Warsaw University of Technology

Faculty of Automotive and Construction Machinery Engineering

INSTITUTE OF VEHEECLES

Laboratory of Combustion Engines Theory

Lab work №1

LOAD CHARACTERISTIC OF COMBUSTION ENGINE

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LOAD CHARACTERISTIC

Load characteristics are determined within the framework of the classical static engine testing for both spark ignition engines and diesel engines. They are used to evaluate the performance of engines, comparative assessment of engines, to determine the general characteristics. They are performed for several values of speed in the field of engine operating speed. These are mainly speed: the speed at which there is maximum power and the speed at which maximum torque occurs. If the characteristics are used to determine the general characteristics and is done usually in the range of engine operating speed in increments of 100 rpm, reducing step in ambiguous curves on the characteristics of the total.

1. PARAMETERS OF LOAD CHARACTERISTIC

Load characteristics is performed at a constant rotational speed of the crankshaft of the engine. Fuel dose is variable. Constant speed of the crankshaft is maintained by properly changed using load of the electric brake. Typical load characteristics shows the dependence of the fuel mass flow rate MFR (G_e) and specific fuel consumption SFC (g_e) from the engine load presented as Raw Power (N_e), Raw Torque (M_e), or Brake Mean Effective Pressure BMEP (p_e).
Depending on the requirements of the study can be completed with additional characteristics such as: content in the exhaust gases C_{CO} of carbon monoxide, carbon dioxide C_{CO2}, hydrocarbons C_{HC}, nitrogen oxides C_{NOx}, particulate matter C_{PM}. In the case of compression ignition engines it could be also the Stoichiometric Ratio λ and dose of fuel injected.

Figure 1a shown load characteristic for compression ignition engine and 1b for spark ignition engine.

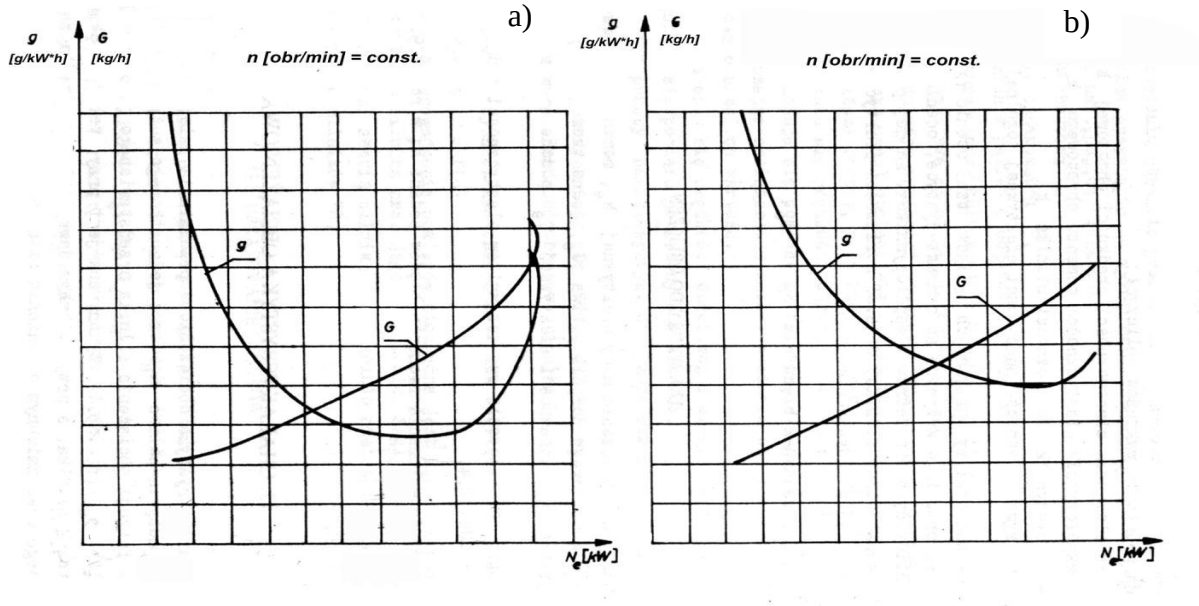

Fig 1. Load characteristic: a) compression ignition engine, b) spark ignition engine

2. COURSE OF EXERCISE

Load characteristic is taken with two characteristic engine speeds - maximum torque or power.

Students performing an exercise record the following values:

- Raw Torque (M_e),
- fuel consumption.

The results of measurements must be stored in a manner indicated below:

Tab. 1. Engine speed: n = ... rpm

No	Measurement points	Torque [N·m]	Time of fuel consumption			Measurement volume [ml]
			1 [s]	2 [s]	3 [s]	
1	100%					
2	80%					
3	75%					
4	60%					
5	50%					
6	40%					
7	25%					
8	10%					

3. STUDY OF THE RESULTS

Based on the measurement results, perform calculations, using the formulas below:

Raw Power

$$\text{Power} = \text{Torque} \times \text{Speed [kW]}$$

where:

$$\text{Speed} = \frac{rev \cdot \pi}{30} \text{ [rad/s]}$$

Fuel mass flow rate MFR

$$\text{MFR} = \rho \times \frac{volume}{time} \text{ [kg/h]}$$

where:

$$\rho \text{ – density [kg/m}^3\text{]}$$

Specific Fuel Consumption SFC

$$\text{SFC} = \frac{MFR}{Power} \text{ [g/kW·h]}$$

Engine efficiency η

$$\eta = \frac{Power}{MFR \cdot HV}$$

where:

HV – heating value [MJ/kg]

The calculation results can be stored in the table given below:

Tab. 2. Engine speed: n = ... rpm

No	Measurement points	Torque [N·m]	Power [kW]	MFR [kg/h]	SFC [g/kW·h]	η
1	100%					
2	80%					
3	75%					
4	60%					
5	50%					
6	40%					
7	25%					
8	10%					

Based on the calculation results should plot the load characteristics – MFR and SFC vs Torque, MFR and SFC vs Power and η vs Power.

4. REPORT

The report shall include:

1. Description of load characteristic.

2. Block diagram of the test stand.

3. The results of the calculations – Tab. 2.

4. Three graphs – MFR and SFC vs Torque, MFR and SFC vs Power and η vs Power.

5. Conclusions and comments.