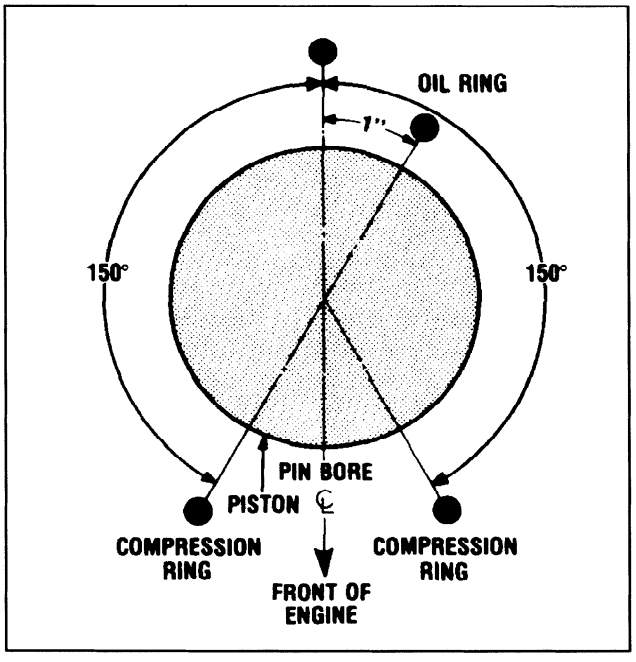
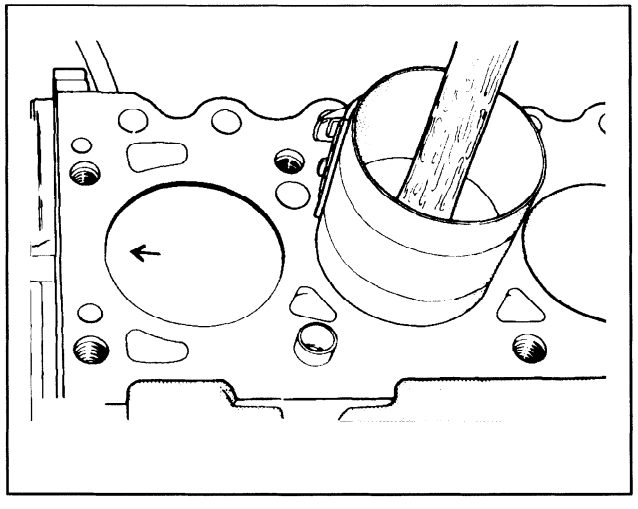
REMOVAL AND INSTALLATION (Continued)





5. Check the clearance of each bearing following the procedure under Overhaul in this section.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Install the connecting rod cap. Tighten the nuts to specification.
8. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crankshaft journal.
9. Install the oil pan and related parts. Follow procedures in this Section.
10. Refer to Cylinder Head Installation and install the cylinder head and related parts. Adjust the valve clearance as described in this Section.
11. Fill and bleed the cooling system. Fill the crankcase.
12. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil and coolant leaks.
13. Operate the engine until engine temperatures have stabilized. Check and adjust the ignition timing. Adjust the engine idle speed and fuel mixture to the specifications.

Oil Filter

Removal

Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the adapter filter recess.

Installation

1. Coat the gasket on the replacement filter with oil. Position the filter on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase as required.

DISASSEMBLY AND ASSEMBLY

Engine Assembly

Disassembly

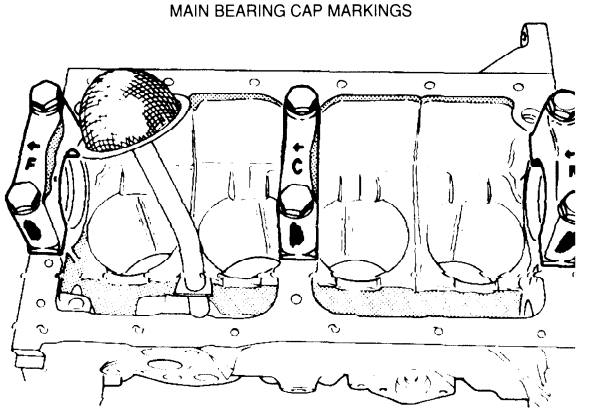
1. Mount the engine on a stand and drain crankcase.
2. Disconnect the fuel line at the fuel pump and carburetor.
3. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position out of the way.
4. Disconnect the water outlet and crankcase ventilation hoses at the intake manifold.
5. Disconnect the wire from the temperature gauge sending unit.
6. Disconnect the throttle rod from the carburetor.
7. Remove the governor mounting bolts and remove governor and drive belt.
8. Remove the thermostat housing and thermostat.
9. Remove the rocker arm cover and gasket.
10. Remove the rocker arm shaft bolts evenly and lift off the rocker arm, shaft assembly.
11. Lift out the push rods from their locations and keep them in their correct order.
12. Remove the cylinder head bolts and lift off the cylinder head and gasket. Do not lay the cylinder head flat on its face as damage to the spark plugs or gasket surface can occur.
13. Remove the fuel pump and oil pump.
14. Remove the dipstick and tube.
15. Remove the secondary wiring.
16. Remove fan, spacer, pulley and generator belt.
17. Remove the generator mounting and adjusting bracket bolts. Remove generator.
18. Remove crankshaft pulley.
19. Remove tne water pump, front cover and crankshaft oil slinger.
20. Remove any ridge and/or carbon deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 0.8 mm (1/32 inch) when removing ridge.**
21. Invert the engine on the stand and remove the oil pan and gaskets.
22. Remove the oil pick up tube and screen.
23. Remove the flywheel and tear engine plate.
24. Remove the tear bearing retainer.
25. Remove the timing chain tensioner.
26. Remove the camshaft sprocket and timing chain.
27. Remove the camshaft thrush plate and the camshaft.
28. Remove the tappets keeping them in their correct order.
29. Make sure all connecting rods and caps are marked so that they can be installed in their original locations. Partially loosen the connecting rod bolts several turns and tap them to release the bearing caps. Remove the bolts completely and remove the caps. Push the pistons out of the bores and remove the assemblies.
30. Remove the main bearing caps bolts evenly and lift off each cap. Lift out the crankshaft and handle with care to avoid possible fracture or damage to finished surfaces.
31. Remove the main bearings from block and cap. Remove the thrust washers.
32. Disassemble the piston and connecting rod assemblies. Remove the piston rings and the two piston pin snap rings. Push the piston pin out of each piston.
33. Remove the coolant drain plug and oil pressure sending unit from the block.
34. Remove the block from the stand.

Assembly

When installing nuts or bolts that must be tightened (refer to the torque specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

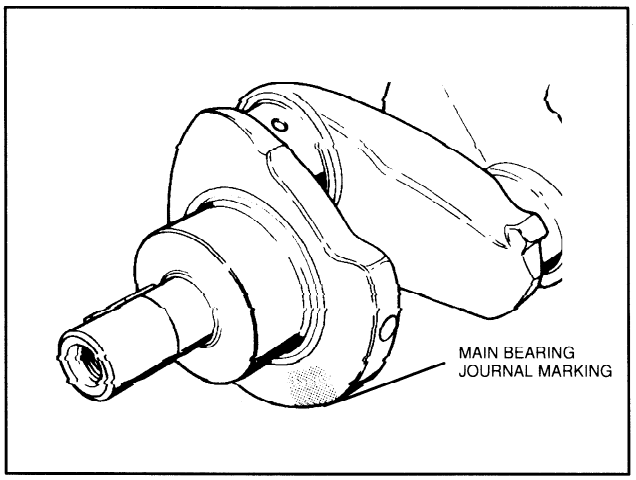
Start the assembly by examining the block and crankshaft to determine the bearings to be used. The block with standard main bearing bores is unmarked. With 0.38 mm (0.015 inch) oversized main bearing bores, the bearing caps are marked with white paint.

MAIN BEARING CAP MARKINGS

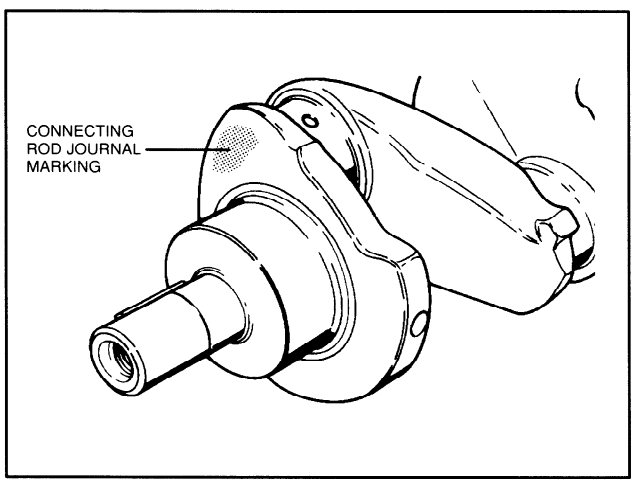


DISASSEMBLY AND ASSEMBLY (Continued)

The crankshaft main bearing journals of standard diameter came in two size categories and are either unmarked or have a yellow paint mark on the first counterweight. See specifications for dimensions.



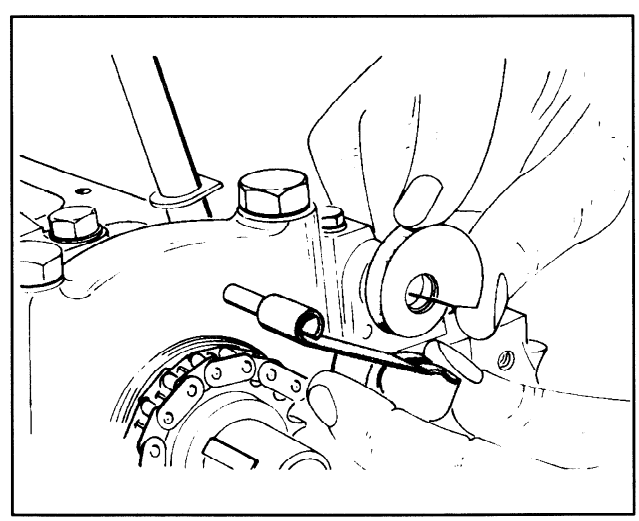
The standard diameter connecting rod journals are unmarked. Where the connecting rod journals are 0.25 mm (.010 inch) undersize, the crankshaft is marked with a green paint spot on the web next to the connecting rod bearing journal number one, as shown.



The standard main bearing and connecting rod bearing inserts have no color marking. Bearing inserts for undersize (u/s) crankshafts or oversize (o/s) cylinder blocks have corresponding inscriptions on the back.

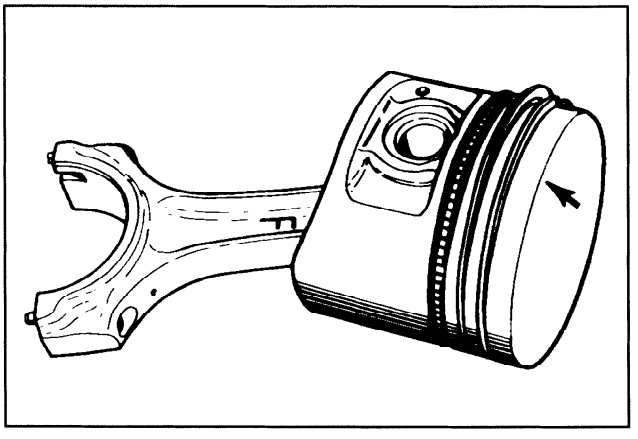
When new bearing inserts are selected they should be measured to ensure that they are the appropriate size. Be sure that the specified tolerances are adhered to by measuring bearing journals and block bores individually with the bearing inserts installed.

1. Mount the block in the stand inverted.
2. Install the coolant drain plug and oil pressure sending unit.
3. Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.
4. Install the lower main bearing inserts in the bearing caps.
5. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.** Check the clearance of each main bearing following the procedures in the Overhaul Section.
6. Install the thrust washers to the center main. Apply alight coat of oil to the journals and bearings. Install the main bearing caps. Tighten the main bearing cap bolts evenly to specifications and check crankshaft rotation.
7. Check the crankshaft end play.
8. Install the tappets into their respective bores.
9. Oil the camshaft journals with heavy engine oil and apply Lubriplate or equivalent to all lobes and then carefully slide it through the bearings.
10. Position the camshaft thrust plate and tighten the attaching bolts to specifications. Check the camshaft end play. Bend the locking tabs to secure the bolts.
11. Install the camshaft sprocket and timing chain aligning the timing marks on the camshaft and crankshaft sprockets. Tighten the attaching bolts to specification and bend up the locking plate tabs.
12. Position the timing chain tensioner arm on the pivot pin and install the tensioner.

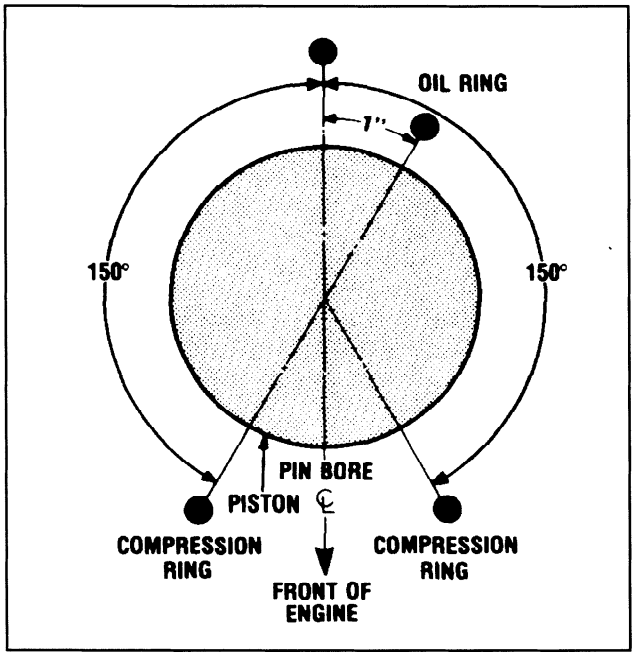


DISASSEMBLY AND ASSEMBLY (Continued)

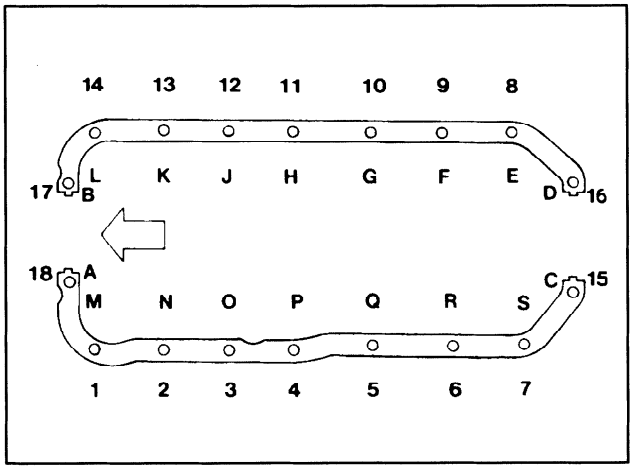
13. Install a new oil seal to the front cover using tool 21-046.
14. Install the oil slinger on the crankshaft and position the front cover gasket in place using oil resistant sealer. Locate the front cover, aligning the seal to the crankshaft with pulley. Tighten the bolts evenly to specification.
15. Install a new oil seal in the rear oil seal carrier using tool 21-059A
16. Position a new gasket on the rear oil seal carrier using oil resistant sealer. Secure the carrier to the cylinder block. Tighten the bolts evenly to specification.
17. Assemble the respective pistons to their connecting rods. Be sure the "F" or "front" on the rod and the arrow on the top of the piston face the same side. Push the piston pin into the piston and rod and install the two piston pin snap rings on service pistons only.



18. Install the rings on the piston starting with the oil ring, then the second compression ring and the top compression ring. Position the gaps as shown.



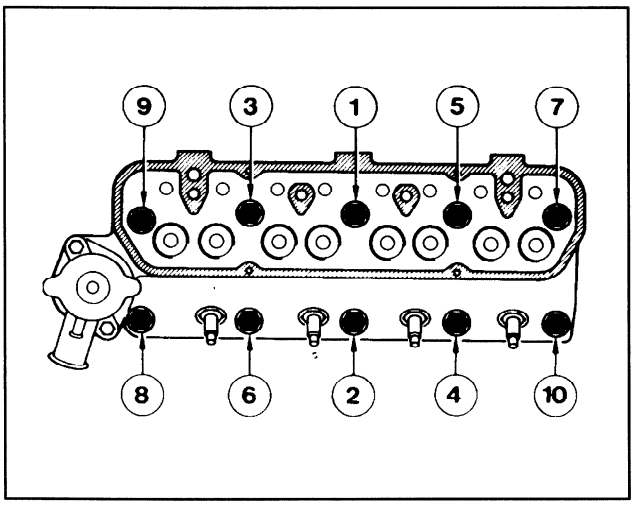
19. Rotate the engine in the stand so that the front end is up. Oil the piston rings and cylinder bores with engine oil. Compress the rings using a universal piston ring compressor. Install the piston and connecting rod assemblies into their respective bores with the arrow on top of the piston pointing toward the front of the block.
20. Install the connecting rod bearings and check the clearances as detailed in the Overhaul Section.
21. Oil the hearings and journals with engine oil and install the connecting rod bearing caps. Tighten the bolts to specification. Check the connecting rod side clearance.
22. Rotate the engine to the inverted position. Replace the oil pump pick up tube and screen. Press the tubes to the full depth of the counter bored holes.
23. Position the flywheel squarely on the crankshaft flange. Tighten the attaching bolts evenly to specification.
24. Install the crankshaft pulley and torque the bolt to specification.
25. Coat the block surface and the oil pan gasket surface with oil resistant sealer. Position the oil pan gaskets on the cylinder block. Position the end seals with the chamfered ends into the grooves, again using an oil resistant sealer at the mating areas. Position the oil pan and tighten the bolts evenly to specification following first the alphabetical, then the numerical sequences shown.



26. Right the engine in the stand. Position a new gasket on the water pump and install the pump on the block.
27. Position the generator and brackets to the block and install mounting bolts.
28. Position a new oil pump mounting gasket to the block using oil resistant sealer. Position the pump to the block, install the mounting bolts and torque to specifications.
29. Position a new gasket to the fuel pump flange and insert the rocker arm through the slot in the block so that the arm lies on the camshaft lobe. Install the mounting bolts and tighten evenly to specification.

DISASSEMBLY AND ASSEMBLY (Continued)

30. Position the cylinder head gasket on the cylinder block using pilot studs.
31. Position the cylinder head, remove the pilot studs and install the cylinder bolts. Tighten the bolts down evenly in sequence and in three steps to specification.



32. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
33. Install the rocker arm shaft assembly to the cylinder head, locating the push rods on the adjusting screws. Tighten the bolts evenly to specification. Adjust the valve clearances. Install the rocker cover.
34. Locate the thermostat in its bore in the cylinder head and install the gasket and thermostat housing. Connect the wire to the temperature gauge sending unit. Connect primary wires to coil.
35. Install dipstick and tube.
36. Position governor and install mounting bolts.
37. Connect the throttle rod to the carburetor.
38. Connect the water outlet and crankcase ventilation hoses at the intake manifold.
39. Connect the leads to the spark plugs.
40. Connect the fuel line at the fuel pump and carburetor.
41. Install remaining generator adjusting arm mounting bolts. Loosen generator and governor adjusting bolts.
42. Install water pump pulley, spacer and fan. Install generator and governor drive belts. Adjust both belts to specifications.
43. Remove engine from stand.

Oil Pump

Disassembly

1. Remove the filter.
2. Remove the end plate and withdraw the rubber O-ring from the groove in the pump body.
3. If it is necessary to replace the rotor assembly, remove the outer rotor, then drive out the retaining pin securing the gear to the shaft and pull off the gear.
4. Remove the inner rotor and shaft.
5. Drill a small hole and insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

Assembly

1. Oil all parts thoroughly.
2. Install the oil pressure relief valve plunger, spring and new cap.
3. Install the inner rotor and shaft assembly in the pump body. Press the gear onto the shaft supporting the shaft at the rotor end on a suitable spacer, until the far end of the gear teeth are 57.2 mm (2-1/4 inches) from the mounting flange. If a new shaft and/or gear are used, drill a 3.2 mm (1/8 inch) hole at right angles to the shaft through the gear shoulder 33.3 mm (1-5/16 inches) from the mounting flange. Replace the gear retaining pin and peen over the ends securely.
4. Install the outer rotor with its chamfered side facing inward toward the pump body.
5. Place a new rubber O-ring in the groove in the pump body. Position the end plate with the machined face toward the rotors and install the retaining bolts.
6. Coat the gasket on the oil filter with engine oil. Position the filter to the pump housing. Hand tighten the filter until the gasket contacts the face, then advance it 1/2 turn.

SECTION 02 — Ignition System Distributorless

BLANK

DESCRIPTION AND OPERATION

WARNING

- **HIGH VOLTAGE PRODUCED BY A DISTRIBUTORLESS IGNITION SYSTEM IS HIGHER THAN FOR A CONVENTIONAL IGNITION SYSTEM.**
- **WHEN CARRYING OUT SERVICE OPERATIONS ON AN ENGINE EQUIPPED WITH DISTRIBUTORLESS IGNITION, IT IS IMPORTANT TO BE AWARE OF THE ABOVE POINT AS WELL AS ALL THE USUAL SAFETY MEASURES TO PREVENT THE POSSIBILITY OF ELECTRIC SHOCKS.**

The purpose of an engine's ignition system is to ignite the fuel/air mixture at the correct time and sequence based upon the input it receives.

The Distributorless Ignition System (DIS) used on the VSG 411/413 engines is a state-of-the-art ignition system. The brain of this system is the Ignition Control Module (ICM), also known as the Universal Electronic Spark Control (UESC) module. This module normally receives four inputs:

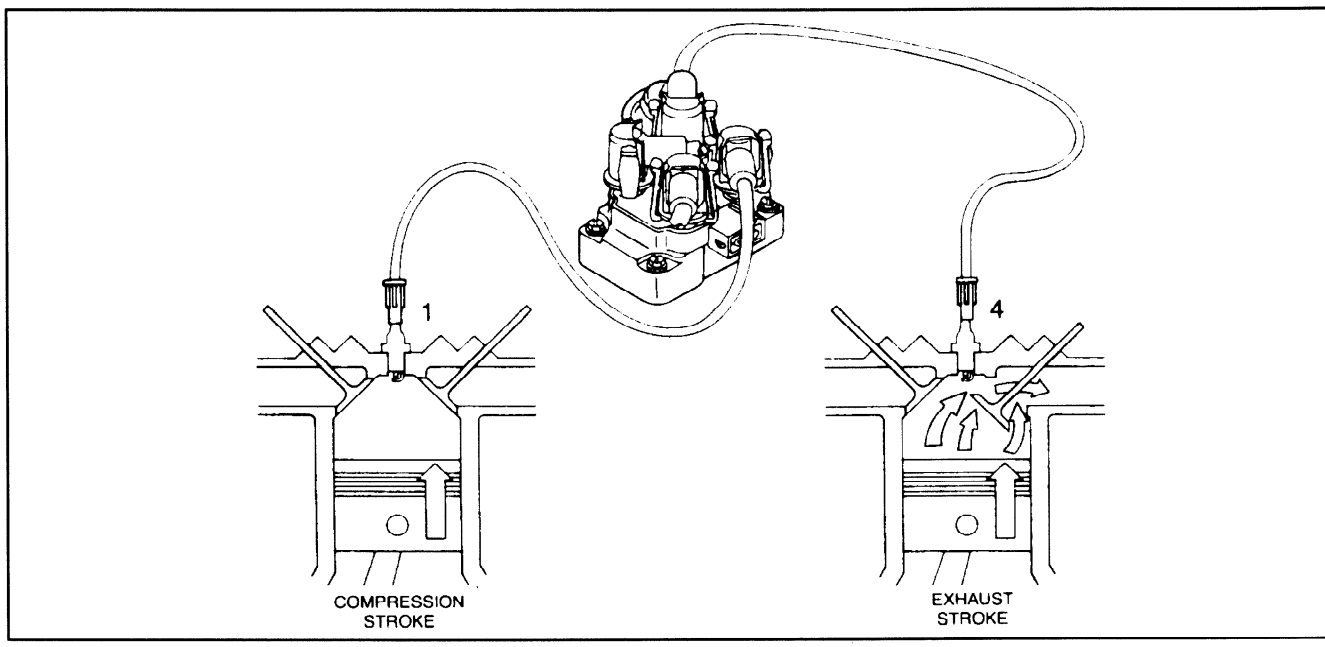
- Crankshaft position
- Crankshaft speed
- Engine temperature
- Engine vacuum (load)

From these inputs, the ICM computes spark strategy (spark advance) to obtain optimum engine performance for correct input conditions.

With this system, the electronic control module monitors the engine load, speed, and operating temperature and decides what degree of spark advance is correct for all of the operating conditions. This system maximizes the benefits of the high compression swirl design. Because timing is set for life inherently in the design of the engine, and there are no moving parts in the ignition system itself, no maintenance is required except for periodic spark-plug checks. The system provides for fixed spark advance at start-up, for cold weather starting, fixed advance for service checking, and for "average value" default settings in case of component failure. Particular attention has been given to spark optimization for excellent fuel economy in the warm-up mode, which is coupled with improved warm-up and a new carburetor.

The spark plugs are paired so that one plug fires during the compression stroke and its companion plug fires during the exhaust stroke. The next time that coil is fired, the plug that was on exhaust will be on compression, and the one that was on compression will be on exhaust. The spark in the exhaust cylinder is wasted but little of the coil energy is lost.

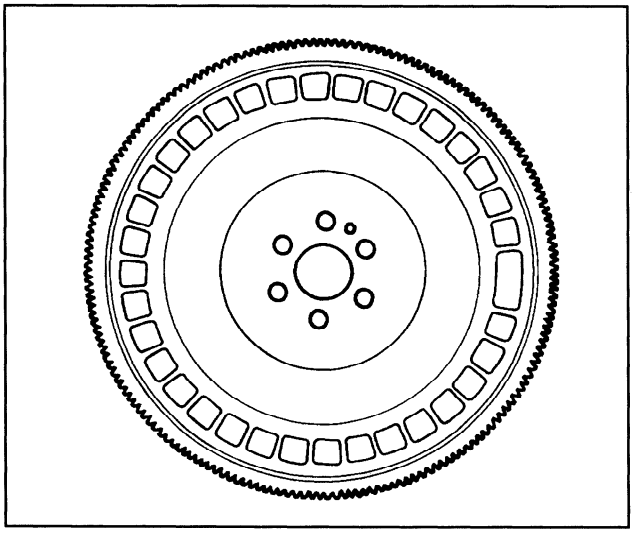
The spark strategy is based on sensors and manifold vacuum input to the ICM module, which include the following **inputs:**



Engine Speed and C/S Position

The crankshaft position and speed information comes to the ICM from the Crankshaft Position Sensor (CKP), also known as the Variable Reluctance Sensor (VRS). The CKP is triggered by teeth cast into the engine side of the flywheel. The 36-1 teeth, spaced 10° apart, indicate to the ICM the crankshaft speed. The missing tooth indicates crankshaft position.

DESCRIPTION AND OPERATION (Continued)



Engine Load

The engine load information is processed into the ICM's electronics by a pressure transducer located within the ICM. A vacuum line connects the transducer to the engine intake manifold. The engine vacuum is proportional to its load.

Engine Temperature

The Engine Coolant Temperature (ECT) Sensor sends engine temperature information to the ICM. The ECT sensor is located in the intake manifold water jacket.

Fuel Octane Level Adjustment

This input to the ICM retards the spark according to the Spark Timing table on page 13. This input is not usually used in the U.S.

The ICM module **outputs** are:

Ignition Coil Driver

The ICM switches two ignition coils on and off at the correct times to give the desired spark advance.

Sensor Fail-safe

If the ICM identifies a failure of any of its inputs, other than the engine speed/position sensor, it will substitute a fixed value for that input until such time that the fault on the input is rectified. A failed sensor is defined as the instantaneous reading of a sensor being made that is either above or below the maximum or minimum reading as defined by the system constants below:

Engine Coolant Temperature	minimum –39°C	(-38°F)
	maximum 112 °C	(234°F)
Manifold Absolute Pressure	minimum 21 kPa	(6.22″ Hg)
	maximum 101 kPa	(29.91″ Hg)

Ignition timing is adjusted constantly by the ICM. Many factors, including all the sensors affect the final ignition setting.

Cranking Mode

Cranking mode is the area of engine operating speed within which the ignition timing is at a static position. The static spark advance is fixed at 10 degrees BTDC up to 250 RPM.

Run Mode

In this mode the RPM is above 250 and the spark advance is calculated in three main sections which are added together. The ICM sections are: Base Spark Advance (BSA) plus Spark Advance Offset Temperature (SAOT) plus Spark Advance Offset Detonation ECT (SAODE).

The final spark advance is then corrected, for propagation delays and finally the spark advance is limited by the system ranges and the spark slew rate limited.

The Base Spark Advance (BSA) is calculated by the ICM looking at speed and load inputs.

The Spark Advance Offset Temperature (SAOT) will change ignition timing from the function of Engine Coolant Temperature (ECT). This allows the spark advance to be altered during cold engine conditions to improve starting and operation.

Spark Advance Offset Detonation ECT (SAODE) the ignition timing is offset as a function of Engine Coolant Temperature (ECT). This allows the spark advance to be reduced during hot engine conditions to avoid detonation and allow base spark advance to be calibrated near to the best performance curve.

Transient Mode

This function is to provide detonation protection when the engine load is increased rapidly by fast opening of the throttle plate. Rapid increases in engine load are determined by large changes in consecutive Manifold Absolute Pressure (MAP) values to the ICM.

Overspeed Mode

If the instantaneous engine speed is greater than the maximum speed threshold, then the spark events are terminated until the instantaneous engine speed falls below 6375 RPM. During this time all other ICM calculations are performed as normal.

SERVICE ADJUSTMENTS AND CHECKS

1. Each 400 hours of engine operation remove the spark plugs and clean & adjust the electrode.
2. Clean and visually check spark plug high tension leads and check for secure fit, replace if necessary.

The ICM must be mounted above the intake manifold vacuum fitting to prevent fuel from entering the ICM chamber

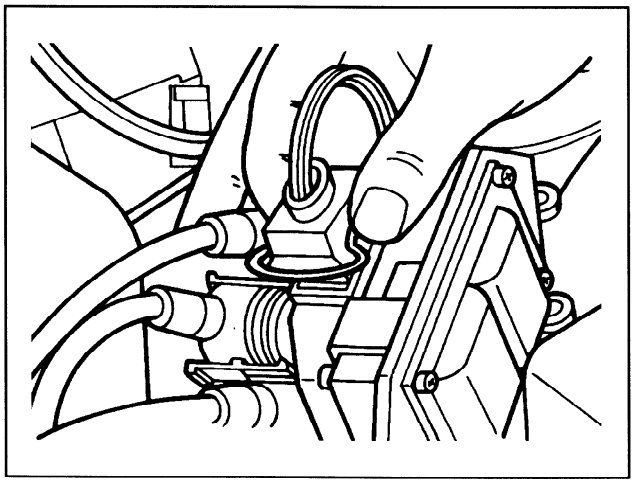
The connecting rubber hose must be compatible with gasoline and be as short as possible. It is recommended that a fuel vapor trap be used in line in the connecting hose.

REMOVAL AND INSTALLATION

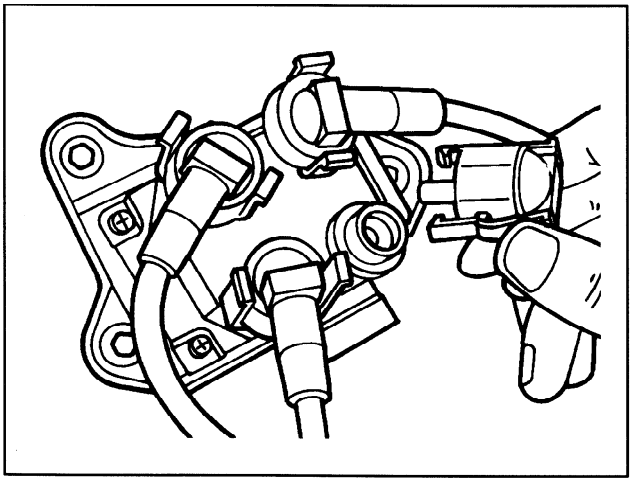
Ignition Coil

Removal

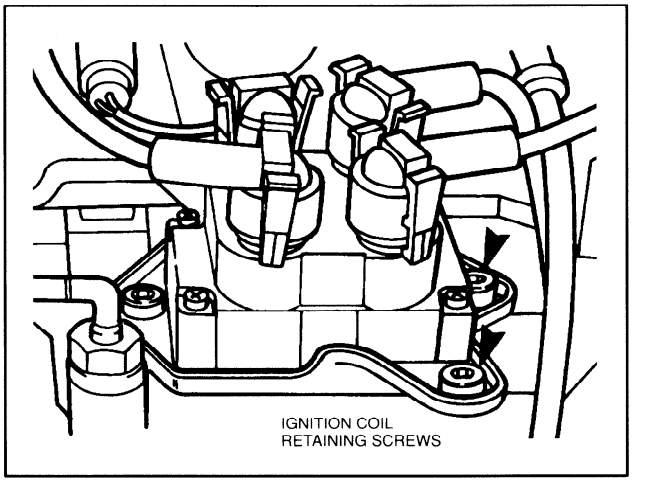
1. Disconnect battery ground lead.
2. Disconnect ignition coil multiplug.



3. Compress 2 lugs and disconnect HT leads at coil.



4. Remove three screws and detach coil assembly.



Installation

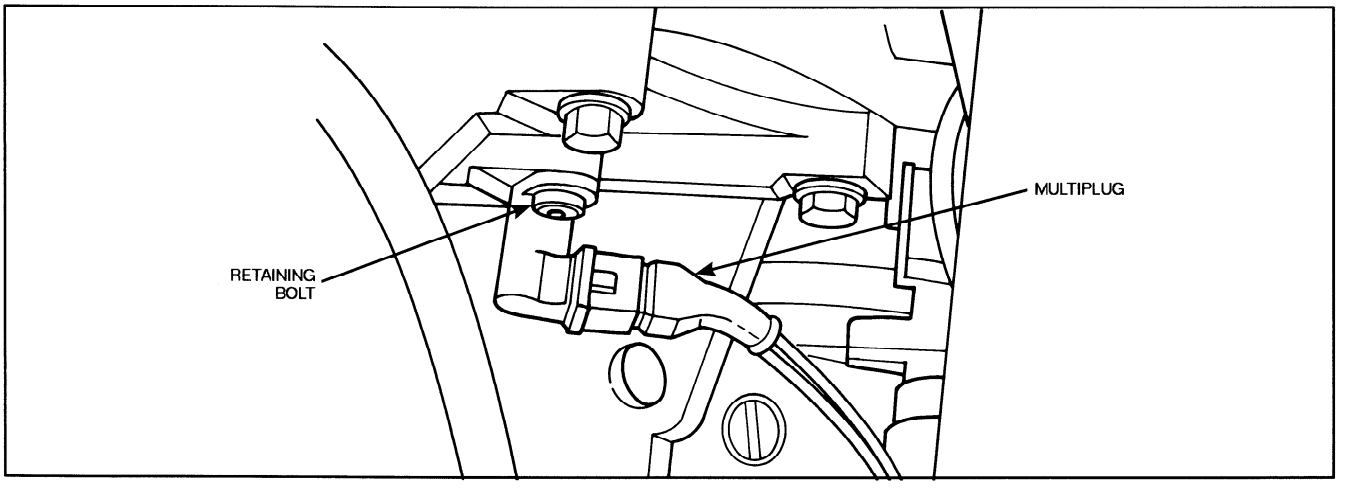
1. Position coil assembly, secure with three screws.
2. Connect HT leads at coil, ensuring that locking tabs snap into position.

   NOTE: HT connections at coil are marked 1 to 4. It is important that each HT lead is connected in correct sequence.
3. Connect ignition coil multiplug.
4. Connect battery ground lead. Start engine and check coil operation.

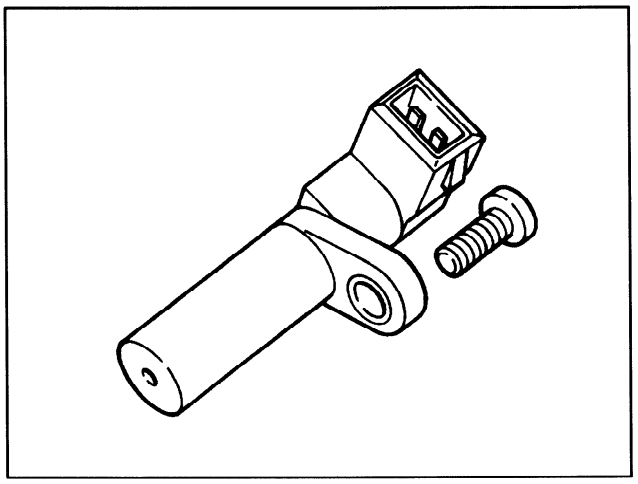
Engine Speed Sensor

Removal

1. Disconnect battery ground cable.
2. Disconnect multiplug from sensor. Remove engine speed sensor, (one screw).



REMOVAL AND INSTALLATION (Continued)



Installation

1. Fit engine speed sensor and secure with screw.
2. Refit sensor multiplug.
3. Connect battery ground cable.

Engine Coolant Temperature Sensor

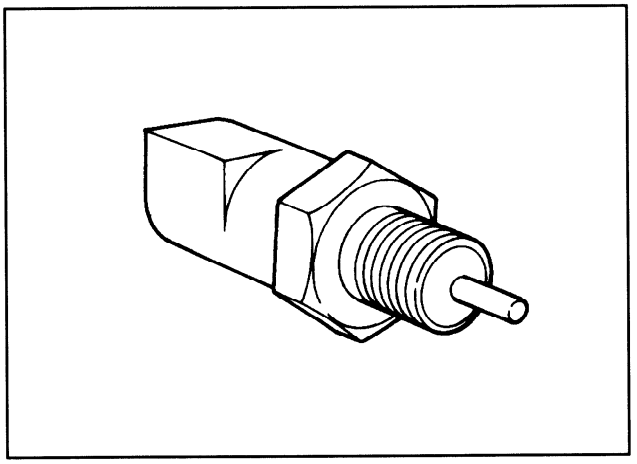
Removal

1. Disconnect battery and release cooling system pressure.

   WARNING: WHEN RELEASING SYSTEM PRESSURE, COVER CAP WITH A THICK CLOTH TO PREVENT COOLANT SCALDING.
2. Place a clean drain tray below engine under radiator drain plug and remove drain plug. To assist draining remove radiator cap.
3. Remove temperature sensor multiplug, located below the intake manifold. To remove multiplug, pull on multiplug, do not pull on wiring.
4. Unscrew sensor from intake manifold

Installation

1. Install sensor into inlet manifold, do not overtighten sensor. Connect multiplug, ensuring that locking tabs snap into position.
2. Replace radiator drain plug and refill system with correct solution. Remove rubber blanking cap on water outlet. When coolant is evident, refit blanking cap. Fill container to "maximum" mark allowing time for air in system to bubble through. Install radiator cap.
3. Connect battery and start engine. Allow engine to warm to normal operating temperature. Check, and if necessary, add coolant.



DIAGNOSING AND TESTING DIS

DIS Diagnosis Equipment

To accurately diagnose DIS, certain diagnostic equipment and tools are required. In addition, the suggested diagnostic equipment may make the job easier and more convenient.

Prior to diagnosing DIS, obtain the following test equipment or equivalent.

- SPARK TESTER, NEON BULB TYPE (CHAMPION CT-436 OR EQUIVALENT)

There is no need to disconnect a plug wire; just place this spark tester on a spark plug wire to determine if spark is being provided to the plug. This is especially useful for those hard to reach plug wires.

- SPARK TESTER GAP TYPE (SPECIAL SERVICE TOOL D81P-6666-A OR EQUIVALENT)

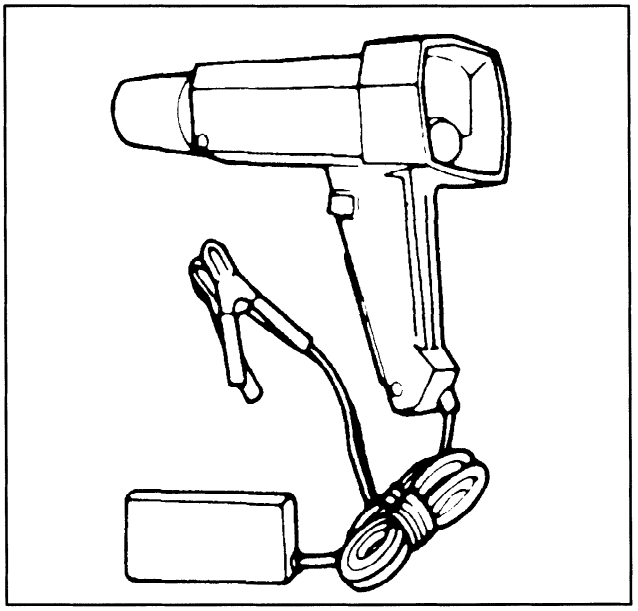
Connect this gap type spark tester between any spark plug wire and engine ground to instantly determine if spark is being provided to the plug. A spark plug with a broken side electrode is not sufficient to check for spark and may lead to incorrect results.

- VOLT-OHMMETER (ROTUNDA 014-00575 OR EQUIVALENT)

A volt-ohmmeter is essential for gathering system operating data during diagnosis, testing, and engine servicing procedures. A digital volt-ohmmeter (DVOM) can also be used for general purpose electrical troubleshooting on conventional starting and charging systems.

- 12-14 VOLT TEST LAMP TIMING LIGHT (ROTUNDA 059-00006 OR EQUIVALENT)

This timing light uses an inductive pickup for convenience and safety on 12 volt systems. This timing light includes a tachometer which reads from zero to 3000 RPM.



DIS Diagnosing

This check will test the engine harness, connectors and sensors for both continuity & resistance.

1. Remove the 12 pin ICM harness plug from the ICM module. Pins 1 and 5 are not used, and therefore do not have female connectors in the 12 pin harness connector plug.
2. Check the following circuits with the volt-ohmmeter (with the sensors connected) per the chart on page 12, with reference to the wiring diagram on page 14.

If the DIS Engine Harness checks are not to the chart specifications (page 12), complete the following:

- Remove the wire harness connector to the ICM.
- Remove each sensor or component from the harness.
- Using a high impedance digital volt-ohmmeter (DVOM) check each wire for continuity or resistance.
- If the wire harness has open circuits or resistance higher than specifications repair or replace the harness.
- If the wire harness checks are to specifications, reconnect each sensor and component and complete another DIS Engine Harness check.
- If the same sensor or component circuit does not test to specifications — replace that sensor or coil.
- If the engine will not start and/or run install a new module and make a normal start.

DIS Cleaning and Inspection

Spark Plugs

Clean spark plugs as necessary using a wire brush or professional spark plug cleaner (follow manufacturer's instructions). Inspect the firing tip. Refer to Spark Plug Inspection Chart. Replace spark plugs if they are worn or damaged.

Ignition Coil

Wipe the coil towers with a clean cloth dampened with soap and water. Remove any soap film and dry with compressed air. Inspect for cracks, carbon tracking and dirt.

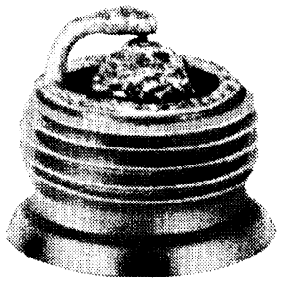
Ignition Wires

Wipe the spark plug wire set with a clean, damp cloth before inspecting it. Without removing the spark plug wire set from the spark plugs or ignition coil, inspect the wire set for visible damage such as cuts, pinches, or cracked or torn boots. Refer to Ignition Wires Removal and Installation in this section and replace as necessary.

DIAGNOSING AND TESTING DIS (Continued)

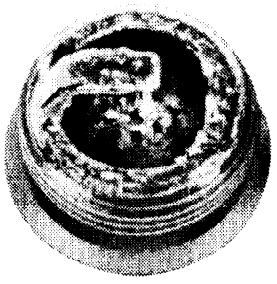
Spark Plug Inspection Chart

GAP BRIDGED



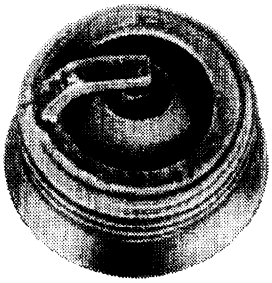
IDENTIFIED BY DEPOSIT BUILD-UP CLOSING GAP BETWEEN ELECTRODES. CAUSED BY OIL OR CARBON FOULING. REPLACE PLUG, OR, IF DEPOSITS ARE NOT EXCESSIVE, THE PLUG CAN BE CLEANED.

OIL FOULED



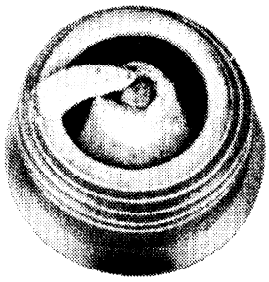
IDENTIFIED BY WET BLACK DEPOSITS ON THE INSULATOR SHELL BORE ELECTRODES CAUSED BY EXCESSIVE OIL ENTERING COMBUSTION CHAMBER THROUGH WORN RINGS AND PISTONS, EXCESSIVE CLEARANCE BETWEEN VALVE GUIDES AND STEMS, OR WORN OR LOOSE BEARINGS. REPLACE THE PLUG. IF ENGINE IS NOT REPAIRED, USE A HOTTER PLUG.

CARBON FOULED



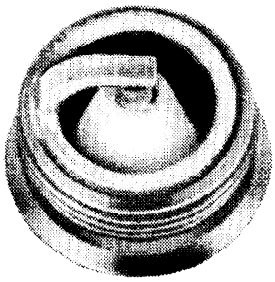
IDENTIFIED BY BLACK, DRY FLUFFY CARBON DEPOSITS ON INSULATOR TIPS, EXPOSED SHELL SURFACES AND ELECTRODES. CAUSED BY TOO COLD A PLUG, WEAK IGNITION, DIRTY AIR CLEANER, DEFECTIVE FUEL PUMP, TOO RICH A FUEL MIXTURE, IMPROPERLY OPERATING HEAT RISER OR EXCESSIVE IDLING. CAN BE CLEANED.

WORN



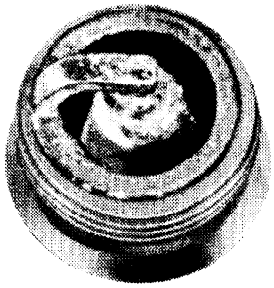
IDENTIFIED BY SEVERELY ERODED OR WORN ELECTRODES. CAUSED BY NORMAL WEAR. SHOULD BE REPLACED

NORMAL



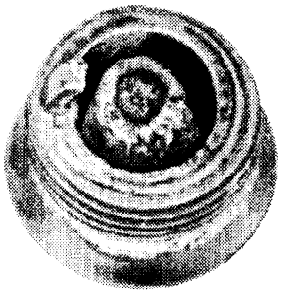
IDENTIFIED BY LIGHT TAN OR GRAY DEPOSITS ON THE FIRING TIP.

LEAD FOULED



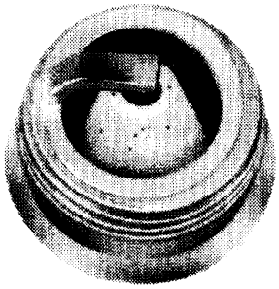
IDENTIFIED BY DARK GRAY, BLACK, YELLOW OR TAN DEPOSITS OR A FUSED GLAZED COATING ON THE INSULATOR TIP. CAUSED BY HIGHLY LEADED GASOLINE. REPLACE THE PLUG.

PRE-IGNITION



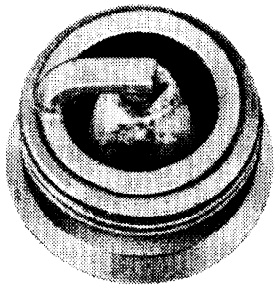
IDENTIFIED BY MELTED ELECTRODES AND POSSIBLY BLISTERED INSULATOR. METALLIC DEPOSITS ON INSULATOR INDICATE ENGINE DAMAGE. CAUSED BY WRONG TYPE OF FUEL, INCORRECT IGNITION TIMING OR ADVANCE, TOO HOT A PLUG, BURNT VALVES OR ENGINE OVERHEATING. REPLACE THE PLUG.

OVERHEATING



IDENTIFIED BY A WHITE OR LIGHT GRAY INSULATOR WITH SMALL BLACK OR GRAY BROWN SPOTS AND WITH BLUISH-BURNT APPEARANCE OF ELECTRODES, CAUSED BY ENGINE OVERHEATING. WRONG TYPE OF FUEL, LOOSE SPARK PLUGS, TOO HOT A PLUG, LOW FUEL PUMP PRESSURE OR INCORRECT IGNITION TIMING. REPLACE THE PLUG.

FUSED SPOT DEPOSIT



IDENTIFIED BY MELTED OR SPOTTY DEPOSITS RESEMBLING BUBBLES OR BLISTERS. CAUSED BY SUDDEN ACCELERATION. CAN BE CLEANED IF NOT EXCESSIVE. OTHERWISE REPLACE PLUG.

DIAGNOSING AND TESTING DIS (Continued)

DIS ENGINE HARNESS CHECKS
(ICM HARNESS CONNECTOR REMOVED; ALL SENSORS CONNECTED TO HARNESS)

Test No.	Harness Connector PIN Nos.	DVOM Reading	Description of Circuit, Wires Checked & Circuit Function
1	2 to 3	200-300 Ω	Engine RPM & Crank Position (Wires 264, 265 & CKP Sensor)
2	4 to 10	105,000 Ω at 0°C (32°F)	Eng. Coolant Temp. Sensor (Wires 354, 354A and 359)
3	6 to 7	Continuity (0 Ω)	ICM Spark Advance. A single wire connects Pins 6 and 7 in a closed loop. Cutting and grounding this wire changes the spark advance. See the following table for values.
4	11 to 12	0.5-1.0 VDC	Check for continuity in the DIS coil circuit (Wires 850/850A to 852/852A)
5	Coil Secondaries #1 to #4	14,000 Ω ±5%	Remove the four spark plug wires and measure the secondary resistance from #1 to #4.
6	Coil Secondaries #2 to #3	14,000 Ω ±5%	Remove the four spark plug wires and measure the secondary resistance from #2 to #3.

SPARK TIMING

Action	Effect on Spark Timing
Loop between Pins 6 and 7 closed or open	None
Ground Pin 7	Retard Base Spark by 1-2 degrees
Ground Pin 6	Retard Base Spark by 2-4 degrees
Ground Pins 6 and 7	Retard Base Spark by 6-8 degrees

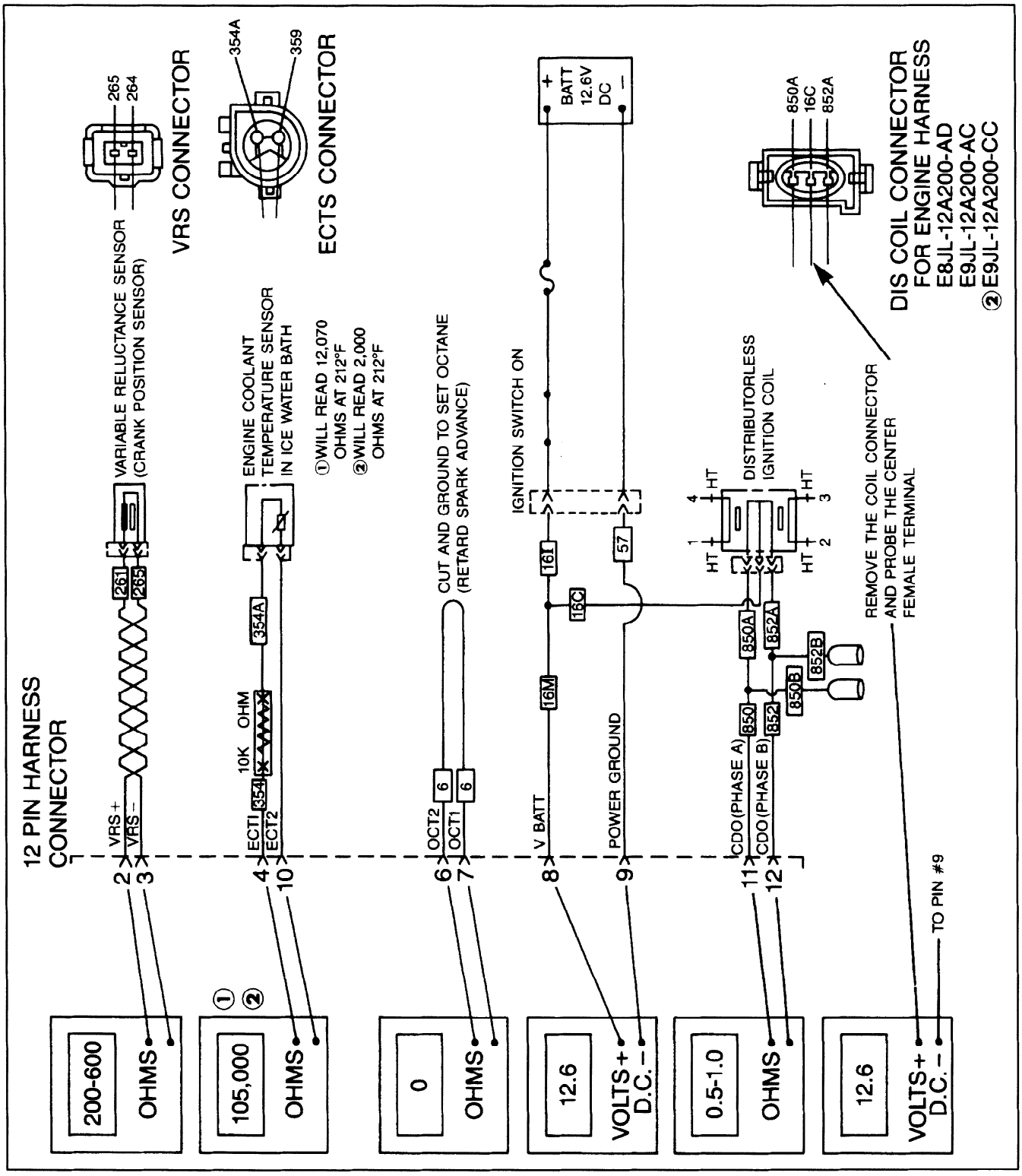
NOTE: For generator set application, the vacuum line between the intake manifold and the ignition module may be disconnected.

ENGINE COOLANT TEMPERATURE SENSOR CHARACTERISTICS

Temperature		Column A Sensor (Ohms) ± 5%	Column B Sensor & Harness (Ohms) ± 5%
°C	°F		
-30	-22	481,000	491,000
-20	4	271,200	281,200
-10	14	158,000	168,000
0	32	95,000	105,000
10	50	58,750	68,750
20	68	37,300	47,300
30	86	24,270	34,270
40	104	16,150	26,150
50	122	10,970	20,970
60	140	7,600	17,600
70	158	5,360	15,360
80	176	3,840	13,840
90	194	2,800	12,800
100	212	2,070	12,070
110	230	1,550	11,550
120	248	1,180	11,180
130	266	903	10,903
140	284	701	10,701
150	302	550	10,550

1. Use column A to check the ECT sensor resistance at the sensor (not through the harness).
2. Use column B to check the ECT sensor resistance at Pin 4 of the ICM connector. This value includes the 10,000 ohm series resistor in the harness.

DIAGNOSING AND TESTING DIS (Continued)

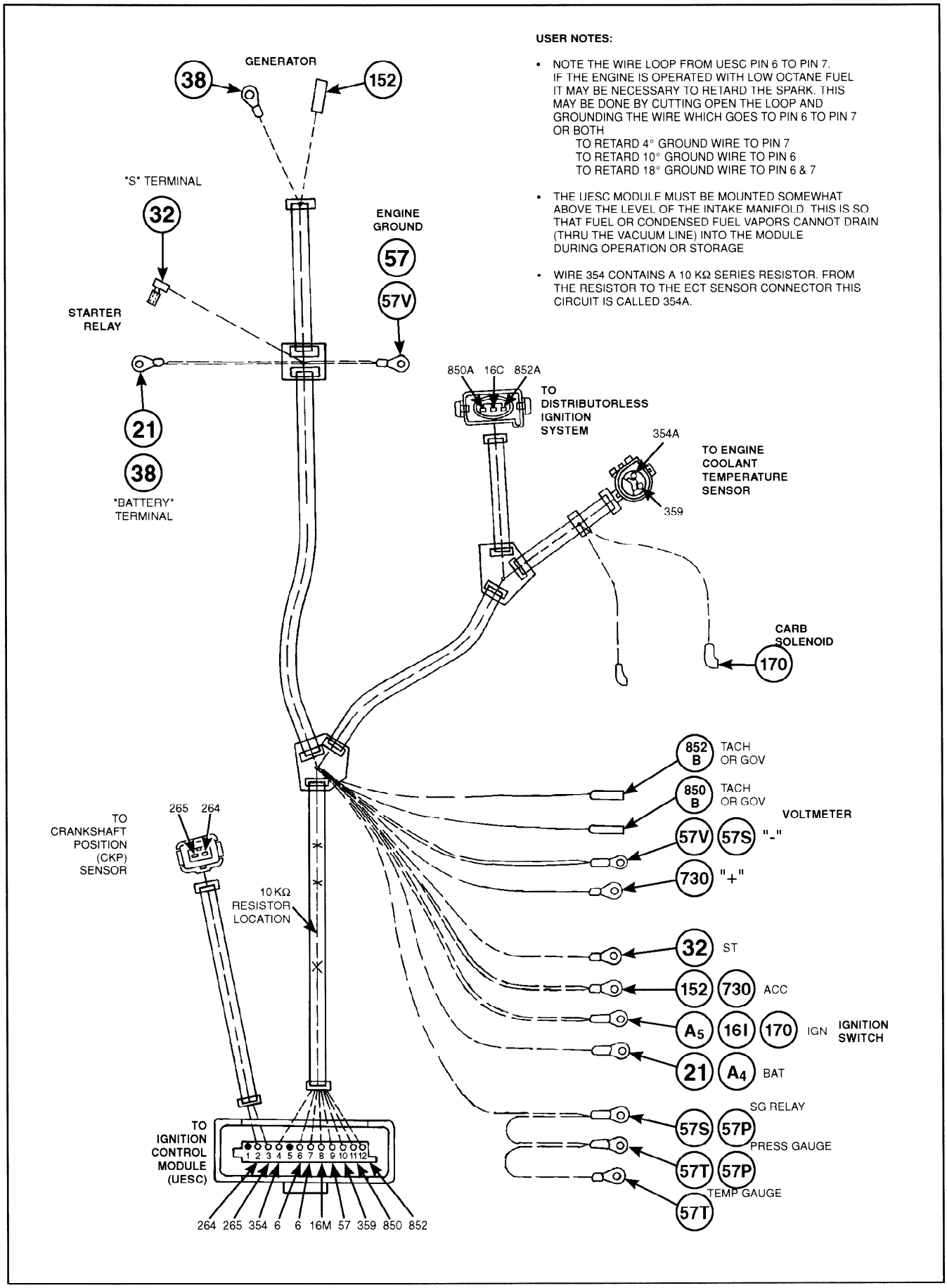


DIAGNOSING AND TESTING DIS (Continued)

WIRING HARNESS CIRCUIT IDENTIFICATION – F4JL-14305-AA

No.	Circuit Description	GA	Base Color	Stripe Color
16I	Ignition Switch to Splice	18	Red	Green
852B	Splice to Electronic Governor or Tachometer	18	Yellow	White
852A	Splice to DIS Coil 2	18	Yellow	White
850B	Splice to Electronic Governor or Tachometer	18	Yellow	Black
850A	Splice to DIS Coil 1	18	Yellow	Black
354A	Resistor to ECT Sensor	18	Brown	White
16C	DIS Coil to Splice	18	Red	Green
852	ICM (Ignition Control Module, or UESC) to Splice	18	Yellow	White
850	ICM to Splice	18	Yellow	Black
359	ICM to ECT Sensor Ground	18	Green	White
57	ICM to Battery Ground	18	Black	
16M	ICM Pin 8 to Splice	18	Red	Green
6	ICM Spark Retard 2° OS1	18	Brown	
6	ICM Spark Retard 4° OS2	18	Brown	
354	ICM to Resistor	18	Brown	White
265	ICM to Crankshaft Position Sensor (CKP) (–)	18	Green	
264	ICM to Crankshaft Position Sensor (CKP) (+)	18	White	
152	"ACC" Terminal of Ign Sw to Generator-Mounted Regulator	18	Yellow	
730	Voltmeter Feed	18	Red	
170	Carburetor Solenoid	18	Blue	Red
57P	Ground Circuit – Pressure Gauge	18	Black	
57S	Ground Circuit Switch – Gauge Relay	18	Black	
57T	Ground Circuit – Temperature Gauge	18	Black	
57V	Ground Circuit – Voltmeter	10	Black	
38	GEN "BATT" Terminal to Starter Solenoid "BATT" Terminal	10	Black	Red
32	Ignition Switch to Starter Motor Relay	18	Red	Blue
21	Starter Solenoid Battery Terminal to Ignition Switch Feed	14	Yellow	

DIAGNOSING AND TESTING DIS (Continued)

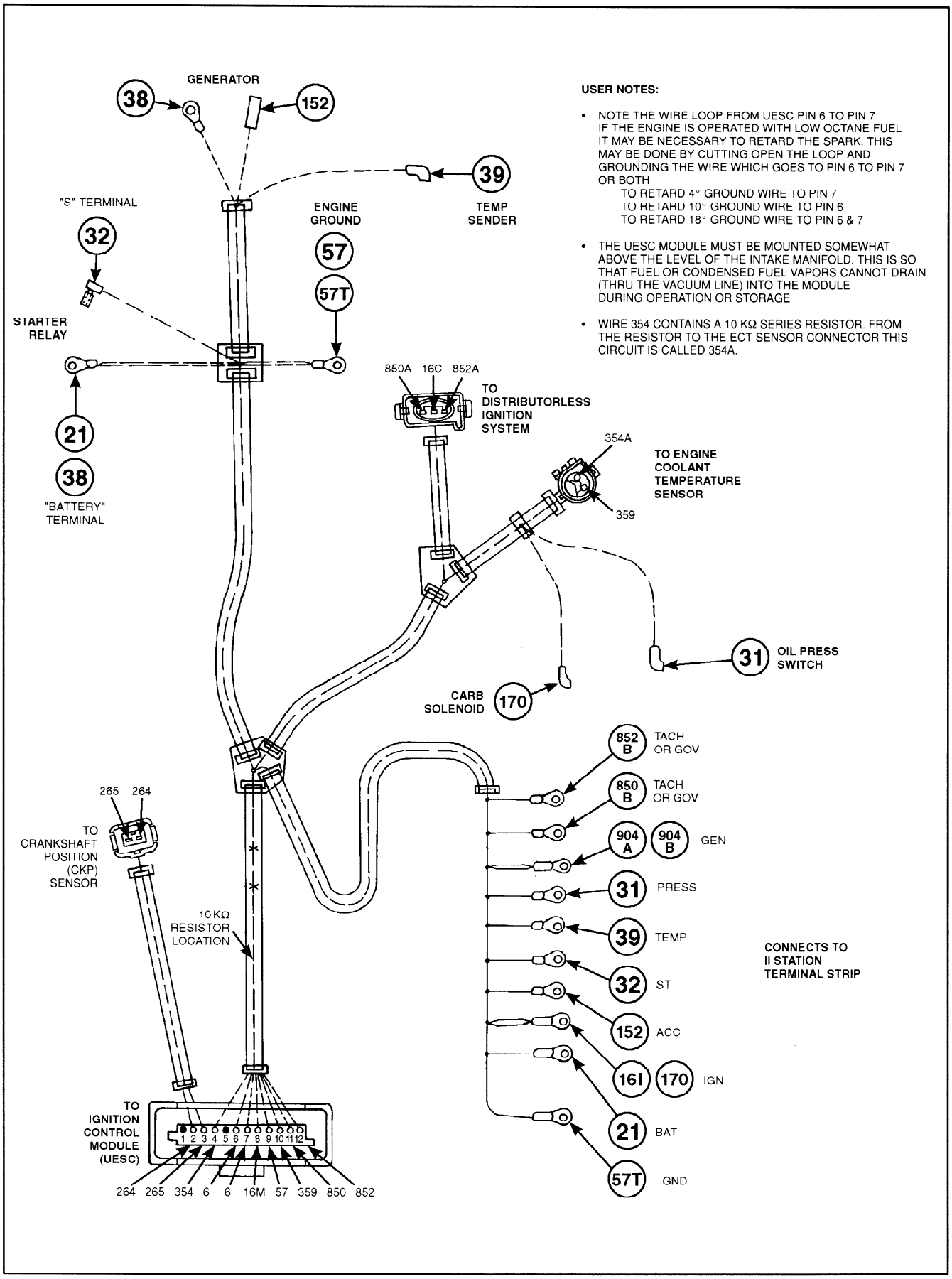


DIAGNOSING AND TESTING DIS (Continued)

WIRING HARNESS CIRCUIT IDENTIFICATION – F4JL-14305-BA

No.	Circuit Description	GA	Base Color	Stripe Color
16I	Ignition Switch to Splice	18	Red	Green
852B	Splice to Electronic Governor or Tachometer	18	Yellow	White
852A	Splice to DIS Coil 2	18	Yellow	White
850B	Splice to Electronic Governor or Tachometer	18	Yellow	Black
850A	Splice to DIS Coil 1	18	Yellow	Black
354A	Resistor to ECT Sensor	18	Brown	White
16C	DIS Coil to Splice	18	Red	Green
852	ICM (Ignition Control Module, or UESC) to Splice	18	Yellow	White
850	ICM to Splice	18	Yellow	Black
359	ICM to ECT Sensor Ground	18	Green	White
57	ICM to Battery Ground	18	Black	
16M	ICM Pin 8 to Splice	18	Red	Green
6	ICM Spark Retard 2° OS1	18	Brown	
6	ICM Spark Retard 4° OS2	18	Brown	
354	ICM to Resistor	18	Brown	White
265	ICM to Crankshaft Position Sensor (CKP) (–)	18	Green	
264	ICM to Crankshaft Position Sensor (CKP) (+)	18	White	
152	Terminal Strip to Generator-Mounted Regulator	18	Yellow	
170	Carburetor Solenoid	18	Blue	Red
39	Temperature Gauge to Temp Sending Unit	18	Red	White
31	Oil Pressure Indicator Light to Oil Pressure Switch	18	White	Red
57T	Ground Circuit – Temperature Gauge	10	Black	
38	GEN "BATT" Terminal to Starter Solenoid "BATT" Terminal	10	Black	Red
32	Ignition Switch to Starter Motor Relay	18	Red	Blue
21	Starter Solenoid Battery Terminal to Ignition Switch Feed	14	Yellow	

DIAGNOSING AND TESTING DIS (Continued)



USER NOTES:

- NOTE THE WIRE LOOP FROM UESC PIN 6 TO PIN 7. IF THE ENGINE IS OPERATED WITH LOW OCTANE FUEL IT MAY BE NECESSARY TO RETARD THE SPARK. THIS MAY BE DONE BY CUTTING OPEN THE LOOP AND GROUNDING THE WIRE WHICH GOES TO PIN 6 TO PIN 7 OR BOTH
  - TO RETARD 4° GROUND WIRE TO PIN 7
  - TO RETARD 10° GROUND WIRE TO PIN 6
  - TO RETARD 18° GROUND WIRE TO PIN 6 & 7
- THE UESC MODULE MUST BE MOUNTED SOMEWHAT ABOVE THE LEVEL OF THE INTAKE MANIFOLD. THIS IS SO THAT FUEL OR CONDENSED FUEL VAPORS CANNOT DRAIN (THRU THE VACUUM LINE) INTO THE MODULE DURING OPERATION OR STORAGE
- WIRE 354 CONTAINS A 10 KΩ SERIES RESISTOR. FROM THE RESISTOR TO THE ECT SENSOR CONNECTOR THIS CIRCUIT IS CALLED 354A.

SECTION 03 — Fuel System

BLANK

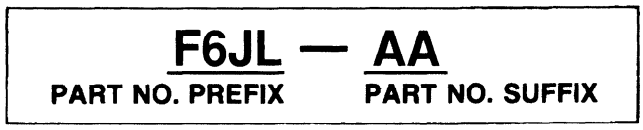
DESCRIPTION AND OPERATION

General Description

The fuel system includes a permanently sealed single-action fuel pump operated by a lobe on the camshaft, and a single-barrel carburetor with either a manual choke or an automatic choke. It also has a screen filter located in the fuel inlet.

Identification

The carburetor is identified on the main body near the fuel inlet. The basic part number for all carburetors is 9510. To procure parts, it is necessary to know the part number prefix and suffix.



DIAGNOSIS AND TESTING

General Information

Water and dirt that accumulate in the fuel tank can cause a restricted fuel line or filter and malfunction of the fuel pump or carburetor. Condensation, which is the greatest source of water entering the fuel tank, is formed by moisture in the air when it strikes the cold interior walls of the fuel tank.

If the accumulation of dirt and water in the filter is excessive, the fuel tank should be removed and flushed, and the line from the fuel pump to the tank should be blown out.

Air leakage in the fuel inlet line can cause low fuel pump pressure and volume.

A restricted fuel tank vent can cause low fuel pump pressure and volume and can result in collapsed inlet hoses or a collapsed fuel tank.

High or low pressure are the two most likely fuel pump troubles that will affect engine performance. Low pressure will cause a lean mixture and fuel starvation at high speeds and excessive pressure will cause high fuel consumption and carburetor flooding.

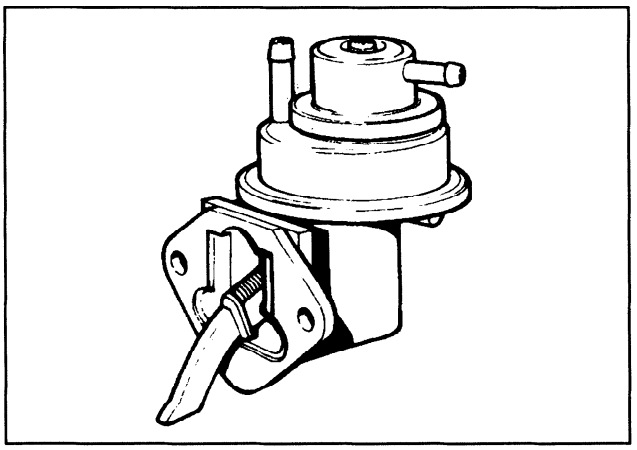
Dirt accumulation in the fuel and air passages, improper idle adjustments, and improper fuel level are the major sources of carburetor troubles.

FUEL PUMP

Description

A single action mechanical fuel pump is standard on this engine. It is located on the right side of the engine and is driven by a lobe on the camshaft.

The pump is permanently sealed and is serviced by replacing the entire unit.



Diagnosis and Testing

To determine that the fuel pump is in satisfactory operating condition, tests for both fuel pump pressure and fuel pump capacity (volume) should be performed.

The tests are performed with the fuel pump installed on the engine and the engine at normal operating temperature at idle speed.

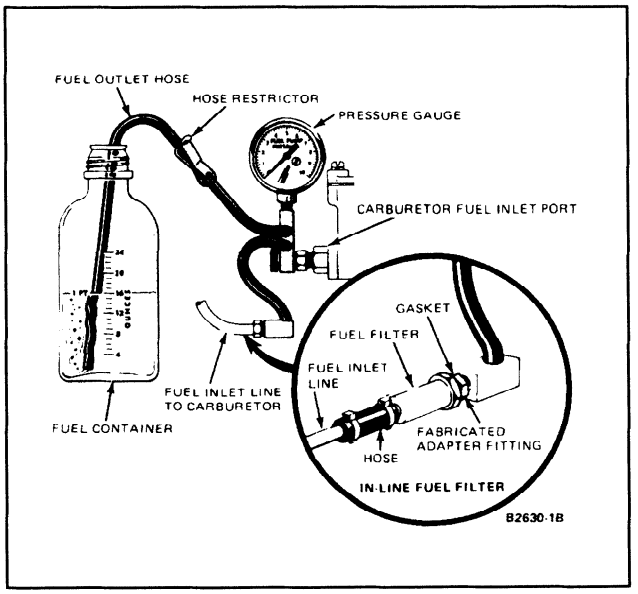
Before the tests, make sure the replaceable fuel filter has been changed within the recommended maintenance mileage interval. When in doubt, install a new filter.

Pressure Tests

Refer to the fuel pump specification and note the fuel pump pressure and capacity (volume) design tolerances.

1. Remove the air cleaner assembly. Disconnect the fuel inlet line or the fuel filter at the carburetor. **Use care to prevent combustion due to fuel spillage.**
2. Connect pressure gauge, restrictor and flexible hose between the fuel filter and carburetor.

   NOTE: Inside diameter of smallest passage in test flow circuit must not be smaller than 5.59 mm (0.220 in).
3. Position the flexible fuel outlet hose and the restrictor so the fuel can be discharged into the graduated container.



4. Before taking a pressure reading operate the engine at the specified idle rpm and vent the system into the container by opening the hose restrictor momentarily.
5. Close the hose restrictor, allow the pressure to stabilize, and note the reading.

If the pump pressure is not within specifications with temperatures normalized at idle speed and in neutral and the fuel lines and filter are in satisfactory condition, the pump is worn or damaged and should be replaced.

If the pump pressure is within specifications, perform the tests for fuel capacity (volume).

Capacity (Volume) Test

With the fuel pump pressure within specifications, test the capacity (volume) as follows:

1. Operate the engine at the specified idle rpm.
2. Open the hose restrictor and expel the fuel into the container, while observing the time required to expel 0.5 liters (one pint). Close the restrictor. 0.5 liters (one pint) or more of fuel should be expelled within the specified time limit (25 sec.).

If the pump volume is below specifications, repeat the test using an auxiliary fuel supply and a new fuel filter. If the pump volume meets specifications while using the auxiliary fuel supply, check for a restriction in the fuel supply from the tank and for the tank not venting properly.

REMOVAL AND INSTALLATION

Fuel Pump Assembly

Removal

1. Disconnect the inlet and outlet lines at the fuel pump.
2. Remove the pump attaching screws, then remove the pump and the gasket. Discard the gasket.

Installation

1. Remove all the gasket material from the mounting pad and pump flange. Apply oil-resistant sealer to both sides of a new gasket and to the threads on the attaching bolts.
2. Position the new gasket on the pump flange and hold the pump in position against the mounting pad. Make sure the rocker arm is riding on the camshaft eccentric. (Turn engine over until the fuel pump eccentric is on the low side of the stroke.)
3. Press the pump tight against the pad, install the attaching screws and alternately tighten them to specification.
4. Connect the fuel inlet and outlet lines.
5. Operate the engine and check for leaks.

ZENITH MODEL #33 CARBURETOR

Operation and Service

The Zenith model #33 carburetor is a singe downdraft unit of two-piece construction, consisting of a cast aluminum air intake and throttle body with a fuel bowl. The single venturi is removable for easy adaptability to meet different size engine requirements.

The mounting flange holes are elongated to allow it to fit either the SAE 1″ or 1-1/4″ flange. A vacuum-operated accelerator pump is used.

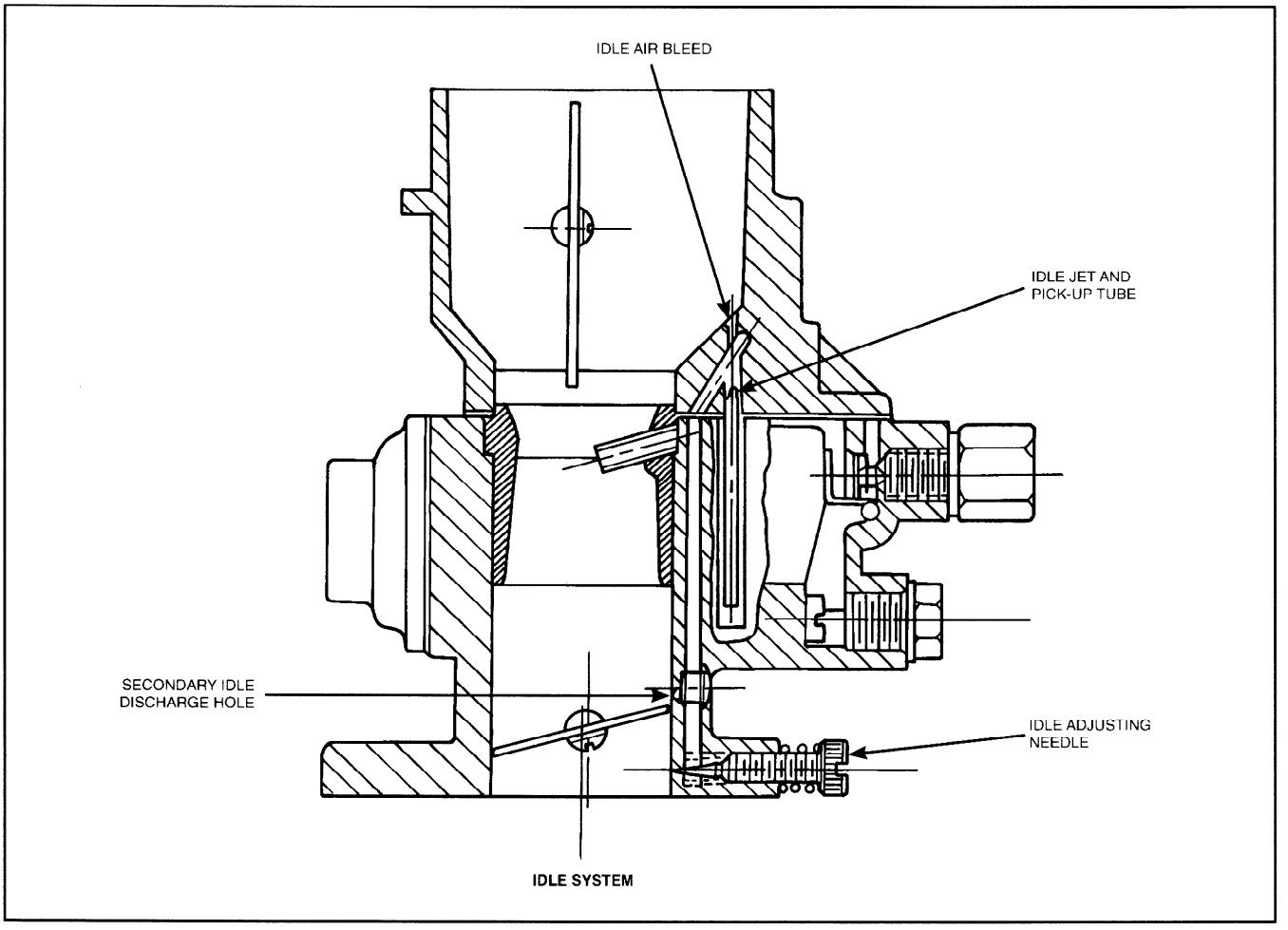
Fuel Supply System

The fuel supply system consists of the threaded fuel inlet connection and fuel valve seat, fuel valve, float and fuel chamber. The fuel supply line is connected to the threaded inlet. Gasoline passes through the connection, through the fuel valve seat and past the fuel valve and into the fuel chamber. The level of the fuel in the fuel chamber is regulated by the float through its control of the fuel valve. The fuel valve does not open and close alternately. It assumes a more or less fixed-opening position as regulated by the float, sufficient to maintain a proper level in the fuel chamber equal to the fuel demand of the engine according to its speed and load.

Idle System

The idle system supplies fuel to run the engine at curb idle and also slow speeds until sufficient velocity is built up in the main venturi to operate the main system.

This system consists of the idle discharge holes, the idle adjusting needle, the passage or channel between the idle jet and the discharge holes, the idle air bleed, and the idle jet and pickup tubes. At idling speeds, manifold vacuum is transmitted through the primary idle discharge hole to the idle jet through a passage running through the throttle and air intake bodies. Fuel from the fuel bowl flows through the main jet into the fuel well where it is picked up by the pickup tube to be metered by the idle jet. As the fuel leaves the idle jet it is mixed with air from the idle air bleed, which is located just above the jet in the air intake, therefore a fuel and air mixture is provided just before the passage to the idle discharge holes. This air bleed calibration is to provide better control of the fuel delivery and to prevent the fuel in the bowl from being siphoned into the intake manifold through the idle system when the engine is shut off.



IDLE SYSTEM

The discharge of the idle fuel into the air stream at curb idle is controlled by the idle adjusting needle in the primary idle discharge hole. Turning the needle in (clockwise) restricts the primary discharge hole to provide a leaner mixture. Turning the needle out (counterclockwise) allows a richer mixture.

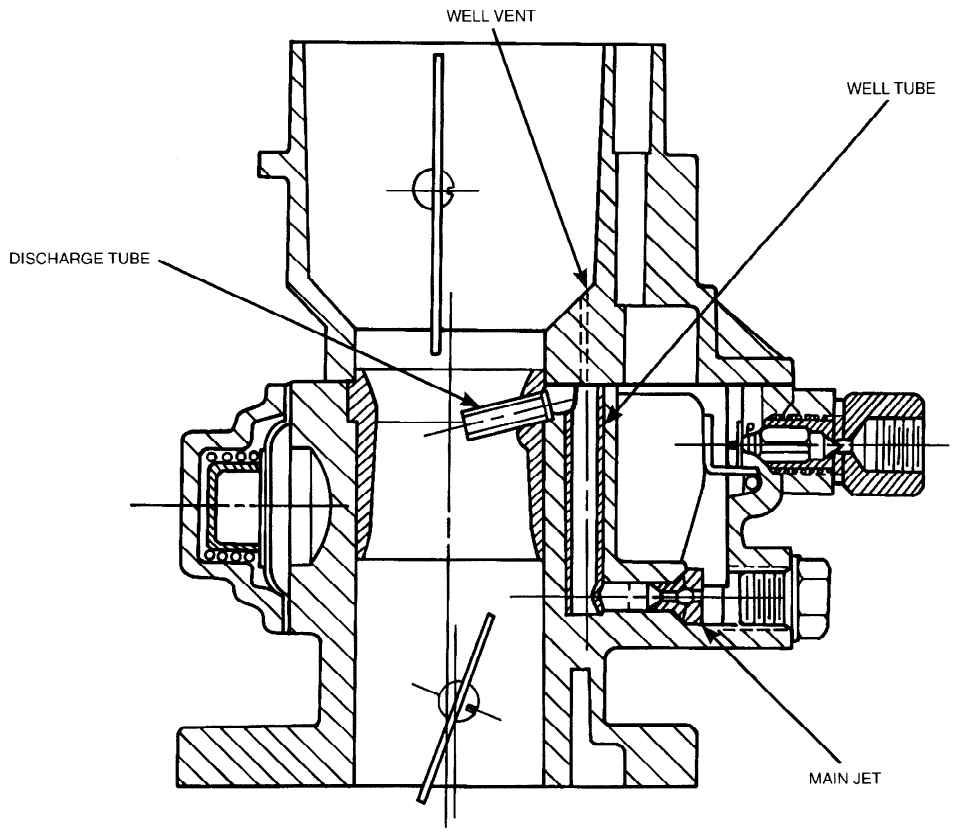
ZENITH MODEL #33 CARBURETOR (Continued)

As the throttle plate opens, extra fuel is discharged from the secondary idle discharge holes as the throttle plate passes them. This hole is precisely located from the closed throttle plate with the size and location depending on fuel requirements. As the throttle plate is opened wider, the idle system gradually ceases to function. The delivery of fuel through the high speed system increases as the throttle plate is advanced. Although the delivery of fuel through the idle system diminishes as the throttle plate approaches the wide open position, it continues to deliver a small volume of fuel contributing to the fuel delivered by the high speed system. It cannot be said that the idle system ceases to deliver fuel entirely at wide open throttle, but it must be made clear that the amount of fuel delivered from the idle system at wide open throttle is minute and relatively unimportant.

High Speed System

The high speed system consists of a venturi, a main jet, a well vent, and a well tube. This system also controls the mixture at part throttle speed.

The main jet controls fuel delivery from about one-quarter to three-quarters throttle opening. To maintain a proper mixture ratio, a small amount of air is admitted through the well vent. There are also air bleed holes located in the well tube at a point below the level of fuel in the well. Introducing air into the well tube below the level of fuel, reduces the surface tension of the fuel and helps fuel flow at low suction. This bleed also restricts fuel flow through the main jet under high suctions.



MAIN SYSTEM

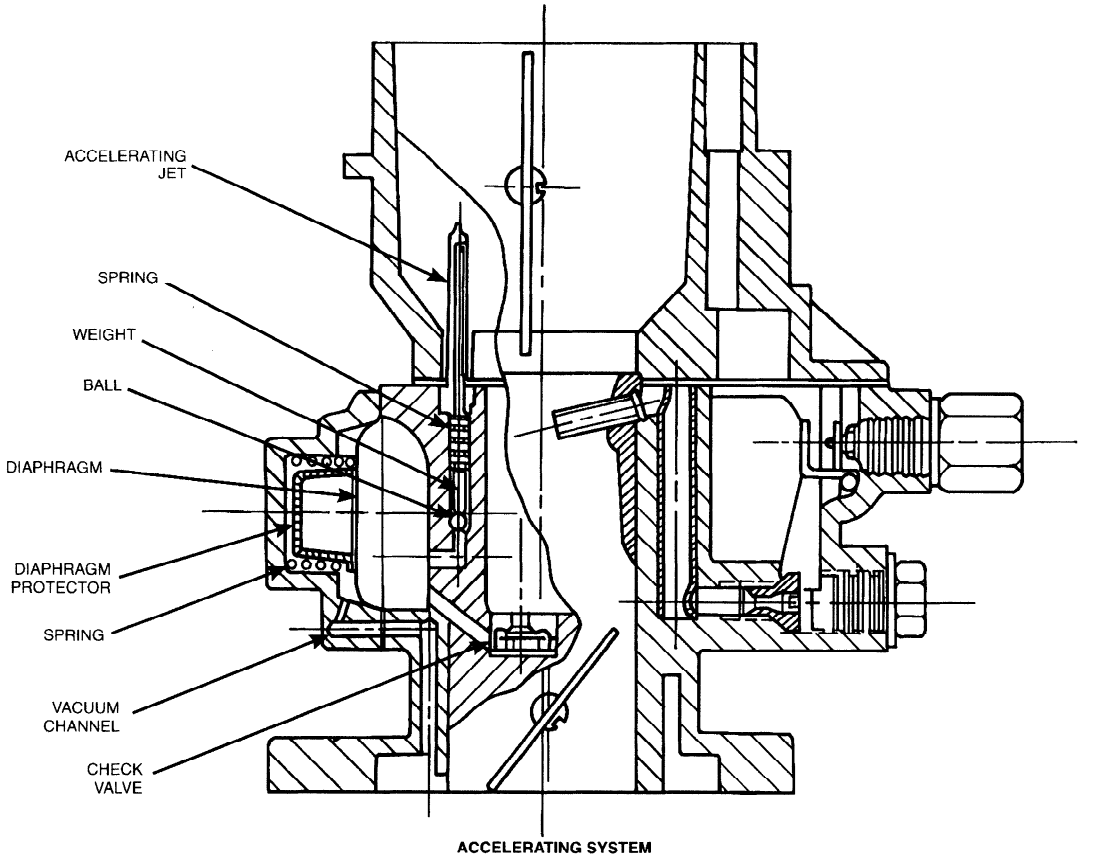
When the throttle plate is opened to a point just above the idle position, enough air passes through the carburetor to lower the pressure at the discharge tube. The float chamber is open to atmospheric pressure; consequently, the greater pressure in the float chamber will cause the fuel to flow from the fuel bowl through the main jet into the main well and well tube.

Air admitted through bleed holes in the well tube, an amount measured by the well vent, is mixed with the fuel. This mixture of fuel from the main well tube passes through the discharge tube in the venturi and is added to the air stream in the venturi. This mixture then passes into the intake manifold.

ZENITH MODEL #33 CARBURETOR (Continued)

Accelerating Pump System

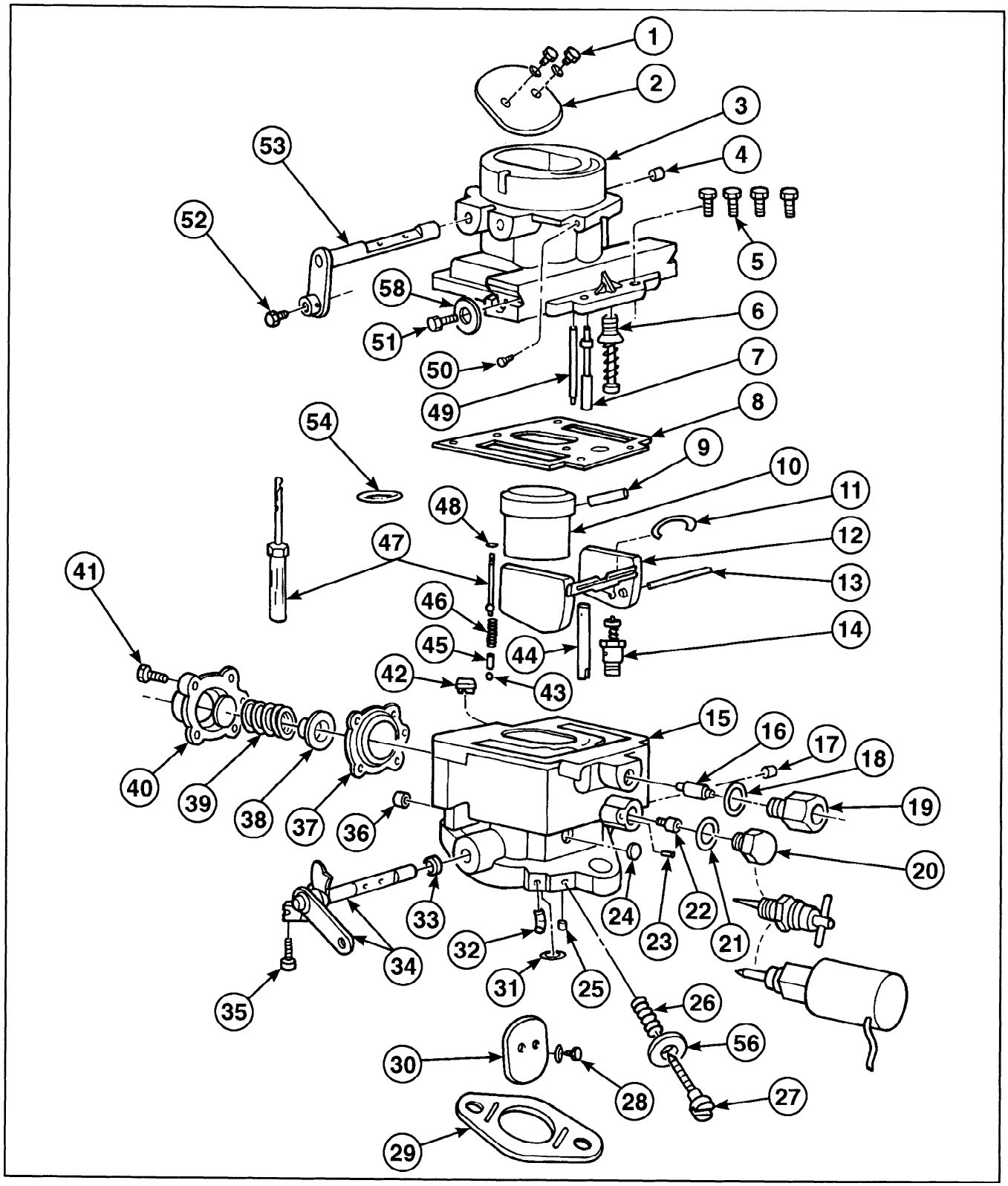
The accelerating pump controls the amount of fuel that is discharged into the air stream on sudden throttle openings. When the throttle is opened suddenly, air rushes through the carburetor into the intake manifold and to the engine. This air is lighter than the liquid fuel and gets into motion more quickly. That means that the air reaches the cylinders of the engine before the first charge of fuel supplied by the high speed system. A lean mixture would result momentarily in this case, and to counteract the condition, additional fuel must be supplied instantly. The supply of that extra fuel is the job of the accelerating pump system.



ACCELERATING SYSTEM

The accelerating system consists of the pump diaphragm assembly, accelerating jet, intake check valve, and three parts making up the refill check. The pump is vacuum operated. In this system the pump diaphragm is pulled against the pump spring by the engine manifold vacuum. When the throttle is opened, the pull on the diaphragm drops allowing the spring to push the diaphragm against the fuel causing it to discharge through the accelerator jet. This amount may be varied by adjusting the travel of the pump spring. Such adjustment is made possible by changing the length of the diaphragm protector in the end of the pump spring.

ZENITH MODEL #33 CARBURETOR (Continued)



ZENITH MODEL #33 CARBURETOR (Continued)

Item	Description
1	Screw & L Washer – Choke Plate
2	Plate – Choke
3	Body – Air Intake
4*	Cup Plug – Shaft Hole
5	Screw – Intake Assembly
6	Piston – Vacuum Power
7*	Tube – Well Filler
8	Gasket – Intake to Body
9*	Tube – Discharge
10	Venturi
11	Retainer – Float Axle
12	Assembly – Float
13	Axle – Float
14	Valve – Power Jet
15	Body – Throttle
16	Valve – Fuel
17*	Cup Plug – Shaft Hole
18	Washer – Main Jet Plug
19	Seat – Fuel Valve
20	Plug – Main Jet
21	Washer – Main Jet Plug
22	Jet – Main
23*	Plug – Fuel Channel
24*	Welch Plug – Idle Port
25*	Plug – Idle Channel
26	Spring – Idle Adjusting Screw
27	Screw – Idle Adjusting
28	Screw & L Washer – Throttle Plate
29	Gasket – Manifold Flange

Item	Description
30	Plate – Throttle
31*	Welch Plug – Vacuum Spark
32*	Tube – Vacuum Spark
33	Seal – Throttle Shaft
34	Lever & Shaft – Throttle
35	Screw – Idle Stop
36*	Plug – Throttle Body
37	Gasket – Pump Diaphragm
38	Protector – Diaphragm
39	Spring – Accelerator Pump
40	Cover – Accelerator Pump
41	Screw – Pump Cover, 4 Required
42*	Assembly – Check Valve
43	Ball – Pump Discharge
44*	Tube – Well
45	Weight – Pump Ball
46	Spring – Pump Weight
47	Jet Assembly – Accelerator
48	Washer – Accelerator Jet
49*	Tube – Idle Jet
50*	Plug – Vacuum Channel
51	Screw – Choke Cable
52	Screw – Choke Swivel
53	Lever & Shaft – Choke
54	O-Ring
55	Washer
56	Washer
57	Pump Spacer (Optional)
58	Washer

*Not normally removed for service.

Disassembly

Disassembly consists of separating the carburetor into two basic groups: air intake and fuel bowl-throttle body and the disassembly of each of these groups. Use exploded illustration as a guide for disassembly and reassembly.

Cleaning and Inspection

Thoroughly clean all metal parts in solvent or Deepclene. Blow out all parts and channels with air pressure. Inspect for damage, excessive wear, burrs or warpage. DO NOT CLEAN NON-METALLIC PARTS in solvent or Deepclene.

NOTE: The following assembly instructions and the exploded illustration are generalized and include all parts possibly found in the carburetor at this time. Therefore, all of the parts shown and mentioned may not be included in the particular assembly being worked on.

Assembly of Air Intake

1. Drive channel plug (50) into vacuum channel flush with surface.
2. Drive cup plug (4) into end of choke shaft hole opposite choke lever.
3. Insert choke shaft (53) with milled flat toward top.
4. Install choke plate (2) in air intake and start screws (1). Note that edges are beveled to fit against wall then closed. On plates including poppet valve, the spring should face the top. Hold choke plate closed with finger and tighten screws.
5. Turn air intake upside down and insert vacuum power piston (6) into cylinder, making sure it will move freely. Hold in place and stake casting with punch at three points to retain piston assembly.
6. Press well filler tube (7) into casting to shoulder. Do not bend or distort.
7. Press idle tube (49) into casting with rolled down orifice into casting until the bottom end is 31.8 mm (1.25 inches) from the cast surface. Do not bend or distort.

Assembly of Fuel Bowl

1. Install the following parts as needed (not normally removed for service):
   a. Cup plug (17) in shaft hole flush
   b. Fuel channel plug (23) flush
   c. Welch plug (24) over idle port
   d. Idle channel plug (25) flush

ZENITH MODEL #33 CARBURETOR (Continued)

e. Welch plug (31) over spark vacuum port
f. Spark vacuum tube (32) to approximately 14 mm (9/16 inch) from casting
g. Throttle body plug (36) flush
h. Pump check valve (42) flush using tool C151-53.
i. Well tube (44) making sure that end openings align with notch in casting at top and fuel channel at bottom.

2. Slide seal (33) over throttle shaft with lip toward lever and install shaft in body.
3. Back out throttle stop screw (35) and pace body on bench with mounting flange up.
4. With milled flat up, install throttle plate (30) with short side toward idle port and start screws (28). Make sure beveled sides of plate are next to throttle body bore. Tap the plate lightly (plate held closed) to center it and tighten screws.
5. While holding throttle closed, screw idle stop screw (35) in until it touches the casting, then screw in an additional 3/4 turn.
6. Install idle needle (27) washer (56) and spring (26) and screw in to gently touch the seat. Back screw out approximately one turn.
7. Install power jet valve (14) using C161-9 wrench. No gasket required.
8. Install main jet (22) and seat firmly with screwdriver. No gasket required.
9. Install main jet plug (20) and washer (21) and tighten securely. If main jet adjustment or solenoid shutoff are used, install in place of plug.
10. Turn body right side up. Insert float axle (13) into holes in float (12).
11. Lower float axle and float into slot provided in body with the float needle sticking into the threaded opening.
12. Install the fuel valve seat (19) and washer (18) making sure that the fuel valve enters the seat properly (the valve will enter the seat more easily if the float is held in the up position) and tighten securely.
13. Insert float axle clip (11) in slot to bear against axle ends. Holding axle in place, raise float by applying light finger pressure to the float bracket. Float pontoons should be approximately level when the valve is seated. If not, bend tab to carefully adjust.
14. Install O-ring (54) on venturi skirt and place venturi (10) into recess provided in body making sure that the nozzle (9) lines up with the notch in the fuel well.
15. Place intake gasket (8) in position on body.

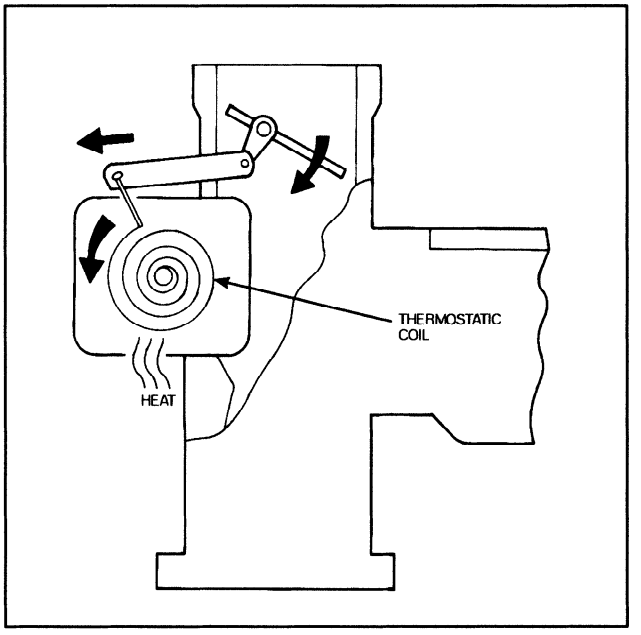
    NOTE: If you have an older model unit with removable accelerator jet; after intake gasket (8) is in place, an additional washer (55) will be assembled over the accelerator jet tube (47) and set inside the large hole in the intake gasket (8) and on top of the smaller washer (48). Lower air intake carefully onto bowl and fasten securely and evenly using attaching screws (5).

16. Place accelerator pump diaphragm (37) in place on body with bagged section into cavity. Insert diaphragm protector (38) into end of spring (39) and install spring with protector against diaphragm.
17. Place cover (40) over spring and compress. Insert screws (41) and tighten evenly and securely.

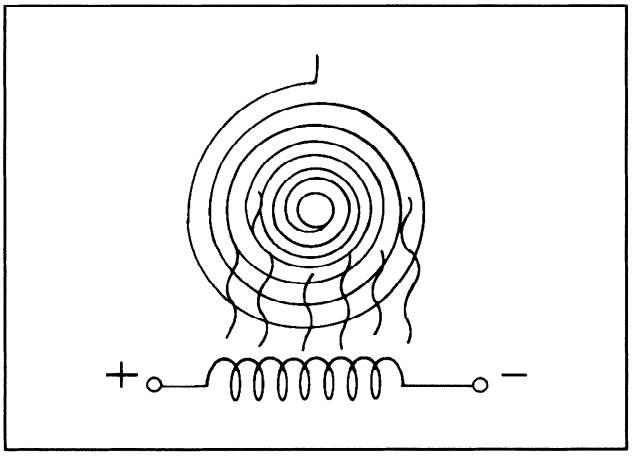
NOTE: Pump spacer (57) will install into cover before assembly if required.

Automatic Choke Operation

When the engine is cranked, a rich mixture is delivered to the engine. When the engine starts, air movement into the carburetor causes the choke plate to open slightly against the thermostatic spring pressure. As the engine warms up the thermostatic coil unwinds and the choke plate gradually opens.



Although the thermostatic coil unwinds as the engine warms up, the actual unwinding of the coil is assisted by an electric heater.



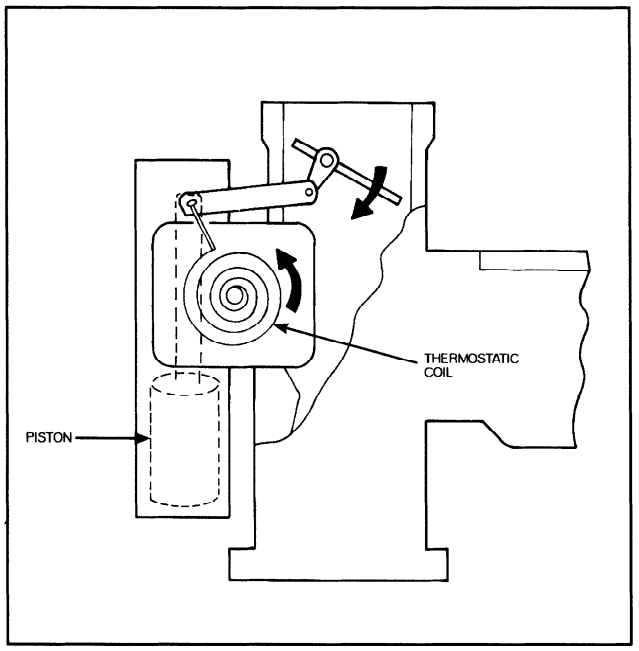
ZENITH MODEL #33 CARBURETOR (Continued)

When the temperature drops below a certain point a thermostatic switch closes and the heater circuit is complete. Electric current, supplied by circuit, now flows through the coil heater. Its electrical resistance to current flow generates the necessary heat.

Choke Pull-Off

After the engine is started, air flow into the carburetor will open the choke plate a small amount against the tension of the thermostatic coil. The choke plate will open this slight amount because it is mounted off center on the choke shaft.

This slight opening of the choke plate is necessary to prevent an overly rich mixture after the engine starts. Because the velocity of the air entering the carburetor will vary with engine speed, the choke plate is linked to a vacuum operated piston that provides a positive pull against the closing tension of the thermostatic coil.



The action of the piston is called choke pull off, and its purpose is two-fold.

- It helps open the choke after the engine starts
- It controls the position of the choke plate depending on engine load.

When the throttle is opened to accelerate, the air/fuel mixture has to be enriched. The action of the accelerator pump provides momentary enrichment, but additional richness is required, since the engine is cold. This added richness is provided by the action of the pull off system.

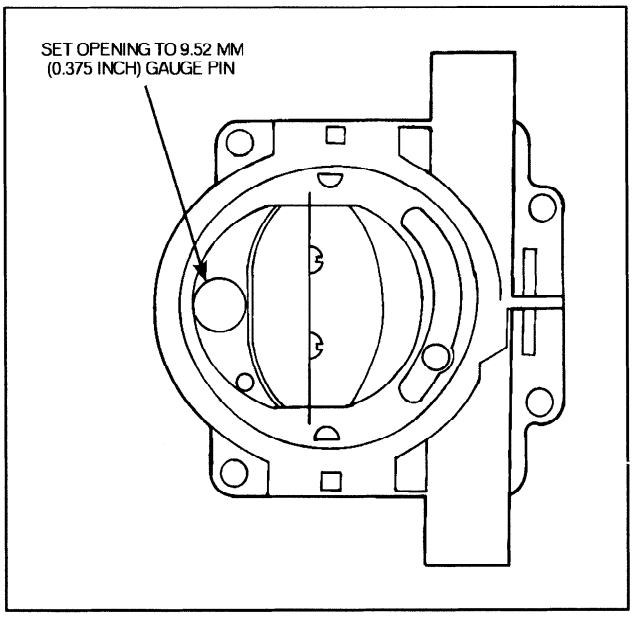
The opening of the throttle valve causes a drop in intake manifold vacuum which is transmitted to the diaphragm or piston. With the lower vacuum signal, the choke coil is able to move the choke valve towards the closed position. The amount it is closed depends on how much vacuum drop occurs during acceleration.

Automatic Choke Setup Procedure

The automatic choke assembly contains a bimetallic (thermostatic) coil spring which regulates the choke plate opening at different temperatures, and a vacuum piston which regulates choke pull-off. The piston exerts a pull against the closing action of the thermostatic spring. This helps to open the choke after the engine starts, and controls the position of the choke plate depending on engine load.

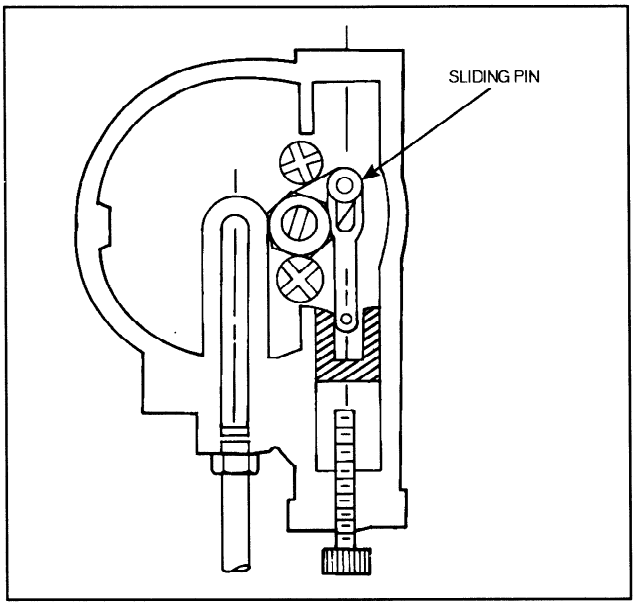
Adjusting the Choke Pull-Off

1. Remove the choke housing cover.
2. Remove the cork insulation strip.
3. Remove the inner plate.
4. Position the sliding pin in the slip link slot away from the piston.
5. Place a 9.52 mm (0.375 inch) gage pin between the top of the choke plate and the inside of the air intake.



ZENITH MODEL #33 CARBURETOR (Continued)

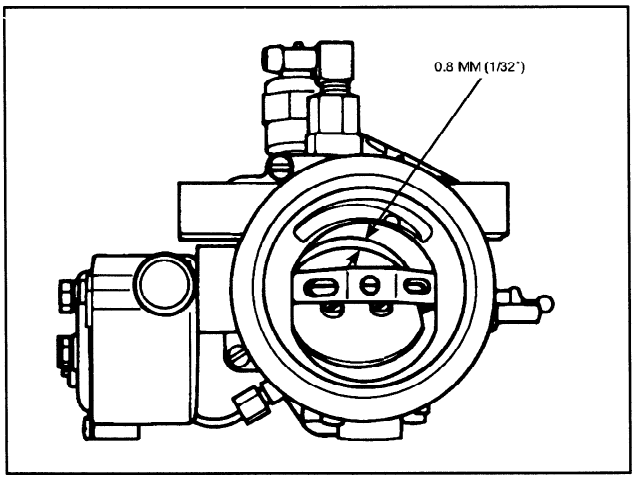
6. Adjust the stop screw until the slip link starts to move away from the pin.



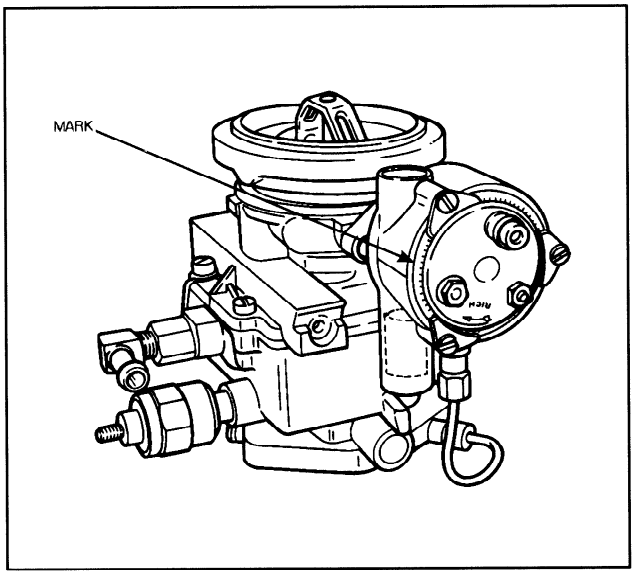
7. Tighten the lock nut to 0.9-1.4 N•m (8-12 lb. in.) to limit the travel of the piston so that the choke plate is pulled to the gage dimension.
8. Install the inner plate.
9. Install the cork insulation strip.
10. Install the choke housing cover.

Adjusting the Thermostatic Spring

1. Manualiy open the choke plate by rotating the choke shaft.
2. Allow the thermostatic spring (inside the choke assembly) to slowly close the choke plate. When the choke housing is at 21°C (70°F), the choke plate should be within 0.8 mm (1/32 inch) of, but not touching, the choke bore.



3. If the choke plate does not meet this dimension, loosen the three cover plate screws to rotate the cover as necessary, and repeat steps 1 and 2.
4. If the carburetor temperature is other than 21°C (70°F), make the following correction:
   - Set the choke plate as described in steps 2 and 3.
   - Readjust the cover plate to compensate for the deviation from 21°C (70°F). Each mark on the cover plate denotes a 2.8°C (5°F) change in the setting. For example, if the actual carburetor temperature is 27°C (80°F) when the choke plate is adjusted, rotate the cover two marks in the LEAN direction. Likewise, if the carburetor temperature is 10°C (50°F), rotate the cover four marks in the RICH direction.



5. Tighten the three cover screws.
6. Check the rotation of the choke shaft to be sure there is no sticking or binding before installing the carburetor.