ME 416 Thermodynamics Applications

Experiment : CFR Engine Test

Cool video to help you understand IC engine operation:

https://www.youtube.com/watch?v=xflY5uS-nnw (start at 1:14)

Objective: To examine some of the characteristics of a spark-ignition engine and find it's maximum power operating point.
To determine how engine performance is affected by changing compression ratio and ignition timing.

Instrumentation:
The engine is monitored by an electronic data-acquisition system.

Information such as pressure vs. piston position (p vs. V) and pressure vs. crank angle (p vs. time) is available. IMEP and maximum pressure for the cycle are also reported on the LabView VI interface.

Procedure:

a) Observe the p-V diagram for motoring w/o firing (gas compression). We will all do this together as a way to test the data acquisition system.
b) Using the supplied fuel (87 octane gasoline with about 10% ethanol added) record data with the engine firing for several different ignition timing settings. Also, vary the compression ratio by adjusting the head position (do 2-4 different compression ratios between r=5 and r=9 as time allows) At each compression ratio, use 5 different timing angles (some advanced some retarded). Observe and record IMEP and maximum pressure for each engine setting (from the computer screen). Also, save the Pressure vs. CAD data to a csv file. Note: as you go to higher compression ratios it may not be possible to advance the spark timing without getting severe knocking. **Do not leave the engine on a knocking condition. With Dr. Damm's help you can take data while the engine is knocking (this may be interesting), but it must be done with care (ask him for help).**

Safety Notes:

a) Remove any watches and bracelets and roll up long sleeves. Tie back long hair. You must not have loose fitting clothing as we are working around rotating machinery.
b) Make sure the exhaust fan is turned on.
c) Make sure that the cooling water is turned on.
d) Do not change the compression ratio while the engine is motoring or firing.

For report:

- For the supplied fuel, plot the P-V for each timing angle at one of the compression ratios tested (on a single graph).

- Using the recorded IMEP, calculate the engine power output for each

operating condition; plot the power output vs. timing angle for each compression ratio on the same plot; can you predict the optimum timing angle for each compression ratio (depending on your data you may or may not be able to make this prediction).

- Plot P_{max} vs. the timing angle for one of the compression ratios tested.

- Pick one of the P-V diagrams that look "typical" of SI engine P-V diagrams and numerically integrate the diagram to get the indicated work per cycle. Compute the IMEP from your indicated work. Does it agree with what the LabView program reported?

- Use the log p vs. log V results for a single "nominal" run (pick any one), estimate the polytropic exponent for the compression and expansion parts of the cycle. Discuss the significance of these results when compared to the "ideal" polytropic exponents.

Note: All items above and any figures should be discussed in the report narrative.