# MORSE TEST

This method is used to measure the Indicated Power without the use of indicator diagram in multicylinder engine.

## FOUR CYLINDER ENGINE

$I_1, I_2, I_3$, and $I_4$ = Indicated power of the cylinder 1, 2, 3, 4 respectively

$F_1, F_2, F_3$ and $F_4$ = Frictional power of the cylinder 1, 2, 3 and 4 respectively

Total BP = Total Indicated power − Total Friction power

$$BP = (I_1 + I_2 + I_3 + I_4) - (F_1 + F_2 + F_3 + F_4)$$

When Cylinder 1 is cut off $I_1 = 0$, but frictional losses remains same

$$\therefore BP_1 = (I_2 + I_3 + I_4) - (F_1 + F_2 + F_3 + F_4)$$

Subtraction $BP - BP_1 = I_1$

$|||^{ly}$ $I_2 = BP - BP_2$

$I_3 = BP - BP_3$

$I_4 = BP - BP_4$

$$\text{Total } IP = (IP_1 + IP_2 + IP_3 + IP_4)$$

# Measurement of air Consumption

$A$ = Area of orifice in $m^2$

$h_w$ = Head of water in m

$d$ = diameter of orifice in m

$\rho_a$ = Density of air in $kg/m^3$

$C_d$ = Coefficient of discharge

Head in terms of air in                $h_w = h_1 - h_2$

$H = h_w \frac{\rho_w}{\rho_a}$

Velocity of air passing through the orifice is given by

$V = \sqrt{2gH}$ m/s

Volume of air passing through the orifice

$\bar{V}_a = A \times V \times C_d$   ($A = \frac{\pi}{4} d^2$, $C_d$ = 0.15)

$= A \times C_d \times \sqrt{2gH}$

Mass of air passing through the orifice is given by

$m_a = \bar{V}_a \cdot \rho_a$ kg/sec

$$\eta_{vol} = \frac{\text{Actual volume of air taken in } m^3/sec}{\text{Displacement volume in } m^3/sec}$$

$$= \frac{C_d \times A \times \sqrt{2gH}}{\frac{\pi D^2}{4} \cdot L \cdot \left(\frac{N}{60} \text{ or } \frac{N}{2}\right) \times \text{No of Cylinders}}$$

$$m_a / \text{kg of fuel} = \frac{N \times C}{33(C_1 + C_2)}$$

N = % of nitrogen        % of $CO_2 = C_1$ } volume

C = % of carbon           % of $CO = C_2$

Measurement of fuel Consumption

$$\text{Fuel Consumption (kg/hr)} = \frac{V_{cc} \times \text{Sp. gravity of fuel}}{1000 \times t}$$

Heat Carried away by Cooling water

$$Q_w = m_w \cdot C_{pw} (T_o - T_i)$$

$$C_{pw} = 4.187 \text{ kJ/kg}$$

Heat Carried away exhaust gases

$$m_a = \frac{N \times C}{33(C_1 + C_2)}$$

$$Q_g = m_g \times C_{pg} (T_g - T_a)$$

$$= (m_a + 1) \cdot C_{pg} (T_g - T_a)$$

Density of air $\rho_a = 1.15 \text{ kg/m}^3$

$C_d = 0.7$

$\rho_{water} = 1000 \text{ kg/m}^3$

Heat Supplied by the fuel

$= m_f \times CV$

Heat equivalent of brake power

$= \text{Brake power} \times 60 \text{ kJ/min}$

Brake Power in kW