

2011 ENGINE

Engine Mechanical - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - Repair Instructions - Off Vehicle - CTS

DRAINING FLUIDS AND OIL FILTER REMOVAL

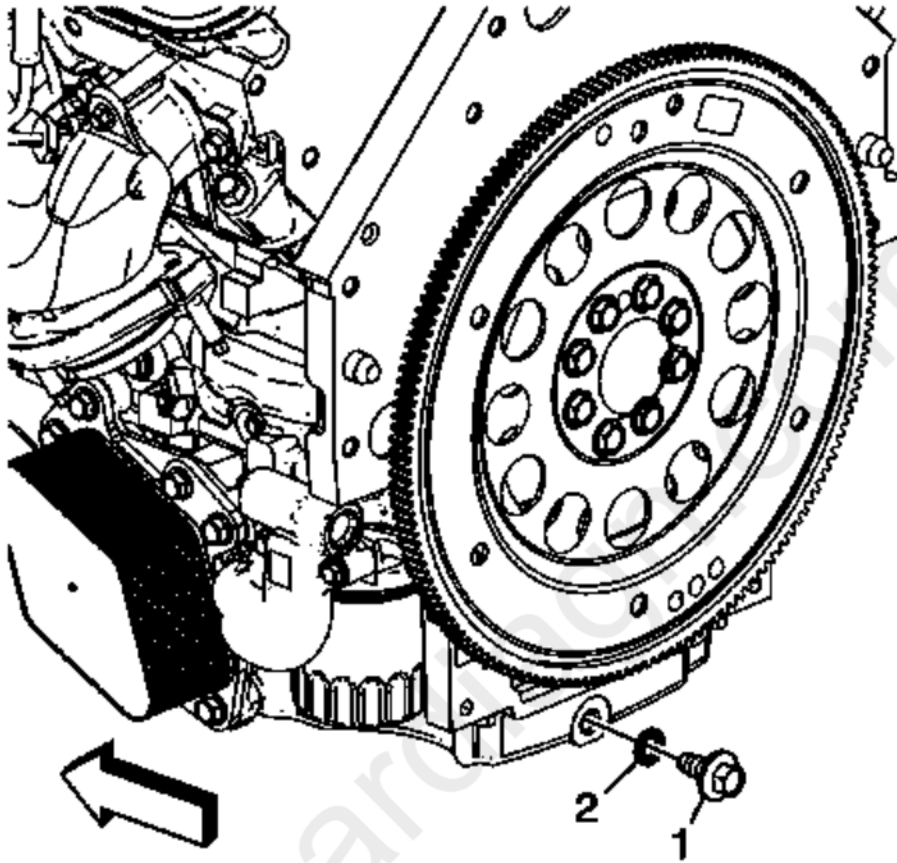


Fig. 1: Identifying Oil Pan Drain Plug & O-ring
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pan drain plug (1) with O-ring (2).

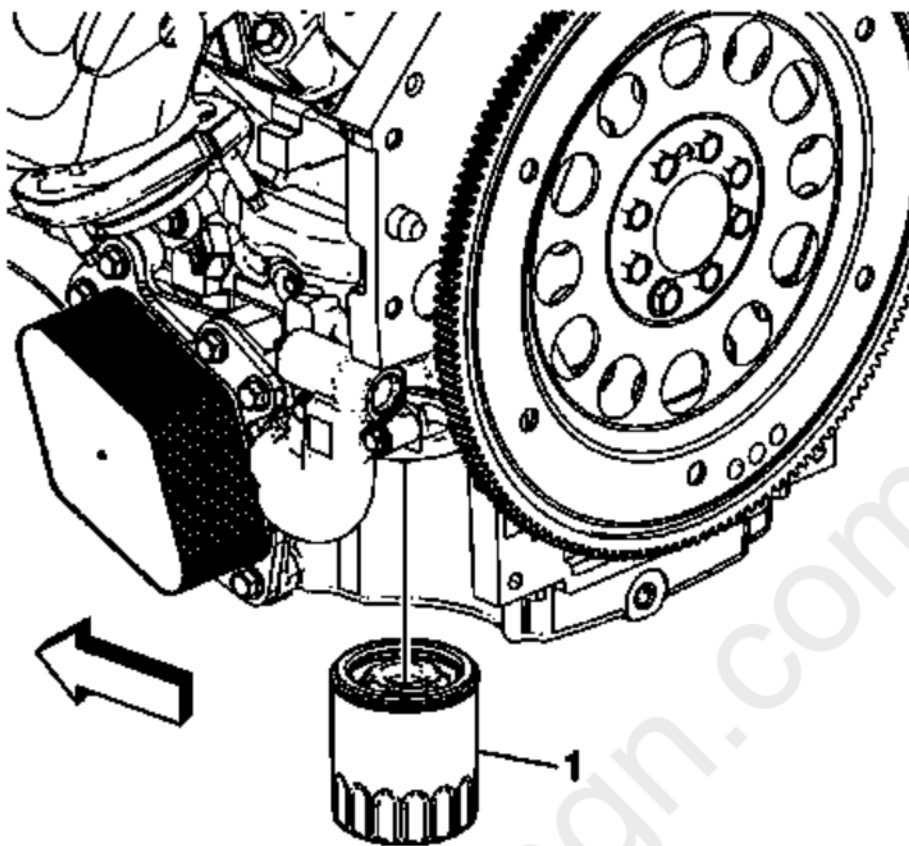


Fig. 2: Identifying Engine Oil Filter
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine oil filter (1).

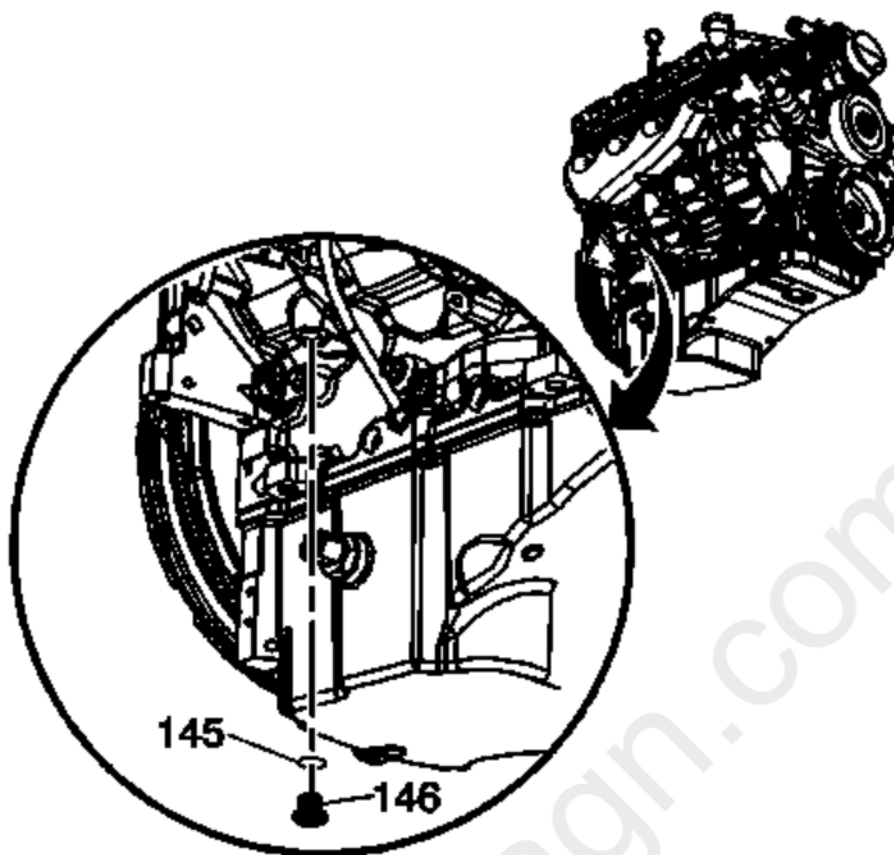


Fig. 3: Engine Block Coolant Drain Plug
Courtesy of GENERAL MOTORS CORP.

3. Remove the right side rear engine block coolant drain hole plug (146) with washer (145).

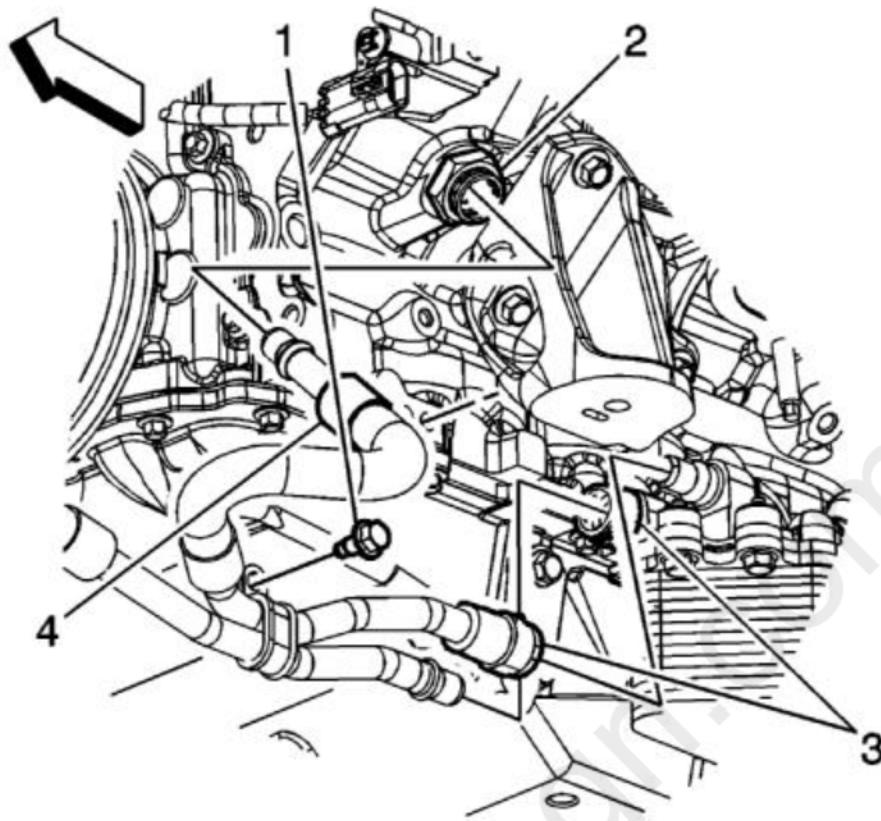


Fig. 4: Identifying Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the engine oil cooler hose/pipe (1) in order to drain coolant from the left side of block.

CRANKSHAFT BALANCER REMOVAL

Special Tools

- **J 41816-A:** Crankshaft Balancer Remover
- **J 41816-2:** Crankshaft End Protector
- **J 42386-A:** Flywheel Holding Tool

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

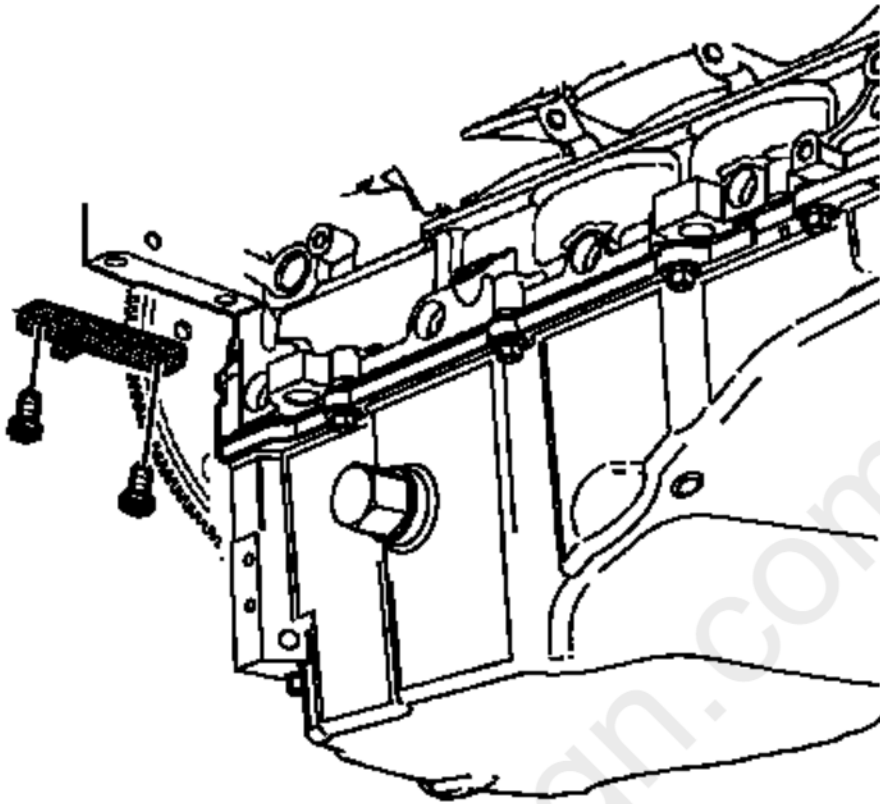


Fig. 5: Identifying J 42386-A

Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE:

- If replacing the crankshaft balancer on manual transmission applications, note the location of any existing balance weights, if applicable. Crankshaft balance weights must be installed into the new balancer in the same location as the old balancer. A properly installed balance weight will be either flush or below flush with the face of the balancer. Refer to Engine Balancing .
- Do not use the crankshaft balancer bolt again. Install a **NEW** crankshaft balancer bolt during final assembly.

1. Install the **J 42386-A**: tool and bolts.

Use 1 M10 - 1.5 x 120 mm and 1 M10 - 1.5 x 45 mm bolt for proper tool operation and tighten the **J 42386-A**: tool bolts to 50 N.m (37 lb ft).

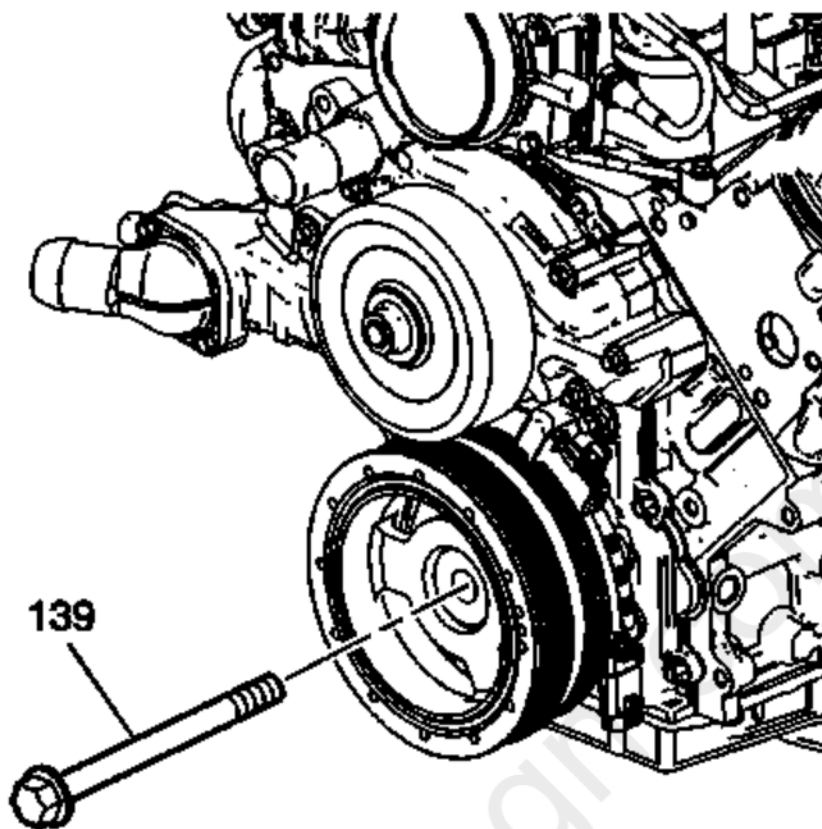


Fig. 6: Crankshaft Balancer Bolt

Courtesy of GENERAL MOTORS CORP.

2. Remove the crankshaft balancer bolt (139). Do not discard the crankshaft balancer bolt. The balancer bolt will be used during the balancer installation procedure.

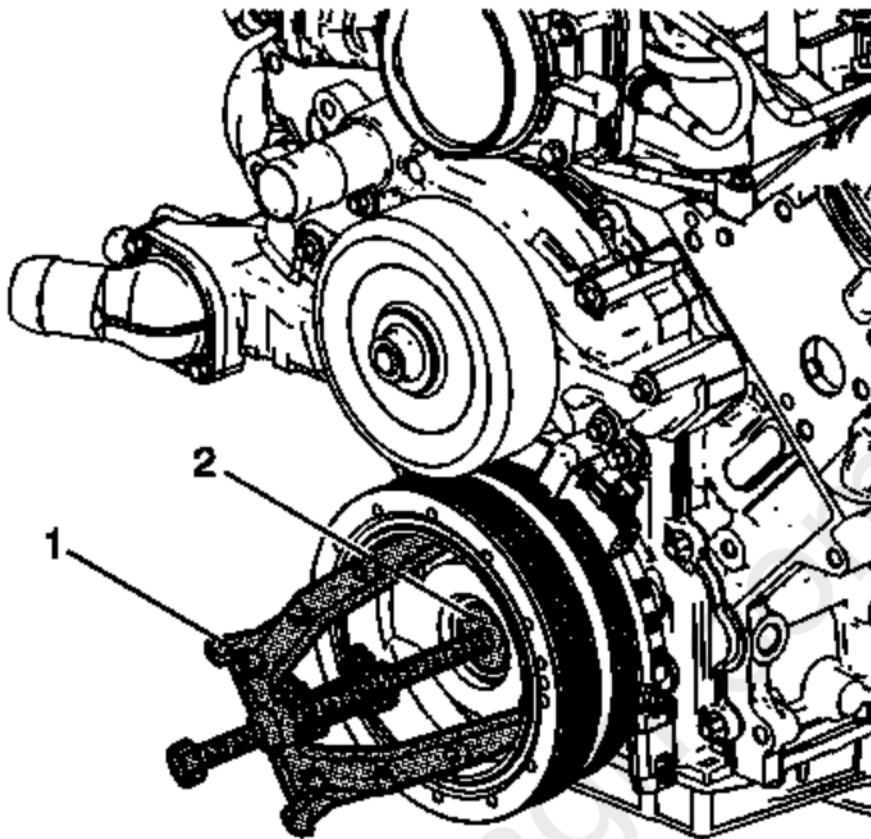


Fig. 7: J 41816 (1) and J 41816-2 (2)
Courtesy of GENERAL MOTORS CORP.

3. Use the **J 41816-A: remover (1)** and the **J 41816-2: protector (2)** in order to remove the crankshaft balancer.

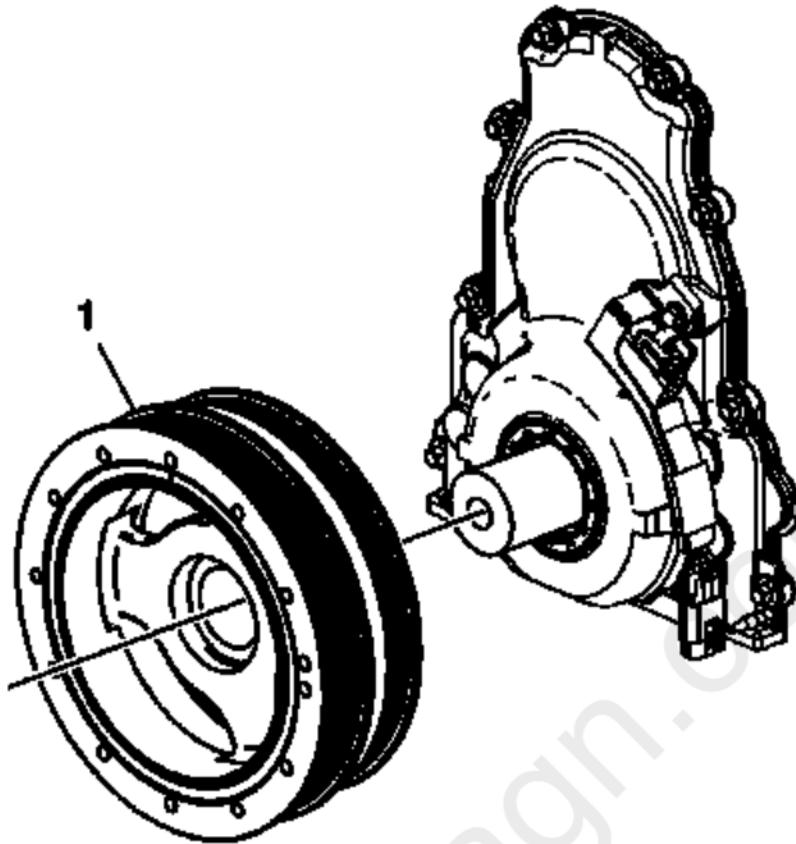


Fig. 8: Crankshaft Balancer

Courtesy of GENERAL MOTORS CORP.

4. Remove the crankshaft balancer (1).

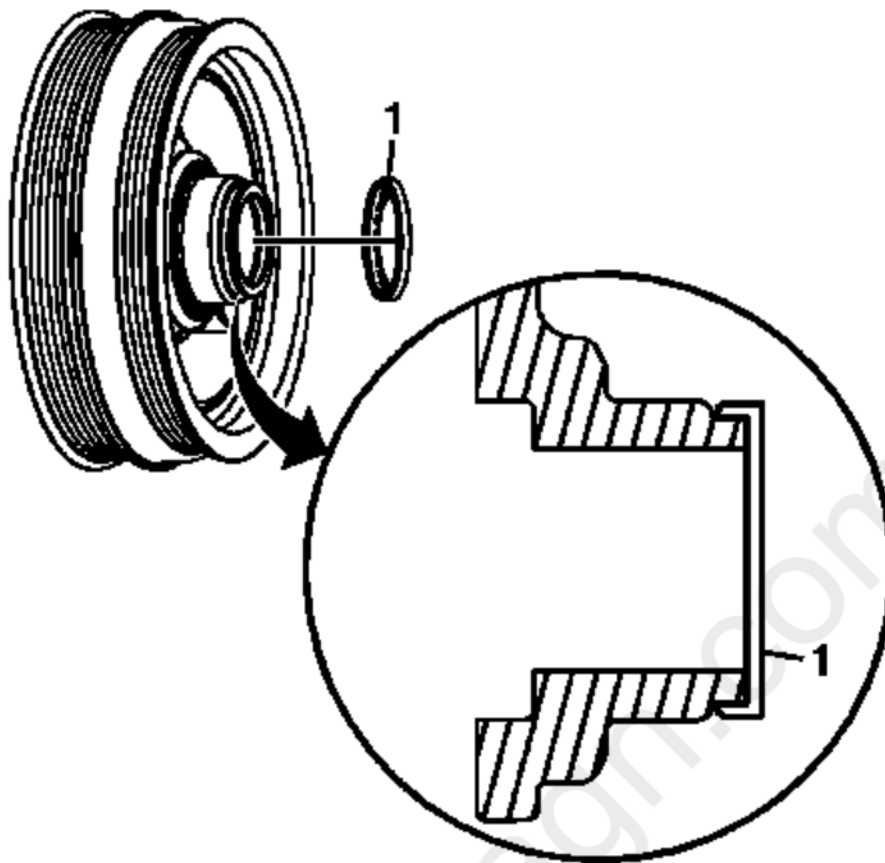


Fig. 9: Crankshaft Balancer Washer
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft balancer washer (1) from the balancer, as required.

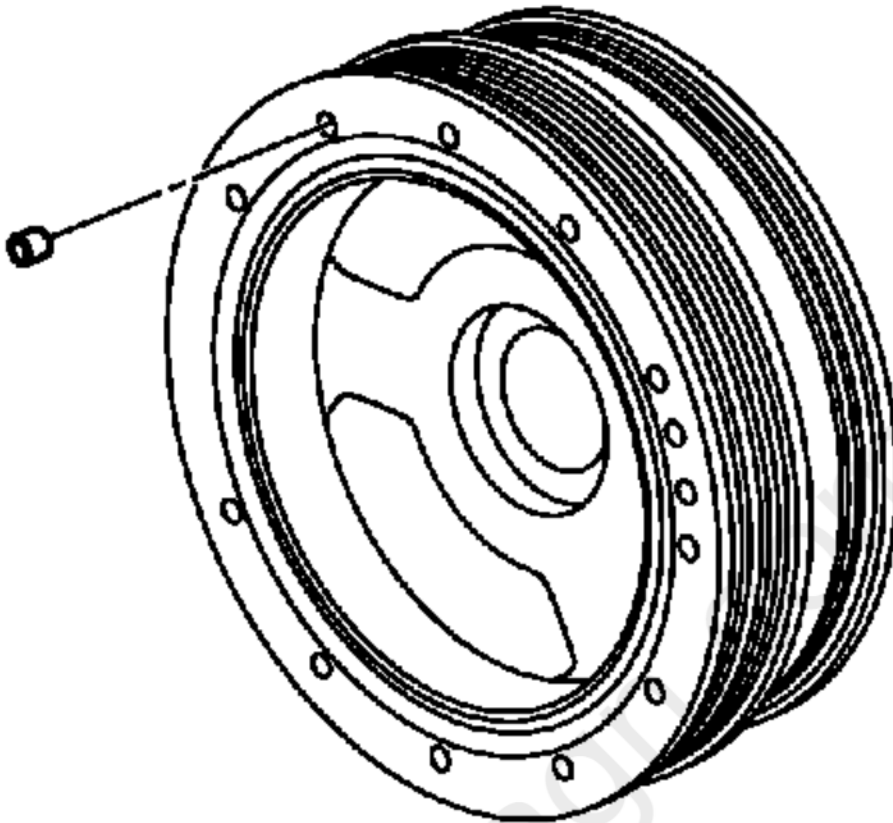


Fig. 10: View Of Balancer Weights In Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

6. Note the position of the crankshaft balance weights, if applicable for manual transmission applications. Refer to **Engine Balancing** and **Crankshaft Balancer Cleaning and Inspection**.

ENGINE FLYWHEEL REMOVAL

SPECIAL TOOLS

J 42386-A: Flywheel Holding Tool

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

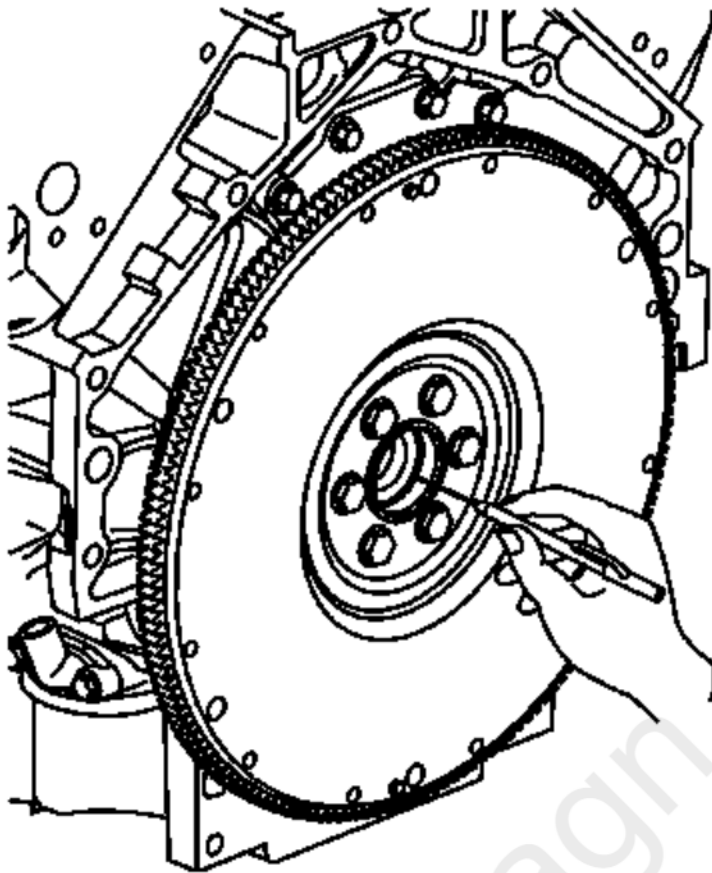


Fig. 11: Mark End Of Crankshaft & Manual Transmission Flywheel
Courtesy of GENERAL MOTORS CORP.

NOTE: For manual transmission applications, note the position and direction of the engine flywheel before removal. The flywheel does not use a locating pin for alignment. Mark or scribe the end of the crankshaft and the flywheel before component removal. The existing manual transmission engine flywheel must be installed to the original position and direction. The engine flywheel will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flywheel bolts. This procedure requires a 3 stage tightening process.

1. Mark or scribe the end of the crankshaft and the manual transmission flywheel. Refer to **Engine Balancing**.

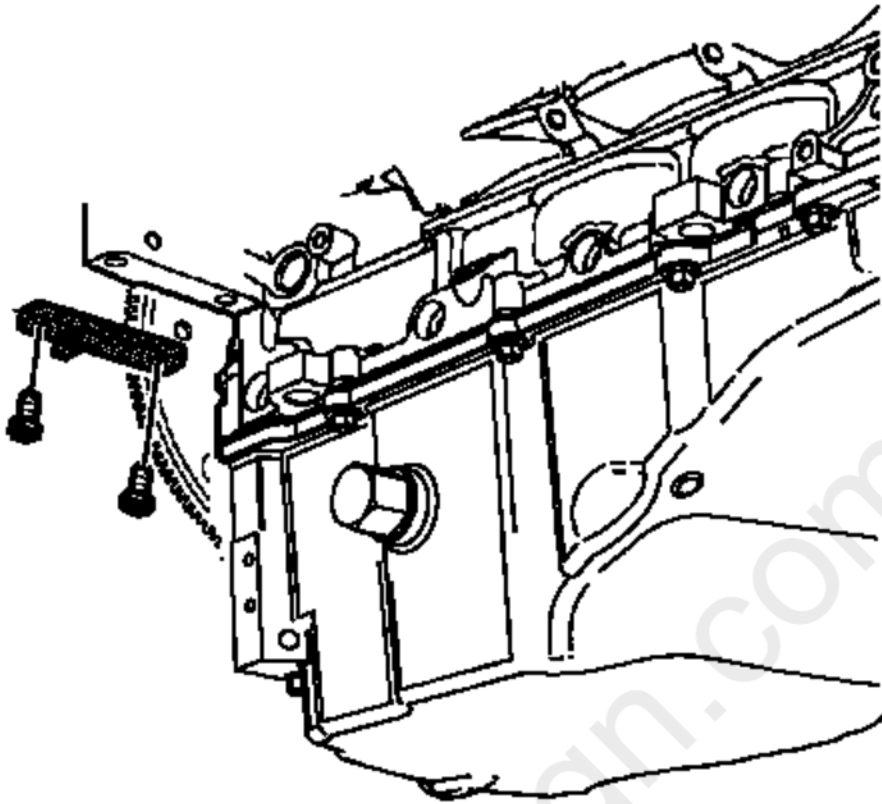


Fig. 12: Identifying J 42386-A
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to SAFETY GLASSES AND COMPRESSED AIR WARNING .

2. Install the **J 42386-A**: flywheel holding tool and bolts.

Use 1 M10 -1.5 x 120 mm and 1 M10 -1.5 x 45 mm bolt for proper tool operation.

Tighten the **J 42386-A**: flywheel holding tool and bolts to 50 N.m (37 lb ft).

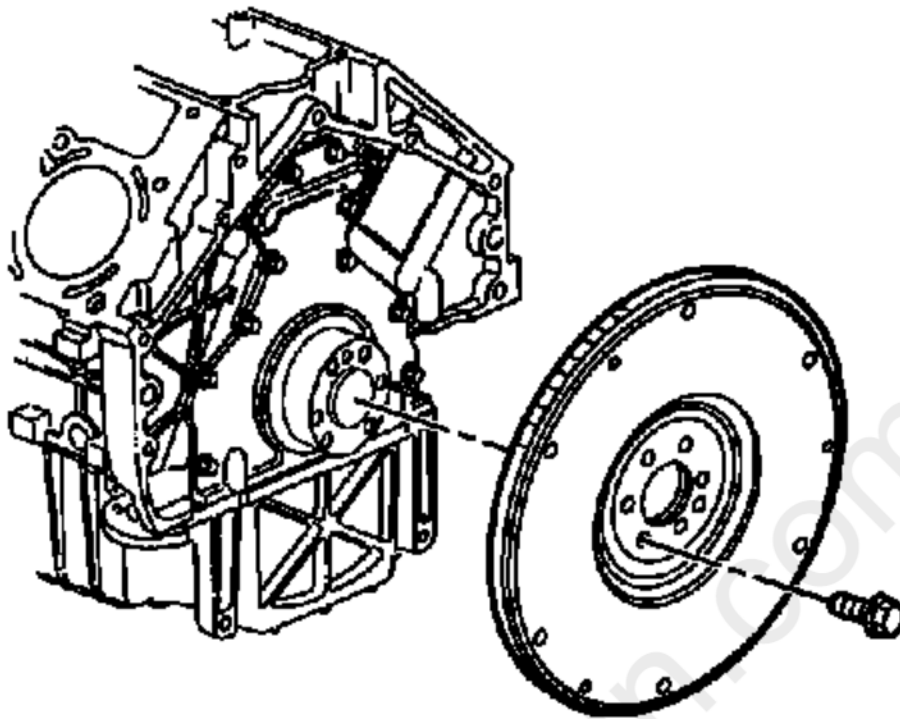


Fig. 13: View Of Engine Flywheel & Bolts (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

3. Remove the flywheel bolts.
4. Remove the manual transmission flywheel.

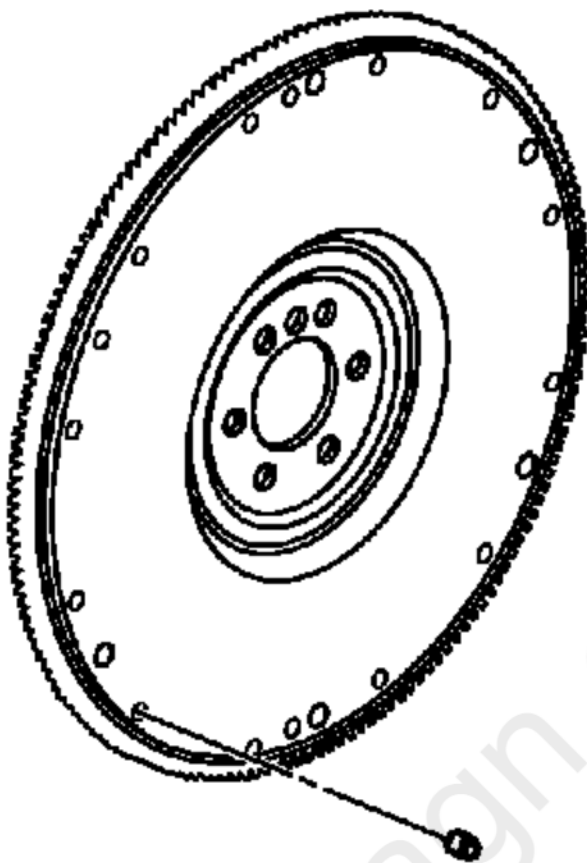


Fig. 14: Locating Flywheel Weights (Manual Transmission)
Courtesy of GENERAL MOTORS CORP.

5. Note the location of the manual transmission flywheel balance weights, if applicable. Refer to **Engine Balancing** .

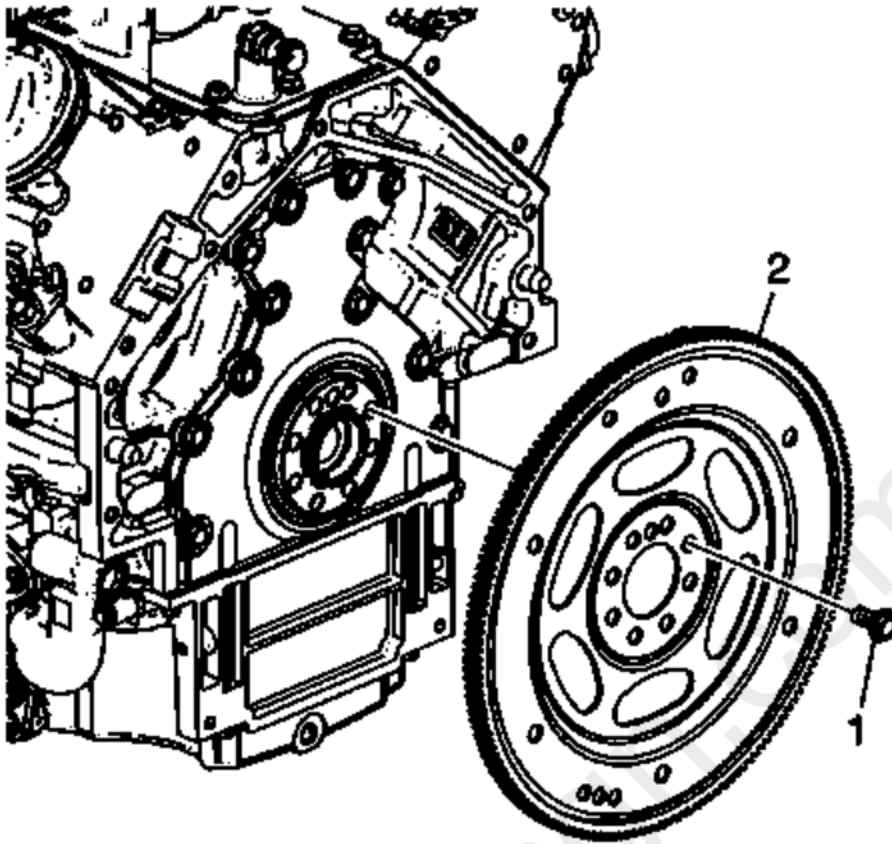


Fig. 15: Identifying Automatic Transmission Flex Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the automatic transmission flex plate bolts (1).
7. Remove the automatic transmission flex plate (2).
8. Remove the **J 42386-A**: flywheel holding tool

CLUTCH PILOT BEARING REMOVAL

Special Tools

- **J 2619-01**: Slide Hammer
- **J 23907**: Slide Hammer with Bearing Adapter
- **J 23907-1**: Slide Hammer

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

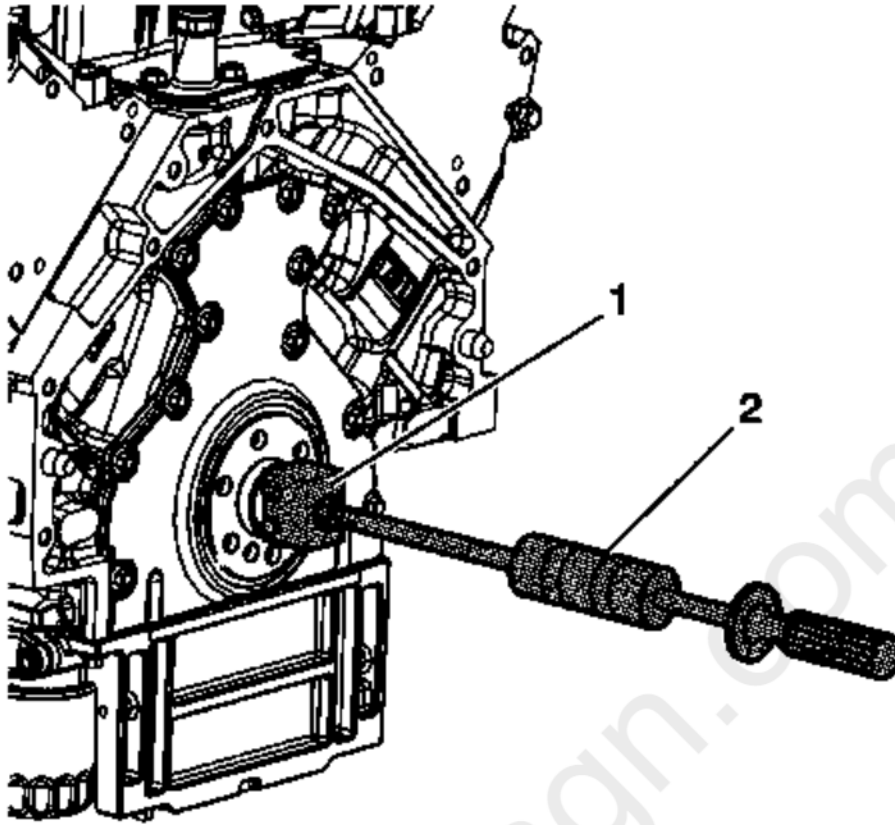


Fig. 16: Clutch Pilot Bearing Slide Hammer & Adapter
Courtesy of GENERAL MOTORS CORP.

NOTE: J 23907-1: slide hammer was part of the J 23907: slide hammer with bearing adapter set. The adapter is still available as J 23907: adapter.

1. Remove the clutch pilot bearing using the **J 23907: adapter (1)** and **J 23907-1: slide hammer (2)**.
 1. Install the legs of the **J 23907: adapter (1)** into the clutch pilot bearing.
 2. Rotate the shaft of the tool until the legs of the tool are snug and contacting the I.D. surface of the bearing.
 3. Install the **J 23907-1: slide hammer (2)** to the **J 23907: adapter (1)**.
 4. Remove the bearing from the rear of the crankshaft.
 5. Remove the special tools from the bearing.

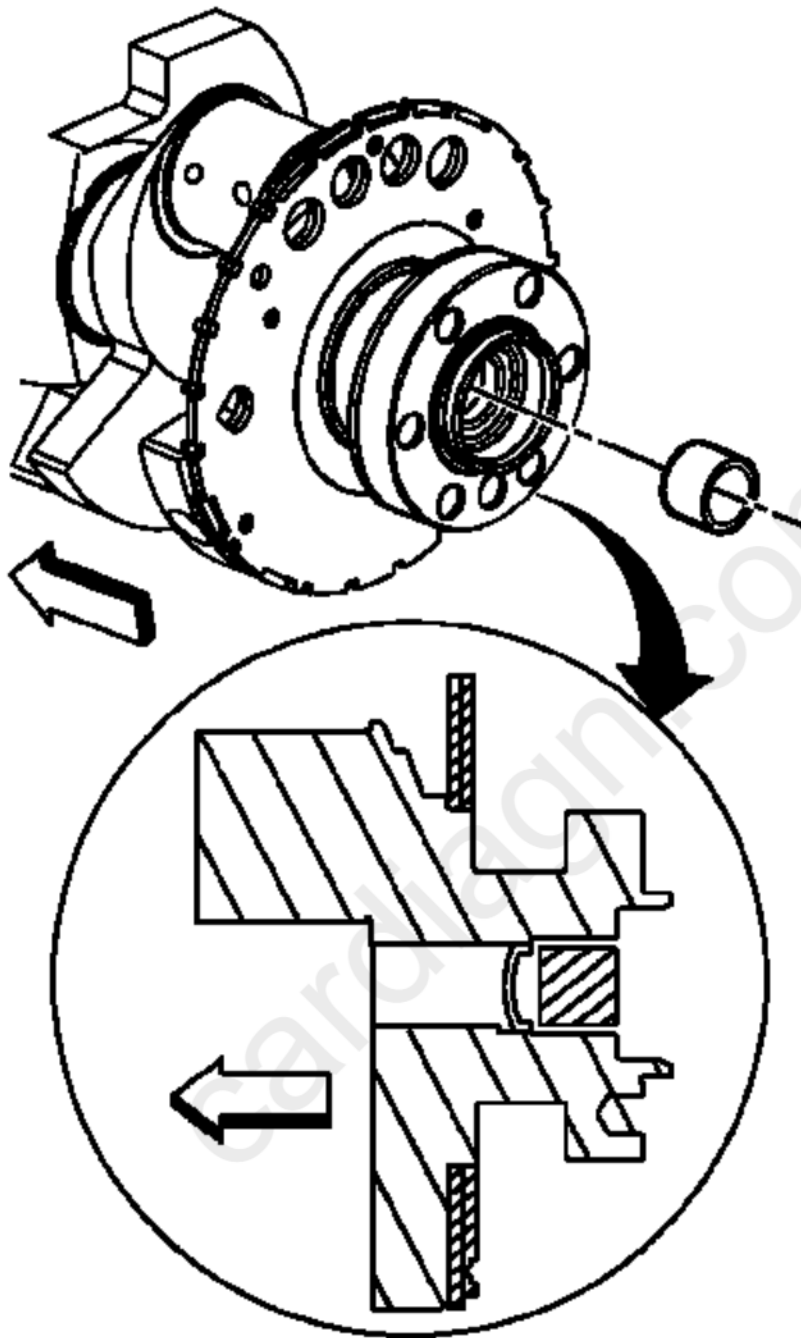


Fig. 17: Locating Clutch Pilot Bearing
Courtesy of GENERAL MOTORS CORP.

2. Discard the bearing.

OIL LEVEL INDICATOR AND TUBE REMOVAL

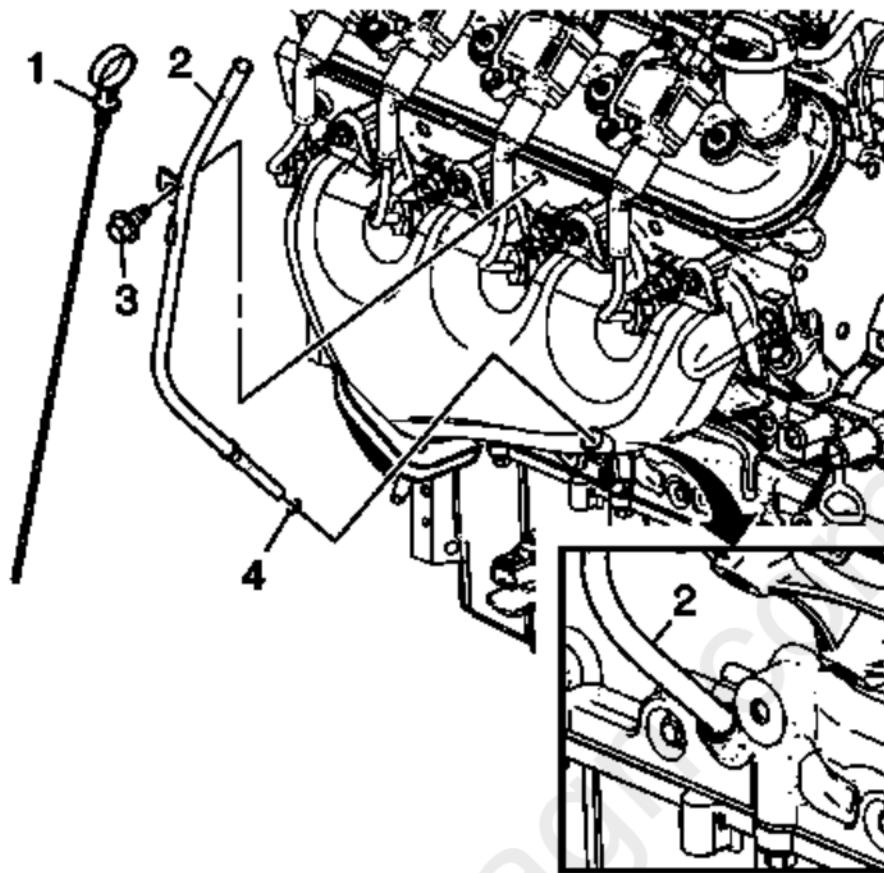


Fig. 18: Identifying Oil Level Indicator Components
Courtesy of GENERAL MOTORS CORP.

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

NOTE: **Inspect the O-ring for cuts or damage. The O-ring may be used again if it is not cut or damaged.**

4. Remove the O-ring (4) from the tube, as required.

EXHAUST MANIFOLD REMOVAL - LEFT SIDE

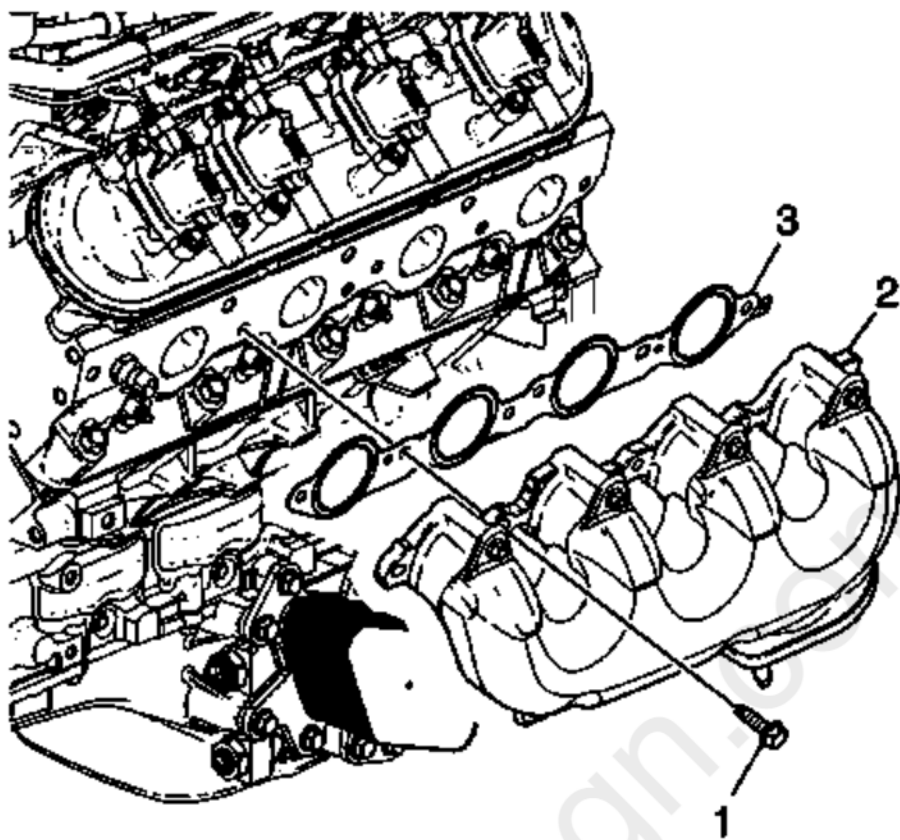


Fig. 19: Identifying Exhaust Manifold, Bolts & Gasket (Left Side)
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires from the spark plugs.
2. Remove the exhaust manifold (2), bolts (1), and gasket (3).
3. Discard the gasket.

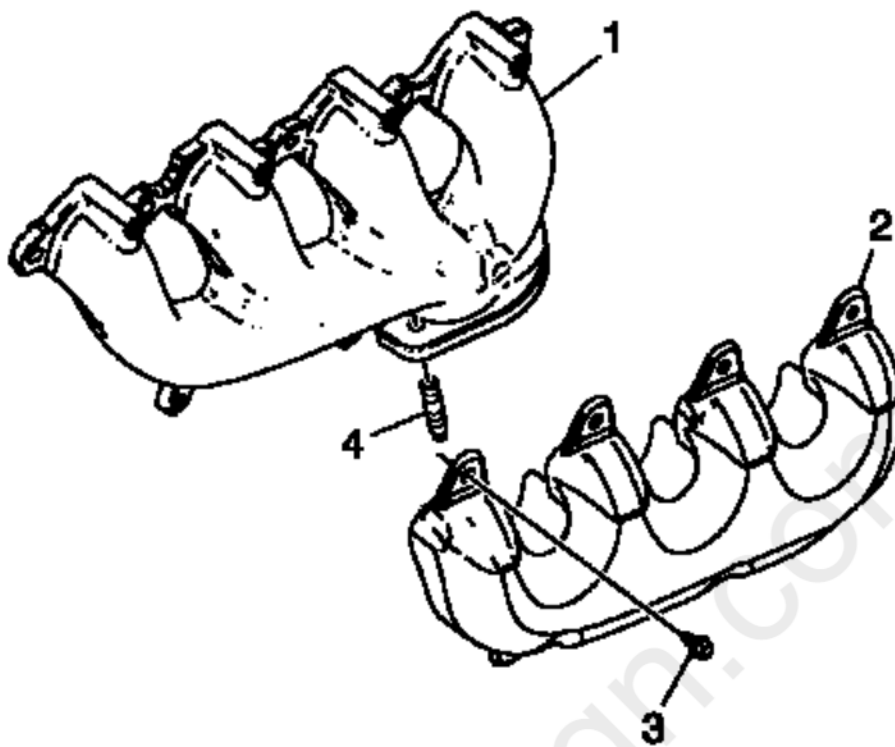


Fig. 20: Identifying Manifold Components (Left Side)
Courtesy of GENERAL MOTORS CORP.

4. Remove the heat shield (2) and bolts (3) from the manifold (1), as required.
5. Remove the studs (4), as required.

EXHAUST MANIFOLD REMOVAL - RIGHT SIDE

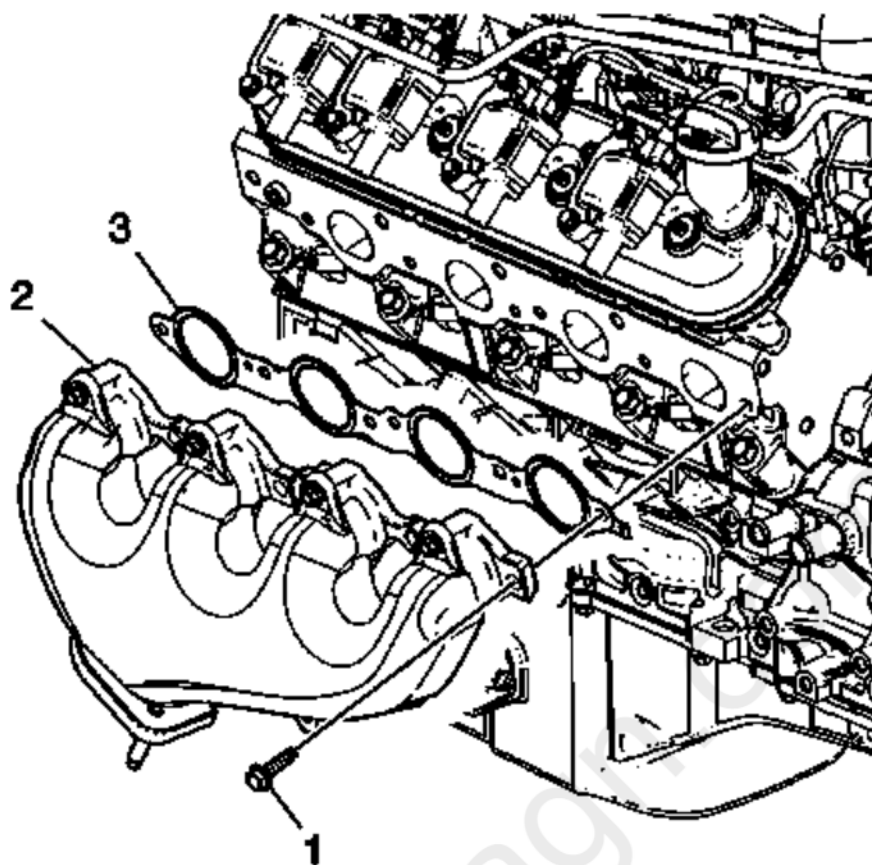


Fig. 21: Identifying Exhaust Manifold, Bolts & Gasket (Right Side)
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires from the spark plugs.
2. Remove the exhaust manifold (2), bolts (1), and gasket (3).
3. Discard the gasket.

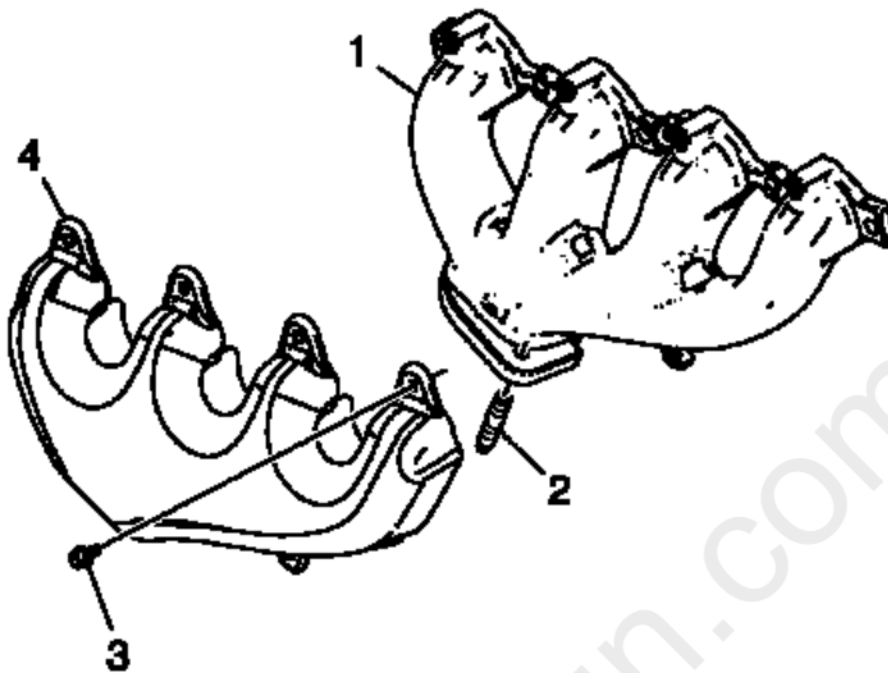


Fig. 22: Identifying Manifold Components (Right Side)
Courtesy of GENERAL MOTORS CORP.

4. Remove the heat shield (4) and bolts (3) from the manifold (1), as required.
5. Remove the studs (2), as required.

WATER PUMP REMOVAL

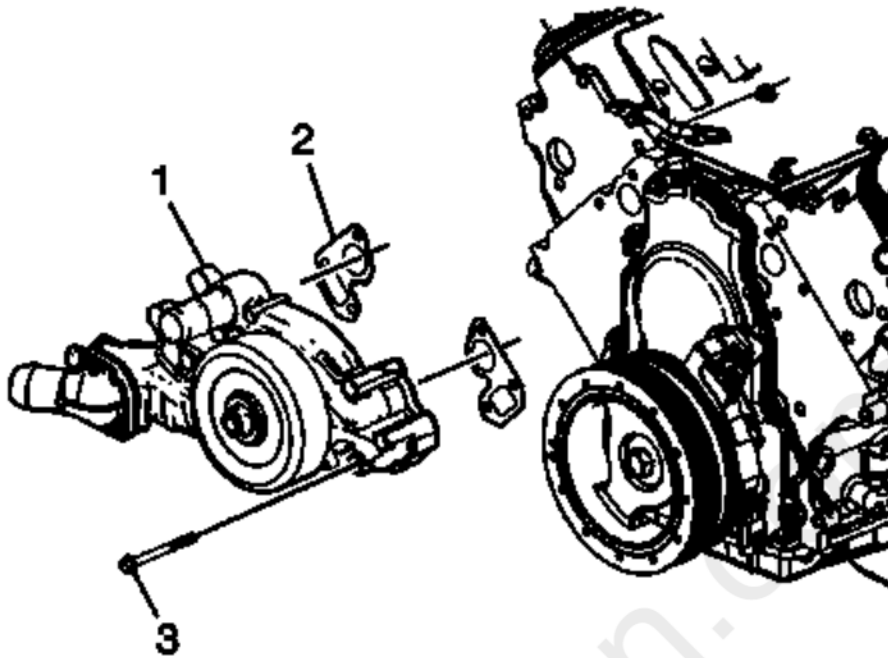


Fig. 23: Water Pump & Gaskets
Courtesy of GENERAL MOTORS CORP.

1. Remove the water pump bolts (3).
2. Remove the water pump (1) and gaskets (2).
3. Discard the water pump gaskets.

THROTTLE BODY ASSEMBLY REMOVAL

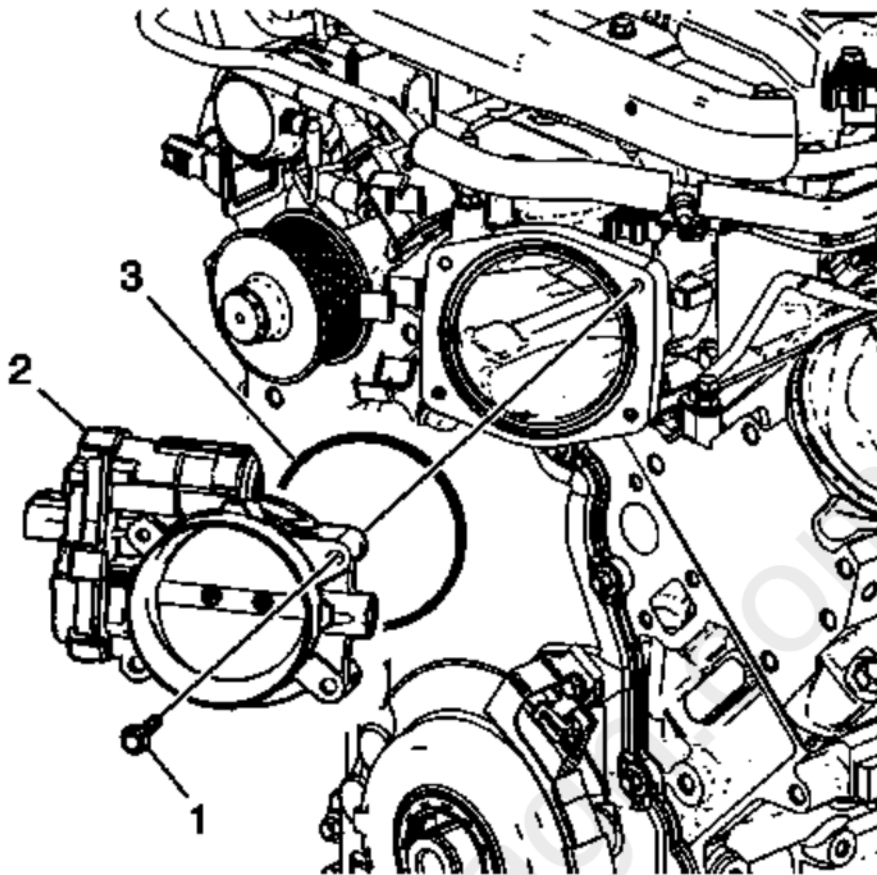


Fig. 24: Identifying Throttle Body Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.

NOTE: The intake manifold, throttle body, fuel injection rail, and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the manifold as a complete assembly.

1. Remove the throttle body bolts (1).
2. Remove the throttle body (2).
3. Remove the throttle body seal (3).
4. Discard the seal.

FUEL RAIL AND INJECTORS REMOVAL (6.2L)

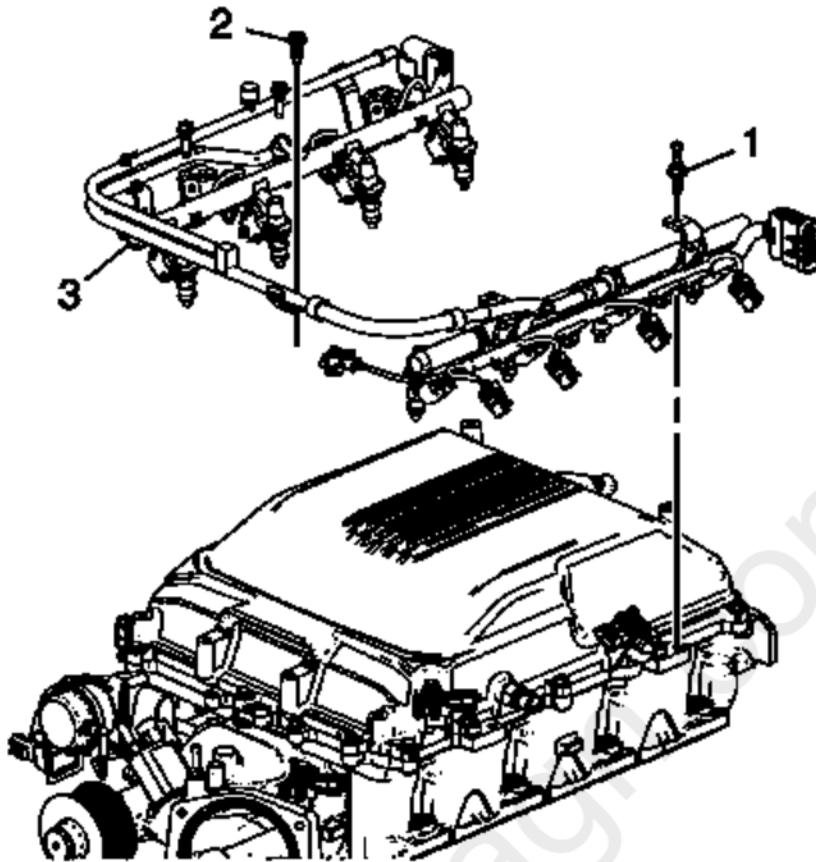


Fig. 25: Identifying Fuel Rail Components
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The supercharger, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the supercharger as an assembly.
- Do not separate the fuel injectors from the fuel rail, unless component service is required.
- Use cleanliness and care when handling the fuel system components. Do not allow dirt or debris to enter the fuel injectors or fuel rail components. Cap ends as necessary.

1. Remove the studs (1), bolt (2) and fuel rail (3). Remove the left side of the fuel rail with flex-hose first, then remove the right side of the fuel rail until all injectors have left their bores.

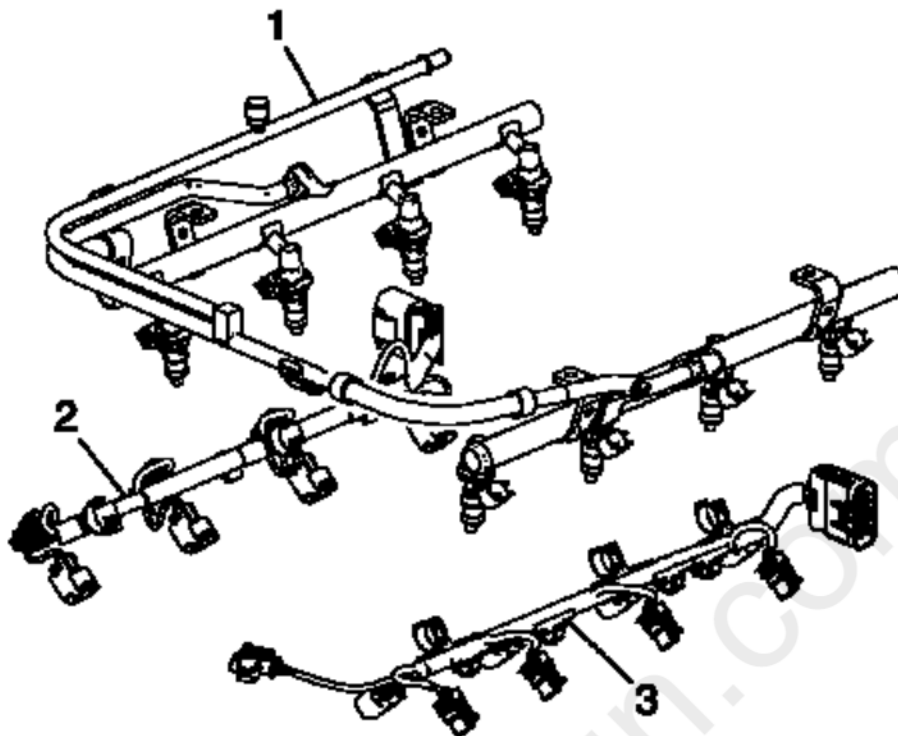


Fig. 26: Identifying Fuel Rail & Wiring Harnesses
Courtesy of GENERAL MOTORS CORP.

2. Remove the wiring harnesses (2) and (3) from the fuel rail (1).

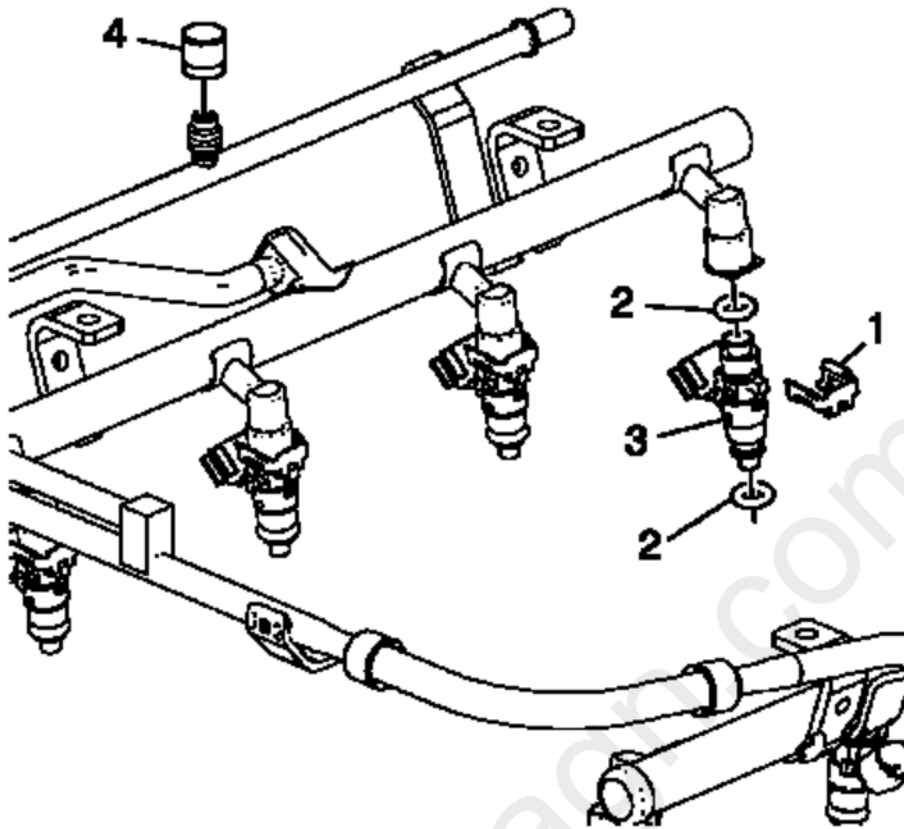


Fig. 27: Identifying Fuel Injector Components
 Courtesy of GENERAL MOTORS CORP.

3. Remove the retainers (1) and fuel injectors (3).
4. Remove the O-rings (2), as required.
5. Remove the service port cap (4), as required.

SUPERCHARGER REMOVAL

SPECIAL TOOLS

EN 48898: Supercharger Lift Fixture

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

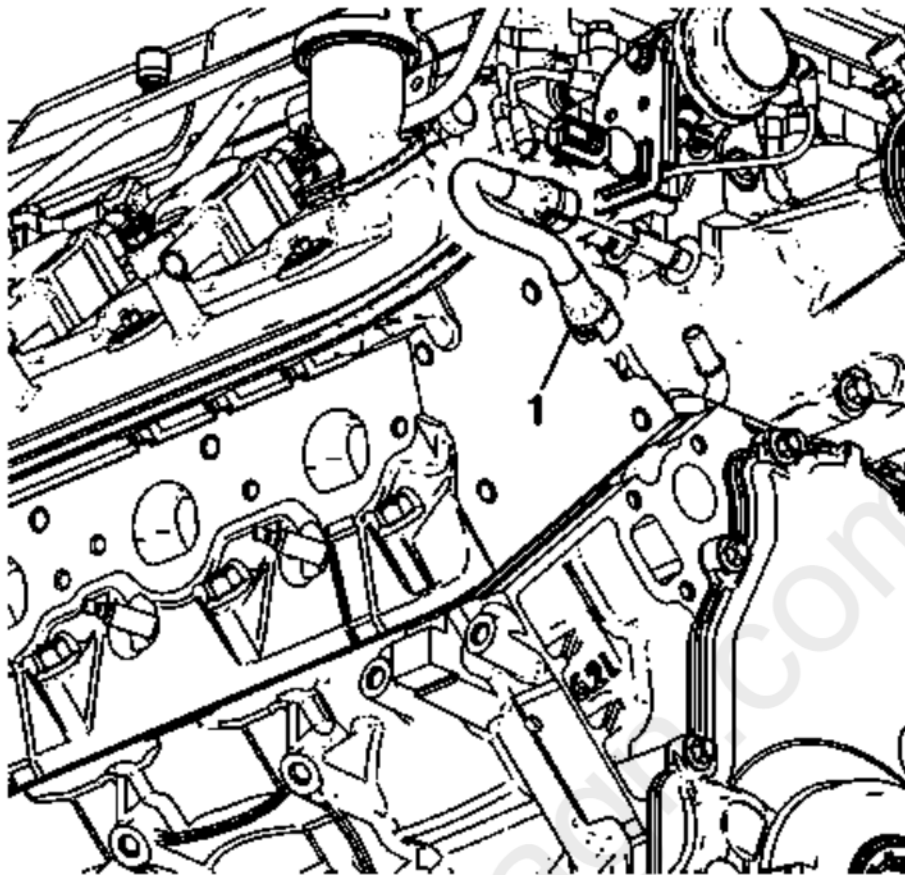


Fig. 28: Identifying Positive Crankcase Ventilation Dirty Air Hose
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The supercharger, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the supercharger as an assembly.
- Cover the inlet area of the supercharger (1) to prevent dirt or debris contamination onto the rotors.

1. Remove the positive crankcase ventilation (PCV) - dirty air hose (1) from the valley cover and supercharger.

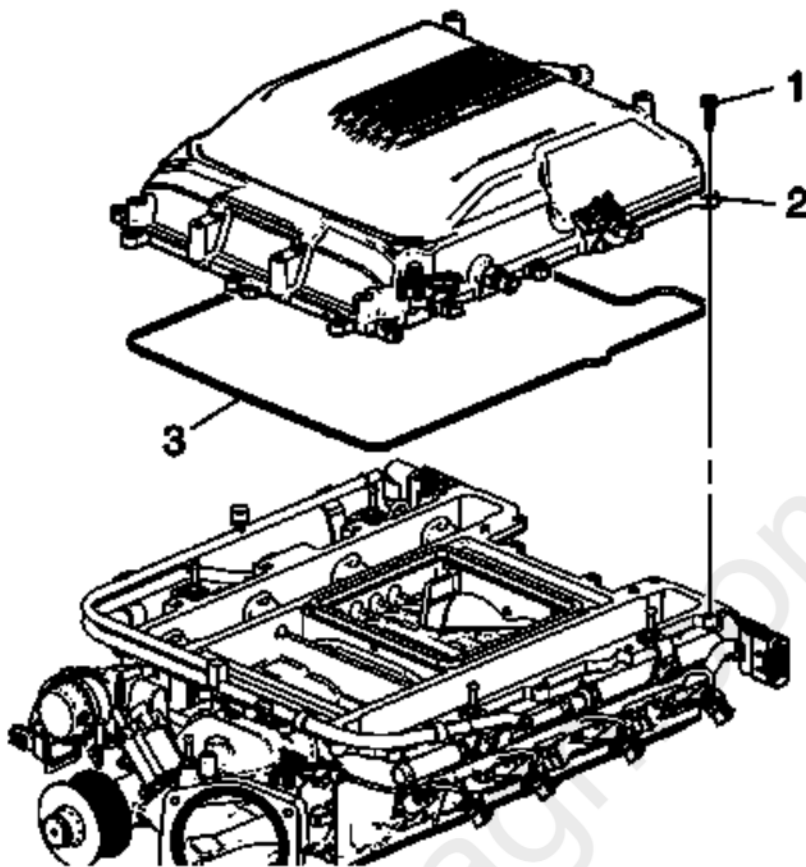


Fig. 29: Identifying Charge Air Cooler Cover Components
Courtesy of GENERAL MOTORS CORP.

2. Remove the supercharger cover bolts (1) and the supercharger cover (2).
3. Remove the supercharger cover seal (3).

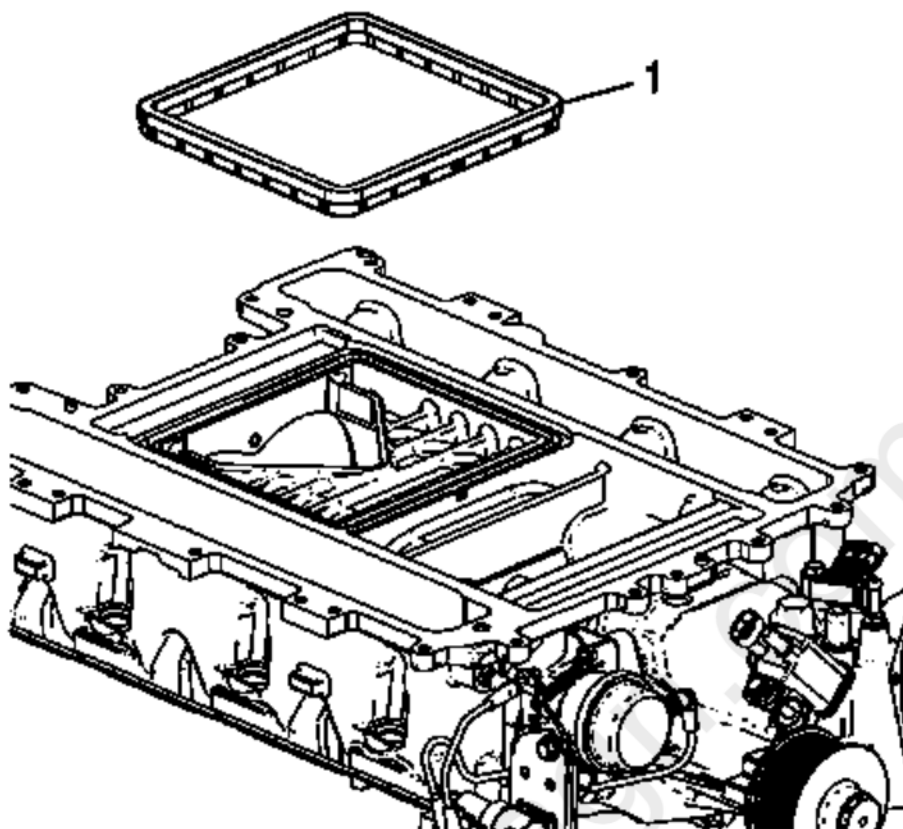


Fig. 30: Identifying Charge Air Cooler Insulator
Courtesy of GENERAL MOTORS CORP.

4. Remove the charge air cooler insulator (1).

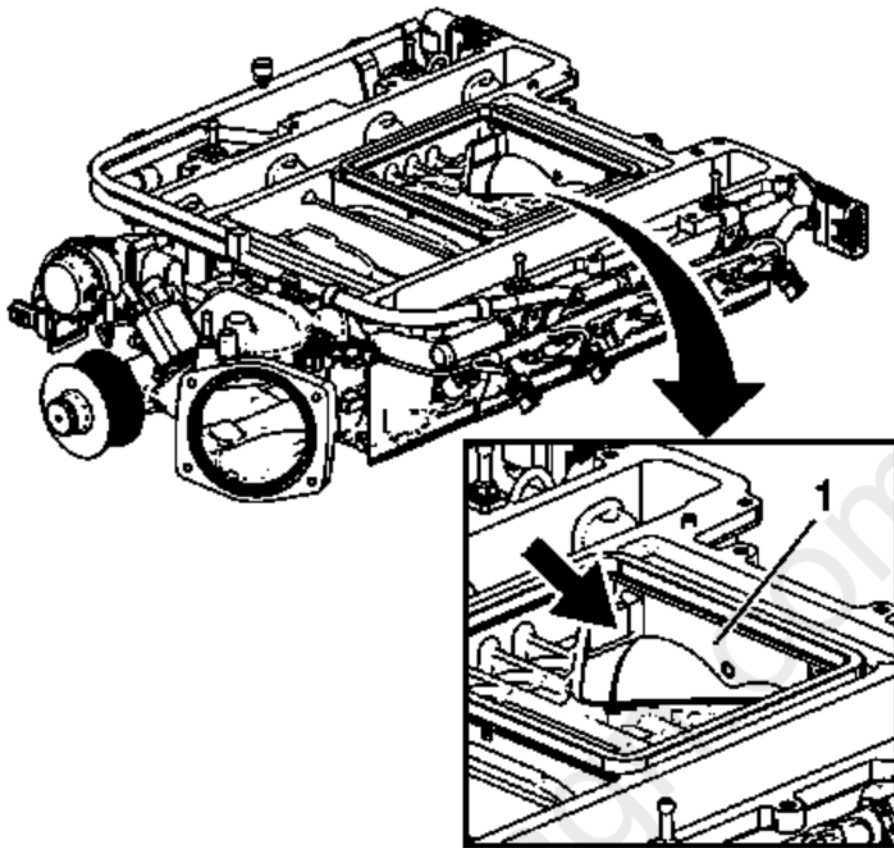


Fig. 31: Identifying Supercharger Rotors Area
Courtesy of GENERAL MOTORS CORP.

5. Cover the supercharger rotors area (1) to prevent dirt or debris contamination onto the rotors.

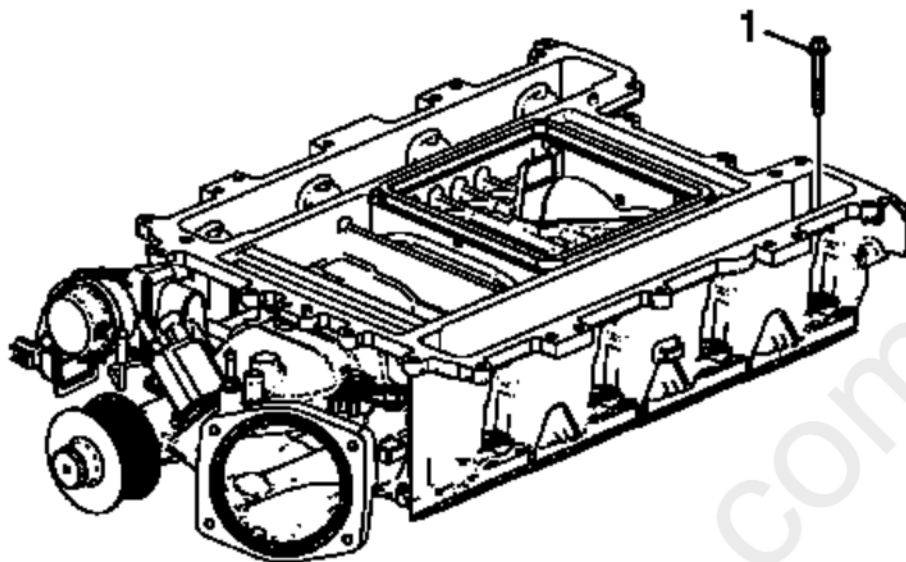


Fig. 32: Identifying Supercharger Bolts
Courtesy of GENERAL MOTORS CORP.

6. Remove the supercharger bolts (1).

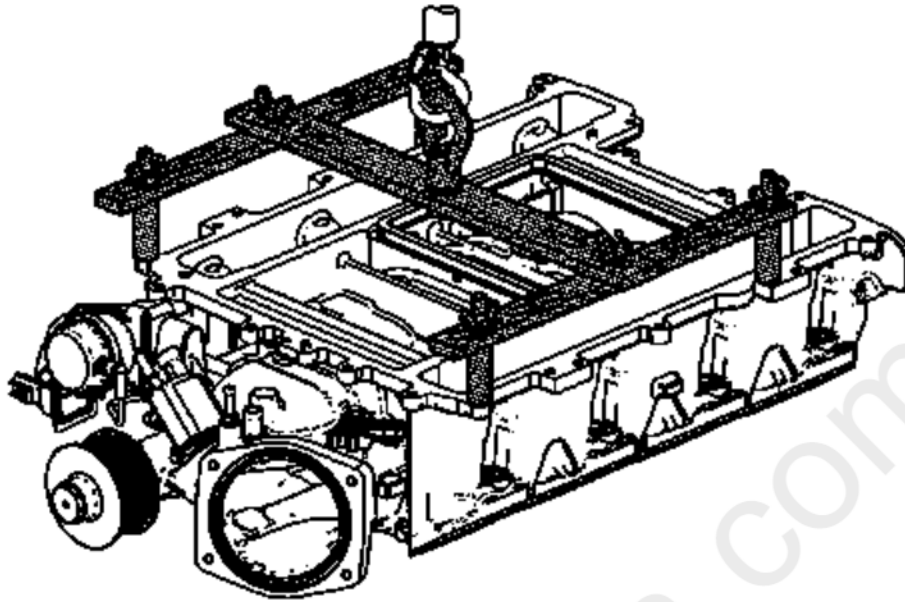


Fig. 33: View Of Supercharger Lift Fixture
Courtesy of GENERAL MOTORS CORP.

7. Install the **EN 48898:** fixture to the supercharger and tighten the **EN 48898:** fixture studs and nuts until snug.
8. Using a lifting device, remove the supercharger from the engine.

ENGINE COOLANT AIR BLEED PIPE AND HOLE COVER REMOVAL

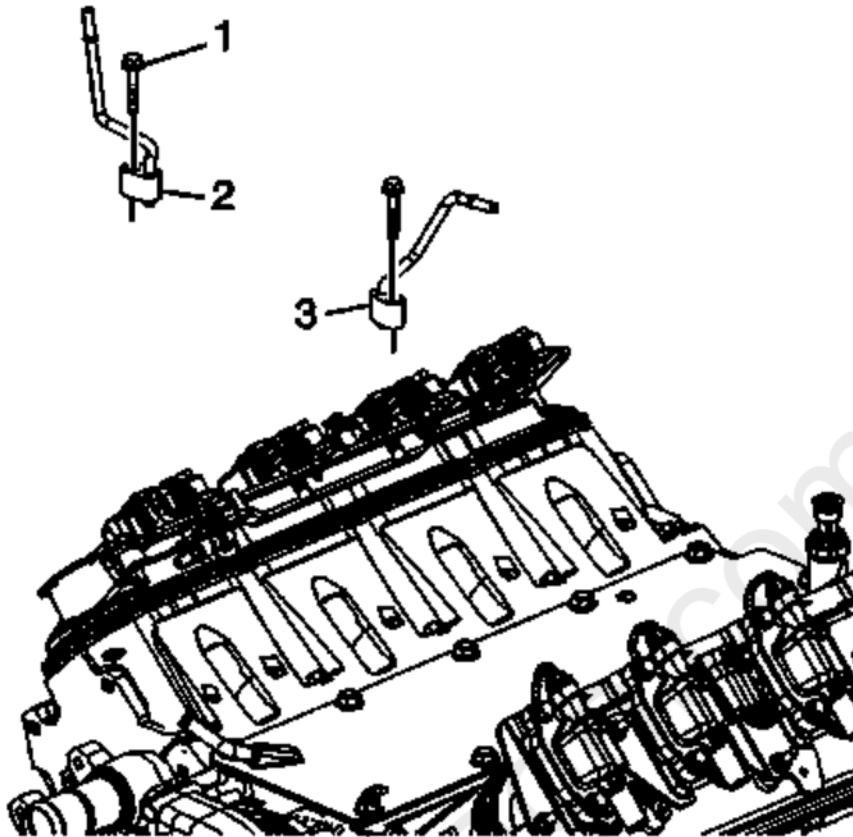


Fig. 34: Identifying Engine Coolant Air Bleed Pipe Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine coolant air bleed pipe bolts (1).
2. Remove the pipes (2 and 3).

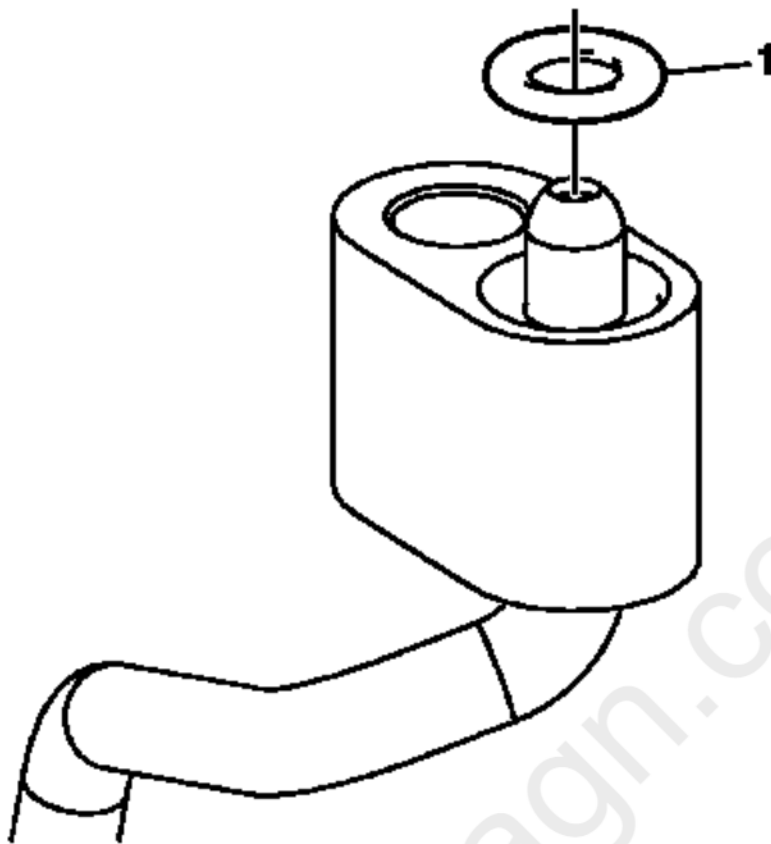


Fig. 35: Identifying Seals

Courtesy of GENERAL MOTORS CORP.

3. Remove the seals (1) from the pipes.
4. Discard the seals.

ENGINE BLOCK VALLEY COVER REMOVAL (6.2L)

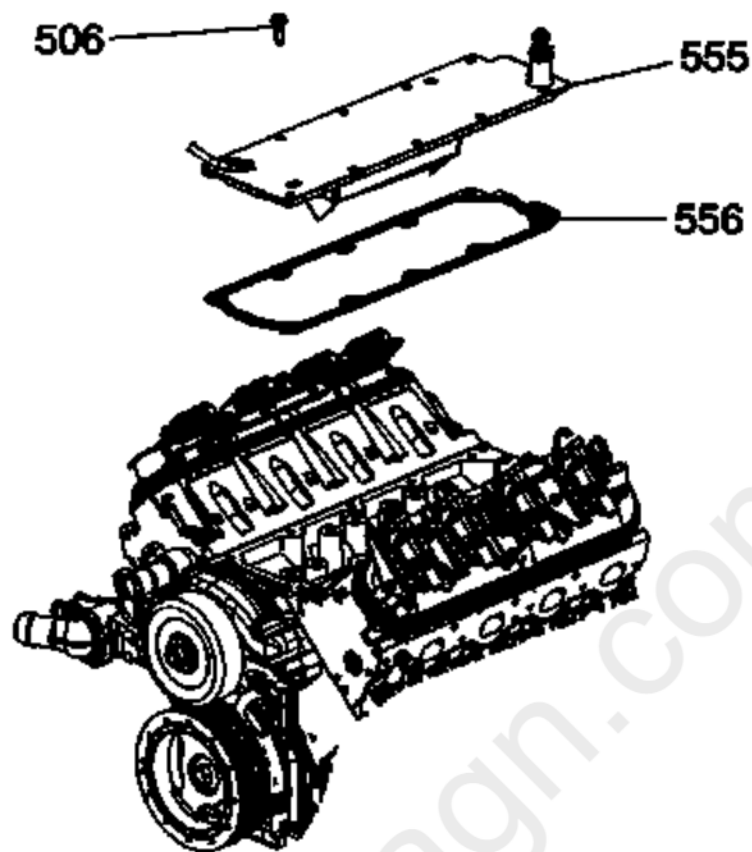


Fig. 36: View Of Engine Valley Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine block valley cover bolts (506).
2. Remove the valley cover (555) and gasket (556).

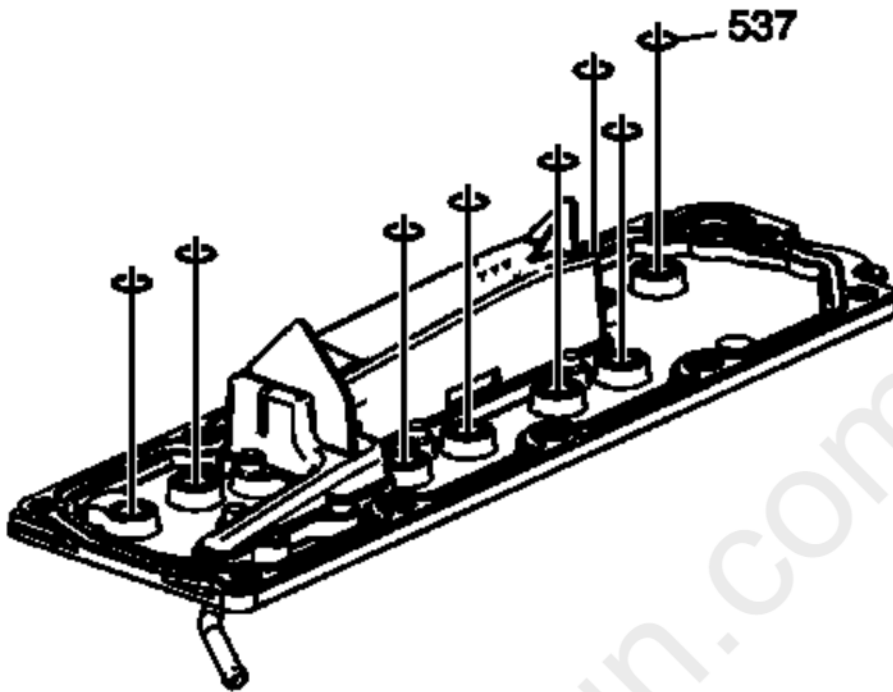


Fig. 37: Valley Cover Seals & Gasket
Courtesy of GENERAL MOTORS CORP.

3. Remove the seals (537) from the cover.

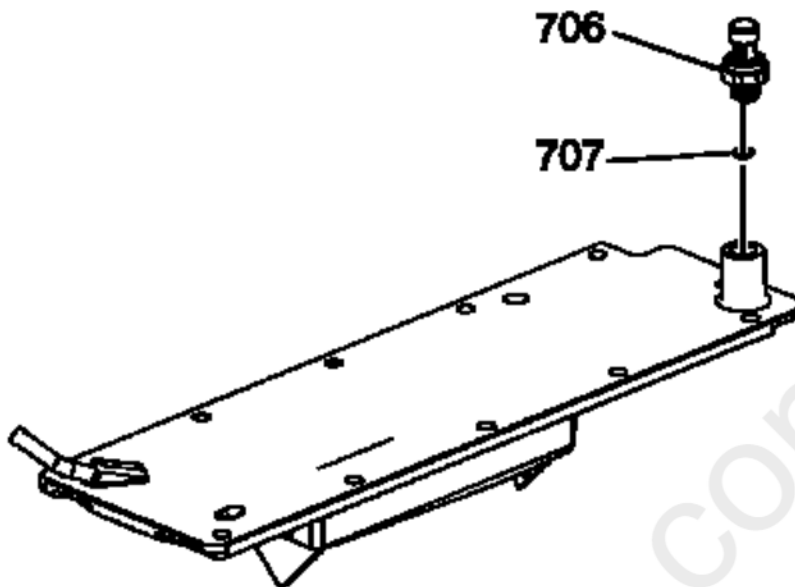


Fig. 38: Oil Pressure Sensor & Washer
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine oil pressure sensor (706) and seal (707), as required.

VALVE ROCKER ARM COVER REMOVAL - LEFT SIDE

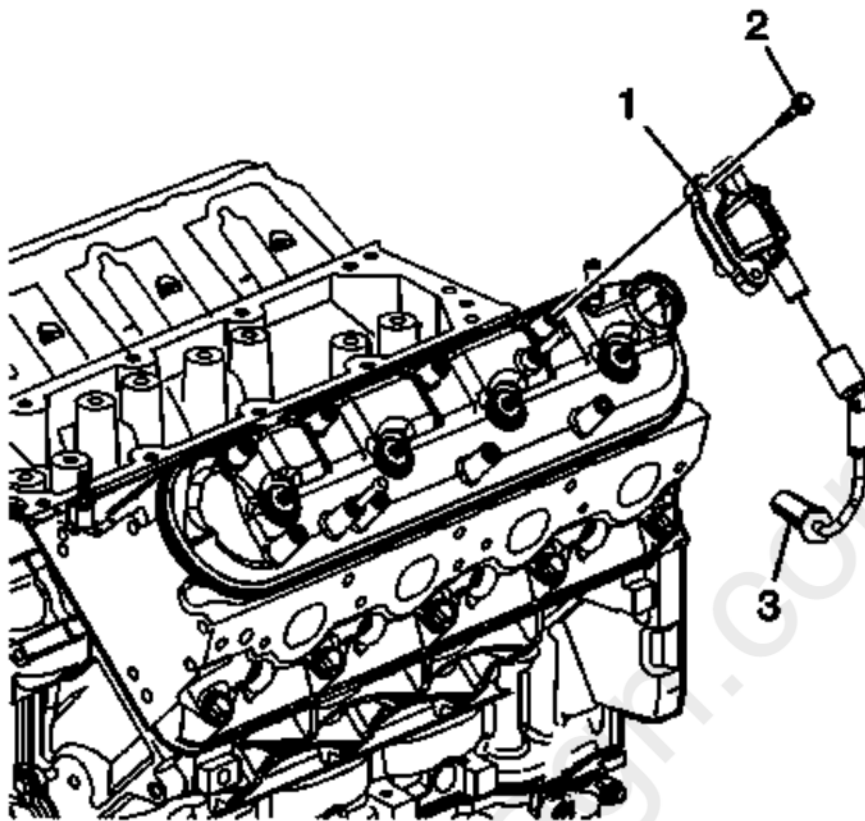


Fig. 39: Identifying Ignition Coil, Bolt & Spark Plug Wire (Left Side)
Courtesy of GENERAL MOTORS CORP.

1. Remove the spark plug wires (3), as required.
2. Remove the ignition coil bolts (2) and ignition coils (1).

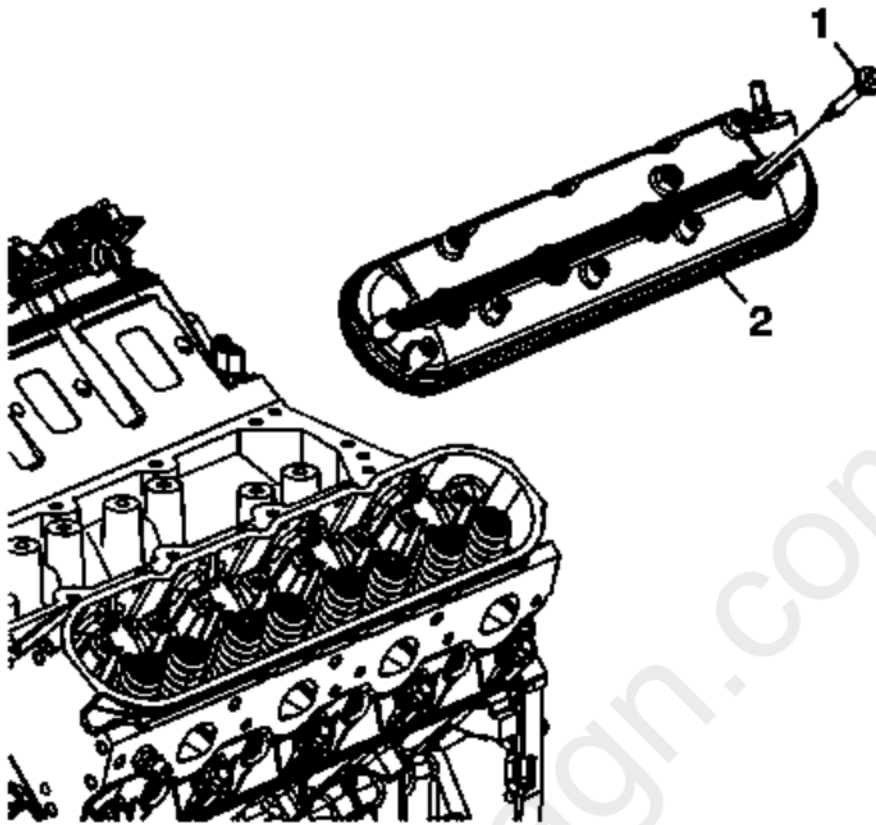


Fig. 40: Identifying Valve Rocker Arm Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve rocker arm cover bolts (1) and cover (2).
4. Remove and discard the valve rocker arm cover gasket, valve rocker arm cover grommets and valve rocker arm cover bolts if they are serviced with the grommet.

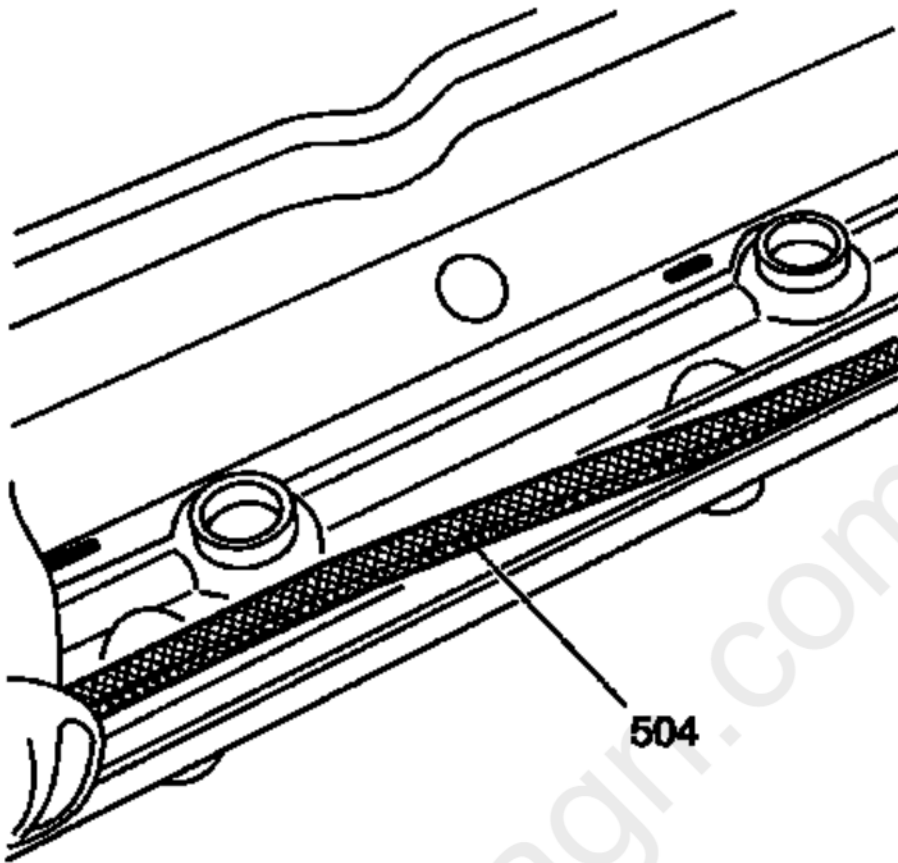


Fig. 41: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the gasket (504) from the cover.

VALVE ROCKER ARM COVER REMOVAL - RIGHT SIDE

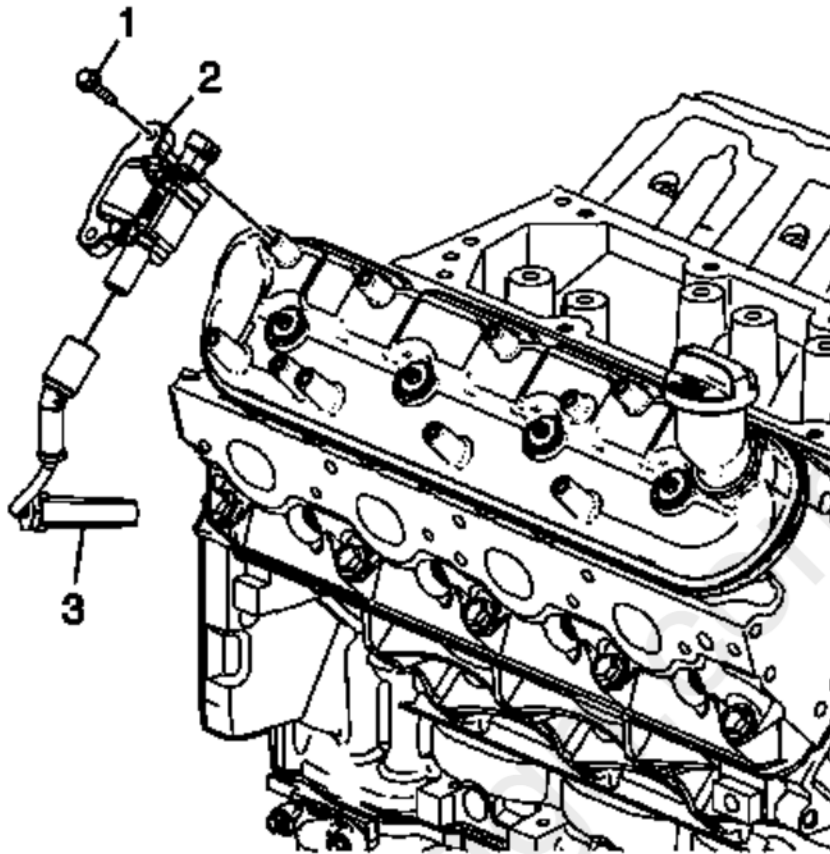


Fig. 42: Identifying Ignition Coil, Bolt & Spark Plug Wire (Right Side)
 Courtesy of GENERAL MOTORS CORP.

NOTE: Do not remove the oil cap from the cover, unless service is required. If the oil cap has been removed from the cover, the locking features of the cap will be damaged and no longer functional.
 If the cap has been removed, install a NEW cap during assembly.

1. Remove the spark plug wires (3), as required.
2. Remove the ignition coil bolts (1) and ignition coils (2).

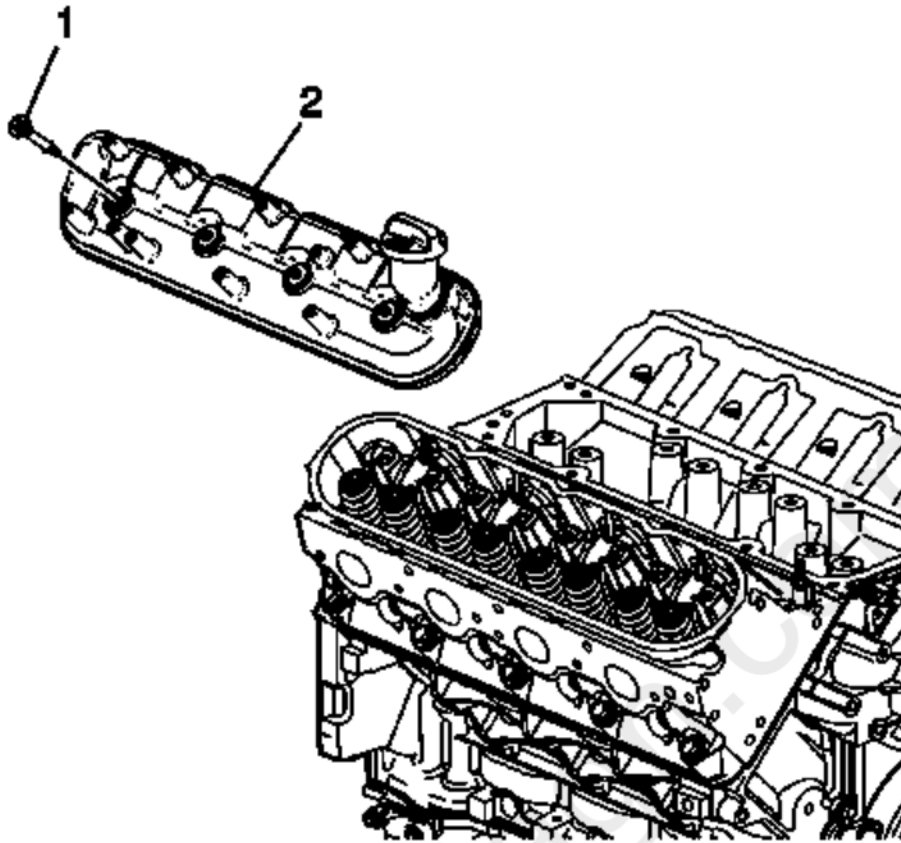


Fig. 43: Identifying Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve rocker arm cover bolts (1) and cover (2).
4. Remove and discard the valve rocker arm cover gasket, valve rocker arm cover grommets and valve rocker arm cover bolts if they are serviced with the grommet.

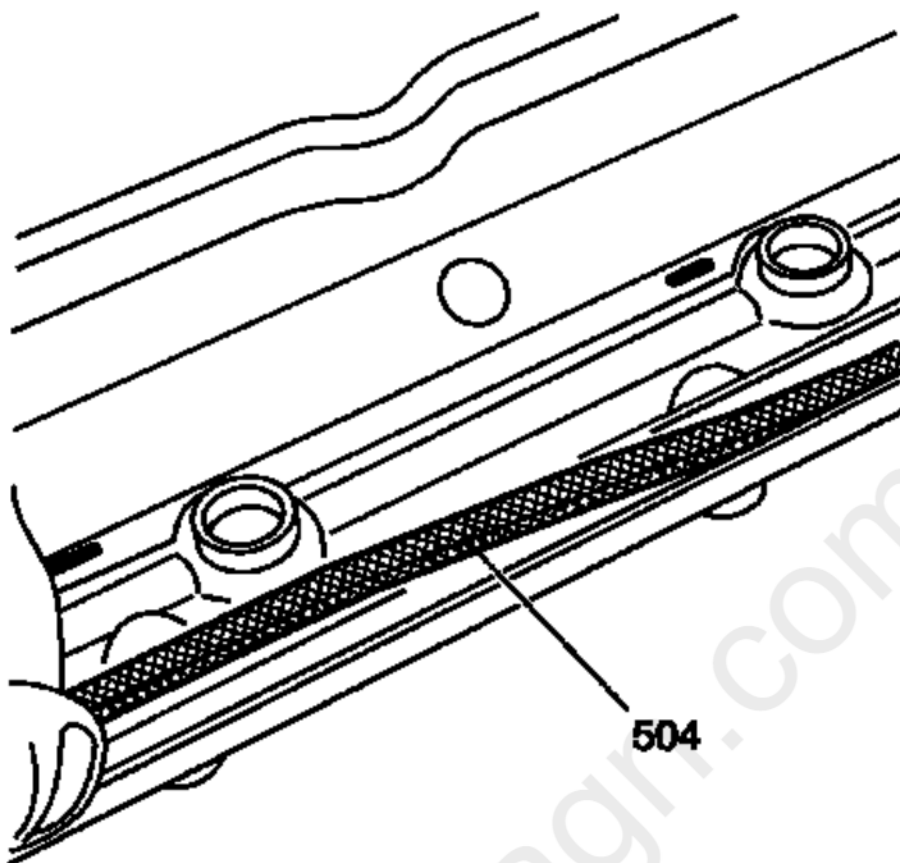


Fig. 44: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

5. Remove the gasket (504) from the cover.

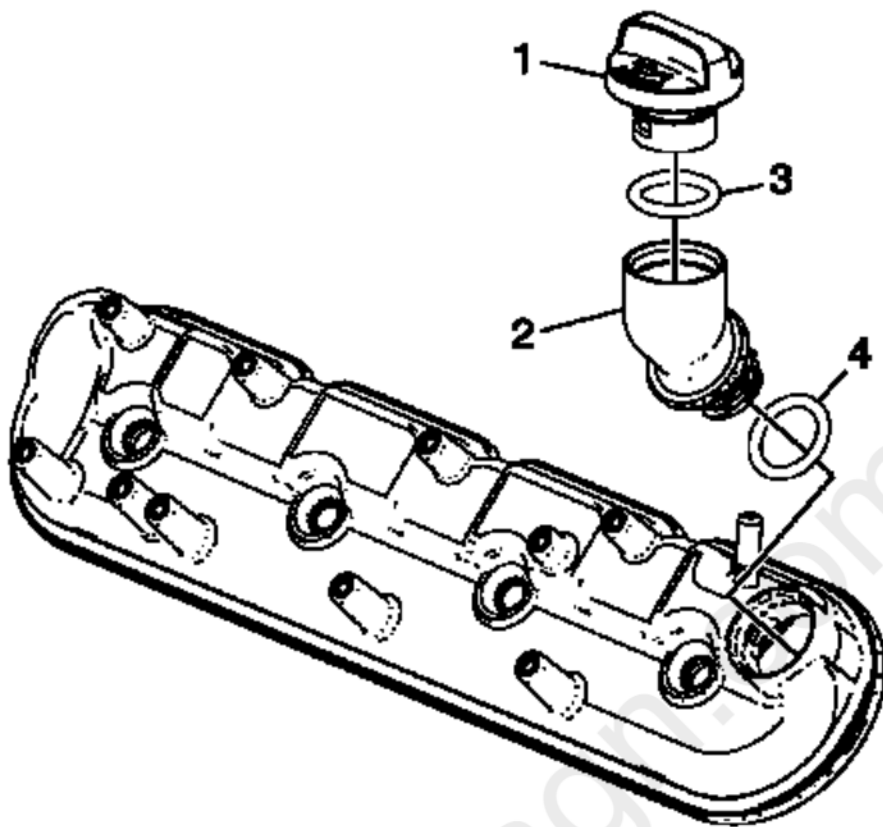


Fig. 45: Identifying Cover Components (Right Side)
Courtesy of GENERAL MOTORS CORP.

6. Remove the oil cap (1), oil fill tube (2) and seals (3, 4) from the cover, as required.

VALVE ROCKER ARM AND PUSH ROD REMOVAL

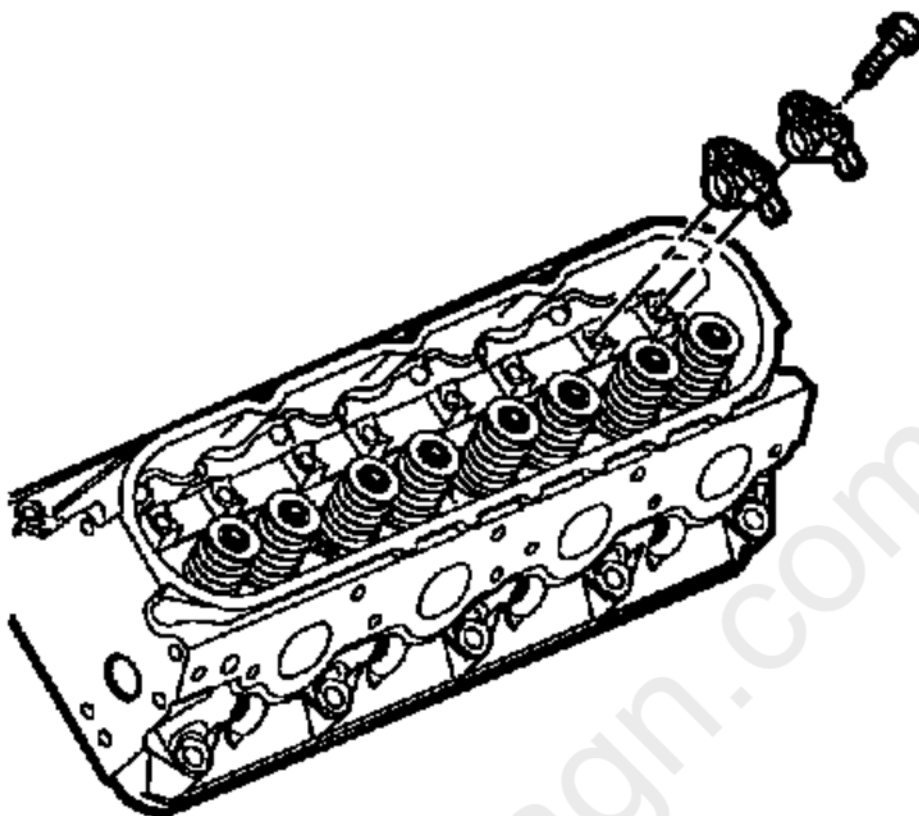


Fig. 46: View Of Rocker Arms & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Place the valve rocker arms, valve pushrods, and pivot support in a rack so they can be installed in the same location from which they were removed.

1. Remove the valve rocker arm bolts.
2. Remove the valve rocker arms.

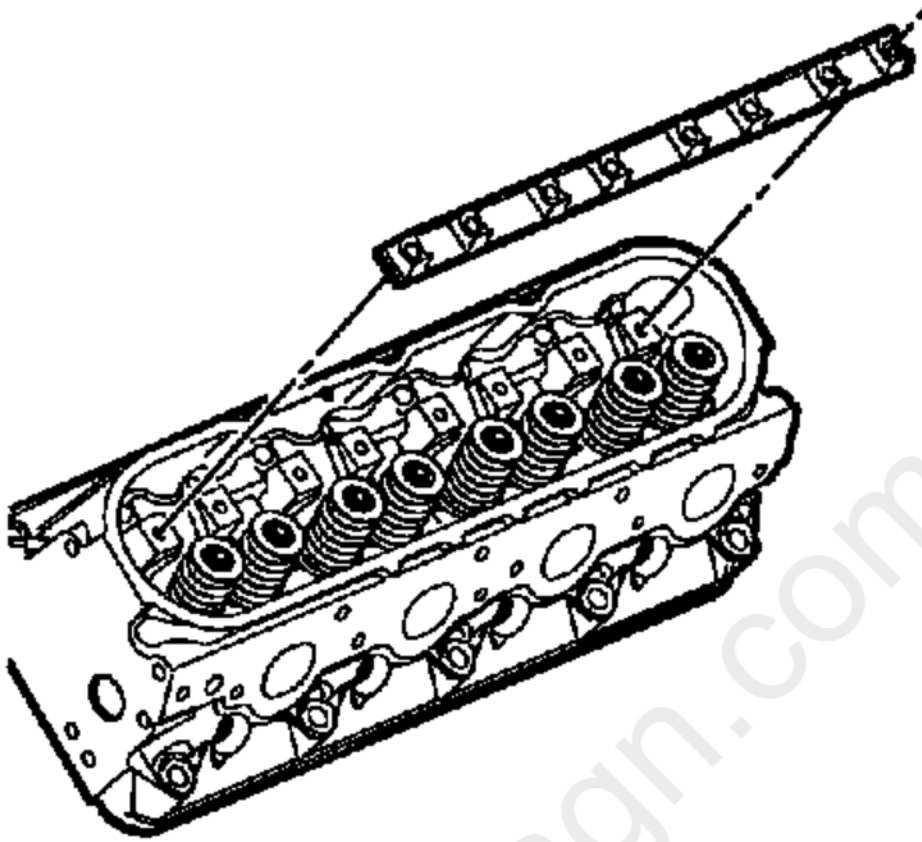


Fig. 47: View Of Valve Rocker Arm Pivot Support
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve rocker arm pivot support.

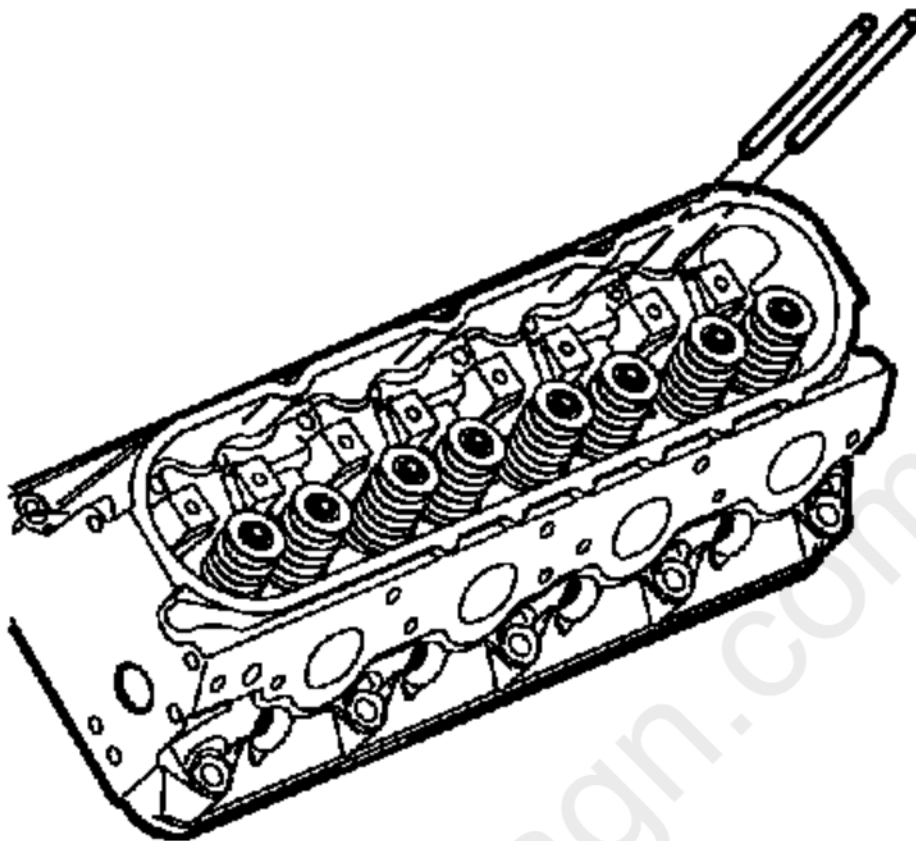


Fig. 48: View Of Pushrods

Courtesy of GENERAL MOTORS CORP.

4. Remove the pushrods.

CYLINDER HEAD REMOVAL - LEFT SIDE

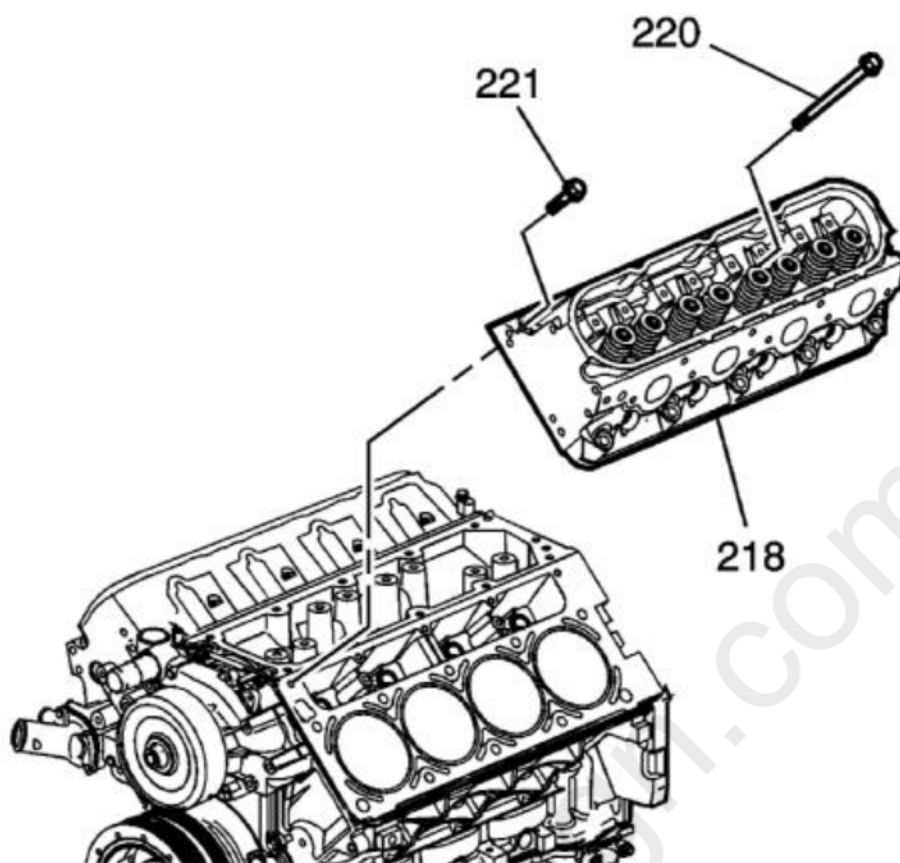


Fig. 49: Cylinder Head & Bolts

Courtesy of GENERAL MOTORS CORP.

NOTE: The cylinder head bolts are of a torque-to-yield design and are NOT to be used again. Install NEW cylinder head bolts during assembly.

1. Remove the cylinder head bolts (220, 221).

CAUTION: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

2. Remove the cylinder head (218).

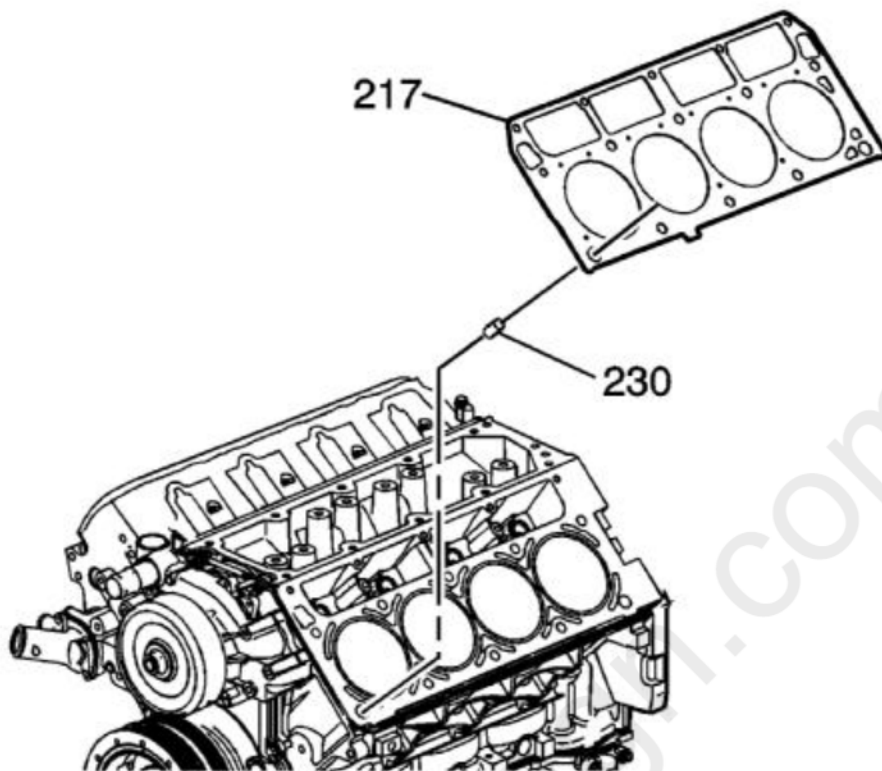


Fig. 50: View Of Cylinder Head Gasket And Alignment Pin - Left
Courtesy of GENERAL MOTORS CORP.

3. Remove the gasket (217) and locating pins (230).
4. Discard the gasket and cylinder head bolts.

CYLINDER HEAD REMOVAL - RIGHT SIDE

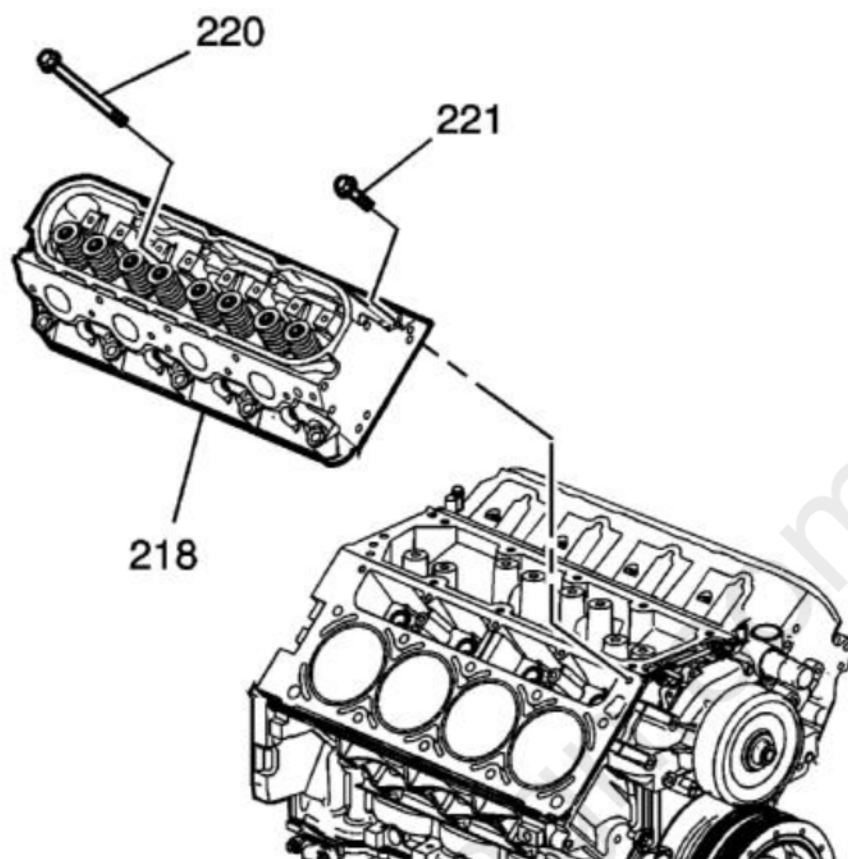


Fig. 51: Right Cylinder Head & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The cylinder head bolts are of a torque-to-yield design and are NOT to be used again. Install NEW cylinder head bolts during assembly.

1. Remove the cylinder head bolts (220, 221).

CAUTION: After removal, place the cylinder head on 2 wood blocks in order to prevent damage to the sealing surfaces.

2. Remove the cylinder head (218).

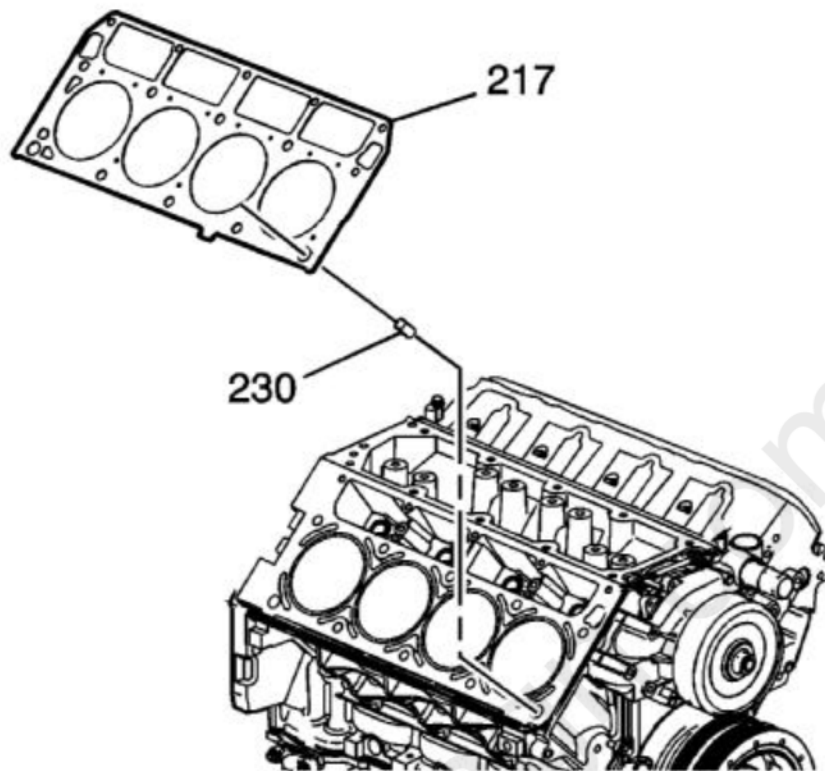


Fig. 52: Cylinder Head Gasket & Locating Pins - Right
Courtesy of GENERAL MOTORS CORP.

3. Remove the gasket (217) and locating pins (230).
4. Discard the gasket and cylinder head bolts.

VALVE LIFTER REMOVAL

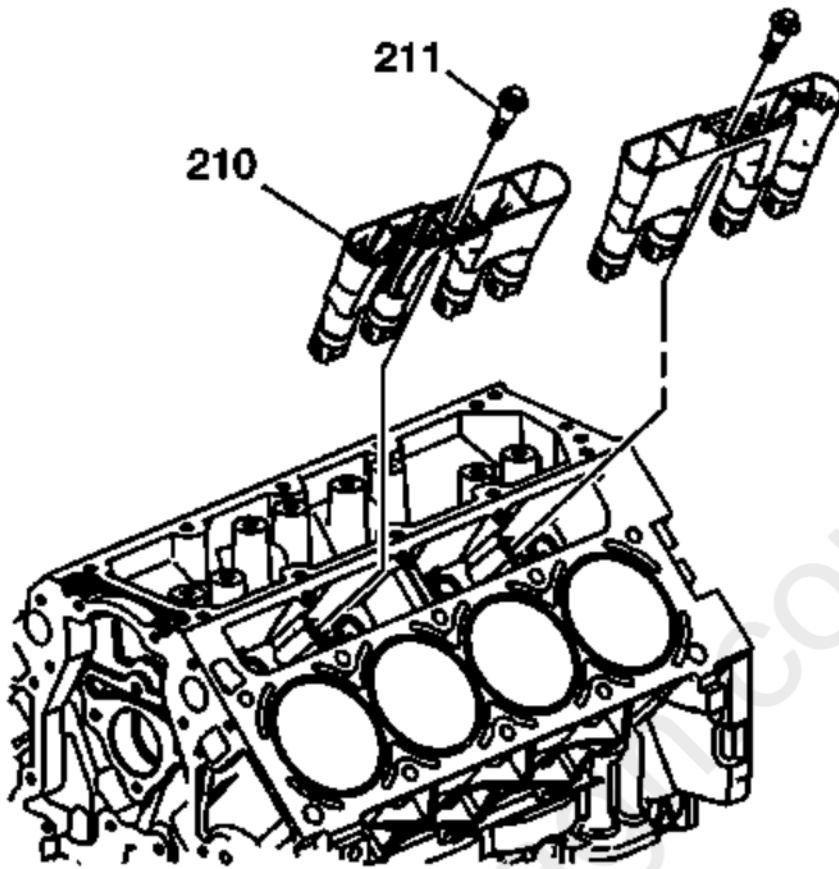


Fig. 53: Valve Lifter Guides, Cylinder Head & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the guide bolts (211).
2. Remove the guides (210) with lifters.

Note the installed position of the guides. The notched area of the guide is to align with the locating tab on the block.

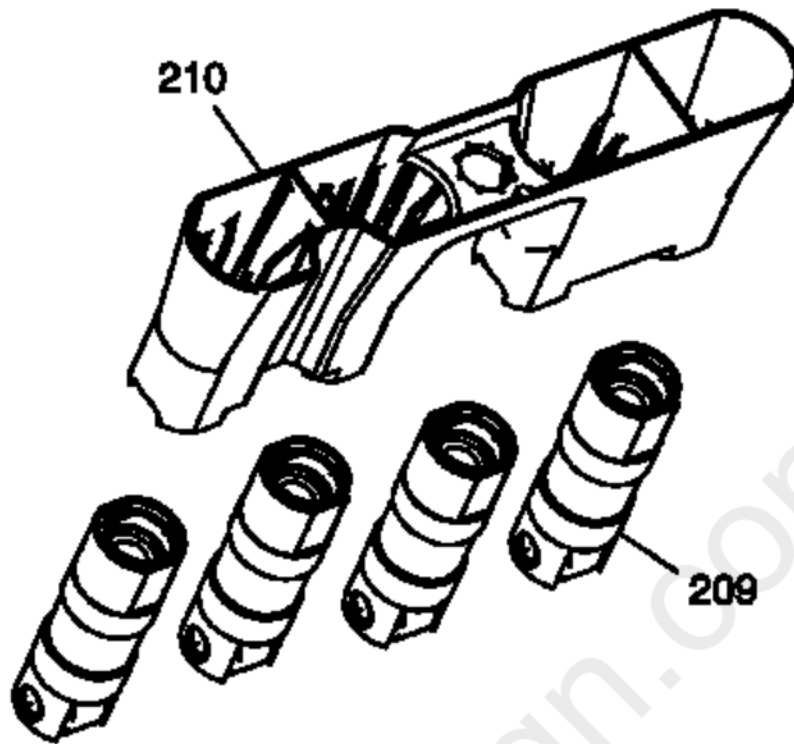


Fig. 54: Valve Lifter Guides & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve lifters (209) from the guide (210).
4. Organize or mark the components so they can be installed in the same location from which they were removed. Refer to **Separating Parts** .

ENGINE OIL COOLER REMOVAL

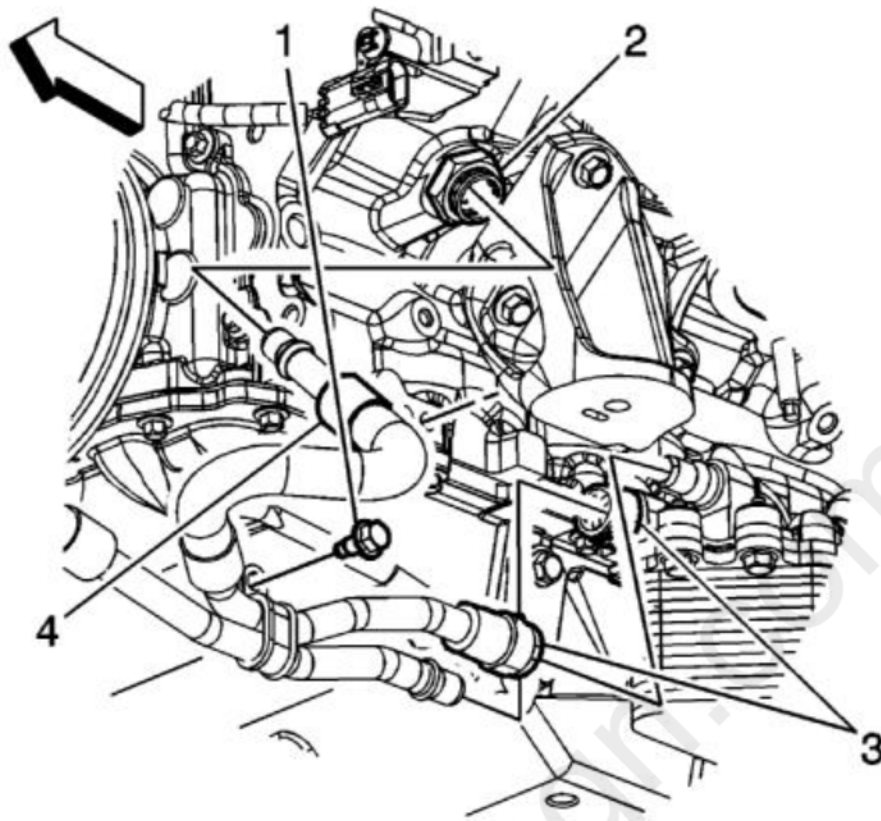


Fig. 55: Identifying Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil cooler coolant hose/pipe bolt (1).
2. Disconnect the hose/pipe (4) from the engine block coolant fitting (2) and oil cooler (3).
3. Remove the hose/pipe.

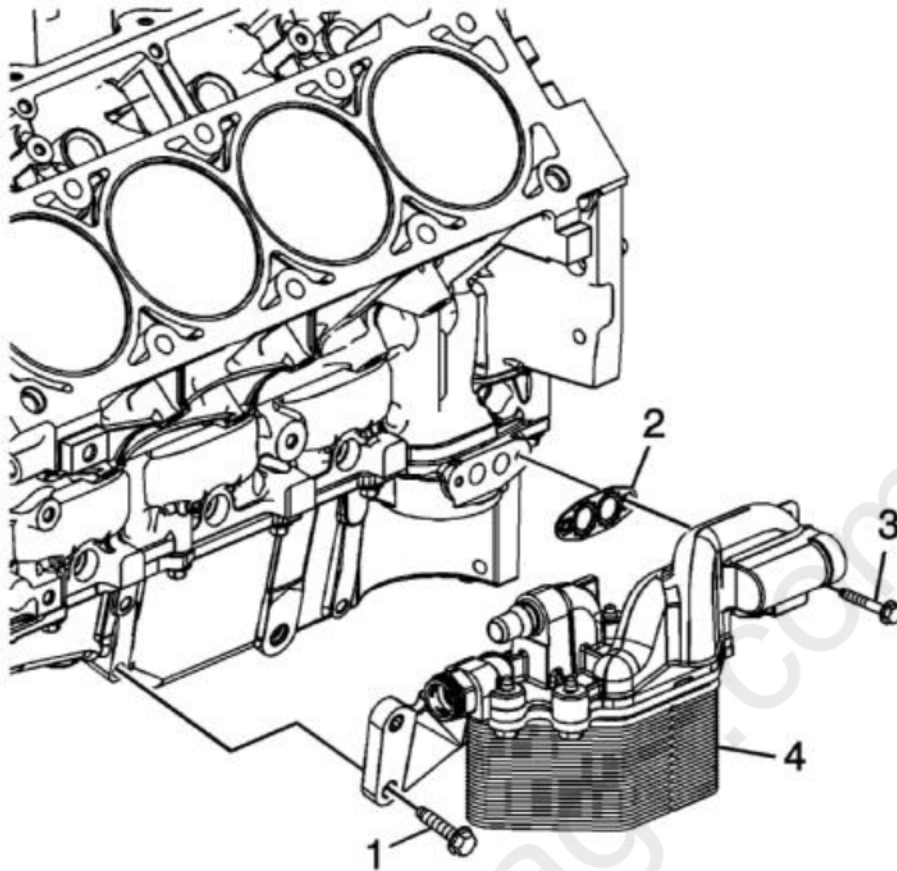


Fig. 56: Identifying Oil Cooler Components
Courtesy of GENERAL MOTORS CORP.

4. Remove the oil cooler M8 (1) and M6 (3) bolts.
5. Remove the oil cooler (4).
6. Remove the oil cooler gasket (2).

OIL FILTER REMOVAL

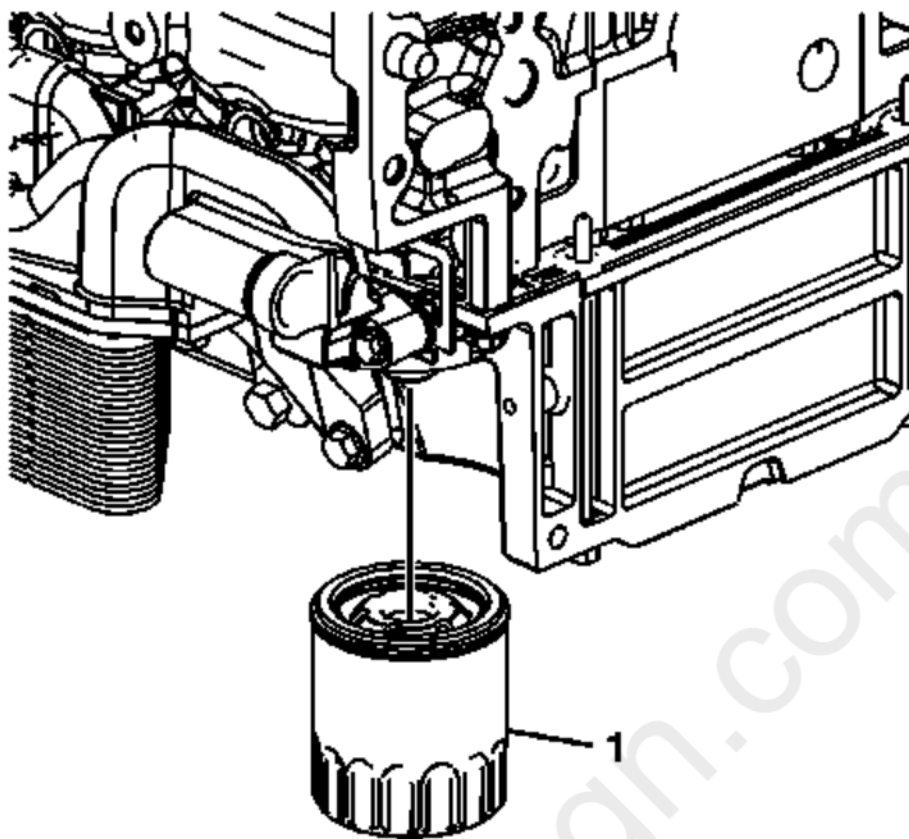


Fig. 57: Identifying Oil Filter

Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter (1).

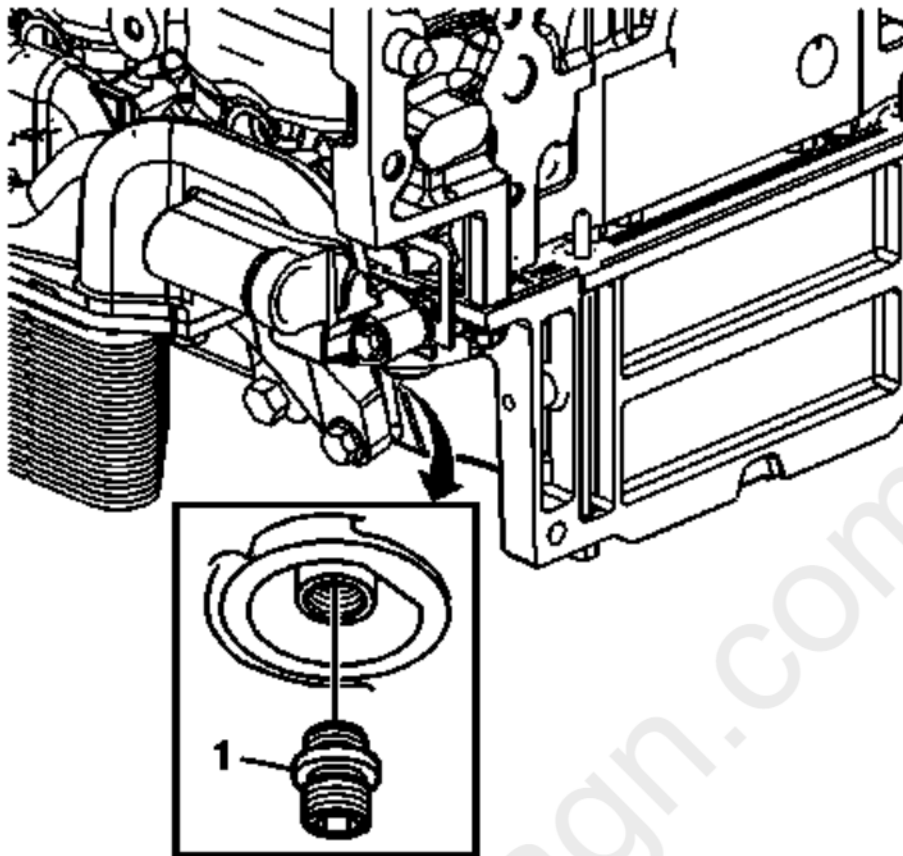


Fig. 58: Identifying Oil Filter Fitting
 Courtesy of GENERAL MOTORS CORP.

2. Remove the oil filter fitting (1), as required.

OIL PAN REMOVAL

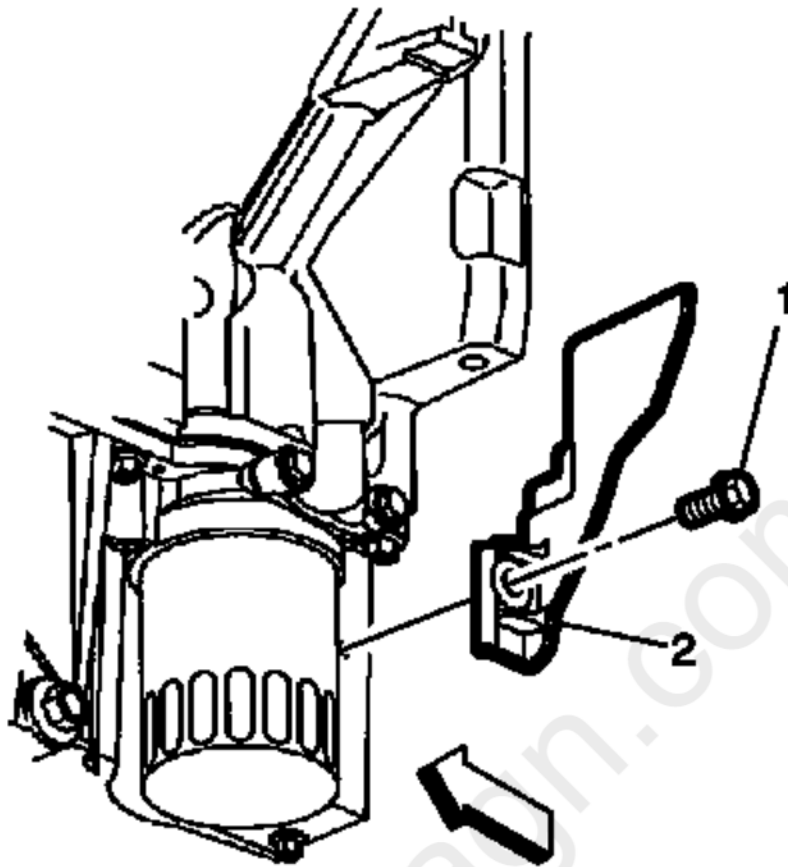


Fig. 59: View Of Left Closeout Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The original oil pan gasket is retained and aligned to the oil pan by rivets. When installing a new gasket, it is not necessary to install new oil pan gasket rivets.
- DO NOT use the oil pan gasket again. When installing the oil pan, install a NEW oil pan gasket.

1. Remove the left closeout cover (2) and bolt (1).

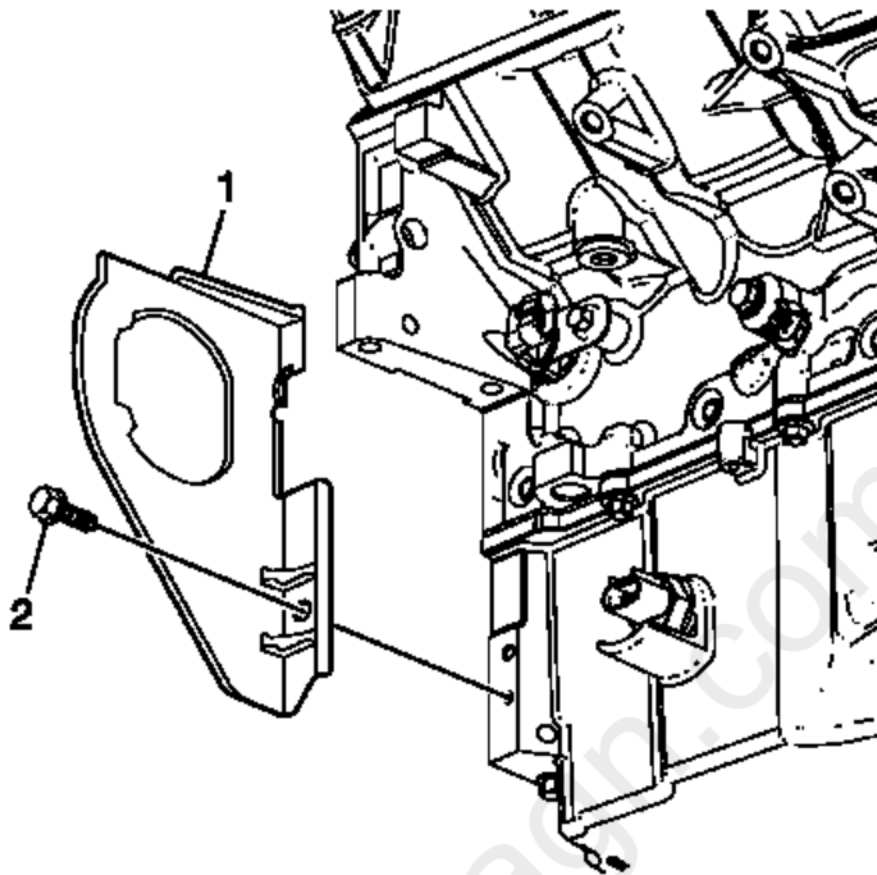


Fig. 60: Identifying Right Closeout Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Remove the right closeout cover (1) and bolt (2).

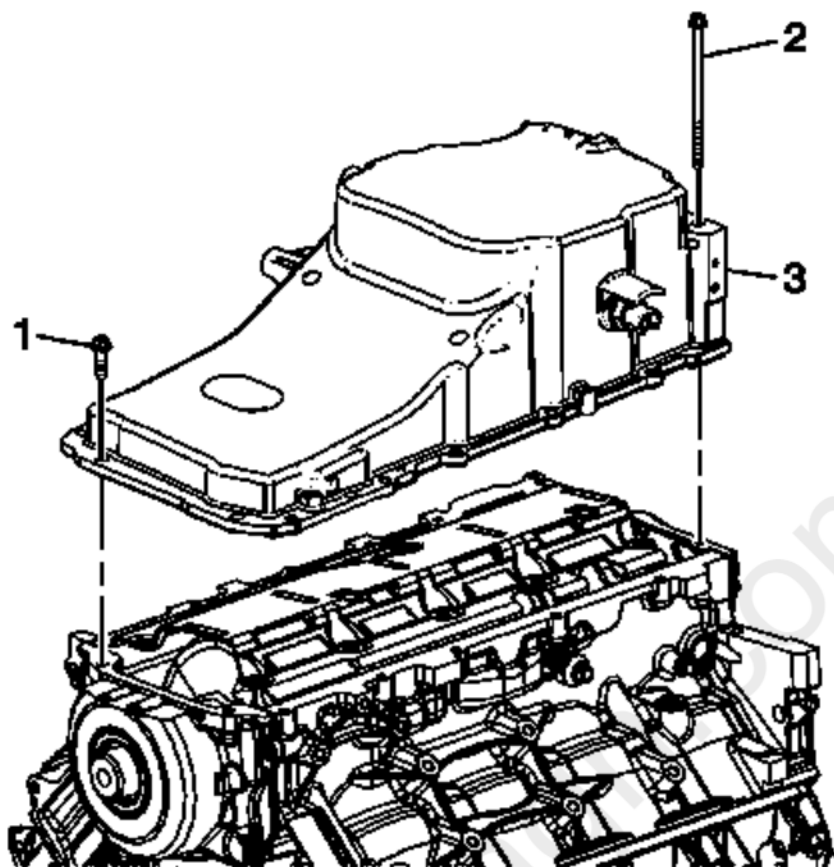


Fig. 61: Identifying Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the oil pan bolts (1, 2).
4. Remove the oil pan (3).

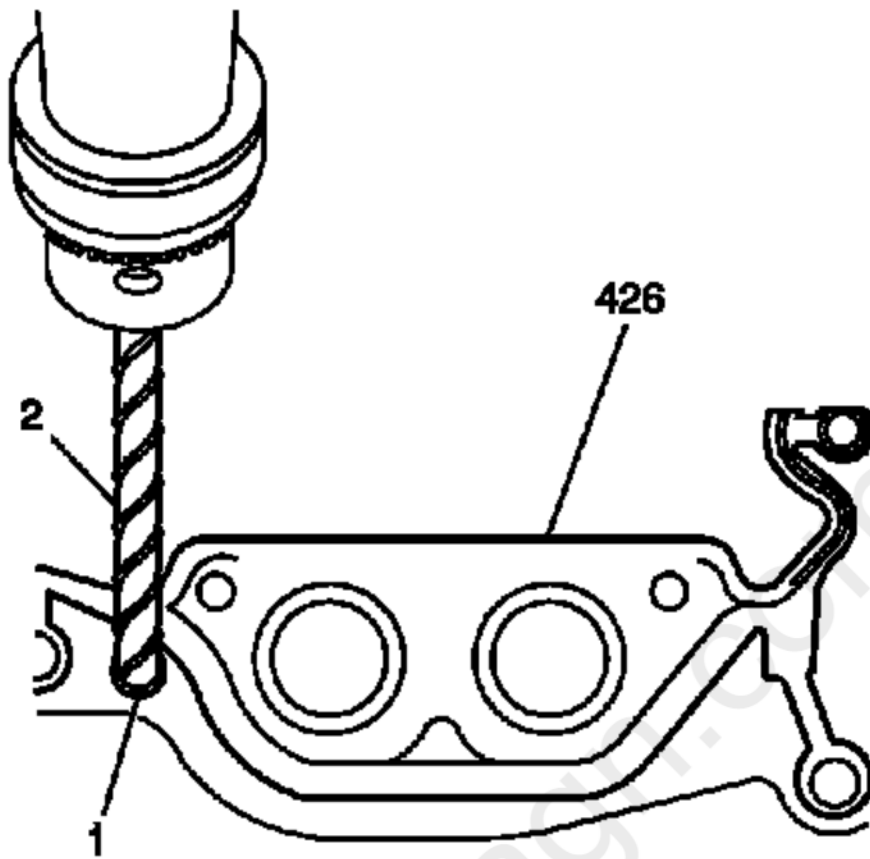


Fig. 62: Drilling Out Oil Pan Gasket Retaining Rivets

Courtesy of GENERAL MOTORS CORP.

NOTE:

- DO NOT allow foreign material to enter the oil passages of the oil pan. Cap or cover the openings, as required.
- Use care not to gouge, score, or damage the oil pan sealing surface.

5. Drill (2) out the oil pan gasket retaining rivets (1), if required.
6. Remove the gasket (426) from the pan.
7. Discard the gasket and rivets.

ENGINE FRONT COVER REMOVAL (6.2L)

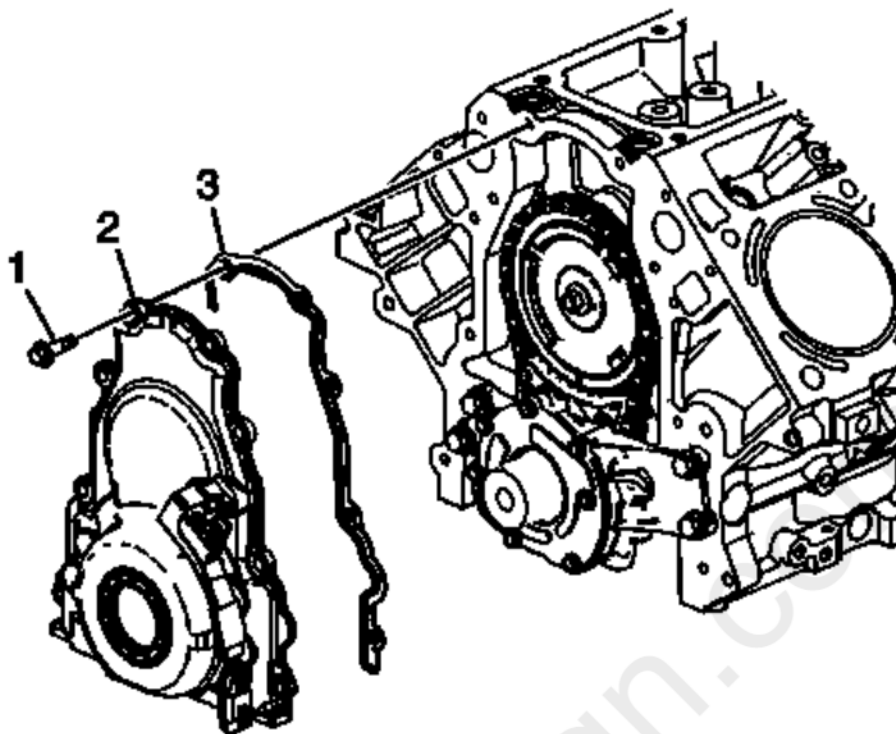


Fig. 63: View Of Front Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

1. Remove the front cover bolts (1).
2. Remove the front cover (2) and gasket (3).
3. Discard the front cover gasket.

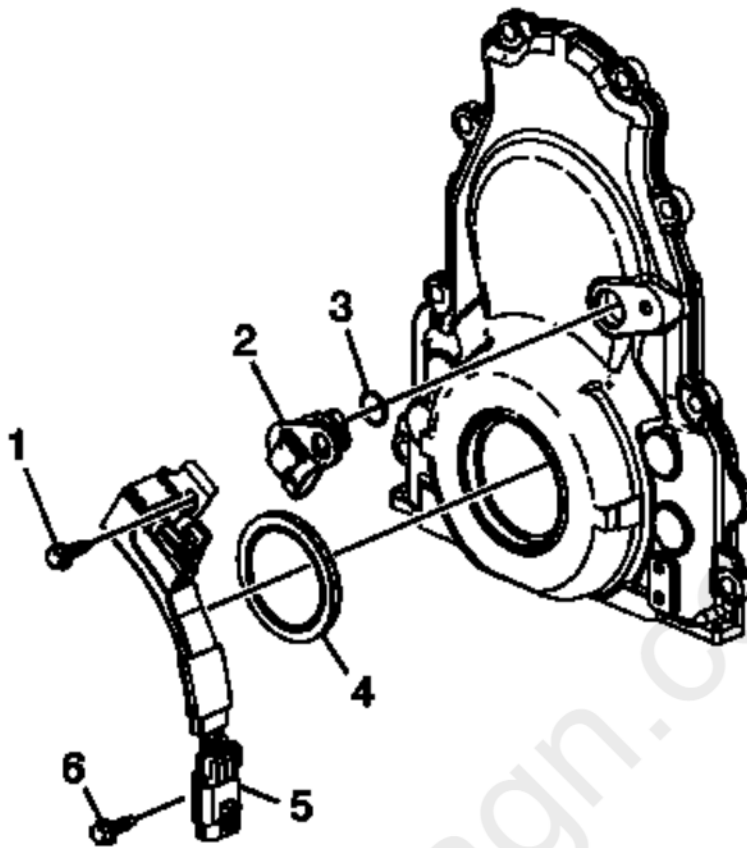


Fig. 64: View Of Front Cover, Oil Seal, Camshaft Position Sensor, Bracket & O Ring
 Courtesy of GENERAL MOTORS CORP.

4. Remove the oil seal (4).
5. Remove the bolts (1, 6), camshaft position (CMP) sensor (2), and wire harness (5).
6. Remove the O-ring (3) from the sensor, as required.

CRANKSHAFT REAR OIL SEAL HOUSING REMOVAL

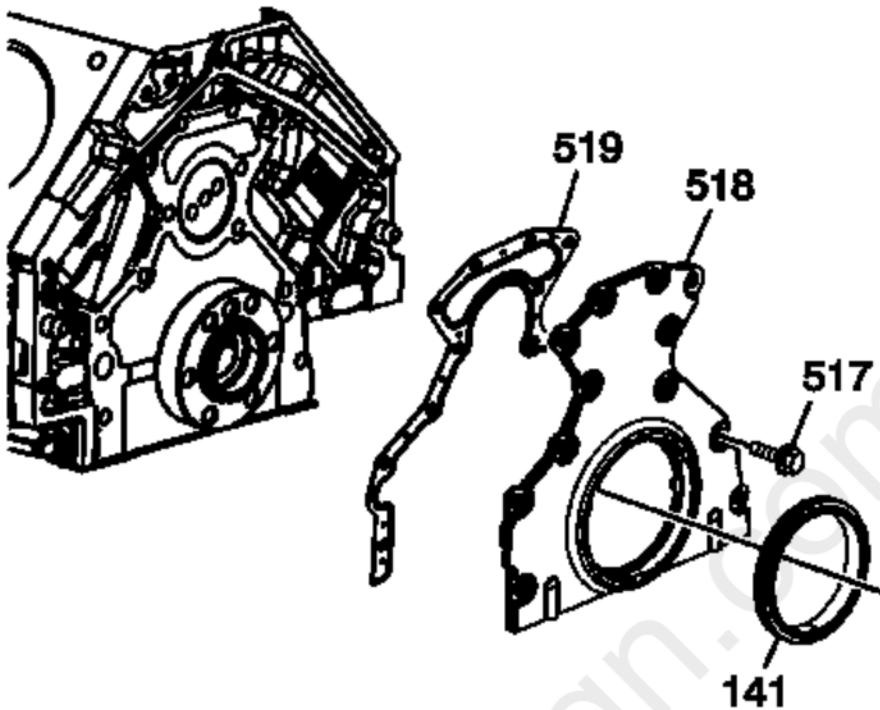


Fig. 65: View of Rear Housing, Gasket and Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the rear oil seal housing bolts (517).
2. Remove the housing (518) and gasket (519).
3. Remove the rear oil seal (141).

OIL PUMP, SCREEN AND CRANKSHAFT OIL DEFLECTOR REMOVAL

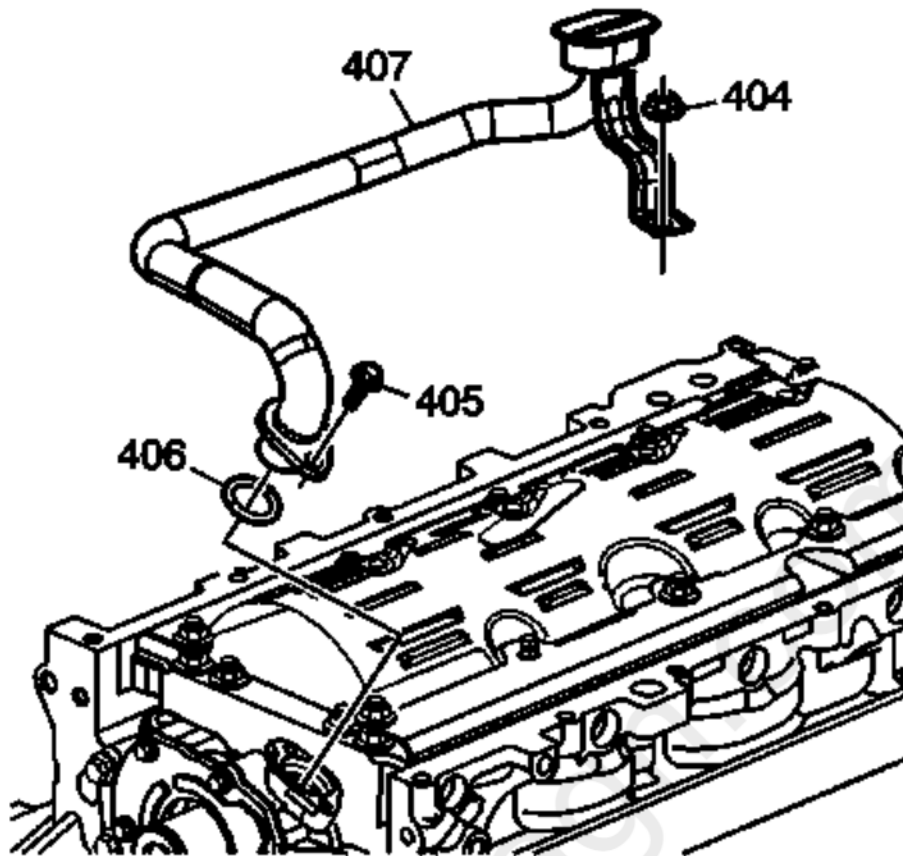


Fig. 66: Oil Pump Screen Bolt, Nut & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil pump screen bolt (405) and nut (404).
2. Remove the oil pump screen (407) with O-ring seal.
3. Remove the O-ring seal (406) from the pump screen.
4. Discard the O-ring seal.

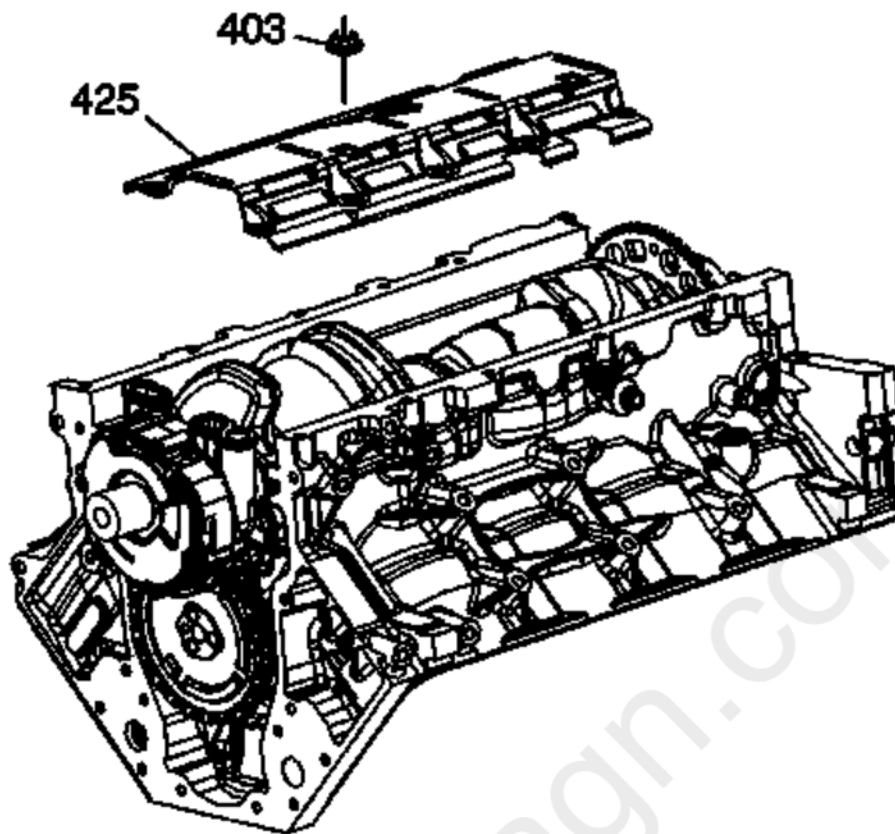


Fig. 67: Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft oil deflector nuts (403).
6. Remove the crankshaft oil deflector (425).

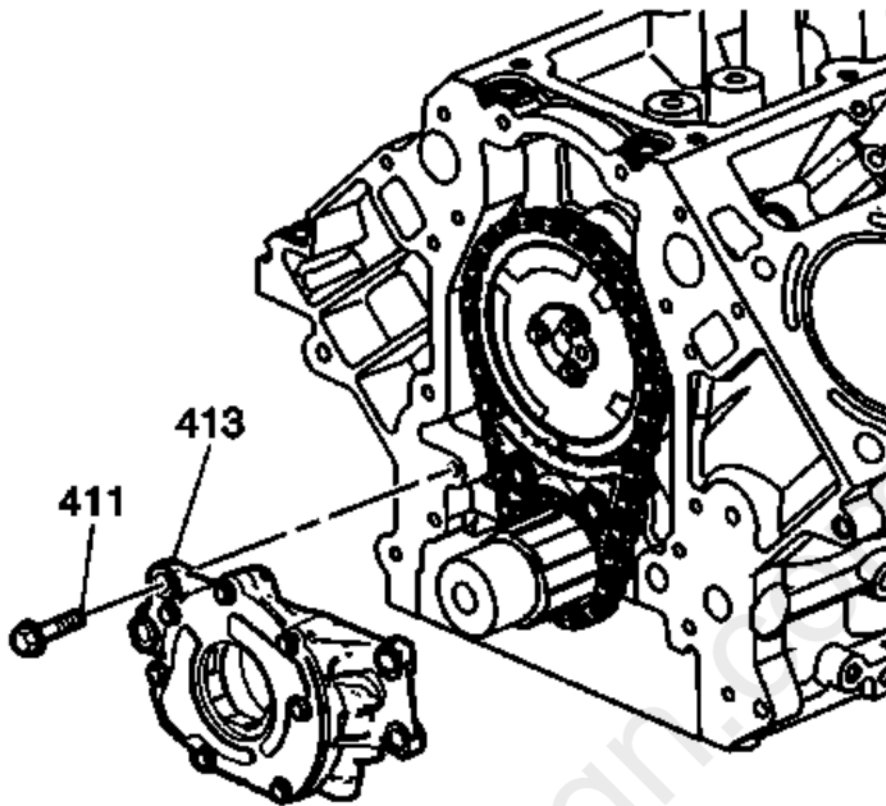


Fig. 68: Identifying Oil Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

7. Remove the oil pump bolts (411).

NOTE: Do not allow dirt or debris to enter the oil pump assembly. Cap ends, as necessary.

8. Remove the oil pump (413).

TIMING CHAIN AND SPROCKET REMOVAL

Special Tools

- **J 8433:** Two Jaw Puller
- **J 41558:** Crankshaft Sprocket Remover
- **J 41816-2:** Crankshaft End Protector

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

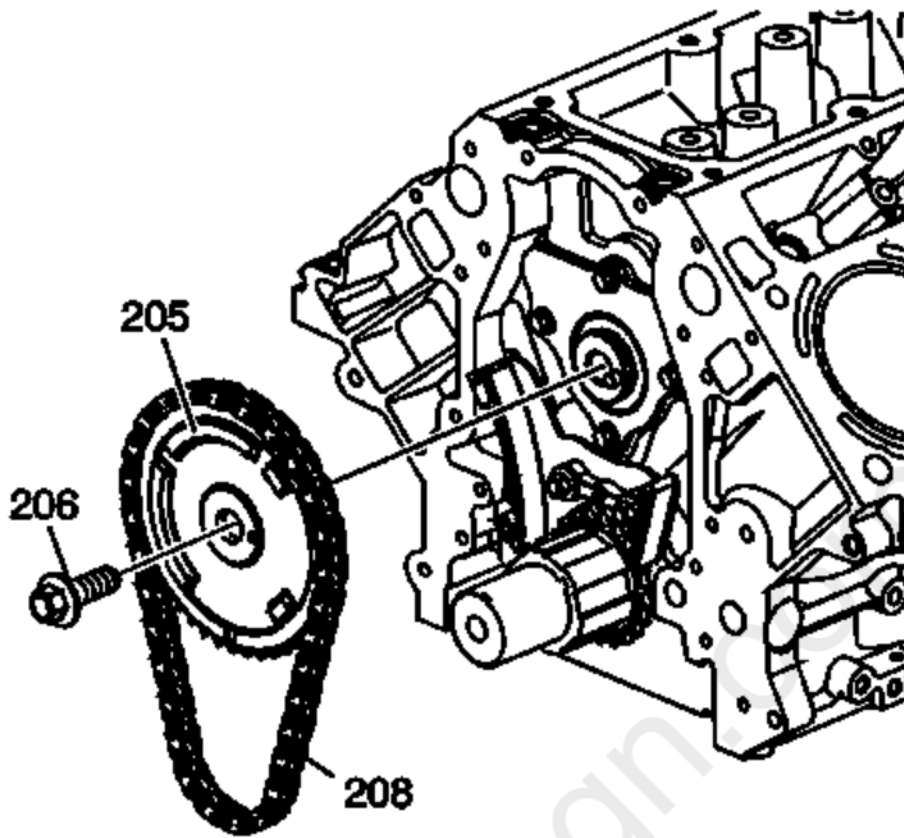


Fig. 69: View Of Camshaft Sprocket, Sprocket Bolt & Timing Chain
Courtesy of GENERAL MOTORS CORP.

CAUTION: Do not turn the crankshaft assembly after the timing chain has been removed in order to prevent damage to the piston assemblies or the valves.

1. Remove and discard the camshaft sprocket bolt (206).
2. Remove the camshaft sprocket (205) and timing chain (208).

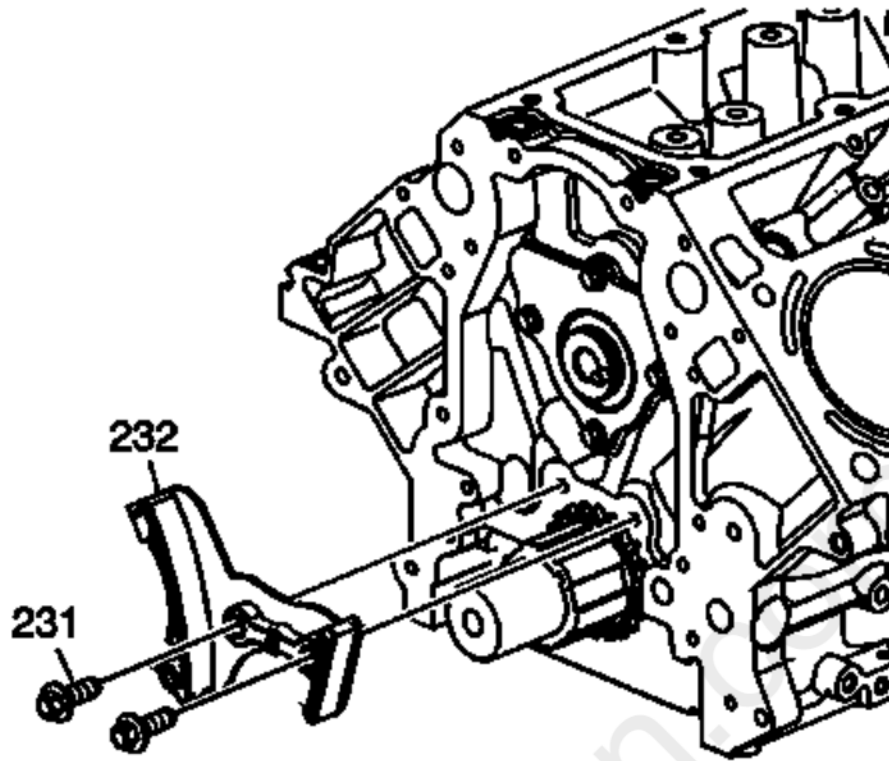


Fig. 70: View Of Timing Chain Tensioner & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the bolts (231) and timing chain tensioner (232).

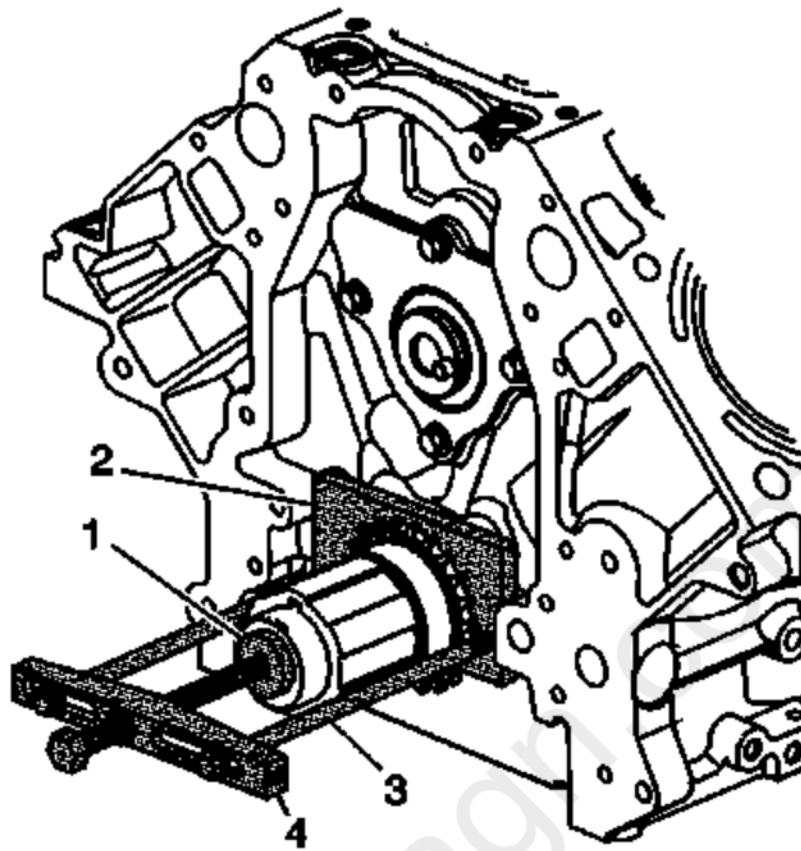


Fig. 71: View Of Crankshaft Sprocket Special Tools
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 41816-2**: protector (1), the **J 41558**: remover (2), bolts (3), and the **J 8433**: puller (4) in order to remove the crankshaft sprocket.

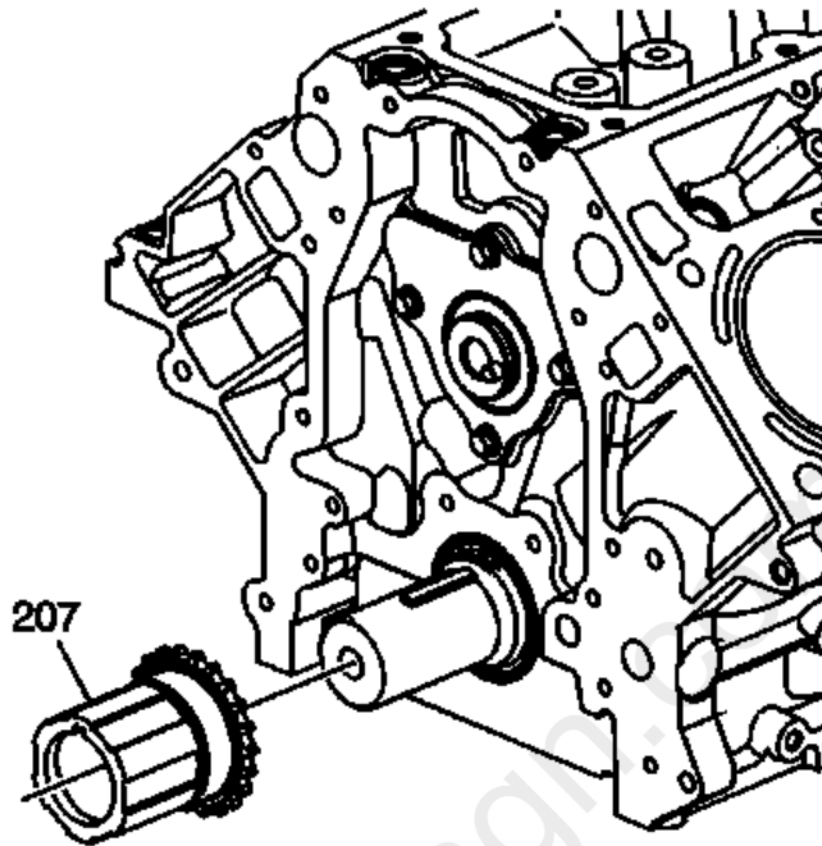


Fig. 72: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

5. Remove the crankshaft sprocket (207).

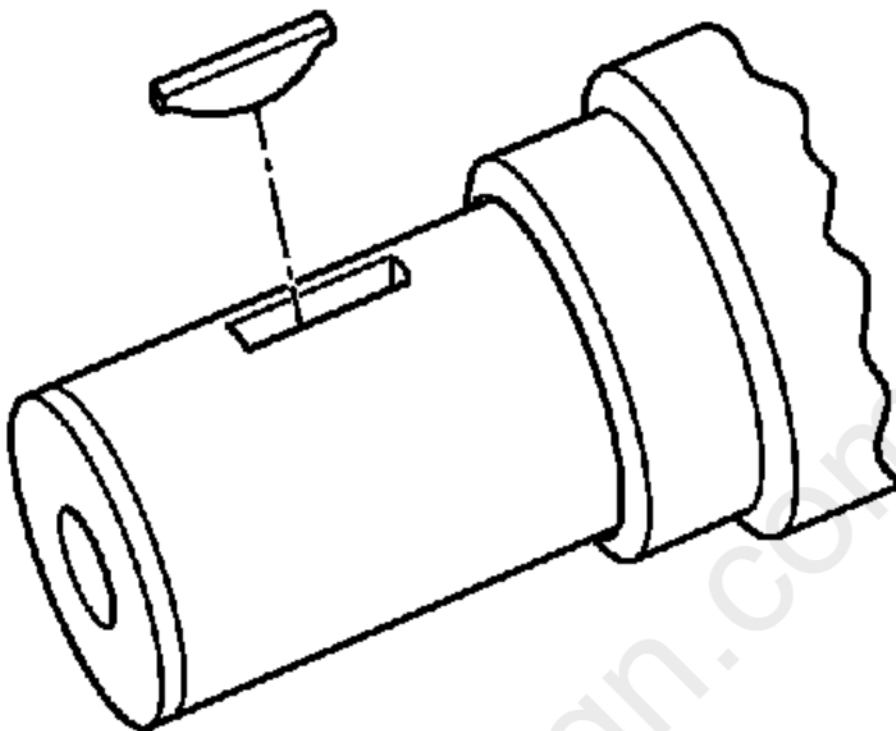


Fig. 73: View Of Crankshaft Key & Keyway
Courtesy of GENERAL MOTORS CORP.

6. Remove the crankshaft sprocket key, as required.

CAMSHAFT REMOVAL

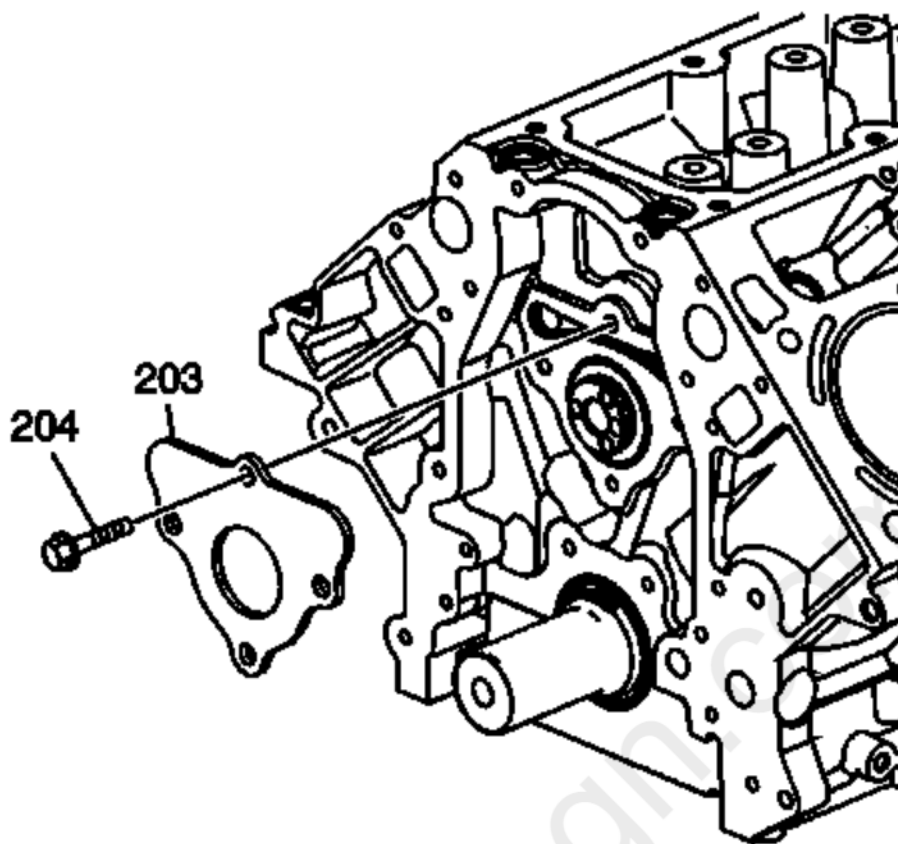


Fig. 74: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

1. Remove the camshaft retainer bolts (204) and retainer (203).

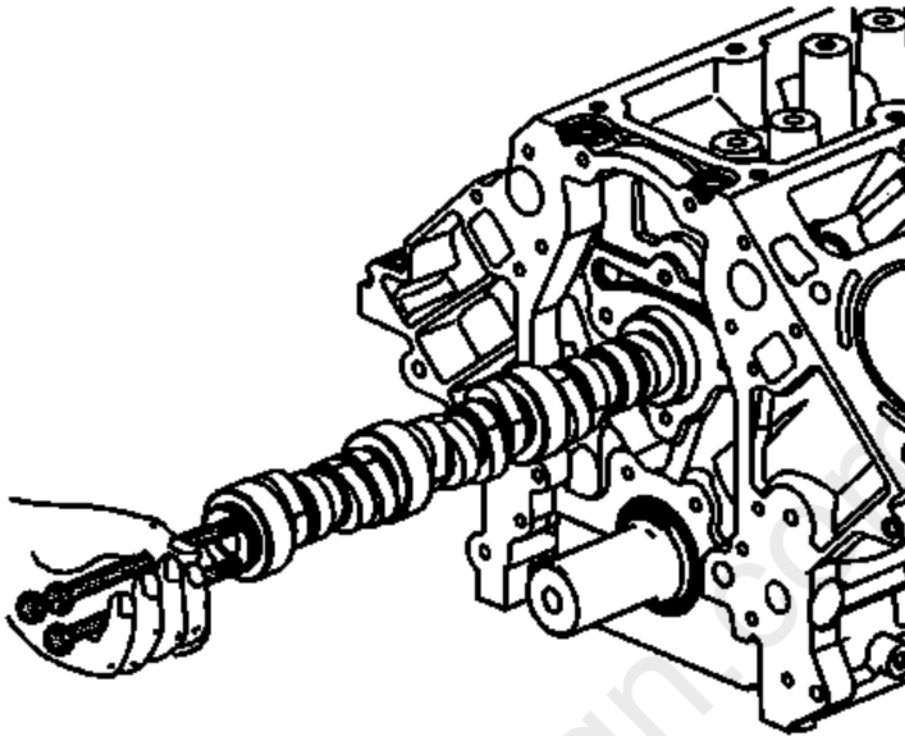


Fig. 75: Camshaft Installation

Courtesy of GENERAL MOTORS CORP.

CAUTION: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

2. Remove the camshaft.
 1. Install the 3 M8-1.25 x 100 mm bolts into the camshaft front bolt holes.
 2. Using the bolts as a handle, carefully rotate and pull the camshaft out of the engine block.
 3. Remove the bolts from the front of the camshaft.

PISTON, CONNECTING ROD, AND BEARING REMOVAL

Tools Required

- **J 24270** Cylinder Bore Ridge Reamer. See **Special Tools** .
- **J 41556** Connecting Rod Guide. See **Special Tools** .

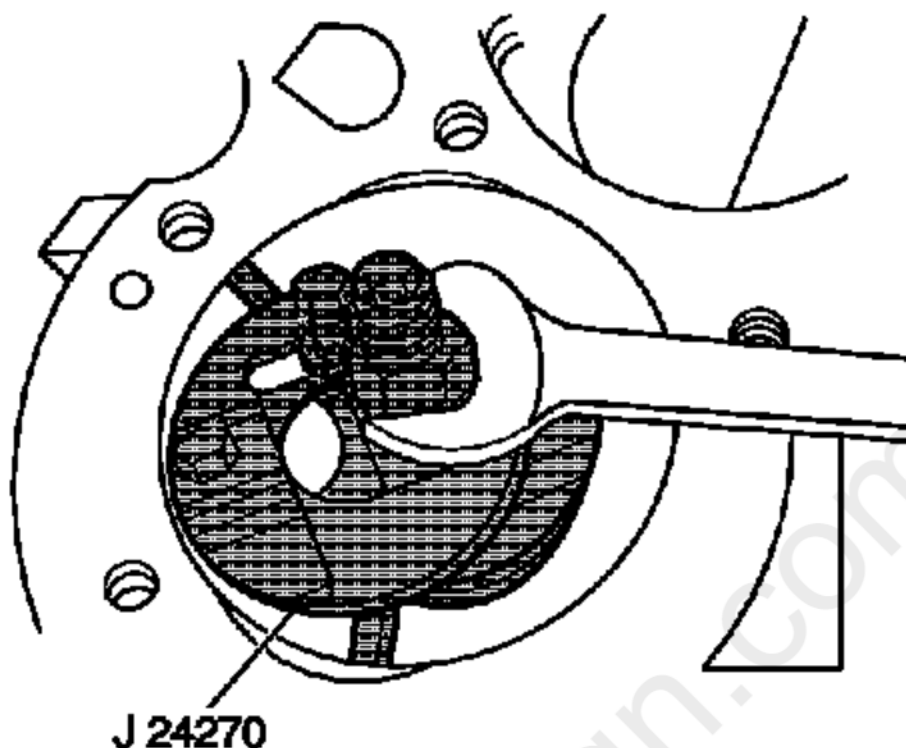


Fig. 76: Cylinder Bore Ring Ridge And Special Tool
Courtesy of GENERAL MOTORS CORP.

1. Use the **J 24270** in order to remove the cylinder bore ring ridge, if required. See **Special Tools**.
 1. Turn the crankshaft until the piston is at the bottom of the stroke.
 2. Place a cloth on top of the piston.
 3. Use the **J 24270**, or equivalent, in order to remove a cylinder ring ridge. See **Special Tools**.
 4. Turn the crankshaft so the piston is at the top of the stroke.
 5. Remove the cloth.
 6. Remove the cutting debris from the cylinder and piston.

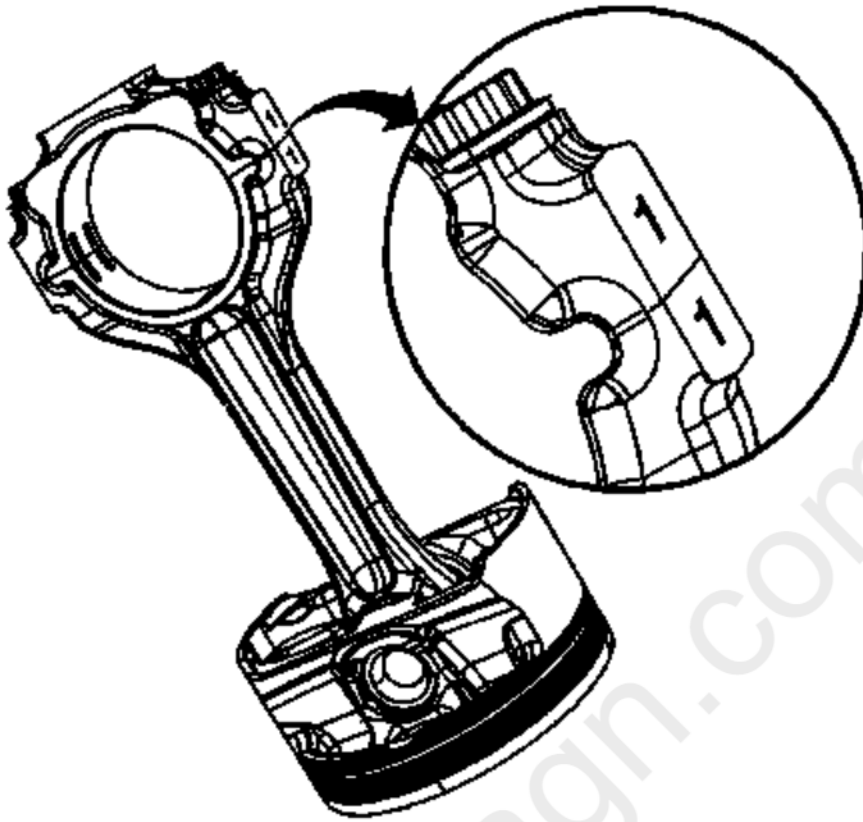


Fig. 77: Matchmarks On Connecting Rods & Caps
Courtesy of GENERAL MOTORS CORP.

2. Using a paint stick or etching tool, place matchmarks or numbers on the connecting rods and the connecting rod caps. The connecting rods and caps **MUST** be assembled to their original position and direction.
 - A stamping mark on the side of the connecting rod, at the crankshaft journal, may affect component geometry.
 - Mark the top of the piston to the specific cylinder bore.

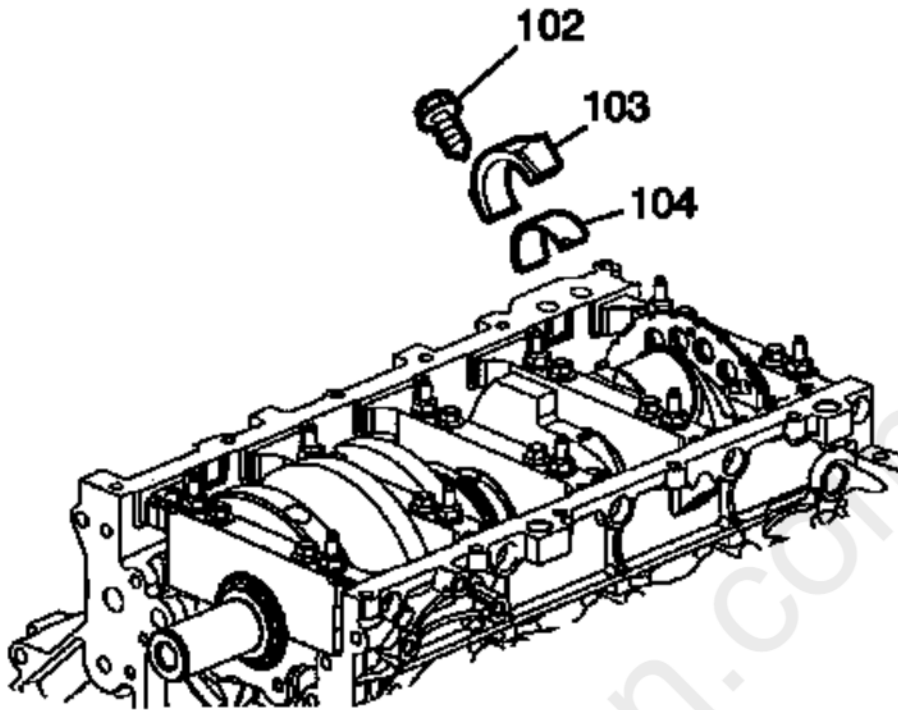


Fig. 78: Connecting Rod Bolt, Cap & Bearing
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: Mark, sort, or organize the connecting rod bearings so they may be installed to their original position and location. The connecting rods and the bearing caps are **NOT** interchangeable. Refer to Separating Parts .

3. Remove the connecting rod bolts (102), cap (103) and bearing (104).

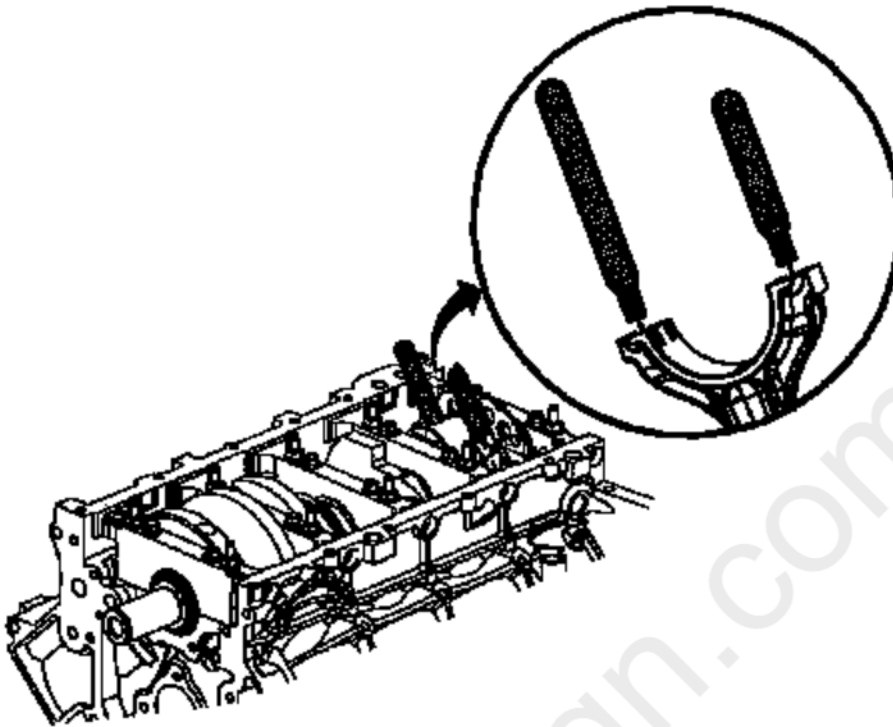


Fig. 79: Installing Piston & Connecting Rod Assembly
Courtesy of GENERAL MOTORS CORP.

4. Install the **J 41556** to the connecting rod. See **Special Tools** .

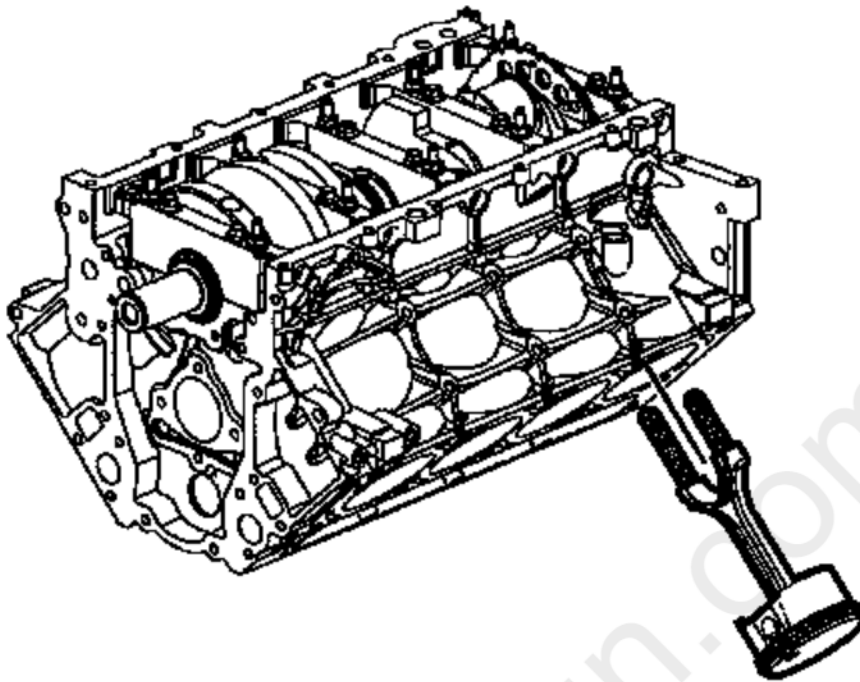


Fig. 80: Piston, Connecting Rod & Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

5. Using a hammer, tap lightly on the end of the **J 41556** in order to remove the piston and connecting rod assembly from the cylinder bore. See **Special Tools** .
6. Remove the **J 41556** . See **Special Tools** .

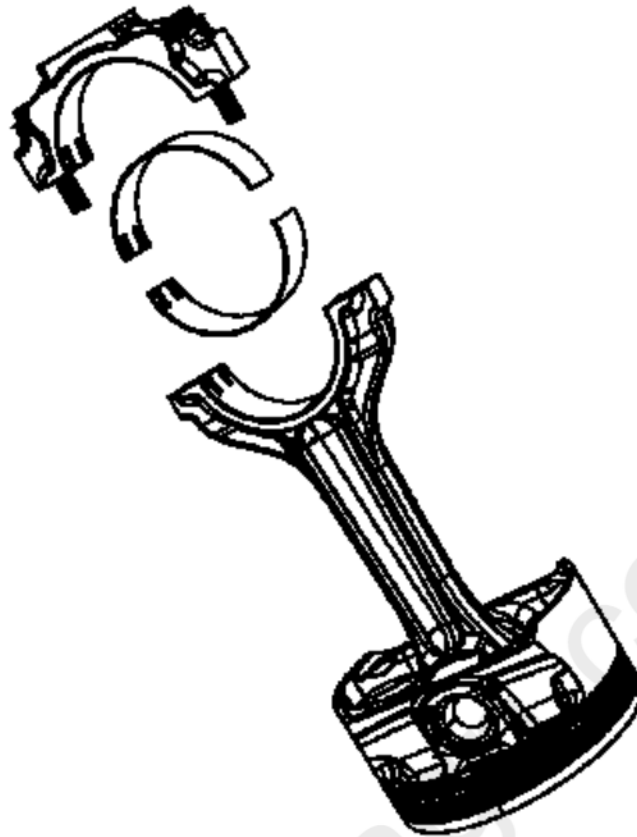


Fig. 81: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

7. Upon removal of the piston and connecting rod assembly, assemble the connecting rod cap and bolts onto the matching connecting rod.

CRANKSHAFT AND BEARING REMOVAL

Special Tools

- **J 6125-1B:** Slide Hammer
- **J 41818:** Crankshaft Bearing Cap Remover

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

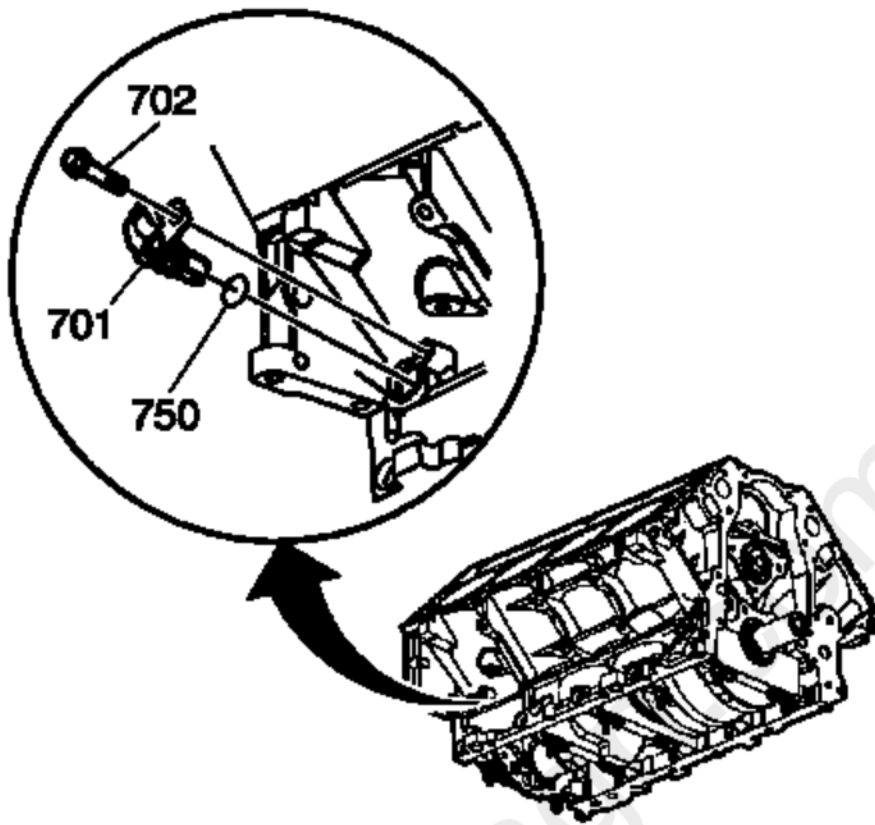


Fig. 82: CKP Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The crankshaft bearing caps are machined with the engine block, for the proper clearances. Mark or identify each crankshaft bearing cap location and direction before removal. The crankshaft bearing caps **MUST** be installed to their original position and direction.
- All M8, and M10 bolts are to be discarded and replaced with **NEW**.

1. Remove the crankshaft position (CKP) sensor bolt (702).
2. Remove the CKP sensor (701).
3. Remove the O-ring (750) from the sensor, as required.

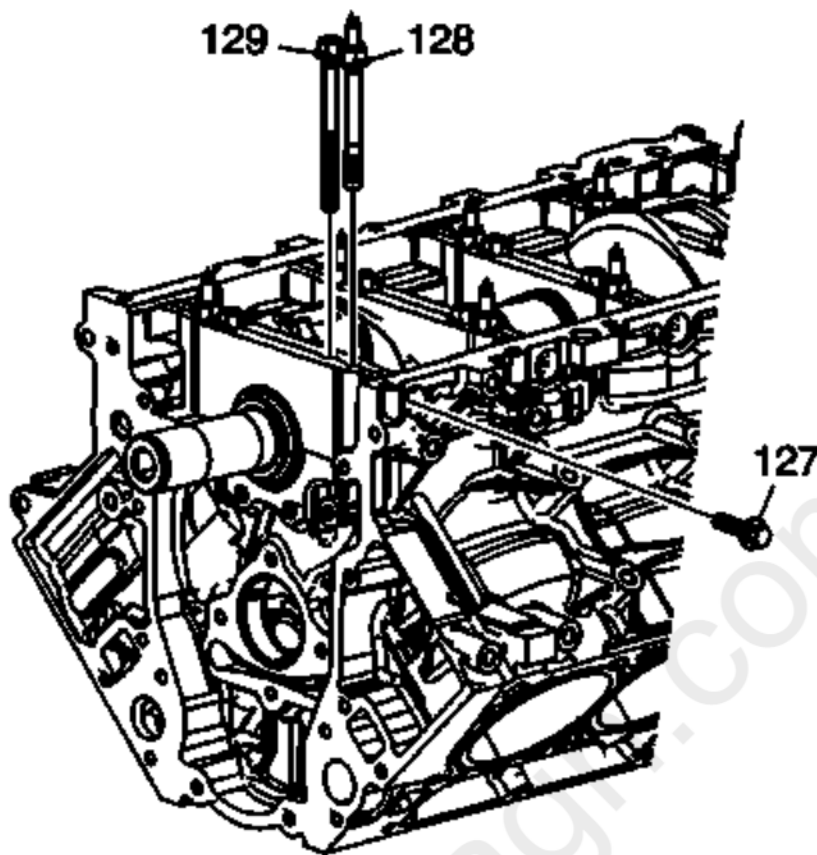


Fig. 83: Identifying Bearing Cap Bolts & Studs
Courtesy of GENERAL MOTORS CORP.

4. Remove and discard the crankshaft bearing cap M8 bolts (127).
5. Remove and discard the bearing cap M10 bolts (129) and studs (128).

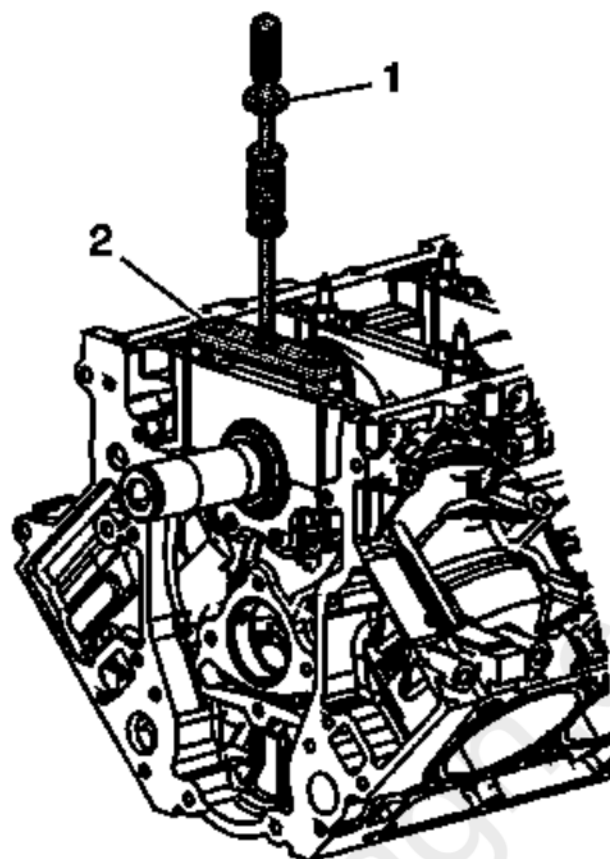


Fig. 84: View Of Crankshaft Bearing Cap Bolts (M10)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

6. Install the **J 41818**: remover (2) and tighten to 11 N.m (100 lb in).
7. Install the **J 6125-1B**: hammer (1) to the **J 41818**: remover (2) in order to remove the crankshaft bearing caps.

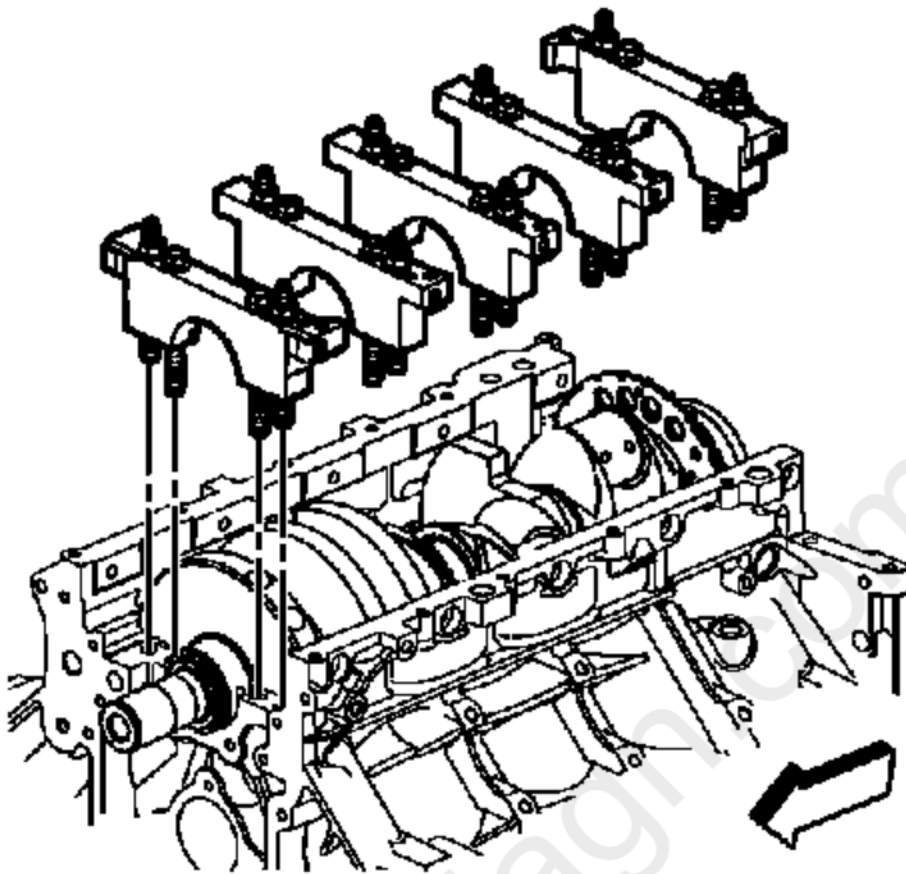


Fig. 85: View Of Crankshaft Main Bearing Caps
Courtesy of GENERAL MOTORS CORP.

8. Remove the bearing caps.

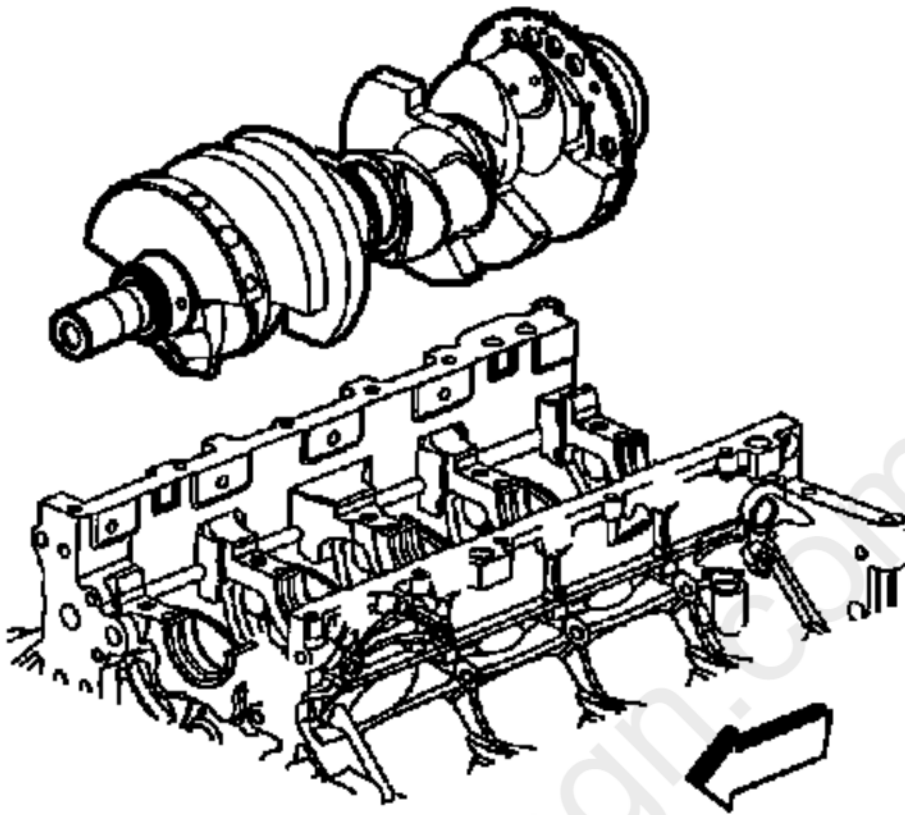


Fig. 86: View Of Crankshaft & Engine Block
Courtesy of GENERAL MOTORS CORP.

9. Remove the crankshaft.

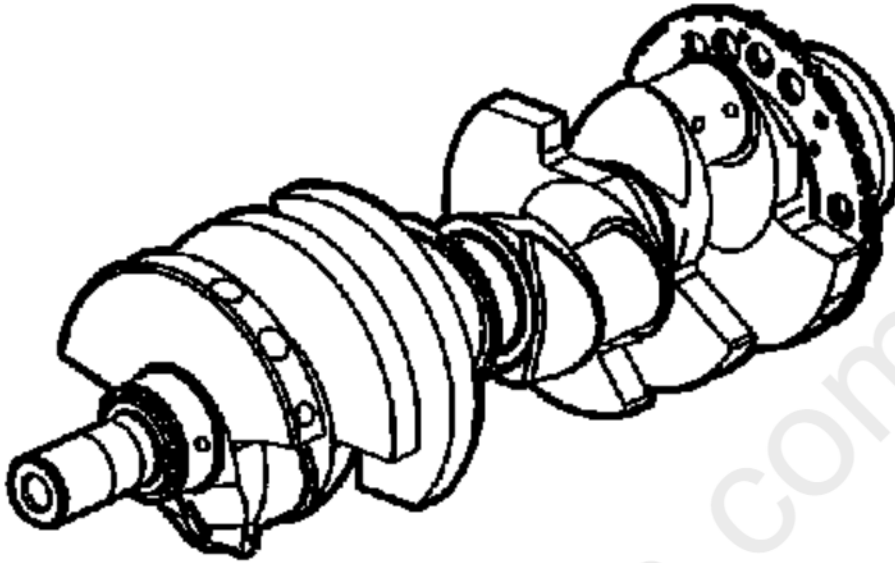


Fig. 87: View Of Camshaft

Courtesy of GENERAL MOTORS CORP.

NOTE: Use care when handling the crankshaft. Avoid damage to the CKP sensor reluctor ring teeth. Nicks, burrs or other damage to the teeth may affect on-board diagnostics (OBD) II system performance.

10. Lay the crankshaft onto 2 wooden V-blocks or other protective surface.

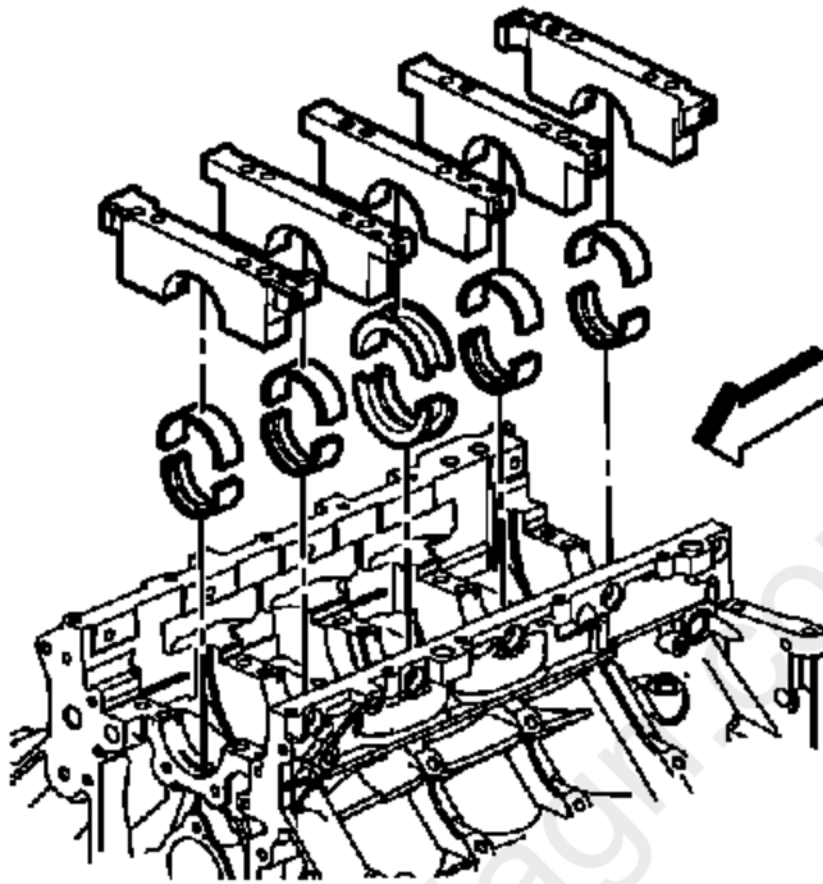


Fig. 88: View Of Crankshaft Bearings & Bearing Caps
Courtesy of GENERAL MOTORS CORP.

11. Remove the crankshaft bearings from the bearing caps and the engine block.
12. Mark, sort, or organize the crankshaft bearings so they may be installed to their original position and location. Refer to Separating Parts .

ENGINE BLOCK PLUG REMOVAL

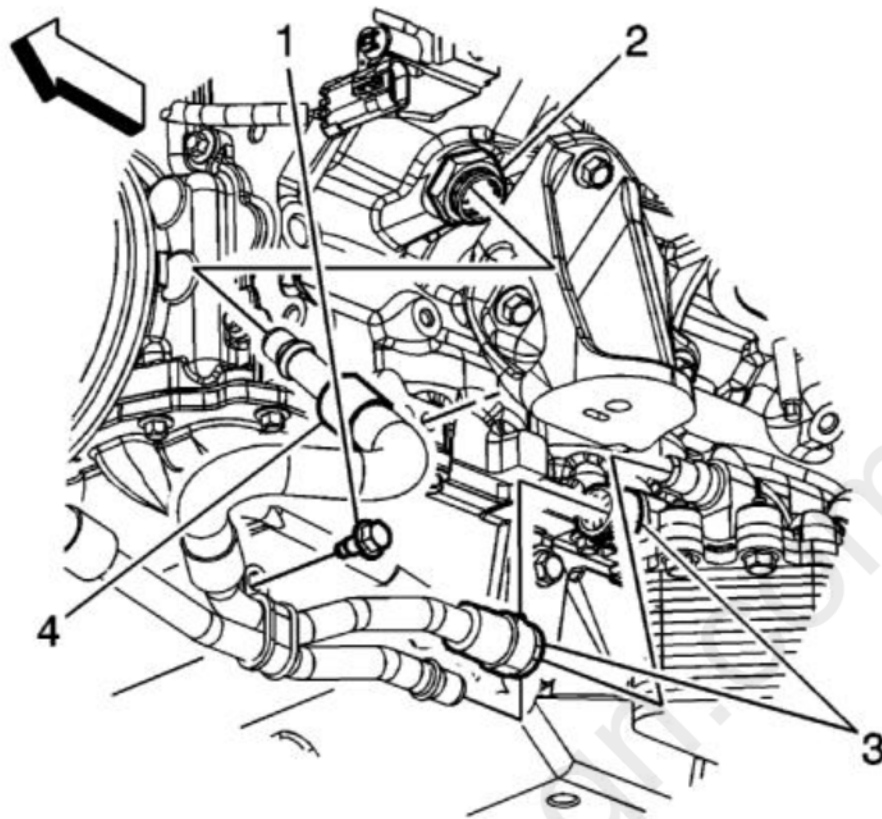


Fig. 89: Identifying Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine oil cooler coolant fitting (2).

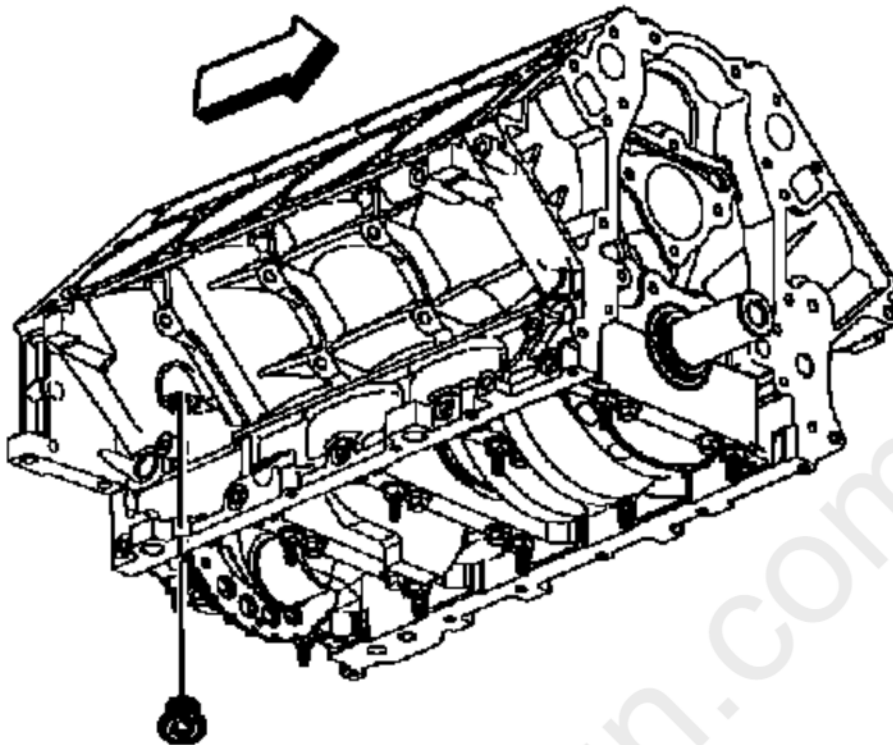


Fig. 90: Engine Block Right Rear Coolant Drain Hole Plug & Seal
Courtesy of GENERAL MOTORS CORP.

2. Remove the engine block right rear coolant drain hole plug and seal.

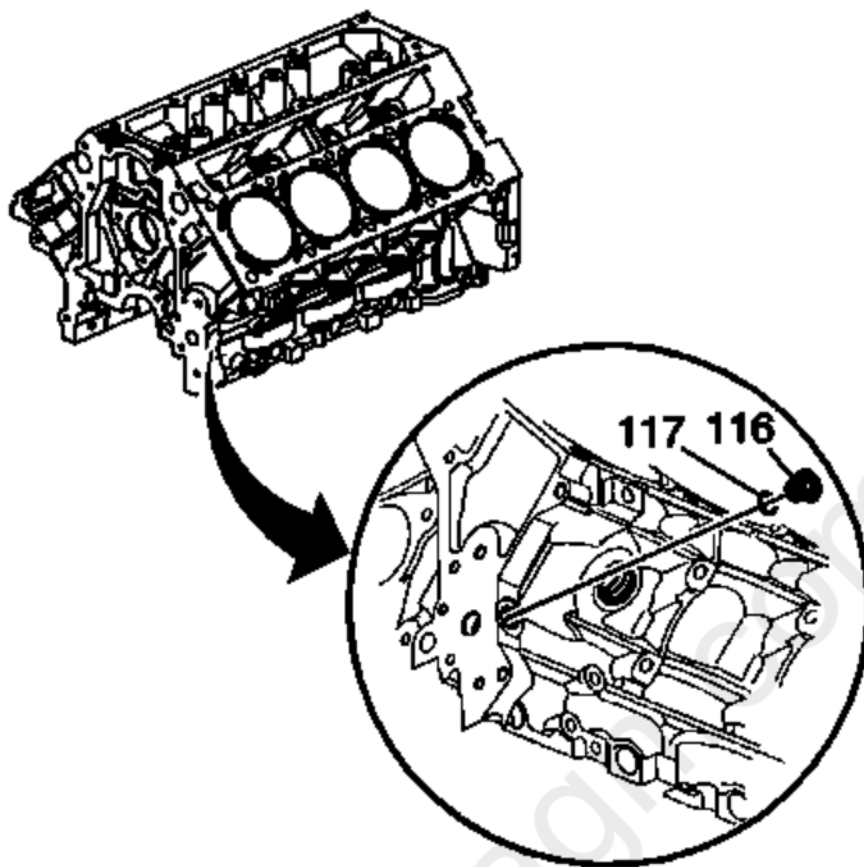


Fig. 91: Locating Engine Block Left Front Oil Gallery Plug & Seal
Courtesy of GENERAL MOTORS CORP.

3. Remove the engine block left front oil gallery plug (116) and seal (117).

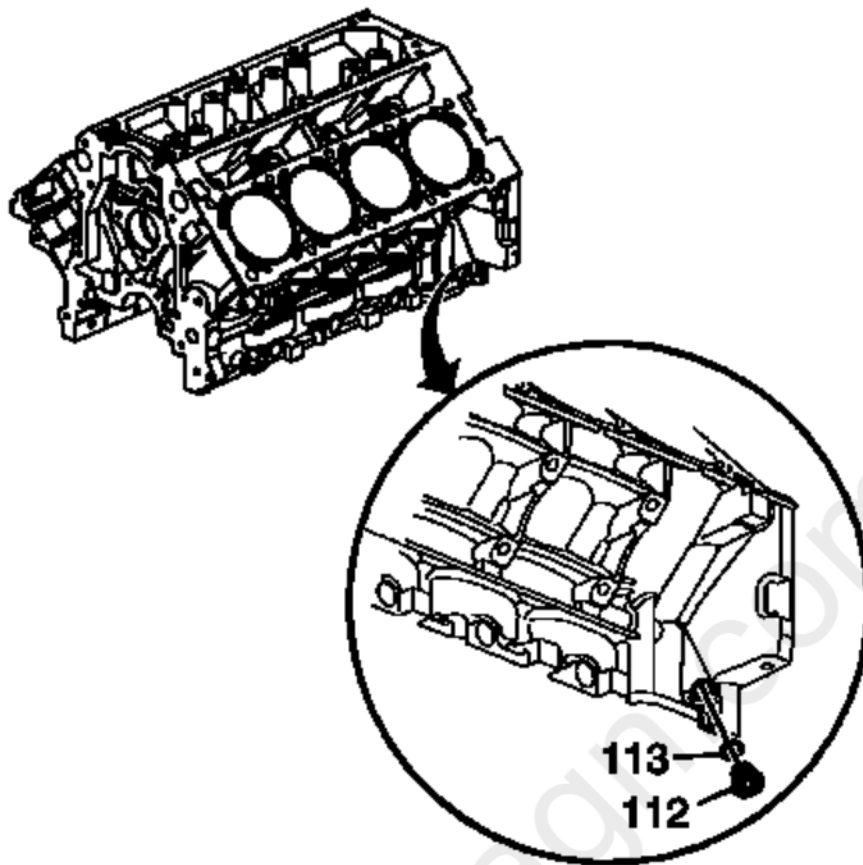


Fig. 92: Locating Engine Block Left Rear Oil Gallery Plug & Seal
Courtesy of GENERAL MOTORS CORP.

4. Remove the engine block left rear oil gallery plug (112) and seal (113).

If the block plug and coolant heater sealing washers are not damaged, they may be used during assembly.

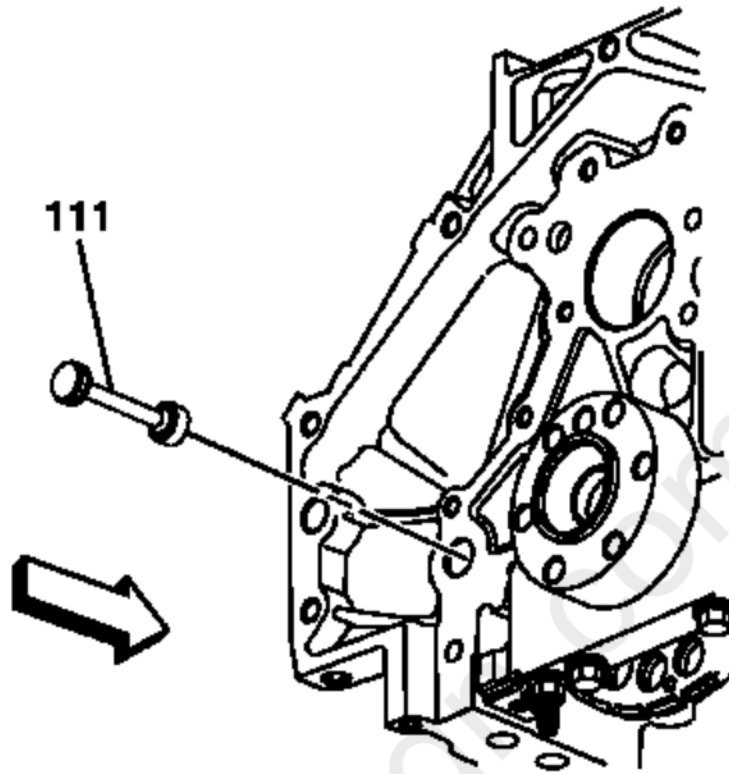


Fig. 93: Identifying Engine Block Rear Oil Gallery Plug & Seal
Courtesy of GENERAL MOTORS CORP.

5. Remove the engine block rear oil gallery plug (111) and seal.
6. Inspect the O-ring seal of the rear oil gallery plug.

If the O-ring seal is not cut or damaged, the plug and O-ring seal may be used during assembly.

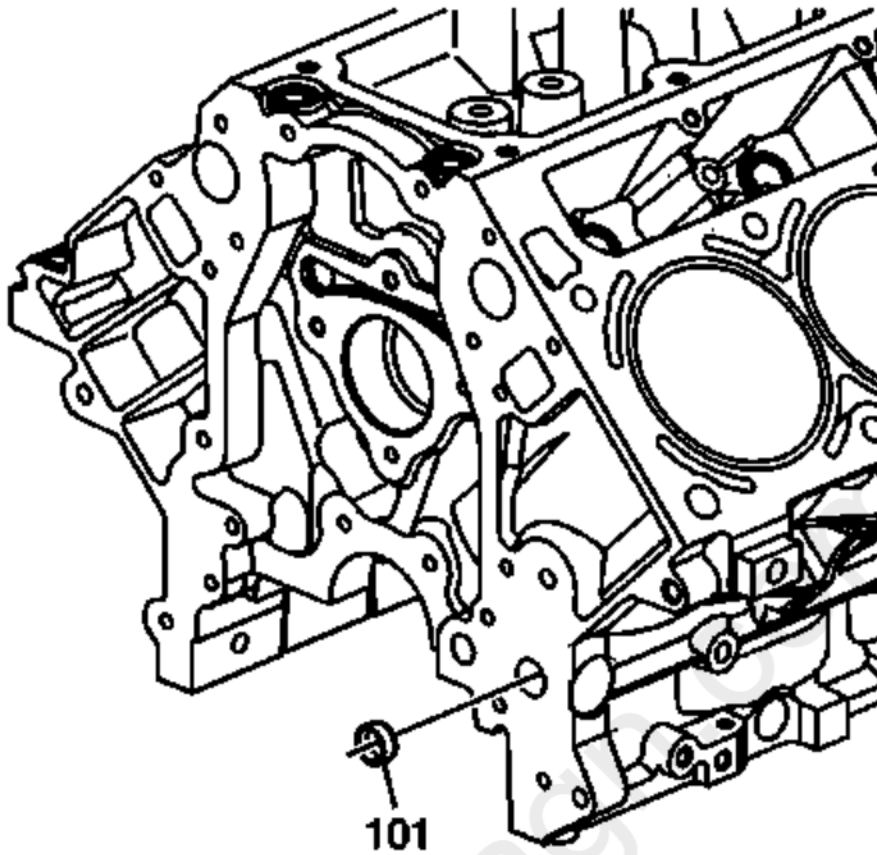


Fig. 94: View Of Engine Block Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

NOTE: Remove the front oil gallery plug, only if service is required. If the front oil gallery plug is removed, a NEW oil gallery plug must be installed.

7. Remove the engine block front oil gallery plug (101).

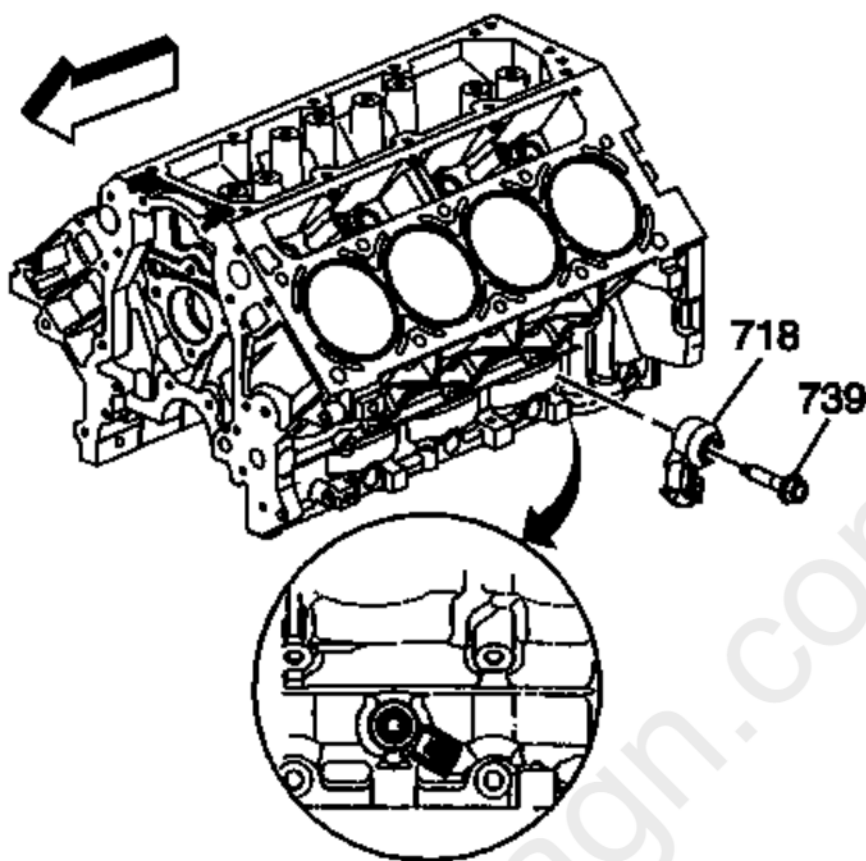


Fig. 95: Left Side Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

8. Remove the left side knock sensor (718) and bolt (739).

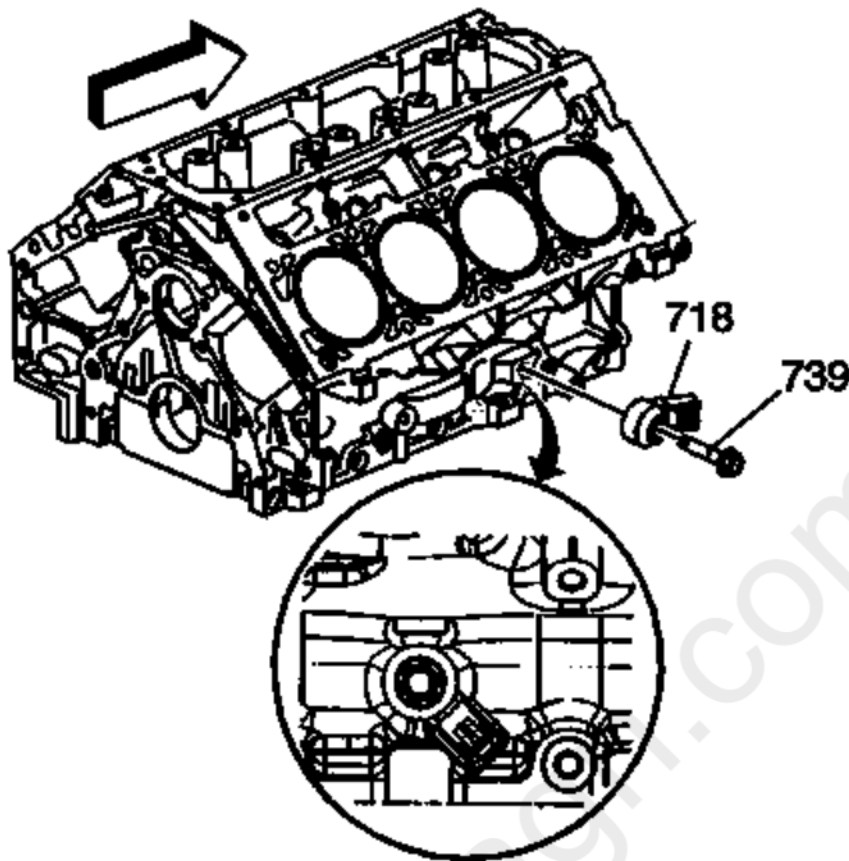


Fig. 96: Right Side Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

9. Remove the right side knock sensor (718) and bolt (739).

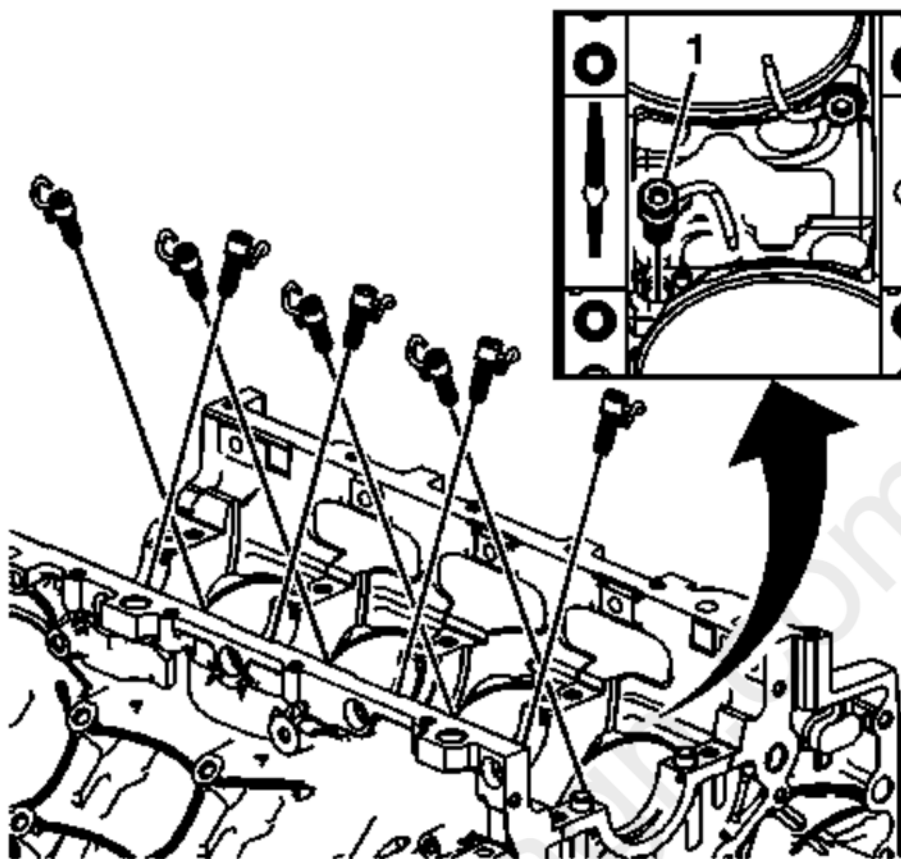


Fig. 97: Identifying Piston Oil Nozzles
Courtesy of GENERAL MOTORS CORP.

10. Remove the piston oil nozzles (1) from the block - 6.2L LS9/LSA.

ENGINE BLOCK CLEANING AND INSPECTION

SPECIAL TOOLS

- **J 8087:** Cylinder Bore Gauge
- **J 42385-100:** Head/Main Bolt Thread Repair Kit

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

CLEANING PROCEDURE

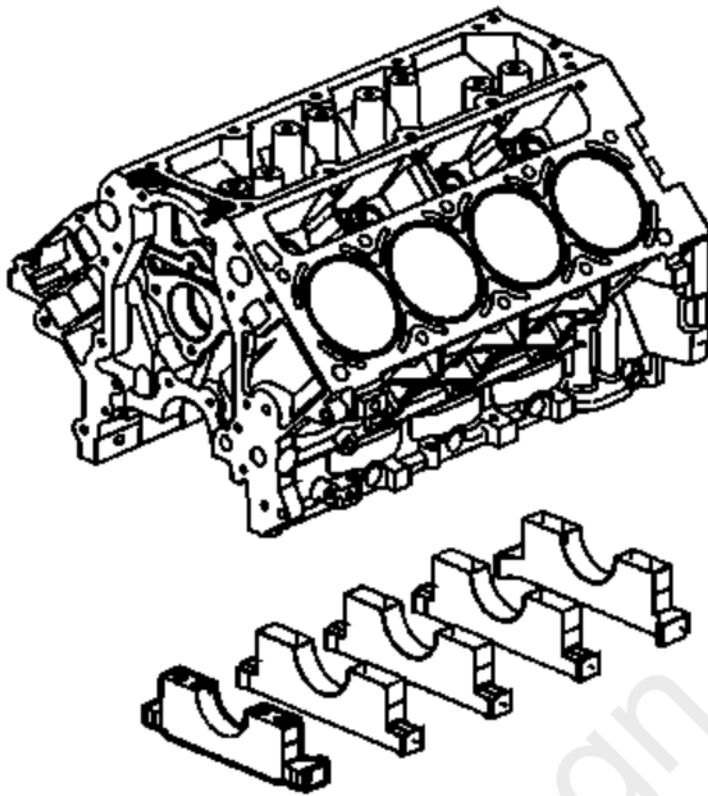


Fig. 98: Main Bearing Caps

Courtesy of GENERAL MOTORS CORP.

CAUTION: Do not use a caustic solution to clean the aluminum engine block.

NOTE: When cleaning the engine block in a thermal type oven, do not exceed 232°C (450°F).

Clean the following components:

- Remove all sludge, dirt, or debris using a cleaning solvent or thermal type oven. Refer to Cleanliness and Care .
- Gasket surfaces

Refer to Replacing Engine Gaskets .

- Coolant passages
- Oil galleries
- Main bearing caps

- Cylinder head bolt holes to remove threadlocking material

Thread repair tool J 42385-107 may be used to clean the threads of any residual threadlocking material.

INSPECTION PROCEDURE

1. Inspect the following components:

- Cylinder walls for excessive scratches, gouging, or ring ridge
- Cylinder bores for excessive ring ridge at the top of the cylinder
- Coolant jacket for cracks
- Valve lifter bores for excessive scoring or wear
- Crankshaft bearing webs for cracks
- Gasket sealing surfaces for excessive scratches or gouging

Refer to **Replacing Engine Gaskets** .

- Oil galleries for restrictions
- Threaded bolt holes for damaged threads
- Cylinder bores for excessive ring ridge at the top of the cylinder

2. Measure the cylinder bores for an oversize condition:

MEASURING THE CYLINDER FOR OVERSIZE

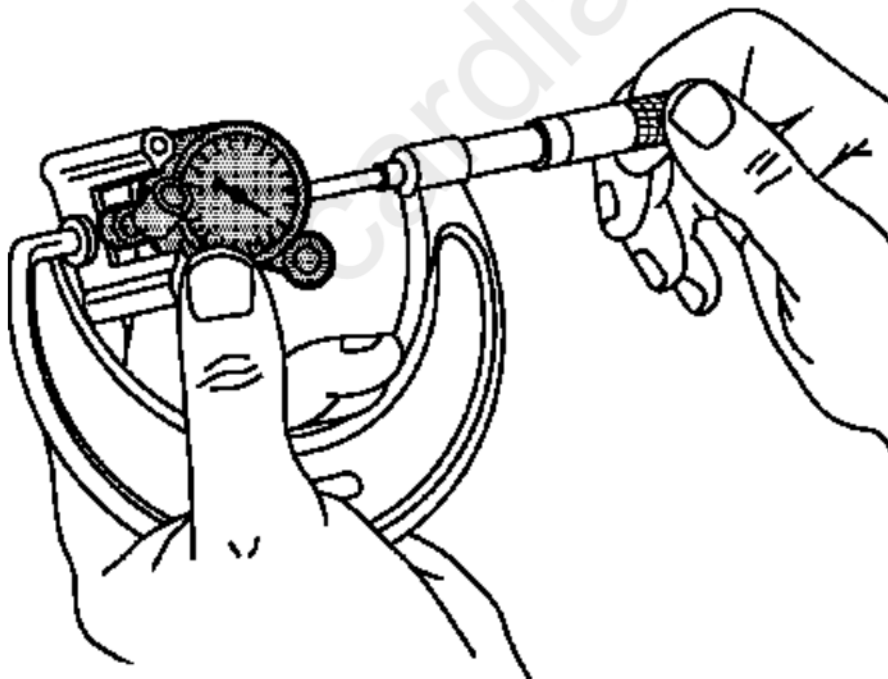


Fig. 99: Measuring Bore Gauge With Micrometer
Courtesy of GENERAL MOTORS CORP.

1. Adjust the micrometer to a dimension slightly smaller than the bore size. Refer to **Engine Mechanical Specifications**.
2. Insert the **J 8087**: gauge into the micrometer and zero the bore gauge dial.

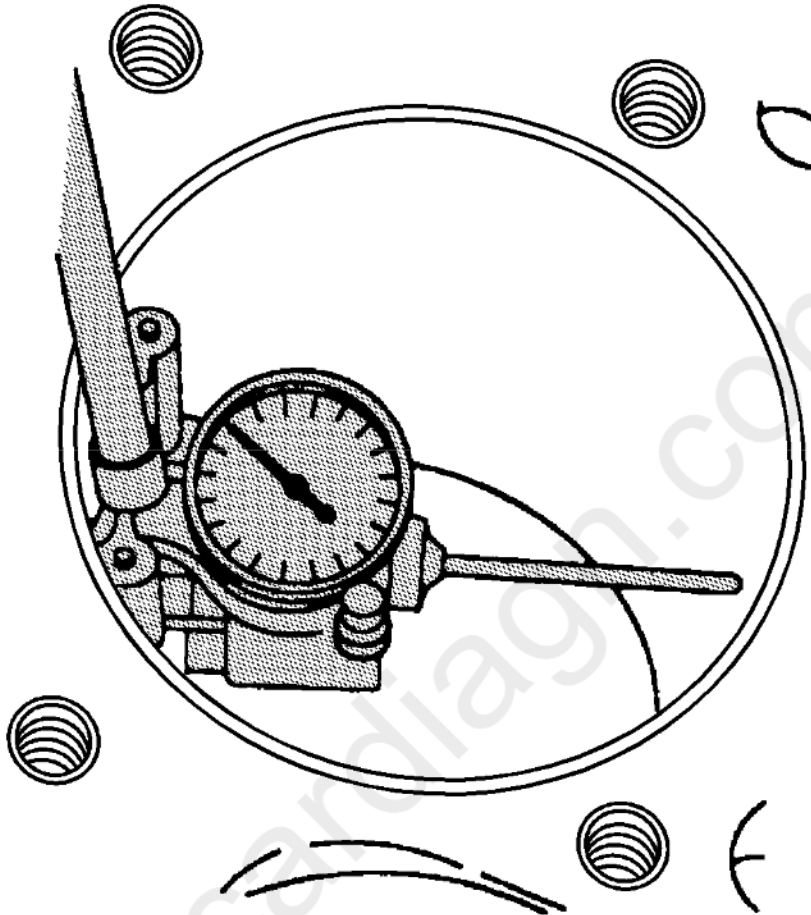


Fig. 100: Measuring Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

3. Using the **J 8087**: gauge, measure the cylinder bore for oversize.

Slide the bore gauge up and down throughout the length of the cylinder bore. Measure the bore, both parallel and perpendicular to the centerline of the crankshaft, at the top, center, and bottom of the bore. A cylinder bore that exceeds the maximum diameter must be serviced with an oversized piston. Refer to **Engine Mechanical Specifications**.

CYLINDER BORING AND HONING

BORING PROCEDURE

NOTE: A 0.5 mm (0.02 in) oversize service piston and a piston ring set are available.

1. Measure all pistons with a micrometer to determine the cylinder bore diameter.
2. Before you use any type of boring bar, use a fine file and clean the top of the cylinder block, removing any dirt or burrs. If you do not check the cylinder block, the boring bar may be improperly positioned or tilted and the cylinder bore could be bored at an incorrect angle.
3. Carefully follow the instructions furnished by the manufacturer regarding use of the equipment.
4. When you bore the cylinders, ensure all the crankshaft bearing caps are in place. Tighten the crankshaft bearing caps to the proper torque in order to avoid distortion of the cylinder bores during final assembly.
5. When you take the final cut with a boring bar, leave 0.03 mm (0.001 in) on the cylinder bore diameter for the finish honing and fit of the piston.

HONING PROCEDURE

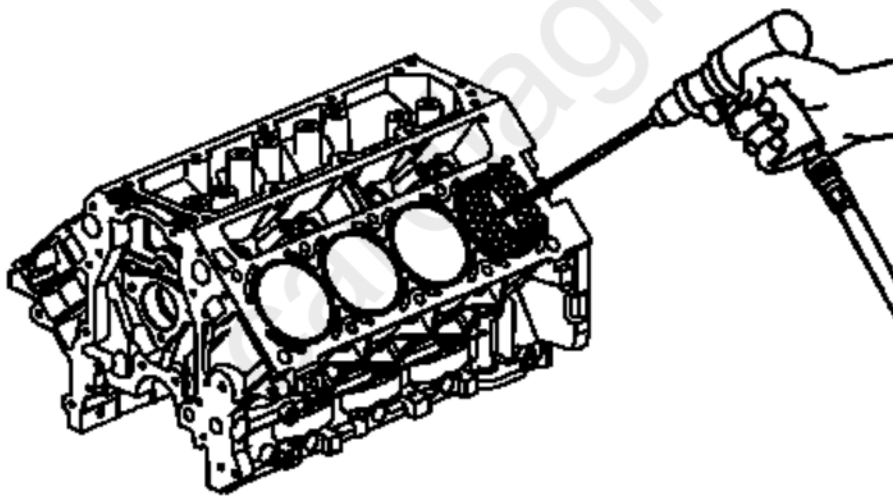


Fig. 101: View Of Honing Of Cylinders
Courtesy of GENERAL MOTORS CORP.

1. When honing the cylinders, follow the manufacturer's recommendations for equipment use, cleaning, and lubrication. Use only clean, sharp stones of the proper grade for the amount of material you remove. Dull,

2011 Cadillac CTS

2011 ENGINE Engine Mechanical - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - Repair Instructions - Off Vehicle - CTS

dirty stones cut unevenly and generate excessive heat. Do not hone to final clearance with a coarse or medium-grade stone. Leave sufficient metal so that all stone marks may be removed with fine-grade stones. Perform final honing with a fine-grade stone, honing the cylinder to the proper clearance.

2. During the honing operation, thoroughly clean the cylinder bore. Repeatedly check the cylinder bore for fit with the selected piston.

All measurements of the piston or the cylinder bore should be made with the components at normal room temperature.

3. When honing a cylinder for fit to an oversize piston, first perform the preliminary honing with a 100-grit stone.
4. Perform final cylinder honing with a 240-grit stone and obtain a 45 degree cross hatch pattern.

A 240-grit stone is preferred for final honing. If a 240-grit stone is not available, a 220-grit stone may be used as a substitute.

5. The finish marks should be clean but not sharp. The finish marks should also be free from imbedded particles and torn or folded metal.
6. By measuring the selected piston at the sizing point and by adding the average of the clearance specification, you can determine the final cylinder honing dimension required.
7. After final honing and before the piston is checked for fit, clean the cylinder bores with hot water and detergent. Scrub the bores with a stiff bristle brush and rinse the bores thoroughly with hot water. Do not allow any abrasive material to remain in the cylinder bores. This abrasive material may cause premature wear of the new piston rings and the cylinder bores. Abrasive material will also contaminate the engine oil and may cause premature wear of the bearings. After washing the cylinder bore, dry the bore with a clean rag.
8. Perform final measurements of the piston and the cylinder bore.
9. Permanently mark the top of the piston for the specific cylinder to which it has been fitted.
10. Apply clean engine oil to each cylinder bore in order to prevent rusting.

DEGLAZING PROCEDURE

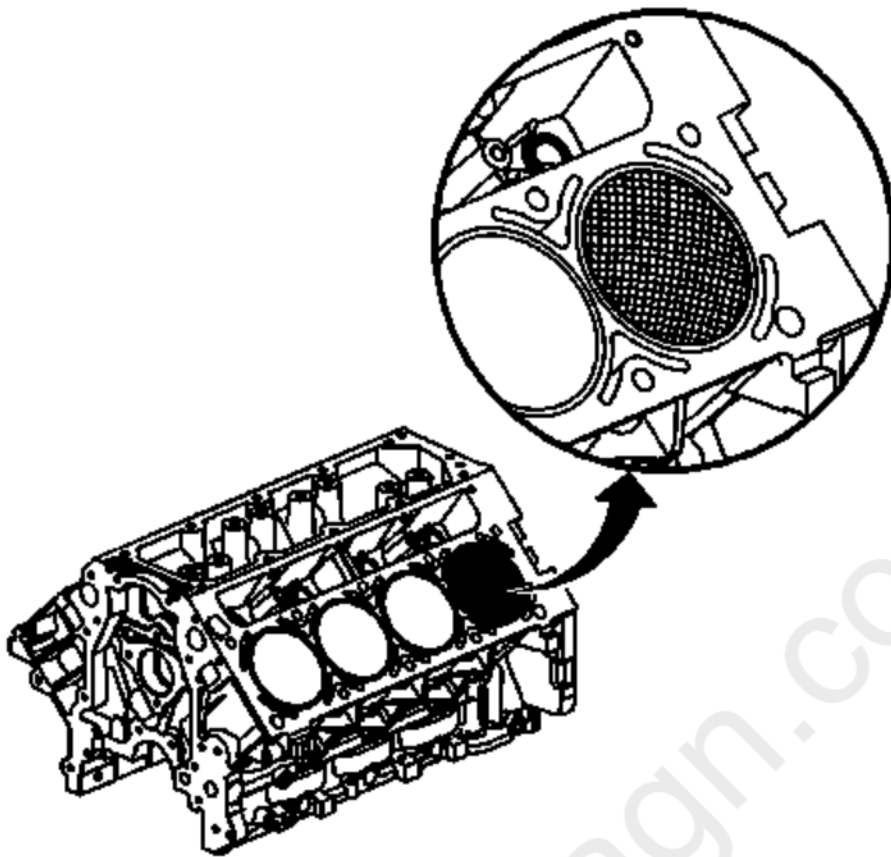


Fig. 102: View Of Deglazed Cylinder Bore
Courtesy of GENERAL MOTORS CORP.

Using a ball type or self centering honing tool, deglaze the cylinder bore lightly. Deglazing should be done only to remove any deposits that may have formed. Use a 240-grit stone of silicone carbide, or equivalent, material when performing the deglazing procedure.

A 240-grit stone is preferred for final honing. If a 240-grit stone is not available, a 220-grit stone may be used as a substitute.

CRANKSHAFT AND BEARING CLEANING AND INSPECTION

SPECIAL TOOLS

- **J 7872:** Magnetic Base Dial Indicator Set
- **J 43690:** Rod Bearing Checking Tool
- **J 43690-100:** Rod Bearing Checking Tool - Adapter Kit

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

CLEANING PROCEDURE

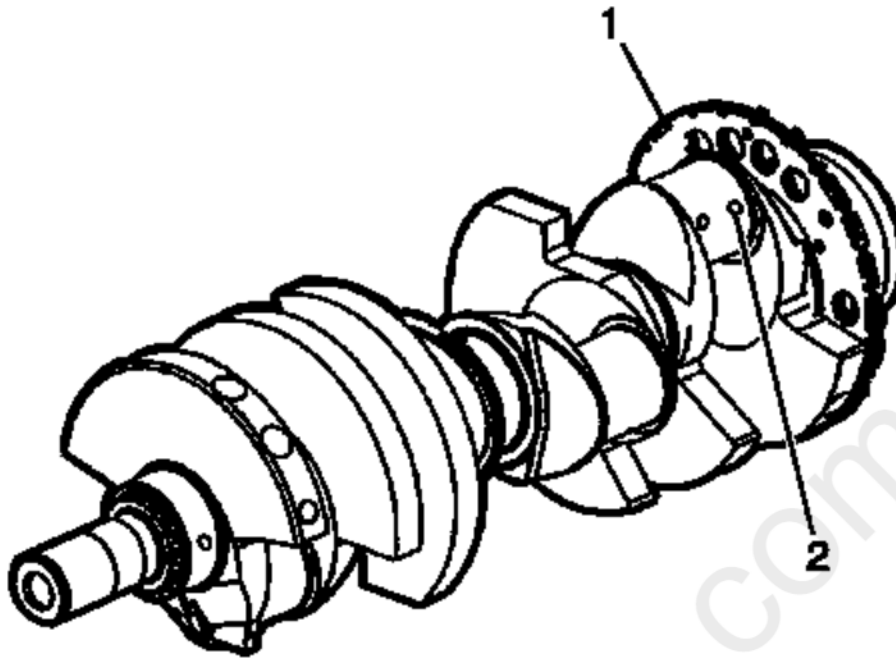


Fig. 103: Oil Passages & CKP Reluctor Ring Teeth
Courtesy of GENERAL MOTORS CORP.

NOTE: Use care when handling the crankshaft. Avoid damage to the bearing surfaces or the teeth of the crankshaft position (CKP) reluctor ring. Damage to the teeth of the CKP reluctor ring may affect on-board diagnostics (OBD) II system performance.

1. Clean the crankshaft with solvent.
2. Thoroughly clean all oil passages (2) and inspect for restrictions or burrs.

WARNING: Refer to **SAFETY GLASSES WARNING** .

3. Dry the crankshaft with compressed air.

INSPECTION PROCEDURE

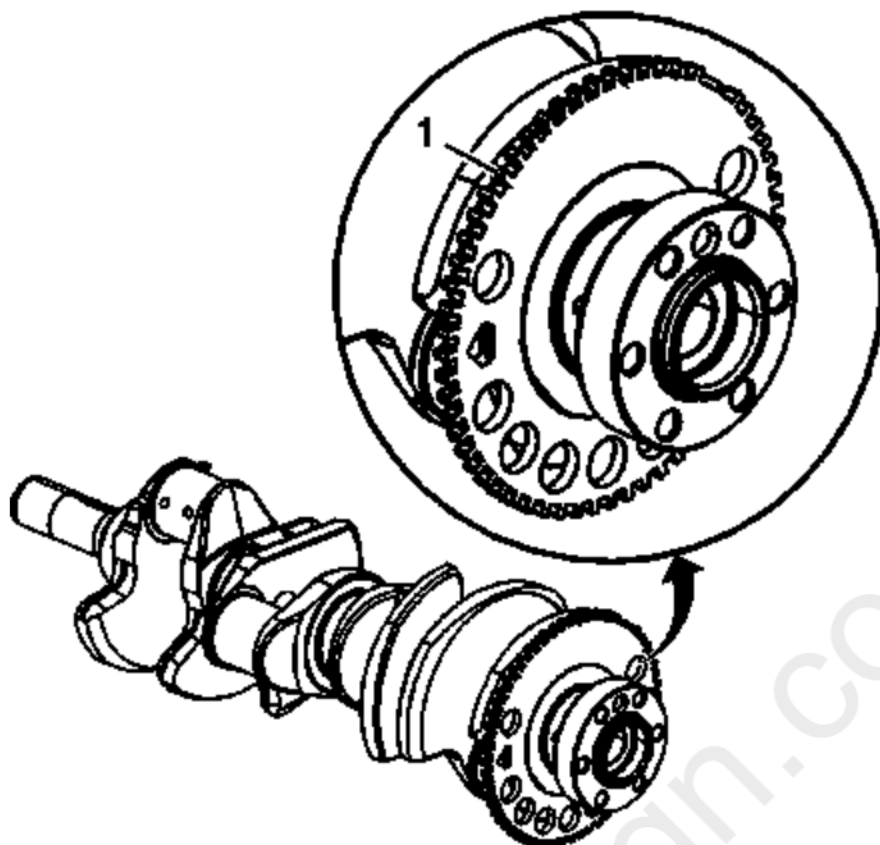


Fig. 104: View Of Reluctor Ring Teeth
Courtesy of GENERAL MOTORS CORP.

NOTE: The reluctor ring teeth should not have imperfections on the rising or falling edges. Imperfections of the reluctor ring teeth may affect OBD II system performance.

1. Inspect the CKP reluctor ring teeth (1) for damage.

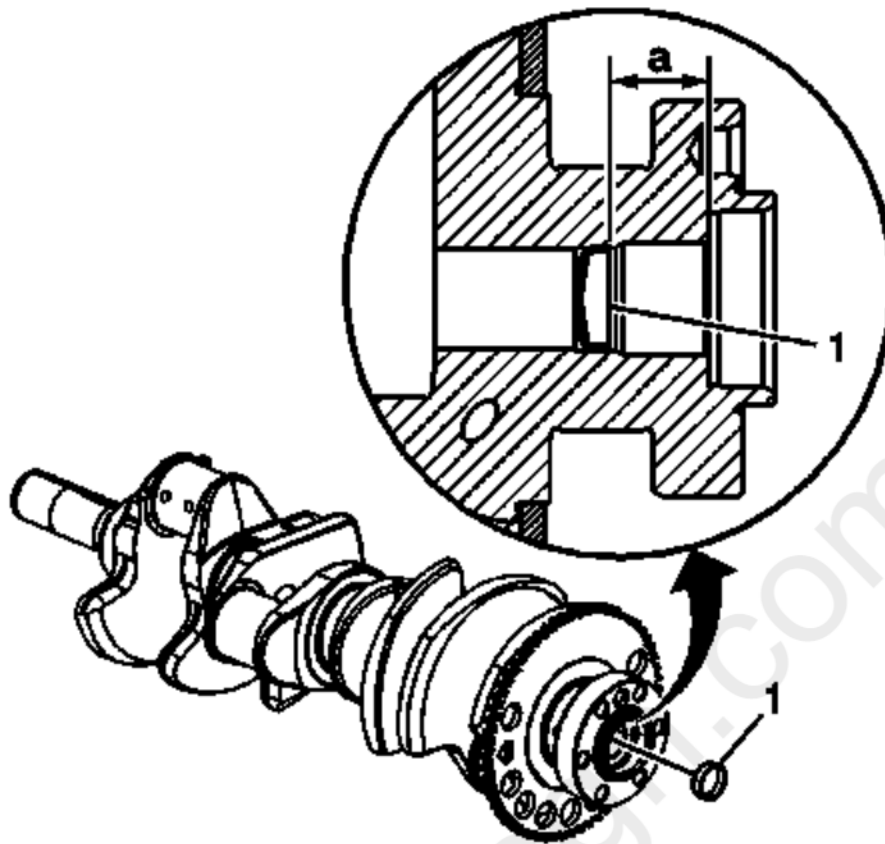


Fig. 105: Identifying Rear Cup Plug
Courtesy of GENERAL MOTORS CORP.

2. Inspect the rear cup plug (1) for leakage, if applicable.

NOTE: If a new plug is required, apply sealant GM P/N 89021297 (Canadian P/N 10953488) to the side of the plug prior to installation.

3. Install the rear cup plug (1) to a depth of 24.4 mm (0.96 in) (a).

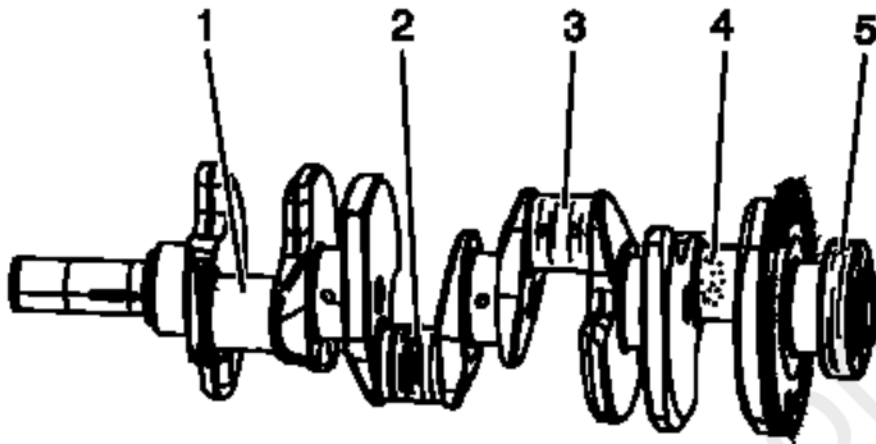


Fig. 106: View Of Crankshaft Journals
Courtesy of GENERAL MOTORS CORP.

4. Inspect the crankshaft journals for wear.

Journals should be smooth (1) with no signs of scoring, wear, or damage.

5. Inspect the crankshaft journals for grooves or scoring (2).
6. Inspect the crankshaft journals for scratches or wear (3).
7. Inspect the crankshaft journals for pitting or imbedded bearing material (4).
8. Inspect the crankshaft rear oil seal surface (5) for grooves or scoring.

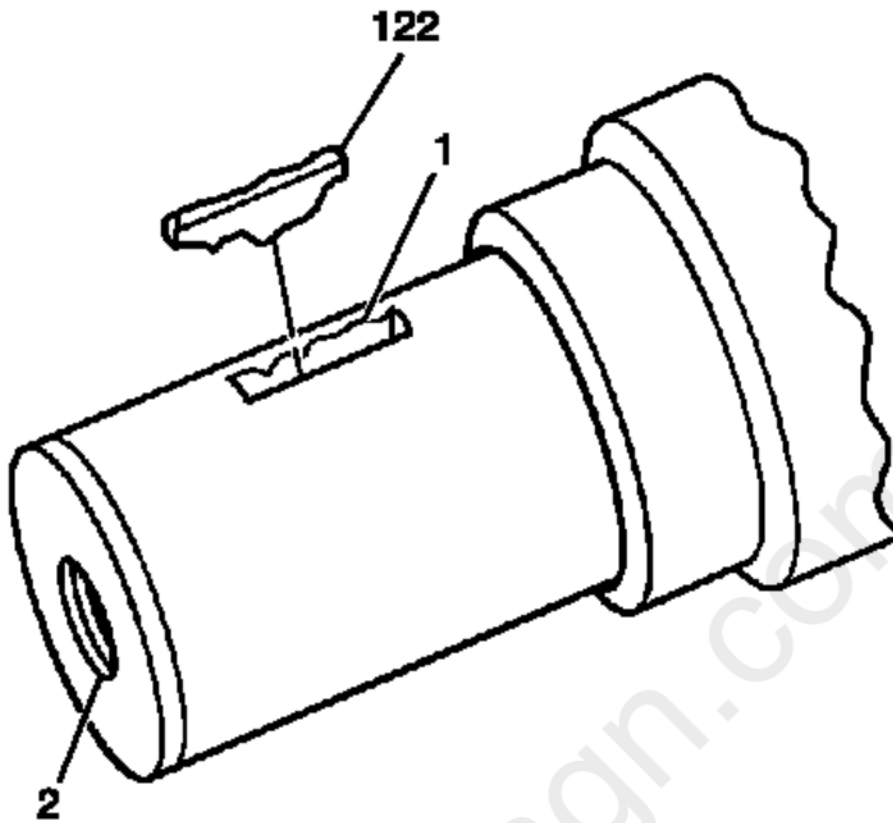


Fig. 107: View Of Crankshaft Key, Keyway & Threaded Hole
Courtesy of GENERAL MOTORS CORP.

9. Inspect the crankshaft key (122), keyway (1), and threaded hole (2) for damage.

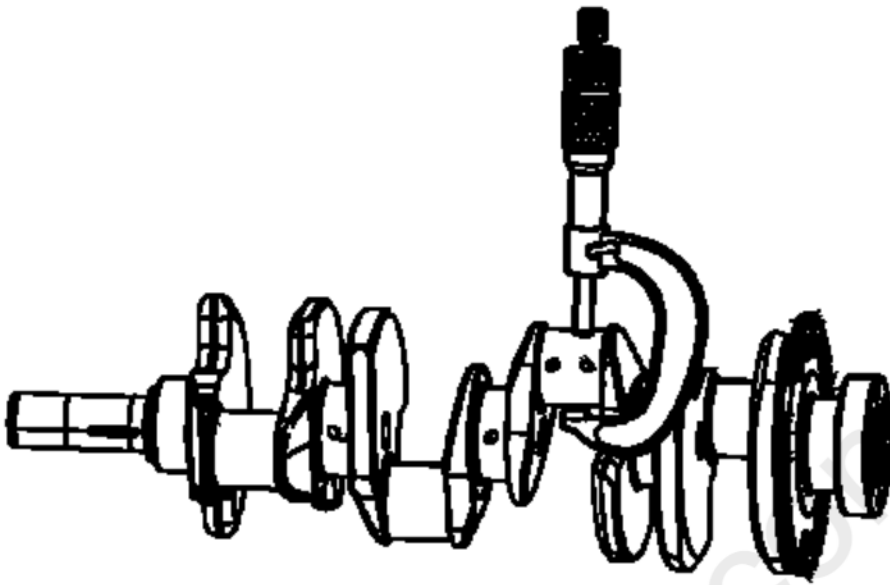


Fig. 108: Measuring Connecting Rod Journals For Out-Of-Round And Taper
Courtesy of GENERAL MOTORS CORP.

10. Measure the main and connecting rod journals for out-of-round and taper. Replace the crankshaft if all journals are not within specification for diameter, out-of-round, and taper. Refer to **Engine Mechanical Specifications** .

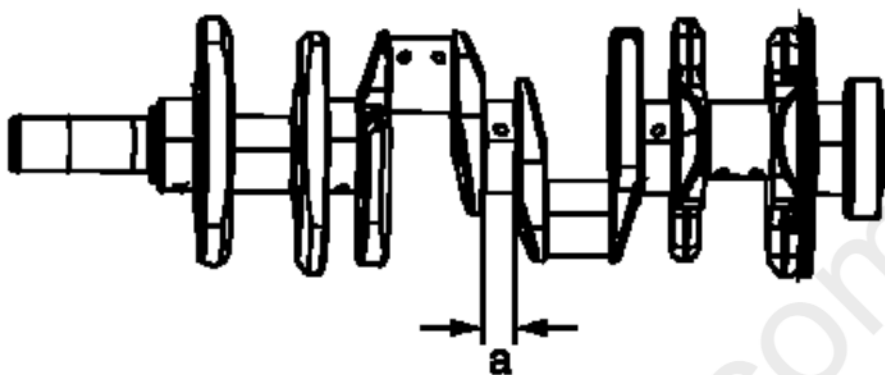


Fig. 109: Measuring Crankshaft Thrust Wall Width
Courtesy of GENERAL MOTORS CORP.

11. Measure the crankshaft thrust wall width.

A crankshaft with a thrust wall width in excess of 26.22 mm (1.0322 in) (a) must be replaced.

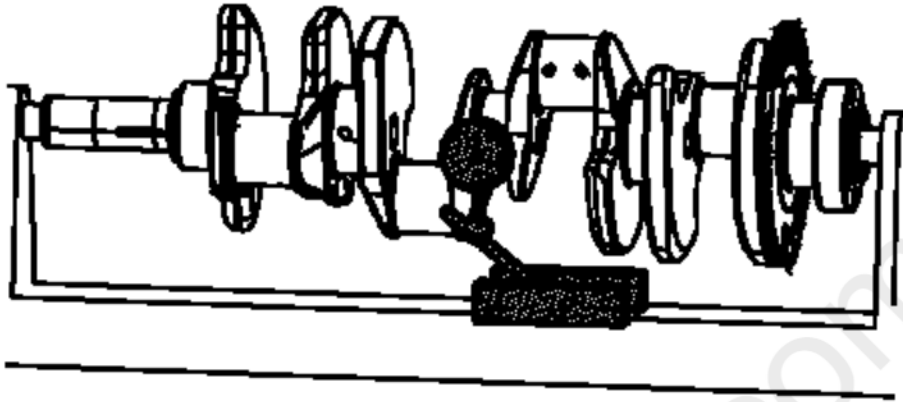


Fig. 110: Measuring Crankshaft Runout
Courtesy of GENERAL MOTORS CORP.

12. Measure the crankshaft runout. Refer to **Engine Mechanical Specifications** .

Use wooden V-blocks or a fixture to support the crankshaft on the front and rear journals.

13. Use the **J 7872**: dial indicator in order to measure the crankshaft runout at the number 3 main journal and the adjacent front and rear intermediate journals.
14. Use the **J 7872**: dial indicator in order to measure the runout of the crankshaft rear flange.
15. Use the **J 7872**: dial indicator in order to measure the runout of the crankshaft position reluctor ring. Reluctor ring runout should be measured 1.0 mm (0.04 in) below the ring teeth.

If the reluctor ring has runout in excess of 0.7 mm (0.028 in), replace the crankshaft.

If runout is not within specification for main journals or rear flange, replace the crankshaft.

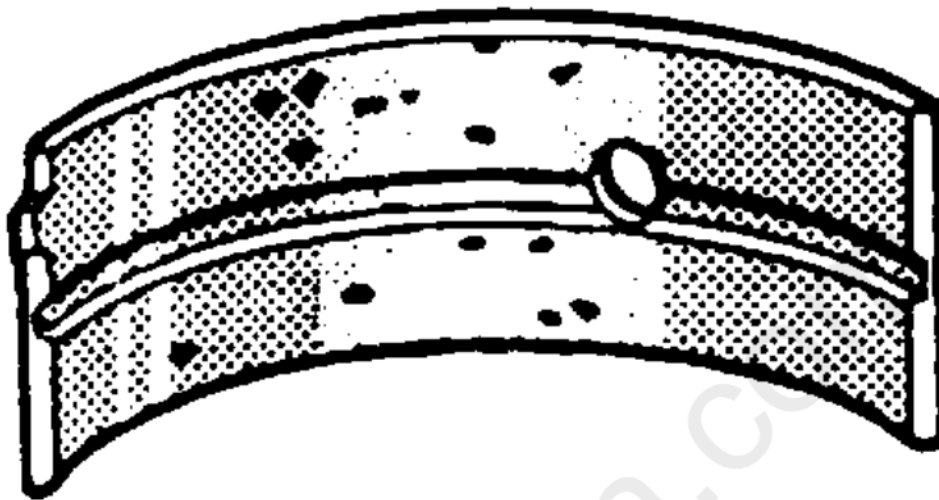


Fig. 111: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

16. Inspect crankshaft bearings for craters or pockets. Flattened sections on the bearing halves also indicate fatigue.

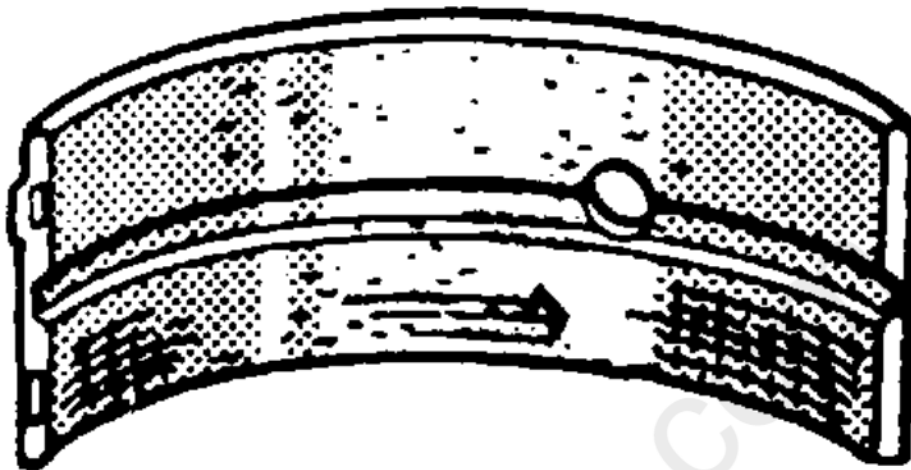


Fig. 112: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

17. Inspect the crankshaft bearings for excessive scoring or discoloration.
18. Inspect the crankshaft bearings for dirt or debris imbedded into the bearing material.

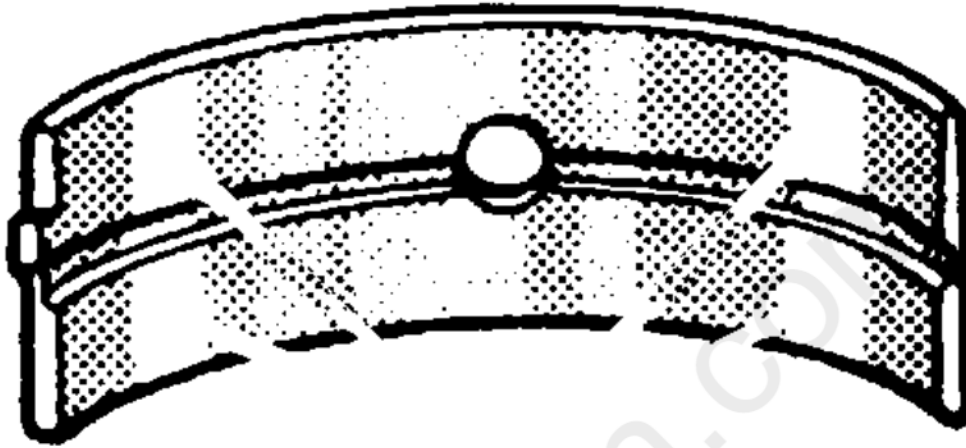


Fig. 113: View Of Improper Seating
Courtesy of GENERAL MOTORS CORP.

19. Inspect the crankshaft bearings for improper seating, indicated by bright, polished sections of the bearing.

If the lower half of the bearing is worn or damaged, both upper and lower halves should be replaced.

Generally, if the lower half is suitable for use, the upper half should also be suitable for use.

MEASURING MAIN BEARING CLEARANCE - GAGING PLASTIC METHOD

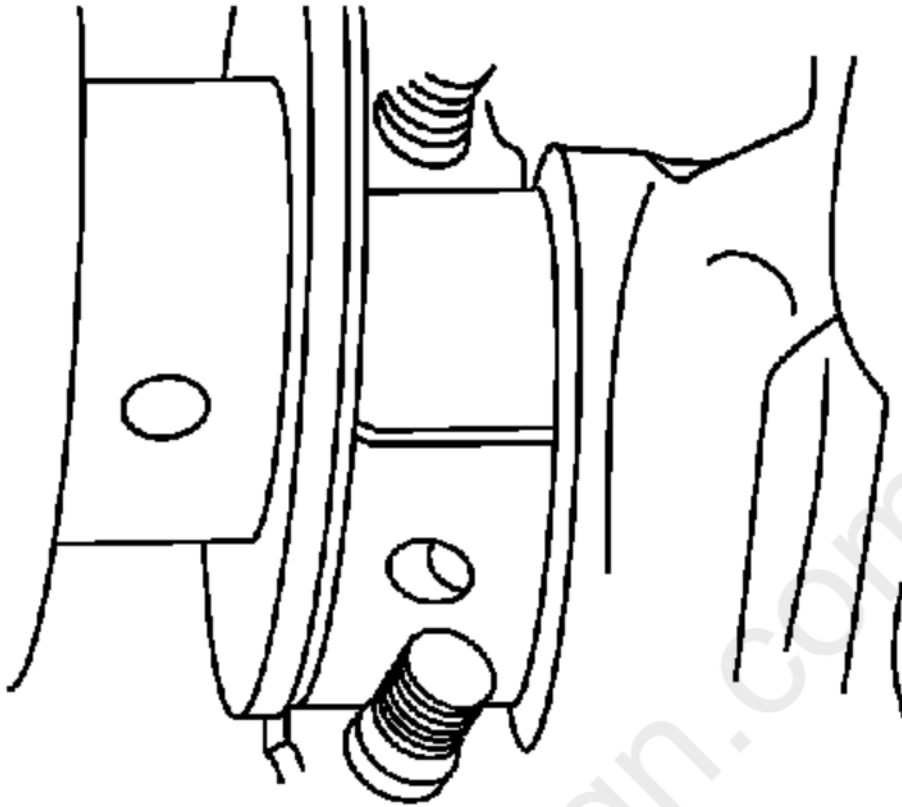


Fig. 114: View Of Gaging Plastic Installed On Crankshaft Journal
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The crankshaft main bearings are a precision insert type. Main bearing caps are machined with the engine block, for proper clearance, and cannot be shimmed or filed for bearing fit. If the clearances are found to be excessive, new bearings and/or engine block and cap repair or replacement may be required.
- Do not rotate the crankshaft while gaging plastic is between the crankshaft journal and the bearing surface.
- The crankshaft bearing clearances are critical. Excessive bearing clearance may affect crankshaft position sensor signals and may affect on-board diagnostics (OBD) II system operation.
- Remove the bearing cap side bolts prior to cap removal.

1. Remove the bearing caps, bearing half, and bolts. Refer to **Crankshaft and Bearing Removal**.
2. Install gaging plastic onto the crankshaft journal. Install the gaging plastic the full width of the crankshaft bearing journal.
3. Install the bearing caps, bearing half, and bolts. Refer to **Crankshaft and Bearing Installation**.

4. Remove the bearing caps, bearing half, and bolts. Refer to **Crankshaft and Bearing Removal**.

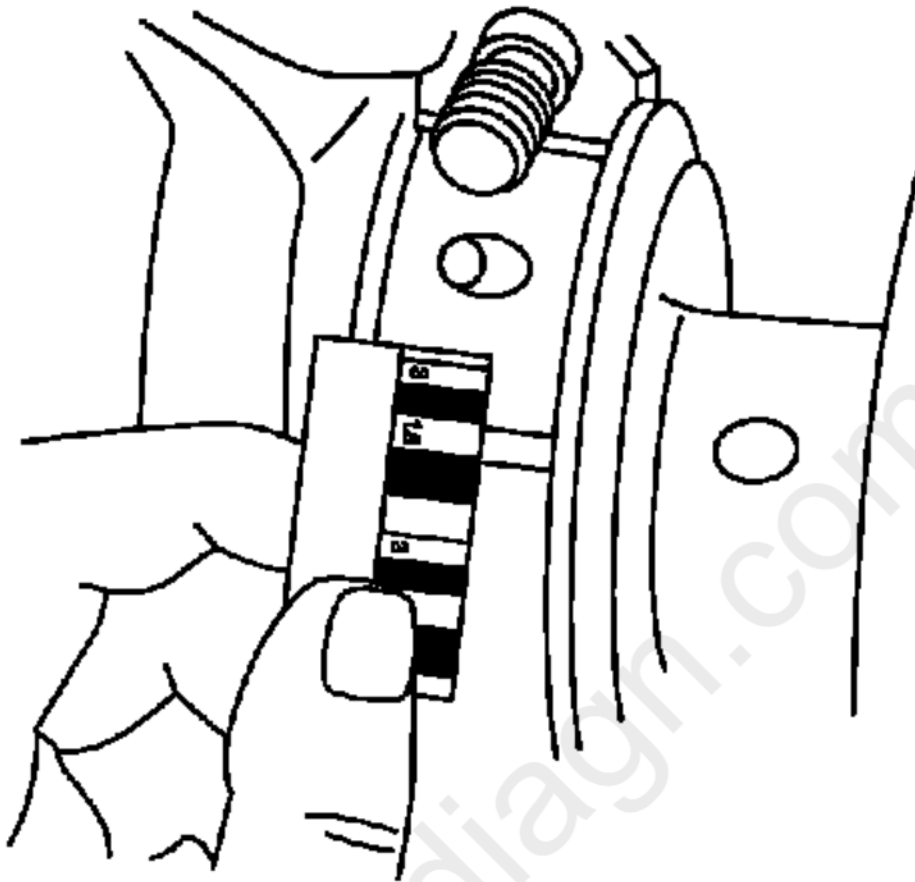


Fig. 115: Measuring Gaging Plastic
Courtesy of GENERAL MOTORS CORP.

5. Using the scale supplied with the plastic gaging kit, measure the gaging plastic at its widest area.
 - If the gaging plastic shows irregularity in the journal, exceeding 0.025 mm (0.001 in), remove the crankshaft and measure the journal with a micrometer.
 - If clearance cannot be brought to specifications, replace the crankshaft or engine block as required. Refer to **Engine Mechanical Specifications**.

MEASURING CONNECTING ROD BEARING CLEARANCE - GAGING PLASTIC METHOD

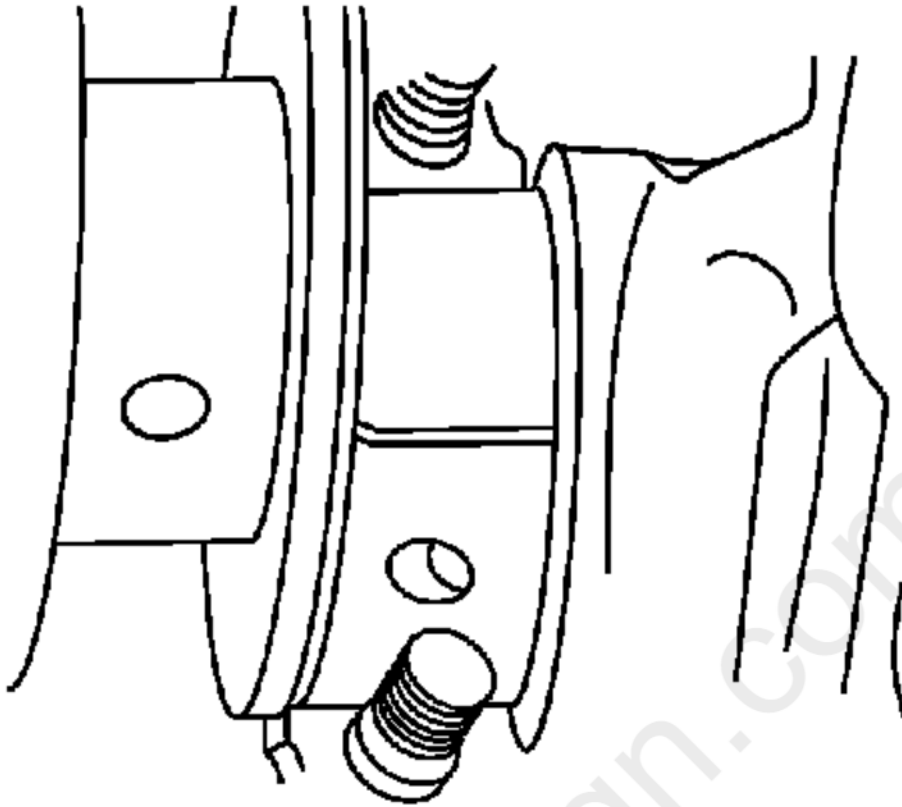


Fig. 116: View Of Gaging Plastic Installed On Crankshaft Journal
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Connecting rod bearings are a precision insert type. Connecting rods are of a powdered metal design and cannot be shimmed or filed for bearing fit. If clearances are found to be excessive, a new bearing and/or connecting rod is required.
- Do not rotate the crankshaft while gaging plastic is between the crankshaft journal and the bearing surface.

1. Remove the bearing cap, bearing half, and bolts. Refer to **Piston, Connecting Rod, and Bearing Removal**.
2. Install the gaging plastic onto the connecting rod bearing journal. Install the gaging plastic the full width of the journal.
3. Install the bearing cap, bearing half, and bolts. Refer to **Piston, Connecting Rod, and Bearing Installation (6.2L)**.
4. Remove the bearing cap, bearing half, and bolts. Refer to **Piston, Connecting Rod, and Bearing Removal**.

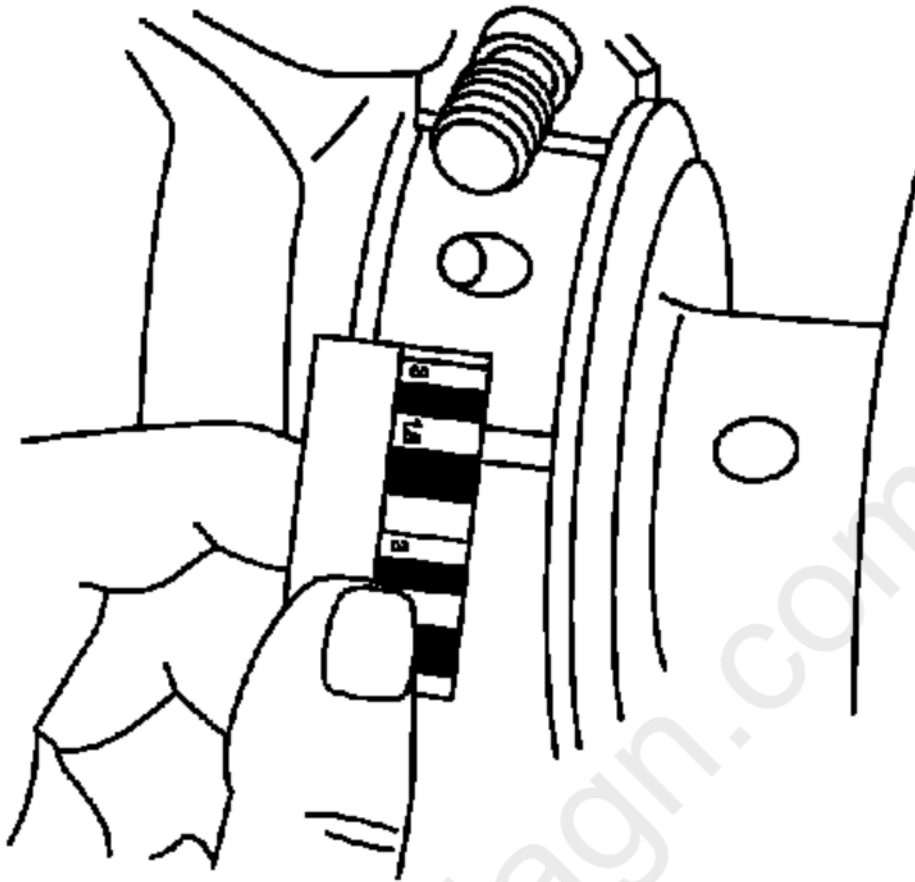


Fig. 117: Measuring Gaging Plastic
Courtesy of GENERAL MOTORS CORP.

5. Using the scale supplied with the plastic gaging kit, measure the gaging plastic at its widest area. Refer to **Engine Mechanical Specifications** .

MEASURING CONNECTING ROD BEARING CLEARANCE - USING J 43690/J 43690-100

J 43690: checking tool and **J 43690-100:** adapter kit have been developed as a more accurate method to measure connecting rod bearing clearances. The instructions below provide an overview of tool set-up and usage. For more detailed information, refer to the tool instruction sheets supplied by the tool manufacturer.

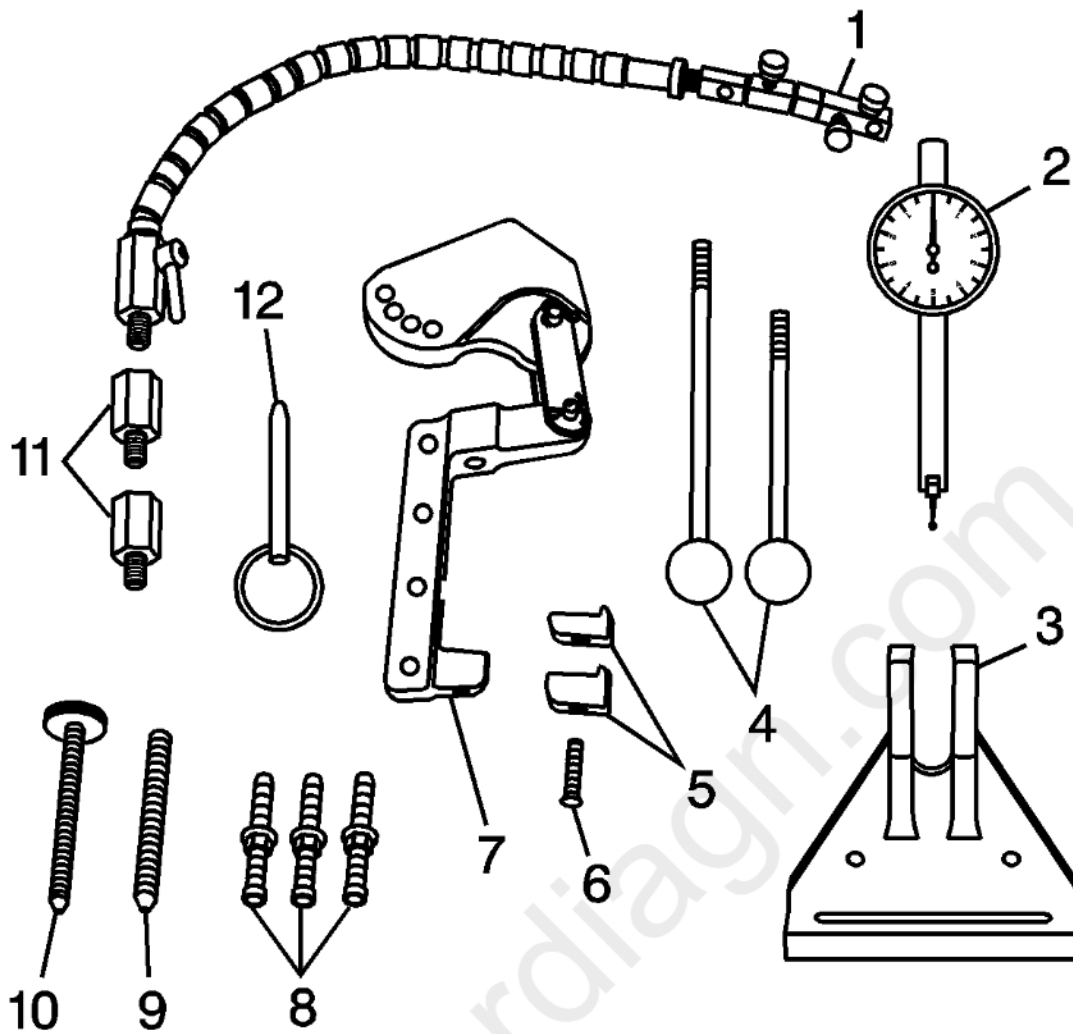


Fig. 118: Identifying Rod Bearing Clearance Checking Tool
Courtesy of GENERAL MOTORS CORP.

J 43690 Rod Bearing Checking Tool

- J 43690-20 Swivel Base (1)
- J 43690-19 Dial Indicator (2)
- J 43690-2 Base (3)
- J 43690-5, J 43690-6 Handle (4)
- J 43690-10, J 43690-11 Foot (5)
- 280307 Screw (6)
- J 43690-1 Pivot Arm Assembly (7)
- J 43690-3, J 43690-7, J 43690-8 Screws (8)
- 280319 Screw (9)

- 280311 Screw (10)
- J 43690-17, J 43690-18 Adapter (11)
- 280310 Pin (12)

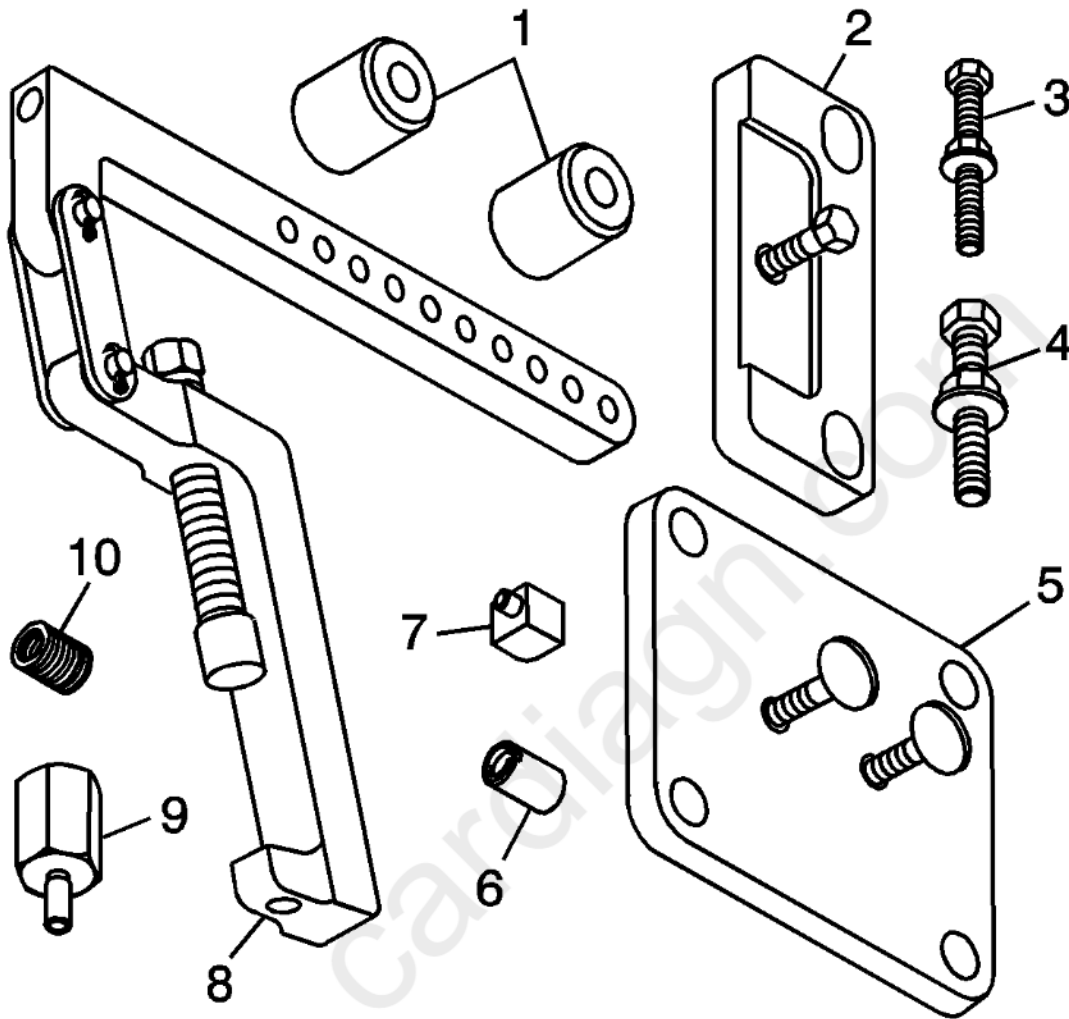


Fig. 119: Identifying Rod Bearing Clearance Tool - Adapter Kit
 Courtesy of GENERAL MOTORS CORP.

J 43690-100 Rod Bearing Checking Tool - Adapter Kit

- J 43690-104 Spacer (1)
- J 43690-105 Retainer Plate (2)
- 505478 Bolt (3)
- 511341 Bolt (4)
- J 43690-106 Retainer Plate (5)
- J 43690-107 Cap (6)

- J 43690-102 Foot (7)
- J 43690-101 Pivot Arm Assembly (8)
- J 43690-103 Adapter (9)
- 505439 Adapter (10)

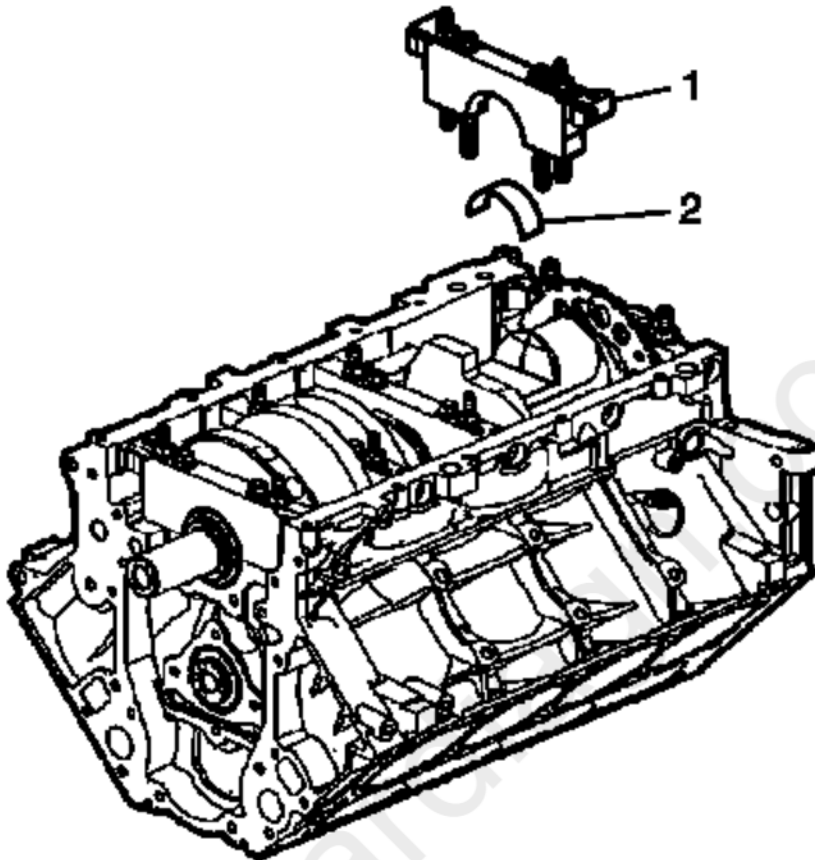


Fig. 120: View Of Bearing Cap, Bolt & Bearing Half
Courtesy of GENERAL MOTORS CORP.

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

1. Rotate the crankshaft until the journal/connecting rod to be measured is in the 12 o'clock position.
2. Remove a bearing cap and bolts (1).
3. Remove the bearing half (2).
4. Insert a piece of paper card stock onto the crankshaft journal.
5. Install the bearing half (2) and cap and bolts (1). Refer to **Fastener Tightening Specifications** .

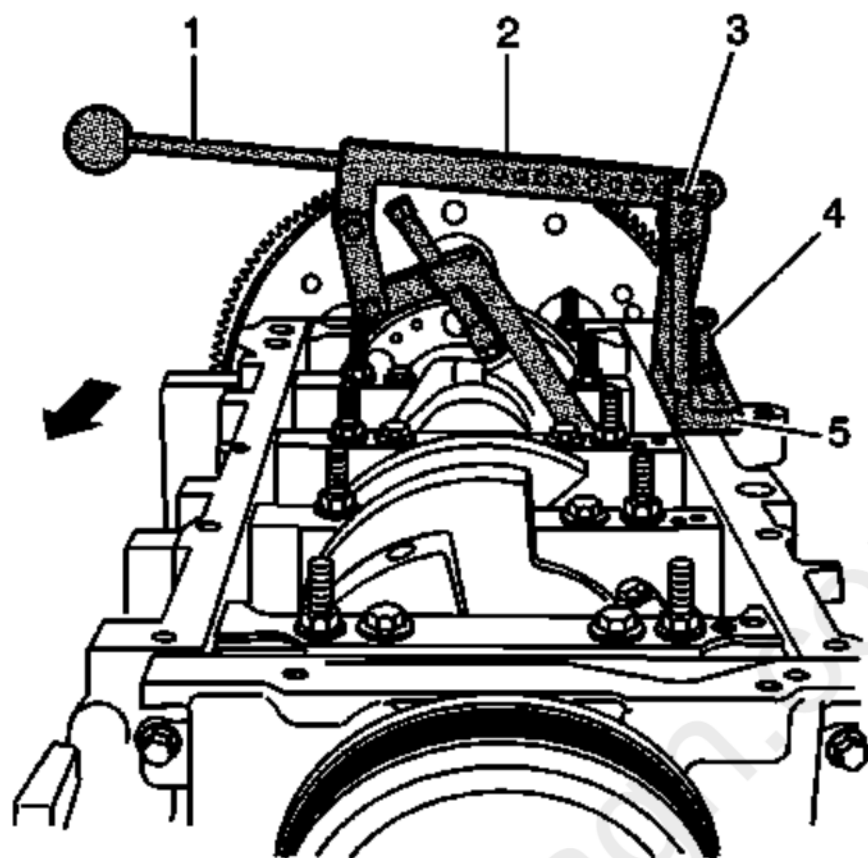


Fig. 121: View Of Special Tool Installed On Engine Block
Courtesy of GENERAL MOTORS CORP.

6. Install the following:

1. J 43690-2 (5)
2. J 43690-3 (4)
3. J 43690-101 (2)
4. 280310 (3)
5. J 43690-5 (1)

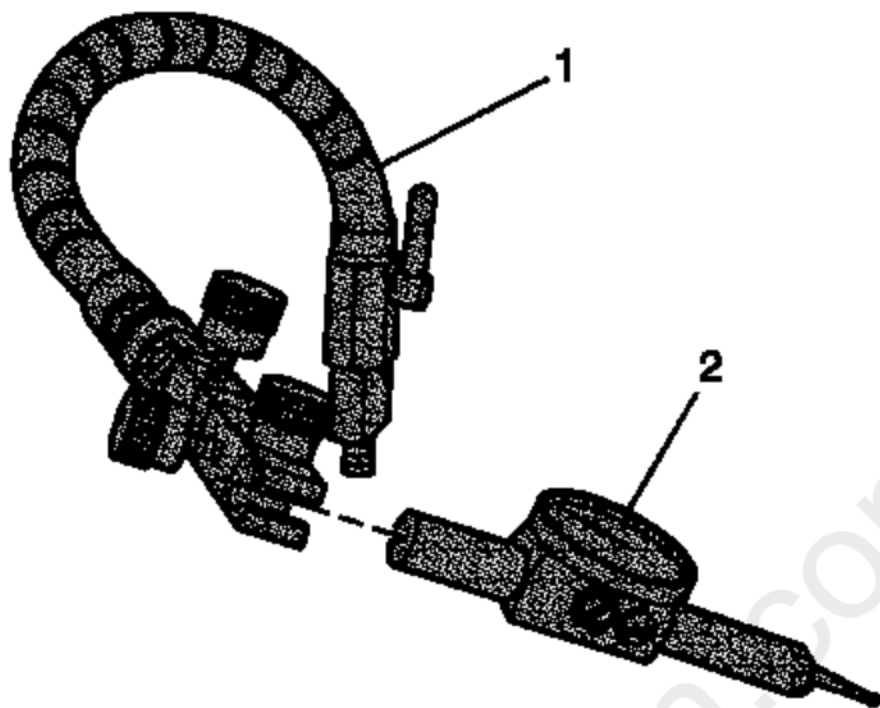


Fig. 122: View Of Swivel Base & Dial Indicator
Courtesy of GENERAL MOTORS CORP.

7. Install the swivel base (1) and dial indicator (2).
8. Adjust per the manufacturers instructions and measure the connecting rod bearing clearance.

The connecting rod side clearance must be within specification. Refer to **Engine Mechanical Specifications** . Service components, as required.

CRANKSHAFT BALANCER CLEANING AND INSPECTION

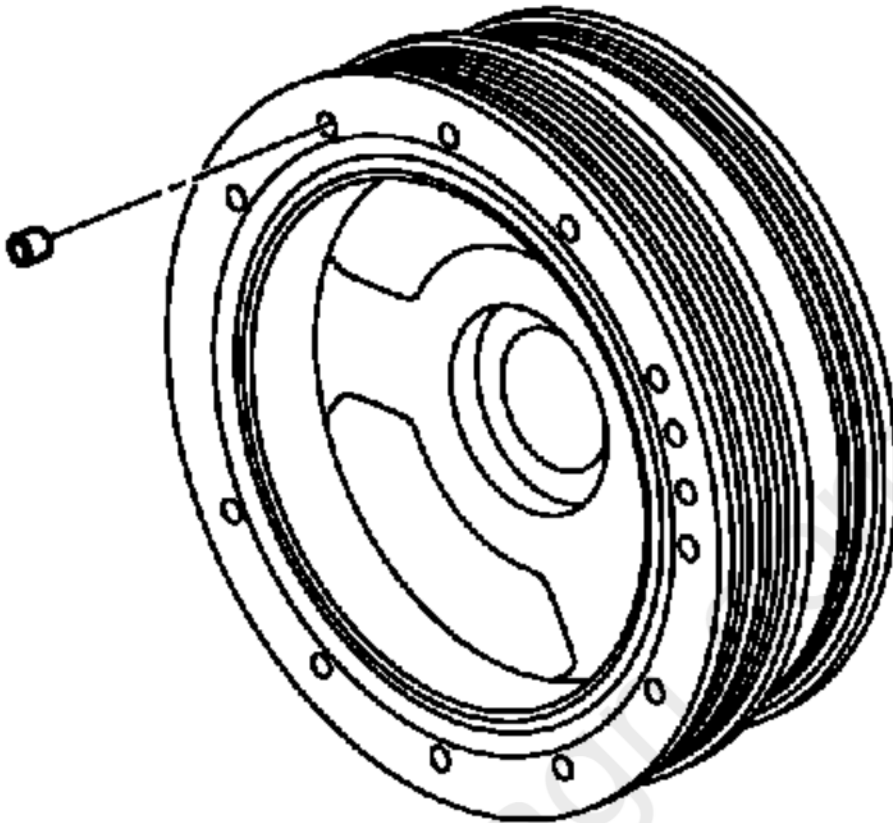


Fig. 123: View Of Balancer Weights In Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

1. Clean the crankshaft balancer in solvent.
2. Using a wire brush, clean the belt grooves of all dirt and debris.
3. Dry the crankshaft balancer with compressed air.
4. Inspect the crankshaft balancer for the following conditions:
 - Loose or improperly installed balance weights - manual transmission applications.

A properly installed balance weight should be installed flush or below flush with the face of the balancer.

- Worn, grooved, or damaged hub seal surface

A crankshaft balancer hub seal surface with excessive scoring, grooves, rust or other damage must be replaced.

Minor imperfections on the hub seal surface may be removed with polishing compound or fine grade emery cloth.

NOTE: In order for the belt to track properly, the belt grooves should be free of all dirt and debris.

- Dirty or damaged belt grooves

The balancer belt grooves should be free of any nicks, gouges, or other damage that may not allow the belt to track properly.

Minor imperfections may be removed with a fine file.

- Worn, chunking or deteriorated rubber between the hub and pulley

REPLACING THE CRANKSHAFT BALANCER AND BALANCE WEIGHTS

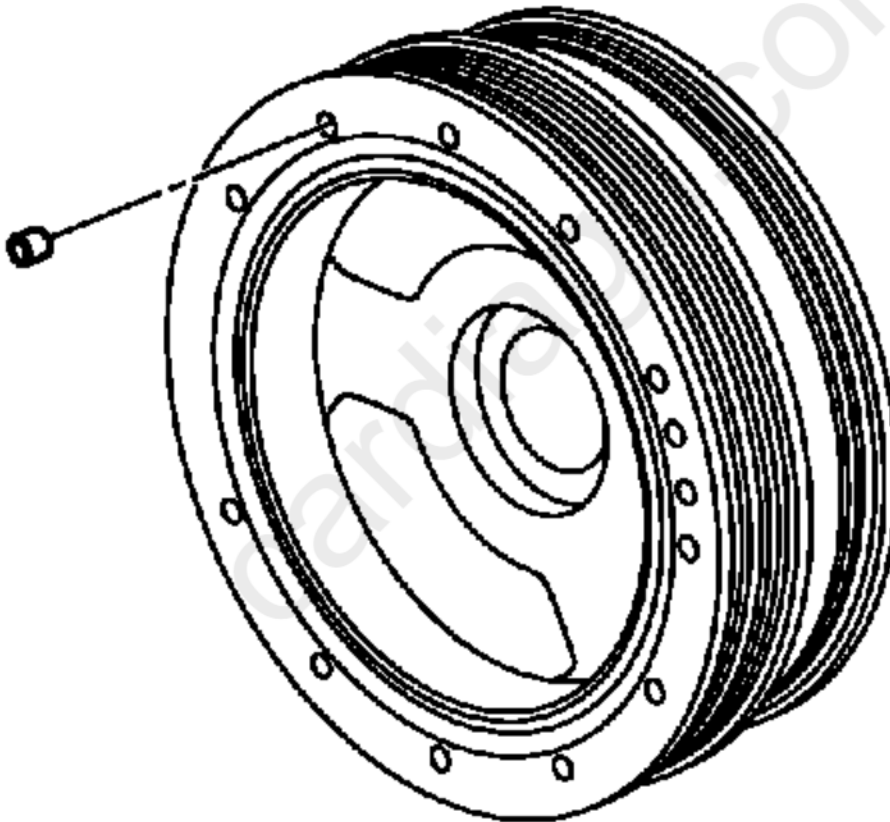


Fig. 124: View Of Balancer Weights In Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

NOTE: If replacing the crankshaft balancer on manual transmission applications, note the location of any existing balance weights, if applicable. Crankshaft balancer weights must be installed into the new balancer in the same

location as the old balancer. A properly installed balance weight is flush or below flush with the face of the balancer.

1. Inspect the crankshaft balancer weight holes for any existing balance weights.

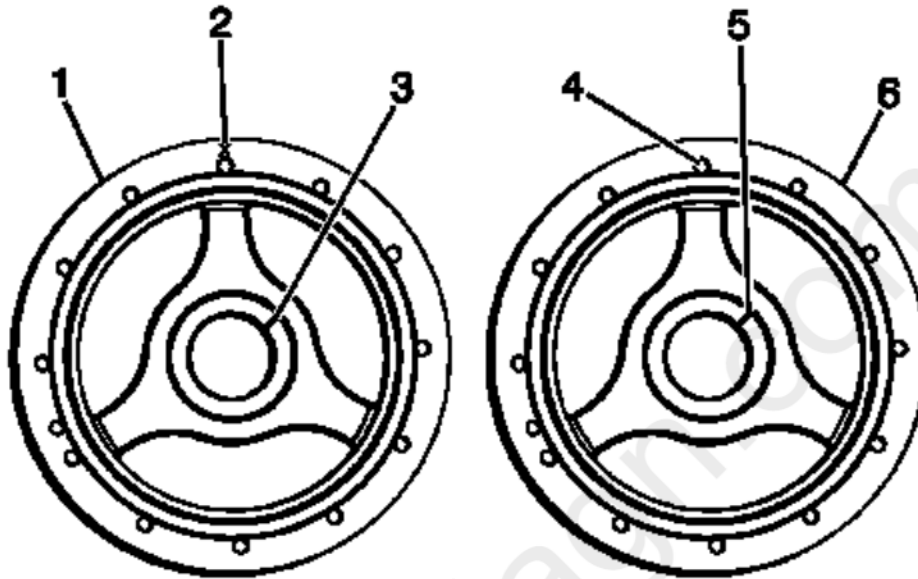


Fig. 125: View Of Balancer And Weights
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to **SAFETY GLASSES WARNING** .

2. Using a punch, position the balance weights in the old balancer (1) to the bottom of the weight holes.
3. With a marking crayon, note the weight holes (2) containing balance weights, if applicable.
4. Lay the old crankshaft balancer (1) on a bench or flat table.

Rotate the old balancer until 1 of the marked balance weight holes (2) is in the 12 o'clock position.

5. Lay the new crankshaft balancer (6) on the bench next to the old balancer.

Rotate the new balancer until 1 of the balance weight holes (4) is in the 12 o'clock position.

6. With a marking crayon, mark the new balancer weight hole (4) located in the 12 o'clock position.
7. Viewing the old balancer, note the position of the crankshaft-to-balancer alignment mark (3).
8. Mark the new balancer in the same location (5).
9. Measure the distance from the top of the balance weights to the face of the old crankshaft balancer.
10. Record the readings.
11. Determine the proper balance weight size for the new balancer. Balance weights are available in 3 different sizes.
 - A balance weight hole depth that measures 13.0 mm (0.512 in), has a short balance weight in the hole. A short balance weight measures 12.7 mm (0.5 in) in length.
 - A balance weight hole depth that measures 6.69 mm (0.263 in), has a medium balance weight in the hole. A medium balance weight measures 19.0 mm (0.75 in) in length.
 - A balance weight hole depth that measures 0.29 mm (0.011 in), has a long balance weight in the hole. A long balance weight measures 25.4 mm (1.0 in) in length.
12. Insert new crankshaft balance weights of the proper size into the new balancer in the same location as the old balancer.

A properly installed balance weight is flush or below flush with the face of the balancer.

ENGINE FLYWHEEL CLEANING AND INSPECTION

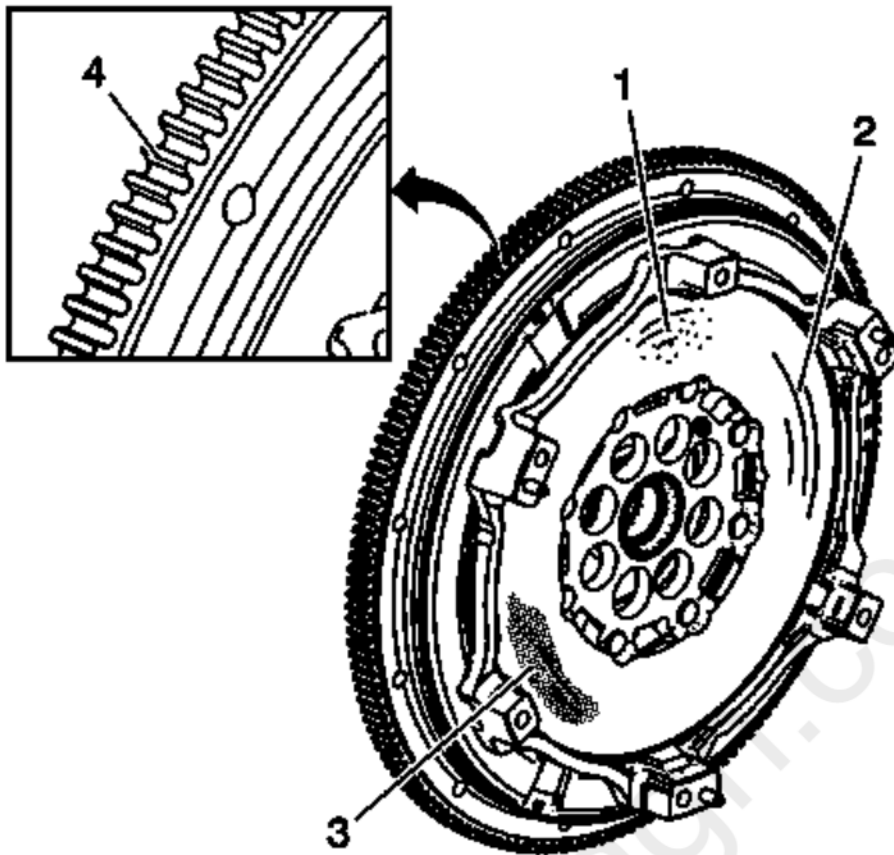


Fig. 126: Identifying Flywheel Surfaces
Courtesy of GENERAL MOTORS CORP.

NOTE: In order to maintain the proper component balance, contact surface taper, and heat transfer, manual transmission flywheels are **NOT** to be machined.

Inspect the dual-mass manual transmission flywheel for the following conditions:

- Pitted surface (1)
- Grooved or scored surface (2)
- Rusted surface (3)
- Damaged ring gear teeth (4)
- Loose or improperly positioned ring gear

The ring gear has an interference fit onto the flywheel and should be positioned completely against the flange of the flywheel.

- Missing, bent or damaged pressure plate locating pins
- The flywheel friction disc contact surface is tapered for improved disc contact. If using a straight edge to determine surface wear, the technician may note less material or a taper to the inner or ID area. This

condition is considered normal and not a determining factor when replacing the flywheel.

AUTOMATIC TRANSMISSION FLEX PLATE CLEANING AND INSPECTION

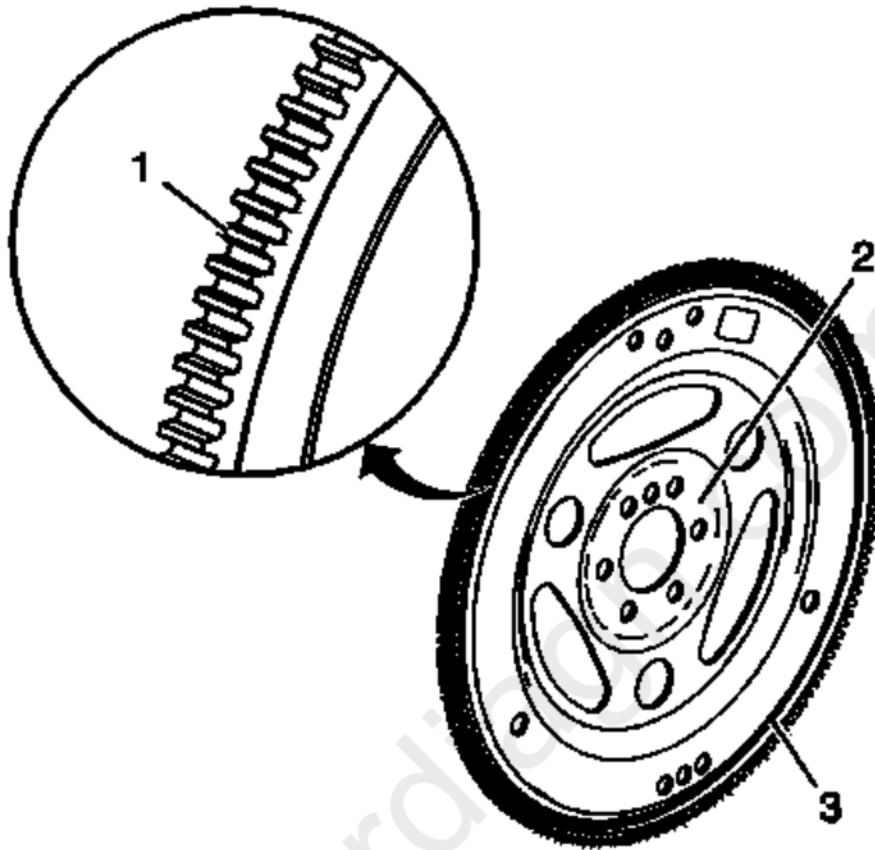


Fig. 127: View Of Ring Gear Teeth
Courtesy of GENERAL MOTORS CORP.

1. Clean the flex plate in solvent.

WARNING: Refer to SAFETY GLASSES AND COMPRESSED AIR WARNING .

2. Dry the flex plate with compressed air.
3. Inspect the flex plate for the following conditions:
 - Damaged ring gear teeth (1)
 - Stress cracks around the flex plate-to-crankshaft bolt hole locations (2)

NOTE: Do not attempt to repair the welded areas that retain the ring gear to the flex plate. Install a new flex plate.

- Welded areas (3) that retain the ring gear onto the flex plate for cracking

PISTON AND CONNECTING ROD DISASSEMBLE

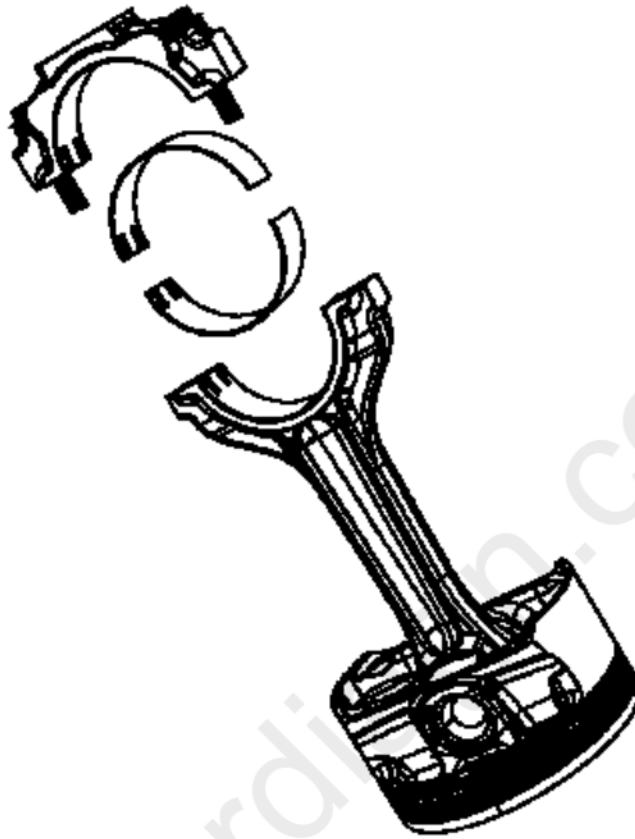


Fig. 128: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the connecting rod bearings from the rod and cap.

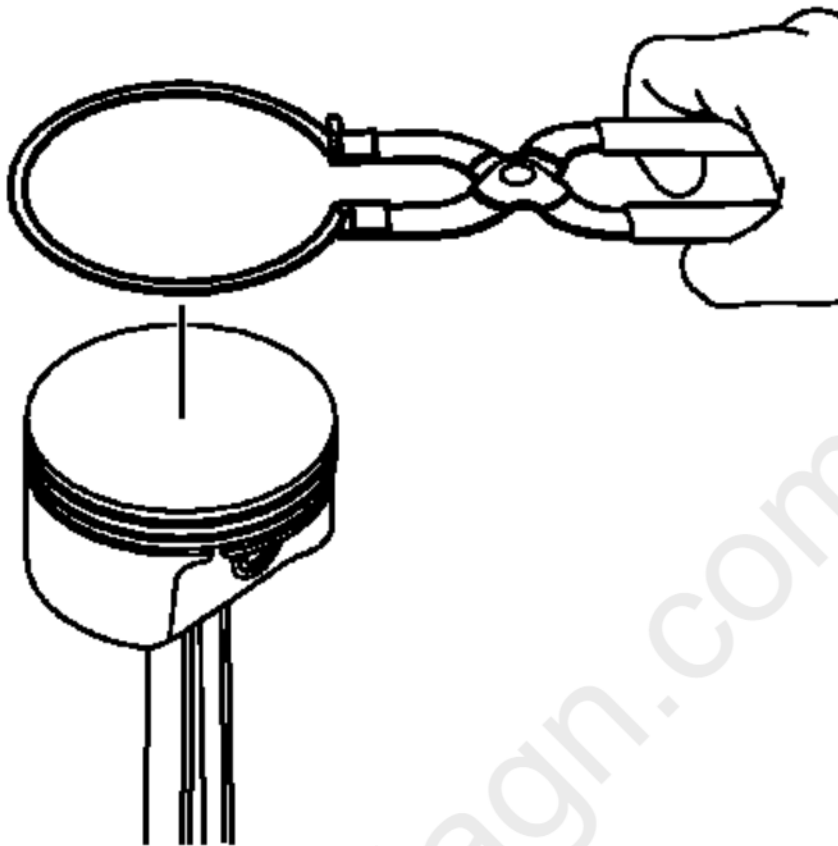


Fig. 129: View Of Piston Rings

Courtesy of GENERAL MOTORS CORP.

2. Using piston ring pliers, remove the piston rings from the piston.

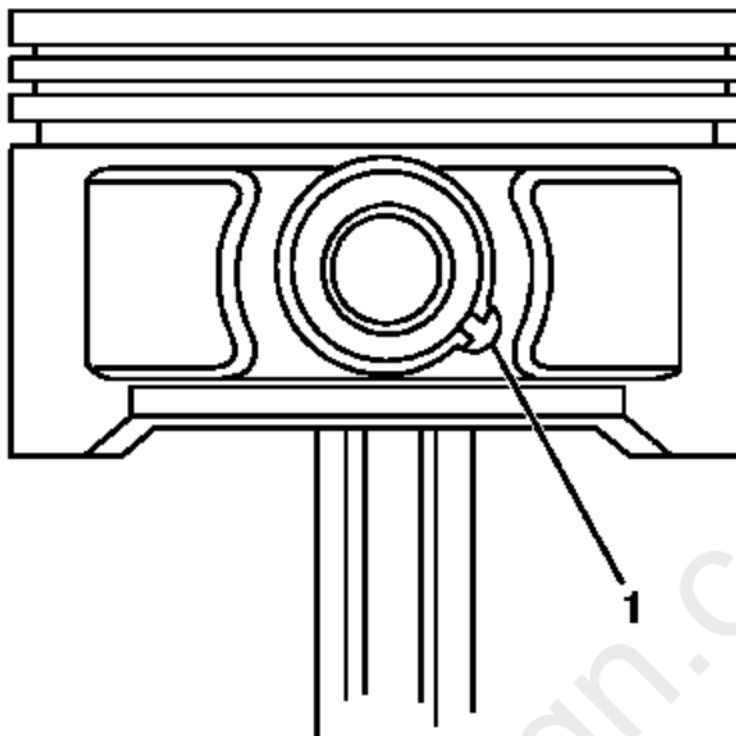


Fig. 130: View Of Piston Pin Retaining Clip & Cutout Area Of Pin Bore
Courtesy of GENERAL MOTORS CORP.

3. Rotate the piston pin retainers until the ring end gaps are positioned in the cutout area (1) of the pin bore.

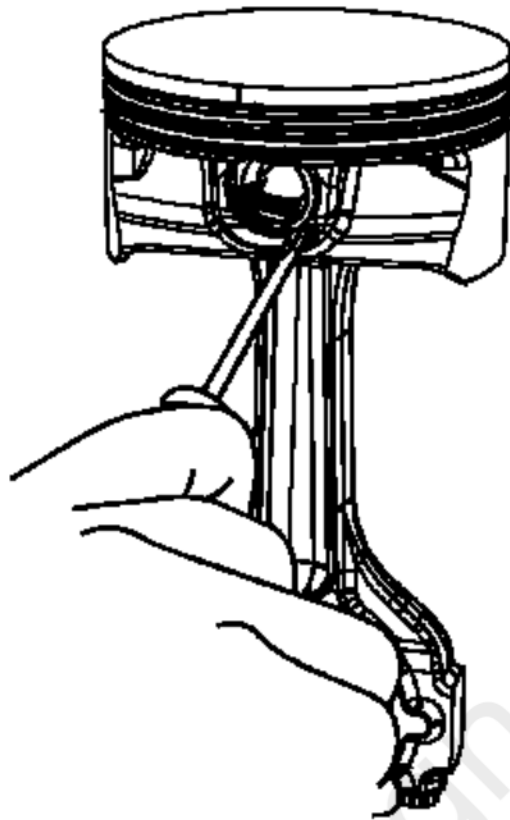


Fig. 131: Piston Pin Retainer
Courtesy of GENERAL MOTORS CORP.

4. Remove the retainers starting in the cutout area of the pin bore.

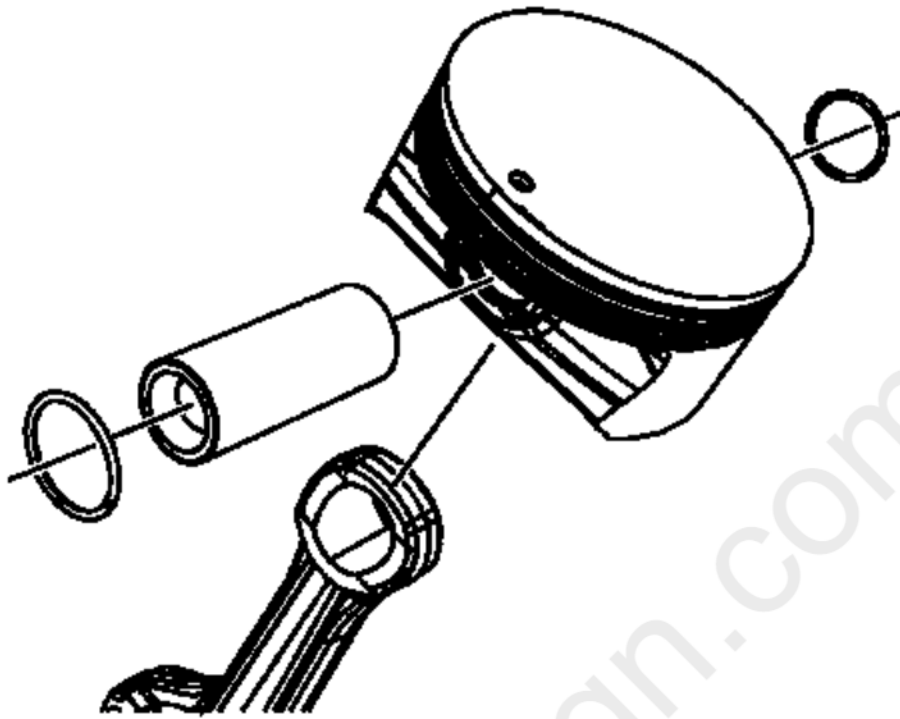


Fig. 132: Piston Pin, Piston & Connecting Rod
Courtesy of GENERAL MOTORS CORP.

5. Remove the pin from the piston and connecting rod.
6. Mark, sort, or organize the piston and the matching piston pin.

PISTON, CONNECTING ROD, AND BEARING CLEANING AND INSPECTION (6.2L)

PISTON, PIN, AND PISTON RINGS

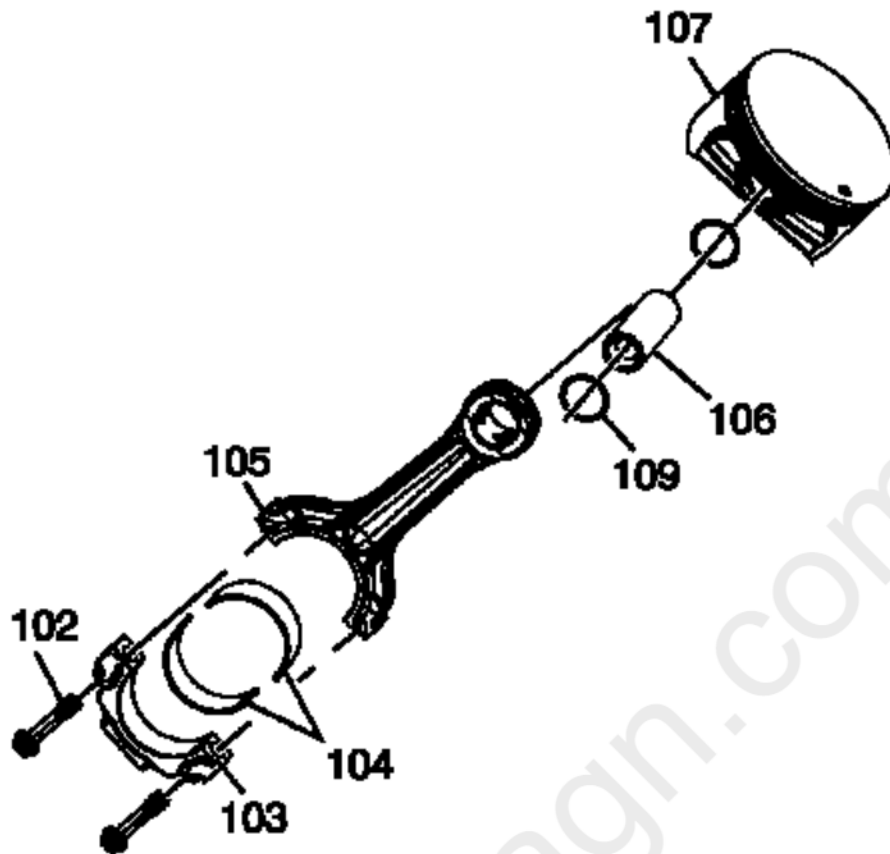


Fig. 133: View Of Piston, Pin & Piston Rings
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Replace pistons, pins, and connecting rods that are damaged or show signs of excessive wear.
- The piston and pin are to be serviced as an assembly.
- Do not wire brush any part of the piston.
- Measurement of the components should be taken with the components at normal room temperature.

1. Clean the varnish and carbon from the piston (107) using cleaning solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

2. Dry the components with compressed air.

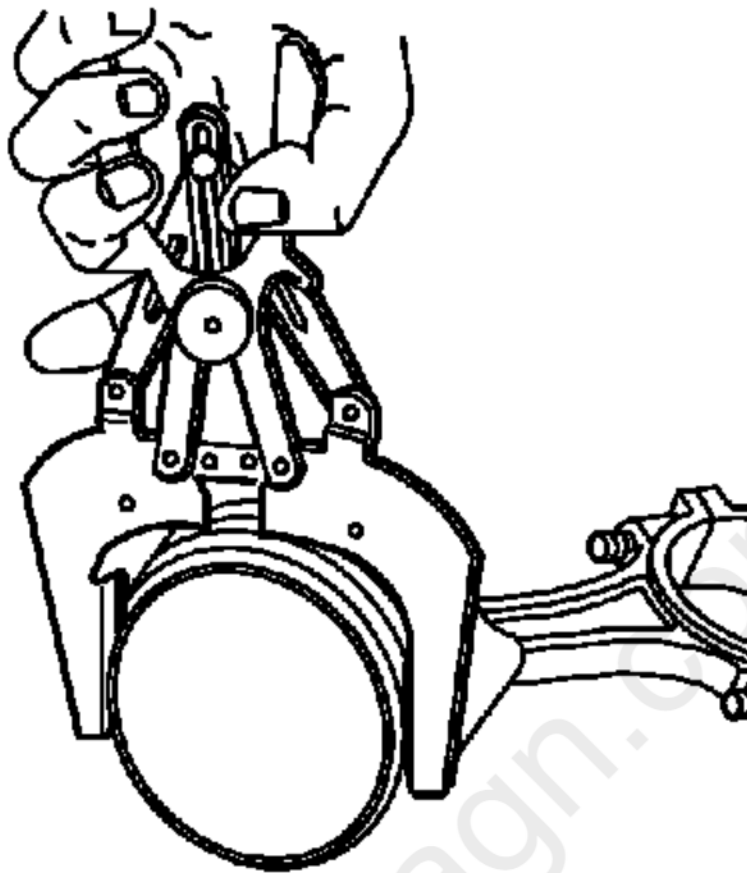


Fig. 134: Cleaning Piston Ring Grooves
Courtesy of GENERAL MOTORS CORP.

3. Clean the piston ring grooves with a suitable ring groove cleaning tool.
4. Clean the oil lubrication holes and slots.

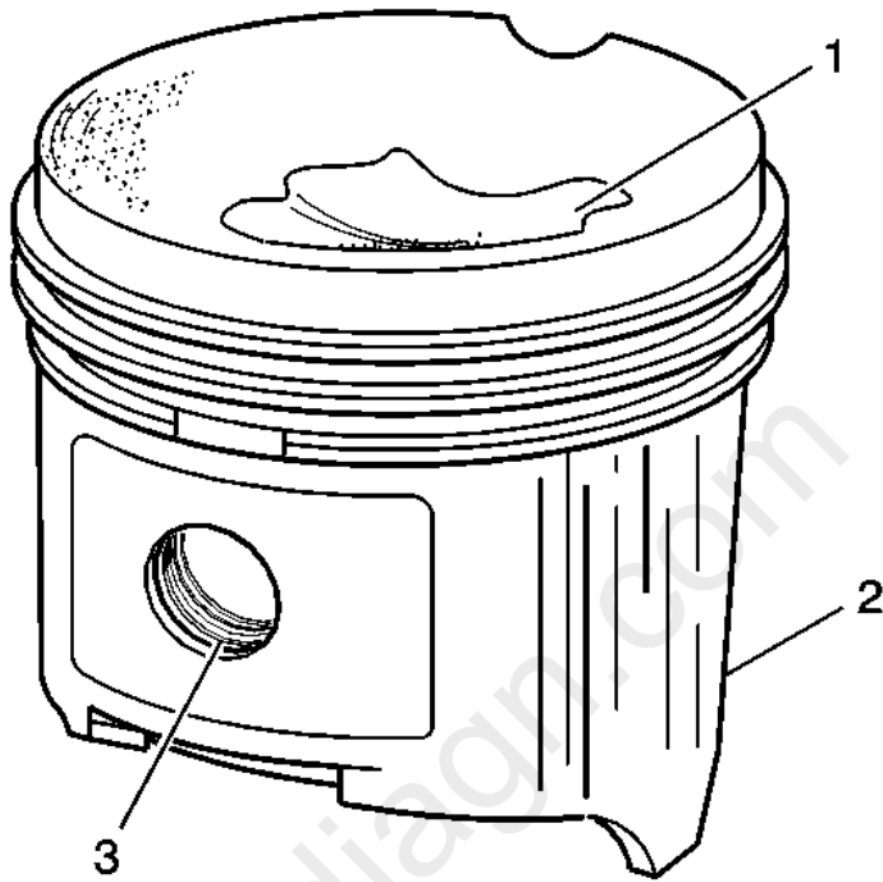


Fig. 135: Identifying Piston Damage Inspection Areas
Courtesy of GENERAL MOTORS CORP.

5. Inspect the piston for the following conditions:

- Cracks in the piston ring lands, the piston skirt, or pin bosses
- Piston ring grooves for nicks, burrs, or warpage which may cause the piston ring to bind

MINOR imperfections may be removed from the piston with a fine file.

- Eroded areas at the top of the piston (1)
- Scuffed or damaged skirts (2)
- Scoring to the piston pin bore (3) or piston pin

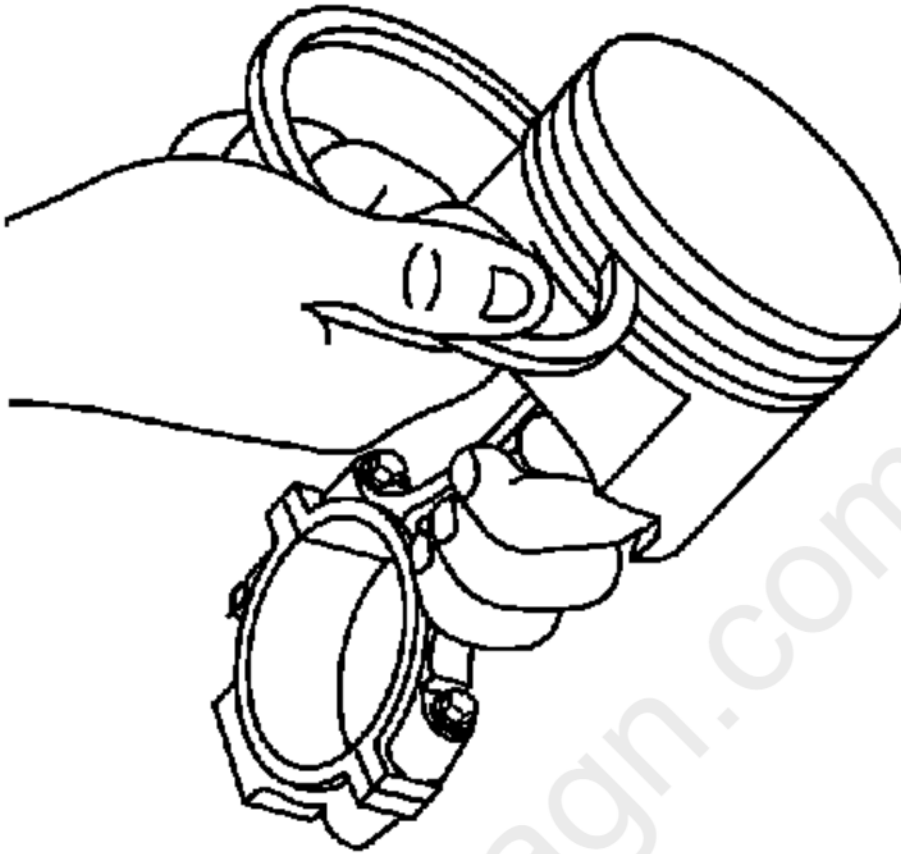


Fig. 136: Inserting Piston Ring Into Ring Groove
Courtesy of GENERAL MOTORS CORP.

6. Insert the edge of the piston ring into the piston ring groove.

Roll the piston ring completely around the piston. If binding is caused by a distorted ring groove, MINOR imperfections may be removed with a fine file. If binding is caused by a distorted piston ring, replace the rings, as required.

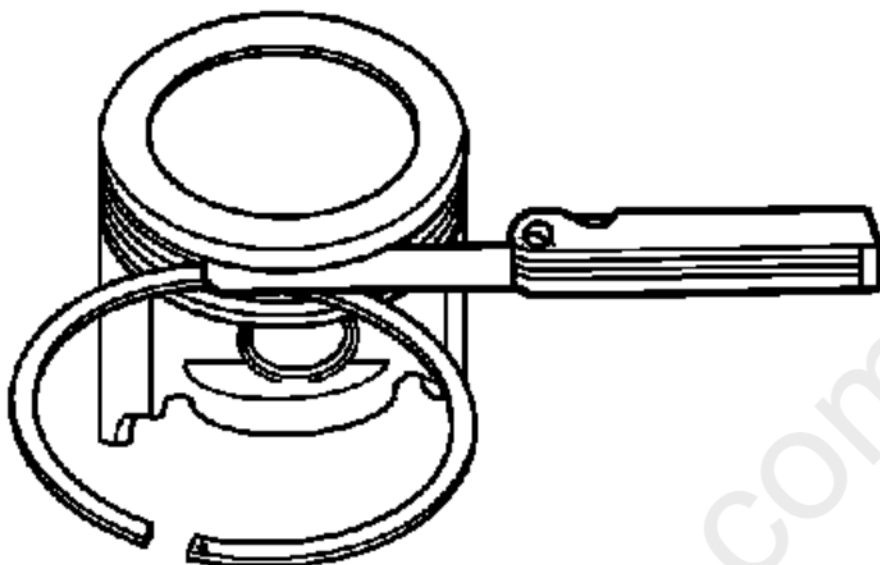


Fig. 137: Measuring Piston Ring Side Clearance
Courtesy of GENERAL MOTORS CORP.

7. Measure the piston ring side clearance with a feeler gauge. If side clearance is not within specifications, try another piston ring. If the proper ring-to-groove clearance cannot be obtained, replace the piston and pin as an assembly. Refer to **Engine Mechanical Specifications** .

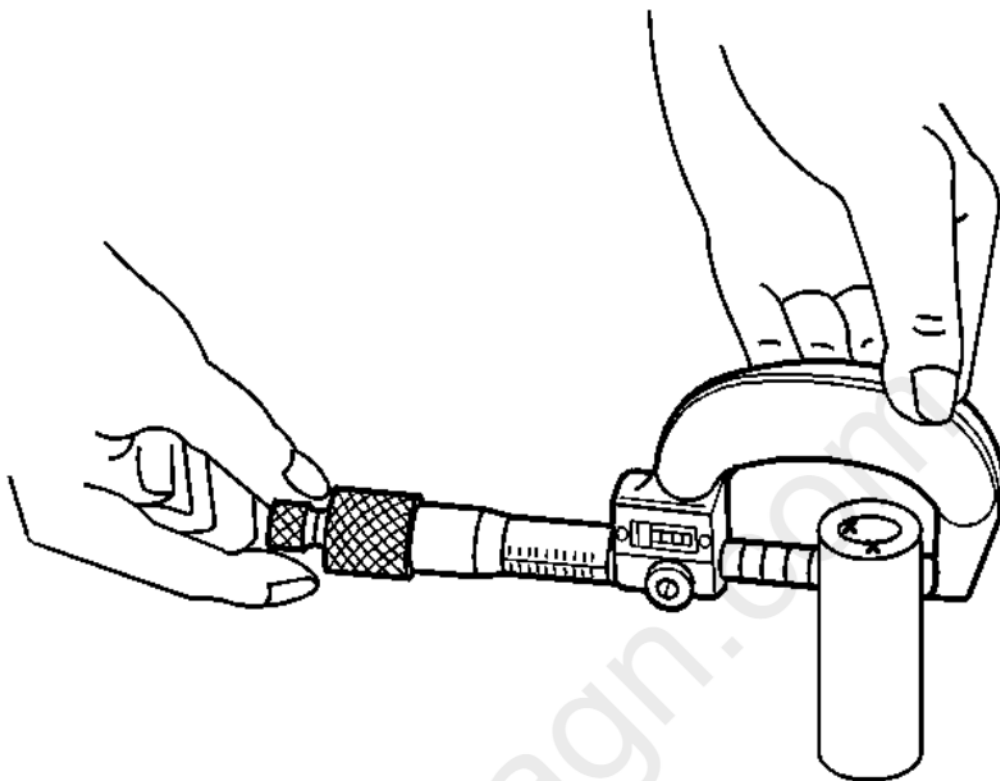


Fig. 138: Measuring Piston Pin Diameter
Courtesy of GENERAL MOTORS CORP.

8. To determine piston pin-to-bore clearance, use a micrometer and measure the piston pin outside diameter (OD).

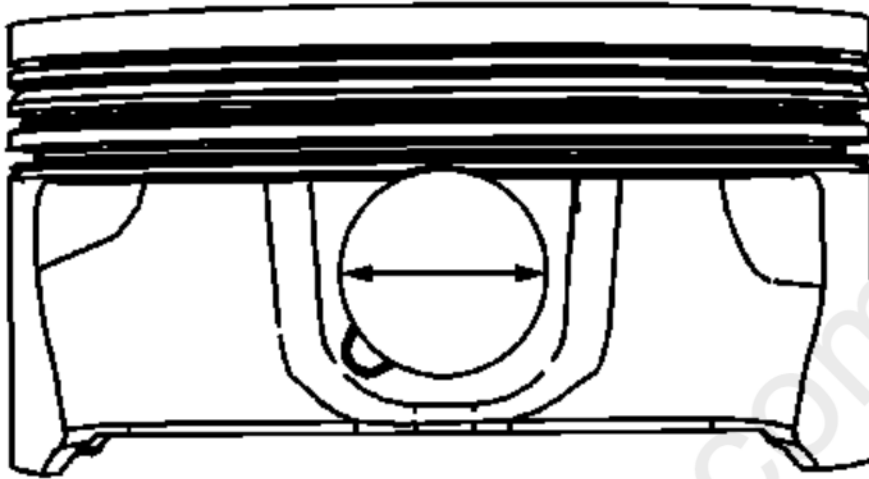


Fig. 139: Measuring Piston Pin-To-Bore Clearance
Courtesy of GENERAL MOTORS CORP.

9. To determine the piston pin-to-bore clearance, use an inside micrometer and measure the piston pin bore inside diameter (ID).
10. Subtract the piston pin OD measurement from the piston pin bore ID measurement to determine pin-to-bore clearance. Refer to **Engine Mechanical Specifications** .

MEASURING PISTON RING END GAP

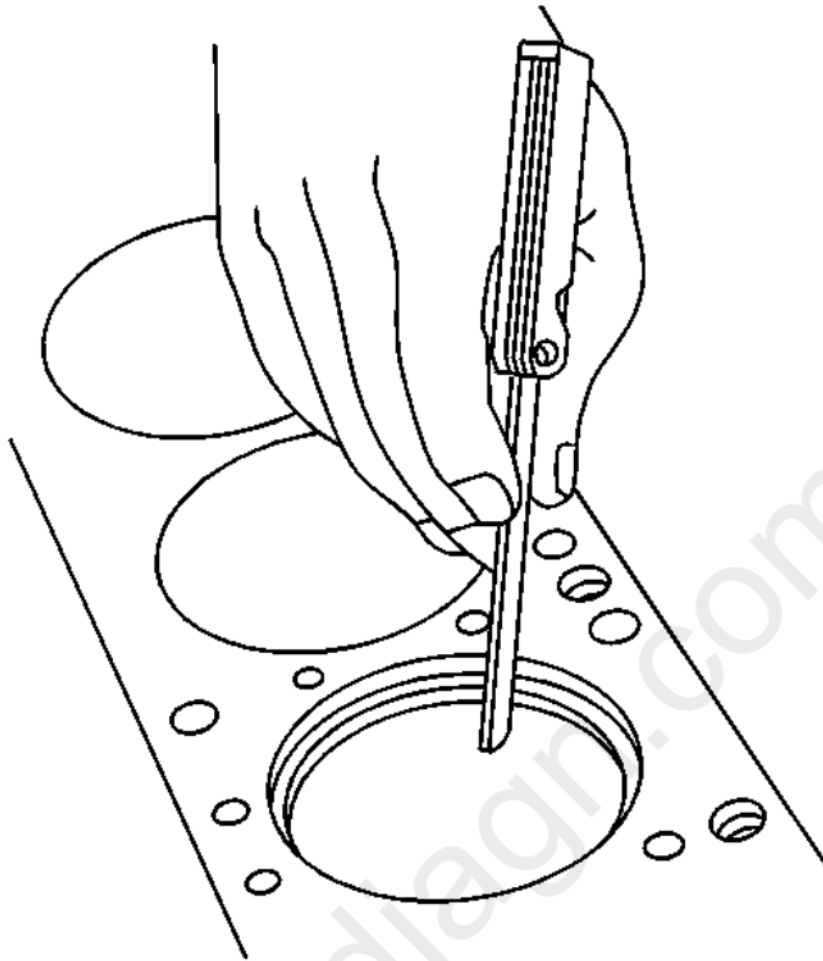


Fig. 140: Measuring Piston Ring End Gap
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not attempt to file the end of the piston ring to achieve the proper end gap clearance.
- Measure the piston ring in the cylinder in which it will be used.

1. Place the piston ring into the cylinder bore 6.5 mm (0.25 in) below the top of the ring travel area. Both rings should be installed with the orientation marks facing the top of the piston.
2. Insert a feeler gauge and measure the piston ring end gap. Refer to **Engine Mechanical Specifications**.

CONNECTING ROD AND BEARINGS

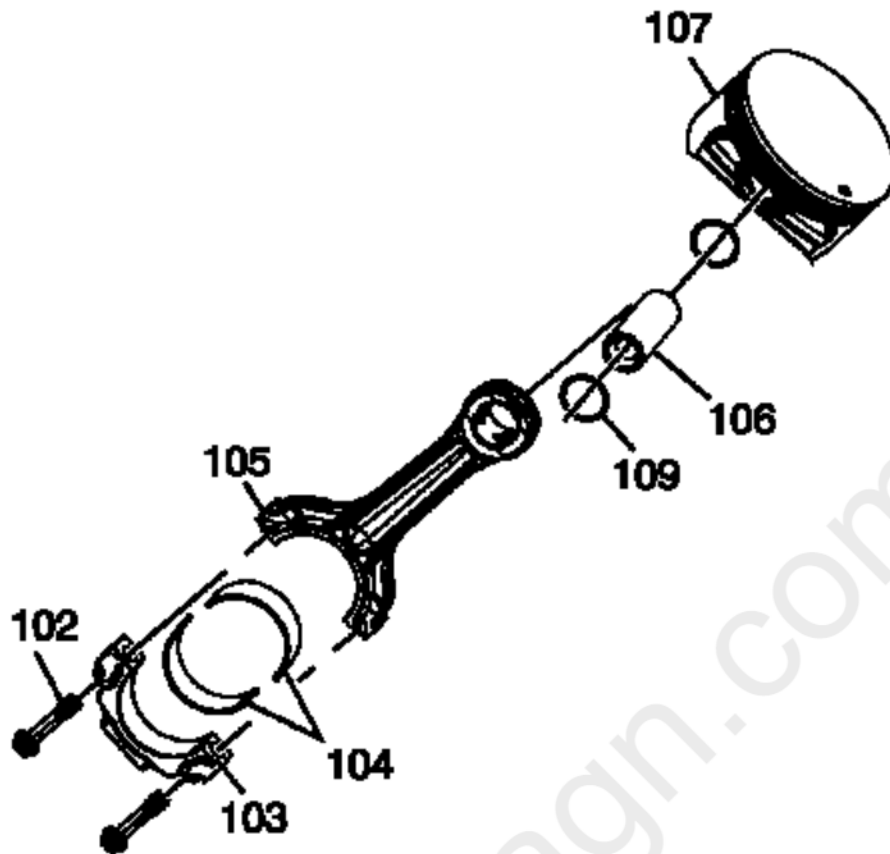


Fig. 141: View Of Piston, Pin & Piston Rings
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The powdered metal connecting rod and cap are machined for proper clearances. The connecting rod and cap must be used as an assembly with no repair or modifications to either mating surface. Do not attempt to repair the rod or cap. If service is required, replace the rod and cap as an assembly.
- Do not attempt to repair the bolt hole threads of the connecting rod.

1. Clean the connecting rod (105) and cap (103) in solvent.

WARNING: Refer to **SAFETY GLASSES WARNING** .

2. Dry the components with compressed air.

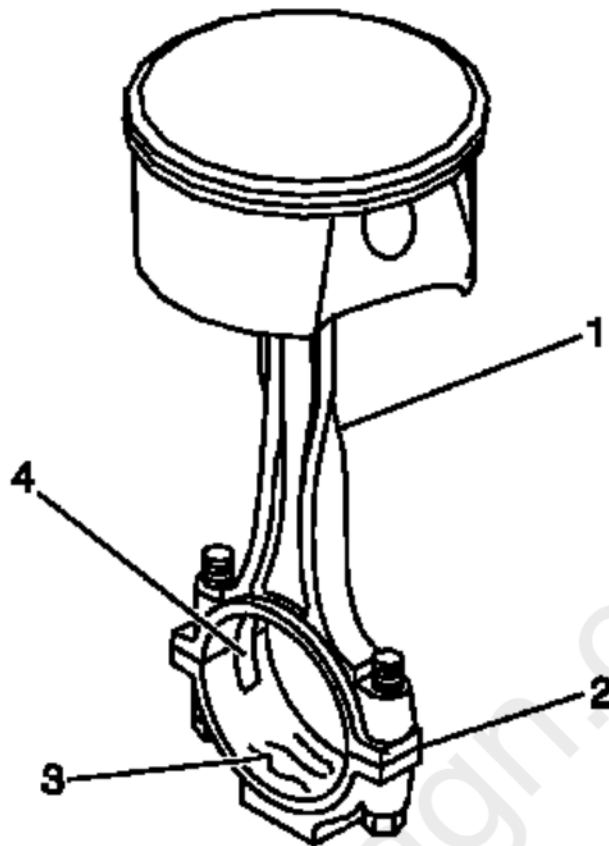


Fig. 142: Identifying Connecting Rod Inspection Areas
Courtesy of GENERAL MOTORS CORP.

3. Inspect the connecting rod for the following conditions:
- Twisting (1)
 - Proper fit of the connecting rod and cap mating surfaces (2)
 - Nicks or gouges in the bearing bore (3)
 - Damage to the bearing locating slots (4)

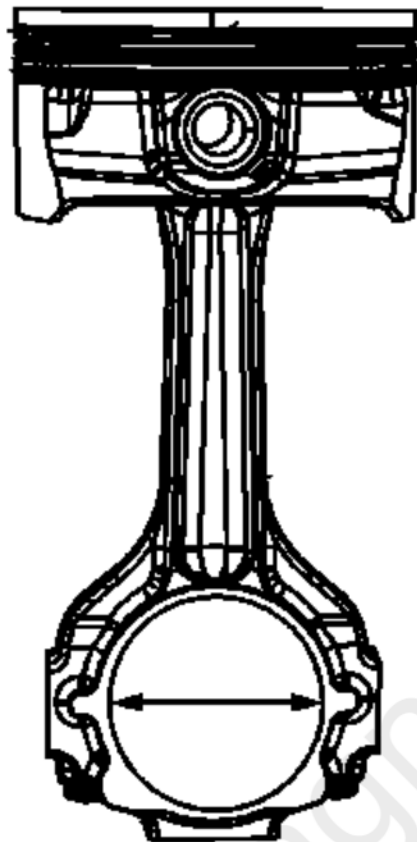


Fig. 143: Identifying Connecting Rod Bearing Bore
Courtesy of GENERAL MOTORS CORP.

4. Measure the connecting rod bearing bore for an out-of-round condition. Refer to **Engine Mechanical Specifications** .

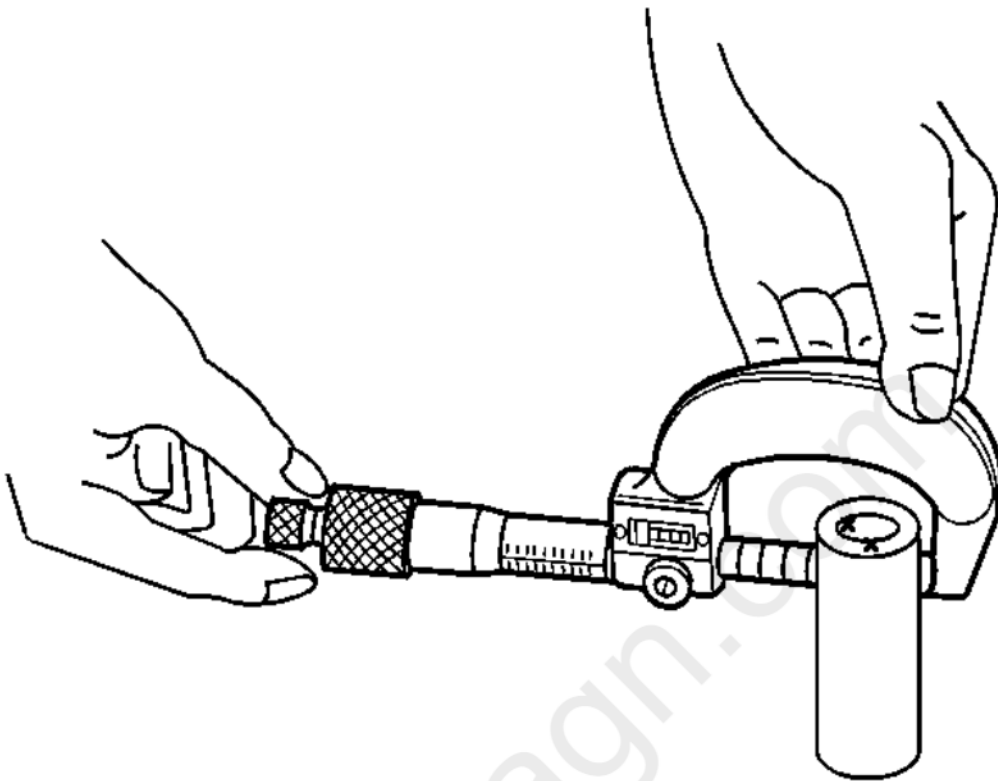


Fig. 144: Measuring Piston Pin Diameter
Courtesy of GENERAL MOTORS CORP.

5. To determine piston pin-to-connecting rod bore clearance, use a micrometer and measure the piston pin OD.

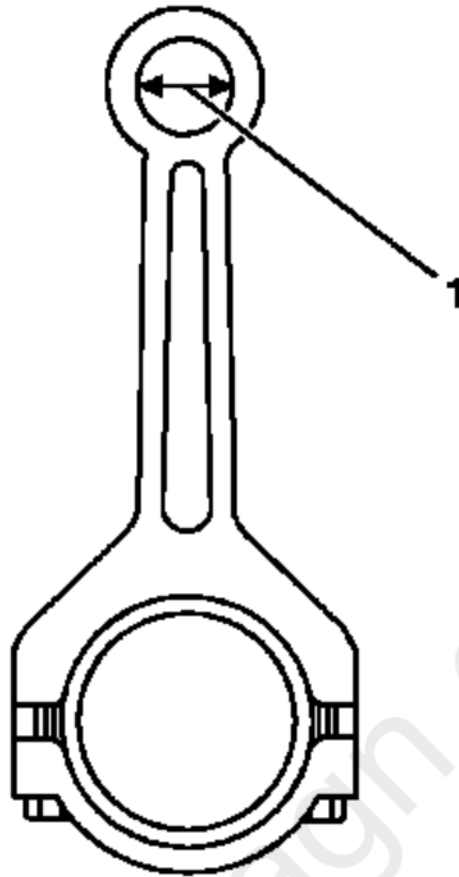


Fig. 145: Measuring Connecting Rod Pin Bore Inside Diameter
Courtesy of GENERAL MOTORS CORP.

6. To determine the piston pin-to-connecting rod bore clearance, use a micrometer and measure the connecting rod pin bore (1) ID.
7. Subtract the piston pin OD measurement from the connecting rod pin bore ID measurement to determine pin-to-bore clearance. Refer to **Engine Mechanical Specifications** .

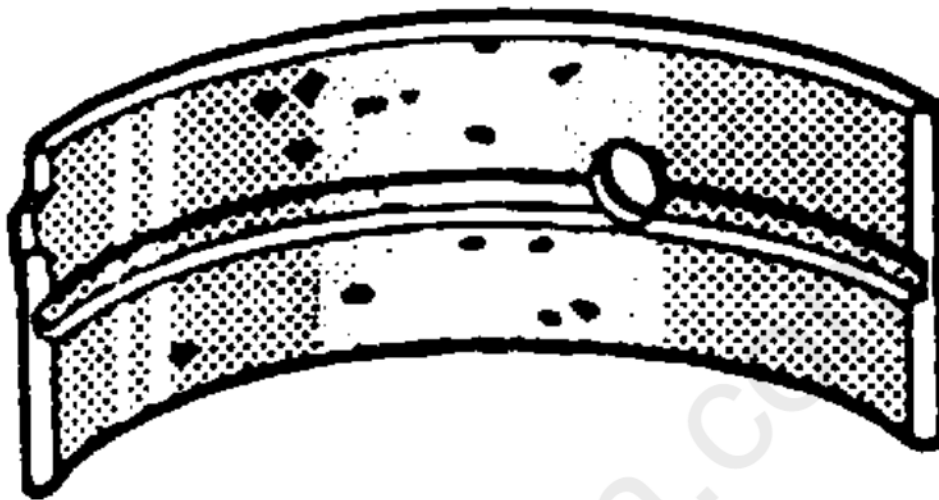


Fig. 146: Identifying Crankshaft Bearing Craters Or Pockets
Courtesy of GENERAL MOTORS CORP.

8. Inspect the connecting rod bearings for craters or pockets. Flattened sections on the bearing halves indicate fatigue.

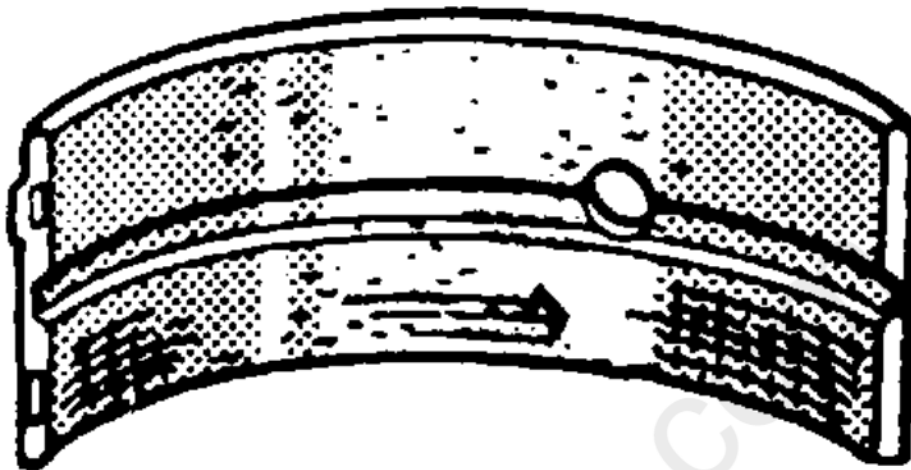


Fig. 147: Identifying Connecting Rod Bearing Scoring Or Discoloration
Courtesy of GENERAL MOTORS CORP.

9. Inspect the connecting rod bearings for excessive scoring or discoloration.
10. Inspect the connecting rod bearings for dirt or debris imbedded into the bearing material.

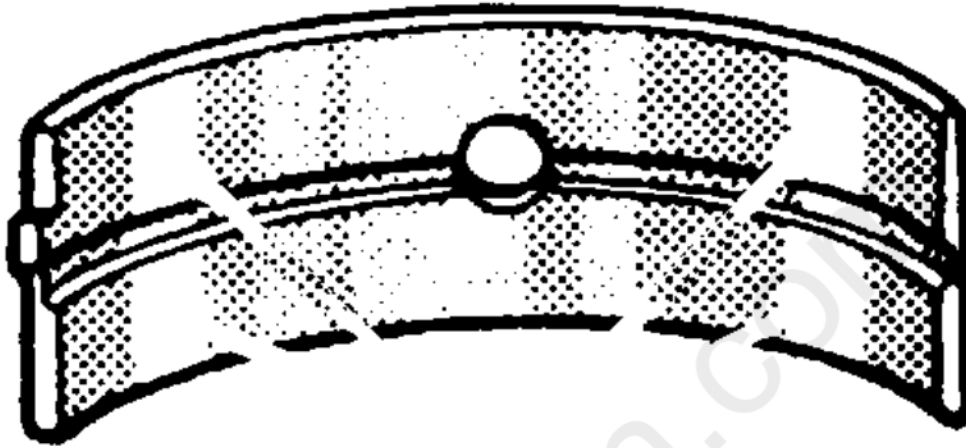


Fig. 148: View Of Improper Seating
Courtesy of GENERAL MOTORS CORP.

11. Inspect the connecting rod bearings for improper seating indicated by bright, polished sections of the bearing surface.
12. To determine the piston pin-to-bore clearance, use an inside micrometer and measure the piston pin bore ID.
13. Subtract the piston pin OD measurement from the piston pin bore ID measurement to determine pin-to-bore clearance. Refer to **Engine Mechanical Specifications** .

PISTON AND CONNECTING ROD ASSEMBLE

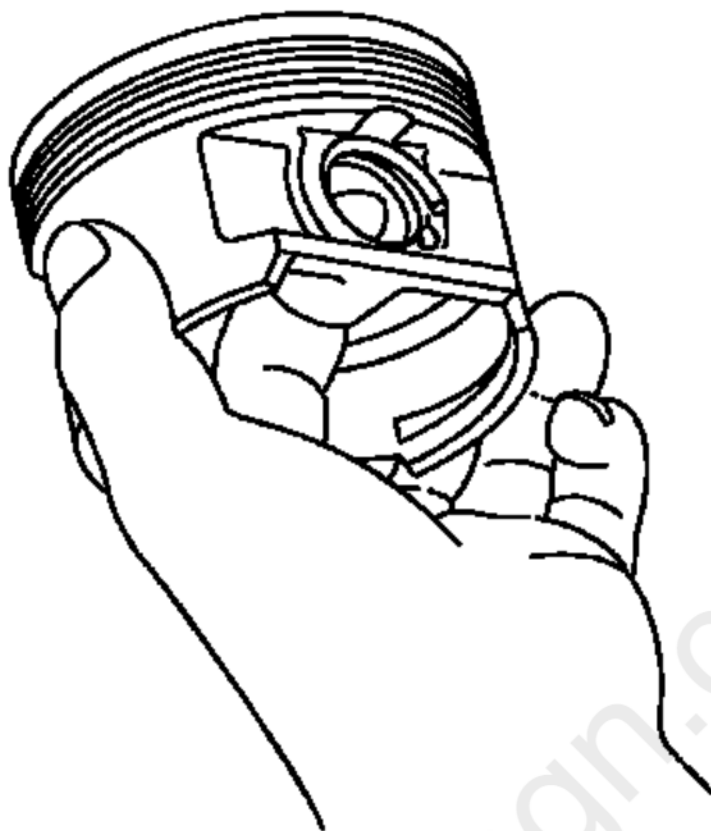


Fig. 149: View Of Retaining Clip In Pin Bore Groove
Courtesy of GENERAL MOTORS CORP.

1. Install the retainer. The retainer should be seated in the groove of the pin bore.

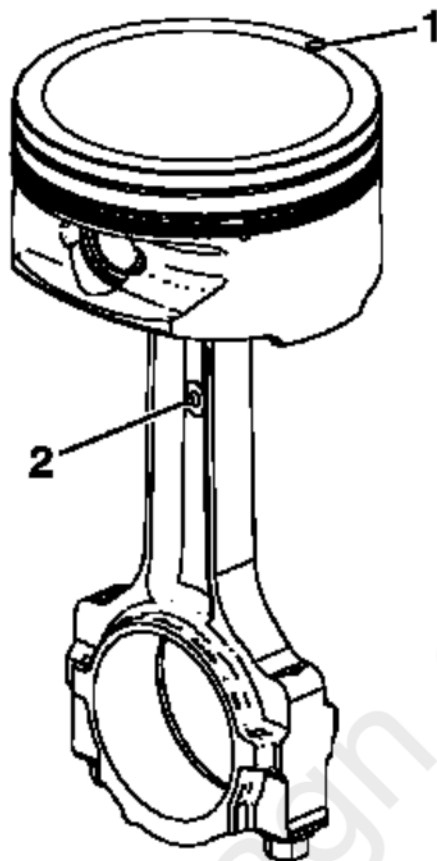


Fig. 150: Identifying Mark On Piston & Dimple On Connecting Rod
Courtesy of GENERAL MOTORS CORP.

2. Assemble the piston and connecting rod. The mark (1) on the top of the piston and the dimple (2) on the connecting rod should be facing the opposite direction.

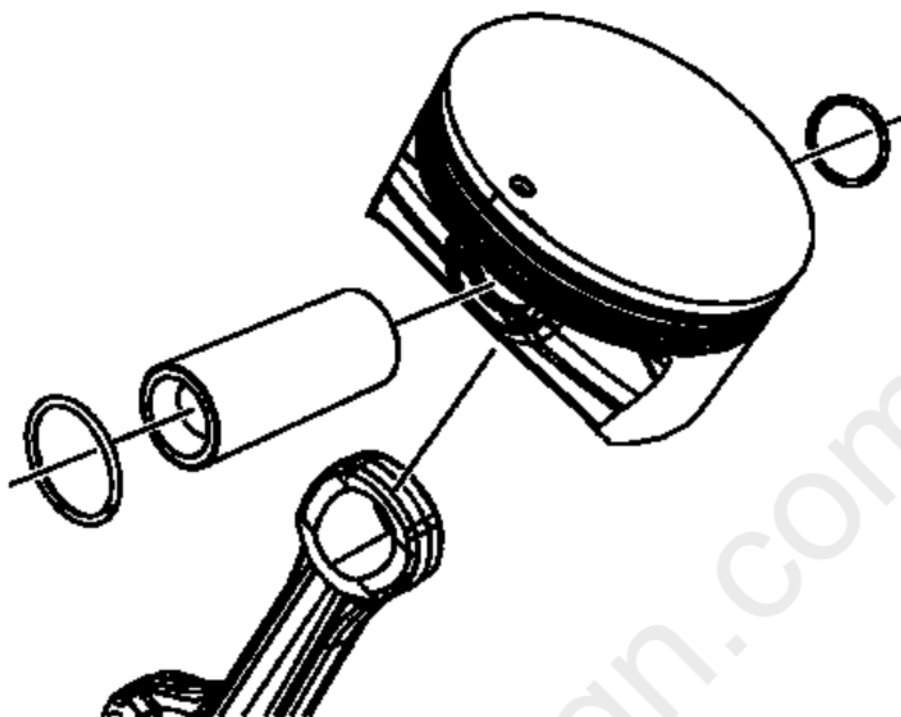


Fig. 151: Piston Pin, Piston & Connecting Rod
Courtesy of GENERAL MOTORS CORP.

3. Install the piston pin to the piston and connecting rod.
4. Install the retainers. The retainers should be seated in the groove of the pin bore.

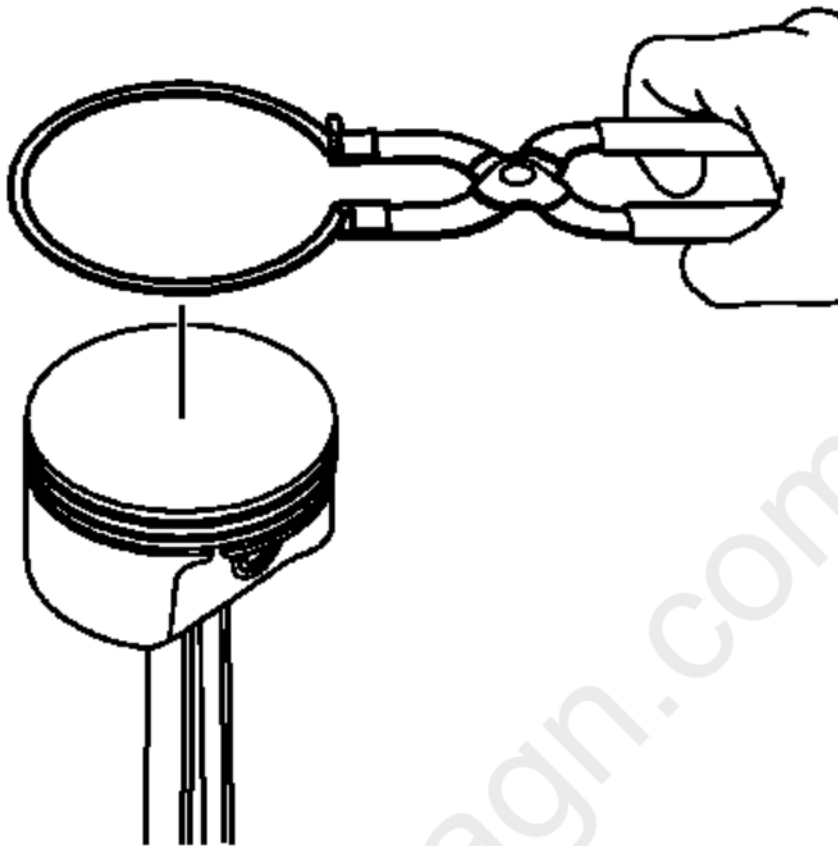


Fig. 152: View Of Piston Rings

Courtesy of GENERAL MOTORS CORP.

NOTE: When installing piston rings, use a ring expander plier type tool. Do not roll the rings into the grooves of the piston. Use caution and care to expand the rings only slightly larger than the outside diameter (OD) of the piston.

5. Using piston ring pliers, install the piston rings onto the piston. The dimple or mark on the piston ring should face the top of the piston. If no dimple or mark can be found on the top compression ring, it may be installed in either direction.
6. Position the oil control ring end gaps a minimum of 25 mm (1.0 in) from each other.
7. Position the compression ring end gaps 180 degrees opposite each other.

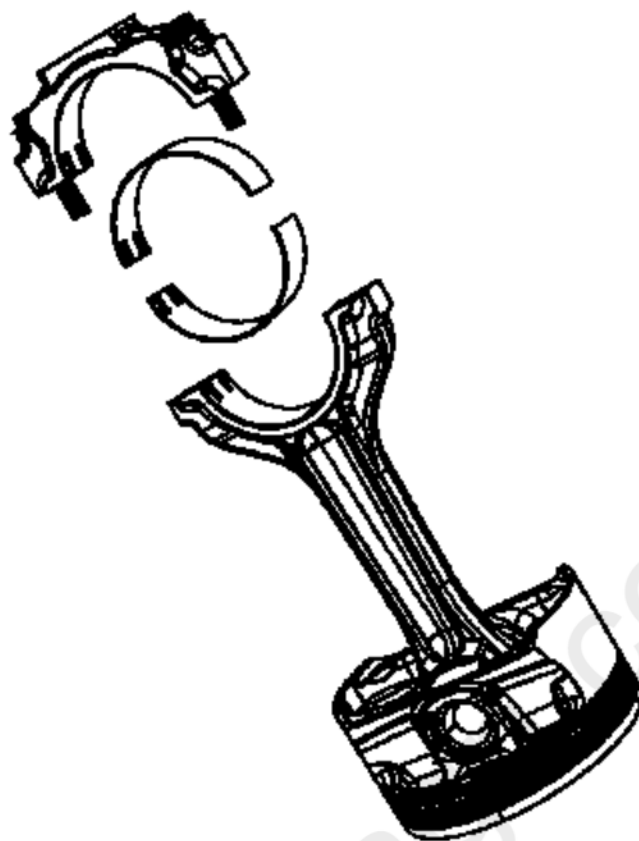


Fig. 153: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

8. Install the connecting rod bearings to the rod and cap.

CAMSHAFT BEARING REMOVAL

SPECIAL TOOLS

J 33049: Camshaft Bearing Service Set

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

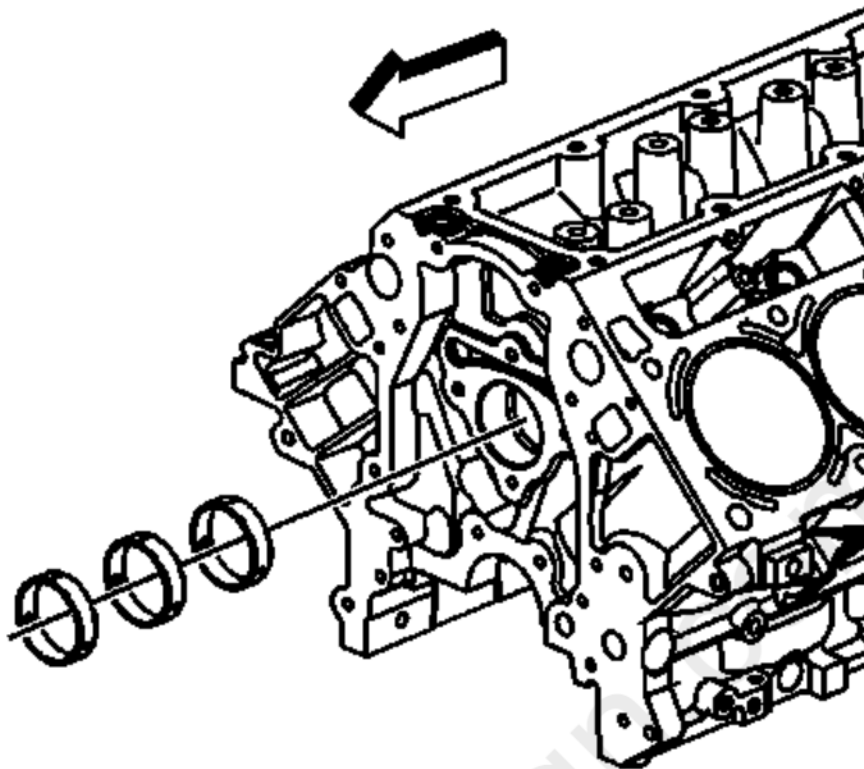


Fig. 154: Camshaft Bearings

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: A loose camshaft bearing may be caused by an enlarged, out of round, or damaged engine block bearing bore.

1. Prior to bearing removal, inspect the camshaft bearings for loose fit in the engine block bearing bores. Refer to Camshaft and Bearings Cleaning and Inspection.
2. Repair or replace the components, as required.

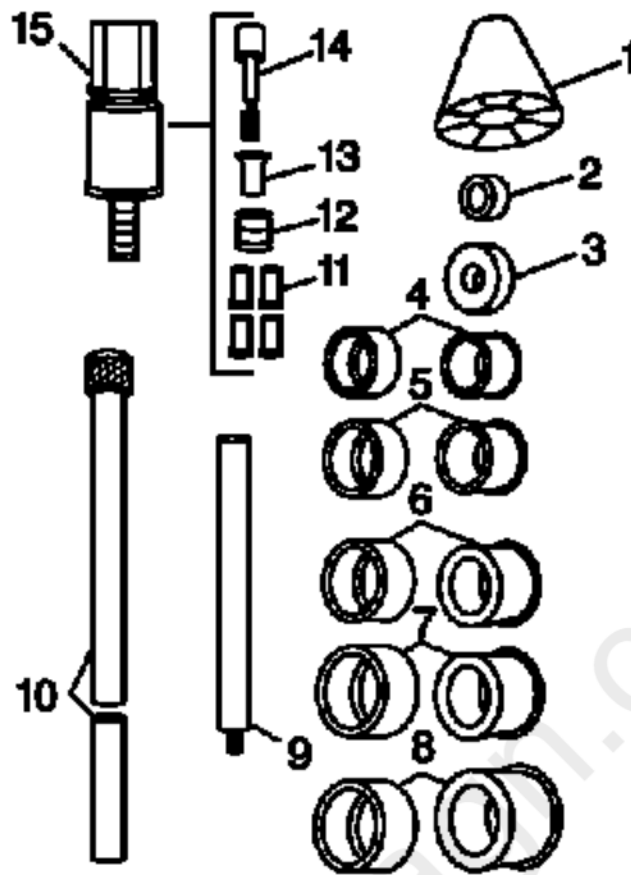


Fig. 155: View Of J 33049 Camshaft Bearing Service Kit Components
Courtesy of GENERAL MOTORS CORP.

3. Select the expanding driver (4-8) and washer (2 or 3) from the **J 33049**: service set.
4. Assemble the tool.
5. Insert the tool through the front of the engine block and into the bearing.
6. Tighten the expander assembly (15) nut until snug.
7. Push the guide cone (1) into the front camshaft bearing in order to align the tool.

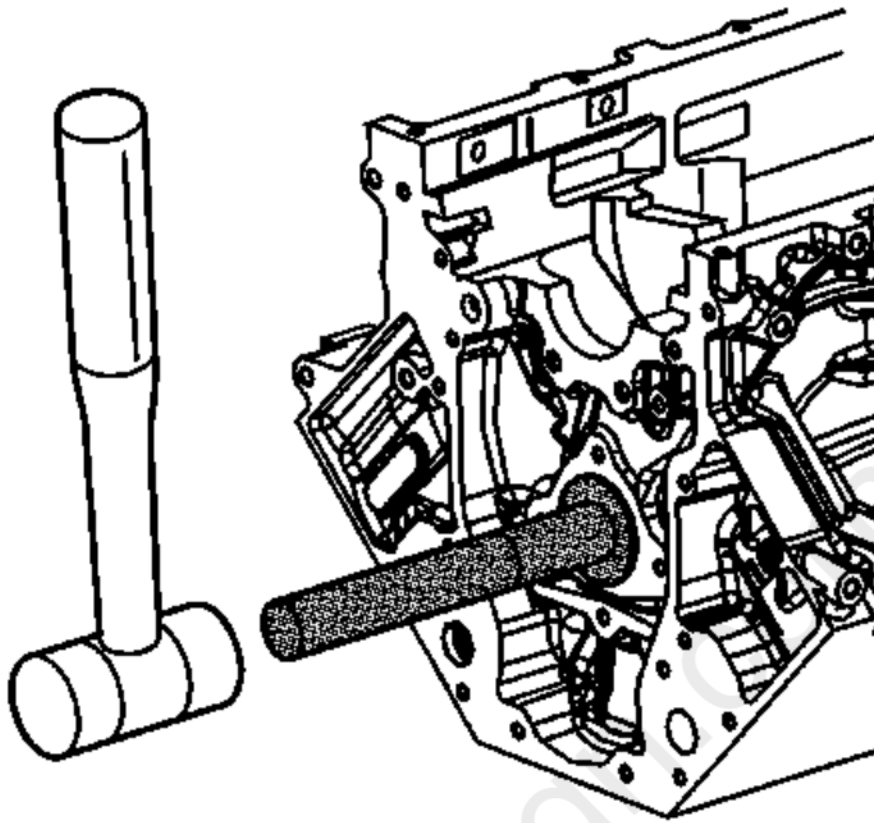


Fig. 156: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

8. Drive the bearing from the block bore.

IMPORTANT: In order to remove the inner camshaft bearings, operate the tool from either end of the block, using the driver bar extension and the guide cone in the front or rear camshaft bearing bore.

9. Repeat the above procedures in order to remove the remaining bearings.

TOOL USAGE INFORMATION

Bearing, Expander, and Expander Driver Information

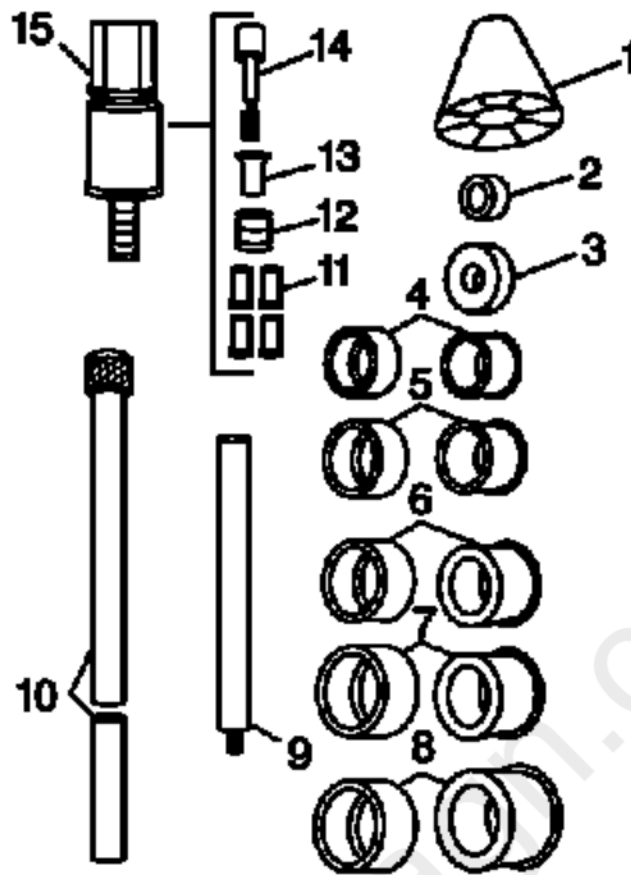


Fig. 157: View Of J 33049 Camshaft Bearing Service Kit Components
 Courtesy of GENERAL MOTORS CORP.

- The tool consists of a guide cone (1), driving washers (2 or 3), expander bearing drivers (4-8), driver bars (9 or 10), expander jaws (11), expander sleeve (12), expander cone (13), expander shaft (14), and expander assembly (15).

NOTE: The expander bearing drivers (4-8) in the J 33049: service set are stamped with a number (1-5) to assist in identifying the appropriate diameter driver.

- Expander assembly (15) is used as a driver for the bearing when inside diameter is 28.575-37.465 mm (1.125-1.475 in) and is used with the small washer.
- Expander bearing driver number 1 inside diameter is 37.465-43.18 mm (1.475-1.7 in) and is used with the expander assembly (15) and the small washer.
- Expander bearing driver number 2 inside diameter is 43.18-48.895 mm (1.7-1.925 in) and is used with the expander assembly (15) and the large washer.
- Expander bearing driver number 3 inside diameter is 48.895-54.61 mm (1.925-2.15 in) and is used with the expander assembly (15) and the large washer.
- Expander bearing driver number 4 inside diameter is 54.61-60.325 mm (2.150-2.375 in) and is used with

expander assembly (15) and the large washer.

- Expander bearing driver number 5 inside diameter is 60.325-68.326 mm (2.375-2.69 in) and is used with expander assembly (15) and the large washer.

Tool Assembly and Operation

1. Select the proper expanding driver and washer from the expanding driver and washer information.

IMPORTANT: To install or remove the expanding driver, always push on or pull from the ends.

Pressure on the outside diameter may cause a bind against the rubber expanding sleeve.

2. Place the expanding driver onto the expander assembly.
3. Ensure the separation lines between the segments of the expanding driver align with the separation lines of the expander assembly.
4. With the small end of the cone facing the driver assembly, place the guide cone over the driving bar.
5. Place the driving washer over the threaded portion of the expander assembly.
6. Screw the expander assembly, with driving washer, onto the driving bar.

For removal of the inner bearings, it may be necessary to install the driver bar extension.

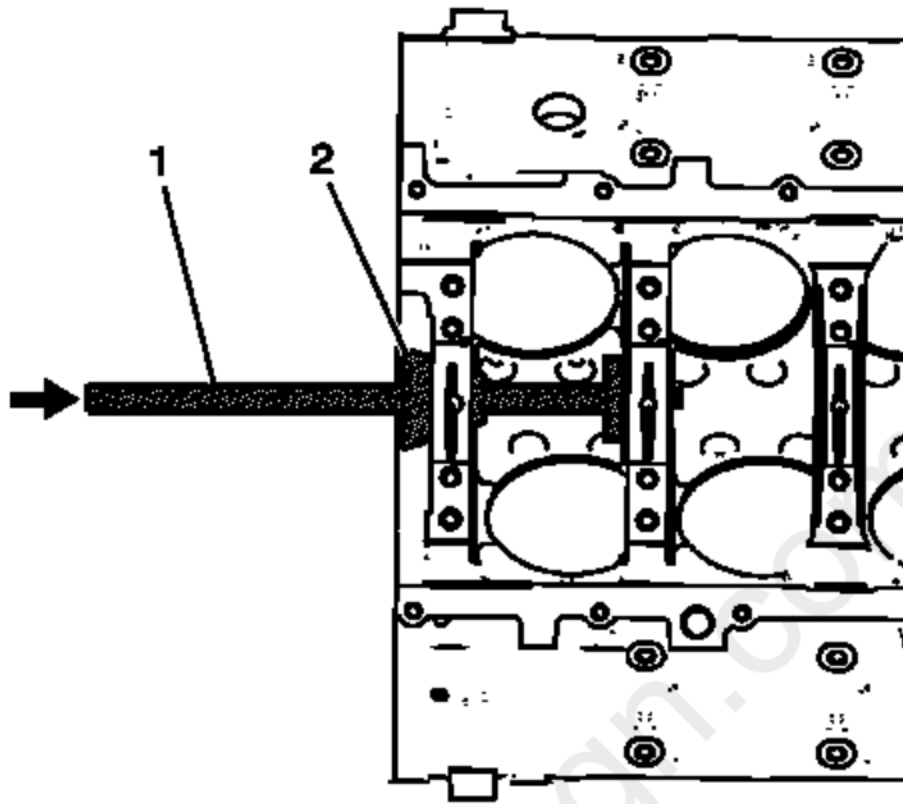


Fig. 158: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

7. Insert the tool (1) into an inner camshaft bearing and tighten until snug.

Operate the tool from the front or rear of the engine block.

On some engine blocks, the nut on the expander assembly is inaccessible, except from either end. In this case, you must use a socket and extension to enlarge and reduce the expander assembly.

8. Slide the nylon cone (2) into the front or rear camshaft bearing. This will properly align the tool.
9. Drive the bearing out of or into the engine block.
10. Repeat the procedure for the additional inner bearings.

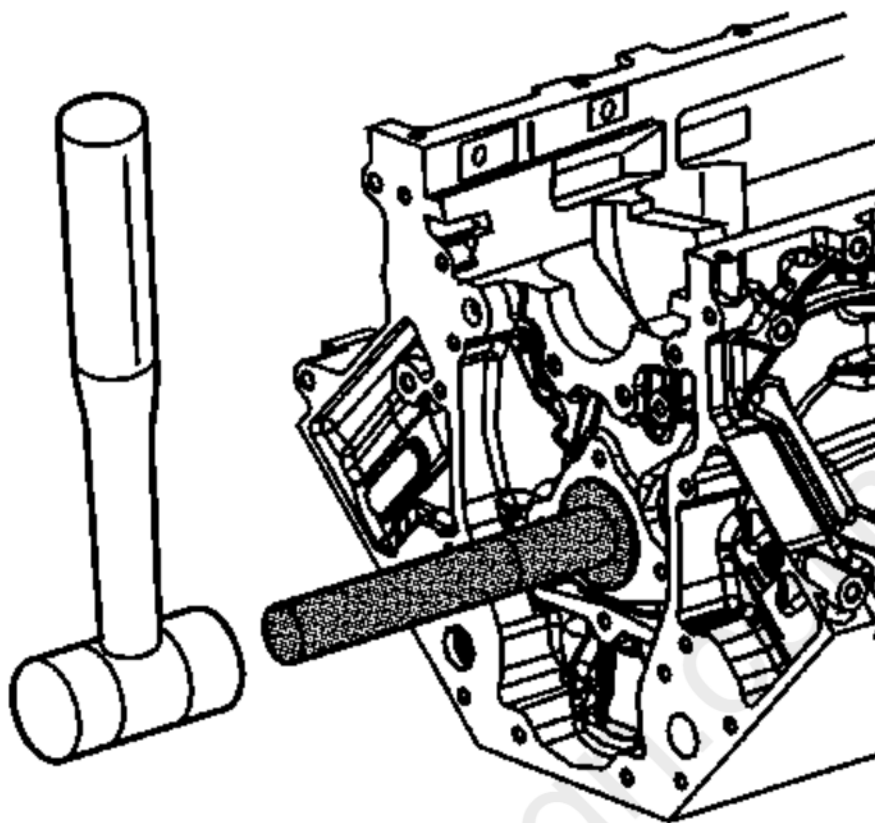


Fig. 159: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

11. For the end bearings, front, position number 1, and the rear, position number 5, remove the nylon cone and driver bar extension.
12. Drive the bearings out of or into the engine block.

CAMSHAFT AND BEARINGS CLEANING AND INSPECTION

SPECIAL TOOLS

- **J 7872:** Magnetic Base Dial Indicator Set
- **J 8520:** Camshaft Lobe Lift Indicator

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

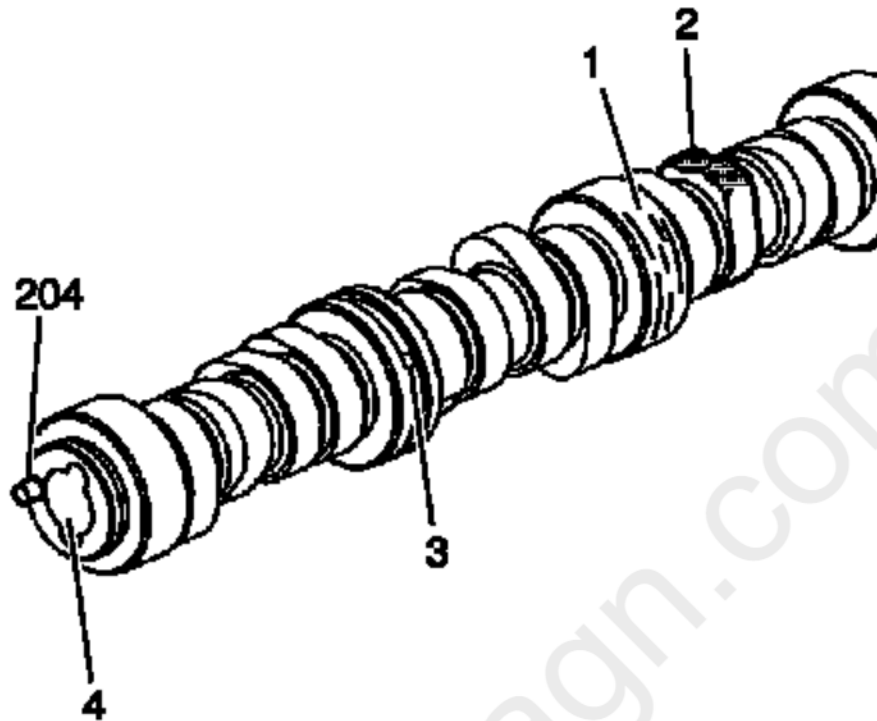


Fig. 160: View Of Camshaft Inspection Points
Courtesy of GENERAL MOTORS CORP.

1. Clean the components in solvent.

WARNING: Refer to SAFETY GLASSES AND COMPRESSED AIR WARNING .

2. Dry the components with compressed air.
3. Inspect the camshaft bearing journals (1) for scoring or excessive wear.
4. Inspect the camshaft valve lifter lobes (2) for scoring or excessive wear.
5. Inspect the threaded bolt hole (4) in the front of the camshaft for damaged threads or debris.
6. Inspect the camshaft sprocket pin (204) for damage.
7. Inspect the camshaft retainer plate for wear or a damaged sealing gasket.

If the camshaft retainer plate sealing gasket is not cut or damaged, it may be used again.

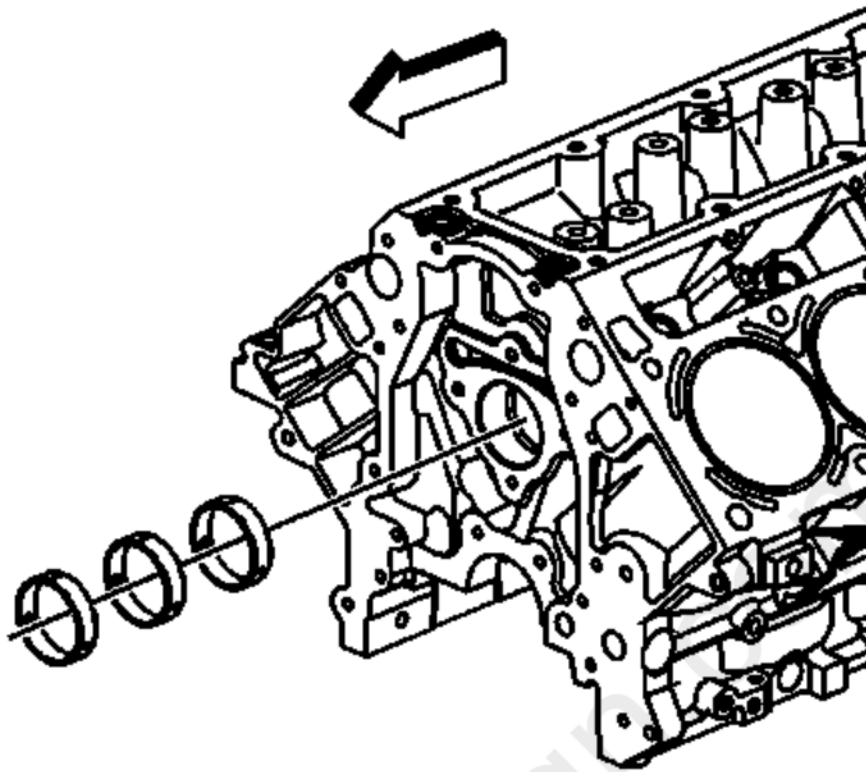


Fig. 161: Camshaft Bearings

Courtesy of GENERAL MOTORS CORP.

NOTE: The LSA engine is built with 2 different camshaft bearing designs; the difference is the composition of the bearing lining material.

- The first design camshaft bearing is composed of a lining material that uses a lead babbitt with copper matrix backing.
- The second design camshaft bearing is lead-free, the lining is composed of a aluminum-tin material.

8. Inspect the camshaft bearings for the following:

- Excessive wear, evidence of galling, pitting, scoring, or embedded debris. On first design camshaft bearings, the presence of the copper color bearing material should be considered normal, and not a guideline for bearing replacement. On 2nd design camshaft bearings, the appearance of the bearing material being different shades of gray are considered normal, and are not guideline for bearing replacement. Measure the bearing inside diameter (ID) as required for an over-sized condition. Refer to **Engine Mechanical Specifications**.
- Proper fit in the engine block. Camshaft bearings have an interference fit to the engine block and should not be loose in the engine block bearing bores.
- The oil lubrication feed hole in the bearing must be in alignment with the drilled out passage in the

block.

- The oil lubrication feed hole is not plugged by debris.
- Bearings with excessive wear or scoring must be replaced.
- Bearings with excessive wear, galling, pitting, scoring, or embedded debris must be replaced.

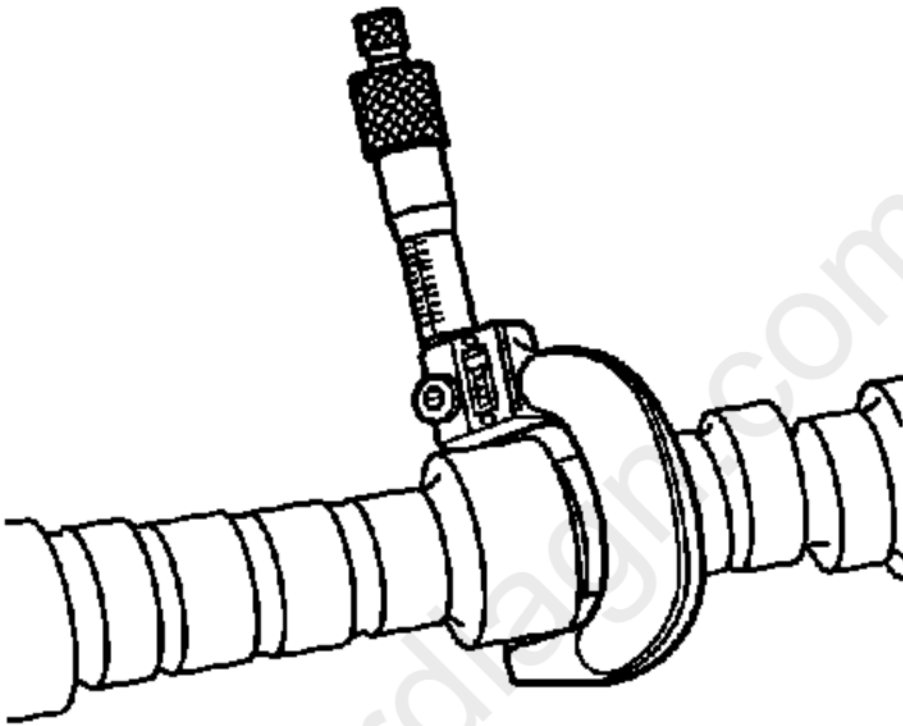


Fig. 162: Measure Camshaft Journals With Micrometer
Courtesy of GENERAL MOTORS CORP.

9. Using a micrometer, measure the camshaft journals for wear and out-of-round. Refer to **Engine Mechanical Specifications** .
 - If the camshaft bearing journals are out-of-round, replace the camshaft.
 - If the camshaft bearing journal diameter is not within specification, replace the camshaft.

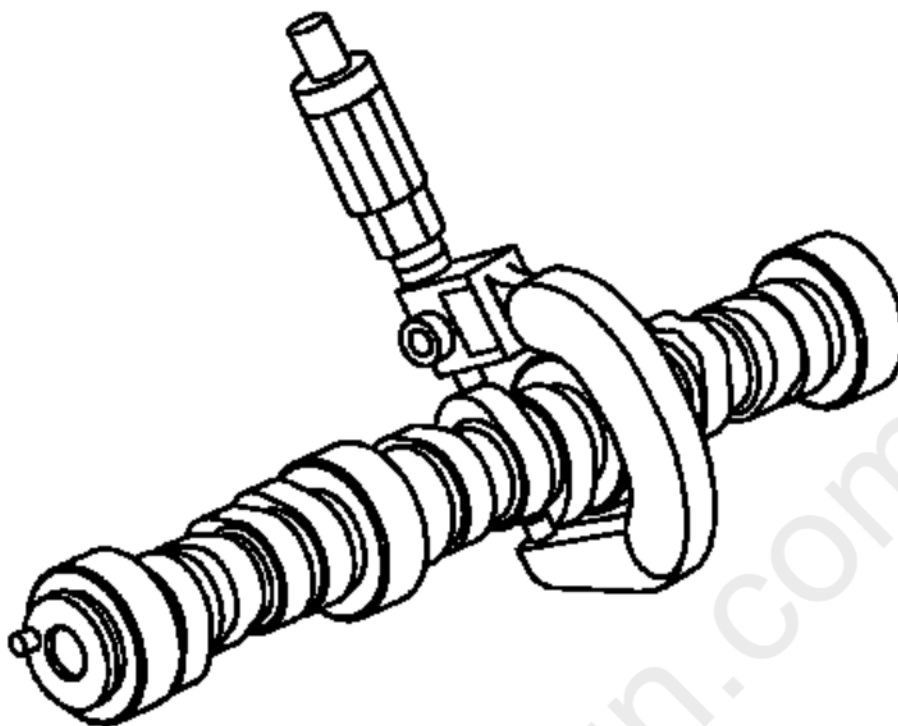


Fig. 163: Measuring Camshaft Lobes
Courtesy of GENERAL MOTORS CORP.

10. Using a micrometer, measure the camshaft lobes for wear. Refer to **Engine Mechanical Specifications** .

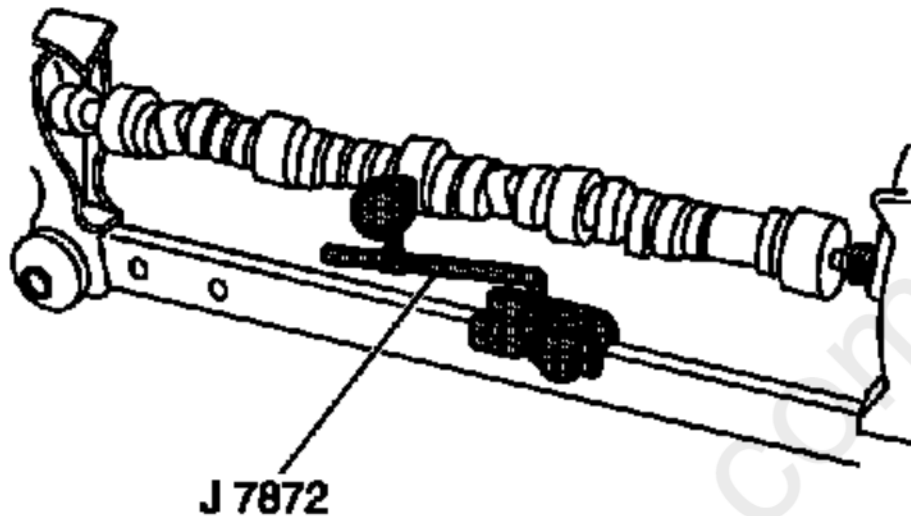


Fig. 164: Measuring Camshaft Runout
Courtesy of GENERAL MOTORS CORP.

11. Measure the camshaft runout.
 1. Mount the camshaft in wooden V-blocks or between centers on a fixture.
 2. Using the **J 7872**: set , measure the runout of the intermediate camshaft bearing journals.
 3. If camshaft runout is not within specification, the camshaft is bent and should be replaced. Refer to **Engine Mechanical Specifications** .

MEASURING CAMSHAFT LOBE LIFT

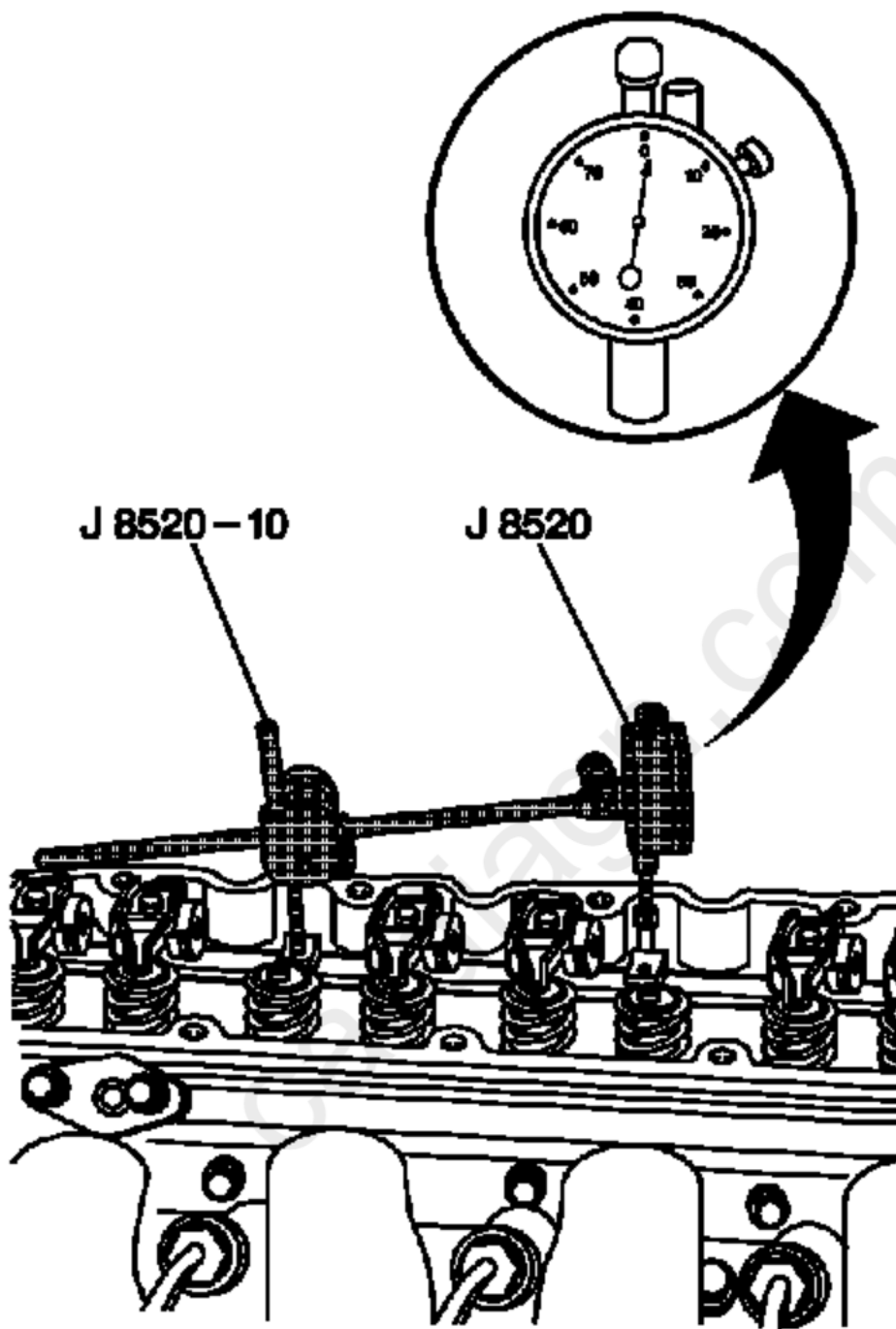


Fig. 165: Measuring Camshaft Lobe Lift
Courtesy of GENERAL MOTORS CORP.

NOTE: Measuring camshaft lobe lift is a procedure used to determine if the camshaft lobes have worn. This test is to be performed prior to engine disassembly and with the camshaft and valve train components installed in the engine.

1. Using the **J 8520:** indicator, measure camshaft lobe lift.
2. Remove the valve rocker arms and bolts.
3. Install the dial indicator mounting stud into the valve rocker arm bolt hole.
4. Assemble the components of the **J 8520:** indicator and position onto the stud.
5. Position the shaft of the dial indicator onto the end of the pushrod.
6. Rotate the face of the dial indicator to zero.
7. Slowly rotate the crankshaft clockwise, until the dial indicator obtains its highest and lowest readings.
8. Compare the total to specifications. Refer to **Engine Mechanical Specifications** . The total lobe lift is the difference between the highest and lowest reading.

CAMSHAFT BEARING INSTALLATION

SPECIAL TOOLS

J 33049: Camshaft Bearing Service Set

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

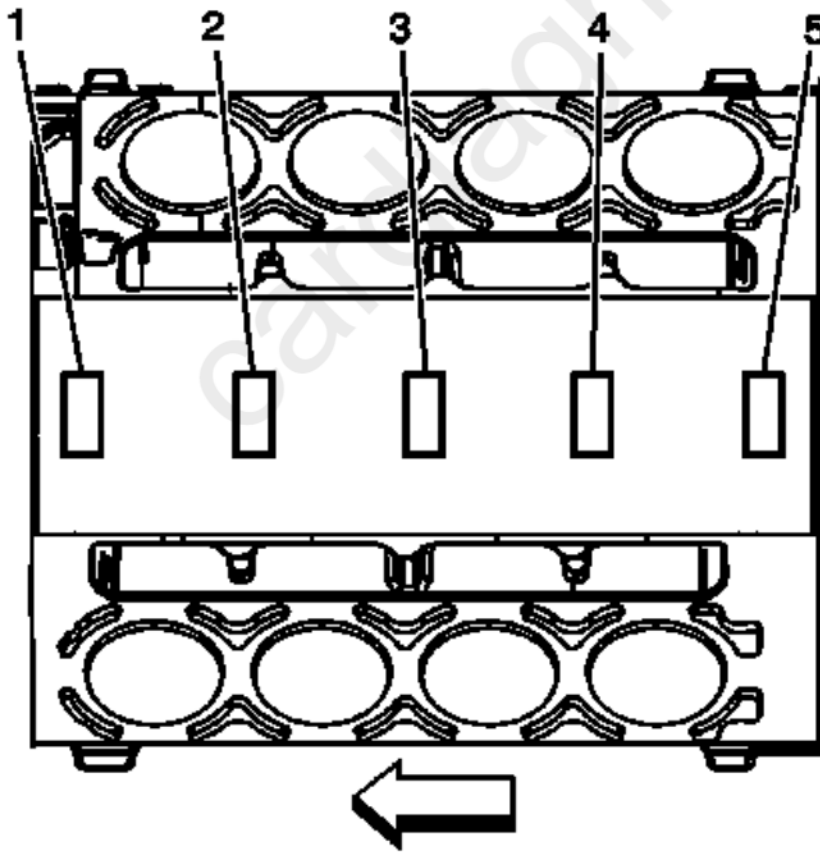


Fig. 166: Identifying Engine Block Camshaft Bearing Bores

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The engine block camshaft bearing bores are machined for 3 different outside diameter (OD) size bearings. Position 1 and 5 are the largest diameter bores. Position 3 is the smallest diameter bore. Position 2 and 4 are the intermediate size bores. The inside diameter (ID) for all camshaft bearings is the same size.

1. Measure the engine block camshaft bearing bores (1-5) in order to identify the correct OD size bearing for each position. Refer to Engine Mechanical Specifications.

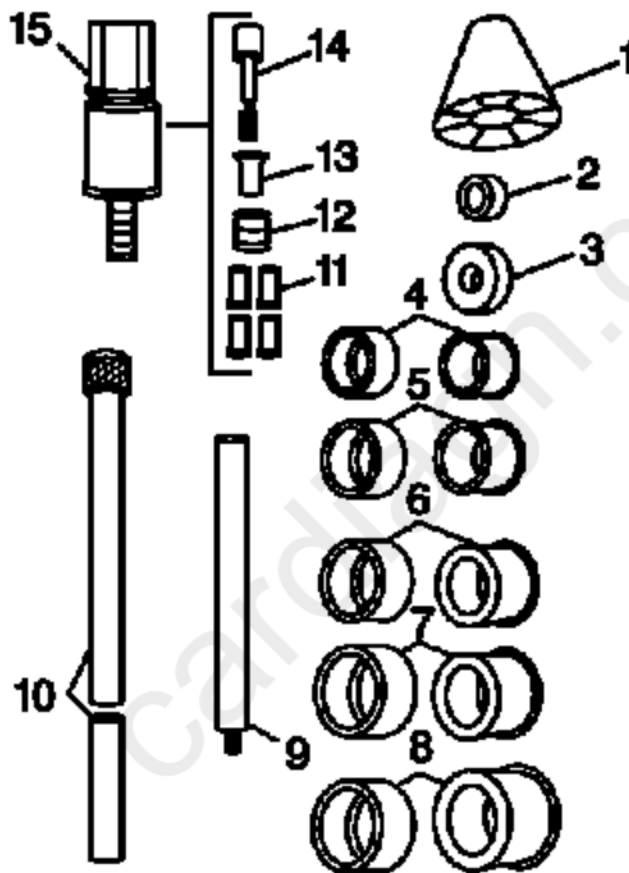


Fig. 167: View Of J 33049 Camshaft Bearing Service Kit Components
Courtesy of GENERAL MOTORS CORP.

2. Select the expanding driver (4-8) and washer (2 or 3) from the **J 33049**: service set. Refer to tool usage information in Camshaft Bearing Removal.
3. Assemble the tool.

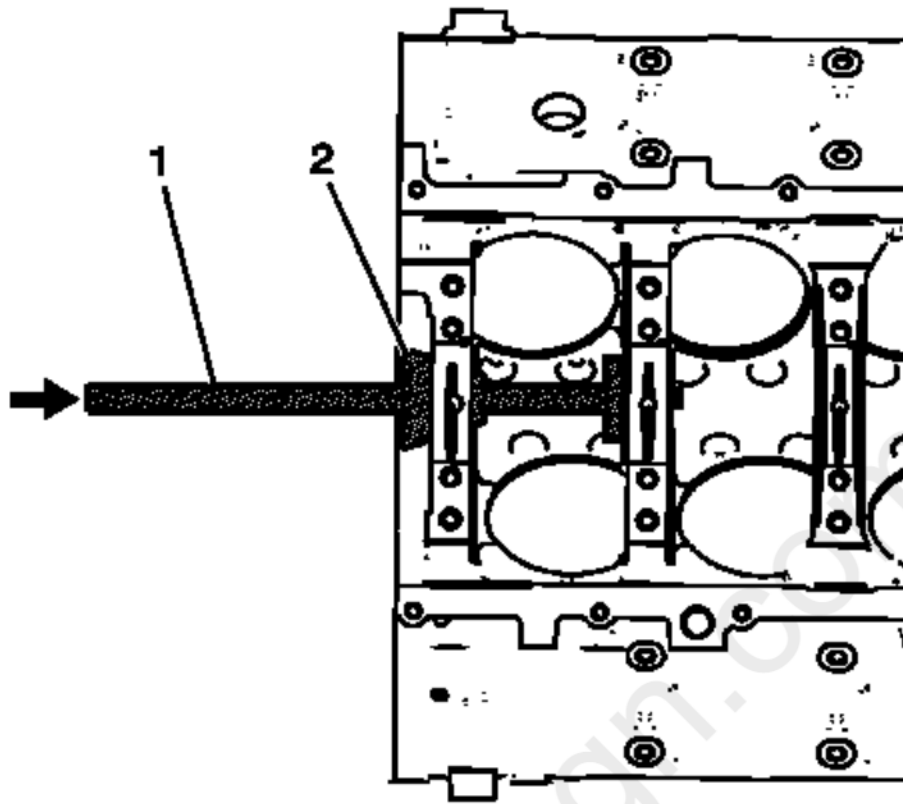


Fig. 168: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

4. Insert the tool (1) through the front or rear of the engine block and into the bearing. For installation of inner bearings, it may be necessary to install the driver bar extension.
5. Tighten the expander assembly nut until snug.
6. Push the guide cone (2) into the front camshaft bearing in order to align the tool.

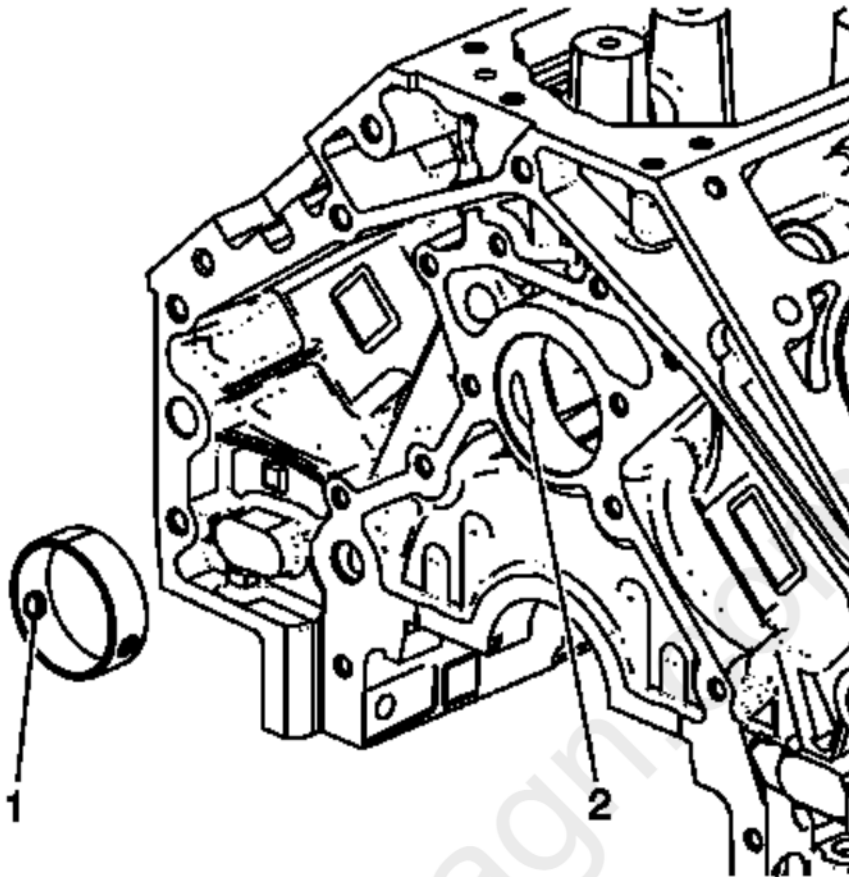


Fig. 169: Camshaft Bearing Oil Feed Hole & Block Bore Oil Passage
Courtesy of GENERAL MOTORS CORP.

CAUTION: Camshaft bearings must be installed with bearing oil feed hole in alignment with the drilled oil passage in the block bore to ensure proper oil flow to the camshaft. The split seam in the bearing must be installed in the 12 o'clock position towards the top of the block. Improperly installed bearings may restrict oil flow causing engine damage.

7. Position the camshaft bearing with oil feed hole (1) in alignment with drilled oil passage in block bore (2).

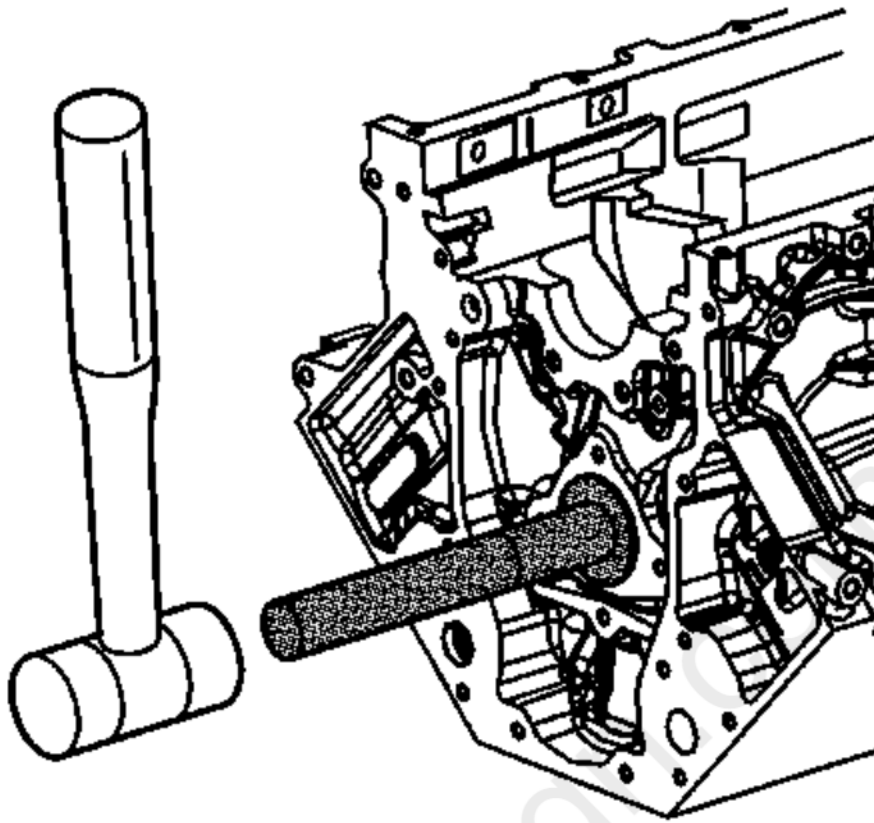


Fig. 170: Driving Bearing Out Of Or Into Engine Block
Courtesy of GENERAL MOTORS CORP.

8. Drive the bearing into the block bore. During installation, ensure the bearing is installed straight.
9. Remove **J 33049**: service set, inspect bearing to confirm the oil hole in the bearing is in alignment with the drilled oil passage in the block bore.
10. Repeat procedure to install the remaining bearings into the block.

CAMSHAFT TIMING CHAIN AND SPROCKET CLEANING AND INSPECTION

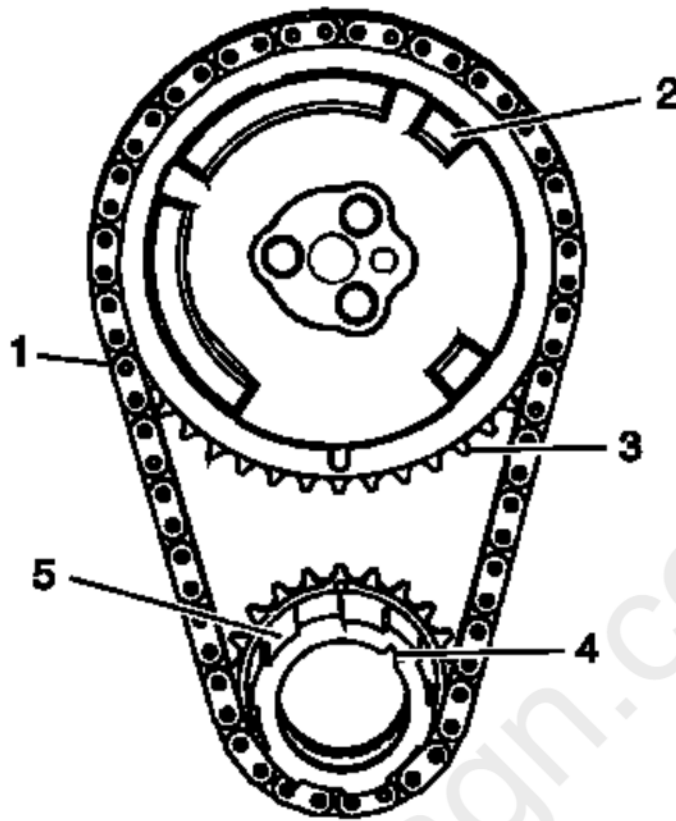


Fig. 171: Timing Chain & Sprockets
Courtesy of GENERAL MOTORS CORP.

1. Clean the components with cleaning solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

2. Dry the components with compressed air.
3. Inspect the timing chain (1) for binding or wear.
4. Inspect the camshaft position (CMP) sensor raised areas (2) for nicks or damage.
5. Inspect for worn, damaged, or chipped teeth (3).
6. Inspect for a damaged keyway (4).
7. Inspect for worn oil pump drive splines (5).

VALVE ROCKER ARM AND PUSH ROD CLEANING AND INSPECTION

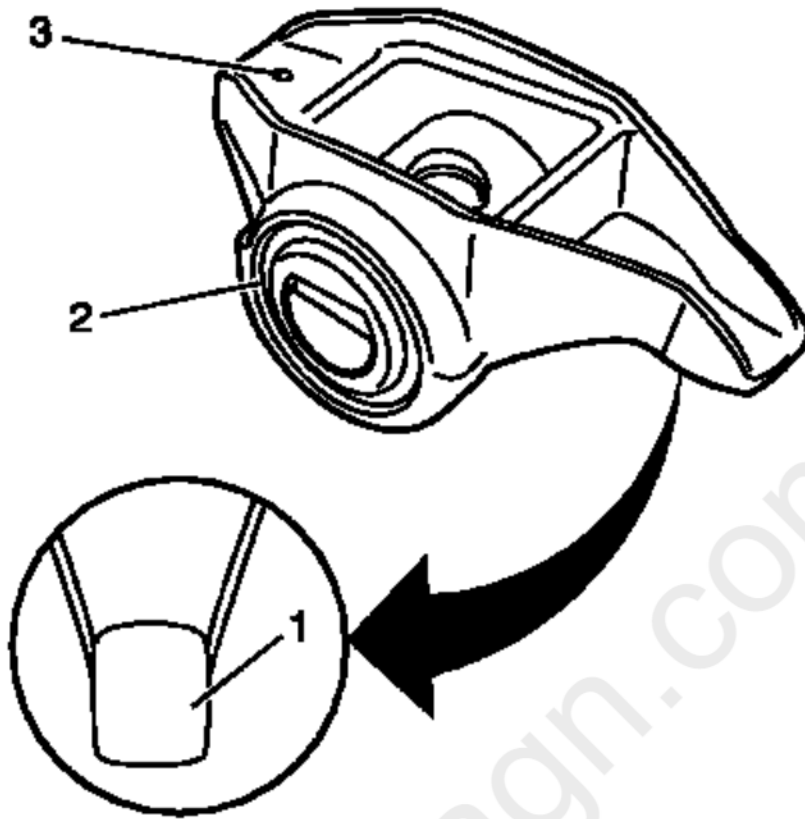


Fig. 172: Identifying Valve Rocker Arm Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Parts that are to be used again must be marked, sorted or organized for assembly.

1. Mark, sort, or organize the components for assembly. Refer to Separating Parts .
2. Clean the components with cleaning solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

3. Dry the components with compressed air.
4. Inspect the valve rocker arms bearings (2) for binding or roughness.
5. Inspect the valve rocker arm pushrod sockets (3) and valve stem mating surfaces (1). These surfaces should be smooth with no scoring or exceptional wear.
6. Inspect the pushrods for worn or scored ends. These surfaces should be smooth with no scoring or exceptional wear.
7. Inspect the pushrods for bends. Roll the pushrod on a flat surface to determine if the pushrod is bent.

8. Inspect the pushrod oil passages for restrictions.
9. Inspect the rocker arm pivot supports for cracks, wear, or other damage.

VALVE LIFTER AND GUIDE CLEANING AND INSPECTION

VALVE LIFTERS

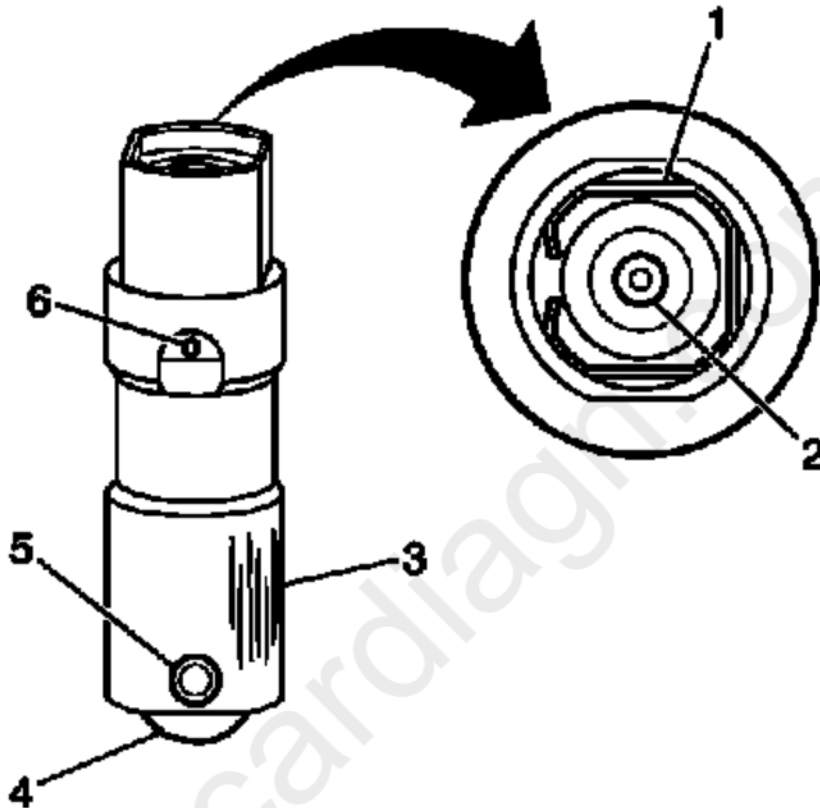


Fig. 173: Identifying Valve Lifter Inspection Areas
Courtesy of GENERAL MOTORS CORP.

NOTE: Components that are to be used again must be marked, sorted or organized for assembly.

1. Clean the components in cleaning solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

2. Dry the components with compressed air.

3. Inspect the valve lifters for the following conditions:

- Bent or broken clip (1)
- Worn pushrod socket (2)
- Scuffed or worn sides (3)

If the valve lifter shows wear, inspect the engine block lifter bores for wear or damage.

- Flat spots on the roller (4)
- Loose or damaged pin (5)
- Plugged oil hole (6)
- Worn or damaged roller bearing

The roller should rotate freely with no binding or roughness.

VALVE GUIDES

Inspect the valve lifter guides for the following conditions:

- Cracks or damage
- Excessive wear in the lifter mounting bores

CYLINDER HEAD DISASSEMBLE

SPECIAL TOOLS

J 8062: Valve Spring Compressor - Head Off

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

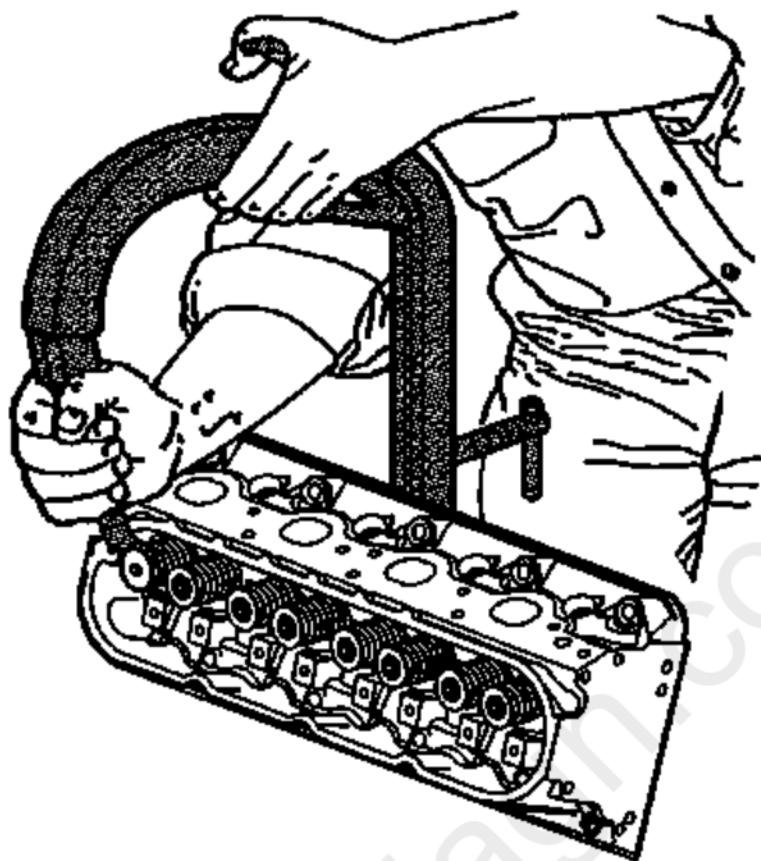


Fig. 174: View Of Compressing Valve Spring Using Special Tool J8062
Courtesy of GENERAL MOTORS CORP.

NOTE:

- With the components at room temperature, remove the spark plugs from the cylinder head.
- Mark, organize, or sort the cylinder head components for assembly. Return the components to their original location during assembly.

1. Remove the spark plugs from the cylinder heads.
2. Use the **J 8062**: valve spring compressor in order to compress the valve spring.

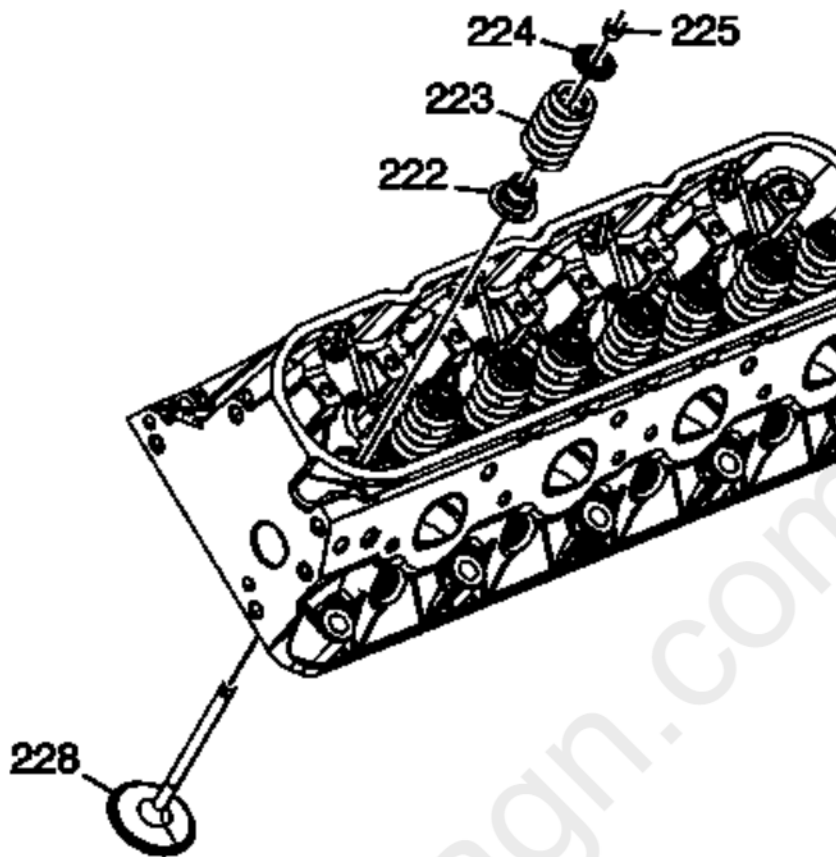


Fig. 175: Valve Stem Keys, Valve Spring Cap & Valve Spring
Courtesy of GENERAL MOTORS CORP.

3. Remove the valve stem keys (225).
4. Remove the valve spring cap (224).
5. Remove the valve spring (223).
6. Remove the valves (228).
7. Remove the valve stem oil seal (222). Refer to **Separating Parts** .

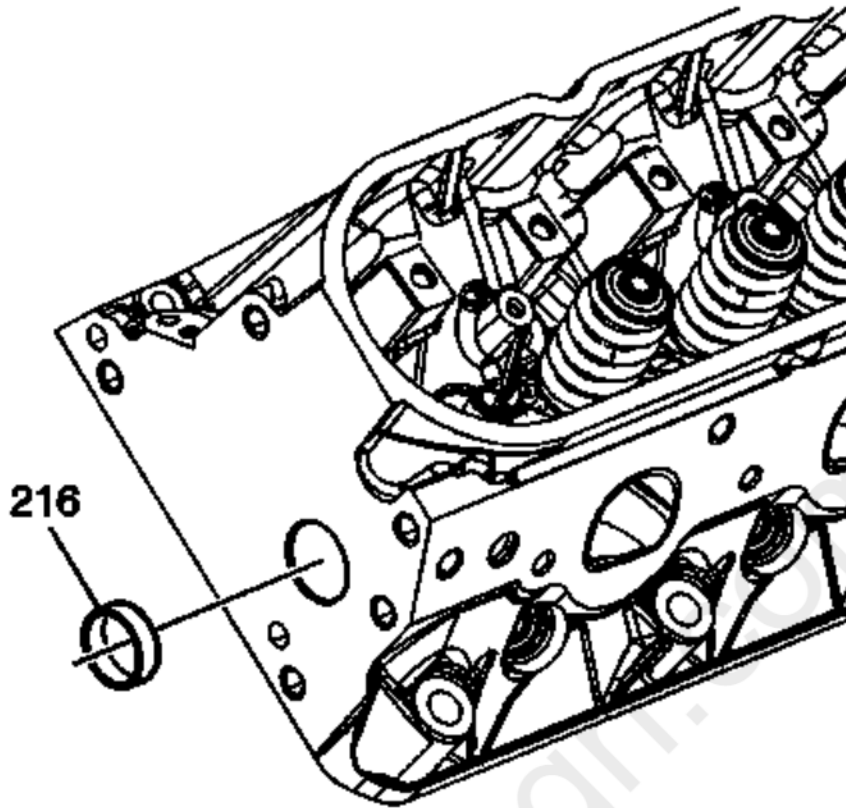


Fig. 176: Locating Cylinder Head Core Hole Plug
Courtesy of GENERAL MOTORS CORP.

8. Remove the cylinder head core hole plugs (216), as required.

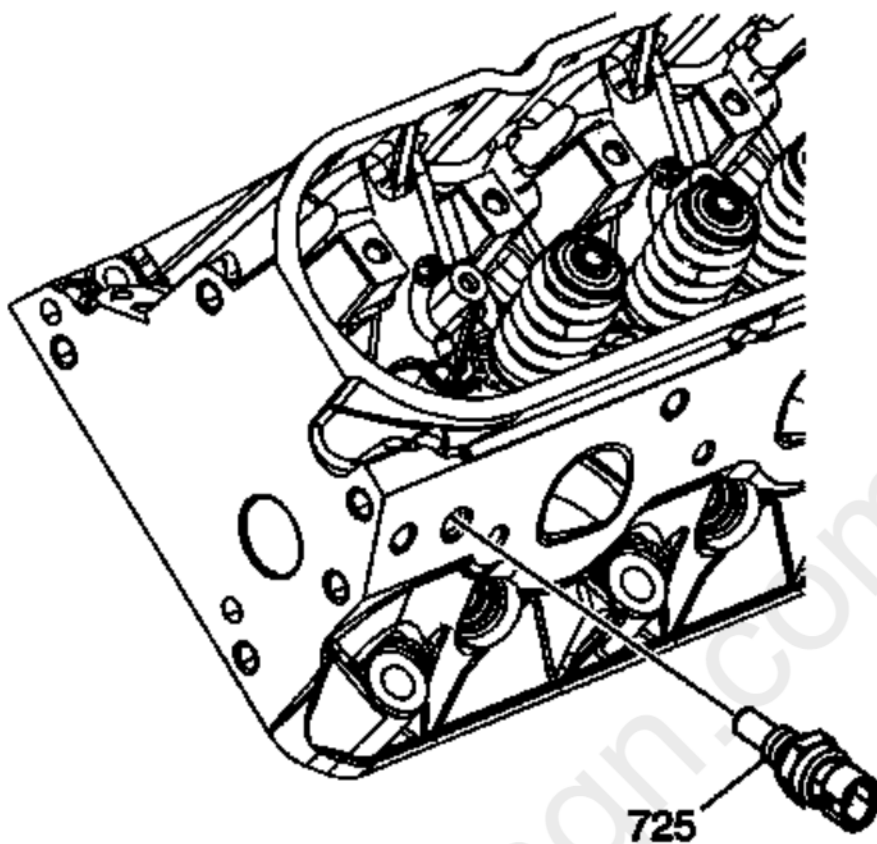


Fig. 177: Locating Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

9. Remove the coolant temperature sensor (725) from the left cylinder head.

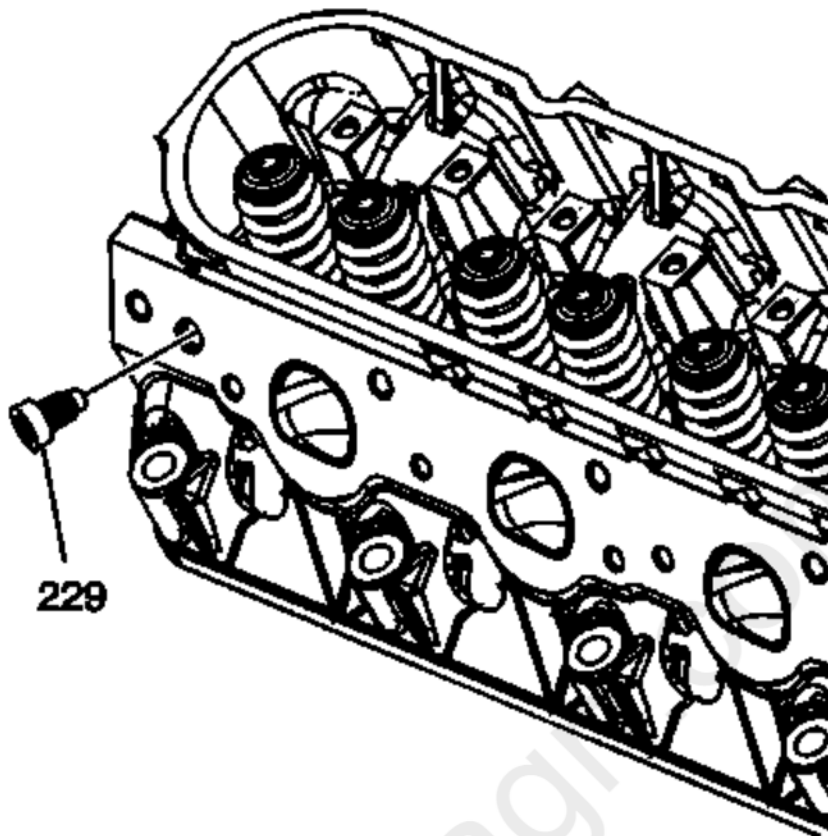


Fig. 178: Locating Coolant Plug
Courtesy of GENERAL MOTORS CORP.

10. Remove the cylinder head plug (229) from the right cylinder head.

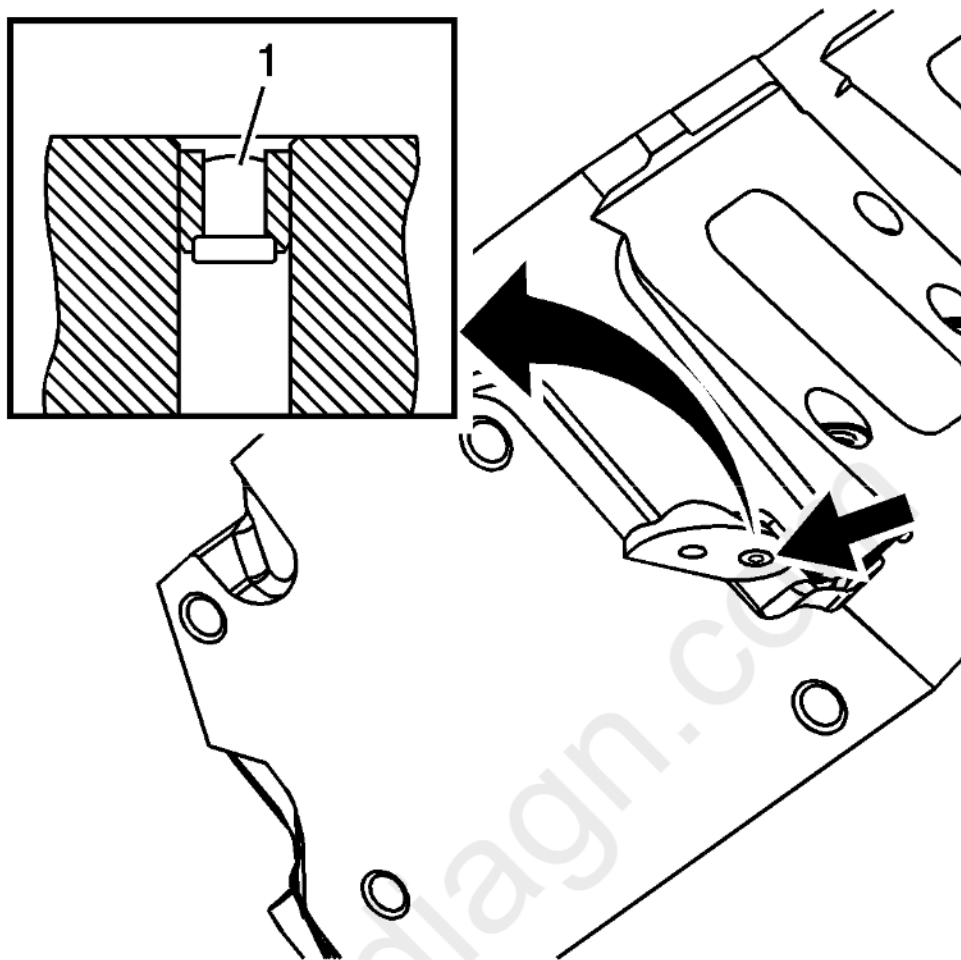


Fig. 179: Rivet-Type Plug

Courtesy of GENERAL MOTORS CORP.

11. Inspect for a leaking plug (1) at the top rear coolant passage of each cylinder head. If service of a leaking plug is required, it is necessary to remove the cylinder head from the engine to properly remove the plug.

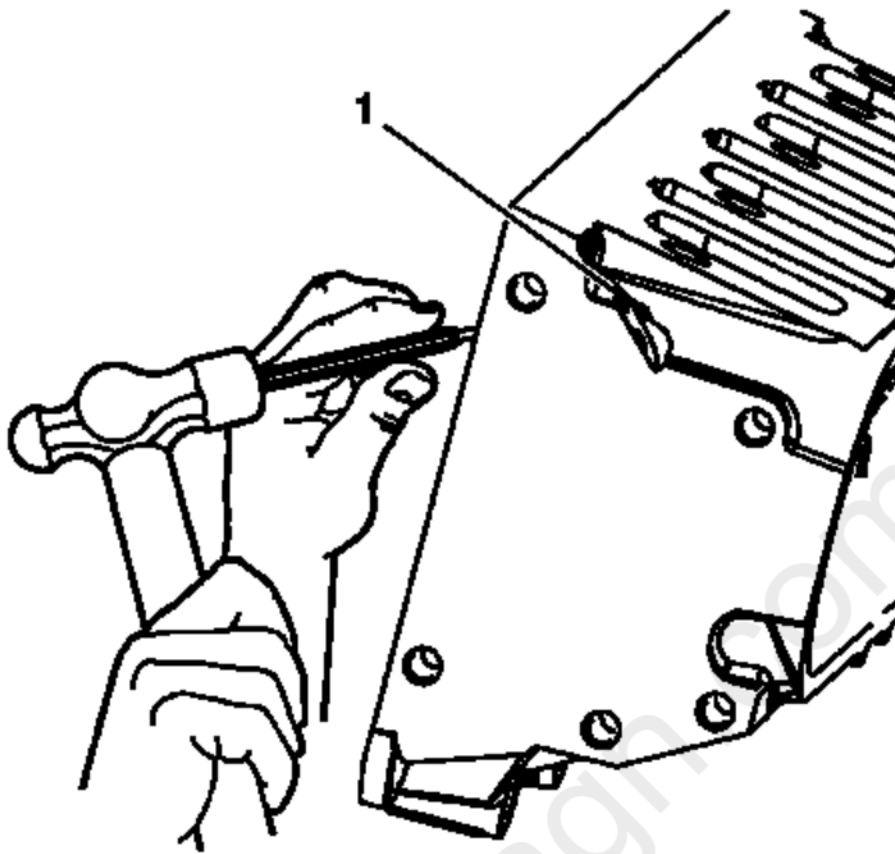


Fig. 180: View Of Plug Assembly
Courtesy of GENERAL MOTORS CORP.

12. Using a 6.43 mm (0.25 in) or smaller punch, remove the plug assembly (1) from the cylinder head.

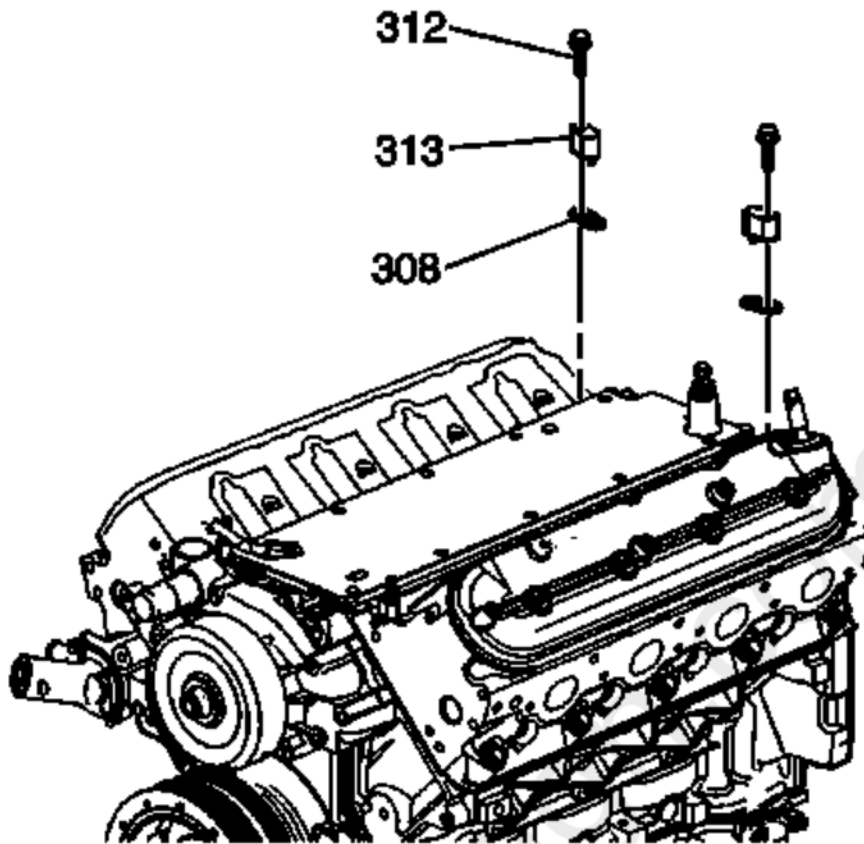


Fig. 181: Engine Coolant Air Bleed Cover, Bolts & Seals
Courtesy of GENERAL MOTORS CORP.

13. If plug removal is required, install either a new plug or a first design coolant air bleed cover (313), seal (308), and bolt (312) to complete the repair. Refer to Cylinder Head Assemble

CYLINDER HEAD CLEANING AND INSPECTION

Special Tools

- **J 8089:** Carbon Removal Brush
- **J 9666:** Valve Spring Tester

For equivalent regional tools, refer to Special Tools

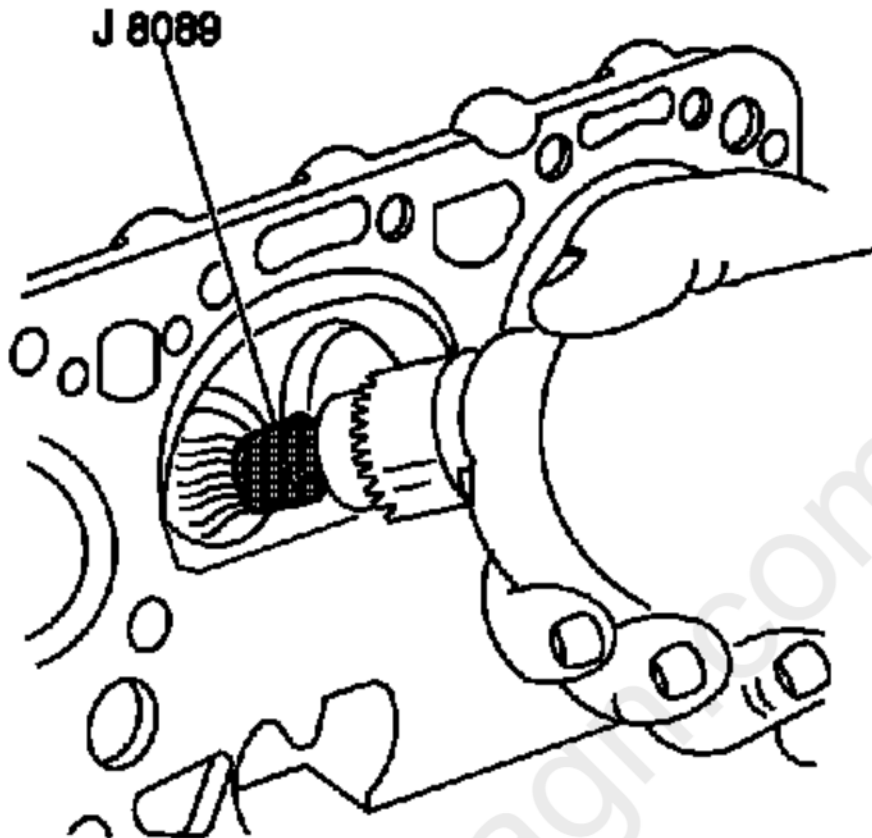


Fig. 182: Cleaning Carbon Using J 8089
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to SAFETY GLASSES WARNING .

NOTE:

- When cleaning a cylinder head in a thermal type oven, do not exceed 204°C (400°F).
- Be careful not to scuff the chamber.

1. Clean the following components:

- Use the **J 8089**: Brush in order to remove the carbon from the combustion chambers.
- Gasket surfaces

Refer to Replacing Engine Gaskets .

- Valve stems and heads on a buffing wheel
- Bolt hole threads

Remove all dirt, debris, or threadlocking material from the bolt holes.

2. Inspect the cylinder head for the following conditions:
 1. Cracks in the exhaust ports and combustion chambers
 2. External cracks in the water chambers
 3. Gasket surfaces for excessive scratches or gouging

Refer to **Replacing Engine Gaskets** .

4. Bolt hole threads for debris or damaged threads

Refer to **Thread Repair** or **Thread Repair Specifications** .

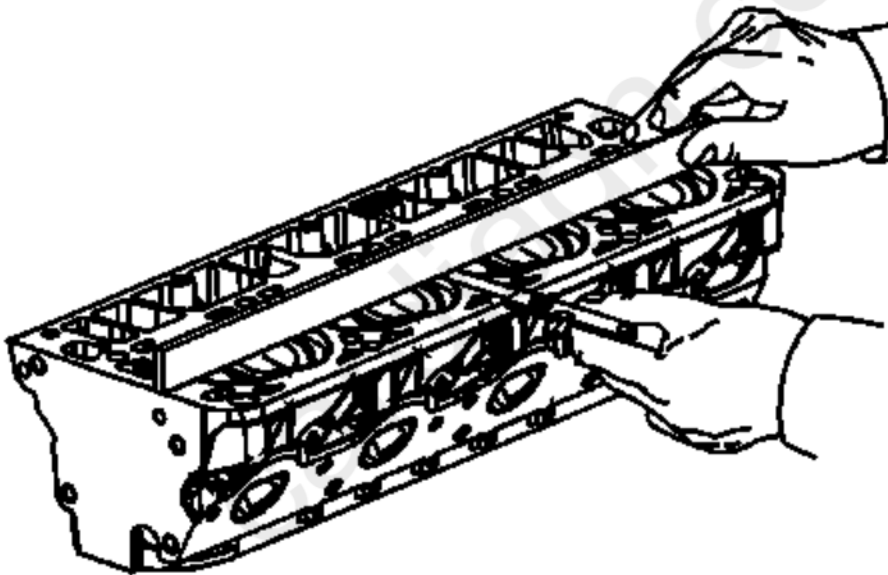


Fig. 183: Inspecting Cylinder Head For Warpage
Courtesy of GENERAL MOTORS CORP.

3. Inspect the cylinder head for warpage. Refer to **Engine Mechanical Specifications** .

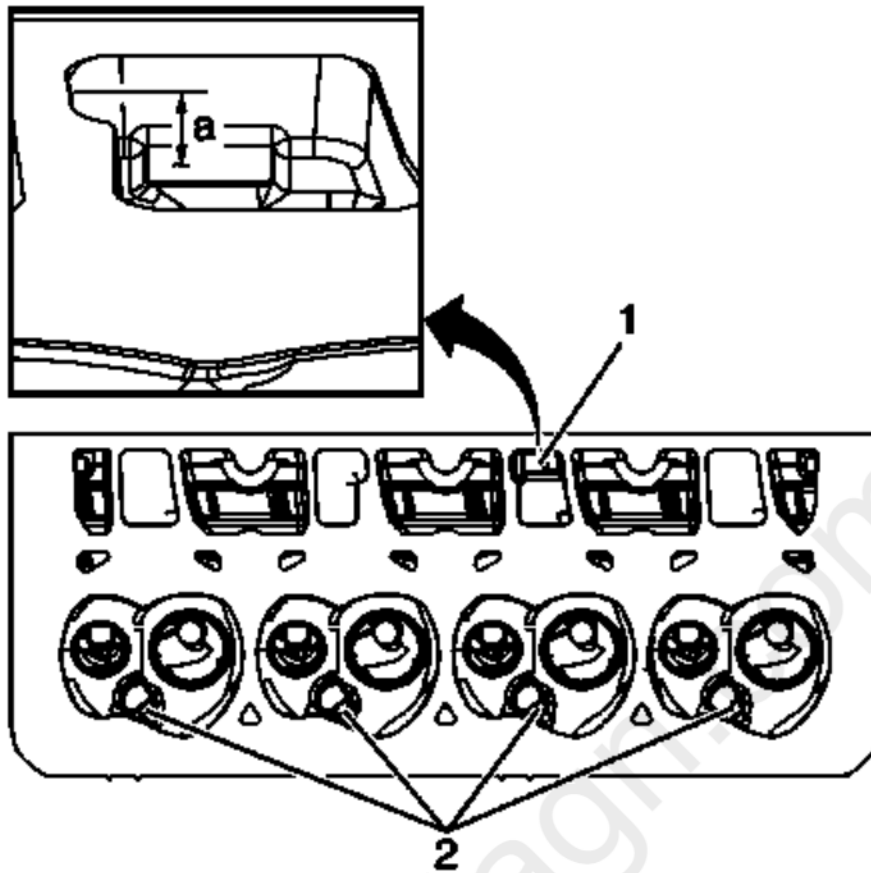


Fig. 184: Identifying Machining Pads
Courtesy of GENERAL MOTORS CORP.

4. Cylinder heads that have excessive warpage or a damaged sealing surface can be machined as required. Determine the cylinder head thickness as measured from the cast in place machining pads (1 and 2) to the head deck sealing surface. A cylinder head that measures less than 6.88-7.12 mm (0.271-0.283 in) (a) cannot be machined and must be replaced.

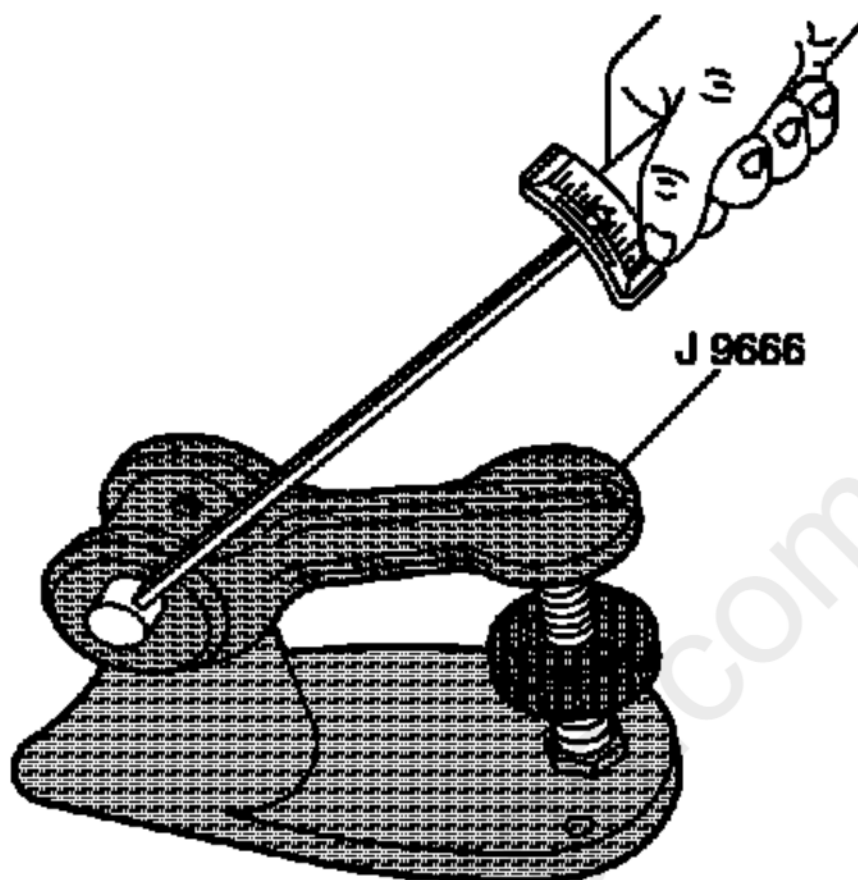


Fig. 185: Measuring Valve Spring Tension
Courtesy of GENERAL MOTORS CORP.

5. Use the **J 9666**: Tester in order to measure the valve spring tension. Refer to **Engine Mechanical Specifications** .

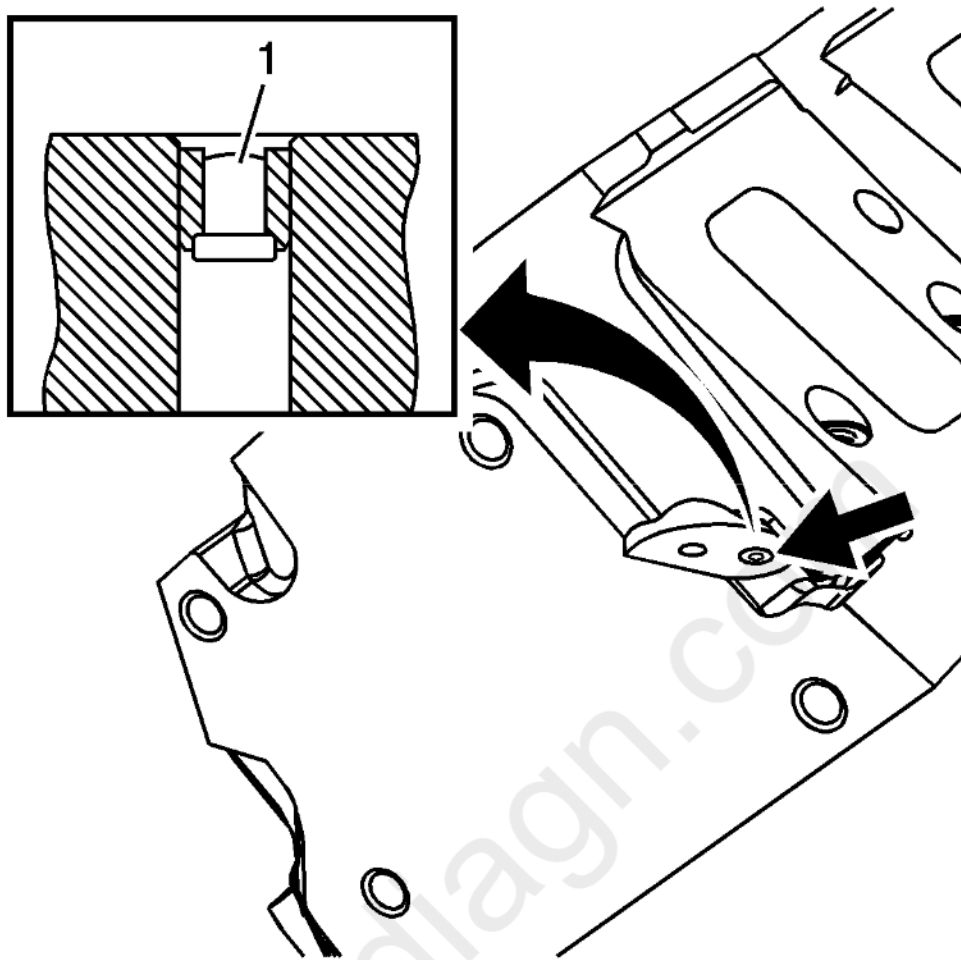


Fig. 186: Rivet-Type Plug

Courtesy of GENERAL MOTORS CORP.

6. Inspect for a leaking plug. Production applications use a rivet-type plug (1) at the top rear coolant passage of each cylinder head. If service of a leaking plug is required, it is necessary to remove the cylinder head from the engine to properly remove the plug. Refer to **Cylinder Head Disassemble**

VALVE GUIDE REAMING, AND VALVE AND SEAT GRINDING (6.2L)

SPECIAL TOOLS

J 8001: Dial Indicator Set

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

VALVE GUIDE REAMING

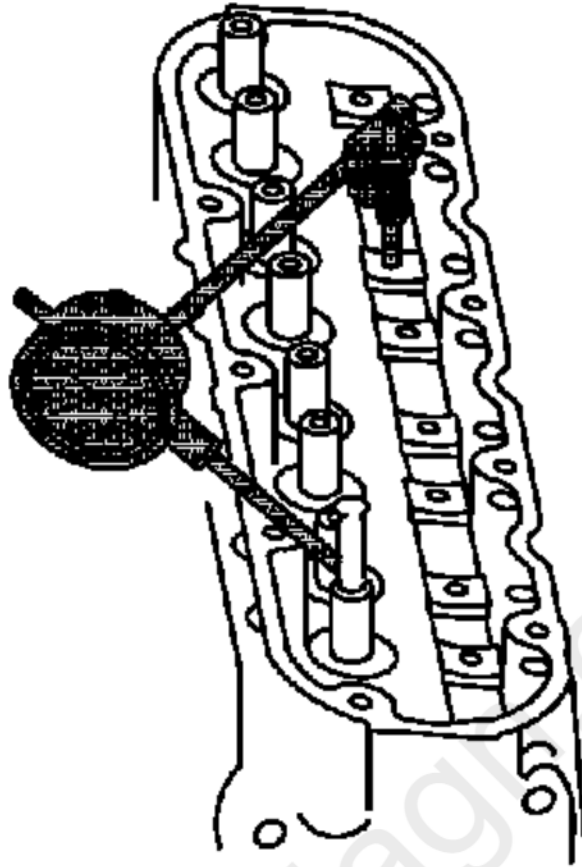


Fig. 187: Measuring Valve Stem-To-Guide Clearance
Courtesy of GENERAL MOTORS CORP.

CAUTION: Excessive valve stem-to-guide clearance may cause a noisy valve train, premature valve stem oil seal wear, component damage, and/or excessive engine oil consumption.

CAUTION: Insufficient valve stem-to-guide clearance will result in noisy or sticking valves. Valves that are too tight may disturb engine smoothness or lead to component damage.

1. Using the **J 8001:** dial indicator, measure the valve stem-to-guide clearance. Position the tip of the dial indicator at the top of the valve guide.

Valve stem-to-guide clearance may also be obtained by using a micrometer to measure the valve stem diameter and a ball type measuring gauge to measure the guide bore.

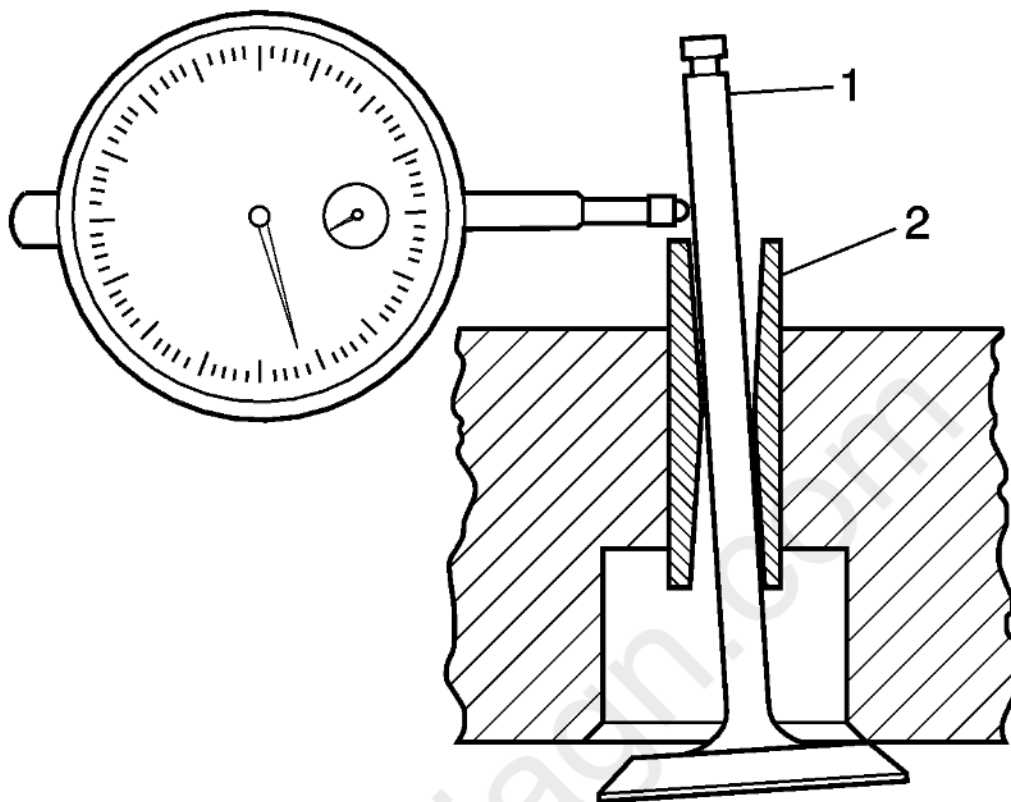


Fig. 188: Valve Stems & Valve Guide
Courtesy of GENERAL MOTORS CORP.

2. If the clearance measurement between the valve stem (1) and guide (2) is not within specification, the valve and/or the cylinder head must be replaced. Refer to **Engine Mechanical Specifications** .

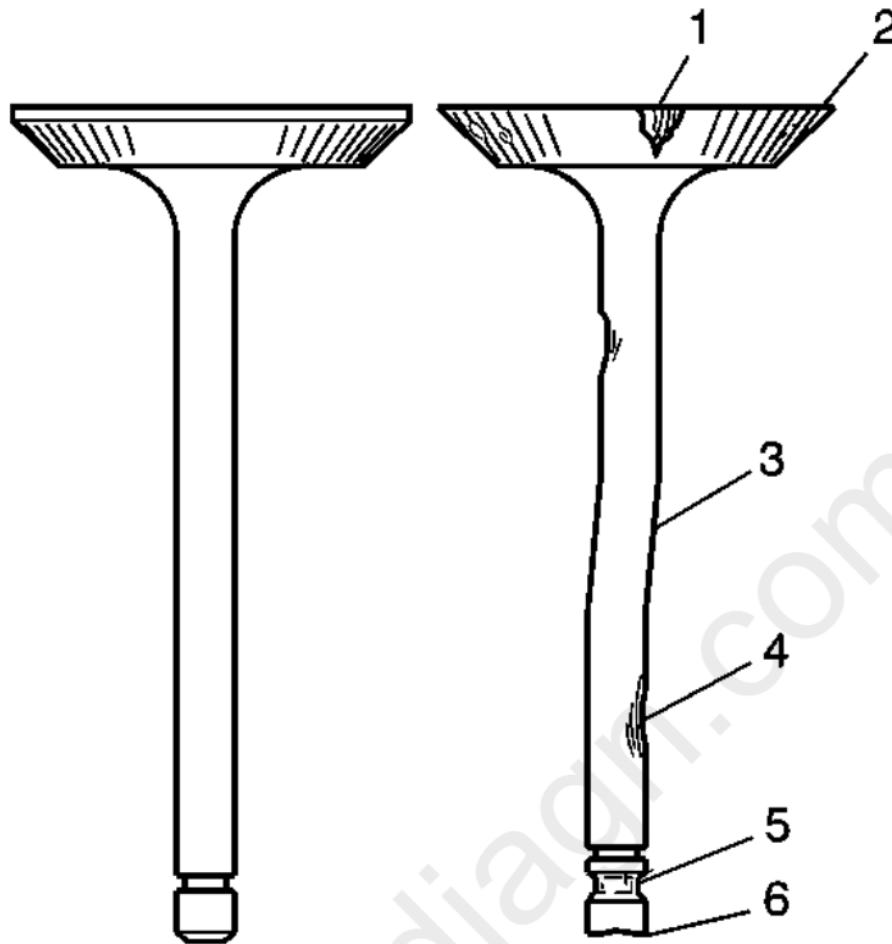


Fig. 189: View Of Inspection Points For Valves Damage
 Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve stems for excessive scoring, wear, or warpage.
 - A valve stem that has excessive scoring (3 or 4) or wear (4 or 6) must be replaced.
 - If a valve guide is worn or has excessive stem-to-guide clearance, the cylinder head should be replaced.
4. Measure the valve stem diameter. If the valve stem diameter is not within specification, the valve must be replaced. Refer to **Engine Mechanical Specifications** .

If the valve stem diameter is within specifications, and the stem-to-guide clearance is excessive, the cylinder head must be replaced.

VALVE AND SEAT GRINDING

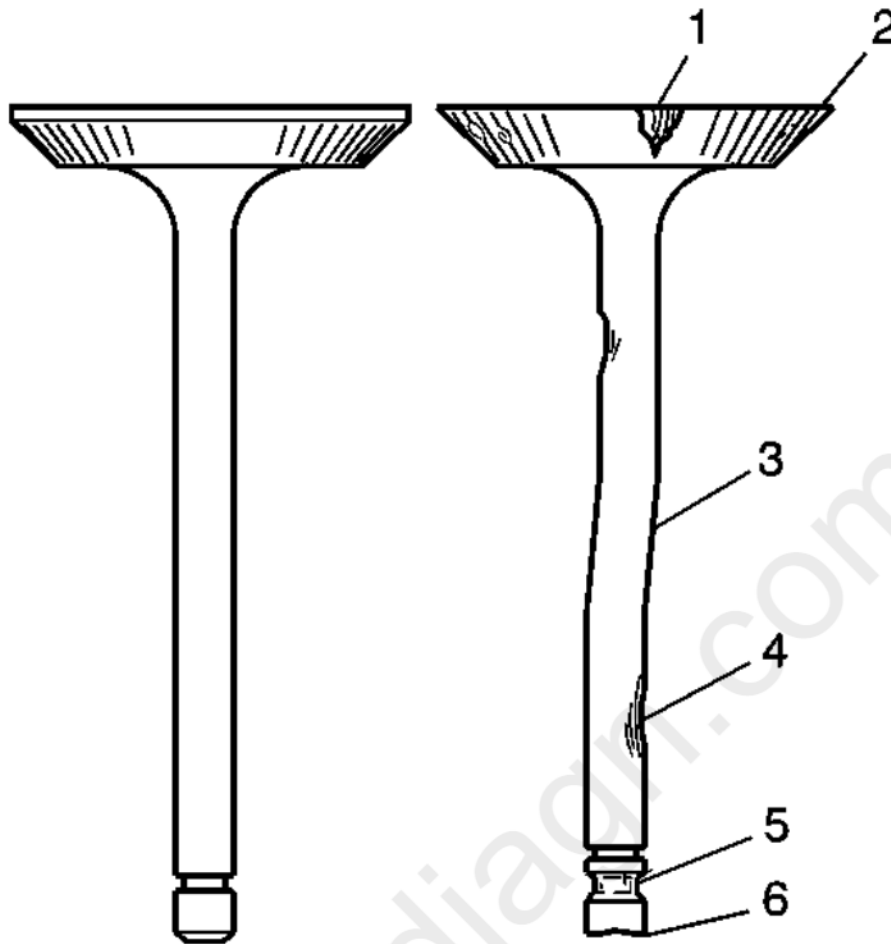


Fig. 190: View Of Inspection Points For Valves Damage
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Reconditioning the valve seats is very important. The seating of the valves must be perfect for the engine to deliver optimum power and performance. Several different types of equipment are available for grinding valve seats.
- Another important factor is the cooling of the valve head. Good contact between the valve and the seat will ensure that heat will be properly dissipated.
- The recommendations of the equipment manufacturer should be followed carefully to obtain the proper results. Regardless of the type of equipment used, it is essential that valve guide bores be free of carbon or dirt to ensure proper centering of the tool pilot in the guide.
- Valves that are pitted must be refaced to the proper angle. Valve

stems that show excessive wear, or valves that are warped excessively must be replaced. When a valve head that is warped excessively is refaced, a knife edge may be ground on part or all of the valve head due to the amount of metal that must be removed. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head, margin, is not within specification after grinding, replace the valve.

- Several different types of equipment are available for refacing valves. The recommendation of the equipment manufacturer should be carefully followed to obtain the proper results.
- **DO NOT** reface intake valves. Intake valves with excessive wear or damage **MUST** be replaced.

1. Inspect the valve for the following conditions:

- Burnt or eroded areas (1)
- A worn margin (2)
- A bent stem (3)
- A worn or scored stem (4)
- A worn key groove (5)
- A worn stem tip (6)

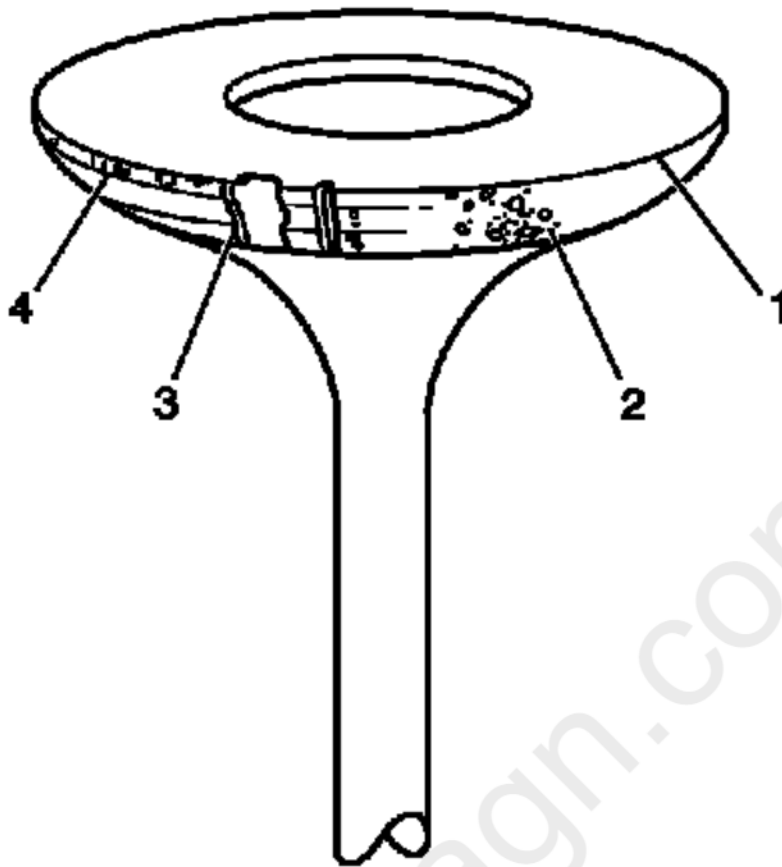


Fig. 191: Valve Face Burning, Pitting & Cracking
Courtesy of GENERAL MOTORS CORP.

2. Inspect the valve face for the following conditions:
 - Worn or no margin (1 or 4)
 - Pitted surfaces (2)
 - Burnt or eroded areas (3)

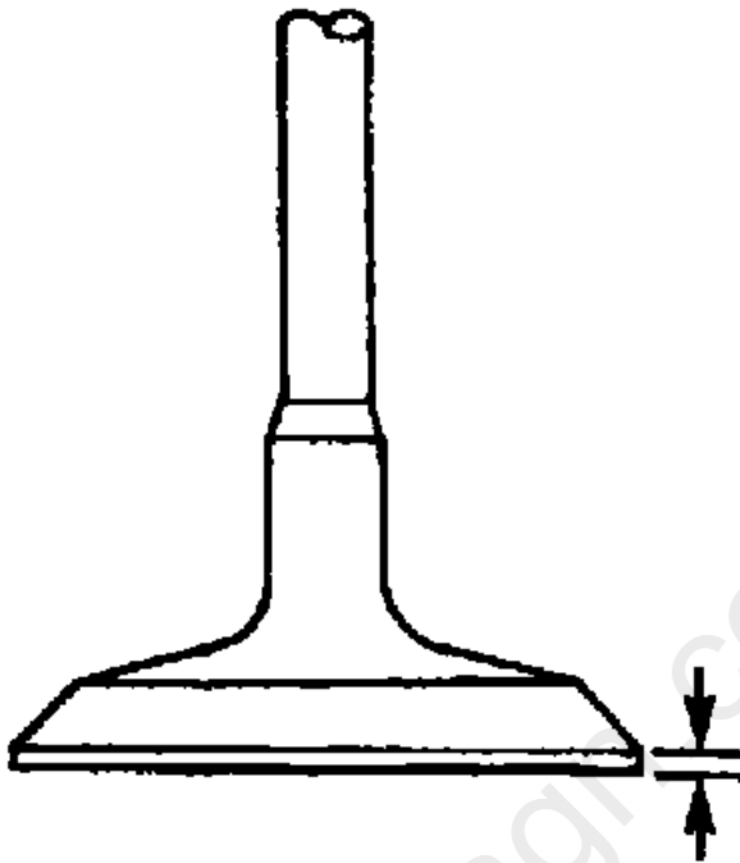


Fig. 192: Valve Margin

Courtesy of GENERAL MOTORS CORP.

3. Inspect the valve margin.

The exhaust valve may be refaced if the margin is within specification before grinding. Refer to **Engine Mechanical Specifications** .

4. Reface pitted exhaust valves on a suitable valve refacing machine.
5. Replace the valve if the margin is not within specification after grinding. Refer to **Engine Mechanical Specifications** .
6. If the valve face has been ground, measure the valve spring installed height after reassembly of the cylinder head. The valve, and/or cylinder head must be replaced if the valve spring installed height is not within specification. Refer to **Cylinder Head Assemble**.
7. Inspect for a loose valve seat in the cylinder head. The valve seat has an interference fit to the cylinder head.
8. Clean the valve guide bores with a suitable tool. Remove all carbon or dirt from the bores.

The valve guide must be clean for the seat grinding tool to obtain proper results.

9. Grind the valve seat.

The recommendations of the equipment manufacturer should be followed carefully to obtain the proper results. Regardless of the type of equipment used, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of the tool pilot in the guide.

10. Inspect the valve seats.

- The valve seats should be concentric to the centerline of the guide, measure valve seat runout. The total indicator runout reading must be within specification. Refer to **Engine Mechanical Specifications**.
- If the valve seat has been ground, measure the valve spring installed height after reassembly of the cylinder head. The cylinder head, and/or valve must be replaced if the valve spring installed height is not within specification after seat grinding. Refer to **Cylinder Head Assemble**.

CYLINDER HEAD ASSEMBLE

SPECIAL TOOLS

J 8062: Valve Spring Compressor - Head Off

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

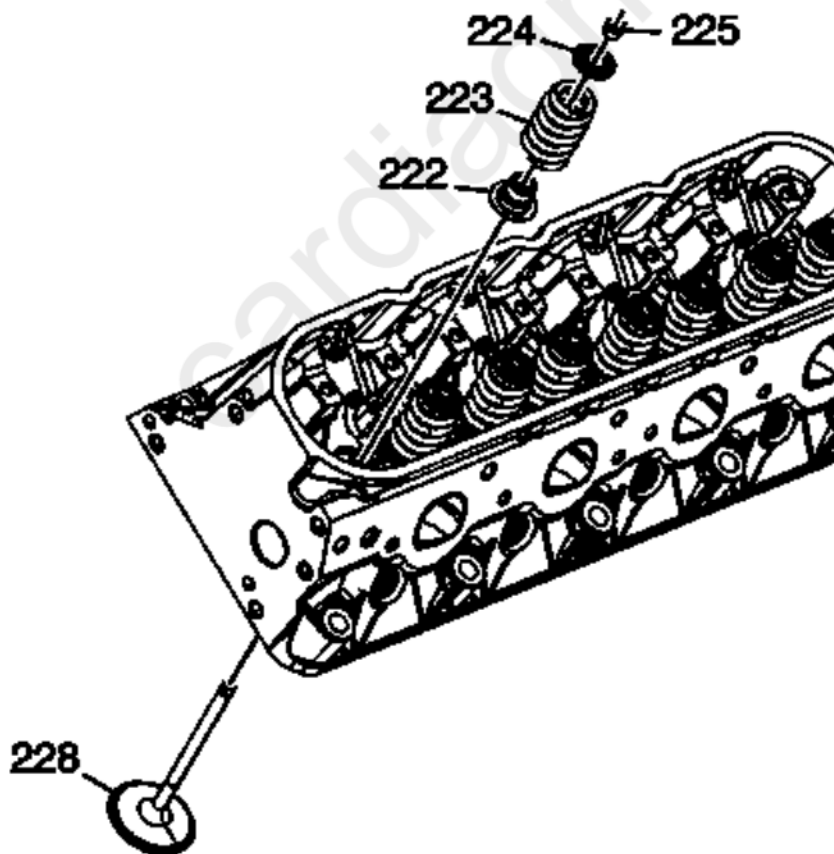


Fig. 193: Valve Stem Keys, Valve Spring Cap & Valve Spring

Courtesy of GENERAL MOTORS CORP.

1. Clean the cylinder head valve spring shim area.

NOTE: When using the valves and related components again, install the parts to their original location.

2. Install the valves (228) into the proper port. Refer to Separating Parts
3. Install a NEW valve stem oil seal (222).
4. Install the valve spring (223).
5. Install the valve spring cap (224).

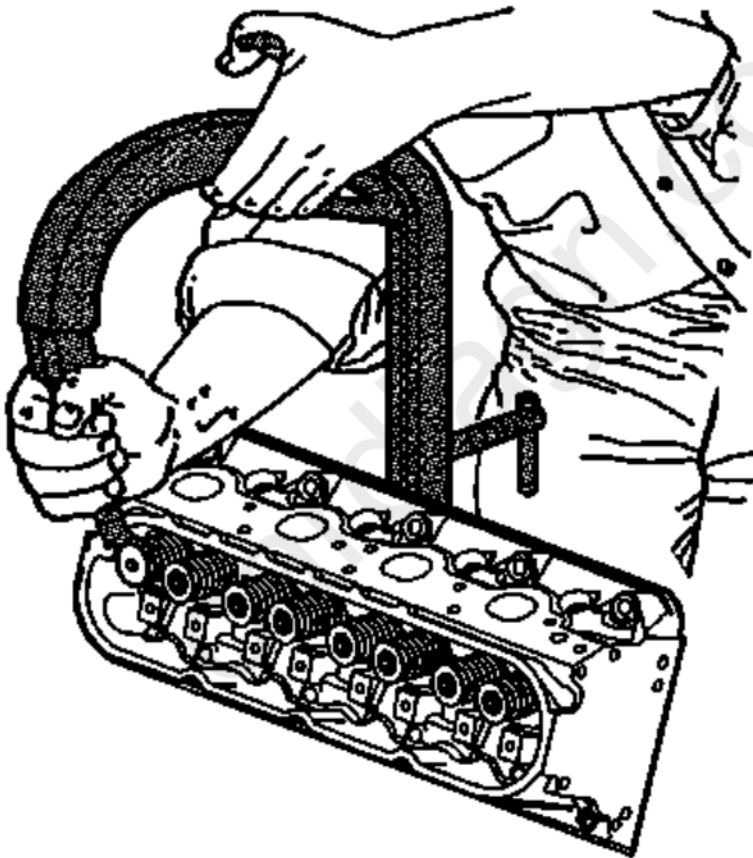


Fig. 194: View Of Compressing Valve Spring Using Special Tool J8062
Courtesy of GENERAL MOTORS CORP.

6. Using the **J 8062**: spring compressor, compress the valve spring.
7. Install the valve stem keys.
 1. Use grease in order to hold the keys in place and remove the **J 8062**: spring compressor.

2. Ensure the keys seat properly in the groove of the valve stem.
3. Tap the end of the valve stem with a plastic face hammer to seat the keys, if necessary.

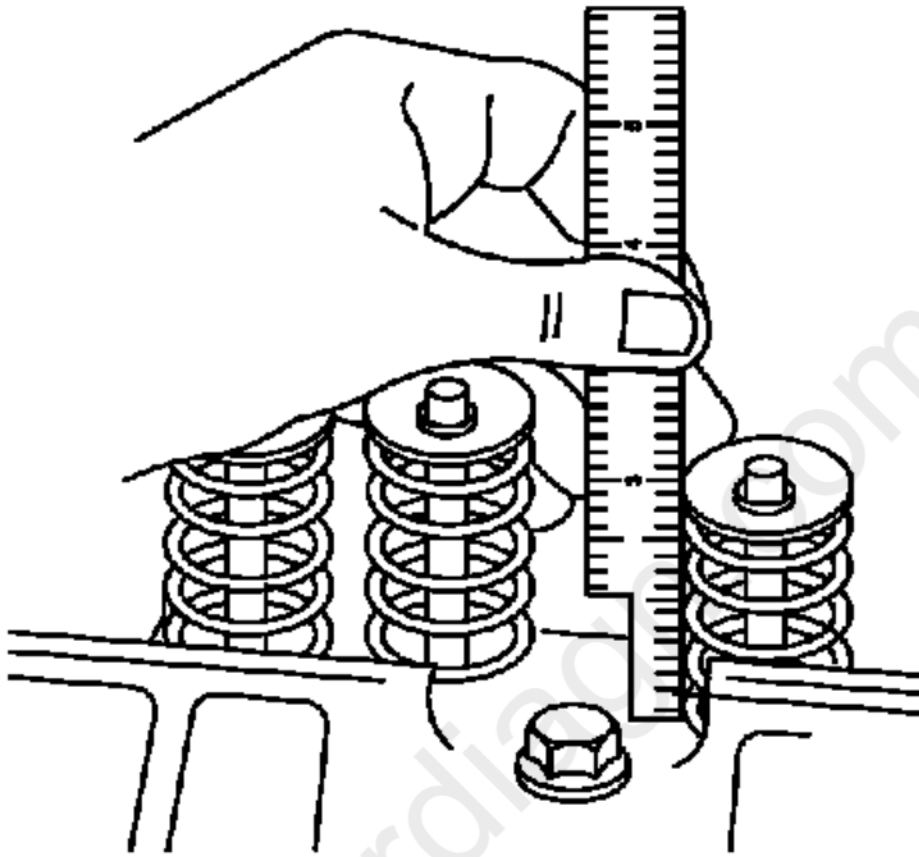


Fig. 195: Measuring Valve Spring Installed Height
Courtesy of GENERAL MOTORS CORP.

8. After installation, measure the valve spring installed height.

Measure from the base of the valve spring to the top of the valve spring. If the spring installed height is not within specification, the valve and/or cylinder head must be replaced. Refer to **Engine Mechanical Specifications**

9. Install the remaining valves, springs, and other components.

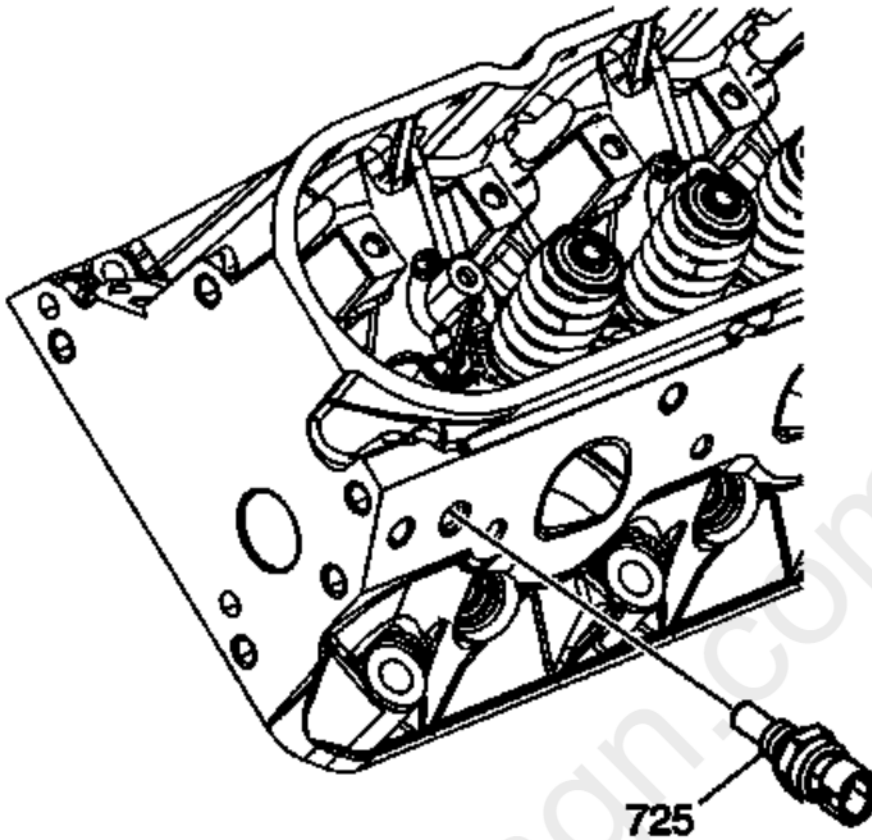


Fig. 196: Locating Coolant Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

10. Install sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent, to the threads of the coolant temperature sensor (725).

CAUTION: Refer to **FASTENER CAUTION** .

11. Install the coolant temperature sensor into the left cylinder head and tighten to 20 N.m (15 lb ft).

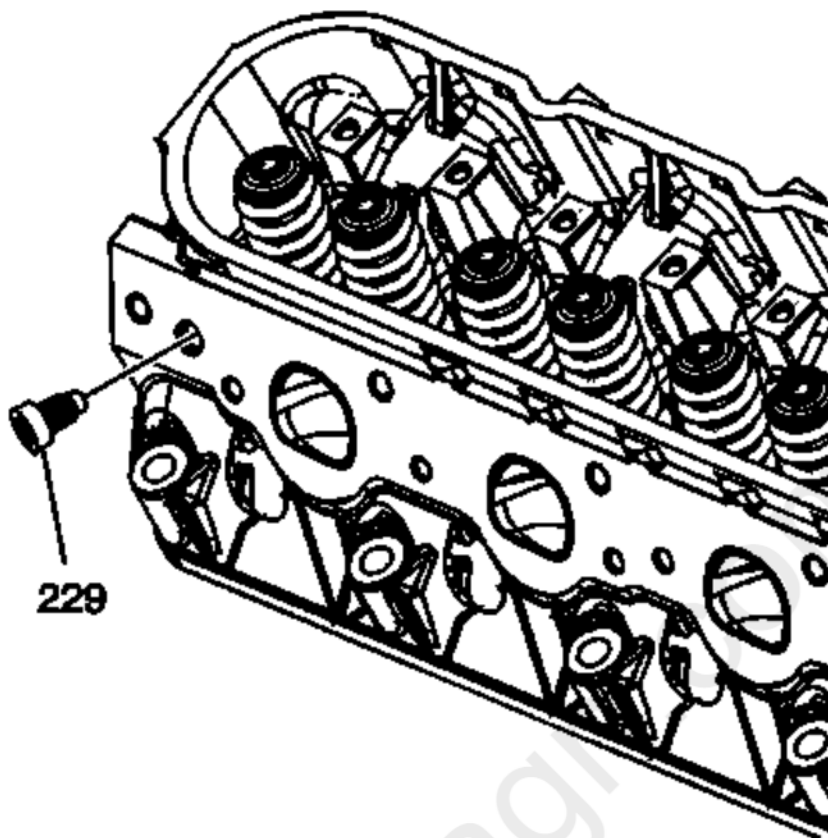


Fig. 197: Locating Coolant Plug
Courtesy of GENERAL MOTORS CORP.

12. Install sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent, to the threads of the cylinder head plug (229).
13. Install the cylinder head plug to the right cylinder head and tighten to 20 N.m (15 lb ft).

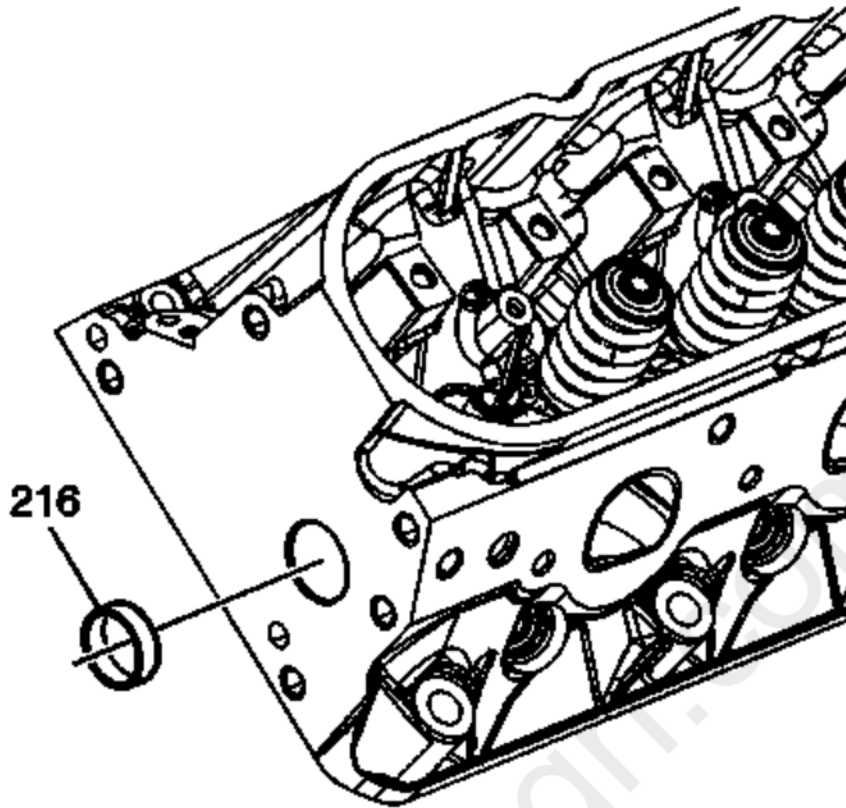


Fig. 198: Locating Cylinder Head Core Hole Plug
 Courtesy of GENERAL MOTORS CORP.

14. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the sides of the cylinder head plugs (216).
15. Install the cylinder head plugs into the cylinder head.

A properly installed plug should be installed 2.5 mm (0.1 in) below the end face of the head.

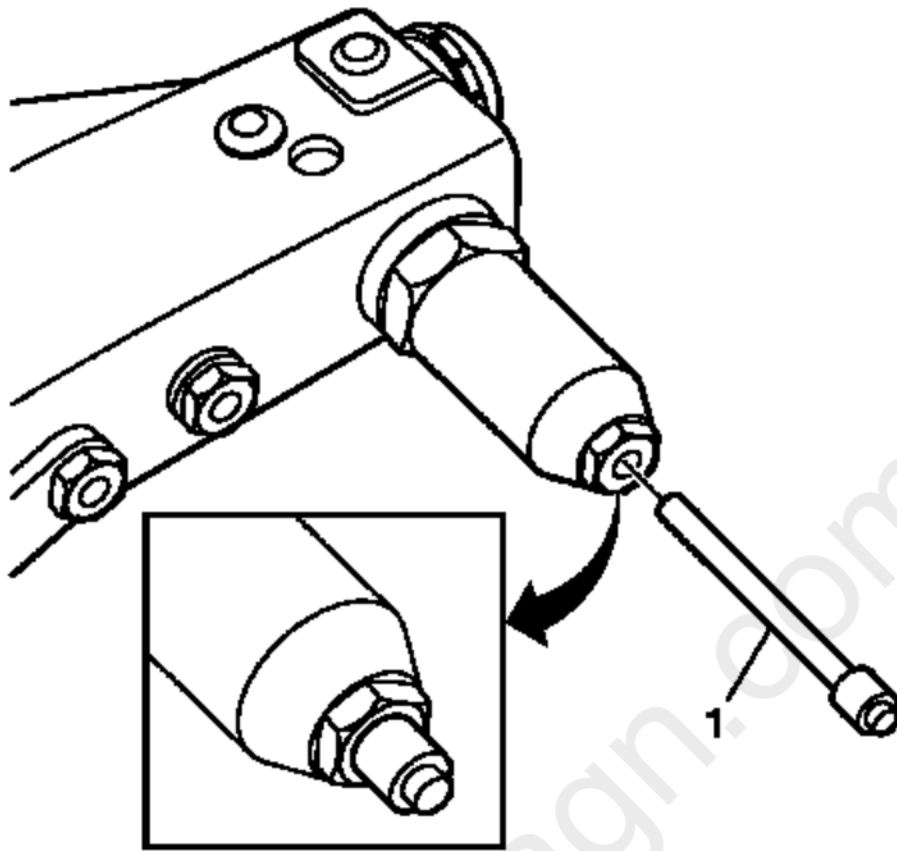


Fig. 199: Rivet Plug

Courtesy of GENERAL MOTORS CORP.

16. Install the rivet plug (1) into a rivet gun.

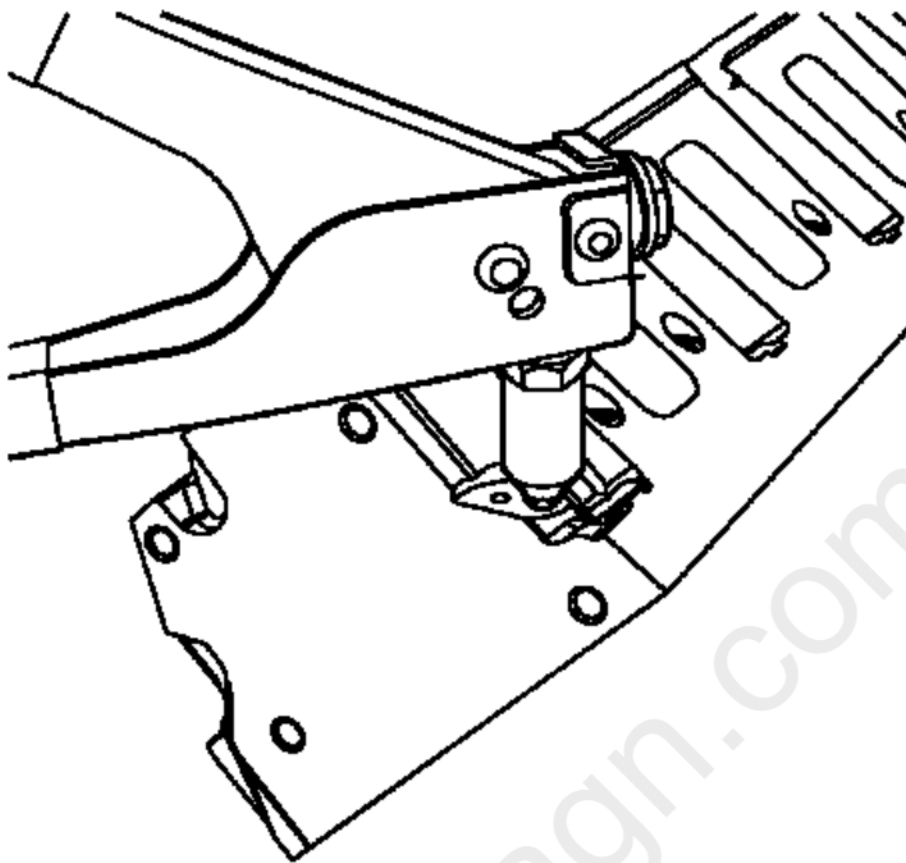


Fig. 200: Illustrating Rivet Installation
Courtesy of GENERAL MOTORS CORP.

17. Insert the rivet into the coolant passage of the cylinder head.
18. Squeezing the handle of the tool, install the rivet.

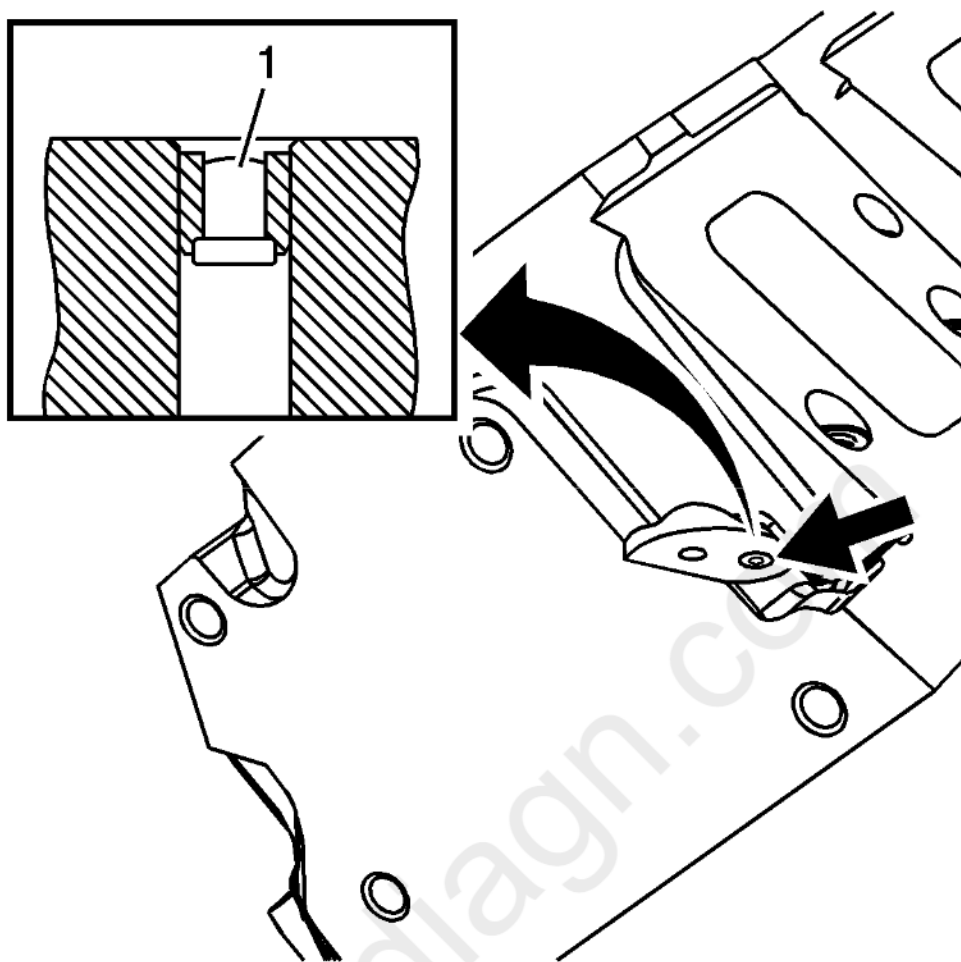


Fig. 201: Rivet-Type Plug
Courtesy of GENERAL MOTORS CORP.

19. Inspect for proper installation of the rivet (1).

A properly installed plug should be installed flush with the surface of the head.

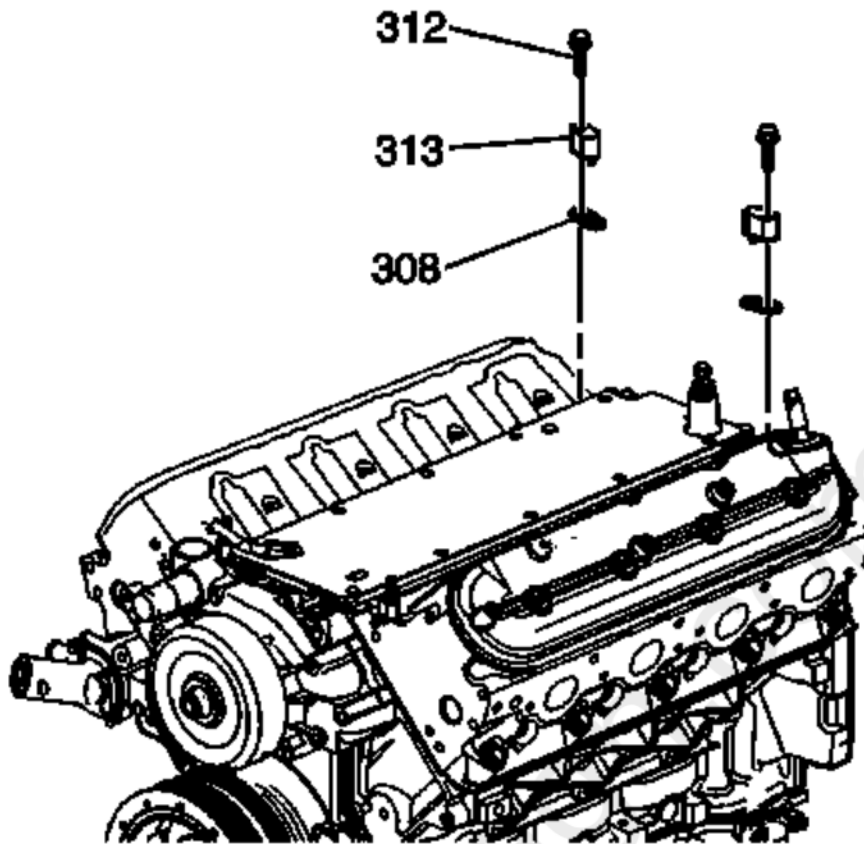


Fig. 202: Engine Coolant Air Bleed Cover, Bolts & Seals
 Courtesy of GENERAL MOTORS CORP.

20. Installation of the first design coolant air bleed cover (313) and bolt (312) may be used instead of the rivet plug to complete the repair. Tighten the coolant air bleed bolts to 12 N.m (106 lb in).

OIL PUMP DISASSEMBLE (6.2L)

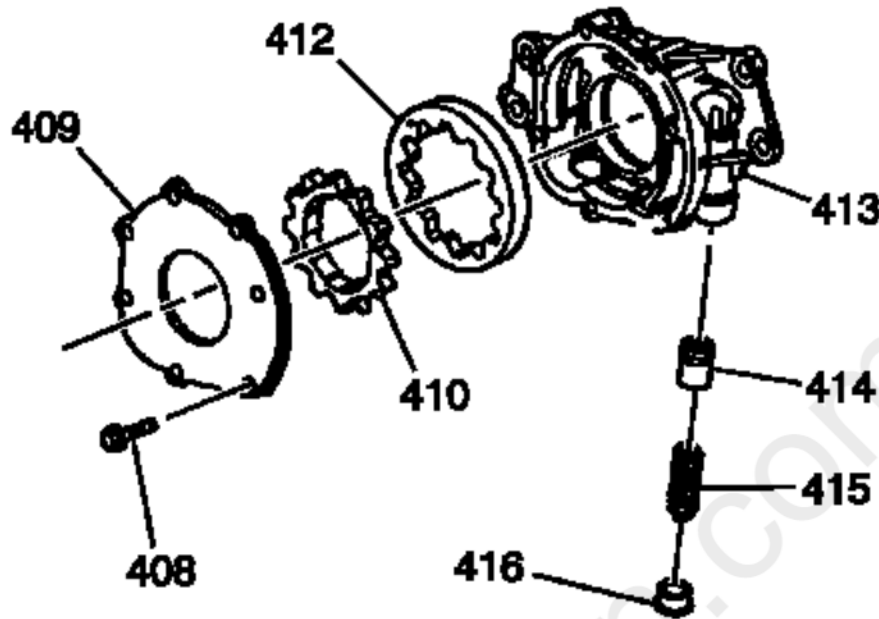


Fig. 203: Exploded View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The internal parts of the oil pump assembly are not serviced separately, excluding the spring. If the oil pump components are worn or damaged, replace the oil pump as an assembly.

1. Remove the oil pump cover bolts (408).
2. Remove the oil pump cover (409).

IMPORTANT: Mark or identify the gears for assembly. Refer to Separating Parts .

3. Remove the drive gear (410).
4. Remove the driven gear (412).
5. Remove the pressure relief valve plug (416).
6. Remove the pressure relief valve spring (415).
7. Remove the pressure relief valve (414).
8. Inspect the oil pump components. Refer to Oil Pump Cleaning and Inspection (6.2L) .

2011 ENGINE

Engine Mechanical - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - Repair Instructions - Off Vehicle - CTS

OIL PUMP CLEANING AND INSPECTION (6.2L)

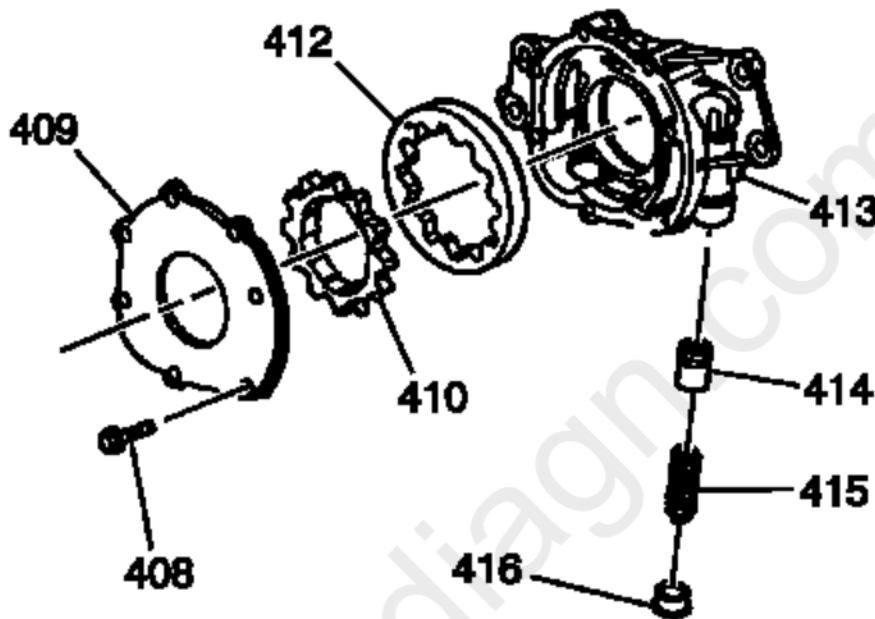


Fig. 1: Exploded View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The internal parts of the oil pump assembly are not serviced separately, excluding the spring. If the oil pump components are worn or damaged, replace the oil pump as an assembly.
- The oil pump pipe and screen are to be serviced as an assembly. Do not attempt to repair the wire mesh portion of the pump and screen assembly.

1. Clean the parts in solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

2. Dry the parts with compressed air.
3. Inspect the oil pump housing (413) and the cover (409) for cracks, excessive wear, scoring, or casting imperfections.
4. Inspect the oil pump housing-to-engine block oil gallery surface for scratches or gouging.
5. Inspect the oil pump housing for damaged bolt hole threads.
6. Inspect the relief valve plug (416) and plug bore for damaged threads.
7. Inspect the oil pump internal oil passages for restrictions.
8. Inspect the drive gear (410) and driven gear (412) for chipping, galling, or wear.

Minor burrs or imperfections on the gears may be removed with a fine oil stone.

9. Inspect the drive gear splines for excessive wear.
10. Inspect the relief valve spring (415) for cracks, scratches, and wear to coils in spring.
11. Inspect the pressure relief valve (414) and bore for scoring or wear.

The valve must move freely in the bore, with no restrictions.

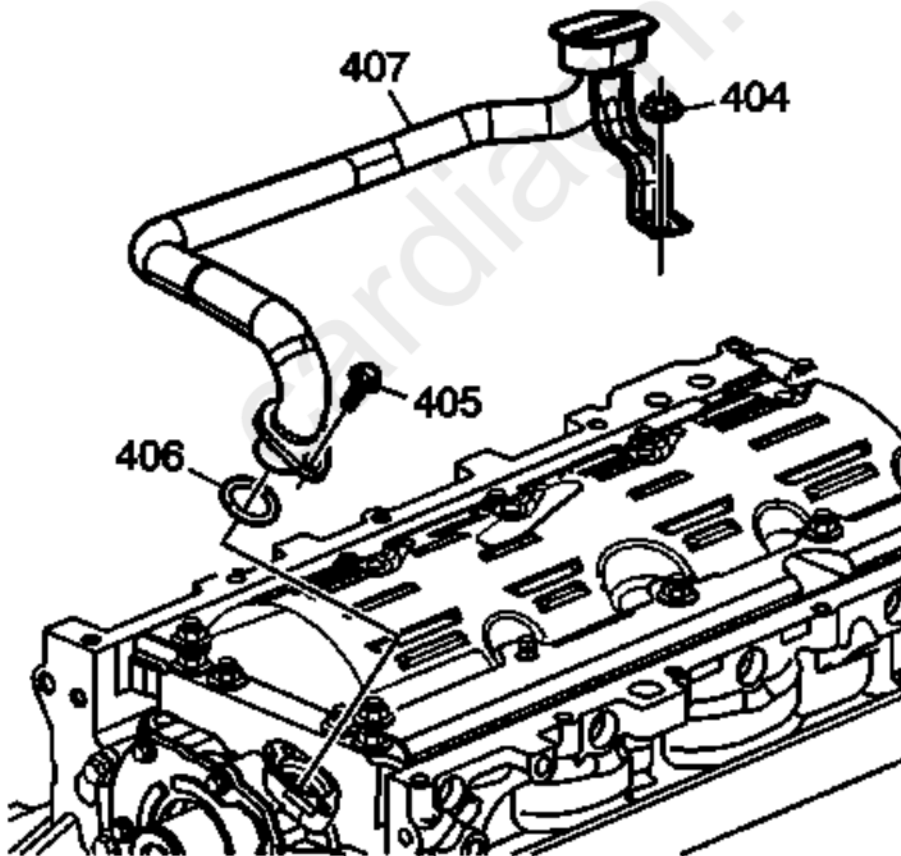


Fig. 2: Oil Pump Screen Bolt, Nut & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

12. Inspect the oil pump screen (407) for debris or restrictions.
13. Inspect the oil pump screen for broken or loose wire mesh.

OIL PUMP ASSEMBLY (6.2L)

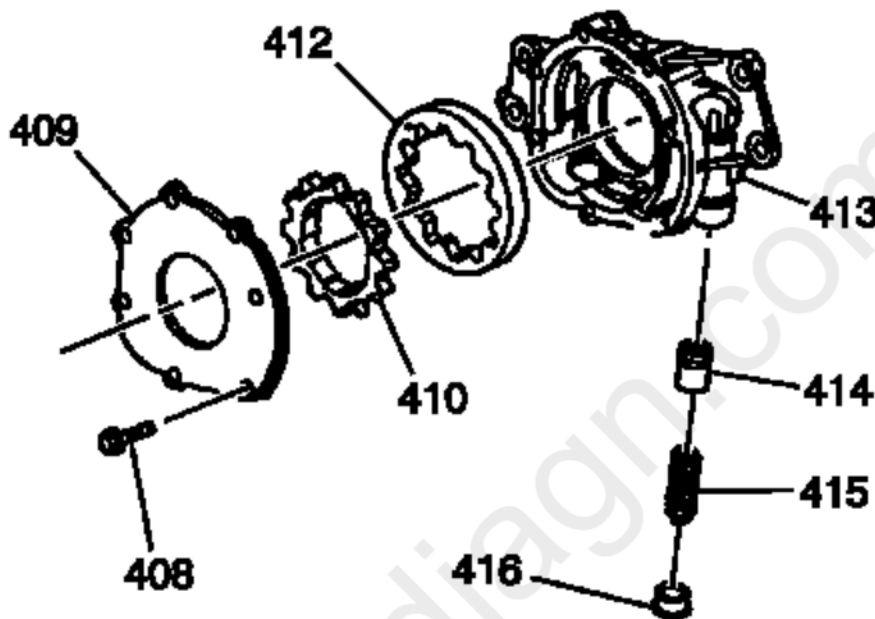


Fig. 3: Exploded View Of Oil Pump
Courtesy of GENERAL MOTORS CORP.

NOTE: Prior to assembling the oil pump, coat all wear or internal surfaces with clean engine oil.

1. Install the driven gear (412) into the pump housing (413).

Install the driven gear with the orientation mark facing the pump cover.

2. Install the drive gear (410) into the pump housing.
3. Install the oil pump cover (409).

CAUTION: Refer to FASTENER CAUTION .

4. Install the oil pump cover bolts (408) and tighten to 12 N.m (106 lb in).
5. Install the relief valve (414).
6. Install the relief valve spring (415).
7. Install the relief valve plug (416) and tighten to 12 N.m (106 lb in).
8. Inspect the oil pump for smooth operation by rotating the drive gear.

PISTON OIL NOZZLE CLEANING AND INSPECTION

NOTE: The piston oil nozzle assembly is designed to provide oil to the bottom side of the piston for cooling purposes. The internal check ball is held in the normally closed position by the spring until system oil pressure exceeds 20.7 kPa (43.5 psi).



Fig. 4: View Of Piston Oil Nozzle Assembly
Courtesy of GENERAL MOTORS CORP.

1. Clean the nozzle assembly in solution.
2. Inspect the nozzle assembly for the following:
 - damaged bolt threads

- damaged or cut O-ring seal
 - bent nozzle
 - A restricted or stuck-open nozzle assembly
3. With no oil pressure, the check ball should be seated and not permit flow through the nozzle tube. Using a blow gun, apply air pressure to the inlet portion of the bolt. Air pressure should unseat the check ball and permit flow through and out of the nozzle tube.

ENGINE FRONT COVER CLEANING AND INSPECTION (6.2L)

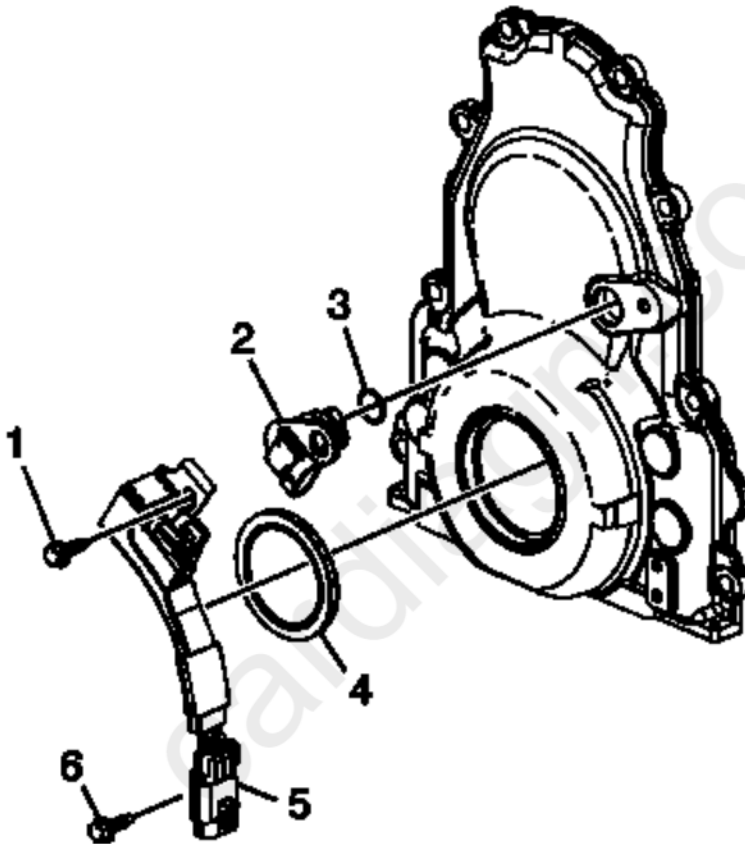


Fig. 5: View Of Front Cover, Oil Seal, Camshaft Position Sensor, Bracket & O Ring
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not use the crankshaft oil seal again. Install a **NEW** crankshaft oil seal during assembly.
- Do not use the front cover-to-engine block gasket again. Install a **NEW** gasket during assembly.

1. Remove the crankshaft oil seal (4) from the front cover.
2. Clean the cover in solvent. Remove the sealant from the cover oil pan surface. Refer to **Replacing**

Engine Gaskets .

WARNING: Refer to **SAFETY GLASSES WARNING** .

3. Dry the cover with compressed air.
4. Inspect the gasket sealing surfaces for excessive scratches or gouging.
5. Inspect the threaded bolt holes for damaged threads or debris.
6. Inspect the crankshaft oil seal and camshaft position (CMP) sensor mounting bores for damage.

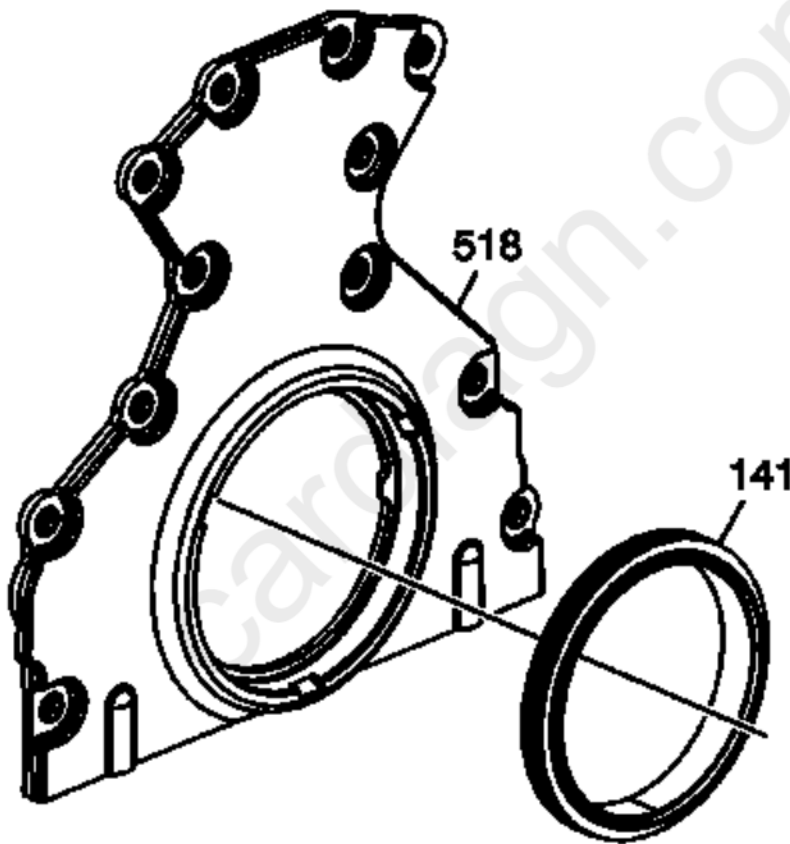
CRANKSHAFT REAR OIL SEAL HOUSING CLEANING AND INSPECTION

Fig. 6: Crankshaft Rear Oil Seal & Housing
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not use the crankshaft rear oil seal again. Install a **NEW** crankshaft oil seal during assembly.
- Do not use the rear housing-to-engine block gasket again. Install a **NEW** gasket during assembly.

1. Remove the crankshaft oil seal (141) from the rear housing.
2. Clean the housing in solvent. Remove the sealant from the housing oil pan surface. Refer to **Replacing Engine Gaskets** .

WARNING: Refer to **SAFETY GLASSES WARNING** .

3. Dry the housing with compressed air.
4. Inspect the gasket sealing surfaces for excessive scratches or gouging.
5. Inspect the housing-to-oil pan threaded bolt holes for damaged threads or debris.
6. Inspect the crankshaft oil seal mounting bore for damage.

ENGINE BLOCK VALLEY COVER CLEANING AND INSPECTION

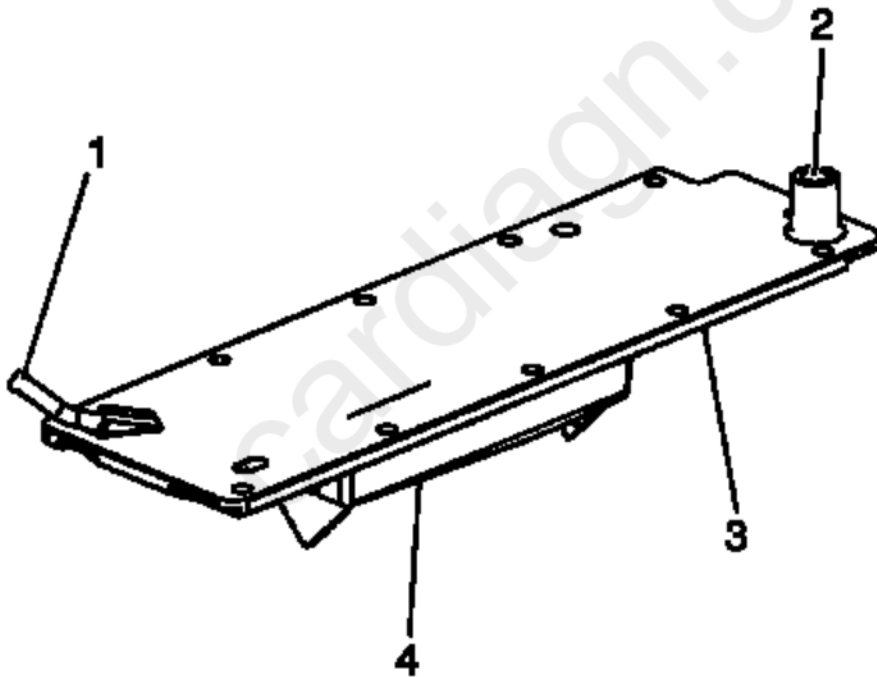


Fig. 7: PCV Passages, Damaged Threads & Damaged Sealing Surfaces
Courtesy of GENERAL MOTORS CORP.

1. Clean the valley cover in solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

2. Dry with compressed air.
3. Inspect for restrictions within the positive crankcase ventilation (PCV) passages (1, 4).
4. Inspect for damaged threads (2) and damaged sealing surfaces (3).

VALVE ROCKER ARM COVER CLEANING AND INSPECTION (6.2L)

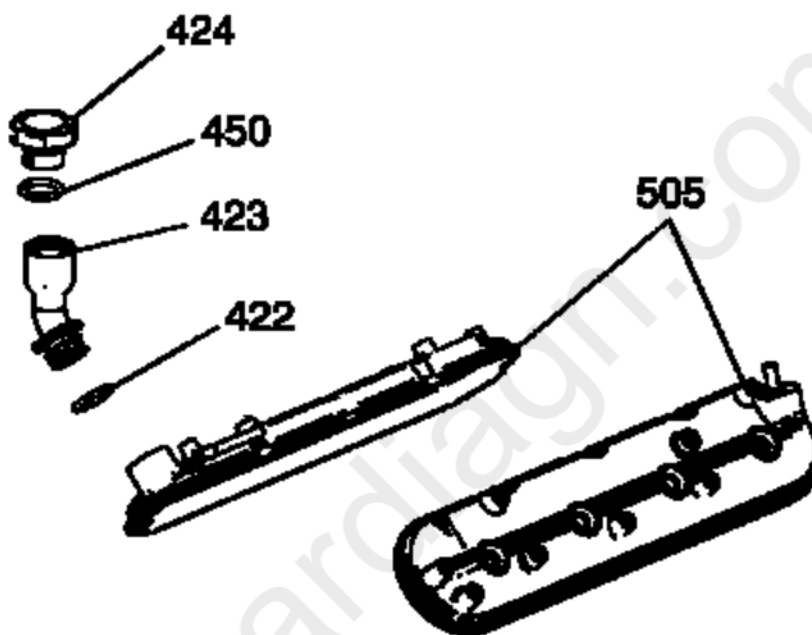


Fig. 8: View Of Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

IMPORTANT:

- Do not use the valve rocker arm cover gasket again. Install a **NEW** gasket during assembly.
- Remove the ignition coils before cleaning the cover in solvent. Do not submerge the ignition coils in solvent.
- Do not remove the oil fill tube from the covers unless service is required. If the tube is removed from the cover, install a **NEW** tube (423) and seal (422) during assembly.

1. Inspect the oil fill tube (423) for a loose fit or damage.
2. Inspect the covers (505) for the following conditions:
 - Scoring or damage to the gasket surfaces
 - Ventilation system passages for restrictions
 - Threaded bolt holes for damage or debris

OIL PAN CLEANING AND INSPECTION

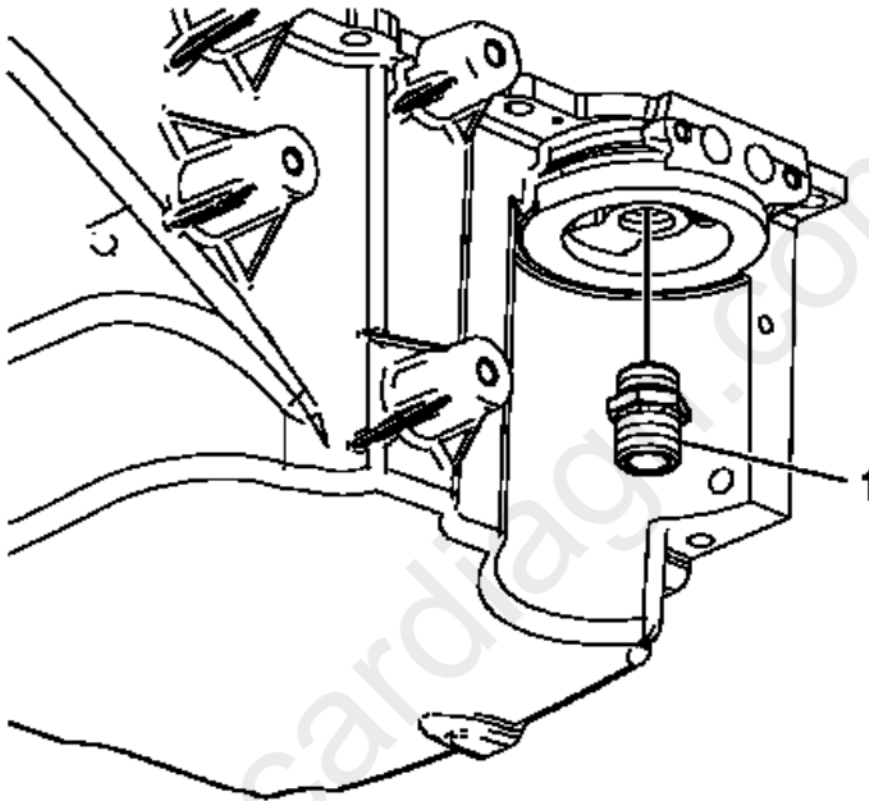


Fig. 9: Identifying Oil Filter Fitting
Courtesy of GENERAL MOTORS CORP.

1. Remove the oil filter fitting (1), as required.

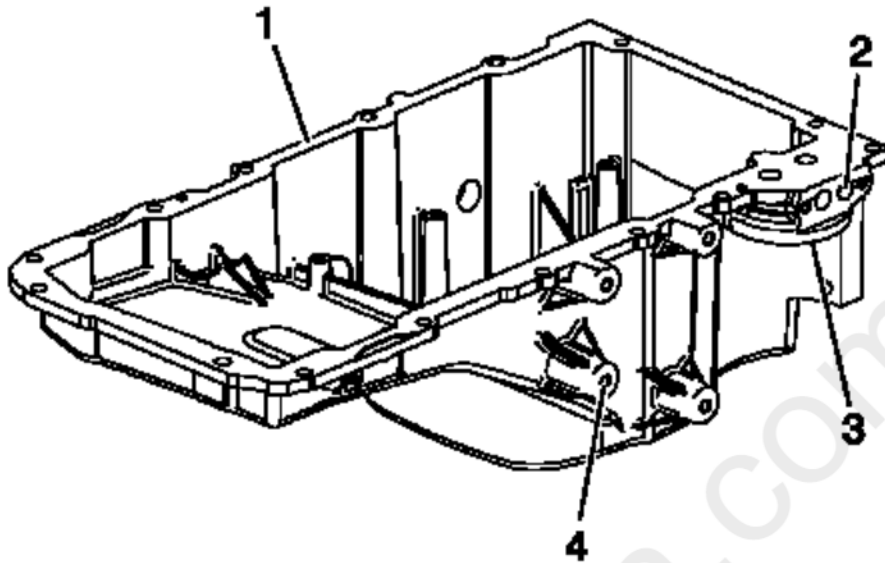


Fig. 10: Identifying Oil Pan Components
Courtesy of GENERAL MOTORS CORP.

2. Clean the oil pan in solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

3. Dry the oil pan with compressed air.
4. Inspect the oil pan for the following conditions:
 - Damaged gasket surfaces (1)
 - Restrictions within the oil passages (2) of the pan
 - Damaged oil filter seal surface (3)
 - Threaded bolt holes (4) for damage

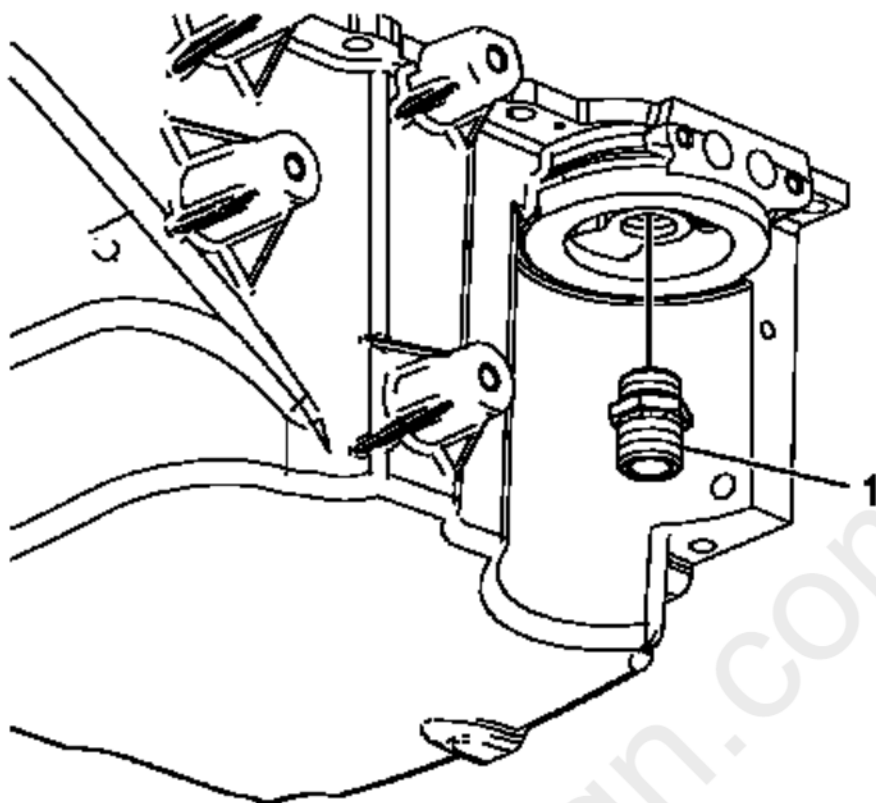


Fig. 11: Identifying Oil Filter Fitting
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

5. Install the oil filter fitting (1), as required, and tighten to 55 N.m (40 lb ft).

ENGINE OIL COOLER DISASSEMBLE

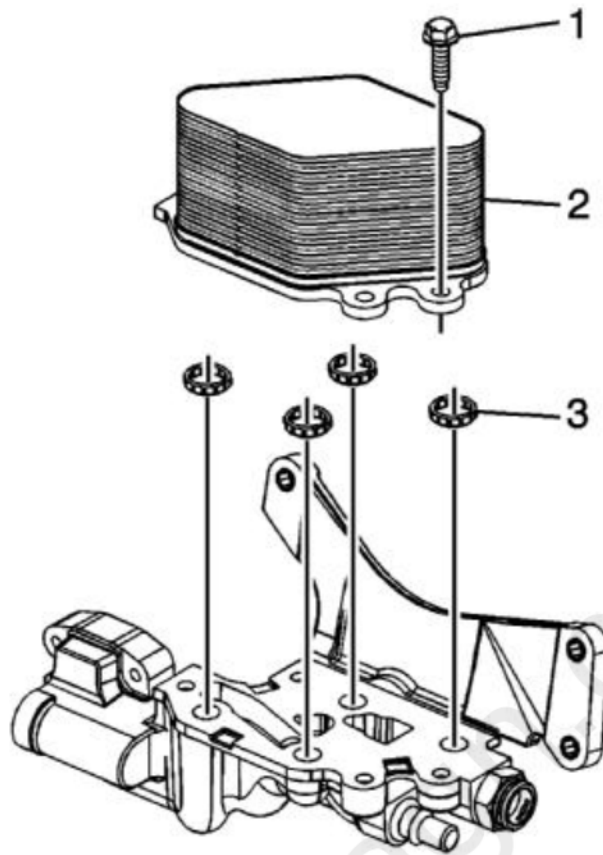


Fig. 12: Identifying Oil Cooler Core Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

1. Remove the oil cooler core bolts (1).
2. Remove the oil cooler core (2).
3. Remove the oil cooler core seals (3).

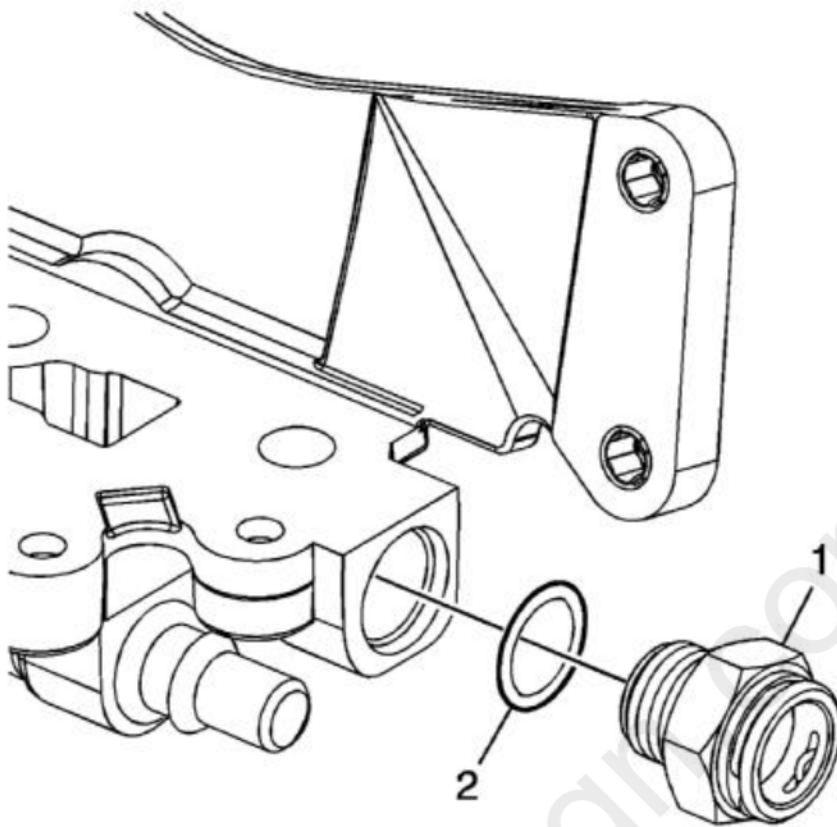


Fig. 13: Identifying Coolant Fitting & Seal
Courtesy of GENERAL MOTORS CORP.

4. Remove the coolant fitting (1), as required.
5. Remove the coolant fitting seal (2).
6. Discard the seal.

ENGINE OIL COOLER CLEANING AND INSPECTION

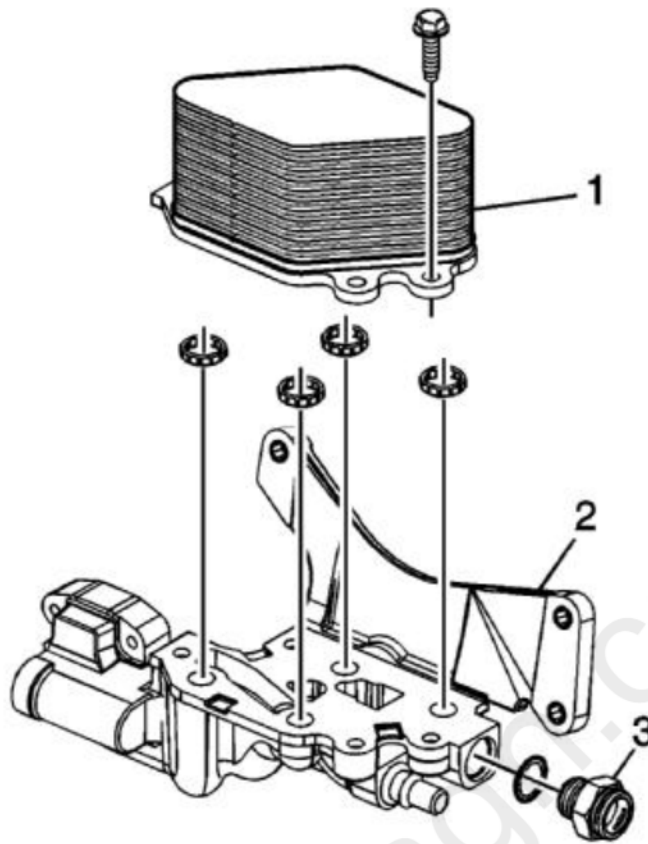


Fig. 14: Identifying Engine Oil Cooler Components
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

1. Inspect the oil cooler housing (2) and the oil cooler core (1) for cracks or casting imperfections.
2. Inspect the oil cooler housing for damaged bolt hole threads.
3. Inspect the oil cooler housing and core for damaged seal surfaces.
4. Inspect the oil cooler core for damaged or broken cooling fins.
5. Inspect for restrictions within the coolant passages of the core or housing.
6. Inspect for restrictions within the oil passages of the core or housing.
7. Inspect for a leaking coolant hose fitting (3).

ENGINE OIL COOLER ASSEMBLE

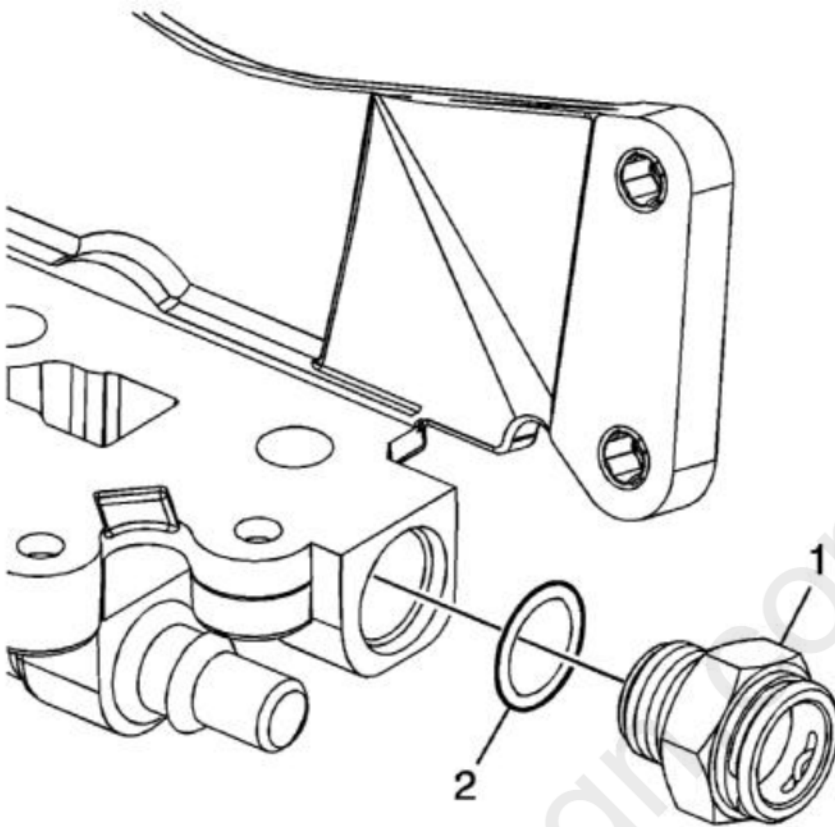


Fig. 15: Identifying Coolant Fitting & Seal
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to ENGINE OIL COOLER DEBRIS CAUTION .

1. Install a NEW coolant fitting seal (2).

CAUTION: Refer to FASTENER CAUTION .

2. Install the coolant fitting (1) and tighten to 35 N.m (26 lb ft).

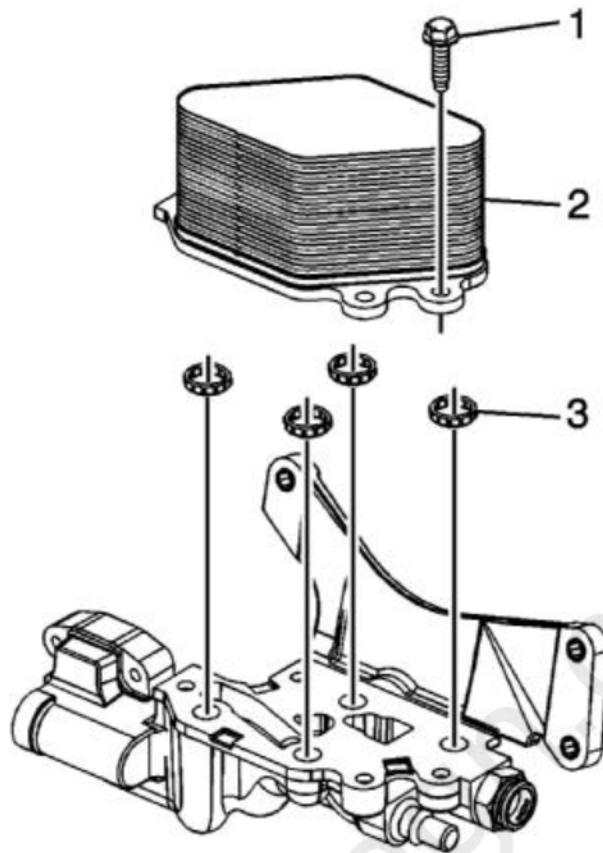


Fig. 16: Identifying Oil Cooler Core Components
Courtesy of GENERAL MOTORS CORP.

3. Install the NEW oil cooler core seals (3).
4. Install the oil cooler core (2).
5. Install the oil cooler core bolts (1) and tighten to 25 N.m (18 lb ft).

SUPERCHARGER DISASSEMBLE

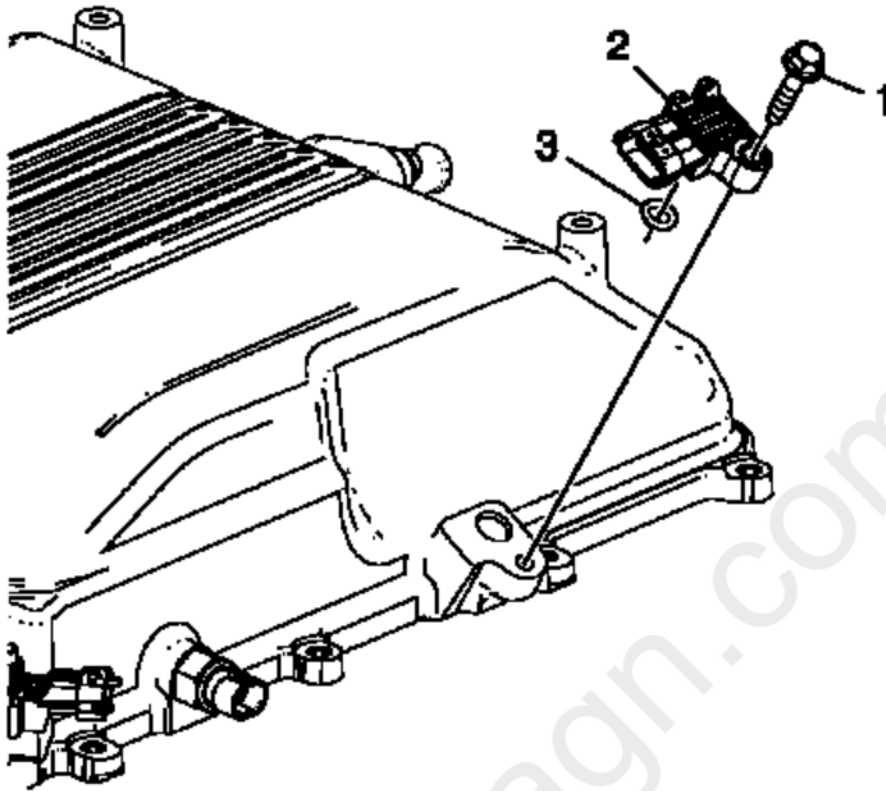


Fig. 17: Identifying Air Outlet Pressure Sensor Components
Courtesy of GENERAL MOTORS CORP.

1. Remove the air outlet pressure sensor bolt (1).
2. Remove the sensor (2).
3. Inspect the sensor seal (3) for damage, do not remove the seal from the sensor. If the seal is damaged, replace the sensor. The seal is serviced with the sensor.

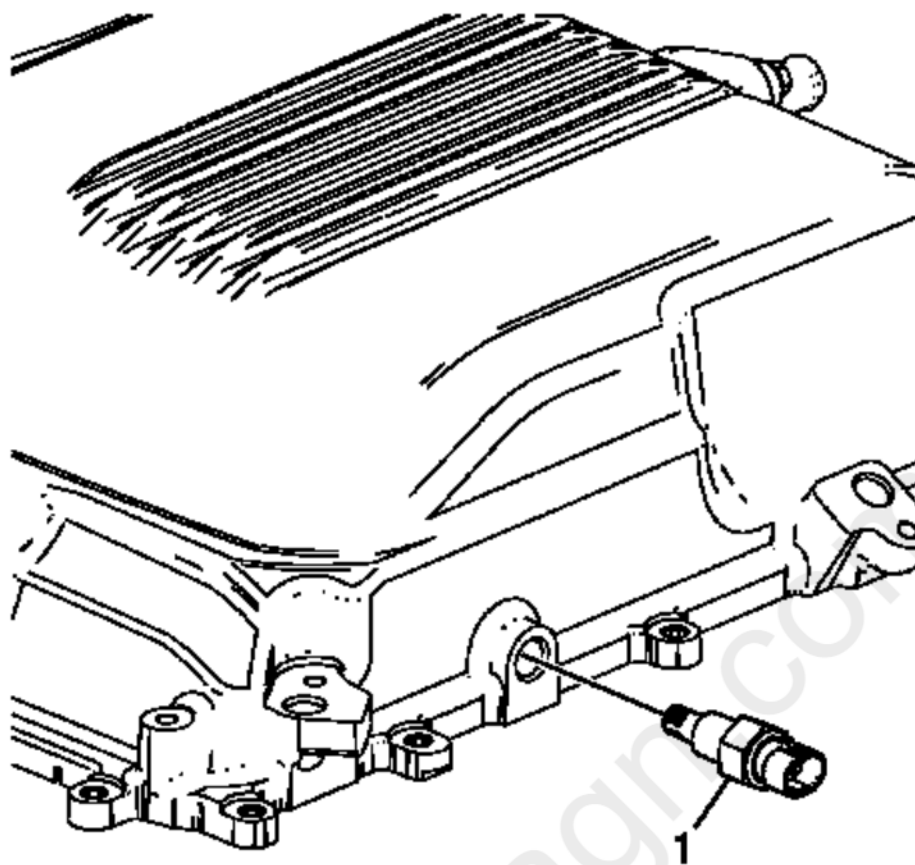


Fig. 18: Identifying Inlet Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the inlet air temperature sensor (1).

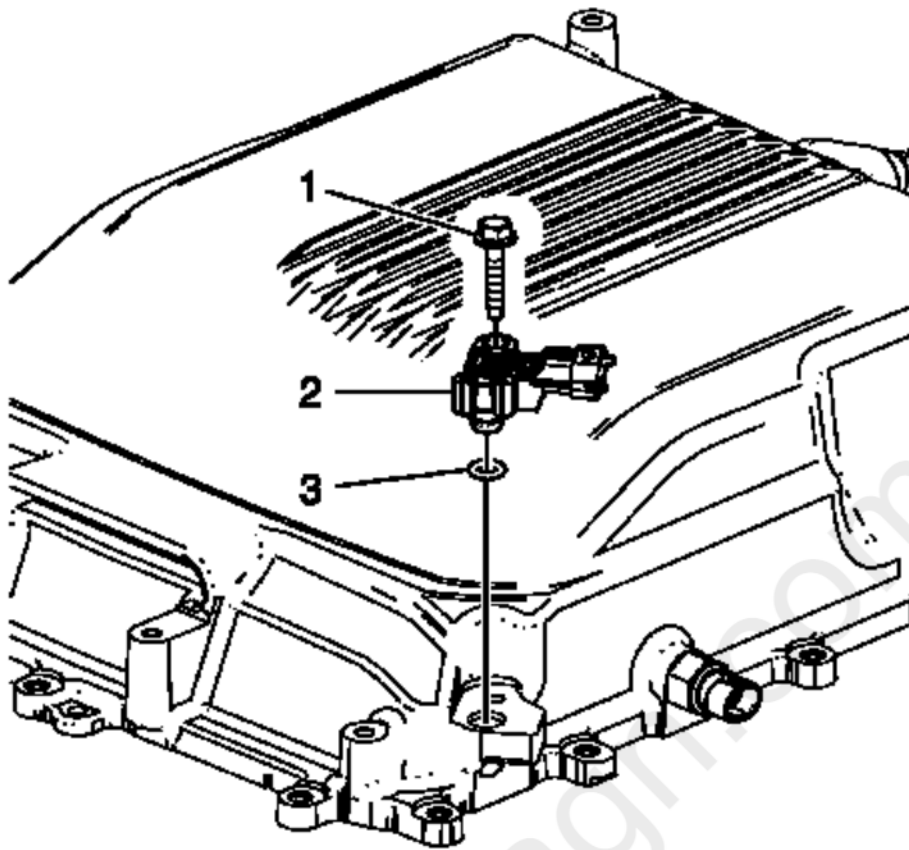


Fig. 19: Identifying Barometric Pressure Sensor Components
Courtesy of GENERAL MOTORS CORP.

5. Remove the barometric pressure (BARO) sensor bolt (1).
6. Remove the BARO sensor (2).
7. Inspect the BARO sensor seal (3) for damage, do not remove the seal from the sensor. If the seal is damaged, do not remove the seal from the sensor. If the seal is damaged replace the sensor. The seal is serviced with the sensor.

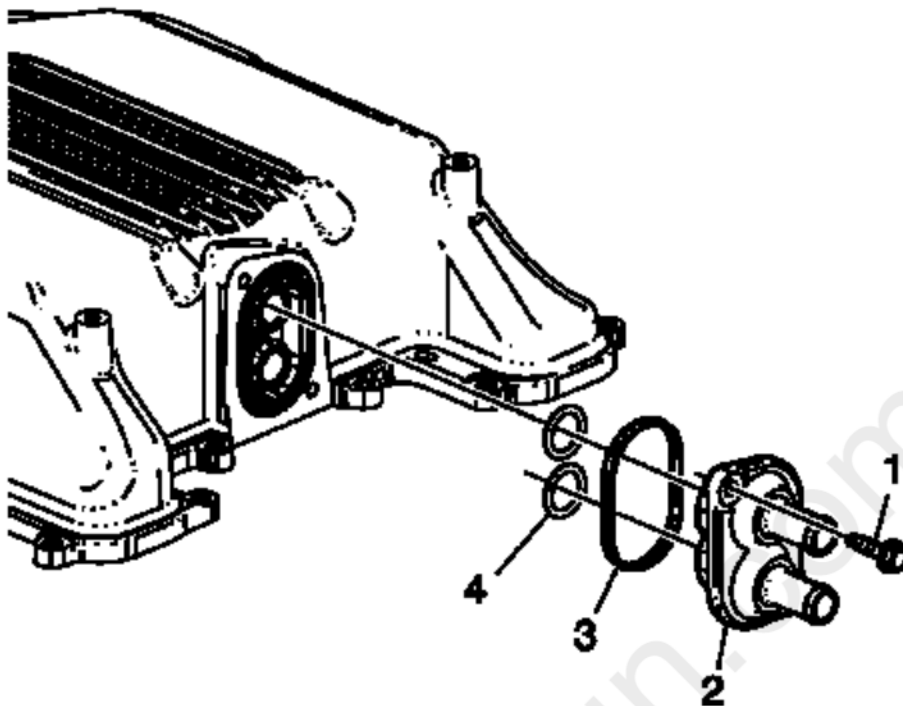


Fig. 20: Identifying Bolts, Plate, & Seals
Courtesy of GENERAL MOTORS CORP.

8. Remove the bolts (1), plate (2), seal (3), seals (4) from the cooler. Discard the seals.

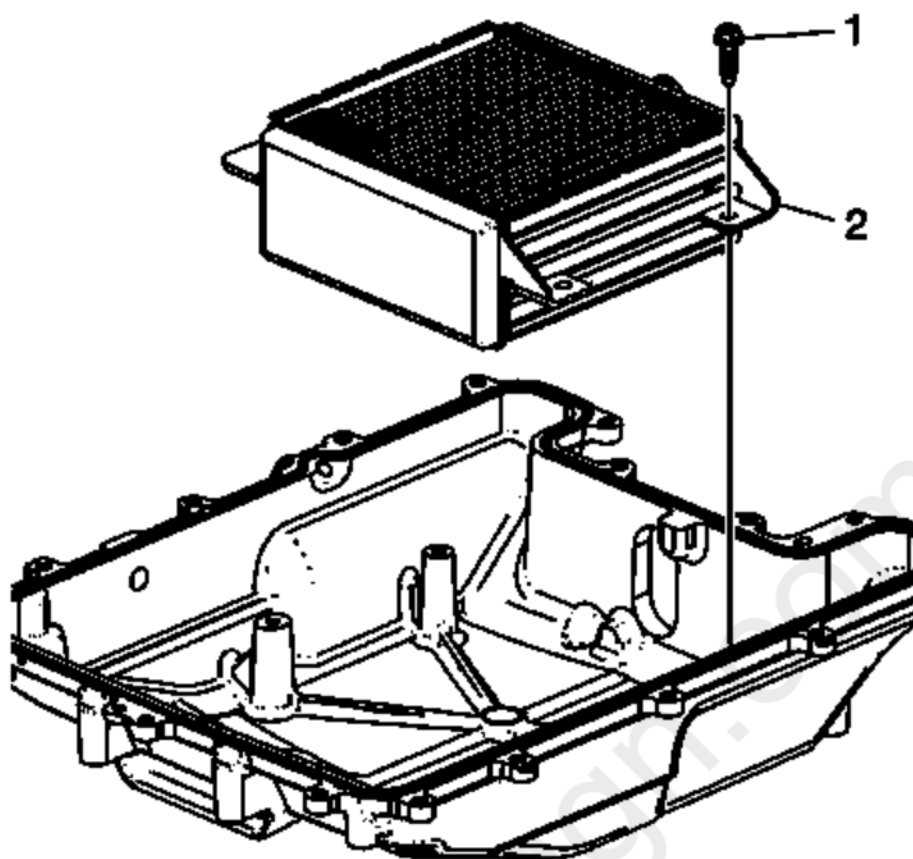


Fig. 21: Identifying Charge Air Cooler & Bolts
Courtesy of GENERAL MOTORS CORP.

9. Remove the charge air cooler (2) and bolts (1).

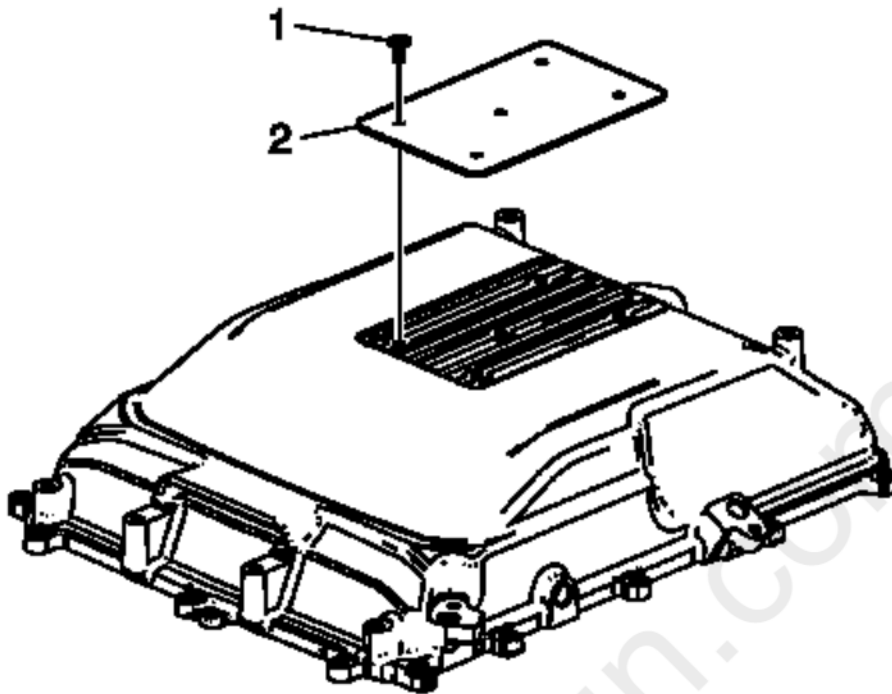


Fig. 22: Identifying Isolator Pad & Bolts
Courtesy of GENERAL MOTORS CORP.

10. Remove the isolator pad (2) and bolts (1), as required.

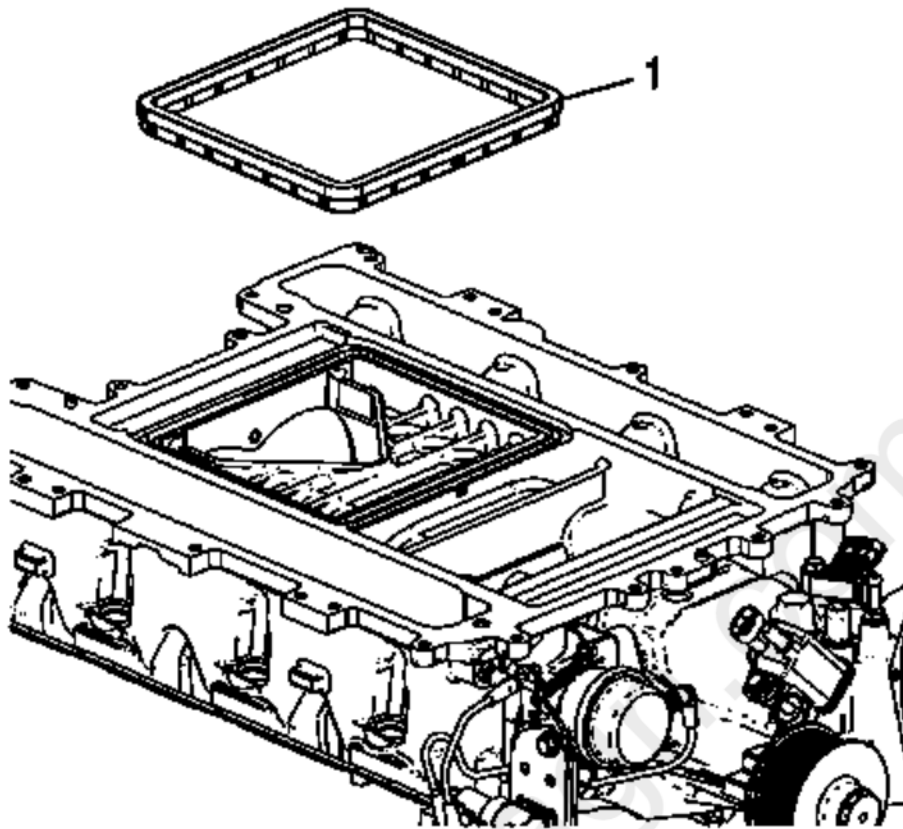


Fig. 23: Identifying Charge Air Cooler Insulator
Courtesy of GENERAL MOTORS CORP.

11. Remove and discard the insulator seal (1).

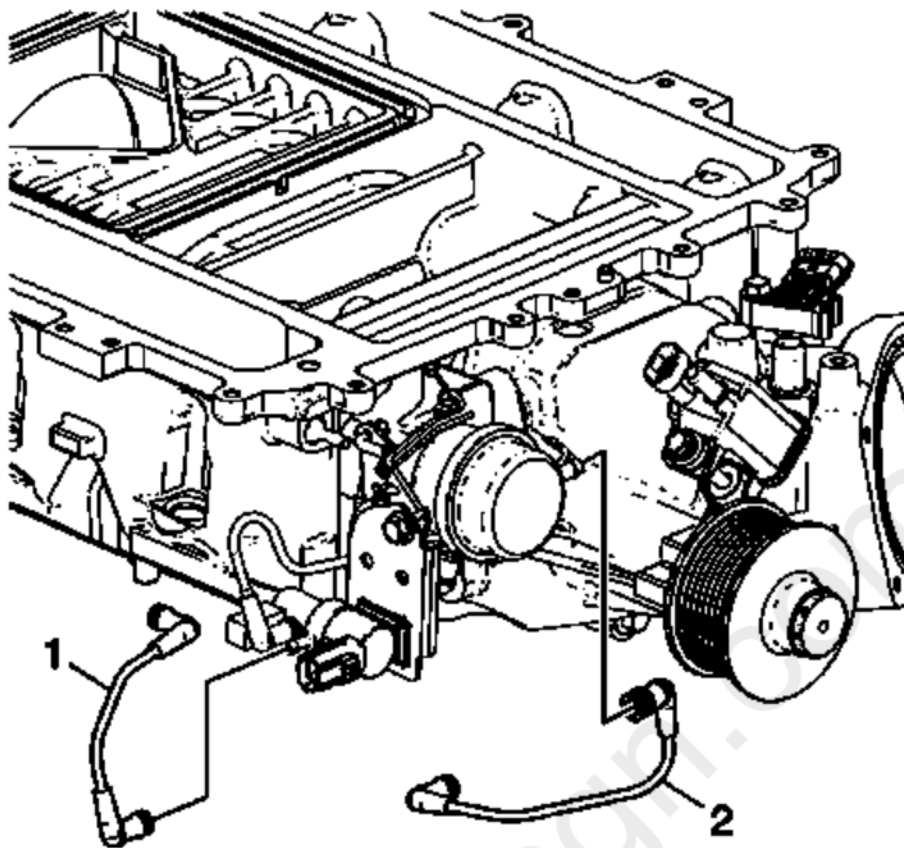


Fig. 24: Identifying Charge Air Bypass Valve Tubes
Courtesy of GENERAL MOTORS CORP.

12. Remove the charge air bypass valve tube (1).
13. Remove the charge air bypass valve vacuum tube (2).

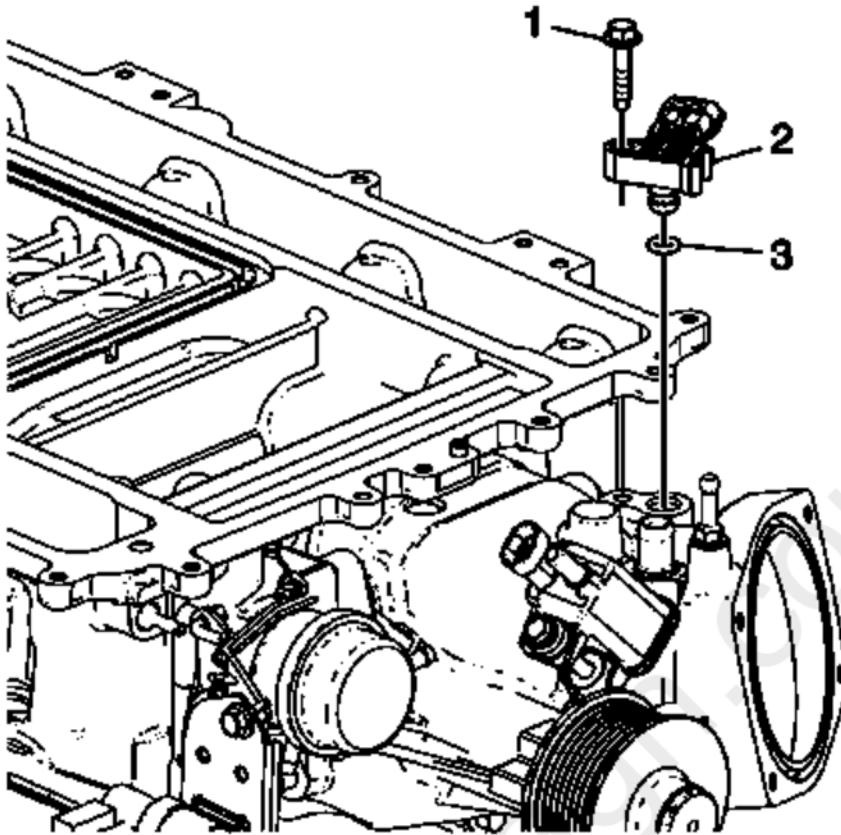


Fig. 25: Identifying Inlet Air Pressure Sensor Components
Courtesy of GENERAL MOTORS CORP.

14. Remove the inlet air pressure sensor bolt (1).
15. Remove the inlet air pressure sensor (2).
16. Inspect the sensor seal (3) for damage, do not remove the seal from the sensor. If the seal is damaged, replace the sensor. The seal is serviced with the sensor.

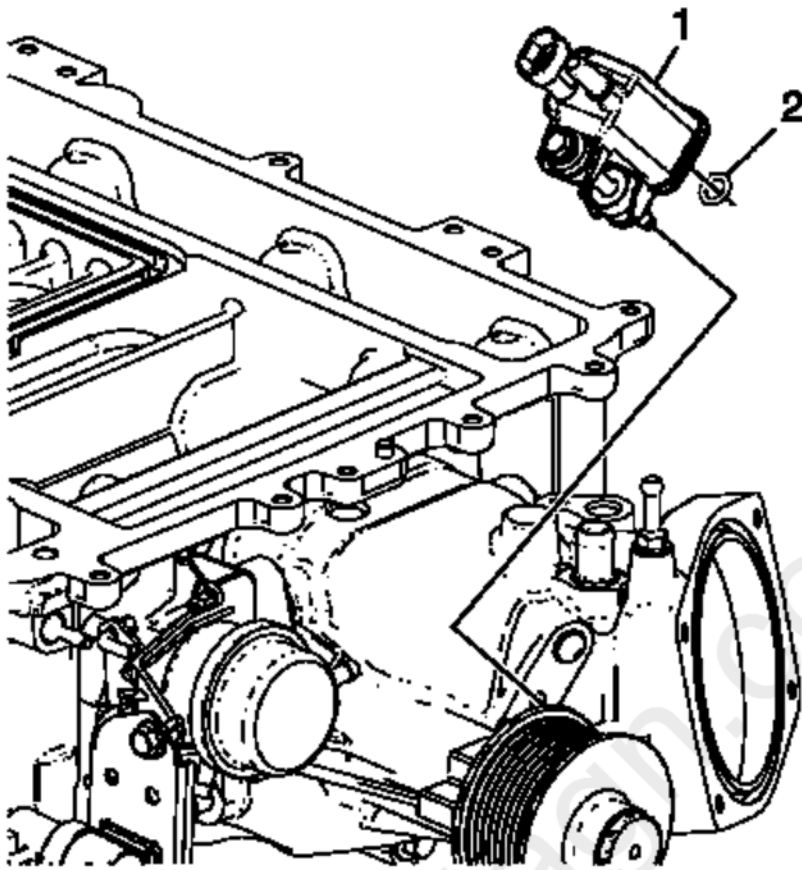


Fig. 26: Identifying EVAP Valve
Courtesy of GENERAL MOTORS CORP.

17. Loosen the evaporative emissions (EVAP) bolt.
18. Remove the EVAP valve (1).
19. Inspect the sensor seal (2) for damage, do not remove the seal from the sensor. If the seal is damaged, replace the sensor. The seal is serviced with the sensor.

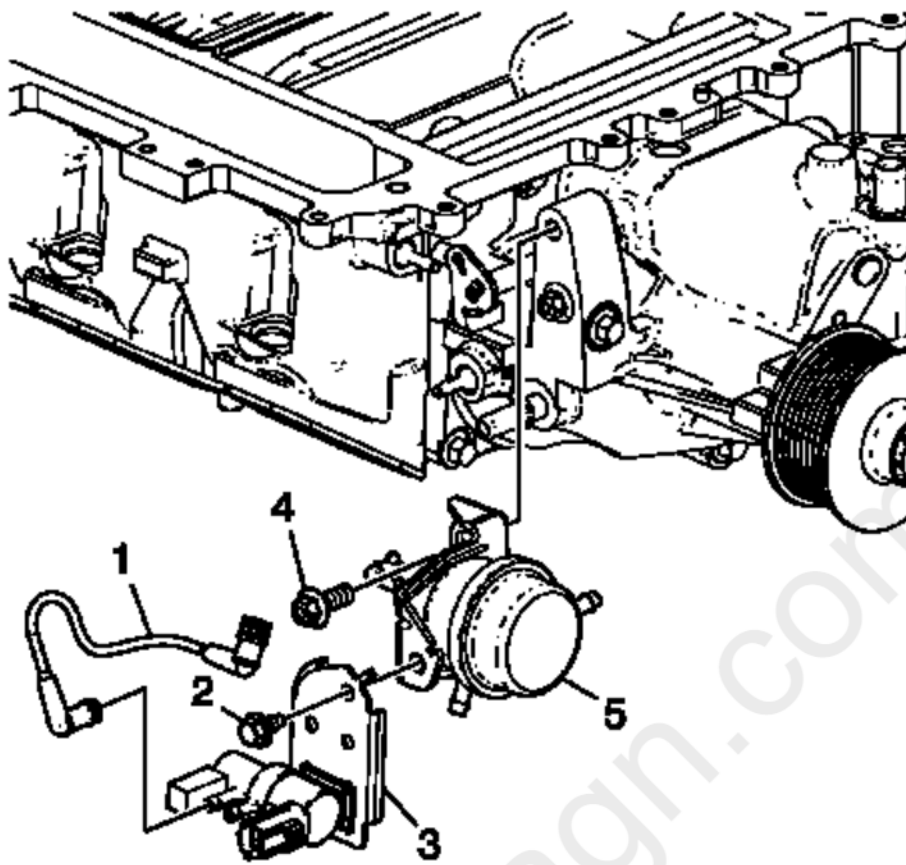


Fig. 27: Identifying Bypass Actuator Components
 Courtesy of GENERAL MOTORS CORP.

20. Remove the bypass actuator tube (1).
21. Remove the charge air bypass valve bolt (2).
22. Remove the charge air bypass valve (3).
23. Remove the bypass actuator bolts (4).
24. Rotate the actuator upward and remove the rod from the lever of the supercharger.
25. Remove the bypass actuator (5).

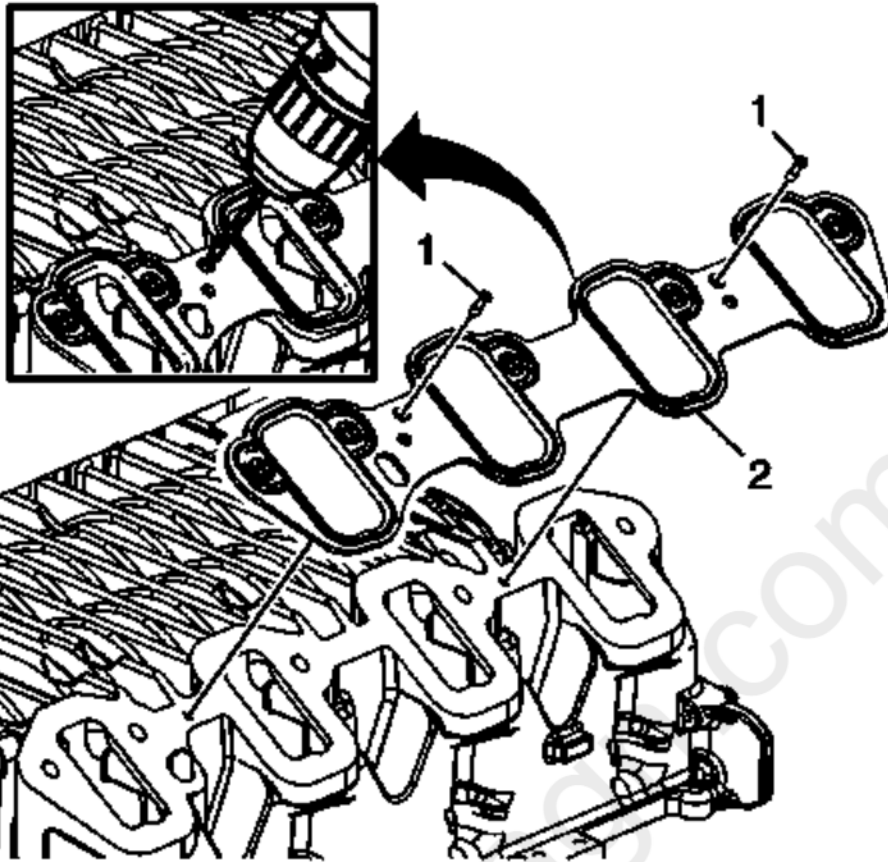


Fig. 28: Identifying Gasket & Rivets
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not allow dirt or debris to enter the passages of the supercharger. Cover the intake ports as required.
- With the manifold positioned upside down on a bench, the lower assembly may be positioned onto the intercooler cover dowel pins. Use care not to reposition or bend the dowel pins.

26. Drill out the gasket rivets (1) using a drill bit with an outside diameter (OD) no larger than 3.2 mm (0.125 in).
27. Remove the gaskets (2).

SUPERCHARGER CLEANING AND INSPECTION

CHARGE AIR COOLER COVER CLEANING AND INSPECTION

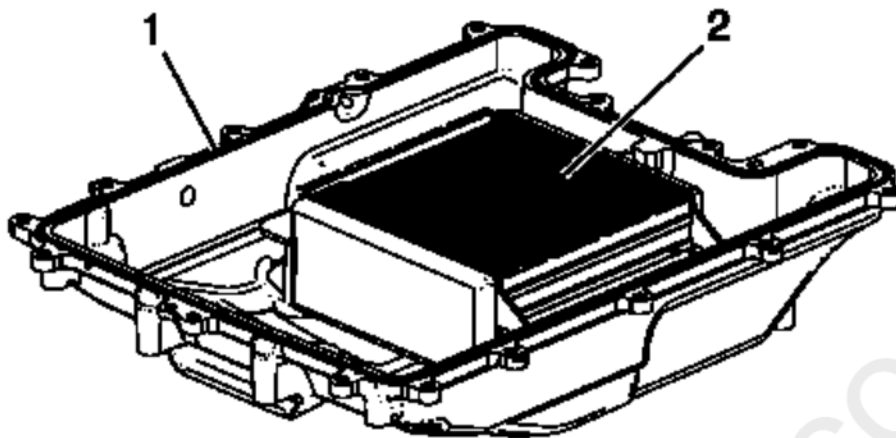


Fig. 29: Identifying Charge Air Cooler Components
Courtesy of GENERAL MOTORS CORP.

Inspect the cover for the following:

- Damaged seal surfaces (1)
- Leaking, restricted, or damaged charge air cooler (2). Refer to **Supercharger Assemble**.

SUPERCHARGER CLEANING AND INSPECTION

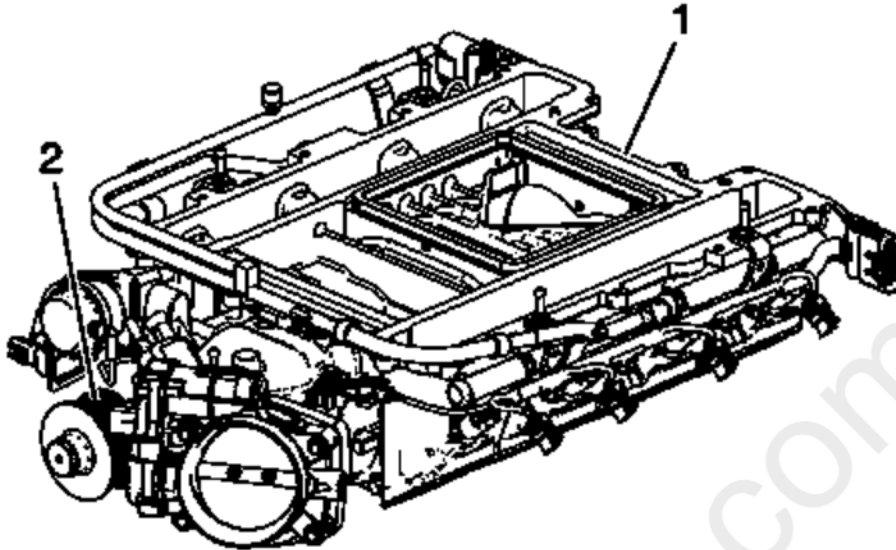


Fig. 30: Identifying Supercharger Damage
Courtesy of GENERAL MOTORS CORP.

1. Inspect the supercharger for the following:
 - Damaged seal surfaces (1)
 - Worn or damaged belt pulley grooves (2)
2. Rotate the pulley of the supercharger by hand. The pulley and rotors should rotate freely with no binding.
3. Operate the boost bypass valve by hand. The bypass valve should operate within the full range of motion with no sticking or binding.

SUPERCHARGER ASSEMBLE

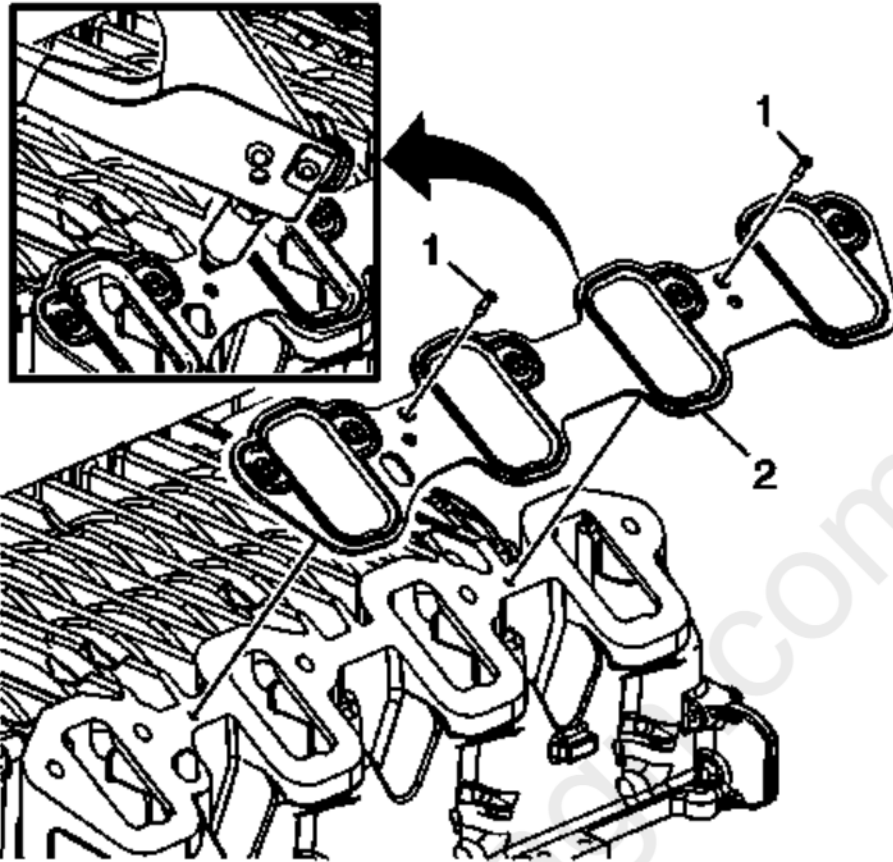


Fig. 31: Identifying Supercharger Gaskets & Rivets
Courtesy of GENERAL MOTORS CORP.

1. Install the NEW gaskets (2).
2. Install NEW gasket rivets (1).

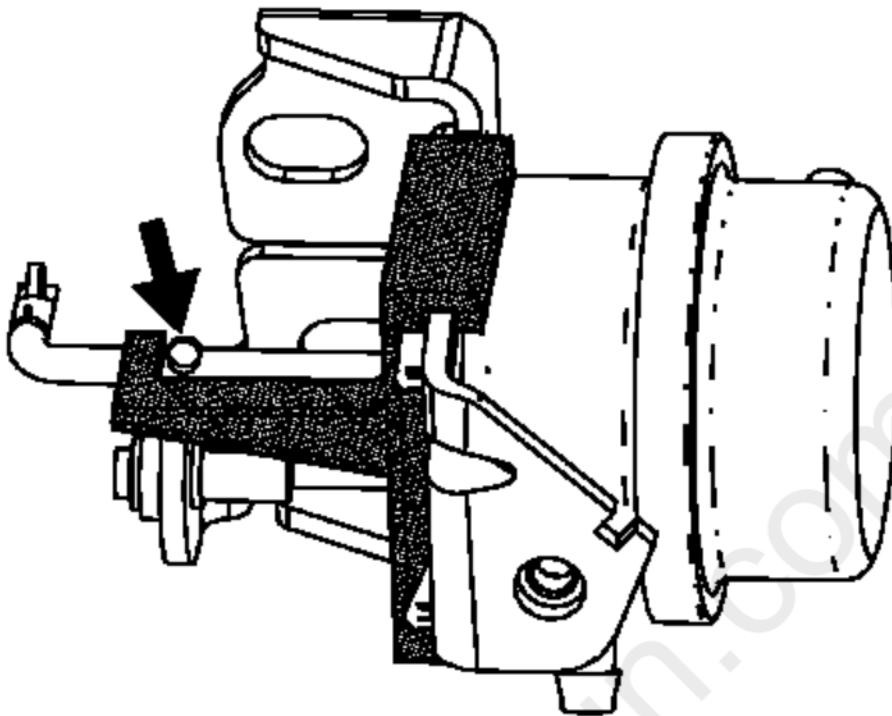


Fig. 32: View Of Actuator Adjustment Tool On Actuator
Courtesy of GENERAL MOTORS CORP.

NOTE: The actuator adjustment tool is provided within the actuator parts kit.

3. Install the actuator adjustment tool onto the actuator. Position the raised portion of the rod in the proper position.

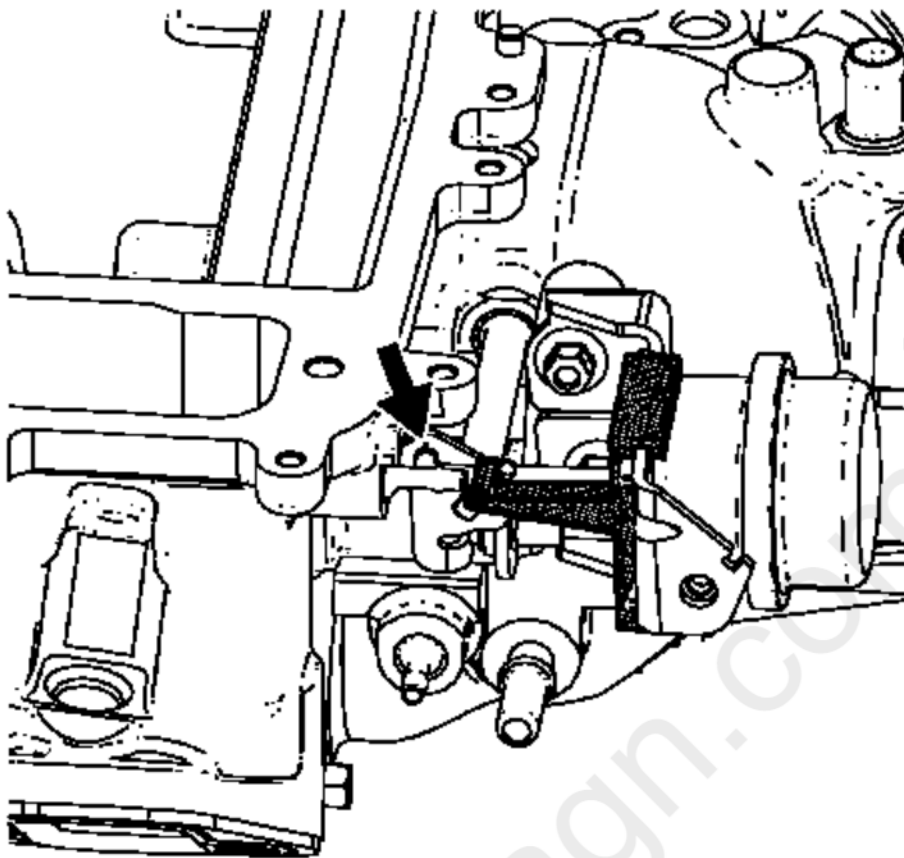


Fig. 33: Locating Rod Of Actuator
Courtesy of GENERAL MOTORS CORP.

4. Install the rod of the actuator into the lever of the supercharger.
5. Rotate the actuator and install the bolts. Do not tighten the bolts at this time.

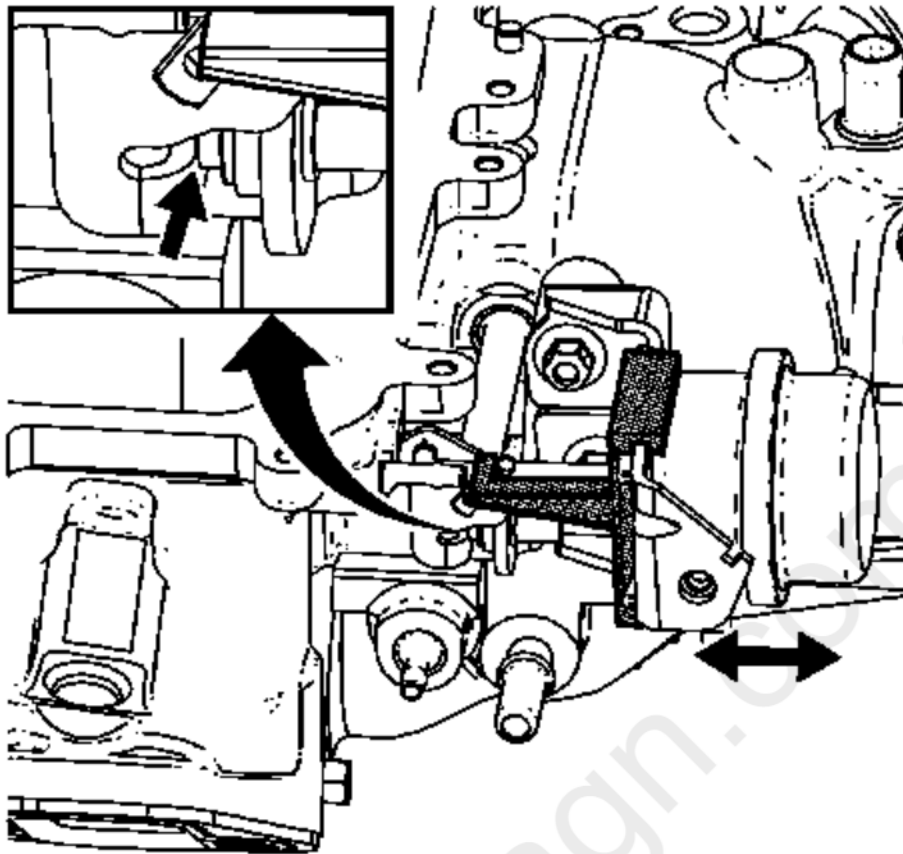


Fig. 34: Ensuring Proper Supercharger Lever Position
 Courtesy of GENERAL MOTORS CORP.

6. Moving the actuator forward or rearward as required, ensure that the supercharger lever is in contact with the adjustment screw on the actuator and that the lever is rotated to the fully closed position.

CAUTION: Refer to **FASTENER CAUTION** .

7. Tighten the actuator bolts to 25 N.m (18 lb ft).
8. Remove the adjustment tool from the actuator.
9. Rotate the adjustment screw on the actuator clockwise 1/4 turn.

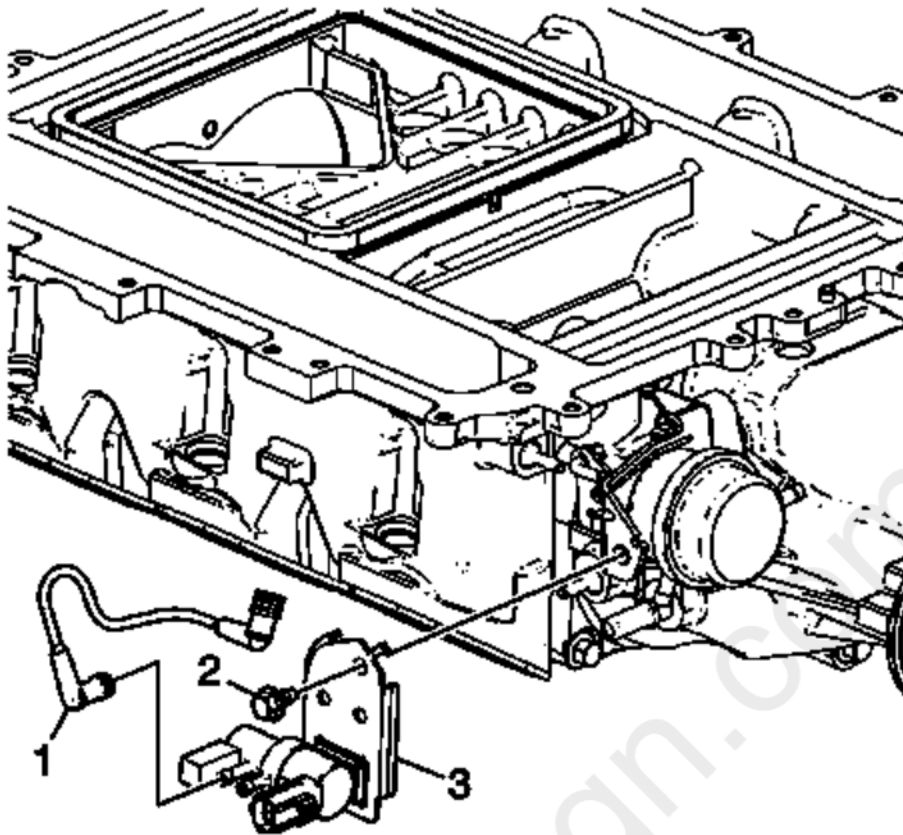


Fig. 35: Identifying Charge Air Bypass Valve Components
Courtesy of GENERAL MOTORS CORP.

10. Install the charge air bypass valve (3).
11. Install the charge air bypass valve bolt (2) and tighten to 12 N.m (108 lb ft).
12. Install the bypass actuator tube (1).

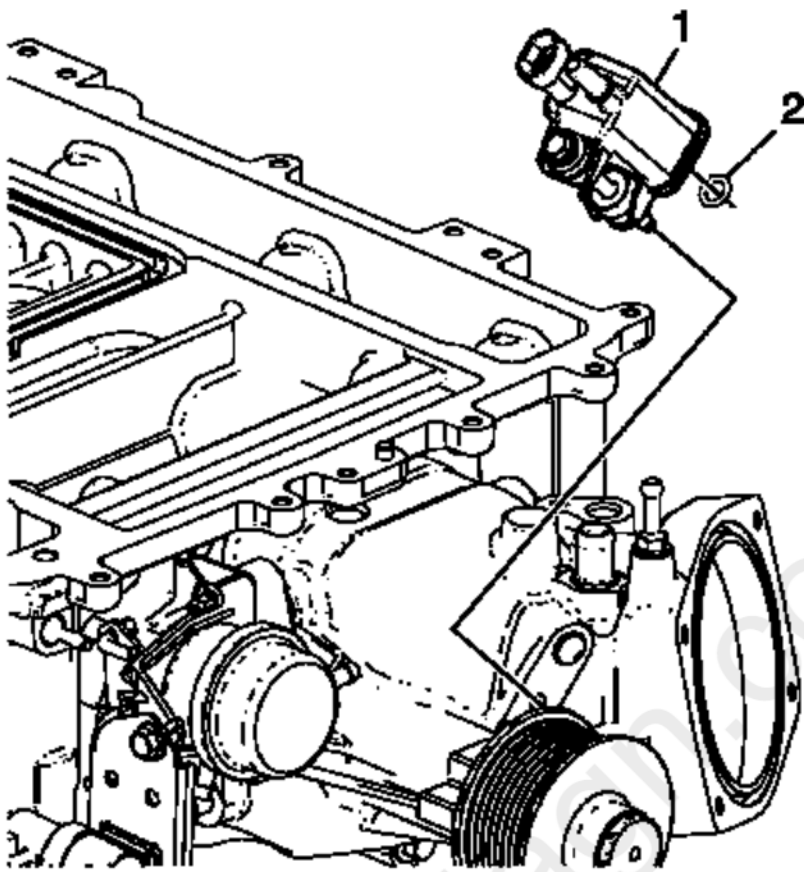


Fig. 36: Identifying EVAP Valve
Courtesy of GENERAL MOTORS CORP.

13. Confirm that the evaporative emission (EVAP) valve seal (2) is installed on the EVAP valve (1).
14. Install the EVAP valve (1) and tighten to 10 N.m (89 lb in).

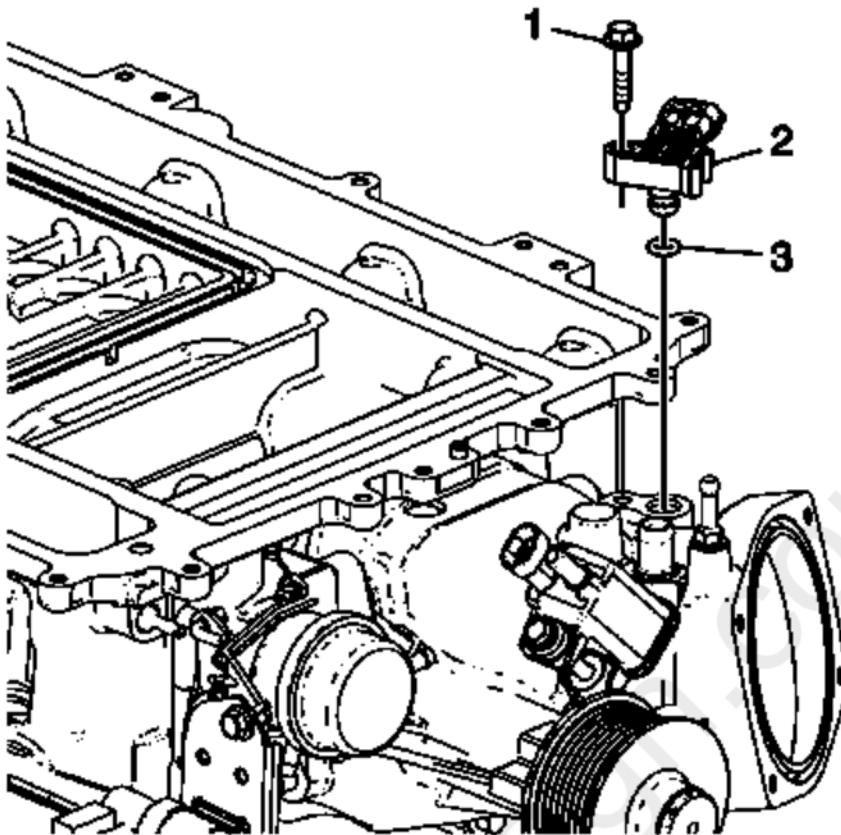


Fig. 37: Identifying Inlet Air Pressure Sensor Components
 Courtesy of GENERAL MOTORS CORP.

15. Confirm that the inlet air pressure sensor seal (3) is installed on the sensor (2).
16. Install the inlet air pressure sensor (2).
17. Install the inlet air pressure sensor bolt (1) and tighten to 10 N.m (89 lb in).

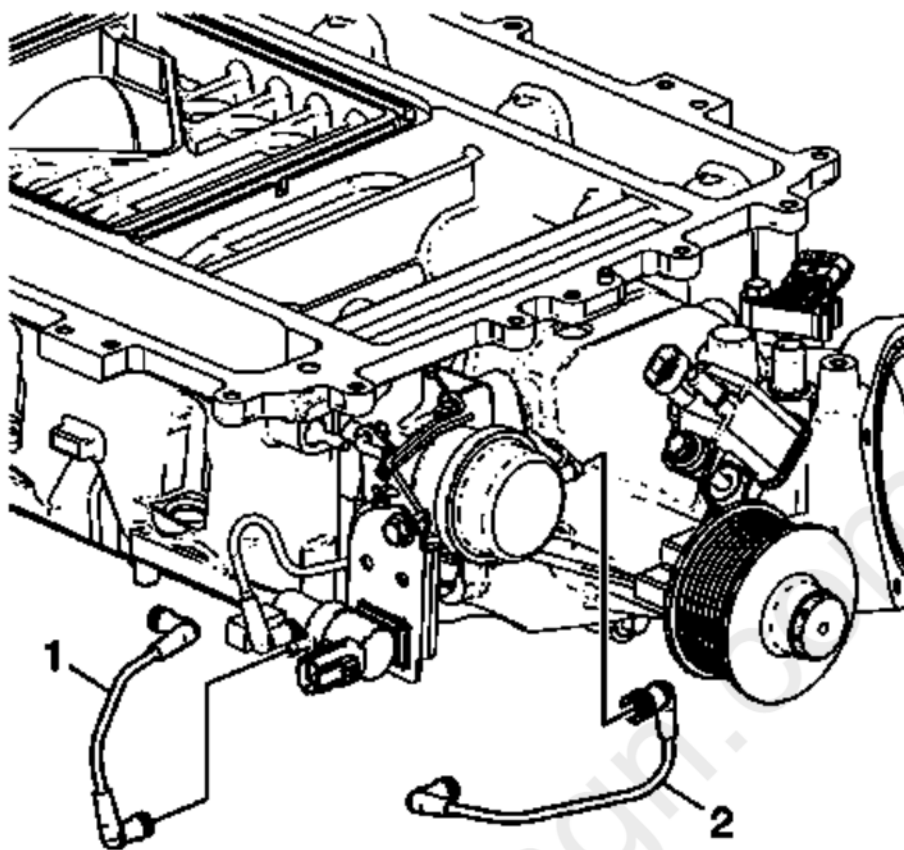


Fig. 38: Identifying Charge Air Bypass Valve Tubes
Courtesy of GENERAL MOTORS CORP.

18. Install the bypass valve vacuum tube (2).
19. Install the bypass valve tube (1).

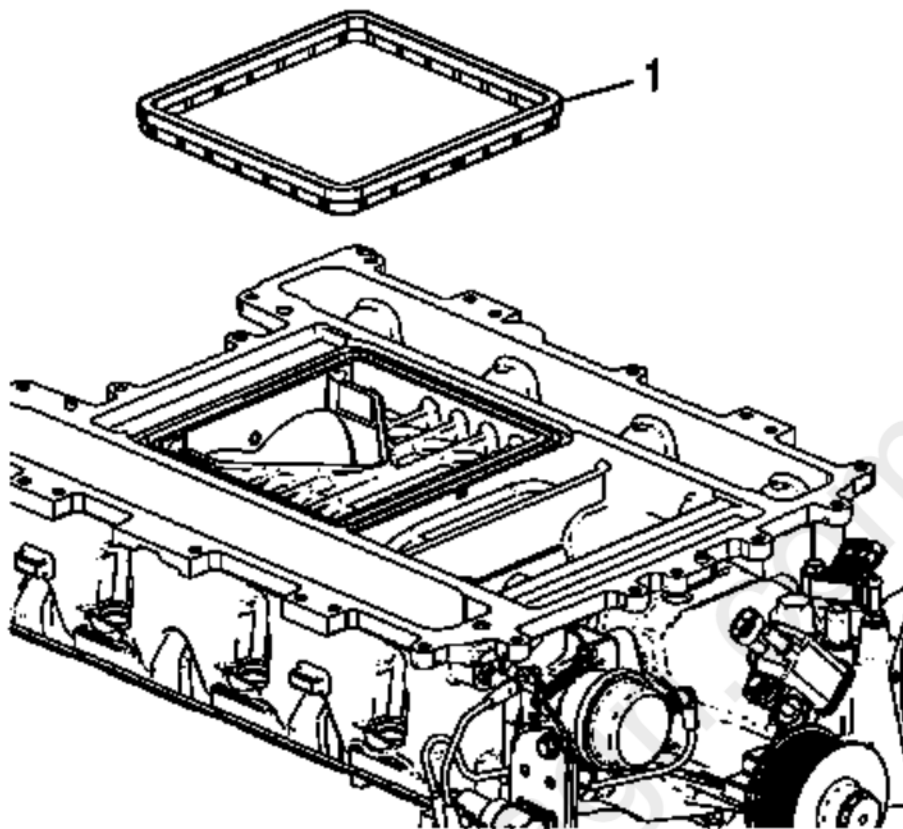


Fig. 39: Identifying Charge Air Cooler Insulator
Courtesy of GENERAL MOTORS CORP.

20. Install the NEW insulator seals (1).

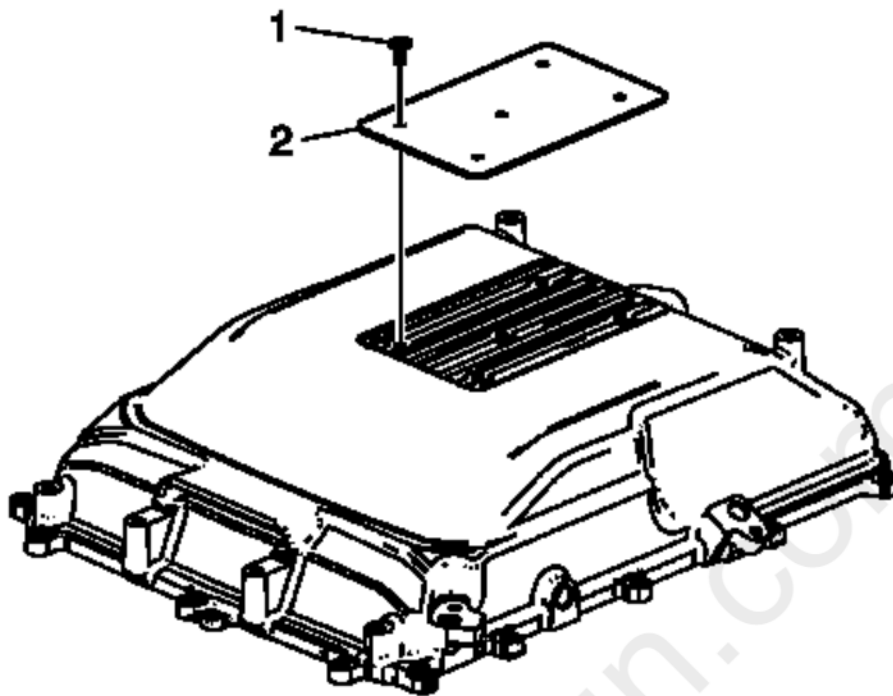


Fig. 40: Identifying Isolator Pad & Bolts
 Courtesy of GENERAL MOTORS CORP.

21. Apply a 5 mm (0.2 in) band of threadlocker GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the bolts (1).
22. Install the isolator pad (2) and bolts (1) and tighten to 5 N.m (44 lb in).

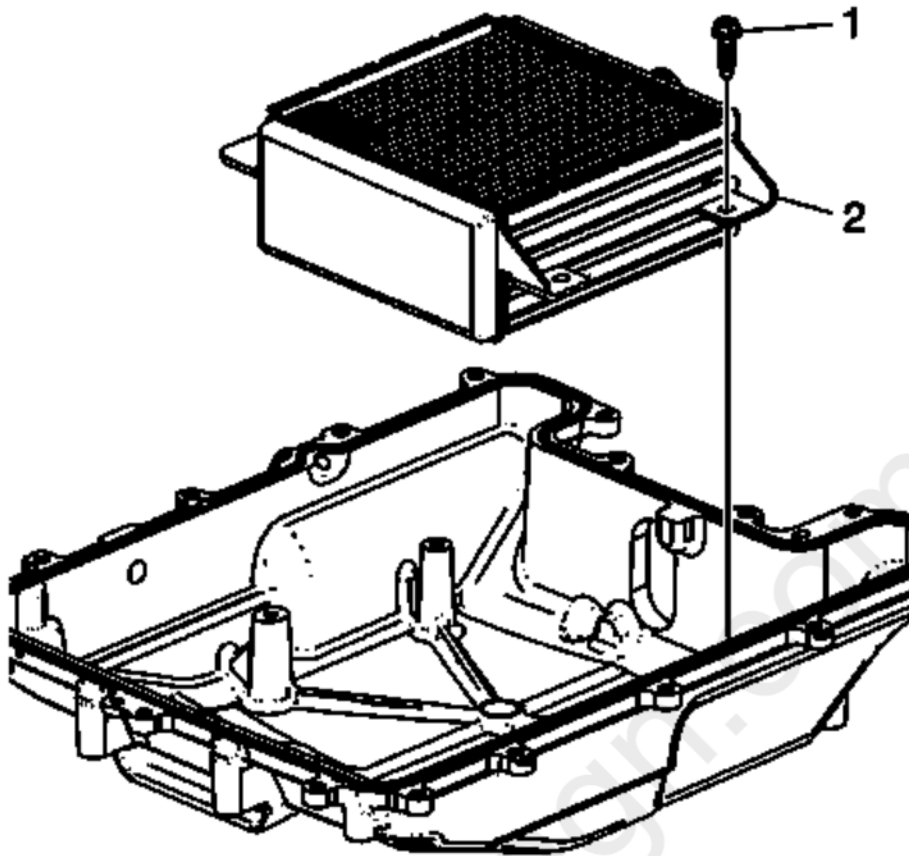


Fig. 41: Identifying Charge Air Cooler & Bolts
Courtesy of GENERAL MOTORS CORP.

23. Apply a 5 mm (0.2 in) band of threadlocker GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the bolts.
24. Install the charger air cooler (2) and bolts (1) and tighten to 10 N.m (89 lb in).

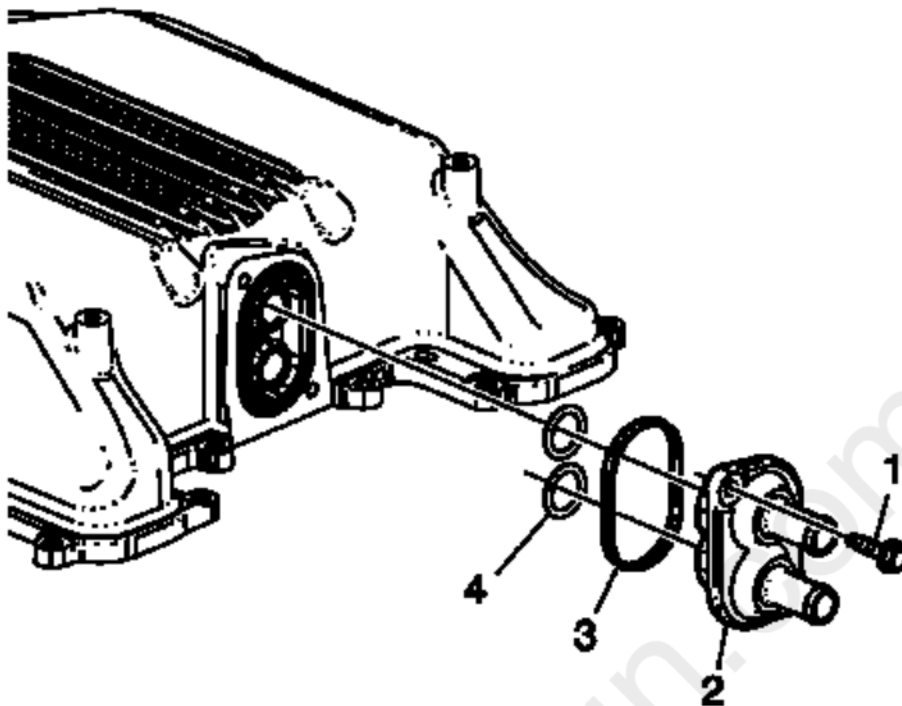


Fig. 42: Identifying Bolts, Plate, & Seals
 Courtesy of GENERAL MOTORS CORP.

25. Lubricate the seals with clean engine oil.
26. Install NEW O-ring seals (4), NEW seal (3), the plate (2), the bolts (1) and tighten to 10 N.m (89 lb in).

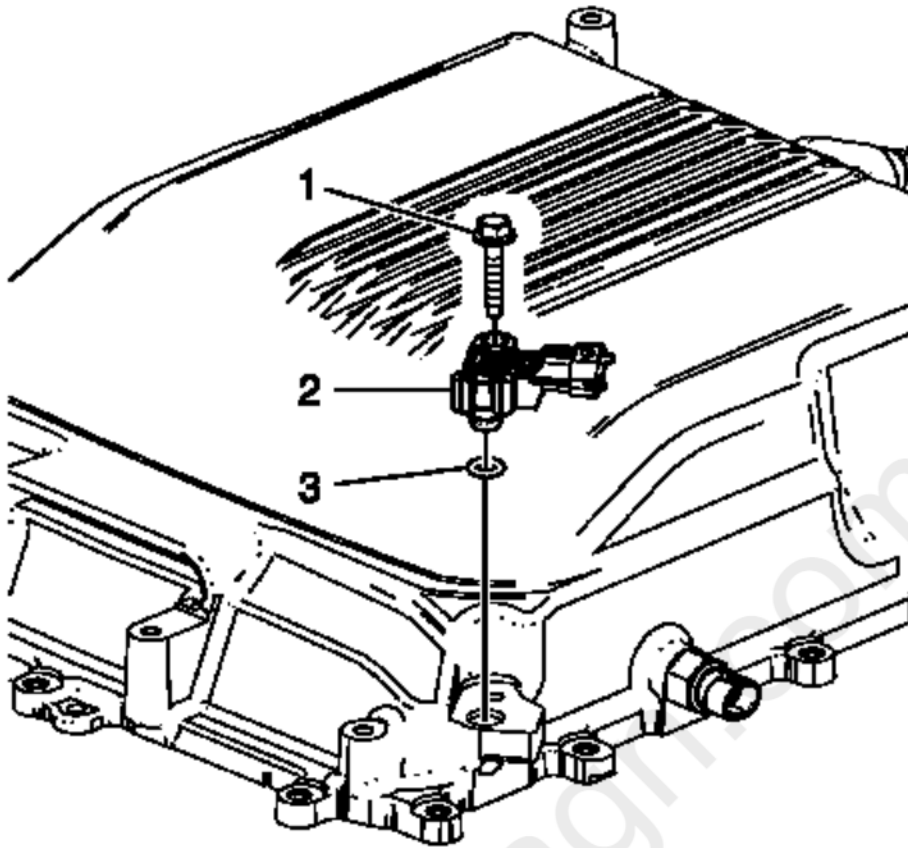


Fig. 43: Identifying Barometric Pressure Sensor Components
Courtesy of GENERAL MOTORS CORP.

27. Confirm that the BARO sensor seal (3) is installed on the BARO sensor (2).
28. Install the BARO sensor (2).
29. Install the BARO sensor bolt (1) and tighten to 10 N.m (89 lb in).

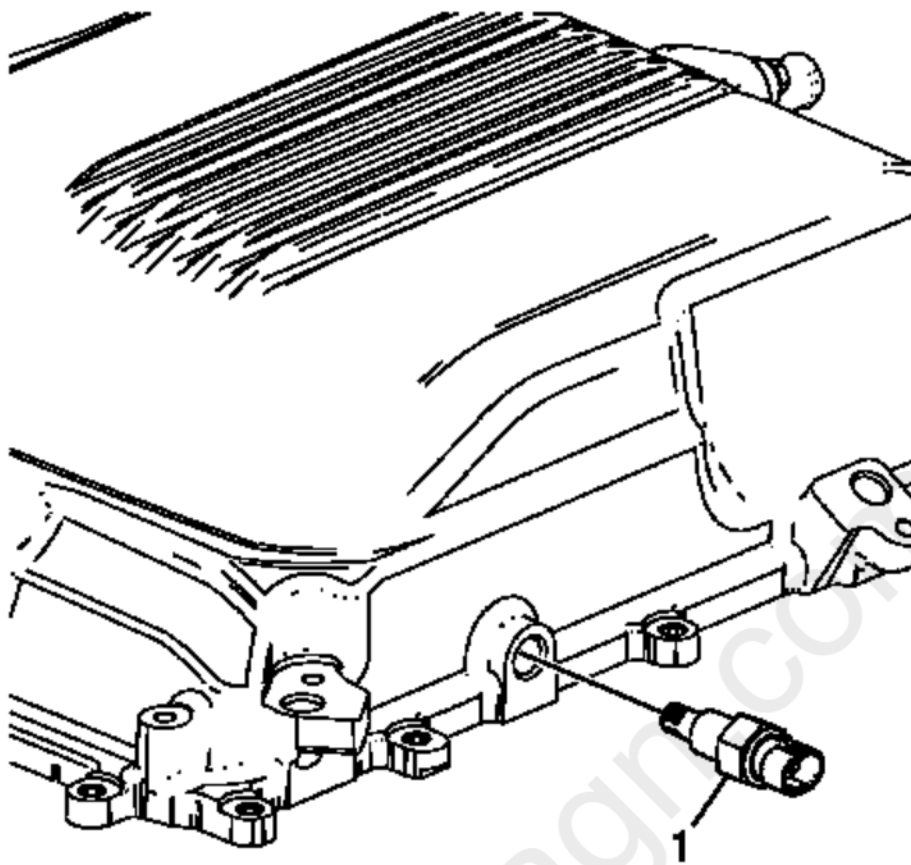


Fig. 44: Identifying Inlet Air Temperature Sensor
Courtesy of GENERAL MOTORS CORP.

30. Install sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent, to the threads of the sensor (1).
31. Install the IAT sensor (1) and tighten to 20 N.m (15 lb ft).

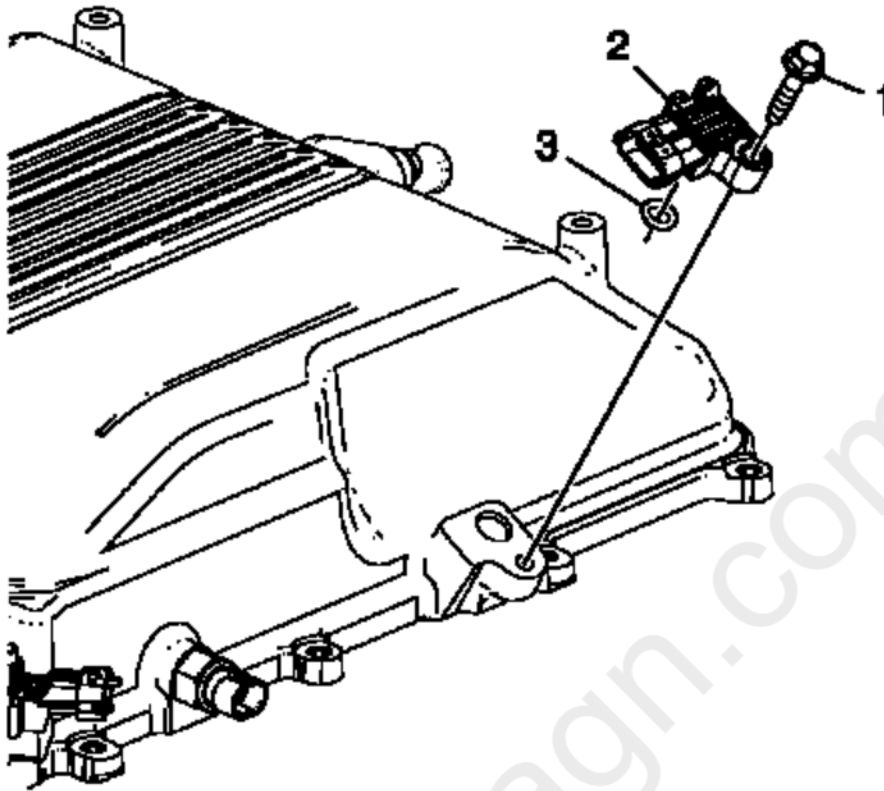


Fig. 45: Identifying Air Outlet Pressure Sensor Components
Courtesy of GENERAL MOTORS CORP.

32. Confirm that the manifold absolute pressure (MAP) sensor seal (3) is installed on the MAP sensor (2).
33. Install the MAP sensor (2).
34. Install the MAP sensor bolt (1) and tighten to 10 N.m (89 lb in).

SUPERCHARGER INTERCOOLER PRESSURE TESTING

Special Tools

- **EN-48974:** Adapter Kit
- **J 46091:** Charge Air Cooler Tester

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

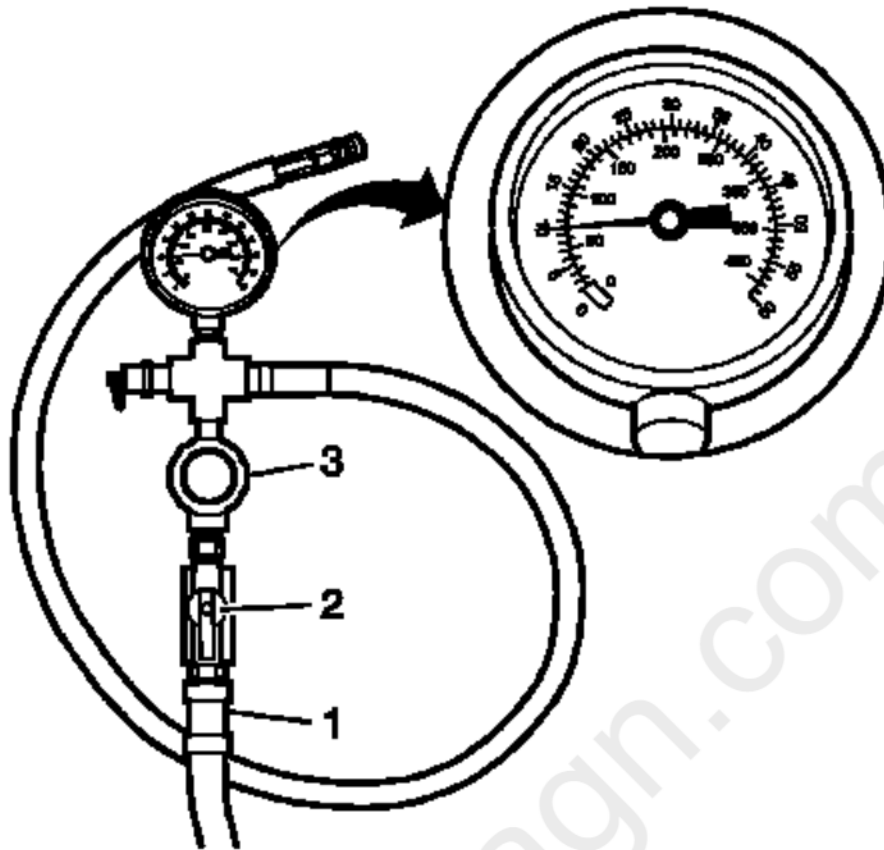


Fig. 46: Identifying J 46091-1 Components
Courtesy of GENERAL MOTORS CORP.

WARNING: Do not apply greater than 69 kPa (10 psi) to the supercharger intercooler, this may damage the charge air cooler and other internal components within the intercooler.

1. Rotate the regulator knob (3) counterclockwise until stop to reduce pressure to 0 kPa (0 psi).
2. Connect the J 46091-1 to a shop air source (1).

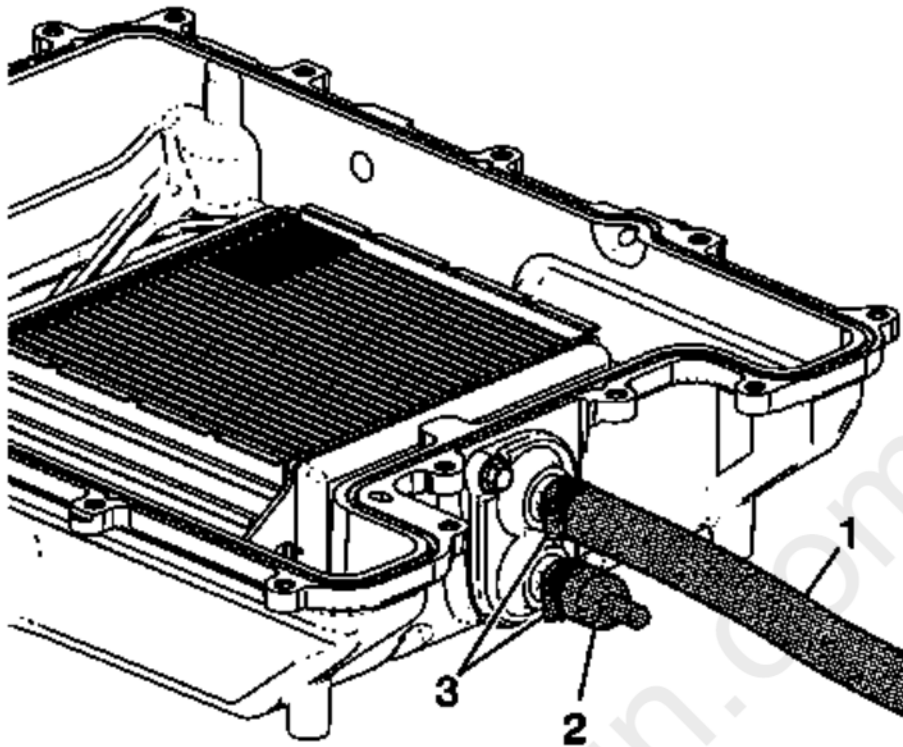


Fig. 47: View Of Kit Adapter Hose, Cap & Clamps
Courtesy of GENERAL MOTORS CORP.

3. Install the **EN-48974**: kit adapter hose (1), cap (2) and clamps (3) to the coolant inlet and outlet connections of the intercooler water manifold. Tighten the clamps until snug.

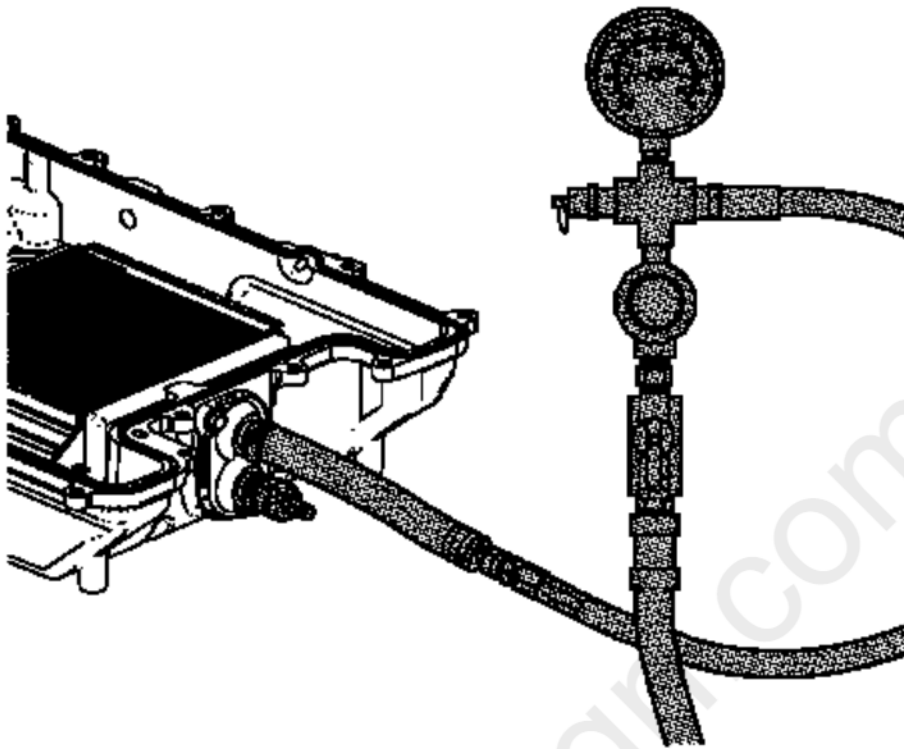


Fig. 48: Installing J 46091-1 To Kit Adapter Hose
Courtesy of GENERAL MOTORS CORP.

4. Install the J 46091-1 to the EN-48974: kit adapter hose.
5. Rotate the knob of the regulator slowly clockwise to increase pressure.

NOTE: The gauge value should not exceed 69 kPa (10 psi). Adjust the pressure regulator as required.

6. With the intercooler pressurized to 69 kPa (10 psi) maximum, close the air inlet valve of the J 46091-1.
7. Inspect for a drop in air pressure on the gauge.
 - If a drop in pressure is noted, inspect for leaks at the tool connections, the charge air coolers, service bleed ports, assembly plant fill port, and water manifold-to-charge air cooler seal locations.
 - If no drop in pressure is noted, the intercooler can be installed onto the engine assembly.

EXHAUST MANIFOLD CLEANING AND INSPECTION

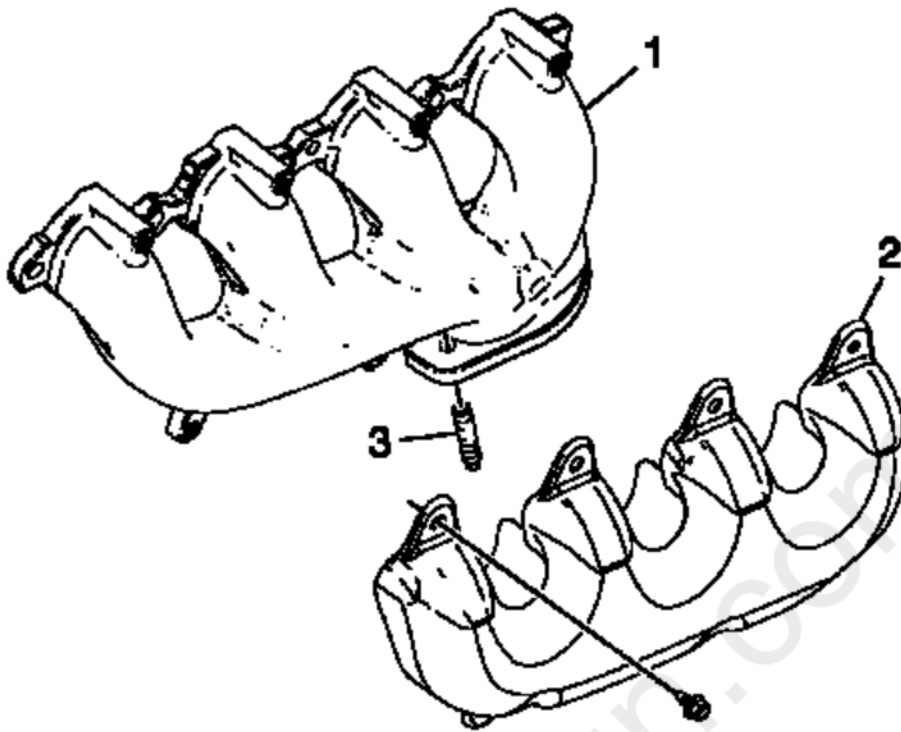


Fig. 49: Identifying Exhaust Manifold Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not use the exhaust manifold-to-cylinder head gaskets again. Upon installation of the exhaust manifold, install a **NEW** gasket. An improperly installed gasket or leaking exhaust system may effect on-board diagnostics (OBD) II system performance.

1. Clean the exhaust manifold (1) and heat shield (2) in solvent.

WARNING: Refer to **SAFETY GLASSES WARNING** .

2. Dry the exhaust manifold with compressed air.
3. Inspect the exhaust manifold-to-cylinder head gasket surface for excessive scratches or gouging.
4. Inspect for a loose, damaged, or cracked heat shield (2).
5. Inspect the exhaust pipe studs (3) for damaged threads.

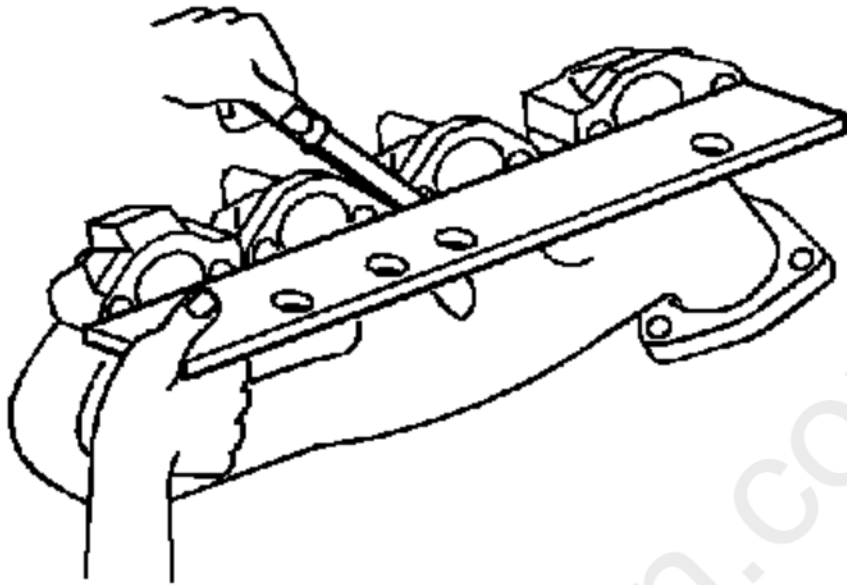


Fig. 50: Measuring Exhaust Manifold To Cylinder Head Surface For Warpage
Courtesy of GENERAL MOTORS CORP.

6. Use a straight edge and a feeler gauge to measure the exhaust manifold cylinder head deck for warpage.

An exhaust manifold deck with warpage in excess of 0.25 mm (0.01 in) within the 2 front or 2 rear runners or 0.5 mm (0.02 in) overall, may cause an exhaust leak and may effect OBD II system performance. Exhaust manifolds not within specifications must be replaced.

ENGINE COOLANT AIR BLEED PIPE AND HOLE COVER CLEANING AND INSPECTION

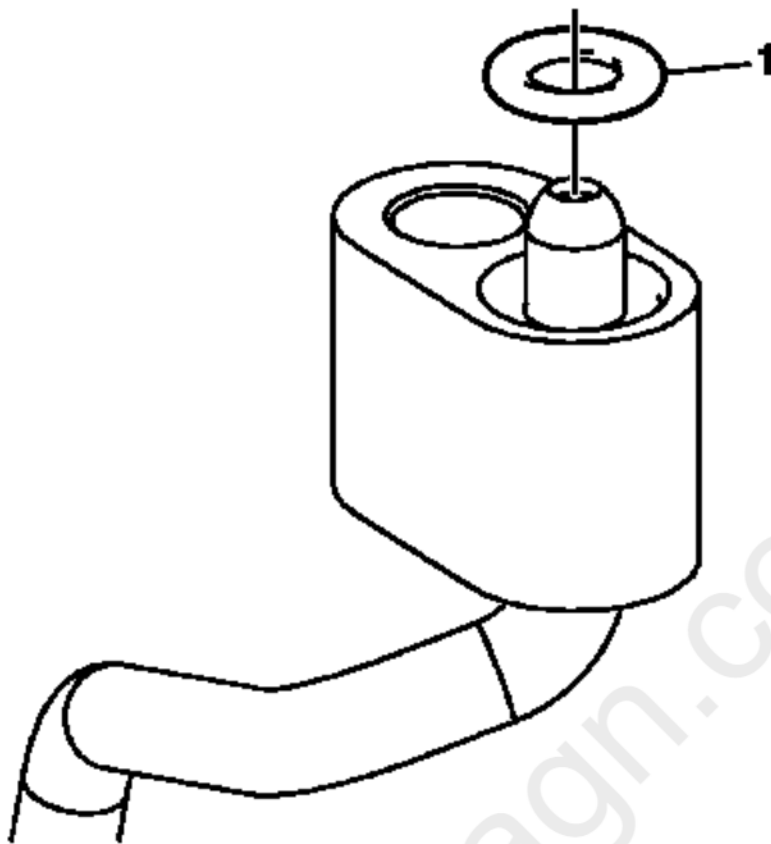


Fig. 51: Identifying Engine Coolant Air Bleed Pipe Seal
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not use the engine coolant air bleed pipe seals again. Upon installation of the pipes, install NEW seals.

1. Remove the seals (1) from the pipes.

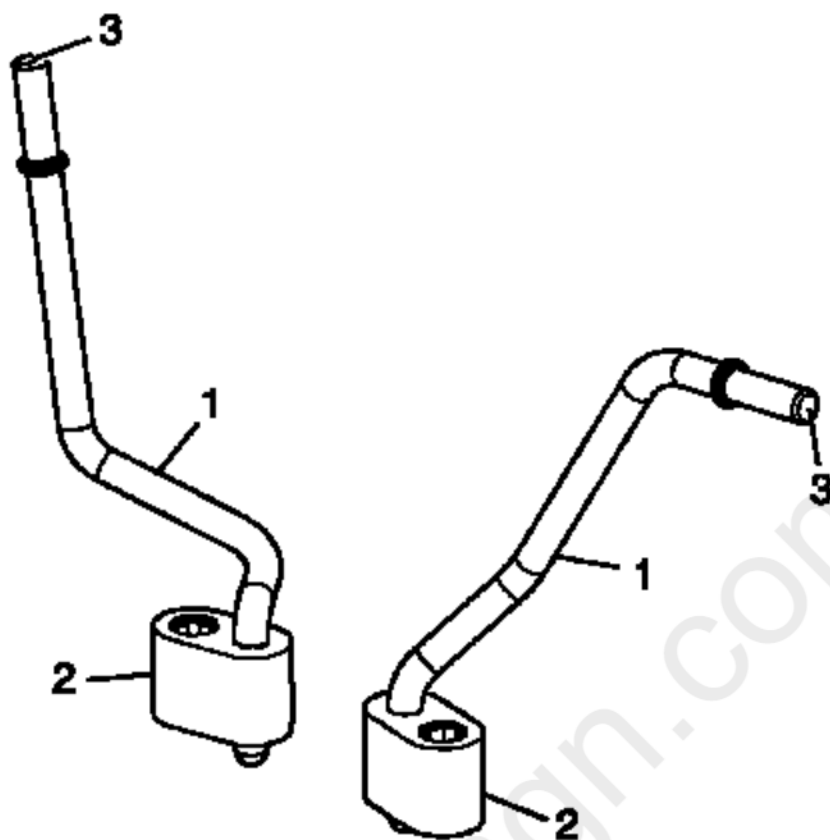


Fig. 52: View Of Engine Coolant Air Bleed Pipes
Courtesy of GENERAL MOTORS CORP.

2. Clean the pipes in solvent.

WARNING: Refer to SAFETY GLASSES WARNING .

3. Dry the pipes with compressed air.
4. Inspect the pipes for damaged sealing surfaces (1, 2) or restrictions within the pipe (3).

WATER PUMP CLEANING AND INSPECTION (6.2L)

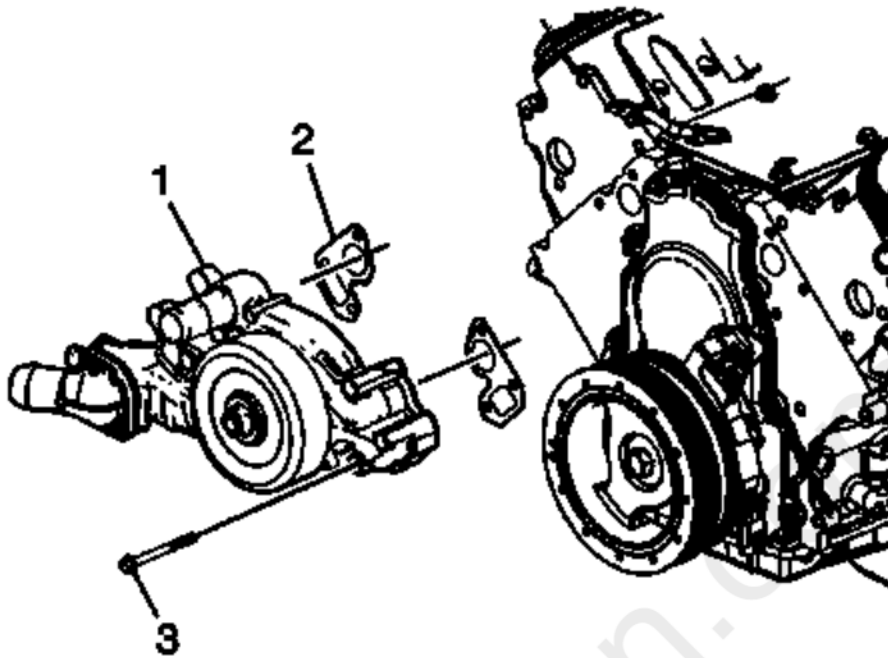


Fig. 53: Water Pump & Gaskets

Courtesy of GENERAL MOTORS CORP.

1. Remove the old gasket from the water pump sealing surfaces. Refer to **Replacing Engine Gaskets** .
2. Clean all excess dirt and debris from the water pump housing.
3. Inspect the water pump (1) for the following conditions:
 - Gasket and hose sealing surfaces for excessive scratches or gouging
 - Restrictions within the internal coolant passages
 - Excessive side-to-side play in the pulley shaft
 - Leakage at the water outlet housing or rear cover gasket
 - Leakage at the water pump vent hole

A stain around the vent hole is acceptable. If leakage, dripping, occurs with the engine running and the cooling system pressurized, replace the water pump.

- Wear or damage in the belt tracking area of the pulley

THREAD REPAIR

Special Tools

- **J 42385-100:** Head/Main Bolt Thread Repair Kit
- **J 42385-300:** Fixtures and Hardware Kit

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

GENERAL THREAD REPAIR

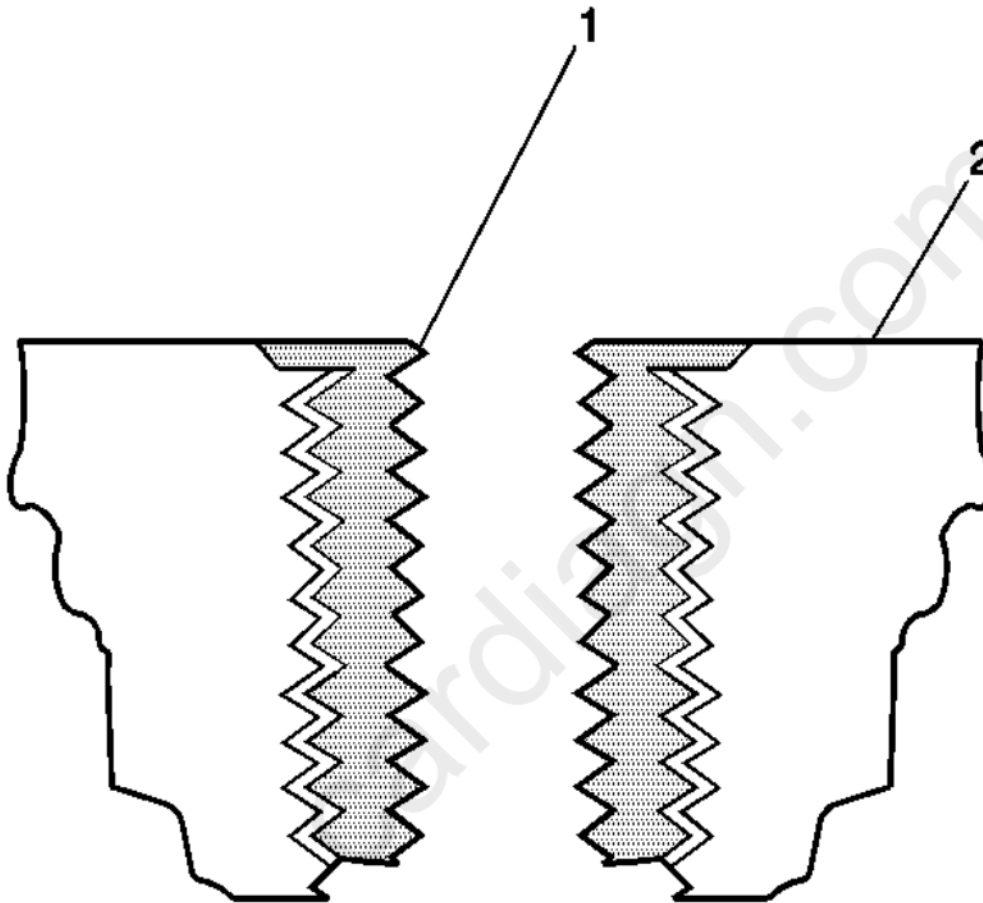


Fig. 54: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

The thread repair process involves a solid, thin walled, self-locking, carbon steel, bushing type insert (1). During the bushing installation process, the driver tool expands the bottom external threads of the insert into the base material (2). This action mechanically locks the insert in place. Also, when installed to the proper depth, the flange of the insert will be seated against the counterbore of the repaired hole.

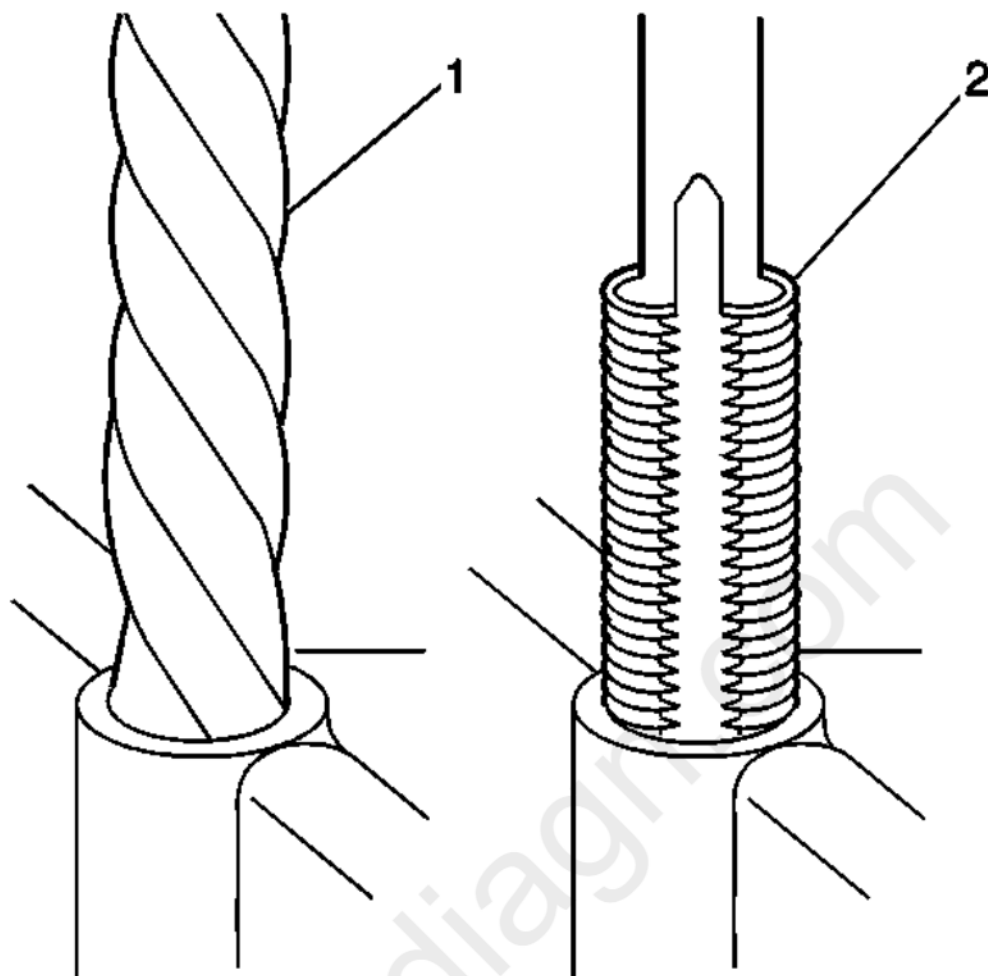


Fig. 55: Drilling & Tapping Threads
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to SAFETY GLASSES WARNING .

NOTE:

- The use of a cutting type fluid GM P/N 1052864 (Canadian P/N 992881), WD 40®, or equivalent, is recommended when performing the drilling, counterboring, and tapping procedures.
- Driver oil **MUST** be used on the installer driver tool.
- The tool kits are designed for use with either a suitable tap wrench or drill motor.

1. Drill out the threads of the damaged hole (1).
 - M6 inserts require a minimum drill depth of 15 mm (0.59 in).

- M8 inserts require a minimum drill depth of 20 mm (0.79 in).
 - M10 inserts require a minimum drill depth of 23.5 mm (0.93 in).
2. Using compressed air, clean out any chips.

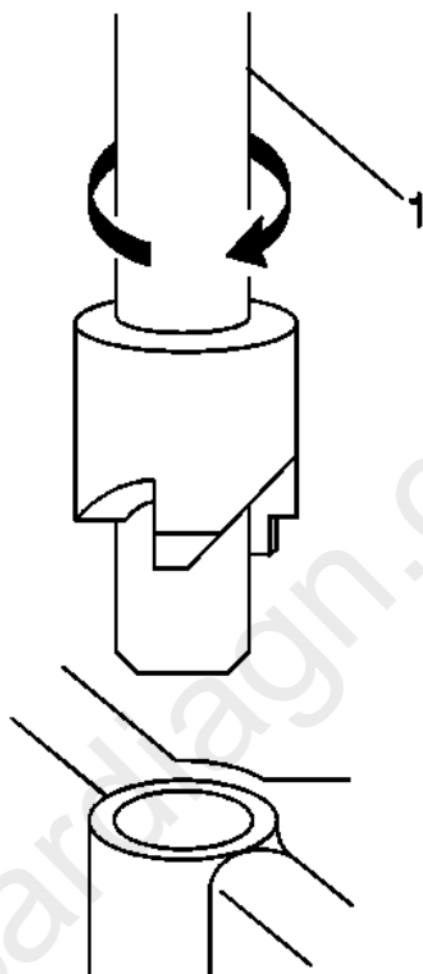


Fig. 56: Counterbore Tool

Courtesy of GENERAL MOTORS CORP.

3. Counterbore the hole to the full depth permitted by the tool (1).
4. Using compressed air, clean out any chips.

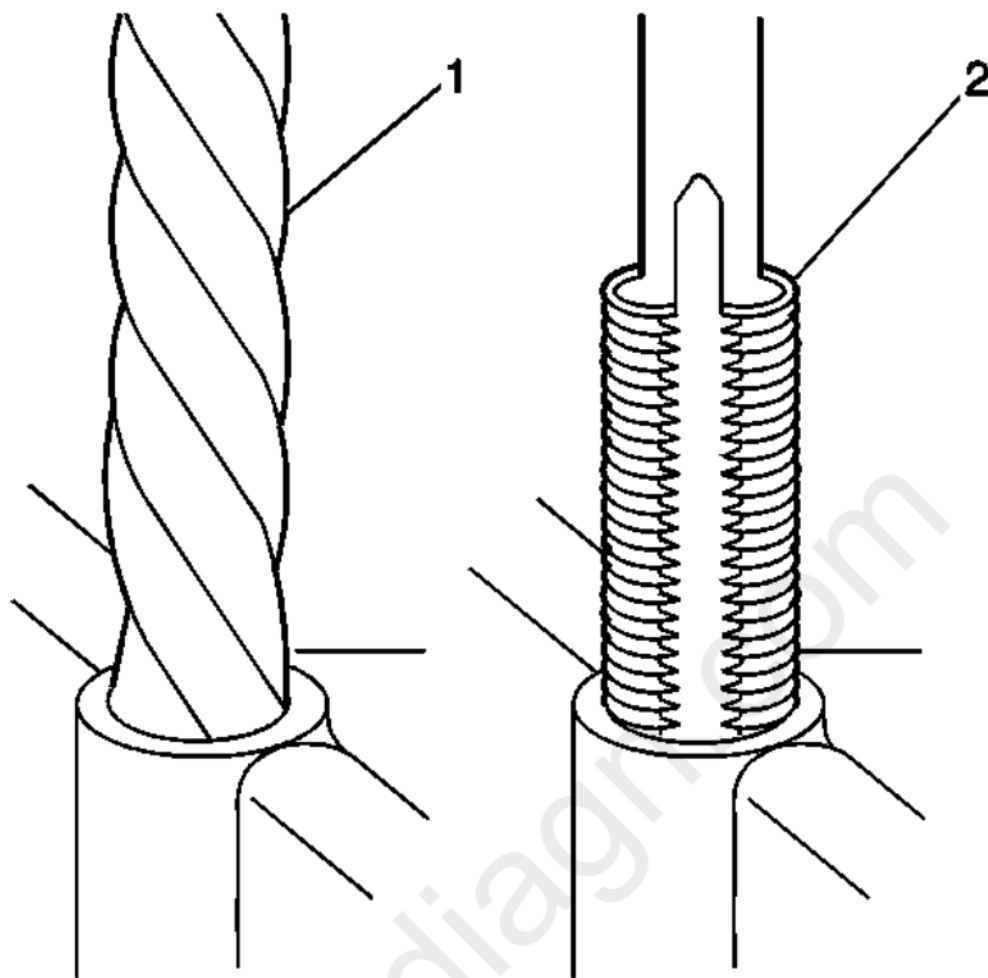


Fig. 57: Drilling & Tapping Threads
Courtesy of GENERAL MOTORS CORP.

5. Using a tap wrench (2), tap the threads of the drilled hole.
 - M6 inserts require a minimum tap depth of 15 mm (0.59 in).
 - M8 inserts require a minimum tap depth of 20 mm (0.79 in).
 - M10 inserts require a minimum tap depth of 23.5 mm (0.93 in).
6. Using compressed air, clean out any chips.
7. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
8. Using compressed air, clean any cutting oil and chips out of the hole.

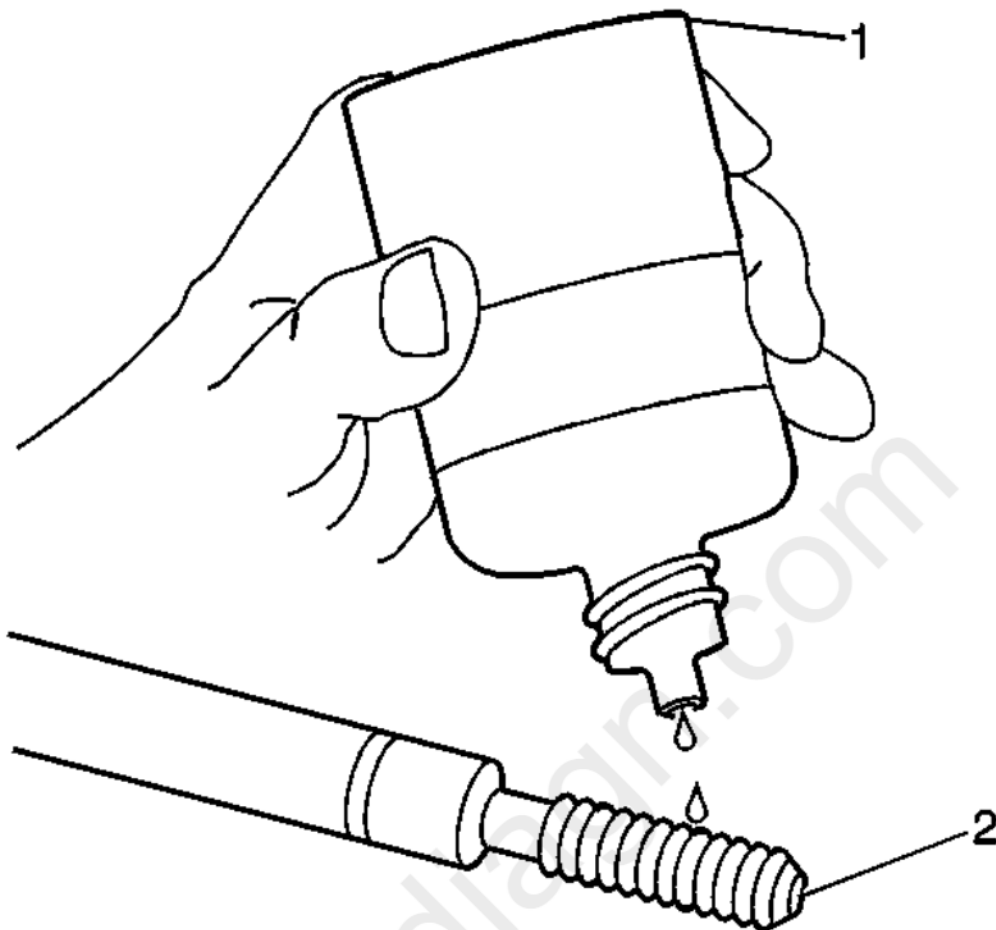


Fig. 58: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

NOTE: Do not allow oil or other foreign material to contact the outside diameter (OD) of the insert.

9. Lubricate the threads of the installer tool (2) with the driver oil (1).

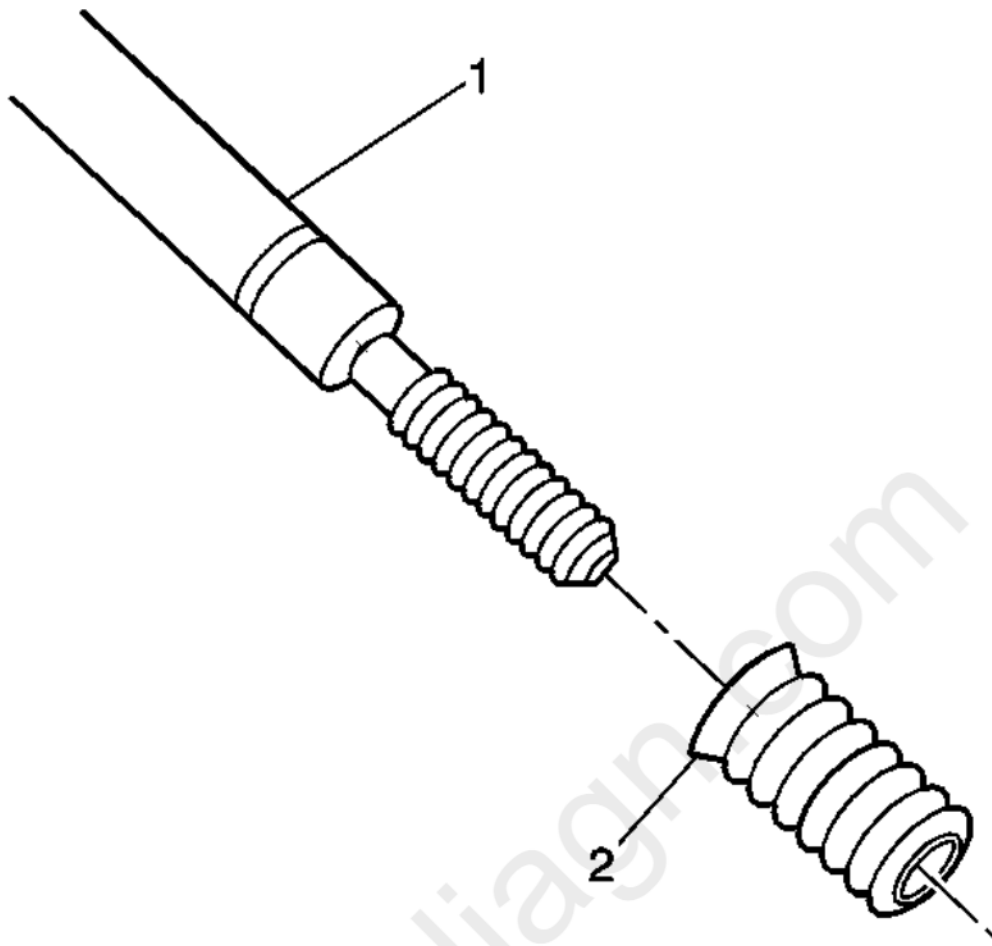


Fig. 59: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

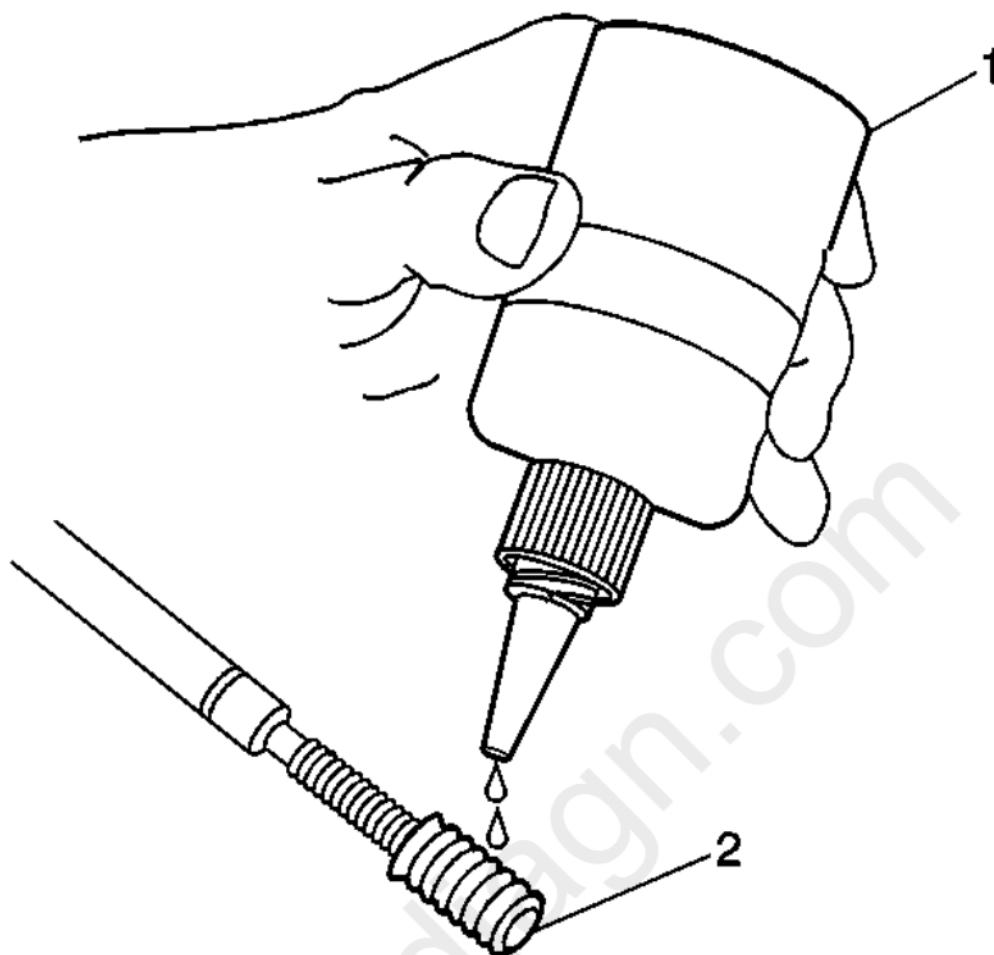


Fig. 60: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

11. Apply threadlock LOCTITE™ 277, J 42385-109 (1), or equivalent, to the insert OD threads (2).

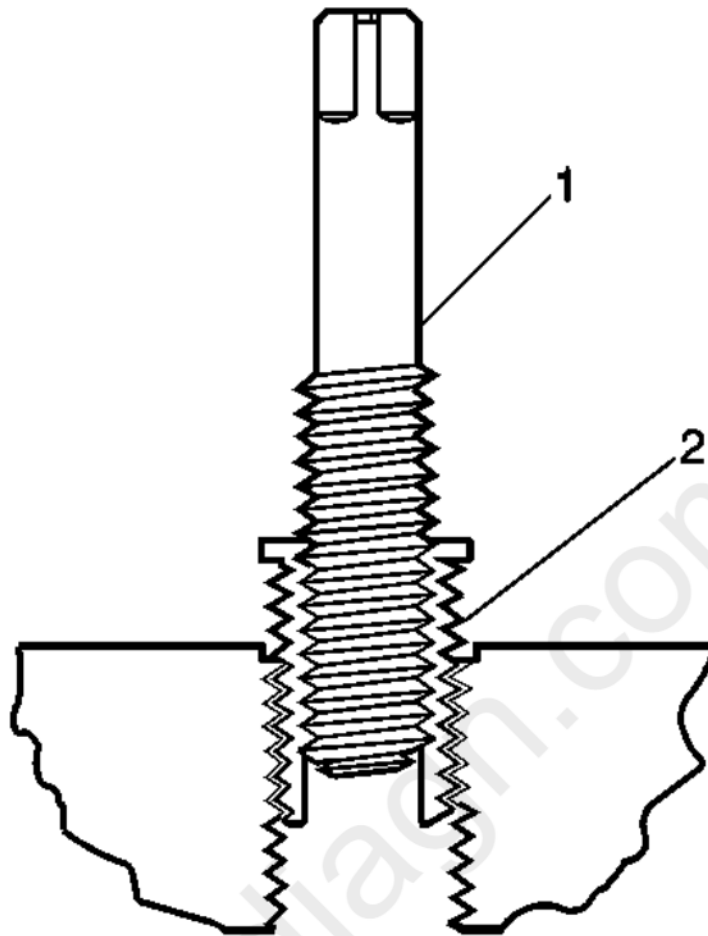


Fig. 61: View Of Insert In Tapped Bolt Hole
Courtesy of GENERAL MOTORS CORP.

12. Install the insert (2) into the hole.

Install the insert until the flange of the insert contacts the counterbored surface. Continue to rotate the installer tool (1) through the insert.

The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

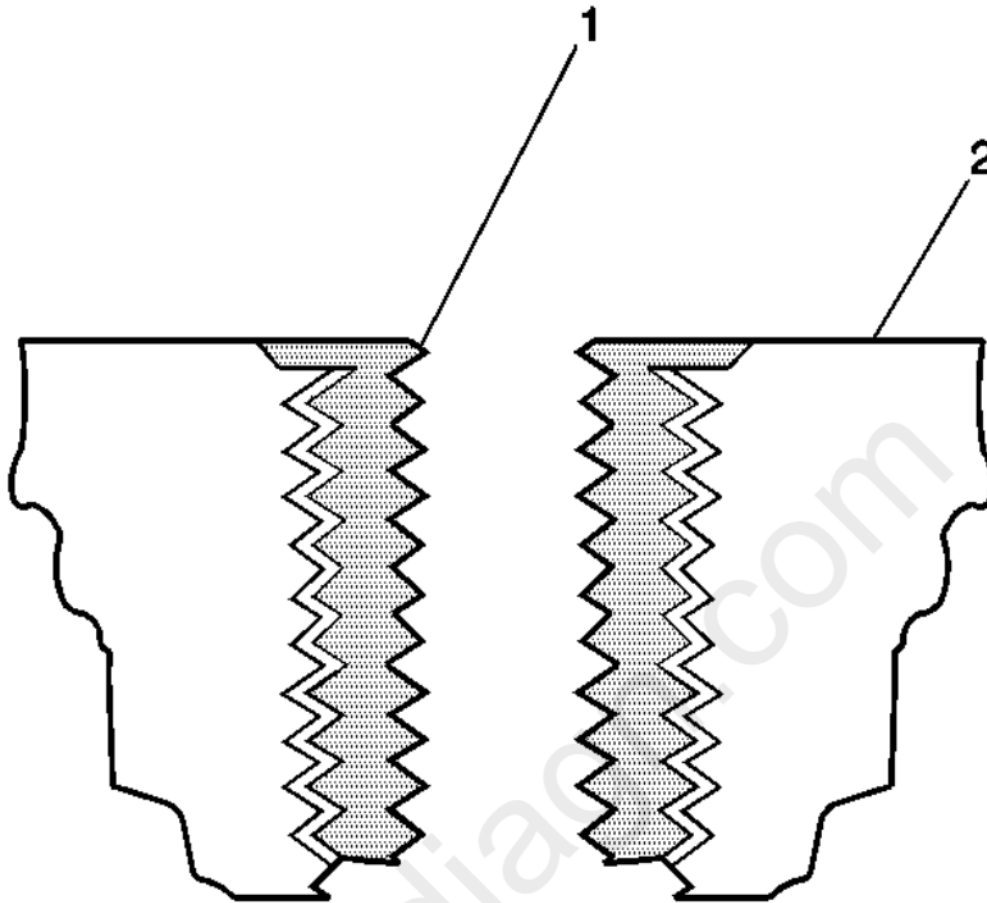


Fig. 62: View Of Bushing Type Insert & Base Material
Courtesy of GENERAL MOTORS CORP.

13. Inspect the insert for proper installation into the hole.

A properly installed insert (1) will be either flush or slightly below flush with the surface of the base material (2).

CYLINDER HEAD BOLT HOLE THREAD REPAIR

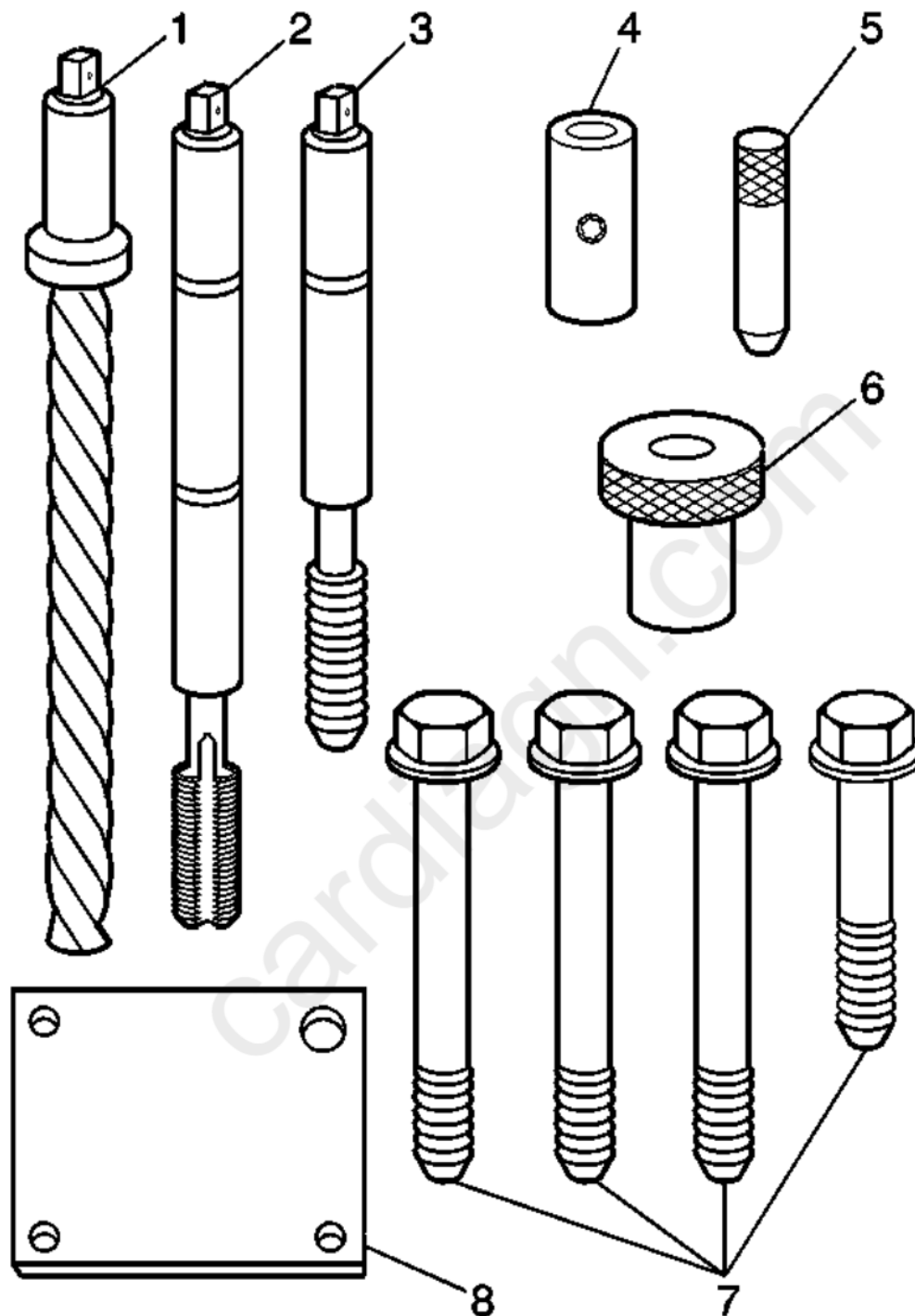


Fig. 63: Identifying Thread Repair Kit Components
Courtesy of GENERAL MOTORS CORP.

1. The cylinder head bolt hole thread repair kit consists of the following items:

- The drill (1)
- The tap (2)
- The installer (3)
- The sleeve (4)
- The alignment pin (5)
- The bushing (6)
- The bolts (7)
- The fixture plate (8)

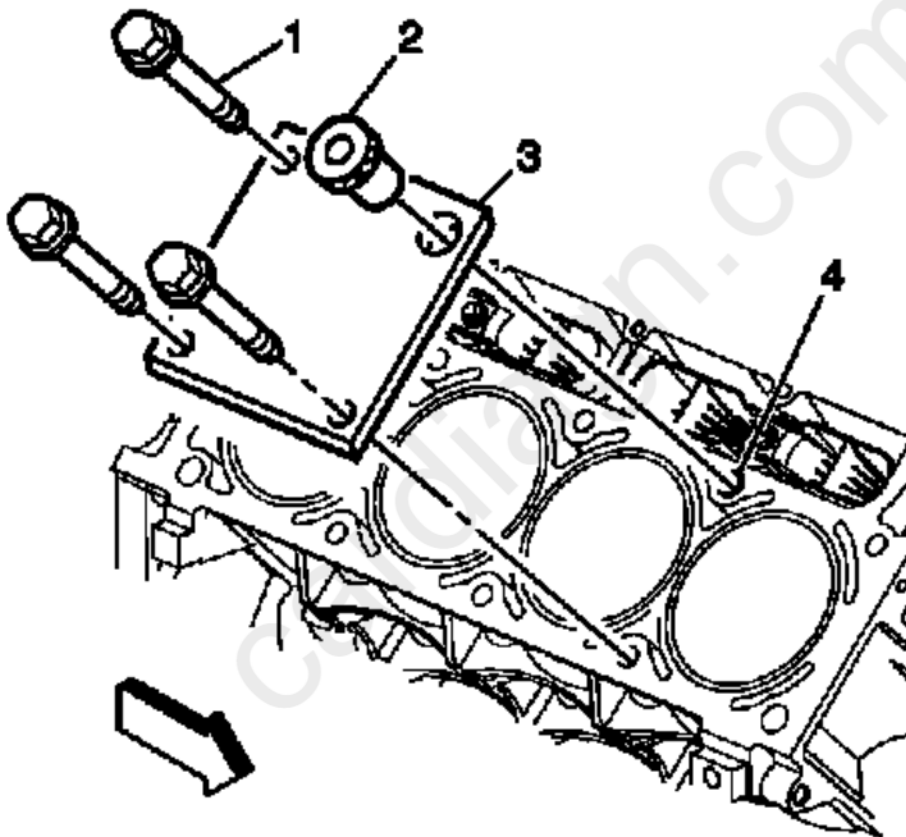


Fig. 64: View Of Fixture Plate, Bolts, Bushing & Cylinder Hole
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to SAFETY GLASSES WARNING .

NOTE:

- The use of a cutting type fluid GM P/N 1052864 (Canadian P/N

992881), WD 40®, or equivalent, is recommended when performing the drilling and tapping procedures.

- **Driver oil MUST be used on the installer driver tool.**
- **The tool kits are designed for use with either a suitable tap wrench or drill motor.**

2. Install the fixture plate (3), bolts (1), and bushing (2) onto the engine block deck.

Position the fixture plate and bushing over the hole that is to be repaired (4).

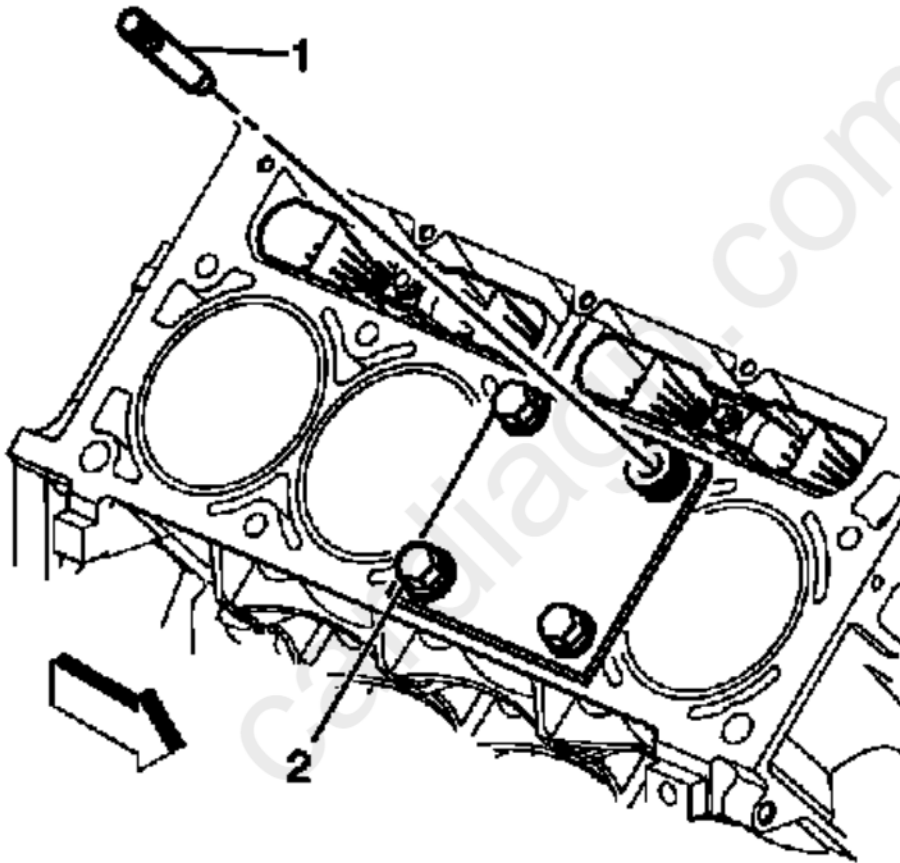


Fig. 65: View Of Alignment Pin & Fixture Retaining Bolts
Courtesy of GENERAL MOTORS CORP.

3. Position the alignment pin (1) through the bushing and into the hole.
4. With the alignment pin in the desired hole, tighten the fixture retaining bolts (2).
5. Remove the alignment pin from the hole.

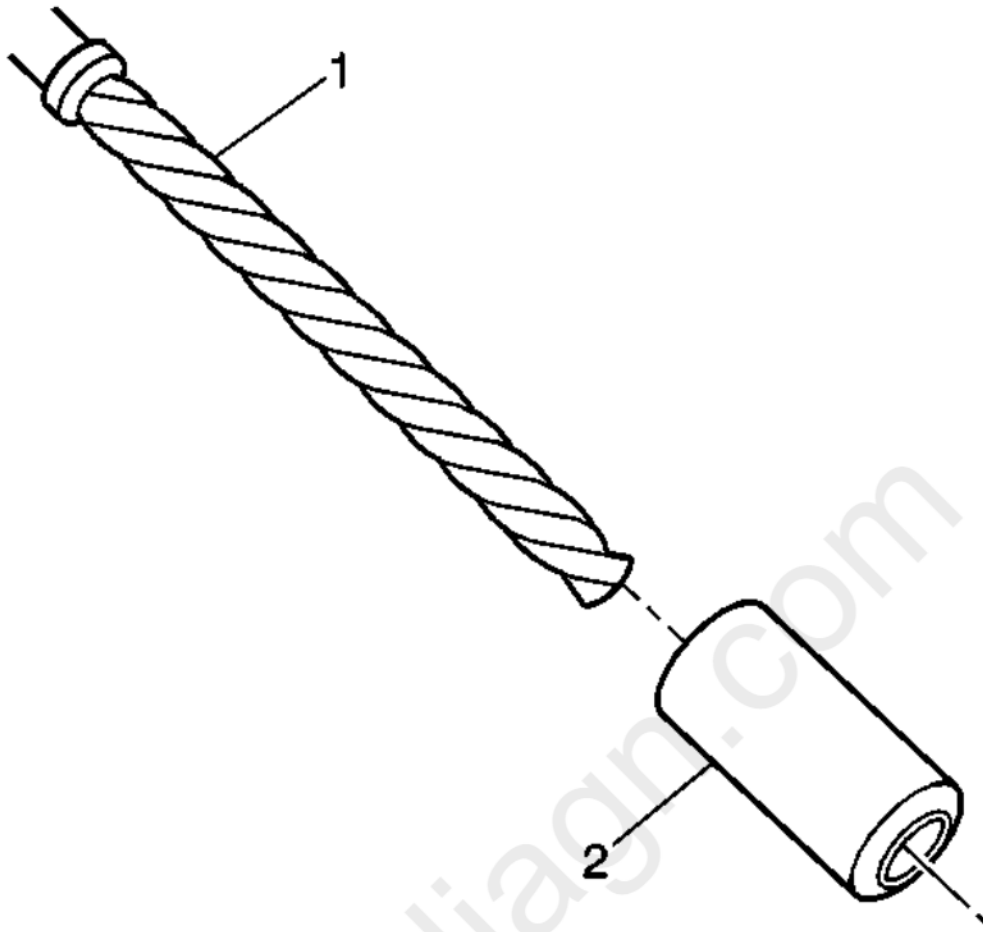


Fig. 66: View Of Stop Collar & Counterbore Drill
Courtesy of GENERAL MOTORS CORP.

6. Install the sleeve (2) onto the drill (1).

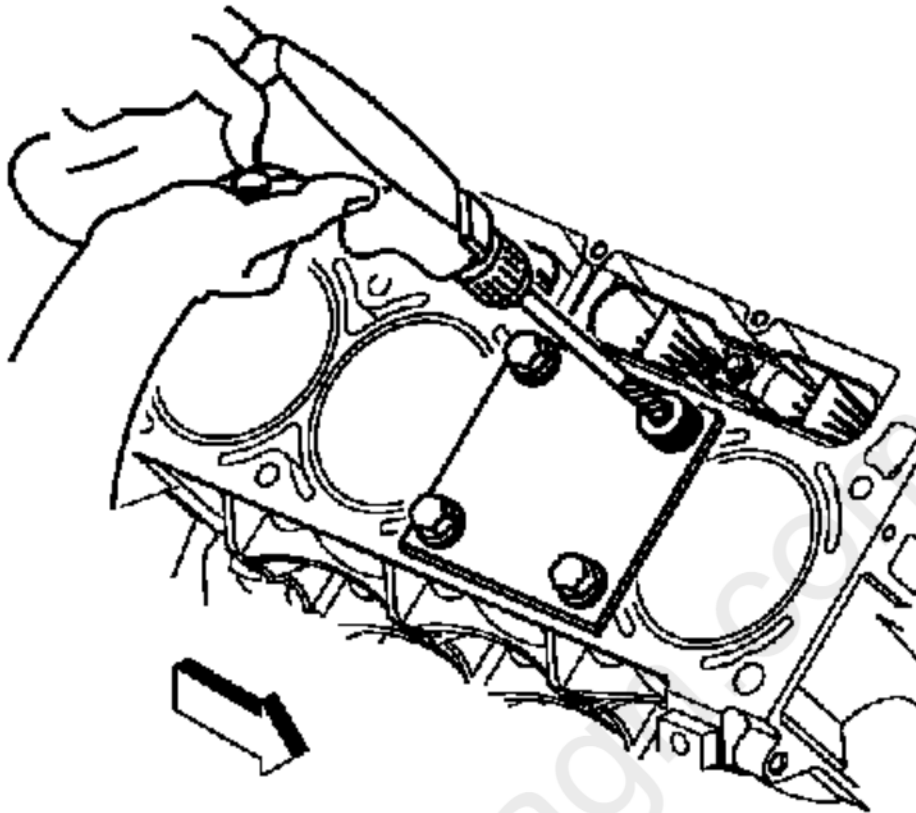


Fig. 67: Drilling Cylinder Head Bolt Hole
Courtesy of GENERAL MOTORS CORP.

NOTE: During the reaming process, it is necessary to repeatedly remove the drill and clean the chips from the hole.

7. Drill out the threads of the damaged hole.

Drill the hole until the stop collar of the drill bit or the sleeve contacts the bushing.

8. Using compressed air, clean out any chips.

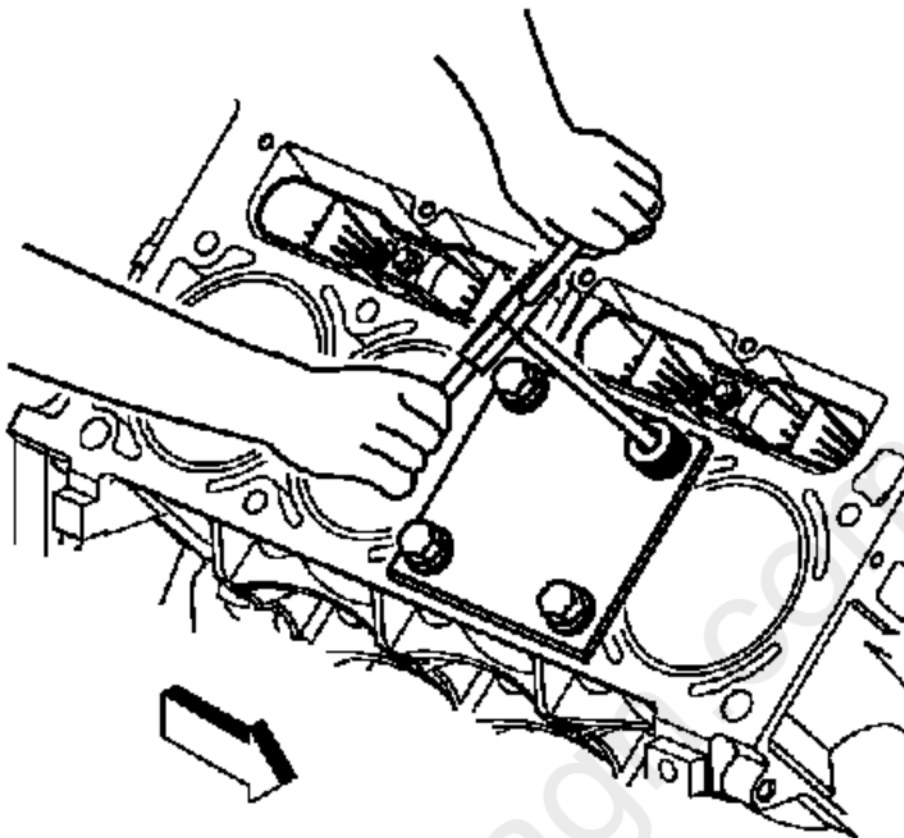


Fig. 68: Tapping Threads Of Drilled Hole Using Tapping Wrench
Courtesy of GENERAL MOTORS CORP.

9. Using a tap wrench, tap the threads of the drilled hole.

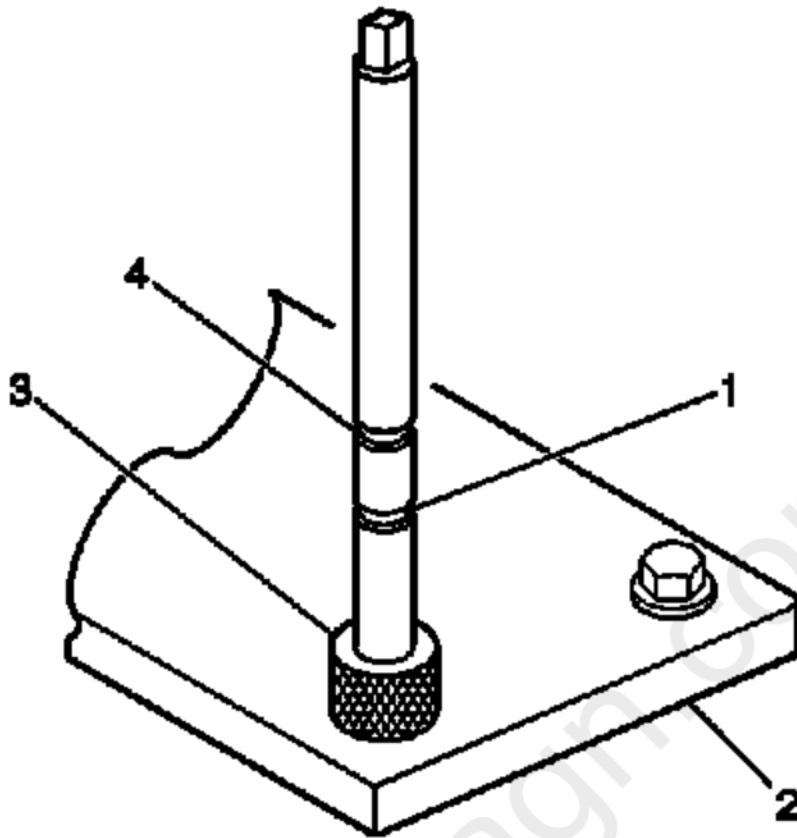


Fig. 69: View Of Tap Upper & Lower Marks, Fixture Plate & Bushing
Courtesy of GENERAL MOTORS CORP.

10. In order to tap the new threads to the proper depth, rotate the tap into the hole until the mark (1) on the tap aligns with the top of the drill bushing (3).
11. Remove the fixture plate (2), bushing (3), and bolts.
12. Using compressed air, clean out any chips.
13. Spray cleaner GM P/N 12346139, GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
14. Using compressed air, clean any cutting oil and chips out of the hole.

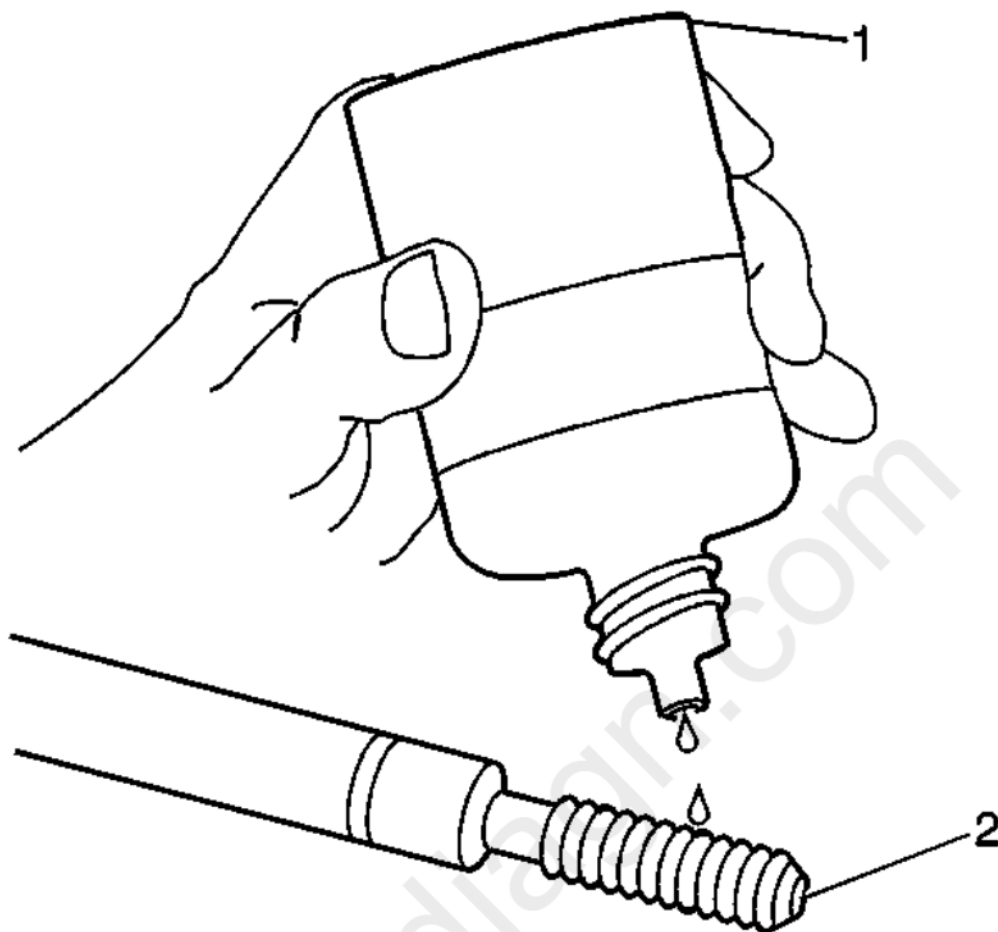


Fig. 70: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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

15. Lubricate the threads of the installer tool (2) with the driver oil (1).

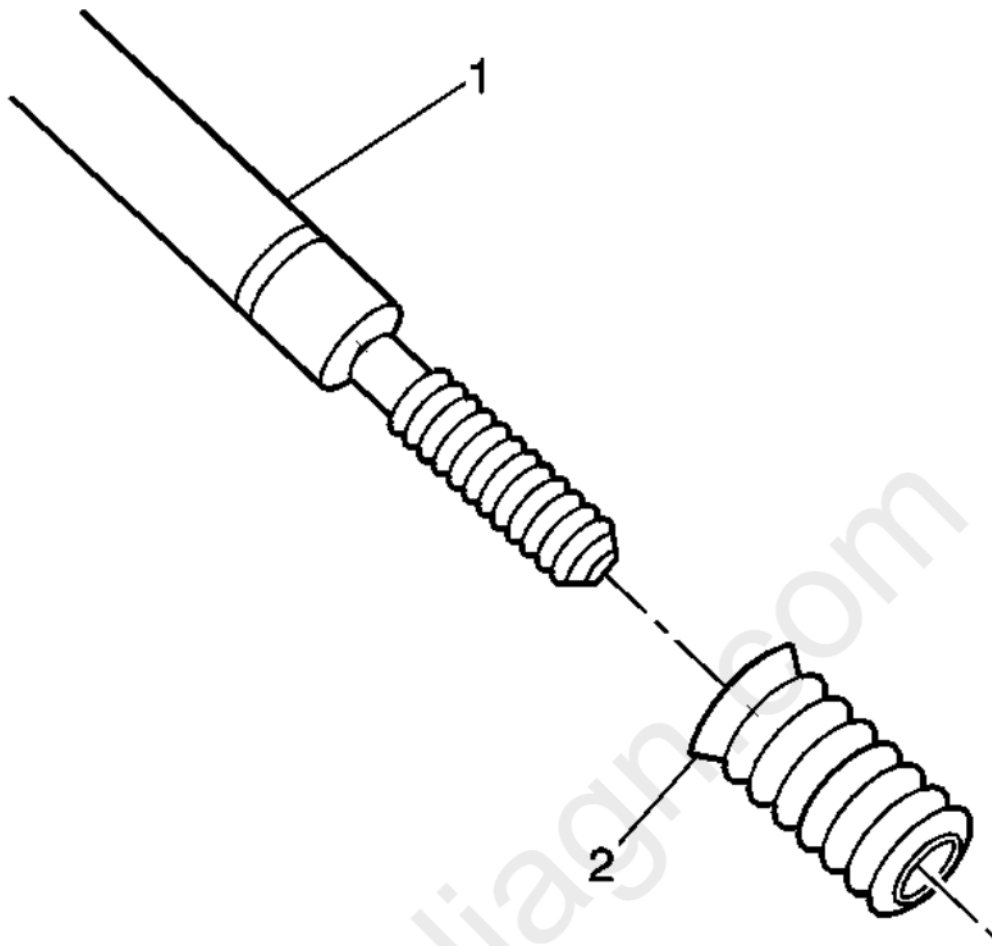


Fig. 71: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

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

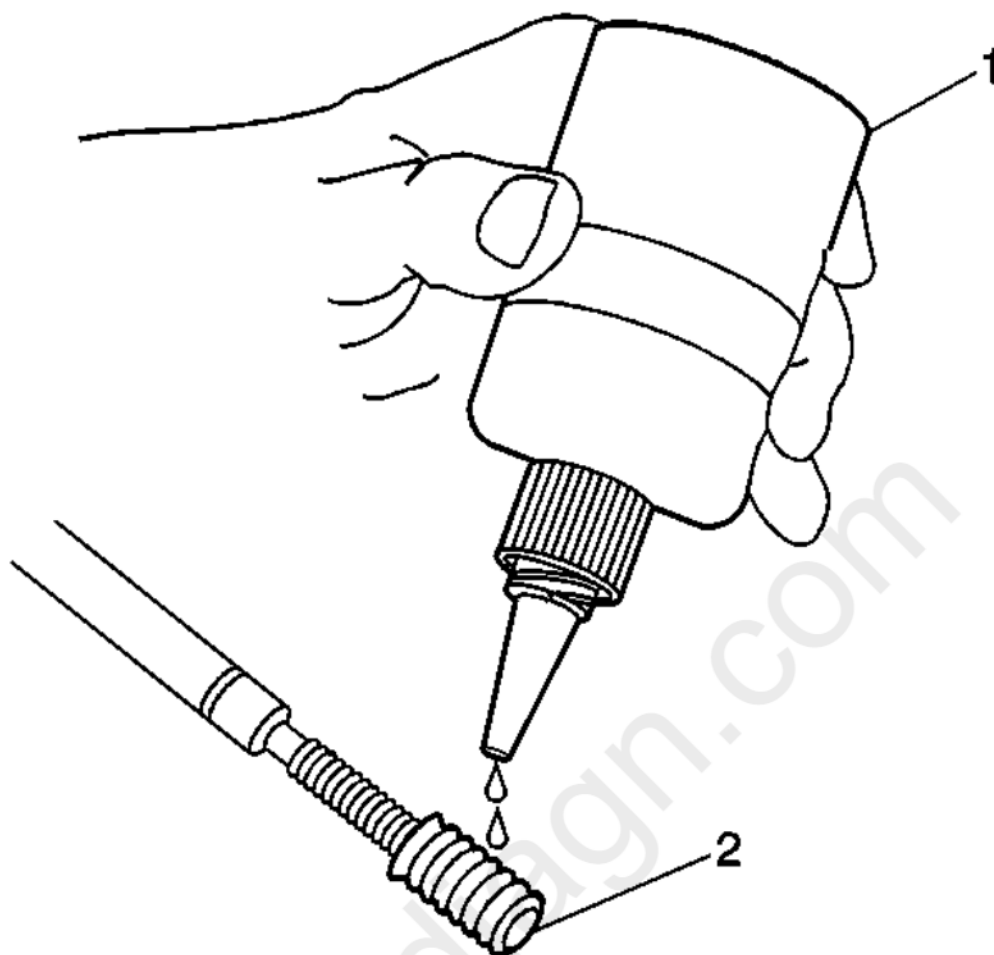


Fig. 72: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

17. Apply threadlock LOCTITE™ 277, J 42385-109 (1), or equivalent, to the insert OD threads (2).

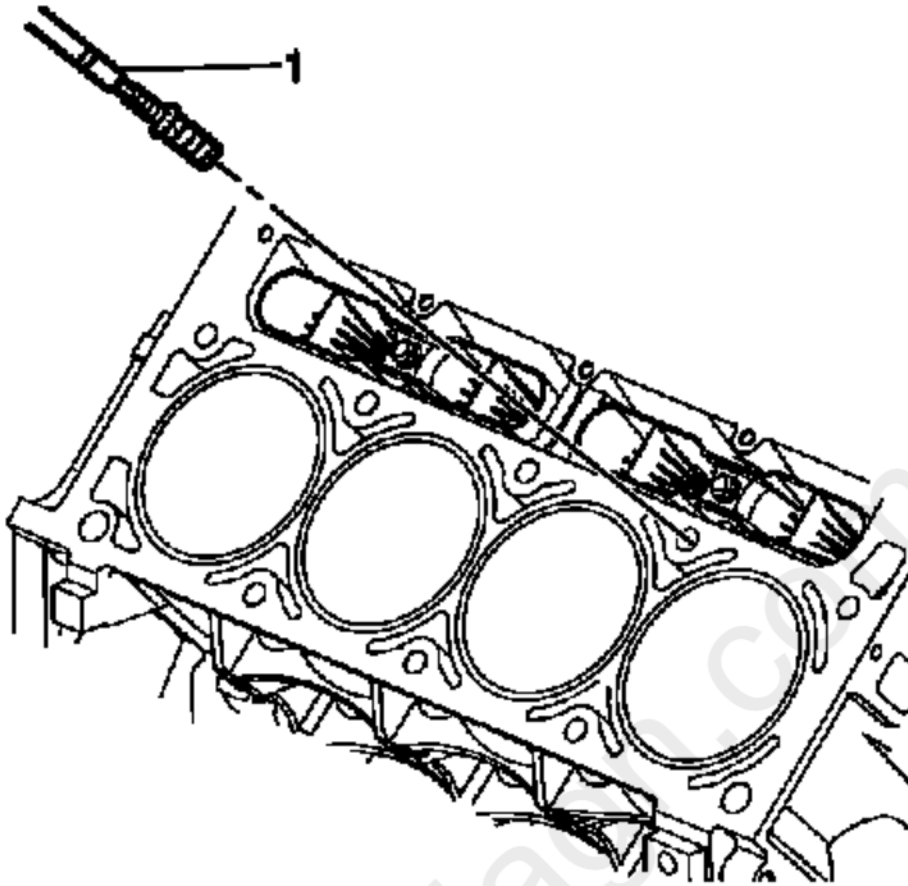


Fig. 73: Installing Insert & Driver Into Cylinder Bolt Hole
Courtesy of GENERAL MOTORS CORP.

18. Install the insert and driver (1) into the hole.

Rotate the driver tool until the mark on the tool aligns with the deck surface of the engine block.

The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

MAIN CAP BOLT HOLE THREAD REPAIR

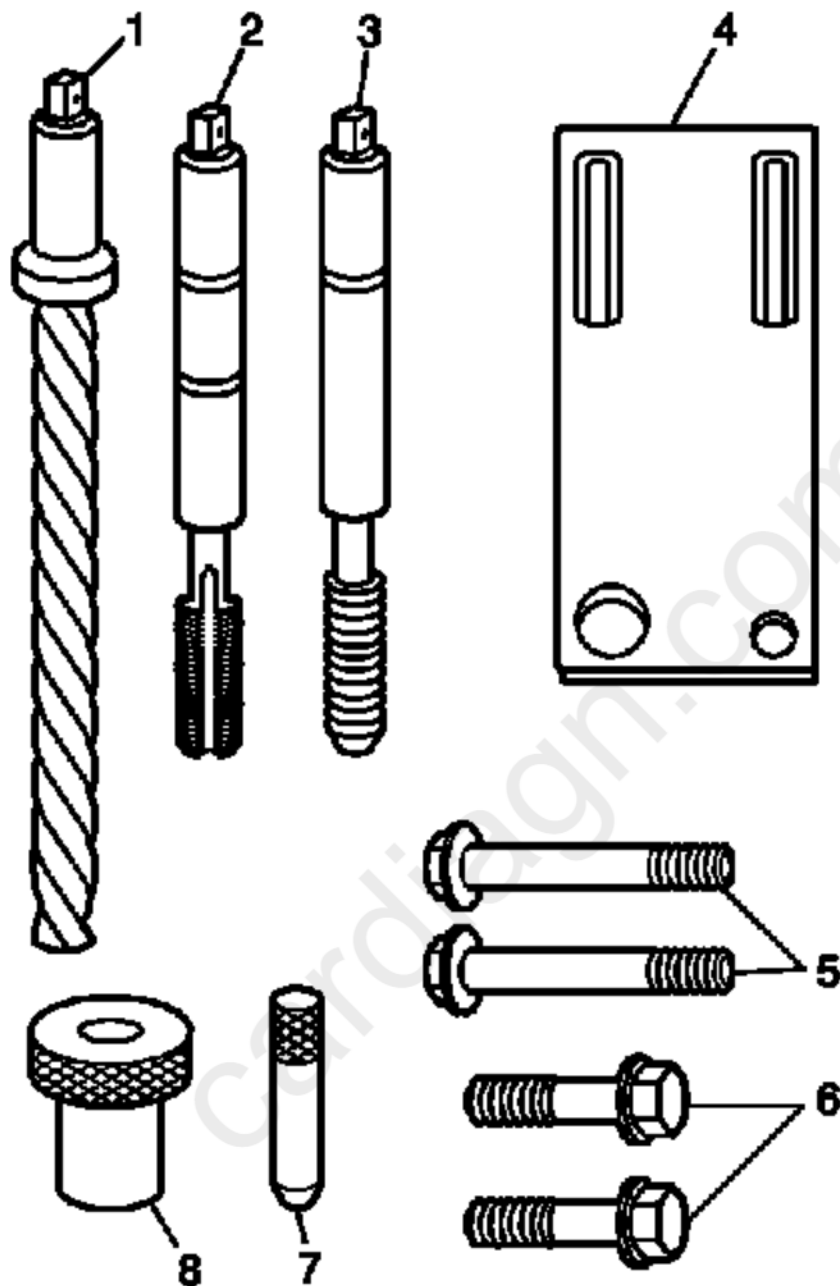


Fig. 74: Identifying Thread Repair Kit Components
Courtesy of GENERAL MOTORS CORP.

1. The main cap bolt hole thread repair kit consists of the following items:
 - The drill (1)
 - The tap (2)
 - The installer (3)

- The fixture plate (4)
- The long bolts (5)
- The short bolts (6)
- The alignment pin (7)
- The bushing (8)

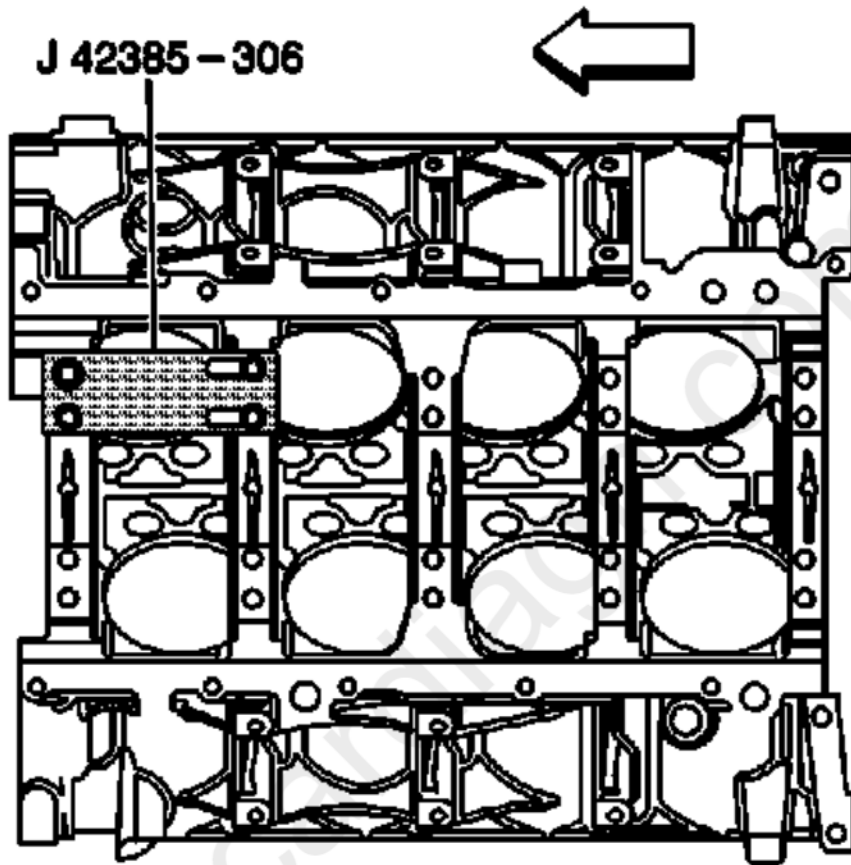


Fig. 75: View Of Fixture Plate, Bolt & Bushing
Courtesy of GENERAL MOTORS CORP.

2. Install the fixture plate, bolt, and bushing onto the engine block.

Position the fixture plate and bushing over the hole that is to be repaired.

3. Position the alignment pin in the desired hole and tighten the fixture retaining bolts.

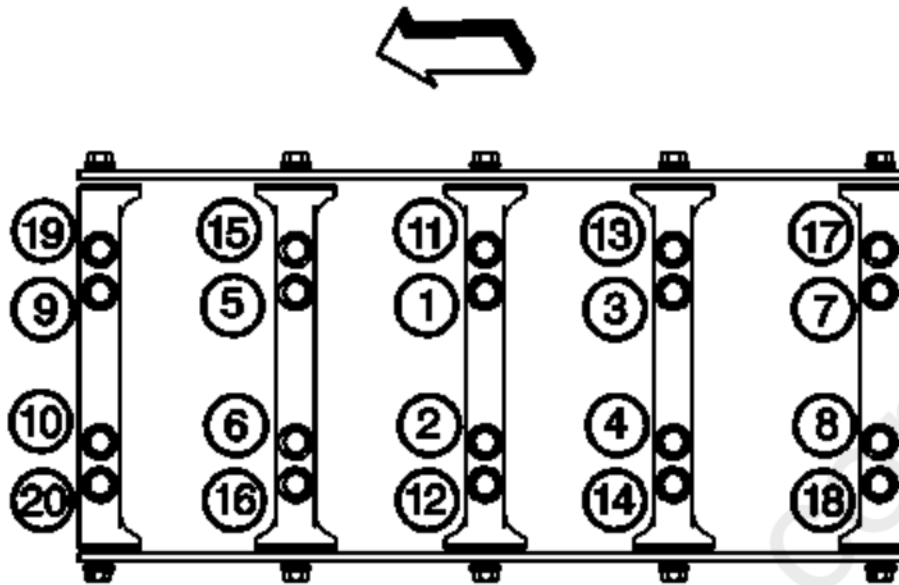


Fig. 76: Crankshaft Main Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

4. Drill out the damaged hole.

The outer bolt hole locations 11-20 have the shallower counterbores. Use sleeve J 42385-316 with the drill.

Drill until the stop collar of the drill bit or the sleeve contacts the bushing.

5. Using compressed air, clean out any chips.

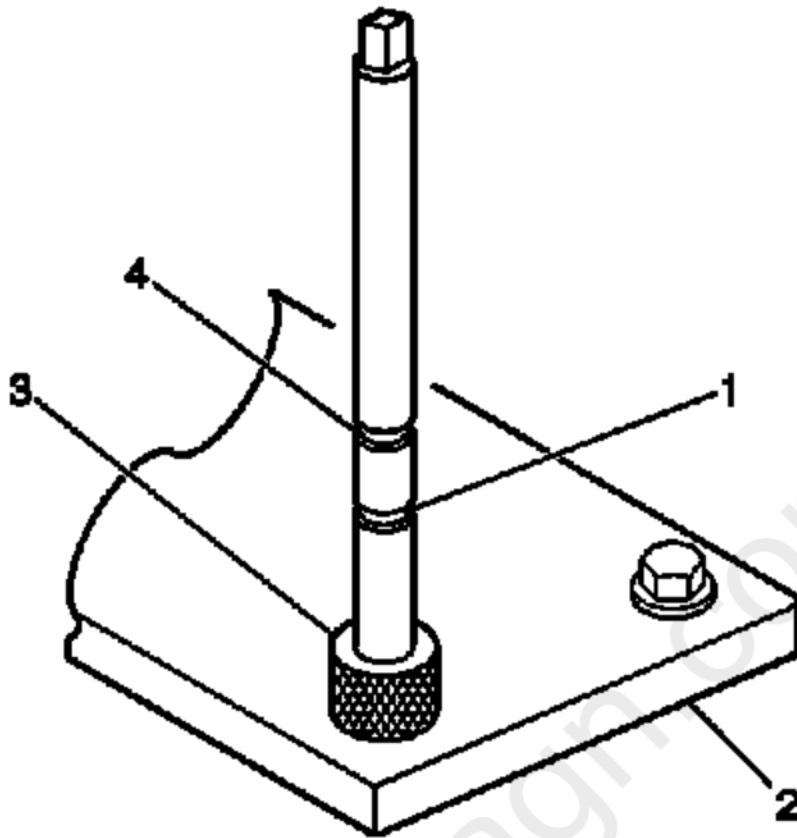


Fig. 77: View Of Tap Upper & Lower Marks, Fixture Plate & Bushing
Courtesy of GENERAL MOTORS CORP.

6. Using a tap wrench, tap the threads of the drilled hole.

In order to tap the new threads to the proper depth, rotate the tap into the hole until the mark on the tap aligns with the top of the bushing.

For the deeper main cap holes 1-10, rotate the tap until the upper mark (4) on the tap aligns with the top of the bushing (3).

For the shallower main cap holes 11-20, rotate the tap until the lower mark (1) on the tap aligns with top of the bushing (3).

7. Using compressed air, clean out any chips.
8. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), or equivalent, into the hole.
9. Using compressed air, clean any cutting oil and chips out of the hole.

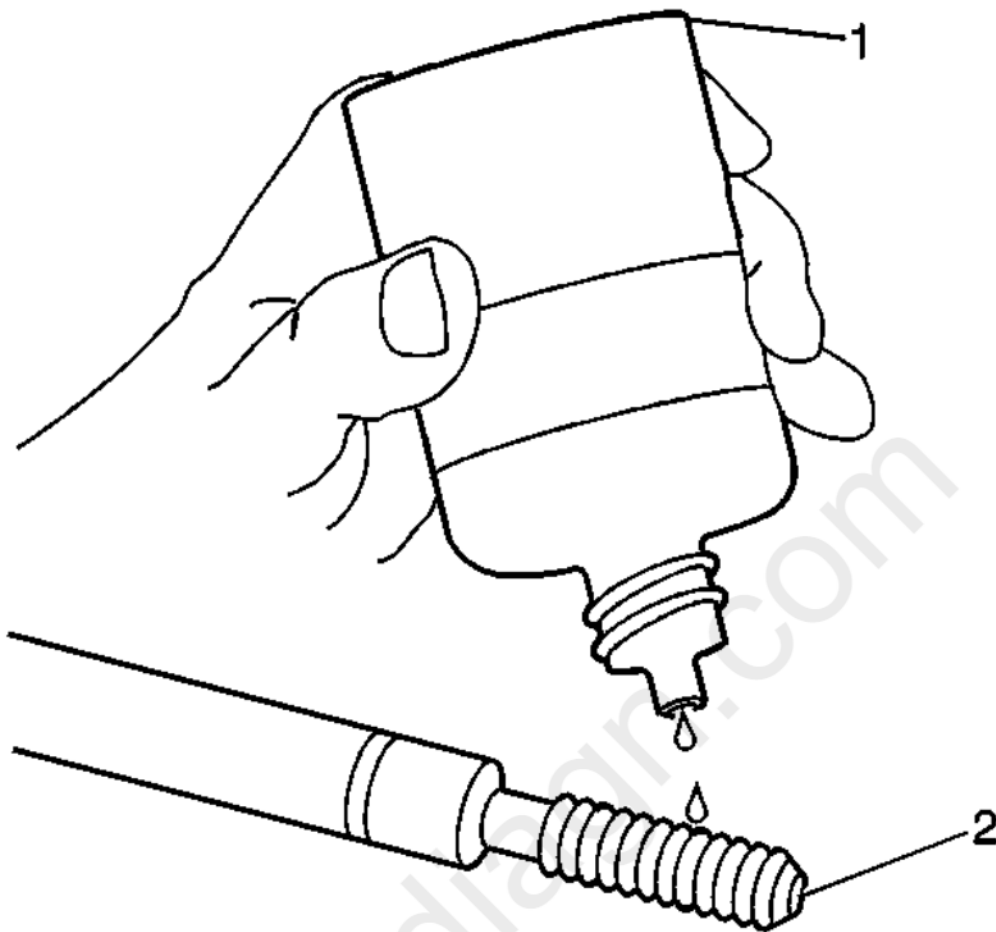


Fig. 78: Lubricating Installer Tool Using Driver Oil
Courtesy of GENERAL MOTORS CORP.

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

10. Lubricate the threads of the installer tool (2) with the driver oil (1).

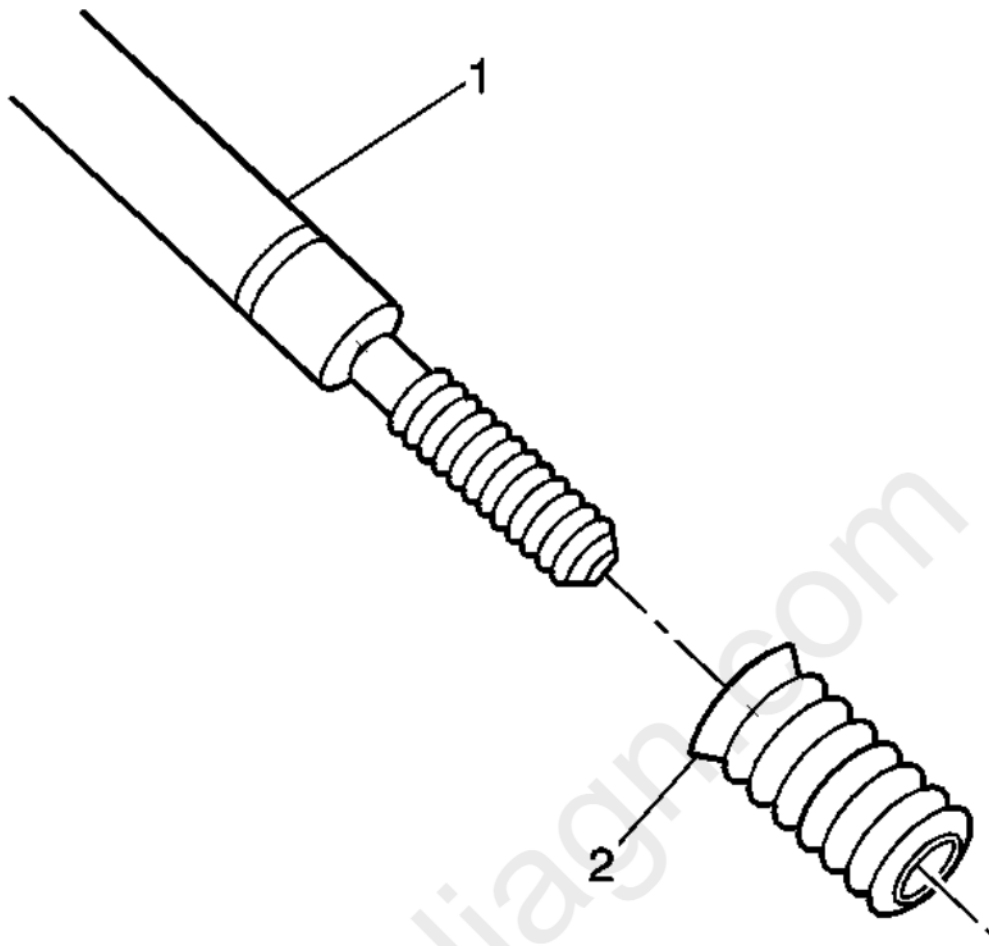


Fig. 79: View of Bushing Type Insert
Courtesy of GENERAL MOTORS CORP.

11. Install the insert (2) onto the driver tool (1).

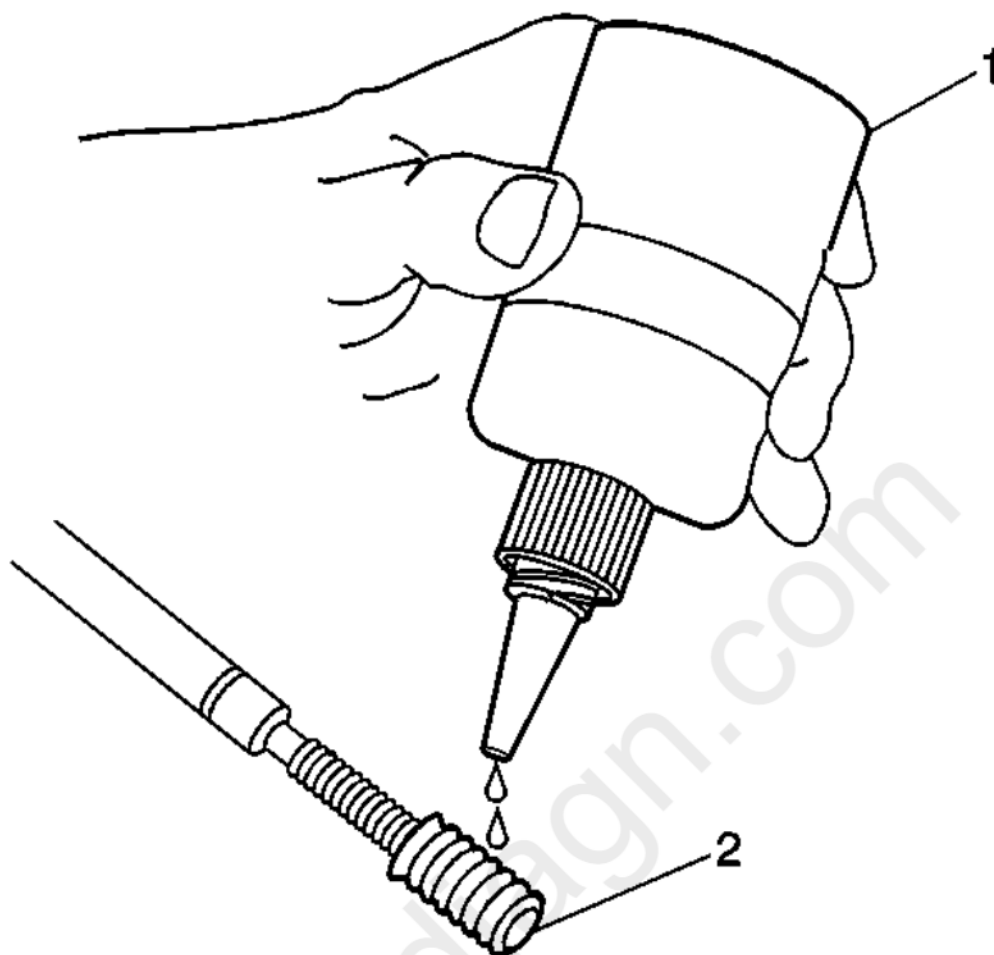


Fig. 80: Applying Threadlock To Insert
Courtesy of GENERAL MOTORS CORP.

12. Apply threadlock LOCTITE™ 277, J 42385-109 (1), or equivalent, to the insert OD threads (2).

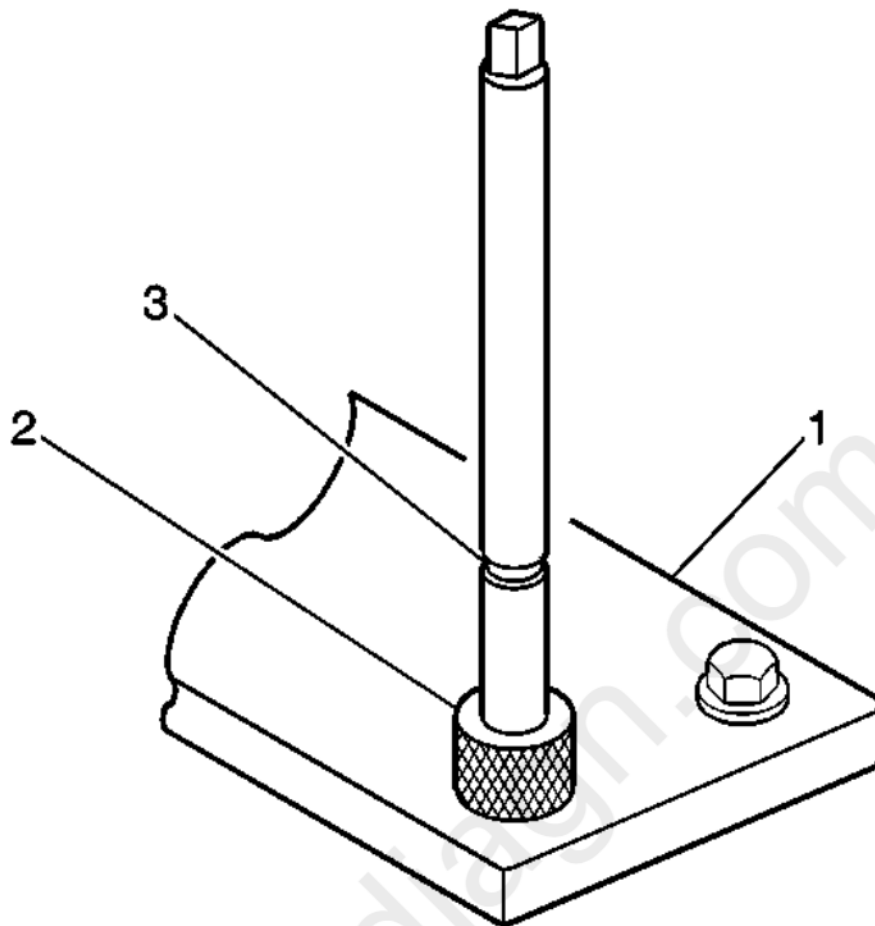


Fig. 81: View Of Fixture Plate, Drill Bushing & Tool Marking
Courtesy of GENERAL MOTORS CORP.

NOTE: The fixture plate and bushing remains installed onto the engine block during the insert installation procedure.

13. Install the insert and driver (1) through the fixture plate and bushing and into the hole.

Rotate the driver tool until the mark on the tool (3) aligns with the top of the bushing (2).

The installer tool will tighten up before screwing completely through the insert. This is acceptable. You are forming the bottom threads of the insert and mechanically locking the insert to the base material threads.

SERVICE PRIOR TO ASSEMBLY

- Dirt or debris causes premature wear of the rebuilt engine. Clean all components. Refer to Cleanliness

and Care .

- Use the proper tools to measure components when inspecting for excessive wear. Components that are not within the manufacturers specifications must be repaired or replaced.
- When the components are installed into an engine, return the components to their original location, position and direction. Refer to **Separating Parts** .
- During assembly, lubricate all moving parts with clean engine oil. This provides initial lubrication when the engine is first started.

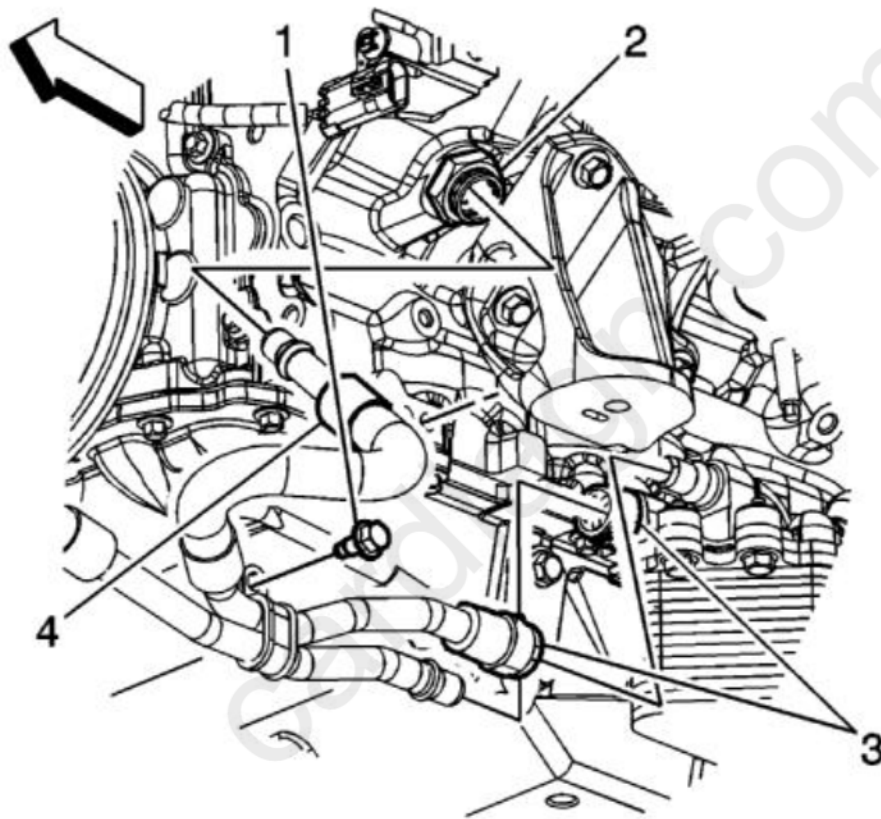
ENGINE BLOCK PLUG INSTALLATION

Fig. 82: Identifying Engine Oil Cooler Hose/Pipe
Courtesy of GENERAL MOTORS CORP.

NOTE: Engine block plug, oil gallery, and coolant sealing washers may be used again if not bent, scored or otherwise damaged.

1. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the threads of the engine oil cooler coolant fitting (2). Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

CAUTION: Refer to **FASTENER CAUTION** .

2. Install the engine oil cooler coolant fitting (2) and tighten to 50 N.m (37 lb ft).

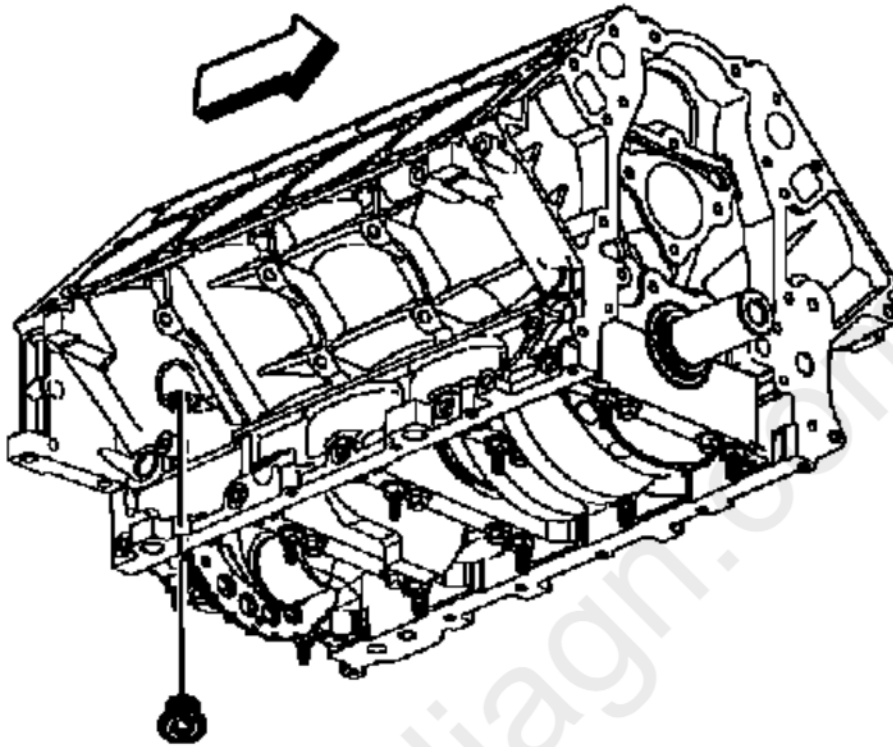


Fig. 83: Identifying Plug Location On Underside Of Block
Courtesy of GENERAL MOTORS CORP.

3. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block right rear coolant drain hole plug sealing washer.
4. Install the engine block right rear coolant drain hole plug and tighten to 60 N.m (44 lb ft).

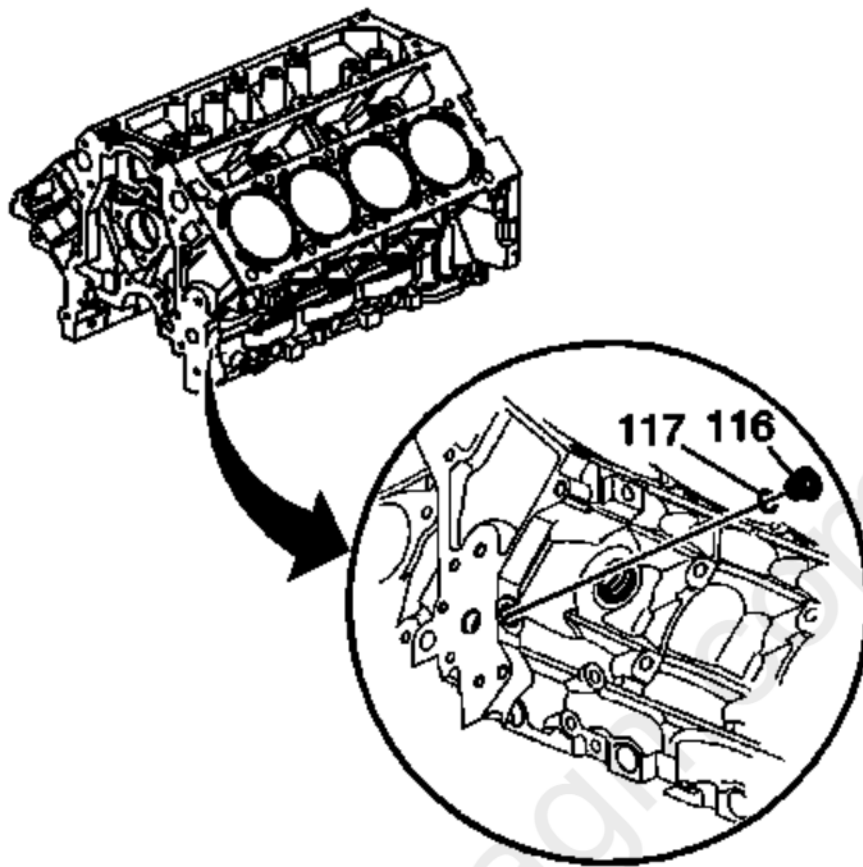


Fig. 84: Locating Engine Block Left Front Oil Gallery Plug & Seal
 Courtesy of GENERAL MOTORS CORP.

5. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block left front oil gallery plug sealing washer (117).
6. Install the engine block left front oil gallery plug (116) and tighten to 60 N.m (44 lb ft).

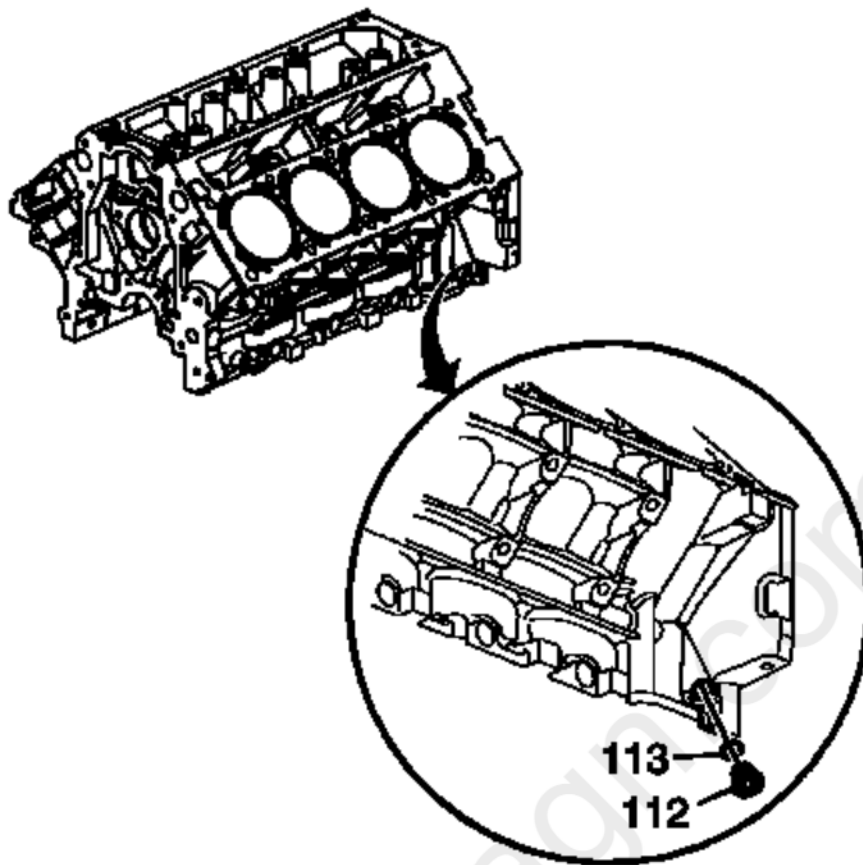


Fig. 85: Locating Engine Block Left Rear Oil Gallery Plug & Seal
Courtesy of GENERAL MOTORS CORP.

7. Apply a 3.175 mm (0.125 in) bead of sealant GM P/N 12346004 (Canadian P/N 10953480) to the engine block left rear oil gallery plug sealing washer (113).
8. Install the engine block left rear oil gallery plug (112) and tighten to 60 N.m (44 lb ft).

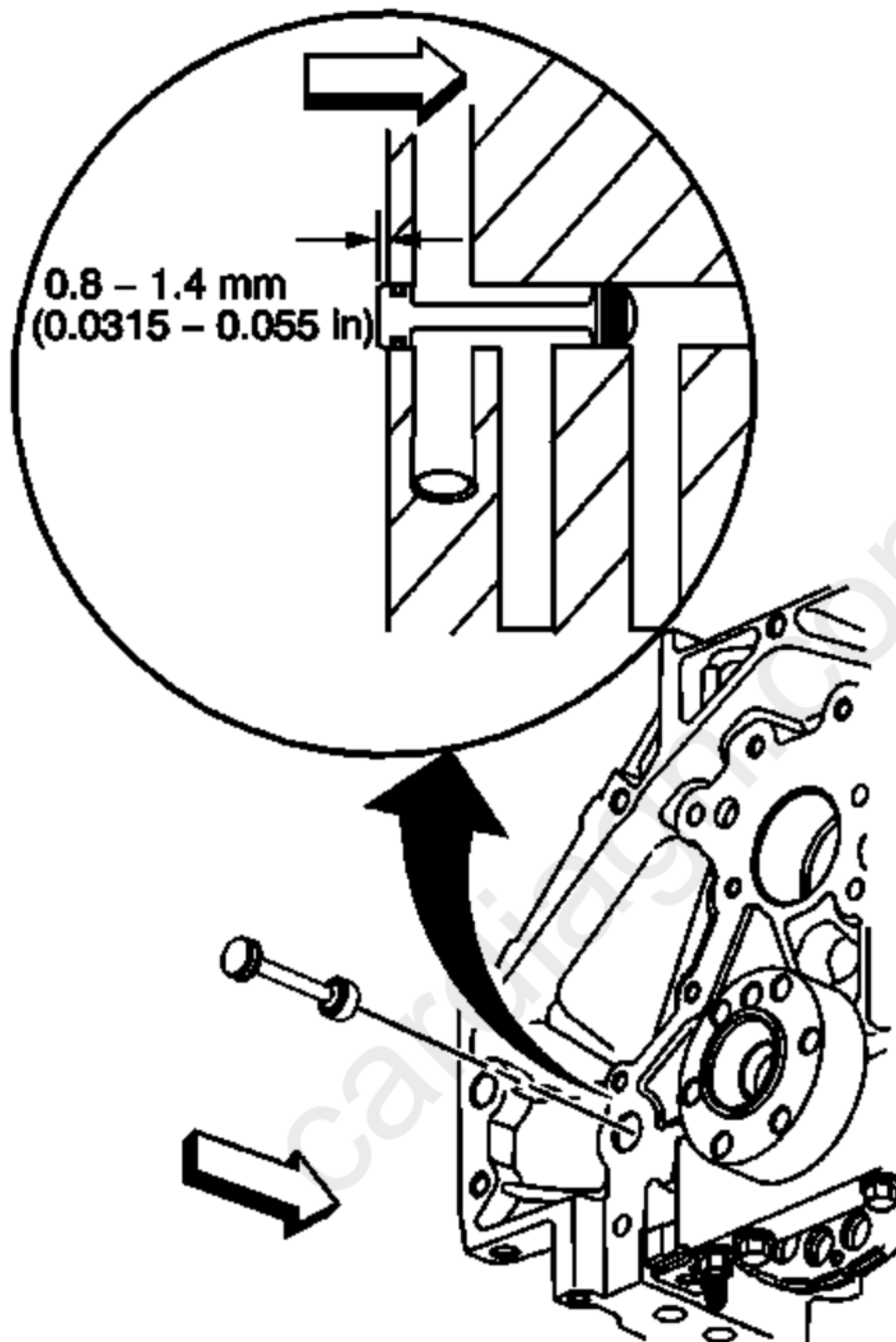


Fig. 86: View Of Engine Block Rear Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

9. Inspect the engine block rear oil gallery plug and O-ring seal. If the O-ring seal on the plug is not cut or damaged, the rear oil gallery plug may be used again.
10. Lubricate the O-ring seal with clean engine oil.
11. Install the O-ring seal onto the plug.
12. Install the engine block rear oil gallery plug into the oil gallery bore. A properly installed block plug will protrude 0.8-1.4 mm (0.0315-0.055 in) beyond the rear face of the block.

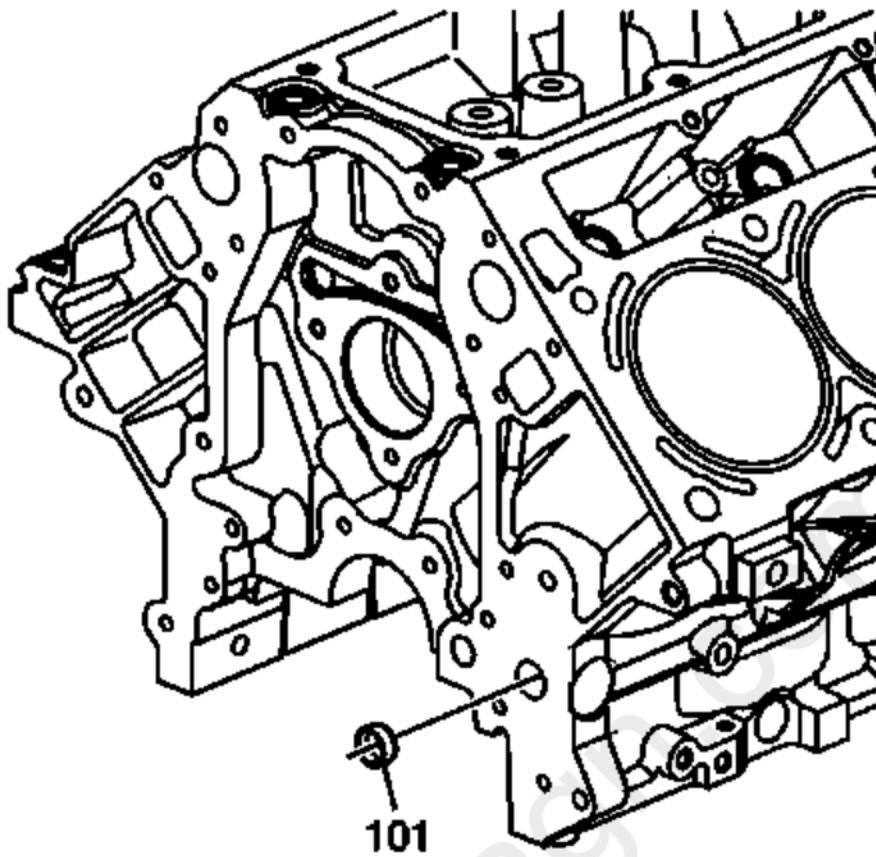


Fig. 87: View Of Engine Block Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

13. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489) to the sides of the NEW front oil gallery plug (101).

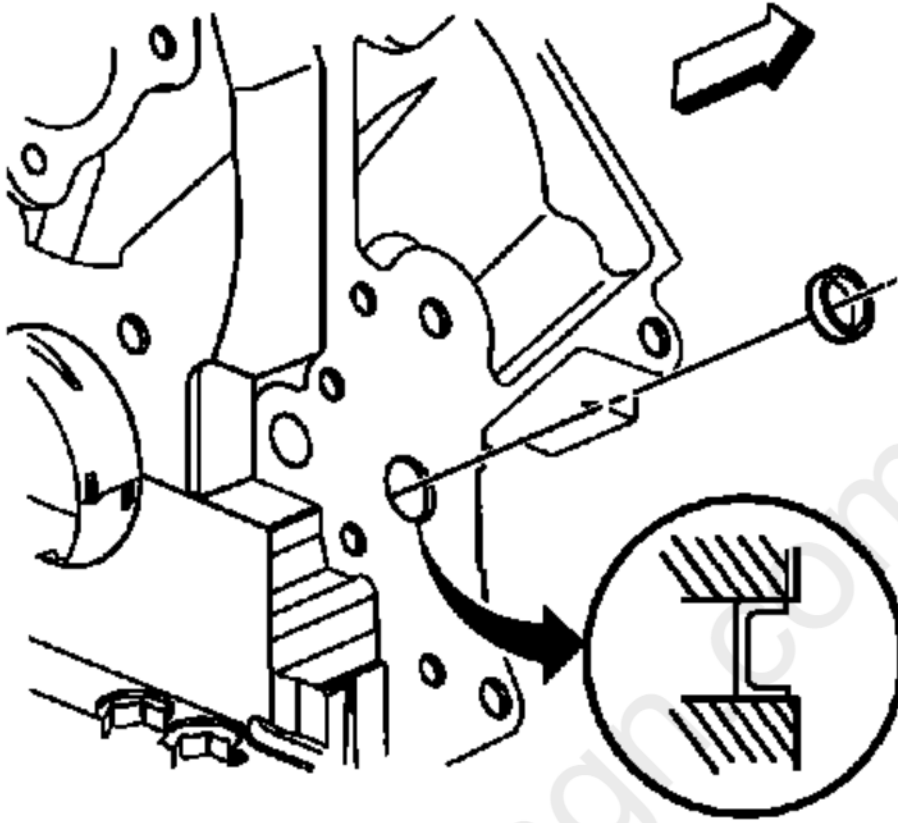


Fig. 88: View Of Engine Block Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

14. Install a NEW engine block front oil gallery plug. Install the plug into the oil gallery bore 2.2-2.8 mm (0.0086-0.011 in) below flush.

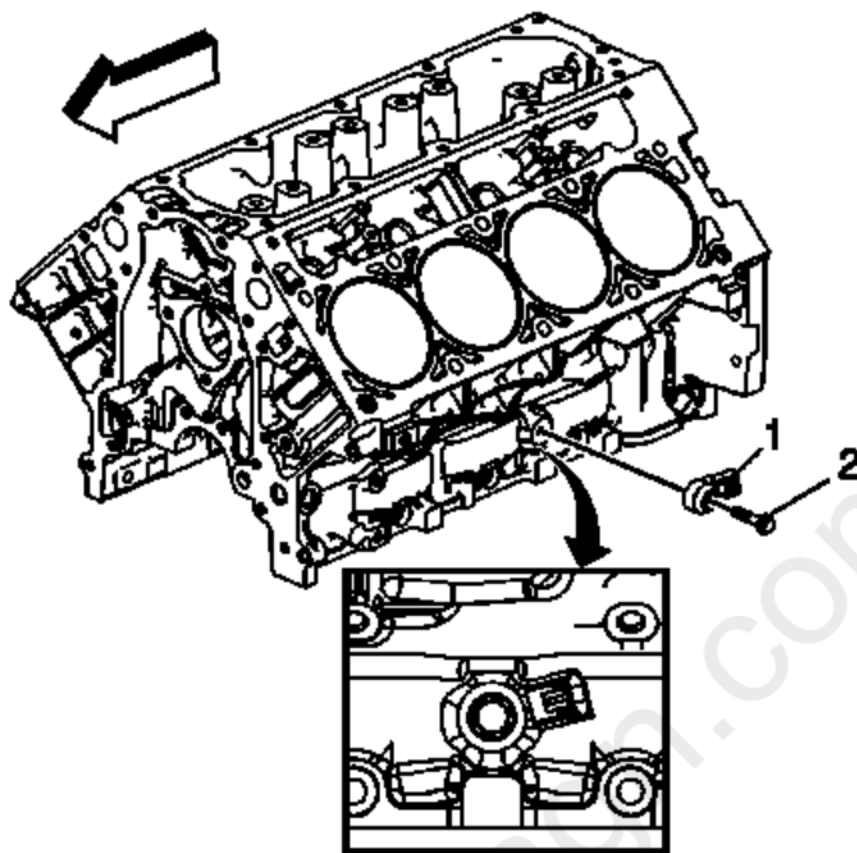


Fig. 89: Identifying Left Side Knock Sensor & Bolt
 Courtesy of GENERAL MOTORS CORP.

15. Install the left side knock sensor (1) and bolt (2) and tighten to 25 N.m (18 lb ft).

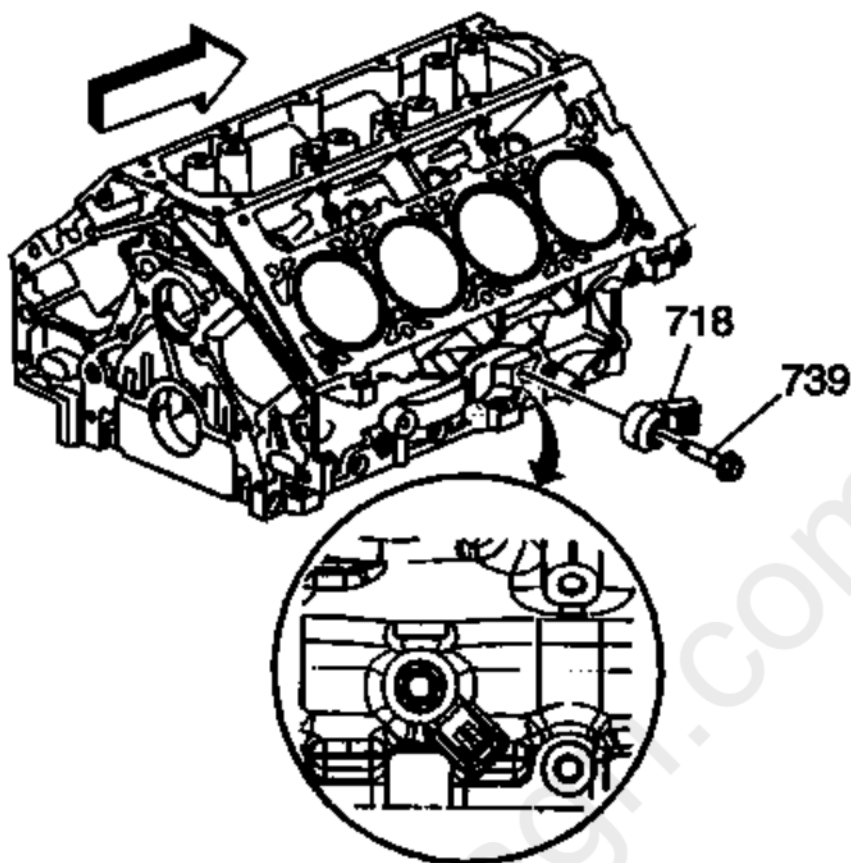


Fig. 90: Right Side Knock Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

16. Install the right side knock sensor (718) and bolt (739) and tighten to 25 N.m (18 lb ft).

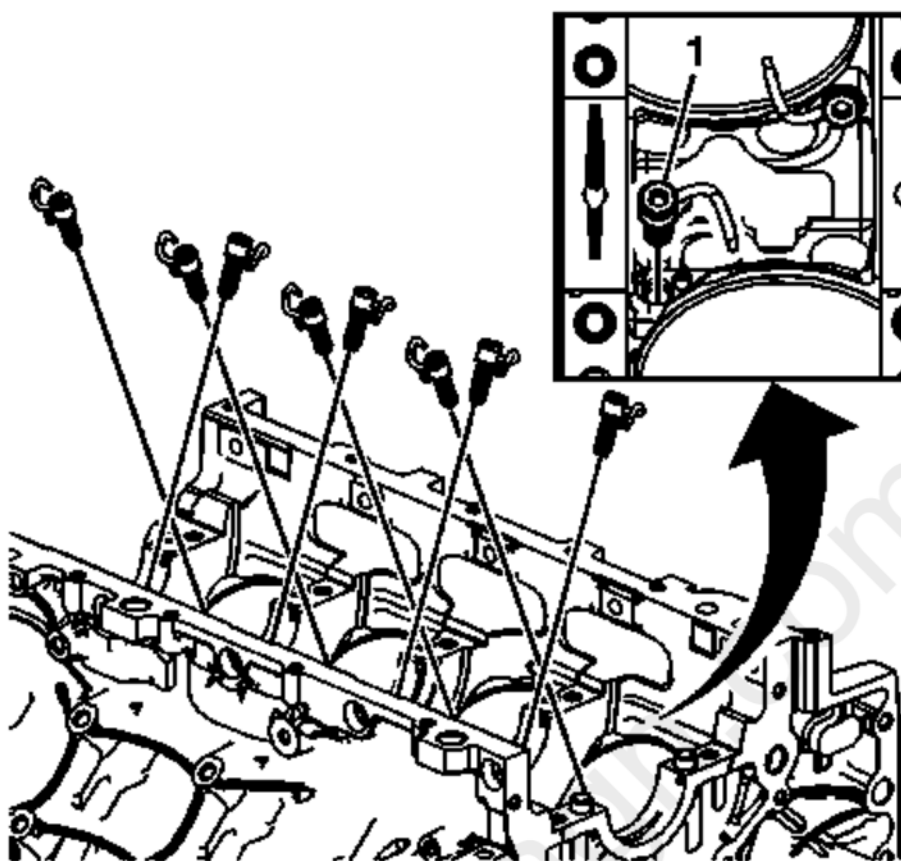


Fig. 91: Identifying Piston Oil Nozzles
Courtesy of GENERAL MOTORS CORP.

17. Install the piston oil nozzles (1) to the block - 6.2L LS9/LSA.
18. Tighten the bolts to 20 N.m (15 lb ft).

CRANKSHAFT AND BEARING INSTALLATION

SPECIAL TOOLS

J 45059: Angle Meter

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

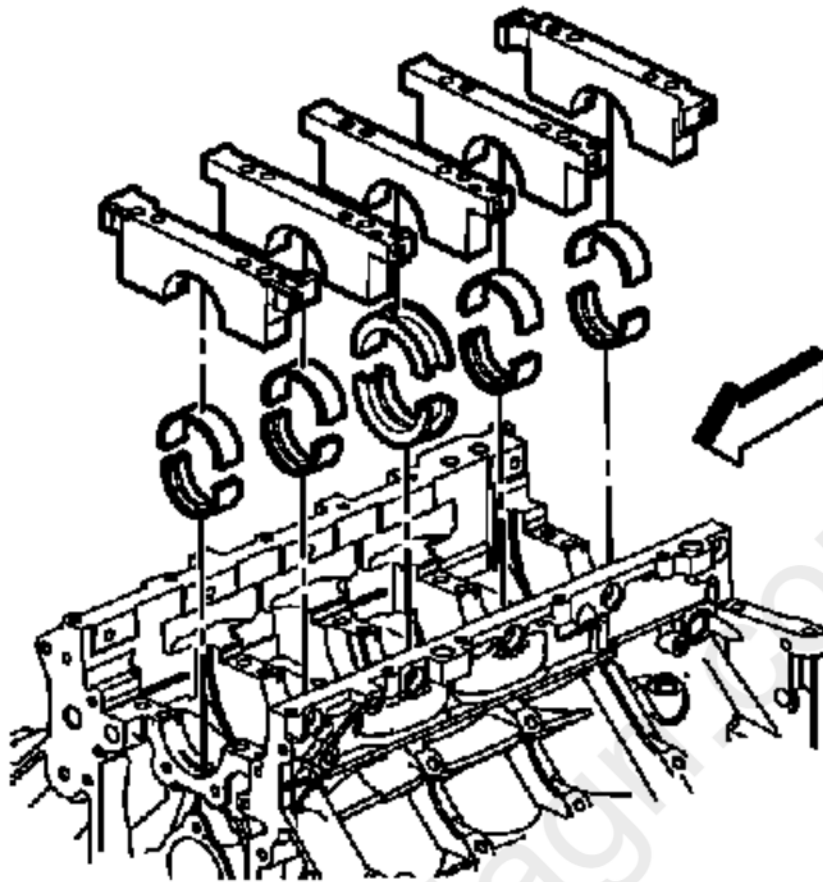


Fig. 92: View Of Crankshaft Bearings & Bearing Caps
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Crankshaft bearing clearances are critical. Excessive crankshaft bearing clearance may affect crankshaft position (CKP) sensor signals and/or on-board diagnostic (OBD) II system performance.
- Crankshaft bearing caps must be installed to the proper location and direction.
- When installing the crankshaft bearings, align the locating tabs on the bearings with the locating notches in the engine block journal bore and the bearing cap.
- Always install crankshaft bearings with their machined partner. Do not file bearings or mix bearing halves.
- In order to prevent engine block oil leakage, install NEW M8 crankshaft bearing cap side bolts.

The crankshaft bearing cap M8 side bolts have a pre-applied sealant patch applied to the bolt flange.

1. Install the crankshaft bearings to the engine block and bearing caps. The thrust bearings are to be installed into center journal.
2. Lubricate the bearing surfaces and crankshaft journals with clean engine oil.

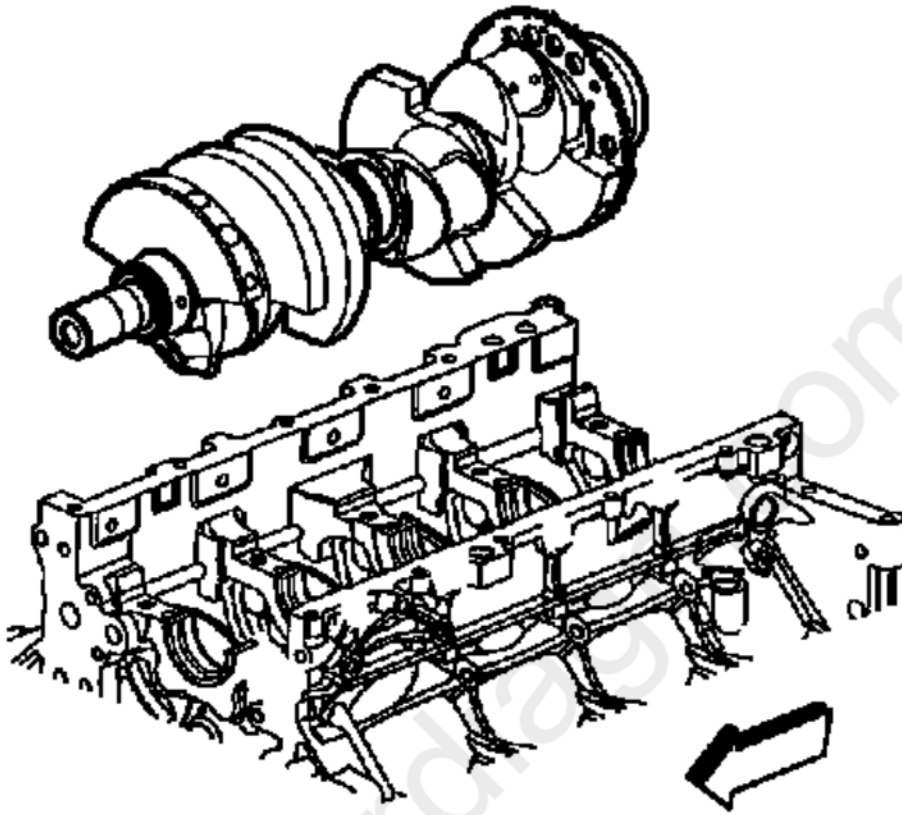


Fig. 93: View Of Crankshaft & Engine Block
Courtesy of GENERAL MOTORS CORP.

CAUTION: To maintain proper crankshaft end play, use extreme care during crankshaft installation. Avoid scoring or damaging the thrust bearing.

3. Install the crankshaft.

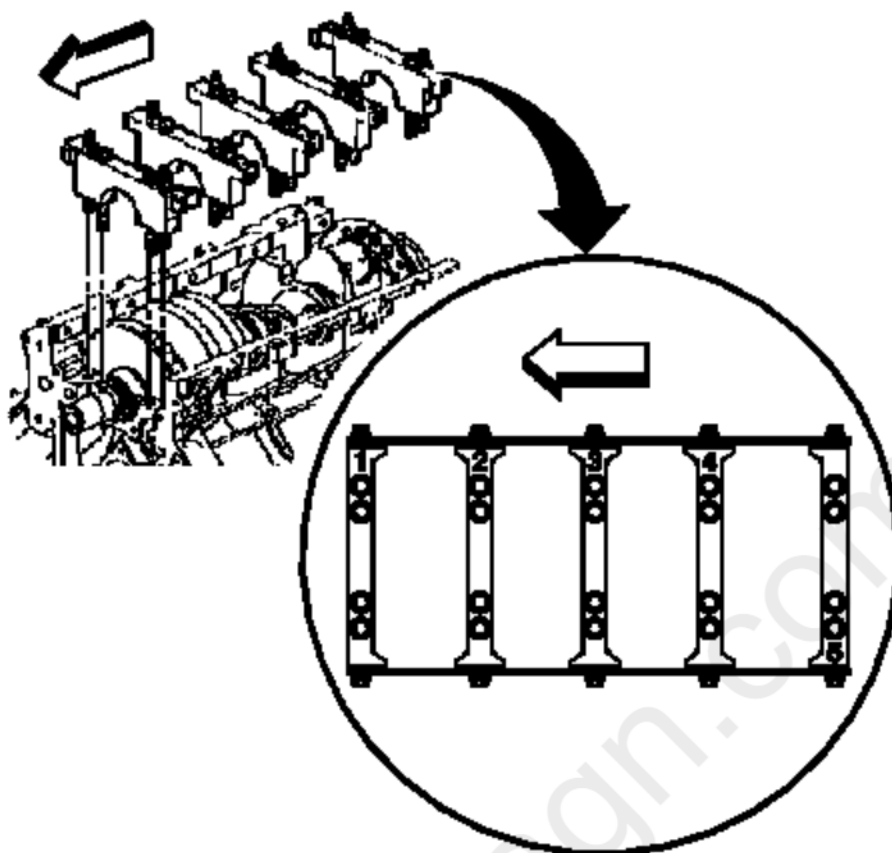


Fig. 94: View of Proper Bearing Cap Installation
Courtesy of GENERAL MOTORS CORP.

NOTE: The bearing caps must be installed in the proper location and direction.

4. Install the crankshaft bearing caps, with bearings, into the engine block.

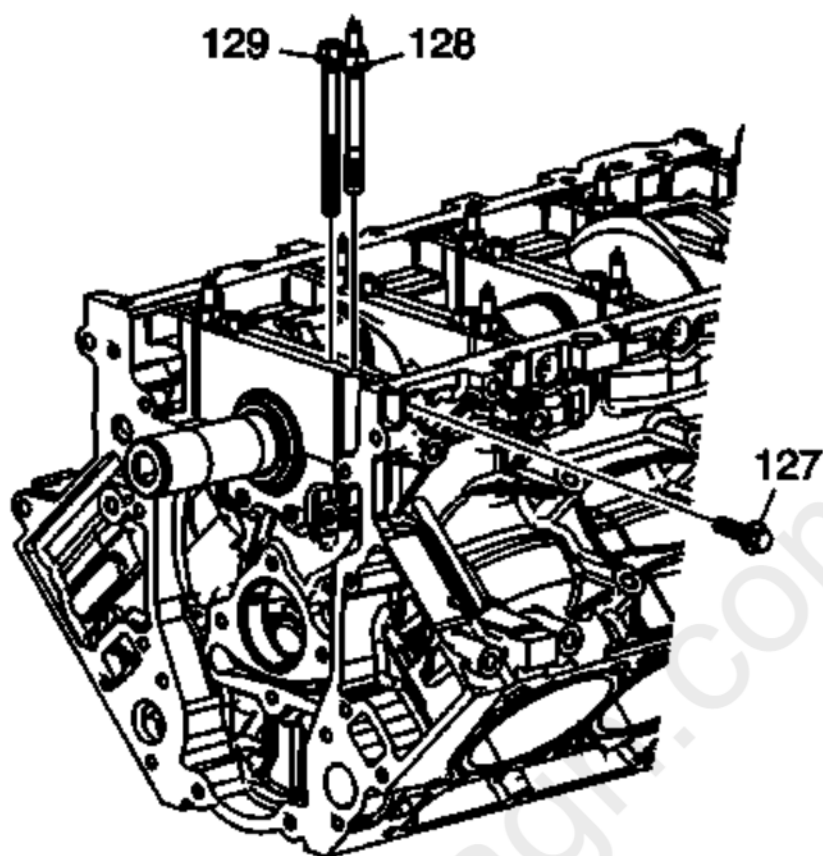


Fig. 95: Identifying Bearing Cap Bolts & Studs
Courtesy of GENERAL MOTORS CORP.

5. Install NEW M10 bolts (129) and NEW studs (128).
6. Using a plastic-face hammer, tap the bearing caps into place.
7. Install the NEW M8 bearing cap side bolts (127).

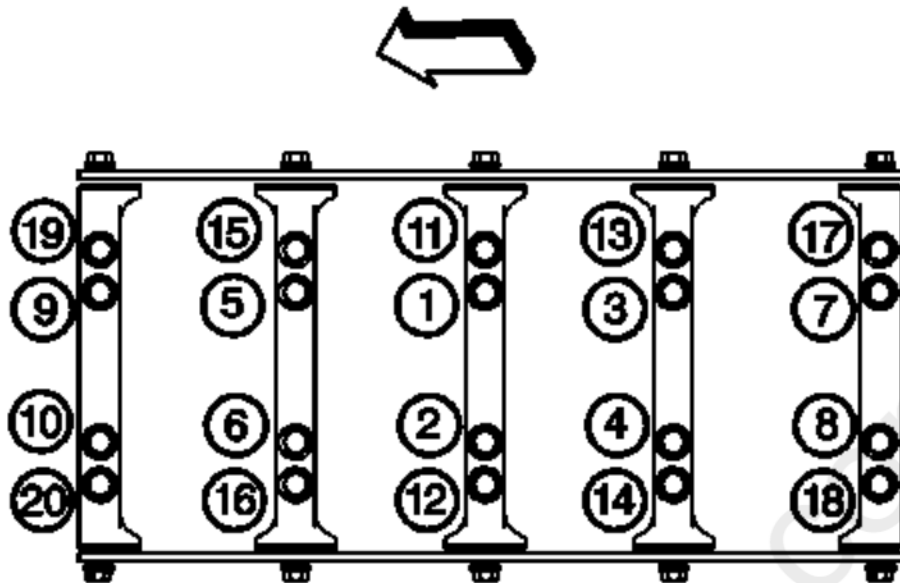


Fig. 96: Crankshaft Main Bearing Cap Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

8. Tighten the M10 bearing cap bolts (1-10) a first pass in sequence to 20 N.m (15 lb ft).

NOTE: To properly align the crankshaft thrust bearings, the final thrust of the crankshaft **MUST** be in the forward direction.

9. Using a plastic-face hammer, tap the crankshaft rearward, then forward in order to align the thrust bearings.
 - Tighten the M10 bolts (1-10) a final pass in sequence 80 degrees using the **J 45059**: meter.
 - Tighten the M10 studs (11-20) a first pass in sequence to 20 N.m (15 lb ft).
 - Tighten the M10 studs (11-20) a final pass in sequence 51 degrees using the **J 45059**: meter.

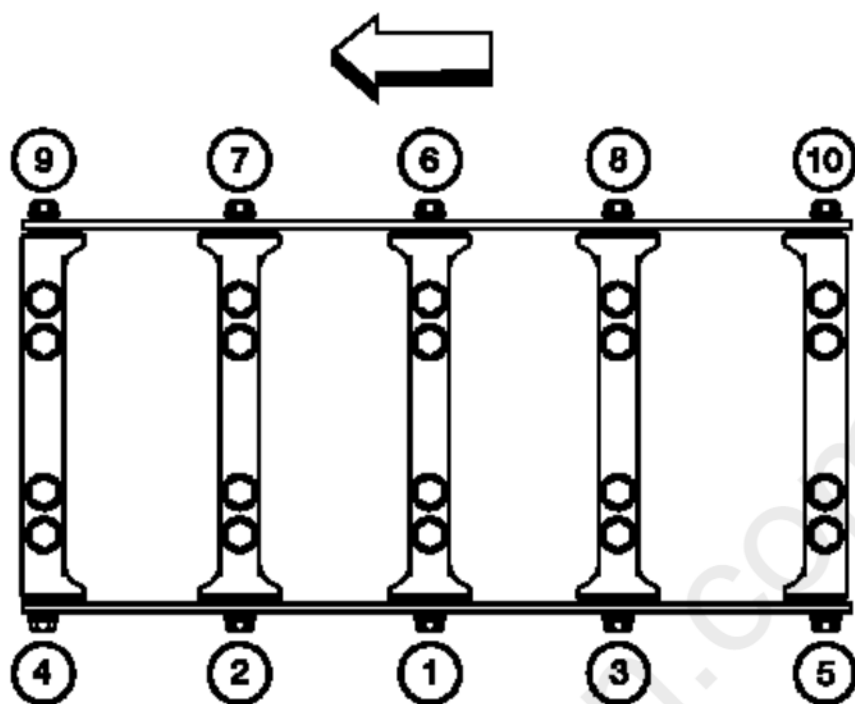


Fig. 97: M8 Main Bearing Cap Side Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

10. Tighten the M8 main bearing cap side bolts (1-10).
 - Tighten the M8 bolts (1-5) a first pass in sequence to 20 N.m (15 lb ft).
 - Tighten the M8 bolts (1-5) a final pass in sequence to 30 N.m (22 lb ft).
 - Tighten the M8 bolts (6-10) a first pass in sequence to 20 N.m (15 lb ft).
 - Tighten the M8 bolts (6-10) a final pass in sequence to 30 N.m (22 lb ft).

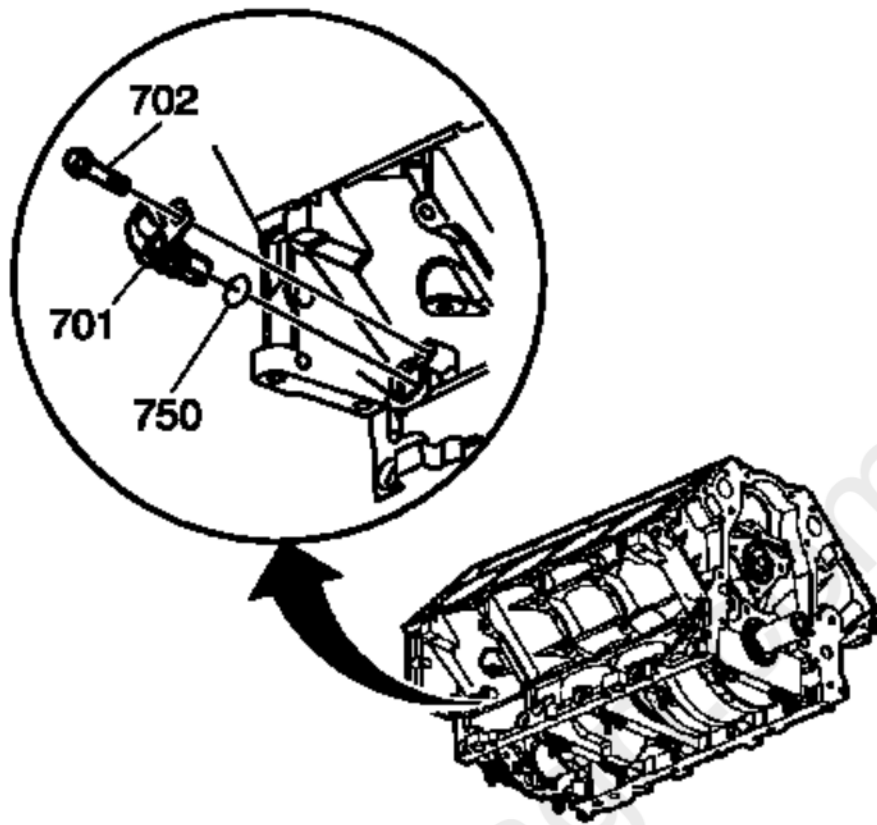


Fig. 98: CKP Sensor, Bolt & O-Ring
Courtesy of GENERAL MOTORS CORP.

11. Install the CKP sensor.
 1. Inspect the CKP sensor O-ring seal (750). If the O-ring seal is not cut or damaged, it may be used again.
 2. Coat the O-ring seal with clean engine oil.
 3. Install the O-ring onto the sensor.
 4. Install the sensor (701). Rotate the sensor until the locating hole in the bracket aligns with the bolt hole in the block.
 5. Install the sensor bolt (702) and tighten to 25 N.m (18 lb ft).

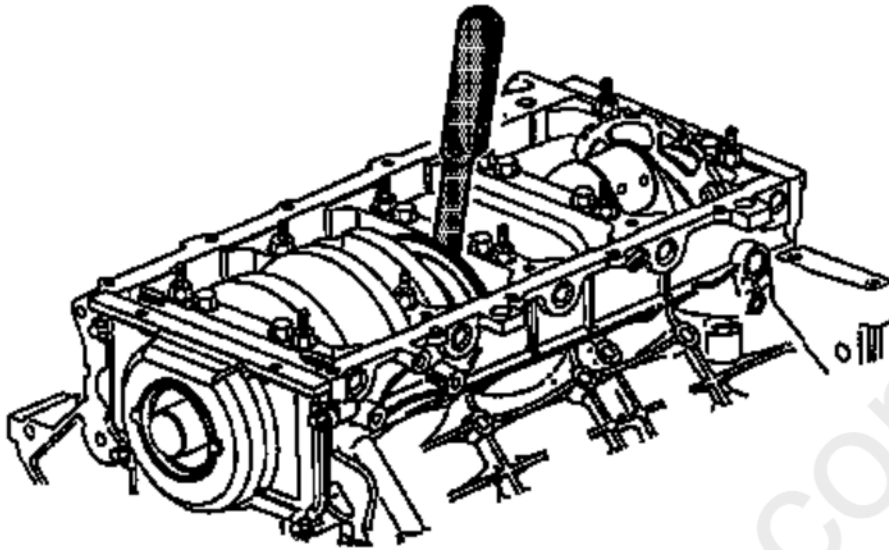


Fig. 99: Measuring Crankshaft End Play
Courtesy of GENERAL MOTORS CORP.

12. Measure the crankshaft end play.
 1. Thrust the crankshaft forward or rearward.
 2. Insert a feeler gauge between the center crankshaft bearing and the bearing surface of the crankshaft and measure the bearing clearance.

The proper crankshaft end play clearance is 0.04-0.2 mm (0.0015-0.0078 in).

3. If the bearing clearance is not within specifications, inspect the thrust surfaces for nicks, gouges or raised metal. Minor imperfections may be removed with a fine stone.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION (6.2L)

SPECIAL TOOLS

- **J 8037:** Piston Ring Compressor
- **J 8087:** Cylinder Bore Gauge
- **J 41556:** Connecting Rod Guide

- **J 45059:** Angle Meter

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

PISTON SELECTION

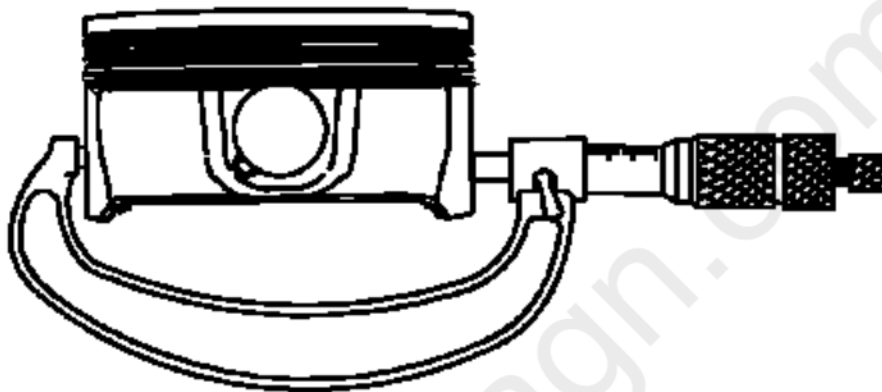


Fig. 100: Measuring Piston Outside Diameter

Courtesy of GENERAL MOTORS CORP.

NOTE: Measurements of all components should be taken with the components at normal room temperature. For proper piston fit, the engine block cylinder bores must not have excessive wear or taper. A used piston, pin, and connecting rod assembly may be installed if, after inspection is within specifications.

1. With a micrometer at a right angle, measure the piston outside diameter (OD). Measure the diameter 43 mm (1.69 in) from the top of the piston. Refer to **Engine Mechanical Specifications** .
2. Record the piston OD.

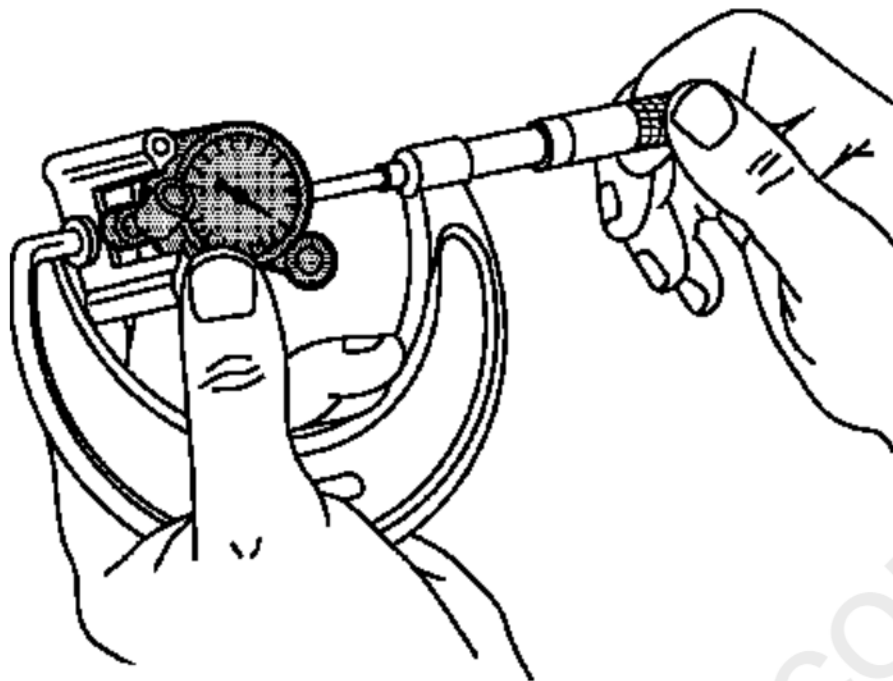


Fig. 101: Measuring Bore Gauge With Micrometer
Courtesy of GENERAL MOTORS CORP.

3. Adjust the micrometer to the recorded piston OD.
4. Insert the **J 8087**: bore gauge into the micrometer and zero the gauge dial.

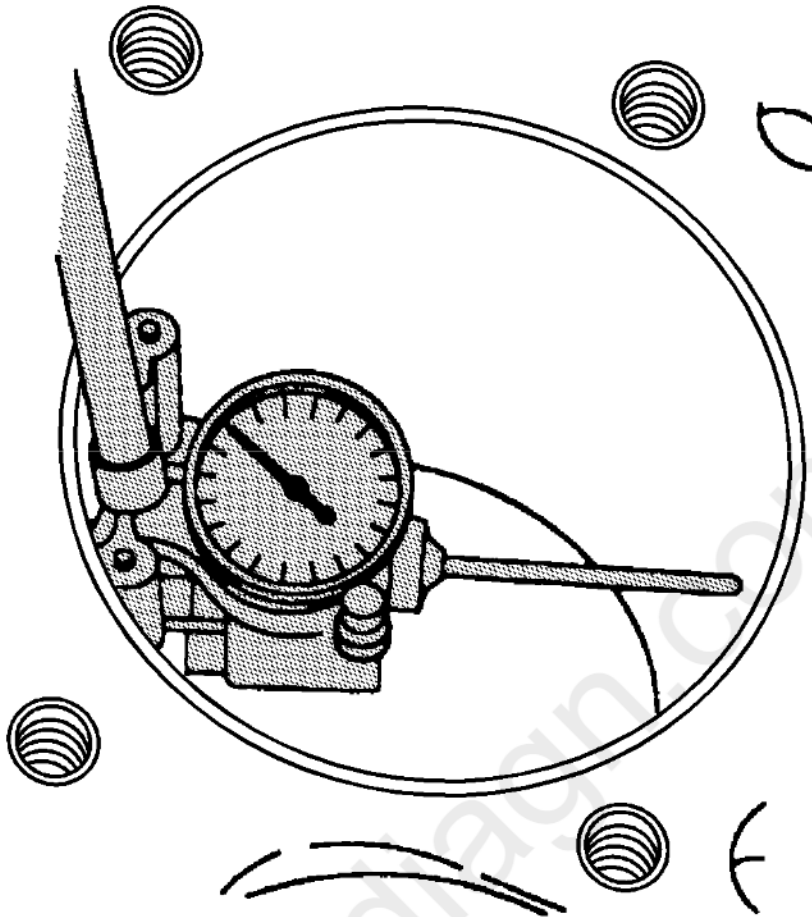


Fig. 102: Measuring Cylinder Bore Using J8087
Courtesy of GENERAL MOTORS CORP.

5. Using the **J 8087**: bore gauge, measure the cylinder bore inside diameter (ID). Measure at a point 64 mm (2.5 in) from the top of the cylinder.
6. Record the cylinder bore ID.
7. Subtract the piston OD from the cylinder bore ID in order to determine the piston-to-bore clearance. Refer to **Engine Mechanical Specifications** .
8. If the proper clearance cannot be obtained, select another piston and pin assembly and measure the clearances again. If the proper fit cannot be obtained, the cylinder bore may require honing for an oversize piston.

PISTON, PIN, AND CONNECTING ROD INSTALLATION

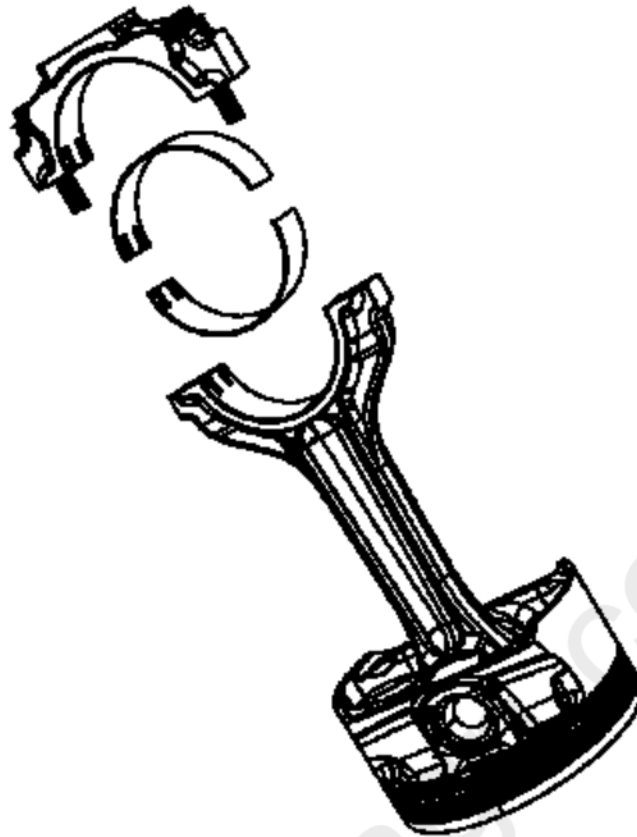


Fig. 103: View Of Piston, Connecting Rod & Bearing Assembly
Courtesy of GENERAL MOTORS CORP.

1. Lubricate the following components with clean engine oil:
 - Piston
 - Piston rings
 - Cylinder bore
 - Bearings and bearing surfaces
2. Install the bearings to the connecting rod and cap.
3. Position the oil control ring end gaps a minimum of 25 mm (1.0 in) from each other.
4. Position the compression ring end gaps 180 degrees opposite each other.

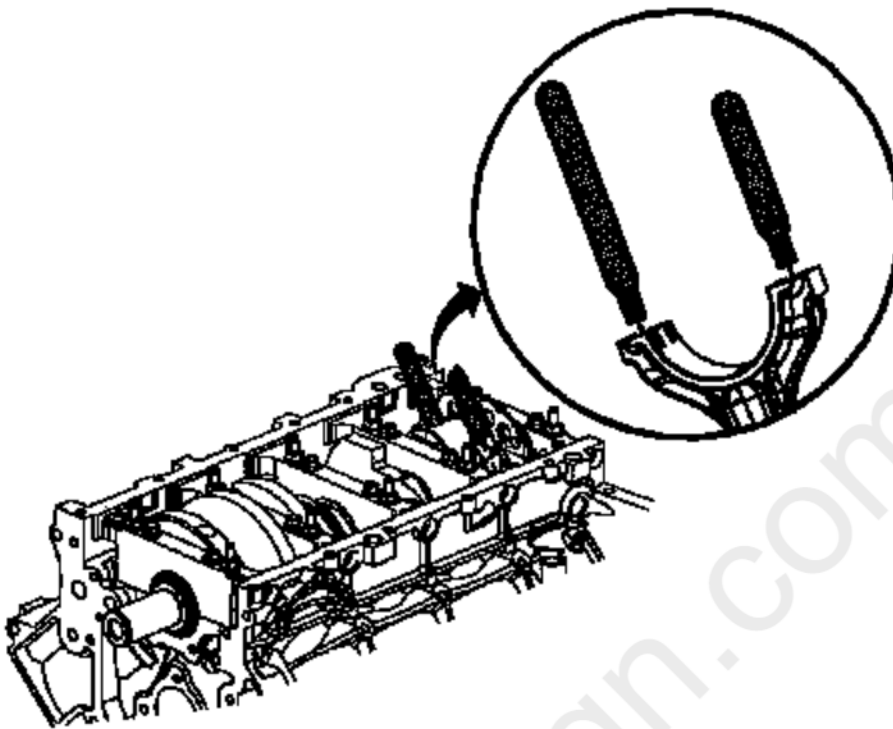


Fig. 104: J 41556 & Connecting Rod
Courtesy of GENERAL MOTORS CORP.

5. Install the **J 41556**: rod guide to the connecting rod.

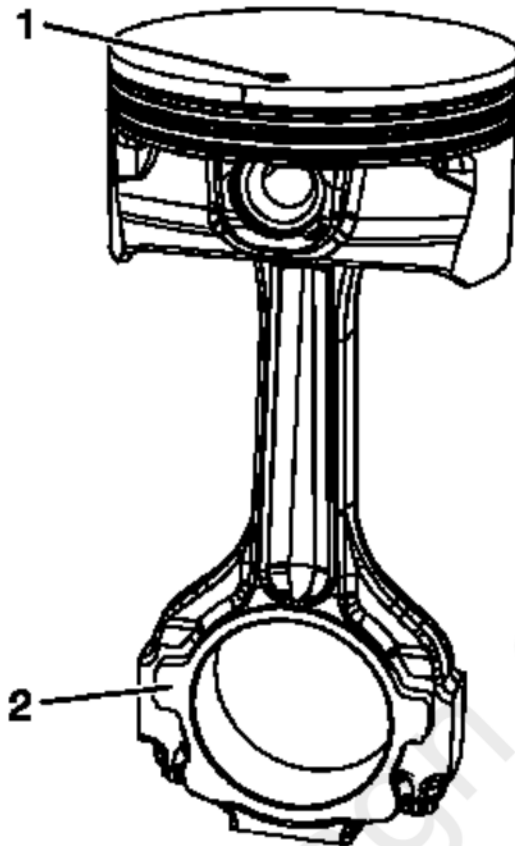


Fig. 105: View of Mark On Top Of Piston & Connecting Rod Tab
Courtesy of GENERAL MOTORS CORP.

6. Identify the proper installation direction of the piston and connecting rod assembly. When installing the piston and connecting rod assembly, the mark on the top of the piston (1) and the tab (2) on the side of the connecting rod should face the front of the engine.

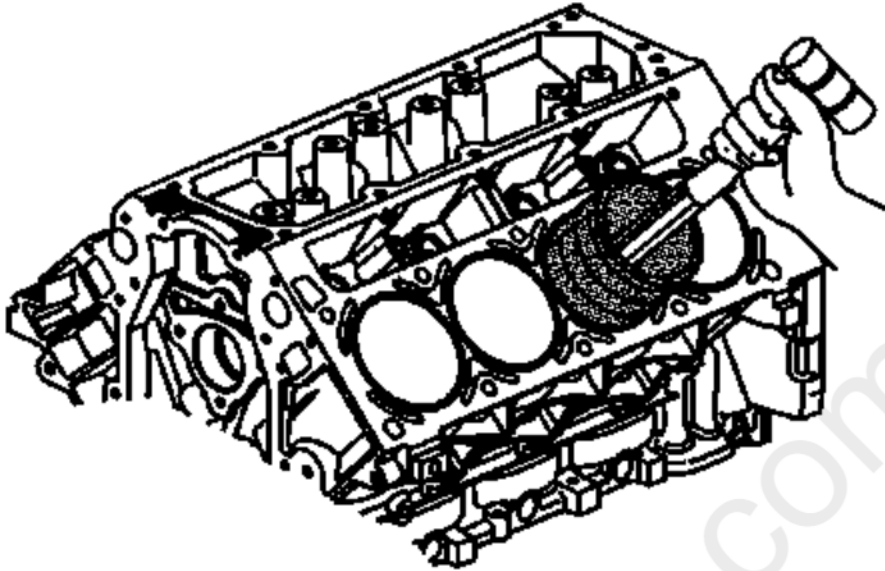


Fig. 106: Piston Ring

Courtesy of GENERAL MOTORS CORP.

7. Install the **J 8037**: ring compressor onto the piston and compress the piston rings.

NOTE: The piston alignment mark **MUST** face the front of the engine block.

8. Install the piston, pin, and connecting rod assembly into the cylinder bore. Hold the piston ring compressor firmly against the engine block. Using a wooden hammer handle, lightly tap the top of the piston until all piston rings have entered the cylinder bore.
9. Use the **J 41556**: rod guide to guide the connecting rod onto the crankshaft journal.
10. Remove the **J 41556**: rod guide from the connecting rod.

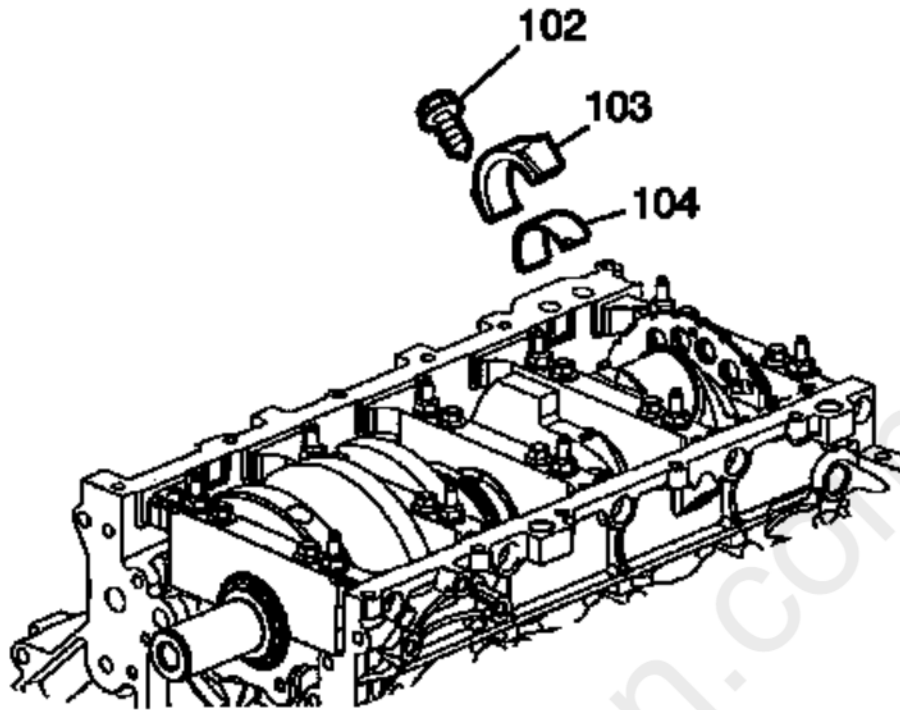


Fig. 107: Identifying Connecting Rod Bolt, Cap & Bearing
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE:

- The connecting rod and cap must be assembled with the mating surfaces properly aligned.
- If re-using connecting rods, DO NOT re-use connecting rod fasteners. During an installation procedure, the new connecting rod bolts can be re-tightened a maximum of 3 times.

11. Install the bearing cap (103), bearing (104), and bolts (102).
 1. Tighten the bolts a first pass to 20 N.m (15 lb ft).
 2. Tighten the bolts a final pass to 85 degrees using the **J 45059**: angle meter.

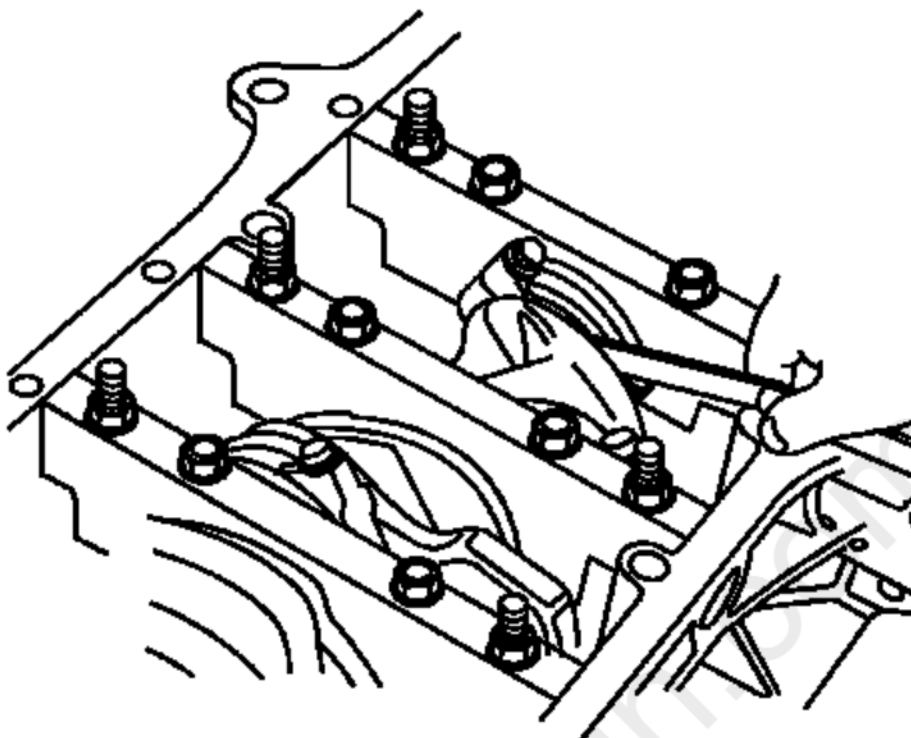


Fig. 108: Measuring Connecting Rod Side Clearance
Courtesy of GENERAL MOTORS CORP.

12. Measure the connecting rods for the proper side clearance. Refer to **Engine Mechanical Specifications** .

CAMSHAFT INSTALLATION (6.2L)

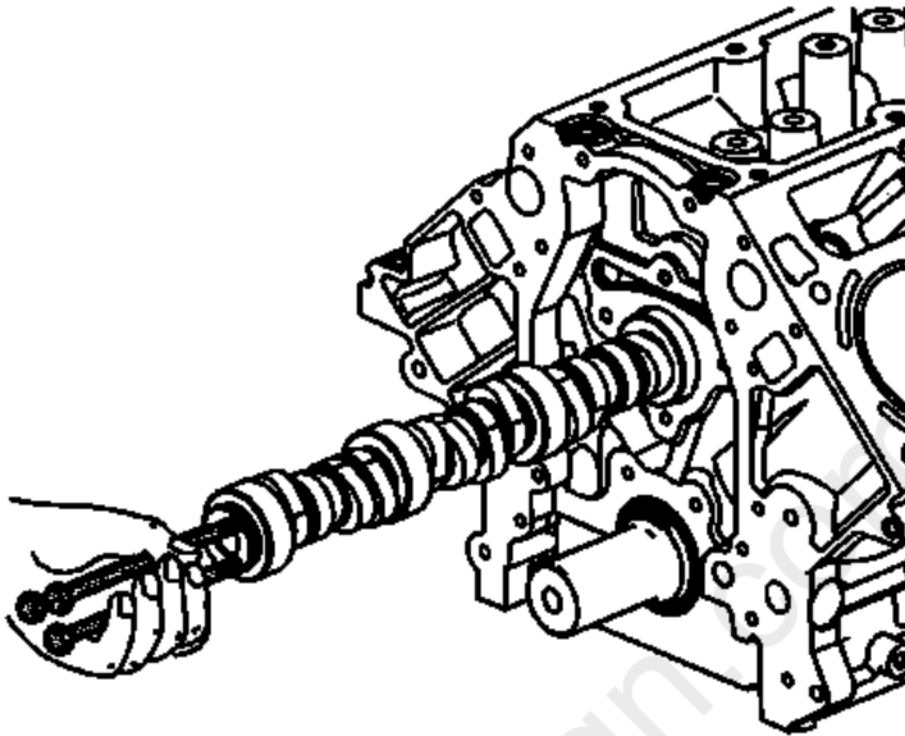


Fig. 109: Camshaft

Courtesy of GENERAL MOTORS CORP.

NOTE: If camshaft replacement is required, the valve lifters must also be replaced.

1. Lubricate the camshaft journals and the bearings with clean engine oil.
2. Install 3 M8 - 1.25 x 100 mm (M8 - 1.25 x 4.0 in) bolts into the camshaft front bolt holes.

CAUTION: All camshaft journals are the same diameter, so care must be used in removing or installing the camshaft to avoid damage to the camshaft bearings.

3. Using the bolts as a handle, carefully install the camshaft into the engine block.
4. Remove the 3 bolts from the front of the camshaft.

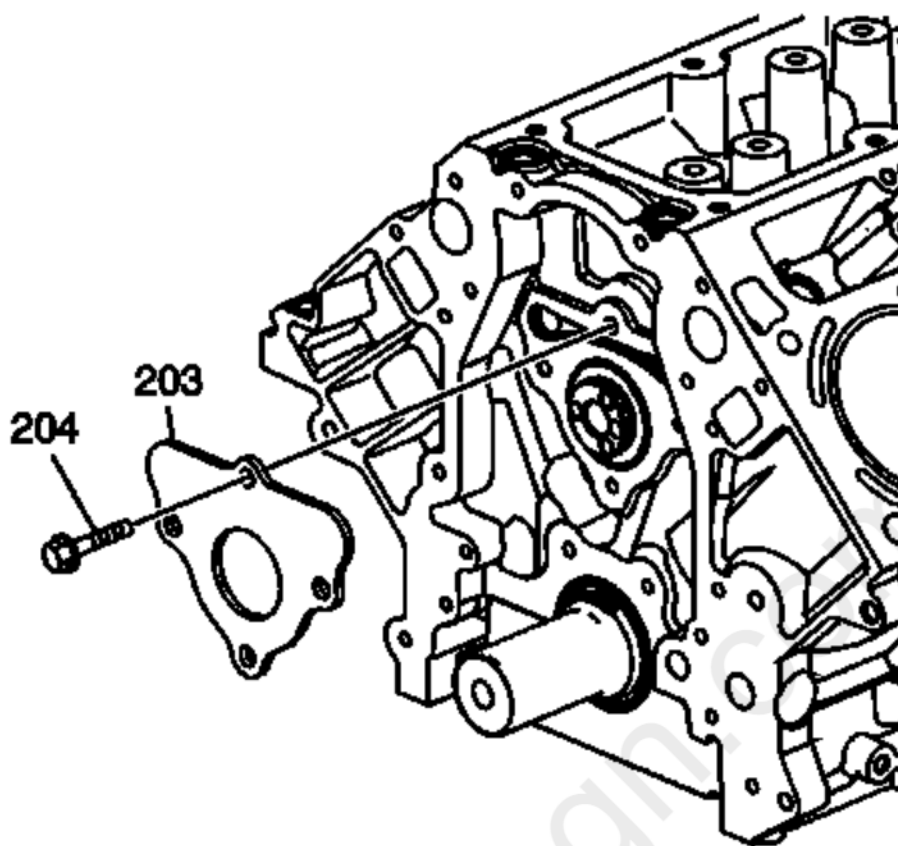


Fig. 110: Camshaft Retainer & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: The gasket surface on the engine block should be clean and free of dirt or debris.

5. Install the camshaft retainer (203) and the bolts (204). Install the retainer with the sealing gasket facing the front of the engine block.

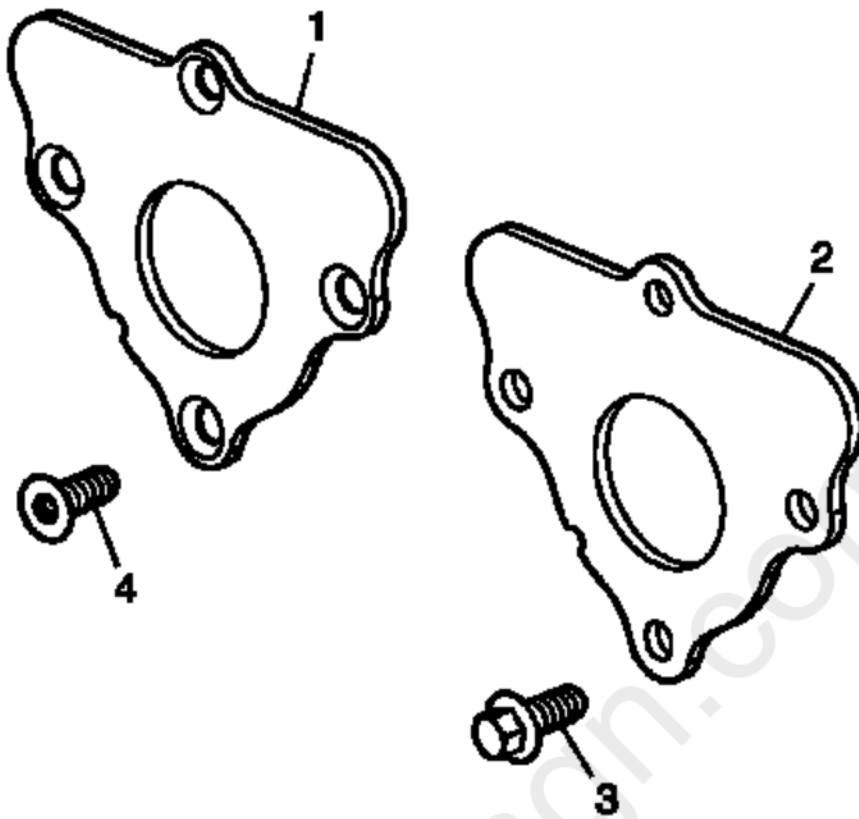


Fig. 111: Identifying Camshaft Retainer Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

6. Tighten the camshaft retainer bolts.
 - Tighten the first design hex head bolts (3) to 25 N.m (18 lb ft).
 - Tighten the second design TORX® head bolts (4) to 15 N.m (11 lb ft).

TIMING CHAIN AND SPROCKET INSTALLATION

Special Tools

- **EN 46330:** Timing Belt Tensioner Retaining Pin
- **J 41478:** Crankshaft Front Oil Seal Installer
- **J 41665-A:** Crankshaft Balancer and Sprocket Installer
- **J 42386-A:** Flywheel Holding Tool
- **J 45059:** Angle Meter

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

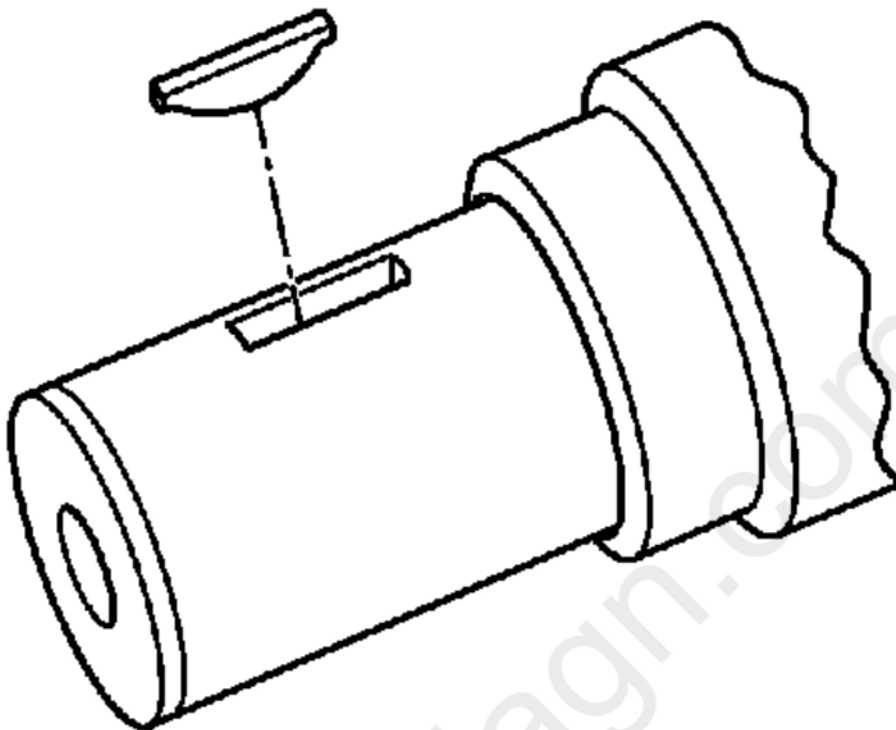


Fig. 112: View Of Crankshaft Key & Keyway
Courtesy of GENERAL MOTORS CORP.

1. Install the key into the crankshaft keyway, if previously removed.

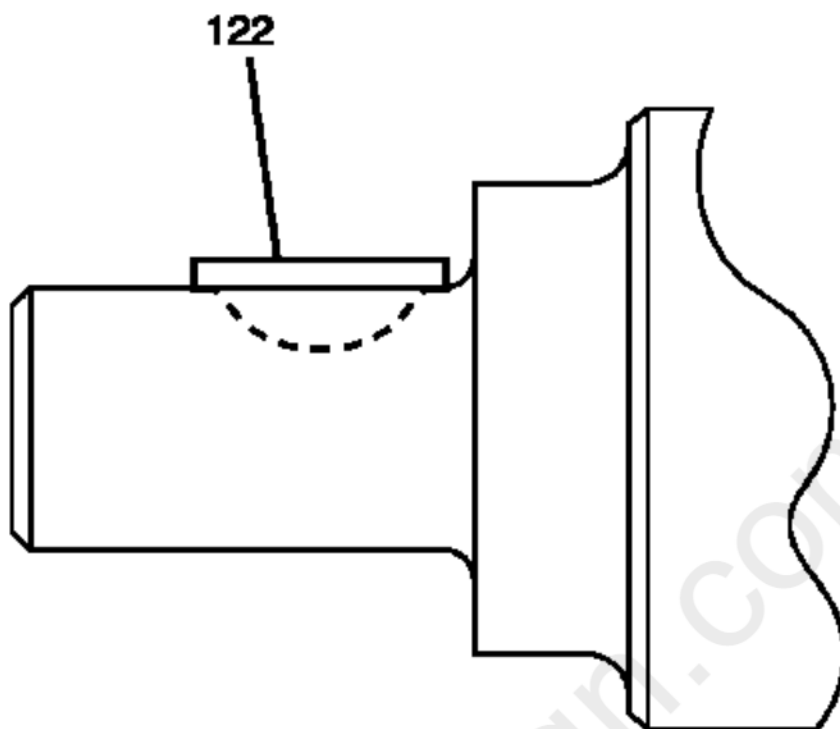


Fig. 113: View Of Installed Crankshaft Key
Courtesy of GENERAL MOTORS CORP.

2. Tap the key (122) into the keyway until both ends of the key bottom onto the crankshaft.

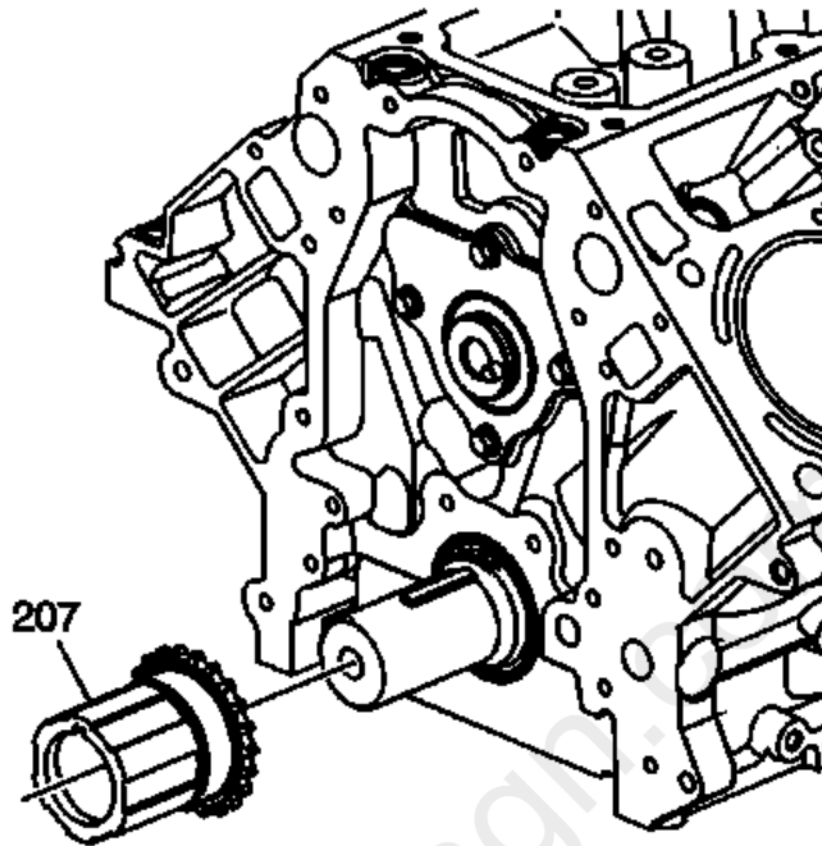


Fig. 114: View Of Crankshaft Sprocket
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft sprocket (207) onto the front of the crankshaft. Align the crankshaft key with the crankshaft sprocket keyway.

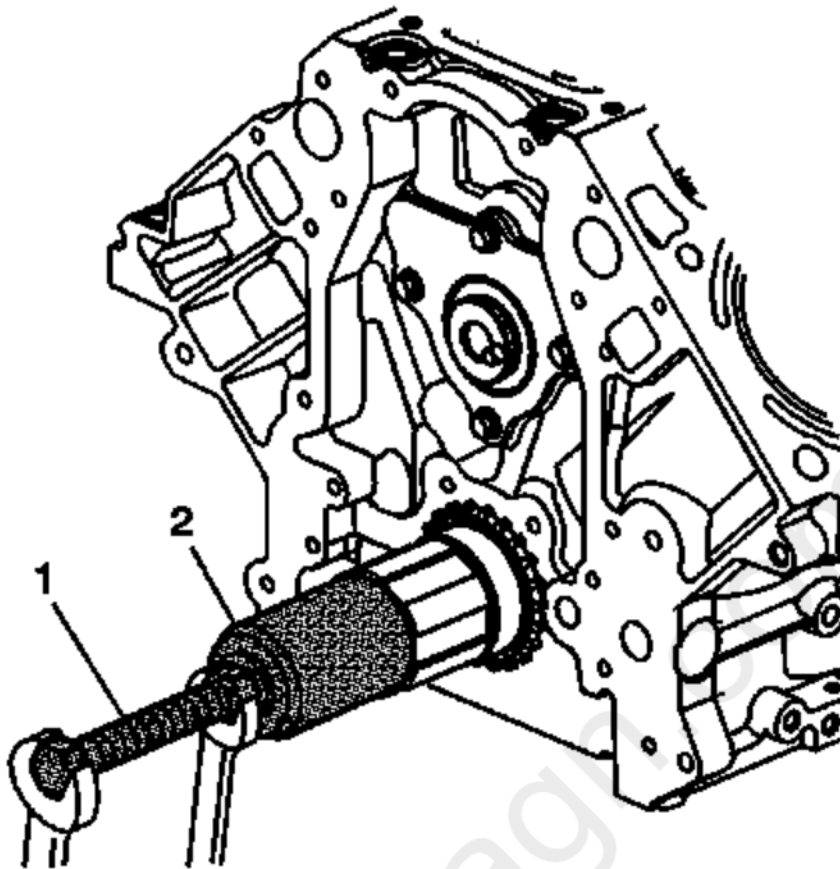


Fig. 115: View Of Crankshaft Sprocket & Installer
Courtesy of GENERAL MOTORS CORP.

4. Use the **J 41478:** installer (1) and the **J 41665-A:** installer (2) in order to install the crankshaft sprocket.
Install the sprocket onto the crankshaft until fully seated against the crankshaft flange.
5. Rotate the crankshaft sprocket until the alignment mark is in the 12 o'clock position.

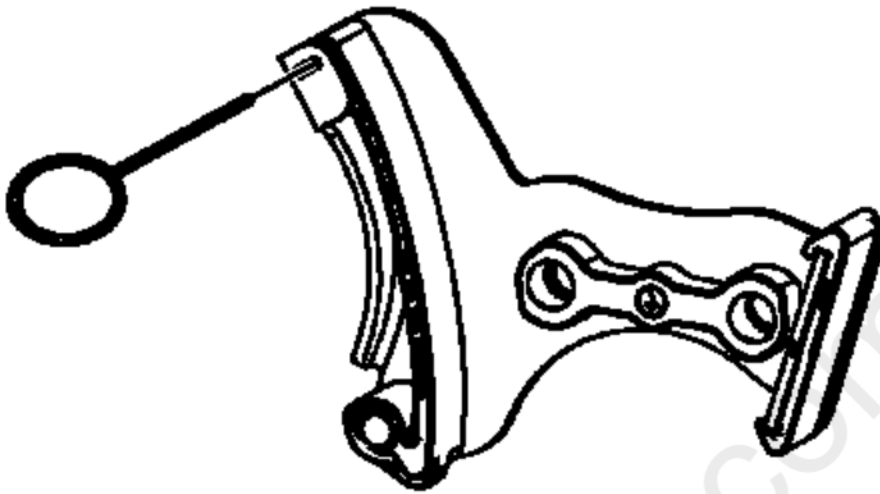


Fig. 116: View Of Compressed Tensioner
Courtesy of GENERAL MOTORS CORP.

6. Compress the timing chain tensioner guide and install the **EN 46330:** pin.

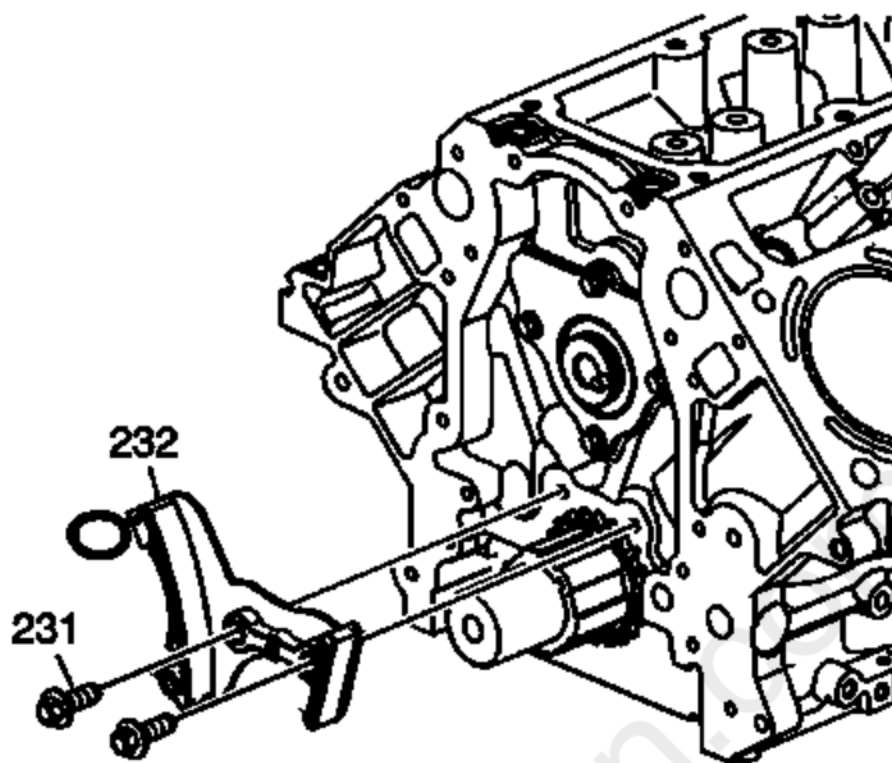


Fig. 117: View Of Timing Chain Tensioner
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

7. Install the timing chain tensioner (232) and bolts (231) and tighten to 30 N.m (22 lb ft).

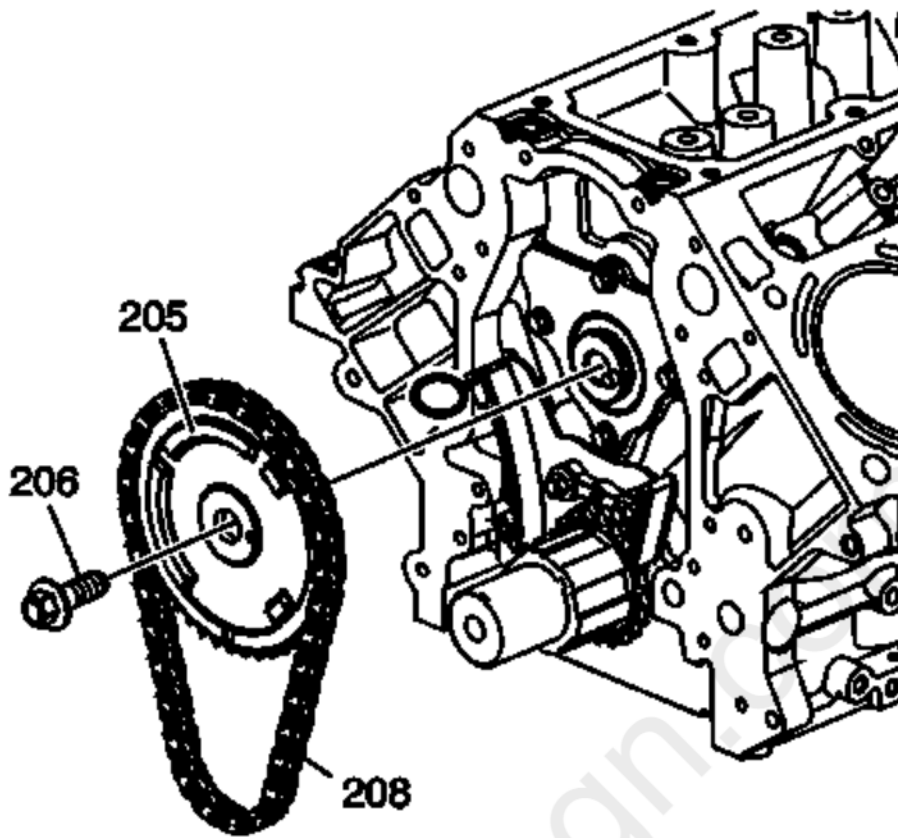


Fig. 118: View Of Camshaft Sprocket & Timing Chain
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The sprocket teeth and timing chain must mesh.
- The camshaft and the crankshaft sprocket alignment marks **MUST** be aligned properly.
- Do not use the camshaft sprocket bolt again. Install a **NEW** bolt during assembly.

8. Install the camshaft sprocket (205), timing chain (208), and a NEW bolt (206).

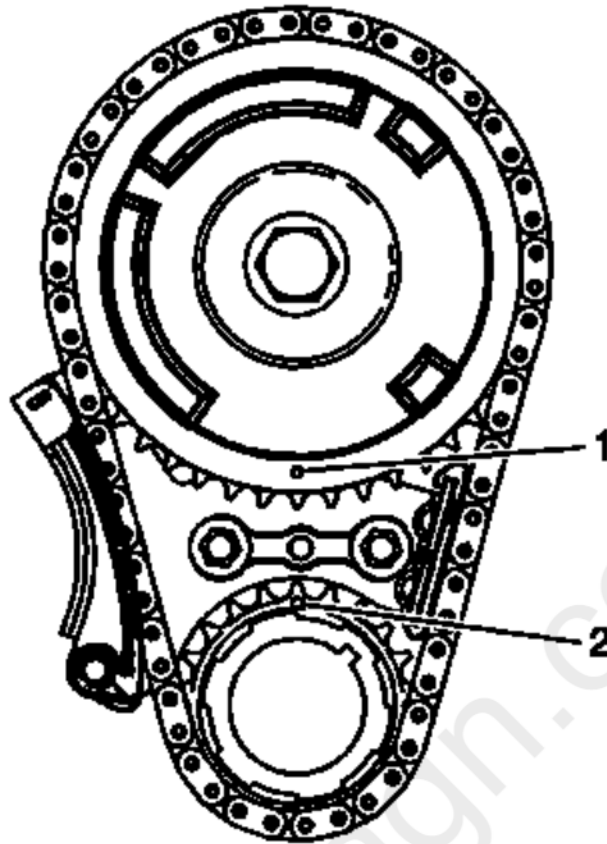


Fig. 119: Identifying Camshaft & Crankshaft Marks
Courtesy of GENERAL MOTORS CORP.

9. Inspect the sprockets for proper alignment. The mark on the camshaft sprocket (1) should be located in the 6 o'clock position and the mark on the crankshaft sprocket (2) should be located in the 12 o'clock position.

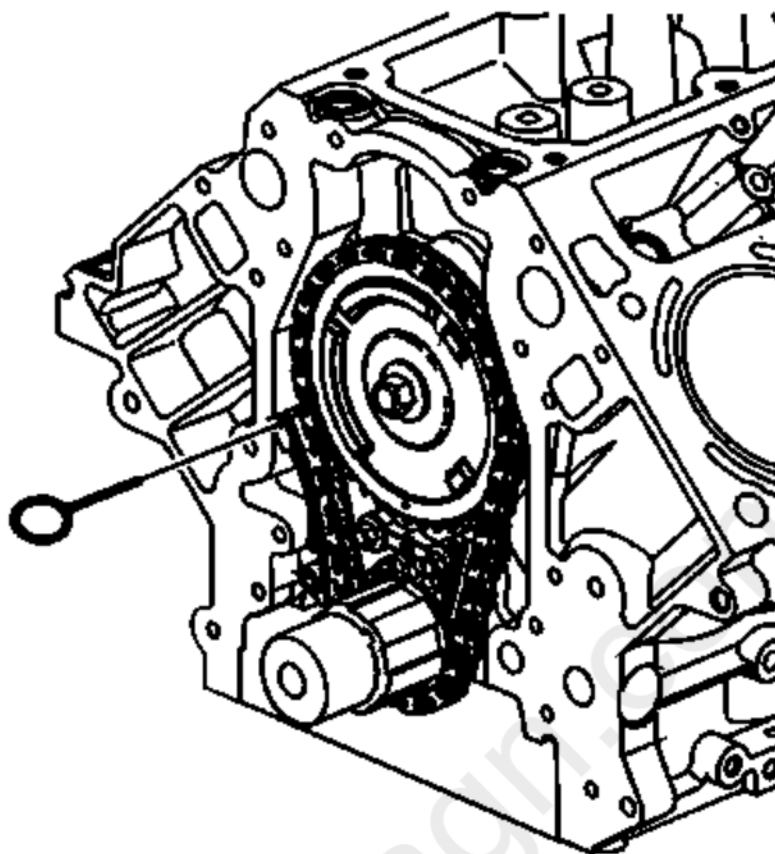


Fig. 120: Locating Tensioner Pin
Courtesy of GENERAL MOTORS CORP.

10. Remove the EN 46330: pin.

NOTE: Do not apply threadlock to the flex plate bolts at this time.

11. Temporarily install the automatic transmission flex plate or manual transmission flywheel and bolts. Refer to **Engine Flywheel Installation (6.2L)**.

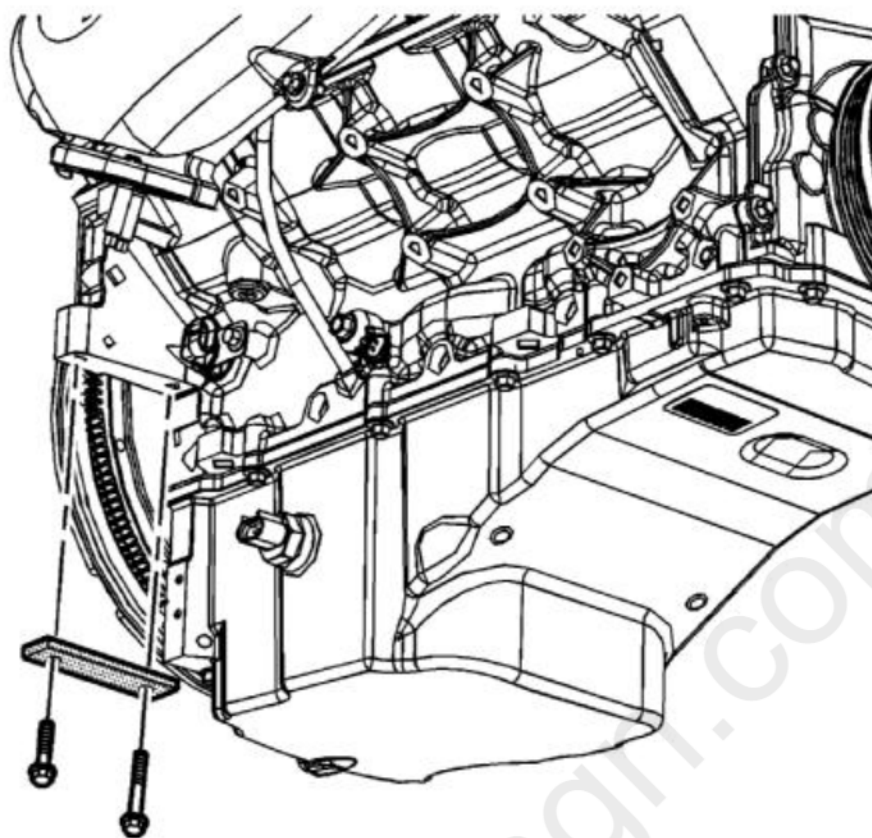


Fig. 121: Identifying J 42386-A Flywheel Holding Tool
Courtesy of GENERAL MOTORS CORP.

12. Install the **J 42386-A** tool and bolts. Use 1 M10-1.5 x 120 mm bolt and 1 M10-1.5 x 45 mm bolt for proper tool operation. Tighten the **J 42386-A** tool bolts to 50 N.m (37 lb ft).

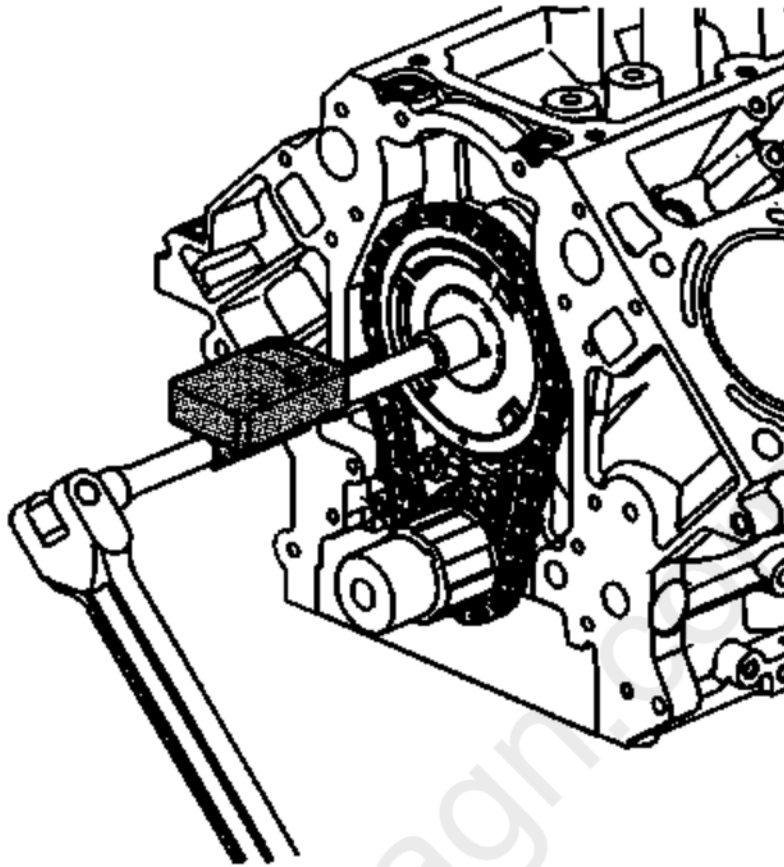


Fig. 122: Identifying Camshaft Sprocket Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

13. Tighten the camshaft sprocket bolt.
 - Tighten the camshaft sprocket bolt a first pass to 75 N.m (55 lb ft)
 - Tighten the camshaft sprocket bolt a final pass an additional 50 degrees using **J 45059**: meter.
14. Remove the **J 42386-A**: tool and bolts.
15. Remove the automatic transmission flex plate or manual transmission flywheel and bolts. Refer to **Engine Flywheel Removal**.

OIL PUMP, SCREEN AND CRANKSHAFT OIL DEFLECTOR INSTALLATION (6.2L)

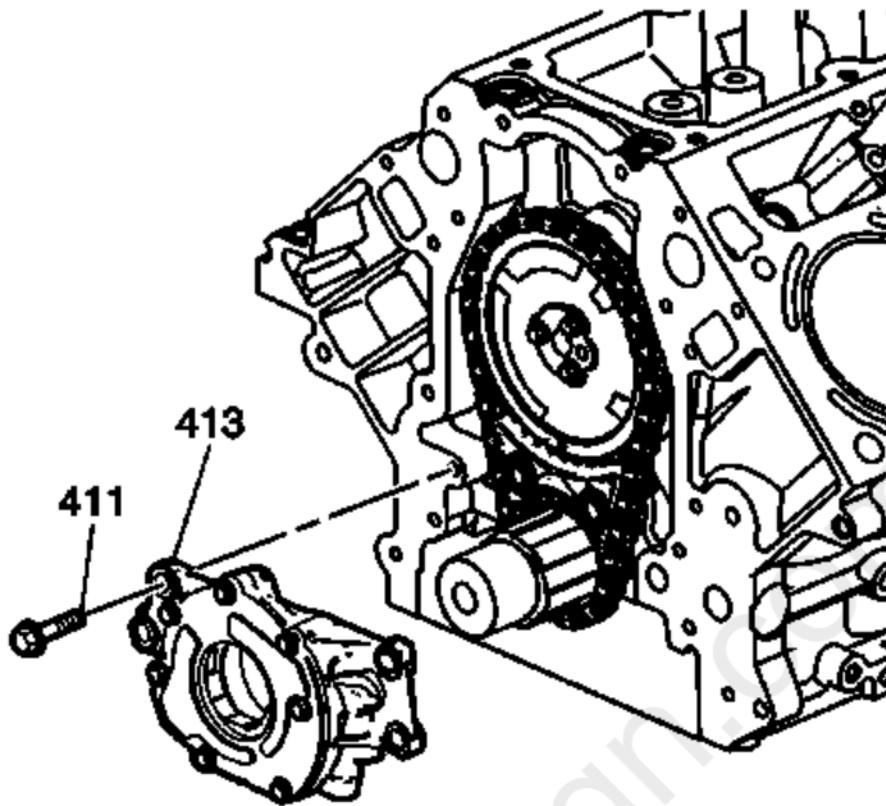


Fig. 123: Identifying Oil Pump & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Inspect the oil pump and engine block oil gallery passages. These surfaces must be clear and free of debris or restrictions.

1. Align the splined surfaces of the crankshaft sprocket and the oil pump drive gear and install the oil pump (413).
2. Install the oil pump onto the crankshaft sprocket until the pump housing contacts the face of the engine block.

CAUTION: Refer to FASTENER CAUTION .

3. Install the oil pump bolts (411) and tighten to 25 N.m (18 lb ft).

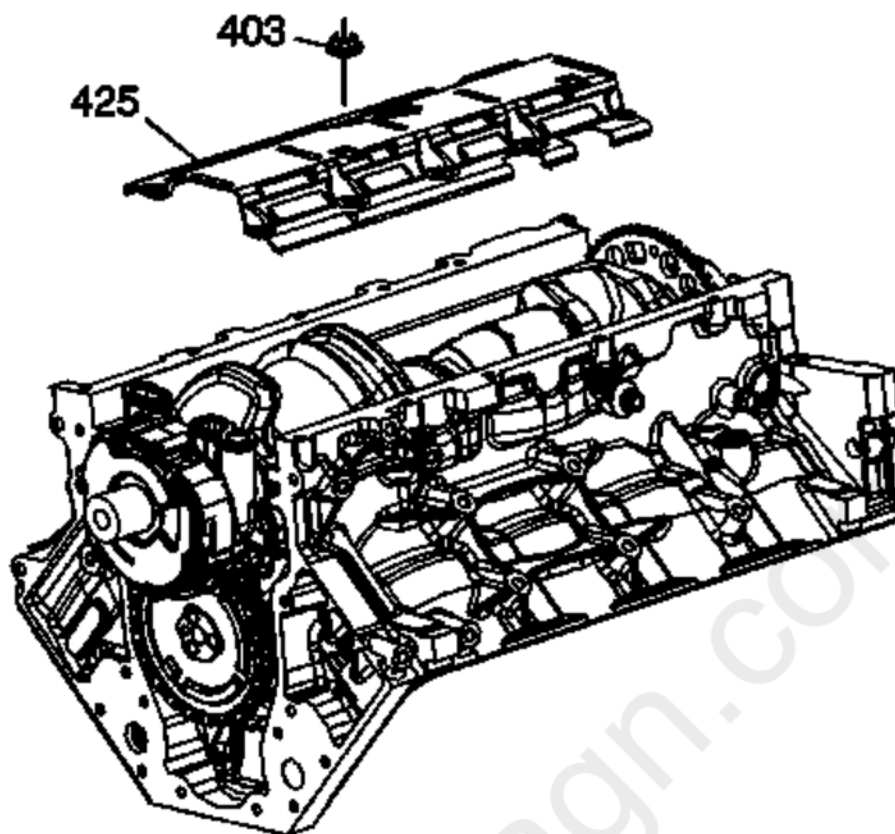


Fig. 124: Crankshaft Oil Deflector & Nuts
Courtesy of GENERAL MOTORS CORP.

4. Install the crankshaft oil deflector (425).

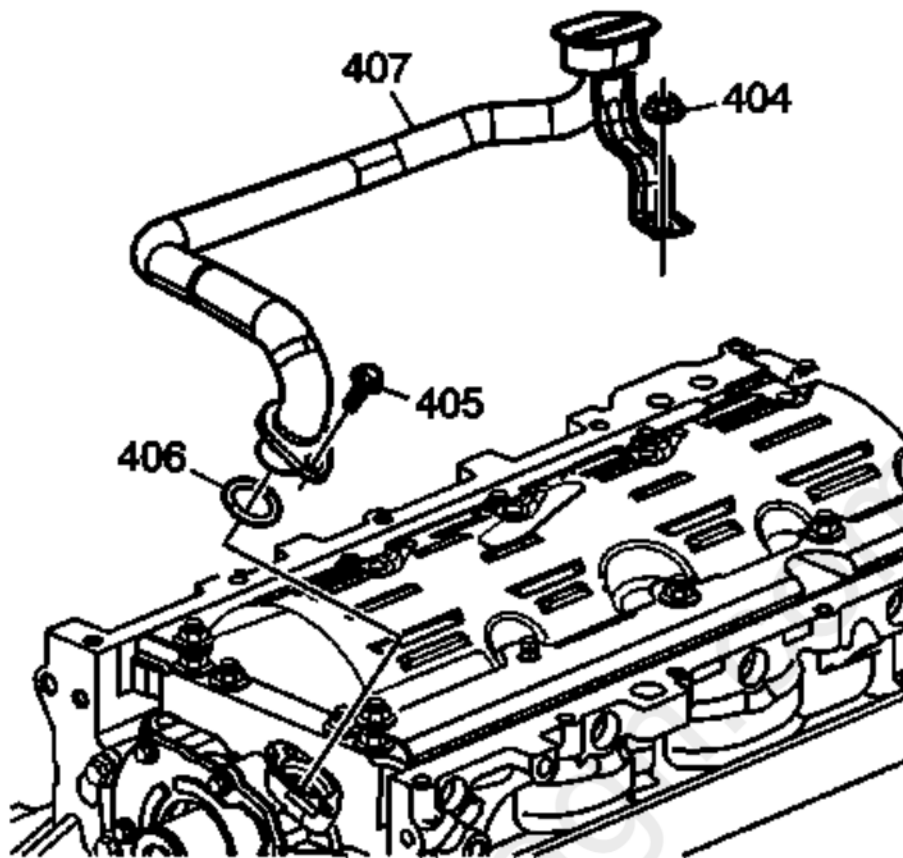


Fig. 125: Oil Pump Screen Bolt, Nut & O-Ring Seal
Courtesy of GENERAL MOTORS CORP.

5. Lubricate a NEW oil pump screen O-ring seal (406) with clean engine oil.
6. Install the NEW O-ring seal onto the oil pump screen.

NOTE:

- Push the oil pump screen tube completely into the oil pump prior to tightening the bolt. Do not allow the bolt to pull the tube into the pump.
- Align the oil pump screen mounting brackets with the correct crankshaft bearing cap bolt/studs.

7. Install the oil pump screen (407).
8. Install the oil pump screen bolt (405) and the deflector nut (404).
 1. Tighten the oil pump screen bolt to 12 N.m (106 lb in).
 2. Tighten the crankshaft oil deflector nut to 25 N.m (18 lb ft).

CRANKSHAFT REAR OIL SEAL HOUSING INSTALLATION (WITHOUT SEAL IN HOUSING)

Special Tools

- **J 41476:** Front and Rear Cover Alignment Tool
- **J 41480:** Front and Rear Cover Alignment

For equivalent regional tools, refer to Special Tools .

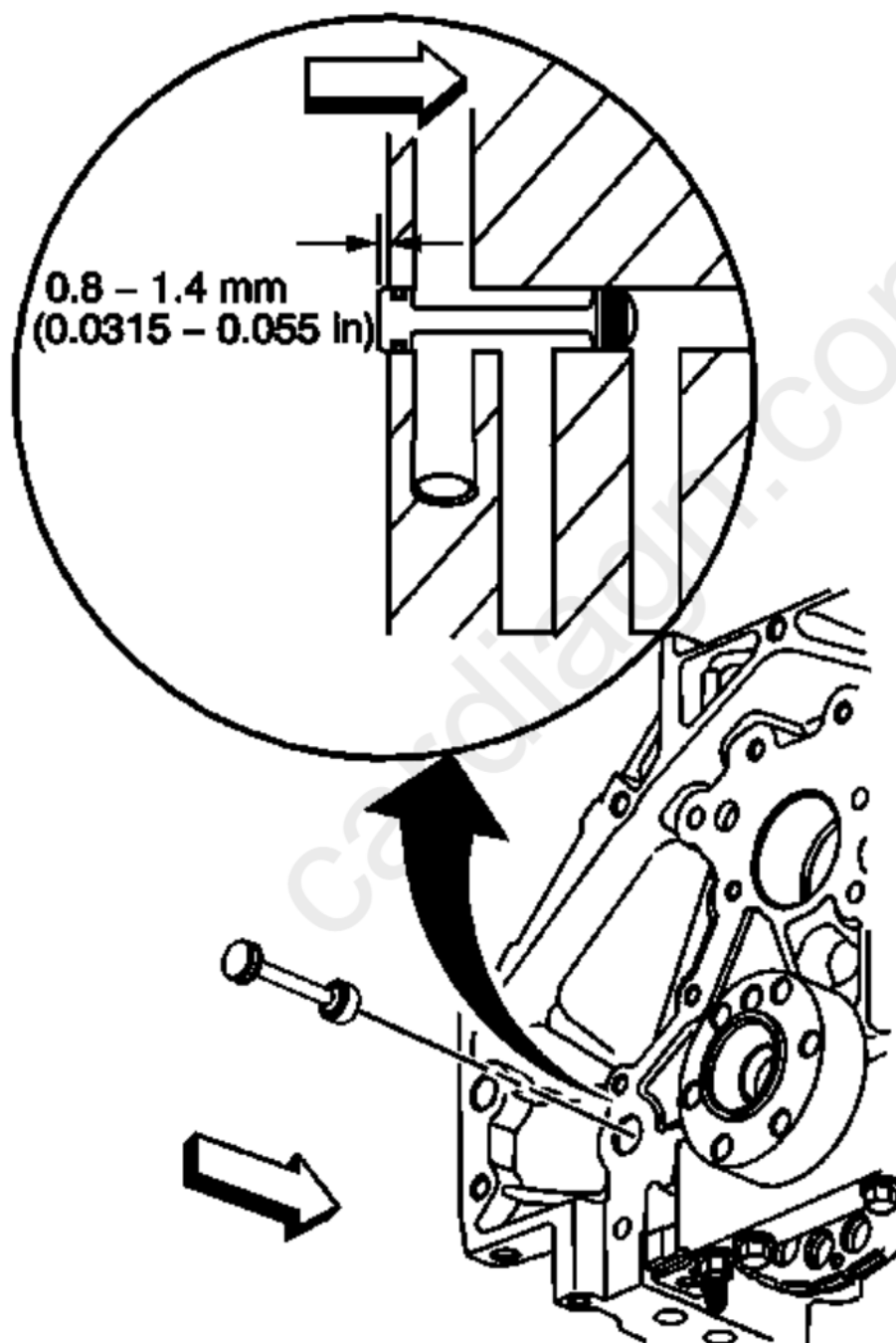


Fig. 126: View Of Engine Block Rear Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not use the crankshaft rear oil seal or the engine rear housing gasket again.
- Do not apply any type of sealant to the rear housing gasket, unless specified.
- The special tools in this procedure are used to properly align the engine rear housing at the oil pan surface and to center the crankshaft rear oil seal.
- The crankshaft rear oil seal will be installed after the rear housing has been installed and aligned. Install the rear housing without the crankshaft oil seal.
 - The crankshaft rear oil seal **MUST** be centered in relation to the crankshaft.
 - The oil pan sealing surface at the rear housing, and the engine block, **MUST** be aligned within specifications.
 - An improperly aligned rear housing may cause premature rear oil seal wear and/or engine assembly oil leaks.

1. Inspect the rear oil gallery plug for proper installation.

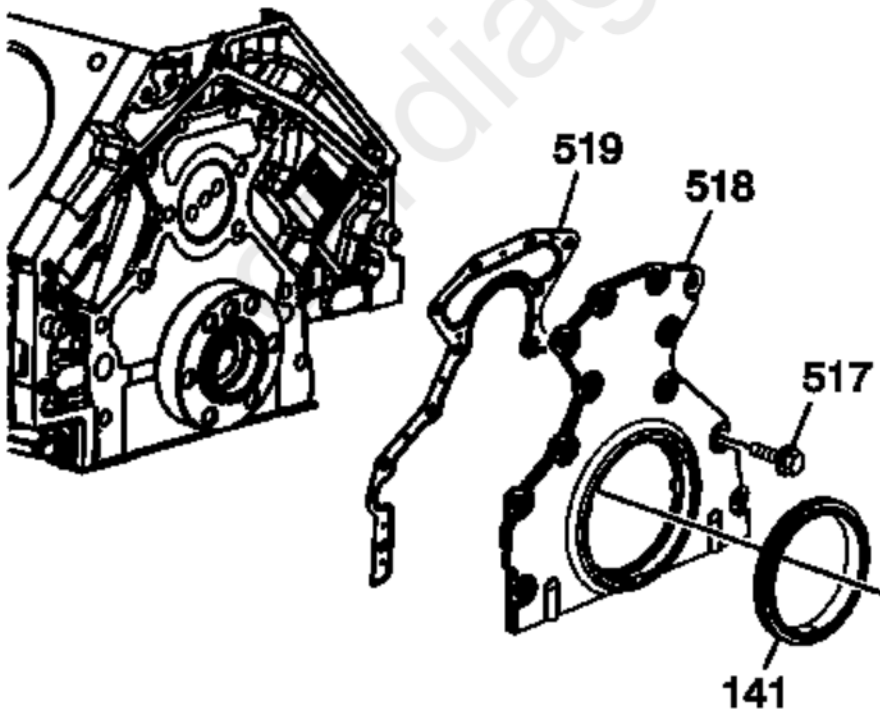


Fig. 127: View of Rear Housing, Gasket and Seal

Courtesy of GENERAL MOTORS CORP.

2. Install the rear housing gasket (519), rear housing (518), and bolts (517).
3. Tighten the bolts finger tight. Do not overtighten.

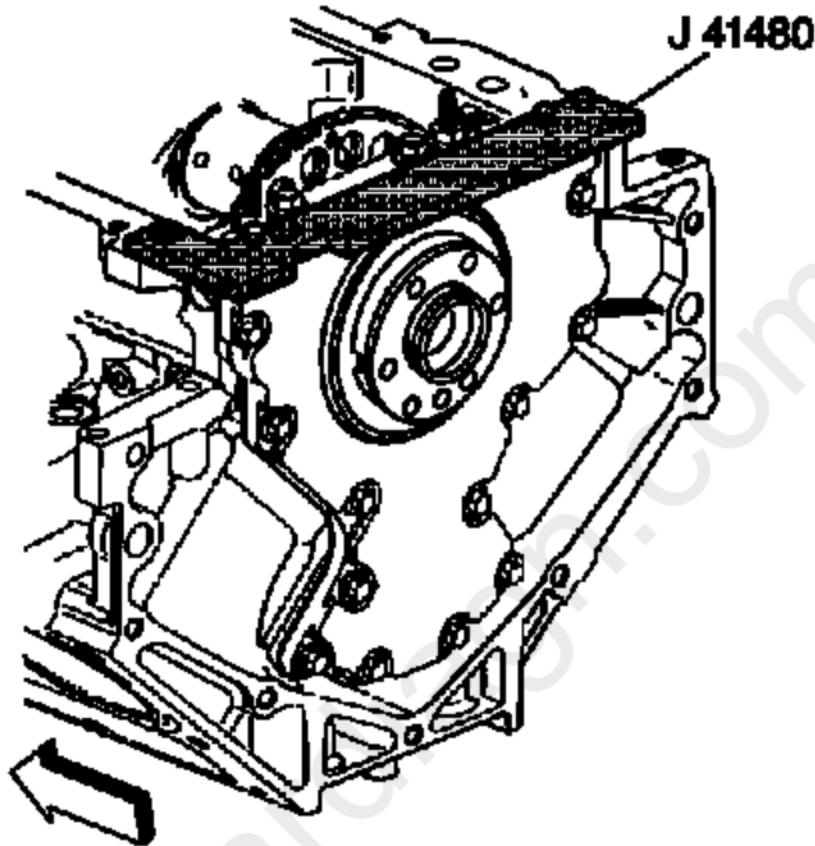


Fig. 128: View Of J 41480 Installed To Engine Block
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE: Start the J 41480: alignment tool-to-rear housing bolts. Do not tighten the bolts at this time.

4. Install the **J 41480**: alignment and bolts. Tighten the tool-to-engine block bolts to 25 N.m (18 lb ft).

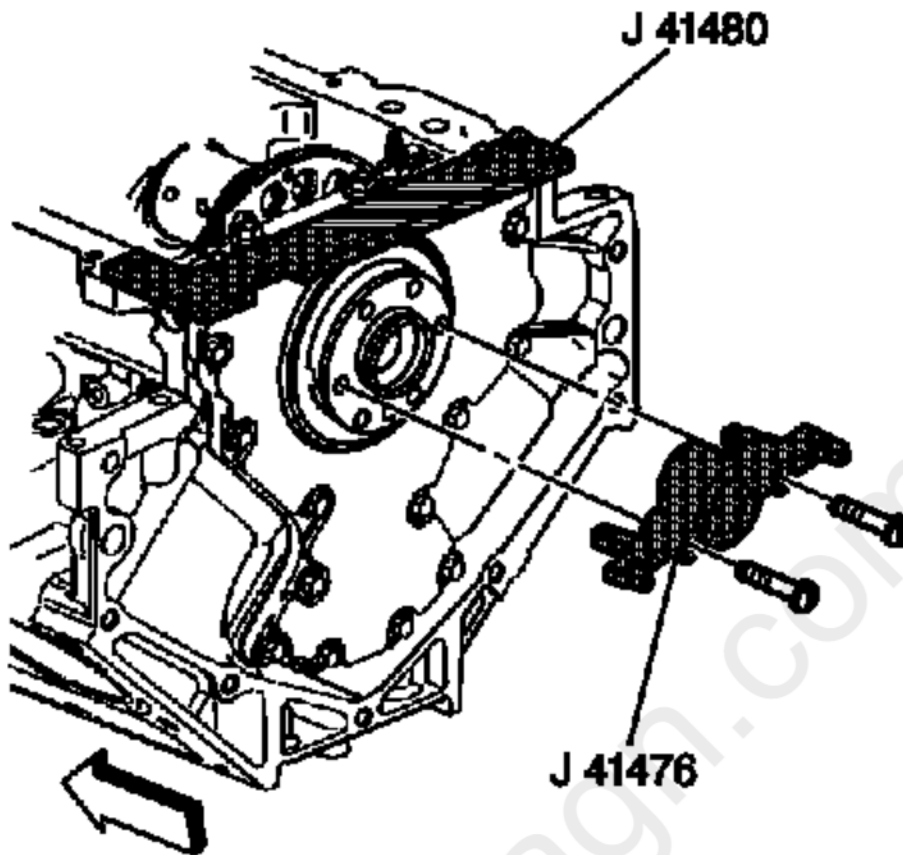


Fig. 129: View Of J 41480 & J 41476
Courtesy of GENERAL MOTORS CORP.

NOTE: To properly align the rear housing, the J 41476: tool must be installed onto the rear of the crankshaft with the tool mounting bolts parallel to the oil pan surface.

5. Rotate the crankshaft until 2 opposing flywheel bolt holes are parallel to the oil pan surface.

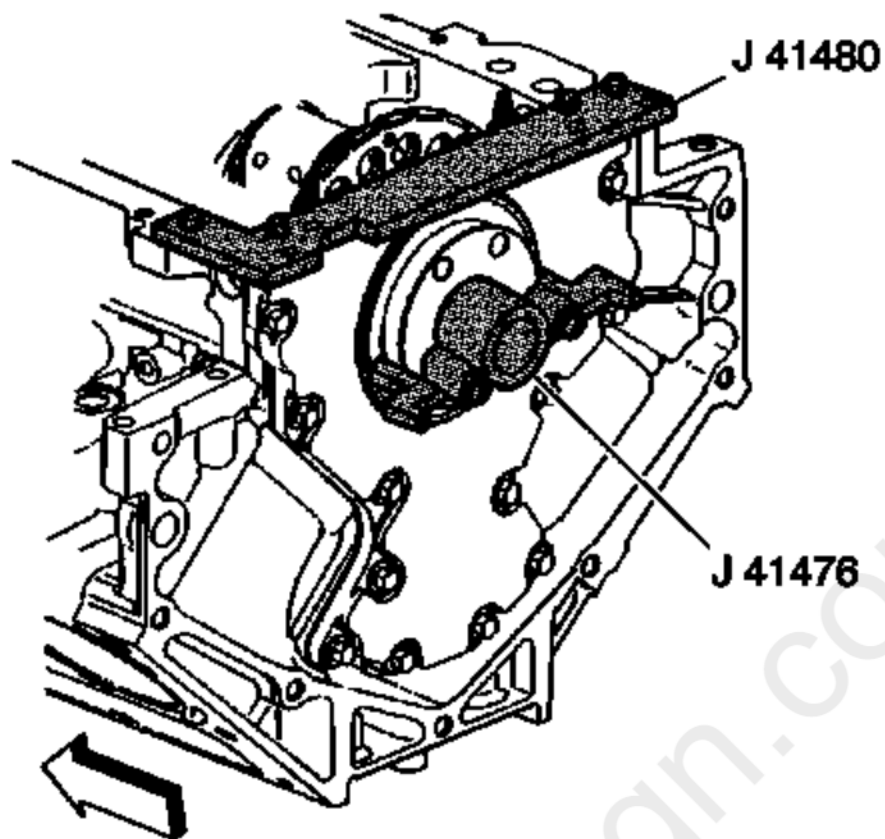


Fig. 130: View Of J 41480 & J 41476 Installed
 Courtesy of GENERAL MOTORS CORP.

NOTE: The tapered legs of the alignment tool must enter the rear housing oil seal bore.

6. Install the **J 41476**: tool and bolts onto the rear of the crankshaft.
 1. Tighten the tool mounting bolts until snug. Do not overtighten.
 2. Tighten the **J 41480**: alignment tool-to-rear housing bolts evenly to 12 N.m (106 lb in).
 3. Tighten the rear housing bolts to 30 N.m (22 lb ft).
7. Remove the tools.

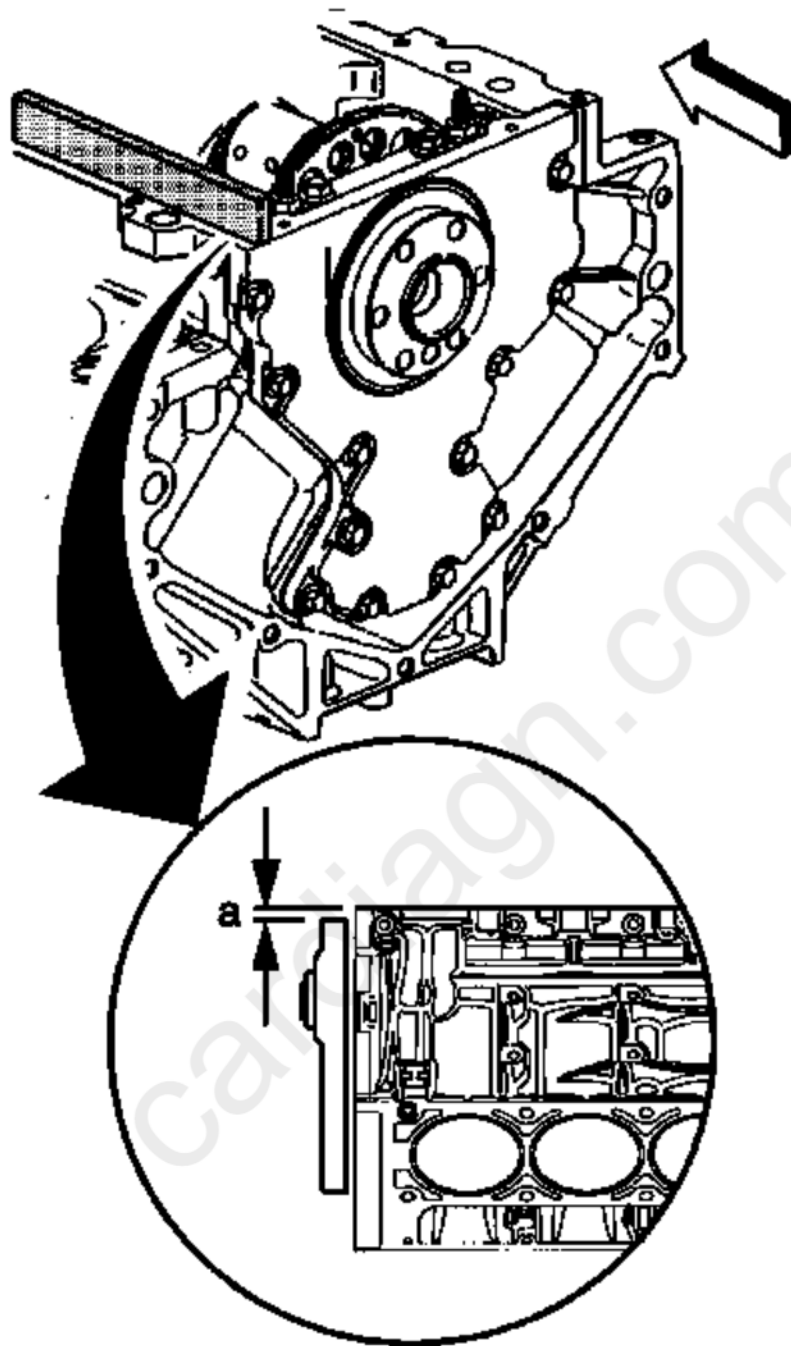


Fig. 131: Identifying Rear Cover-To-Engine Block Proper Installation Position
Courtesy of GENERAL MOTORS CORP.

8. Measure the rear housing-to-engine block oil pan surface for flatness.
 1. Place a straight edge onto the engine block and rear housing oil pan sealing surfaces.

Avoid contact with the portion of the gasket that protrudes into the oil pan surface.

2. Insert a feeler gauge between the rear housing and the straight edge. The housing must be flush with the oil pan or no greater than 0.5 mm (0.02 in) below flush (a).
9. If the rear housing-to-engine block oil pan surface alignment is not within specifications, repeat the housing alignment procedure.
10. If the correct rear housing-to-engine block alignment at the oil pan surface cannot be obtained, replace the rear housing.

CRANKSHAFT REAR OIL SEAL HOUSING INSTALLATION (WITH SEAL IN HOUSING)

Special Tools

- **J 41479-2A:** Crankshaft Rear Oil Seal Installation Guide
- **J 41480:** Front and Rear Cover Alignment

For equivalent regional tools, refer to Special Tools

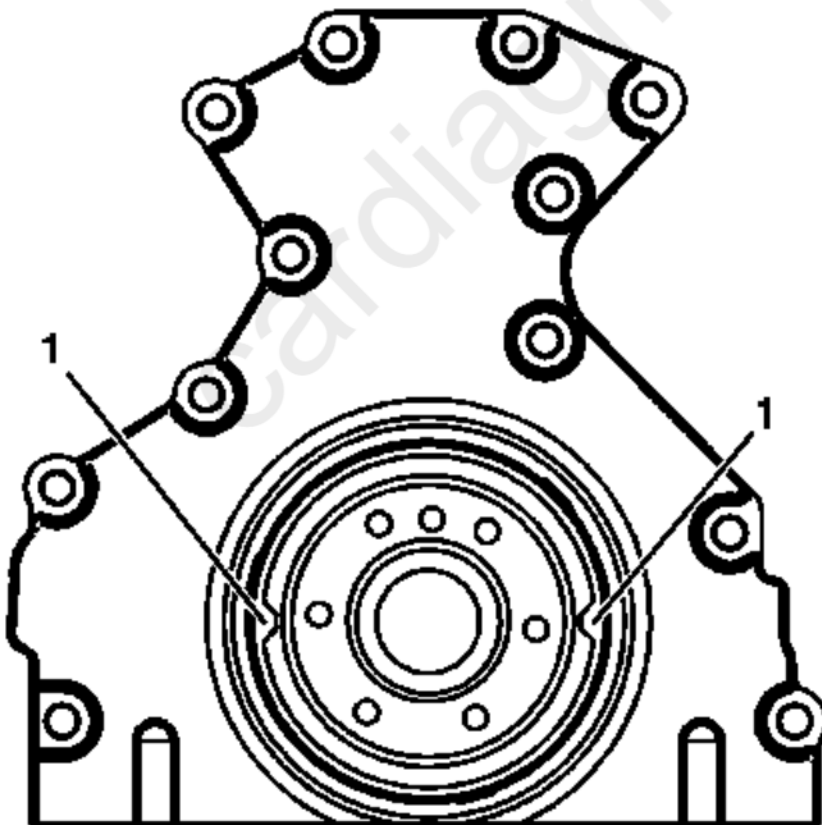


Fig. 132: View Of Rear Housing Alignment Tabs
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not use the crankshaft rear oil seal or the engine rear housing gasket again.
- Do not apply any type of sealant to the rear housing gasket, unless specified.
- The special tool in this procedure is used to properly align the engine rear housing at the oil pan surface.
- First design rear housings do not have alignment tabs for alignment of the housing horizontally. J 41476: tool is required to properly align first design rear housings. The rear oil seal must be removed from the housing for proper use of the tool.
- Second design rear housings have alignment tabs for alignment of the housing horizontally. J 41476: tool is not required for proper alignment of second design rear housings. The housing may be installed and aligned with the seal already installed into the housing.

1. Inspect the rear housing to identify for alignment tabs (1).

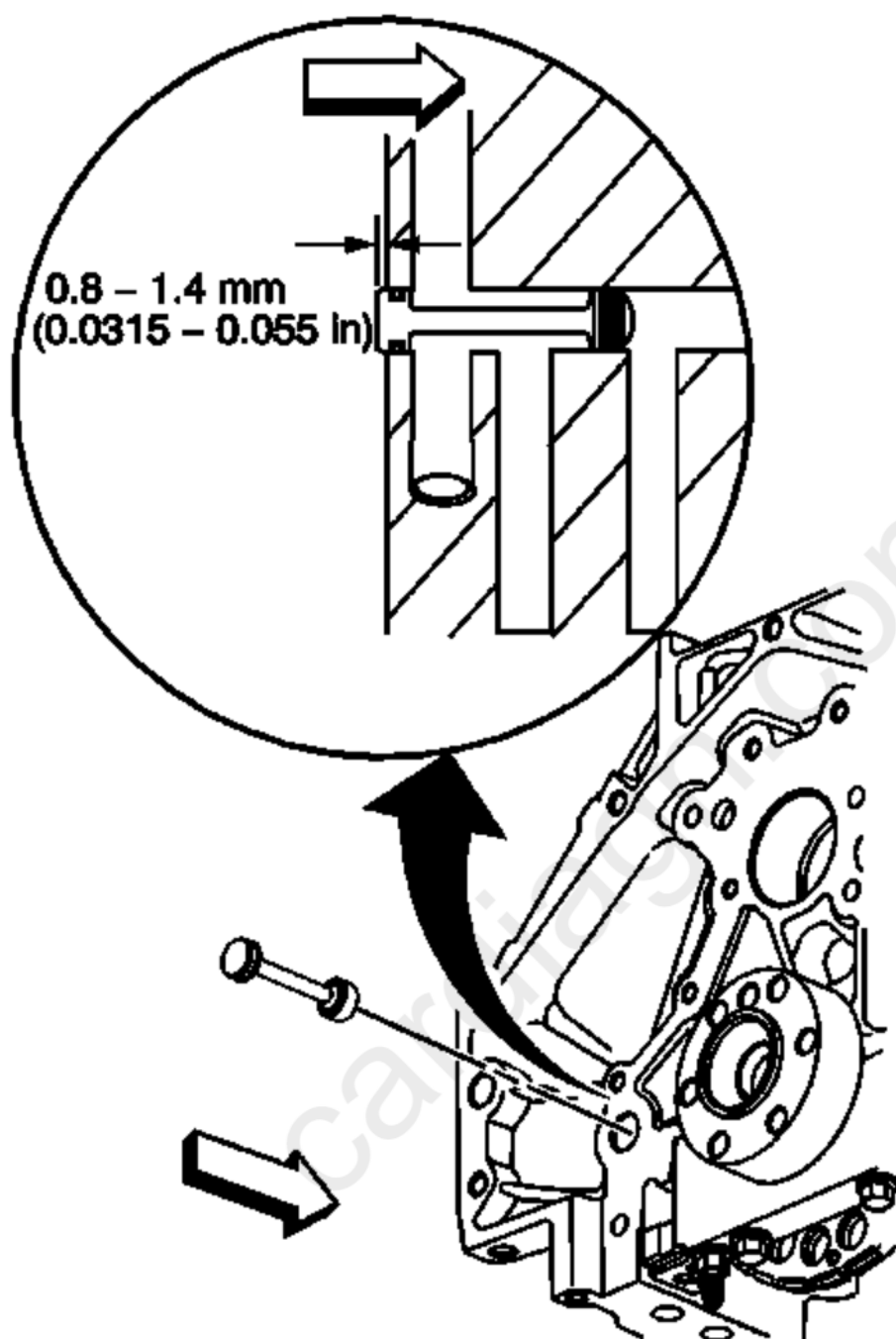


Fig. 133: View Of Engine Block Rear Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

2. Inspect the rear oil gallery plug for proper installation.

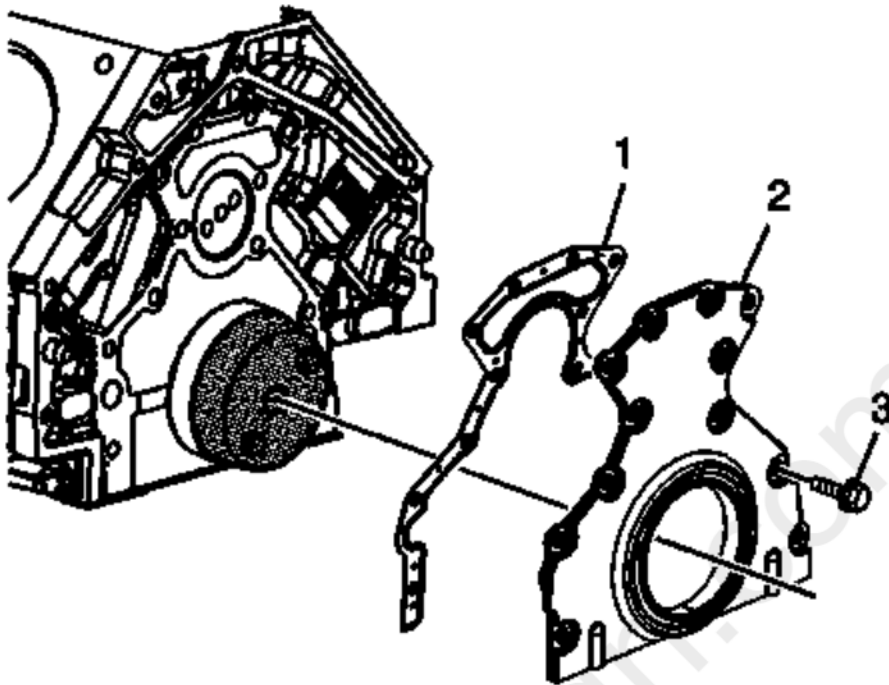


Fig. 134: View Of Rear Housing Gasket, Rear Housing With Seal And Bolts
 Courtesy of GENERAL MOTORS CORP.

3. Install the **J 41479-2A**: guide cone and bolts onto the rear of the crankshaft.
4. Tighten the bolts until snug. Do not overtighten.
5. Install the rear housing gasket (1), rear housing with seal (2), and bolts (3).
6. Tighten the bolts finger tight. Do not overtighten.
7. Remove the **J 41479-2A**: guide and bolts.

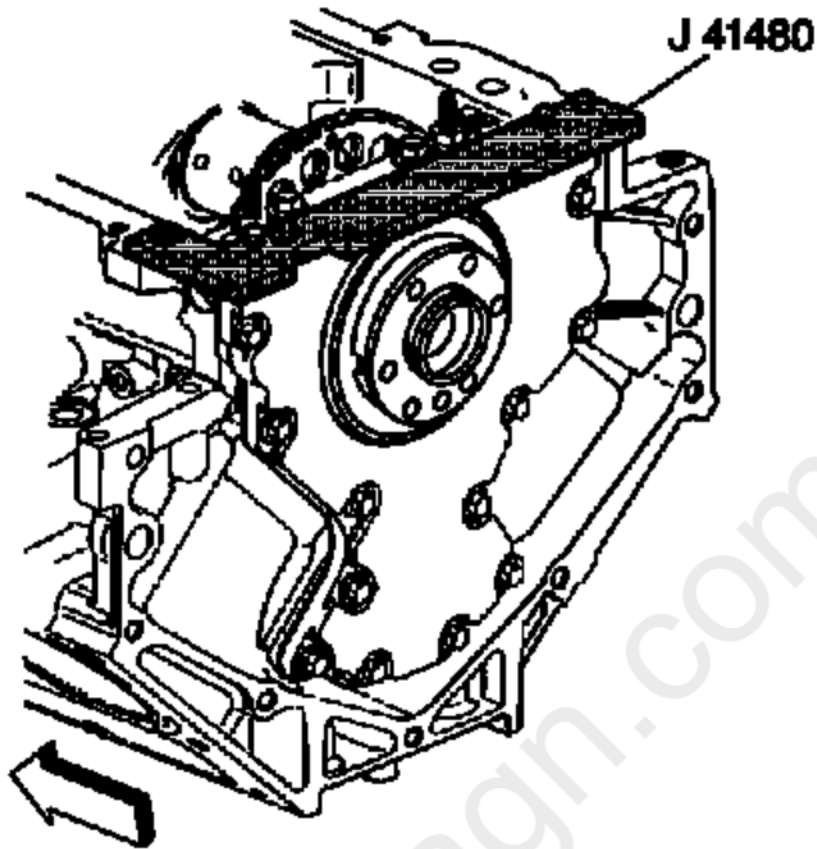


Fig. 135: View Of J 41480 Installed To Engine Block
 Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

8. Install the **J 41480**: alignment and bolts.
 1. Tighten the tool-to-engine block bolts to 25 N.m (18 lb ft).
 2. Tighten the **J 41480**: alignment tool-to-rear housing bolts evenly to 12 N.m (106 lb in).
 3. Tighten the rear housing-to-engine block bolts to 30 N.m (22 lb ft).
9. Remove the **J 41480**: alignment and bolts.

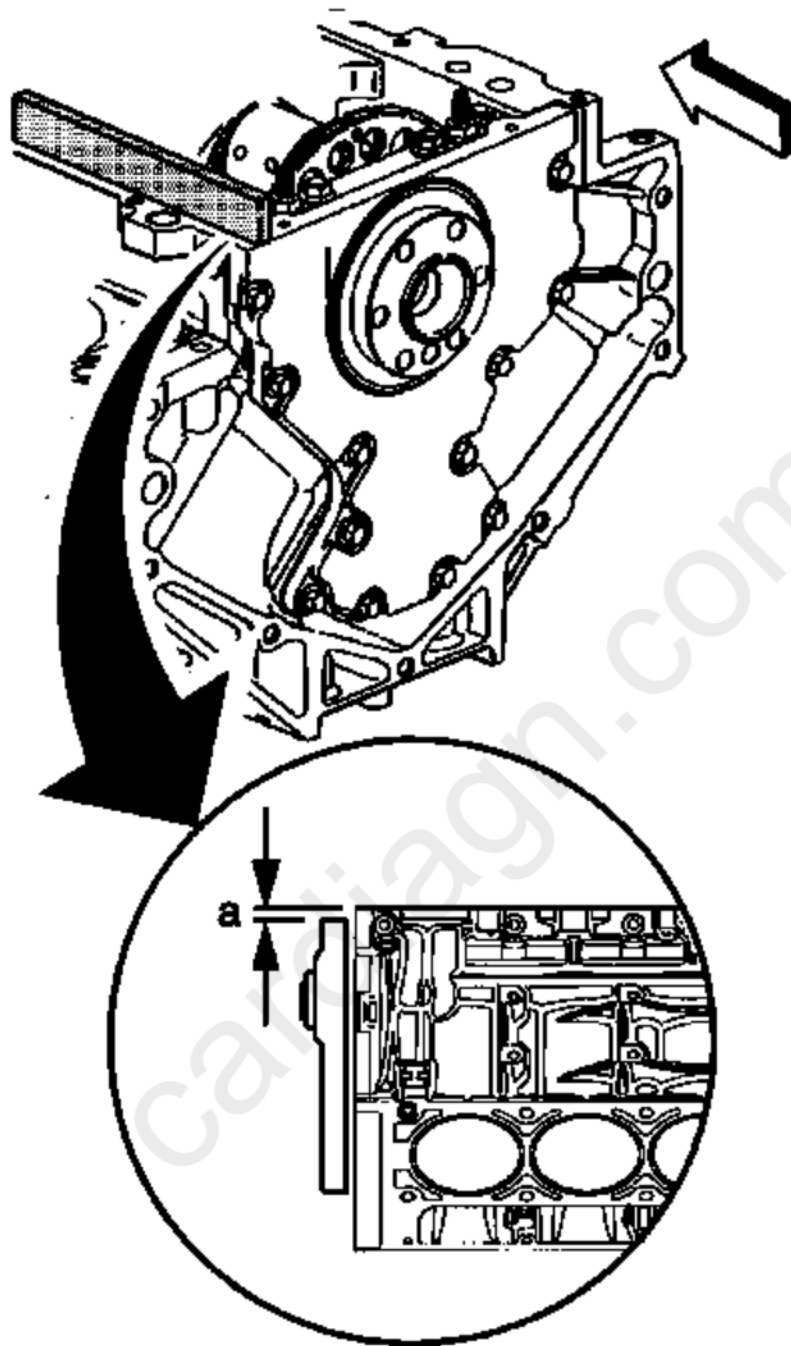


Fig. 136: Identifying Rear Cover-To-Engine Block Proper Installation Position
Courtesy of GENERAL MOTORS CORP.

10. Measure the rear housing-to-engine block oil pan surface for flatness.
 1. Place a straight edge onto the engine block and rear housing oil pan sealing surfaces.

Avoid contact with the portion of the gasket that protrudes into the oil pan surface.

2. Insert a feeler gauge between the rear housing and the straight edge. The housing must be flush with the oil pan or no greater than 0.5 mm (0.02 in) (a) below flush.
11. If the rear housing-to-engine block oil pan surface alignment is not within specifications, repeat the housing alignment procedure.
12. If the correct rear housing-to-engine block alignment at the oil pan surface cannot be obtained, replace the rear housing.

CRANKSHAFT REAR OIL SEAL INSTALLATION

Special Tools

- **J 41479** Crankshaft Rear Oil Seal Installer. See Special Tools .
- **J 41479-2A** Crankshaft Rear Oil Seal Installation Guide

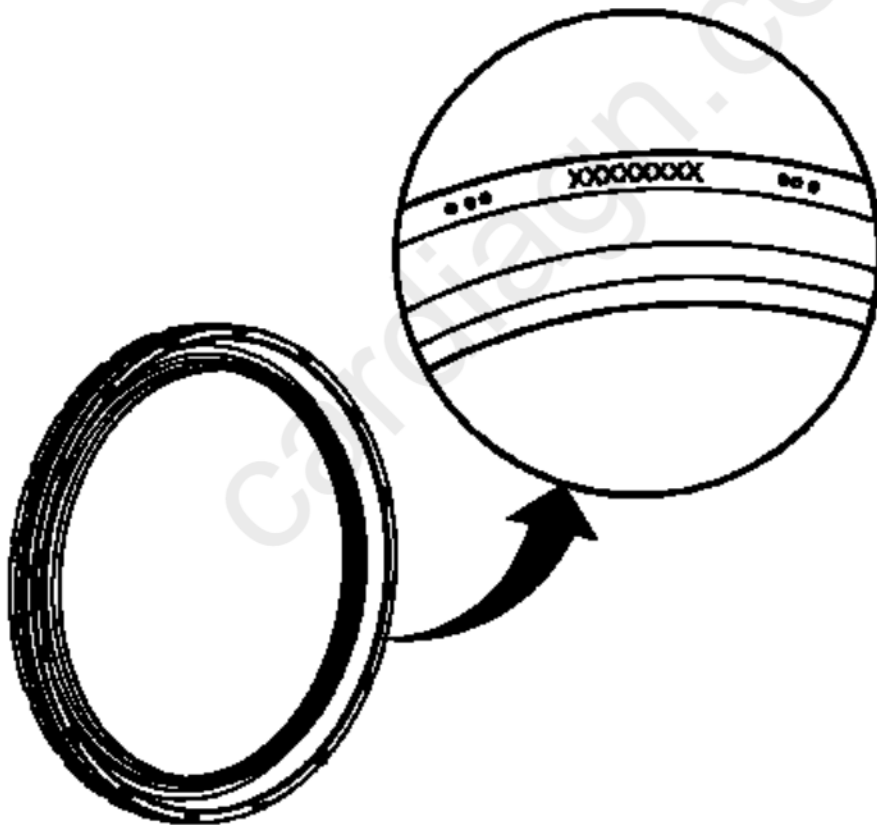


Fig. 137: Identifying Oil Seal

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: For proper orientation, note the installation direction of the oil seal. The

oil seal is a reverse-lip design. The part number is applied to the outside face of the seal, as shown in illustration.

1. Inspect the seal and identify the part number markings for proper orientation.

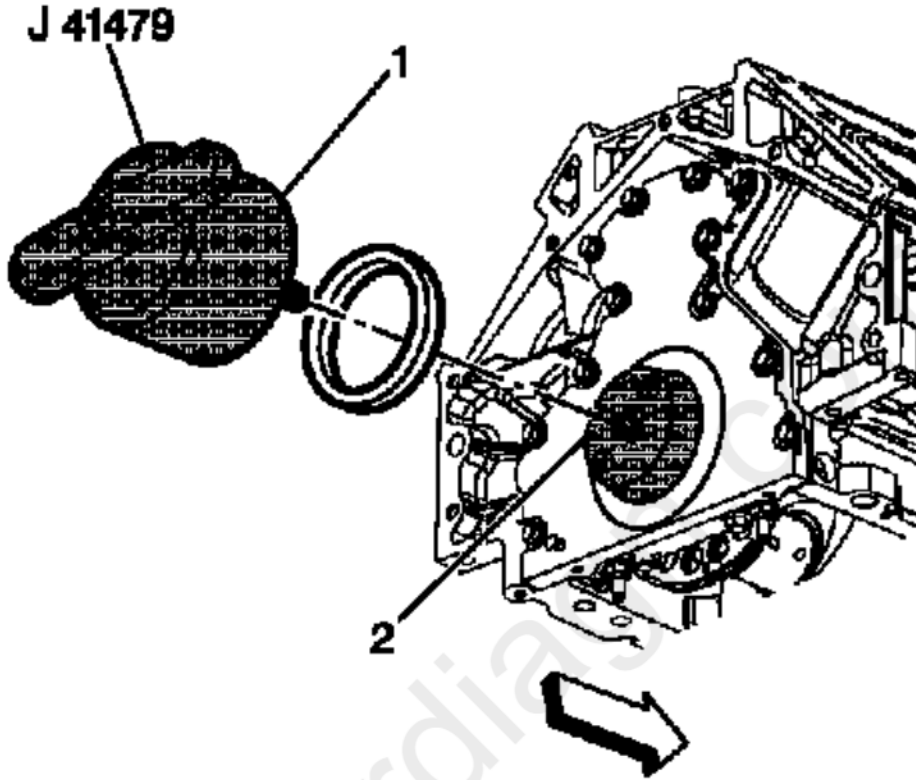


Fig. 138: View Of Special Tool J 41479 Cone & Bolts
Courtesy of GENERAL MOTORS CORP.

2. Install the **J 41479** or the **J 41479-2A** cone (2) and bolts onto the rear of the crankshaft. The **J 41479-2A** may be required for manual transmission or 5.3L LS4 applications. See **Special Tools** .
3. Tighten the bolts until snug. Do not overtighten.
4. Install the rear oil seal onto the tapered cone (2) and push the seal to the rear seal bore. Install the oil seal with the part number markings facing away from the engine.
5. Thread the **J 41479** threaded rod into the tapered cone until the tool (1) contacts the oil seal. See **Special Tools** .
6. Align the oil seal onto the tool (1).
7. Rotate the handle of the tool (1) clockwise until the seal enters the rear housing and bottoms into the seal bore.
8. Remove the tool.

ENGINE FRONT COVER INSTALLATION

Special Tools

- **EN-48853:** Front Cover Alignment Tool
- **J 41480:** Front and Rear Cover Alignment

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

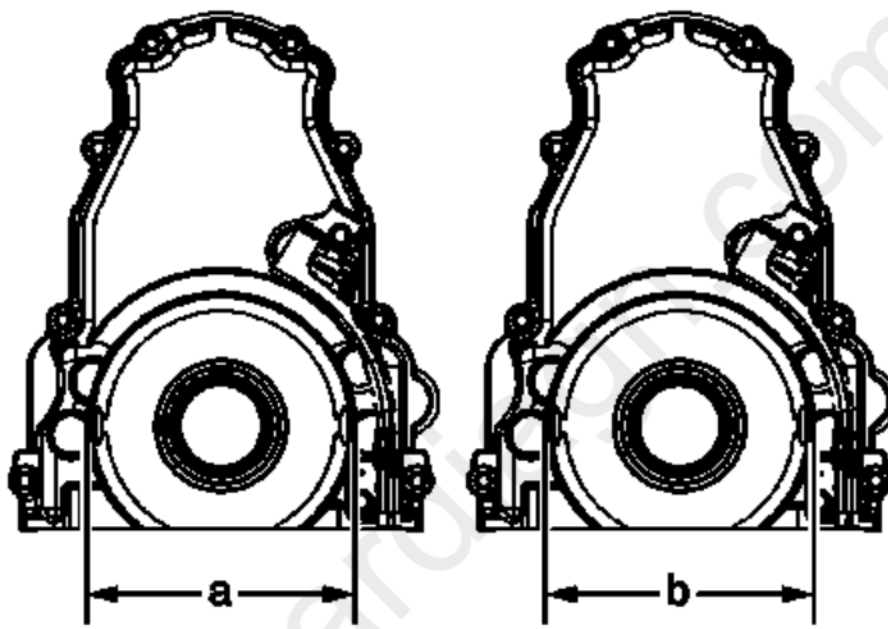


Fig. 139: Identifying Alignment Tab Distance On Front Cover
Courtesy of GENERAL MOTORS CORP.

1. Measure the alignment tab distance on the front cover.

The engine front cover may have either a 141 mm (5.55 in) dimension (a) or 159 mm (6.26 in) dimension (b) alignment tab distance. Front cover alignment tool **EN-48853:** alignment tool is designed to properly align both front covers. For the 141 mm (5.55 in) cover, adapters EN-48853-2 must be used.

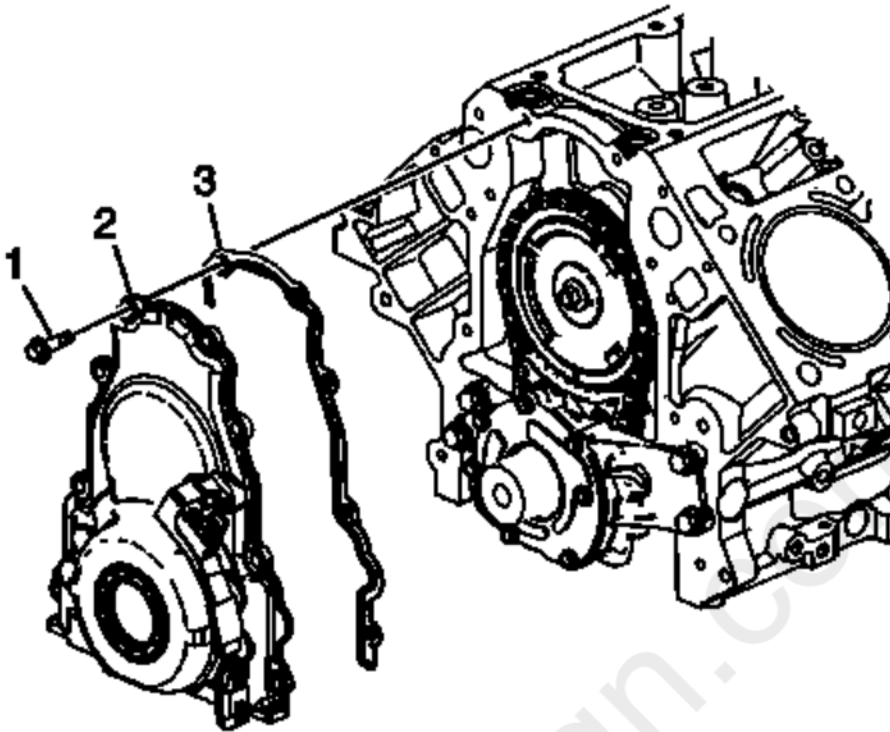


Fig. 140: View Of Front Cover & Gasket
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE:

- Do not use the crankshaft oil seal or the engine front cover gasket again.
- Do not apply any type of sealant to the front cover gasket, unless specified.
- The special tools in this procedure are used to properly align the engine front cover at the oil pan surface and to center the crankshaft front oil seal.
 - All gasket surfaces should be free of oil or other foreign material during assembly.

The crankshaft front oil seal **MUST** be centered in relation to the crankshaft.

- The oil pan sealing surface at the front cover and engine block

MUST be aligned within specifications.

- An improperly aligned front cover may cause premature front oil seal wear and/or engine assembly oil leaks.

2. Install the front cover gasket (3), front cover (2), and bolts (1).
3. Tighten the cover bolts finger tight. Do not overtighten.

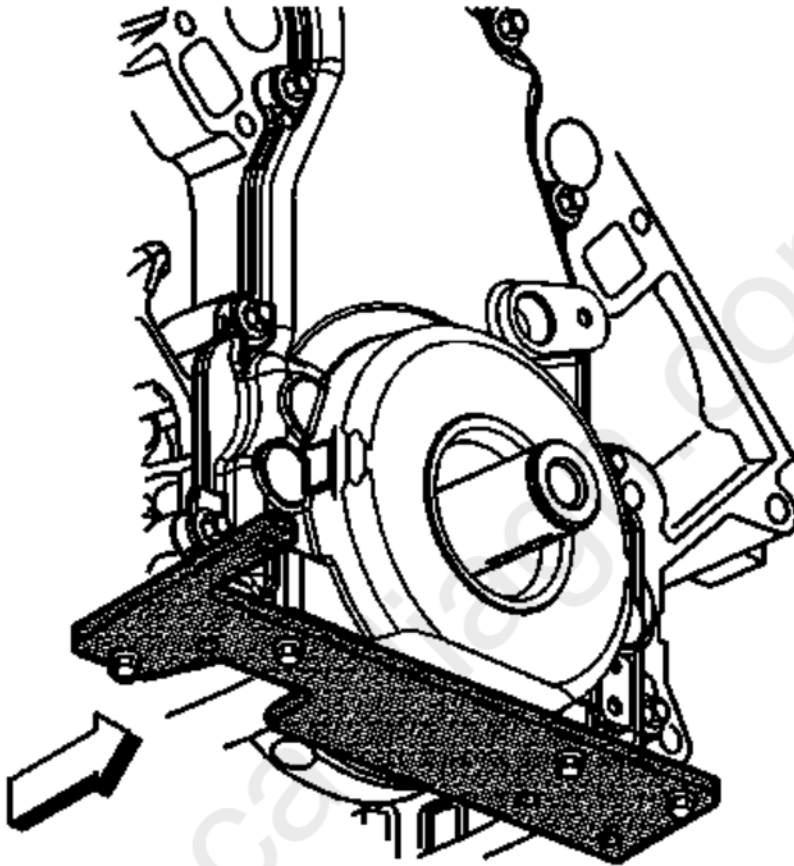


Fig. 141: Front Cover Alignment Tool
Courtesy of GENERAL MOTORS CORP.

NOTE: Start the tool-to-front cover bolts. Do not tighten the bolts at this time.

4. Install the **J 41480**: cover alignment and tighten the tool-to-engine block bolts to 25 N.m (18 lb ft).

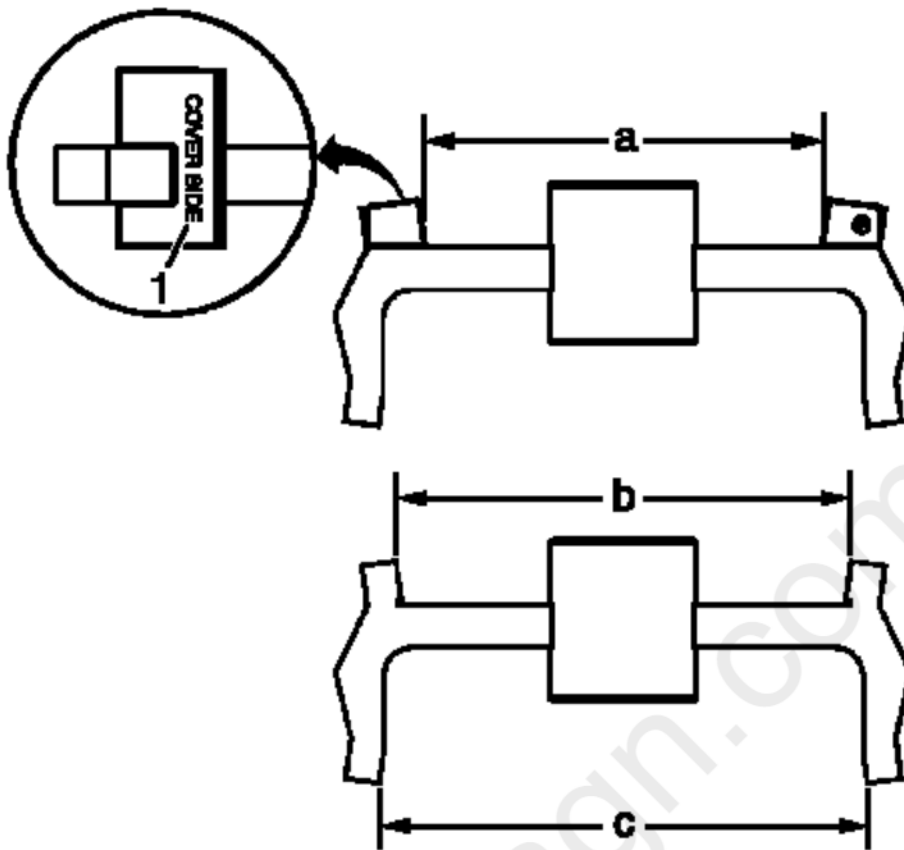


Fig. 142: EN 48853-2 Adapters

Courtesy of GENERAL MOTORS CORP.

5. Install the EN-48853-2 adapters as required for usage on the 141 mm (5.55 in) dimension (a) front cover. Position the adapters against the legs of the **EN-48853** tool with the words "cover side" (1) facing away from the tool.

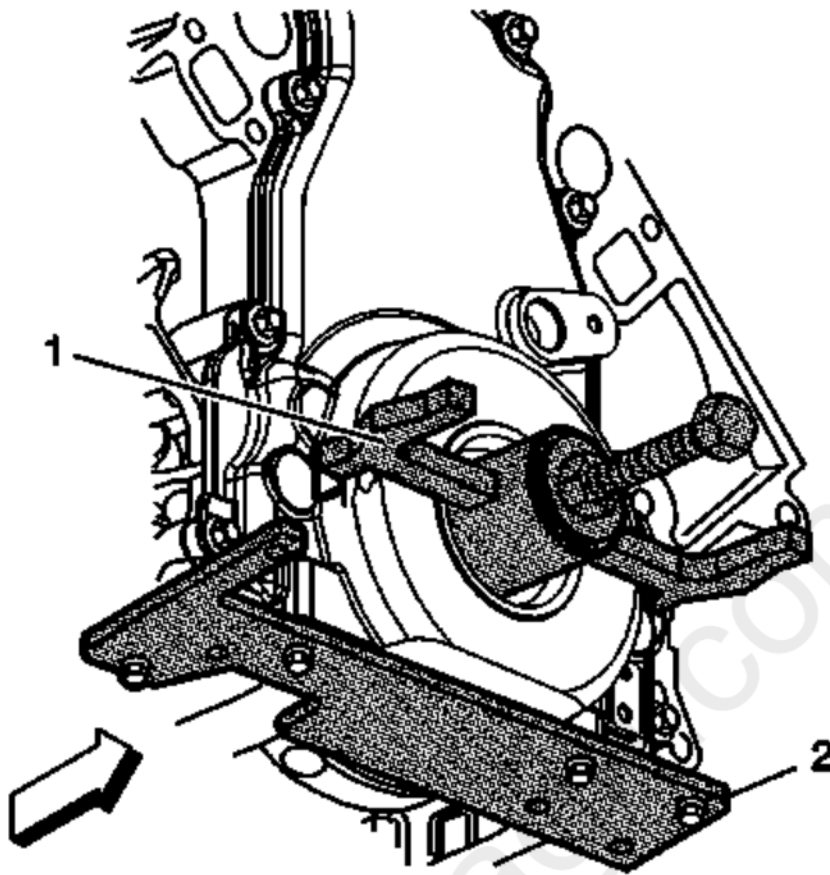


Fig. 143: View Of EN-48853 & J 41480
Courtesy of GENERAL MOTORS CORP.

NOTE: Align the tapered legs of the tool with the machined alignment surfaces on the front cover.

6. Install the **EN-48853**: alignment tool (1).
7. Install the crankshaft balancer bolt.
8. Tighten the crankshaft balancer bolt by hand until snug. Do not overtighten.
9. Tighten the **J 41480**: cover alignment (2).
10. Tighten the engine front cover bolts to 25 N.m (18 lb ft).
11. Remove the tools.

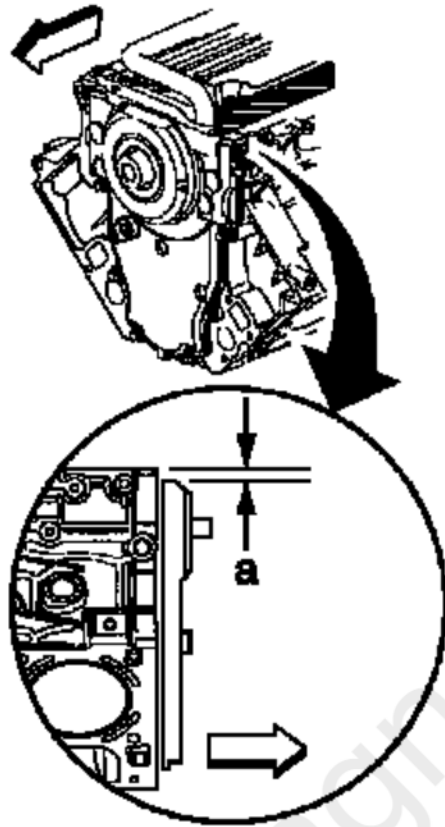


Fig. 144: Oil Pan Surface Flatness & Front Cover-To-Engine Block
Courtesy of GENERAL MOTORS CORP.

12. Measure the oil pan surface flatness, front cover-to-engine block.
 1. Place a straight edge across the engine block and front cover oil pan sealing surfaces.

Avoid contact with the portion of the gasket that protrudes into the oil pan surface.
 2. Insert a feeler gauge between the front cover and the straight edge tool. The cover must be flush with the oil pan surface or no greater than 0.3 mm (0.0118 in) (a) below flush.
13. If the front cover-to-engine block oil pan surface alignment is not within specifications, repeat the cover alignment procedure.
14. If the correct front cover-to-engine block alignment cannot be obtained, replace the front cover.

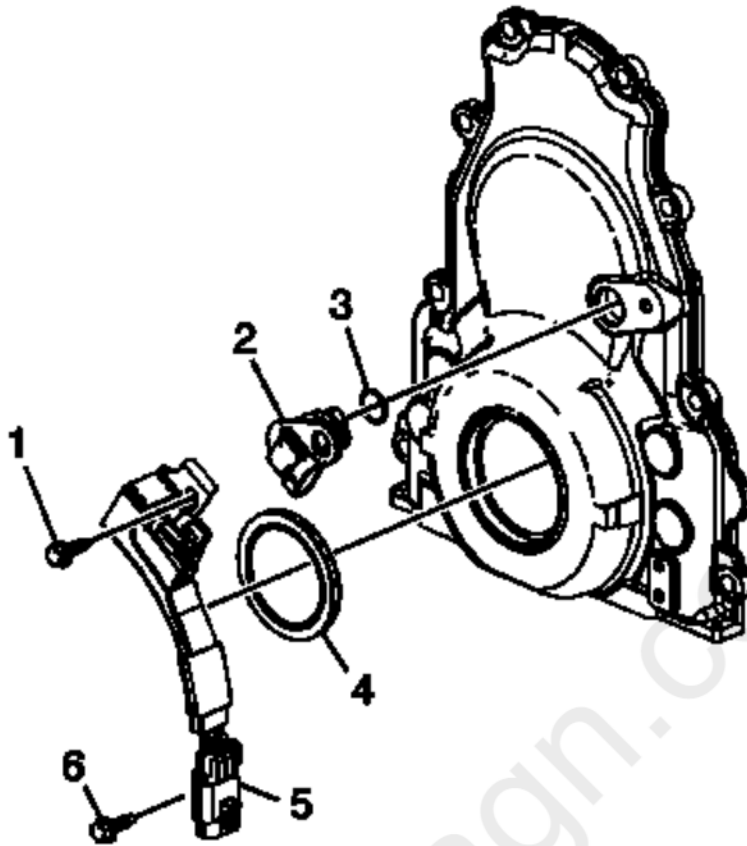


Fig. 145: View Of Front Cover, Oil Seal, Camshaft Position Sensor, Bracket & O Ring
Courtesy of GENERAL MOTORS CORP.

15. Inspect the camshaft position (CMP) sensor O-ring seal (3) for cuts or damage. If the seal is not cut or damaged, it may be used again.
16. Lubricate the O-ring seal with clean engine oil.
17. Install the O-ring seal onto the sensor (2).
18. Install the sensor to the cover.
19. Install the CMP sensor wire harness (5) and bolts (1, 6). Tighten the bolts to 12 N.m (106 lb in).

CRANKSHAFT FRONT OIL SEAL INSTALLATION

Special Tools

- **EN-47812:** Installer Bolt
- **J 41478:** Crankshaft Front Oil Seal Installer
- **J 41478-1A:** Crankshaft Front Oil Seal Installer Cone

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

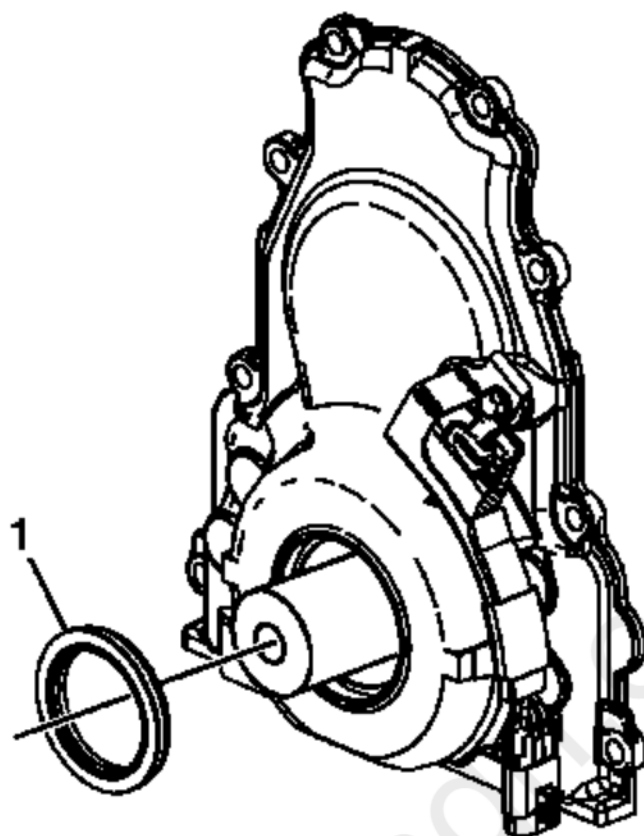


Fig. 146: View Of Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Do not lubricate the oil seal sealing surface.
- Do not use the crankshaft front oil seal again.

1. Lubricate the outer edge of the oil seal (1) with clean engine oil.
2. Lubricate the front cover oil seal bore with clean engine oil.

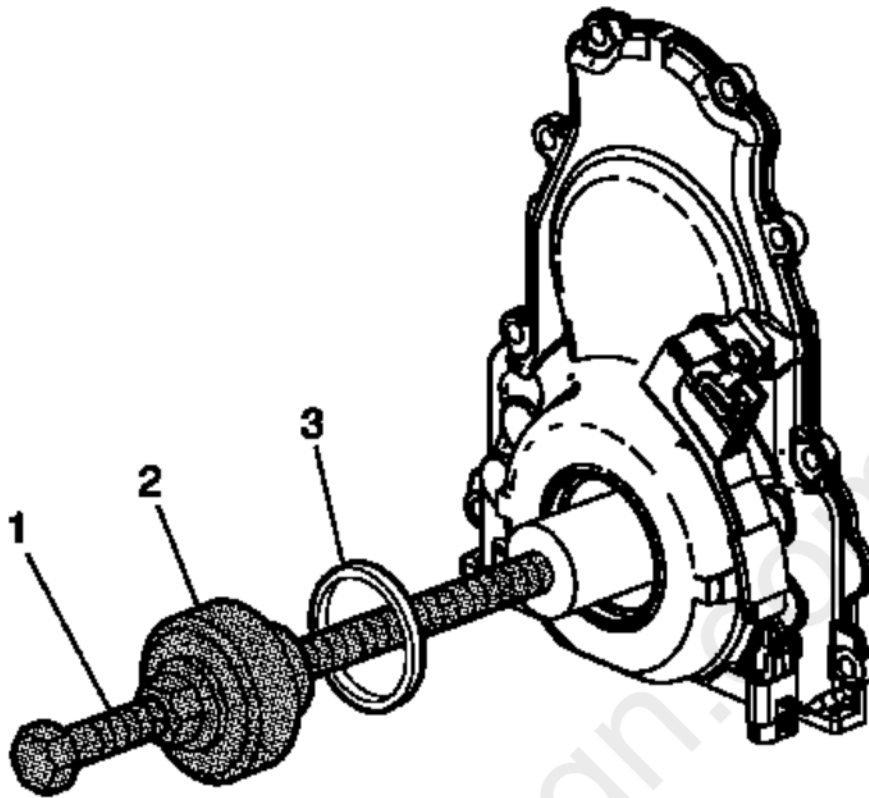


Fig. 147: Crankshaft Front Oil Seal
Courtesy of GENERAL MOTORS CORP.

3. Using the **EN-47812:** bolt and the **J 41478:** installer, install the crankshaft front oil seal.
4. Install the **EN-47812:** bolt threaded rod (1), nut, washer, the **J 41478-1A:** installer cone (2), and oil seal (3) into the end of the crankshaft.
5. Use the **J 41478:** installer in order to install the oil seal into the cover bore.
 1. Use a wrench and hold the hex on the installer bolt.
 2. Use a second wrench and rotate the installer nut clockwise until the seal bottoms in the cover bore.
 3. Remove the tool.
 4. Inspect the oil seal for proper installation. The oil seal should be installed evenly and completely into the front cover bore.

OIL PAN INSTALLATION

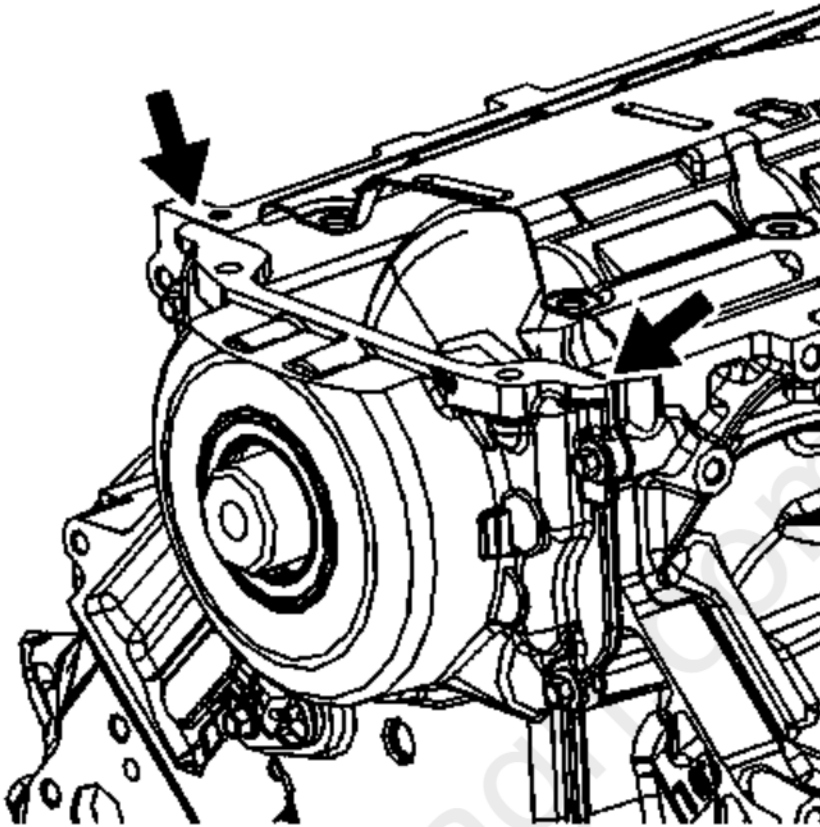


Fig. 148: Applying A 5 mm (0.2 in) Bead Of Sealant To The Engine Block
Courtesy of GENERAL MOTORS CORP.

NOTE:

- The alignment of the structural oil pan is critical. The rear bolt hole locations of the oil pan provide mounting points for the transmission housing. To ensure the rigidity of the powertrain and correct transmission alignment, it is important that the rear of the block and the rear of the oil pan are flush, or even. The rear of the oil pan must **NEVER** protrude beyond the engine block and transmission housing plane.
- Do not use the oil pan gasket again.
- It is not necessary to rivet the **NEW** gasket to the oil pan.

1. Apply a 5 mm (0.2 in) bead of sealant GM P/N 12378521 (Canadian P/N 88901148), or equivalent, 20 mm (0.8 in) long to the engine block. Apply the sealant directly onto the tabs of the front cover gasket that protrude into the oil pan surface. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

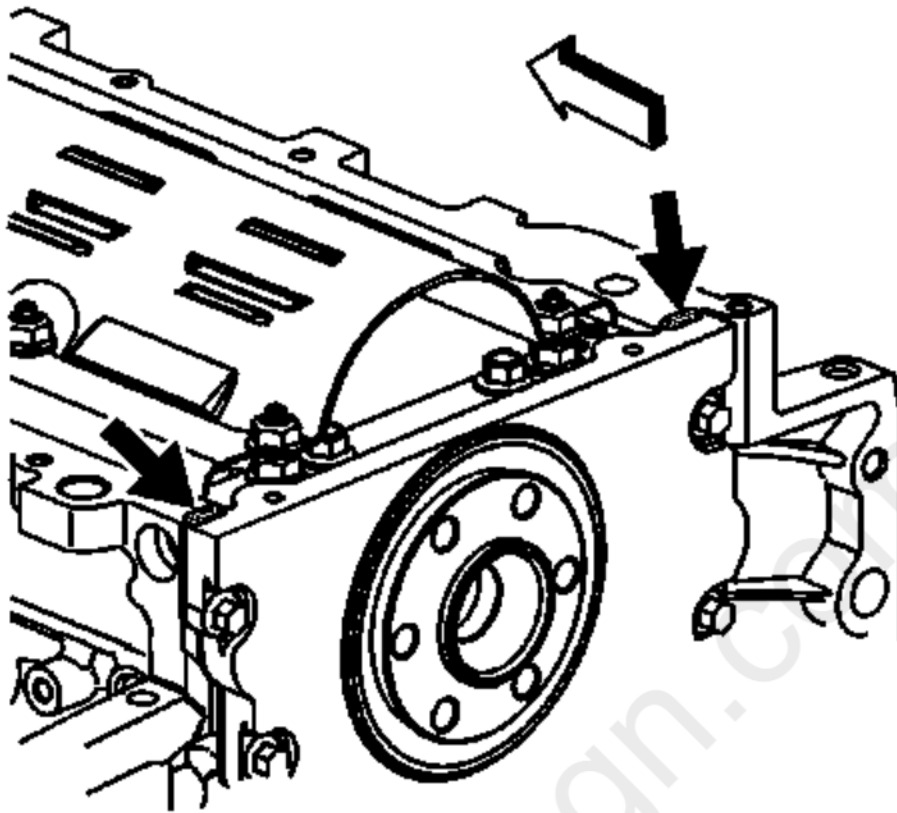


Fig. 149: View Of Sealant On Engine Rear Cover Gasket Tabs
Courtesy of GENERAL MOTORS CORP.

2. Apply a 5 mm (0.2 in) bead of sealant GM P/N 12378521 (Canadian P/N 88901148), or equivalent, 20 mm (0.8 in) long to the engine block. Apply the sealant directly onto the tabs of the rear housing gasket that protrude into the oil pan surface.

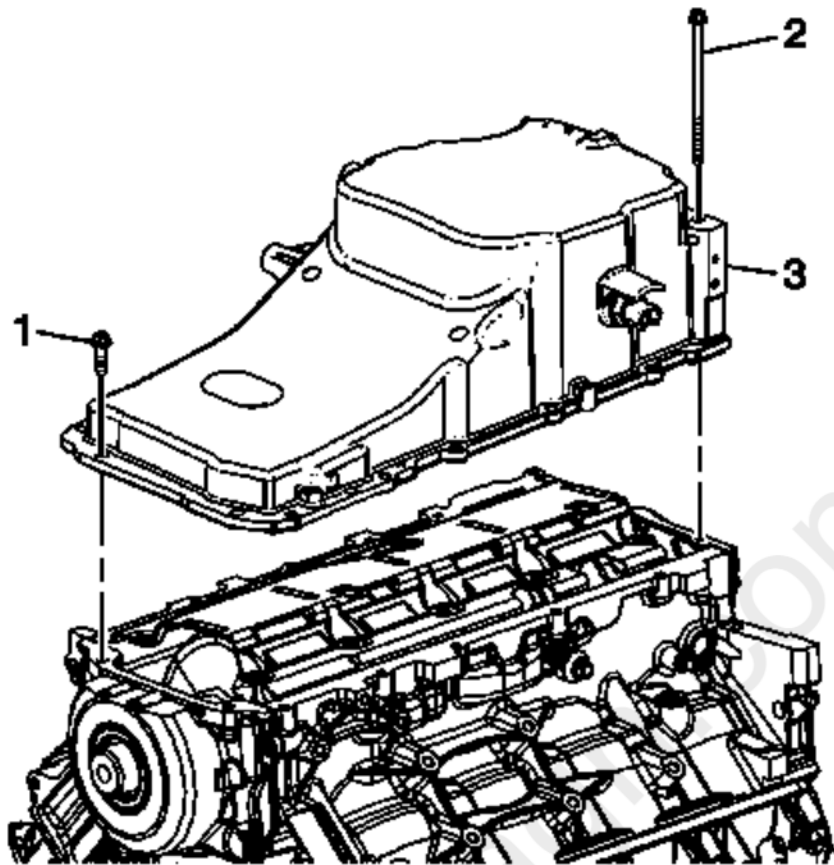


Fig. 150: Identifying Oil Pan & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Pre-assemble the oil pan gasket to the pan.
 1. Install the gasket onto the oil pan.
 2. Install the oil pan bolts (1, 2) to the pan and through the gasket.
4. Install the oil pan (3), gasket and bolt to the engine block.
5. Tighten the bolts finger tight. Do not overtighten.

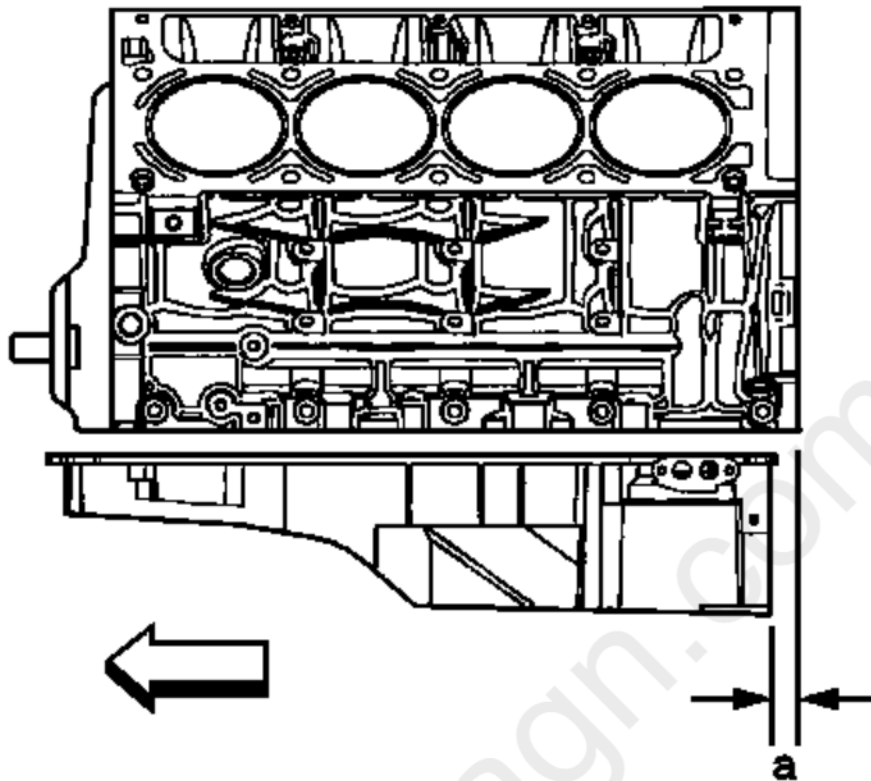


Fig. 151: Measuring Oil Pan-To-Engine Block Alignment
Courtesy of GENERAL MOTORS CORP.

6. Place a straight edge across the rear of the engine block and the rear of the oil pan at the transmission housing mounting surfaces.

CAUTION: Refer to **FASTENER CAUTION** .

7. Align the oil pan until the rear of the engine block and the rear of the oil pan are flush, or even.
8. Tighten the oil pan-to-block and oil pan-to-front cover bolts to 25 N.m (18 lb ft).
9. Tighten the oil pan-to-rear cover bolts to 12 N.m (106 lb in).
10. Measure the oil pan-to-engine block alignment.
 1. Place a straight edge across the rear of the engine block and rear of oil pan at the transmission housing mounting surfaces.

NOTE: The rear of the oil pan must NEVER protrude beyond the engine

block and transmission housing mounting surfaces.

2. Insert a feeler gauge between the straight edge and the oil pan transmission housing mounting surface. The rear of oil pan must be flush with the rear face of block or no greater than 0.5 mm (0.02 in) below flush (a).
3. If the oil pan alignment is not within specifications, remove the oil pan and repeat the above procedure.

ENGINE OIL COOLER INSTALLATION

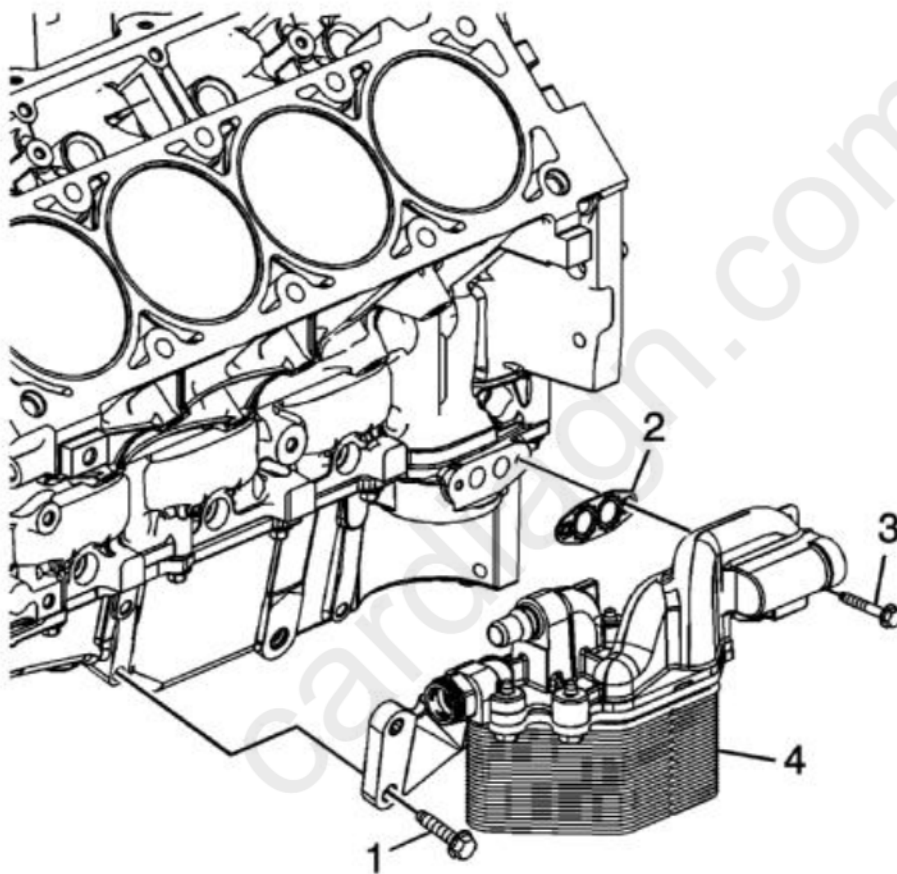


Fig. 152: Identifying Oil Cooler Components
Courtesy of GENERAL MOTORS CORP.

1. Install the oil cooler gasket (2).
2. Install the oil cooler (4).

CAUTION: Refer to FASTENER CAUTION .

3. Install the oil cooler M8 (1) and M6 (3) bolts.

- Tighten the M6 bolts to 10 N.m (89 lb in).
- Tighten the M8 bolts to 25 N.m (18 lb ft).

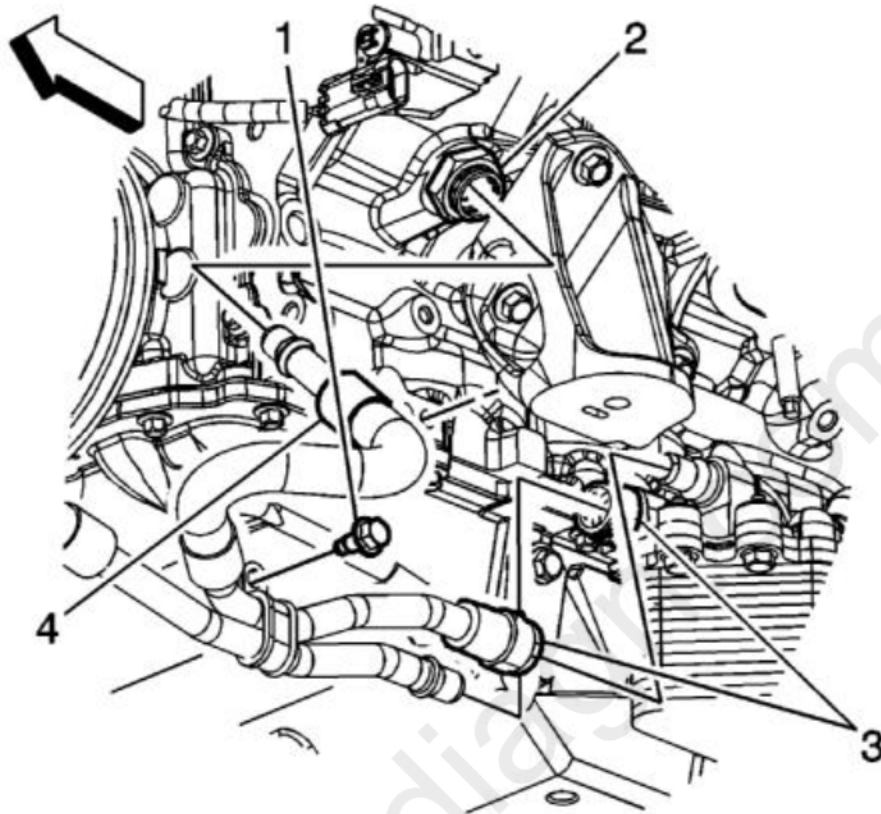


Fig. 153: Identifying Engine Oil Cooler Hose/Pipe
 Courtesy of GENERAL MOTORS CORP.

4. Install the engine oil cooler coolant fitting (2) to the block, as required and tighten to 50 N.m (37 lb ft).
5. Install the hose/pipe (4) to the fitting (2) and cooler (3).
6. Install the bolt and tighten to 25 N.m (18 lb ft).

OIL FILTER INSTALLATION

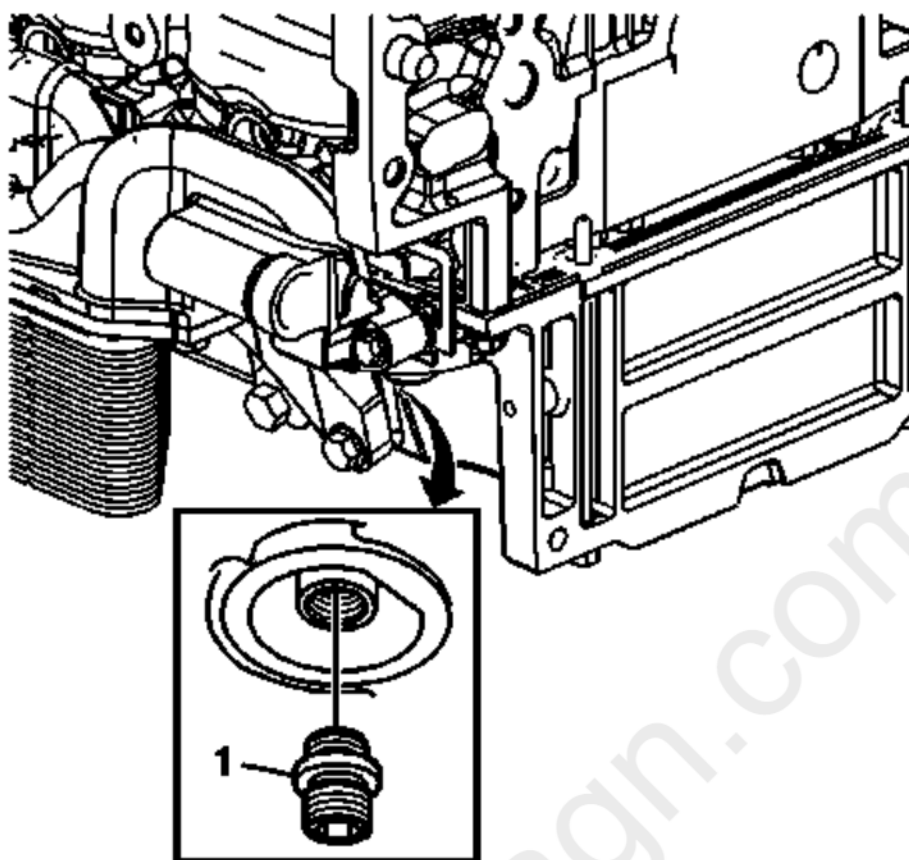


Fig. 154: Identifying Oil Filter Fitting
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

1. Install the oil filter fitting (1) and tighten to 55 N.m (40 lb ft).

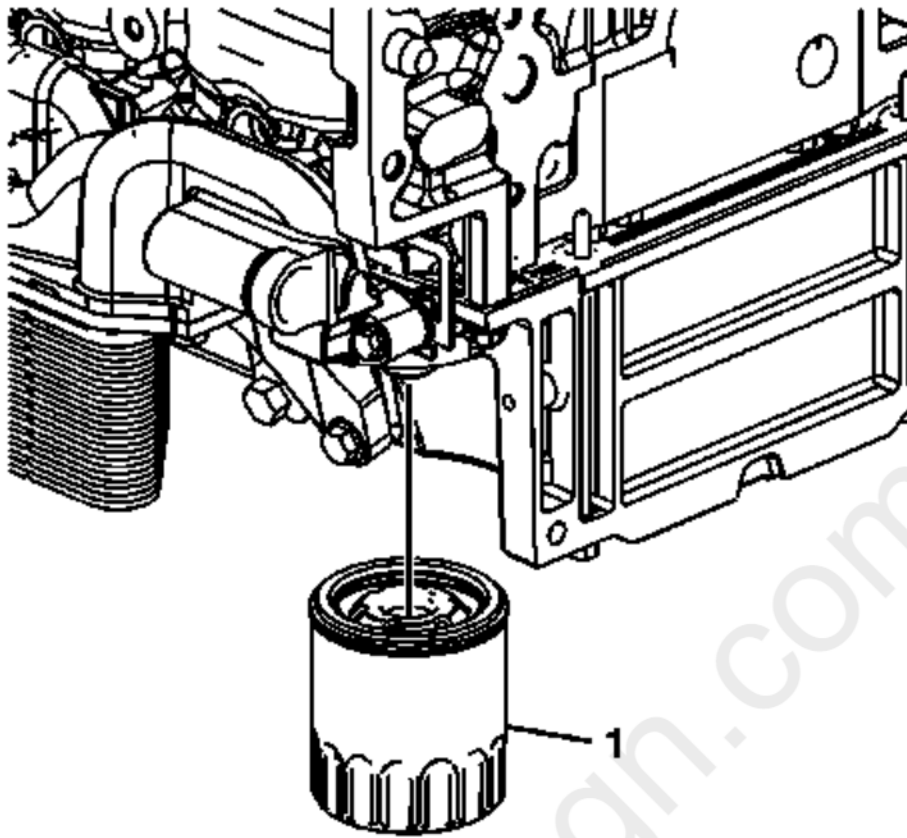


Fig. 155: Identifying Oil Filter

Courtesy of GENERAL MOTORS CORP.

2. Lubricate the oil filter seal with clean engine oil.
3. Install the oil filter (1) and tighten to 30 N.m (22 lb ft).

VALVE LIFTER INSTALLATION

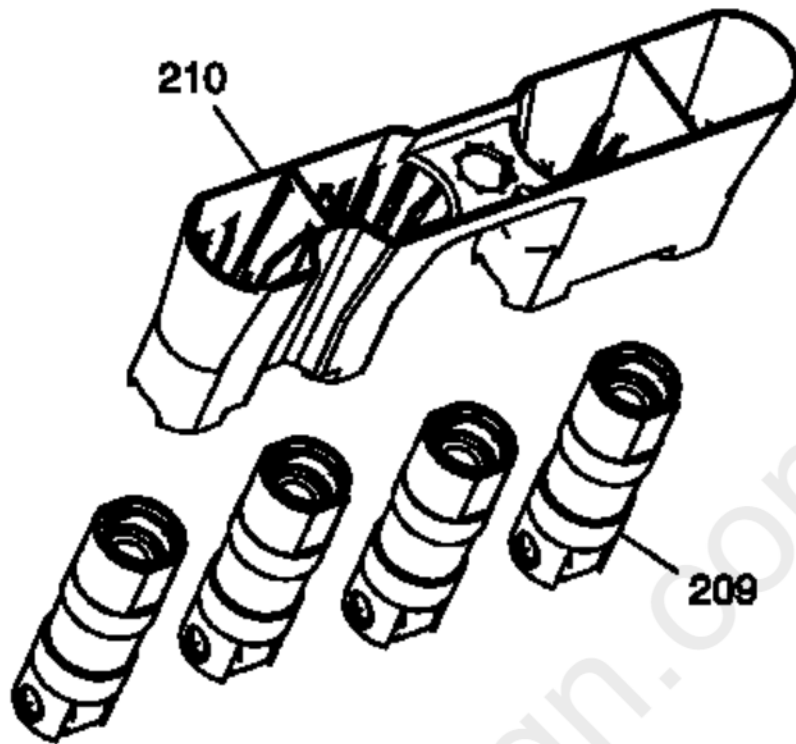


Fig. 156: Valve Lifter Guides & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:

- When using the valve lifters again, install the lifters to their original locations.
- If camshaft replacement is required, the valve lifters must also be replaced.

1. Lubricate the valve lifters (209) and engine block valve lifter bores with clean engine oil.
2. Insert the valve lifters into the lifter guides (210).

Align the flat area on the top of the lifter with the flat area in the lifter guide bore. Push the lifter completely into the guide bore.

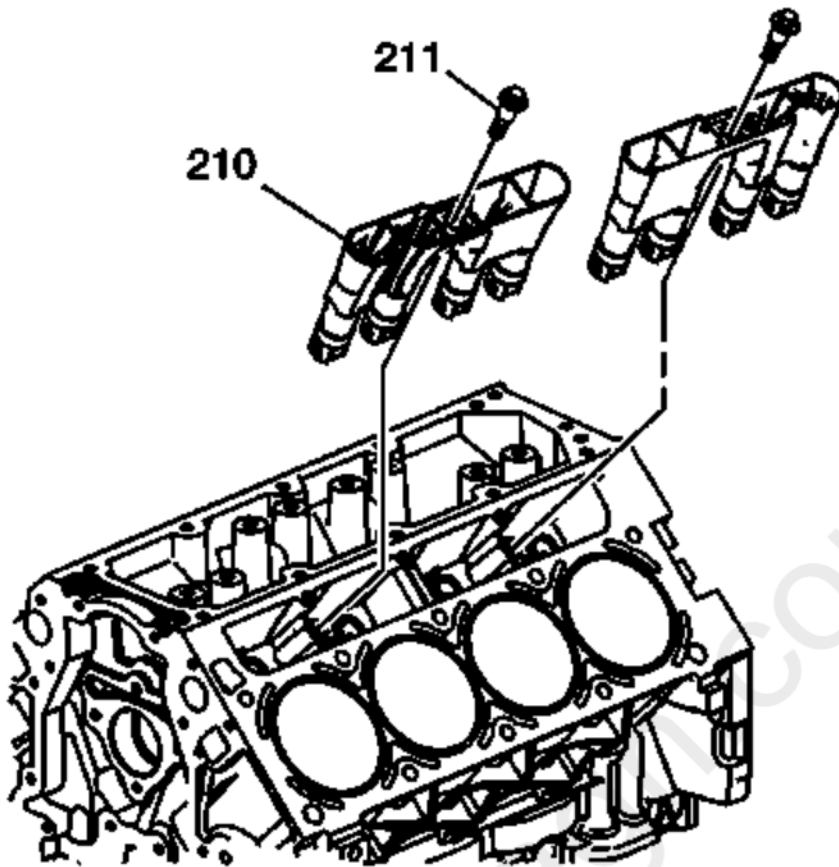


Fig. 157: Valve Lifter Guides, Cylinder Head & Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the valve lifters and guide assembly (210) to the engine block.

CAUTION: Refer to FASTENER CAUTION .

4. Install the valve lifter guide bolts (211).

Tighten: Tighten the valve lifter guide bolts to 12 N.m (106 lb in).

CYLINDER HEAD INSTALLATION - LEFT SIDE

Special Tools

- **J 42385-100:** Thread Repair Kit
- **J 45059:** Angle Meter

For equivalent regional tools, refer to Special Tools

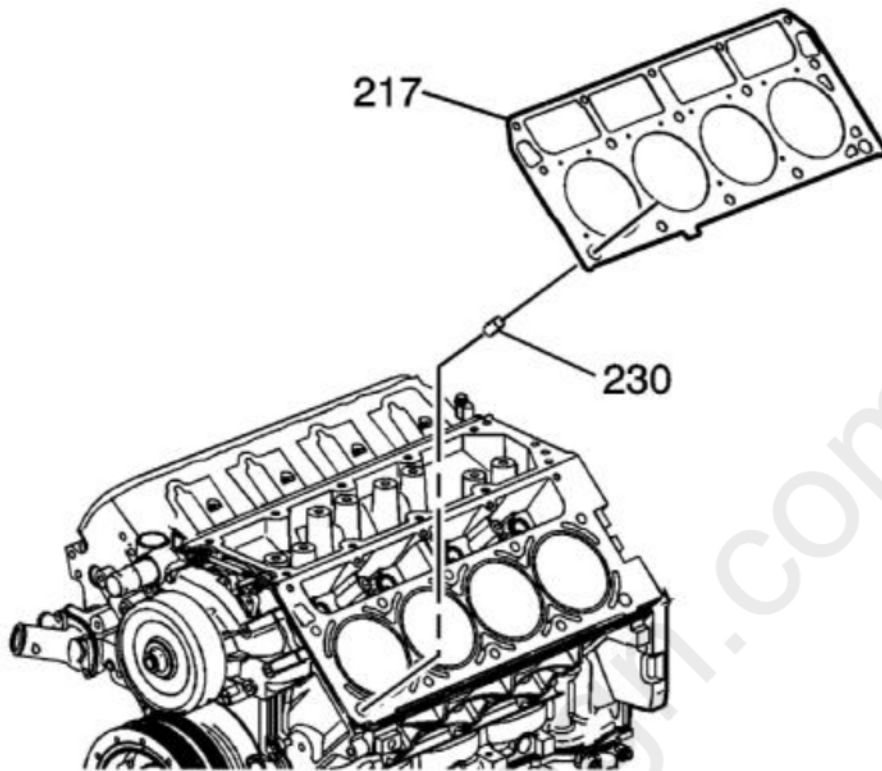


Fig. 158: View Of Cylinder Head Gasket And Alignment Pin - Left
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to SAFETY GLASSES WARNING .

CAUTION: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.

NOTE:

- Do not use the cylinder head bolts again. Install NEW cylinder head bolts during assembly.
- Do not use any type of sealant on the cylinder head gasket, unless specified.
- The cylinder head gaskets must be installed in the proper direction and position.

1. Clean the engine block cylinder head bolt holes, if required.

Thread repair tool J 42385-107 may be used to clean the threads of old threadlocking material.

2. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
3. Clean the cylinder head bolt holes with compressed air.
4. Install the cylinder head locating pins (230).

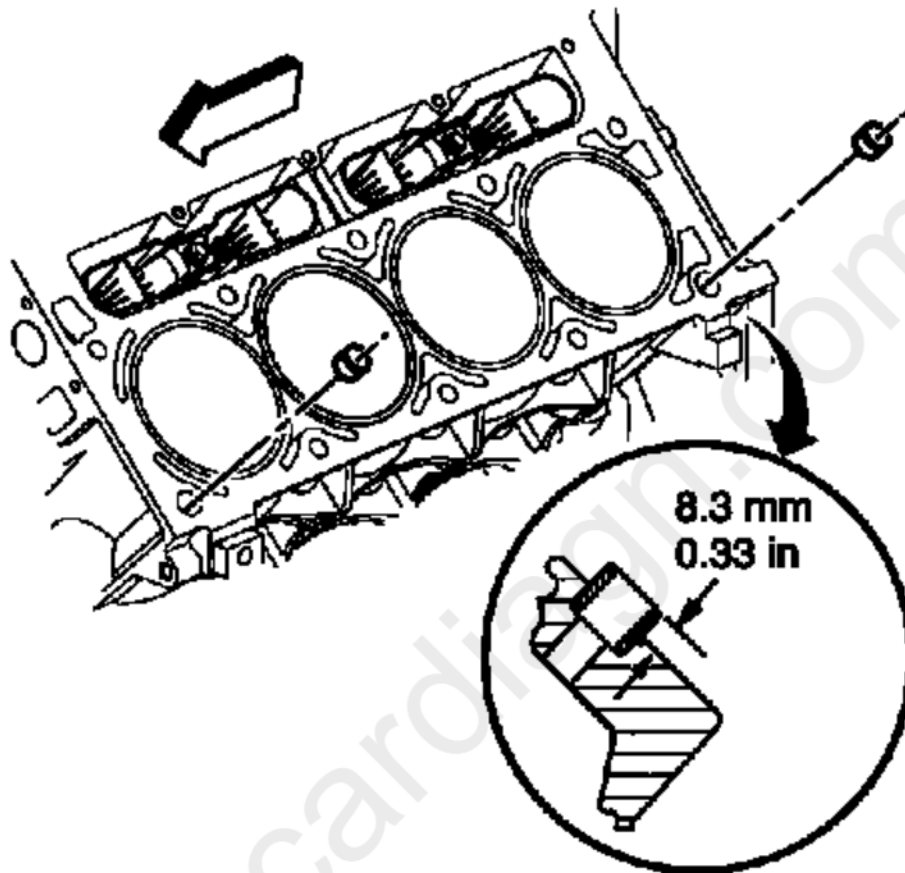


Fig. 159: Cylinder Head Locating Pins
Courtesy of GENERAL MOTORS CORP.

5. Inspect the locating pins for proper installation.

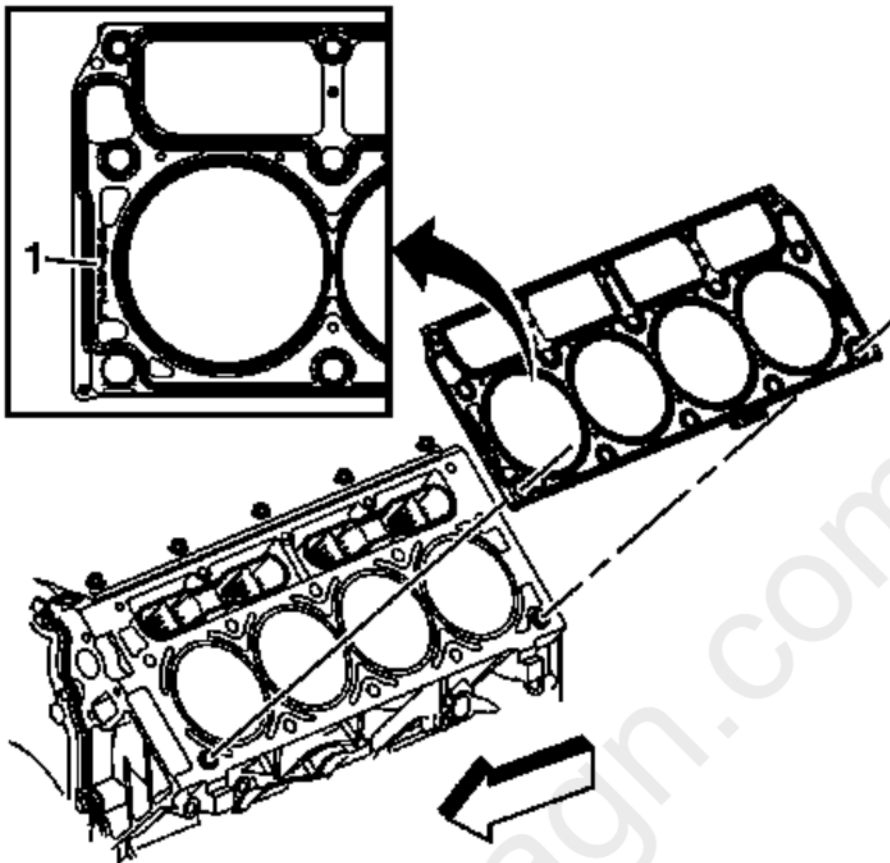


Fig. 160: Identifying Displacement Markings
Courtesy of GENERAL MOTORS CORP.

6. Inspect the displacement markings (1) on the gasket for proper usage.

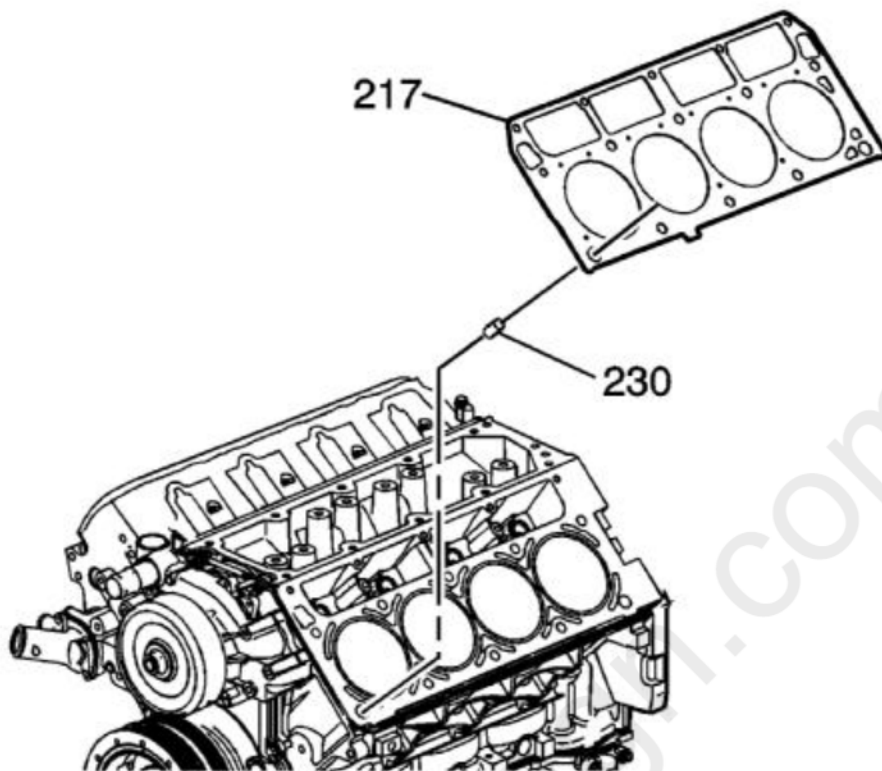


Fig. 161: View Of Cylinder Head Gasket And Alignment Pin - Left
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW cylinder head gasket (217) onto the locating pins.

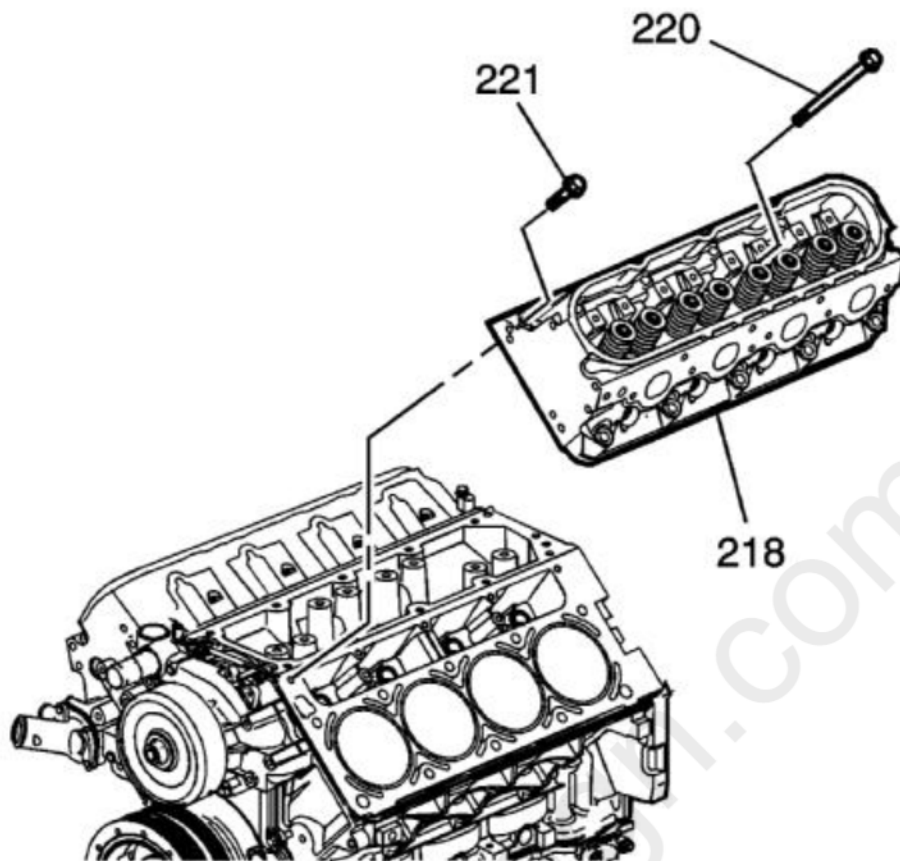


Fig. 162: Cylinder Head & Bolts

Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head (218) onto the locating pins and the gasket.
9. Install the NEW cylinder head bolts (220, 221).

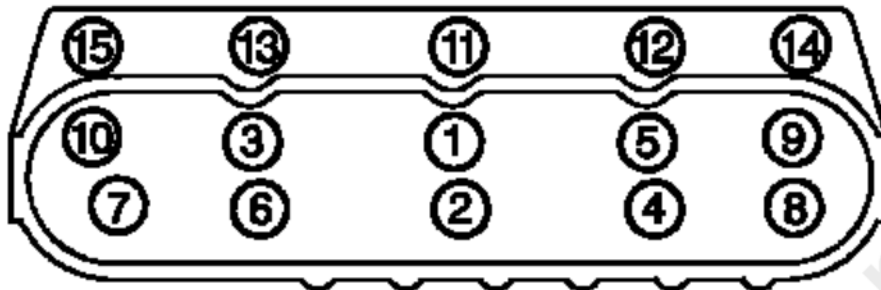


Fig. 163: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

10. Tighten the cylinder head bolts.
 1. Tighten the M11 cylinder head bolts (1-10) a first pass in sequence to 50 N.m (37 lb ft).
 2. Tighten the M11 cylinder head bolts (1-10) a second pass in sequence to 80 degrees using the **J 45059**: meter.
 3. Tighten the M11 cylinder head bolts (1-10) a final pass in sequence to 55 degrees using the **J 45059**: meter.
 4. Tighten the M8 cylinder head bolts (11-15) to 30 N.m (22 lb ft). Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.

CYLINDER HEAD INSTALLATION - RIGHT SIDE

Special Tools

- **J 42385-100**: Thread Repair Kit
- **J 45059**: Angle Meter

For equivalent regional tools, refer to Special Tools

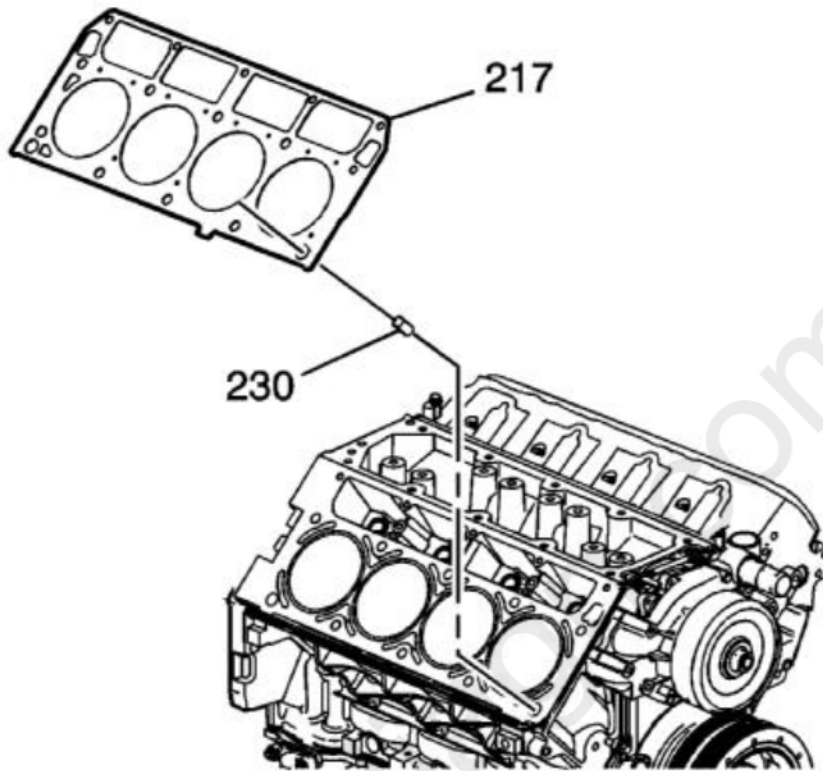


Fig. 164: Cylinder Head Gasket & Locating Pins - Right
Courtesy of GENERAL MOTORS CORP.

WARNING: Refer to SAFETY GLASSES WARNING .

CAUTION: Clean all dirt, debris, and coolant from the engine block cylinder head bolt holes. Failure to remove all foreign material may result in damaged threads, improperly tightened fasteners or damage to components.

NOTE:

- Do not use the cylinder head bolts again. Install NEW cylinder head bolts during assembly.
- Do not use any type of sealant on the cylinder head gasket, unless specified.
- The cylinder head gaskets must be installed in the proper direction and position.

1. Clean the engine block cylinder head bolt holes, if required.

Thread repair tool J 42385-107 may be used to clean the threads of old threadlocking material.

2. Spray cleaner GM P/N 12346139 (Canadian P/N 10953463), GM P/N 12377981 (Canadian P/N 10953463), or equivalent, into the hole.
3. Clean the cylinder head bolt holes with compressed air.
4. Install the cylinder head locating pins (230).

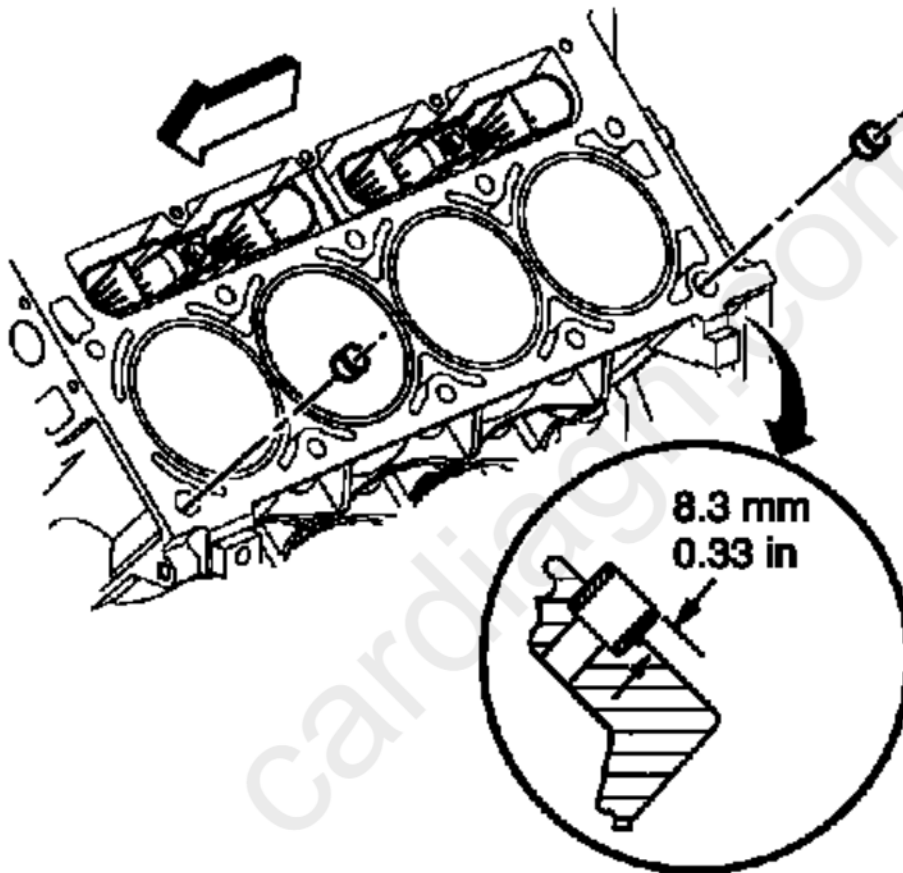


Fig. 165: Cylinder Head Locating Pins
Courtesy of GENERAL MOTORS CORP.

5. Inspect the locating pins for proper installation.

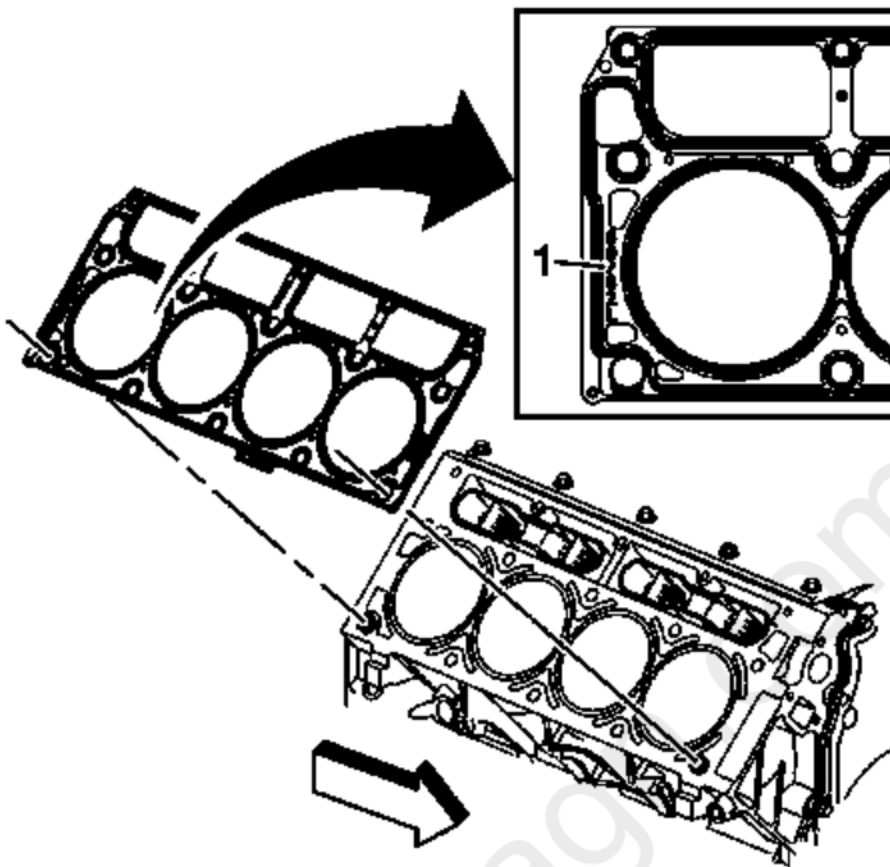


Fig. 166: Identifying Displacement Markings
Courtesy of GENERAL MOTORS CORP.

6. Inspect the displacement markings (1) on the gasket for proper usage.

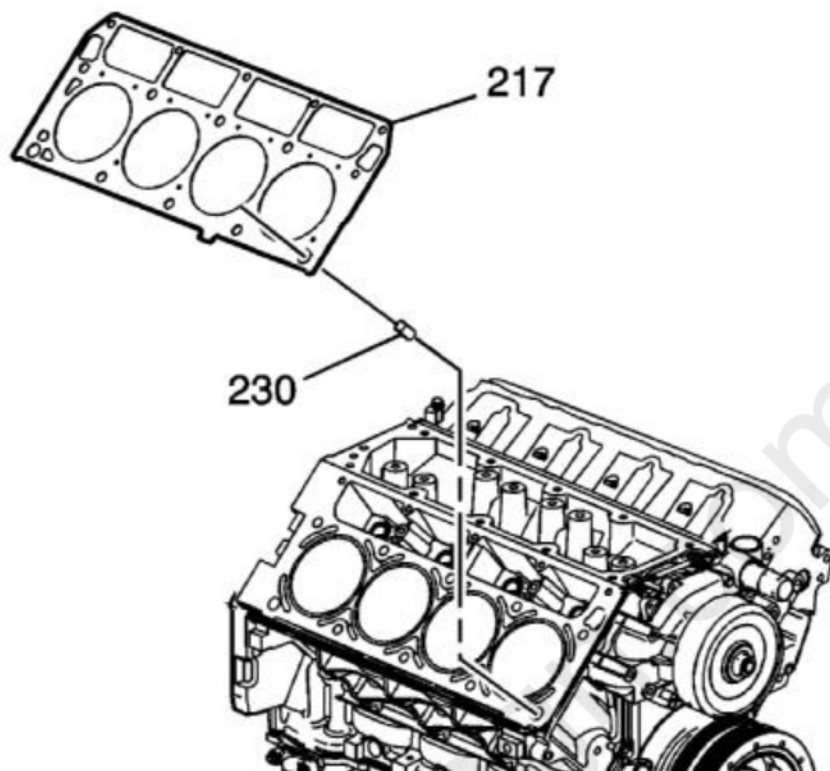


Fig. 167: Cylinder Head Gasket & Locating Pins - Right
Courtesy of GENERAL MOTORS CORP.

7. Install the NEW cylinder head gasket (217) onto the locating pins.

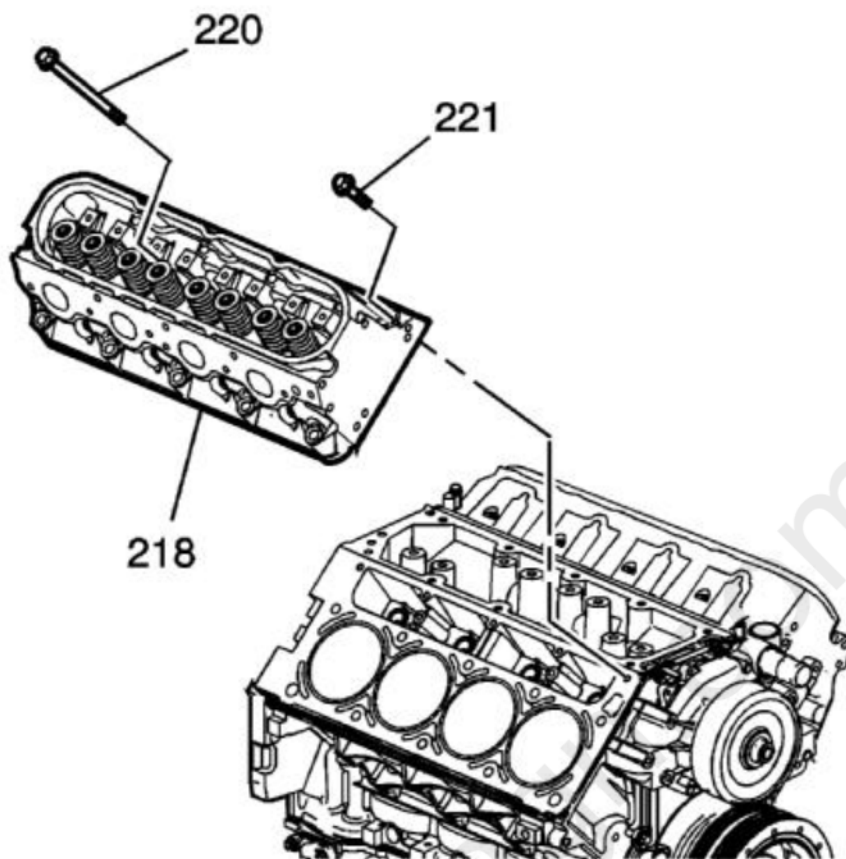


Fig. 168: Right Cylinder Head & Bolts
Courtesy of GENERAL MOTORS CORP.

8. Install the cylinder head (218) onto the locating pins and the gasket.
9. Install the NEW cylinder head bolts (220, 221).

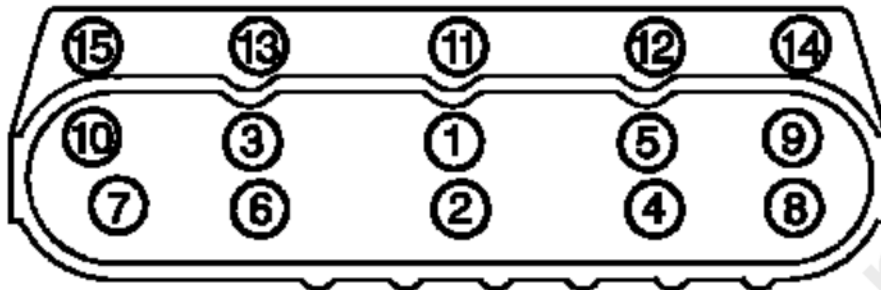


Fig. 169: Cylinder Head Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

10. Tighten the cylinder head bolts.
 1. Tighten the M11 cylinder head bolts (1-10) a first pass in sequence to 50 N.m (37 lb ft).
 2. Tighten the M11 cylinder head bolts (1-10) a second pass in sequence to 80 degrees using the **J 45059**: meter.
 3. Tighten the M11 cylinder head bolts (1-10) a final pass in sequence to 55 degrees using the **J 45059**: meter.
 4. Tighten the M8 cylinder head bolts (11-15) to 30 N.m (22 lb ft). Begin with the center bolt (11) and alternating side-to-side, work outward tightening all of the bolts.

VALVE ROCKER ARM AND PUSH ROD INSTALLATION

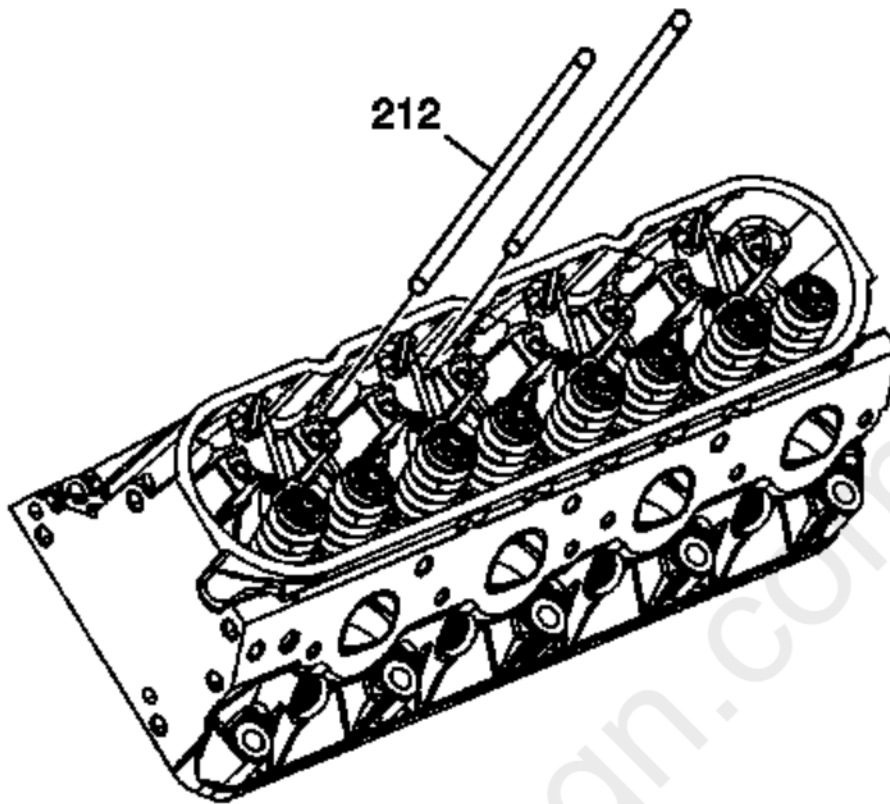


Fig. 170: View Of Valve Pushrods
Courtesy of GENERAL MOTORS CORP.

NOTE:

- When using the valve train components again, always install the components to the original location and position.
- Valve lash is net build, no valve adjustment is required.

1. Lubricate the valve rocker arms and pushrods with clean engine oil.
2. Lubricate the flange of the valve rocker arm bolts with clean engine oil.

NOTE:

Ensure the pushrods seat properly to the valve lifter sockets.

3. Install the pushrods (212).

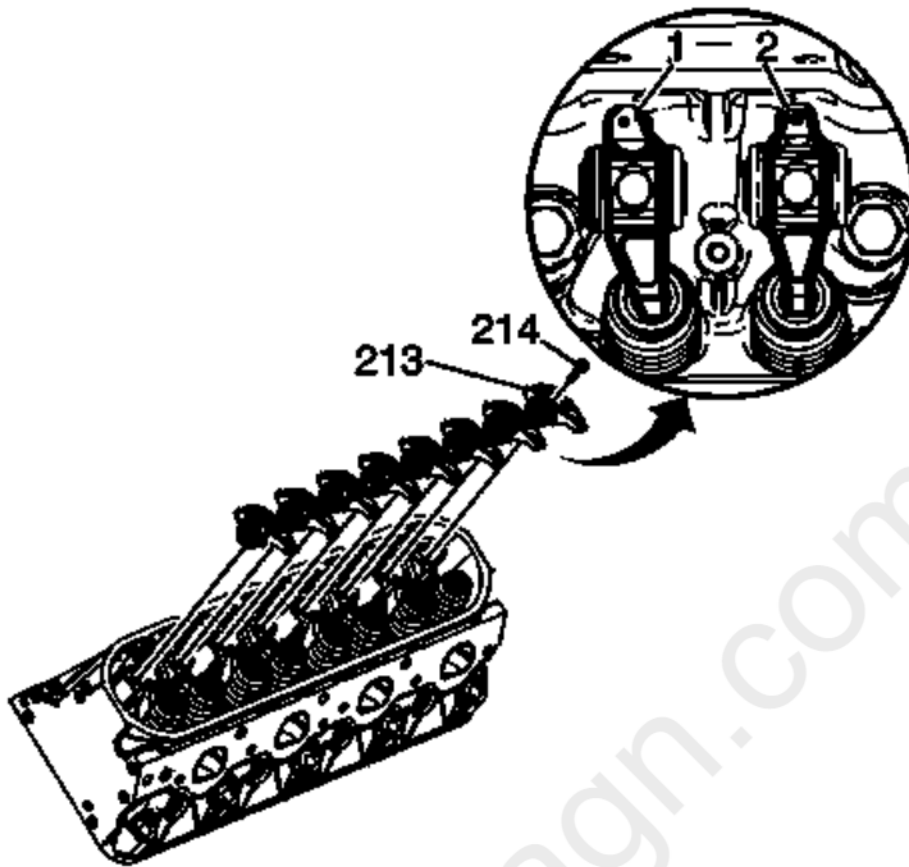


Fig. 171: View Of Valve Rocker Arm Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:

- Ensure the pushrods seat properly to the ends of the rocker arms.
- **DO NOT** tighten the rocker arm bolt at this time.

4. Install the rocker arms (213) and bolts (214). Note the locations of the intake (1) and exhaust (2) valve rocker arms. The intake rocker arms (1) have an offset design.

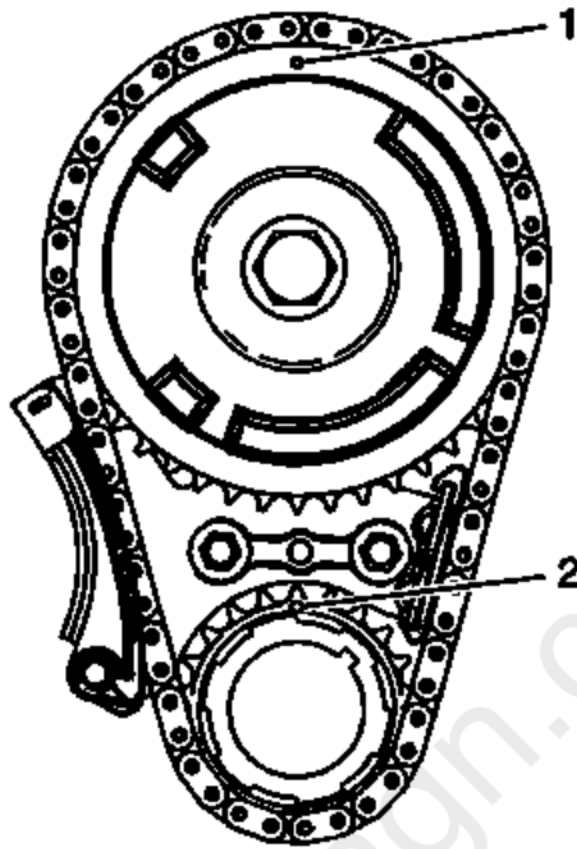


Fig. 172: Camshaft & Crankshaft Sprocket Alignment Marks
Courtesy of GENERAL MOTORS CORP.

5. Rotate the crankshaft until number 1 piston is at top dead center of compression stroke.

In this position, cylinder number 1 rocker arms will be off lobe lift, and the crankshaft sprocket key will be at the 1:30 position. The camshaft and crankshaft sprocket alignment marks (1, 2) will be in the 12 o'clock positions. If viewing from the rear of the engine, the additional crankshaft pilot hole, non-threaded, will be in the 10:30 position.

The engine firing order is 1, 8, 7, 2, 6, 5, 4, 3.

Cylinders 1, 3, 5 and 7 are left bank.

Cylinders 2, 4, 6, and 8 are right bank.

CAUTION: Refer to FASTENER CAUTION .

6. With the engine in the number 1 firing position, tighten the following valve rocker arm bolts:
 - Tighten exhaust valve rocker arm bolts 1, 2, 7, and 8 to 30 N.m (22 lb ft).

- Tighten intake valve rocker arm bolts 1, 3, 4, and 5 to 30 N.m (22 lb ft).
- 7. Rotate the crankshaft 360 degrees.
- 8. Tighten the following valve rocker arm bolts:
 - Tighten exhaust valve rocker arm bolts 3, 4, 5, and 6 to 30 N.m (22 lb ft).
 - Tighten intake valve rocker arm bolts 2, 6, 7, and 8 to 30 N.m (22 lb ft).

VALVE ROCKER ARM COVER INSTALLATION - LEFT SIDE

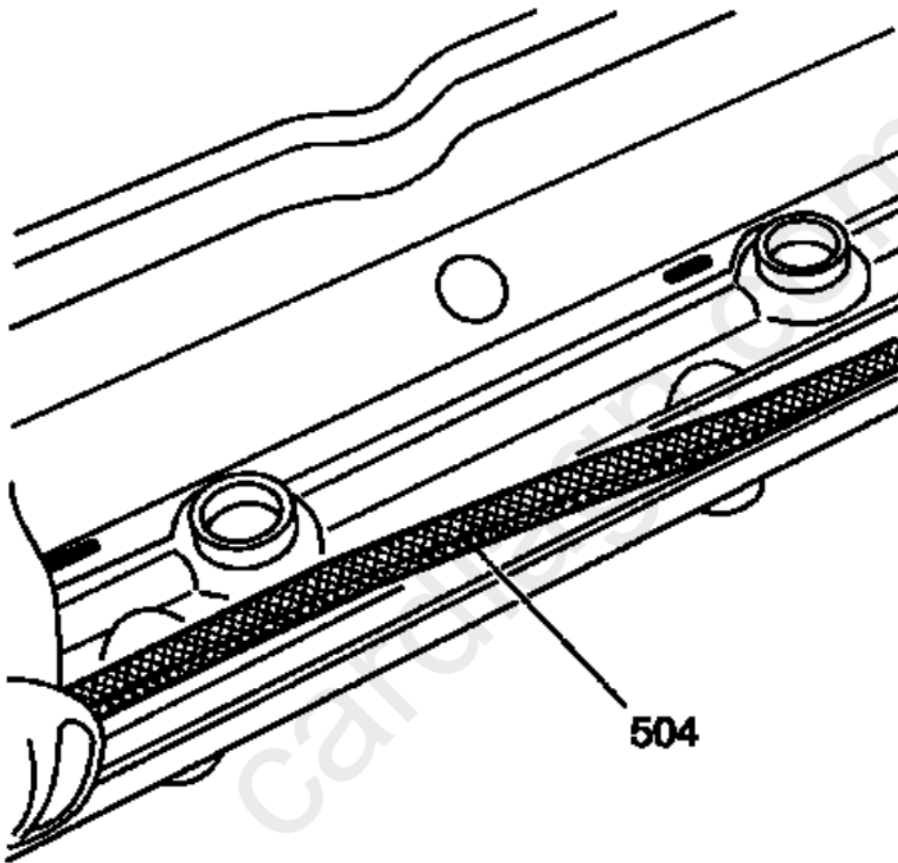


Fig. 173: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE:

- All gasket surfaces should be free of oil or other foreign material during assembly.
- DO NOT use the valve rocker arm cover gasket again.

1. Install NEW valve rocker arm cover grommets and use NEW valve rocker arm cover bolts if they are serviced with the grommet.
2. Install a NEW gasket (504) into the valve rocker arm cover.

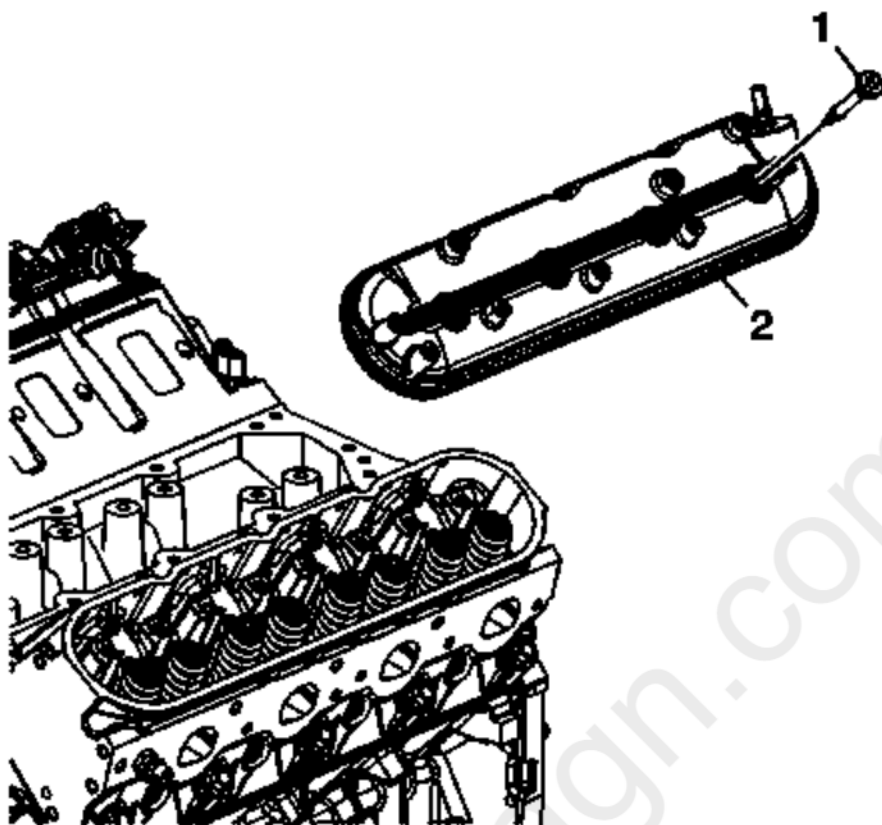


Fig. 174: Identifying Valve Rocker Arm Cover & Bolt
Courtesy of GENERAL MOTORS CORP.

3. Install the valve rocker arm cover (2) onto the cylinder head.

CAUTION: Refer to **FASTENER CAUTION** .

4. Install the cover bolts (1) with grommets and tighten to 12 N.m (106 lb in).

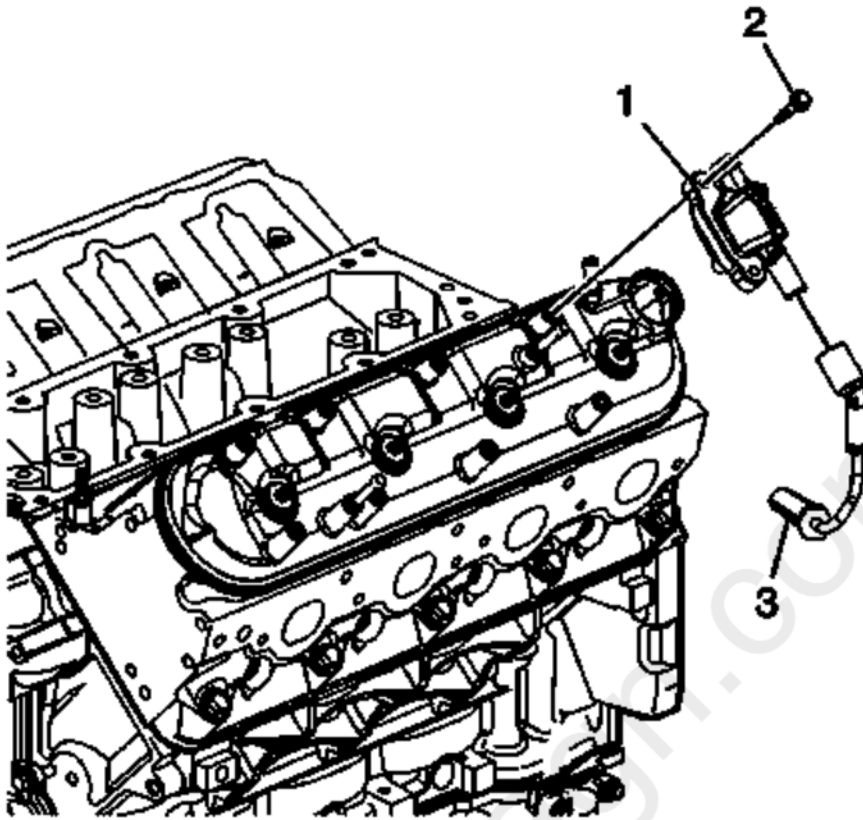


Fig. 175: Identifying Ignition Coil, Bolt & Spark Plug Wire (Left Side)
Courtesy of GENERAL MOTORS CORP.

5. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the ignition coil bolts (2).
6. Install the ignition coils (1) and bolts (2) and tighten to 12 N.m (106 lb in).
7. Install the spark plug wires (3).

VALVE ROCKER ARM COVER INSTALLATION - RIGHT SIDE

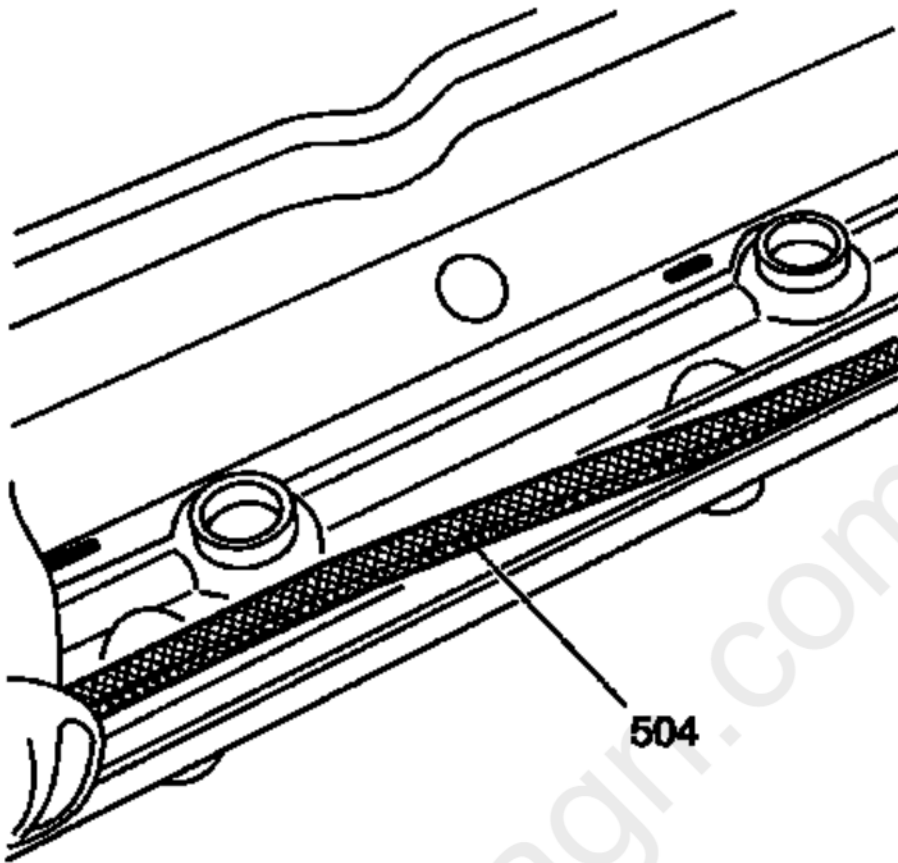


Fig. 176: View Of Valve Rocker Arm Cover Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE:

- All gasket surfaces should be free of oil or other foreign material during assembly.
- DO NOT use the valve rocker arm cover gasket again.

1. Install NEW valve rocker arm cover grommets and use NEW valve rocker arm cover bolts if they are serviced with the grommet.
2. Install a NEW gasket (504) into the valve rocker arm cover.

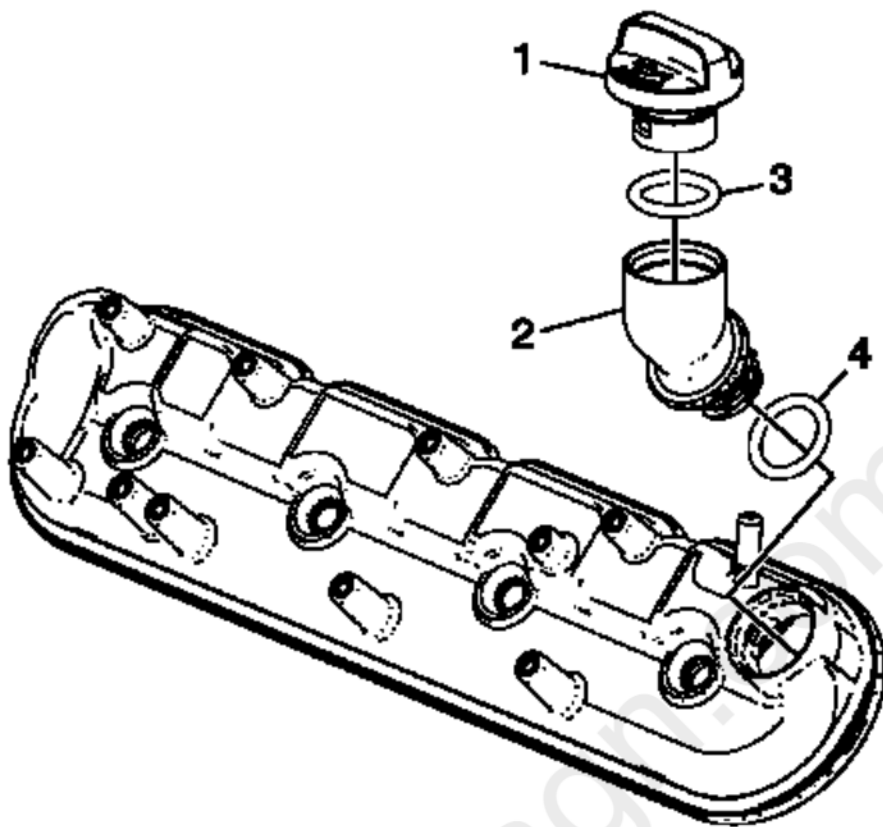


Fig. 177: Identifying Cover Components (Right Side)
Courtesy of GENERAL MOTORS CORP.

3. Install a NEW oil cap (1), oil fill tube (2) and seals (3, 4) to the valve rocker arm cover, as required.

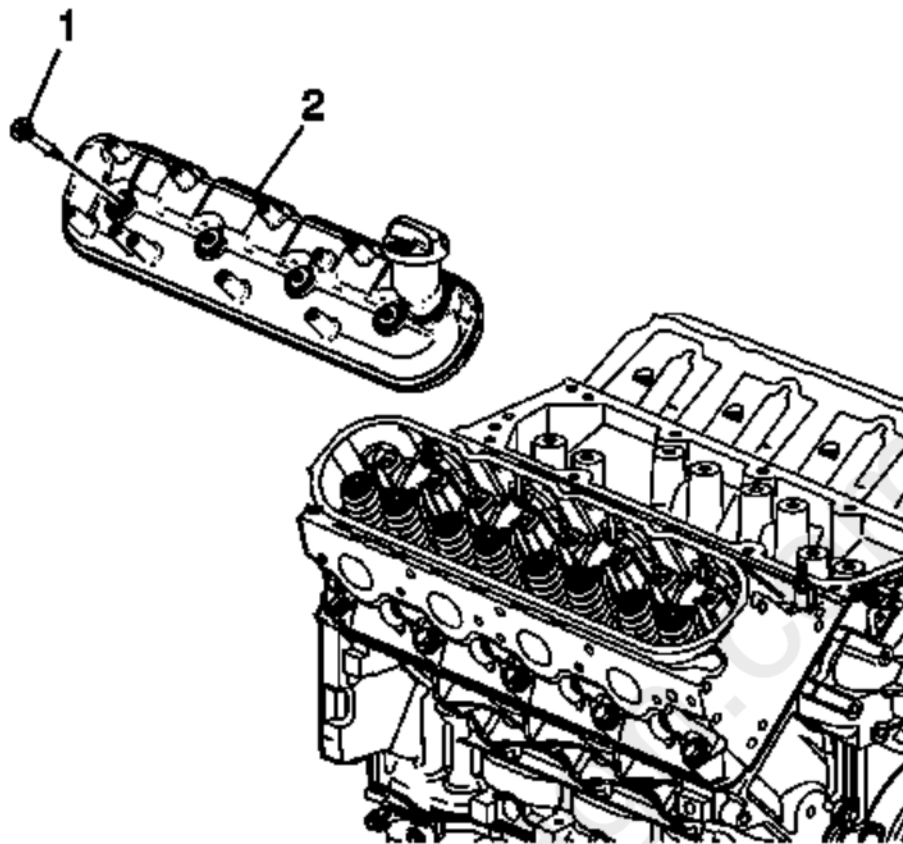


Fig. 178: Identifying Valve Rocker Arm Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the valve rocker arm cover (2) onto the cylinder head.

CAUTION: Refer to FASTENER CAUTION .

5. Install the cover bolts (1) with NEW grommets and tighten to 12 N.m (106 lb in).

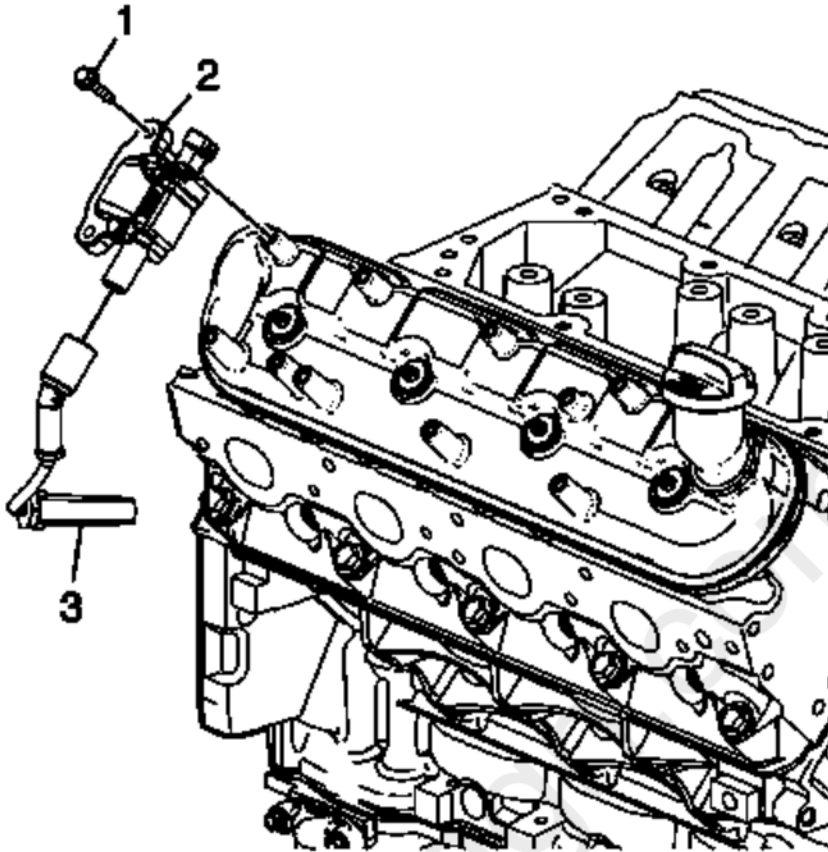


Fig. 179: Identifying Ignition Coil, Bolt & Spark Plug Wire (Right Side)
 Courtesy of GENERAL MOTORS CORP.

6. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the ignition coil bolts (1).
7. Install the ignition coils (2) and bolts (1) and tighten to 12 N.m (106 lb in).
8. Install the spark plug wires (3).

ENGINE BLOCK VALLEY COVER INSTALLATION (6.2L)

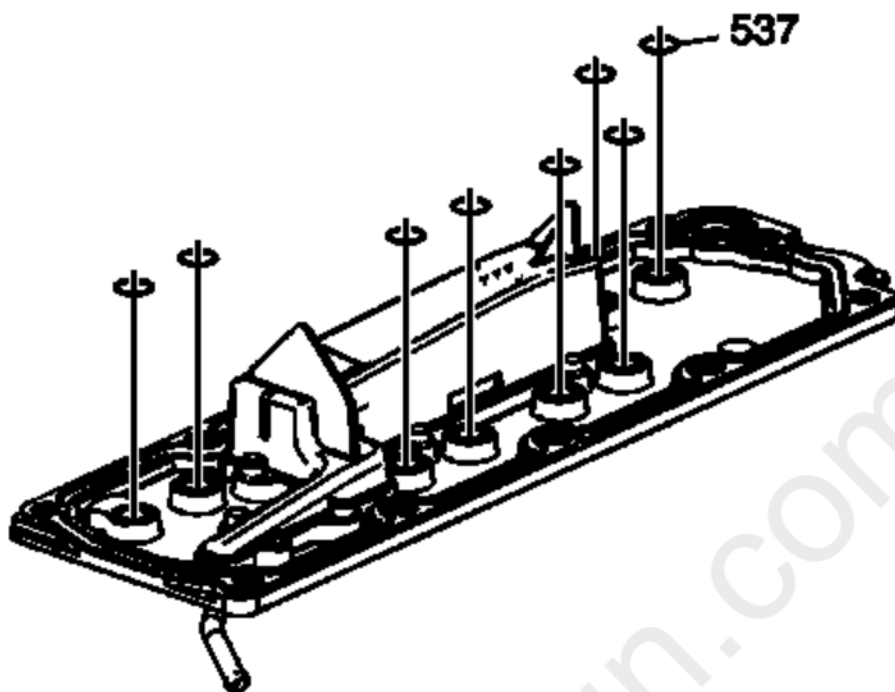


Fig. 180: Valley Cover Seals & Gasket
Courtesy of GENERAL MOTORS CORP.

NOTE: All gasket surfaces should be free of oil or other foreign material during assembly.

1. Lubricate the O-ring seals (537) with clean engine oil.
2. Install the O-ring seals (537) to the cover.

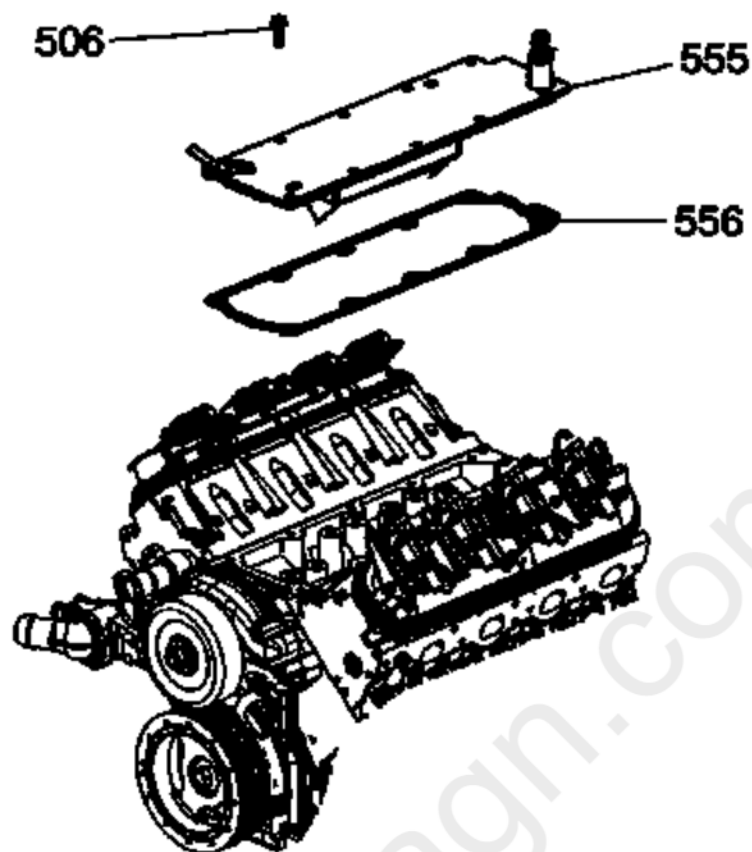


Fig. 181: View Of Cover, Gasket, And Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to **FASTENER CAUTION** .

3. Install the cover (555), gasket (556), and bolts (506) and tighten the cover bolts to 25 N.m (18 lb ft).

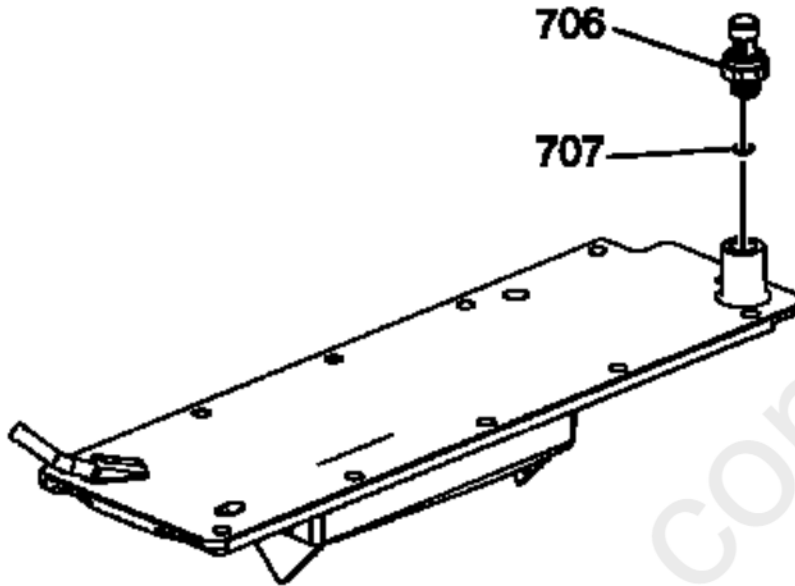


Fig. 182: Oil Pressure Sensor & Washer
Courtesy of GENERAL MOTORS CORP.

4. Apply sealant GM P/N 12346004 (Canadian P/N 10953480), or equivalent, to the threads of the sensor.
5. Install the oil pressure sensor (706) and sealing washer (707) and tighten the sensor to 35 N.m (26 lb ft).

ENGINE COOLANT AIR BLEED PIPE AND HOLE COVER INSTALLATION

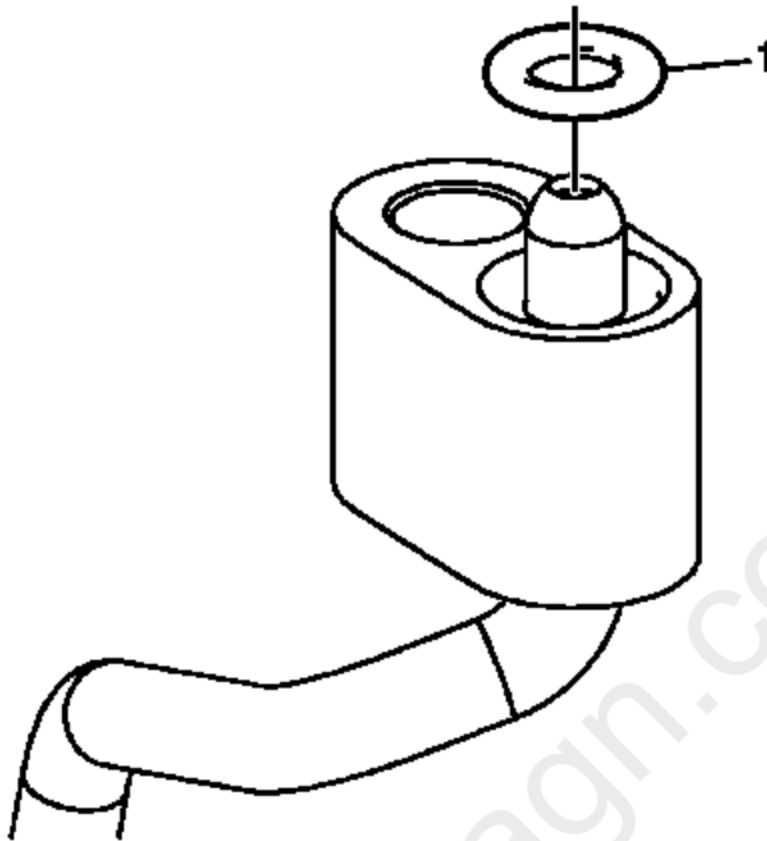


Fig. 183: Identifying Seals

Courtesy of GENERAL MOTORS CORP.

1. Install the seals (1) onto the engine coolant air bleed pipe.

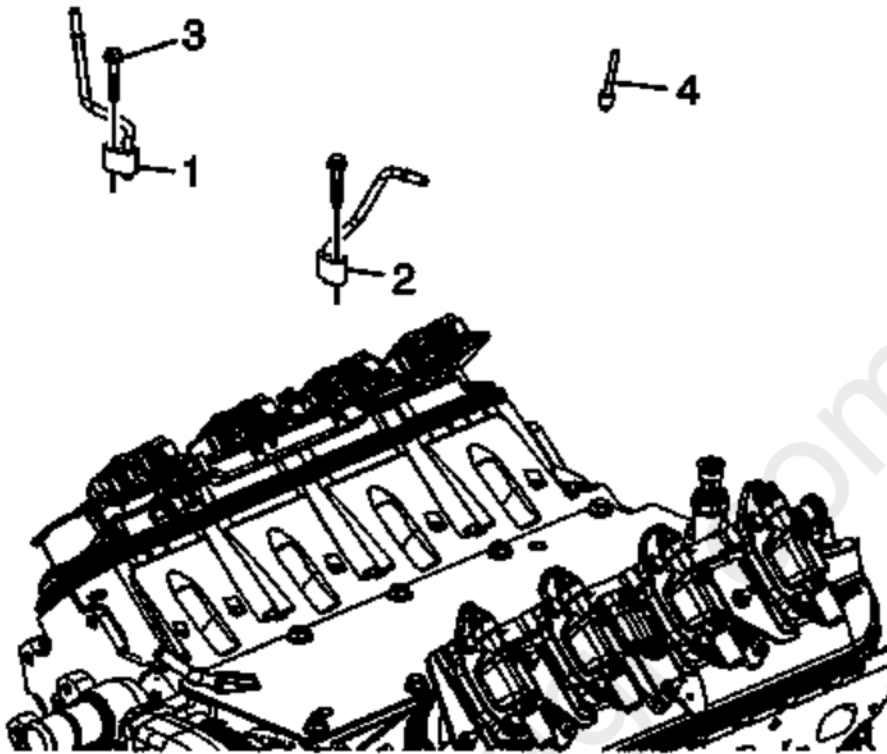


Fig. 184: Identifying Pipes & Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE: Production engines use a rivet-type plug at the top rear coolant passage of each cylinder head. If service of a leaking plug is required, it is necessary to remove the cylinder head from the engine to properly remove the plug. Refer to Cylinder Head Disassemble .

2. Install the pipes (1 and 2) and bolts (3) and tighten to 12 N.m (106 lb in).
3. As required, install either a NEW plug (4), or the earlier design coolant air bleed covers, bolts and gaskets. Refer to Cylinder Head Assemble . If required, tighten the cover bolts to 12 N.m (106 lb in).

SUPERCHARGER INSTALLATION

SPECIAL TOOLS

EN 48898: Supercharger Lift Fixture

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

NOTE:

- The supercharger, throttle body, fuel injection rail and fuel injectors may be removed as an assembly. If not servicing the individual components, remove the supercharger as an assembly.
- Cover the rotors area of the supercharger to prevent dirt or debris contamination onto the rotors.

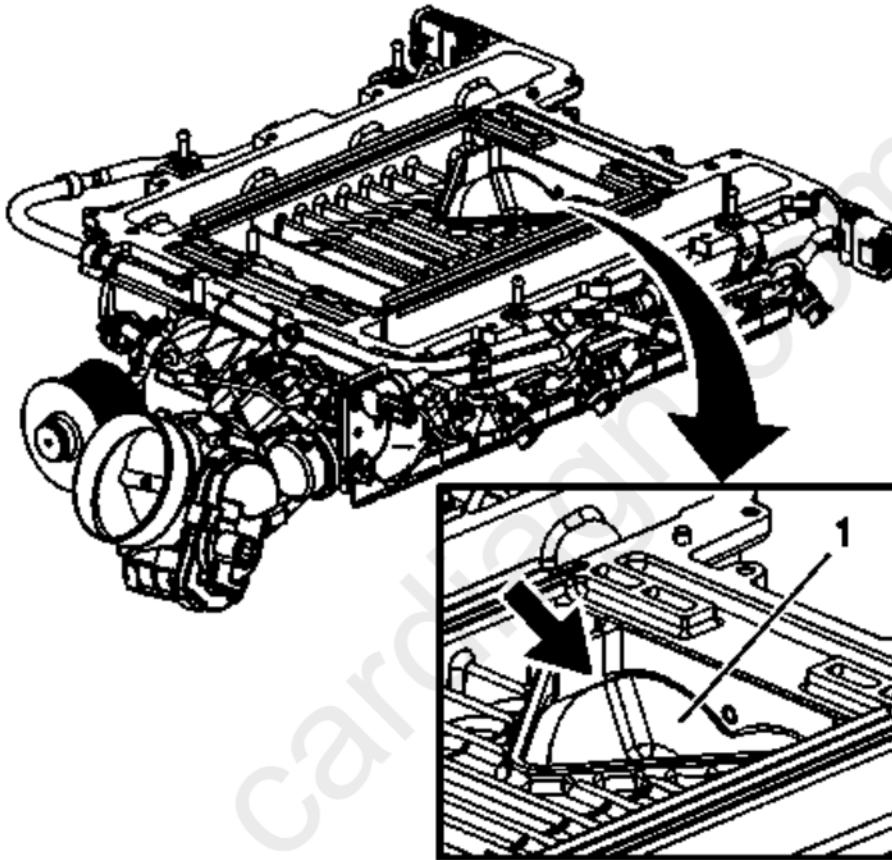


Fig. 185: Identifying Inlet Area Of Supercharger
Courtesy of GENERAL MOTORS CORP.

1. Cover the inlet area of the supercharger (1) to prevent dirt or debris contamination onto the rotors.

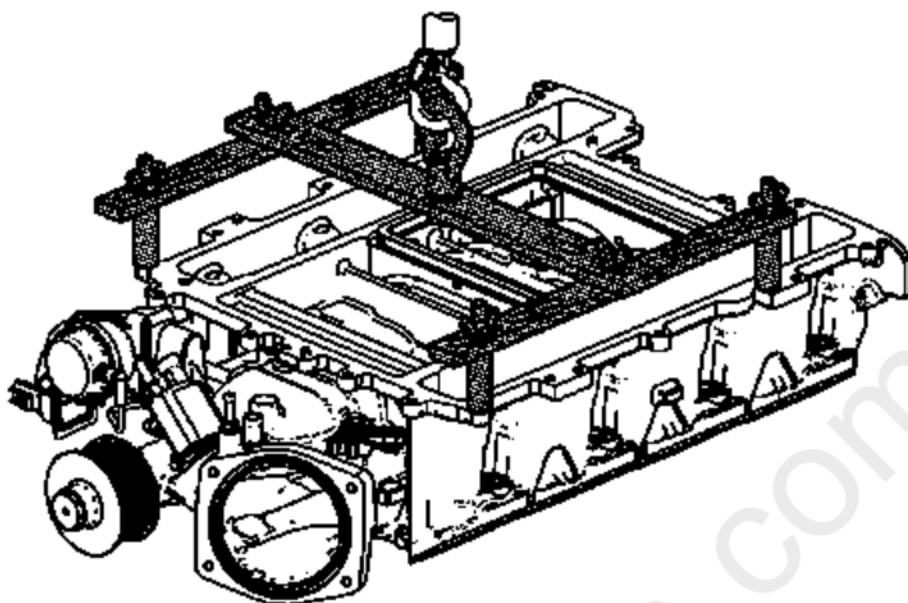


Fig. 186: View Of Supercharger Lift Fixture
Courtesy of GENERAL MOTORS CORP.

2. Install the **EN 48898:** fixture to the supercharger.
3. Tighten the **EN 48898:** fixture bolts and nuts until snug.
4. Using the lifting device, install the supercharger onto the engine. Align the dowel pin at the right front of the supercharger to the cylinder head.

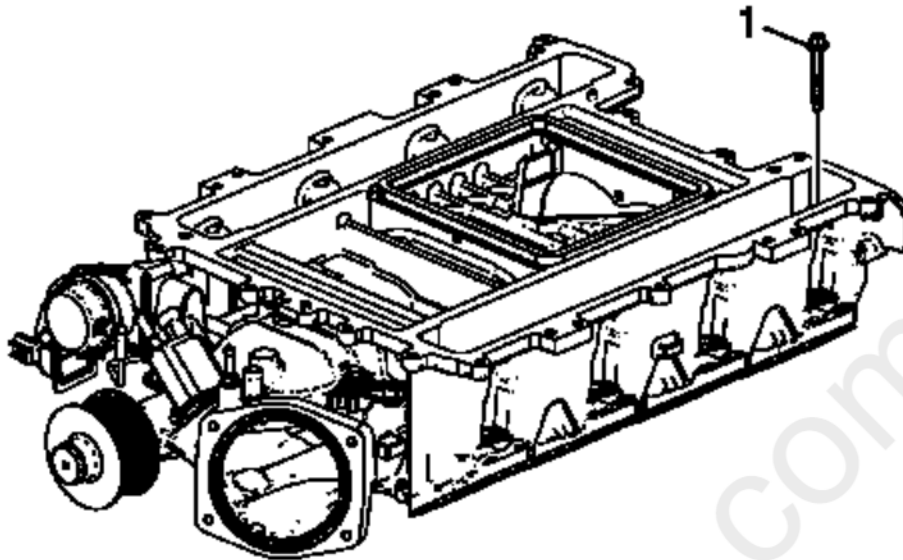


Fig. 187: Identifying Supercharger Bolts
Courtesy of GENERAL MOTORS CORP.

5. Apply a 5 mm (0.2 in) band of threadlocker GM P/N 12345382 (Canadian P/N 10953489) or equivalent to the threads of the bolts.
6. Install the supercharger bolts (1).

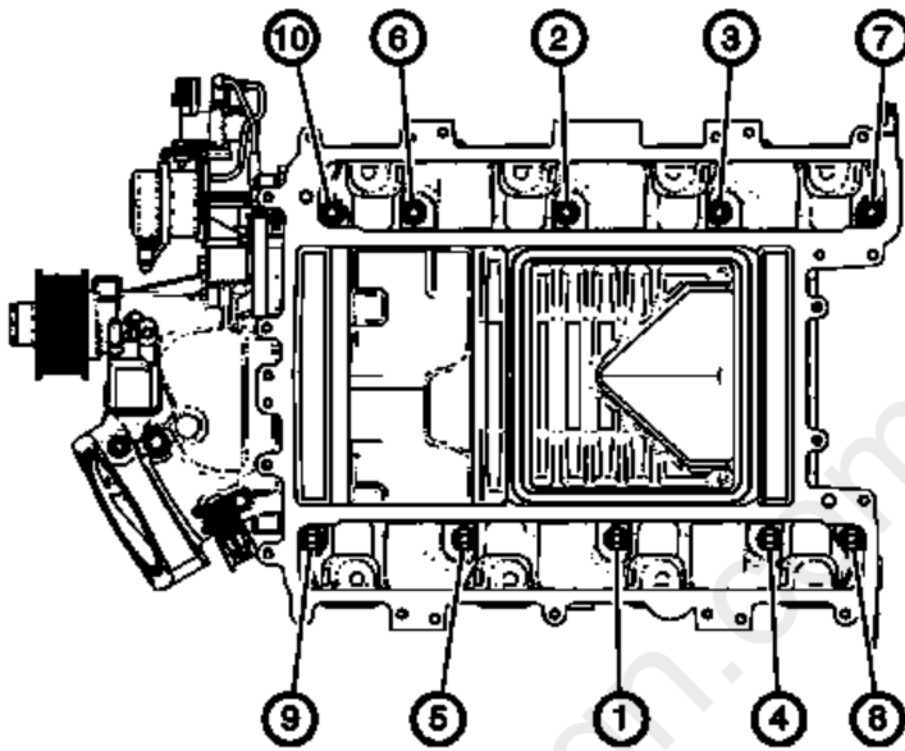


Fig. 188: Identifying Supercharger Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

7. Tighten the bolts.
8. Tighten the bolts a first pass in sequence to 5 N.m (44 lb in).
9. Tighten the bolts a final pass in sequence to 10 N.m(89 lb in).

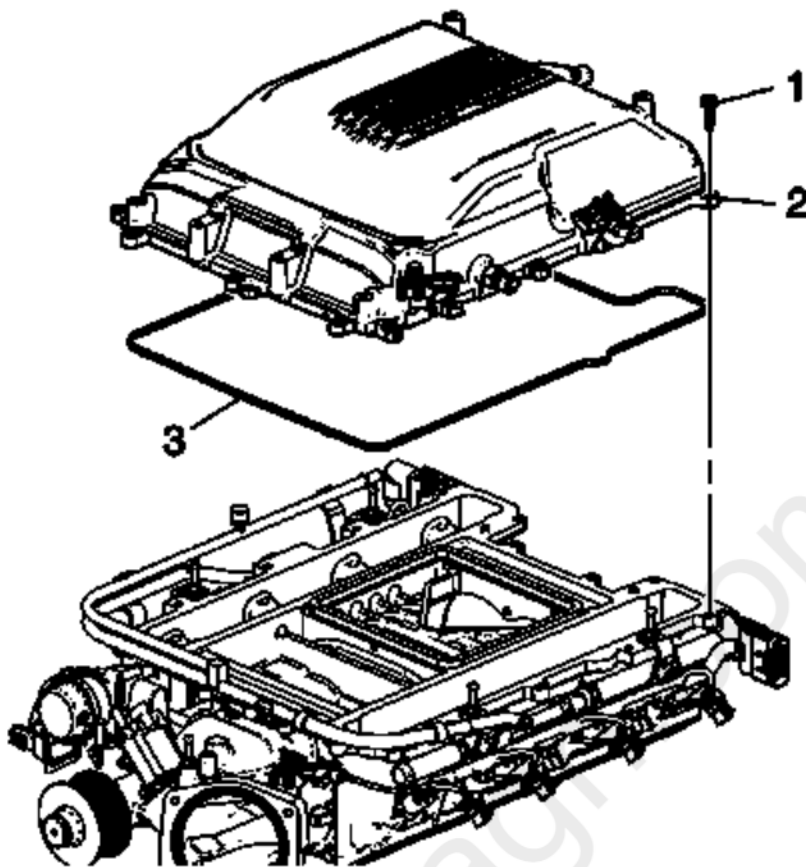


Fig. 189: Identifying Charge Air Cooler Cover Components
Courtesy of GENERAL MOTORS CORP.

10. Install a NEW supercharger cover seal (3).
11. Install the supercharger cover bolts (1) and the supercharger cover (2).

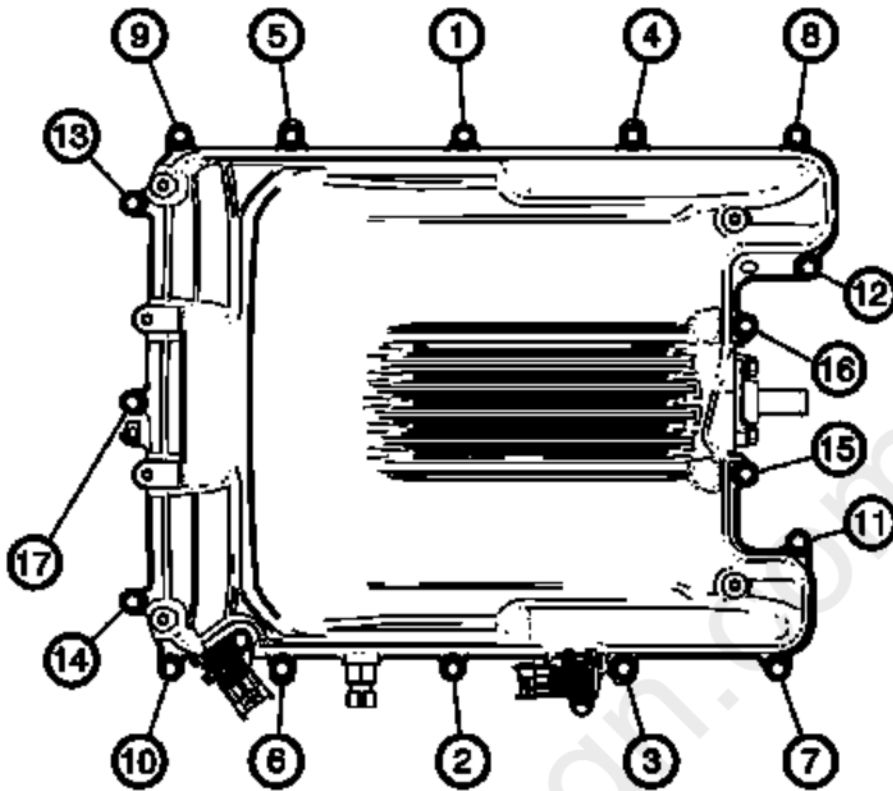


Fig. 190: Identifying Supercharger Cover Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

12. Tighten the bolts.
13. Tighten the bolts a first pass in sequence to 5 N.m(44 lb in).
14. Tighten the bolts a final pass in sequence to 10 N.m(89 lb in).
15. Install the fuel rail with injectors as required. Refer to **Fuel Rail and Injectors Installation**.

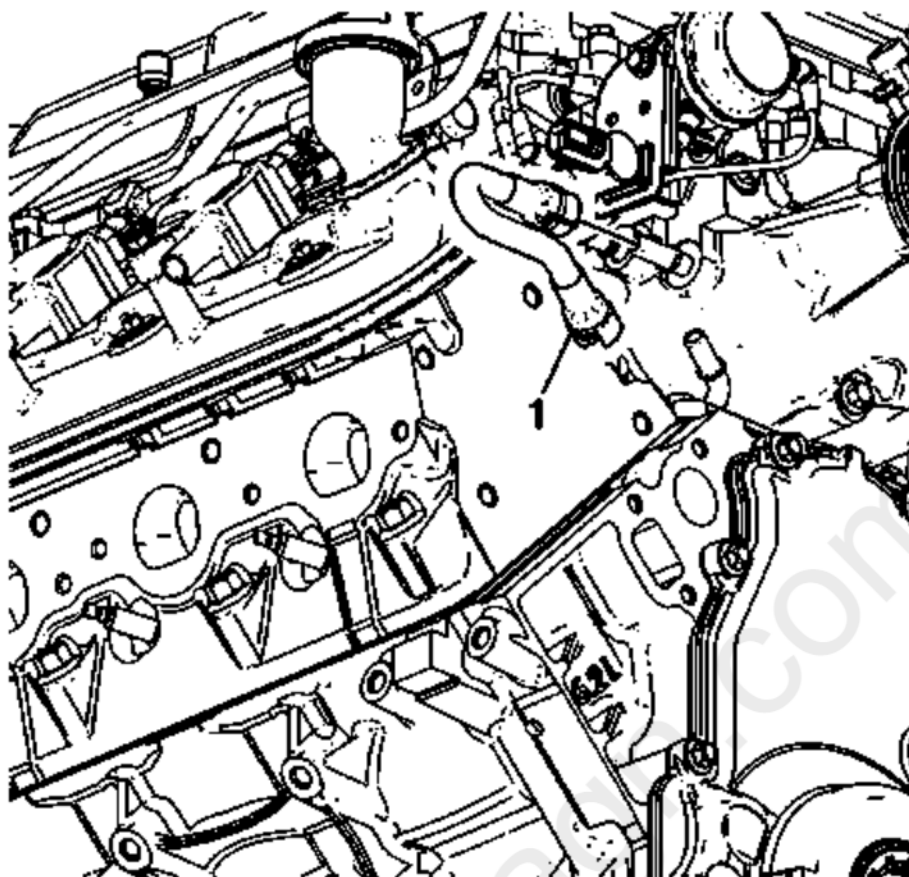


Fig. 191: Identifying Positive Crankcase Ventilation Dirty Air Hose
Courtesy of GENERAL MOTORS CORP.

16. Install the positive crankcase ventilation (PCV) - dirty air hose (1) to the valley cover and supercharger.

FUEL RAIL AND INJECTORS INSTALLATION

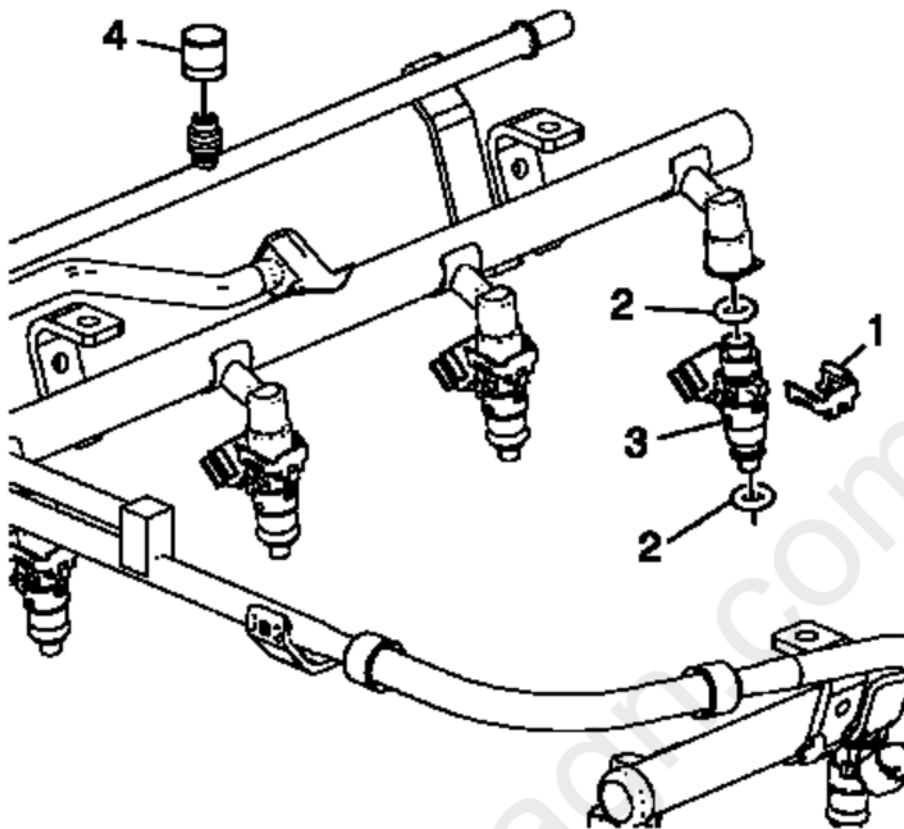


Fig. 192: Identifying Fuel Injector Components
 Courtesy of GENERAL MOTORS CORP.

NOTE: DO NOT use the fuel injector O-ring seals again. Install NEW fuel injector O-ring seals during assembly.

1. Lubricate the NEW fuel injector O-ring seals (2) with clean engine oil.
2. Install the O-ring seals to the fuel injectors.
3. Install the fuel injectors (3) and retainers (1).

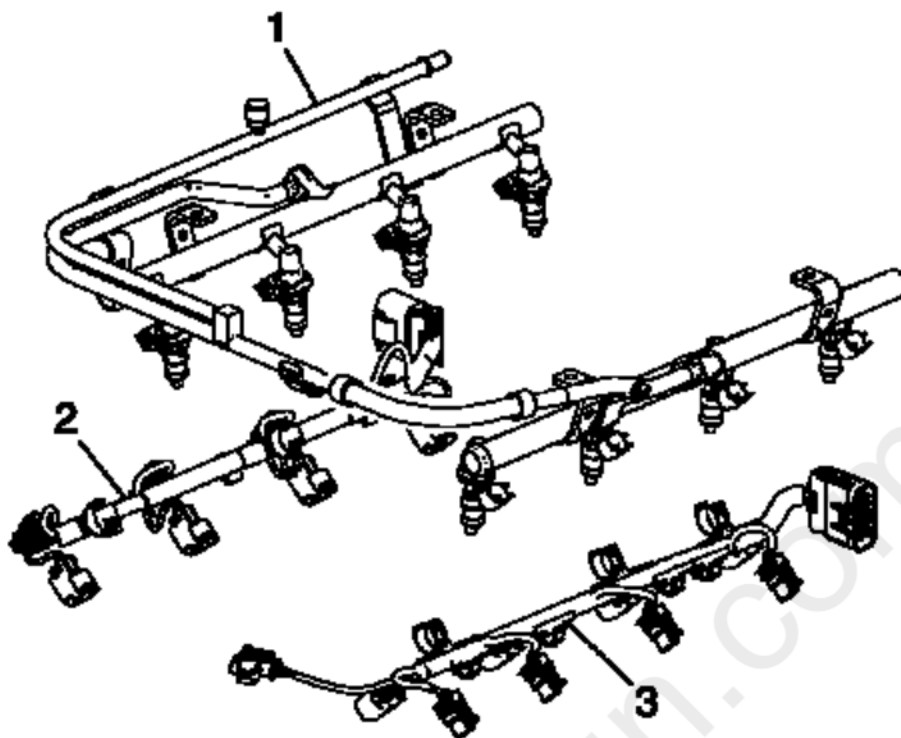


Fig. 193: Identifying Fuel Rail & Wiring Harnesses
Courtesy of GENERAL MOTORS CORP.

4. Install the wiring harnesses (2) and (3) onto the fuel rail (1).

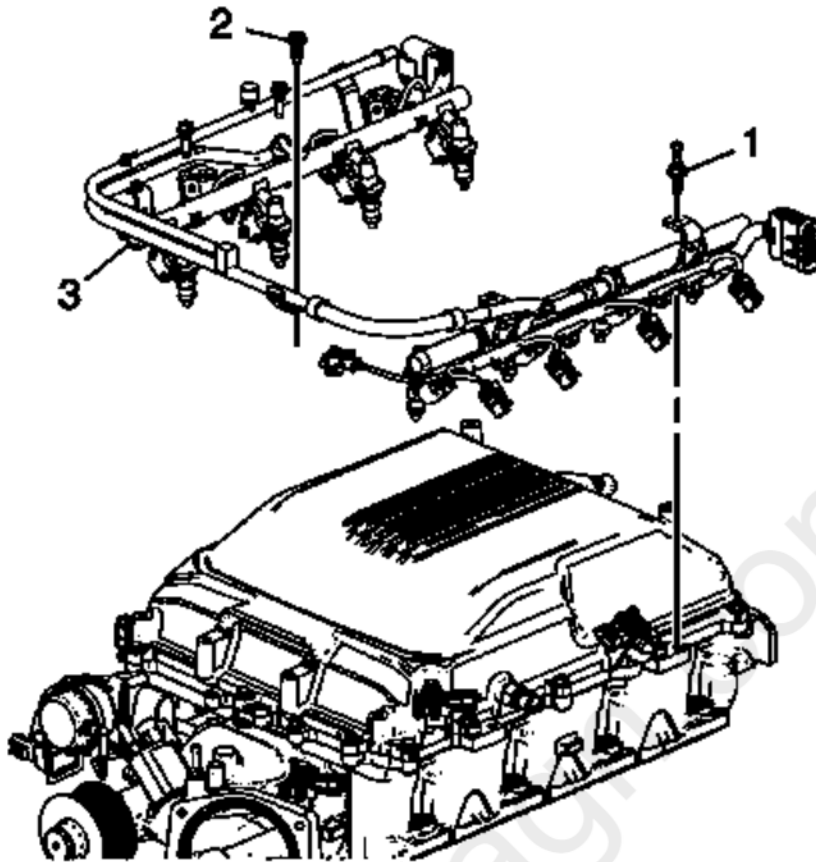


Fig. 194: Identifying Fuel Rail Components
Courtesy of GENERAL MOTORS CORP.

5. Install the fuel rail assembly (3). Install the right side first, then install the left side with flex hose until all injectors have entered their bores.
6. Apply a 5 mm (0.2 in) band of threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the fuel rail studs and bolt. Refer to **Adhesives, Fluids, Lubricants, and Sealers** .

CAUTION: Refer to **FASTENER CAUTION** .

7. Install the fuel rail studs (1) and bolt (2) and tighten to 10 N.m (89 lb in).

THROTTLE BODY ASSEMBLY INSTALLATION

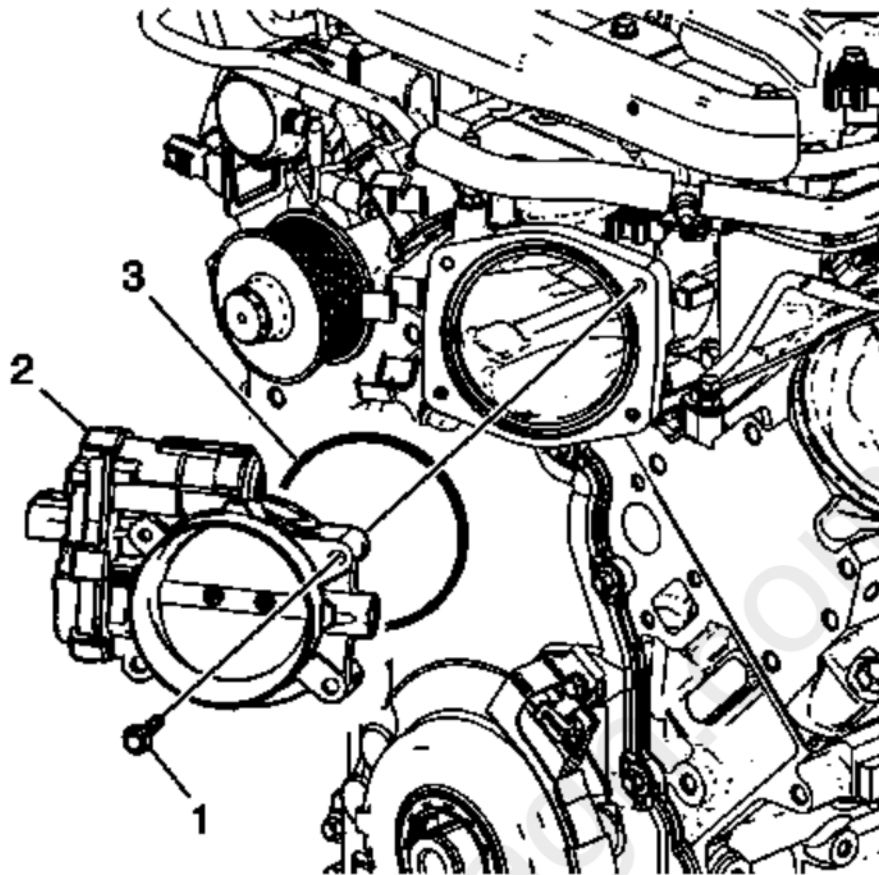


Fig. 195: Identifying Throttle Body Components
Courtesy of GENERAL MOTORS CORP.

NOTE: DO NOT use the throttle body gasket again. Install a NEW gasket during assembly.

1. Install the throttle body gasket (3) to the supercharger.

CAUTION: Refer to FASTENER CAUTION .

2. Install the throttle body (2) and bolts (1) and tighten to 10 N.m (89 lb in).

WATER PUMP INSTALLATION

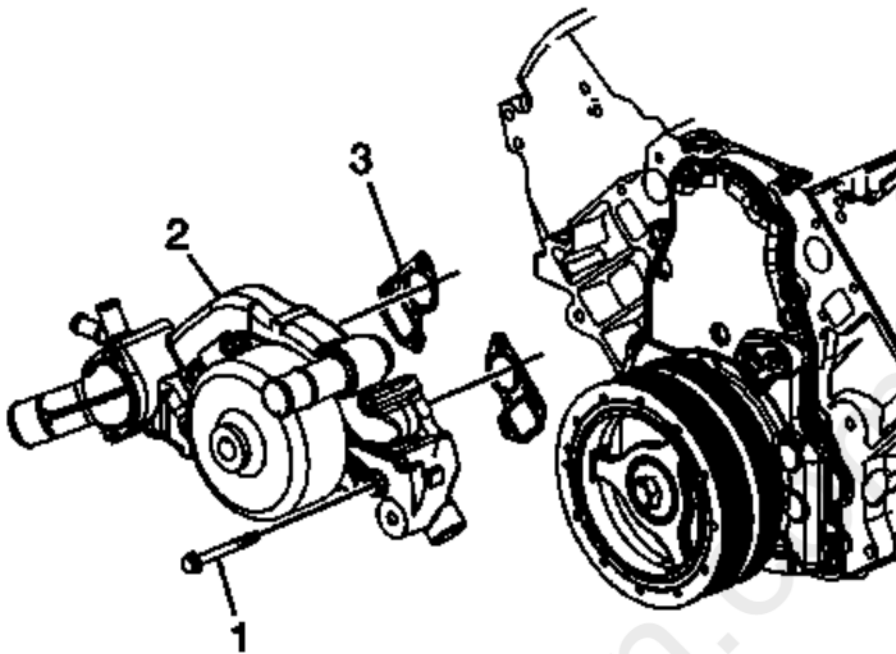


Fig. 196: Identifying Water Pump Components
Courtesy of GENERAL MOTORS CORP.

NOTE: All gasket surfaces are to be free of oil or other foreign material during assembly.

1. Install the water pump (2) and NEW gaskets (3).

CAUTION: Refer to FASTENER CAUTION .

2. Install the water pump bolts (1).
 1. Tighten the water pump bolts a first pass to 15 N.m (11 lb ft).
 2. Tighten the water pump bolts a final pass to 30 N.m (22 lb ft).

EXHAUST MANIFOLD INSTALLATION - LEFT SIDE

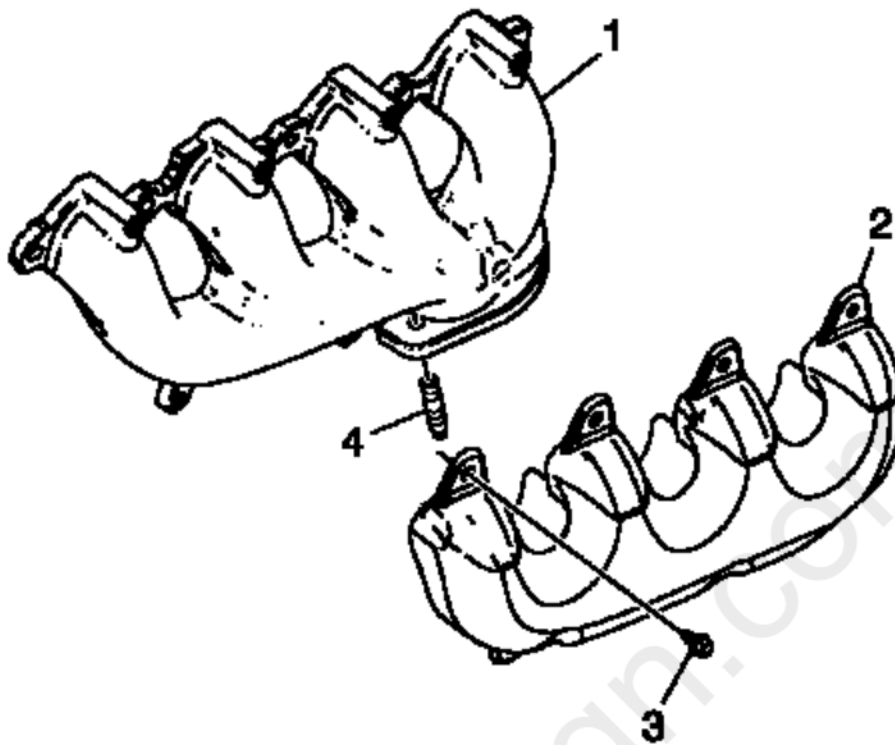


Fig. 197: Identifying Manifold Components (Left Side)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE:

- Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets may affect vehicle emissions and/or on-board diagnostic (OBD) II system performance.
- The cylinder head exhaust manifold bolt hole threads must be clean and free of debris or threadlocking material.
- Do not apply sealant to the first 3 threads of the bolt.

1. Install the heat shield (2) and bolts (3) onto the manifold (1) and tighten to 12 N.m (106 lb in).
2. Install the exhaust pipe studs (4) and tighten to 20 N.m (15 lb ft).

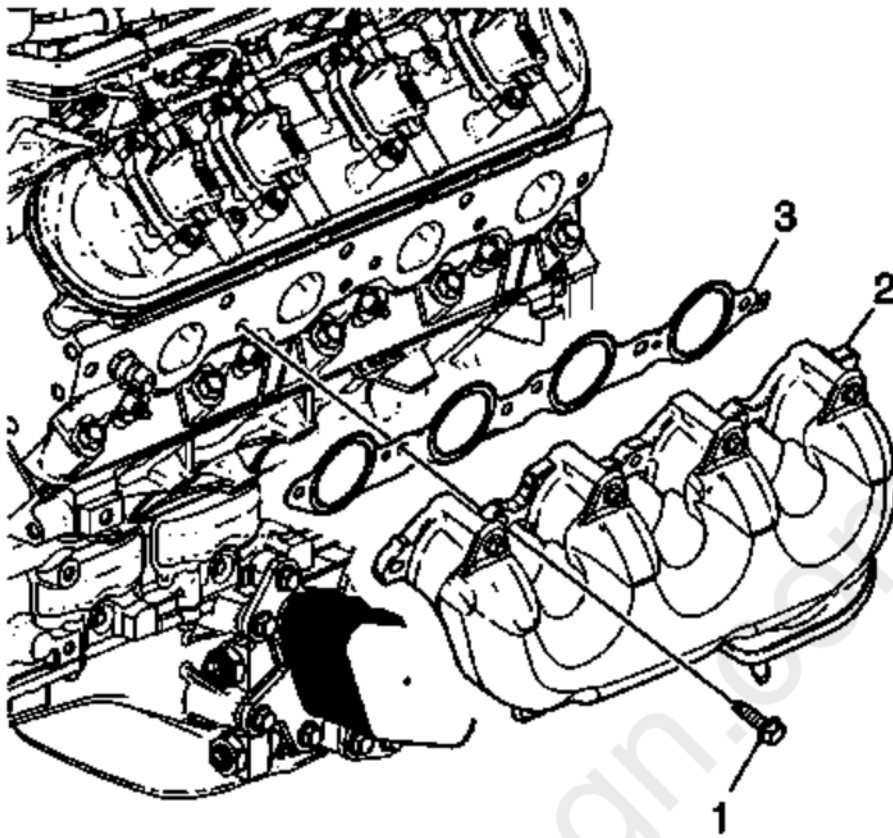


Fig. 198: Identifying Exhaust Manifold, Bolts & Gasket (Left Side)
Courtesy of GENERAL MOTORS CORP.

3. Apply a 5 mm (0.2 in) wide band of threadlock GM P/N 12345493 (Canadian P/N 10953488), or equivalent, to the threads of the exhaust manifold bolts. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.
4. Install the exhaust manifold (2), NEW gasket (3), and bolts (1).
 1. Tighten the exhaust manifold bolts a first pass to 15 N.m(11 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.
 2. Tighten the exhaust manifold bolts a final pass to 20 N.m(15 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.
5. Using a flat punch, bend over the exposed edge of the exhaust manifold gasket at the rear of the left cylinder head.

EXHAUST MANIFOLD INSTALLATION - RIGHT SIDE

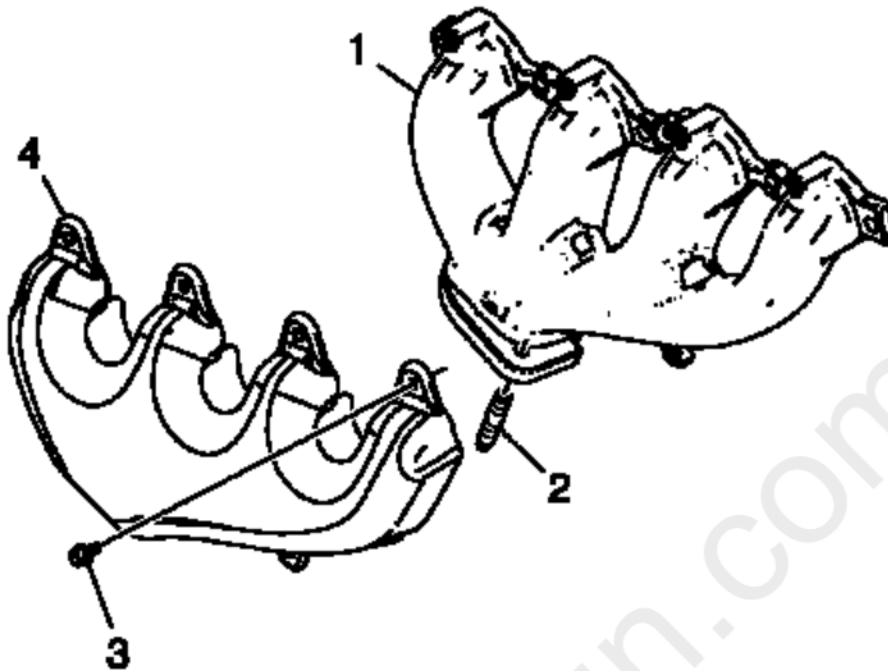


Fig. 199: Identifying Manifold Components (Right Side)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE:

- Tighten the exhaust manifold bolts as specified in the service procedure. Improperly installed and/or leaking exhaust manifold gaskets may affect vehicle emissions and/or on-board diagnostic (OBD) II system performance.
- The cylinder head exhaust manifold bolt hole threads must be clean and free of debris or threadlocking material.
- Do not apply sealant to the first 3 threads of the bolt.

1. Install the heat shield (4) and bolts (3) onto the manifold (1) and tighten to 12 N.m (106 lb in).
2. Install the exhaust pipe studs (2) and tighten to 20 N.m (15 lb ft).

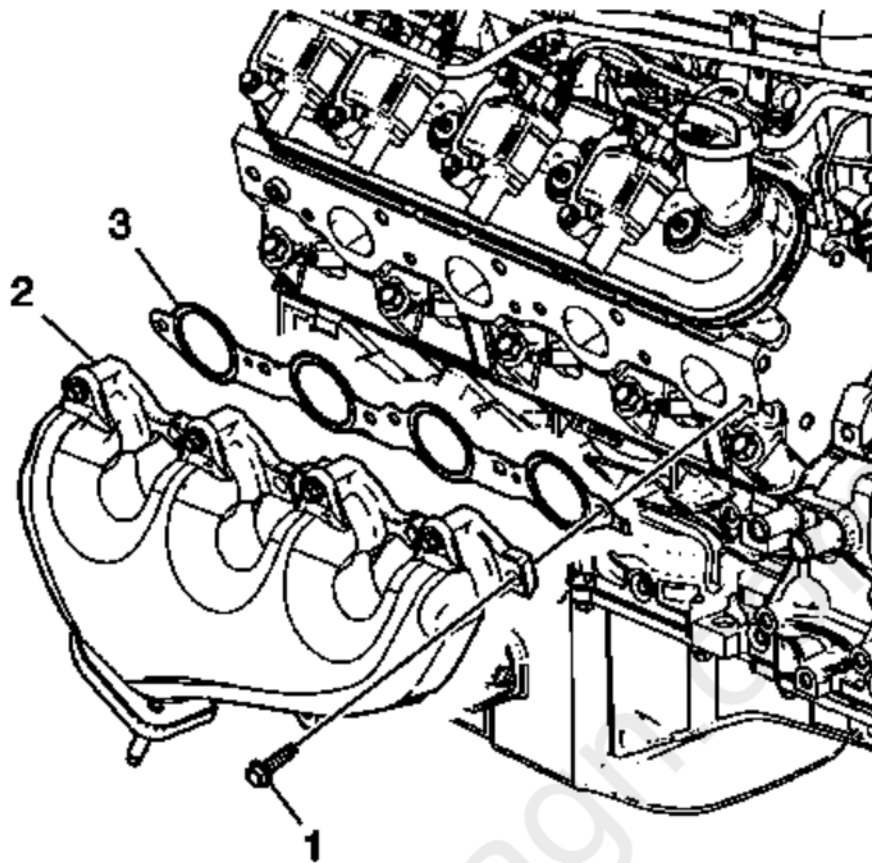


Fig. 200: Identifying Exhaust Manifold, Bolts & Gasket (Right Side)
Courtesy of GENERAL MOTORS CORP.

3. Apply a 5 mm (0.2 in) wide band of threadlock GM P/N 12345493 (Canadian P/N 10953488), or equivalent, to the threads of the exhaust manifold bolts. Refer to **Adhesives, Fluids, Lubricants, and Sealers**.
4. Install the exhaust manifold (2), NEW gasket (3), and bolts (1).
 1. Tighten the exhaust manifold bolts a first pass to 15 N.m (11 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.
 2. Tighten the exhaust manifold bolts a final pass to 20 N.m (15 lb ft). Tighten the exhaust manifold bolts beginning with the center 2 bolts. Alternate from side-to-side, and work toward the outside bolts.
5. Using a flat punch, bend over the exposed edge of the exhaust manifold gasket at the rear of the left cylinder head.

OIL LEVEL INDICATOR AND TUBE INSTALLATION

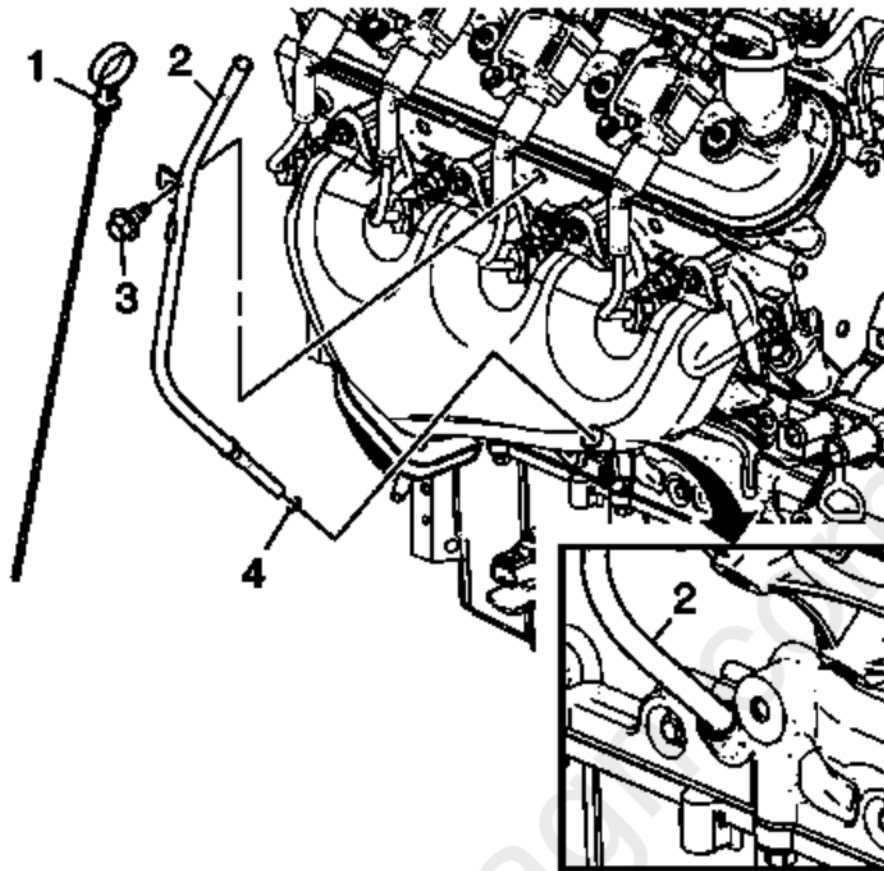


Fig. 201: Identifying Oil Level Indicator Components
Courtesy of GENERAL MOTORS CORP.

1. Inspect the O-ring seal (4) for cuts or damage. If the oil level indicator tube O-ring seal is not cut or damaged, it may be used again.
2. Lubricate the O-ring seal with clean engine oil.
3. Install the O-ring seal onto the oil level indicator tube (2).
4. Install the oil level indicator tube into the engine block and rotate into proper position.

CAUTION: Refer to FASTENER CAUTION .

5. Install the tube bolt (3) and tighten the oil level indicator tube bolt to 25 N.m (18 lb ft).
6. Install the oil level indicator (1) into the tube.

CLUTCH PILOT BEARING INSTALLATION (NON-LS9)

Special Tools

- **J 8433:** Two Jaw Puller

- **J 45949:** Pilot Bearing and Flywheel Locator Installer

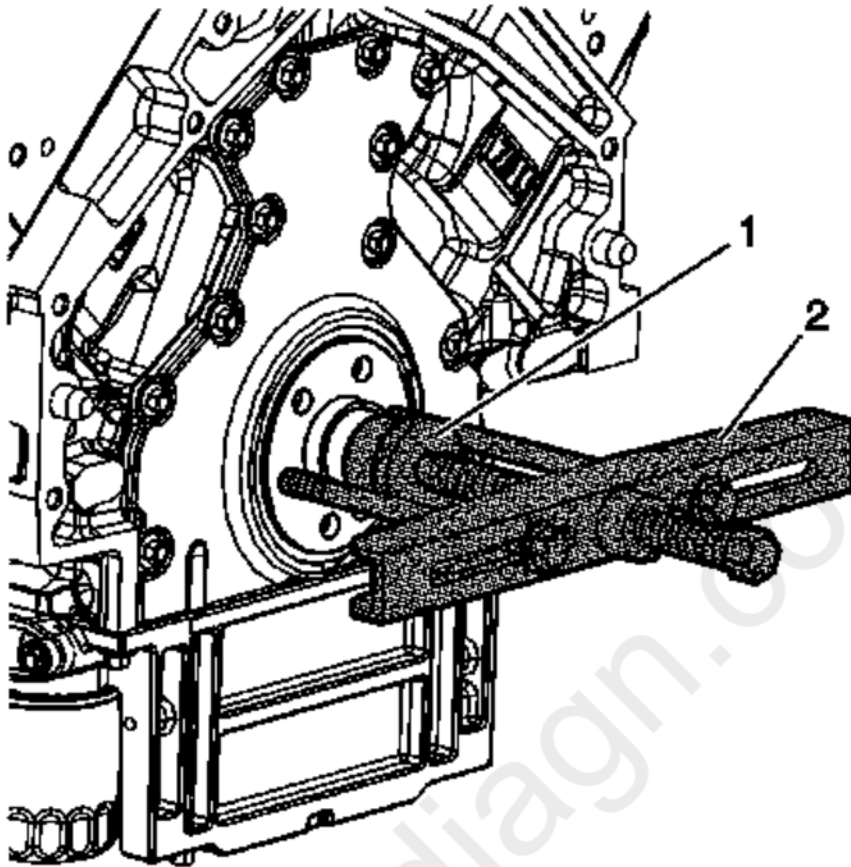


Fig. 202: Identifying Special Tools
Courtesy of GENERAL MOTORS CORP.

1. Position the bearing to the rear of the crankshaft.
2. Assemble the **J 8433:** two jaw puller (2), the **J 45949:** pilot bearing and flywheel locator installer (1) and bolts to the rear of the crankshaft.

Tighten the bolts until snug.

3. Rotate the bolt of the **J 8433:** two jaw puller (2) until the bearing is seated in the bore of the crankshaft.
4. Remove the tools.

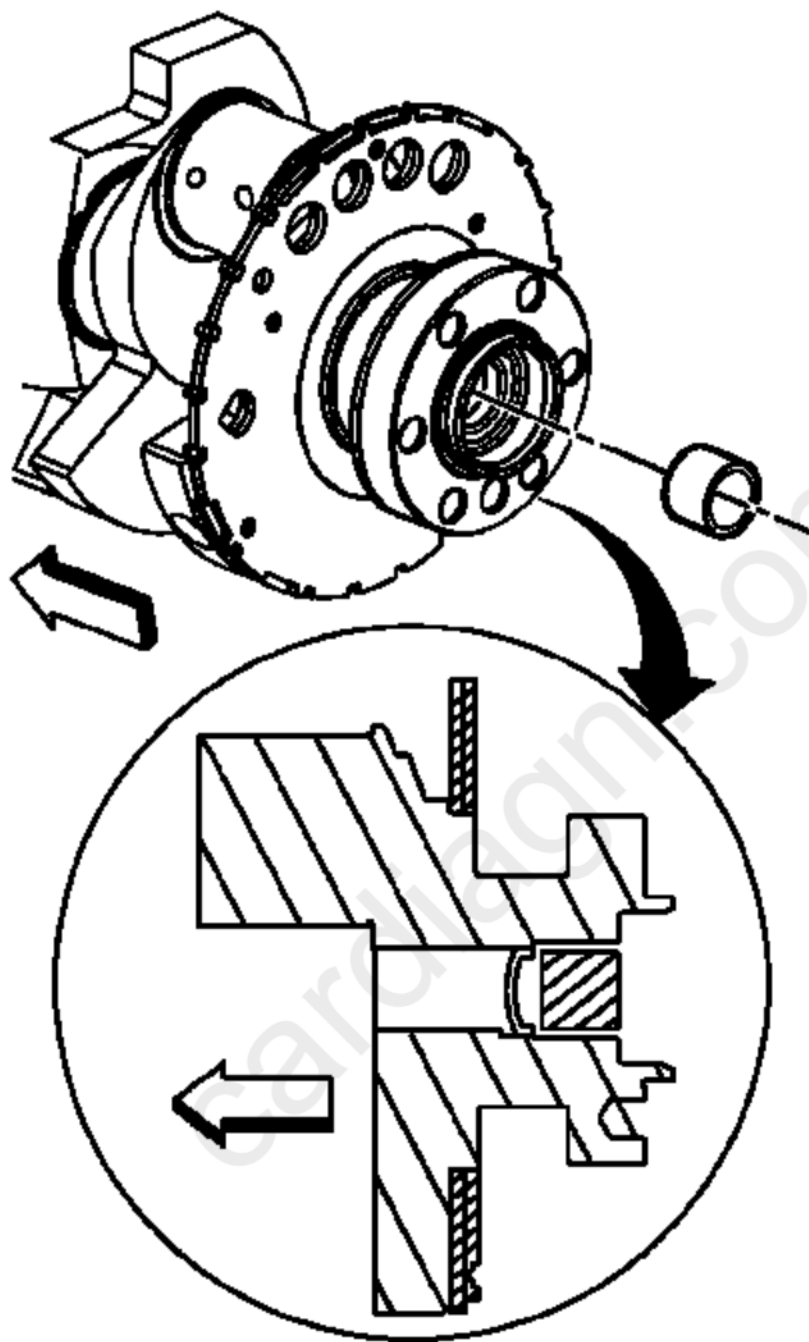


Fig. 203: Locating Clutch Pilot Bearing
Courtesy of GENERAL MOTORS CORP.

5. Inspect the clutch pilot bearing for proper installation.

ENGINE FLYWHEEL INSTALLATION (6.2L)

SPECIAL TOOLS**J 42386-A: Flywheel Holding Tool**

For equivalent regional tools, refer to Special Tools .

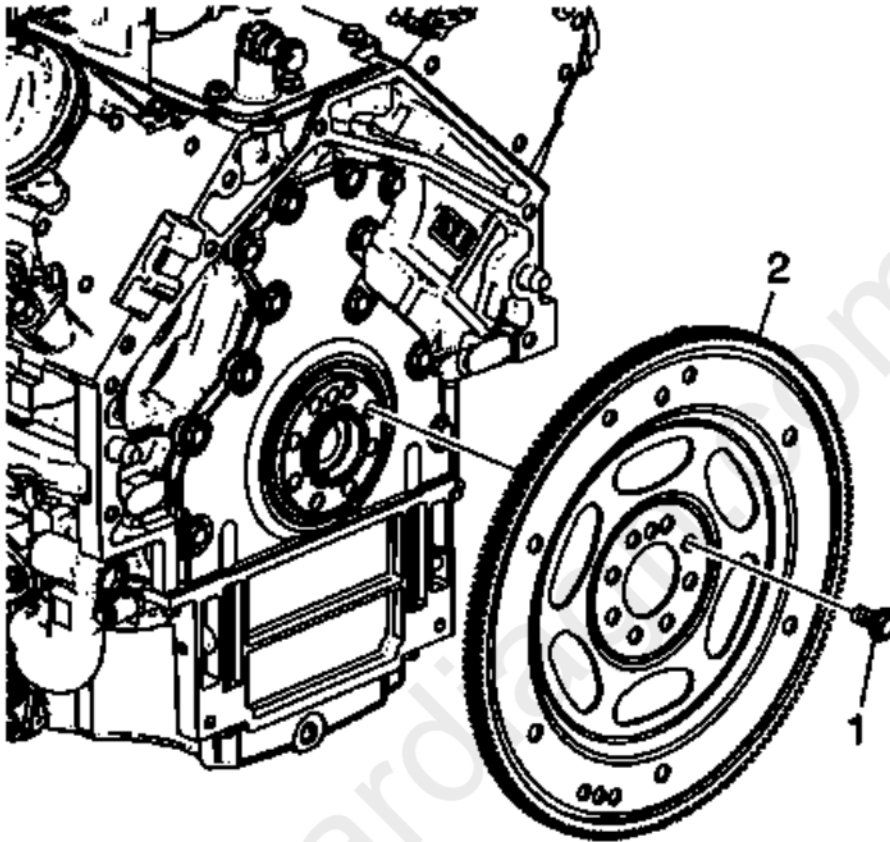


Fig. 204: Identifying Automatic Transmission Flex Plate & Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE:

- For manual transmission applications, note the position and direction of the engine flywheel before removal. Mark or scribe the end of the crankshaft and flywheel before component removal. The existing manual transmission engine flywheel must be installed to the original position and direction.
- The flywheel does not use a locating pin for alignment and will not initially seat against the crankshaft flange, but will be pulled onto the crankshaft by the engine flywheel bolts. This procedure requires a 3 stage tightening process.

1. Install the automatic transmission flex plate to the crankshaft, if applicable.
2. Install the manual transmission flywheel (2) to the crankshaft, if applicable. Refer to Engine Balancing .

3. Apply threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent, to the threads of the flywheel bolts (1).
4. Install the bolts loosely.

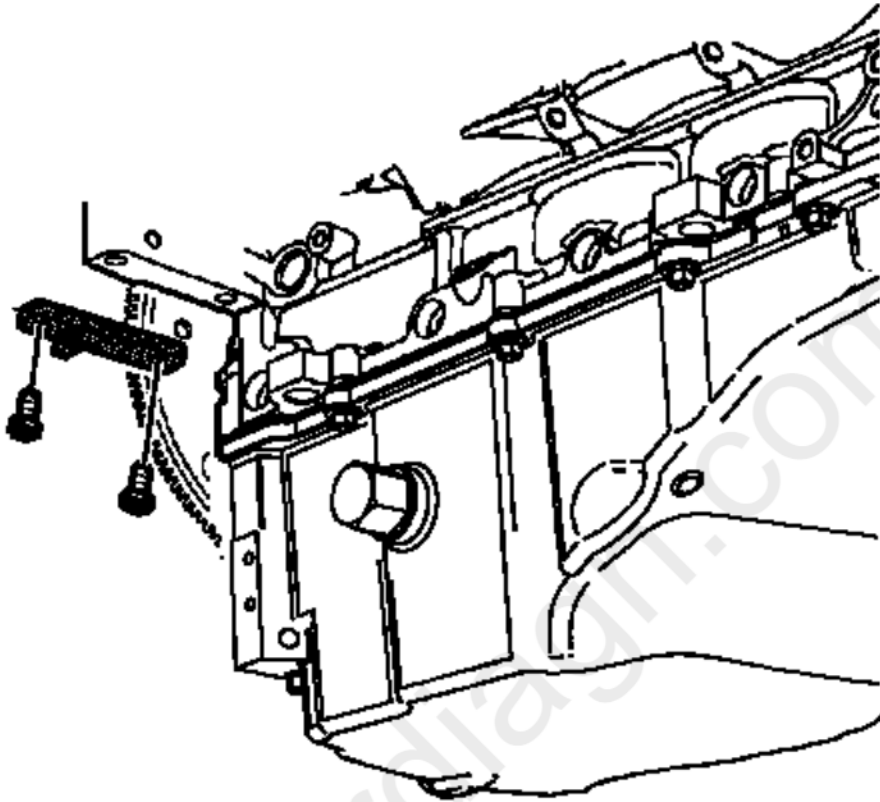


Fig. 205: Identifying J 42386-A
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

5. Install the **J 42386-A**: flywheel holding tool and bolts.

Use 1 M10 -1.5 x 120 mm and 1 M10 -1.5 x 45 mm bolt for proper tool operation.

Tighten the **J 42386-A**: flywheel holding tool and bolts to 50 N.m (37 lb ft).

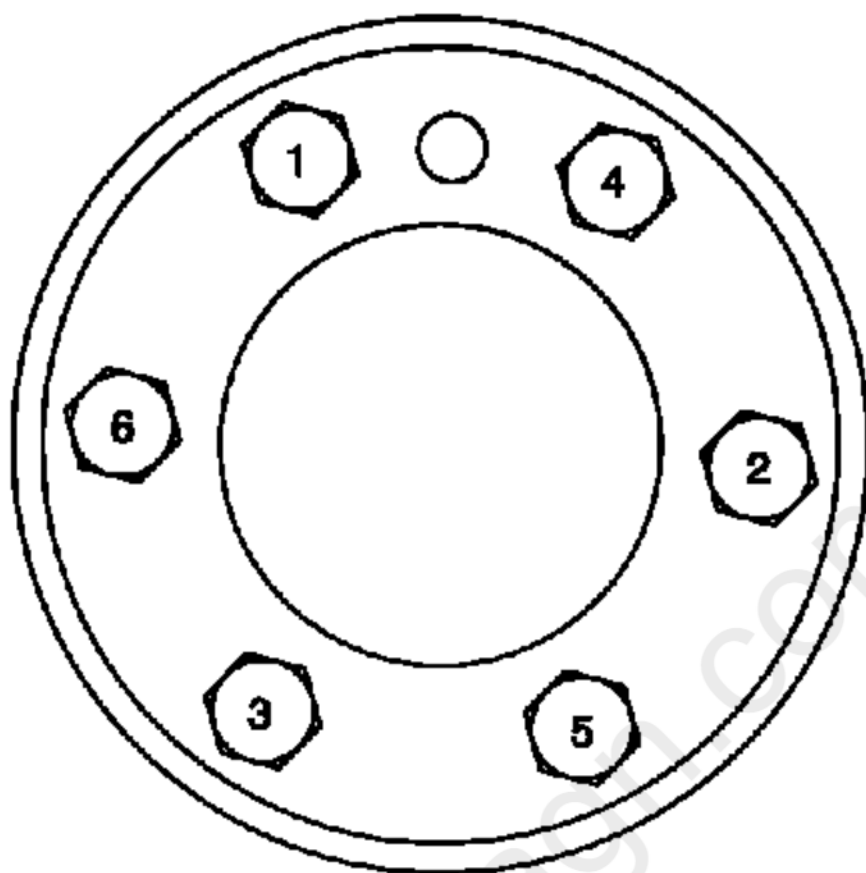


Fig. 206: Identifying Flywheel Bolt Tightening Sequence
Courtesy of GENERAL MOTORS CORP.

6. Torque the bolts.
 1. Tighten the bolts (1-6) a first pass in sequence to 20 N.m (15 lb ft).
 2. Tighten the bolts (1-6) a second pass in sequence to 50 N.m (37 lb ft).
 3. Tighten the bolts (1-6) a final pass in sequence to 100 N.m (74 lb ft).
7. Remove the **J 42386-A**: flywheel holding tool

2011 ENGINE

Engine Mechanical - 4.8L, 5.3L, 6.0L, 6.2L, or 7.0L - Repair Instructions - Off Vehicle - CTS

CRANKSHAFT BALANCER INSTALLATION

Special Tools

- EN-47812: Installer Bolt
- J 41665-A: Crankshaft Balancer and Sprocket Installer
- J 42386-A: Flywheel Holding Tool
- J 45059: Angle Meter

For equivalent regional tools, refer to Special Tools

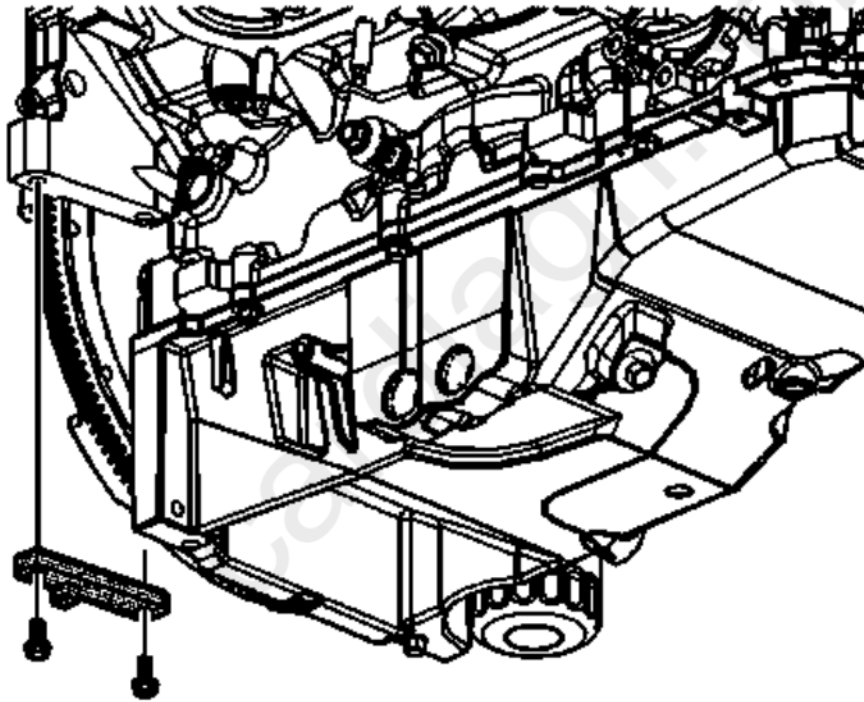


Fig. 1: View Of J 42386-A And Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to FASTENER CAUTION .

NOTE:

- If replacing the crankshaft balancer, note the location of any existing balance weights, if applicable. Install new balance weights into the new crankshaft balancer, if applicable. Crankshaft balance weights must be installed into the new balancer in the same location as the old balancer. A properly installed balance weight will be either flush or below flush with the face of the balancer. Refer to Engine Balancing and Crankshaft Balancer Cleaning and Inspection .
- Ensure the teeth of the tool engage the engine flywheel teeth.
- The used crankshaft balancer bolt is used only during the installation procedure. Install a NEW crankshaft balancer bolt during final assembly.

1. Install the **J 42386-A**: holding tool and bolts.

Use 1 M10 - 1.5 x 120 mm and 1 M10 - 1.5 x 45 mm bolt for proper tool operation and tighten the **J 42386-A**: holding tool bolts to 50 N.m (37 lb ft).

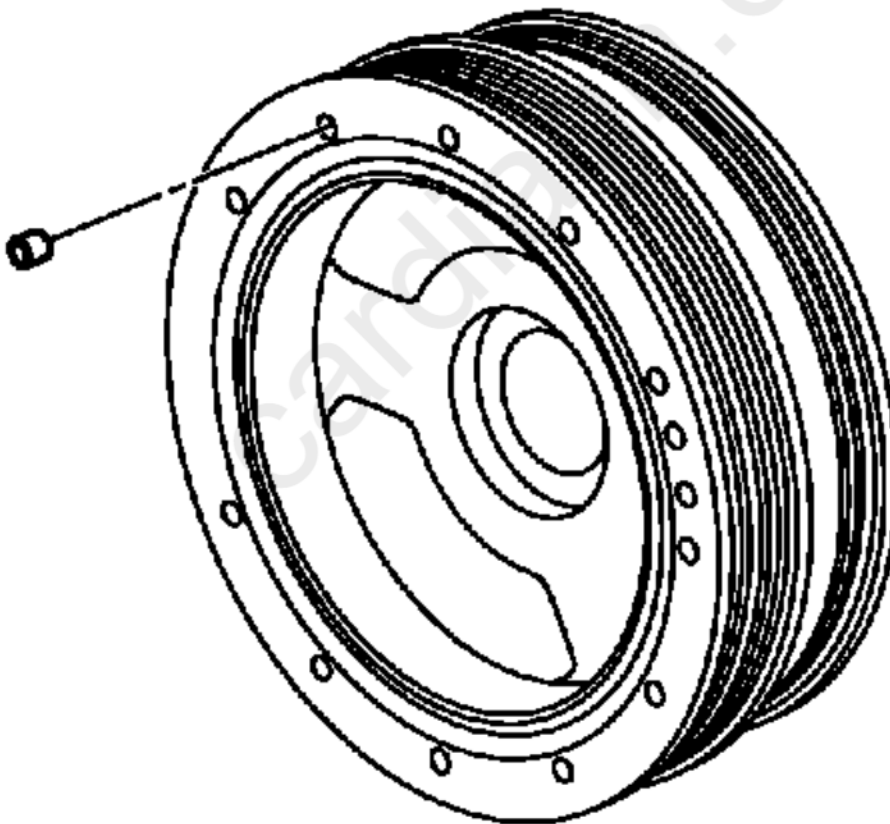


Fig. 2: Balancer Weights In Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

2. Install balance weights into the new balancer, if applicable.

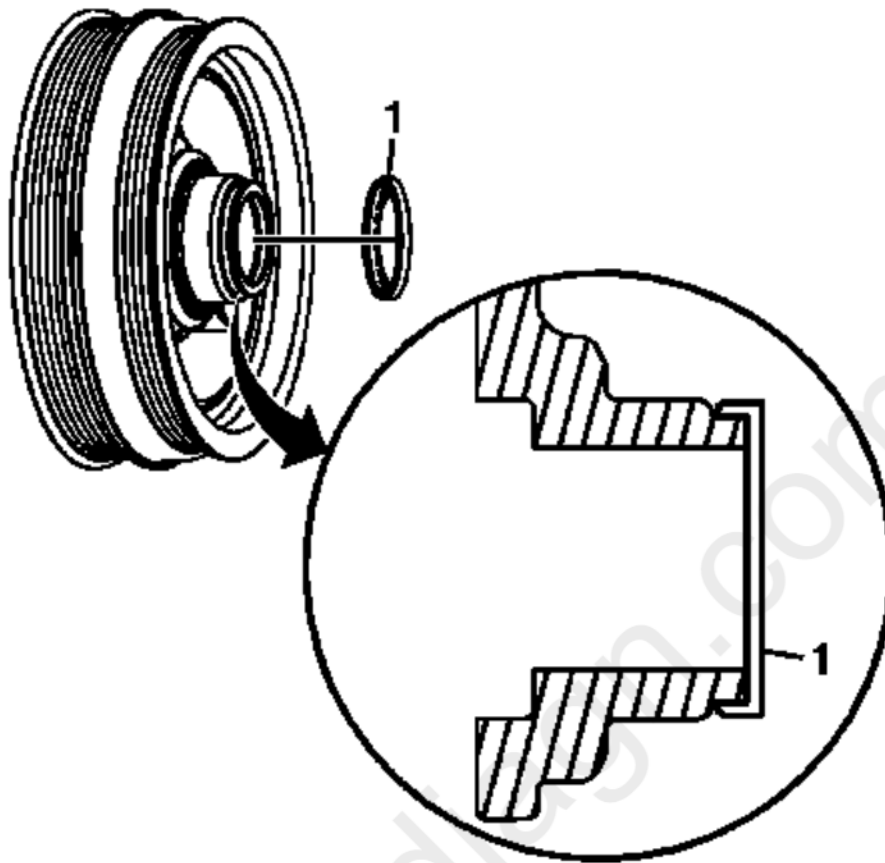


Fig. 3: Crankshaft Balancer Washer
Courtesy of GENERAL MOTORS CORP.

3. Install the crankshaft balancer washer (1) onto the crankshaft balancer.

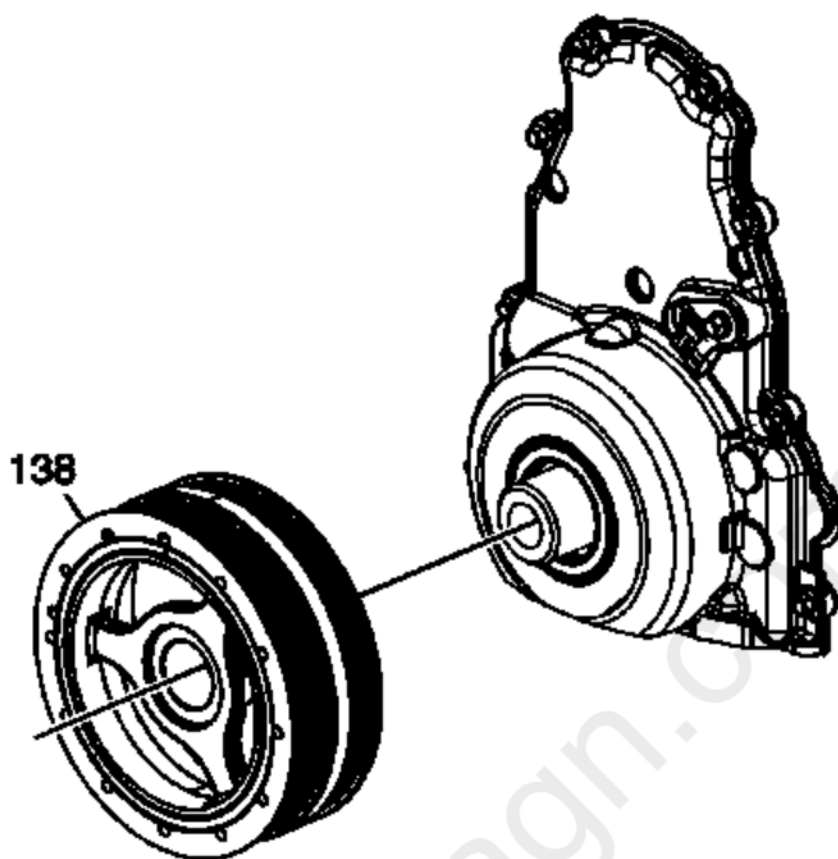


Fig. 4: View Of Crankshaft Balancer
Courtesy of GENERAL MOTORS CORP.

NOTE: The balancer should be positioned onto the end of the crankshaft as straight as possible prior to tool installation.

4. Position the balancer (138) onto the end of the crankshaft.

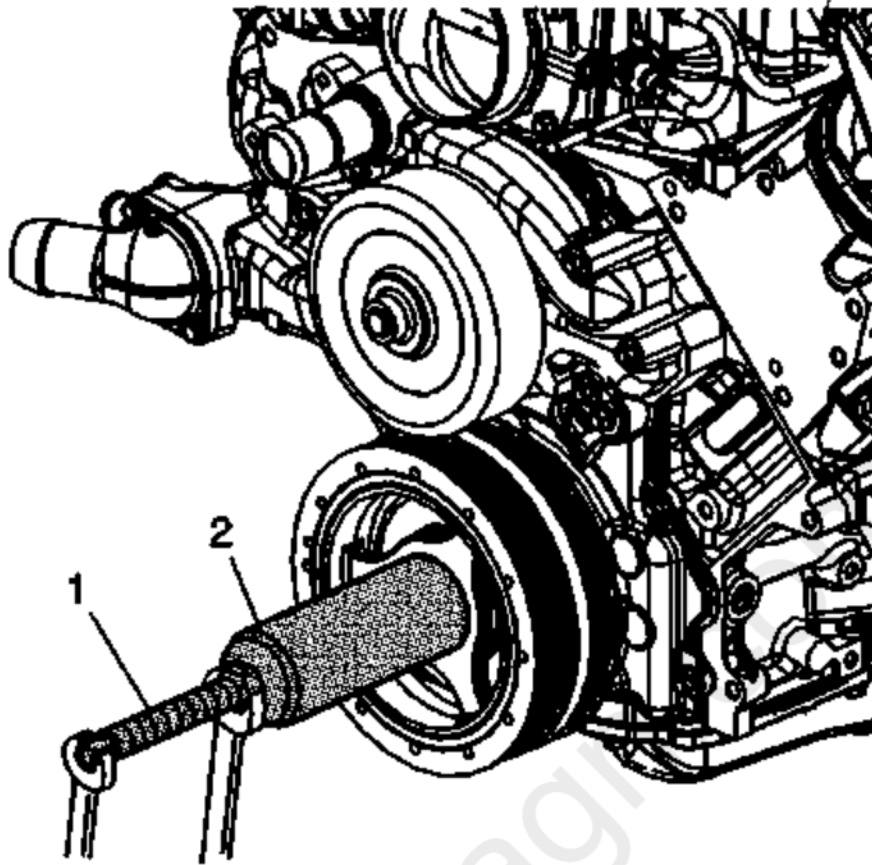


Fig. 5: Using Special Tools J 41665 & EN-47812 To Install Balancer
Courtesy of GENERAL MOTORS CORP.

5. Use the **J 41665-A**: installer (2) and the **EN-47812**: installer bolt (1) in order to install the balancer.
 1. Assemble the **EN-47812**: installer bolt (1), nut, washer and the **J 41665-A**: installer (2).

Insert the smaller end of the **J 41665-A**: installer (2) into the front of the balancer.
 2. Use a wrench and hold the hex end of the **EN-47812**: installer bolt (1).
 3. Use a second wrench and rotate the installation tool nut clockwise until the balancer is started onto the crankshaft.
 4. Remove the **J 41665-A**: installer (2) and reverse the installation tool.

Position the larger end of the **J 41665-A**: installer (2) against the front of the balancer.
 5. Use a wrench and hold the end of the **EN-47812**: installer bolt (1).
 6. Use a second wrench and rotate the installation tool nut clockwise until the balancer is installed onto the crankshaft.
 7. Remove the balancer installation tools.

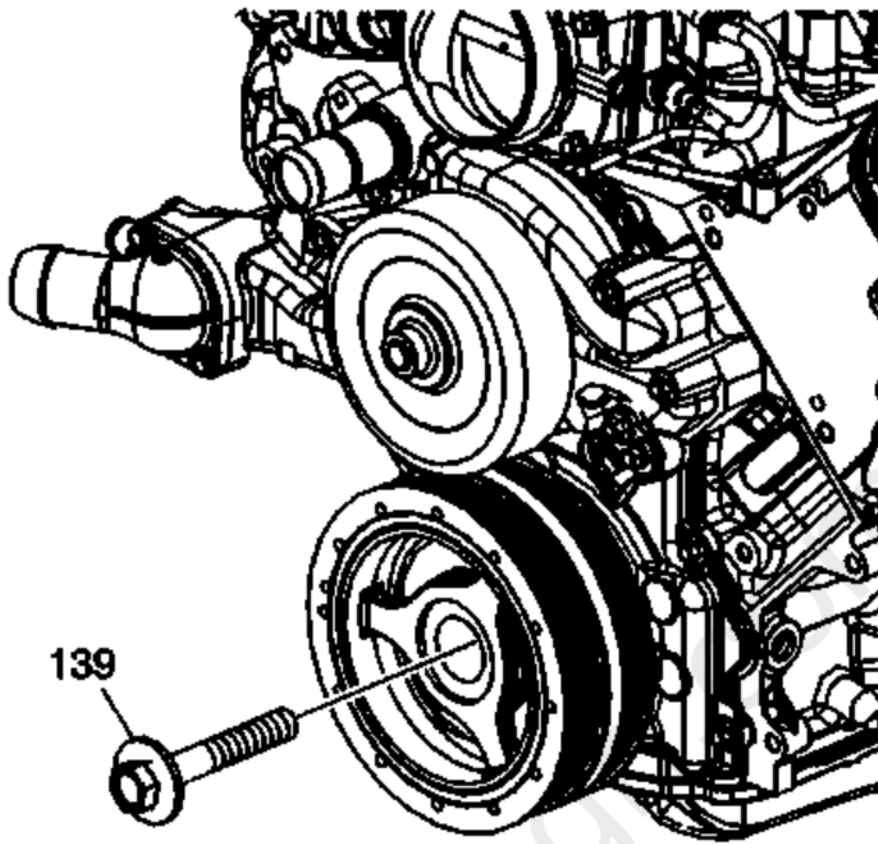


Fig. 6: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

6. Install the used crankshaft balancer bolt (139) and tighten to 330 N.m (240 lb ft) to fully seat the balancer.
7. Remove the used crankshaft balancer bolt.

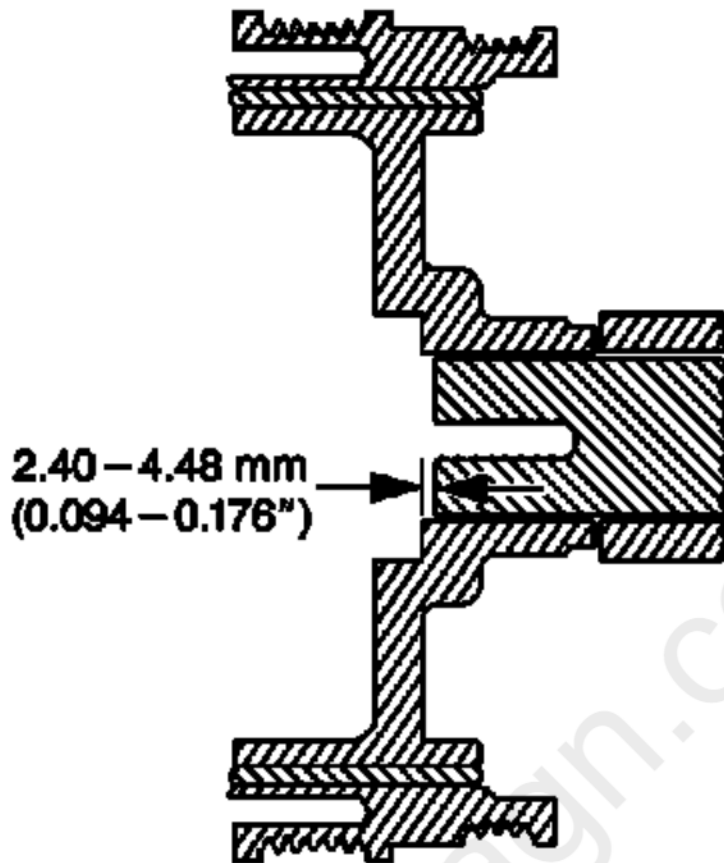


Fig. 7: Identifying Hub To Crankshaft Distance
Courtesy of GENERAL MOTORS CORP.

NOTE: The nose of the crankshaft should be recessed 2.40-4.48 mm (0.094-0.176 in) into the balancer bore.

8. Measure for a correctly installed balancer. If the balancer is not installed to the proper dimensions, install the **J 41665** installer and repeat the installation procedure.

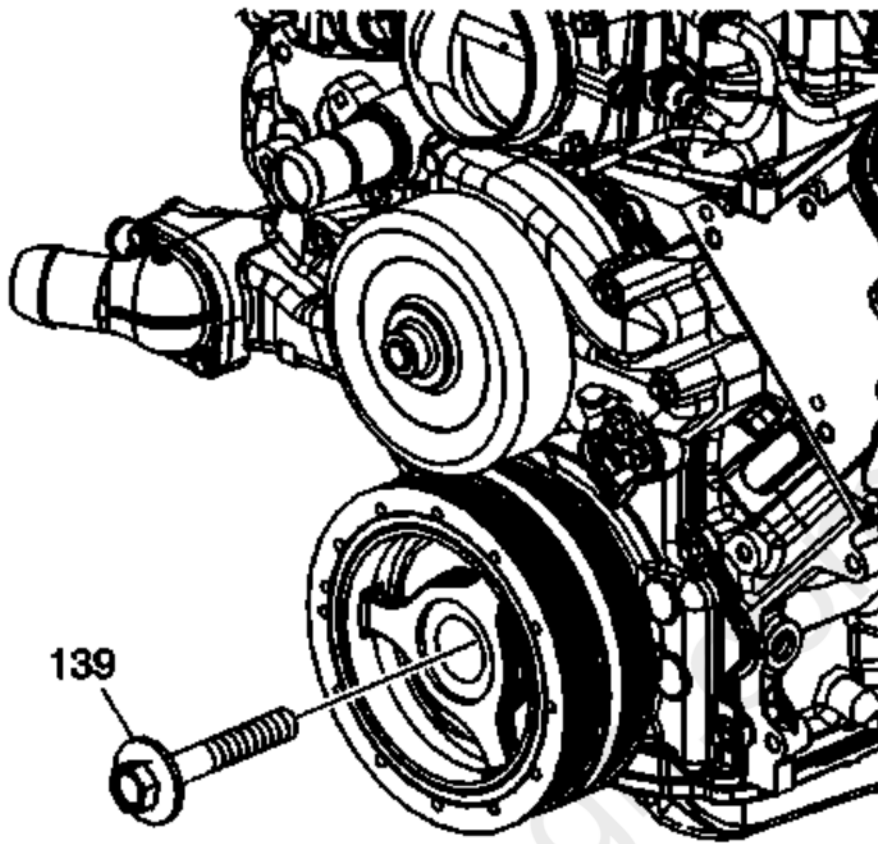


Fig. 8: View Of Crankshaft Balancer Bolt
Courtesy of GENERAL MOTORS CORP.

9. Install the NEW crankshaft balancer bolt (139):
 1. Tighten the crankshaft balancer bolt to 150 N.m (110 lb ft).
 2. Loosen the crankshaft balancer bolt 360 degrees.
 3. Tighten the crankshaft balancer bolt to 80 N.m (59 lb ft).
 4. Tighten the crankshaft balancer bolt a final pass to 200 degrees using the **J 45059**: meter.
10. Remove the **J 42386-A**: tool.

ENGINE PRELUBING

SPECIAL TOOLS

J 45299: Engine Preluber

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

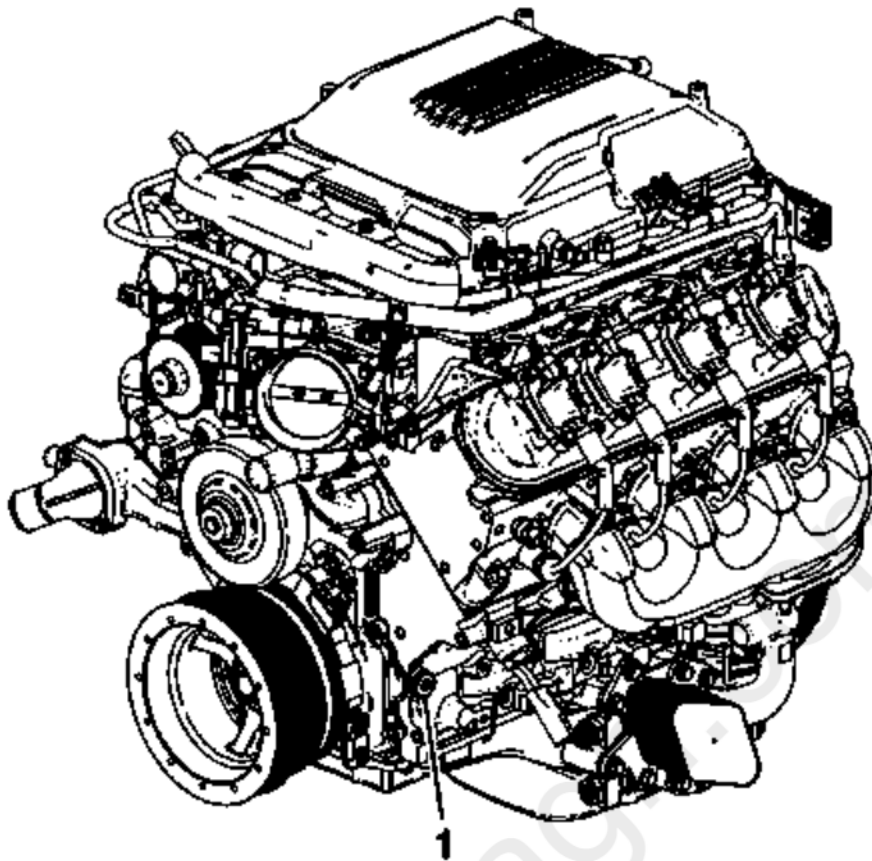


Fig. 9: Identifying Engine Block Left Front Oil Gallery Plug
Courtesy of GENERAL MOTORS CORP.

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

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

CAUTION: Refer to FASTENER CAUTION .

2. Install the oil filter and tighten to 30 N.m (22 lb ft).
3. Locate the engine block left front oil gallery plug (1).
4. Install the M16 x 1.5 adapter P/N 509375.

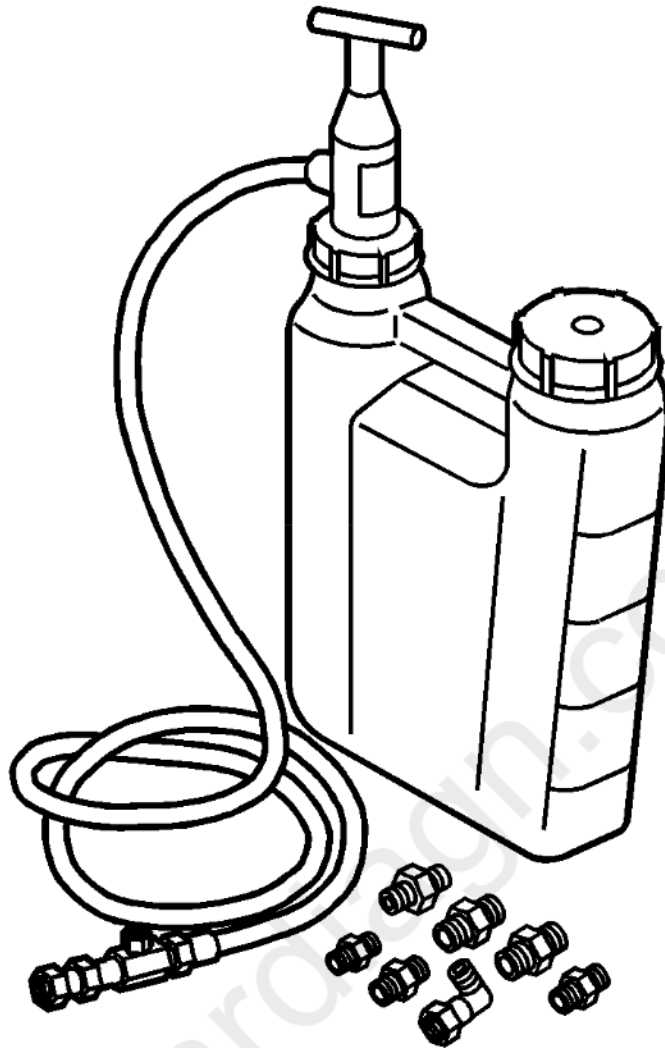


Fig. 10: Identifying Engine Preluber J 45299
Courtesy of GENERAL MOTORS CORP.

5. Install the flexible hose to the adapter and open the valve.
6. Pump the handle on the **J 45299**: preluber in order to flow a minimum of 1-1.9 liters (1-2 quarts) engine oil. Observe the flow of engine oil through the flexible hose and into the engine assembly.
7. Close the valve and remove the flexible hose and adapter from the engine.
8. Install the gallery plug to the engine and tighten to 60 N.m (44 lb ft).
9. Top-off the engine oil to the proper level.