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2.61 Internal Combustion Engines
Spring 2008

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2.61 Internal Combustion Engine Laboratory Session

Engine Disassembly

2/07/08 (Thursday)

1:00 – 3:00 PM

Please report to Vikram Mittal and Thane Dewitte in the Sloan Automotive Lab.

Everybody should wear safety glasses.

The purpose of this session is to get some hands-on experience on the mechanical aspect of the engine. You should learn the mechanical construction of the engine, how the different components are arranged, and get a feel for the size and weight of the components. It is important to know the numbers. Do weigh and measure the components.

There are two engines. Both are Ford 4-cylinder, 16-valve engines for the compact size vehicles. The more modern one has a plastic intake manifold to reduce cost and NVH (Noise, Vibration and Harshness). The class will be divided into two groups; each group is responsible to disassemble one engine. However the whole class should participate in the initial 'looking' at each of the whole engine and the final study of all the parts for both engines.

Before disassembly, take a look at the engines as a whole, note the arrangement of the different components, the gas exchange circuit: intake, exhaust, EGR (Exhaust Gas Recirculation), and PCV (Positive Crankcase Ventilation) system; the coolant circuit; the fuel flow circuit. Understand the function of these components.

When the engine is opened, look at the valve train arrangement, the lubrication circuit, the EGR route, the coolant passage, and the piston/ crank/ balance weight arrangement.

Record the following on the next page. The measurements may be shared by the group, but the comments and calculations should be done by each individual.

Measure the intake runner length and the size of the manifold (these values do not have to be precise). Calculate the organ pipe frequency (wave length = 4*runner length) of the former and the ratio of the latter to the displacement volume.

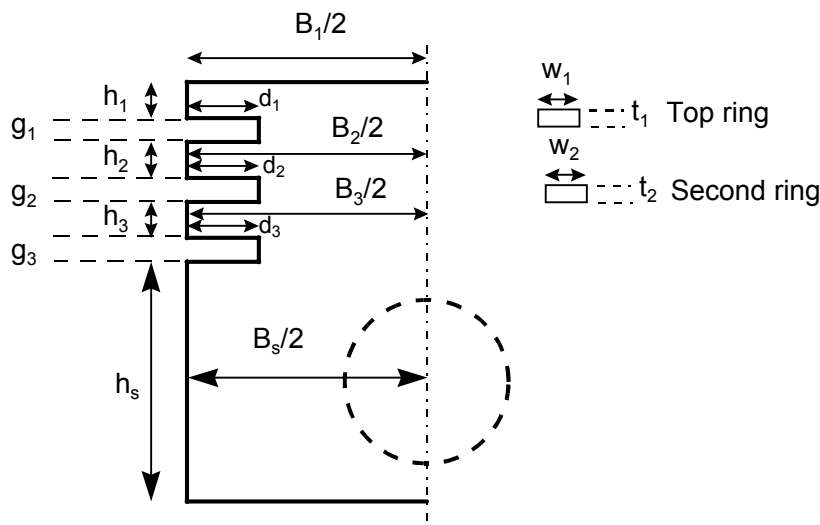
Measure the Bore, the stroke, and the connecting rod lengths.

Measure the mass and dimensions of the piston (see figure). (Why are the values of B_1 , B_2 , B_3 and B_s different?)

Estimate the inertia force required to move the piston at 6000 rpm. Estimate the temperature at which the top land (diameter B_1) would be touching the liner which is kept by the coolant to be at 100° C.

Measure the valve diameters and the lifts. (The latter may be obtained from the cam measurements.) Why are the valve diameters different?

Measure the valve masses. Estimate the spring force required to operate at 1000 and 6000 rpm.



Engine (just fill in this form for the engine that you are working on)	Measurements (units required)	Comments
Intake runner length		
organ pipe frequency (lowest)		
Manifold volume		
Ratio of above to displacement		
Bore		
Stroke (2a)		
Connecting Rod Length (ℓ)		
Displacement (V_D)		
Piston mass		
Piston diameter at first land (B_1)		
Inertia force required to move piston at 6000 rpm		
Piston diameter at second land (B_2)		
Piston diameter at third land (B_3)		
Piston diameter at skirt (B_s)		
Top land height (h_1)		
Second land height (h_2)		
Third land height (h_3)		
Skirt height (h_s)		
Top ring groove gap (g_1)		
Second ring groove gap (g_2)		
Control ring groove gap (g_3)		
Top ring groove depth (d_1)		
Second ring groove depth (d_2)		
Control ring groove depth (d_3)		
Top ring width (w_1)		
Top ring thickness (t_1)		
Second ring width (w_2)		
Second ring thickness (t_2)		
Temperature at which top land interferes with liner		
Intake valve mass		
Intake valve diameter		
Intake valve Lift		
Spring force estimate for 1000 rpm		
Spring force estimate for 6000 rpm		
Exhaust valve mass		
Exhaust valve diameter		
Exhaust valve lift		
Spring force estimate for 1000 rpm		
Spring force estimate for 6000 rpm		