EXPERIMENT: Energy Balance and Thermal Efficiency of SI Engine

OBJECTIVES:

- To determine the energy balance calculation for internal combustion engine
- To measure the thermal efficiency of an engine running in specific compression ratio.

APPARATUS:

- EFI Petrol Engine Test Bed
- 150 kW Hydraulic Dynamometer
- Computer with ET-DHB-2 software
- Exhaust Gas Calorimeter
- Fuel Consumption Device
- Air Consumption Device
- Heat Exchanger system

TEORY:

$H_1 = P_s + (H_2 - H_3) + Q_1 + Q_2$

H_1 = Combustion energy of fuel = $m_f CL \times 10^3$

P_s = Power output of engine

H_2 = Enthalpy of exhaust gas = $(m_f + m_a)C_p T_e$

H_3 = Enthalpy of inlet air = $m_a C_p T_a$

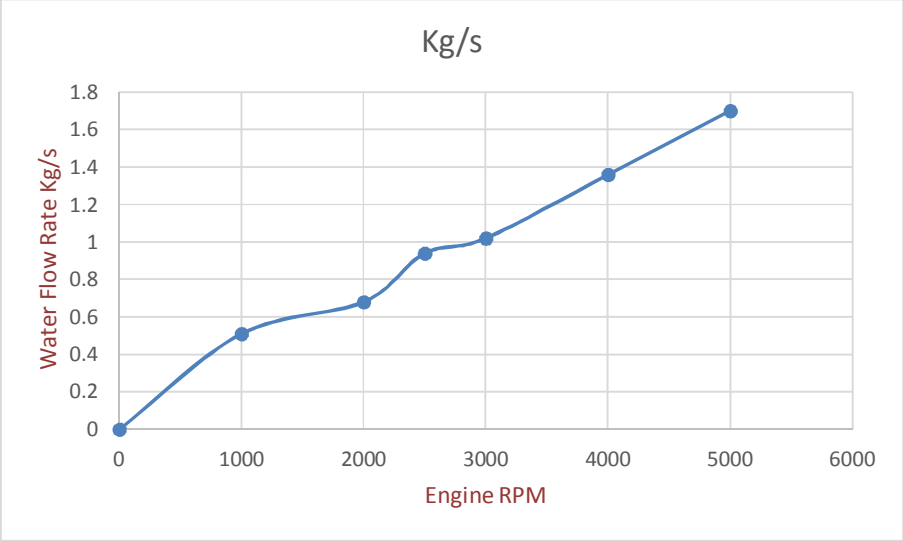
Q_1 = Heat to cooling water = $m_w C_w (T_{2w} - T_{1w})$

Q_2 = Convection and Radiation

Specific heat capacity of air at constant pressure (C_p)	= 1.005 kJ/kgK
Specific heat capacity of water (C_w)	= 4.18 kJ/kgK
Lower calorific of gasoline fuel (CL)	= 43.8 MJ/kg
Fuel density	= 0.74 kg/l

Cooling water flow rate with engine speed

RPM	Kg/s
0	0
1000	0.51
2000	0.68
2500	0.94
3000	1.02
4000	1.36
5000	1.7



PROCEDURE:

1. Prepare all required equipment (Dynamometer, Engine and Instrument panel)
2. Turn ON the power switch of the Instrument Panel (Analog Force Meter and RPM meter). Set the load control to minimum load.
3. Start the engine and adjust the throttle for 2000 rpm allow time for warming-up
4. Slowly increase the throttle setting to full open conditions while starting to put load at 25% throttle opening. Continue to increase the throttle until wide open condition and adjust the load to maintain the engine speed at 3000 rpm.
5. After cooling fan started, run the ET-DHB-2 software, the data will be displayed on the computer monitor in Real-time graphics and presented in digital displays. Observe the measurements below:
    a. Fuel consumption rate (kg/s)
    b. Air consumption rate (kg/s)
    c. Exhaust gas temperature leaving the engine (ºC)
    d. Inlet air temperature (ºC)
    e. Cooling water inlet temperature (ºC)

f. Cooling water outlet temperature (ºC)
g. Engine rpm and power

CALCULATIONS:

- Calculate the distribution of energy for those specific conditions at the experiment above.
- Calculate the overall efficiency of the engine

RESULTS:

- Tabulate the energy distribution as percentages

DISCUSSION:

1. Discuss the term ñEnergy Balanceò
2. Discuss the ways that uncountable losses could occur.
3. Discuss the practical values with the typical values of energy losses of an engine.
4. Practical errors and how to overcome.

OBSERVATIONS:

EXPERIMENT: ENERGY BALANCE AND THERMAL EFFICIENCY OF SI ENGINE

EXPERIMENT NO:

ADMISSION NO:

Description	Reading
Fuel Consumption Rate (kg/s)	
Air Consumption Rate (kg/s)	
Exhaust gas temperature leaving the engine (ºC)	
Inlet air temperature (ºC)	
Cooling water inlet temperature (ºC)	
Cooling water outlet temperature (ºC)	
Engine speed (rpm)	
Engine power (kW)	