TUNE-UP

ENGINE IDENTIFICATION

VEHICLE IDENTIFICATION NUMBER CODE

Engines may be identified by the 8th letter of Vehicle Identification Number (VIN). The VIN is located at the left front corner of instrument panel and is visible through windshield.

VIN Engine Codes

Application	Code
2.8L (173") 2-Bbl.	1
2.8L (173") 2-Bbl.	X
2.8L (173") 2-Bbl. High Output	Z
3.0L (181") 2-Bbl.	E
3.8L (229") 2-Bbl.	K
3.8L (231") 2-Bbl.	A
3.8L (231") 4-Bbl. Turbo	3
4.1L (252") 4-Bbl.	4

ENGINE IDENTIFICATION NUMBER CODE

Engine code letters are provided on all engines. The code on 2.8L engines is stamped on a vertical pad, located at the front of the engine block, below the cylinder head to the right of the water pump. On 3.0L engines, the code is stamped on a flange at left rear of engine block. On 3.8L and 4.1L engines, codes will be found on labels attached to both the right and left rocker arm covers.

TUNE-UP NOTES

NOTE – *In order to comply with emission standards, specifications shown on engine compartment emission control tune-up decal must be used in all instances.*

CAUTION – *Before making a compression test or cranking engine with a remote starting switch, disconnect ignition switch "BATT" terminal lead at distributor.*

CAUTION – *Do not remove spark plug wires with engine running. H.E.I. secondary voltage is higher than standard ignition systems and may inflict harmful electrical shock.*

CAUTION – *Damage to H.E.I. electronic module and/or ignition coil may result if "TACH" terminal, in distributor cap connector, is directly grounded.*

ENGINE COMPRESSION

Compression Ratio	
2.8L (VIN Z & 1)	8.9:1
2.8L (VIN X) & 3.0L	8.5:1
3.8L (229")	8.6:1
3.8L (231") & 4.1L	8.0:1
Compression Pressure	100 psi minimum
Max. Variation Between Cylinders	30%

Test compression pressure with engine at normal operating temperature, all spark plugs removed and throttle and choke valves wide open.

VALVE CLEARANCE

Hydraulic Lifters	
2.8L	1.5 turns down from zero lash
3.0L, 3.8L (231") & 4.1L	Zero Lash
3.8L (229")	1 turn down from zero lash

VALVE ARRANGEMENT

2.8L

E-I-I-E-I-E (Left Bank – Front to Rear)
E-I-E-I-I-E (Right Bank – Front to Rear)

3.0L, 3.8L & 4.1L
E-I-E-I-I-E (Left Bank – Front to Rear)
E-I-I-E-I-E (Right Bank – Front to Rear)

SPARK PLUGS

Application	Gap (In.)	Torque Ft. Lbs. (N·m)
2.8L	.045	7-15 (9-20)
3.0L	.080	15 (20)
3.8L (229")	.045	22 (30)
3.8L (231") & 4.1L	.080	15 (20)

Spark Plug Type

Application	AC No.
2.8L	R43TS
3.0L	R44TS8
3.8L (229")	R45TS
3.8L (231") & 4.1L	R45TS8

HIGH TENSION WIRE RESISTANCE

Carefully remove ends of wire from spark plug and distributor. Using an ohmmeter, check resistance while gently twisting wire. If resistance is not to specification, or fluctuates from infinity to any value, replace wire.

Resistance (Ohms) Per Wire

Wire Length	Resistance
Under 24"	30,000 Max.
Over 24"	50,000 Max.

DISTRIBUTOR

All models are equipped with High Energy Ignition system and no adjustment is required.

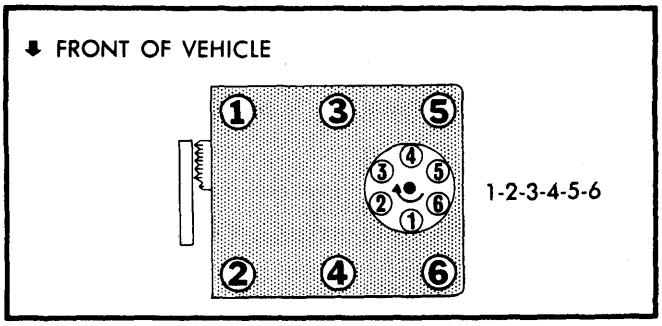

Fig. 1 2.8L Firing Order & Timing Marks

TUNE-UP (Cont.)

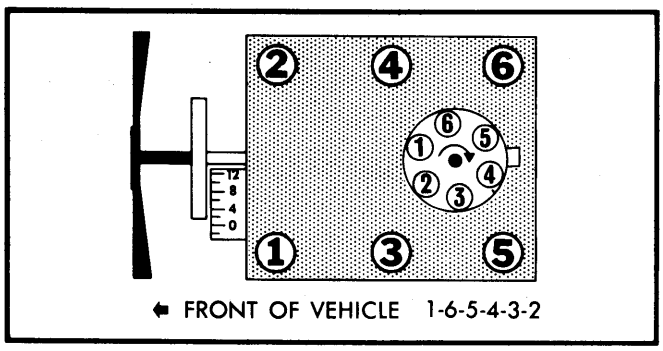

Fig. 2 3.8L (229") Firing Order & Timing Marks

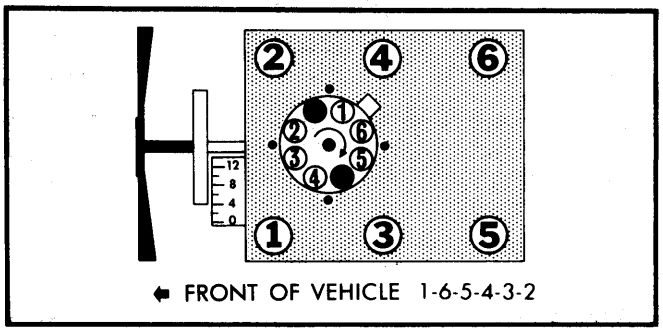

Fig. 3 3.0L, 3.8L (231") & 4.1L Firing Order & Timing Marks

IGNITION TIMING

NOTE – *Engines are equipped with a receptacle for a magnetic probe timing light, located at 9.5° ATDC. Do not use this location for timing with a conventional light.*

Check or adjust ignition timing with engine at normal operating temperature, choke off, air cleaner installed and A/C off. Disconnect 4-wire connector at base of distributor. On 2.8L engines, disconnect and plug EGR and canister purge hoses. After adjustment, reconnect hoses and connector at distributor.

Ignition Timing Specifications (Degrees BTDC@RPM)

Application	Man. Trans.	Auto. Trans.
2.8L		
Camaro & Firebird	10@850	10@600
All Other Models		
Federal	6@850	10@750
Calif.	6@750	10@750
3.0L		15@①
3.8L (229")		6@600
3.8L (231") & 4.1L		15@500

① – At idle speed.

HOT (SLOW) IDLE RPM

NOTE – *On most models, idle speed is controlled by the ECM and an Idle Speed Control (ISC) motor. Other models use standard solenoids to adjust idle RPM. Identify the idle speed system used on vehicle, then follow appropriate procedure for adjustment.*

Idle Speed (With Solenoid) – **1)** Warm engine to normal operating temperature and adjust timing. With A/C off, adjust idle speed screw to curb idle RPM.

2) Disconnect compressor clutch wire and turn A/C on. Open throttle slightly to allow plunger to extend. Turn solenoid plunger to obtain correct solenoid RPM. Reconnect compressor clutch wire.

Idle Speed (RPM)

Application	Curb Idle	Solenoid Energized
2.8L (VIN X)		
Man. Trans.	800	1050
Auto. Trans.	600	800
2.8L (VIN Z)		
Man. Trans.	①750	1100
Auto. Trans.	750	900
2.8L (VIN 1)	①600	700
3.0L	②	②
3.8L (229")	600	②
3.8L (231") & 4.1L	500	②

① – Federal man. trans. is 850 RPM.
② – See Emission Control Decal under hood.

Idle Speed (With Idle Speed Control) – **1)** Prior to making adjustments, check for an identification letter on ISC plunger. See *Fig. 4*. If no letter appears, remove plunger and measure length of plunger (distance "A" in *Fig. 4*). Record measurement. Install plunger into ISC and position so that distance measured from back side of plunger to ISC is less than distance "B" listed in Idle Speed Control Plunger chart.

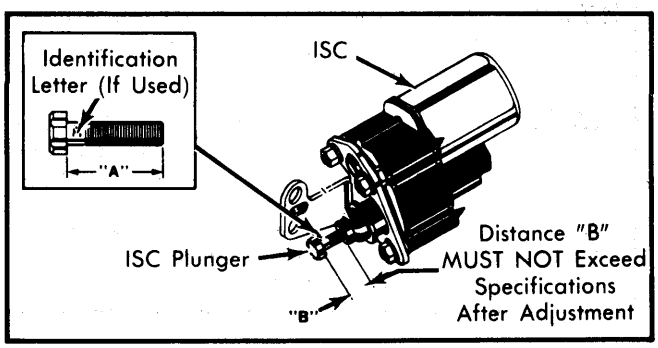

Fig. 4 Measuring Idle Speed Control Plunger

2) With transmission in "P", brakes set and wheels blocked, prepare vehicle for adjustment as described on Emission Control Decal. Connect tachometer to engine. Connect dwell meter to Mixture Control Solenoid dwell lead. Set dwell meter in 6-cylinder scale. Turn A/C off (if equipped), start engine and run until engine enters "Closed Loop" operation (dwell meter needle starts to fluctuate). Stop engine.

NOTE – *DO NOT disconnect or connect ISC connector with ignition "ON" or damage to ECM may result.*

TUNE-UP (Cont.)

3) Unplug ISC connector from motor. Retract plunger by applying 12 volts to terminal "C" and grounding terminal "D" or ISC motor. See *Fig. 5*. Do not leave 12 volts connected to the ISC motor any longer than necessary to retract plunger.

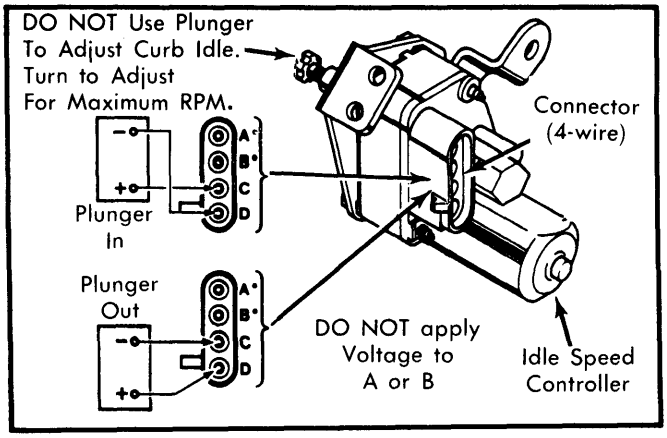

Fig. 5 Idle Speed Control Adjustment Connections

CAUTION — *NEVER connect a voltage source across terminals "A" and "B" or internal throttle contact switch will be damaged.*

4) Start engine and run until dwell meter starts to vary (Closed Loop operation), then place transmission in "D". Adjust carburetor slow idle screw until Minimum Authority RPM is obtained. With idle adjusted, place transmission in "P".

5) Extend ISC plunger by applying 12 volts to terminal "D" and grounding terminal "C" of ISC motor connector. See *Fig. 5*. Adjust plunger to obtain Maximum Authority RPM. Recheck adjustment RPM by applying voltage to extend plunger (plunger will ratchet at full extension).

6) After adjustment, measure distance from back of plunger head to ISC motor (distance "B" in *Fig. 4*). Distance must not exceed distance listed in Idle Speed Control Chart.

Idle Speed Control Plunger

Identification Letter	Distance "A"	Distance "B"
None	9/16"	7/32"
None	41/64"	5/16"
X	47/64"	25/64"
A	49/64"	27/64"
Y	51/64"	15/32"
S	27/32"	1/2"
Z	7/8"	35/64"
G	29/32"	37/64"
E	1"	43/64"
L	1 3/32"	3/4"
J	1 3/16"	27/32"
N	1 7/64"	59/64"
T	1 11/32"	1"

7) Retract plunger and turn engine off. Disconnect all test equipment and wires. Make sure ignition is off, then reconnect ISC motor 4-terminal connector. Clear diagnostic trouble code by removing battery voltage from terminal "R" of ECM for about 10 seconds. This can be done by removing the ECM fuse from the fuse block.

IDLE MIXTURE

NOTE — *Idle mixture adjustment is not normally necessary. Mixture should be checked only if vehicle fails testing or carburetor has been disassembled.*

MIXTURE SCREW PLUG REMOVAL

1) Remove carburetor from engine, invert carburetor and drain fuel into a container. Place carburetor on a suitable holding fixture with manifold side up.

2) Use hacksaw to make 2 small cuts below mixture plugs on bottom of throttle body. Use flat punch or chisel to break out throttle body to gain access to plugs.

3) Use a punch to drive out plug. If hardened steel plug shatters, remove loose pieces.

4) Repeat steps **2)** and **3)** to remove remaining plug (if equipped).

MIXTURE CONTROL ADJUSTMENT

2.8L (VIN 1) Engine Only — 1) Remove carburetor and remove mixture screw plugs. Turn screws in until lightly seated, then back out 1½ turns.

2) Remove vent stack screen. Turn part throttle lean mixture screw in until lightly seated and back out 2½ turns. Reinstall carburetor without air cleaner.

3) Disconnect bowl vent line; disconnect and plug vacuum hose at "T" in vent line if used. Disconnect EGR valve and canister purge at carburetor and plug ports. Remove secondary vacuum break thermal vacuum switch from air cleaner, disconnect hot air valve hose from air cleaner, and plug switch. Leave all other hoses connected.

4) Connect tachometer to brown connector and dwell meter to green connector near carburetor. Set dwell meter on 6 cylinder setting. Run engine for at least 3 minutes or until dwell reading begins to vary.

5) Run engine at 3000 RPM and adjust lean mixture screw to achieve 35° dwell. Allow dwell to stabilize between adjustments. Return to idle and adjust idle speed to 700 RPM when cooling fan is off.

6) Adjust idle mixture screws to obtain dwell reading of 25°. Allow readings to stabilize between adjustments. Disconnect mixture control solenoid while cooling fan is off and check for drop of at least 50 RPM.

7) Repeat 3000 RPM check and adjustment procedure if necessary. When dwell readings are correct, reconnect system hoses, replace vent screen, and remove test equipment.

TUNE-UP (Cont.)

All Except 2.8L (VIN 1) Engine – 1) Mixture control solenoid should be checked before adjustment. Stop engine and remove air cleaner. Insert thin metal scale in "D" shaped hole in air horn. Press down to determine travel of solenoid. Total movement should be 1/8".

NOTE – *If solenoid movement is not correct, see Rochester E2ME and E4ME Carburetor articles in FUEL SYSTEMS Section for adjustment procedures.*

2) To adjust idle air bleed valve, set parking brake and block drive wheels. Disconnect and plug hoses as directed on Emission Control Tune-Up decal in engine compartment. Check ignition timing and adjust if necessary.

3) Connect a dwell meter to lead wire from mixture control solenoid in carburetor, then set dwell meter on 6 cylinder scale. Start engine and run at idle until normal operating temperature is reached and a varying dwell is noted on dwell meter.

NOTE – *It is absolutely essential that engine is operated for a sufficient length of time to ensure the engine coolant sensor, and the oxygen sensor in the exhaust, are at full operational temperature.*

4) Adjust curb idle speed (on models with ISC, do not adjust). Observe dwell reading. If dwell needle is moving, no adjustment is necessary. If needle is fixed at one point, proceed with adjustment.

5) With engine stopped, cover carburetor air intakes and vents with tape. Drill rivet heads on idle air bleed plug (above primary bores). Remove plug and blow out metal chips and rivet pieces. Start engine, run until warm, and adjust idle air bleed valve with screwdriver until dwell varies within 25-35° range.

CAUTION – *Perform this step carefully. The idle air bleed valve is very sensitive in controlling air/fuel ratios and the valve should be turned only in 1/8 turn increments.*

6) If after performing this adjustment, the dwell reading does not vary and is not within the 25-35° range, it will be nesessary to remove carburetor to gain access to the plugs covering the idle mixture needles and adjust the idle mixture as follows:

7) Turn screws until lightly seated. Back out screws 3 1/2 turns. Reinstall carburetor and check dwell when engine is warm.

8) If dwell is below limits turn screws out in 1/8 turn increments. If above limits, turn screws in at 1/8 turn increments. Reset idle speed if necessary. Remove all test equipment and reconnect all hoses.

COLD (FAST) IDLE RPM

Disconnect and plug vacuum hose to EGR valve. Place cam follower on specified step of fast idle cam as described on Emission Control Decal under hood. With engine at normal operating temperature, set fast idle speed using fast idle screw. After adjustment is complete, reconnect vacuum hose to EGR valve.

Fast Idle Speed (RPM)

Application	Man. Trans.	Auto. Trans.
2.8L (VIN X)	2400	2600
2.8L (VIN Z)	2600	2800
2.8L (VIN 1)	2600	2500
3.0L	.....	2300
3.8L (229")	.....	2200
3.8L (231") & 4.1L	.....	2000

AUTOMATIC CHOKE

The choke cover is riveted on in a fixed position on all carburetors and no adjustment is necessary or possible.

FUEL PUMP

Make all tests at slow idle speed. For models with fuel return line, pinch off return line. For vacuum test, connect vacuum gauge to inlet side of pump.

Pressure	
All Models	5.5-6.5 psi
Vacuum	Minimum 15 In. Hg
Volume	1 pint in 30 sec.

EXHAUST EMISSION SYSTEMS

See EXHAUST EMISSION SYSTEMS section.

GENERAL SERVICING

IGNITION

DISTRIBUTOR

Delco-Remy – High Energy Ignition with Electronic Spark Timing (HEI-EST)

IGNITION COIL

Coil Resistance (Ohms@75°F)

Application	Primary	Secondary
All Models	0.4-1.0	6000-30,000

Coil Output

At all engine speeds	①25-35 KV Minimum

① – Replace if below 25 KV.

CARBURETION

CARBURETORS

Application	Model
2.8L (VIN X & Z)	Rochester E2ME
2.8L (VIN 1)	Rochester E2SE
3.0L	Rochester E2ME
3.8L (229")	Rochester E2ME
3.8L (231") 2-Bbl.	Rochester E2ME
3.8L (231") Turbo	Rochester E4ME
4.1L	Rochester E4ME

GENERAL SERVICING (Cont.)

ELECTRICAL

BATTERY

Application	Cold Crank Amps@0°F	Reserve Capacity Minutes
Caprice, Electra, Impala, LeSabre, Riviera & All Cadillac (Exc. Cimarron)		
Standard	350	90
Optional	465	115
Cutlass, El Camino, Malibu, Monte Carlo & Regal		
Standard	370	80
Optional	465	115
All Other Models		
Standard	315	75
Optional	465	115

STARTER

Delco-Remy solenoid actuated with overrunning clutch.

Starter Specifications

Application	Volts	Amps	Test RPM
11095	10.6	50-80	7,500-11,400
1109544	9.0	45-70	7,000-11,900
1982236	9.0	60-80	6,800-10,300
1998234	9.0	65-95	7,500-11,400
1998236	9.0	60-85	6,800-10,300
1998237	9.0	65-95	7,500-10,500

ALTERNATOR

Application	Standard Amps	Optional Amps
2.8L & 3.0L	42	63 & 70
3.8L (229")	37	55, 63 & 70
3.8L (231") & 4.1L	42 or 55	70 & 85

ALTERNATOR REGULATOR

Delco-Remy nonadjustable, integral with alternator.

Operating Voltage (At 85°F)	13.8-14.8

BELT ADJUSTMENT

Tension (Lbs.) Using Strand Tension Gauge

Application	New	Used
2.8L		
Air Pump	100	45
All Other Belts	135	65-80
All Other Engines		
Air Pump	80	45
Alternator	145	70
A/C & Pwr. Str.	170	90

COOLING CAPACITIES

Application	Quantity
2.8L	
Camaro & Firebird	12.5 qts.
All Other Models	
Without A/C	11.4 qts.
With A/C	11.7 qts.
3.0L	13.7 qts.
3.8L (229")	15.0 qts.
3.8L (231")	
Standard	13.6 qts.
With HD Cooling	14.1 qts.
4.1L	
Cadillac	11.8 qts.
All Other Models	13.0 qts.

OIL & FUEL CAPACITIES

Application	Quantity
Crankcase (Including Filter)	
2.8L	4.0 qts.
3.0L	4.5 qts.
3.8L (229")	4.0 qts.
3.8L (231") & 4.1L	5.0 qts.
Fuel Tank	
Bonneville, Grand Prix & Malibu	18.1 gals.
Camaro & Firebird	16.0 gals.
Caprice, Electra, Impala, LeSabre, Monte Carlo, Delta 88 & 98	25.0 gals.
Celebrity, Century, Cutlass Ciera & 6000	16.4 gals.
Citation	15.1 gals.
Cutlass & Regal	18.0 gals.
DeVille & Fleetwood	18.2 gals.
Eldorado & Seville	13.0 gals.
Omega, Phoenix & Skylark	14.0 gals.
Riviera & Toronado	21.0 gals.

TRANSMISSION & DIFFERENTIAL CAPACITIES

Application	Quantity
Man. Trans. (SAE 80W-90)	3.5 pts.
Man. Transaxle (Dexron II)	3.0 qts.
Auto. Trans. (Dexron II)	
200C	7.0 pts.
200-4R	7.0 pts.
250C	8.0 pts.
350C	6.3 pts.
Auto. Transaxle (Dexron II)	
125	5.0 pts.
325	10.0 pts.
Rear Axles (SAE 80W-90)	
7.5" Ring Gear	3.5 pts.
8.5" Ring Gear	4.5 pts.
8.75" Ring Gear	5.4 pts.
Final Drive (SAE 80W-90)	3.2 pts.