1977 AND 1978 MAINTENANCE MANUAL SUPPLEMENT

MOTORHOME

ZE06581, ZE06584

TRANSMODE

ZE06083, ZE06583

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

GMC TRUCK & COACH
DIVISION OF GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

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SECTION 6A
ENGINE
(403 CUBIC INCH)

CONTENTS

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 6A-2 of this supplement".

CAUTION: THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

GENERAL INFORMATION

DESCRIPTION

Effective with Motorhome Vehicle Identification No. TZE167V101285 and TransMode Vehicle Identification No's TZE337V101287 and TZE367V101312, 1977 Motorhome and TransMode vehicles are equipped with a 403 cubic inch engine (figure 1). 1978 Model Vehicles are equipped with the same engine and all service information in this section applies.

The left bank of cylinders (as viewed from the driver's seat) are numbered (from front to rear) 1-3-5-7. Cylinders in the right bank are numbered (from front rear) 2-4-6-8. Refer to figure 2).

The required engine maintenance, and unit numbers and engine identification is outlined in Section 0 of this supplement. The Engine Specifications are listed at the back of this section.

ENGINE MAINTENANCE AND STORAGE

Refer to SECTION 0 at the beginning of this supplement for recommendations pertaining to engine servicing intervals. Winterization and storage are also covered in SECTION 24A of Maintenance Manual X-7525.

ENGINE LUBRICATION SYSTEM
(FIGURE 3)

The engine oil pan forms a reservoir for engine oil to provide lubrication and also hydraulic fluid to operate the valve lifters. Oil pressure for lubrication is furnished by a gear type oil pump that is bolted to the rear main bearing cap and driven by the camshaft gear through a hexagonal drive shaft.

Oil enters the pump through a screened inlet located near the bottom rear of the oil pan. The pressurized oil from the pump passes through the engine oil cooler located in the radiator tank then to the oil filter located on the right rear side of the engine block, see figure 4. The oil filter base has a by-pass valve which in the event of filter restriction will open at 5.3 to 6.3 psi. It then enters the right oil gallery where it is distributed to the five main bearings. The right bank valve lifters receive oil from this gallery from eight feed holes that intersect the gallery.

The five camshaft bearings are lubricated from vertical passages intersecting the main bearing oil passages. At the front main bearing a third passage connects the right main oil gallery to the left gallery which then feeds the left bank of valve lifters.

The engine oil pressure warning light switch is connected to the front of the left oil gallery. The switch is calibrated to turn on the instrument panel warning light when engine oil pressure is too low. The switch, normally closed, is set to open at 2-6 psi. The rear oil gallery plug has a .040" orifice to help purge contaminants from the gallery.

At the front end of the right gallery, a small

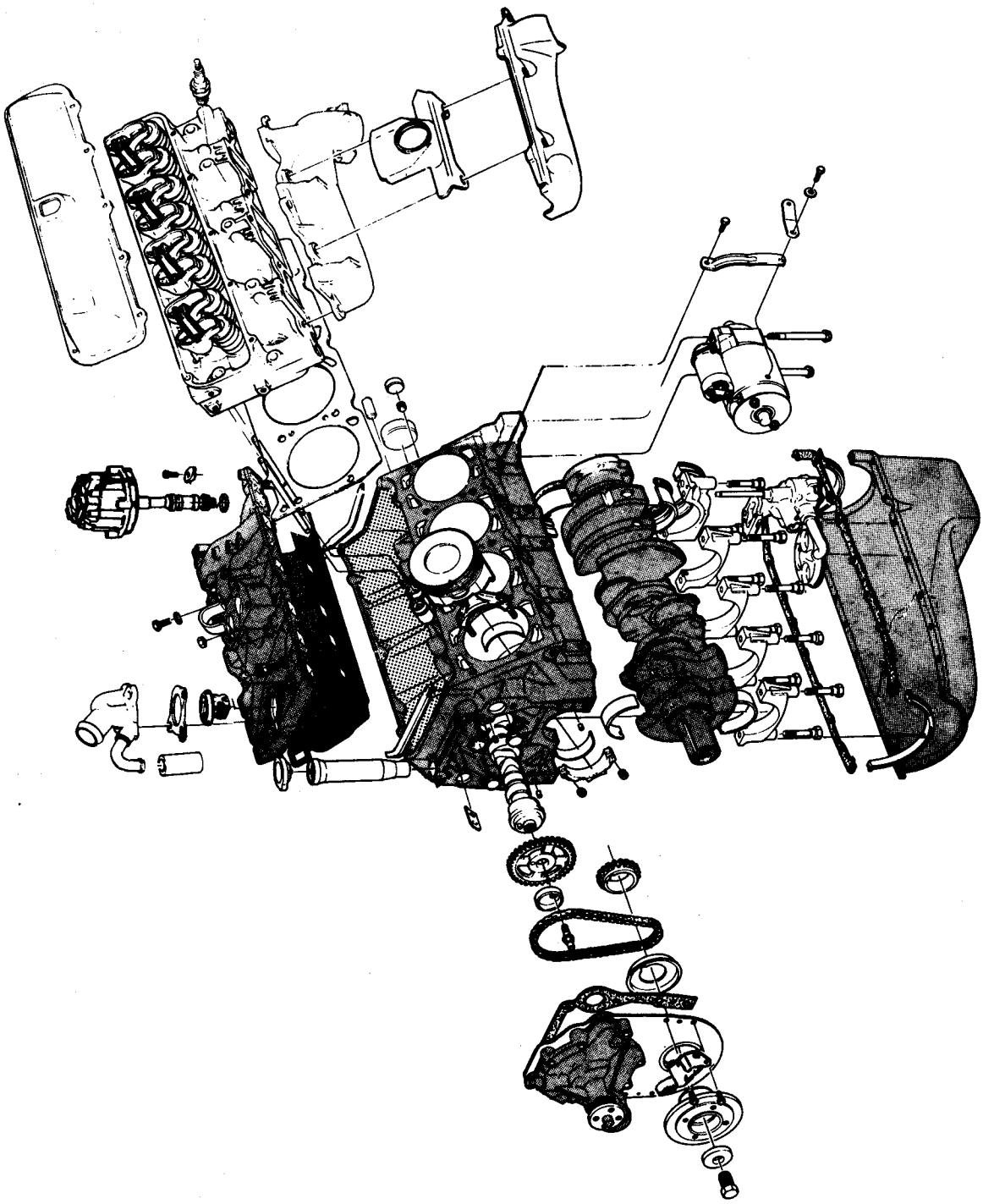


Figure 1—403 Engine Components

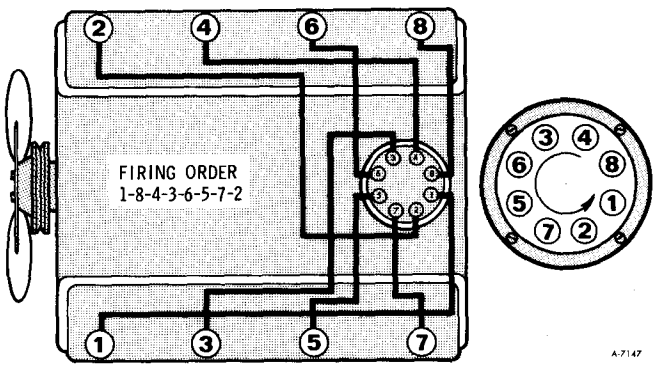


Figure 2—Cylinder Numbers and Secondary Wiring

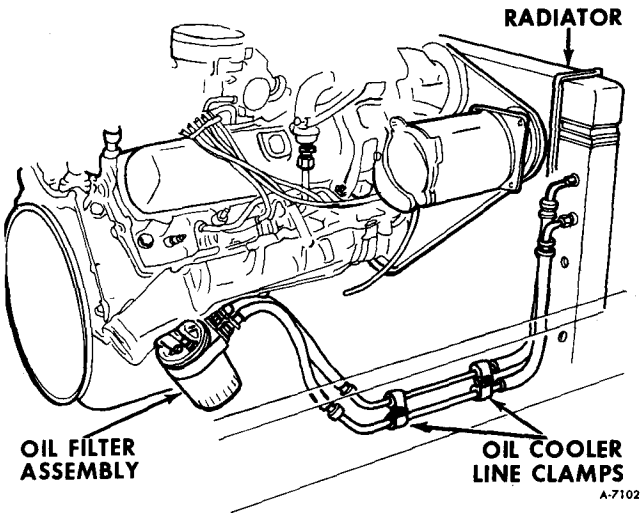


Figure 4—Oil Lines to Cooler

orifice sprays oil to lubricate the fuel pump eccentric cam and the timing chain.

The oil pump and distributor drive gear are lubricated by splash from the rear cam bearing and connecting rod bearings.

The rocker arms and valve tips are lubricated by means of oil furnished through the hydraulic lifters and hollow push-rods. A disc

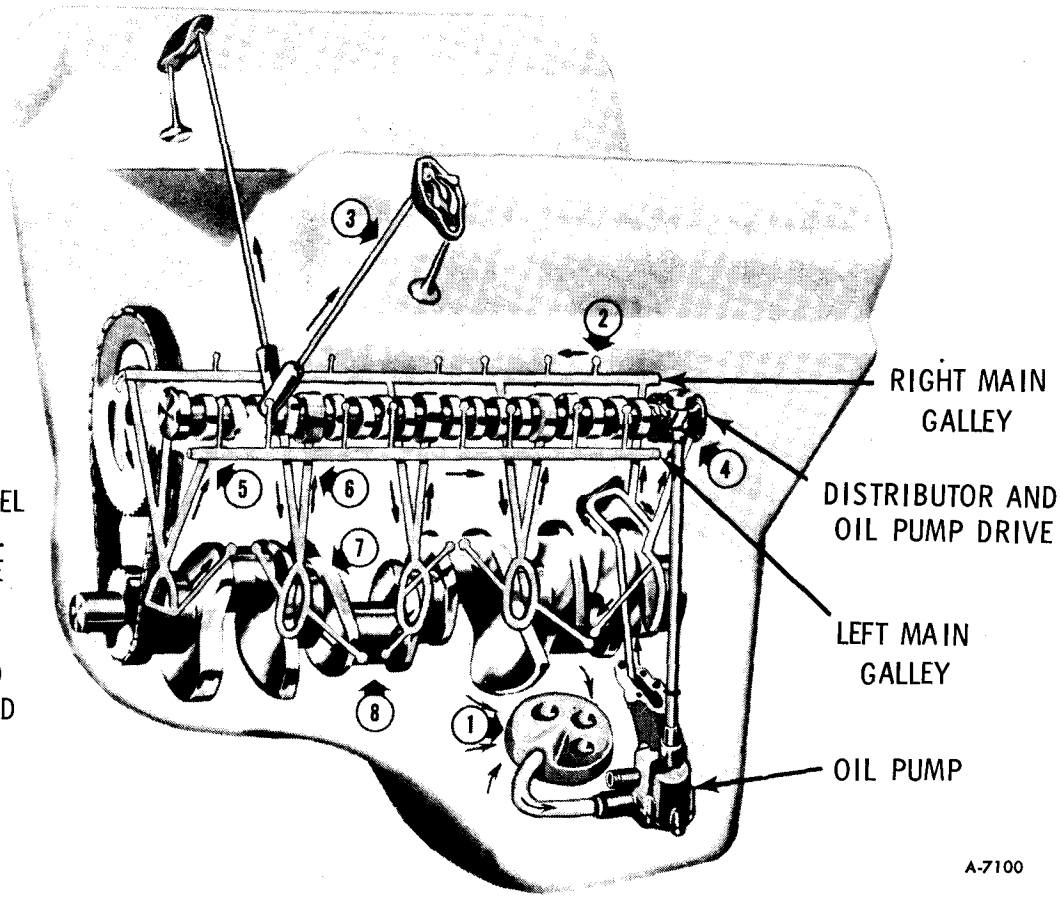


Figure 3—Engine Lubrication

valve in the lifter meters oil to the push rods.

The connecting rod bearings are oiled by constant oil flow from passages drilled through the crankshaft connecting the main journals to the rod journals. A groove around each main bearing furnishes oil to the drilled crankshaft passages.

Oil returns to the oil pan reservoir from the rocker arms through passages at each end of the cylinder heads. Oil from the valve lifter compartment returns through clearance holes in the lower portion of the compartment near the camshaft. The timing chain compartment drains directly into the oil pan.

ENGINE DIAGNOSIS

ENGINE DIAGNOSIS (CONT'D)

GENERAL ENGINE CHECKS

1. EMISSION CONTROL CHECK

To diagnose Emission Control Systems, refer to "Emission Control Charts" in this manual.

2. BATTERY CHECK

The battery must be fully charged before proceeding with engine diagnosis. When the battery has a low charge, determine and repair the cause of the low charge before proceeding with further diagnosis. Refer to "Battery Diagnosis Charts" in Maintenance Manual X-7525.

3. CHOKE CHECK

Freedom of operation may be checked by holding the throttle in the open position and manually operating the automatic choke linkage. When possible, choke linkage should be checked on a cold carburetor. Refer to "Carburetor Diagnosis Charts" in Maintenance Manual X-7525.

4. FLOODING CHECK

Flooding occurs when an excessive amount of fuel enters the cylinders and prevents ignition. If flooding is suspected, look for wet throttle plates, external leakage around the throttle plate shaft, external leakage at the bowl gasket and/or wet spark plugs. If the engine is running, a flooding condition will be indicated by a rough engine idle, poor acceleration, and heavy, black smoke from the exhaust system. Flooding is usually caused by improper operation of the carburetor fuel inlet system or a high float level setting. Additional causes are listed in "Carburetor Diagnostic Procedures" in Maintenance Manual X-7525.

5. CARBURETOR ICING CHECK

Carburetor icing generally occurs when ambient temperatures range from $30^{\circ}F$ to $50^{\circ}F$ ($-1.1^{\circ}C$ to $10^{\circ}C$), and the relative humidity is above 60%. Moisture from in-rushing air collects and freezes between the throttle plates and the throttle base, cutting off the air

supply to the engine, and stalling the engine.

NOTE: If icing occurs, check operation of the thermostatically controlled air cleaner as described in Section 6T of this supplement.

If icing occurs after the engine is at a normal operating temperature, allow the engine to stand for a short period of time. The carburetor casting will absorb enough heat from the engine to thaw the ice. If the icing occurs while the engine is still cold, the ice may be melted by pouring a small amount of anti-icing additive directly into the carburetor. Neither of the above procedures will prevent a recurrence of the icing condition.

The most effective way to prevent icing is to add an anti-icing additive to the fuel.

6. SPARK INTENSITY CHECK

Disconnect a spark plug wire (twist boot and remove) and remove spark plug. Install a good properly gapped plug in spark plug wire and lay spark plug on clean dry surface of engine, so spark gap at plug can be seen when cranking engine. The spark should jump the gap regularly and be blue in color. A good spark indicates that the ignition primary and secondary circuits are functioning properly. A weak spark (usually a pale orange color), an intermittant spark or no spark at all indicates trouble within the distributor.

Examine secondary lead wires for deteriorated insulation. Correct as necessary. Examine for cracked or burned condition of the distributor cap "button" (center of distributor cap). Look and listen for spark jumping to ground. This condition may require spark plug wire replacement. (This can best be observed in dark area.)

7. HARD STARTING ENGINE CHECK

The problem of an engine that cranks normally but starts hard when cold can usually be traced to an excessively lean fuel mixture. Excessively lean fuel mixtures are usually caused by an improper choke setting or an insufficient amount of fuel being delivered to the cylinders.

If the engine starts OK cold, but is hard to start when hot, the problem may be due to an excessive amount of fuel being discharged through the carburetor. A hot engine hard start or no start condition may also be due to the coil breaking down after it becomes heated. Hard starting occurring only after a hot engine has been shut down for a few minutes, indicates carburetor percolation or vapor lock which causes a rich fuel condition. Refer to "Carburetor Diagnosis" in Maintenance Manual X-7525 for individual fuel problems. (Corroded or loosened terminal could be the cause.)

8. ACCELERATING PUMP DISCHARGE CHECK

Remove the air cleaner and manually operate the throttle linkage while observing the fuel discharge from the accelerator pump nozzles. When the throttle plates are opened, a quick steady stream of fuel should be discharged into the carburetor. Failure of the accelerator pump to discharge a sufficient amount of fuel usually indicates a problem in the fuel delivery system between the supply tank and the carburetor. Refer to "Fuel Pump and/or Carburetor Diagnosis" charts in Maintenance Manual X-7525. Insufficient fuel discharge, however, may also be due to the operation of the accelerator pump circuit within the carburetor.

9. VACUUM LEAKAGE CHECK

With the engine at idle speed, squirt a mixture of kerosene and 10W motor oil around areas where vacuum leakage may occur. A noticeable change in the engine idle when the mixture is squirted on a given point indicates a vacuum leak at that point.

CAUTION: *Kerosene and oil mixture is flammable. Careless application may result in fire. DO NOT use gasoline.*

10. EXCESSIVE FUEL CONSUMPTION CHECK

There are a number of factors, other than engine or carburetor problems, that will contribute to excessive fuel consumption. One of the most important of these is the driving habits of the operator.

When the operator habitually makes "jackrabbit" starts and stops, "rides" the brake pedal, overloads the vehicle, drives at excessively high speeds for prolonged periods, fails to hold a consistent throttle position, (continu-

ously accelerates, then coasts) and/or operates the vehicle under short run conditions (cold engine) the majority of the time, this could be the problem.

Vehicle air resistance at high speeds has a major effect on fuel consumption. Head winds, excessively high speeds, or added protrusions to the vehicle profile will cause an increase in fuel consumption.

When it has been determined that the operator is not at fault, make a fuel consumption test using a calibrated fuel measuring device. The amount of fuel used to drive the vehicle a measured distance should be recorded. Then record the amount of fuel used to return to the starting point. An average of the two readings should be used in determining the existence of a fuel consumption problem. While making the fuel consumption test, the vehicle odometer should be checked over a measured mile for proper calibration.

If the results of the fuel consumption test indicate that a fuel consumption problem does exist, the diagnostic procedures outlined in this manual under "Excessive Fuel Consumption in Carburetor" and/or "Ignition Diagnosis" charts should be followed.

VAPOR LOCK CHECK

The term "vapor lock" means the flow of fuel to the mixing chamber in the carburetor has been stopped (locked) by the formation of vaporized fuel pockets or bubbles caused by overheating the fuel by hot fuel pump, hot fuel lines or hot carburetor.

The more volatile the fuel the greater the tendency for it to vapor lock. Vapor lock is encouraged by high atmospheric temperature, hard driving, defective engine cooling and high altitude.

A mild case of vapor lock will cause missing and hard starting when engine is warm; also, a "sag" during an acceleration or surge during cruise. Somewhat more severe vapor lock will stop the engine which cannot be started again until it has cooled off enough so that any vaporized fuel has condensed to a liquid.

NOTE: Percolation means simply that gasoline in the carburetor bowl is boiling over into the intake manifold. This condition is most apt to occur immediately after a hot engine is shut off. The carburetor has provision for relieving the vapor pressure of overheated fuel in the carburetor bowl by means of internal vents. If, however, percolation should take place, the engine may be started by allowing it to cool slightly and then holding the throttle wide open while cranking to clear the intake manifold of excess fuel.

Some causes of vapor lock may be due to winter grade fuel used in summer (most vapor lock occurs in April due to this), or temperature under hood is too high.

NOTE: Applying wet cloths to fuel lines, fuel pump and/or carburetor can cause fuel to condense and permit engine to run.

ENGINE WILL NOT TURN OVER

GENERAL

Neutral safety switch (located on steering column).

Check dipstick for congealed oil, improper viscosity, or presence of water in oil.

Remove spark plugs to check for hydrostatic lock (liquid in combustion chamber).

ELECTRICAL

Check ignition switch and wiring.

BATTERY

See "Battery Diagnosis Charts".

STARTER

See "Starter Diagnosis Charts".

MECHANICAL

Seized bearings, rings, and/or pistons.

ENGINE TURNS OVER SLOWLY BUT DOES NOT START

GENERAL

Bad or corroded connections.

Undersized battery cable.

Poor ground.

Oil viscosity tpo heavy.

MECHANICAL

Tight bearings, rings, pistons, etc.

BATTERY

See "Battery Diagnosis Charts".

STARTER

See "Starter Diagnosis Charts".

ENGINE TURNS OVER AT NORMAL SPEED—STARTS HARD WHEN COLD

NOTE: Most conditions under "Does Not Start" may also cause hard starting when cold.

IGNITION

Ignition timing incorrect.

Defective electronic module.

FUEL

If condition occurs only when ambient temperature is below 32°F (0°C), check for ice restriction in the fuel supply system. If necessary, thaw system and add anti-icing additive to the fuel.

NOTE: "In cold weather" cranking speed is reduced by thickening of oil and reduction of battery efficiency.

ENGINE TURNS OVER AT NORMAL SPEED—STARTS HARD WHEN HOT

NOTE: This condition is usually caused by an over-supply of fuel due to any of the items listed under "Does Not Start" due to excessive fuel supply.

GENERAL

Check proper starting procedure (setting choke, accelerator pumping, accelerator position, etc.)

Ignition timing incorrect.

Defective electronic module (ignition).

Engine overheating. Refer to ENGINE OVERHEATS in this section.

FUEL

Vapor lock.
Flooding.
Accelerator pump.
Carburetor faulty.
Fuel pump faulty.
Fuel restricted.

MECHANICAL

Choke mechanism binding, sticking and/or improper adjustment.

IGNITION

Check for faulty spark plugs.

ENGINE STARTS—FAILS TO KEEP RUNNING OR STALLS HOT OR COLD

GENERAL

Vapor lock.
*Engine overheats. (refer to ENGINE OVERHEATS).
*Engine runs too cool.
Idle speed too low.
Positive crankcase ventilation valve.
Leak in intake manifold (vacuum line faulty or disconnected).
Exhaust crossover in intake manifold plugged.
Exhaust system restricted.
Air intake restricted.
Carburetor icing.
Ignition timing incorrect.
Defective electronic module (ignition).

MECHANICAL

Throttle linkage defective or improperly adjusted.
Valve train faulty.
Valve lifter or valve clearance.
Low compression.
Choke valve faulty, stuck, or binding.
Head cracked or gasket leaking.
Excessive engine friction.

FUEL

Dirt and/or water in fuel system.
Faulty fuel pump.
Float level too high.
Idle adjustment incorrect.
Idle compensator valve faulty.
Needle valve seat faulty.
Mixture too rich or too lean.
Faulty carburetor.

IGNITION

Spark plugs damp or dirty and/or gap incorrectly set or not installed properly.

Faulty coil.
Faulty capacitor (radio suppression).

Defective module.

Distributor advance mechanism faulty or timing improperly set.

Worn rotor or loose distributor cap; deteriorated or corroded wiring or connections; incorrect wiring.

ENGINE TURNS OVER AT NORMAL SPEED BUT DOES NOT START OR STARTS HARD

NOTE: If ignition timing is set too far advanced, spark may occur too early when engine is cranked. The first (and only) explosion runs the engine backward. A kickback may jam the starter or break the starter drive housing.

IGNITION

OPEN PRIMARY
Defective electronic module.
Primary lead connection loose at distributor.
Primary windings in coil broken.
Open ignition switch circuit.

GROUNDED PRIMARY

NOTE: A grounded coil primary winding, a grounded ignition switch, or a grounded switch-to-coil primary lead will cause excessive current flow and will usually cause wires to burn.

Grounded or faulty capacitor (radio suppression).
Cracked or faulty insulator at distributor primary terminal.
Distributor-to-coil lead grounded.
Primary coil winding grounded.
Broken or loose ignition wire or faulty switch.

FAULTY SECONDARY
Corroded spark plug cable terminals.
Chafed or cracked cable insulation.
Ignition coil weak or inoperative.
Moisture on ignition coil, terminals, distributor cover, spark plug porcelains, or in distributor.

ENGINE TURNS OVER AT NORMAL SPEED BUT DOES NOT START OR STARTS HARD (CONT'D)

FAULTY SECONDARY (CONT'D)

Improper type of spark plugs.
Cracked distributor cap or a burned carbon track from distributor cap center terminal to housing.
Improper installation of spark plug cables (not correct for firing order).
Spark plugs damaged, dirty, or wet, porcelains cracked, or gaps improperly spaced.
Rotor contact spring bent or broken.
Distributor cap center terminal (inner) broken or missing.

MECHANICAL

Choke binding, sticking, or improper adjustment.
Low or erratic compression. (Check valve train mechanism, rings, blown head gasket, etc.)

FUEL

Hot engine vapor lock.
No fuel or insufficient fuel.
Water and/or dirt (Fuel System).
Excessive fuel.
Accelerator pump faulty.
Fuel pump worn or defective.
Fuel filter dirty.
Carburetor dirty or defective.
Vent in fuel tank clogged or restricted.
Carburetor mounting bolts loose.

GENERAL

Defective ignition switch.
Check proper starting procedure (setting choke, accelerator pumping, accelerator position etc.)
Air cleaner dirty.
Engine timing.
Restricted exhaust.
Poor ground or faulty wiring.

ENGINE STALLS AT IDLE—ENGINE COLD (OK WHEN HOT)

CARBURETOR

Idle too low.
Choke high, idle too low.

MECHANICAL

Linkage improperly adjusted or damaged.

ENGINE STALLS AT IDLE—ENGINE HOT (OK WHEN COLD)

GENERAL

Vapor lock.

Engine overheats. (Refer to "Engine Overheats" in this section.)

Positive crankcase ventilation valve.

CARBURETOR

Idle set too low.

MECHANICAL

Throttle linkage improperly adjusted or faulty.

ROUGH ENGINE IDLE

NOTE: When repairs have been made it may be necessary to re-adjust idle speed.

GENERAL

Check all vacuum hoses for proper routing, broken or disconnected hoses and/or caps. Also vacuum leaks.
Restricted air cleaner. (Remove air cleaner with engine running and note engine rpm.)
Incorrect ignition timing.
Defective electronic module (ignition).
Positive crankcase ventilation valve dirty or stuck.
Restricted exhaust.
Cold engine (faulty thermostat).
Fuel volatility too high or low.

IGNITION

Improper plug or plug gap.
Faulty plugs.
Defective coil.
Defective capacitor (radio suppression).
Faulty rotor or cap.
Loose wiring.
Damaged or corroded coil wiring or spark plug cables.
Moisture on wiring or in distributor cap.
Cracked distributor cap.

FUEL

Engine idle speed improper.
Mixture too rich or lean.
Float level.
Dirt and water in fuel system.
Carburetor mounting bolts loose.

MECHANICAL

Choke linkage, secondary throttle plates sticking, binding or damaged.
Low compression.
Valve train faulty (burnt or sticky valves, broken spring, bent push rod etc.)
Loose engine mounts or worn insulation.
Improperly torqued cylinder head.
Leaking or worn valve guides.

ENGINE HAS INCONSISTENT IDLE SPEED (LOPES)

NOTE: If idle speed is slow, unstable, rolling, frequent stalling, and oily engine compartment, the positive crankcase ventilation valve may be completely plugged, or the valve may be stuck in the "OPEN" position. A valve stuck in the "CLOSED" position is indicated by breather back-flow at heavy throttle and oily engine compartment. If the valve is stuck in the intermediate position it will be indicated by rough, fast idle and stalling.

GENERAL

Restricted exhaust.
Vacuum leak. (Intake valve stem leaking, carburetor mounting gasket leaking, carburetor throttle shaft in carburetor leaking, intake manifold or vacuum hoses leaking).
Ignition timing incorrect.
Defective electronic module (ignition).
Restricted air cleaner.
Overheated engine (refer to "Engine Overheats" in this section).
Blown head gasket.
Low compression.
Quality of fuel.
Lean idle mixture.

FUEL

Dirt and/or water in fuel system.
Too rich or lean mixture.
Filter restricted.
Faulty fuel pump.
Faulty carburetor.

MECHANICAL

Throttle shaft, accelerator pedal and/or throttle linkage sticking or binding.
Timing chain or gears and/or camshaft lobes worn.
Burned, warped, pitted, leaky or sticking valves.
Inoperative choke.
Sticking hydraulic lifter.

ENGINE HAS INCONSISTENT IDLE SPEED (LOPES) (CONT'D)

IGNITION

Defective electronic module.
Excessive oil or dirt on ignition system.
Spark plugs damp or gap incorrectly set.
Excessive moisture on ignition wires and caps.
Leaks in ignition wiring (dirty, corroded, or faulty wiring).
Ignition wires making poor contact.
Faulty coil.
Defective capacitor (radio suppression).
Cracked distributor cap, radial contacts in distributor cap burned or worn.
Defective pole piece and plate assembly.
Faulty spark advance mechanism.

ENGINE RUNS—MISSES AT IDLE ONLY

GENERAL

Vacuum leak.
Ignition timing incorrect.
Exhaust restriction.
Blown head gasket.
Low compression.
Fuel quality poor.
Air cleaner dirty.

IGNITION

Spark plugs wrong type, defective, worn or wrong gap.
Leaks in ignition wiring.
Faulty coil.
Defective capacitor (radio suppression).
Defective electronic module.
Defective or worn rotor and/or cap.

MECHANICAL

Leaky or incorrect valve.
Worn or leaky valve guide.
Worn timing chain, gears, sprocket or camshaft lobe.
Dirt in hydraulic lifter.

FUEL

Flooding in carburetor.

Refer to "Engine Has Inconsistent Speeds" covered earlier in this section.

ENGINE RUNS—MISSES AT HIGH SPEED ONLY

GENERAL

Overheating (refer to "Engine Overheats" in this section).
Detonation or pre-ignition.
Sub-standard fuel.
Faulty or dirty air cleaner.
Valve train faulty or worn.
Mild vapor lock.
Exhaust vapor lock.
Exhaust manifold clogged or restricted.
Air cleaner plugged.

FUEL

Faulty fuel pump.
Restricted fuel filter.
Choke valve not completely closed.
Carburetor throttle lever loose on shaft.
Exhaust manifold clogged with carbon.
Exhaust manifold, muffler, or tail pipe restricted.
Intermittent delivery of fuel to carburetor so that momentarily the mixture is too weak for combustion.

IGNITION

Clean, gap, and/or replace spark plugs, as necessary.
Too hot spark plugs—change to colder type, but note that a hot plug may be due to loose installation or lack of plug gasket (if gasket is called for).
Weak spark or coil.
Improper ignition timing.
Defective electronic module.
Centrifical advance not functioning properly.
Distributor shaft worn.
Defective pole piece and plate assembly.
Worn rotor or damaged distributor cap.

MECHANICAL

Incorrect valve timing.
Sticking hydraulic lifters.
Valve springs broken.
Valve springs shimmy.
Valve springs too weak to close valves promptly.

ENGINE RUNS—MISSES ERRATICALLY AT ALL SPEEDS

GENERAL

Restricted exhaust.
Compression low.
Internal coolant leakage.
Engine overheating.
Timing improperly set.

MECHANICAL

Compression leak at head gasket or between cylinders (this can be noted when missing occurs in two adjacent cylinders).
Intermittently sticking valves.
Broken valve spring.
Valve(s) held open slightly by faulty mechanism.

IGNITION

Wrong type spark plugs.
Fouled spark plug or broken porcelain.
Faulty spark plug cables.
Low battery voltage.
Low generator voltage.
Faulty coil
Defective capacitor (radio suppression).
Weak spark or no spark in one or more cylinders.
Faulty distributor cap or rotor.
Primary circuit restricted or open intermittently.
Primary circuit detoured by short intermittently.
Secondary circuit restricted or open intermittently.
Secondary circuit detoured by short intermittently.

FUEL

Fuel pump faulty.
Needle valve in carburetor sticking.
Improper float level.
Mixture too rich or too lean.
Passage in carburetor dirty.

ENGINE RUNS—MISSES STEADILY AT ALL SPEEDS

GENERAL

Worn camshaft lobes.
Compression low.
Vacuum leak in intake manifold.
Ignition timing off.
Fuel poor quality.
Defective electronic module (ignition).

FUEL

Dirty jets in carburetor.
Water or dirt in fuel.
Fuel filter plugged.
Fuel pump worn or diaphragm faulty.

IGNITION

Worn or dirty plugs or gap set too wide in plugs.
Worn distributor shaft.
Burned distributor rotor.
Faulty coil or capacitor.
Defective pole piece and plate assembly.

MECHANICAL

Valve train faulty.

ENGINE RUNS—BUT MISSES ON ONE CYLINDER

GENERAL

Compression leak.
Vacuum leak at intake manifold.
Ignition timing improperly set.
Defective electronic module (ignition).
Overheated engine. (Refer to "ENGINE OVERHEATS" in this section).
Clogged exhaust.

IGNITION

Defective spark plug or spark plug wire.
Distributor cap defective.

MECHANICAL

Valve train defective.
Stuck hydraulic lifter.
Defective rings or piston.

ENGINE RUNS—BUT MISSES ON DIFFERENT CYLINDERS

GENERAL

Compression leaking.
Vacuum leak at intake manifold or carburetor.
Defective head gasket.
Ignition timing off.
Poor grade fuel.
Carbon in engine.
Restricted exhaust.

IGNITION

Spark plugs faulty.
Coil wire or distributor cap faulty.
Distributor rotor faulty.
Defective electronic module.
Defective pole piece and plate assembly.

FUEL

Fuel pump faulty.
Carburetor faulty.

MECHANICAL

Faulty rings.
Faulty valve train.

ENGINE HESITATES OR STALLS DURING ACCELERATION (SPIT BACK THROUGH CARBURETOR)

GENERAL

Vapor lock.
Carburetor icing.
Restricted exhaust.
Compression low.
Intake manifold leaking (carburetor attaching bolts loose).
Partly blocked or dragging brake shoes (refer to "Brake" chart).
Air cleaner dirty.
Engine timing incorrect.
Excessive carbon in engine.
Heavy oil in engine.
Wrong or poor grade fuel.
Excessive rolling resistance from low air in tires, applied brakes, wheel alignment, overloading etc.

IGNITION

Distributor faulty.
Wiring oily or faulty.
Coil defective.
Faulty plugs.
Vacuum advance faulty.
Defective pole piece and plate assembly.

MECHANICAL

Accelerator pump stroke or throttle linkage improperly adjusted.
Stuck hydraulic lifters.
Intake manifold loose or leaking.
Carburetor mounting loose or leaking.
Valve train damaged or faulty.

ENGINE SURGES

GENERAL

Exhaust system restricted or faulty.
Cylinder(s) not firing properly.
TVS switch(s) faulty.
Vacuum leaks.

IGNITION

Check out complete ignition system.
Faulty spark plug wires.

FUEL

Fuel pump faulty.
Faulty needle valve and seat.
Float level setting wrong.
Defective parts in carburetor.
Restrictions in fuel lines or filter.

LACK OF POWER OR HIGH SPEED PERFORMANCE

NOTE: It should be noted that the altitude of operation has a decided effect on performance. An engine adjusted for sea level altitudes will lack performance at high altitudes; an engine operating normally at high altitudes may have a lean carburetor adjustment and show signs of pre-ignition when operated at sea level.

IGNITION

Ignition timing incorrect.
Centrifugal advance not operating properly.
Vacuum advance not operating properly.
Defective electronic module.
Defective pole piece and plate assembly.
Faulty spark plugs.
Faulty ignition cables.
Faulty ignition coil.
Worn or burned distributor rotor.
Worn distributor shaft.
Poor ground.

GENERAL

Pre-ignition.
Engine overheating. (Refer to "Engine Overheats" in this section).
Sub-standard fuel.
Overloaded vehicle.
Excessive carbon in engine.
Defective torque converter.
Excessive rolling resistance (dragging brakes, tight wheel bearings, underinflated tires).
Restricted exhaust.
Dirty air cleaner.
Transmission or power steering faulty.

MECHANICAL

Choke mechanism faulty.
Lack of engine compression.
Incorrect valve timing.
Inaccurate speedometer (gives impression of lack of performance).
Valve spring weak, broken valves or valves sticking when hot.
Valve timing incorrect.
Worn camshaft lobes.
Blown cylinder head gasket.
Burned, warped or pitted valves.

ENGINE FAILS TO REACH OPERATING TEMPERATURE

GENERAL

Thermostat removed.

COOLING

Defective thermostat (stuck open).
Faulty temperature sending unit or dash unit.

ENGINE OVERHEATS

NOTE: Coolant is used to cool the engine and air is used to cool the coolant. Anything which prevents the coolant air system from working properly will cause engine to overheat. (Air, oil or grease in the coolant will reduce the ability of the coolant to absorb the heat from the block and to transfer heat to the coolant in the radiator.)

GENERAL

Scale or rust deposits.
Slipping fan belt.
Low coolant. (Leaky system—internal or external.)
Pre-Ignition.
Detonation.
Excessive friction in engine or elsewhere in power transmitting units. (Brakes dragging, etc.)
Excessive back pressure in exhaust system.
Overloading vehicle.
High altitude.
Hot climate operation.
Insufficient oil in crankcase.

ENGINE OVERHEATS (CONT'D)

FUEL

Carburetor mixture too lean.

MECHANICAL

Valve timing incorrect.
Cylinder head bolts loose.
Warped or damaged head or block.
Wrong head gasket.

IGNITION

Timing late.
Distributor advance faulty.

COOLING

Restricted flow of coolant. (Defective components—dirt, rust and scale.)
Leaking head gasket. (Permits air in cooling system and coolant in engine.)
Thermostat fails or wrong thermostat.
Hoses defective.
Exterior of radiator clogged with dirt, leaves, or insects.
Water pump defective or loose.
Wrong type of coolant.
Wrong fan or hydraulic fan inoperative, or defective.
Wrong pressure cap or faulty cap.
Radiator fins bent or mutilated.

SPARK KNOCK, PING, OR DETONATION

NOTE: A sharp metallic knock due to instantaneous abnormal combustion.

GENERAL

Low octane fuel.
Too high compression.
Timing advanced too far.
Heavy carbon deposits.
Manifold heat control valve faulty.
Faulty distributor advance mechanism.

COOLING

Overheated engine. (See "Engine Overheats" in this section.)

Hot weather.

High altitude.

ENGINE CONTINUES TO RUN AFTER IGNITION IS TURNED OFF (DIESELING)

NOTE: When the engine won't stop as the ignition is turned off, the cause is often due to red hot carbon particles resting on heavy carbon deposit in a very hot engine.

GENERAL

Improper idle speed (too high).
High engine temperature.
Poor grade fuel (octane too low).
Improper ignition timing.
Defective electronic module (ignition).
Quick shut-down of hot engine.

MECHANICAL

Improper valve timing.

IGNITION

Advanced timing.
Improper heat range or improperly installed spark plugs.
Electrical feed through ignition system (faulty switch).

FUEL

Carburetor too lean.
Throttle plates misaligned.

PRE-IGNITION

NOTE: Hot spot in combustion chamber ignites fuel before spark occurs. May not be noticed unless severe.

GENERAL

Overheated engine.
Carbon deposits.
Spark plugs not tight.
Spark plugs with wrong heat range.
Ignition timing and dwell improperly set.

MECHANICAL

Leak at valve due to clearance, valve sticking, weak or broken spring.

Valve timing.

FLAT SPOT (SAG, STRETCHINESS)

NOTE: Does not respond promptly when throttle is opened quickly.

GENERAL

Poor fuel quality.
Vapor lock.
Late ignition timing.

MECHANICAL

Accelator pump linkage adjustment incorrect.
Accelerator linkage faulty or improperly adjusted.

FUEL

Low fuel pump pressure.
Accelerator pump piston or diaphragm leaks.
Accelerator pump valves leak or passages restricted.
Float level incorrect.
Defective fuel pump.
Carburetor defective or improperly set.
Fuel filter plugged.
Dirt in carburetor jets.

BACKFIRES, POPPING BACK OR SPITBACK THROUGH CARBURETOR (SUBDUED EXPLOSION IN INTAKE MANIFOLD)

GENERAL

Cold engine and choke too lean.
Loose carburetor mounting bolts.
Loose intake manifold bolts.
Incorrect ignition timing.
Vacuum leaks (hoses etc.).
Defective electrical module (ignition).

IGNITION

Leaking distributor cap may cause backfire to occur in cylinder on intake stroke.
Two crossed spark plug wires may also cause backfire through carburetor.

FUEL

Lean mixture.
Dirt or water in fuel.
Faulty accelerator pump.

MECHANICAL

Leaky or sticky intake valve.
Weak or broken intake valve spring.
Faulty heat valve.
Plugged heat crossover passage.
Improper camshaft timing.
Improper valve lash.

AFTER-BURNING OR MUFFLER EXPLOSION (BACKFIRE)

NOTE: A subdued put-putting at the exhaust tailpipe may be due to leaky exhaust valves which permit the mixture to finish combustion in the muffler. If exhaust pipe or muffler is red hot, it is important to let it cool, as there is some danger of setting the vehicle on fire. Most likely to occur when mixture is lean.

GENERAL

Late timing.
Burnt exhaust valve.
Air cleaner restricted.
Air leak in exhaust manifold or pipe.

MECHANICAL

Late valve timing.
Worn or broken exhaust valve spring.
Tight exhaust valve.
Choke stuck closed.

IGNITION

Intermittent open circuit in primary. (Ammeter needle swings further away from zero when generator is charging.)
Intermittent short in primary. (Ammeter swings toward zero when generator is charging.)
Short in coil or secondary coil wire.

FUEL

Carburetor flooding.

SMOKE

WHITE

Condensing water vapor which is a normal product of combustion—no problem—usually seen on cold days.

BLACK

Excessively rich fuel mixture. (See "Excessive Fuel Consumption, covered later in this section.)

BLUE
(OR BLUISH WHITE)

Excessive oil consumption (see "Excessive Oil Consumption" covered later in this section.)

EXCESSIVE FUEL CONSUMPTION

GENERAL

"Jack Rabbit" starts.
High speed.
Short drives.
Restricted Choke (partly closed).
Clogged air cleaner.
Loss of compression.
Excessive rolling resistance from low tires, dragging brakes, wheel misalignment, etc.
Restricted exhaust.
Engine overheating.
Crankcase ventilating system faulty.
Trailer towing.
Worn-out or badly tuned engine.

IGNITION

Faulty ignition system.

FUEL

Excessive fuel pump pressure.
Float level high.
Faulty carburetor.
Leakage or loose fittings.
Idle speed settings incorrect.
Accelerator pump improperly adjusted.

MECHANICAL

Faulty valves or valve train.
Faulty rings.
Choke mechanism binding or improperly adjusted.
Accelerator linkage binding or improperly adjusted.
Fuel tank cap missing.

LOW OIL PRESSURE

GENERAL

Low oil level.

Clogged oil filter.

Thin or diluted oil (frequent stops in cold weather).

Viscosity (too light grade).

Oil has foam from water (condensation or leaking head gasket).

Overheating.

MECHANICAL

Faulty pressure sending unit, line, or gauge.

Worn oil pump.

Excessive bearing clearance.

Oil pump relief valve dirty, worn, spring weak or worn.

Oil pump suction tube loose or cracked.

Screen clogged (ice, gummy, sludge or dirt).

Air leak in oil pump (loose cover or too thick gasket).

Loose connections in oil lines.

HIGH OIL PRESSURE

GENERAL

Oil too heavy (viscosity).

Main oil passage on pressure side of pump clogged.

MECHANICAL

Faulty gauge.

Oil pressure relief valve adjustment too heavy.

Relief valve spring too stiff.

Oil pressure passage clogged.

NO OIL PRESSURE WHILE IDLING

GENERAL

Faulty oil gauge sending unit.

Leakage at internal oil passage.

MECHANICAL

Oil pump nut functioning properly. (Valve stuck by foreign material.)

Excessive clearance at bearings (camshaft, rod or main).

NO OIL PRESSURE WHILE ACCELERATING

GENERAL

Low oil level in oil pan.

MECHANICAL

Leakage at internal oil passages.

NO OIL PRESSURE

GENERAL

Suction loss.

Oil pressure gauge faulty.

Not enough oil in pan.

Pipe to oil pressure gauge stopped up.

Oil passage on discharge side of pump stopped up.

Oil screen or passages on intake side of pump stopped up.

MECHANICAL

Oil pump inoperative.

Relief valve stuck open.

BURNED, STICKING OR BROKEN VALVES

GENERAL

Over-speeding engine.
Deposits on valve seats and/or gum formation on stems or guides.
Warped valves or faulty valve forgings.
Exhaust back pressure.
Improper ignition timing.

MECHANICAL

Weak valve springs.
Improper valve clearance.
Improper valve guide clearance and/or worn valve guides.
Out-of-round valve seats or incorrect valve seat width.

EXCESSIVE OIL CONSUMPTION

NOTE: Check the PCV valve for proper operation before checking causes of leak. A clogged crankcase vent valve can build up pressure in the crankcase which will cause seals and gaskets to leak.

EXTERNAL LEAKAGE

Oil pan drain plug loose or gasket missing.
Crack or hole in oil pan.

Oil pan gasket leaks due to:
a. Loose screws;
b. Damaged gasket;
c. Improperly installed gasket;
d. Bent oil pan flange.

Timing case cover gasket leaks due to:
a. Loose screws;
b. Damaged gasket;
c. Improperly installed gasket;
d. Bent cover flange;

Front crankshaft oil seal leaks due to:
a. Worn oil seal;
b. Seal not properly installed;
c. Rough surface on crankshaft, or fan pulley or damper;
d. Damper or pulley loose;
e. Seal or cover not centered on crankshaft;
f. Oil return passage to crankcase clogged up.

Rear main bearing oil seal leaks due to:
a. Worn oil seal;
b. Improper oil seal installation;
c. Worn rear main bearing;
d. Rough crankshaft. Oil passage to crankcase clogged.

Expansion plug in block at rear of camshaft leaks due to poor fit, careless installation, or corrosion.

Leakage at any external piping.
Plugs at ends of oil passages in cylinder block leak.
Oil filter leaks.
Leakage at distributor housing.
Valve cover leaks due to loose screws, defective gasket, improperly installed gasket or bent cover flange.
Rocker arm cover or push rod cover leaks due to loose screws, defective gasket, improper gasket installation or bent cover flange.
Pipe connections loose on oil gauge or oil filter lines.
Improperly seated or broken fuel pump gasket.
Broken push rod cover gasket, oil filter gasket, or timing chain cover gasket.
Worn timing chain cover oil seal.
Worn or improperly seated rear main bearing oil seal.
Loose oil line plugs.
Rear camshaft bearing drain hole plugged.
Loose rocker arm cover, gasket broken, or cover distorted or bent.
Rear main bearing side seal improperly installed.

INTERNAL LEAKAGE

Carbon in oil ring slot.
Rings fitted too tight in grooves.
Leaky piston rings due to wear, scuffs or broken.
Leaky piston rings due to sticking caused by gummy deposit. Try to free up with suitable

solvent poured in fuel tank. Blue smoke at tail pipe indicates badly leaking rings.

Worn pistons and cylinders.

Cylinder block distorted by tightening cylinder head bolts unevenly.

Excessive clearance between intake valve stems and guides allows oil mist to be sucked into cylinders.

Worn main or rod bearings allow excessive leakage from bearings.

Worn rings or worn valve seals, resulting in cylinder walls flooded with oil.

Result in cylinder walls are flooded with oil.

Oil pressure too high due to faulty action of oil pressure relief valve, or clogged relief passage.

If pressure lubricated, loose piston pins may permit excessive leakage to cylinder walls.

Grade of oil used is too light. A poor quality oil may become far too thin when engine is hot. Hard driving on hot days will also consume more oil.

Clogged crankcase ventilation system.

Intake valve seals damaged or missing.

Plugged drain back holes in head.

Intake manifold gasket leak in conjunction with rocker cover gasket leak.

Ring grooves or oil return slots clogged.

Rings sticking in ring grooves of piston.

Ring grooves worn excessively in piston.

Compression rings installed upside down.

Excessively worn or scored cylinder walls.

Cylinder walls not properly honed or finished.

Oil too thin (diluted).

Oil level too high.

Excessive main or connecting rod bearing clearance.

Piston ring gaps not staggered.

Incorrect size rings installed.

Piston rings out-of-round, broken or scored.

Insufficient piston ring tension due to engine overheating.

ENGINE NOISY

NOTE: When diagnosing engine noise problems, be careful that noises caused by accessories are not mistaken for engine noises. Removal of accessory drive belts will eliminate any noises caused by these units.

In general, engine noises are either synchronized to engine speed or one-half engine speed. Those that are timed to engine speed are sounds that have to do with the crankshaft, rods, pistons, and wrist pins. The sounds emitted at one-half engine speed are valve train noises.

The use of a stethoscope will often aid in locating an engine noise. Caution must be exercised, however, because noise will travel to other metal parts not involved in the problem. A timing light will aid in determining if the noise is synchronized with engine speed or at one-half engine speed.

Engine noise sometimes may be isolated by grounding the spark plug leads one at a time. If the noise lessens appreciably or disappears, it is confined to that particular cylinder.

No definite rule or test can be listed that will positively determine the source of a noise complaint.

Fuel pumps, distributors, flywheels, water pumps, drive belts, or carbon buildup in the combustion chamber may contribute to noisy engine operation. The following information can therefore be used only as a general guide to noise diagnosis. There is no substitute for experience.

A. NOISY MAIN BEARINGS

NOTE: A loose main bearing is indicated by a powerful, but dull, thud or knock when the engine is pulling. If all main bearings are loose a noticeable clatter will be audible.

The thud occurs regularly every other revolution. The noise is loudest when the engine is "lugging" or under heavy load. The sound is heavier and duller than a connecting rod noise. Low oil pressure also accompanies this condition. The knock can be confirmed by shorting spark plugs on cylinders adjacent to the bearing. Knock will disappear or be less when plugs are shorted. This test should be made at a fast idle equivalent to 15 mph. If bearing is not quite loose enough to produce a knock by itself, the bearing may knock if oil is too thin or if there is no oil at the bearing.

Regular noise: worn main bearings; irregular; worn end-thrust bearings.

GENERAL

Insufficient oil supply.

Low oil pump pressure.

Thin or diluted oil.

MECHANICAL

Excessive bearing clearance.
Excessive crankshaft end play.
Eccentric or out-of-round crankshaft journals.
Sprung crankshaft.
Excessive belt tension.
Loose harmonic balancer.
Loose flywheel or torque converter.

NOTE: Crankshaft End Play—Intermittent rap or knock that is sharper than a loose main bearing. Repeated disengagements of the transmission may cause a change in the rap.

B. NOISY ROD BEARINGS

NOTE: Rods with excessive clearance knock under all speeds and under both idle and load conditions. At the early stage of looseness, rod noise may easily be confused with piston slap or loose pins. Rod knock noise increases in intensity with engine speed. Low oil pressure also accompanies this condition.

GENERAL

Excessive bearing clearance.
Worn crankpin.
Lack of oil (thin or diluted).
Low oil pressure.
Journals out-of-round.
(A metallic knock which is usally loudest at about 30 mph with throttle closed. Knock can be reduced or even eliminated by shorting spark plug. If bearing is not loose enough to produce a knock by itself, the bearing may knock if oil is too thin or if there is no oil at the bearing.)

MECHANICAL

Misaligned rod.
Connecting rod bolts not tightened correctly. (Should connecting rod misalignment be suspected, check for a diagonal wear pattern on the piston skirt, and for excessive wear on the opposite edges of the connecting rod bearings.)

NOTE: Automatic transmission coupling noise caused by loose transmission-to-engine bolts sounds like rod bearing noise.

C. NOISY TIMING GEARS

NOTE: A high frequency light knock difficult to isolate without a sound detecting device. It is about the same intensity whether the engine is idling or at high speeds or under load.

GENERAL

Gears misaligned.

Excessive backlash.

Chipped—usually camshaft gear.

MECHANICAL

Gears loose on hubs or shafts.
Eccentric gear, usually due to high keys.
Teeth meshed too tight (new oversize gear).
Too much end play in camshaft or crankshaft.
Front camshaft bearing clearance excessive.

D. NOISY TIMING CHAIN

GENERAL

Chain loose due to wear.
Sprocket teeth worn.
Sprockets misaligned.
Loose vibration damper or drive pulley.

MECHANICAL

Sprocket loose on hubs or shaft.
Front camshaft bearing clearance excessive.
Front main bearing clearance excessive.

E. NOISY PISTONS

NOTE: Piston pin, piston and connecting rod noises are difficult to tell apart. A loose piston pin causes a shaft double knock which is usually heard when engine is idling. Severity of knock should increase when spark plug to this cylinder is short-circuited. However, on some engines the knock becomes more noticeable at 25 to 35 mph on the rod.

GENERAL

Worn or loose piston pin or bushing.
Improper fit of pin.
(Listen for a light ticking or tapping noise. More noticeable with no load on engine. May disappear completely under load. Generally, piston pin noise can be noticed on deceleration of the engine.)
Piston-to-cylinder bore clearance excessive.
(Sounds very similar to tappet or lifter noise. Removing one spark plug wire at a time may be helpful in determining which cylinder is noisy. One indication of piston slap is a decrease in noise as the engine warms up. Piston slap is always louder when the engine is cold. Retard timing slightly, noise should decrease.)
Lack of lubrication.
Carbon deposits on top of piston strikes cylinder head.
Worn or broken piston ring land. (Most noticeable during acceleration.)
Broken or cracked piston.
Engine overheating.
Fuel of too low octane rating.
Operating without air cleaner.

MECHANICAL

Excessive rod bearing clearance.
Misaligned connecting rods.
Worn rings, cylinder walls, low ring tension, broken rings, out-of-round or tapered bores.
Top of piston strikes ridge at top of cylinder bore.
Piston rubs against cylinder head gasket.
Excessive side clearance of rings in groove, clearance between ring and groove and/or ring gap.
Undersize pistons installed.
Wrong type and/or size rings installed.
Cylinder bores tapered or eccentric.
Pins improperly assembled.
Insufficient ring gap clearance.
Pistons 180° out of position.

F. NOISY VALVE MECHANISM

GENERAL

Sticking or warped valves.
Bent push rods.
Dirty, worn, or scored parts.
Broken or weak springs.
Damaged valve lifter and/or camshaft lobes.
Insufficient or poor oil to valve mechanism. (Thin, foaming, or diluted.)
Excessive valve stem-to-guide clearance.
Valve lifter incorrectly fitted to bore size.
Pulled or loose rocker arm bolts.

MECHANICAL

Hydraulic lifter not working properly or faulty. (Faulty lifter can usually be located with the aid of a stethoscope.)
Hydraulic lifter "pumped up" from excessive speed—temporary noise.

G. NOISY WATER PUMP

NOTE: Listen for a ratchety or grinding sound which increases with engine rpm. In the early stages, the grinding noise may disappear at higher engine rpm. Disconnect the fan belt, and run engine. If noise disappears, trouble most likely is the water pump bearing. Bearing failure or start of failure can be detected by grasping the water pump pulley with both hands and moving it in a sidewise motion. If sloppiness is present, the bearing is unserviceable.

GENERAL

Rough bearing.
Pump seal too hard.

MECHANICAL

Shaft pulley loose.
Impeller loose on shaft.
Too much end play in pump shaft.
Too much clearance between shaft and bearings.
Impeller blades rubbing against pump housing.
Impeller pin sheared off.
Impeller broken.

H. NOISY GENERATOR (REFER TO GENERATOR DIAGNOSIS CHARTS)

GENERAL

Brush squeal.
Bearings.
Faulty diode or stator.

MECHANICAL

Loose mounts.
Belt too tight.

I. NOISY FAN

GENERAL

Fan blades bent.
Fan out-of-balance when made.
Fan shaft end play excessive.

MECHANICAL

Fan blades loose on clutch.
Fan blades strike shroud.

J. NOISY FUEL PUMP

NOTE: Diagnosis of fuel pumps suspected as noisy requires that some form of sounding device be used. Judgement by ear alone is not sufficient, otherwise a fuel pump may be needlessly replaced in attempting to correct noise contributed by some other component. Use of a stethoscope, a long screwdriver, or a sounding rod is recommended to locate the area or component causing the noise. The sounding rod can easily be made from a length of copper tubing 1/4 to 3/16 inch in diameter. Dowel rods are also good.

If the noise has been isolated to the fuel pump, remove the pump and run the engine with the fuel remaining in the carburetor bowl. If the noise level does not change, the source of the noise is elsewhere and the original fuel pump should be reinstalled.

K. NOISY FAN BELT

GENERAL

Belt worn or burned.

Wrong belt. Does not fit pulley grooves properly.

Belt or pulley dirty or sticky with gummy oil.

Pulley bent, cracked or broken.

MECHANICAL

Belt too tight. Squeaks.

Belts pulleys misaligned.

Belt loose; squeaks when engine is accelerated.

L. MISCELLANEOUS NOISE

(RATTLES, SQUEAKS, ETC., FROM LOOSELY MOUNTED ACCESSORIES; GENERATOR, HORN, OIL PAN, ETC.)

LOOSE FLYWHEEL

A thud or click which is usually irregular. To test, idle the engine at about 20 mph and shut off the ignition. If thud is heard, the flywheel may be loose.

EXCESSIVE CRANKSHAFT END PLAY

A rather sharp rap which occurs at idling speed but may be heard at higher speeds also.

FAN SHROUD

Loose shroud or radiator.

ENGINE VIBRATION

Unequal compression in cylinders.

Missing at high speed.

Unbalances fan or loose fan blade.

Incorrect adjustment of engine mounts, or damaged mounts.

Loose engine mounts.

Engine support loose on frame or cylinder block.

Unbalanced or sprung crankshaft.

Excessive engine friction due to tight piston etc.

Defective vibration damper.

LOOSE ENGINE MOUNTINGS

Occasional thud with vehicle in operation. Most likely to be noticed at the moment the throttle is opened or closed.

M. PRE-IGNITION OR SPARK KNOCK

GENERAL

Low octane fuel being used.

Muffler or exhaust passage restricted.

Excessive carbon deposit in combustion chamber.

Hot spot in head—possibly caused by foreign matter clogging small water passages between head and block.

Engine lugging—produces unbalanced heat.

Compression too high for octane rating of fuel being used.

Overheated spark plug due to being too "hot" for the application, not seated properly, or not torqued to specifications.

IGNITION

Faulty ignition system or timing advanced beyond specifications.

Defective electronic module.

FUEL

Carburetor, mixture lean.

Operating with standard specifications at high altitudes allowing rich fuel mixture.

IN-VEHICLE SERVICE OPERATIONS

ENGINE OIL PRESSURE TEST
(FIGURE 5)

1. Remove oil pressure warning light switch from left front of engine.
2. Install oil pressure gauge in hole.
3. Set parking brake. Put transmission selector in "N" (neutral position).
4. Start engine and run until normal operating temperature is obtained.
5. Oil pressure should be 7 psi minimum at slow idle; 35 psi at 1500-3000 rpm.

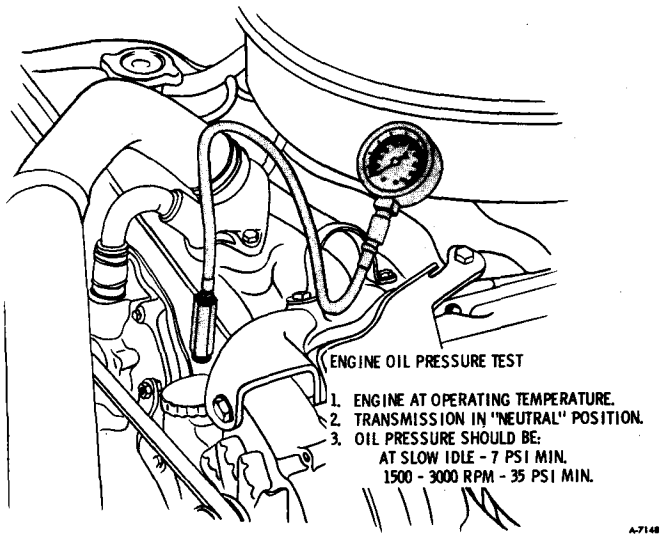


Figure 5—Checking Engine Oil Pressure

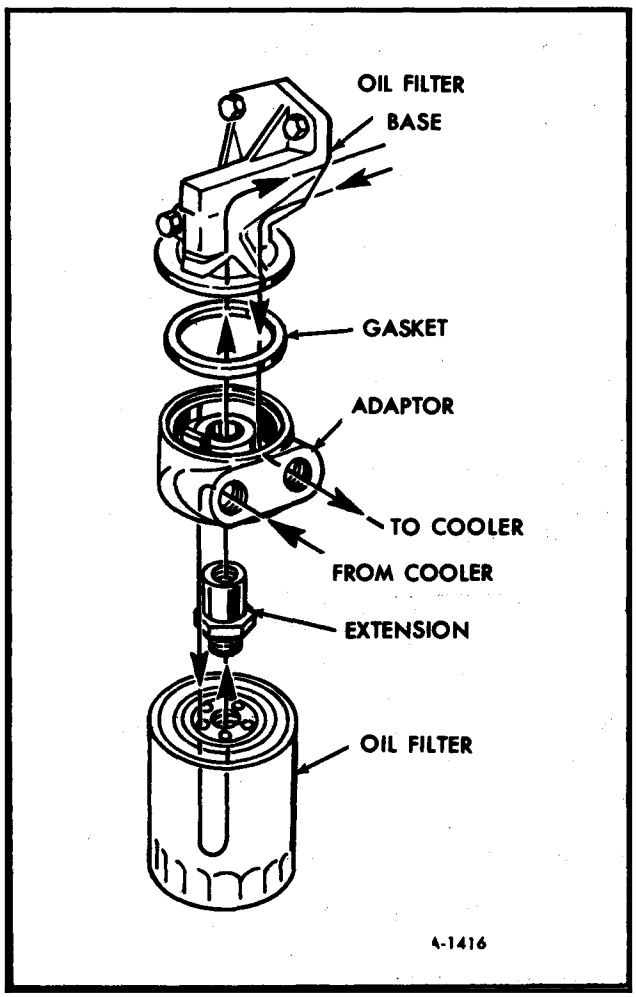


Figure 6—Oil Filter

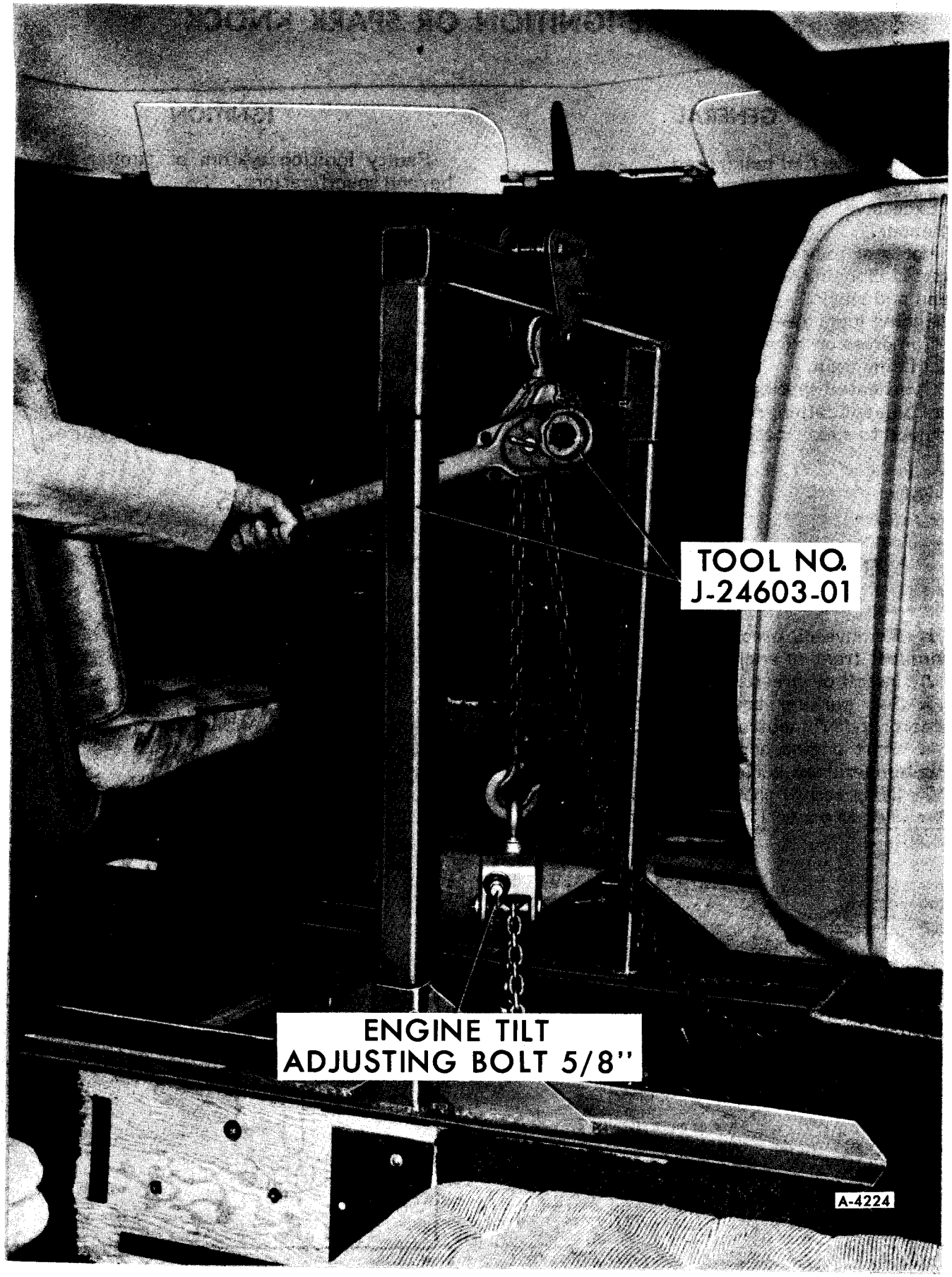


Figure 7—Attaching Engine Removal Tool

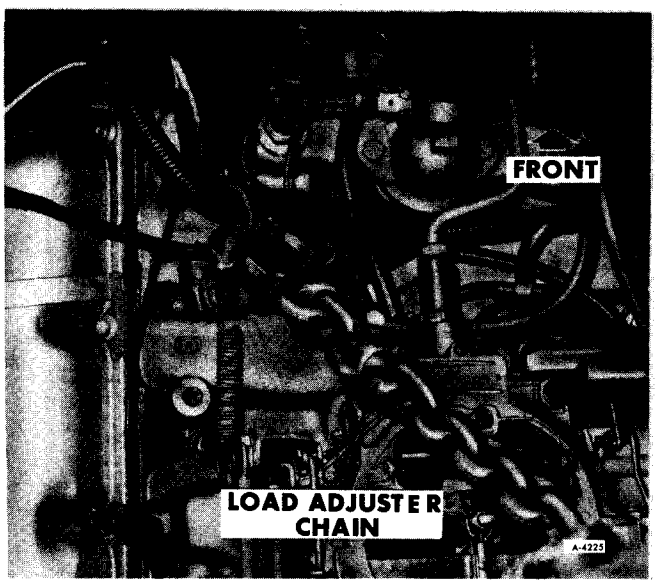


Figure 8—Engine Front Lift Location

OIL FILTER ASSEMBLY

(FIGURE 6)

REMOVAL

1. Hoist vehicle.
2. Remove oil filter.
3. Loosen oil cooler line fittings from the adapter.
4. Remove oil filter extension fitting and adapter.
5. Remove 3 bolts securing oil filter base to engine block.
6. Remove filter base and gasket.

INSTALLATION

1. Install gasket and filter base to engine block. Torque bolts to 35 ft. lbs.
2. Install adapter and oil filter extension fitting. Torque to 55 ft. lbs.
3. Reposition oil cooler lines and attach to adapter.
4. Apply a film of engine oil to the filter gasket and install. Torque by tightening 2/3 turn after gasket contacts adapter.

NOTE: If a new oil filter is being installed, add one quart of oil.

5. Start engine, check for possible leaks. Stop engine and after several minutes check for proper engine oil level.

ENGINE FRONT SUPPORT CUSHION

REMOVAL

1. Attach Engine Lift Tool J-24603-01 as shown in figure 7.

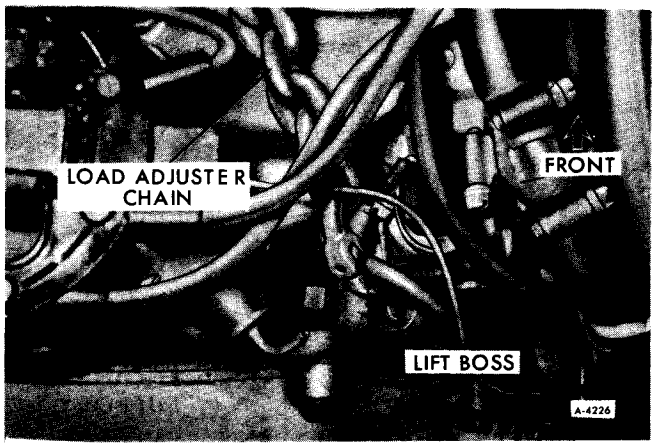


Figure 9—Engine Rear Lift Location

NOTE: To properly position engine removal tool, remove seat belt plate and anchor bolt assembly. Attach load adjuster chain to front and rear engine lift locations as shown in figures 8 and 9.

2. Referring to figure 10, remove bolts "A" and "B". Also remove nuts "C" and "D".
3. Adjust Tool No. J-24603-01 so that the front of the engine is raised just enough to enable removal of support cushion.
4. Remove engine support cushion.

INSTALLATION

1. Install new studs into engine support cushion and torque to 30 ft. lbs.
2. Install engine support cushion into place.
3. Lower engine, making sure holes in engine support line up with holes in engine support cushion.
4. Referring to figure 9, install bolts "A" and "B" with nuts and lock washers. Torque both nuts to 45 ft. lbs.
5. Install nuts "C" and "D" and torque to 30 ft. lbs. Note that these nuts are prevailing torque flange nuts; if replacements are used they must be the same type of fastener.
6. Remove tool No. J-24603-01. Install air cleaner and engine cover.

REAR ENGINE MOUNTS

REMOVAL

1. Lift engine cover and remove air cleaner assembly.
2. Attach Engine Lift Tool No. J-24603-01 as shown in figure 7.
3. Remove bolts "A", "B" and "C" on both sides of the engine/transmission rear support (figure 11).
4. Adjust tool, No. J-24603-01 so that the rear of the transmission is raised and there is enough clearance to remove the engine restrictor and transmission mount.

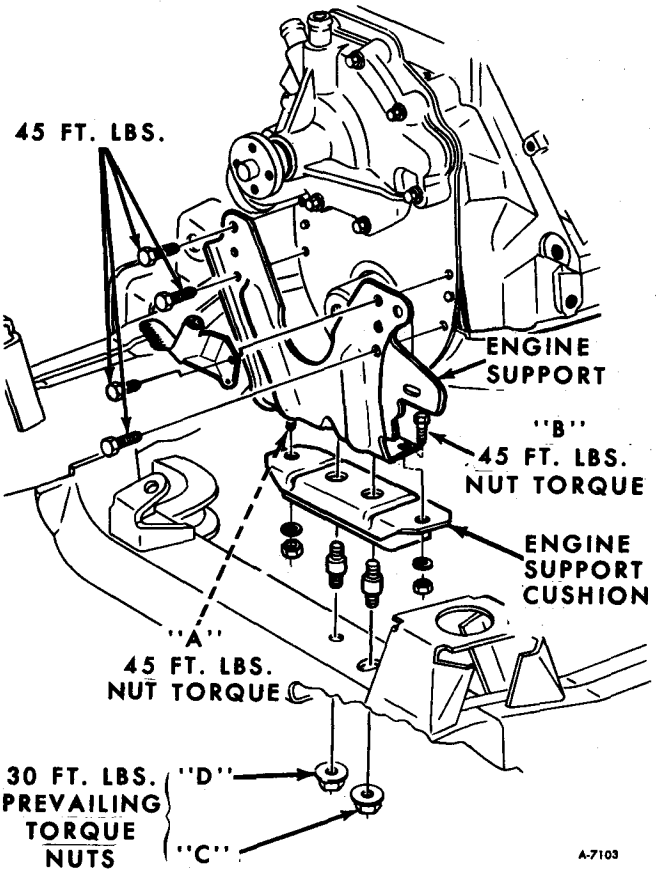


Figure 10—Engine Front Mounting

INSTALLATION

1. Install engine restrictor and transmisison mount. Lower engine.
2. Install all bolts and nuts finger tight to insure proper alignment. Torque bolts "A" and "B" on the transmisiosn support bracket to 50 ft. lbs. Torque bolt "C" to 55 ft. lbs.

NOTE: Observe placement of transmission mount before removal, and assemble mount with tab positioned as required by hole pattern.

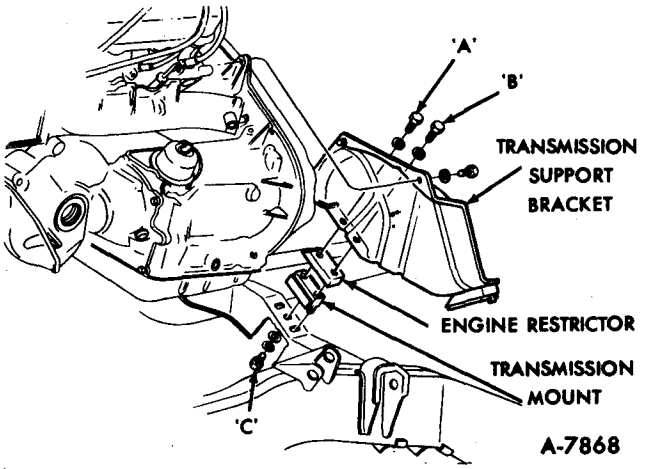


Figure 11—Engine Rear Mounting

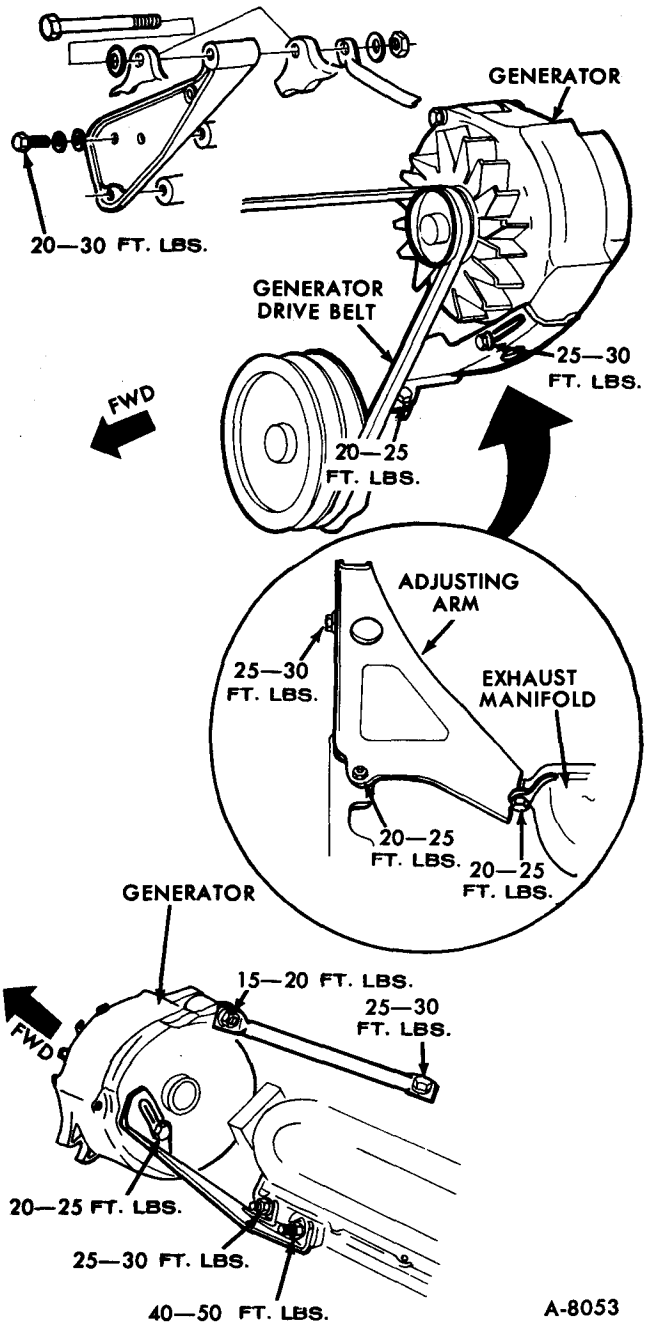


Figure 12—Generator Mounting

3. Remove tool J-24603-01 and replace air cleaner. Install engine cover.

INTAKE MANIFOLD

REMOVAL

1. Disconnect battery negative cables from both main and auxiliary batteries.
2. Remove air cleaner assembly.
3. Drain radiator, then disconnect upper radiator hose and thermostat by-pass hose from water outlet. Disconnect heater hose at rear of manifold.
4. Generator bracket removal is not required. However, upper brace from generator

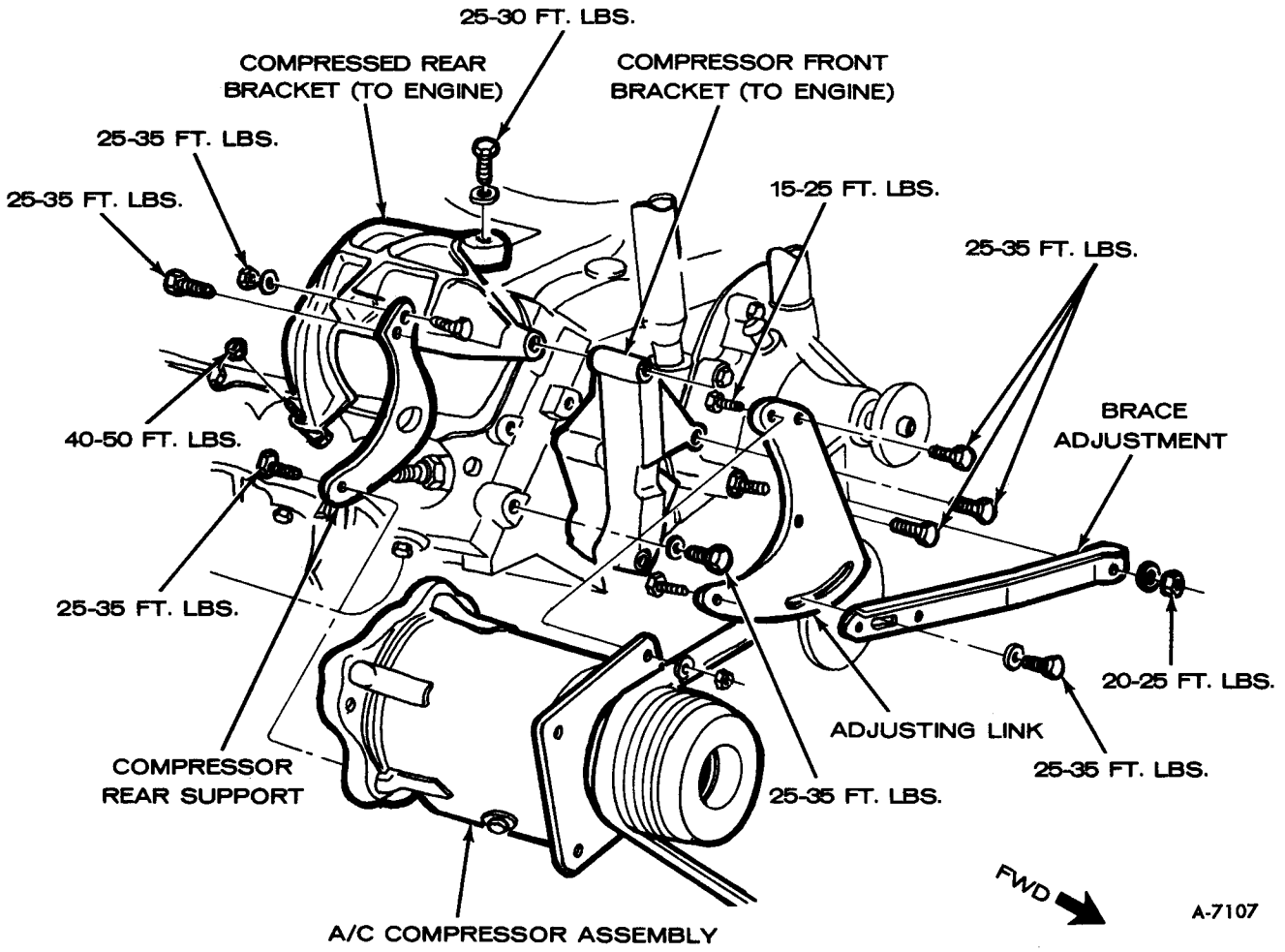


Figure 13—Air Conditioning Compressor Mounting

to intake manifold must be removed at both the generator and the intake manifold. Generator mounting is shown in figure 12.

5. Remove air conditioning compressor brackets and struts as necessary. See figure 13.

6. Remove engine oil filter lower tube and flexible elbow.

7. Disconnect temperature gauge wire.

8. Disconnect throttle cable, and cruise control (if so equipped) from carburetor throttle lever. Remove cruise control chain.

9. Remove fuel line from fuel pump to carburetor.

10. Disconnect vacuum hoses from distributor and tee, and also from the front of the carburetor which leads to the carbon canister. Refer to Section 6T in this supplement for vacuum hose routings.

11. Disconnect vacuum hoses from intake manifold to brake booster, heater control, and cruise control (if so equipped).

12. Pull PCV valve from grommet in the right valve cover.

13. Disconnect spark plug cables from spark plugs on all cylinders. Disconnect distributor cap and carefully remove distributor harness assembly.

14. Remove intake manifold bolts, then remove manifold with carburetor attached.

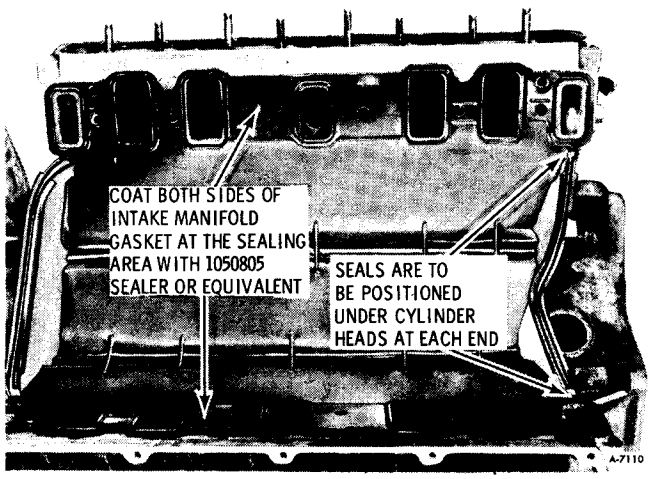
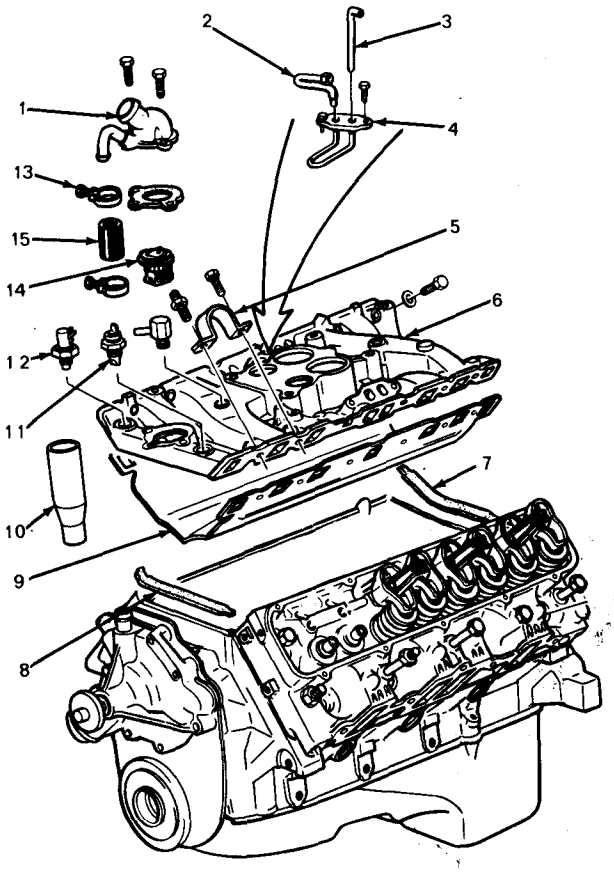


Figure 14—Intake Manifold Gasket



1 Engine Water Outlet
2 Choke Hot Air Pipe
3 Choke Clean Air Pipe
4 Choke Heater
5 Engine Lift Strap
6 Intake Manifold
7 Rear Seal
8 Front Seal
9 Intake Manifold Gasket
10 Oil Filler Lower Tube
11 Engine Water Temperature Switch
12 Thermal Vacuum Switch
13 Clamp
14 Thermostat
15 Thermostat By-Pass Hose

Figure 15—Intake Manifold and Gasket

15. Clean machined surfaces of cylinder head and intake manifold with a putty knife. Use care not to gouge or scratch machined surfaces.

INSTALLATION

1. Coat both sides of gasket sealing surface that seal the intake manifold to the head with Part No. 1050805 sealer or equivalent and

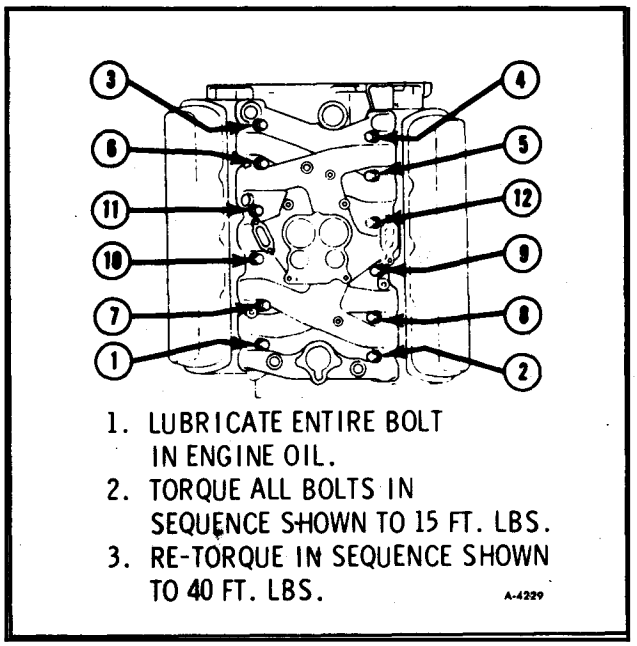


Figure 16—Intake Manifold Torque Sequence

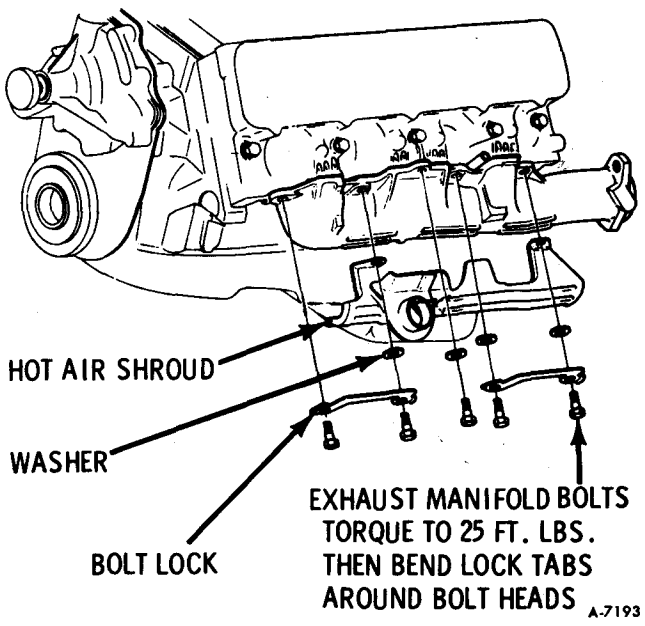


Figure 17—Hot Air Shroud

position intake manifold gasket. (See figure 14).

2. Install front and rear end seals, making sure that ends are positioned under cylinder heads as shown in figures 14 and 15.

3. Install intake manifold. Lubricate bolts entirely with engine oil, install and torque to 15 ft. lbs. in sequence (figure 16). Retorque in sequence to 40 ft. lbs.

4. Install distributor harness assembly and secure. Connect spark plug cables on the spark plugs (refer to figure 2 for proper spark plug cable connection).

5. Install PCV valve into grommet on R.H. valve cover.

6. Connect vacuum hoses to the distributor tee and to front of carburetor (from the carbon canister). Connect to the intake manifold vacuum hoses from the brake booster, heater control and cruise control (if equipped).

7. Connect throttle cable, and cruise control (if equipped).

8. Install fuel line from fuel pump to carburetor.

9. Connect temperature gauge wire.

10. Install air conditioning bracket(s) and any struts which were removed. (Refer to figure 13).

11. Install oil fill tube and flexible elbow.

12. Install generator brace (also mounting bracket, if removed).

13. Adjust belt tension. Refer to "Belt Tension" later in this section.

14. Connect upper radiator hose, thermostat and by-pass hose to the water outlet. Connect heater hose at rear of manifold.

15. Install air cleaner assembly.

16. Connect battery negative cable(s) to the batteries.

17. Fill radiator. Start engine and check for leaks.

L.H. EXHAUST MANIFOLD

REMOVAL

1. Remove air cleaner.
2. Remove hot air shroud as shown in figure 17.

NOTE: Shroud is attached to exhaust manifold by bolts No. 2 and 5.

3. Hoist vehicle.
4. Remove power steering or generator brackets and braces as required.
5. Disconnect exhaust pipe.
6. Remove exhaust manifold.

INSTALLATION

1. Position exhaust manifold on engine and install bolts No. 3 and 4 finger tight (figure 17).
2. Position hot air shroud, power steering and generator braces (as required). Torque braces (as required). Torque shroud bolts to 25 ft. lbs. and bend tabs around bolt heads.
3. Install power steering and generator brackets. Adjust belt tension. Refer to "Belt Tension" later in this section.
4. Connect exhaust pipe and tighten pipe to manifold bolts until they bottom on spacer.
5. Lower vehicle.
6. Install air cleaner.

R.H. EXHAUST MANIFOLD

REMOVAL

1. Hoist vehicle.
2. Disconnect exhaust pipe.
3. Remove exhaust manifold.

INSTALLATION

1. Install exhaust manifold and torque bolts to 25 ft. lbs. Bend tabs around bolt heads.
2. Connect exhaust pipe and tighten pipe to manifold bolts until they bottom on spacers.
3. Lower vehicle.

VALVE COVER

REMOVAL

1. Remove air cleaner.
2. Disconnect positive crankcase ventilation from valve cover.
3. Disconnect spark plug cables from spark plugs and move back and out of the way.
4. Loosen belts and remove accessories and mounting brackets. It will be necessary to wire the air conditioning compressor up for support after removing its brackets and support struts (figure 13).

NOTE: Refrigerant lines do not have to be disconnected from the compressor.

5. Remove valve cover to cylinder head attaching screws as shown in figure 18.
6. Clean gasket surfaces on cylinder head and valve cover.

INSTALLATION

1. Thoroughly clean the head and valve cover gasket surface. Then apply Part No.

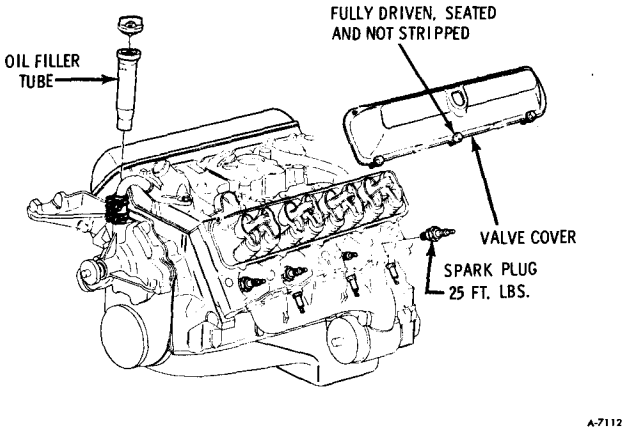


Figure 18—Valve Cover

1051435 RTV (Room Temperature Vulcanizing) sealer or equivalent to the valve cover (figure 19).

2. Replace valve cover and torque attaching screws so fully driven, seated and not stripped.

3. Install accessories and mounting brackets as necessary. Adjust belt tension. Refer to "Belt Tension" later in this section.

4. Connect spark plug cables, and connect PCV valve to valve cover.

5. Install air cleaner.

ROCKER ARM ASSEMBLIES
(FIGURE 20)

REMOVAL

1. Remove valve cover. Refer to "Valve Cover" earlier in this section.

2. Remove rocker arm flanged bolts, pivot and rocker arms (figure 21).

NOTE: Remove each set (one set per cylinder) as a unit.

INSTALLATION

1. Position a set of rocker arms (for one cylinder) in the proper location.

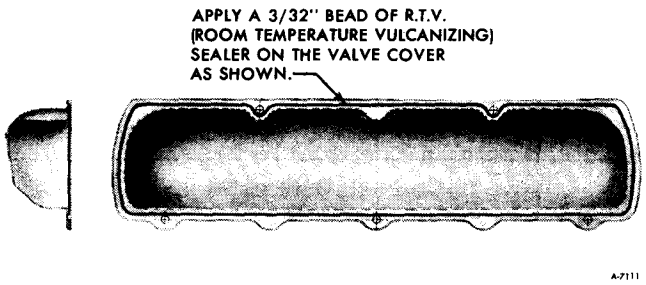


Figure 19—Sealer on Valve Cover

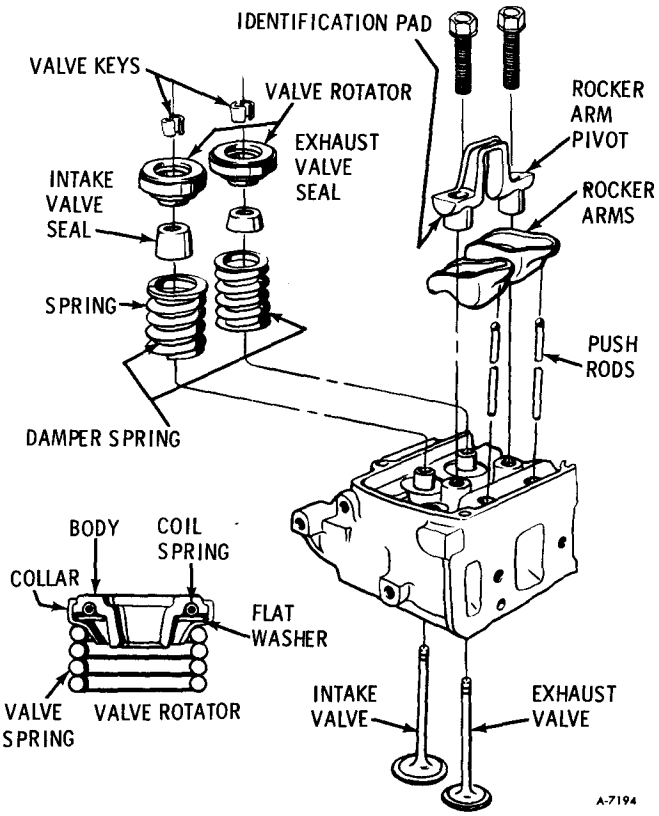


Figure 20—Cylinder Head Components

2. Lubricate wear points with Part No. 1050169 Lubricant or equivalent and install the pivots.

3. Install the hardened flanged bolts and tighten alternately. Torque bolts to 25 ft. lbs.

VALVE LIFTERS

OPERATION

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a

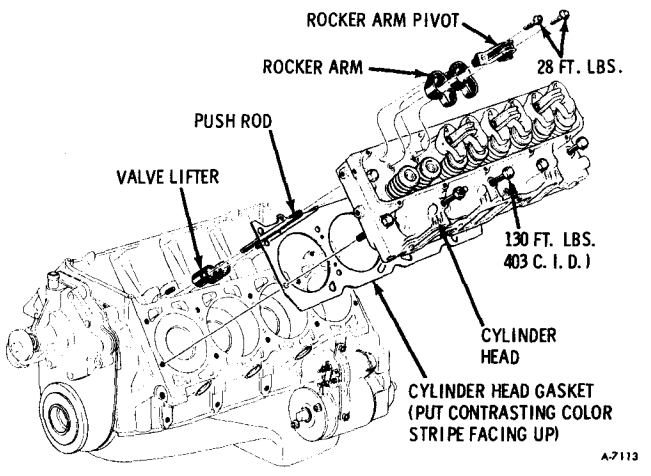


Figure 21—Removing Rocker Arms

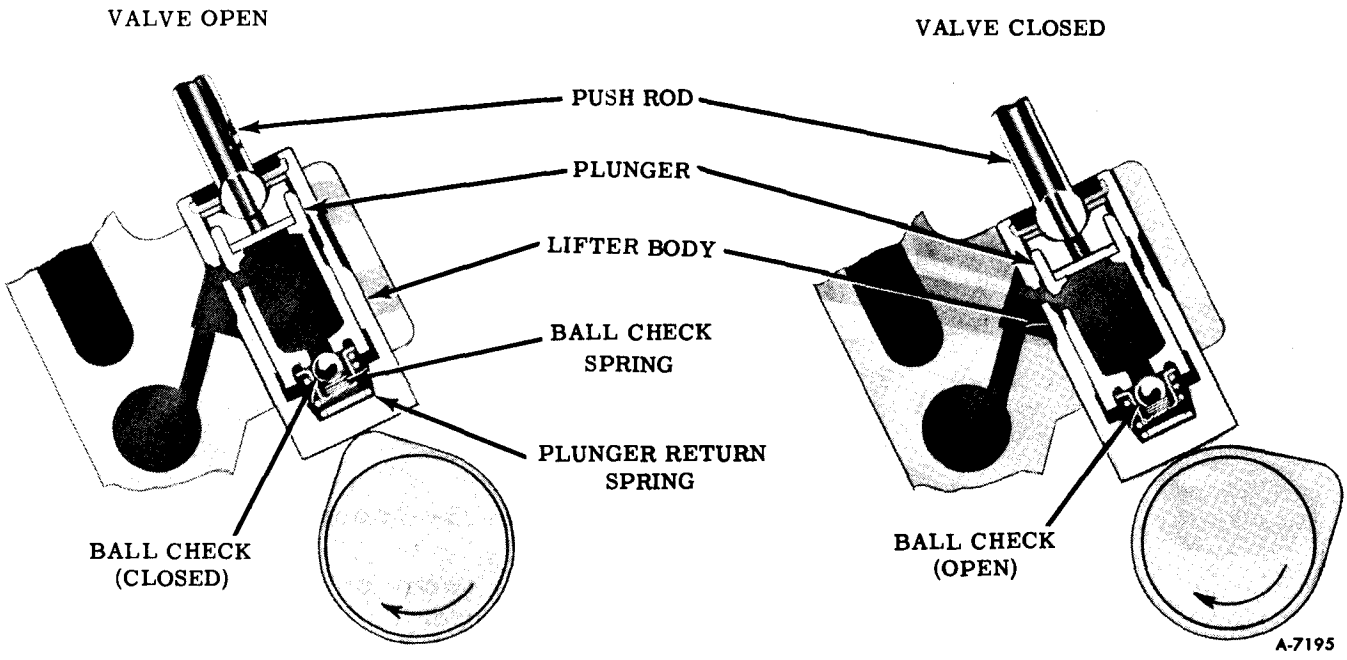


Figure 22—Valve Lifter (Cutaway View)

groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the pushrods to the rocker arms.

When the lifter begins to ride up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash (figure 22).

VALVE LIFTER DIAGNOSIS

1. MOMENTARILY NOISY WHEN VEHICLE IS STARTED:

This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.

2. INTERMITTENTLY NOISY ON IDLE ONLY, DISAPPEARING WHEN ENGINE SPEED IS INCREASED:

Intermittent clicking may be an indication of a flat or pitted ball, or it may be caused by dirt.

Correction: Clean the lifter and inspect. If ball is defective, replace lifter.

3. NOISY AT SLOW IDLE OR WITH HOT OIL, QUIET WITH COLD OIL OR AS ENGINE SPEED IS INCREASED:

Insert a .015" feeler gauge between the rocker arm and valve stem. If noise momentarily disappears and then reappears after a few seconds with the feeler still inserted, it is an indication that the lifter leakdown rate is too fast.

Correction: The lifter must be replaced.

4. NOISY AT HIGH VEHICLE SPEEDS AND QUIET AT LOW SPEEDS.

a. High oil level - Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation.

Correction: Drain oil until proper level is obtained. See Section 0 in Maintenance Manual X-7525.

b. Low oil level - Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters.

Correction: Fill until proper oil level is

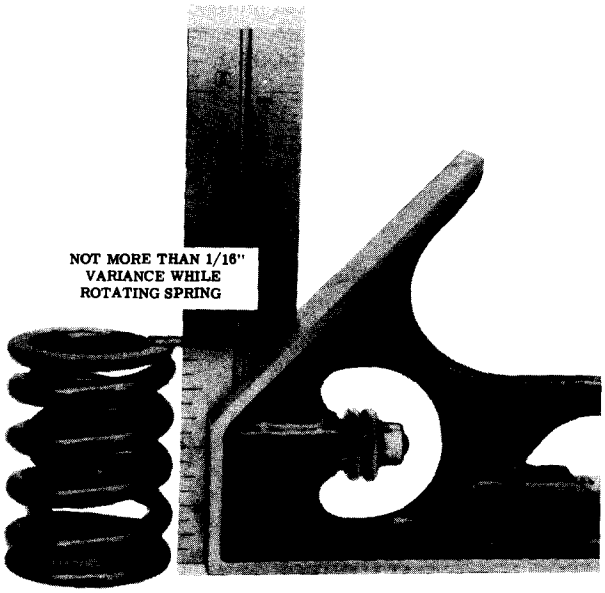


Figure 23—Checking Valve Spring

obtained. See Section 0 in Maintenance Manual X-7525.

5. NOISY AT IDLE BECOMING LOUDER AS ENGINE SPEED IS INCREASED TO 1500 RPM.

This noise is not connected with lifter malfunction. It becomes most noticeable in the vehicle at 10 to 15 mph "L" range, or 30 to 35 mph "D" range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:

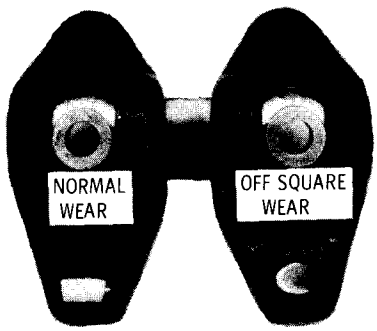


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Figure 24—Rocker Arm Wear

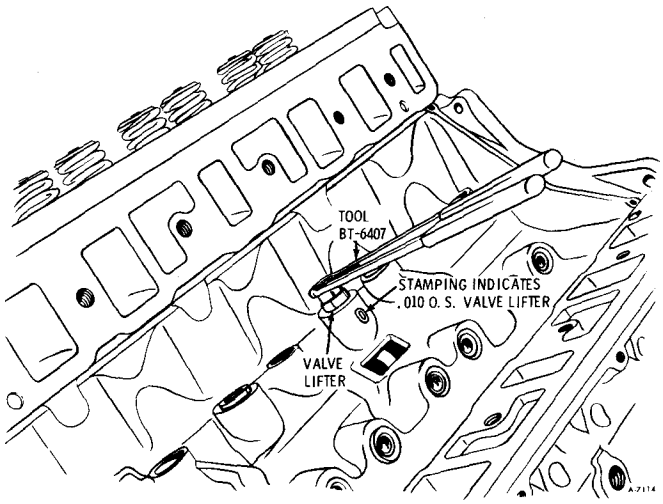


Figure 25—Removing Valve Lifter

1. Badly worn or scuffed valve tip and rocker arm pad.
2. Excessive valve stem to guide clearance.
3. Excessive valve seat runout.
4. Off square valve spring.
5. Off square rocker arm pad.
6. Excessive valve face runout.
7. Valve spring damper clicking on rotator.

Correction: Remove valve covers and while listening with a stethoscope, locate noisy valves by increasing engine speed slightly above idle, about 1500 rpm. With gloved hand, push side-ways on valve spring. Noise will change, either becoming louder or disappearing completely. Some noise will be present in all valve locations. It is necessary to determine which are actually responsible for the noise.

a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correction is obtained, check for an off square valve spring. If spring is off square more than 1/16" in free position, replace spring (figure 23).

b. Observe rocker arm pad for excessive wear or excessive off square. Replace as required (figure 24).

c. Check for excessive valve stem to guide clearance. If necessary, correct as required.

6. VALVES NOISY REGARDLESS OF ENGINE SPEED

This condition can be caused by foreign particles or excessive valve lash.

Correction: With transmission in "Park" and parking brake on, run the engine at a moderate speed.

If this method does not quiet the lifter, strike the rocker arm above the push rod with

a mallet while the engine is idling. This method of correction has proven successful for dislodging a foreign particle which is preventing the ball from seating properly.

b. Check for valve lash by turning engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push rod can be freely moved up and down a certain amount with rocker arm held against valve.

Valve lash indicates one of the following:

1. Worn push rod.
2. Worn rocker arm.
3. Lifter plunger stuck in down position due to dirt or varnish.
4. Defective lifter.

Checking of the above four items:

1. Observe upper end of push rod. Excessive wear of the spherical surface indicates one of the following conditions.

a. Improper hardness of the push rod ball. The push rod and rocker arm must be replaced.

b. Improper lubrication of the push rod. The push rod and rocker arm must be replaced. The oiling system to the push rod should be checked.

2. If push rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.

3. If valve lash exists and push rod and rocker arm are okay, trouble is in the lifter. Lifter should be replaced.

REMOVAL (FIGURE 25)

NOTE: Valve lifters and push rods should be kept in order so they can be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters, the .010" oversize lifter is etched "0" on the side of the lifter. The cylinder block will also be marked if the oversize lifter is used.

1. Remove intake manifold and gasket. Refer to "Intake Manifold" earlier in this section.
2. Remove valve covers, rocker arm assemblies and push rods. Refer to those areas earlier in this section.
3. If lifters are varnished, apply carburetor cleaning solution to lifter body. Allow five minutes for solution to remove varnish. Remove valve lifters.

CAUTION: *Carburetor cleaning solvent should be used in a well ventilated room. Avoid contact with skin and prolonged breathing of fumes.*

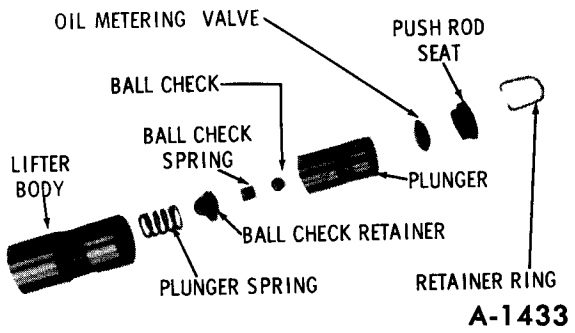


Figure 26—Valve Lifter Components

DISASSEMBLY

1. Remove retainer ring with a small screwdriver.
2. Remove push rod seat and oil metering valve.
3. Remove plunger and plunger spring. If plunger is stuck tight, allow lifter to soak in carburetor cleaning solvent for approximately five minutes, then remove.
4. Remove ball check retainer from plunger, then remove ball and spring.

CLEANING AND INSPECTION

After lifters are disassembled, all parts (figure 26) should be cleaned in clean solvent. A small particle of foreign material under the ball check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the body or plunger is defective, replace with a new lifter assembly.

NOTE: Do not condemn valve lifters that have a slight gap or show evidence of leakage where the lifter foot is welded to the lifter body.

Whenever lifters are removed, check the lifter foot for abnormal wear as follows:

1. Place a straight edge across the lifter foot.

NOTE: Lifter foot must be clean and dry.

2. While holding the lifter at eye level check for light between the straight edge and lifter foot.
3. If light indicates a concave surface of the lifter foot, the lifter should be replaced and the camshaft inspected for wear. Wear at the CENTER of the cam base circle is NORMAL. The camshaft should be replaced ONLY when wear is present across FULL

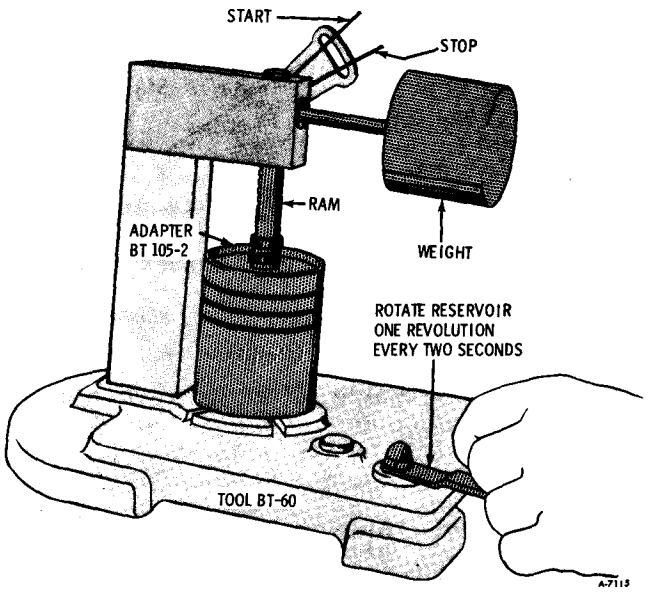


Figure 27—Valve Lifter Testing

WIDTH of cam base circle. Full wear across the nose of the cam is normal.

ASSEMBLY

1. Assemble ball check, spring and retainer into plunger (figure 25). Make sure retainer flange is pressed tight against bottom of recess in plunger.
2. Install plunger spring over ball check retainer.
3. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
4. Assemble oil metering valve and push rod seat and seat retaining ring in groove.

NOTE: Lifters must be assembled while submerged in Hydraulic Lifter Test Fluid J-5268 or equivalent, and leak-down tested before placing into service.

5. Install Tester J-5790, then fill reservoir with hydraulic lifter test fluid J-5268 to ½" below top of reservoir.
6. Assemble ball check and retainer into plunger (figure 26).

Make sure retainer flange is pressed tight against bottom of recess in plunger.

7. Install plunger spring over ball check retainer.
8. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
9. Place assembly into the tester cup, then position oil control valve and push rod seat onto plunger.
10. Position the ¼" steel ball on the push rod seat. Lower tester ram until it contacts the steel ball.
11. Allow ram to move downward by its own weight until air bubbles disappear.
12. Raise ram, then allow to lower as in Step 4. Repeat this procedure several times or until all air is expelled from lifter.

DO NOT ATTEMPT to expel air from lifter by pumping on ram.

13. After all air is expelled, allow ram to bleed down lifter until retaining groove is exposed.
14. Install retaining ring.
15. Adjust ram screw so that it contacts the steel ball in the push rod seat when the pointer is at the start line.
16. Raise arm, then start test by resting ram on steel ball. Rotate reservoir one revolution every two seconds and time the indicator from the start to the stop line (figure 27). Allowable leak down rate is six seconds minimum for used lifters and 9 to 60 seconds for new lifters.
17. If leak-down tolerance is within specifications, the lifter can be placed in service without removing test fluid.

INSTALLATION

NOTE: Prime new lifters by working lifter plunger while submerged in new engine oil. Lifter could be damaged when starting engine if dry.

1. Install lifters and push rods into original position in cylinder block. See note under "Removal".
2. Install manifold gaskets and manifold. Refer to "Intake Manifold" earlier in this section.
3. Position rocker arms, pivots and bolts on cylinder head as shown in figure 20.
4. Install valve covers. Refer to "Valve Cover" earlier in this section.

CYLINDER HEAD AND GASKET

REMOVAL

1. Drain radiator. Drain cock located at lower left side of radiator. By raising the rear wheels approximately 2-1/2 feet, enough engine coolant will drain from the engine block to allow removal of the heads.

NOTE: To avoid overloading the front suspension raise front of the vehicle enough so front wheels are just off the ground.

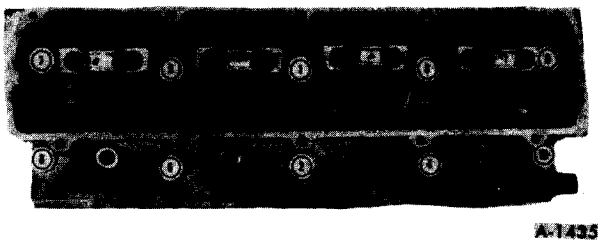


Figure 28—Cylinder Head Torque Sequence

2. Remove intake manifold. Refer to "Intake Manifold" earlier in this section.
3. Remove exhaust manifold, see "L.H. and R.H. Exhaust Manifold Removal" earlier in this section.
4. Loosen or remove any accessory brackets which interfere with head removal.
5. Remove valve cover. Refer to "Valve Cover" earlier in this section.
6. Remove rocker arm bolts, pivots, rocker arms and push rods as shown in figure 20.

NOTE: Scribe pivots and keep rocker arms separated so they can be installed in their original locations.

7. Remove cylinder head bolts, then remove cylinder head.

NOTE: If a clearance problem is encountered for number 7 or 8 cylinder head bolts (figure 28) or push rods, pull these out far enough to clear the block, secure with rubberbands, and remove or install with the cylinder heads.

CAUTION: *Gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. The cylinder head bolt threads into the block and threads on cylinder head bolt must be cleaned. Dirt will affect bolt torque.*

INSTALLATION

Head gaskets are a special composition gasket that must be used WITHOUT a sealer. These gaskets are to be installed with the contrasting color stripe facing "up". Use a new head gasket.

1. Clean and dip cylinder head bolts in engine oil.
2. Install cylinder head and torque bolts to 100 ft. lbs. in sequence as shown in figure 28. Then retorque in sequence to 130 ft. lbs.

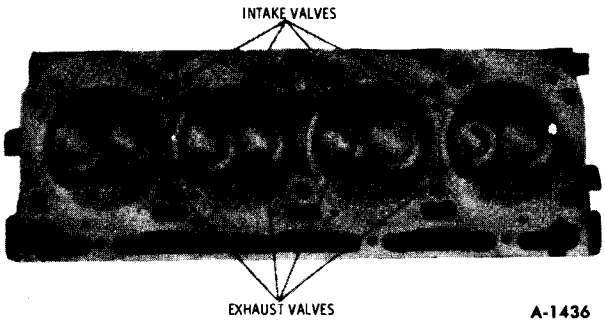


Figure 29—Valve Location

NOTE: Torque head bolts before installing rocker arms and pivots if a clearance problem is encountered.

3. Install push rods, pivots, rocker arms and bolts. Torque rocker arm pivot bolts to 25 ft. lbs., tighten by alternating from side to side.

NOTE: Be sure to place rocker arms and pivots in their original locations.

4. Install valve cover. Refer to "Valve Cover" earlier in this section.
5. Install intake manifold. Refer to "Intake Manifold" earlier in this section.
6. Install any accessory brackets that were removed previously.
7. Install exhaust manifold. Refer to "L.H. and R.H. Exhaust Manifold Installation" earlier in this section. Torque bolts to 25 ft. lbs. Bend tabs around bolt heads.
8. Add engine coolant.
9. Start engine and check for leaks.

VALVES AND SPRINGS WITH HEAD REMOVED

REMOVAL

1. Remove spark plugs.
2. Remove valve keys by compressing valve spring with a tool J-5892-1 or equivalent.
3. Remove valve spring rotators or retainers and springs.
4. Remove oil seals from valve stems.
5. Remove valves. Keep valves separated so they can be installed in their original locations (figure 29).

RECONDITIONING VALVES

When reconditioning valves and valve seats, clean carbon from cylinder heads and valves using care not to gouge or scratch machined surfaces. A soft wire brush is suitable for this purpose. Whenever valves are replaced or new

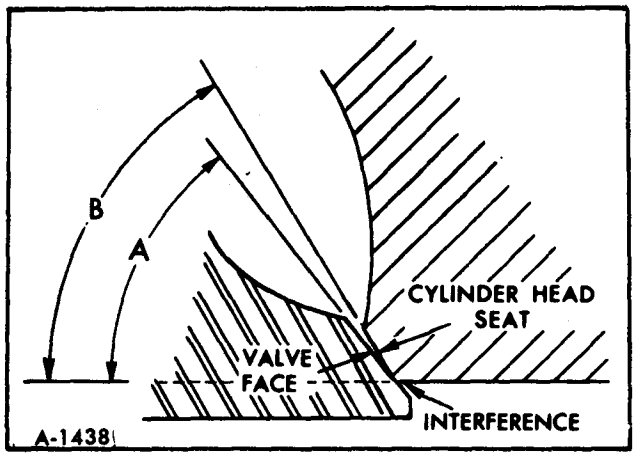


Figure 30—Relation of Valve and Seat Angles

valves installed, the valve seats must be reconditioned.

Figure 30 shows the relation of valve angle and valve seat angle.

Narrow the valve seats to the specified width.

NOTE: This operation is done by grinding the portside with a 30° stone to lower the seat and a 60° stone to raise the seat.

See "Engine Specification" Chart for valve seat width.

NOTE: Exhaust valve seats are induction hardened and must be ground, not cut.

If valve guide bores are worn excessively, they can be reamed oversize. This will require replacement of the valves with oversize valves (stems). The guide bores should be reamed

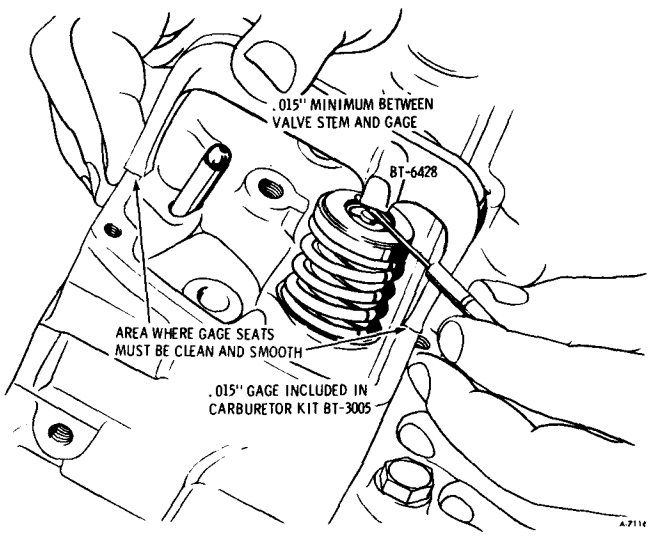


Figure 31—Measuring Valve Stem Height

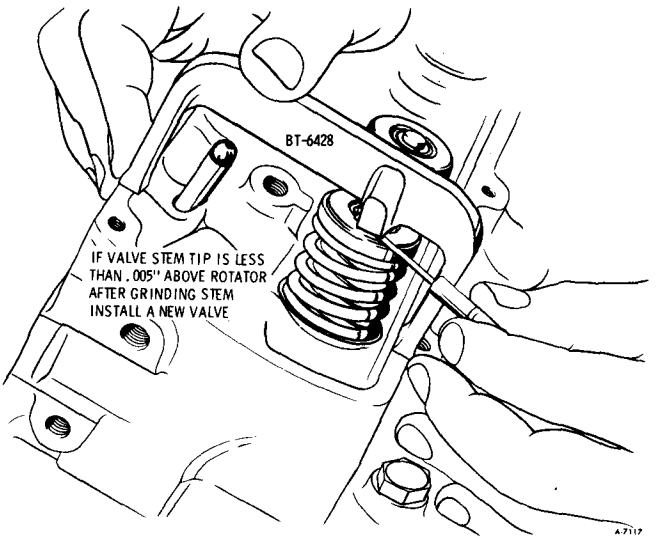


Figure 32—Measuring Rotator Height

before grinding the valve seats. Valve clearance in guide bore should be .0015" to .0032" (exhaust) or .002" to .0027" for the intake valve.

MEASURING VALVE STEM HEIGHT (FIGURE 31)

Whenever a new valve is installed, or after grinding valves, it will be necessary to measure valve stem height. Install Gauge BT-6428. There should be at least .015" clearance on all valves between gauge surface and end of valve stem. (Valve stem can be gauged with or without the valve rotator on the valve). If clearance is less than .015", remove valve and grind tip of valve stems as required on a valve refacing machine using the "Vee" block attachment to insure a smooth 90° end. Also be

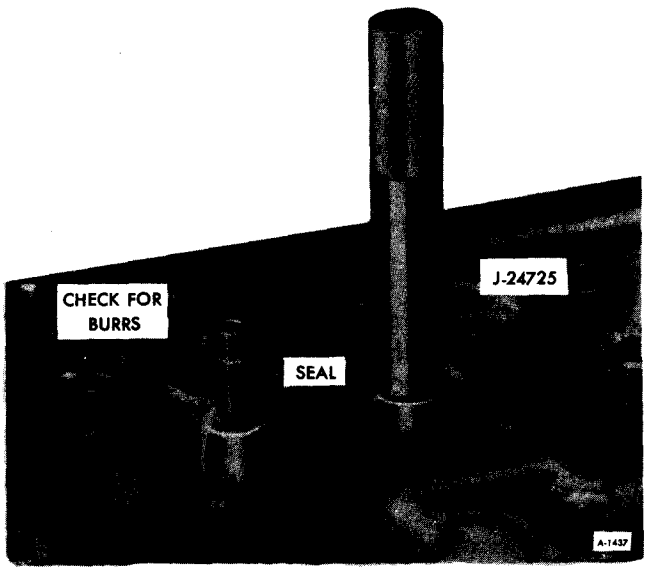


Figure 33—Valve Seal Installation

certain to break sharp edge on ground valve tip. Observe an original valve to determine chamfer.

After all valve keys have been installed on valves, tap each valve stem end with a hammer to seat valve rotators and keys. Re-gauge all valves between valve stem and gauge (.015" minimum) and valve rotator and gauge (.030" minimum) (figures 31 and 32). If any valve stem end is less than .005" above rotator, the valve is too short and a new valve must be installed.

NOTE: There must be a minimum of .030" clearance between valve rotator and gauge. Failure to maintain this clearance will cause rocker arm and valve rotator interference. Example:

Valve Rotator to Gauge Clearance . . 0.38"
Minus Valve Stem to Gauge Clearance . -0.35"
.003"

This is less than .005" and a new valve should be installed.

INSTALLATION

1. Install valves in their respective guides.
2. Install new oil seals over valve stem, using Tool J-24725 (figure 33).

Position seals down as far as possible on valve stem. The seals will correctly position themselves when the engine is started.

NOTE: Inspect seal for cracks after installation.

3. Position valve springs over valve stems.
4. Install valve rotators, then compress springs with a tool such as J-5892-1 and install valve stem keys.
5. Check valve springs and keys to be sure they are properly seated.
6. Torque spark plugs to 25 ft. lbs.

VALVE GUIDE BORES

As previously stated, if the valve guide bores are worn excessively, they can be reamed oversize. The following reamers are available:

.003" Oversize Valve Guide Reamer (BT-6414-1)
.005" Oversize Reamer (BT-6414-4)
.013" Oversize Valve Guide Reamer (BT-6414-3)

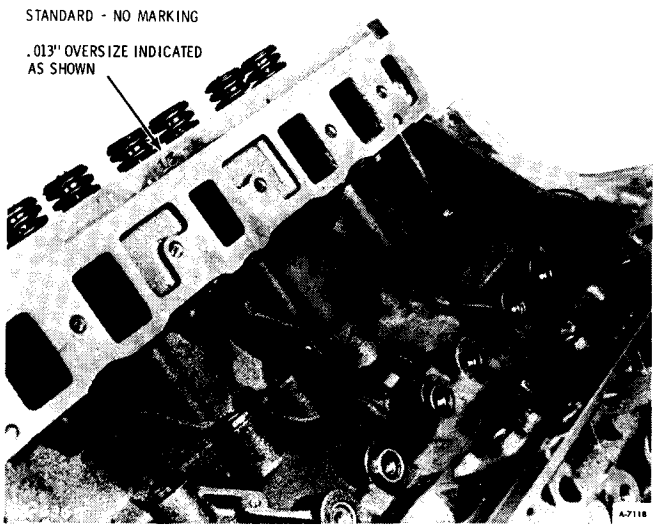


Figure 34—Valve Guide Bore Marking

If a standard valve guide bore is being reamed, use the .003" oversize reamer. For the .005" oversize valve guide bore, use the .005" oversize reamer; use the .013" reamer for the .010" or .013" O.S. valve guide bore.

If too large a reamer is used and the spiraling is removed, it is probable that the valve will not receive the proper lubrication.

Occasionally a valve guide bore will be oversize as manufactured. These are marked on the inboard side of the cylinder heads on the machined surface just above the intake manifold surface (figure 34). These markings are visible without removing any parts other than the air cleaner assembly. Before removing the cylinder heads to perform service to either the valves or valve guide bores, the cylinder heads should be inspected to determine if these markings are present. If no

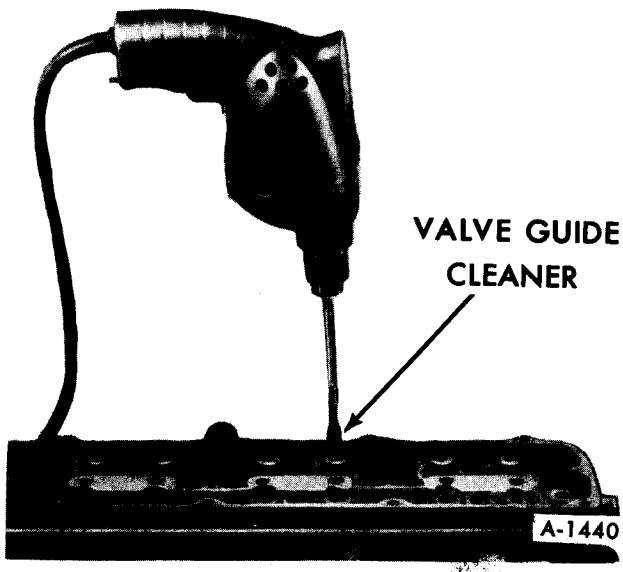


Figure 35—Cleaning Valve Guide Bores

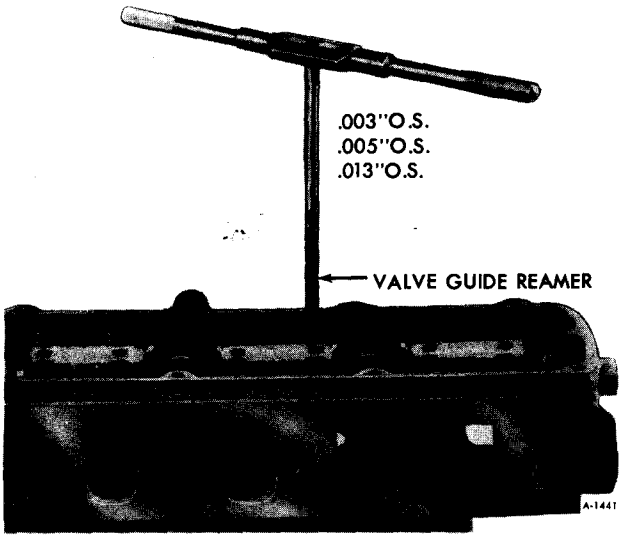


Figure 36—Reaming Valve Guide Bores

markings are present, the guide bores are standard. If oversize markings are present, any valve replacement will require an oversize valve. If the oversize marking is present, only that particular bore would be oversize, not all bores in that cylinder head. Service valves are available in five different stem diameters: Standard, .003" oversize, .005" oversize, .010" oversize, and .013" oversize.

REAMING PROCEDURE

Before attempting to ream the valve guide bores they should be cleaned using a tool as shown in figure 35.

This procedure to ream valve guide bores using a reamer is shown in figure 36. Use care to hold reamer straight in valve guide bore.

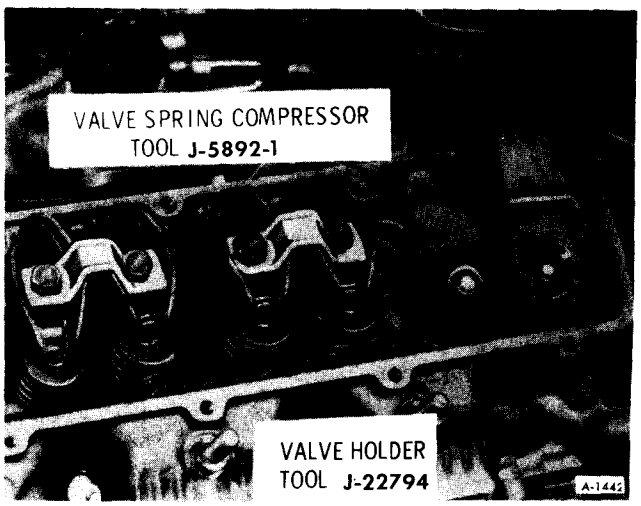


Figure 37—Removing Valve Spring

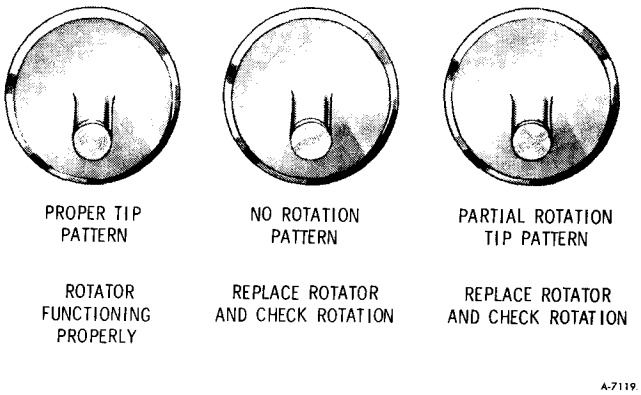


Figure 38—Valve Stem Wear

REPLACING VALVE SPRING (HEAD ON ENGINE)

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

REMOVAL

1. Remove valve covers. Refer to "Valve Cover" earlier in this section.
2. Remove rocker arm assemblies.
3. Remove spark plug and install Tool J-22794 into spark plug hole and attach to an air hose to hold the valve against its seat (figure 37).
4. Install Tool J-5892-1 (figure 37). Compress the valve spring until valve keys are accessible, then remove keys, valve rotators and springs.

NOTE: If valve spring does not compress, tap tool with a hammer to break bind at rotator and keys.

CHECKING ROTATORS

The rotators cannot be disassembled and require replacement only when they fail to rotate the valve.

Rotator action can be checked by applying a daub of paint across the top of the body and down the collar. Run engine approximately 1500 rpm; there should appear to be motion between the body and collar, the body will appear to "walk" around the collar. Rotator action can be either clockwise or counter-clockwise, sometimes on removal and reinstallation; the direction of rotation will change but this does not matter so long as it rotates.

Anytime the valves are removed for service the tips should be inspected for improper pattern which could indicate valve rotator malfunction (figure 38).

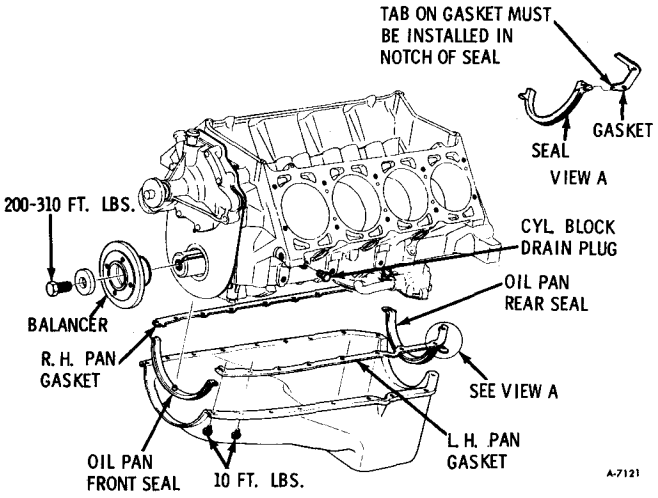


Figure 39—Oil Pan Assembly

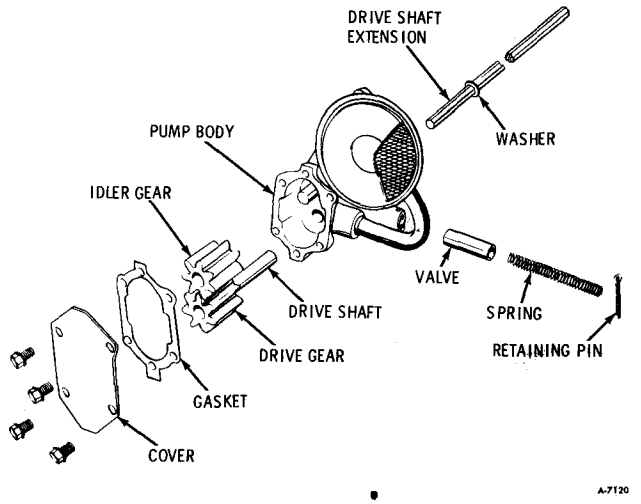


Figure 40—Oil Pump Components

INSTALLATION

1. Install valve spring and rotator. Using Tool J-5892-1, compress the valve spring until the valve keys can be installed.
2. Remove tool No. J-22794 and install spark plugs. Torque to 25 ft. lbs.
3. Install rocker arm assemblies.
4. Install valve covers. Refer to "Valve Cover" earlier in this section.

OIL PAN

REMOVAL

1. Remove transmission and final drive. Refer to "Engine Removal" later in this section.
2. Remove oil pan drain plug and drain oil.
3. Disconnect relay tie rod from the idler arm and the relay lever. Also disconnect steering shock absorber from crossmember bracket.
4. Remove fan and clutch assembly (4 bolts). Removal of these components will allow the engine to be raised slightly for oil pan removal.
5. Disconnect power steering pump.
6. Install engine removal tool (see figures 7, 8 and 9). Remove 4 front support bolts and front motor mount bolts.
7. Remove flywheel.
8. Remove oil pan attaching bolts.
9. Raise front of engine enough so the oil pan can be removed (approximately one inch). Remove oil pan.
10. Clean gasket surfaces on the engine block and the oil pan.

INSTALLATION

1. Apply sealer Part No. 1050805 or equivalent to both sides of gaskets. Position all gaskets on engine block (figure 39).
2. Position oil pan on engine. Start all bolts and install until finger tight. Torque oil pan bolts to 10 ft. lbs.
3. Install flywheel and torque bolts to 60 ft. lbs.
4. Lower engine to position. Install four (4) front support bolts and torque to 50 ft. lbs. (figure 10).
5. Torque engine mount support bracket to front cover bolts to 50 ft. lbs. (figure 10).
6. Install power steering pump.
7. Attach fan shroud to radiator support (4 bolts). Install fan and clutch assembly to pulley. Torque nuts to 10-15 ft. lbs.
8. Connect relay tie rod and torque nuts to 50 ft. lbs., then insert cotter pin. Connect steering shock absorber to bracket at crossmember, torque nut to 40 ft. lbs.
9. Install oil pan drain plug. Torque to 30 ft. lbs.
10. Install transmission and final drive. Refer to "Engine Replacement" later in this section.
11. Lower vehicle.
12. Add engine oil. Refer to Section "0" Maintenance Manual X-7525 for proper viscosity and quanity information.
13. Start engine and check for leaks.

OIL PUMP

REMOVAL

1. Remove oil pan. Refer to "Oil Pan" earlier in this section.
2. Remove the oil pump to rear main bearing cap attaching bolts, then remove pump and drive shaft extension.

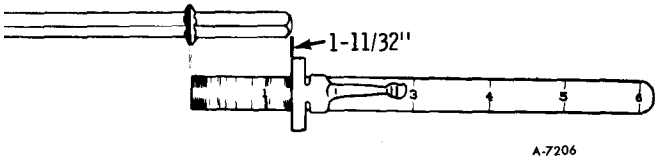


Figure 41—Oil Pump Driveshaft Extension

DISASSEMBLY (FIGURE 40)

1. Remove the oil pump drive shaft extension.

NOTE: Do not attempt to remove the washers from the drive shaft extension. The drive shaft extension and washers must be serviced as an assembly (figure 41).

2. Remove the cotter pin, spring and the pressure regulator valve.

NOTE: Position thumb over pressure regulator bore before removing cotter pin, as the spring is under pressure.

3. Remove the oil pump cover attaching screws and remove the oil pump cover and gasket.

4. Remove the drive gear and idler gear from the pump body.

INSPECTION

Check the gears for scoring or other damage. If they are damaged, new gears should be installed. During assembly, the gear end clearance should be gauged. Proper end clearance is .0015" to .0085". Also check the pressure regulator valve, valve spring and bore for damage. Proper valve to bore clearance is .0025" to .0050". The checking of gear end clearance will be covered in "Assembly".

ASSEMBLY

1. Install the gears and shaft in the oil pump body and check the gear end clearance by placing a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. The clearance should be between .0015" to .0085". If the end clearance is near the excessive reading check for scores in the cover that would bring the total clearance over the specified amount.

2. Position a new gasket on the pump body and install the oil pump cover. Install cover screws and tighten alternately and evenly. Torque to 8 ft. lbs.

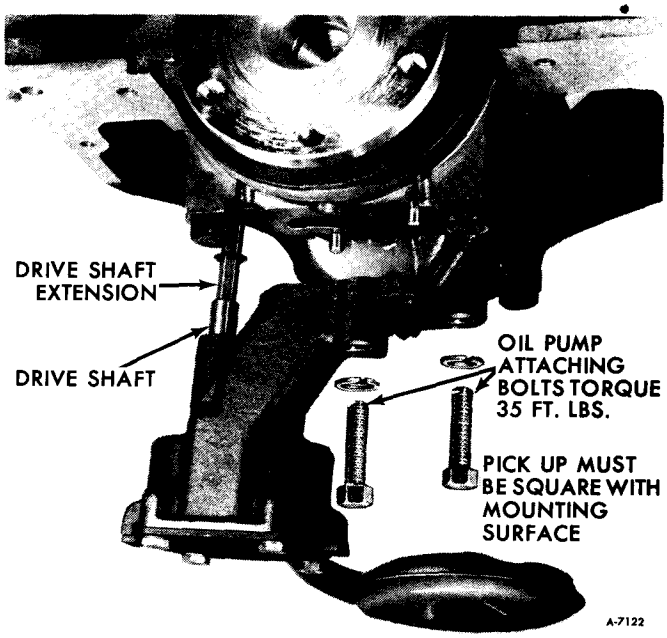


Figure 42—Oil Pump Installation

3. Position the pressure regulator valve into the pump cover, closed end first, then install the spring and cotter pin.

NOTE: When assembling the drive shaft extension to the drive shaft, the END OF THE EXTENSION NEAREST THE WASHERS MUST BE INSERTED INTO THE DRIVE SHAFT.

INSTALLATION

1. Insert the drive shaft extension through the opening in the main bearing cap and block until the shaft mates into the distributor drive gear.

2. Position pump onto the rear main bearing cap, and install attaching bolts. Torque bolts to 35 ft. lbs. (figure 42).

3. Install the oil pan. Refer to "Oil Pan" installation earlier in this section.

CONNECTING ROD AND PISTON ASSEMBLY

REMOVAL

1. Remove intake manifold. Refer to "Intake Manifold" earlier in this section.

2. Remove head or heads, oil pan and oil pan and oil pump assembly. Refer to those areas earlier in this section.

NOTE: Stamp cylinder number on the machined surfaces of the bolt bosses of the connecting rod and cap for identification when reinstalling. If the pistons are to be

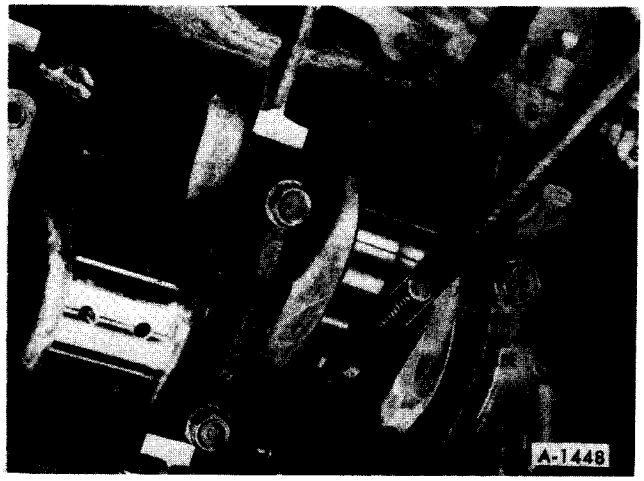


Figure 43—Connecting Rod Bolt Guide

removed from the connecting rod, mark cylinder number on piston with a silver pencil or quick drying paint for proper cylinder identification and cap to rod location. The right bank is numbered 2-4-7-8, left bank 1-3-5-7.

Examine the cylinder bore above ring travel. If ridge exists, remove ridge with ridge reamer before attempting to remove the piston and rod assembly.

3. Remove rod bearing cap and bearing.
4. Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads (figure 43).
5. Remove rod and piston assembly through the top of the cylinder bore.
6. Remove other rod and piston assemblies in the same manner.

INSTALLATION

Refer to "Connecting Rod and Piston Assembly Installation" later in this section.

ROD BEARINGS

The connecting rod bearings are designed to have a slight projection above the rod and cap faces to insure a positive contact.

Connecting rod bearings can be replaced without removing the rod and piston assembly from the engine.

REMOVAL

1. Remove oil pan. Refer to "Oil Pan" earlier in this section.

NOTE: It may be necessary to remove oil pump to provide access to rear connecting rod bearings.

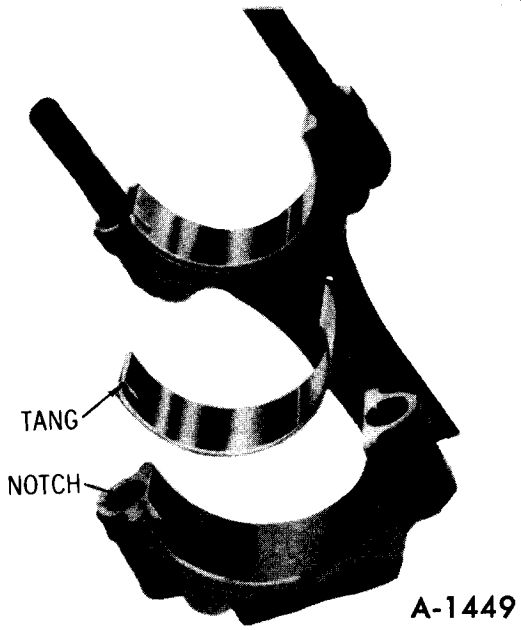


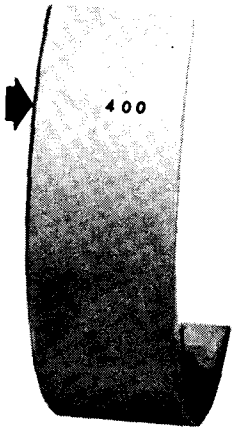
Figure 44—Bearing Tang and Notch

2. With connecting rod journal at the bottom, stamp cylinder number on machined surfaces of connecting rod and cap for identification when reinstalling, then remove caps.
3. Inspect journals for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone by moving the stone on the journal circumference. Do not move the stone back and forth across the journal. If the journals are scored or ridged, the crankshaft must be replaced.
4. The connecting rod journals should be checked for out-of-round and correct size with a micrometer. Maximum out-of-round must not exceed .0015".

NOTE: Refer to "Engine Specifications" later in this section.

NOTE: Crankshaft rod journals will normally be standard size; if any undersized crankshafts are used, all will be .010" U.S. and an "X" will be stamped on the pad at the L.F. upper corner of the block.

5. Clean oil from journal bearing cap, connecting rod and outer and inner surface of bearing inserts. Position insert so that tang is properly aligned with notch in rod and cap (figure 44).
6. Place a piece of plastic gauging material in the center of lower bearing shell.
7. Reinstall bearing cap and torque to 42 ft. lbs.
8. Remove bearing cap and determine bear-



403 C. I. D.

UNDERSIZE BEARINGS WILL ALSO BE STAMPED WITH .010" IN THIS LOCATION

A-7124

Figure 45—Bearing Identification

ing clearances by comparing the width of the flattened plastic gauging material at its widest point with the graduation on the plastic gauging material container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. If this clearance is greater than .0035", replace the bearing and recheck clearance with plastic gauging material.

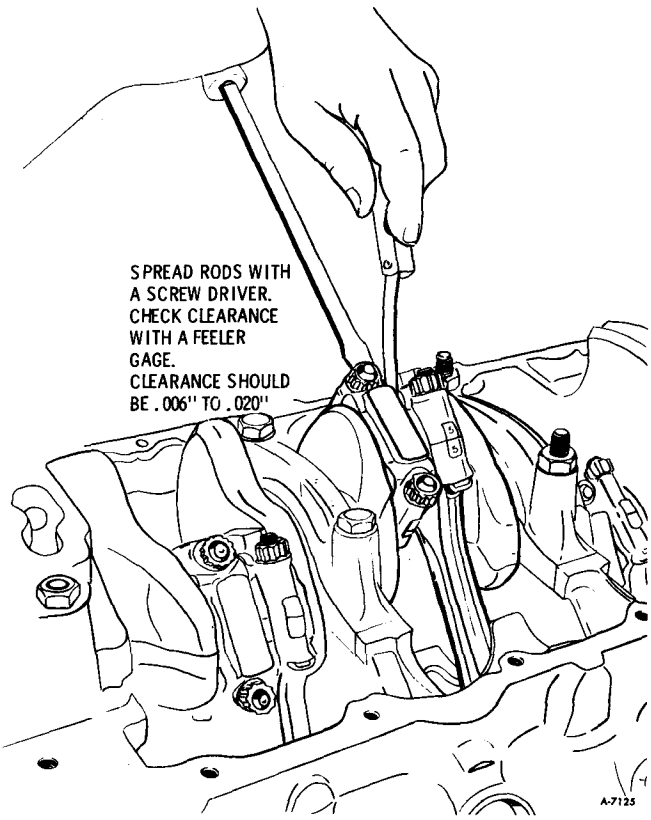


Figure 46—Connecting Rod Side Clearance

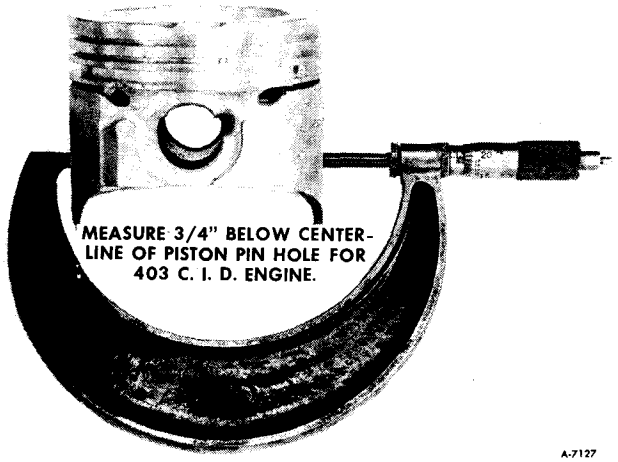


Figure 47—Measuring Piston

NOTE: Lubricate bearing with engine oil before installation. Repeat Steps 2 through 8 on remaining connecting rod bearings. All rods must be connected to their journals when rotating the crankshaft to prevent engine damage.

NOTE: Bearings are identified as shown in figure 45.

9. Measure the rod side clearance as shown in figure 46. Clearance should be .006" to .020".

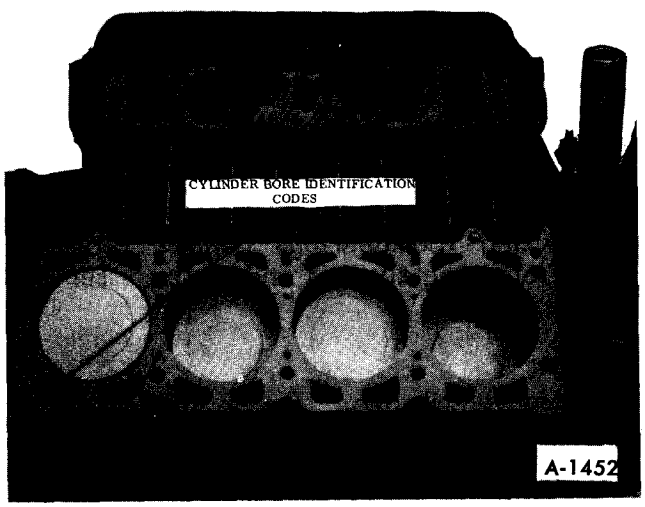


Figure 48—Cylinder Bore Marking

NOTE: If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

PISTONS

MEASURING PISTON (FIGURE 47)

NOTE: Refer to PISTON INFORMATION CHART.

When replacing pistons, the original cylinder size is stamped with a letter code on the block near each cylinder on the cylinder head surface (figure 48) or on the oil pan rail.

When measuring piston for size or taper, measurement must be made on skirt 90° from piston pin hole (with the piston pin removed) (figure 47).

When measuring taper, measure at the center line of the piston pin hole and at the bottom of the skirt. The largest reading must be at the bottom of the skirt. Allowable taper is .000" to .0001".

NOTE: In some engines, oversize pistons may be found. These pistons will be .010" oversize.

Each piston should be fitted to its individual cylinder and marked for that cylinder.

CLEANING PISTON

Clean the pistons by scraping carbon off the top of the piston. Deposits in the ring grooves should be removed with a suitable ring groove cleaning tool. It is important that the ring grooves be completely free of deposits.

PISTON INFORMATION CHART —403 C.I.D. ENGINE

Bore Diameter	Cylinder Bore Selection	Bore Sizes	Piston Selection	Piston Size	Piston Diameter	Piston To Cyl. Bore Clearance	Ring Size
	A	4.3500-4.3505	A	4.3495-4.3490			
4.3500-	B	4.3505-4.3510	B	4.3500-4.3495	4.3510-		Std.
4.3520	C	4.3510-4.3515	C	4.3505-4.3500	4.3490		
Std.	D	4.3515-4.3520	D	4.3510-4.3505	Std.	.0005 to .0015	
4.3600-	J	4.3600-4.3605	J	4.3595-4.3590			
4.3620	K	4.3605-4.3610	K	4.3600-4.3595	4.3610-		.010" O.S.
	L	4.3610-4.3615	L	4.3605-4.3600	4.3590		
.010" O.S.	M	4.3615-4.3620	M	4.3610-4.3605	.010" O.S.		

CHECKING CYLINDER BORE

NOTE: Refer to PISTON INFORMATION CHART.

Cylinder bore size can be measured with inside micrometers or a cylinder gauge. Maximum allowable taper of the cylinder bore is .001". The most wear will occur at the top of the ring travel.

Reconditioned cylinder bores should be held to not more than .001" out-of-round and .001" taper.

If the cylinder bores are smooth, the cylinder walls should not be deglazed. If the cylinder walls are scored the walls may have to be honed before installing new rings. It is important that reconditioned cylinder bores be thoroughly washed with a soap and water solution to remove all traces of abrasive material to eliminate premature wear.

RINGS

(FIGURE 49)

The pistons have three rings (two compression rings and one oil ring). The oil ring consists of two rails and an expander.

RING TOLERANCES

When installing new rings, ring gap and side clearance should be checked as follows:

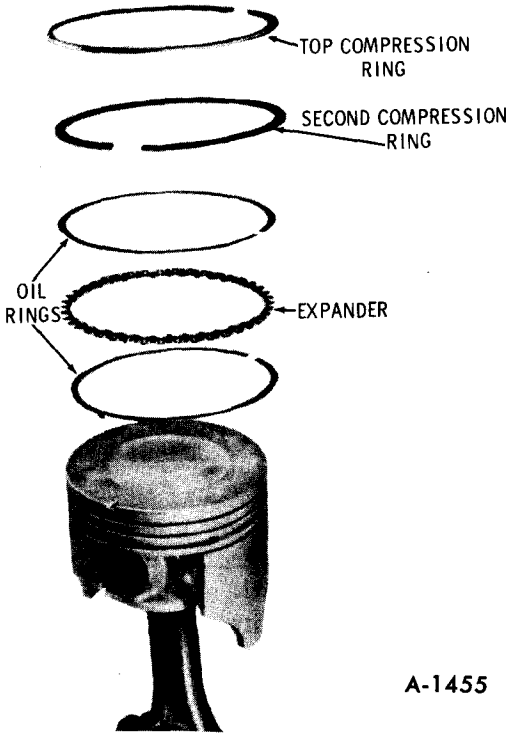


Figure 49—Piston Rings

PISTON RING AND RAIL GAP

Each ring and rail gap must be measured with the ring or rail positioned squarely and at the bottom of the ring-travel area of the bore (figure 50).

The gap measurement should be .013" to .023" for compression rings and .015" to .055" for oil rings.

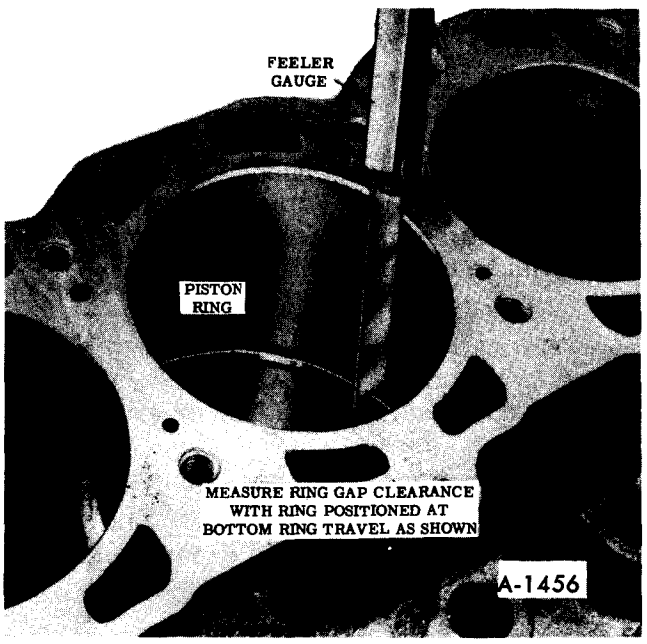


Figure 50—Measuring Piston Ring Gap

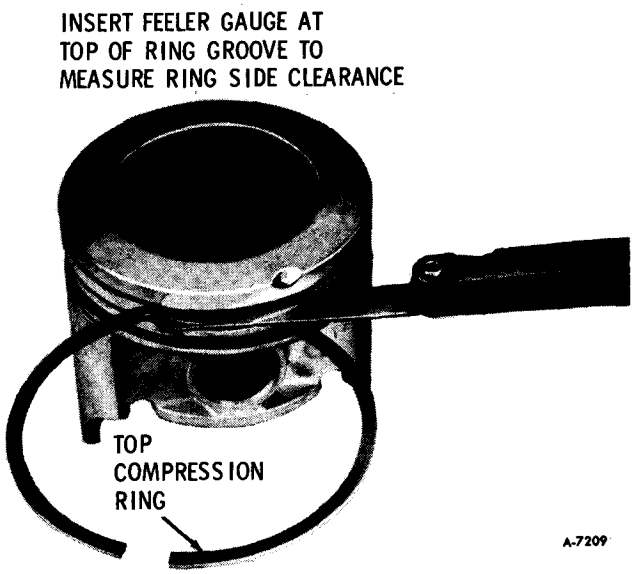


Figure 51—Piston Ring Side Clearance

SIDE CLEARANCE

Each ring must be checked for side clearance (see chart) in its respective piston groove by inserting a feeler gauge between the ring and its upper land (figure 51). The Piston grooves must be cleaned before checking ring for side clearance.

NOTE: To check oil ring side clearance, the oil rings must be installed on the piston.

ALLOWABLE SIDE CLEARANCE:

Compression Rings	.002" to .004"
Oil Ring	.015" to .055"

RING IDENTIFICATION AND INSTALLATION

For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

CONNECTING ROD AND PISTON ASSEMBLY

(FIGURE 52)

INSTALLATION

1. Install connecting rod bolt guide hose over rod bolt threads (figure 43).
2. Apply engine oil to rings and piston, then install piston ring compressing tool on piston (figure 53).
3. Install assembly in its respective cylinder bore so notch cast in top of piston is towards the front of engine.

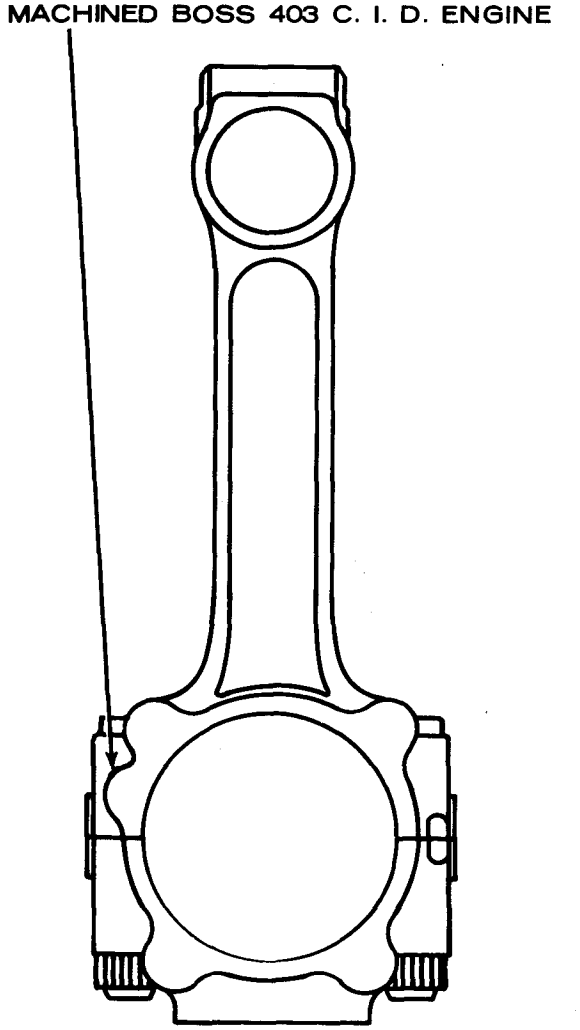


Figure 52—Connecting Rod Identification

4. Lubricate the crankshaft journal with engine oil and install connecting rod bearing and cap, with bearing index tang in rod and cap on same side.

NOTE: When more than one rod and piston assembly is being installed, the connecting rod cap attaching nuts should only be tightened enough to keep each rod in position until all have been installed. This will facilitate installation of remaining piston assemblies.

The clearance between the adjacent rods, when checked with a feeler gauge on each crankpin, should be from .006 " to .020" (figure 46).

5. Torque rod bolt nuts to 42 ft. lbs.

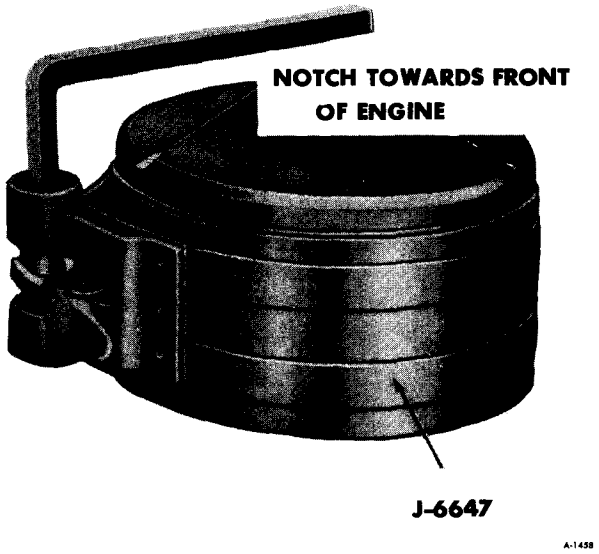


Figure 53—Piston Ring Compressor

PISTON PINS

The correct piston pin fit in the piston is .0003" to .0005" loose. If the pin to piston clearance is to the high limit (.0005"), the pin can be inserted in the piston with very little hand pressure and will fall through the piston by its own weight. If the clearance is .0003", the pin will not fall through. It is important that the piston pin hole be clean and free of oil when checking pin fit. The pin is a press fit in the connecting rod.

When replacement of a piston pin is necessary, use Piston Pin Tool Set J-24086 (figure 54). The 403 cubic inch engine (with a piston pin diameter of .9803" - .9807") has a narrow connecting rod pin boss. Use Pin Guide J-24086-2 (GREEN) for this engine application. The Piston Pin Installer — J-24086-9 — is a variable insertion length tool. The insertion

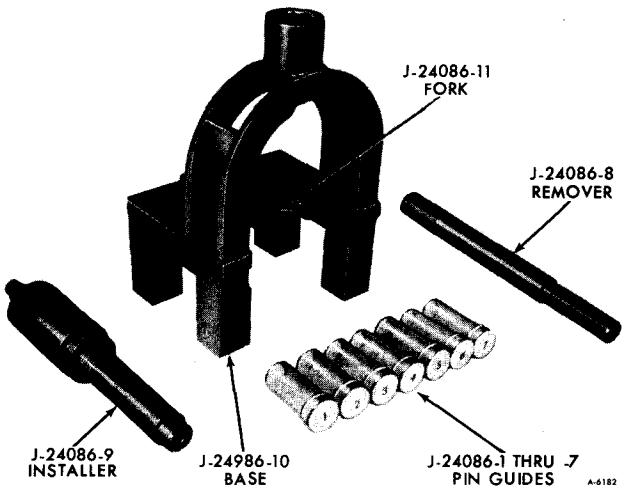


Figure 54—Piston Pin Tool Set J-24086

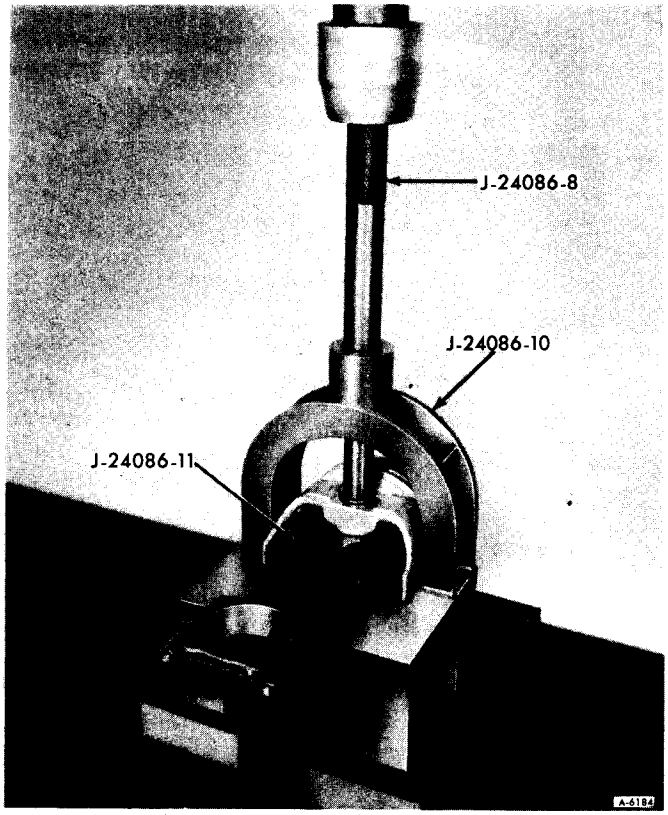


Figure 55—Removing Piston Pin with J-24086-8

length is varied by rotating the hub on the shaft much like adjusting a micrometer. An alpha-numeric scale is used to determine the desired length for a given piston pin assembly. The correct setting for installation of new piston pins in the 403 cubic inch engine is H-4.

REMOVAL

1. Position Tool J-24086-11, the Support Fork of the piston pin tool set, between the connecting rod and piston (figure 55).
2. Install the J-24086-8 Removal Arbor through the alignment hole in the tool base.

NOTE: It is important that the piston, rod and pin assembly be centered with the removal arbor.

3. Press the piston pin out of the connecting rod.

INSTALLATION

1. Install proper pin guide (J-24086-2, Green) through piston and into connecting rod. Hand tap pin guide into piston for proper retention. Drop piston pin into the other side of the piston.

NOTE: The pin guide centers the connecting rod in the piston. When the piston, connecting rod, piston pin and pin guide assembly are positioned on the fork of the tool, the pin guide will also center this assembly in the tool. If a pin guide that is too small is used, the piston assembly will not be located centrally in the tool, and damage may occur to the fork of the tool.

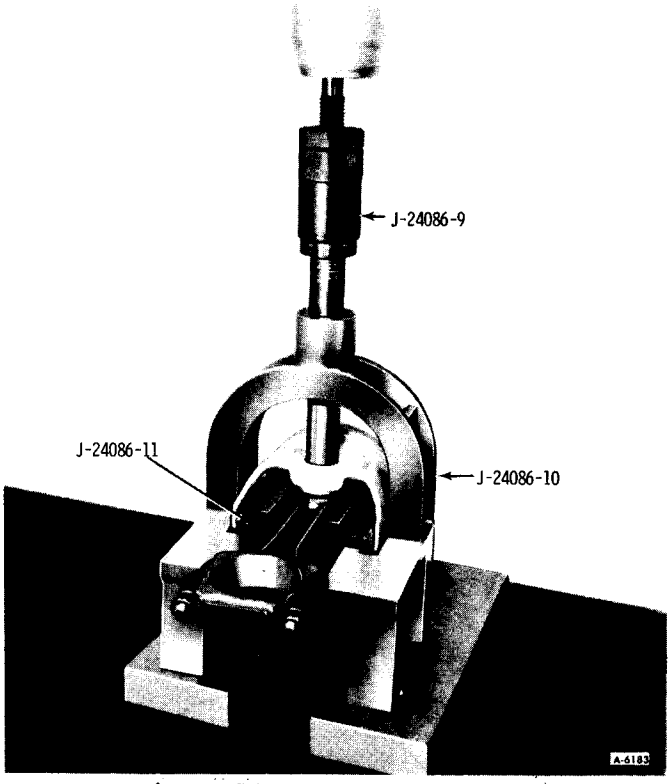


Figure 56—Installing Piston Pin with J-24086-9

2. Install piston assembly onto fork assembly of tool. Tool will support connecting rod at the piston pin. Be sure piston assembly is slid onto the fork until the pin guide contacts the fork.
3. Adjust the Installing Arbor, J-24086-9, to the proper length by turning the numbered sleeve on the lettered shaft until the specified alphanumeric setting (H-4 for 403 cubic inch engine) is obtained. Turn knurled nut to lock numbered sleeve on shaft.
4. Insert the installing arbor through the hole in the arch of the tool (figure 56). Press piston pin into the connecting rod until the sleeve on the installing arbor contacts the top of the tool arch. The pin guide will fall out of the connecting rod as the piston pin is pressed in.

CAUTION: *Do not exceed 5000 lbs. of force when stopping the installing arbor sleeve against the arch.*

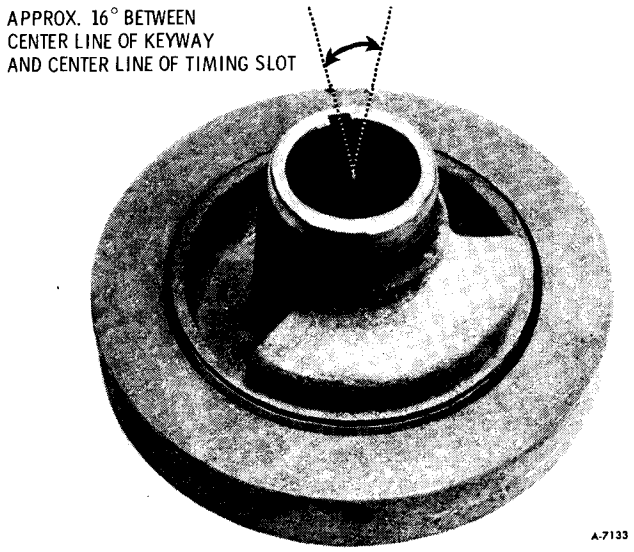


Figure 57—Harmonic Balancer

CRANKSHAFT PULLEY

REMOVAL

1. Loosen all belts enough so they may be slipped off crankshaft pulley.
2. Hoist vehicle.
3. Remove 4 pulley bolts and pulley.

INSTALLATION

1. Install pulley and 4 bolts. Torque bolts to 10 ft. lbs.
2. Install belts. Refer to "Belt Tension" next in this section.

BELT TENSION

NOTE: All belt tension checks must be taken at center of greatest span of the belt.

1. Using Belt Tension Gauge J-23573 (BT-33-73-F), check power steering belt. If necessary, adjust power steering belt FIRST before other belt adjustment is made. A "used" power steering belt (in operation more than one hour) should be adjusted to 70-80 lbs. A new power steering belt should be adjusted to 110-140 lbs.
2. Check and adjust (as required) the generator and air conditioning compressor belts. Belt tension should be the same as above.

HARMONIC BALANCER
(FIGURE 57)

REMOVAL

1. Remove engine cover.
2. Loosen all accessory drive belts.

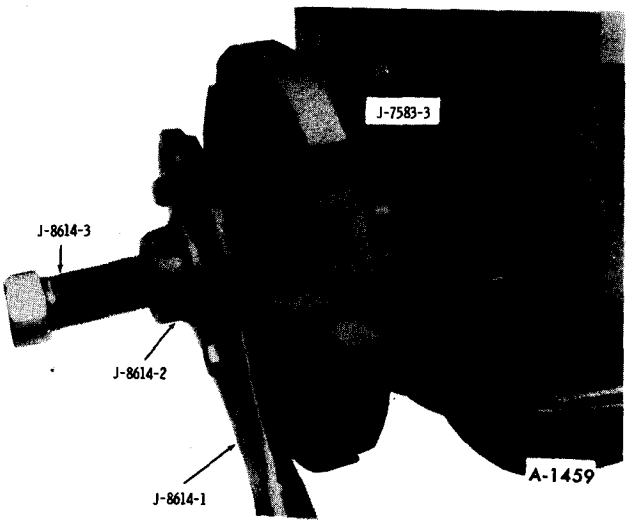


Figure 58—Removing Harmonic Balancer

3. Raise vehicle.
4. Remove fan and fan clutch assembly. Refer to ENGINE COOLING (SEC. 6K) in this supplement. Then remove bolts attaching fan shroud to radiator support. Remove shroud.
5. Slip belts off crankshaft pulley.
6. Remove 4 crankshaft pulley bolts and remove pulley.
7. Remove harmonic balancer hub bolt and washer.
8. Using balancer puller, remove balancer as shown in figure 58.

CAUTION: *Use of any other type puller such as a universal claw type which pulls on the outside of the hub can destroy the balancer. The outisde ring of the balancer is bonded in rubber to the hub; by pulling on the outside rather than the hub, it is possible to break the bond. The timing mark is on the outside ring of the balancer; if the bond between the hub and the outside ring is broken, the outside ring could slip which would change the location of the timing mark.*

If it is suspected that the bond between the sections of the harmonic balancer has been broken and the timing mark changed, it can be visually checked as shown in figure 57. The center of the keyway should be approximately 16° from timing slot. In addition there are chisel aligning markers between the weight and hub. These marks should be aligned.

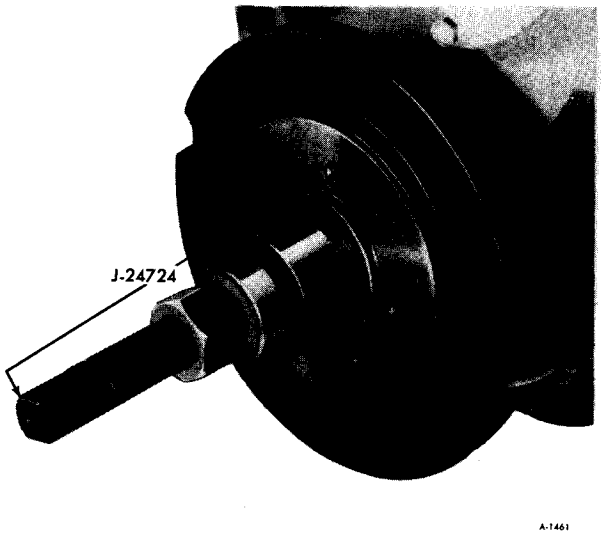


Figure 59—Installing Harmonic Balancer

INSTALLATION

1. Apply sealer Part No. 1050805 or equivalent, to inside diameter of pulley hub and to crankshaft key to prevent possible oil leakage. Coat outside area of crankshaft pulley hub which enters seal with Special Seal Lubricant No. 1050169 or equivalent.
1. Install harmonic balancer on crankshaft (figure 59). Use tool J-24724.

NOTE: Balancer to crankshaft fit is .001" tight to .0007" loose.

3. Install washer and bolt. Torque bolt to 200-310 ft. lbs.
4. Install pulley and position belts over pulley.
5. Install fan shroud to radiator support. Replace fan and clutch assembly. Refer to ENGINE COOLING (SEC. 6K) for installation procedures.
6. Lower vehicle.
7. Tension drive belts. Refer to "Belt Tension" earlier in this section.
8. Install engine cover.

OIL SEAL—FRONT COVER

REMOVAL (FRONT COVER INSTALLED)

1. Raise vehicle.
2. Loosen belts so they may be slipped off crankshaft pulley. Remove belts.
3. Remove crankshaft pulley and harmonic balancer. Refer to "Crankshaft Pulley" and "Harmonic Balancer" earlier in this section.
4. Using Front Cover Seal Removing Tool (such as BT-6406), remove oil seal.

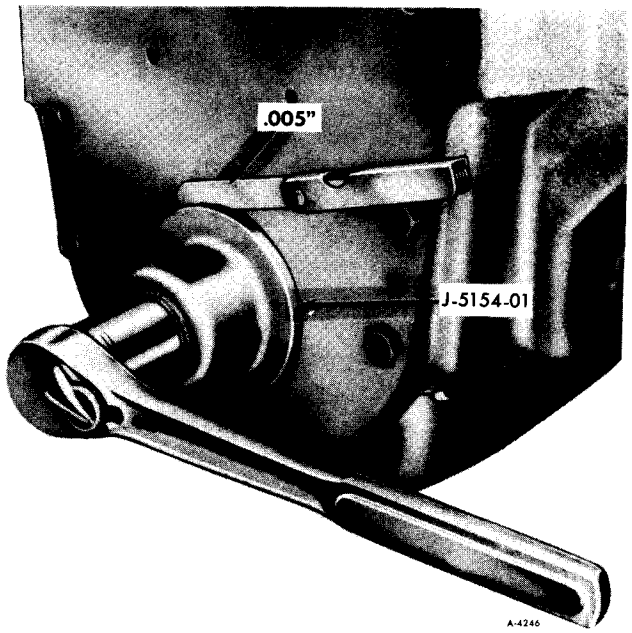


Figure 60—Front Cover Oil Seal Installation

INSTALLATION

1. Apply Part No. 1050805 sealer or equivalent to outside diameter of seal.
2. Using Tool J-5154-01, install oil seal as shown in figure 60.
3. Install crankshaft pulley and harmonic balancer. Refer to "Crankshaft Pulley" and "Harmonic Balancer" earlier in this section.
4. Install and adjust belts. Refer to "Belt Tension" earlier in this section.
5. Lower vehicle.

FRONT COVER
(FIGURE 61)

REMOVAL

1. Raise vehicle.
2. Drain cooling system. Disconnect radiator hoses, heater hoses, and bypass hose from the water pump and radiator.
3. Drain oil.
4. Remove all drive belts.
5. Remove fan and fan clutch assembly. Remove fan shroud from radiator support. (Refer to ENGINE COOLING (SEC. 6K) for procedure.)
6. Remove crankshaft pulley and harmonic balancer. See "Crankshaft Pulley" and 'Harmonic Balancer" earlier in this section.
7. Remove oil pan. Refer to "Oil Pan" earlier in this section.
8. Remove front cover to block attaching bolts.
9. Remove front cover, timing indicator and water pump assembly (figure 62).

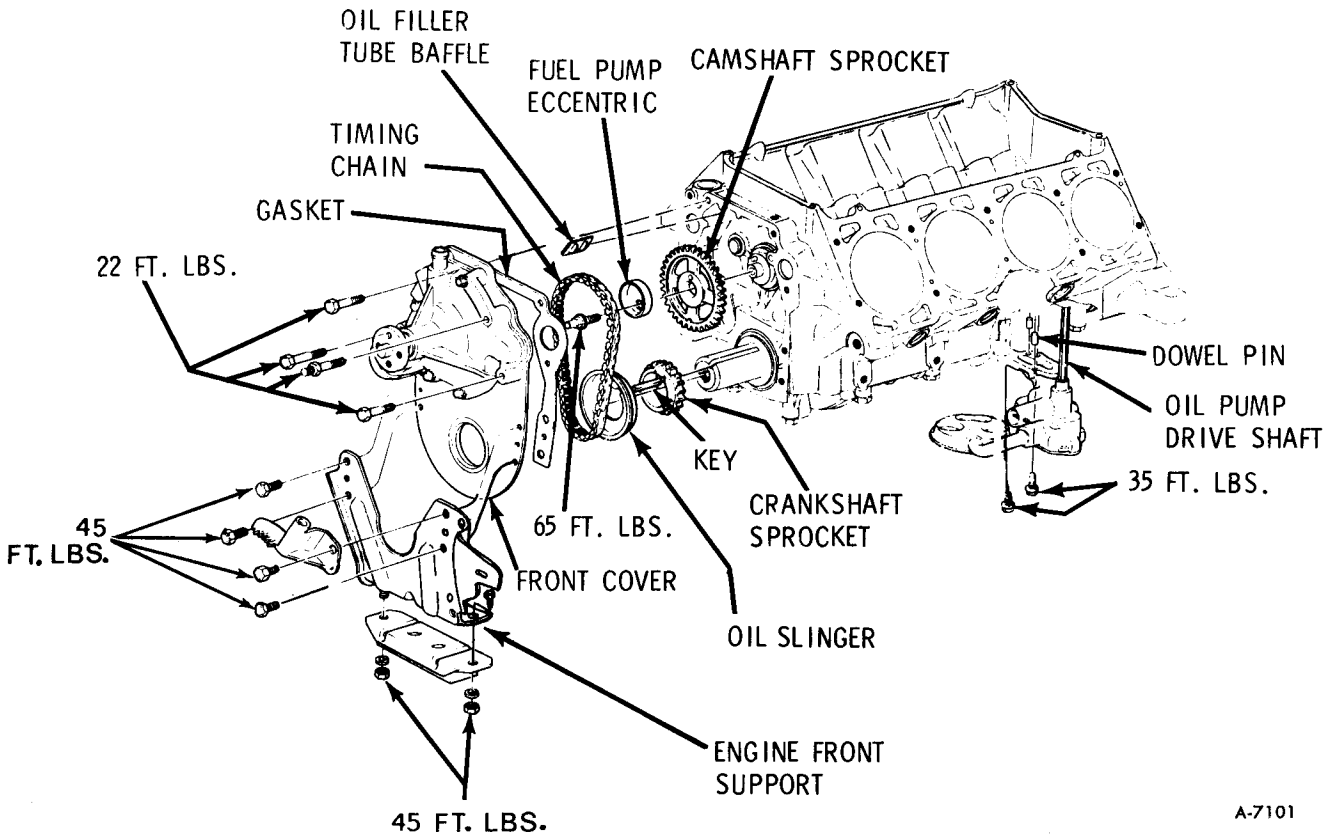


Figure 61—Engine Front Cover Components

Remove front cover and both dowel pins. It may be necessary to grind a flat on the pins to get a rough surface for gripping.

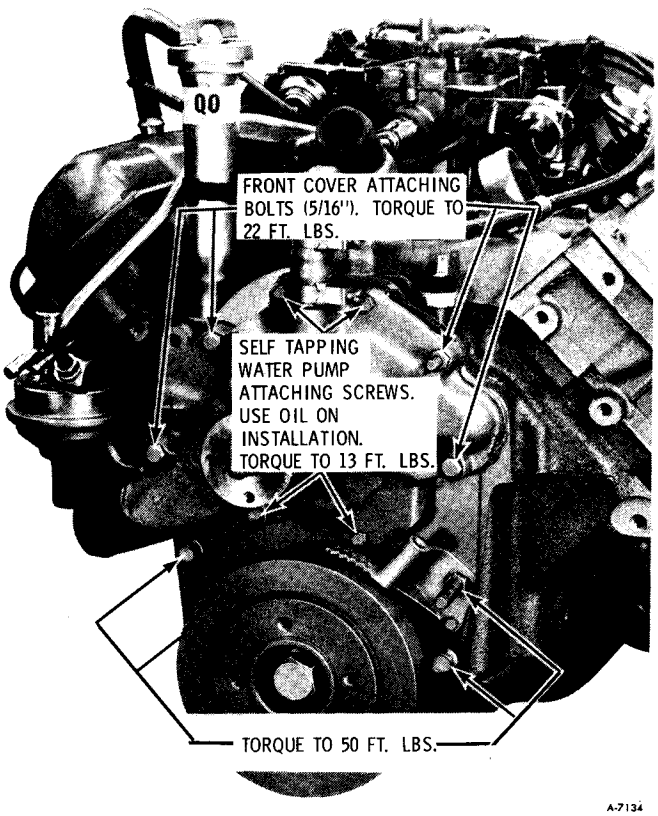


Figure 62—Engine Front Cover Bolts

INSTALLATION

1. Grind a chamfer on one end of each dowel pin as shown in figure 63.
2. Cut excess of material from front end of oil pan gasket on each side of engine block.
3. Clean block, oil pan and front cover mating surfaces with solvent.
4. Trim about 1/8" from each end of new front pan seal, using a sharp tool as shown in figure 64.
5. Install new front cover gasket on engine block and new front seal on front cover. Apply

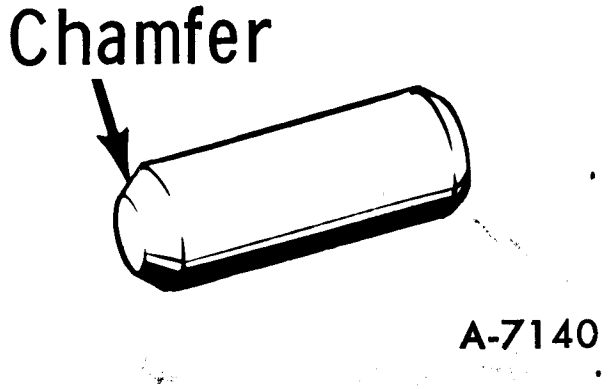


Figure 63—Dowel Pin Chamfer

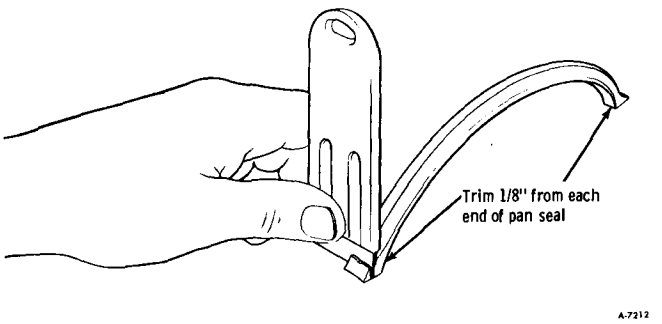


Figure 64—Trimming Pan Seals

sealer Part No. 1050805 or equivalent sealer to gasket around coolant holes and place on block.

6. Apply R.T.V. sealer at junction of block, pan and front cover as shown in figure 65.

7. Place cover on front of block and press downward to compress seal. Rotate cover left into cavity using a small screwdriver as shown in figure 66.

8. Apply engine oil to bolts (threads and heads).

9. Install 2 bolts finger tight to hold cover in place.

10. Install 2 dowel pins (chamfered end first).

11. Install remaining front cover bolts. Install timing indicator and water pump assembly. Then torque all fasteners evenly, to specification, as shown in figure 62.

12. Apply lubricant Part No. 1050169 or equivalent on balancer seal surface.

13. Install oil pan. Refer to "Oil Pan" earlier in this section.

14. Install balancer and balancer bolt. Refer to "Harmonic Balancer" earlier in this section. Torque balancer bolt from 200-310 ft. lbs.

15. Connect radiator hoses, bypass hose and heater hoses.

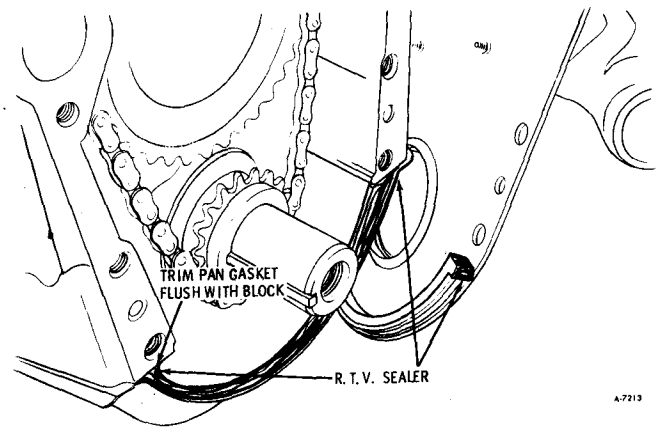


Figure 65—Applying R.T.V. Sealer and Trimming Pan Gasket

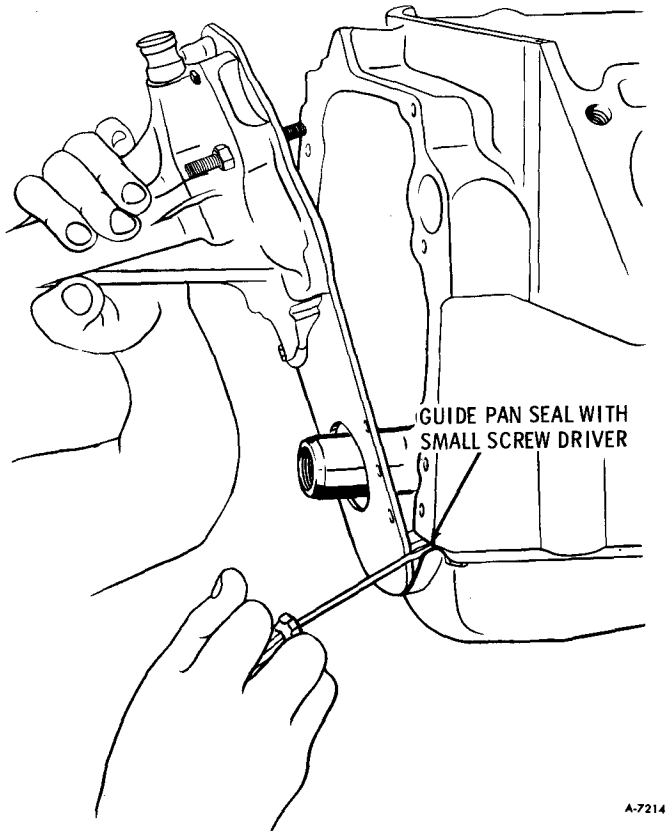


Figure 66—Guide Seal in Pan While Pushing Downward

16. Install crankshaft pulley and four attaching bolts. Torque to 10 ft. lbs. Refer to "Crankshaft Pulley" earlier in this section.

17. Install fan and clutch assembly. Torque clutch to hub bolts to 10-15 ft. lbs. Install radiator fan shroud and attaching bolts (4).

18. Install all drive belts, and adjust. Refer to "Belt Tension" earlier in this section.

19. Replace oil drain plug and shut radiator drain cock.

20. Lower vehicle.

21. Fill radiator and crankcase. Start engine

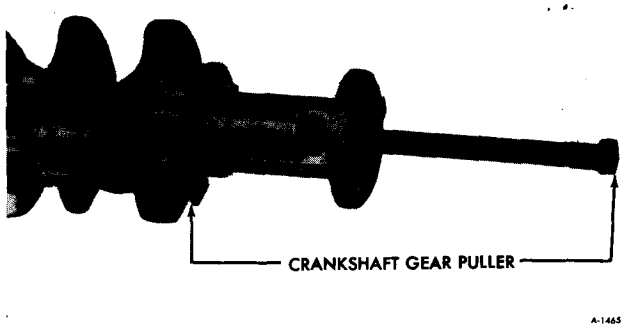


Figure 67—Crankshaft Gear Removal

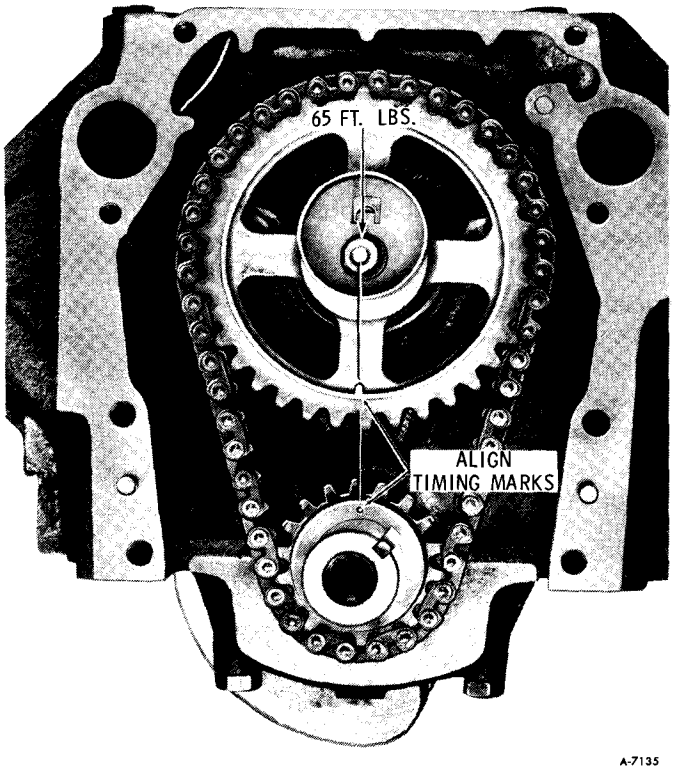


Figure 68—Timing Gear Position

and check for leaks. (Use of spray foot powder or equivalent may aid in detecting leaks.)

TIMING CHAIN AND GEARS

REMOVAL

1. Raise vehicle.

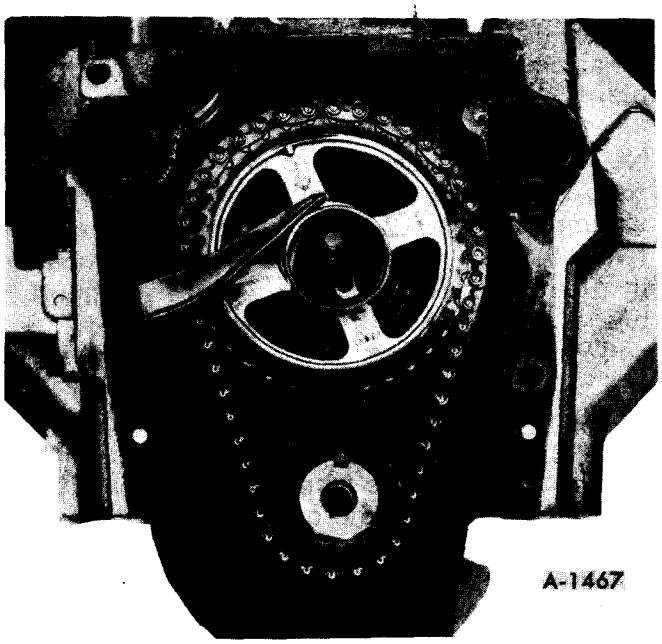


Figure 69—Fuel Pump Eccentric

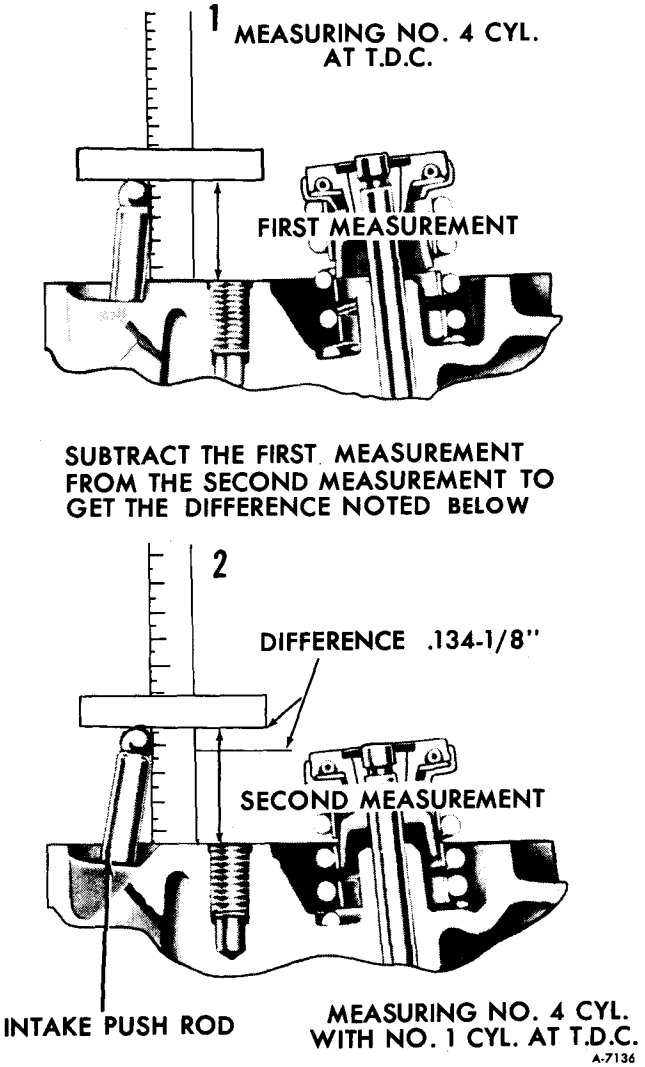


Figure 70—Checking Valve Timing

2. Remove front cover. See "Front Cover" earlier in this section.
3. Remove fuel pump eccentric.
4. Remove oil slinger, cam gear and timing chain.
5. Remove key, then crankshaft gear.

NOTE: Gear to crankshaft fit tolerances may be such that a puller is necessary (figure 67).

CAUTION: *Remove crankshaft key, if possible, before using puller; if not, align puller so that it does not overlap end of key when using puller. Keyway is machined only part way in crankshaft gear and breakage would occur.*

INSTALLATION

1. Install camshaft gear, crankshaft gear and timing chain together, and then align timing marks as shown in figure 68.

NOTE: When the timing marks are in alignment (figure 68), number six cylinder is at T.D.C. To obtain T.D.C. for number one cylinder, slowly rotate crankshaft one rotation. This will bring the cam mark to the top, number one will then be in the firing position.

2. Install fuel pump eccentric with flat side rearward (figure 69).
3. Drive crankshaft gear key in with a brass hammer until it bottoms in gear.
4. Install oil slinger.
5. Install front cover. See "Front Cover" earlier in this section.
6. Lower vehicle.

CHECKING VALVE TIMING WITHOUT REMOVING FRONT COVER

1. Remove distributor cap, right valve cover, No. 4 cylinder intake and exhaust rocker arms and pivot.
2. Remove wire from "BAT" terminal of HEI distributor.
3. Turn ignition switch on. Crank engine until rotor is in line with No. 4 spark plug wire position. No. 4 piston will be approximately at the top of the cylinder.
4. Measure from pivot boss on head surface to top of No. 4 intake push rod. Record measurement (figure 70).
5. Slowly turn engine 1-1/2 revolutions until rotor approaches No. 1 spark plug wire position. Continue to turn engine until timing mark on crank pulley is aligned with 0 on indicator. This is top dead center of No. 1 piston.
6. Again measure from pivot boss surface to top of No. 4 cylinder intake push rod (figure 70).
7. Measurement should increase over the first measurement as shown in figure 70.
8. If measurement increase is not within 1/32" of that shown on chart, camshaft is advanced or retarded.

ENGINE REPLACEMENT

The engine assembly may be removed with or without the transmission and final drive attached.

NOTE: It is recommended that transmission and final drive be removed from the vehicle before the engine.

In some situations repair to the engine (ie. piston replacement, oil pan gasket replacement, oil pump repair etc.) requires removal of the engine oil pan. If this is the case, refer to "Oil Pan" earlier in this section.

Refer to steps 1 through 19 for removal of transmission and final drive with engine remaining in vehicle.

Refer to steps 20 through 42 for removal of engine after the transmission and final drive have been removed.

WARNING: A VEHICLE OF THIS SIZE AND WEIGHT COMBINED WITH THE WEIGHT AND BULKINESS OF THE ENGINE AND/OR TRANSMISSION AND FINAL DRIVE DURING REMOVAL PRESENTS A POTENTIALLY DANGEROUS SITUATION TO PERSONNEL. ENGINE, TRANSMISSION AND FINAL DRIVE REMOVAL EITHER AS A UNIT OR SEPARATE COMPONENTS SHOULD BE PERFORMED WHILE USING A "TWIN POST" HOIST.

REMOVAL

1. Disconnect negative (—) battery cables from both the automotive and living area batteries.

NOTE: Drain radiator before raising vehicle.

2. Remove engine cover, remove air cleaner assembly and position engine removal tool No. J-24603-01 to the engine. Adjust lift mechanism until all slack is removed from the cable. (See figure 7).

NOTE: To properly position engine removal tool, remove seat belt plate and anchor bolt assembly. Attach load adjustor chain to front and rear engine lift locations as shown in figures 8 and 9. Then install support braces and chain fall as shown in figures 7, 8 and 9.

3. Raise vehicle. See WARNING at the beginning of "Engine Replacement".
4. Disconnect wires from starter solenoid.
5. Remove starter motor.
6. Referring to figure 71, remove flywheel cover bolts "B", "C" and "D". Loosen bolt "A" and pivot cover out of the upper L.H. bolt "A" slot.
7. Disconnect transmission shift linkage and

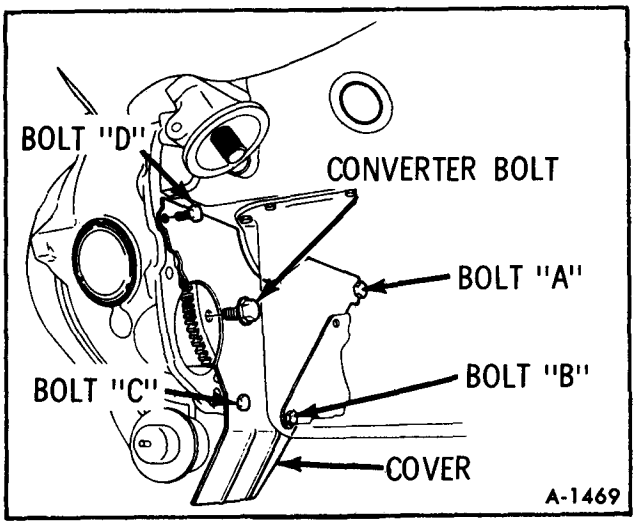


Figure 71—Flywheel Cover Removal

speedometer cable from transmission and position to one side. Remove bracket from frame.

8. Disconnect transmission oil cooler lines, detent solenoid wire and modulator tube from the transmission. Position all to the side.

9. Disconnect R.H. drive axle from the final drive output shaft. (Refer to Section 3B, Maintenance Manual X-7525.) Move drive axle rearward.

10. Remove output shaft bracket from engine and remove R.H. output shaft assembly from final drive.

11. Disconnect L.H. drive axle from flange at final drive and reposition axle forward and clear of the flange.

12. Remove bolt "X". (See figure 72).

13. Remove three (3) bolts that secure the converter to the flywheel.

NOTE: Rotate flywheel to gain access. Mark or scribe converter to flywheel for reassembly.

14. Remove three (3) transmission to support bracket bolts (figure 11).

15. Remove support bracket to crossmember bolts.

16. Position transmission jack under transmission as shown in figure 73.

17. Remove six (6) bolts that attach the flywheel housing to the engine.

18. Slide transmission rearward.

NOTE: Reposition transmission support bracket upward as required to obtain clearance between transmission and floor.

19. Remove transmission and final drive.
20. Lower vehicle.
21. Remove engine oil dipstick.

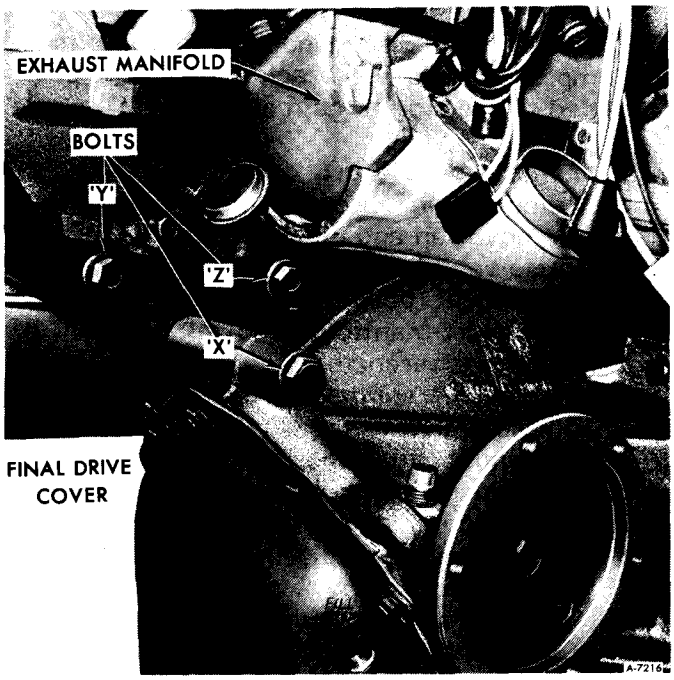


Figure 72—Disconnecting Final Drive from Engine

22. Disconnect vacuum hoses to the brake booster and heater controls from the intake manifold. Disconnect the vacuum hose to the carbon canister from the front of the carburetor.

23. Disconnect throttle linkage.

24. Disconnect heater hoses.

25. Disconnect wire from brake combination valve.

26. Disconnect engine harness.

27. Remove engine oil filler upper tube.

28. Remove engine oil dipstick tube.

29. Disconnect upper radiator hose from engine.

30. Remove necessary support struts and remove air conditioning compressor from bracket(s). Support compressor up and out of way with wire.

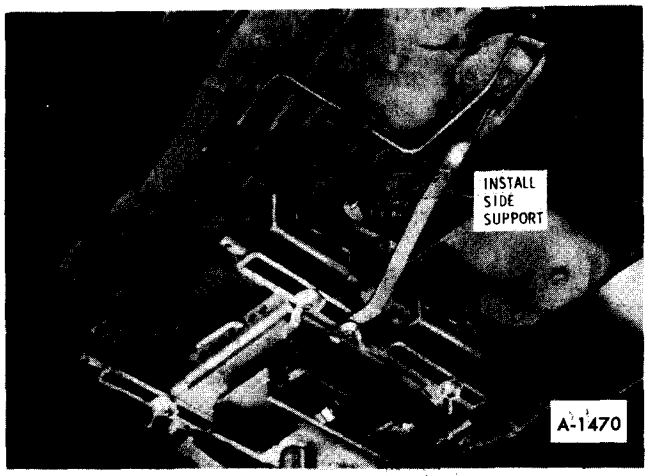


Figure 73—Transmission Jack Installation

NOTE: Do not disconnect refrigerant lines. Compressor and its brackets can be positioned to the side to gain access.

31. Remove generator.
32. Remove fan shroud from radiator support. Remove fan and clutch assembly.
33. Raise vehicle.
34. Disconnect both R.H. and L.H. exhaust pipes at exhaust manifolds. Move up and out of way for more clearance.
35. Disconnect engine oil cooler tubes from tube to hose union.
36. Disconnect fuel line from fuel pump.
37. Disconnect lower radiator hose.
38. Disconnect power steering hoses from the power steering pump.
39. Remove engine front mounting bolts.
40. Remove hub cap from L.H. hub. Remove cotter pin and axle nut. Tap lightly on outboard end of L.H. axle until splines are free. Remove L.H. drive assembly.
41. Raise engine assembly using engine removal tool J-24603-01 (figure 7).
42. Gradually remove engine assembly by alternately raising, tilting and lowering the engine assembly. Use care when supporting engine on dolly to prevent damage to oil pan.

INSTALLATION

INSTALLATION CAUTION

CAUTION: *When installing new or repaired engine and its attachments, correct routing of the power steering hoses is very important. Although sequence of assembly is not vital, the power steering hoses, when installed, must not be twisted, kinked, or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening in operation under pressure. They should also be free of twist under strain. All fittings must be held while tightening or loosening nuts.*

1. Using tool J-24603-01 as shown in figures 7, 8, and 9, raise engine assembly adjusting and tilting until engine front mount lines up so bolts may be installed. Install nuts finger tight.
2. Install L.H. drive axle into knuckle and torque axle nut to 110 ft. lbs. Advance nut to next castellation if necessary and install cotter pin.

NOTE: Do not allow drive axle to hang unsupported. Use a piece of wire to support drive axle.

3. Raise transmission and final drive using the transmission jack. Position transmission support bracket while raising the transmission.
4. Position transmission and install six (6) bolts that attach flywheel housing to engine. Torque bolts to 25 ft. lbs.
5. Position transmission support bracket and referring to figure 11, torque bolts "A", "B" and "C" to 55 ft. lbs. Torque bolts "D" and "E" to 55 ft. lbs.
6. Install three (3) converter to flywheel bolts. Torque to 30 ft. lbs.

NOTE: Rotate flywheel to gain access. Refer to figure 71.

7. Attach final drive to engine. Refer to figure 72, install bolt "X" and torque to 105 ft. lbs.
8. Properly position L.H. drive axle and torque NEW attaching bolts to 65 ft. lbs.
9. Install R.H. output shaft into final drive and attach support bolts to engine.

NOTE: When attaching the right hand output shaft to the engine bracket, do not let the shaft hang. Assemble bracket bolts loosely, and by moving the flange end of the shaft up and down, and back and forth, find the center location. Hold the shaft in this position and then torque the bolts to 55 ft. lbs. on support.

10. Position R.H. drive axle and torque NEW attaching bolts to 65 ft. lbs.
11. Connect transmission cooler lines and tighten fittings to 20 ft. lbs. Then connect detent solenoid wire and modulator tube.
12. Connect transmission shift linkage and speedometer cable.
13. Referring to figure 71, install flywheel cover and tighten bolts "A", "B", "C" and "D" to 5 ft. lbs. torque.
14. Install starter, hand start both bolts.

NOTE: Tighten lower bolt first. Then tighten upper bolt. Torque to 30 ft. lbs. Connect wires to starter.

15. Tighten engine front mounting nuts to 50 ft. lbs. torque.
16. Connect power steering lines to the power steering pump.
17. Install fan shroud and torque bolts to 15 ft. lbs.

18. Install engine fan and clutch assembly. Torque nuts to 15 ft. lbs.
19. Connect lower radiator hose. Torque clamp to 17 in. lbs.
20. Connect fuel line to fuel pump.
21. Connect engine oil cooler lines.
22. Connect R.H. and L.H. exhaust pipes. Tighten pipe to exhaust manifold bolts until they bottom on spacer.
23. Lower vehicle and remove engine removal tool J-24603-01.
24. Install generator and braces. See figure 12 for torque values. Refer to "Belt Tension" earlier in this section.
25. Install air conditioning compressor and support struts (figure 13). Refer to "Specifications" at the end of this section for torque values. Refer to "Belt Tension" earlier in this section also.
26. Connect upper radiator hose to engine. Torque clamp to 17 in. lbs.
27. Install engine oil dipstick tube.
28. Install engine oil filler upper tube.
29. Connect engine harness.
30. Connect wire to the brake combination valve.
31. Connect heater hoses.
32. Connect throttle linkage.
33. Connect vacuum hoses to the brake booster and heater controls to the intake manifold. Connect the vacuum hose from the carbon canister to the front of the carburetor.
34. Add engine oil and transmission fluid, as required. Add engine coolant. Refer to "Engine Cooling" (SEC. 6K) in Maintenance Manual X-7525. Also refer to SECTION 7, Maintenance Manual X-7525 for details on "Checking and Adding Transmission Fluid".
35. Connect battery negative (—) ground cables.
36. Check transmission shift linkage. Refer to SECTION 7 in Maintenance Manual X-7525, under "Linkage Adjustment".
37. Adjust all drive belts using tool J-23573 (BT-33-73-F). Refer to "Belt Tension" earlier in this section.
38. Shut engine off. After several minutes check engine oil level. Check also for possible fuel and coolant leaks.

CAUTION: *For step 39, see "Caution" on page one of this section."*

39. Install seat belt plate and anchor bolt assembly.
40. Install air cleaner assembly and engine cover.

OUT-OF-VEHICLE SERVICE OPERATIONS

CAMSHAFT

REMOVAL

1. Remove engine. Refer to "Engine Replacement" earlier in this section.
2. Remove oil pan. Refer to "Oil Pan" earlier in this section.
3. Remove crankshaft pulley and harmonic balancer. Refer to "Crankshaft Pulley" and "Harmonic Balancer" earlier in this section.
5. Remove both valve covers. Refer to "Valve Covers" earlier in this section.
7. Remove intake manifold and gasket, front and rear seal. Refer to "Intake Manifold" earlier in this section.
8. Remove rocker arms, push rods and valve lifters. Refer to those items earlier in this section for removal.

NOTE: Parts position should be noted so they will be installed in their original location.

9. Remove bolt securing fuel pump eccentric, remove eccentric, camshaft gear, oil slinger and timing chain. Refer to "Timing Chain and Gears" in this section.
10. Remove camshaft by carefully sliding it out the front of the engine.

NOTE: Do not force shaft as damage can occur to camshaft bearings.

INSTALLATION

1. Coat camshaft and bearings liberally with Part No. 1051396 or equivalent before installing. Camshaft gear and crankshaft gear must be aligned as shown in figure 68.
2. Slide camshaft into block.

NOTE: Do not force shaft as damage may occur to camshaft bearings.

3. Install gears, timing chain, eccentric and oil slinger. Refer to "Timing Chain and Gears" earlier in this section.
4. Install valve lifters, push rods and rocker arms. Refer to "Rocker Arm Assemblies" earlier in this section.
5. Install intake manifold and gasket.

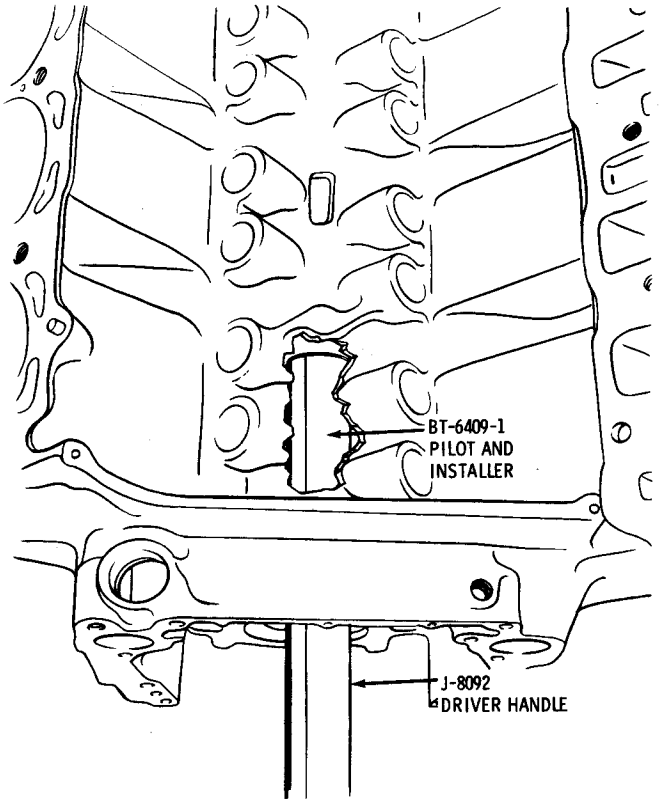


Figure 74—Installing No. 1 Cam Bearing

Refer to "Intake Manifold" earlier in this section. Install belts and adjust. Refer to "Belt Tension" as described earlier in this section.

6. Install distributor as described in SECTION 6Y of this supplement.

7. Install valve covers. Connect spark plug cables.

8. Install front cover. Refer to "Front Cover" earlier in this section.

9. Install crankshaft pulley and harmonic balancer. Refer to "Harmonic Balancer" and "Crankshaft Pulley" earlier in this section.

10. Install oil pan. Refer to "Oil Pan" as described earlier in this section.

11. Install engine. Refer to "Engine Replacement" earlier in this section.

CAMSHAFT BEARINGS

The camshaft bearings must be replaced in complete sets. All bearings must be removed before any can be installed. No. 1 bearing must be removed first, then No. 2, then 3, 4, and 5. When installing the bearings, No. 5 must be installed first, then, 4, 3, 2 and 1.

REMOVAL

1. Remove camshaft as described in "Camshaft" earlier in this section.

NOTE: Each cam bearing is different in diameter and the correct sequence must be used both for removal and installation.

2. Using a cam bearing remover set drive out No. 1 (front cam bearing).

3. Drive out No. 2 bearing. Remove No. 3 and 4 bearings in the same manner.

4. When removing No. 5 bearing drive out rear cup plug, located behind No. 5 camshaft bearing. See Figure 69.

INSTALLATION (FIGURE 74)

NOTE: To aid aligning bearings with oil passages, place each bearing in the front bore with tapered edge toward block and align the oil hole in the bearing with the center of the oil slot in the bore. Mark top of bearing. When installing the bearings the mark will act as a guide.

1. Install new cup plug in rear of No. 5 bearing bore and seal with a permanent type sealer.

2. Drive No. 5 camshaft bearing into place and check oil hole alignment as shown in figure 75.

3. Install remaining bearings in correct sequence. Check all oil hole openings for proper alignment. Wire must enter hole or the bearing will not receive sufficient lubrication.

CAMSHAFT AND OIL GALLERY PLUGS

(Figure 76)

The left hand rear oil gallery plug is not shown. It is a threaded plug in the end of the left gallery just rearward of the distributor. A small hole is provided in the plug for distributor lubrication. The cup plug shown provides access to the threaded plug.

The front oil gallery plugs (not shown) are threaded. The plug on the right side has a small hole which provides lubrication for the timing chain and gears.

To find out if the camshaft plug at the rear of the engine is properly installed: Place a straight edge across the machined surface of the rear of the block and measure from the straight edge to the lip of the plug. Dimension should be .250" maximum to .160" minimum.

Figure 75—Checking Oil Hole Alignment

CRANKSHAFT (FIGURE 77)

REMOVAL (CYLINDER HEADS ON)

1. With engine on stand oil pan, oil pump and front cover removed, rotate crankshaft to the position where the connecting rod nuts are most accessible. Figure 78 shows No. 3 and No. 4 rods in the fully extended position.
2. Remove main bearing caps.
3. Remove connecting rod caps.
3. Remove connecting rod caps and install thread protectors.
4. Note position of keyway in crankshaft so it can be installed in the same position.
5. Lift crankshaft out of block. Rods will pivot to the center of the engine when the crankshaft is removed.

Do not allow pistons to move in their bore during or after crankshaft removal.

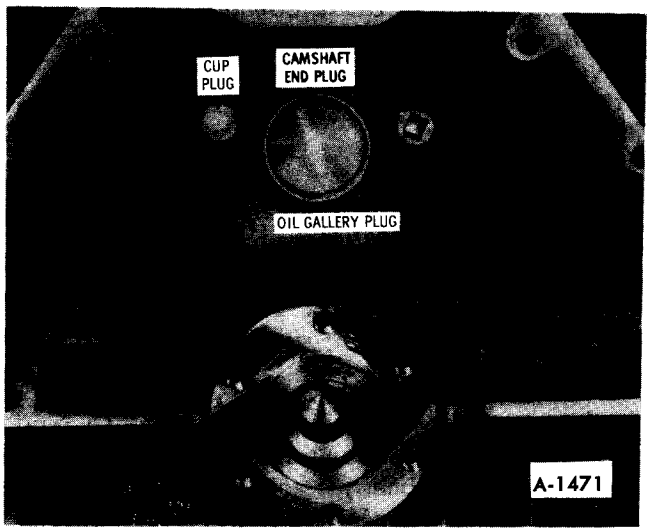


Figure 76—Camshaft and Oil Gallery Plugs

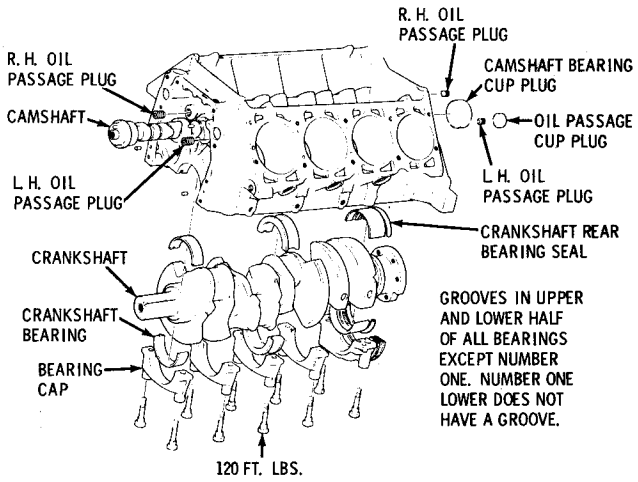


Figure 77—Crankshaft Components

INSTALLATION

1. Install sufficient oil pan bolts in pan rails to align rods with rubber bands as shown in figure 78.

Align rods so that the inner thread protectors of adjacent rods overlap approximately one inch as shown. Alignment can be adjusted by increasing tension on rubber bands with additional turns around the pan bolts or thread protectors.

2. Position crankshaft keyway in the same

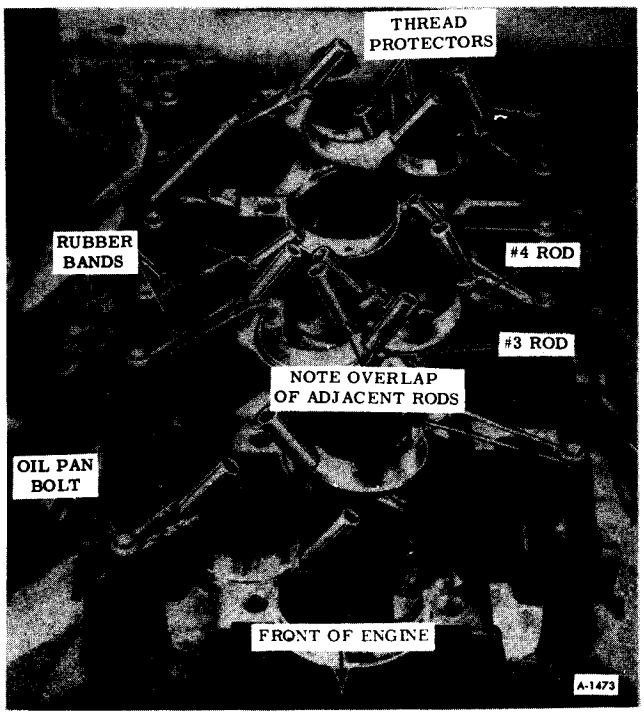


Figure 78—Crankshaft Removal

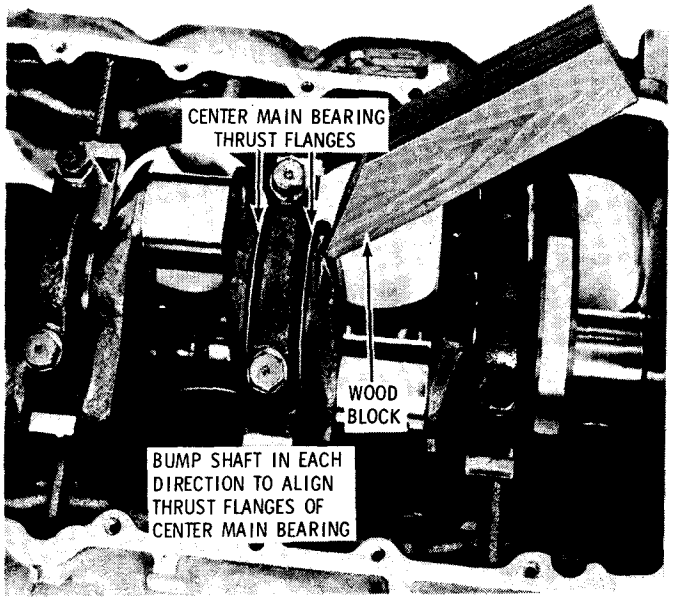


Figure 79—Aligning Center Main Bearing Flanges

position as removed and lower into block. The connecting rods will follow the crank pins into the correct position as the crankshaft is lowered.

3. Remove rubber bands, thread protectors and pans bolts and assemble engine.

REMOVAL (CYLINDER HEADS REMOVED)

1. With engine on stand, remove oil pan, front cover, connecting rods and oil pump.

2. Remove main bearing caps and lift crankshaft out of block.

INSTALLATION

1. Measure the crankshaft journals with a micrometer to determine the correct size rod and main bearings to be used.

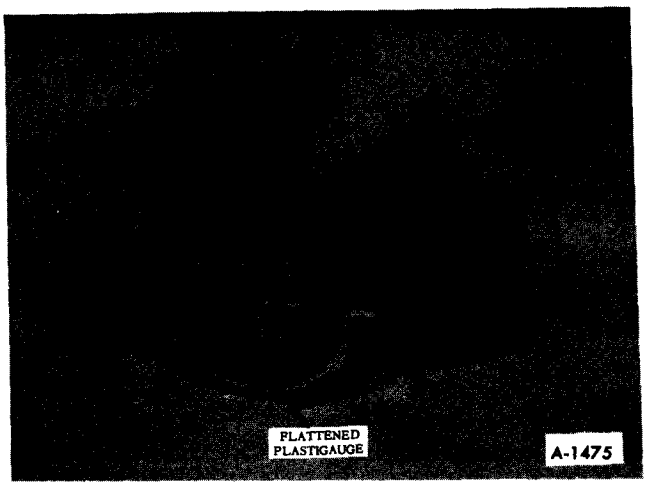


Figure 80—Checking Bearing Clearance

NOTE: Whenever a new or reconditioned crankshaft is installed, new connecting rod bearings and main bearings should be installed.

2. Position upper half of main bearings in block and lubricate with engine oil.

3. Install a new rear main bearing seal.

4. After oil passages in crankshaft have been checked for being open and shaft is clean, place shaft in block. Lubricate thrust flanges of the center bearing with 1050169 Lubricant or equivalent. Install caps with lower half of bearing lubricated with engine oil. Lubricate cap bolts with engine oil and install, but do not tighten.

5. With a block of wood (figure 79) bump shaft in each direction to align thrust flanges of center main bearing.

NOTE: After bumping shaft in each direction, wedge the shaft to the front and hold it while torquing No. 3 cap bolts.

6. Torque No.'s 1, 2, 3 and 4 main bearing cap bolts to 80 ft. lbs. and No. 5 bolts to 120 ft. lbs.

7. Reassemble engine and install in vehicle.

MAIN BEARINGS

Main bearing clearance must not exceed .0035" on all bearings. The .0035" clearance is permissible only if the engine is disassembled for other than a bearing noise condition. If bearings are noisy or if a visual inspection indicates defective bearings, new bearings must be installed within the specifications outlined under "Main Bearings".

Bearings which fall within the .0035" specifications should not be rejected if the bearings show a normal wear pattern or slight radial grooves, unless they have been established to be defective.

CHECKING BEARING CLEARANCES

1. If not already removed, remove oil pan. Refer to "Oil Pan" earlier in this section.

2. Remove bearing cap and wipe oil from crankshaft journal and outer and inner surfaces of bearing shell.

3. Place a piece of plastic gauging material in the center of bearing.

4. Use a floor jack or other means to hold crankshaft against upper bearing shell. This is necessary to obtain accurate clearance readings when using plastic gauging material.

5. Reinstall bearing cap and bearing. Place engine oil on cap bolts and install.

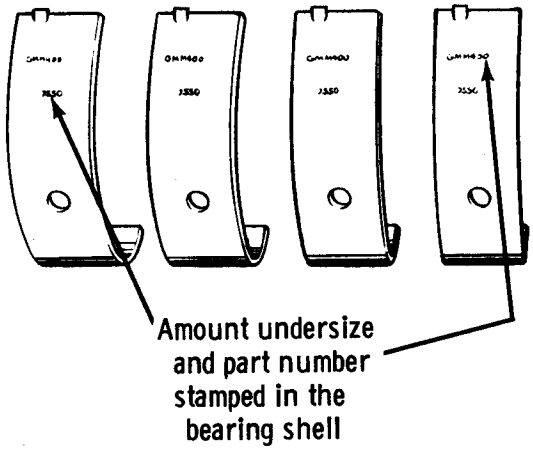


Figure 81—Main Bearing Identification

Torque Nos. 1, 2, 3, and 4 bolts to 80 ft. lbs. and No. 5 bolt to 120 ft. lbs.

6. Remove bearing cap and determine bearing clearance by comparing the width of the flattened plastic gauging material at its widest point with graduation on the plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch (figure 80). If this clearance is greater than .0035" REPLACE BOTH BEARING SHELLS AS A SET. Recheck clearance after replacing shells.

NOTE: Main bearing end thrust clearance should be .0035" to .0135" as checked with a dial indicator.

MAIN BEARING REPLACEMENT

Main bearing clearance must be corrected by the use of selective upper and lower shells. UNDER NO CIRCUMSTANCES should the use of shims behind the shells, to compensate for wear, be attempted.

NOTE: The upper and lower shells must be installed in pairs. Sizes of the bearings are located on the tang (figure 81). It is possible to have more than one bearing size in the same engine.

To install main bearing shells, proceed as follows:

1. Loosen all main bearing caps.
2. Remove bearing cap and remove lower shell.
3. Insert a flattened cotter pin or roll out pin (or tool J-8080 if available) in the oil passage hole in the crankshaft, then rotate the crankshaft in the direction opposite to cranking rotation. The pin will contact the upper shell and roll it out.

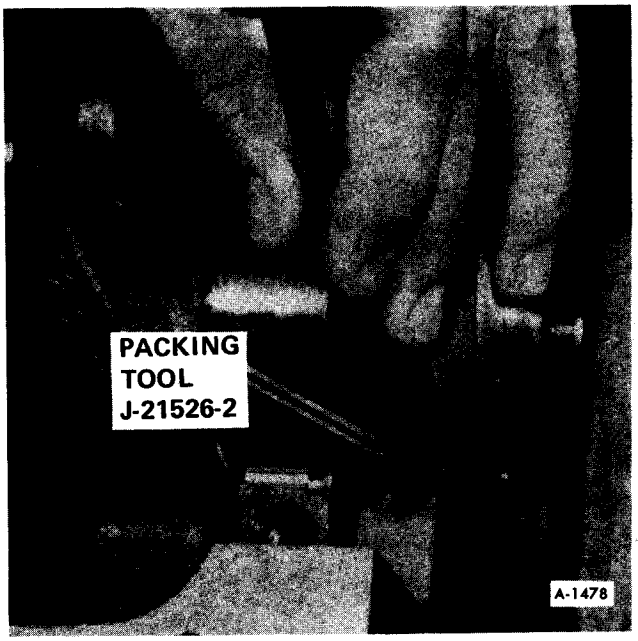


Figure 82—Packing Seal into Cylinder Block

4. The main bearing journals should be checked for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.

NOTE: The journals can be measured for out-of-round with the crankshaft installed by using a crankshaft caliper and inside micrometer or a main bearing micrometer. The upper bearing shell must be removed when measuring the crankshaft journals. Maximum out-of-round of the crankshaft journals must not exceed .0015".

4. Clean crankshaft journals and bearing caps thoroughly before installing new main bearings.
5. Apply Special Lubricant, Part No. 1050169 or equivalent to the thrust flanges of bearing shells on No. 3 bearing.
6. Place new upper shell on crankshaft journal with locating tang in correct position and rotate shaft to turn it into place using cotter pin or roll out pins during removal.
7. Place new bearing shell in bearing cap.
8. No. 5 bearing-Install new asbestos oil seal in the rear main bearing cap as described later in this section. Install Part No. 1050805 or equivalent sealer on cap as shown.
9. Install bearing caps, lubricate bolt

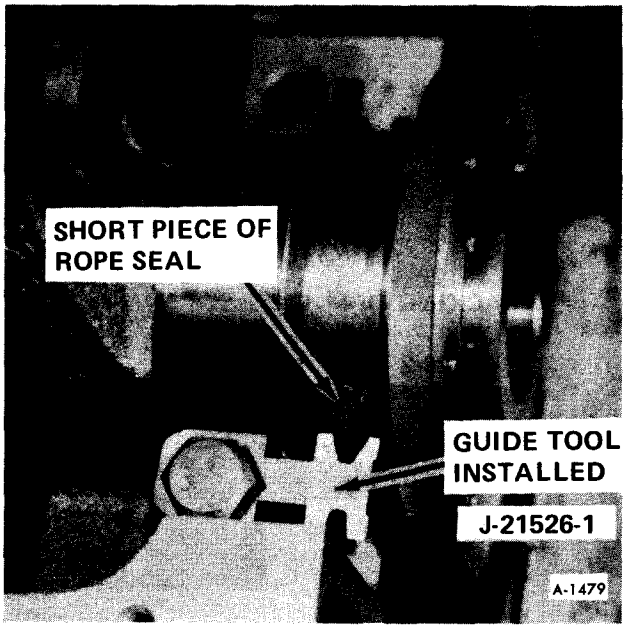


Figure 83—Guide Tool Installed

threads with engine oil, then install. Torque Nos. 1 through 4 to 80 ft. lbs. and No. 5 to 120 ft. lbs.

REAR MAIN BEARING UPPER OIL SEAL

REPAIR

Tool J-21526 is available to provide a means of CORRECTING engine rear main bearing upper seal leaks WITHOUT the necessity of removing the crankshaft. However, replacement of the rear main bearing upper oil seal requires crankshaft removal.

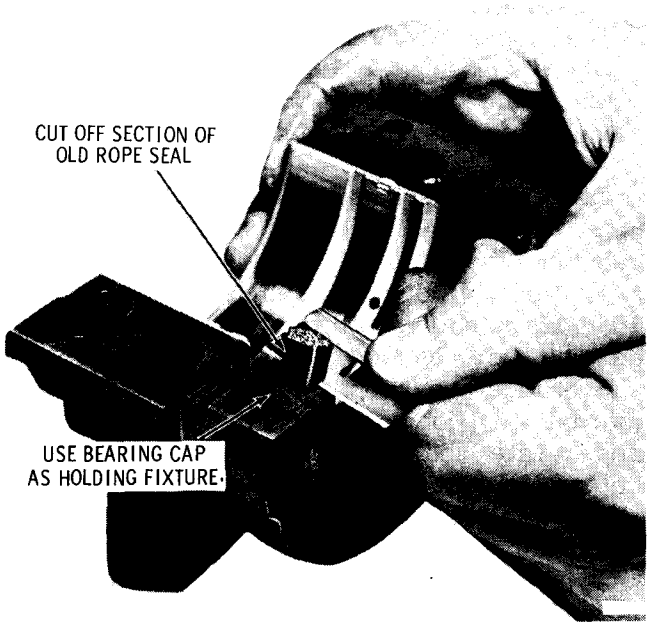


Figure 84—Cutting Off Lower Seal Ends

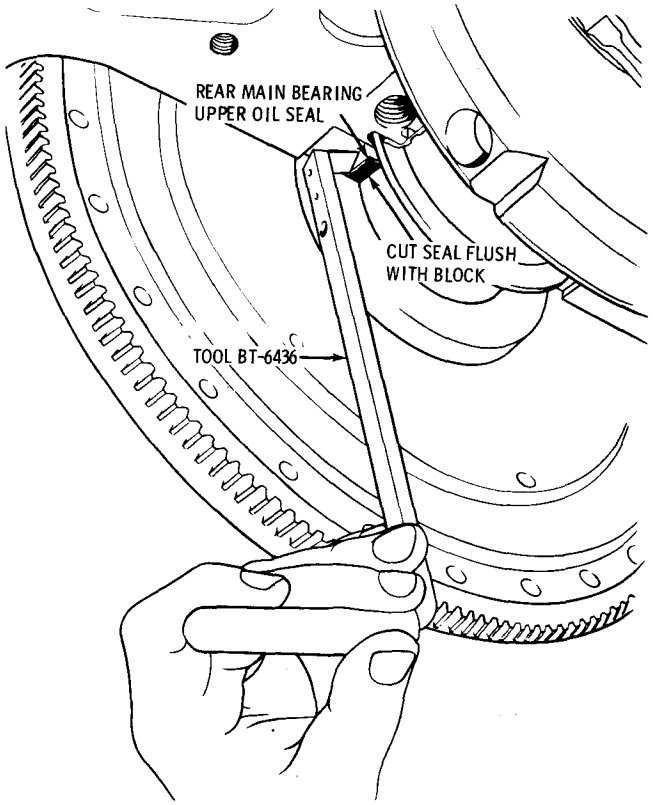


Figure 85—Cutting Off Upper Seal Ends

Listed below is a procedure for seal leak correction.

1. Drain oil and remove oil pan and rear main bearing cap.
2. Insert Packing Tool J-21526-2 against one end of seal in cylinder block and drive the old seal gently into the groove until it is

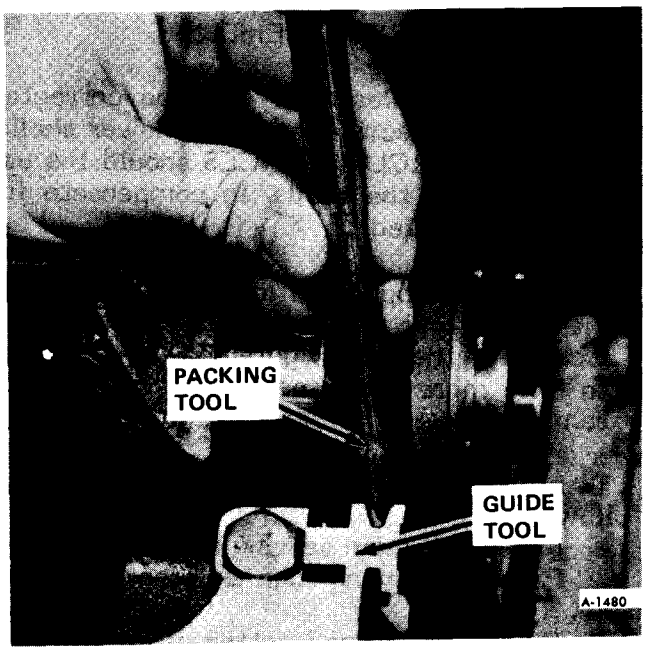


Figure 86—Packing Seal into Guide and Cylinder Block

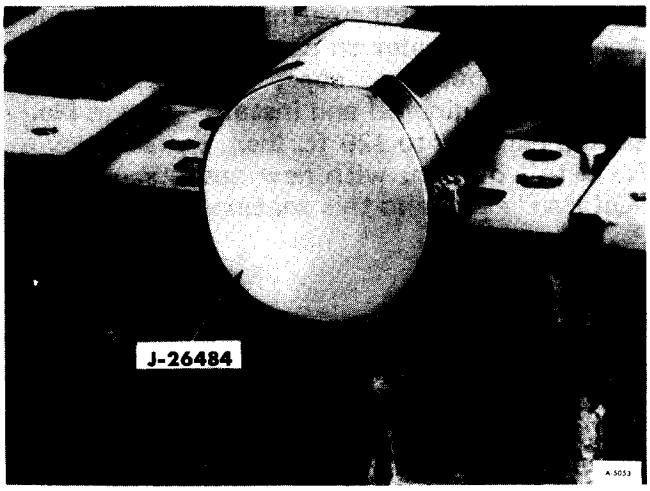


Figure 87—Installing Rear Main Seal - Upper Half

packed tight. Distance varies from 1/4" to 3/4" depending on the amount of pack required. See figures 82 and 83.

3. Repeat this on the other end of the seal in the cylinder block.

4. Measure the amount the seal was driven up on one side; add 1/16", then cut this length from the old seal removed from the main bearing cap with a single edge razor blade. Measure the amount the seal was driven up on the other side. Add 1/16" and cut another length from old seal. Use main bearing cap as a holding fixture when cutting seal as shown in figure 84.

5. Place a drop of Part No. 1050805 Sealer or equivalent, on each end of seal and cap as indicated.

6. Work these two pieces of seal into the cylinder block (one piece on each side) with two small screwdrivers. Use guide tool J-21526-1 as shown in figure 83. Using packing tool, pack these short pieces up into the block. Use a seal trimming tool to trim seal flush with block as shown in figure 85. Refer also to figure 86.

NOTE: Place a piece of shim stock between seal and crankshaft to protect bearing surface before trimming.

7. Form a new rope seal in the rear main bearing cap. Refer to "Rear Main Lower Oil Seal" next in this section.

8. Assemble the cap to the block and torque to specifications.

REPLACEMENT

1. Remove crankshaft. Refer to "Crankshaft" earlier in this section.

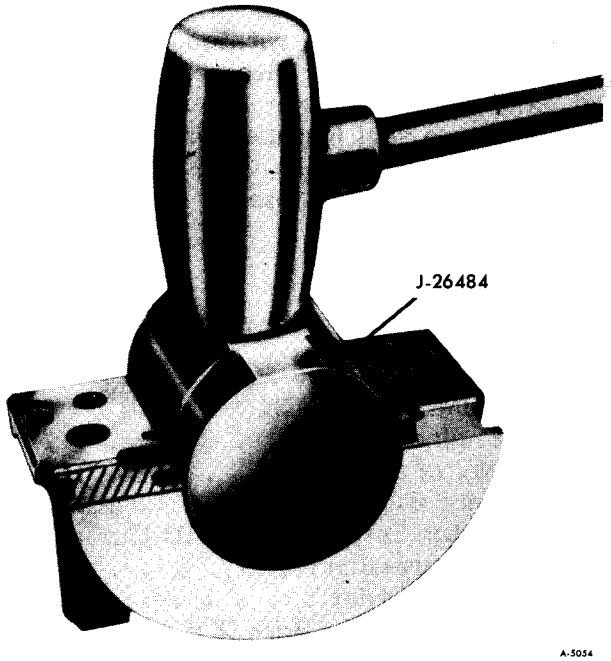


Figure 88—Installing Rear Main Seal - Lower Half

2. Remove upper oil seal.

3. Install a new rear main bearing upper seal. Use tool J-26484 as shown in figure 87.

4. After correctly positioning seal, rotate tool slightly and cut off each end of seal flush with block.

5. Install crankshaft as described earlier in this section under "Crankshaft".

REAR MAIN BEARING OIL SEAL

REMOVAL

1. Remove oil pan. Refer to "Oil Pan" earlier in this section.

2. Remove the rear main bearing cap.

3. Remove rear main bearing insert and old seals.

4. Clean bearing cap and seal grooves and inspect for cracks.

INSTALLATION

1. Install seal into bearing cap, packing by hand.

2. Using seal installer J-26484 hammer seal into groove (figure 88).

NOTE: To check if seal is fully seated in the bearing cap, slide the tool away from the seal. With tool fully seated in the bearing cap, slide tool against the seal. If undercut area of tool slides over the seal is fully seated. If tool butts against the seal, the seal must be driven further into the seal groove. Rotate tool before cutting off excess seal packing.

3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seal installer when cutting seal to avoid damage to tool.

4. Clean bearing insert and install in bearing cap.

5. Clean crankshaft bearing journal and seal contact. Install sealer on cap as shown.

6. Install bearing caps, lubricate bolt threads with engine oil and install. Torque No. 5 bearing cap bolt to 120 ft. lbs.

7. Install oil pan, with new gaskets. Refer to "Oil Pan" earlier in this section.

ENGINE SPECIFICATIONS

CYLINDER BLOCK	
Engine Type	90° V-type
No. of Cylinders	8
Bore and Stroke	4.351" X 3.385"
Piston Displacement 403 Cu. In.	
Compression Ratio	8.5:1
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (ID)	2.687" - 2.688"
CRANKSHAFT	
Diameter-Main Bearing Journal	2.4995" - 2.4985" (2,3,4,5)
	2.4998"-2.4988" (1)
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156" - 1.166"
No. 3	1.1985" - 2.0015"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.1248" - 2.1238"
Width-Connecting Rod Bearing (with fillets)	1.877" - 1.887"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	1.250"
Clearance - Crankshaft End	.0035" - .0135"
MAIN BEARINGS	
Bearing Clearance - Crankshaft 1,2,3, & 4	.0005" - .0021"
Bearing Clearance (Vertical)	.0015" - .0031"
Width-Bearing Shell	
No. 1,2, and 4	.970" - .980"
No. 3	1.193" - 1.195"
No. 5	1.624"
CONNECTING RODS	
Length-Center to Center	5.998"-6.002"
Diameter-Connecting Rod Bore	2.2495" - 2.2500"
Diameter-Pin Bore	.9789" - .9795"
Bearing Clearance - (Vertical)	.0004" - .0033"
Side Clearance - Big End	.006" - .020"
PISTON	
Diameter Nominal Outside	4.351"
Top of Piston to Center of Pin	1.617"-1.613"
Clearance at Thrust Surface (selective)	.001" - .002"
Weight Less Pin & Rings (all)	700.23 ± 2 g.
Skirt Taper	.0003" - .0017" Larger at Bottom
Ring Width (2 compression)	.0798" - .0808"
Ring Width (1 oil)	.1881" - .1891"

ENGINE SPECIFICATIONS (CONT'D)

PISTON PINS	
Diameter	.9803" - .9807"
Pin to Piston Clearance	.0003" - .0005"
Pin to Rod Fit	.0008" - .0018" Press
PISTON RINGS	
No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0780" - .0770"
Gap Clearance Compression Rings	.010" - .023"
Clearance in Groove Compression Rings-Upper	.0020" - .0040"
Clearance in Groove Compression Rings-Lower	.0020" - .0040"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015" - .055"
CAMSHAFT	
Bearing Journal Diameters	
No. 1	2.0365" - 2.0357"
No. 2	2.0165" - 2.0157"
No. 3	1.9965" - 1.9957"
No. 4	1.9765" - 1.9757"
No. 5	1.9565" - 1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3 and 4	.741"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020" - .0058"
End Clearance	.011" - .077"
Push Rod - Length	8.265"
VALVE - INTAKE	
Diameter Head	2.000" - 1.990"
Diameter - Stem	.3425" - .3432"
Angle - Valve (A^{o}) See Figure 30	44^{o}
Angle - Valve Seat (B^{o}) See Figure 30	45^{o}
Width - Valve Seat (Cylinder Head)	.037" - .075"
Overall Length	4.667"
Clearance in Guide	.0010" - .0027"
Lash	Hydraulic
VALVE EXHAUST	
Diameter - Head	1.497" - 1.507"
Diameter - Stem	.3420" - .3427"
Angle - Valve (A^{o}) See Figure 30	30^{o}
Angle - Valve Seat (B^{o}) See Figure 30	31^{o}
Width - Valve Seat (Cylinder Head)	.050" - .090"
Overall Length	4.675"
Clearance in Guide	.0015" - .0032"
Lash	Hydraulic
VALVE SPRINGS	
Length	1.96"
Diameter - Wire	.192"
Inside Diameter	.1065" - 1.041"
Load	76 - 84 lbs. @ 1.670"
Load @ 1.270"	180 - 194 lbs.

ENGINE SPECIFICATIONS (CONT'D)

VALVE LIFTERS	
Diameter - Body*	.8422" - .8427"
Length - Overall	2.000"
Clearance in Boss	.0005" - .0020"
* Also available in .010" Over Size	
CAMSHAFT SPROCKET	
Width of Sprocket	.420" - .400"
Pitch	.500"
No. of Teeth	36
CRANKSHAFT SPROCKET	
Width of Sprocket	.400" - .410"
Overall Width of Gear	.991" - 1.001"
Pitch	.500"
No. of Teeth	18
TIMING CHAIN	
Width	Morse-.627, Linkbelt-.720" - .750"
No. of Links	48
Pitch	.500"
FLYWHEEL	
No. of Teeth on Starter Gear	166
No. of Teeth on Starter Pinion	9
LUBRICATION SYSTEM	
Crankcase Capacity Drain and Refill	5 Qts.
Drain & Refill with Filter Change	6 Qts.
Oil Pump	
Clearance Pressure Relief Valve in Bore	.0025" - .0050"
End Clearance-Gear	.0025" - .0065"

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below specification.

APPLICATION	FT. LBS.
FUEL PUMP	
Fuel Pump to Block Bolt and Nut	25
Fuel Pump Eccentric to Camshaft	65
EXHAUST SYSTEM	20
ENGINE	
Crankshaft Bearing Cap Bolts Nos. 1, 2, 3 & 4	80
Crankshaft Bearing No. 5	120
Flywheel to Crankshaft	60
Oil Pump to Bearing Cap Bolts	35
Oil Pump Cover to Pump Bolts	8
Rocker Arm Pivot Bolt to Head	25
Valve Cover Bolts	Fully driven, seated, not stripped
Oil Pan Bolts	10
Oil Pan Drain Plug	30
Crankshaft Balancer or Hub to Crankshaft Bolt	200-310

TORQUE SPECIFICATIONS (CONT'D)

APPLICATION	FT. LBS.
Oil Filter Element to Base	20
Oil Filter Assembly to Cylinder Block Bolts	35
Oil Filter Extension Fitting	55
Support/Front Cover Block	50
Fan Driven Pulley to Hub Bolts	20
Fan Driving Pulley to Balancer Bolts	20
Water Pump to Front Cover Bolts	13
Water Outlet to Manifold Bolts	20
Intake Manifold to Cylinder Head Bolts*	40
Exhaust Manifold to Cylinder Head Bolts	25
Carburetor to Intake Manifold Bolts	10
Choke Tube and Plate to Intake Manifold Bolts	15
Air Cleaner to Carburetor Stud	5
Engine Front Support Cushion Studs	30
Engine Support to Mount	45
Engine Mount to Crossmember Mount	30
Transmission Rear Mount to Crossmember	55
Transmission Rear Mount to Support	50
Starter to Cylinder Block Bolt	35
Starter Brace to Cylinder Block Bolts	25
Starter Brace to Starter	15
Starter Brace to Starter Stud	8
Distributor Clamp to Cylinder Block Bolt	17
Spark Plugs	25
Cylinder Head Bolts*	130
Connecting Rod Nuts	42

* Clean and dip entire bolt in engine oil before tightening to obtain a correct torque reading.

SPECIAL TOOLS

J-5154-01	Timing Cover Oil Seal Installer
J-5892-1	Valve Spring Compressor
J-6647	Piston Ring Compressor (3-7/8")
J-7583-3	Pilot (used with J-8614-01 Harmonic Balancer Remover)
J-8080	Main Bearing Shell Remover
J-21526-1	Rope Seal Repair Guide Tool
J-21526-2	Rope Seal Repair Packing Tool
J-22794	Valve Holder
J-24603-01	Engine Removal Fixture
J-24724	Crankshaft Harmonic Balancer Installer
J-24725	Valve Stem Seal Installer
J-26484	Rear Main Bearing Oil Seal Installer
BT-33-73F (J-23573)	Belt Tension Gauge
BT-6428	Valve Stem Height Gauge

SECTION 6K
ENGINE COOLING

The information described in Maintenance Manual X-7525 under the heading ENGINE COOLING (SEC. 6K) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

COOLING SYSTEM CHECKS

The procedure for checking the cooling system is outlined below. As with all service recommendations, these suggestions should be adjusted to vehicle usage.

DRAIN AND FILL SYSTEM

Always drain system coolant when the engine is hot. This is to hold in suspension fine particles that tend to settle in low places in the block when the engine is not operating. Refer to "Draining, Flushing and Refilling Cooling System" in Section 6K of Maintenance Manual X-7525.

CHECK THE COOLANT

While draining the engine, check the color and the "feel" of the coolant. If it shows an unusual amount of oil sediment or feels slippery, this indicates that engine oil may be leaking into the cooling system. A coating of lube oil on the insides of the coolant passages reduce's the system's efficiency. Engine overheating often results. Besides this, a leak in the cooling system may also permit coolant to flow into the lube oil passages. The contaminated lubricant which results can seriously damage the engine.

If engine oil if found in the coolant, examine the oil cooler core for cracks. Should a pressure check of the core show no leakage, replacement of head-to-block gaskets, coolant and oil seals is indicated. If this fails to solve the problem, the cause may be a damaged cylinder head or block.

PRESSURE CHECK SYSTEM

Pressure check on radiator and system determines ability of system to hold pressure and therefore is an indicator of cooling efficiency.

CHECK THE THERMOSTAT

If the engine operating temperature deviates from the normal range, remove the thermostat and check it. A thermostat which remains closed or only partially open restricts the flow of coolant. This can cause an engine to overheat. Serious damage to engine components may result. A thermostat which is stuck in the wide-open position does not allow the engine to reach its normal operating temperature. The incomplete combustion which results from cold engine operation promotes the build-up of excess carbon deposits on the pistons, rings, and valves. Replace any thermostat found to be defective. Refer to "Thermostat" in Section 6K, Maintenance Manual X-7525.

CHECK HOSES AND BRACKETS

Check the condition of hoses and clamps. Hoses should be pliable but show no signs of "ballooning". Look for cracks, cuts, and kinks - areas of potential leaks. If the lower radiator hose showed signs of collapsing when the engine was accelerated - an indication of weakness - replace it. Replace any hoses which feel unnusually hard or spongy.

Inspect hose brackets, supports, ties, and clamps to make sure they are secure, unbroken, and retain hoses properly. Retighten brackets and clamps as needed. Replace any components which are found to be split or badly corroded, broken, or deteriorated.

CHECK THE DRIVE BELTS

For efficient warm-weather operation, check the condition of the fan and water pump drive belts. Look especially for worn or frayed areas and for cracking and splitting on the underside of the belts. Worn belts can fail at any time and should be replaced.

Check the tension on serviceable belts and adjust as needed. Avoid over - or undertightening fan and pulley belts. Remember - overtightening can lead to early belt and bearing failure. Undertightening results in slippage which can lead to belt and pulley "glazing", inefficient fan and water pump operation, and engine overheating. When replacing belts, don't guess at the tension required. Use belt tension gauge BT33-73F and adjust to correct tension. Refer to "Belt Tension" later in this section.

FAN AND FAN CLUTCH

Vehicles equipped with a 403 cubic inch engine have a heavy duty fan clutch and a revised replacement procedure for fan and clutch (see below). The fan has a full shroud to replace the partial shroud and venturi rings used with the 455 cubic inch engine. For 1977 model vehicles equipped with 455 cubic inch engines, refer to Section 6K, Maintenance Manual X-7525 for fan and fan clutch replacement procedure.

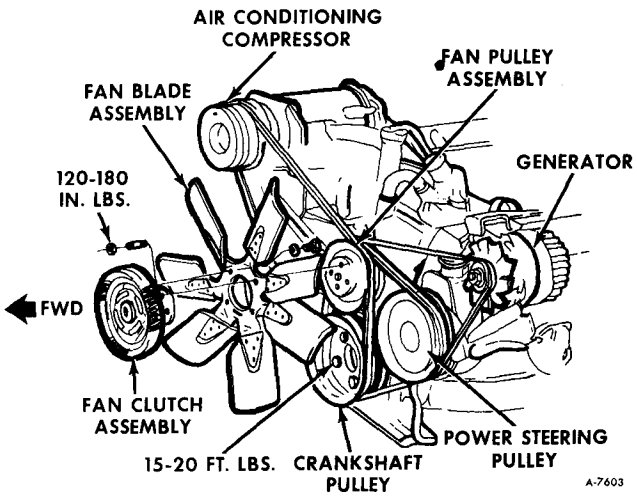


Figure 1—Fan and Drive Belts

REMOVAL

1. Raise vehicle.
2. Remove the four nuts attaching fan clutch to water pump hub (see figure 1).
3. With assembly in the shroud area and removed from the hub, remove the four attaching bolts that secure fan clutch.
4. Remove fan and fan clutch after they are separated from each other.

WARNING: IF A FAN BLADE IS BENT OR DAMAGED IN ANY WAY, NO ATTEMPT SHOULD BE MADE TO REPAIR AND REUSE THE DAMAGED PART. A BENT OR DAMAGED FAN ASSEMBLY SHOULD ALWAYS BE REPLACED WITH A NEW FAN ASSEMBLY. IT IS ESSENTIAL THAT FAN ASSEMBLIES REMAIN IN PROPER BALANCE AND PROPER BALANCE CANNOT BE ASSURED ONCE A FAN ASSEMBLY HAS BEEN BENT OR DAMAGED. A FAN ASSEMBLY THAT IS NOT IN PROPER BALANCE COULD FAIL AND FLY APART DURING SUBSEQUENT USE CREATING AN EXTREMELY DANGEROUS CONDITION.

INSTALLATION

1. Install fan and fan clutch separately into the area in the shroud between the water pump and the radiator. Be careful not to damage the radiator core.
2. Install four attaching bolts that secure the fan to the fan clutch and torque to 15-20 ft. lbs. (See figure 1).
3. Position the assembly over the water pump hub studs and torque the attaching nuts to 15-20 ft. lbs.
4. Lower vehicle.

WATER PUMP

1977 and 1978 vehicles equipped with a 403 cubic inch engine have a new water pump replacement procedure.

REMOVAL

1. Drain radiator. Disconnect bypass and remove heater hose from water pump. Loosen all pulley belts.
2. Raise vehicle. Disconnect lower radiator hose from water pump.
3. Remove four nuts attaching fan clutch to water pump hub. (See figure 1.) Position fan and fan clutch assembly forward in the shroud. Be careful not to allow the assembly to damage the radiator core.
4. Remove water pump pulley.
5. Disconnect the power steering pump.
6. Remove water pump attaching bolts. Remove water pump.
7. Clean engine block of old gasket at sealing surfaces.

INSTALLATION

1. Apply a thin coat of Part No. 1050026 Sealer or equivalent to the water pump housing to retain the new gasket, then position on the housing.
2. Install the pump assembly. Coat all bolts with engine oil and torque the self-tapping bolts to 13 ft. lbs. and torque the others to 25 ft. lbs.
3. Connect the power steering pump bracket. Torque nut to 22 ft. lbs.
4. Install water pump pulley. Reposition all belts.
5. Install fan and fan clutch assembly. Torque four nuts to 15-20 ft. lbs. See figure 1.
6. Connect lower radiator hose to water pump.
7. Lower vehicle.
8. Secure clamp on bypass hose and install heater hose to water pump.
9. Tension all belts. Refer to "Belt Tension" later in this section.
10. Refill radiator. If new coolant is used refer to Section 0, Maintenance Manual X-7525.

BELT TENSION

To carry their full load, drive belts must grip the entire area of contact with the pulley. When operated in a loose condition, belts can slip, tear, burn or grab and snap. More belts fail from undertightening than from overtightening.

When operated in too tight a condition, belts can damage the engine by causing side loading on the crankshaft, crankshaft bearings, and accessories or accessory bearings. Excessive tension will also stretch and weaken belts.

DO NOT use belt dressings to extend belt life. Most dressings contain chemicals which tend to soften belts. This softening process will increase the friction between the belt and pulley grooves; however, this is only temporary.

NOTE: After a belt has been in operation one hour or approximately 50 miles, it is considered used. A "used" belt should be tightened to 70 to 80 pounds. A new belt or belt that has never been tensioned before should be tightened to 110 to 140 pounds. All belt tension checks must be taken midway on the greatest span of that belt. When drive belts are worn they should be replaced, as excessive tightening will not prevent slippage and can cause damage to bearings.

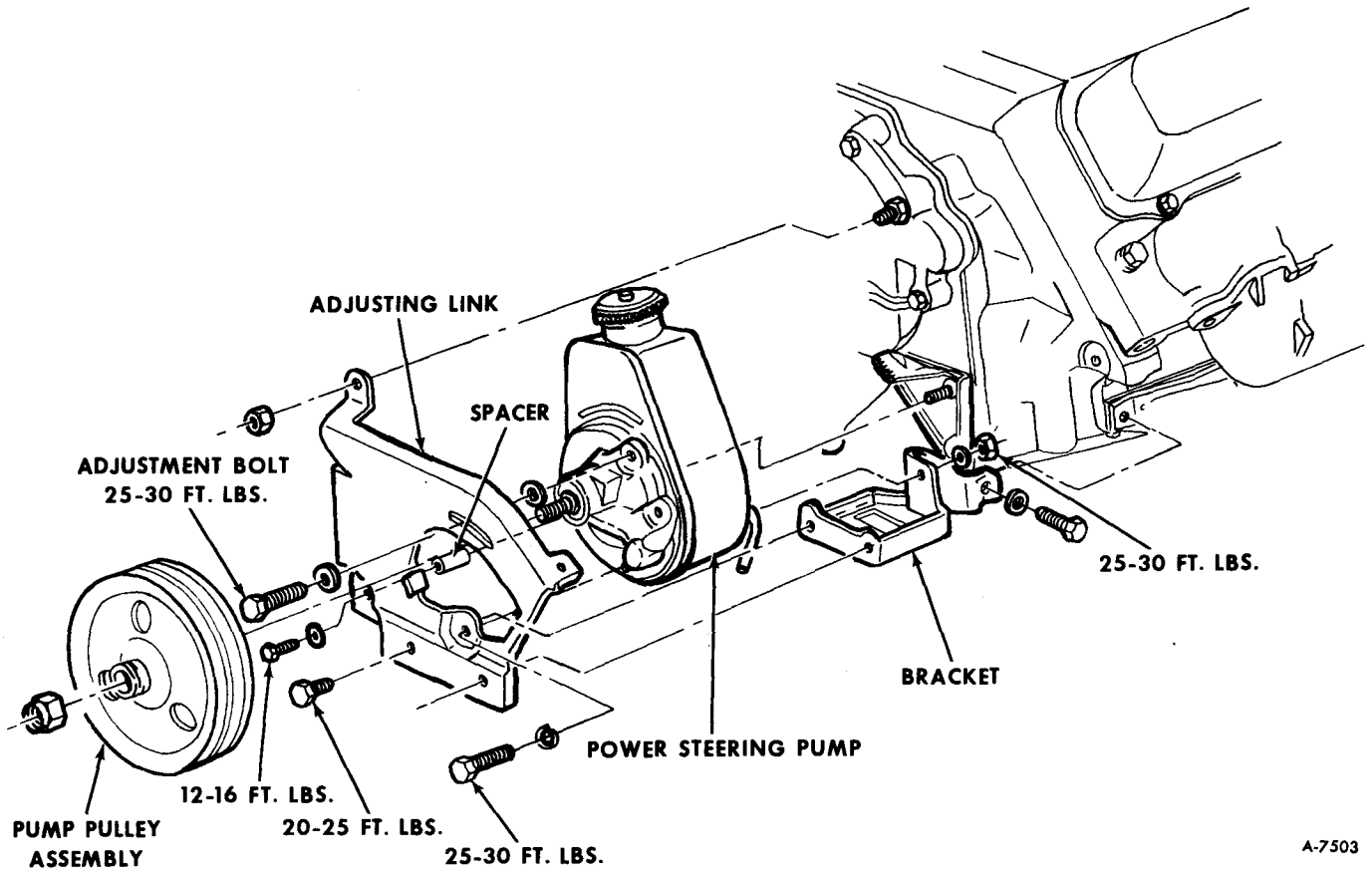


Figure 2—Power Steering Pump Mounting

All vehicles MUST have power steering belt checked and adjusted, if necessary, first. Then check and adjust (as required) the generator and air conditioning compressor belts. Use Belt Tension Gauge J-23573 (Burroughs Tool-BT-33-73F). If the belt tension on any belt is incorrect, proceed to adjust tension as outlined below.

ADJUSTING BELT TENSION

POWER STEERING PUMP BELT (FIGURE 2)

When adjusting a power steering pump belt, never pry against the pump reservoir or pull against the filler neck. To increase belt tension move the pump outward by prying against the bracket pry lugs, or against the pump housing casting extension directly behind the pump drive pulley. Also, power steering hoses should not be damaged or twisted during belt tensioning procedure.

1. Loosen the power steering pump attaching bolts and adjust the pump drive belt to correct tension with belt tension gauge by moving the pump outward, away from the engine.
2. Tighten all mounting bolts until snug, then remove pry bar.
3. Tighten mounting bolts to specified torque (figure 2).
4. Check belt tension and remove belt tension gauge.

GENERATOR AND AIR CONDITIONING COMPRESSOR BELTS

To adjust generator or air conditioning compressor belts:

1. Loosen bolts at support bracket.
2. Move generator or air conditioning compressor away from engine to increase belt tension.
3. Tighten mounting bolts to specified torque (figures 3 and 4).
4. Check belt tension and remove belt tension gauge.

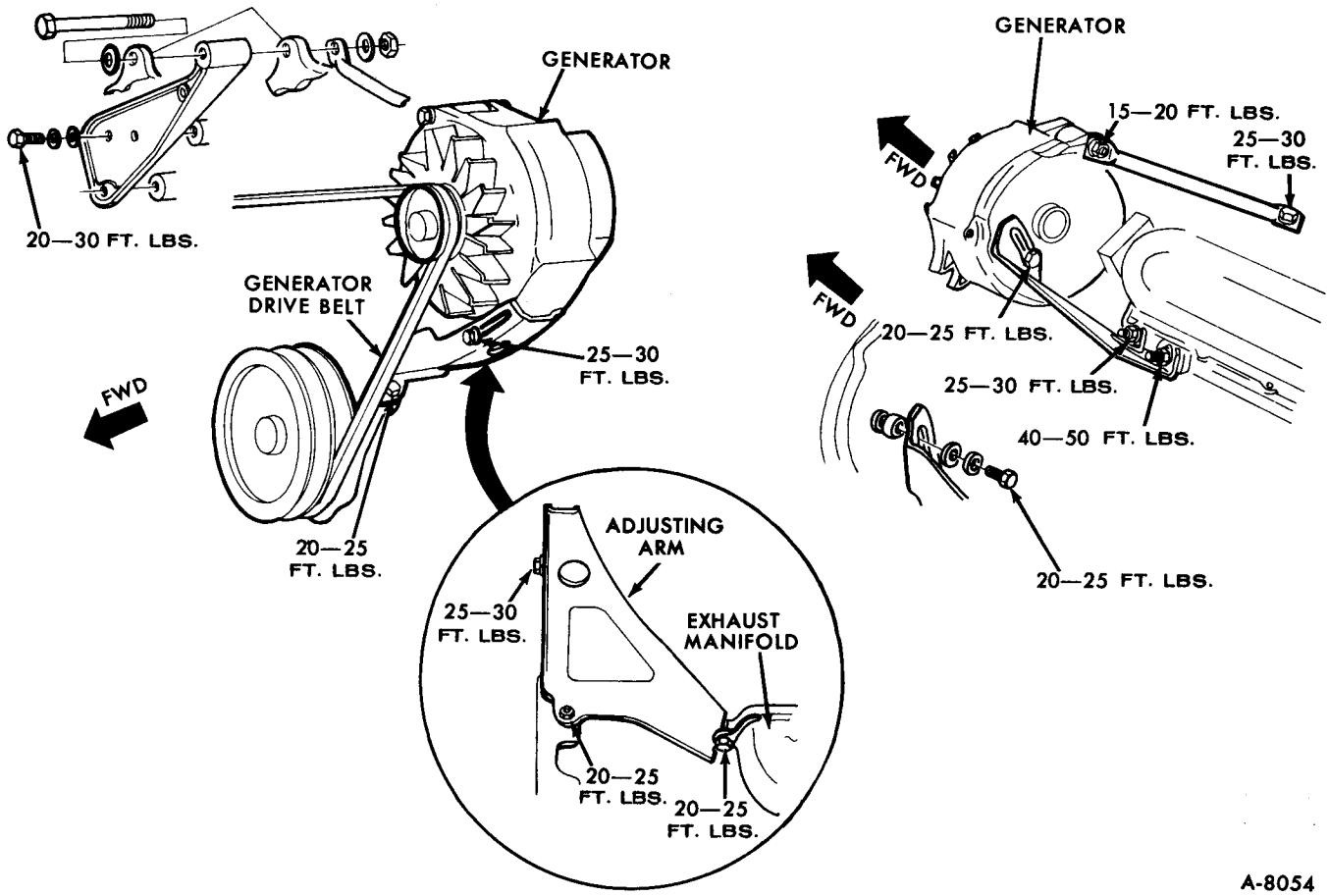


Figure 3—Generator Mounting

BELT REPLACEMENT

POWER STEERING PUMP BELT

Removal

1. Loosen generator attaching bolts. Loosen air conditioning compressor bolts and remove generator and air conditioning compressor belts (see below).
2. Remove power steering pump belt.

Installation

1. Install belts.
2. Adjust belt tension, tighten bolts to specified torque (figure 2).
3. Check pump fluid level, add fluid as necessary.

GENERATOR BELT

Removal

1. Loosen bolts at generator adjusting arm and loosen pivot bolt at generator support bracket.
2. Move generator toward engine until belt can be removed from pulley.

Installation

1. To install new belt, position belt on pulley and move generator away from engine until required tension is measured.
2. Tighten generator adjusting arm bolts and pivot bolt to specified torque (figure 3).

AIR CONDITIONING COMPRESSOR BELT

Removal and installation of air conditioning compressor belt is accomplished in the same manner as described above. Refer also to figure 4 for view of compressor mounting and for torque specifications.

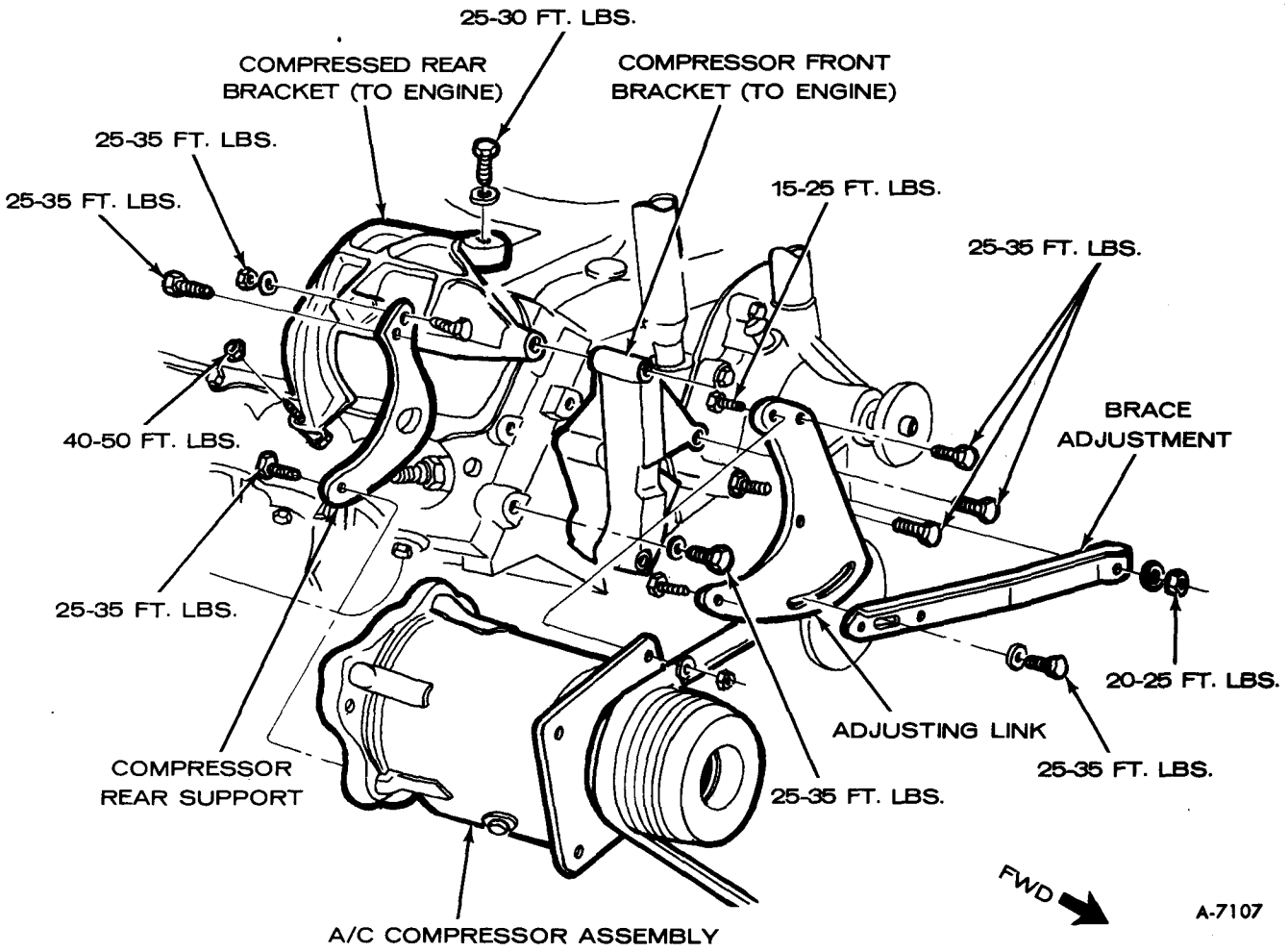


Figure 4—Air Conditioning Compressor Mounting

SPECIAL TOOLS

J-23573. . . . . Belt Tension Gauge

SECTION 6M
ENGINE FUEL SYSTEM

The information described in Maintenance Manual X-7525 under the heading ENGINE FUEL SYSTEM (SEC. 6M) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

CARBURETOR

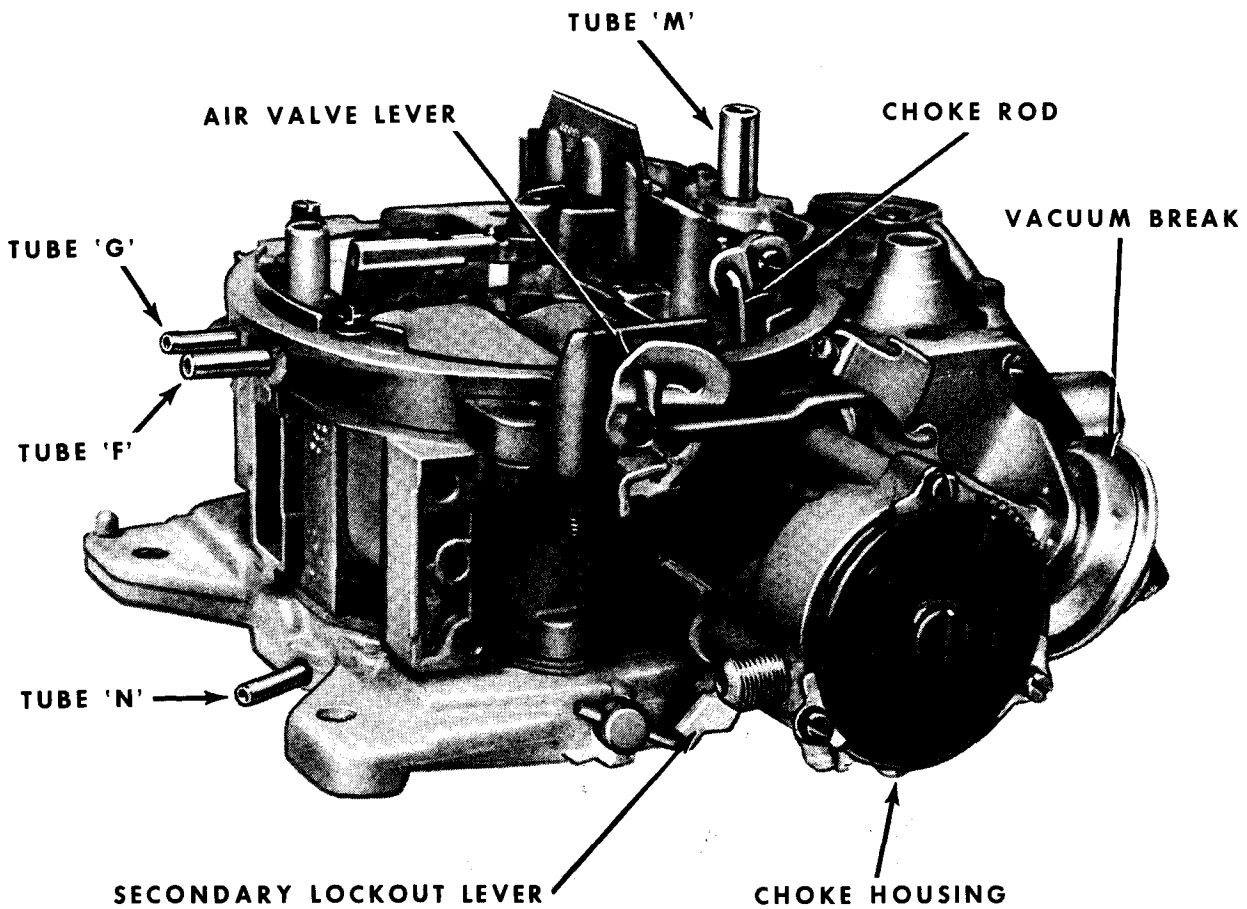


Figure 1—M4MC Carburetor (Side View)

GENERAL DESCRIPTION

The M4MC model carburetor (figure 1 and 2) used on the 403 cubic inch engine is a two stage carburetor of downdraft design. The triple venturi system is used on the primary side of the carburetor with 1-3/8" throttle valve bores.

NOTE: For carburetor service information on the 1977 Certified 455 cubic inch engine, refer to SECTION 6M of Maintenance Manual X-7525. Procedures are the same as those described for the carburetor on the 1976 certified engine.

The secondary side has two large bores (2-1/2"). Using the air valve principle in the secondary side, fuel is metered in direct proportion to the air passing through the secondary bores.

A baffle is used on the secondary side of the air horn, above the main well bleed tubes, to deflect incoming air for good secondary nozzle performance on heavy acceleration.

For ease of serviceability, alphabetical code letters are included in the air horn, float bowl, and throttle body at external tube locations to identify air and vacuum hose routings (figures 1 and 2).

Code letters for figures 1 and 2 tube identification are:

AIR HORN
- A—Vacuum Hose to Vacuum Break
- M—Vent Tube for Float Bowl
- F—Clean Air Hose to Choke Hot Air Pipe
- G—Vent Hose to Vacuum Delay Valve

FLOAT BOWL
- B—Hose to TVS Switch and Solenoid Valve
- H—Hose to TVS Switch
- T—Hose to carbon Canister (1978 California Carburetor, ONLY)

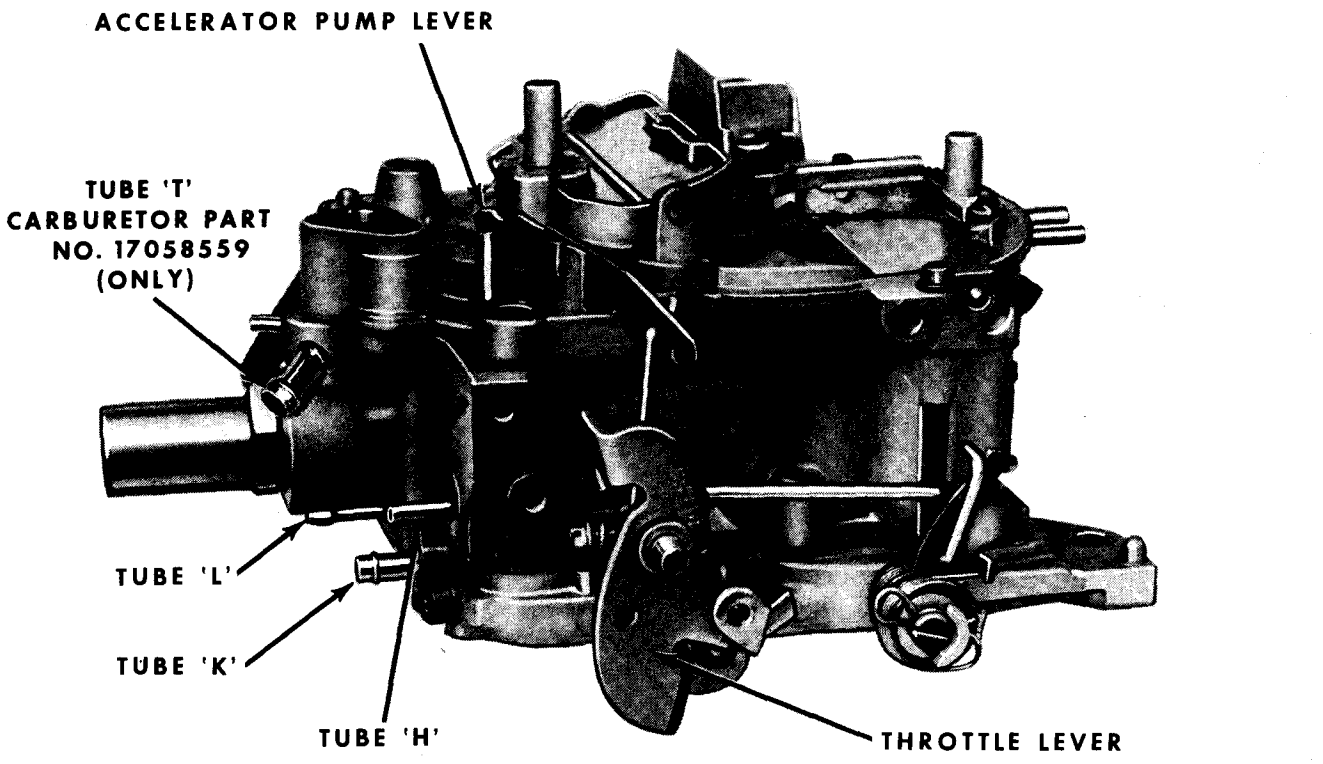


Figure 2—M4MC Carburetor (Side View)

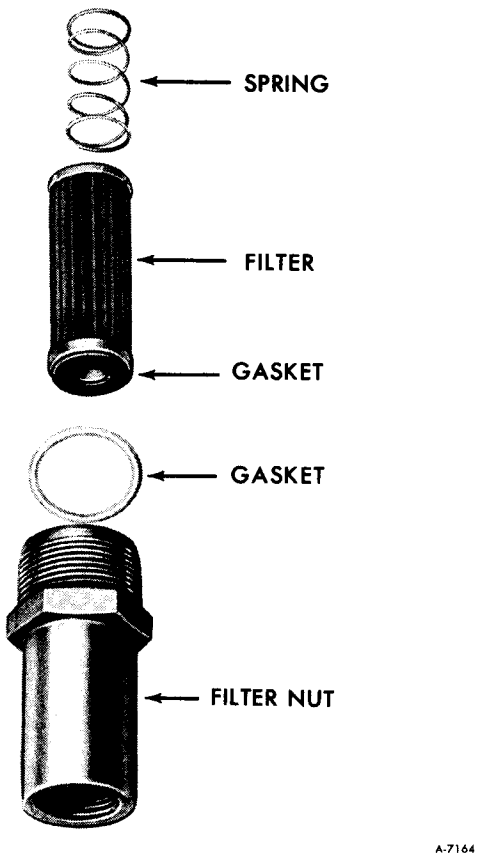


Figure 3—Fuel Filter

THROTTLE BODY
N—Hose to Air Cleaner
L—PCV Valve to Throttle Body
K—Carbon Canister Purge Hose

The float assembly is used with a windowless type needle seat for good fuel handling in the float bowl. Also, a plastic filler block is used above the float chamber to reduce fuel slosh in this area. A 2" pleated paper fuel inlet filter is used for maximum filtration of incoming fuel (figure 3).

The main metering system uses separate main wells to feed each fuel nozzle for improved fuel flow in the venturi system.

In order to provide a close tolerance adjustment in the main metering system, an adjustment screw is provided in a well next to the main power piston to very accurately set the depth of the metering rods in the main metering jets.

CAUTION: *No attempt should be made to change the APT adjustment. If float bowl replacement is required the new bowl assembly will include an adjustment screw pre-set by the factory.*

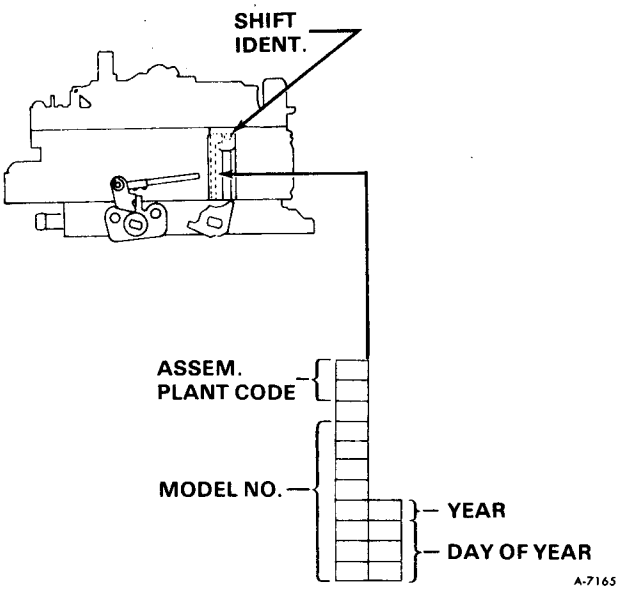


Figure 4—Carburetor Identification

An expander (garter) spring beneath the plunger cup on the accelerator pump assembly improves pump fuel delivery.

All models use the bowl mounted hot air choke housing with thermostatic control assembly. A single (front) vacuum break assembly is used.

The choke shaft and certain other parts of the choke system are Teflon coated to insure smooth choke operation.

The carburetor part number is stamped on a vertical section of the float bowl, near the secondary throttle lever. Refer to part number on the bowl when servicing the carburetor (figure 4).

The primary side of the carburetor has six systems of operation. They are float, idle, main metering, power, pump, and choke (figures 5 thru 10). The secondary side has one metering system which supplements the primary main metering system and receives fuel from a common float chamber.

CARBURETOR REPLACEMENT

REMOVAL

1. Raise engine cover to gain access to carburetor (allow engine cover to lean against instrument panel).
2. Remove air cleaner.
3. Disconnect fuel inlet line from carburetor fuel filter.
4. Disconnect vacuum hoses.
5. Disconnect throttle cable. Disconnect cruise control linkage (if so equipped).

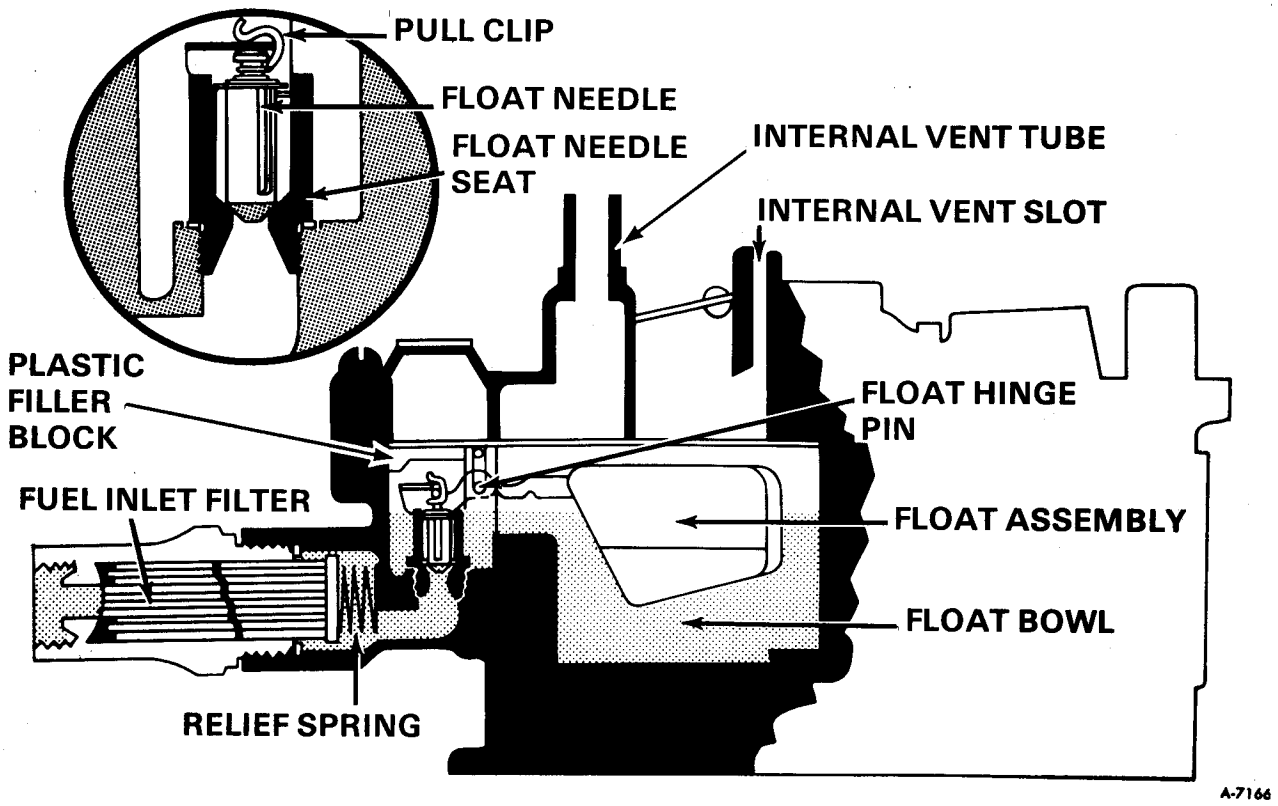


Figure 5—Float System

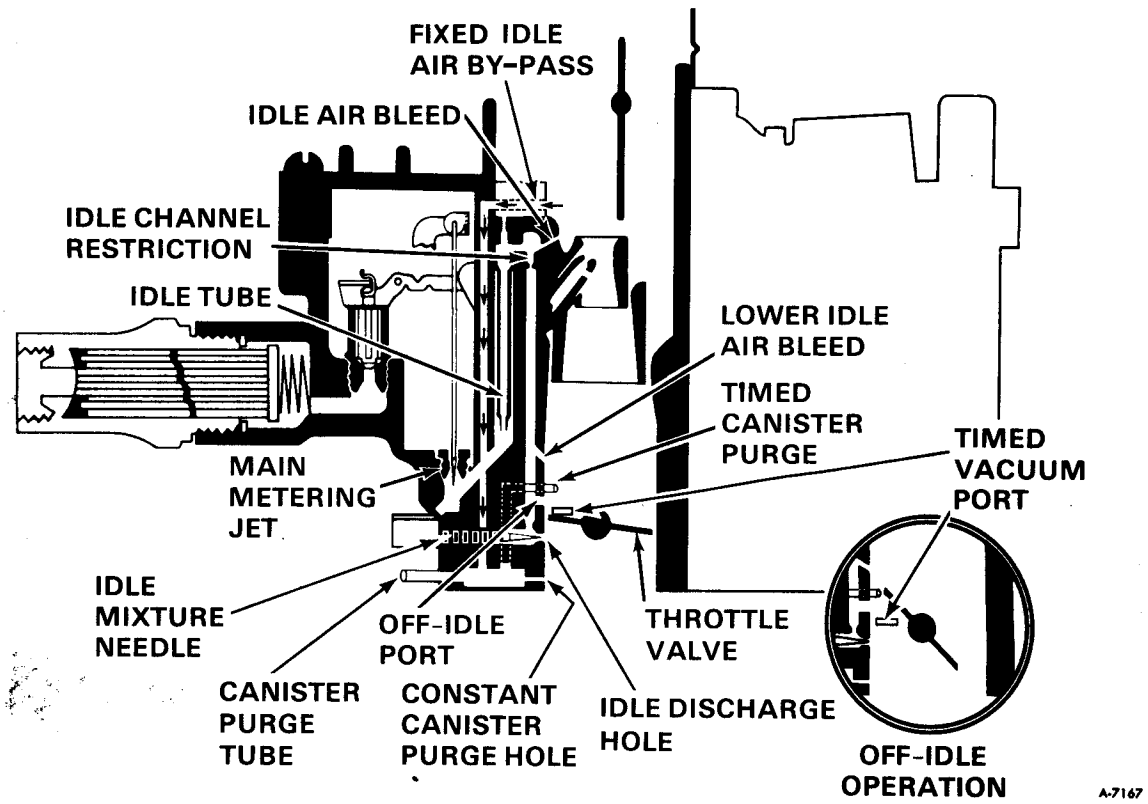


Figure 6—Idle System

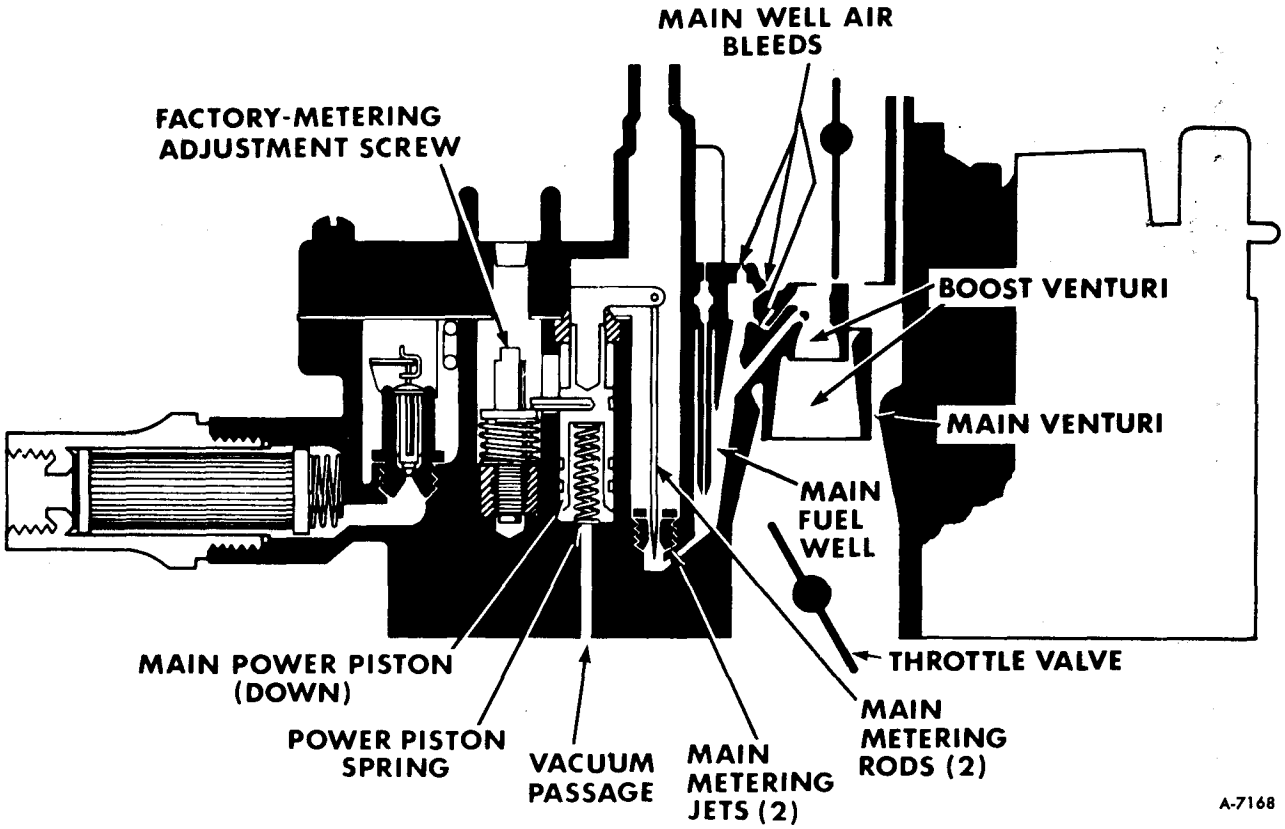


Figure 7—Main Metering System

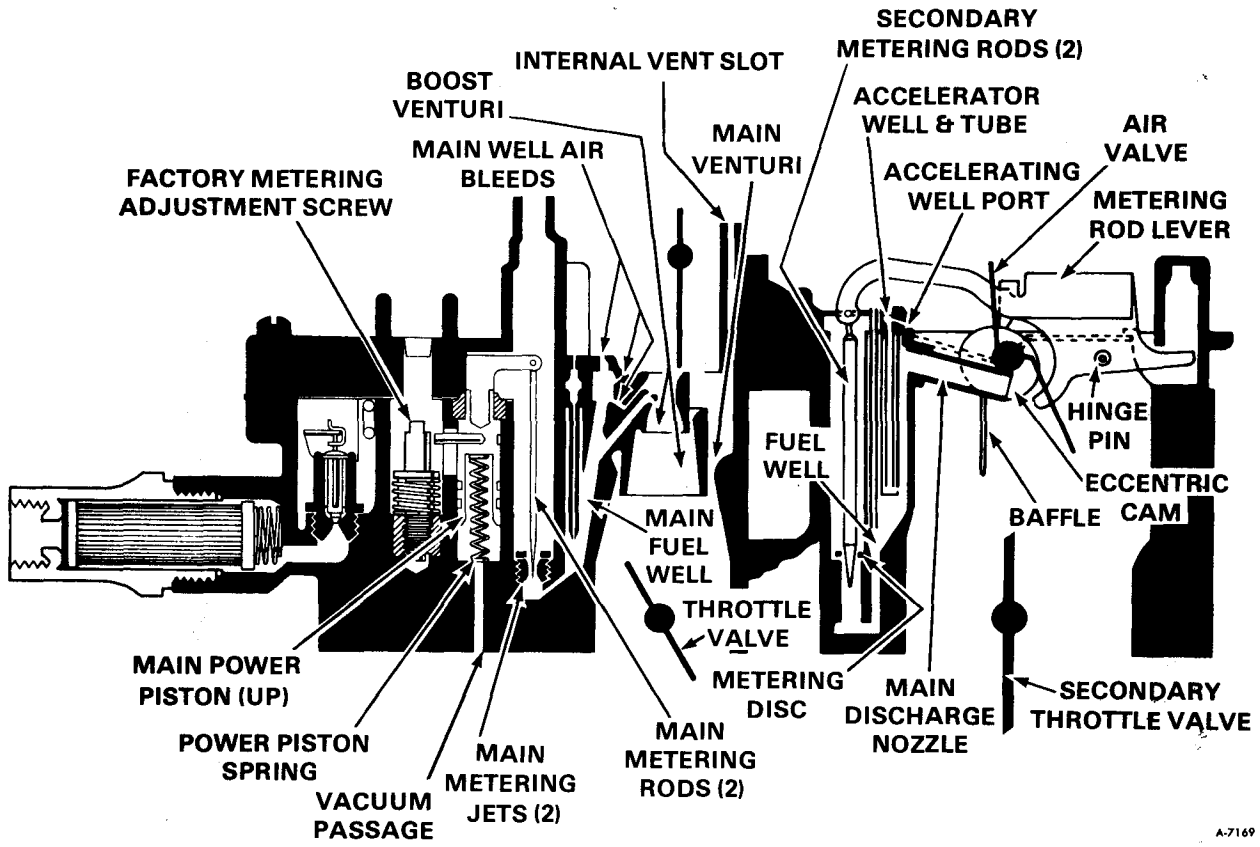


Figure 8—Power System

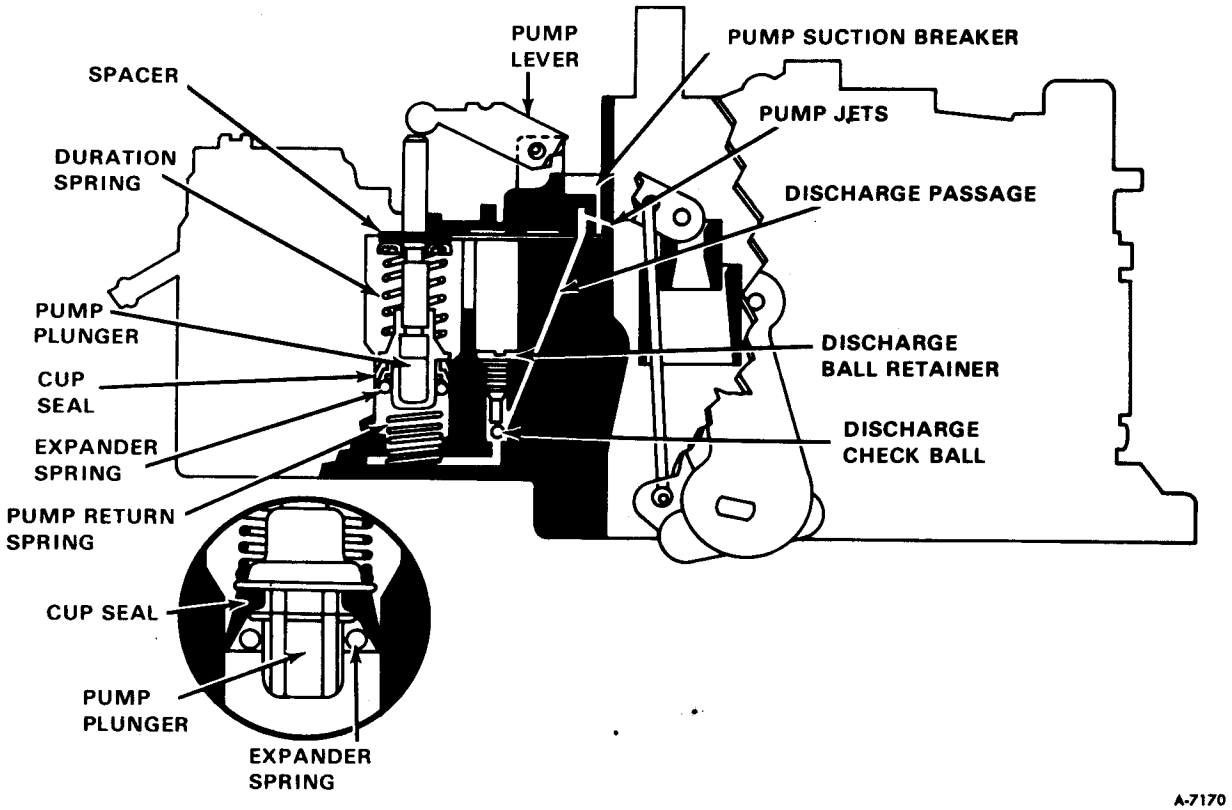


Figure 9—Pump System

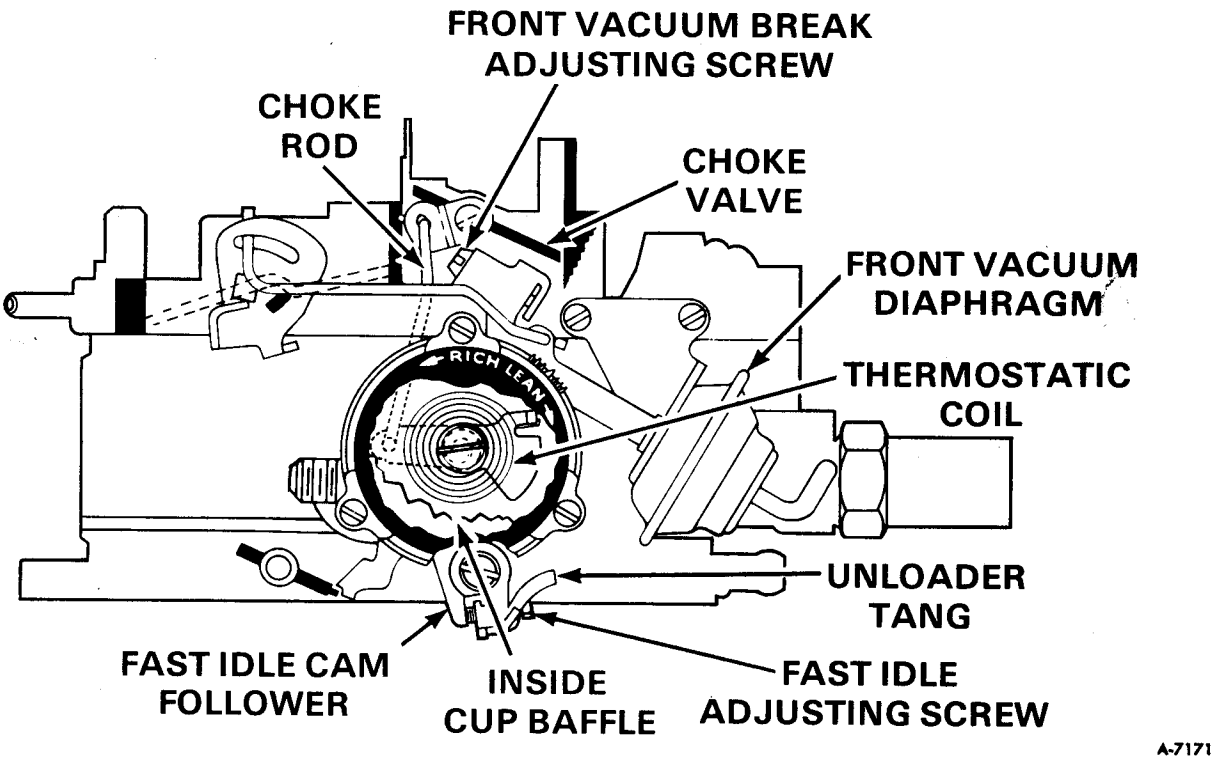


Figure 10—Choke System

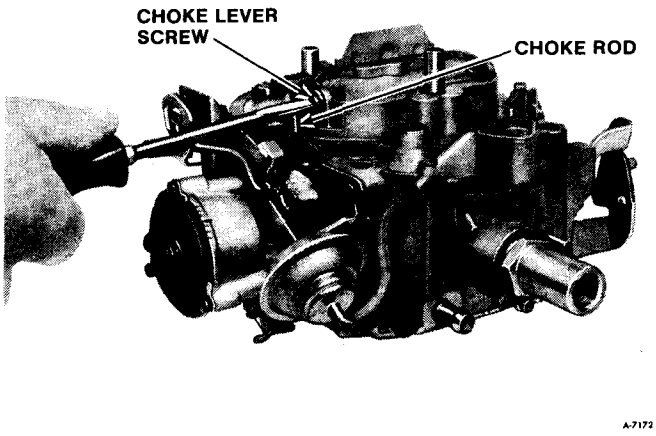


Figure 11—Removing Upper Choke Lever

6. Remove air cleaner stud.
7. Disconnect choke housing pipe.
8. Remove four carburetor to manifold attaching bolts.
9. Remove carburetor.

INSTALLATION

1. Install a new carburetor to manifold gasket.
2. Install carburetor. Tighten the four attaching bolts to 120 in. lbs. using the following tightening sequence:
   a. Left Rear Bolt.
   b. Right Front Bolt.
   c. Right Rear Bolt.
   d. Left Front Bolt.
3. Connect choke housing pipe.
4. Install air cleaner stud.
5. Connect throttle cable. Connect cruise control linkage if removed.
6. Connect vacuum lines.

NOTE: To aid in connecting vacuum hoses to the proper port on the carburetor, refer to "General Information" earlier in this section for explanation of carburetor vacuum port codes. Also, refer to Sections 6T and 8 of this supplement for vacuum hose routing diagrams.

CARBURETOR DISASSEMBLY

NOTE: Before performing any service on the carburetor, it is essential that the carburetor be placed on a holding fixture such as tool J-9789-118. Without the use of the holding fixture, it is possible to bend or nick the throttle valves.

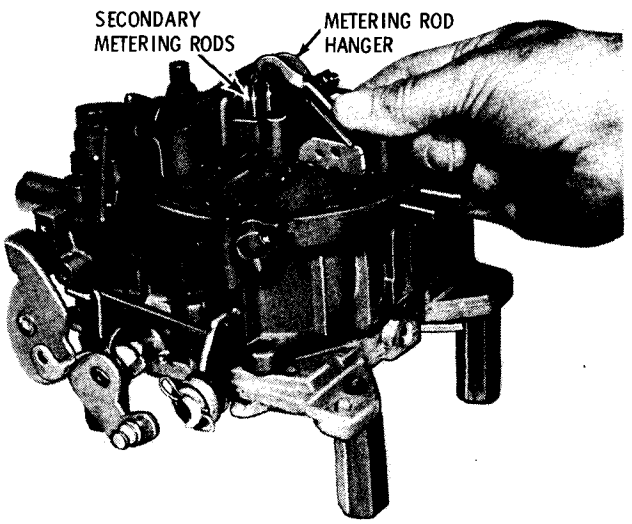


Figure 12—Removing Secondary Metering Rods

AIR HORN REMOVAL

1. Remove upper choke lever from the end of the choke shaft by removing retaining screw (figure 11). Then rotate upper choke lever to remove choke rod from slot in lever.
2. Remove choke rod from lower lever inside the float bowl casting.

NOTE: Remove choke rod by holding lower lever outward with small screwdriver.

3. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger (figure 12).

4. With small drift, drive roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn. Then remove pump lever from pump rod (figure 13). Note location of rod if in inner or outer hole in pump lever.

CAUTION: *Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.*

5. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws, figure 14.) Remove air baffle deflector from beneath the two center air horn screws.

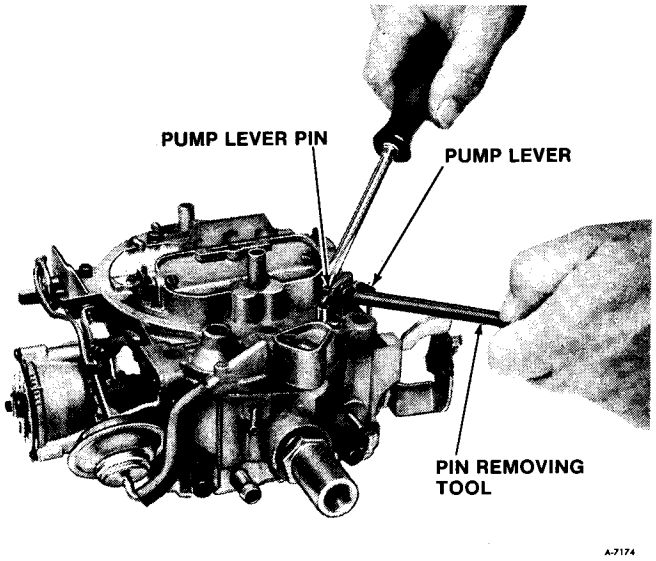


Figure 13—Removing Pump Lever

6. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later (figure 15).

CAUTION: *When removing air horn from float bowl, use care to prevent bending the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE.*

AIR HORN DISASSEMBLY

Remove front vacuum break bracket attaching screws. The vacuum break assembly may now be removed from the air valve dashpot rod and the dashpot rod from the air valve lever (figure 16).

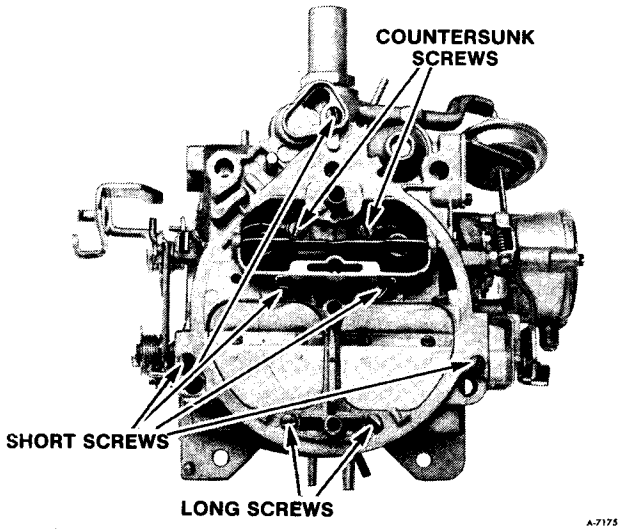


Figure 14—Removing Air Horn Screws

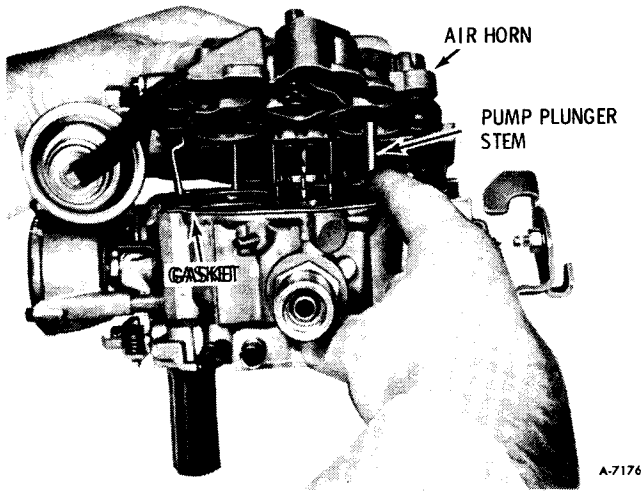


Figure 15—Removing Air Horn

CAUTION: Do not place vacuum break assembly in carburetor cleaner.

Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:

Remove staking on two choke valve attaching screws, then remove choke valve and shaft from air horn.

NOTE: Air valves and air valve shaft should not be removed. However, if it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. Instructions for assembly are included in the repair kit.

FLOAT BOWL DISASSEMBLY (FIGURE 17)

1. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being

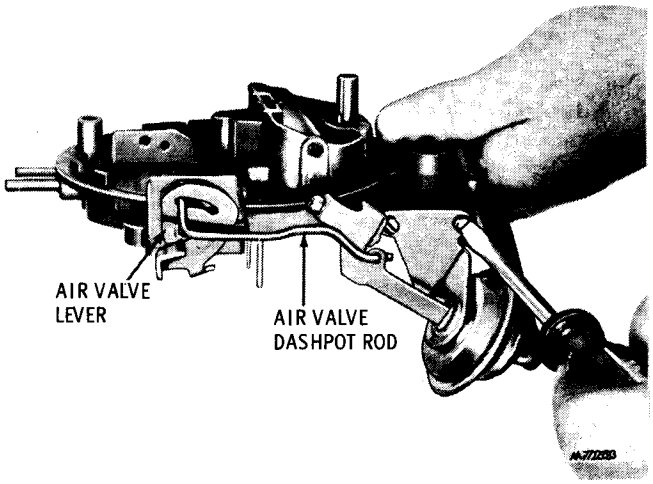


Figure 16—Removing Front Vacuum Break

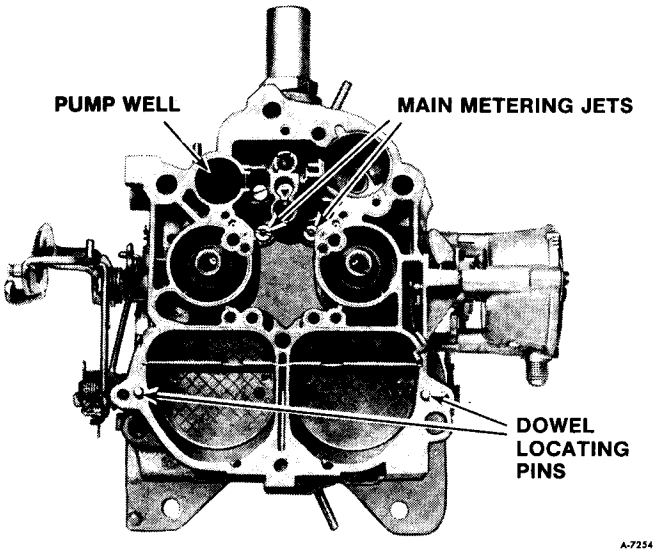


Figure 17—Float Bowl

careful not to distort springs holding the main metering rods.

2. Remove pump plunger from pump well.

3. Remove pump return spring from pump well.

4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free.

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

CAUTION: *Do not remove power piston by using pliers on metering rod hanger.*

5. Remove the power piston spring from the well.

CAUTION: *The A.P.T. metering rod adjustment screw is pre-set at the factory and no attempt should be made to change this adjustment in the field. If float bowl replacement is required during service, the new bowl assembly will be supplied with an A.P.T. metering rod screw which will be pre-set as required at the factory.*

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod. Then rotate rod to remove from hanger (figure 18).

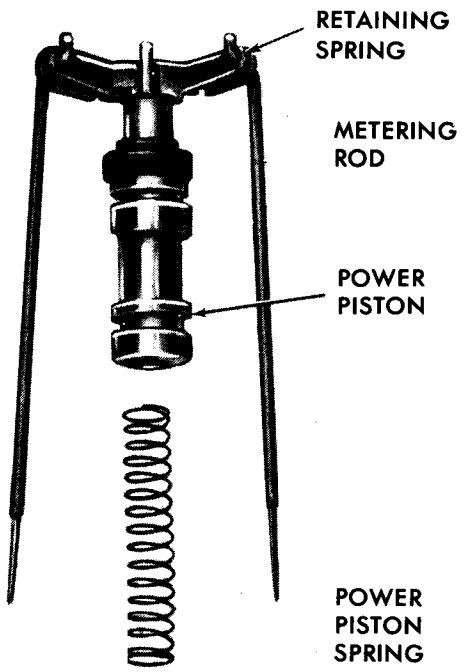


Figure 18—Power Piston and Metering Rods

CAUTION: *Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully the position of tension spring to aid later during assembly.*

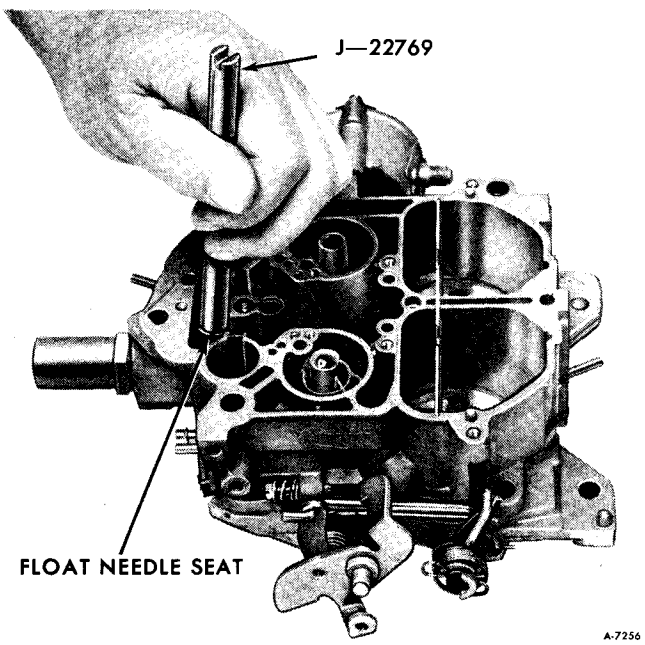


Figure 19—Removing Float Needle Seat

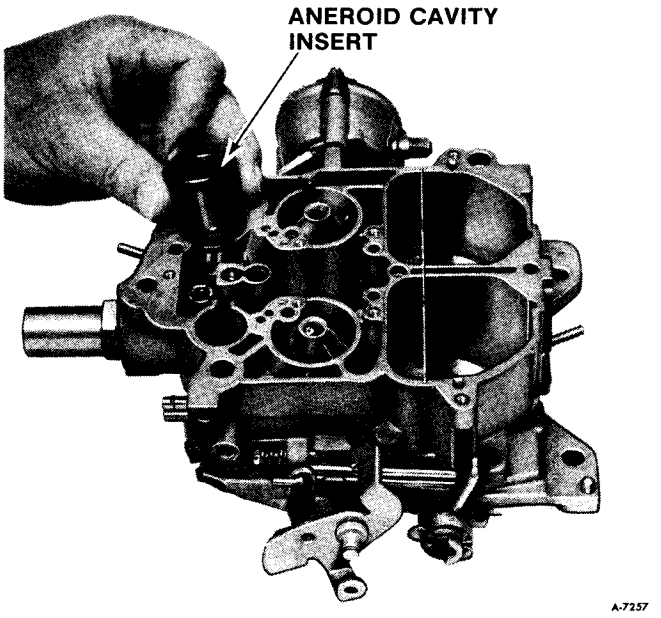


Figure 20—Removing Aneroid Cavity Insert

7. Remove plastic filler block over float valve.

8. Remove float assembly and float needle by pulling needle seat and gasket using seat remover tool J-22769 (figure 19).

9. Remove aneroid cavity insert from float bowl (figure 20).

10. Remove primary metering jets, only if necessary (figure 21).

NOTE: No attempt should be made to remove the secondary metering jets (metering orifice plates). The jets are fixed and, if damaged, bowl replacement is required.

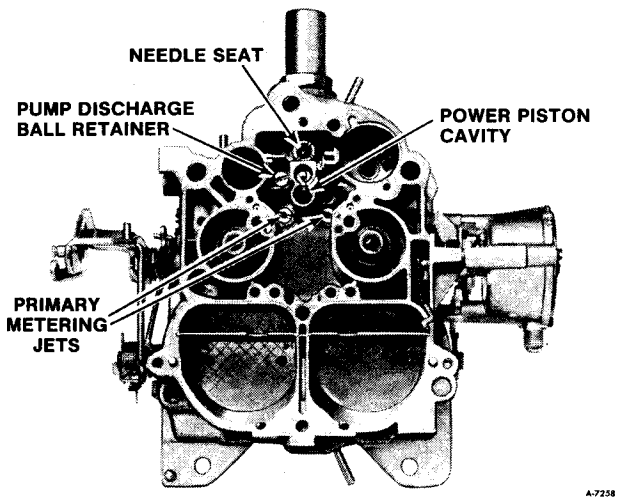


Figure 21—Primary Metering Jets

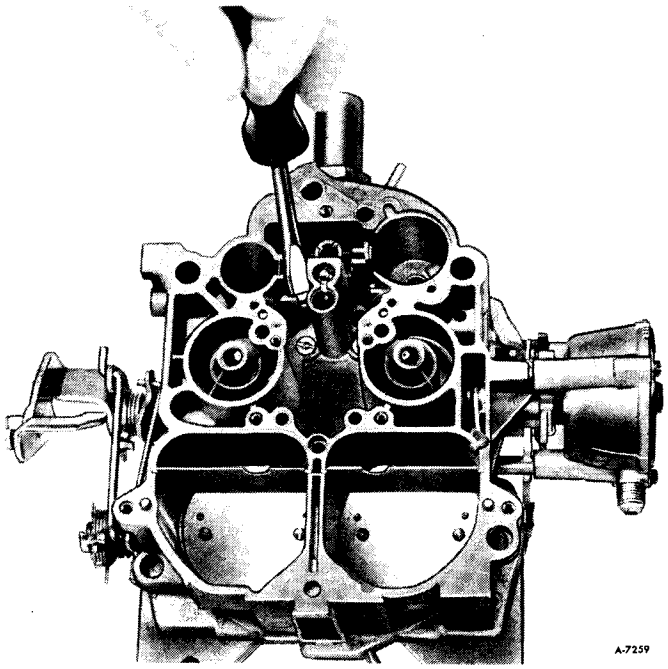


Figure 22—Removing Pump Discharge Ball Retainer and Check Ball

11. Remove pump discharge ball retainer and check ball (figure 22).

12. Remove secondary air baffle, if replacement is required.

13. Remove pump well fill slot baffle.

CHOKE DISASSEMBLY

1. Remove three attaching screws and retainers from choke cover and coil assembly. Then pull straight outward and remove choke cover and coil assembly from choke housing. Remove choke cover gasket.

NOTE: Do not remove baffle plate from beneath the thermostatic coil. Distortion of the thermostatic coil may result if forced off the center retaining post on the choke cover.

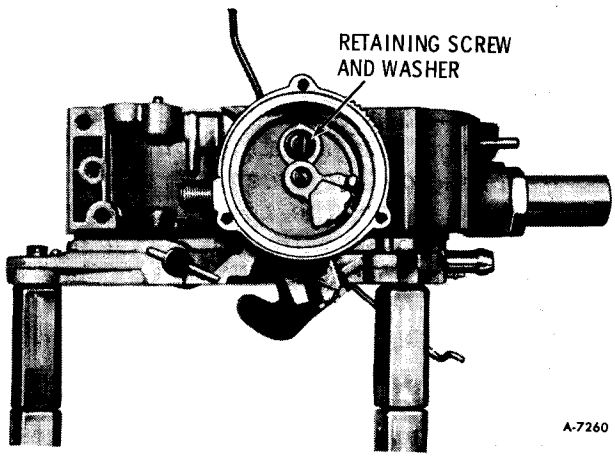


Figure 23—Choke Housing

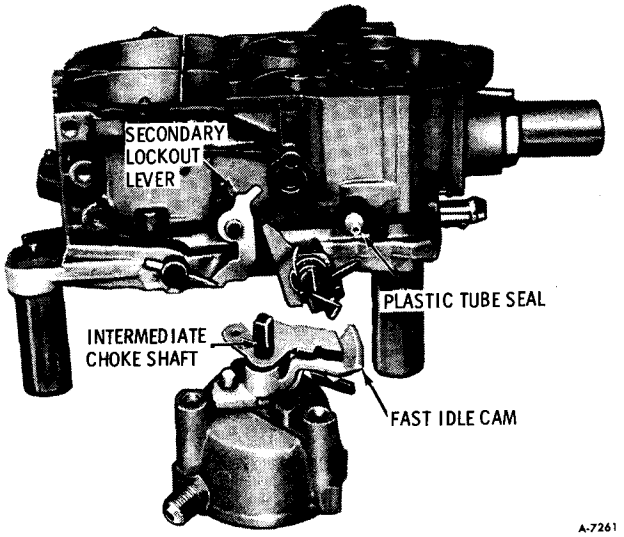


Figure 24—Choke Assembly

2. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (figure 23). The complete choke assembly can be removed from the float bowl by sliding outward.

3. Remove secondary throttle valve lockout lever from float bowl (figure 24).

4. Remove lower choke lever from inside float bowl cavity by inverting bowl.

5. Remove plastic tube seal from choke housing (figure 24).

CAUTION: *Plastic tube seal should not be immersed in carburetor cleaner.*

6. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing (figure 23). Then remove thermostatic coil lever from flats on intermediate choke-shaft. Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft (figure 24).

CAUTION: *Remove the cup seal from inside choke housing shaft hole if the housing is to be immersed in carburetor cleaner. Also, remove the cup seal from the float bowl plastic insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT.*

REMAINING FLOAT BOWL PARTS

1. Remove fuel inlet nut, gasket, filter assembly and spring (figure 25).

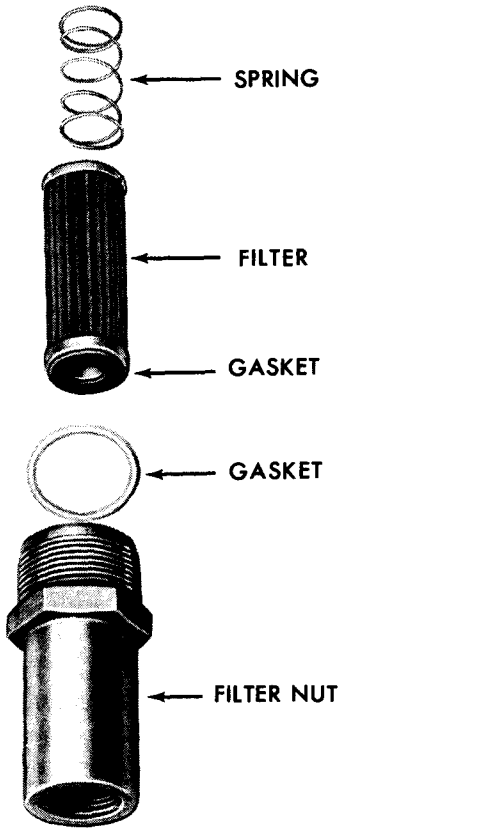


Figure 25—Fuel Filter

2. Remove throttle body by removing throttle body attaching screws.

3. Remove throttle body to float bowl insulator gasket.

THROTTLE BODY DISASSEMBLY

1. Remove pump rod from throttle lever.

2. DO NOT REMOVE idle mixture limiter caps, unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the idle mixture needles are removed, adjustment procedures are covered later in this section under "Idle Mixture Adjustment".

If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been re-adjusted.

CARBURETOR CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *Any rubber parts, plastic parts, diaphragms and pump plungers should not be put in immersion type cleaner as these components will swell, harden or distort.*

The plastic cam on the air valve shaft (where used) and bushing in float bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.
2. Check, repair or replace parts if the following problems are encountered.

a. FLOODING

1. Inspect float needle for dirt, deep wear grooves, scores from proper seating.
2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. HESITATION

1. Inspect pump plunger for cracks, scores or excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours, before testing if dried out.
2. Inspect pump duration and return spring for being weak or distorted.
3. Check all pump passages and jets for dirt, improper sealing inlet and discharge balls, scores in pump well.
4. Check pump linkage for excessive wear, repair or replace as necessary.

c. HARD STARTING—POOR COLD OPERATION

1. Inspect float needle for sticking, dirt, etc.
2. Examine fast idle cam for wear or damage.
3. Also check items under "FLOODING".

d. POOR PERFORMANCE—POOR GAS MILEAGE

1. Power piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.
2. Check air valve for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in the kit.
3. Clean all fuel and vacuum passages in castings.

e. ROUGH IDLE

1. Inspect idle needle for ridges, burrs or being bent.
2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks or burrs.
3. Check all idle fuel passages.
4. Check throttle levers and valves for binds.

CARBURETOR ASSEMBLY

THROTTLE BODY ASSEMBLY

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles four turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under idle mixture adjustment.
2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point toward throttle lever.

FLOAT BOWL ASSEMBLY

1. Install new throttle body to bowl gasket over two locating dowels on bowl.
2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely.
3. Place carburetor on proper holding fixture.
4. Install fuel inlet filter spring, filter assembly, new gasket and inlet nut and tighten nut (18 ft. lbs.).

NOTE: Ribs on closed end of filter element prevent filter from being incorrectly installed unless forced.

CAUTION: *Tightening beyond specified torque can damage nylon filter gasket.*

CHOKE HOUSING TO FLOAT BOWL ASSEMBLY

1. Install new cup seal into plastic insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.
2. Install secondary throttle valve lock-out lever on boss on float bowl with recess in hole in lever facing inward (figure 26).
3. Install new cup seal into inside choke housing shaft hole. Lips on seal face inward, toward inside of housing.
4. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward).
5. Carefully install fast idle cam and intermediate choke shaft assembly through seal in choke housing, then install thermostatic coil lever onto flats on intermediate choke shaft.

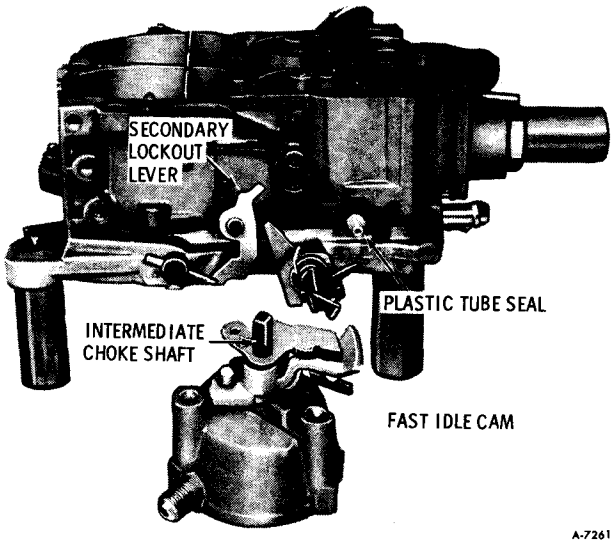


Figure 26—Secondary Lockout Lever

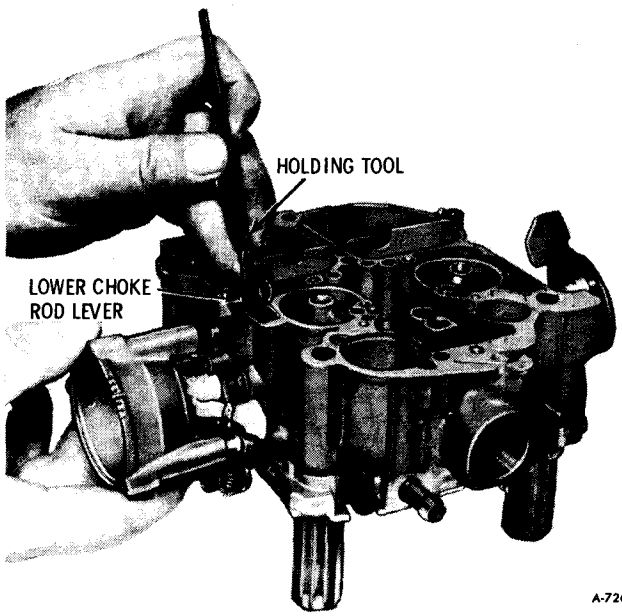


Figure 27—Installing Choke Lever and Housing

Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face toward fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

6. Install lower choke rod inner lever into cavity in float bowl. Install plastic tube seal into cavity on choke housing before assembling choke housing to bowl. Install choke housing to bowl, sliding intermediate choke shaft into lower choke inner lever (figure 27).

NOTE: Tool J-23417 can be used to hold the lower choke lever in position while installing the choke housing.

NOTE: The intermediate choke shaft lever and fast idle cam are in correct position when the tang on lever is beneath the fast idle cam. Do not install choke cover and coil assembly until inside coil lever is adjusted. See carburetor adjustments at the end of this section.

COMPLETION OF FLOAT BOWL ASSEMBLY

1. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be even with bowl casting.

2. Install baffle inside of pump well with slot toward bottom.

3. Install pump discharge check ball and retainer in passage next to pump well (figure 28). Tighten retainer securely.

4. Install primary main metering jets, if removed (figure 28).

5. Install aneroid cavity insert into float bowl.

6. Install new needle seat assembly, with gasket, using seat installer J-22769.

7. To make float adjustment easier, carefully bend float arm upward at notch in arm before assembly. Install needle by sliding float lever under needle pull clip — correct installation of the needle pull clip is to hook the clip over the edge of the float on the float arm facing the float pontoon (figure 29). With float lever in pull clip, hold float assembly at toe and install retaining pin from aneroid cavity side (ends of retaining pin face the accelerating pump well).

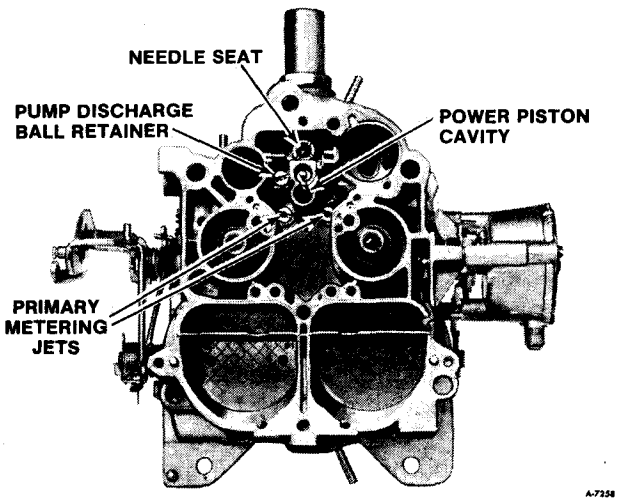


Figure 28—Primary Metering Jets

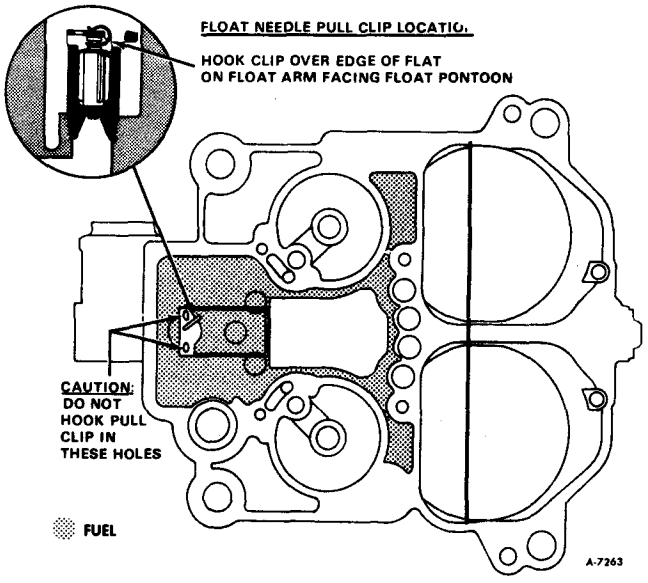


Figure 29—Float Needle Pull Clip Location

CAUTION: *Do not install float needle pull clip into holes in float arm.*

FLOAT LEVEL ADJUSTMENT
(FIGURES 37 AND 42)

1. Hold float retainer firmly in place.
2. Push float down lightly against needle.
3. With adjustable T-scale, gauge from top of float bowl casting (air horn gasket removed) to top of float at toe-gauging point 3/16" back from toe (see insert, figures 37 and 42).
4. Bend float arm as necessary for proper adjustment by pushing on pontoon (see figures 33 and 40 for specification).
5. Visually check float alignment after adjustment.
6. Install plastic filler block over float needle, pressing downward until properly seated.
7. Install primary power piston spring in power piston well.

If primary metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod (figure 30). Install power piston assembly in well (aligning pin on piston with slot in well) with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

8. Install pump return spring in pump well.
9. Install air horn gasket by carefully sliding tab of gasket around primary metering rods and beneath the primary power piston hanger.

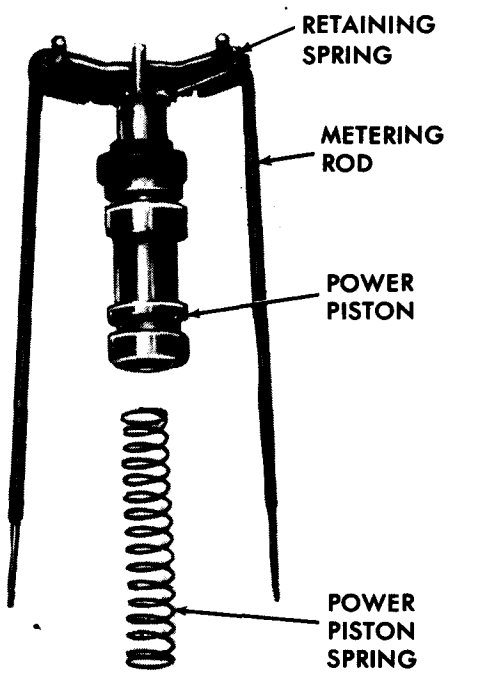


Figure 30—Power Piston and Metering Rods

Position gasket over the two dowel pins on the float bowl.

10. Carefully lift corner of the air horn gasket and install pump plunger in the pump well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket.

AIR HORN ASSEMBLY

If removed, install choke shaft, choke valve and two attaching screws. Tighten screws securely and stake lightly in place.

NOTE: Check choke valve for freedom of movement and proper alignment before staking screws in place.

AIR HORN TO BOWL INSTALLATION

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, accelerating well tubes, pull-over enrichment tubes (if used) and pump plunger stem are positioned properly through the holes in the air horn gasket.

CAUTION: *Do not force the air horn assembly onto the bowl but rather lightly lower in place.*

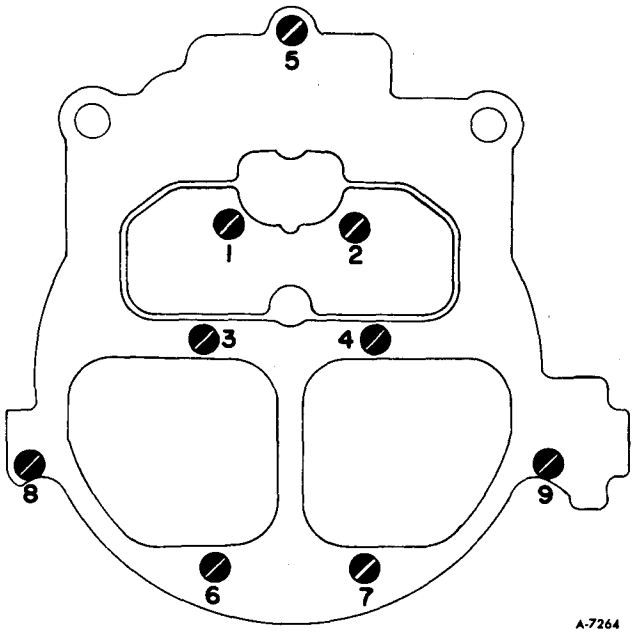


Figure 31—Air Horn Screw Tightening Sequence

2. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area (figure 31).

NOTE: Install secondary air baffle beneath screws No. 3 and 4 (figure 31). All air horn screws must be tightened evenly and securely.

3. Install vacuum break diaphragm rod into the slot in lever on the end of the air valve shaft. Then install the other end of rod into hole in the front vacuum break diaphragm plunger. Install front vacuum break diaphragm and bracket assembly to air horn using two retaining screws through the bracket. Tighten screws securely (figure 32).

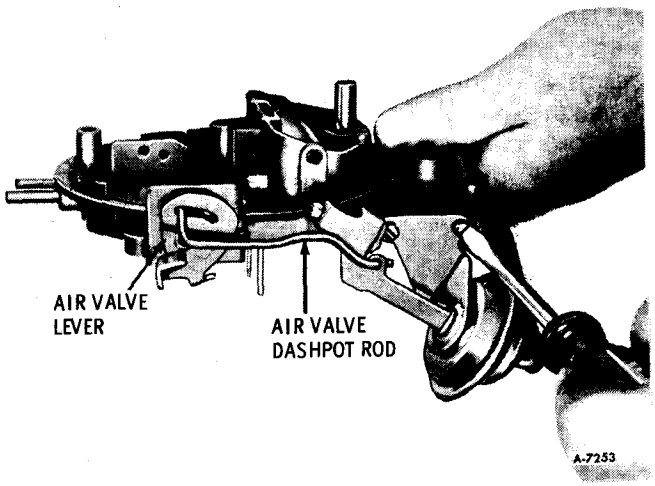


Figure 32—Installing Front Vacuum Break

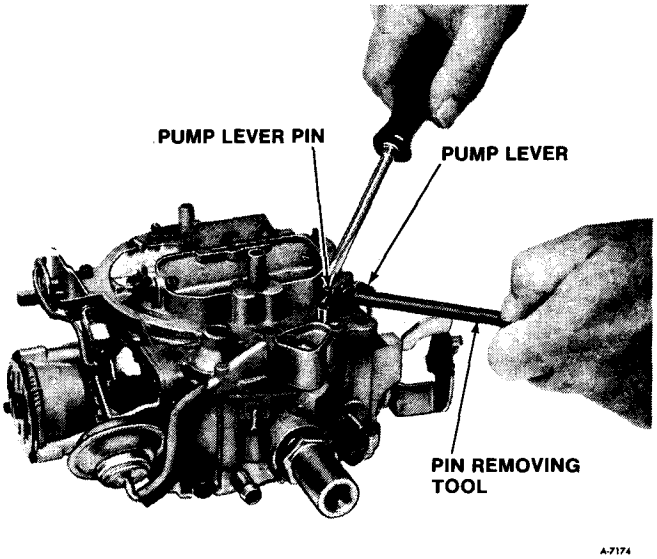


Figure 33—Installing Pump Lever

NOTE: Do not attach vacuum break hose until vacuum break adjustments are completed. See carburetor adjustments later in this section.

4. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever, noted at disassembly. Align hole in pump lever with hole in air horn casting. Using screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn (figure 33).

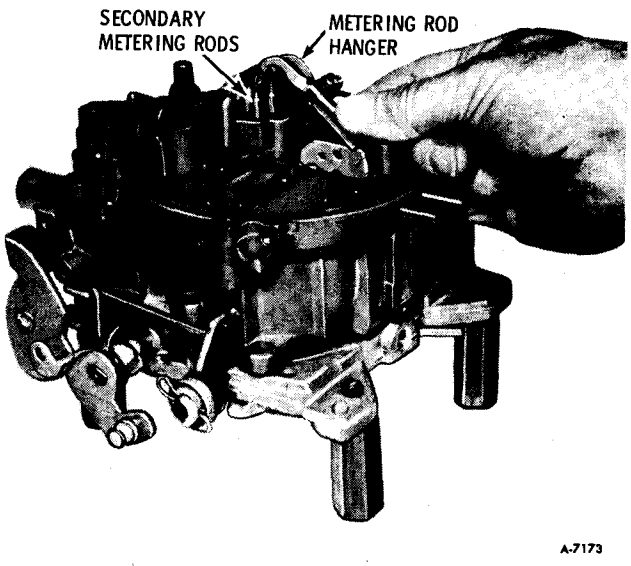


Figure 34—Installing Secondary Metering Rods

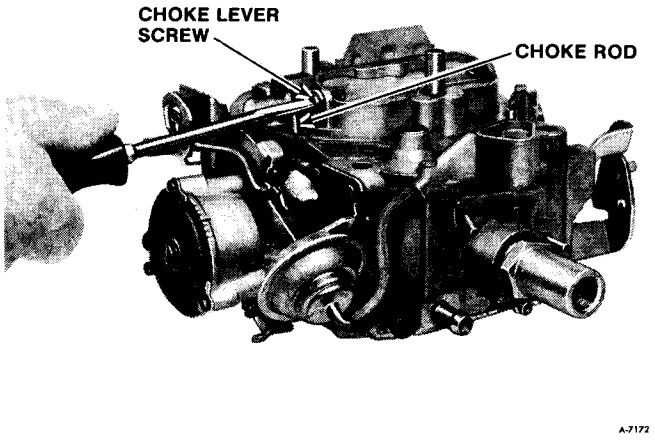


Figure 35—Installing Choke Lever

CAUTION: *Use care installing the small roll pin to prevent damage to pump lever casting bosses.*

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw and tighten securely. Work air valves up and down several times to make sure they are free in all positions (figure 34).

6. Connect choke rod into lower choke lever inside bowl cavity; then install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching screw (figure 35). Tighten screw securely.

NOTE: Make sure the flats on the end of the choke shaft align with flats in the choke lever.

NOTE: The front vacuum break and fast idle cam must be adjusted. Then, the thermostatic coil lever inside the choke housing has to be indexed properly before installing the choke thermostatic coil and cover assembly and gasket. Refer to Carburetor Adjustments, later in this section.

7. After the vacuum break, fast idle cam, and inside thermostatic coil lever are adjusted, the thermostatic coil and cover assembly and gasket should be installed and the cover assembly rotated until the choke valve just closes. At this point, the index cover should be adjusted. See Carburetor Adjustments, later in this section. Install three choke cover retainers and screws and tighten securely. Torque the choke pipe nut to 95 in. lbs.

IDLE SETTING PROCEDURE (ON-VEHICLE)

Adjustment must be made with test equipment known to be accurate. Refer to Emission Control Information Label (located on engine valve cover).

1. Adjustments must be made with engine at normal operating temperature, choke open, and air conditioning off. Remove air cleaner and disconnect air cleaner vacuum hose at carburetor Port "N". Plug port "N".
2. Set parking brake and block drive wheels.
3. At carburetor, disconnect vacuum hoses to TVS switch (Port "B" and "H"). Also disconnect hose to carbon canister (Port "K"). Plug these ports at carburetor.
4. Set timing to specification.
5. Adjust idle speed screw to 600 rpm (In DRIVE "D").
6. With throttle lever held against idle speed screw, adjust stem of throttle lever actuator to provide 0.020" clearance between the actuator stem and throttle lever.
7. Adjust fast idle as follows: Place cam follower on low step of fast idle cam against the shoulder of next higher step. Adjust fast idle screw to 900 rpm (In "PARK").
8. Remove plugs from carburetor vacuum ports. Connect the previously disconnected vacuum hoses.
9. Install air cleaner and connect air cleaner vacuum hose.

IDLE MIXTURE ADJUSTMENT

Idle mixture screws are preset and capped at the factory.

Before suspecting the carburetor to be the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, PCV system and compression. Also, check vacuum hoses for leaks.

In the case of major carburetor overhaul, throttle body replacement, or when poor idle quality exists, idle mixture may be adjusted. To properly set idle mixture to achieve the smoothest idle while maintaining emission levels within the standards prescribed by Federal and State laws, the following procedures MUST be followed:

1. With engine at normal operating temperature, choke open, air conditioning off, remove air cleaner and disconnect air cleaner vacuum hose at carburetor Port "N". Plug Port "N".
2. Set parking brake and block drive wheels.

CARB NO.	GAUGE
17057254 17057559 17058254 17058559	15/32"

(1) WITH ENGINE RUNNING AT IDLE, CHOKE WIDE-OPEN, CAREFULLY INSERT GAUGE IN VENT SLOT OR VENT HOLE (NEXT TO AIR CLEANER MOUNTING STUD) IN AIR HORN. RELEASE GAUGE AND ALLOW IT TO FLOAT FREELY.

CAUTION: DO NOT PRESS DOWN ON GAUGE TO CAUSE FLOODING OR DAMAGE TO FLOAT.

(2) READING AT EYE LEVEL, OBSERVE MARK ON GAUGE THAT LINES UP WITH TOP OF CASTING AT THE VENT SLOT OR VENT HOLE. SETTING SHOULD BE WITHIN ±1/16" FROM SPECIFIED FLOAT LEVEL SETTING.

REMOVE FLOAT GAUGE FROM AIR HORN.

(3) IF THE MECHANICAL SETTING (STEP 2) VARIES OVER ±1/16" FROM SPECIFICATIONS, REMOVE AIR HORN AND ADJUST FLOAT LEVEL TO SPECIFICATIONS FOLLOWING NORMAL ADJUSTMENT PROCEDURES.

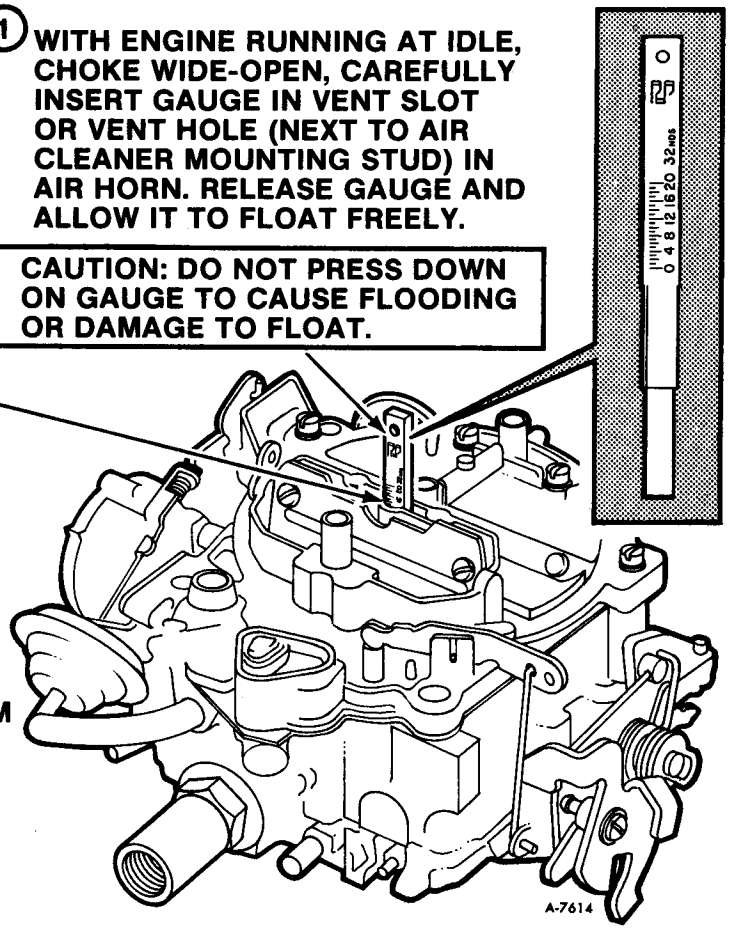


Figure 36—Float Gauge - External Checking Procedure

3. At carburetor, disconnect vacuum hoses to TVS switch (Port "B" and "H"). Also disconnect hose to carbon canister (Port "K"). Plug these ports at carburetor.

4. Connect an accurate vacuum gauge to the intake manifold. Also connect an ACCURATE tachometer to the engine.

5. Carefully remove caps from idle mixture screws. Be careful not to bend screws.

6. Lightly seat screws, then EQUALLY richen (back out screws 4 full turns).

7. Start engine and adjust idle speed screw to obtain 650 rpm (in DRIVE "D").

8. Adjust mixture screws EQUALLY to obtain maximum rpm.

9. With transmission in DRIVE "D", adjust idle speed screw to obtain 650 rpm. Note manifold vacuum reading.

10. EQUALLY lean (turn in) mixture screws until the idle speed is 600 rpm. Manifold vacuum reading should not be reduced by more than 2 inches of mercury from reading obtained in Step 9. If reading is reduced more than 2 inches, repeat steps 6-10.

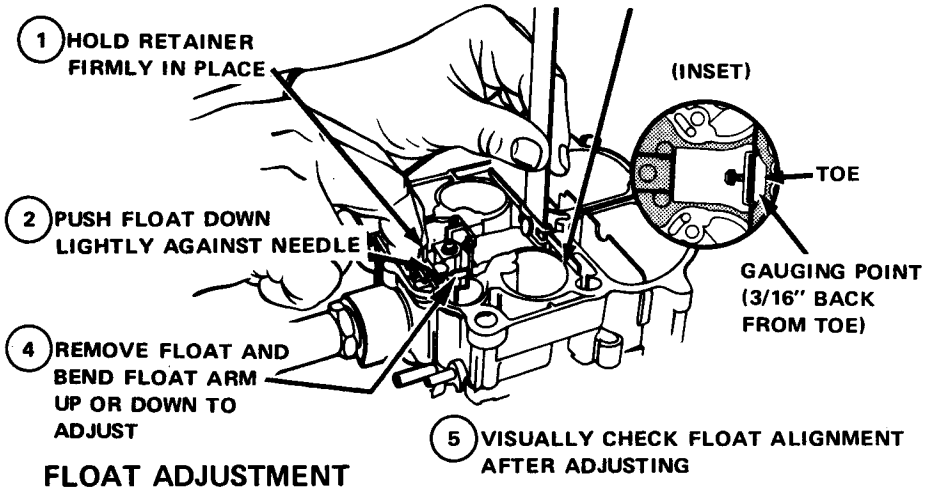
11. Remove plugs from carburetor vacuum ports. Connect the previously disconnected vacuum hoses.

12. Install air cleaner and connect air cleaner vacuum hose.

CARBURETOR ADJUSTMENTS

On 1978 and past model carburetors (except those using a screen over the vent slot in the air horn), it is now possible to externally check the float level using a new float gauge J-9789-130 (figure 36). This gauge is designed to quickly and accurately measure externally the float level on carburetors to eliminate the need to remove the carburetor air horn to check float level. Using this gauge, the float level may be checked "on-the-vehicle".

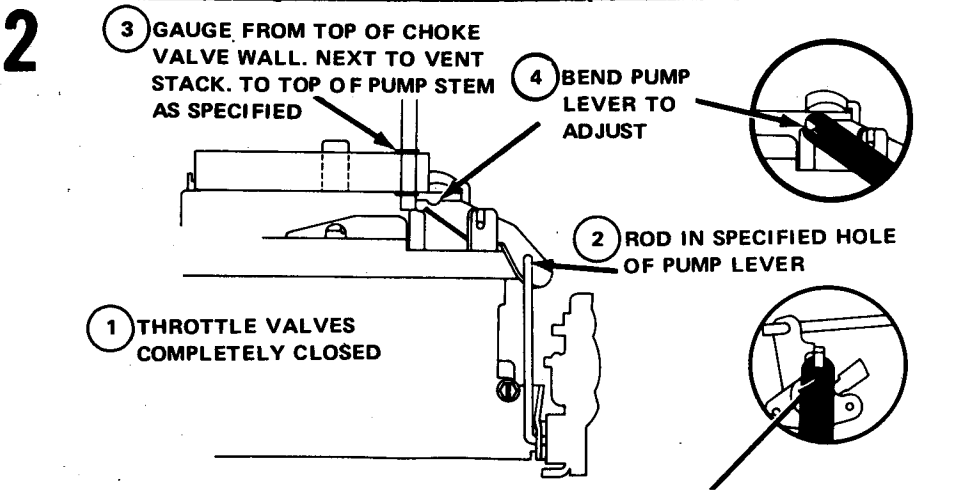
1



FLOAT ADJUSTMENT

CARB. NO.	GAUGE	
17057254 17057559	15/32"	

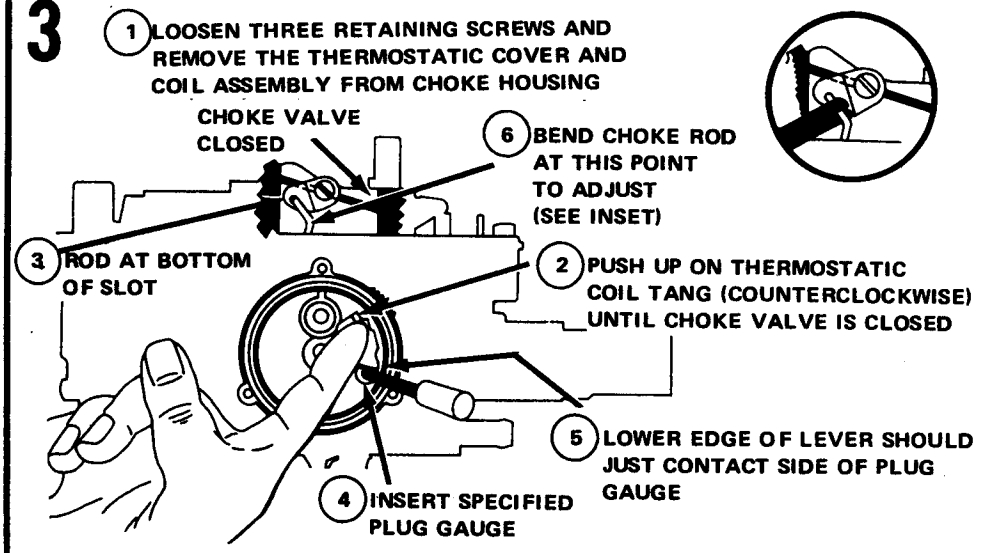
2



PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC.
17057254 17057559	9/32"	Inner

3



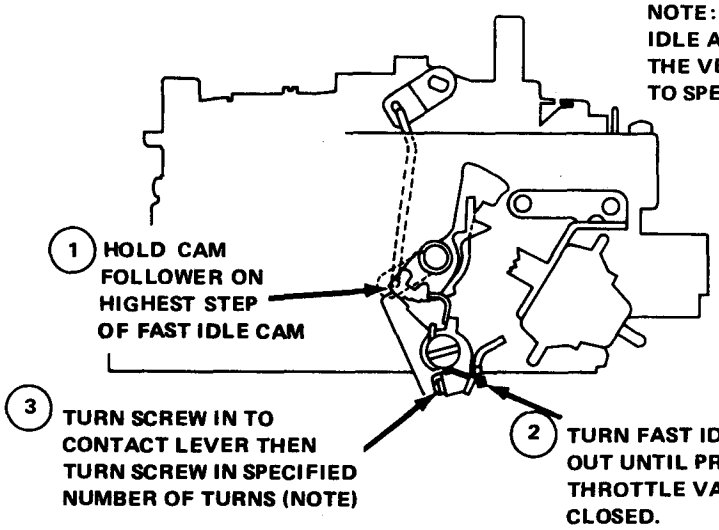
CHOKE COIL LEVER ADJUSTMENT

A-7265

CARB. NO.	PLUG GAUGE	
17057254 17057559	.120"	

Figure 37—1977 Carburetor Adjustments

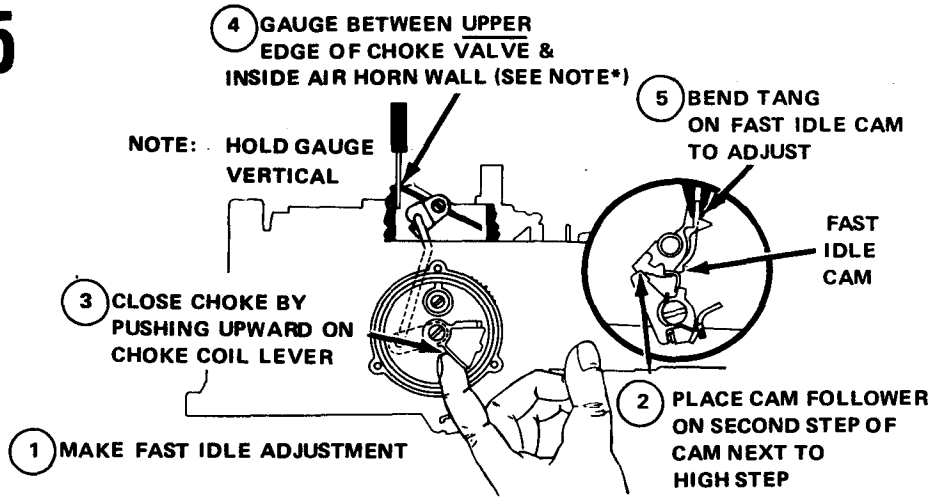
4



FAST IDLE ADJUSTMENT (BENCH SETTING)

CARB. NO.	NO. TURNS
17057254 17057559	3

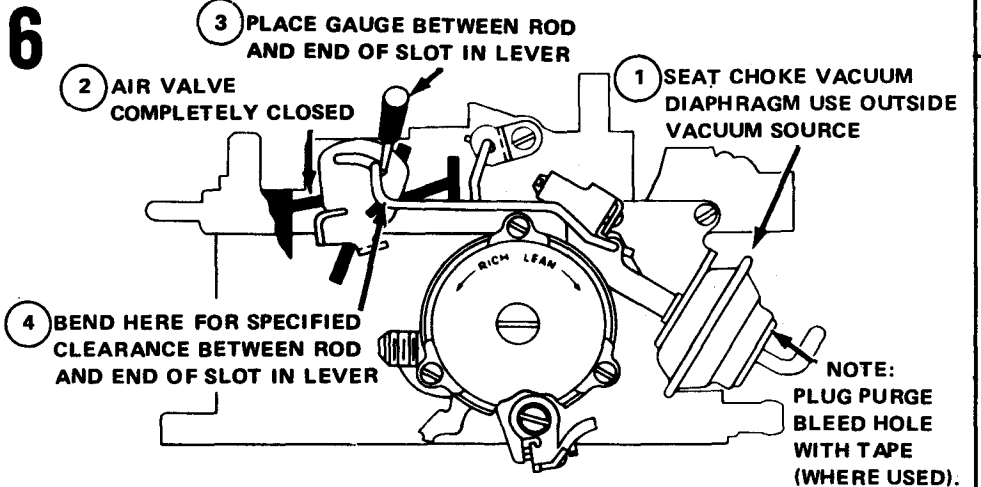
5



CHOKE ROD (FAST IDLE CAM) ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057254 17057559	.100"

6



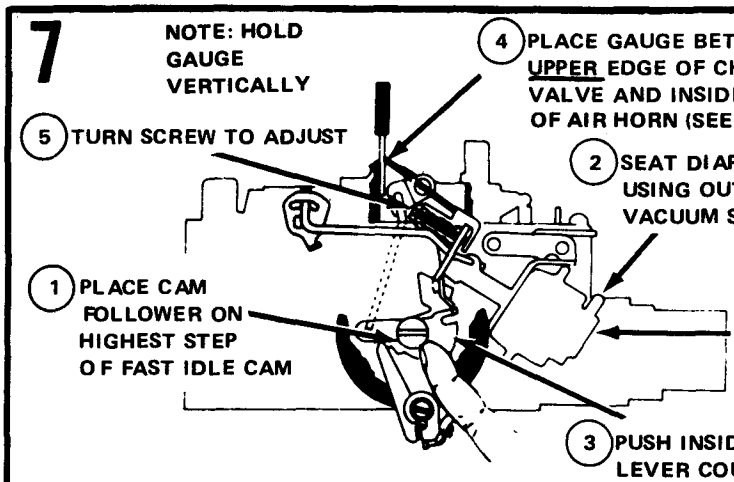
AIR VALVE ROD ADJUSTMENT

A-7266

CARB. NO.	PLUG GAUGE
17057254 17057559	.030"

Figure 38—1977 Carburetor Adjustments

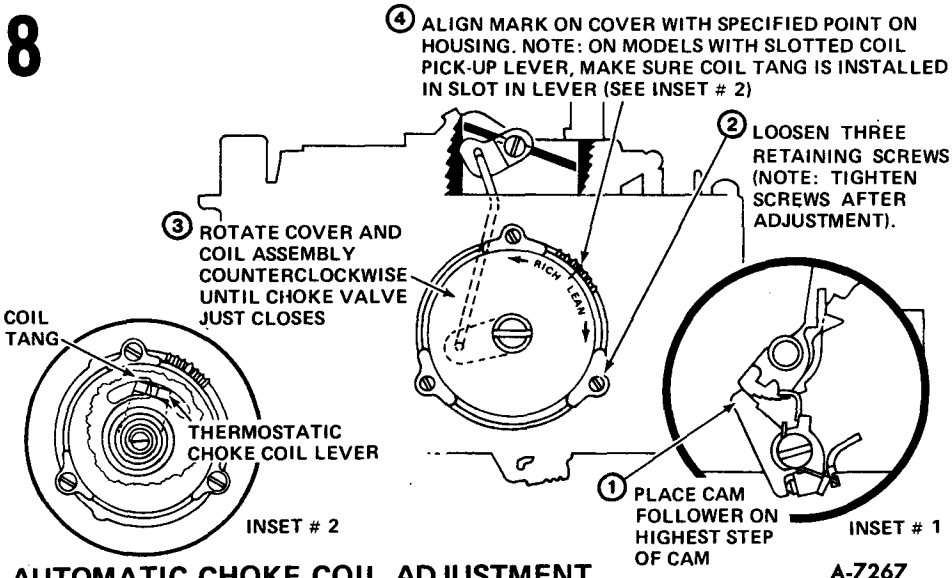
7



FRONT VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057254	.135"
17057559	.140"

8

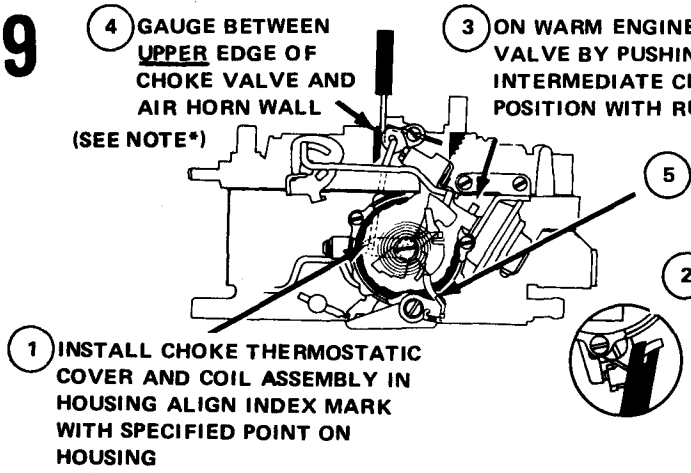


AUTOMATIC CHOKE COIL ADJUSTMENT

CARB. NO.	INDEX MARK
17057254	3NR
17057559	

Figure 39—1977 Carburetor Adjustments

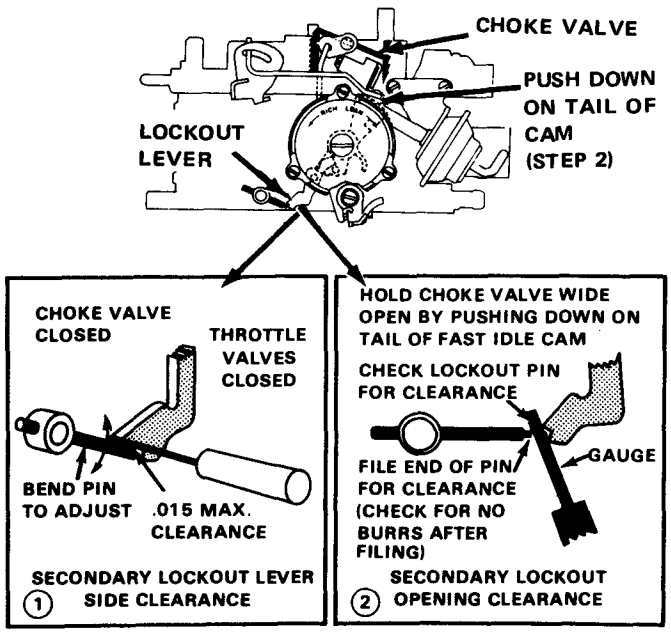
9



UNLOADER ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057254	.220"
17057559	.230"

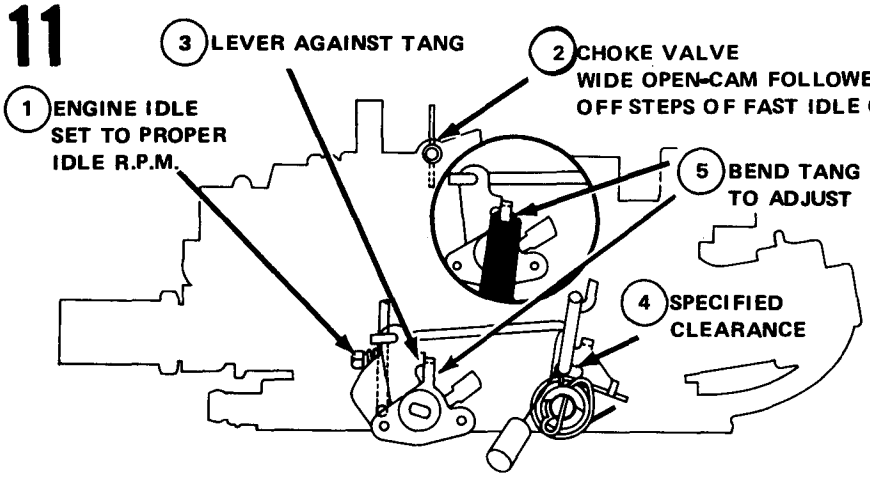
10



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057254	.015"
17057559	

11



SECONDARY CLOSING ADJUSTMENT

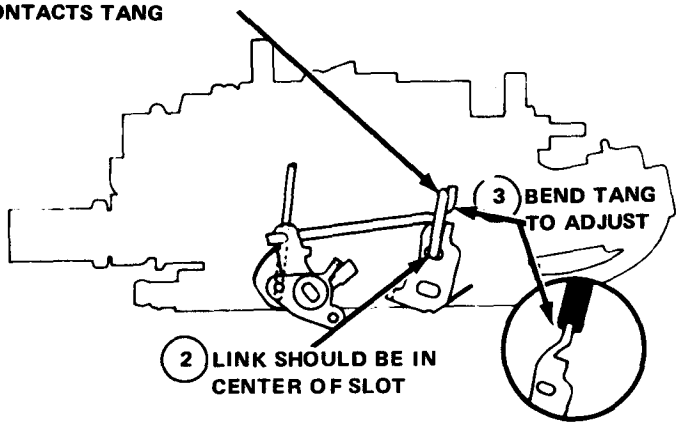
A-7268

CARB. NO.	PLUG GAUGE
17057254	.020"
17057559	

Figure 40—1977 Carburetor Adjustments

12

1. OPEN PRIMARY THROTTLE UNTIL ACTUATING LINK CONTACTS TANG
2. LINK SHOULD BE IN CENTER OF SLOT
3. BEND TANG TO ADJUST

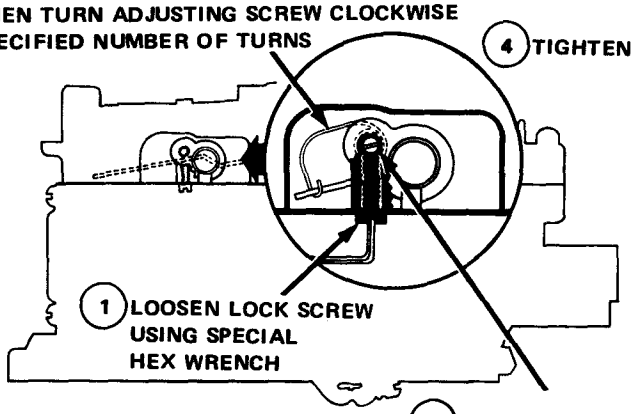


(See Figure)

SECONDARY OPENING ADJUSTMENT

13

3. TURN TENSION ADJUSTING SCREW CLOCKWISE UNTIL AIR VALVE JUST CLOSES. THEN TURN ADJUSTING SCREW CLOCKWISE SPECIFIED NUMBER OF TURNS
4. TIGHTEN LOCK SCREW
1. LOOSEN LOCK SCREW USING SPECIAL HEX WRENCH
2. TURN TENSION ADJUSTING SCREW COUNTERCLOCKWISE UNTIL AIR VALVE OPENS PART WAY

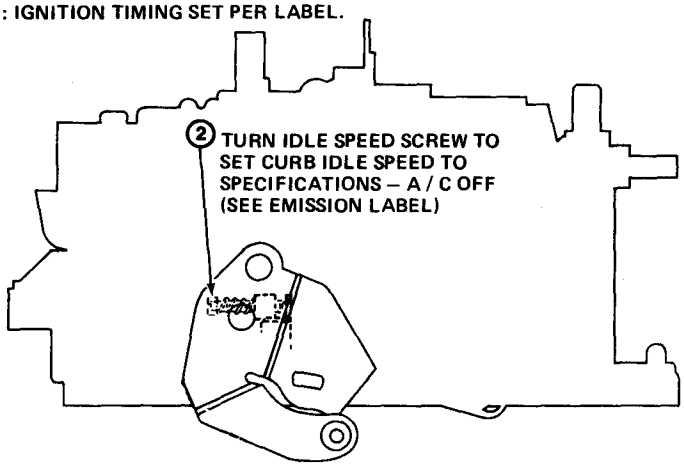


CARB. NO.	NO TURNS
17057254	½
17057559	

AIR VALVE SPRING ADJUSTMENT

14

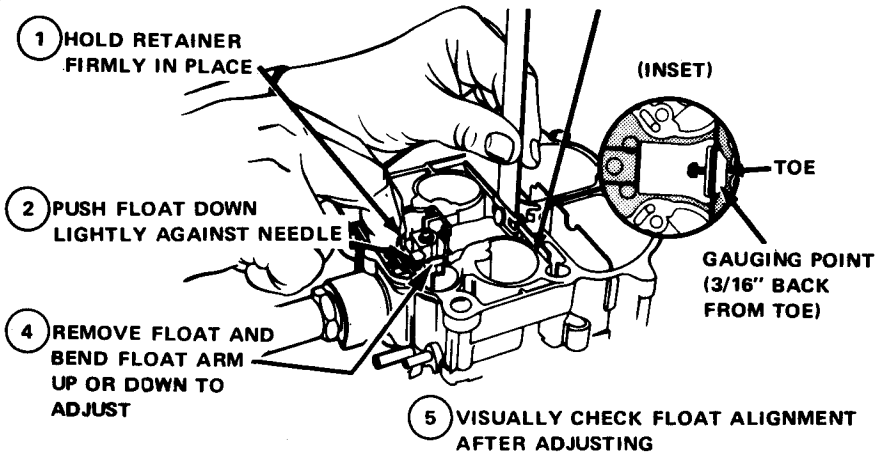
1. PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL.
2. TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS – A / C OFF (SEE EMISSION LABEL)



IDLE SPEED ADJUSTMENT A-7269

Figure 41—1977 Carburetor Adjustments

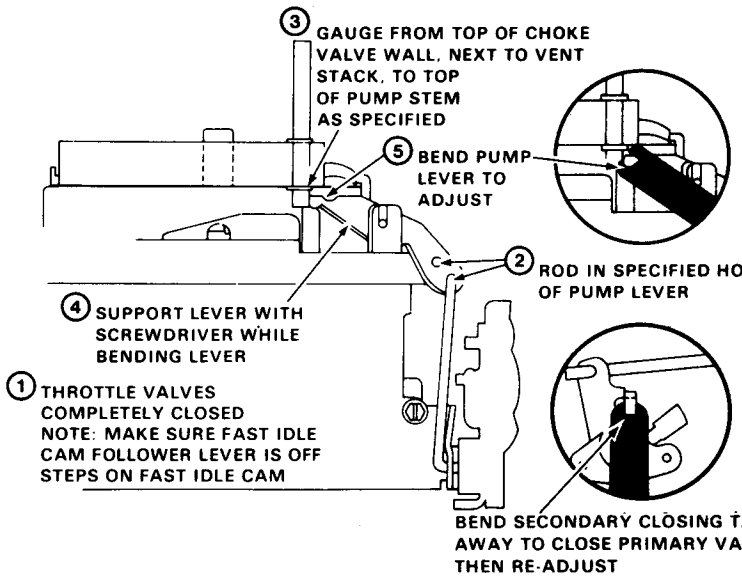
1



FLOAT LEVEL ADJUSTMENT

CARB. NO.	GAUGE	
17058254 17058559	15/32"	

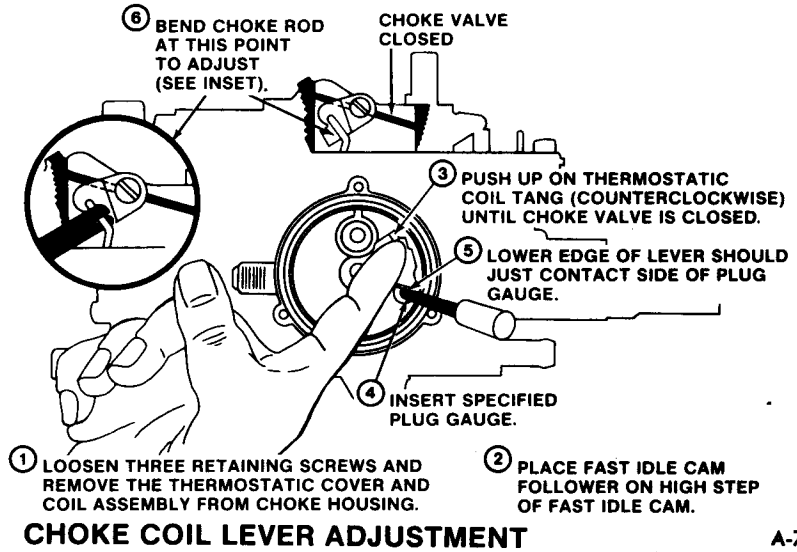
2



PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC
17058254 17058559	9/32"	Inner

3

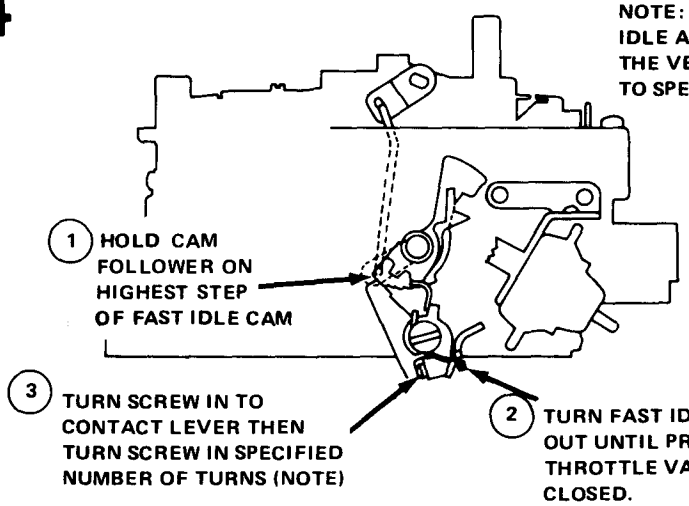


CHOKE COIL LEVER ADJUSTMENT A-7615

CARB. NO.	PLUG GAUGE	
17058254 17058559	.120"	

Figure 42—1978 Carburetor Adjustments

4



FAST IDLE ADJUSTMENT (BENCH SETTING)

CARB. NO.	NO. TURNS
17058254 17058559	3

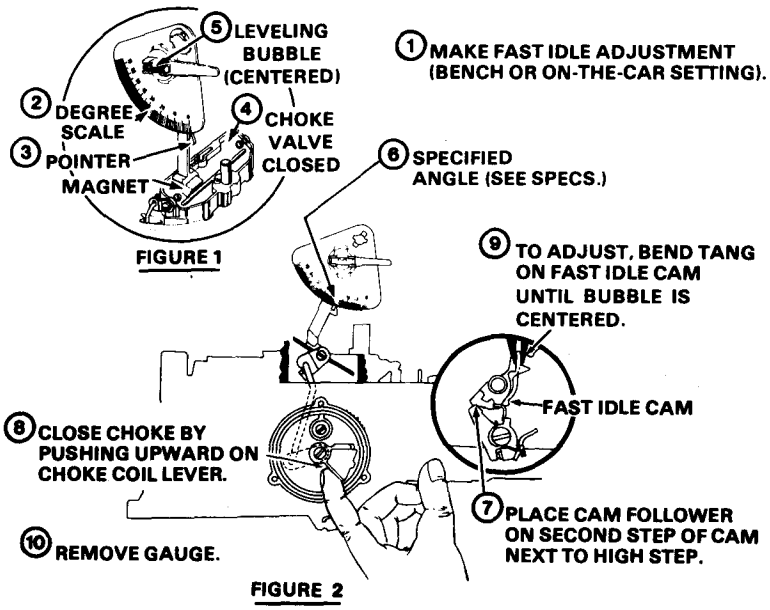
5

FIGURE 1

1. MAKE FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING).
2. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
3. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
4. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
5. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

6. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
7. PLACE CAM FOLLOWER ON SECOND STEP OF CAM NEXT TO HIGH STEP.
8. CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER.
9. TO ADJUST, BEND TANG ON FAST IDLE CAM UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE.

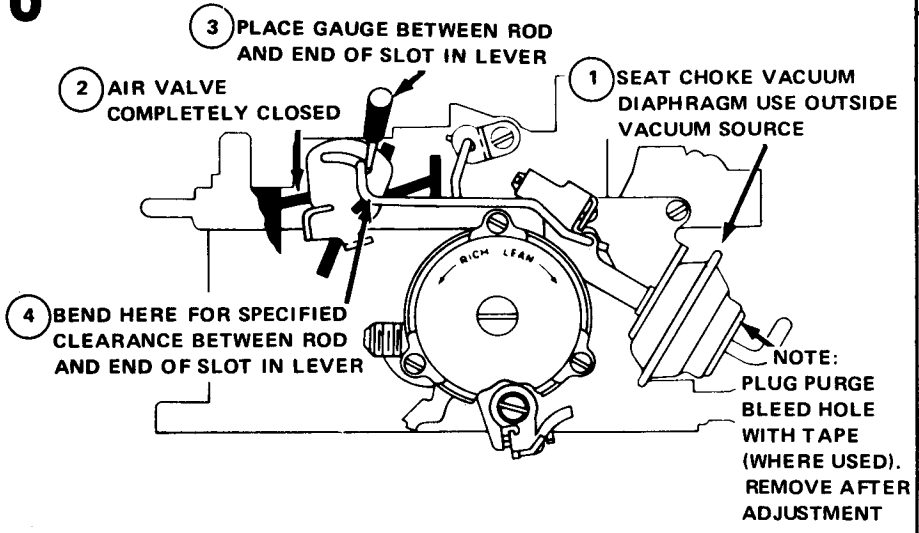


CHOKE ROD (FAST IDLE CAM) ADJUSTMENT - ANGLE GAUGE METHOD A-7616

CARB. NO.	ANGLE GAUGE	PLUG GAUGE
17058254 17058559	19°	.100"

Figure 43—1978 Carburetor Adjustments

6



AIR VALVE ROD ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17058254 17058559	.030"	

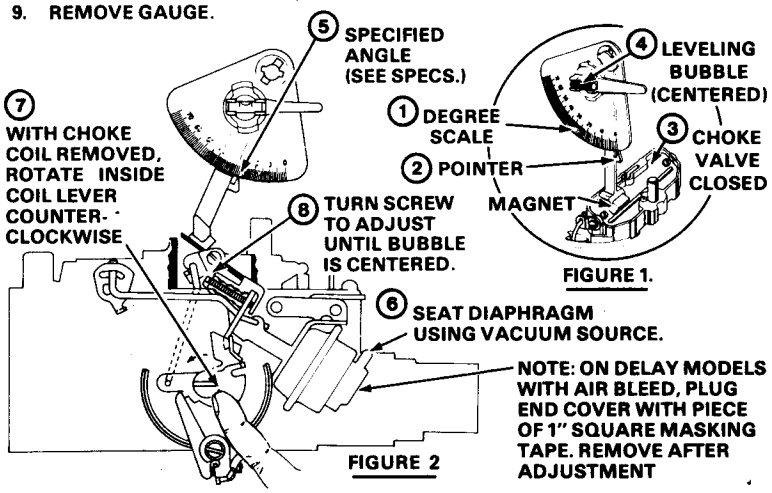
7

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUST MENT IS OPPOSITE POINTER.
6. SEAT CHOKE VACUUM DIAPHRAGM USING VACUUM SOURCE.
7. HOLD CHOKE VALVE TOWARDS CLOSED POSITION, PUSHING COUNTER-CLOCKWISE ON INSIDE COIL LEVER.
8. TO ADJUST, TURN SCREW IN OR OUT UNTIL BUBBLE IS CENTERED.
9. REMOVE GAUGE.



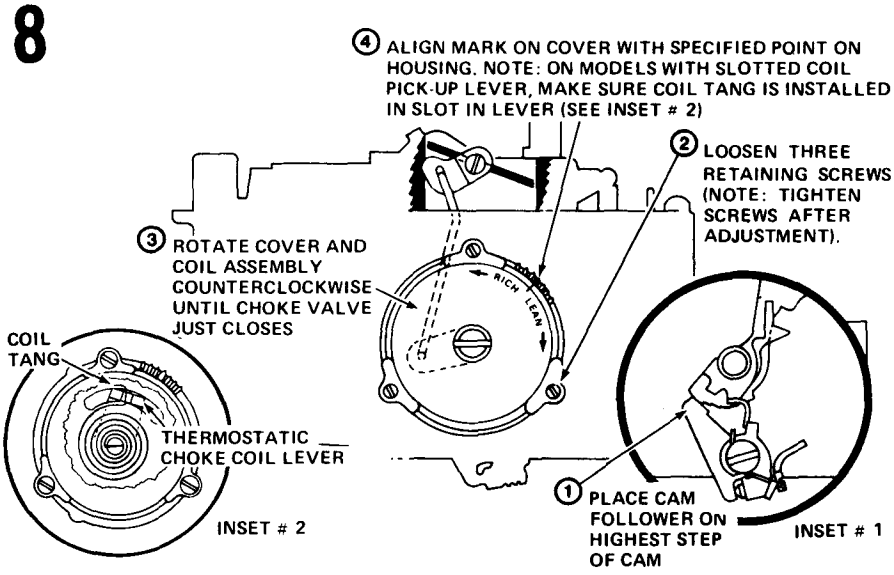
FRONT VACUUM BREAK ADJUSTMENT - ANGLE GAUGE METHOD

A-7617

CARB. NO.	ANGLE GAUGE	PLUG GAUGE
17058254 17058559	24°	.135"

Figure 44—1978 Carburetor Adjustments

8



AUTOMATIC CHOKE COIL ADJUSTMENT

CARB. NO.	INDEX MARK
17058254 17058559	3NR

9

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING. ALIGN INDEX MARK WITH SPECIFIED POINT ON HOUSING.
7. HOLD PRIMARY THROTTLE VALVES WIDE OPEN.
8. ON WARM ENGINE, CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).
9. TO ADJUST, BEND TANG ON FAST IDLE LEVER UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE.

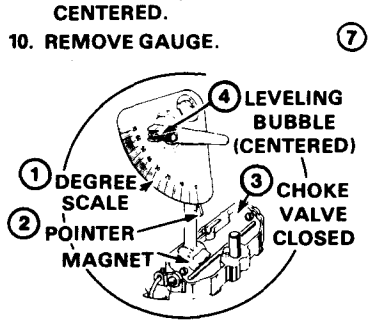
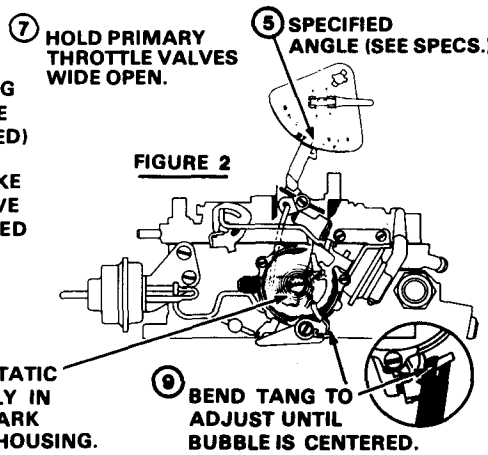


FIGURE 1



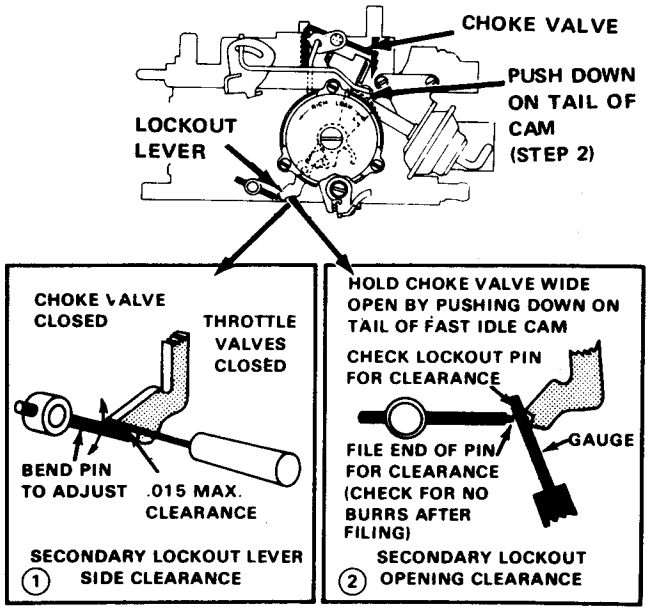
8 ON WARM ENGINE, CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).

UNLOADER ADJUSTMENT - ANGLE GAUGE METHOD A-7618

CARB. NO.	ANGLE GAUGE	PLUG GAUGE
17058254	35°	.220"
17058559	36.5°	.230"

Figure 45—1978 Carburetor Adjustments

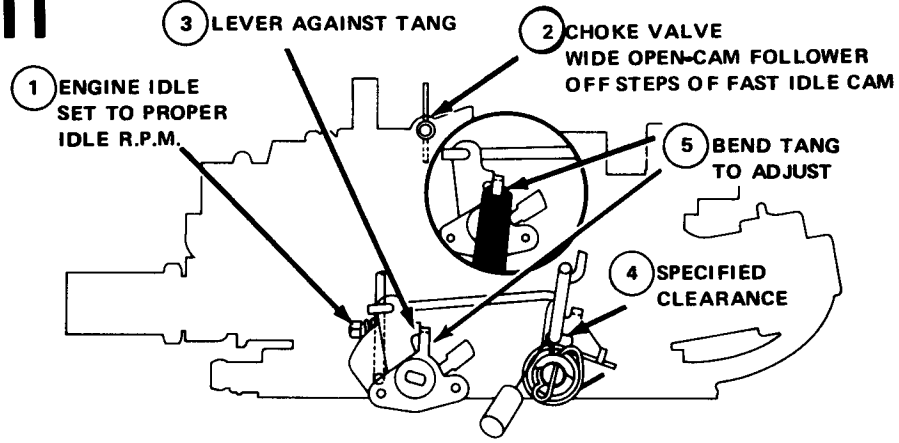
10



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17058254 17058559	.015"	

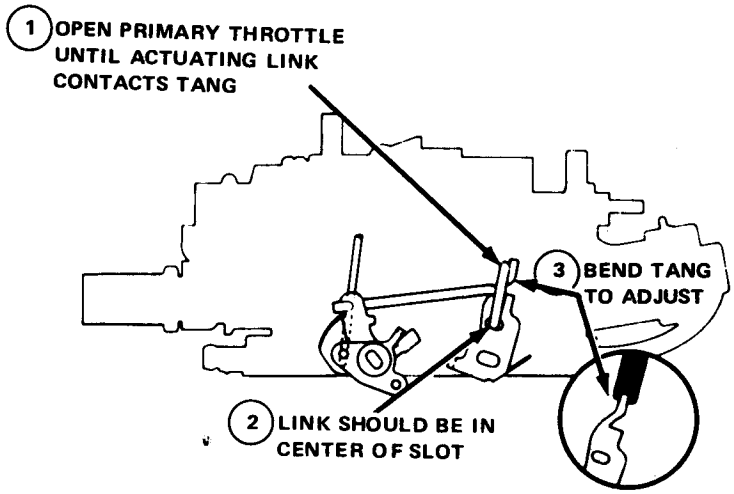
11



SECONDARY CLOSING ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17058254 17058559	.020"	

12



SECONDARY OPENING ADJUSTMENT A-7619

(SEE FIGURE)

Figure 46—1978 Carburetor Adjustments

	CARB. NO.	NO. TURNS	
13 ③ TURN TENSION ADJUSTING SCREW CLOCKWISE UNTIL AIR VALVE JUST CLOSES. THEN TURN ADJUSTING SCREW CLOCKWISE SPECIFIED NUMBER OF TURNS ④ TIGHTEN LOCK SCREW ① LOOSEN LOCK SCREW USING SPECIAL HEX WRENCH ② TURN TENSION ADJUSTING SCREW COUNTERCLOCKWISE UNTIL AIR VALVE OPENS PART WAY **AIR VALVE SPRING ADJUSTMENT**	17058254 17058559	½	
14 ① PREPARE VEHICLE FOR ADJUSTMENTS – SEE EMISSION LABEL ON VEHICLE. NOTE: IGNITION TIMING SET PER LABEL. ② TURN IDLE SPEED SCREW TO SET CURB IDLE SPEED TO SPECIFICATIONS – A / C OFF (SEE EMISSION LABEL) **IDLE SPEED ADJUSTMENT -** A-7620			

Figure 47—1978 Carburetor Adjustments

FUEL PUMP

FUEL FLOW TEST

The following revised test procedure is due to the addition of the HEI (High Energy Ignition) System:

1. Disconnect the wire from the "BAT" terminal of the HEI distributor.
2. Disconnect fuel line at the carburetor inlet fitting. Install a rubber hose approximately 8-10" long over the end of the fuel line.
3. Place a suitable container at end of the hose and crank engine a few revolutions.

NOTE: If little or no gasoline flows from open end of line then the fuel line is restricted, fuel tank screen restricted or the pump is inoperative. Correct as necessary.

4. Reconnect fuel line at the carburetor, tighten line fitting while holding fuel inlet nut.
5. Reconnect wire to the "BAT" terminal of the HEI distributor.
6. Start engine and check for leaks.

SPECIAL TOOLS

J-29789-118	Carburetor Holding Fixture
J-9789-130	Float Gauge
J-22769	Float Needle Seat Remover
J-23417	Choke Lever Installer
J-26701	Choke Angle Gauge

SECTION 6T

EMISSION CONTROL SYSTEMS

The information described in Maintenance Manual X-7525 under the heading EMISSION CONTROL SYSTEMS (SEC. 6T) is applicable to models covered by this supplement with the exception of the following:

NOTE: For emission control systems service information on the 1977 Certified 455 cubic inch engine refer to Maintenance Manual X-7525 (SEC. 6T). Procedures are the same as those described for the 1976 Certified engine.

NOTE: For intervals on servicing emission control components on the 403 cubic inch engine, refer to SECTION 0 of this supplement.

POSITIVE CRANKCASE VENTILATION (PCV)

PCV SYSTEM CHECKS

The following is a simplified PCV system checking procedure. The previously used CT-3 tester, is no longer required.

1. Remove PCV valve from engine.
2. Shake PCV valve. Listen for free movement of check needle in valve.
3. If valve does not rattle, replace valve.
4. Remove PCV valve from engine valve cover. Leave other end of valve attached to hose that is connected to carburetor at vacuum port "L". Start engine. Check for vacuum through valve by placing thumb over end of valve.
5. If no vacuum is felt, check for plugged hoses or valve. Hoses may be cleared with compressed air. If hoses are cracked or cut, replace them. The PCV valve must be replaced if plugged.

NOTE: If the PCV system is continually being plugged with deposits, the cause is generally the use of an incorrect PCV valve or excessive engine blow-by due to an engine malfunction (Refer to ENGINE (SEC. 6A) for additional assistance in diagnosing problem.)

THERMOSTATICALLY CONTROLLED AIR CLEANER

The thermostatically controlled air cleaner is standard equipment on engines covered by this manual. The unit consists of an air cleaner assembly which includes a temperature sensor, vacuum motor, control damper assembly and connecting vacuum hoses. The motor is controlled by the temperature sensor. The vacuum motor operates the air control damper assembly to control the flow of pre-heated and non pre-heated air into the carburetor. The pre-heated air is obtained from the hot air tube and shroud on the exhaust manifold.

PURPOSE

At underhood temperatures below 79°F 26°C) heated air is directed into the air cleaner. This system provides the most desriable emission control throughout the operating range of the engine and results in improved engine warm-up and eliminates tendency for ice to form in the carburetor.

OPERATION
(FIGURES 1, 2 & 3)

During engine warm-up with engine compartment temperatures below 79°F (26°C), the temperature sensor is closed. This allows engine vacuum to be directed to the vacuum motor closing the damper assembly to outside air. With the damper closed, the cool air will flow through the openings at the end of the shroud where it is heated. The heated air then flows up through the hot air pipe and adapter into the air cleaner. As the temperature inside the air cleaner reaches approximately 105°F (41°C), the sensor bleeds off vacuum to the vacuum motor causing the control damper

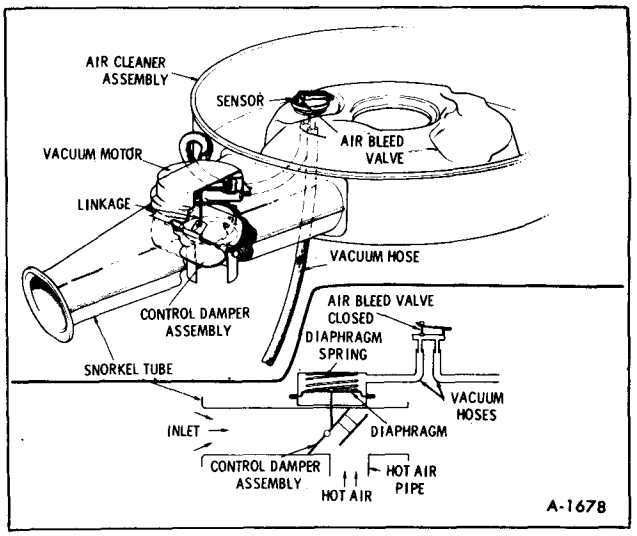


Figure 1—Hot Air Delivery Mode

to open allowing engine compartment air to be mixed with the heated air as needed to keep the air temperature approximately 105°F (41°C), if the ambient temperature is 105°F (41°C) or below.

Under full throttle or below 3" to 7" of Hg. vacuum, the vacuum motor will no longer hold the valve open to hot air. The hot air tube is closed off allowing only outside air to enter the air cleaner.

SYSTEM CHECKS

Inspect installation to make certain all vacuum hoses and the hot air flexible aluminum tube are properly connected. Check vacuum motor and damper assembly for proper operation. Checking procedure is given under "Diagnosis".

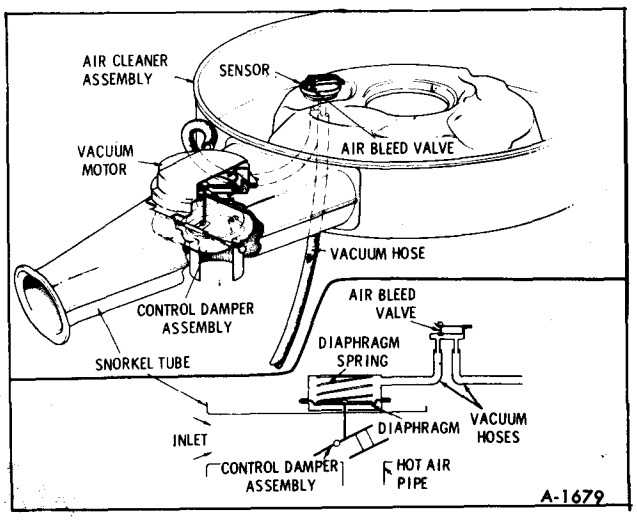


Figure 2—Regulating Mode

DIAGNOSIS

VACUUM MOTOR AND DAMPER ASSEMBLY

1. With the engine off, remove air cleaner cover and tape thermometer (J-5421) in air cleaner next to sensor (figure 4).

NOTE: If temperature is below 79°F (26°C) continue to Step 2. If temperature is above 79°F (26°C) remove air cleaner and allow to cool to at least 72°F (22°C).

2. Install a tee in vacuum line at vacuum motor and connect a vacuum gauge in line.
3. With engine off, the control damper should be open.
4. Install the cover on the air cleaner without the wing nut and start the engine.
5. With engine at idle speed, the control damper should be closed with the ambient temperature at 79°F (26°C) or below.
6. Using a small mirror observe the control damper snorkel. When it reaches the full open position (outside air), quickly remove cover on air cleaner and record reading on thermometer and vacuum gauge. Refer to "Specifications for Damper Operation" to determine if damper is operating properly.

SPECIFICATIONS FOR DAMPER OPERATION

Temperature

79°F (26°C) or lower, damper fully closed; 151°F (66°C) or higher, damper fully open.

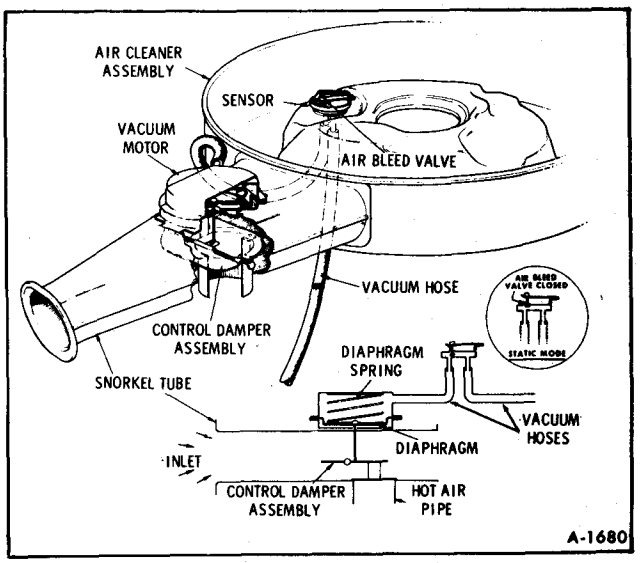


Figure 3—Cold Air Delivery Mode

Vacuum

3" of vacuum or lower, damper fully open. Below 79°F (26°C).

7" of vacuum or higher, damper fully closed. Below 79°F (26°C).

1. If temperature is within specifications, the thermostatically controlled air cleaner is functioning properly.
2. If temperature is out of specifications and vacuum is correct, replace sensor.
3. If both temperature and vacuum are within specifications and damper is not operating correctly, replace vacuum motor.
4. If both temperature and vacuum are not within specifications, it is an indication that the vacuum motor diaphragm is leaking.

COMPONENT REPLACEMENT

Refer to Maintenance Manual X-7525 (SEC. 6T) for component replacement procedures.

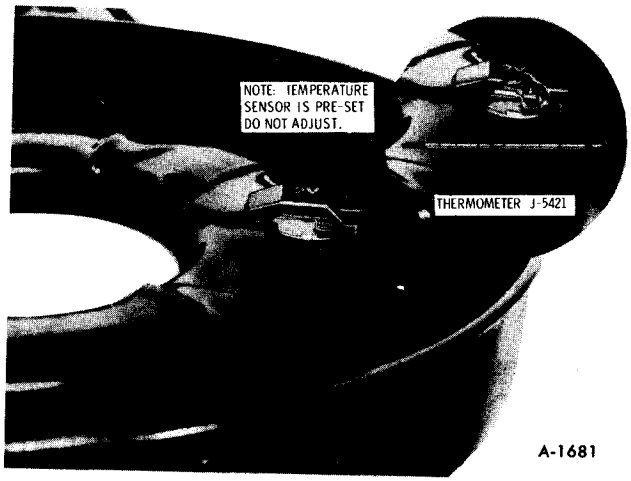


Figure 4—Checking Air Cleaner Sensor

ADDITIONAL EMISSION CONTROLS

Two additional emission control systems are found on the 1977 and 1978 Certified 403 engines. The systems are Thermal Vacuum Switch (TVS) and Throttle Return Control (TRC).

NOTE: Figure 5 is a schematic of the TVS and TRC system components and hose routing for all engines except California. Figure 6 is an emission control schematic of 1977 California engines.

CARBURETOR VACUUM PORTS

All vacuum ports on the carburetor have a identification letter located on the carburetor near each port opening. Following is a list of the port openings (by letter), and also what connects to that specific port:

NOTE: It is essential when performing any service work on the engine that all vacuum hoses be reconnected to the proper vacuum port.

AIR HORN

A—Vacuum Hose to Vacuum Break
M—Vent Tube for Float Bowl
F—Clean Air Hose to Choke Hot Air Pipe
G—Vent Hose to Vacuum Delay Valve

FLOAT BOWL

B—Hose to TVS Switch and Solenoid Valve (Full Manifold Vacuum)
H—Hose to TVS Switch (Ported Vacuum)
T—Hose to Carbon Canister (1978 California Carburetor, ONLY)

THROTTLE BODY

N—Hose to Air Cleaner
L—PCV Valve to Throttle Body
K—Carbon Canister Purge Hose

TVS SYSTEM

The Thermal Vacuum Switch (TVS) System is used on all 1977 and 1978 Certified 403 engines. The TVS function is to control spark timing at specified intervals during engine operation. Differences in components exist between California engines and all other states. These differences will be explained in the following:

TVS (ALL ENGINES EXCEPT CALIFORNIA) (FIGURE 5)

Description

The retarded spark setting at idle speeds required for effective emission control makes engines tend to run hotter during idle or low speed operation.

To protect against overheating, the engine is equipped with a thermal vacuum switch (TVS). The temperature sensitive switch is mounted in the engine cooling jacket near the right

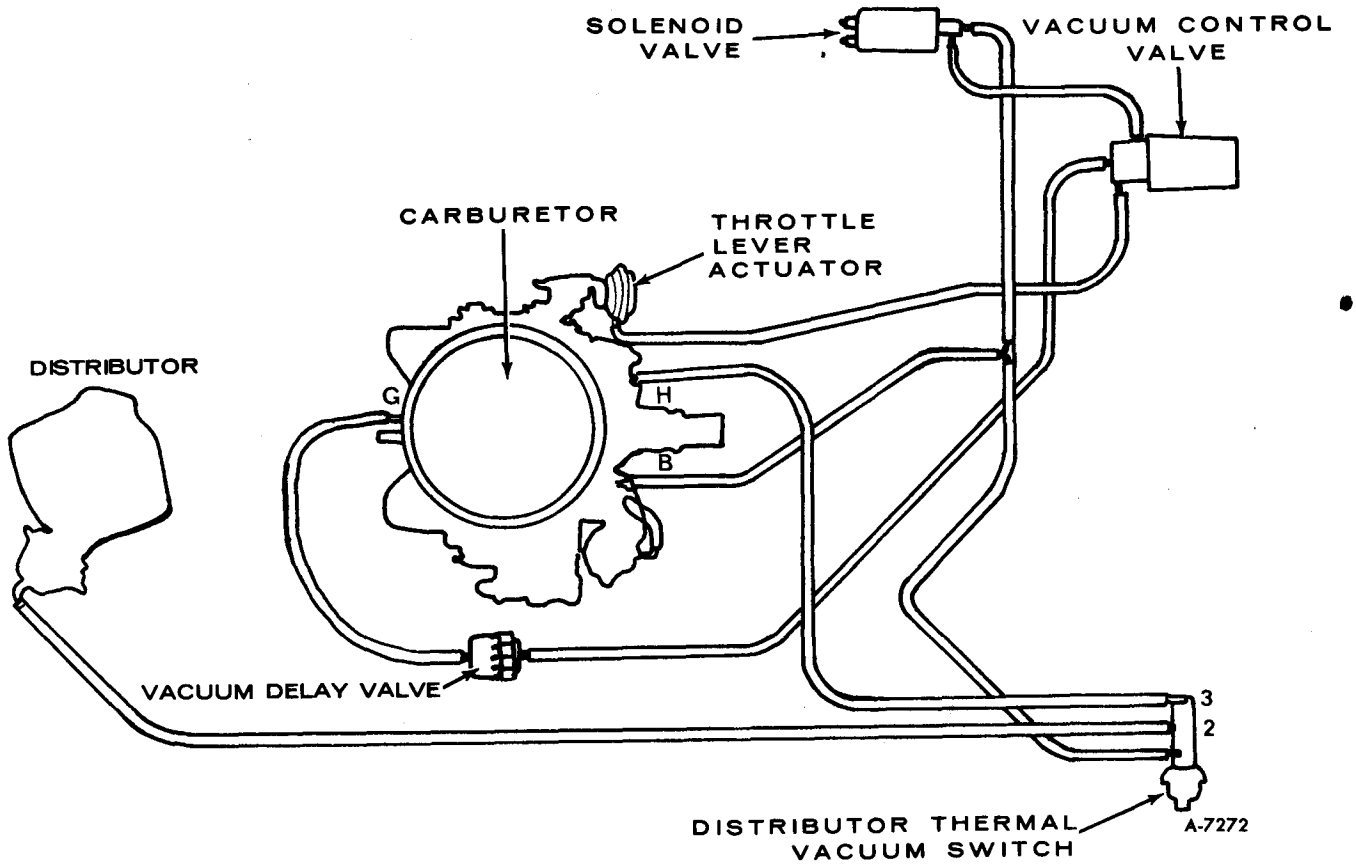


Figure 5—Emission Control Vacuum Hose Schematic (All Engines Except California)

front of the intake manifold. Vacuum control hoses are connected to the switch and to the distributor vacuum advance mechanism.

Operation

When the engine coolant reaches a temperature of 217-223°F (103-106°C) the valve inside the TVS switch changes position and directs manifold vacuum to the distributor advance mechanism. This advances the spark timing slightly and speeds up the engine. The result is less heat rejected to the coolant together with higher fan speed for better cooling action. This is the only time the distributor vacuum advance mechanism is advanced at idle speed.

When the engine has cooled down, below 210°F (99°C), the valve inside the TVS switch moves back to retard spark timing at idle speed.

TVS Switch Hose Routing

Port "3" (Top Port)	Hose to Ported Vacuum on Carburetor (Carburetor Port "H")
Port "2" (Middle Port)	Hose to Distributor Vacuum Advance Mechanism
Bottom Port	Hose to Manifold Vacuum on Carburetor (Carburetor Port "B") and Solenoid Valve

TVS Switch Functional Check

With engine off — coolant temperature below 210°F (99°C):

1. Disconnect hose and cap port "3" (top port).
2. Disconnect hose at port "2" (middle port). Connect a vacuum gauge to port "2".
3. Disconnect hose from bottom port. Connect an external vacuum source to bottom port (such as J-23738). Apply 17 inches Hg vacuum to the bottom port. If vacuum gauge at port "2" (middle port) reads greater than 5 inches Hg, replace the TVS switch.
4. Remove external vacuum source, vacuum gauge, and port cap. Reconnect vacuum hoses to proper port on switch (figure 5).

NOTE: The TVS switch must be installed with soft sealant on the threads.

5. Check all hoses for proper connection, cracking, abrasion or deterioration. Replace as necessary.

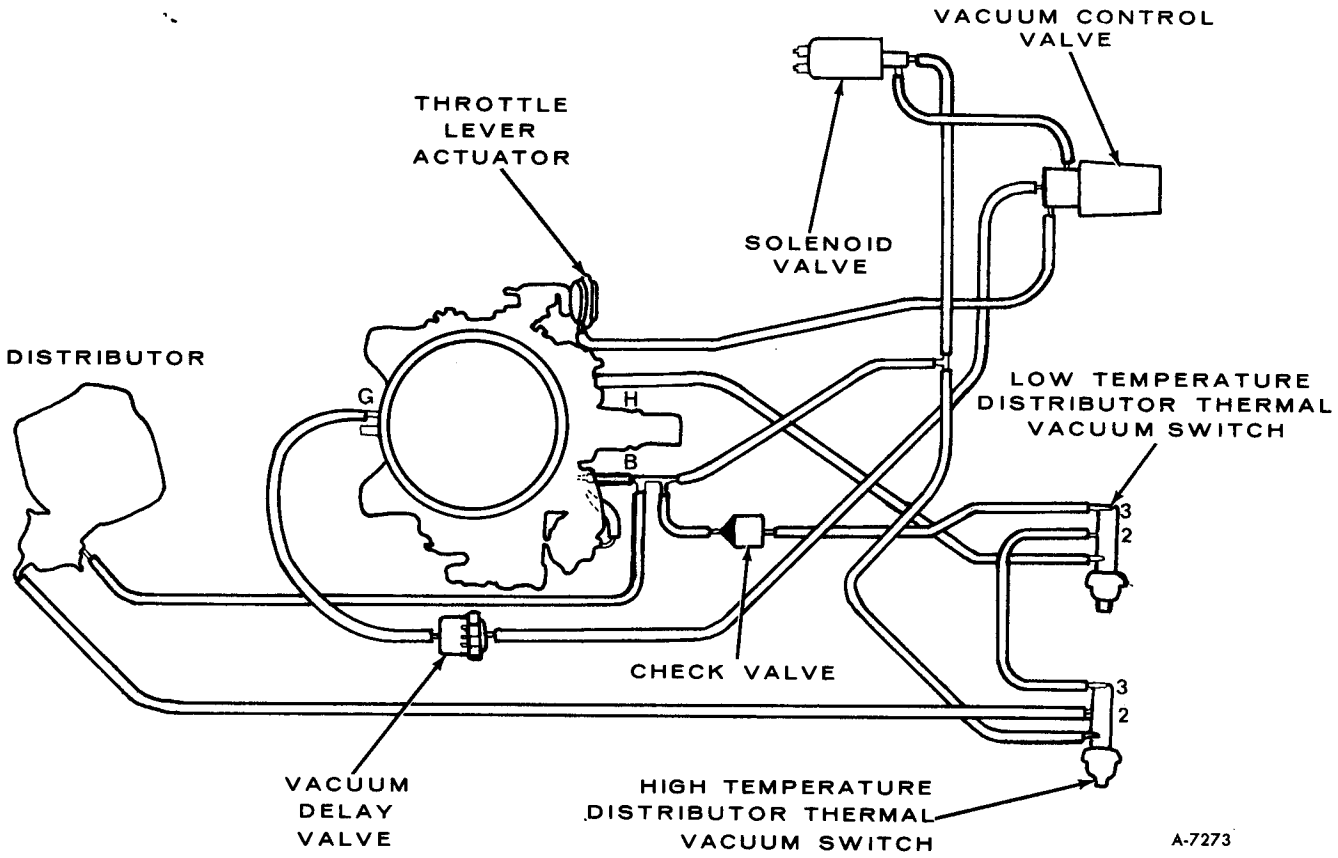


Figure 6—Emission Control Vacuum Hose Schematic (1977 California Engines)

TVS (CALIFORNIA ENGINES ONLY) (FIGURES 6 AND 7)

NOTE: The 1977 and 1978 California TVS systems are the same, except for modifications in hose routings due to changes in the 1978 Evaporation Control System (ECS). Details of the ECS changes are covered in SEC. 8 of this supplement.

The California TVS system contains additional controls for distributor vacuum advance beyond that used on engines for other states. These additional components are: Low Temperature TVS Switch, vacuum check valve, additional vacuum hoses, and distributor vacuum unit that includes both an advance and retard feature.

NOTE: The high temperature TVS switch is the same switch as used on engines for other states. The upper portion of the high temperature TVS switch (located right front of intake manifold) is black in color. While the upper portion of the low temperature TVS switch (located left front of intake manifold) is yellowish-white in color.

Operation

1. Below 160°F (71°C)—During cold operation with temperature below 160°F (71°C), the vacuum applied to the distributor advance unit is the highest vacuum trapped by the check valve until the coolant temperature reaches 160°F (71°C). During this period the distributor is advanced (vacuum advance unit) at all throttle positions to improve cold driveability.
2. 160-180° F (71-82° C)—During normal operation with the throttle open and the coolant temperature between 160-180°F (71-82°C), ported vacuum is connected to the vacuum advance connection of the distributor. At the same time vacuum is applied to the retard connection of the distributor. This results in distributor advance because the advance side of the vacuum diaphragm unit has a larger effective area than the retard side.

At idle, with the throttle closed, ported vacuum applied to the advance connection is ineffective compared to the vacuum applied to the retard connection and the distributor timing is retarded. This is the only period in which the distributor is retarded.

3. Above 220°F (104°C)—During hot operation with coolant temperature above 220°F

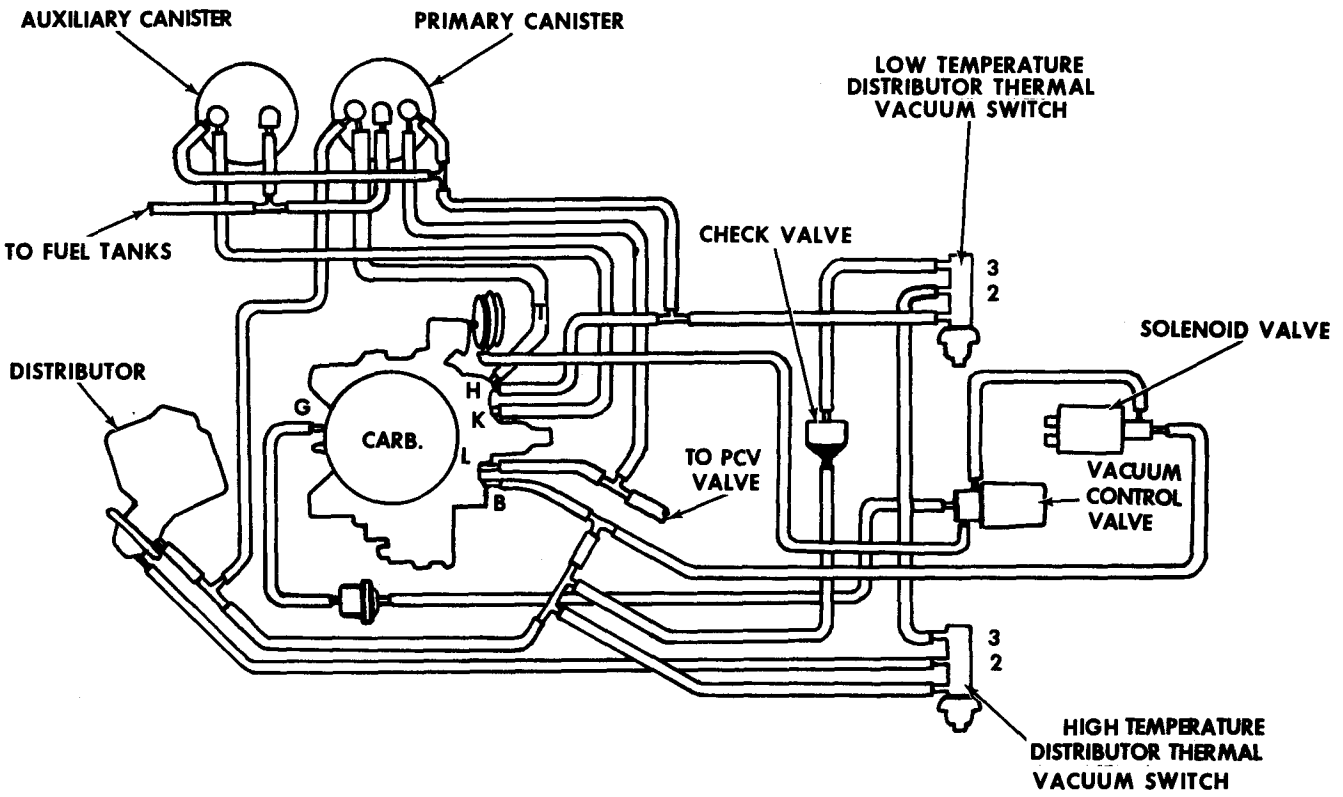


Figure 7—Emission Control Vacuum Hose Schematic (1978 California Engines)

(104°C), manifold vacuum is applied to the distributor vacuum advance connection, advancing the timing. This results in better engine cooling, particularly at idle.

High Temperature TVS Switch Hose Routing

Port "3" (Top Port)	Hose to Low Temperature TVS Switch (Port "2")
Port "2" (Middle Port)	Hose to Distributor Vacuum Advance Mechanism
Bottom Port	Hose to Manifold Vacuum on Carburetor (Carburetor Port "B") and Solenoid Valve

Low Temperature TVS Switch House Routing

Port "3" (Top Port)	Hose to Check Valve and Manifold Vacuum on Carburetor (Carburetor Port "B")
Port "2" (Middle Port)	Hose to High Temperature TVS Switch (Port "3")
Bottom Port	Hose to Ported Vacuum on Carburetor (Carburetor Port "H")

High Temperature TVS Switch Functional Check

With engine off - coolant temperature below 210°F (99°C).

1. Disconnect hose and cap port "3" (top port).
2. Disconnect hose at port "2" (middle port). Connect a vacuum gauge to port "2".
3. Disconnect hose from bottom port. Connect and external vacuum source to bottom port (such as J-23738). Apply 17 inches Hg vacuum to the bottom port. If vacuum gauge at port "2" (middle port) reads greater than 5 inches Hg, replace the TVS switch.
4. Remove external vacuum source, vacuum gauge, and port cap. Reconnect vacuum hoses to proper port on switch (figures 6 and 7).

NOTE: The TVS switch must be installed with soft sealant on the threads.

5. Check all hoses for proper connection, cracking, abrasion, or deterioration. Replace as necessary.

Low Temperature TVS Switch Functional Check - Below 160°F (71°C)

Use same procedure as "High Temperature

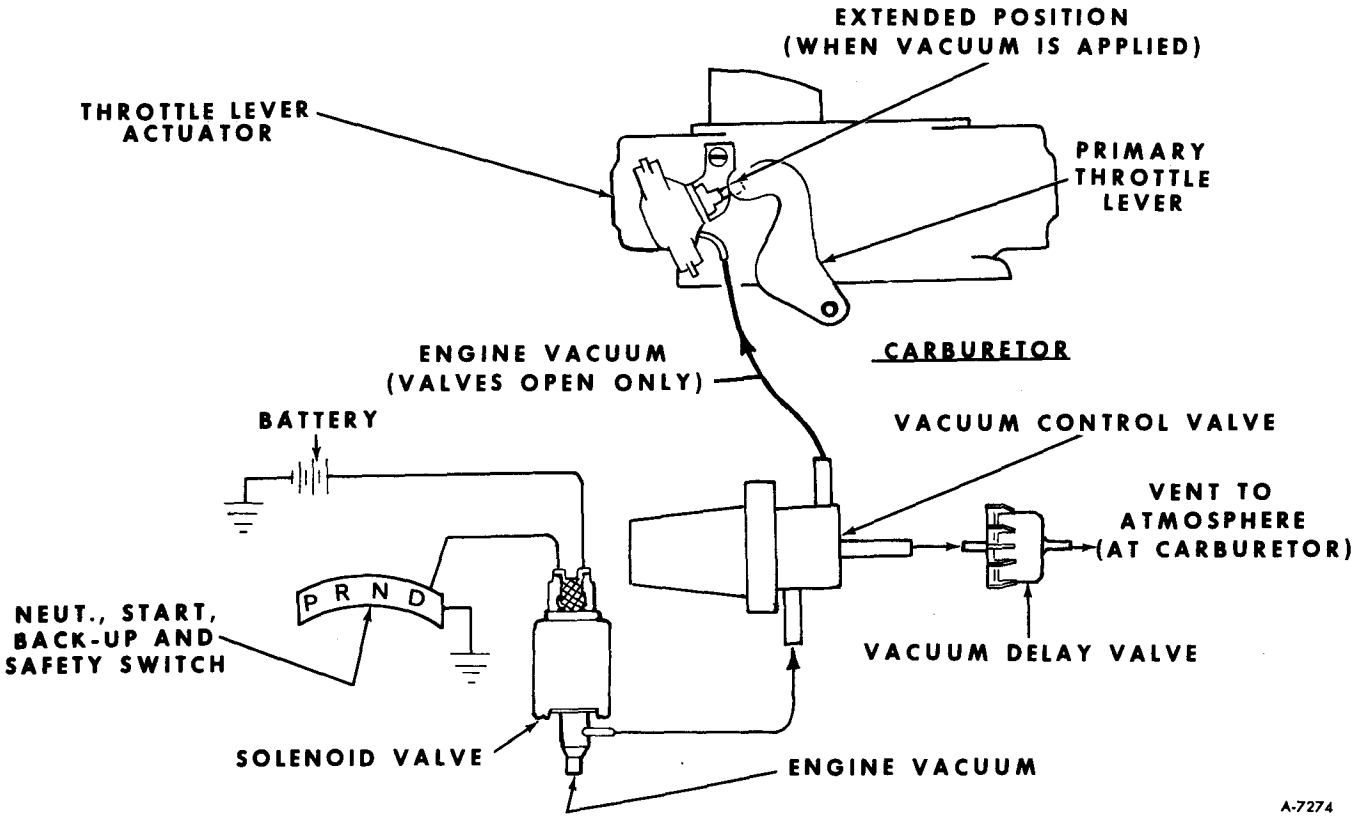


Figure 8—Throttle Return Control System

TVS Switch Functional Check" given immediately preceeding this step.

Low Temperature TVS Switch Functional Check - Above 160°F (71°C)

With engine off - coolant temperature above 160°F (71°C).

1. Disconnect hose and cap bottom port.
2. Disconnect hose and attach a vacuum gauge to port "2" (middle port).
3. Disconnect hose from port "3" (top port). Connect an external vacuum source (such as J-23738) to port "3". Apply 17 inches of Hg vacuum to port "3". If vacuum gauge at port "2" (middle port) reads greater than 5 inches of Hg, replace the low temperature TVS switch.
4. Remove external vacuum source, vacuum gauge, and port cap. Reconnect vacuum hoses (figures 6 and 7).

NOTE: The TVS switch must be installed with soft sealant on the threads.

5. Check all hoses for proper connection, cracking, abrasion, or deterioration. Replace as necessary.

THROTTLE RETURN CONTROL (TRC)

Vacuum hose routings for the throttle return control (TRC) system is shown in figures 5, 6 and 7. Figure 8 illustrates a simplified layout of the TRC system.

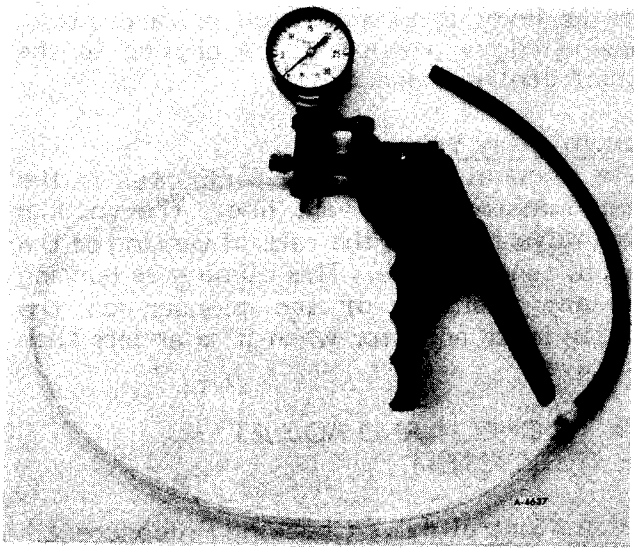


Figure 9—Vacuum Pump and Gauge (J-23738)

The TRC system is designed to reduce hydrocarbon emissions during decelleration by controlling the rate of throttle closing, causing a more complete buring. The system consists of: throttle lever actuator, vacuum control valve, solenoid valve, and vacuum delay valve.

TRC COMPONENTS (FIGURE 8)

Throttle Lever Actuator

The throttle lever actuator is mounted on the intake manifold at the carburetor. This device controls the position of the primary throttle plates a preset amount in excess of curb idle when engine vacuum is applied. This actuating vacuum is controlled by a separate vacuum control valve.

The throttle lever actuator bracket is secured by two bolts torqued to 20-25 ft. lbs. The actuator is mounted to the bracket by a single nut torqued to 15-20 ft. lbs. One tab on the washer under the nut is to be bent up against side of nut after torquing.

Vacuum Control Valve

The vacuum control valve is bracket mounted to the engine and retained by a single nut torqued to 15-20 ft. lbs. This on-off valve senses engine vacuum when the solenoid valve is open, and opens above a preset high vacuum level. The valve when open allows a vacuum signal to be applied to the throttle lever actuator as long as the preset vacuum level is exceeded.

Solenoid Valve

The solenoid valve is bracket mounted to the engine by a single bolt torqued to 25-30 ft. lbs. This on-off valve opens when the transmission selector lever is in a forward drive position, allowing engine vacuum to be applied to the vacuum control valve.

Vacuum Delay Valve

The vacuum delay valve is mounted in the vacuum control valve vent line. The vacuum delay valve restricts the rate of venting of the vacuum control valve. This eliminates hunting (unsteady position) of the plunger on the throttle lever actuator when it is at less than full travel.

HOW TO CHECK AND ADJUST THE TRC SYSTEM

Vacuum Control Valve Checking Procedure

1. Disconnect vacuum control valve to solenoid valve hose at the vacuum control valve. Connect an external vacuum source (J-23738, figure 9) equipped with a vacuum gauge at valve.
2. Disconnect the valve to actuator hose at the valve and connect a vacuum gauge to the valve.
3. Remove vent hose, then place finger firmly over the end of the vent fitting.
4. Apply a minimum of 23 inches Hg vacuum to the vacuum control valve and seal off the vacuum source. The gauge on the actuator side should read the same as the source gauge. If not, then the valve needs adjustment. If the vacuum drops off on either gauge (finger still on the vent fitting), the valve is leaking and must be replaced.

NOTE: Unless accurately calibrated vacuum gauges are used, check the two gauges used in this step against each other and apply any difference observed to determine that the actuator and source vacuum readings are equal.

5. With a minimum of 23 inches Hg vacuum level in the valve, remove finger from vent fitting. The vacuum reading on the actuator side will drop to zero and the reading on the source gauge will drop to 20.0-21.0 inches Hg (valve set point). If the reading is not within these limits, the valve must be adjusted by using the following procedure.

Vacuum Control Valve Adjusting Procedure (Figure 10)

1. Disconnect vacuum control valve to solenoid valve hose at the vacuum control valve. Connect an external vacuum source equipped with a vacuum gauge (figure 9).
2. Disconnect the valve to actuator hose at the valve and connect a vacuum gauge to the valve.
3. Remove vent hose, then place finger firmly over the end of the vent fitting.
4. Apply 23 inches Hg vacuum to the control valve and seal off the valve. Remove finger from vent fitting. The vacuum reading on the actuator side will drop to zero and the reading on the source gauge will drop to a value which is designated as the valve set point. If this reading is not 20-21 inches of Hg, adjust the valve set point.
5. To adjust the valve set point:

a. Gently pry off the conical plastic cover.

b. Loosen jam nut and turn the adjusting nut in (clockwise) to raise the set point or out (counterclockwise) to lower the set point valve.

c. Recheck the valve set point per steps 3 and 4.

d. Repeat steps (b) and (c) as necessary with jam nut tightened to obtain 20-21 inches of Hg.

e. Reinstall plastic cover.

f. If the valve cannot be adjusted within limits of step (d), replace valve.

Throttle Lever Actuator Checking Procedure

1. Disconnect vacuum control valve to actuator hose at the actuator and connect to an external vacuum source equipped with a vacuum gauge (figure 9).

2. Apply 20 inches Hg vacuum to the actuator and seal off the vacuum source. If the vacuum gauge reading drops, then the actuator is leaking and must be replaced. Release vacuum to actuator.

3. Check the throttle lever, shaft, and linkage to be sure that these components operate freely without binding or sticking.

4. Start engine and run until warmed up and idle is stable. If equipped with air conditioning, turn controls to off position. Place transmission selector lever in "PARK" or "N" (neutral). Note idle rpm.

5. Apply 20 inches Hg vacuum to the actuator. Manually open the throttle slightly and allow to close against the extended actuator plunger. Note the engine rpm.

6. Release and reapply 20 inches Hg vacuum to the actuator and note the rpm to which the engine speed increases (do not assist the actuator).

7. If the rpm obtained in step 6 is not within 150 rpm of that obtained in step 5, then the actuator plunger may be binding due to dirt, corrosion, varnish, etc., or the actuator diaphragm may be too weak. If binding is not indicated or cannot be corrected, then the actuator must be replaced.

8. Release the vacuum from the actuator and the engine speed should return to within 50 rpm of the idle speed noted in step 4. If it does not the plunger may be binding due to dirt, corrosion, varnish, etc. If the problem cannot be corrected, the actuator must be replaced.

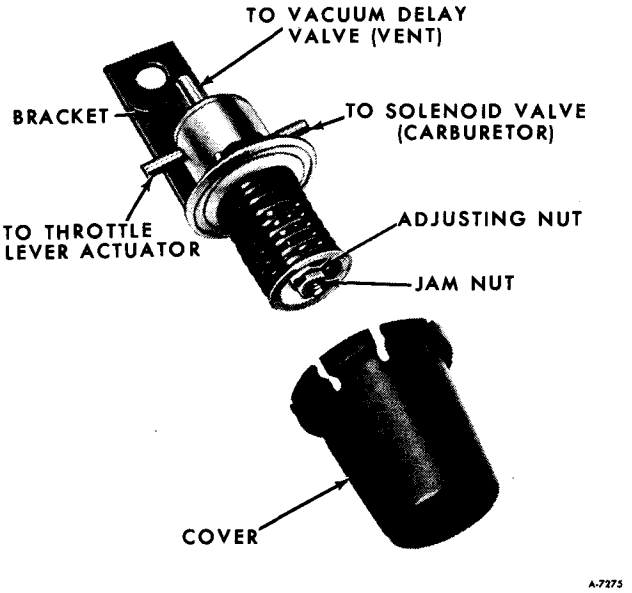


Figure 10—Vacuum Control Valve

Throttle Lever Actuator Adjusting Procedure

1. Throttle lever should rest on curb idle screw (choke fully open).

2. Adjust stem of actuator to provide 0.020 inch clearance between actuator stem and throttle lever.

Vacuum Delay Valve Checking Procedure

1. Remove vacuum delay valve (figure 8) from control valve vent line.

2. Install hand operated vacuum source equipped with a vacuum gauge (figure 9) to port marked "SOL".

3. Seal port marked "DIST" with finger. Apply 15 inches Hg vacuum to "SOL" port. Vacuum gauge should hold steady. If gauge drops to zero (with "DIST" port sealed) valve is leaking and must be replaced.

4. Remove finger from "DIST" port. Vacuum should fall slowly to zero. (15 inches Hg drops to 5 inches Hg in 4-7 seconds.)

a. If vacuum remains steady or drops at a slower rate than 10 inches Hg in 7 seconds, valve is plugged and should be replaced.

b. If vacuum falls at a faster rate than 10 inches Hg in 4 seconds, replace valve.

SPECIAL TOOLS

J-5421	Thermometer
J-23738	Hand Operated Vacuum Pump

SECTION 6Y
ENGINE ELECTRICAL

The information described in Maintenance Manual X-7525 under the heading ENGINE ELECTRICAL (SEC. 6Y) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "CAUTION: See "Caution" on page two of this section".

CAUTION: THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

BATTERIES

1977 and 1978 Motorhome and TransMode vehicles are equipped with two batteries: the main (automotive) battery and an auxiliary battery. TransMode vehicles equipped with the optional motor generator also have a third or cranking battery located in the motor generator (storage) compartment

MOTORHOME: The main (chassis) battery in the 1977 and 1978 Motorhome is a maintenance-free battery identified by the absence of vent plugs on the cover. The auxiliary (living area) battery may be either a maintenance-free battery or a flame arrestor-type filler vent cap battery.

TRANSMODE: 1977 and 1978 TransMode vehicles have maintenance-free main and auxiliary batteries. TransModes equipped with the motor generator option include a maintenance-free cranking battery for the motor generator.

BATTERIES WITH FLAME ARRESTOR VENT CAPS

See ENGINE ELECTRICAL (SEC. 6Y) in Maintenance Manual X-7525 for information on batteries with flame arrestor vent caps.

MAINTENANCE-FREE BATTERIES

DESCRIPTION

The maintenance-free battery (figure 1) is identified by the absence of vent plugs on the cover. The side-mounted positive and negative terminals are tightly sealed to retard possible leakage. Except for the small vent holes located on each side, the battery is completely sealed. The vent holes should be free from obstruction because they allow gases produced in the battery to escape. At normal charging voltages, the amount of these gases is extremely small, due to the special chemical composition in the battery grid design. Water never needs to be added to the maintenance-free battery.

TEST INDICATOR

A test indicator in the battery cover provides a visual inspection area for testing purposes only. It is not to be used to determine if the battery is good or bad, charged or discharged. Correct use of this feature is important. Refer to "Testing Maintenance-Free Batteries" below. Refer also to figure 1 in this section.

BATTERY MAINTENANCE

The battery carrier and holddown should be clean and free from corrosion prior to battery replacement. The carrier should also be in sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the wing nuts should be tight. However, the wing nuts should not be tightened to the point where the battery case or cover will be placed under severe strain.

The external condition of the battery should be checked periodically for damage such as cracked cover, case and vent plugs or for the presence of dirt and corrosion. The battery

should be kept clean. An accumulation of acid film and dirt may permit current to flow between the terminals, which will slowly discharge the battery. For best results when cleaning batteries, wash first with a diluted ammonia or a soda solution to neutralize any acid present; then flush with clean water.

BATTERY DIAGNOSIS

A battery has three major functions in the chassis electrical system. First, it provides a source of energy for cranking the engine. Second, it acts as a voltage stabilizer for the electrical system. And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

The battery is not designed to last indefinitely; however, with proper care it will provide many years of service.

If the battery tests good but fails to perform satisfactorily in service for no apparent reason, one or more of the following factors may be the cause of the trouble:

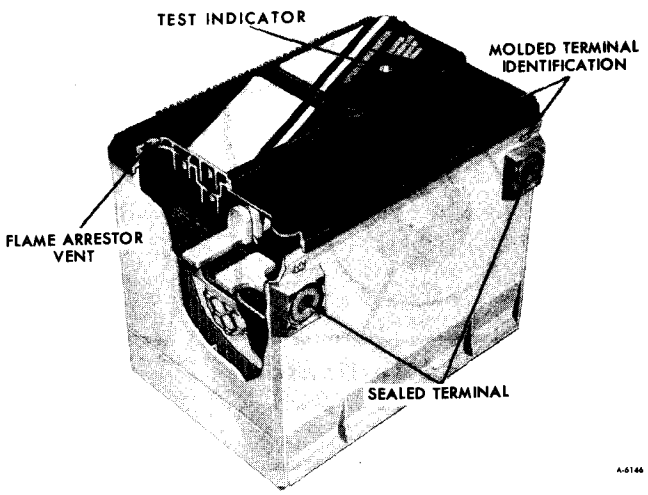
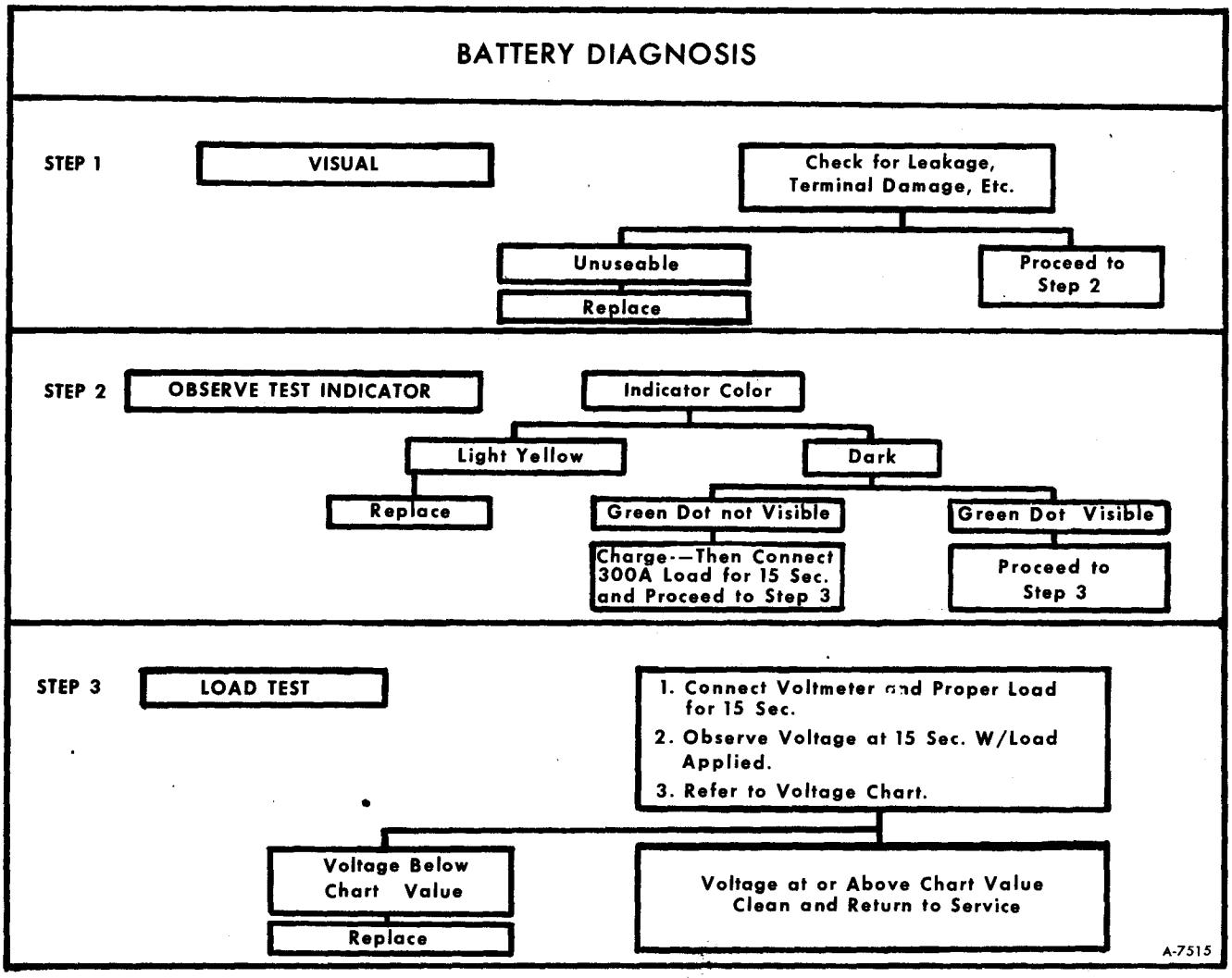


Figure 1—Maintenance-Free Battery

1. Vehicle accessories inadvertently left on overnight.
2. Slow-speed driving for short duration.
3. Vehicle electrical load exceeding the generator capacity, particularly if a lot of



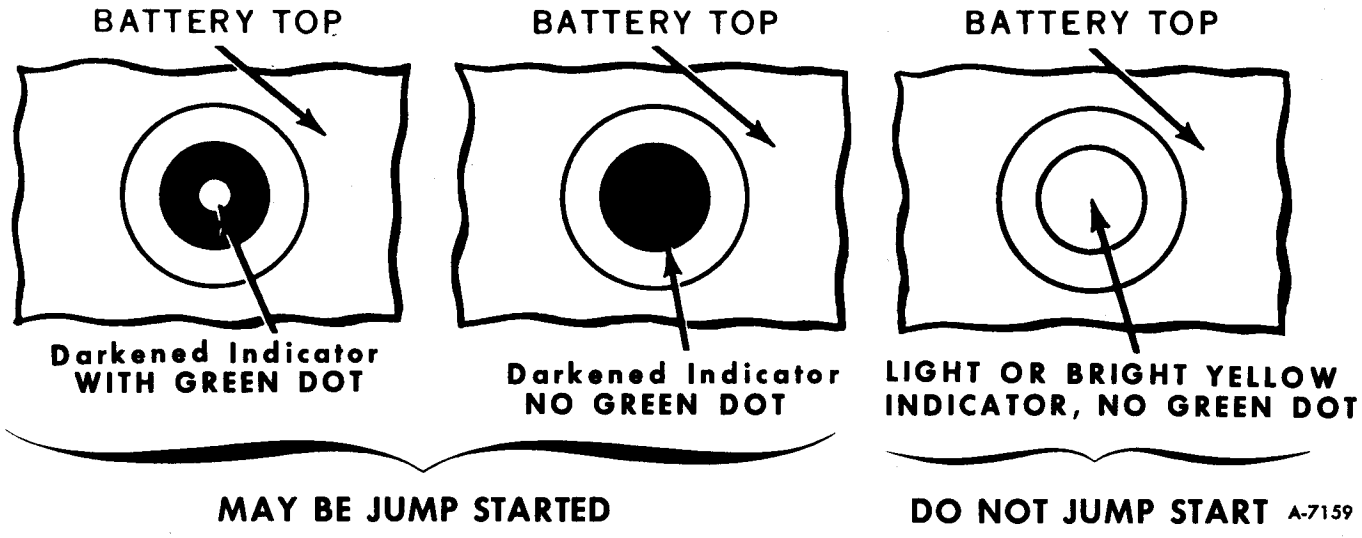


Figure 2—Test Indicator Conditions (Maintenance Free Battery)

special equipment has been added to the system.

4. Defects in the charging system such as high resistance connections, slipping fan belt, faulty generator or voltage regulator.

5. Battery abuse, which includes the failure to keep the battery cable terminals clean and tight, or, loose battery hold-down.

6. Mechanical defects in the electrical system, such as shorted or pinched wires.

TESTING MAINTENANCE-FREE BATTERIES

STEP 1 - VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover that could permit loss of electrolyte. If obvious physical damage is noted, replace battery. Determine cause of damage and correct as necessary.

STEP 2 - TEST INDICATOR (FIGURE 2)

The test indicator, built into the top cover, provides a visual inspection area for battery testing only. This test indicator is to be used only with accepted diagnostic procedures. It is not to be used by itself to determine if the battery is good or bad, or charged or discharged. The indicator includes a plastic rod that extends into the electrolyte. At the bottom of the rod, a green plastic ball is suspended in a cage. When the electrolyte specific gravity is about 1.225 or above, the green ball floats against the end of the rod and becomes visible so that the indicator appears GREEN. At this 1.225 specific gravity, the battery is approximately 3/4 full charge. When the battery is less than about 3/4 fully charged, the green ball sinks and the indicator appears DARK. When the electrolyte level drops below a minimum level, i.e., below the pointed tip of the rod, the indicator window changes to YELLOW or CLEAR. In this case the charging system should be checked. Although the battery is capable of further service, if a cranking complaint has been reported, replace the battery. DO NOT CHARGE, TEST OR JUMP START.

It is important when observing the test indicator that the battery be relatively level and have a clean top so that the correct indication may be seen. A light may be required in some poorly lit areas. Following are the possible test indicator readings:

A. GREEN DOT VISIBLE.

Any green appearance is interpreted as a "green dot" and the battery is ready for testing. Proceed to step 3.

B. DARK—GREEN DOT NOT VISIBLE.

Battery must be charged before testing. Refer to "Charging Procedure" later in this section.

NOTE: Battery should be charged until green dot appears, but not more than 60 ampere hours (for example - 15 amperes for four hours). Do not charge a battery if the green dot is visible. (On rare occasions immediately following periods of prolonged cranking, the green dot may still remain visible. If left alone, the dot will disappear in a short time. Should this occur, a boost-charge of 20 ampere-hours is recommended.)

C. LIGHT

DO NOT attempt charging or testing when charge indicator is light. Check charging system.

CAUTION: *To avoid explosion hazard, never attempt to charge or jump start a maintenance-free battery which exhibits a light indicator condition. Departures from this procedure could result in serious personal injury or property damage.*

STEP 3 - REMOVE SURFACE CHARGE

Connect 300-ampere load across terminals for 15 seconds to remove surface charge from the battery. Be sure and stop the load after 15 seconds.

If battery is in the vehicle, connection may be made to existing terminals. If battery is out of vehicle, adapters for the side terminals are required.

STEP 4 - LOAD TEST

A. Connect voltmeter and proper ampere load across terminals. Refer to the following "Load Chart" for the proper ampere load as used for a specific battery.

AMPERE LOAD CHART

PART NUMBER	MODEL NUMBER	AMPERE LOAD
1980400	R85-5	170A
1980402	R89-5	230A

B. Read voltage after 15 seconds with load connected, then disconnect load.

C. If minimum voltage is 9.6* or more, battery is good.

D. If minimum voltage is less than 9.6*, replace battery.

*This volatge (9.6) is to be used for battery ambient temperatures of 70°F (21°C) and above. For temperatures below 70°F refer to "Voltage and Temperature Chart" below.

VOLTAGE AND TEMPERATURE CHART

AMBIENT TEMPERATURE	MINIMUM VOLTAGE
70°F & Above (21°C)	9.6
60°F (16°C)	9.5
50°F (10°C)	9.4
40°F (4°C)	9.3
30°F (-1°C)	9.1
20°F (-7°C)	8.9
10°F (-12°C)	8.7
0°F (-18°C)	8.5

CHARGING PROCEDURE

The maintenance-free battery can be fast charged or slow charged with ordinary chargers in the same manner as for conventional batteries. Either method will restore the battery to full charge. However, the time required for full charge depends upon battery state of charge, capacity, temperature and charger capability.

On rare occasions following a prolonged cranking, the green dot in the test indicator may still be visible as shown in figure 2. Should this occur, a boost charge of 20-ampere hours (maximum) is permissible. When there has been a cranking complaint and the test indicator is completely dark in appearance, charge the battery (50-75 ampere hours) and then proceed to test the battery.

DO NOT CHARGE OR LOAD TEST a maintenance-free battery when the test indicator is completely light yellow or clear in appearance. When this occurs, replace the battery.

CHARGING OR TESTING ADAPTERS

Batteries may be charged or tested either in or out of the vehicle. However, if the batteries are charged or tested out of the vehicle, terminal adapters are necessary to facilitate the procedures.

CHARGING GUIDELINES

Typical charging guidelines that apply to all batteries, including maintenance-free, are as follows:

1. Discontinue charge if spewing of electrolyte occurs, or if battery temperature exceeds 125°F.
2. Do not charge if electrolyte level is low . . (light yellow indication).
3. Allow suspected "frozen" battery to warm up 4 to 6 hours before charging.
4. A cold, discharged battery requires more ampere-hours of charge than a warm battery; usually about 25% more.
5. A battery that has set in a "completely" discharged condition for a prolonged time, or is extremely cold, may not accept current for several hours after initially starting the charger.

Satisfactory recharge is indicated either by the attainment of the specified ampere-hours of charge or by the appearance of the green dot.

Charging periods to obtain up to 50-75 ampere hours are recommended for the most satisfactory results. Remember that charging may be stopped when the GREEN DOT APPEARS. The battery is sufficiently charged

after 50-75 ampere hours even though the GREEN DOT MAY NOT YET APPEAR.

Remember that if the charge rate in amperes tapers or decreases to lower values with time, the charging time in hours would have to be increased to obtain the required number of ampere-hours. (A partially charged battery would require less time to recharge.)

BATTERY CHARGING GUIDE

MODEL	R 89-5				
SLOW RATE	5	A	@	15	HRS.
	10	A	@	7½	HRS.
FAST RATE	20	A	@	3-3/4	HRS.
	30	A	@	2½	HRS.
	40	A	@	2	HRS.
	50	A	@	1½	HRS.
MODEL	R 85-5				
SLOW RATE	5	A	@	10	HRS.
	10	A	@	5	HRS.
FAST RATE	20	A	@	2½	HRS.
	30	A	@	1½	HRS.

JUMP STARTING WITH AUXILIARY (BOOSTER) BATTERY

NOTE: Do not push or tow this vehicle to start it. Under some conditions this may damage certain parts of the vehicle.

If only the main (automotive) battery is discharged, hold battery switch on instrument panel momentarily in "BAT BOOST". This supplies current from the auxiliary battery (or batteries). After use, switch is designed to return to the "BAT NORMAL" position.

If the vehicle has discharged batteries, it can be jump started from another battery.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow exactly the procedure outlined below, being careful not to cause sparks:

CAUTION: *The instructions below must be followed EXACTLY or personal injury (particularly to eyes) or property damage may result from battery explosion, battery acid, or electrical (short circuit) burns.*

THE MAJOR SAFETY PRECAUTION IS TO MAKE THE FINAL CONNECTION TO GROUND AT THE RADIATOR RIGHT MOUNTING BRACKET (PASSENGER SIDE OF VEHICLE). THIS HELPS REDUCE THE CHANCE OF AN EXPLOSION DUE TO SPARKS.

To lessen the chance of an explosion, never expose the battery to open flames or electric sparks. Also do not smoke near the battery. Batteries give off a gas which is flammable and explosive.

To lessen the risk of injury in case an explosion does occur, WEAR EYE PROTECTION or shield your eyes when working near either battery. Do not lean over a battery.

Do not allow battery fluid to contact eyes, skin, fabrics or painted surfaces because battery fluid is a corrosive acid. FLUSH ANY CONTACTED AREA WITH WATER IMMEDIATELY AND THOROUGHLY. ALSO GET MEDICAL HELP IF EYES ARE AFFECTED.

To lessen the risk of a short circuit, remove rings, metal watch bands and other metal jewelry. Also do not allow metal tools to contact:

The positive terminal junction block stud in this vehicle, marked "VEHICLE BATTERY POSITIVE", or

The positive battery terminal on either vehicle, or

Metal in contact with either positive terminal.

Also, make certain when attaching the jumper cable clamps to the junction block stud, and to the positive terminal of the other battery, that neither clamp contacts any other metal.

JUMP START PROCEDURE

1. This vehicle has a 12-volt automotive battery and a negative ground electrical system. Make sure that the other vehicle also has a 12-volt battery and negative ground. Its owner's manual may provide that information. If unsure of voltage (or if the voltage and

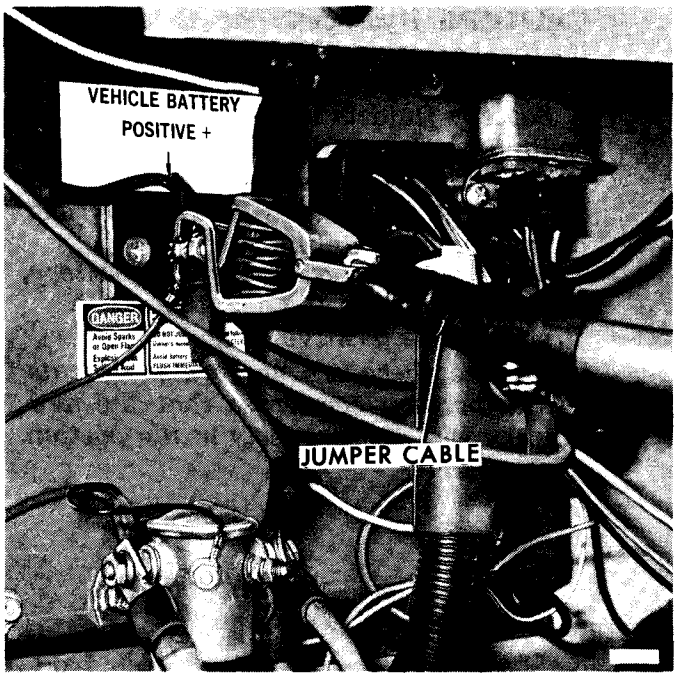


Figure 3—Connecting Jumper Cable to "Vehicle Battery Positive" Stud

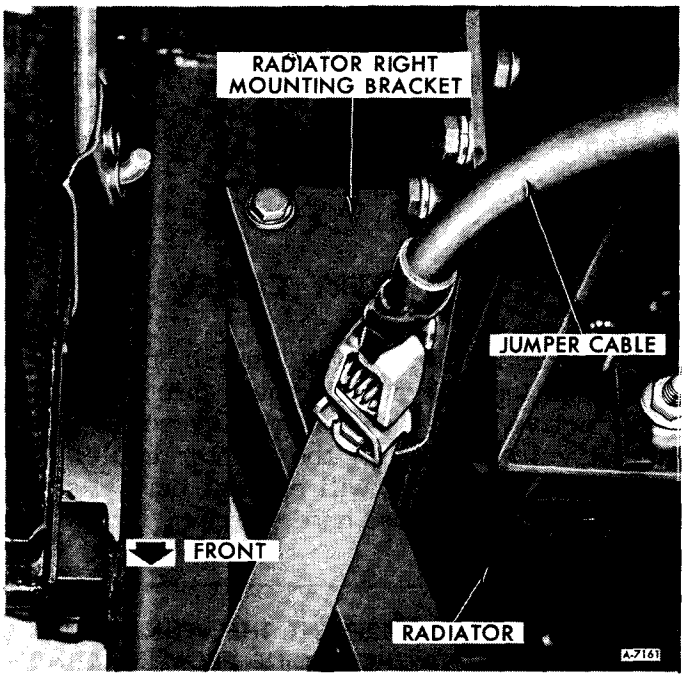


Figure 4—Connecting Jumper Cable To Radiator Right Mounting Bracket (Passenger Side)

ground are different from this vehicle), do not attempt to jump start, as personal injury or severe damage to electrical and electronic parts may result.

2. Position the other vehicle with the good (charged) battery so that the jump starting cables will reach this vehicle's battery. Do not allow the vehicles to touch, and check to see that the bumpers do not touch.

3. Turn off all electrical motors and accessories in both vehicles. Turn off all lights except those needed to protect the vehicle or illuminate the work area. Turn off the ignition, apply the parking brake firmly, and put the automatic transmission in "PARK" (manual transmission "NEUTRAL") in both vehicles.

4. If the discharged battery has filler caps, check the fluid level. (Do not use an open flame to check and do not smoke.) Add clear drinking water to the proper level if low, and replace caps before jump starting. If the battery is a sealed-type, do not attempt to jump start the vehicle, or charge or test the battery if the center of the test indicator in the battery is bright or light yellow (figure 2). Instead, install a new battery.

5. Jumper Cable Connection Instructions (See Illustrations).

- Connect the first jumper cable from the positive "+" (red) terminal on the battery in the other vehicle to the positive terminal junction block stud in this vehicle, marked "VEHICLE BATTERY POSITIVE" (figure 3). This is located behind the right access door above the main (automotive battery). Never connect "+" (red) to "-" (black), or "-" to "+".
- Next, connect one end of the second cable to the grounded negative "–" (black) terminal of the OTHER vehicle's battery, regardless of which vehicle has the discharged battery.
- Lastly, connect the other end of the second jumper cable to the radiator right mounting bracket (passenger side) in THIS vehicle (figure 4). Do not connect the cable to pulleys, fans, or other parts that move. Beware of touching hot manifolds which can cuase severe burns.

6. Start the engine in the vehicle with the good (charged) battery and run the engine at a moderate speed.

NOTE: If the discharged battery is completely dead, it may be necessary to run the engine of the vehicle with the charged battery for a few minutes at a moderate speed to slightly charge the discharged battery. This will help when cranking the engine in the vehicle with the discharged battery, especially when outside temperatures are very low.

7. Start the engine of the vehicle that has the discharged battery.

8. Remove the battery cables by reversing the above sequence EXACTLY. Start by removing the cable from the radiator right mounting bracket in THIS vehicle as the FIRST step.

BATTERY CABLES

Excessive resistance caused by terminal connection and partial short circuits through defective cable insulation will result in abnormal voltage drop in the starter cable. Low voltage at starter will prevent normal starter operation and cause hard starting.

WARNING: TO PREVENT THE VEHICLE FROM MOVING AND THE ENGINE FROM STARTING WHILE PERFORMING THESE CHECKS, ENGAGE THE PARKING BRAKE AND PLACE THE TRANSMISSION IN "NEUTRAL" POSITION.

1. Check voltage drop between engine block and negative battery terminal. Place one prod of test voltmeter on engine block and the other on negative battery terminal. Operate starter and note the voltage reading.

2. Check voltage drop between ungrounded (+) battery terminal and starter terminal stud with starter operating.

3. Check voltage drop between starter housing and frame with starter operating.

4. If the voltage drop in any of the above is more than 1.0 volt, there is excessive resistance in the circuit. To eliminate resistance, the cables should be disconnected and connections cleaned. If cables are frayed or the clamps excessively corroded the cables should be replaced. When selecting new cables, be sure they are at least as large as the ones being replaced.

BATTERY REPLACEMENT

When handling a battery, the following cautions must be observed:

CAUTION: *Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.*

Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately.

When removing or replacing a battery, always disconnect the negative cable first then the positive cable.

Be sure there are no foreign objects in the battery carrier so that the new battery will rest properly in the bottom of the carrier.

REMOVAL

1. Disconnect the negative cable from the radiator right mounting bracket.
2. Disconnect the positive cable from the positive terminal junction block stud, marked "VEHICLE BATTERY POSITIVE".
3. Loosen the battery hold-down and remove it from the carrier. Remove the battery from the vehicle.

INSPECTION

Inspect the battery for physical damage such as cracked top or battery case which would permit the loss of electrolyte. If any damage is noted, correct the cause.

INSTALLATION

1. Be sure there are no foreign objects in the carrier, so that the replacement battery will rest properly in the bottom of the carrier.
2. Install battery and tighten hold-down evenly until snug. Do not draw down tight enough to distort or crack the case or cover.
3. Be sure the cables are in good condition. Install positive battery terminal to the positive terminal junction block stud marked "VEHICLE BATTERY POSITIVE." Then connect the ground cable to the radiator right mounting bracket.
4. Torque cable connections at battery to 60-90 in. lb. Do not over-torque.
5. Check polarity to be sure the battery is not reversed with respect to the charging system.

MAINTENANCE-FREE BATTERY SPECIFICATIONS

PART NO.	VOLTS	WATT RATING @ 0°F. (-18°C)	MINUTES RESERVE CAPACITY @ 25 AMPS	COLD CRANKING RATING (AMPS)		LOAD TEST AMPS LOAD
				0°F (-18°C)	-20°F (-29°C)	
1980400*	12	3200	80	350	270	170
1980402+	12	4000	125	465	375	230

* R-85-5: Used for Motor Generator Cranking Battery (optional) in TRANSMODE vehicles.

\+ R-89-5: Main (automotive) battery in MOTORHOME vehicle. Main and auxiliary battery in TRANSMODE vehicles.

GENERATING SYSTEM

GENERATOR MOUNTING

Vehicles equipped with 403 cubic inch engine have a new generator mounting. Refer to figure 5.

GENERATOR QUICK CHECK

When generator tell-tale light is on, following procedure will aid in determining cause of problem:

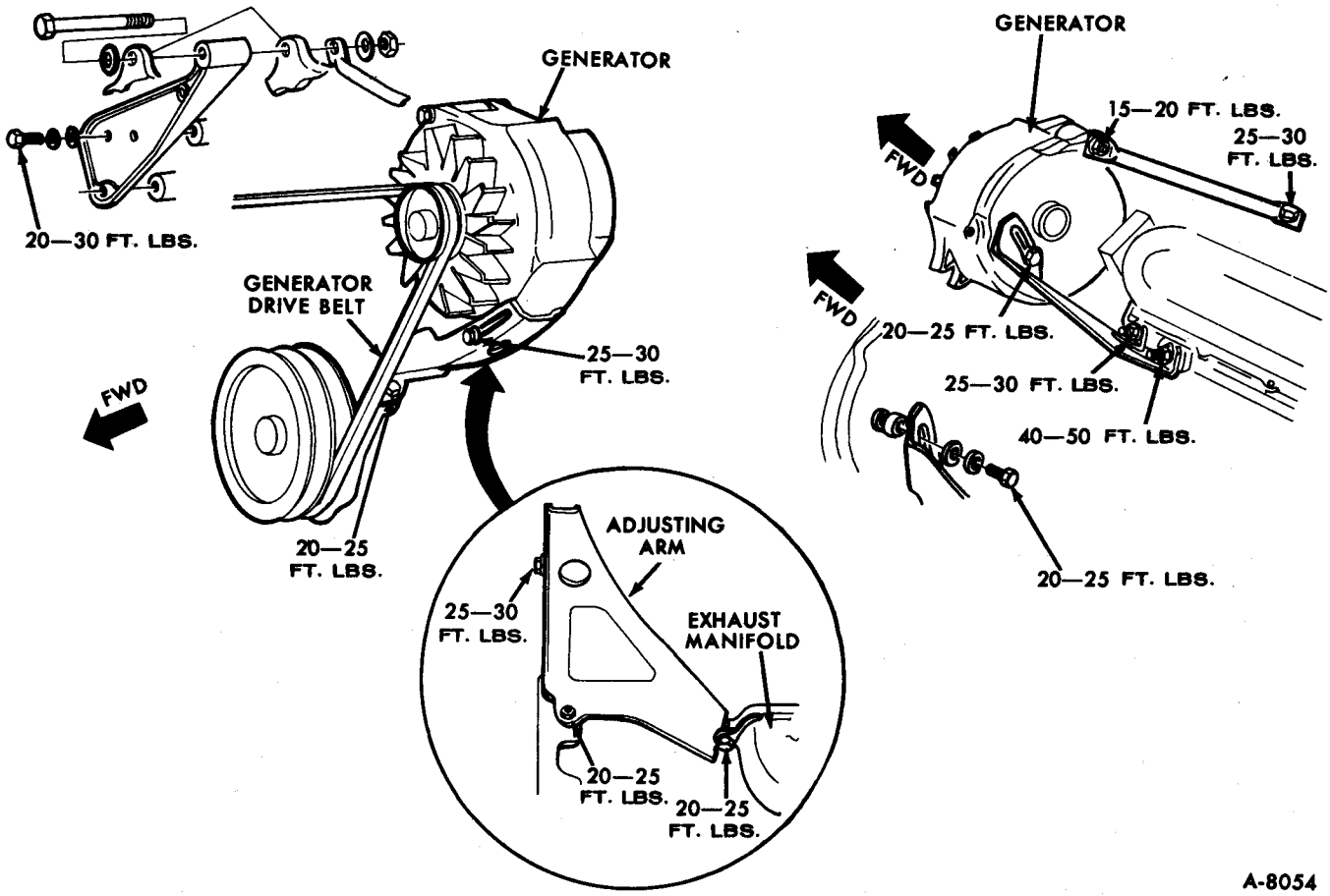


Figure 5—Generator Mounting

UNDERCHARGED BATTERY

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally. The following procedure also applies to circuits with an ammeter:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery defect is suspected, see "Battery Service And Diagnosis" in this section.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.
5. Check operation of diode assembly as follows:
   With the engine operating at fast idle, use a voltmeter to measure voltage at the three terminals of the diode assembly. Attach the positive lead to the indicated terminal, the negative lead to chassis ground.
   a. With positive lead to generator terminal on diode assembly and negative lead to ground, reading should be 13.1 to 15.5 volts. If reading at generator terminal is zero volts, check wiring to generator for open connection.
   b. With positive lead to bat. No. 1 terminal on diode assembly and negative lead to ground, reading should be 12.1 to 14.5 volts.
   c. With positive lead to bat. No. 2 terminal and negative lead to ground, reading should be 12.1 to 14.5 volts.

   If reading on bat. terminal No. 1 or No. 2 is zero volts, replace diode assembly. Reading at battery terminals No. 1 and No. 2 should be approximately 1.0 volts less than reading at generator terminal. If reading at bat. terminals is more than 1.0 volts less than generator terminal reading, replace diode assembly.

   If readings at generator terminal and bat. terminals are identical, see "Discharged Batteries" in this chart.
6. With engine running, connect a voltmeter from:
   a. Generator "BAT" terminal to ground.
   b. Generator No. 1 terminal to ground.
   c. Generator No. 2 terminal to ground.

   A zero reading indicates an open between voltmeter connection and battery.
7. If previous Steps 1 through 6 check satisfactorily, check generator as follows:
   a. Disconnect battery ground cable.
   b. Connect an ammeter in the circuit at the "BAT" terminal of the generator.
   c. Reconnect battery ground cable.
   d. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the battery.
   e. Operate engine at moderate speed as required, and adjust carbon pile as required, to obtain maximum current output.

If ampere output is within 10 amps of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 6.

If amperes output is not within 10 amps of rated output, determine if test hole is accessible.

If test hole is accessible, ground the field winding by inserting a screwdriver into the test hole.

CAUTION: Tab is within 3/4-inch of casting surface. Do not force screwdriver deeper than 1-inch into end frame.

Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

If test hole is not accessible, disassemble generator and make tests listed in "GENERATOR REPAIR", Maintenance Manual X-7525.

If output is not within 10 amps of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in "GENERATOR REPAIR", Maintenance Manual X-7525.

If output is within 10 amps of rated output, test regulator with an approved regulator tester, and check field winding as covered in "GENERATOR REPAIR", Maintenance Manual X-7525.

OVERCHARGED BATTERY

1. To determine battery condition, see "Battery Service And Diagnosis" in this section.
2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.
3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive battery water usage, proceed as follows:
   a. Separate end frames as covered in "Disassembly" under Heading of "GENERATOR REPAIR" in Maintenance Manual X-7525. Check field winding for grounds and shorts. If defective, replace rotor and test regulator with an approved regulator tester.
   b. Connect ohmmeter using lowest range scale from brush lead clip to end frame; then reverse lead connections.
   c. If both readings are zero, either the brush lead clip is grounded or regulator may be defective.
   d. A grounded brush lead clip can result from omission of insulating washer, omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, test regulator with an approved regulator tester.

DISCHARGED BATTERIES

This condition could exist if a failed diode assembly allows the vehicle automotive battery or living area battery to be discharged by the other circuit (i.e., no isolation between battery circuits) during times when the engine is not in operation. To check diode continuity and resistance:

1. Disconnect all leads to diode assembly.
2. Connect ohmmeter leads to generator terminal and bat. No. 1 terminal at diode assembly. Using appropriate scale, observe reading. Reverse lead connections to terminals and observe reading using appropriate scale. If both readings are the same, replace diode assembly. A good diode section will give one high and one low reading.
3. Repeat above procedure with ohmmeter leads connected to generator terminal and bat. No. 2 terminal. Using appropriate scale, observe reading. Reverse lead connections to terminals and observe reading using appropriate scale. If this test gives one high and one low reading, diode assembly is good. If both readings are the same, replace diode assembly.

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Figure 6—Generating System Diagnosis

FAULTY INDICATOR LAMP OPERATION

Check the indicator lamp for normal operation as shown below:

Switch	Lamp	Engine
OFF	OFF	STOPPED
ON	ON	STOPPED
ON	OFF	RUNNING

If the indicator lamp operates normally, proceed to "UNDERCHARGED BATTERY" or "OVERCHARGED BATTERY" in the "GENERATING SYSTEM DIAGNOSIS CHART" in this section. Otherwise, proceed to either one of the following three abnormal conditions:

Switch On, Lamp Off, Engine Stopped - This condition can be caused by the defects listed under "Switch Off, Lamp On" or by an open in the circuit.

Switch Off, Lamp On - In this case, disconnect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as covered in "GENERATOR REPAIR", Section 6Y, Maintenance Manual X-7525. This condition will cause an undercharged battery.

Switch On, Lamp On, Engine Running - Check for a blown fuse (where used) between indicator lamp and switch. The other possible causes of this condition are covered in "UNDERCHARGED BATTERY" in the "GENERATING SYSTEM DIAGNOSIS CHART" in this section.

To determine where an open exists, check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

If no defects are found, proceed to "UNDERCHARGED BATTERY" in the "GENERATING SYSTEM DIAGNOSIS CHART" in this section.

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Figure 7—Faulty Indicator Lamp Operation

1. With vehicle not running, attach voltmeter leads across automotive battery terminals, the red lead to the battery positive (+) terminal and the black lead to the battery ground (-) terminal.

2. Check voltage reading. If battery is fully charged, voltage reading should be approximately 12.6 volts. If battery is discharged, voltage will be less.

3. Crank the engine. With engine running at fast idle, there should be an immediate voltage rise to approximately 13.6 to 14.2 volts. This indicates that the generator is functioning. If voltage does not rise when engine is started, then problem exists in generator circuit itself. To check, refer to "Generating System Trouble Symptoms," Sec. 6Y, Maintenance Manual X-7525.

If voltage rises to 13.6 volts or above when engine is started, but tell-tale light remains on, then problem exists in tell-tale circuit. Proceed to check tell-tale warning circuit.

HIGH ENERGY IGNITION SYSTEM

All vehicles covered by this supplement are equipped with High Energy Ignition Systems. Information following applies to both 455 cubic inch engine (1977) and 403 cubic inch engine (1977 and 1978). High energy ignition system specifications are listed at the end of this section.

GENERAL DESCRIPTION

The eight cylinder HEI distributor (figure 8) combines all ignition components in one unit. The ignition coil is on the distributor cap and connects to the rotor. HEI performs basically the same function as a conventional ignition system, except the module and pick-up coil of the HEI system do electronically what the contact points of the conventional system do mechanically.

The high energy ignition system is a pulse triggered, transistor - controlled, inductive discharge ignition system. This system features a built-in ignition coil, an electronic module and a magnetic pick-assembly. This assembly, located inside the distributor, contains a permanent magnet, a pole piece with internal teeth, and a pick-up coil. When the teeth of the timer core rotating on the distributor shaft inside the pole piece approach the teeth of the pole piece, voltage is induced in the pick-up coil. The electronic module then turns the ignition coil primary current "on". As the teeth align and then separate, a reversal in voltage potential signals the module to open the ignition coil primary circuit. When the primary, circuit opens, a high voltage induced in the ignition coil secondary winding is directed through the rotor and high voltage leads to fire the spark plugs. The capacitor in the distributor is for noise suppression.

The module automatically controls the dwell period, stretching it with increasing engine speed. The HEI system also features a longer spark duration, made possible by the higher amount of energy stored in the coil primary. This is desirable for firing lean fuel mixtures.

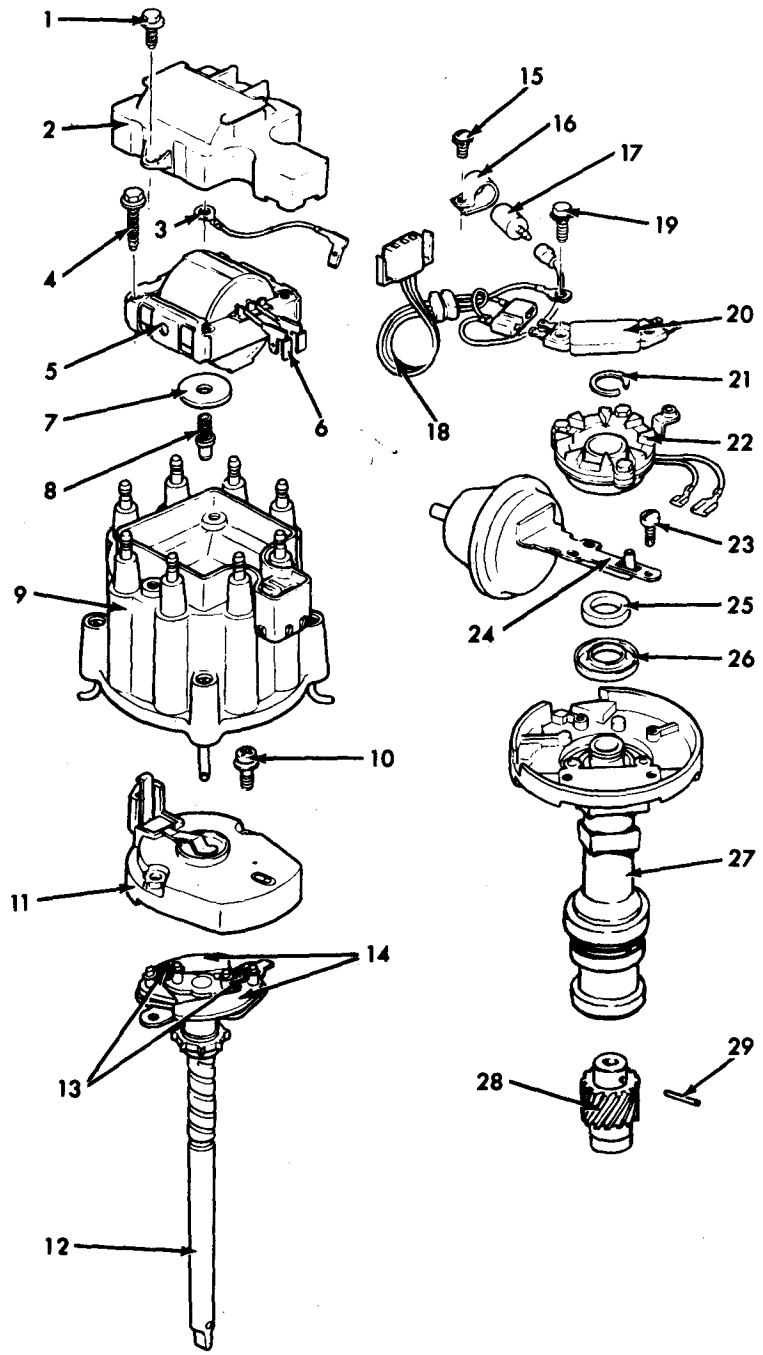
THEORY OF OPERATION

The pick-up coil is connected to the electronic module, which in turn is connected to the primary winding in the ignition coil. There is a magnetic field surrounding the permanent magnet and pick-up coil, which increases in the strength as the teeth of the timer core approach alignment with the teeth of the pole piece.

This increasing magnetic field induces a voltage in the pick-up coil, and current then flows to the ignition coil primary winding. When the teeth are exactly aligned and start to separate, the polarity of the pick-up coil voltage is reversed.

It is this reversal of voltage potential which signals the module to electronically shut off the ignition coil primary circuit. This in turn collapses the coil magnetic field and induces high voltage in the ignition coil secondary, firing one spark plug. A typical HEI schematic is shown in figure 9.

The electronic module delivers full battery voltage to the ignition coil, which is limited to 5.0 to 5.5 amps. There is no primary calibrated resistance wire in the HEI system. The electronic module acts as an "ON-OFF" switch for primary current, triggered by changing polarity of pick-up coil voltage. There is no energy lost due to breaker point arching or capacitor charging time lag. The capacitor in the HEI unit funcitons only as a radio noise suppressor.



1. Cover Attaching Screw (2)
2. Cover
3. Ground Lead
4. Coil Attaching Screw (4)
5. Ignition Coil
6. Coil Terminals
7. Rubber Seal
8. Brush (Spring and Button)
9. Cap
10. Rotor Attaching Screw (2)
11. Rotor
12. Shaft Assembly
13. Springs
14. Weights
15. Bracket Attaching Screw
16. Capacitator Bracket
17. Capacitator
18. Wiring Harness
19. Module Attaching Screw (2)
20. Electronic Module
21. Retainer (Thin "C" Washer)
22. Pole Piece and Plate Assembly (Pick-up Coil)
23. Vacuum Advance Attaching Screw (2)
24. Vacuum Advance Control
25. Felt Washer
26. Plastic Seal
27. Housing
28. Gear
29. Pin

Figure 8—HEI Distributor Components

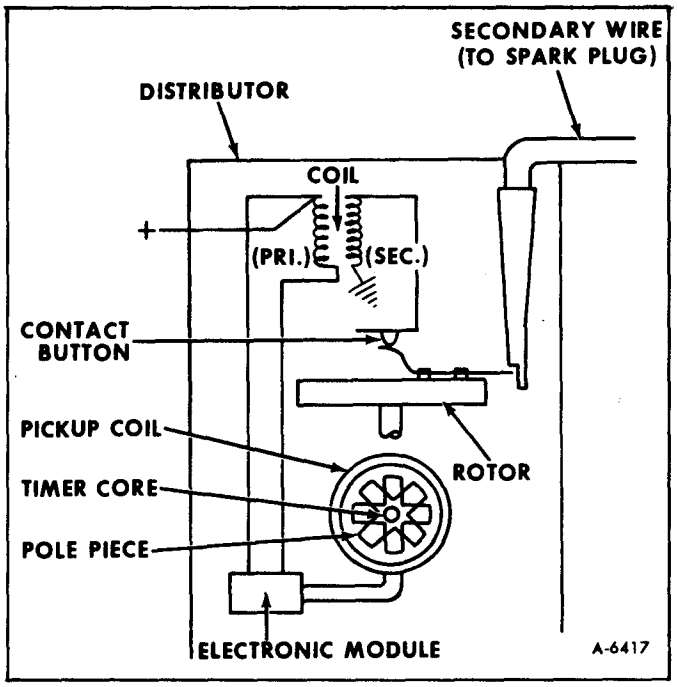


Figure 9—HEI Schematic

The higher current and instantaneous circuit triggering enables the HEI system to deliver up to approximately 35,000 volts through the secondary wiring to the spark plugs.

An exploded view of the HEI system is shown in figure 8.

HEI DISTRIBUTOR COMPONENTS

IGNITION COIL

In the eight cylinder HEI system, the ignition coil is built into the distributor cap. The coil is somewhat smaller physically than a conventional coil, but has more primary and secondary windings. It is built more like a true transformer with the windings surrounded by the laminated iron core. A conventional coil has the iron core inside the windings. Although the HEI coil operates in basically the same way as a conventional coil, it is more effective in generating higher secondary voltage when the primary circuit is broken.

ELECTRONIC MODULE

The electronic module (contained within the distributor) is a solid state unit containing five complete circuits.

These circuits control spark triggering, switching, current limiting, dwell control and distributor pick-up. Dwell angle is controlled by a transistor circuit within the module and is varied in direct relation to engine speed.

POLE PIECE AND PLATE ASSEMBLY

The pole piece and plate assembly (often referred to as the pick-up coil assembly) consists of the following:

1. A stationary pole piece with internal teeth.

2. A pick-up coil and magnet which are located between the pole piece and a bottom plate.

CENTRIFUGAL AND VACUUM ADVANCE

The centrifugal and vacuum advance mechanisms are basically the same types of units that provide spark advance in the breaker-type system. Centrifugal advance is achieved through the rotation of the timer core in relation to the distributor shaft. Vacuum advance is achieved by attaching the pick-up coil and pole piece to the vacuum advance unit actuating arm.

OTHER IGNITION COMPONENTS

BATTERY

Chassis batteries available on 1977 and 1978 Motorhome and TransMode vehicles are maintenancefree batteries. These batteries are completely sealed and are identified by the absense of vent plugs on the cover. Additional battery information can be found at the beginning of this section.

IGNITION SWITCH

The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly. For a complete explanation of the key and lock cylinder, and the actuator rod assembly, refer to the Steering Section (SEC. 9) of Maintenance Manual X-7525.

The ignition switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking. The ignition switch has five positions: OFF, LOCK, ACCESSORY, RUN and START. OFF is the center position of the key-lock cylinder, and LOCK is the next position to the left. ACCESSORY is located one more detent to the left of LOCK. Turning the key to the right of the OFF position until spring pressure is felt will put the ignition switch in the RUN position, and when turned fully to the right against spring pressure, the switch will be in

the START position.

All ignition switch have five terminals which are connected in different combinations for each of the three operating positions. A brass plate inside the switch has three contacts which connect these terminals . There is also a ground pin in the switch which contacts the "ground" terminal when the ignition switch is in the START position. This pin contacts the IGN. terminal when in the OFF position.

Ignition Start and Run Circuit

The ignition switch is fed from a junction at the horn relay to Bat. terminal of the switch. When the ignition switch is in the OFF position, no current flows through the switch. When the ignition switch is turned to the ACC. position, the BAT. terminal is connected to the ACC. terminal. This permits operation of accessories when the engine is not running.

When the ignition switch is turned to the START position, the BAT. terminal is connected to the SOL. and IGN. terminals. When the clutch or automatic transmission neutral start switches are closed, current flows to the starter solenoid. This energizes the solenoid windings. The solenoid has two sets of windings: a "pull-in winding and a "hold-in" winding. Both windings are used to create the magnetic field to actuate the solenoid plunger and move the starter pinion into engagement with the flywheel. As the solenoid plunger reaches the end of its travel, it closes a switch which connects battery voltage to the starter motor. With battery voltage applied to both terminals of the "pull-in" windings, the "pull-in" winding is no longer energized, so that only "hold-in" winding keeps the starter solenoid engaged.

During cranking, current is directed from the battery through the brass disc in the starter solenoid housing to the "B" terminal on the solenoid and then to the ignition coil.

NOTE: The instrument panel warning lights are fed from the ignition terminal of the ignition switch and have battery voltage applied to them when the ignitoin switch is in the START and RUN position. These circuits are explained in "Chassis Electrical" (Section 12) Maintenance Manual X7525.

When the ignition switch is released from the START to the RUN position, the BAT. terminal is connected to the IGN. terminal and the ACC terminal. This permits operation of all accessories and the ignition system.

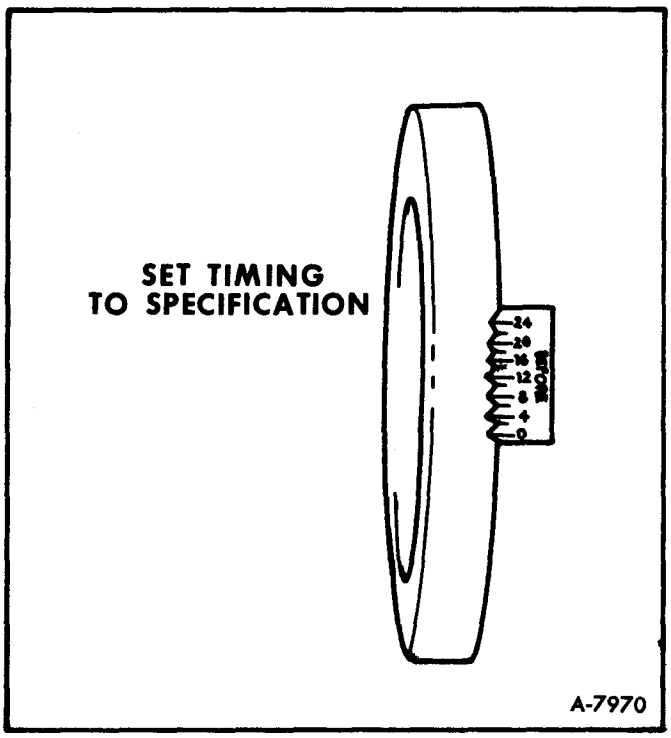


Figure 10—Timing Marks

IGNITION TIMING

The ignition timing marks are located on the engine front cover. A saw slot on the harmonic balancer indicates engine top dead center (figure 10).

Timing Light Connections

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 8mm diameter silicone rubber jacket. The silicone spark plug boots form a tight seal on the plug and the boot should be twisted 1/2 turn before removing. Care should also be exercised when connecting a timing light or other pick-up equipment.

When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. Do not pierce the plug lead because once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground and the spark plug will not fire correctly.

Tachometer Connections

There is a mechanics tachometer pick-up lead which may be used when setting ignition timing. Most tachometers can be used; however, be sure the equipment is compatible with the HEI system.

CAUTION: *Grounding the distributor tachometer terminal could damage the HEI electronic module.*

When using tachometer connect tachometer to the tach. pick-up terminal, then connect the tachometer to ground. Follow tachometer manufacturer's instructions.

TIMING PROCEDURE

To adjust ignition timing, proceed as follows:

NOTE: Air conditioning controls in instrument panel must be "OFF" when setting ignition timing.

1. Remove air cleaner and plug manifold vacuum fitting.
2. Disconnect distributor vacuum lines and plug vacuum source fittings.
3. Connect tachometer and adjust engine speed to correct rpm as listed on the vehicle emissions label located either on the engine rocker cover or on the air cleaner. 1977 model vehicles with 455 cu. in. engine must be set at 1100 rpm with transmission in "PARK"; 1977 and 1978 model vehicles with 403 cu. in. engine must be set as follows: California certified engines at 2,000 rpm with transmission in "PARK", Federal certified engines at 1,100 rpm with transmission in "PARK".
4. With the use of a timing light, set timing to 8^{o}DTCD (455 cu. in. engine) or 12^{o}BTDC (403 cu. in. engine) by loosening the distributor clamp bolt and rotating the distributor until the specification is obtained.

NOTE: The indicator has four "V" slots, each representing 4^{o}.

5. Tighten the distributor clamp bolt and recheck timing to make sure distributor was not moved during tightening of bolt.

6. Remove plug from vacuum source fittings and reconnect hoses to distributor and/or carburetor. Remove plug from manifold fitting, connect vacuum hose and install air cleaner.

SPARK PLUGS

Resistor-type, special gap spark plugs are used in engines covered by this manual.

Spark plugs are protected by an insulating boot made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. The boots prevent flash-over with resultant missing of the engine, even though a film is allowed to accumulate on exposed portion of plug insulators.

Do not mistake corona discharge for flash-over or a shorted insulator. Corona is a steady blue light appearing around insulator, just above the shell crimp. It is the visible evidence of high-tension field, and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high-speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat. This burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling, continual stop-and-go or slow-speed driving.

Factory installed spark plugs have a type number on the insulator which designates thread size as well as relative position of the plug in the Heat Range. Type numbers starting with 4 are 14 MM thread size.

The last digit of the type number indicates the Heat Range Position of the plug in the Heat Range System. These numbers are read the same as a thermometer—the higher the last digit, the hotter the plug will operate in the engine; the lower the last digit, the cooler the plug will operate.

Spark plug life is governed to a large extent by operating conditions, and plug life varies accordingly.

Worn and dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting, and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to dirty or leaded plugs, excessive gap, or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow, or blistered oxide deposits on the plugs. The black deposits are usually the result of slow speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn piston rings, faulty ignition, over-rich fuel mixture and spark plugs which are too "cold" will also result in carbon deposits. Red,

brown, or yellow oxide deposits, a consequence of the combustion of leaded fuel, usually result in spark plug failure under severe operating conditions.

The oxides have no adverse affect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulator which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out of the plug.

Excessive gap wear on plugs of low mileage usually indicates the engine is operating at speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used.

Too lean a fuel mixture will also result in excessive electrode wear.

Spark plug life will also be affected by incorrect timing of the engine which results in excessively high operating temperature.

Broken insulators are usually the result of improper installation or carelessness. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping, and generally are visible. This type of a break may result from the plug operating too "hot" such as encountered in sustained periods of high speed operation or under extremely heavy loads, especially if not installed correctly. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode (figure 11). Spark plugs with broken insulators should always be replaced.

Spark plugs, to give good performance in a particular engine, must operate within a certain temperature range, neither too hot nor too cool. If the spark plug remains too "cool", oil, soot, carbon, and lead components will deposit on the insulator, causing FOULING and MISSING. If the plug runs to "hot", the deposits accumulated on the insulator surface during continuous slow or stop-and-go driving may become blistered, electrodes will wear rapidly, and under extreme conditions, premature ignition (preignition) of the fuel mixture result. Either condition will seriously affect the performance of the engine.

The use of spark plugs in the proper heat range is of vital importance to good engine performance. Frequently, the wrong type of spark plug, one with an improper heat range for the engine, may have been installed when replacing spark plugs originally fitted by the engine manufacturer. Such misapplication may lead to poor performance.

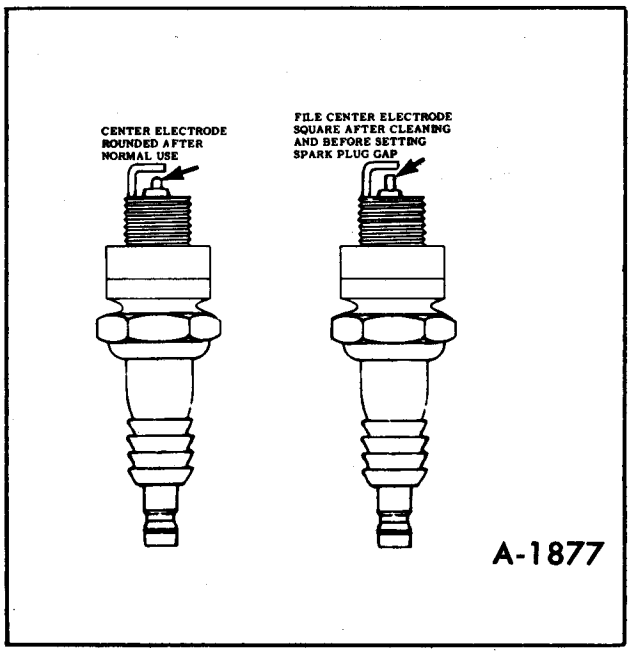


Figure 11—Spark Plug Electrodes

SPARK PLUG REPLACEMENT

Removal

Before removing any spark plug, blow all dirt and any foreign matter out of plug sockets in cylinder head.

1. Use care when removing spark plug wire boots from spark plugs. (Refer to "Spark Plug Wires" in this section.) Before removing, twist the boot 1/2 turn, and only pull on the boot to remove the wire.
2. Using a suitable spark plug wrench socket, remove spark plug. Ordinary wrenches may damage porcelain on plugs.

Inspection And Cleaning

Inspect plugs for cracked porcelain and burned electrodes, and check spark plug gap. Also check for loose terminals. Replace plugs which have excessively burned electrodes or cracked porcelain. Plugs should be cleaned with an abrasive- type cleaner. If porcelain is badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and number of heat range. Use a wire feeler gauge when checking spark plug gap.

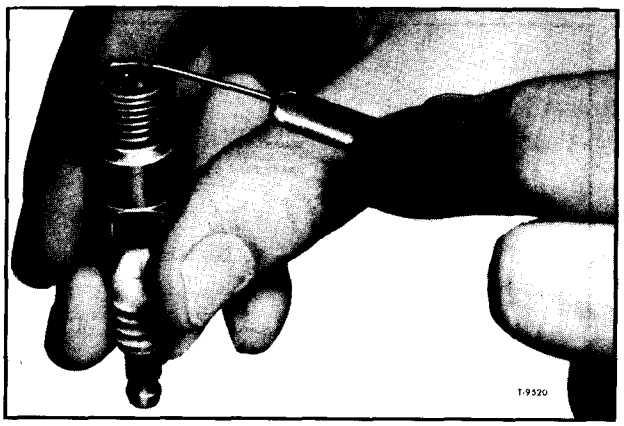


Figure 12—Checking Spark Plug Gap

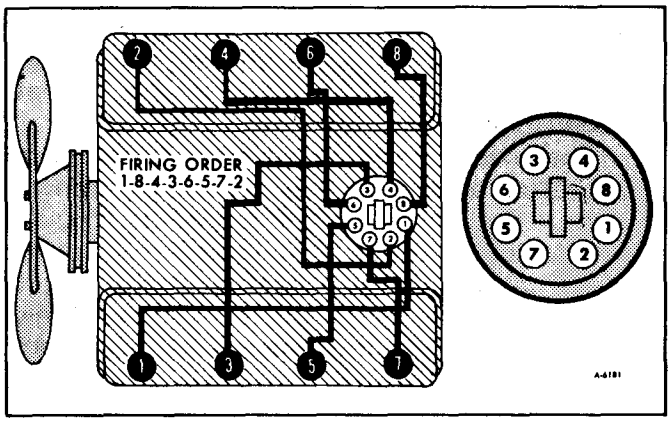


Figure 13—Secondary Wiring

Spark Plug Gap Adjustment

Setting spark plug gap is a precision operation and should be treated as such. Refer to "Specifications", at end of this section for proper gap dimensions. All plugs must be set to the same dimension, using a standard round feeler gauge (figure 12).

CAUTION: *Before adjusting gap, file center electrode flat (used plugs only). In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center as this may break the lower insulator. Always make adjustment by bending the grounding or side electrode.*

Installation

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly will cause radio ignition noise, crossfiring of plugs or shorting of the leads to ground.

Improper installation is one of the greatest single causes of unsatisfactory spark plug performance and is the result of one or more of the following practices:

1. Installation of plugs using excessive torque which changes the gap setting.
2. Installation of plugs using insufficient torque to fully seat the plug.
3. Installation of plugs into corroded spark plug hole threads.

Failure to install plugs properly will cause them to operate at excessively high temperatures and result in reduced operating life under mild operation or complete destruction under severe operation where the intense heat cannot be dissipated rapidly enough.

Also, check to be sure that spark plug threads and cylinder head threads are not dirty or damaged. Dirty or damaged threads cause a faulty torque reading, resulting in incorrect installation and consequent poor spark plug life and faulty operation.

1. Install spark plugs in the engine and tighten finger tight.

CAUTION: *Refer to "Caution" on page one of this section.*

2. Using a suitable spark plug wrench socket and torque wrench, tighten plugs to 26 ft. lbs. torque. The proper socket must be used in torquing plugs because an ordinary socket will bind against the cylinder head and give a false torque reading.

Spark plugs which are not tightened properly will result in too high an operating temperature (if too loose) or distortion of the spark plug body and gap setting (if too tight).

SPARK PLUG WIRES
(FIGURES 13 and 14)

Because of the higher voltage, the HEI system has larger diameter (8 millimeter) spark plug wires with silicone insulation. This silicone wire is gray in color, more heat resistant than standard black wire and less vulnerable to deterioration. However, silicone insulation is soft and very pliable, so that scuffing and cutting is easier than on standard black wires. It is important that these more pliable cables not be mishandled and that they be routed correctly to prevent chafing or cutting.

The silicone spark plug wire boots seal more tightly to the spark plugs than ordinary boots. Removal of boots from spark plugs must be done with care. The old practice of pulling them by the wires or with pliers will almost always cause damage to the boot or wire joint. It is recommended that the boot be twisted about a half turn in either direction to break

the seal before pulling on the boot to remove the wire.

The spark plug cable retainer is designed to hold the wires firmly to prevent chafing or cutting. The wires in the retainer cannot be repositioned until the cable retainer is unlocked. Any attempt to pull the spark plug wires with the retainer in lock position could result in damage to the plug wires. To unlock the cable retainer, use a small screwdriver between the tab and the lock.

To remove wiring harness from cap, release wiring harness from latch and remove wiring harness, both right and left side (refer to figure 14).

WARNING: DO NOT REMOVE SPARK PLUG WIRES WITH THE ENGINE RUNNING. THE HIGHER SECONDARY VOLTAGE IS CAPABLE OF JUMPING AN ARC OF GREATER DISTANCE AND COULD CAUSE AN ELECTRIC SHOCK. OPERATING THE ENGINE WITH ONE OR MORE SPARK PLUG WIRES DISCONNECTED CAN ALSO RESULT IN DAMAGE TO THE DISTRIBUTOR CAP.

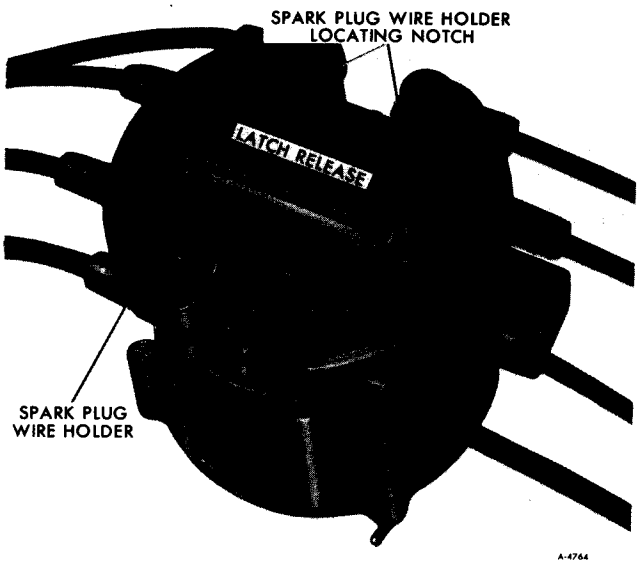


Figure 14—Distributor Cap Wiring

Checking Spark Plug Wires

For information on checking of spark plug wires, refer to "DIAGNOSIS OF SPARK PLUG WIRES" in this section.

HEI SYSTEM DIAGNOSIS

SPARK PLUG WIRE DIAGNOSIS

Resistance specifications for both 7mm wires used with standard systems and 8mm wires used with HEI systems are identical (3,000 to 5,000 ohms per foot). Inspect all spark plug wires for high resistance and continuity with an ohmmeter.

OHMMETER TEST

NOTE: For proper operation, it is necessary to keep ignition wires and distributor clean and free of any dirt or corrosion.

1. Disconnect both ends of ignition cable being tested and clean terminals.
2. Set ohmmeter on high scale and connect ohmmeter to each end of cable being tested. Twist cable gently while observing ohmmeter.
3. If ohmmeter reads above 25,000 ohms or fluctuates from infinity to any value, replace cable being tested.
4. If the resistance of each cable is not within the following bands, replace the cable being tested: (for example)

0 to 15" cable - 3,000/10,000 ohms
15 to 25" cable - 4,000/15,000 ohms
25 to 35" cable - 6,000/25,000 ohms

INSULATION TEST

If the engine periodically runs rough, stalls, or won't start, the problem could be related to precipitation, condensation, or road splash situation which coats the ignition system with moisture. To determine if this is the trouble, the following procedure can be used:

1. Carefully remove the distributor spark plug and coil wire retaining cap (hard hat) from the distributor. Then remove the spark plug and coil nipples from the retainer and reconnect them to the distributor.
2. Connect a ground probe to the engine. (The probe can be made by attaching one end of a 3-foot insulated wire to a screwdriver blade and the other end to a suitable engine ground.)
3. Start the engine and let it idle at the hot rpm specification.
4. Use a water spray bottle (household cleaning solution bottle with manual spray pump) to wet the insulation, simulating the conditions it might encounter in wet weather driving.

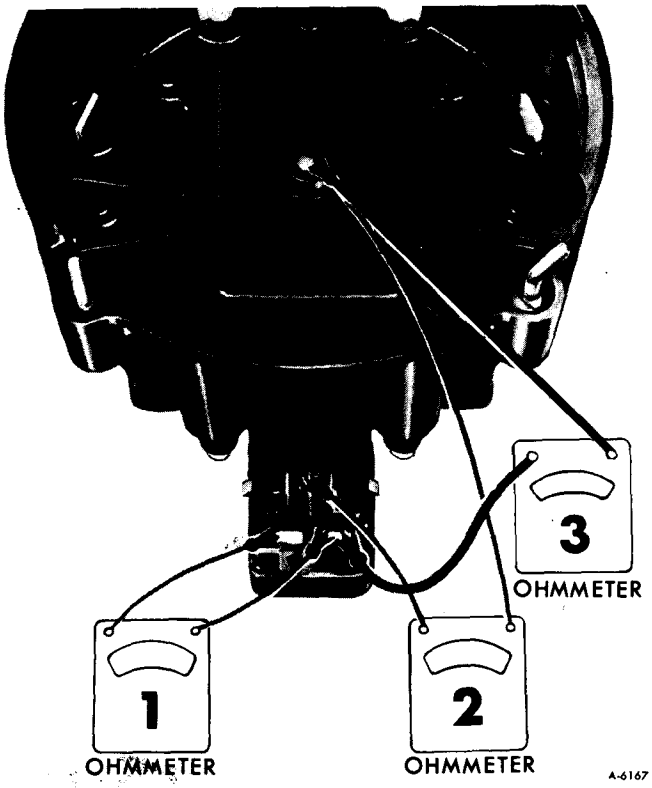


Figure 15—Ohmmeter Check of Ignition Coil

5. Starting at either end of the suspect wire, thoroughly trace the insulation of the wire, boot and nipple, observing for spark jumping through the insulation to the test probe.

6. Use particular care to probe the underside and lower edges of the spark plug boot. Also, carefully probe the joint areas where the wire enters the boot and nipple.

7. Test the suspect wire(s) for internal conductor damage using the ohmmeter procedure described previously.

It is recommended that the aforementioned procedure be performed in subdued light. It should be noted, however, that a faint arcing or "corona phenomena" (a faint glow adjacent to the surface of an electrical conductor at high voltage) will always be present in various degrees of intensity, dependent on humidity and lighting conditions. This condition is not usually indicative of enough leakage to produce the subject complaint unless the engine falters noticeably.

If a strong arc or any opening in the insulation of wire, boot or nipple is observed and the engine falters noticeably, the wires(s) should be replaced.

CAUTION: *Plug wires are damaged by Refrigerant-12. When charging air conditioning system, avoid Refrigerant-12 contact with spark plug wires. If air conditioning system has had a leakage failure, check spark plug wires as described above.*

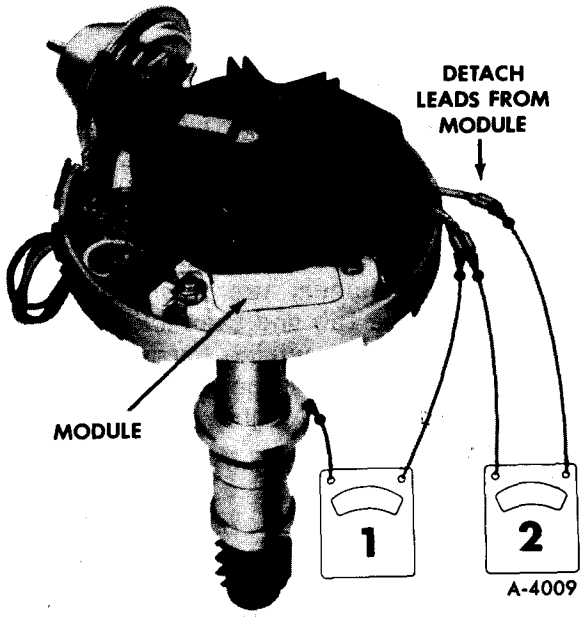


Figure 16—Ohmmeter Check of Pick-Up Coil

DISTRIBUTOR COMPONENT DIAGNOSIS USING OHMMETER

IGNITION COIL TEST

1. Remove distributor cap and coil assembly by disengaging the four locking latches.

2. Inspect the distributor cap and coil assembly. Inspect rotor for spark arc-over.

3. Check primary coil. Connect ohmmeter as shown in figure 15, step 1. Use low ohmmeter scale and the reading should be zero; however, if it is not, replace the coil.

4. Check the secondary of the coil by connecting an ohmmeter as shown in figure 15, step 2. Using the high scale of the ohmmeter, the reading should be high but not infinite. If the reading is infinite, check the distributor cap and carbon button for arced or burned condition. If the cap and rotor button are not defective, replace ignition coil.

5. As shown in figure 15, step 3, check the primary and secondary in order to determine if they are shorted together. The ohmmeter reading should be infinite. Refer to figure 8 for additional information.

PICK-UP COIL TEST

1. In order to test the pick-up coil for an open, connect an ohmmeter as shown in figure 16, step 1. Use the ohmmeter middle scale. If the ohmmeter reads less than 500 ohms or

more than 1500 ohms while flexing the leads, replace the pick-up coil.

2. If the pick-up coil does not have an open, check the pick-up coil for ground as shown in figure 16,step 2. If the reading on the high scale is infinite, the pick-up coil is good.

HIGH ENERGY IGNITION SYSTEM DIAGNOSIS WITH TESTER J-24642

If engine will not start, perform this on-vehicle test of the ignition system BEFORE checking HEI module with tester J-24642:

1. Insure that wiring connector is properly attached to connector at side of distributor.

2. Check that all spark plug leads are properly connected at distributor (figure 17) and spark plugs.

3. Connect voltmeter or test light from "BAT" terminal lead on distributor to ground (figure 5).

4. Turn on ignition switch. If voltage is zero or test light does not come on, repair open circuit between "BAT" terminal and battery.

5. When reading is battery voltage, or test light lights, remove one spark plug lead by twisting spark plug boot to loosen. Insert extension, hold spark plug lead with insulated pliers so extension is 1/4" away from dry area of engine block while cranking engine, or install any good spark plug with proper gap in lead and lay on engine block while cranking engine.

6. If sparking occurs trouble is not ignition distributor. Check fuel system and spark plugs. Check timing. Distributor may have shifted.

7. If no spark, make test No. 1 with Module Tester J-24642 or equivalent.

TESTING TESTER J-24642

Before module tester J-24642 is used, proper operation of tester can be verified by the use of special tool J-24642-101, Tester Verification Kit.

The series of checks in the verification procedure are performed with the following items:

1. A test resistor-connector J-24642-101 (100 Ohms $\pm$ 5%, 2 Watts).
2. A known good HEI module.
3. A fully charged 12-volt automotive battery.
4. A jumper wire (18 ga. x 20" is adequate).
5. The J-24642 tester.

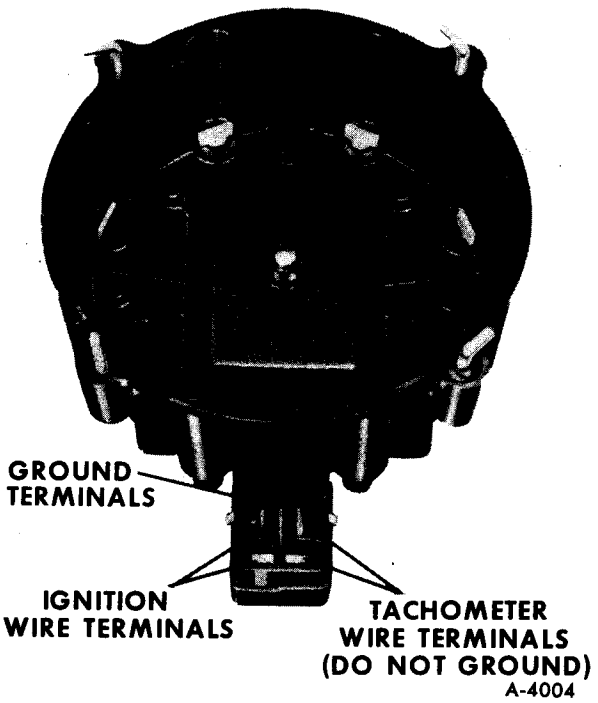


Figure 17—Terminals on Distributor Cap

Check. No. 1

1. Connect the tester's battery cable to a fully charged automotive battery (11-1/2 to 12-1/2 volts), with red lead of tester to battery positive terminal (+) and black lead of tester to battery negative terminal (-). Make no other connections to the tester.

Observe both indicator lights. If either or both lights are on, the module tester is defective.

2. Press the "TEST" button and observe the lights.

RED "REPLACE" light should come on and stay on.

GREEN "GOOD" light should remain off.

The tester is defective if these two conditions are not met.

Check No. 2

1. Connect the tester and a known good HEI module in the following manner:

A. Connect the two-way connector of the tester to the module.

B. Connect the green and white tester leads to the corresponding "G" and "W" terminals of the module.

C. Connect red lead of tester to 12-volt automotive battery positive (+) terminal and black lead of tester to battery negative (-) terminal.

D. Connect ground lead of tester to HEI module ground terminal. The module ground is located at the mounting screw hold-down nearest two-way connector terminals.

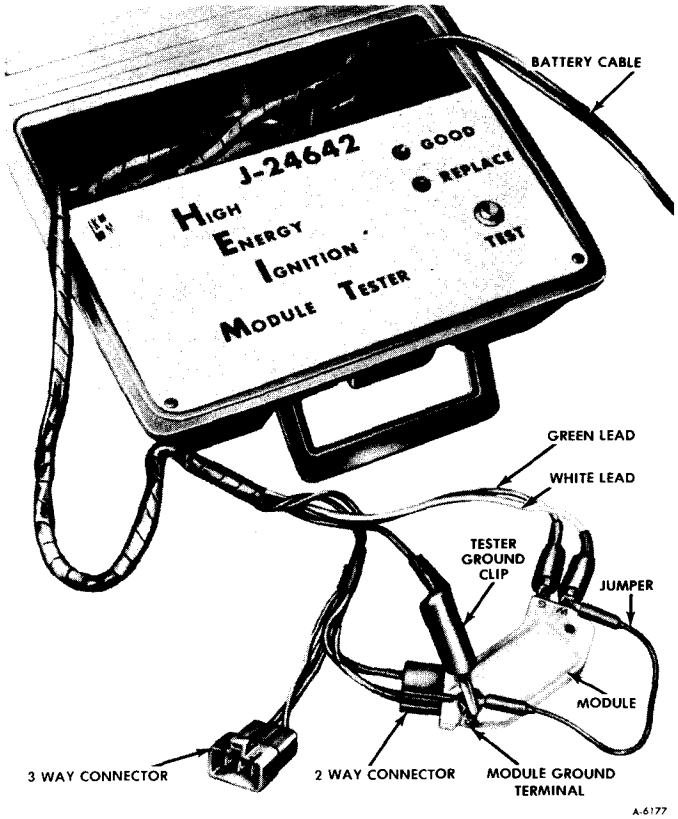


Figure 18—Check No. 3 with Tester J-24642-101

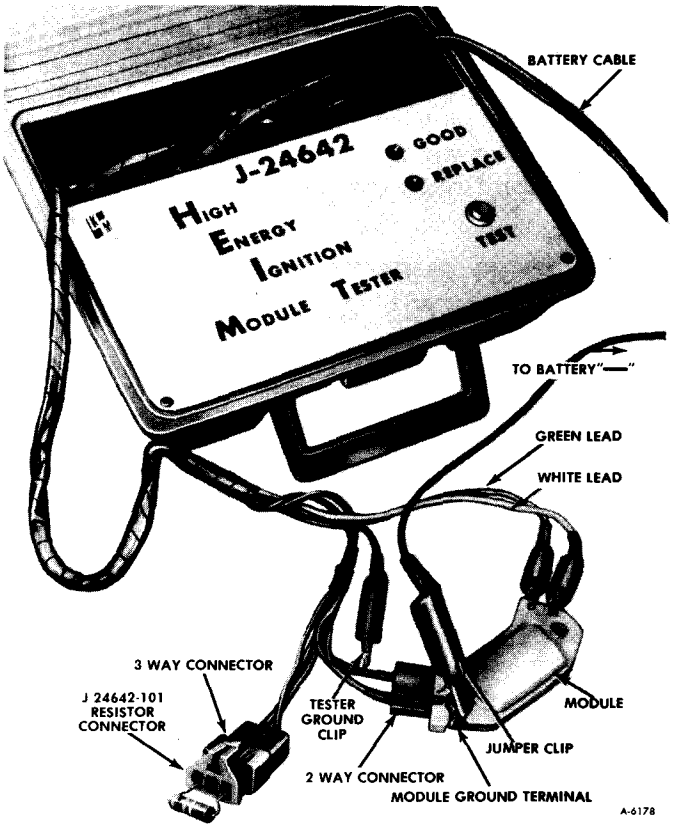


Figure 19—Check No. 4 With Tester J-24642-101

2. Press "TEST" button and observe the lights.

RED "REPLACE" light should come on momentarily and then go out.

GREEN "GOOD" light should come one and stay on.

If not, the tester is defective.

Check No. 3

1. To the setup of Check 2, add a jumper wire connecting the "W" and ground "G" terminal of the module as shown in figure 18.

NOTE: Do not connect the jumper from the "G" terminal of the HEI module to ground as damage to the tester will result.

2. Press "TEST" button and observe the lights.

RED "REPLACE" light should come on and stay on as long as button is held down.

GREEN "GOOD" light should remain off.

Tester is defective if these two conditions are not met.

Check No. 4

1. From the setup of Check 3, remove the jumper wire. Disconnect the tester ground lead from the module ground terminal. Using a jumper wire, connect the module ground lead to the negative terminal of the battery. Plug the J-24642-101 resistor-connector (or equivalent) into the 3-way connector as shown in figure 19.

2. Press the "TEST" button and observe the lights.

RED "REPLACE" light should come on and stay on.

If GREEN "GOOD" light comes on while the button is pressed, the tester is defective.

When the tester has passed these four checks, its proper operation is verified. You may now begin diagnosis of the high energy ignition system.

TESTING PROCEDURE FOR HEI MODULE USING TESTER J-24642

The module tester provides the means of checking the HEI module in or out of the vehicle. It operates by generating a signal equivalent to the pick-up coil signal, measuring the output of the HEI module and determining whether or not it is within the specified range. There are three tests and some subtests performed by the tester. TEST 1 is used if the vehicle does not run, TEST 2 if the vehicle runs but not satisfactorily, and TEST 3 if the module is out of the vehicle and must be checked. In all tests, the battery must be fully charged. Low voltage or slow cranking speeds

will result in a false "REPLACE" indication.

Test No. 1 - CRANK TEST, Distributor Cap in Place (Engine does not run) (Figure 20)

1. Disconnect (pull) module 3-way harness connector from its socket in the side of the distributor cap.
2. Connect 3-way connector of tester J-24642 to the module harness connector.

NOTE: The 3-way connector should connect only one way to the module connector. Match wire colors between module connector and tester 3-way connector.

3. Connect red lead of tester J-24642 to battery positive (+) terminal and black lead to battery negative (-) terminal.
4. Crank engine, press and hold "TEST" button.

NOTE: During cranking, battery voltage must be 9 volts or more and engine speed 100 rpm or more for tester to be accurate.

5. A momentary indication on the red "REPLACE" light and then a steady indication on the green "GOOD" light means that both the HEI module and the pick-up coil are good. Proceed to step 6. A steady indication of the red "REPLACE" light means that either the pick-up coil or the HEI module is defective. Check the HEI module with TEST 2 and check the pick-up coil with ohmmeter (see chart on diagnosing the HEI system without use of module tester).

NOTE: A tester check is complete within a few seconds. Prolonged holding of the "TEST" button in excess of 15 seconds will cause the module and/or the resistor to heat and may produce erratic test results or damage to the resistor, module or tester.

6. If pick-up coil and module test good, remove distributor cap and coil assembly by turning four latches.
7. Check primary of ignition coil in cap for continuity with an ohmmeter. (Refer to figure 15, step 1.) Reading should be zero or near zero. If not, replace ignition coil. After coil is replaced, proceed to steps 10 and 11.
8. Check secondary of coil (figure 15, step 2.) Use high scale. Reading should not be infinite. If everything checks good to this point, the HEI system is good.
9. If reading is infinite, check cap and rotor

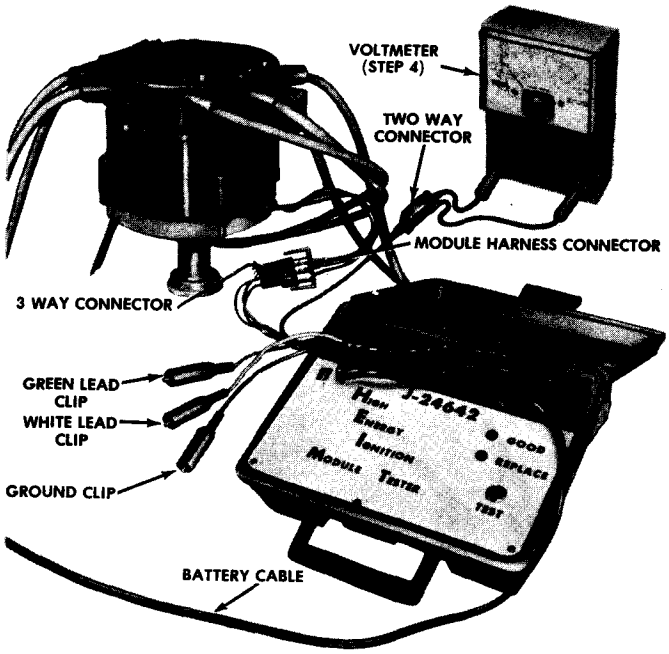


Figure 20—Test No. 1, Using Tool J-24642 (Crank Test)

button for arced or burned condition. If necessary, replace cap. If cap and carbon button do not appear defective, replace ignition coil. After ignition coil is replaced, proceed with steps 10 and 11.

10. Continue module check by connecting a voltmeter to the two-way connector, the red lead to the positive (+) terminal and the brown lead to the negative (-) terminal. Select the scale which best covers the 0-10 volt DC range. The meter should read "zero" volts.
11. Press and hold the "TEST" button. The voltmeter should continue to read "zero" volts. If the meter gives a voltage indication, the module is defective and should be replaced.

Test 2 - MODULE IN VEHICLE, Distributor Cap Removed (Engine runs Poorly) (Figure 21)

1. Perform steps 1 through 4 of TEST 1.
2. Disconnect green and white pick-up coil leads from the HEI module and attach the green and white tester leads to the "G" and "W" terminals of the module.
3. Press and hold the "TEST" button. A momentary indication on the red "REPLACE" light, then a steady indication on the green "GOOD" light means the HEI module is good. A steady indication on the red "REPLACE" light means that the module is defective and should be replaced. If the module is good, check the pick-up coil (See steps C-9 and C-10 of High Energy Ignition Diagnosis Chart later in this section.)

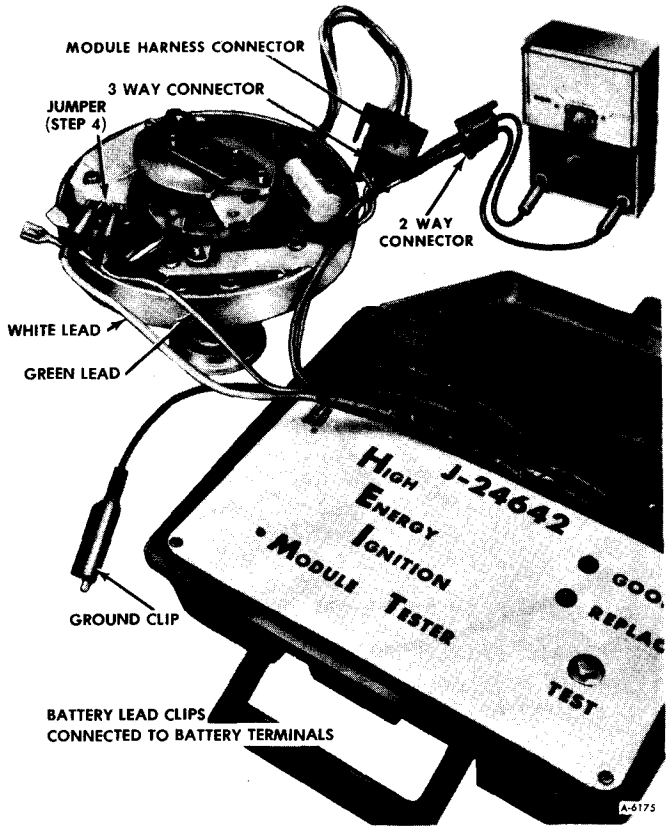


Figure 21—Test No. 2, Using Tool J-24642

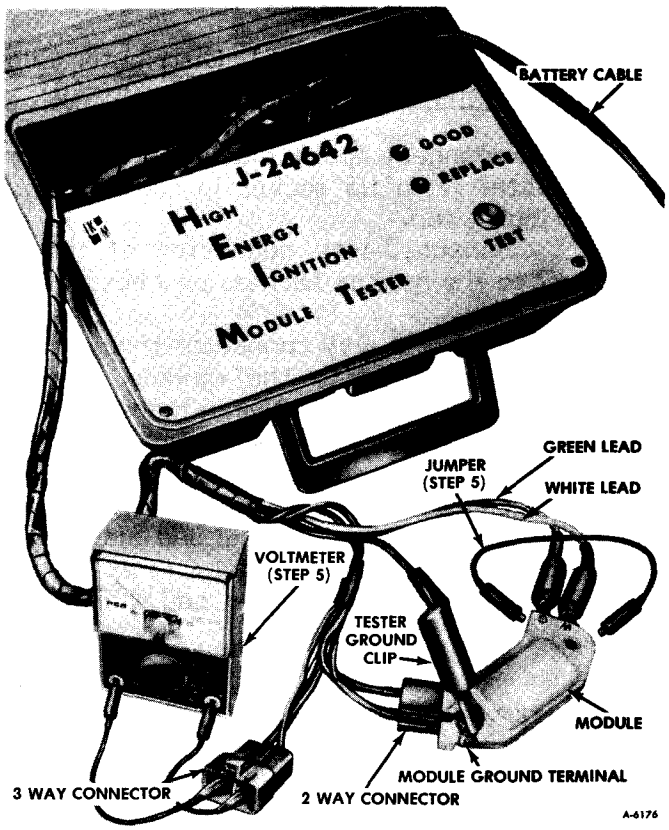


Figure 22—Test No. 3, Using Tool J-24642

4. Check the ignition coil primary for continuity with an ohmmeter (figure 15, step 1). Reading should be zero or near zero. If everything checks good to this point, the HEI system is good. If the coil is open, replace it and proceed with steps 10 and 11 of Test 1.

Test 3 - MODULE OUT OF DISTRIBUTOR (Figure 22)

1. Connect the two-way connector of the tester to the HEI module and the green and white tester leads to the corresponding "G" and "W" terminals of the module.

2. Connect red lead of tester to battery positive (+) terminal of 12-volt automotive battery, and black lead of tester to battery negative (-) terminal.

3. Connect ground clip of tester to HEI module ground terminal. The module ground is located at the mounting screw hold-down nearest two-way connector terminals.

4. Press and hold the "TEST" button. A momentary indication of the red "REPLACE" light, then a steady indication of the green "GOOD" light means that the module is good. A steady indication on the red "REPLACE" light means the module is defective and should be replaced.

5. Perform steps 10 and 11 of TEST 1, except connect the voltmeter in this check to the 3-way connector, as shown in figure 22.

DIAGNOSING HIGH ENERGY IGNITION SYSTEM WITHOUT USE OF MODULE TESTER J-24642

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Careful adherence to the following procedures will lead to the location and correction of HEI system problems. Normally only a portion of the procedures need be performed.

1. Insure that wiring connector is properly attached to connector at side of distributor.
2. Insure that all spark plug leads are properly connected at distributor and spark plugs.

SYSTEM CHECKS ON THE VEHICLE

A. ENGINE WILL NOT START. USE VOLTMETER OR TESTLIGHT.

A-1. Connect voltmeter from "BAT" terminal lead on distributor to ground.

A-2. Turn on ignition switch.

A-3. If voltage is zero, repair open circuit between "BAT" terminal and battery.

A-4. If reading is Battery voltage, twist spark plug boot to loosen, remove lead, insert extension, hold spark plug lead with insulating pliers so extension is ¼" away from dry area of engine block while cranking engine or remove one spark plug lead. Install any good spark plug with proper gap in lead and lay on engine block while cranking engine.

A-5. If sparking occurs trouble is not ignition distributor.

A-6. Check fuel system and spark plugs and secondary wiring. Check timing (distributor shifted).

A-7. Proceed to Component Checks.

B. ENGINE RUNS ROUGH.

B-1. Insure that proper fuel is being delivered to carburetor.

B-2. Check all hoses for leakage.

B-3. Visually inspect and listen for sparks jumping to ground.

B-4. Check initial timing (distributor shifted).

B-5. Check centrifugal advance on engine.

B-6. Twist boots to loosen, remove all spark plugs and check for usual defects – proper gap, fouling, cracked insulators, inside and out, etc. Check secondary wiring.

B-7. If no defects are found follow procedure under Component Checks.

C. COMPONENT CHECKS USING OHMMETER.

C-1. Remove cap and coil assembly by turning four locking latches.

C-2. Inspect cap and coil assembly and rotor for spark arc-over.

C-3. Check primary coil. Connect ohmmeter, Step 1, Figure 14. Use low scale. Reading should be zero. If not, replace coil.

C-4. Check secondary of coil. Connect ohmmeter, Step 2, Figure 14. Use high scale. Reading should be high but not infinite.

C-5. If reading is infinite, check cap and carbon button for arced or burned condition. If necessary, replace cap. If cap and rotor button do not appear defective, replace ignition coil.

C-6. In Step 3, Figure 14, check that primary and secondary are not shorted together. Refer to Figure 25. Reading should be infinite.

C-7. Connect test stand vacuum source to vacuum unit.

C-8. If vacuum unit is inoperative, replace.

C-9. Check pick-up coil for broken wire or open. Connect ohmmeter, Step 1, Figure 15. Use middle scale. If ohmmeter reads less than 500 ohms or more than 1500 ohms (while flexing leads) replace pick-up coil. (C-11 below).

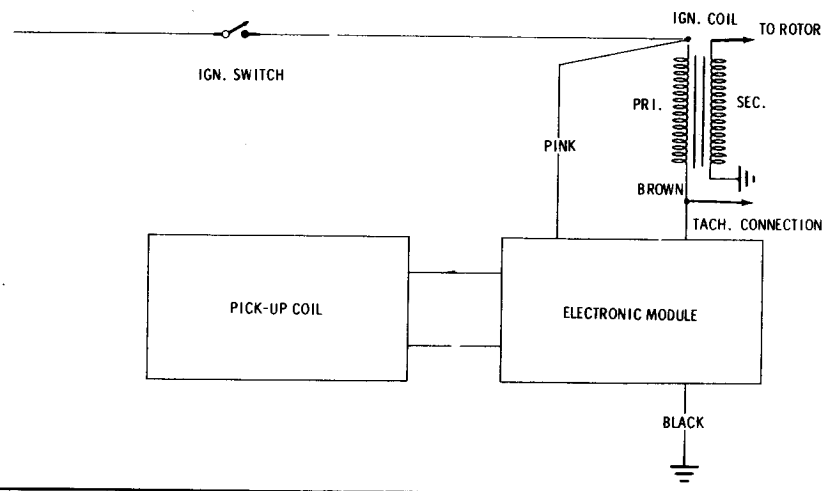
C-10. If Step 1 is ok, check pick-up coil for ground with ohmmeter, Step 2, Figure 15. Use high scale. If reading is not infinite (no deflection on meter) replace coil. (C-11 below).

C-11. Remove unit from engine, remove rotor and shaft assembly from housing and remove thin "C" washer to replace pick-up coil (refer to distributor component repair).

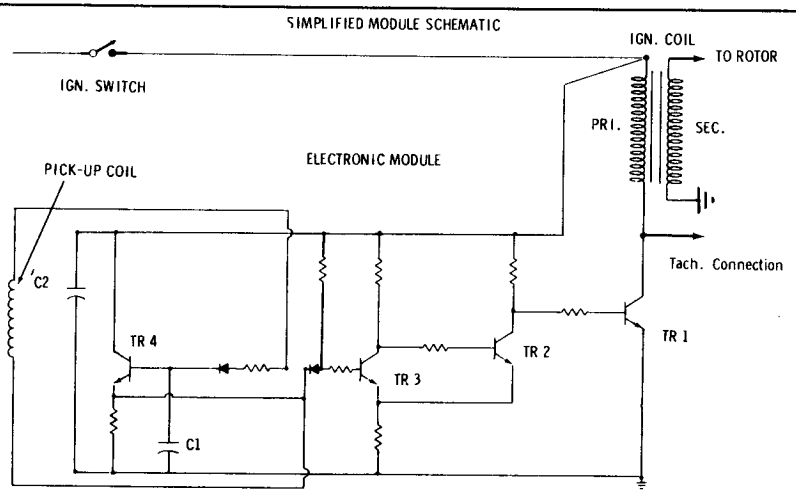
C-12. If no defects have been found, remove connector and two attaching screws and replace module.

Figure 23—Diagnosing High Energy Ignition System Without Use of Module Tester J-24642

HIGH ENERGY IGNITION DIAGNOSIS WITH OSCILLOSCOPE



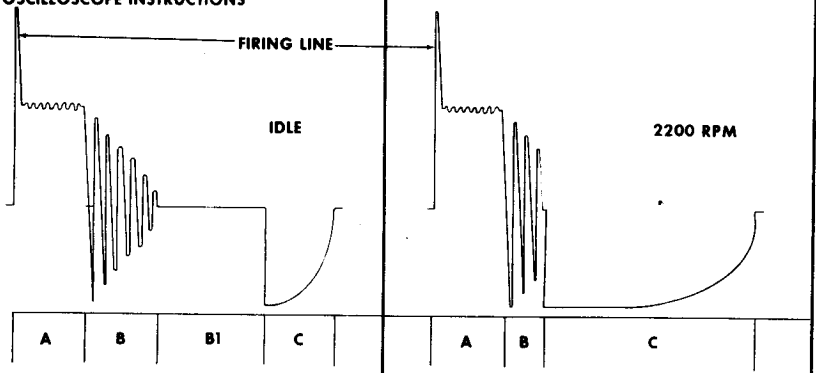
SIMPLIFIED MODULE SCHEMATIC



Dwell mode - TR1 - ON; TR2 - OFF; TR3 - ON. Signal at Pick-up Coil turns TR3 OFF, charges C1 and turns on TR4. This results in Firing Mode: TR1 - OFF; TR2 - ON, and TR3 - OFF. The reduced primary current induces a high voltage in the secondary windings firing the spark plug.

TR4 stays on until C1 is discharged. When C1 is discharged TR3 turns on returning to Dwell Mode. At higher engine speeds, C1 charges less and less, resulting in reduced firing times, and thus longer Dwell periods. This is how the Dwell Zone expands. C2 is capacitor in distributor for radio suppression.

OSCILLOSCOPE INSTRUCTIONS



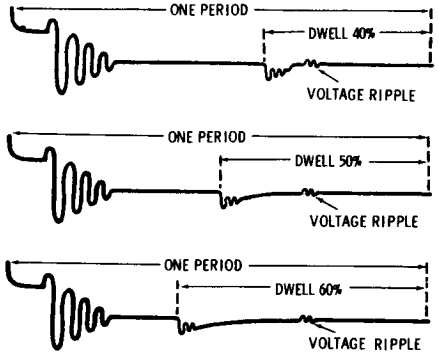
PATTERN FOR ONE CYLINDER ONLY

Scope Instructions:
1. Scope secondary pick-up can not be connected since center coil terminal is inside distributor.
2. Connect pick-up to #1 spark plug as usual.
3. Connect primary pick-up to "Tach" terminal of distributor.

This will display primary pattern in parade only.
(NOTE: A special adapter placed on top of the coil-cap assembly may be used with some scopes to view the Secondary pattern. The output voltage will read low with the adapter; this is normal.)

Scope pattern
A. Spark Zone - spark plug arcing
B. Coil - Condenser Zone
B1. Firing Zone - no plug arc
C. Dwell Zone - module on, current through coil primary

TYPICAL SCOPE PATTERNS
(SEE YOUR EQUIPMENT MFG. FOR ACTUAL PATTERNS)



SECONDARY VOLTAGE PATTERNS

It is normal if dwell time varies from cylinder to cylinder. A 40% to 60% variation is shown, it could be more or less. The voltage ripple shown may or may not be seen, either is normal. Variation in dwell time or voltage ripple as shown does NOT indicate a bad module.

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Figure 24—HEI Distributor Scope Pattern Information

HIGH ENERGY IGNITION DIAGNOSIS WITH OSCILLOSCOPE

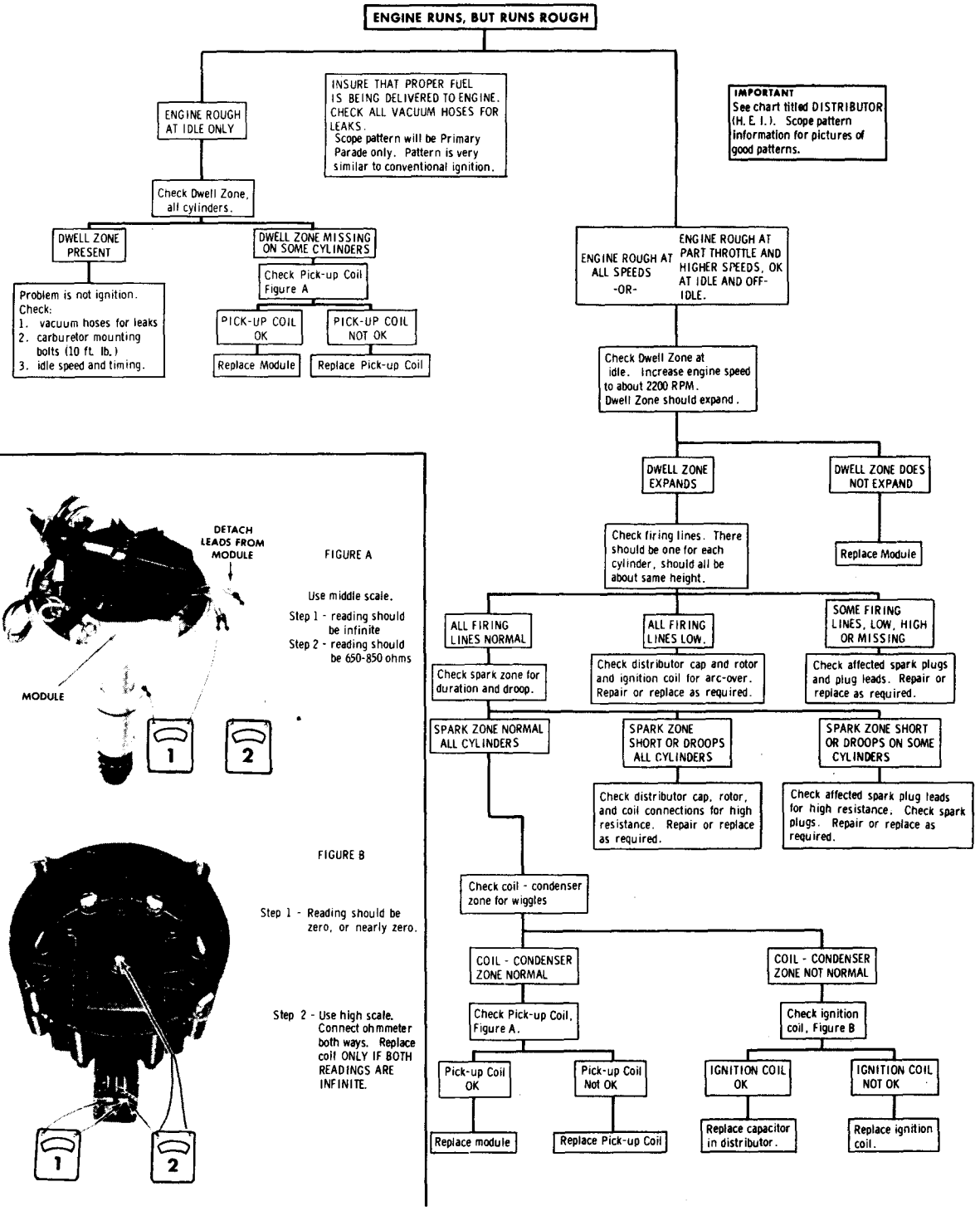


Figure 25—High Energy Ignition Diagnosis With Oscilliscope

HEI SYSTEM SERVICE

SERVICING PRECAUTIONS

NOTE: For HEI systems, engine diagnostic analyzers using oscilliscopes will require a special adapter and distributor machines will also require modifications. Major manufacturers of such equipment have instructions on how such modificatoins can be performed on their equipment.

The HEI system is capable of producing up to 35,000 volts as compared to 25,000 volts with conventional systems. Use care when working with these higher voltages to avoid contact with high voltage points such as spark plug leads.

Care should be taken when connecting timing light or other pick-up equipment. Use proper adapters. Do not force contacts between the boot and secondary wiring and do not puncture the silicone jackets (the high voltage available will cause arcing from the puncture point to ground).

If secondary wiring is punctured or burned, it must be replaced to prevent misfiring. If boots and nipples on the spark plug wires are damaged, the arc will also go to ground, causing misfiring.

Care should be used when connecting battery or in jump starting with the battery. Reversing the connections or polarity could cause damage to electronic module.

Also do not operate the engine with one or more spark plugs wires disconnected. (To do so may cause arcing to occur in the distributor cap and cause carbon tracking.)

Do not ground the tachometer connection. This could cause damage to the electronic module. (Make certain that tachometer is designed for HEI operation.)

When making compression checks, the ignition switch connector should be disconnected from the HEI distributor.

ELECTRONIC MODULE

The electronic module is serviced by complete replacement only. When replacing the module, small "dabs" of special silicone grease MUST be applied to the flat portion of the module which will rest on the metal mounting surface. If this grease is not applied the module will not cool properly, which can cause the module to malfunction. A tube of this special silicone grease is supplied with each replacement module. Make certain the replacement module is the correct part number.

CAUTION: *When connecting battery, as in jump starting, reversing connections or polarity can result in damage to the electronic module.*

POLE PIECE AND PLATE ASSEMBLY

The pole piece and plate assembly (often referred to as the pick-up coil assembly) is also serviced by complete replacement only. Make certain the replacement assembly is the correct part number. Production vehicles contain pick-up coils with leads that terminate in a yellow connector body that attaches to the module. The pole piece and plate assembly should not be unnecessarily disassembled as the polarity of the assembly could be changed and affect proper operation of the vehicle.

SPARK PLUG WIRES

HEI system spark plug wires are soft and very pliable, so that scuffing and cutting is easier than on standard black wires. When servicing the HEI system, do not mishandle these cables.

Use care when removing spark plug wire boots from spark plugs. The silicone spark plug wire boots seal more tightly to the spark plugs than ordinary boots. Twist the boot about 1/2 turn in each direction before removing, and pull on the boot only to remove the wire.

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

If it is necessary to remove an individual wire from the wiring harness assembly, hold grommet of wire down and press retainer tab out of wire holder. To reinstall, lightly lubricate tab end of spark plug wire with silicone. Rotate wire until seated in holder.

COMPONENT REPLACEMENT

DISTRIBUTOR REPLACEMENT

REMOVAL

1. Disconnect wiring harness connectors at distributor cap terminals.
2. Remove distributor cap from housing by releasing four cap retaining latches. Position cap out of way.

NOTE: Be careful not to damage latches. Position screwdriver at top of latch and turn.

3. Disconnect vacuum advance hose from vacuum advance mechanism.
4. Scribe a mark on engine in line with direction the rotor points. Note and mark position of distributor housing in relation to engine.

NOTE: To insure correct timing of the distributor, the distributor must be installed with the rotor correctly positioned.

5. Remove distributor clamp screw and hold-down clamp.
6. Slowly lift distributor from engine and mark position rotor points as teeth on distributor disengage from teeth on camshaft.

INSTALLATION

1. Push the distributor down into position in the engine block.
2. Install distributor hold-down clamp and tighten clamp screw snugly.
3. Move distributor housing to approximate position relative to engine as noted during removal.
4. Position distributor cap to housing with tab in base of cap aligned with notch in housing; secure cap with four latches.
5. Connect wiring harness connector to terminals on side of distributor cap. Connector will fit only one way. Connect battery ground cable.
6. Adjust ignition timing to Specifications as described earlier in this section. Tighten hold-down clamp screw securely.

Installation—Engine Disturbed

NOTE: To insure correct timing of the distributor, the distributor must be installed with the rotor correctly positioned.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing the distributor.

1. Remove No. 1 spark plug.
2. Disconnect feed wire connector at the "BAT" terminal from distributor to prevent engine from starting.
3. Place finger over No. 1 spark plug hole and crank engine slowly until compressor is felt.
4. Align timing mark on crankshaft pulley to "O" on engine timing indicator.
5. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor.
6. Install distributor and connect feed wire.
7. Install distributor cap and spark plug wires.
8. Check engine timing.

DISTRIBUTOR DISASSEMBLY

Following is the complete distributor disassembly of which part or all can be used as required.

1. Remove distributor from engine as described above.
2. Remove rotor (figure 26) from distributor shaft by removing two screws.

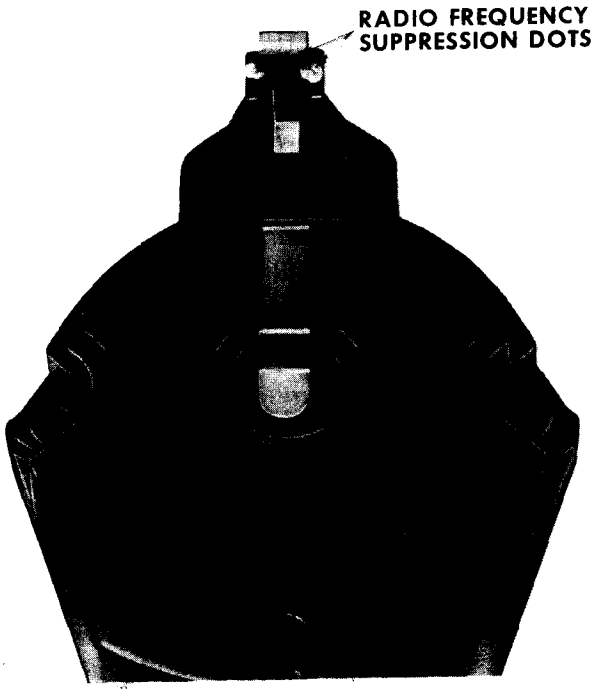


Figure 26—HEI Rotor

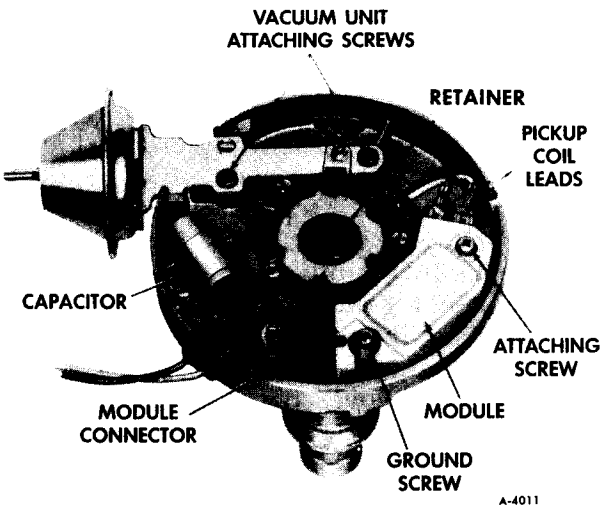


Figure 27—Top View of Distributor Housing With Shaft Removed

3. Before removing gear from distributor shaft, scratch a mark on gear and shaft for correct reassembly. If gear is assembled 180° from original position, the timing will be changed one half tooth.

4. Using a small drift, drive out roll pin retaining gear to shaft.

CAUTION: *Distributor gear should be supported in such a way that no damage will occur to the distributor shaft while removing pin.*

5. Remove driven gear. Some distributors may have washers between gear and distributor housing, or on the housing itself. Remove and replace washers as required.

6. Check role pin hole on shaft for burrs. Remove shaft and weight assembly from housing (figure 27).

7. If necessary, remove two advance springs, weight retainer, and advance weights.

8. Remove module attaching screws and module from housing. Disconnect wiring leads from module where connector may be removed from "B" and "C" terminals. Remove wires from "W" and "G" module terminals.

NOTE: Do not wipe lubricant from module or distributor unless replacing module. Special lubricant is provided with new modules.

9. Remove retainer from upper end of distributor housing.

10. Remove pole piece and plate assembly from housing. Do not remove three securing screws (figure 28).

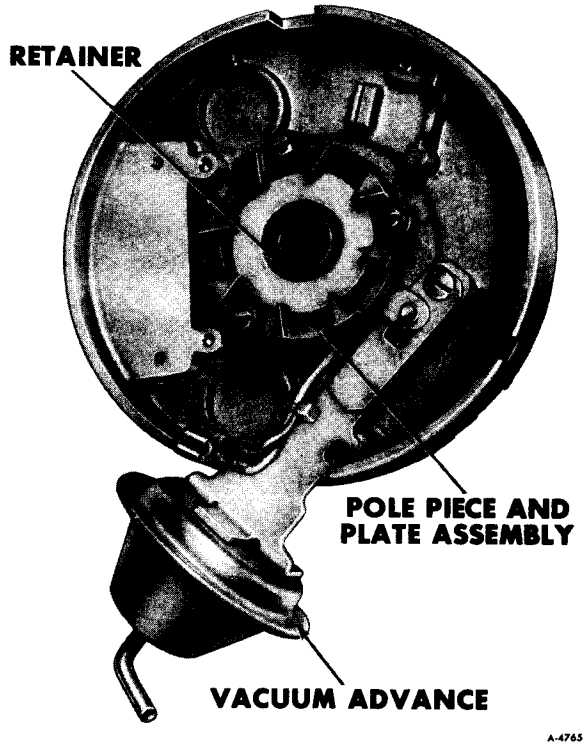


Figure 28—Pole Piece and Plate Assembly

NOTE: Pole piece and plate assembly is serviced as an assembly. It should not be unnecessarily disassembled as the polarity of the assembly could be changed and effect proper operation of the vehicle.

11. Remove capacitor attaching screw and disconnect wiring lead. Remove capacitor and bracket from housing.

12. Remove wiring harness connector from distributor.

13. Remove felt washer and plastic seal.

NOTE: No attempt should be made to secure the shaft bushings in the housing.

14. Inspect and replace parts as required.

DISTRIBUTOR ASSEMBLY

1. Repack lube cavity in housing with Delco Distributor lubricant or equivalent.

2. Replace plastic seal and felt washer.

3. Reinstall wiring harness assembly with grommet in distributor housing notch. Engage plastic wiring insulator to housing.

4. Attach lead wire from wiring harness to capacitator, if disassembled. Install capacitator and bracket securing ground wire from wiring harness with capacitator attaching screw.

5. Install module with two attaching screws.

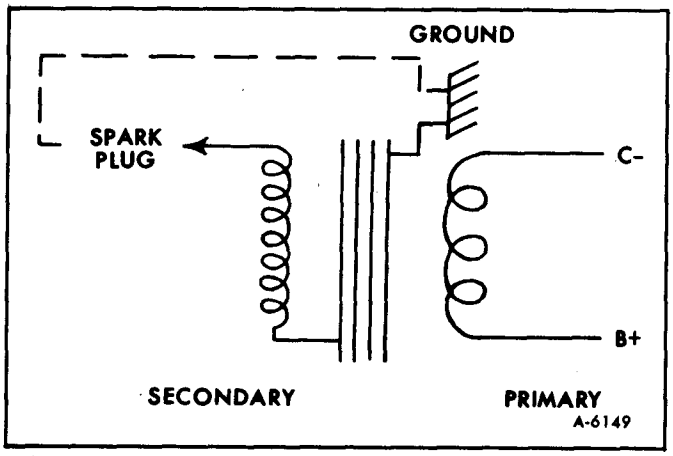


Figure 29—Ignition Coil Schematic

NOTE: Apply a layer of special silicone lubricant between module and housing to improve heat transfer. Lubricant is included with new modules. If installing a new module, be sure part number is correct for this particular distributor.

6. Install vacuum advance unit, pin side up, with two attaching screws.

7. Position pole piece and plate assembly with arm over pin of vacuum advance unit.

NOTE: If arm of pole piece and plate assembly is not properly installed on pin of vacuum adavance unit, the arm can float and cause timing to vary. If installing a new pole piece and plate assembly, be sure part number is correct for this particular distributor.

8. Install retainer to secure position of pole piece and plate assembly.

9. Install connector to "B" and "C" terminals on module with tab on top. Connect green wire to "G" terminal and white wire to "W" terminal.

10. Install distributor shaft and rotate to check for even clearance all around between teeth on pick-up coil of pole piece and plate assembly and teeth on distributor shaft.

NOTE: If necessary to adjust for proper clearance, loosen three screws on pole piece and plate assembly. Move pole piece teeth to provide even clearance. Tighten three screws (figure 28).

11. Install washers between gear and housing, if distributor is so equipped. Slide gear onto shaft in same position as marked when removed.

12. Install roll pin into gear and shaft.

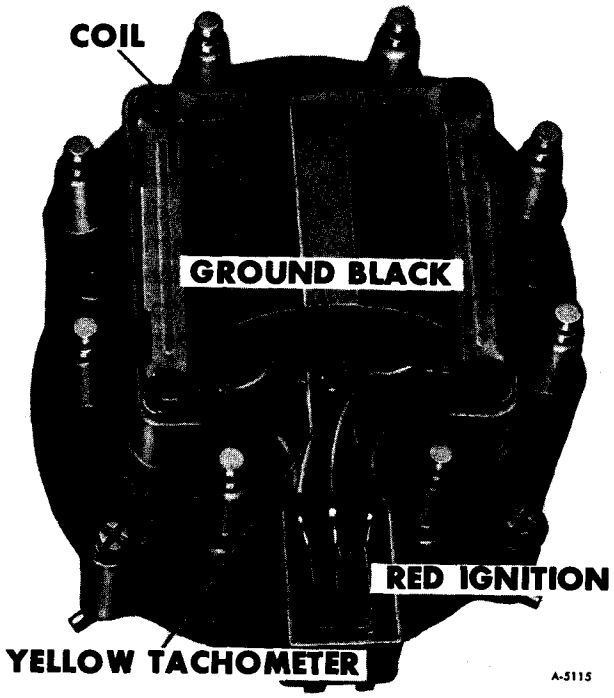


Figure 30—Ignition Coil

NOTE: To prevent damage to the permanent magnet in the pole piece and plate assembly, suport the driven gear when installing the roll pin.

13. If removed, carefully reassemble advance weights and springs on advance weight plate.

14. Position rotor to advance weight plate and tighten retaining screws.

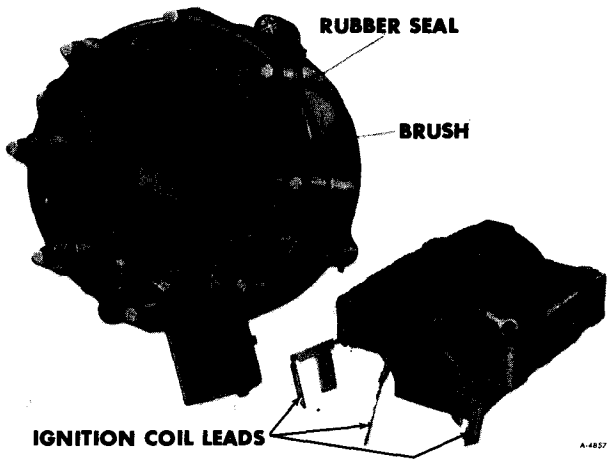


Figure 31—Ignition Coil And Seal (Typical)

15. Position cap on housing making sure cap is properly seated (notch in housing matches tab in cap). Engage four locking latches.

IGNITION COIL REPLACEMENT

REMOVAL (REFER TO FIGURES 29 AND 30)

1. Disconnect battery ground cable from atutomotive battery.
2. Disconnect spark plug wire holder from distributor cap terminals; disconnect ignition/tachometer wiring harness connector from ignition coil terminal connector.

NOTE: Use care not to damage ignition/tachometer wiring harness connector latches.

3. Remove three screws securing coil cover to distributor cap.
4. Remove four screws securing ignition coil to distributor cap, and remove two ground wires.
5. Disengage yellow and red coil wire terminals by pushing coil leads from underside of connector, and remove ignition coil from distributor cap.

NOTE: The yellow and red wires are both primary. The two black wires are ground for secondary. The primary and secondary coil windings are isolated, as shown in figure 29.

6. Check condition of seal and resistor brush (spring and button). (Refer to figure 8).

NOTE: Do not wipe silicone lubricant from seal.

INSTALLATION (REFER TO FIGURES 30 AND 31)

1. Position resistor brush (spring and button) and seal in distributor cap.

NOTE: Make sure seal is coated with silicone lubricant and properly positioned in place.

2. Position coil into distributor cap with terminals over connector at side of cap.

NOTE: If replacing ignition coil, be sure part number is correct.

3. Push coil lead wires into connector on side of cap (figure 30).
4. Install two ground wires and four coil attaching screws.
5. Install coil cover onto distributor cap with attaching screws.
6. Position distributor cap on housing, making sure cap is seated properly, and engage four locking latches.
7. Connect ignition/tachometer wiring harness connector at ignition coil terminal; connect spark plug wire holder at distributor cap terminal.

ELECTRONIC MODULE REPLACEMENT

REMOVAL

1. Disconnect ignition/tachometer wiring harness connector at ignition coil terminal connector.
2. Disconnect spark plug wire holder from distributor cap terminals.
3. After releasing four lock latches, remove distributor cap and position out of way.
4. Remove rotor from distributor shaft by loosening two screws.
5. Remove two module attaching screws and lift module from housing. Disconnect wiring leads from module where connector attaches to module "B" and "C" terminals, and remove two leads from "W" and "G" module terminals.

NOTE: Do not wipe lubricant from module or distributor housing unless replacing the module. A tube of special silicone grease is supplied with each replacement module. When installing module, be sure module has "dabs" of silicone grease on back of module where module rests on metal mounting surface. If not applied, the module will not cool properly, which can cause the module to malfunction.

INSTALLATION

1. Install module with two attaching screws
2. Install connector to "B" and "C" terminals on module with tab on top and connect green wire to "G" terminal and white wire to "W" terminal.
3. Install rotor to advance weight plate and tighten retaining screws.
4. Position distributor cap to housing with tab in base of cap aligned with notch in housing, and secure with four latches.
5. Connect wiring harness connector to terminals on side of distributor cap.

VACUUM ADVANCE UNIT REPLACEMENT

REMOVAL

1. Remove distributor cap and rotor.
2. Remove two vacuum advance attaching screws.
3. Turn pick-up coil clockwise and push rod end of the vacuum advance down so that it will disengage and clear the pick-up coil plate.

INSTALLATION

To install, reverse removal procedure.

HIGH ENERGY IGNITION SYSTEM SPECIFICATIONS— 455 CUBIC INCH ENGINE (1977)

DISTRIBUTOR	FEDERAL
Make	Delco-Remy
Model No.	1112893
Rotation (Viewed at Rotor)	Clockwise
Dwell	Electronic
Centrifugal Advance*	
Start Distributor	
(Degrees)	0
RPM	900
Intermediate Distributor	
(Degrees)	9
RPM	2000
Maximum Distributor	
(Degrees)	16
RPM	3400
Firing Order	1-8-4-3-6-5-7-2

(*) Set with Vacuum Disconnected

IGNITION TIMING*	
Idle Speed (RPM)	
(Transmission in "PARK")	1100
Distributor Setting	8^{o} BTDC

*With Distributor Vacuum Ports on Carburetor Plugged

DISTRIBUTOR VACUUM CONTROL	
Model No.	1973523
Inches of Mercury to Start Advance	8-10
Inches of Mercury for Maximum Advance	19-20
Maximum Advance (Engine Degrees)*	24^{o}

*Plus or Minus One Degree

SPARK PLUGS	
Make	AC
Type	R46SX
Size	14MM
Point Gap	.080"
Torque (Ft. Lbs.)	25
Hex Size	13/16
Distributor Clamp to Block Bolt (Ft. Lbs.)	17

HIGH ENERGY IGNITION SYSTEM SPECIFICATIONS —403 CUBIC INCH ENGINE (1977 AND 1978)

DISTRIBUTOR	FEDERAL	CALIFORNIA
Make	Delco-Remy	Delco-Remy
Model No.	1103267	1103309
Rotation (Viewed at Rotor)	Clockwise	Clockwise
Dwell	Electronic	Electronic
Centrifugal Advance *		
Start Distributor—		
(Degrees)	0	0
RPM	1100	2200
Intermediate Distributor		
(Degrees)	9	11
RPM	2000	2600
Maximum Distributor		
(Degrees)	16	16
RPM	3400	3400
Firing Order	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2
(*) Set with Vacuum disconnected		

IGNITION TIMING*		
Idle Speed (RPM) (Transmission in "PARK")	1100	2000
Distributor Setting	12^{o} BDTC	12^{o} BDTC
*With Distributor Vacuum Ports on Carburetor Plugged.		

DISTRIBUTOR VACUUM CONTROL		
Model No.	1973609	1973634
Inches of Mercury to Start Advance	4-5	11
Inches of Mercury for Maximum Advance	7-8	14
Maximum Advance (Engine Degrees)*	8^{o}	10^{o}
*Plus or Minus one Degree.		

SPARK PLUGS		
Make	AC	AC
Type	R46SZ	R46SX
Size	14MM	14MM
Point Gap	.060"	.080"
Torque (Ft. Lbs.)	25	25
Hex Size	13/16	13/16
Distributor Clamp to Block Bolt (Ft. Lbs.)	17	17

SECTION 8

FUEL TANK AND EXHAUST

The information described in Maintenance Manual X-7525 under the heading FUEL TANK AND EXHAUST (SEC. 8) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

EVAPORATION CONTROL SYSTEM (ECS) (1978 CALIFORNIA VEHICLES ONLY)

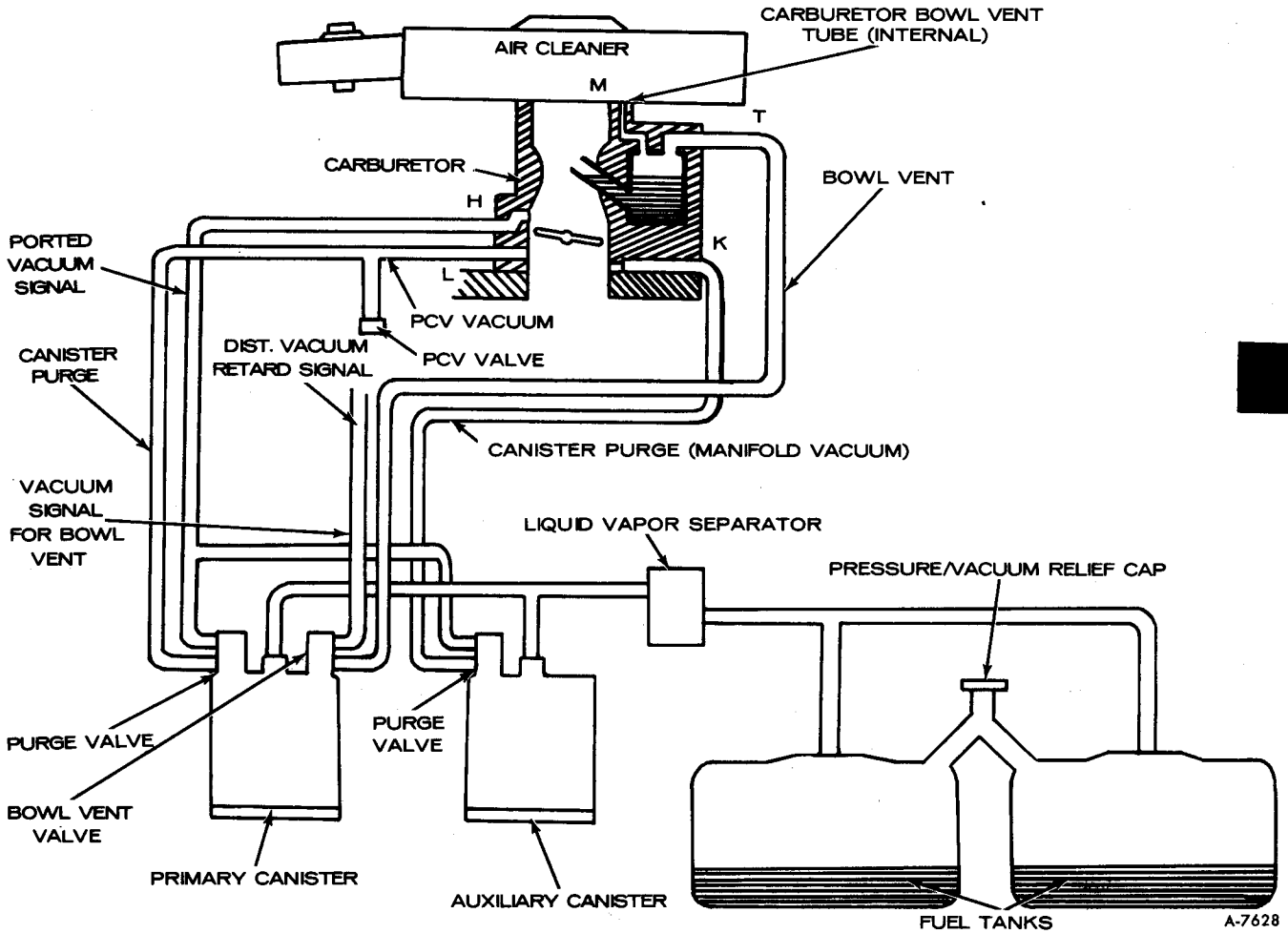


Figure 1—Evaporation Control System (ECS) Schematic

DESCRIPTION

The ECS system used on 1978 California vehicles (figure 1) designed to limit the discharge of gasoline vapors into the atmosphere. The following features are incorporated into the system. Special fuel tanks, filler cap, liquid-vapor separator, hoses, carbor canisters (figures 2 and 3) and carburetor modifications are included in the system. Vapors generated by the evaporation of fuel in the fuel tanks and carburetor float bowl are now stored in the carbon canisters. During periods of engine operation, the fuel vapors are fed into the engine for consumption. The amount of vapor drawn into the engine from the carbon canisters is too small to have any effect on fuel economy or engine operation.

NOTE: The vacuum hose routings for 1978 California emission systems is shown in figure 4.

DIAGNOSIS OF ECS

PROBLEM	POSSIBLE CAUSE	CORRECTION
EVIDENCE OF FUEL LOSS OR FUEL VAPOR ODOR		
A) From Area Fuel Tank Or Fuel Cap Perform Pressure Check To Determine Possible Causes	1. Leaking or plugged fuel or EVAP hoses.	1. Repair or replace hoses as necessary.
	2. Leaking fuel cap.	2. Repair or replace cap as necessary.
	3. Leaking fuel filler neck or hoses.	3. Repair or replace as necessary.
	4. Fuel filler neck gasket surface nicked, burred or dented.	4. Repair or replace as necessary.
	5. Leaking sending unit(s) or gasket.	5. Repair or replace as necessary.
	6. Leaking fuel tank switching solenoid valve.	6. Replace solenoid valve.
	7. Inoperative fuel tank switch.	7. Replace switch.
B) From Engine Compartment - Perform Pressure Check To Determine Possible Causes	1. Liquid fuel leaking from fuel lines, fuel pump or carburetor.	1. Tighten fuel lines, repair or replace fuel pump or carburetor as necessary.
	2. Cracked or damaged canisters.	2. Repair or replace canisters as necessary.
	3. Inoperative bowl vent valve (see Bowl Vent Check Procedures).	3. Repair or replace hoses. Replace canister.
	4. Inoperative purge valve (see Purge Valve Check Procedures).	4. Repair or replace hoses. Replace canister.
	5. Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses or control hoses.	5. Check for proper connections, and check routing as well as condition. Correct as necessary.
	6. Bowl vent hose misrouted.	6. Reroute hose without low spots.
	7. Air cleaner or air cleaner gasket improperly seated.	7. Reinstall air cleaner and/or replace gasket.
POOR IDLE OR DRIVEABILITY SLUGGISH	1. Inoperative purge valve (see Purge Valve Check Procedures).	1. Replace or repair hoses. Replace canister.
	2. Inoperative bowl vent valve (see Bowl Vent Check Procedures).	2. Repair or replace hoses. Replace canister.
	3. Disconnected or misrouted vapor or vacuum control hoses.	3. Check for proper connection and routing. Correct as necessary.
COLLAPSED FUEL TANK (LOSS OF TANK CAPACITY)	1. Plugged or pinched vapor pipe or hoses and defective fuel tank cap.	1. Check all lines from tank to canister and replace cap.
	2. Canister filter plugged and defective fuel tank cap.	2. Replace filter in canister and cap.

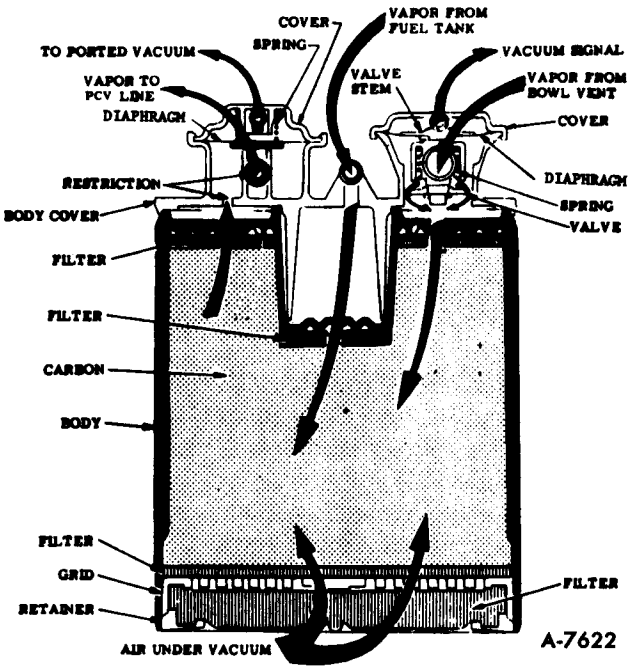


Figure 2—Primary Canister

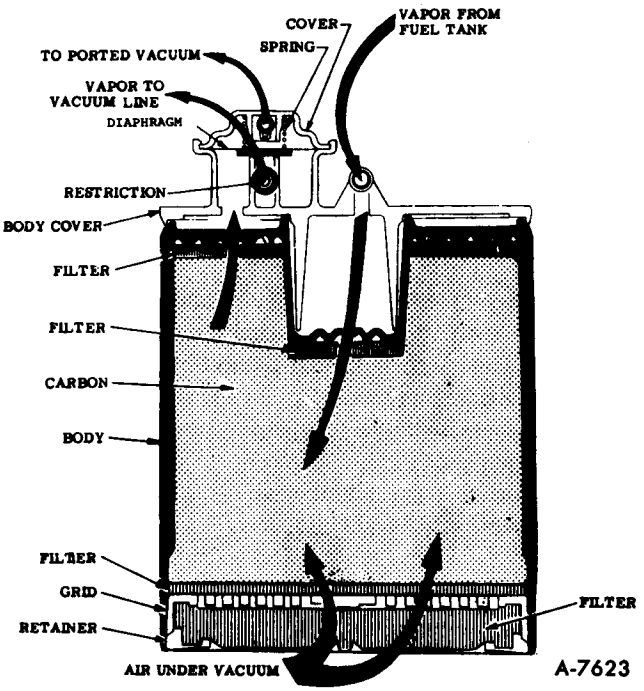


Figure 3—Auxiliary Canister

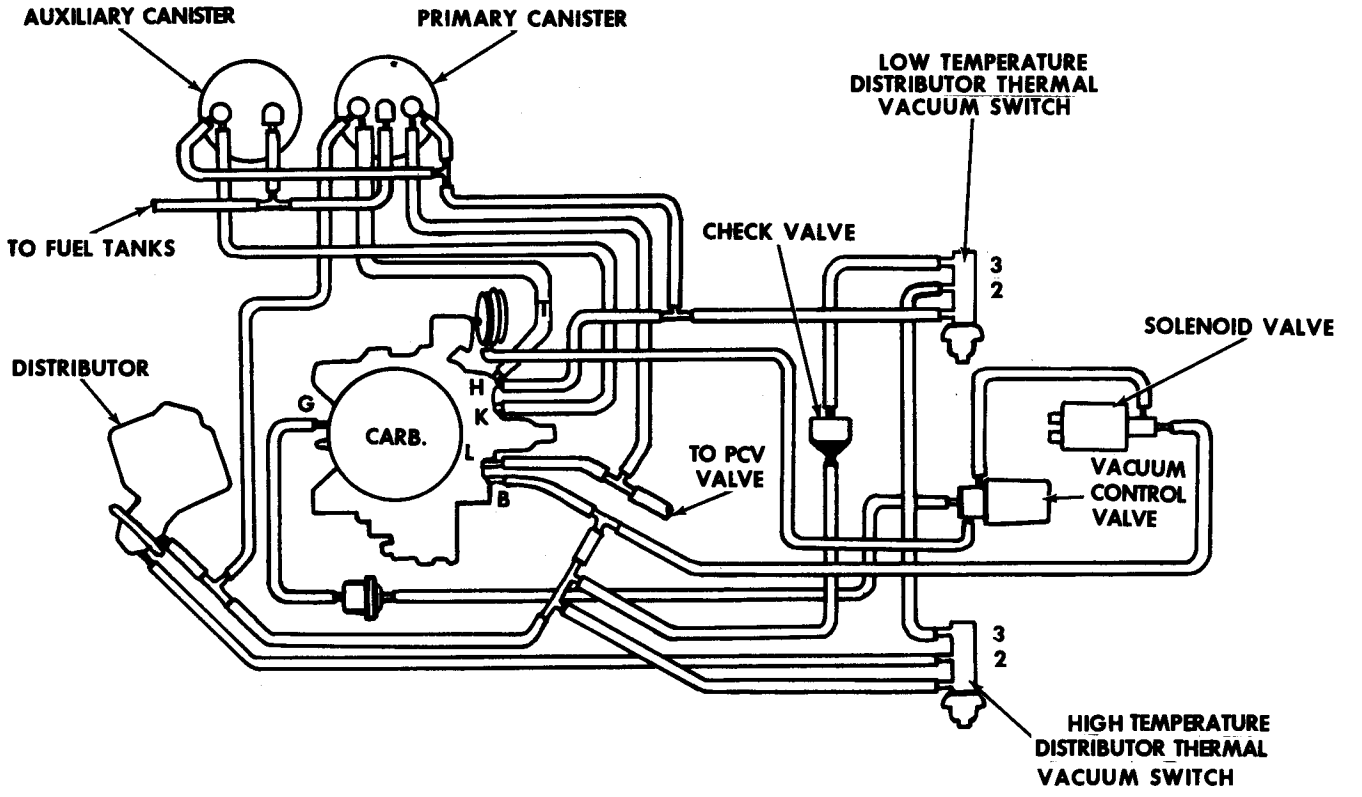


Figure 4—Emission Control Vacuum Hose Schematic

ON-VEHICLE SERVICE

PRESSURE CHECKING ECS

1. Stabilize vehicle by operating until warmed up.
2. Remove tank line at canister and observe for liquid in the line.
3. Apply 15" H_2O pressure to the fuel vapor line.
   a. Observe for excessive loss of pressure.
   b. If negligible pressure loss occurs observe for fuel vapor smell or fuel loss at points listed in Diagnostics under Possible Cause.
   c. Remove fuel filler cap and observe for pressure in tank(s).
4. Remove fuel filler cap and blow on vent line to check for obstructions.

CHECKING CARBURETOR BOWL VENT VALVE

1. Remove the bowl vent vapor hose from the carburetor.
2. Check the open condition of the valve by placing this hose against the mouth and blowing. There should only be a light resistance to flow.
3. If a high resistance or plugged system is found, check for a plugged or restricted hose. Hose may be cleared with compressed air. If the hose is clear, remove the canister filter. If the restriction persists, replace the canister.
4. A simple check of the valve closed condition can be obtained with the same procedure as in Step 2, but with the engine operating at operating temperature. Manifold vacuum will be applied to the valve through the control line. The bowl vent line should exhibit a plugged condition.
5. If the valve is not closed, remove the control vacuum line and check for vacuum. If no vacuum is present, check hose for restriction or vacuum leak. Repair or replace as required. If vacuum is present, replace canister.

CHECKING CANISTER PURGE VALVE

1. Remove purge valve control vacuum line. Check for a vacuum signal with engine operating above idle (1500 RPM).
2. Apply an external vacuum source to the purge valve control diaphragm. A good valve will hold vacuum.
3. If the valve will not hold vacuum, replace canister.
4. If valve holds vacuum, remove purge line and check for vacuum. If no vacuum, check PCV hoses and system. Repair or replace as necessary. If there is vacuum, blow into canister purge valve. If restriction persists, replace canister.

COMPONENT REPLACEMENT

Component replacement procedures are the same as described under "Evaporation Control System" in FUEL TANK AND EXHAUST (SEC. 8) of maintenance manual X-7525.

SECTION 9
STEERING

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: See "Caution" on page one of this section.

CAUTION: THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

The information described in Maintenance Manual X-7525 under the heading STEERING (SEC. 9) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

STEERING SYSTEM DIAGNOSIS

Wear, looseness or binding of any of the moving parts of the steering system and suspension system will affect vehicle alignment. Accurate alignment cannot be achieved as long as such conditions go uncorrected.

For detailed diagnosis of front suspension and steering system problems (such as hard steering, poor directional stability, excessive play in system, and other problems) refer to FRONT SUSPENSION (SEC. 3A) in this supplement.

STEERING LINKAGE

NOTE: Effective with Vehicle Identification Numbers TZE167V101401 (Motorhome), TZE337V101429 (23' TransMode) and TZE367V101393 (26' TransMode), Motorhome and TransMode vehicles are equipped with METRIC TIE ROD CLAMPS. The new torque specification for these clamps is 16-22 N·m (12-16 ft. lbs.). Replacement clamps and fasteners must be tightened to proper torque specification.

Refer to FRONT SUSPENSION (SEC. 3A) of this manual for toe-in adjustment procedure.

POWER STEERING PUMP

Power steering pump mounting and hose routing has been revised on vehicles equipped with 403 cubic inch engines. This revision is effective with Vehicle Identification Numbers TZE167V101285 (Motorhome), TZE337V101287 (23' TransMode) and TZE367V101312 (26' TransMode). Refer to figures 1 and 2 for pump installation and hose routing.

REMOVAL
(FIGURE 1)

1. Disconnect negative battery cable.
2. Loosen power steering and generator belts.
3. Disconnect pressure line and return hose from pump. (Install caps at both pump fittings to prevent drainage of oil from pump).
4. Remove power steering pump mounting bolts and nuts.
5. Remove power steering pump with adjusting link attached.
6. Remove adjusting link from pump.
7. Remove pulley from shaft using puller tool J-25034 (figure 3).

CAUTION: *Do not hammer pulley off shaft as this will damage pump.*

INSTALLATION
(FIGURE 1)

CAUTION: *See "Caution" on page one of this section.*

1. Install adjusting link on pump.
2. Install pulley on shaft using Tool J-25033.

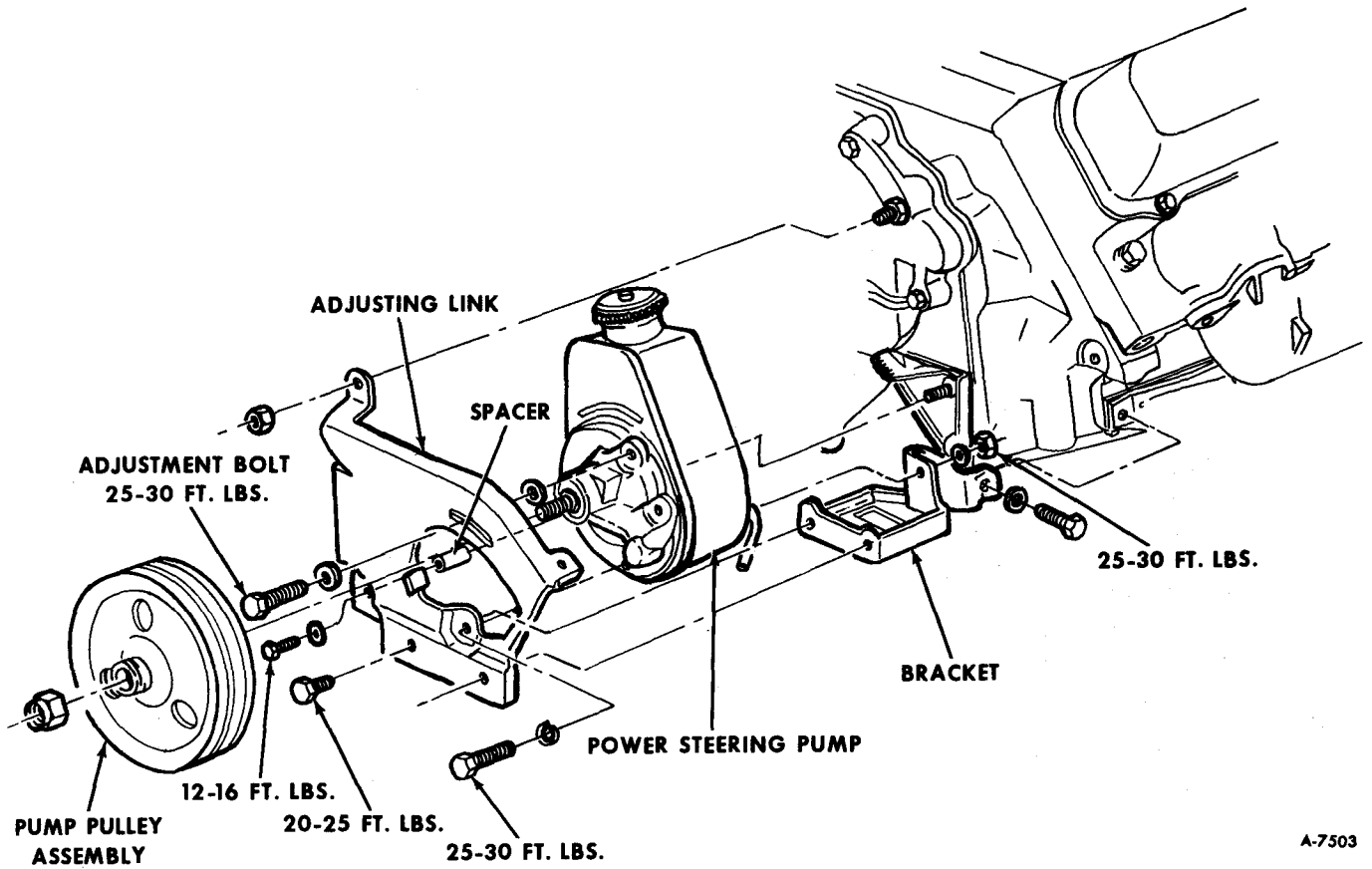


Figure 1—Pump Installation

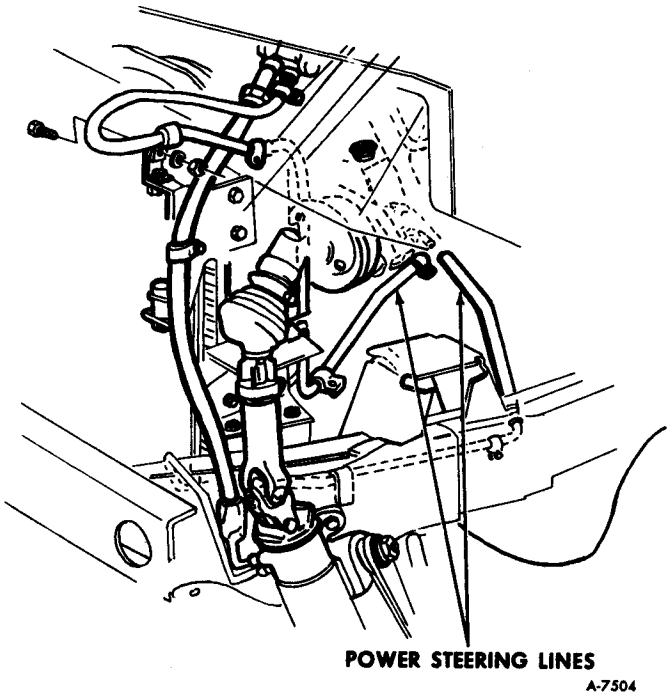


Figure 2—Power Steering Pump Hose Routing

CAUTION: *Do not hammer pulley on, as this will damage internal pump parts (figure 4).*

3. Install pump assembly on engine and secure with bolts and nuts (torque to 25-30 ft. lbs.).

CAUTION: *Correct routing of the power steering hoses is very important. Although sequence of assembly is not vital, the power steering hoses, when installed, must not be twisted, kinked or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening in operation. They should also be free of twist under strain. When poor hose assembly routing exists, hose and assemblies should not be bent or mutilated by pulling on them. The situation should be corrected by loosening the fittings and properly repositioning the hose assembly before retightening nuts. All fittings must be held while tightening or loosening nuts.*

4. Connect and tighten hose fittings to 30-40 ft. lbs.

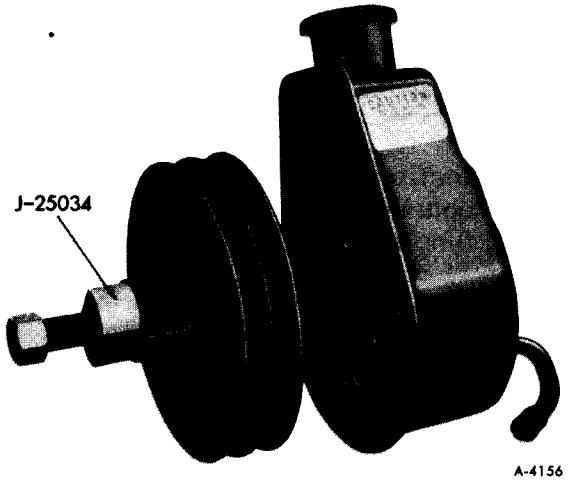


Figure 3—Pulley Removal—Special Tool J-25034

5. Fill reservoir with fluid. Bleed pump by turning pulley backward (counterclockwise as viewed from front) until air bubbles cease to appear.

6. Install pump belts over pulley.

7. Move pump until belts are tight, then tighten adjusting screws. Do not pry on reservoir or pull on filler neck.

8. Adjust belts and bleed system. (Refer to ADJUSTMENTS, Section 9 Maintenance Manual X-7525).

9. Connect battery ground cable.

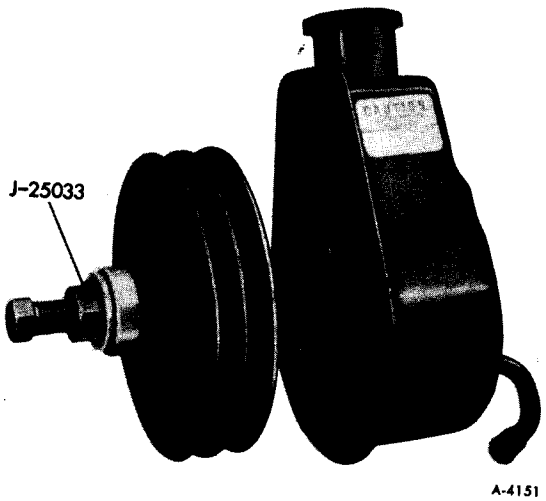


Figure 4—Pulley Installation—Special Tool J-25033

STEERING COLUMN

GENERAL INFORMATION AND OPERATION

The function-locking steering column includes important features in addition to the steering function:

1. The ignition switch and lock are mounted conveniently on the column.
2. With the column-mounted lock, the ignition, steering and gearshifting operation can be locked to inhibit theft of the vehicle.

The tilt function-locking columns are designed for ease of entry and driver comfort. These columns have seven different steering wheel angle positions.

The tilt mechanism consists of an upper and lower steering shaft assembly with a universal joint between them. A support assembly is held to the mast jacket by a lock plate, and a steering housing assembly is positioned over the upper steering shaft and secured to the support by two pivot pins. Two lock shoes are pinned to the housing assembly and engage a pin in the support assembly. When the release lever is pulled up and the lock shoes disengage the support pin, the steering wheel is pushed up by a spring compressed between the support and housing assemblies.

The operation of the lock is the same as in other GM vehicles. To start the vehicle, you insert the key in the lock, turn the unit clockwise to "start" and let the switch return to the "on" position. The "off", "lock" and "accessory" positions are also the same as in other GM vehicles. When you engage the shift lever in "park" and lock the ignition, the steering wheel locks and the gearshift locks.

The function-locking column may be easily diassembled and reassambled. If the column is serviced, it is important that only the specified screws, bolts and nuts be used as designated. Equally as important is correçt torque of bolts and nuts.

When the column is removed, special care must be taken in handling this assembly. Only the specified wheel puller should be used. When the column is removed from the vehicle, such actions as a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity. It is, therefore, important that the removal and installation and the disassembly and reassembly procedures be carefully followed when servicing the assembly.

LOWER STEERING SHAFT

(FIGURE 5)

REMOVAL

1. Set front wheels in straight ahead position. This can be done by driving the vehicle a short distance on a flat surface. Block wheels fore and aft so that vehicle cannot move.
2. Mark relationship between companion flange and splined slip shaft, and between splined slip shaft and slip yoke assembly. (See figure 5.) Also mark relationship between lower steering shaft yoke end (universal joint) and steering gear input shaft.
3. Remove clamp bolt and nut attaching lower steering shaft to steering column.
4. Remove bolt and nut securing lower steering shaft to steering gear input shaft.
5. Compress splined shaft into steering slip yoke assembly, and carefully lift lower steering shaft out of vehicle.

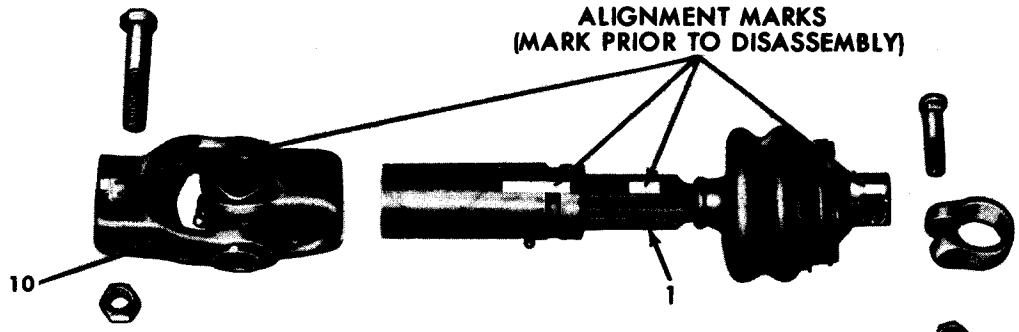
DISASSEMBLY

With lower steering shaft assembly on a bench, separate the splined shaft from the slip yoke assembly.

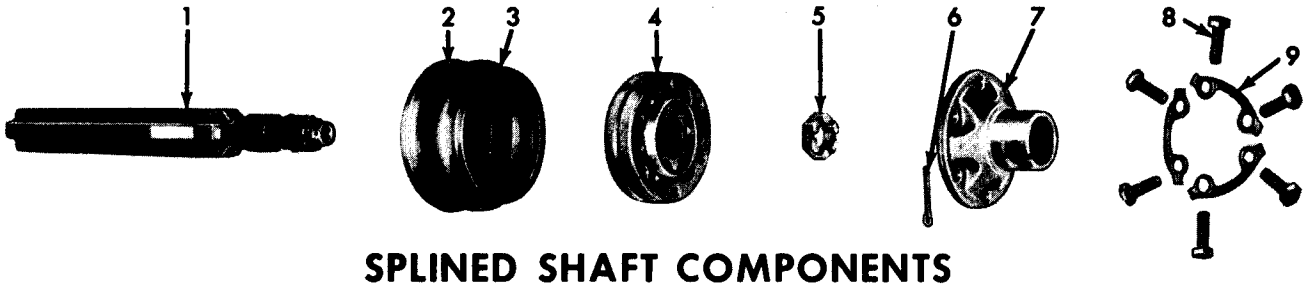
NOTE: Whenever steering shaft is disassembled, it is mandatory that exposed spline areas be protected from nicks, scratches, and contamination until shaft is reassembled.

CONSTANT VELOCITY (CV)
JOINT DISASSEMBLY

1. Remove retainer strap holding dust boot to CV joint assembly. Slip boot off of CV joint.
2. Remove locks (lock tab washers) on companion flange. MARK RELATIONSHIP



LOWER STEERING SHAFT ASSEMBLY



SPLINED SHAFT COMPONENTS

1. Splined shaft
2. Dust Boot
3. Retainer Strap (Not Shown)
4. "CV" Joint Assembly
5. Nut
6. Cotter Pin
7. Flange
8. Screw
9. Lock Washer
10. Yoke-Universal Joint

A-6166

Figure 5—Lower Steering Shaft—Disassembled

BETWEEN COMPANION FLANGE AND SPLINED SLIP SHAFT (if not already marked). Then remove 6 bolts attaching flange to CV joint assembly (figure 5).

3. Remove cotter pin and large nut from splined shaft, then remove CV joint assembly from shaft.

NOTE: The CV joint is not to be repaired. It must be replaced as a new unit only.

YOKE DISASSEMBLY (CROSS-TYPE UNIVERSAL JOINT)

1. With steering shaft removed from vehicle, remove the snap rings from universal joint bearings. Discard snap rings.

2. Support yoke in arbor press (clamp yoke end) and drive one side of bearing until opposite bearing comes out of yoke. Use of soft drift and hammer may aid in bearing removal.

3. Turn yoke over and drive out the opposite bearing. Remove the remaining two bearings the same way. Note position of grease fitting for reassembly.

4. Remove journal cross.

ASSEMBLY

CV UNIVERSAL JOINT ASSEMBLY

1. Install new CV joint assembly on splined shaft.

CAUTION: *When tightening large nut to retain CV joint, do not hold splined shaft in coated area as damage to this surface may result.*

CAUTION: *See "CAUTION" on page one of this section.*

2. Install large nut on shaft. Torque nut. See Specifications at the end of this section for torque value. Install new cotter pin through holes in shaft. See "NOTE" in Specifications at the end of this section.

3. Pull dust boot up and into groove on side of CV joint assembly. Be sure that boot groove is free of grease prior to assembly of boot. Install new retainer strap and pull tight with a force of 40-45 pounds.

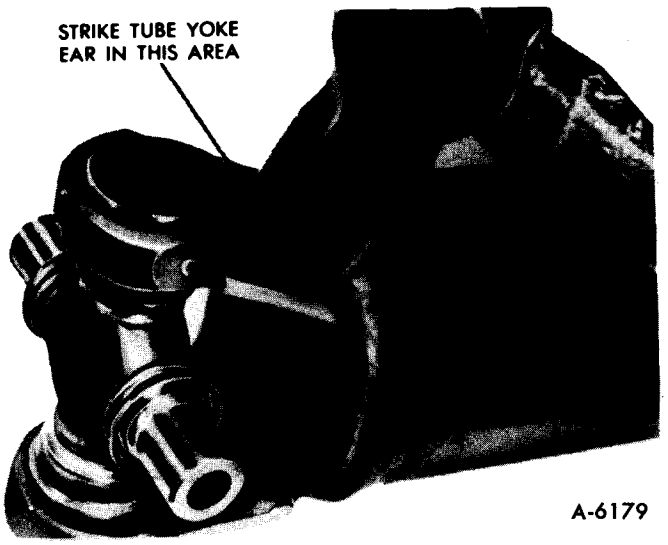


Figure 6—Seating the Snap Rings

NOTE: Before proceeding with step 4, the cavity between the flange coupling and the CV joint assembly must be packed with lubricant. (Use a Lithium-soap base grease having extreme pressure properties meeting GM 6031-M, or equivalent.)

4. Install companion flange (align marks made during disassembly for correct relationship between flange and splined slip shaft) and install six bolts with lock-tab washers.

5. Torque companion flange bolts. See Specifications at the end of this section for torque value. Then, bend up lock tabs against bolt heads.

YOKE ASSEMBLY
(CROSS-TYPE UNIVERSAL JOINT)

1. Align yoke end and steering slip shaft as marked during removal. Install journal cross into yokes with grease fitting in position as noted during removal.

2. Insert two bearings into one yoke and insert journal cross into bearing on one side. Press both bearings in far enough to install new snap rings.

NOTE: If difficulty is encountered in seating snap rings, strike the yoke firmly with a hammer to aid in seating the snap rings. This springs the yoke ears slightly (figure 6).

3. Turn shaft one-half turn and install remaining two bearings and new snap rings into adjacent yoke.

4. Lubricate universal joint at grease fitting (figure 7), using a Lithium-soap base grease having extreme pressure properties meeting GM 6031-M, or equivalent.

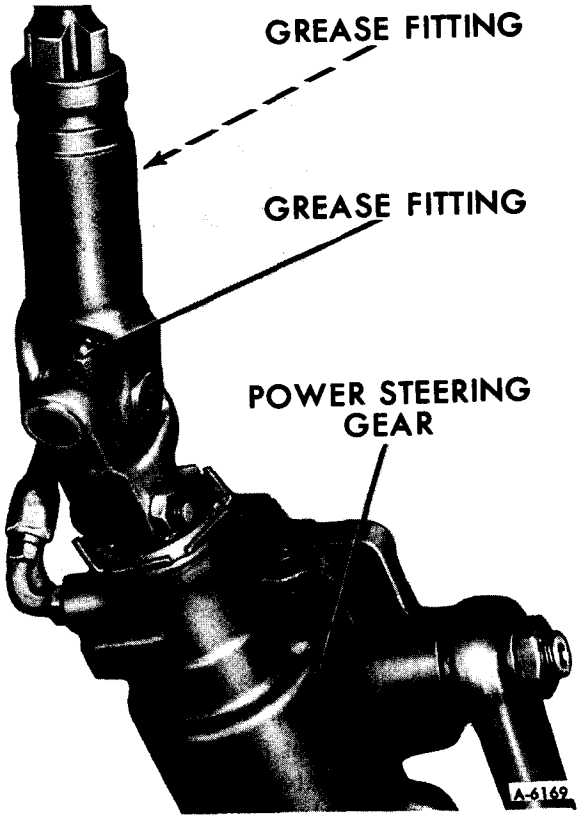


Figure 7—Lower Steering Shaft Grease Fittings

INSTALLATION

CAUTION: *See "CAUTION" on page 1 of this section regarding the fasteners referred to in step 1 and step 3.*

1. Align marks made at removal and assemble the lower shaft yoke end (universal joint) onto the steering gear input shaft. Install clamp bolt and nut, and torque nut to Specifications listed at the end of this section.

NOTE: If alignment marks have not been made, or if new parts are being used, be certain that steering gear input shaft is in high point of travel (centered position) before clamp bolt and nut are installed.

2. Raise lower steering shaft into position and guide companion flange (CV joint end) onto the steering column.

3. Install steering clamp bolt and nut, and torque nut to Specifications listed at the end of this section.

STEERING WHEEL HORN ASSEMBLY

(FIGURE 8)

REMOVAL

1. To remove horn assembly from steering wheel, loosen and remove mounting screws (3) securing horn assembly to shroud.

2. Disconnect horn electrical connection at center of shroud.

3. Lift off horn assembly.

INSTALLATION

To install, reverse removal procedure.

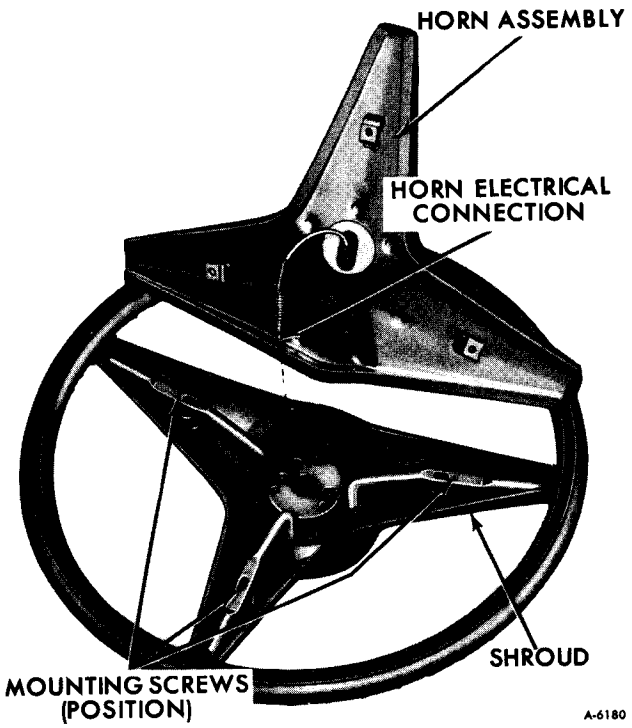


Figure 8—Horn Assembly

SPECIFICATIONS

LOWER STEERING SHAFT	TORQUE
CV Joint Nut * (CV Joint to Splined Steering Shaft)	20 -30 ft. lbs.
Companion Flange Bolts (6)	8 -12 ft. lbs.
Shaft Bolt Nut (Universal Joint to Steering Gear)	40 -45 ft. lbs.
Steering Clamp Bolt Nut (Companion Flange to Steering Column)	40 -45 ft. lbs.

*NOTE: After reaching minimum torque required, nut must always be tightened to insert cotter pin. Never back nut off.

SECTION 10

WHEELS AND TIRES

The information described in Maintenance Manual X-7525 under the heading WHEELS AND TIRES (SEC. 10) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

RADIAL TIRES

Steel-belted bias-ply tires are standard equipment on 1977 model vehicles. Optional equipment for 1977 models includes steel-belted radial tires. Steel-belted radial tires are standard equipment on all 1978 model vehicles. (NOTE: Bias-ply nylon tires are also available as optional equipment on the 1978 TransMode vehicles only.)

Tire size is either 8.75-16.5 LT or 8.75 R-16.5 LT, load range "D". Cold inflation pressure rating for bias-belted tires is 60 psi; radial tires should be inflated to 65 psi. For continuous high speed operation over 65 mph (105 km/h), cold inflation pressure should be increased 10 psi above the recommended cold inflation pressure.

NOTE: Radial tires may have the appearance of being under-inflated when at recommended cold inflation pressure. Refer to figure 1 for view of properly inflated radial tire.

TIRE REPLACEMENT

CAUTION: *Do not mix different construction types of tires on the vehicle such as radial , bias, and bias-belted tires, because vehicle handling may be seriously affected.*

When replacing radial tires, you should use size 8.75R-16.5 LT, load range "D". If bias-ply steel belted tires are used (or bias-ply nylon on a TransMode) use tire size 8.75-16.5LT, load range "D". Construction type must be steel-belted radial, bias-ply steel belted or bias-ply nylon. Use of any other size, load range or other construction type of tires may seriously affect load carrying capacity, ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis. If replacing only a single tire, it should be paired on the same axle with the least worn tire of the vehicle.

WHEEL REPLACEMENT

Wheels must be replaced if they are bent, heavily rusted, if they leak air or if lug nuts continually loosen. Do not straighten bent wheels or use inner tubes in leaking wheels used with tubeless tires.

When replacing wheels for any reason, the replacement wheels should be equivalent in load capacity, inflation pressure capacity, diameter, width, offset and mounting consideration to those originally installed on the vehicle. Be sure the word "RADIAL" is stamped on the rim.

PROPERLY INFLATED RADIAL TIRE

PROPERLY INFLATED BIAS OR BIAS-BELTED TIRE

A-6192

Figure 1—Tire Inflation

SECTION 12
CHASSIS ELECTRICAL

The information described in Maintenance Manual X-7525 under the heading CHASSIS ELECTRICAL (SEC. 12) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

INSTRUMENT PANEL

The instrument panel is new in 1977 (see figures 1 and 2). This new panel includes the ash tray (formerly mounted to the side trim panel) and air conditioning ducts mounted in new locations. However, the major parts of the instrument panel remain the same, including cluster cowl panel (sometimes called "rear cover"), foam ring panel and cluster bezel, valence panel, right hand instrument panel, glove box and glove box reinforcement.

All instruments and gauges are installed in the instrument cluster as shown in figure 3.

The instrument panel gauges utilize printed circuits. They are connected to the vehicle wiring through multiple terminal connectors which are plugged into the back side of the gauges. The cluster cowl, cluster bezel and all instruments and gauges can be serviced in the vehicle as described in CHASSIS ELECTRICAL (SEC. 12), Maintenance Manual X-7525.

Illumination and indicator lamps can be replaced without removing the gauges and are of a 1/2 turn locking type with printed circuit connections. Regular maintenance is not required on the instrument cluster other than maintaining clean, tight electrical connections and replacing defective parts. Foam ring cluster mounting is shown in figure 4. Valence panel and ash tray mounting is shown in figure 2. Glove box stop is shown in figure 1.

SPEEDOMETER AND GAUGE CLUSTER
(Figure 5)

"Face" changes have taken place on the

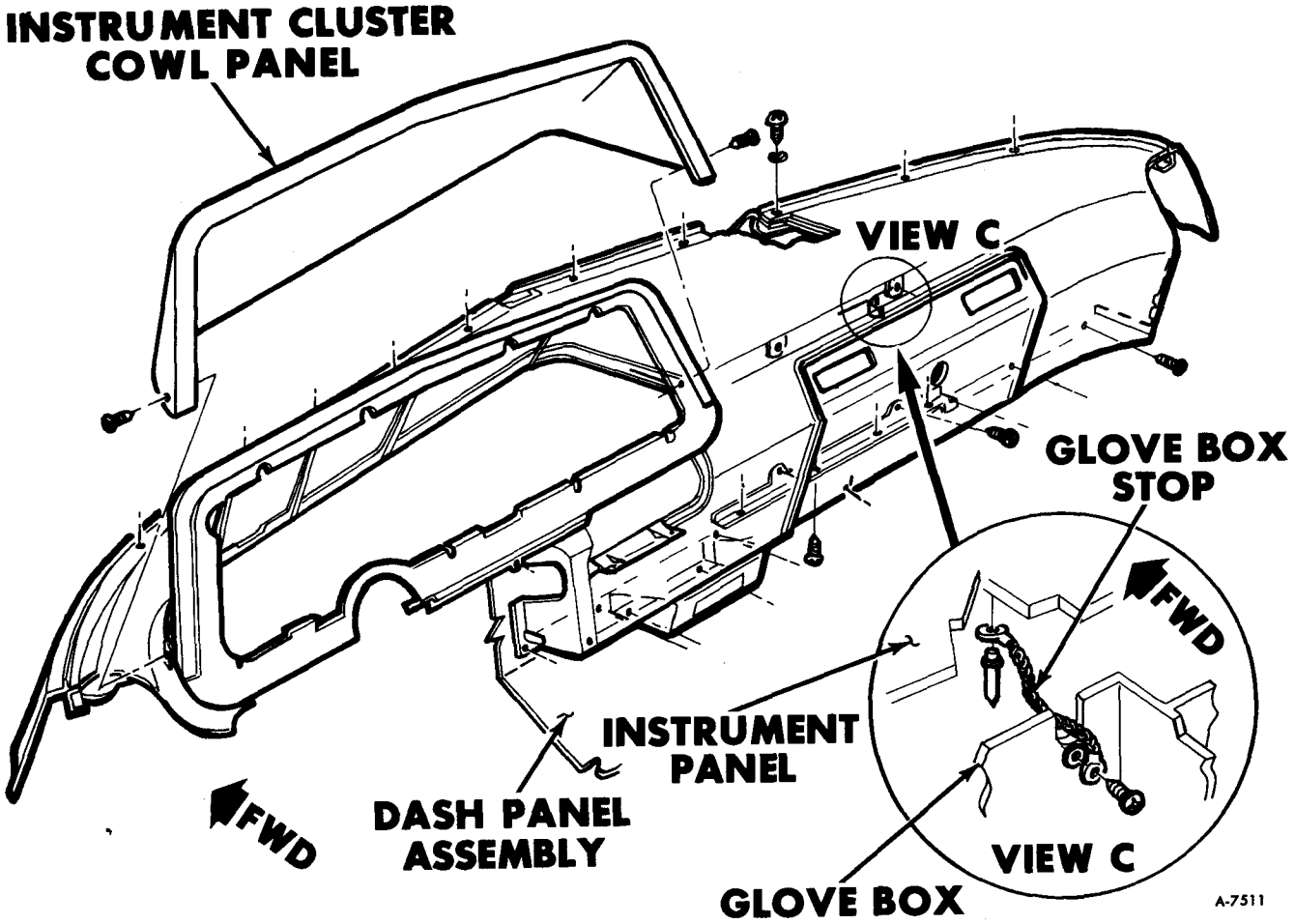


Figure 1—Instrument Panel

speedometer head and gauge cluster. The speedometer now includes kilometers per hour as well as miles per hour. However, both components are serviced in the bezel as before.

PRINTED CIRCUITS

Tell-tale printed circuit (figure 6) provides electrical contacts for illumination of various warning lights. Bulbs used in the tell-tale panel are listed in Specifications at the end of this section. Check various tell-tale circuits as described in CHASSIS ELECTRICAL (SEC. 12), Maintenance Manual X-7525. "Engine Water" (Low Coolant) tell-tale circuit can be checked as shown under "Engine Water Indicator" immediately following.

ENGINE WATER INDICATOR ("LOW COOLANT")
(FIGURE 7)

All vehicles are equipped with a coolant level warning light, "Engine Water," which illuminates in the printed circuit tell-tale panel (see figure 7) when a cooling system low

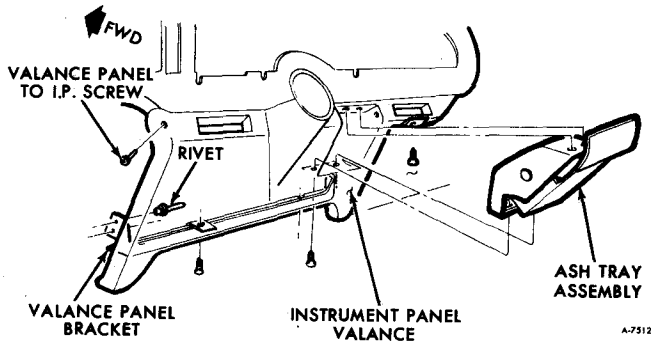


Figure 2—Instrument Panel Valence

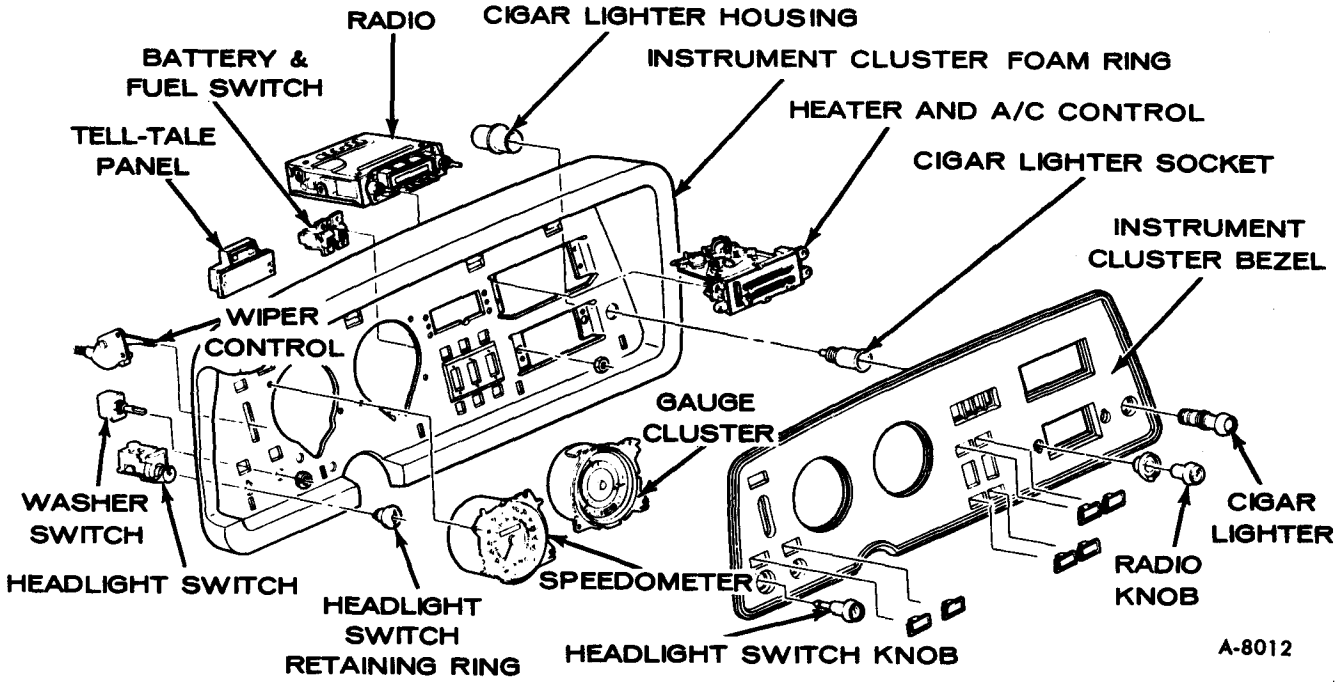


Figure 3—Left Hand Instrument Panel Assembly Components

water condition occurs in the radiator of the vehicle. The indicator module is located in the instrument panel wiring harness beneath the speedometer connector. If "Engine Water" indicator system malfunctions, refer to "Coolant Level Indicator Diagnosis Chart", Sec. 12, Maintenance Manual X-7525. See servicing details before refilling coolant as discussed in Sec. 13, RADIATOR AND COOLANT RECOVERY SYSTEM, Maintenance Manual X-7525.

SYSTEM OPERATION (FIGURE 8)

The engine water (low coolant) indicator system is a D.C. powered, transistorized circuit utilizing a stainless steel probe to sense the presence of coolant in the vehicle cooling system. When coolant level in radiator is satisfactory, the 16/Yellow wire is grounded through the radiator probe. When fluid level in the radiator drops below the probe, probe resistance increases. If probe resistance is high enough to trigger the integrated circuit of the module, a ground path is provided for the tell-tale panel, turning the "ENGINE WATER" light on.

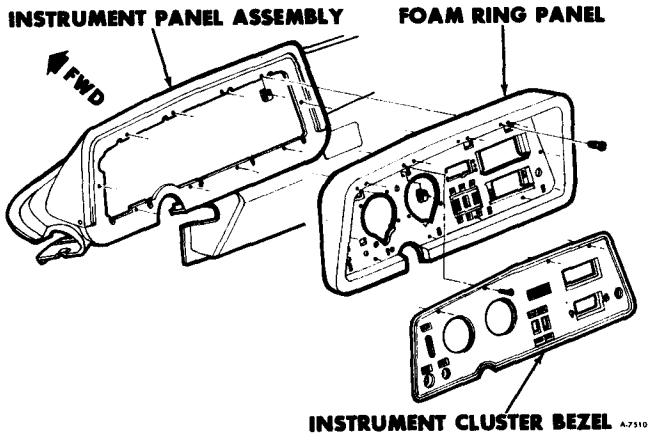


Figure 4—Instrument Cluster Assembly and Bezel

"ENGINE WATER" TELL-TALE CIRCUIT CHECK

1. Remove instrument panel rear cover.
2. Remove tell-tale light panel connector and remove the tell-tale panel.

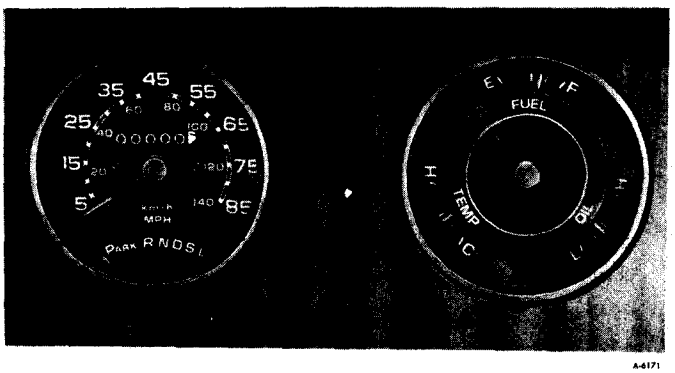


Figure 5—Speedometer and Gauge Cluster

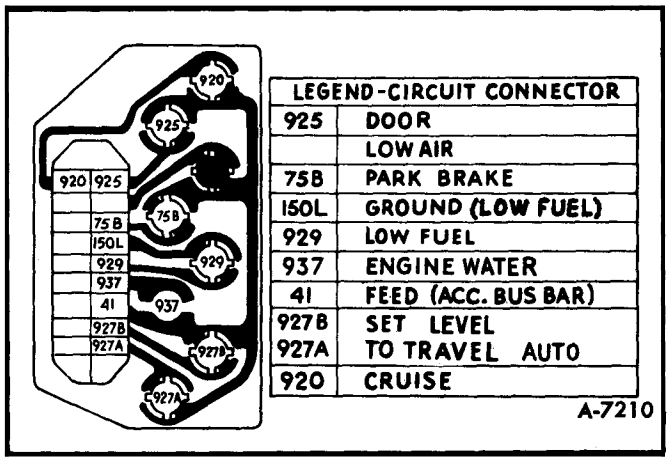


Figure 6—Tell Tale Printed Circuit

3. With a continuity light, connect one probe of test light to "41" of the printed circuit ("FEED") and the other probe to "937".

If the test light lights, bulb and circuit are good. If the test light does not light, remove the "937" bulb and check bulb. If bulb is good, problem is in the printed circuit board.

NOTE: There is no "low air" warning system on circuit "900".

ENGINE WATER MODULE REPLACEMENT

The engine water (low coolant) module is replaced from the rear of the instrument panel. The module is taped to the instrument panel wiring below the speedometer connector (see "Instrument Panel Wiring" later in this section for location), and is connected to the wiring harness through a 5-wire connector. (See figure 8).

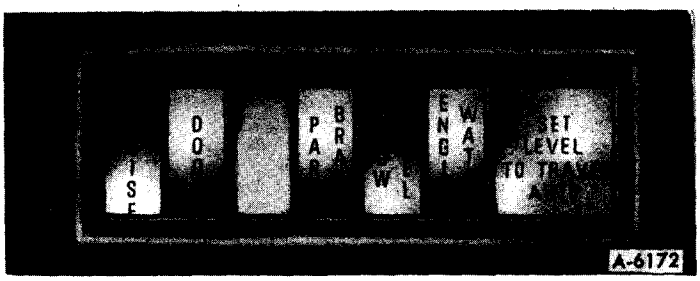


Figure 7—Tell-Tale Panel

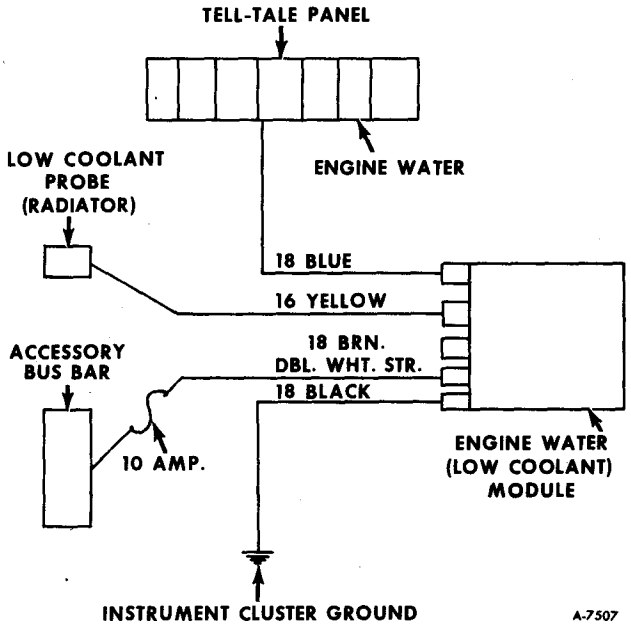


Figure 8—Engine Water ("Low Coolant") System Schematic

1. Remove instrument panel rear cover.

2. Remove tape from module. Remove module from dash panel.

3. Disconnect electrical connector from module.

4. Install replacement module in reverse sequence of removal.

RADIATOR PROBE REPLACEMENT

1. Disconnect lead wire from probe sensor.

2. Unscrew probe sensor from radiator.

3. Install replacement probe sensor in reverse sequence of removal. Torque probe sensor to 25-30 in. lbs.

ENGINE WATER "SYSTEM" CHECK

Disconnect lead wire from sensor probe in radiator. Turn ignition key to "ON" position. Check for illumination of "Engine Water" bulb in tell-tale panel. If bulb does not light, then problem is in low coolant module or tell-tale printed circuit board. See tell-tale printed circuit check procedure of "Coolant Level Indicator Diagnosis" chart, Sec. 12, Maintenance Manual X-7525.

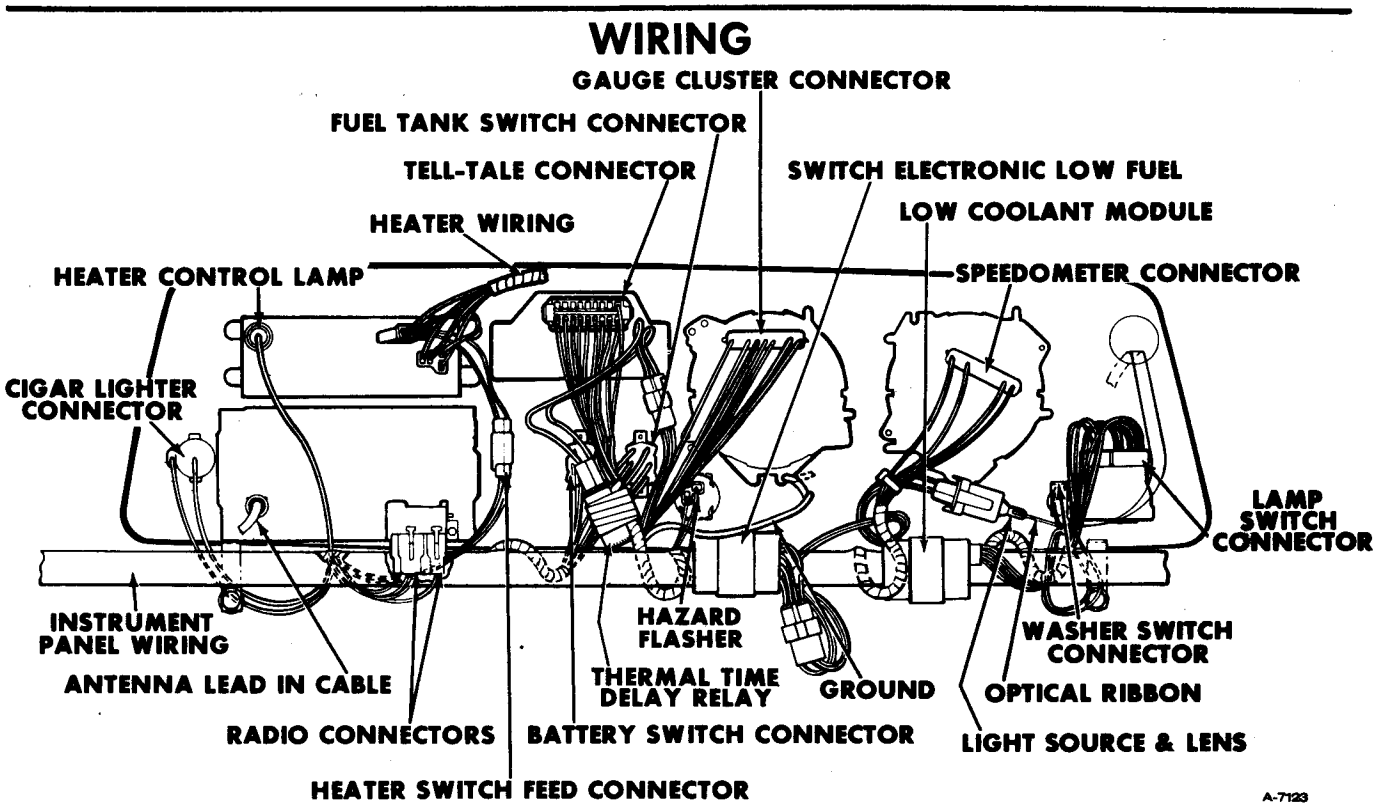


Figure 9—Instrument Panel Wiring, Typical

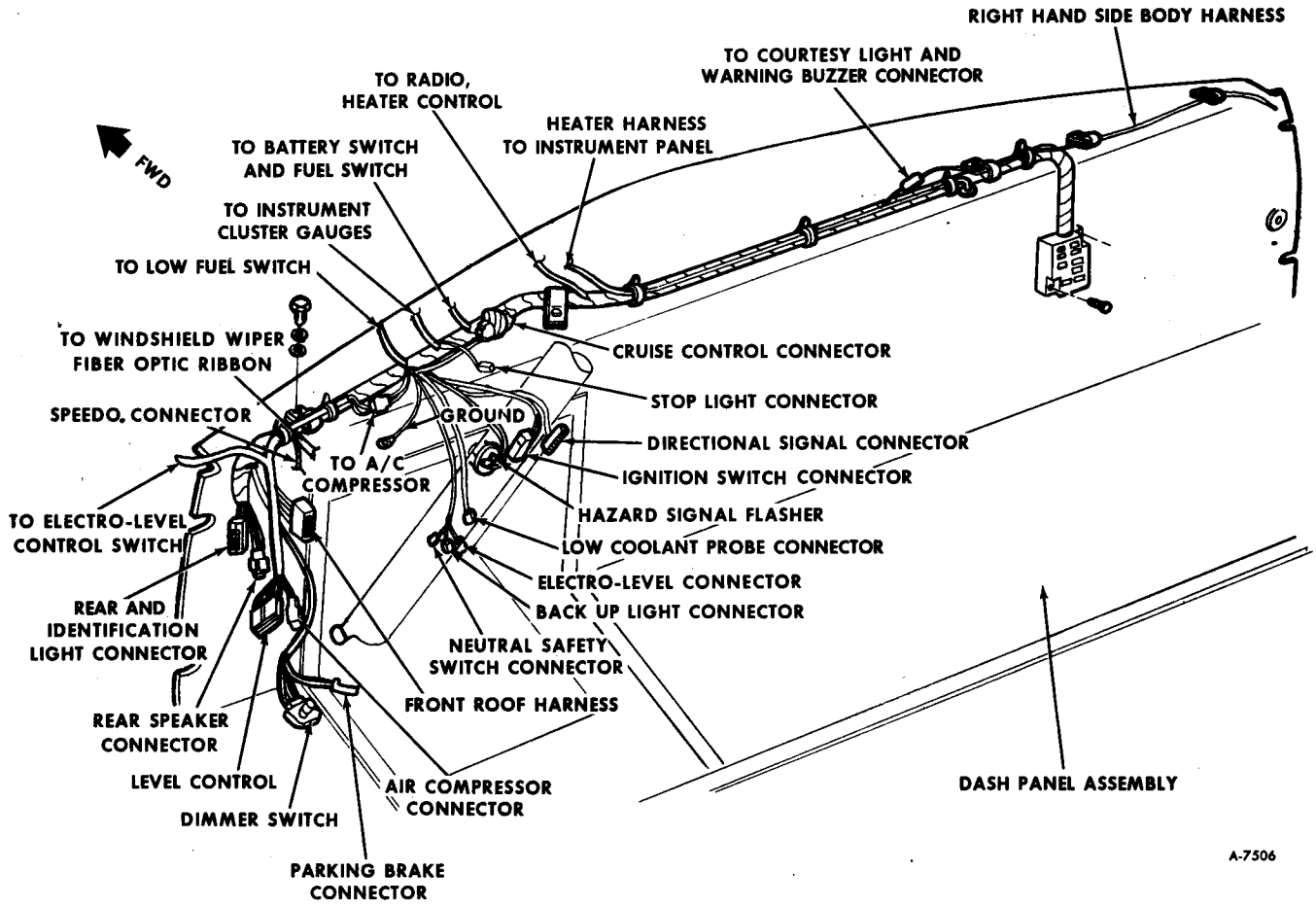


Figure 10—Instrument Panel and Electro-Level Control Harness

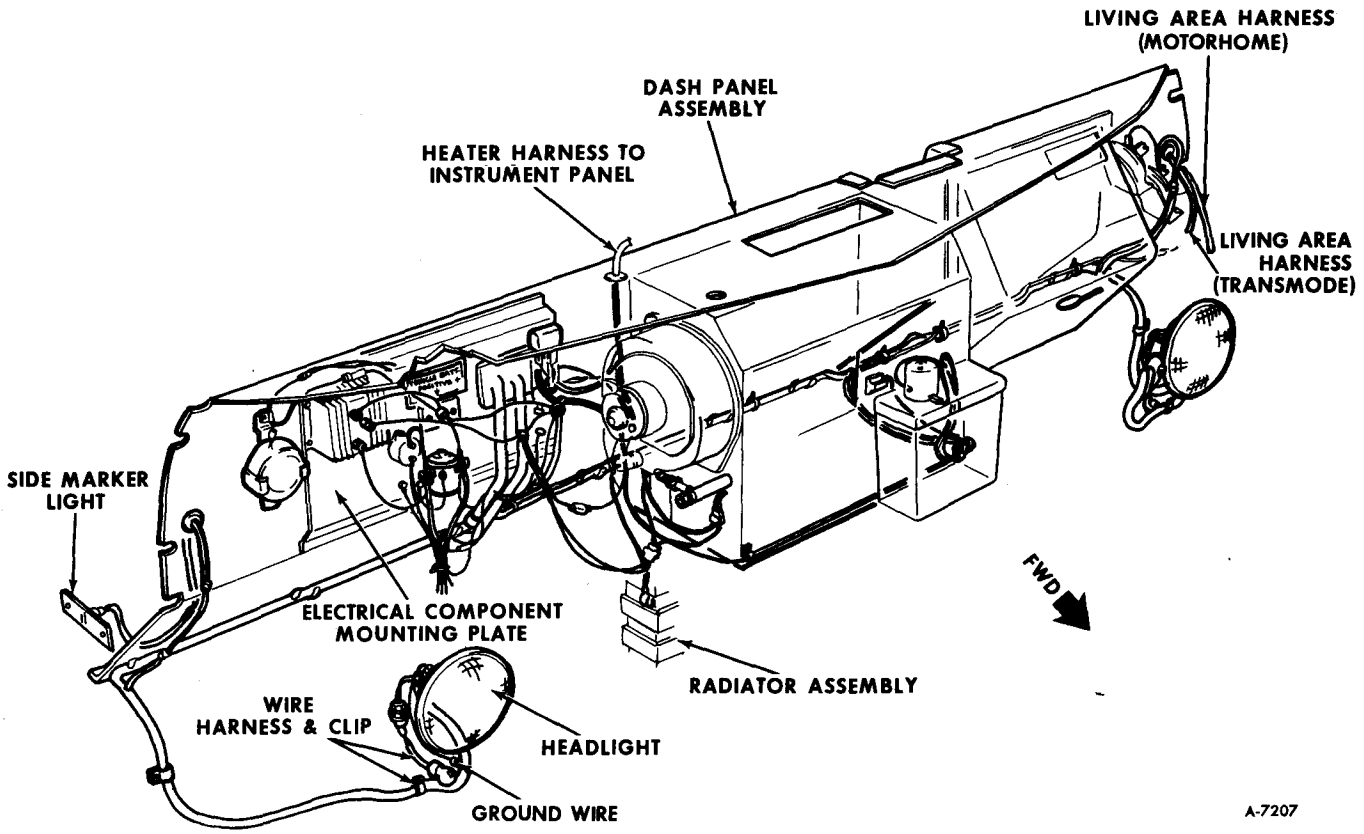


Figure 11—Dash Panel Wiring

INSTRUMENT PANEL WIRING

Wiring to the instrument panel has been revised in models covered by this supplement. Refer to figure 9 for typical panel wiring and proper connector locations. Refer also to figure 10 for dash panel wiring, and figure 11 for instrument panel wiring harness, which includes Electro-Level control switch connector location.

Note that the turn signal flasher, formerly mounted with combined turn signal/hazard

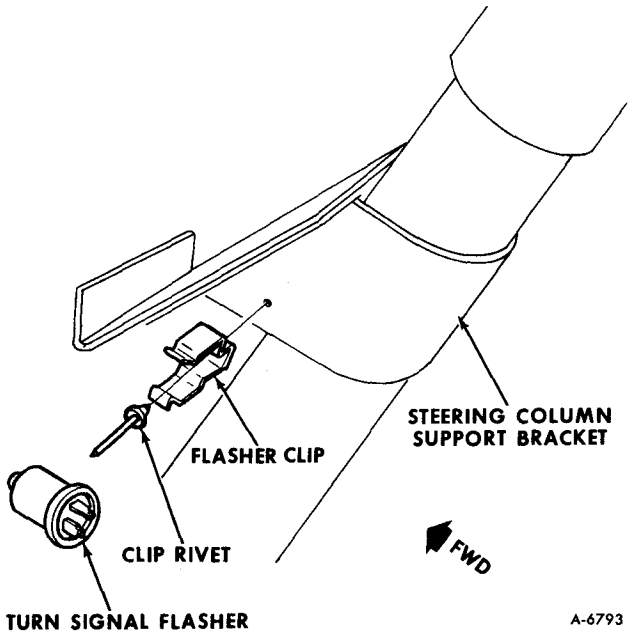


Figure 12—Turn Signal Flasher Mounting

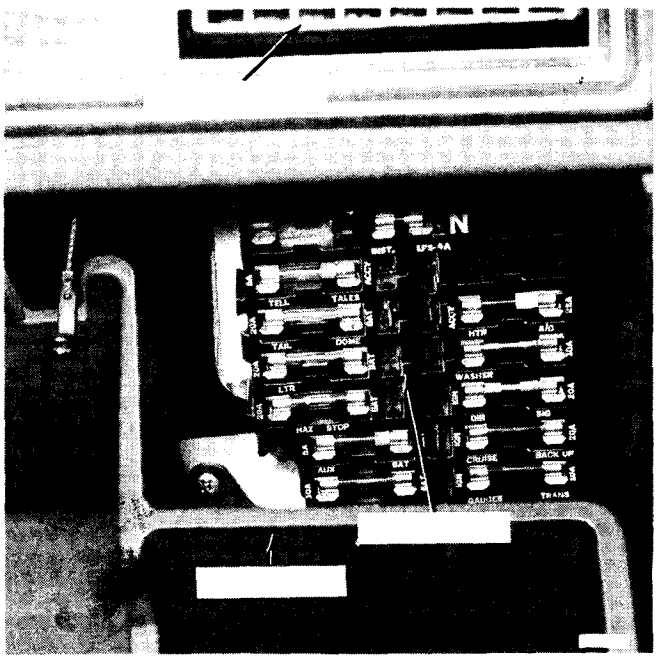


Figure 13—Fuse Panel Location

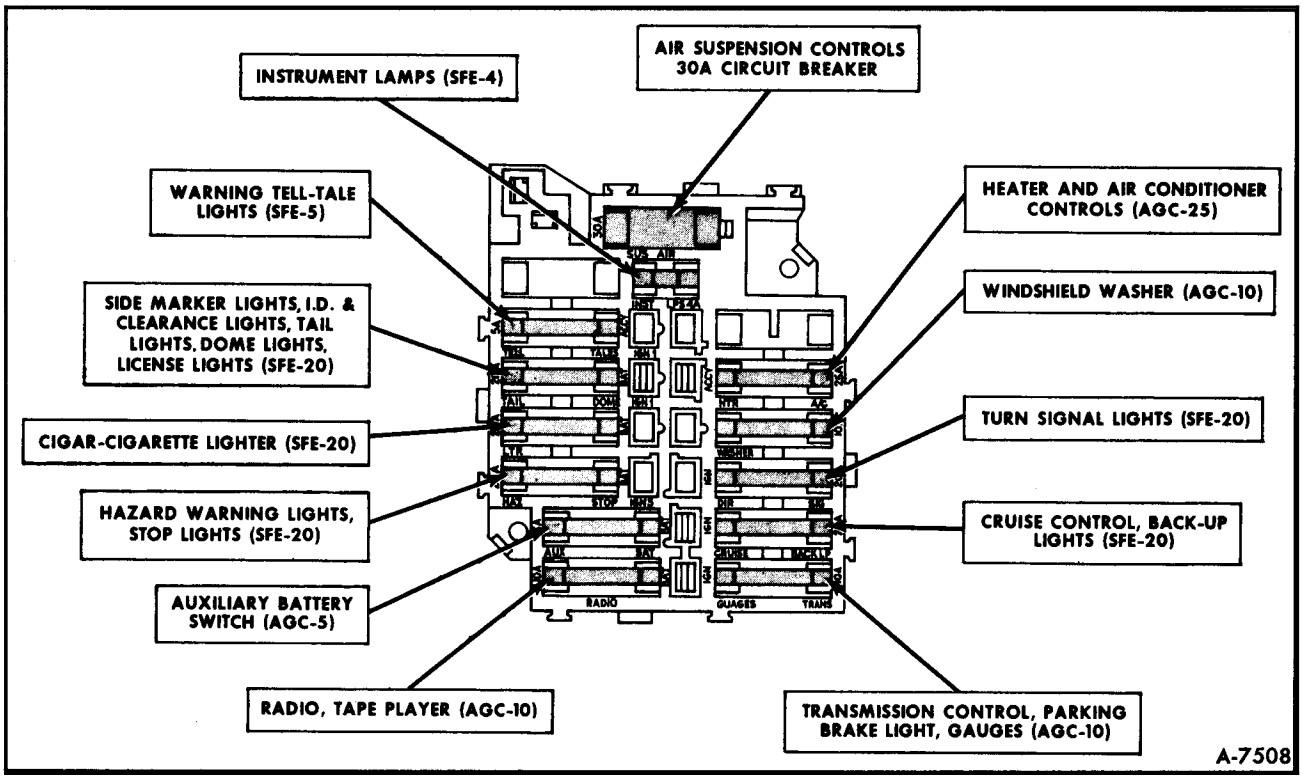


Figure 14—Fuse Panel

warning flasher, is now clipped to the steering column bracket below the instrument panel (at left side). See figure 12 for turn signal flasher mounting. The hazard warning flasher remains clipped to the instrument panel below the gauge cluster.

A time delay relay used in the automative air conditioning has been added to the heater wiring harness. For location of relay, refer to "Electrical Component Operation" of AIR CONDITIONING AND HEATING SECTION (Sec. 1B) of this supplement.

FUSE PANEL

The fuse panel location has changed—it is still mounted on the bulkhead panel behind the glove box assembly but has moved over slightly and is now mounted in an upright position (see figure 13 for location).

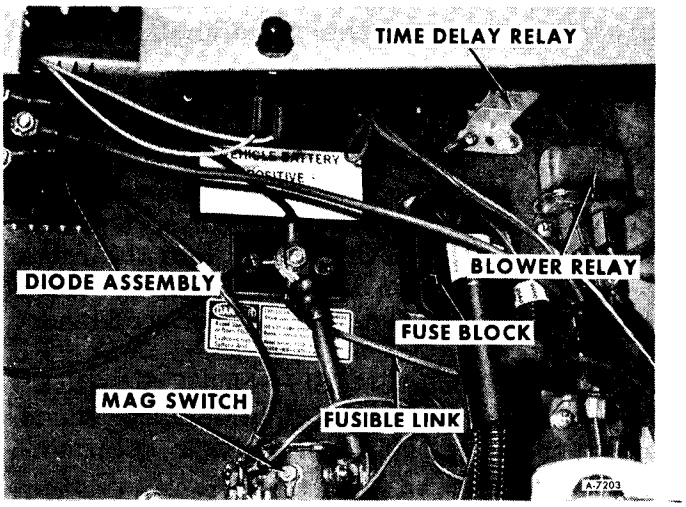


Figure 15—Motorhome Electrical Component Mounting Plate

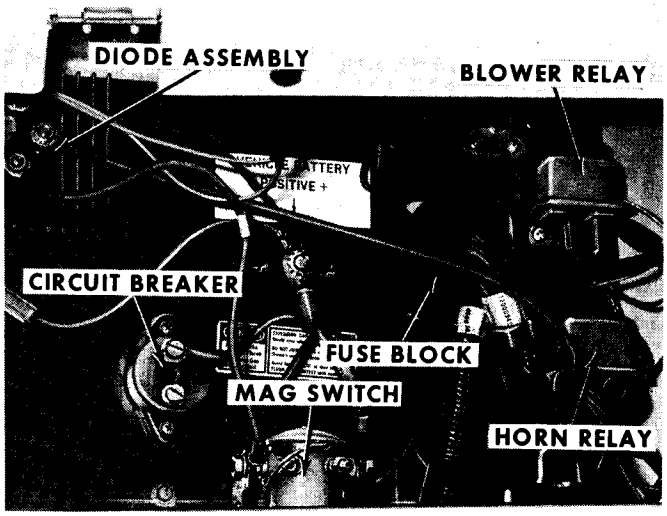


Figure 16—TransMode Electrical Component Mounting Plate

To gain access to the fuse block, open the glove box door, then release the secondary cable latch in the back of the glove compartment. Glove box will now come forward, exposing fuse block. Fuses and circuit breakers located on this panel are shown in figure 14.

ELECTRONIC COMPONENT MOUNTING PLATES

The positon of components mounted to electrical component mounting plates in Motorhome and TransMode vehicles has changed—refer to figures 15 and 16 for views of new mounting plates in these vehicles.

RADIO AND TAPE PLAYER—1977 AND 1978

Radio options for 1977 Motorhome and TransMode vehicles include an AM radio, AM-FM radio, AM-FM Stereo radio, and an AM-FM Stereo radio with 8-track tape.

Radio options for 1978 Motorhome and TransMode vehicles include an AM-FM Stereo radio and an AM-FM Stereo radio with 8-Track Tape. All description, operation and diagnosis information included in CHASSIS ELECTRICAL (SEC. 12), of Maintenance Manual X-7525 is applicable to models covered by this supplement with the exception of the following:

STEREO TAPE PLAYER CONVECTOR

Vehicles equipped with optional stereo 8-track tape player have an integral radio convector. Convector test and replacement procedures specified in Maintenance Manual X-7525 are no longer applicable.

SIX-SPEAKER RADIO SYSTEM

1978 Motorhomes with stereo radios are equipped with a six-speaker stereo system (not available in TransMode). For the most pleasing stereo effect, ths six speakers are cross-fired, with the left front, right middle, and left rear speakers reproducing the left channel sound and the opposite speakers reproducing the right channel sound. Balance adjustment procedure is the same as for the four speaker system. (Refer to "Balance Adjustment" in SEC. 12 of Maintenance Manual X-7525).

RADIO SPEAKER REPLACEMENT

REMOVAL

1. Remove four screws securing dome lamp and speaker panel to headliner (front speakers) or speaker grille to rear panel (rear speakers). If removing center speaker on Motorhome, remove four screws securing speaker to ceiling panel.
2. Disconnect speaker wires.
3. Remove nuts securing speaker to grille and remove speaker.

INSTALLATION

NOTE: Make certain that reinstalled speakers are not grounded to chassis or vehicle ground circuit. Speaker wiring is returned directly to radio and bridge audio output circuit.

1. Install nuts securing speaker to grille.
2. Connect speaker wires.
3. Install screws securing speaker assembly to headliner (or rear panel or ceiling).

DIAGNOSIS OF RADIO

Basic radio and radio/tape player diagnostic procedures are covered in SEC. 12, Maintenance Manual X-7525. Included here is a supplemental diagnosis procedure for radio noise problems, applicable to all models covered by this supplement as well as models covered by Maintenance Manual X-7525.

DIAGNOSIS OF RADIO NOISE

In correcting radio interference, there are two immediate problems to solve: the first problem is locating the source of the noise, and the second problem is discovering the actual path of interference. The engine, generator, switches and blower can be the originating sources of radio noise, and the noise is either radiated directly into the radio or enters the system through a path provided by the antenna lead-in or the power feed lead.

PRELIMINARY DIAGNOSIS—NOISE SOURCE

A description of the interference sound coming from the radio will assist in determining its origin.

The major sources of radio noise originate at either the engine or generator. Engine noise may be described as an ignition, frying or

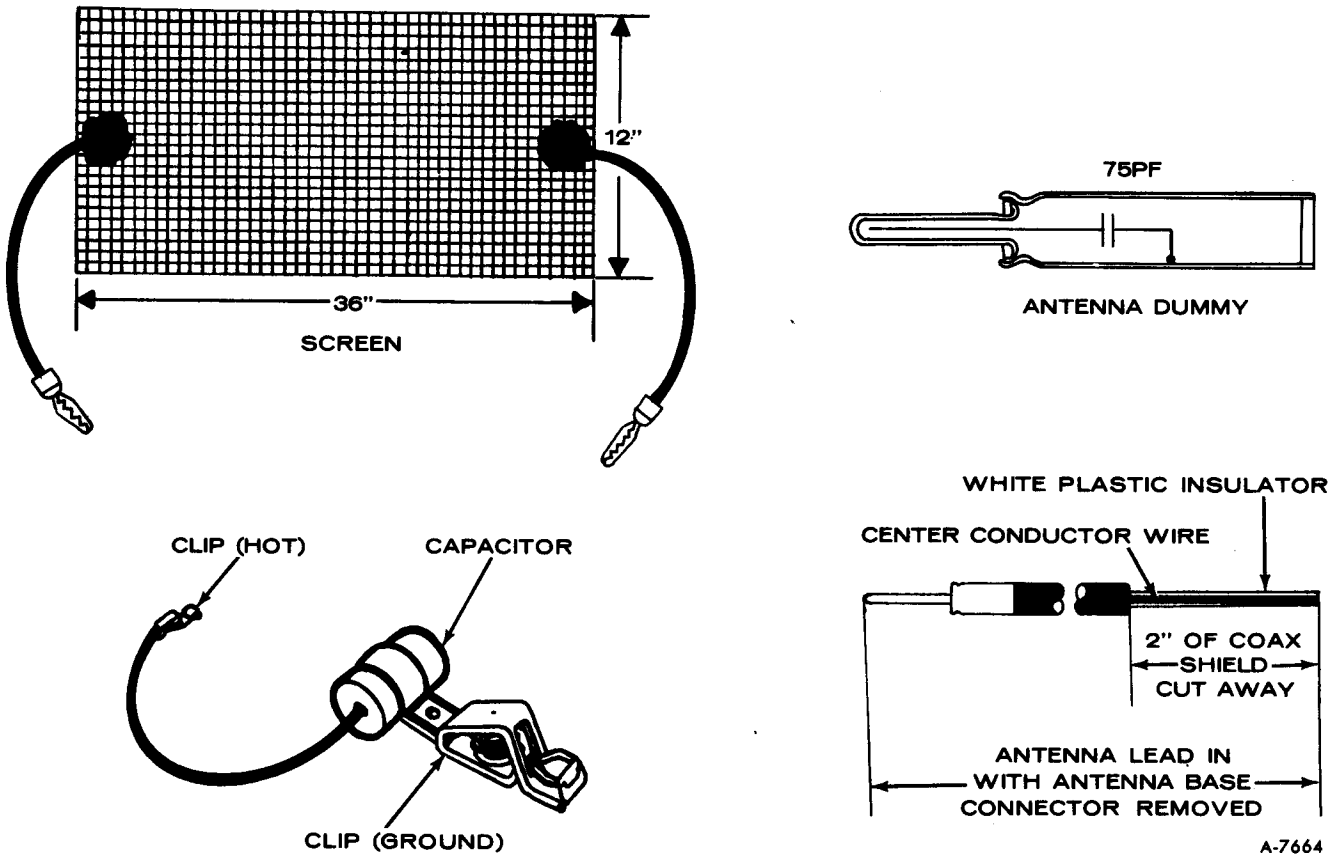


Figure 17—Radio Suppression Tools

popping sound in the radio. The generator sound is a whine or siren-like noise in the background that increases or decreases with the engine rpm.

The minor sources of noise in the radio system are discharged from either an electrical switch or the blower motor. An electrical switch generates a pop noise that can be heard in the radio system when the switch is directly or indirectly activated by the driver. A blower noise is a sound in the radio which changes speed in accordance with the blower motor operational speed.

Because of the relative complication of the two major radio noise sources (engine and generator) longer diagnostic procedures are required for detecting and solving the radio interference they create. Minor in comparison, the switch pop and blower motor noises have simple solutions after their detection. Therefore, the following suppression procedures for both the major and minor sources of radio noise appear in a decreasing order of complexity.

PRELIMINARY DIAGNOSIS—NOISE ENTRY

If all the radio components are well grounded and the source of the radio noise is not the fault of the radio chassis, determine how the interference is entering the radio.

Radio noise can penetrate the system four ways: through the antenna, through the power feed lead, through direct radiation into the radio or through the speaker leads. The great percentage of radio noises enter the system by being radiated into either the antenna or power feed lead.

An easy way to determine if the interference is getting in on the antenna lead-in or the power feed lead is to temporarily install an antenna dummy into the antenna socket at the rear of the radio chassis. The antenna dummy may be fabricated from an old antenna lead in and a 75 PF capacitor as illustrated in figure 17. The antenna dummy will prevent noise from entering the radio through the antenna socket.

To use this tool, disconnect the radio antenna from the rear of the radio chassis and plug in the antenna dummy. Turn on the engine and radio to see if the noise has been eliminated and if it has, the noise was radiated into the radio through the antenna lead-in. However, if

the noise remains then the interference is coming in on the power feed lead.

Depending on where the radio noise originated and by what path the interference is getting into the radio system (either through the antenna lead-in or power feed lead) , the interference entry problems require different solutions for the inlet conditions. They will be discussed individually under the following noise suppression procedures.

PRELIMINARY CHECKS

1. All ground straps must be clean and tight.
2. Ignition system must use resistance type spark plugs and TVRS spark plug cables.
3. The radio and antenna lead-in must be properly grounded, cleaned and tightened.
4. Antenna must be trimmed (peaked) correctly on the AM scale.

ENGINE NOISE SUPPRESSION

Interfering engine noises in the radio system may sound like an ignition, frying or popping sound and will commonly be radiated into the radio through the power feed lead or the antenna lead-in. Decide the path of entry by performing the antenna dummy test as described in "Preliminary Diagnosis—Noise Entry" under "DIAGNOSIS OF RADIO NOISE".

POWER FEED NOISE ENTRY

Engine noises on the power feed line are usually the result of large voltage spikes which cannot be handled by the input filter in the radio. One way to correct this problem is to find out its cause and eliminate it. This procedure is by far the most difficult remedy to implement. Another alternative in eliminating the interference is to add external filters for reducing the voltage spikes to a sufficient level so that the radio filter can suppress the balance.

As the first, but less desirable course of action, try moving any wiring harness from close proximity to the ignition system to reduce the possibility of the ignition system voltage spikes entering the harness.

The alternative approach uses capacitors for filtering the voltage spike interferences from the power feed lead by installing them ahead of the lead. This will reduce the intensity of the spike low enough to assure its final suppression by the radio input filter. As shown in figure 17, temporarily connect a .3 MFD or .5 MFD ignition-type capacitor to the various cavities in the fuse block, a .5 MFD to a 2 MFD capacitor to the battery terminal of the generator and/or a suitable filter package into the power feed lead. If any of these temporary remedies appear to aid in the engine noise suppression, proceed to a more permanent fix.

ANTENNA NOISE ENTRY

Engine noise coming in on the antenna system is a radiated signal which may be suppressed or shielded from the antenna. However, to accomplish a fix for this problem, it will be necessary to locate the source of the difficulty. Generally the noise will radiate from either the instrument panel or the engine compartment.

Two tools will assist in locating the problem. One tool is a piece of 36" x 12" screen with two clip leads at either end (or 36" x 36" screen for use over engine hatch) as shown in figure 17. The screen will be used as a shield to stop the noise radiation to the antenna. The second tool is an antenna test probe which is fabricated from a long antenna lead-in of approximately five to six feet. Make the test probe as shown in figure 17.

To locate the source of the radio noise, turn on the engine and radio with its antenna plugged in. Now lay the piece of screen across the instrument panel and attach its clip leads, located on either end of the screen, to bare metal on the vehicle. If the radio noise disappears or its intensity is reduced, the interference is being radiated up through the instrument panel and the screen is providing the shield necessary to remove the noise from the antenna.

Further pinpointing of the interference is established by using antenna test probe, illustrated in figure 17, to find the source of the noise. Unplug the antenna from the rear of the radio chassis and connect the test probe into the antenna socket. Turn the engine and radio on. Start probing the upper and lower instrument panel area for the entire length of the instrument panel wiring harness with the cut-away end of the test probe. Be careful not to grab the cut-away end while making the checks since it will cause faulty results. A noisy wiring harness is a likely suspect for radio interference and if it is determined to be the cause, add a .5 MFD capacitor from the faulty wire in the harness to ground.

If the screen on top of the instrument panel reduces the noise, but probing the instrument panel wiring harness fails to produce a sufficient interference source, then the noise is probably radiated from the engine campartment up through the instrument panel to the

radio. Using the antenna test probe, check the dash panel behind the instrument panel, the heater duct area and accelerator pedal linkage for extraordinary noise sources. If a source is discovered, suppress it. When diagnosing the dash panel or instrument panel for an interference source, keep in mind that these panels will exhibit "normal interference sources" which may require a comparison diagnosis with another identical vehicle.

GENERATOR NOISE SUPPRESSION

Generator whine may be described as an annoying high pitched whistle or a siren-like noise; both fluctuate with the rise and fall of the engine rpm, affecting the radio quality in a variety of ways. The produced interference can be heard on either the AM or tape modes at low volume, which may increase in intensity as the volume control is increased. Similar to other radio noises, generator whine can get into the radio system being carried through the power feed wire, through the antenna lead-in or radiated directly into the radio.

Prior to diagnosis and with the radio operating in the vehicle, make certain the antenna and radio are properly grounded, and a good connection between the antenna lead-in and radio is maintained. Corrosion or other causes of poor connection make the radio system more susceptible to all noise interference.

Before attempting to eliminate the generator noise, determine if the noise is affecting the radio on the AM band, the tape function or both.

DIAGNOSIS

1. Tune the radio to an AM station at midband or above.

NOTE: For the combination radio/tape players, insert a tape deck upside down to turn on the set without music.

2. Start the engine and listen for the generator whine which increases and decreases with the fluctuation of engine rpm.

3. If no generator noise is detected, it may be necessary to increase the radio volume and load the generator by turning on the headlights and a few accessories.

4. If the generator whine is encountered, remove the antenna lead-in from the radio, and add the antenna dummy to the radio as outlined in "Preliminary Diagnosis—Noise Entry" under "DIAGNOSIS OF RADIO NOISE". If the noise persists, a power feed entry is the problem and may be remedied by adding a .5 to a 2 MFD capacitor to the generator output terminal or a .5 MFD capacitor to the radio feed cavity at the fuse block.

5. However, if the generator noise is eliminated by installing the antenna dummy, the radio interference is radiated into the antenna lead-in. Detect the source of the antenna radiation as outlined in "Antenna Noise Entry" under "ENGINE NOISE SUPPRESSION".

6. To correct the antenna noise problem, make certain the antenna system is well grounded by measuring the continuity between it and the vehicle ground; try running the faulty wire through a shielded cable; or try to add a .5MFD capacitor to any offensive circuit under the instrument panel.

SWITCH NOISE SUPPRESSION

A switch pop is described as either a crackling, pop or snapping sound heard in the radio when the driver directly or indirectly activates a controlling switch. To stop a switch pop from entering into the radio system, it is necessary to know which vehicle system is causing the noise. For example, when applying the brake system, the brake light switch contacts will meet, sending a sudden surge of current through the switch and wiring harness to the brake lights. The wiring harness may act as a radiating antenna causing the radio to intercept the radiated power surge, and a pop is then heard in the radio speakers.

Generally whenever the switch contacts open and close, an arc is produced. The arc will affect the radio performance in two ways, either by producing a single voltage spike which will enter the radio through the power feed or antenna lead, or by radiating a broad band of frequencies which will enter the receiver via direct radiation or the antenna lead.

A good course of action for suppressing a switch pop is to put a capacitor on the controlling switch. Usually a .5 MFD capacitor can be tried on two position: across the switch contacts if they are accessible, or from the hot side of the switch to ground. Sometimes a capacitor in both positions will cure the problem.

BLOWER MOTOR NOISE SUPPRESSION

Blower motor noise shows up as a static sound in the radio which will follow in intensity according to the blower motor speed. The

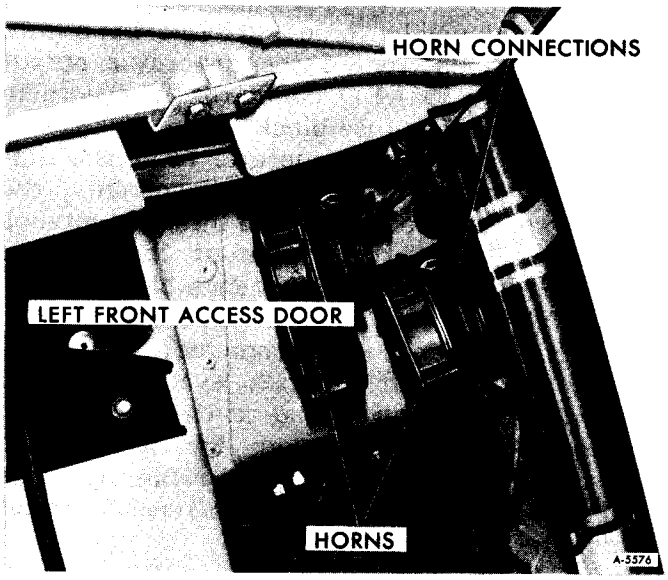


Figure 18—Horn Installation

noise is caused by arcing in the motor brushes. Suppress the motor noise by adding a .25 MFD feed-through capacitor on the blower motor power feed wire. Be sure the capacitor has a good ground or the noise will persist. If the interference is not eliminated, put another .5MFD capacitor in parallel with the feed-through capacitor.

HORN

Horn mounting has been revised in models covered by this supplement. These two air-tone "S" type vibrating electric horns are mounted typically as shown in figure 18 (viewed behind front access door-driver side).

The electric air-tone "S" type horn is carefully adjusted and inspected during manufacture and is designed to operate indefinitely without attention. The horn assembly should not be adjusted or repaired. "Horn Diagnosis" procedures described in Maintenance Manual X-7525 are not affected by new installation.

LIGHT BULB SPECIFICATIONS— 1977 AND 1978

INSTRUMENT PANEL

Usage	Quantity	Bulb No.
Brake System Tell-Tale	1	161
Generator Tell-Tale	1	161
Park Brake Tell-Tale	1	74
Cruise Control Tell-Tale	1	74
Door Ajar Tell-Tale	1	74
Low Fuel Tell-Tale	1	74
Engine Water Tell-Tale	1	74
Electro-Level Tell-Tale	2	74
High Beam Indicator	1	161
Turn Signal Indicator	2	168
Instrument Cluster Lights	2	194
Speedo Cluster Lights	2	194
Dome Lights	2	211
Radio Dial (AM/FM Stereo Tape)	1	566
Radio Dial (Except AM/FM Stereo Tape)	1	1893
Heater Control	1	1895
Voltmeter	1	53

EXTERIOR

Usage	Quantity	Bulb No.
Clearance and I.D.	10	67
License	1	67
Side Markers-Front	2	194
Side Markers-Rear	2	194
Back-Up Lights	2	1156
Parking and Turn Signals	2	1157
Stop and Tail	2	1157
Headlights	2	6014

VEHICLE FUSES AND CIRCUIT BREAKERS

The following fuses are located in the fuse block behind the glove box in the dash. Do not use fuses of higher amperage rating than those specified below—or property damage may result.

Usage	Name On Fuse Block	Fuse Type
Instrument Lamps	INST LPS	SFE-4
Warning Tell-Tale Lights	TELL TALES	SFE-5
Side Marker Lights I.D. & Clearance Lights Tail Lights Dome Lights License Lights	TAIL DOME	SFE-20
Cigar-Cigarette Lighter	LTR	SFE-20
Hazard Warning Lights, Step Lights	HAZ STOP	SFE-20
Auxiliary Battery Switch	AUX BAT	AGC-5
Radio, Tape Player	RADIO	AGC-10
Heater and Air Conditioner	HTR A/C	AGC-25
Windshield Washers	WASHER	AGC-10
Turn Signal Lights	DIR SIG	SFE-20
Cruise Control, Back-Up Lights	CRUISE BACK-UP	SFE-20
Transmission Control, Parking Brake Light, Gauges	GAUGES TRANS	AGC-10

VEHICLE FUSES AND CIRCUIT BREAKERS (CON'T)

The following circuits employ circuit breakers or have fuses located as indicated:

Headlight Circuit Breaker	Built Into Light Switch
Main Harness Fusible Link	Between Junction Block and Horn Relay
Heater Blower Fusible Link	Built Into Line at Right Access Door Near Heater Blower Relay
Hazard Signal Flasher GM No. 673499	In Clip behind Instrument Panel at Fuel Selector Switch
Turn Signal Flasher GM No. 491392	On Left Side of Steering Column
Vehicle Trouble Light AGC-10	In Line, Behind Access Door, Near Light
Air Suspension Compressor 30A Circuit Breaker	In Fuse Block
Water Pump	In Line, Near Water Pump

SECTION 13

RADIATOR AND COOLANT RECOVERY SYSTEM

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: See "Caution" on page one of this section.

CAUTION: THIS FASTENER IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

NOTE: Refer to "Specifications" at the end of this section for all torque values not given in the text.

CONTENTS

NOTE: Refer to ENGINE COOLING (SECTION 6K) of Maintenance Manual X-7525 for information relative to coolant circulation, temperature indicators, thermostats, and fan belts. For coolant recommendations and capacities, refer to to GENERAL INFORMATION AND LUBRICATION (SECTION 0) in Maintenance Manual X-7525.

DESCRIPTION

All vehicles are equipped with a cross-flow radiator and a recovery-type cooling system. The level in the coolant recovery reservoir should be maintained at the "COLD" line when coolant is cold.

At normal operating temperatures, level can reach "HOT" line on reservoir. However, should the coolant level fall below the cold level line, additional coolant (other than for draining and refill) should be added through the coolant recovery reservoir.

MAINTENANCE

At regular intervals, cooling system components should be inspected to determine if service is required. Regular systematic checks will reveal faulty condition of various units and indicate necessity of servicing or replacement of such components before failure occurs.

Suggested checks are:

1. Frequently check coolant level. If low, add recommended coolant as required.

2. Check hose connections and tighten clamps if seeping is evident. Cracked, stripped, or corroded clamps should be replaced.

3. Inspect radiator hoses for spongy or checked appearance. Deteriorated hoses should be replaced before bursting occurs which would result in coolant loss and could cause extensive engine damage due to overheating.

4. Check radiator core for leaks and for accumulation of dirt which obstructs air passages and reduces effective heat transfer.

To assist in maintaining effecient heat dissipation, an occasional external flushing withwater will remove majority of dirt accumulation and foreign matter form between core fins.

Water under moderate pressure should be directed from behind core to force debris out in opposite direction of its entrance. Water should be directed in line with fins, not sideways, to reduce possibility of bending fins.

5. Inspect radiator mounting pads for deterioration and replace as required.

6. Inspect for proper clearance between fan blades and shroud. Check fan attaching bolts for tightness and observe alignment of fan blades in relation to each other. Replace fan if any blade is bent. Distance between blades and shroud should be equal around entire perimeter of the ring. If adjustment is required, shroud attaching bolts may be loosened and the shroud shifted as necessary to provide proper clearance.

7. Check radiator filler cap seals for evidence of cracking or separation. Replace as required.

8. When coolant loss is evident or engine overheating occurs, the damaged or clogged radiator should be serviced by a radiator specialist or replaced with a new one. Efficient repair of radiators requires the use of special tools and equipment as well as provisions for making proper tests. If radiator core requires painting, spray with special radiator paint; do not use paint mixed with oil, as oil mixed paint will form an insulation and prevent efficient dissipation of heat.

RADIATOR MOUNTING

The 403 cubic inch engine was first used in vehicles identified with the following Vehicle Identification Numbers:

Motorhome	TZE167V101285
23' TransMode	TZE337V101287
26' TransMode	TZE367V101312

Beginning with these vehicles the radiator core venturi ring and venturi ring seal are no longer used. Refer to figures 1 and 2 for radiator and fan shroud mounting with 403 engine.

RADIATOR REPLACEMENT

REMOVAL

1. Disconnect battery ground cable.
2. Open drain cock at lower corner of radiator assembly (figure 1), and drain radiator.
3. While radiator is draining, remove vehicle front grille.
4. Disconnect brake fluid lines and oil fill tube from radiator (clamped to driver side).
5. Remove bolts mounting air conditioning condenser to radiator support (two bolts each side). If necessary, remove condenser side baffles and lower front baffle. Then pull condenser forward.
6. Disconnect coolant recovery hose from radiator.
7. Disconnect upper radiator hose.
8. Remove two shroud-to-support upper bolts. Refer to figure 2..
9. Raise vehicle.
10. Disconnect lower radiator hose.
11. Disconnect transmission oil cooler lines and engine oil cooler lines at radiator.
12. Disconnect power steering hose clamps from radiator.
13. Remove lower bolts securing shroud to radiator support (figure 2), and carefully place shroud over engine fan to provide clearance for radiator removal.
14. Disconnect lead wire to low coolant probe sensor ("engine water" sensor).
15. Remove radiator support mounting bracket (see figure 1) on driver side. Remove three radiator support bolts on each side.
16. Lower radiator and support from vehicle.

If replacing radiator, remove support channel from radiator. Place new radiator core in radiator support channel, and secure support channels to radiator.

Lift radiator assembly up into vehicle. It is suggested that this be attempted only with two persons, as the assembly is quite heavy.

INSTALLATION

CAUTION: *See "Caution" on page one of this section.*

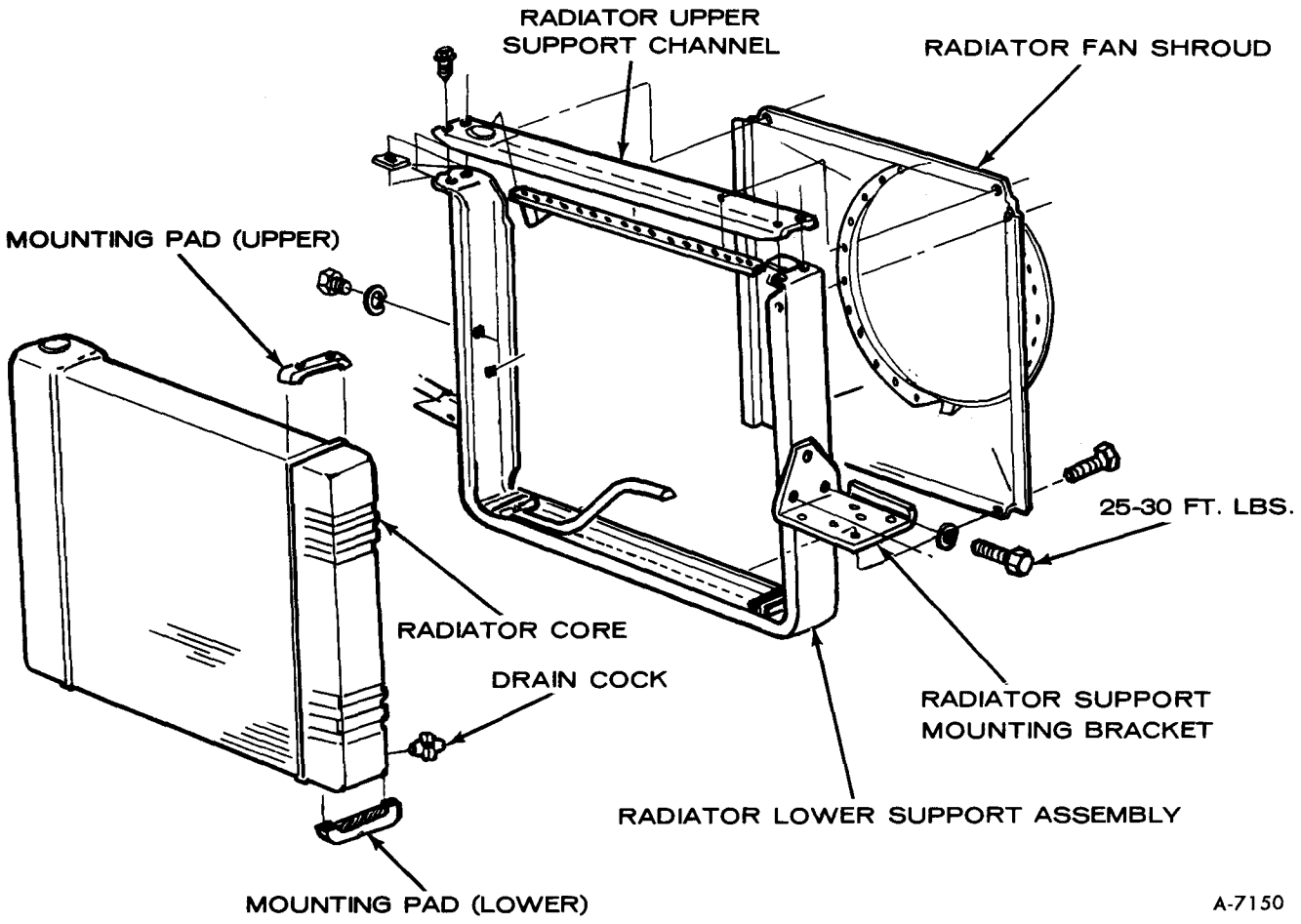


Figure 1—Radiator Mounting

1. Install radiator and support channel in vehicle. Torque attaching bolts to specification.
2. Insert low coolant probe sensor and torque to 25-30 in. lbs. Connect probe lead wire.
3. Install two fan shroud to radiator support lower bolts.
4. Connect power steering hose clamps to radiator.
5. Install upper support channel assembly bolts.
6. Connect lower radiator hose.
7. Connect engine oil cooler and transmission cooler lines at radiator.
8. Install two shroud-to-support upper bolts.
9. Lower vehicle.
10. Connect radiator upper hose.
11. Connect coolant recovery hose at radiator.
12. Install condenser. Replace any baffles which were removed.
13. Connect brake lines and oil fill tube (one clamp-driver side of radiator.)
14. Install vehicle front grille.

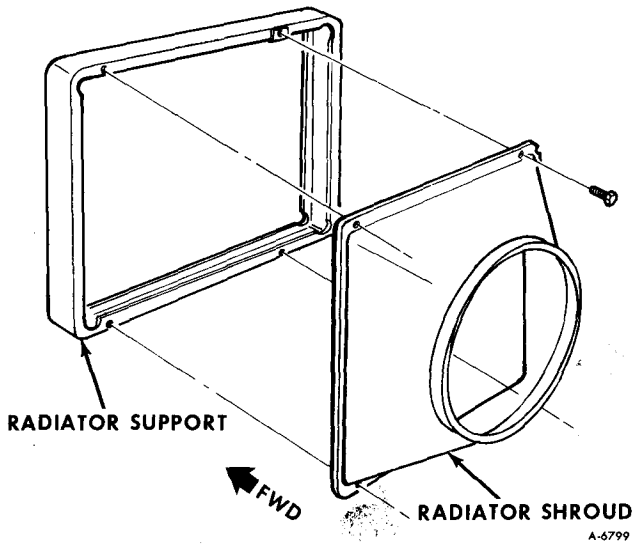


Figure 2—Radiator Shroud

15. Refill radiator following procedure described in Section 6K, Maintenance Manual X-7525.

16. Start engine and check for leaks.

NOTE: For service and diagnosis of "Coolant Level" indicator system, refer to CHASSIS ELECTRICAL (Section 12), Maintenance Mnaual X-7525.

PRESSURE CAP AND VALVE

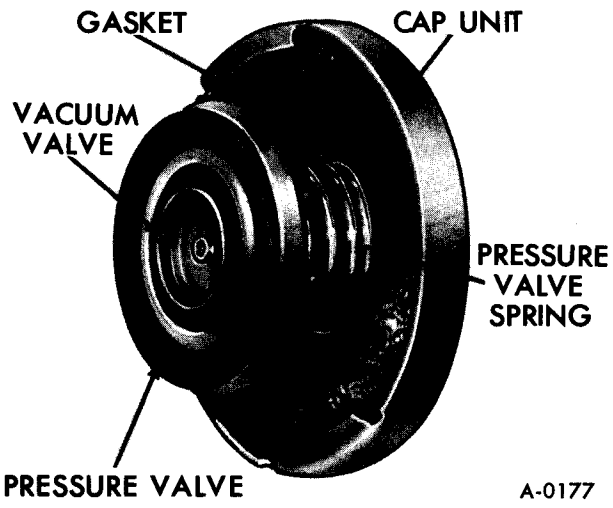


Figure 3—Pressure Cap

A pressure relief valve assembly, integral with the radiator filler cap, incorporates a pressure valve and a vacuum valve. (See figure 3). When pressure in system reaches valve setting (See "Specification" at end of this section), pressure valve opens and liquid is allowed to escape. As liquid in the system cools it contracts; this allows pressure valve to close and also creates a partial vacuum in system. Atmospheric pressure acting through the overflow tube unseats the vacuum valve and allows coolant to enter radiator.

The radiator filler cap is constructed with a spring-loaded rubber seal which is pressed firmly against surface of filler neck seat when cap is installed. Rubber seal must be in good condition and top of radiator filler neck must be clean and smooth in order to form an air-tight seal. Seal of filler cap and operation of pressure relief valve can be checked using a conventional cooling system testing kit.

CAUTION: *When the engine is at normal operating temperature or above, the internal pressure built up in the cooling system will blow out scalding fluid and vapors if the radiator cap is suddenly removed. To prevent loss of coolant and to avoid the danger of being burned, the coolant level should be checked, or coolant added, only to the coolant recovery reservoir. If the radiator cap must be removed when the engine is hot, place a cloth over the cap and rotate the cap slowly counterclockwise to first stop and allow pressure to escape completely. Then turn cap again slowly counterclockwise to remove.*

COOLANT RECOVERY SYSTEM

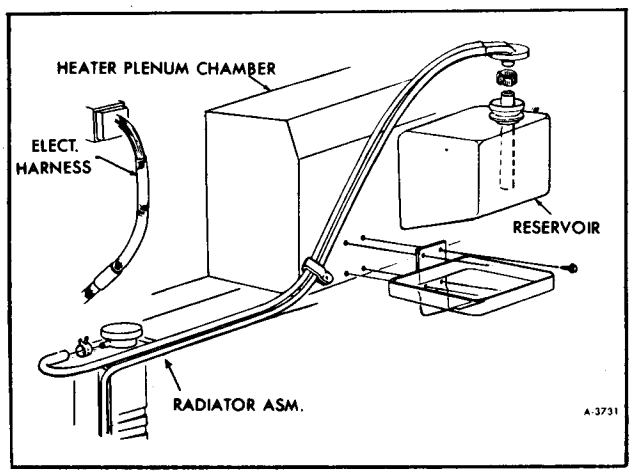


Figure 4—Coolant Recovery System

The coolant recovery system consists of a reservoir, pressure cap and interconnecting hose. The reservoir is mounted above the radiator and is accessible from the front access doors and connected to the radiator filler neck with a hose. The coolant level must be maintained at the "COLD" mark on the side of the reservoir when coolant is cold. A gasket incorporated into the filler cap forms a seal at the radiator filler neck. A leak at this gasket will result in loss of coolant during normal operation. The pressure cap must be installed so that the marking on top of the cap aligns with the overflow tube on the filler neck.

Refer to figure 4 for removal and installation of coolant recovery system components.

ENGINE COOLANT

COOLANT RECOMMENDATIONS

For coolant drain and refill procedure, refer to SECTION 6K of Maintenance Manual X-7525. Cooling system maintenance intervals will be found in SECTION 0 of this supplement.

COOLANT TESTING

Always test solution before adding water or anti-freeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature. Other testers are provided with thermometers and tables and indicate freezing points corresponding to readings made at various temperatures. Disregarding temperatures of solution may cause an error as large as $30^{o}F$ ($1.1^{o}C$). Read and be guided by instructions furnished by the tester manufacturer.

In the event coolant freezes solid in extreme cold weather, place vehicle in warm building or improvise some means of thawing coolant before starting engine. Under no circumstance should engine be operated when coolant is frozen solid. After thawing, refill system with a higher concentration of anti-freeze solution and start engine. Inspect entire system for leakage and then test coolant with hydrometer to determine if adequate anti-freeze protection is provided.

COOLANT PRECAUTIONS

1. Overheating is not always caused by a defective cooling system; incorrect ignition timing, dragging brakes, or under-inflated tires can cause overheating.
2. Keep water pump and fan drive belts at proper tension. Refer to ENGINE COOLING SYSTEM (Section 6K) of this manual.
3. Do not remove radiator filler cap when engine is hot. Wait until system cools off.
4. Do not pour cold water into cooling system when the engine is hot. Wait until system cools off.
5. If cooling system requires frequent refilling, check for leaks.
6. Keep all connections tight, and make sure gasket on radiator filler cap is in good condition.
7. When filling system with anti-freeze solution, always follow recommendations of anti-freeze manufacturer.
8. Use only ethylene glycol base coolant meeting GM Specification 1899M.
9. Drain and flush cooling system every other year, preferably at start or end of winter operation.

COOLING SYSTEM PRESSURE RELIEF VALVE (PRESSURE CAP)

Models	Valve Opening Stamped	PSI
Motorhome and TransMode	RC32	9

TORQUE SPECIFICATIONS

FASTENER	TORQUE
Radiator Support Mounting Bracket Bolts to Radiator Support	25-30 Ft. Lbs.

SECTION 24

MISCELLANEOUS GMC LIVING AREA FACILITIES

The information in this section pertains to components and/or systems found in the GMC Motorhome (Models ZEO6581 or ZEO6584) ONLY.

CONTENTS

SECTION 24B

LIVING AREA ELECTRICAL

The information described in Maintenance Manual X-7525 under the heading LIVING AREA ELECTRICAL (SEC. 24B) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

MODEL ZEO6581

CONVERTER REPLACEMENT

The 120-volt/12-volt power converter is located in the living area electrical compartment.

1. Disconnect battery ground cable from living area battery. Unplug converter at 120-volt outlet.

2. Disconnect converter lead at fuse panel (figure 1).

3. Remove converter 4 mounting bolts (figure 1). Pull converter forward (or tip sideways if possible) to allow access to wall panel retaining screws.

4. Remove wall panel retaining screws (behind power converter) and pull wall forward.

5. Disconnect ground screw and converter ground wire from frame (belt rail) behind wall panel (figure 1). Lift out converter.

6. Converter installation is reverse of removal procedure. Be sure to attach converter ground wire securely before converter is placed in position. Torque mounting bolts to specification (figure 1).

NOTE: Figure 2 is a schematic of the 1978 120-volt electrical system.

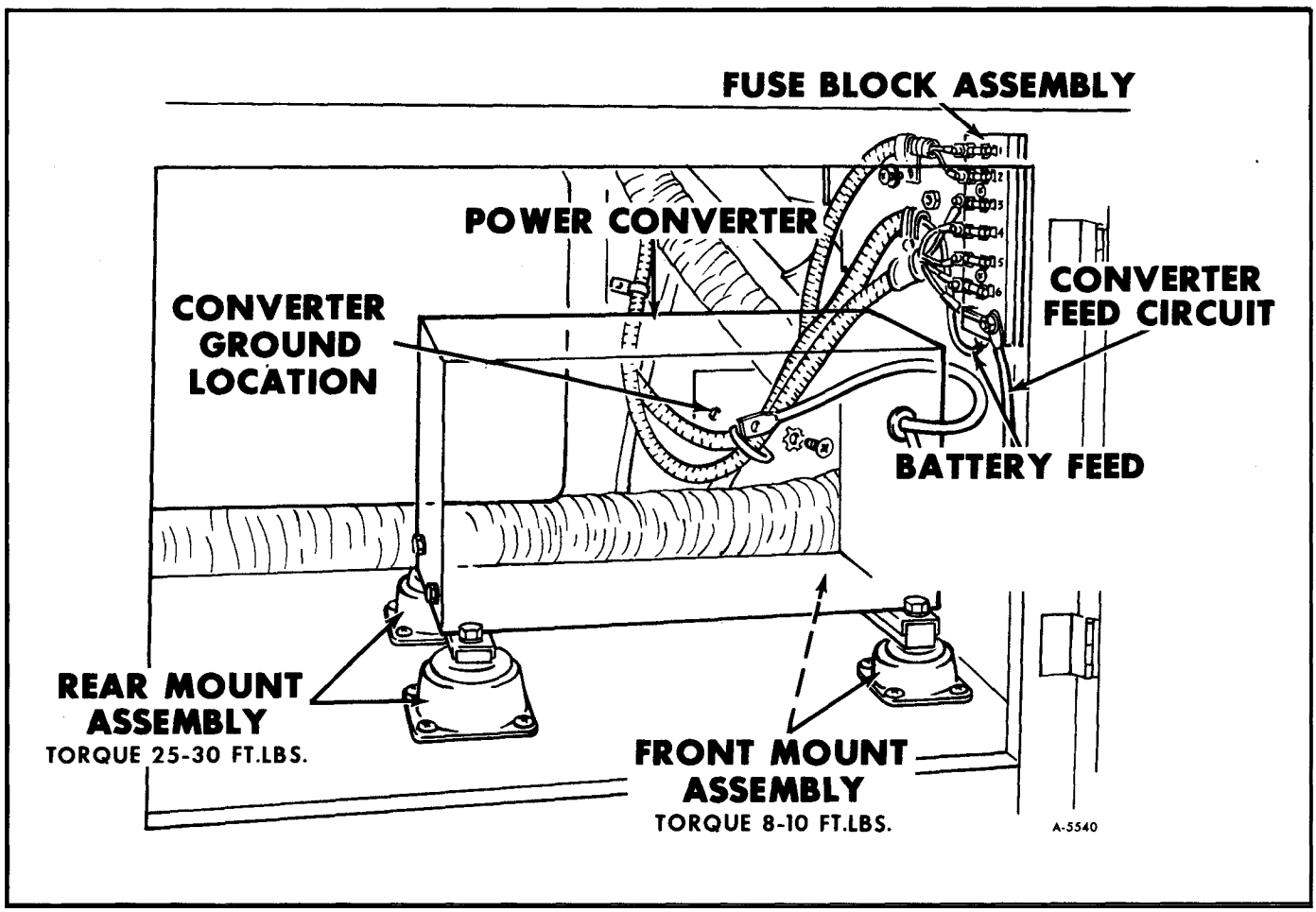
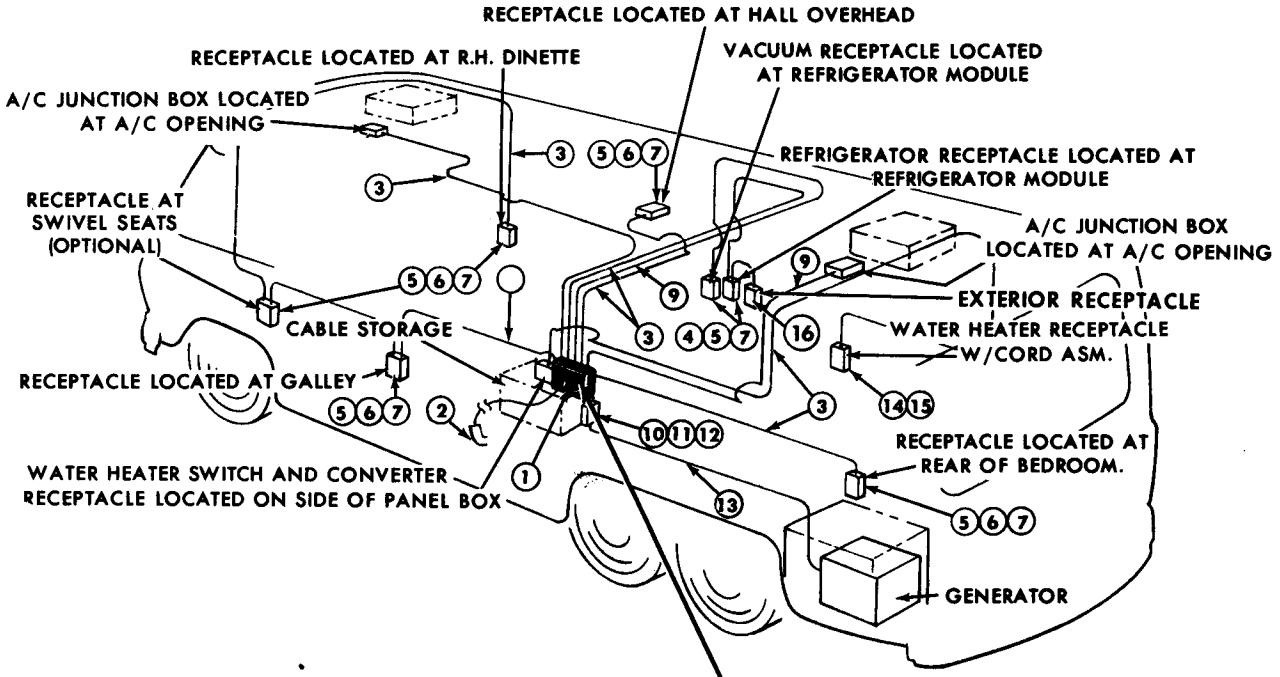


Figure 1—Converter Installation (ZE06581)

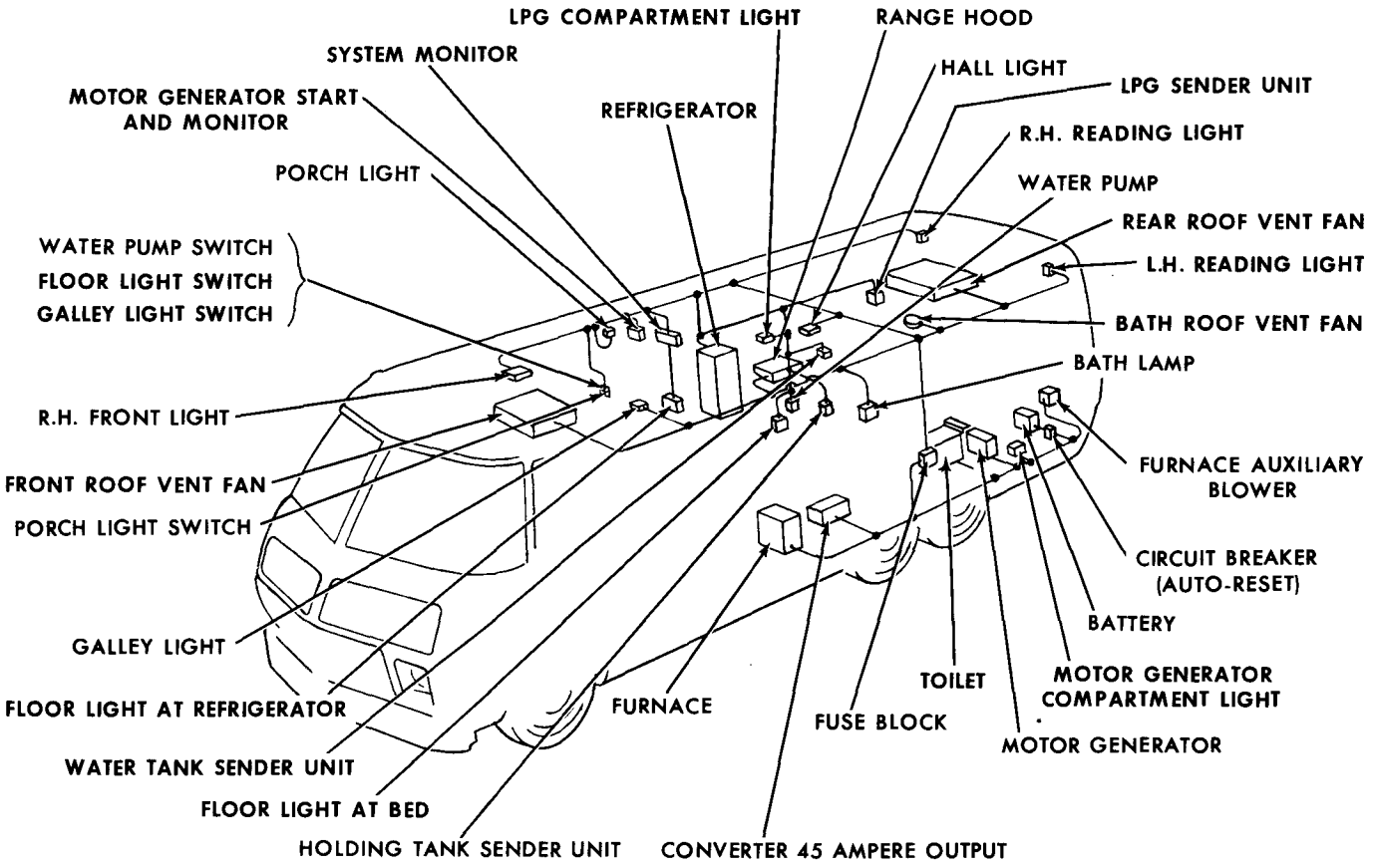


ITEM NO.	PART NAME
1	MAIN PANEL BOX
2	#8-4 WIRE CORD TYPE '50' W/PLUG
3	WIRE 12/2 W/GROUND WIRE
4	SINGLE RECEPTACLE
5	OUTLET BOX
6	DUPLEX RECEPTACLE
7	OUTLET PLATE
8	SWITCH & RECEPTACLE
9	14/2 W/GROUND WIRE
10	3 POLE 4 WIRE RECPTACLE
11	OUTLET BOX
12	OUTLET PLATE
13	#6-2 WIRE CORD IN METAL CONDUIT
14	'J' BOX
15	BLANK COVER PLATE
16	EXTERIOR RECETACLE

CIRCUIT BREAKER PANEL				
CIRCUIT #1	CIRCUIT #2	CIRCUIT #3	CIRCUIT #4	CIRCUIT #5
FRONT AIR COND. RECEPT.	WATER HEATER RECEPT.	HALL OVER RECEPT.	MICROWAVE RECEPT.	REAR AIR COND. RECEPT.
	CONVERTER RECEPT.	BEDROOM RECEPT.		
		GALLEY RECEPT.		
		SWIVEL CHAIR RECEPT.(OPT.)		
		R.H. DINETTE RECEPT.		
		REFRIGERATOR RECEPT.		
		EXTERIOR RECEPT.		
		VACUUM RECEPT.		

A-7648

Figure 2—1978 Living Area 120-Volt AC Electrical Schematic (ZE06581)



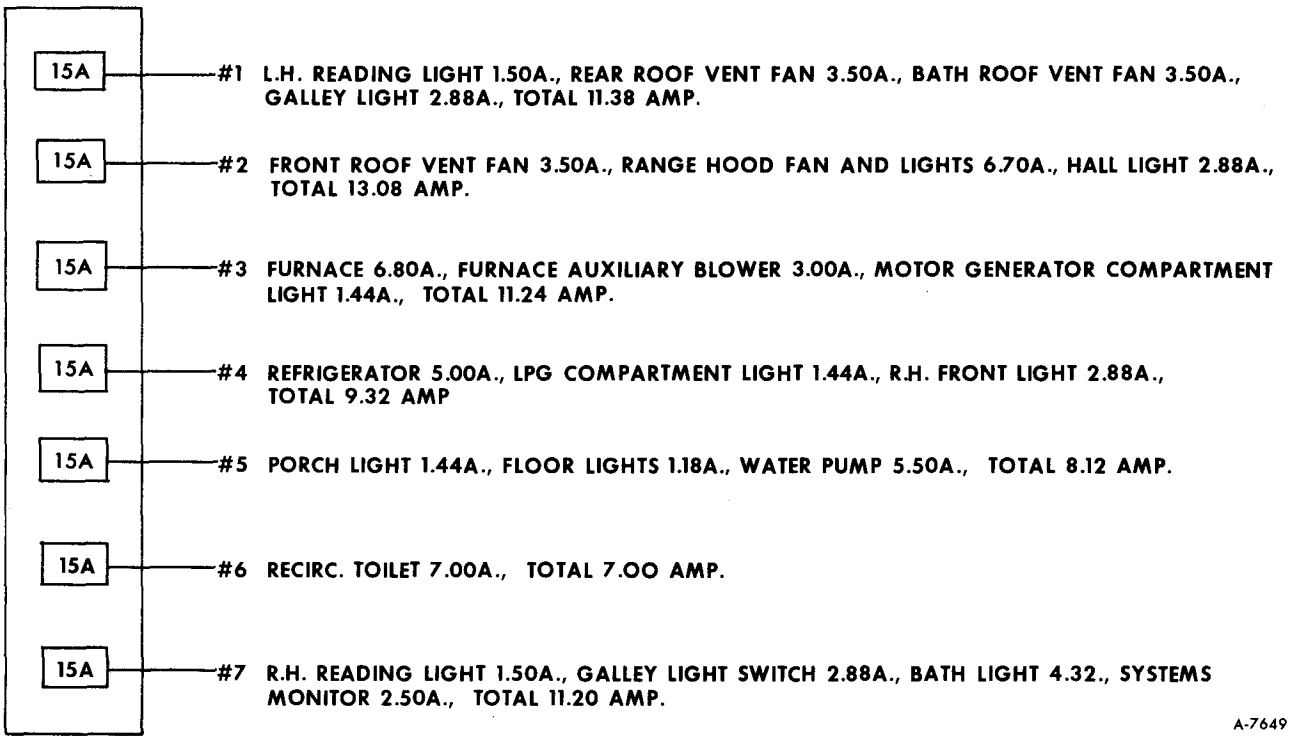
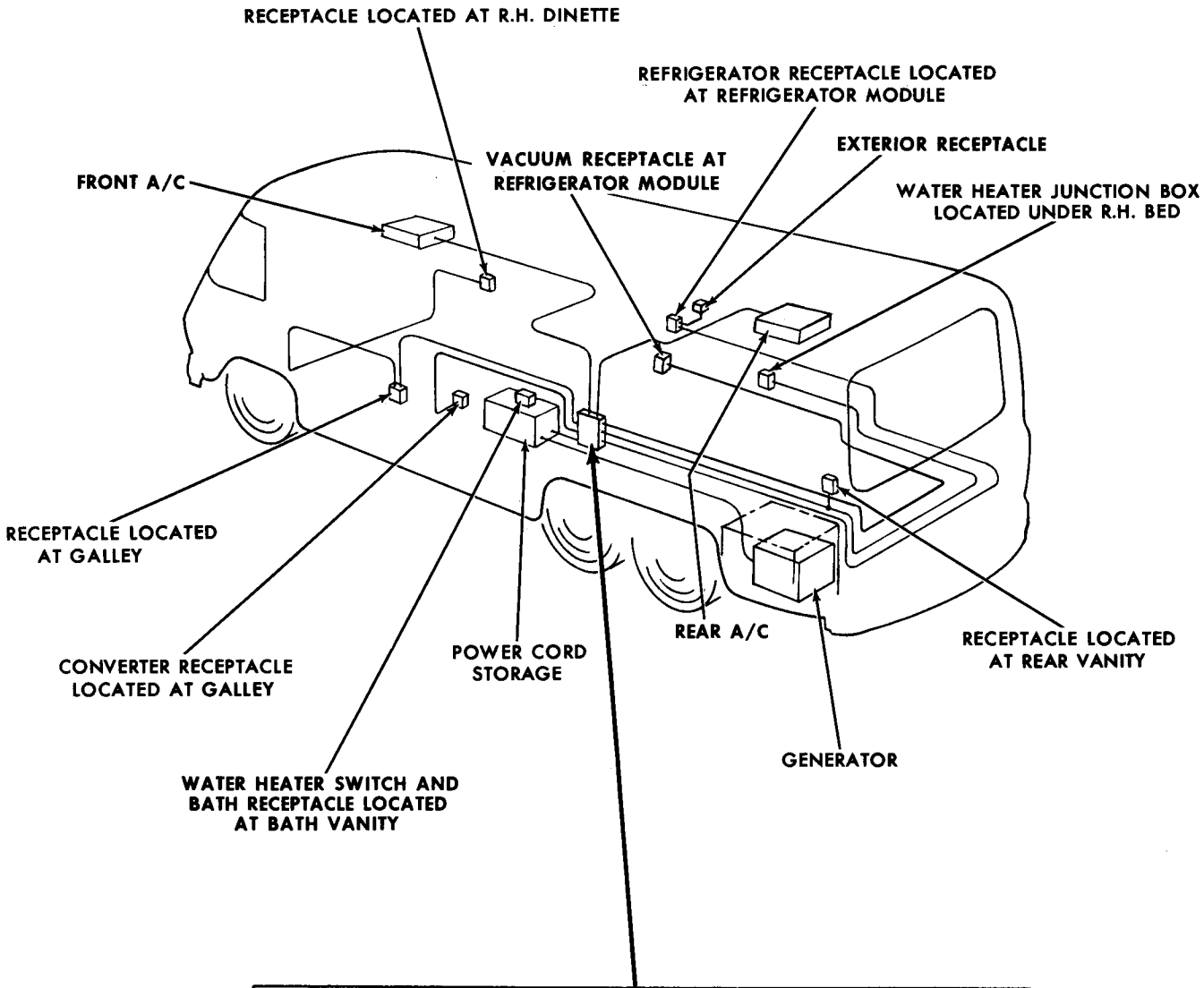


Figure 3—Living Area 12-Volt D C Electrical Schematic (ZE06584)



CIRCUIT BREAKER PANEL				
CIRCUIT #1	CIRCUIT #2	CIRCUIT #3 GRD. FAULT PROTECTED	CIRCUIT #4	CIRCUIT #5
FRONT AIR COND. RECEPT.	WATER HEATER RECEPT.	BEDROOM RECEPT.	VACUUM RECEPT.	REAR AIR COND.
	CONVERTER RECEPT.	GALLEY RECEPT.		
		R.H. DINETTE RECEPT.		
		REFRIGERATOR RECEPT.		
		BATH RECEPT.		
		EXTERIOR RECEPT.		

A-7650

Figure 4—Living Area 120-Volt AC Electrical Schematic (ZE06584)

MODEL ZEO6584

DESCRIPTION

The 12-volt living area circuits are protected by automotive-type fuses, and the 120-volt circuits are protected by circuit breakers like those found in modern homes. Schematics of the 12-volt and 120-volt systems are shown in figures 3 and 4. The 12-volt living area fuse block is located in the bathroom vanity beneath the sink, as shown in figure 5. In the event of an overloaded circuit, the cause should be corrected and a new fuse of the same capacity must be installed.

The main circuit breaker panel (figure 6) is located just above the left rear twin bed. To gain access to panel, push lightly on access door. The panel contains circuit breakers that are designed to snap to the neutral position in the event of an overloaded 120-volt circuit. Once the cause of an overload is corrected, the circuit breaker must be moved first to the "OFF" position and then to the "ON" position.

The 120-volt/12-volt power converter is located behind the oven, above the furnace (figure 7). When the vehicle is plugged into 120-volt external power source, the converter powers all 12-volt components and recharges the living area battery.

For explanation of 12-volt fuse block number code, refer to figure 3. The circuit breakers for the 120-volt system and the circuits they protect are shown in figure 4.

GROUND FAULT INTERRUPTER CIRCUIT BREAKER

In Model ZEO6584, the circuit breaker panel includes a ground-fault interrupter circuit breaker designed to protect user from the hazards of line to ground electric shock (figure 6).

The ground-fault interrupting circuit breaker is designed to protect individuals using appliances plugged into the bedroom, galley, dinette, refrigerator, bath, and optional exterior receptacle.

If an appliance continuously trips the circuit breaker, the appliance is defective and should be repaired or replaced. Circuit breaker may also trip if circuit is overloaded. Problem should be corrected before circuit breaker is reset.

TESTING THE CIRCUIT BREAKER

For maximum protection against electrical shock hazard, the circuit breaker should be tested at least once a month and the test date recorded.

Test Procedure

1. Push "test" button. The circuit breaker should move to the center position, which indicates that power to the protected circuit is discontinued.
2. To restore power, push the circuit breaker to "OFF" position before resetting circuit breaker to "ON" position.

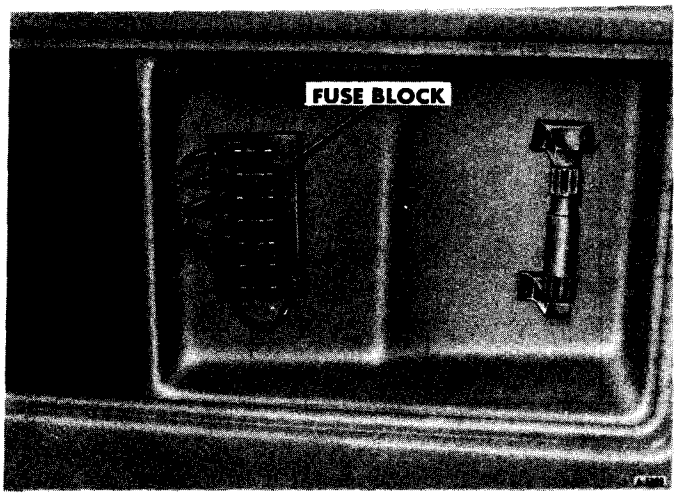


Figure 5—Fuse Panel (ZE06584)

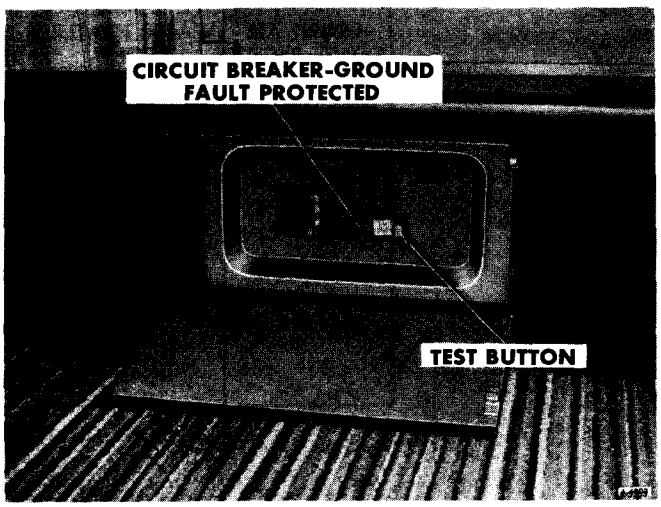


Figure 6—Circuit Breaker Panel (ZE06584)

CAUTION: *If circuit breaker does not trip when the test button is pushed, a loss of ground fault protection is indicated and a potentially lethal situation exists. The circuit breaker should be replaced.*

CONVERTER REPLACEMENT

Model ZEO6584 converter is located behind the oven, above the furnace (figure 7). If power converter does not appear to be functioning properly, be certain that ground wire is connected securely to frame and that positive lead is securely fastened at circuit breaker above converter.

NOTE: Converter humming does not indicate failure.

1. Shut off LP gas at tank.
2. Disconnect battery ground cable from living area battery.
3. Unplug converter at 120-volt outlet near furnace.
4. Disconnect gas lines at range. Remove range/oven. (Refer to "Range/Oven Unit Replacement", Maintenance Manual X-7525, Sec. 24H for detailed procedure.)

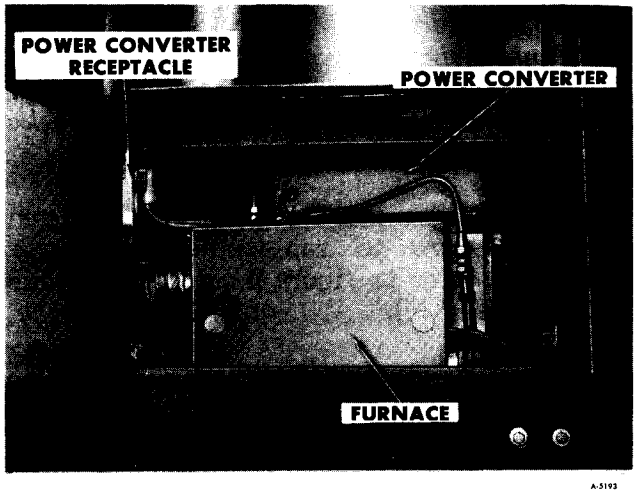


Figure 7—Converter Location (ZE06584)

5. Remove mounting bolt "A" at upper end of rear mounting bracket (figure 8). Disconnect converter ground wire from frame. Disconnect converter feed at circuit breaker.

NOTE: This circuit breaker is an automatic reset type, rated at 60 amps.

6. Remove two bracket bolts "B" and "C" (figure 8) securing side bracket to furnace mounting bracket. Next, remove front and rear bracket bolts "D" and "E" (figure 8), closest to vehicle interior. Lift off rear mounting bracket.

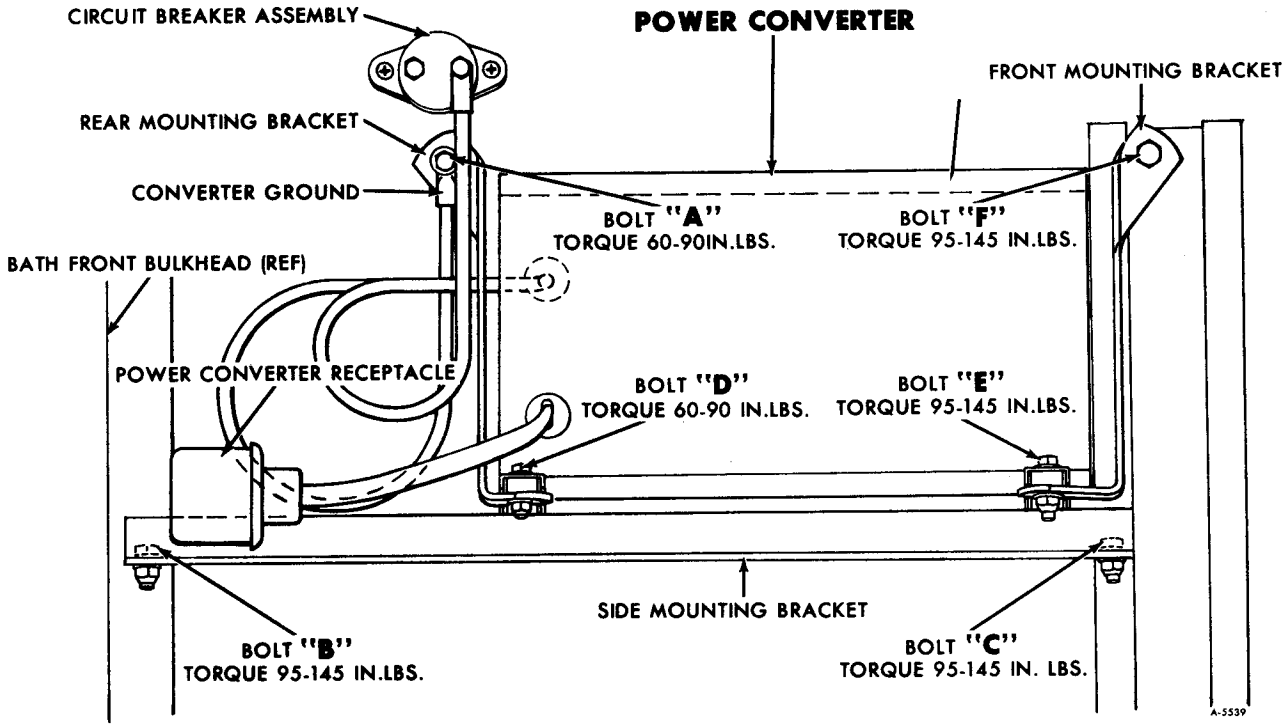


Figure 8—Converter Installation (ZE06584)

7. Loosen remaining front bracket bolt "F", and rotate front mounting bracket forward, allowing converter to be pulled out. Converter will be removed with side mounting bracket attached.

8. Remove side mounting bracket from converter. Secure to replacement converter assembly. Refer to figure 8 for torque values (bolts "B" and "C").

9. Converter installation is reverse of removal procedure. Tighten all attaching parts to torque indicated in figure 8.

EXTERIOR RECEPTACLE

The optional exterior receptacle in model ZEO6584 is located on the right side of the vehicle, behind the refrigerator grille. The exterior receptacle is wired into circuit #3 in the circuit breaker panel, which is ground fault protected. This is designed to protect anyone using appliances that are plugged into this receptacle from the hazards of line to ground electric shock.

If an appliance continuously trips the circuit breaker, the appliance is defective and should be repaired or replaced.

SPECIFICATIONS

LIVING AREA 12-VOLT SYSTEMS FUSES (ZEO6581)

The following are located in the fuse block in the living area electrical compartment, near the hall closet. Do not use fuses of higher amperage rating than those specified below, or damage may result.

Usage	No. on Fuse Block	Fuse Type
L.H. Front Light Front Roof Vent Fan Galley Light Rear Roof Vent Fan	No. 1	AGC-15
Range Hood Vent Fan and Lights Bath Vent Fan Rear L.H. Reading Light	No. 2	AGC-15
Porch Light Aisle Lights Galley Light Water Pump Systems Monitor	No. 3	AGC-15
Refrigerator Hall Light LPG Compartment Light	No. 4	AGC-15
R.H. Front Light Bath Light Rear R.H. Reading Light	No. 5	AGC-15
Toilet (Recirc.)	No. 6	AGC-15
Furnace Furnace Auxiliary Blower Oven Light Motor Generator Compartment Light	No. 7	AGC-15

LIVING AREA 12-VOLT SYSTEMS FUSES (ZEO6584)

The following are located in the fuse block in the bathroom vanity beneath the sink.

Do not use fuses of higher amperage rating than those specified below, or damage may result.

Usage	No. on Fuse Block	Fuse Type
L.H. Reading Light Rear Roof Vent Fan Bath Roof Vent Fan Galley Light	No. 1	AGC-15
Front Roof Vent Fan Range Hood Fan and Lights Hall Light	No. 2	AGC-15
Furnace Furnace Auxiliary Blower Motor Generator Compartment Light	No. 3	AGC-15
Refrigerator LPG Compartment Light Front Light	No. 4	AGC-15
Porch Light Floor Lights Water Pump	No. 5	AGC-15
Recirc. Toilet	No. 6	AGC-15
R.H. Reading Light Galley Light Switch Bath Light Systems Monitor	No. 7	AGC-15

LIGHT BULB SPECIFICATIONS (LIVING AREA)

Usage	Quantity	Bulb. No.
R.H. Front Light	2	1141
L.H. Front Light	2	1141
Kitchen Light	2	1141
Hall Light	2	1141
Porch Light	1	1141
Compartment Lights	2	1141
Range Hood Lights	2	1156
Rear Compartment Reading Lights	2	1383
Bathroom Lights	6	1141
Aisle Lights	2	67
Visor Vanity Mirror	2	74
Microwave Oven		
Oven Cavity (120-volt)	2	25 Watt
Timer Dial (120-volt)	1	7 Watt

12-VOLT LIVING AREA COMPONENTS CURRENT RATING

R.H. Front Light	2.88 Amp.
L.H. Front Light	2.88 Amp.
Hall Light	2.88 Amp.
Rear R.H. Reading Light	1.50 Amp.
Rear L.H. Reading Light	1.50 Amp.
Kitchen Light	2.88 Amp.
Aisle Lights (Per Light)	.59 Amp.
Porch Light	1.44 Amp.
Bathroom Lights (ZEO6581)	8.64 Amp.
Bathroom Lights (ZEO6584)	4.32 Amp.
Range Hood Vent Fan and Light	6.70 Amp.
Furnace Blower	6.8 Amp.
Water Pump	5.5 Amp.
Refrigerator (ZEO6581)	6.0 Amp.
Refrigerator (ZEO6584)	5.0 Amp.
Recirculating Toilet	7.0 Amp.
Monitor Panel	2.5 Amp.
Front Vent Fan	3.50 Amp.
Rear Vent Fan	3.50 Amp.
Bath Vent Fan	3.50 Amp.
Oven Lamp (L.P. Gas Oven)	1.44 Amp.
Furnace Auxiliary Blower	3.00 Amp.
Motor Generator Compartment Lamp	1.44 Amp.
LPG Compartment Lamp	1.44 Amp.

120-VOLT SYSTEM CURRENT RATING

Water Heater	8.7 Amp.
Power Converter	6.8 Amp.
Refrigerator (ZEO6581)	0.7 Amp.
Refrigerator (ZEO6584)	0.6 Amp.
Roof Mount Air Conditioner (Front)	15.0 Amp.
(Rear)	12.0 Amp.
Vacuum Cleaner	7.0 Amp.
Microwave Oven	14.8 Amp.

SECTION 24C
MOTOR GENERATOR

The information described in Maintenance Manual X-7525 under the heading MOTOR GENERATOR (SEC. 24C) is applicable to models covered by this supplement with the exception of the following:

Contents of this section are listed below:

MOTOR GENERATOR CAUTION

CAUTION: *Do not interfere with or bypass electrical circuit breaker or attempt in other ways to defeat its purpose. Don't fill fuel tank while engine is running and don't smoke when filling fuel tank. Wipe up any oil and gasoline spills immediately and make sure oily rags aren't left on the power plant or in its compartment. Replace any compartment insulation that may become fuel or oil soaked. Do not use flammable materials directly above or around the power plant compartment. Make sure the ventilation system provides a constant flow of air to expel any fuel vapor from motor generator compartment while vehicle is in transit. Also, be sure any openings made in the motor generator compartment for conduit, wiring, etc. are sealed to prevent toxic gases from entering vehicle interior. Do not remove oil-fill cap while engine is running.*

IGNITION AND BATTERY CHARGING SYSTEM

ONAN MOTOR GENERATOR (6KW AND 4KW)

BREAKER POINT ADJUSTMENT AND TIMING PROCEDURE

To maintain maximum efficiency from the Onan unit, check the breaker points every 100 hours and change the breaker points every 200 hours of operation. The breaker point box may be of two types, refer to figure 1 or figure 2. To change the breaker points and set the ignition timing, use the procedure appropriate to particular unit.

TYPE 1 BREAKER POINTS

1. Remove the two screws and the cover on the breaker box.
2. Remove the two spark plugs so the engine can easily be rotated by hand. Check condition of spark plugs at this time.
3. Remove mounting screw (A) and pull the points out of the box just far enough so screw (B) can be removed and leads disconnected.
4. Remove screw (C) and replace condenser with a new one. Tighten screw (C).
5. Replace points with a new set. Tighten screw (B) but do not completely tighten mounting screw (A).
6. Remove push-on terminal from ignition coil negative terminal. Connect test lamp, one lead to battery positive (+) terminal at starter, the other lead to push-on terminal (–)

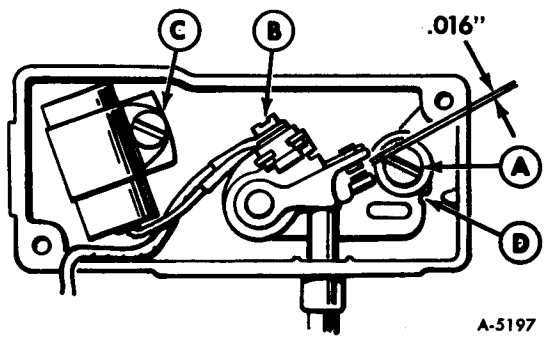


Figure 1—Breaker Point Adjustment—Type 1

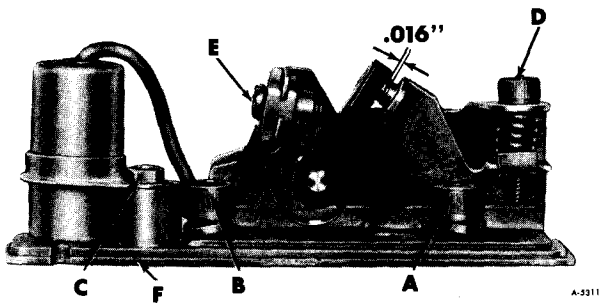


Figure 2—Breaker Point Adjustment—Type 2

removed from ignition coil terminal. (To use Ohmmeter or self-powered test lamp, remove push-on terminal from ignition coil negative terminal. Connect one of meter leads to removed terminal, the other to suitable engine ground. Do not connect Ohmmeter to battery positive lead at starter or damage to instrument could result.)

7. Rotate engine clockwise (facing flywheel) by hand until 20° BTDC mark on flywheel aligns with center of timing access hole. (Note, early units marked at 25° BTDC should be set at 25° BTDC.) Then, using a screwdriver inserted in notch (D) on the left side of the points (reverse view of figure 1), adjust points until test lamp just goes out (or Ohmmeter reads Infinity). Tighten screw (A).

8. To check, turn crankshaft against rotation (counterclockwise) until points just close. At this time test lamp should light (or Ohmmeter should read "Zero"). Now slowly rotate the engine clockwise. Lamp should go out (or Ohmmeter read Infinity) just as the points break, which is the time at which ignition occurs. (6KW — 20° BTDC or 25° BTDC, whichever is marked on flywheel.) Breaker points are now adjusted properly and timing is set.

NOTE: Type 1 breaker box assembly may be converted to Type 2 breaker box assembly to provide easier access to ignition contacts.

TYPE 2 BREAKER POINTS

1. Remove single screw and the breaker point cover box.

2. Remove the two spark plugs so the engine can easily be rotated by hand. Check condition of spark plugs at this time.

3. Using a screwdriver, remove mounting screw (C). Use an Allen wrench to remove mounting screws (A) and (B). Loosen screw (E) to remove leads. Remove points and condenser from base (F).

4. Replace points and condenser with a new set. Tighten screws (A), (B) and (C). Connect leads and tighten screw (E).

5. Remove push-on terminal from ignition coil negative terminal. Connect test lamp, one lead to battery positive (+) terminal at starter, the other lead to push-on terminal (–) removed from ignition coil terminal. (To use Ohmmeter or self-powered test lamp, remove push-on terminal from ignition coil negative terminal. Connect one of meter leads to removed terminal, the other to suitable engine ground. Do not connect Ohmmeter to battery positive (+) lead at starter or damage to instrument could result.

6. Rotate engine clockwise (facing flywheel) by hand until 20° BTDC mark on flywheel aligns with center of timing access hole. (Note, early units marked at 25° BTDC should be set at 25° BTDC.) Then, using an Allen wrench inserted in screw (D), adjust points until test lamp just goes out (or Ohmmeter reads Infinity).

7. To check, turn crankshaft against rotation (counterclockwise) until points just close. At this time test lamp should light (or Ohmmeter should read "Zero" resistance). Now slowly rotate engine clockwise. The lamp should go out (or Ohmmeter read Infinity) just as the points break, which is the time at which ignition occurs. (6KW—20° BTDC or 25° BTDC, whichever is marked on flywheel.) Breaker points are now adjusted properly and timing is set.

SECTION 24D
REFRIGERATOR

The information described in Maintenance Manual X-7525 under the heading REFRIGERATOR (SEC. 24D) is applicable to models covered by this supplement with the exception of the following:

GENERAL INFORMATION

The Norcold six cubic foot refrigerator will be used in model ZEO6584. The refrigerator will operate on either 12-volts D.C. or 120-volts A.C. This dual voltage refrigerator automatically switches from A.C. to D.C. or D.C. to A.C.

The six cubic foot refrigerator cooling system is basically the same as the seven and one-half cubic foot refrigerator with the exception of the power required to operate the swing motor compressor. Refer to "Compressor Voltage Check" and "Compressor Amperage" for specific values required.

REFRIGERATOR SERVICING

COMPRESSOR VOLTAGE CHECK

The voltage is checked at the compressor terminals with an A.C. voltmeter (Figure 1).

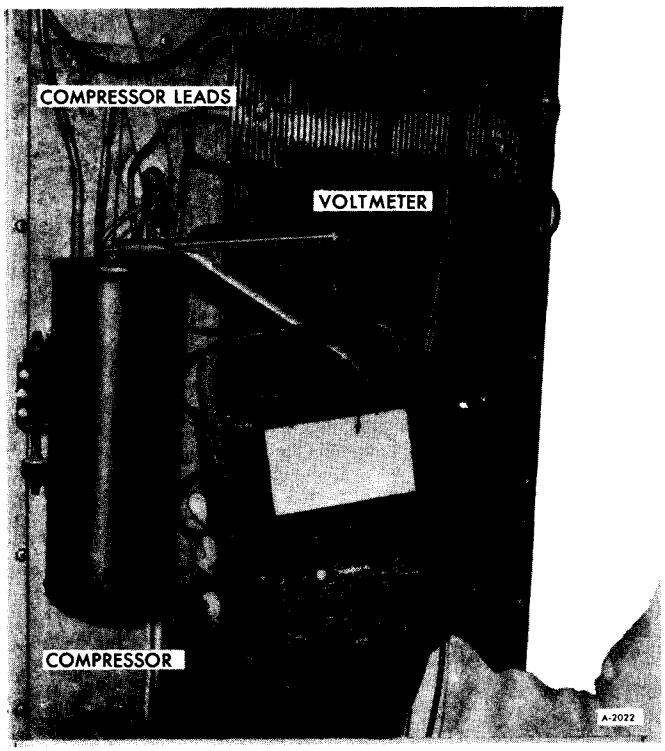


Figure 1—Checking Compressor Voltage

NOTE: A standard (RMS) A.C. voltmeter will read a high A.C. compressor voltage on D.C. operation. The reason being the inverter does not produce a true sine wave on D.C. operation. The 120-volt A.C., 60 cycles/second, will produce a true sine wave which an A.C. voltmeter is designed to read.

If the voltage at the compressor is not adequate the voltage source should be checked.

A.C. Operation

Using a standard (RMS) A.C. voltmeter the voltmeter reading should be:

6 cubic foot model = 19 to 21 volts
7-1/2 cubic foot model = 22 to 24 volts

D.C. Operation

Using a standard (RMS) A.C. voltmeter the voltmeter reading should be:

6 cubic foot model - 27.2 to 29.2 volts
7-1/2 cubic foot model - 31.5 to 33.5 volts

COMPRESSOR AMPERAGE

One method of determining whether or not the proper amount of freon is in the cooling

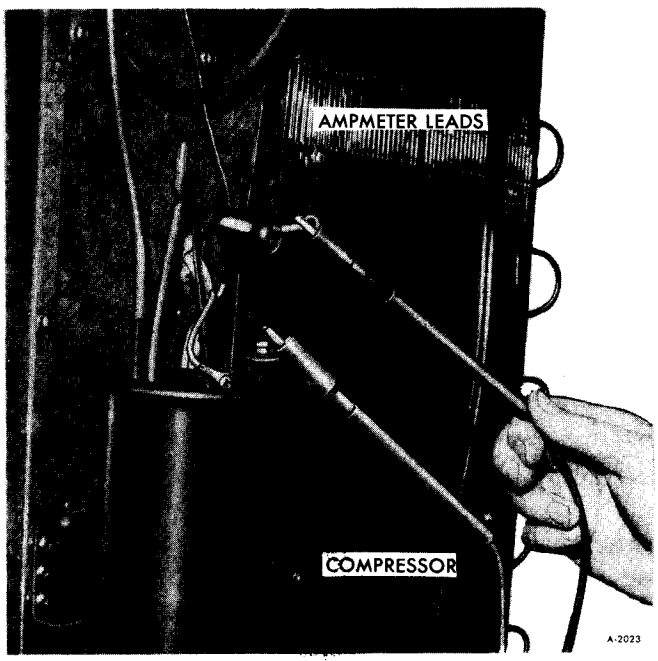


Figure 2—Checking Compressor Amperage

system is to measure the number of amps drawn by the compressor when connected to a 120-volt source.

This is done by removing one of the compressor leads and connecting a 0-5 A.C. ammeter in series with the compressor (figure 2). A reading of 2 amps should be read for the six cubic foot model and approximately 2.6 amps for the seven and one-half cubic foot model.

If the amperage reading is high, this is an indication the system is undercharged. If a low reading is obtained the system is overcharged. If it is determined that the system is under or overcharged, the entire cooling system must be replaced.

NORCOLD REFRIGERATOR SPECIFICATIONS

Model	6 Cubic Foot	7.5 Cubic Foot
Compressor Power	40 Watts	60 Watts
Compressor Amps Required	2 Amps	2.6 Amps
Compressor Volts Required (A.C. Operation)	19 to 21 Volts A.C.	22 to 24 Volts A.C.
Compressor Volts Required (D.C. Operation)	27.2 to 29.2 Volts A.C.	31.5 to 33.5 Volts A.C.
Compressor Motor Resistance	2 to 3 Ohms	2 to 3 Ohms
Compressor Motor Speed	60 Strokes/Sec.	60 Strokes/Sec.
Inverter Output	11 Volts A.C.	11 Volts A.C.
Transformer Output	20 Volts A.C.	23 Volts A.C.
Input Voltage	12 Volts A.C. or 120 Volts A.C.	12 Volts D.C. or 120 Volts A.C.
Refrigerant	R 12	R 12
Refrigerant Charge	2.56 Ounces	3.17 Ounces

SECTION 24G
FURNACE

The information described in Maintenance Manual X-7525 under the heading FURNACE is applicable to models covered by this supplement with the exception of the following:

DUO-THERM FURNACE

CONTENTS

GENERAL INFORMATION

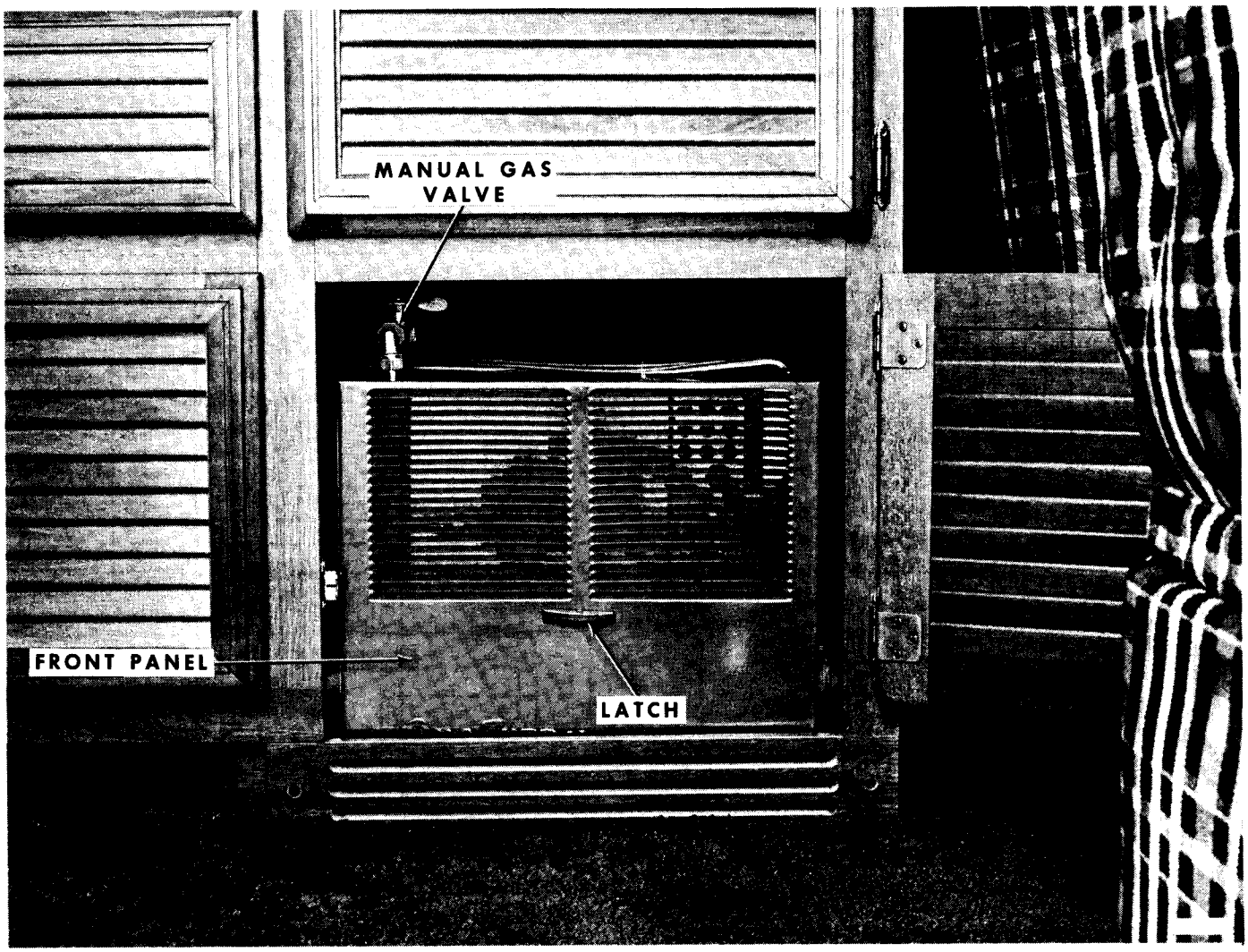


Figure 1—Duo-Therm Furnace Installed

During the 1977 model year the 30,000 B.T.U. Duo-Therm furnace (figure 1) was installed as standard equipment in the GMC Motorhome, the furnace is located in the compartment, at floor level, under the kitchen sink. The identification plate is located at the front of the combustion chamber assembly. The furnace has no pilot light, but is ignited by a direct spark ignition system.

The furnace utilizes a sealed combustion system. The combustion air is drawn in from outside the vehicle, passes through the combustion chamber and returned to the outside. Air inside the vehicle is drawn through the front panel on the furnace and passed around the heat chamber, then discharged into heat ducts located on the front and rear sides of the furnace casing.

NOTE: An auxiliary furnace blower located behind the kitchen range/oven aids in conducting heated air to the bathroom module.

The furnace operates on 12-volts D.C. and its wiring diagram is shown in figure 2.

COMPONENT DESCRIPTION

GAS CONTROL VALVE

The gas control valve (figure 3) contains a manual shut off for the LP gas supply to the furnace. Also included in the valve is a pressure regulator which limits LP gas to the furnace between 10 1/2 and 11 1/2 inches of water pressure.

NOTE: This valve is in addition to the LP gas regulator valve located at the LP gas tank.

GAS SOLENOID VALVE

The gas solenoid valve (figure 3) controls the flow of LP gas to burner assembly. Opening and closing of this valve is controlled by the sail switch and the ignition system.

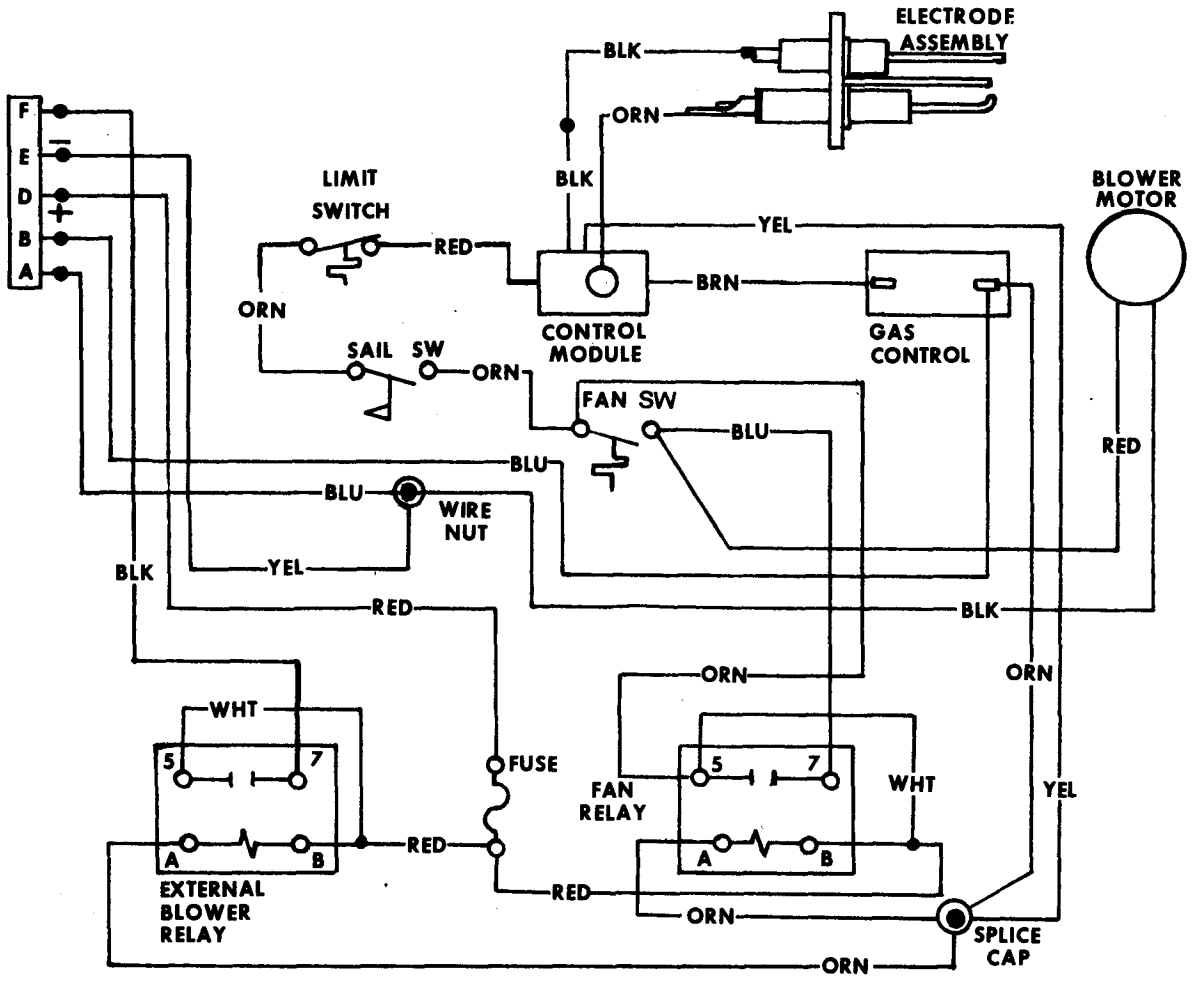


Figure 2—Duo-Therm Furnace Wiring

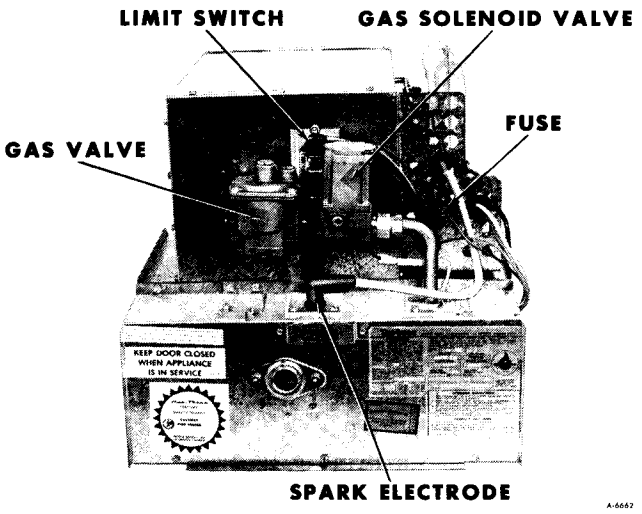


Figure 3—Furnace Components (Front View)

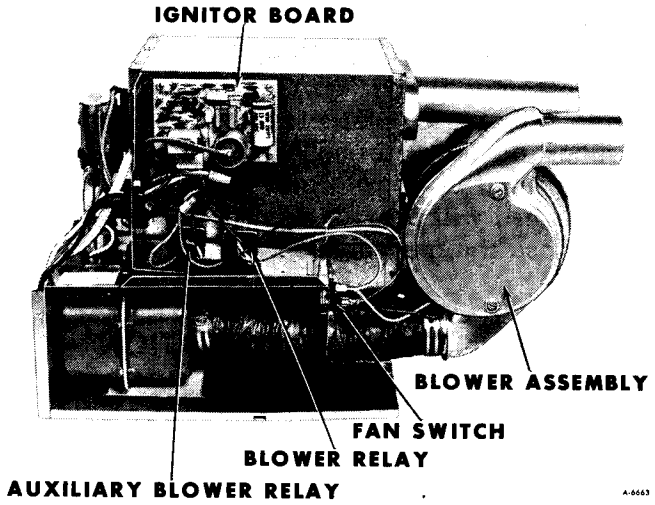


Figure 4—Furnace Components (Side View)

LIMIT SWITCH

The limit switch function is to turn off the gas supply to the burner assembly if furnace temperature exceeds the high temperature limit of 200°F (93°C). If this temperature is exceeded during furnace operation the limit switch will open causing the gas solenoid valve to close, thus shutting off LP gas to the furnace.

BLOWER ASSEMBLY

The furnace blower assembly contains one motor that is used to drive both the combustion air and circulating air blower wheels. The combustion air blower is sealed so as to allow no passage of air between it and the circulating air blower. The combustion air blower wheel draws air from outside the vehicle into the combustion chamber, and forces combustion products out the exhaust tube. The circulating air blower wheel pulls air into the front of the furnace, forces it across the heat chamber, and discharges it to the heat ducts located on both sides of the furnace casing.

RELAYS

Two relays (figure 4) are located on the right side of the furnace. The auxiliary blower relay is energized when the thermostat contacts close (calling for heat). When energized this relay feeds current to the auxiliary blower motor located behind the range/oven. When the thermostat contacts open the auxiliary blower motor will shut off.

The blower relay energizes the blower motor when thermostat calls for heat. When the thermostat contacts open the blower relay contacts open, thus the ground circuit for the relay is broken. The blower will continue until the fan switch shuts off the blower.

FAN SWITCH

The fan switch (figure 4) controls the sequence of blower operation. The fan switch is a two pole switch. When the bimetal disc in the switch is heated to operating temperature, the switch changes position. The blower will continue to run as long as the circulating air chamber is hot even though the thermostat contacts are open and the gas solenoid valve is closed. When the chamber cools, the fan switch changes back to its original position and shuts the blower off.

SAIL SWITCH

The sail switch is located on the bottom of the blower assembly. The switch operates in response to the flow of air generated by the blower. If for any reason the air from the blower is not sufficient, the switch will not operate. This may be caused by a slow motor due to low voltage, restricted return air, or lint accumulation on the blower wheel. Once the switch engages the solenoid valve opens, gas flows to burner, and ignition occurs.

IGNITION SYSTEM

The direct spark ignition system consists of a solid state printed ignitor board, an ignitor assembly and connecting high and low voltage wires. The ignitor board is not field repairable.

The thermostat contacts when closed allows current to the ignitor board, to open the gas solenoid valve and provide the ignition spark. As soon as the flame is established, the spark ceases. Should the flame not be established

within a period of 15 seconds the system will close the gas solenoid valve.

Electronic flame sensing circuitry in the spark electrode detects the presence or absence of main burner flame. If the flame is extinguished during normal operation, the ignitor board will provide one re-try for ignition, then close the gas valve.

SEQUENCE OF OPERATION

When the thermostat calls for heat, the furnace blower motor is energized immediately. When the blower reaches minimum operating speed (approximately 1-2 seconds) the main burner of the furnace is designed to ignite. The furnace will continue to run until the thermostat is satisfied or is turned to a lower setting. Following approximately one minute of burner operation a slight "snap" will be heard from within the furnace. This is the furnace fan switch changing to its normal run position. After this occurs and the thermostat is satisfied or is turned to a lower setting the main burner flame will go out, but the blower will continue to run for a short period of time and then shut off. If thermostat is adjusted to a lower setting or to "OFF" before the furnace has operated for one minute, the blower and main burner will shut off at the same time.

OPERATING FURNACE

This furnace has no pilot light, but is ignited by a direct spark ignition system. No manual lighting is required.

START-UP

1. Set thermostat located in rear of Motorhome living area to "OFF" position. Remove front panel from furnace. Turn gas valve on furnace to "OFF" position. Wait 5 minutes. This will allow any LP gas fumes in combustion chamber to dissipate.

NOTE: Be sure control valve at LP gas tank is fully open.

2. Open furnace manual valve fully. The manual valve is located just above the furnace. Do not attempt to operate furnace with valve partly opened as proper operation depends on valve being fully open.
3. Turn furnace gas valve to "ON" position. Do not attempt to operate furnace with valve partly opened as proper operation depends on valve being fully opened.
4. Set thermostat to "ON" position and adjust to desired temperature setting. When furnace ignites it will continue to run until thermostat is satisfied or is turned to a lower setting.
5. Allow 15 seconds for burner to ignite. Look for flame at furnace view port. Install furnace front panel when ignition is obtained. Furnace will now operate automatically.
6. If burner does not light, set thermostat on "OFF" position, wait 15 seconds and repeat steps 4-5.
7. If ignition is not obtained after 3 tries, go to shutdown and determine cause.

SHUTDOWN

1. Turn gas valve to "OFF" position.
2. Set thermostat on "OFF" position.

FURNACE DIAGNOSIS

BURNER DOES NOT LIGHT

PROBLEM	POSSIBLE CAUSE	CORRECTION
NO VOLTAGE TO FURNACE	1. Blown fuse living area fuse block.	1. Correct short and replace fuse.
BLOWER DOES NOT OPERATE	1. Defective blower relay.	1. Replace blower relay.
BLOWER SPEED INADEQUATE TO CLOSE SAIL SWITCH	1. Insufficient voltage - furnace operating voltage is 9 to 15 volts D.C.	1. Charge batteries or connect to shore power (external power).

FURNACE DIAGNOSIS

BURNER DOES NOT LIGHT

PROBLEM	POSSIBLE CAUSE	CORRECTION
SAIL SWITCH NOT CLOSING	1. Insufficient voltage.	1. Charge batteries or connect to shore power (external power).
	2. Loose connection.	2. Repair connection.
	3. Defective switch.	3. Replace switch.
GAS SOLENOID VALVE NOT OPENING	1. Open or short in gas solenoid valve coil.	1. Replace gas solenoid valve.
	2. Voltage not present at gas solenoid valve during ignition phase.	2. Repair defective wiring to gas solenoid valve or replace ignitor board or replace sail switch.
NO SPARK AT IGNITOR	1. Short or open in high voltage lead.	1. Replace high voltage lead.
	2. Ignitor not grounded.	2. Correct ground.
	3. Incorrect spark gap.	3. Set spark gap to 1/8" $\pm$ 1/32".
	4. Cracked ceramic on ignitor.	4. Replace ignitor.
	5. Defective ignitor board.	5. Replace ignitor board.
LIMIT SWITCH OPEN	1. Limit switch is normally closed below 200^{O}F (94^{O}C).	1. Replace limit switch if there is no continuity across switch below 200^{O}F (94^{O}C).

FURNACE LIGHTS BUT SHUTS DOWN AFTER A PERIOD

FURNACE LIGHTS BUT SHUTS DOWN AFTER A FEW SECONDS	1. Ground screw loose.	1. Secure the green grounding wire to grounding screw located near the blower relays. **NOTE:** On early furnaces the green wire is grounded in the furnace junction box.
	2. Burner assembly mounting screws loose.	2. Tighten burner assembly mounting screws.
FURNACE LIGHTS BUT RANDOMLY SHUTS DOWN DURING DUTY CYCLE	1. Check flame sensor electrode lead for continuity.	1. Replace lead.
	2. Flame sensing electrode not located properly.	2. Position flame sensing electrode so that tip is in flame. The current should be 5-15 microamps through the electrode lead.
	3. Air in L.P.G. line or regulator frozen.	3. Purge L.P.G. tank and add methyl alcohol.

COMBUSTION CHAMBER ASSEMBLY REPLACEMENT

WARNING: BEFORE ANY REMOVAL OR DISASSEMBLY PROCEDURES ARE PERFORMED ON THE FURNACE, BE SURE LP GAS IS COMPLETELY TURNED OFF AT THE LP GAS TANK AND REMOVE FURNACE FUSE FROM FUSE BLOCK TO AVOID PERSONAL INJURY.

WARNING: DUE TO THE POSSIBILITY OF PERSONAL INJURY ON SHARP SHEET METAL, CARE SHOULD BE TAKEN ANY TIME SERVICE IS PERFORMED ON THE FURNACE.

REMOVAL

1. Shut off LP gas at LP gas tank and remove furnace fuse from fuse block in living area electrical compartment.

2. Remove toe board in front of furnace at floor level (figure 5) by removing two retaining screws, then remove front panel from furnace.

3. Close manual gas valve (note this valve is located just above furnace).

4. Disconnect gas line lower fitting from furnace gas valve (figure 6). Loosen gas line upper fitting. Rotate gas line 90^{0}to allow for removal of combustion chamber assembly (figure 8).

5. Remove cover from junction box (figure 6).

6. Inside the junction box remove the wire nuts retaining wiring harness to furnace wiring. Carefully, separate wires in junction box. Using pliers, apply light pressure on special grommet. Pull grommet and furnace wiring from junction box (figure 7).

7. Remove two combustion chamber assembly mounting screws (figure 8).

8. Carefully pull combustion chamber assembly out of furnace casing (figure 9). Remove from vehicle.

INSTALLATION

NOTE: To aid in installation of combustion chamber assembly, remove inlet and outlet vent caps from outside of Motorhome (figure 10).

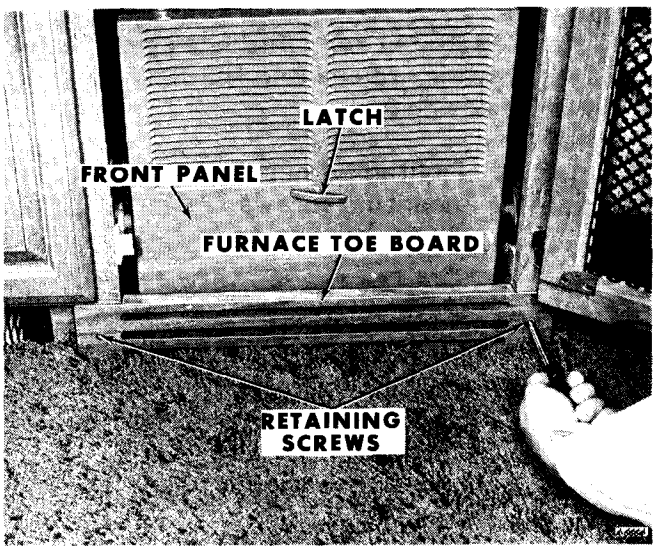


Figure 5—Removal of Furnace Toe Board

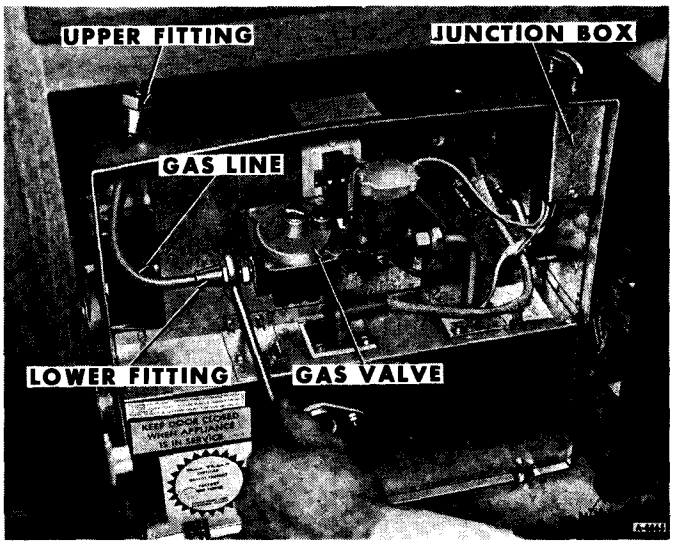


Figure 6—Disconnecting Furnace Gas Line

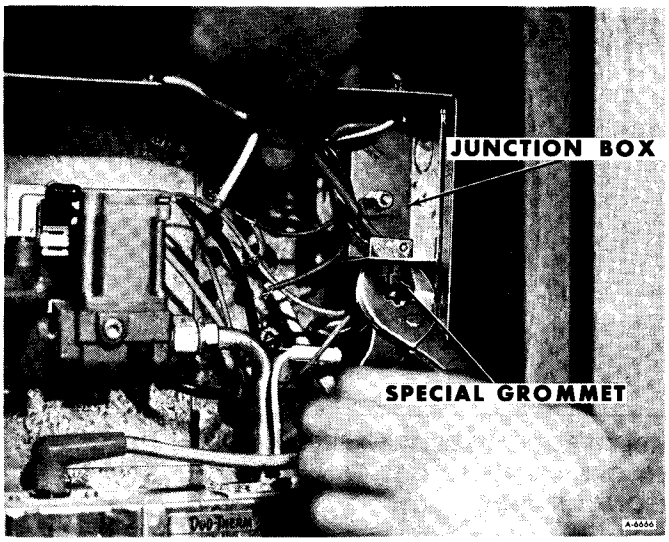


Figure 7—Removing Wiring from Junction Box

1. Carefully slide combustion chamber assembly into furnace casing.

2. Install two combustion chamber assembly retaining screws (figure 8).

3. Install furnace wiring and special grommet into junction box (figure 7).

4. With aid of wiring diagram (figure 2) connect wiring harness to furnace wiring using solderless connectors in the junction box. Install junction box cover.

5. Connect gas line to furnace gas valve (figure 6). Tighten upper and lower fittings on gas line.

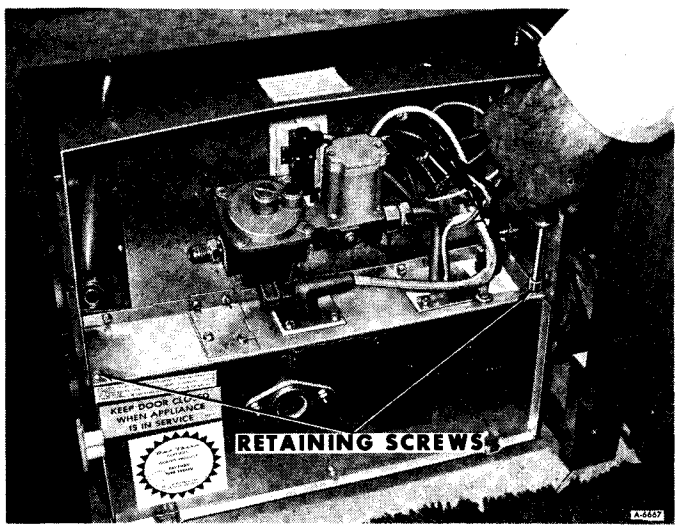


Figure 8—Removing Combustion Chamber Assembly Retaining Screws

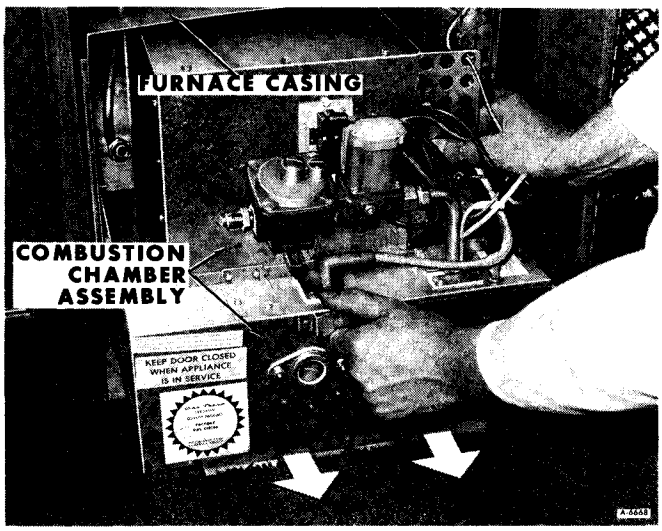


Figure 9—Removing Combustion Chamber Assembly

6. Install furnace toe board with two retaining screws (figure 5).

7. Carefully install furnace vent caps from outside of vehicle (figure 10).

8. Move vehicle outside of service building to be sure of adequate ventilation while operating furnace. Check furnace for proper operation by performing furnace "Start-Up" and "Shutdown" as described earlier in this section.

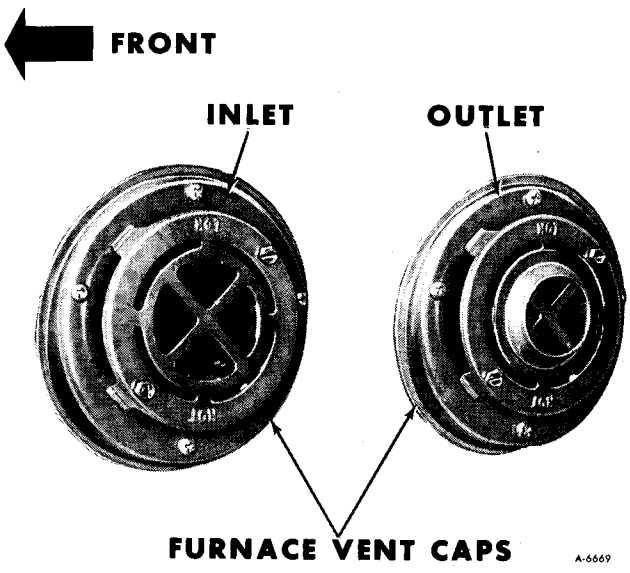


Figure 10—Furnace Vent Caps

COMPONENT REPLACEMENT

The following components (figure 3) can be inspected and replaced without removing the combustion chamber assembly from the vehicle.

1. Gas Valve.
2. Gas Solenoid Valve.
3. Limit Switch.
4. Furnace Fuse.

Removal of the combustion chamber assembly is required for replacement of other furnace components.

WARNING: BEFORE ANY REMOVAL OR DISASSEMBLY PROCEDURES ARE PERFORMED ON THE FURNACE, BE SURE LP GAS IS COMPLETELY TURNED OFF AT THE LP GAS TANK AND REMOVE FURNACE FUSE FROM FUSE BLOCK TO AVOID PERSONAL INJURY.

WARNING: DUE TO THE POSSIBILITY OF PERSONAL INJURY ON SHARP SHEET METAL, CARE SHOULD BE TAKEN ANY TIME SERVICE IS PERFORMED ON THE FURNACE.

GAS VALVE REPLACEMENT

REMOVAL

1. Close manual gas valve (note this valve is located just above furnace).
2. Disconnect gas line from gas valve (figure 6).
3. Remove gas solenoid valve from main burner gas line (figure 11).
4. Separate gas valve from gas solenoid valve.

INSTALLATION

1. Connect gas valve to gas solenoid valve using nipple.

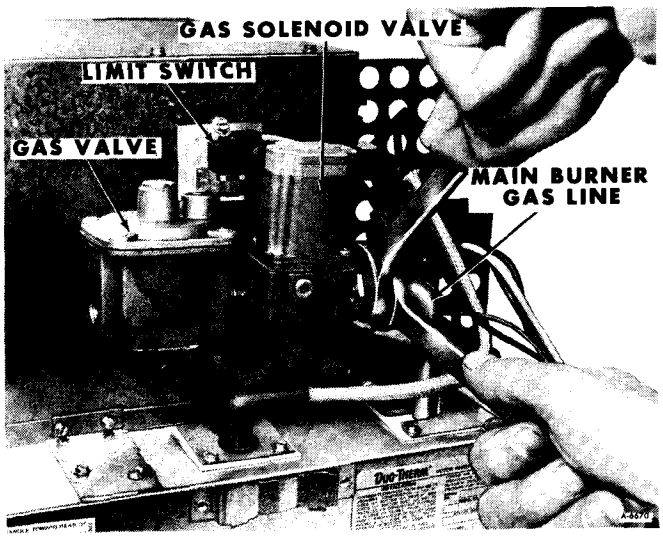


Figure 11—Removing Gas Solenoid Valve

2. Connect gas solenoid valve to main burner gas line (figure 11).
3. Connect gas line to gas valve (figure 6).

GAS SOLENOID VALVE REPLACEMENT

REMOVAL

1. Close manual gas valve (note this valve is located just above furnace).
2. Disconnect gas line from gas valve (figure 6).
3. Remove gas solenoid valve from main burner gas line (figure 11).
4. Separate gas solenoid valve from gas valve.

INSTALLATION

1. Connect gas solenoid valve to gas valve using nipple.
2. Connect gas solenoid valve to main burner gas line (figure 11).
3. Connect gas line to gas valve (figure 6).

LIMIT SWITCH REPLACEMENT

REMOVAL

1. Remove gas solenoid valve as described earlier in this section under "Gas Solenoid Valve Replacement."
2. Disconnect electrical leads from limit switch (figure 12).

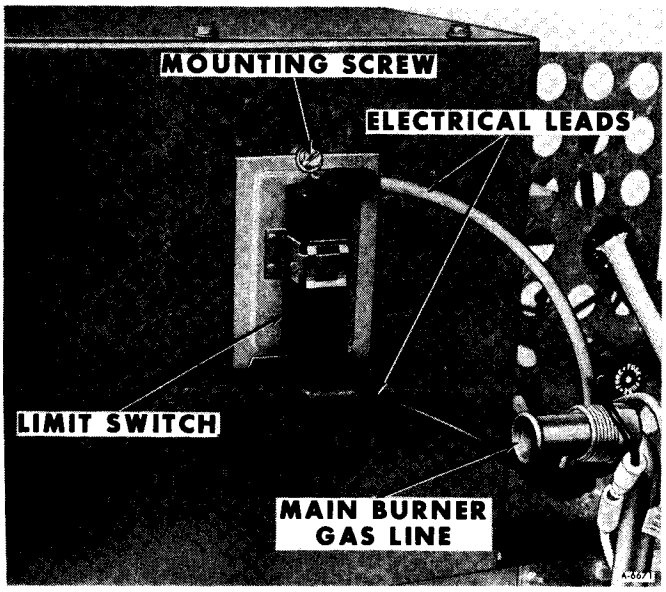


Figure 12— Limit Switch Installed

3. Remove limit switch mounting screw. Carefully remove limit switch from combustion chamber assembly.

INSTALLATION

1. Carefully install limit switch into opening on front of combustion chamber assembly. Retain switch in position with mounting screw (figure 12).
2. Connect electrical leads to limit switch.
3. Install gas solenoid valve as described under "Gas Solenoid Valve Replacement," earlier in this section.

FAN SWITCH REPLACEMENT

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. The fan switch is located on the right side of the furnace (figure 4).
3. Disconnect electrical leads from fan switch (figure 13).
4. Remove two mounting screws and separate fan switch from warm air housing.

INSTALLATION

1. Locate fan switch on warm air housing (figure 13). Retain switch in position with two mounting screws.
2. Connect electrical leads to fan switch.
3. Install combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.

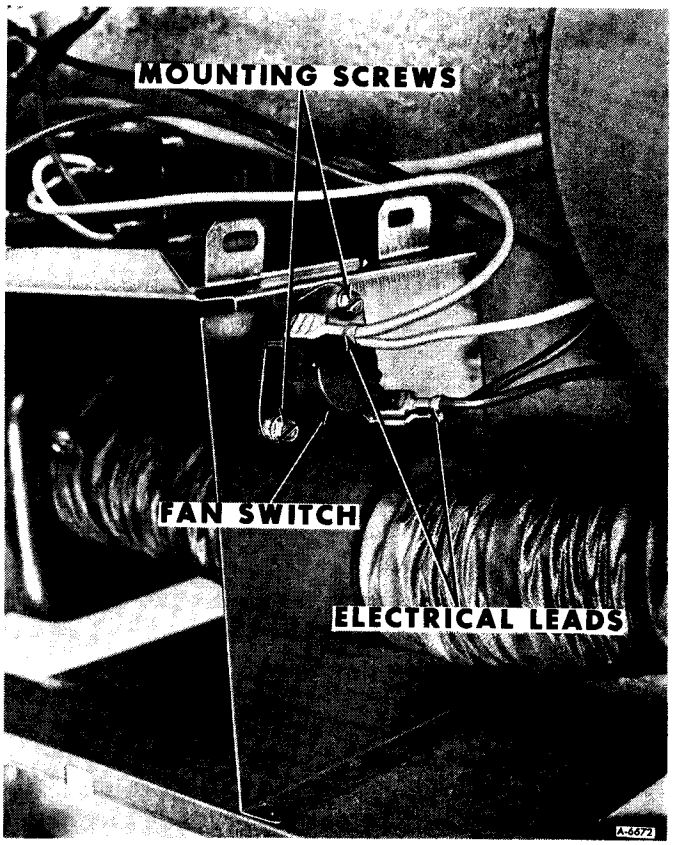


Figure 13—Fan Switch Installed

SAIL SWITCH REPLACEMENT

NOTE: The sail switch (also sometimes called combustion air switch) is located on the bottom of the blower assembly (figure 14).

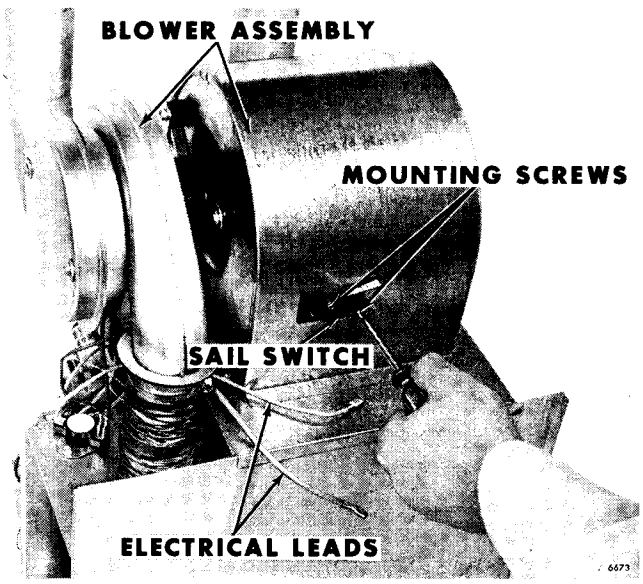


Figure 14—Removing Sail Switch

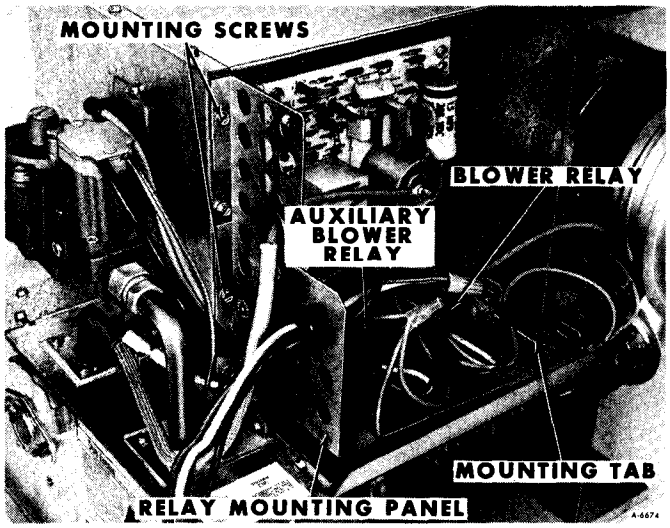


Figure 15—Furnace Relay Mounting Panel Installed

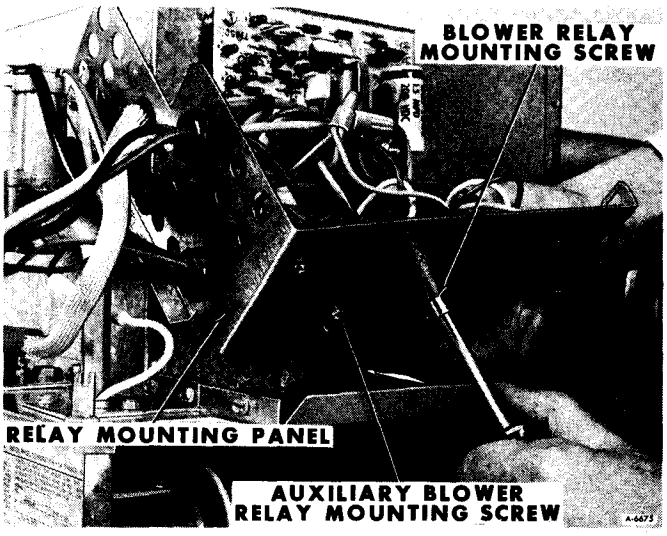


Figure 16—Removing Blower Relay

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. Disconnect electrical leads from sail switch (figure 14).
3. Remove two mounting screws. Carefully lift sail switch away from blower assembly.

INSTALLATION

1. Carefully position sail switch on bottom of blower assembly. Install two mounting screws. Check that sail arm on the sail switch does not contact sheet metal on blower assembly.
2. Connect electrical leads to switch.
3. Install the combustion chamber assembly as described in "Combustion Chamber Assembly Replacement" earlier in this section.

FURNACE RELAY REPLACEMENT

NOTE: Two relays are located on the right side of the furnace (figure 4). The auxiliary blower relay when energized activates the auxiliary blower motor that is located behind the oven. The blower relay when energized, activates the furnace blower assembly. Replacement procedures for either relay is the same.

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. Remove two relay panel mounting screws (figure 15).
3. Carefully raise relay mounting panel, sufficiently to allow access to relay mounting screw.
4. Remove relay mounting screw (figure 16).
5. Tag relay electrical leads to aid in proper location during relay installation. Disconnect electrical leads from relay. Remove relay.

INSTALLATION

1. Connect electrical leads to relay (refer to figure 2, if necessary).
2. Install relay mounting screw (figure 16).
3. Be sure relay mounting panel engages mounting tab (figure 15). Install two panel mounting screws.

IGNITOR BOARD REPLACEMENT

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. Remove special shoulder bolt (figure 17).
3. Remove electrical connector from ignitor board.
4. Remove high voltage lead from ignitor board.
5. Remove four mounting screws and remove ignitor board.

INSTALLATION

1. Position ignitor board on combustion chamber assembly.
2. Install four ignitor board mounting screws (figure 17).

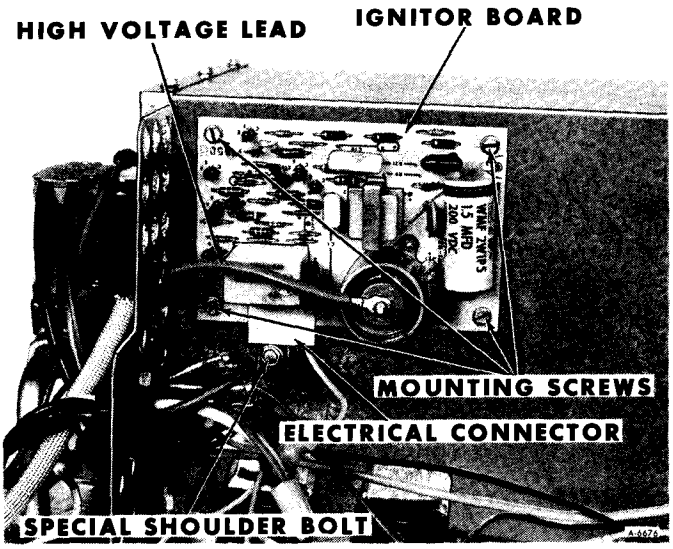


Figure 17—Location Of Ignitor Board

3. Attach electrical connector to ignitor board. Retain electrical connector in proper position by installing special shoulder bolt.
4. Connect high voltage lead to ignitor board.
5. Install the combustion chamber assembly as described in "Combustion Chamber Assembly Replacement" earlier in this section.

SPARK ELECTRODE ASSEMBLY REPLACEMENT

REMOVAL

1. Remove combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.

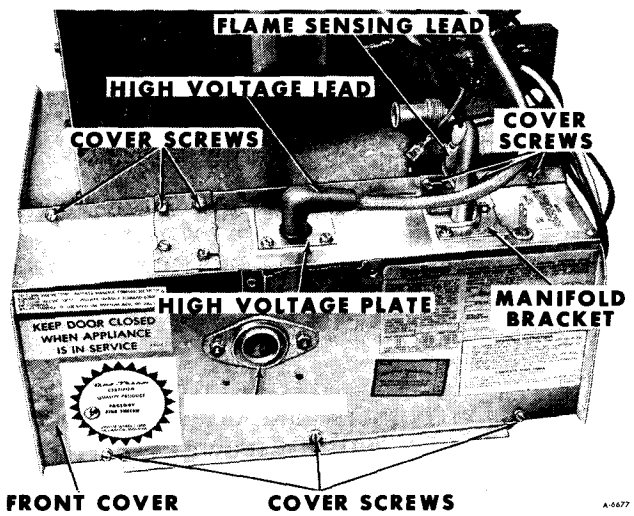


Figure 18—Location Of Furnace Front Cover

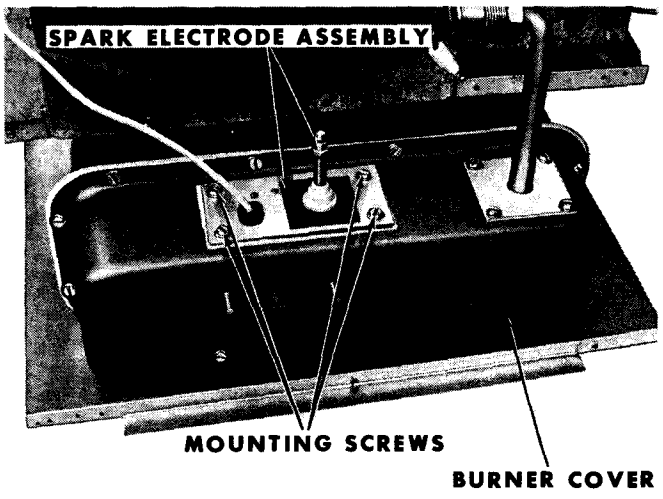


Figure 19—Spark Electrode Installed

2. Disconnect high voltage lead from spark electrode (figure 18). Remove high voltage plate and gasket.
3. Disconnect flame sensing lead near manifold bracket.
4. Remove manifold bracket and gasket.
5. Remove sight glass and gasket.
6. Remove front cover screws and then carefully remove front cover.
7. Remove four spark electrode mounting screws (figure 19).
8. Note spark electrode must clear burner orifices during removal (figure 20). Carefully move spark electrode assembly to the right. Gently tilt upward as shown, and remove from burner cover.

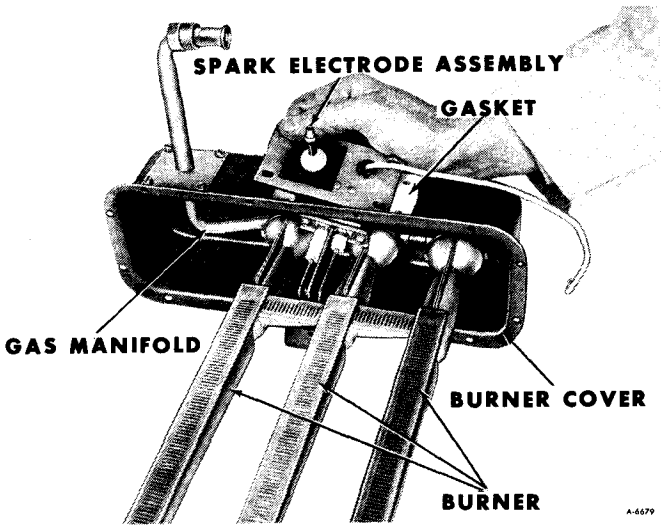


Figure 20—Removing Spark Electrode Assembly

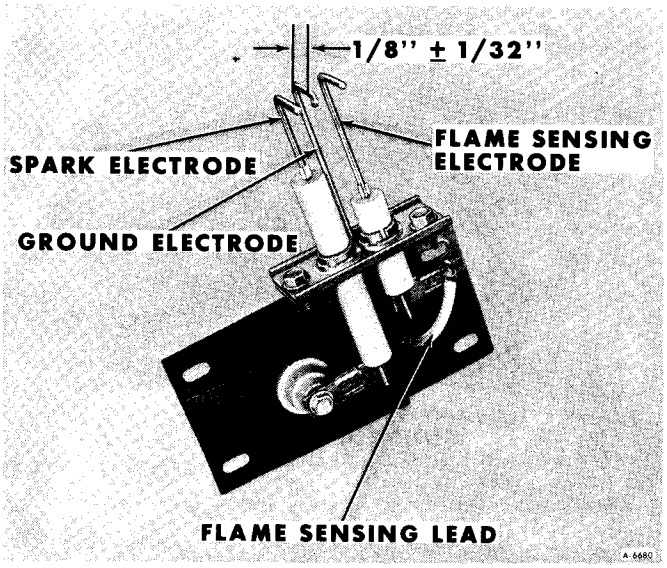


Figure 21—Spark Electrode Assembly

INSTALLATION

NOTE: Before installing spark electrode assembly, check the spark gap. The gap between the spark electrode and ground electrode should be 1/8" ± 1/32" (figure 21).

1. Noting the location of burner orifices (figure 20), carefully install spark electrode assembly and gasket. Secure spark electrode assembly with four mounting screws (figure 19).
2. Install furnace front cover (figure 18). Be sure flame sensing lead is located next to main burner gas line.
3. Install sight glass and gasket.
4. Install manifold bracket and gasket.
5. Connect flame sensing lead near manifold bracket.
6. Install high voltage plate and gasket. Connect high voltage lead to spark electrode.
7. Install the combustion chamber assembly as described in "Combustion Chamber Assembly Replacement" earlier in this section.

BURNER ASSEMBLY REPLACEMENT

NOTE: The burner assembly of the furnace is composed of three burners which are attached to the burner cover (figure 20).

REMOVAL

1. Remove spark electrode assembly as described earlier in this section under "Spark Electrode Assembly Replacement."

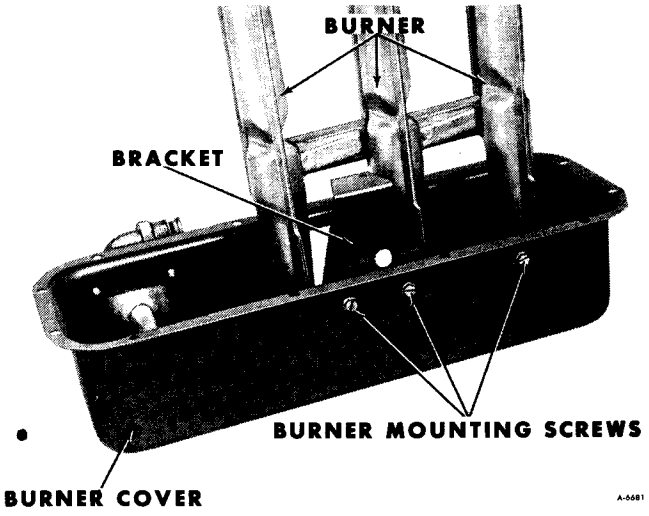


Figure 22—Burner Mounting To Burner Cover

2. Remove burner cover and gasket from combustion chamber (figure 19).

NOTE: The burners are attached to the burner cover (figure 22).

3. Remove burner mounting screws and then carefully remove burners from burner cover.

INSTALLATION

NOTE: Be sure any accumulated soot deposits are removed from inside the combustion chamber. If soot deposits are excessive check for high LP gas pressure, as necessary, when assembly of furnace is complete. There is no main air adjustment on this furnace.

NOTE: At this time the three burner orifices should be checked for obstructions. The orifices can be cleaned using a wooden tooth pick if required, or replaced if necessary.

1. Position burners and bracket in burner cover, and secure with the mounting screws.
2. Install burner assembly and burner cover, and gasket in combustion chamber (figure 19).
3. Install spark electrode assembly as described earlier in this section under "Spark Electrode Assembly Replacement."

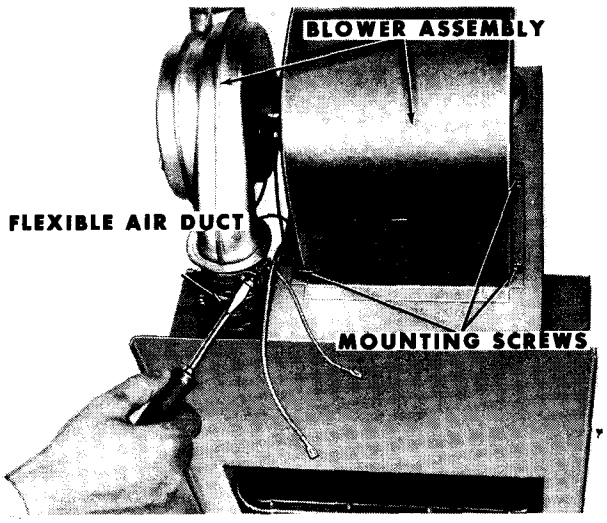


Figure 23—Disconnecting Flexible Duct From Blower

BLOWER MOTOR REPLACEMENT

REMOVAL

1. Remove sail switch as described earlier in this section under "Sail Switch Replacement.

2. Disconnect flexible air duct from blower assembly (figure 23). Disconnect blower motor electrical leads.

3. Remove three blower assembly mounting screws. Remove blower assembly from furnace.

4. Remove outer combustion air housing attaching screws (figure 24). Remove housing and metal plate, located between inner and outer housing.

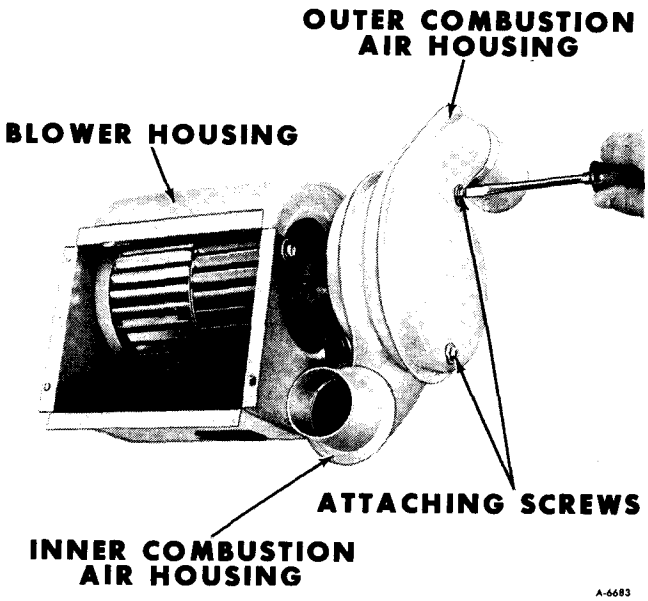


Figure 24—Removing Outer Combustion Air Housing

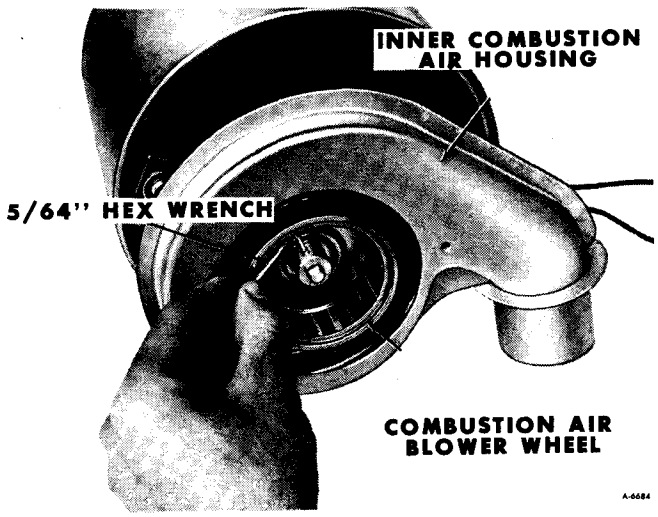


Figure 25—Removing Combustion Air Blower Wheel

5. Using a 5/64" hex wrench, remove combustion air blower wheel (figure 25).

6. Remove two retaining nuts holding inner combustion air housing to blower motor (figure 26). Remove housing.

7. Loosen the recirculating air blower wheel retaining screw using a 1/8" hex wrench (figure 27).

8. Remove three blower motor retaining screws and washers (figure 28). Carefully remove blower motor from blower housing.

NOTE: When the blower motor has been removed from the blower housing, this will allow recirculating air blower wheel to be removed.

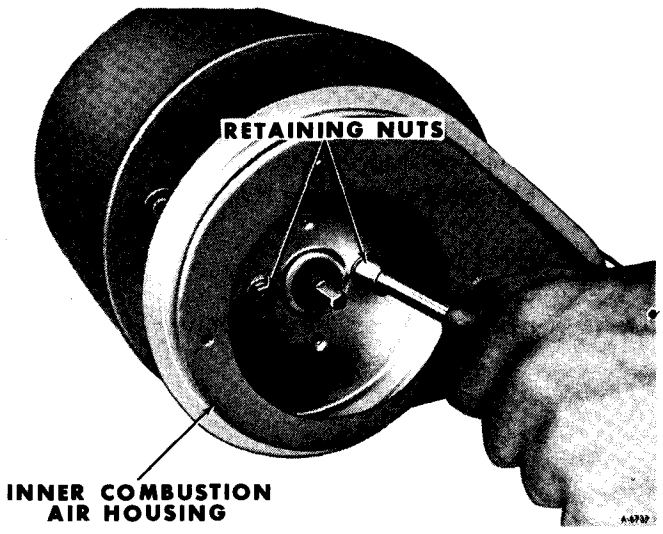


Figure 26—Removing Inner Combustion Air Housing

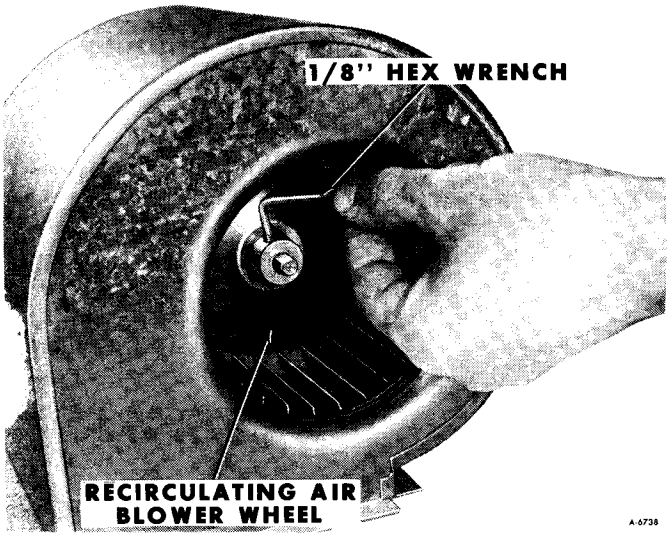


Figure 27—Loosening Recirculating Air Blower Wheel Retaining Screw

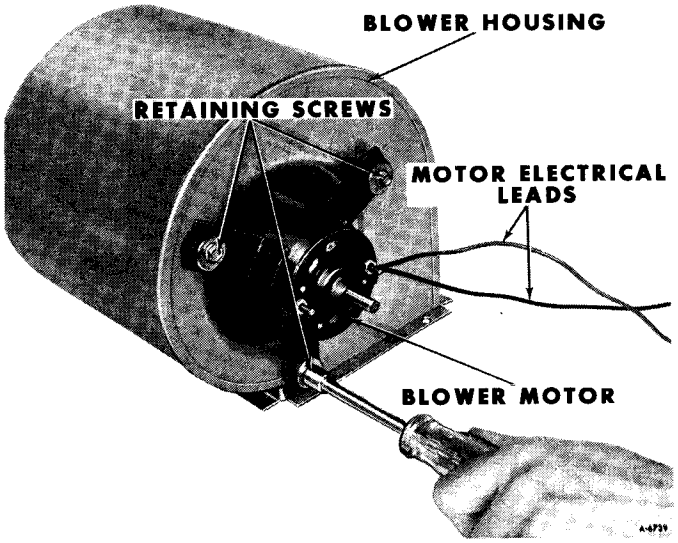


Figure 28—Removing Blower Motor Retaining Screws

INSTALLATION

1. Position the recirculating air blower wheel in blower housing.

2. Install blower motor to blower housing using three retaining screws. Before installing the retaining screws check to be sure the motor is positioned as shown in figure 28, with motor electrical leads facing blower housing mounting flange.

3. Install recirculating blower wheel retaining screw (figure 27). Before tightening retaining screw be sure blower wheel is clearing both sides of blower housing. Also, be sure retaining screw is tightened onto flat surface on the blower shaft.

4. Install the inner combustion air housing to the blower motor (figure 26). Be sure inner housing is aligned as shown in figure 24 with blower housing.

5. Install combustion air blower wheel (figure 25).

6. Position metal plate between inner and outer combustion air housings. Install outer combustion air housing (figure 24).

7. Install blower assembly to furnace with three mounting screws (figure 23). Connect blower electrical leads and flexible air duct.

8. Install sail switch as described earlier in this section under "Sail Switch Replacement."

SPECIFICATIONS

Duo-Therm Furnace	Model No.	65930-926
GM Part No.		2028332
Operating Voltage Range	Maximum	15 Volts DC
	Minimum	9 Volts DC
BTU Input		30,000
BTU Output		24,000
Furnace Fuse (Automotive Type)		15 Amp.

SECTION 24J
LIVING AREA WATER SYSTEM

The information described in Maintenance Manual X-7525 under the heading LIVING AREA WATER SYSTEM (Sec. 24J) is applicable to models covered by this supplement with the exception of the following:

GENERAL INFORMATION

The water system in model ZE06584 (illustrated in figure 1) functions basically the same as model ZE06581, with the exception of the component location and the addition of a new dry bath.

WATER SYSTEM SERVICING (ZE06584)

GALLEY SINK FAUCET

REMOVAL

1. Turn off water pump at water pump switch located beside entrance door. Open faucet to reduce line pressure.
2. Disconnect water lines from faucet.
3. Remove faucet retaining nut and special washer from underneath sink.
4. Remove faucet from sink.

REPAIR

The galley sink faucet can be repaired by procuring parts from a local plumbing supply distributor.

INSTALLATION

1. Position faucet assembly on sink.
2. Install special washer and faucet retaining nut from underneath sink.
3. Connect water lines to faucet.

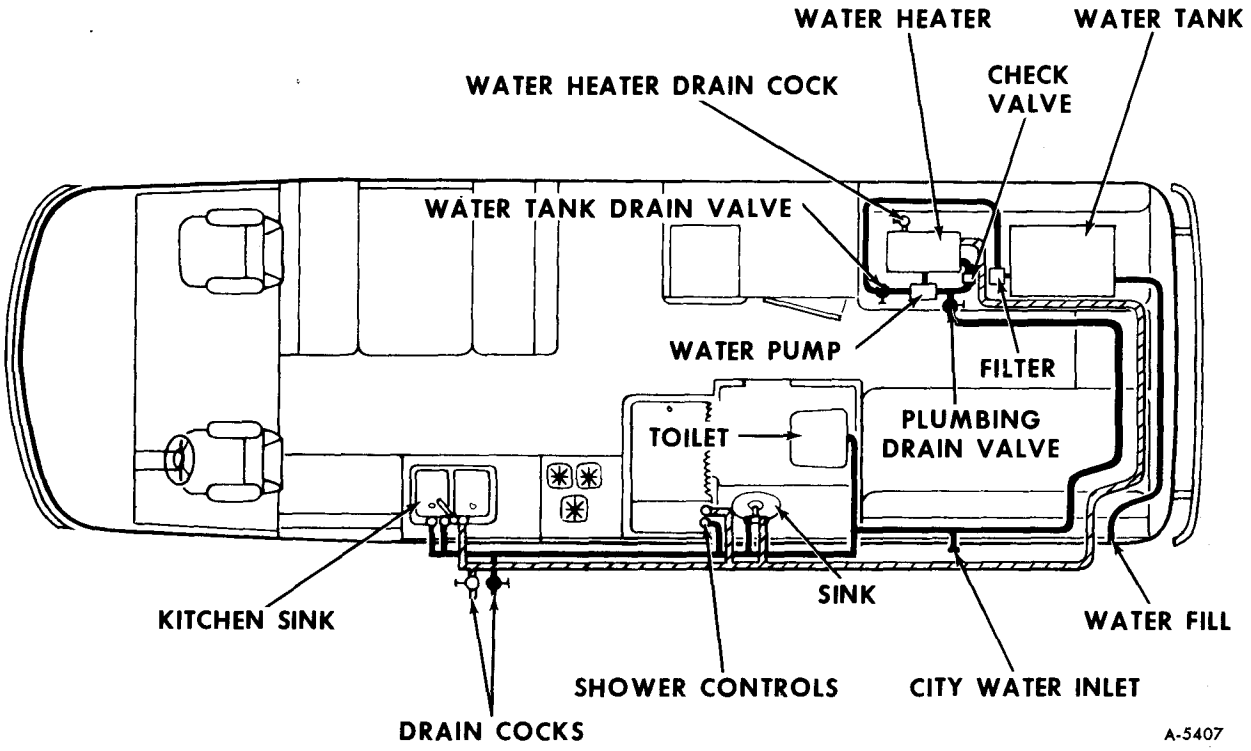


Figure 1—Living Area Water System (ZE06584)

4. Turn on water pump and operate faucet. Check for leaks.

NOTE: For a reverse water supply installation (cold water supply on the left and hot water on the right), it is only necessary to remove the faucet handle and rotate the cam 180°. Reinstall faucet handle and check for proper operation.

SHOWER FAUCET

REMOVAL

1. Turn off water pump at water pump switch located beside entrance door. Open faucet to reduce line pressure.
2. Remove screws retaining track of vanity compartment located underneath bathroom sink. Note that 12-volt living area fuse block is located in this compartment. Remove compartment only sufficiently to gain access to shower faucet.
3. Tag water lines (hot and cold) for installation. Disconnect water lines from back of faucet.
4. Remove elbows from backside of faucet.
5. Remove retaining nuts and washers that hold faucet to shower wall. Remove faucet.
6. Disconnect hose to shower head from faucet.

REPAIR

The shower faucet can be repaired by procuring parts from a local plumbing supply distributor.

INSTALLATION

1. Connect hose from shower head to faucet.
2. Position faucet on shower wall. Install washers and retaining nuts that hold faucet to shower wall.
3. Install two elbows to backside of faucet.
4. Connect water lines to elbows on back of faucet.
5. Turn on water pump and operate shower. Check for leaks.

BATHROOM SINK FAUCET

REMOVAL

1. Turn off water pump at water pump switch beside entrance door. Open faucet to reduce line pressure.
2. Remove doors from vanity compartment underneath bathroom sink.
3. Disconnect water lines from faucet.
4. Remove retaining nuts that hold faucet to sink. Remove faucet.

REPAIR

The bathroom sink faucet can be repaired by procuring parts from a local plumbing supply distributor.

INSTALLATION

1. Position faucet on sink. Install retaining nuts that hold faucet to sink.
2. Connect water lines to faucets.
3. Turn on water pump and operate faucet. Check for leaks.
4. Install doors in vanity compartment underneath sink.

WATER TANK

REMOVAL

1. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.
2. Remove right twin bed to gain access to water compartment.
3. Turn off water pump at switch beside entrance door. Turn off water heater at switch located in bathroom.
4. Open tank drain valve and allow tank to drain (see figure 1).
5. Disconnect inlet, outlet, and vent hoses from tank.
6. Disconnect the tank hold down straps.

NOTE: Do not cut straps to remove tank.

7. Remove water tank.

INSTALLATION

1. Position tank in water compartment.
2. Connect tank hold down straps.
3. Install inlet, outlet, and vent hoses on water tank.
4. Close water tank drain valve (see figure 1).
5. Fill water tank and turn on water pump to pressurize the system. Check for leaks.
6. Install right twin bed over water compartment
7. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

WATER PUMP

REMOVAL

1. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.
2. Remove right twin bed to gain access to water compartment.

3. Turn off water pump at switch beside entrance door. Turn off water heater switch located in bathroom.
4. Open tank drain valve and plumbing drain valve (valves are located on either side of pump) (figure 1).
5. Disconnect 12-volt electrical supply to pump by removing pump fuse.

NOTE: Water pump fuse is located in fuse holder, just to the left of the water pump.

6. Disconnect electrical leads from water pump.
7. Disconnect inlet and outlet hose from pump.
8. Remove four water pump mounting bolts and remove pump.

INSTALLATION
1. Position pump in water tank compartment. Install four pump mounting bolts.
2. Connect inlet and outlet hoses at pump.
3. Connect electrical leads to water pump.
4. Connect electrical supply to water pump by installing pump fuse in fuse holder that is located just to the left of water pump.
5. Close the tank and plumbing drain valves.
6. Fill water tank and turn on water pump to pressurize the system. Check for leaks.
7. Install right twin bed over water compartment.
8. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

WATER HEATER

REMOVAL
1. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.
2. Remove right twin bed to gain access to water compartment.
3. Turn off water pump at switch beside entrance door. Turn off water heater switch located in bathroom. Be sure motor generator is turned off and external power cord is not connected to an external power source.
4. Open plumbing drain valve (figure 1) and water heater drain valve (located underneath the water heater).
5. Remove access panel on water heater Disconnect two electrical leads and ground wire from water heater. Remove electrical supply cord and conduit from water heater.
6. Remove hose from pressure temperature relief valve.
7. Disconnect inlet (cold) and outlet (hot) water hoses from water heater.

WARNING: IF WATER HEATER IS EQUIPPED WITH A PRE-HEAT ASSEMBLY BE SURE ENGINE HAS BEEN ALLOWED TO COOL ONE-HALF HOUR BEFORE ATTEMPTING TO REMOVE PRE-HEAT ASSEMBLY TO AVOID PERSONAL INJURY.

8. If water heater is equipped with pre-heat assembly, remove from water heater with pre-heat hoses remaining attached to unit.
9. Remove four water heater to floor mounting bolts and remove water heater.

INSTALLATION
1. Install water heater and secure to floor with four mounting bolts.
2. If water heater was equipped with pre-heat assembly, install unit in water heater with pre-heat hoses remaining attached.
3. Connect inlet (cold) and outlet (hot) water hoses to water heater.
4. Install hose to pressure temperature relief valve.
5. Install electrical supply cord and conduit to heater. Connect two electrical leads and ground wire to water heater.
6. Close plumbing drain valve (figure 1) and water heater drain valve (located underneath the water heater).
7. Turn on the water pump and open the hot water faucet in the bathroom, until water heater is filled (air no longer coming out of faucet). Check system for leaks.
8. Turn on water heater switch with 120-volt power supply connected to the Motorhome power cord. Check for proper water heater operation.
9. Shut off water heater and water pump switch.
10. Install right twin bed over water compartment.
11. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

WATER HEATER CHECK VALVE

(Refer to Figure 1)

A check valve is installed in the cold water line (inlet) at the water heater to prevent hot water from entering the Motorhome's cold water system.

REMOVAL

1. Remove bolsters (back cushions), is so equipped, from right rear corner of vehicle.

2. Remove right twin bed to gain access to water compartment.

3. Turn off water pump at switch beside entrance door. Turn off water heater switch located in bathroom.

4. Open plumbing drain valve and water heater drain valve (located underneath the water heater).

5. Disconnect hoses from check valve and remove.

INSTALLATION

1. Connect hoses to check valve.

NOTE: Be sure arrow molded into body of check valve is pointing toward water heater.

2. Close plumbing drain valve and water heater drain valve (located underneath water heater).

3. Turn on water pump and open the hot water faucet in the bathroom, until water heater is filled (air no longer coming out of faucet). Check for leaks.

4. Install right twin bed over water compartment.

5. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

DRAINING LIVING AREA WATER SYSTEM (ZEO6584)

1. Open the holding tank dump valve, after making proper connection to approved dumping station.

2. Turn off water heater at switch located in the bathroom.

3. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.

4. Remove right twin bed to gain access to water compartment.

5. Open the water heater drain cock (located underneath the water heater). Open the tank drain valve and plumbing drain valve (valves are located on either side of water pump).

6. Open the water tank drain valve and plumbing drain valve (figure 1).

7. Open the two water line drain cocks at the kitchen sink. To gain access to water line drain cocks for the kitchen sink, remove the second drawer located to the left of the kitchen sink compartment.

8. Open the kitchen and bathroom faucets.

9. Turn the flush knob on top of the toilet 90^{0} clockwise until water no longer enters the toilet bowl.

10. Open the shower head shut-off valve and open shower faucets, with shower head extended toward shower stall drain.

11. At the external water connection (inside external utilities compartment), remove hose connection cover. Depress momentarily the button on the check valve to allow this portion of plumbing to drain. Install hose connection cover.

12. Using low air pressure (30 psi maximum), blow back through all faucets, forcing water from any low areas. Allow system to drain.

13. Turn on water pump, momentarily, to remove any water remaining in pump housing, then shut off.

14. Close all water line drain cocks and valves, including the water heater drain cock. Close kitchen, bathroom, and shower faucets. Close holding tank dump valve and latch. Stow holding tank tubes and replace dust cap.

WATER TREATMENT UNIT

On vehicles equipped with the water treatment unit (formerly water purifier) (figure 2), the lower two cartridges are identified with two stickers ("A" and "B"). Servicing this unit is described by the following:

NOTE: Under normal family usage the cartridge assembly is designed to last for several years. Interval for replacement of either cartridge may be determined by restriction of water flow at treated faucet. The filter cartridges are designed to restrict water flow when replacement is required. Be sure the cartridge assembly (all three tanks) is removed from the vehicle when unheated, and temperatures fall below freezing. The cartridge assembly should then be stored in a heated facility.

WATER TREATMENT UNIT CARTRIDGE REPLACEMENT

(Refer to Figure 2)

NOTE: Replace the primary cartridge "A" (refer to sticker on cartridge for identification) when the flow rate diminishes. Cartridge "B" may also require replacement after an extended period of use. This replacement is to be made when the replacement of cartridge "A" fails to restore the flow rate of assembly to a satisfactory level.

1. Shut off water pump and close inlet valve to cartridge assembly.
2. Remove plastic tubing connectors at either end of old cartridge.
3. Remove old cartridge and discard.
4. Locate the new replacement cartridge in the same position as the one just removed with arrow on label pointing to the outlet end of unit.
5. Connect plastic tubing to the new cartridge making certain that the tubing coming from the inlet valve connects to the "INLET" fitting.

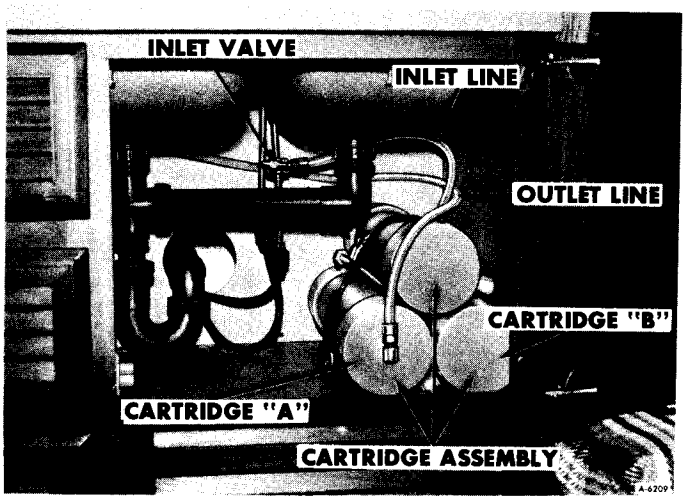


Figure 2—Water Treatment Unit Cartridge Location

6. Open the inlet valve, turn on water pump and then place water treatment faucet handle in the "UP" position water treatment faucet is located beside the galley sink faucet). Allow a full flow of water from faucet for about 15 minutes. Water treatment unit is now ready for normal usage.

SECTION 24K
TOILET

The information described in Maintenance Manual X-7525 under the heading TOILET (Sec. 24K) is applicable to models covered by this supplement with the addition of the following:

AQUA-MAGIC III

GENERAL INFORMATION

The Aqua-Magic III toilet (figure 1) is a fresh water, permanently installed flushing system. It uses a pressure flushing system. The fresh water flushing system cleans bowl with a minimum of water. No-splash bowl feature, maintains water seal even while vehicle is in motion.

TOILET TROUBLE DIAGNOSIS

Problem	Possible Cause	Correction
WATER KEEPS RUNNING INTO THE BOWL	1. Water trap in the bottom of the bowl not closing completely, which in turn keeps the ball valve partially open.	1. Remove foreign matter from water trap. Check to see that flush knob closes all the way (rotates through 90^{o} rotation).
	2. If running water persists, and the knob works satisfactorily, faulty ball valve.	2. Replace ball valve.
TOILET LEAKS. THERE IS WATER ON THE FLOOR.	1. Leak at water supply connection.	1. If the leak is in the back of the toilet, check the water supply connection. Correct as necessary.
	2. Closet flange base seal.	2. If the leak is at the closet flange area, check the closet flange nuts for tightness. If leak continues, remove the toilet and check the closet flange height. The height should be 1/4" to 7/16" above the floor. Adjust closet flange height accordingly and replace closet flange seal.
POOR FLUSH	1. Flush knob not fully opened.	1. The knob must be held fully open during the flush. A good flush should occur within five seconds. If the problem persists, remove the water supply line and check the water supply. The flow rate should be at least eleven quarts per minute to ensure an adequate flush.

1. Cover
2. Hinge Pin Retainer
3. Hinge Pin
4. Flush Knob
5. Knob Retainer
6. Top
7. Knob Crank
8. Stein Retainer
9. O-ring
10. Screw
11. Ball Valve
12. Screw
13. Vacuum Breaker Cover
14. Float Seal
15. Float
16. Star Washer
17. Bowl
18. Spring Mounting Bracket
19. Push Link
20. Spring
21. Water Trap Crank
22. Screw
23. Washer
24. Seal
25. Water Trap
26. Base
27. Flange Seal
28. Nut
29. Bolt
30. Sealant
31. Water Trap Seal
32. Screw
33. Seal
34. Screw
35. Seat

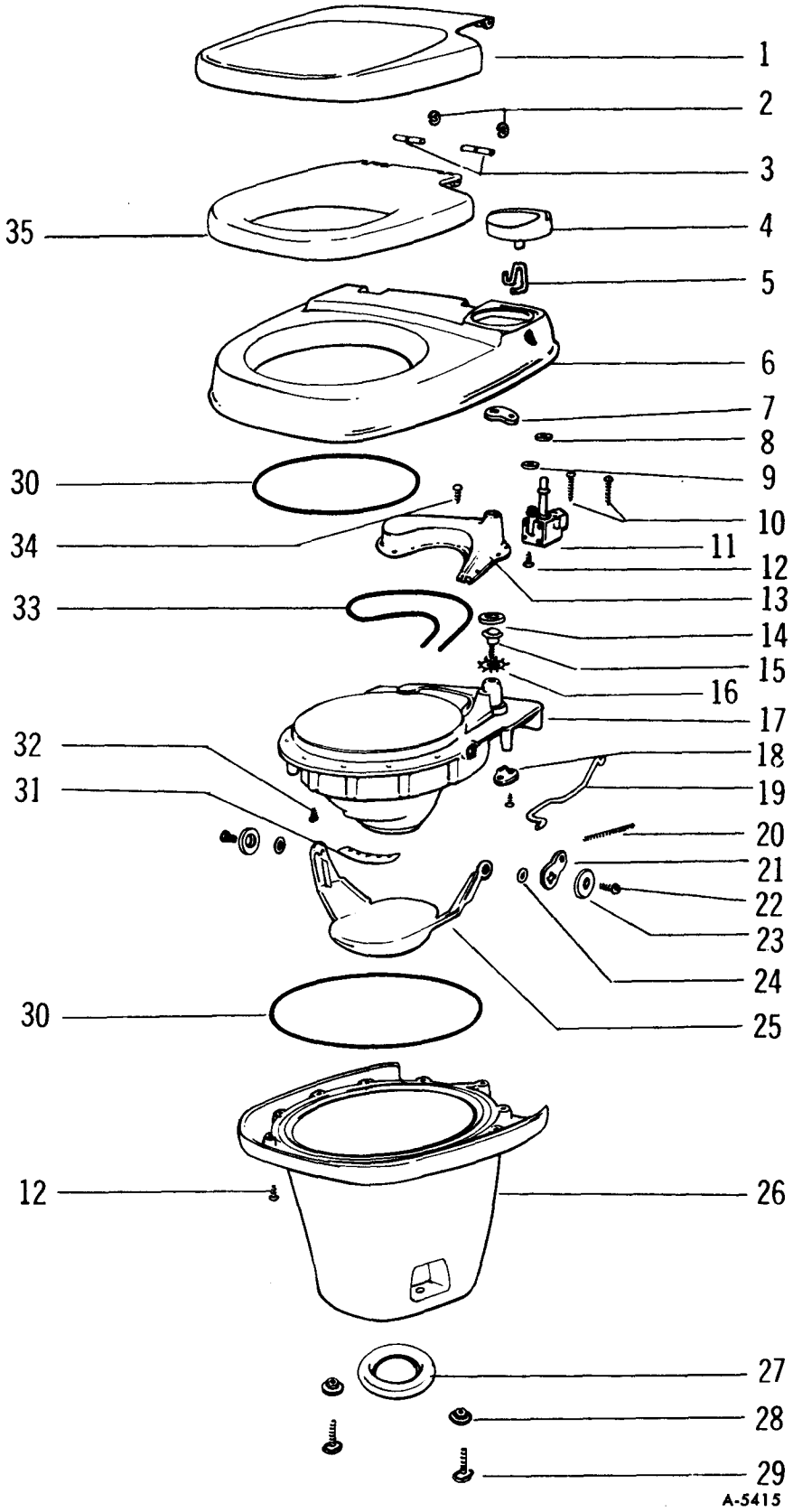


Figure 1—Aqua-Magic III Toilet

TOILET REPLACEMENT

REMOVAL

1. Turn off water pump at water pump switch located beside entrance door. Open cold water faucet in bathroom sink to reduce line pressure.
2. Disconnect toilet water fill line at right rear corner of toilet (below flush knob).
3. Flush toilet several times, if necessary, to remove water from water trap.
4. Remove two nuts located at base of toilet.
5. Lift toilet off mounting studs and remove from vehicle.
6. To avoid holding tank fumes entering vehicle place suitable air tight covering over toilet mounting flange.

INSTALLATION

1. Remove air tight covering (if used) from toilet mounting flange.
2. Install new flange seal.
3. Set toilet in place and install two mounting nuts located at base of toilet.
4. Connect toilet water fill line at right rear corner of toilet (below flush knob).
5. Turn on water pump and momentarily open cold water faucet to bleed out air in water line.
6. Flush toilet several times and check for leakage. Correct as necessary.

COMPONENT REPLACEMENT

(Refer to Figure 1)

BALL VALVE REPLACEMENT

1. Remove flush knob by pulling straight upward.
2. Remove 12 screws from underside of base. Remove base from bowl and lid assembly.
3. Remove 8 screws holding bowl to lid assembly. Carefully separate bowl from lid assembly, noting they are held together by a non-hardening type caulking material.
4. Remove 3 screws securing ball valve to bowl, and remove ball valve.
5. Install ball valve by reversing steps 1-4. Note the two long ball valve retaining screws are installed from the top, and the one short screw is installed from underneath.

VACUUM BREAKER COVER REPLACEMENT

1. Remove flush knob.
2. Remove 12 screws from underside of base. Remove base from bowl and lid assembly.
3. Remove 8 screws holding bowl to lid assembly. Carefully separate bowl from lid assembly, noting they are held together by a non-hardening type caulking material.
4. Remove 17 screws retaining vacuum breaker cover to bowl assembly.
5. Install vacuum breaker cover by reversing steps 1-4.

WATER TRAP REPLACEMENT

1. Remove flush knob.
2. Remove 12 screws from underside of base. Remove base from bowl and lid assembly.
3. Remove 8 screws holding bowl to lid assembly. Carefully separate bowl from lid assembly, noting they are held together by a non-hardening type caulking material.
4. Remove 2 screws holding water trap to bowl. Then disconnect push link from water trap. Remove water trap.
5. Install water trap by reversing steps 1-4.

MAINTENANCE

No routine maintenance is required to clean the unit, use any high grade, non-abrasive cleaner. Do not use highly concentrated or high acid content household cleaners (no scouring powder).

SECTION 24L

HOLDING TANK AND DRAINAGE SYSTEM

The information described in Maintenance Manual X-7525 under the heading HOLDING TANK AND DRAINAGE SYSTEM (Sec. 24L) is applicable to models covered by this supplement with the addition of the following illustration (figure 1).

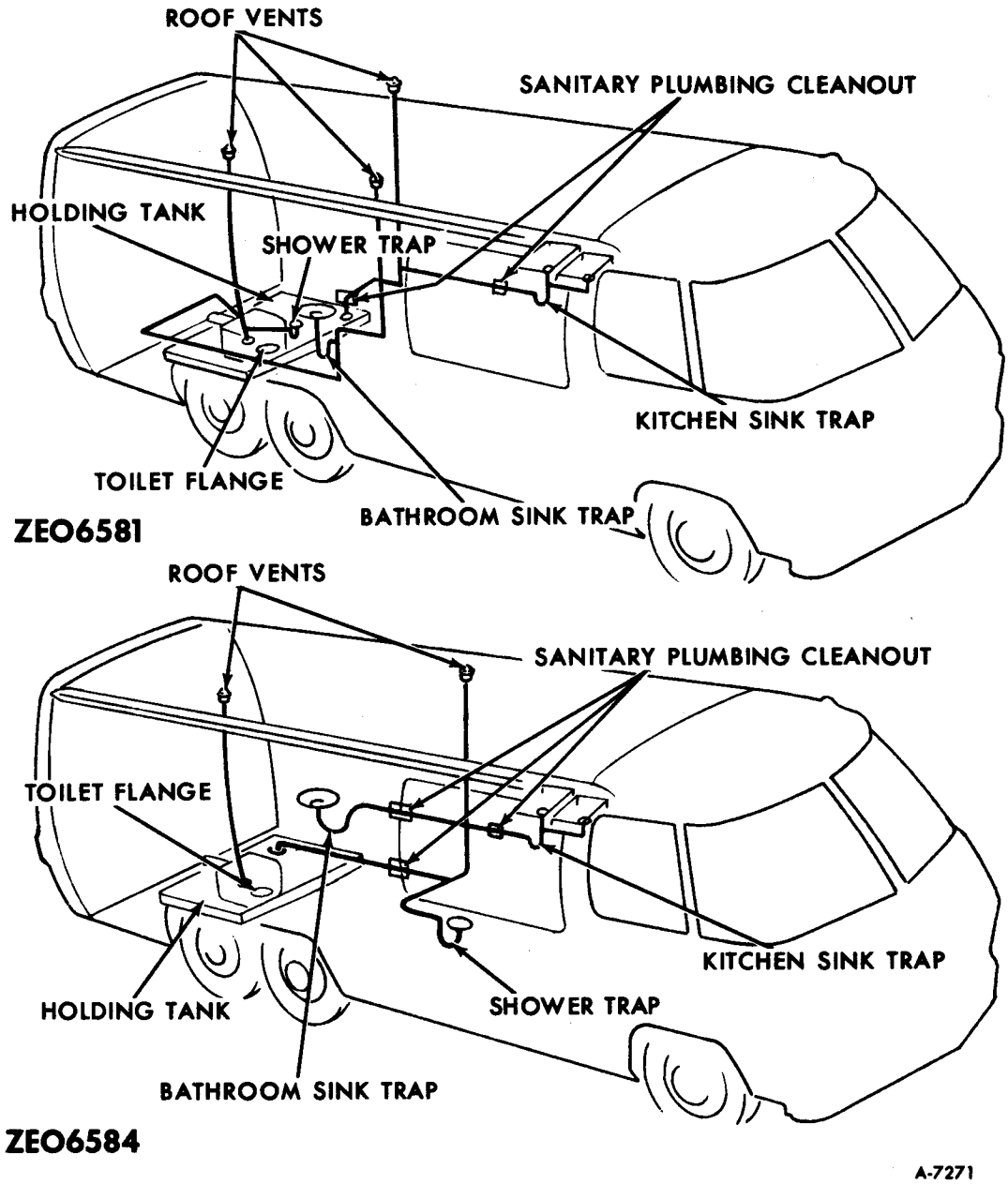


Figure 1—Drainage System (Models ZE0651 and ZE06584)

USE OF METRIC AND CUSTOMARY NUTS, BOLTS AND SCREWS

General Motors Engineering Standards have adopted a portion of the standard metric fastener sizes defined by SI (Systeme International). This was done to reduce the number of sizes used and yet retain the best strength characteristics in each thread size. For example, the customary 1/4—20 and 1/4—28 screws are replaced by the metric M6.3 x 1 screw which has nearly the same diameter and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is illustrated below:

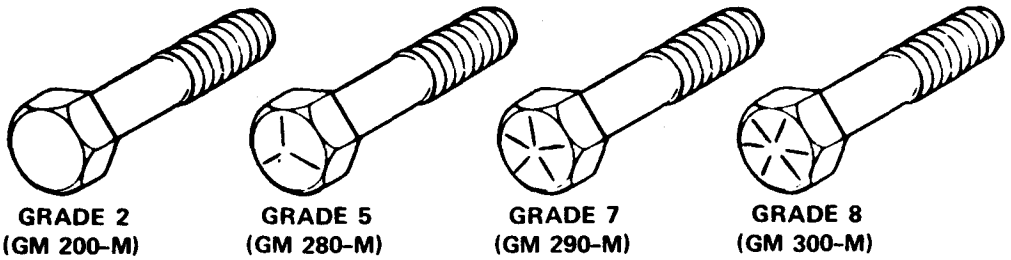
CUSTOMARY	METRIC
1/4	M6.3
Thread Major Diameter in Inches	Thread Major Diameter in Millimetres
20 Number of Threads per Inch	1 Distance Between Threads in Millimetres

Care should be taken when servicing to guard against cross threading or improper retention due to interchanged metric and inch nuts and bolts.

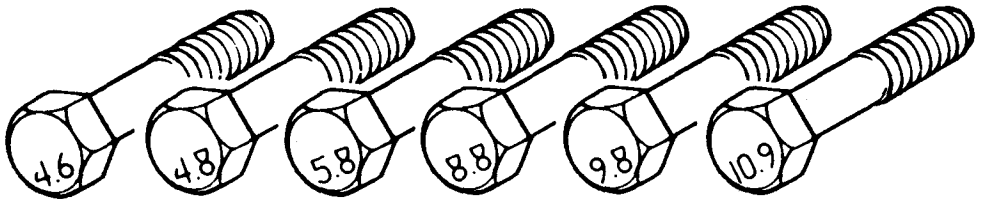
When obtaining metric or customary nuts, bolts, and screws locally for servicing care must be exercised in selecting parts that are equivalent to the original parts in dimensions, strength, and pitch of threads.

METRIC BOLT AND NUT IDENTIFICATION

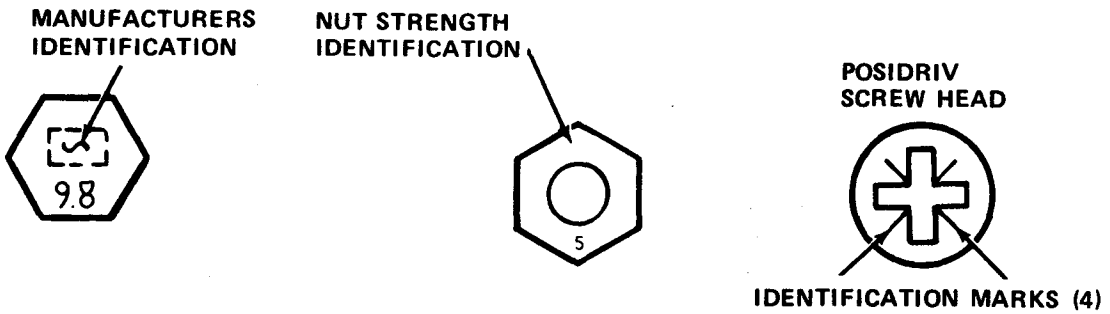
Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. The following figure illustrates the different strength markings.



Customary (inch) bolts - Identification marks correspond to bolt strength - Increasing numbers represent increasing strength.

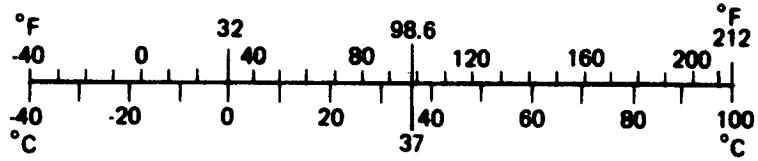


Metric Bolts - Identification class numbers correspond to bolt strength - Increasing numbers represent increasing strength.



SI METRIC-CUSTOMARY CONVERSION TABLE

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimetres (mm)
Foot	0.304 8	metres (m)
Yard	0.914 4	metres
Mile	1.609	kilometres (km)
AREA		
$Inch^2$	645.2	$millimetres^2$ (mm^2)
	6.45	$centimetres^2$ (cm^2)
$Foot^2$	0.092 9	$metres^2$ (m^2)
$Yard^2$	0.836 1	$metres^2$
VOLUME		
$Inch^3$	16 387.	mm^3
	16.387	cm^3
	0.016 4	litres (l)
Quart	0.946 4	litres
Gallon	3.785 4	litres
$Yard^3$	0.764 6	$metres^3$ (m^3)
MASS		
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(°F-32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
ACCELERATION		
$Foot/sec^2$	0.304 8	$metre/sec^2$ (m/s^2)
$Inch/sec^2$	0.025 4	$metre/sec^2$
TORQUE		
Pound-inch	0.112 98	newton-metres (N-m)
Pound-foot	1.355 8	newton-metres
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of mercury	3.377	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000. or $3.6x10^6$	joules (J = one W's)
LIGHT		
Foot candle	10.764	$lumens/metre^2$ (lm/m^2)
FUEL PERFORMANCE		
Miles/gal	0.425 1	kilometres/litre (km/l)
Gal/mile	2.352 7	litres/kilometre (l/km)
VELOCITY		
Miles/hour	1.609 3	kilometres/hr. (km/h)

HOW TO USE CONVERSION CHARTS

Left Column is units of 10, (0, 10, 20, 30 etc.);
Top Row is in units of one (0, 1, 2, 3, etc).

EXAMPLE: Feet to Inches Conversion Chart

feet	0	1	2	3	4	5	6	7	8	9	feet
	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	
--		12	24	36	48	60	72	84	96	108	--
10	120	132	144	156	168	180	192	204	216	228	10
20	240	252	264	276	288	300	312	324	336	348	20
30	360	372	384	396	408	420	432	444	456	468	30
40	480	492	504	516	528	540	552	564	576	588	40
50	600	612	624	636	648	660	672	684	696	708	50

12 feet equals 144 inches. Read across from 10 and down from 2.
6 feet equals 72 inches. Read down from 6.

FEET TO METRES

ft	0	1	2	3	4	5	6	7	8	9	ft
	m	m	m	m	m	m	m	m	m	m	
--		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	--
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17,983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

METRES TO FEET

m	0	1	2	3	4	5	6	7	8	9	m
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
--		3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	--
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	157.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

MILES TO KILOMETRES

mile	0	1	2	3	4	5	6	7	8	9	mile
	km	km	km	km	km	km	km	km	km	km	
--		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	--
10	16.093	17.703	19.312	20.921	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.593	69.202	70.811	72.421	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.779	101.39	103.00	104.61	106.22	107.83	109.44	111.04	60
70	112.65	114.26	115.87	117.48	119.09	120.70	122.31	123.92	125.53	127.14	70
80	128.75	130.36	131.97	133.58	135.19	136.79	138.40	140.01	141.62	143.23	80
90	144.84	146.45	148.06	149.67	151.28	152.89	154.50	156.11	157.72	159.33	90
100	160.93	162.54	164.15	165.76	167.37	168.98	170.59	172.20	173.81	175.42	100

KILOMETRES TO MILES

km	0	1	2	3	4	5	6	7	8	9	km
	mil	mil	mil	mil	mil	mil	mil	mil	mil	mil	
--		0.621	1.243	1.864	2.486	3.107	3.728	4.350	4.971	5.592	--
10	6.214	6.835	7.457	8.078	8.699	9.321	9.942	10.562	11.185	11.805	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.776	17.399	18.019	20
30	18.641	19.263	19.884	20.506	21.127	21.748	22.370	22.990	23.613	24.233	30
40	24.855	25.477	26.098	26.720	27.341	27.962	28.584	29.204	29.827	30.447	40
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.417	36.040	36.660	50
60	37.282	37.904	38.525	39.147	39.768	40.389	41.011	41.631	42.254	42.874	60
70	43.497	44.118	44.739	45.361	45.982	46.603	47.225	47.845	48.468	49.088	70
80	49.711	50.332	50.953	51.575	52.196	52.817	53.439	54.059	54.682	55.302	80
90	55.924	56.545	57.166	57.788	58.409	59.030	59.652	60.272	60.895	61.515	90
100	62.138	62.759	63.380	64.002	64.623	65.244	65.866	66.486	67.109	67.729	100

GALLONS (U.S.) TO LITRES

U.S. gal	0	1	2	3	4	5	6	7	8	9	U.S. gal
	L	L	L	L	L	L	L	L	L	L	
--		3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0638	--
10	37.8543	41.6397	45.4251	49.2105	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5528	117.3482	121.1337	124.9191	128.7045	132.4899	136.2754	140.0608	143.8462	147.6316	30
40	151.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2713	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0527	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6924	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4738	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1135	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

LITRES TO GALLONS (U.S.)

L	0	1	2	3	4	5	6	7	8	9	L
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
--		0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	--
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2267	4.4909	4.7551	5.0192	10
20	5.2834	5.5476	5.8118	6.0759	6.3401	6.6043	6.8684	7.1326	7.3968	7.6610	20
30	7.9251	8.1893	8.4535	8.7176	8.9818	9.2460	9.5102	9.7743	10.0385	10.3027	30
40	10.5668	10.8310	11.0952	11.3594	11.6235	11.8877	12.1519	12.4160	12.6802	12.9444	40
50	13.2086	13.4727	13.7369	14.0011	14.2652	14.5294	14.7936	15.0577	15.3219	15.5861	50
60	15.8503	16.1144	16.3786	16.6428	16.9069	17.1711	17.4353	17.6995	17.9636	18.2278	60
70	18.4920	18.7561	19.0203	19.2845	19.5487	19.8128	20.0770	20.3412	20.6053	20.8695	70
80	21.1337	21.3979	21.6620	21.9262	22.1904	22.4545	22.7187	22.9829	23.2470	23.5112	80
90	23.7754	24.0396	24.3037	24.5679	24.8321	25.0962	25.3604	25.6246	25.8888	26.1529	90
100	26.4171	26.6813	26.9454	27.2096	27.4738	27.7380	28.0021	28.2663	28.5305	28.7946	100

GALLONS (IMP.) TO LITRES

IMP gal	0	1	2	3	4	5	6	7	8	9	IMP gal
	L	L	L	L	L	L	L	L	L	L	
--		4.5460	9.0919	13.6379	18.1838	22.7298	27.2758	31.8217	36.3677	40.9136	--
10	45.4596	50.0056	54.5515	59.0975	63.6434	68.1894	72.2354	77.2813	81.8275	86.3732	10
20	90.9192	95.4652	100.0111	104.5571	109.1030	113.6490	118.1950	122.7409	127.2869	131.8328	20
30	136.3788	140.9248	145.4707	150.0167	154.5626	159.1086	163.6546	168.0005	172.7465	177.2924	30
40	181.8384	186.3844	190.9303	195.4763	200.0222	204.5682	209.1142	213.6601	218.2061	222.7520	40
50	227.2980	231.8440	236.3899	240.9359	245.4818	250.0278	254.5738	259.1197	263.6657	268.2116	50
60	272.7576	277.3036	281.8495	286.3955	290.9414	295.4874	300.0334	304.5793	309.1253	313.6712	60
70	318.2172	322.7632	327.3091	331.8551	336.4010	340.9470	345.4930	350.0389	354.5849	359.1308	70
80	363.6768	368.2223	372.7687	377.3147	381.8606	386.4066	390.9526	395.4985	400.0445	404.5904	80
90	409.1364	413.6824	418.2283	422.7743	427.3202	431.8662	436.4122	440.9581	445.9041	450.0500	90
100	454.5960	459.1420	463.6879	468.2339	472.7798	477.3258	481.8718	486.4177	490.9637	495.5096	100

LITRES TO GALLONS (IMP.)

L	0	1	2	3	4	5	6	7	8	9	L
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
--		0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5398	1.7598	1.9798	--
10	2.1998	2.4197	2.6397	2.8597	3.0797	3.2996	3.5196	3.7396	3.9596	4.1795	10
20	4.3995	4.6195	4.8395	5.0594	5.2794	5.4994	5.7194	5.9394	6.1593	6.3793	20
30	6.5593	6.8193	7.0392	7.2592	7.4792	7.6992	7.9191	8.1391	8.3591	8.5791	30
40	8.7990	9.0190	9.2390	9.4590	9.6789	9.8989	10.9189	10.3389	10.5588	10.7788	40
50	10.9988	11.2188	11.4388	11.6587	11.8787	12.0987	12.3187	12.5386	12.7586	12.9786	50
60	13.1986	13.4185	13.6385	13.8585	14.0785	14.2984	14.5184	14.7384	14.9584	15.1783	60
70	15.3983	15.6183	15.8383	16.0582	16.2782	16.4982	16.7182	16.9382	17.1581	17.3781	70
80	17.5981	17.8181	18.0380	18.2580	18.4780	18.6980	18.9179	19.1379	19.3579	19.5779	80
90	19.7978	20.0178	20.2378	20.4578	20.6777	20.8977	21.1177	21.3377	21.5576	21.7776	90
100	21.9976	22.2176	22.4376	22.6575	22.8775	23.0975	23.3175	23.5374	23.7574	23.9774	100

POUNDS TO KILOGRAMS

lb	0	1	2	3	4	5	6	7	8	9	lb
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
--		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	--
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.730	42.184	42.638	43.092	43.545	43.998	44.453	44.906	90
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442	100

KILOGRAMS TO POUNDS

kg	0	1	2	3	4	5	6	7	8	9	kg
	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	
--		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	--
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.752	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.389	92.594	94.799	97.003	99.208	101.41	103.62	105.82	108.03	40
50	110.23	112.44	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07	50
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12	60
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17	70
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21	80
90	198.42	200.62	202.83	205.03	207.23	209.44	211.64	213.85	216.05	218.26	90
100	220.46	222.67	224.87	227.08	229.28	231.49	233.69	235.89	238.10	240.30	100

POUNDS PER SQUARE INCHES TO KILOPASCALS

lb/in^2	0	1	2	3	4	5	6	7	8	9	lb/in^2
	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	
--	0.0000	6.8948	13.7895	20.6843	27.5790	34.4738	41.3685	48.2663	55.1581	62.0528	--
10	68.9476	75.8423	82.7371	89.6318	96.5266	103.4214	110.3161	117.2109	124.1056	131.0004	10
20	137.8951	144.7899	151.6847	158.5794	165.4742	172.3689	179.2637	186.1584	193.0532	199.9480	20
30	206.8427	213.7375	220.6322	227.5270	234.4217	241.3165	248.2113	255.1060	262.0008	268.8955	30
40	275.7903	282.6850	289.5798	296.4746	303.3693	310.2641	317.1588	324.0536	330.9483	337.8431	40
50	344.7379	351.6326	358.5274	365.4221	372.3169	379.2116	386.1064	393.0012	399.8959	406.7907	50
60	412.6854	420.5802	427.4749	434.3697	441.2645	448.1592	455.0540	461.9487	468.8435	475.7382	60
70	482.6330	489.5278	496.4225	503.3173	510.2120	517.1068	524.0015	530.8963	537.7911	544.6858	70
80	551.5806	558.4753	565.3701	572.2648	579.1596	586.0544	592.9491	599.8439	606.7386	613.6334	80
90	620.5281	627.4229	634.3177	641.2124	648.1072	655.0019	661.8967	668.7914	675.6862	682.5810	90
100	689.4757	696.3705	703.2653	710.1601	717.0549	723.9497	730.8445	737.7393	744.6341	751.5289	100

KILOPASCALS TO POUNDS PER SQUARE INCHES

kPa	0	1	2	3	4	5	6	7	8	9	kPa
	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	
--		.1450	.2901	.4351	.5801	.7252	.8702	1.0153	1.1603	1.3053	--
10	1.4504	1.5954	1.7404	1.8855	2.0305	2.1756	2.3206	2.4656	2.6107	2.7557	10
20	2.9007	3.0458	3.1908	3.3359	3.4809	3.6259	3.7710	3.9160	4.0610	4.2061	20
30	4.3511	4.4961	4.6412	4.7862	4.9313	5.0763	5.2213	5.3664	5.5114	5.6564	30
40	5.8015	5.9465	6.0916	6.2366	6.3816	6.5267	6.6717	6.8167	6.9618	7.1068	40
50	7.2518	7.3969	7.5419	7.6870	7.8320	7.9770	8.1221	8.2671	8.4121	8.5572	50
60	8.7022	8.8473	8.9923	9.1373	9.1824	9.4274	9.5724	9.7175	9.8625	10.0076	60
70	10.1526	10.2976	10.4427	10.5877	10.7327	10.8778	11.0228	11.1678	11.3129	11.4579	70
80	11.6030	11.7480	11.8930	12.0381	12.1831	12.3281	12.4732	12.6182	12.7633	12.9083	80
90	13.0533	13.1984	13.3434	13.4884	13.6335	13.7785	13.9236	14.0686	14.2136	14.3587	90
100	14.5037	14.6487	14.7938	14.9388	15.0838	15.2289	15.3739	15.5190	15.6640	15.8090	100

POUND FEET TO NEWTON-METRES

ft-lb	0	1	2	3	4	5	6	7	8	9	ft-lb
	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	
--		1.3558	2.7116	4.0675	5.4233	6.7791	8.1349	9.4907	10.8465	12.2024	--
10	13.5582	14.9140	16.2698	17.6256	18.9815	20.3373	21.6931	23.0489	24.4047	25.7605	10
20	27.1164	28.4722	29.8280	31.1838	32.5396	33.8954	35.2513	36.6071	37.9629	39.3187	20
30	40.6745	42.0304	43.3862	44.7420	46.0978	47.4536	48.8094	50.1653	51.5211	52.8769	30
40	54.2327	55.5885	56.9444	58.3002	59.6560	61.0118	62.3676	63.7234	65.0793	66.4351	40
50	67.7909	69.1467	70.5025	71.8584	73.2142	74.5700	75.9258	77.2816	78.6374	79.9933	50
60	81.3491	82.7049	84.0607	85.4165	86.7724	88.1282	89.4840	90.3898	92.1956	93.5514	60
70	94.9073	96.2631	97.6189	98.9747	100.3305	101.6863	103.0422	104.3980	105.7538	107.1096	70
80	108.4654	109.8213	111.1771	112.5329	113.8887	115.2445	116.6003	117.9562	119.3120	120.6678	80
90	122.0236	123.3794	124.7353	126.0911	127.4469	128.8027	130.1585	131.5143	132.8702	134.2260	90
100	135.5818	136.9376	138.2934	139.6493	141.0051	142.3609	143.7167	145.0725	146.4283	147.7842	100

NEWTON-METRES TO POUND FEET

N·m	0	1	2	3	4	5	6	7	8	9	N·m
	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	
--		.7376	1.4751	2.2127	2.9502	3.6878	4.4254	5.1692	5.9005	6.6381	--
10	7.3756	8.1132	8.8507	9.5883	10.3258	11.0634	11.8010	12.5385	13.2761	14.0136	10
20	14.7512	15.4888	16.2264	16.9639	17.7015	18.4390	19.1766	19.9142	20.6517	21.3893	20
30	22.1269	22.8644	23.6020	24.3395	25.0771	25.8147	26.5522	27.2898	28.0274	28.7649	30
40	29.5025	30.2400	30.9776	31.7152	32.4527	33.1903	33.9279	34.6654	35.4030	36.1405	40
50	36.8781	37.6157	38.3532	39.0908	39.8283	40.5659	41.3035	42.0410	42.7786	43.5162	50
60	44.2537	44.9913	45.7288	46.4664	47.2040	47.9415	48.6791	49.4167	50.1542	50.8918	60
70	51.6293	52.3669	53.1045	53.8420	54.5796	55.3171	56.0547	56.7923	57.5298	58.2674	70
80	59.0050	59.7425	60.4801	61.2176	61.9552	62.6928	63.4303	64.1679	64.9055	65.6430	80
90	66.3806	67.1181	67.8557	68.5933	69.3308	70.0684	70.8060	71.5435	72.2811	73.0186	90
100	73.7562	74.4938	75.2313	75.9689	76.7064	77.4440	78.1816	78.9191	79.6567	80.3943	100

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

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1978 Transmode with Electro Level II (Models ZEO6083, ZEO6583)

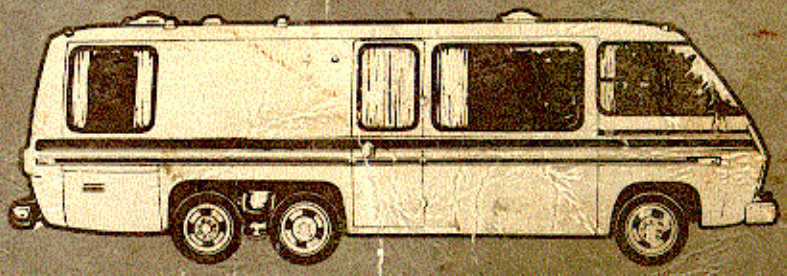
X-7725

GMC

1977 & 1978
MAINTENANCE MANUAL
SUPPLEMENT

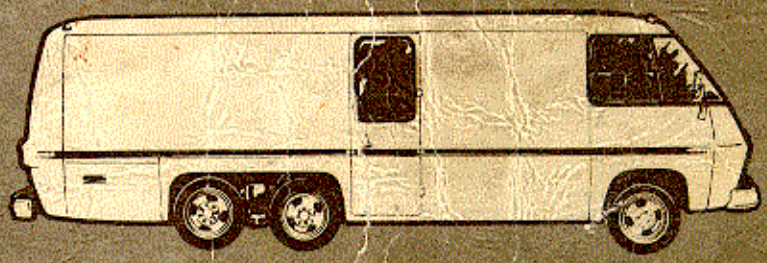
Motorhome

ZE06581
ZE06584



TransMode

ZE06083
ZE06583



GMC TRUCK & COACH

Division of General Motors Corporation

FOREWARD

Information in this Supplement when used in conjunction with the 1975 & 1976 Maintenance Manual (Form No. X-7525) provides coverage for 1977 and 1978 GMC Motorhomes andTransModes.

References are made to special tools in the various sections of this supplement. These tools or their equivalent, are necessary and are recommended to readily and efficiently accomplish certain service operations. The tools, however, are not supplied by General Motors Corporation. Information regarding the availability of these tools can be obtained from the Zone Office or from the Service Department at the factory.

All information, illustrations and specifications contained in this supplement are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

GMC TRUCK & COACH
DIVISION OF GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended by GMC Truck & Coach and described in this manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various Warnings and Cautions which should be carefully read in order to minimize risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It is also important to understand that these Warnings and Cautions are not exhaustive. GMC Truck & Coach could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, GMC Truck & Coach have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by GMC Truck & Coach must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

CAUTION

These vehicles contain some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatches or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.