

4) Adiabatic compression $\rightarrow$

The cylinder is positioned on the insulating stand. The gas is further compressed slowly till it returns to its initial state (P_1, V_1, T_1) and after then, if W_4 work done in the adiabatic compression from (P_4, V_4, T_2) to (P_1, V_1, T_1) then

$$W = \frac{nR(T_1 - T_2)}{\gamma - 1} = \text{area DAEFD}$$

Net work done by the gas per cycle is $\rightarrow$

Total work done by the gas $= W_1 + W_2$

Total work done on the gas $= W_3 + W_4$

Net work is done by gas in one complete cycle is

$$W = W_1 + W_2 - (W_3 + W_4) \quad (\because W_2 = W_4)$$

then $W = W_1 - W_3 = Q_1 - Q_2$

$$W = \text{area ABCDA}$$

In the Carnot engine, the work done by the gas per cycle is numerically equivalent to the area enclosed by the Carnot cycle on a pressure-volume figure.