

"Calculating Mixture Properties and Heat Release"

T_ambient = 75 [F]
P_ambient = 14.7 [psia]

"Methanol Calculations"

"Balanced Reaction: CH₄O + 1.5 (O₂ + 3.76 N₂) --> 1 CO₂ + 2 H₂O + 1.5*3.76 N₂"

MF_CH4O = 1/(1+1.5*4.76)
p_CH4O = P_ambient * MF_CH4O

MF_air = (1.5*4.76)/(1+1.5*4.76)
p_air = P_ambient * MF_air

x_CH4O = **quality(Methanol, T=T_ambient, P=p_CH4O)**
v_CH4O = **volume(Methanol, T=T_ambient, P=p_CH4O)**
v_air = **volume(Air, T=T_ambient, P=p_air)**

v_mix_CH4O = MF_CH4O*v_CH4O + MF_air*v_air

AFR_CH4O = (1.5*32 + 1.5*3.76*28)/(12+4+16)

"IsoOctane Calculations - Gasoline Approximation"

"Balanced Reaction: C₈H₁₈ + 12.5 (O₂ + 3.76 N₂) --> 8 CO₂ + 9 H₂O + 12.5*3.76 N₂"

MF_C8H18 = 1/(1+12.5*4.76)
p_C8H18 = P_ambient * MF_C8H18

MF_air_IsoOctane = (12.5*4.76)/(1+12.5*4.76)
p_air_IsoOctane = P_ambient * MF_air_IsoOctane

v_C8H18 = **volume(C₈H₁₈, T=T_ambient, P=p_C8H18)**
v_air_IsoOctane = **volume(Air, T=T_ambient, P=p_air_IsoOctane)**

v_mix_C8H18 = MF_C8H18*v_C8H18 + MF_air_IsoOctane*v_air_IsoOctane

AFR_C8H18 = (12.5*32 + 12.5*3.76*28)/(12*8+18)

"Nitromethane properties from thermo.us"**"Trapped Mass Approximation"**

Vol_engine = 355 [in^3]
eta_v = 0.85
Mass_CH4O_engine = eta_v*Vol_engine***convert**(in^3, ft^3)/v_mix_CH4O
Mass_C8H18_engine = eta_v*Vol_engine***convert**(in^3, ft^3)/v_mix_C8H18

DELTAH_mix_CH4O = -2.76***convert**(MJ/kg, Btu/lbm)
Boom_CH4O = Mass_CH4O_engine*(-DELTAH_mix_CH4O)
DELTAH_mix_C8H18 = -2.78***convert**(MJ/kg, Btu/lbm)
Boom_C8H18 = Mass_C8H18_engine*(-DELTAH_mix_C8H18)

SOLUTION**Unit Settings: Eng F psia mass deg**

| | |
|--|--|
| AFR _{C8H18} = 15.05 [lbm/lbm] | AFR _{CH4O} = 6.435 [lbm/lbm] |
| Boom _{C8H18} = 12.35 [Btu] | Boom _{CH4O} = 8.131 [Btu] |
| ΔH _{mix,C8H18} = -1195 [Btu/lbm] | ΔH _{mix,CH4O} = -1187 [Btu/lbm] |
| η _v = 0.85 [dim] | Mass _{C8H18,engine} = 0.01034 [lbm] |
| Mass _{CH4O,engine} = 0.006853 [lbm] | MF _{air} = 0.8771 [dim] |
| MF _{air,IsoOctane} = 0.9835 [dim] | MF _{C8H18} = 0.01653 [dim] |
| MF _{CH4O} = 0.1229 [dim] | p _{air} = 12.89 [psia] |
| p _{air,IsoOctane} = 14.46 [psia] | P _{ambient} = 14.7 [psia] |
| p _{C8H18} = 0.243 [psia] | p _{CH4O} = 1.806 [psia] |

$$T_{\text{ambient}} = 75 \text{ [F]}$$

$$V_{\text{air}} = 15.36 \text{ [ft}^3\text{/lbm]}$$

$$V_{\text{C}_8\text{H}_{18}} = 206.7 \text{ [ft}^3\text{/lbm]}$$

$$V_{\text{mix,C}_8\text{H}_{18}} = 16.89 \text{ [ft}^3\text{/lbm]}$$

$$X_{\text{CH}_4\text{O}} = 100$$

$$V_{\text{engine}} = 355 \text{ [in}^3\text{]}$$

$$V_{\text{air,IsoOctane}} = 13.7 \text{ [ft}^3\text{/lbm]}$$

$$V_{\text{CH}_4\text{O}} = 97.73 \text{ [ft}^3\text{/lbm]}$$

$$V_{\text{mix,CH}_4\text{O}} = 25.48 \text{ [ft}^3\text{/lbm]}$$

No unit problems were detected.

KEY VARIABLES

$$\text{Boom}_{\text{C}_8\text{H}_{18}} = 12.35 \text{ [Btu]} \quad \textit{Heat Released - Gasoline}$$

$$\text{Boom}_{\text{CH}_4\text{O}} = 8.131 \text{ [Btu]} \quad \textit{Heat Released - Methanol}$$

$$\text{AFR}_{\text{C}_8\text{H}_{18}} = 15.05 \text{ [lbm/lbm]} \quad \textit{Air-Fuel Ratio - Gasoline}$$

$$\text{AFR}_{\text{CH}_4\text{O}} = 6.435 \text{ [lbm/lbm]} \quad \textit{Air-Fuel Ratio - Methanol}$$

$$\text{MF}_{\text{C}_8\text{H}_{18}} = 0.01653 \text{ [dim]} \quad \textit{Mass Fraction - Gasoline}$$

$$\text{MF}_{\text{CH}_4\text{O}} = 0.1229 \text{ [dim]} \quad \textit{Mass Fraction - Methanol}$$

$$V_{\text{C}_8\text{H}_{18}} = 206.7 \text{ [ft}^3\text{/lbm]} \quad \textit{Specific Volume - Gasoline Vapor}$$

$$V_{\text{CH}_4\text{O}} = 97.73 \text{ [ft}^3\text{/lbm]} \quad \textit{Specific Volume - Methanol Vapor}$$