MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mechanical Engineering

2.61 INTERNAL COMBUSTION ENGINES

Homework Set #1

The purpose of this set of homework is to give you a feel for the design values of practical engines. *Not all the relevant numbers are given in the problem statement.* Make reasonable estimates and engineering judgments of the unknown parameters.

You have to calculate a lot of numbers. Use Matlab or Excel to do the calculations.

Problems (the problem numbers refer to the ones in the text book):

1.2 Draw a free body diagram of the piston. Also calculate the cylinder pressure force on the piston for a highly boosted turbo-engine at 100 bar pressure with a bore of 85 mm.

2.5 Note the relative magnitude of the different terms in the road power requirement. Also estimate the force for accelerating the vehicle on a flat road from 40 to 60 mph in 5 seconds.

2.8 Calculate bsfc in g/kW-h. The exercise is to get a sense of the bfsc values; note the differences due to the differences in fuel LHV.

2.13 See Figure 1-8 for timing information and Fig 2.2 for piston speeds. Combustion starts at ~20^{o} BTDC and ends at ~40^{o} ATDC. (Note that the pressure values in that figure are for part-load and not for WOT operation. We are, however, only interested in the timing of the various processes; so the figure is still relevant.)

Exercise that you do to enrich yourselves but you do not have to hand in anything:

Go to the "Related Resources" section, look at the "engine performance specifications" spread sheet. Explore the spread sheet by sorting the data according to years, BMEP, peak power density, etc. Note some of the outliers, e.g. the Honda Formula One race engine. Get a feel for the peak power density and the max BMEP of the typical engines. (There are separate sheets for SI and light duty Diesel engines.)

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