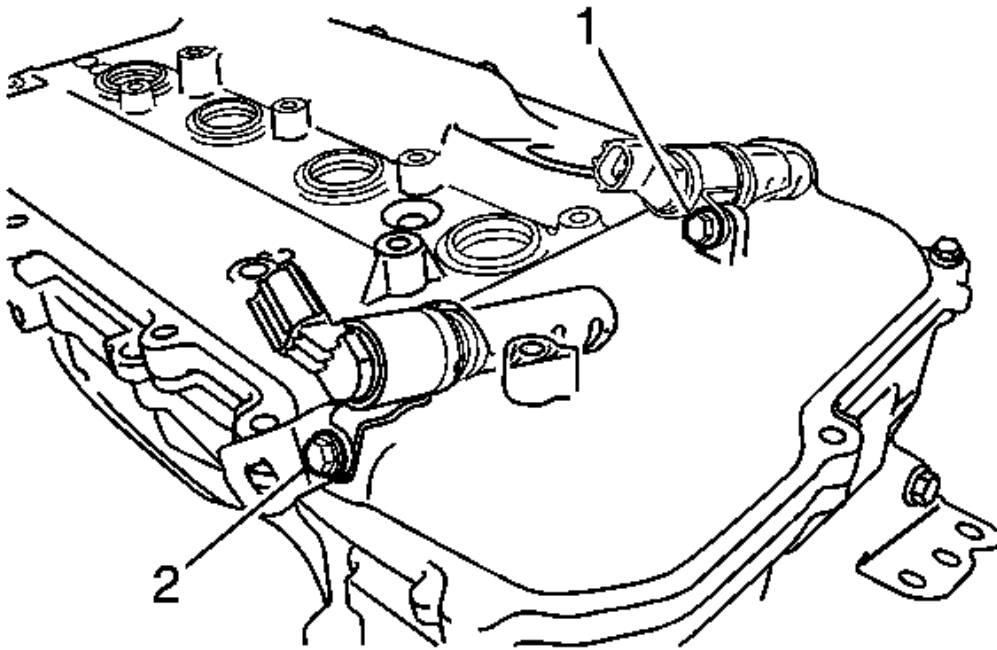


Fig. 117: Identifying Oil Camshaft Timing Control Valves, Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Remove the 2 bolts (1, 2), O-rings, bracket and 2 oil camshaft timing control valves.

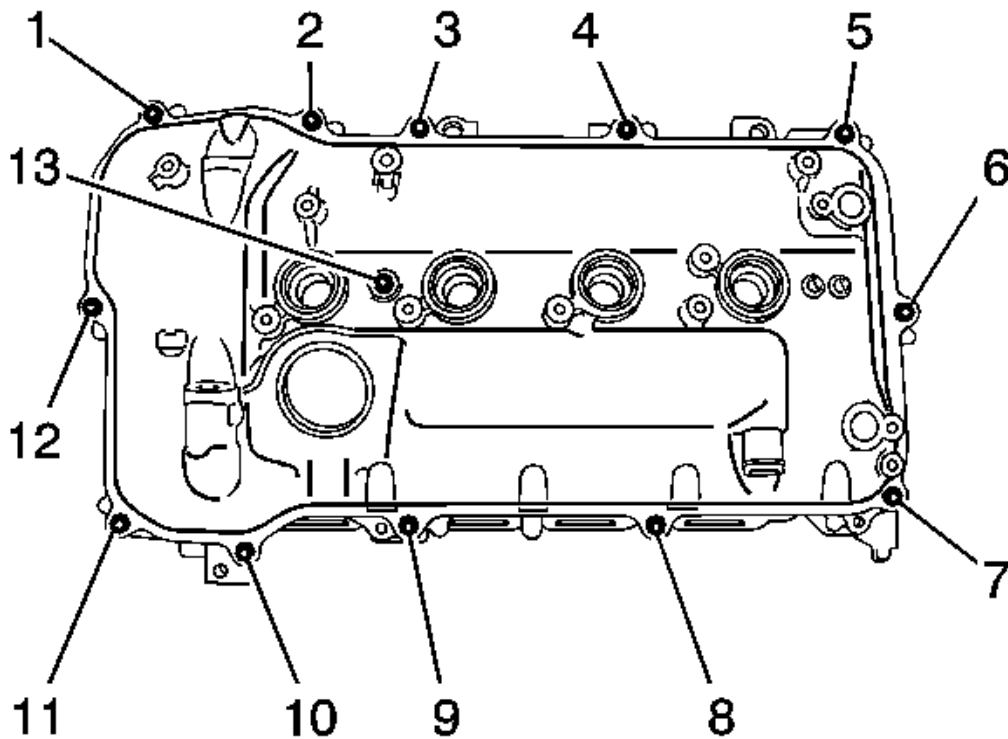


Fig. 118: Identifying Cylinder Head Cover Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the 13 bolts (1-13), seal washer and cylinder head cover.

INSTALLATION PROCEDURE

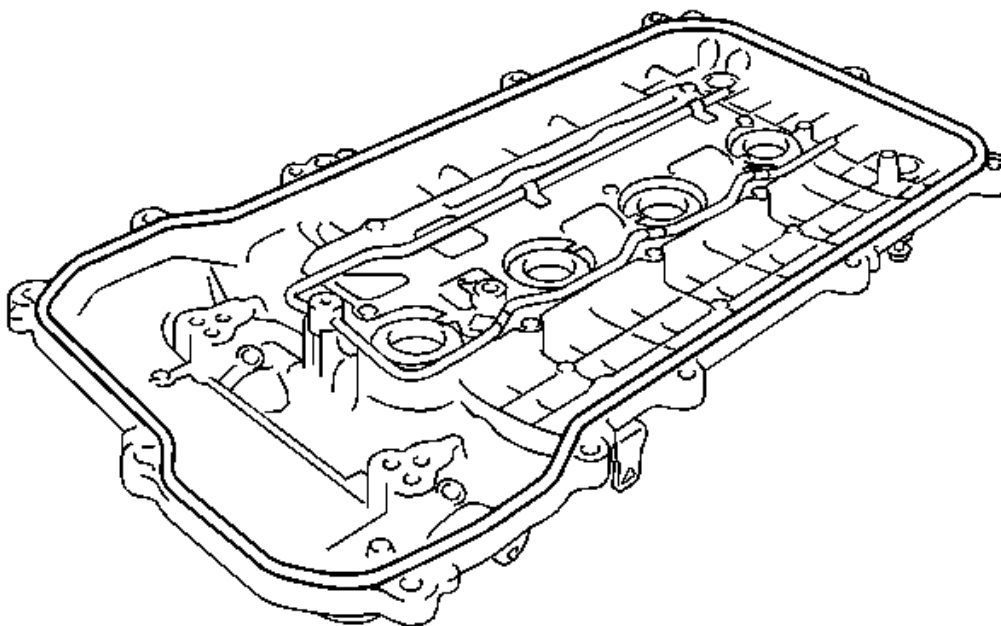


Fig. 119: View Of Cylinder Head Cover Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install a new gasket to the cylinder head cover.

NOTE:

- Remove any oil from the contact surfaces.
- Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after the installation.

2. Apply Three Bond 1217B, or equivalent, GM part number 12378521 (Canadian part number 88901148).

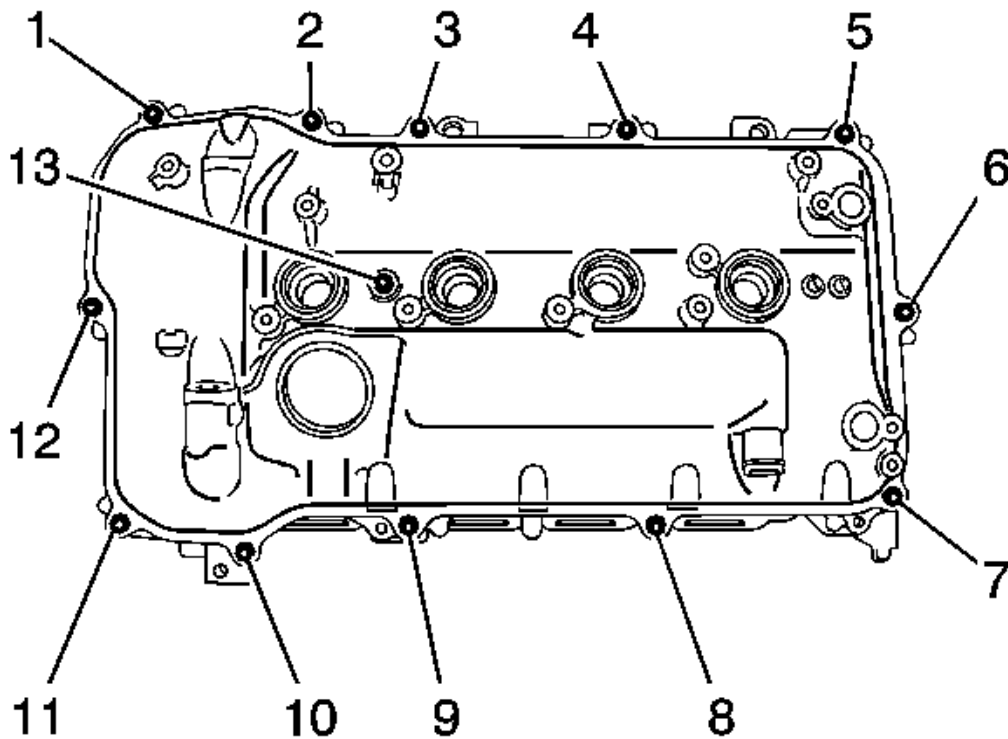


Fig. 120: Identifying Cylinder Head Cover Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the cylinder head cover with a new seal washer and the bolts (1-13) and tighten to 10 N.m (7 lb ft).

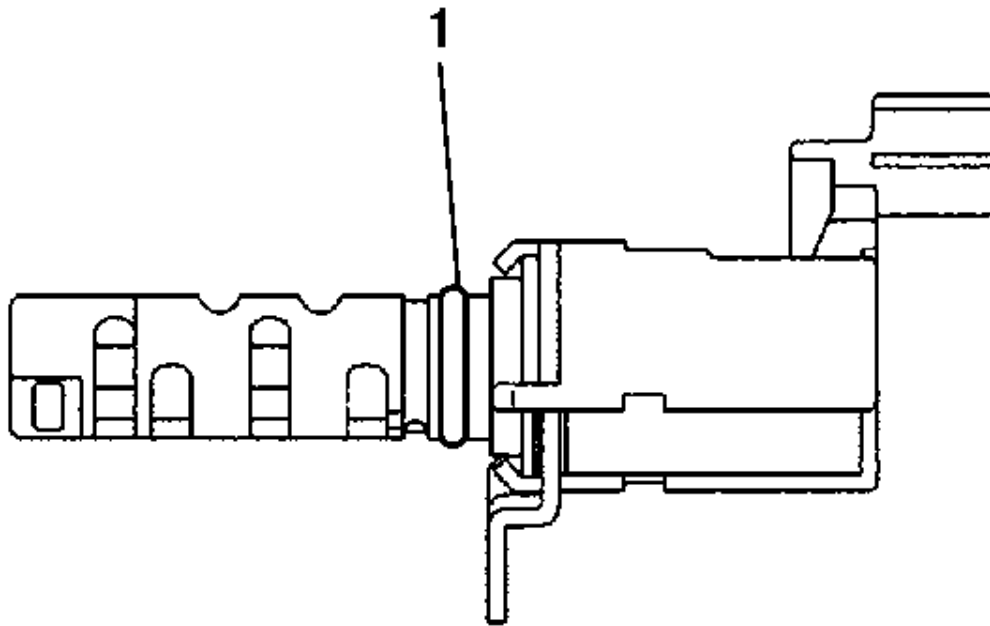


Fig. 121: View Of Camshaft Timing Oil Control Valve Assembly
Courtesy of GENERAL MOTORS CORP.

4. Apply a light coat of engine oil to a new O-ring (1), then install it onto the camshaft timing oil control valve.

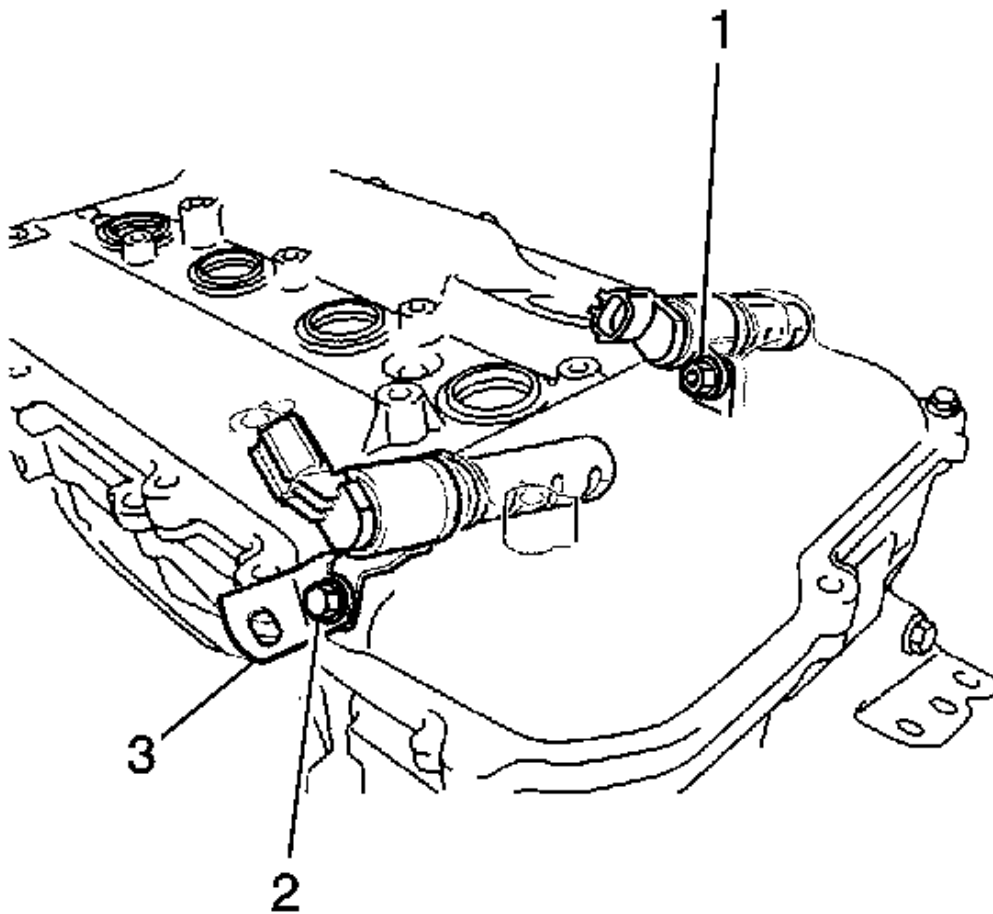


Fig. 122: View Of Camshaft Timing Oil Control Valves, Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

5. Install the 2 camshaft timing oil control valves and bracket with the 2 bolts (1, 2) and tighten to 10 N.m (7 lb ft).

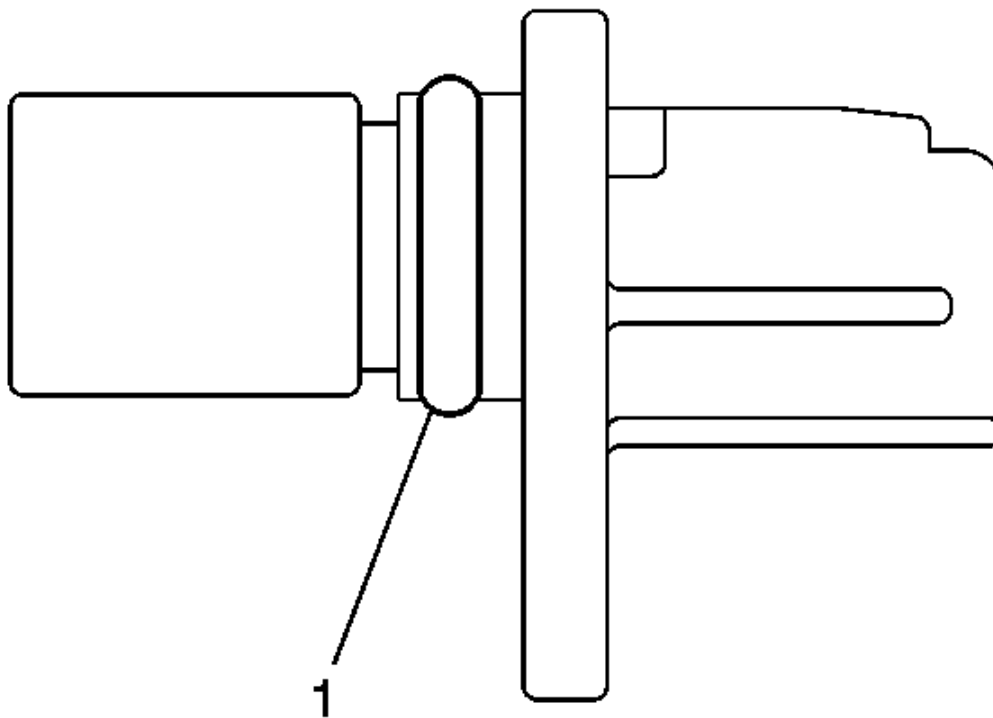


Fig. 123: Identifying Camshaft Position Sensor & O-Ring
Courtesy of GENERAL MOTORS CORP.

6. Install the camshaft position sensor.
7. Apply a light coat of engine oil to the O-ring (1) of the sensor.

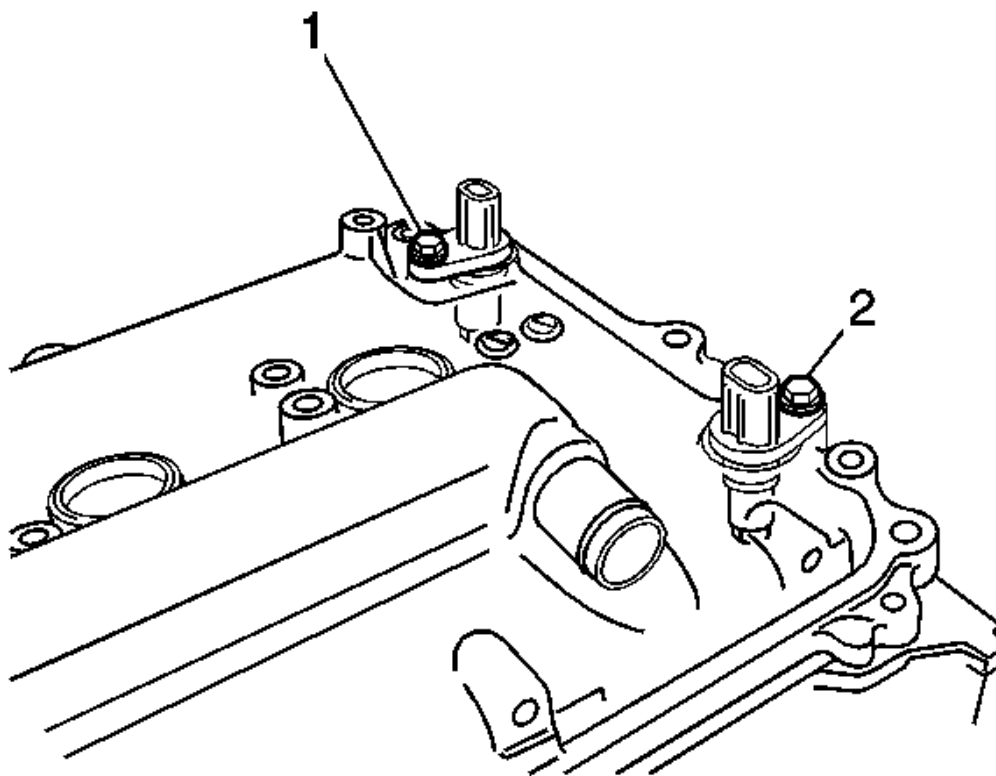


Fig. 124: Identifying Camshaft Position Sensors
Courtesy of GENERAL MOTORS CORP.

8. Install the 2 sensors with the 2 bolts (1, 2) and tighten to 10 N.m (7 lb ft).

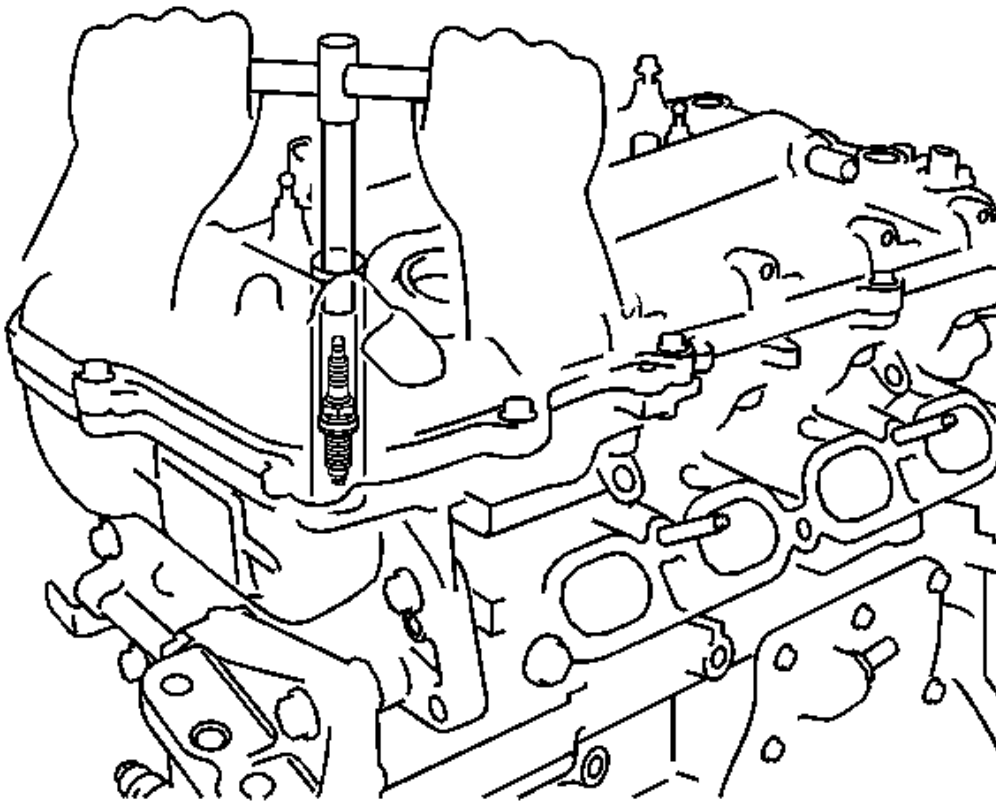


Fig. 125: Removing/Installing Spark Plug
Courtesy of GENERAL MOTORS CORP.

9. Using a 14 mm spark plug wrench, install the 4 spark plugs and tighten to 20 N.m (15 lb ft).
10. Install the ignition coils.

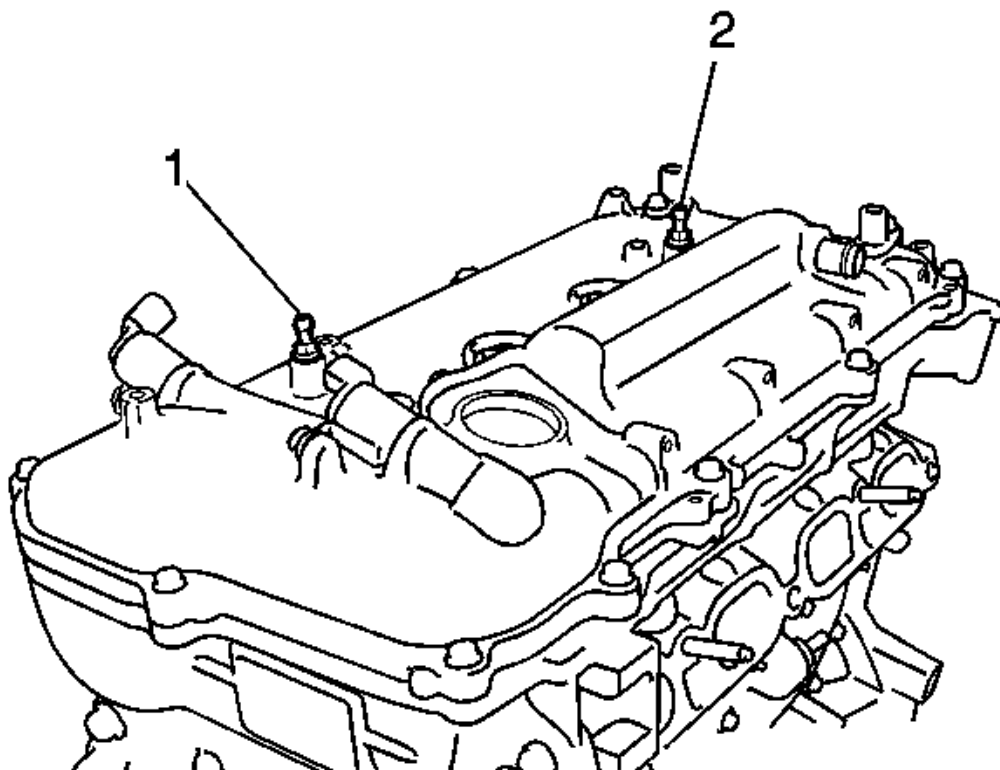


Fig. 126: View Of Engine Cover Joints
Courtesy of GENERAL MOTORS CORP.

11. Install the 2 engine cover joints (1, 2) and tighten to 10 N.m (7 lb ft).

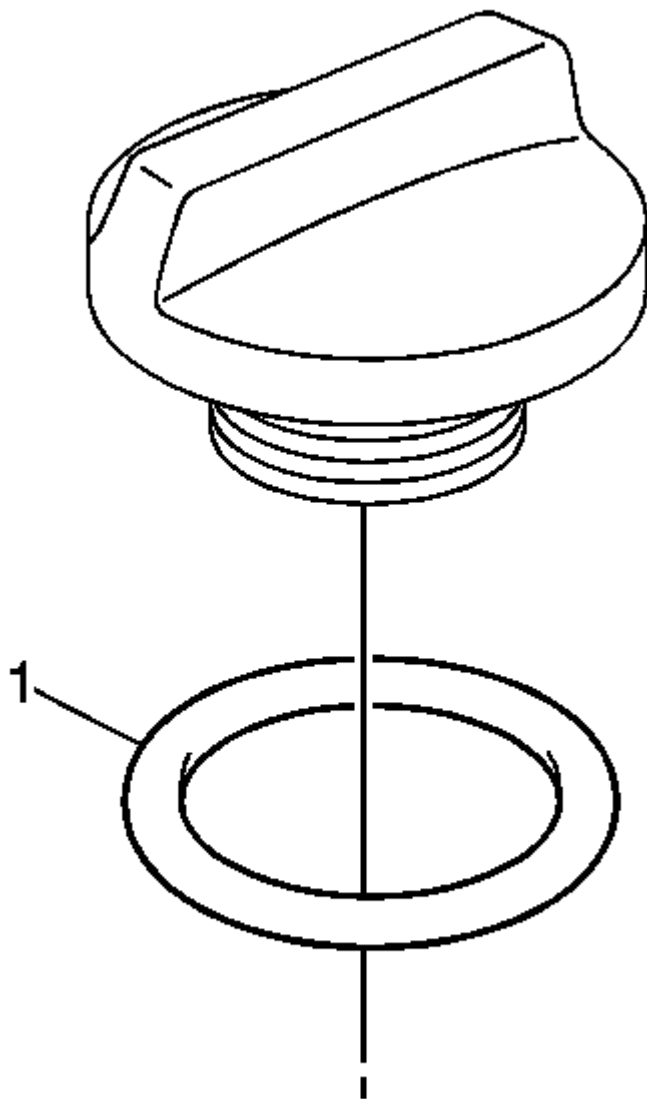


Fig. 127: View Of Oil Filler Cap Gasket
Courtesy of GENERAL MOTORS CORP.

12. Install the oil filler cap gasket (1).

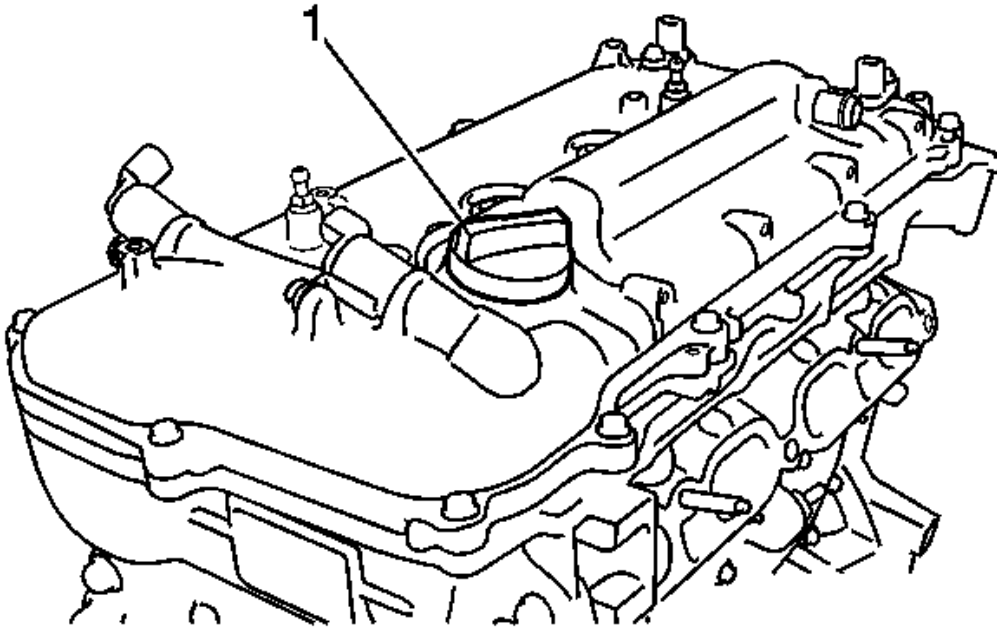


Fig. 128: Identifying Oil Filler Cap
Courtesy of GENERAL MOTORS CORP.

13. Install the oil filler cap (1).
14. Install the engine cover. Refer to **Engine Cover Replacement**.

CYLINDER HEAD REPLACEMENT

REMOVAL PROCEDURE

1. Remove the engine assembly with transaxle. Refer to **Engine Replacement**.
2. Install the engine stand.
3. Remove the intake manifold.
4. Disconnect the fuel tube assembly.
5. Remove the fuel delivery pipe assembly.
6. Remove the fuel injector assembly.
7. Remove the ignition coil assembly.
8. Remove the oil level dipstick assembly. Refer to **Oil Level Indicator and Tube Removal**.
9. Remove the exhaust manifold. Refer to **Exhaust Manifold Removal**.
10. Remove the ventilation hose.

11. Remove the water by-pass hoses.
12. Remove the water by-pass pipe.
13. Remove the inlet water hose.
14. Remove the thermostat.
15. Remove the radio setting condenser.
16. Remove the cylinder head cover assembly. Refer to Camshaft Cover Removal.

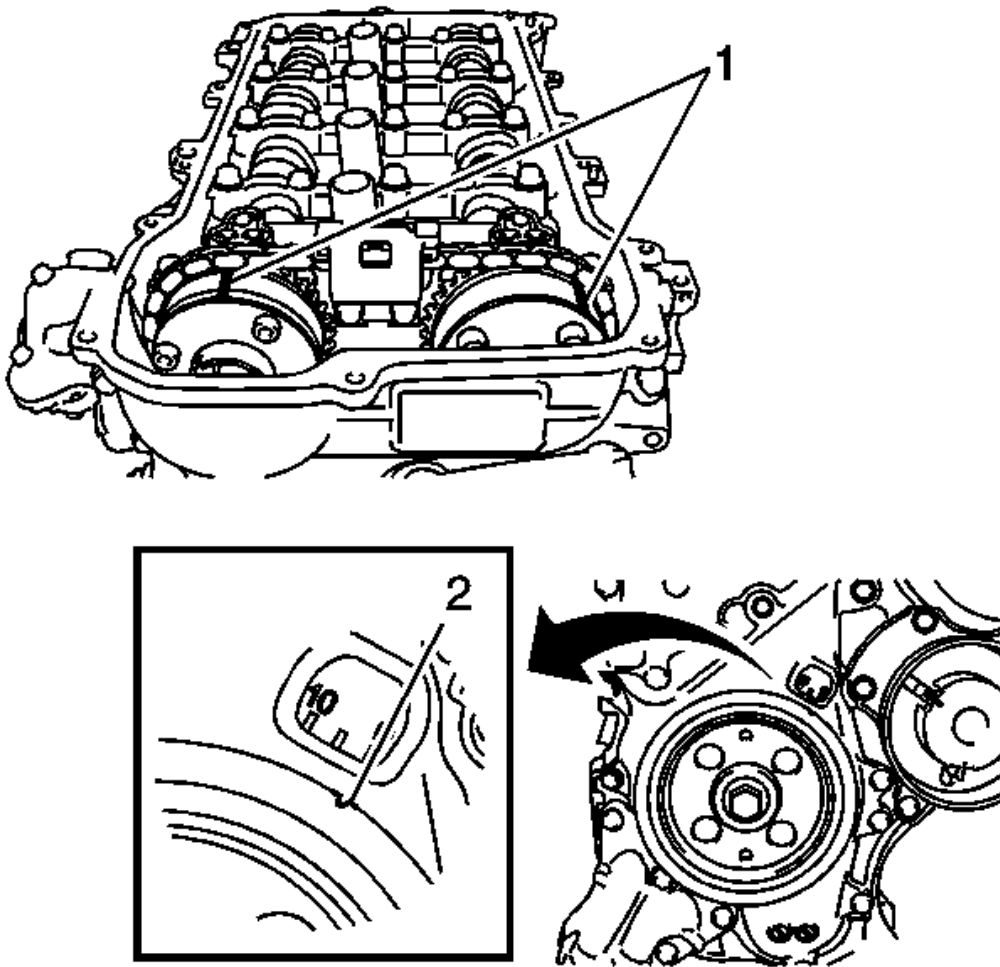


Fig. 129: Setting No. 1 Cylinder To TDC/Compression Stroke
Courtesy of GENERAL MOTORS CORP.

17. Set the No. 1 cylinder to TDC/compression.
 1. Turn the crankshaft pulley until its groove and the timing mark 0 of the timing chain cover (2) are

aligned.

2. Check that each timing mark of the camshaft timing gear (1) and sprocket are aligned with each timing mark located on the bearing caps as shown in the illustration. If not, turn the crankshaft by 1 revolution, 360 degrees, to align the timing marks as above.
18. Remove the crankshaft pulley.
19. Remove the chain tensioner assembly. Refer to **Timing Chain Tensioner Removal**.
20. Remove the timing chain cover assembly. Refer to **Timing Chain Housing Removal**.
21. Remove the timing chain cover oil seal.

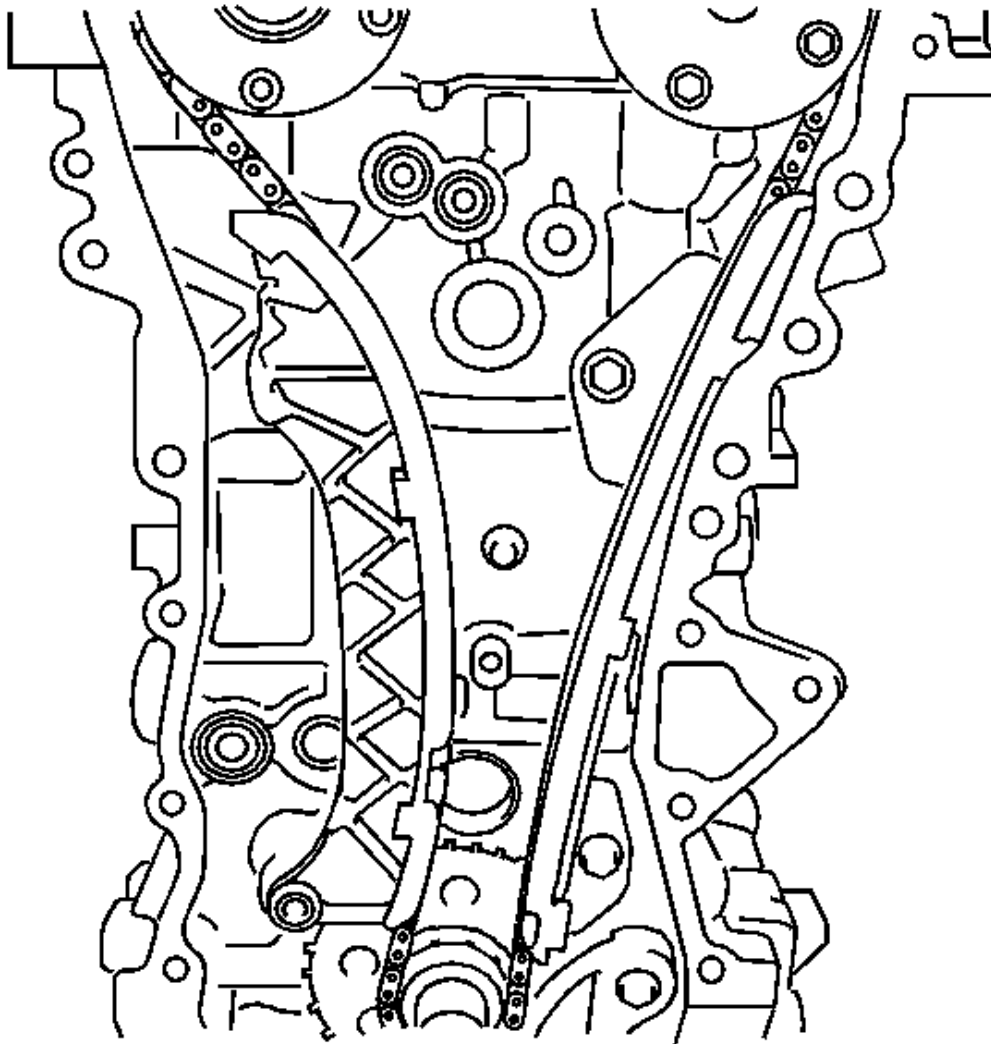


Fig. 130: Identifying Timing Chain Tensioner Slipper
Courtesy of GENERAL MOTORS CORP.

22. Remove the chain tensioner slipper.

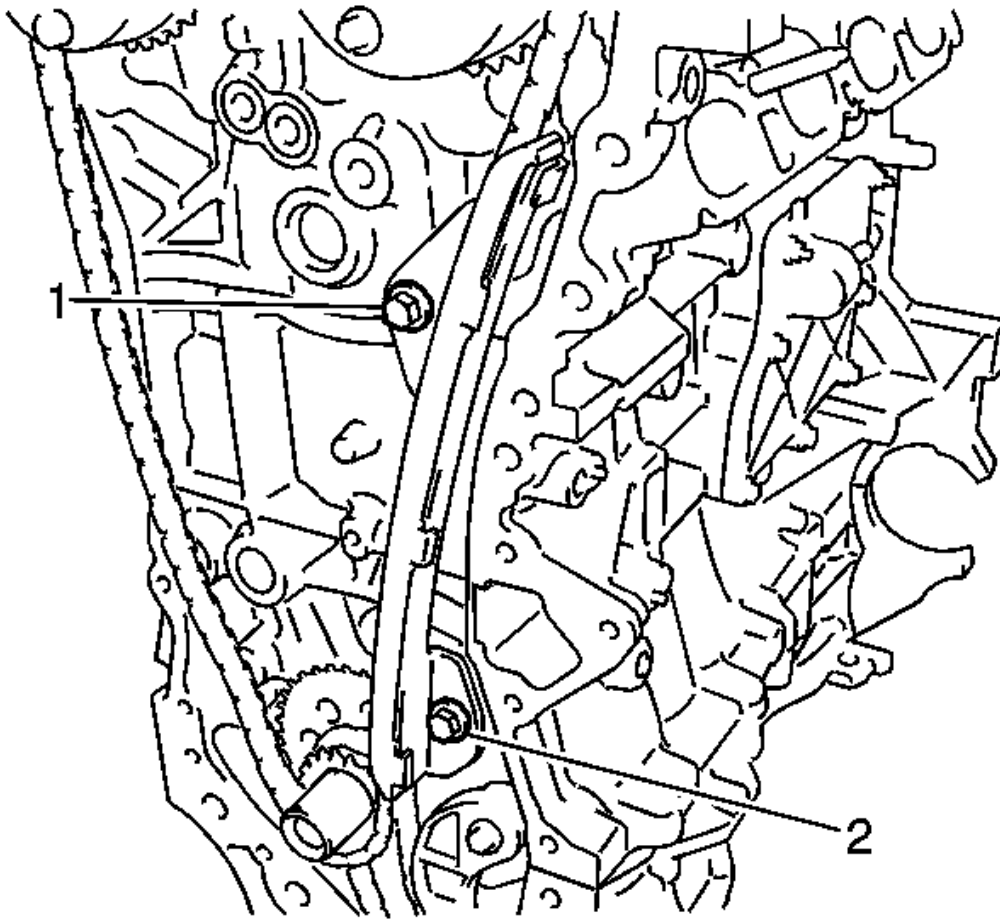


Fig. 131: Identifying Timing Chain Damper
Courtesy of GENERAL MOTORS CORP.

23. Remove the 2 bolts (1, 2) and chain vibration damper.

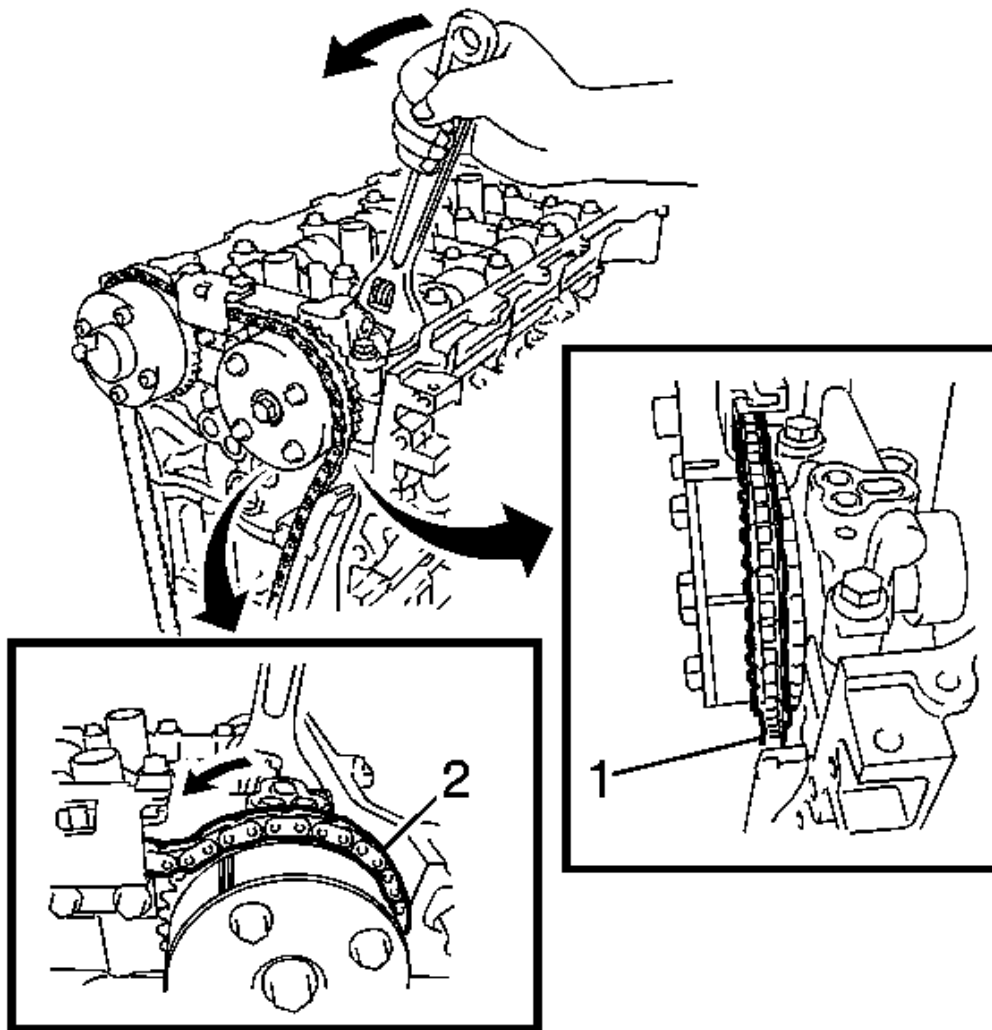


Fig. 132: View Of Timing Chain Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

24. Hold the hexagonal portion of the camshaft with a wrench and turn the camshaft timing gear assembly counterclockwise to loosen the chain (1) between the camshaft timing gears.

NOTE: Be sure to release the chain from the sprocket completely.

25. With the chain loosened, release the chain from the camshaft timing gear assembly and place it on the camshaft timing gear assembly (2).
26. Turn the camshaft clockwise to return it to the original position and remove the chain.

27. Remove the chain vibration damper.
28. Remove the intake camshaft. Refer to Intake Camshaft and Valve Lifter Removal .
29. Remove the exhaust camshaft. Refer to Exhaust Camshaft and Valve Lifter Removal .

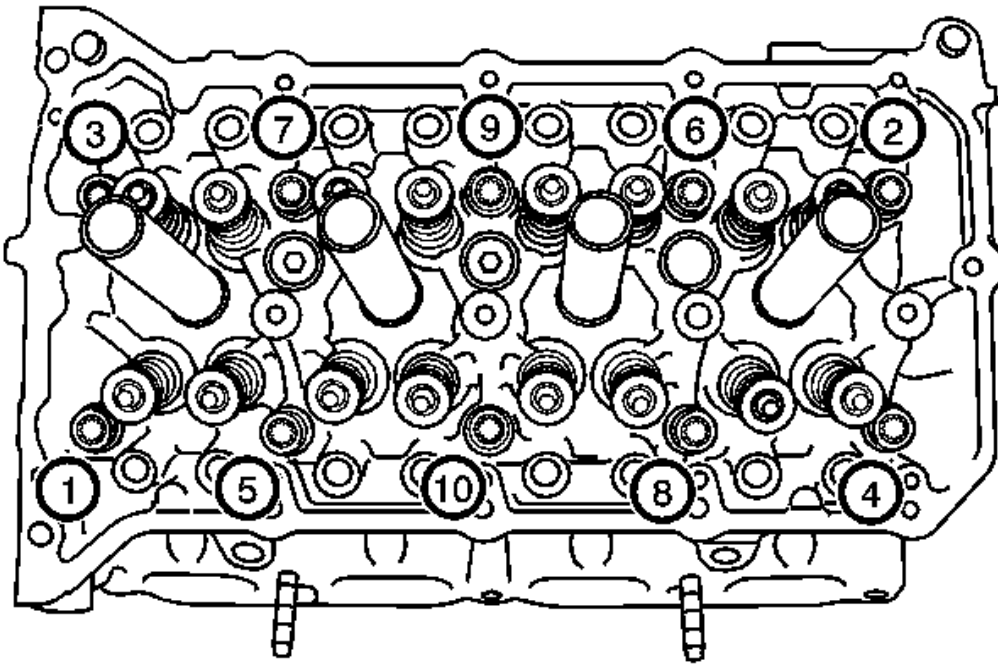


Fig. 133: Identifying Cylinder Head Bolt Loosening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: Head warpage or cracking could result from removing the bolts in the wrong order.

30. Using several steps, uniformly loosen and remove the 10 cylinder head bolts and 10 plate washers with a 10 mm bi-hexagon wrench in the sequence shown.
31. Using a screwdriver with its tip wrapped with tape, pry between the cylinder head and cylinder block, and remove the cylinder head.

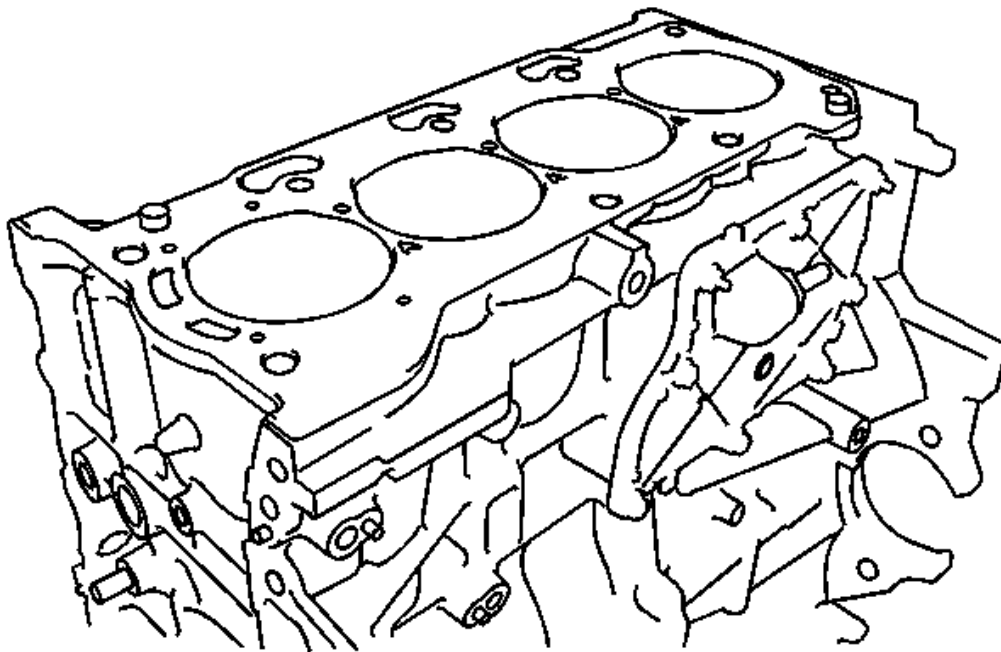


Fig. 134: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

32. Remove the cylinder head gasket.
33. Inspect the cylinder head set bolt.

INSTALLATION PROCEDURE

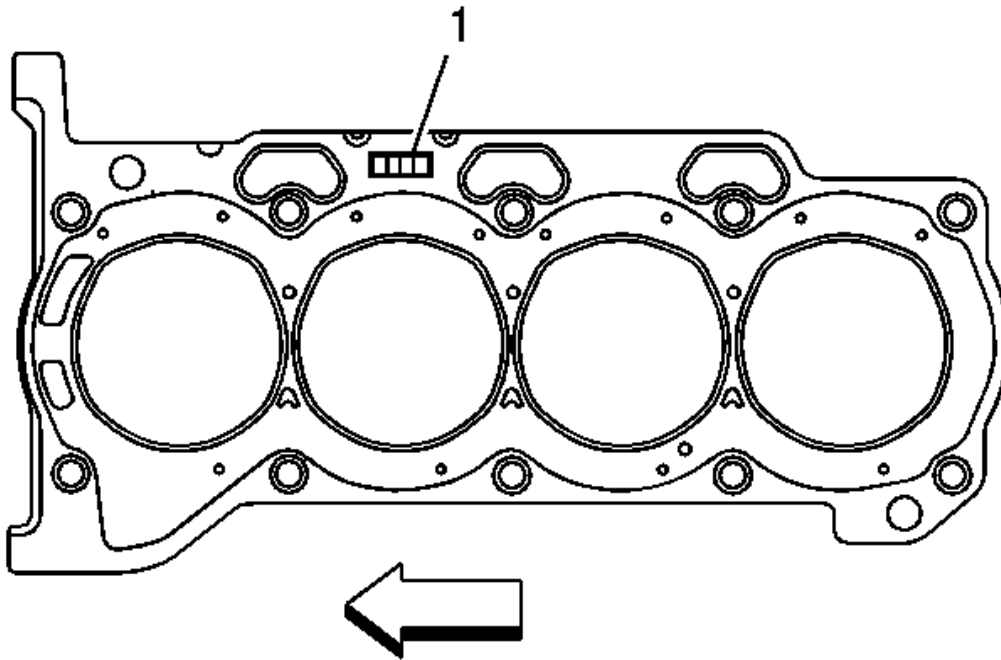


Fig. 135: Identifying Cylinder Block Contact Surface
 Courtesy of GENERAL MOTORS CORP.

NOTE:

- Remove any oil from the contact surface.
- Make sure that the gasket is installed in the correct direction.

1. Install cylinder head gasket.
2. Place a new gasket on the cylinder block surface with the Lot No. stamp (1) facing upward.

NOTE:

The cylinder head bolts are tightened in 2 progressive steps.

3. Install the cylinder head assembly.
4. Apply a light coat of engine oil to the bolt threads and the area beneath the bolt heads that come in contact with the washers.
5. Install the bolts and plate washers to the cylinder head.

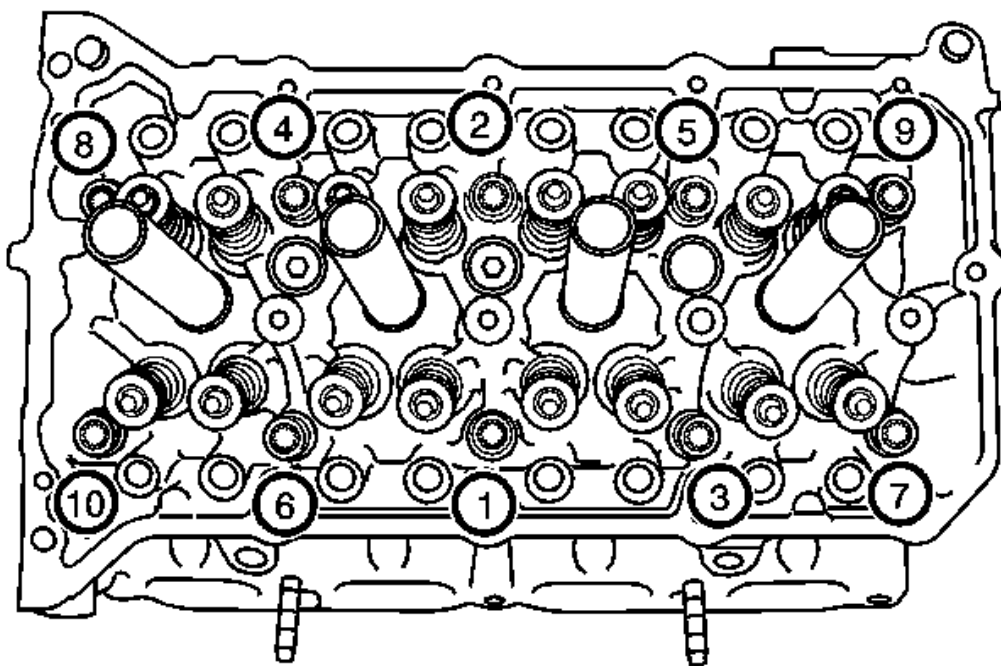


Fig. 136: Identifying Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

6. Using several passes, with a 10 mm bi-hexagon wrench, uniformly install and tighten the 10 cylinder head set bolts and plate washers in the order shown and tighten to 49 N.m (36 lb ft).

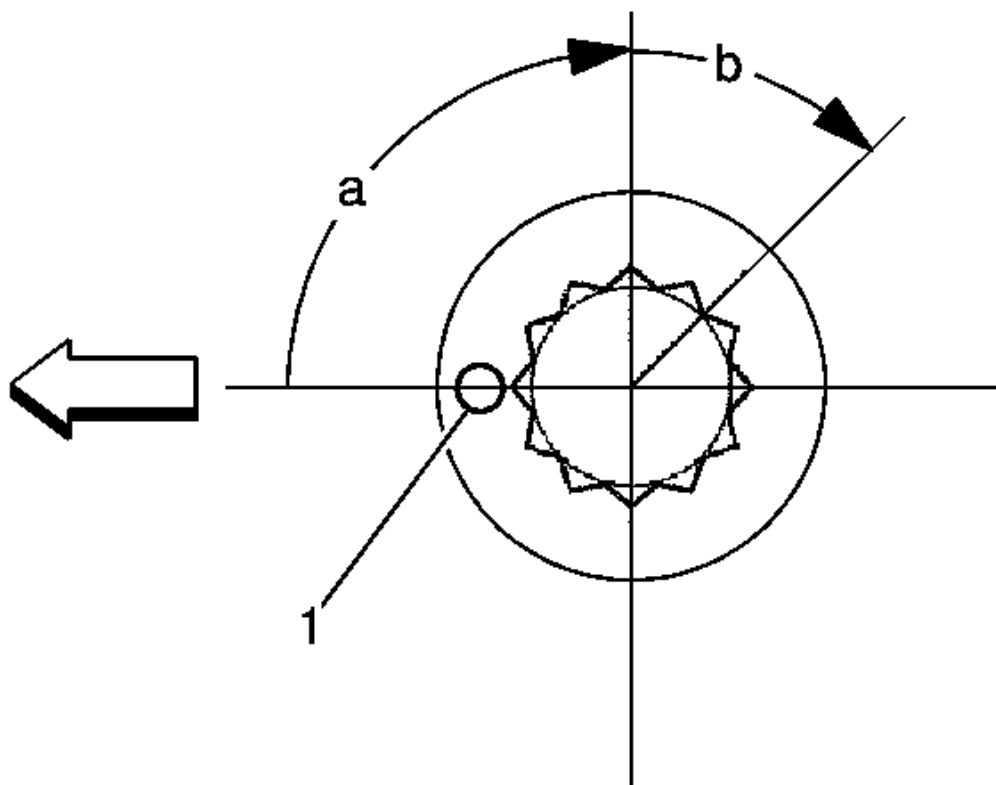


Fig. 137: Marking Front Side Of Cylinder Head Bolts
Courtesy of GENERAL MOTORS CORP.

7. Mark the front side of the cylinder head bolts with paint (1).
8. Retighten the cylinder head bolts an additional 90 degrees (a), then once more 45 degrees (b) as shown in the illustration.
9. Check that the paint mark is now at a 135 degrees angle to the front.
10. Install the exhaust camshaft. Refer to **Exhaust Camshaft and Valve Lifter Installation** .
11. Install the intake camshaft. Refer to **Intake Camshaft and Valve Lifter Installation** .

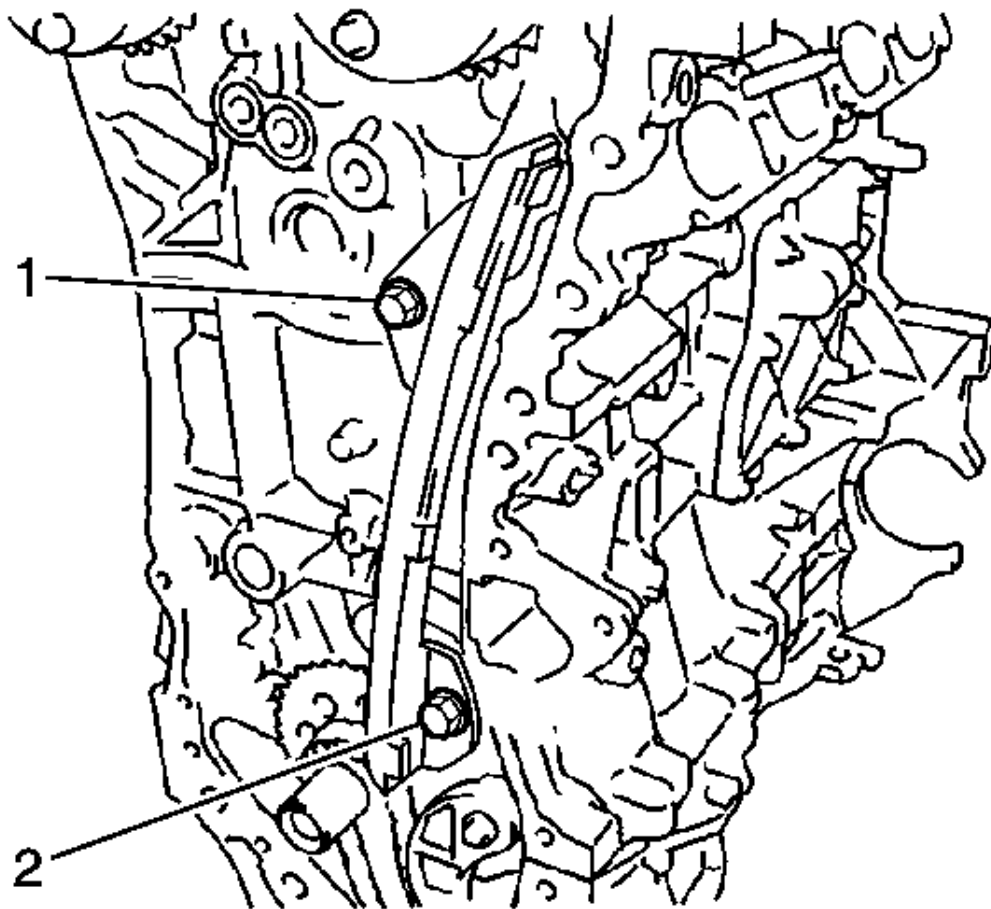


Fig. 138: Identifying No. 1 Chain Vibration Damper
Courtesy of GENERAL MOTORS CORP.

12. Install the No 1 chain vibration damper with the 2 bolts (1, 2) and tighten to 21 N.m (16 lb ft).
13. Install the chain vibration damper.
14. Install the chain assembly.
15. Check the No. 1 cylinder TDC/compression.
16. Hand tighten the crankshaft pulley bolt.

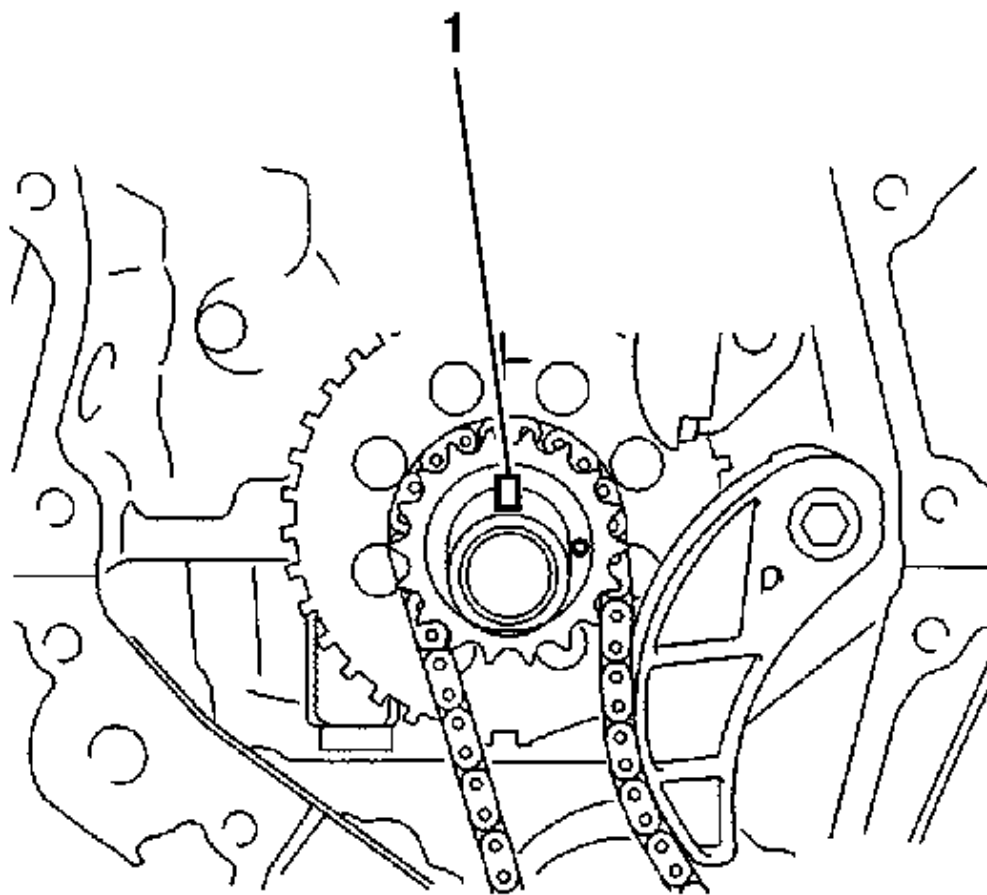


Fig. 139: Identifying Timing Gear Key
Courtesy of GENERAL MOTORS CORP.

17. Turn the crankshaft counterclockwise to position the timing gear key (1) to the top.
18. Remove the crankshaft pulley bolt.

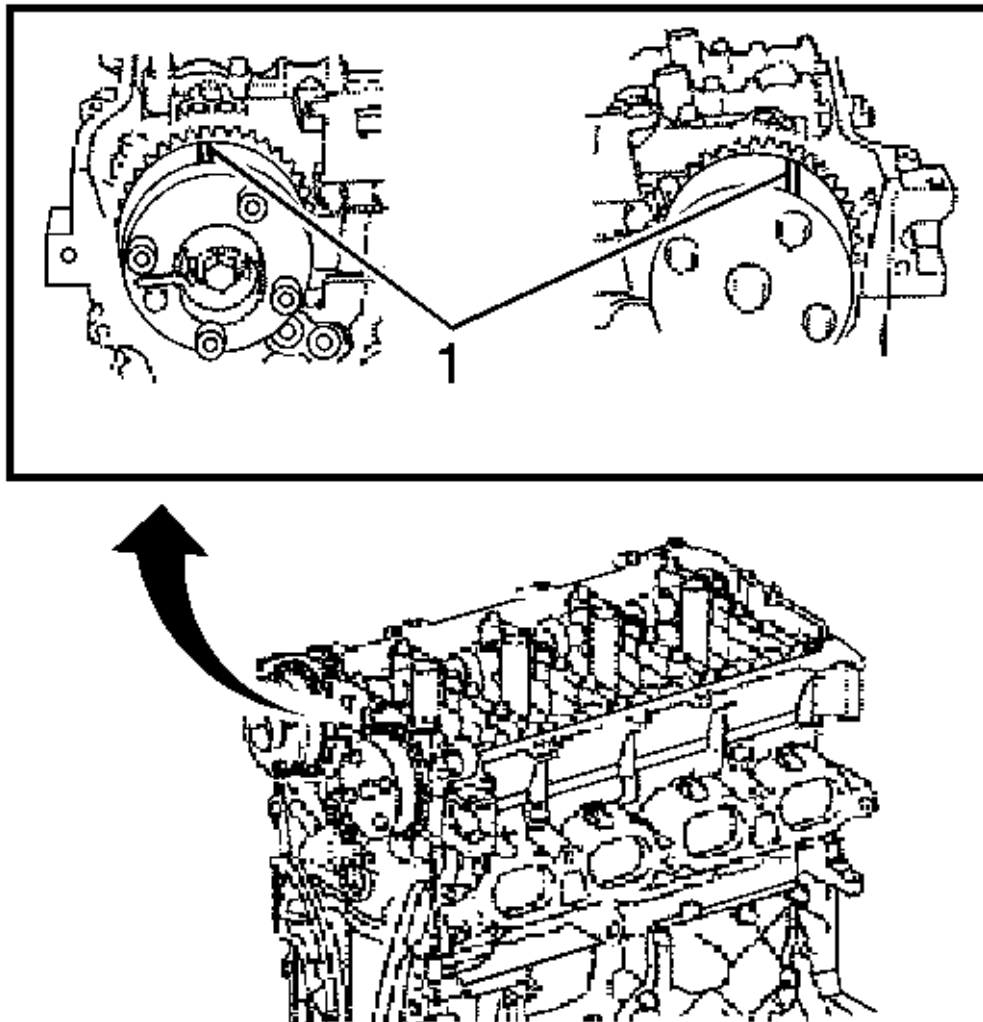


Fig. 140: Checking Timing Marks On Each Camshaft Timing Gear
Courtesy of GENERAL MOTORS CORP.

19. Check the timing marks (1) on each camshaft timing gear.

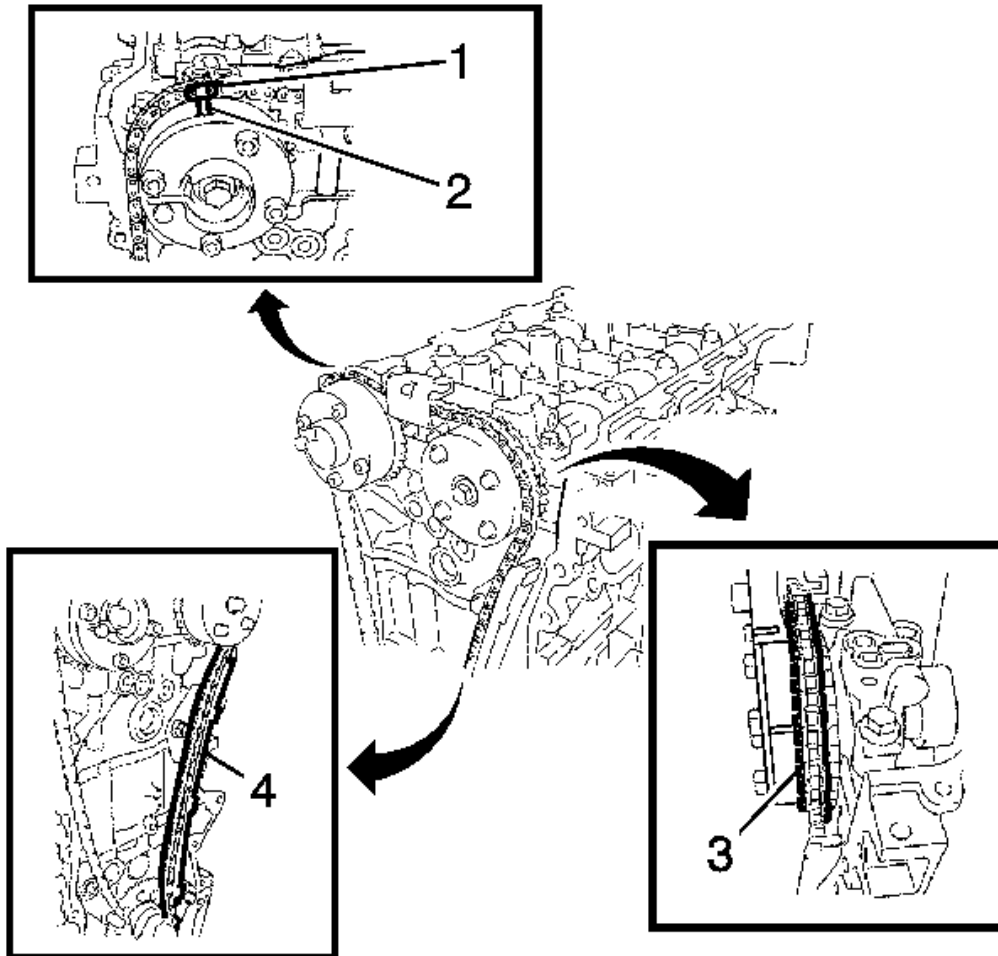


Fig. 141: Positioning Timing Marks
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Be sure to position the mark plate at the front of the engine.
- The mark plate on the camshaft side is colored orange.
- Do not pass the chain around the sprocket of the camshaft timing gear assembly. Only place it on the sprocket.
- Pass the chain through the vibration damper (4)

20. Align the mark plate (1), orange, with the timing mark as shown in the illustration and install the chain.

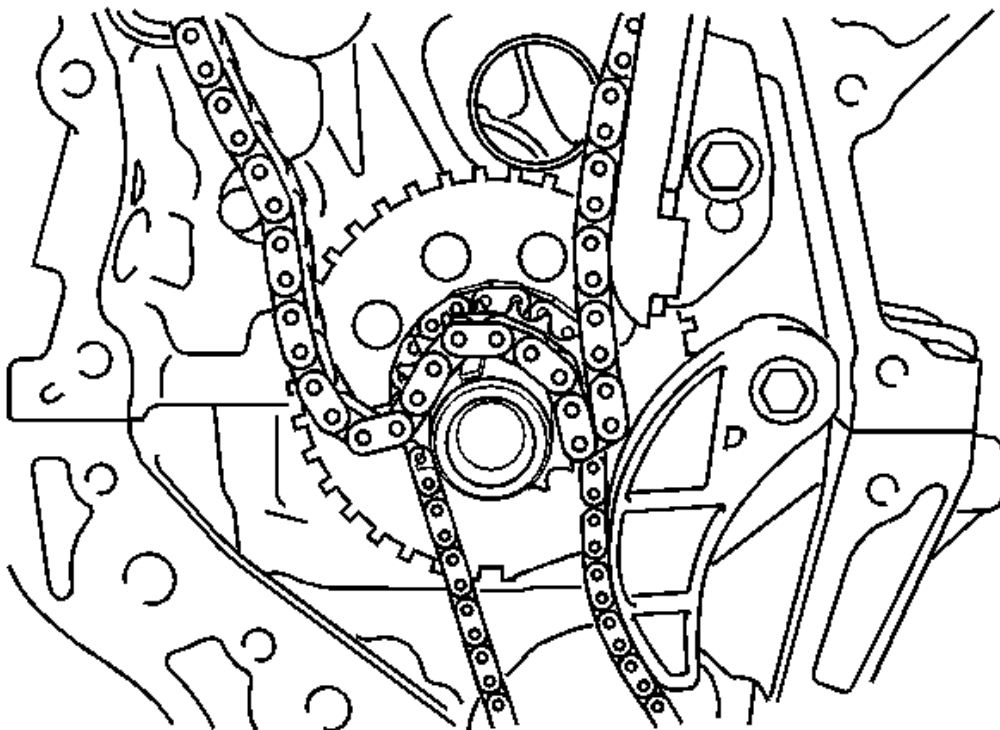


Fig. 142: Placing Chain On Crankshaft
Courtesy of GENERAL MOTORS CORP.

21. Place the chain on the crankshaft without passing it around the shaft.

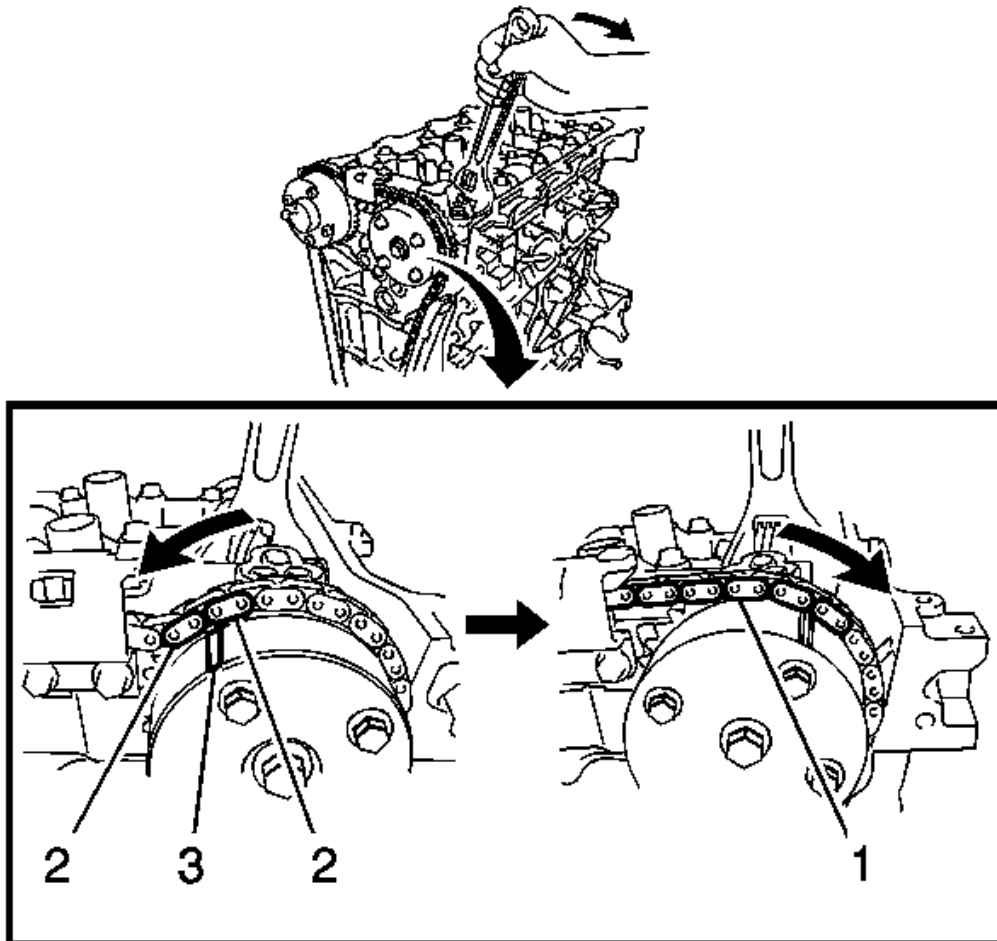


Fig. 143: Aligning Mark Plates

Courtesy of GENERAL MOTORS CORP.

NOTE:

- Be sure to position the mark plate at the front of the engine.
- The mark plate on the camshaft side is colored orange.

22. Hold the hexagonal portion of the camshaft with a wrench and turn the camshaft timing gear assembly counterclockwise to align the mark plate, orange (2), and timing mark (3).

NOTE:

To tension the chain, slowly turn the camshaft timing gear assembly clockwise to prevent the chain from being misaligned.

23. Hold the hexagonal portion of the camshaft with a wrench and turn the camshaft timing gear assembly

clockwise.

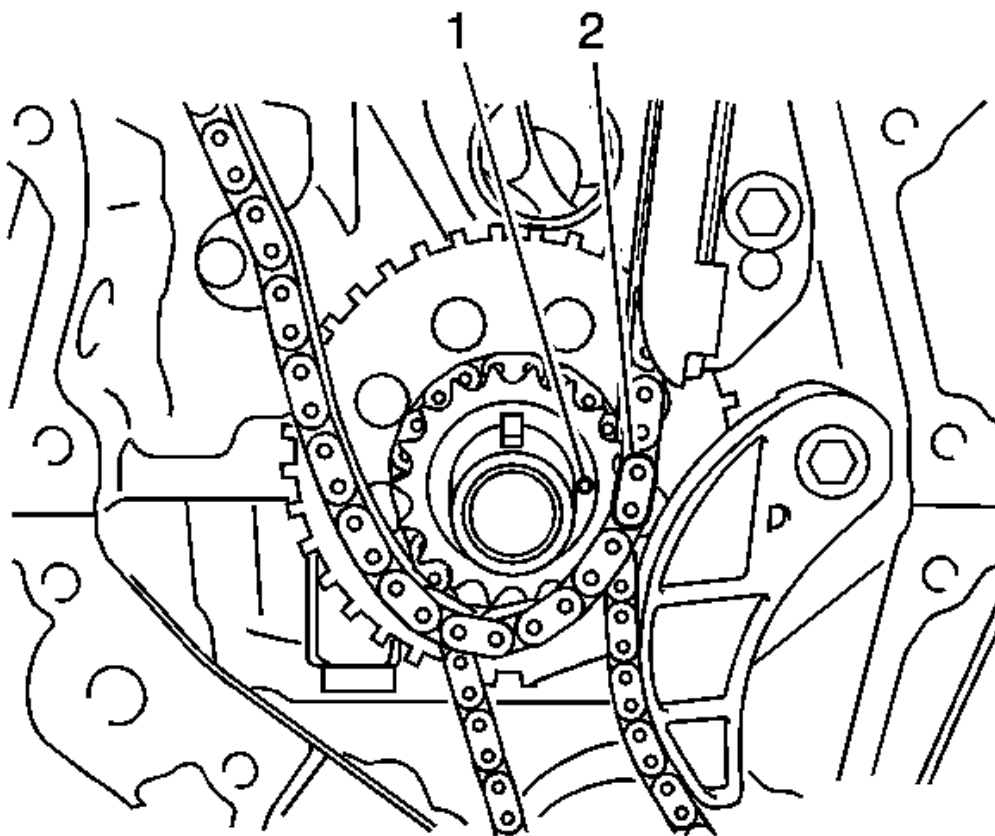


Fig. 144: Aligning Marks On Crankshaft Plate
Courtesy of GENERAL MOTORS CORP.

NOTE: The mark plate on the crankshaft side is colored yellow.

24. Align the mark plate (2), yellow, and timing mark (1) and install the chain to the crankshaft timing gear.

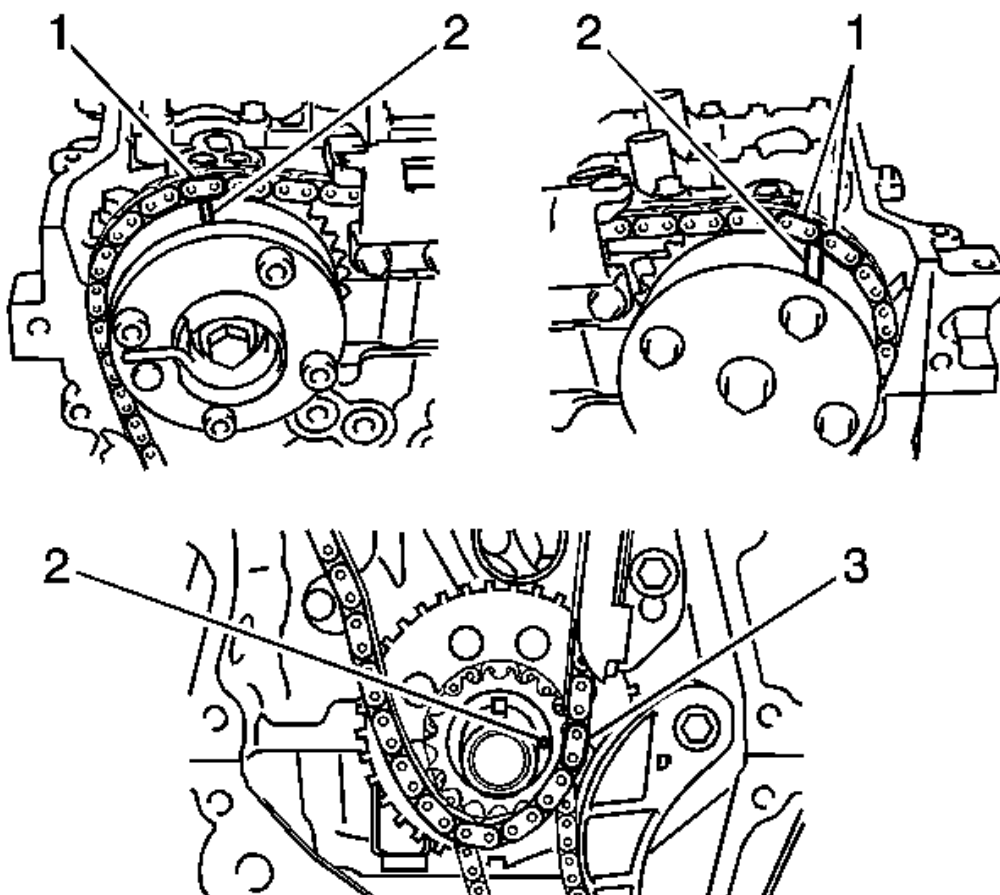


Fig. 145: Checking Timing Marks
Courtesy of GENERAL MOTORS CORP.

25. Recheck each timing mark (1, 2, 3) at TDC/compression.

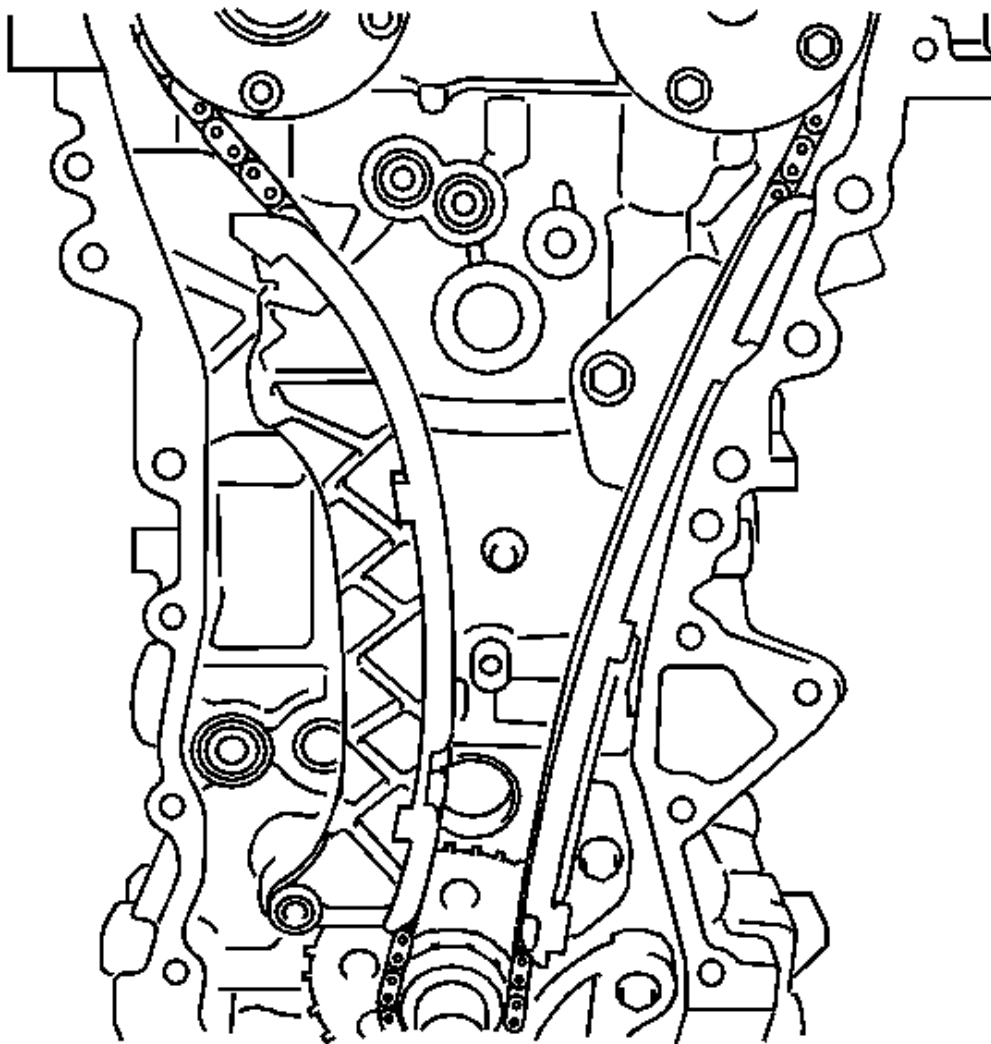


Fig. 146: Identifying Timing Chain Tensioner Slipper
Courtesy of GENERAL MOTORS CORP.

26. Install the chain tensioner slipper.
27. Install the timing chain cover assembly. Refer to **Timing Chain Housing Installation** .
28. Install the crankshaft pulley.
29. Install the chain tensioner assembly. Refer to **Timing Chain Tensioner Installation** .
30. Install the cylinder head cover assembly. Refer to **Camshaft Cover Installation** .
31. Install the radio setting condenser.

32. Install the thermostat.
33. Install the inlet water.
34. Install the inlet water hose.
35. Install the water by-pass hoses.
36. Install the water by-pass pipe.
37. Install the ventilation hose.
38. Install the exhaust manifold. Refer to **Engine Flywheel Installation** .
39. Install the oil level dipstick assembly. Refer to **Oil Level Indicator and Tube Installation** .
40. Install the ignition coil assembly.
41. Install the fuel injector assembly.
42. Install the delivery pipe spacer.
43. Install the fuel delivery pipe assembly.
44. Install the fuel tube assembly.
45. Install the intake manifold. Refer to **Intake Manifold Installation** .
46. Remove the engine stand.
47. Install the engine assembly with transaxle. Refer to **Engine Replacement**.

OIL PUMP REPLACEMENT

REMOVAL PROCEDURE

1. Remove the engine assembly with transaxle. Refer to **Engine Replacement**
2. Install the engine stand.
3. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
4. Disconnect the fuel tube assembly.
5. Remove the fuel delivery pipe assembly.
6. Remove the fuel injector assembly.
7. Remove the ignition coil assembly.
8. Remove the oil level dipstick sub-assembly.
9. Remove the exhaust manifold. Refer to **Exhaust Manifold Replacement (1.8L)** .
10. Remove the ventilation hose.
11. Remove the water by-pass pipe.
12. Remove the water by-pass hoses.
13. Remove the inlet water hose.
14. Remove the inlet water.
15. Remove the thermostat.
16. Remove the radio setting condenser.
17. Remove the cylinder head cover. Refer to **Camshaft Cover Replacement**.
18. Set the No. 1 cylinder to TDC/compression.

19. Remove the crankshaft pulley.
20. Remove the chain tensioner assembly.

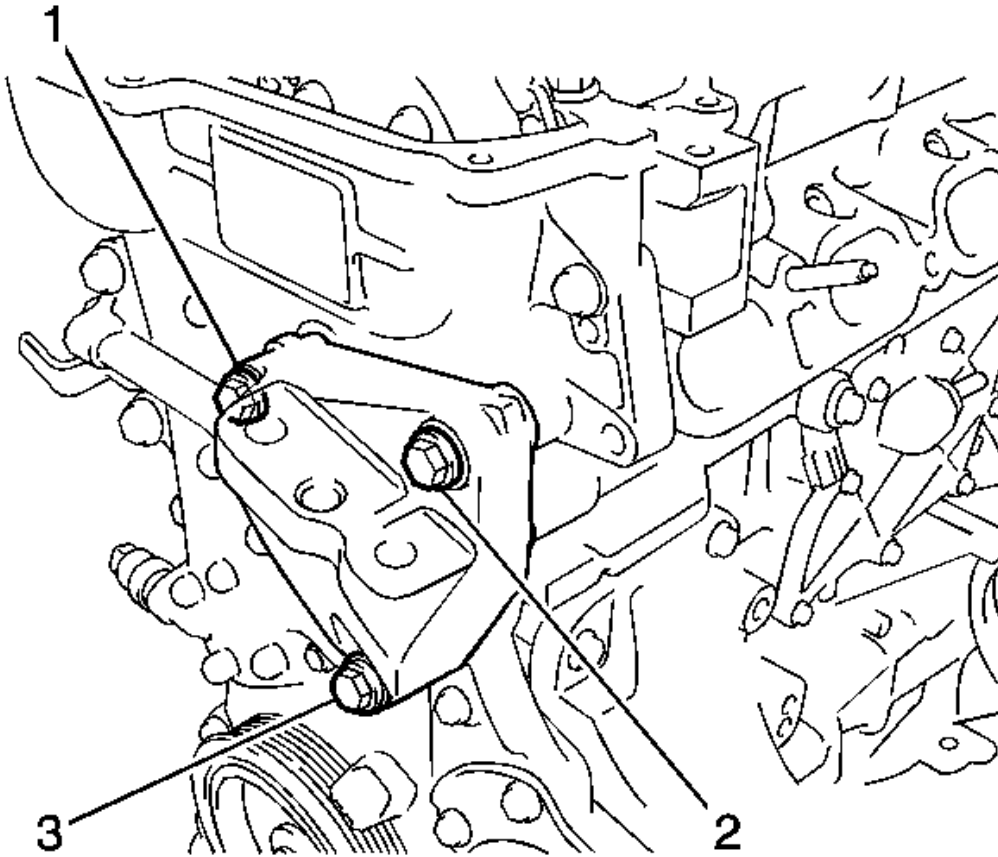


Fig. 147: Identifying Engine Mounting Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

21. Remove the 3 bolts (1-3) and engine mounting bracket.

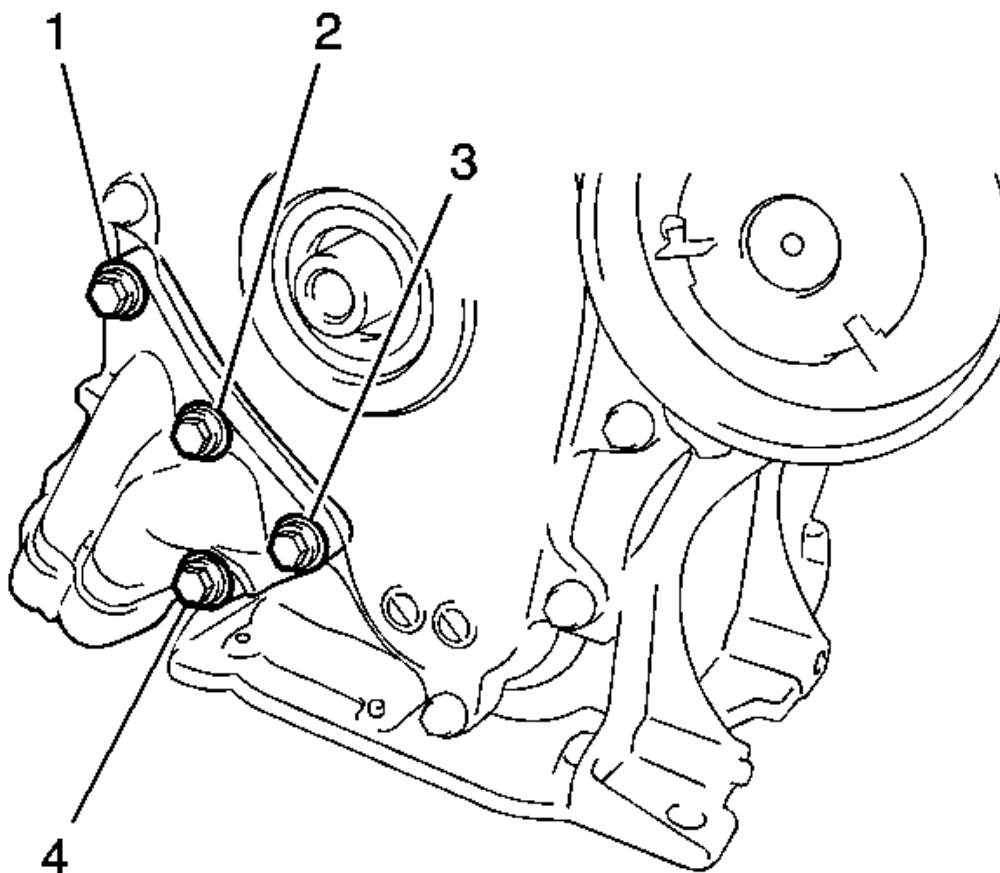


Fig. 148: Identifying Oil Filter Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

22. Remove the 4 bolts (1-4) and oil filter bracket.

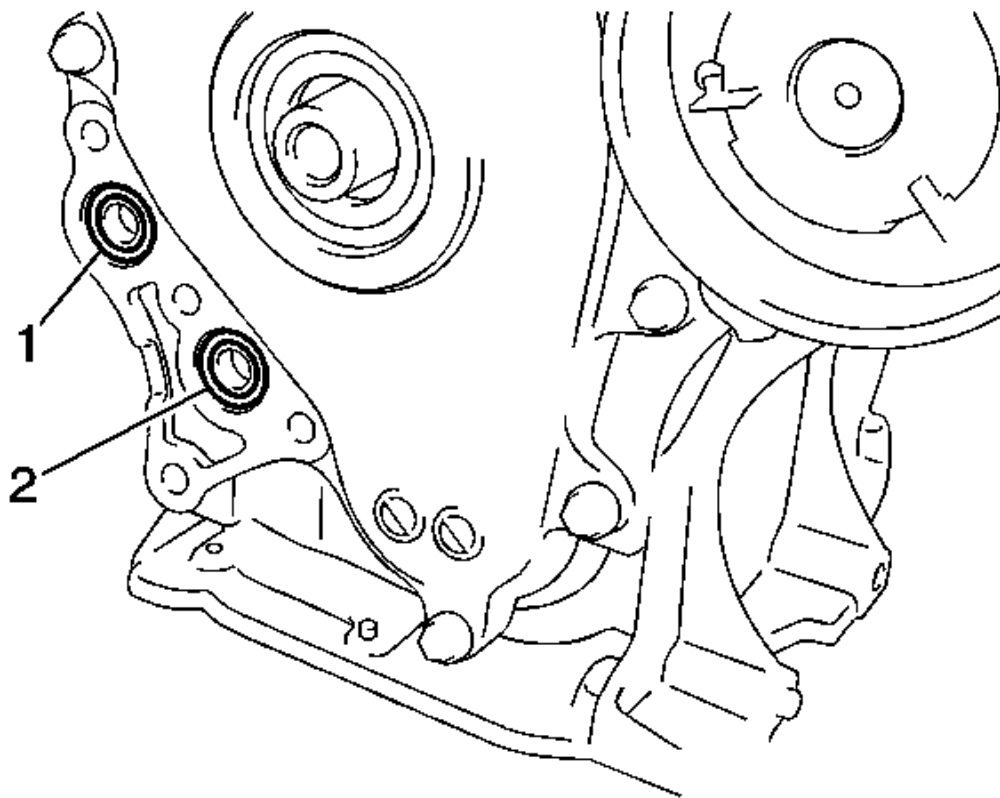


Fig. 149: View Of O-Rings
Courtesy of GENERAL MOTORS CORP.

23. Remove the 2 O-rings (1-2).

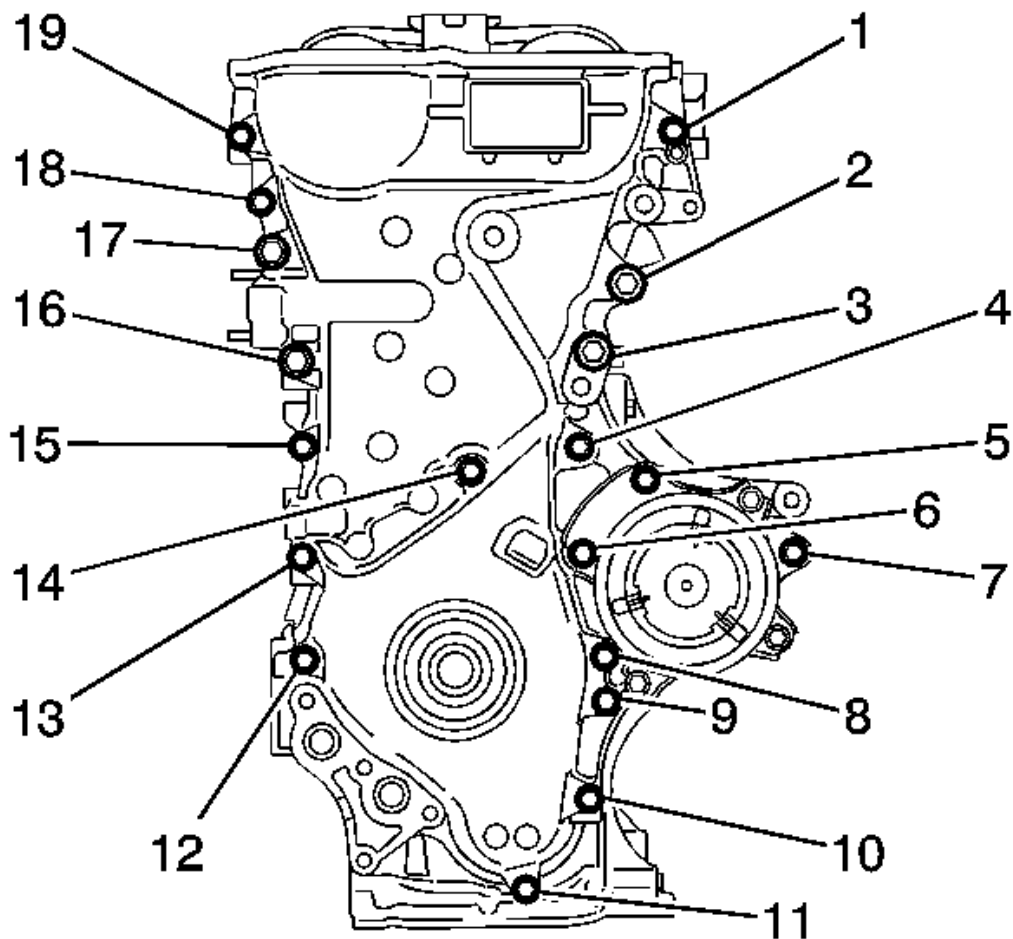


Fig. 150: Identifying Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

24. Remove the 19 bolts (1-19).

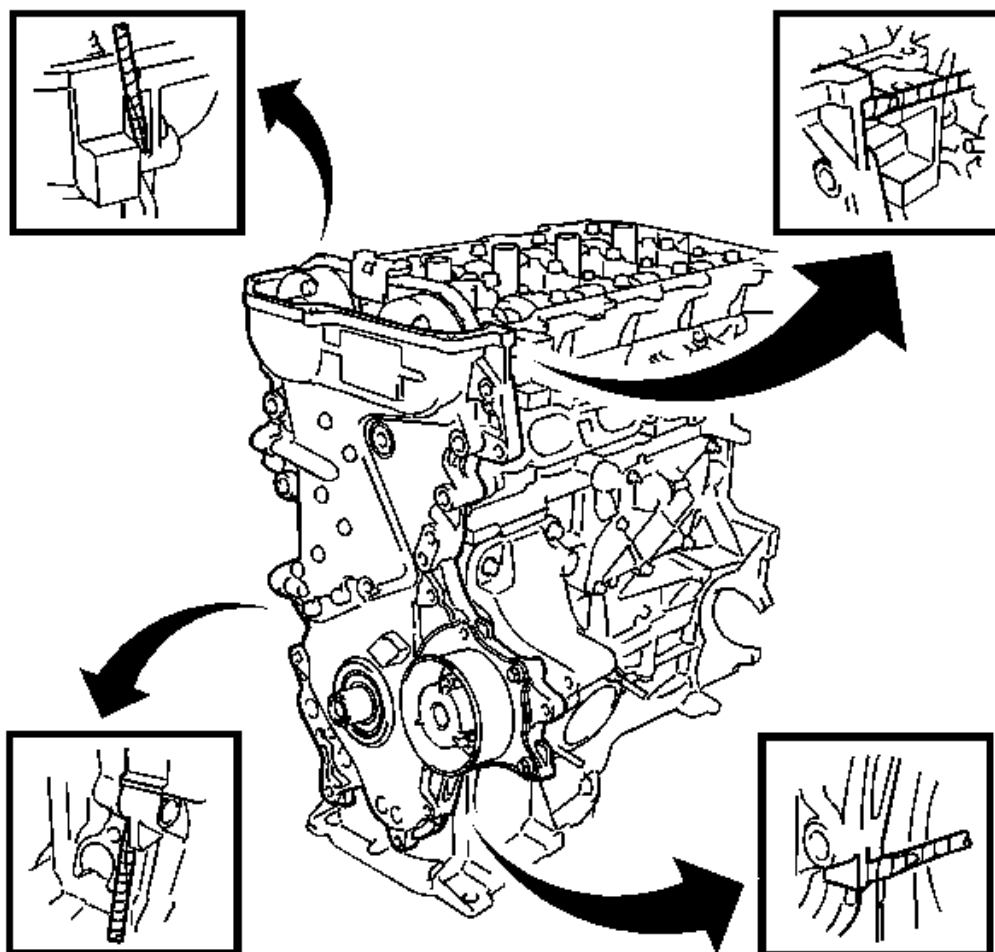


Fig. 151: View Of Timing Chain Cover
Courtesy of GENERAL MOTORS CORP.

NOTE: Tape the screwdriver tip before use.

25. Remove the timing chain cover by prying between the timing chain cover and cylinder head or cylinder block with a screwdriver.

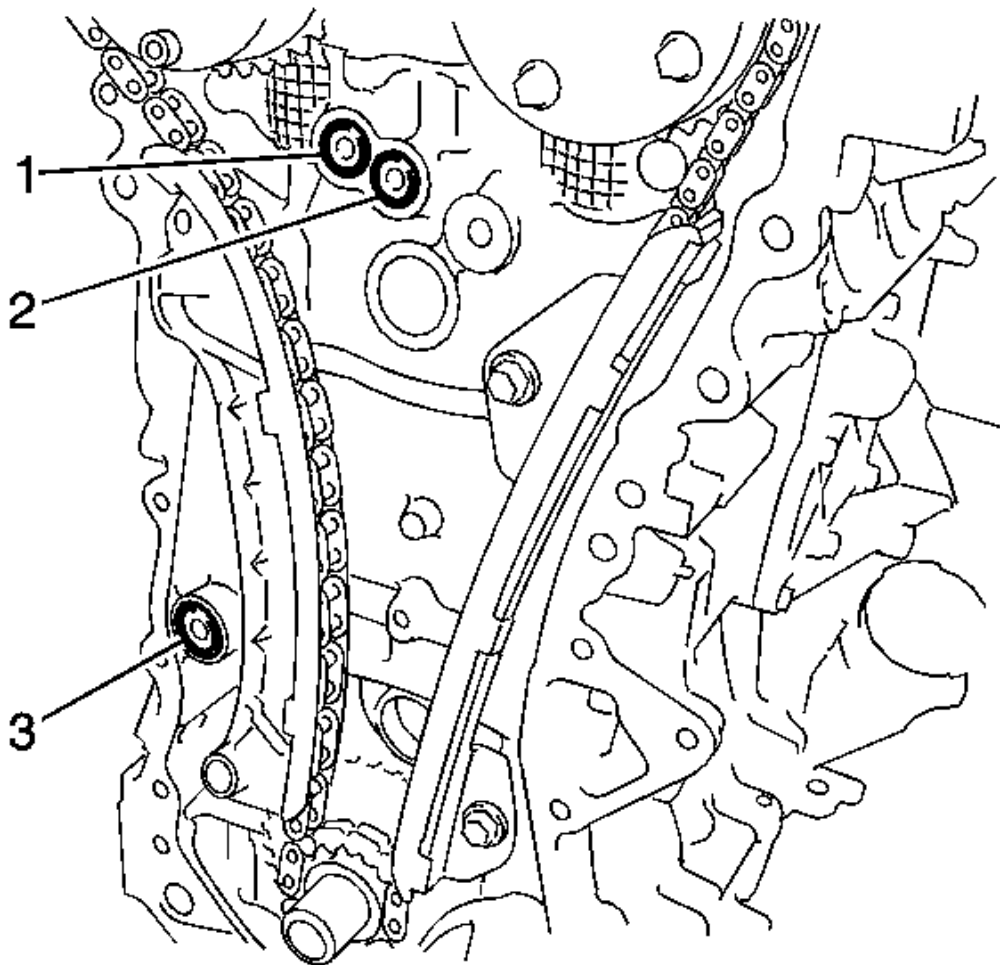


Fig. 152: Locating O-Rings

Courtesy of GENERAL MOTORS CORP.

26. Remove the 3 O-rings (1-3).

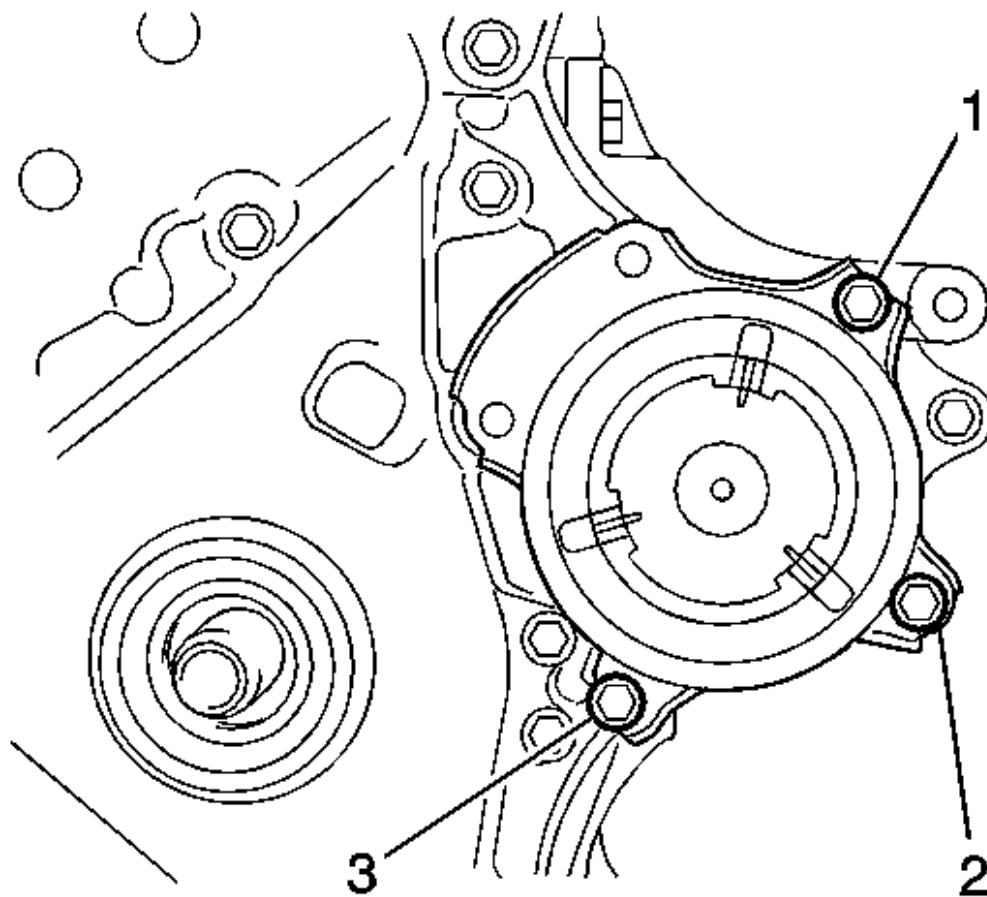


Fig. 153: View Of Water Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

27. Remove the 3 bolts (1-3) and water pump.

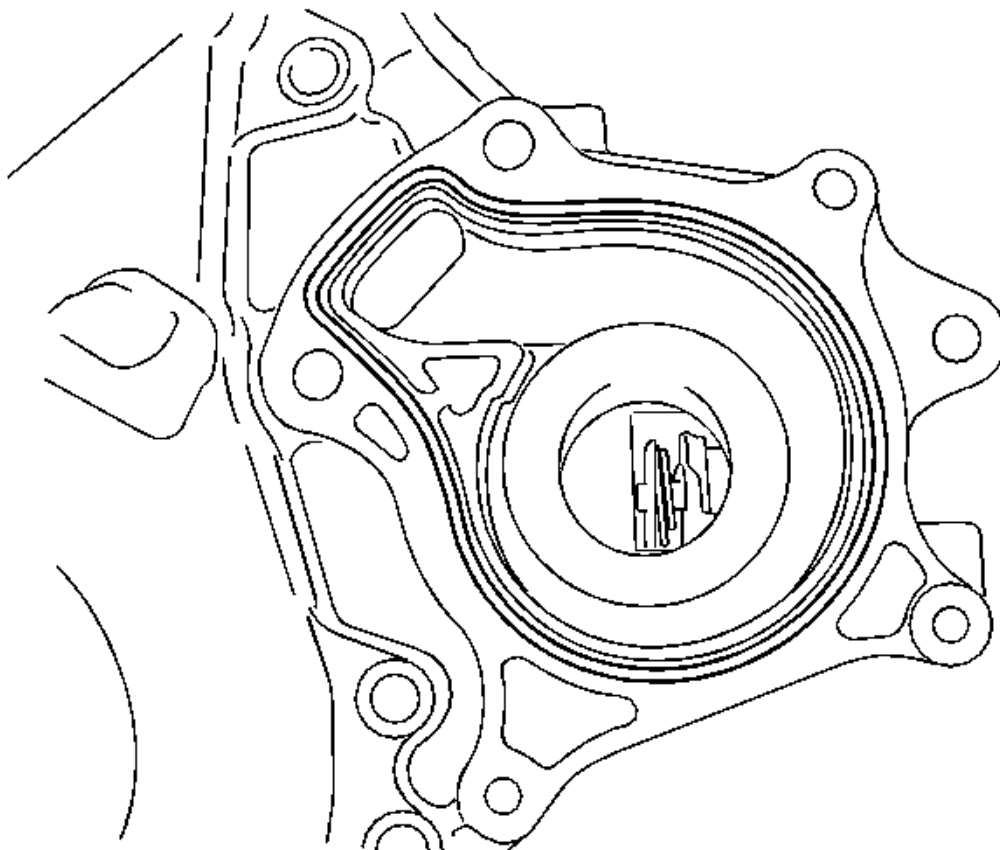


Fig. 154: View Of Water Pump Gasket
Courtesy of GENERAL MOTORS CORP.

28. Remove the gasket.

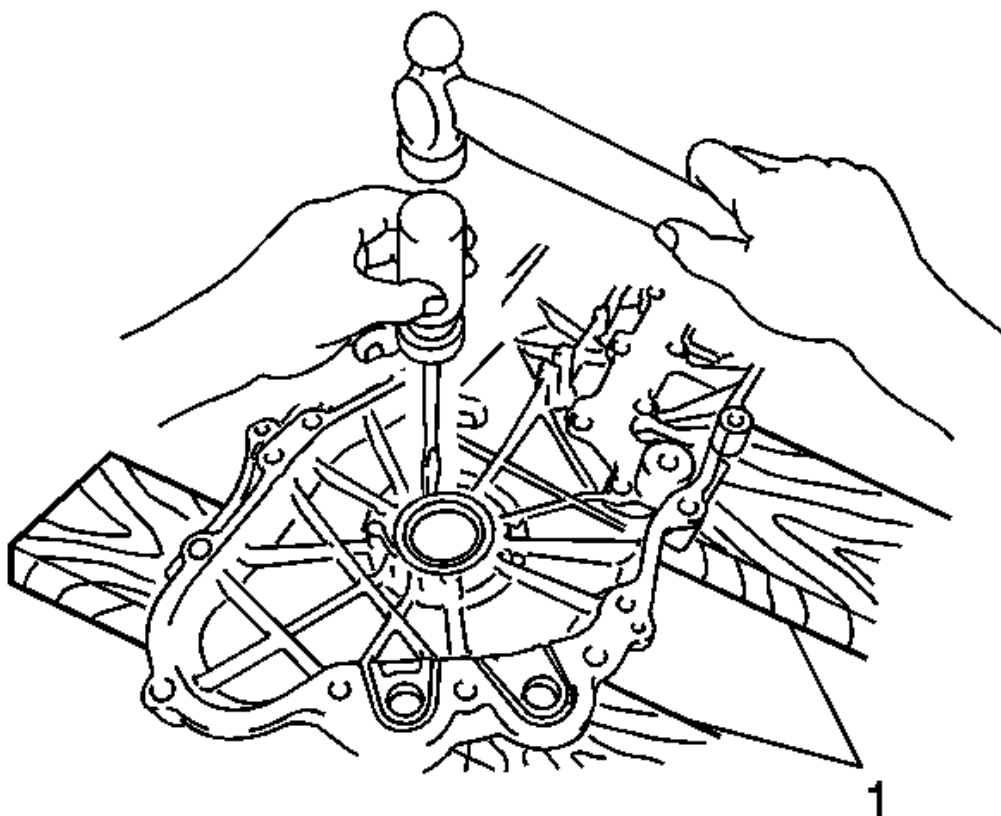


Fig. 155: Removing Chain Cover Seal
Courtesy of GENERAL MOTORS CORP.

29. Place the timing chain cover on wooden blocks (1).

NOTE: **Tape the screwdriver tip before use.**

30. Using a screwdriver, pry out the oil seal.
31. Remove the chain tensioner slipper.
32. Remove the chain vibration damper.
33. Remove the chain assembly.

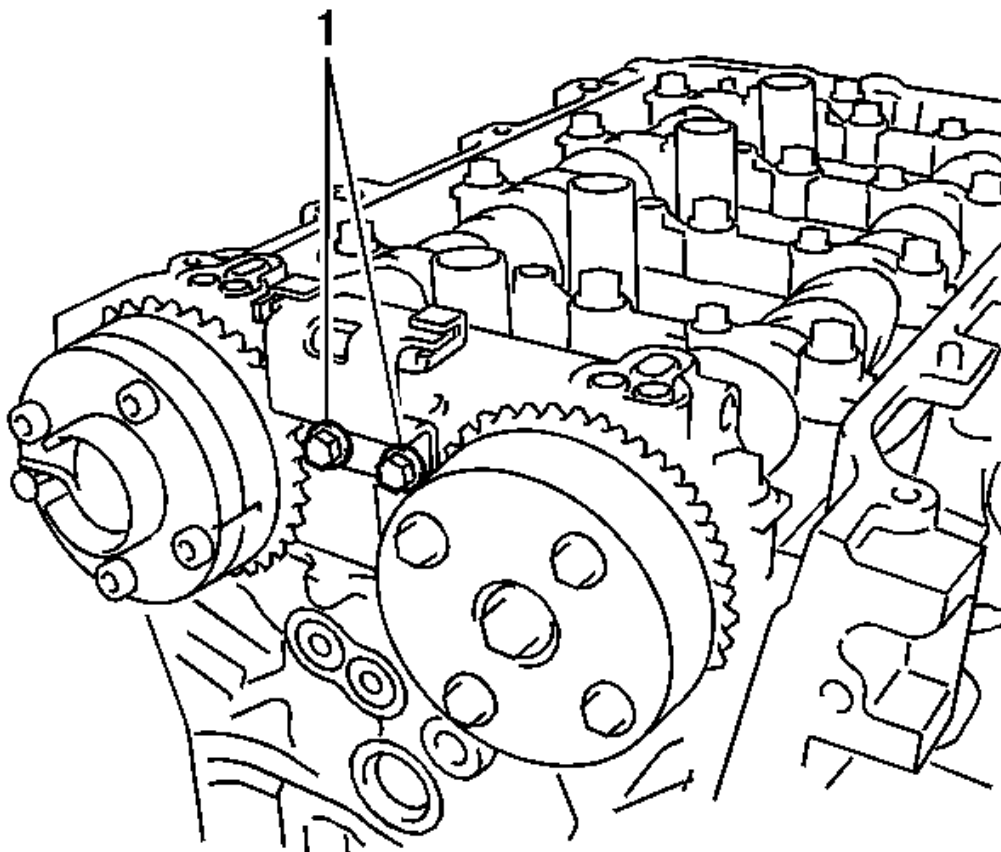


Fig. 156: Identifying Chain Vibration Damper Bolts
Courtesy of GENERAL MOTORS CORP.

34. Remove the 2 bolts (1) and chain vibration damper.
35. Hand tighten the crank pulley bolt.

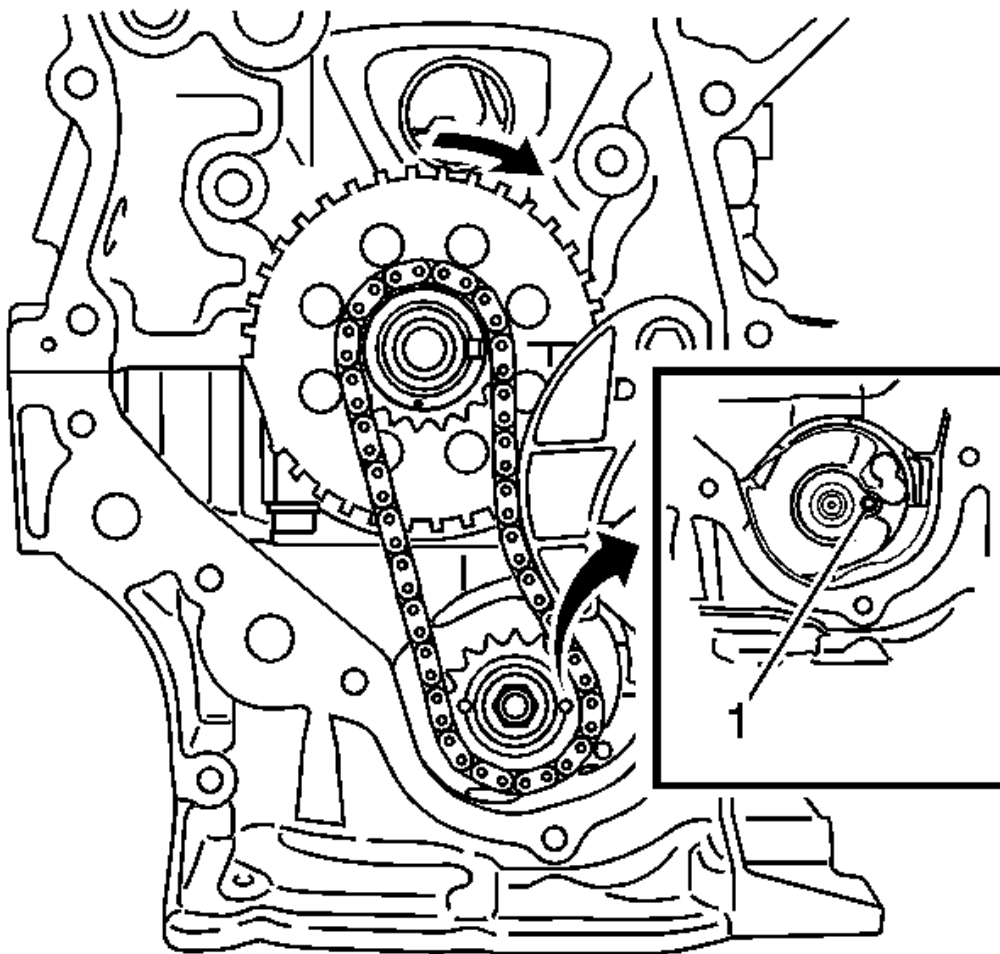


Fig. 157: Aligning Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not rotate the crankshaft more than 90 degrees. If the crankshaft is rotated too much without the timing chain installed, the valves may hit the pistons and cause damage.

36. Turn the crankshaft 90 degrees clockwise to align the adjusting hole (1) of the oil pump drive shaft sprocket with the groove of the oil pump.
37. Remove the crank pulley bolt.

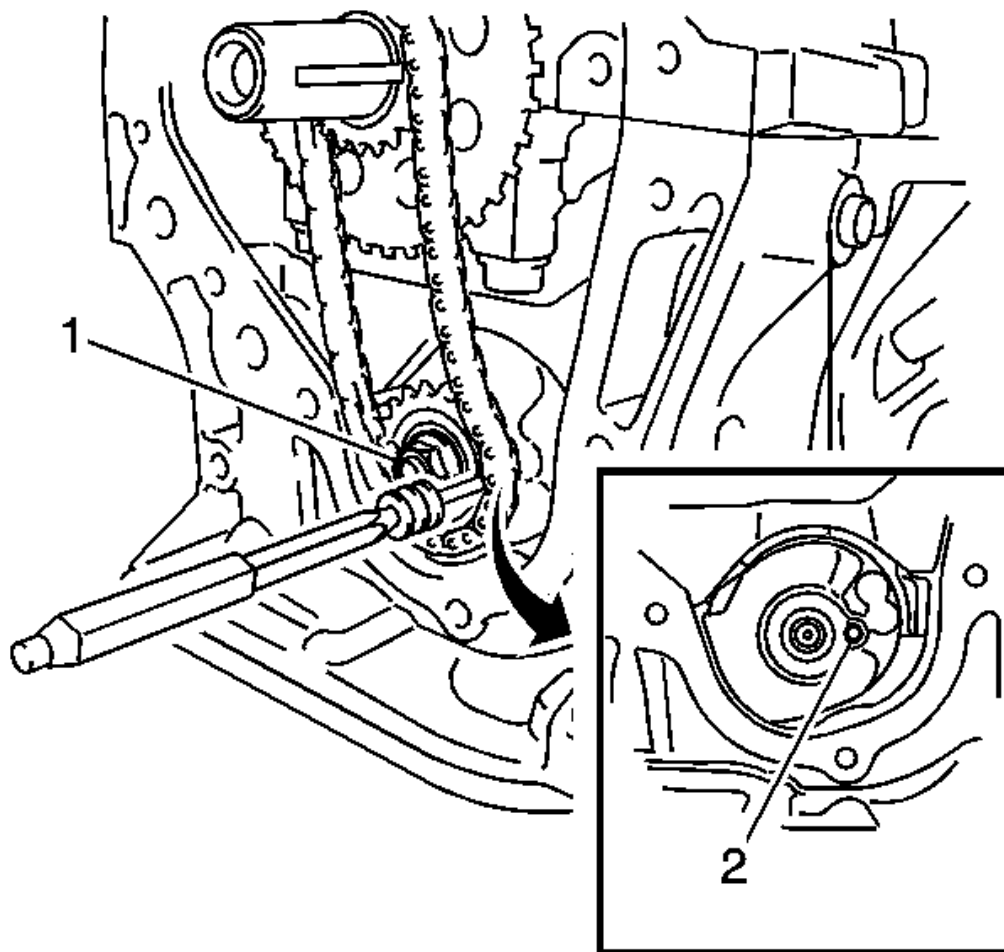


Fig. 158: Identifying Adjusting Hole
Courtesy of GENERAL MOTORS CORP.

38. Insert a pin punch (3 mm) into the adjusting hole (2) of the oil pump drive shaft sprocket (1) to lock the gear in position, and then remove the nut.

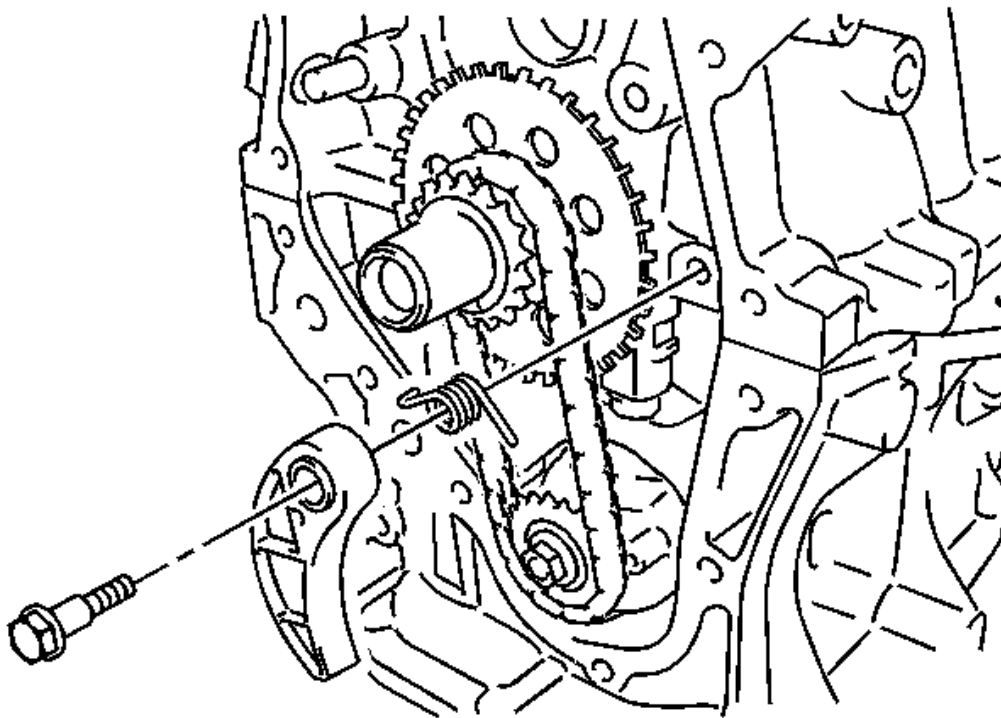


Fig. 159: View Of Chain Tensioner Plate, Spring & Bolt
Courtesy of GENERAL MOTORS CORP.

39. Remove the bolt, chain tensioner plate, and spring.

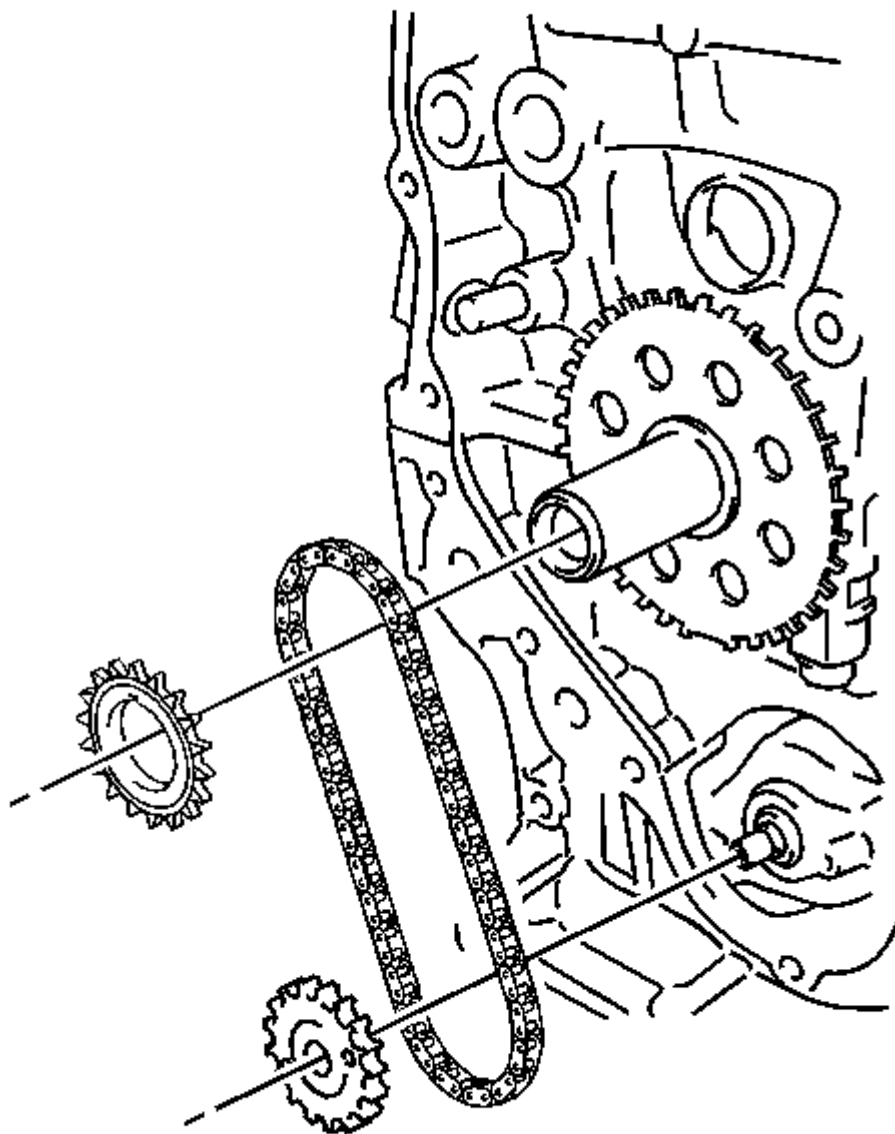


Fig. 160: View Of Crankshaft Timing Sprocket, Oil Pump Drive Shaft Gear & No. 2 Chain
Courtesy of GENERAL MOTORS CORP.

40. Remove the crankshaft timing sprocket, oil pump drive shaft gear, and chain assembly.
41. Remove the crankshaft position sensor plate.

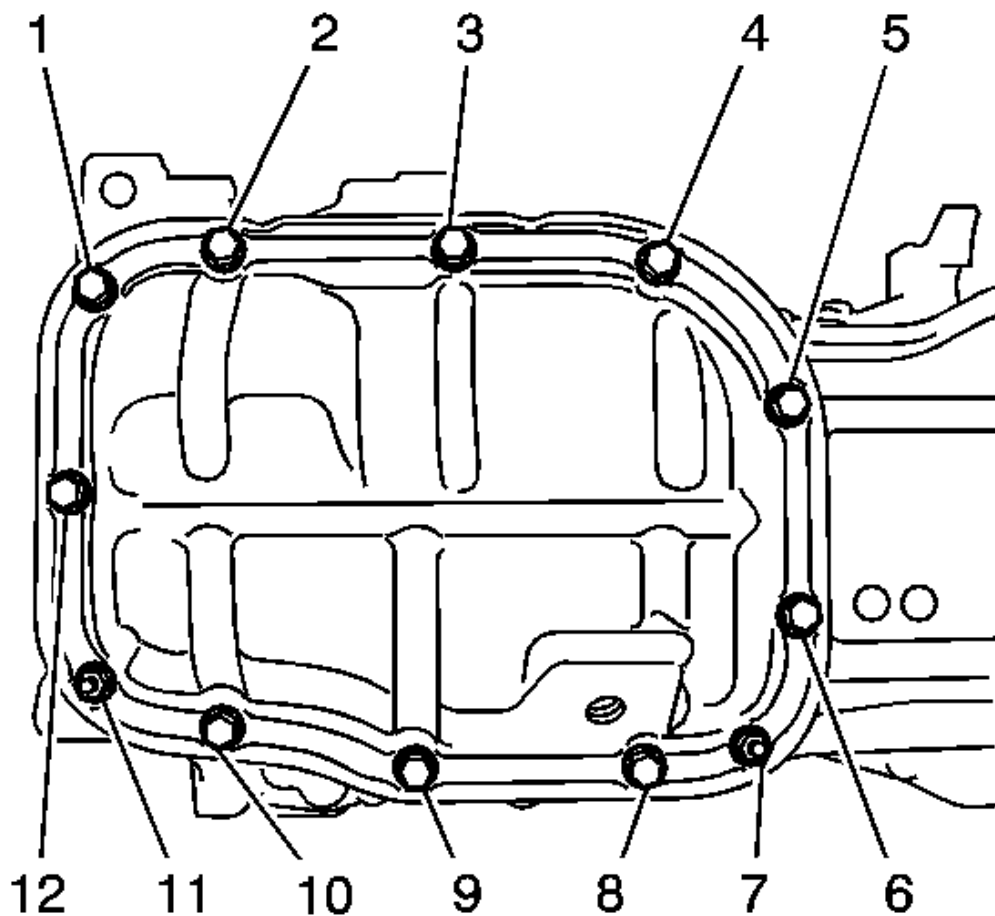


Fig. 161: Identifying Oil Pan Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

42. Remove the 10 bolts (1-6, 8-10, 12) and 2 nuts (7, 11).

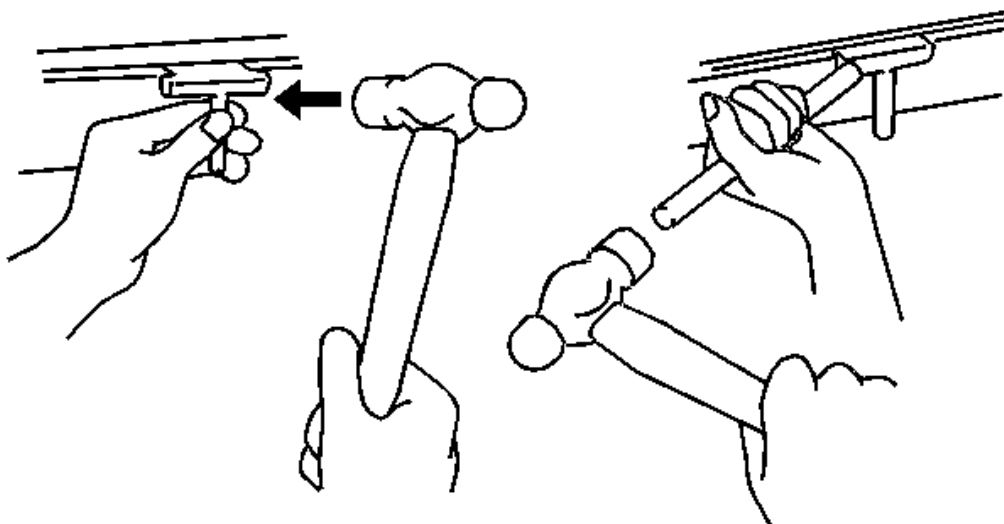


Fig. 162: Removing Oil Pan

Courtesy of GENERAL MOTORS CORP.

NOTE: Be careful not to damage the contact surfaces of the crankcase, chain cover, and oil pan.

43. Insert the blade of oil pan seal cutter between the crankcase and oil pan. Cut through the sealer and remove the oil pan.

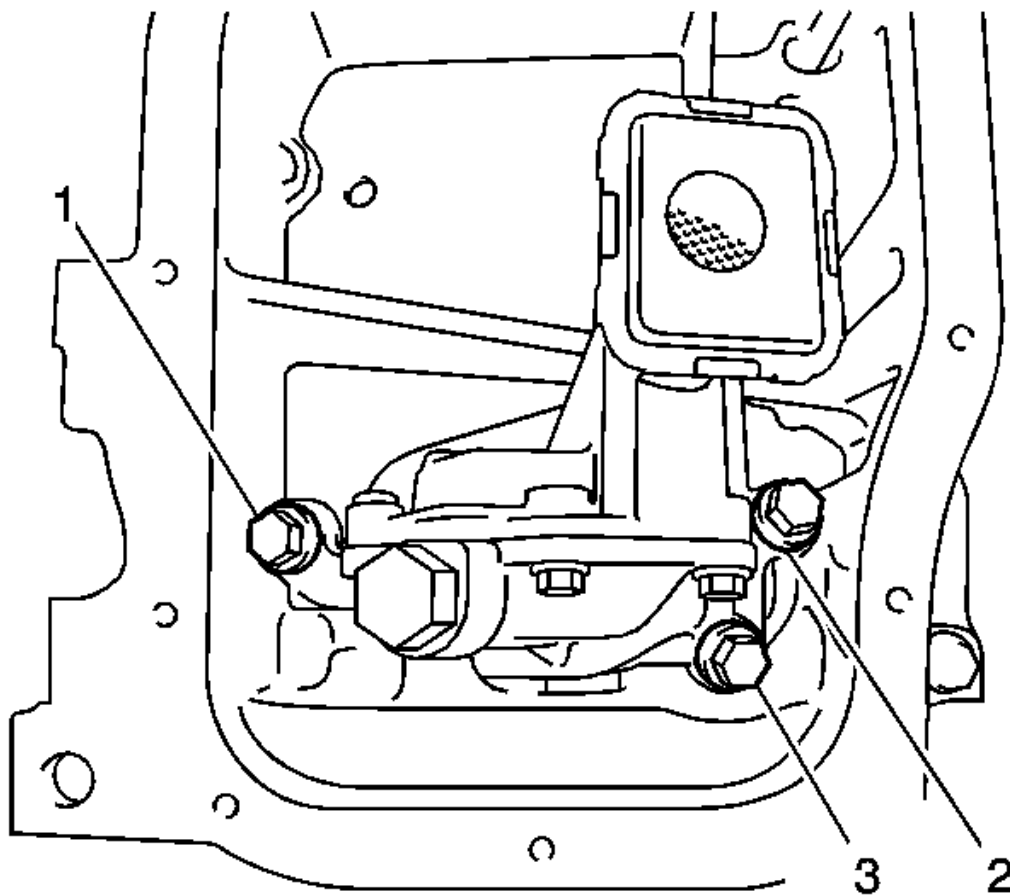


Fig. 163: Identifying Oil Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

44. Remove the 3 bolts (1, 2, 3) and oil pump.

INSTALLATION PROCEDURE

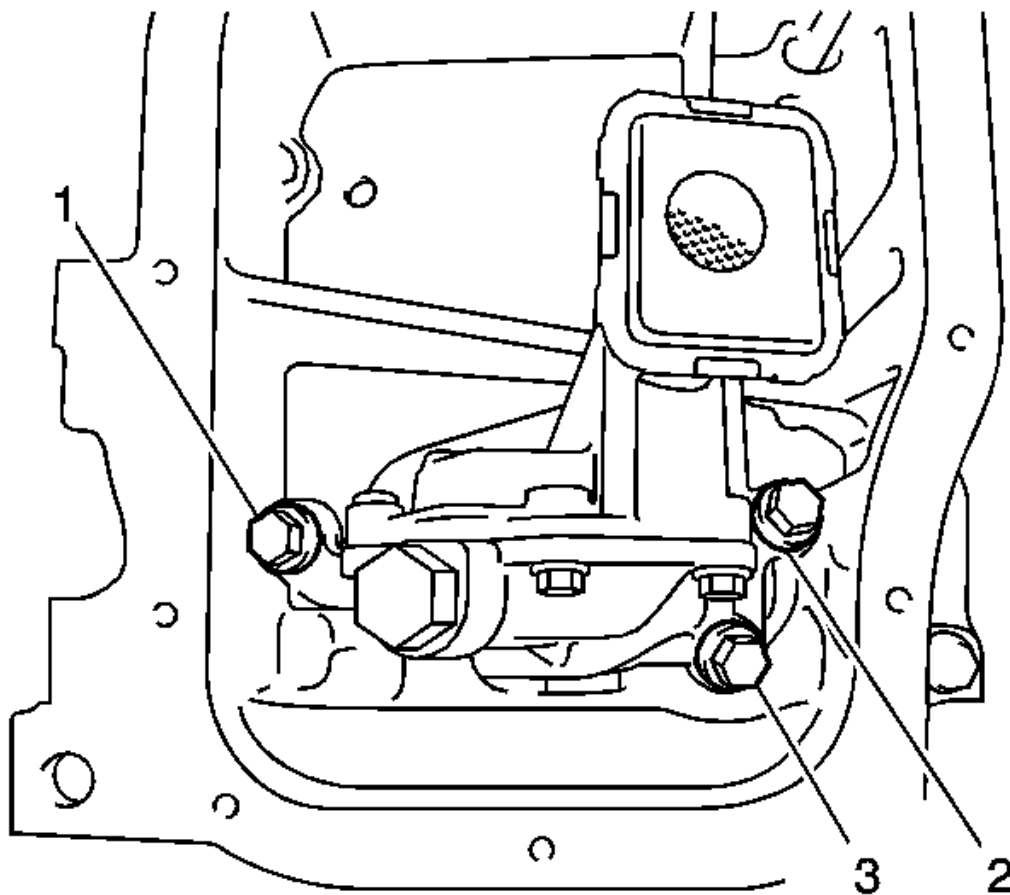


Fig. 164: Identifying Oil Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the oil pump with the 3 bolts (1-3) and tighten to 21 N.m (16 lb ft).
2. Remove any old sealing material and be careful not to drop any oil on the contact surfaces of the cylinder block and oil pan.

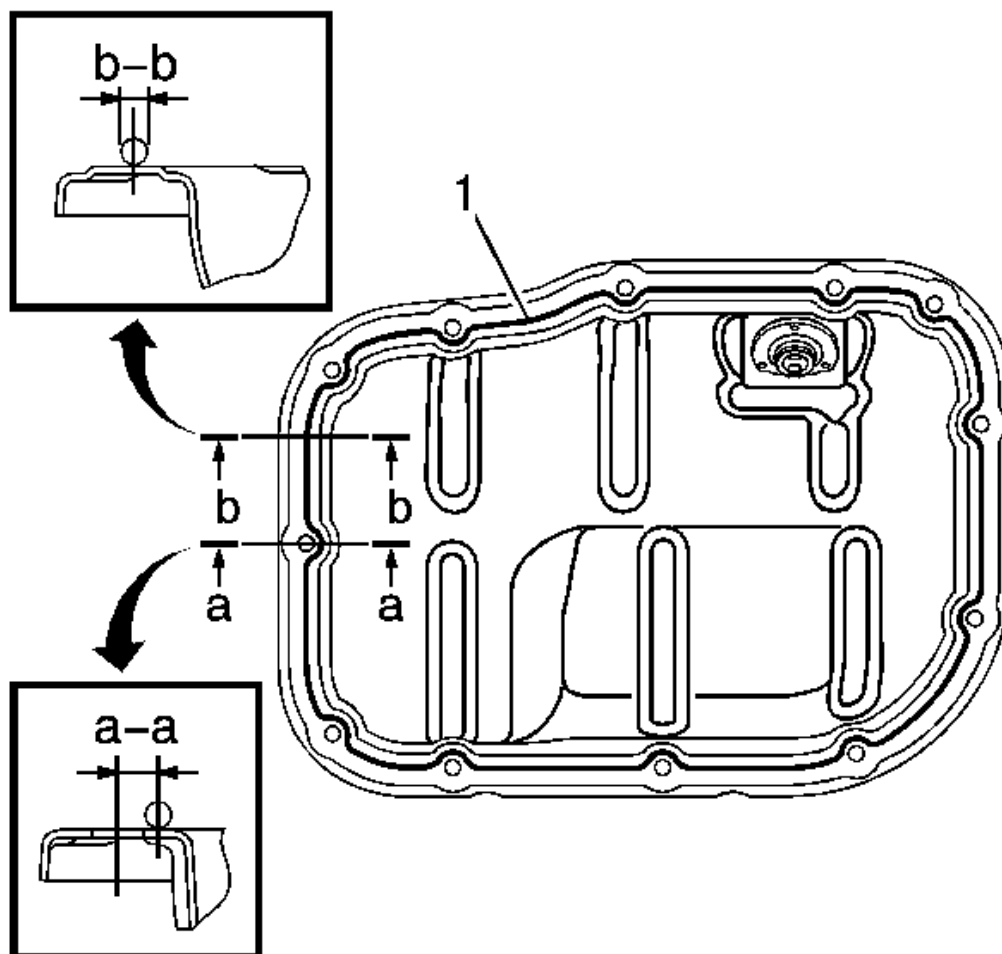


Fig. 165: View Of Oil Pump Contact Surfaces

Courtesy of GENERAL MOTORS CORP.

NOTE:

- Remove any oil from the contact surfaces.
- Install the oil pan within 3 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after installing the oil pan.

3. Apply a continuous bead of sealant (1), diameter: 4.0 mm (0.157 in), as shown in the illustration, Three Bond 1217B, or equivalent, GM part number 12378521 (Canadian part number 88901148).

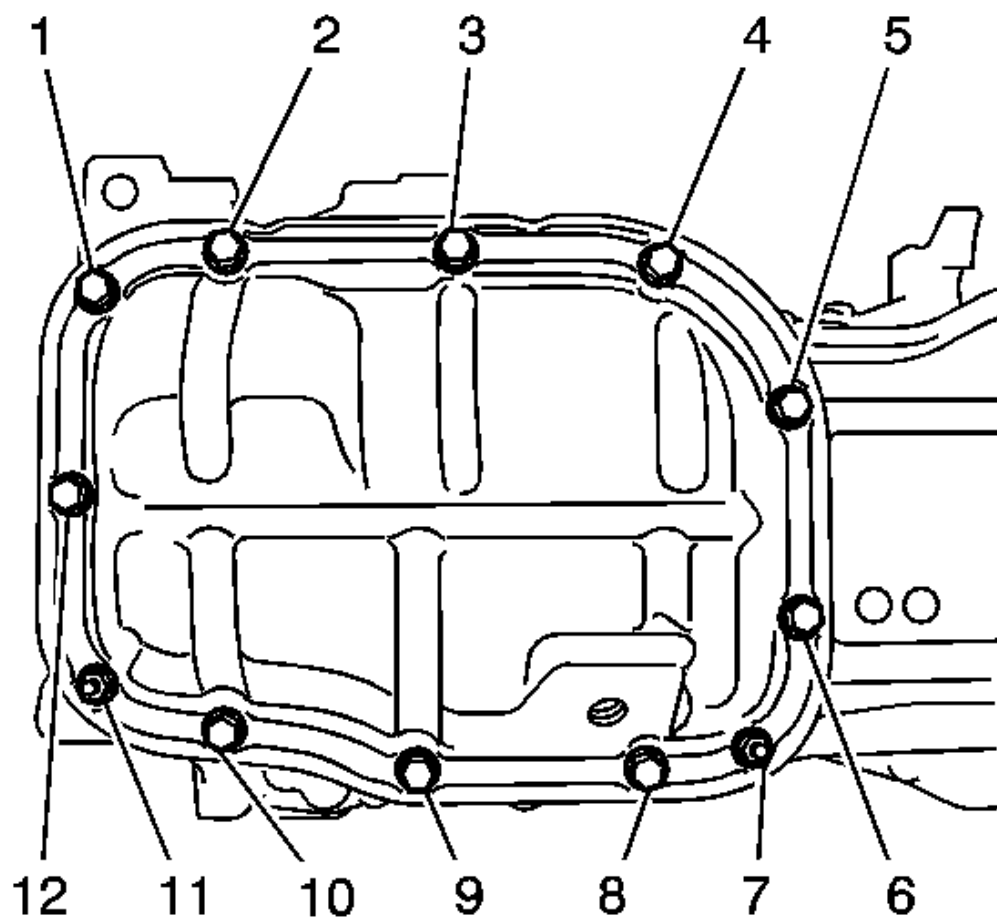


Fig. 166: Identifying Oil Pan Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the No. 2 oil pan with the 10 bolts (1-6, 8-10, 12) and 2 nuts (7, 11) and tighten to 10 N.m (7 lb ft).
5. Install the crankshaft position sensor plate.

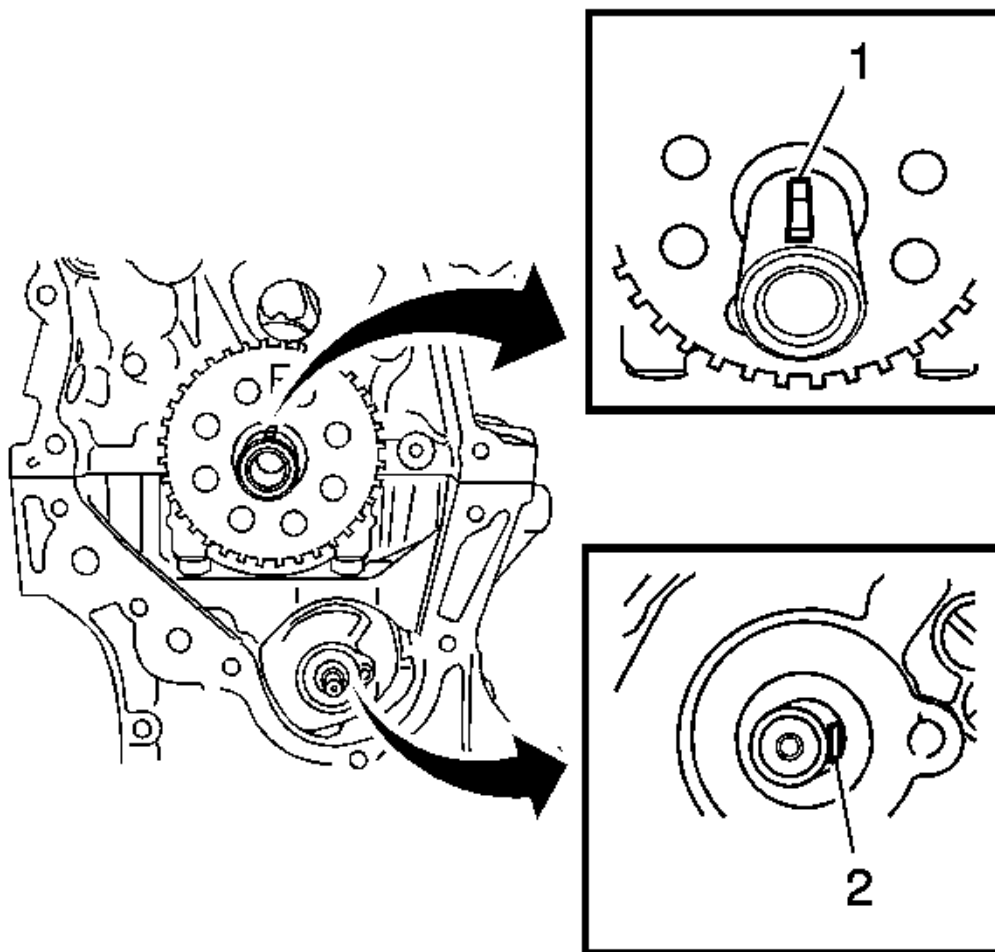


Fig. 167: Identifying Crankshaft Key
Courtesy of GENERAL MOTORS CORP.

6. Set the crankshaft key (1).
7. Turn the drive shaft (2) so that the cutout faces right horizontal position.

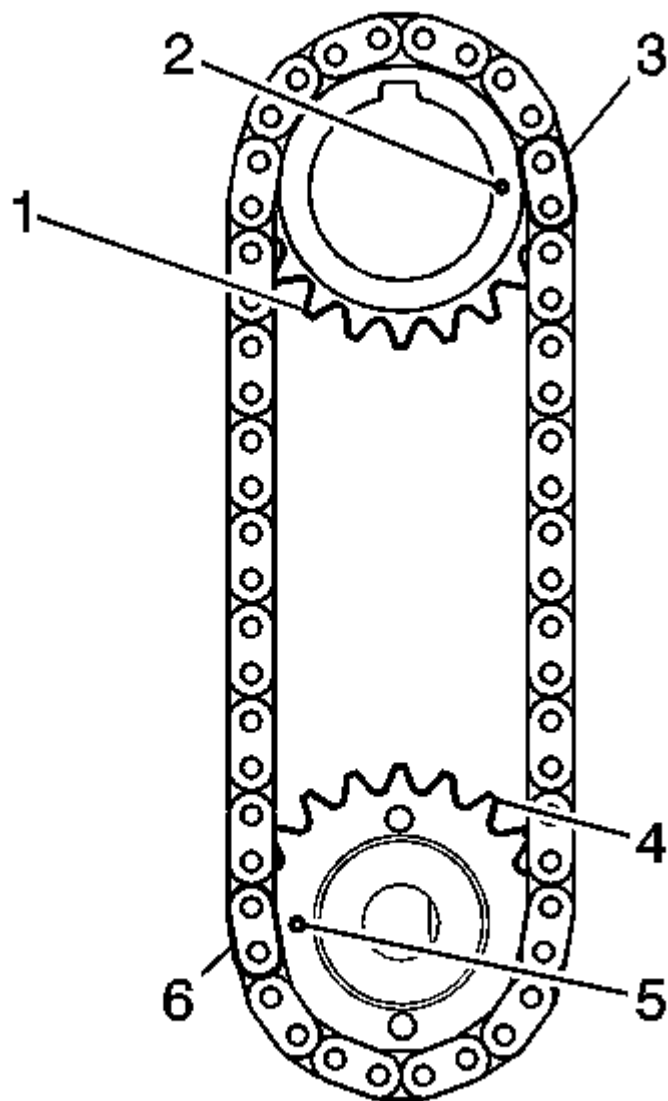


Fig. 168: Aligning Link Marks With Timing Marks Of Each Gear
Courtesy of GENERAL MOTORS CORP.

8. Align the yellow mark links (3, 6) with the timing marks (2, 5) of each gear.
9. Install the sprockets onto the crankshaft and oil pump shaft with the chain on the gears.
10. Hand tighten the oil pump drive shaft sprocket with the nut.

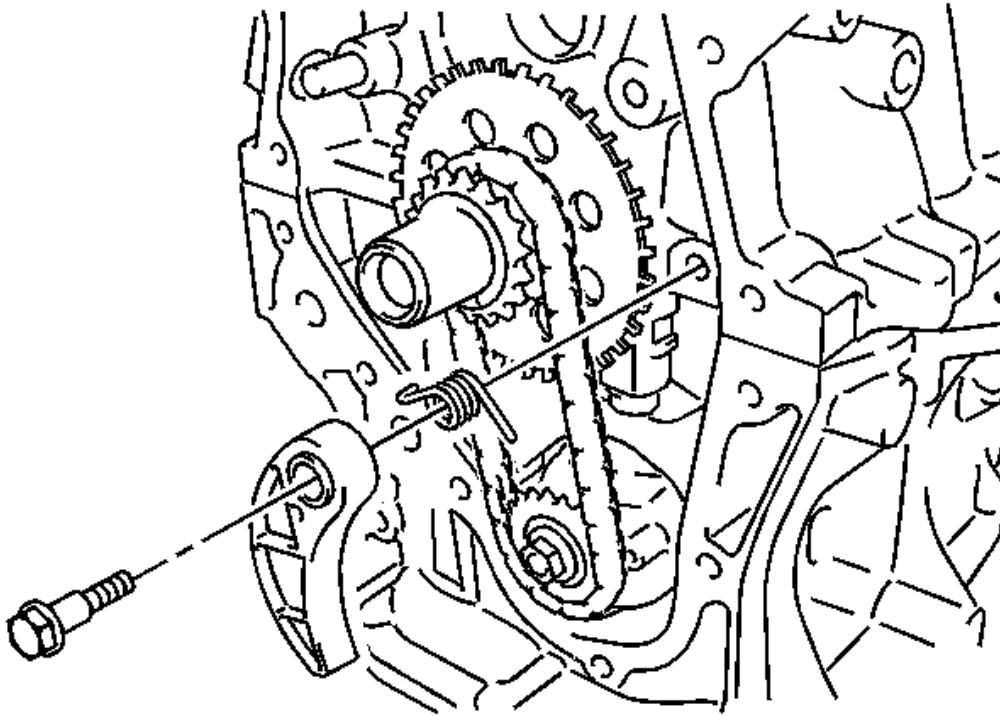


Fig. 169: View Of Chain Tensioner Plate, Spring & Bolt
Courtesy of GENERAL MOTORS CORP.

11. Insert the damper spring into the adjusting hole, and then install the chain tensioner plate with the bolt and tighten to 10 N.m (7 lb ft).

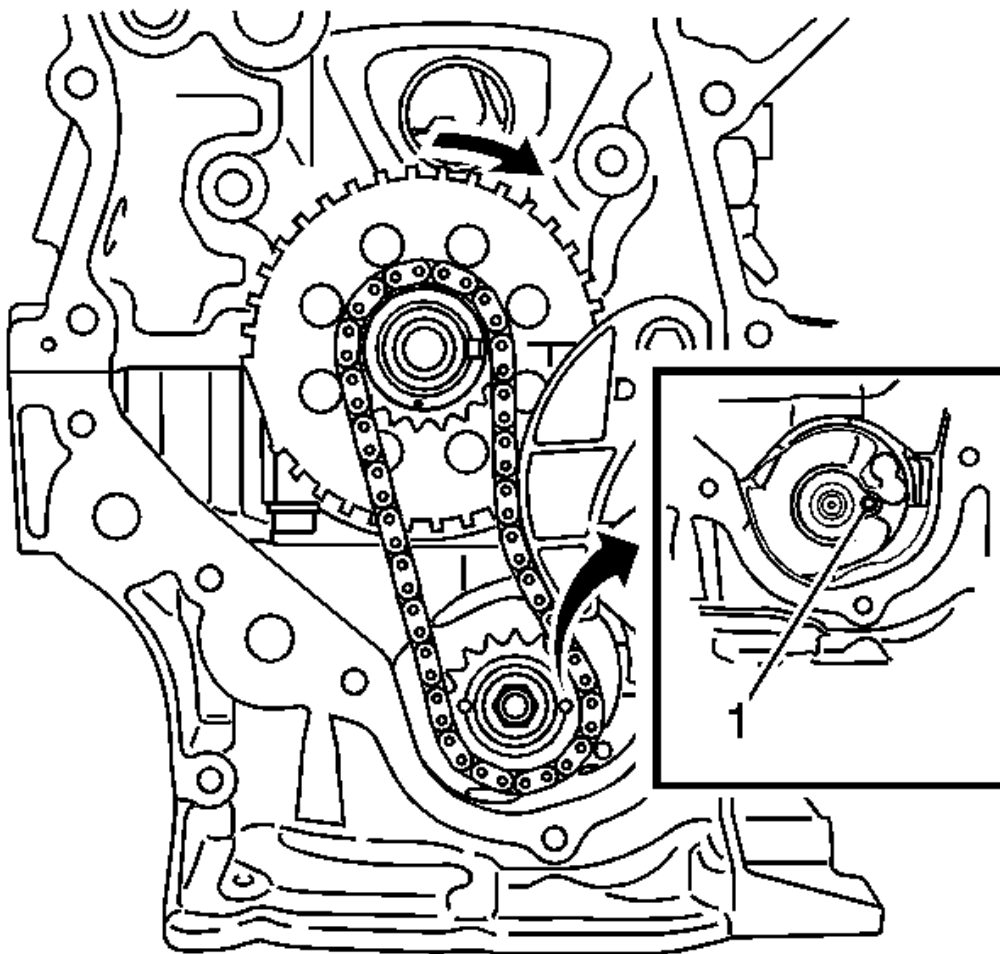


Fig. 170: Aligning Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

12. Align the adjusting hole of the oil pump drive shaft sprocket (1) with the groove of the oil pump.

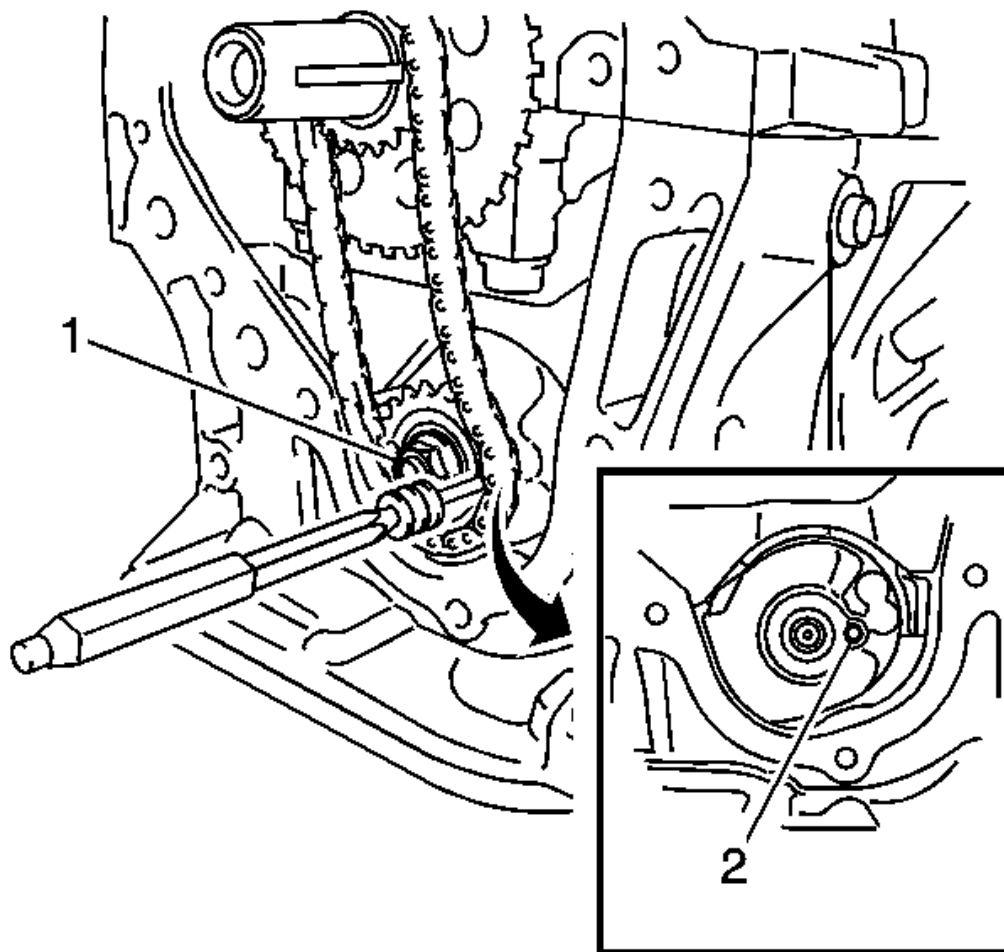


Fig. 171: Identifying Adjusting Hole
Courtesy of GENERAL MOTORS CORP.

13. Insert a pin punch (3 mm) into the adjusting hole (2) of the oil pump drive shaft gear to lock the gear in position, and then tighten the nut (1) to 28 N.m (21 lb ft).

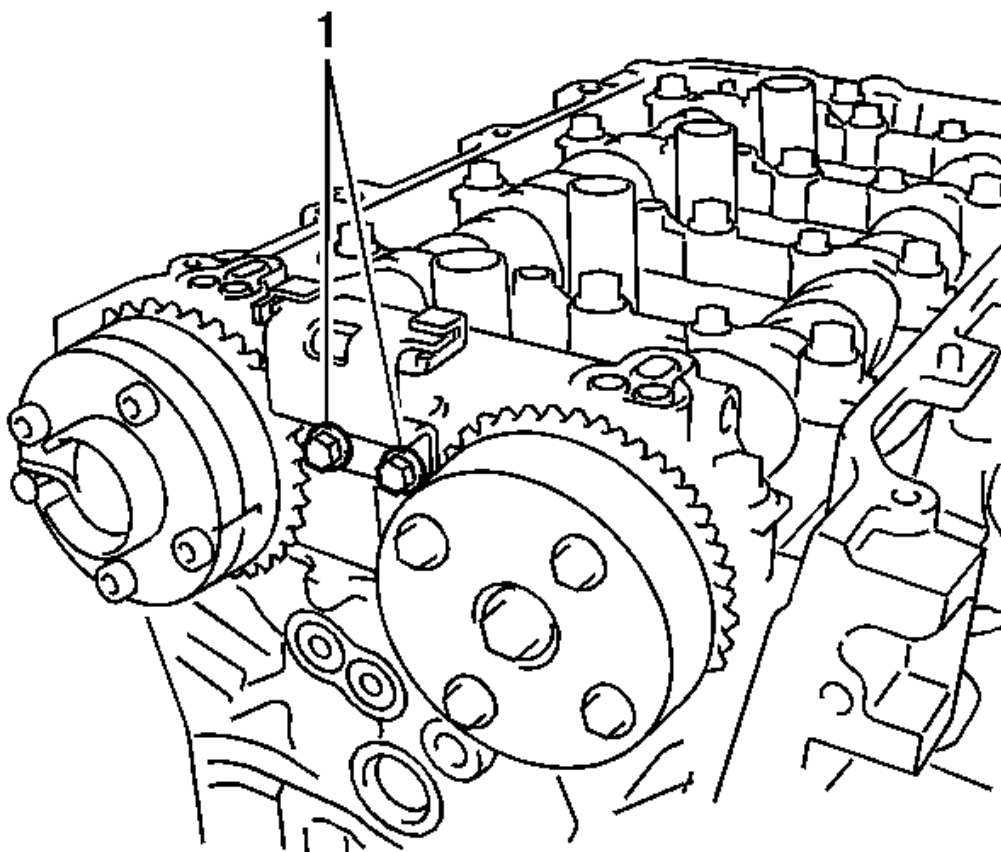


Fig. 172: Identifying Chain Vibration Damper Bolts
Courtesy of GENERAL MOTORS CORP.

14. Install the chain vibration damper with the 2 bolts (1) and tighten to 10 N.m (7 lb ft).
15. Install the chain sub-assembly.
16. Install the chain tensioner slipper.
17. Apply MP grease to the lip of the oil seal.
18. Remove any old sealant material and be careful not to drop any oil on the contact surfaces of the timing chain cover sub-assembly, cylinder head, and cylinder block.

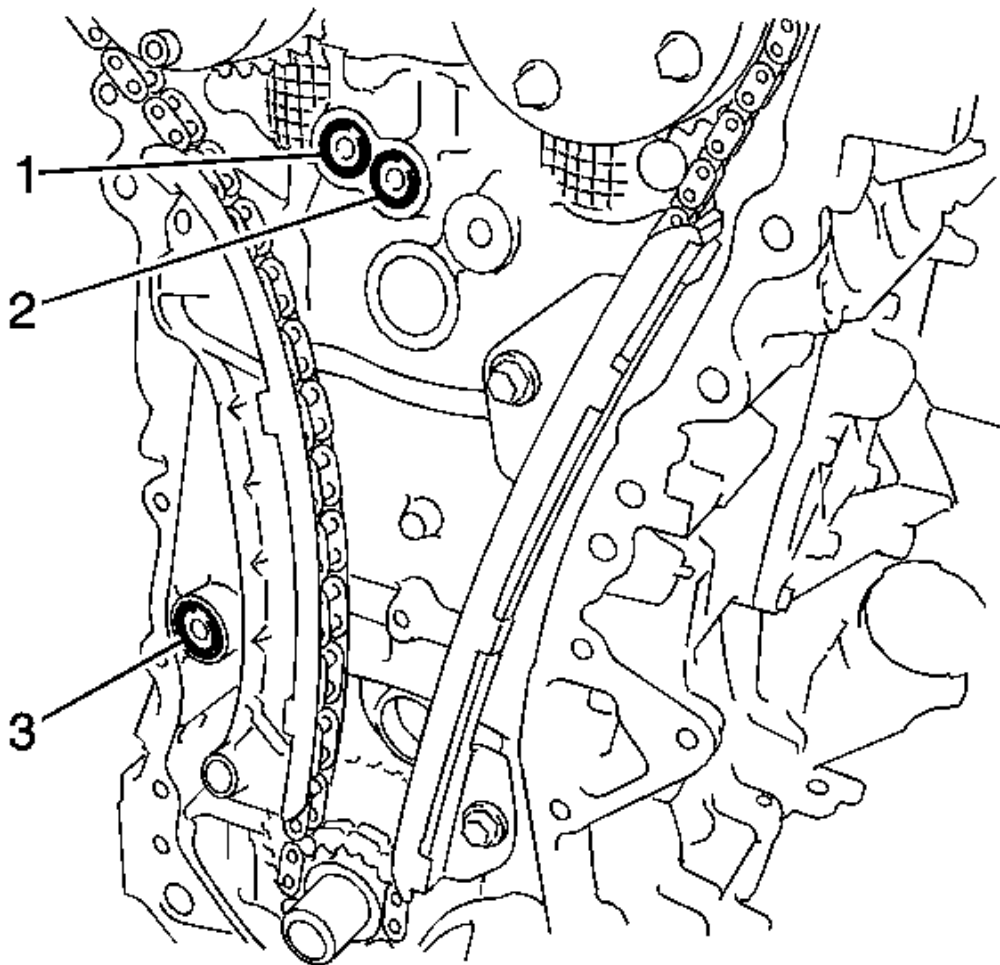


Fig. 173: Locating O-Rings

Courtesy of GENERAL MOTORS CORP.

19. Install the 3 new O-rings (1-3).

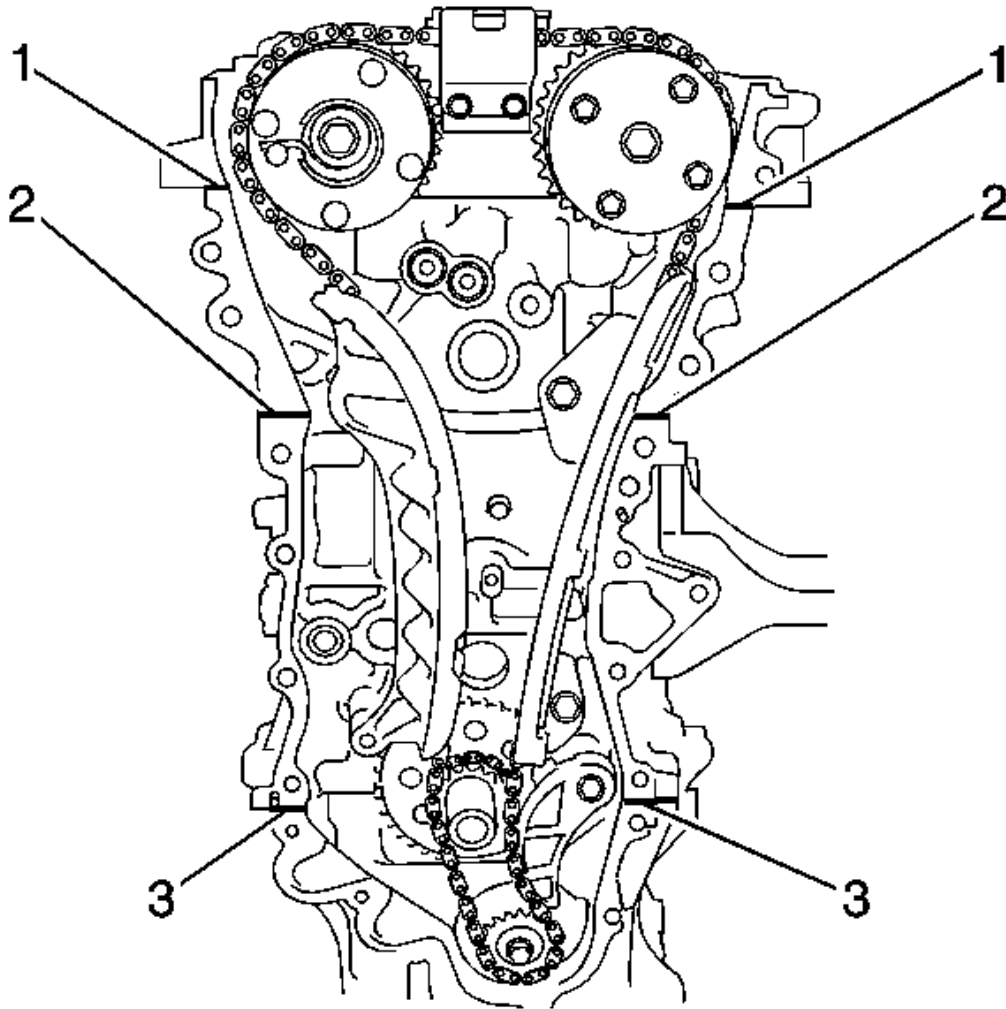


Fig. 174: View Of Chain Cover Contact Surfaces
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Remove any oil from the contact surfaces.
- Install the chain cover within 3 minutes after applying sealant.
- Do not start the engine for at least 2 hours after installing the timing chain cover sub-assembly.

20. Apply Three Bond 1217B, or equivalent, GM part number 12378521 (Canadian part number 88901148) to the parting lines of the camshaft housing (1), cylinder head (2) and lower crankcase (3)

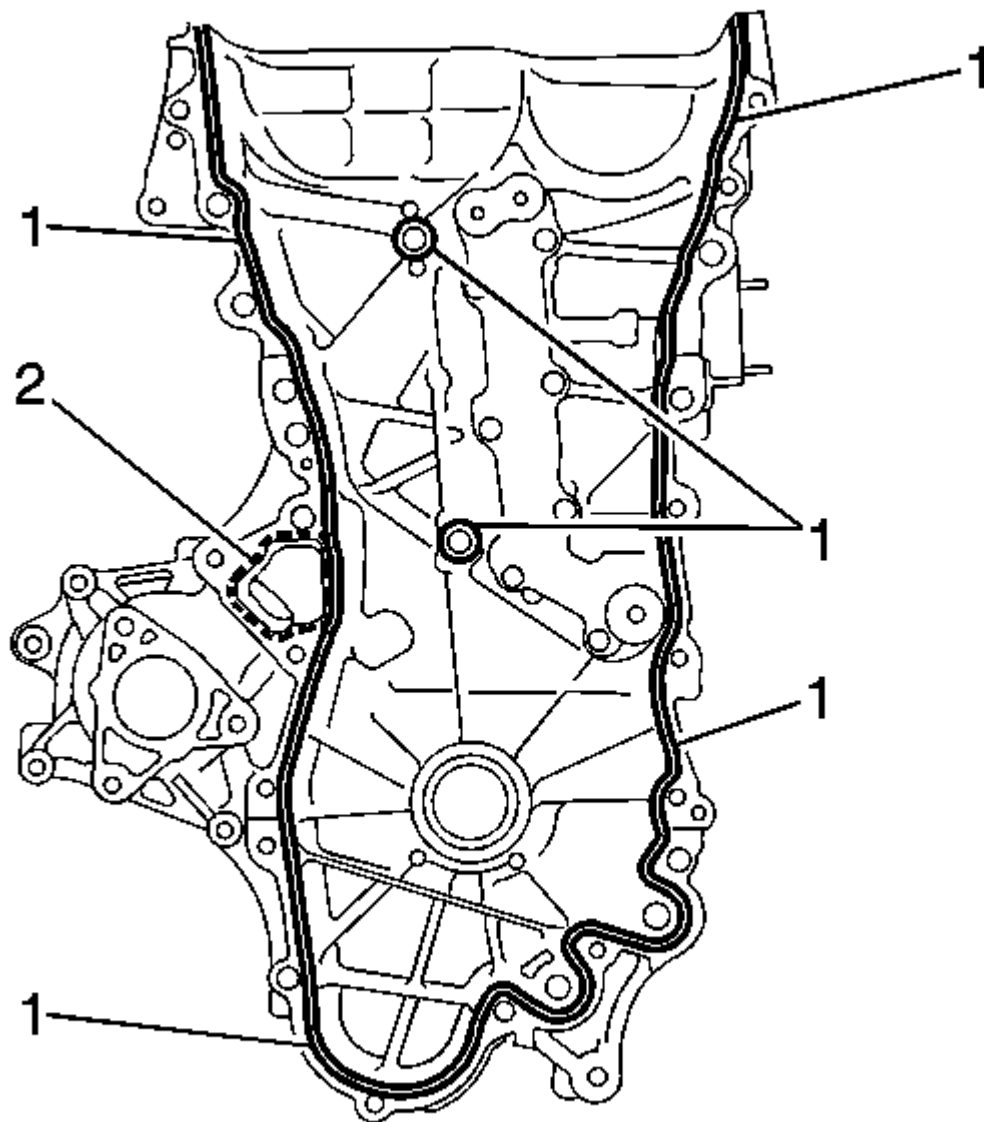


Fig. 175: Identifying Sealant Area For Timing Chain Cover
Courtesy of GENERAL MOTORS CORP.

NOTE:

- When the contact surfaces are wet, wipe them with oil-free cloth before applying sealant.
- Install the timing chain cover sub-assembly within 3 minutes and tighten the bolts within 15 minutes after applying sealant.

- **Do not start the engine for at least 2 hours after installing.**

21. Apply sealant to the timing chain cover in a continuous line as follows:

Continuous Line Area (1)

- Sealant Diameter - 3.0 mm (0.118 in)
- Application Position form Inside Seal Line - 2.5 mm (0.098 in)
- Sealant - Three Bond 1207B or equivalent

Dashed Line Area (2)

- Sealant Diameter - 4.0 mm (0.156 in)
- Application Position form Inside Seal Line - 3.0 mm (0.118 in)
- Sealant - Three Bond 1207B or equivalent

22. Hand install the timing chain cover subassembly with the 19 bolts.

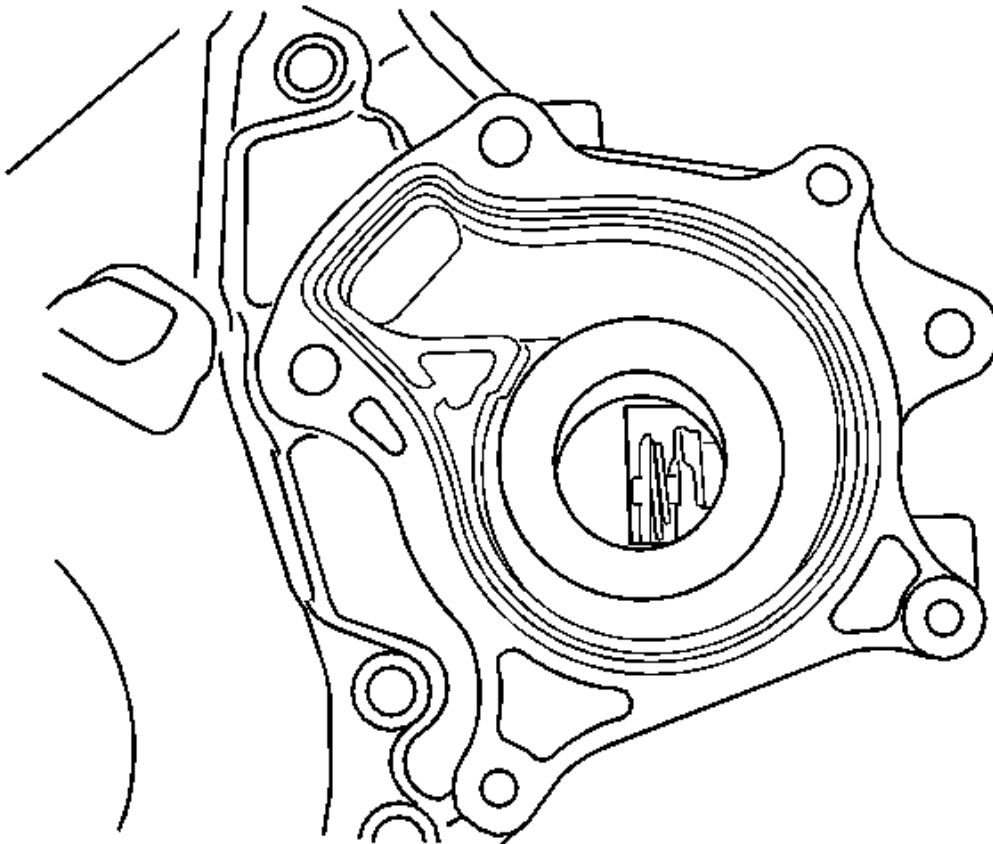


Fig. 176: Identifying Water Pump Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE: Remove any oil from the contact surfaces.

23. Install a new gasket.

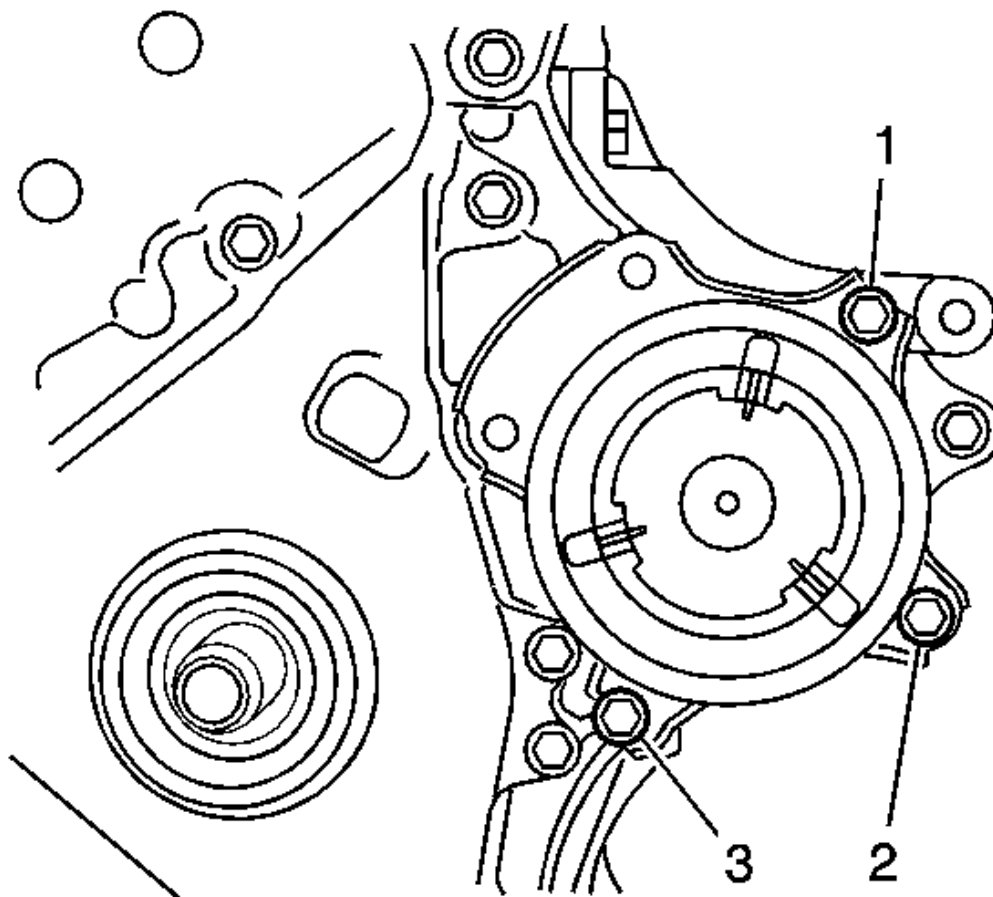


Fig. 177: Identifying Water Pump Bolts
Courtesy of GENERAL MOTORS CORP.

24. Install the water pump with the 3 bolts (1, 2, 3) and tighten to 24 N.m (18 lb ft).

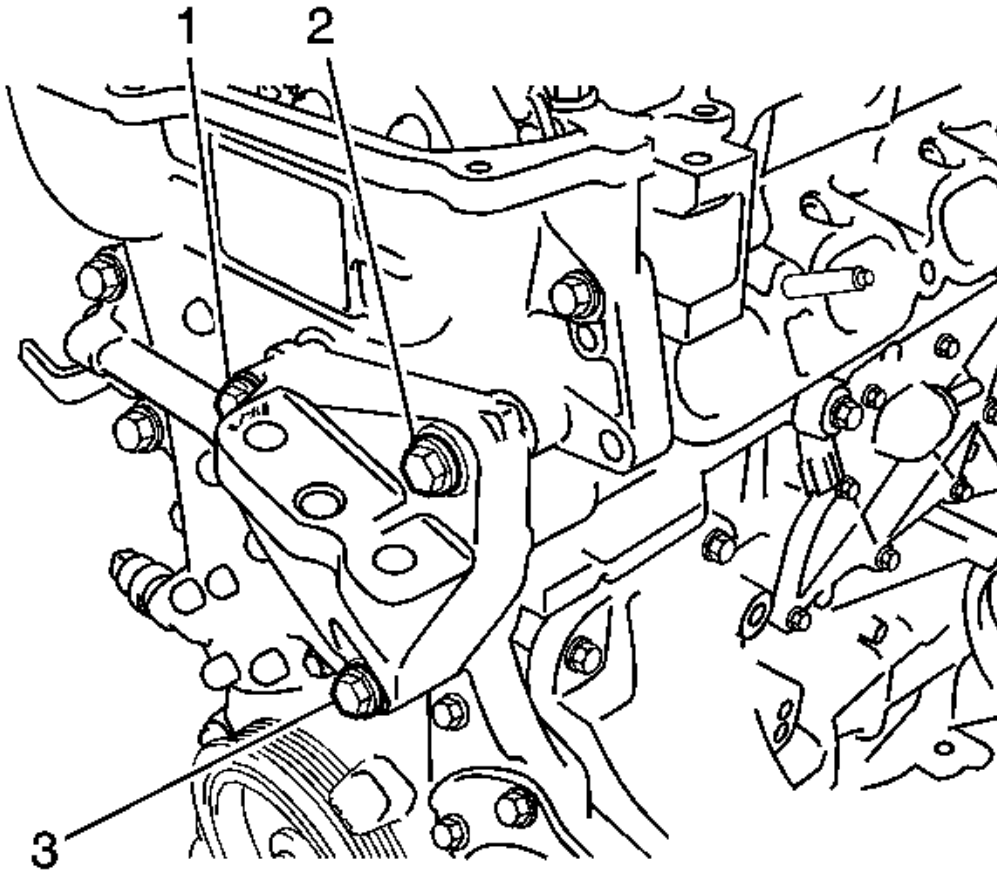


Fig. 178: Identifying Mounting Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

25. Install the mounting bracket within 10 minutes after installing the timing chain cover assembly.
26. Hand tighten the engine mounting bracket with the 3 bolts (1, 2, 3).

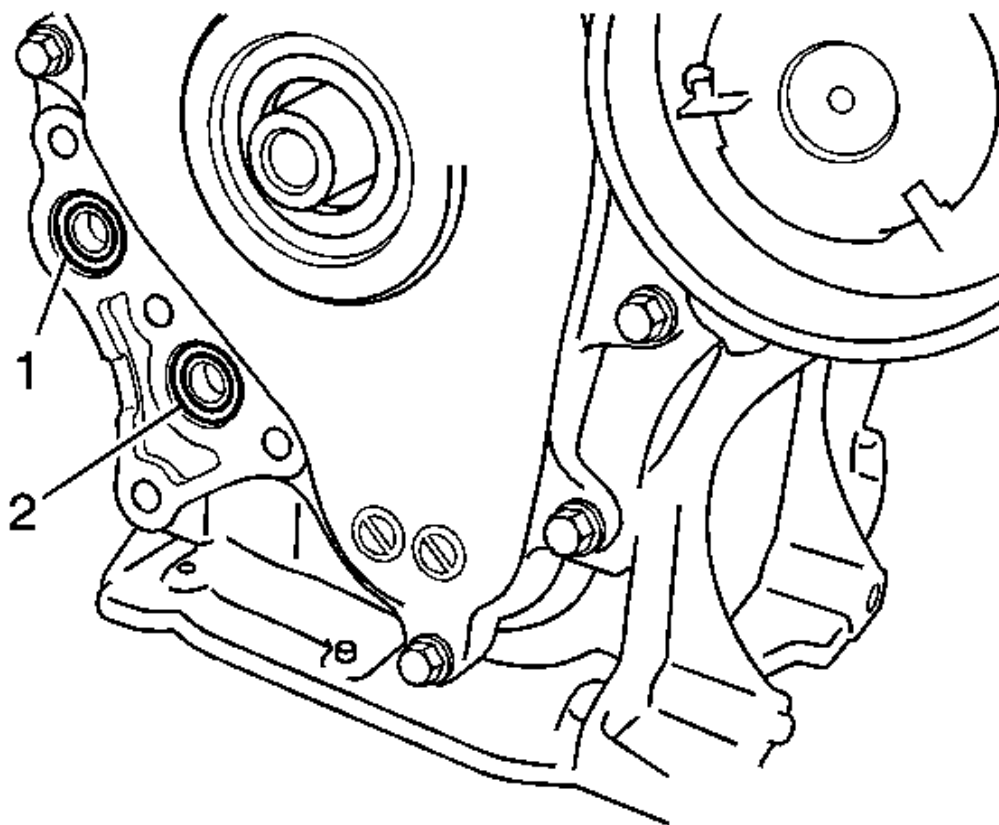


Fig. 179: Identifying 2 New O-Rings
Courtesy of GENERAL MOTORS CORP.

27. Install 2 new O-rings (1, 2).

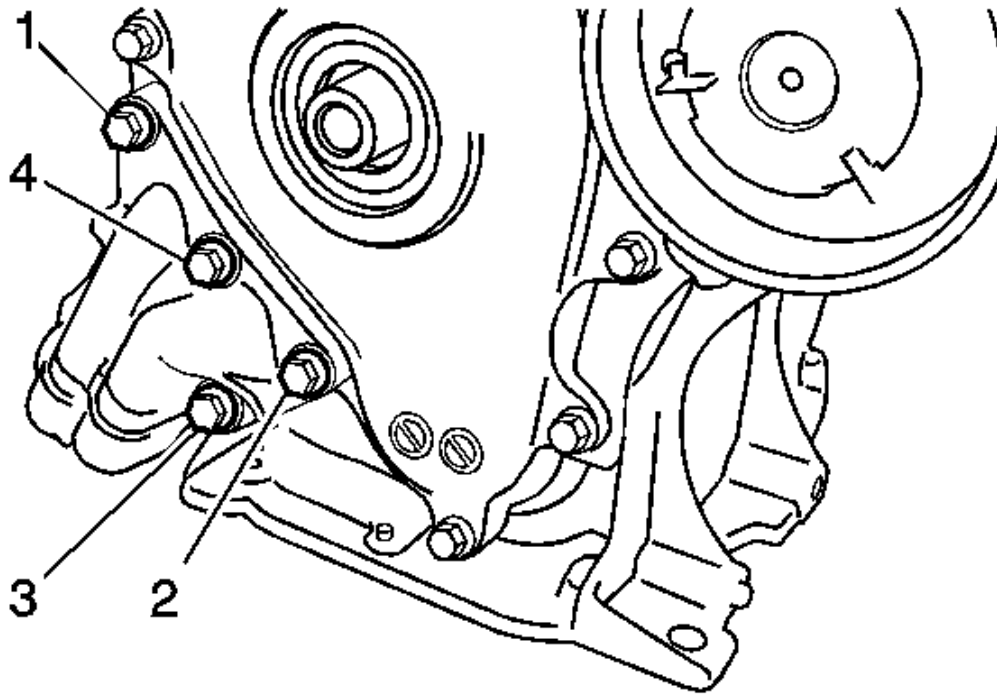


Fig. 180: Identifying Oil Filter Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

28. Install the oil filter bracket within 10 minutes after installing the chain cover.
29. Temporarily tighten the oil filter bracket with the 4 bolts (1-4).

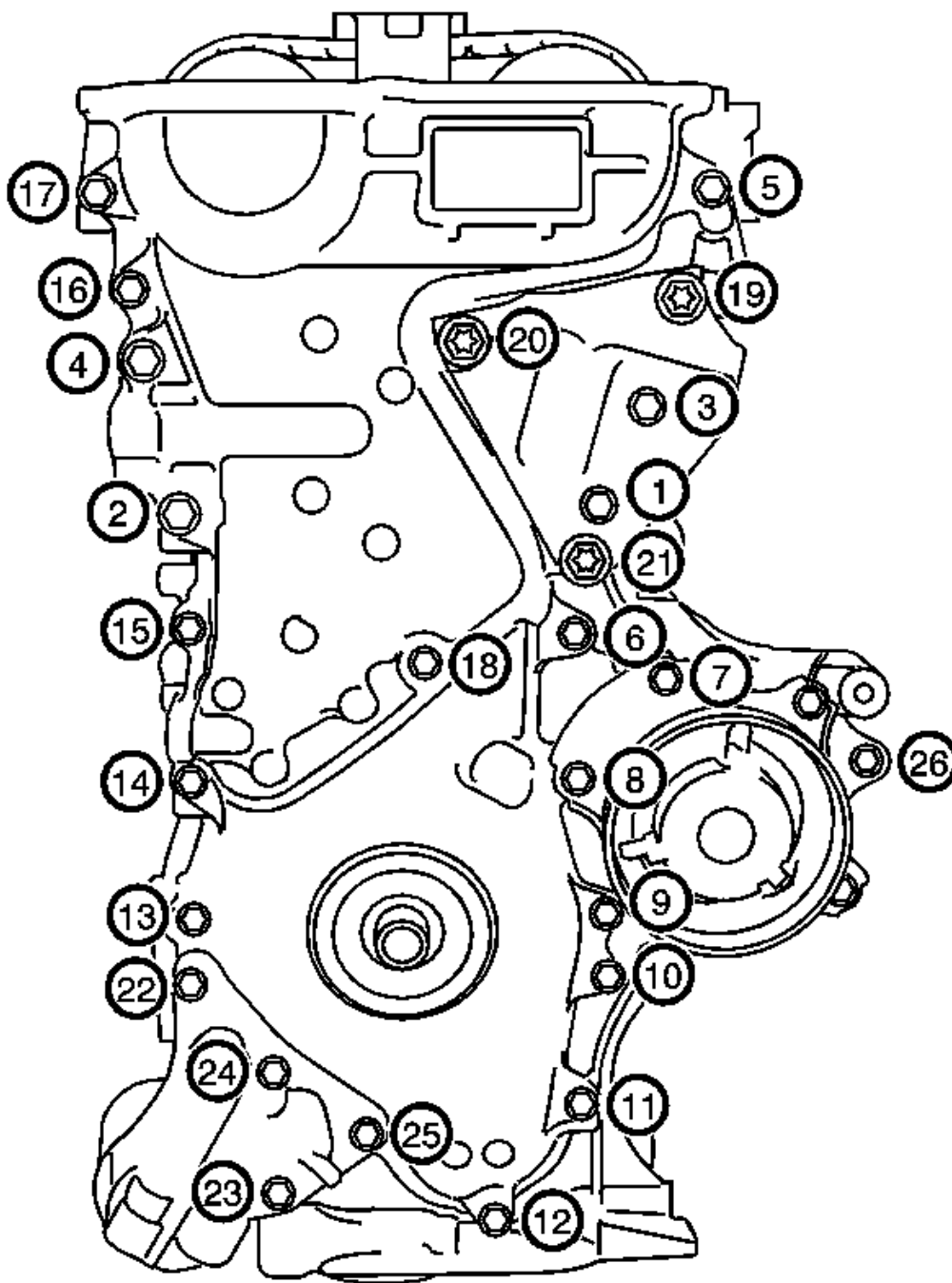


Fig. 181: Identifying Front Cover Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.

NOTE:

- **When the contact surfaces are wet, wipe them with oil-free cloth before applying sealant.**
- **Do not start the engine for at least 2 hours after installing**

30. Apply Three Bond 1324 or equivalent to the threads of the bolt 5.
31. Install the chain cover within 3 minutes and tighten the bolts within 15 minutes after applying the sealant.
32. Torque the bolts in the above sequence.

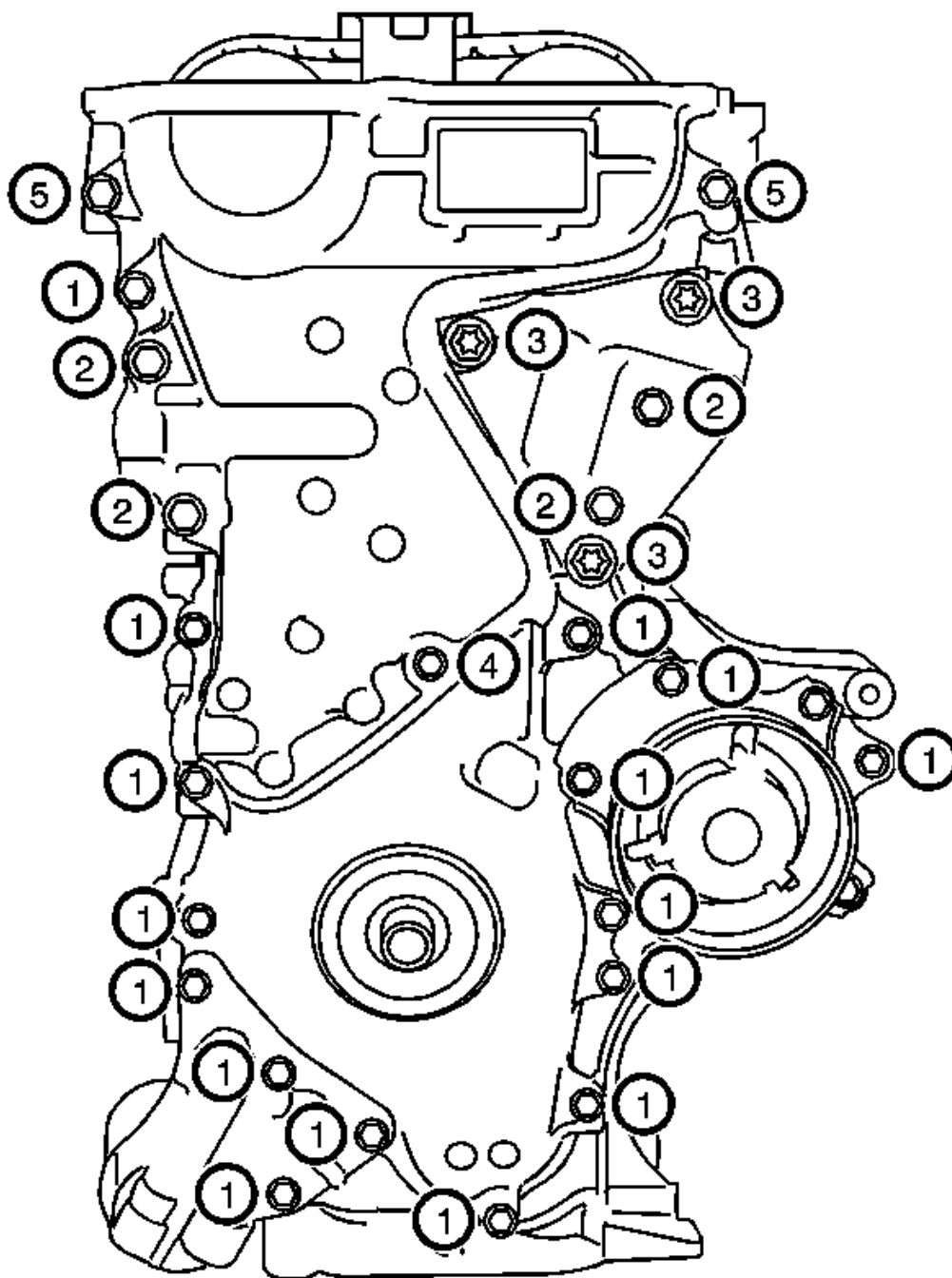


Fig. 182: Identifying Timing Chain Cover Sub-Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

33. Fully tighten the timing chain cover sub-assembly with the 26 bolts.
 - bolts 1 and 5 to 26 N.m (19 lb ft)
 - bolts 2 and 3 to 51 N.m(37 lb ft)
 - bolt 4 to 10 N.m (7 lb ft)
34. Install the crankshaft pulley.
35. Install the chain tensioner assembly.
36. Install the cylinder head cover. Refer to **Camshaft Cover Replacement**.
37. Install the radio setting condenser.
38. Install the thermostat.
39. Install the inlet water.
40. Install the inlet water hose.
41. Install the water by-pass hoses.
42. Install the water by-pass pipe.
43. Install the ventilation hose.
44. Install the exhaust manifold. Refer to **Engine Flywheel Installation** .
45. Install the oil level dipstick assembly.
46. Install the ignition coil assembly.
47. Install the fuel injector assembly.
48. Install the delivery pipe spacer.
49. Install the fuel delivery pipe assembly.
50. Install the fuel tube assembly.
51. Install the intake manifold. Refer to **Intake Manifold Replacement**.
52. Remove the engine stand.
53. Install the engine assembly with transaxle. Refer to **Engine Replacement**.

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Special Tools

- **J-8614-A:** Pinion Flange Holder and Remover
- **J-22928-B:** Seal Installer

REMOVAL PROCEDURE

1. Remove the engine assembly with transaxle. Refer to **Engine Replacement**.
2. Remove the transaxle assembly.
3. Remove the clutch cover assembly and disc for the manual transaxle.

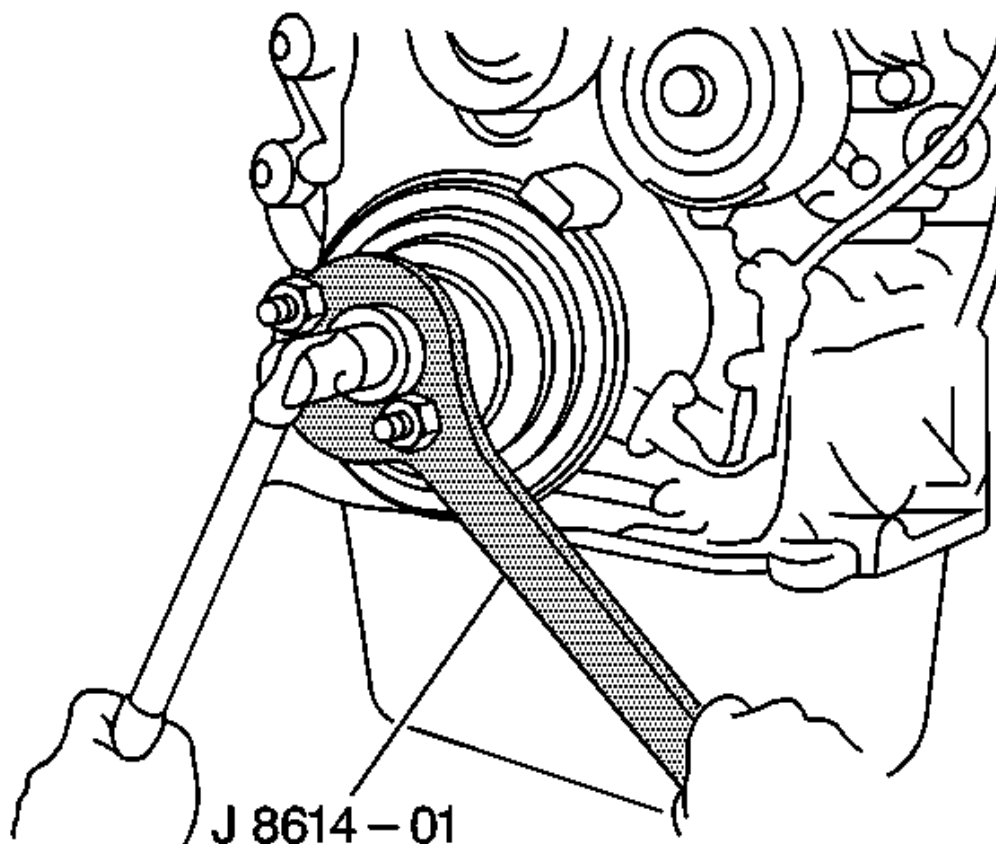


Fig. 183: Removing/ Installing Crankshaft Pulley Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

4. Using the **J-8614-A**: holder and remover, hold the crankshaft.
5. Remove the 8 bolts (1-8) and the flywheel for manual transmissions.

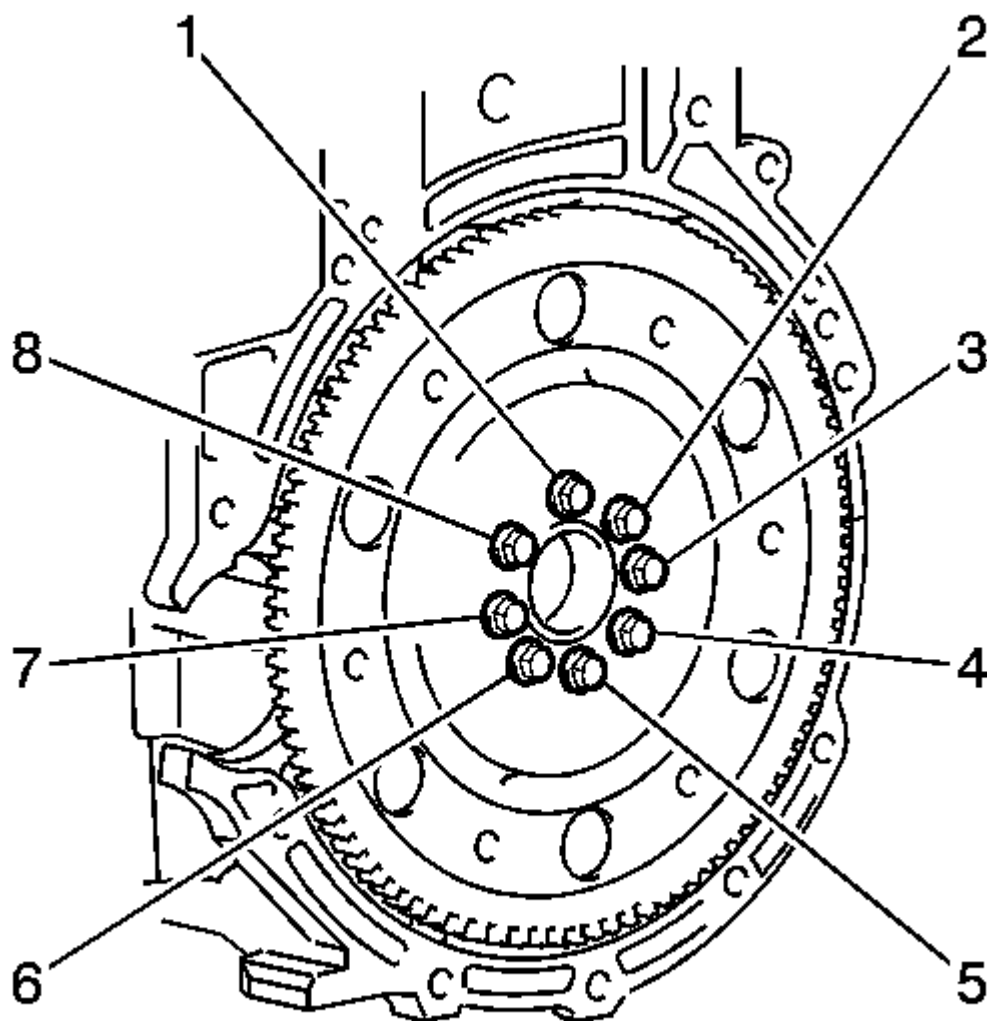


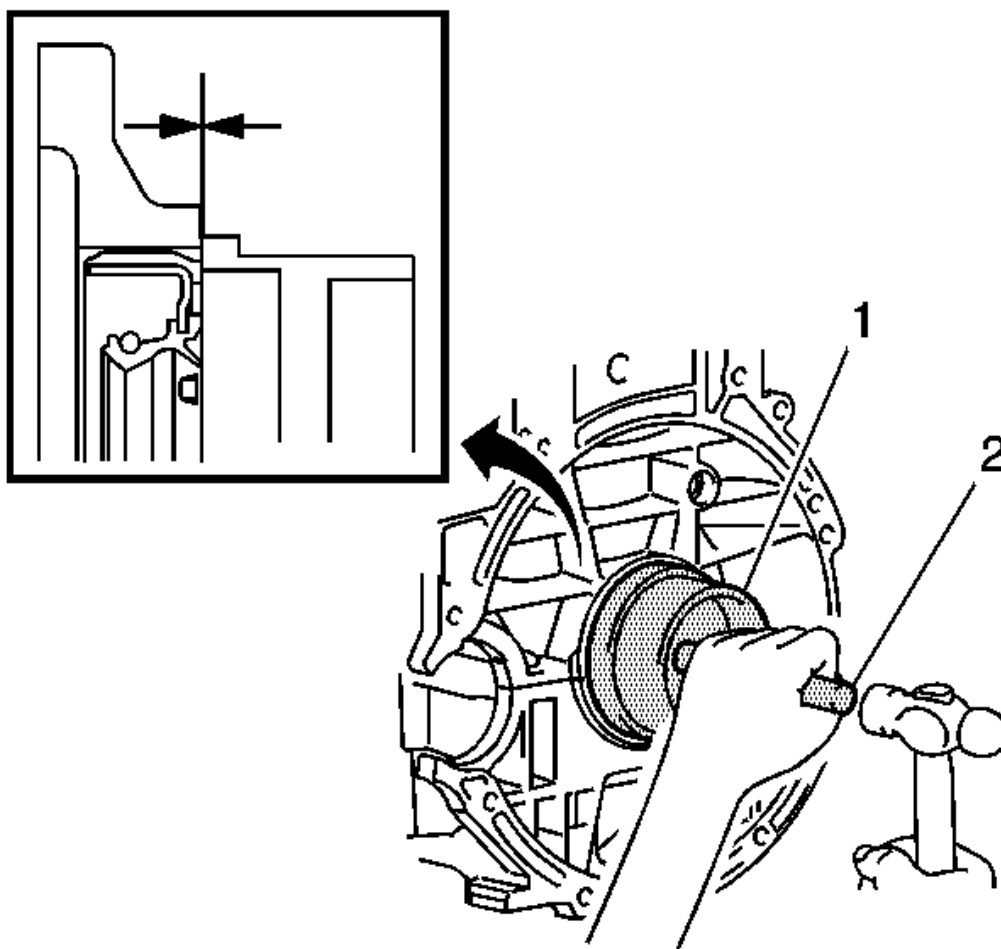
Fig. 184: Identifying Drive Plate Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the 8 bolts (1-8), rear spacer, drive plate and front spacer for automatic transmissions.
7. Using a knife, cut off the lip of the oil seal.

NOTE: After removing, check the crankshaft for nicks or burrs. Smooth the surface with 400-grit sandpaper.

8. Using a screwdriver with its tip wrapped with tape, pry out the oil seal.

INSTALLATION PROCEDURE

**Fig. 185: Tapping In Oil Seal**

Courtesy of GENERAL MOTORS CORP.

NOTE: Keep the lip free from foreign matter.

1. Apply MP grease to the lip of a new oil seal.

NOTE:

- Wipe any extra grease off the crankshaft.
- Do not tap the oil seal at an angle.

2. Using the **J-22928-B**: installer (1) and a hammer, tap in the oil seal until its surface is flush with the rear

oil seal retainer edge.

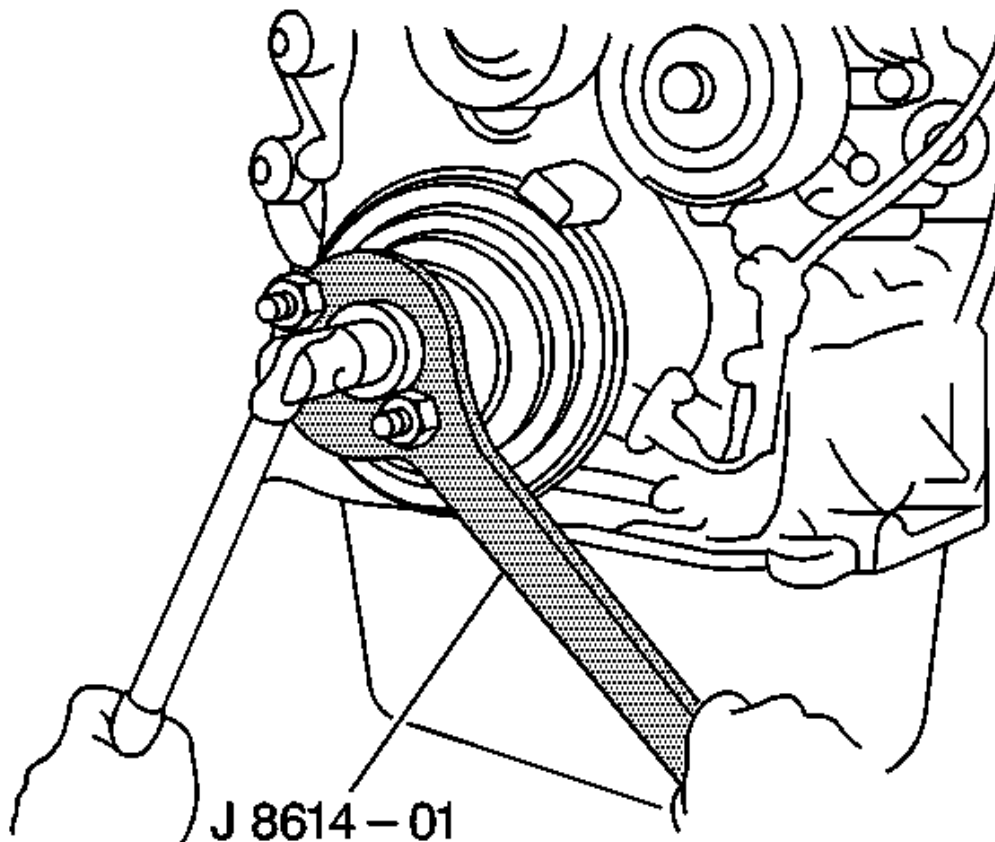


Fig. 186: Removing/ Installing Crankshaft Pulley Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

3. Using the **J-8614-A**: holder and remover, hold the crankshaft.

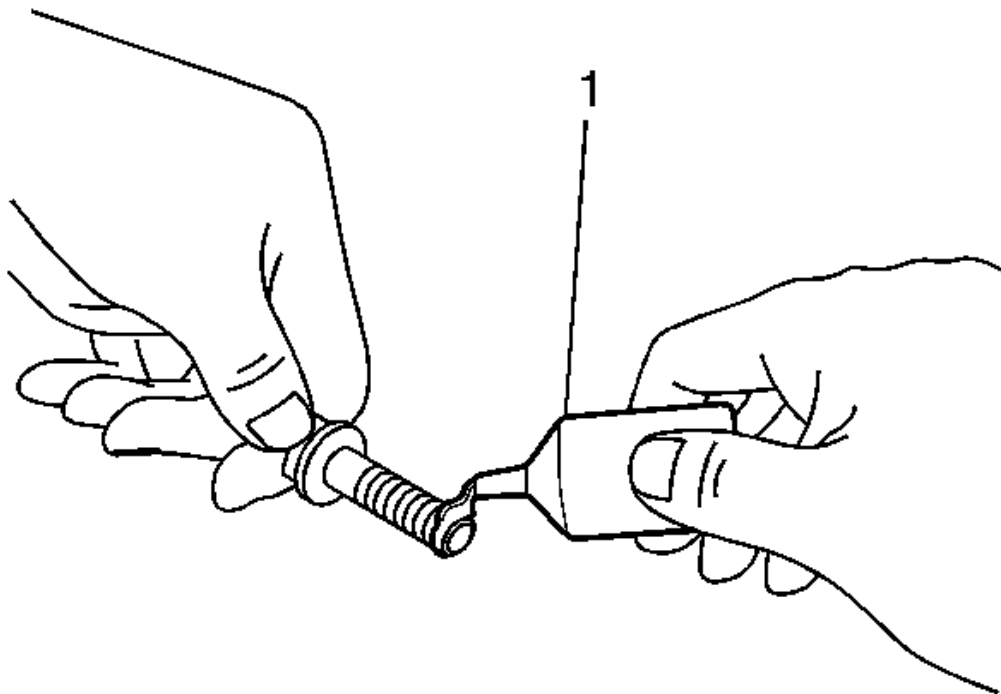


Fig. 187: Applying Adhesive To Bolt
Courtesy of GENERAL MOTORS CORP.

4. Clean the bolts and bolt holes.
5. Apply adhesive Three Bond 1324 (1) or equivalent to 2 or 3 end threads of the new bolts.

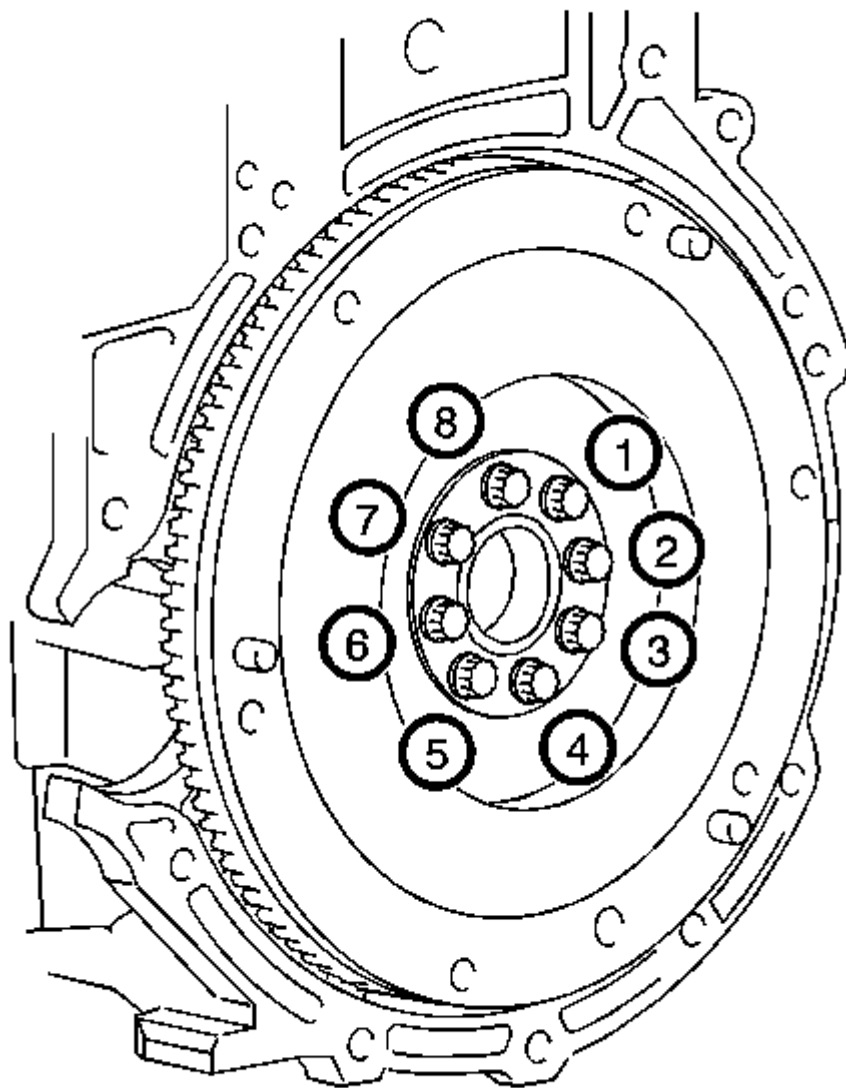


Fig. 188: Identifying Flywheel/Flexplate Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

6. Using several steps, uniformly install and tighten the 8 bolts in the sequence and tighten to 49 N.m (36 lb ft) for manual transmissions.

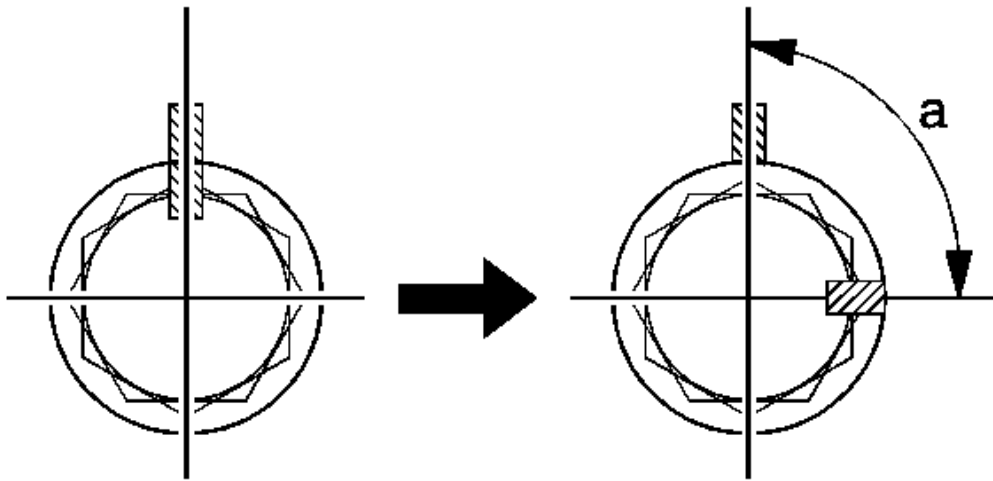


Fig. 189: Identifying Flywheel/Flexplate Tightening Final Step
Courtesy of GENERAL MOTORS CORP.

7. Mark the front of the bolts with paint.
8. Retighten the 8 bolts an additional 90 degrees in the same sequence.
9. Check that the paint marks are now at a 90 degree angle to the front.
10. Check that the crankshaft turns smoothly.

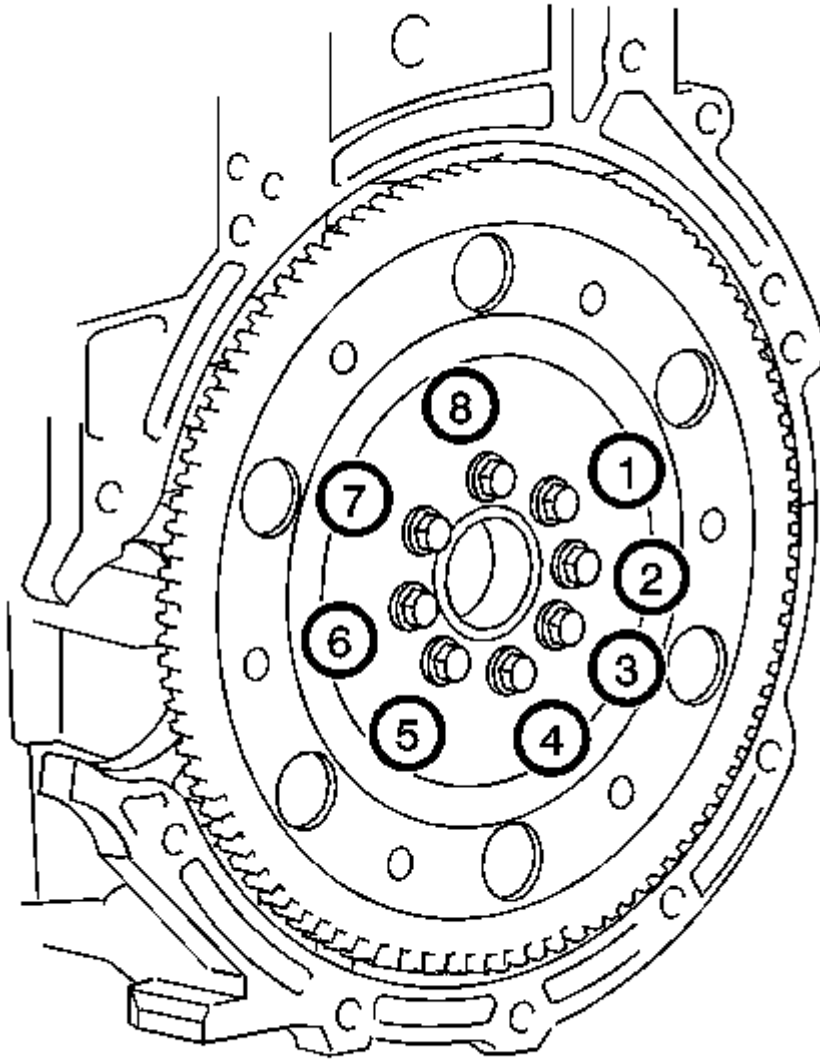


Fig. 190: View Of Front Spacer, Rear Spacer & Drive Plate Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

11. Install the front spacer, drive plate and rear spacer with the 8 bolts. Uniformly tighten the 8 bolts in the sequence shown to 88 N.m (65 lb ft) for automatic transmissions.
12. Install the clutch disc assembly and clutch cover for the manual transaxle.
13. Inspect and adjust the clutch cover assembly for the manual transaxle.
14. Install the manual transaxle assembly for the manual transaxle.
15. Install the automatic transaxle assembly for the automatic transaxle.

16. Install the engine assembly with transaxle. Refer to **Engine Replacement**.

ENGINE REPLACEMENT

REMOVAL PROCEDURE

1. Discharge the fuel system pressure. Refer to **Fuel Pressure Relief**.
2. Align the front wheels facing straight ahead.
3. Remove the front wheel.
4. Remove the engine under cover LH.
5. Remove the engine under cover RH.
6. Drain the engine coolant. Refer to **Cooling System Draining and Filling**.
7. Drain the manual transaxle oil for the manual transaxle.
8. Drain the automatic transaxle fluid for the automatic transaxle.

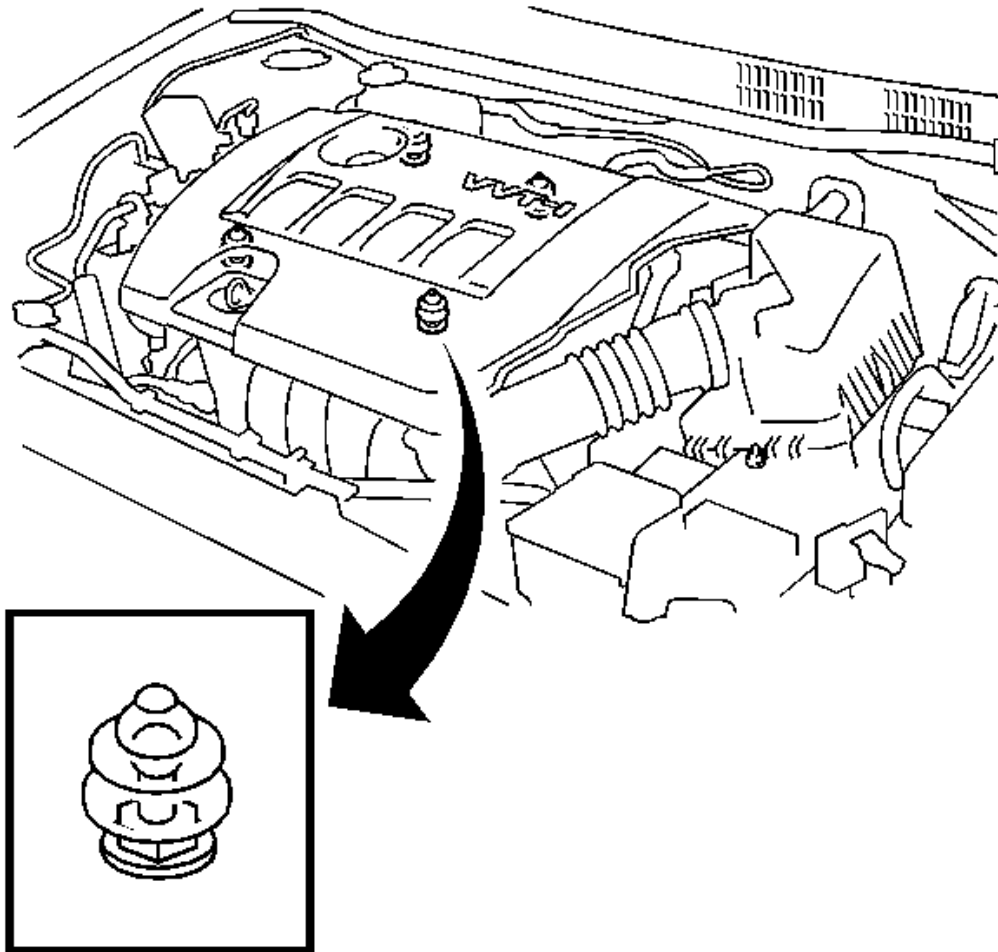


Fig. 191: View Of Engine Cover Clips
Courtesy of GENERAL MOTORS CORP.

NOTE: Attempting to disengage both front and rear clips at the same time may cause the cover to break.

9. Remove the engine cover.

Hold the rear of the cover and raise it to disengage the 2 clips on the rear of the cover. Continue to raise the cover to disengage the 2 clips on the front of the cover and remove the cover.

10. Separate the air cleaner filter element from the air cleaner.

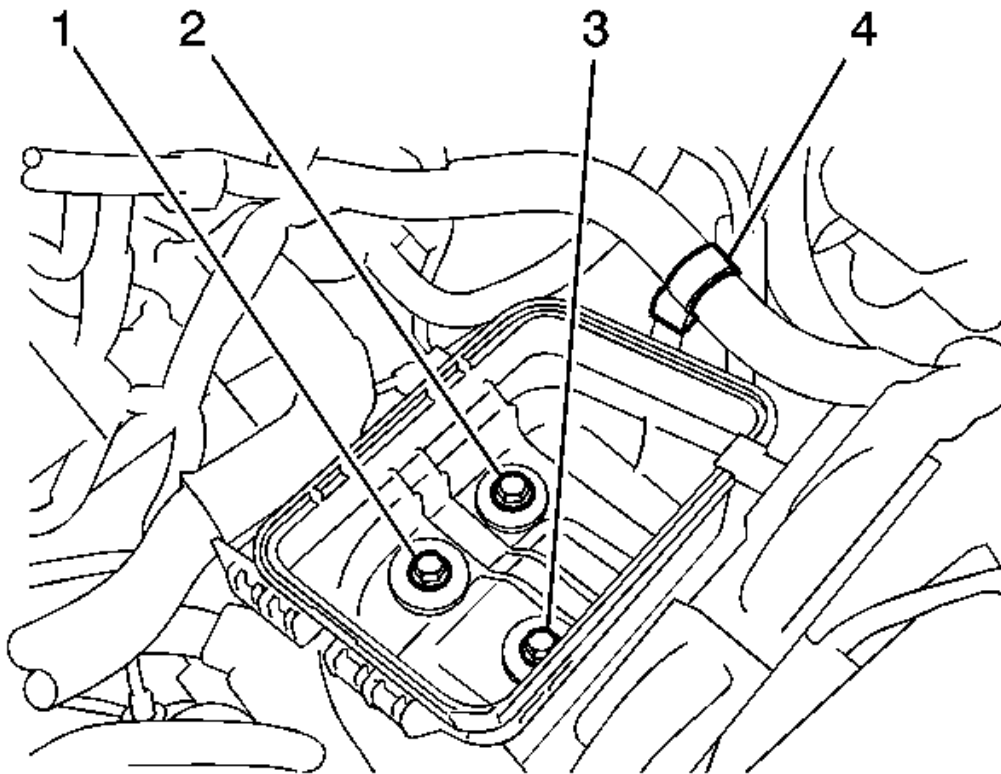


Fig. 192: Identifying Air Cleaner Case & Engine Wire Harness Clamp
Courtesy of GENERAL MOTORS CORP.

11. Disconnect the engine wire harness clamp (4) from air cleaner case.
12. Remove the 3 bolts (1-3) and the air cleaner case.
13. Remove the battery. Refer to **Battery Replacement** .

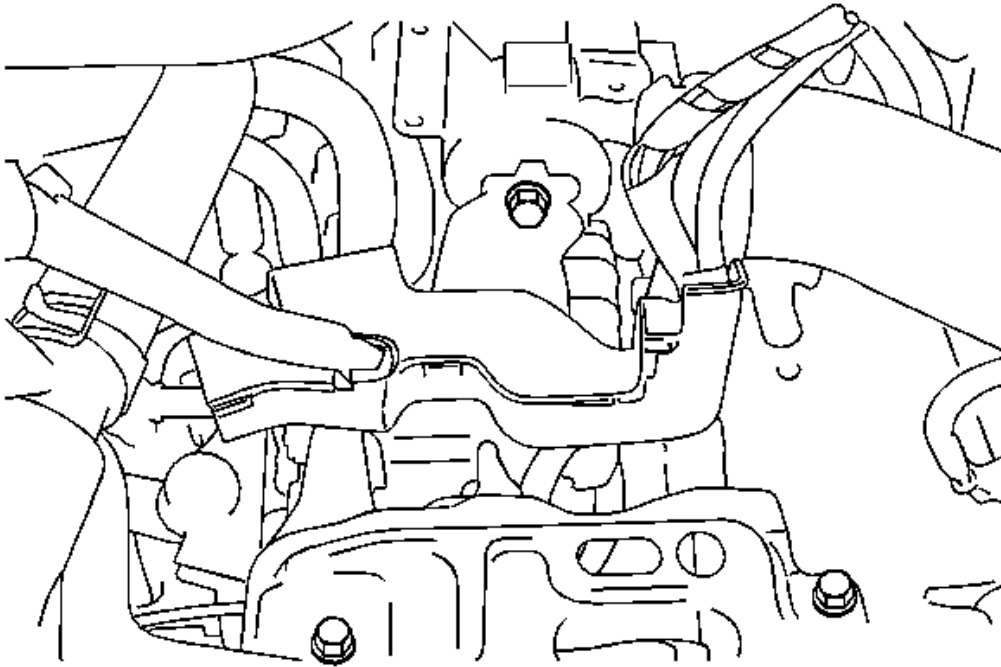


Fig. 193: Identifying Wire Harness Clamps At Battery Carrier
Courtesy of GENERAL MOTORS CORP.

14. Remove the battery carrier. Refer to **Battery Tray Replacement** .
15. Separate the 2 wire harness clamps from the battery carrier.

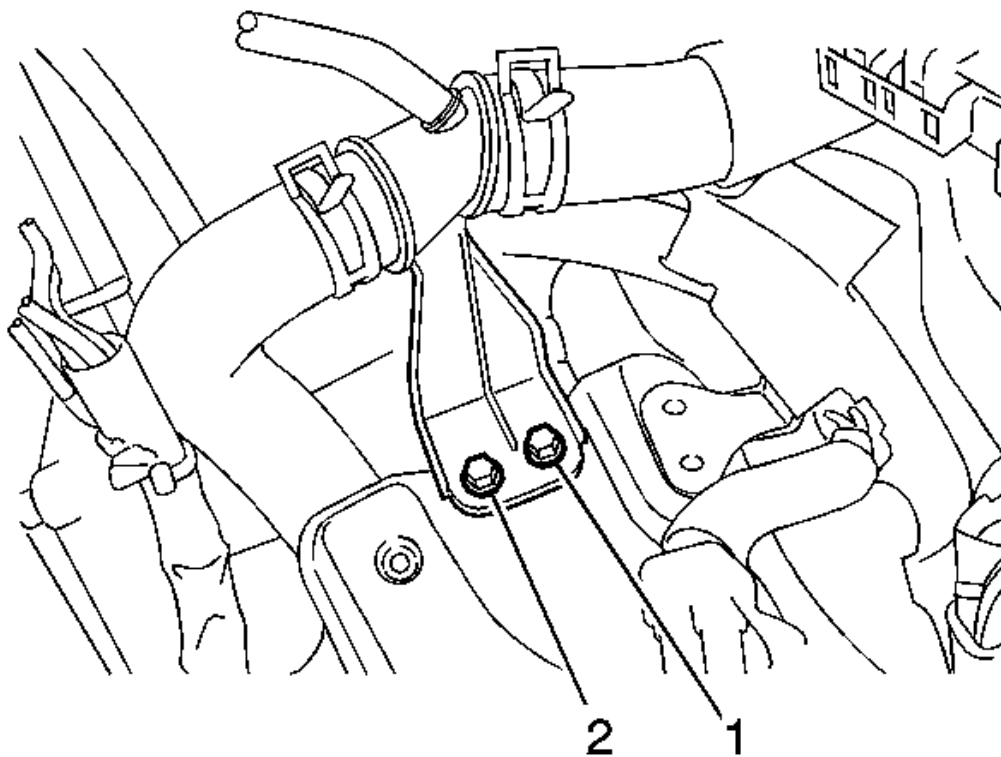


Fig. 194: Identifying Radiator Pipe Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

16. Remove the 2 bolts (1).
17. Separate the radiator pipe from the battery carrier.

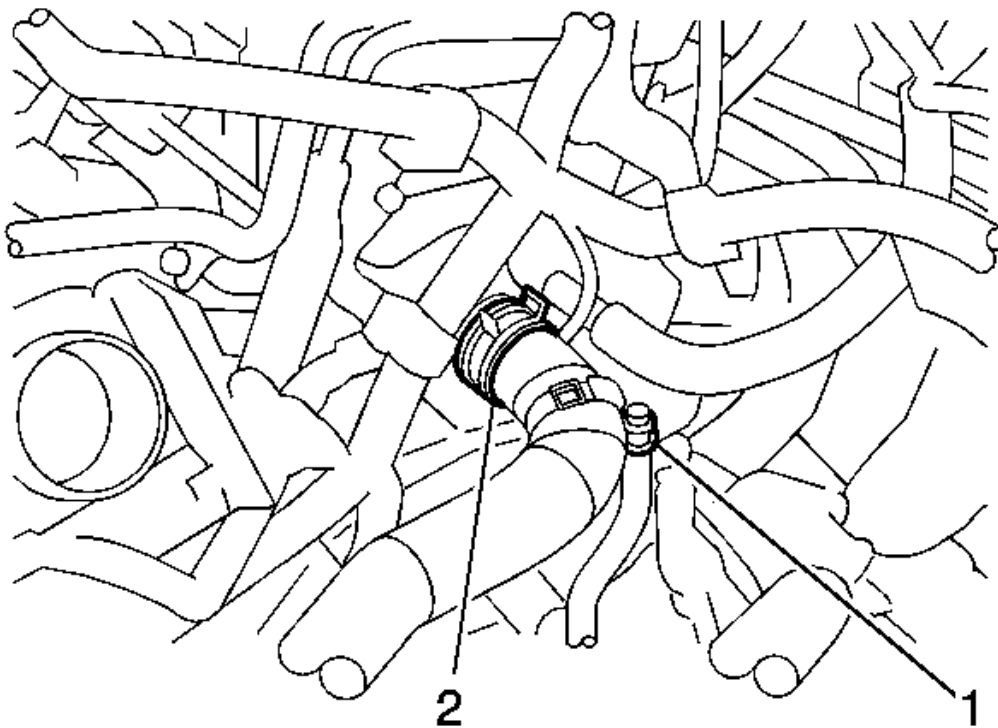


Fig. 195: Identifying Upper Radiator Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

18. Disengage the clamp (1) from the upper radiator hose.
19. Disconnect the upper radiator hose from the cylinder head.

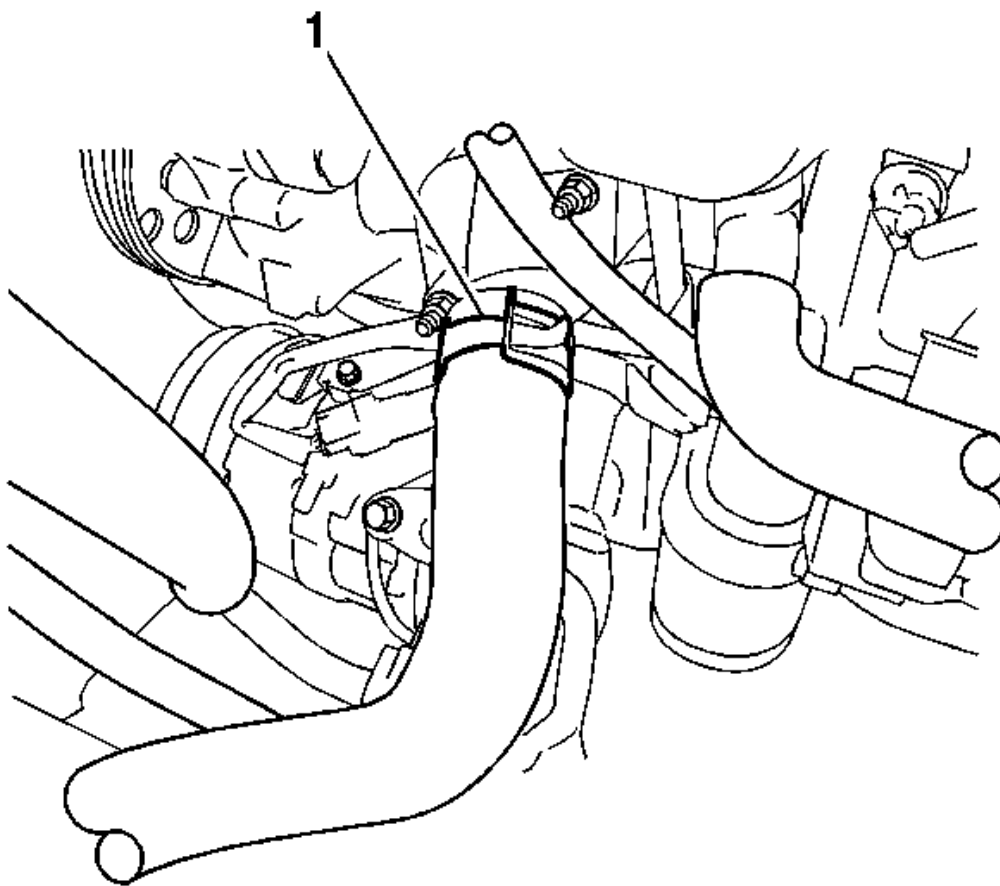


Fig. 196: Identifying Lower Radiator Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

20. Disconnect the lower radiator hose (1) from the water inlet.

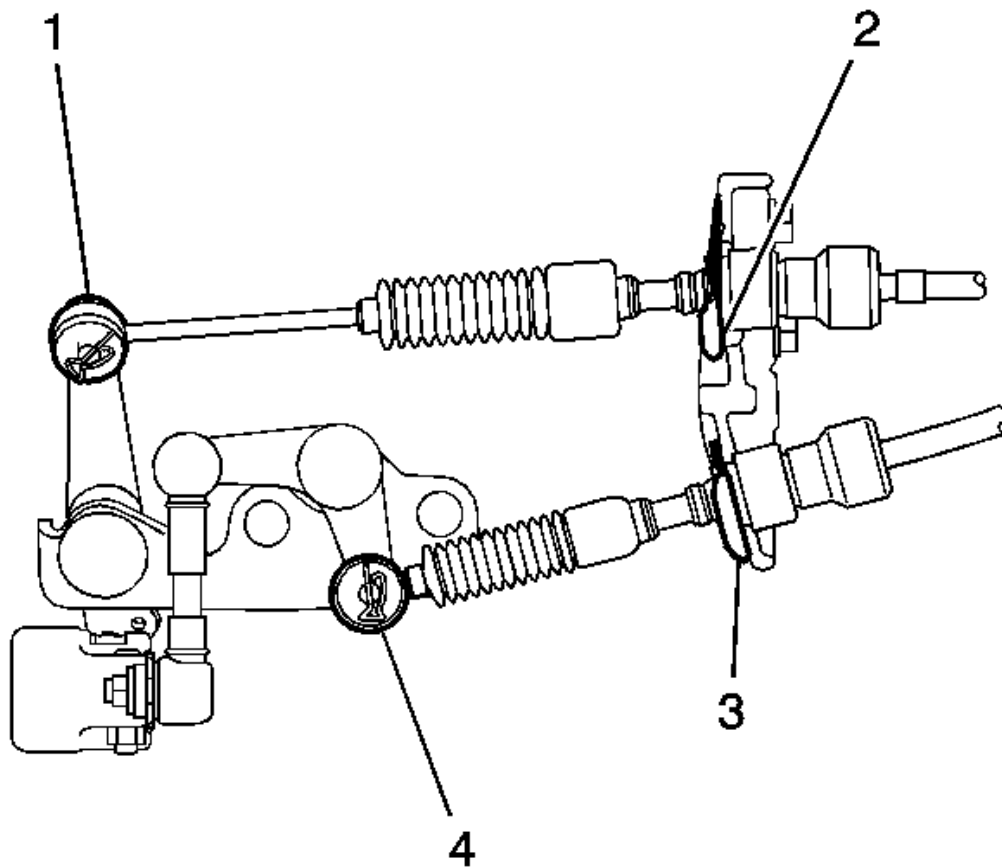


Fig. 197: Identifying Manual Transmission Shift Control Cables
Courtesy of GENERAL MOTORS CORP.

21. If equipped with manual transmission, remove the 2 clips (1, 4) and disconnect the 2 cables (2, 3) from the transaxle.

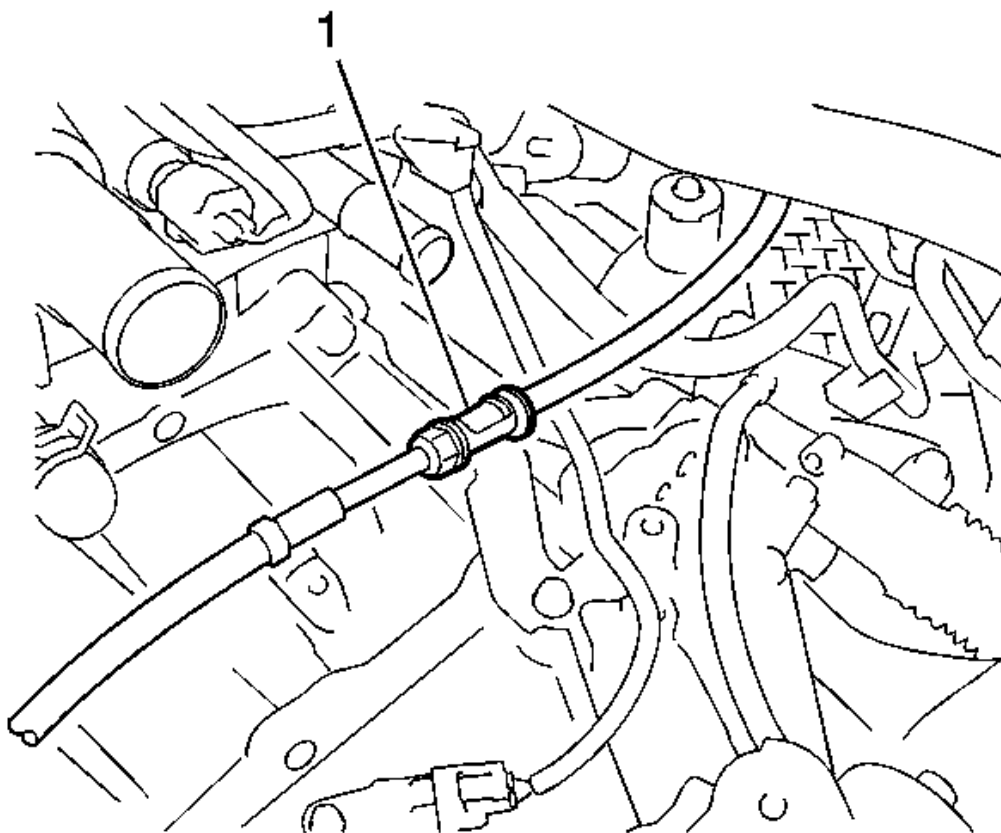


Fig. 198: Identifying Automatic Transmission Shift Control Cable
Courtesy of GENERAL MOTORS CORP.

22. If equipped with automatic transmission, disconnect the control cable from the control cable support.
23. Remove the nut and disconnect the control cable from the control shaft lever.
24. Remove the clip (1) and disconnect the control cable from the control cable bracket.
25. Remove the bolt and disconnect the clamp of the control cable.

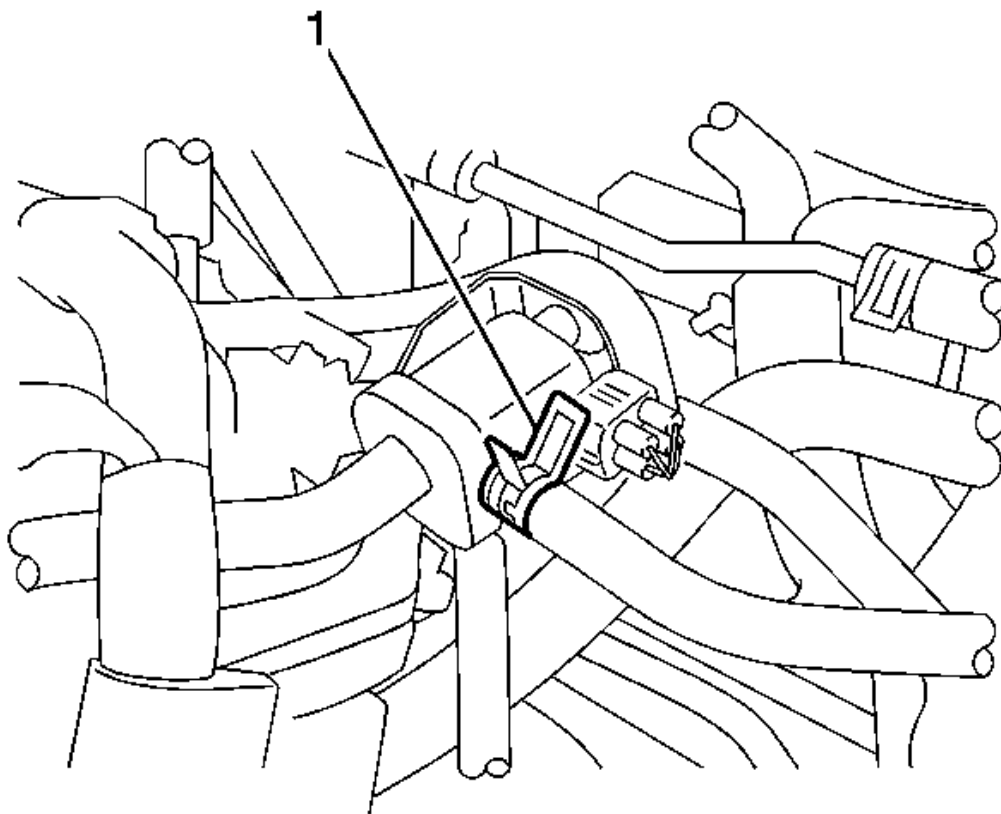


Fig. 199: Identifying Fuel Vapor Feed Hose Assembly
Courtesy of GENERAL MOTORS CORP.

26. Disconnect the fuel vapor feed hose assembly (1).

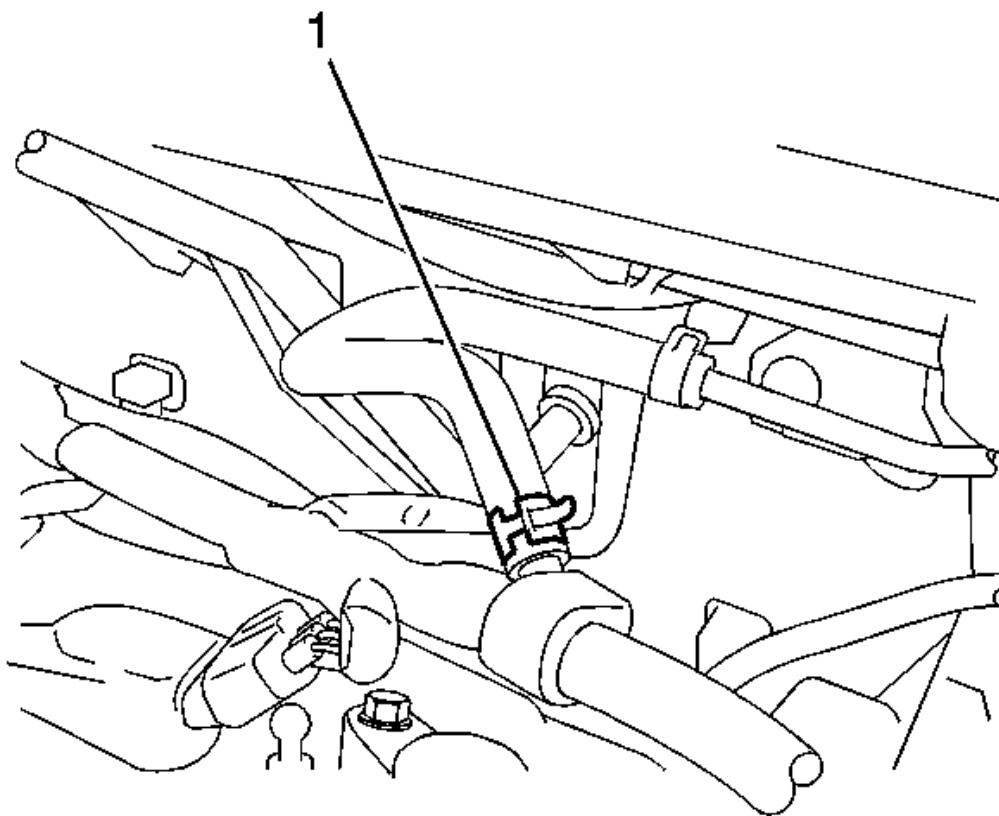


Fig. 200: Identifying Connector Tube Hose & Union
Courtesy of GENERAL MOTORS CORP.

27. Disconnect the union to connector tube hose (1).

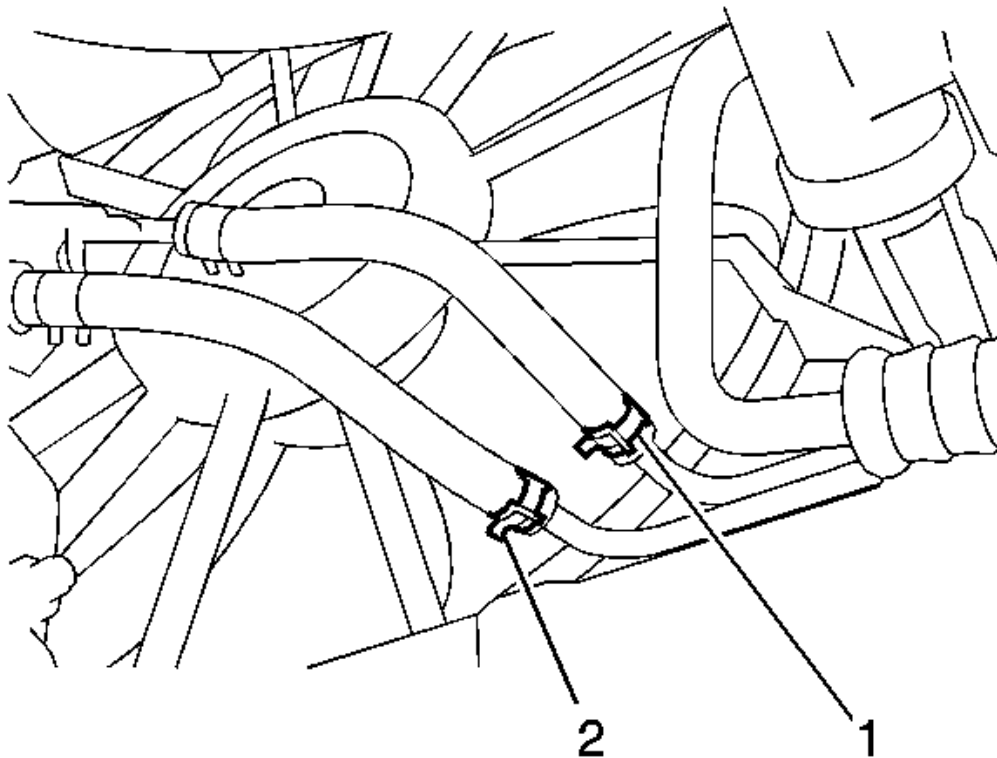


Fig. 201: Identifying Cooler Hoses & Oil Cooler Tube
Courtesy of GENERAL MOTORS CORP.

28. Disconnect the 2 oil cooler hoses (1, 2) from the oil cooler tube, if equipped with automatic transaxle.

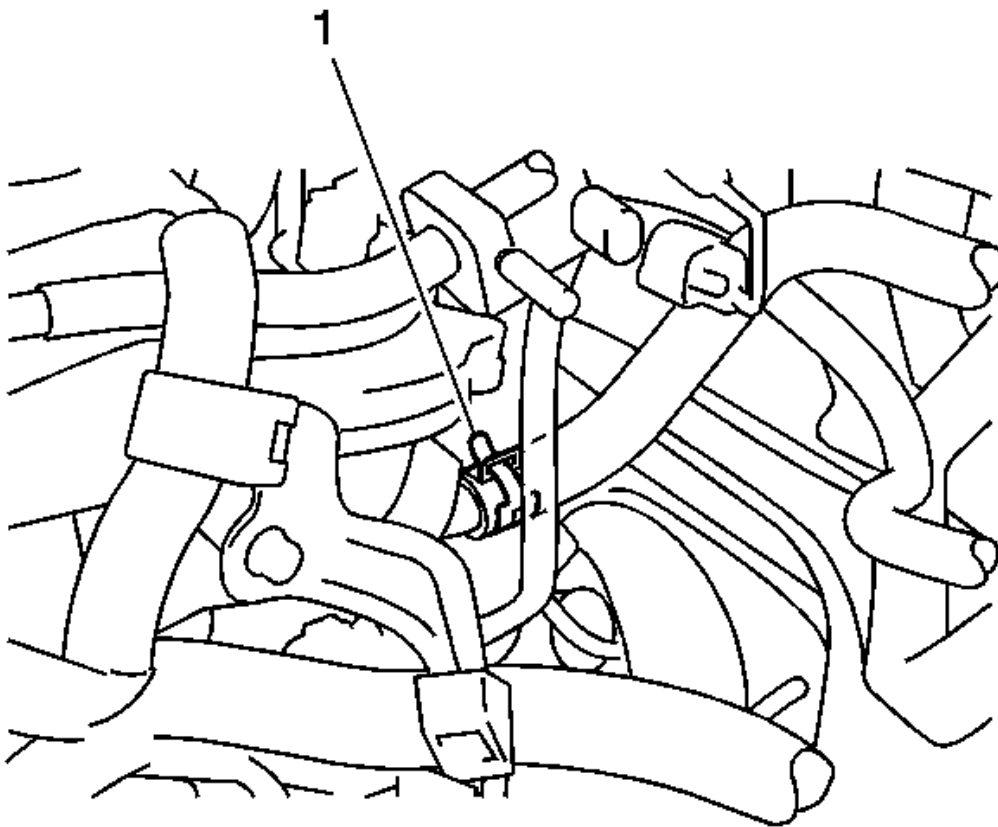


Fig. 202: Identifying Heater Outlet Hose
Courtesy of GENERAL MOTORS CORP.

29. Disconnect the outlet heater water hose (1) from the engine.

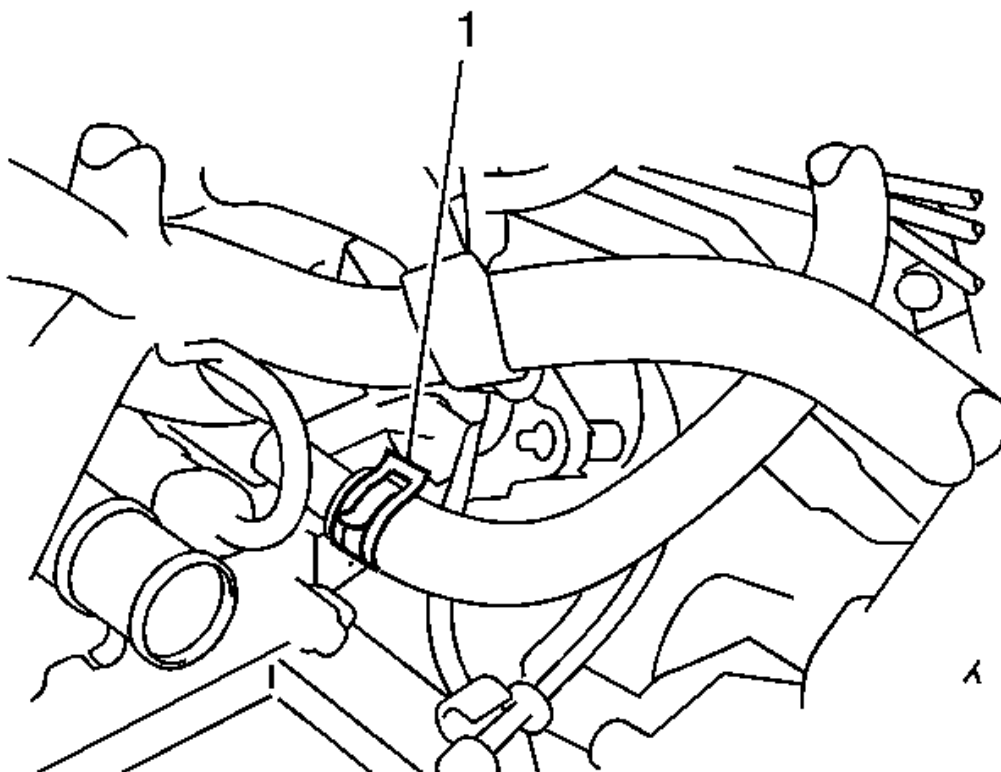


Fig. 203: Identifying Heater Inlet Hose
Courtesy of GENERAL MOTORS CORP.

30. Disconnect the inlet heater water hose (1) from the engine.

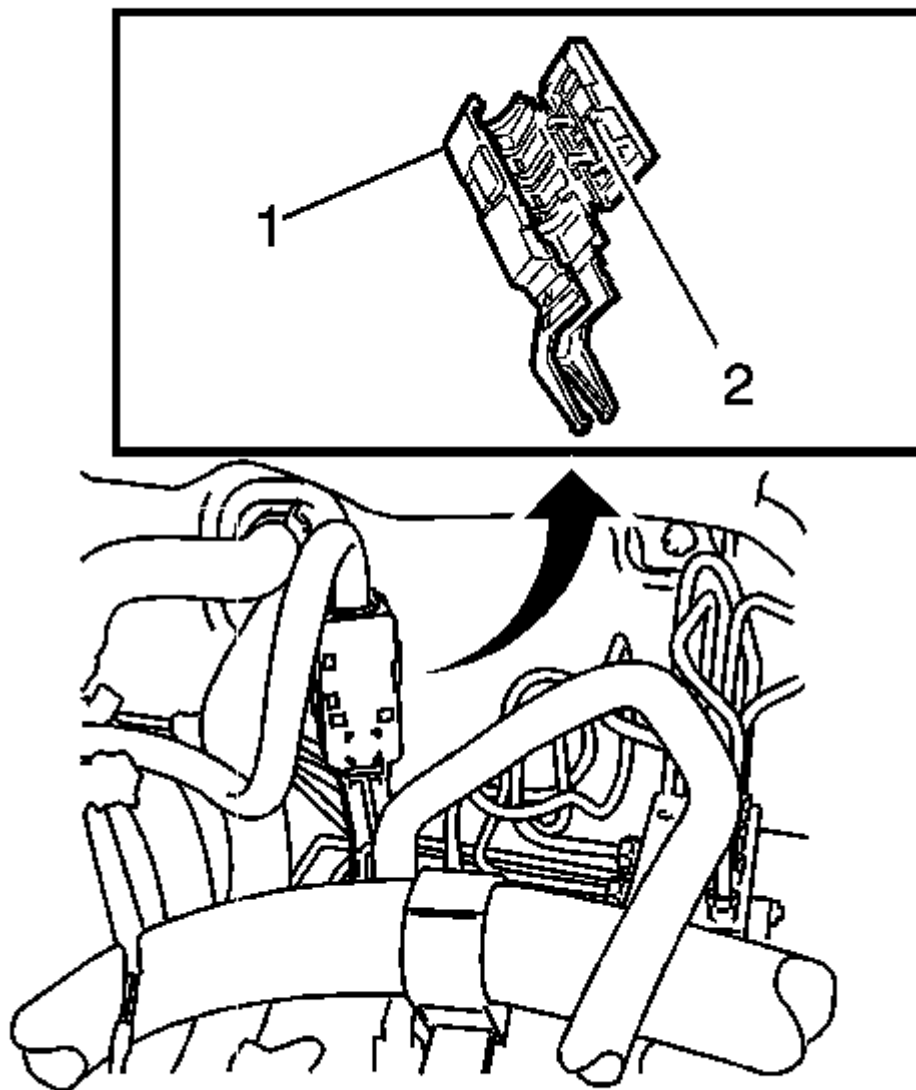


Fig. 204: Identifying Fuel Pipe Clamp & Claw
Courtesy of GENERAL MOTORS CORP.

31. Release the claw and remove the fuel pipe clamp (1).

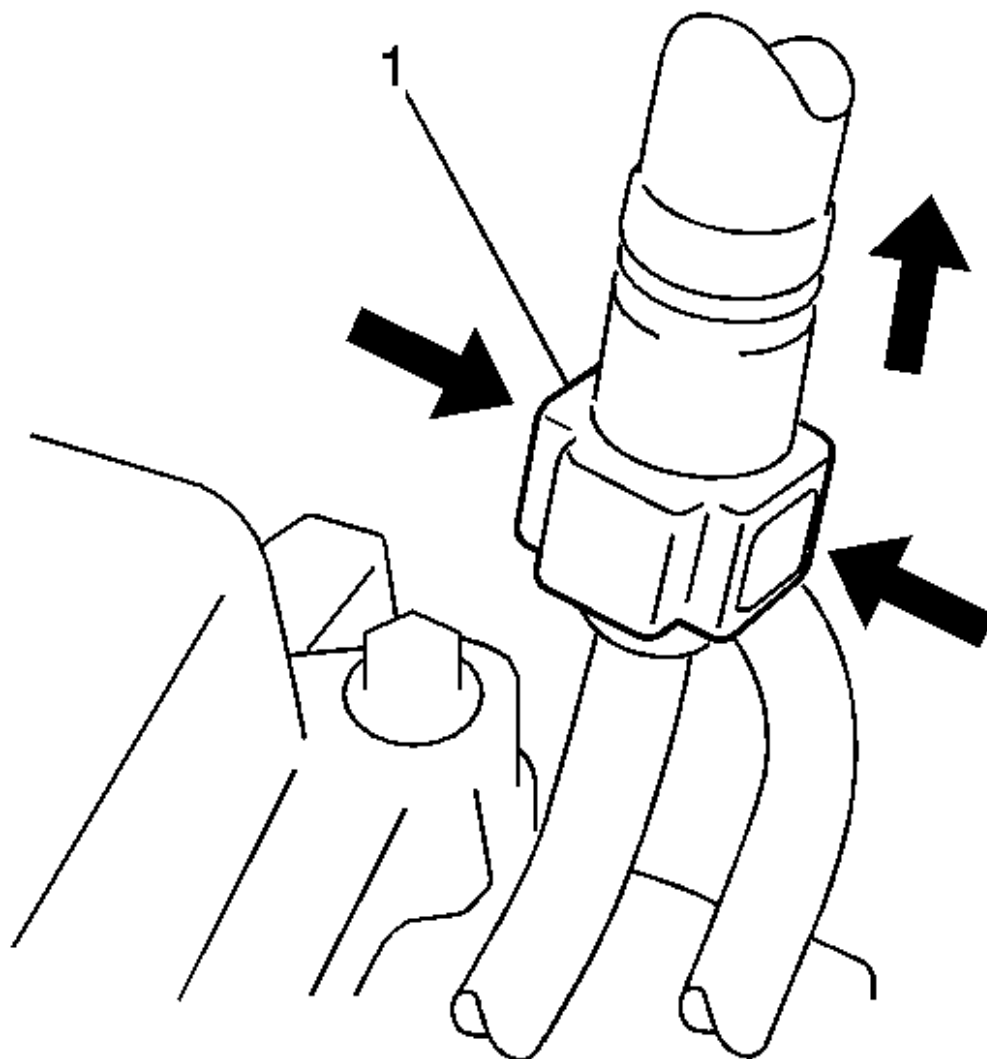


Fig. 205: View Of Fuel Tube Connector
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Remove any dirt and foreign matter from the fuel tube connector before performing this work.
- Do not allow any scratches or foreign matter on the parts when disconnecting, as the fuel tube connector has the O-rings that seal the pipe. Perform this work by hand. Do not use any tools.
- Do not forcibly bend, kink or twist the nylon tube.

- **Protect the disconnected parts by covering them with vinyl bags after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**

32. Pinch the retainer (1) then pull the fuel tube connector out of the pipe.
33. Remove the V-ribbed belt.
34. Remove the generator assembly.
35. Separate the compressor with pulley assembly with air conditioning system.
36. Disconnect the connector.

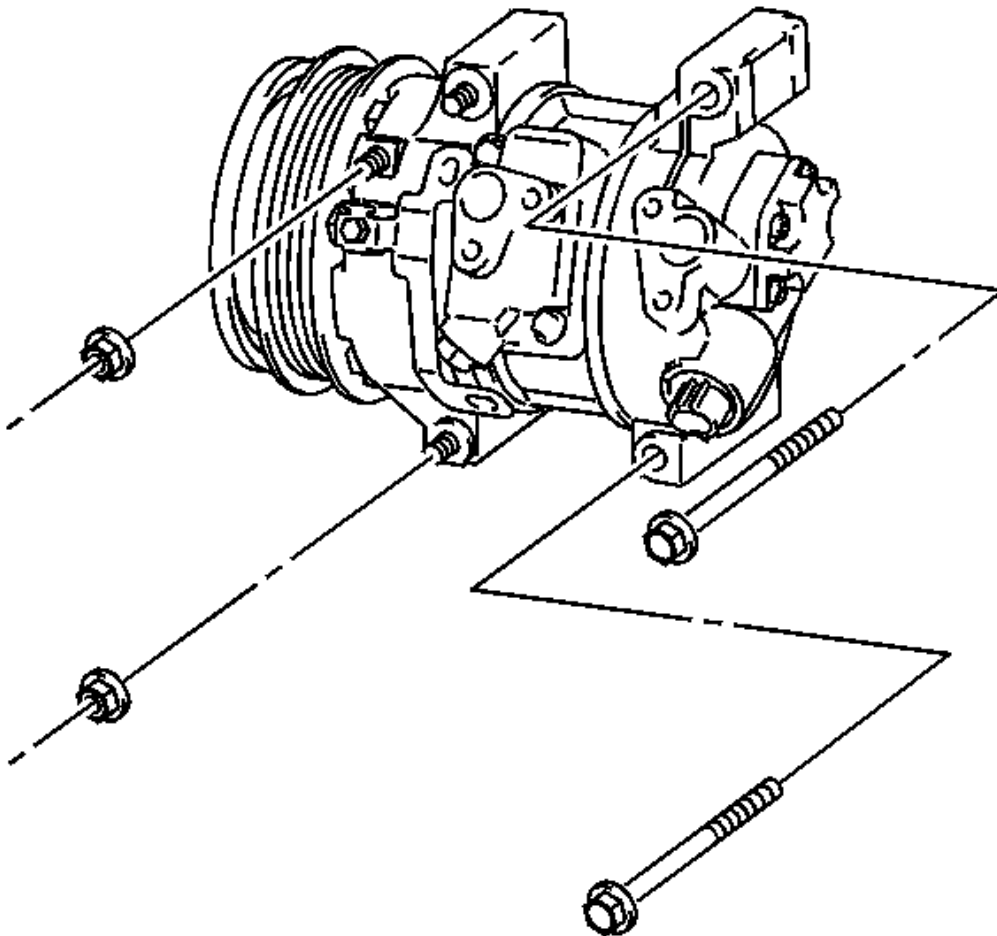


Fig. 206: Identifying A/C Compressor Bolts & Nuts

Courtesy of GENERAL MOTORS CORP.

37. Remove the 2 bolts and 2 nuts.

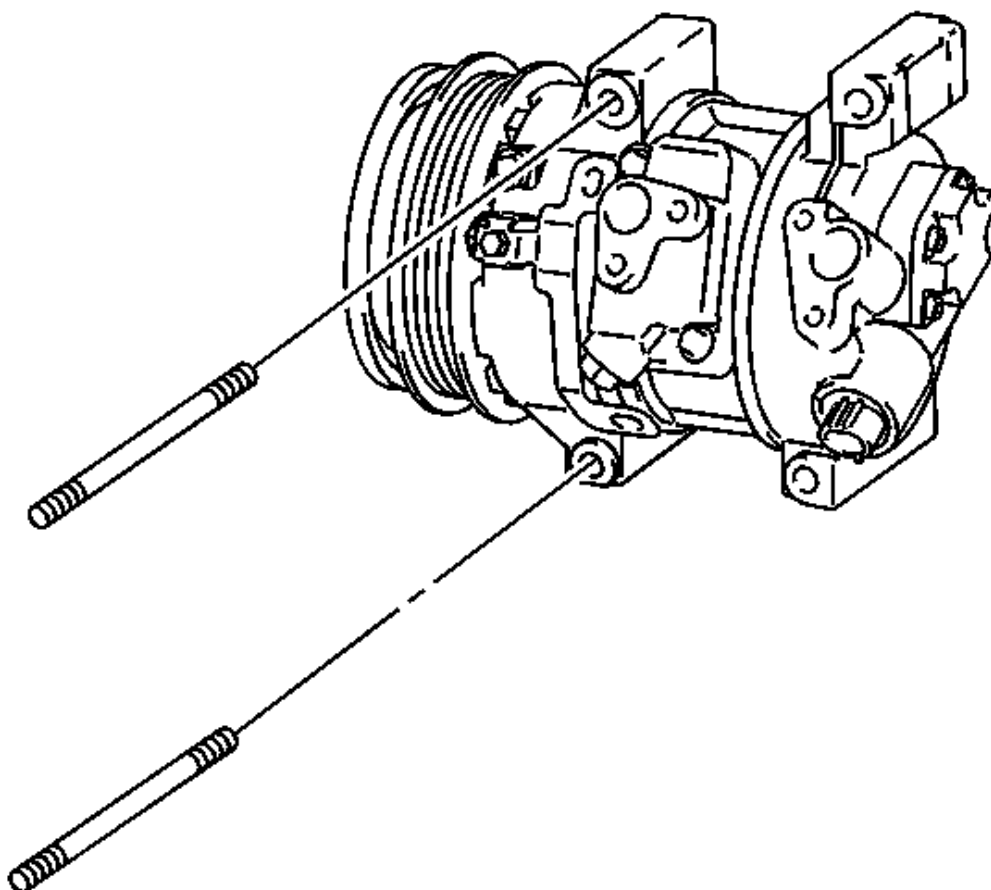


Fig. 207: Identifying A/C Compressor Studs

Courtesy of GENERAL MOTORS CORP.

NOTE: **Secure the compressor and hoses off to the side instead of discharging the A/C system.**

38. Using a TORX socket wrench, remove the 2 stud bolts and compressor with pulley assembly.

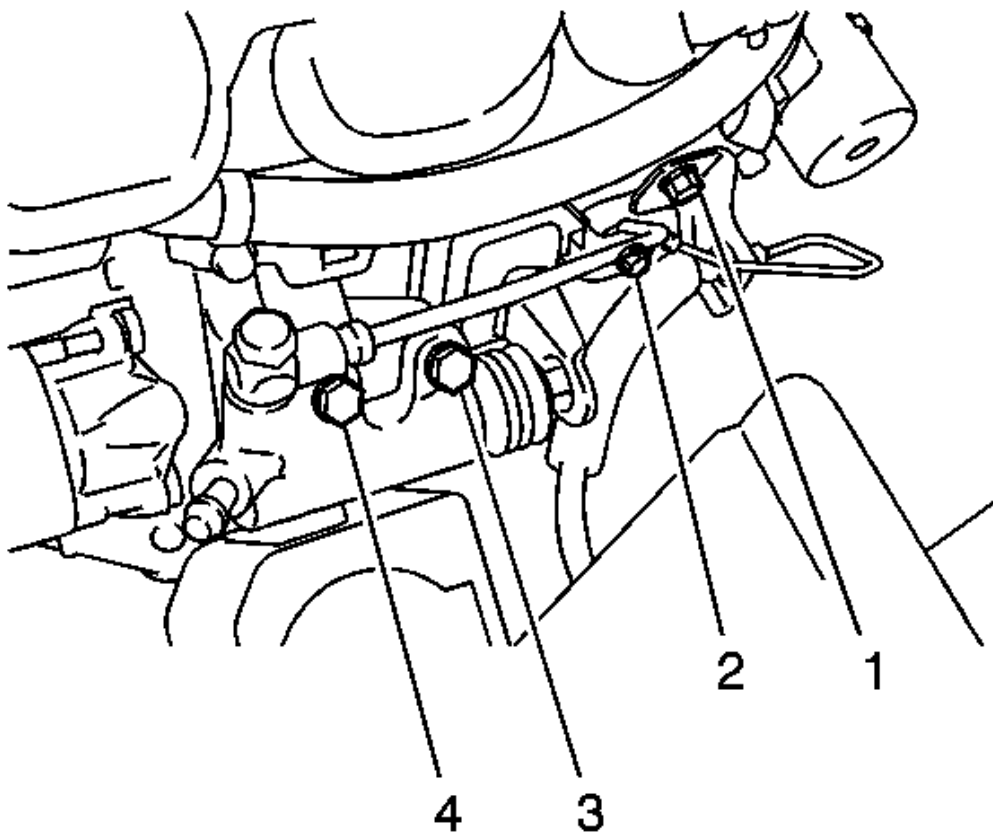


Fig. 208: Identifying Clutch Release Cylinder Assembly, Bracket & Bolts
Courtesy of GENERAL MOTORS CORP.

39. Remove the 4 bolts (1-4) and clutch tube bracket, and separate the clutch release cylinder assembly.

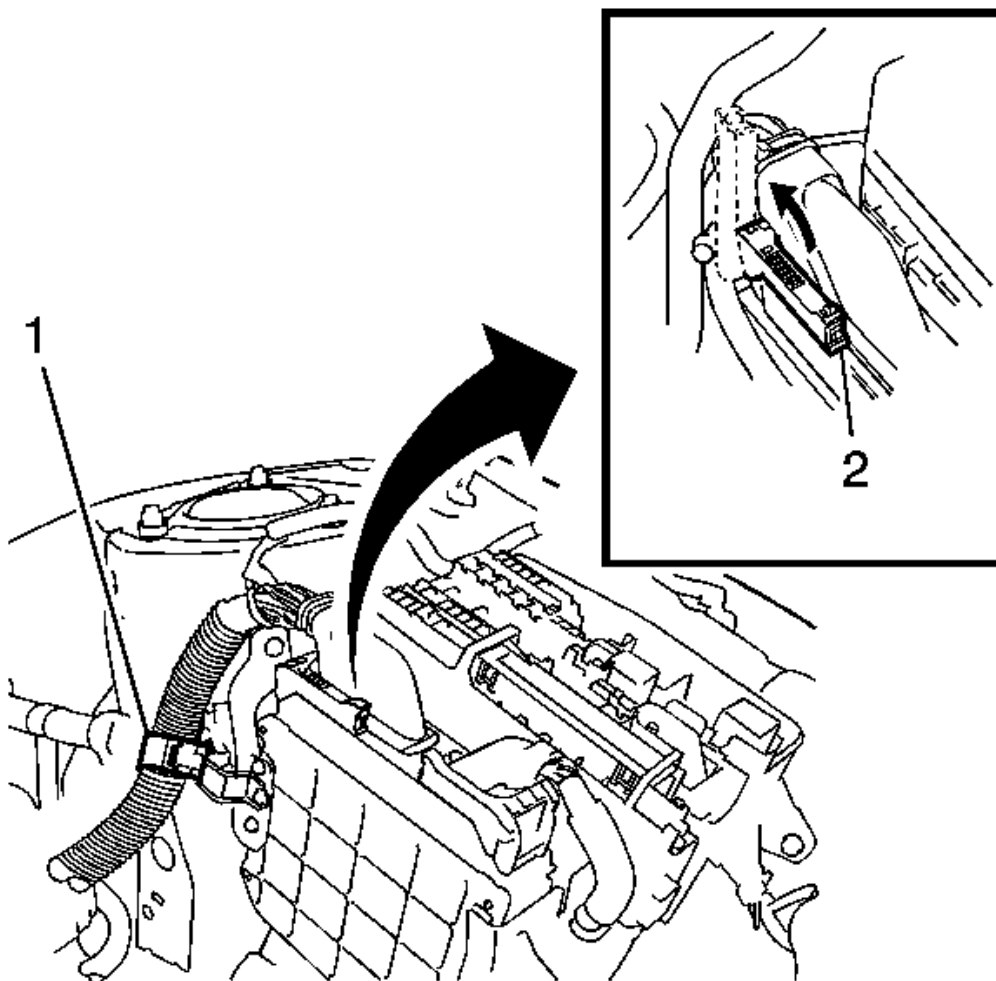


Fig. 209: View Of Lever & ECM Connector
Courtesy of GENERAL MOTORS CORP.

40. Disconnect the wire harness from the clamp (1).
41. Pull up the lever (2) and disconnect the ECM connector.

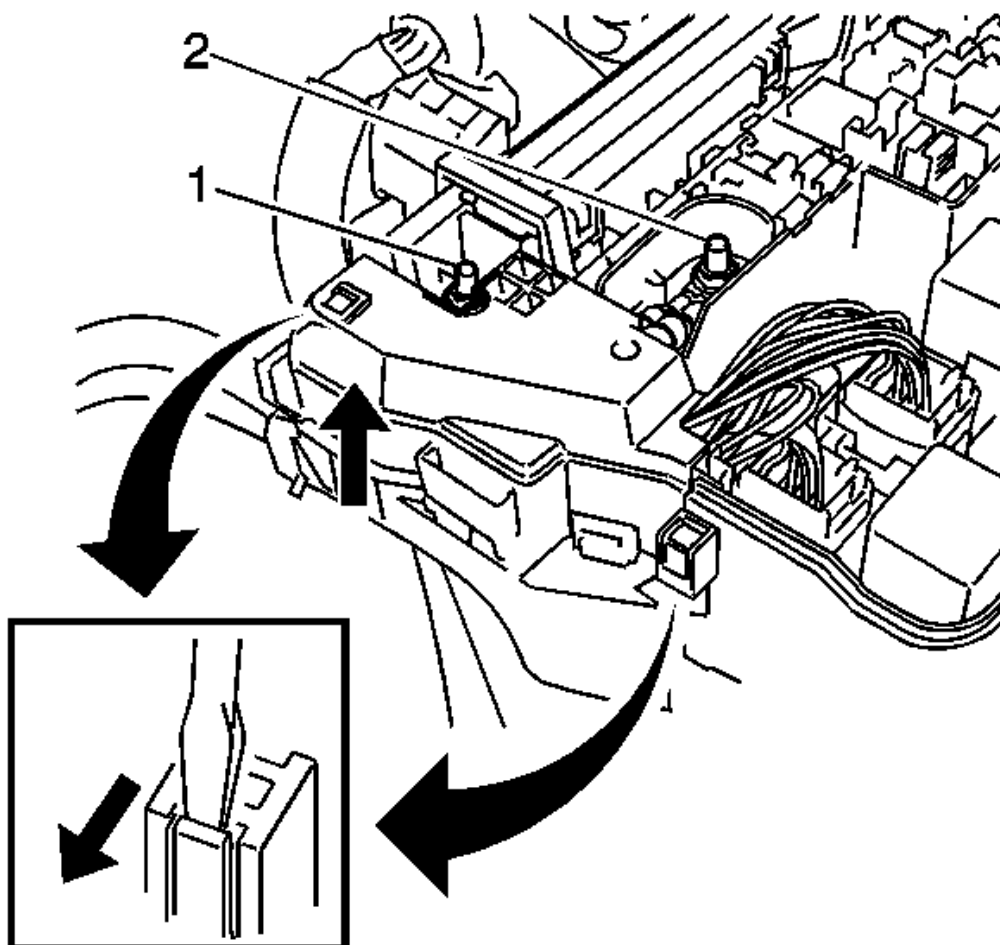


Fig. 210: Locating Engine Room Junction Block, Wire Harness & Connectors
 Courtesy of GENERAL MOTORS CORP.

42. Remove the 2 nuts (1, 2).
43. Remove the 3 connectors and 2 clamps from the engine room junction block and disconnect the wire harness.

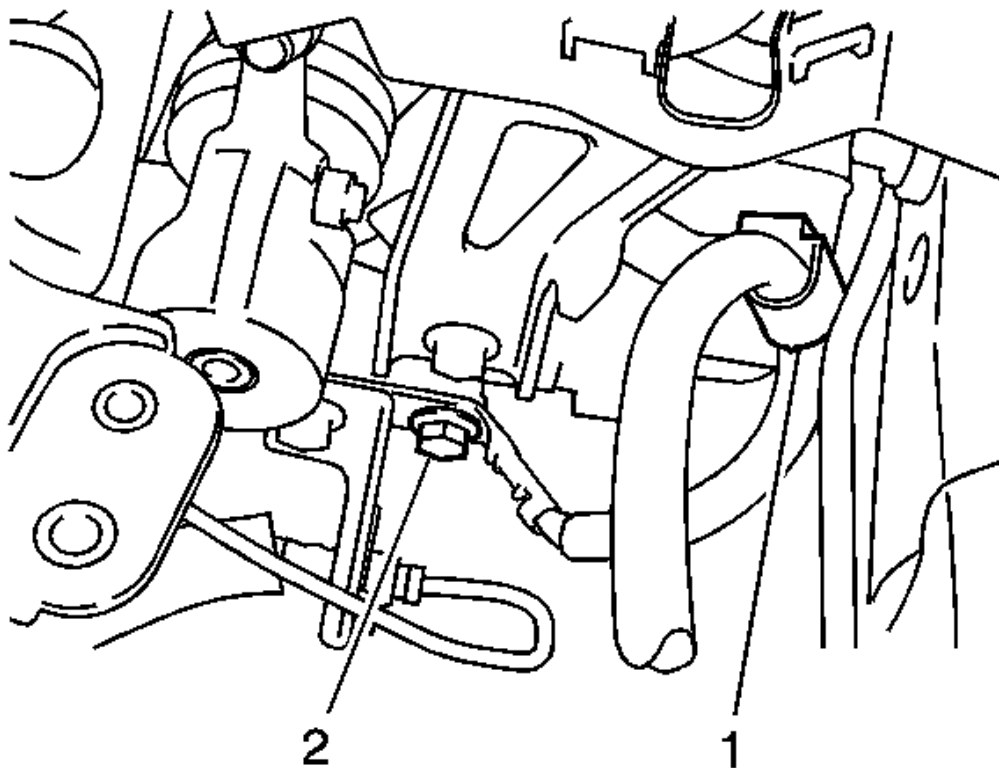


Fig. 211: View Of Bolt & Clamp (Manual Transaxle)
Courtesy of GENERAL MOTORS CORP.

44. Remove the bolt (2) and clamp (1) for the manual transaxle.

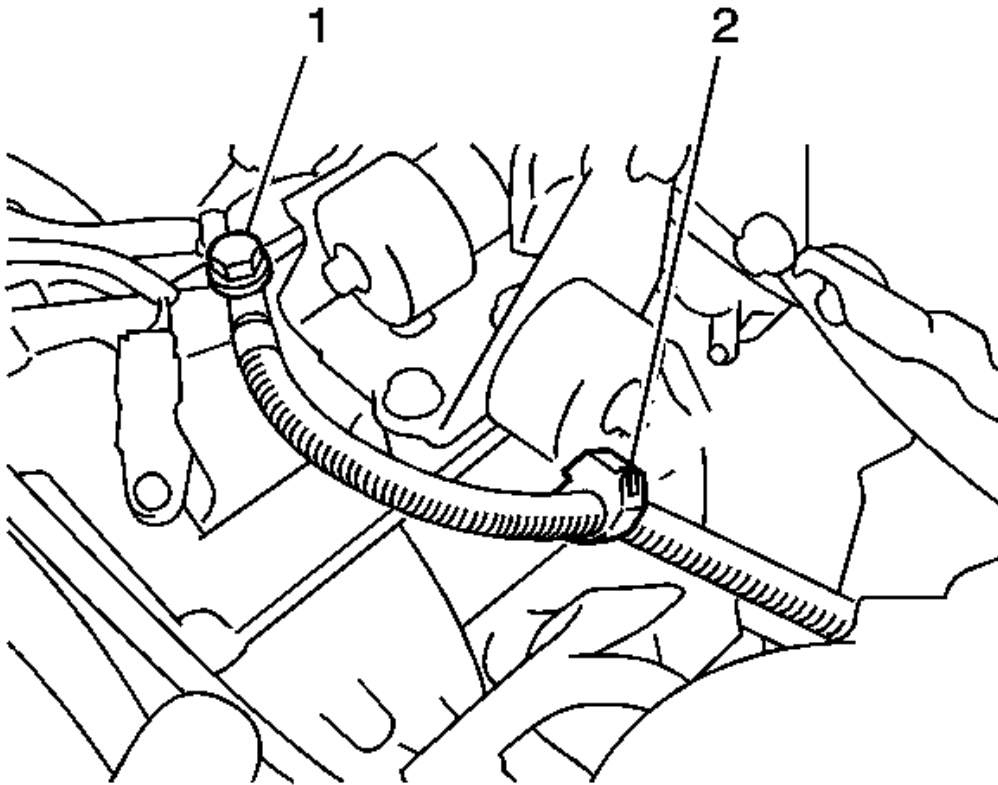


Fig. 212: Identifying Bolt & Clamp (Automatic Transaxle)
 Courtesy of GENERAL MOTORS CORP.

45. Remove the bolt (1) and clamp (2) for the automatic transaxle.
46. Remove the ground cable on the right side of the cylinder head.
47. Secure the steering wheel.
48. Remove the column hole cover silencer sheet.
49. Separate the steering intermediate shaft assembly.
50. Disconnect the steering column hole cover sub-assembly.
51. Remove the front exhaust pipe assembly.
52. Remove the front axle shaft LH nut.
53. Remove the front axle shaft RH nut.
54. Disconnect the front speed sensor LH.
55. Disconnect the front speed sensor RH.
56. Separate the tie rod end assembly LH.

57. Separate the tie rod end assembly RH.
58. Separate the front stabilizer link assembly LH.
59. Separate the front stabilizer link assembly RH.
60. Separate the front lower suspension arm assembly LH.
61. Separate the front lower suspension arm assembly RH.

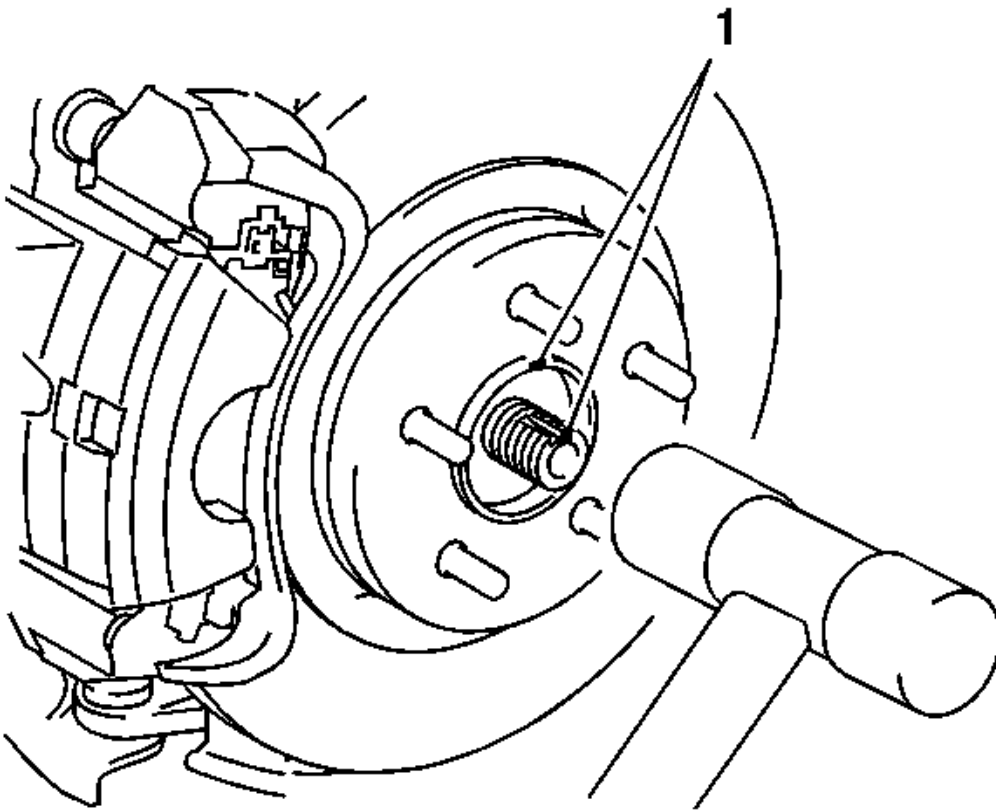


Fig. 213: View Of Axle Hub

Courtesy of GENERAL MOTORS CORP.

62. Separate the steering knuckle from the axle hub LH.
 1. Put matchmarks (1) on the drive shaft and axle hub.
 2. Using a plastic-faced hammer, disconnect the front axle assembly LH.
63. Separate the steering knuckle from the axle hub RH.
64. Remove the flywheel housing under cover-for automatic transaxle.
65. Remove the drive plate and torque converter clutch setting bolt-for automatic transaxle.

66. Remove the front suspension crossmember assembly. Refer to **Front Suspension Crossmember Replacement (All Wheel Drive)** or **Front Suspension Crossmember Replacement (Two Wheel Drive)**.
67. Remove the engine assembly with transaxle.

NOTE: Place the engine on wooden blocks or equivalent so that the engine is level.

68. Set the engine lifter.

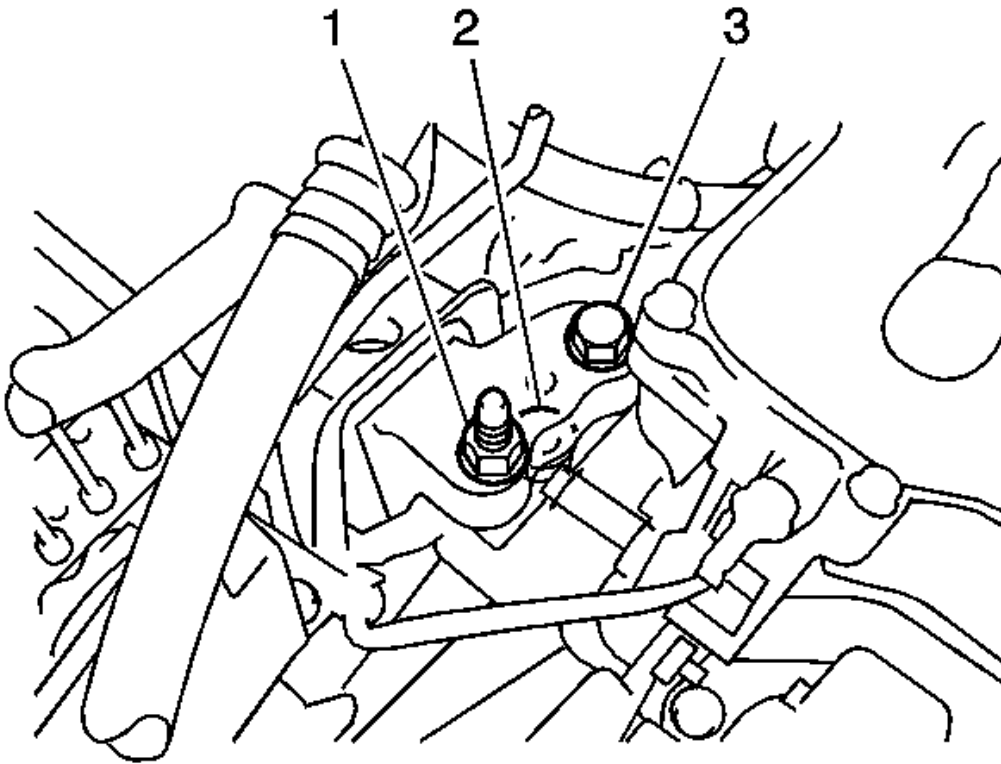


Fig. 214: Identifying Engine Mounting Insulator Bolts - Right Side
Courtesy of GENERAL MOTORS CORP.

69. Remove the bolt (1) and 2 nuts (2, 3), and separate the engine mount RH.

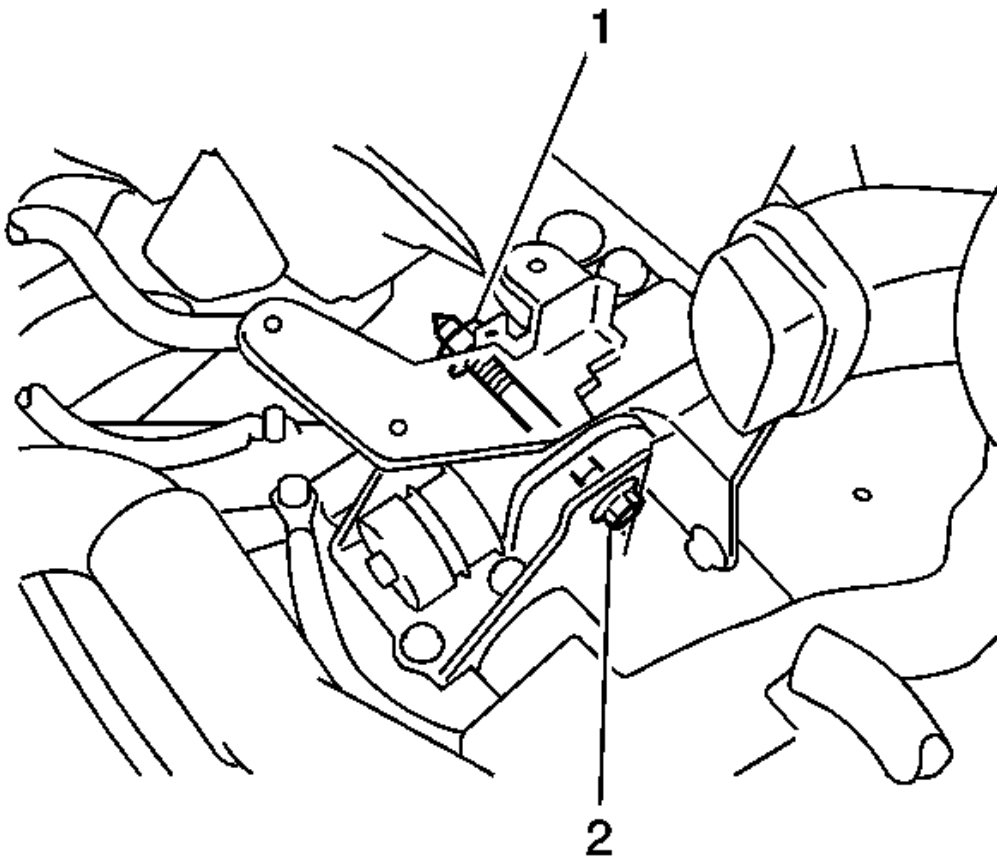


Fig. 215: Identifying Left Side Engine Mounting Insulator Through Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

70. Remove the through bolt (1) and nut (2), and separate the engine mount LH.
71. Carefully remove the engine with transaxle from the vehicle.

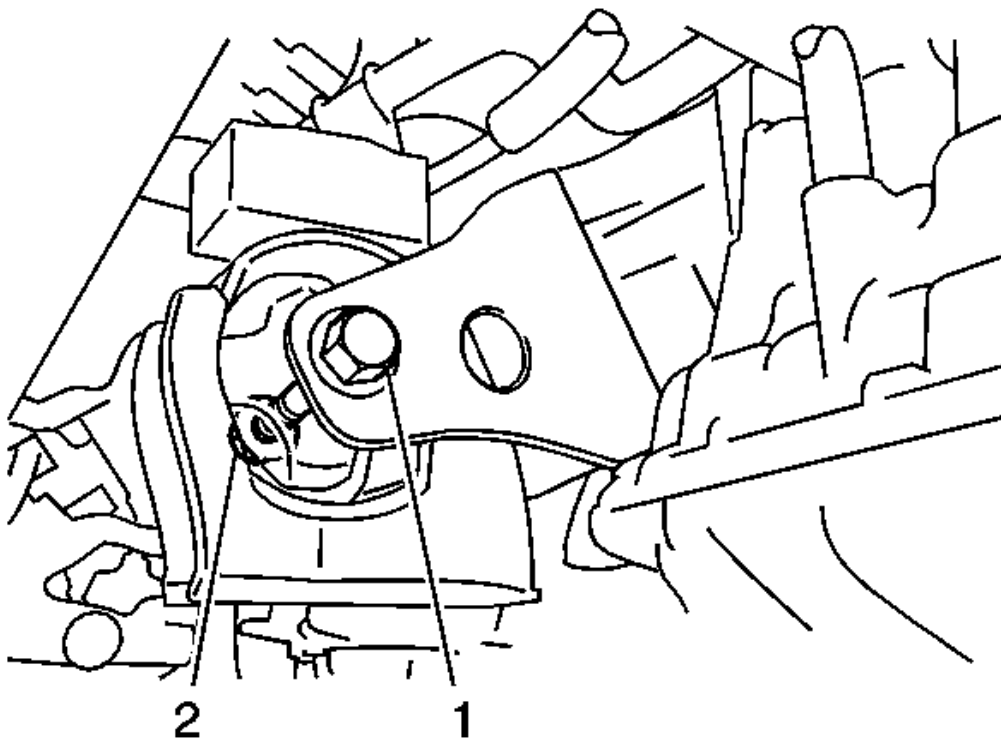


Fig. 216: Identifying Front Engine Mounting Insulator Bolt
Courtesy of GENERAL MOTORS CORP.

72. Remove the bolt (1) and nut (2), and remove the front engine mount.

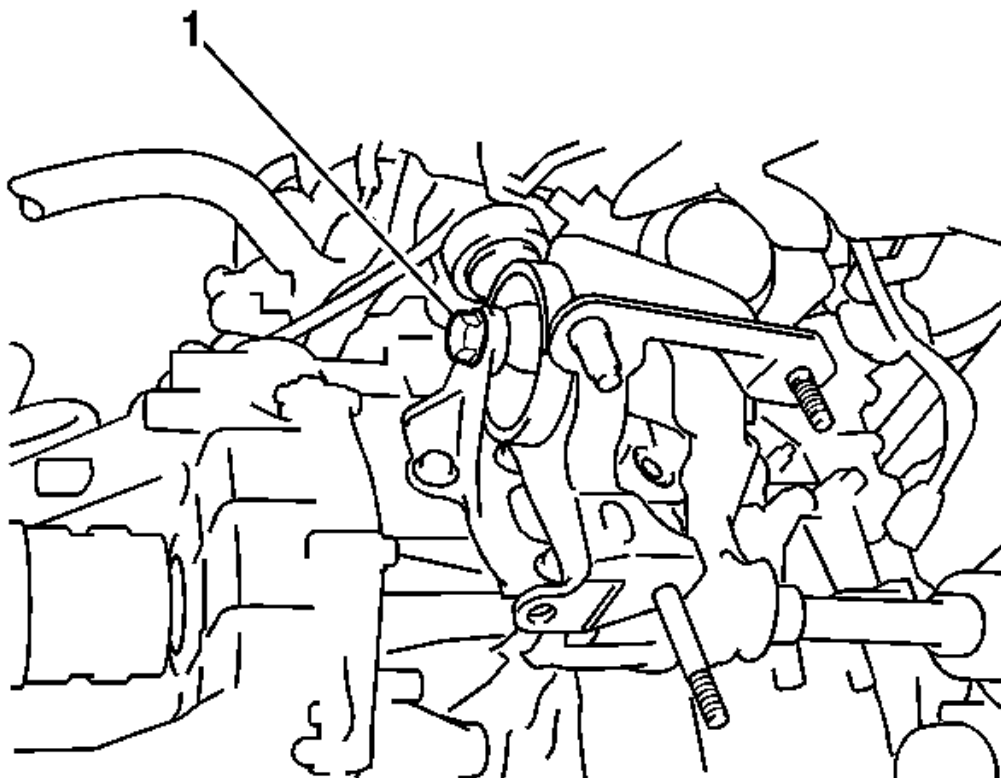


Fig. 217: Identifying Rear Engine Mounting Insulator Through Bolt
Courtesy of GENERAL MOTORS CORP.

73. Remove the through bolt (1) and the rear engine mount.

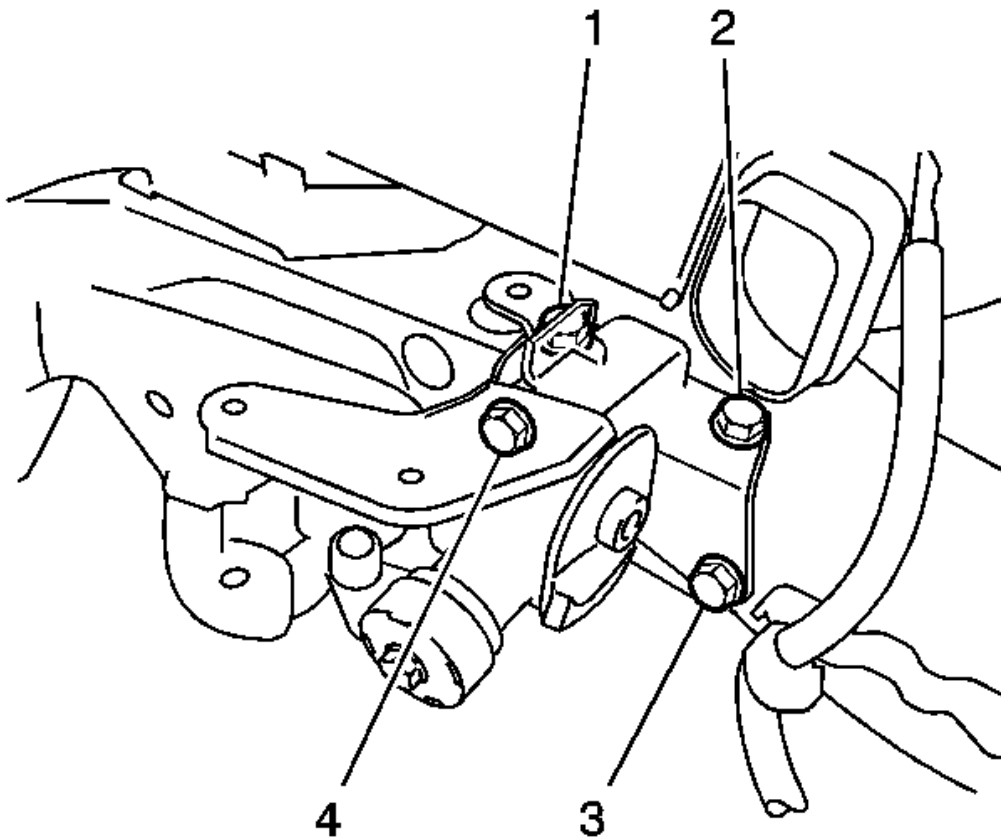


Fig. 218: Identifying Left Side Engine Mounting Insulator Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Perform this procedure only when replacement of the engine mounting insulator is necessary.

74. Remove the 4 bolts (1-4) and engine mount LH.

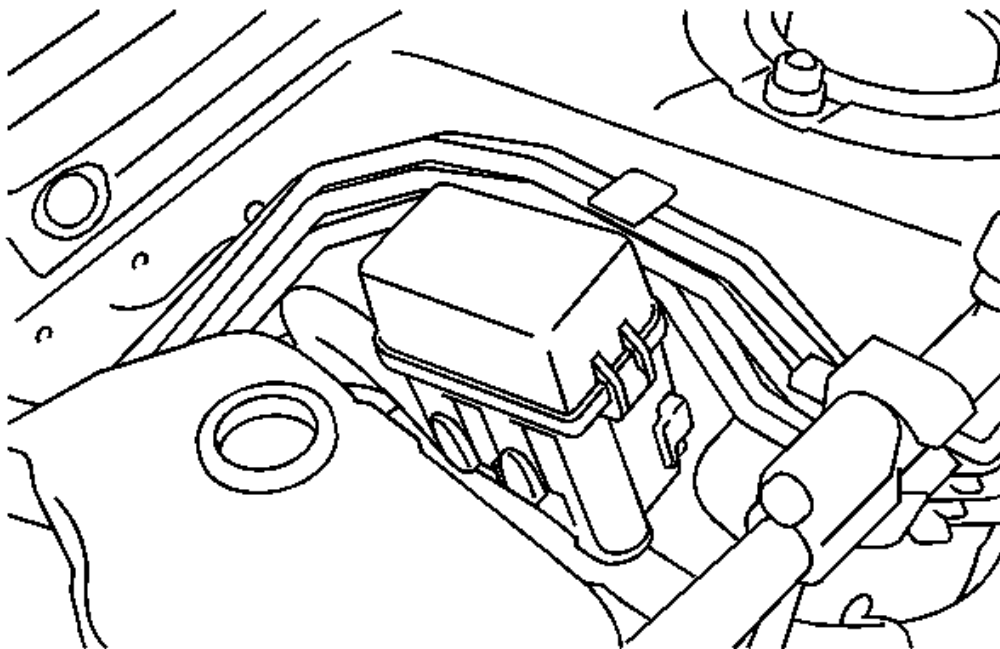


Fig. 219: View Of Relay Block Assembly
Courtesy of GENERAL MOTORS CORP.

75. Remove the engine mount RH.
76. Disconnect the clamp, and release the relay block assembly.

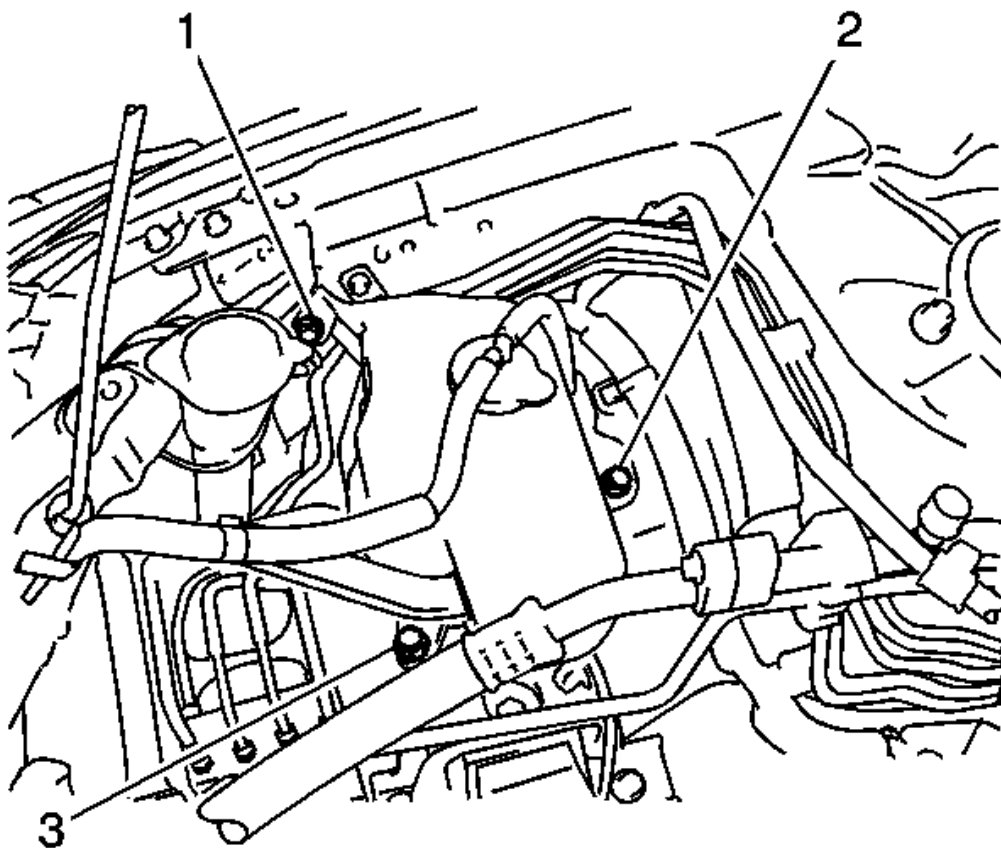


Fig. 220: Identifying Radiator Reserve Tank Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

77. Remove the 3 bolts (1-3) and radiator reserve tank.

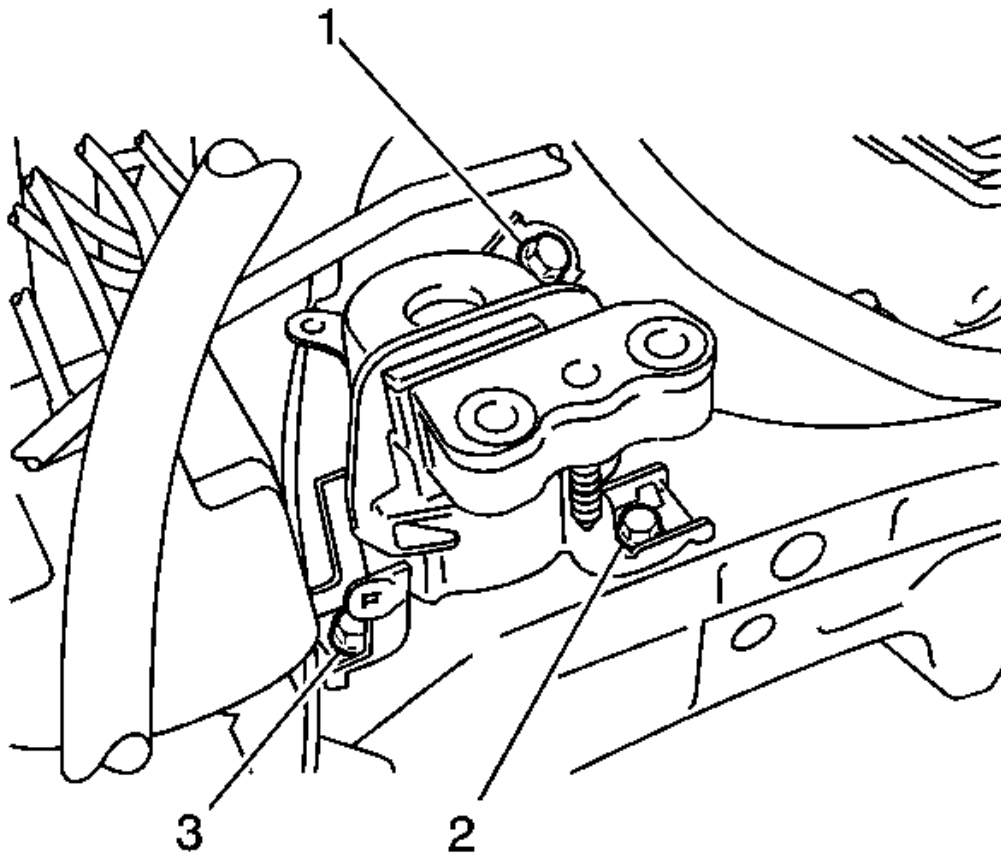


Fig. 221: View Of Engine Mounting Insulator Bolts - Right Side
Courtesy of GENERAL MOTORS CORP.

NOTE: Perform this procedure only when replacement of the engine mounting insulator is necessary.

78. Remove the 3 bolts (1-3) and engine mount RH.

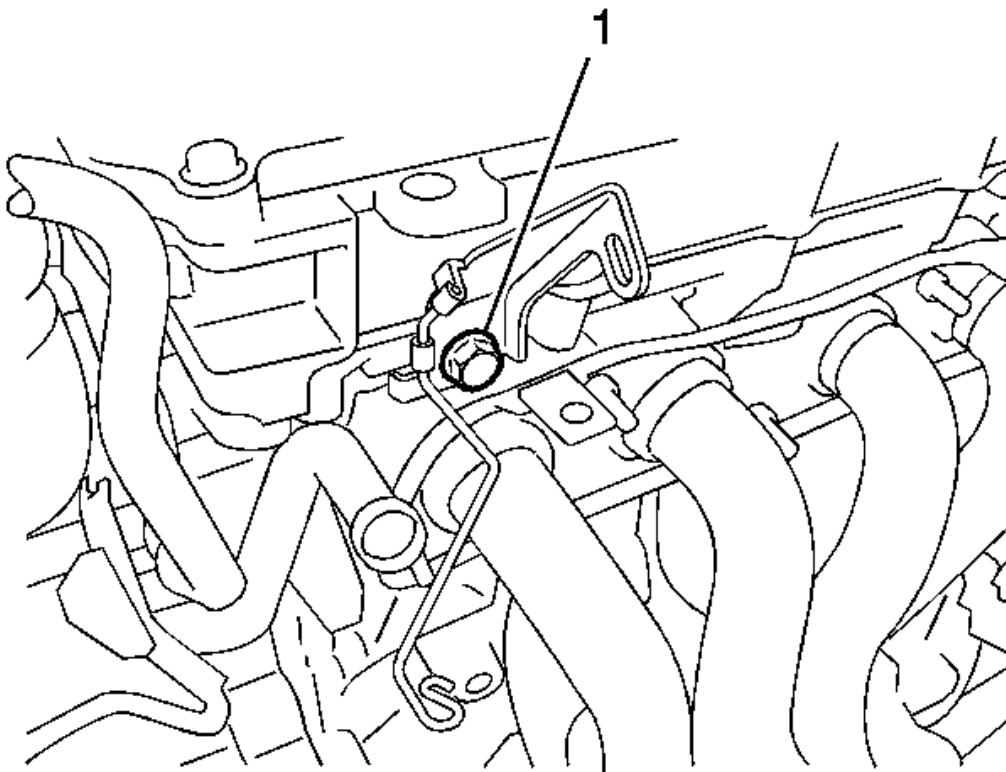


Fig. 222: Identifying Wire Harness Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

79. Remove the bolt (1) and wire harness bracket.

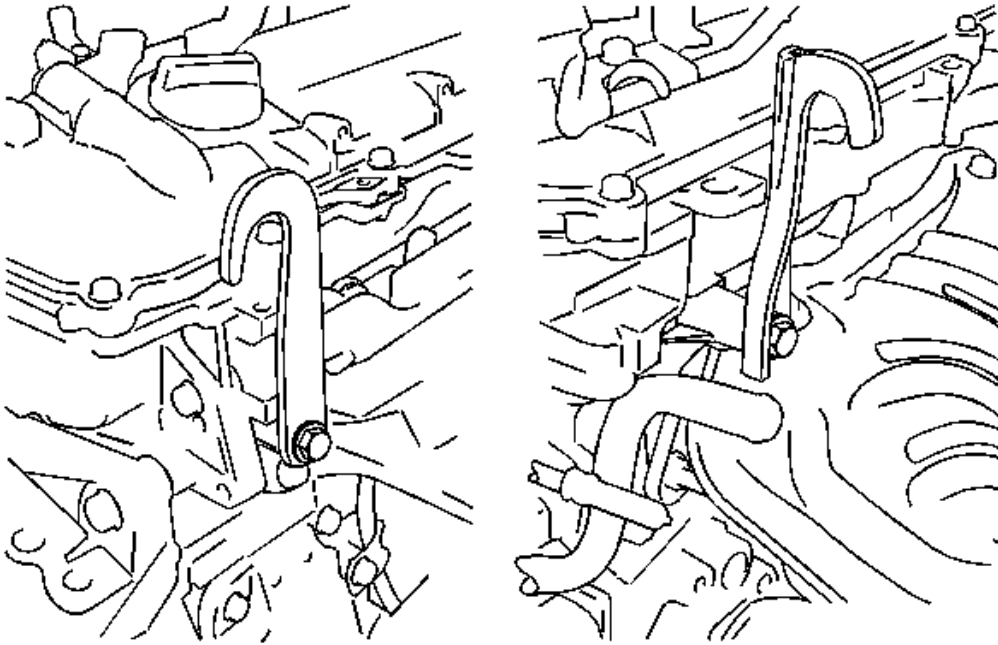


Fig. 223: Installing Engine Hangers
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

80. Install the 2 engine hangers with the 2 bolts and tighten to 43 N.m (32 lb ft).
81. Remove the flywheel housing side cover.
82. Remove the starter assembly.
83. Remove the transaxle assembly.
84. Remove the clutch cover assembly for the manual transaxle.
85. Remove the clutch disc assembly for the manual transaxle.
86. Remove the flywheel assembly for the manual transaxle.
87. Remove the drive plate and ring gear assembly for the automatic transaxle.
88. Remove the engine wire harness.

INSTALLATION PROCEDURE

1. Install the engine wire harness.

2. Install the flywheel assembly for the manual transaxle.
3. Install the drive plate and ring gear assembly for the automatic transaxle.
4. Install the clutch disc assembly for the manual transaxle.
5. Install the clutch cover assembly for the manual transaxle.
6. Inspect and adjust clutch cover assembly for the manual transaxle.
7. Install the transaxle assembly.
8. Install the starter assembly.
9. Install the flywheel housing side cover.

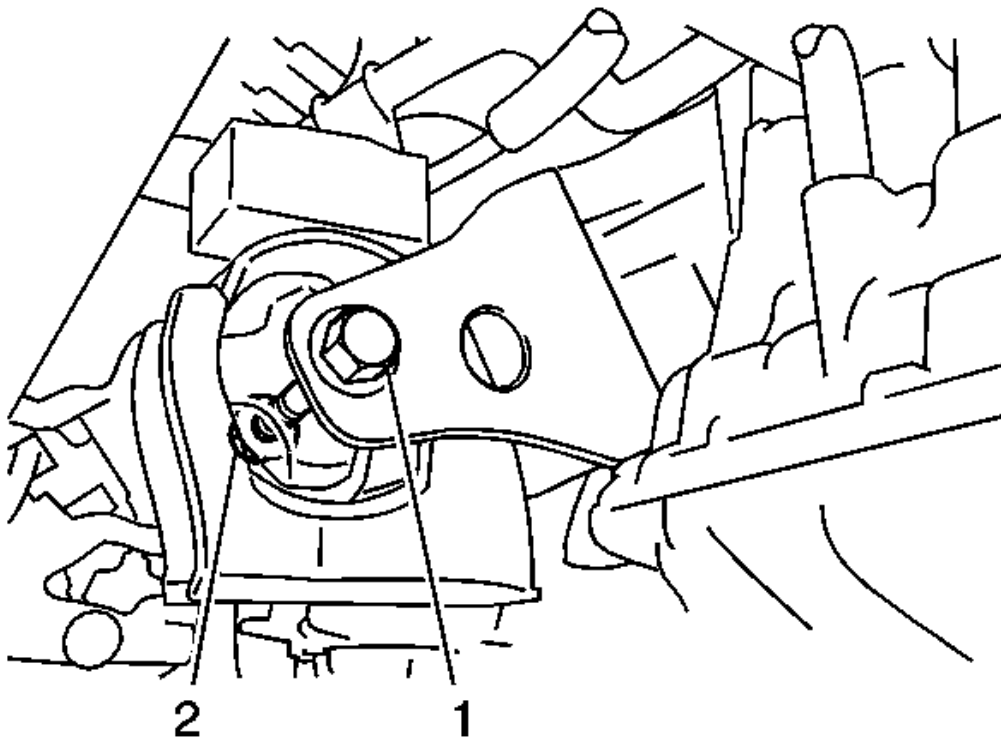


Fig. 224: Identifying Front Engine Mounting Insulator Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

10. Install the front engine mount with the nut (2) and bolt (1) and tighten to 73 N.m (54 lb ft).

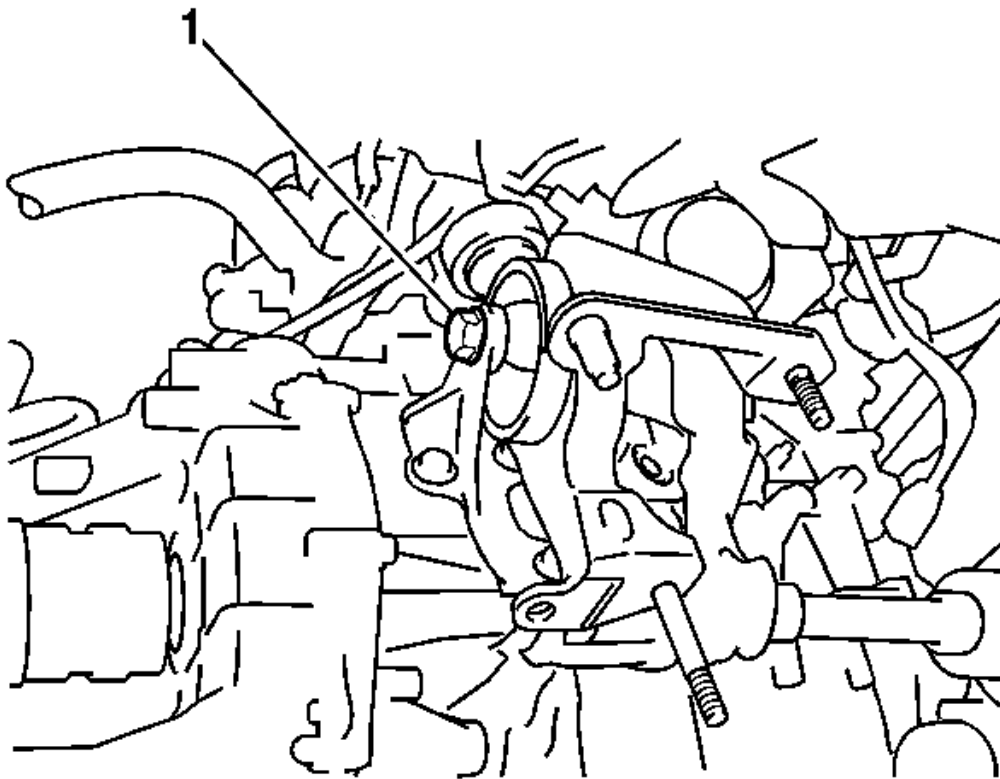


Fig. 225: Identifying Rear Engine Mounting Insulator Through Bolt
Courtesy of GENERAL MOTORS CORP.

11. Install the rear engine mount to the engine mounting bracket with the through bolt (1) and tighten to 65 N.m (50 lb ft).

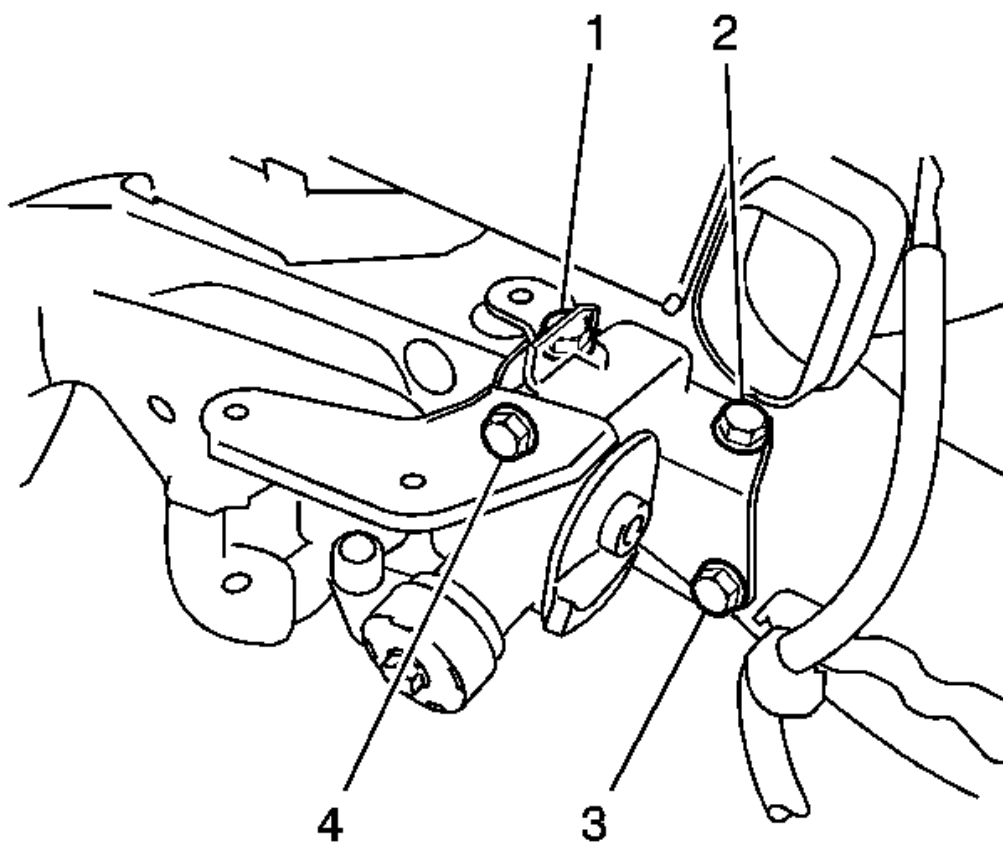


Fig. 226: Identifying Left Side Engine Mounting Insulator Bolts
Courtesy of GENERAL MOTORS CORP.

12. Temporarily install the engine mount LH with the 4 bolts (1-4).

NOTE: Perform this procedure only when replacement of the engine mounting insulator is necessary.

13. Install the 4 bolts and tighten to 52 N.m (38 lb ft).

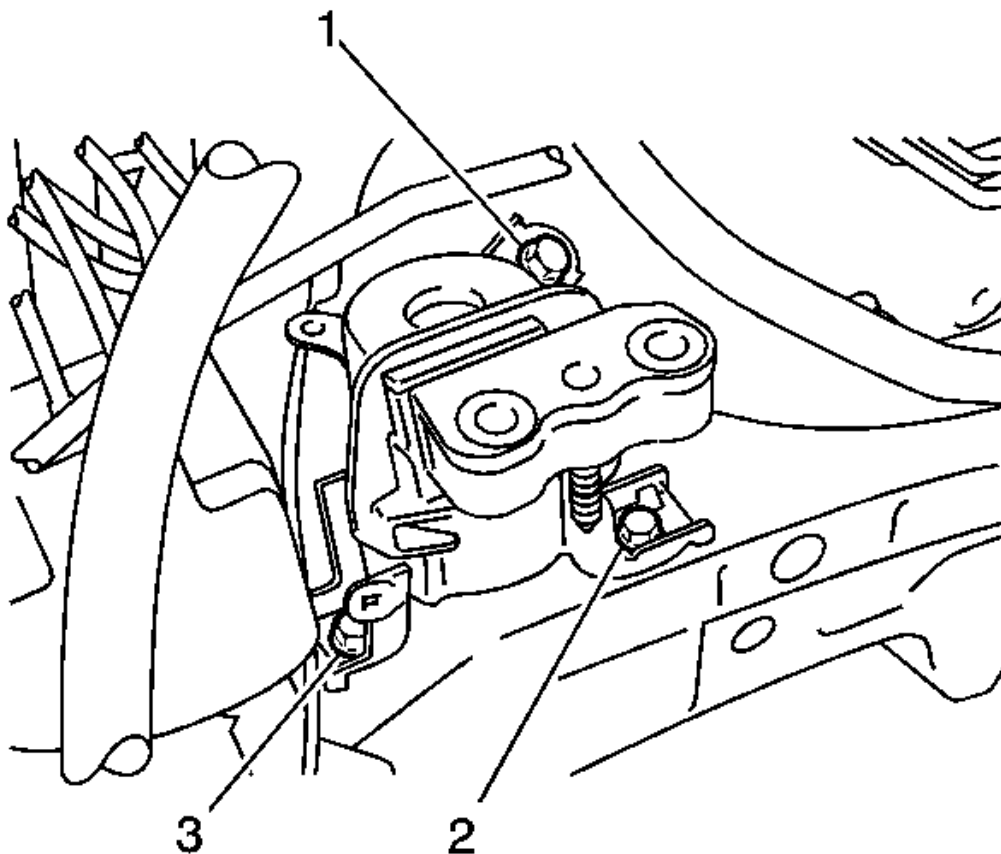


Fig. 227: View Of Engine Mounting Insulator Bolts - Right Side
Courtesy of GENERAL MOTORS CORP.

14. Install the engine mount RH with the 3 bolts (1-3) and tighten to 52 N.m (38 lb ft).

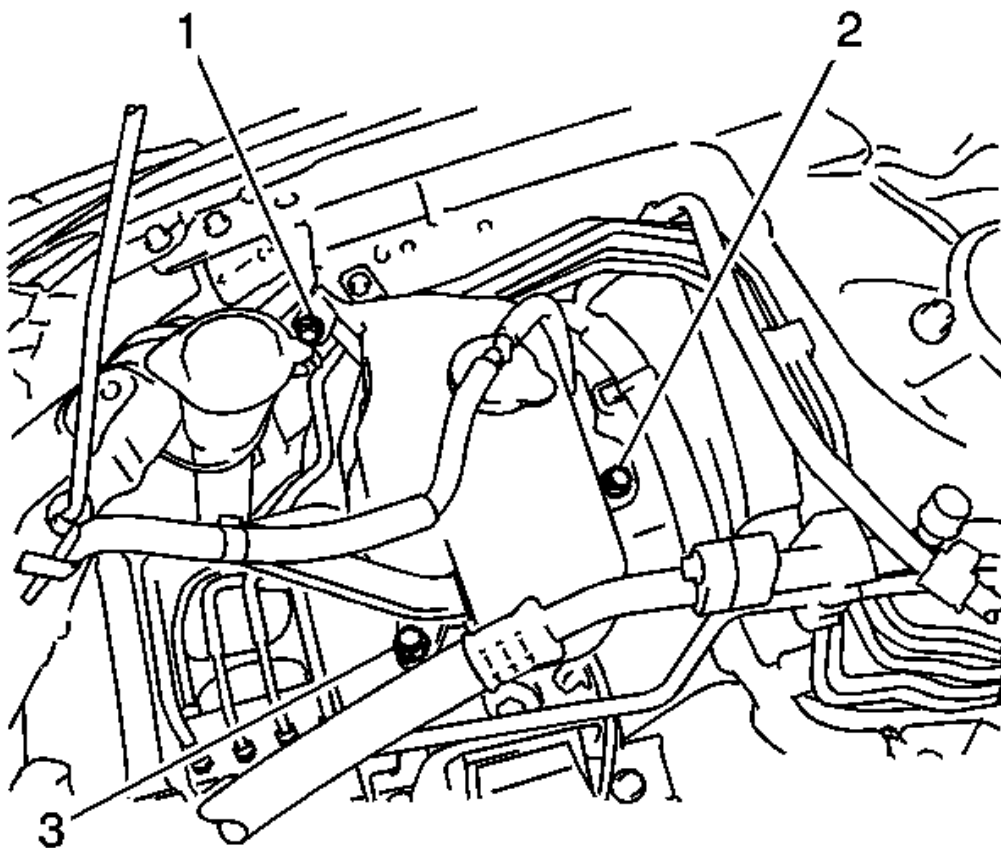


Fig. 228: Identifying Radiator Reserve Tank Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the radiator reserve tank with the 3 bolts (1-3) and tighten to 7.0 N.m (62 lb in).

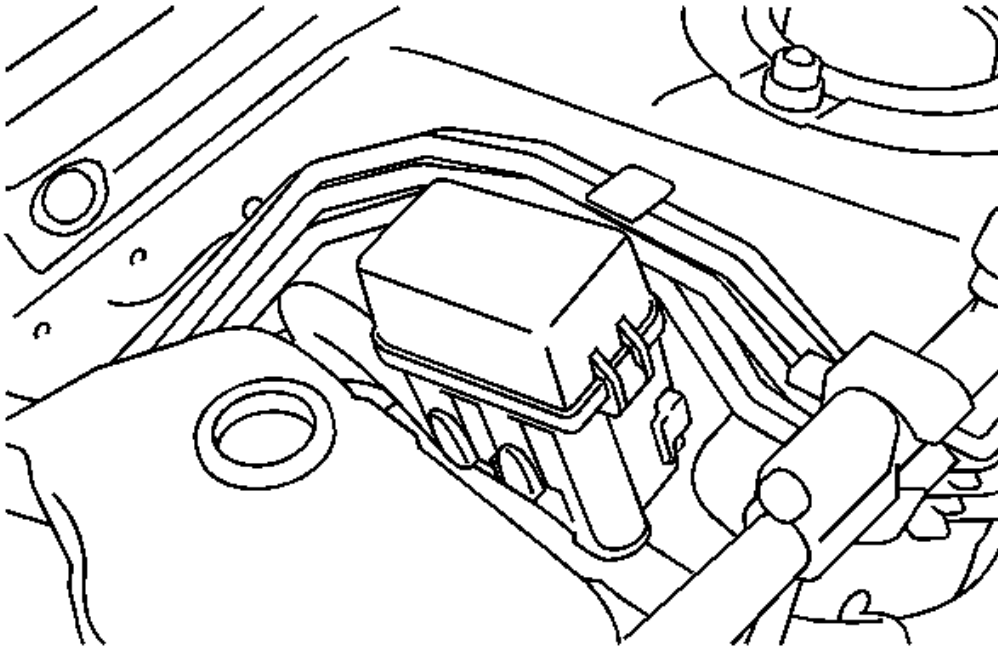


Fig. 229: View Of Relay Block Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Perform this procedure only when replacement of the engine mount is necessary.

16. Install the relay block assembly.
17. Set the engine assembly with transaxle and front suspension crossmember on the engine lifter.

NOTE: Do not raise the engine more than necessary. If the engine is raised excessively, the vehicle may also be lifted up.

NOTE:

- Make sure that the engine is clear of all wiring and hoses.
- While raising the engine into the vehicle, do not allow it to contact the vehicle.

18. Operate the engine lifter and lift the engine assembly with transaxle and front suspension crossmember to the position where the engine mounts RH and LH can be installed.

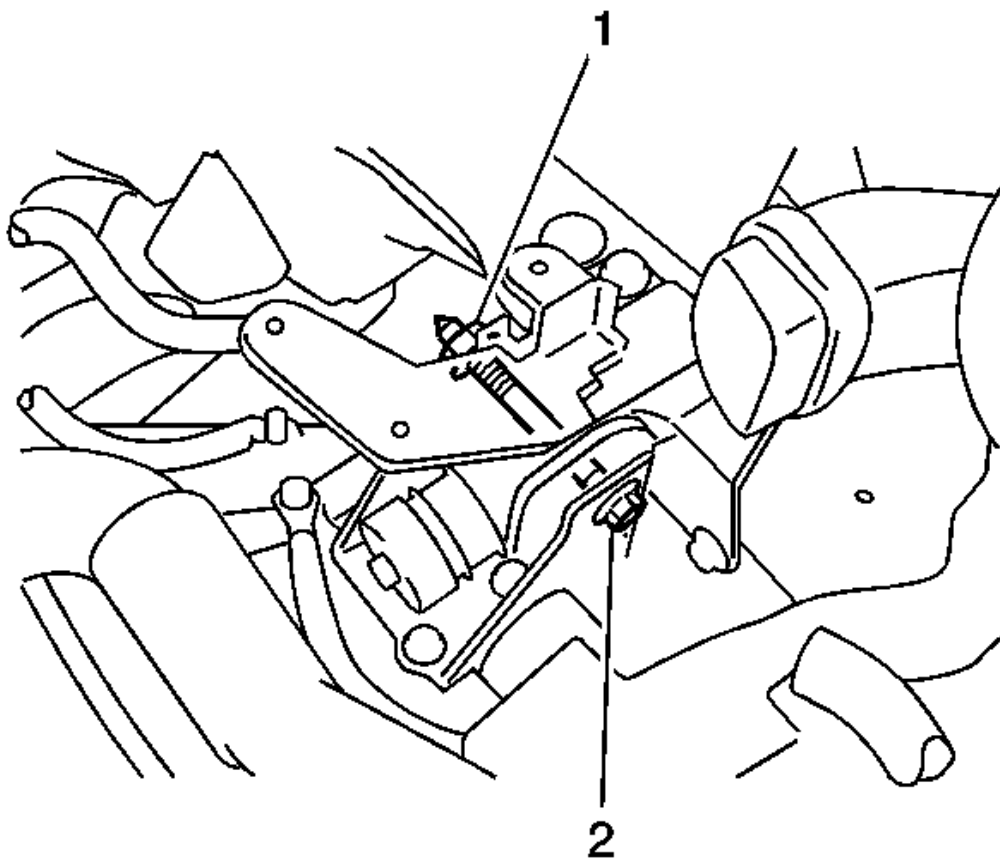


Fig. 230: Identifying Left Side Engine Mounting Insulator Through Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

19. Install the engine mount LH with the through bolt (2) and nut (1) and tighten to 56 N.m (41 lb ft).

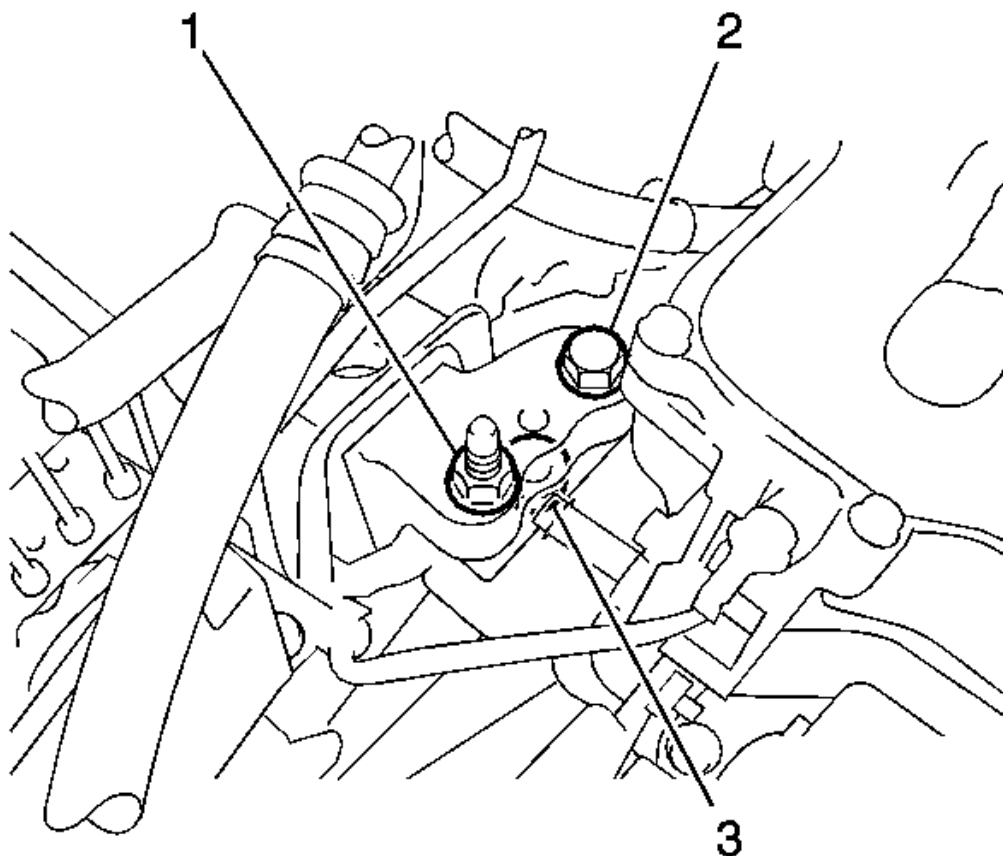


Fig. 231: Identifying Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

20. Install the engine mount RH with the bolt (1) and 2 nuts (2, 3) and tighten.
 - Nut 2 to 95 N.m (70 lb ft)
 - Nut 3 to 52 N.m (38 lb ft)
 - Bolt to 95 N.m (70 lb ft)
21. Install the front suspension crossmember assembly. Refer to **Front Suspension Crossmember Replacement (All Wheel Drive)** or **Front Suspension Crossmember Replacement (Two Wheel Drive)**.
22. Remove the 2 engine hangers with the 2 bolts.

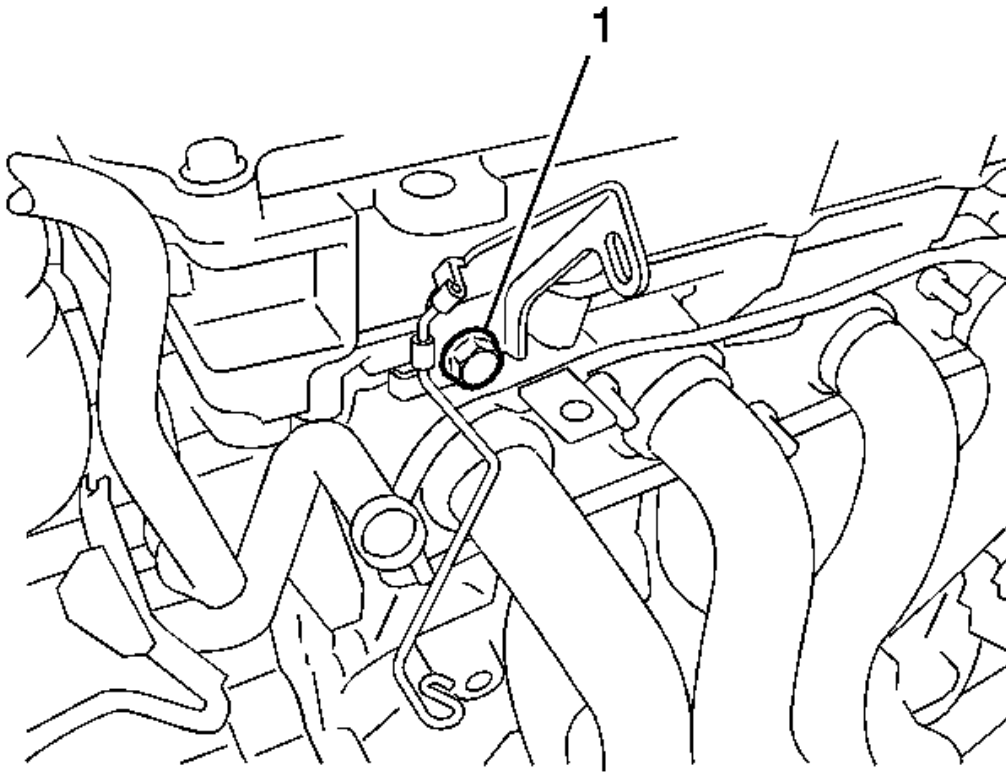


Fig. 232: Identifying Wire Harness Bracket Bolt
Courtesy of GENERAL MOTORS CORP.

23. Install the wire harness bracket with the bolt (1) and tighten to 60 N.m (44 lb ft).
24. Install the drive plate and torque converter clutch setting bolt for the automatic transaxle.
25. Install the flywheel housing under cover for the automatic transaxle.

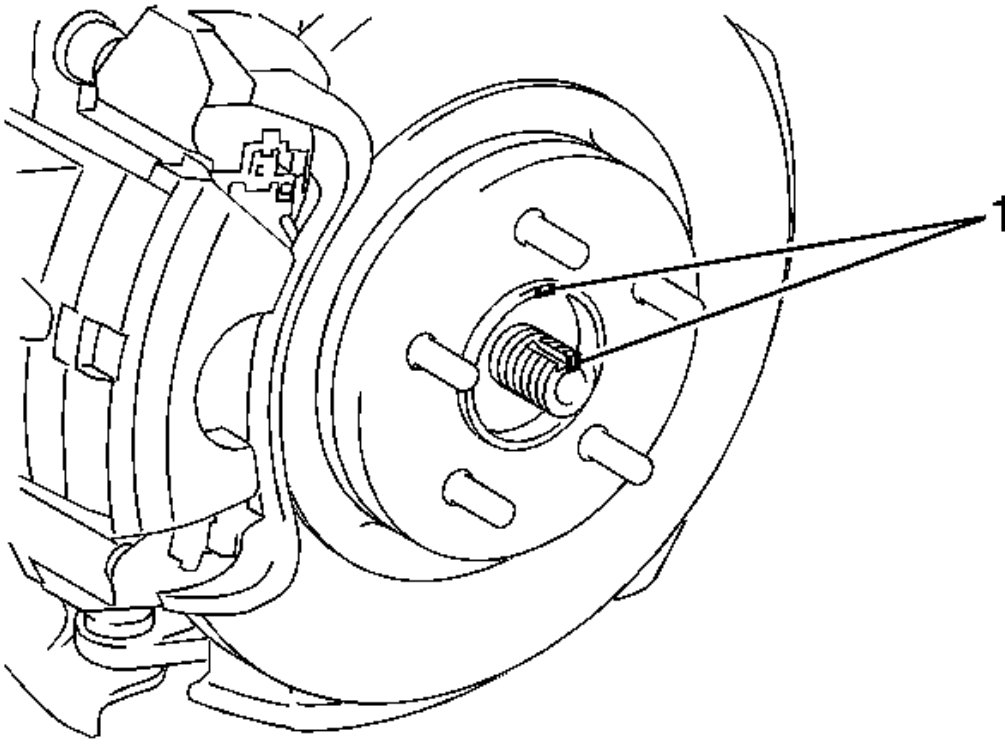


Fig. 233: Identifying Front axle Hub Nut
Courtesy of GENERAL MOTORS CORP.

26. Install the steering knuckle with axle hub LH by aligning the matchmarks (1) and connect the front drive shaft assembly to the front axle assembly LH.
27. Install the steering knuckle with axle hub RH.
28. Install the front lower suspension arm assembly LH.
29. Install the front lower suspension arm assembly RH.
30. Install the front stabilizer link assembly LH.
31. Install the front stabilizer link assembly RH.
32. Connect the tie rod end assembly LH.
33. Connect the tie rod end assembly RH.
34. Install the front speed sensor LH.
35. Install the front speed sensor RH.
36. Install the front axle shaft LH nut.
37. Install the front axle shaft RH nut.
38. Install the front exhaust pipe assembly.

- 39. Install the steering column hole cover sub-assembly.
- 40. Install the steering intermediate shaft assembly.
- 41. Install the column hole cover silencer sheet.

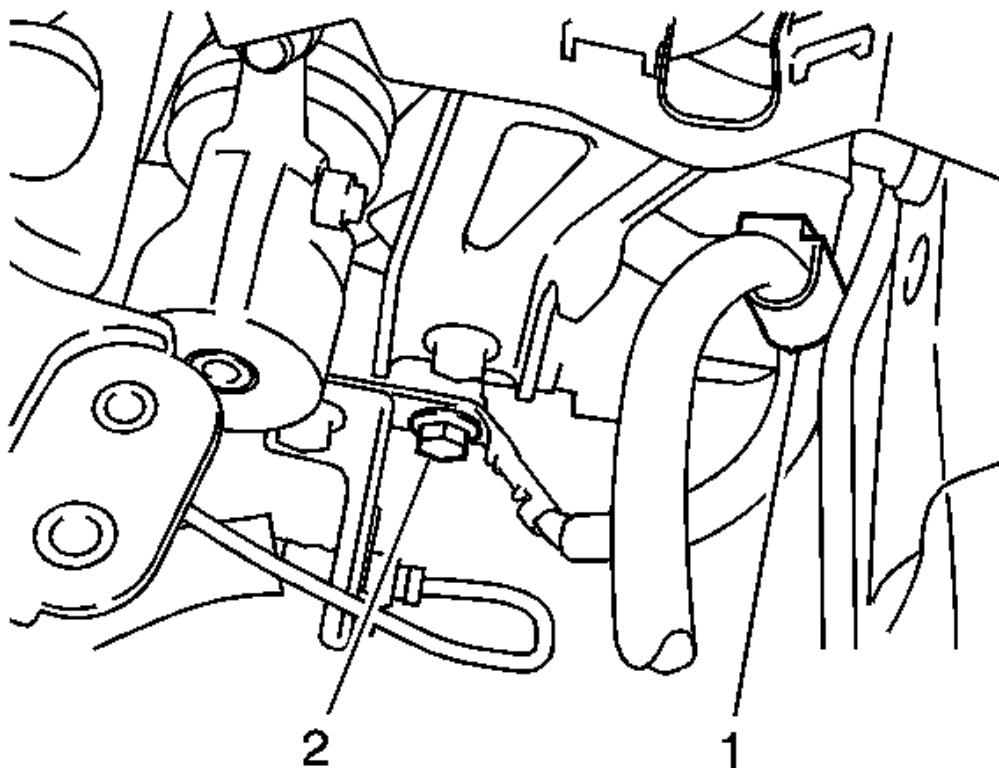


Fig. 234: View Of Bolt & Clamp (Manual Transaxle)
Courtesy of GENERAL MOTORS CORP.

- 42. Install the ground wire to the engine compartment wire with the bolt (2) and clamp (1) for the manual transaxle and tighten to 13 N.m (10 lb ft).

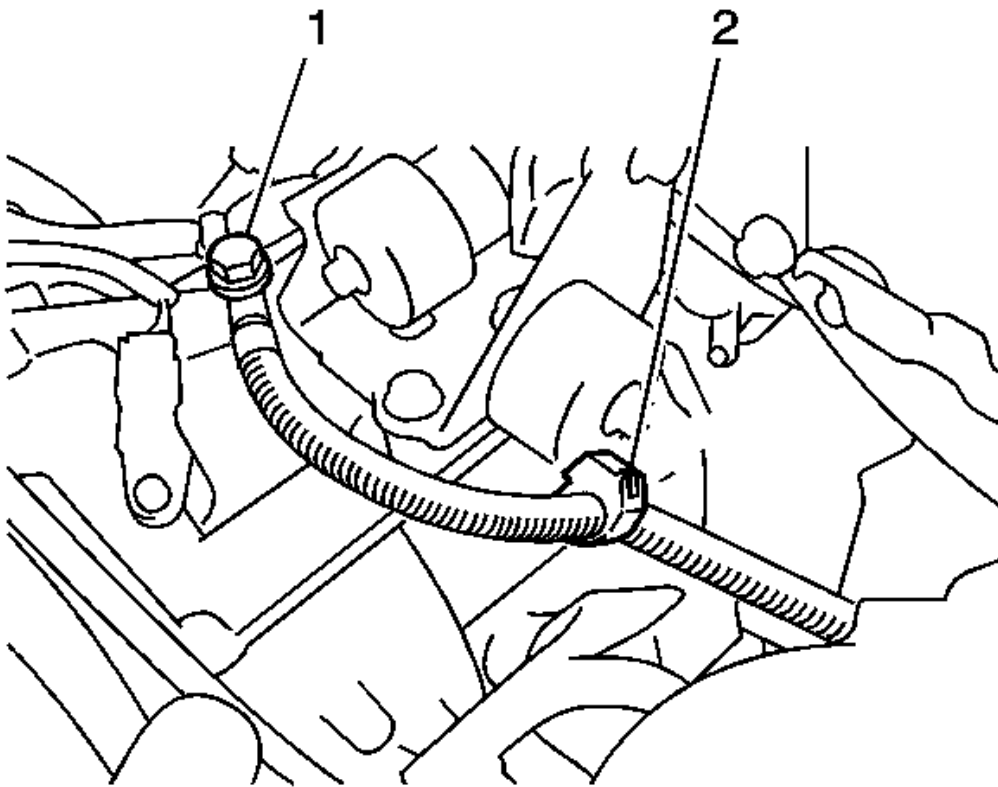


Fig. 235: Identifying Bolt & Clamp (Automatic Transaxle)
Courtesy of GENERAL MOTORS CORP.

43. Install the ground wire to the engine compartment wire with the bolt (1) and clamp (2) for the automatic transaxle and tighten to 26 N.m (19 lb ft).

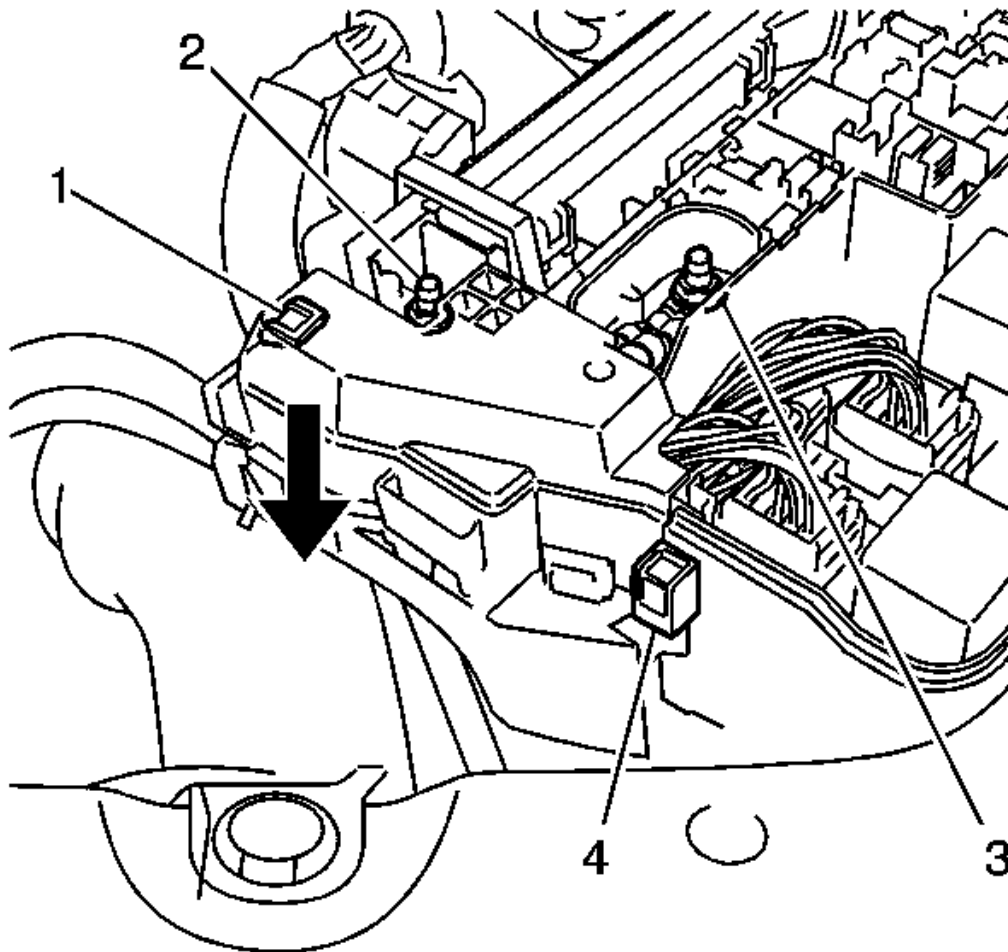


Fig. 236: Identifying Wire Harness Retainer Nuts
Courtesy of GENERAL MOTORS CORP.

44. Install the wire harness with the 2 nuts (2, 3) and tighten to 8.4 N.m (74 lb in).
45. Connect the 3 connectors and wire harness clamp to the engine room junction block.

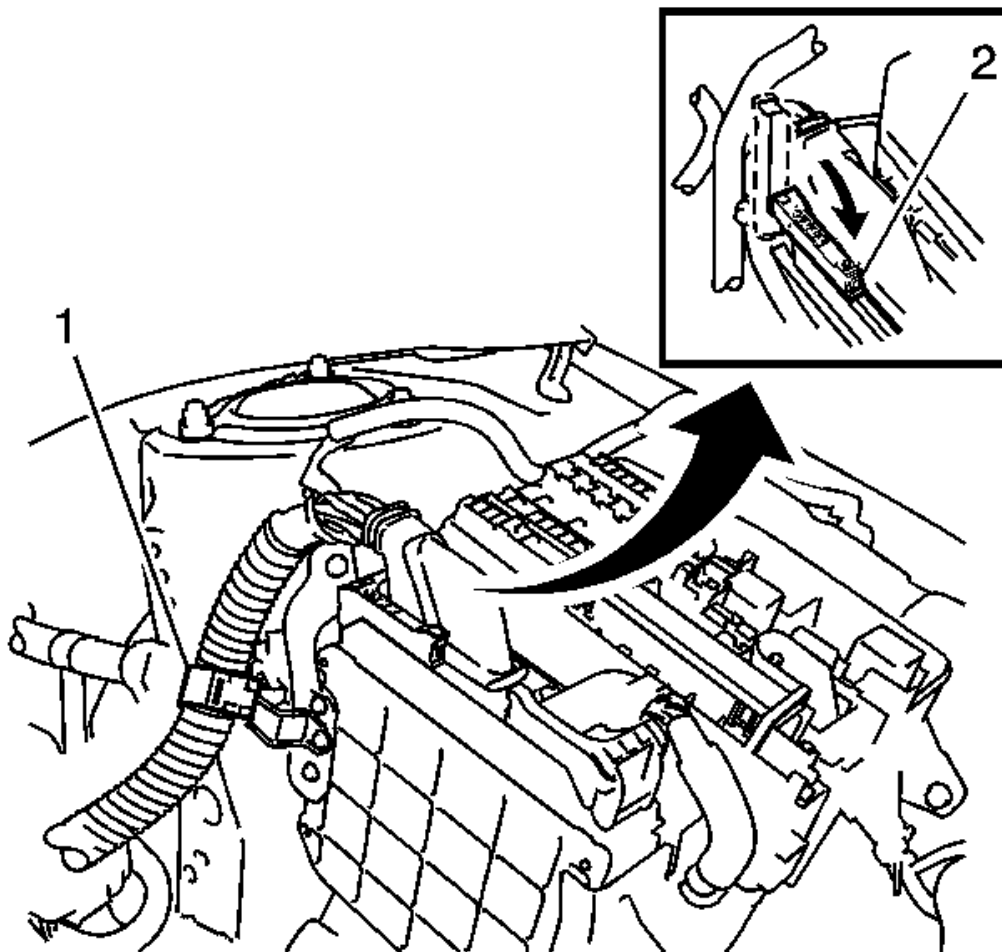


Fig. 237: Exploded View Of Fuel Tank Vent Hose & Charcoal Canister
 Courtesy of GENERAL MOTORS CORP.

46. Connect the connector to the ECM with the clamp (1) and lock lever (2).

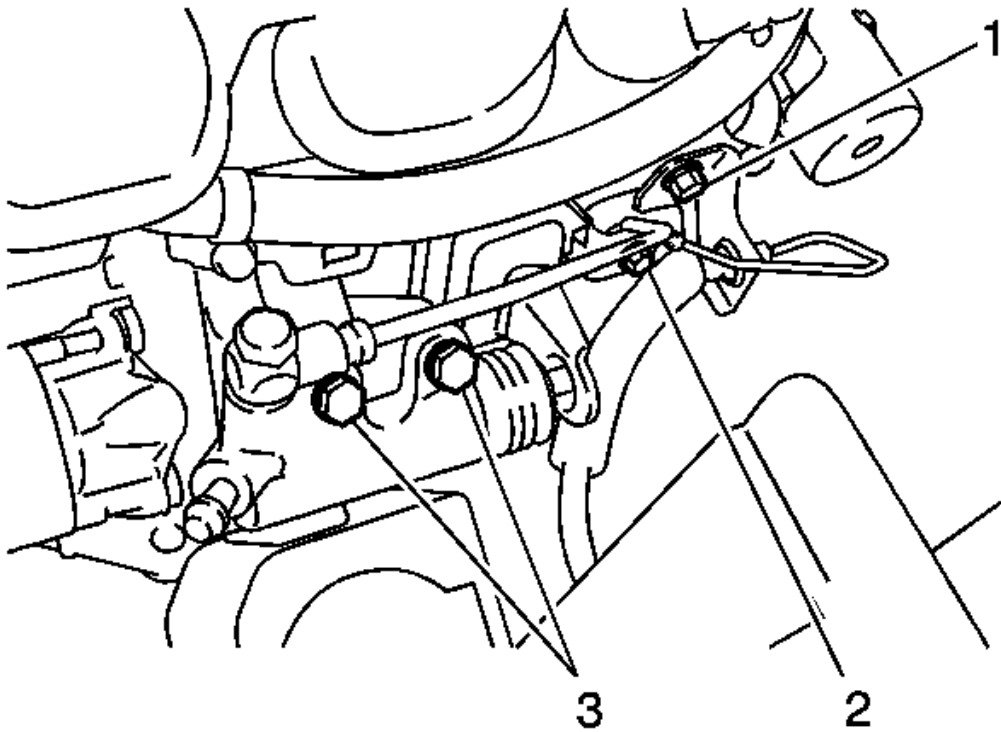


Fig. 238: Identifying Clutch Release Cylinder Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

47. Install the clutch release cylinder assembly with the 5 bolts (1-3) and clutch tube bracket for the manual transaxle and tighten.
 - Bolt 3 to 12 N.m (9 lb ft)
 - Bolt 1 to 12 N.m (9 lb ft)
 - Bolt 2 to 8.0 N.m (71 lb in)
48. Install the compressor with pulley assembly with air conditioning system.
49. Install the generator assembly. Refer to **Generator Replacement (1.8L)**.
50. Install the V-ribbed belt. Refer to **Drive Belt Replacement**.

NOTE: Align the fuel tube connector with the pipe, then push the fuel tube connector in until the retainer makes a click sound. If the connection is tight, apply a small amount of engine oil to the tip of the pipe. After connecting, pull on the pipe and connector to make sure that they are securely connected.

51. Connect the fuel tube connector and fuel pipe.

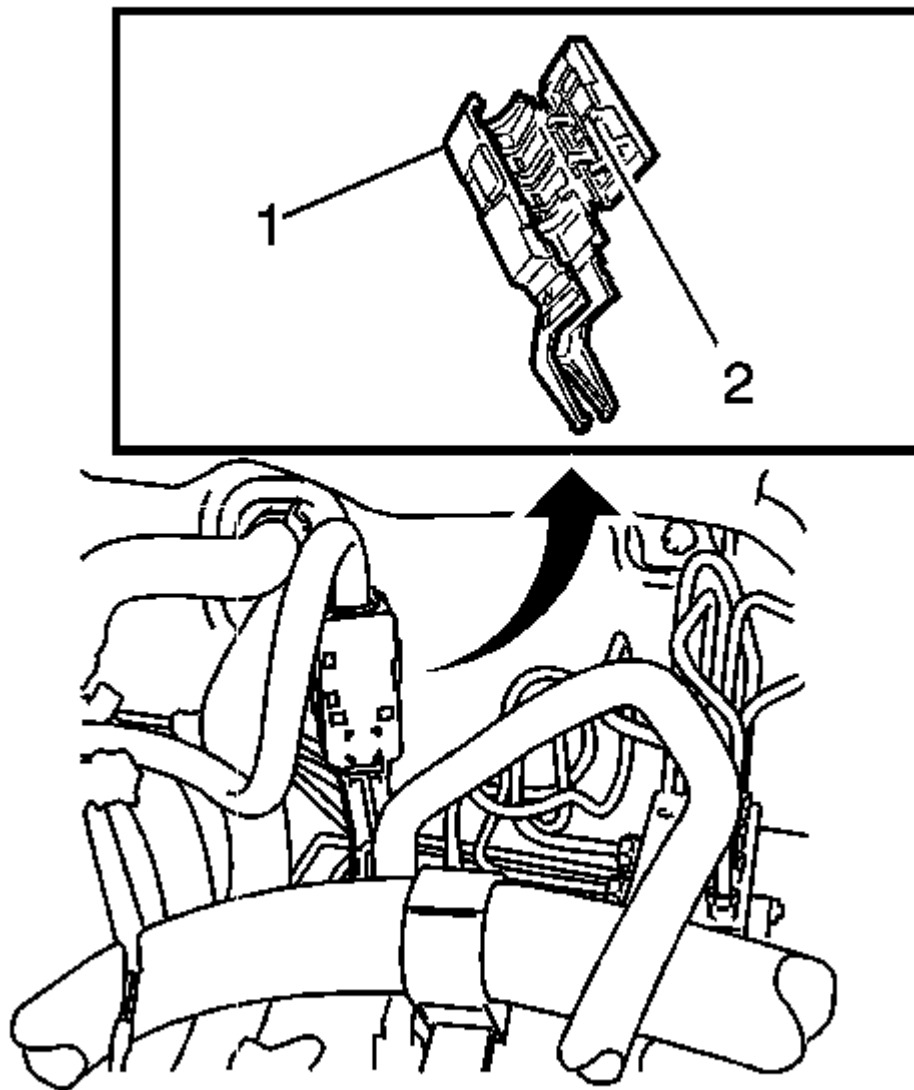


Fig. 239: Identifying Fuel Pipe Clamp & Claw
Courtesy of GENERAL MOTORS CORP.

52. Engage the claw (2) and install the fuel pipe clamp (1).

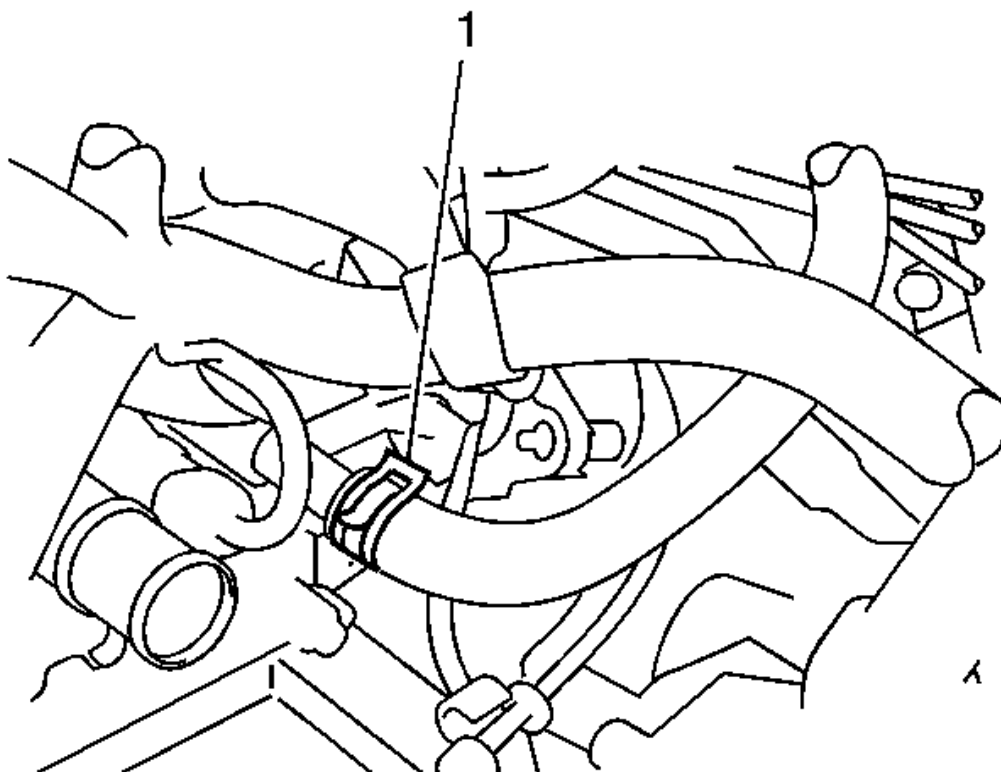


Fig. 240: Identifying Heater Inlet Hose
Courtesy of GENERAL MOTORS CORP.

53. Connect the inlet heater water hose with the clamp (1).

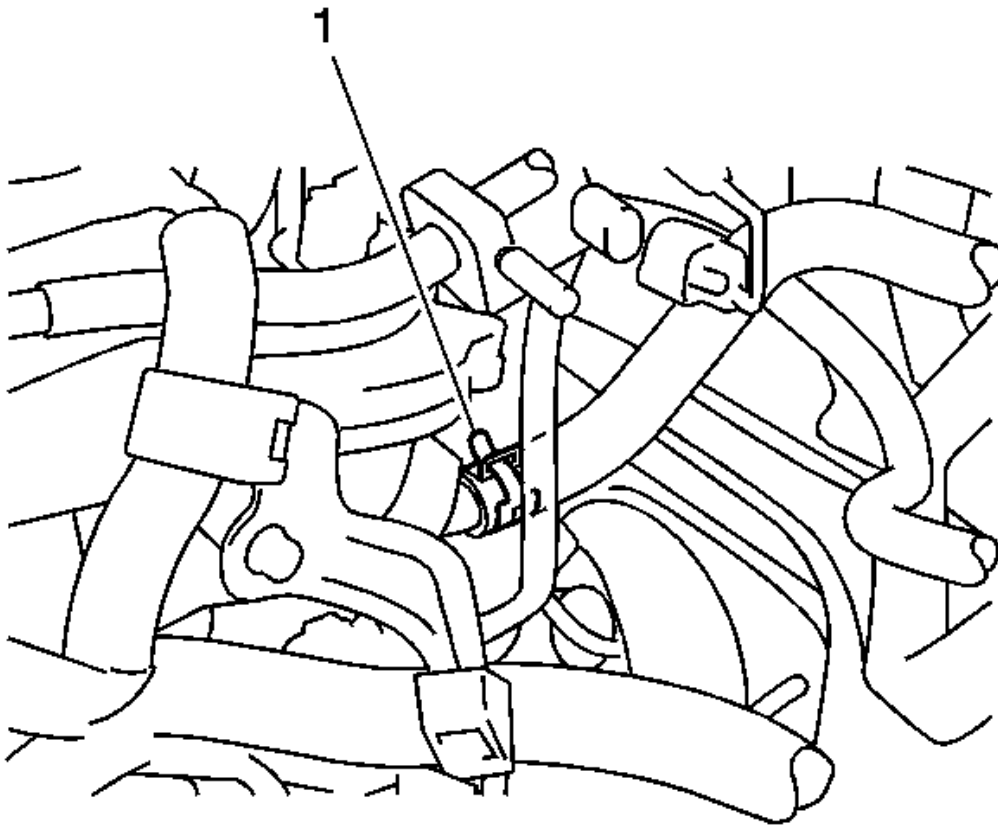


Fig. 241: Identifying Heater Outlet Hose
Courtesy of GENERAL MOTORS CORP.

54. Connect the outlet heater water hose with the clamp (1).
55. Connect the union to check valve hose with the clamp.

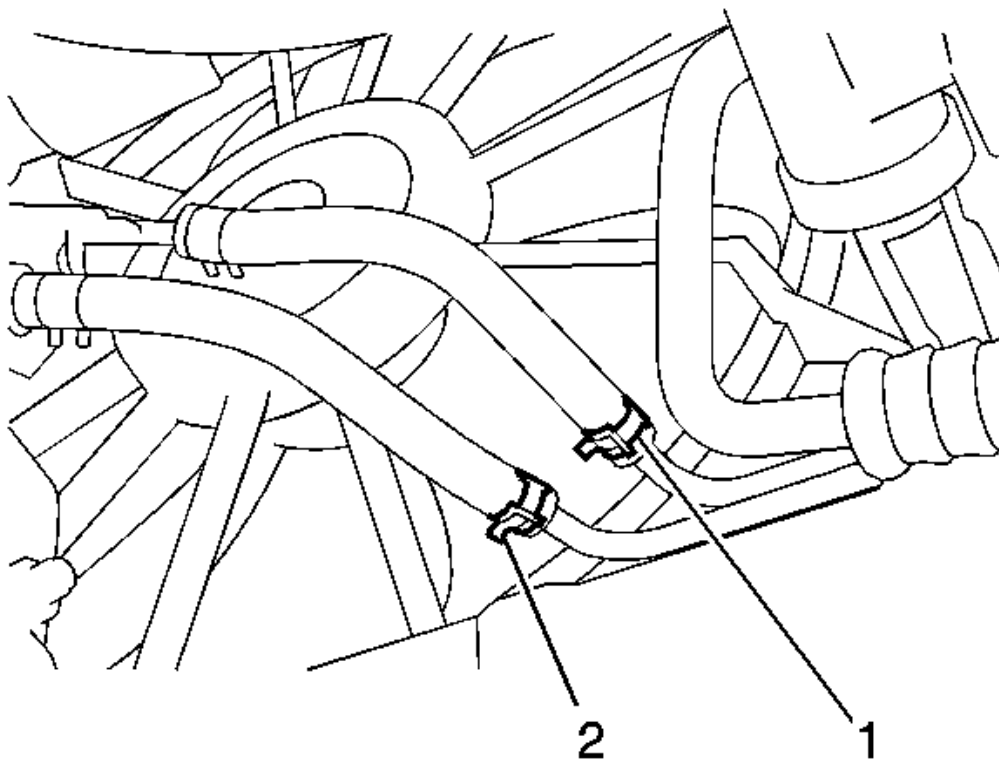


Fig. 242: Identifying Cooler Hoses & Oil Cooler Tube
Courtesy of GENERAL MOTORS CORP.

56. Connect the 2 oil cooler hoses with the clamps (1, 2)-for automatic transaxle.

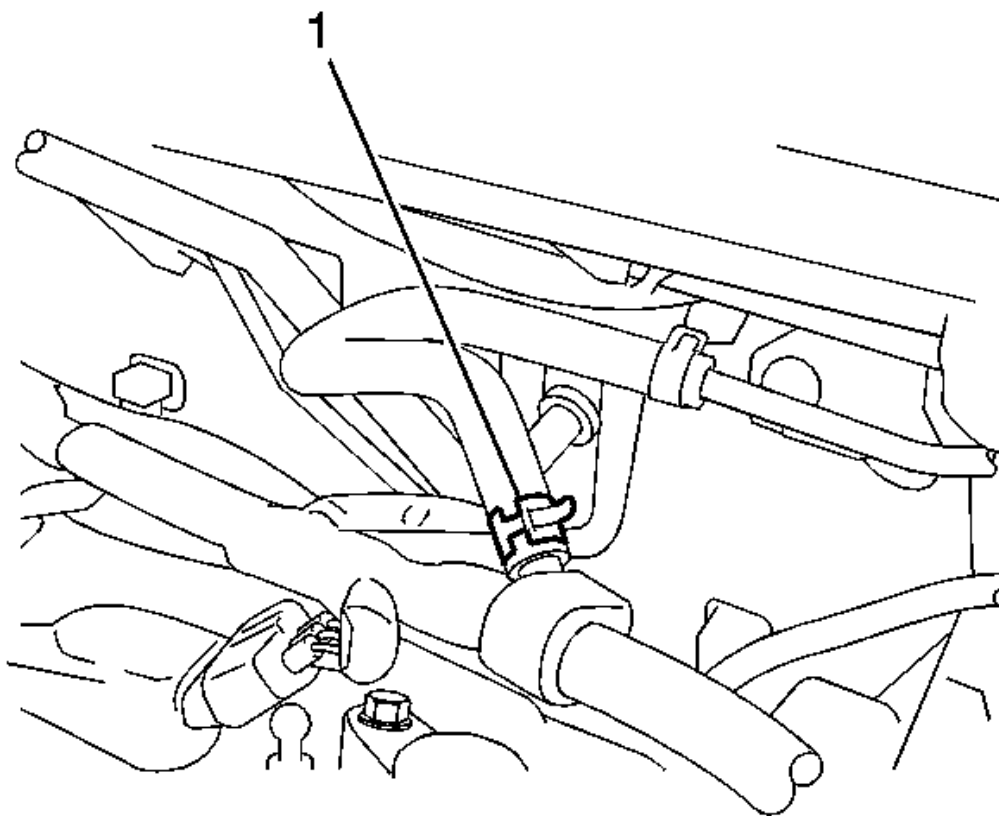


Fig. 243: Identifying Connector Tube Hose & Union
Courtesy of GENERAL MOTORS CORP.

57. Connect the union to connector tube hose (1).

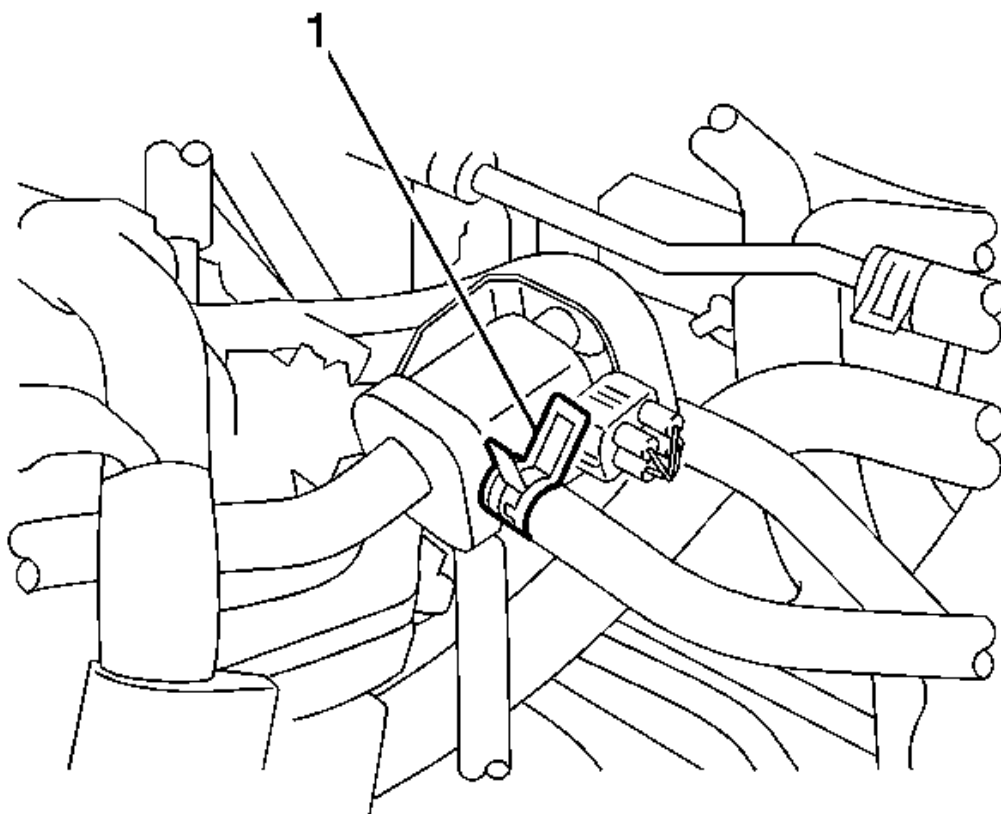


Fig. 244: Identifying Fuel Vapor Feed Hose Assembly
Courtesy of GENERAL MOTORS CORP.

58. Connect the fuel vapor feed hose (1) assembly.

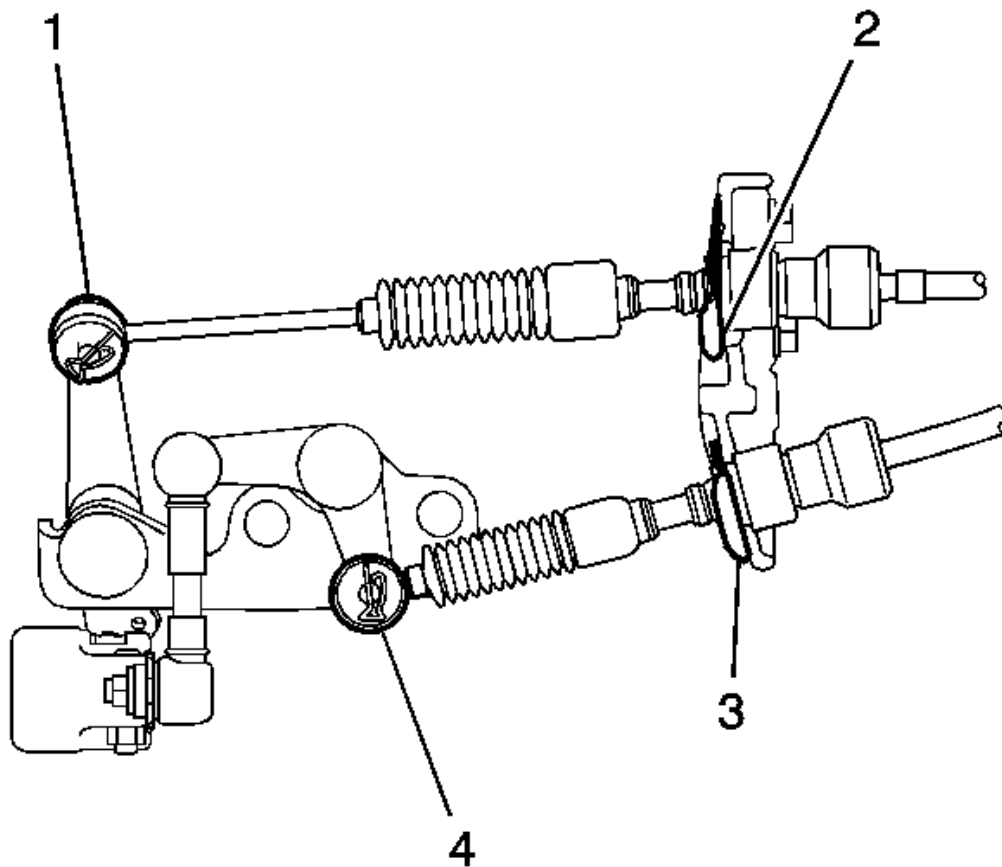


Fig. 245: Identifying Manual Transmission Shift Control Cables
Courtesy of GENERAL MOTORS CORP.

59. Install the transmission control cables (2, 3) to the control cable bracket with 2 new clips (1, 4)-for manual transaxle.

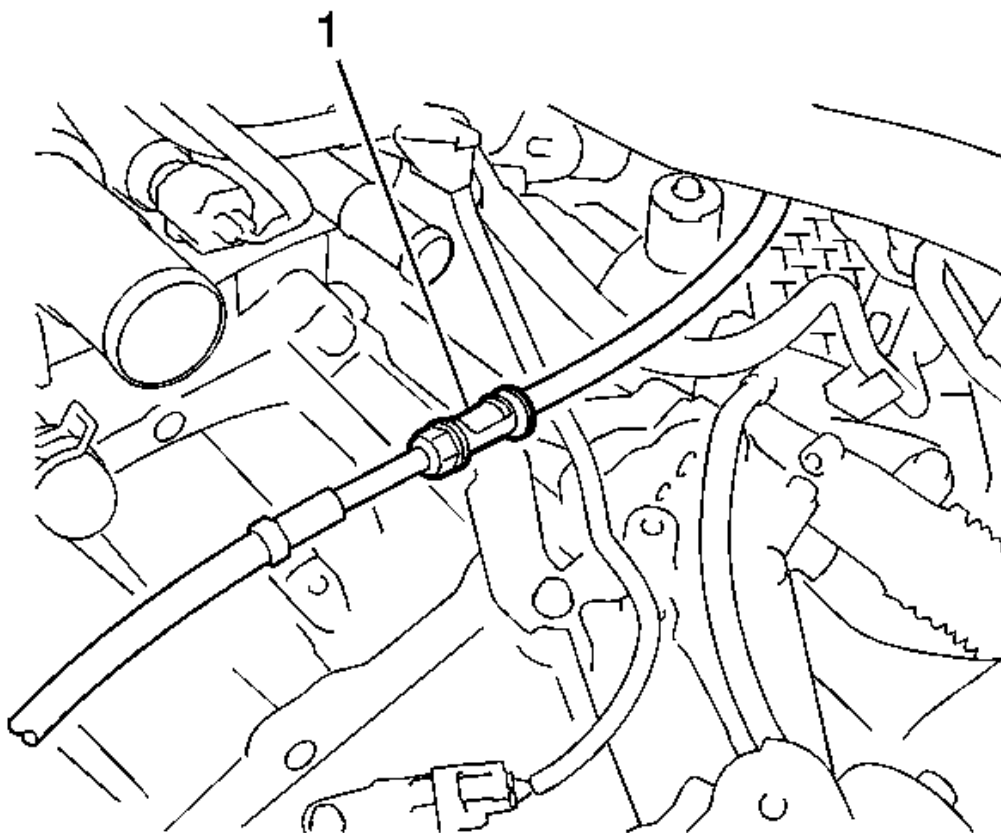


Fig. 246: Identifying Automatic Transmission Shift Control Cable
Courtesy of GENERAL MOTORS CORP.

60. If equipped with automatic transmission secure the control cable onto the control cable bracket (1) with the clip.
61. Connect the control cable onto the control shaft lever with the nut and tighten to 12 N.m (9 lb ft).
62. Connect the control cable to the cable support.
63. Connect the clamp of the control cable with the bolt and tighten to 12 N.m (9 lb ft).

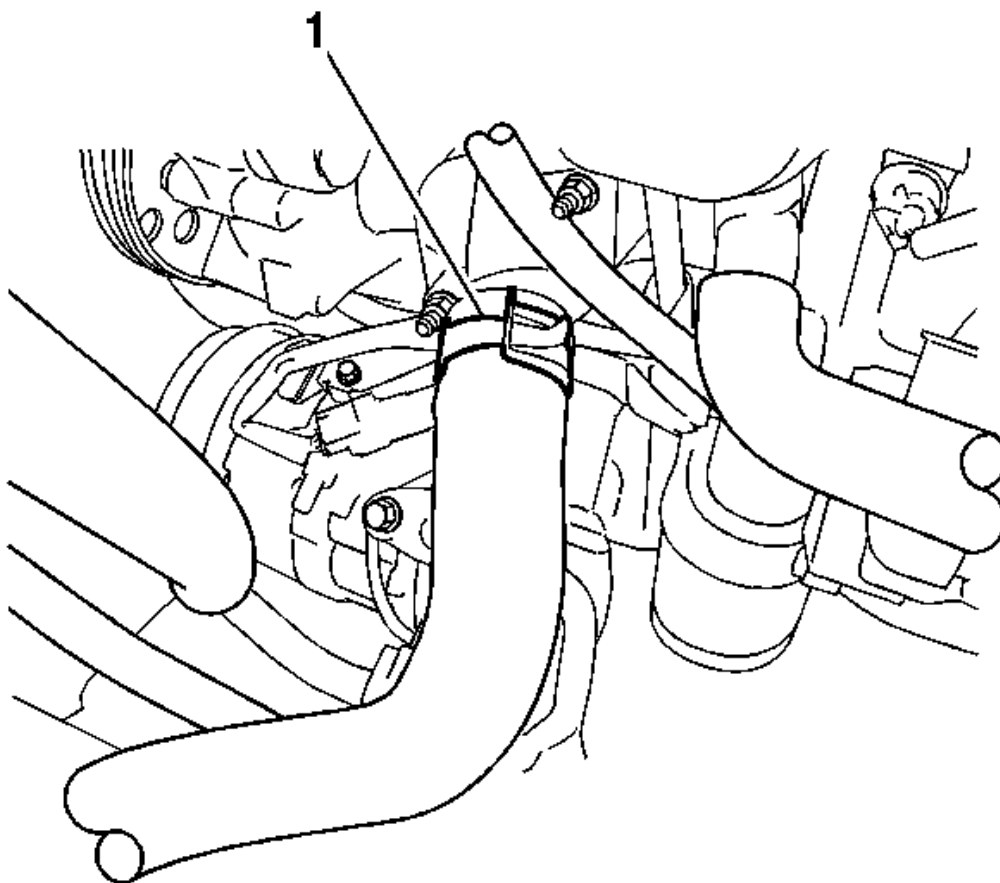


Fig. 247: Identifying Lower Radiator Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

64. Connect the radiator hose with the clamp (1).

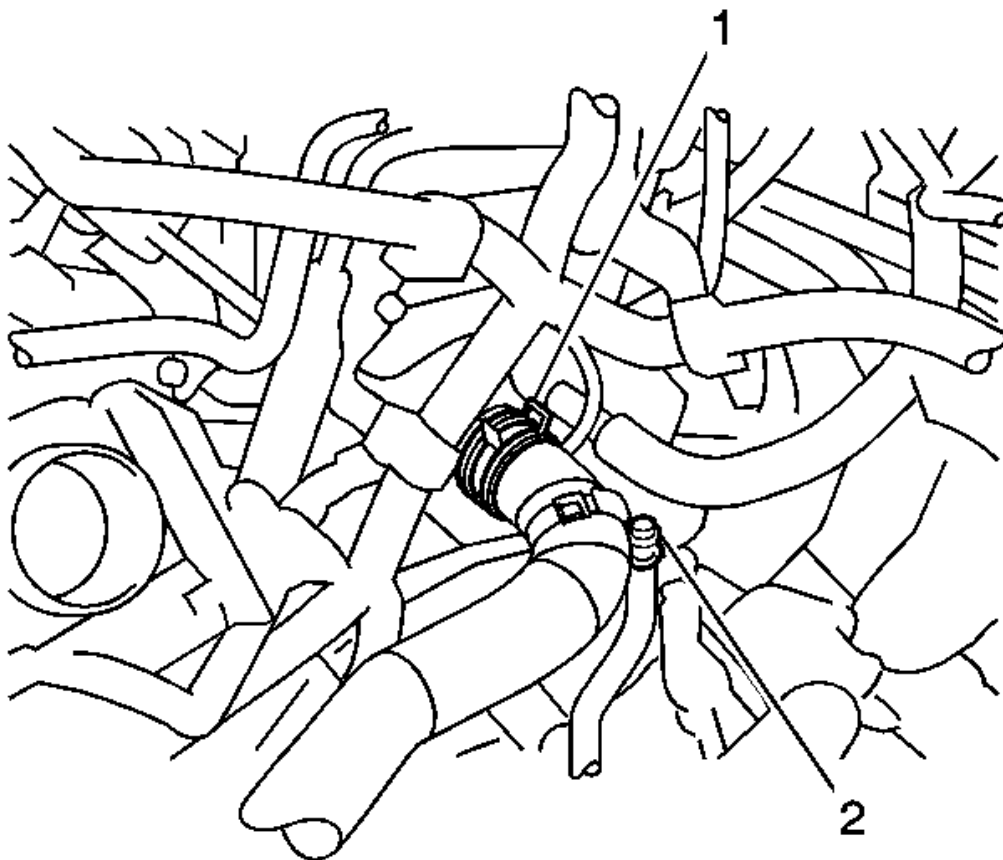


Fig. 248: Identifying Radiator Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

65. Connect the radiator hose with the clamp (1).
66. Install the battery carrier with the 4 bolts and tighten to 19 N.m (14 lb ft).

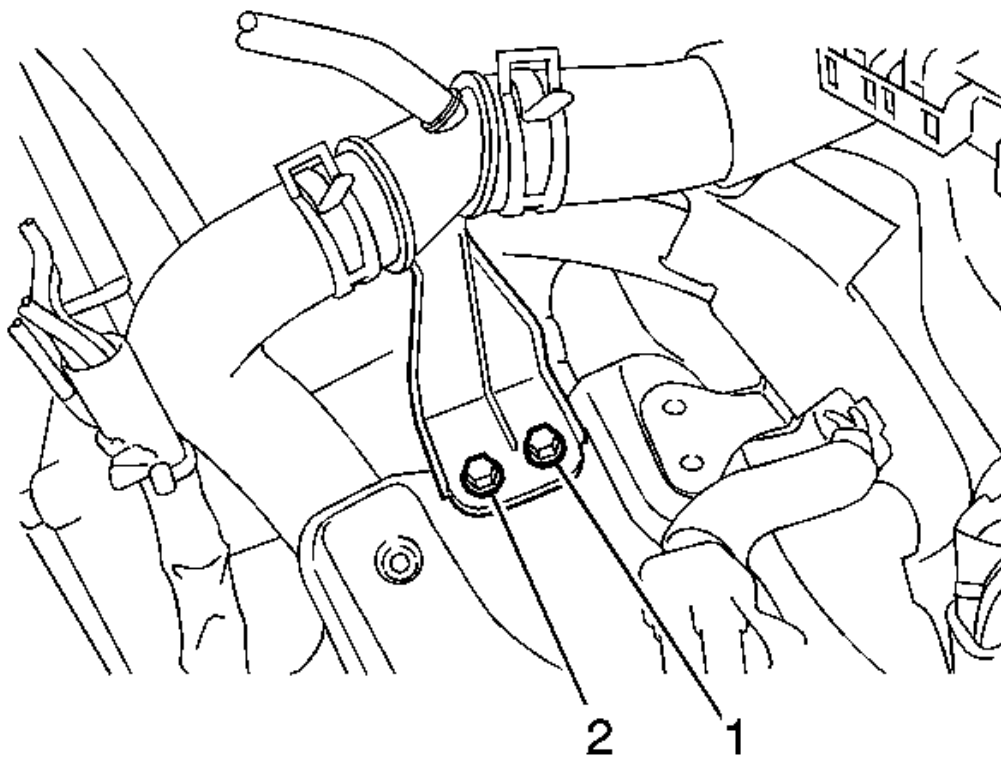


Fig. 249: Identifying Radiator Pipe Bracket Bolts
Courtesy of GENERAL MOTORS CORP.

67. Connect the radiator pipe with the 2 bolts (1, 2) and tighten to 8.8 N.m (78 lb in).

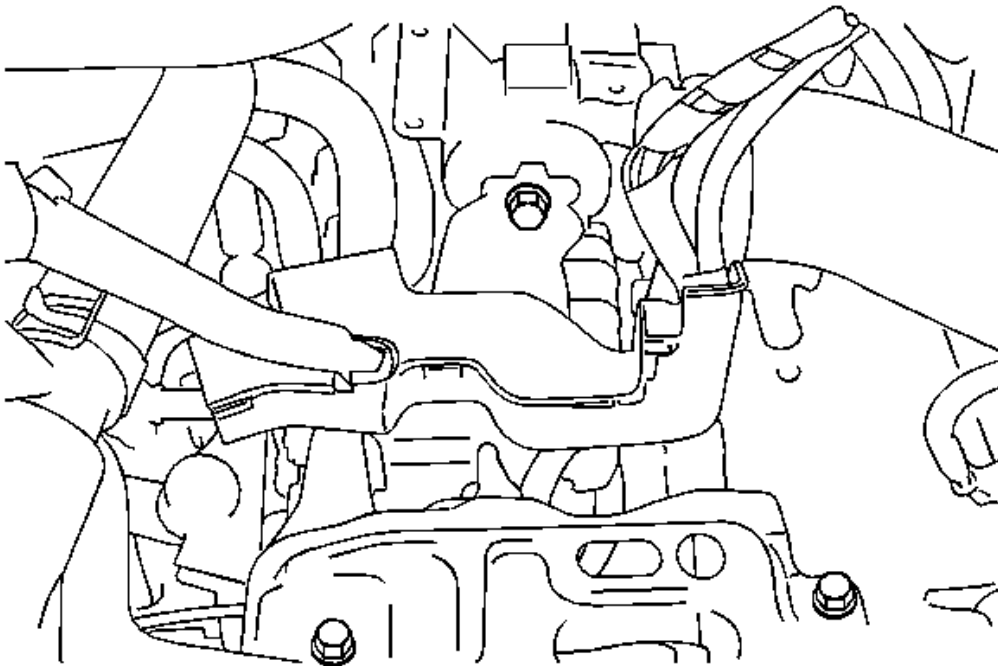


Fig. 250: Identifying Wire Harness Clamps At Battery Carrier
Courtesy of GENERAL MOTORS CORP.

68. Connect the 2 wire harness clamps.
69. Install the battery clamp with the bolt and nut and tighten.
 - The bolts to 6.5 N.m (58 lb in)
 - The nut to 3.5 N.m (31 lb in)
70. Connect the battery cables and tighten to 5.4 N.m (48 lb in).

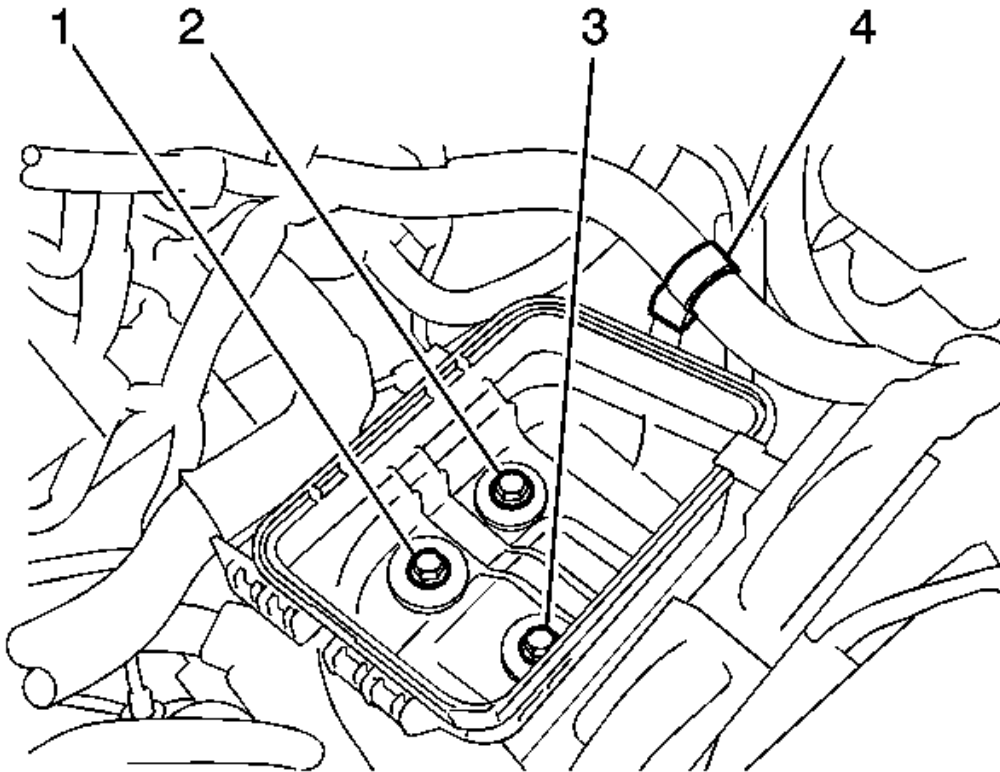


Fig. 251: Identifying Air Cleaner Case & Engine Wire Harness Clamp
 Courtesy of GENERAL MOTORS CORP.

71. Install the air cleaner case with the 3 bolts (1-3) and tighten to 7.0 N.m (62 lb in).
72. Install the wire harness clamp (4) to the air cleaner case.
73. Add transaxle oil for the manual transaxle.
74. Add automatic transaxle fluid for the automatic transaxle.
75. Inspect transaxle fluid level for the automatic transaxle.
76. Inspect for automatic transaxle fluid leak for the automatic transaxle.
77. Inspect the shift lever position for the automatic transaxle.
78. Adjust the shift lever position for the automatic transaxle.
79. Add the engine coolant. Refer to **Cooling System Draining and Filling** .
80. Add the engine oil.
81. Inspect the engine oil level.
82. Inspect the for fuel leak.
83. Inspect the for engine coolant leak.

84. Inspect the for oil leak.
85. Inspect the for exhaust gas leak.
86. Install the engine under cover LH.
87. Install the engine under cover RH.
88. Install the front wheels and tighten the nuts to 103 N.m (76 lb ft).
89. Inspect the ignition timing.
90. Inspect the engine idle speed.
91. Adjust the front wheel alignment. Refer to **Wheel Alignment Measurement** .

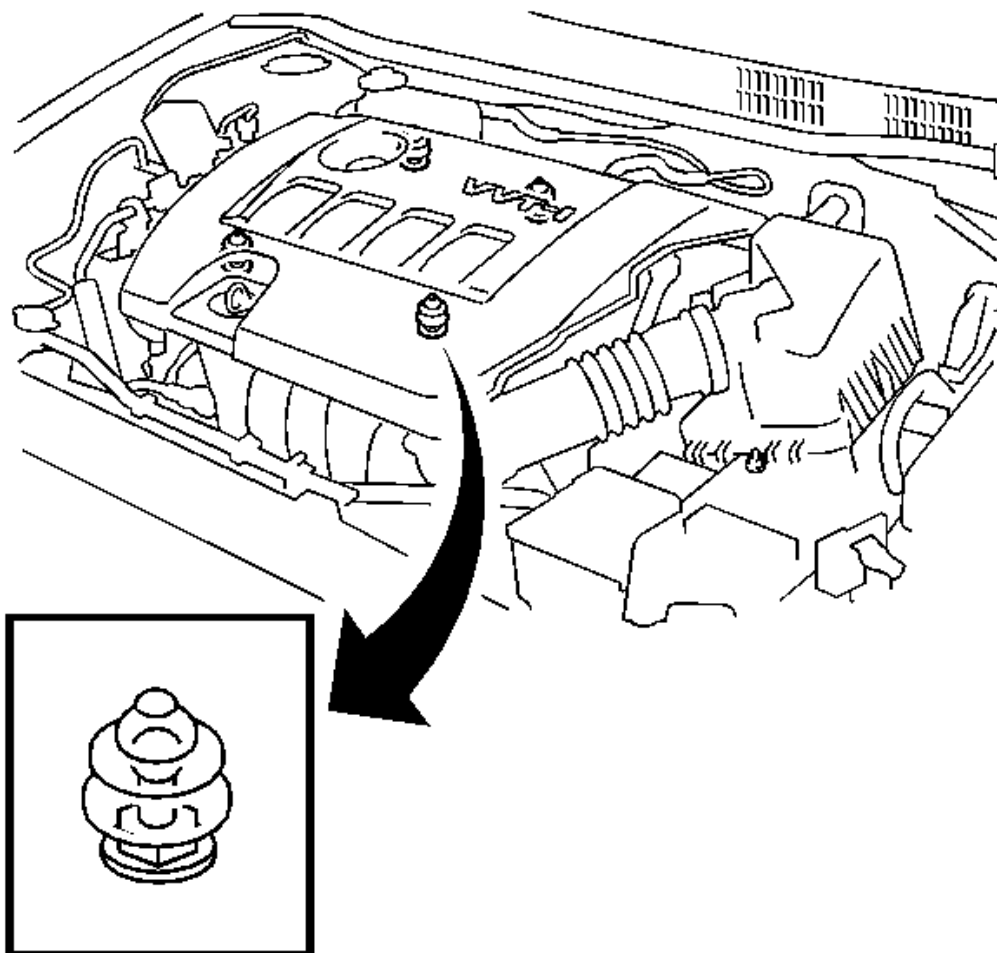


Fig. 252: View Of Engine Cover Clips
Courtesy of GENERAL MOTORS CORP.

NOTE: Be sure to engage the clips securely. Do not apply excessive force or do not hit the cover to engage the clips. This may cause the cover to break.

92. Engage the 4 clips to install the No. 2 cylinder head cover.
93. Check the ABS speed sensor signal.

ENGINE OIL AND OIL FILTER REPLACEMENT

NOTE: For environmental protection, used oil and used oil filters must be disposed of at designated disposal sites.

1. Remove the oil filler cap.
2. Remove the oil drain plug and drain the oil into a container.

CAUTION: Refer to Fastener Caution .

3. Clean and install the oil drain plug with a new gasket and tighten to 37 N.m (27 lb ft).

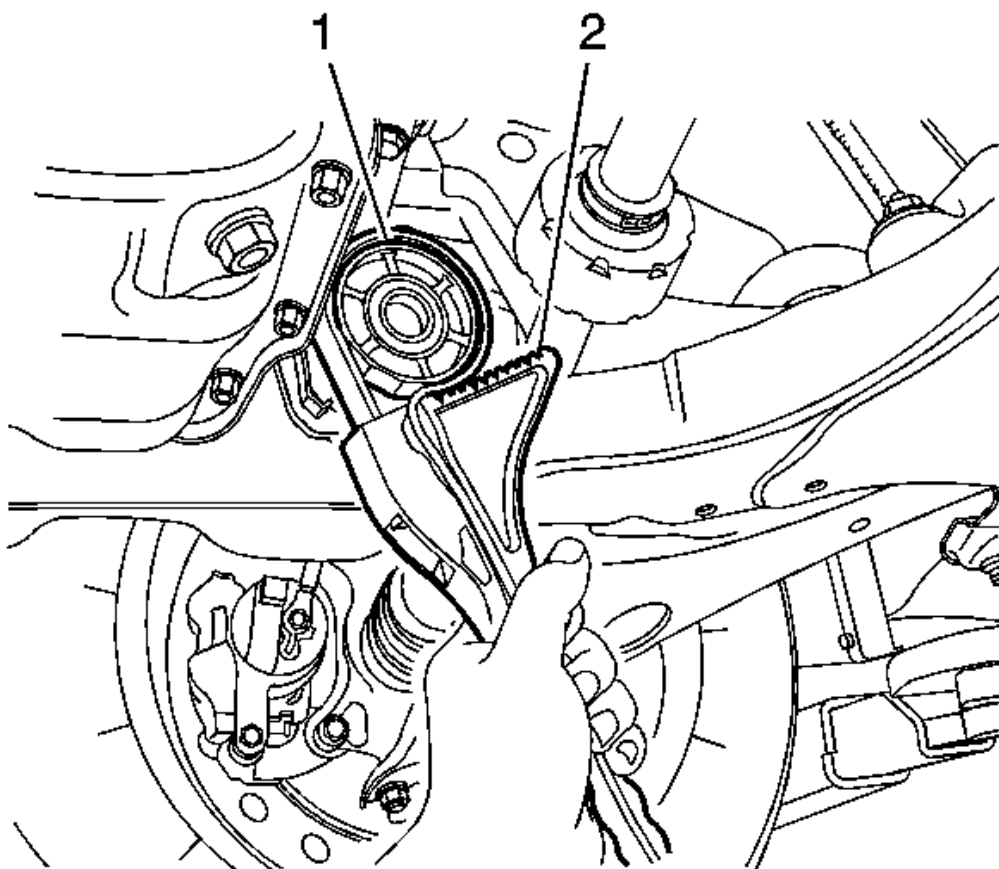


Fig. 253: Loosening Oil Filter Cap
Courtesy of GENERAL MOTORS CORP.

4. Using a strap type wrench (2), loosen the oil filter cap 4 revolutions, align the cap ribs vertically, and drain the remaining engine oil in the oil filter and cap.

NOTE: Set a container below the oil filter cap assembly before loosening the oil filter cap.

5. Remove the oil filter cap (1) assembly.

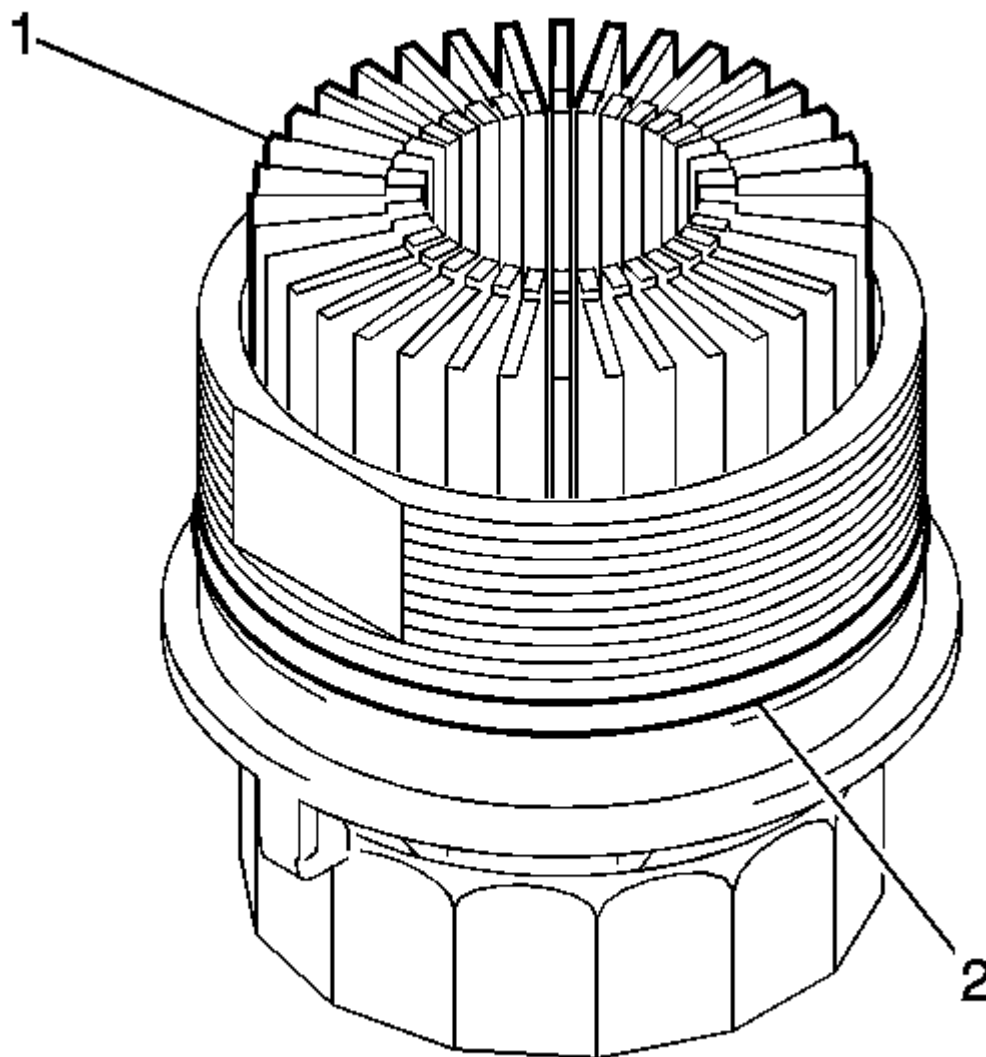


Fig. 254: View Of Oil Filter Element & O-Ring
Courtesy of GENERAL MOTORS CORP.

NOTE: Be sure to remove the O-ring (2) (for the cap) by hand, without using any tools, to prevent damage to the groove for the O-ring on the cap.

6. Remove oil filter element (1) and O-ring (2) from the oil filter cap.
7. Clean the oil filter cap threads and O-ring groove.
8. Apply a small amount of engine oil to a new O-ring and install it to the oil filter cap.

9. Set a new oil filter element in the oil filter cap.
10. Remove any dirt or foreign matter from the installation surfaces.

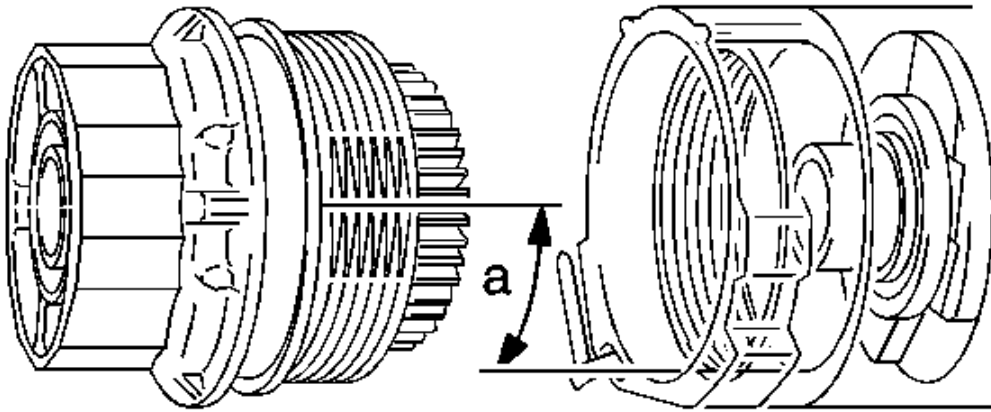


Fig. 255: Tightening Oil Filter

Courtesy of GENERAL MOTORS CORP.

NOTE: Make sure that the O-ring does not get caught between the parts.

11. Apply a small amount of engine oil to the O-ring of the oil filter cap assembly. Align the cutout in the oil filter cap threads 90 degrees to the grooves in the oil filter bracket and temporarily tighten the cap.

NOTE: After tightening the oil filter cap assembly, check for gaps between the installation surfaces. Do not remove the oil filter bracket clip when installing the oil filter cap assembly. Do not cross thread the oil filter cap assembly.

12. Using a strap type wrench, tighten the oil filter cap assembly to 25 N.m (18 lb ft).
13. Add fresh engine oil and install the oil filler cap.
14. Inspect for oil leaks.