Question #81608, Engineering / Mechanical Engineering

A single stage reciprocating compressor takes 1 m3 of air per minutes at 1.013 bar and 15 C and delivers it at 7 bar. Assuming that the law of compression is pV1.35=constant, and that clearance is negligible. Calculate the indicated power (kW)

Solution

$$m = \frac{p_1 V_1}{R T_1} = \frac{(1.013 \cdot 10^5)(1)}{(0.287)(288)} = 1.226 \frac{kg}{min}$$

$$T_2 = T_1 \left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}} = 288 \left(\frac{7}{1.013}\right)^{\frac{1.35-1}{1.35}} = 425.2 \ K$$

The indicated power:

$$IP = \frac{n-1}{n} mR(T_2 - T_1) = \frac{1.35 - 1}{1.35}(1.226)(0.287)(425.2 - 288) = 254 \frac{kJ}{min} = \frac{254}{60} kW = 4.23 \ kW.$$

Answer: $4.23 \ kW$.