Software Information

- Please check, whether your inputs, the equations applied and the charactersitics are displayed correctly.
- You are welcome to send your feedback via `https://github.com/oemof/tespy/issues`.
- LaTeXpackages required are:
  - graphicx
  - float
  - hyperref
  - booktabs
  - amsmath
  - units
  - cleveref
- To supress these messages, call the model documentation with the keyword draft=False.

TESPy Version:	0.4.0 - dev
Commit:	d918f10d@feature/self_documenting_models
CoolProp version:	6.4.0
Python version:	3.8.0 (default, Oct 28 2019, 16:14:01) [GCC 8.3.0]

1 Connections in offdesign mode

1.1 Specified connection parameters

label	T in °C (1)	p in bar (2)	m in kg/s (3)
fuel:out1_combustion engine:in4	30.000	-	-
ambient:out1_combustion engine:in3	30.000	5.000	-
cooling water inlet1:out1_combustion engine:in1	60.000	3.000	50.000
cooling water inlet2:out1_combustion engine:in2	80.000	3.000	50.000

Table 1: Specified connection parameters

1.2 Equations applied

$$0 = T\left(p, h\right) - T_{\mathrm{spec}} \tag{1}$$

$$0 = p - p_{\mathrm{spec}} \tag{2}$$

$$0 = \dot{m} - \dot{m}_{\mathrm{spec}} \tag{3}$$

1.3 Specified fluids

label	Ar (4)	CH4 (5)	CO2 (6)	H2O (7)	N2 (8)	O2 (9)
fuel:out1_combustion engine:in4	0.000	1.000	0.000	0.000	0.000	0.000
ambient:out1_combustion engine:in3	0.013	0.000	0.000	0.000	0.755	0.231
cooling water inlet1:out1_combustion engine:in1	0.000	0.000	0.000	1.000	0.000	0.000
cooling water inlet2:out1_combustion engine:in2	0.000	0.000	0.000	1.000	0.000	0.000

Table 2: Specified fluids

1.4 Equations applied

$$0 = x_{\mathrm{Ar}} - x_{\mathrm{Ar,spec}} \tag{4}$$

$$0 = x_{\mathrm{CH4}} - x_{\mathrm{CH4,spec}} \tag{5}$$

$$0 = x_{\mathrm{CO2}} - x_{\mathrm{CO2,spec}} \tag{6}$$

$$0 = x_{\mathrm{H2O}} - x_{\mathrm{H2O,spec}} \tag{7}$$

$$0 = x_{\mathrm{N2}} - x_{\mathrm{N2,spec}} \tag{8}$$

$$0 = x_{\mathrm{O2}} - x_{\mathrm{O2,spec}} \tag{9}$$

2 Components in offdesign mode

2.1 Components of type CombustionEngine

2.1.1 Mandatory constraints

$$\begin{aligned}0 =& \dot{m}_{\mathrm{in},1} - \dot{m}_{\mathrm{out},1}\\ 0 =& \dot{m}_{\mathrm{in},2} - \dot{m}_{\mathrm{out},2}\\ 0 =& \dot{m}_{\mathrm{in},3} + \dot{m}_{\mathrm{in},3} - \dot{m}_{\mathrm{out},3}\end{aligned} \tag{10}$$

$$0 = x_{i,\mathrm{in},j} - x_{i,\mathrm{out},j} \; \forall i \in \text{network fluids}, \forall j \in [1,2] \tag{11}$$

$$\begin{aligned}0 =& p_{\mathrm{in},3} - p_{\mathrm{out},3}\\ 0 =& p_{\mathrm{in},3} - p_{\mathrm{in},4}\end{aligned} \tag{12}$$

$$\begin{aligned}&\Delta \dot{m}_{\mathrm{fluid}} = \dot{m}_{\mathrm{in},3} \cdot x_{\mathrm{fluid,in},3} + \dot{m}_{\mathrm{in},4} \cdot x_{\mathrm{fluid,in},4} - \dot{m}_{\mathrm{out},3} \cdot x_{\mathrm{fluid,out},3}\\ &\dot{m}_{\mathrm{fluid,m}} = \frac{\dot{m}_{\mathrm{in},3} \cdot x_{\mathrm{fluid,in},3} + \dot{m}_{\mathrm{in},4} \cdot x_{\mathrm{fluid,in},4}}{M_{\mathrm{fluid}}}\\ &\dot{m}_{\mathrm{H,m}} = \dot{m}_{\mathrm{CH4,m}} \cdot 4\\ &\dot{m}_{\mathrm{C,m}} = \dot{m}_{\mathrm{CH4,m}} \cdot 1\\ &\dot{m}_{\mathrm{O2,m,stoich}} = \frac{\dot{m}_{\mathrm{H,m}}}{4} + \dot{m}_{\mathrm{C,m}}\end{aligned} \tag{13}$$

$$0 = \Delta \dot{m}_{\mathrm{Ar}} \tag{14}$$

$$0 = \Delta \dot{m}_{\mathrm{CH4}} - \dot{m}_{\mathrm{CH4,m}} \cdot M_{\mathrm{CH4}} \tag{15}$$

$$0 = \Delta \dot{m}_{\mathrm{CO2}} + \dot{m}_{\mathrm{C,m}} \cdot M_{\mathrm{CO2}} \tag{16}$$

$$0 = \Delta \dot{m}_{\mathrm{H2O}} + \frac{\dot{m}_{\mathrm{H,m}}}{2} \cdot M_{\mathrm{H2O}} \tag{17}$$

$$0 = \Delta \dot{m}_{\mathrm{N2}} \tag{18}$$

$$0 = \Delta \dot{m}_{\mathrm{O2}} - \dot{m}_{\mathrm{O2,m,stoich}} \cdot M_{\mathrm{O2}} \tag{19}$$

$$\begin{aligned}0 =& \sum_i \dot{m}_{\mathrm{in},i} \cdot \left(h_{\mathrm{in},i} - h_{\mathrm{in},i,\mathrm{ref}}\right) - \dot{m}_{\mathrm{out},3} \cdot \left(h_{\mathrm{out},3} - h_{\mathrm{out},3,\mathrm{ref}}\right)\\ &+ LHV_{fuel} \cdot \left(\sum_i \dot{m}_{\mathrm{in},i} \cdot x_{fuel,\mathrm{in},i} - \dot{m}_{\mathrm{out},3} \cdot x_{fuel,\mathrm{out},3}\right)\\ &+ \dot{Q}_1 + \dot{Q}_2 + P + \dot{Q}_{\mathrm{loss}}\\ &\forall i \in [3,4]\\ &T_{\mathrm{ref}} = 298.15\,\mathrm{K}\; p_{\mathrm{ref}} = 10^5\,\mathrm{Pa}\end{aligned} \tag{20}$$

$$\begin{aligned}0 =& P \cdot f_{\mathrm{TI}}\left(\frac{P}{P_{\mathrm{design}}}\right)\\ &+ LHV_{fuel} \cdot \left[\sum_i \left(\dot{m}_{\mathrm{in},i} \cdot x_{fuel,\mathrm{in},i}\right) - \dot{m}_{\mathrm{out},3} \cdot x_{fuel,\mathrm{out},3}\right]\\ &\forall i \in [3,4]\end{aligned} \tag{21}$$

$$
\begin{aligned}
0 =& LHV_{fuel} \cdot \left[\sum_i \left(\dot{m}_{\text{in},i} \cdot x_{fuel,\text{in},i} \right) - \dot{m}_{\text{out},3} \cdot x_{fuel,\text{out},3} \right] \cdot f_{\text{Q1}} \left(\frac{P}{P_{\text{design}}} \right) \\
& - \dot{m}_{\text{in},1} \cdot \left(h_{\text{out},1} - h_{\text{in},1} \right) \cdot f_{\text{TI}} \left(\frac{P}{P_{\text{design}}} \right) \\
& \forall i \in [3, 4]
\end{aligned} \tag{22}
$$

$$
\begin{aligned}
0 =& LHV_{fuel} \cdot \left[\sum_i \left(\dot{m}_{\text{in},i} \cdot x_{fuel,\text{in},i} \right) - \dot{m}_{\text{out},3} \cdot x_{fuel,\text{out},3} \right] \cdot f_{\text{Q2}} \left(\frac{P}{P_{\text{design}}} \right) \\
& - \dot{m}_{\text{in},2} \cdot \left(h_{\text{out},2} - h_{\text{in},2} \right) \cdot f_{\text{TI}} \left(\frac{P}{P_{\text{design}}} \right) \\
& \forall i \in [3, 4]
\end{aligned} \tag{23}
$$

$$
\begin{aligned}
0 =& LHV_{fuel} \cdot \left[\sum_i \left(\dot{m}_{\text{in},i} \cdot x_{fuel,\text{in},i} \right) - \dot{m}_{\text{out},3} \cdot x_{fuel,\text{out},3} \right] \cdot f_{\text{QLOSS}} \left(\frac{P}{P_{\text{design}}} \right) \\
& + \dot{Q}_{\text{loss}} \cdot f_{\text{TI}} \left(\frac{P}{P_{\text{design}}} \right) \\
& \forall i \in [3, 4]
\end{aligned} \tag{24}
$$

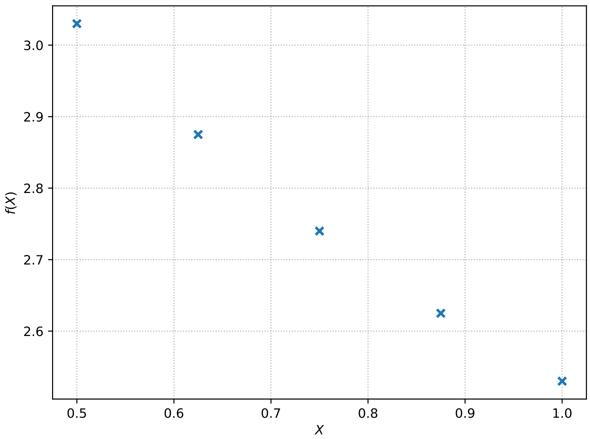

Figure 1: Characteristics of combustion engine (eq. 21)

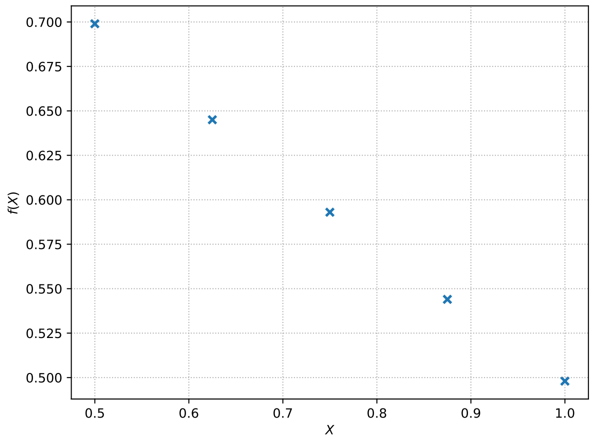

Figure 2: Characteristics of combustion engine (eq. 22)

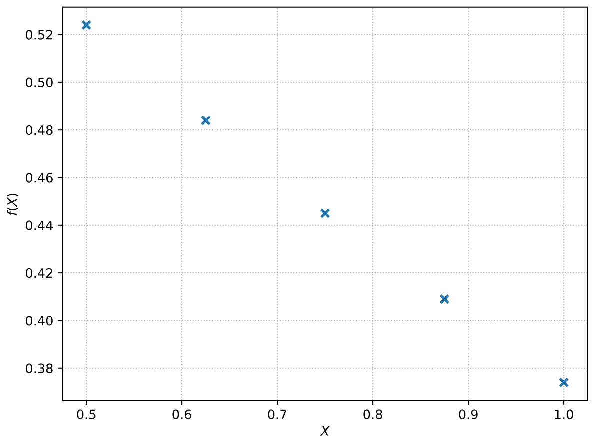

Figure 3: Characteristics of combustion engine (eq. 23)

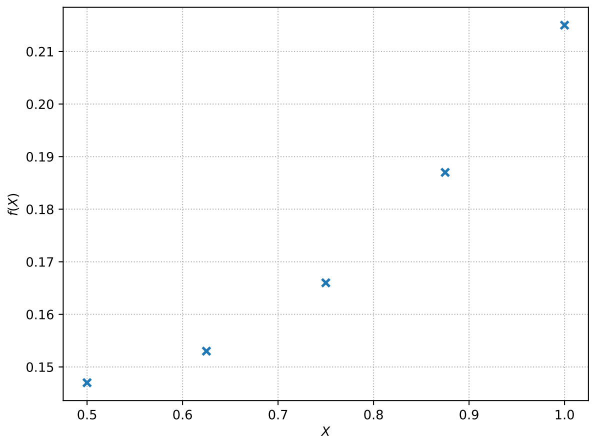

Figure 4: Characteristics of combustion engine (eq. 24)

2.1.2 Inputs specified

label	lamb (25)	pr1 (26)	pr2 (27)
combustion engine	1.200	0.990	0.990

Table 3: Parameters of components of type CombustionEngine

2.1.3 Equations applied

$$0 = \frac{\dot{m}_{\text{fuel,m}}}{\dot{m}_{\text{O}_2\text{,m}} \cdot (n_{\text{C,fuel}} + 0.25 \cdot n_{\text{H,fuel}})} - \lambda$$
$$\dot{m}_{\text{fluid,m}} = \frac{x_{\text{fluid}} \cdot \dot{m}}{M_{\text{fluid}}} \tag{25}$$

$$0 = p_{\text{in,1}} \cdot pr1 - p_{\text{out,1}} \tag{26}$$

$$0 = p_{\text{in,2}} \cdot pr2 - p_{\text{out,2}} \tag{27}$$