SECTION 2-C

ENGINE TUNE UP AND TROUBLE DIAGNOSIS

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SERVICE BULLETIN REFERENCE

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2-9 ENGINE TUNE UP

The purpose of an engine tune up is to restore power and performance that has been lost through wear, corrosion, or deterioration of one or more parts or units. In the normal operation of an engine these changes take place gradually at quite a number of points so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be assured by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

The parts or units which affect power and performance may be divided, for analysis, into three groups in accordance with their function in producing (1) *Ignition* (2) *Compression* (3) *Carburetion*. The tune up procedure should cover these groups in the order given. While the items affecting ignition and compression may be handled according to individual preference, correction of items in the carburetion group should not be attempted until all items in ignition and compression have been satisfactorily corrected.

Most of the procedures required for complete engine tune up are covered separately in other sections of this manual; therefore, this paragraph gives an outline only, with references to the numbered paragraphs where detailed information is given. The suggested procedure for engine tune up is as follows:

1. Inspect battery and cables (par. 10-17).
2. Test cranking motor circuit if battery is in good condition but cranking speed is low (par. 10-37).
3. Inspect generator (par. 10-26). If difficulty is experienced in keeping battery charged, test generator regulator (par. 10-29).
4. Inspect entire ignition system and make indicated corrections (par. 10-44). Before removal of spark plugs for cleaning, warm up engine for steps 5 and 6 which should be performed before spark plugs are reinstalled.
5. Check cylinder head bolts for proper torque (par. 2-16).
6. Test cylinder compression pressure with all spark plugs removed, using a reliable pressure gauge as follows:

(a) Connect jumper wire between primary terminal of distributor and ground on engine to avoid high tension sparking while cranking engine. Turn ignition switch "ON".

(b) Insert rubber fitting of compression gauge into a spark plug port and hold gauge tightly in position.

(c) Push throttle wide open and crank engine until compression gauge reaches its highest reading, which should require only a few revolutions of engine.

(d) Repeat this test on all cylinders, making sure to fully release pressure in gauge after each test.

(e) The compression gauge hand should jump to about 75 pounds on the first compression stroke, with a few more strokes giving maximum pressure. If the pressure is built up in the gauge in jerky steps of 10 or 20 pounds at a time, it indicates leakage of pressure at some point such as head gasket, valves, or piston rings.

(f) Normal compression pressure at cranking speed is approximately as follows, in an engine which is fully broken in.

Series 40 .... 112 lbs./sq. in.
Series 50-70, Syncro-Mesh . . 114 lbs./sq. in.
Series 50-70, Dynaflow . . . . . 118 lbs./sq. in.

Pressure variation between all cylinders should not exceed 6 lbs./sq. in.

(g) Low compression pressure in two adjacent cylinders indicates a head gasket leak between the two cylinders.

(h) If one or more cylinders have low compression pressure or there is considerable variation between cylinders, inject S.A.E. 20 engine oil (not over 1 tablespoon full) into each low-reading cylinder. Crank the engine a few revolutions and recheck the compression pressure. A material increase in pressure indicates that compression is being lost past the pistons and rings, whereas no increase in pressure indicates sticking or poorly seating valves.

7. Check valve lash and adjust as necessary (par. 2-14).

8. Clean strainers in fuel pump and carburetor inlet (par. 3-9).

9. Inspect and test fuel pump (par. 3-17).

10. Free up and lubricate manifold heat valve (par. 3-11).

11. Clean and refill air cleaner (par. 3-8).

12. Check operation of choke valve and setting of choke thermostat (par. 3-13).

13. Check adjustment of fast idle cam and choke unloader (Carter par. 3-23; Stromberg par. 3-30).

14. Check timing of accelerator vacuum switch if starting difficulty is experienced (Carter par. 10-32; Stromberg par. 10-33).

15. Check throttle linkage adjustment (par. 3-10).

16. Adjust carburetor (par. 3-12).

17. Adjust fan belt (par. 2-27).

18. Inspect all water hose connections and tighten clamps.

19. Road test car for power and overall performance.

2-10 EXCESSIVE VALVE NOISE

a. Excessive Noise with Adjustable Valve Lash Mechanism

With the valves lashed uniformly to specifications, the noise level should be very low as observed in the car while driving. The sound of valve action will be audible, however, when the hood is raised or when the engine is operating on fast idle during warm up.

The valve lash must not be reduced below specifications in an attempt to eliminate valve noise, as this will cause formation of carbon on valve seat and stems which will then increase valve noise and lower the engine performance. Burned or warped valves will result from insufficient lash clearance.

The following conditions generally cause excessive valve noise:

(1) *Excessive or Uneven Valve Lash Clearances.* Adjust valve lash (par. 2-14).

(2) *Insufficient Oil to Valve Mechanism.* Check piping, restricted fittings, and oil line screen (when used) to remove any obstruction to proper flow of oil to rocker arm shaft.

(3) *Sticking Valves.* Sticking valves are usually indicated by an intermittent loudness of action, although valves will be unusually noisy at all times if they are sticking badly. Sticking valves will cause irregular operation or missing on a low-speed pull. Recondition valves (par. 2-17).

(4) *Warped or Eccentric Valves, Worn Guides.* Check valves and replace if necessary. Install new valve guides if worn. See paragraph 2-17.

(5) *Worn or Scored Parts in Valve Train.* Inspect rocker arms, ball studs, push rod ends, push rods for bends, valve lifters, and camshaft for worn or scored wearing surfaces. Replace parts as required.

b. Excessive Noise with Hydraulic Valve Lifters

NOTE: *When an engine equipped with hydraulic valve lifters has been standing for considerable time (such as overnight) some valve noise will occur when engine is first started. This is because oil escapes from the lifters that are holding valves open against valve spring pressure. These lifters will fill with oil and noise will disappear after a few seconds of running. This condition must not be classed as excessive valve noise.*

To locate a noisy valve lifter remove the rocker arm cover. With engine idling place a finger on each valve spring cap in succession. A distinct shock will be felt when the valve returns to its seat if a valve lifter is not functioning properly. The valve will return to its seat with no shock whatever if valve lifter is functioning properly.

There are four general types of hydraulic valve lifter noise that may be encountered as follows:

(1) *Loud, Hard Rapping Noise.* This may be caused by an insufficient supply of oil to valve mechanism due to low oil level in crankcase, defective oil pump, clogged oil passages or dented oil pipes. If oil supply is satisfactory, this condition is caused by the valve lifter plunger sticking in bore of lifter body so that the spring cannot push plunger back to its normal working position. Clean or replace valve lifter (par. 2-15).

(2) *Moderate Rapping or Clicking Noise.* This can be caused by excessive worn valve stem guide, eccentricity of valve and seat, or warped valve. See paragraph 2-17. It also can be caused by excessive clearance of valve lifter in crankcase, or by a worn or scored cam. Moderate rapping or clicking also can be caused by too rapid leakage of oil between lifter body and plunger.

(3) *Intermittent Clicking.* This is the most difficult condition to locate. It can be located only by listening carefully or feeling with a finger on each valve spring cap or rocker arm in succession until the click appears and is located either by hearing or feeling. This type of click is almost always caused by a microscopic piece of dirt which keeps circulating through the lifter and momentarily is caught between the check valve ball and seat. In rare cases the ball itself may be out of round or have a flat spot which upon contacting the seat permits leakage of oil. Clean or replace the valve lifter (par. 2-15).

(4) *General Noise Throughout the Valve Train.* This condition, in almost all cases, will be a definite indication of an insufficient supply of oil to valve mechansim caused by low oil level in crankcase, defective oil pump, clogged oil passages or dented oil pipes.

2-11 HARD STARTING, IMPROPER PERFORMANCE, EXCESSIVE FUEL OR OIL CONSUMPTION

a. Hard Starting, Improper Performance, Excessive Fuel Consumption

These subjects are covered in Section 3-B. See paragraph 3-5 for hard starting, paragraph 3-6 for improper engine performance, and paragraph 3-7 for excessive fuel consumption.

b. Excessive Oil Consumption

If an engine is reported to be using an excessive amount of oil, a thorough inspection should be made for external leaks and the conditions of operation should be carefully considered before assuming that the engine is using too much oil as a result of an internal condition.

Place clean paper on the floor under engine and run the engine at medium speed until the oil is thoroughly warmed up, then stop the engine and check for oil leaks and dripping on the paper. Inspect both sides and front and rear ends of engine for wet spots. Pay particular attention to rocker arm cover, push rod cover, and lower crankcase gaskets. All external leaks should be corrected and the results noted before attempting any internal correction.

The conditions of operation have an important bearing on oil consumption. The following points should be checked.

(1) *Improper reading of oil gauge rod.* An erroneous reading will be obtained if car is not level, gauge rod is not pushed down against stop, or insufficient drain-back time (1 minute) is not allowed after stopping engine. An oversupply of oil may be added if gauge rod markings are not understood. The space between arrows represents 2 quarts and space between adjacent holes represents one quart.

(2) *Oil too light.* The use of oil of lower viscosity than specified for prevailing temperatures will contribute to excessive oil consumption.

(3) *Continuous high speed driving.* In any automobile engine, increased oil consumption per mile may be expected at speeds above 60 MPH.

(4) *High speed driving following slow speed town driving.* When a car is used principally for slow speed town driving under conditions where considerable crankcase dilution occurs, a rapid lowering of oil level may occur when the car is driven for some distance at high speed. This is because the dilution from town driving is removed by the heat of the high speed driving. This is a normal condition and should not be mistaken for excessive consumption.

(5) *Vacuum pump diaphragm leaking.* A cracked diaphragm in the vacuum pump can cause excessive oil consumption by permitting oil to be drawn from the crankcase through the pump and intake manifold into the combustion chambers. If the windshield wiper action is sluggish when the engine is accelerated it indi-

cates a defective diaphragm. With the wiper operating, disconnect vacuum pipe at manifold and hold a piece of clean paper near open end of pipe. An oily discharge indicates that oil is passing through the vacuum pump and the diaphragm requires replacement.

(6) *Valve Guides and Rocker Arm Oil Baffle.* Excessively worn valve guides may cause excessive oil consumption. An oil baffle is mounted above the rocker arms to prevent excessive spraying of oil upon the valve stems from the rocker arms. If this baffle is removed, the surplus oil thrown upon the valve stems will be pulled down into the combustion chamber and lost. The baffle is particularly necessary to control oil consumption at this point during high speed driving.

(7) *Piston rings not worn in.* A new engine, or an engine in which new rings have been installed, will require sufficient running to wear in the rings to provide proper seating against the cylinder walls. During the wear-in period a higher than average oil consumption is to be expected, and no attempt should be made to improve oil economy by replacing rings before the engine has been in service for at least 3000 miles.

2-12 COOLING SYSTEM TROUBLE DIAGNOSIS

a. Excessive Water Loss

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold because small leaks which may show dampness or dripping when cold can easily escape detection when the engine is hot, due to the rapid evaporation of the leakage. Tell-tale stains of grayish-white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no dampness.

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur. To avoid losses from this cause never fill radiator above the level line stamped on rear side of head tank.

The use of alcohol anti-freeze with a high temperature radiator thermostat will cause boiling and loss of coolant through the overflow pipe.

Air or gas entrained in the cooling system will raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant to level line stamped in rear side of radiator head tank.
2. Block open the filler cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to lower end of overflow pipe.
3. Run engine in neutral at a safe high speed until the temperature gauge stops rising and remains stationary; in other words, until the engine reaches a constant operating temperature.
4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.
5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

b. Overheating of Cooling System

It must be remembered that the Buick pressure cooling system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of water or permanent type anti-freeze may go considerably above 212°F without danger of boiling.

In a pressure system using the bellows type gas-filled thermostat a high temperature during the warm-up period is normal. On all Series 40-50 and 1948 Series 70 equipped with Syncro-Mesh Transmission, which use the 7 pound radiator cap, the thermostat may not open until approximately 180°F is reached. On Series 70 equipped with Dynaflow Drive, which uses the

13 pound cap and the tube and fin radiator, the temperature may reach 190°-195°F. These conditions must not be mistaken for overheating.

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss. See subparagraph *b* above.
2. Slipping or broken fan belt (par. 2-27).
3. Radiator air passages clogged with dirt, bugs, etc.
4. Radiator thermostat stuck in closed position (par. 2-28).
5. Restriction in radiator, hoses, or water jacket passages.
6. Improper ignition timing (par. 10-47).
7. Improper carburetor adjustment (par. 3-12).
8. Exhaust manifold valve stuck (par. 3-11).
9. Shortage of engine oil or improper lubrication due to internal conditions.
10. Dragging brakes (par. 8-15).

2-13 ENGINE VIBRATION OR ROUGHNESS

If unusual vibration or roughness develops in the operation of a car, test first to determine whether the condition originates in the engine or in other operating units. Time will often be saved by checking the recent history of the car to find out whether the roughness developed gradually or became noticeable following an accident or installation of repair parts.

Vibration is usually most pronounced when driving at a certain speed. If the engine is run at the equivalent or critical speed with car standing and transmission in neutral, the vibration will still exist if the engine, clutch, or transmission is at fault. By running engine at the critical speed with the transmission in high gear and clutch disengaged, any vibration originating in the transmission will be eliminated.

If the vibration does not exist during the tests with car standing still, refer to Diagnosis of Rear Axle Noises (par. 5-3, 5-4, 5-5) and to Car Roughness or Vibration (par. 6-12).

If tests indicate that the vibration originates in the engine or clutch, the following items should be investigated and corrected as required.

a. Bent Fan Blades

Fan blades may be bent by accident or by the objectionable practice of turning the engine by means of the blades. Vibration caused by bent blades may be determined by running the engine at the critical speed with the fan belt temporarily removed.

b. Engine Tune Up

An engine which is not properly tuned up will run rough and vibrate, particularly at idling and low speeds. A thorough engine tune-up operation is the proper correction (par. 2-9).

c. Engine Mountings

Vibration may be caused by broken or deteriorated engine mountings, or by mountings that are loose or improperly adjusted. Adjust and tighten loose mountings (par. 2-31) or replace faulty mountings.

d. Crankshaft Balancer

Loose or broken springs in the crankshaft balancer will cause a pronounced rattle which usually becomes noticeable before the condition is such as to cause vibration in the engine. If the balancer is damaged by accident in such manner that the parts cannot function freely, extreme roughness will be produced which may eventually cause breakage of the crankshaft if it is not corrected. A balancer which shows external evidence of damage or which is suspected of being inoperative should be replaced and the result checked, since it is not possible to test the balancer in any other way.

e. Unbalanced Connecting Rods or Pistons

Vibration will result if connecting rods or pistons are installed which are not of equal weight with all other rods or pistons in engine. If new parts have recently been installed, these should be checked to determine whether they are standard Buick parts or have been altered in weight by filing, machining, or other repairs.

f. Unbalanced Clutch Assembly or Flywheel

Engine roughness may be caused by an unbalanced combination of clutch, flywheel, and crankshaft even though these units are balanced individually during manufacture. This may occur if clutch or flywheel is removed without marking them so that they are reinstalled in original position, or if new parts are installed. An unbalanced condition of clutch, flywheel and crankshaft may be corrected as described in paragraph 2-34.