

General Motors 4 Engines

1600cc 4 CYLINDER

IDENTIFICATION CODING

ENGINE IDENTIFICATION

Engine Code is stamped on pad at right side of block below number 1 spark plug.

| Application | Code |
|--------------|------|
| 1600cc | E |

ENGINE REMOVAL

See *Engine Removal* at end of *ENGINE* Section.

CYLINDER HEAD & MANIFOLDS

INTAKE MANIFOLD

Removal – 1) Drain cooling system and remove air cleaner. Disconnect battery negative cable. Disconnect upper radiator and heater hoses at intake manifold.

2) Remove EGR valve. Disconnect all wiring, hoses, linkage and fuel line from carburetor.

3) If equipped with A/C, remove upper radiator support, drive belts, fan and pulley assembly, and timing belt cover. Unbolt compressor and set aside.

4) Remove upper and lower A/C compressor brackets. Remove coil. Remove intake manifold bolts and manifold.

Installation – 1) Clean all gasket mating surfaces. Install intake manifold with new gasket and tighten bolts in sequence.

2) Reverse removal procedure to complete assembly. Ensure that all drive belts are properly adjusted. Start engine and run until at operating temperature. Check for leaks.

EXHAUST MANIFOLD

Removal – 1) Disconnect battery negative cable. Raise vehicle and disconnect exhaust pipe at manifold flange.

2) Lower vehicle and disconnect carburetor heat tube. Remove pulse air injection tubing, if equipped. Remove exhaust manifold bolts and manifold.

Installation – 1) Clean all mating surfaces of manifold and head. Install manifold and torque to specification.

2) Reverse disassembly procedure to complete installation. Start engine and check for exhaust leaks.

CYLINDER HEAD

Removal – 1) Remove engine front upper and lower covers. Remove crankshaft drive pulley, idler pulley and timing belt.

2) Drain cooling system. Disconnect upper radiator hose and heater hose at intake manifold. Remove air cleaner and accelerator cable support bracket.

3) Disconnect all wiring. Raise vehicle and disconnect exhaust pipe from manifold. Lower vehicle and disconnect oil dipstick tube from manifold.

4) Disconnect fuel line at carburetor. Remove coil, cam covers, camshaft, rocker arms, guides and valve lifters with shims.

NOTE – Keep rocker arms, guides, lifters and shims in order for installation in original location

5) Remove cam carrier from head. Remove head from engine.

Installation – 1) Install new head gasket over dowel pins with legend "This Side Up" facing up. Place head on engine.

2) Apply sealer to top of head and cam carrier mating surfaces. Coat head bolts with sealer and tighten in sequence (see Fig. 1). Reverse removal procedure to complete installation.

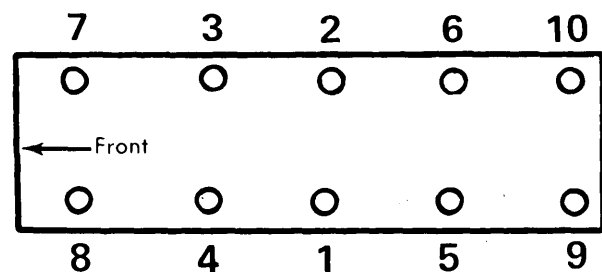


Fig. 1 Cylinder Head Tightening Sequence

VALVES

VALVE ARRANGEMENT

I-E-I-E-I-E-I-E (Front to rear).

VALVE GUIDE SERVICING

Guides are integral with cylinder head. If valve stem clearance in guide is excessive, valves with oversize stems are available. Ream guide bores to accommodate oversize stems and afford specified clearance using suitable reamer set (J-26590).

VALVE STEM OIL SEALS

Install oil seal on valve stem before installing spring. Make sure that seal is flat and not twisted. **NOTE** – Do not interchange intake and exhaust seals. Intake is identified by the letters "IN" and exhaust by "EX".

VALVE SPRINGS

Removal – Remove camshaft covers, depress valve spring with valve spring compressing tool J-8062 (or equivalent) and remove rocker arms.

NOTE – Keep rocker arms and guides separate for reinstallation in original location.

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2) Install suitable air line adapter to spark plug port and apply air pressure. Depress valve springs and remove rocker guides, valve retainers, caps, springs and valve stem oil seals.

Installation — 1) Test spring with suitable spring tester. Replace springs not within specifications.

2) Install oil seal, compress valve spring and cap and install retainers and guides. **NOTE** — Grease may be used to hold retainers in place. Release spring tension ensuring retainers seat properly. Reverse removal procedure to complete assembly.

VALVE SPRING INSTALLED HEIGHT

Specified height is 1.25" (32 mm) measured from top of spring seat or shim to top of valve spring. If measured height exceeds specifications, install a valve spring seat shim to meet specifications.

VALVE STEM INSTALLED HEIGHT

Specified height is .71" (18 mm) measured from end of valve stem to top of cylinder head. This height is required to assure correct operation of hydraulic lifters. If measured height exceeds specifications, grind tip of valve. **CAUTION** — Do not grind more than .030" (.75 mm) from any exhaust valve tip.

HYDRAULIC VALVE LASH ADJUSTERS

NOTE — Lash adjusters are serviced as complete assemblies only. Parts are not interchangeable between adjusters

No adjustment of lash adjusters is required. Servicing of adjusters requires only that care and cleanliness be exercised in the handling of parts. Adjuster must be full of oil prior to installation.

PISTONS, PINS & RINGS

OIL PAN

See Oil Pan Removal at end of ENGINE Section.

PISTON & ROD ASSEMBLY

NOTE — New pistons must be installed in same cylinders for which they were fitted and used pistons in same cylinder from which they were removed.

Removal — 1) With cylinder head and oil pan removed, use a ridge reamer to remove any ridge or deposits on upper end of cylinder bore. **NOTE** — Piston must be at bottom of stroke and covered with cloth to collect cuttings.

2) Inspect rods and caps for cylinder identification and mark as necessary. Remove rod cap covering studs for crankshaft and cylinder wall protection.

3) Carefully push piston and rod assembly out top of cylinder block.

Installation — 1) Lightly coat cylinders, pistons and rings with engine oil. Ensure ring gaps are properly spaced (see Fig. 2). Marked side of compression rings are toward top of piston.

2) Install ring compressor on piston ensuring ring gap positions do not change. Install piston and rod assembly with notch in piston top facing front of engine.

3) Tap piston and rod assembly carefully into correct cylinder with suitable tool. **NOTE** — Do not damage cylinder wall or crankshaft journal with rod studs.

4) With connecting rod seated on crankshaft journal, install rod caps and tighten nuts.

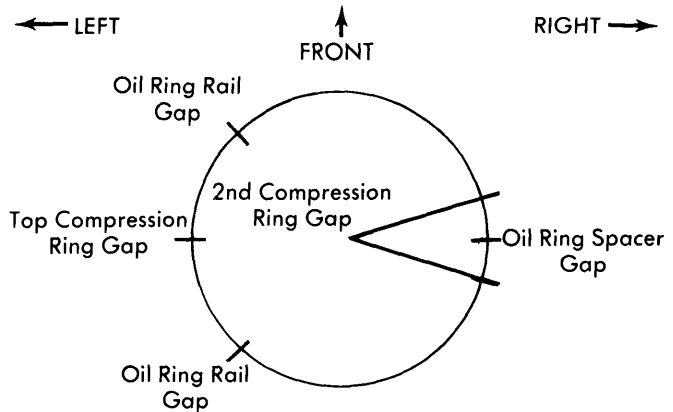


Fig. 2 Ring Gap Location on Piston

FITTING PISTONS

Measure piston bore diameter, then measure piston diameter at skirt across centerline of piston pin. Maximum acceptable clearance is .002" (.050 mm) for either a used or new piston in worn cylinder bore. Oversize pistons are available in .001" (.025 mm) and .030" (.75 mm) oversize.

PISTON PINS

Inspection — Piston and piston pin are matched set and are not serviced separately. Measure diameter of piston pin with a micrometer and measure piston pin bore with a dial bore gauge or inside micrometer. If clearance is in excess of specifications, replace piston pin.

Removal — Place piston on suitable support. Using a pilot tool as driver, use arbor press to push pin from piston and rod.

Installation — Lubricate piston pin bores in piston and connecting rod and assemble rod to piston (alignment of rod in relation to notch on piston head is not important). Place piston on suitable support and using a pilot tool and arbor press, push pin into piston and rod assembly. Check piston for freedom of movement on pin.

CRANKSHAFT & ROD BEARINGS

MAIN & CONNECTING ROD BEARINGS

NOTE — Following procedures are with oil pan removed.

Connecting Rod Bearings — 1) Remove rod caps after ensuring caps and rods are marked for cylinder identification. Use Plastigage method to check for proper clearances.

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2) Replace bearings not within specifications. New bearings are available in standard and the following undersizes: .001" (.025 mm), .010" (.25 mm) and .020" (.50 mm).

3) Selective fitting is required on each connecting rod. **NOTE** — Standard bearing halves may be used with a .001" (.025 mm) undersize bearing. Coat bearing surfaces with oil, install rod cap with bearing and tighten nuts.

Main Bearings — 1) With oil pan removed, support crankshaft at both ends. Start with rear main cap and work forward. Remove one cap at a time and use Plastigage method to check clearances. Replace bearings not within specifications.

2) Check crankshaft journal for wear. If journal is not within specifications, remove crankshaft and grind to suitable undersize. **NOTE** — A standard bearing half may be used with a .001" (.025 mm) undersize, or a .001" (.025 mm) bearing half may be used with a .002" (.050 mm) to obtain correct clearance.

3) Using a suitable tool installed in crankshaft oil hole, rotate crankshaft clockwise to remove upper bearing half. Coat new upper bearing half with engine oil, press firmly to crankshaft journal and rotate bearing into place. Ensure tang on bearing corresponds to notch in bearing saddle.

4) Install main bearing cap with lower bearing half in place and tighten bolts.

THRUST BEARING ALIGNMENT

With crankshaft forced toward front of engine, check end play at front of number five bearing cap with a feeler gauge. If end play exceeds specifications, thrust bearings must be replaced.

REAR MAIN BEARING OIL SEAL

Removal — With engine removed from vehicle, remove oil pan and rear main bearing cap. Clean bearing cap and cylinder block and inspect crankshaft seal surface for excessive wear, nicks, etc.

Installation — Install new seal in cylinder block, taking care to seat seal against rear main bearing bulkhead. Coat horizontal bearing cap split line with suitable sealer and install rear bearing cap while sealer is still wet to touch. Install and tighten cap bolts and place suitable two part sealer in vertical grooves. Remove excess sealer and reinstall oil pan.

CAMSHAFT**ENGINE FRONT COVER**

Removal — 1) Remove upper and lower timing belt covers. Remove crankshaft drive pulley, timing belt and timing sprocket.

2) Remove attaching bolts, three oil pan bolts to cover and remove front cover. Remove oil cover gasket and exposed portion of oil pan gasket. Inspect front cover oil seal and replace if necessary.

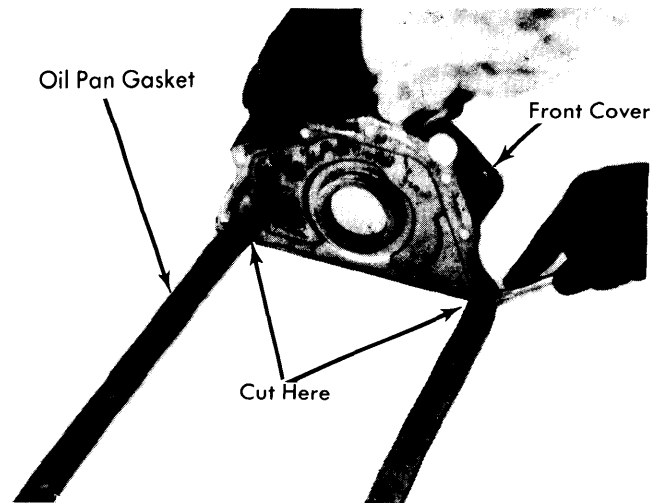


Fig. 3 Fabricating Front Cover-to-Oil Pan Gasket by Cutting a Section from NEW Oil Pan Gasket

Installation — 1) Replace front cover gasket. Cut portion of oil pan gasket as shown in Fig. 3. Apply suitable sealing compound to new portion of oil pan gasket.

2) Complete installation by reversing removal procedure.



Fig. 4 Installing Front Engine Cover. Note Centering Tool is Fitted Through Oil Seal Hole in Cover

FRONT COVER OIL SEAL

Removal & Installation — Remove front cover and pry seal out with large screwdriver. Be careful not to bend cover during this operation. Place open end of new seal toward inside of front cover. Reinstall cover.

TIMING BELT REPLACEMENT

Removal — 1) Remove timing belt upper cover and rotate crankshaft until timing mark on pulley is at 0° (No. 1 cylinder at TDC). Remove A/C compressor and brackets if necessary.

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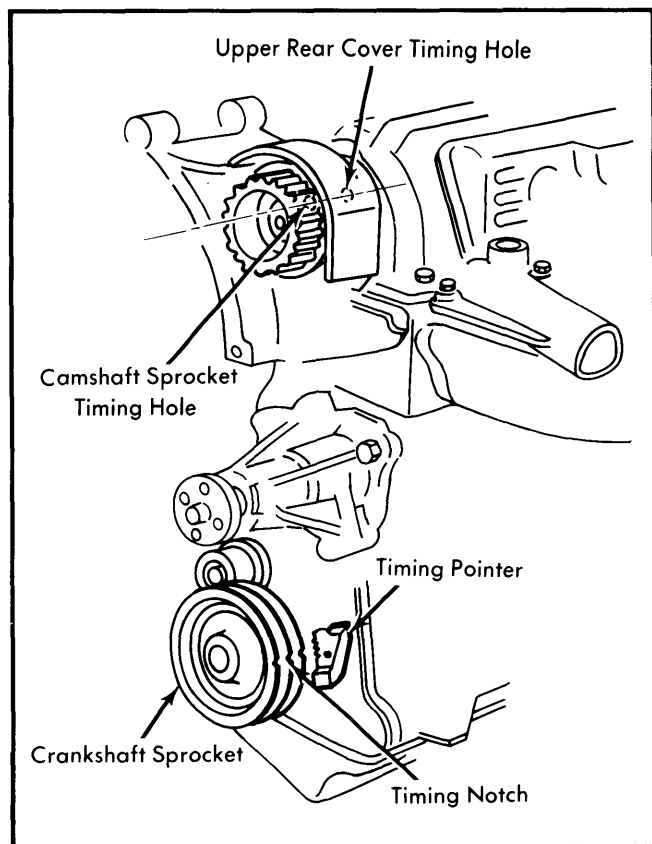


Fig. 5 Sprocket Timing Marks

2) Insert $\frac{1}{8}$ " drill rod through hole in rear upper cover and hole in camshaft drive sprocket.

3) Remove lower belt cover and loosen idler pulley so that idler can rotate clockwise. Remove timing belt.

Installation – 1) Install belt on sprocket and use $\frac{1}{4}$ " Allen wrench to move idler counter clockwise until all slack is removed from belt, then tighten idler belt.

NOTE – Do not let timing belt back up.

2) Use belt tension gauge between camshaft sprocket and idler pulley. Be sure gauge finger is in notch between teeth of belt.

3) Use $\frac{1}{4}$ " Allen wrench on idler pulley to obtain correct tension. Reverse removal procedures to complete installation.

CAMSHAFT

Removal – With timing belt and camshaft sprocket removed, remove rocker arms and heater assembly. Remove cam carrier rear cover and camshaft thrust plate bolts, slide camshaft rearward slightly and remove thrust plate. Remove motor mount nuts and wire retainers, raise engine and remove camshaft.

Installation – To install, reverse removal procedure. **NOTE** – Apply Molycoat (or equivalent) to rocker arms if camshaft was replaced.

CAMSHAFT BEARINGS

This engine uses no camshaft bearings. Camshaft rides directly in camshaft carrier. Inspect bearing surfaces of carrier for wear or damage. If bearing areas are defective, camshaft carrier must be replaced.

CAM LOBE LIFT

1) Remove camshaft cover and install dial indicator on cam carrier. Intake and exhaust lobe on same cylinder can be measured in this manner. Turn crankshaft in direction of normal rotation until plunger is on heel of cam lobe.

2) Zero indicator. Turn engine slowly until indicator is in fully raised position. **NOTE** – Ignition primary lead must be disconnected from coil if using remote starter switch.

3) Record reading and compare with specifications. Continue procedure for each cylinder to be checked.

ENGINE OILING

Crankcase Capacity – 4 quarts. Add $\frac{1}{2}$ quart with filter change. Change oil every 12 months or 7500 miles, whichever comes first.

Oil Filter – Replace at first oil change and every second oil change thereafter.

Normal Oil Pressure – 34-42 psi @ 2000 RPM.

Pressure Regulator Valve – Located in oil pump body. Not adjustable.

ENGINE OILING SYSTEM

All oil from the oil pump passes through a full-flow oil filter and into a main gallery. Main, connecting rod and camshaft bearings are pressure lubricated along with the valve lash adjusters. Piston pins and cylinder walls are splash lubricated. No lubrication is supplied to the timing belt.

OIL PUMP

Disassembly – Remove oil pump cover bolts. Remove cover and gasket. Remove pump gear assembly, pressure regulator valve and related parts. Replace pickup tube "O" ring if necessary. Ensure "O" ring seats properly when pickup tube is installed in pump body.

Reassembly – Clean and inspect all parts for wear or damage. **NOTE** – Pump gears and body are not serviced separately. If pump gears or body are worn or damaged, replace entire pump assembly. To assemble, reverse disassembly procedure.

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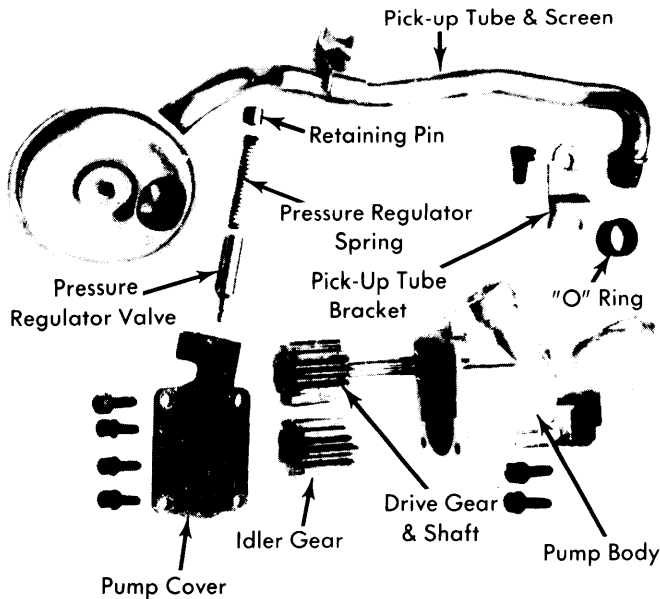


Fig. 6 Exploded View of Oil Pump Assembly

TIGHTENING SPECIFICATIONS

| Application | Ft. Lbs. |
|-----------------------------------|----------|
| Camshaft Carrier/Head Bolts | 75 |
| Camshaft Sprocket Bolts | 75 |
| Crankshaft Pulley Bolt | 75 |
| Connecting Rod Nuts | 40 |
| Exhaust Manifold | |
| Center Bolts | 15 |
| End Legs | 22 |
| Flywheel Bolt | 50 |
| Idler Pulley Bolts | 15 |
| Intake Manifold Bolts | 15 |
| Main Bearing Caps | 50 |
| Water Pump Bolts | 15 |
| Camshaft Cover Nuts | 1 |
| Crankcase Cover Bolts | 5 |
| Oil Pan Bolts | 4 |
| Oil Pump Cover Screws | 7 |
| Oil Pump Bolts | 15 |

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

| Engine | HP at RPM | Torque (Ft. Lbs. at RPM) | Compr. Ratio | Bore | | Stroke | | Displ. | |
|--------|-----------|--------------------------|--------------|------|----|--------|------|----------|------|
| | | | | in. | mm | in. | mm | cu. ins. | cc |
| 1600 | 63@4800 | 82@3200 | 8.6-1 | 3.23 | 82 | 2.98 | 75.7 | 97.6 | 1600 |

In. (mm)

VALVES

| Engine & Valve | Head Diam. | Face Angle | Seat Angle | Seat Width | Stem Diameter | Stem Clearance | Valve Lift |
|----------------|--------------------------------|------------|------------|--------------------------|------------------------------|----------------------------|-----------------|
| 1600 cc Int. | 1.5303-1.5405 (38.87-39.13) | 45° | 46° | .049-.059 (1.25-1.50) | .3138-.3144 (7.970-7.986) | .0006-.0017 (.015-.045) | .3866 (9.82) |
| Exh. | 1.2547-1.2659 (31.87-32.15) | 45° | 46° | .063-.075 (1.60-1.90) | .3130-.3136 (7.950-7.965) | .0014-.0025 (.035-.065) | .3866 (9.82) |

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

| Engine | MAIN BEARINGS | | | | CONNECTING ROD BEARINGS | | |
|---------|----------------------------------|----------------------------|----------------|------------------------------|-------------------------|----------------------------|--------------------------|
| | Journal Diam. In. (mm) | Clearance In. (mm) | Thrust Bearing | Crankshaft End Play In. (mm) | Journal Diam. In. (mm) | Clearance In. (mm) | Side Play In. (mm) |
| 1600 cc | 2.0078-2.0088 (50.998-51.024) | .0009-.0026 (.024-.066) | No.5 | .004-.008 (.101-.203) | | .0014-.0031 (.036-.079) | .004-.012 (.101-.304) |

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ENGINE SPECIFICATIONS (Cont.)

| PISTONS, PINS, RINGS | | | | | | |
|----------------------|----------------------------|----------------------------|---------------------|-------|---------------------------|----------------------------|
| Engine | PISTONS | PINS | | RINGS | | |
| | Clearance In. (mm) | Piston Fit In. (mm) | Rod Fit In. (mm) | Rings | End Gap In. (mm) | Side Clearance In. (mm) |
| 1600 cc | .0008-.0016 (.020-.040) | .0001-.0003 (.003-.007) | ① | 1 | .009-.019 (.229-.483) | .012-.027 (.305-.686) |
| | | | | 2 | .008-.018 (.203-.452) | .012-.032 (.305-.813) |
| | | | | 3 | .015-.055 (.381-1.397) | .000-.005 (.000-.127) |

① — Pin is locked in rod.

| VALVE SPRINGS | | | |
|---------------|----------------------------|-------------------------------------|------------------------------|
| Engine | Free Length In. (mm) | PRESSURE Lbs. @ In. (kg @ mm) | |
| | | Valve Closed | Valve Open |
| 1600 cc | 1.505 (38.23) | 64-72@1.26 (29-33@32) | 167-179@.886 (76-81@22.5) |

| CAMSHAFT ① | | | |
|------------|---------------------------|-----------------------|-----------------------|
| Engine | Journal Diam. In. (mm) | Clearance In. (mm) | Lobe Lift In. (mm) |
| 1600 cc | | | .20407 (5.1834) |

① — End play is .007-.017" (.1743 mm)