GROUP 6

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SECTION 6

GENERAL INFORMATION

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ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES. THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE **OR** ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON. THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS. CAPS. ETC., FOR PURPOSES OF SERVICING THE PRODUCT MUST BE STRICTLY FOLLOWED AND. WHEREVER PRACTICABLE. RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

For vehicles sold in Canada and equipped with non-closed loop engines. also refer to the appropriate Canadian Service Manual supplement.

DESCRIPTION OF GROUP 6

SECTION 6A - ENGINE MECHANICAL

This section contains information on the mechanical parts of the engine, such as block, crankshaft, pistons, valve train, and camshaft. Overhaul procedures, removal and replacement procedures, and specifications are also covered. Specific Engine Mechanical subsections for each engine are listed in the Table of Contents, Group 6.

SECTION 66 - ENGINE COOLING

Engine cooling system components such as radiator, water pump, thermostat, and cooling fan, are covered in this section.

SECTION 6C - FUEL SYSTEM

This section contains information on all the parts of the fuel system **except** the carburetor, Throttle Body Injection unit (TBI) or port fuel injectors. Items covered are fuel tank, fuel pump, and fuel lines. Specific sections are used for each carburetor, or TBI unit as follows:

6C1 - E4MC Carburetor, 5.0 Liter VIN Code Y

6C2 - E2ME Carburetor, 3.8 Liter VIN Code A

For all fuel injection applications, see Section 6E, Driveability and Emissions.

SECTION 6D - ENGINE ELECTRICAL

Items covered in this section are battery, generator, starter, distributor, engine wire harness, spark plugs and wires, and ignition switch.

SECTION 6E - DRIVEABILITY AND EMISSIONS

This section covers emission control systems general information, and diagnostic procedures which will lead to repairing performance and driveability related problems for gasoline engine equipped vehicles. All emission components are covered, as well as all removal and replacement procedures. Instructions on use of special tools are also given. Diesel engine performance and driveability diagnosis is in this section (Section 6). Specific sections are:

6E1 - Carbureted
6E2 - Fuel Injection (TBI)
6E3 - Fuel Injection (Port)
6E3 - Fuel Injection Riviera (Port)

SECTION 6F - EXHAUST SYSTEM

This section has information on all exhaust system parts, such as tailpipes, mufflers, and the catalytic converter.

SECTION 6J - TURBOCHARGER MECHANICAL

All information on mechanical diagnosis and service procedures of the turbocharger and related components are in this section.

GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to the wiring harness or other electrical parts.

GENERAL INFORMATION ON ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to bend against the pump screen resulting in damage to the oil pick-up unit.

When working on the engine, remember that the 12-volt electrical system is capable of causing short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the carburetor, throttle body or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine **is** started.

IN THE MECHANICAL PROCEDURES DESCRIBED IN THIS SECTION, GENERALLY NO REFERENCES WILL BE MADE TO THE REMOVAL OF OPTIONAL EOUIPMENT SUCH **AS** POWER STEERING PUMP, AIR CONDITIONING COMPRESSOR, ETC.

SHOULD IT BECOME NECESSARY TO REMOVE ANY SUCH ITEM TO PERFORM OTHER SERVICE, REFER TO THE APPROPRIATE SECTION OF THIS SERVICE MANUAL FOR SPECIFIC INFORMATION.

ENGINE PERFORMANCE DIAGNOSIS

INTRODUCTION

Engine Performance Diagnosis procedures are guides that will lead to the most probable causes of engine performance complaints. They cover the components of the fuel, ignition, and mechanical systems that could cause a particular complaint, and then outline repairs in a logical sequence.

It is important to determine if the **"Service Engine Soon"** light is **"ON"** or has come **"ON"** for a short interval while driving. If the **"Service Engine Soon"** light has come **"ON,"** the Computer Command Control System should be checked for stored **"Trouble Codes"** (See Diagnostic Circuit Check, Section 6E, for the engine you are working on) which may indicate the cause for the performance complaint.

Each Symptom is defined, and it is important that the correct one be selected based on the complaints reported or found. The definition of each symptom is included with the symptom.

The words used may not be what you are used to in all cases, but because these terms have been used interchangeably for so long, it was necessary to decide on the most common usage and then define them. If the definition is not understood, and the exact Symptom is not used, the Diagnostic procedure will not work.

It is important to keep two facts in mind:

1. The procedures are written to diagnose problems on cars that have **"run well at one time"** and that time and wear have created the condition.
2. All possible causes cannot be covered, particularly with regard to emission controls. If doing the work prescribed does not correct the complaint, then either the wrong Symptom was used or a more detailed analysis will have to be made.

All of the Symptoms can be caused by worn out or defective parts such as Spark Plugs, Ignition Wiring, etc. If time and/or mileage indicate that parts should be replaced, it is recommended that it be done.

Refer to:

- Section 6E1 - Carbureted Engines
- Section 6E2 - Fuel Injection (TBI)
- Section 6E3 - Fuel Injection (Port)
- Section 6E3 - Fuel Injection Riviera (Port)

ENGINE MECHANICAL DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

ENGINE WILL NOT CRANK

1. Loose or corroded battery cables. Check connections at batteries, engine block and starter solenoid.
2. Discharged battery(s). Check generator output, and generator belt tension.
3. Engine or belt driven accessory possibly seized. Check to make sure that the engine and belt driven accessories are not seized. Correct as necessary.
4. Starter inoperative. Check voltage to starter and starter solenoid. If **OK,** remove starter for repair.

ENGINE OVERHEATS

1. Coolant system leak, oil cooler system leak or coolant recovery system not operating. Check for leaks and correct as required. Check coolant recovery tank, hose and radiator cap.
2. Belt slipping or damaged. Replace tensioner or belt as required.
3. Thermostat stuck closed. Check and replace if required.
4. Electrical cooling fan operation. Refer to ELECTRICAL DIAGNOSIS.
5. Head gasket leaking. Check and repair as required.

EXCESSIVE OIL LOSS

- External oil leaks. Tighten bolts and/or replace gaskets and seals as necessary. See Oil Leak Diagnosis.
- Improper reading of dipstick. Check oil with car on a level surface and allow adequate drain-down time.
- Improper oil viscosity. Use recommended S.A.E. viscosity for prevailing temperatures. See Section OB.,
- Continuous high speed driving, and/or severe usage such as trailer hauling, will normally cause decreased oil mileage.
- PCV system malfunctioning.
- Valve guides and/or valve stem seals worn, or seals omitted. Ream guides and install oversize service valves and/or new valve stem seals.
- Piston rings broken, worn, or not seated. Allow adequate time for rings to seat. Replace broken or worn rings as necessary.
- Piston improperly installed or misfitted.

OIL LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedure may help in locating and repairing most leaks.

FINDING THE LEAK

1. Identify the fluid, determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. At what point is the fluid leaking from? After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper. After a few minutes, you should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around all gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4. If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent. Clean the area well, then dry the area. Operate the vehicle for several miles at normal operating temperature and varying speeds. After operating the vehicle, visually check the suspected component. If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and black light kit is available for finding leaks. Refer to the manufacturers directions when using the kit.

1. Pour specified amount of dye into leaking component.
2. Operate the vehicle under normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

REPAIRING THE LEAK

Once the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check to be sure that the following conditions are correct as they may cause a leak.

Gaskets

1. Fluid level/pressure is too high.
2. Plugged vent.
3. Improperly torqued fasteners or dirty/damaged threads.
4. Warped flanges or sealing surface.
5. Scratches, burrs or other damage to the sealing surface.
6. Damaged or worn gasket.
7. Cracking or porosity of the component.
8. Improper sealant used (where applicable).

Seals

1. Fluid level/pressure is too high.
2. Plugged vent.
3. Damaged seal bore (scratched, burred or nicked).
4. Damaged or worn seal.
5. Improper installation.
6. Cracks in component.
7. Shaft surface scratched, nicked or damaged.
8. Loose or worn bearing causing excess seal wear.

INSTRUMENT PANEL OIL WARNING LAMP "ON" AT IDLE

1. Oil cooler or cooler line restricted. Remove restrictions in cooler or cooler line.
2. Oil pump pressure low. See oil pump repair procedures in Section 6A.

LOW OIL PRESSURE

- Slow idle speed. Set idle speed to correct specification, if not ECM controlled.
- Incorrect or malfunctioning oil pressure switch.
- Incorrect or malfunctioning oil pressure gage. Replace with proper gage.
- Improper oil viscosity or diluted oil. Install oil of proper viscosity for expected temperature, or install new oil if diluted with moisture or unburned fuel mixtures.
- Oil pump worn or dirty.
- Plugged oil filter.
- Oil pickup screen loose or plugged.
- Hole in oil pickup tube.
- Excessive bearing clearance. Replace if necessary.
- Cracked, porous or plugged oil galleys. Repair or replace block.
- Galley plugs missing or misinstalled. Install plugs or repair as necessary.
- Poor seal at timing cover gasket (VINS A, 3, L, and 7 engine only). Replace gasket.

ENGINE NOISE DIAGNOSIS

VALVE TRAIN NOISE

- Low oil pressure. Repair as necessary. (See diagnosis above for low oil pressure.)
- Loose rocker arm attachments. Inspect and repair as necessary.
- Worn rocker arm and/or pushrod.
- Broken valve spring.
- Sticking valves.
- Lifters worn, dirty, or defective. Clean, inspect, test and replace as necessary.
- Camshaft worn, or poor machining. Replace camshaft.
- Worn valve guides.

KNOCKS COLD AND CONTINUES AFTER TWO TO THREE MINUTES-INCREASES WITH TORQUE

- Vacuum operated EFE engines may have valve knock. Replace EFE valve.
- Flywheel contacting splash shield. Reposition splash shield.
- Loose or broken balancer or drive pulleys. Tighten or replace as necessary.
- Excessive piston to bore clearance. Replace piston.
  Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock which disappears in **1.5** minutes should be considered acceptable.
- Bent connecting rod.

HEAVY KNOCK HOT WITH TORQUE APPLIED

- Broken balancer or pulley hub. Replace parts as necessary.
- Loose torque converter bolts.
- Accessory belts too tight or nicked. Replace and/or tension to specs as necessary.
- Exhaust system grounded. Reposition as necessary.
- Flywheel cracked.
- Excessive main bearing clearance. Replace as necessary.
- Excessive rod bearing clearance. Replace as necessary.

LIGHT KNOCK HOT

- Detonation or spark knock. Check operation of EST or ESC (See Section 6D or 6E). Check engine timing and fuel quality.
- Loose torque converter bolts.
- Exhaust leak at manifold. Tighten bolts and/or replace gasket.
- Excessive rod bearing clearance. Replace bearings as necessary.

KNOCKS ON INITIAL START-UP BUT ONLY LASTS A FEW SECONDS

- Noisy mechanical fuel pump. Replace pump.
- Improper oil viscosity. Install proper oil viscosity for expected temperatures. See Section OB.
- Hydraulic lifter bleed down. Clean, test and replace as necessary.
  When the engine **is** stopped, some valves will be open. Spring pressure against lifters will tend to bleed lifter down. Attempts to repair should be made only if the problem is consistent.
- Excessive crankshaft end clearance. Replace crankshaft thrust bearing.
- Excessive front main bearing clearance. Replace worn parts.

KNOCKS AT IDLE HOT

- Loose or worn drive belts. Tension and/or replace as necessary.
- A/C Compressor or generator bearing. Replace as necessary.
- Noisy mechanical fuel pump. Replace pump.
- Valve train. Replace parts as necessary.
- Improper oil viscosity. Install proper viscosity oil for expected temperature. See Section OB.
- Excessive piston pin clearance. Ream and install oversize pins or replace piston and pin.
- Connecting rod alignment. Check and replace rods as necessary.
- Improper piston to bore clearance. Hone bore or rebore cylinder and fit new piston.
- Loose crankshaft balancer. Tighten bolts and/or replace worn parts.
- Piston pin offset to wrong side. Install correct piston.

ENGINE COMPRESSION TEST

important

- Disconnect the **"BAT."** terminal from the HEI distributor and/or remove the ignition fuse from the fuse block.

To determine if the valves or pistons are at fault, a test should be made to determine the cylinder compression pressure. When checking cylinder compression, the throttle and choke should be open, all spark plugs removed, and the battery at or near full charge. The lowest reading cylinder should not be less than 70% of the highest and no cylinder reading should be less than 689 kPa (100 PSI).

This should be done with four **"puffs"** per cylinder.

Normal - Compression builds up quickly and evenly to specified compression on each cylinder.

Piston Rings - Compression low on first stroke tends to build up on following strokes but does not reach normal. Improves considerably with addition of oil.

Valves - Low on first stroke does not tend to build up on following strokes. Does not improve much with addition of oil.

Use approximately three squirts from a plunger type oiler.