Chapter 6: ICE testing

Fuel can be measured using a: Flow meters
Calibrated glass

Air can be measured using an air box with an orifice

→ Pressure drop in the orifice is measured using an orific meter

$$\dot{m}_a = C_d \, A_0 \sqrt{2 \, g \, h \, \rho_f \, \rho_a}$$

→ Manometer fluid density

↳ height difference in manometer

$= \dfrac{P}{RT}$ for air

Indicated power is measured by:
1. Indicator diagram : Area under PV diagram by plan meter which traces of the perimeter

2. Motoring : Electrical dynamometer as a motor connected to the engine
   i- The engine is operated with no fuel ⟹ $P_{motor} = P_{friction}$
   ii- The engine is operated with fuel ⟹ $P_{motor} = P_{Brake}$
   ii- $P_{indicated} = P_{friction} + P_{Brake}$

3- Morse test- :- Used for multi-cylinder engines
   i- The engine runs at a constant speed, torque is measured
   ii- One cylinder is cut-out → Shortining the plug in S.I.E
   → Disconnecting an injector in C.I

iii- The speed is fixed (By reducing the load), torque is measured

iv- Repeat for all cylinders

For a 4-Cylinder engine:

Brake Power → $B = (I_1 - L_1) + (I_2 - L_2) + (I_3 - L_3) + (I_4 - L_4)$

Indicated power ↗ ↖ Power Loss

$B_1 = (0 - L_1) + (I_2 - L_2) + (I_3 - L_3) + (I_4 - L_4) \Rightarrow B_{Tot} - B_1 = I_1$

$B_2 = (I_1 - L_1) + (0 - L_2) + (I_3 - L_3) + (I_4 - L_4) \Rightarrow B_{Tot} - B_2 = I_2$

$B_3 = (I_1 - L_1) + (I_2 - L_2) + (0 - L_3) + (I_4 - L_4) \Rightarrow B_{Tot} - B_3 = I_3$

$B_4 = (I_1 - L_1) + (I_2 - L_2) + (I_3 - L_3) + (0 - L_4) \Rightarrow B_{Tot} - B_4 = I_4$

Then

$B_{Tot} = I_1 + I_2 + I_3 + I_4 - L$

• Assuming L_1, L_2, L_3, L_4 are constants If ω is constant

Deficiencies of morse test method:

1. Friction loss between firing and motering are different

2. The mixture between cylinders is upset when one of the cylinders is cut out

4. William's Line method

Applicable for CIE only → Nearly linear relationship between b.p & fuel consumption

i- Engine speed is constant, load is reduced in increments (fuel consumption decreases) → b.p is measured

ii- The following graph is obtained

$$P_{Ind} = P_{fr} + P_{B.P}$$

Fuel consumption

Constant- speed

B

B.P

Power loss
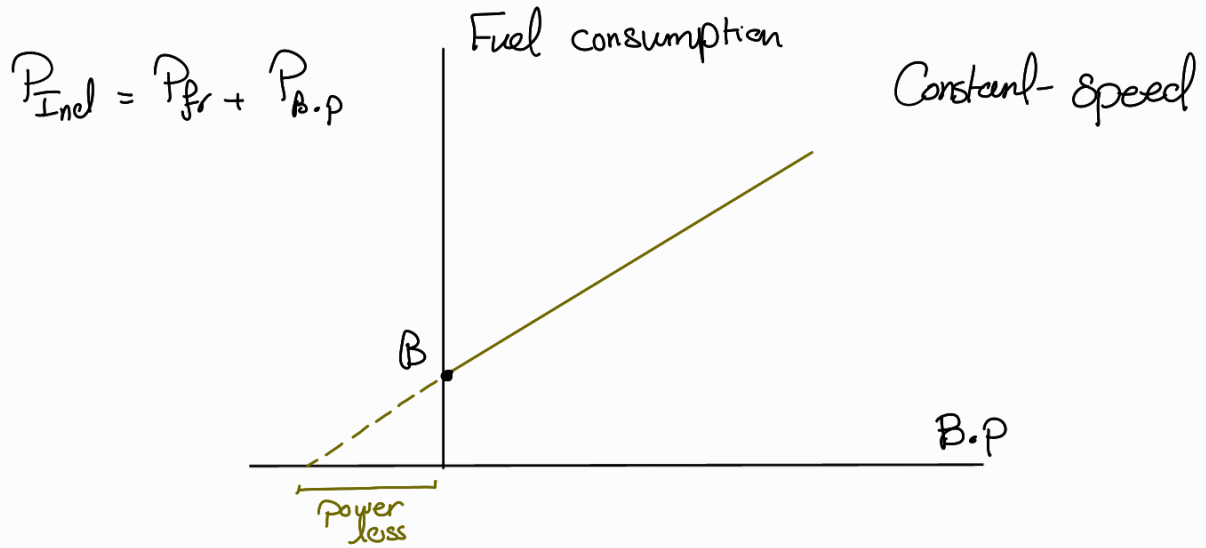
Disadvantages: relation between b.p & fuel consumption
is not linear.

Q3: $B.P = I.d - F.P$

working loop   → Dead cycle
 – Pumping loop

not sure