

ENGINE TUNE-UP

TUNE-UP SEQUENCE INDEX

SUBJECT	PAGE	SUBJECT	PAGE
Spark Plugs—Removal	6C-1	Fuel Lines and Filter—Inspect and Service.	6C-4
Compression Test	6C-1	Coolant Level and Hoses—Check	6C-4
Spark Plugs—Clean-Test-Install	6C-2	Crankcase Oil Level—Check	6C-4
Ignition System—Service and Repairs	6C-2	Choke Adjustment	6C-4
Battery and Battery Cables—Clean and Test	6C-3	Connect Tune-Up Equipment	6C-4
Generator and Regulator	6C-3	Ignition Point Dwell	6C-4
Fan Belt—Inspect and Adjust	6C-3	Ignition Timing and Advance	6C-5
Manifold Heat Valve—Check Operation	6C-3	Idle Speed and Mixture Adjustment	6C-5
Intake Manifold Bolts—Tighten	6C-3	Crankcase Ventilation	6C-5
		Road Test	6C-6

INTRODUCTION

Engine tune-up is diagnosis and preventive maintenance performed at regular intervals to restore maximum performance and economy in an engine.

It is advisable to follow a definite and thorough procedure of analysis and correction as suggested by the sequence-index above.

SPARK PLUG REMOVAL

1. Remove any foreign matter from around spark plugs by blowing out with compressed air, then disconnect wires and loosen each plug one turn.

2. Reconnect plug wires, start engine and accelerate to approximately 1000 rpm to blow out loose carbon.

NOTE: Cleaning carbon in this manner prevents chips from lodging under valves and giving a false compression reading or damaging valves.

3. Stop engine, disconnect wires and remove plugs.

TEST COMPRESSION

Test compression with engine warm, all spark plugs removed and throttle and choke wide open. Crank engine through at least four compression strokes to obtain highest possible reading. No cylinder should be less than 80% of the highest cylinder (see examples). Excessive variation between cylinders, accompanied by low speed missing of the cylinder or cylinders which are low, usually indicates a valve not properly seating, a burned valve or broken piston ring. Low pressures, even though uniform, may indicate worn rings. This will usually be accompanied by excessive oil consumption.

6 Cyl.

Example 1

Cyl.	1	2	3	4	5	6
Press.	129	127	130	121	116	102

80% of 130 (highest) is 104. Thus cylinder No. 6 is less than 80% of No. 3. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

Example 2

Cyl.	1	2	3	4	5	6
Press.	85	96	90	87	85	91

80% of 96 is 77. While all cylinders are well above 77, they are all excessively low. This indicates all poor valves or, if accompanied by oil consumption, worn rings or low crank speed.

If compression is subnormal, tune-up will probably not be satisfactory.

V-8

Example 1

Cyl.	1	2	3	4	5	6	7	8
Press.	136	138	135	144	102	137	140	141

80% of 144 (highest) is 115. Thus cylinder No. 5 is less than 80% of No. 4. This condition, accompanied by low speed missing, indicates a burned valve or broken piston ring.

Example 2

Cyl.	1	2	3	4	5	6	7	8
Press.	85	91	90	87	96	93	87	89

80% of 96 is 77. While all cylinders are well above 77, they are all excessively low. This indicates all

poor valves or, if accompanied by oil consumption, worn rings or low crank speed. If compression is subnormal, tune-up will probably not be satisfactory.

NOTE: The compression check is important because an engine with low or uneven compression cannot be tuned successfully to give peak performance. Therefore, it is essential that improper compression be corrected before proceeding with an engine tune-up.

CLEAN, SERVICE AND INSTALL SPARK PLUGS

1. Inspect each plug individually for badly worn electrodes, glazed, broken or blistered procelains and replace plugs where necessary. Refer to spark plug diagnosis information presented in "Engine Electrical" for an analysis of plug conditions.

2. Clean serviceable spark plugs thoroughly, using an abrasive-type cleaner. File the center electrode flat.

3. Inspect each spark plug for make and heat range. All plugs must be of the same make and number or heat range.

4. Adjust spark plug gaps to .035" using a round feeler gauge.

CAUTION: Never bend the center electrode to adjust gap. Always adjust by bending ground or side electrode.

5. If available, test plugs with a spark plug tester.

6. Inspect spark plug hole threads and clean before installing plugs. Corrosion deposits can be removed with a 14 mm, x 1.25 SAE spark plug tap (available through local jobbers) or by using a small wire brush in an electric drill. Use plenty of grease on tap to catch any chips.

CAUTION: Use extreme care when using tap to prevent cross threading. Also crank engine several times to blow out any material dislodged during cleaning operation.

7. Install spark plugs to engine with new gaskets and tighten to 23 lb. ft. torque.

Improper installation is one of the greatest single causes of unsatisfactory spark plug performance. Improper installation is the result of one or more of the following practices:

- Installation of plugs with insufficient torque to fully seat the gasket.
- Installation of the plugs using excessive torque which changes gap settings.

- Installation of plugs on dirty gasket seal.
- Installation of plugs to 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.

Always remove corrosion deposits in hole threads before installing plugs. When corrosion is present in threads, normal torque is not sufficient to compress the plug gasket and early failure from overheating will result.

Always use a new gasket and wipe seats in head clean. The gasket must be fully compressed on clean seats to complete heat transfer and provide a gas tight seal in the cylinder. For this reason as well as the necessity of maintaining correct plug gap, the use of correct torque is extremely important during installation.

SERVICE IGNITION SYSTEM AND MAKE NECESSARY REPAIRS

1. Replace brittle or damaged spark plug wires. Install all wires to proper spark plug. Proper positioning of spark plug wires in supports is important on V-8 engines to prevent cross-firing.

2. Tighten all ignition system connections.

3. Replace or repair any wires that are frayed, loose or damaged.

4. Remove distributor cap, clean cap and inspect for cracks, carbon tracks and burned or corroded terminals. Replace cap where necessary.

5. Clean rotor and inspect for damage or deterioration. Replace rotor where necessary.

6. Check the distributor centrifugal advance mechanism by turning the distributor rotor as far as possible, then releasing the rotor to see if the springs return it to its retarded position. If the rotor does not return readily, the distributor must be disassembled and the cause of the trouble corrected.

7. Check to see that the vacuum advance control operates freely by turning the movable breaker plate to see if the spring returns to its retarded position. Any stiffness in the operation of the spark control will affect the ignition timing. Correct any interference or binding condition noted.

8. Examine distributor points and clean or replace if necessary.

- Contact points with an overall gray color and only slight roughness or pitting need not be replaced.
- Dirty points should be cleaned with a clean point file.

Use only a few strokes of a clean, fine-cut contact file. The file should not be used on other metals and should not be allowed to become greasy or dirty. Never use emery cloth or sandpaper to clean contact points since particles will embed and cause arcing and rapid burning of points. Do not attempt to remove all roughness nor dress the point surfaces down smooth. Merely remove scale or dirt.

- Replace points that are burned or badly pitted.

Where burned or badly pitted points are encountered, the ignition system and engine should be checked to determine the cause of trouble so it can be eliminated. Unless the condition causing point burning or pitting is corrected, new points will provide no better service than the old.

- On 6 cyl. engines, adjust distributor contact gap to .019" (new points) or .016 (used points), using a flat feeler gauge. Breaker arm rubbing block must be on high point of lobe during adjustment.

NOTE: Used contact points should be cleaned before adjusting with a feeler gauge.

9. Lubricate distributor breaker cam with distributor cam lubricant.

10. Install rotor and distributor cap. Press all wires firmly into cap towers.

SERVICE BATTERY AND BATTERY CABLES

State of Charge Test

1. Measure the specific gravity of the electrolyte in each cell. If it is below 1.230 (corrected to 80°F.), recharge with a slow rate charger, or if desired, further check battery.

2. Connect a voltmeter across the battery terminals and measure the terminal voltage of the battery during cranking (remove the coil secondary lead during this check to prevent engine from firing). If the terminal voltage is less than 9.0 volts at room temperature, approx. 80°±20°F.), the battery should be further checked. See section 12 for further tests.

Inspect for signs of corrosion on battery, cables and surrounding area, loose or broken carriers, cracked or bulged cases, dirt and acid, electrolyte leakage and low electrolyte level. Fill cells to proper level with distilled water or water passed through a demineralizer.

The top of the battery should be clean and the battery hold-down bolts properly tightened. Particular care should be taken to see that the top of the battery is kept clean of acid film and dirt because of the high voltage between the battery terminals. For best results when cleaning batteries, wash first with a dilute ammonia or soda solution to neutralize any acid present and then flush off with clean water. Care must be taken to keep vent plugs tight so that the neutralizing solution does not enter the cell. The hold-down clamp should be kept tight enough to prevent the battery from shaking around in its holder, but it should not be tightened to the point where the battery case will be placed under a severe strain.

To insure good contact, the battery cables should be tight on the battery posts. If the battery posts or cable terminals are corroded, the cables should be cleaned separately with a soda solution and a wire brush. After cleaning and before installing clamps, apply a thin coating of petrolatum to the posts and cable clamps to help retard corrosion.

If the battery has remained undercharged, see Charging Circuit - Preliminary Checks, section 6E.

If the battery has been using too much water, the voltage regulator setting is too high.

GENERATOR AND REGULATOR

The generator and regulator tests during tune-up consist of the preceding battery tests; the condition of the battery may indicate further tests and adjustments as outlined in "Engine Electrical."

FAN BELT

1. Inspect fan belt condition.
2. Check and adjust if necessary for correct tension of belt, as follows:
 - a. Using a Burroughs tension gauge check the fan belt midway between the water pump pulley and generator pulley.
 - b. Adjust generator on its mounting bracket to proper fan belt tension. See section 6A.

CHECK OPERATION OF MANIFOLD HEAT VALVE

Check manifold heat control valve for freedom of operation. If shaft is sticking, free it up with heat valve lubricant Pt. No. 1050422 or equivalent.

TIGHTEN INTAKE MANIFOLD BOLTS

To check for a possible leak at the intake manifold, apply some heavy oil around the suspected

area. Tighten all bolts to specification and sequence as outlined in section 6. If gasket is bad, replace.

CHECK FUEL LINES AND SERVICE FUEL FILTER

1. Inspect fuel lines for kinks, bends or leaks and correct any defects found.

2. Clean filter in carburetor inlet.

NOTE: If a complaint of poor high speed performance exists on the vehicle, fuel pump tests described in section 6B should be performed.

INSPECT AND SERVICE COOLING SYSTEM

Inspect cooling system for leaks, weak hoses, loose hose clamps and correct coolant level, and service as required.

NOTE: A cooling system pressure test, as described in section 6A may be performed to detect internal or external leaks within the cooling system.

CHECK LUBRICANT LEVEL AND INSPECT FOR OIL LEAKS

Check level of lubricant in crankcase and inspect engine for oil leaks.

CHECK CARBURETOR CHOKE AND UNLOADER OPERATION AND ADJUSTMENT

The specified choke setting provides ideal choke operation in all climates. No seasonal changes are necessary. For setting, see ENGINE FUEL, section 6B.

The choke should just close at 75°F. when set at index. In rare cases, it may be necessary to change slightly (never more than two notches) from the standard setting to properly calibrate the choke. Excess carbon in choke housing may indicate a leaking choke heat tube.

Choke linkage and fast idle cam must operate freely. Do not lubricate linkage since this will collect dust and cause sticking.

Check unloader adjustment with engine running and transmission in neutral. Disconnect vacuum hose from throttle return check and plug end of vacuum hose. Adjust contact screw of throttle return check to obtain 1050 engine rpm. After adjustment, unplug vacuum hose and reconnect to throttle return check.

CAUTION: The throttle return check plunger must be restrained from turning while adjusting plunger screw to prevent injury to diaphragm.

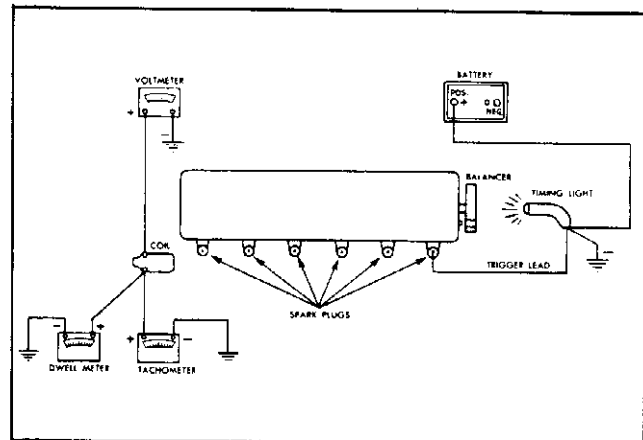


Fig. 6C-1 Schematic of Tune-Up Instrumentation

CONNECT TUNE-UP EQUIPMENT

Follow manufacturer recommendations for the use of testing equipment. Fig. 6C-1 shows a basic schematic for instrumentation which will apply to many types of test equipment and may be used as a rough guide if equipment manufacturer's instructions are not available.

Connections shown in Fig. 6C-1 are made as follows:

1. Timing light
 - a. Positive lead to positive battery terminal.
 - b. Negative lead to ground.
 - c. Trigger lead to number 1 spark plug.
2. Tachometer
 - a. Positive lead to distributor side of coil.
 - b. Negative lead to ground.
- NOTE: With capacitor discharge system, connect positive lead to tachometer lead at amplifier.*
3. Dwell Meter (except CD system)
 - a. Positive lead to distributor side of coil.
 - b. Negative lead to ground.

TEST DWELL AND DWELL VARIATION

Two methods are offered for dwell or point gap adjustment on the vehicle. Whenever possible, a

dwelling meter should be used for better accuracy. The engine must be thoroughly warmed up before proceeding.

V-8

1. With engine running at idle, raise the adjusting screw window and insert an Allen wrench in the socket of the adjusting screw.

2. With dwelling meter connected, adjust dwelling angle to 30 degrees for all V-8 engines. A 2-degree variation is allowable for wear. If a dwelling meter is not available, turn adjusting screw clockwise until engine starts to misfire, then turn screw one-half turn in the opposite direction to complete adjustment.

3. Close access cover fully to prevent the entry of dirt into the distributor.

6 Cyl.

On 6 cyl., adjust point gap with a flat feeler gauge to .019" (new) or .016 (used).

TEST IGNITION TIMING AND ADVANCE

1. Attach a timing light and tachometer as shown in Fig. 6C-1.

2. Disconnect spark advance hose at carburetor and connect vacuum gauge there.

NOTE: Disconnect both hoses on A.I.R. cars with dual acting vacuum control unit.

3. Set parking brake, start engine and run at idle speed.

4. Aim timing light at marks on lower timing chain cover and harmonic balancer.

5. Adjust timing as required by loosening clamp bolt and rotating distributor until correct timing is indicated, then tighten clamp bolt.

6. Disconnect timing light.

7. Reconnect distributor spark advance and vacuum gauge with a T, then perform idle speed and mixture adjustment.

6 Cyl.	5°BTDC
6 Cyl. (A.I.R.) 1Bbl. only	0°TDC
V-8 (All)	6°BTDC

IDLE SPEED AND MIXTURE

Omit steps 1 and 2 when proceeding from timing procedure.

1. Connect tachometer and vacuum gauge to engine. Set parking brake. Start engine, allow to idle.

2. With a thoroughly warmed-up engine, check to see that choke is fully open and carburetor is on slow idle.

3. Adjust idle speed and mixture screws to give proper idle speed and peak vacuum at idle.

NOTE: Depress hot idle compensator valve while adjusting all engines so equipped.

Hot idle speed - RPM	326 & 400 (exc. G.T.O.)		428 & G.T.O.	All w/A.I.R.
	6 Cyl.	4-bbl.	4-bbl.	
Auto. Trans. in Dr.	500	500	600	600
Auto. Trans.* A/C off Trans. in Dr.	500	600	600	600
Manual Trans.	600	600	700	700
Manual Trans.* A/C off	600	700	700	700

*IDLE SPEED-UP DEVICE—ADJUST (6-cylinder Tempests with air conditioning only). (1) Set hot idle speed and mixture as above in drive. (2) Turn air conditioning on for maximum cooling and adjust diaphragm plunger screw to obtain the following engine speeds.

	Std.	w/A.I.R.
Automatic transmission in Dr.	600	600
Manual transmission	600	700

CAUTION: The idle speed-up diaphragm plunger must be restrained from turning while adjusting plunger screw to prevent injury to diaphragm.

FAST IDLE SPEED—ADJUST

Follow procedures outlined in ENGINE FUEL SECTION and adjust fast idle speed to settings given at end of that section.

POSITIVE CRANKCASE VENTILATION

All 1967 engines have either "standard" or "closed" positive ventilation systems utilizing manifold vacuum to draw fumes and contaminating vapors into the combustion chamber where they are burned. The crankcase ventilation system has an important function and should be understood and serviced properly.

In both positive and closed crankcase ventilation, air is drawn through the engine, through a regulating

valve and into the manifold, drawing crankcase vapors and fumes with it to be burned. Positive ventilation uses a vented-meshed oil filler cap for clean air intake to the engine, while closed positive ventilation system draws the clean air from the carburetor air cleaner and has a nonvented oil filler cap.

The positive ventilation valves are designed specifically for each engine to control the amount of flow from the crankcase to manifold. VALVES SHOULD NEVER BE INTERCHANGED BETWEEN 6 AND 8 CYLINDER ENGINES.

The crankcase ventilation valve and the vented oil filler cap will eventually become plugged and ineffective. The valve should be tested and the vented oil filler cap should be washed in solvent, blown dry with compressed air and then re-oiled at regular intervals (see section O).

The PCV system should be serviced as follows:

1. Disconnect all hoses and blow them out with compressed air. If any hose cannot be freed of obstructions, replace with new hose.

2. Remove crankcase ventilation valve assembly from rubber grommet.

3. The valve cannot be disassembled. Test for a defective valve as follows:

- a. Connect tachometer and vacuum gauge as for idle speed and mixture adjustment.

- b. Set parking brake and start engine.

- c. Disconnect check valve from push rod cover, block opening of valve, and read engine rpm change.

- d. A change of less than 50 rpm indicates a plugged ventilation valve and metering hole -- replace the valve and adjust idle speed and mixture.

4. Clean crankcase and intake manifold connectors; using care not to allow dirt to enter openings.

5. Remove crankcase oil filler cap. Clean cap in solvent and blow dry.

NOTE: Oil filler cap should be re-oiled if used on standard P.C.V. System.

6. Clean and re-oil ventilation filter in air cleaner on closed P.C.V. Systems.

7. Reinstall Positive Crankcase Ventilation System.

8. Adjust carburetor idle to specifications, section 6B.

ROAD TEST

TEST PERFORMANCE OF CAR

Observe performance of engine at low speed, during acceleration, and at constant speed. Check for missing, stalling, surging, poor acceleration or flat spots on acceleration. If any irregularity is found, tests listed under diagnosis should be conducted to find and correct trouble.

TEST OPERATION OF:

BRAKES—Pedal should not go closer than 2" from floor mat (1" with power brakes) and car should not pull to either side. Fluid level in master cylinder should be 1/2" below top of master cylinder housing filler opening.

PARKING BRAKE—Should hold the car without excessive movement of parking brake pedal.

AUTOMATIC TRANSMISSION—Observe shift pattern at minimum and full throttle and test forced downshifts. Watch for any indications of slipping or unusual shift characteristics that may indicate need for adjustment.

STEERING GEAR—See that steering operates normally and that steering wheel does not have excessive play. Also observe for alignment of steering wheel, pull, wander, or other irregularity that might indicate need for front end alignment.

WINDSHIELD WIPER—Wiper operation should be tested with windshield wet in order to properly judge the action.

CLUTCH—See that clutch engages smoothly and that lash is correct. Follow procedure for adjusting clutch pedal height and lash in the clutch section. Hard pedal or lack of pedal return may indicate need for overcenter spring adjustment.

LIGHTS AND HORNS—Test operation of headlights, tail lights, stop lights, parking lights, direction signals, and all other lights, as well as the horns.

INSTRUMENTS—Observe operation of all instruments. Observe especially for possible abnormal reading which may indicate trouble.

ACCESSORIES—Test operation of radio, heater, defroster, cigar lighter, other accessories.