Estimate of Amount of Vapourized Diesel Fuel Required to Reach the Lower Eplosive Limit in a Given Volume of Air

Input Parameters and Assumptions

All values from various online sources, mostly Wikipedia.

ρ_d	"Density of diesel fuel"	$\rho_d := \frac{1}{2} \cdot \left(0.82 \frac{kg}{L} + 0.845 \frac{kg}{L} \right)$
γ_d	"Molar density of diesel fuel"	$\gamma_d := 200 \frac{g}{mol}$
ρ_a	"Sea level density of air"	$\rho_a := 1.2 \frac{kg}{m^3}$
γ_a	"Molar density of air"	$\gamma_a := 0.8 \cdot 2 \cdot 14 \frac{g}{mol} + 0.2 \cdot 2 \cdot 16 \frac{g}{mol}$
V_e	"Engine compartment volume"	$V_e := 41472\ in^3$

Assumption: The ideal gas law defines the behaviour of vapourized diesel fuel to an accpetable degree of precision.

Mass Basis Calculation

Mass of air in engine compartment volume:

$$m_a := \rho_a \cdot V_e = 0.816\ kg$$

Mass of vapourized diesel fuel (1 percent of air mass):

$$m_d := 0.01 \cdot m_a = 0.00816\ kg$$

Volume vapourized diesel fuel:

$$V_d := \frac{m_d}{\rho_d} = 9.80\ mL$$

Volume Basis Calculation:

Mols air in engine compartment volume:

$$N_a := \frac{m_a}{\gamma_a} = 28.3\ mol$$

Mols of vapourized diesel fuel equivalent to 1 percent of the number of mols of air:

$$N_d := 0.01 \cdot N_a = 0.283\ mol$$

Equivalent mass of vapourized diesel fuel:

$$m_d := N_d \cdot \gamma_d = 56.6\ g$$

Volume of vapourized diesel fuel:

$$V_d := \frac{m_d}{\rho_d} = 68.0\ mL$$