Engineering Software

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Basic Engineering Equations

Here are some of the basic engineering equations related to the conservation of mass, momentum and energy and energy conversion systems.

Basic Conservation Equations

Continuity Equation

$$m = \rho v A \ [kg/s]$$

Momentum Equation

$$F = (vm + pA)_{out - in} \ [N]$$

Energy Equation

$$Q - W = ((h + v^2/2 + gh)m)_{out - in} \ [kW]$$

Energy Conversion Systems Equations

State Equation for Ideal Gas

$$pv = RT \ [kJ/kg]$$

Perfect Gas

$$c_p = \text{constant} \ [kJ/kg*K]$$

Kappa

$$\chi = c_p/c_v \ [/]$$

Energy Conversion Systems Equations

Isentropic Compression

$$T_2/T_1 = (p_2/p_1)^{(\chi-1)/\chi}\ [/]$$

$$T_2/T_1 = (V_1/V_2)^{(\chi-1)}\ [/]$$

$$p_2/p_1 = (V_1/V_2)^{\chi}\ [/]$$

Energy Conversion Systems Equations

Flame Temperature [K]

$$h_{reactants} = h_{products}\ [kJ/kg]$$

Energy Conversion Systems Equations

Isentropic Expansion

$$T_1/T_2 = (p_1/p_2)^{(\chi-1)/\chi} \; [/]$$

$$T_1/T_2 = (V_2/V_1)^{(\chi-1)} \; [/]$$

$$p_1/p_2 = (V_2/V_1)^{\chi} \; [/]$$

Energy Conversion Systems Equations

Sonic Velocity

$$v_s = (\chi RT)^{1/2} \text{ [m/s]}$$

Mach Number

$$M = v/v_s \text{ [/]}$$

Thrust

$$\text{Thrust} = vm + (p - p_{atm})A \text{ [N]}$$

Energy Conversion Systems Equations

Isentropic Flow

$$T_t/T = (1 + M^2(\chi - 1)/2)\ [/]$$

$$p_t/p = (1 + M^2(\chi - 1)/2)^{\chi/(\chi-1)}\ [/]$$

$$h_t = (h + v^2/2)\ [kJ/kg]$$

$$T_t = (T + v^2/(2c_p))\ [K]$$

Energy Conversion Systems Equations

Cycle Efficiency

$$\eta = W_{net}/Q \ [/]$$

Heat Rate

$$HR = (1/\eta)3{,}412 \ [Btu/kWhr]$$

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