

This lab is divided into three different sections. The first section covers fuel injection systems. The second section, the carburetors and fuel pumps and the third section covers spark ignition systems. Although this is not a formal report all questions must be answered **NEATLY** and graphs must be computer generated. (A copy of this lab exercise is on the web drive)

Fuel Injection Systems

This is to familiarize you with the different injection systems. Carefully, examine each of the different systems to understand the following topics.

- A). How is the fuel metered in the injection system.
- B). What determines the start and end of injection.
- C). How is the fuel distributed to the different injectors.
- D). How does the governor operate.

Answer the following questions for the different types of injector pumps.

CAV In-line Injector Pump

- 1). How is the volume of fuel per injection regulated.

- 2). Describe how the governor and throttle linkage regulate the fuel injection volume.

- 3). Carefully examine the cutaway injection pump and the complete pump with an aneroid attached, and determine how the aneroid limits fuel injection volume when the throttle is suddenly changed. Describe the mechanism that achieves this goal.

Lucas Rotary Pumps

1) Carefully examine the pump to understand the operation of rotary pump. How is the fuel directed to each injector in turn?

2) Does this pump have an automatic advance mechanism and where is it located.

Large Grey Pump

1) Is this an in-line or rotary pump.

2). How many cylinders does the injection pump's engine have? If the number of cylinders is greater than 3, how can the injector pump cam only have 3 lobes.

3) How is the fuel metered in this pump

4) How is the fuel directed to each cylinder and why does the plunger rotate on each injection stroke.

John Deere Injectors

Read the John Deere Technical Manual on testing fuel injection nozzles, including the sections on opening pressure test, chatter test and leakage test (section 35-54 to 35-56). Use the nozzle tester to estimate the following values.

1). Valve Opening Pressure

2). Valve closing pressure

3). Number of holes on the injector nozzle tip.

Carburetor and Spark Ignition System**Carburetor Study**

Carburetors supply the correct air-fuel ratio to the engine over a wide range of engine speeds and loads. The carburetor meters and atomizes the fuel and mixes the fuel with the incoming air. The fuel continues to vaporize and mix with the air as the mixture moves past the throttle and through the intake manifold.

Carburetors contain the following "systems":

Float System	Power or Load System
Choke System	Accelerator System
Idle System	Economizer System (sometimes)

PROCEDURE: Work together with your lab partners. If required, obtain a service manual describing the assigned carburetors (or a carburetor of similar design). Spend a few minutes reviewing the material in the manual.

For two of the carburetor's on display:

Carefully separate the throttle body and fuel bowl. Be careful with the bowl cover gasket as it will have to be reused. Remove the float and lever assembly. **DO NOT DROP OR LOOSE THE FLOAT VALVE.** Do not remove the float valve seat. When possible remove the venturi. Do not remove the throttle plate or shaft. Remove the idle adjusting needle, but not the idle jet. Remove the load adjusting needle and nozzle. Be extremely careful with all parts. Inspect the disassembled carburetor. By comparing the carburetor with the drawings in the manual, determine the purpose of all orifices and passages in the carburetor. Be able to trace through the operation of all of the carburetor systems.

On another sheet of paper, neatly answer the following questions for each carburetor:

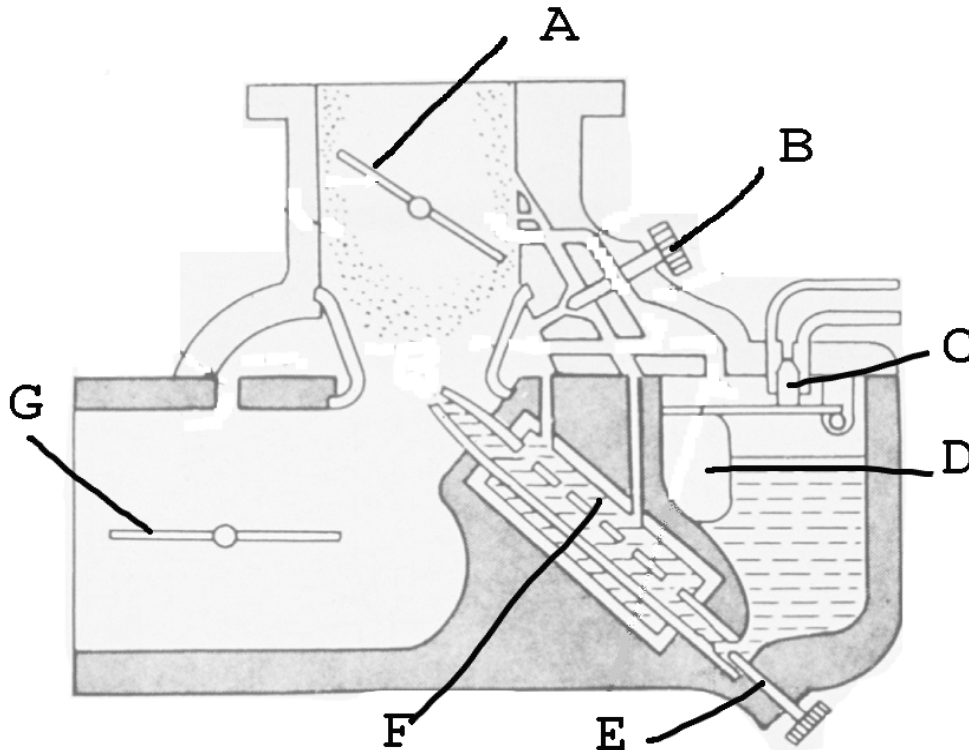
1. What is the make of the carburetor and the color the carburetor is painted?
2. Identify the type of carburetor, i.e., Up Draft, Down Draft or Side Draft
3. Determine the position of the butterfly throttle valve. I.e., Top/bottom/side of the carburetor
4. Determine the position of the choke. I.e., Top/bottom/side of the carburetor
5. Does the choke contain a vacuum relief valve to prevent all the air from being cut off?
6. Does the carburetor have an economizer system? If so, briefly describe the operation of the economizer particular for that carburetor.
7. Does the carburetor contain an accelerator well and/or acceleration pump?
8. Identify the following components of the carburetor if present.
 - a). Idle Speed Screw
 - b). Idle mixture Needle
 - c). Idle mixture jet
 - d). Main (or Load) mixture needle
 - e). Main (or Load) mixture jet
 - f). Throttle stop screw

After you have satisfied you understand the operation of each carburetor, carefully reassemble the carburetor. When reassembling the carburetors keep the idle mixture screw and load adjusting needle at least two turns from the closed position. (DO NOT TURN THESE SCREWS TIGHTLY INTO THEIR SEATS.)

Answer the following general questions:

A) Why do carburetors in cars often have an acceleration pump whereas tractor engine carburetors often only have an acceleration well.

B). Identify the carburetor parts numbered on the drawing below.



Fuel Pump Study

Carefully inspect the cut away of the fuel pump and answer the following questions:

C). Explain how fuel is drawn into the fuel cavity above the diaphragm and the method of actuation.

D). How is fuel forced out of the cavity above the diaphragm?

E). What prevents the fuel pressure from increasing when fuel consumption is low.

Different components of a spark ignition system are laid out on the desk. Carefully inspect all the components on the desk. Observe the difference in wire diameter for the primary winding and secondary windings of a coil.

- A). (i) Describe how the mechanical advance system changes the ignition timing when the engine speed increases.
- (ii) Why is it important that the ignition timing be advanced when speed increases?
- B). (i) Describe and compare the vacuum advance system for the Auto-Lite and GM Delco-Remy Ignition System.
- (ii) Describe the engine operating conditions when the vacuum advance will operate.

A spark ignition system model is provided on the front desk.

CAUTION THIS IGNITION SYSTEM HAS HIGH VOLTAGE COMPONENTS AND NO ADJUSTMENTS EXCEPT CHANGING THE GAP DISTANCE MUST BE UNDERTAKEN WITH POWER SUPPLIED TO THE SYSTEM. POWER MUST BE REMOVED FOR ALL DISTANCE MEASUREMENTS.

1). **DISCONNECT ALL POWER LEADS TO THE BATTERY PROVIDED AND REMOVE THE PLUG FROM THE WALL.** Use feeler gauges supplied to adjust the point's gap to 0.035 inches. Then adjust the gap between the electrodes to approximately 1/8 inch.

A). Set the speed control dial to 2. Connect the alligator clips to the 12 V batteries and plug in the power cord. The distributor will begin to rotate and a spark will arc across the electrodes.

(i). Observe the spark between the electrode and record any observations.

(ii). Using the insulated electrode slowly increase the gap between the electrodes until the spark across the electrodes cease. **DISCONNECT THE BATTERY AND UNPLUG THE POWER.**

Measure and record the distance between the electrodes. Reset the gap to 1/8".

B). Repeat part A for speed control setting 4,6,8.

2). Repeat part 1 with points gaps of 0.030, 0.025, 0.020, 0.015, 0.010, 0.005 inches.

Points Gap	Maximum Spark Distance				Comments
	2	4	6	8	
0.035"					
0.030"					
0.025"					
0.020"					
0.015"					
0.010"					
0.005"					

Plot multiple curves a single graph of Maximum spark distance (y-axis) versus speed (x-axis) for each points gap setting. (i.e., Each curve will have four points representing four speeds for a single points gap)

3). What is the effect of the points gap on maximum spark distance? Explain the reason for these trends.

4). What is the effect of speed on maximum spark distance? Explain the reason for these trends.

5). Does an increase in the point's gap reduce or increase the dwell time? Why is dwell time important for both inductive (coil) and capacitive discharge (capacitor) ignition systems?