

2010 ENGINE**Engine Mechanical - 2.4L (LAX) - Repair Instructions - On Vehicle - Vibe****DRIVE BELT REPLACEMENT****SPECIAL TOOLS**

J-39914: Serpentine Belt Tension Unloader

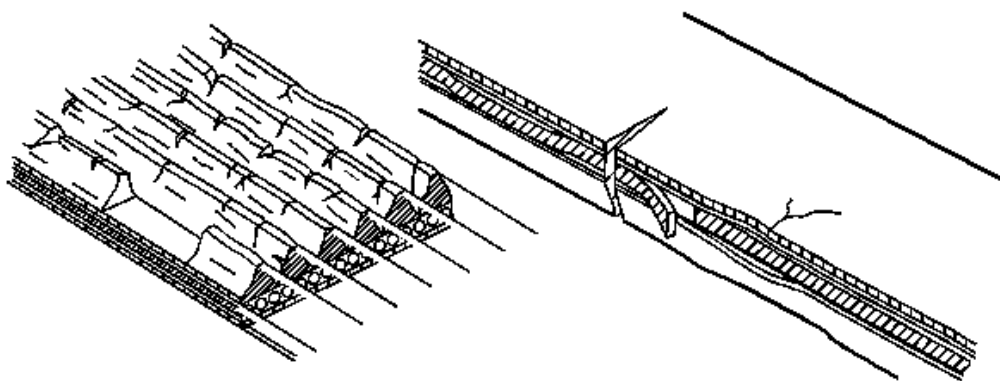
ON-VEHICLE INSPECTION

Fig. 1: View Of V-Ribbed Belt

Courtesy of GENERAL MOTORS CORP.

1. Check V-ribbed belt.
2. Check the 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 cords are exposed
- The belt has chunks missing from the ribs

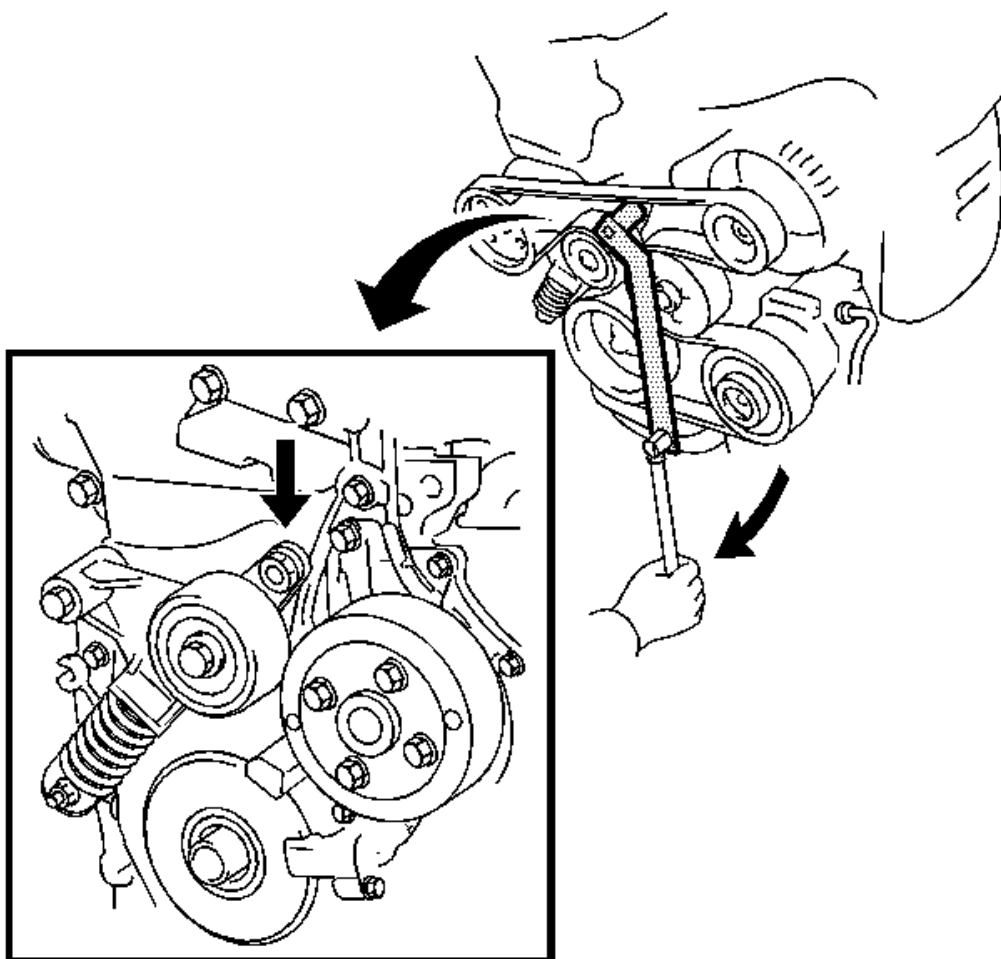


Fig. 2: Checking That Belt Fits Properly
Courtesy of GENERAL MOTORS CORP.

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

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

REMOVAL PROCEDURE

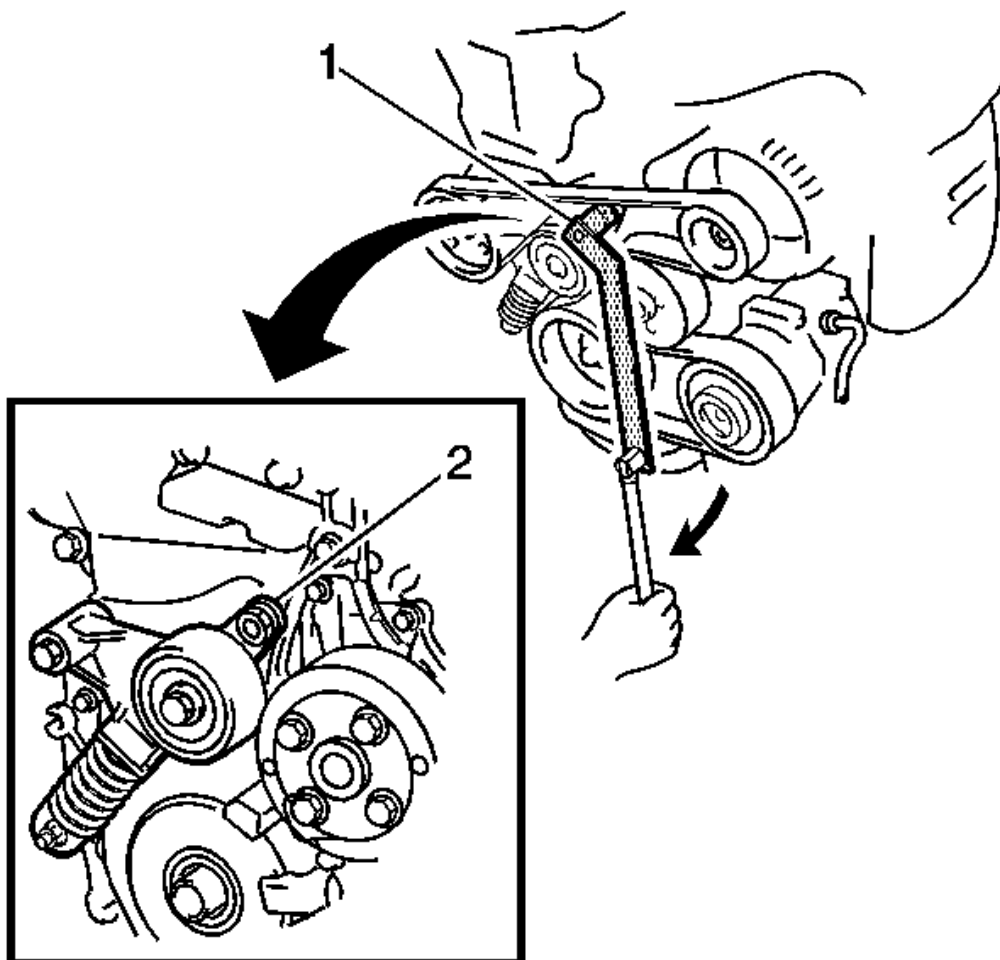


Fig. 3: Removing/Installing Belt
Courtesy of GENERAL MOTORS CORP.

1. Remove engine under cover RH.
2. Remove V-ribbed belt.
3. Using the **J-39914: unloader (1)**, slowly turn the V-ribbed belt tensioner clockwise.

NOTE: Make sure that the **J-39914: unloader** and other tools are set to the tensioner securely. When compressing the V-ribbed belt tensioner, slowly turn the tensioner. Be careful not to pinch your fingers between the parts.

4. Remove the V-ribbed belt from each pulley and slowly return the tensioner.

INSTALLATION PROCEDURE

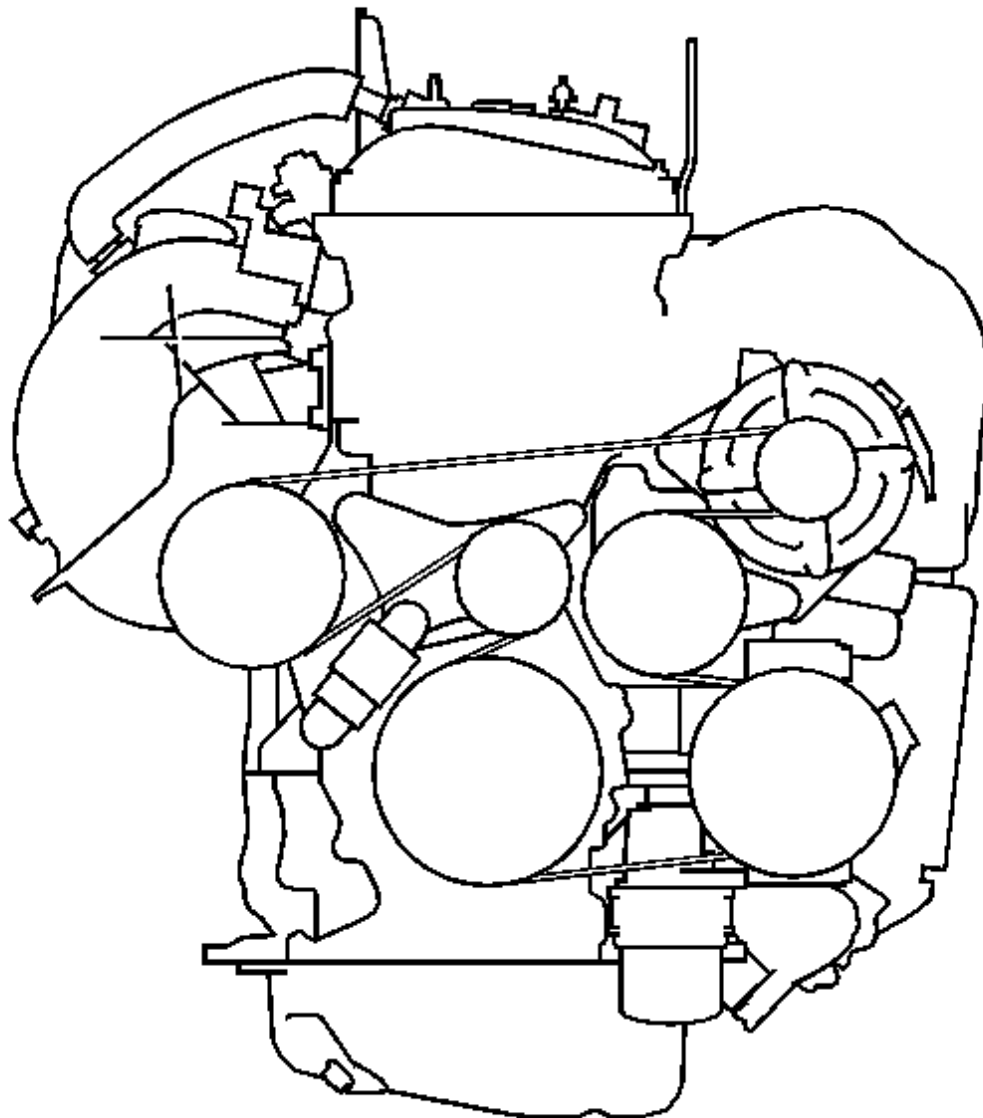


Fig. 4: View Of Belt Routing
Courtesy of GENERAL MOTORS CORP.

NOTE: V-ribbed belt layout.

1. Install V-ribbed belt.

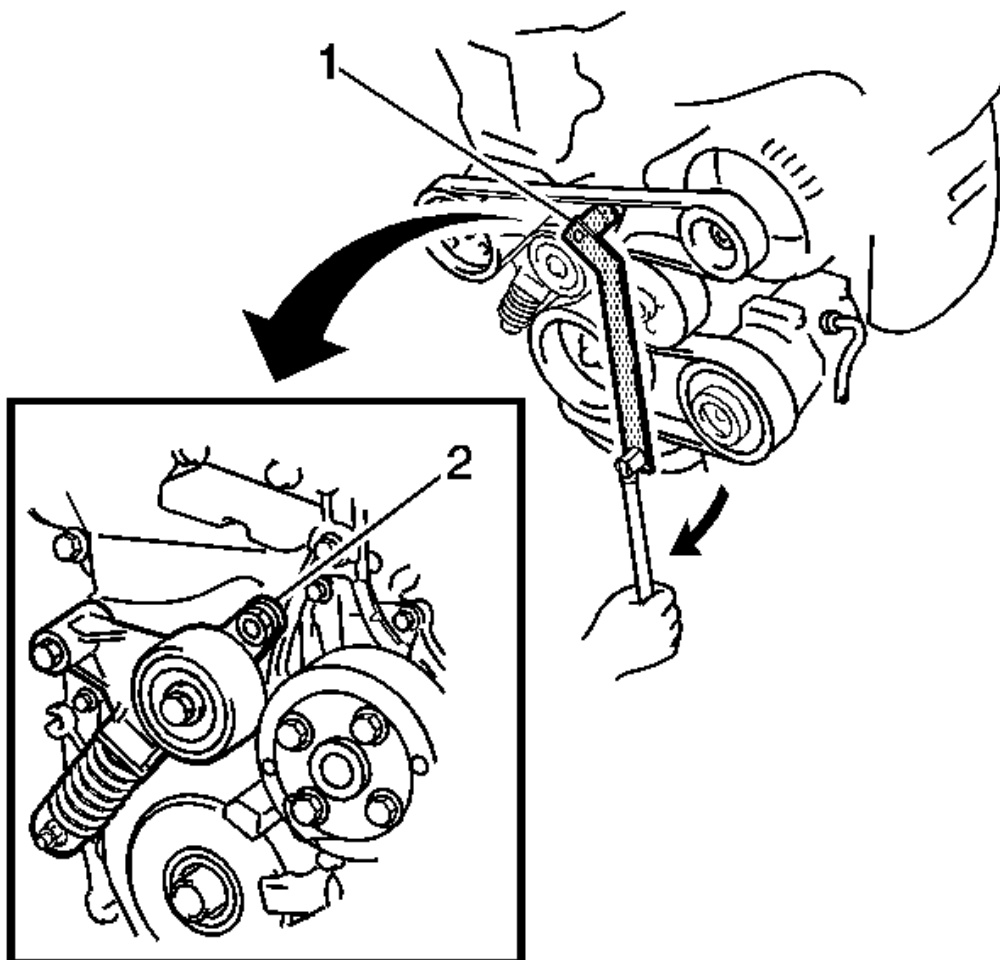


Fig. 5: Removing/Installing Belt
Courtesy of GENERAL MOTORS CORP.

2. Using the **J-39914**: unloader (1), slowly turn the V-ribbed belt tensioner EM clockwise and install the V-ribbed belt.
3. Install the engine under cover RH.

DRIVE BELT TENSIONER REPLACEMENT

REMOVAL PROCEDURE

WARNING: Refer to Battery Disconnect Warning .

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.
2. Remove the accessory drive belt. Refer to **Drive Belt Replacement**.
3. Remove the right side engine mount. Refer to **Engine Mount Replacement**.
4. Using the fixture, raise the engine assembly.

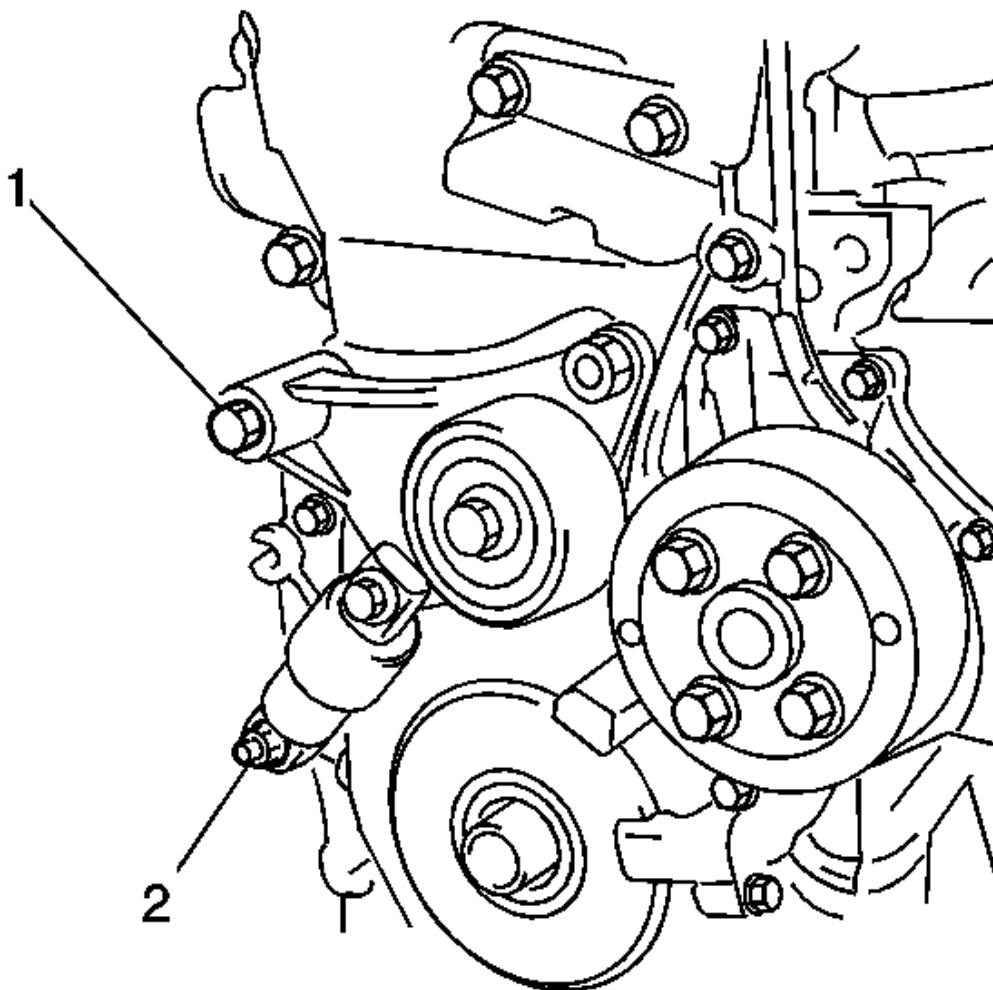


Fig. 6: Identifying Belt Tensioner Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the lower drive belt tensioner nut (2).

6. Remove the upper drive belt tensioner bolt (1) and remove the tensioner.

INSTALLATION PROCEDURE

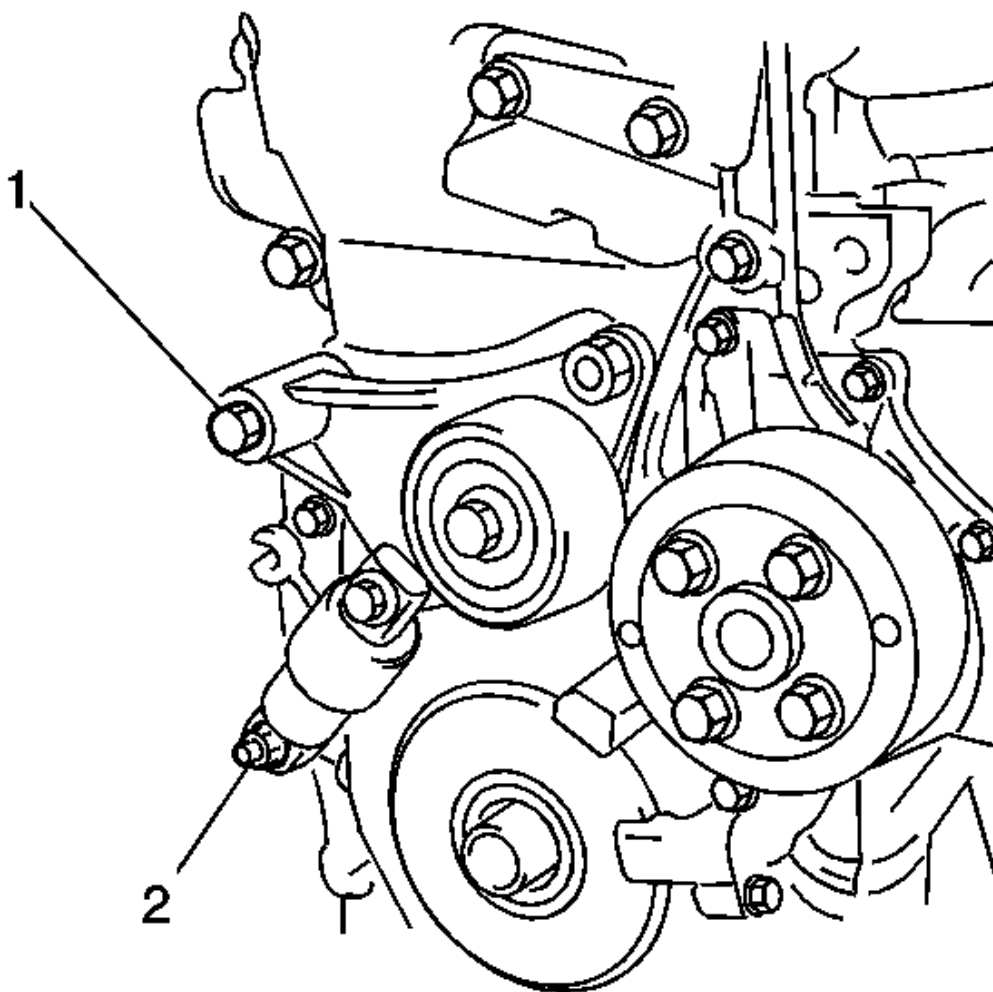


Fig. 7: Identifying Belt Tensioner Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the drive belt tensioner.

Tighten: Tighten the bolt (1) and nut (2) to 60 N.m (44 lb ft).

2. Lower the engine assembly enough to position the right side engine mount in place.
3. Install the right side engine mount. Refer to **Engine Mount Replacement**.
4. Remove the engine support fixture.
5. Install the accessory drive belt. Refer to **Drive Belt Replacement**.
6. Connect the negative battery cable.

ENGINE COVER REPLACEMENT

REMOVAL PROCEDURE

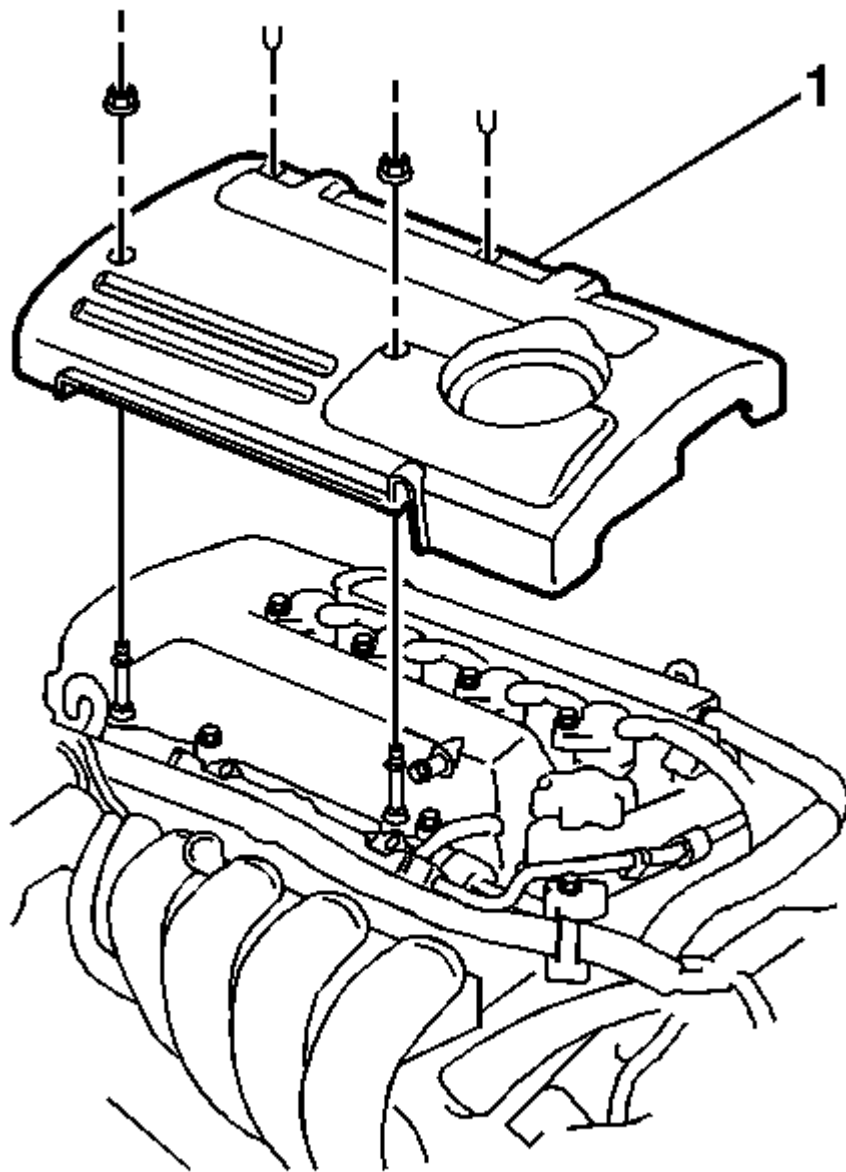


Fig. 8: View Of Engine Top Cover, Plastic Retainers & Fasteners
Courtesy of GENERAL MOTORS CORP.

1. Remove the 2 engine cover fasteners.
2. Remove the 2 engine cover plastic retainers.
3. Remove the engine cover (1) from the engine.

INSTALLATION PROCEDURE

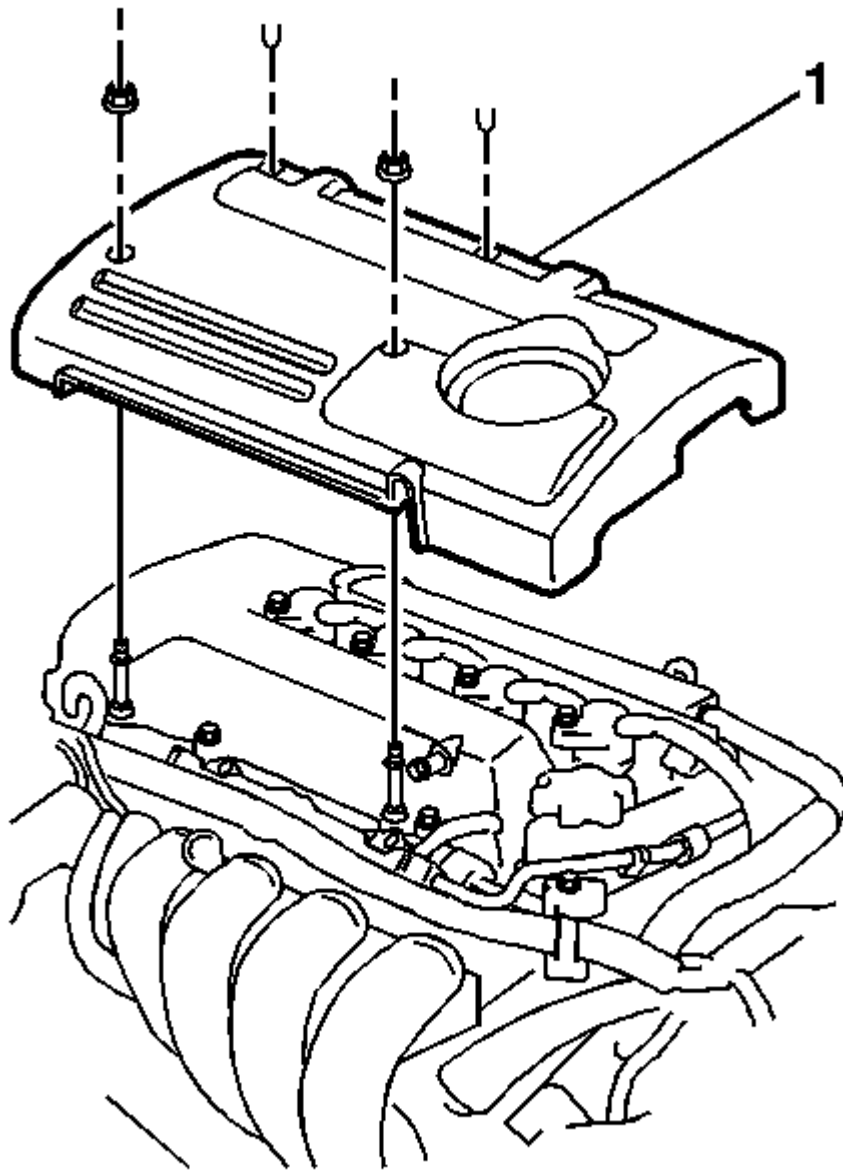


Fig. 9: View Of Engine Top Cover, Plastic Retainers & Fasteners
Courtesy of GENERAL MOTORS CORP.

1. Position the engine cover (1) to the engine.

CAUTION: Refer to Fastener Caution .

2. Install the 2 engine cover fasteners.

Tighten: Tighten the engine cover fasteners to 7 N.m (62 lb in).

3. Install the 2 engine cover plastic retainers.

ENGINE SUPPORT FIXTURE

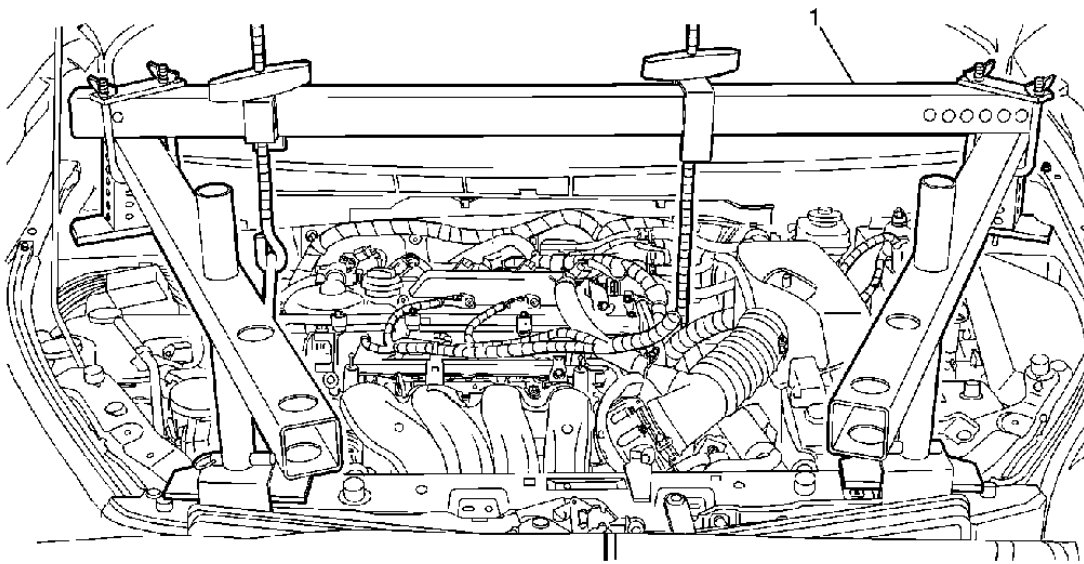


Fig. 10: Engine Support Fixture

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

WARNING: Refer to Battery Disconnect Warning .

1. Disconnect the negative battery cable. Refer to Battery Negative Cable Disconnection and Connection .

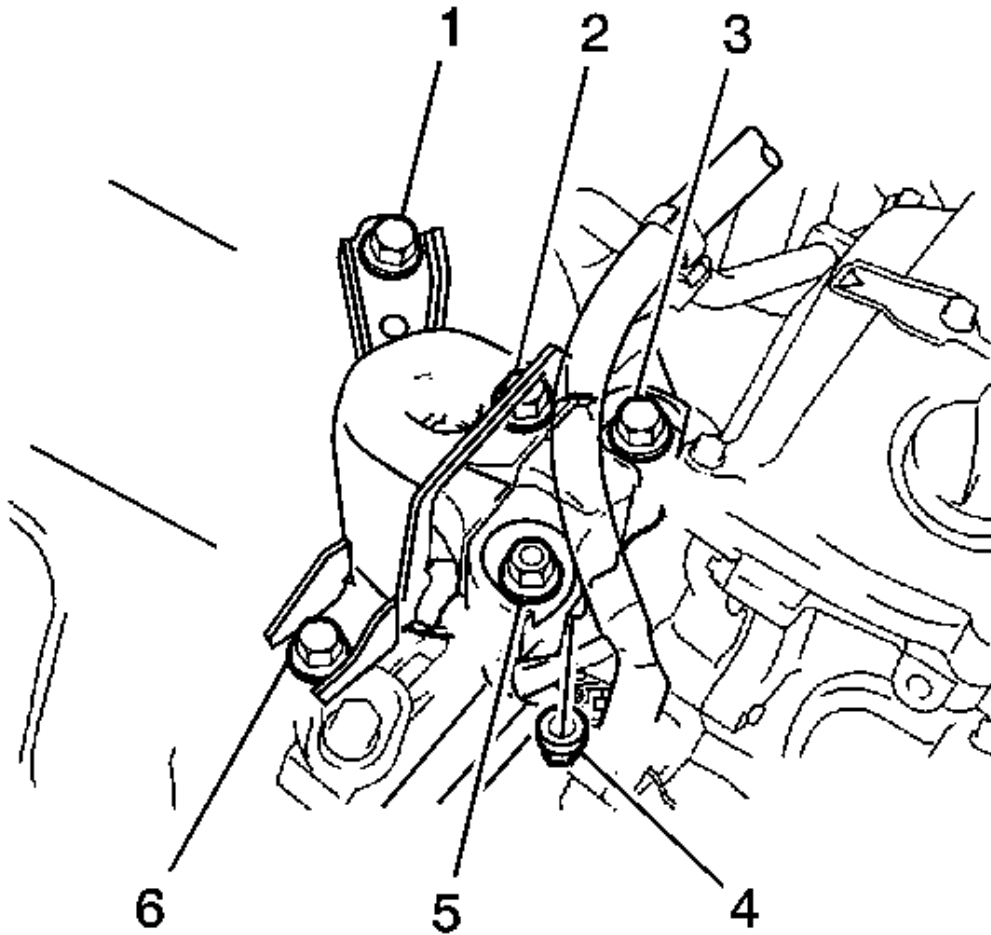


Fig. 11: Identifying Engine Mounts & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not apply excessive force to the return tube when removing the right engine mounting insulator sub-assembly.

NOTE: Keep clearance by lowering the engine using the engine support fixture when removing the front engine mounting insulator.

2. Install the engine support fixture. Refer to [Engine Support Fixture](#) .
3. Remove the 4 bolts (1, 2, 3, 6) and 2 nuts (4, 5), then remove the right engine mounting insulator.

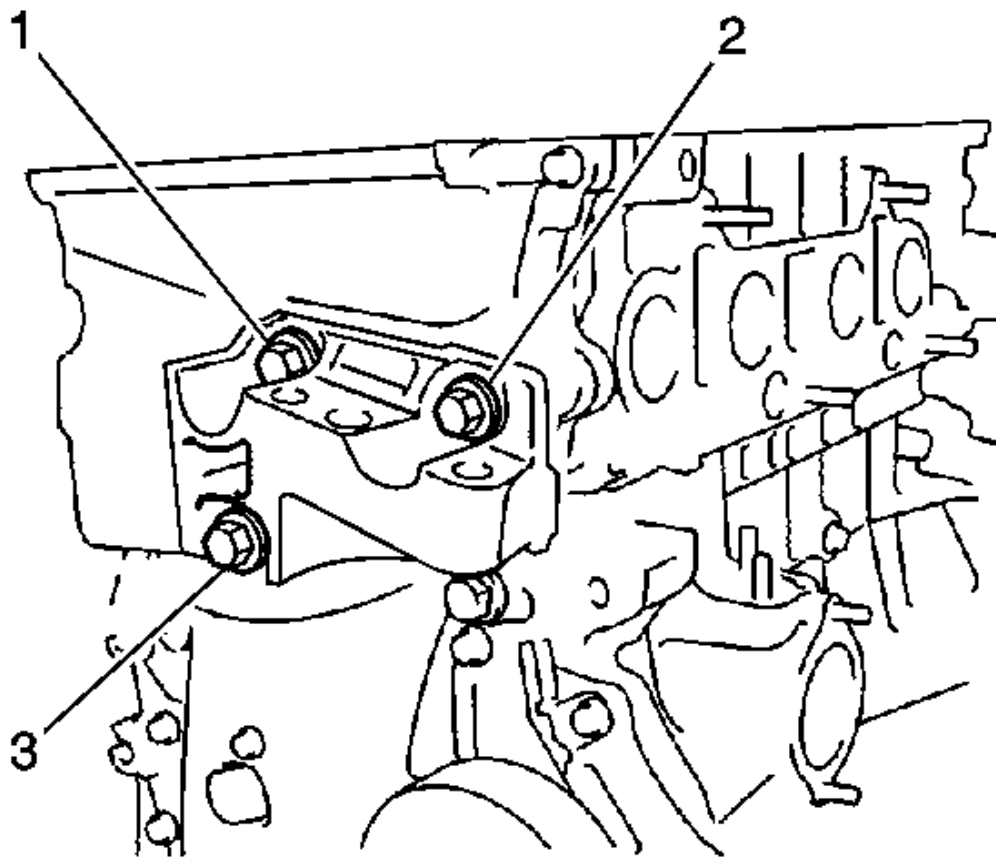


Fig. 12: Identifying Engine Mount Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the 3 bolts (1, 2, 3) and transverse engine mounting bracket.

INSTALLATION PROCEDURE

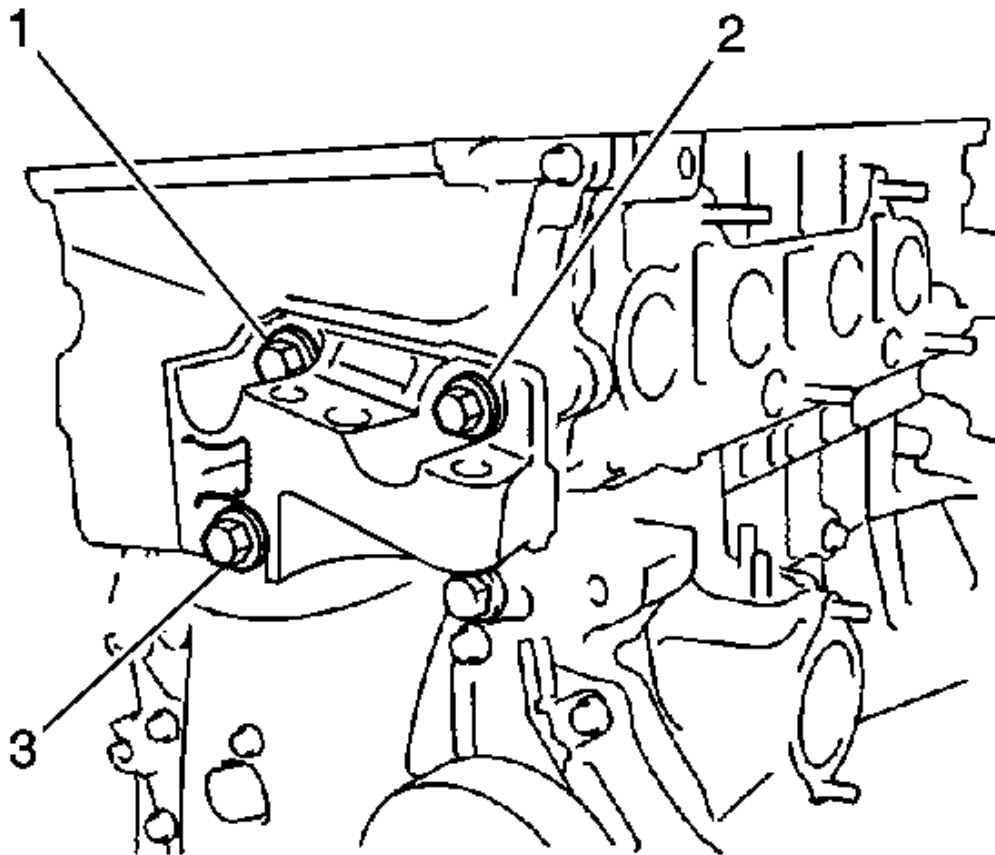


Fig. 13: Identifying Engine Mount Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

1. Install the engine transverse engine mounting bracket with the 3 bolts (1, 2, 3) and tighten to 55 N.m (41 lb ft).

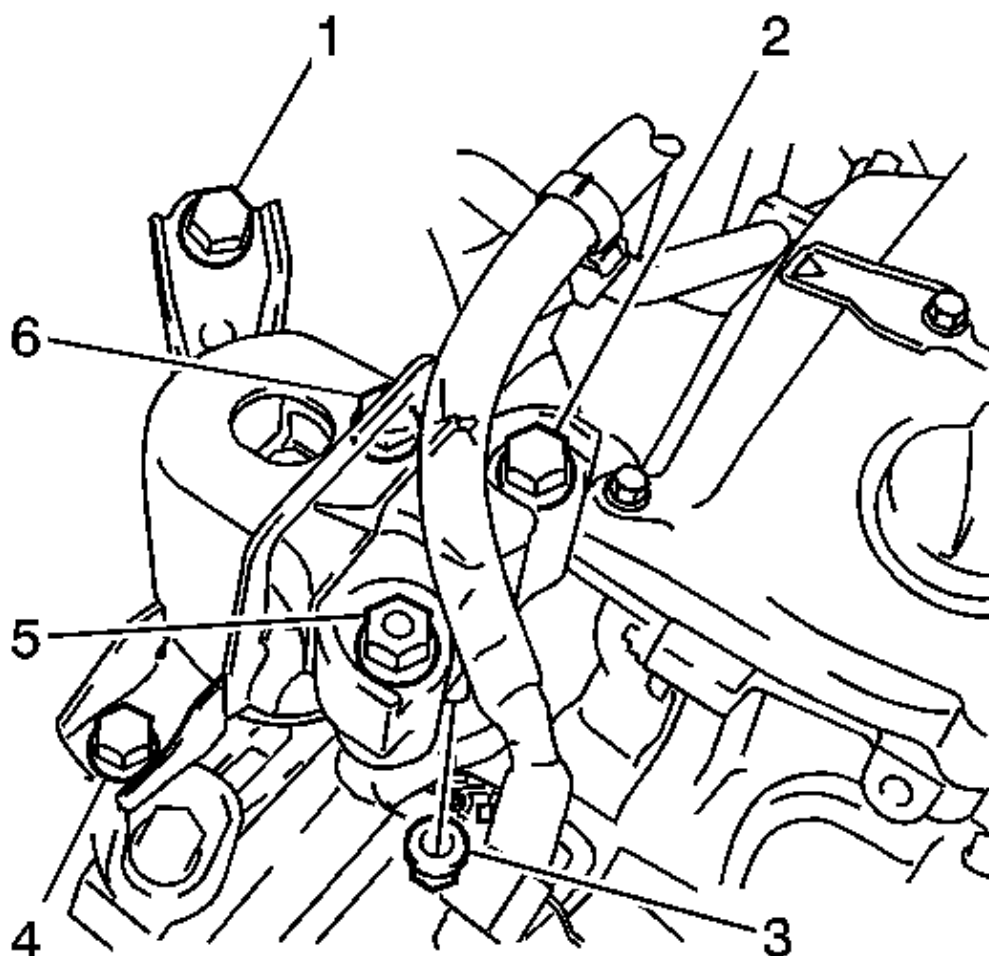


Fig. 14: View Of Right Engine Mounting Insulator Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the right engine mounting insulator sub-assembly with the 4 bolts (1, 2, 4, 6) and 2 nuts (3, 5) and tighten
 - Bolts 1, 4 and 6 to 52 N.m (38 lb ft)
 - Bolt 2 to 95 N.m (70 lb ft)
 - Nut 5 to 95 N.m (70 lb ft)
 - Nut 3 to 52 N.m (38 lb ft)
3. Remove the engine support fixture.
4. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection** .

ENGINE BLOCK HEATER REPLACEMENT

REMOVAL PROCEDURE

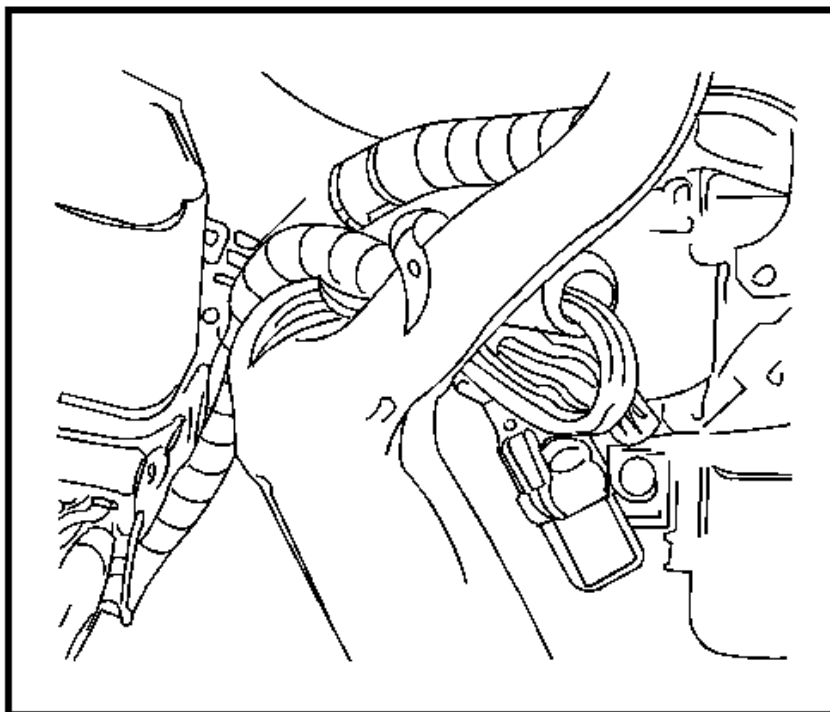
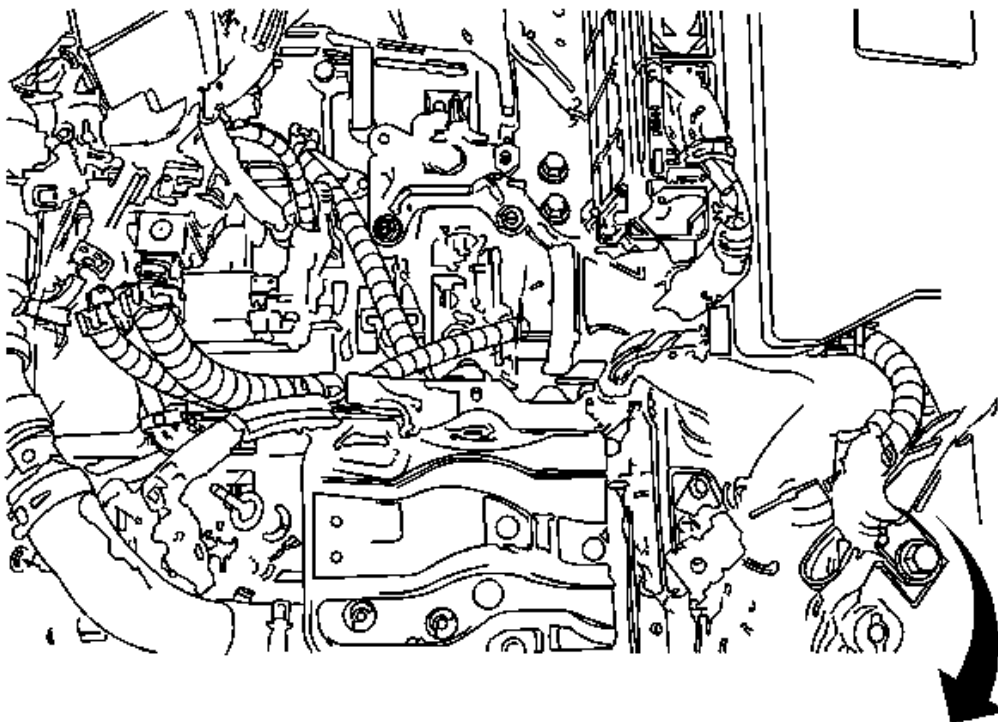


Fig. 15: Identifying Engine Block Heater Harness Plug Bundle
Courtesy of GENERAL MOTORS CORP.

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

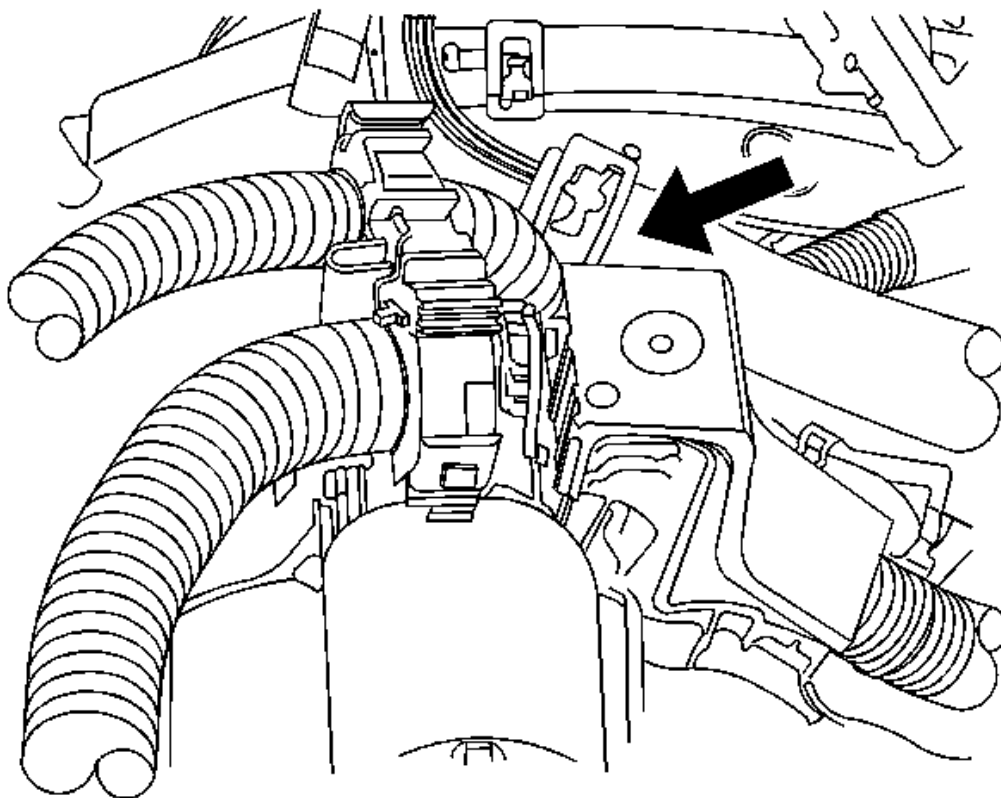


Fig. 16: Identifying Engine Block Heater Harness Retainer
Courtesy of GENERAL MOTORS CORP.

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

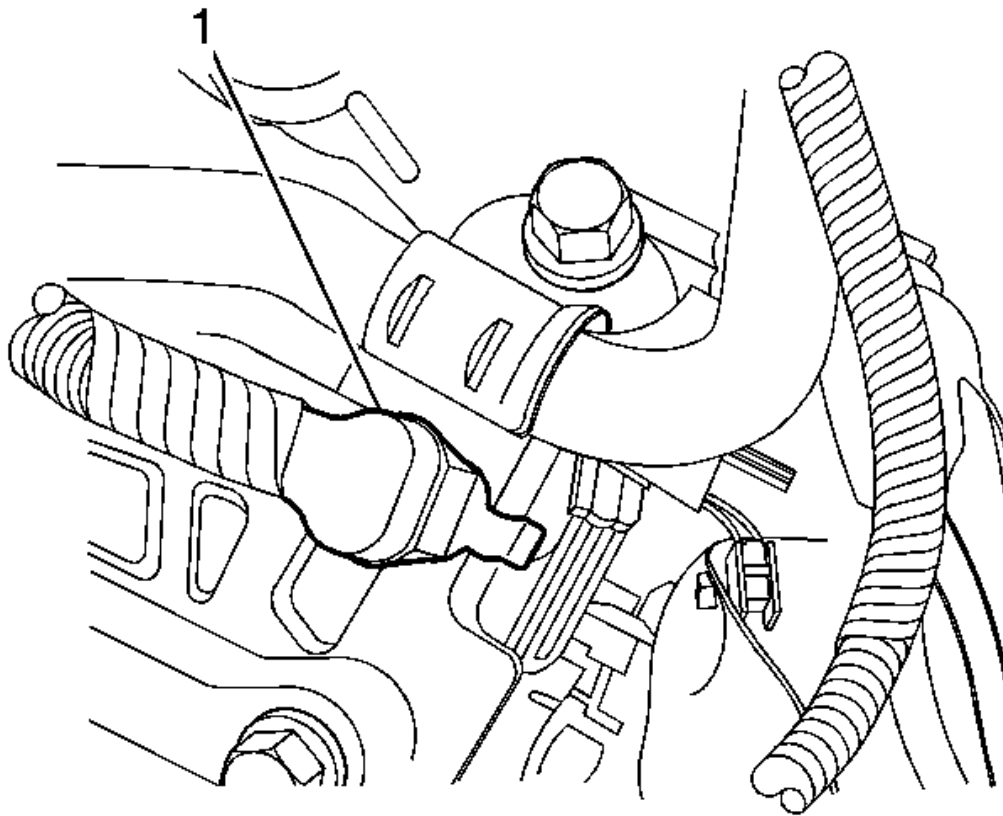


Fig. 17: Locating Engine Block Heater Element Retaining Clip
Courtesy of GENERAL MOTORS CORP.

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

INSTALLATION PROCEDURE

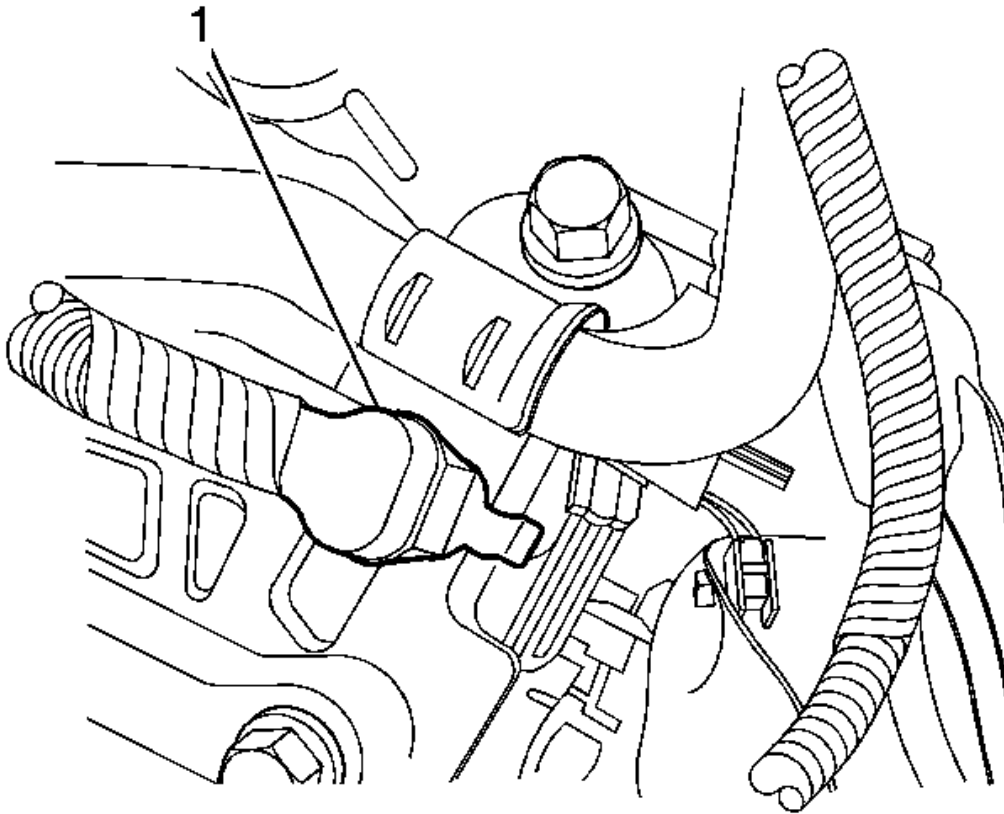


Fig. 18: Locating Engine Block Heater Element Retaining Clip
Courtesy of GENERAL MOTORS CORP.

NOTE: Visually inspect that the engine block heater harness plug (1) 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 into the engine block cavity in the nine o'clock position.

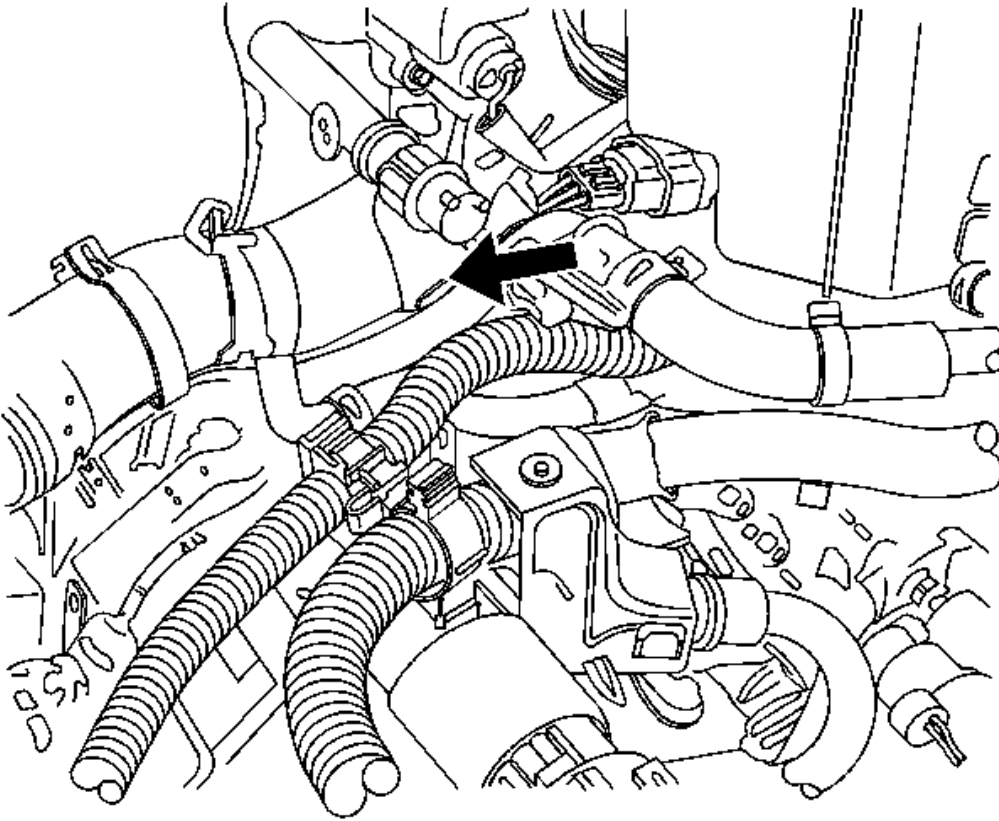


Fig. 19: Identifying Engine Block Heater Routing
Courtesy of GENERAL MOTORS CORP.

2. Route block heater harness below the heater hose.

NOTE: **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 forward of the engine harness protector.

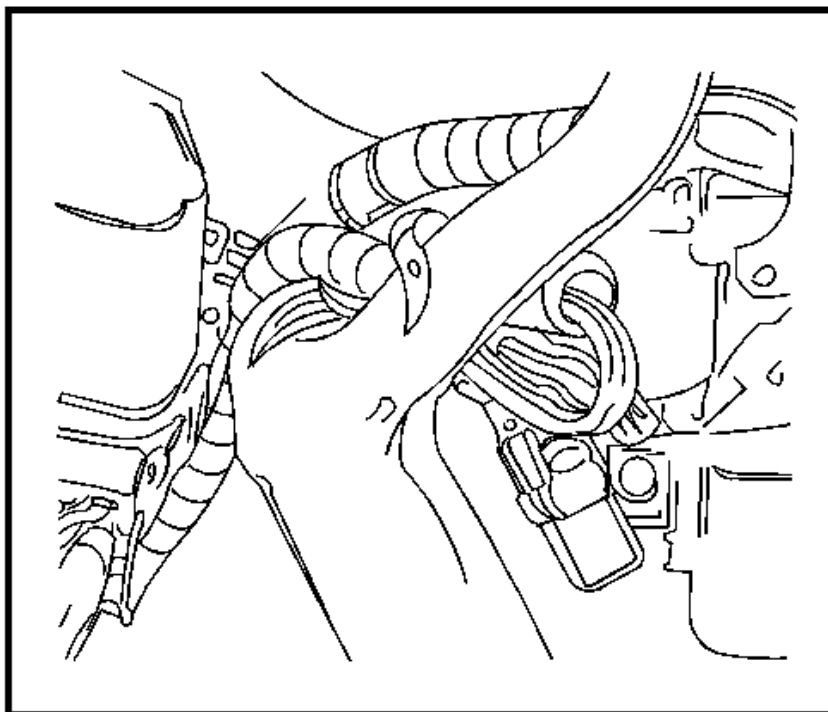
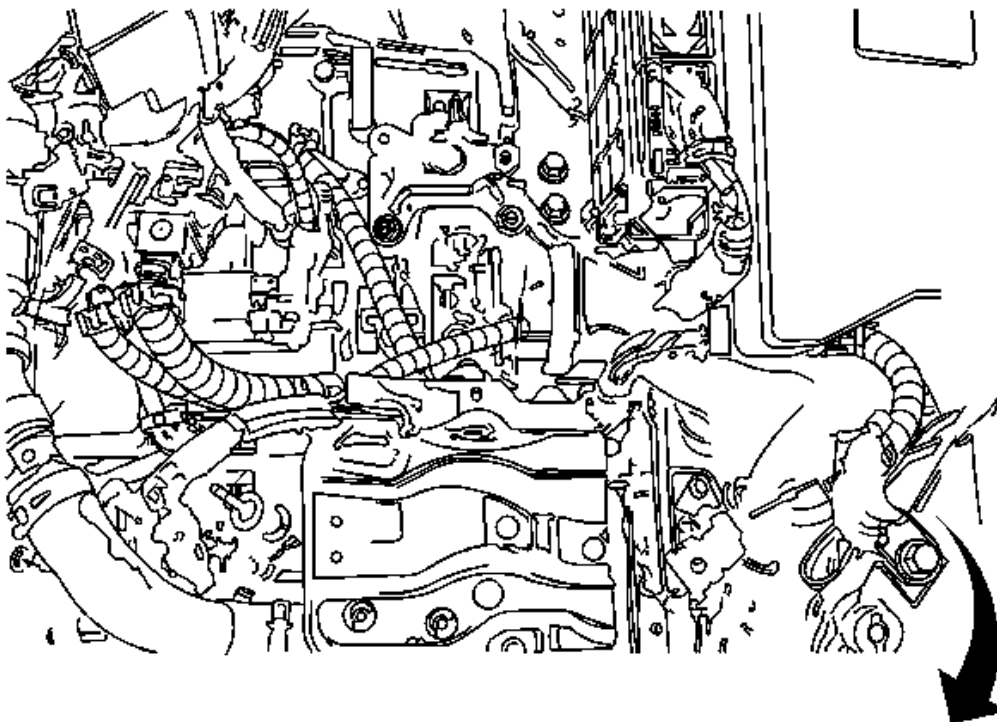


Fig. 20: Identifying Engine Block Heater Harness Plug Bundle
Courtesy of GENERAL MOTORS CORP.

4. Route the engine block heater harness below the battery tray bracket and along the battery harness.
5. Route the engine block heater harness rearward and behind the air inlet. Bring harness upward along the air inlet.

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

6. Clip the engine block heater harness plug bundle to the air inlet attachment flange close to the neck.

INTAKE MANIFOLD REPLACEMENT

REMOVAL PROCEDURE

1. Discharge fuel system pressure. Refer to **Fuel Pressure Relief**

WARNING: Refer to **Battery Disconnect Warning**

2. Disconnect the cable from negative battery terminal. Refer to **Battery Negative Cable Disconnection and Connection**.
3. Remove the windshield wiper motor and link assembly. Refer to **Windshield Wiper Motor Replacement**
4. Remove the outer cowl top panel.
5. Remove the suspension tower damper assembly (with front strut bar).
6. Remove the engine cover. Refer to **Engine Cover Replacement**.
7. Drain the engine coolant. Refer to **Cooling System Draining and Filling**.
8. Remove the air cleaner cap with hose.
9. Remove the throttle body assembly.
10. Disconnect the fuel main tube.
11. Disconnect the ventilation hose.
12. Remove the fuel delivery pipe sub-assembly.

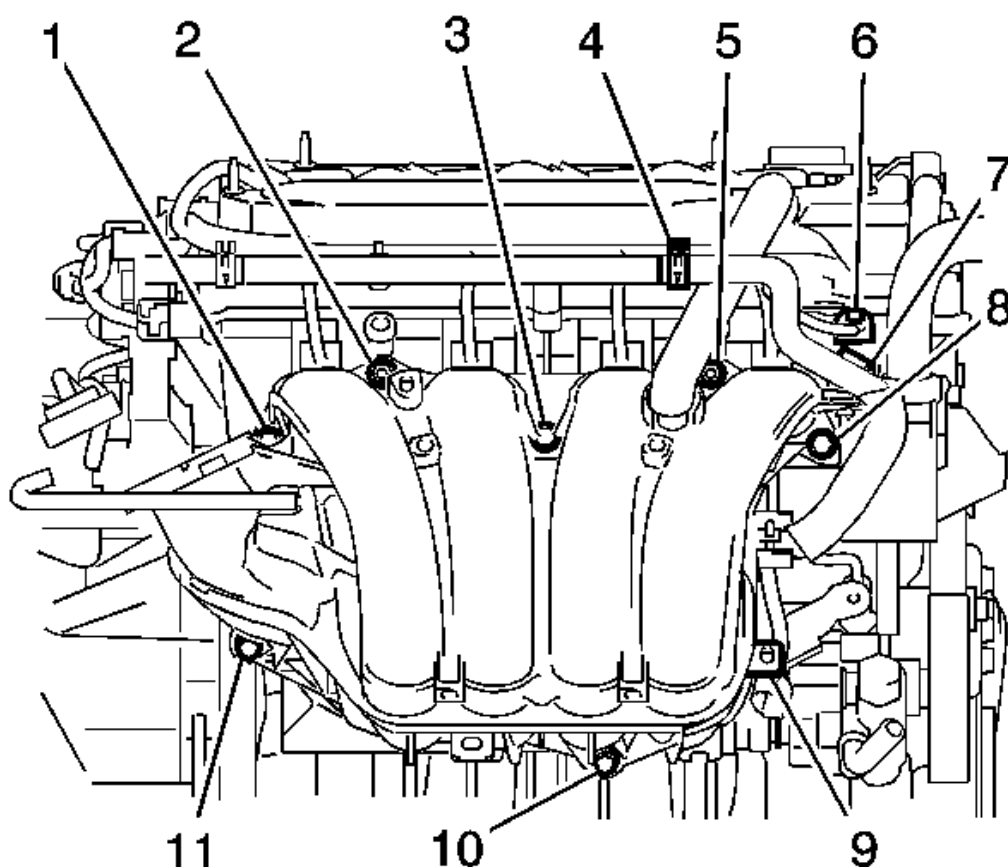


Fig. 21: View Of Intake Manifold, Bolts & Nuts
 Courtesy of GENERAL MOTORS CORP.

13. Disconnect the union to check valve hose (4) from the brake booster.
14. Disconnect the camshaft timing oil control valve connector.
15. Remove the wire harness clamp.
16. Remove the union to check valve hose from the vacuum hose clamp.
17. Remove the 5 bolts (1, 3, 8, 10, 11), 2 nuts (2, 5) and intake manifold.

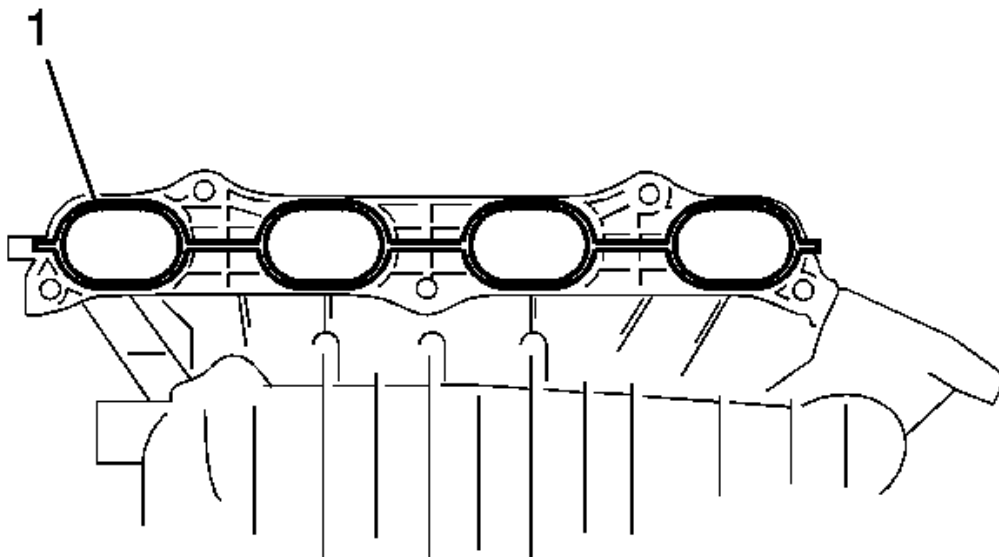


Fig. 22: View Of Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

18. Remove the gasket (1) from the intake manifold.

INSTALLATION PROCEDURE

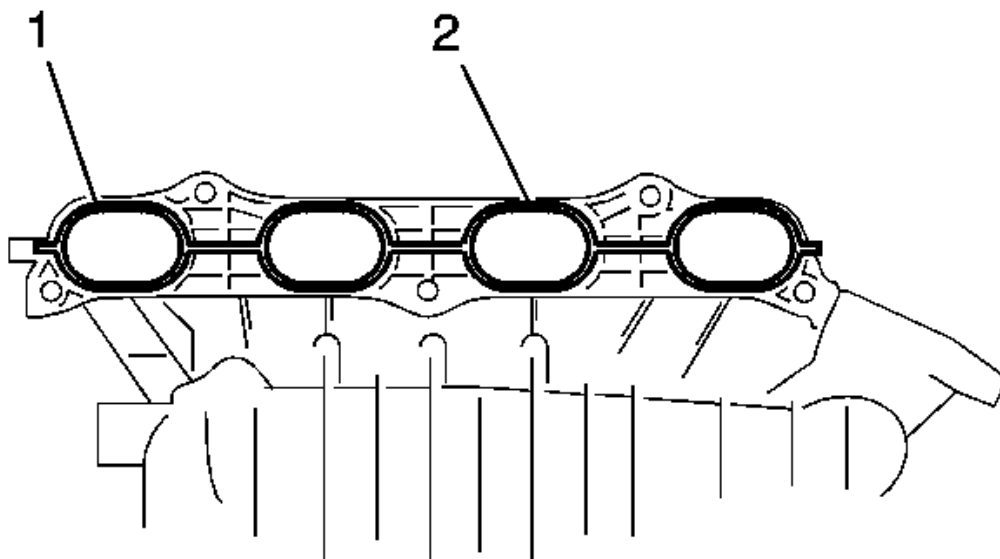


Fig. 23: Identifying Intake Manifold Gasket
Courtesy of GENERAL MOTORS CORP.

1. Install a new gasket (1) into the intake manifold.

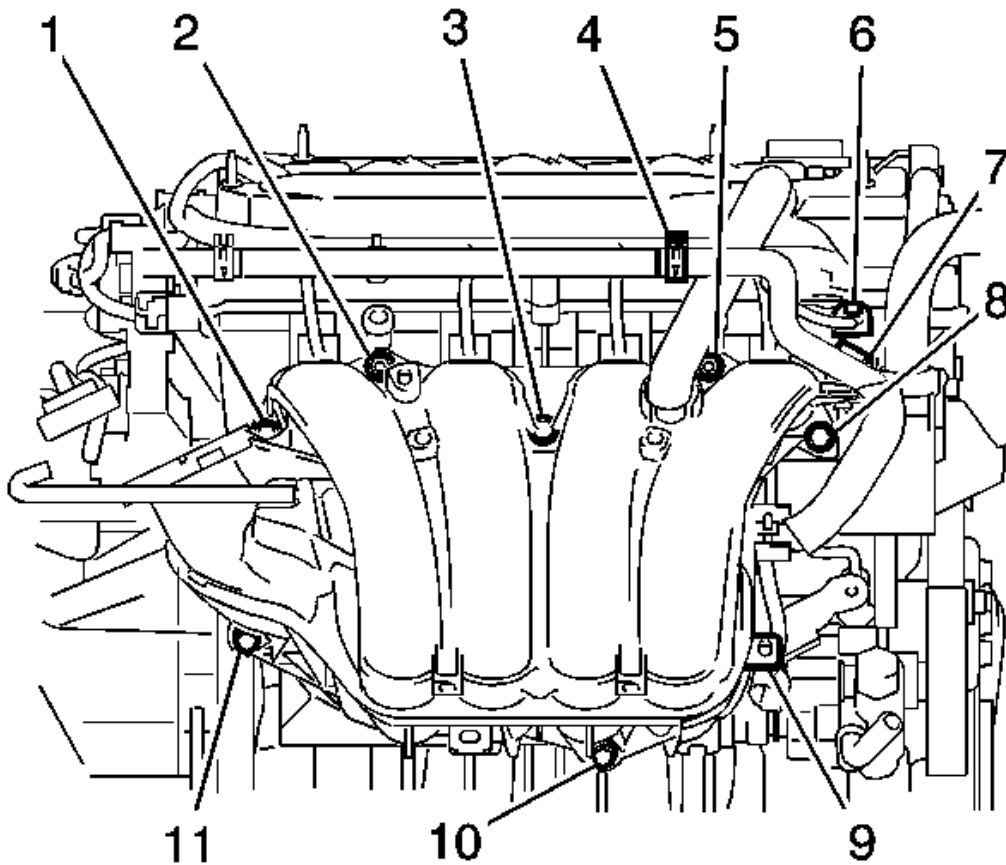


Fig. 24: View Of Intake Manifold, Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution

2. Install the intake manifold with the 5 bolts (1, 3, 8, 10, 11) and 2 nuts (2, 5) and tighten to 30 N.m (22 lb ft).
3. Fit the union to check valve hose into the vacuum hose clamp (4).
4. Install the wire harness clamp.
5. Connect the camshaft timing oil control valve connector.
6. Connect the union to check valve hose to the brake booster.
7. Install fuel delivery pipe sub-assembly.
8. Connect the ventilation hose.

9. Connect the fuel main tube.
10. Install the throttle body assembly.
11. Install the air cleaner cap with hose.
12. Connect the cable to negative battery terminal.
13. Add the engine coolant. Refer to **Cooling System Draining and Filling**
14. Inspect for coolant leak.
15. Inspect for fuel leak.
16. Install the engine cover. Refer to **Engine Cover Replacement**
17. Install the suspension tower damper assembly (with front strut bar).
18. Install the outer cowl top panel.
19. Install the windshield wiper motor and link assembly. Refer to **Windshield Wiper Motor Replacement**.
20. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnection and Connection**.

INTAKE CAMSHAFT AND VALVE LIFTER REPLACEMENT

REMOVAL PROCEDURE

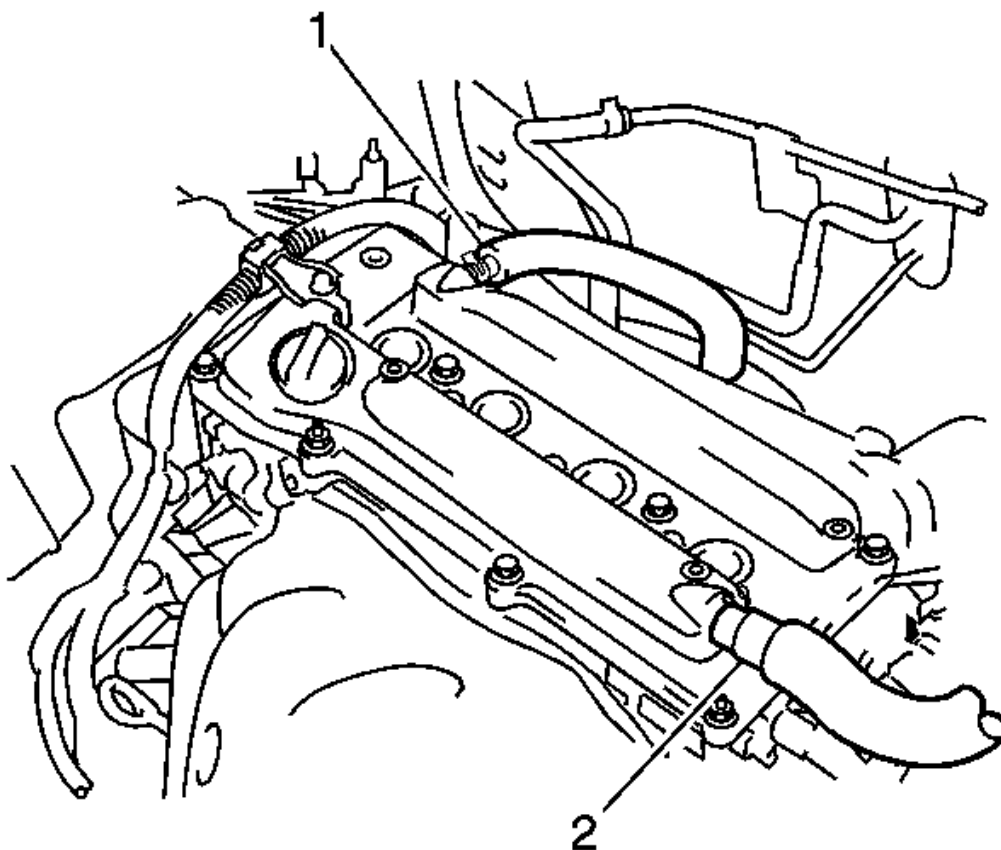


Fig. 25: View Of Engine Cover Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the right engine under cover.
2. Remove the engine cover. Refer to **Engine Cover Replacement**.
3. Remove the ignition coil assembly. Refer to **Ignition Coil Replacement**.
4. Remove the spark plug. Refer to **Spark Plug Replacement**.
5. Remove the 2 ventilation hoses (1, 2) from the cylinder head cover sub-assembly.

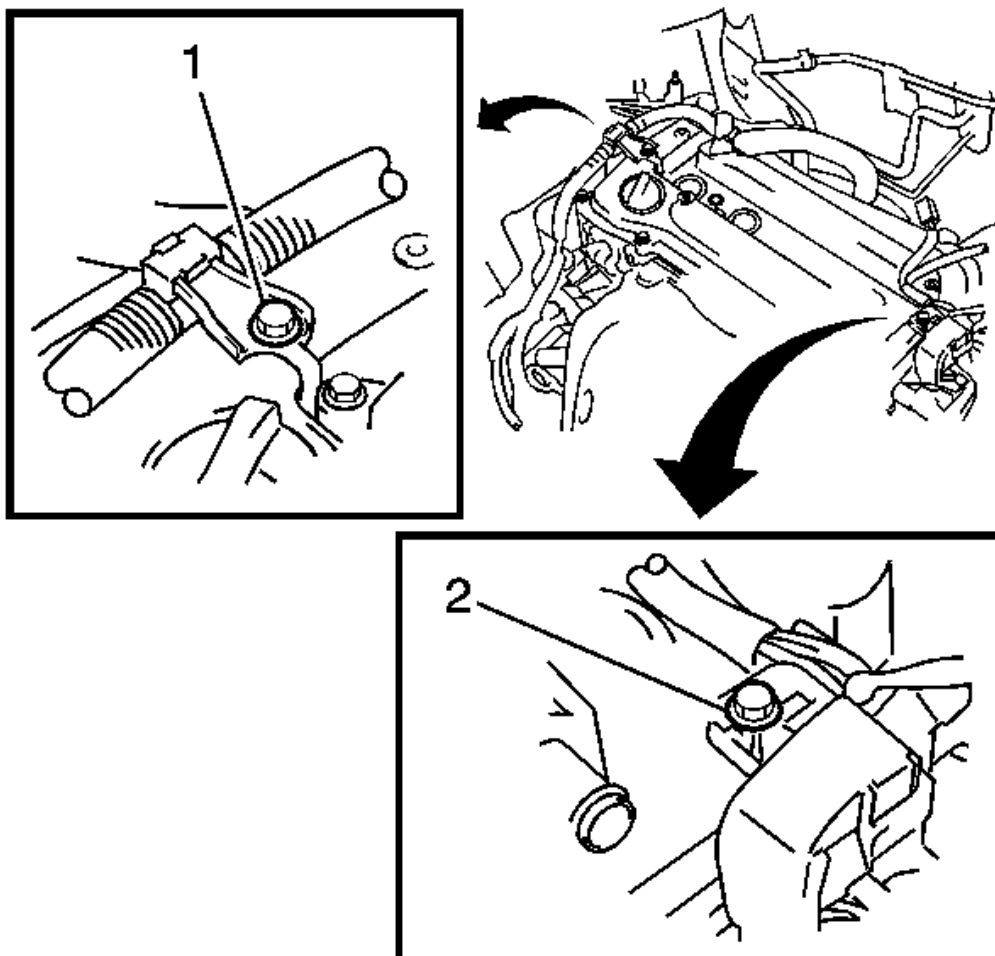


Fig. 26: View Of Wire Harness Brackets
Courtesy of GENERAL MOTORS CORP.

6. Remove the 2 bolts (1, 2) and separate the 2 wire harness brackets.

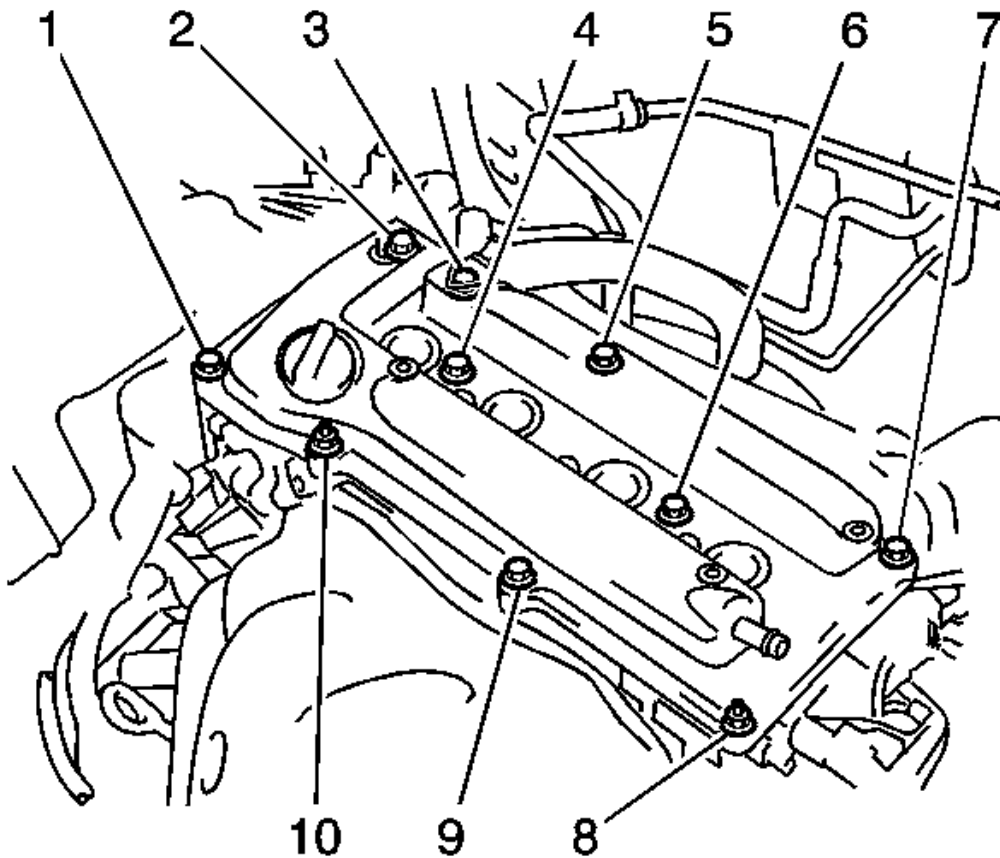


Fig. 27: Identifying Cylinder Head Cover Sub-Assembly Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

7. Remove the 8 bolts (1-7, 9) and 2 nuts (8, 10), then remove the cylinder head cover sub-assembly and gasket.

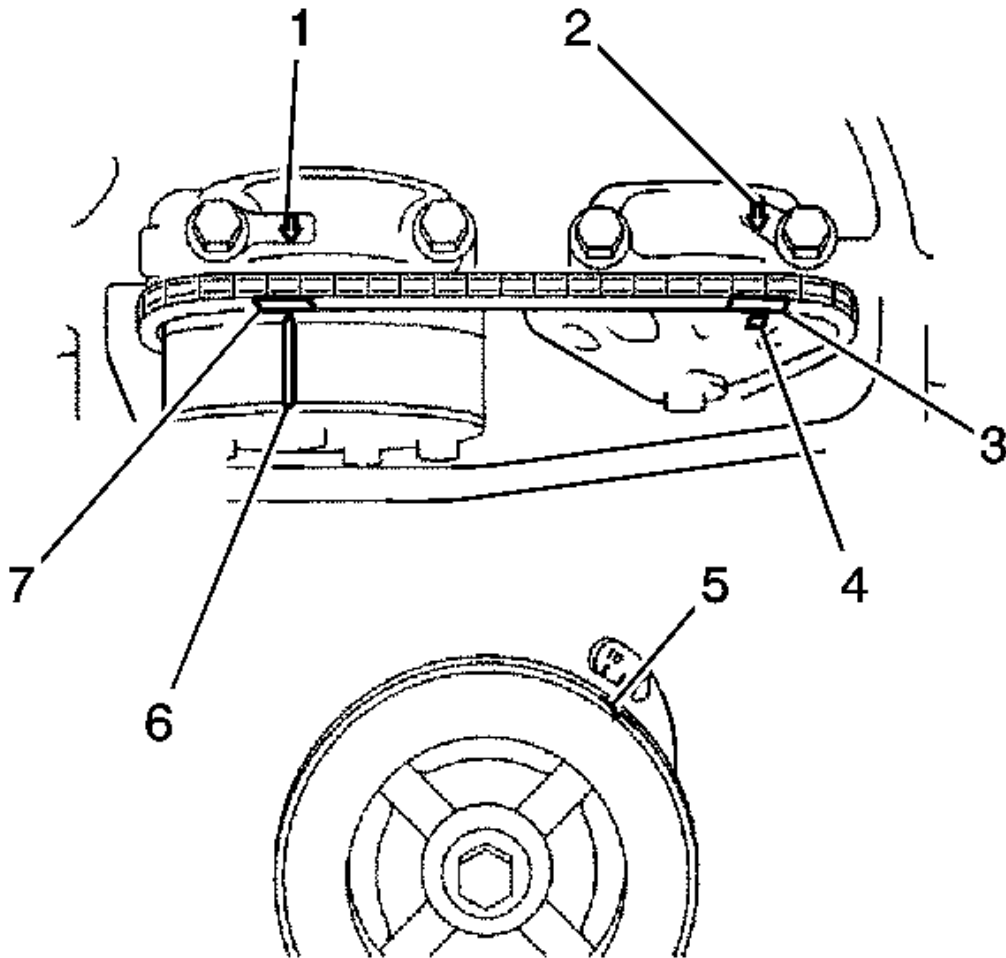


Fig. 28: Setting No. 1 Cylinder To TDC/compression Stroke
Courtesy of GENERAL MOTORS CORP.

8. Set No. 1 cylinder to TDC/compression by turning the crankshaft pulley until the groove (5) and the timing mark "0" on the timing chain cover are aligned.
9. Check that each timing mark on the camshaft timing gear (4, 6) and sprocket is aligned with each timing mark located on the bearing caps (1, 2), as shown in the illustration.
10. If not, turn the crankshaft pulley by 1 revolution (360°) to align the timing marks as illustrated.
11. Place paint marks on the chain (3, 7) in alignment with the timing marks on the camshaft timing gear and camshaft timing sprocket.
12. Remove the chain tensioner assembly.

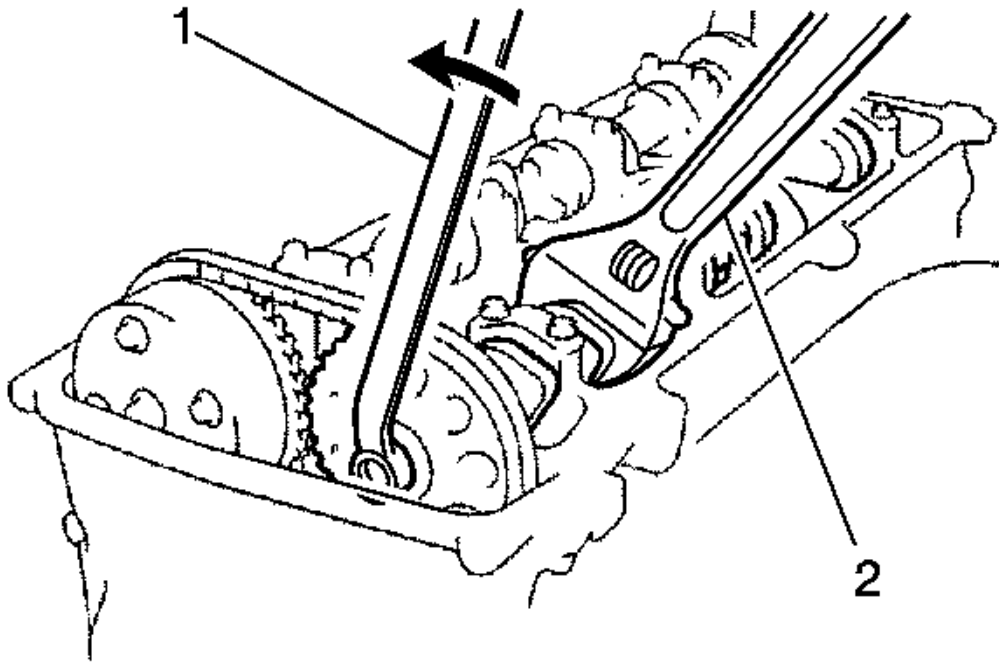


Fig. 29: Identifying Camshaft Timing Gear & Sprocket
Courtesy of GENERAL MOTORS CORP.

13. Loosen the camshaft timing gear or sprocket. While holding the exhaust camshaft with a wrench (2), loosen the No. 2 camshaft timing set bolt.

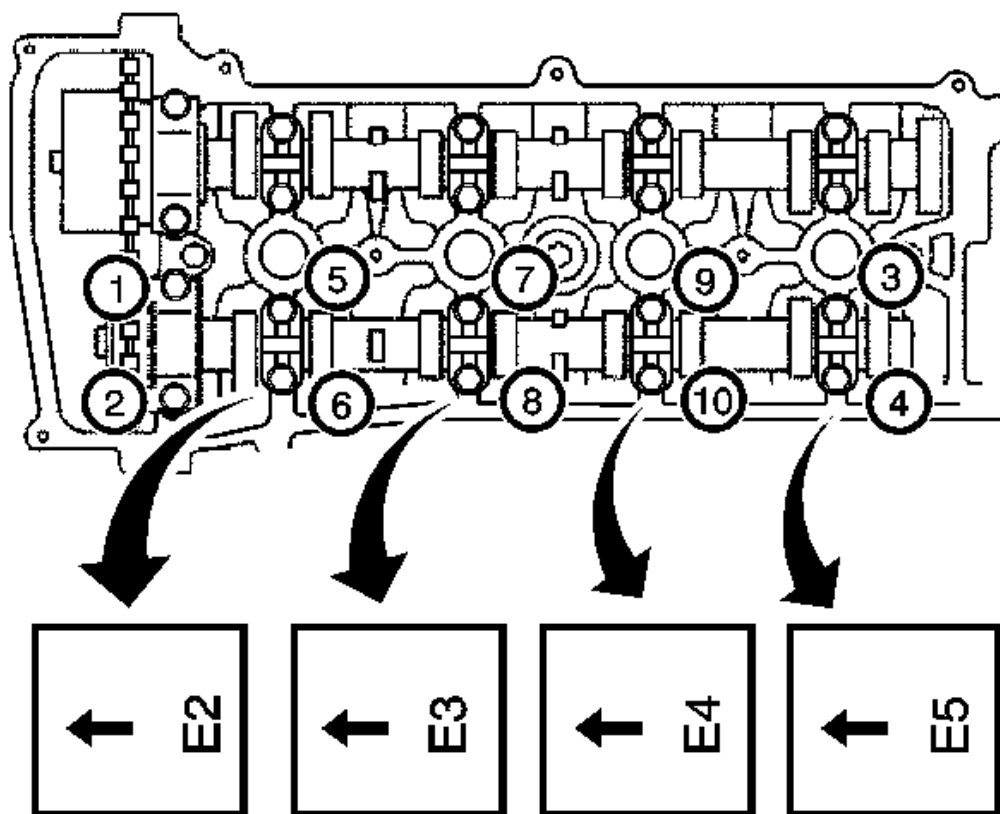


Fig. 30: Identifying Bearing Cap Bolt Removal Sequence
Courtesy of GENERAL MOTORS CORP.

14. Remove the exhaust camshaft using several steps, uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.
15. Remove the 5 bearing caps.

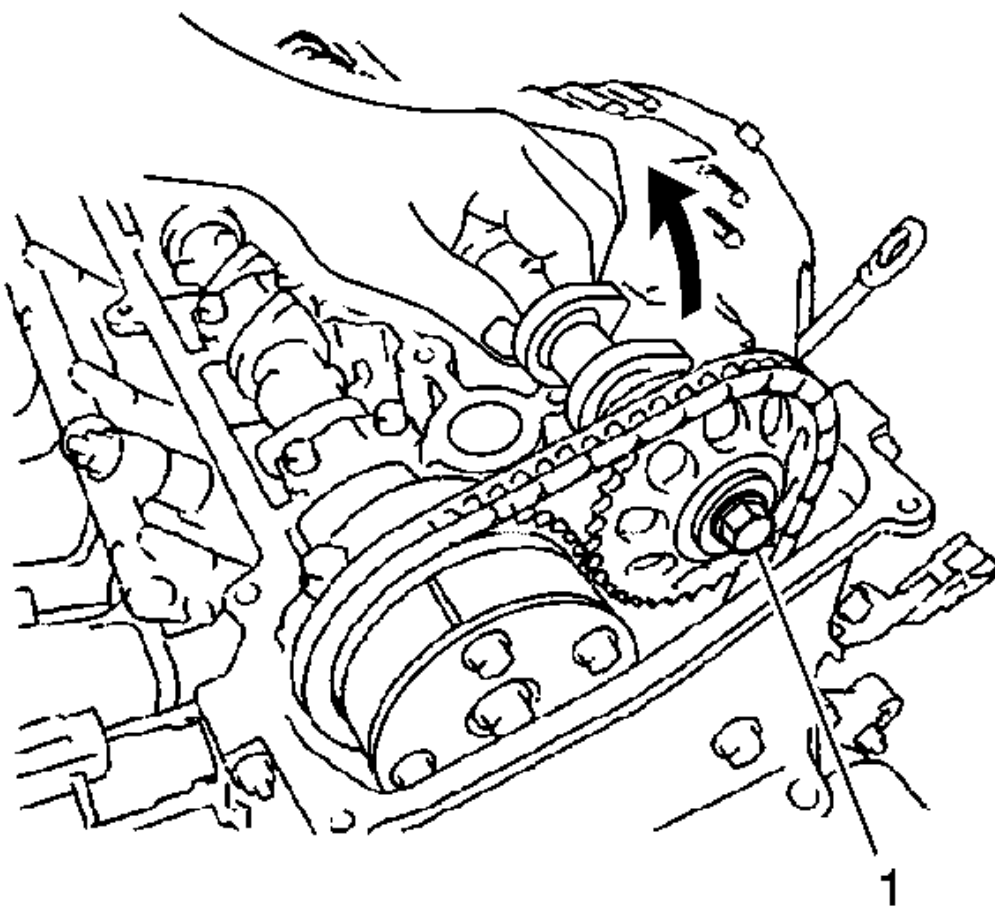


Fig. 31: View Of Camshaft Timing Sprocket & Set Bolt
Courtesy of GENERAL MOTORS CORP.

16. While holding the exhaust camshaft by hand, remove the camshaft timing sprocket set bolt (1).
17. Remove the camshaft timing sprocket from the exhaust camshaft with the timing chain wrapped on the sprocket.
18. Remove the camshaft timing sprocket from the timing chain.

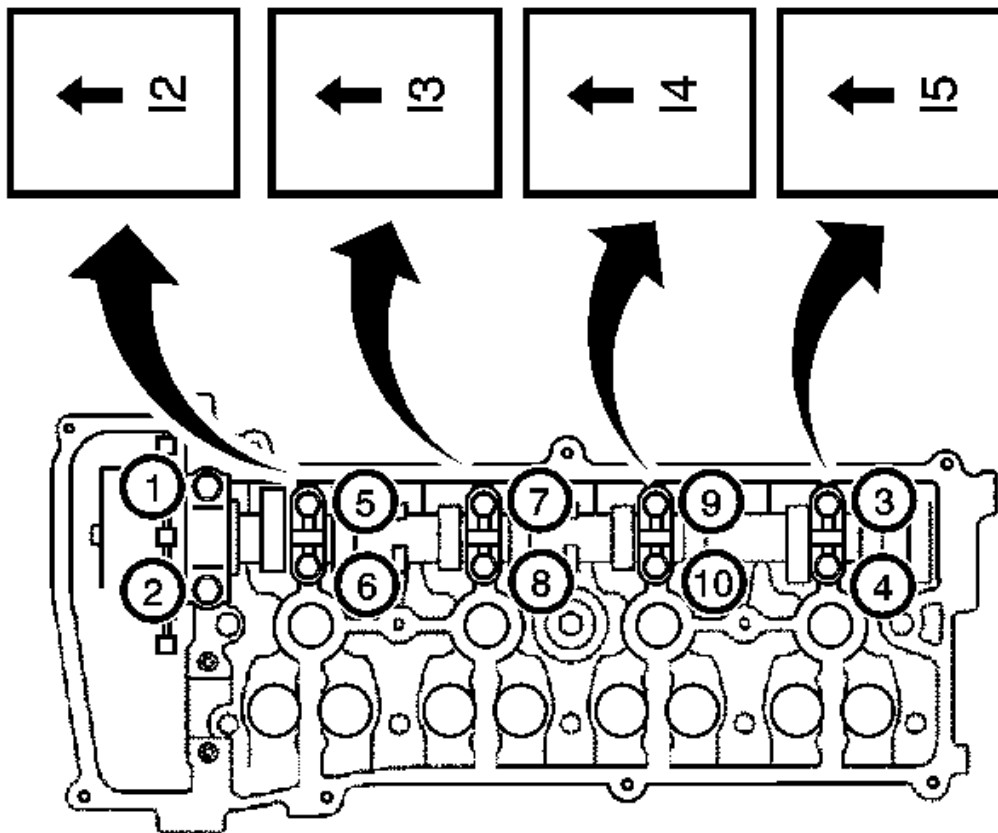


Fig. 32: Identifying Bearing Cap Bolt Removal Sequence
Courtesy of GENERAL MOTORS CORP.

19. Remove the intake camshaft using several steps, uniformly loosen and remove the 10 bearing caps bolts in the sequence shown in the illustration.
20. Remove the 5 bearing caps.
21. Remove the camshaft and camshaft timing gear assembly while holding the timing chain by hand.

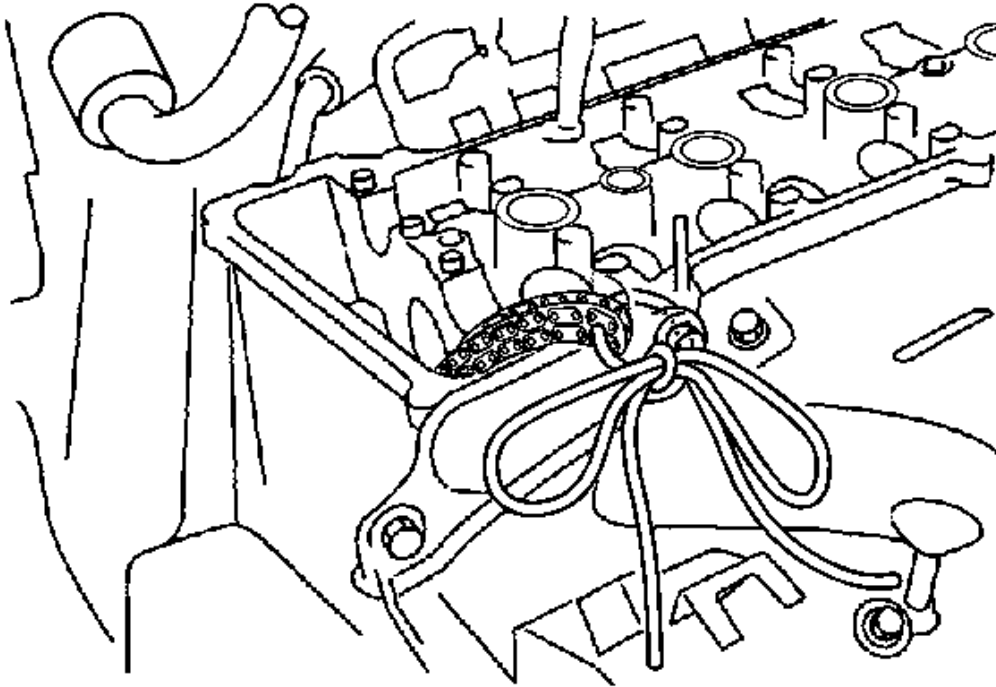


Fig. 33: Supporting Timing Chain With String
Courtesy of GENERAL MOTORS CORP.

NOTE: Be careful not to drop anything inside the timing chain cover.

22. Support the timing chain with a string to prevent it from slipping off the crankshaft sprocket as shown in the illustration.

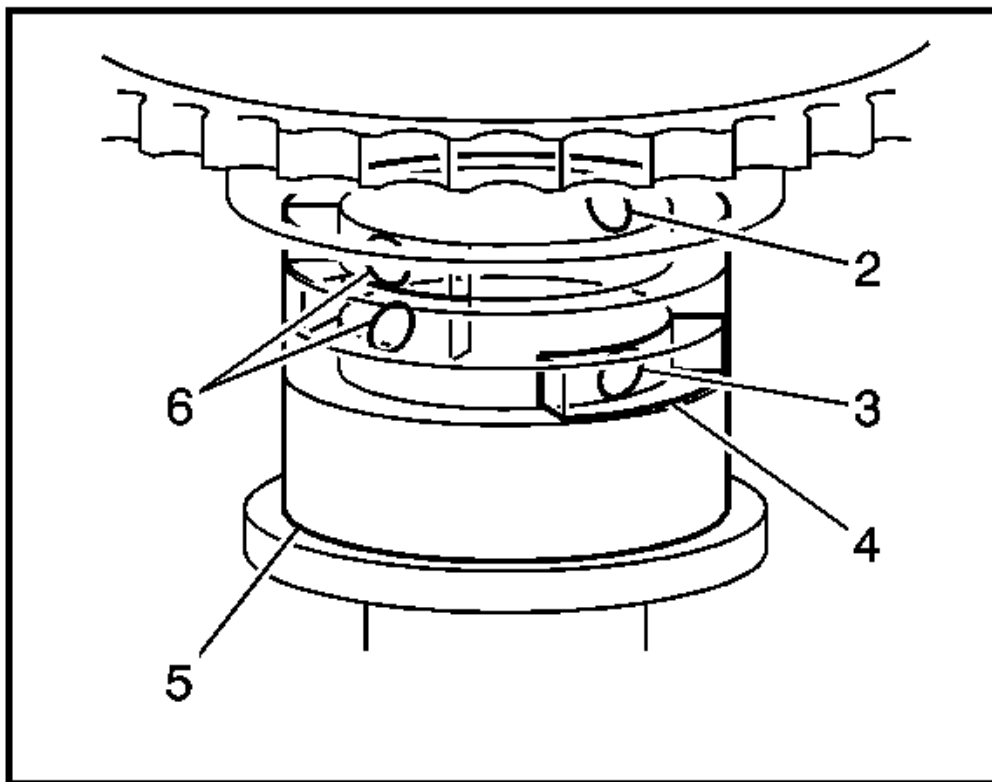
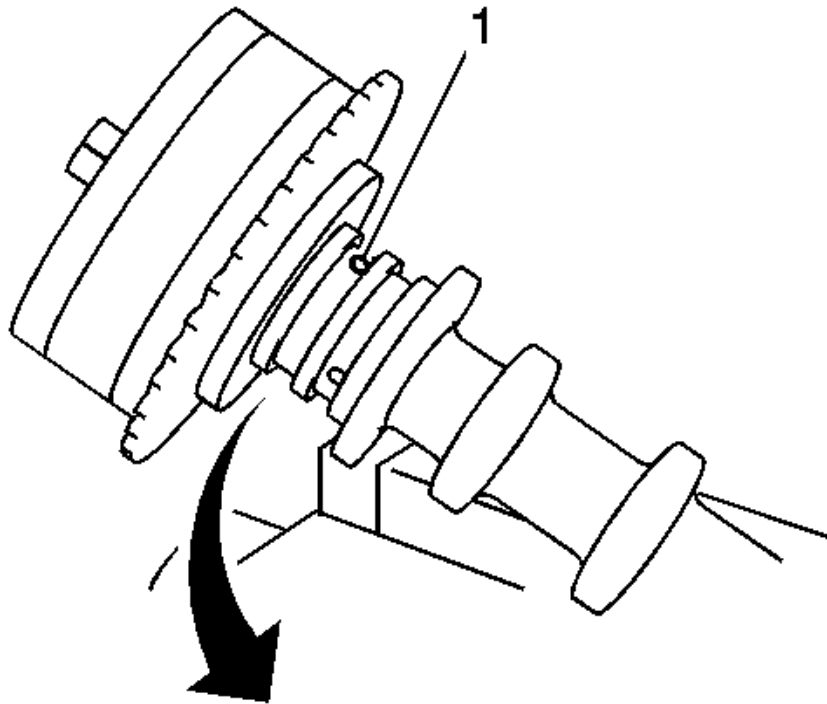


Fig. 34: View Of Camshaft & Timing Gear Assembly
Courtesy of GENERAL MOTORS CORP.

23. Remove camshaft timing gear assembly by clamping the camshaft in a vise, and make sure that the camshaft timing gear assembly does not rotate.
24. Cover all the oil path with vinyl tape except the advance side path (1) shown in the illustration.

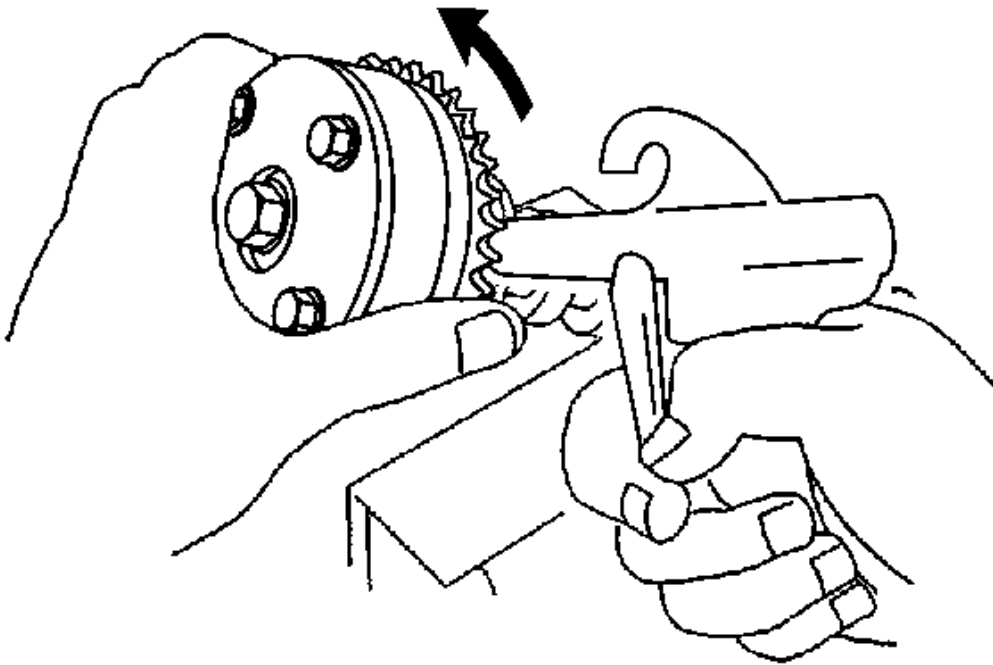


Fig. 35: Rotating Gear Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Cover the paths with a piece of cloth to avoid oil splashes.**

25. Apply air pressure of 150 kPa (22 psi) to the oil path, then turn the camshaft timing gear assembly to the advance direction (counterclockwise) by hand.

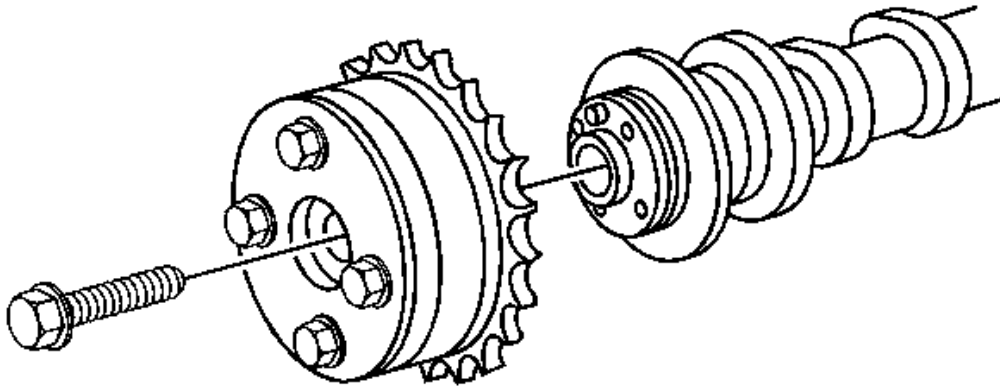


Fig. 36: View Of Camshaft Timing Gear Assembly
Courtesy of GENERAL MOTORS CORP.

- NOTE:** Be sure not to remove the other 4 bolts. When reusing the camshaft timing gear, release the straight pin lock first, then install the gear.
- NOTE:** Depending on the air pressure, the camshaft timing gear assembly may turn to the advance side without applying force by hand. Also, if the pressure is difficult to apply because of air leakage from the port, the lock pin may be difficult to release.

26. Remove the flange bolt of the camshaft timing gear.

INSPECTION PROCEDURE

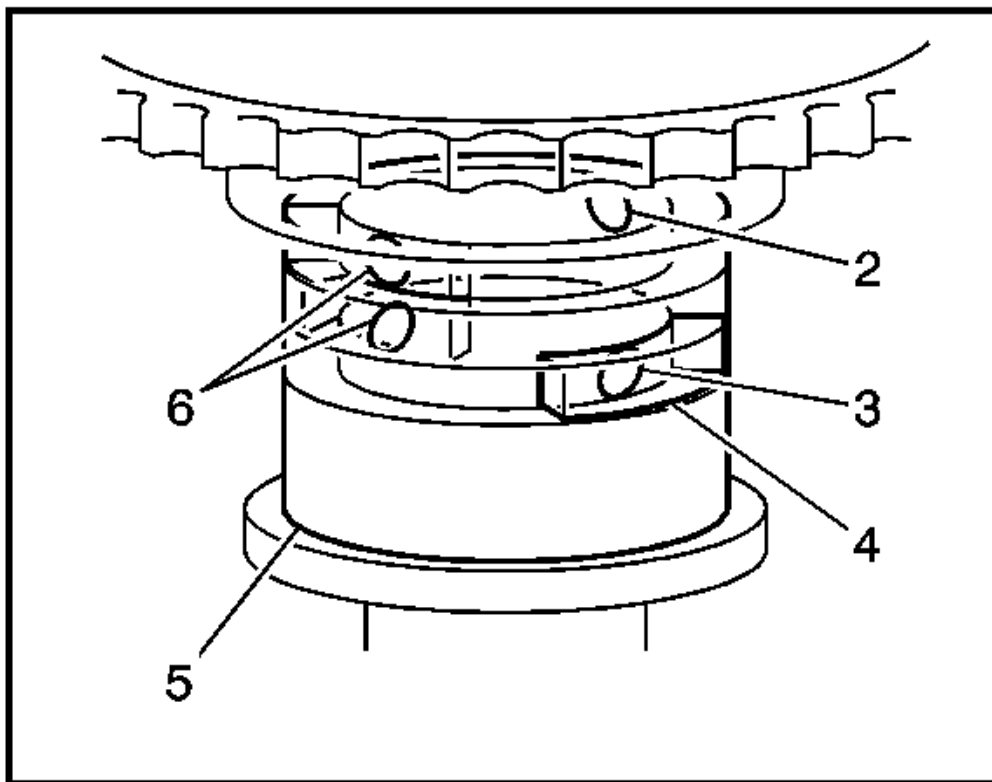
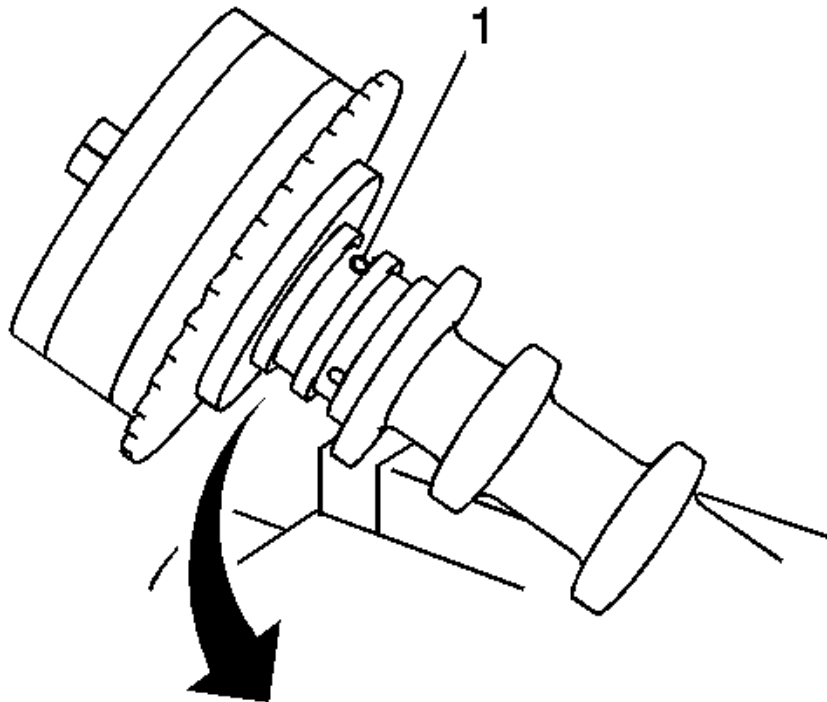


Fig. 37: View Of Camshaft Timing Gear
Courtesy of GENERAL MOTORS CORP.

1. Inspect camshaft timing gear assembly as follows.
 1. Install the camshaft timing gear assembly.
 2. Clamp the camshaft in a vise, and make sure that the camshaft timing gear assembly does not rotate.
2. Cover all the oil paths with vinyl tape except the advance side path (1) shown in the illustration.

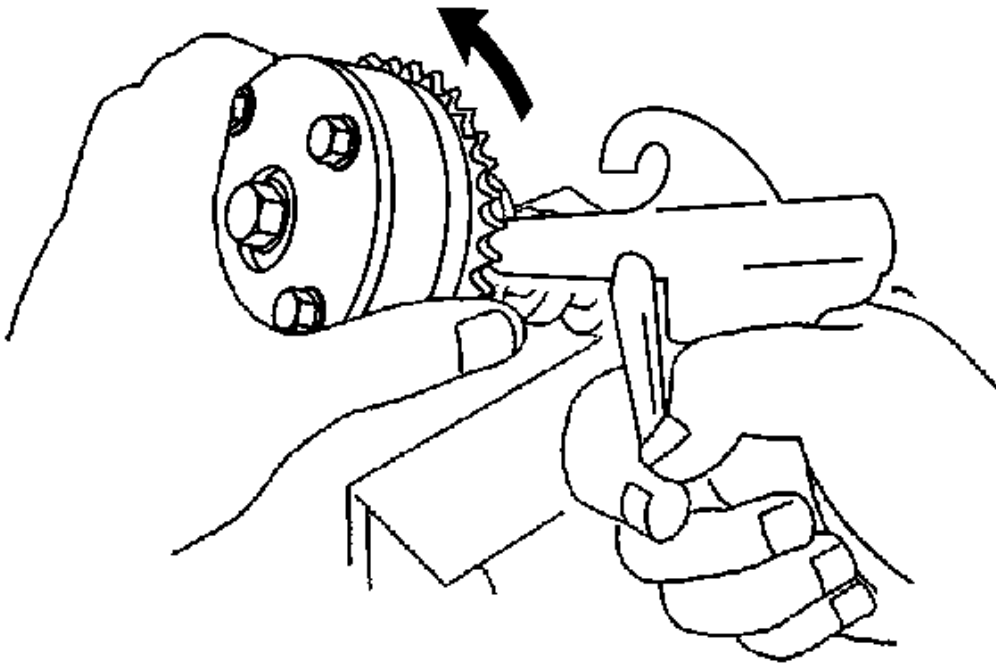


Fig. 38: Rotating Gear Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Cover the paths with a piece of cloth to avoid oil splashes.

3. Apply air pressure of 150 kPa (22 psi) to the oil path.

NOTE: Depending on the air pressure, the camshaft timing gear may turn to the advance side without applying force by hand. Also, if enough air pressure cannot be applied because of air leakage from the path, releasing the lock pin may be difficult.

4. Check that the camshaft timing gear revolves in the advance direction (counterclockwise) by hand.

NOTE: Do not use air pressure to perform the smooth rotation check.

5. Check for smooth rotation. Turn the camshaft timing gear within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.
6. Check the lock in the most retarded position. Confirm that the camshaft timing gear is locked at the most retarded position.
7. Remove the camshaft timing gear assembly.

INSTALLATION PROCEDURE

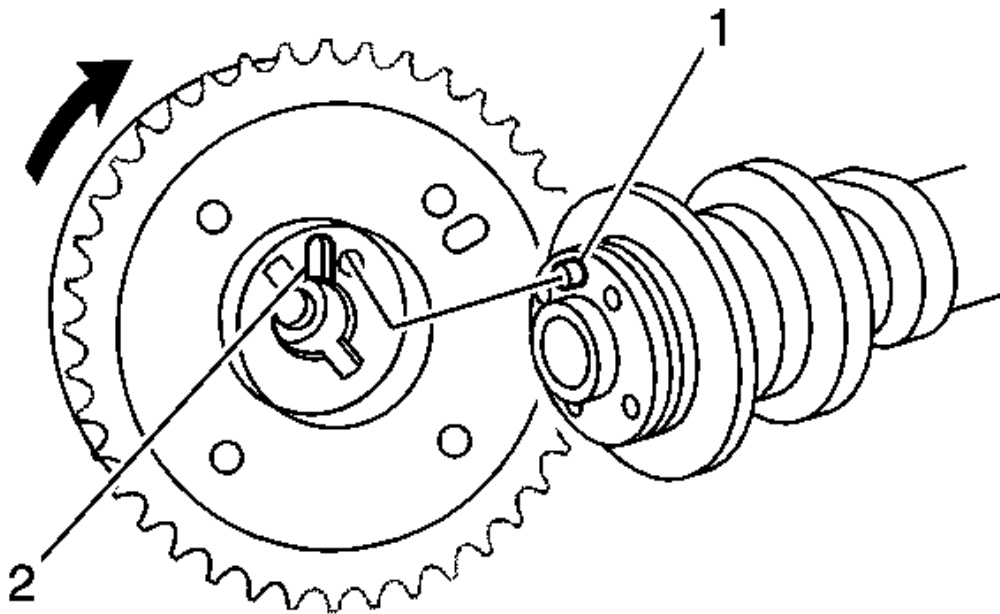


Fig. 39: View Of Camshaft Timing Gear
Courtesy of GENERAL MOTORS CORP.

1. Install camshaft timing gear assembly by putting the camshaft timing gear and camshaft together with the straight pin (1) and key groove misaligned, as shown in the illustration.

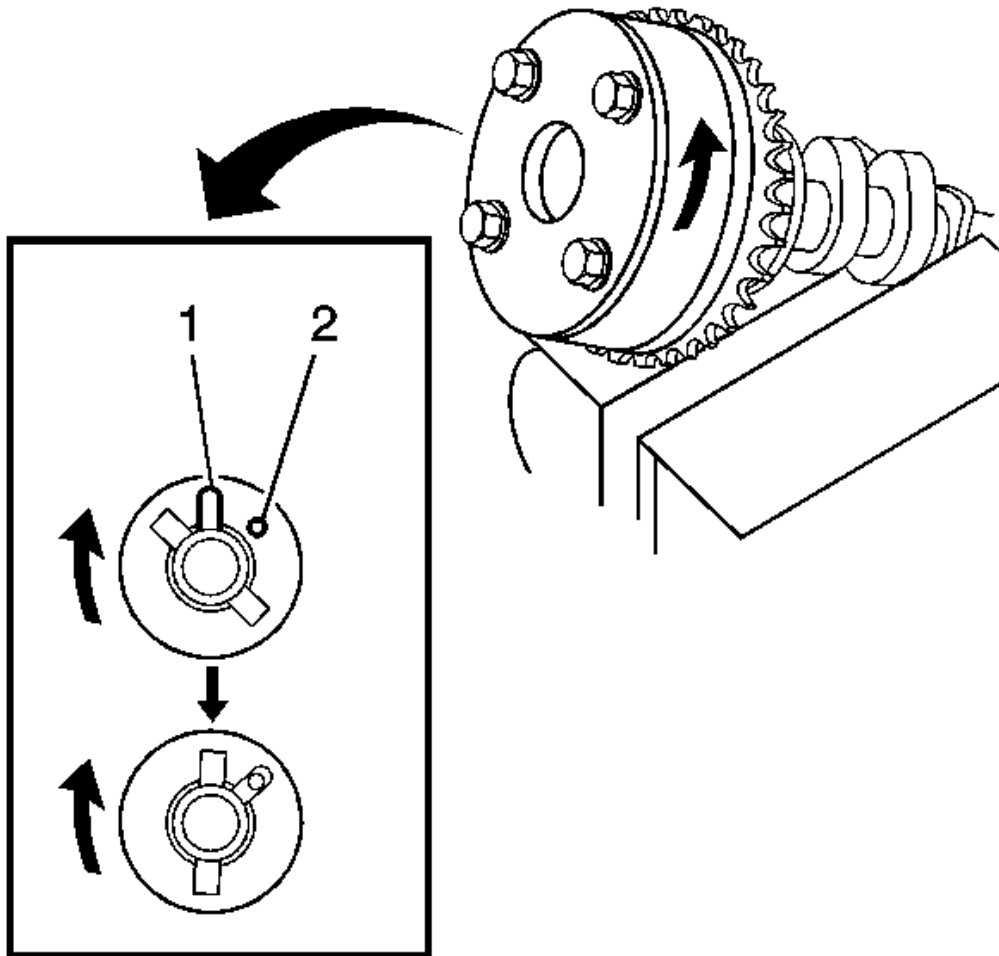


Fig. 40: Turning Camshaft Timing Gear
Courtesy of GENERAL MOTORS CORP.

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

2. 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 fits (1) into the groove.
3. Check that there is no clearance between the gear flange and camshaft.

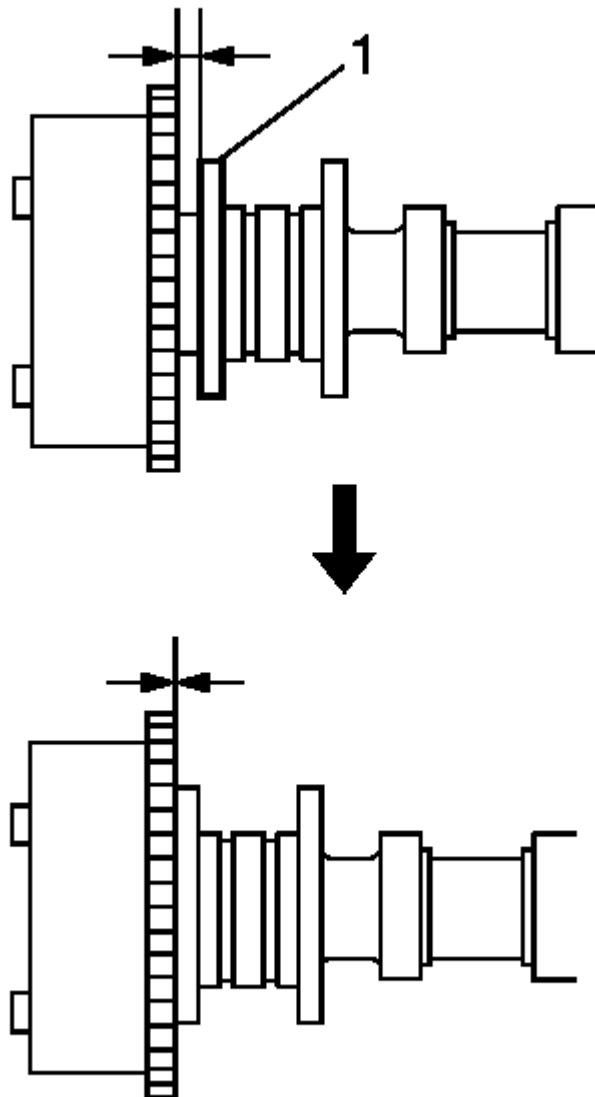


Fig. 41: Checking For Clearance Between Gear Flange & Camshaft
Courtesy of GENERAL MOTORS CORP.

4. Check that there is no clearance (1) between the gear flange and camshaft.

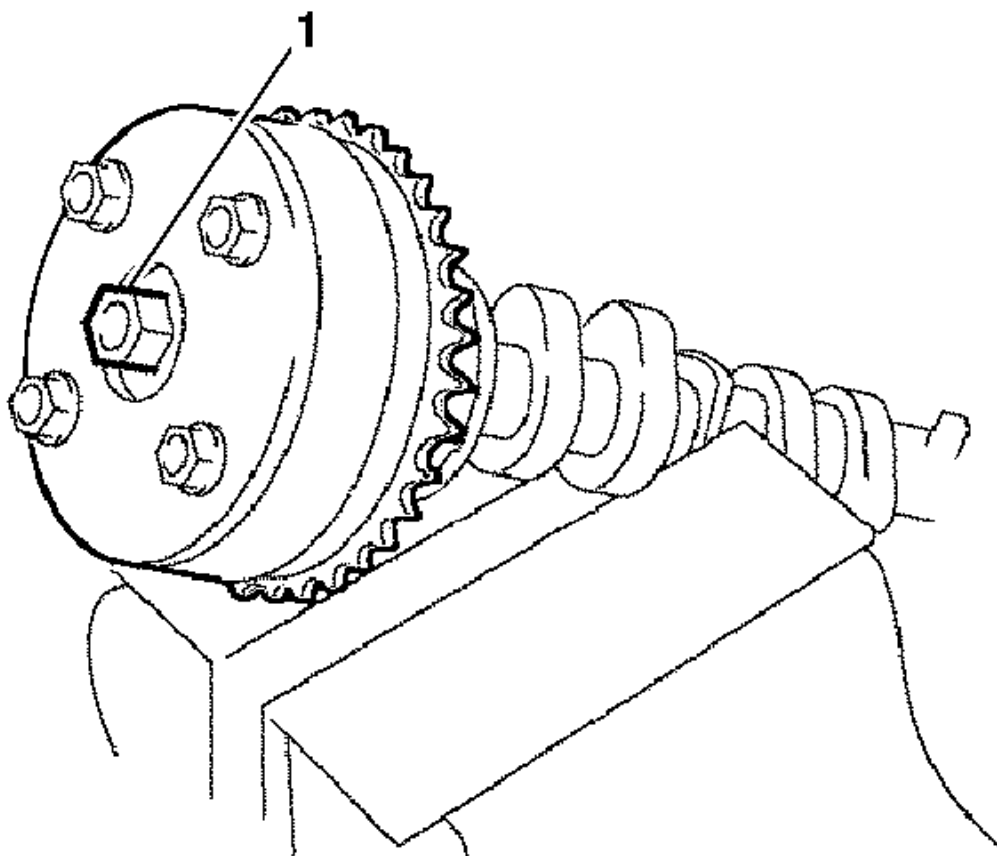


Fig. 42: View Of Camshaft Timing Gear Flange Bolt
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

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

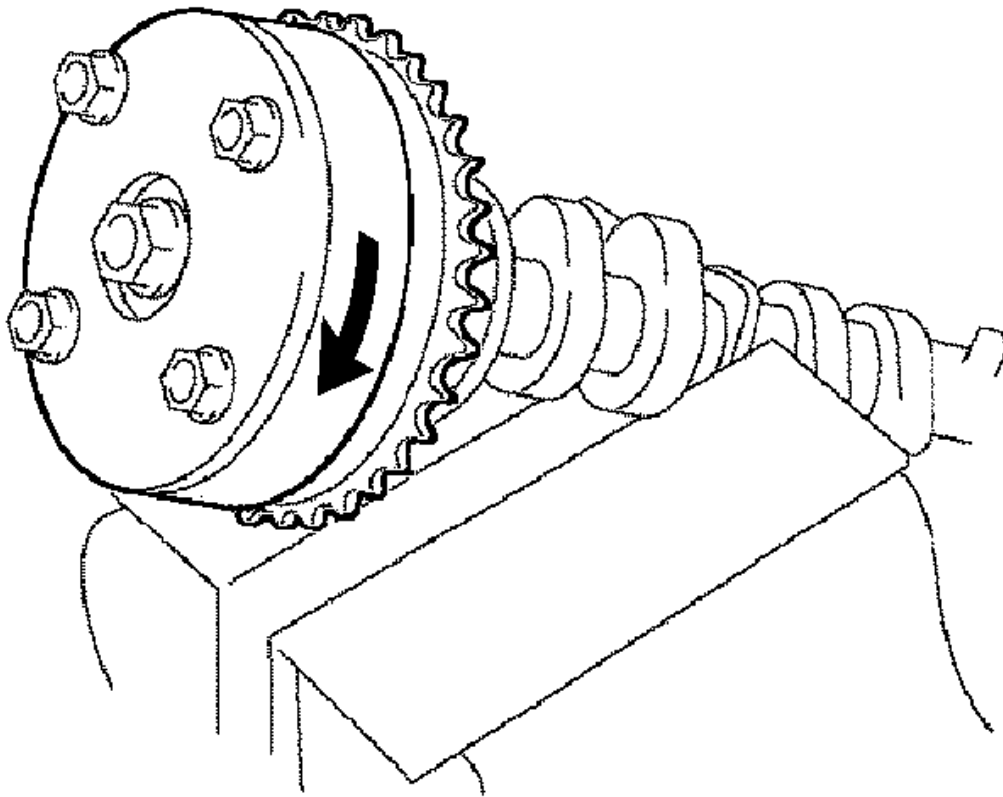


Fig. 43: Rotating Camshaft Timing Gear
Courtesy of GENERAL MOTORS CORP.

6. Check that the camshaft timing gear assembly can move to the retard direction (clockwise) and is locked in the most retarded position.

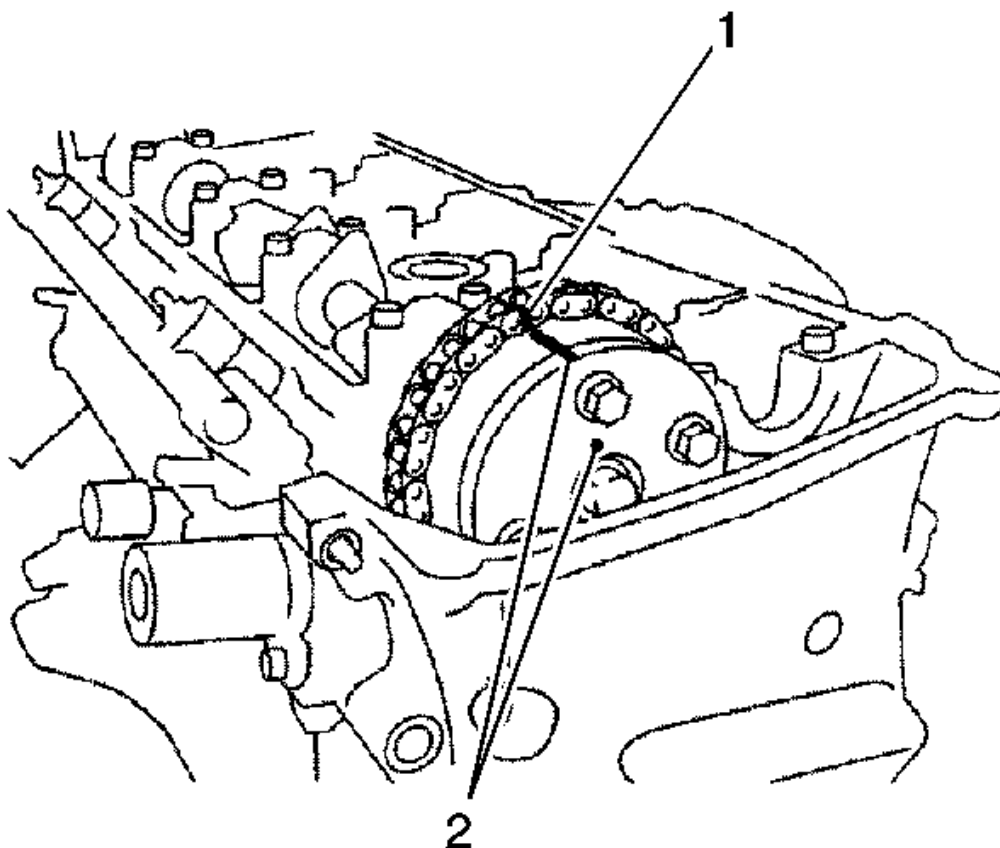


Fig. 44: Installing Timing Chain
Courtesy of GENERAL MOTORS CORP.

7. Apply a light coat of engine oil to the journal portion of the intake camshaft.
8. Install the timing chain onto the camshaft timing gear with the paint mark (1) aligned with the timing mark on the camshaft timing gear as shown in the illustration.

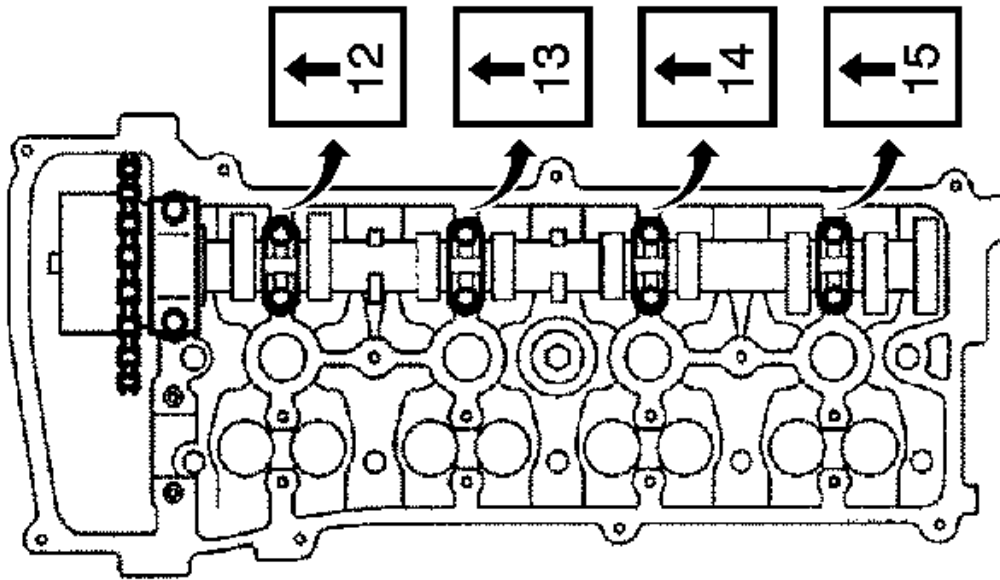


Fig. 45: Checking Front Mark & Number Order
Courtesy of GENERAL MOTORS CORP.

9. Examine the front marks and numbers, and check that the order is as shown in the illustration. Then install the bearing caps into the cylinder head.
10. Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.

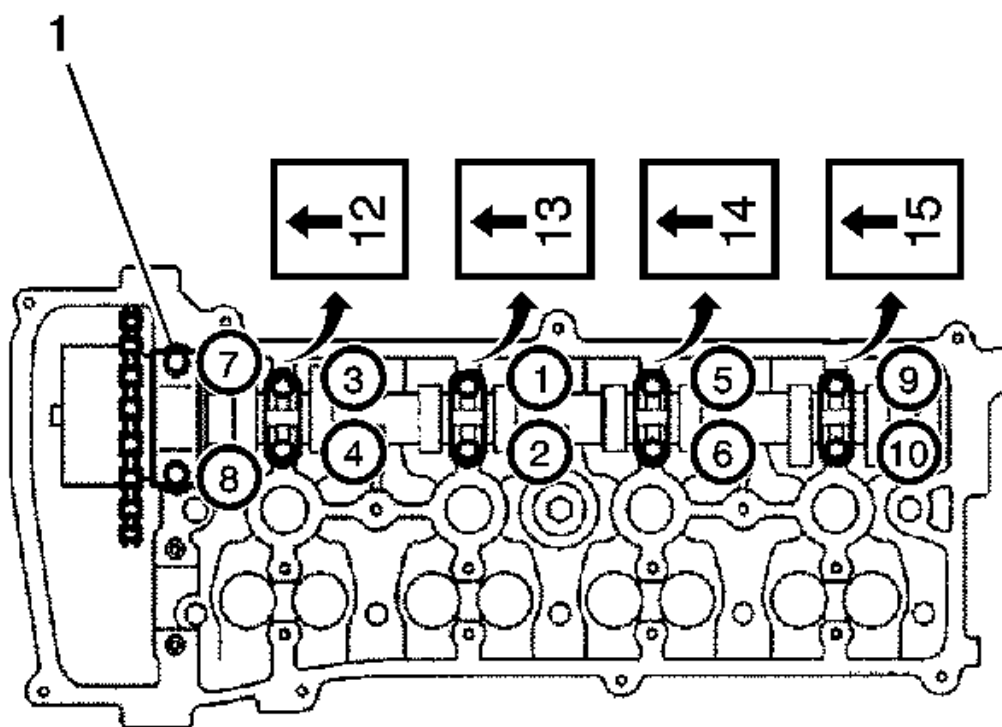


Fig. 46: Identifying Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

11. Using several steps, uniformly install the 10 bearing cap bolts (1) in the sequence shown in the illustration and tighten.
 - The thrust bearing bolts to 30 N.m (22 lb ft)
 - The remaining bearing bolts to 9.0 N.m (80 lb in)

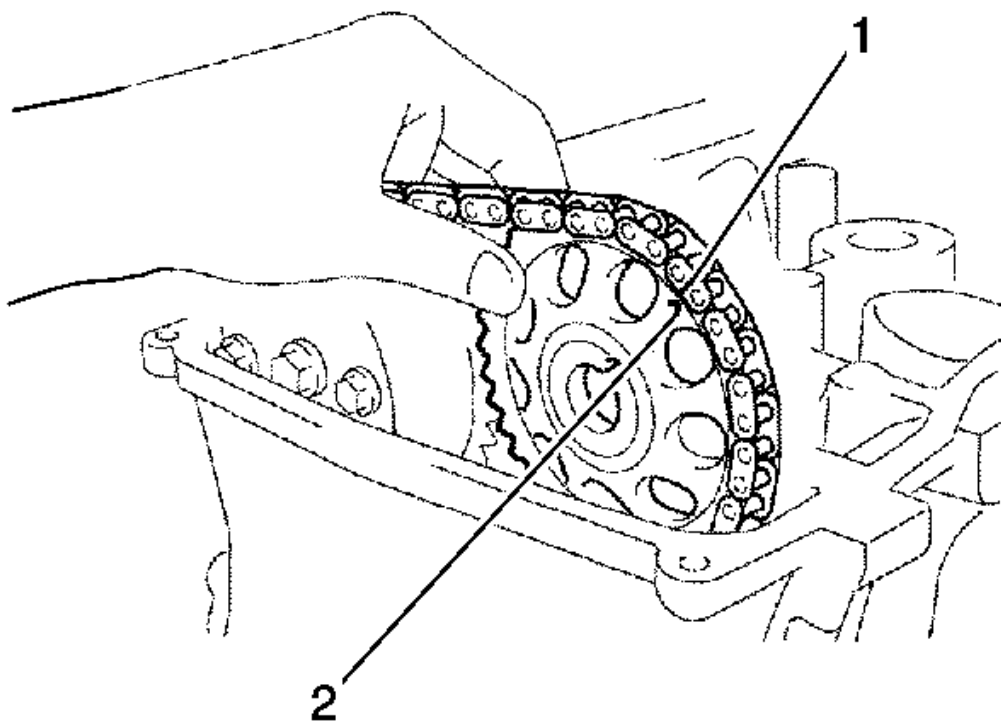


Fig. 47: View Of Timing Chain Alignment Marks
Courtesy of GENERAL MOTORS CORP.

12. Install the exhaust camshaft.
 1. Apply a light coat of engine oil to the journal portion of the exhaust camshaft.
 2. Put the exhaust camshaft on the cylinder head with the paint mark (1) on the chain aligned with the timing mark (2) on the camshaft timing sprocket.

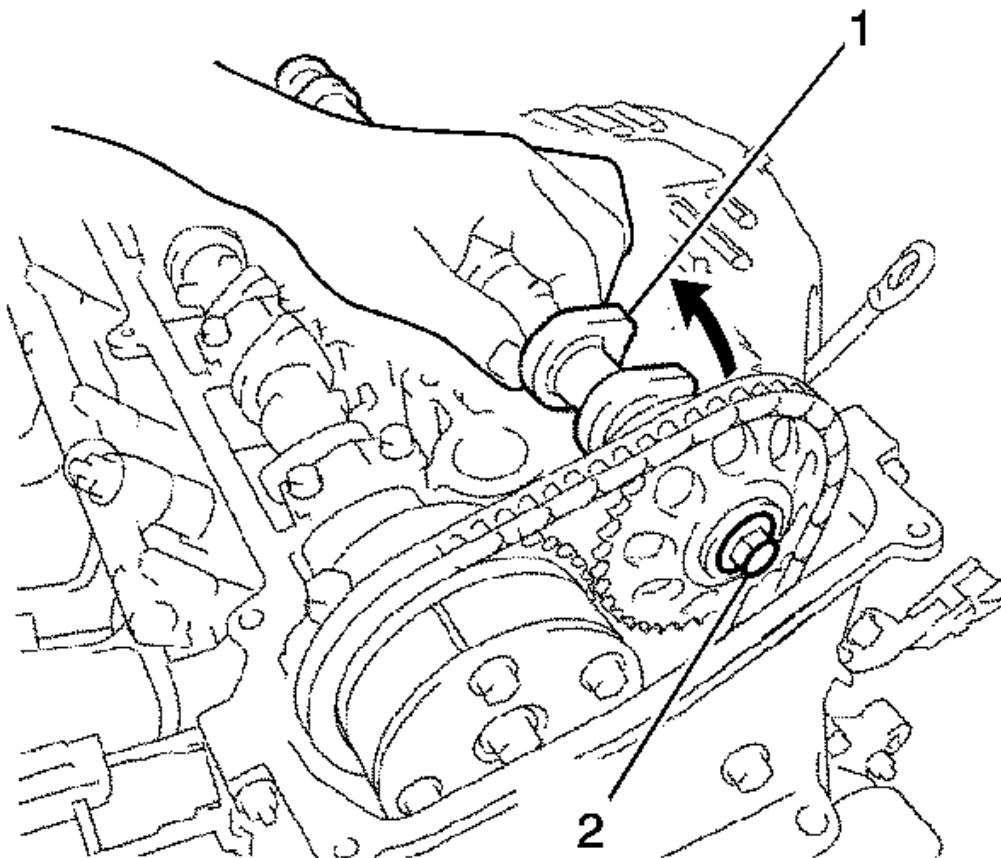


Fig. 48: Tightening Camshaft Timing Sprocket Set Bolt
Courtesy of GENERAL MOTORS CORP.

13. While holding the exhaust camshaft (1) by hand, temporarily tighten the camshaft timing sprocket set bolt (2).

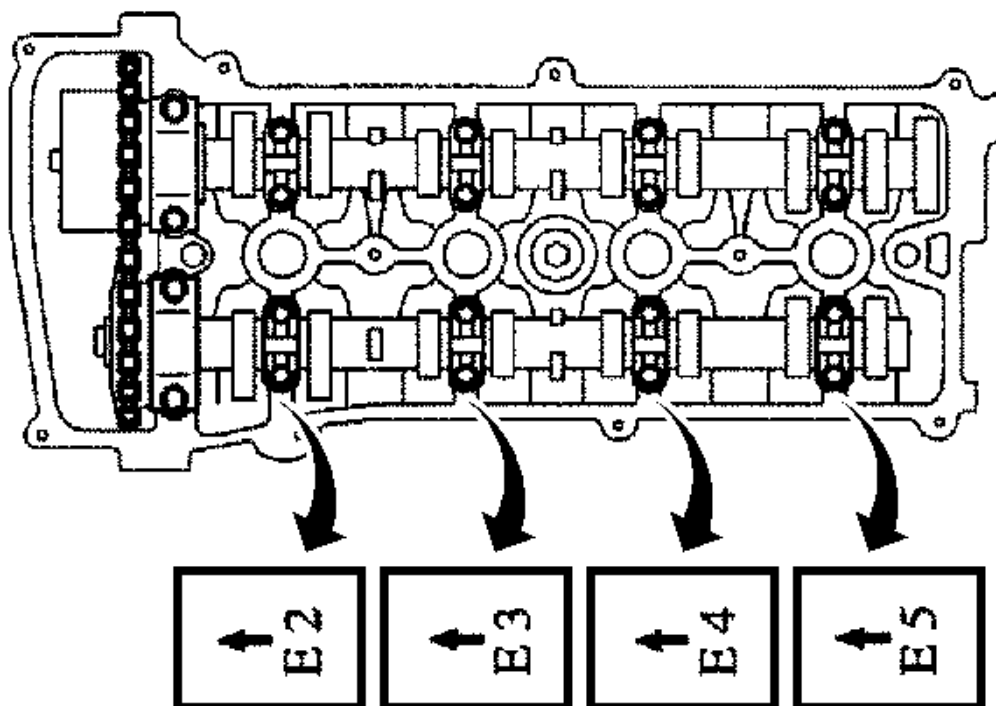


Fig. 49: View Of Front Marks & Numbers On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

14. Examine the front marks and numbers, and check that the order is as shown in the illustration. Then install the bearing caps onto the cylinder head.
15. Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

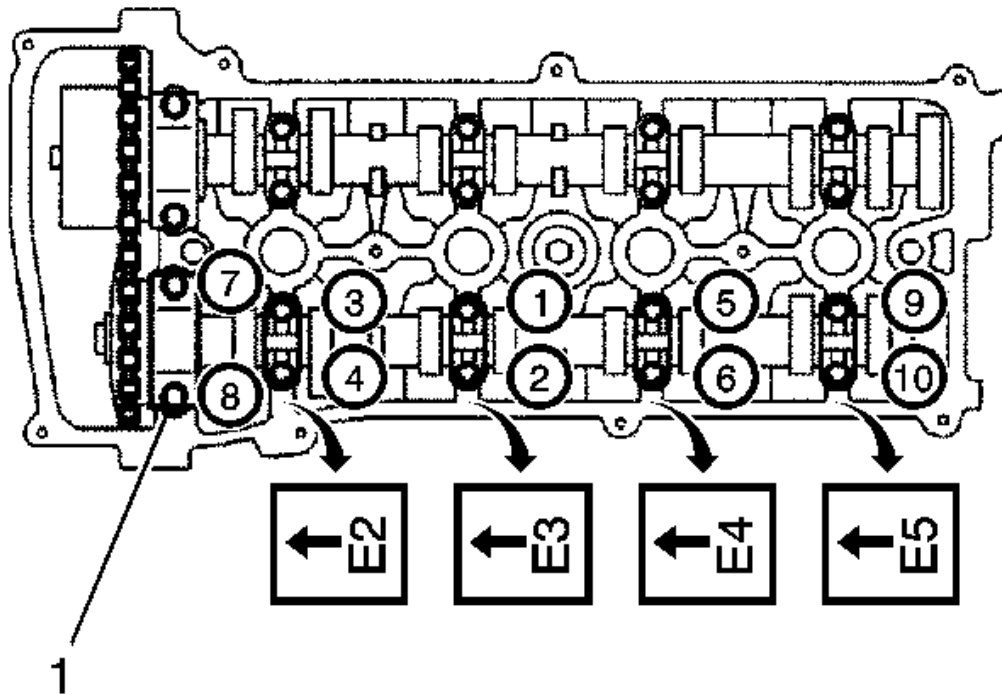


Fig. 50: Identifying Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

16. Using several steps, uniformly install the 10 bearing cap bolts (1) in the sequence shown in the illustration and tighten.
 - The thrust bearing bolts to 30 N.m (22 lb ft)
 - The remaining bearing bolts to 9.0 N.m (80 lb in)

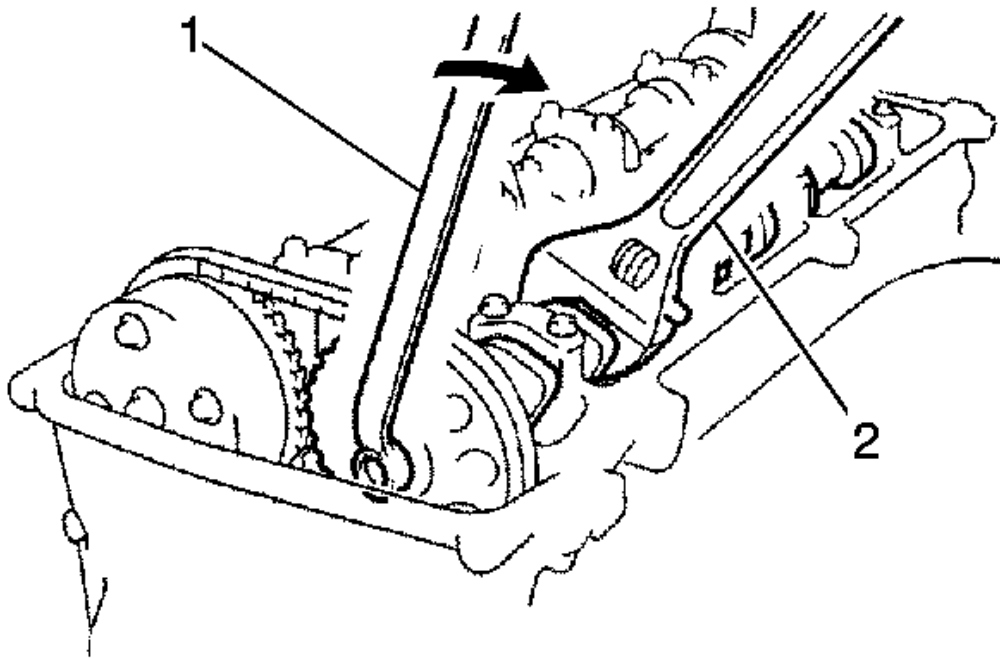


Fig. 51: Tightening Camshaft Timing Sprocket Set Bolt
Courtesy of GENERAL MOTORS CORP.

17. While holding the exhaust camshaft with a wrench (2), tighten the camshaft timing sprocket set bolt to 54 N.m (40 lb ft).

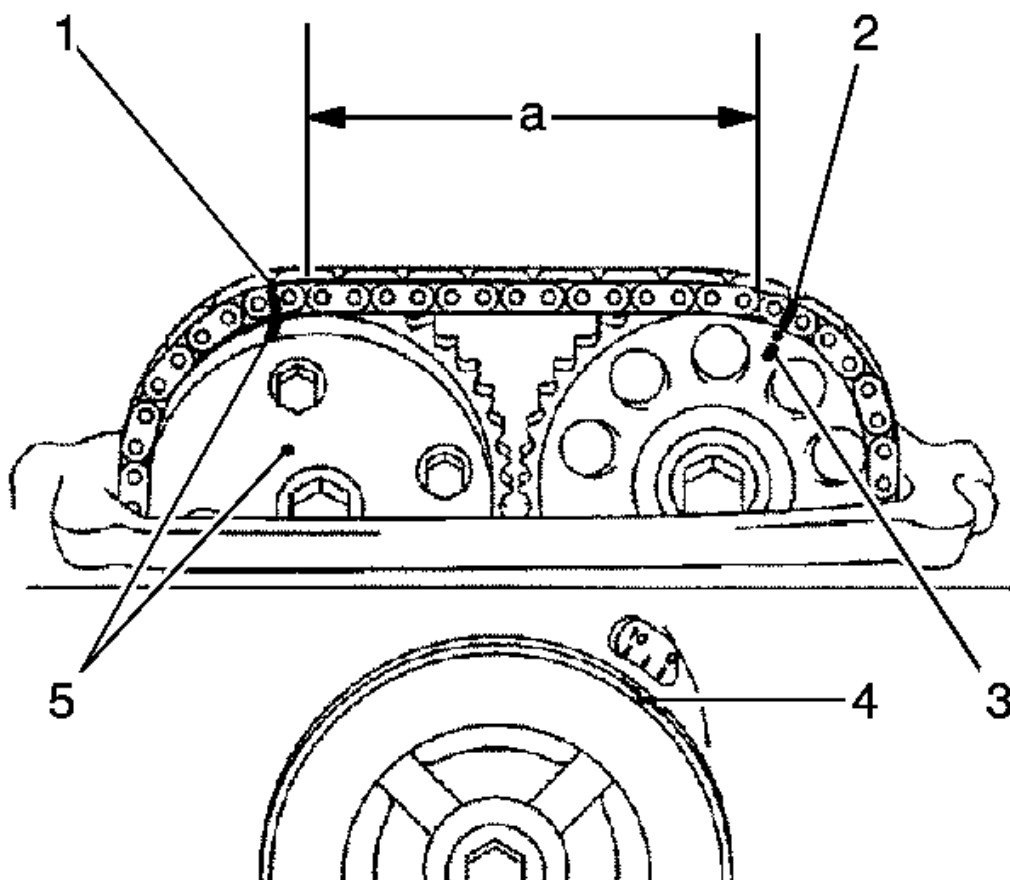


Fig. 52: Checking Timing Chain Paint Mark Alignment
Courtesy of GENERAL MOTORS CORP.

18. Check that the paint marks on the chain are aligned with the timing marks (1, 2) on the camshaft timing gear and camshaft timing sprocket. Also, check that the crankshaft pulley groove (4) is aligned with the timing mark 0 on the timing mark chain cover.

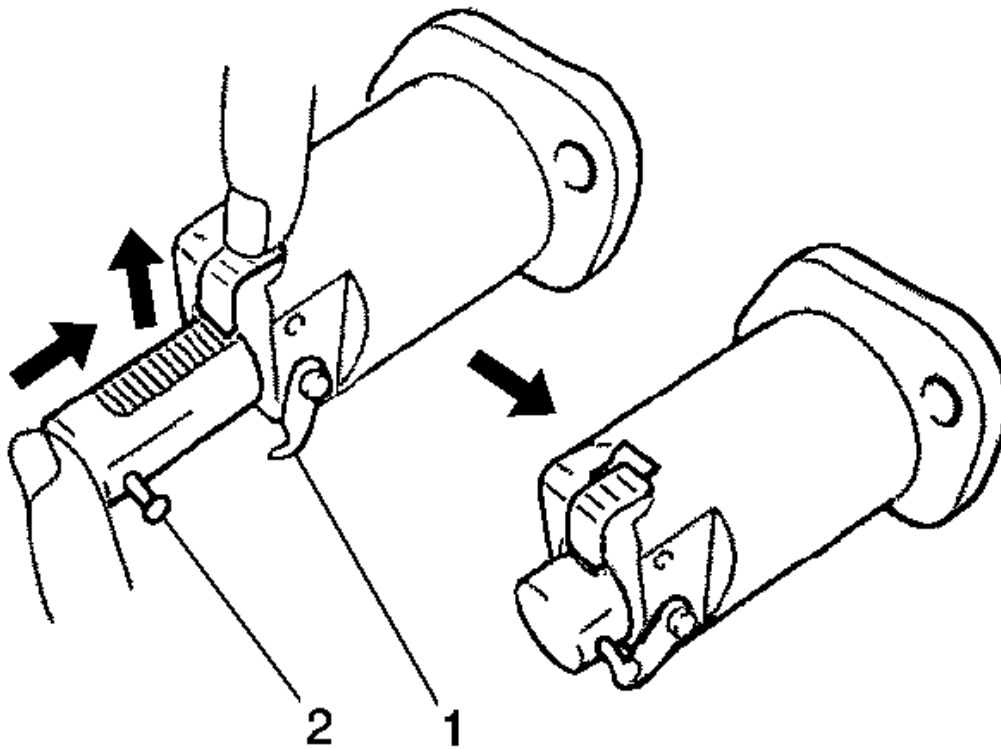


Fig. 53: View Of Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

19. Install the chain tensioner assembly. Release the ratchet pawl, then fully push in the plunger and hook the hook (1) to the pin (2) so that the plunger is in the position shown in the illustration.

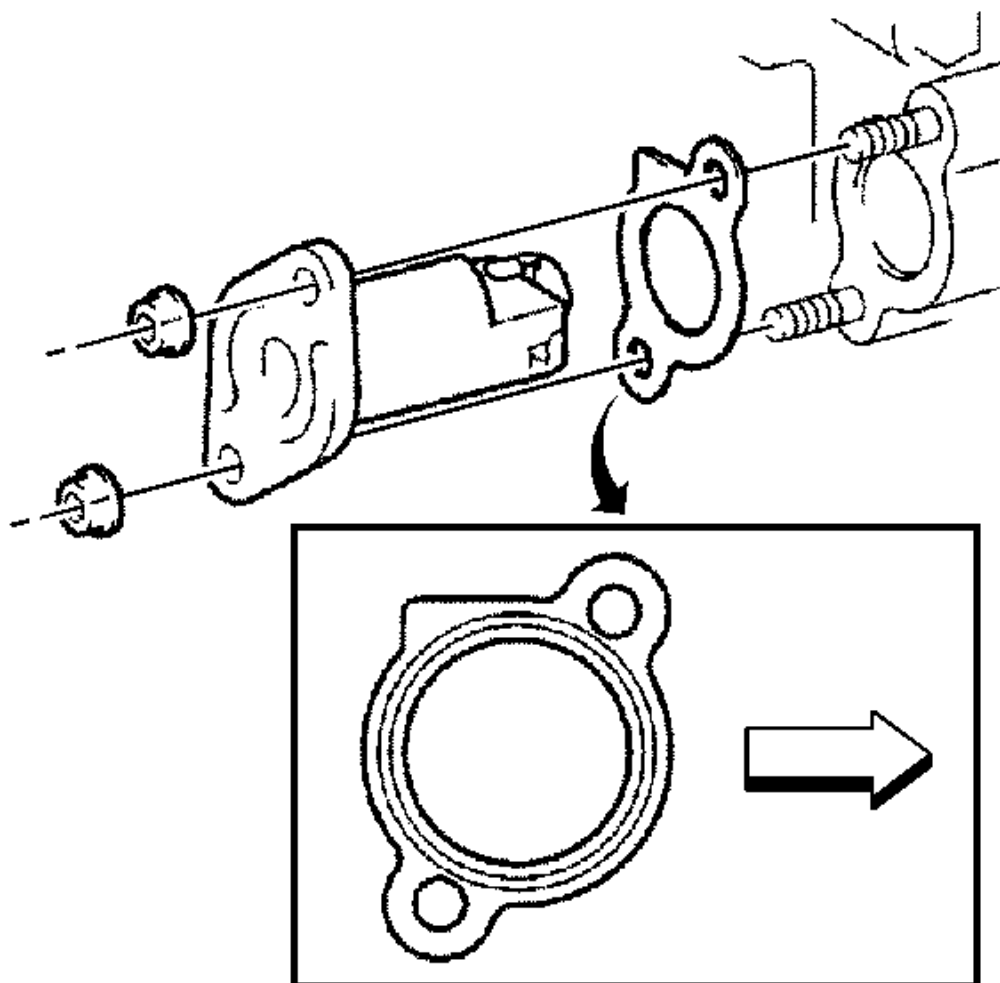


Fig. 54: View Of Chain Tensioner, Gasket & Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: When installing the chain tensioner, set the hook again if the hook releases the plunger.

20. Install a new gasket and chain tensioner with the 2 nuts and tighten to 9.0 N.m (80 lb in).

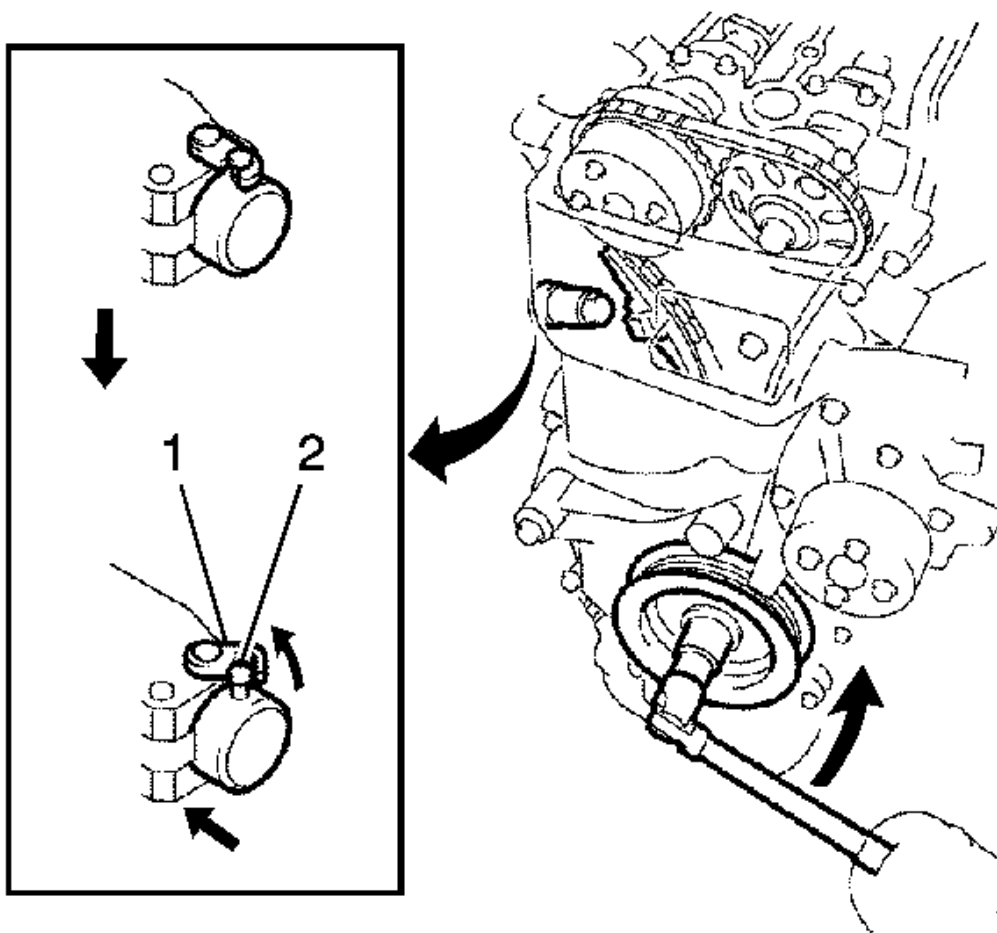


Fig. 55: Rotating Crankshaft Counterclockwise
Courtesy of GENERAL MOTORS CORP.

21. Turn the crankshaft counterclockwise, then disconnect the plunger knock pin (2) from the hook (1).

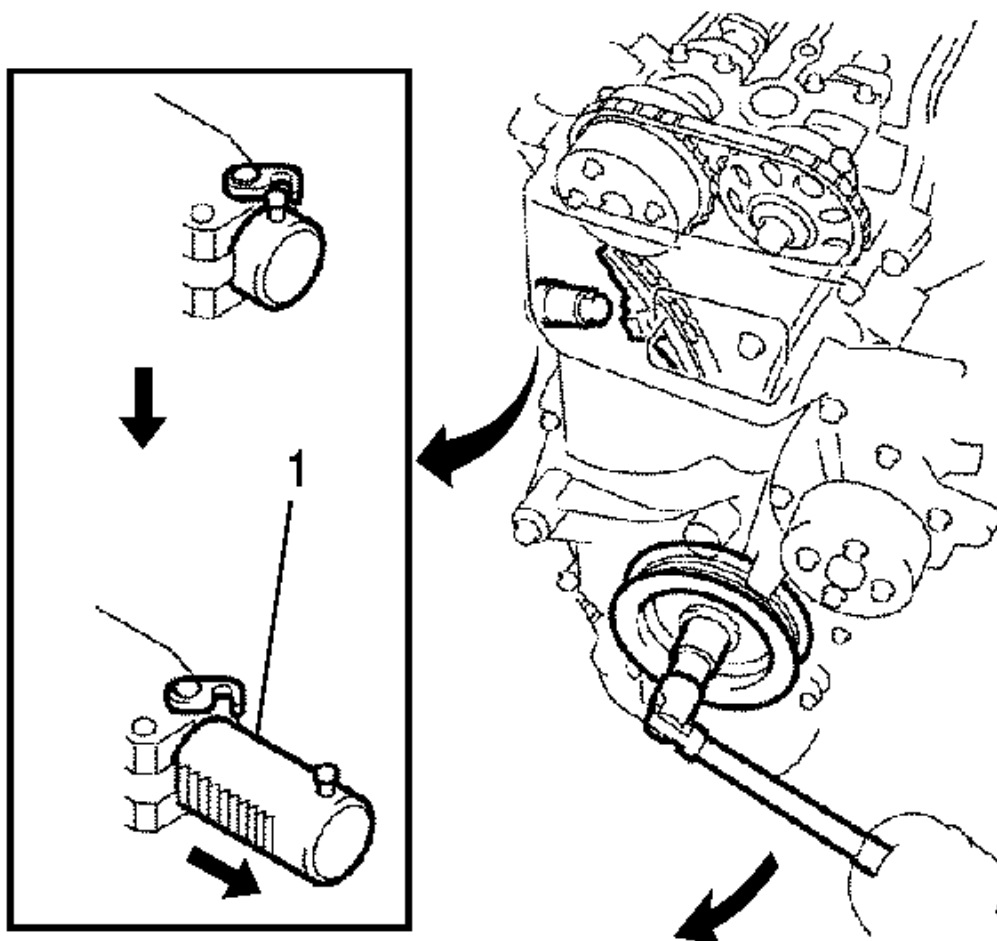


Fig. 56: View Of Chain Tensioner & Plunger
Courtesy of GENERAL MOTORS CORP.

22. Turn the crankshaft clockwise, then check that the plunger (1) is extended.
23. Set the No. 1 cylinder to TDC/compression.
24. Check the valve clearance. Refer to **Valve Clearance Adjustment**.

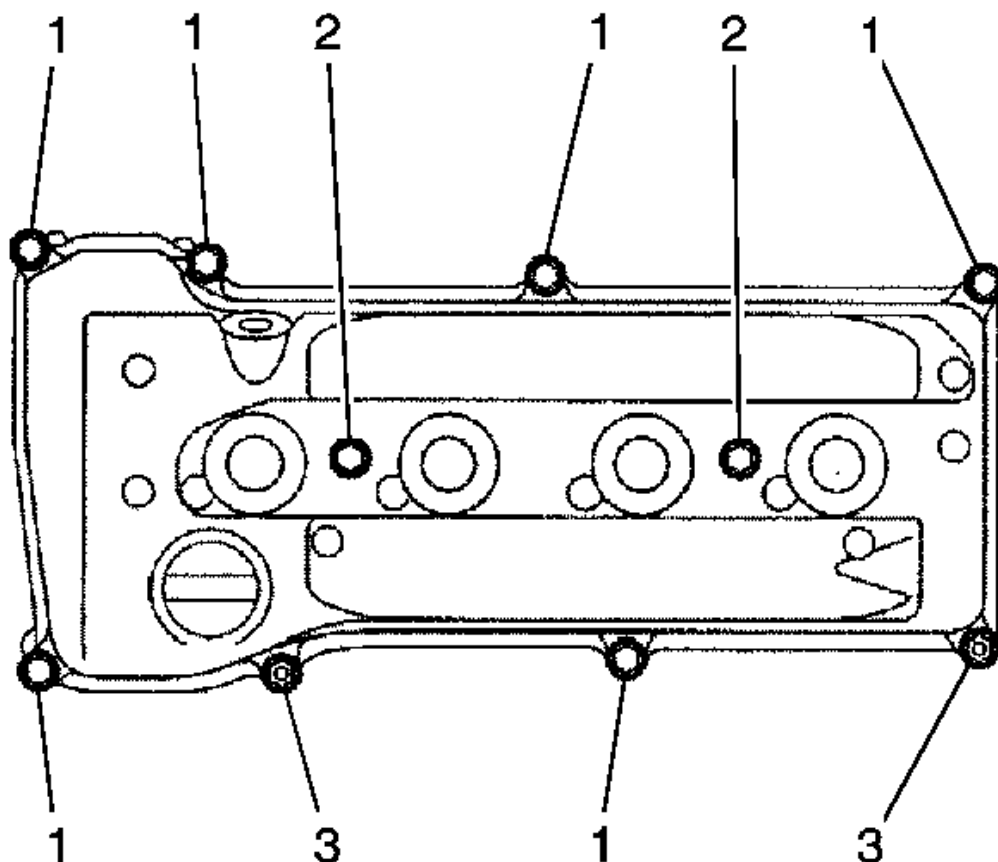


Fig. 57: Identifying Cylinder Head Cover Bolts
Courtesy of GENERAL MOTORS CORP.

25. Remove any old packing material from the contact surface.
26. Install the cylinder head cover gasket with the 8 bolts (1) and 2 nuts (3) and tighten.
 - Bolts 1 to 11 N.m (8 lb ft)
 - Bolts 2 to 14 N.m (10 lb ft)
 - Nuts to 11 N.m (8 lb ft)

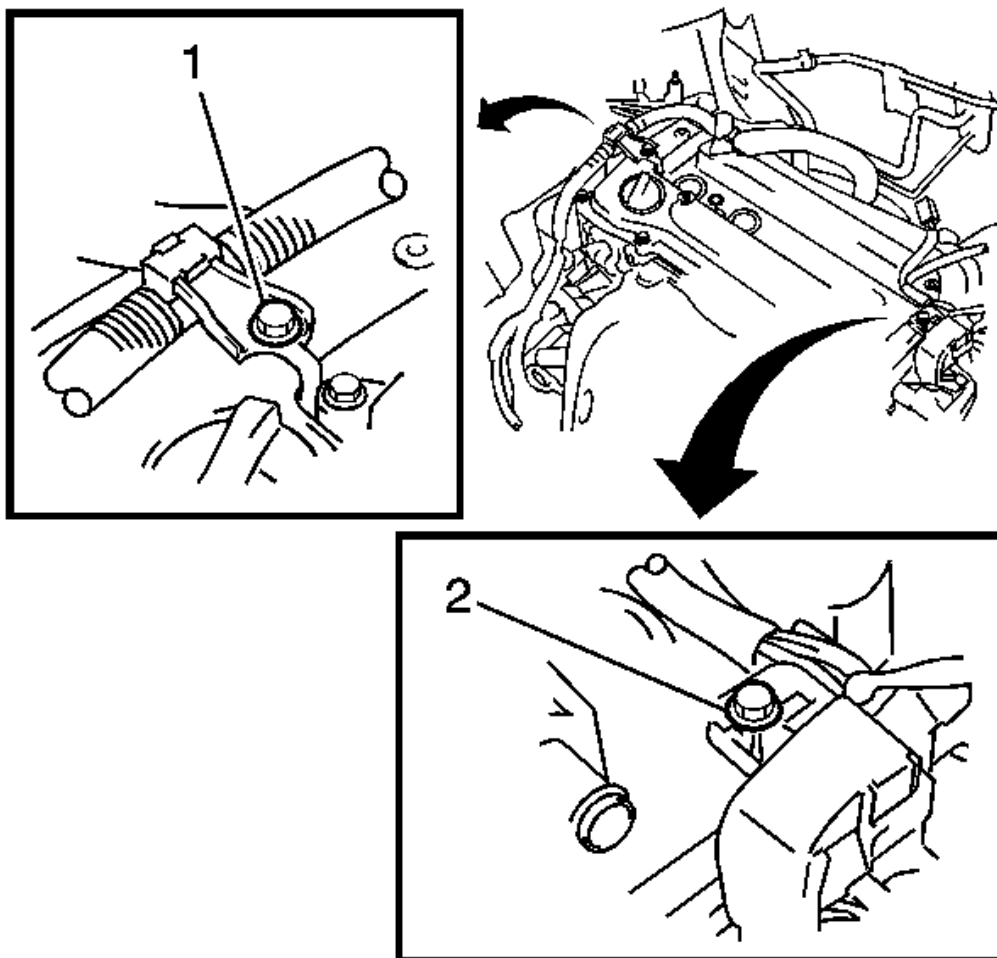


Fig. 58: View Of Wire Harness Brackets
Courtesy of GENERAL MOTORS CORP.

27. Install the 2 engine wire harness brackets with the 2 bolts (1, 2) and tighten to 8.4 N.m (74 lb in).

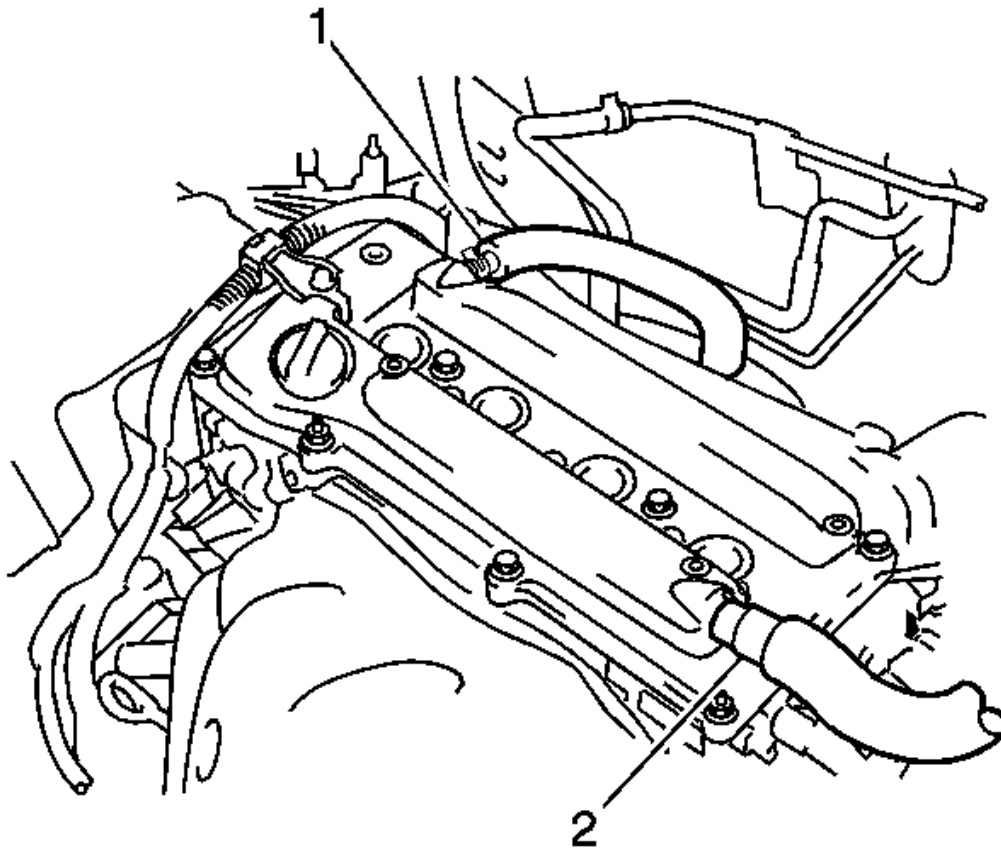


Fig. 59: View Of Engine Cover Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

28. Connect the 2 ventilation hoses (1, 2) to the cylinder head cover.
29. Install the spark plug. Refer to **Spark Plug Replacement** .
30. Install the ignition coil assembly. Refer to **Ignition Coil Replacement** .
31. Inspect for oil leak.
32. Inspect the ignition timing.
33. Install the engine cover. Refer to **Engine Cover Replacement**.
34. Install the engine under right cover.

EXHAUST CAMSHAFT AND VALVE LIFTER REPLACEMENT

REMOVAL PROCEDURE

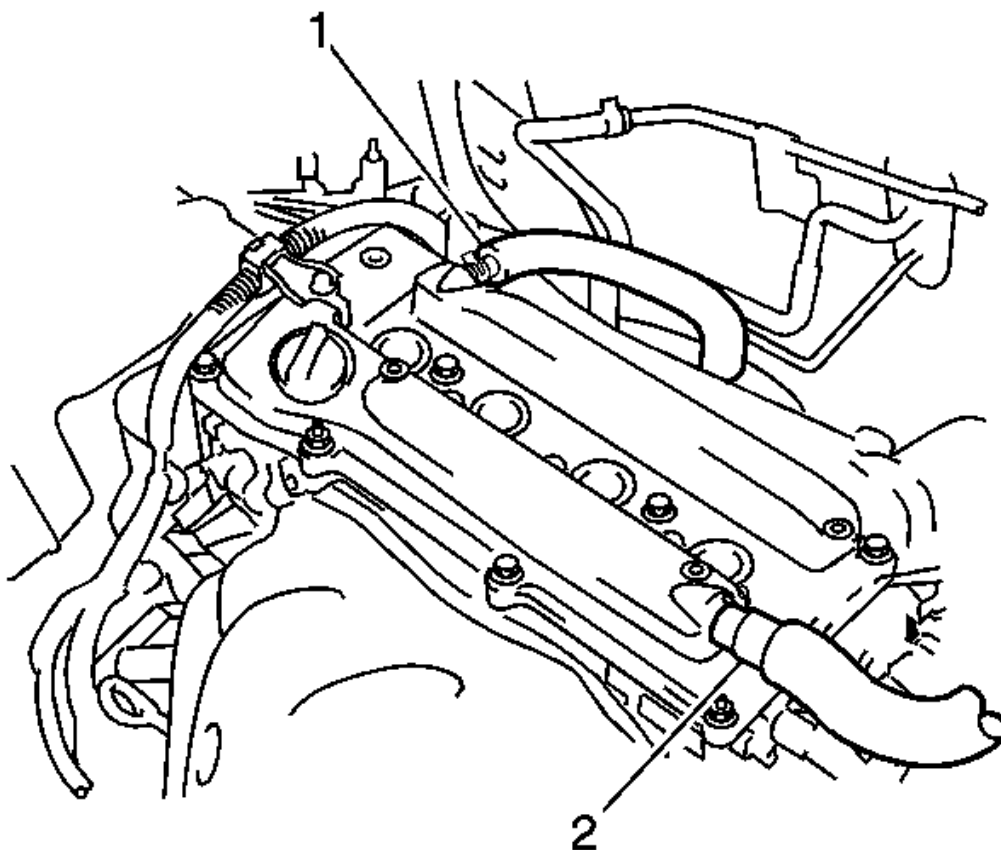


Fig. 60: View Of Engine Cover Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the right engine under cover.
2. Remove the engine cover sub-assembly. Refer to **Engine Cover Replacement**.
3. Remove the ignition coil assembly. Refer to **Spark Plug Replacement**.
4. Remove the spark plug. Refer to **Spark Plug Replacement**.
5. Remove the 2 ventilation hoses (1, 2) from the cylinder head cover.

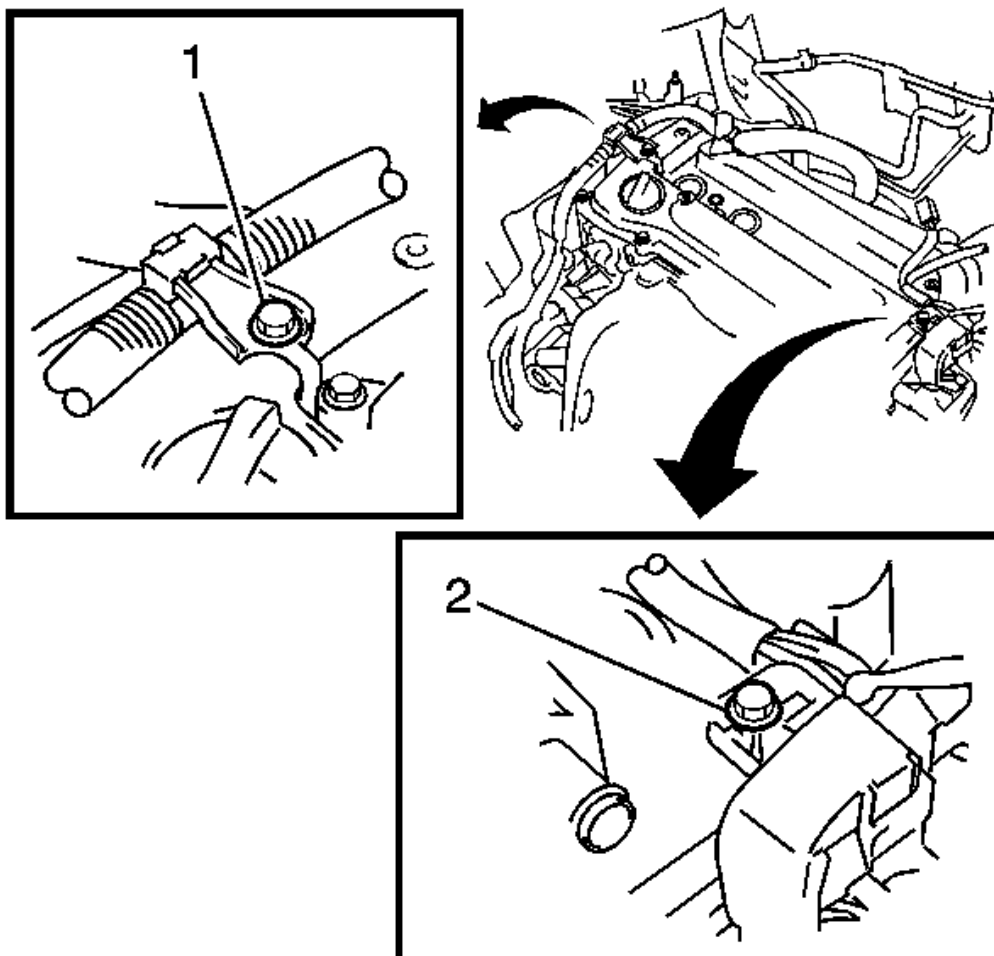


Fig. 61: View Of Wire Harness Brackets
Courtesy of GENERAL MOTORS CORP.

6. Remove the 2 bolts (1, 2) and separate the 2 wire harness brackets.

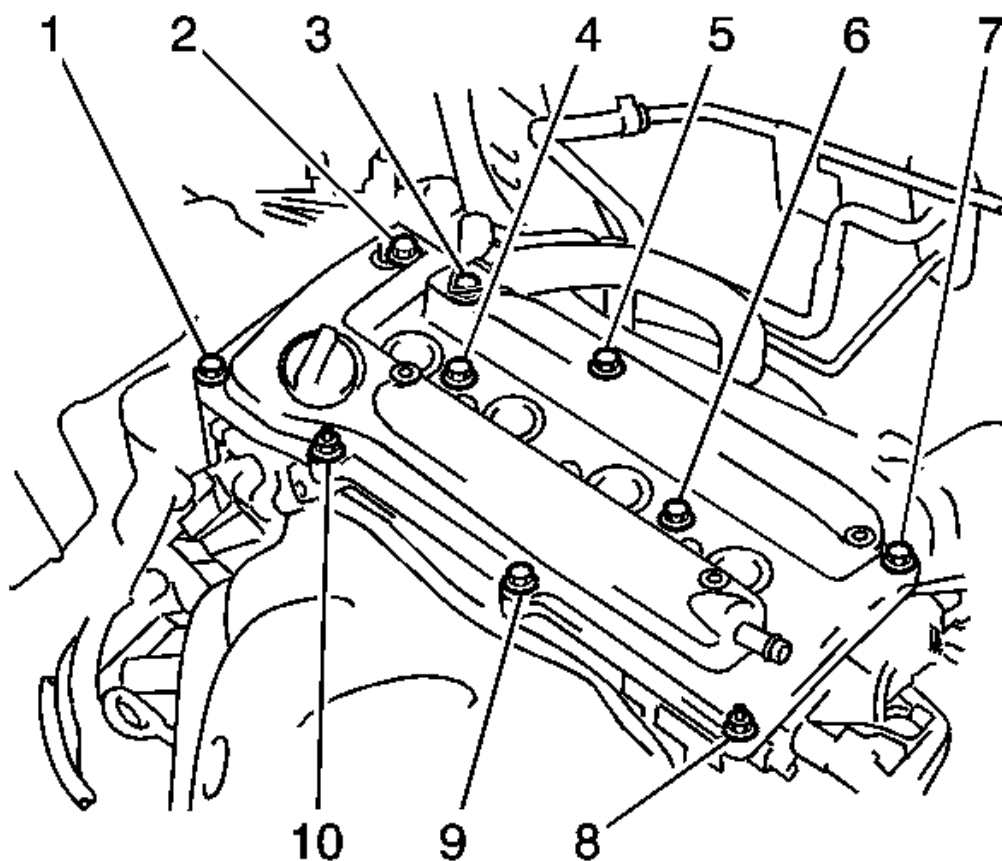


Fig. 62: Identifying Cylinder Head Cover Sub-Assembly Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

7. Remove the 8 bolts (1-7, 9), and 2 nuts (8, 10), then remove the cylinder head cover sub-assembly and gasket.

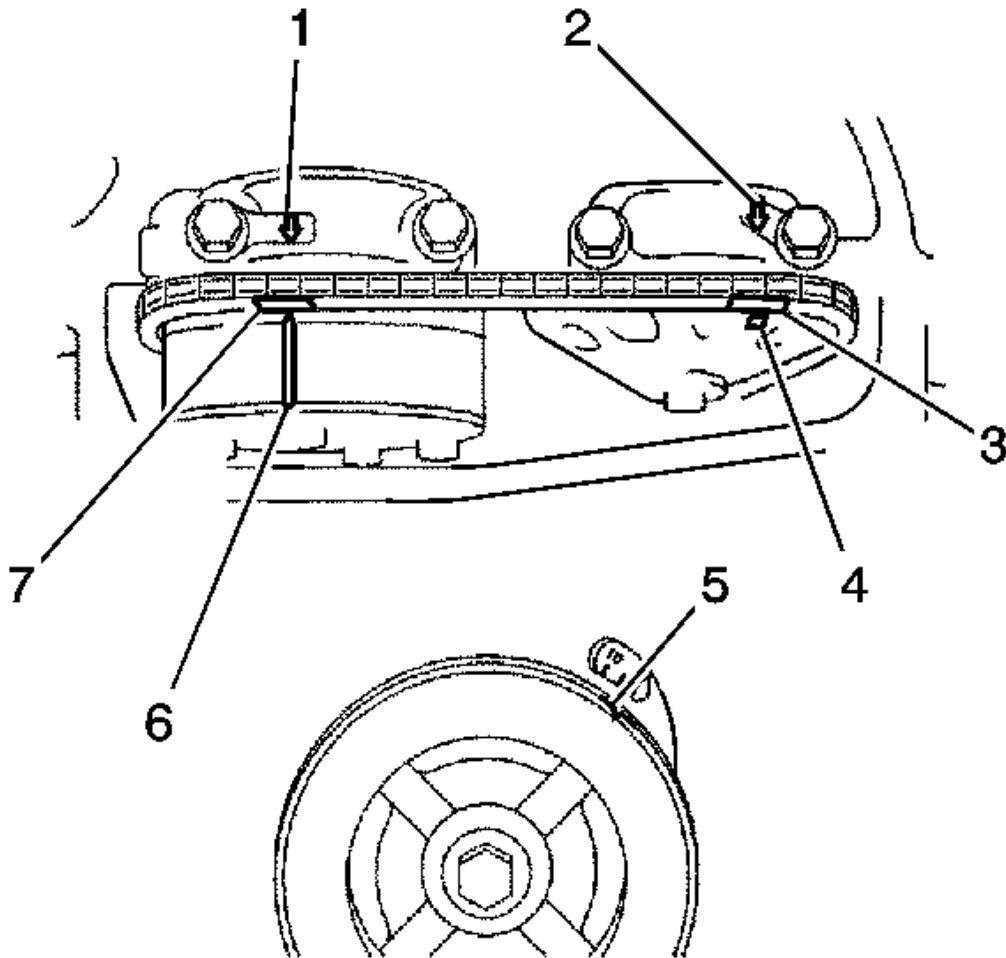


Fig. 63: Setting No. 1 Cylinder To TDC/compression Stroke
Courtesy of GENERAL MOTORS CORP.

8. Set No. 1 cylinder to TDC/compression by turning the crankshaft pulley until the groove and the timing mark "0" (5) on the timing chain cover are aligned.
9. Check that each timing mark on the camshaft timing gear (4, 6) and sprocket is aligned with each timing mark located on the intake and exhaust bearing caps, as shown in the illustration.
10. If not, turn the crankshaft pulley by 1 revolution (360°) to align the timing marks as illustrated.
11. Place paint marks (3, 7) on the chain in alignment with the timing marks on the camshaft timing gear and camshaft timing sprocket.
12. Remove the chain tensioner assembly.

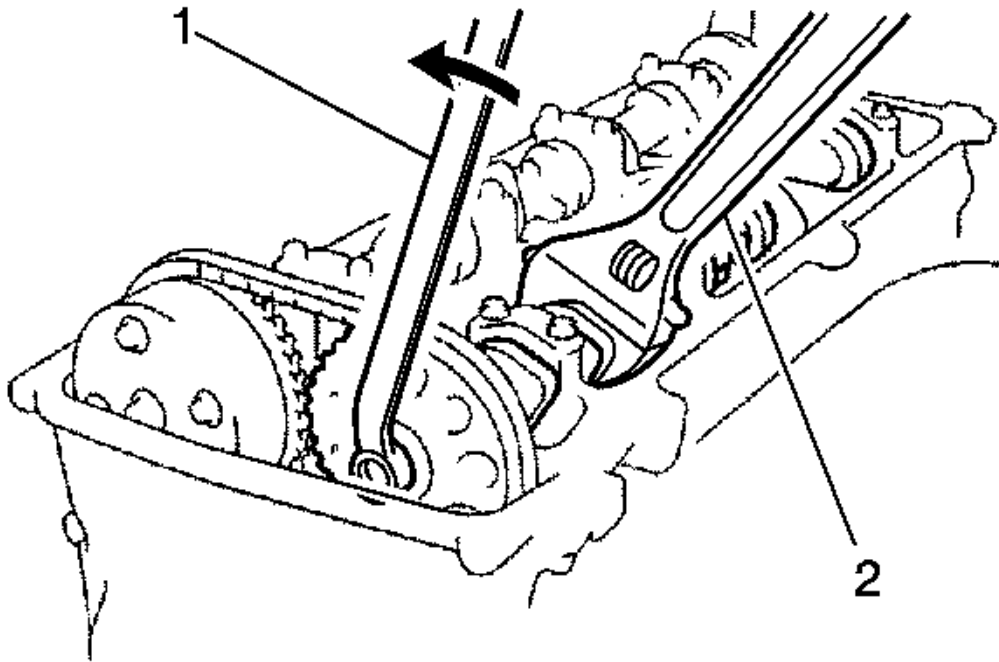


Fig. 64: Identifying Camshaft Timing Gear & Sprocket
Courtesy of GENERAL MOTORS CORP.

13. Loosen the camshaft timing gear or sprocket. While holding the exhaust camshaft with a wrench (2), loosen the No. 2 camshaft timing set bolt.

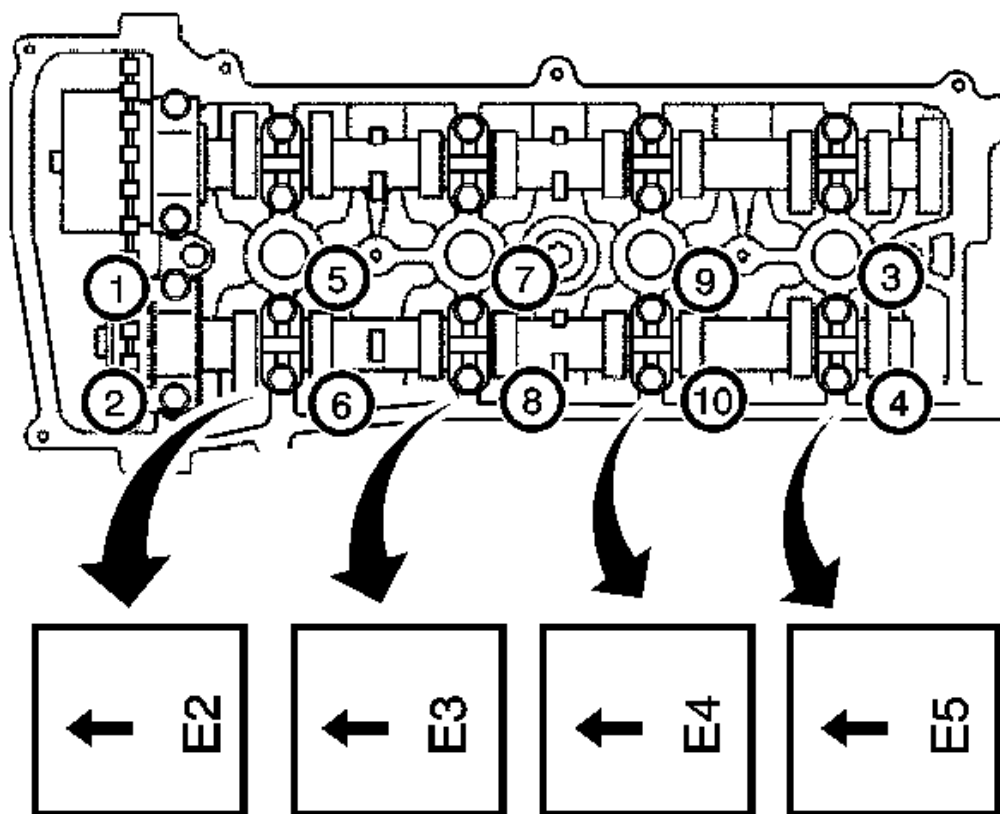


Fig. 65: Identifying Bearing Cap Bolt Removal Sequence
Courtesy of GENERAL MOTORS CORP.

14. Remove the exhaust camshaft using several steps, uniformly loosen and remove the 10 bearing cap bolts in the sequence shown in the illustration.
15. Remove the 5 bearing caps.

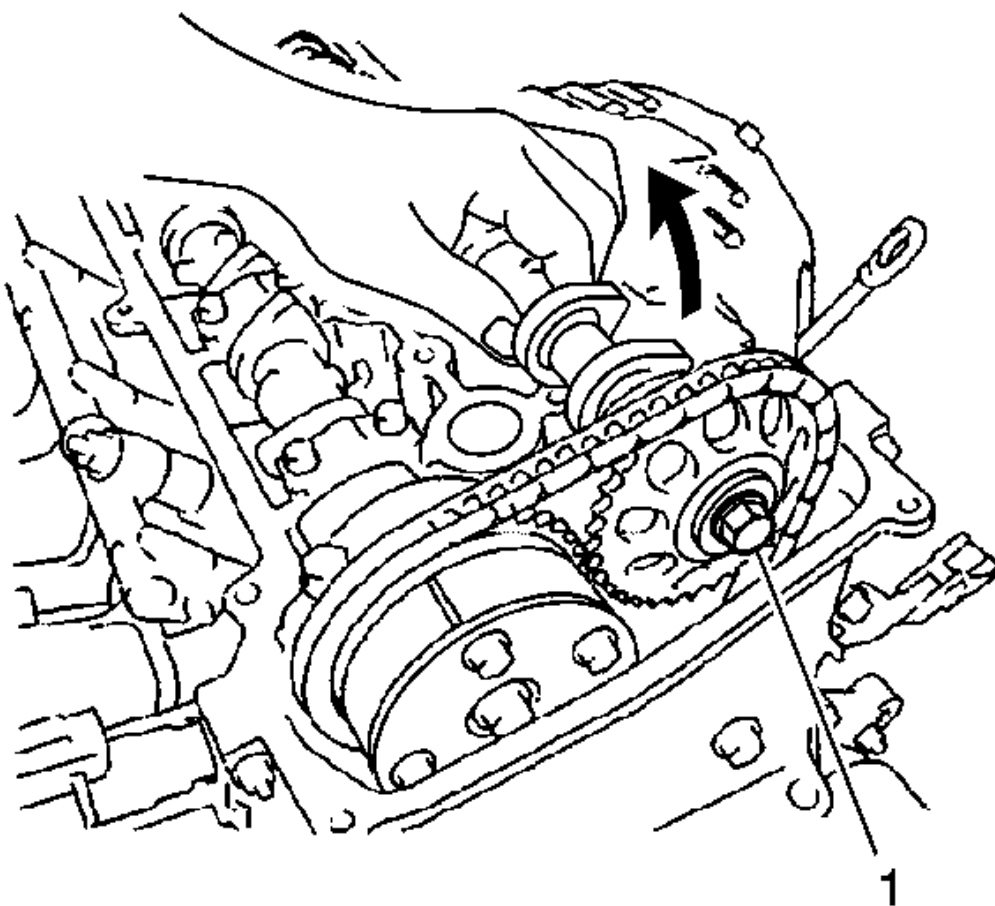


Fig. 66: View Of Camshaft Timing Sprocket & Set Bolt
 Courtesy of GENERAL MOTORS CORP.

16. While holding the exhaust camshaft by hand, remove the camshaft timing sprocket set bolt (1).
17. Remove the camshaft timing sprocket from the No. 2 camshaft with the timing chain wrapped on the sprocket.
18. Remove the camshaft timing sprocket from the timing chain.

INSTALLATION PROCEDURE

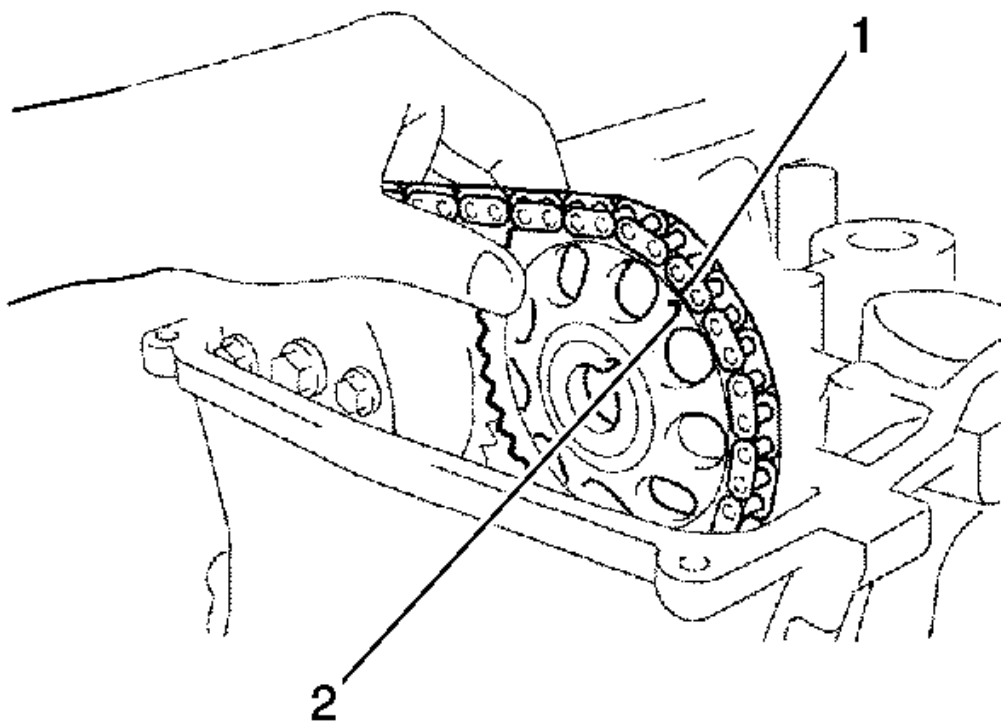


Fig. 67: View Of Timing Chain Alignment Marks
Courtesy of GENERAL MOTORS CORP.

1. Install the exhaust camshaft.
 1. Apply a light coat of engine oil to the journal portion of the exhaust camshaft.
 2. Put the exhaust camshaft on the cylinder head with the paint mark (1) on the chain aligned with the timing mark (2) on the camshaft timing sprocket.

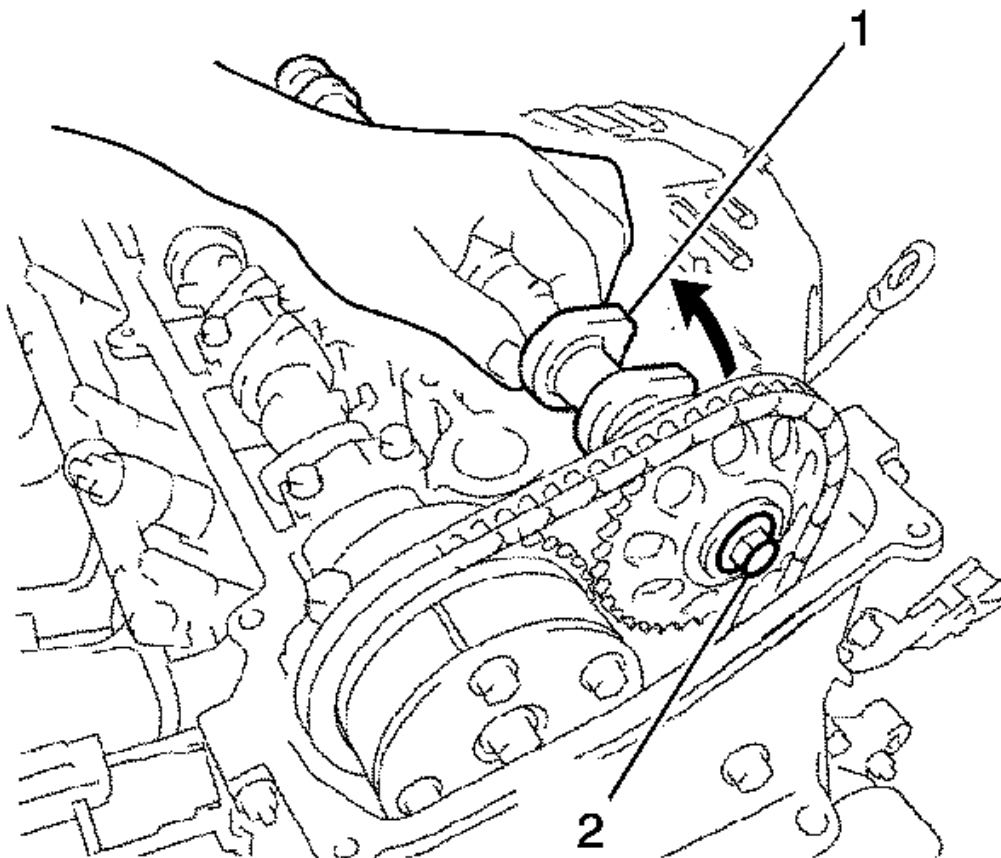


Fig. 68: Tightening Camshaft Timing Sprocket Set Bolt
Courtesy of GENERAL MOTORS CORP.

2. While holding the exhaust camshaft by hand, temporarily tighten the camshaft timing sprocket set bolt (2).

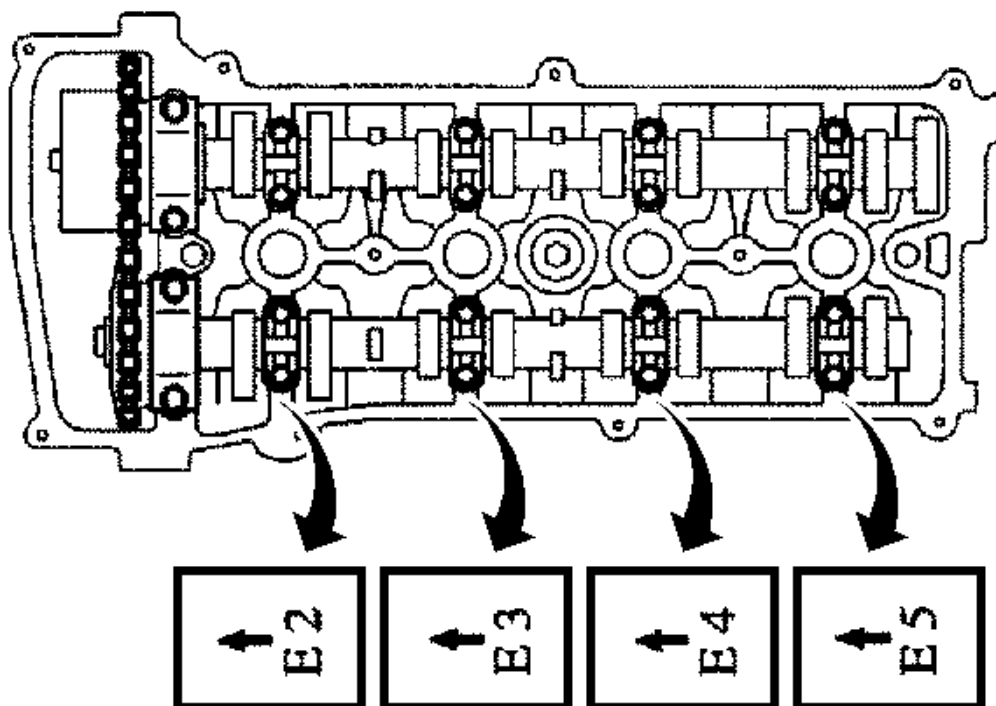


Fig. 69: View Of Front Marks & Numbers On Bearing Caps
Courtesy of GENERAL MOTORS CORP.

3. Examine the front marks and numbers, and check that the order is as shown in the illustration. Then install the bearing caps onto the cylinder head.
4. Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

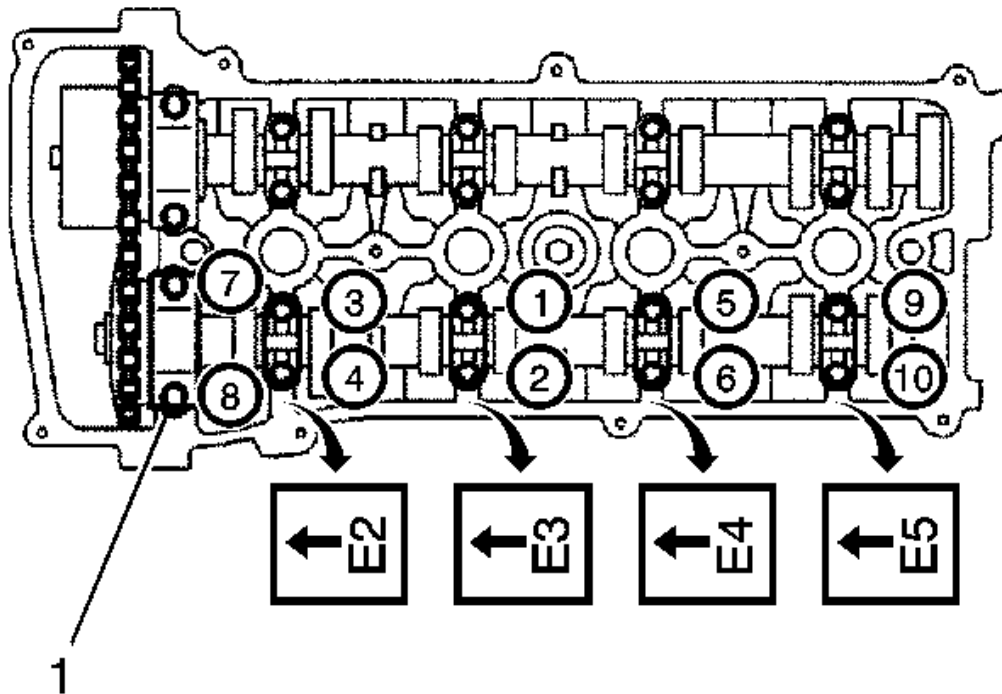


Fig. 70: Identifying Bearing Cap Bolt Tightening Sequence
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

5. Using several steps, uniformly install the 10 bearing cap bolts (1) in the sequence shown in the illustration and tighten.
 - The thrust bearing bolts to 30 N.m (22 lb ft).
 - The remaining bearing bolts to 9.0 N.m (80 lb in).

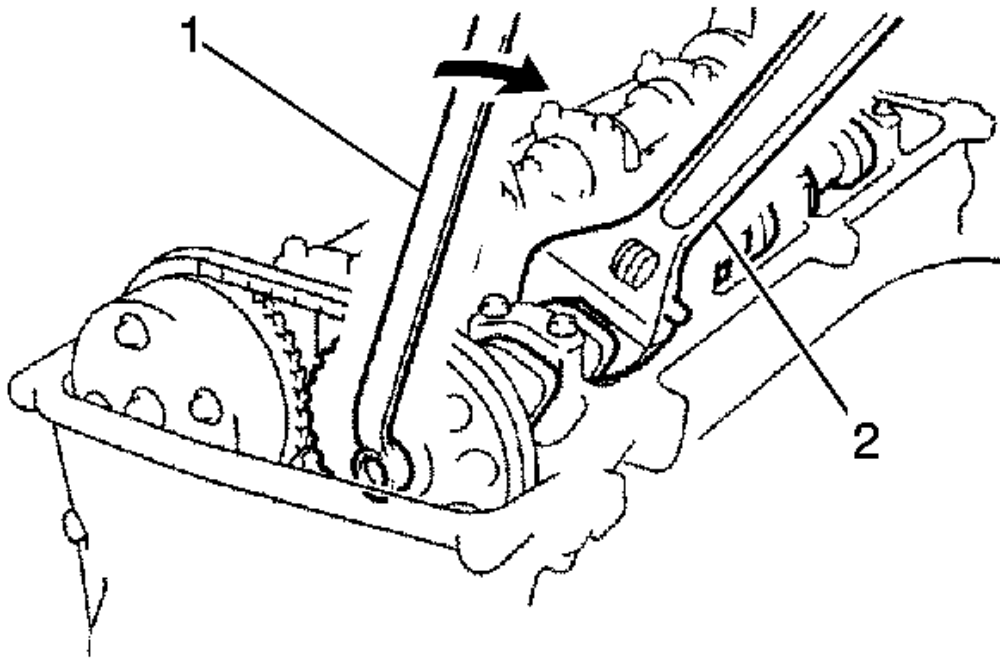


Fig. 71: Tightening Camshaft Timing Sprocket Set Bolt
Courtesy of GENERAL MOTORS CORP.

6. While holding the camshaft with a wrench (2), install the camshaft timing sprocket set bolt and tighten to 54 N.m (40 lb ft).

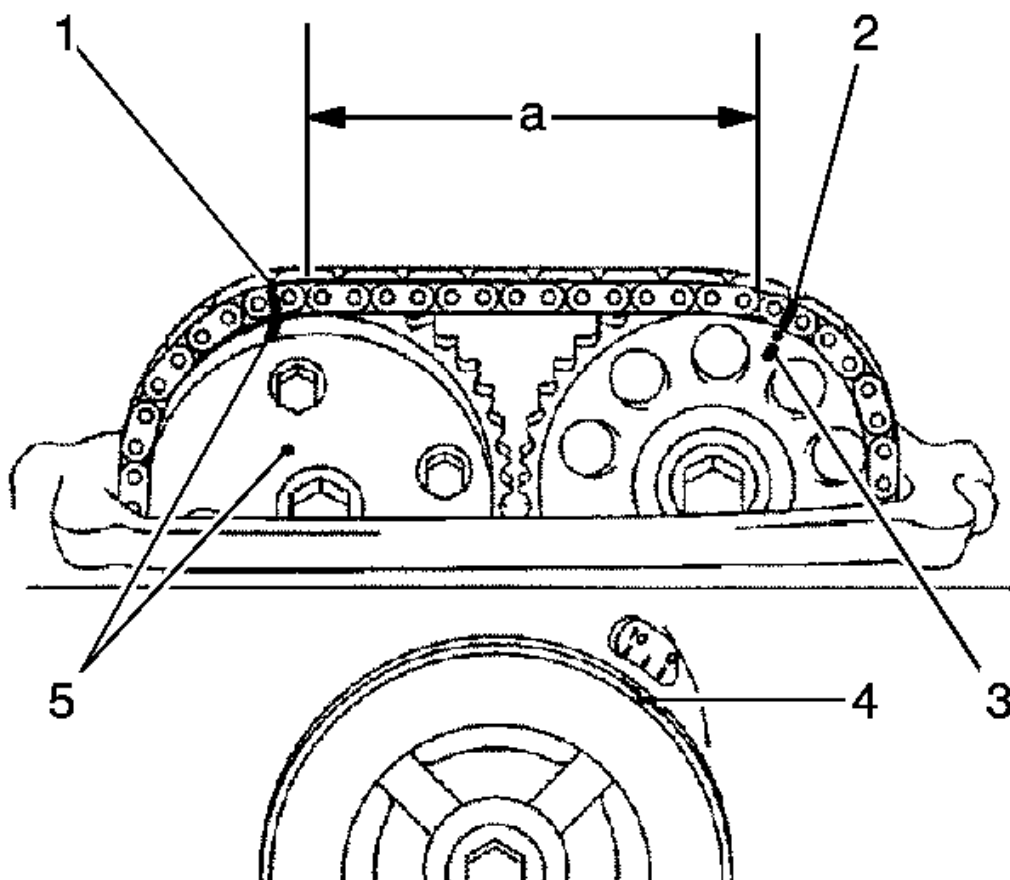


Fig. 72: Checking Timing Chain Paint Mark Alignment
Courtesy of GENERAL MOTORS CORP.

7. Check that the paint marks (1, 2) on the chain are aligned with the timing marks (3, 5) on the camshaft timing gear and camshaft timing sprocket. Also, check that the crankshaft pulley groove (4) is aligned with the timing mark 0 on the timing mark chain cover.

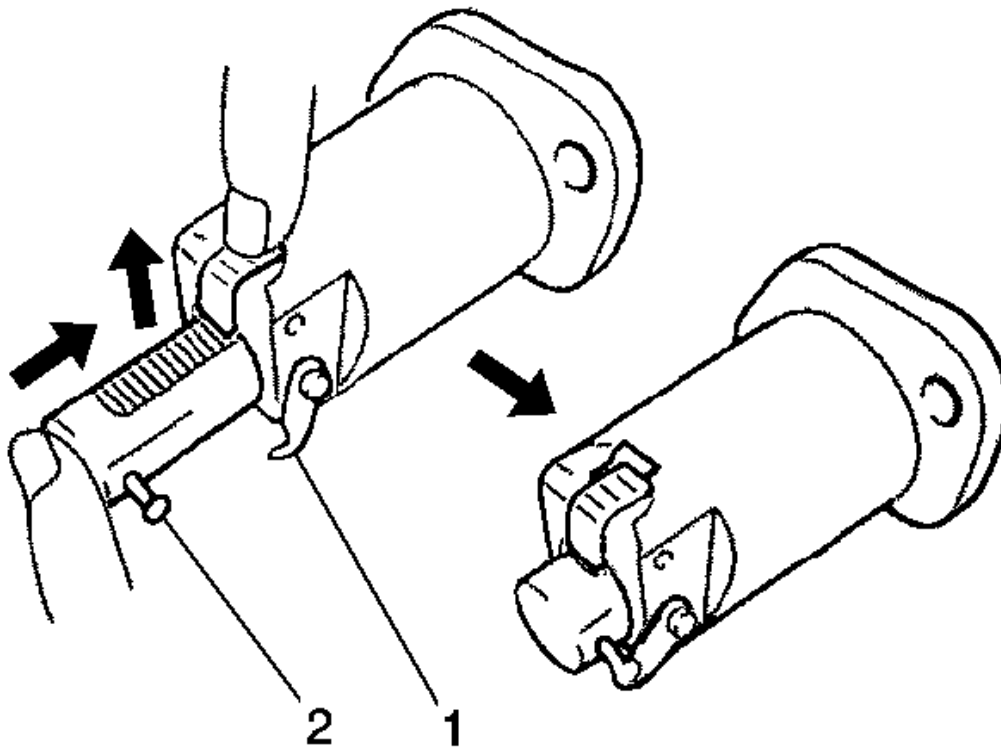


Fig. 73: View Of Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

8. Install the chain tensioner assembly. Release the ratchet pawl, then fully push in the plunger and hook the hook (1) to the pin (2) so that the plunger is in the position shown in the illustration.

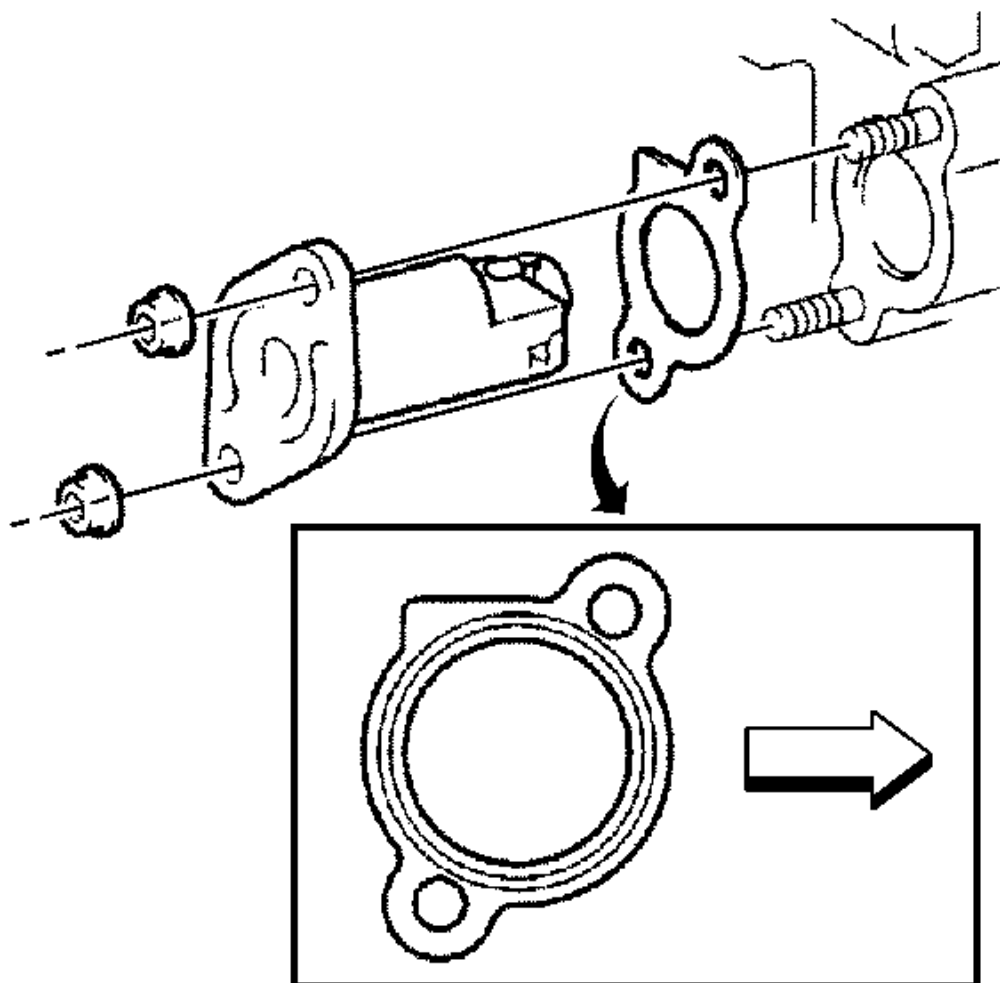


Fig. 74: View Of Chain Tensioner, Gasket & Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: When installing the chain tensioner, set the hook again if the hook releases the plunger.

9. Install a new gasket and the chain tensioner with the 2 nuts and tighten to 9.0 N.m (80 lb in).

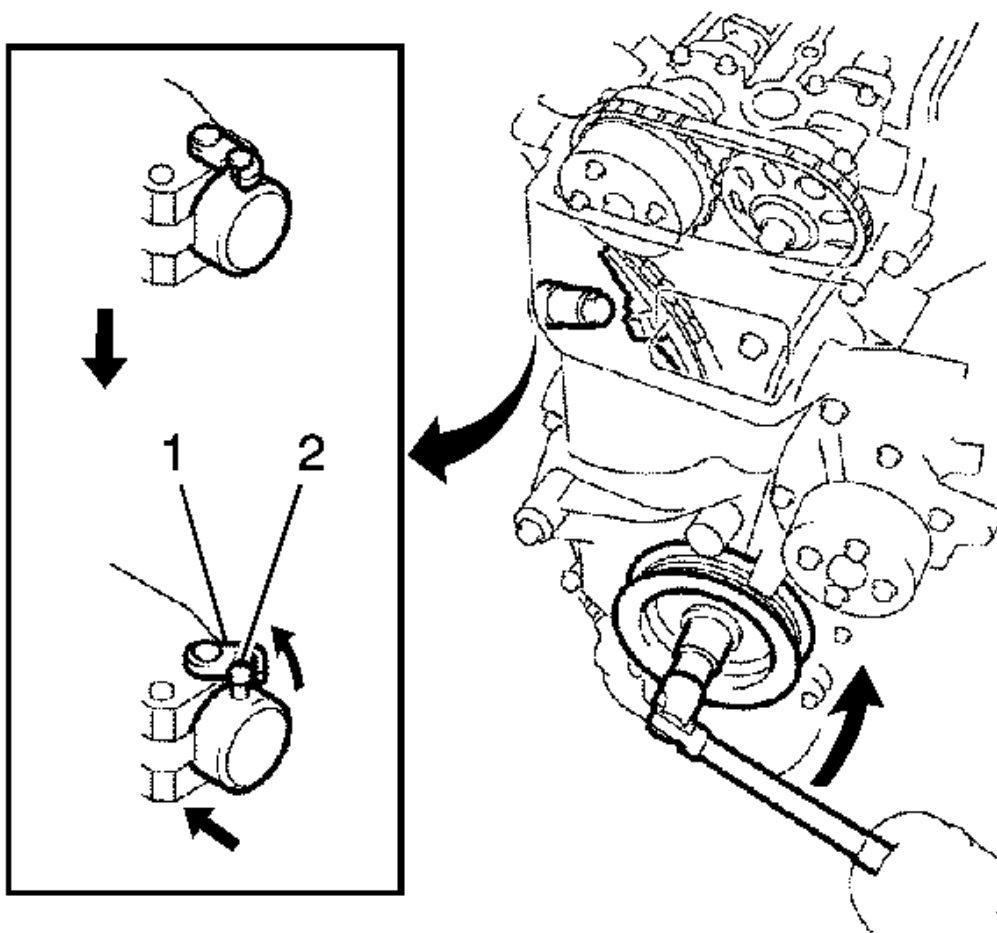


Fig. 75: Rotating Crankshaft Counterclockwise
Courtesy of GENERAL MOTORS CORP.

10. Turn the crankshaft counterclockwise, then disconnect the plunger knock pin (2) from the hook (1).

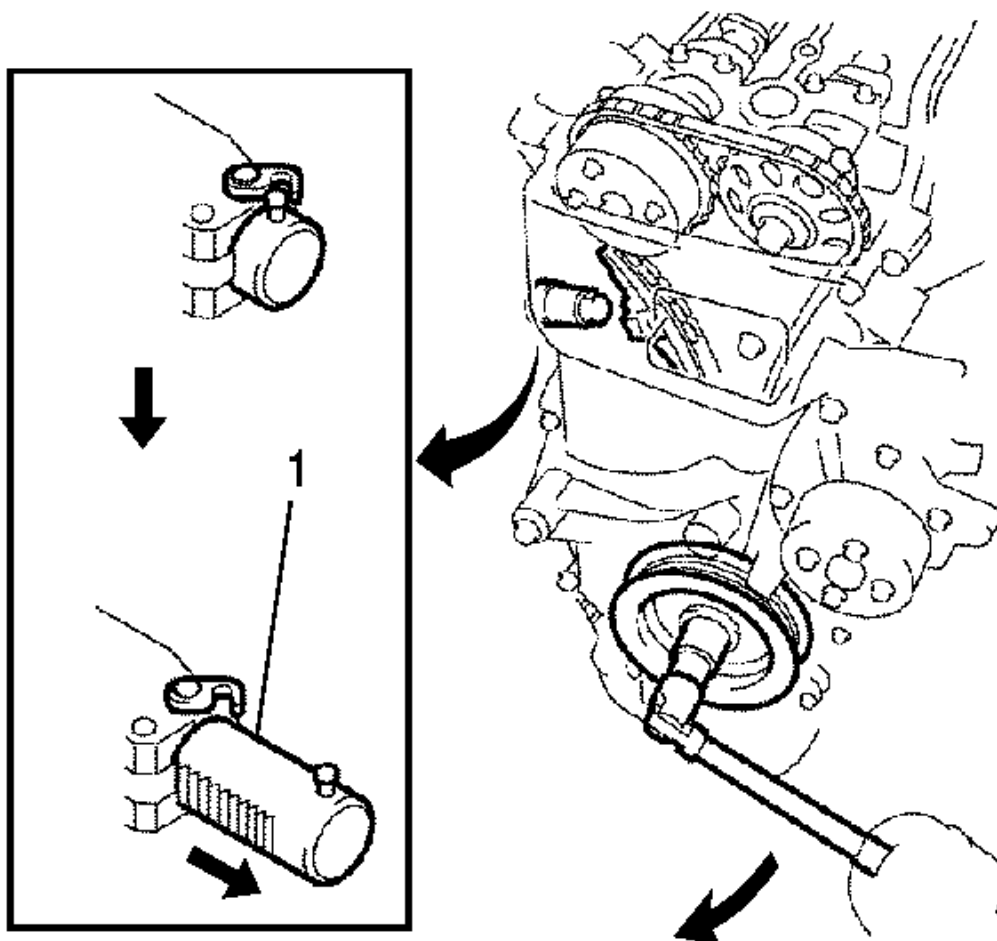


Fig. 76: View Of Chain Tensioner & Plunger
Courtesy of GENERAL MOTORS CORP.

11. Turn the crankshaft clockwise, then check that the plunger (1) is extended.
12. Set No. 1 cylinder to TDC/compression.
13. Check the valve clearance. Refer to **Valve Clearance Adjustment**.
14. Remove any old packing material from the contact surface.

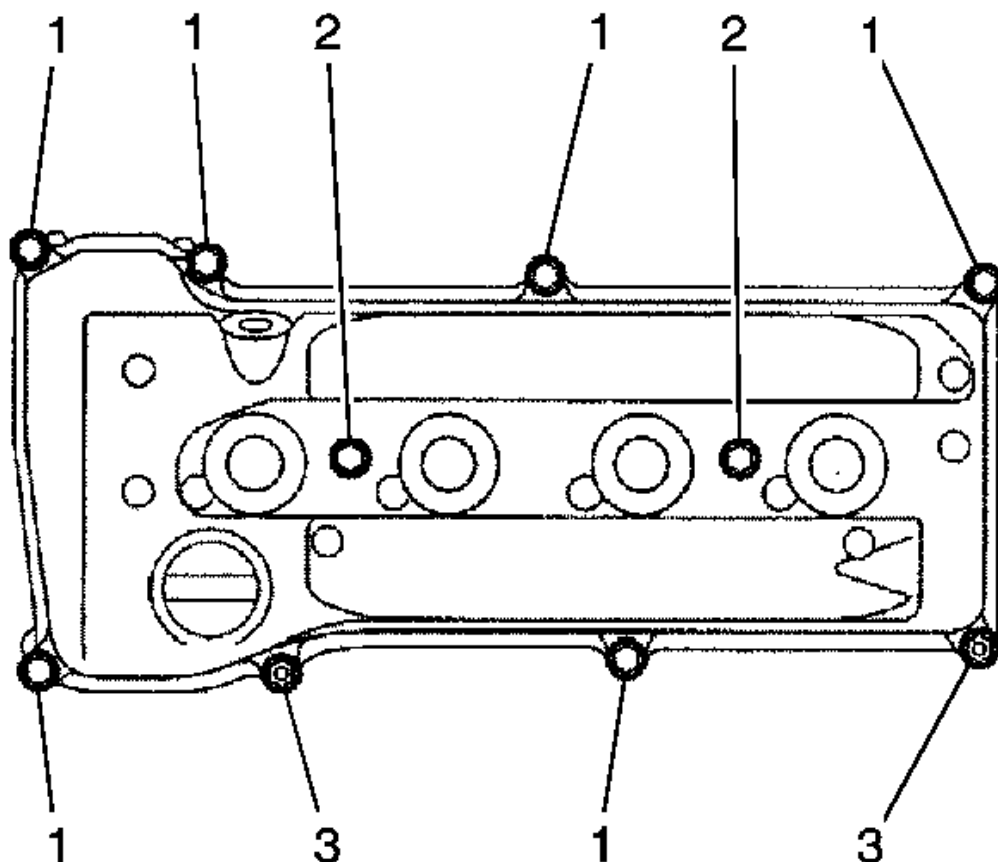


Fig. 77: Identifying Cylinder Head Cover Bolts
Courtesy of GENERAL MOTORS CORP.

15. Install the cylinder head cover gasket and subassembly with the 8 bolts (1, 2) and 2 nuts (3) and tighten.
- Bolts 1 to 11 N.m (8 lb ft)
 - Bolts 2 to 14 N.m (10 lb ft)
 - Nuts to 11 N.m (8 lb ft)

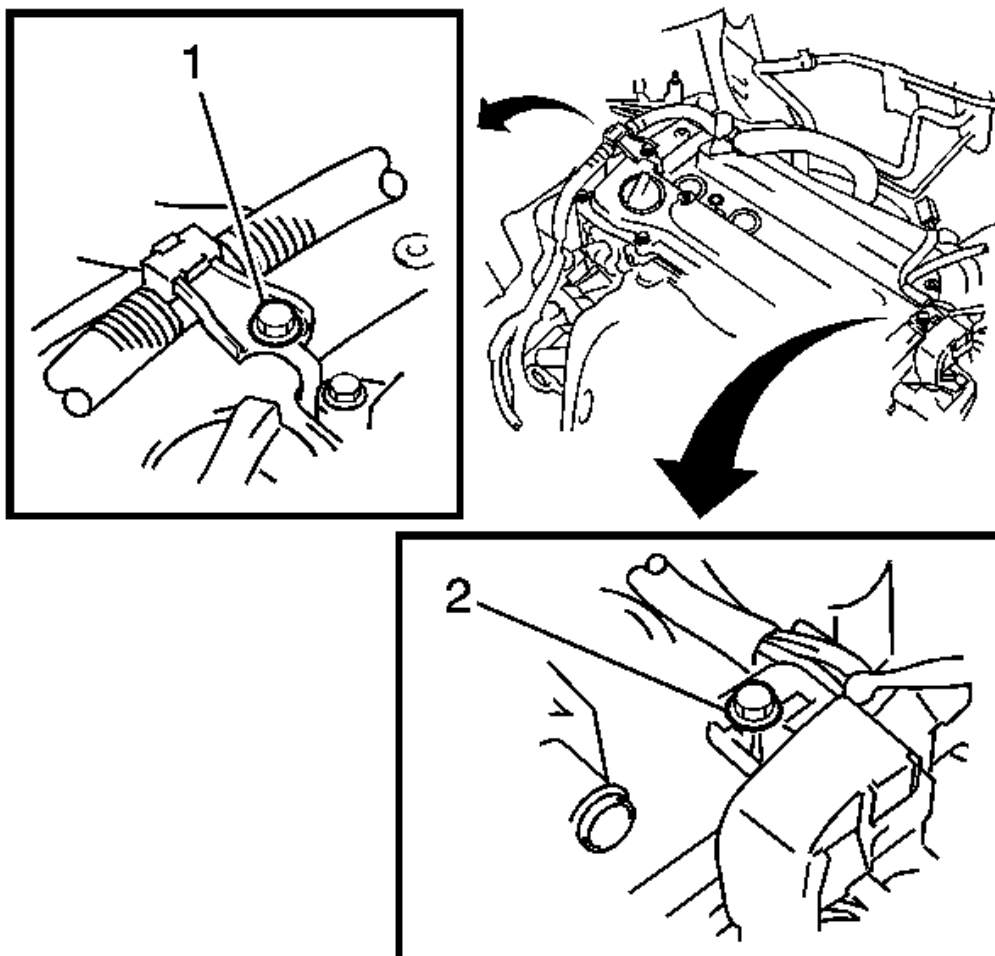


Fig. 78: View Of Wire Harness Brackets
Courtesy of GENERAL MOTORS CORP.

16. Install the 2 engine wire harness brackets with the 2 bolts (1, 2) and tighten to 8.4 N.m (74 lb in).

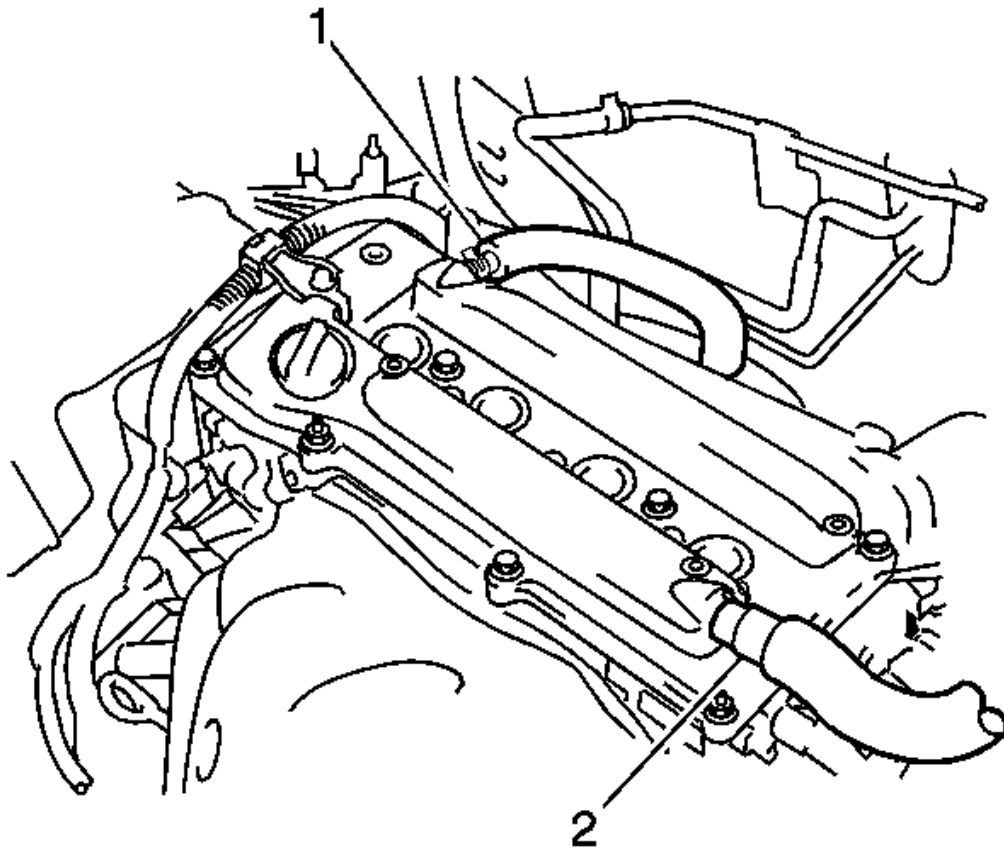


Fig. 79: View Of Engine Cover Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

17. Connect the 2 ventilation hoses (1, 2) to the cylinder head cover.
18. Install the spark plug. Refer to **Spark Plug Replacement** .
19. Install the ignition coil assembly. Refer to **Ignition Coil Replacement** .
20. Inspect for oil leak.
21. Inspect the ignition timing.
22. Install the engine cover sub-assembly. Refer to **Engine Cover Replacement**.
23. Install the engine under right cover.

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 V-ribbed belt. Refer to **Drive Belt Replacement**

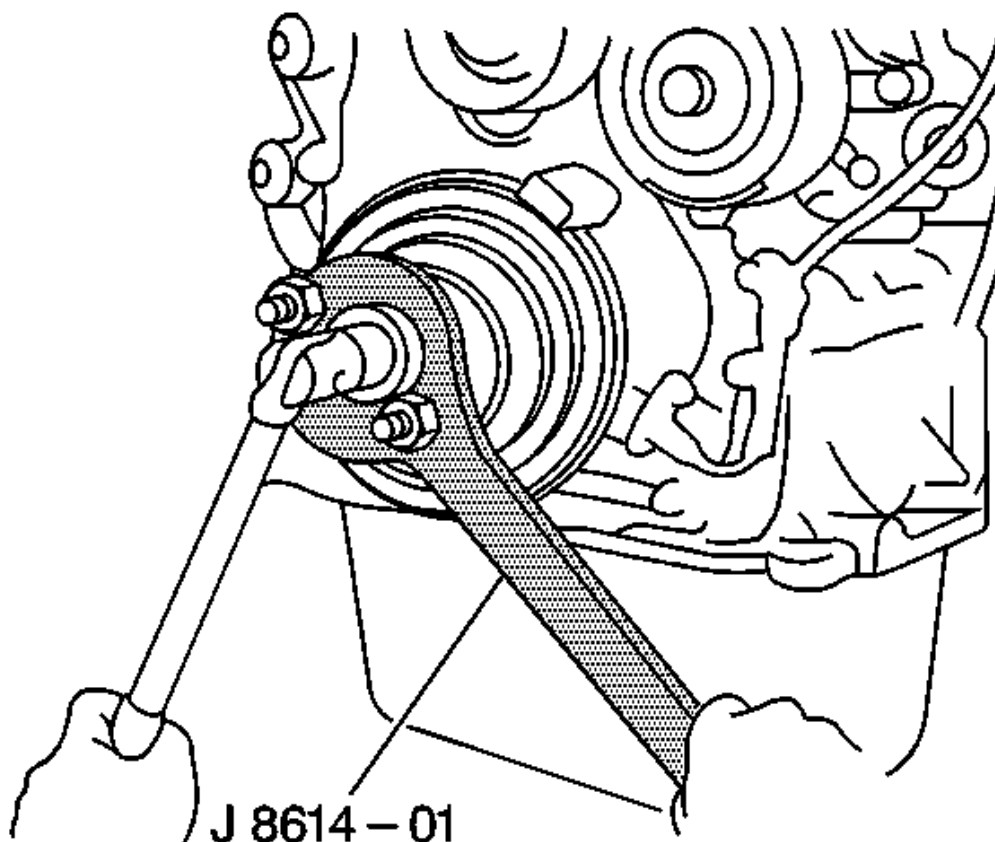


Fig. 80: Removing/Installing Crankshaft Pulley Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

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

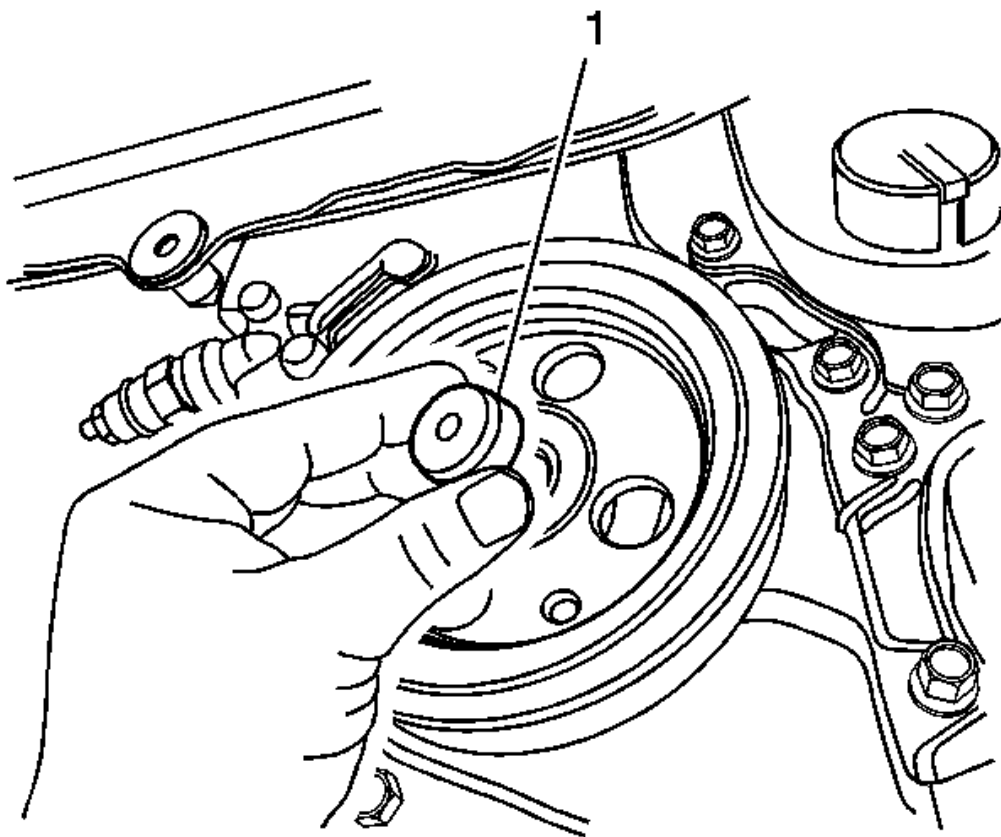


Fig. 81: Placing Protector On End Of Crankshaft
Courtesy of GENERAL MOTORS CORP.

5. Place the **J-21052-4**: protector on the end of the crankshaft.

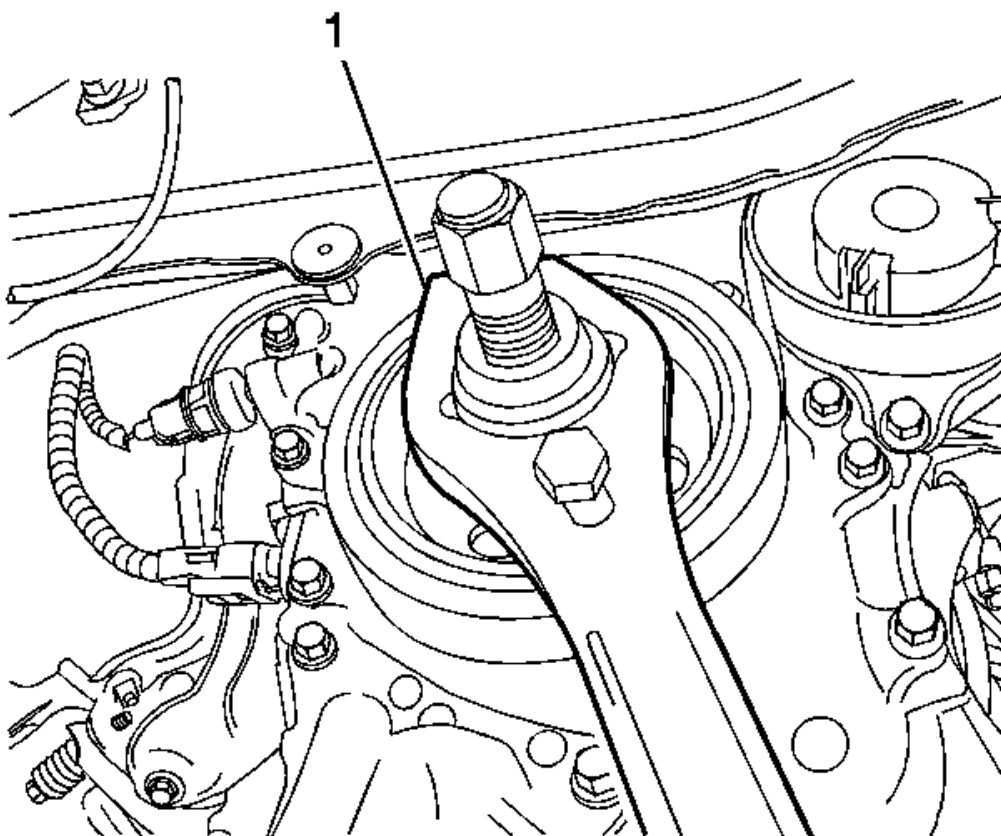


Fig. 82: Removing Crankshaft Pulley

Courtesy of GENERAL MOTORS CORP.

6. Using the **J-8614-A**: holder and remover, remove the crankshaft pulley.

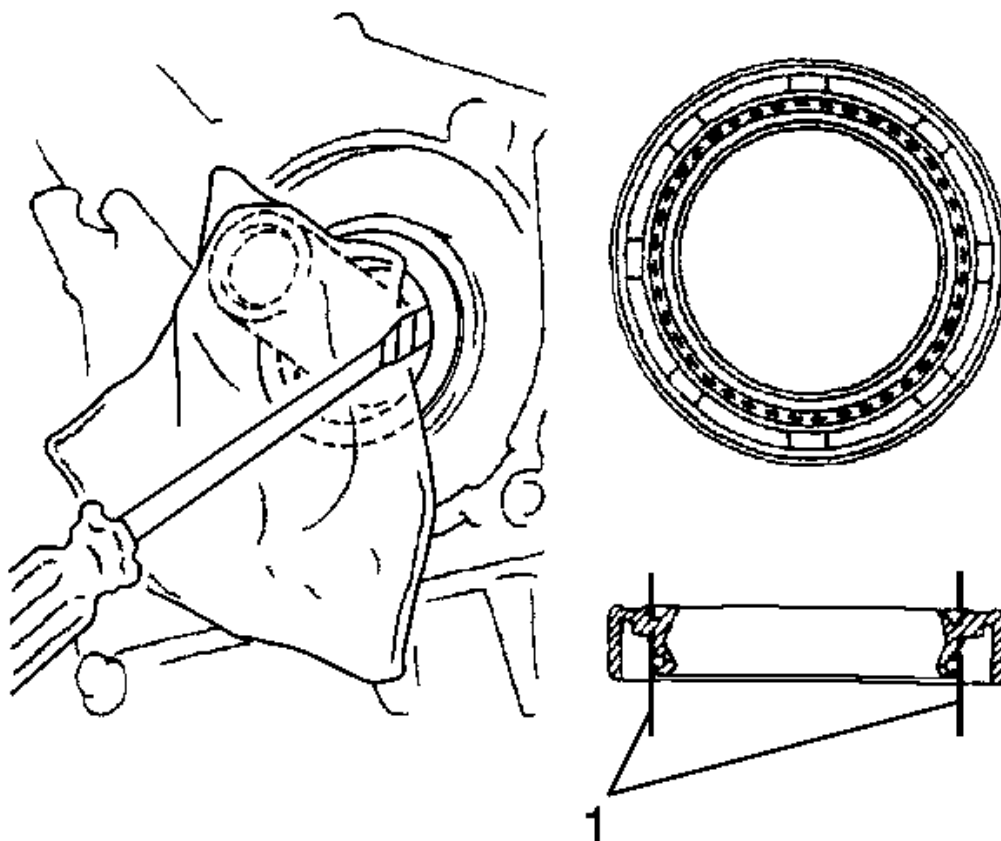


Fig. 83: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: After removing, check the crankshaft for damage. If damaged, smooth the surface with 400-grit sandpaper.

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

INSTALLATION PROCEDURE

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

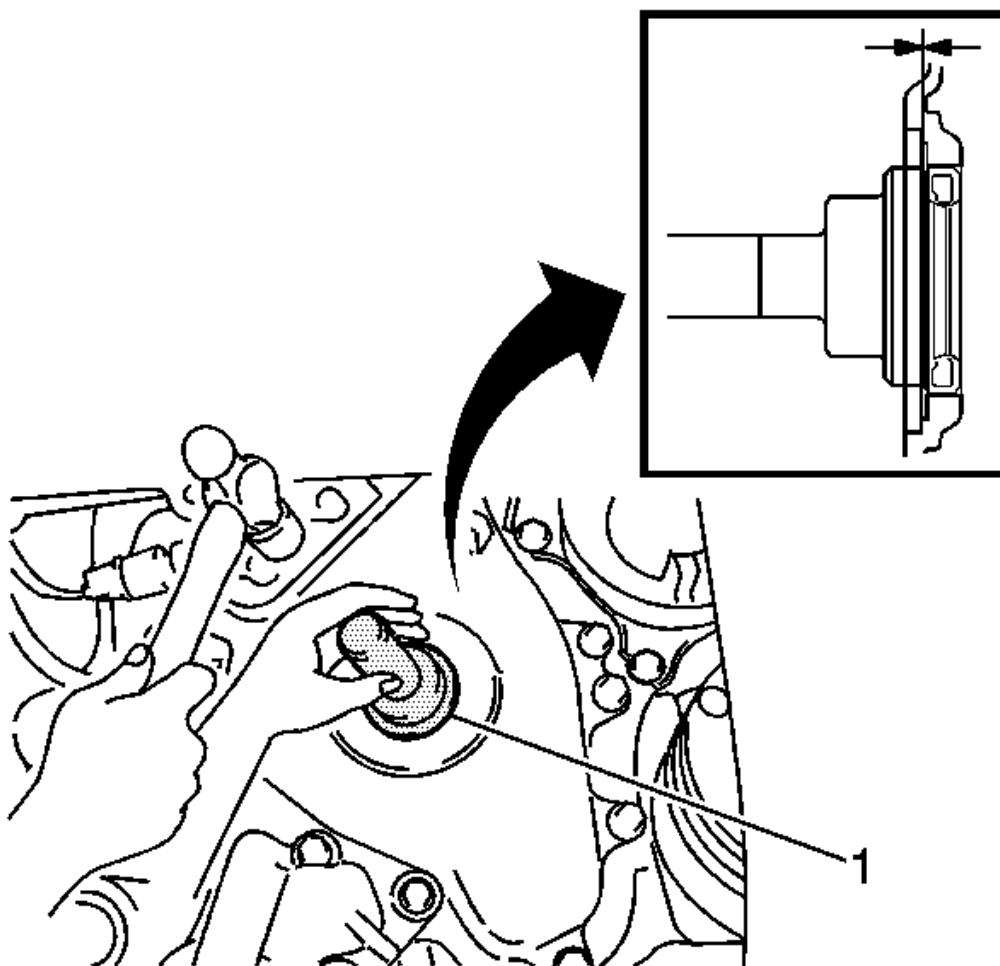


Fig. 84: Tapping In Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Wipe off extra grease from the crankshaft.

3. Using the **J-41665-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.

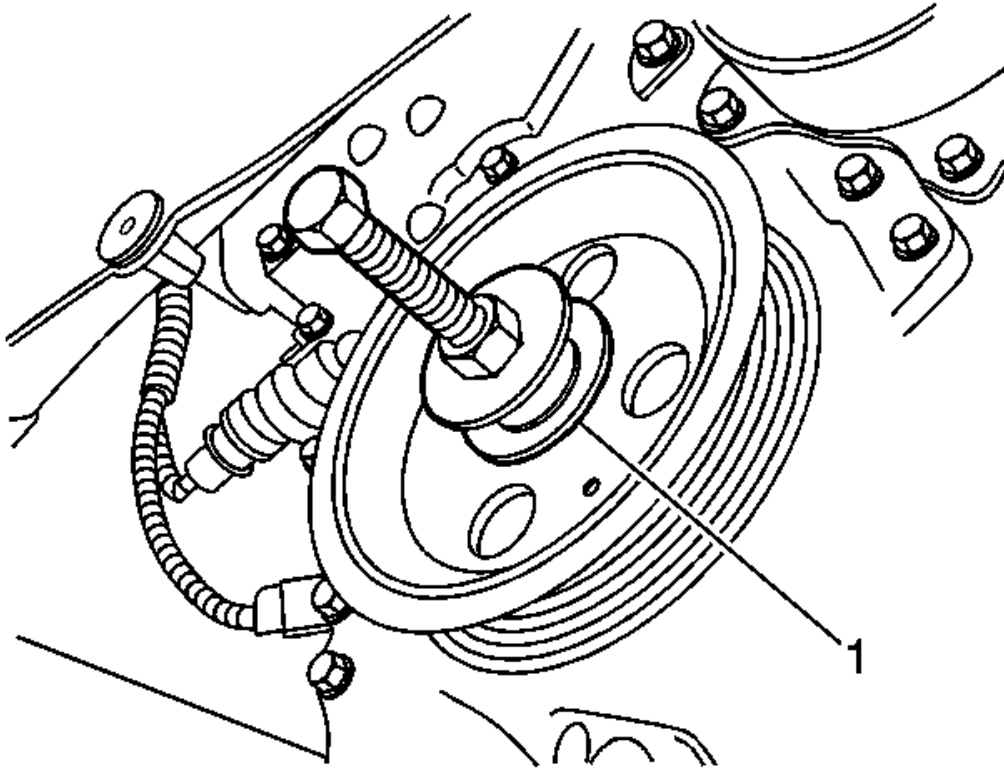


Fig. 85: Pushing Pulley On Crankshaft
Courtesy of GENERAL MOTORS CORP.

5. Using the **J-41998-A**: installer (1), push the pulley on the crankshaft.

CAUTION: Refer to Fastener Caution

6. Using **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 engine oil if necessary.
9. Inspect for engine oil leak.
10. Install the engine under cover RH.
11. Install the front wheel RH.

CAMSHAFT COVER REPLACEMENT

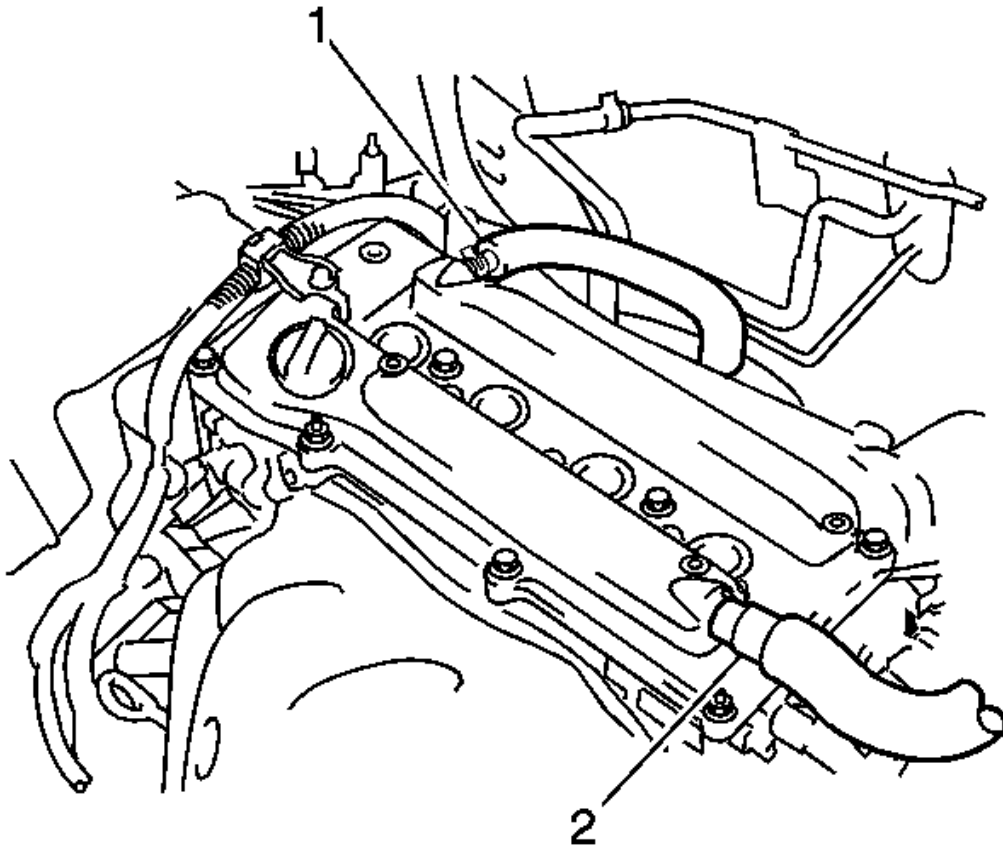
REMOVAL PROCEDURE

Fig. 86: View Of Engine Cover Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove engine cover. Refer to **Engine Cover Replacement**.
2. Remove ignition coil assembly. Refer to **Ignition Coil Replacement**.
3. Remove the 2 ventilation hoses (1, 2) from the cylinder head cover.

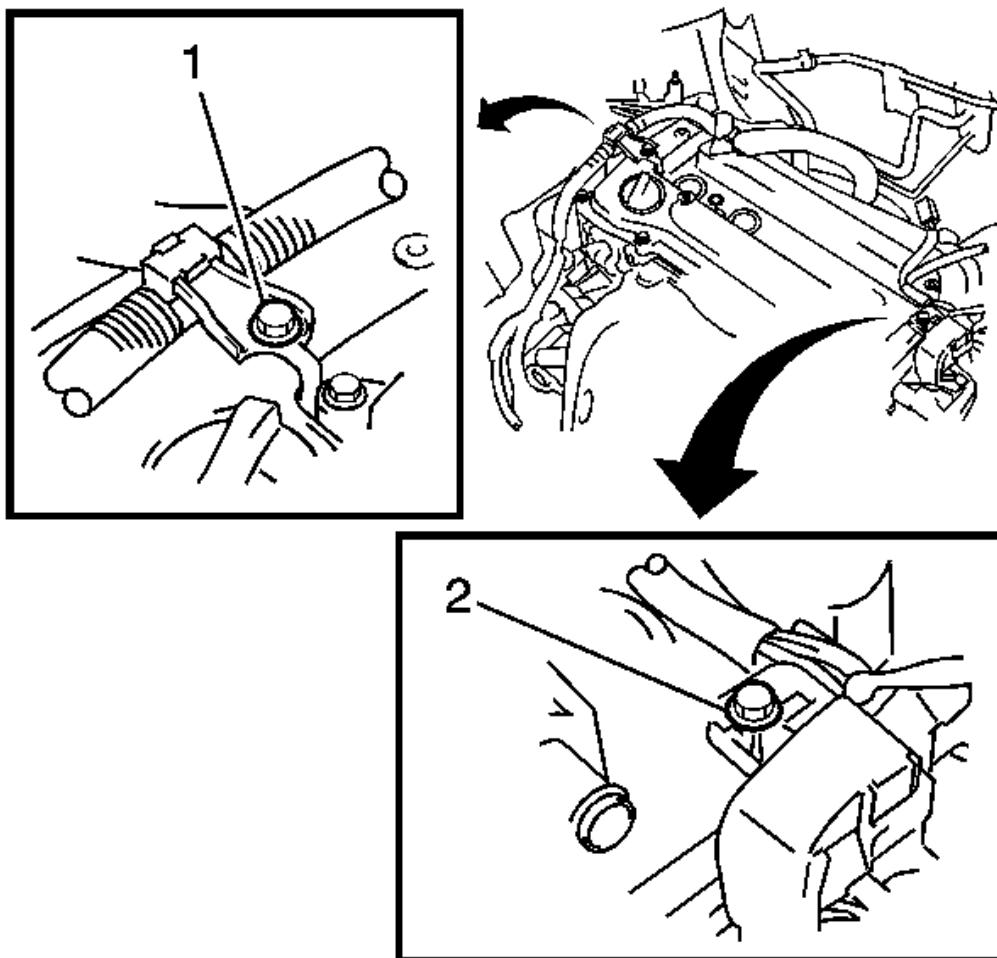


Fig. 87: View Of Wire Harness Brackets
Courtesy of GENERAL MOTORS CORP.

4. Remove the 2 bolts (1, 2) and separate the 2 wire harness brackets.

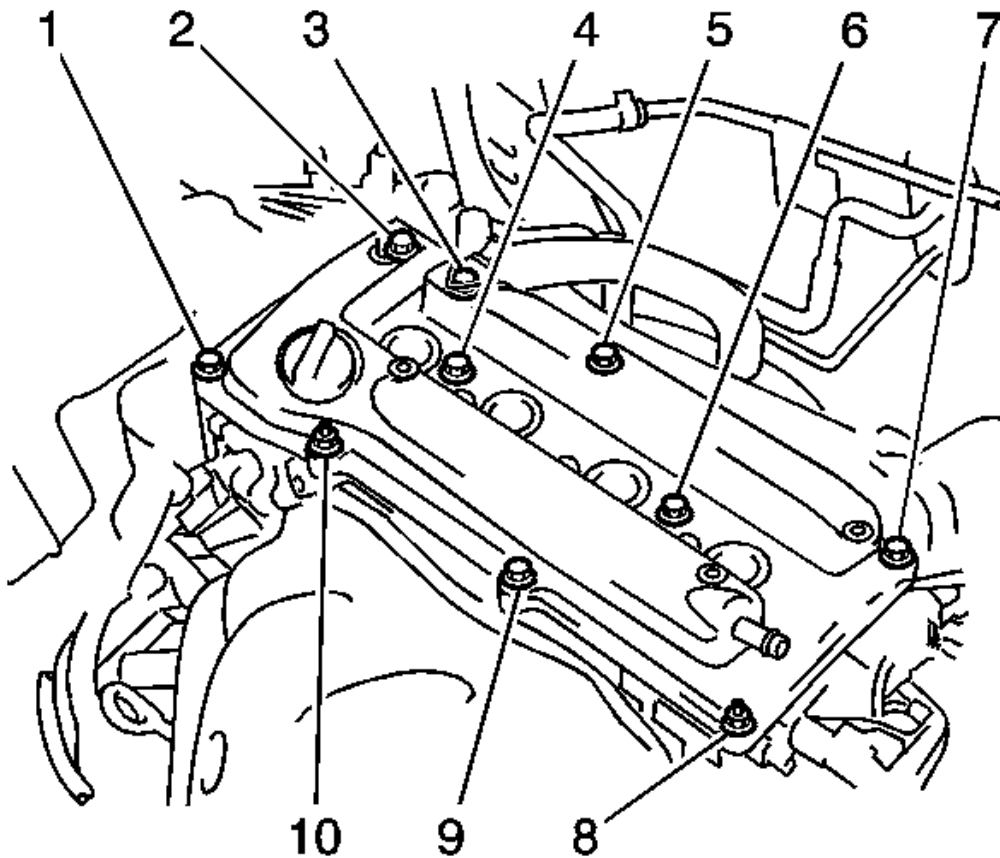


Fig. 88: Identifying Cylinder Head Cover Sub-Assembly Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

5. Remove the 8 bolts (1-7, 9) and 2 nuts (8, 10), then remove the cylinder head cover and gasket.

INSTALLATION PROCEDURE

1. Remove any old sealing material from the contact surface.

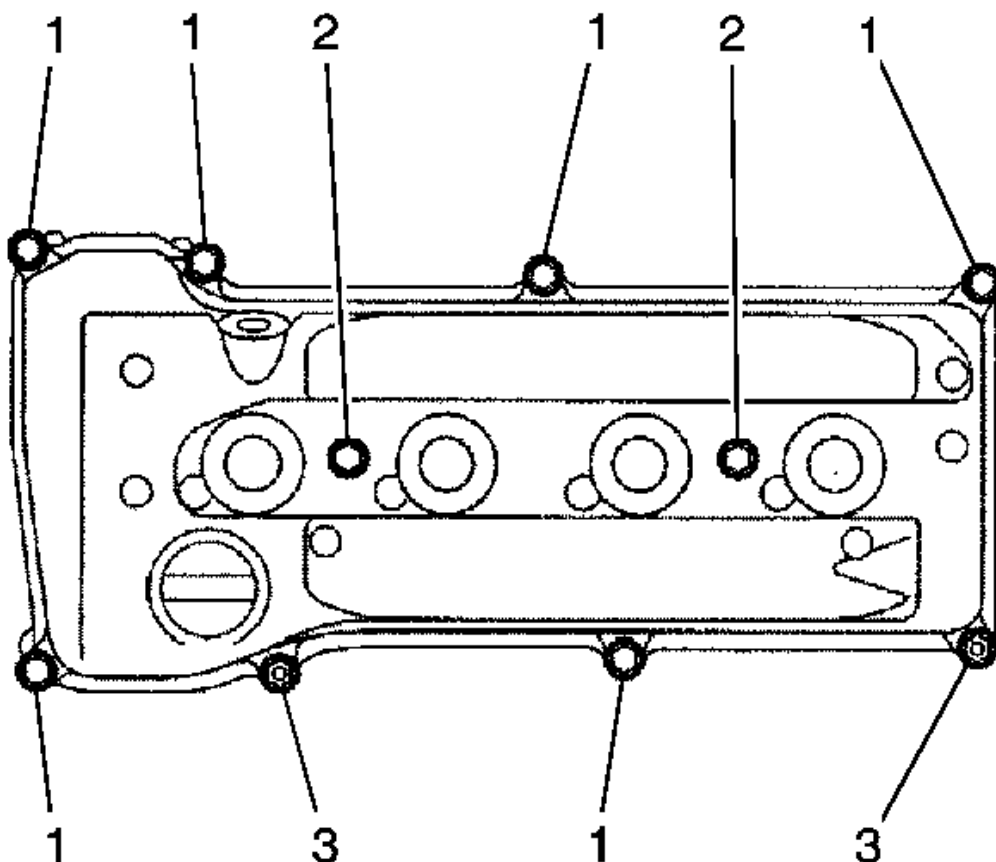


Fig. 89: Identifying Cylinder Head Cover Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

2. Install the cylinder head cover gasket and cover with the 8 bolts (1, 2) and 2 nuts (3), then tighten.
 - Bolt (1) to 11 N.m (8 lb ft)
 - Bolt (2) to 14 N.m (10 lb ft)
 - Nut (3) to 11 N.m (8 lb ft)

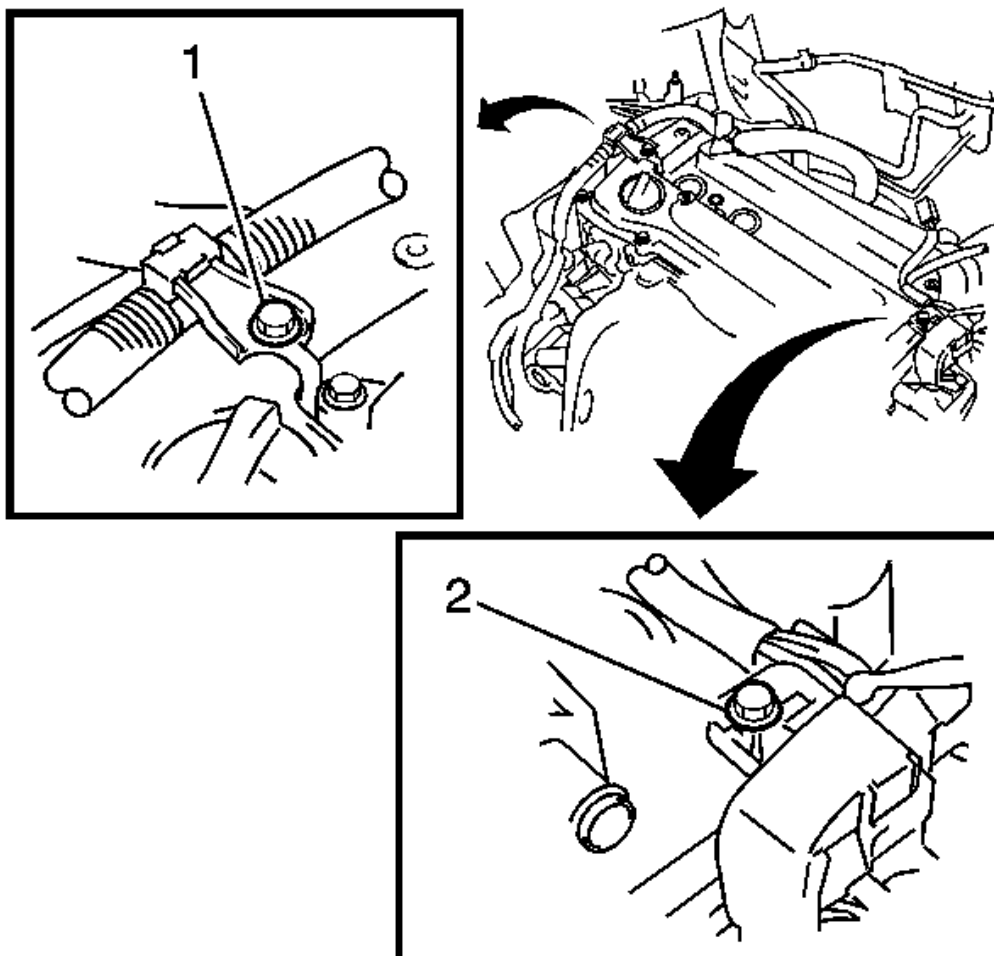


Fig. 90: View Of Wire Harness Brackets
Courtesy of GENERAL MOTORS CORP.

3. Install the 2 engine wire harness brackets with the 2 bolts (1, 2) and tighten to 8.4 N.m (74 lb in).

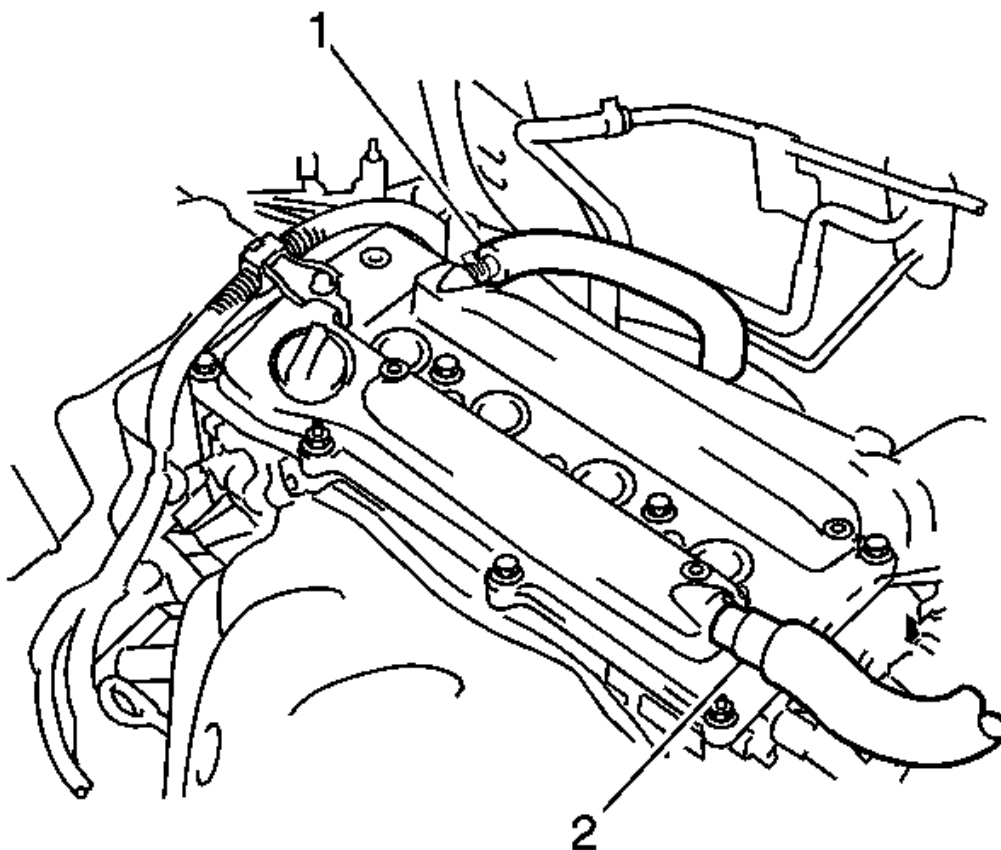


Fig. 91: View Of Engine Cover Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

4. Connect the 2 ventilation hoses (1, 2) to the cylinder head cover.
5. Install ignition coil assembly. Refer to **Ignition Coil Replacement** .
6. Inspect for oil leak.
7. Install the engine cover. Refer to **Engine Cover Replacement**.

CYLINDER HEAD REPLACEMENT

SPECIAL TOOLS

J-8614-A: Pinion Flange Holder and Remover

REMOVAL PROCEDURE

1. Discharge the fuel system pressure. Refer to **Fuel Pressure Relief** .
2. Disconnect the cable from the negative battery terminal. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the windshield wiper motor and link assembly. Refer to **Windshield Wiper Motor Replacement** .
4. Remove the outer cowl top panel.
5. Remove the suspension tower damper assembly with front strut bar.
6. Remove the right front wheel.
7. Remove the left engine under cover.
8. Remove the right engine under cover.
9. Remove the engine cover. Refer to **Engine Cover Replacement**.
10. Drain the engine coolant. Refer to **Cooling System Draining and Filling** .
11. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
12. Remove the catalytic converter. Refer to **Catalytic Converter Replacement (2.4L AWD)** or **Catalytic Converter Replacement (2.4L FWD)** .
13. Remove the front exhaust pipe assembly. Refer to **Front Pipe Replacement (2.4L AWD)** or **Front Pipe Replacement (2.4L FWD)** .
14. Remove the V-ribbed belt. Refer to **Drive Belt Replacement**.
15. Remove the generator assembly. Refer to **Generator Replacement (2.4L)** .
16. Separate the radiator reserve tank assembly.
17. Remove the air cleaner with hose.
18. Remove the throttle body assembly.
19. Remove the ignition coil assembly. Refer to **Ignition Coil Replacement** .
20. Remove the spark plug. Refer to **Spark Plug Replacement** .
21. Remove the cylinder head cover. Refer to **Camshaft Cover Replacement**.

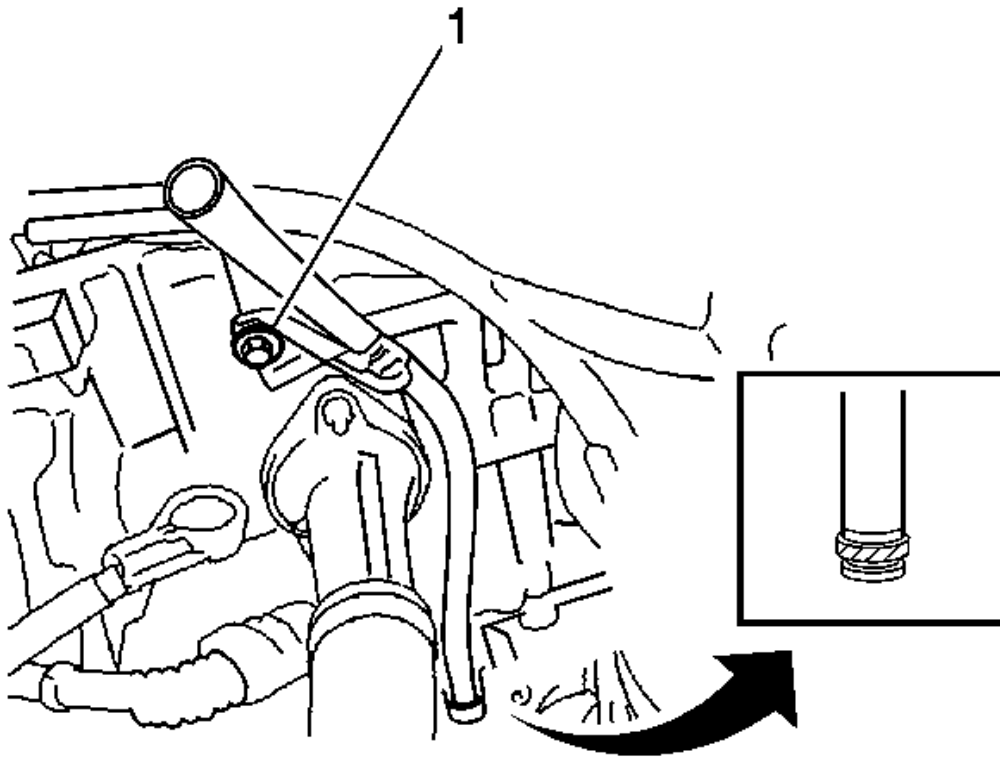


Fig. 92: Identifying Engine Oil Level Dipstick Guide Bolt
 Courtesy of GENERAL MOTORS CORP.

22. Remove the bolt (1) and engine oil level dipstick guide.
23. Remove the O-ring from the engine oil level dipstick guide.
24. Remove the engine oil level dipstick guide.
25. Disconnect the fuel main tube.
26. Remove the fuel delivery pipe.
27. Remove the camshaft timing oil control valve assembly.
28. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
29. Remove the exhaust manifold heat insulator.

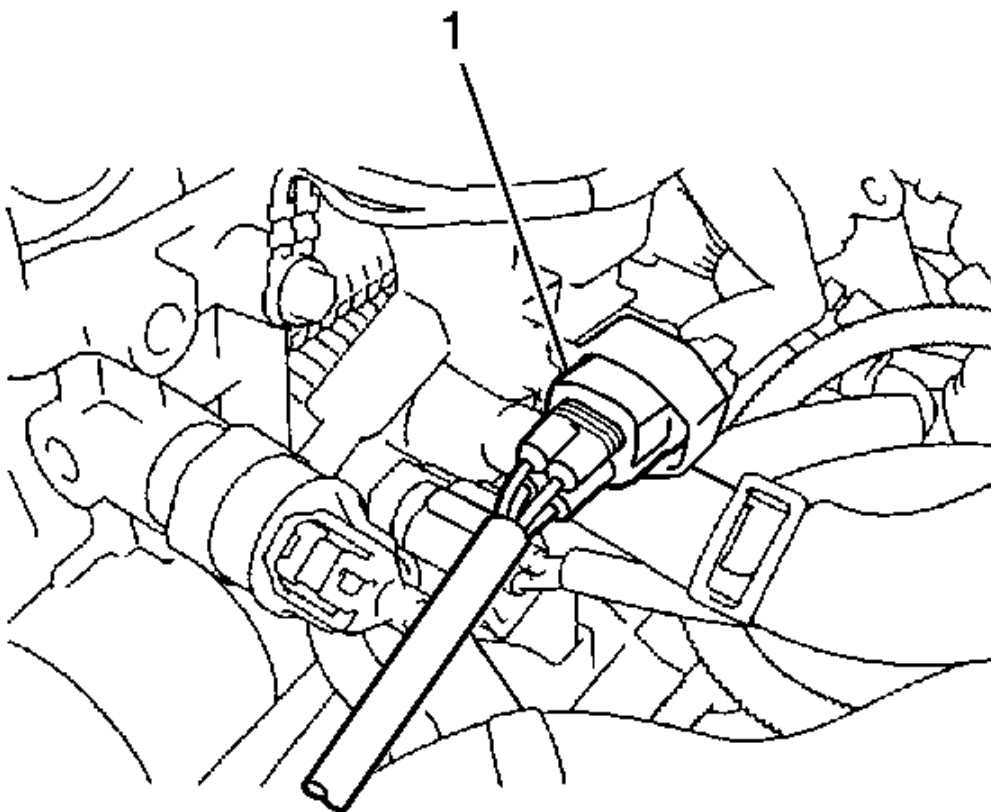


Fig. 93: Air-Fuel Ratio Sensor Connector
Courtesy of GENERAL MOTORS CORP.

30. Disconnect the air-fuel ratio sensor connector (1).

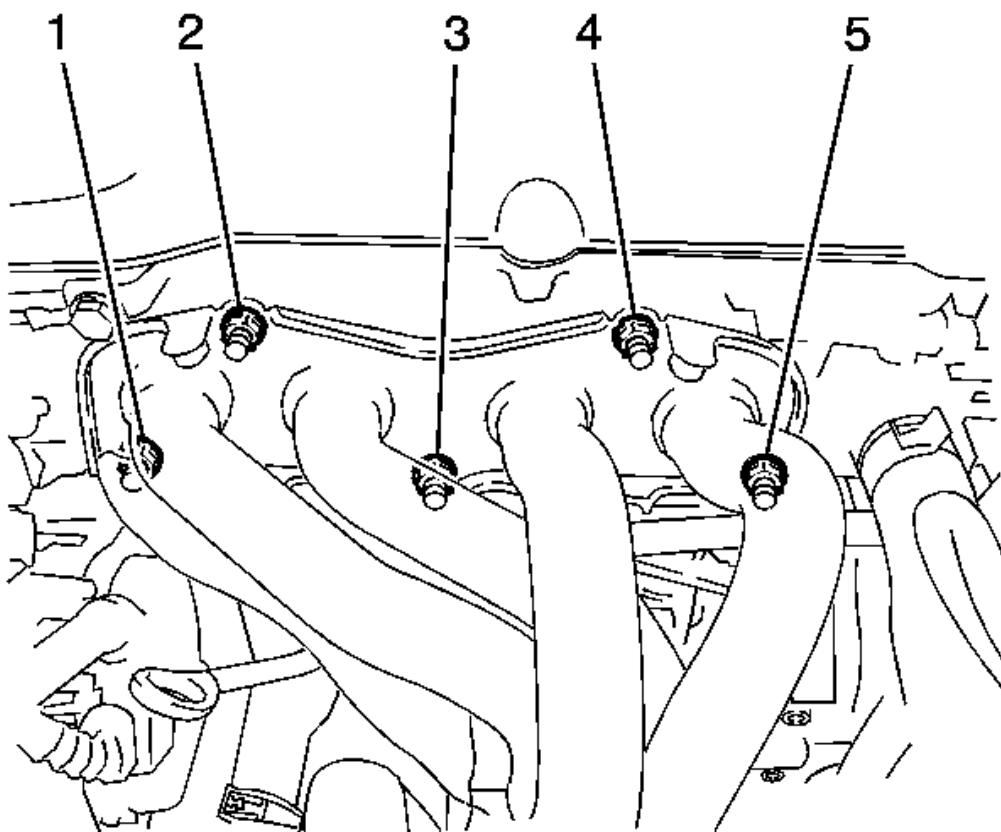


Fig. 94: Identifying Nuts & Exhaust Manifold Converter
Courtesy of GENERAL MOTORS CORP.

31. Remove the 5 nuts (1-5), exhaust manifold converter, and gasket.

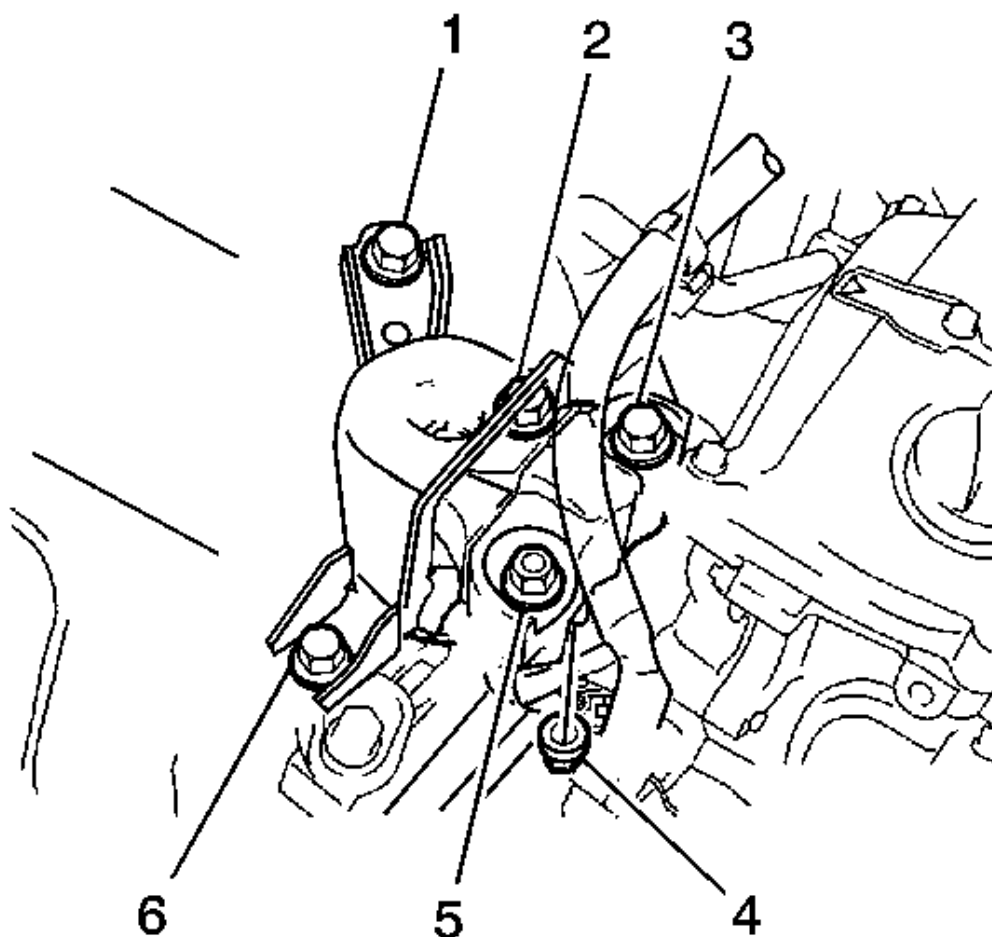


Fig. 95: Identifying Engine Mounts & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not apply excessive force to the return tube when removing the right engine mounting insulator sub-assembly.

NOTE: Keep clearance by lowering the engine using the engine support fixture when removing the front engine mounting insulator.

32. Install the engine support fixture. Refer to Engine Support Fixture .
33. Remove the 4 bolts (1, 2, 3, 6) and 2 nuts (4, 5), then remove the right engine mounting insulator.

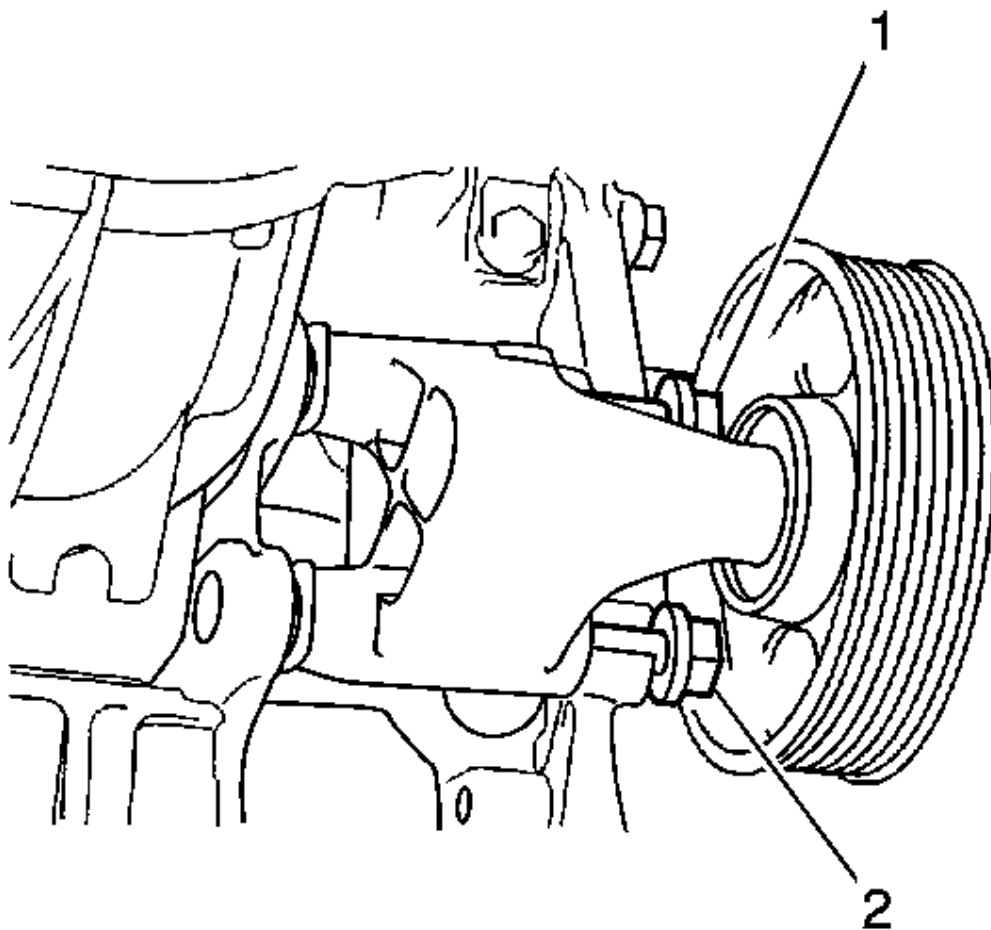


Fig. 96: Identifying Idler Pulley Sub-Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

34. Loosen the 2 bolts (1, 2) and remove the idler pulley.

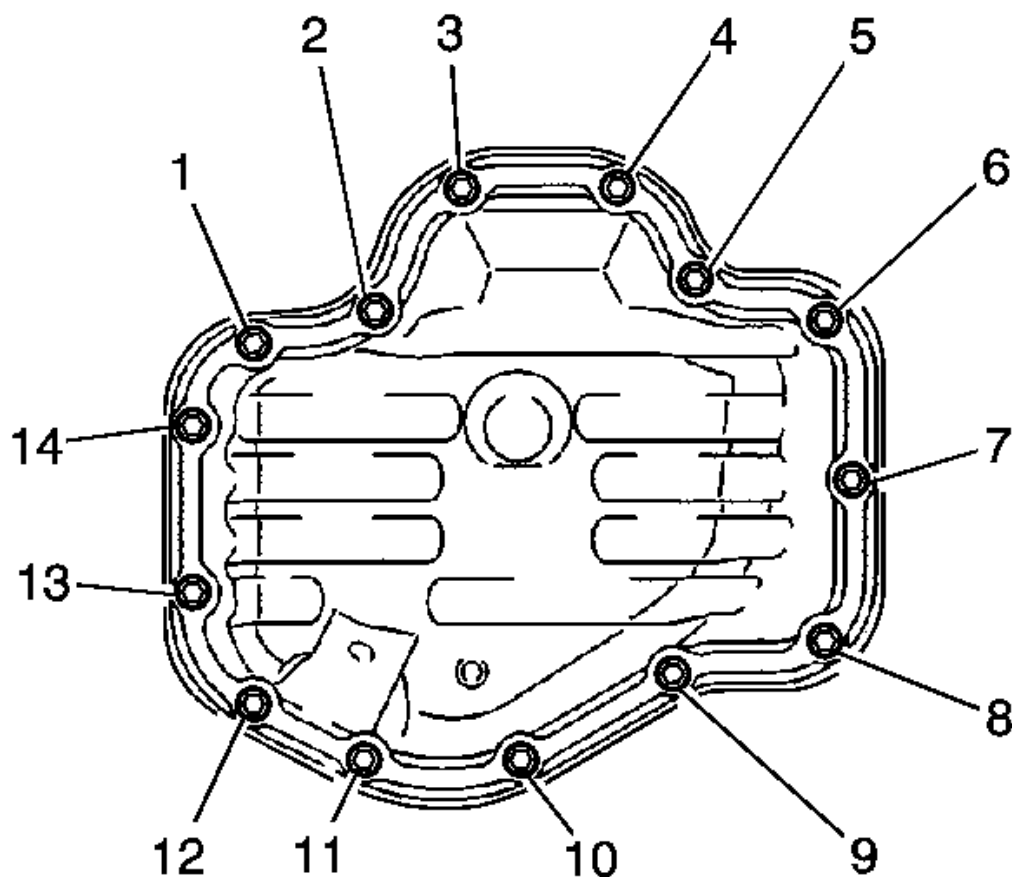


Fig. 97: Identifying Oil Pan Sub-Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

35. Remove the 12 bolts (2-11) and 2 nuts (1, 12).

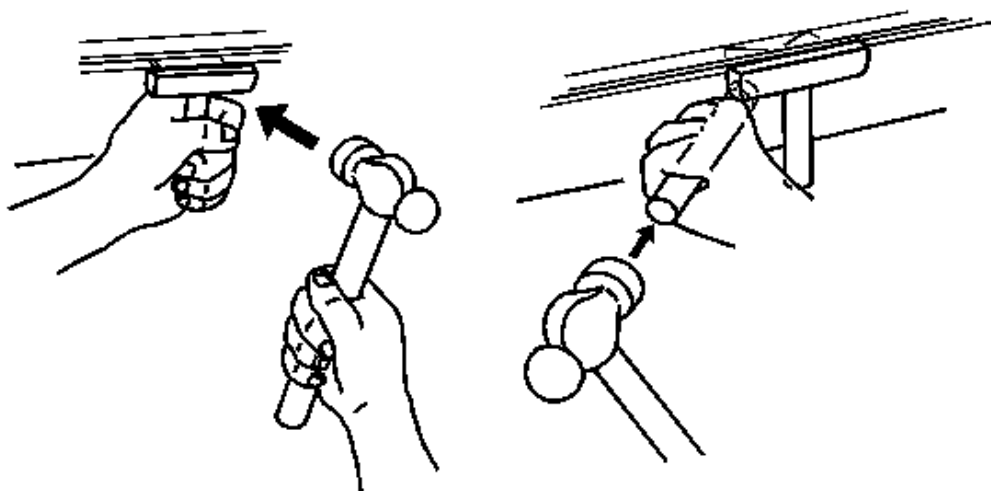


Fig. 98: Removing Oil Pan

Courtesy of GENERAL MOTORS CORP.

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

36. Insert the blade of oil pan seal cutter between the crankcase, chain cover and oil pan, then cut through the applied sealer and remove the oil pan.

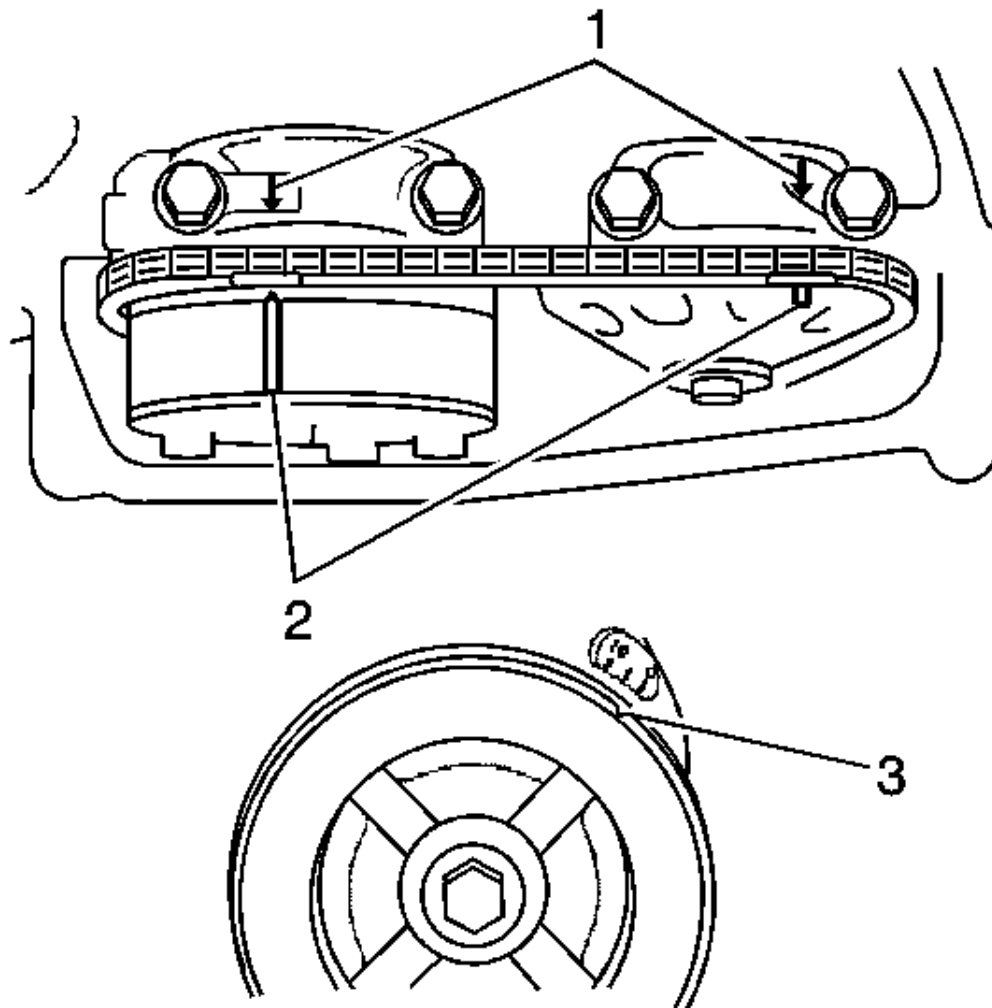


Fig. 99: Setting Engine To No. 1 Cylinder To TDC/Compression Stroke
Courtesy of GENERAL MOTORS CORP.

37. Set No. 1 cylinder to TDC/compression.
 - Turn the crankshaft pulley until the groove (3) and the timing mark 0 on the timing chain cover are aligned.
 - Check that each timing mark (2) on the camshaft timing gear and sprocket is aligned with the timing marks located on the camshaft bearing caps (1) as shown in the illustration. If not, turn the crankshaft by 1 revolution (360°) to align the timing marks as above.
38. Remove the crankshaft pulley.

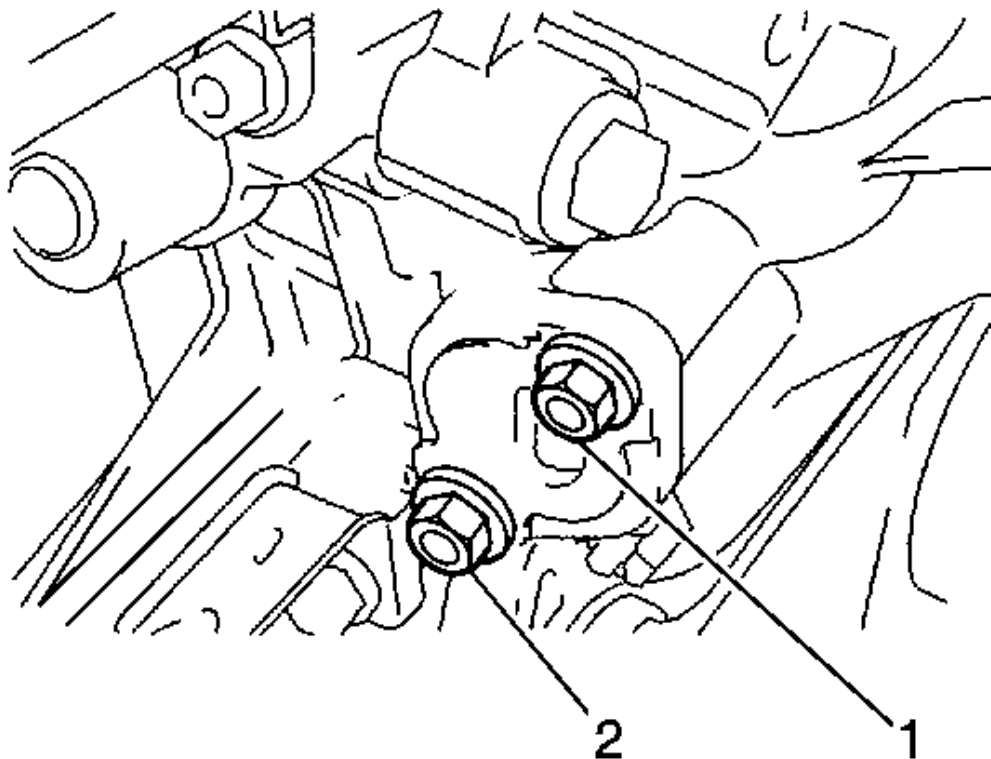


Fig. 100: Identifying Chain Tensioner Assembly Nuts
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not turn the crankshaft without the chain tensioner assembly installed.

39. Remove the 2 nuts (1, 2) and the chain tensioner assembly, and gasket.

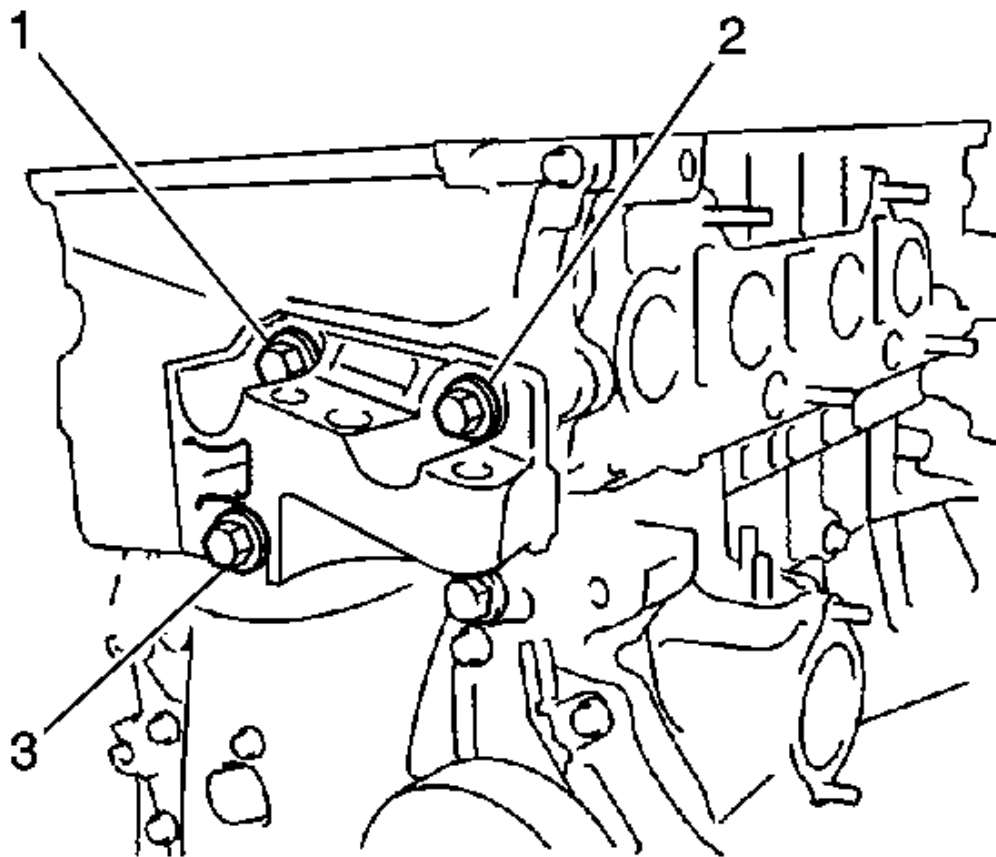


Fig. 101: Identifying Engine Mount Bolts
Courtesy of GENERAL MOTORS CORP.

40. Remove the 3 bolts (1, 2, 3) and transverse engine mounting bracket.

NOTE: **Do not lift the engine more than necessary.**

41. Lift the engine upward.

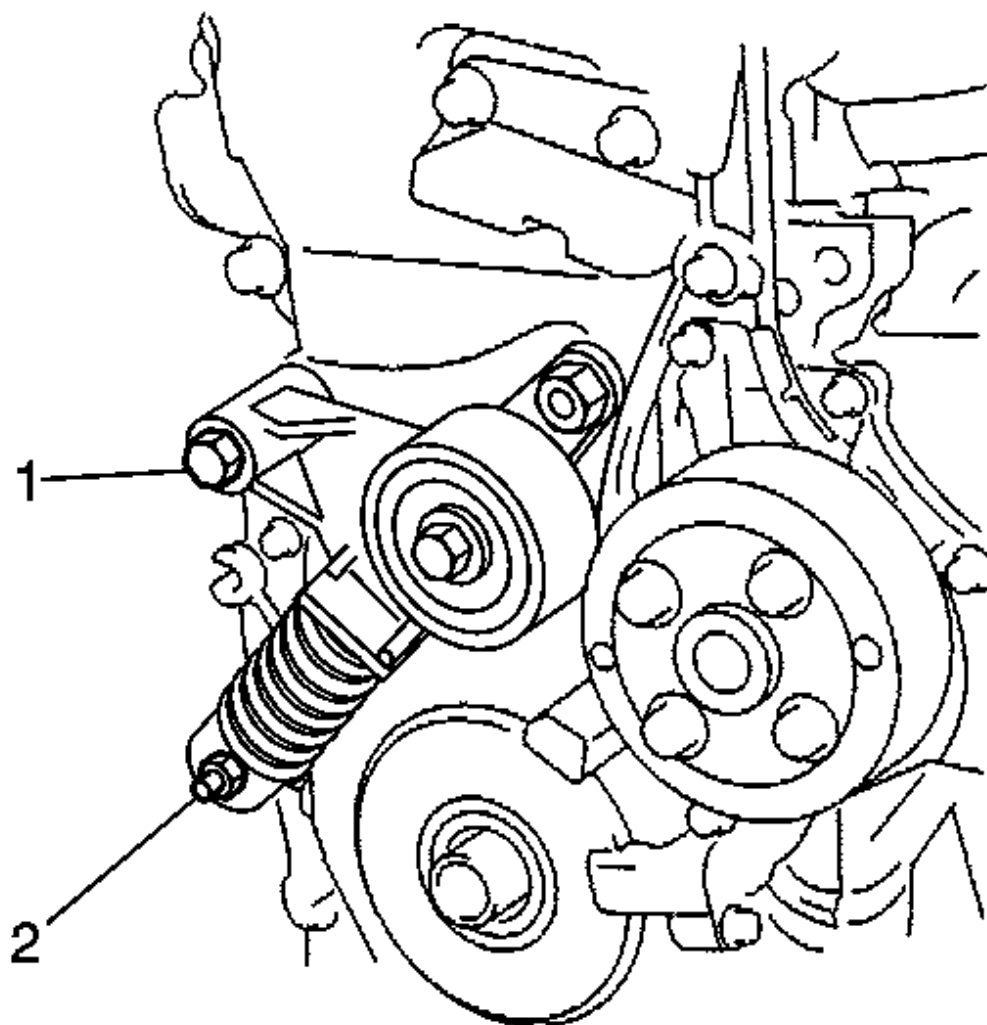


Fig. 102: Identifying V-Ribbed Belt Tensioner Assembly
Courtesy of GENERAL MOTORS CORP.

42. Remove the bolt (1), nut (2) and V-ribbed belt tensioner assembly.
43. Remove the crankshaft position sensor.
44. Remove the timing chain cover assembly. Refer to **Timing Chain Housing Removal**.

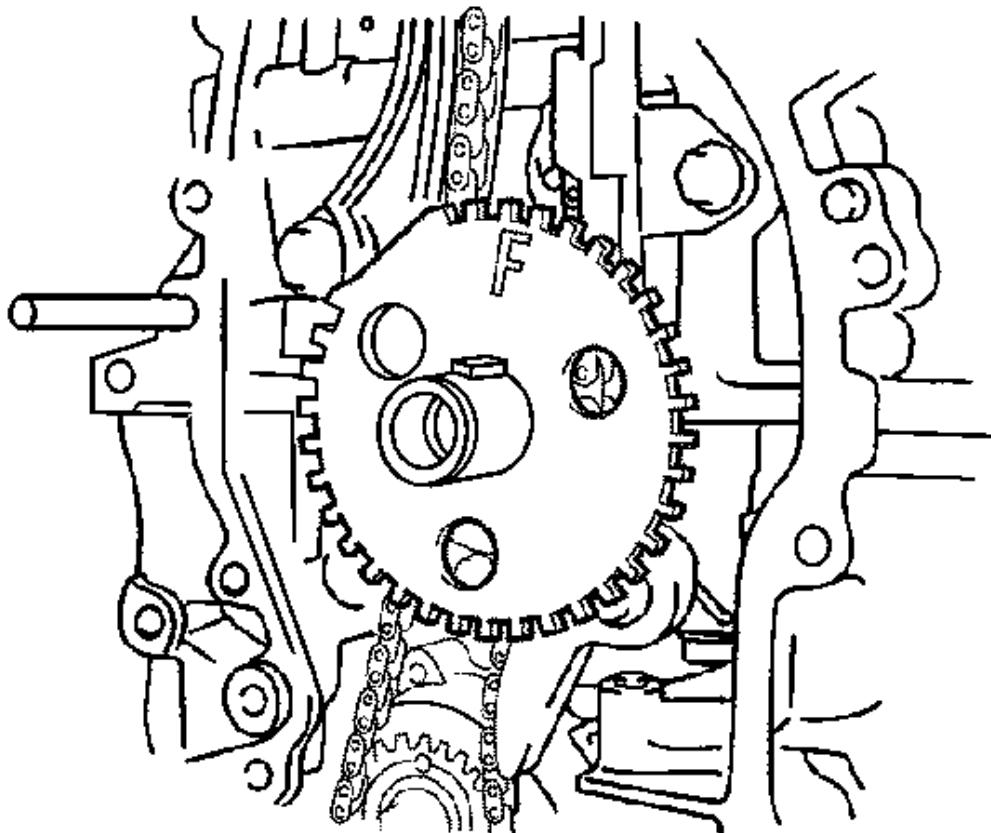


Fig. 103: Identifying Crankshaft Position Sensor Plate
Courtesy of GENERAL MOTORS CORP.

45. Remove the crankshaft position sensor plate.

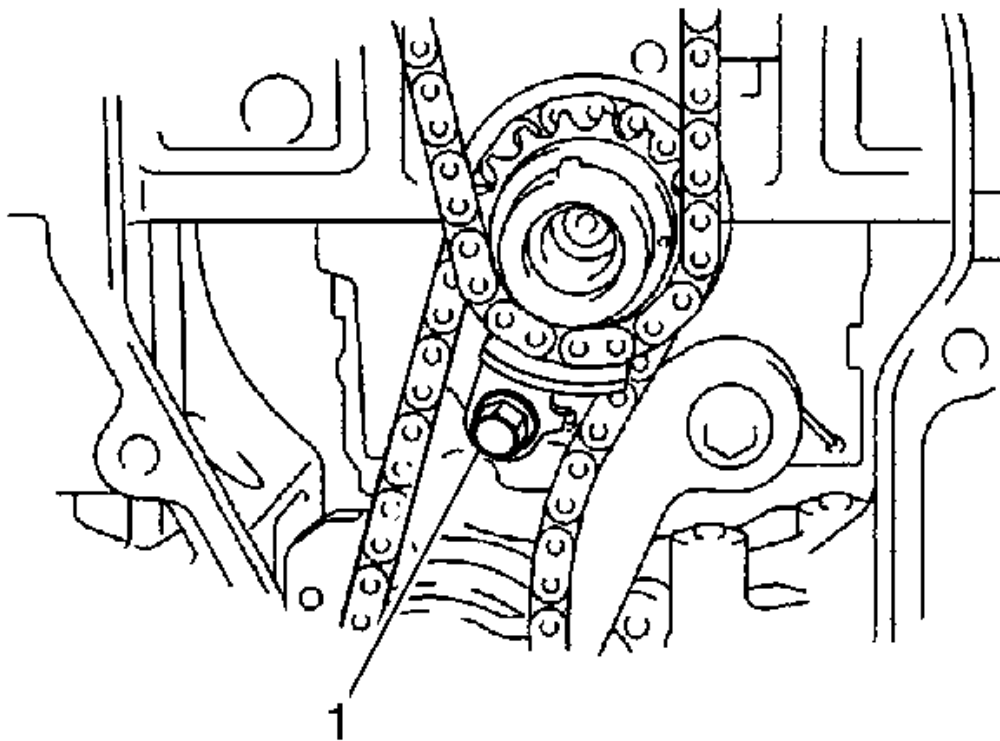


Fig. 104: Identifying Timing Chain Guide & Bolt
Courtesy of GENERAL MOTORS CORP.

46. Remove the bolt (1) and timing chain guide.

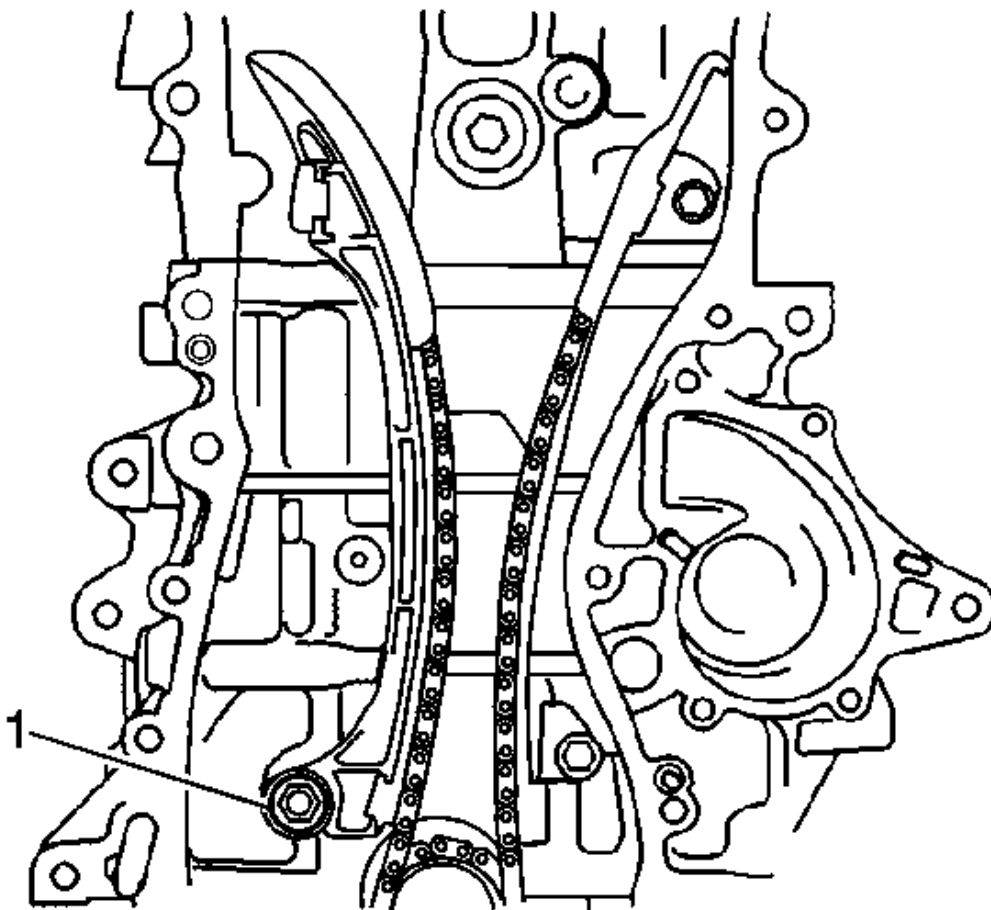


Fig. 105: View Of Chain Tensioner Slipper & Bolt
Courtesy of GENERAL MOTORS CORP.

47. Remove the bolt (1) and chain tensioner slipper.

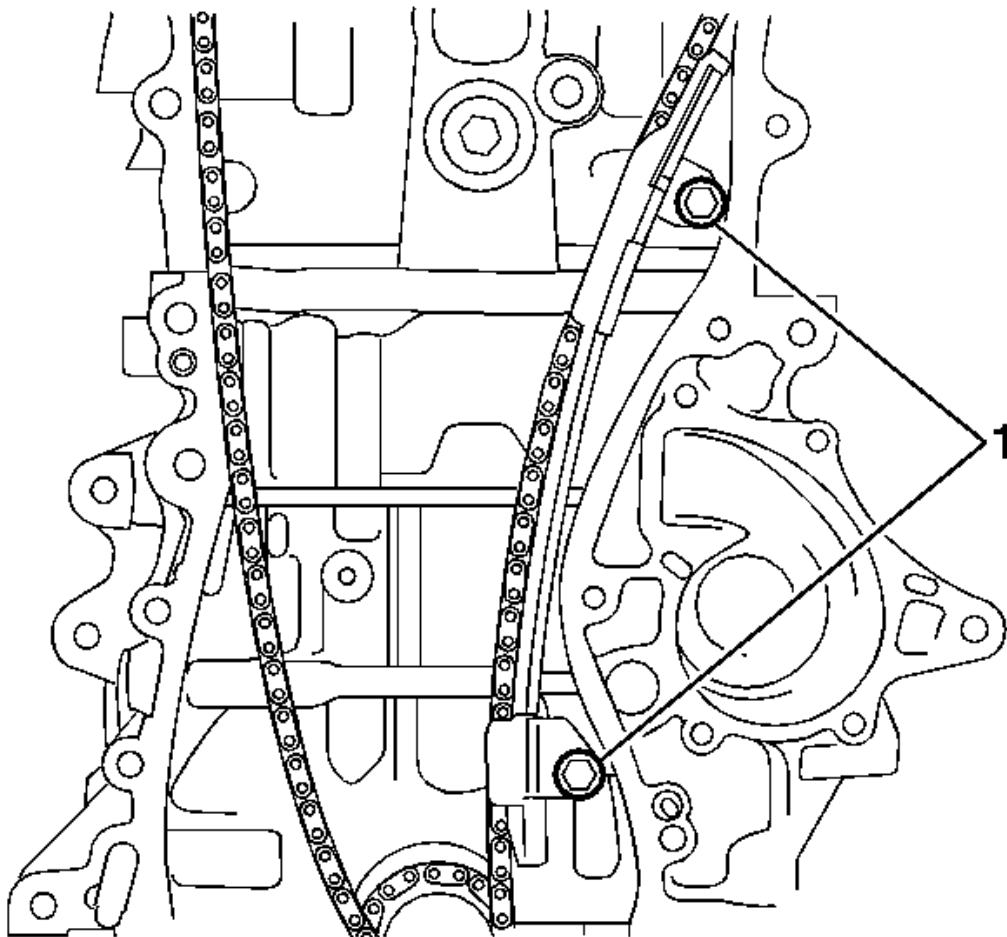


Fig. 106: View Of Chain Vibration Damper
Courtesy of GENERAL MOTORS CORP.

48. Remove the 2 bolts (1) and the chain vibration damper.
49. Remove the chain sub-assembly.

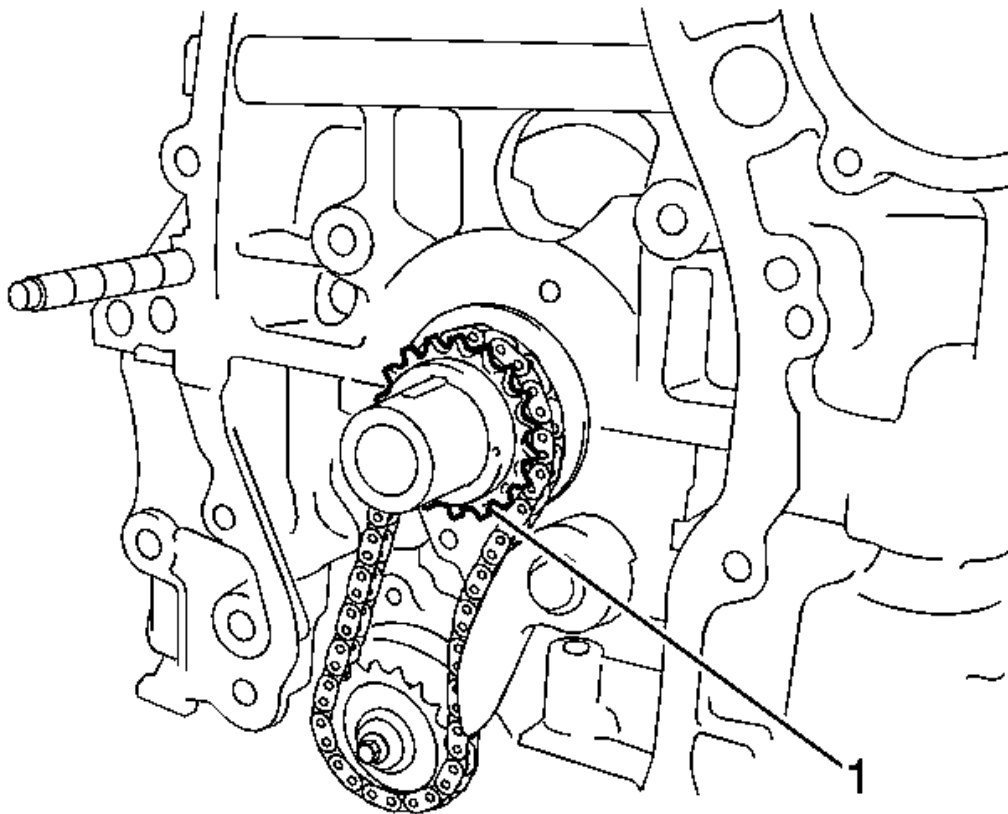


Fig. 107: View Of Crankshaft Timing Gear/Sprocket
Courtesy of GENERAL MOTORS CORP.

50. Remove the crankshaft timing gear (1) from the crankshaft.

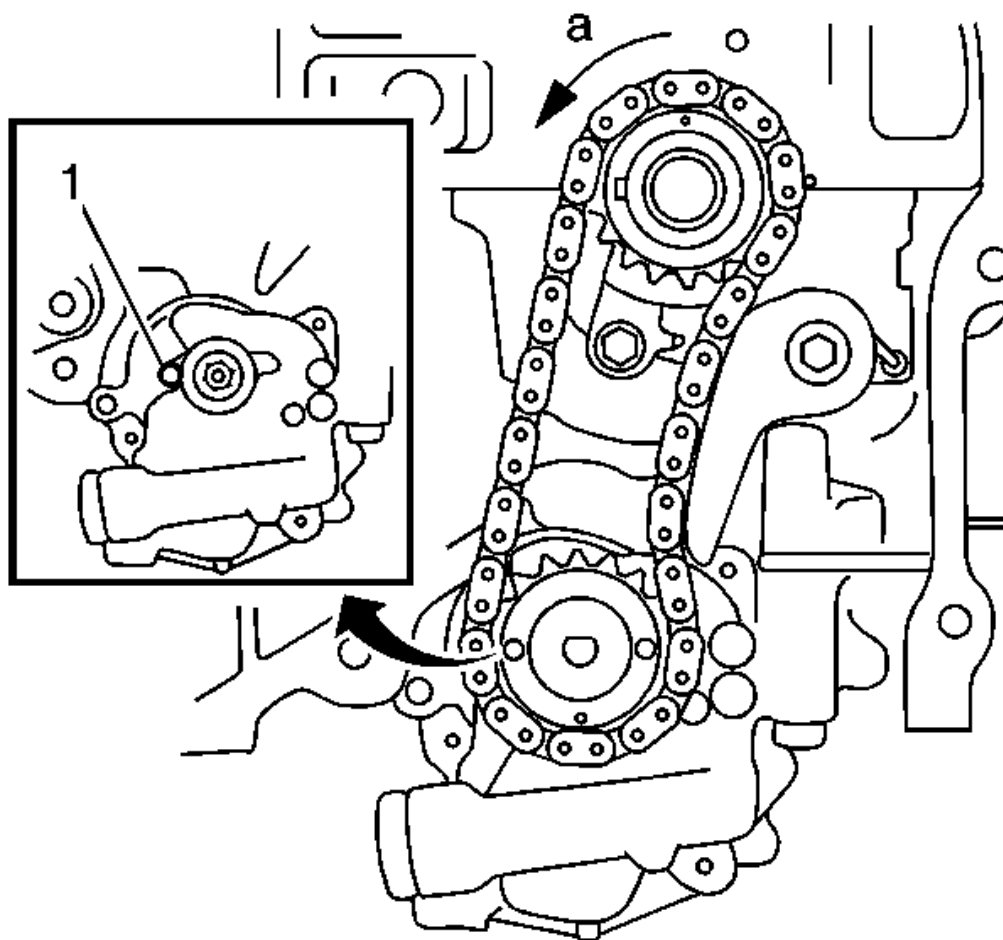


Fig. 108: Aligning Adjusting Hole
Courtesy of GENERAL MOTORS CORP.

51. Turn the crankshaft 90 degrees counterclockwise to align the adjusting hole (1) on the oil pump drive shaft sprocket with the groove on the oil pump.

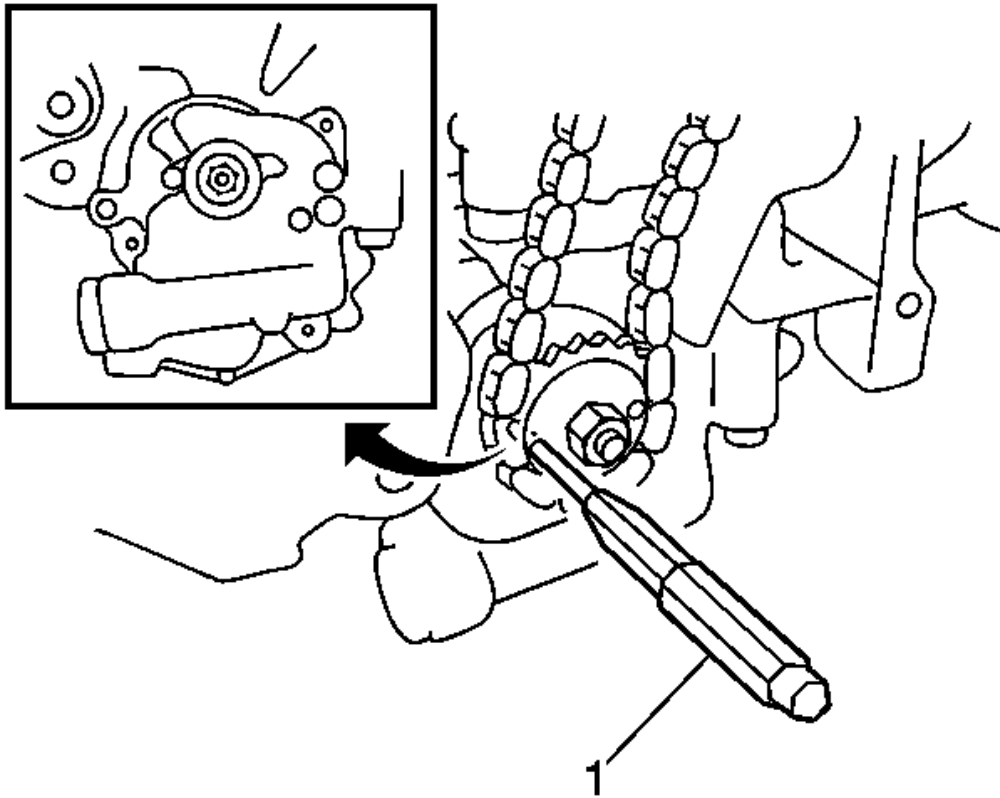


Fig. 109: Locking Gear In Position

Courtesy of GENERAL MOTORS CORP.

52. Insert a 4 mm diameter bar (1) into the adjusting hole of the oil pump drive shaft sprocket to lock the gear in position, and then remove the nut.

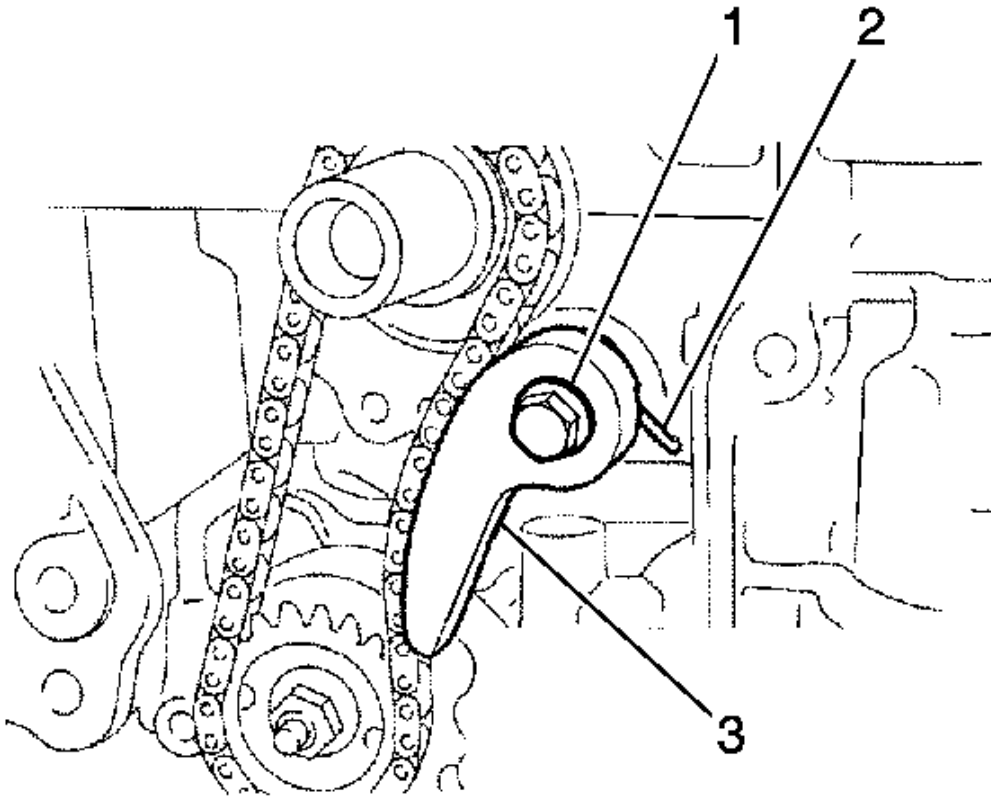


Fig. 110: View Of Chain Tensioner Plate, Spring & Bolt
 Courtesy of GENERAL MOTORS CORP.

53. Remove the bolt (1), chain tensioner plate (3) and spring (2).
54. Remove the oil pump drive sprocket, oil pump drive shaft sprocket and oil pump drive chain.
55. Disconnect the No. 1 radiator hose.
56. Disconnect the outlet heater water hose.
57. Disconnect the inlet heater water hose.
58. Disconnect the engine wiring as follows:
 1. Disconnect the radio setting condenser connector.
 2. Disconnect the engine oil pressure switch connector.
 3. Disconnect the engine coolant temperature sensor connector.
 4. Disconnect the camshaft position sensor connector.
 5. Remove the bolt and ground cable.
59. Remove the intake camshaft. Refer to **Intake Camshaft and Valve Lifter Replacement**.

60. Remove the exhaust camshaft. Refer to **Exhaust Camshaft and Valve Lifter Replacement**.

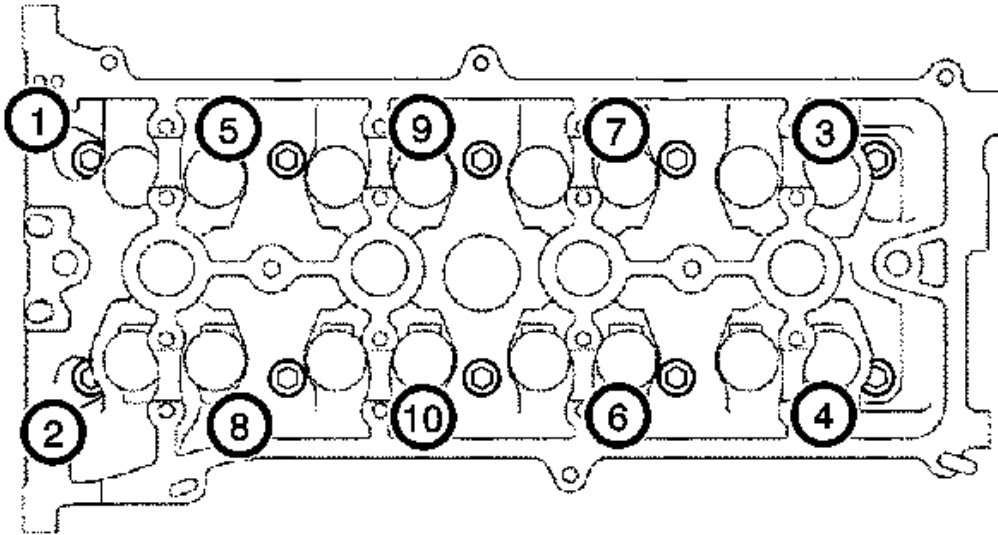


Fig. 111: Identifying Cylinder Head Bolt Loosening Sequence
Courtesy of GENERAL MOTORS CORP.

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

61. In 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 in the illustration.

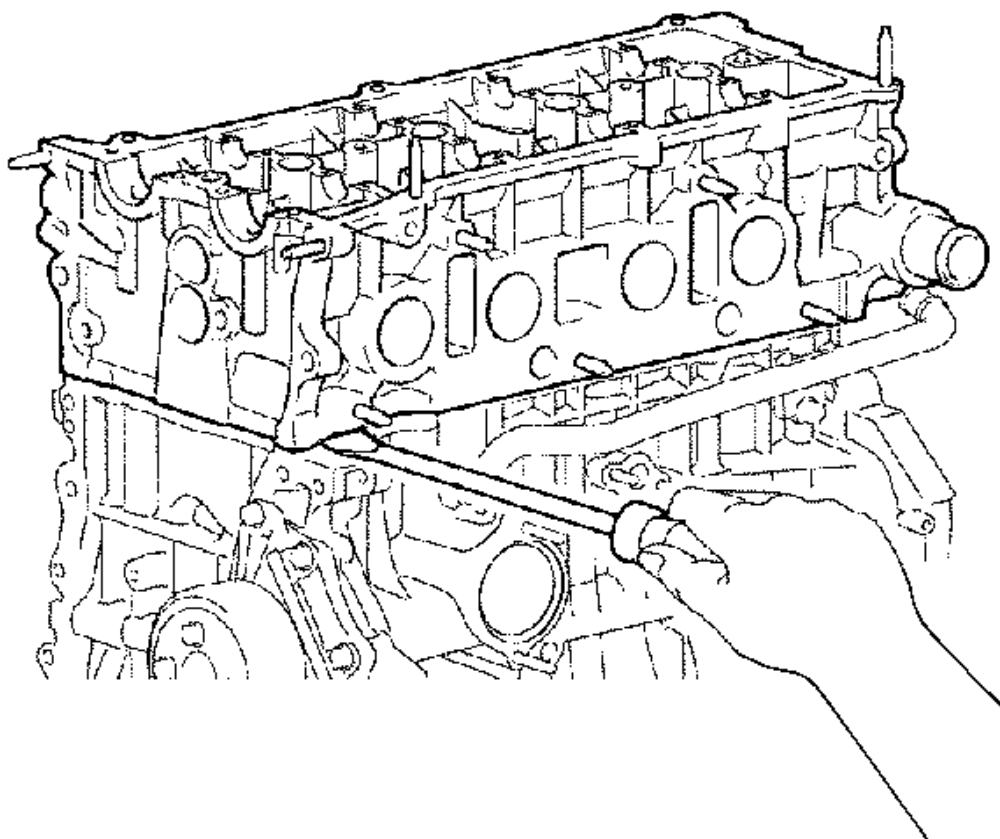


Fig. 112: Removing Cylinder Head
Courtesy of GENERAL MOTORS CORP.

NOTE: Be careful not to damage the contact surfaces between the cylinder head and cylinder block.

62. Using a screwdriver with its tip wrapped with tape, pry between the cylinder head and cylinder block, and remove the cylinder head.

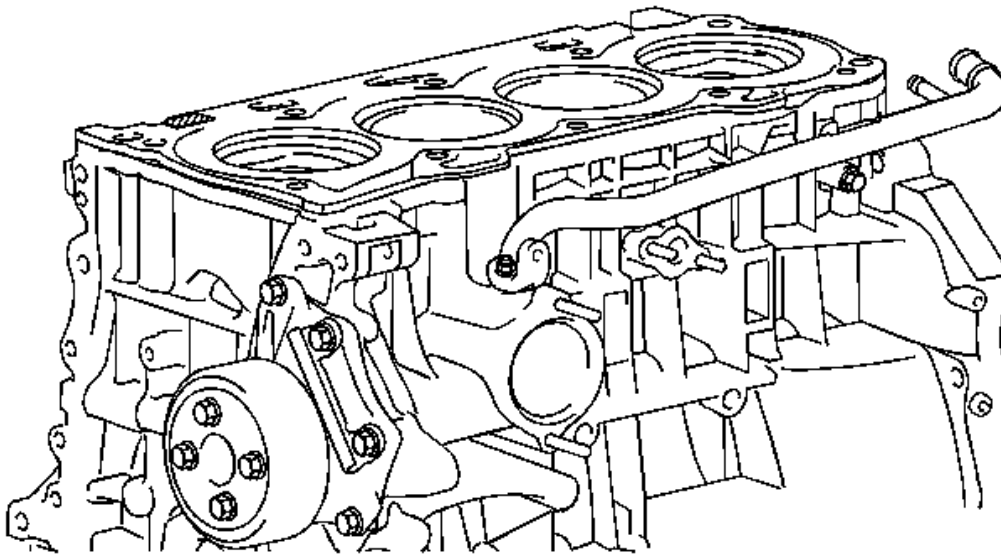


Fig. 113: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

63. Remove cylinder head gasket.

INSTALLATION PROCEDURE

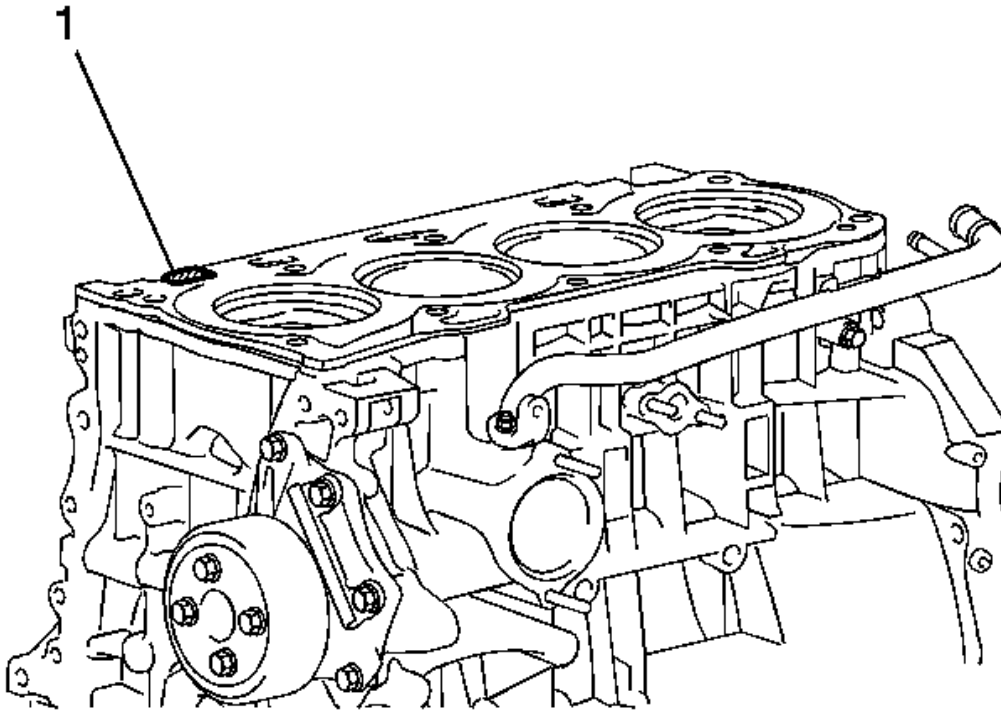


Fig. 114: View Of Cylinder Head Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE: Remove any oil from the contact surface. Be careful of the installation direction.

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

NOTE: Place the cylinder head gently in order to avoid damaging the cylinder head gasket.

3. Place the cylinder head on the cylinder head gasket.

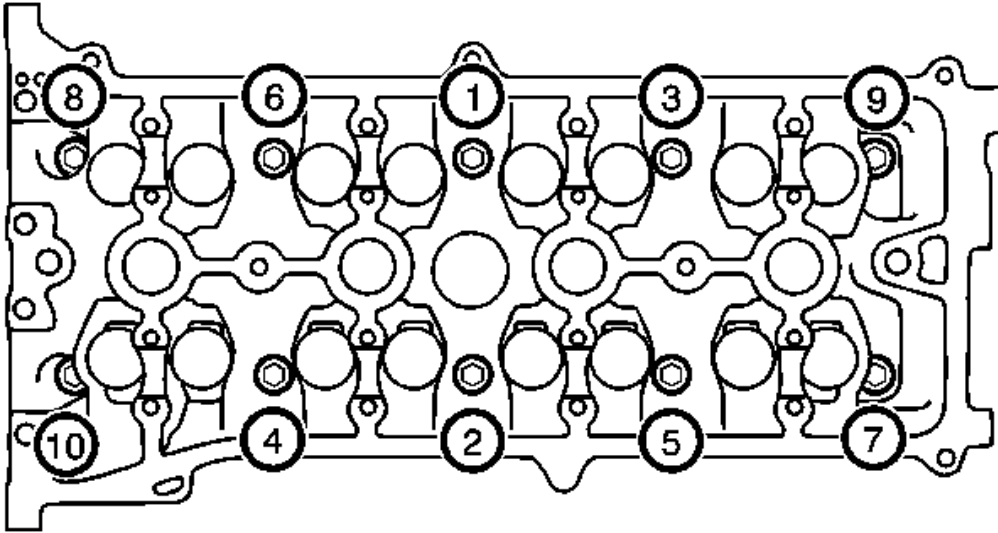


Fig. 115: Identifying Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

NOTE: The cylinder head bolts are tightened in 2 successive steps. Apply a light coat of engine oil to the threads and under the heads of the cylinder head set bolts. Using several steps, uniformly install and tighten the 10 cylinder head set bolts and plate washers with a 10 mm bi-hexagon wrench in the order shown in the illustration.

CAUTION: Refer to Fastener Caution .

4. Install the cylinder head bolts and tighten to 70 N.m (52 lb ft).

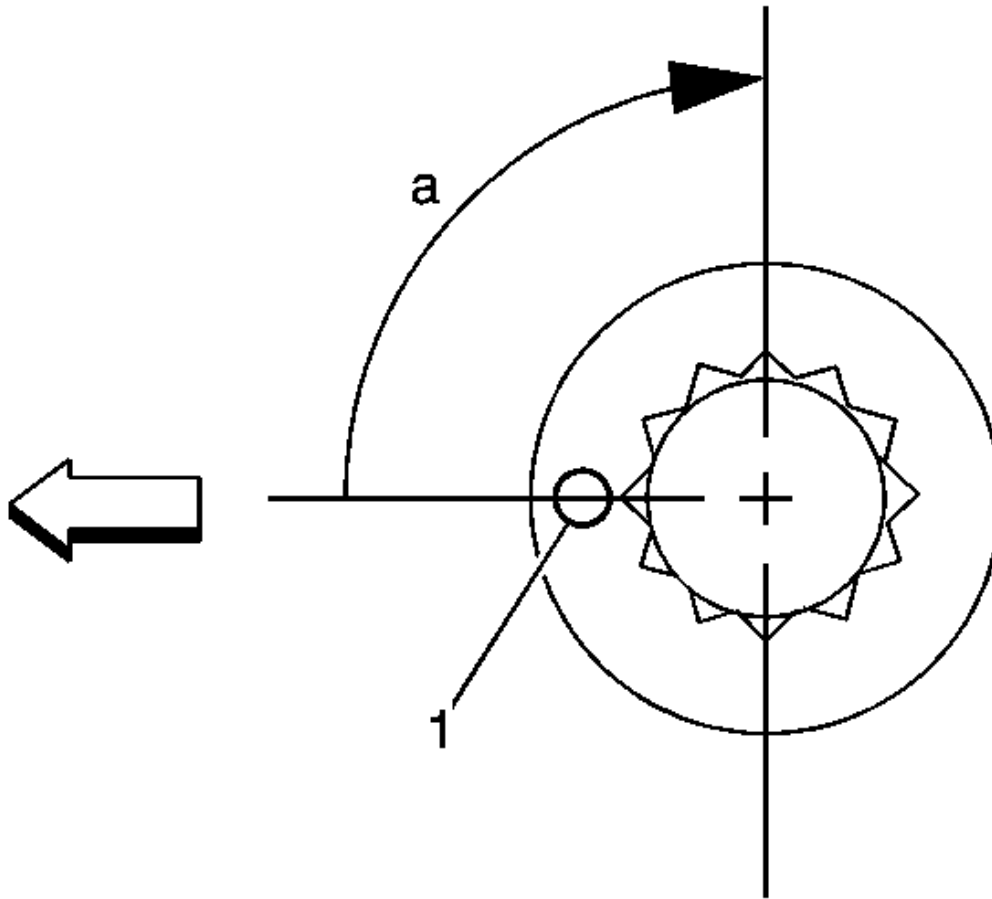


Fig. 116: Identifying Head Bolt Positioning
Courtesy of GENERAL MOTORS CORP.

5. Mark the front of the cylinder head bolts with paint (1).
6. Further tighten the cylinder head bolts by 90 degrees as shown in the illustration.
7. Check that the paint mark is now at a 90 degrees angle (a) to the front.
8. Install the intake camshaft. Refer to **Intake Camshaft and Valve Lifter Replacement**.
9. Install the exhaust camshaft. Refer to **Exhaust Camshaft and Valve Lifter Replacement**.
10. Connect the inlet heater water hose.
11. Connect the outlet heater water hose.
12. Connect the radiator hose.

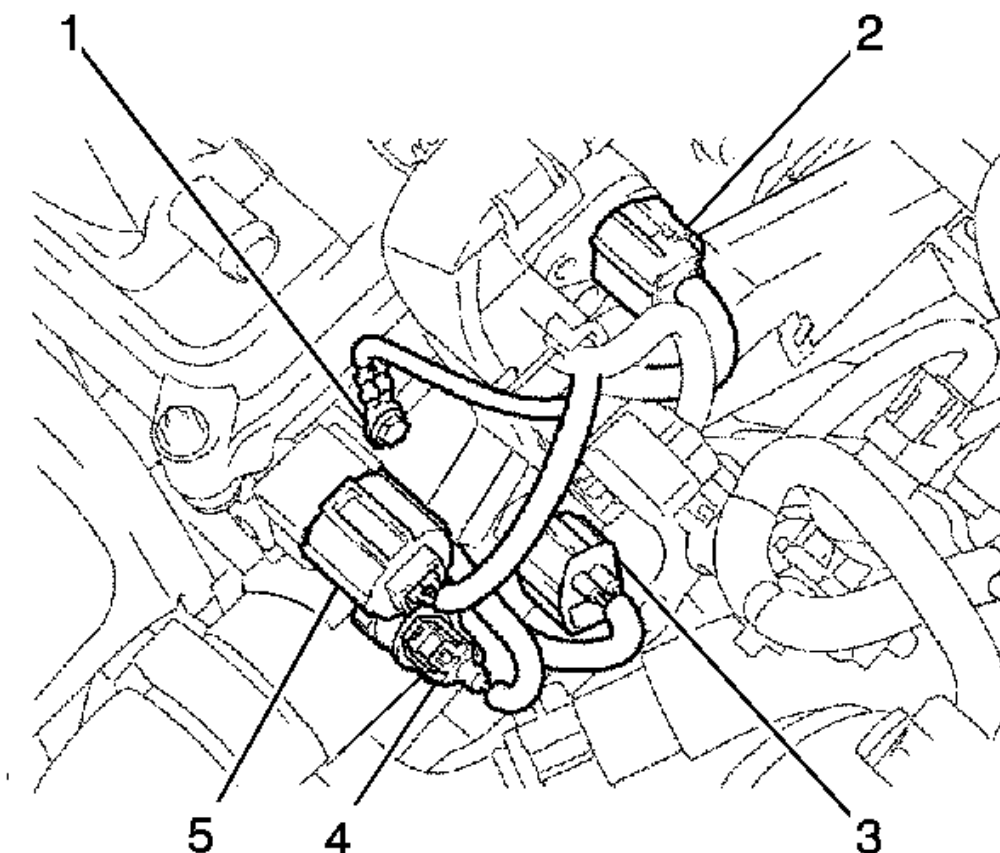


Fig. 117: Identifying Engine Wire Harness Connectors
Courtesy of GENERAL MOTORS CORP.

13. Connect engine wire.

- Connect the ground cable with the bolt (1) and tighten to 8.4 N.m (74 lb in).
- Connect the camshaft position sensor connector.
- Connect the engine coolant temperature sensor connector.
- Connect the engine oil pressure switch connector.
- Connect the radio setting condenser connector.
- Connect the heater water inlet hose.

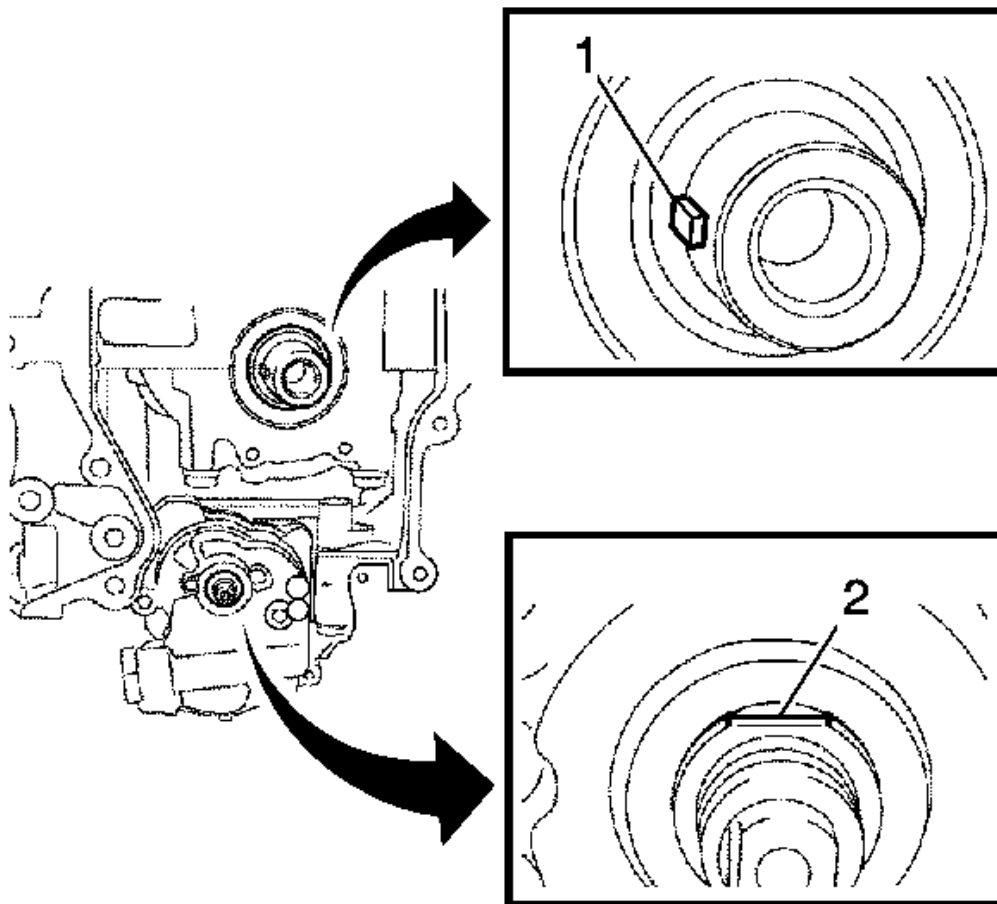
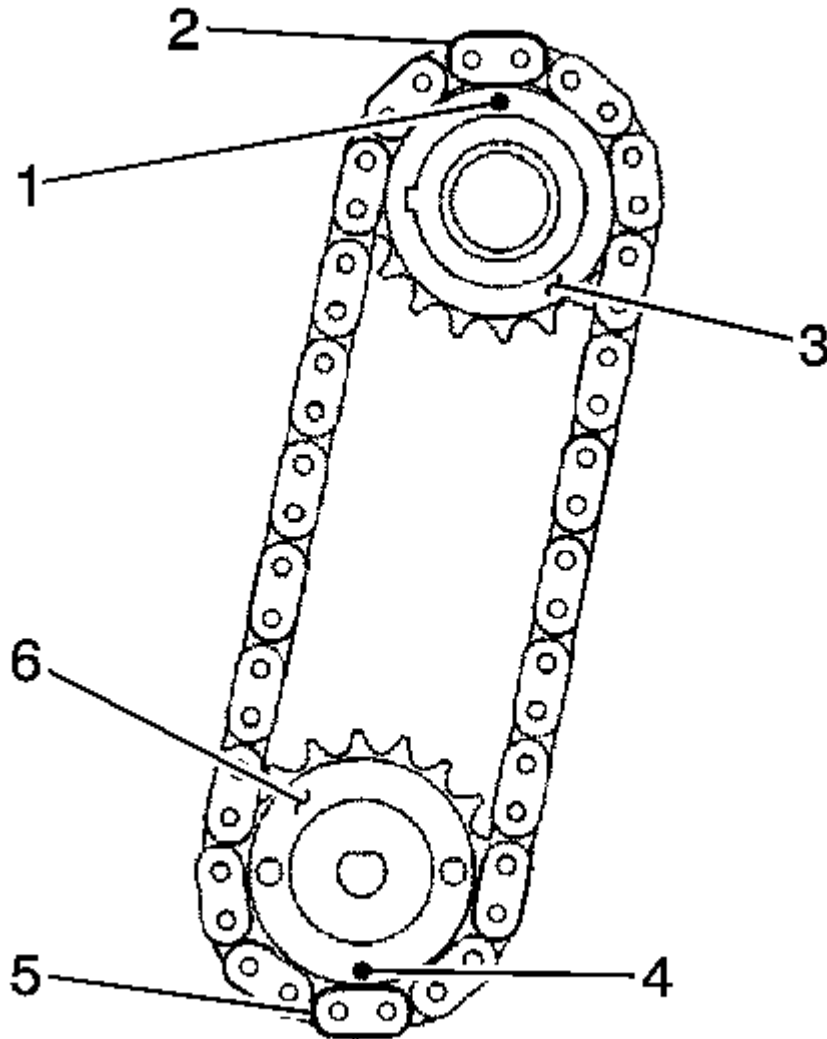


Fig. 118: Identifying Proper Crankshaft Key Position
Courtesy of GENERAL MOTORS CORP.

14. Set the crankshaft key (1) in the left horizontal position.
15. Turn the cutout of the oil pump drive shaft (2) so that it faces upward.



Courtesy of GENERAL MOTORS CORP.

16. Align the yellow mark links (2, 5) with the timing marks of each gear (1, 4) as shown in the illustration.
17. Install the sprockets onto the crankshaft and oil pump shaft with the chain wrapped on the gears.
18. Temporarily tighten the oil pump drive shaft sprocket with the nut.

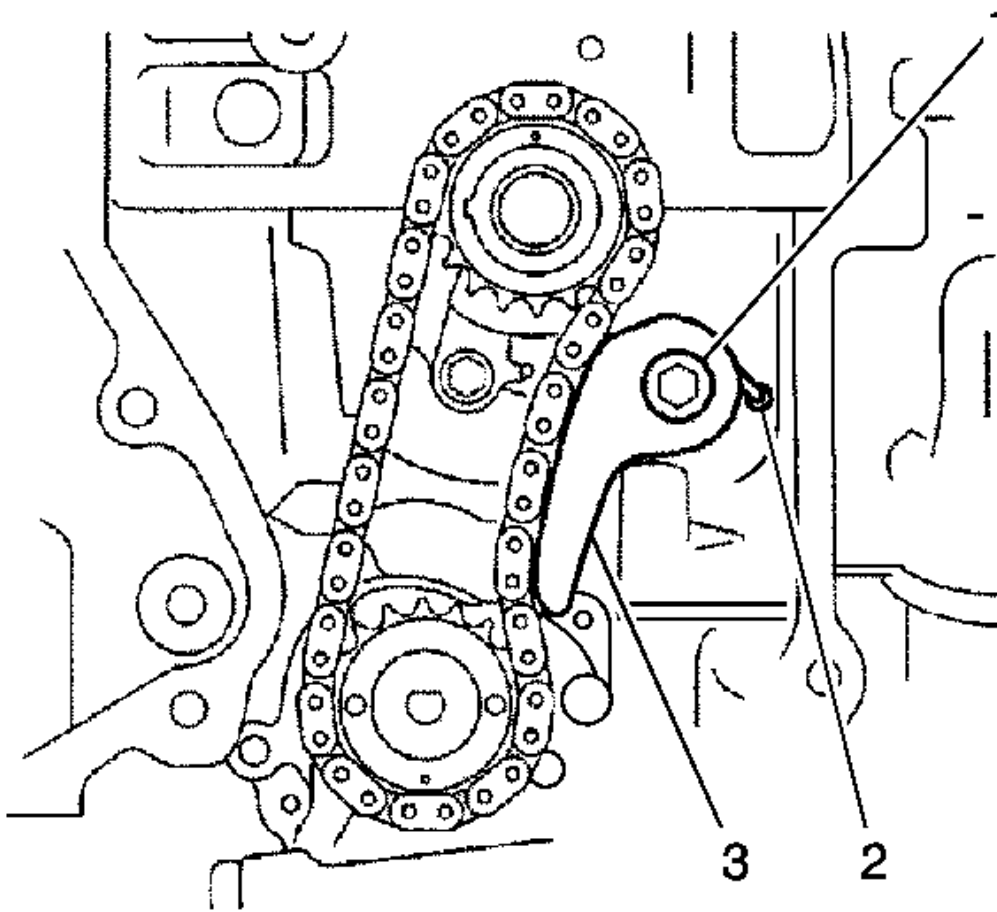


Fig. 120: Identifying Chain Tensioner Plate & Bolt
Courtesy of GENERAL MOTORS CORP.

19. Insert the damper spring (2) into the adjusting hole, and then install the chain tensioner plate (3) with the bolt (1) and tighten to 12 N.m (9 lb ft).

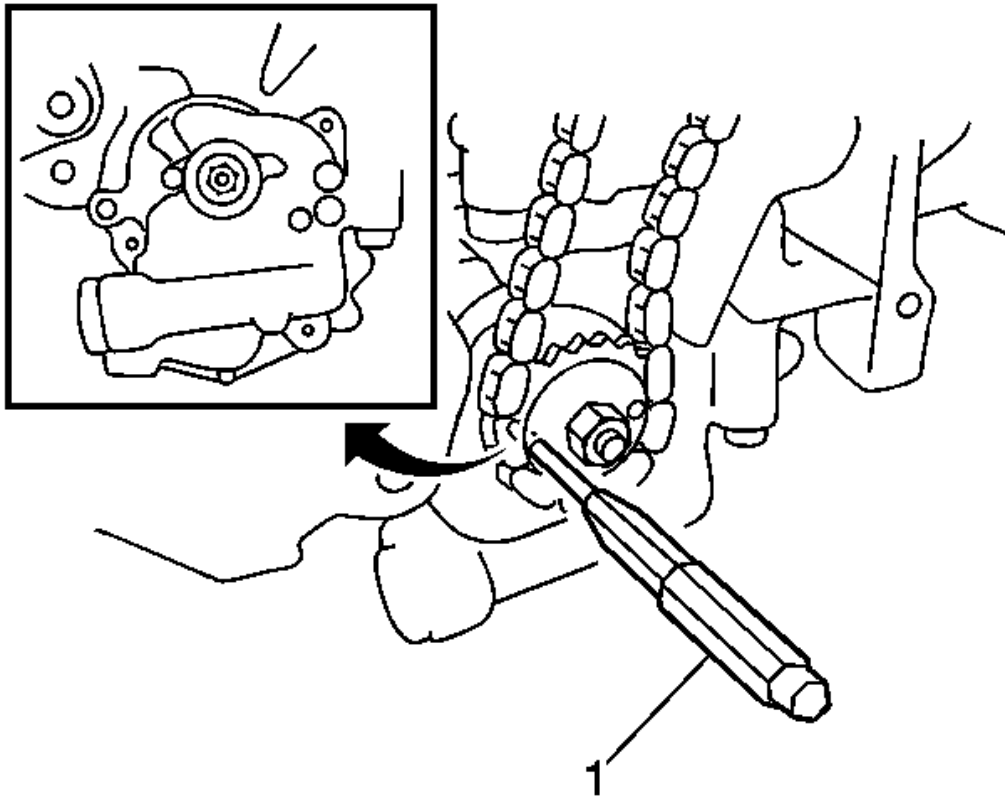


Fig. 121: Locking Gear In Position
Courtesy of GENERAL MOTORS CORP.

20. Align the adjusting hole on the oil pump drive shaft sprocket with the groove on the oil pump.
21. Insert a 4 mm diameter bar (1) into the adjusting hole on the oil pump drive shaft gear to lock the gear in position, and then tighten the nut to 30 N.m (22 lb ft).

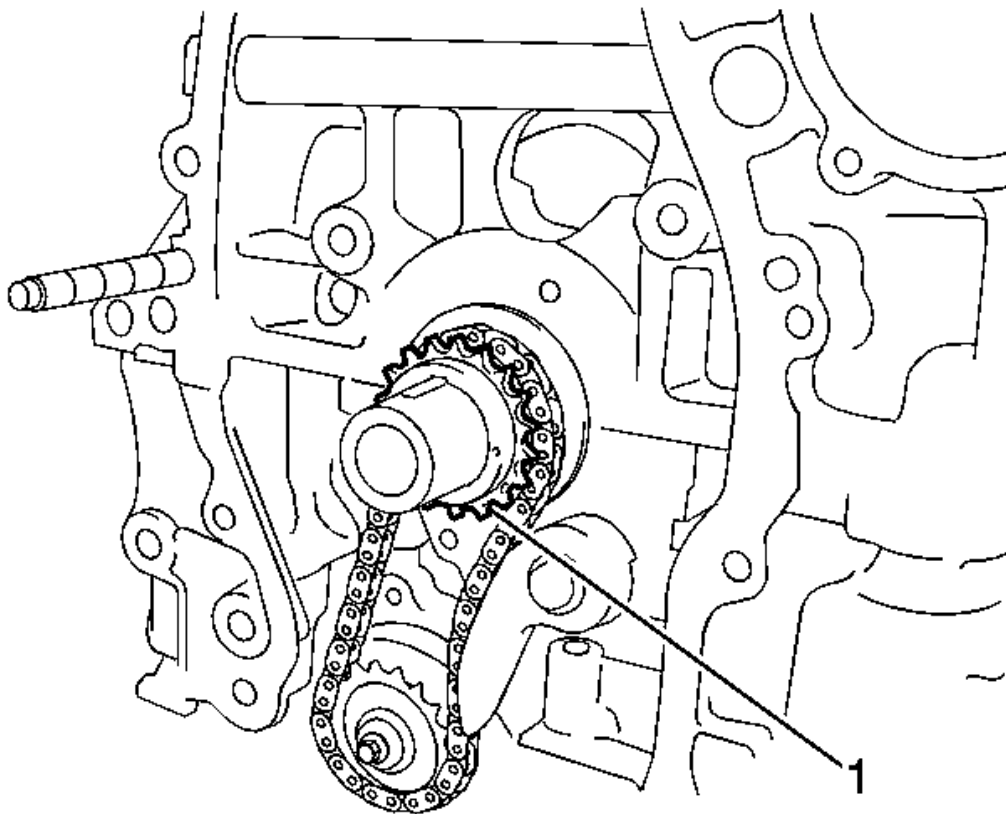


Fig. 122: View Of Crankshaft Timing Gear/Sprocket
Courtesy of GENERAL MOTORS CORP.

22. Install the crankshaft timing gear (1) to the crankshaft.

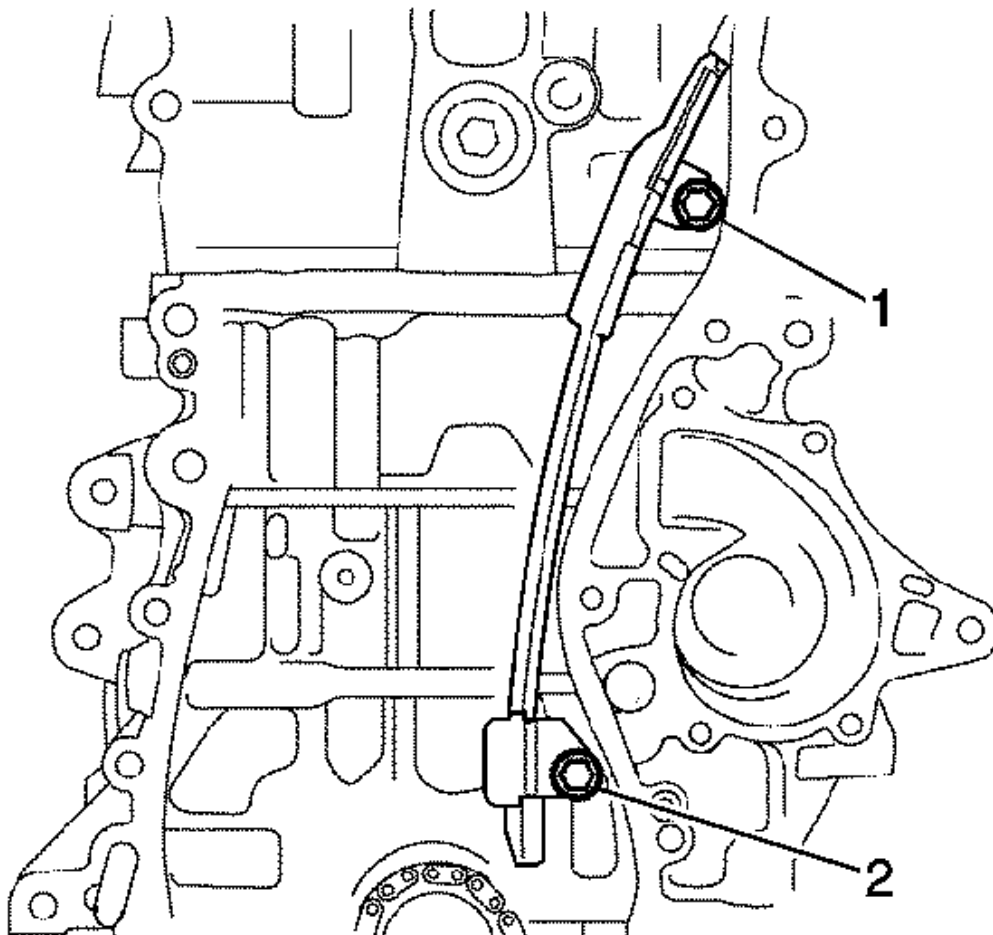


Fig. 123: Identifying Chain Vibration Damper
Courtesy of GENERAL MOTORS CORP.

23. Install the chain vibration damper with the 2 bolts (1, 2) and tighten to 9.0 N.m (80 lb in).

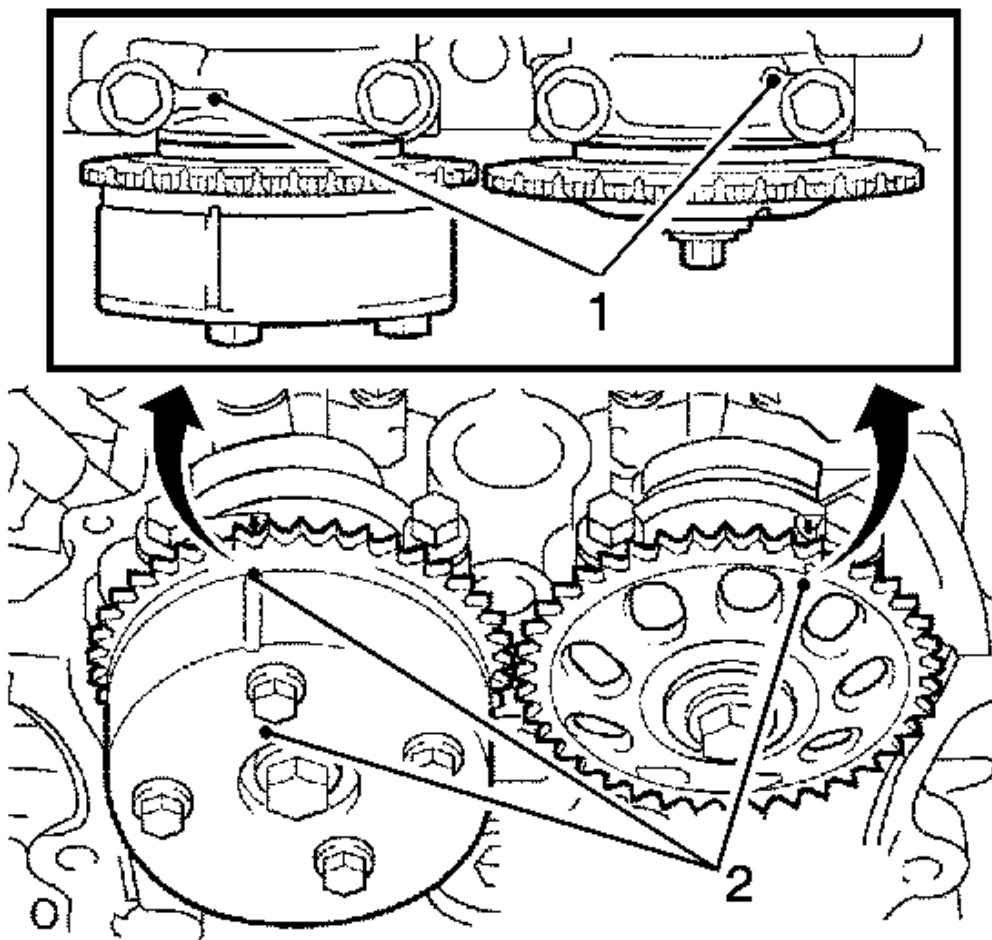


Fig. 124: View Of Setting No. 1 Cylinder To TDC Compression Stroke
Courtesy of GENERAL MOTORS CORP.

24. Set the No. 1 cylinder to TDC/compression.
25. Turn the camshafts with a wrench (using the hexagonal lobe) to align the timing marks on the camshaft timing gear (2) with the timing marks located on the bearing caps (1) as shown in the illustration.

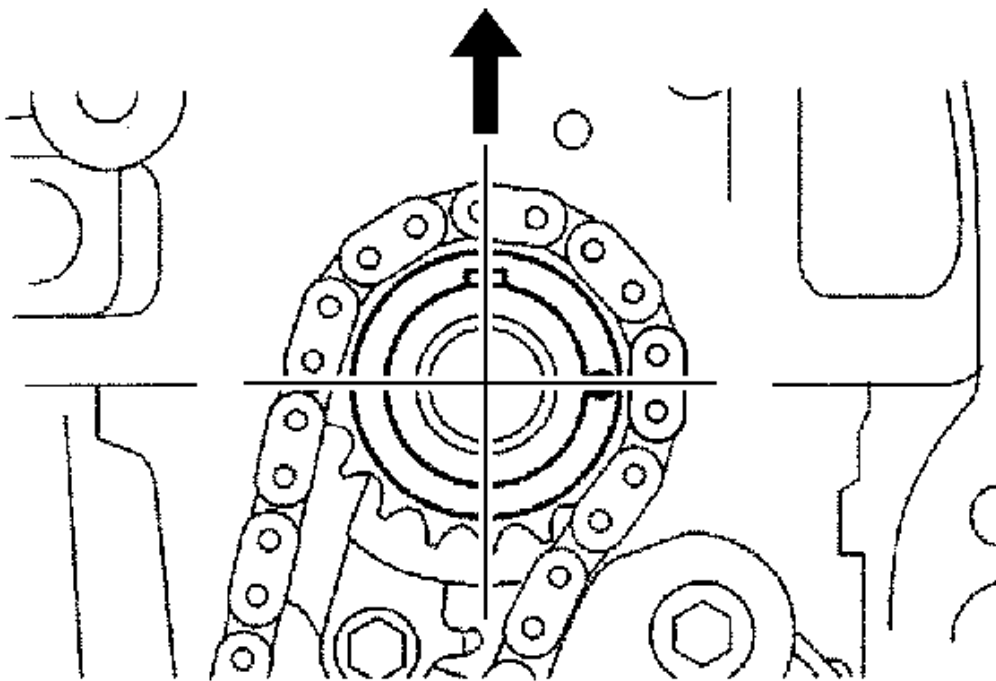


Fig. 125: Setting Crankshaft Upward
Courtesy of GENERAL MOTORS CORP.

26. Using the crankshaft pulley bolt, turn the crankshaft to position the key on the crankshaft upward.

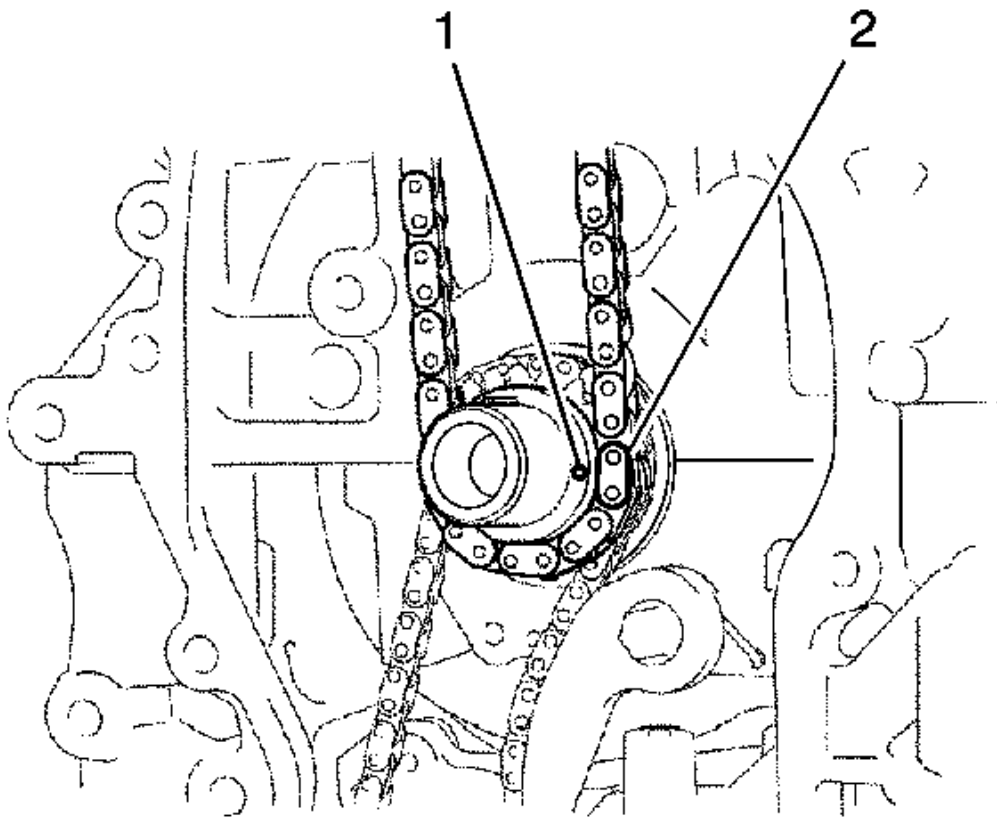


Fig. 126: View Of Crankshaft Timing Sprocket
Courtesy of GENERAL MOTORS CORP.

27. Install the chain onto the crankshaft timing sprocket with the gold or orange mark link (2) aligned with the timing mark (1) on the crankshaft.

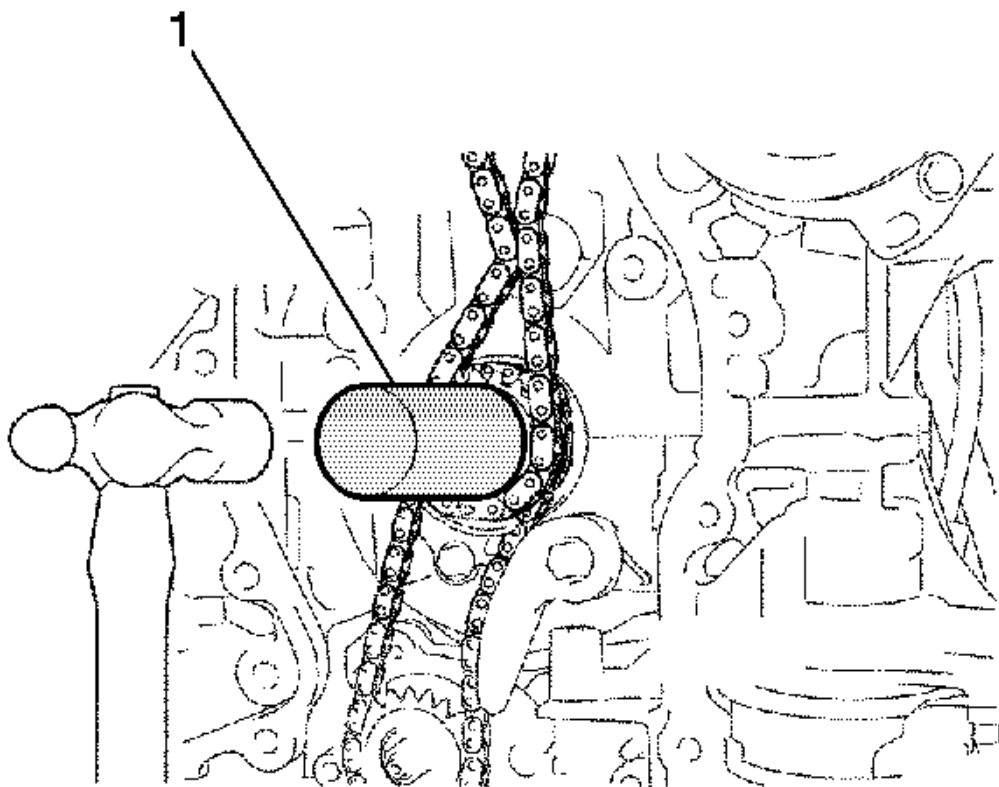


Fig. 127: Tapping In Crankshaft Timing Sprocket
Courtesy of GENERAL MOTORS CORP.

28. If necessary, tap in the crankshaft timing sprocket with a suitable tool (1).

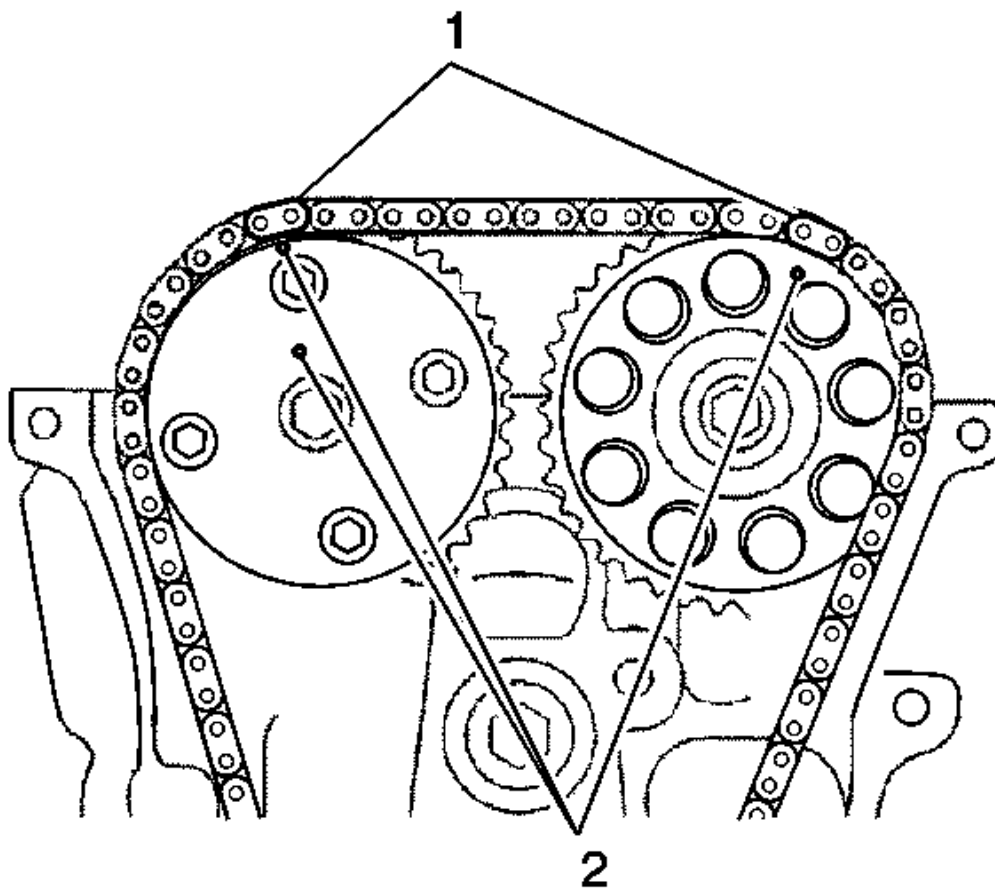


Fig. 128: Aligning Colored Timing Chain Links
Courtesy of GENERAL MOTORS CORP.

29. Align the gold or yellow links (1) with the timing marks located on the camshaft timing gear (2), then install the chain.

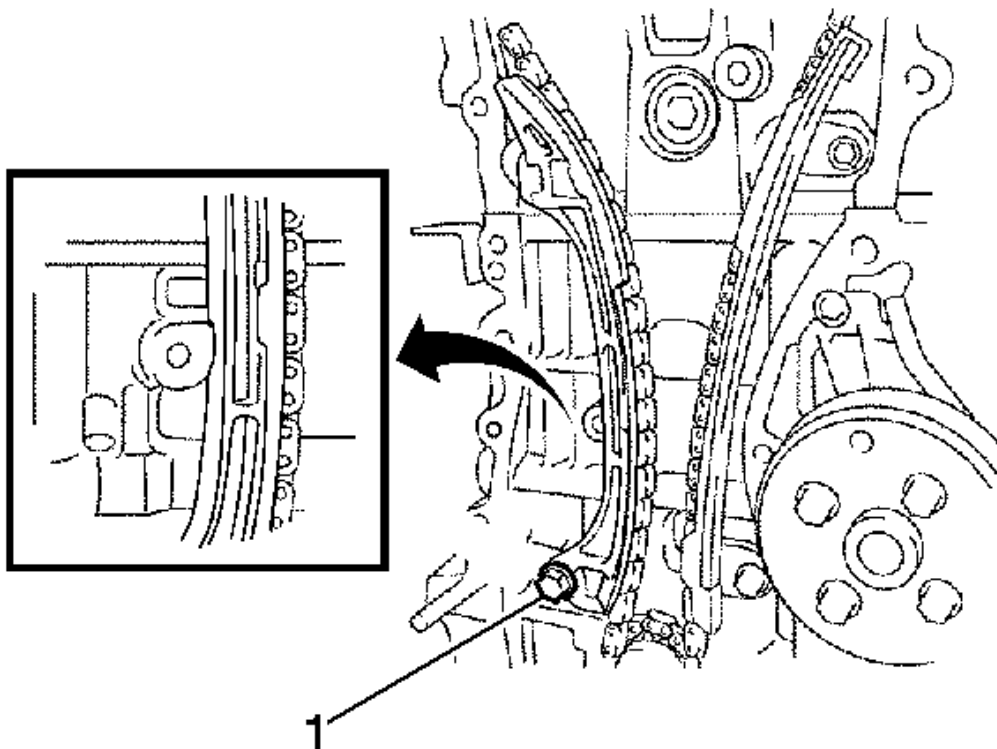


Fig. 129: View Of Chain Tensioner Slipper & Bolt
Courtesy of GENERAL MOTORS CORP.

30. Install the chain tensioner slipper with the bolt (1) and tighten to 19 N.m (14 lb ft).

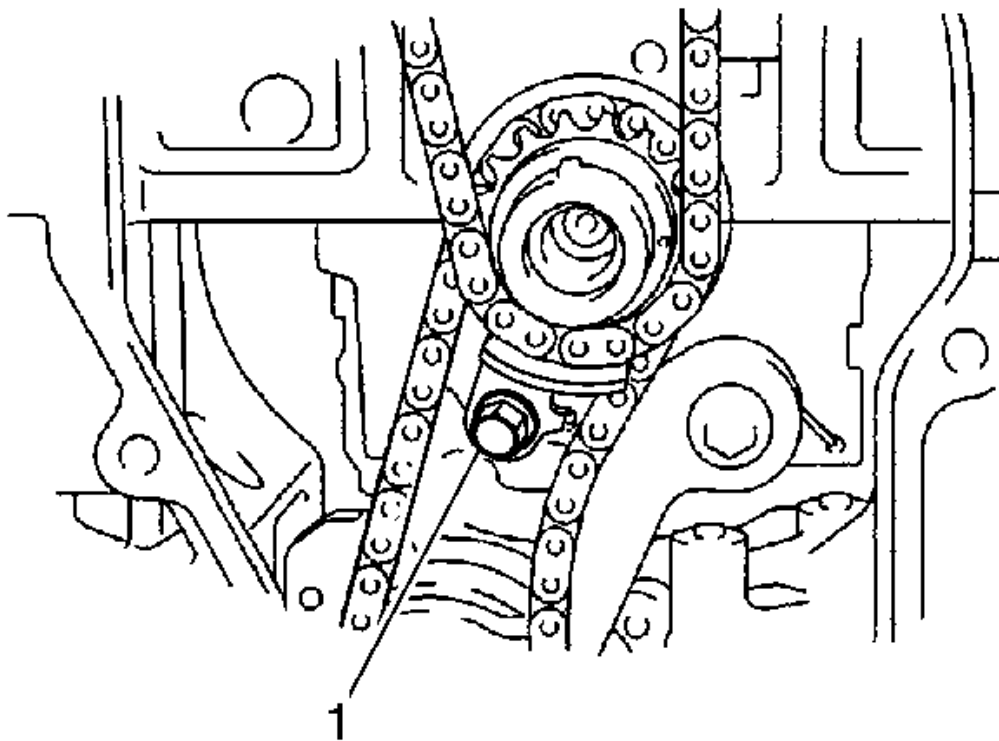


Fig. 130: Identifying Timing Chain Guide & Bolt
Courtesy of GENERAL MOTORS CORP.

31. Install the timing chain guide with the bolt (1) and tighten to 9.0 N.m (80 lb in).

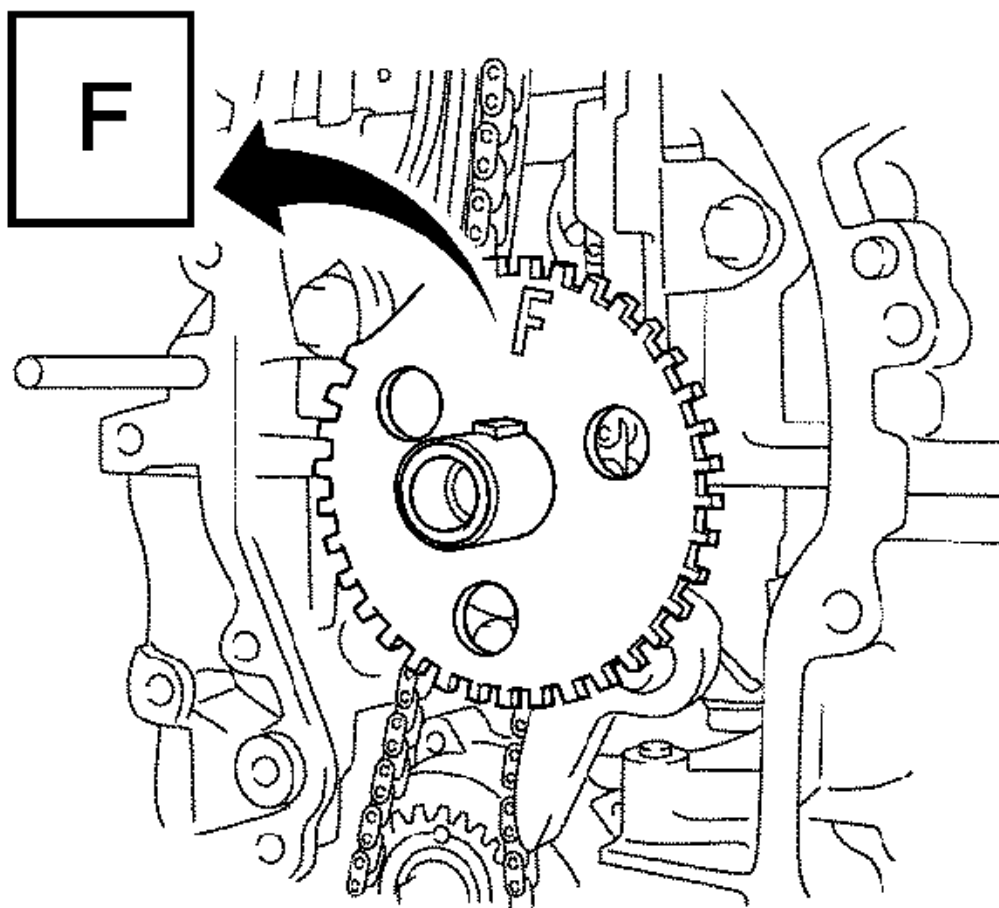


Fig. 131: Locating Sensor Plate "F" Mark
Courtesy of GENERAL MOTORS CORP.

32. Install the crankshaft position sensor plate. Install the sensor plate with the "F" mark facing forward.
33. Install the timing chain or belt cover sub-assembly. Refer to **Timing Chain Housing Installation** .

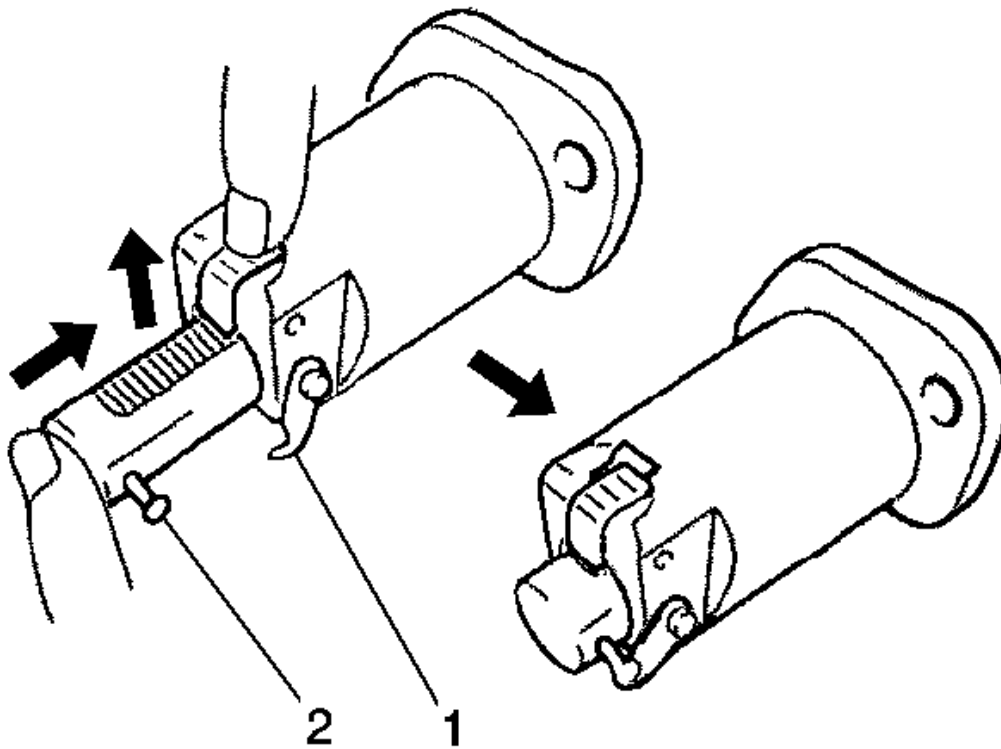


Fig. 132: View Of Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

34. Release the ratchet pawl, then fully push in the plunger and set the hook (1) to the pin (2) so that the plunger is in the position shown in the illustration.

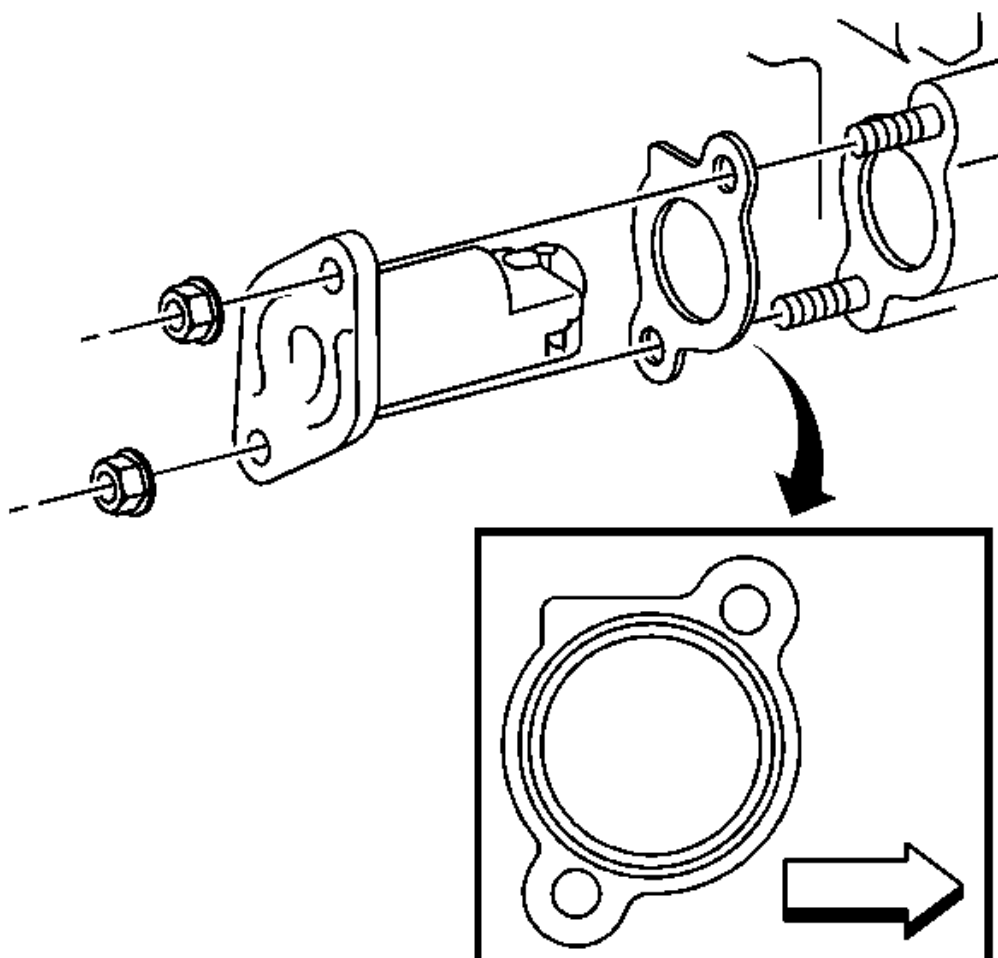


Fig. 133: View Of Gasket, Chain Tensioner & Nuts
 Courtesy of GENERAL MOTORS CORP.

NOTE: When installing the chain tensioner, set the hook again if the hook releases the plunger.

35. Install a new gasket and the chain tensioner with the 2 nuts and tighten to 9.0 N.m (80 lb in).

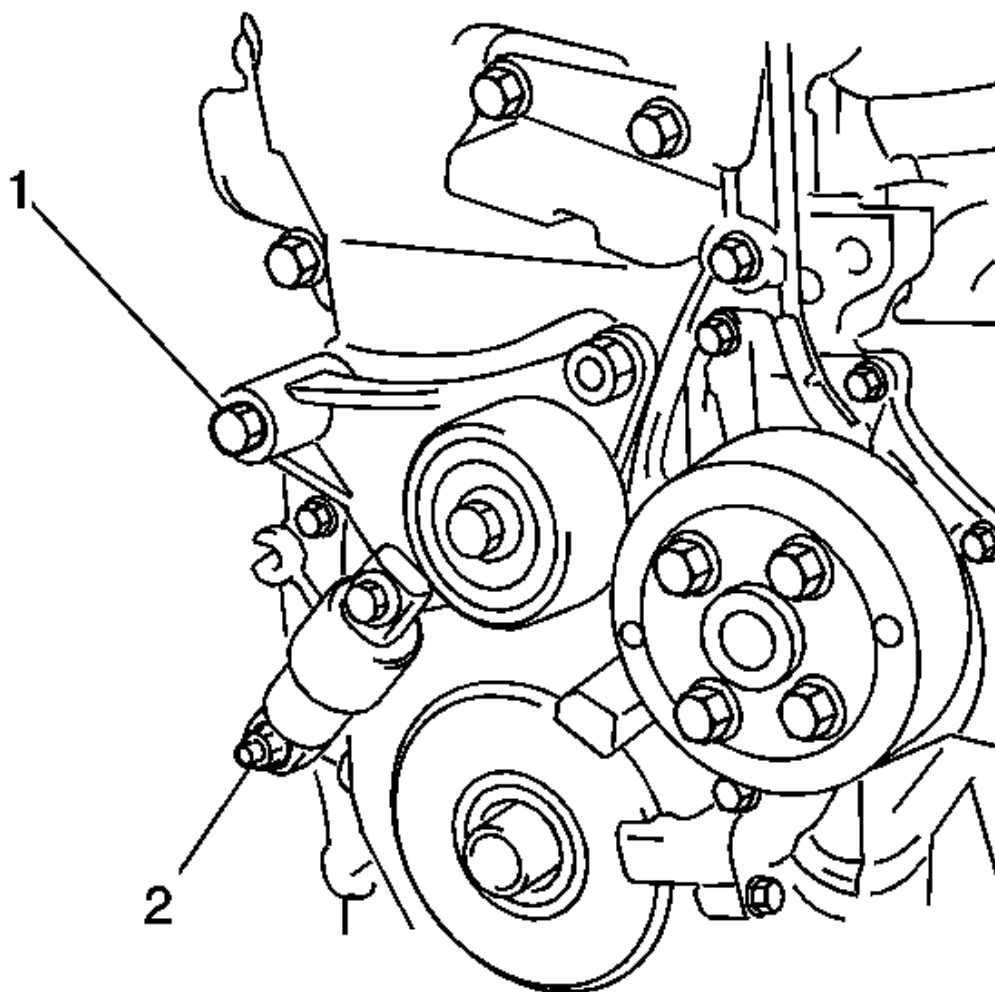


Fig. 134: Identifying Belt Tensioner Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not lift the engine more than necessary.

36. Except the spring type V-ribbed belt tensioner-Install the V-ribbed tensioner assembly with the bolt (1) and nut (2) and tighten to 60 N.m (44 lb ft).

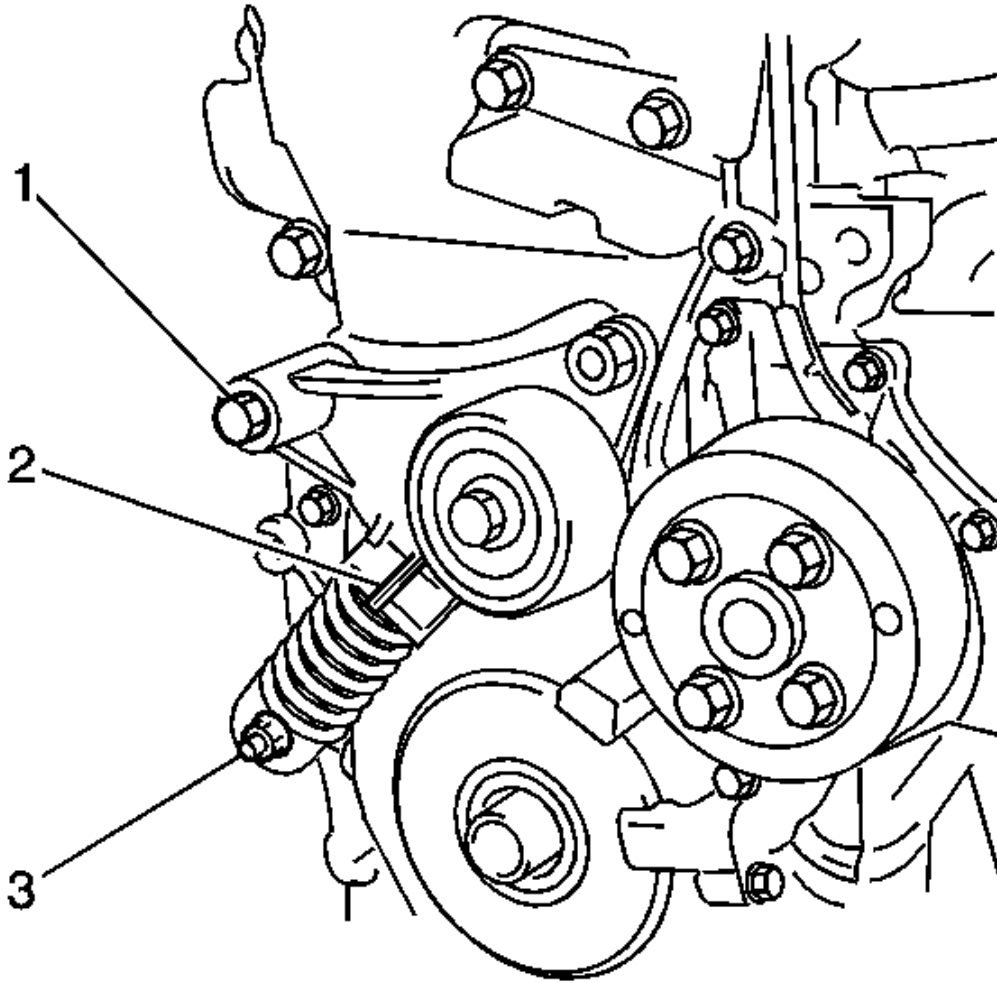


Fig. 135: Identifying Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

NOTE: When replacing the V-ribbed belt tensioner with a new one, do not pull out the pin. Do not lift the engine more than necessary.

37. Spring type V-ribbed belt tensioner-Install the V-ribbed belt tensioner to the engine by first tightening the bolt (1) and then tightening the nut (1) to 60 N.m (44 lb ft).

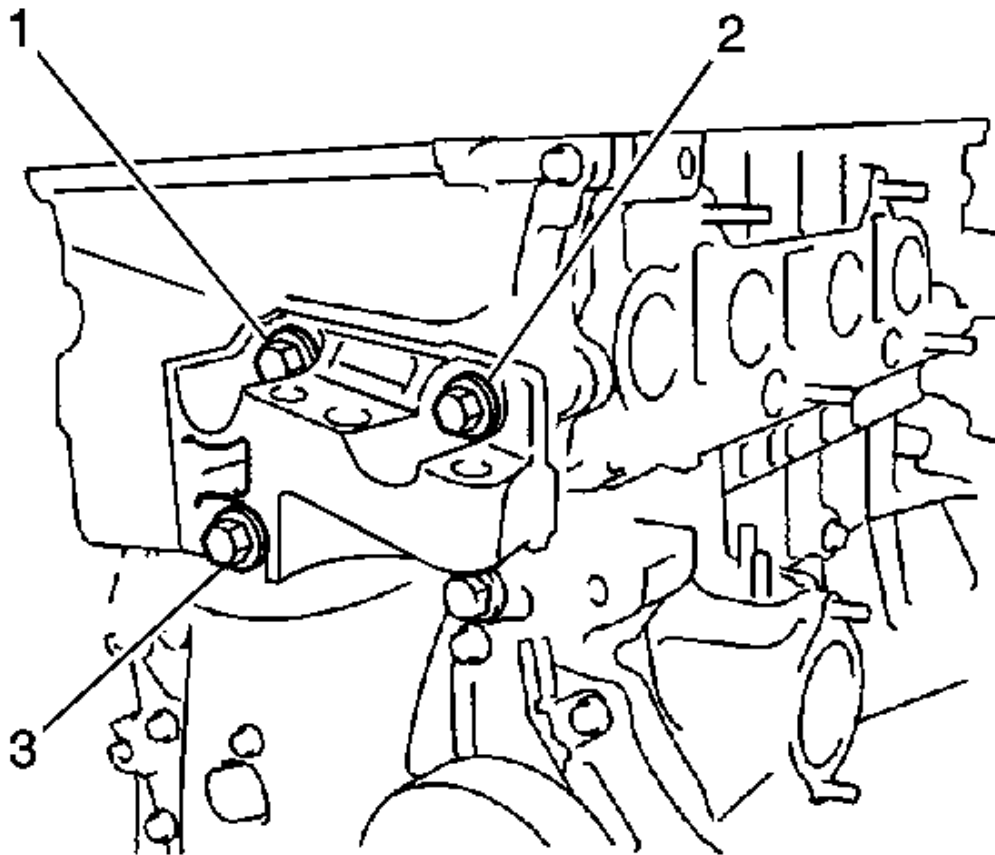


Fig. 136: Identifying Engine Mount Bolts
Courtesy of GENERAL MOTORS CORP.

38. Install the engine transverse engine mounting bracket with the 3 bolts (1, 2, 3) and tighten to 55 N.m (41 lb ft).

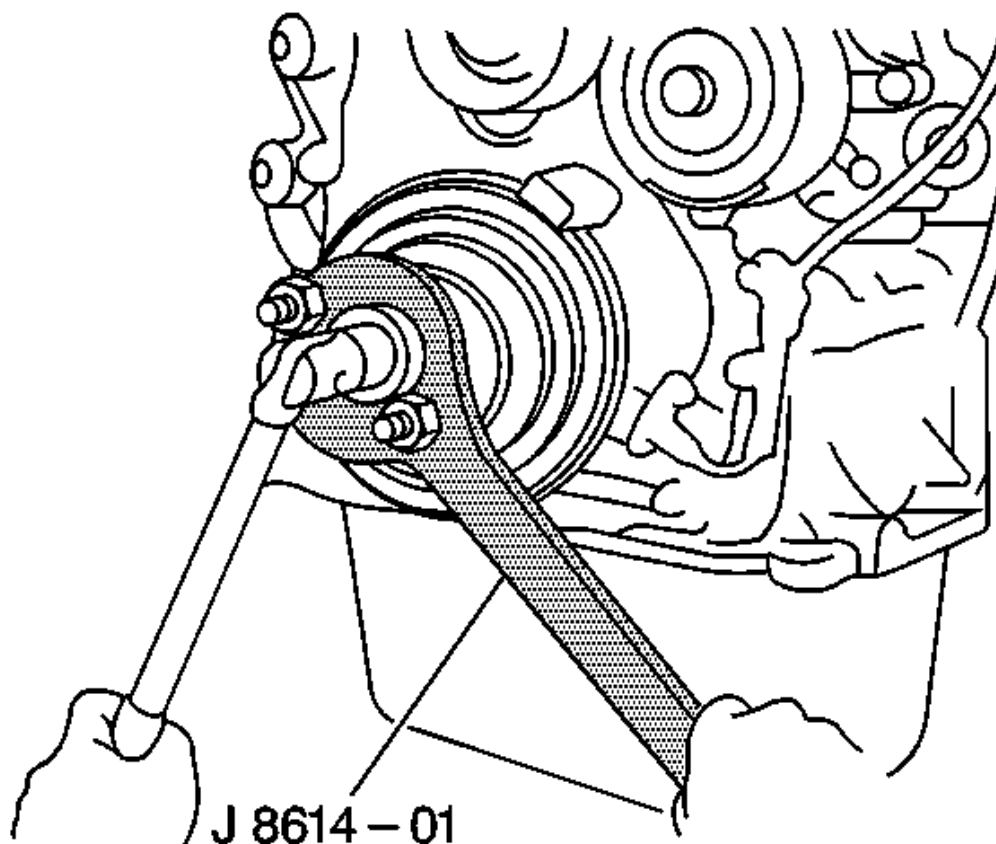


Fig. 137: Removing/Installing Crankshaft Pulley Retaining Bolt
 Courtesy of GENERAL MOTORS CORP.

39. Install the crankshaft pulley.
40. Using the **J-8614-A**: holder and remover, fix the pulley in place and tighten the bolt to 180 N.m (133 lb ft).

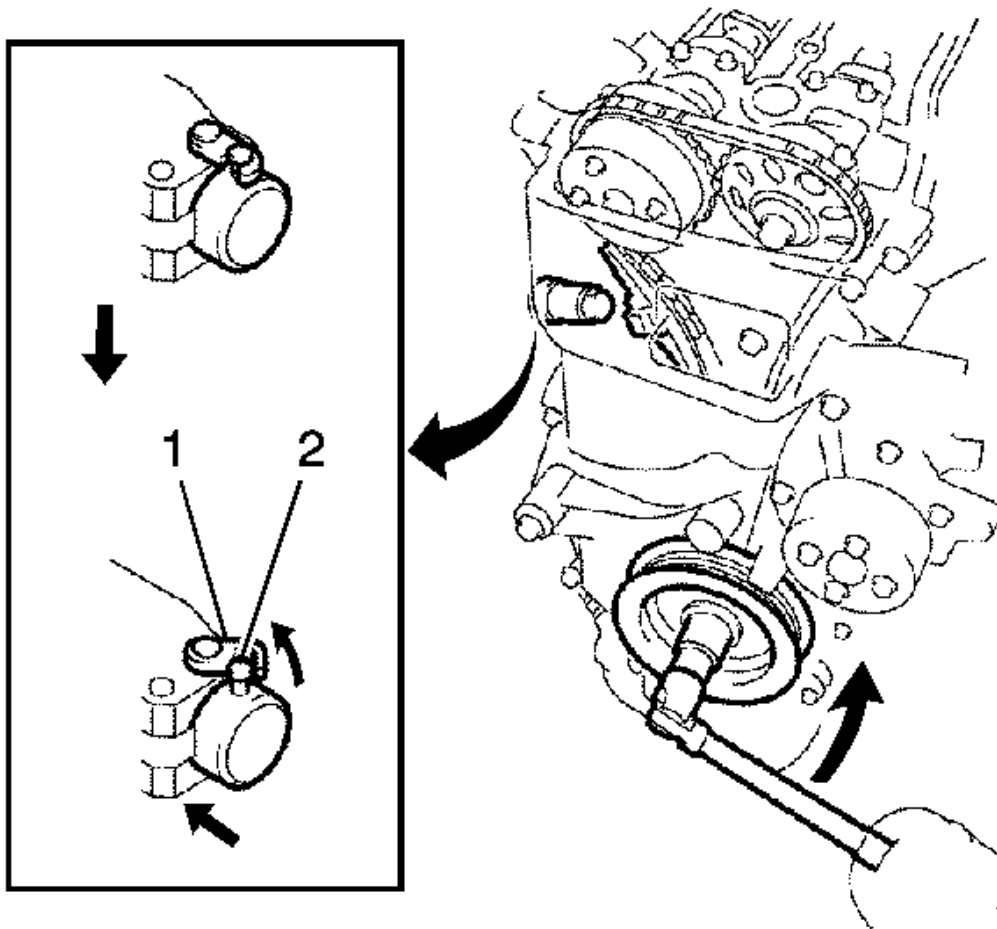


Fig. 138: Rotating Crankshaft Counterclockwise
Courtesy of GENERAL MOTORS CORP.

41. Turn the crankshaft counterclockwise, then disconnect the plunger knock pin (2) from the hook (1).

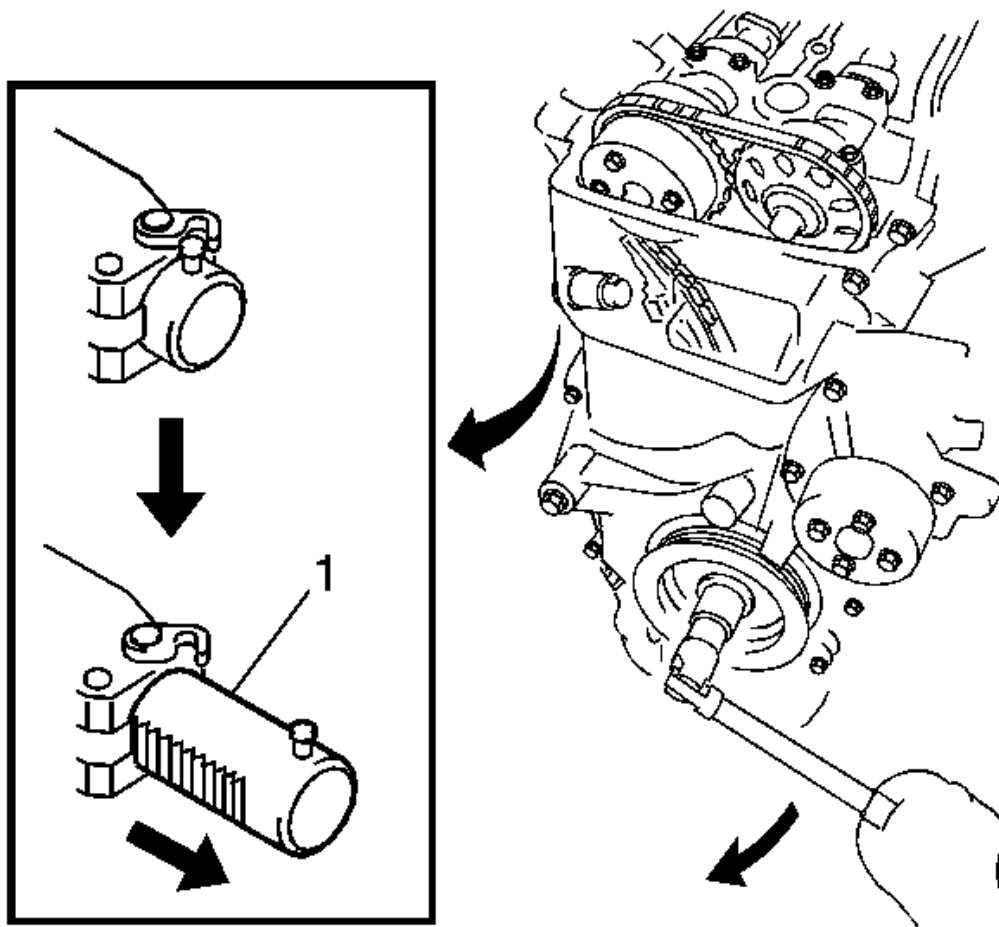


Fig. 139: View Of Tensioner Plunger Assembly
Courtesy of GENERAL MOTORS CORP.

42. Turn the crankshaft clockwise, then check that the plunger (1) is extended.
43. Remove any old packing material and be careful not to drop any oil on the contact surfaces of the cylinder block and oil pan.

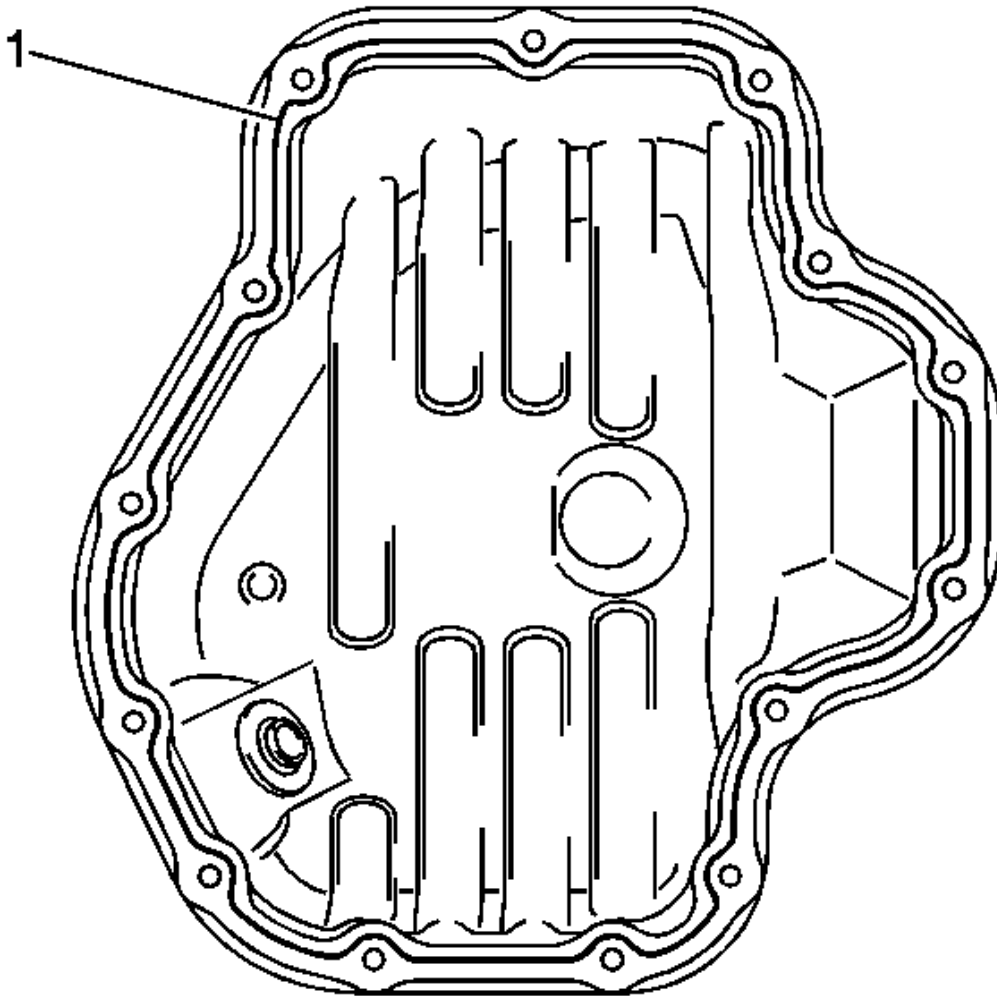


Fig. 140: View Of Oil Pan Sealing Surface
Courtesy of GENERAL MOTORS CORP.

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

44. Apply a continuous bead of sealant, diameter 4.0-4.5 mm (0.158-0.177 in), as shown in the illustration, Three Bond 1217B or equivalent GM part number 12378521 (Canadian part number 88901148).
45. Install the oil pan (1) onto the cylinder block.

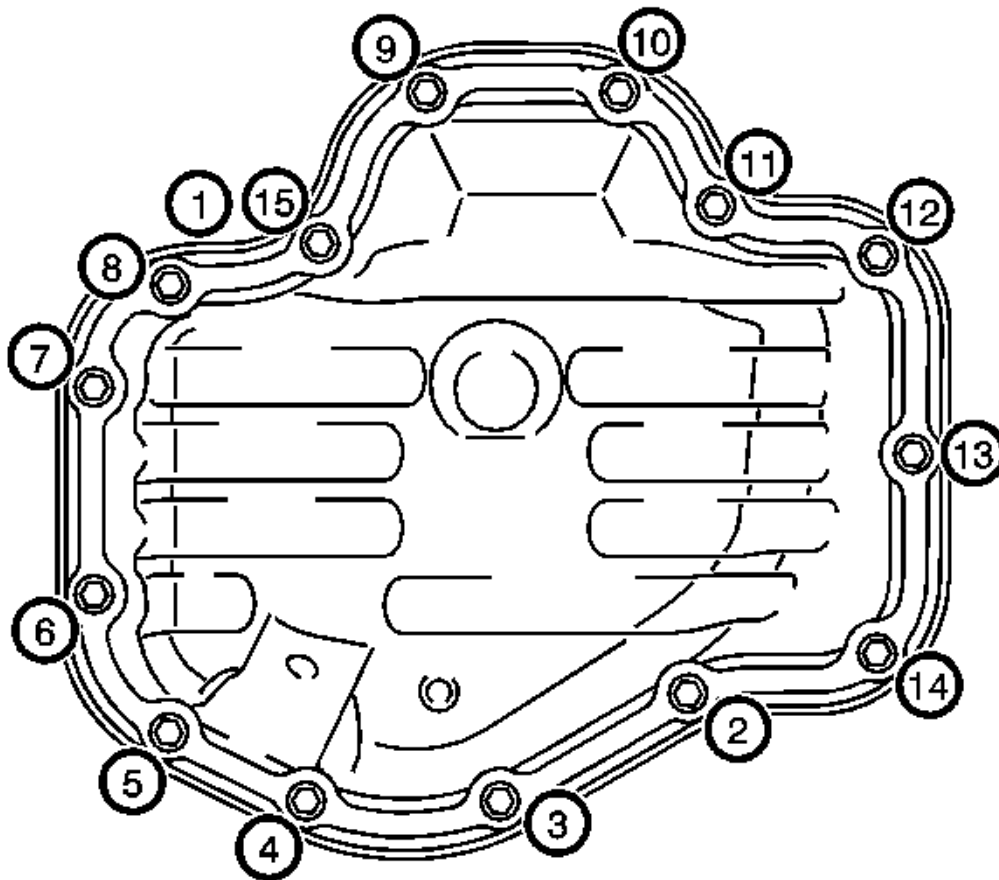
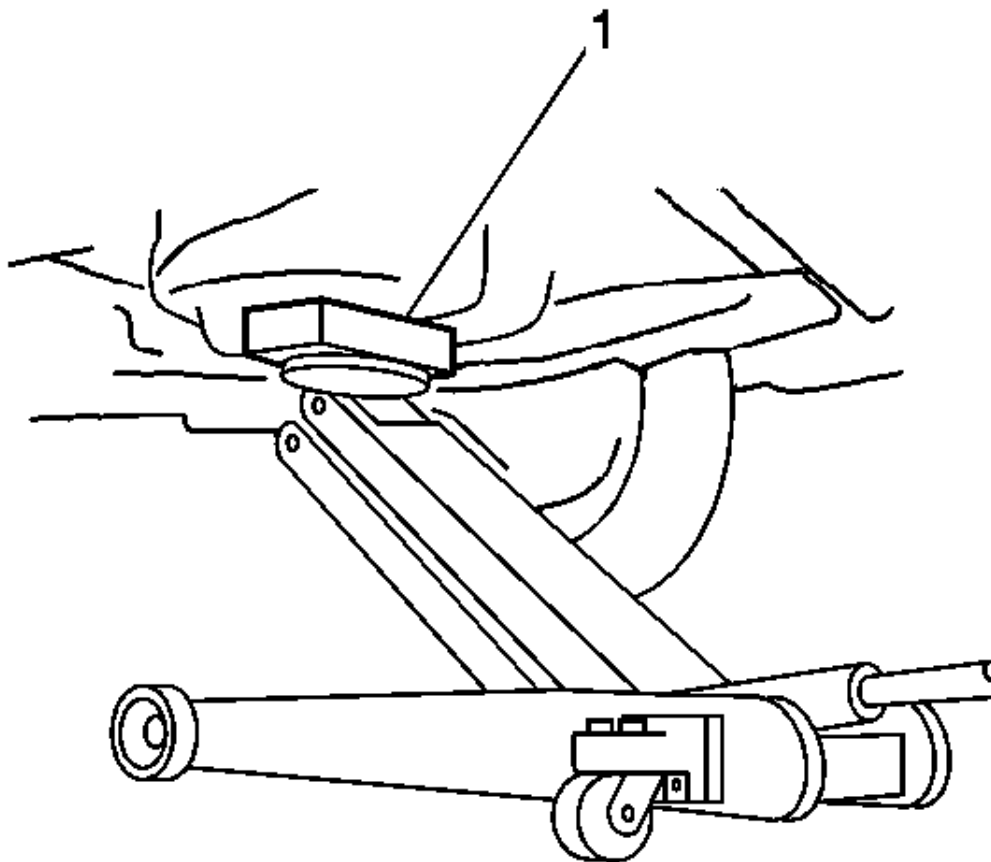


Fig. 141: Identifying Oil Pan Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

46. Uniformly tighten the 12 bolts and 2 nuts in the sequence shown in the illustration to 9.0 N.m (80 lb ft).

**Fig. 142: Supporting Engine****Courtesy of GENERAL MOTORS CORP.**

47. Place a wooden block (1) between a floor jack and the engine, then support the engine using the floor jack.
48. Remove the engine support fixture.
49. Install the crankshaft position sensor.

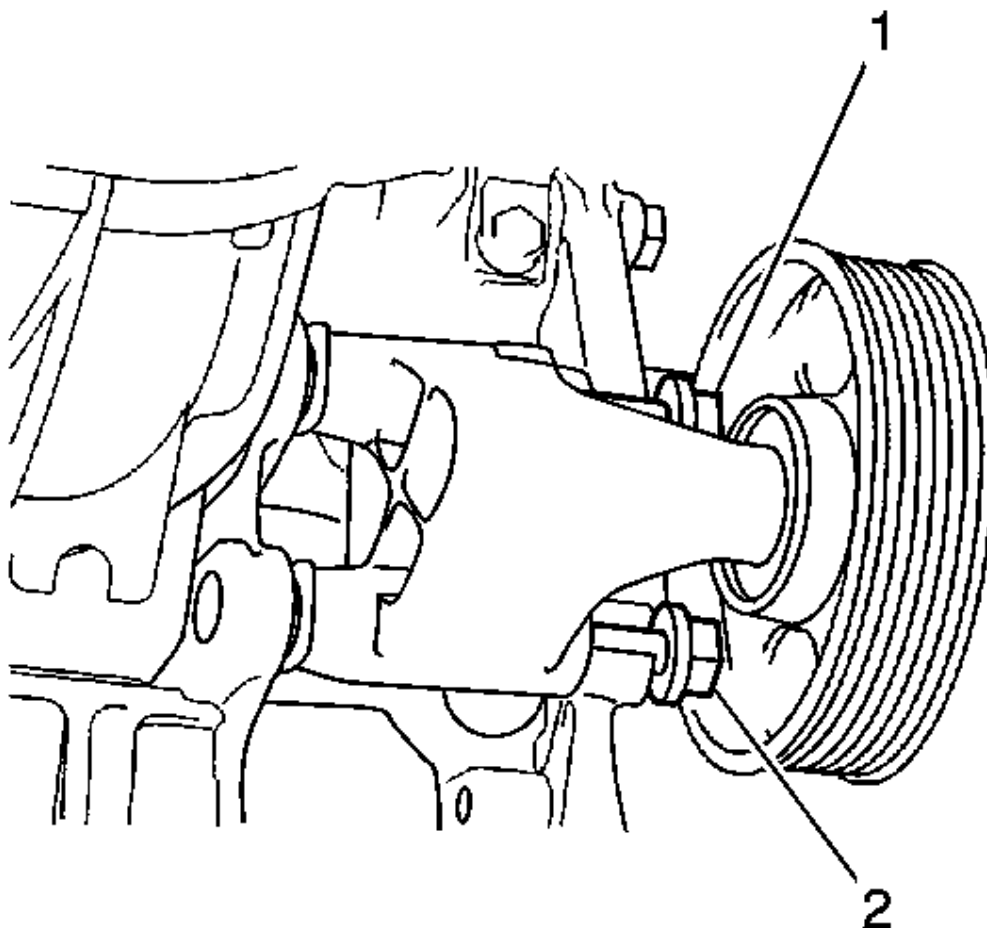


Fig. 143: Identifying Idler Pulley Sub-Assembly Bolts
Courtesy of GENERAL MOTORS CORP.

50. Install the idler pulley sub-assembly with the 2 bolts (1, 2) and tighten to 50 N.m (37 lb ft).

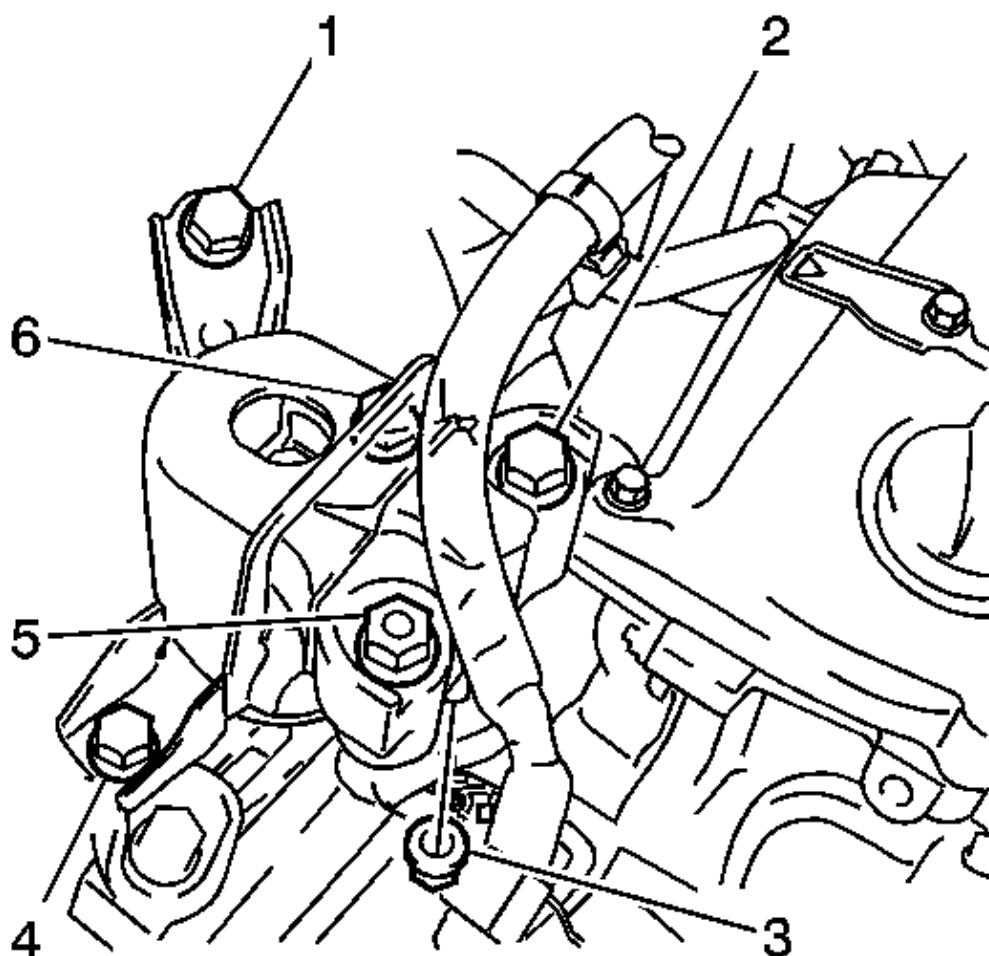


Fig. 144: View Of Right Engine Mounting Insulator Sub-Assembly
Courtesy of GENERAL MOTORS CORP.

51. Install the right engine mounting insulator sub-assembly with the 4 bolts (1, 2, 4, 6) and 2 nuts (3, 5) and tighten.
- Bolts 1, 4 and 6 to 52 N.m (38 lb ft)
 - Bolt 2 to 95 N.m (70 lb ft)
 - Nut 5 to 95 N.m (70 lb ft)
 - Nut 3 to 52 N.m (38 lb ft)
52. Install the exhaust manifold converter assembly. Refer to **Exhaust Manifold Replacement (2.4L)** .
53. Install the intake manifold. Refer to **Intake Manifold Replacement**.

54. Install the camshaft timing oil control valve assembly.
55. Install the fuel delivery pipe assembly.
56. Connect the fuel main tube.

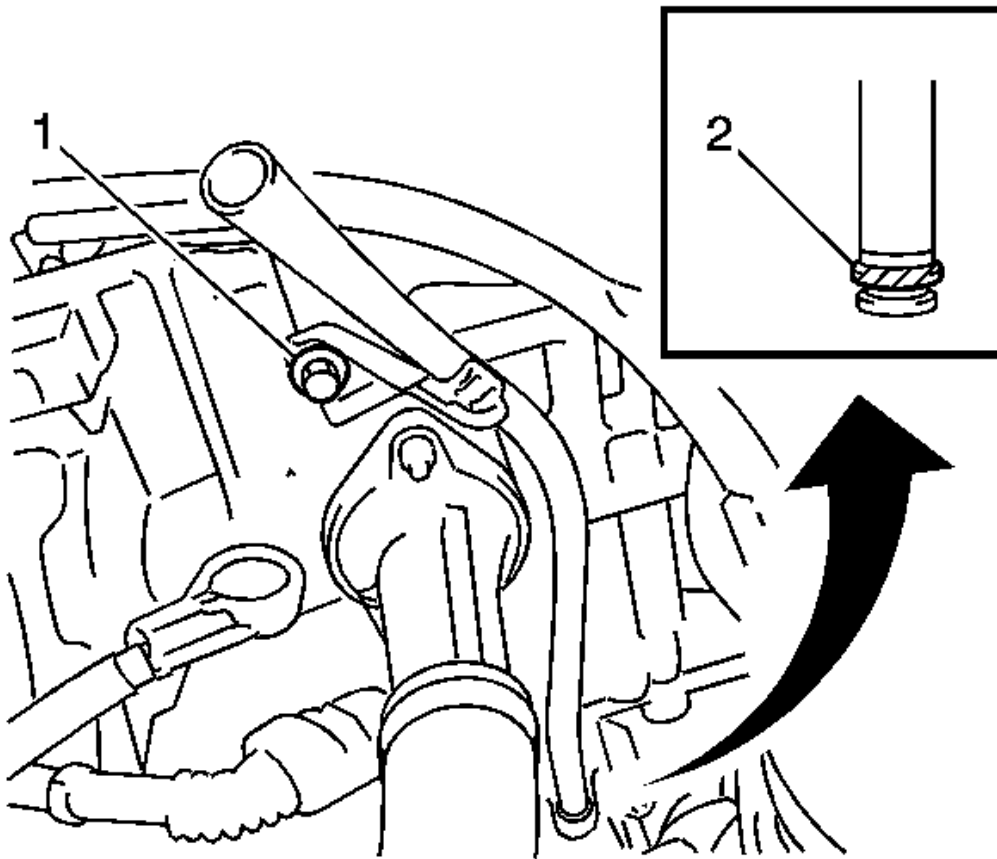


Fig. 145: Identifying Engine Oil Level Dipstick Guide & Bolt
Courtesy of GENERAL MOTORS CORP.

57. Apply a light coat of engine oil to a new O-ring (2) and install it onto the engine oil level dipstick guide.
58. Install the engine oil level dipstick guide with the bolt (1) and tighten to 9.0 N.m (80 lb ft).
59. Install the engine oil level dipstick.
60. Install the cylinder head cover. Refer to **Camshaft Cover Replacement**.
61. Install the spark plug. Refer to **Spark Plug Replacement**.
62. Install the ignition coil assembly. Refer to **Ignition Coil Replacement**.
63. Install the throttle body assembly.

64. Install the air cleaner cap with hose.
65. Install the radiator reserve tank assembly.
66. Install the generator assembly. Refer to **Generator Replacement (2.4L)** .
67. Install the V-ribbed belt. Refer to **Drive Belt Replacement**
68. Install the front exhaust pipe assembly. Refer to **Front Pipe Replacement (2.4L AWD)** or **Front Pipe Replacement (2.4L FWD)** .
69. Install the catalytic converter assembly. Refer to **Catalytic Converter Replacement (2.4L AWD)** or **Catalytic Converter Replacement (2.4L FWD)** .
70. Connect the cable to negative battery terminal.
71. Add engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
72. Add engine coolant. Refer to **Cooling System Draining and Filling** .
73. Inspect for fuel leak.
74. Inspect for coolant leak.
75. Inspect for oil leak.
76. Inspect for exhaust gas leak.
77. Inspect the ignition timing.
78. Inspect the engine idling speed.
79. Install the suspension tower damper assembly, with front strut bar.
80. Install the outer cowl top panel.
81. Install the windshield wiper motor and link assembly. Refer to **Windshield Wiper Motor Replacement** .
82. Install the engine cover. Refer to **Engine Cover Replacement**.
83. Install the left engine under cover.
84. Install the right engine under cover.
85. Install the right front wheel.

OIL PUMP REPLACEMENT

REMOVAL PROCEDURE

1. Discharge the fuel system pressure.

WARNING: Refer to **Battery Disconnect Warning** .

2. Disconnect the cable from negative battery terminal. Refer to **Battery Negative Cable Disconnection and Connection** .
3. Remove the windshield wiper motor and link assembly. Refer to **Windshield Wiper Motor Replacement** .
4. Remove the outer cowl top panel.
5. Remove the suspension tower damper assembly, with front strut bar.

6. Remove the right front wheel.
7. Remove the left engine under cover.
8. Remove the right engine under cover.
9. Remove the engine cover. Refer to **Engine Cover Replacement**.
10. Drain the engine coolant. Refer to **Cooling System Draining and Filling**.
11. Drain the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
12. Remove the catalytic converter assembly. Refer to **Catalytic Converter Replacement (2.4L AWD)** or **Catalytic Converter Replacement (2.4L FWD)**.
13. Remove the front exhaust pipe assembly. Refer to **Front Pipe Replacement (2.4L AWD)** or **Front Pipe Replacement (2.4L FWD)**.
14. Remove the v-ribbed belt. Refer to **Drive Belt Replacement**.
15. Remove the generator assembly. Refer to **Generator Replacement (2.4L)**.
16. Disconnect the radiator hose.
17. Disconnect the outlet heater water hose.
18. Disconnect the inlet heater water hose.
19. Separate the radiator reserve tank assembly.
20. Remove the air cleaner cap with hose.
21. Remove the throttle body assembly.
22. Remove the ignition coil assembly. Refer to **Ignition Coil Replacement**.
23. Remove the spark plug. Refer to **Spark Plug Replacement**.
24. Remove the cylinder head cover. Refer to **Camshaft Cover Replacement**.
25. Remove the engine oil level dipstick.
26. Remove the engine oil level dipstick guide.
27. Remove the fuel main tube.
28. Remove the fuel delivery pipe sub-assembly.
29. Remove the camshaft timing oil control valve assembly.
30. Remove the intake manifold. Refer to **Intake Manifold Replacement**.
31. Remove the intake manifold insulator.
32. Remove the exhaust manifold converter. Refer to **Exhaust Manifold Replacement (2.4L)**.
33. Remove the right engine mount.
34. Remove the idler pulley.
35. Remove the oil pan.
36. Set the cylinder to TDC/compression.
37. Remove the crankshaft pulley.
38. Remove the chain tensioner assembly.
39. Remove the transverse engine mounting bracket.
40. Remove the v-ribbed belt tensioner assembly.
41. Remove the crankshaft position sensor.

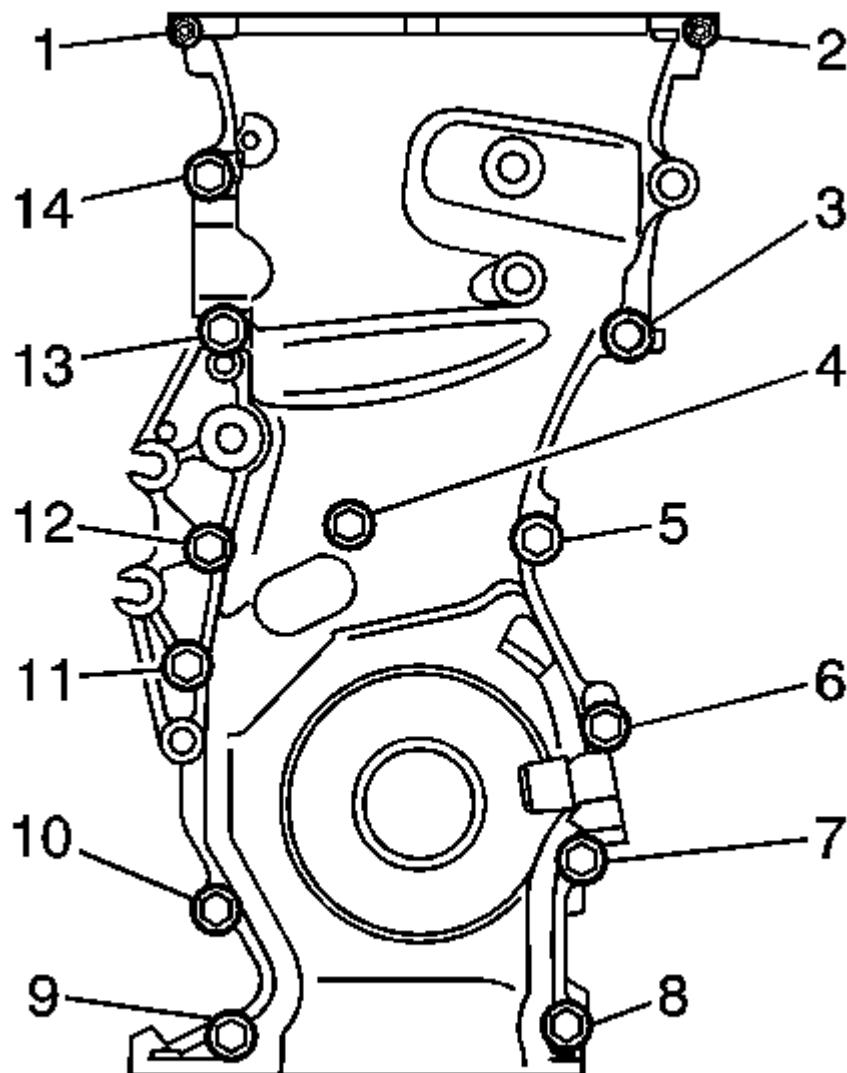


Fig. 146: Identifying Front Cover Bolts
Courtesy of GENERAL MOTORS CORP.

42. Using an E10 TORX® socket, remove the stud bolt for the V-ribbed belt tensioner.
43. Remove the 12 bolts (3-14) and 2 nuts (1, 2).

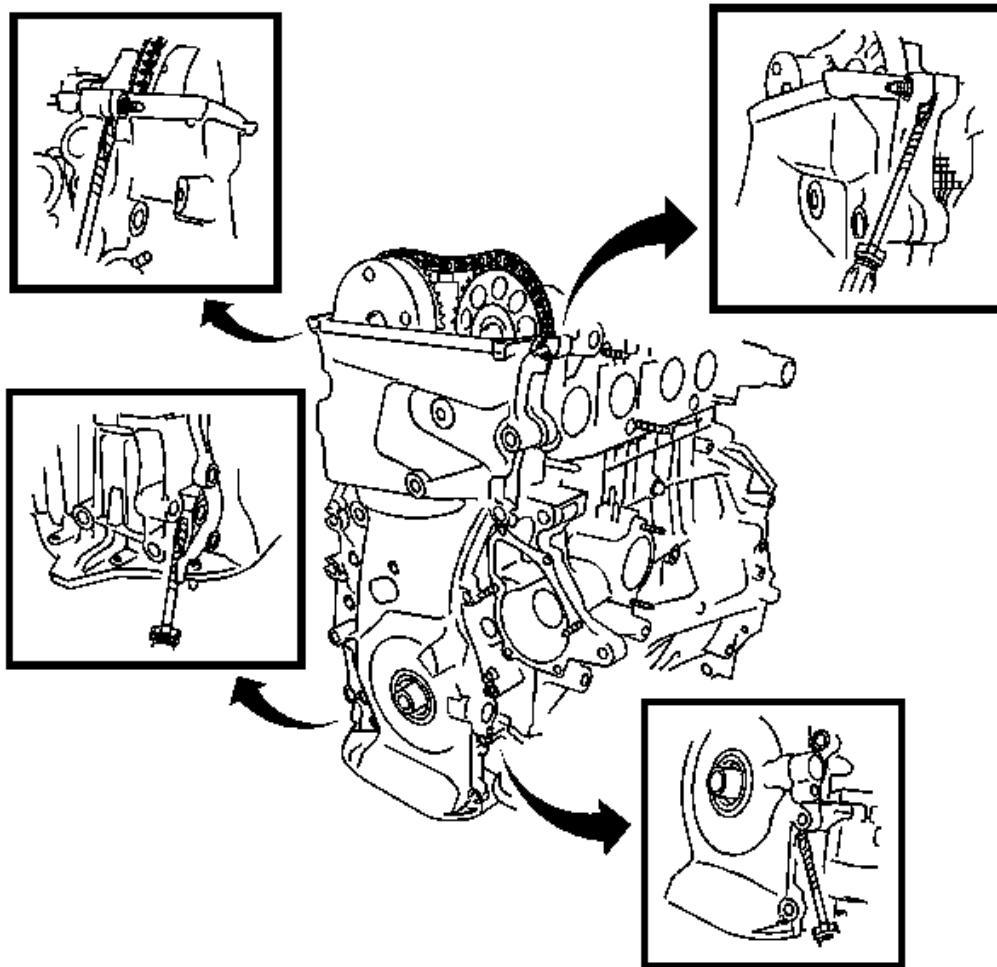


Fig. 147: Identifying Timing Chain Cover Components
Courtesy of GENERAL MOTORS CORP.

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

44. Remove the timing chain cover by prying the portions between the timing chain cover, cylinder head and cylinder block with a screwdriver.
45. Remove the No. 1 crankshaft position sensor plate.
46. Remove the timing chain guide.
47. Remove the chain tensioner slipper.
48. Remove the No. 1 chain vibration damper.
49. Remove the chain sub-assembly.

50. Remove the crankshaft timing sprocket.
51. Remove the No. 2 chain sub-assembly.

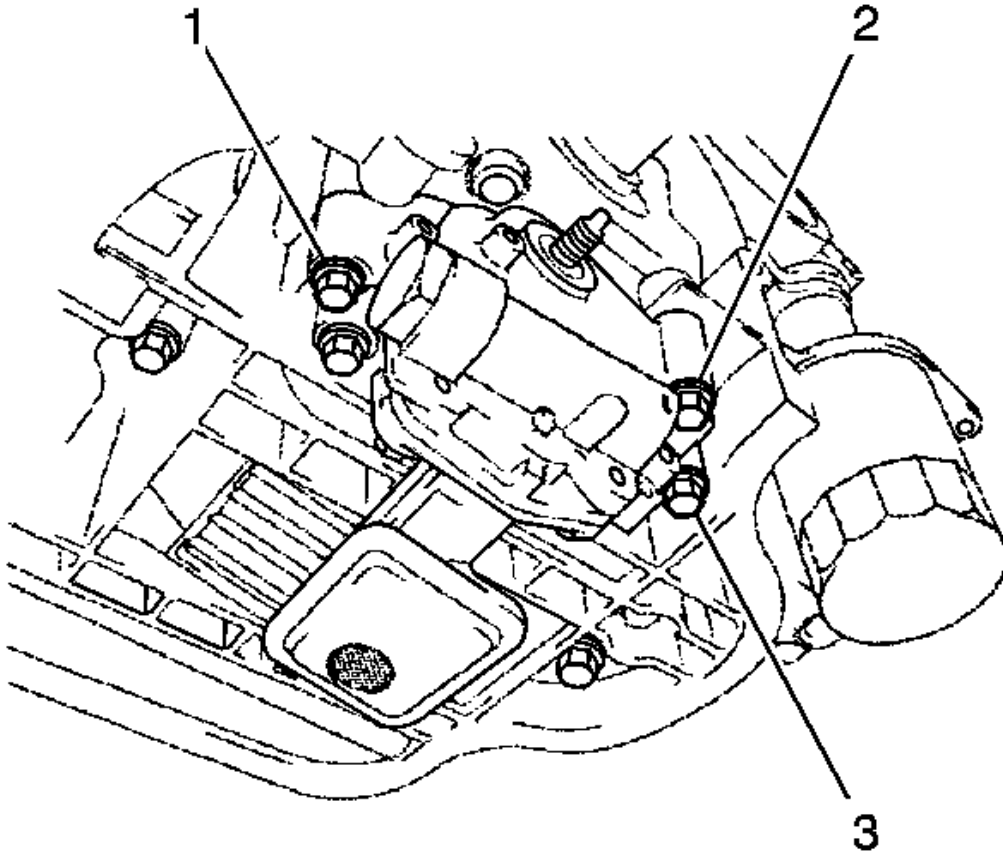


Fig. 148: View Of Oil Pump, Gasket & Bolts
Courtesy of GENERAL MOTORS CORP.

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

DISASSEMBLY PROCEDURE

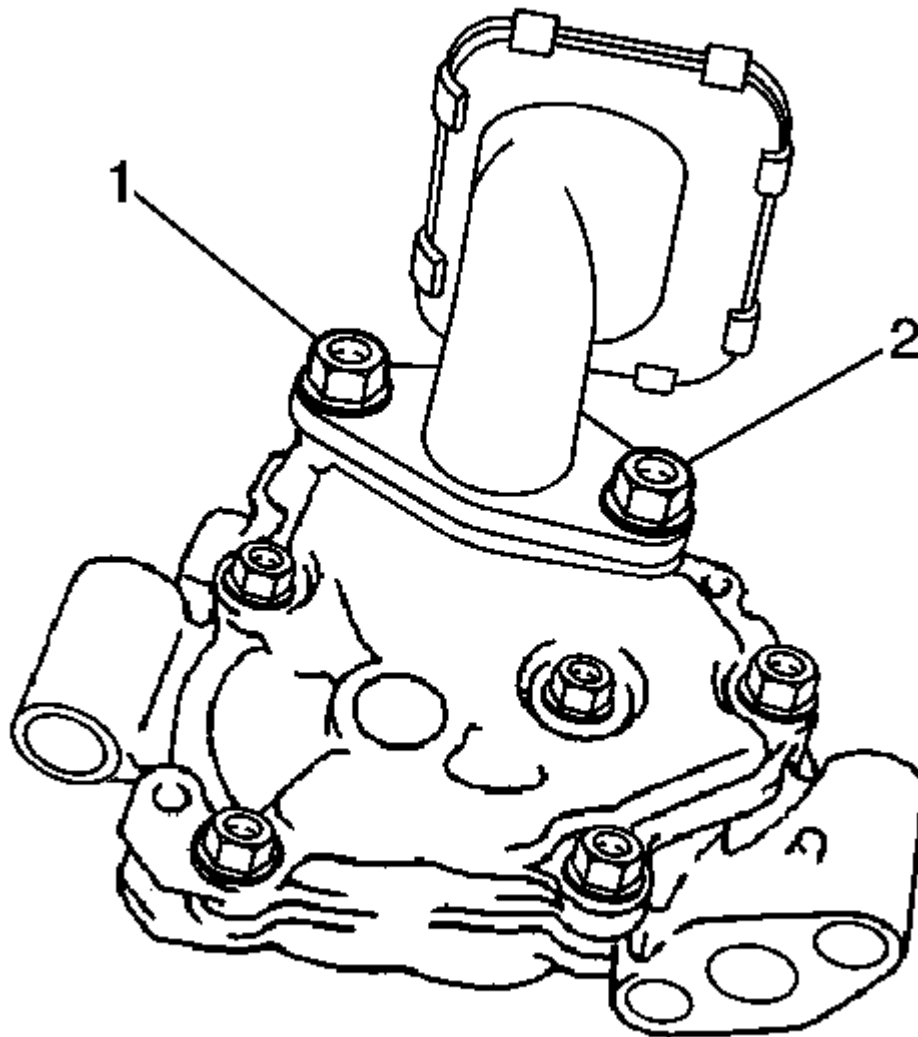


Fig. 149: Identifying Oil Pump Strainer & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the 2 nuts (1, 2), oil pump strainer and gasket.

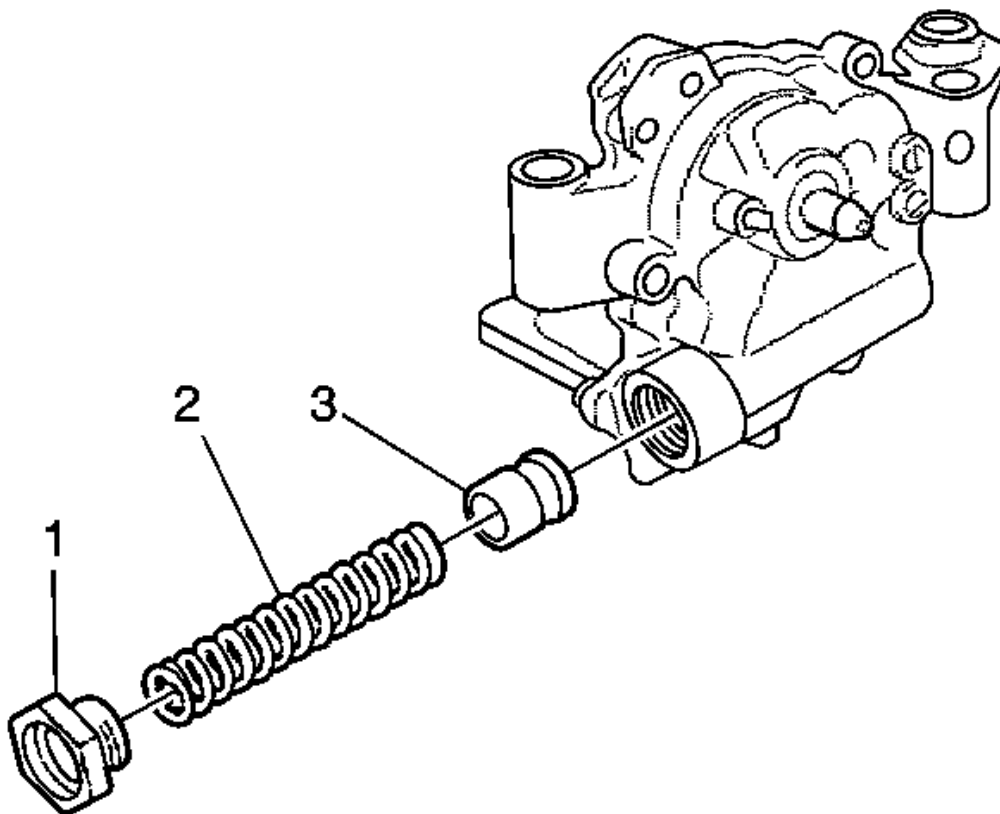


Fig. 150: View Of Oil Pump Valve Spring & Relief Valve
Courtesy of GENERAL MOTORS CORP.

2. Using a 27 mm socket wrench, remove the plug (1).
3. Remove the valve spring (2) and relief valve (3).

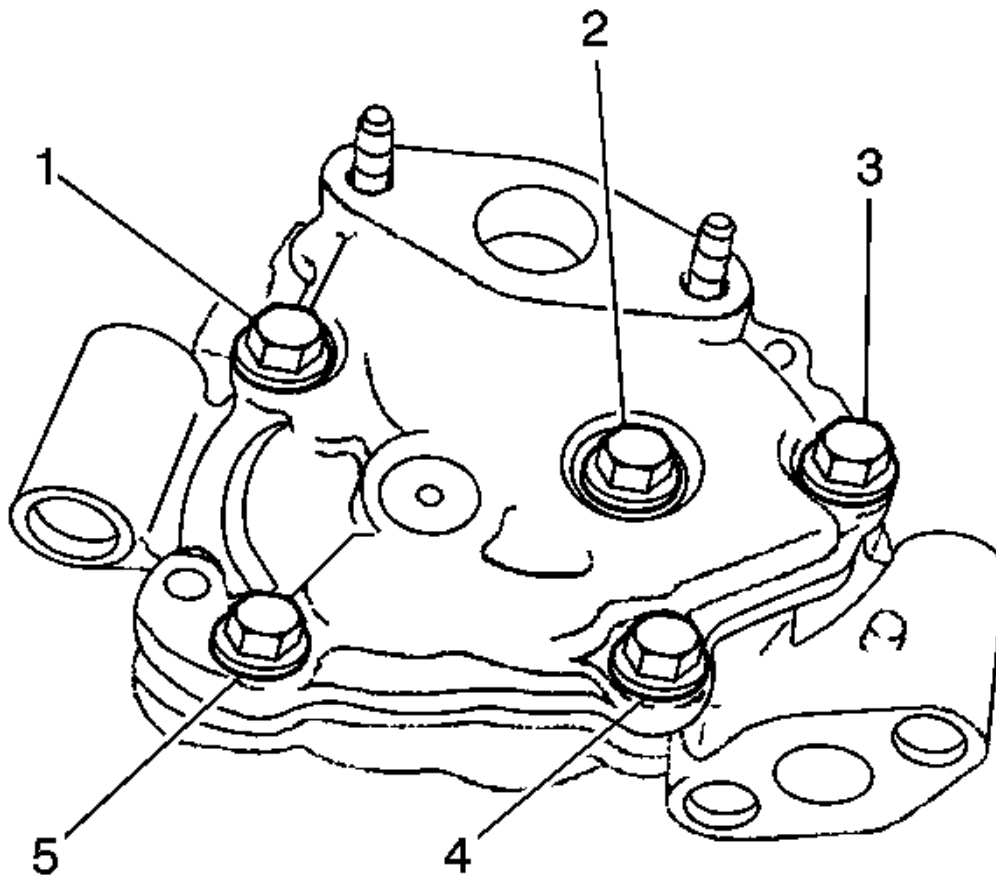


Fig. 151: View Of Oil Pump Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

4. Remove the 5 bolts (1-5) and oil pump cover.
5. Remove the oil pump drive and driven rotors from the oil pump.

INSPECTION PROCEDURE

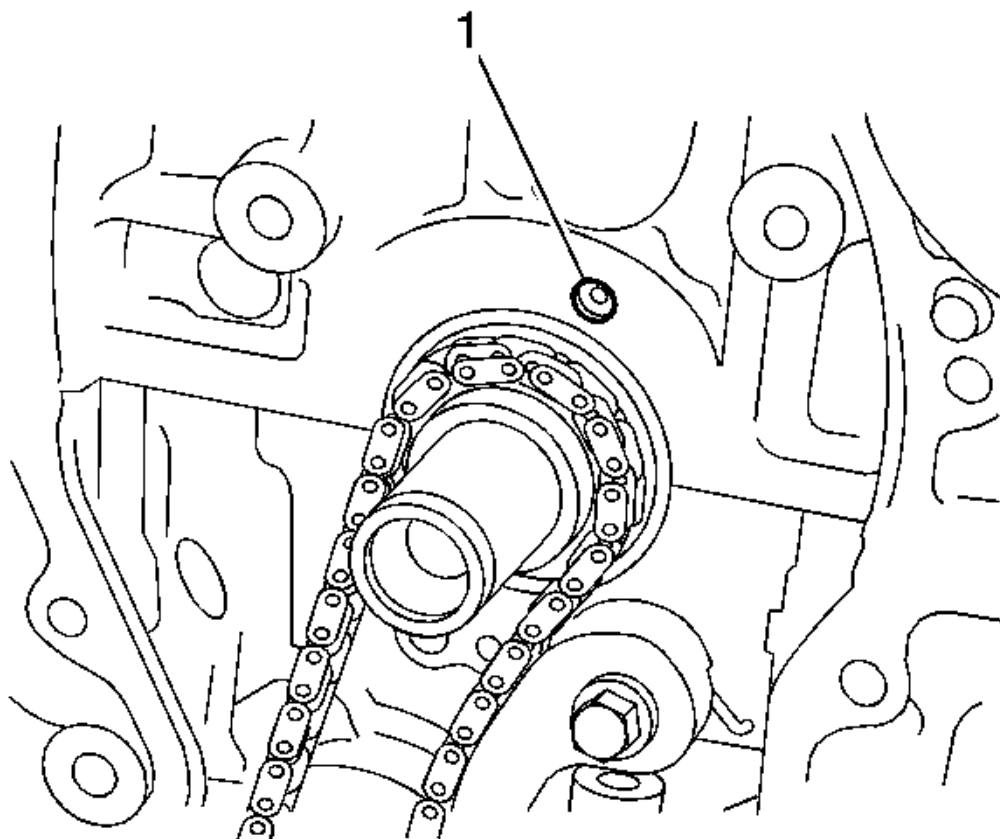


Fig. 152: Identifying Oil Jet

Courtesy of GENERAL MOTORS CORP.

1. Check the oil jet (1) for damage or clogging. If necessary, repair the cylinder block.

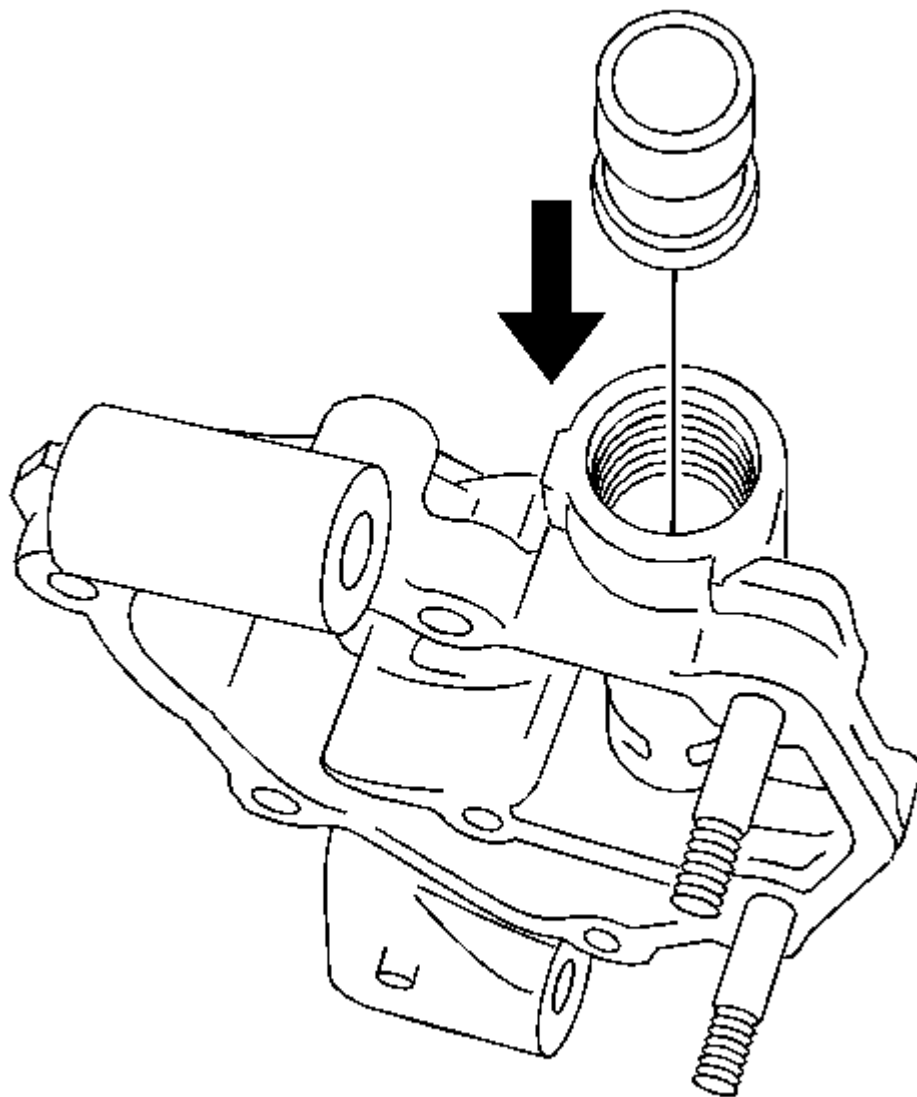


Fig. 153: Checking Oil Pump Relief Valve
Courtesy of GENERAL MOTORS CORP.

2. Check the relief valve.
3. Coat the valve with engine oil, and then check that the valve falls smoothly into the valve hole by its own weight.

If it does not, replace the relief valve. If necessary, replace the oil pump assembly.

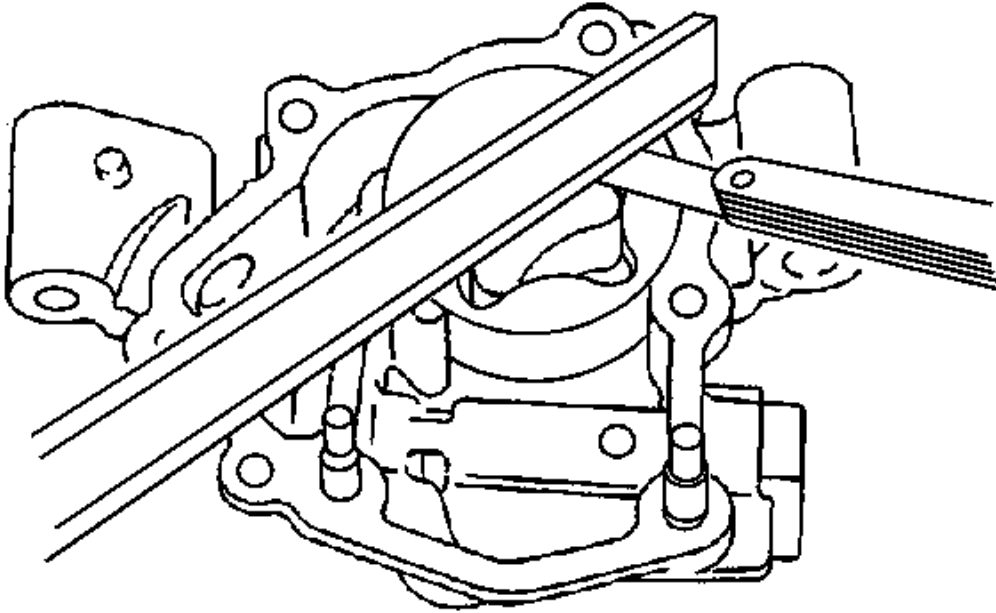


Fig. 154: Inspecting Oil Pump Side Clearance
Courtesy of GENERAL MOTORS CORP.

4. Check the side clearance.
5. Using a feeler gauge and precision straightedge, measure the clearance between the rotors and precision straightedge.

If the side clearance is greater than the maximum, replace the oil pump assembly.

Specification:

- Standard Clearance: 0.030 to 0.085 mm (0.0012 to 0.0034 in.)
- Maximum Clearance: 0.160 mm (0.0063 in.)

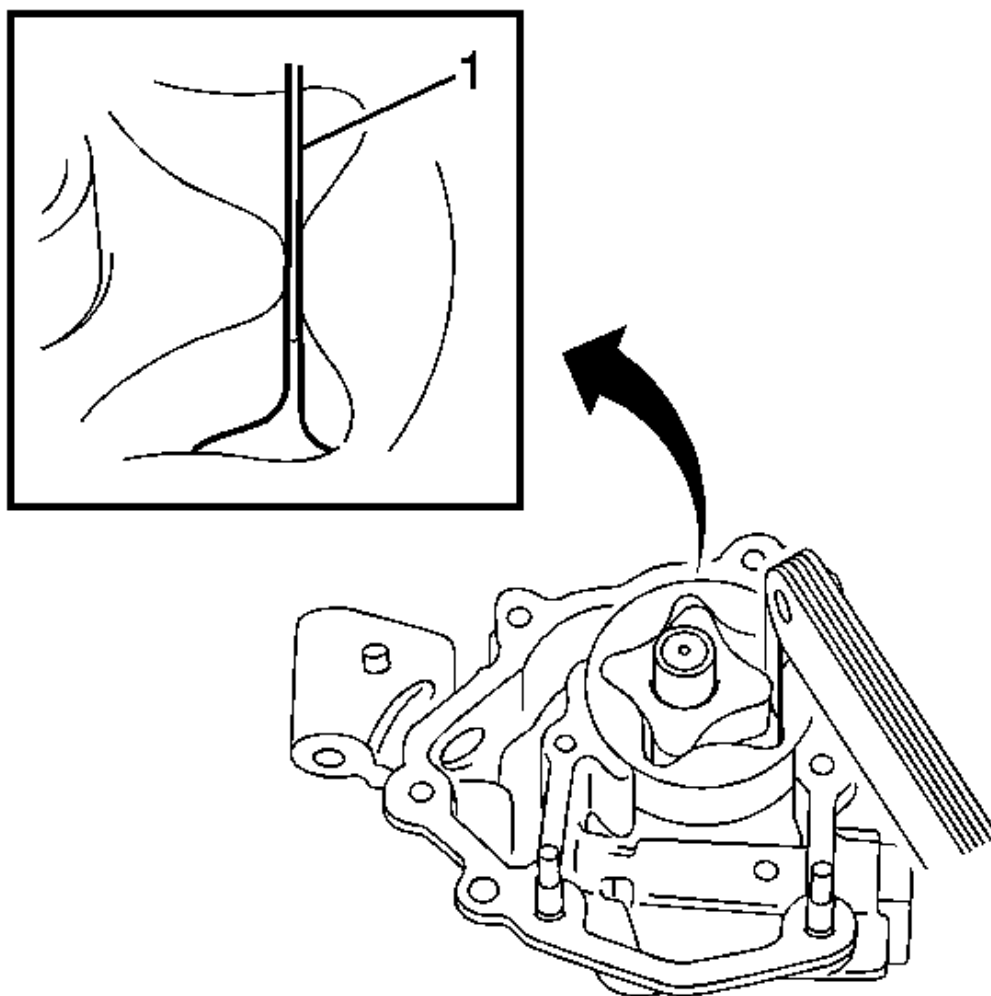


Fig. 155: Checking Oil Pump Gear Tip Clearance
Courtesy of GENERAL MOTORS CORP.

6. Check the tip clearance.
7. Using a feeler gauge (1), measure the clearance between the drive and driven rotor tips.

If the tip clearance is greater than the maximum, replace the oil pump assembly.

Specification:

- Standard Clearance: 0.080-0.160 mm (0.0031-0.0063 in)
- Maximum Clearance: 0.35 mm (0.0138 in)

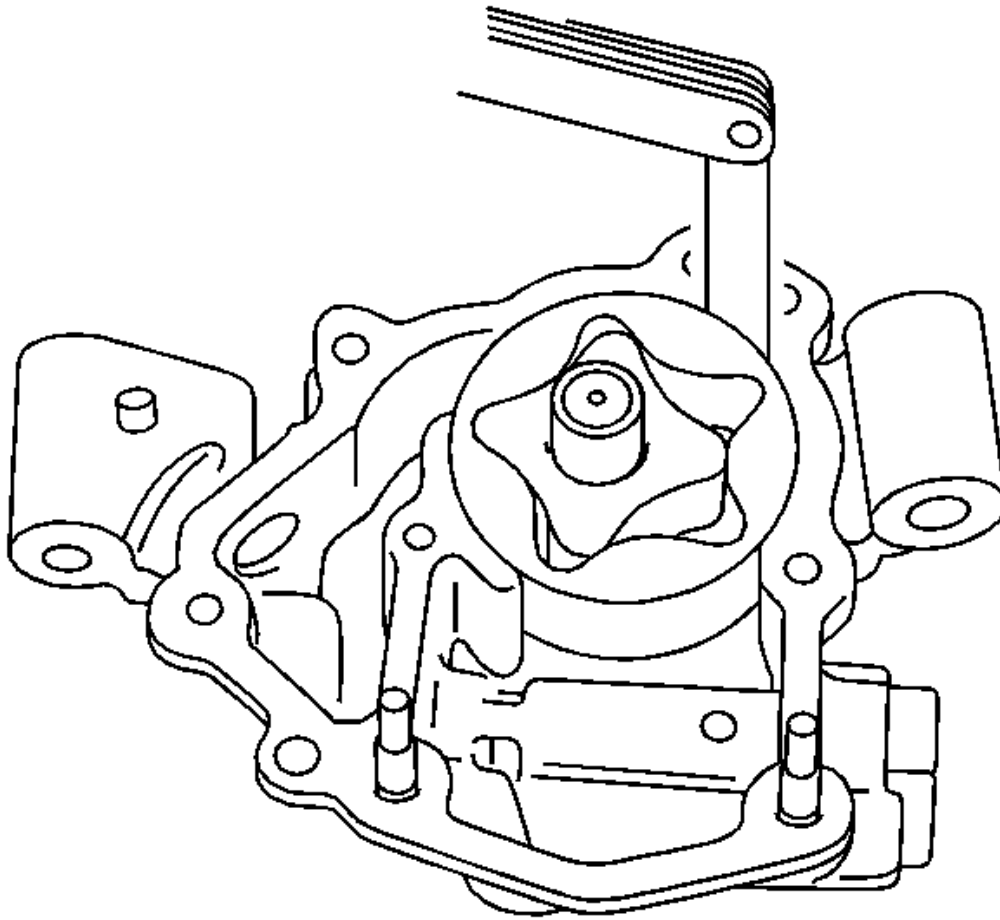


Fig. 156: Checking Oil Pump Body Clearance
Courtesy of GENERAL MOTORS CORP.

8. Check the body clearance.
9. Using a feeler gauge, measure the clearance between the driven rotor and pump body.

If the body clearance is greater than the maximum, replace the oil pump assembly.

Specification:

- Standard Clearance: 0.100-0 0.170 mm (0.0039-0.0067 in)
- Maximum Clearance: 0.325 mm (0.0128 in)

10. Inspect No. 2 chain sub-assembly.

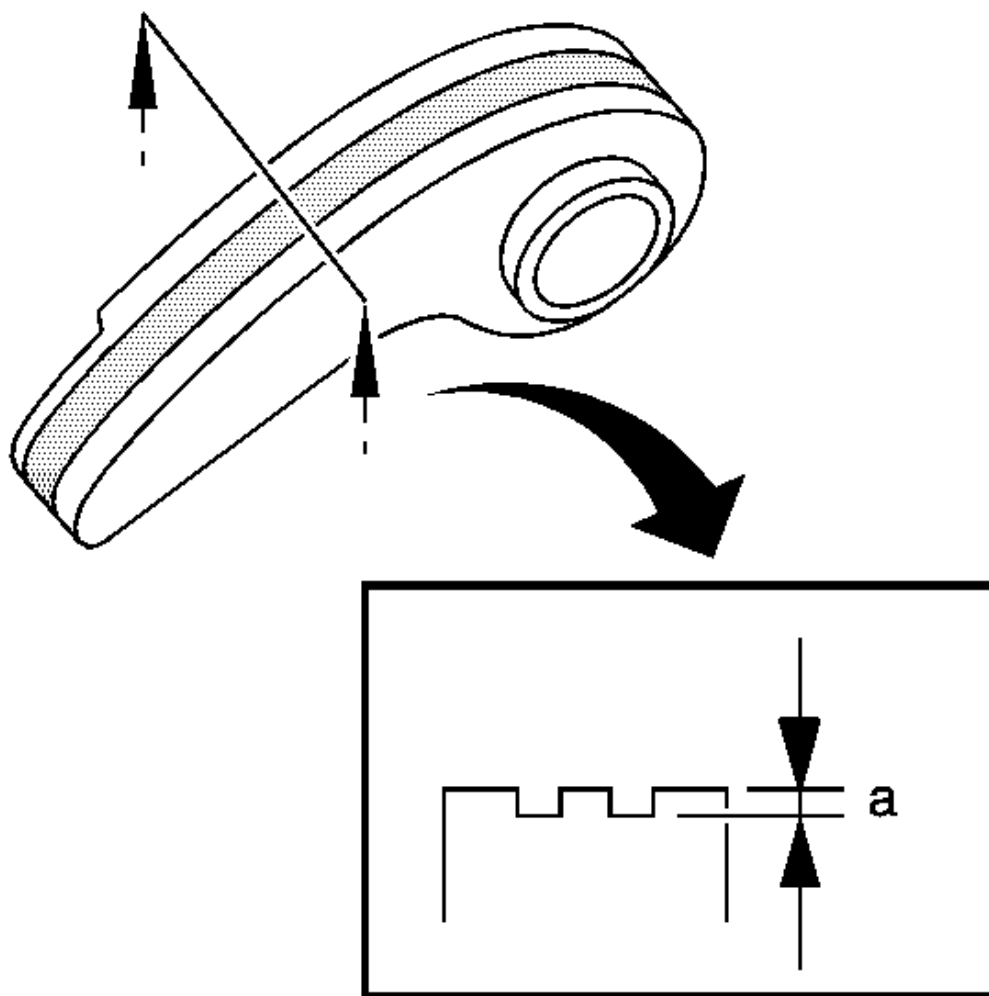


Fig. 157: Inspecting Chain Tensioner Plate
Courtesy of GENERAL MOTORS CORP.

11. Inspect chain tensioner plate.
12. Measure the chain tensioner plate wear.

If the wear (a) is greater than the maximum, replace the chain tensioner plate.

Specification: Maximum wear: 0.5 mm (0.020 in.)

REASSEMBLY PROCEDURE

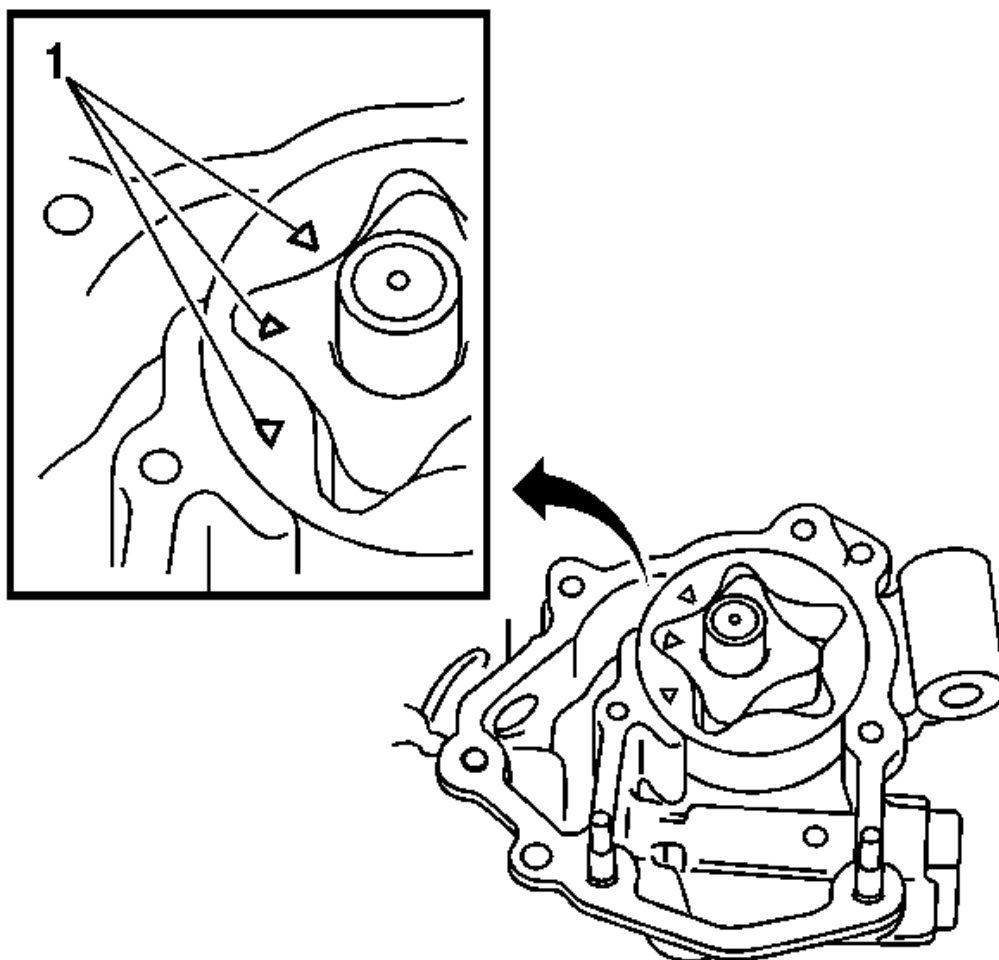


Fig. 158: Identifying Oil Pump Marks
Courtesy of GENERAL MOTORS CORP.

1. Coat the drive rotor and driven rotor with engine oil.
2. Place the drive and driven rotors into the oil pump with the marks (1) facing the pump cover side.

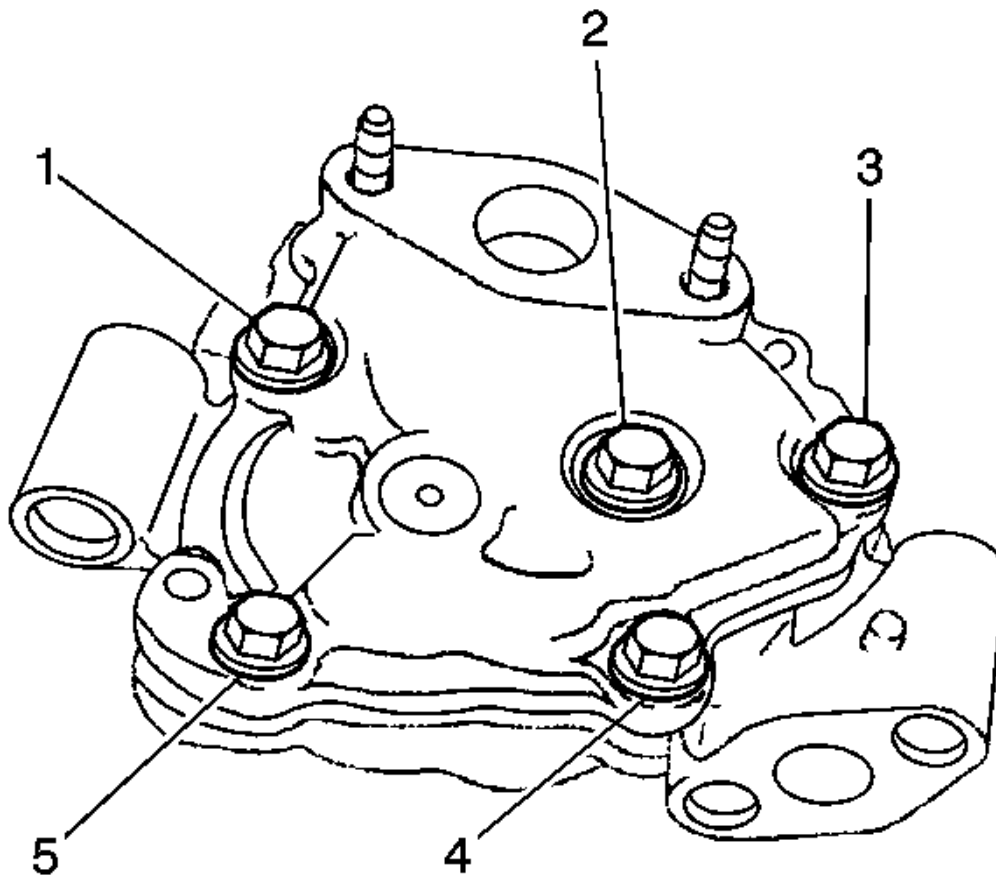


Fig. 159: View Of Oil Pump Cover & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

3. Install the oil pump cover with the 5 bolts (1-5) and tighten to 8.8 N.m (78 lb in).
4. Coat the relief valve with engine oil.

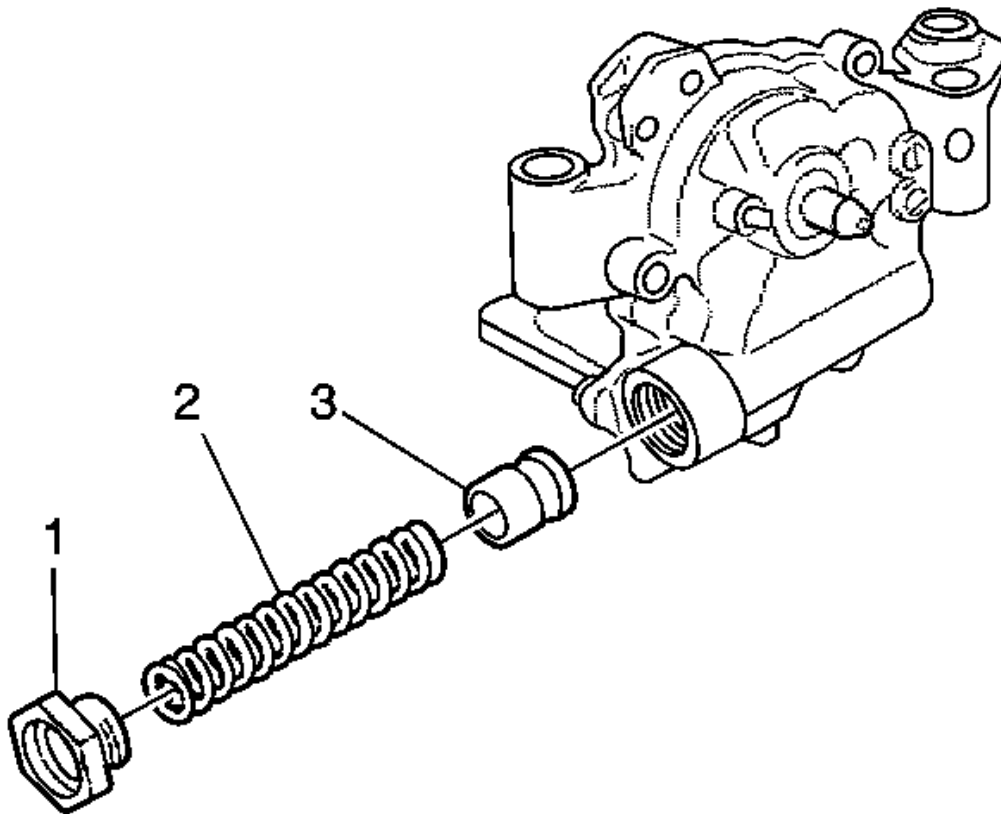


Fig. 160: View Of Oil Pump Valve Spring & Relief Valve
Courtesy of GENERAL MOTORS CORP.

5. Insert the relief valve (3) and spring (2) into the pump body hole.
6. Using a 27 mm socket wrench, install the plug (1) and tighten to 49 N.m (36 lb ft).

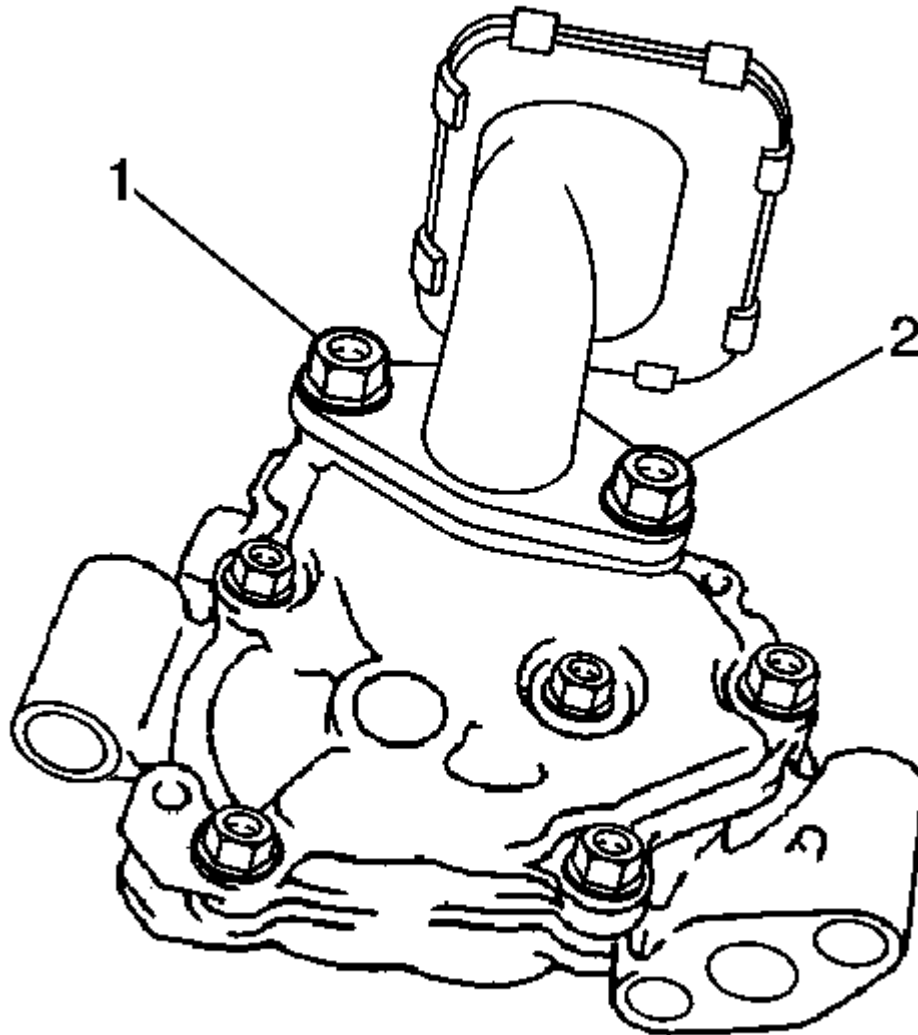


Fig. 161: Identifying Oil Pump Strainer & Gasket
Courtesy of GENERAL MOTORS CORP.

7. Install a new gasket and the oil strainer with the 2 nuts (1, 2) and tighten to 8.8 N.m (78 lb in).

INSTALLATION PROCEDURE

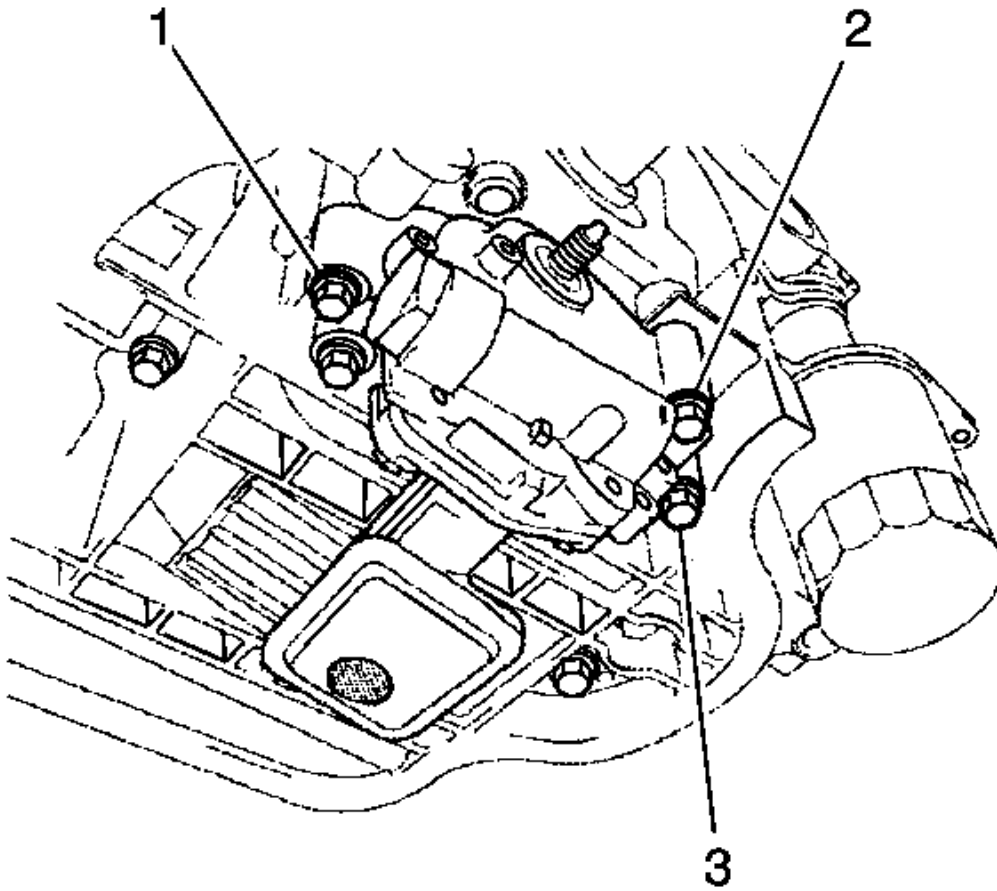


Fig. 162: Identifying Oil Pump, Gasket & Bolts
 Courtesy of GENERAL MOTORS CORP.

1. Install a new gasket and the oil pump with the 3 bolts (1, 2, 3) and tighten to 19 N.m (14 lb ft).
2. Install the No. 2 chain sub-assembly.
3. Install the crankshaft timing sprocket.
4. Install the No. 1 chain vibration damper.
5. Install the chain sub-assembly.
6. Install the chain tensioner slipper.
7. Install the timing chain guide.
8. Install the crankshaft position sensor plate.
9. Remove any old sealing material and be careful not to drop any oil on the contact surfaces of the timing chain cover, cylinder head and cylinder block.

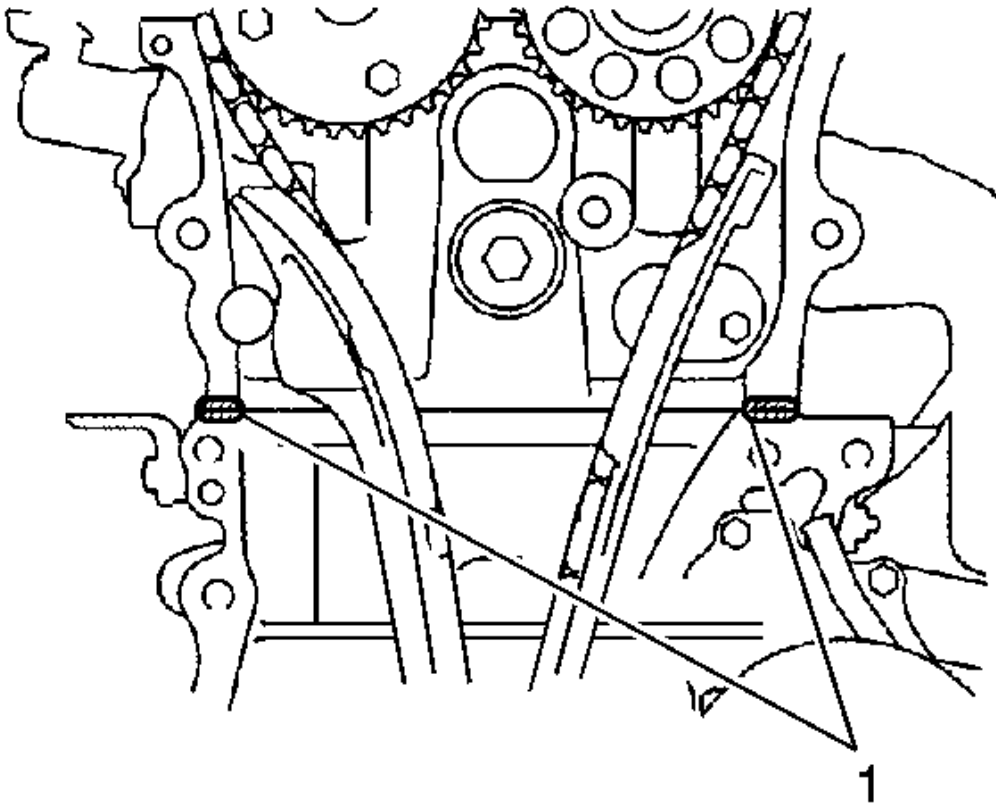


Fig. 163: Applying MP grease

Courtesy of GENERAL MOTORS CORP.

NOTE:

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

10. Apply Three Bond 1217B, or equivalent, GM part number 12378521 (Canadian part number 88901148) to the timing chain cover.

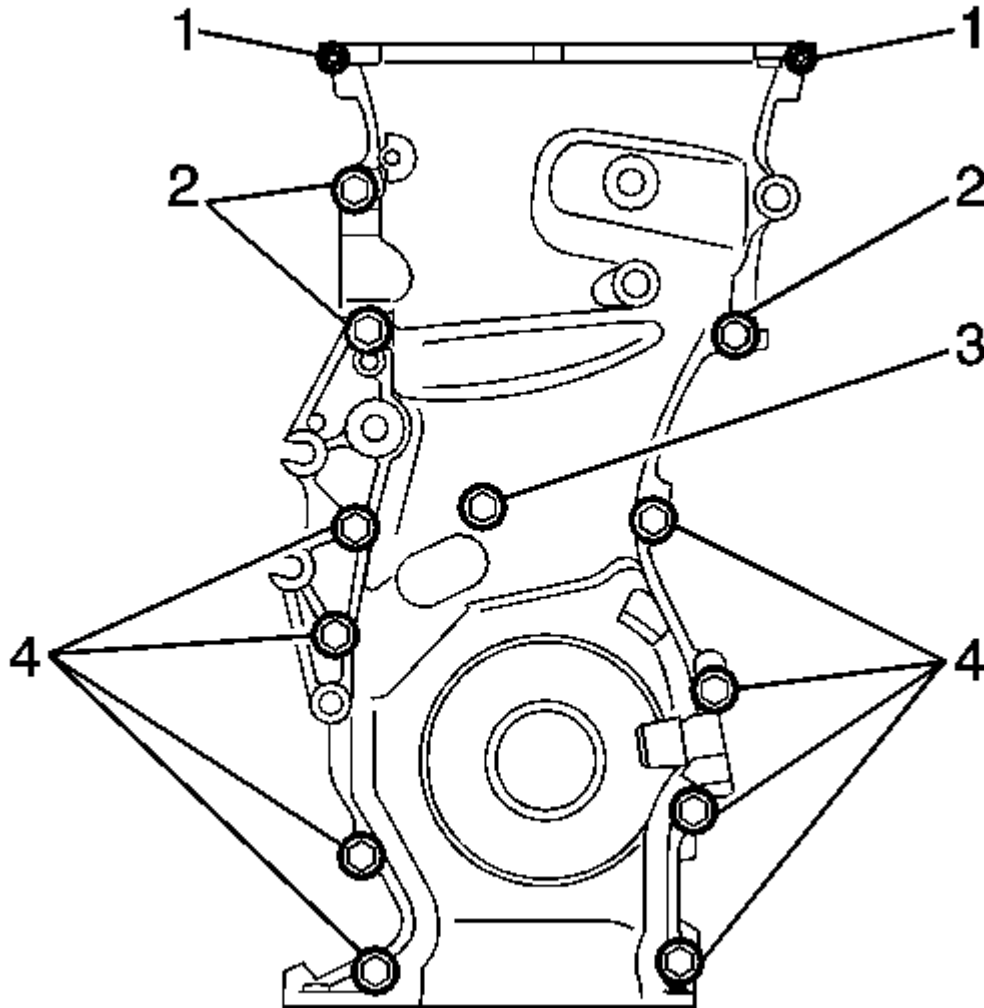


Fig. 164: Identifying Timing Chain Cover Bolts
Courtesy of GENERAL MOTORS CORP.

11. Install the timing chain cover with the 12 bolts (2, 3, 4) and 2 nuts (1) and tighten.
 - Bolt 3 to 9.0 N.m (80 lb in).
 - Bolts 4 to 25 N.m (18 lb ft).
 - Bolts 2 to 55 N.m (41 lb ft).
 - Nuts 1 to 11 N.m (8 lb ft).

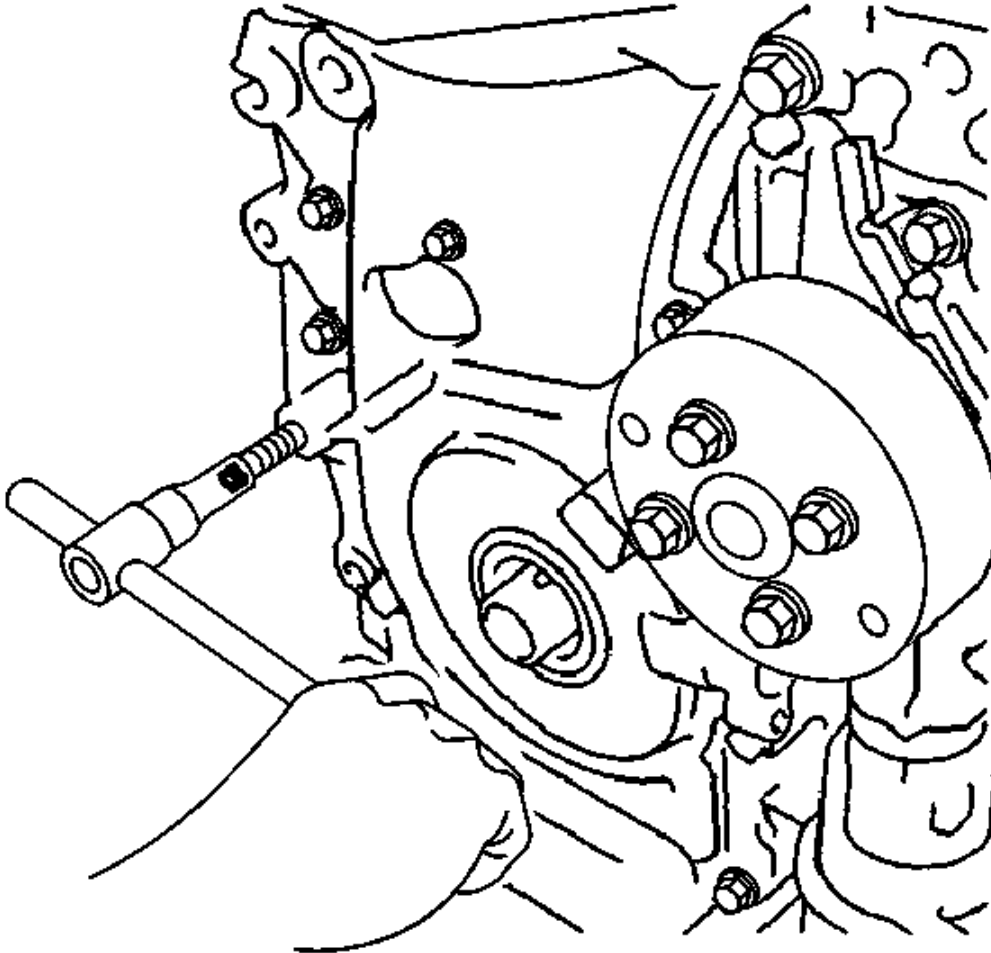


Fig. 165: Installing Stud Bolt For V-Ribbed Belt Tensioner
Courtesy of GENERAL MOTORS CORP.

12. Using an E10 TORX® socket, install the stud bolt for the V-ribbed belt tensioner and tighten to 22 N.m (16 lb ft).
13. Install the chain tensioner assembly.
14. Install the v-ribbed belt tensioner assembly.
15. Install the transverse engine mounting bracket.
16. Install the crankshaft pulley.
17. Install the oil pan.
18. Install the crankshaft position sensor.
19. Install the idler pulley.

20. Install the right engine mount.
21. Install the exhaust manifold converter. Refer to **Exhaust Manifold Replacement (2.4L)** .
22. Install the intake manifold insulator.
23. Install the intake manifold. Refer to **Intake Manifold Replacement**.
24. Install the camshaft timing oil control valve assembly.
25. Install the fuel delivery pipe sub-assembly.
26. Connect the fuel main tube.
27. Install the engine oil level dipstick guide.
28. Install the engine oil level dipstick.
29. Install the cylinder head cover. Refer to **Camshaft Cover Replacement**.
30. Install the spark plug. Refer to **Spark Plug Replacement** .
31. Install the ignition coil assembly. Refer to **Ignition Coil Replacement** .
32. Install the throttle body assembly.
33. Install the air cleaner cap with hose.
34. Install the radiator reserve tank assembly.
35. Connect the inlet heater water hose.
36. Connect the outlet heater water hose.
37. Install the radiator hose.
38. Install the generator assembly. Refer to **Generator Replacement (2.4L)** .
39. Install the v-ribbed belt. Refer to **Drive Belt Replacement**.
40. Install the front exhaust pipe assembly. Refer to **Front Pipe Replacement (2.4L AWD)** or **Front Pipe Replacement (2.4L FWD)** .
41. Install the catalytic converter assembly. Refer to **Catalytic Converter Replacement (2.4L AWD)** or **Catalytic Converter Replacement (2.4L FWD)** .
42. Connect the cable to negative battery terminal.
43. Add the engine oil. Refer to **Engine Oil and Oil Filter Replacement**.
44. Add the engine coolant. Refer to **Cooling System Draining and Filling** .
45. Inspect the fuel leak.
46. Inspect the coolant leak.
47. Inspect the oil leak.
48. Inspect the exhaust gas leak.
49. Inspect the ignition timing.
50. Inspect the engine idle speed.
51. Install the suspension tower damper assembly (with front strut bar).
52. Install the outer cowl top panel.
53. Install the windshield wiper motor and link assembly. Refer to **Windshield Wiper Motor Replacement**
54. Install the engine cover. Refer to **Engine Cover Replacement**.
55. Install the left engine under cover.

56. Install the right engine under cover.
57. Install the right front wheel.

CRANKSHAFT REAR OIL SEAL REPLACEMENT

Special Tools

- **J-8614-01:** Flange and Pulley Holding Tool
- **J-22928-B:** Seal Installer
- **J-42176:** Universal Driver Handle - Non-Threaded

REMOVAL PROCEDURE

1. Remove the automatic transaxle assembly. Refer to **Transmission Disassemble** , **Transmission Replacement** for the MVB 4 speed transmission or **Transmission Replacement** for the MVD 5 speed transmission.
2. Remove the manual transaxle assembly. Refer to **Transmission Replacement** for the MVC 5 speed transmission or **Transmission Replacement** for the MVE 5 speed transmission.
3. Remove the clutch cover and disc assembly (for manual transaxle).

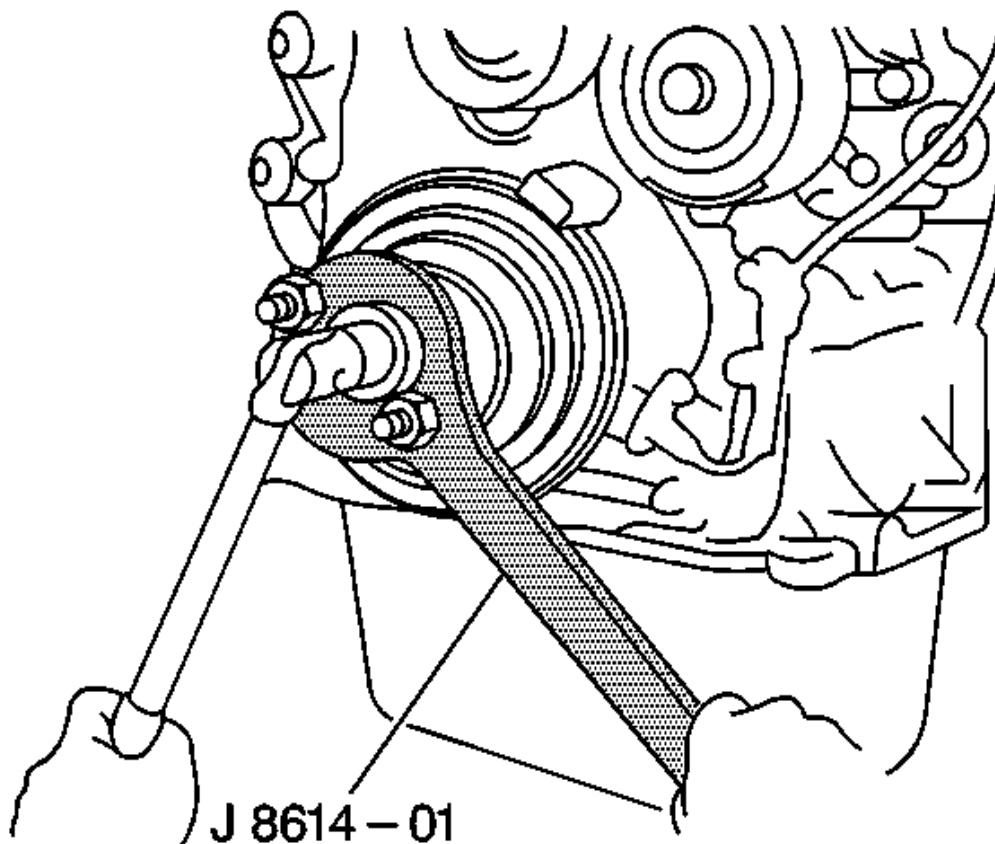


Fig. 166: Removing/Installing Crankshaft Pulley Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

4. Using **J-8614-01**: holding tool, hold the crankshaft.

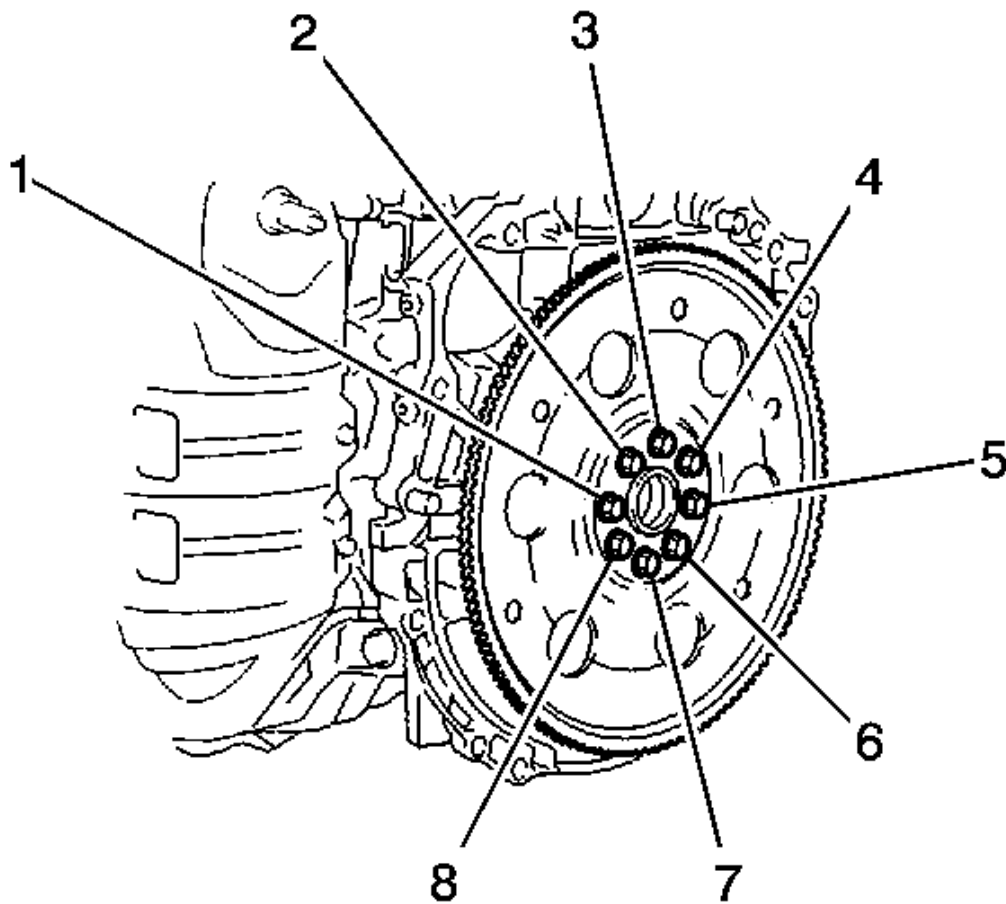


Fig. 167: Identifying Rear Drive Plate Spacer Bolts
Courtesy of GENERAL MOTORS CORP.

5. For automatic transmissions, remove the 8 bolts (1-8), rear drive plate spacer, drive plate and front drive plate spacer.

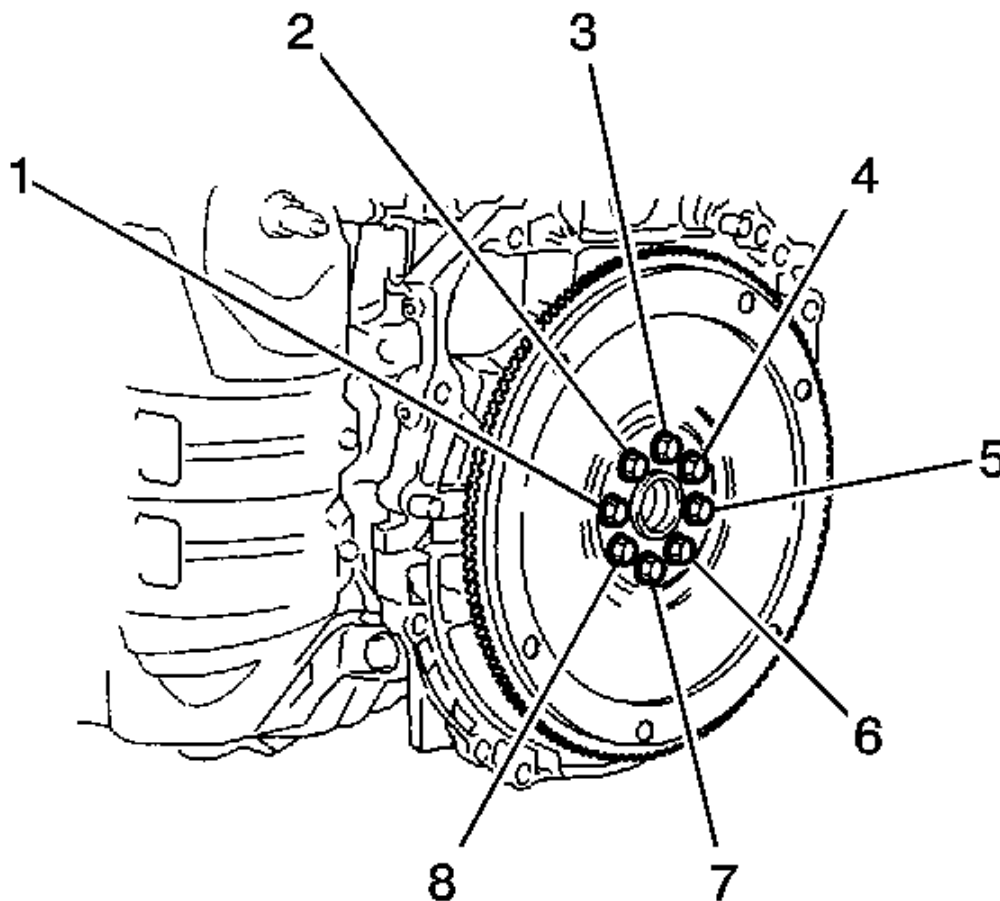


Fig. 168: View Of Flywheel & Bolts
Courtesy of GENERAL MOTORS CORP.

6. For manual transmissions, remove the 8 bolts (1-8) and flywheel.

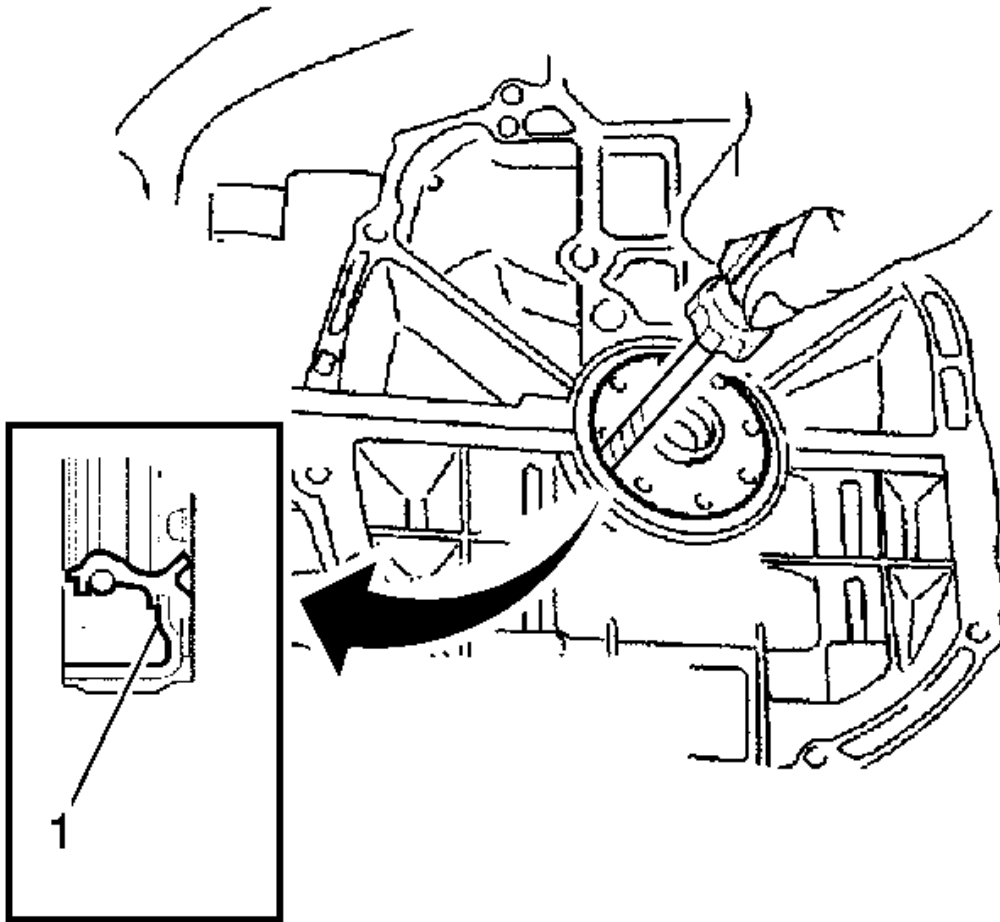


Fig. 169: Identifying Oil Seal

Courtesy of GENERAL MOTORS CORP.

7. Using a knife, cut off the lip of the oil seal (1).

NOTE:

- After removing, check the crankshaft for damage. If damaged, smooth the surface with 400-grit sandpaper.
- Tape the screwdriver tip before use.

8. Using a screwdriver, pry out the oil seal.

INSTALLATION PROCEDURE

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

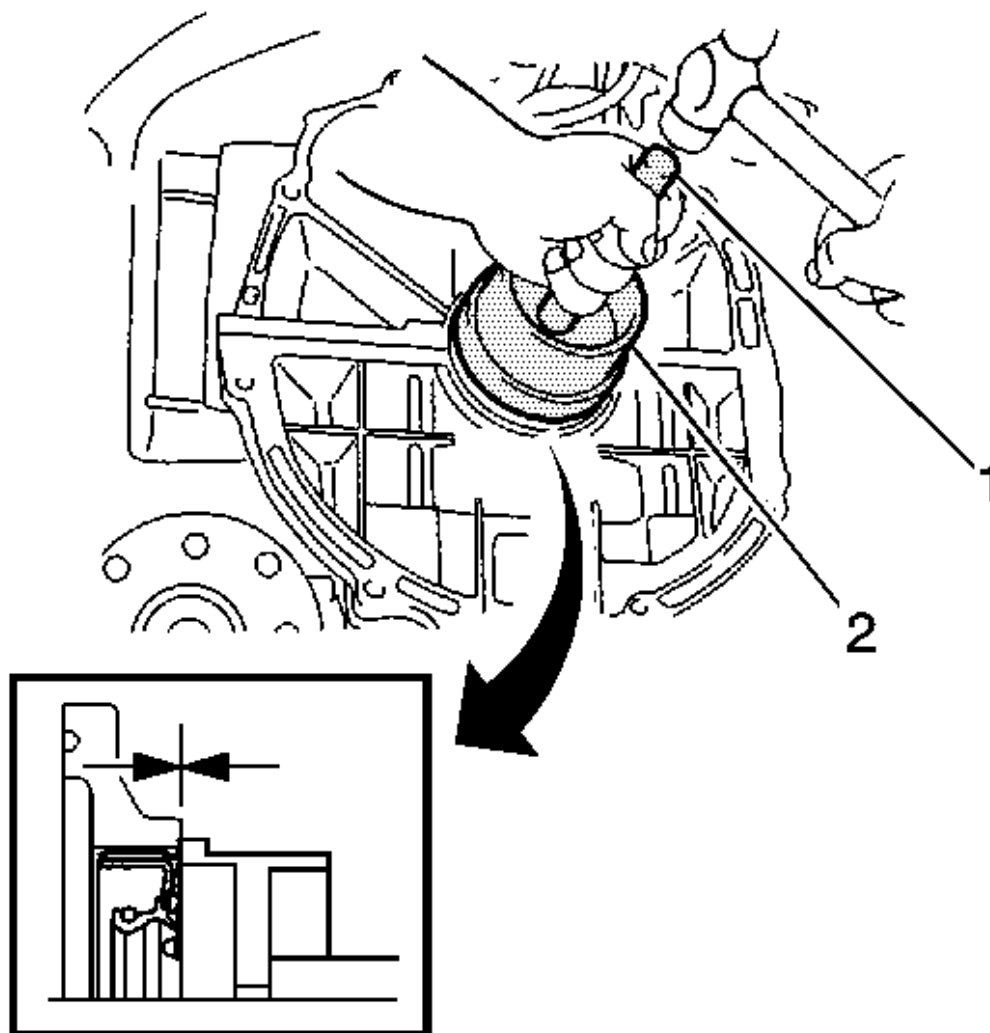


Fig. 170: Tapping In Rear Crankshaft Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Keep the lip free from foreign matter. Do not tap on the oil seal at an angle.

2. Using the **J-22928-B**: installer and a hammer (1, 2), tap in the rear crankshaft oil seal until its surface is flush with the rear oil seal retainer edge.
3. For automatic transaxle, clean the 8 bolts and 8 bolt holes.
4. Apply adhesive to 2 or 3 threads of the 8 bolts.

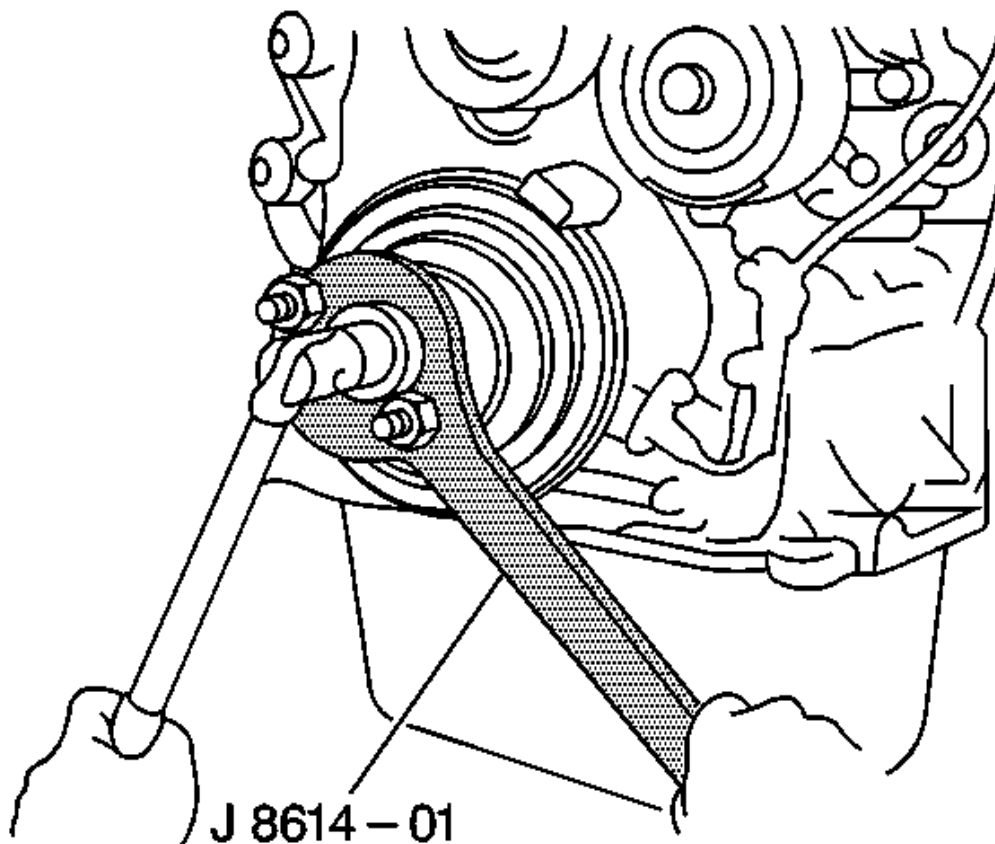


Fig. 171: Removing/Installing Crankshaft Pulley Retaining Bolt
Courtesy of GENERAL MOTORS CORP.

5. Using the **J-8614-01**: holding tool, hold the crankshaft.

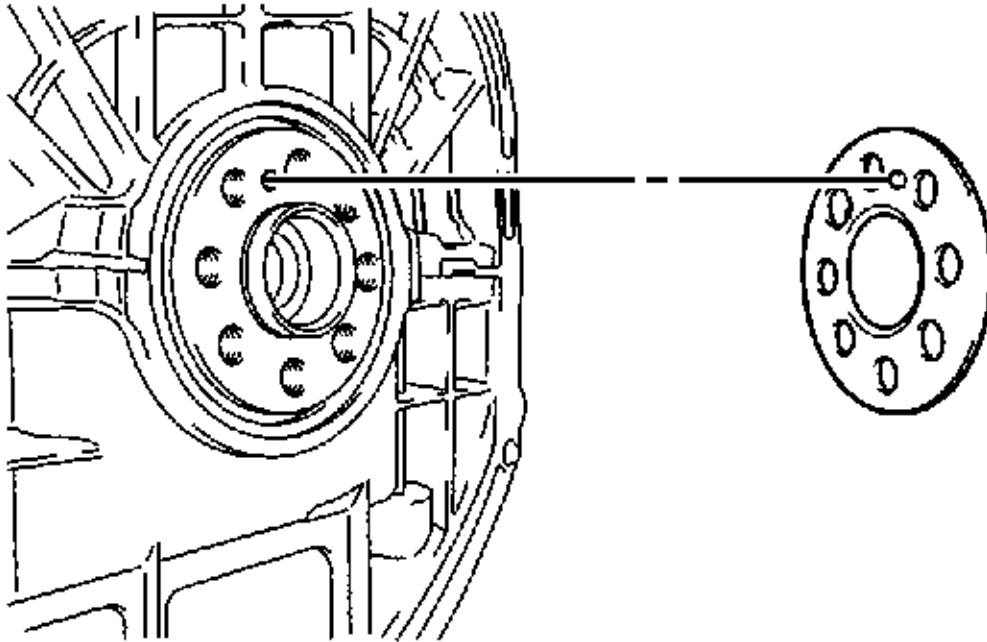


Fig. 172: Identifying Front Drive Plate Spacer
Courtesy of GENERAL MOTORS CORP.

NOTE: **Align the pin of the front spacer with the pin hole of the crankshaft.**

6. Install the front drive plate spacer.

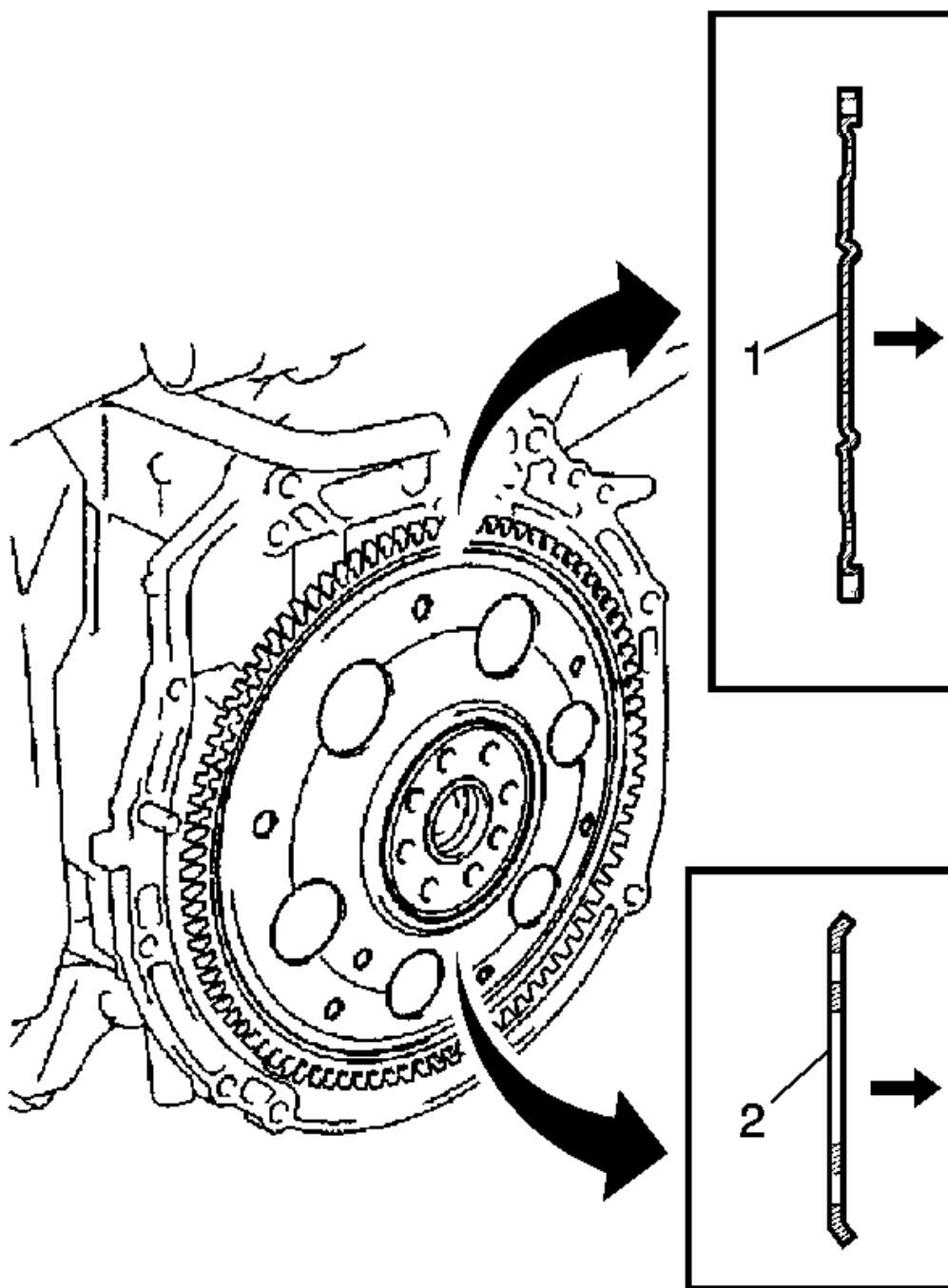


Fig. 173: View Of Drive Plate & Rear Drive Plate Spacer
Courtesy of GENERAL MOTORS CORP.

7. Install the drive plate (1) and rear drive plate spacer (2) onto the crankshaft.

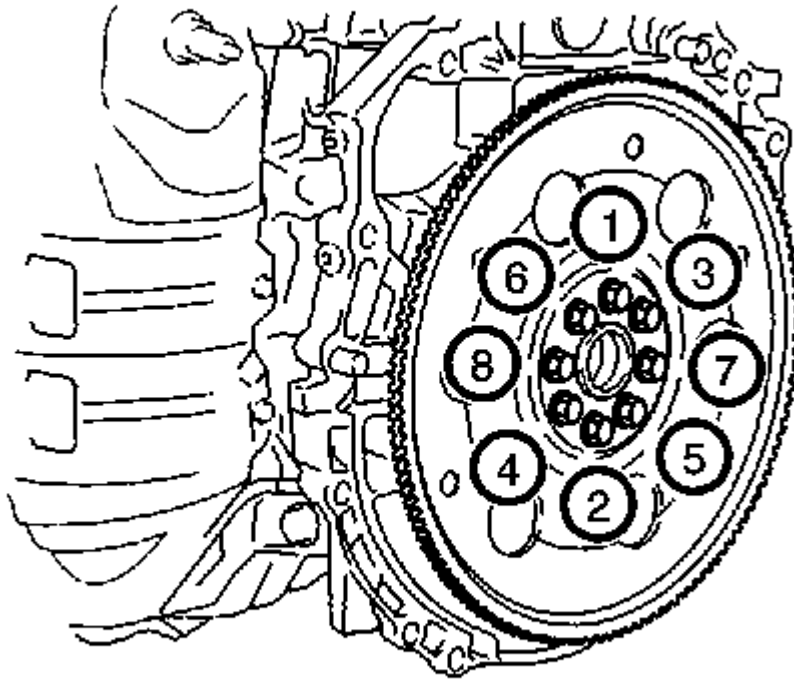


Fig. 174: Identifying Drive Plate Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution .

8. In several steps, uniformly install and tighten the 8 bolts in the sequence shown in the illustration to 98 N.m (72 lb ft).
9. For manual transaxle, clean the 8 bolts and 8 bolt holes.
10. Apply adhesive to the end 2 or 3 threads of the 8 bolts.

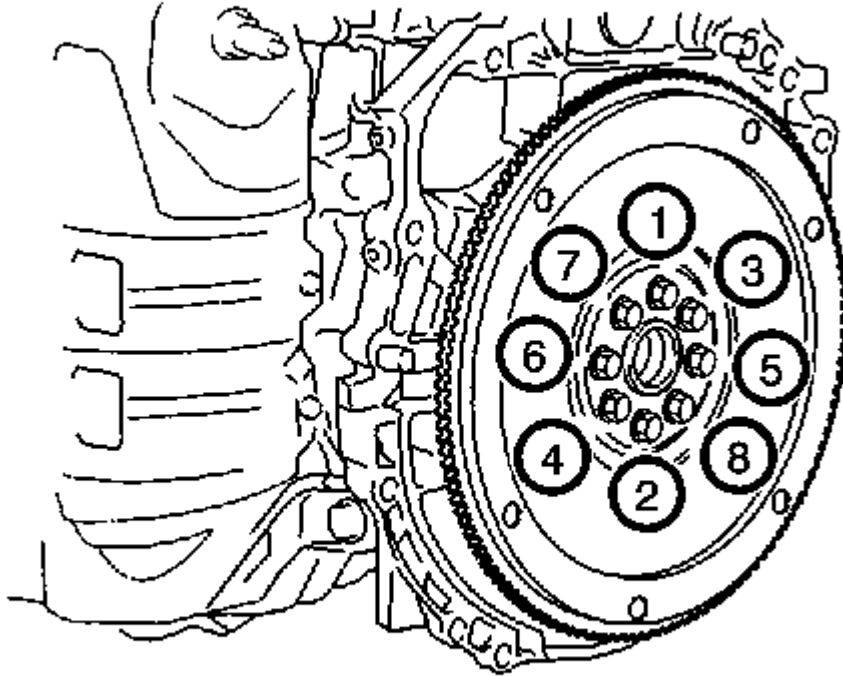


Fig. 175: Identifying Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

11. In several steps, uniformly install and tighten the 8 bolts in the sequence shown in the illustration to 130 N.m (96 lb ft).
12. Install the clutch disc assembly (for manual transaxle).
13. Install the clutch cover assembly (for manual transaxle).
14. Install the automatic transaxle assembly. Refer to **Transmission Disassemble** , **Transmission Replacement** for the MVB 4 speed transmission or **Transmission Replacement** for the MVD 5 speed transmission.
15. Install the manual transaxle assembly. Refer to **Transmission Replacement** for the MVC 5 speed transmission or **Transmission Replacement** for the MVE 5 speed transmission.

ENGINE REPLACEMENT

REMOVAL PROCEDURE

1. Align front wheels facing straight ahead.
2. Discharge fuel system pressure. Refer to **Fuel Pressure Relief** .

3. Disconnect the cable from negative battery terminal. Refer to **Battery Negative Cable Disconnection and Connection**.
4. Remove the front wheels.
5. Remove the engine under left cover.
6. Remove the engine under right cover.
7. Drain the engine coolant. Refer to **Cooling System Draining and Filling**.
8. Drain the transfer case.

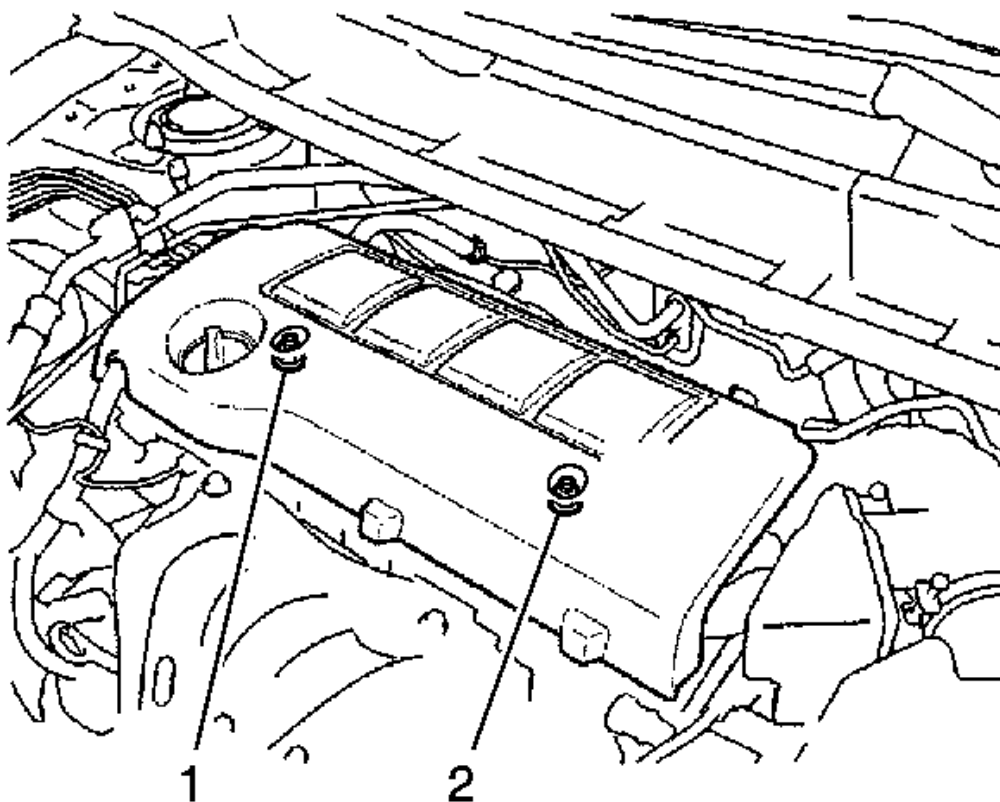


Fig. 176: Identifying Engine Cover Nuts
Courtesy of GENERAL MOTORS CORP.

9. Remove the 2 nuts (1, 2) and the engine cover.

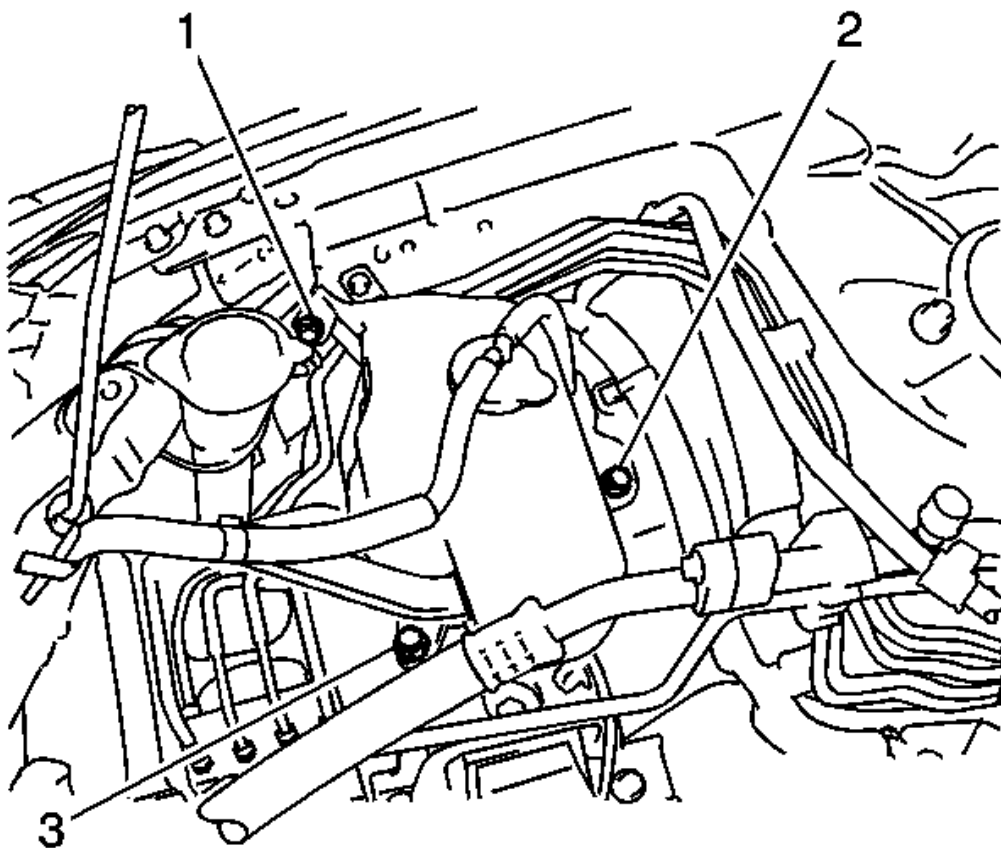


Fig. 177: Identifying Radiator Reserve Tank Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Separate the 3 bolts (1, 2, 3) and radiator reserve tank assembly.
11. Remove air cleaner cap with hose.

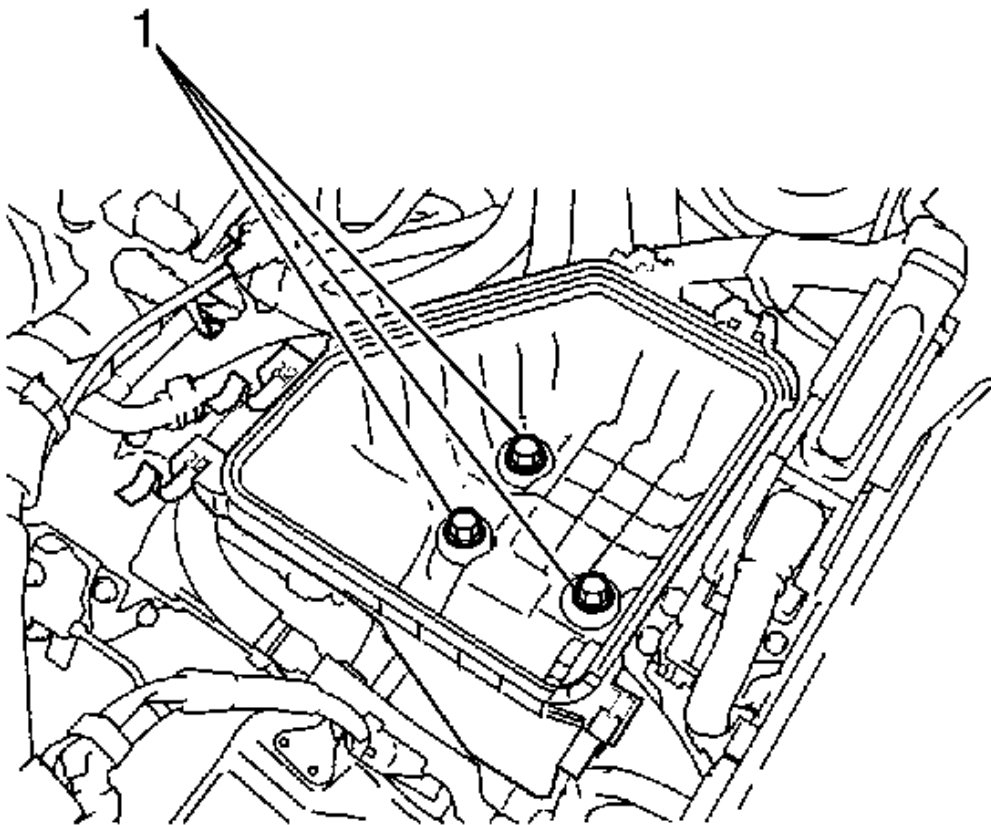


Fig. 178: Identifying Air Cleaner Case & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Remove the 3 bolts (1) and air cleaner case.

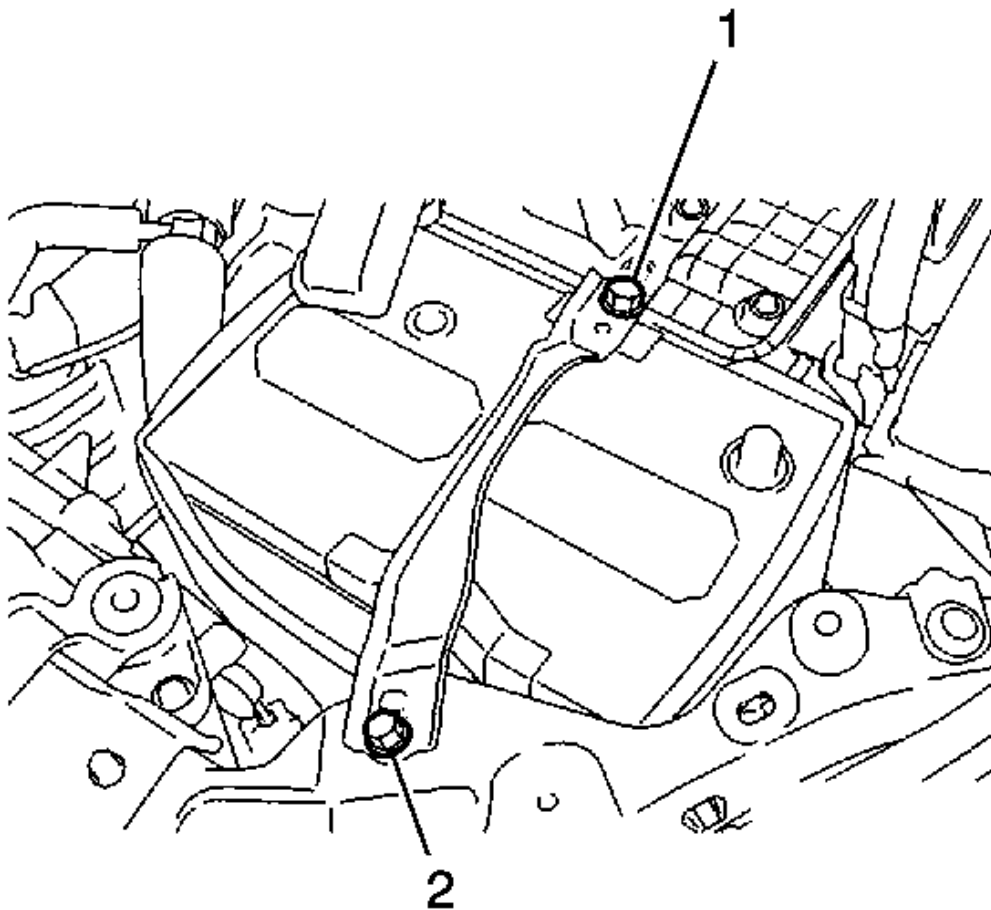


Fig. 179: Identifying Battery Clamp Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

13. Remove the bolt (2), nut (1) and battery clamp.
14. Remove the battery and battery insulator.

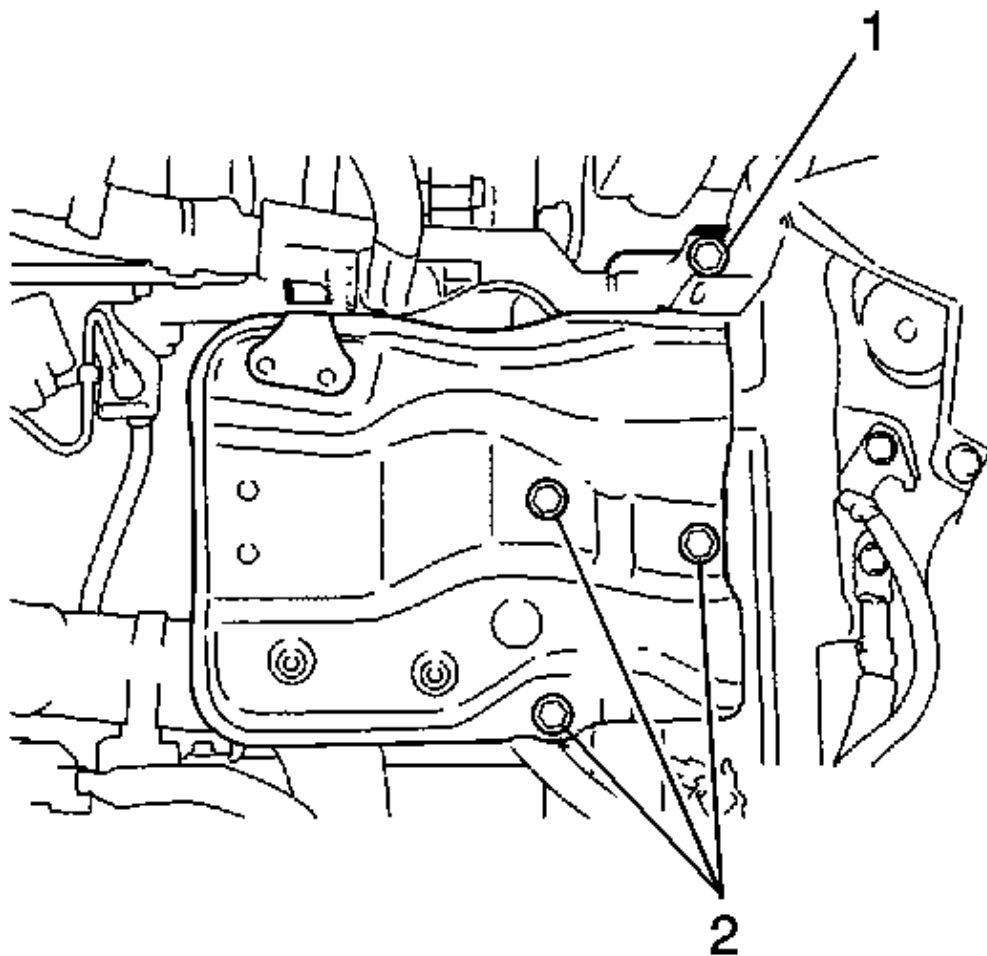


Fig. 180: Identifying Bolts & Battery Carrier
Courtesy of GENERAL MOTORS CORP.

15. Separate the 2 wire harness clamps from the battery carrier.
16. Remove the 4 bolts (1, 2) and battery carrier.

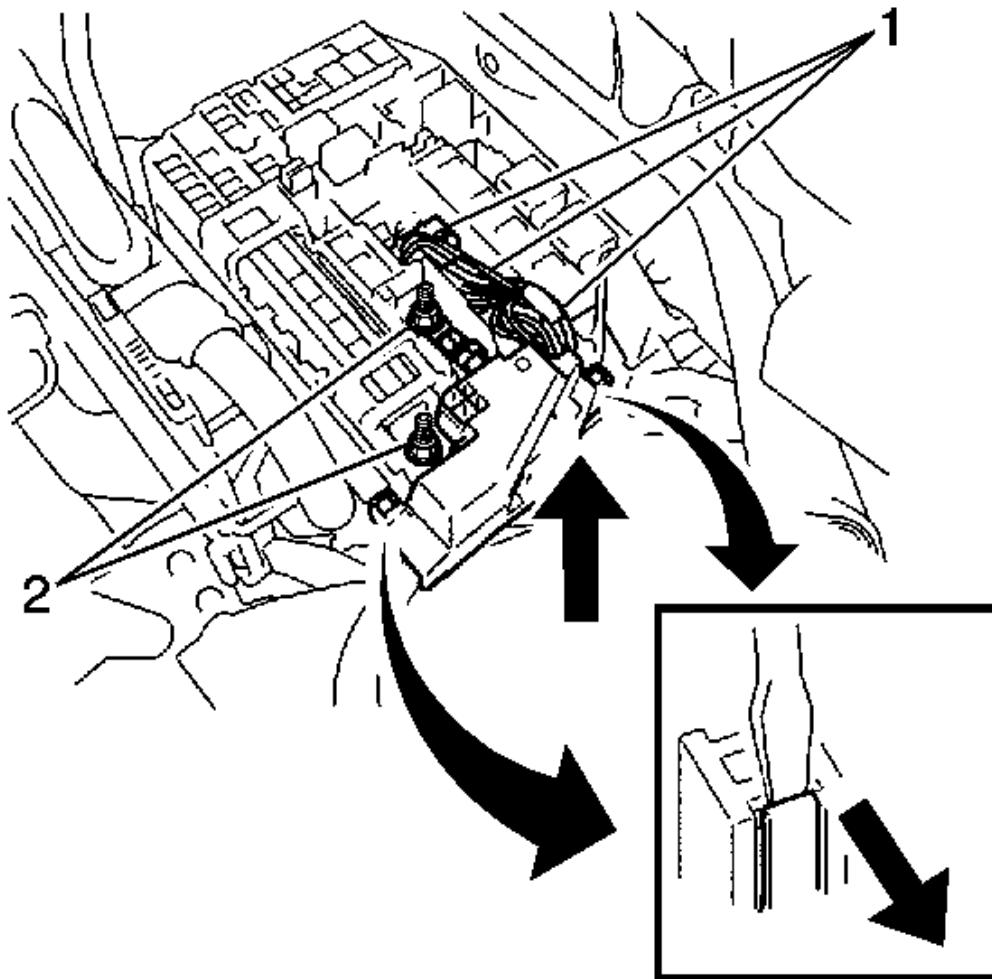


Fig. 181: Identifying Wire Harness & Fasteners
Courtesy of GENERAL MOTORS CORP.

17. Separate wire harness.
18. Disconnect the 3 connectors (1) from the engine room relay block.
19. Remove the 2 nuts (2) from the engine room relay block.
20. Using a screwdriver, unlock the 2 claws.
21. Pull the engine room relay block upward.

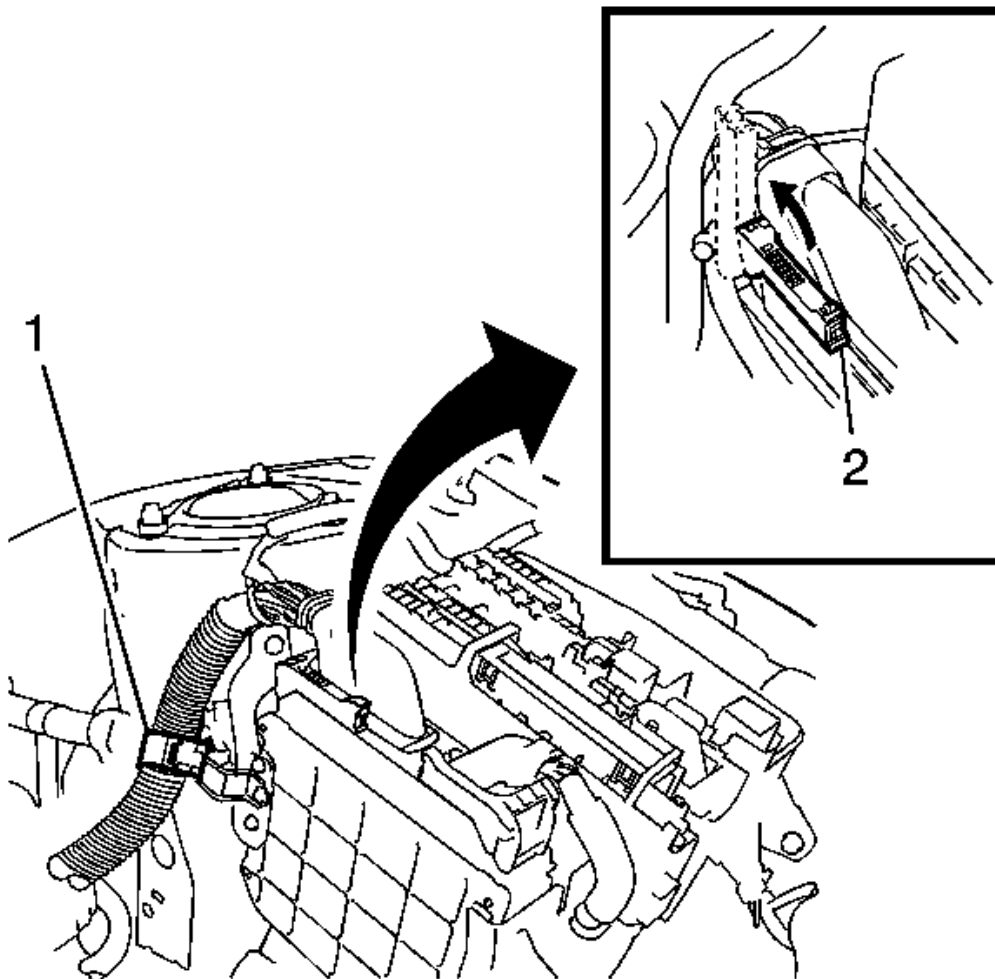


Fig. 182: View Of Lever & ECM Connector
Courtesy of GENERAL MOTORS CORP.

22. Pull up the lever and disconnect the ECM connector.
23. Disconnect the harness clamp (1).

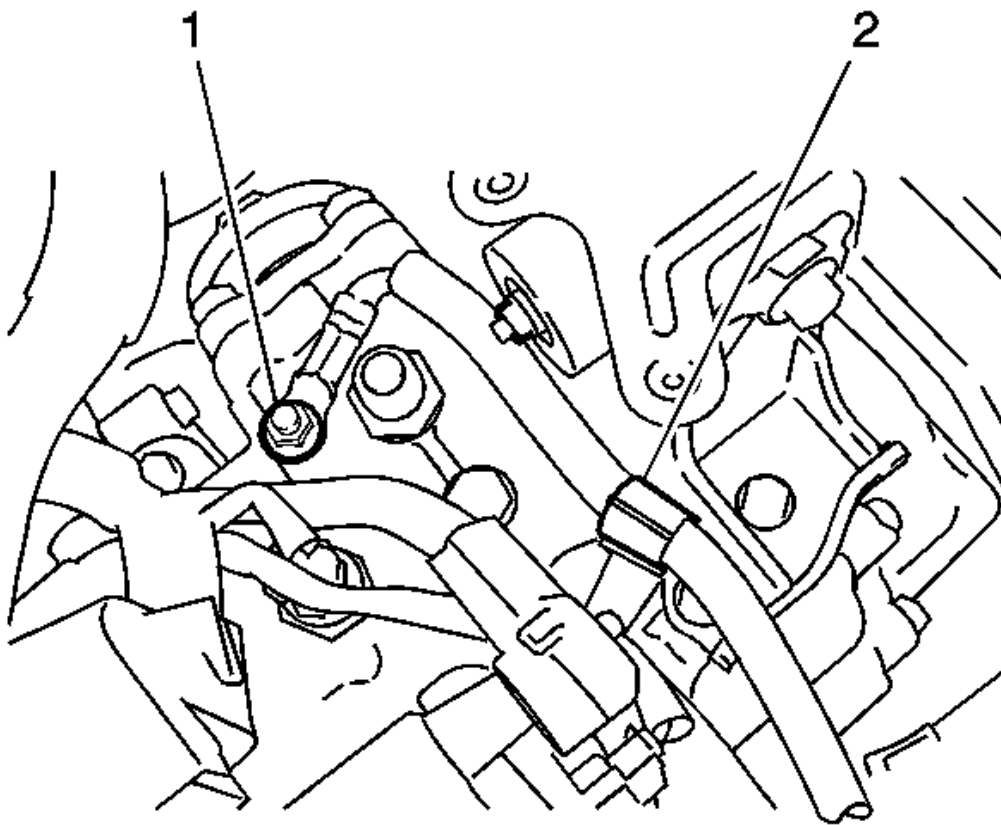


Fig. 183: Identifying Clamp & Ground Cable - Manual Transaxle
Courtesy of GENERAL MOTORS CORP.

24. Remove the bolt, clamp (2) and disconnect the ground cable (1) (for Manual Transaxle).

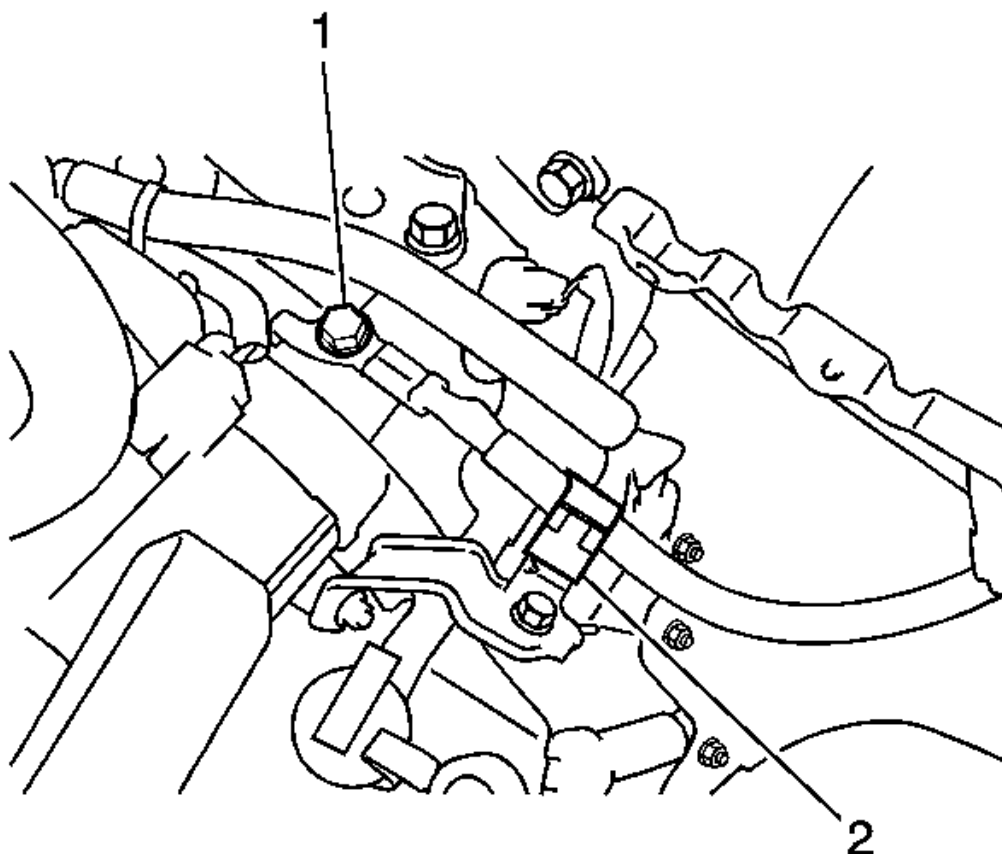


Fig. 184: Identifying Clamp & Ground Cable - Automatic Transaxle
 Courtesy of GENERAL MOTORS CORP.

25. Remove the bolt, clamp (2) and disconnect the ground cable (1) (for Automatic Transaxle).
26. Remove the V-ribbed belt. Refer to **Drive Belt Replacement**.
27. Remove the generator assembly. Refer to **Generator Replacement (2.4L)**

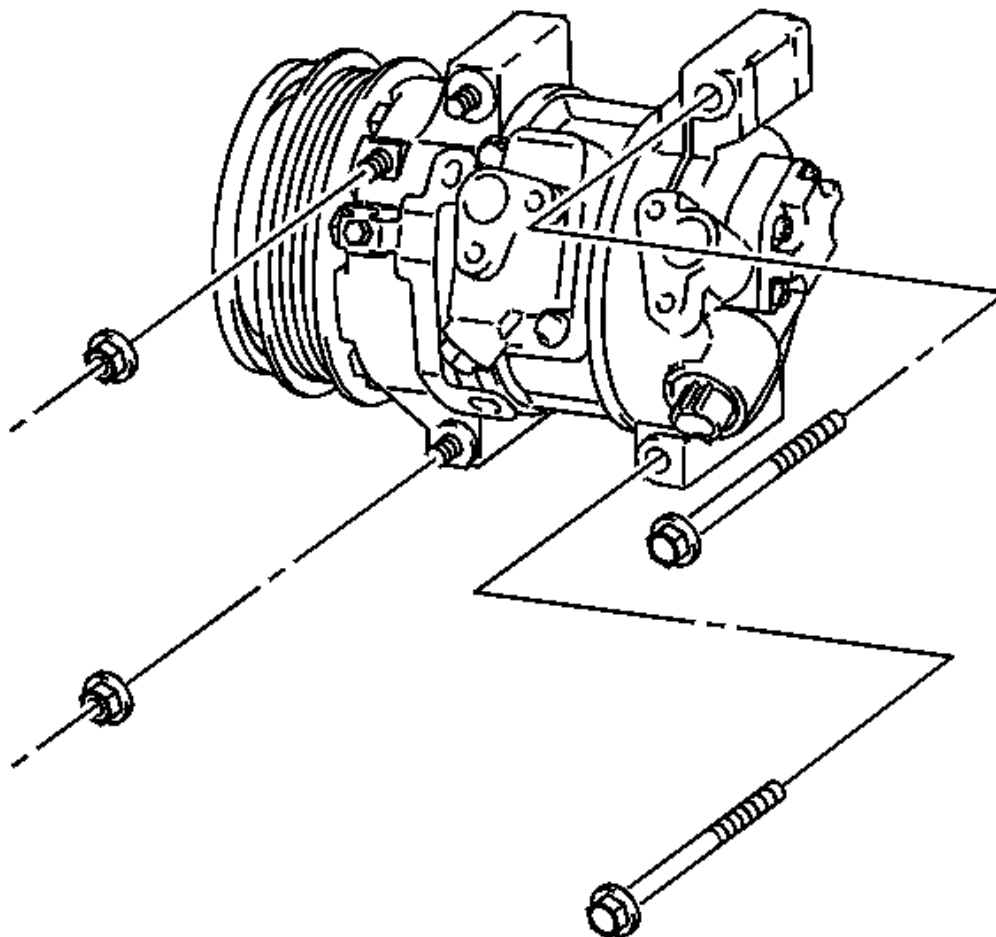


Fig. 185: Identifying A/C Compressor Bolts & Nuts
Courtesy of GENERAL MOTORS CORP.

28. Remove the 2 bolts and 2 nuts.

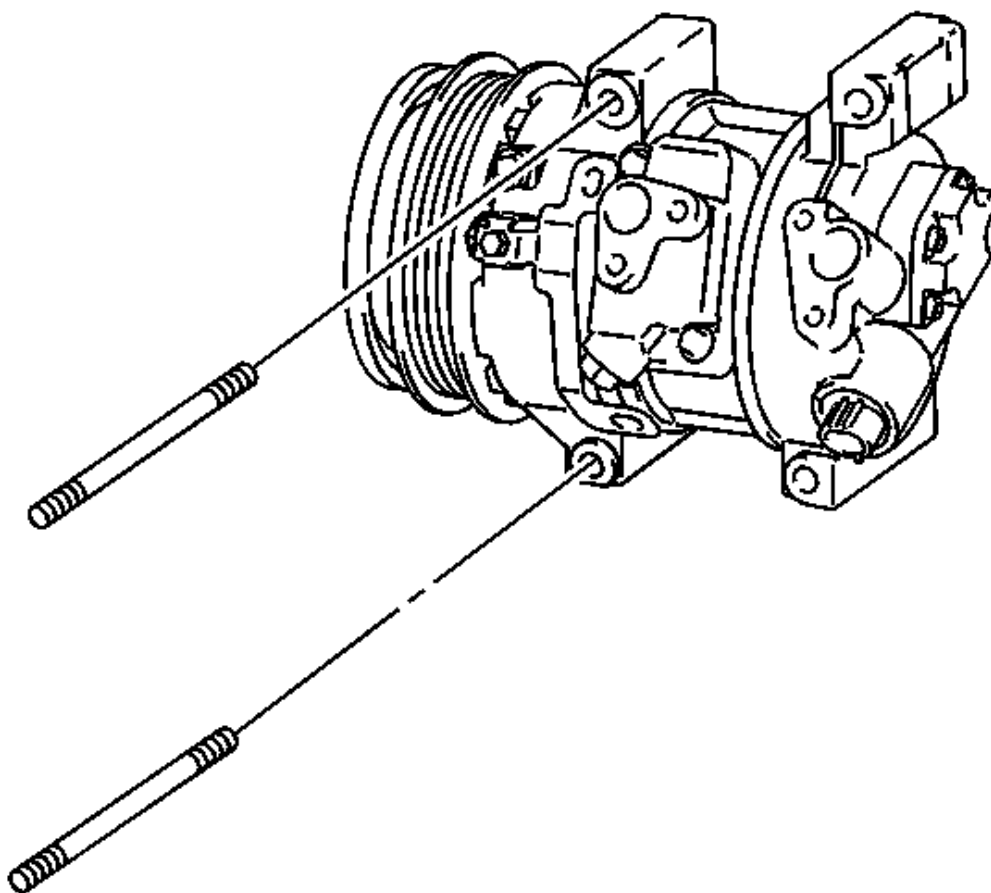


Fig. 186: Identifying A/C Compressor Studs
Courtesy of GENERAL MOTORS CORP.

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

29. Using a TORX socket wrench (E8), remove the 2 stud bolts and compressor assembly (with Air Conditioning System) with pulley.

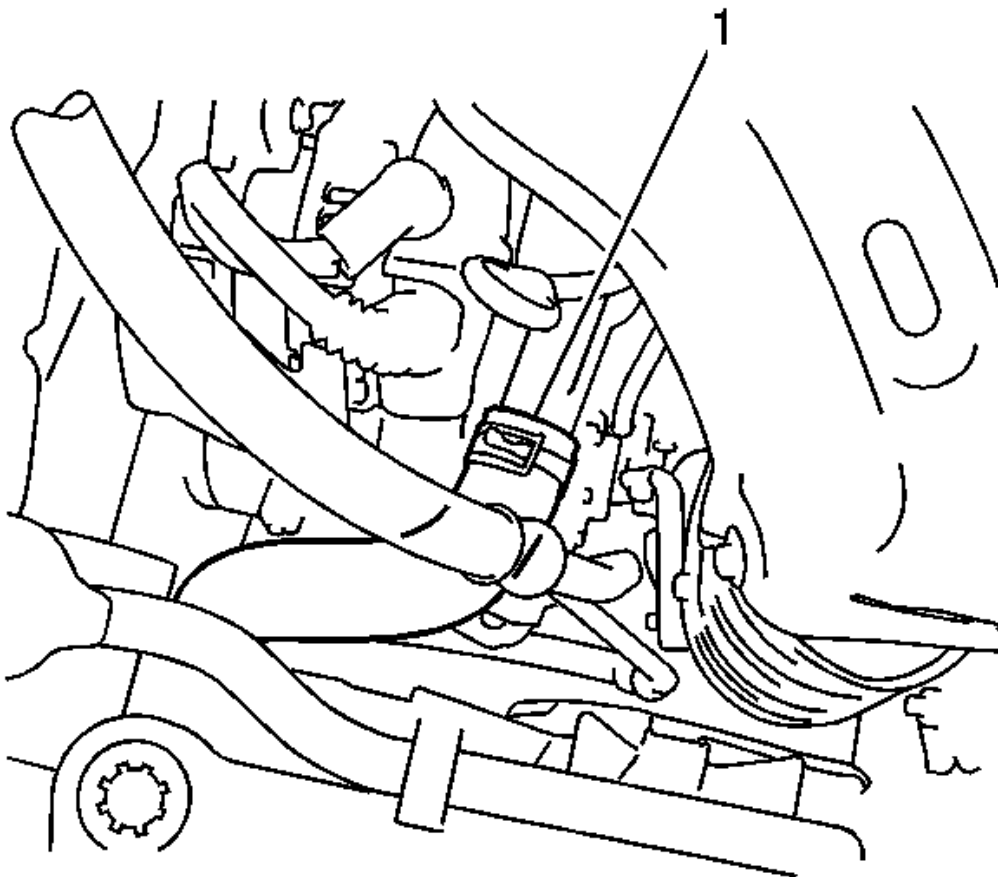


Fig. 187: Locating Upper Radiator Hose
Courtesy of GENERAL MOTORS CORP.

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

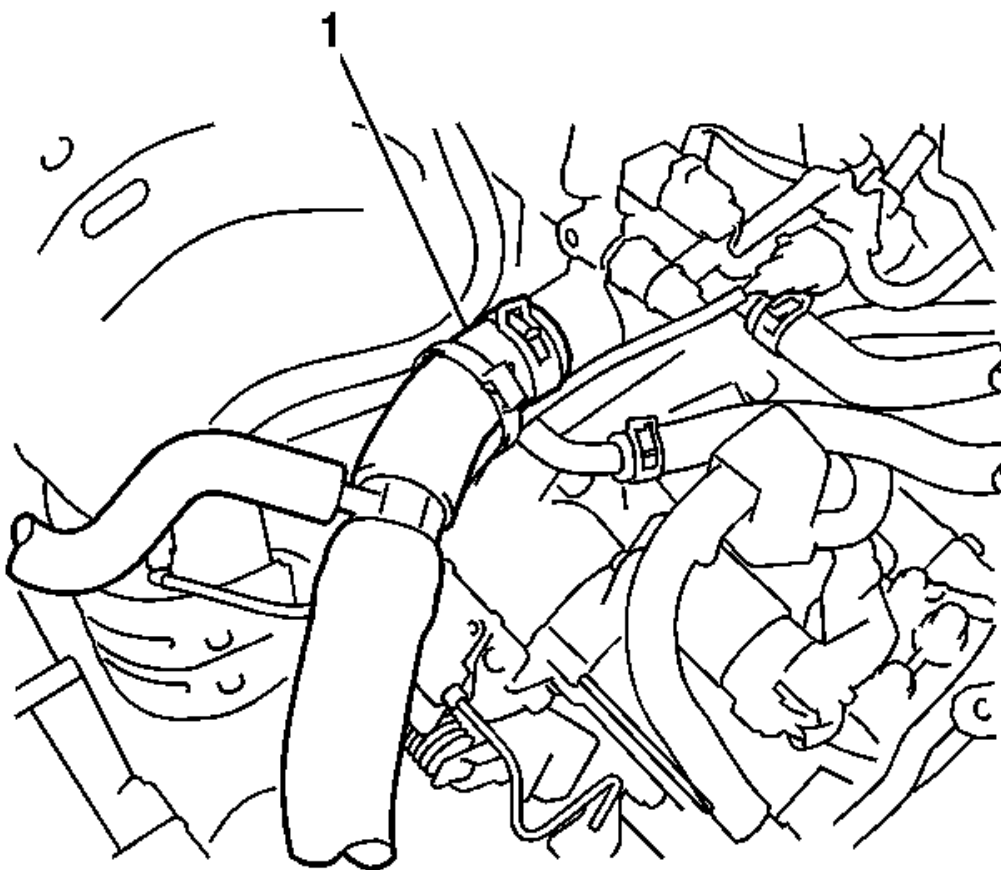


Fig. 188: View Of Upper Radiator Hose At Cylinder Head
Courtesy of GENERAL MOTORS CORP.

31. Disconnect the upper radiator hose (1) from the cylinder head.

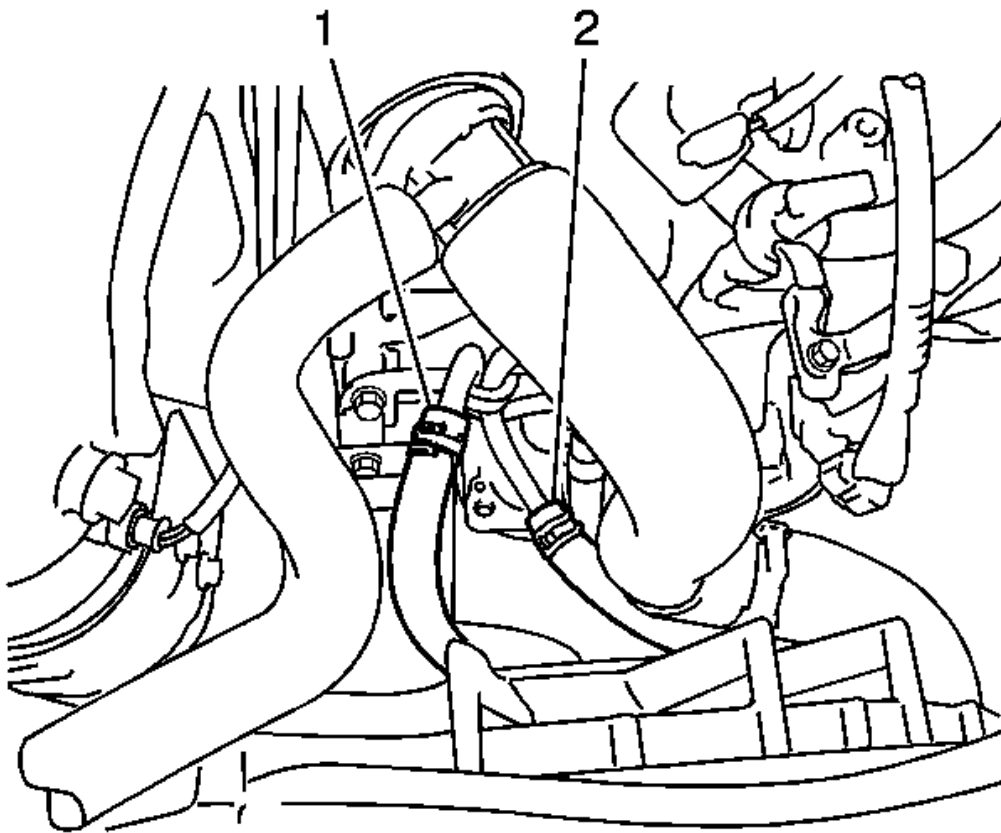


Fig. 189: View Of Oil Cooler Hoses - Automatic Transaxle
Courtesy of GENERAL MOTORS CORP.

32. Disconnect the 2 oil cooler hoses (1, 2) (for Automatic Transaxle).
33. Disconnect the breather hose (for Automatic Transaxle)



Fig. 190: View Of Heater Water Outlet Hose
Courtesy of GENERAL MOTORS CORP.

34. Disconnect the outlet heater water hose (1).
35. Disconnect the inlet heater water hose.

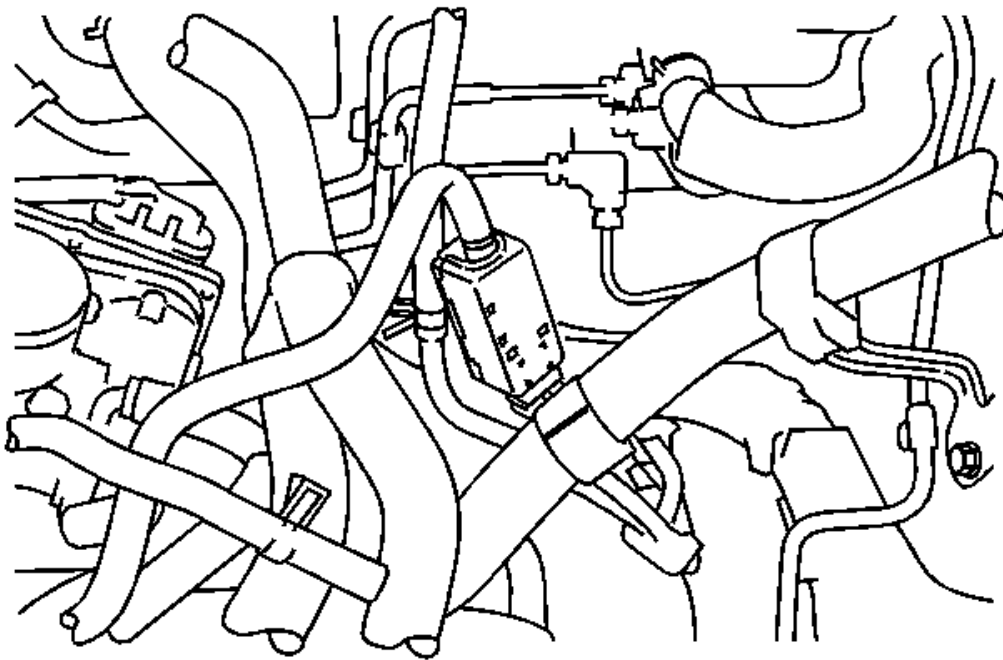


Fig. 191: Identifying Fuel Pipe Clamp
Courtesy of GENERAL MOTORS CORP.

36. Release the claw and remove the fuel pipe clamp.

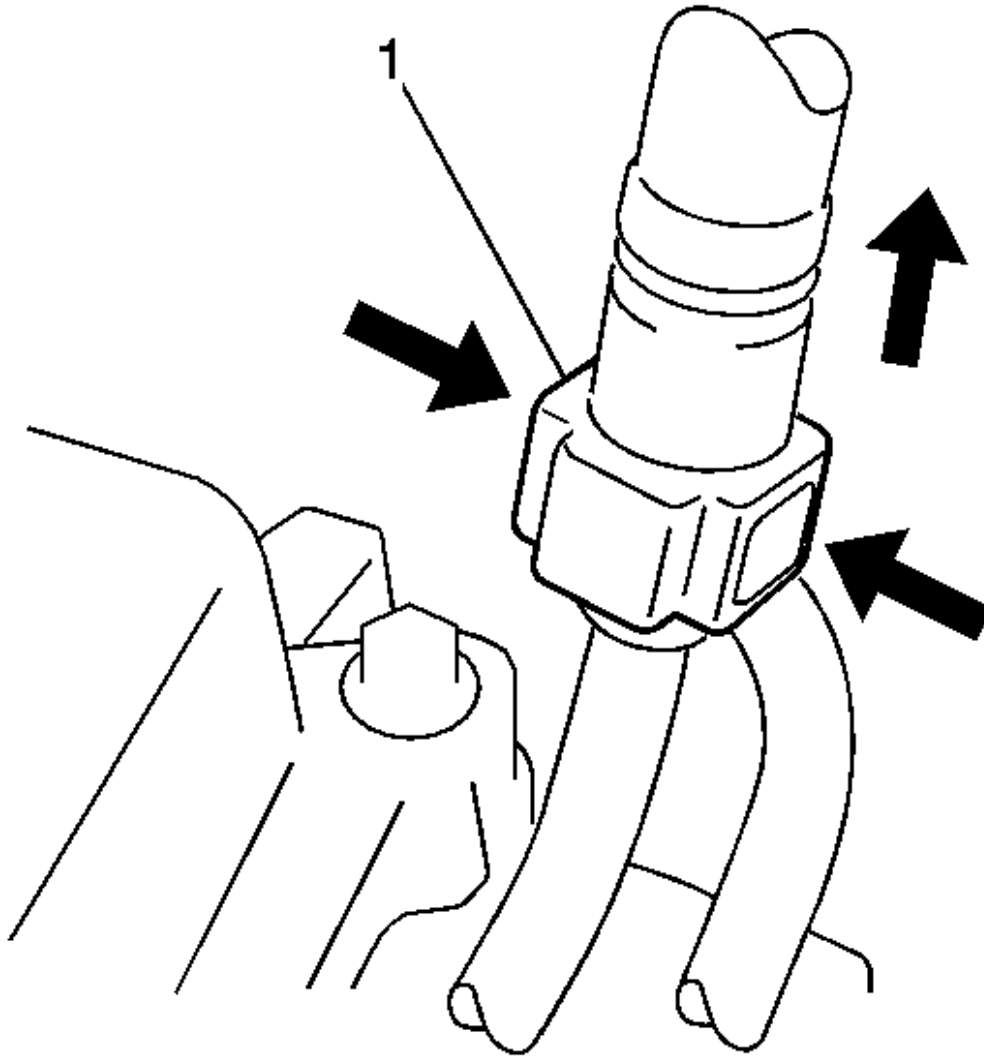


Fig. 192: View Of Fuel Tube Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: Remove any dirt or 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 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.

37. Pinch the retainer (1) as illustrated, then pull the fuel tube connector out of the pipe.

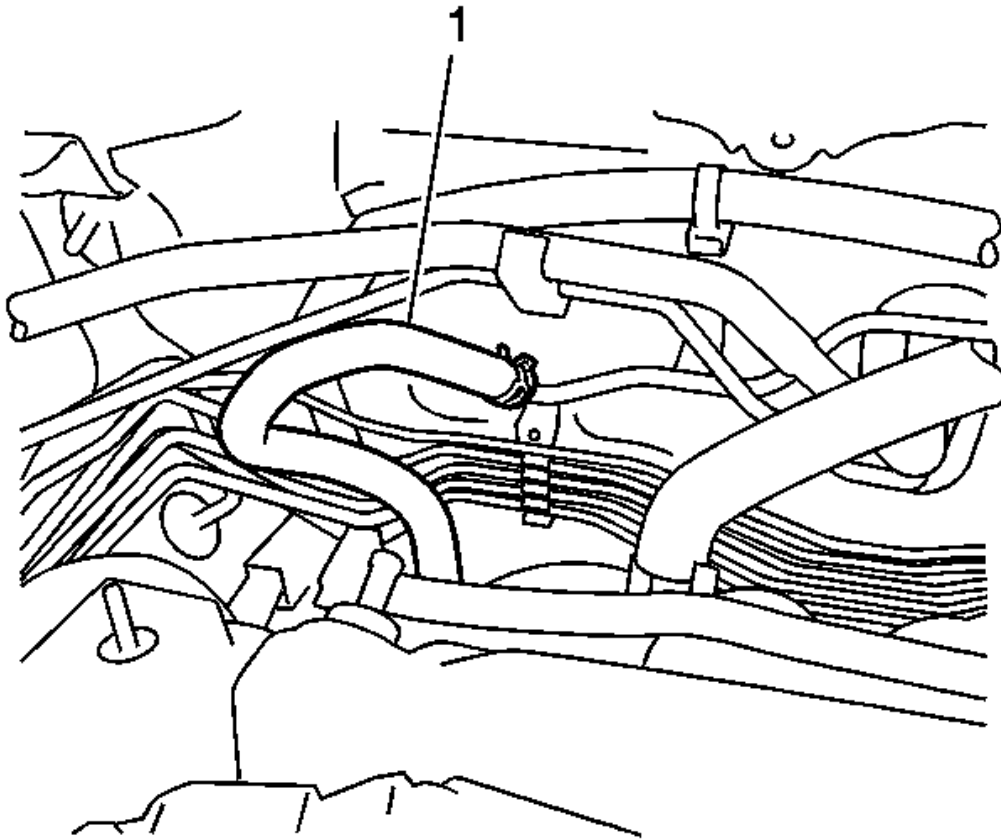


Fig. 193: Identifying Connector Tube Hose Union
Courtesy of GENERAL MOTORS CORP.

38. Disconnect the union to connector tube hose (1).
39. Separate the clutch release cylinder assembly (for Manual Transaxle).

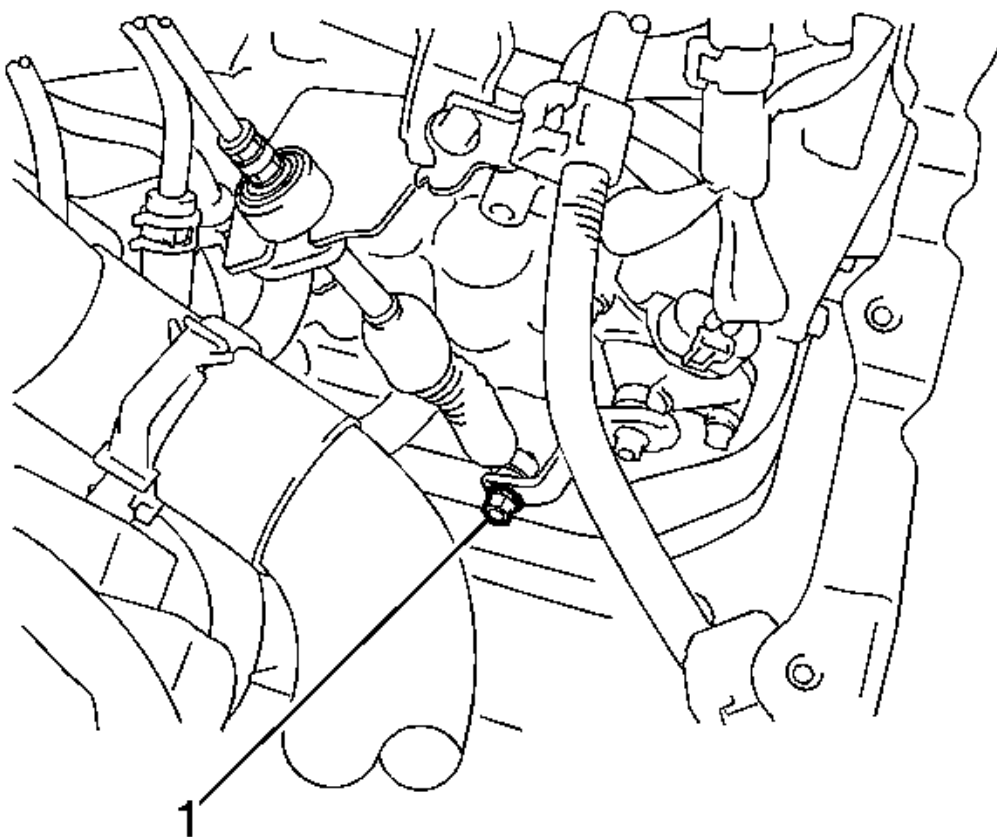


Fig. 194: Locating Control Cable Assembly Nut
Courtesy of GENERAL MOTORS CORP.

40. U250E Automatic Transaxle-Remove the nut (1) and disconnect the control cable assembly and the control shaft lever from the transmission.
41. Remove the clip and disconnect the transmission control cable assembly from the control cable bracket.

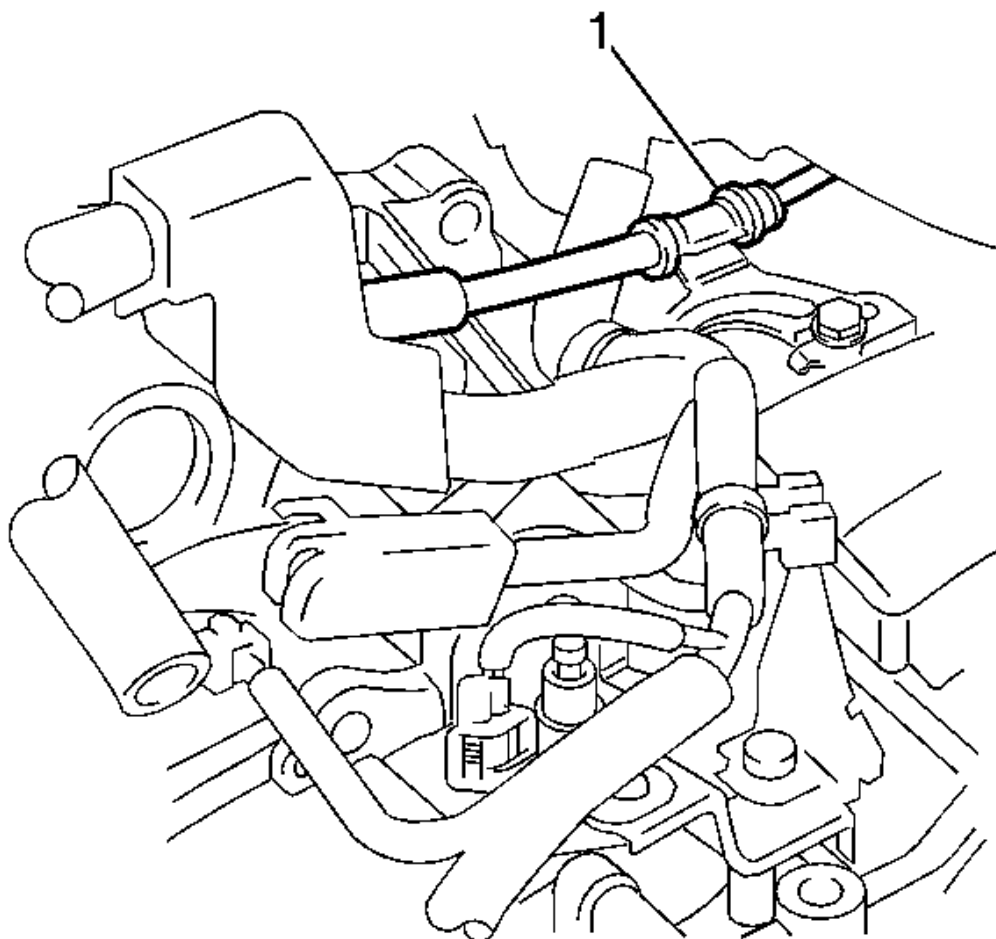


Fig. 195: Identifying Control Cable Assembly & Control Cable Bracket
Courtesy of GENERAL MOTORS CORP.

42. Disconnect the control cable assembly (1) from the control cable bracket.

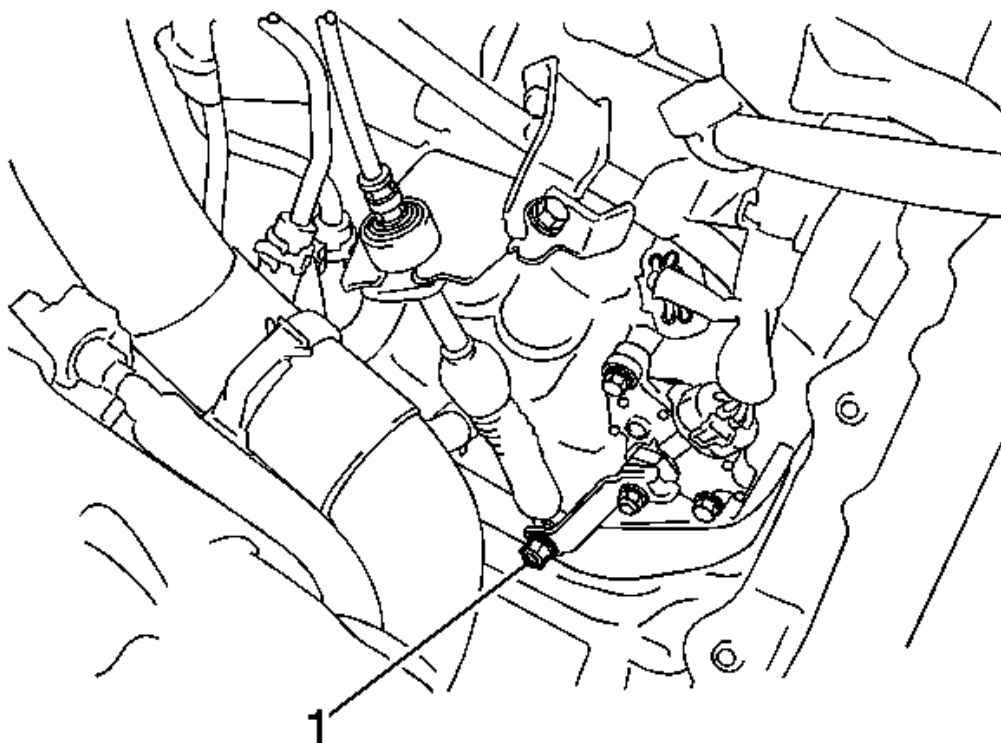


Fig. 196: Locating Cable Assembly & Control Shaft Lever Bracket
Courtesy of GENERAL MOTORS CORP.

43. U140F Automatic Transaxle-Remove the nut (1) and disconnect the control cable assembly and the control shaft lever from the transmission.
44. Remove the clip and disconnect the transmission control cable assembly from the control cable bracket.

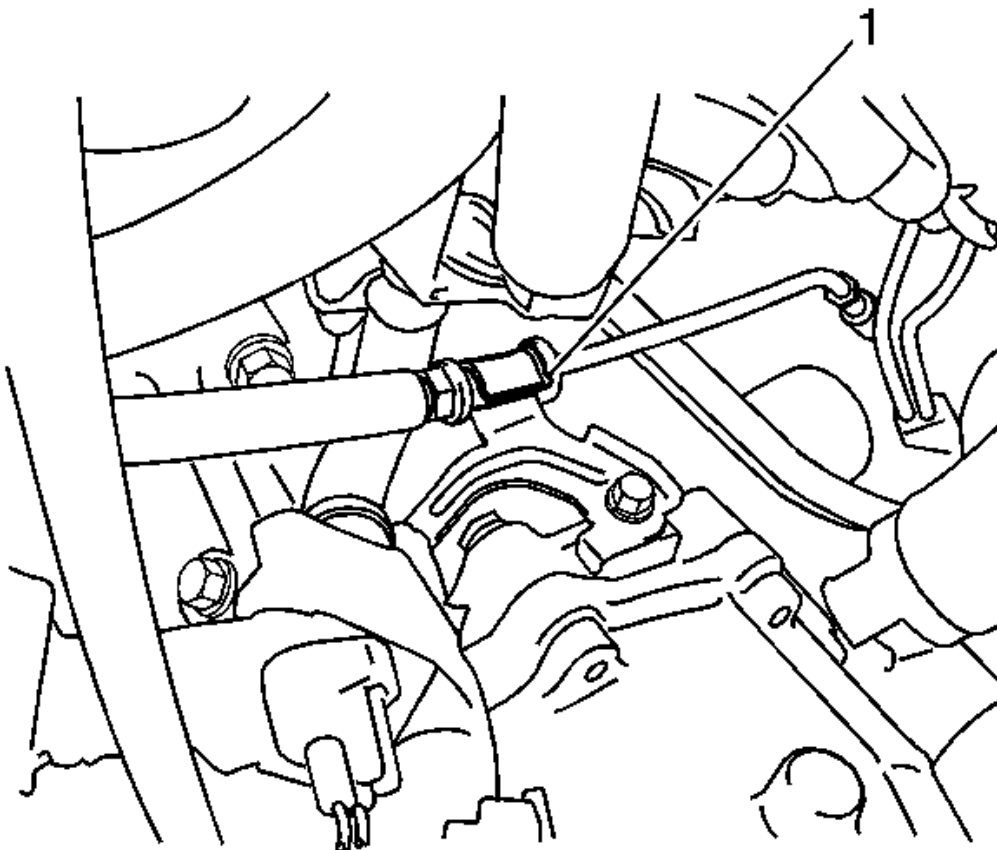


Fig. 197: Identifying Control Cable Bracket
Courtesy of GENERAL MOTORS CORP.

45. Disconnect the control cable assembly (1) from the control cable bracket.

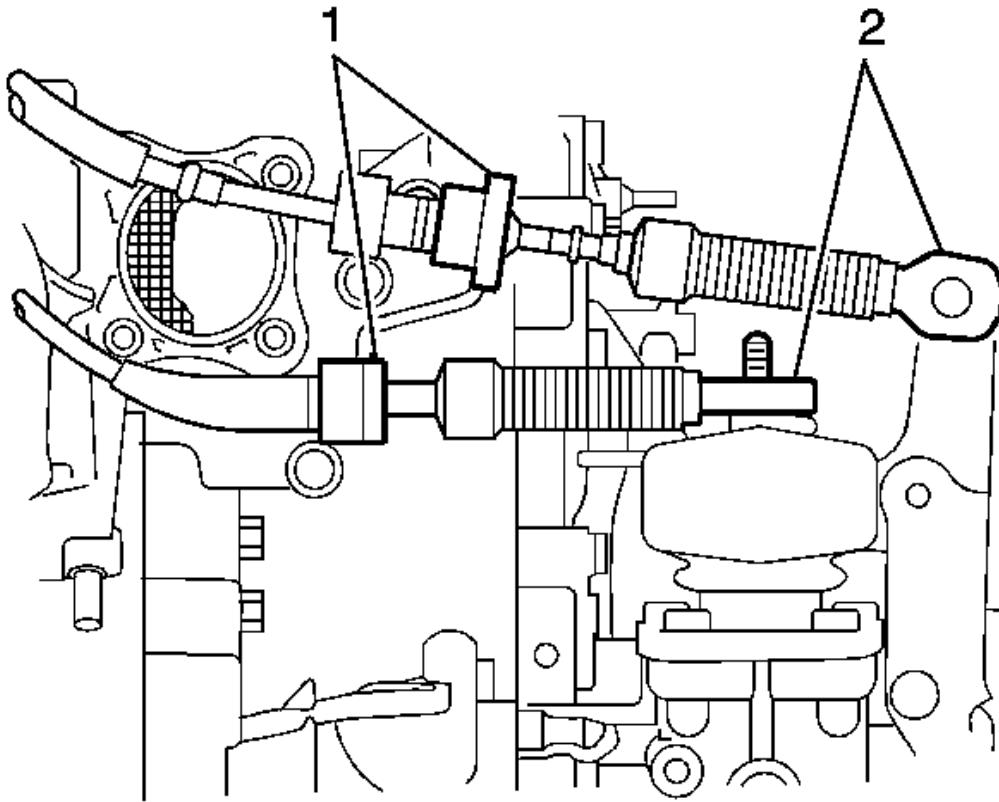


Fig. 198: Locating Transmission Shift Lever Cables, Cable Bracket & Clips
Courtesy of GENERAL MOTORS CORP.

46. E351 Manual Transaxle: Remove the 2 clips (1) and disconnect the 2 transmission control cables (2) from the control cable bracket 1.
47. Secure the steering wheel.
48. Remove the column hole cover silencer sheet.
49. Separate the steering intermediate shaft assembly.
50. Separate the steering column hole cover sub-assembly.
51. Remove the catalytic converter assembly. Refer to **Catalytic Converter Replacement (2.4L AWD)** or **Catalytic Converter Replacement (2.4L FWD)** .
52. Remove the front exhaust pipe assembly. Refer to **Front Pipe Replacement (2.4L AWD)** or **Front Pipe Replacement (2.4L FWD)** .
53. Remove the propeller with the center bearing shaft assembly (for 4WD). Refer to **Propeller Shaft Replacement**
54. Remove the front axle shaft left nut.

55. Remove the front axle shaft right nut.
56. Separate the left tie rod end assembly.
57. Separate the right tie rod end assembly.
58. Separate the left front stabilizer link assembly.
59. Separate the right front stabilizer link assembly.
60. Separate the left front lower suspension arm sub-assembly.
61. Separate the right front lower suspension arm sub-assembly.
62. Separate the left steering knuckle with axle hub.

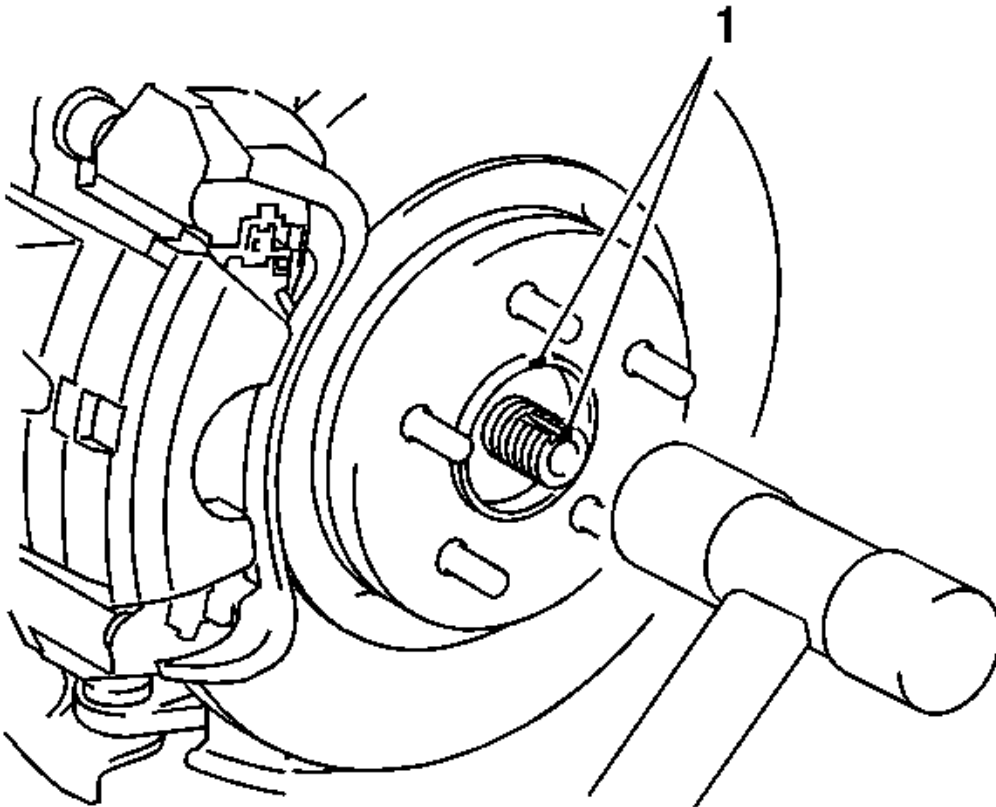


Fig. 199: Identifying Axle Hub & Drive Shaft Matchmarks
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not punch the marks.

63. Put matchmarks (1) on the drive shaft and axle hub.

NOTE: Be careful not to damage the boot and speed sensor rotor. Do not excessively push out the drive shaft from the axle assembly.

64. Using a plastic-faced hammer, disconnect the left front axle assembly.
65. Separate the right steering knuckle with axle hub.

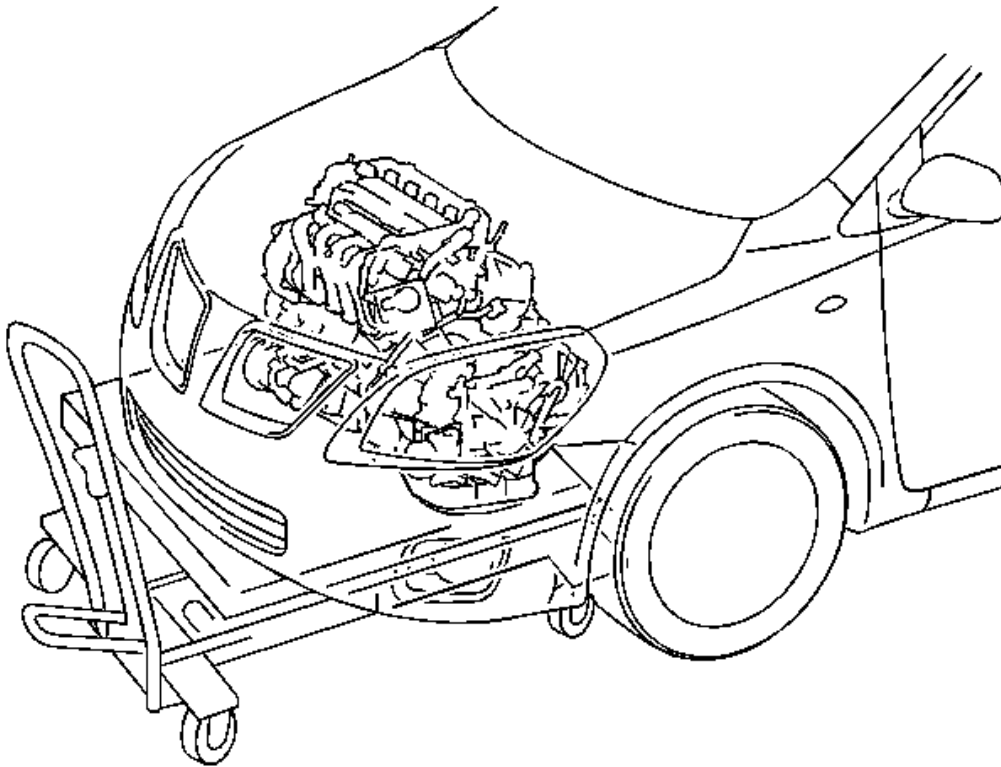


Fig. 200: View Of Engine Lifter
Courtesy of GENERAL MOTORS CORP.

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

66. Set the engine assembly with transaxle on the engine lifter.

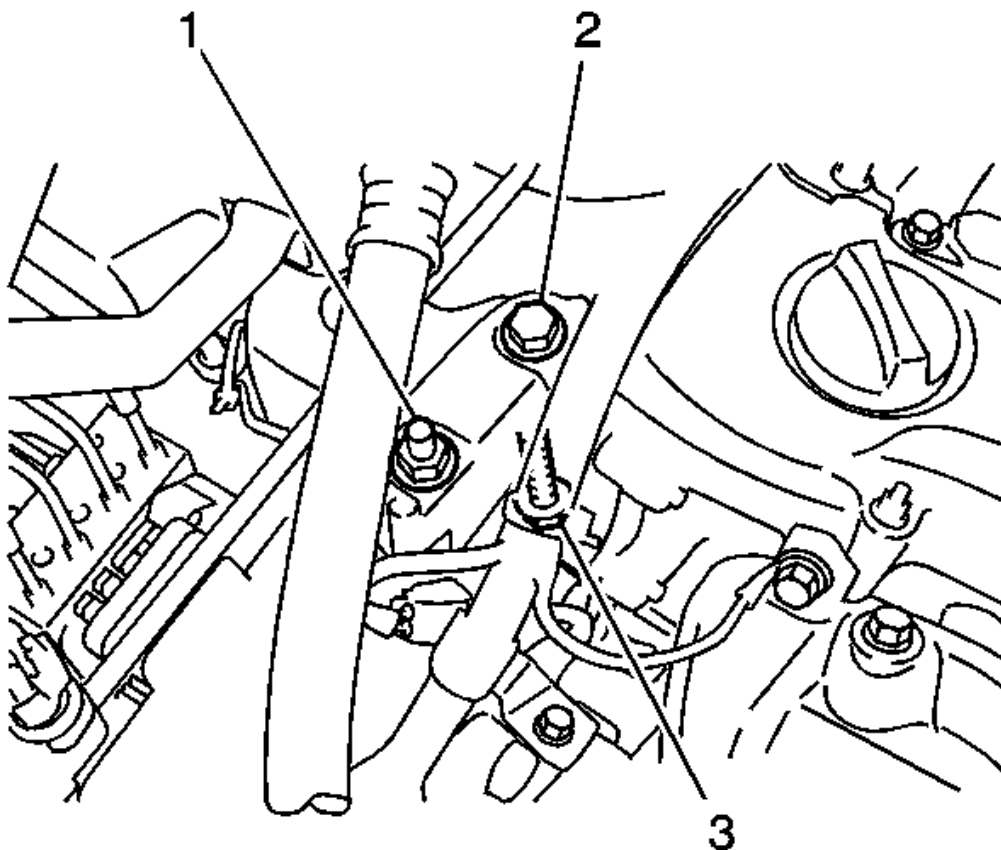


Fig. 201: Identifying Right Engine Mounting Insulator Nuts
Courtesy of GENERAL MOTORS CORP.

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

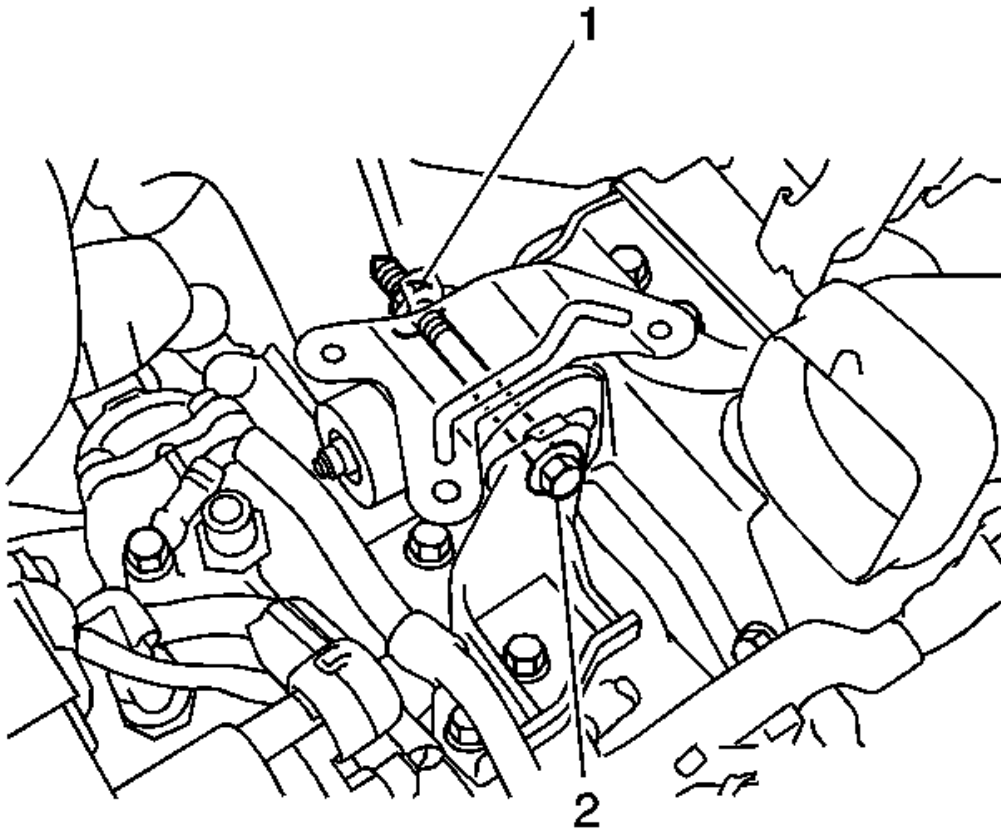


Fig. 202: Identifying Left Engine Mounting Insulator Through Bolt & Nut
Courtesy of GENERAL MOTORS CORP.

68. Remove the through bolt (2) and nut (1), and separate the left engine mounting insulator.
69. Carefully remove the engine with transaxle from the vehicle.
70. Remove the front suspension crossmember mounting bolts. Refer to **Front Suspension Crossmember Replacement (All Wheel Drive)** or **Front Suspension Crossmember Replacement (Two Wheel Drive)**

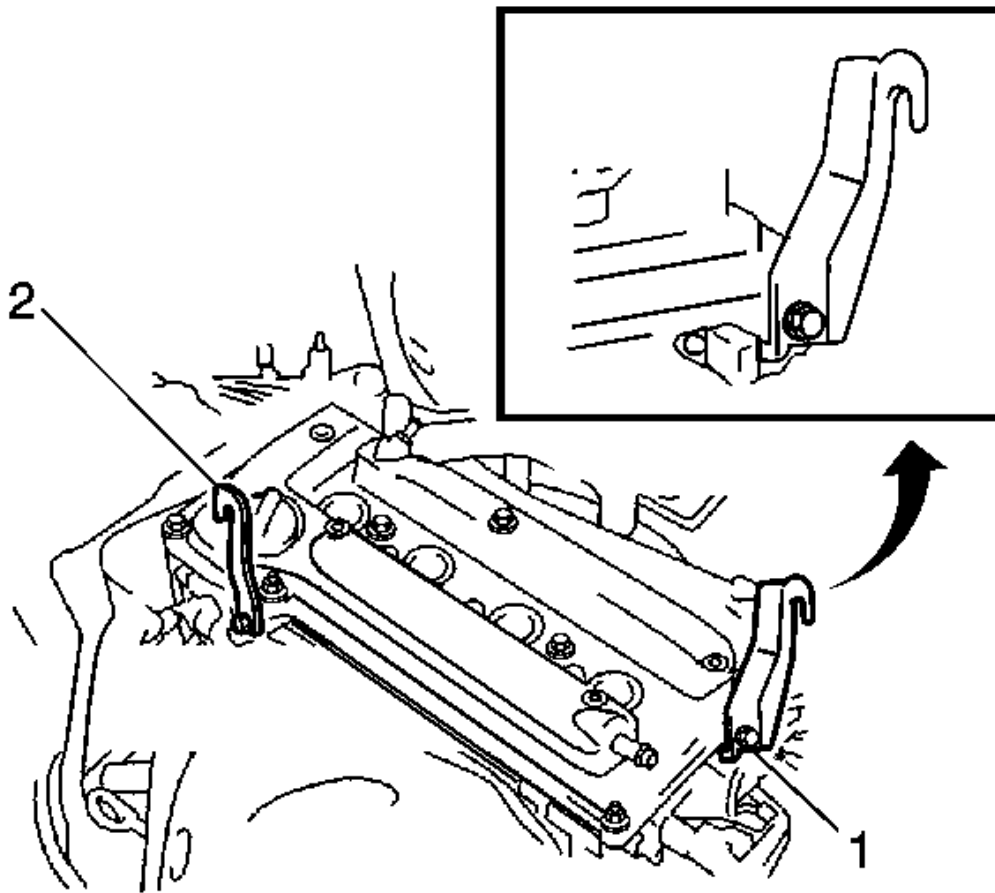


Fig. 203: Identifying Engine Lift Hangers
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fastener Caution

71. Install the suitable engine hangers (1) with the new bolts as shown in the illustration and tighten to 38 N.m (28 lb ft).

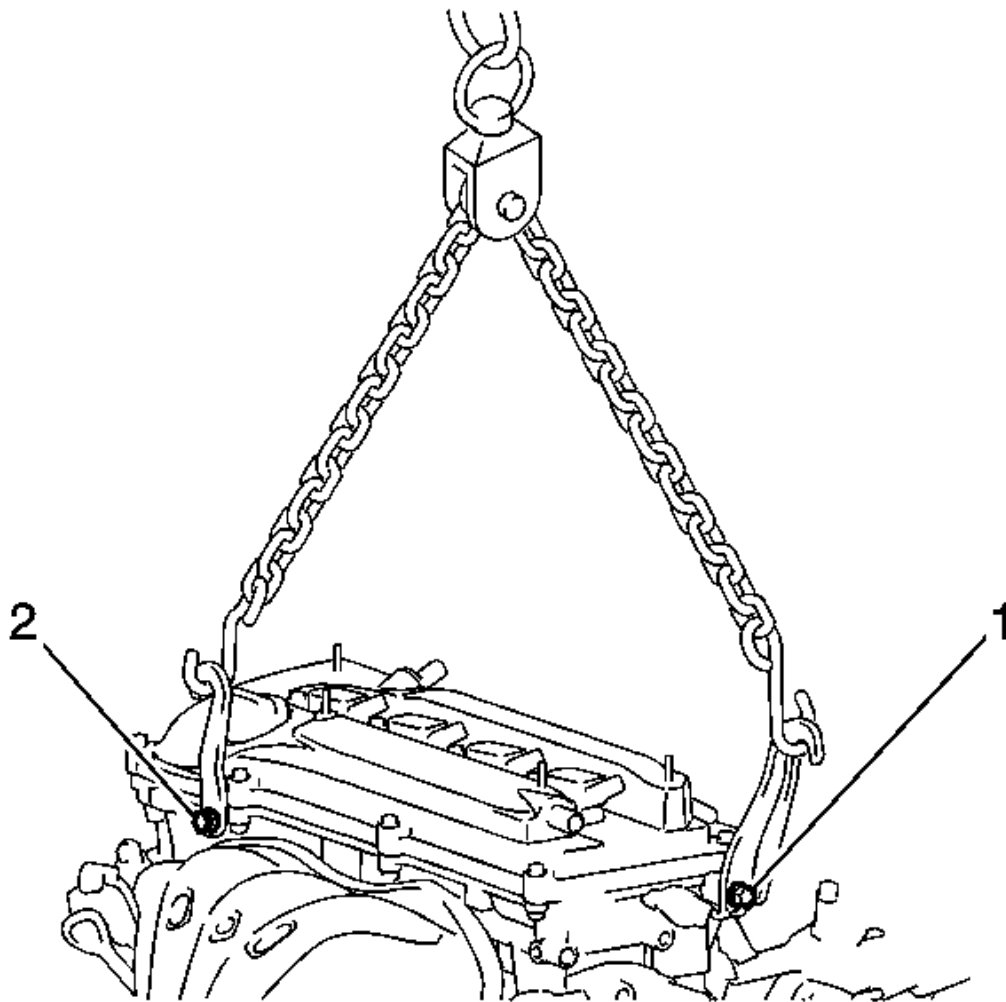


Fig. 204: View Of Engine Sling
Courtesy of GENERAL MOTORS CORP.

72. Using an engine sling device (1, 2) and a chain block, suspend the engine assembly with transaxle.

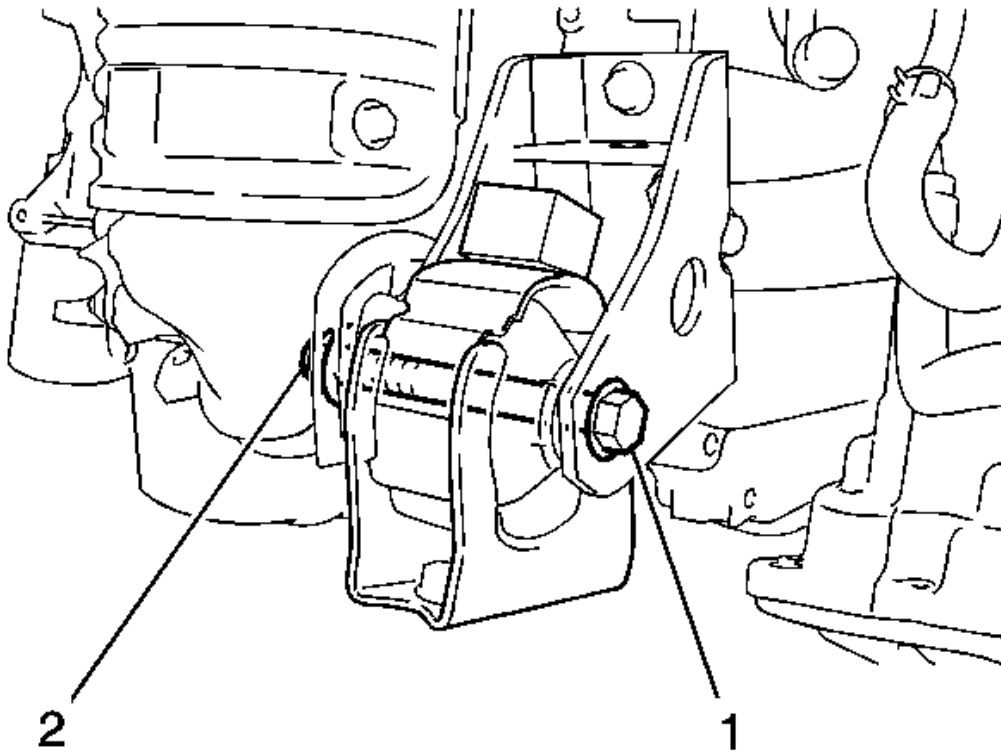


Fig. 205: Identifying Front Engine Mounting Insulator Through Bolt
Courtesy of GENERAL MOTORS CORP.

73. Remove the through bolt (1) and nut (2), and separate the front engine mounting insulator.

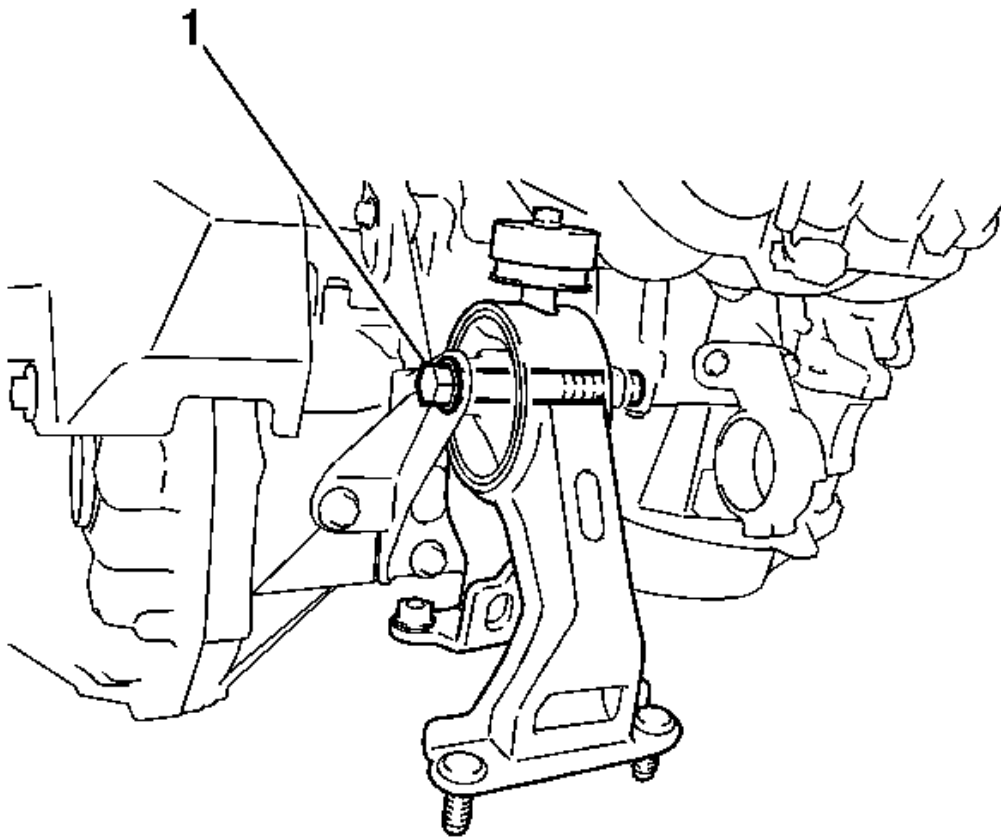


Fig. 206: Identifying Rear Engine Mounting Insulator Through Bolt - 2WD
Courtesy of GENERAL MOTORS CORP.

74. Remove the through bolt (1) and separate the rear engine mounting insulator (for 2WD).

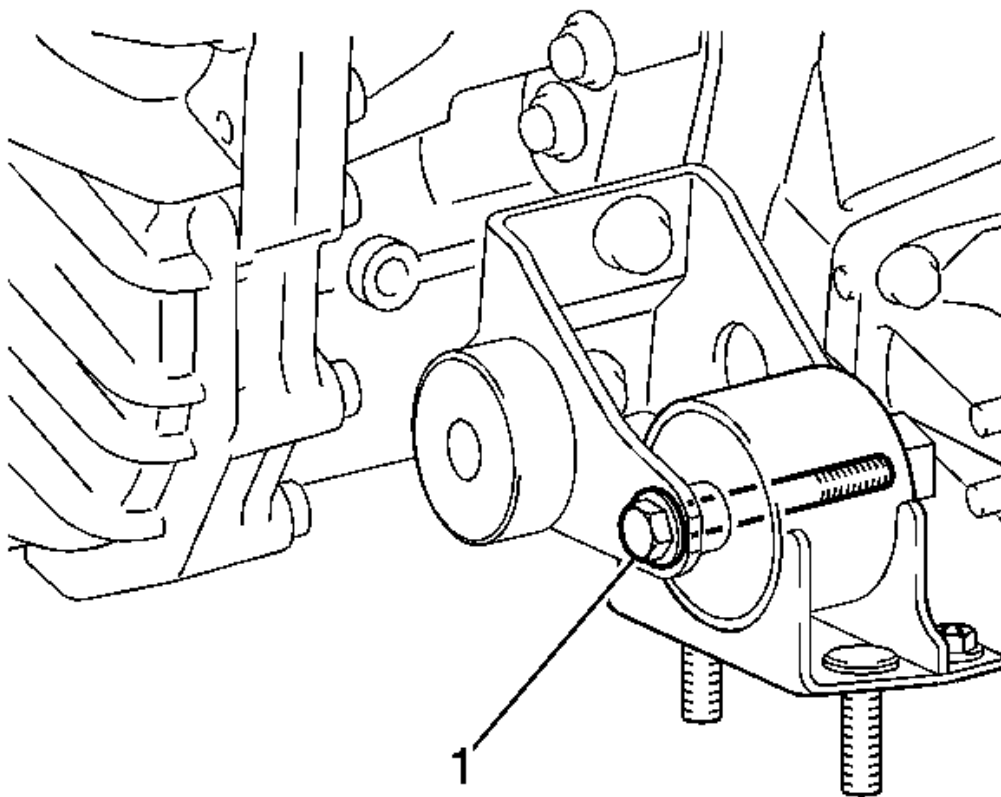


Fig. 207: Identifying Rear Engine Mounting Insulator Through Bolt - 4WD
Courtesy of GENERAL MOTORS CORP.

75. Remove the through bolt (1) and separate the rear engine mounting insulator (for 4WD).

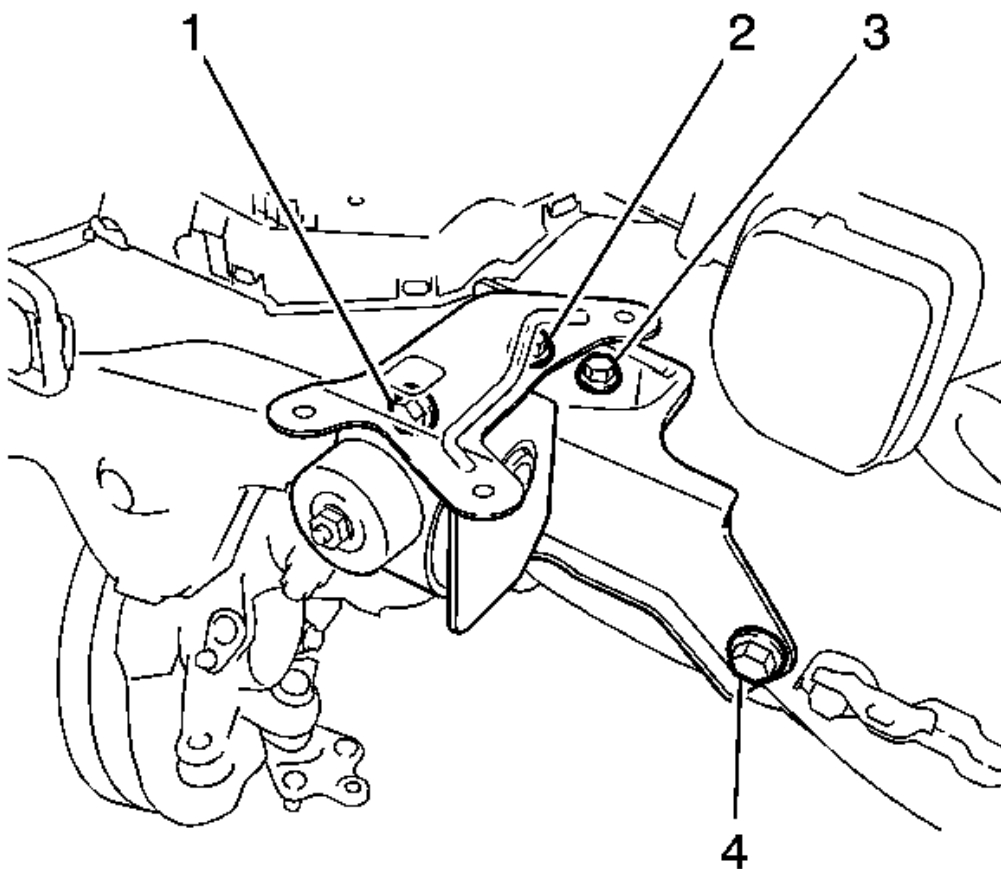


Fig. 208: Identifying Left Engine Mounting Insulator & Bolts
Courtesy of GENERAL MOTORS CORP.

76. Remove the 4 bolts (1-4) and left engine mounting insulator.

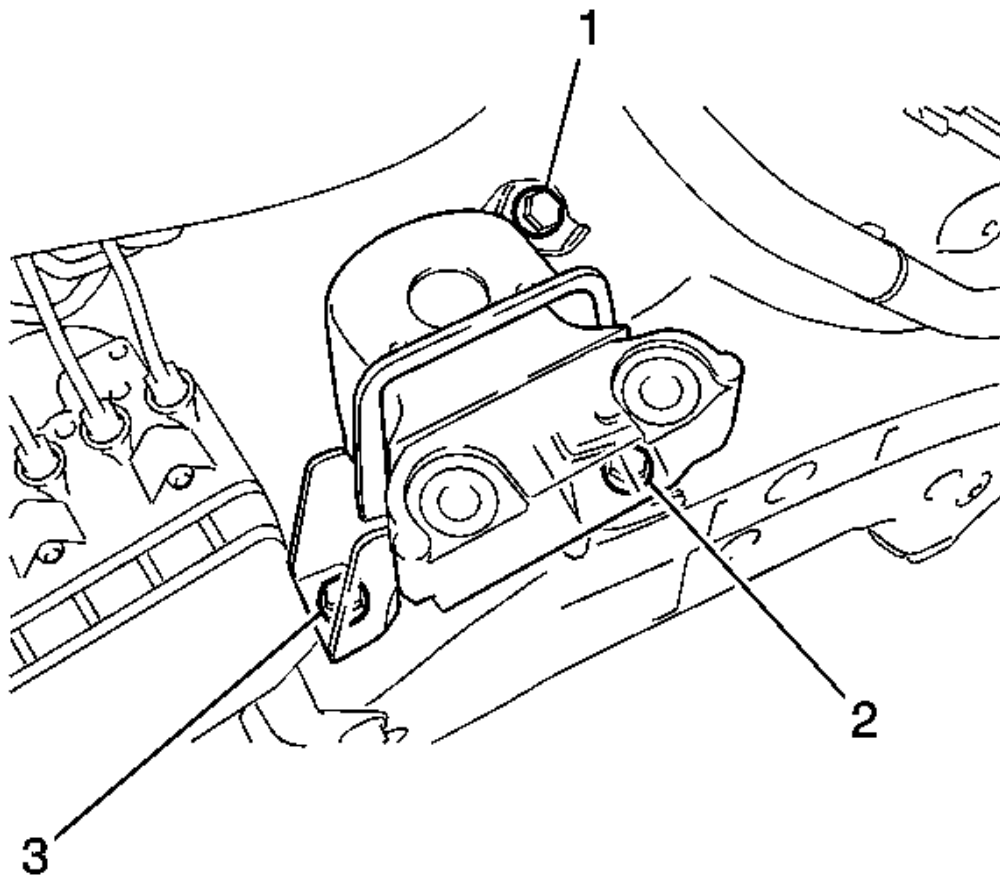


Fig. 209: Identifying Right Engine Mounting Insulator Sub-Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

77. Remove the 3 bolts (1-3) and right engine mounting insulator sub-assembly.

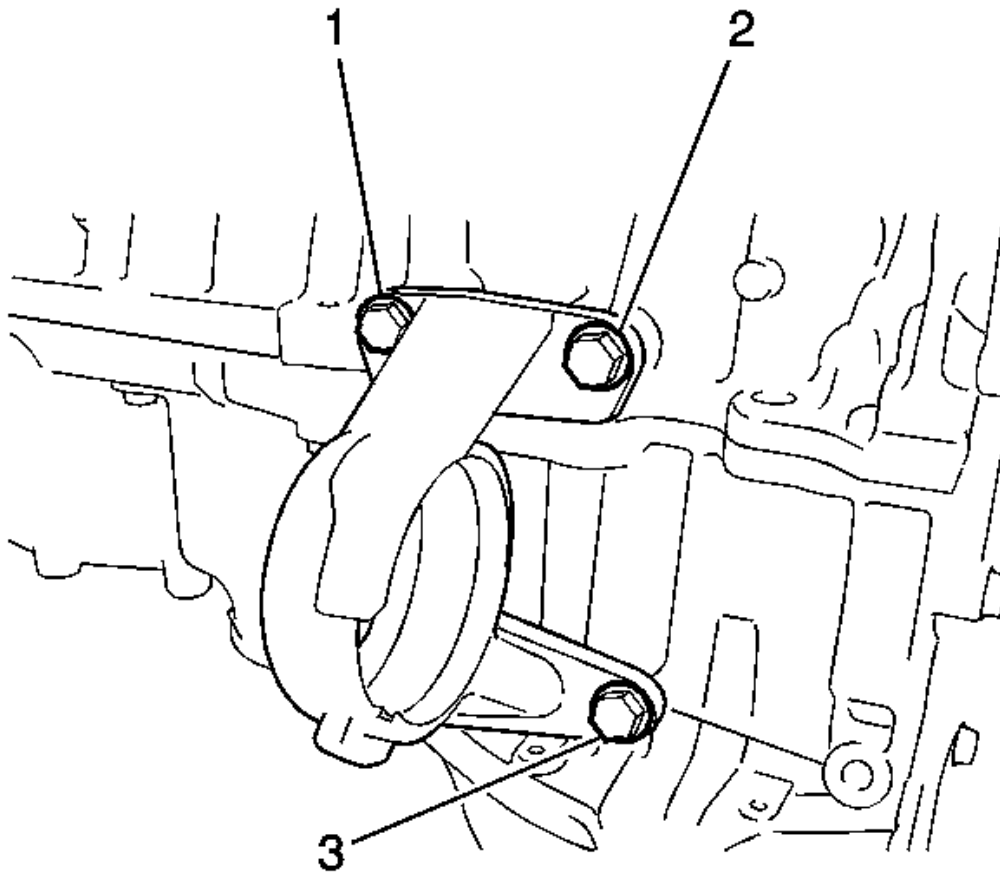


Fig. 210: Identifying Drive Shaft Bearing Bracket - (2WD)
Courtesy of GENERAL MOTORS CORP.

78. Remove the 3 bolts (1-3) and drive shaft bearing bracket (for 2WD).
79. Remove the starter assembly.
80. Remove the manual transaxle assembly.
81. Separate the transaxle assembly. Refer to **Transmission Replacement** for the MVA 4 speed transmission, **Transmission Replacement** for the MVD 5 speed transmission or **Transmission Replacement** for the MVC 5 speed transmission.
82. Remove the clutch cover assembly (for manual transaxle).
83. Remove the clutch disc assembly (for manual transaxle).
84. Remove the flywheel assembly (for manual transaxle).
85. Remove the drive plate and ring gear assembly (for automatic transaxle).
86. Remove the engine wire harness.

INSTALLATION PROCEDURE

1. Install the engine wire harness.
2. Install the drive plate and ring gear subassembly (for automatic transaxle).
3. Install the flywheel assembly (for manual transaxle).
4. Install the clutch disc assembly (for manual transaxle).
5. Install the clutch cover assembly (for manual transaxle).
6. Install the transaxle assembly. Refer to **Transmission Replacement** for the MVA 4 speed transmission, **Transmission Replacement** for the MVD 5 speed transmission or **Transmission Replacement** for the MVC 5 speed transmission.
7. Install the starter assembly.

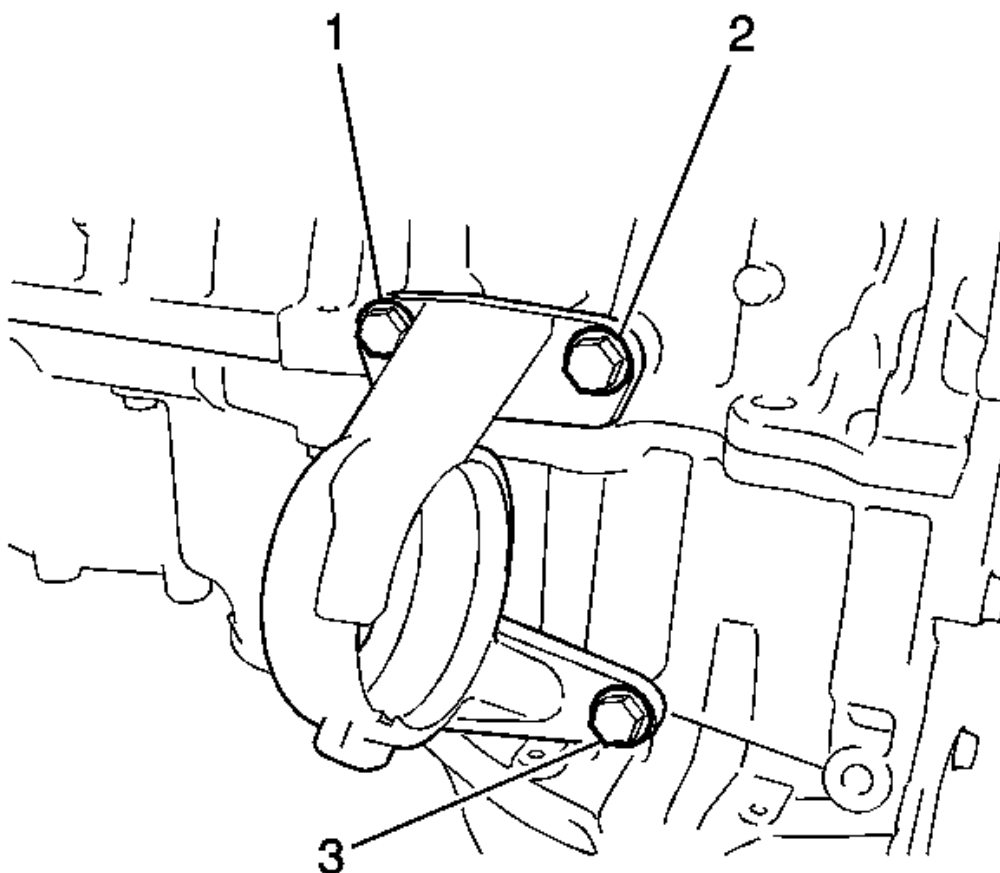


Fig. 211: Identifying Drive Shaft Bearing Bracket - (2WD)
Courtesy of GENERAL MOTORS CORP.

8. Install the drive shaft bearing bracket with the 3 bolts (1, 2, 3) and tighten to 64 N.m (47 lb ft) (for 2WD).

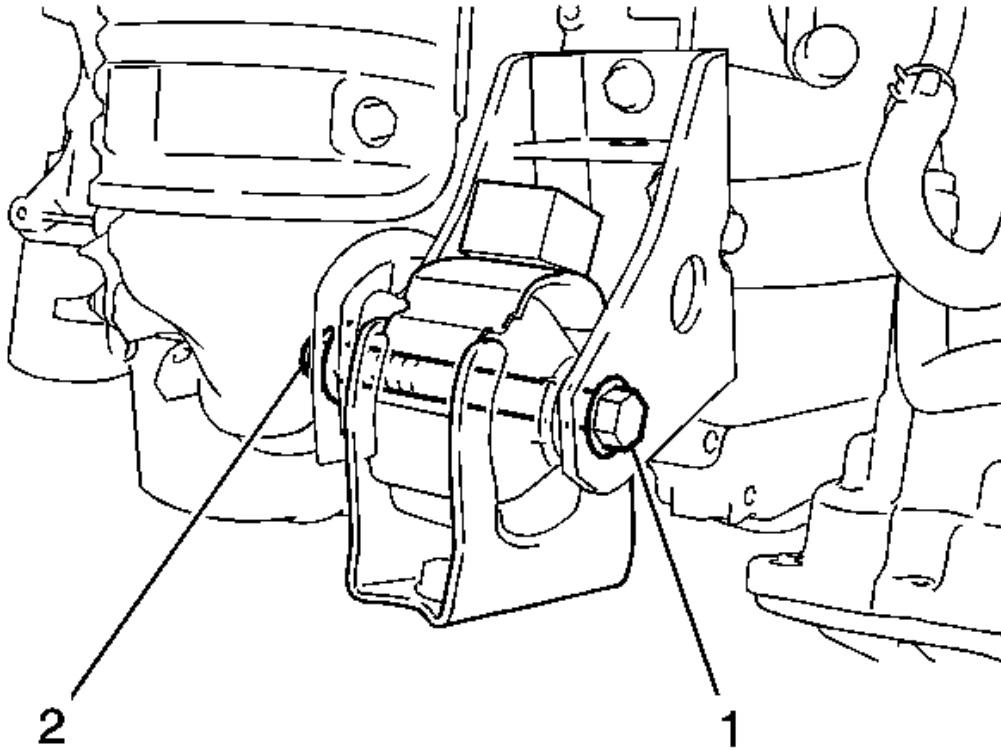


Fig. 212: Identifying Front Engine Mounting Insulator Through Bolt
Courtesy of GENERAL MOTORS CORP.

9. Temporarily tighten the front engine mounting insulator with the nut (2) and through bolt (1).

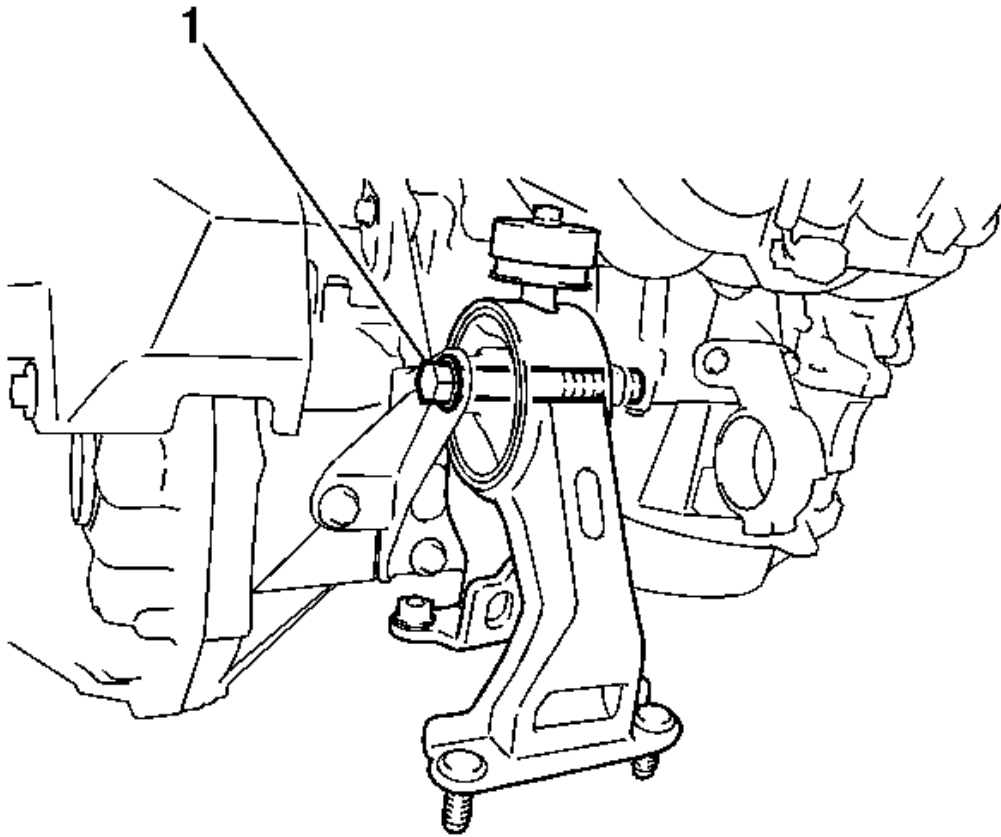


Fig. 213: Identifying Rear Engine Mounting Insulator Through Bolt - 2WD
Courtesy of GENERAL MOTORS CORP.

10. Temporarily tighten the rear engine mounting insulator to the engine mounting bracket with the through bolt (1) (for 2WD).

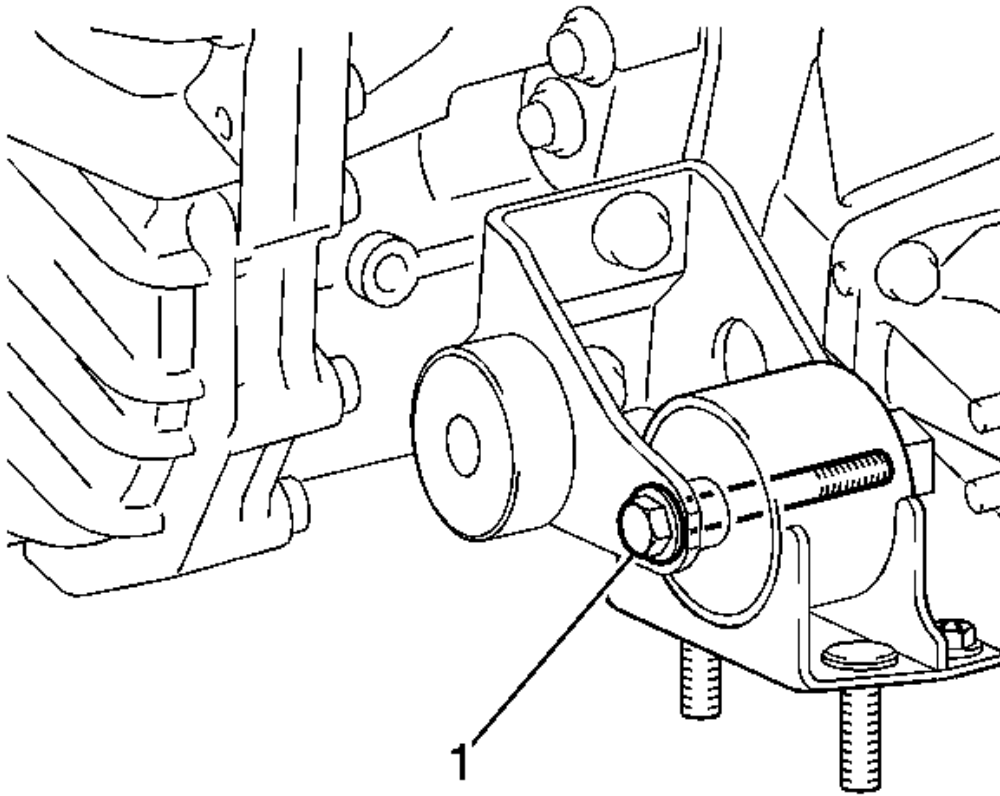


Fig. 214: Identifying Rear Engine Mounting Insulator Through Bolt - 4WD
Courtesy of GENERAL MOTORS CORP.

11. Temporarily tighten the rear engine mounting insulator to the engine mounting bracket with the through bolt (1) (for 4WD).

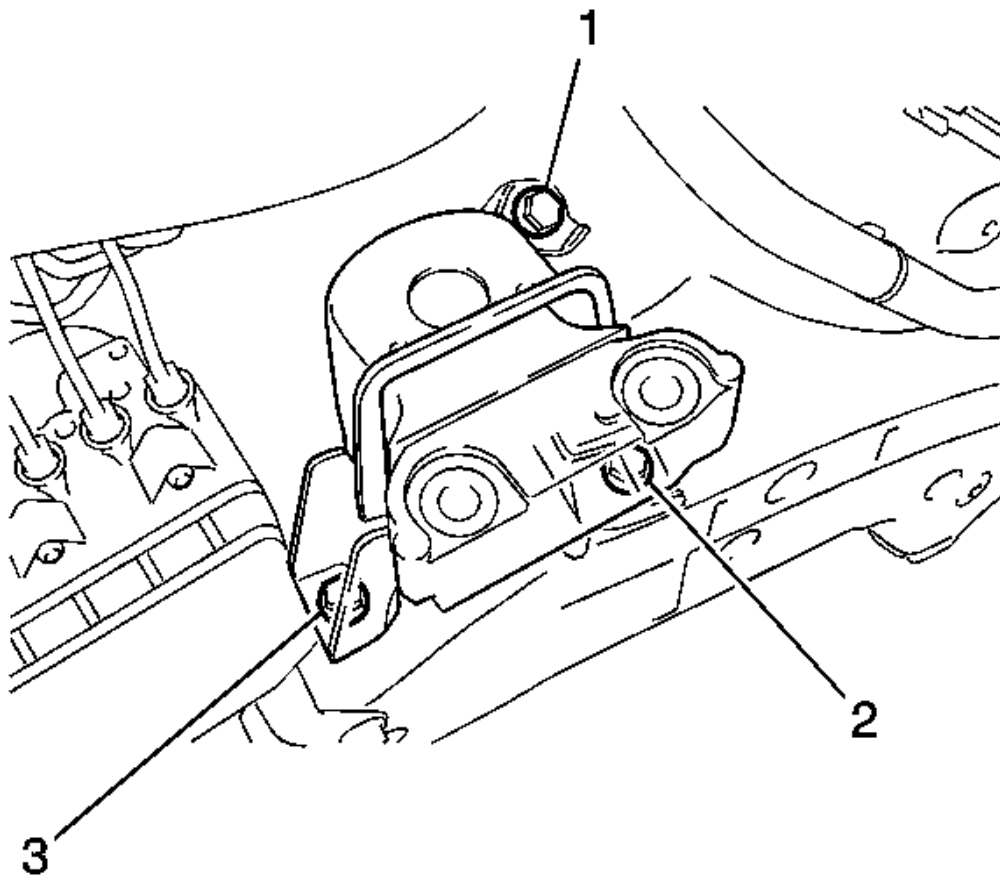


Fig. 215: Identifying Right Engine Mounting Insulator Sub-Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

12. Install the right engine mounting insulator with the 3 bolts (1, 2, 3) and tighten to 52 N.m (38 lb ft).

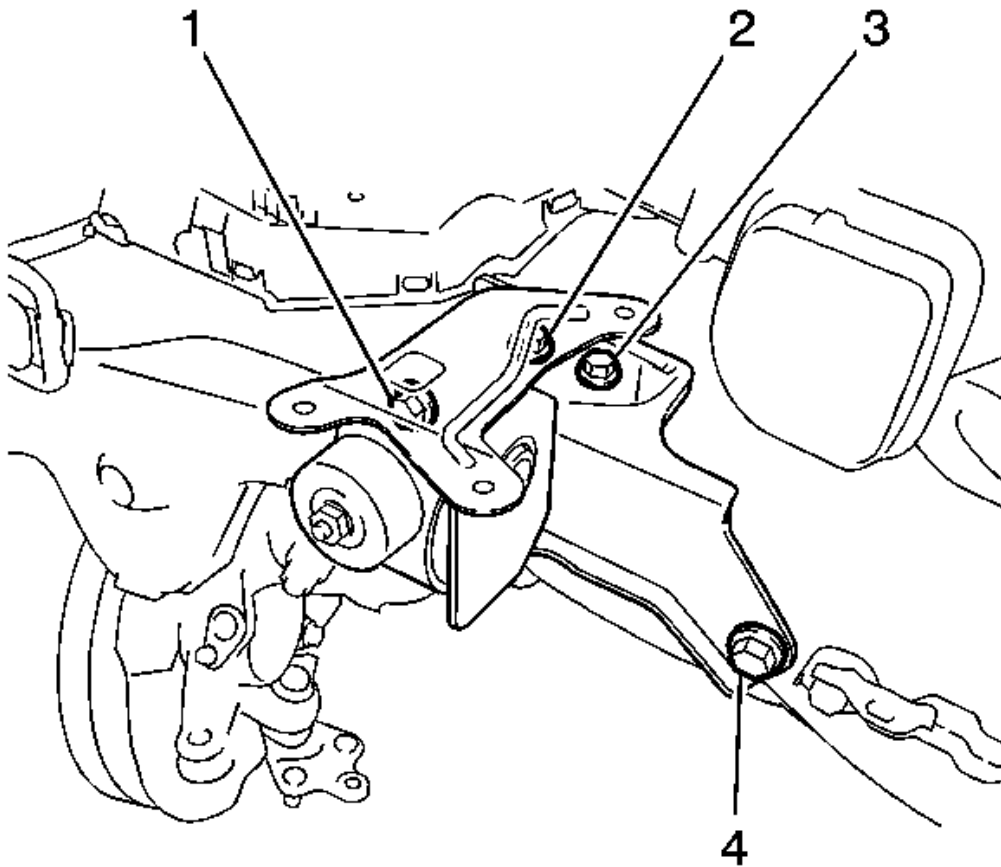


Fig. 216: Identifying Left Engine Mounting Insulator & Bolts
Courtesy of GENERAL MOTORS CORP.

13. Temporarily install the left engine mounting insulator with the 4 bolts (1-4).

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

14. Tighten the 4 bolts to 52 N.m (38 lb ft).

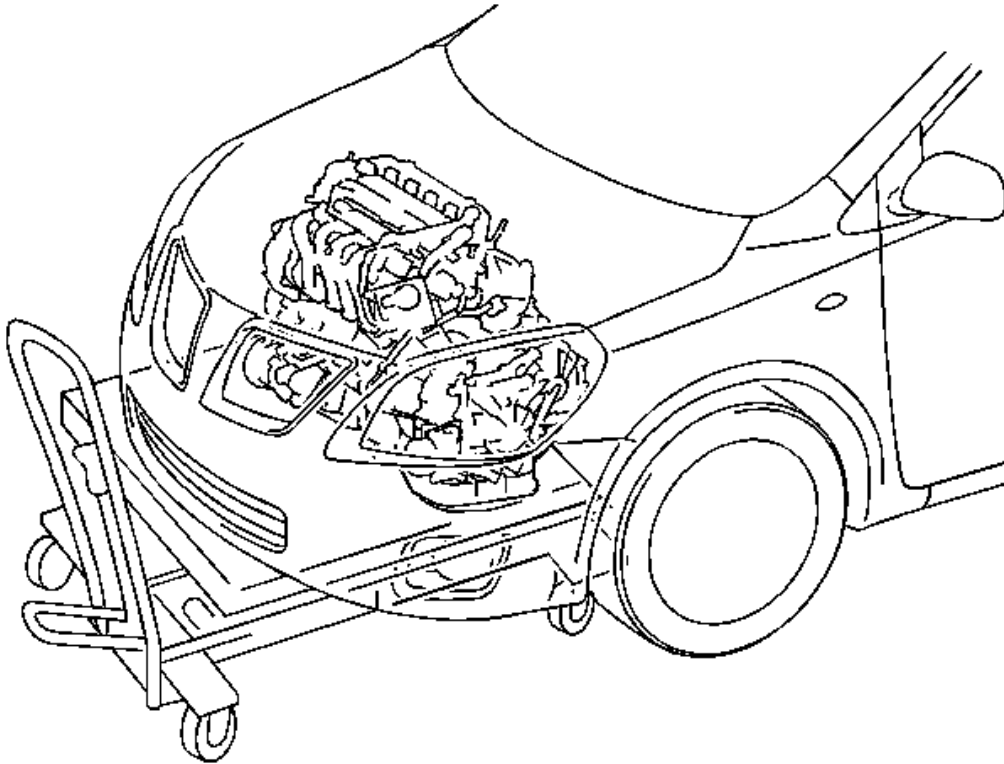


Fig. 217: View Of Engine Lifter

Courtesy of GENERAL MOTORS CORP.

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

15. Set the engine assembly with transaxle on the engine lifter.
16. Remove the 2 bolts and 2 engine hangers.

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.

17. Operate the engine lifter and lift the engine assembly with transaxle to the position where the engine mounting insulators RH and LH can be installed.

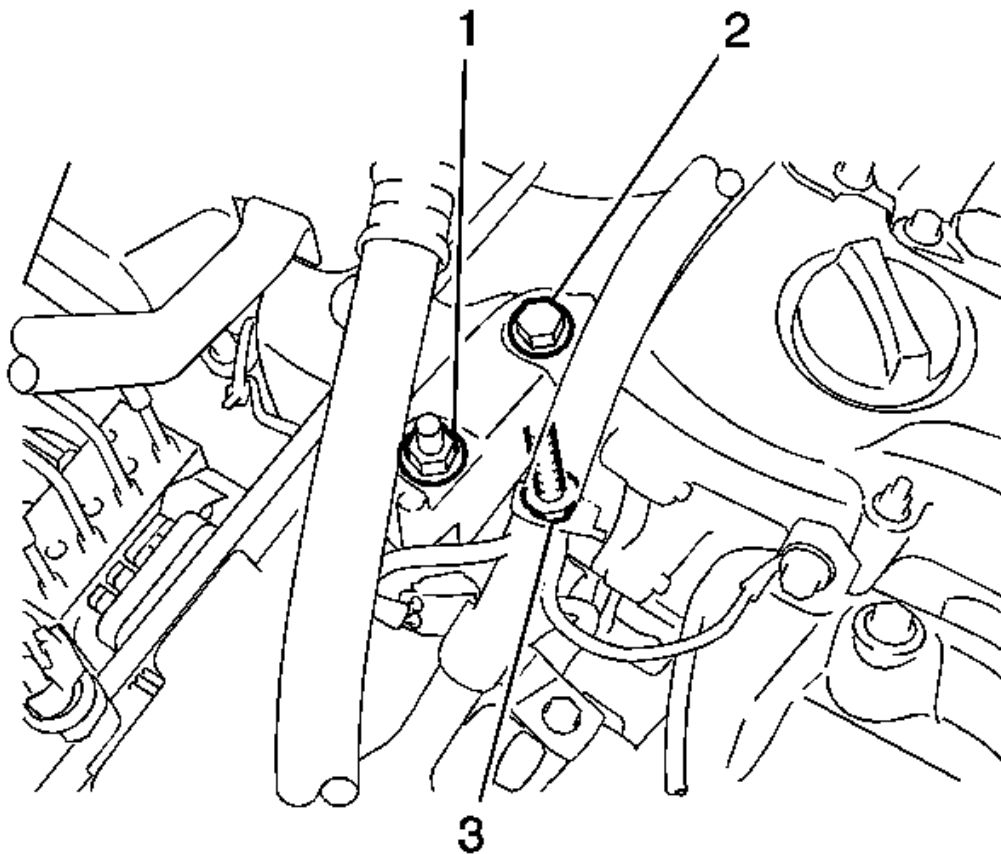


Fig. 218: View Of Right Engine Mounting Insulator, Bolt & Nuts
Courtesy of GENERAL MOTORS CORP.

18. Install the right engine mounting insulator with the bolt (2) and 2 nuts (1, 3) and tighten.
 - Nut 1 to 95 N.m (70 lb ft)
 - Nut 2 to 52 N.m (38 lb ft)
 - Bolt 3 to 95 N.m (70 lb ft)

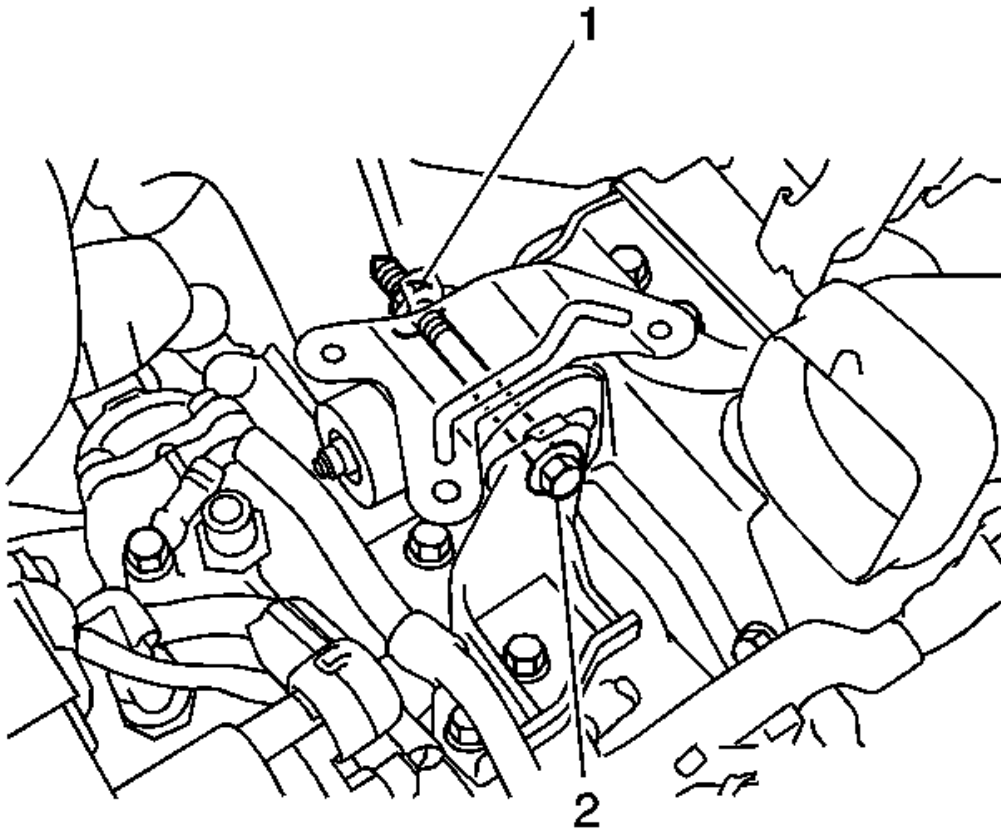


Fig. 219: Identifying Left Engine Mounting Insulator Through Bolt & Nut
 Courtesy of GENERAL MOTORS CORP.

19. Install the engine mounting insulator LH with the through bolt (2) and nut (1) and tighten to 56 N.m (41 lb ft).
20. Temporarily tighten the center engine mounting member sub-assembly.
21. Install the front suspension crossmember mounting bolts. Refer to **Front Suspension Crossmember Replacement (All Wheel Drive)** or **Front Suspension Crossmember Replacement (Two Wheel Drive)** .
22. Fully tighten the center engine mounting member sub-assembly.

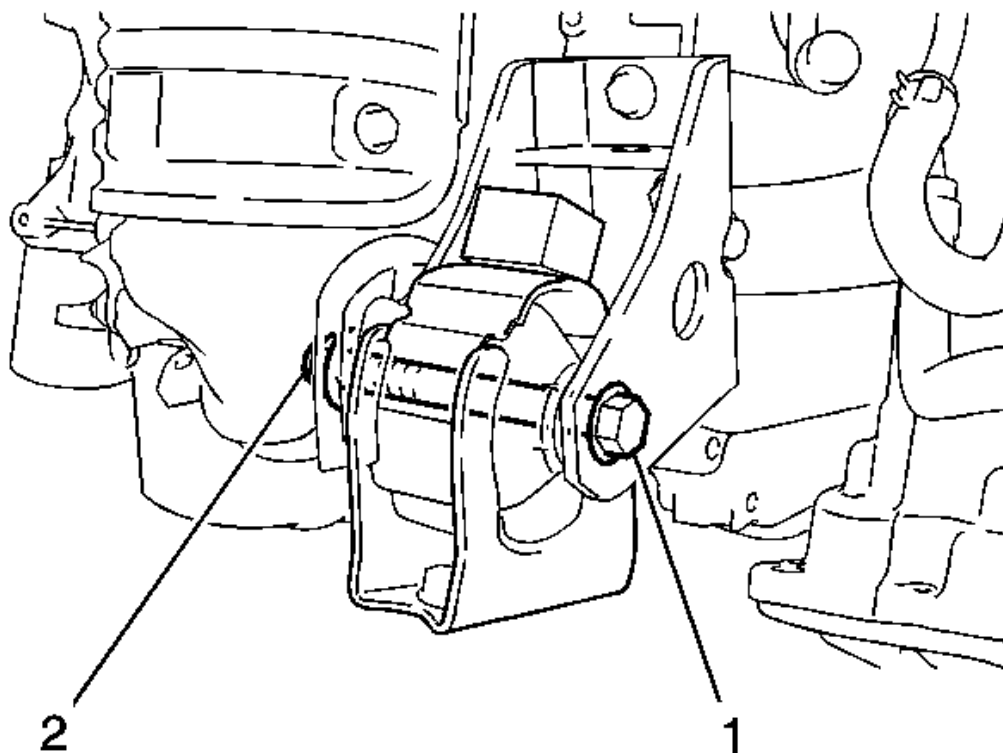


Fig. 220: Identifying Front Engine Mounting Insulator Through Bolt
Courtesy of GENERAL MOTORS CORP.

23. Fully tighten the front engine mounting insulator with the nut (2) and through bolt (1) and tighten to 73 N.m (53 lb ft).
24. Fully tighten the rear engine mounting insulator to the engine mounting bracket with the through bolt and tighten to 65 N.m (48 lb ft) (for 2WD).

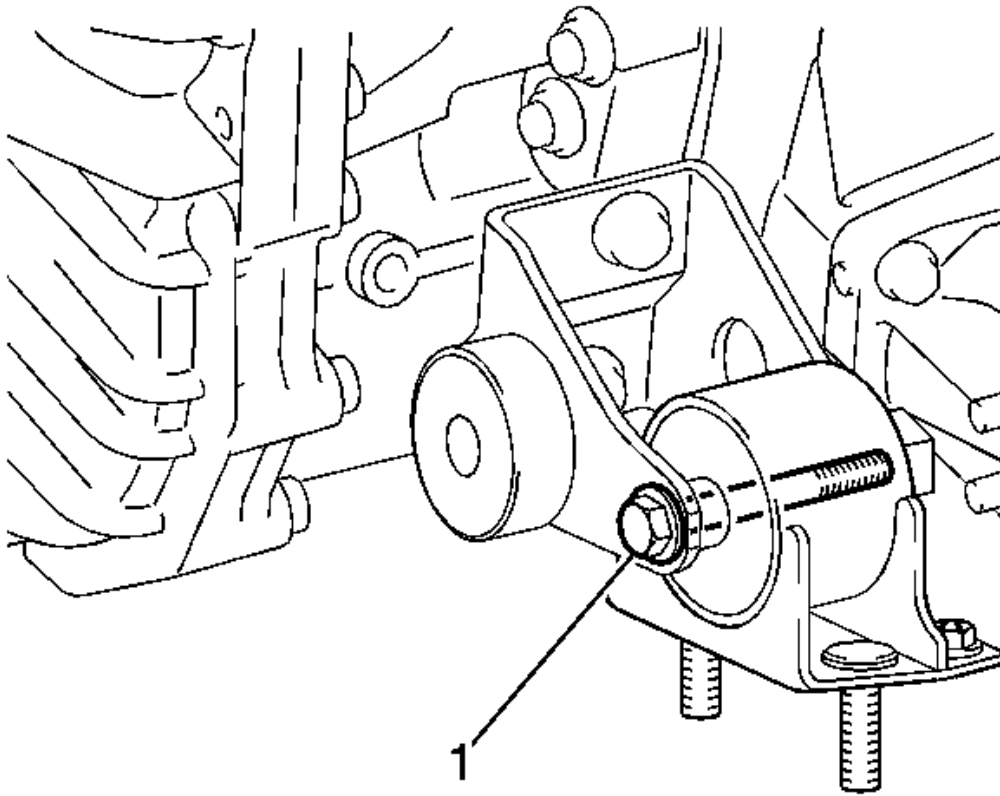


Fig. 221: Identifying Rear Engine Mounting Insulator Through Bolt - 4WD
Courtesy of GENERAL MOTORS CORP.

25. Fully tighten the rear engine mounting insulator to the engine mounting bracket with the through bolt (1) and tighten to 65 N.m (48 lb ft) (for 4WD).
26. Install the drive plate and torque converter clutch setting bolt.

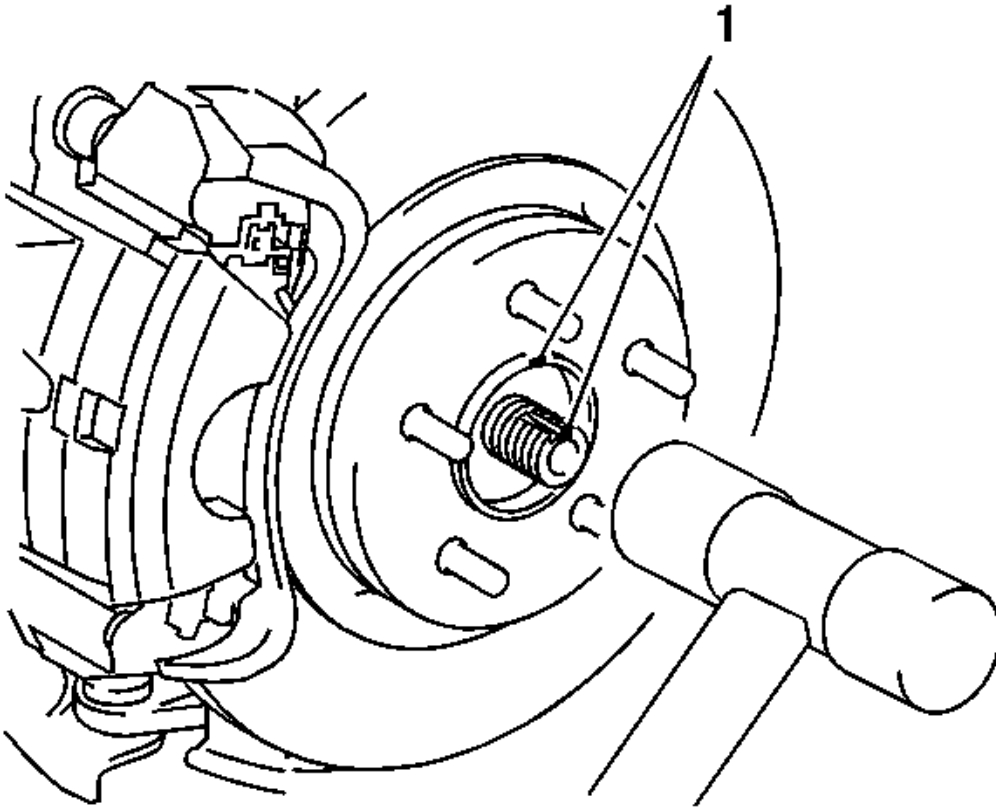


Fig. 222: Identifying Axle Hub & Drive Shaft Matchmarks
 Courtesy of GENERAL MOTORS CORP.

27. Align the matchmarks (1) and connect the left front drive shaft assembly to the front axle assembly.
28. Install the right steering knuckle with axle hub.
29. Install the left front lower suspension arm assembly.
30. Install the right front lower suspension arm assembly.
31. Install the left front stabilizer link assembly.
32. Install the right front stabilizer link assembly.
33. Install the left tie rod end assembly.
34. Install the right tie rod end assembly.
35. Install the left front axle shaft nut. Refer to **Front Wheel Drive Shaft Replacement - Left Side** .
36. Install the right front axle shaft nut. Refer to **Front Wheel Drive Shaft Replacement - Right Side** .
37. Temporarily tighten the propeller with center bearing shaft assembly (for 4WD).
38. Install the propeller with center bearing shaft (for 4WD). Refer to **Propeller Shaft Replacement** .

39. Install the front exhaust pipe assembly. Refer to **Front Pipe Replacement (2.4L AWD)** or **Front Pipe Replacement (2.4L FWD)**.
40. Install the catalytic converter assembly. Refer to **Catalytic Converter Replacement (2.4L AWD)** or **Catalytic Converter Replacement (2.4L FWD)**.
41. Install the steering column hole cover sub-assembly.
42. Install the steering intermediate shaft assembly.
43. Install the column hole cover silencer sheet.

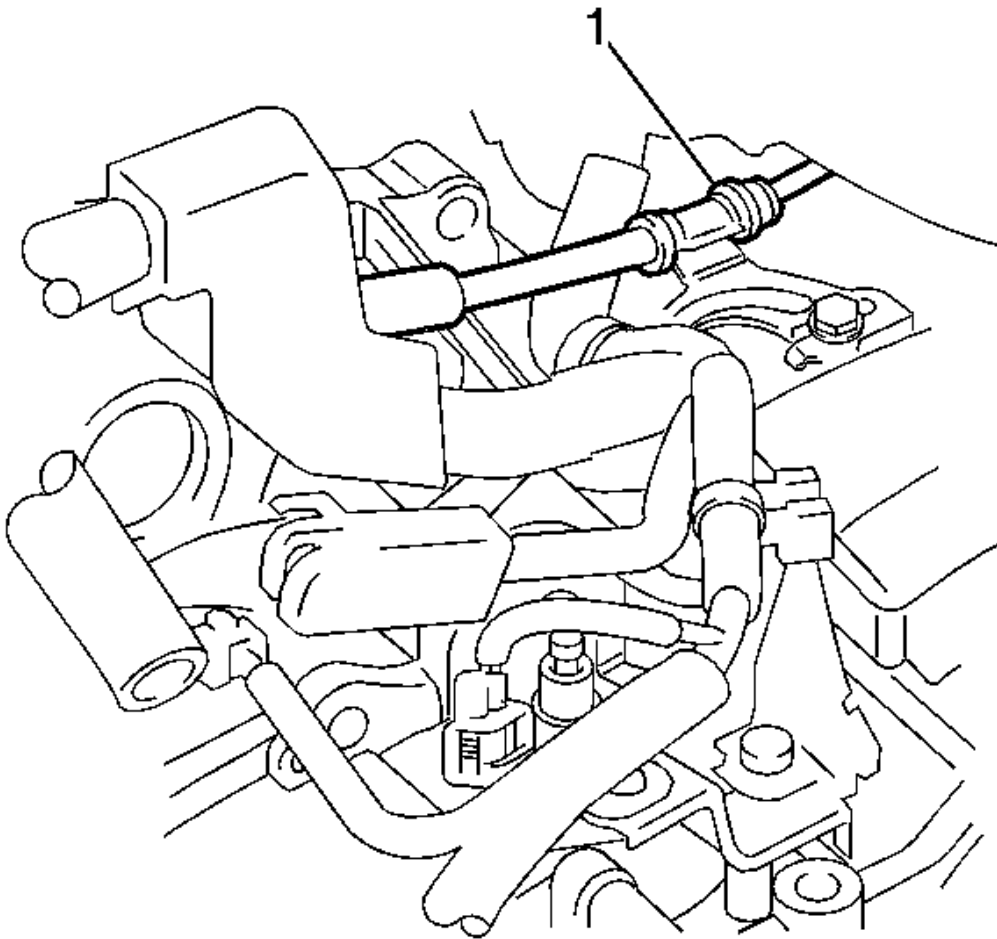


Fig. 223: Identifying Control Cable Assembly & Control Cable Bracket
Courtesy of GENERAL MOTORS CORP.

44. U250e automatic transaxle-Connect the transmission control cable to the control cable bracket (1).

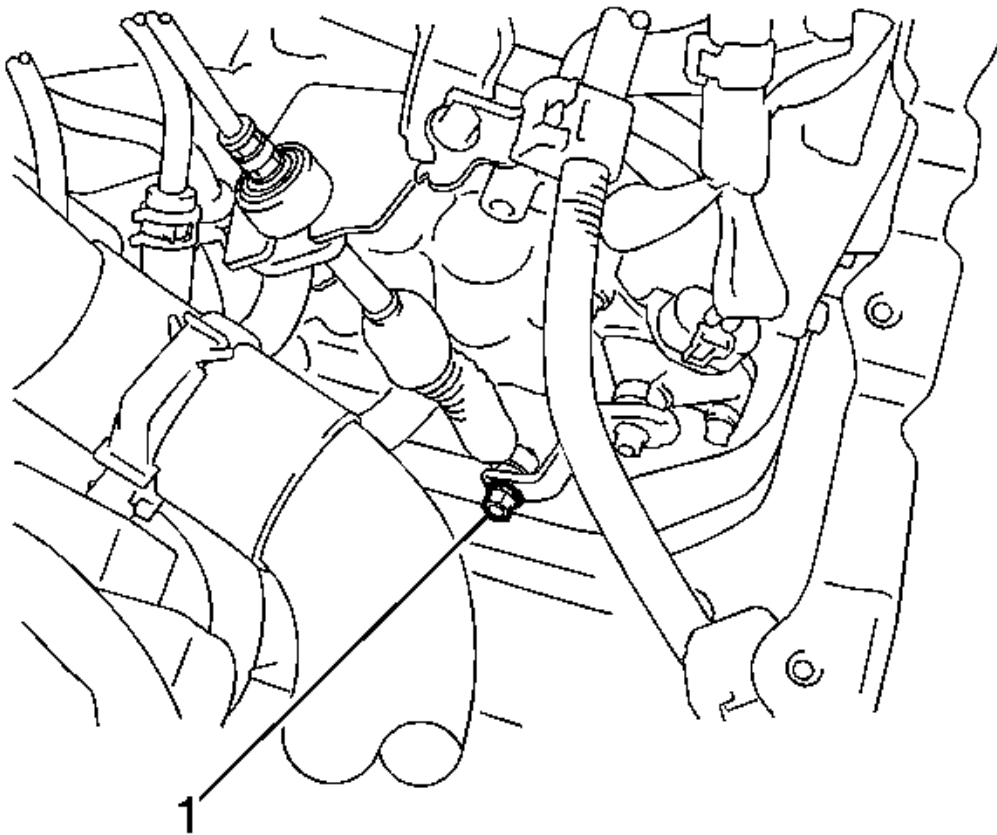


Fig. 224: Locating Control Cable Assembly Nut
Courtesy of GENERAL MOTORS CORP.

45. Connect the transmission control cable to the bracket with a new clip.
46. Connect the transmission control cable assembly to the control shaft lever with the nut (1) and tighten to 12 N.m (9 lb ft).

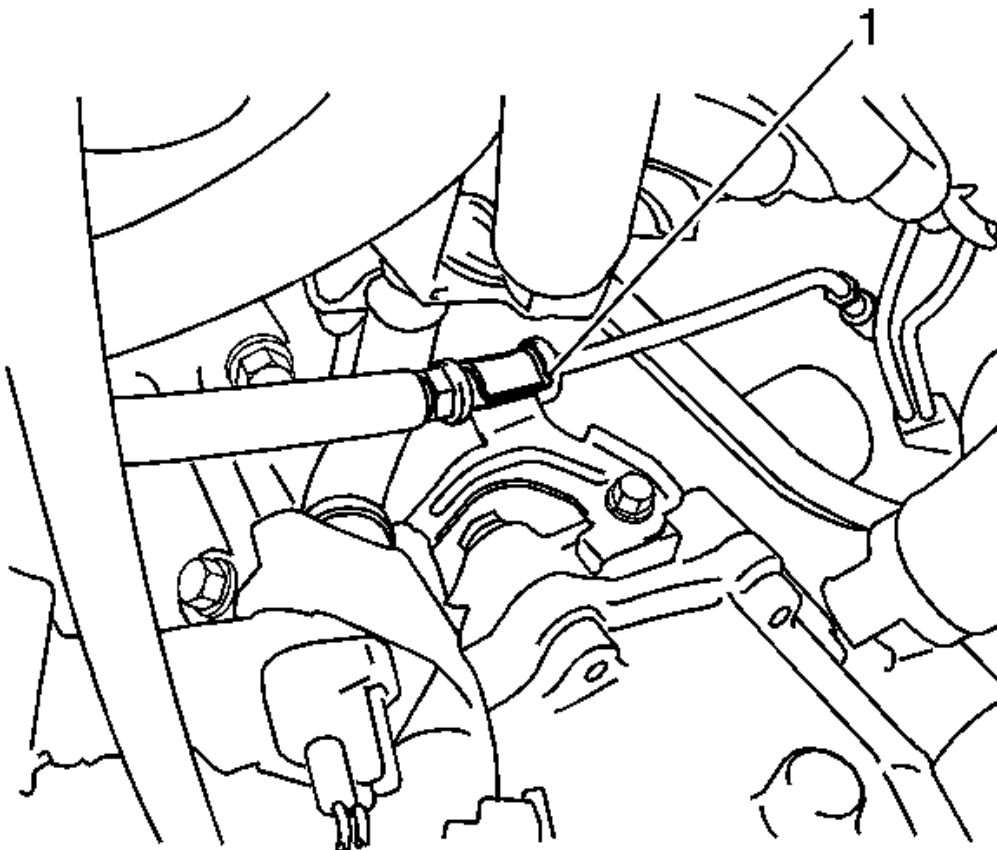


Fig. 225: Identifying Control Cable Bracket
Courtesy of GENERAL MOTORS CORP.

47. U140F Automatic Transaxle-Connect the transmission control cable to the control cable bracket (1).

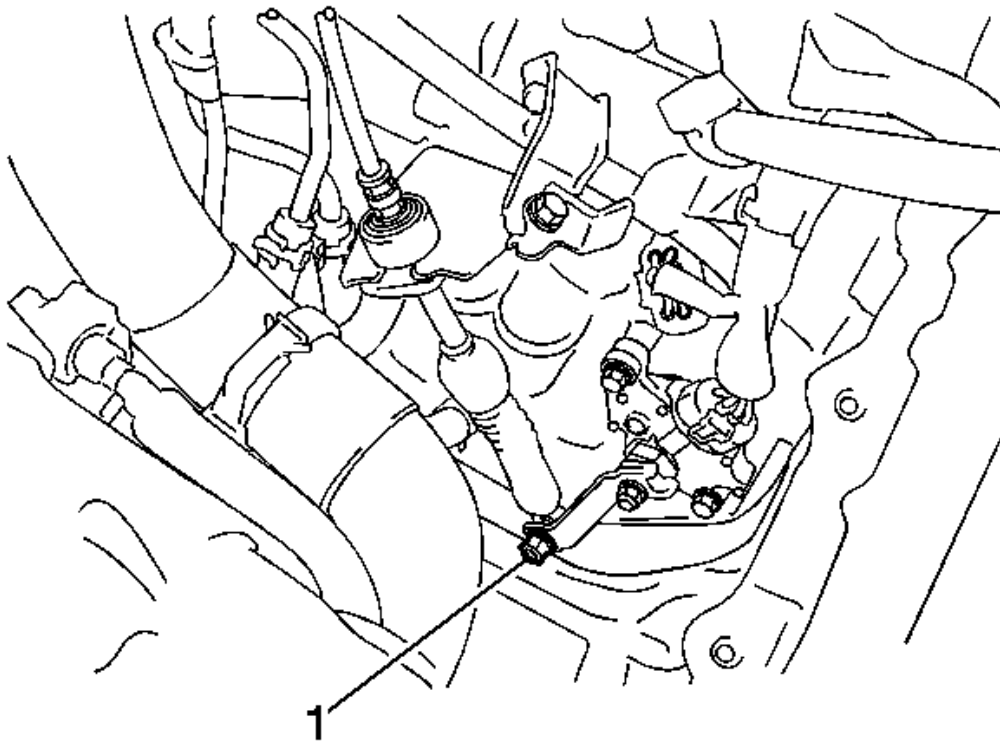


Fig. 226: Locating Cable Assembly & Control Shaft Lever Bracket
Courtesy of GENERAL MOTORS CORP.

48. Connect the transmission control cable to the bracket with a new clip.
49. Connect the transmission control cable assembly to the control shaft lever with the nut (1) and tighten to 12 N.m (9 lb ft).

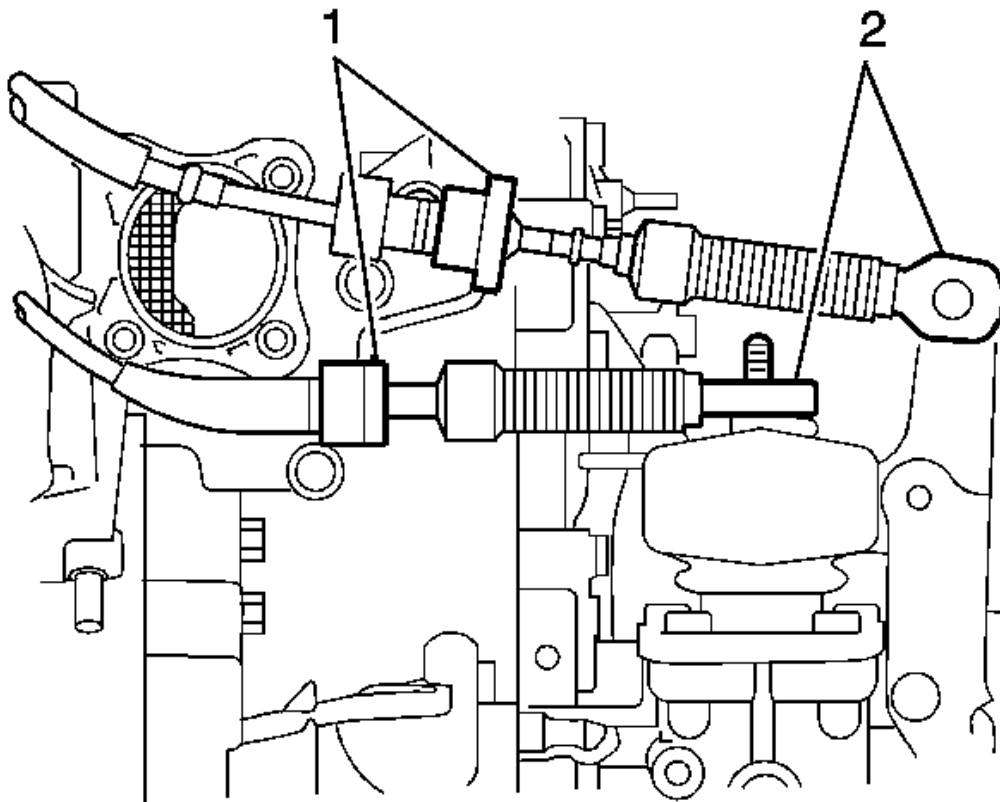


Fig. 227: Locating Transmission Shift Lever Cables, Cable Bracket & Clips
Courtesy of GENERAL MOTORS CORP.

50. E351 Manual Transaxle-Install the 2 transmission control cables (1, 2) to the control cable bracket with 2 new clips 1.
51. Install the clutch release cylinder assembly (for manual transaxle).

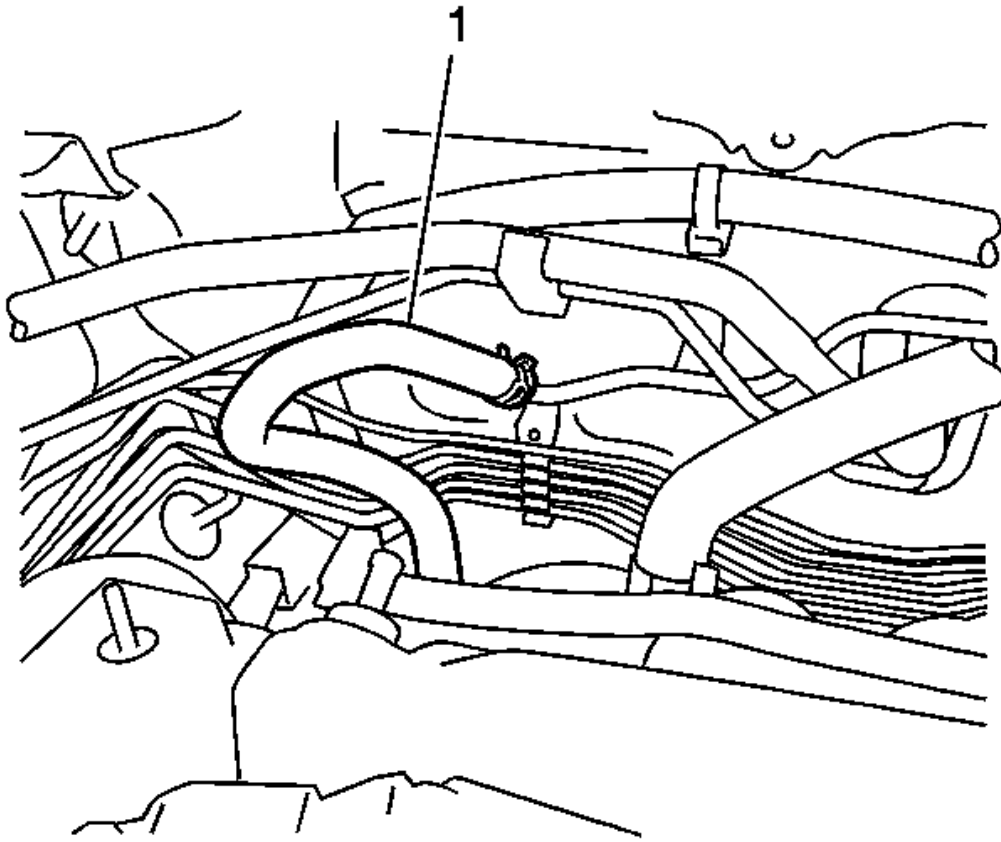


Fig. 228: Identifying Connector Tube Hose Union
Courtesy of GENERAL MOTORS CORP.

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

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 the pipe and connector to make sure that they are securely connected.

53. Connect the fuel tube connector and fuel pipe.

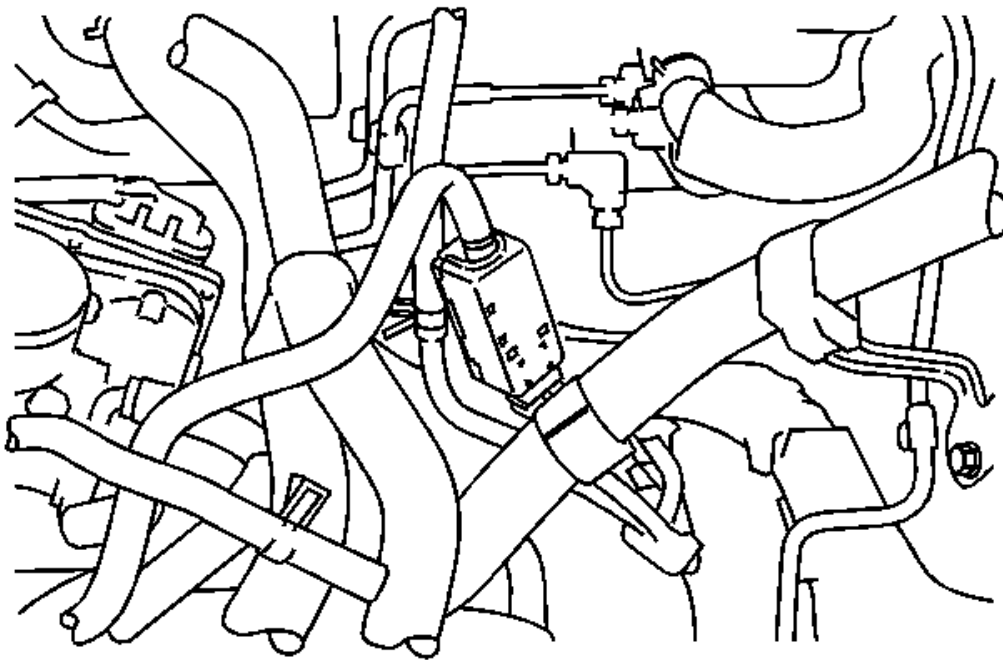


Fig. 229: Identifying Fuel Pipe Clamp
Courtesy of GENERAL MOTORS CORP.

54. Engage the claw and install the fuel pipe clamp.

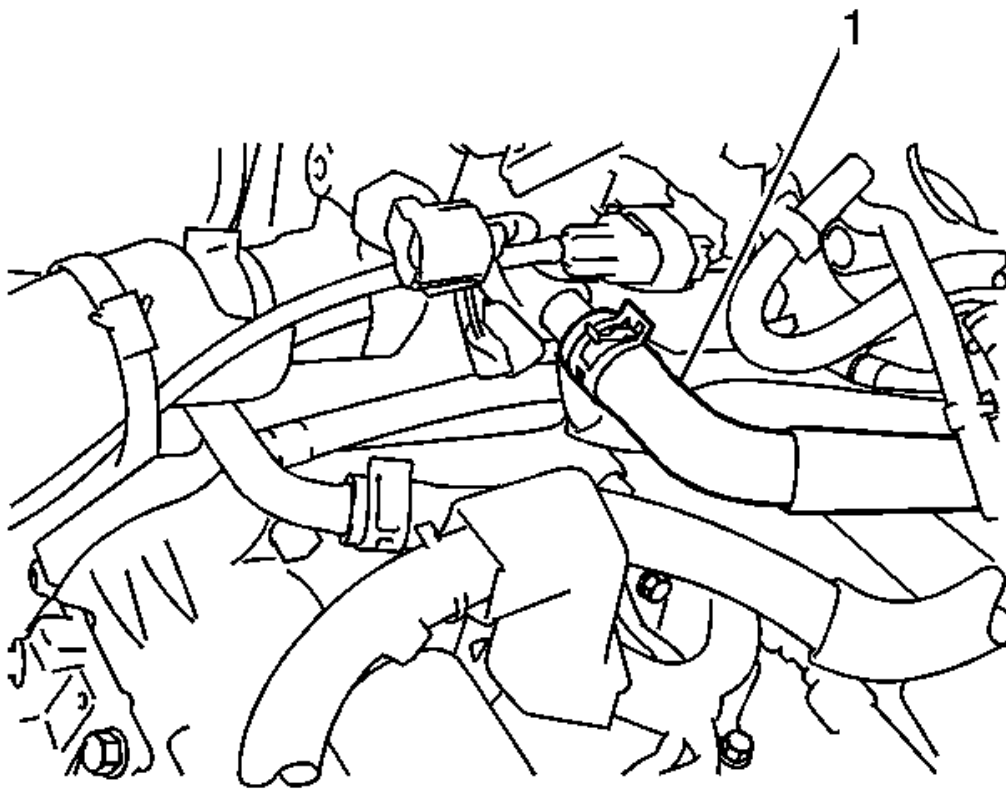


Fig. 230: Identifying Heater Inlet Hose & Clamp
Courtesy of GENERAL MOTORS CORP.

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



Fig. 231: View Of Heater Water Outlet Hose
Courtesy of GENERAL MOTORS CORP.

56. Connect the outlet heater water hose (1) with the clamp.
57. Install the breather hose (for Automatic Transaxle).

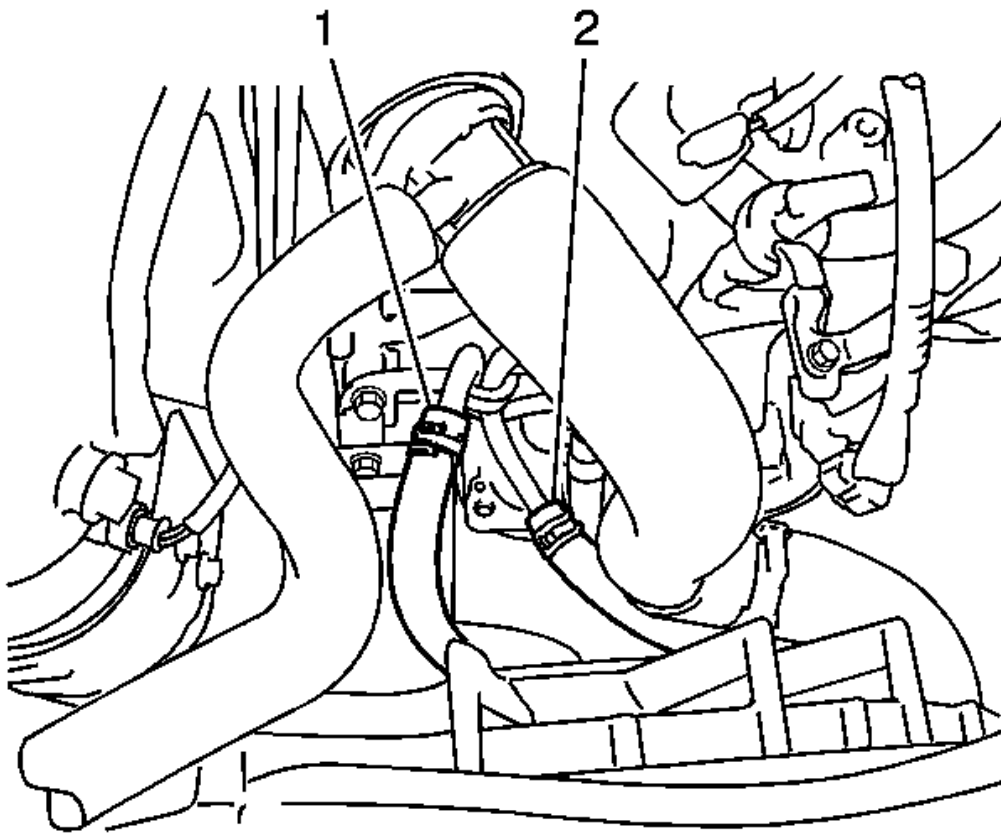


Fig. 232: View Of Oil Cooler Hoses - Automatic Transaxle
Courtesy of GENERAL MOTORS CORP.

58. Connect the 2 oil cooler hoses (1, 2) with the clamps (for Automatic Transaxle).

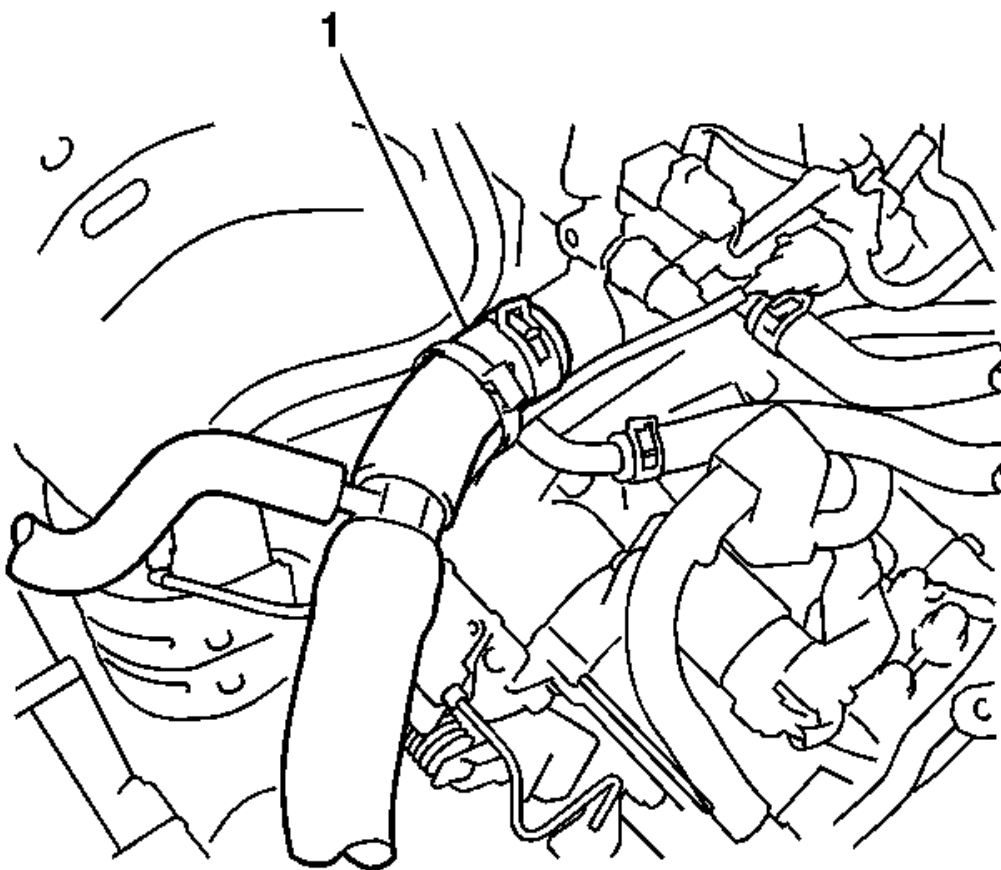


Fig. 233: View Of Upper Radiator Hose At Cylinder Head
Courtesy of GENERAL MOTORS CORP.

59. Connect the upper radiator hose (1) with the clamp.

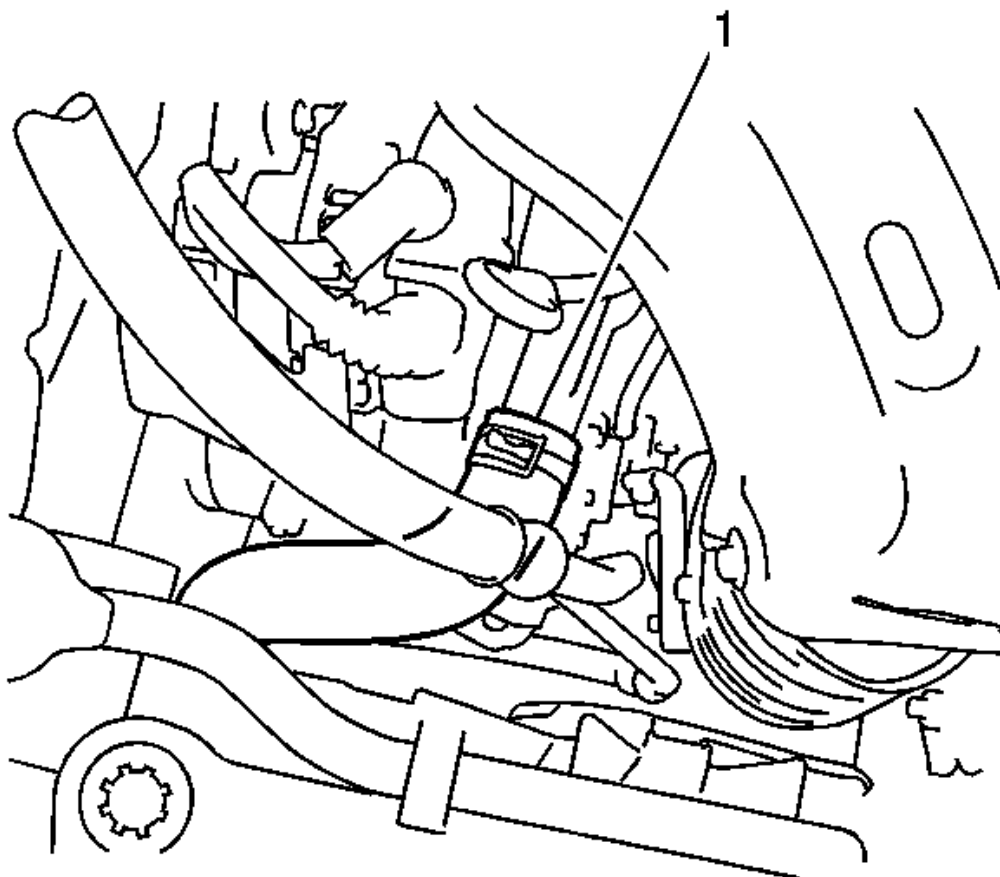


Fig. 234: Locating Upper Radiator Hose
Courtesy of GENERAL MOTORS CORP.

60. Connect the lower radiator hose (1) with the clamp.
61. Install the compressor assembly with pulley (with air conditioning system). Refer to **Air Conditioning Compressor Replacement (2.4L (LAX))** .
62. Install the generator assembly. Refer to **Generator Replacement (2.4L)** .
63. Install the V-ribbed belt. Refer to **Drive Belt Replacement**.
64. Install the throttle body assembly.

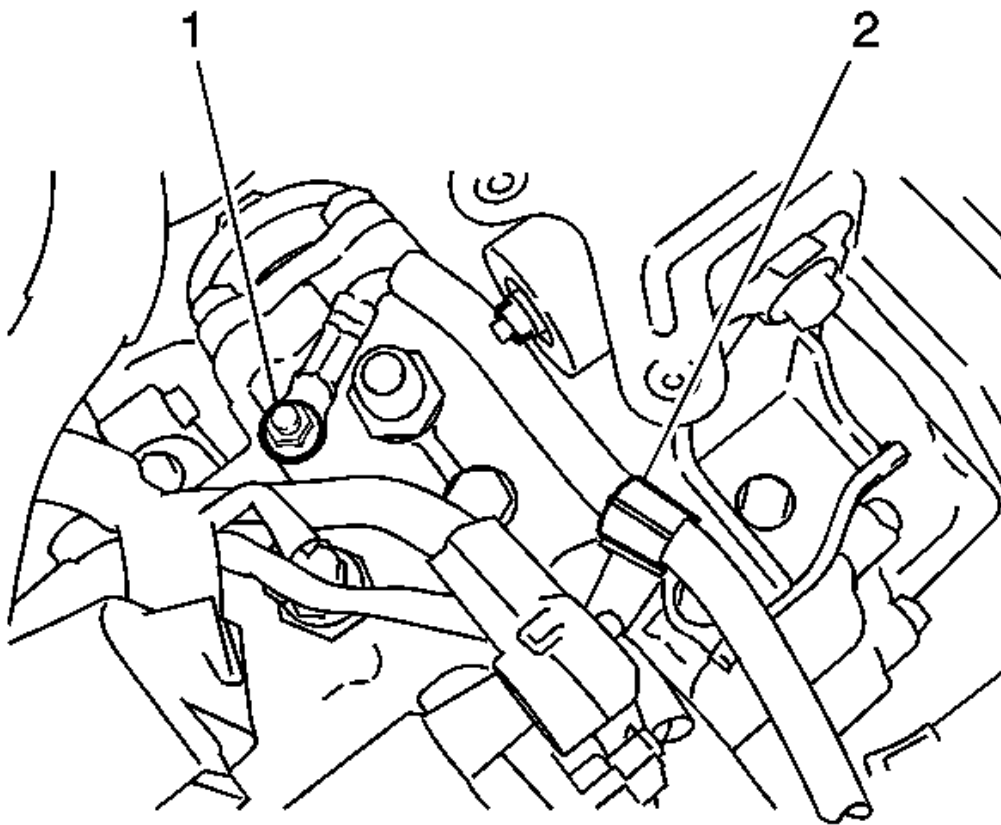


Fig. 235: Identifying Clamp & Ground Cable - Manual Transaxle
Courtesy of GENERAL MOTORS CORP.

65. Install the ground cable to the engine compartment wire with the bolt (1) and clamp (2) (for Manual Transaxle) and tighten to 13 N.m (10 lb ft).

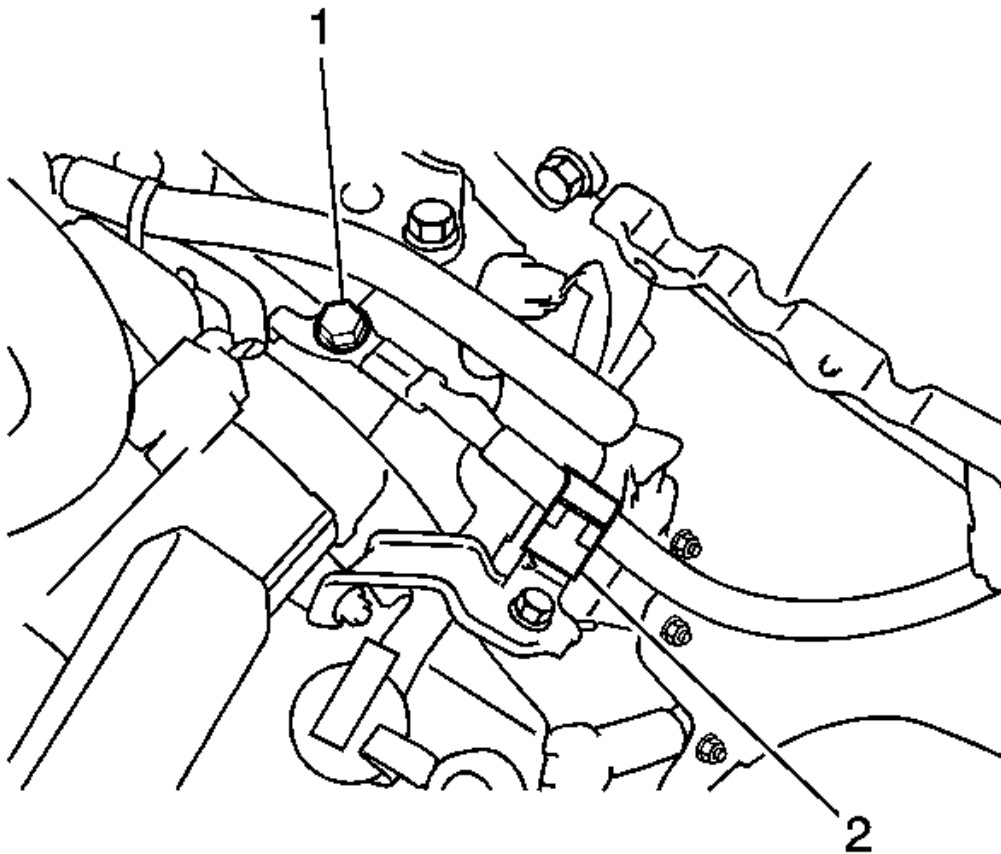


Fig. 236: Identifying Clamp & Ground Cable - Automatic Transaxle
Courtesy of GENERAL MOTORS CORP.

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

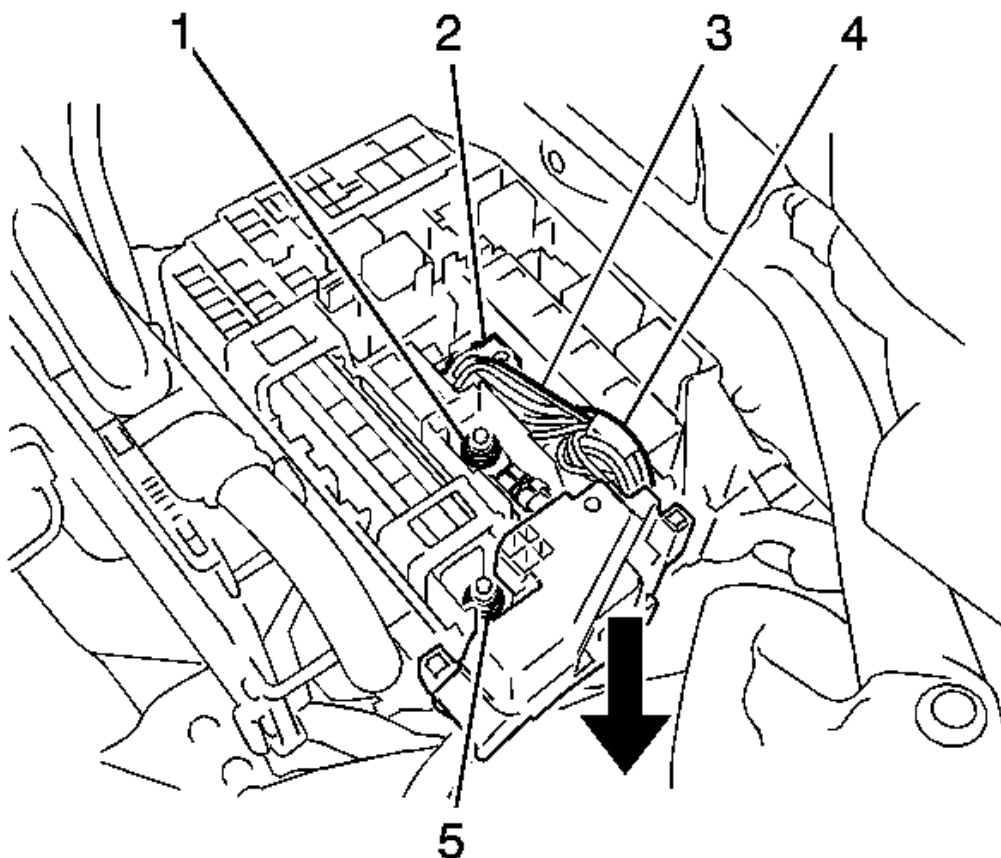


Fig. 237: Identifying Wire Harness & Nuts
Courtesy of GENERAL MOTORS CORP.

67. Install the wire harness with the 2 nuts (1, 5) and tighten to 8.4 N.m (74 lb in).
68. Connect the 3 connectors (2, 3, 4).

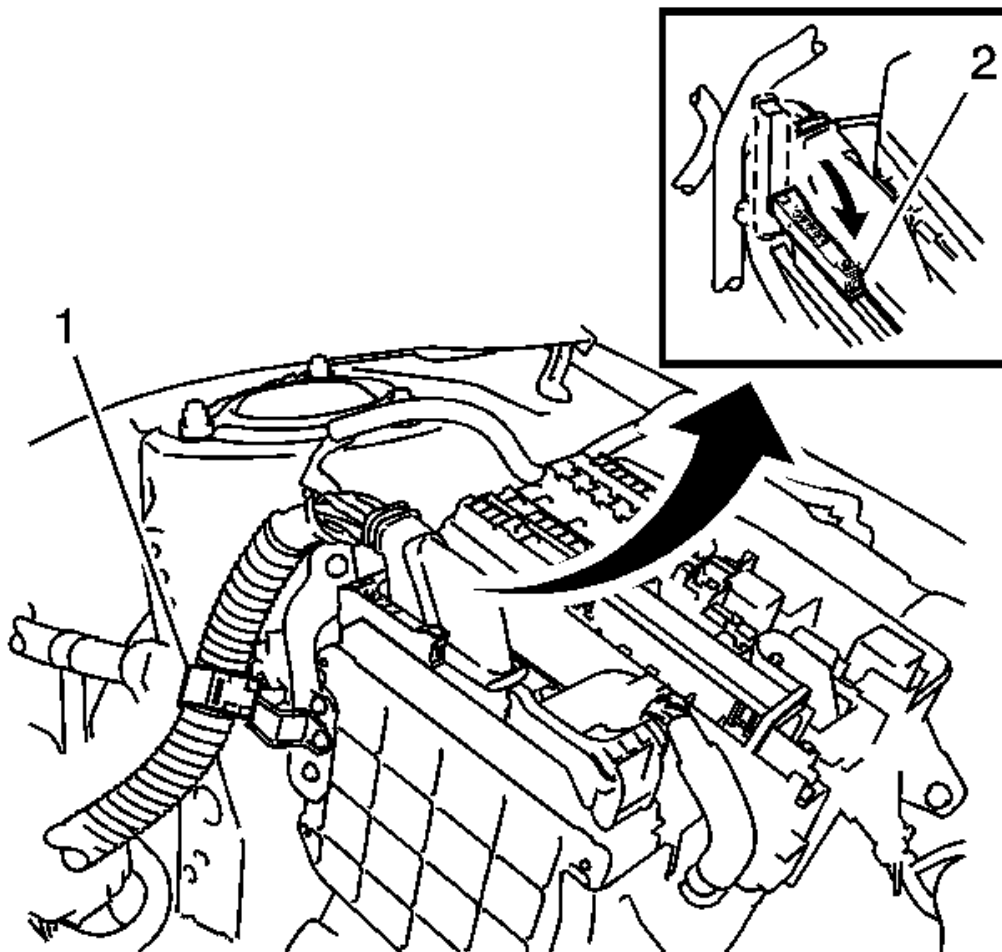


Fig. 238: Exploded View Of Fuel Tank Vent Hose & Charcoal Canister
 Courtesy of GENERAL MOTORS CORP.

69. Connect the connector to the engine control computer with the clamp and lock lever (2).

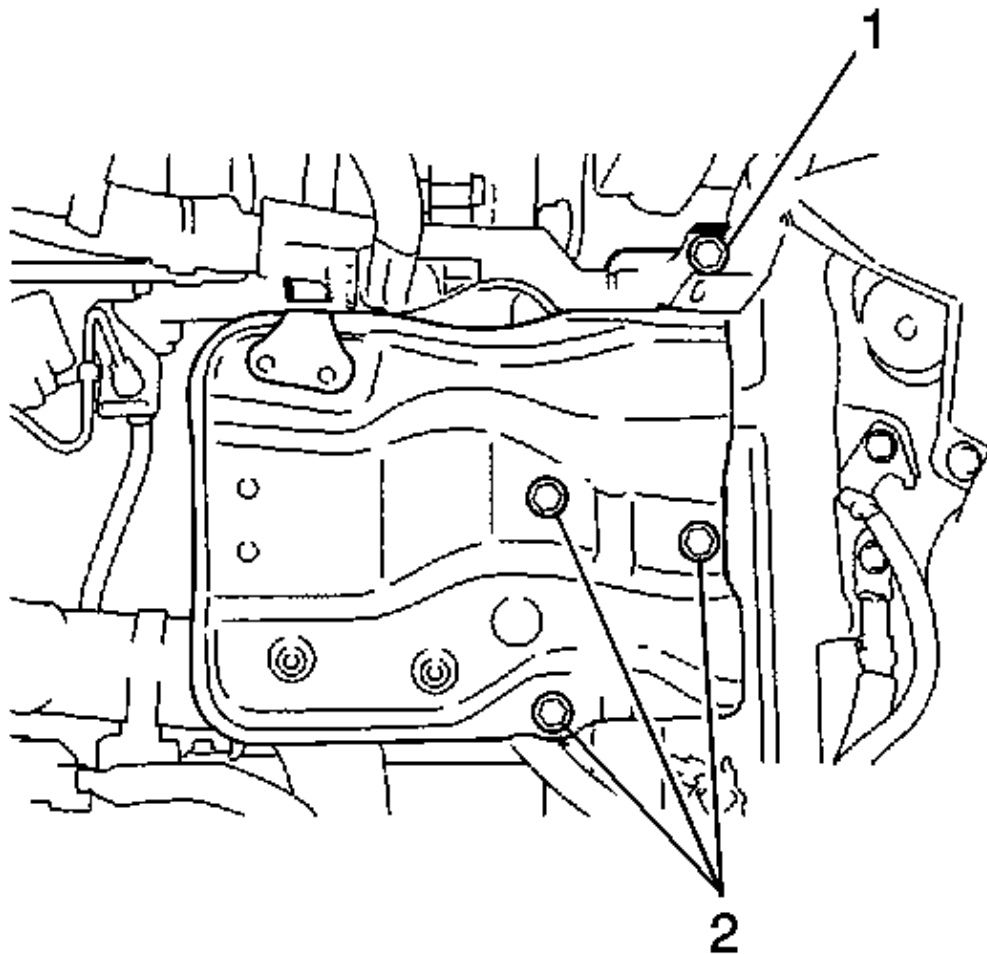


Fig. 239: Identifying Bolts & Battery Carrier
 Courtesy of GENERAL MOTORS CORP.

70. Install the battery carrier with the 4 bolts (1, 2) and tighten to 13 N.m (10 lb ft).
71. Connect the 2 wire harness clamps.
72. Install the battery tray, battery and battery insulator. Refer to **Battery Tray Replacement** .

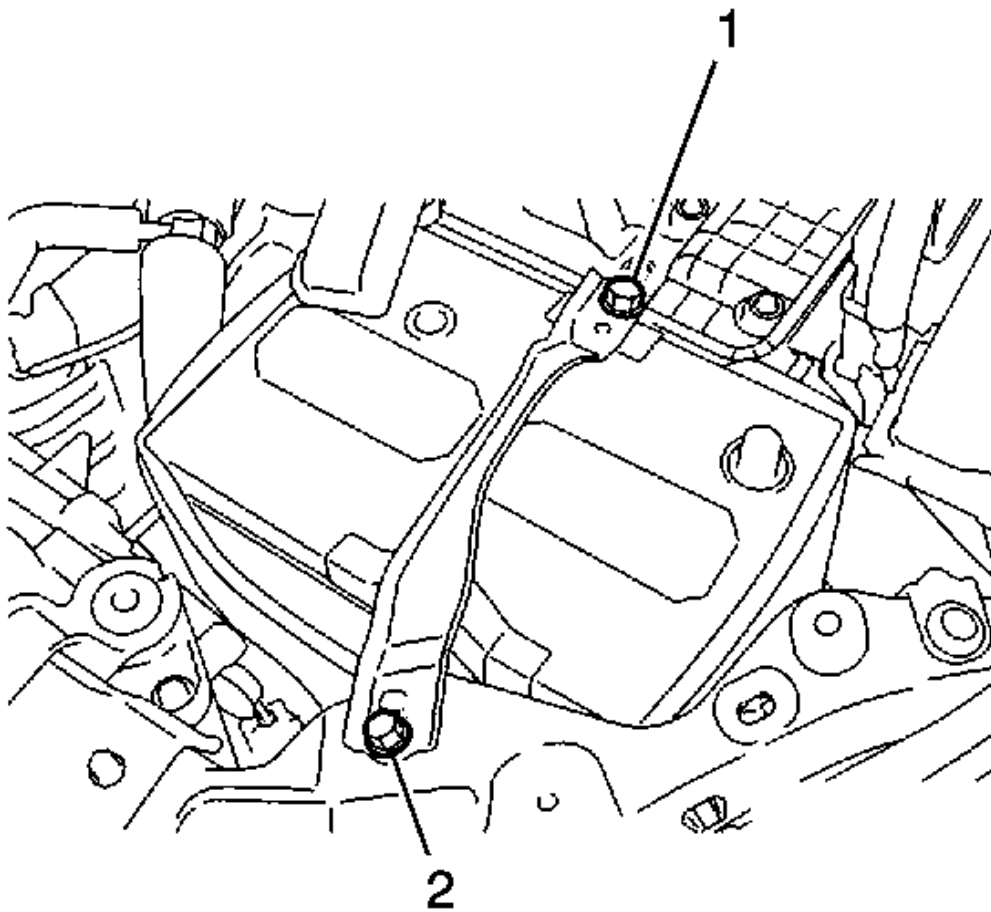


Fig. 240: Identifying Battery Clamp Nut & Bolt
Courtesy of GENERAL MOTORS CORP.

73. Install the battery clamp with the bolt (1) and nut (2) and tighten.
- Bolt to 6.5 N.m (58 lb in)
 - Nut to 3.5 N.m (31 lb in)

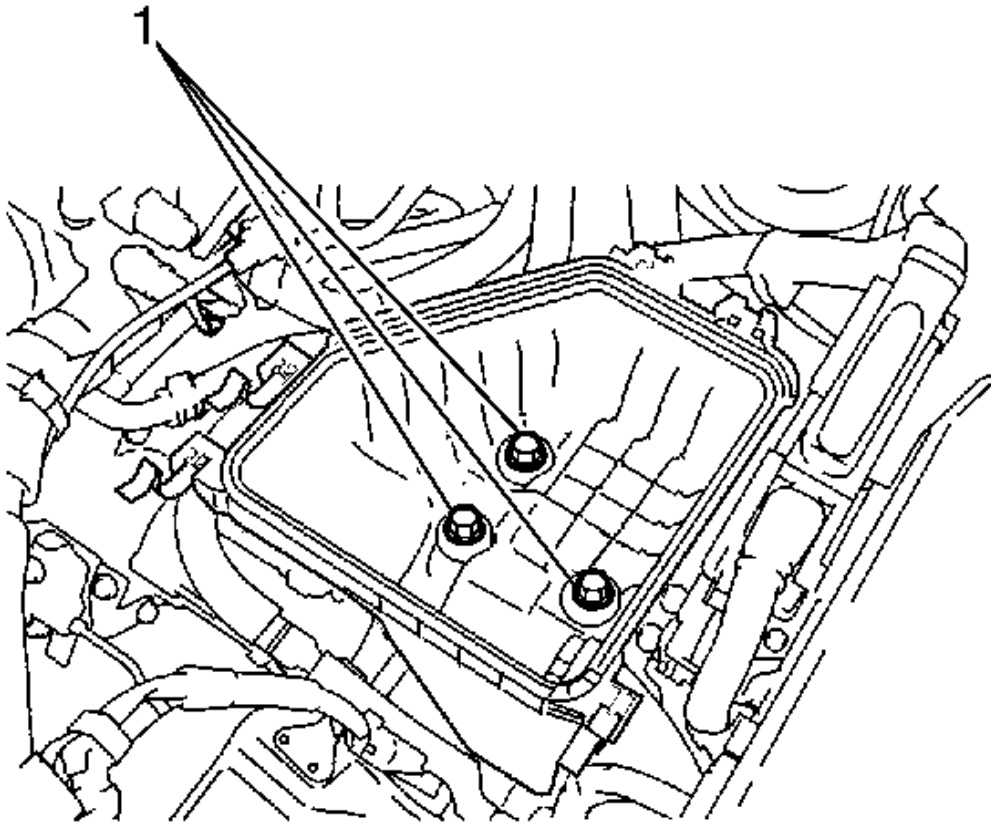


Fig. 241: Identifying Air Cleaner Case & Bolts
Courtesy of GENERAL MOTORS CORP.

74. Install the air cleaner case with the 3 bolts (1) and tighten to 7.0 N.m (62 lb in).
75. Install the engine wire clamp to the air cleaner case.
76. Install the air cleaner filter element.
77. Install the air cleaner cap with hose.

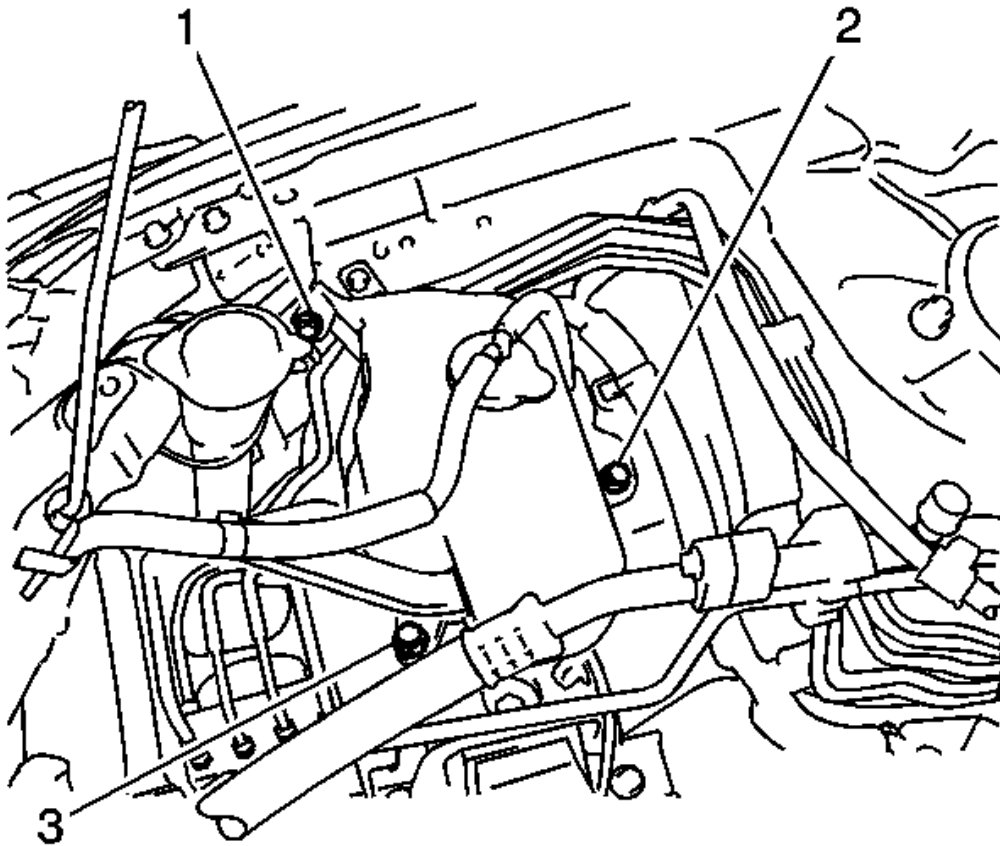


Fig. 242: Identifying Radiator Reserve Tank Assembly & Bolts
Courtesy of GENERAL MOTORS CORP.

78. Install the radiator reserve tank assembly with the 3 bolts (1, 2, 3) and tighten to 7.0 N.m (62 lb in).
79. Add manual transaxle oil (for manual transaxle).
80. Inspect the manual transaxle oil (for manual transaxle).
81. Add automatic transaxle fluid (for automatic transaxle).
82. Inspect the transaxle fluid level (for automatic transaxle).
83. Add transfer case oil.
84. Inspect the transfer case oil.
85. Inspect the shift lever position (for automatic transaxle).
86. Adjust the shift lever position (for automatic transaxle) Refer to **Park/Neutral Position Switch Adjustment** .
87. Add engine coolant. Refer to **Cooling System Draining and Filling** .

88. Connect the cable to negative battery terminal. Refer to **Battery Negative Cable Disconnection and Connection** .
89. Warm up the engine.
90. Fill the brake fluid reservoir (for manual transaxle)
91. Bleed the clutch line (for manual transaxle).
92. Inspect the fluid level (for manual transaxle).
93. Inspect for fuel leak.
94. Inspect for coolant leak
95. Inspect for oil leak.
96. Inspect for exhaust gas leak.
97. Install the engine under left cover.
98. Install the engine under right cover.
99. Install the front wheels. Refer to **Tire and Wheel Removal and Installation** .
100. Inspect the ignition timing.
101. Inspect the engine idling speed.
102. Adjust the front wheel alignment. Refer to **Wheel Alignment Measurement** .

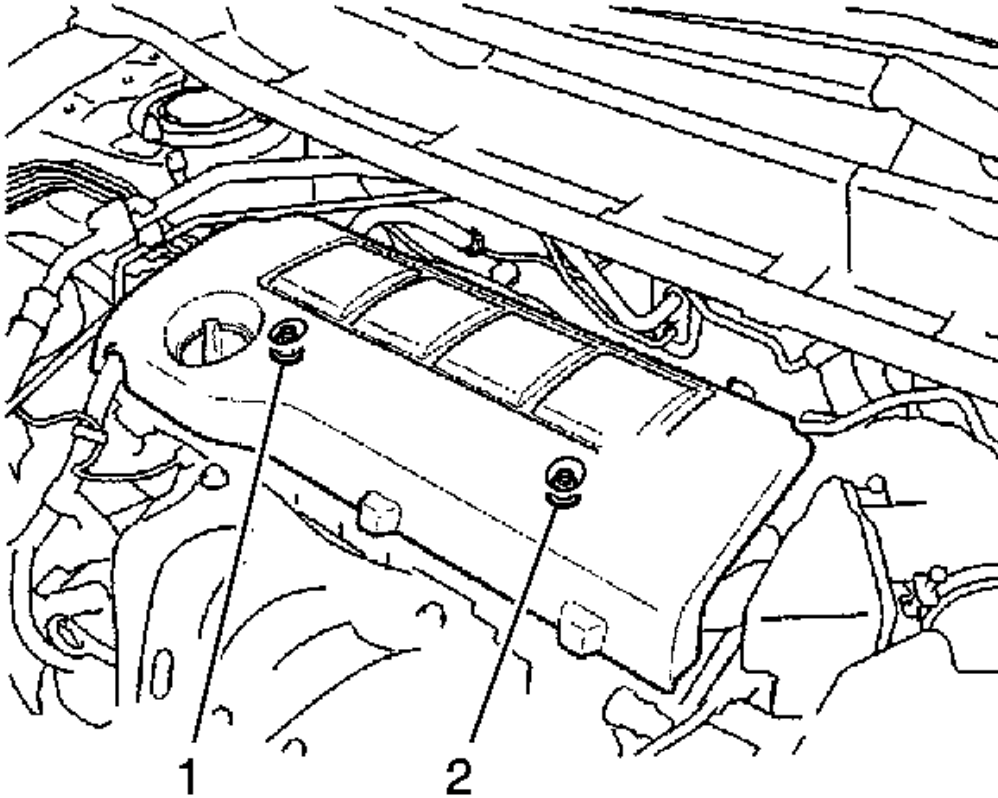


Fig. 243: Identifying Engine Cover Nuts
Courtesy of GENERAL MOTORS CORP.

103. Install the engine cover with the 2 nuts (1, 2).
104. 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.

Tighten: Tighten to 40 N.m (29 lb ft).

4. Using a strap type wrench, remove the oil filter.
5. Clean the oil filter installation surface.
6. Apply engine oil to the oil filter gasket.
7. Lightly screw the oil filter into the engine until the oil filter does not turn.
8. Using a strap type wrench, tighten the oil filter.
9. Depending on the work space available, choose from the following:
 - If enough space is available, use a torque wrench to tighten the oil filter.

Tighten: Tighten to 18 N.m (13 lb ft).

- If enough space is not available to use a torque wrench, tighten the oil filter a 3/4 turn by hand or use a common wrench.
10. Add fresh engine oil and install the oil filler cap.
 11. Inspect for oil leaks.