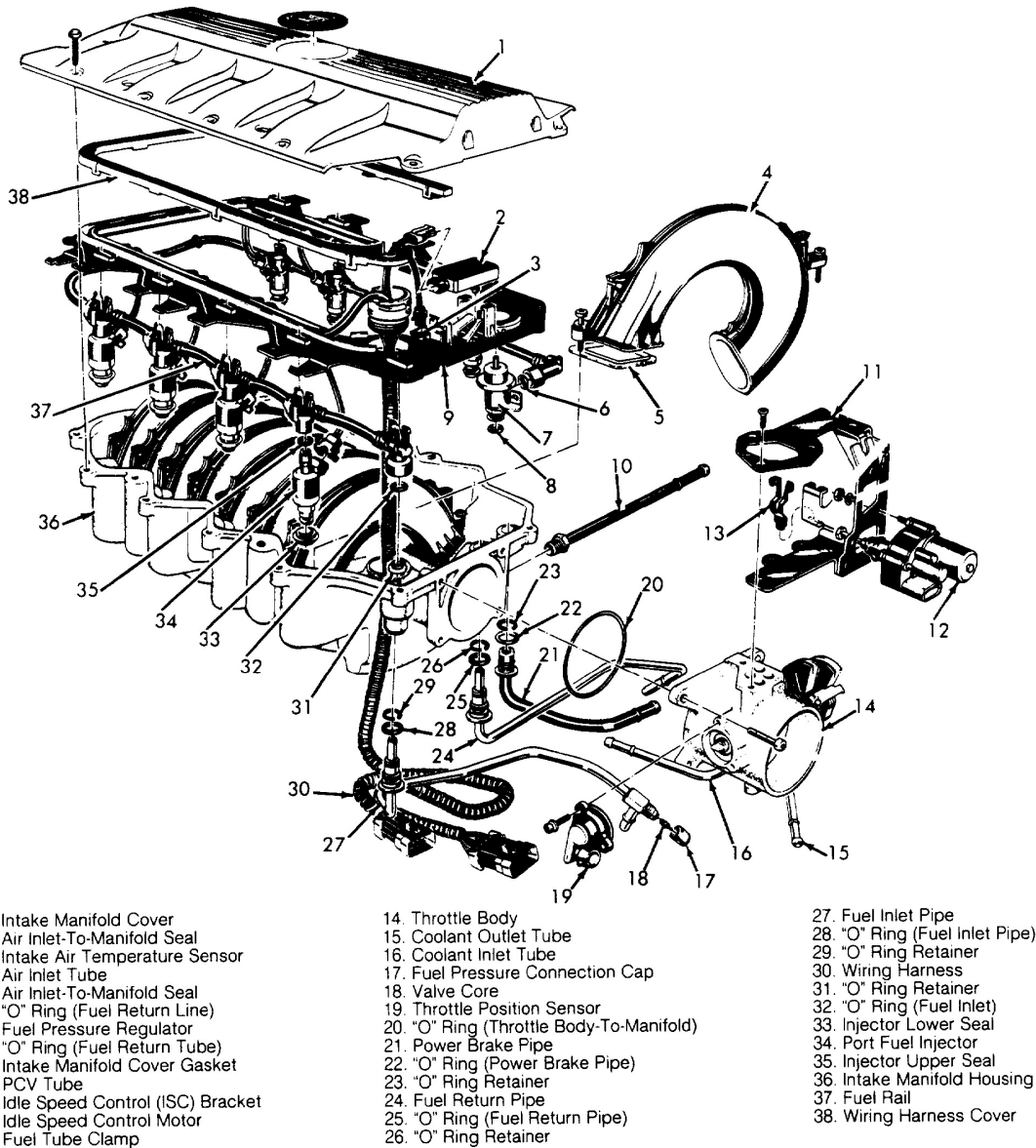


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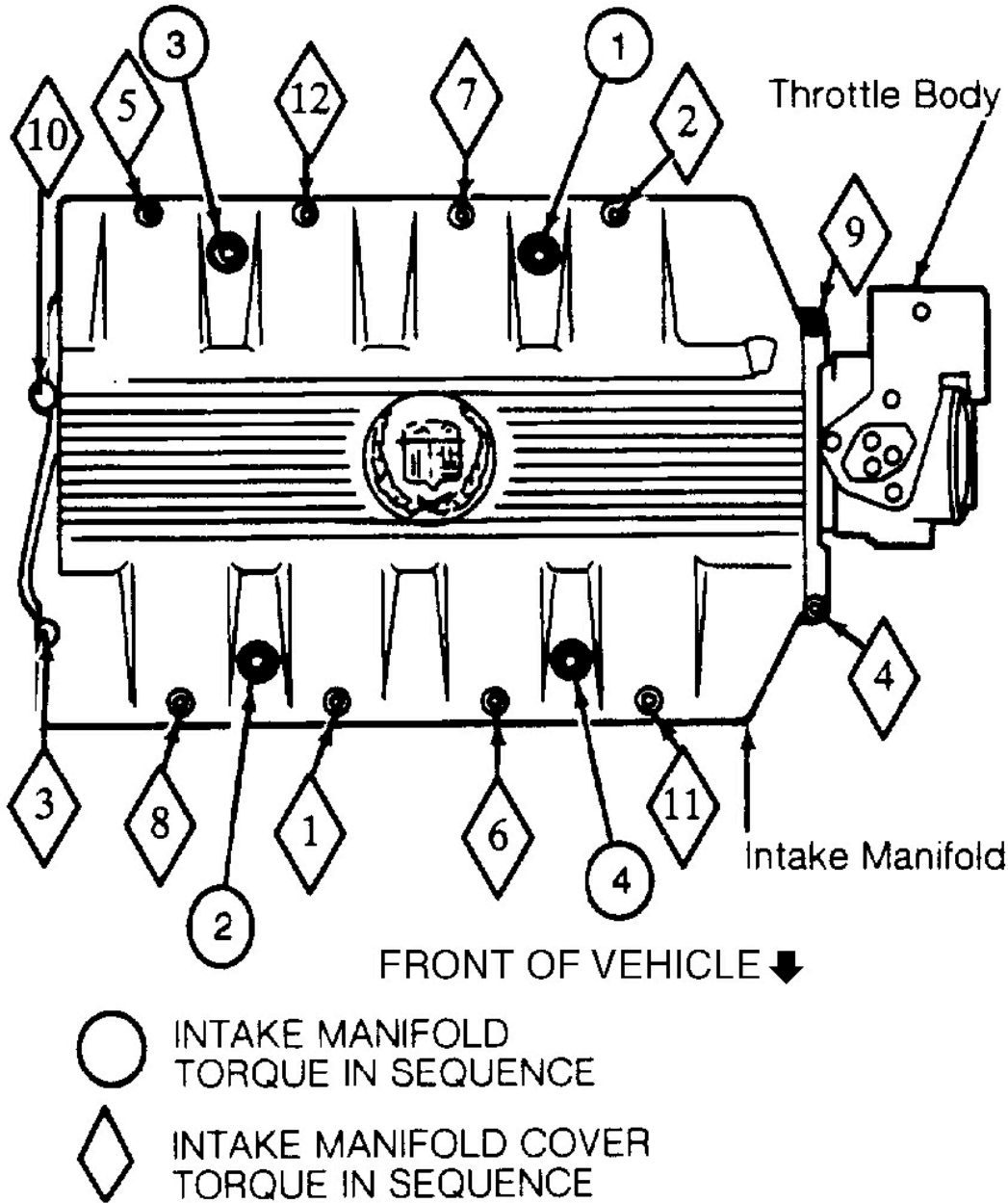
**Fig. 2: Exploded View Of Intake Manifold**  
Courtesy of GENERAL MOTORS CORP.

## Installation

1. Position NEW throttle body "O" ring seal on throttle body with petroleum jelly.

**CAUTION: DO NOT reuse old throttle body "O" ring seal. DO NOT use silicone lubricants on throttle body "O" ring seal.**

- To complete installation, reverse removal procedure using NEW manifold seals if removed. Tighten intake manifold and intake manifold cover to specification. See **Fig. 3** . See **TORQUE SPECIFICATIONS** .



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**Fig. 3: Intake Manifold Tightening Sequence**

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Courtesy of GENERAL MOTORS CORP.

### EXHAUST MANIFOLD

#### Removal (Left)

1. Remove cradle beauty panel. Remove air cleaner assembly. Disconnect left and right engine torque struts and position aside. Remove engine cooling fans. Install engine support fixture (J 28467-A). Raise vehicle on hoist.
2. Remove 2 nuts securing motor mount to engine cradle. Remove 2 bolts securing motor mount bracket to crankcase. Remove 2 bolts securing motor mount bracket to cylinder head. Remove 2 nuts securing motor mount to motor mount bracket. Remove 2 bolts securing "Y" pipe to converter and reposition converter aside. Lower vehicle.
3. Raise engine by adjusting engine support fixture. Remove motor mount and bracket. Raise vehicle.
4. Remove 4 bolts securing rear generator bracket. Remove 2 bolts at manifold outlet flange. Remove exhaust manifold bolts and remove manifold and gasket. Discard gasket if damaged.

#### Installation (Left)

For installation, reverse removal procedure.

### CYLINDER HEAD

#### Removal

1. Remove engine. See **ENGINE** . Remove intake manifold, cam covers, harmonic balancer, front cover and oil pump. See **INTAKE MANIFOLD & SEALS** , **CAM COVER(S)** , **HARMONIC BALANCER** , **FRONT COVER** and **OIL PUMP** .
2. Remove chain tensioner from timing chain for head being removed. Remove cam sprockets from head being removed (timing chain remains in chain case). Remove timing chain guides (Access retaining screws through plugs at front of cylinder head).
3. Remove water crossover. Remove exhaust manifold. See **EXHAUST MANIFOLD** . Remove cylinder head bolts in reverse order of tightening sequence. See **Fig. 4** . Remove cylinder head and gasket.

**CAUTION: With camshafts in place, some valves are open at all times. DO NOT rest head face down or valve damage will occur.**

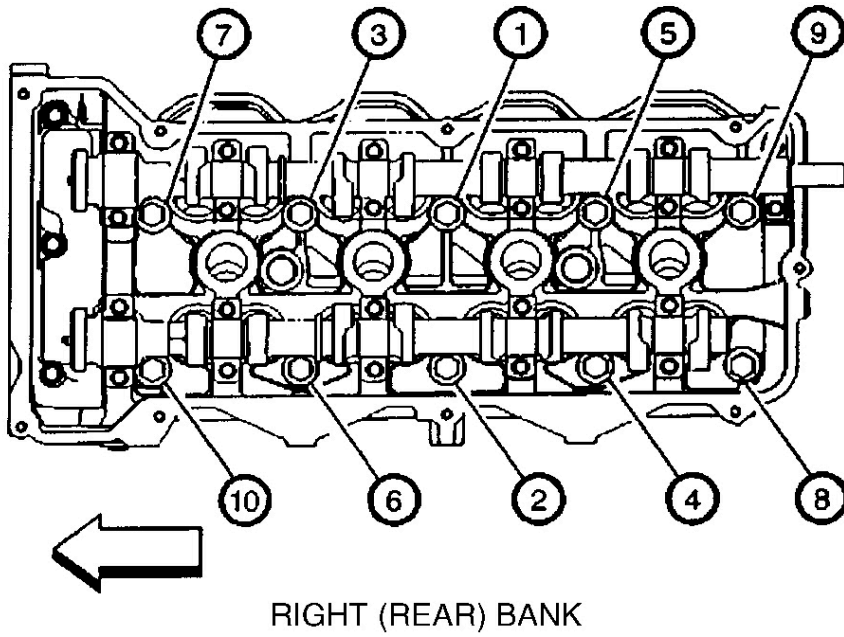
#### Installation

**NOTE: The following installation procedure includes information from General Motors technical service bulletin, 99-06-010106.**

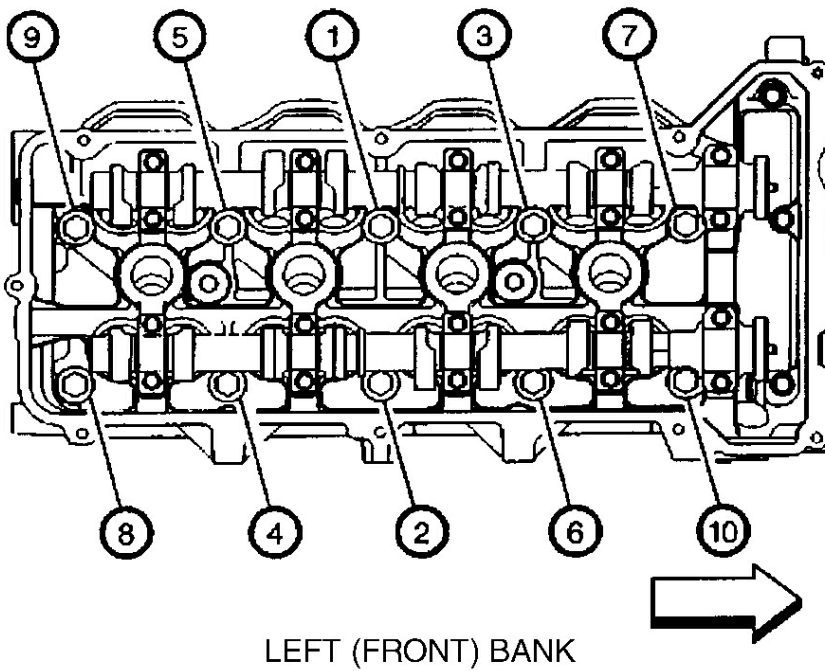
1. Install head with NEW head gasket. Lube washers and underside of bolt heads with engine oil before installation. Tighten head bolts to specification. See **TORQUE SPECIFICATIONS** . See **Fig. 4** . To complete installation, reverse removal procedure.

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RIGHT (REAR) BANK



LEFT (FRONT) BANK

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**Fig. 4: Cylinder Head Tightening Sequence**  
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FRONT COVER

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### Removal & Installation

Remove serpentine belt. Remove bolt securing power steering hose. Remove harmonic balancer. See **HARMONIC BALANCER** . Remove belt tensioner. Remove belt idler pulley. Remove front cover and gasket (Gasket is reusable. DO NOT discard unless damaged). For installation, reverse removal procedure.

### CRANKSHAFT FRONT SEAL

#### Removal

Remove harmonic balancer. See **HARMONIC BALANCER** . Pry out seal with a screwdriver or pry bar.

**CAUTION: DO NOT gouge front cover bore or crankshaft.**

#### Installation

Lubricate seal lips with engine oil and position seal with garter spring toward engine. Using Seal Installer (J 38818) with Harmonic Balancer Installer (J 39344), push seal into front cover until installer bottoms. To finish installation, reverse removal procedure.

### CAMSHAFT SECONDARY DRIVE (TIMING) CHAIN(S)

#### Removal

1. Rotate engine to TDC No. 1 cylinder. Remove front cover. See **FRONT COVER** . Remove right hand cam cover. See **CAM COVER(S)** . Remove right hand secondary chain tensioner.
2. Remove right hand chain guide. Access upper chain guide mounting bolt through hole in cylinder head covered with plastic plug.
3. Remove right hand cam sprocket bolts and sprockets. Remove secondary drive chain. Repeat steps 1)
4. to remove left hand chain.

#### Installation

Retime camshafts. See **CAMSHAFT** . Install front cover. See **FRONT COVER** . Install cam cover(s). See **CAM COVER(S)** .

### CAMSHAFT DRIVE CHAIN TENSIONER

#### Removal

Remove front cover. See **FRONT COVER** . Remove 2 tensioner mounting bolts. Remove tensioner.

#### Installation

1. Before installation, tensioner must be collapsed. Rotate ratchet release lever counterclockwise and hold.

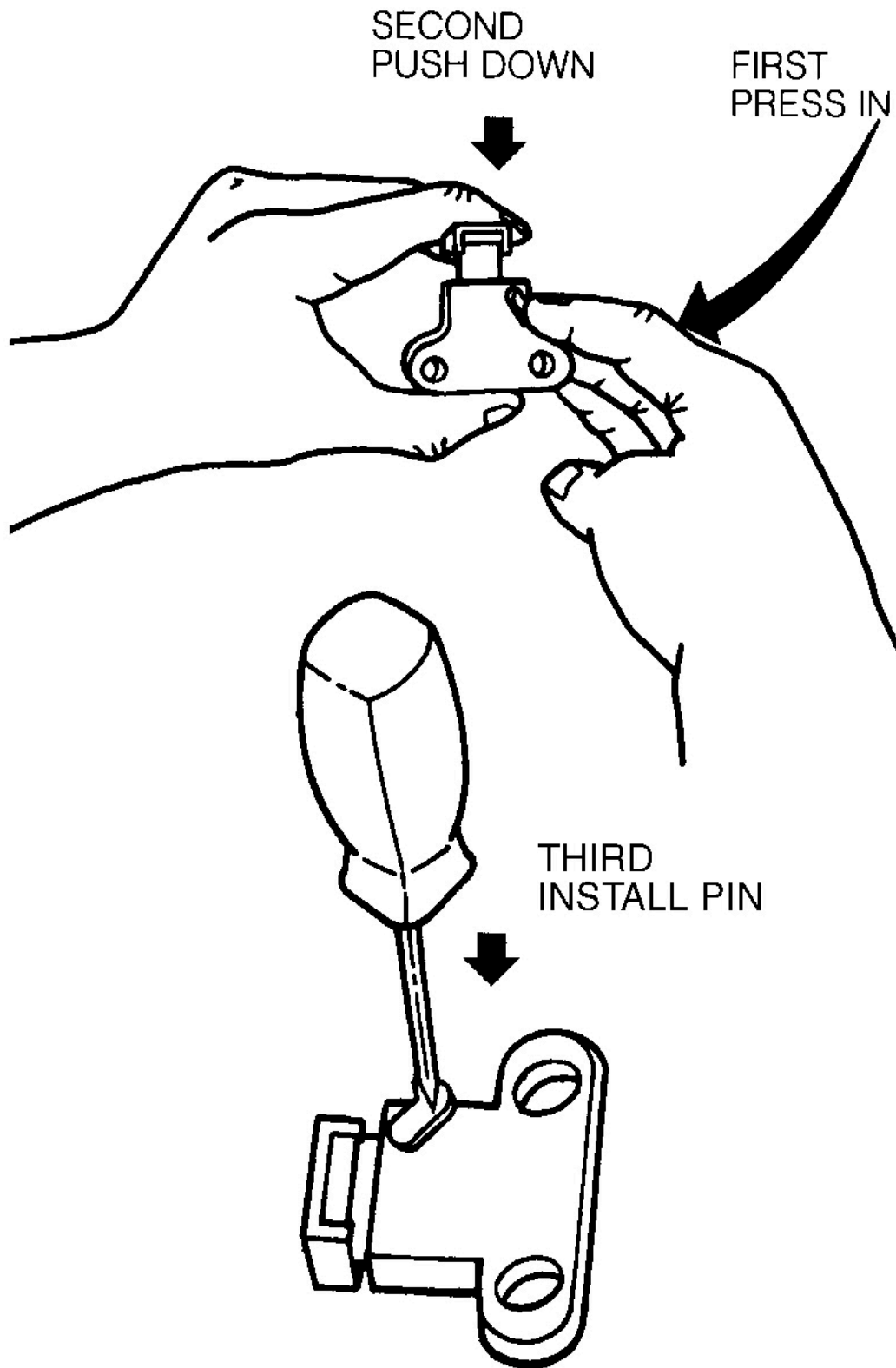
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See **Fig. 5** .

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**Fig. 5: Collapsing Tensioner**

Courtesy of GENERAL MOTORS CORP.

2. Collapse tensioner shoe and hold. Release ratchet lever and slowly release pressure on shoe. As ratchet lever moves to first click, hold tensioner shoe inward and insert a pin through hole in release lever. See **Fig. 5**.
3. Locked ratchet mechanism should hold shoe in collapsed position. Install tensioner and bolts and tighten to specification. See **TORQUE SPECIFICATIONS**. Remove retaining pin allowing tensioner shoe to extend. Install front cover. See **FRONT COVER**.

**CAMSHAFT PRIMARY CHAIN**

**NOTE:** SMU - Section 6A2 - Engine Mechanical - Revised Camshaft #47-61-02 included.

**Removal**

1. Remove engine assembly and place on engine stand. See **ENGINE**. Remove serpentine drive belt, idler pulley and belt tensioner. Remove front cover and oil pump See **FRONT COVER** and **OIL PUMP**. Remove cam covers. See **CAM COVER(S)**.
2. Remove 3 timing chain tensioners. Remove camshaft sprocket bolt from all 4 camshafts and remove sprockets. Remove secondary drive chains from intermediate shaft sprocket.
3. Remove bolt from intermediate shaft sprocket and slide gears and primary drive chain off crankshaft and intermediate shaft. Unless wear is evident, it is unnecessary to remove intermediate shaft.

**Installation**

1. Retime camshafts. See **CAMSHAFT**. Install front cover. See **FRONT COVER**. Install cam cover(s). See **CAM COVER(S)**.

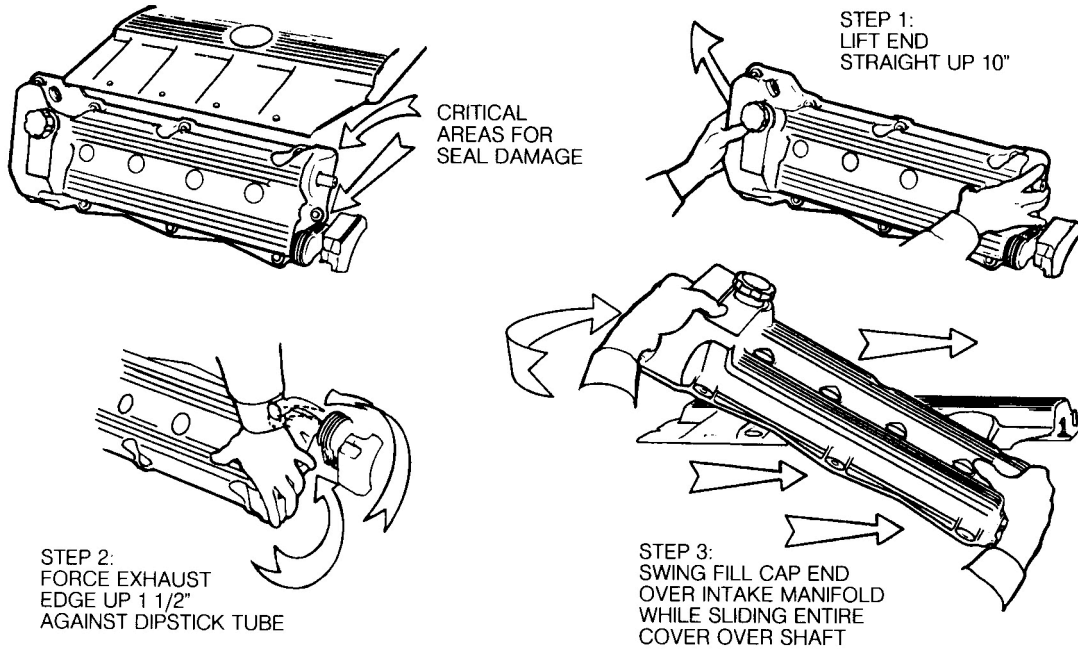
**CAM COVER(S)****Removal (Left Cover)**

1. Disconnect battery. Partially drain coolant from radiator. Disconnect upper radiator hose at water crossover. disconnect spark plug wires.
2. Remove right hand fan. Disconnect battery cable at generator. Disconnect cable harness cup at cam cover and position aside. Disconnect PCV fresh air tube from cam cover.
3. Remove left and right torque struts. Disconnect water pump drive belt. Using Pulley Remover (J 38825), remove water pump pulley. Remove camshaft seal retainer screws and remove seal. Disconnect battery cable retainer at front of cam cover. Remove cam cover screws.
4. Remove cam cover by moving cam drive end of cover up and then pivot entire cover around water pump drive shaft. Continue moving cover upward and pivoting so that edge of cover closely follows left edge of intake manifold cover. See **Fig. 6** and **Fig. 7**. Discard cover seal if there is any evidence of damage or if seal comes out of groove in cover during removal. Spark plug seals may be reused if undamaged.

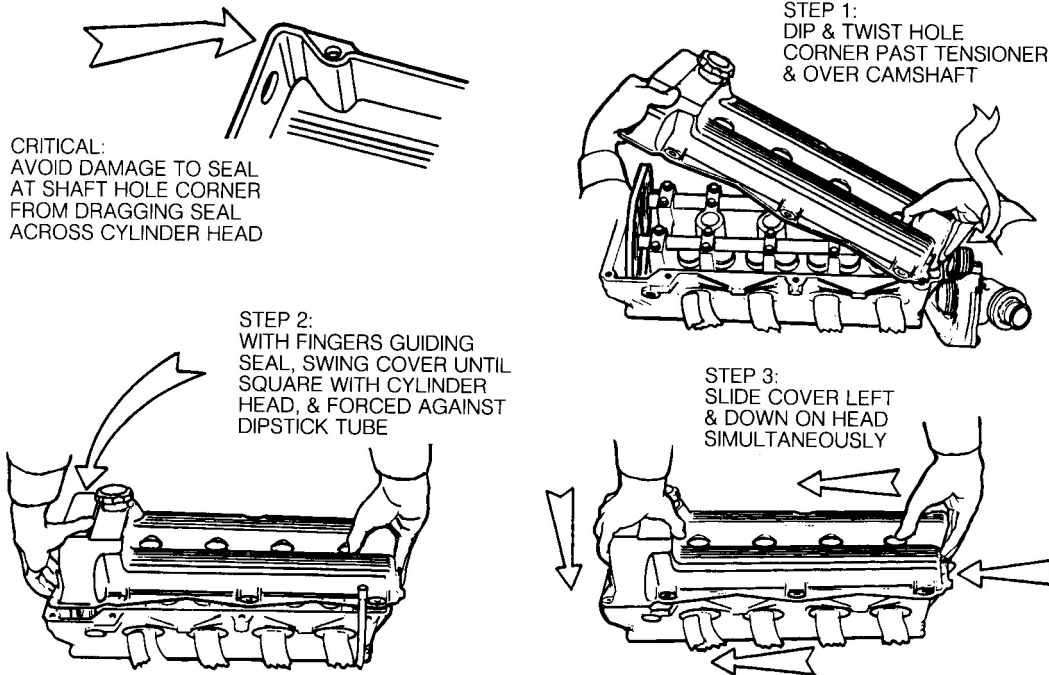


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REMOVAL



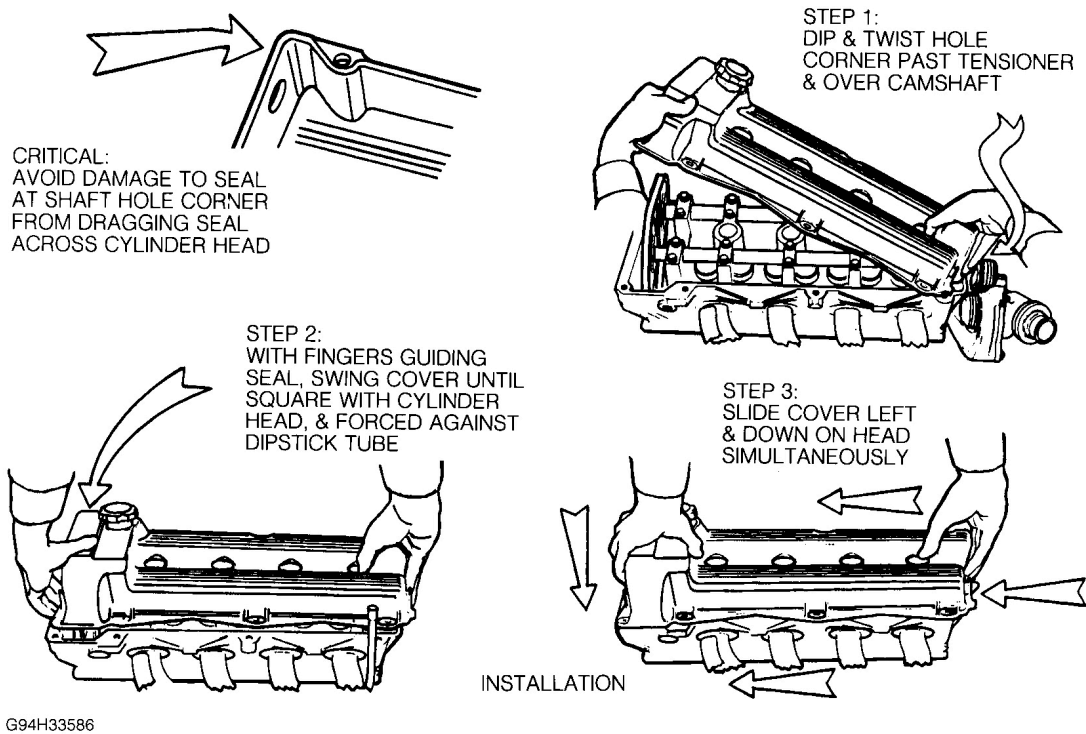
INSTALLATION

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**Fig. 6: Removing Left Cam Cover**  
Courtesy of GENERAL MOTORS CORP.

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**Fig. 7: Installing Left Cam Cover**  
Courtesy of GENERAL MOTORS CORP.

### Installation (Left Cover)

1. Install spark plug and cam cover seals as required. Insert intake cam through hole in cam cover and, using fingers, guide cam cover up over edge of cylinder head. See **Fig. 6** and **Fig. 7**. Use care to prevent exposed section of cam cover seal from being damaged by edge of cylinder head casting. Work cover into position by allowing top edge of cover to follow left hand edge of intake manifold.
2. Install cam cover screws and tighten to specification. See **TORQUE SPECIFICATIONS**. To complete installation, reverse removal procedure. Install water pump pulley using Pulley Installer (J 38823). Tighten all fasteners to specification.

### Removal (Right Cover)

1. Disconnect Battery. Raise vehicle and disconnect exhaust "Y" pipe at converter. Position converter aside. Lower vehicle.
2. Remove tower-to-tower brace. Disconnect Distributorless Ignition System (DIS) wiring connectors (4) and mounting bolts (5). Remove DIS and right bank spark plug wires. Disconnect PCV valve.
3. Remove purge canister solenoid from rear of cover. Remove 3 screws securing wiring harness to cover. Remove cam cover screws.
4. Support front of engine cradle and remove 2 mounting screws at front of cradle. Remove left and right torque struts. Lower cradle (or raise vehicle) to provide clearance at rear of engine compartment. Remove