Diesel – Prozess:

$$\varepsilon = \frac{V_1}{V_2} > 1 \qquad \varphi := \frac{V_3}{V_2} > 1$$

$$Q_{41} = m c_v (T_1 - T_4)$$

$$Q_{23} = m \underbrace{\varkappa c_v}_{c_p} (T_3 - T_2)$$

Isobaren $2 \to 3$

$$\frac{T_3}{T_2} = \frac{V_3}{V_2} = \varphi \Rightarrow T_3 = \varphi T_2$$

Isentropen $3 \to 4$, $1 \to 2$

$$\left(\frac{T_4}{T_3}\right) = \left(\frac{V_3}{V_4}\right)^{\varkappa-1} = \left(\frac{V_3}{V_2} \cdot \frac{V_2}{V_1}\right)^{\varkappa-1} = \varphi^{\varkappa-1} \left(\frac{V_2}{V_1}\right)^{\varkappa-1} = \varphi^{\varkappa-1} \frac{T_1}{T_2}$$

$$\Rightarrow T_4 = T_3 \varphi^{\varkappa-1} \frac{T_1}{T_2} = \varphi T_2 \cdot \varphi^{\varkappa-1} \frac{T_1}{T_2} = \varphi^{\varkappa} T_1$$

Wirkungsgrad

$$\eta_D = 1 + \frac{Q_{41}}{Q_{23}} = 1 - \frac{1}{\varkappa} \frac{T_4 - T_1}{T_3 - T_2}$$

$$= 1 - \frac{1}{\varkappa} \frac{\varphi^{\varkappa} T_1 - T_1}{\varphi T_2 - T_2}$$

$$= 1 - \frac{1}{\varkappa} \frac{\varphi^{\varkappa} - 1}{\varphi - 1} \frac{T_1}{T_2}$$

$$\underline{= 1 - \frac{1}{\varepsilon^{\varkappa-1}} \cdot \frac{1}{\varkappa} \cdot \frac{\varphi^{\varkappa} - 1}{\varphi - 1}}$$

Analyse der Formel

$$f(q) = \frac{q^{x} - 1}{q - 1}$$ monoton steigend

Optimum = Minimum, d.h. $q = 1$

$$\lim_{q \to 1} f(q) \underset{\text{l'Hospital}}{=} \lim_{q \to 1} \frac{x\, q^{x-1}}{1} = x$$

$$\eta_D = 1 - \frac{1}{\varepsilon^{x-1}} \cdot \frac{1}{x} f(q) < 1 - \frac{1}{\varepsilon^{x-1}} \cdot \frac{1}{x} \cdot x = 1 - \frac{1}{\varepsilon^{x-1}} = \eta_0$$