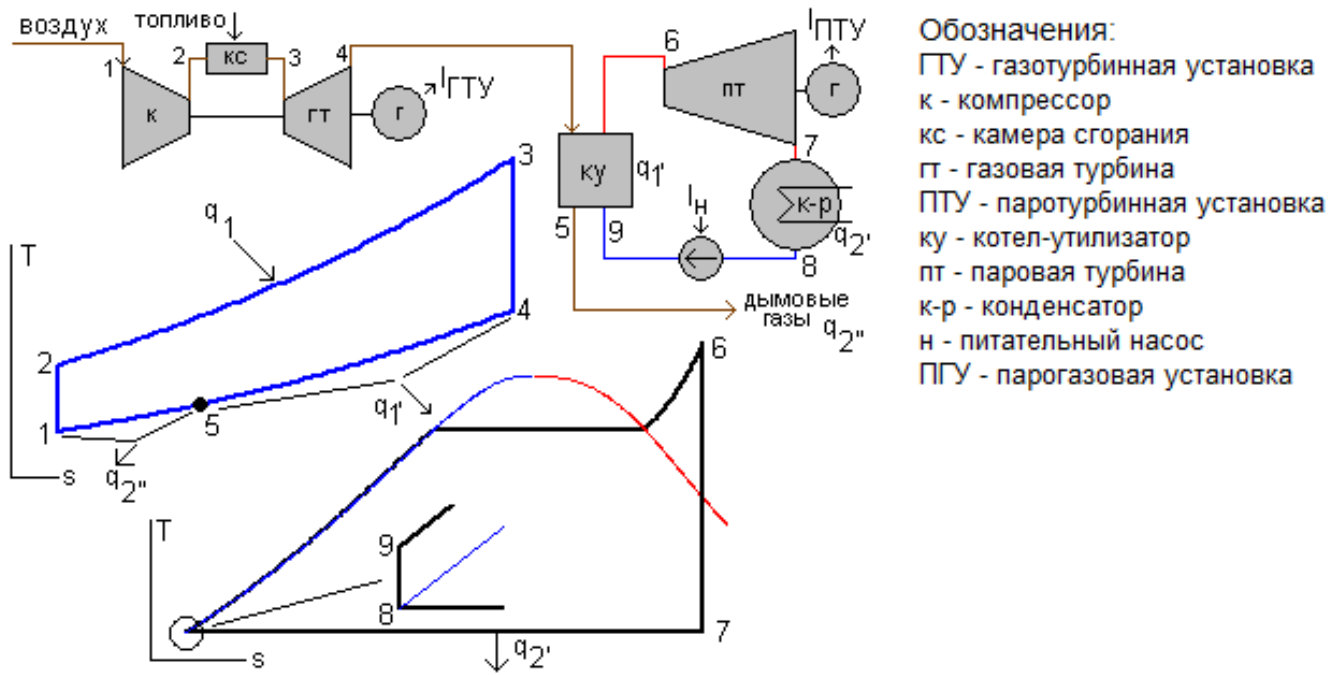


Author: Valery Ochkov (ochkov@twi.mpei.ac.ru), Aung Thu Ya Tun (aungthuyatun198@gmail.com),
 Moscow Power Engineering Institute (MPEI)



Start

```
[> restart
[> with(Units[Standard]) :
[> with(ThermophysicalData) :
[> Digits := 20 :
```

```
[> t6 := (480 + 273.15) K
t6 := 753.15 K (2.1)
```

```
[> p6 := 9 MPa
p6 := 9 MPa (2.2)
```

```
[> p7 := 4.76 kPa
p7 := 4.76 kPa (2.3)
```

$$h_6 := \text{Property}(\text{enthalpy, pressure} = p_6, \text{temperature} = t_6, \text{water}) :$$

$$s_6 := \text{Property}(\text{entropy, pressure} = p_6, \text{temperature} = t_6, \text{water}) :$$

$$s_7 := s_6 :$$

$$x_7 := \text{Property}(Q, P = p_7, \text{entropy} = s_7, \text{water})$$

$$77,13\% \quad (2.4)$$

$$t_7 := \text{Property}(\text{temperature, pressure} = p_7, Q = 1, \text{water}) : t_7 - 273.15 \text{ K}$$

$$32,00 \text{ }^\circ\text{C} \quad (2.5)$$

$$h_7 := \text{Property}(\text{enthalpy, } T = t_7, Q = x_7, \text{water})$$

$$2\,004,4 \frac{\text{kJ}}{\text{kg}} \quad (2.6)$$

$$I_{III} := h_6 - h_7$$

$$1\,332,0 \frac{\text{kJ}}{\text{kg}} \quad (2.7)$$

$$hw_7 := \text{Property}(\text{enthalpy, } T = t_7, Q = 0, \text{water})$$

$$134,1 \frac{\text{kJ}}{\text{kg}} \quad (2.8)$$

$$sw_7 := \text{Property}(\text{entropy, } T = t_7, Q = 0, \text{water})$$

$$,4643 \frac{\text{kJ}}{\text{kg K}} \quad (2.9)$$

$$h_8 := hw_7$$

$$134,1 \frac{\text{kJ}}{\text{kg}} \quad (2.10)$$

$$p_9 := p_6$$

$$9,0 \text{ MPa} \quad (2.11)$$

$$s_9 := sw_7$$

$$464,3 \frac{\text{J}}{\text{kg K}} \quad (2.12)$$

$$\begin{aligned} > t_9 := \text{Property}(\text{temperature, pressure} = p_9, \text{entropy} = s_9, \text{water}) : t_9 - 273.15\text{K} \\ & \qquad \qquad \qquad 32,22 \text{ }^\circ\text{C} \end{aligned} \quad (2.13)$$

$$\begin{aligned} & : \\ > h_9 := \text{Property}(\text{enthalpy, pressure} = p_9, \text{temperature} = t_9, \text{water}) \\ & \qquad \qquad \qquad 143,1 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (2.14)$$

$$\begin{aligned} & : \\ > I_{III} := h_9 - h_8 \\ & \qquad \qquad \qquad 9,023 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (2.15)$$

$$\begin{aligned} & , \quad : \\ > q_1 := h_6 - h_9 \\ & \qquad \qquad \qquad 3\,193,3 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (2.16)$$

$$\begin{aligned} & : \\ > \eta_{III} := \frac{I_{III} - I_{III}}{q_1} \\ & \qquad \qquad \qquad 41,43\% \end{aligned} \quad (2.17)$$

$$\begin{aligned} & : \\ > t_1 := (15 + 273.15) \text{K} : \\ > p_1 := 0.1 \text{MPa} : \\ > p_2 := 1 \text{MPa} : \\ > t_3 := (1100 + 273.15) \text{K} : \\ > t_5 := (130 + 273.15) \text{K} : \\ & : \\ > h_1 := \text{Property}(\text{enthalpy, pressure} = p_1, \text{temperature} = t_1, \text{air}) \\ & \qquad \qquad \qquad 414377,83 \frac{\text{J}}{\text{kg}} \end{aligned} \quad (3.1)$$

$$\begin{aligned} & : \\ > s_1 := \text{Property}(\text{entropy, pressure} = p_1, \text{temperature} = t_1, \text{air}) \\ & \qquad \qquad \qquad 3849,95 \frac{\text{J}}{\text{kg K}} \end{aligned} \quad (3.2)$$

$$\begin{aligned} & : \\ > s_2 := s_1 : \\ & : \\ > t_2 := \text{Property}(\text{temperature, pressure} = p_2, \text{entropy} = s_2, \text{air}) : t_2 - 273.15\text{K} \\ & \qquad \qquad \qquad 279,46 \text{ }^\circ\text{C} \end{aligned} \quad (3.3)$$

$$\begin{aligned} > h_2 := \text{Property}(\text{enthalpy, pressure} = p_2, \text{temperature} = t_2, \text{air}) \\ & \qquad \qquad \qquad 683,60 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (3.4)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > p_3 := p_2 : \\ & \qquad \qquad \qquad : \\ > s_3 := \text{Property}(\text{entropy, pressure} = p_3, \text{temperature} = t_3, \text{air}) \\ & \qquad \qquad \qquad 4,867 \frac{\text{kJ}}{\text{kg K}} \end{aligned} \quad (3.5)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > h_3 := \text{Property}(\text{enthalpy, pressure} = p_3, \text{temperature} = t_3, \text{air}) \\ & \qquad \qquad \qquad 1\,610,34 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (3.6)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > p_4 := p_1 : \\ & \qquad \qquad \qquad : \\ > s_4 := s_3 : \\ & \qquad \qquad \qquad : \\ > t_4 := \text{Property}(\text{temperature, pressure} = p_4, \text{entropy} = s_4, \text{air}) : t_4 - 273.15\text{K} \\ & \qquad \qquad \qquad 498,01 \text{ }^\circ\text{C} \end{aligned} \quad (3.7)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > h_4 := \text{Property}(\text{enthalpy, pressure} = p_4, \text{temperature} = t_4, \text{air}) \\ & \qquad \qquad \qquad 916,82 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (3.8)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > q_1 := h_3 - h_2 \\ & \qquad \qquad \qquad 926,74 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (3.9)$$

$$\begin{aligned} > I_{IT} := h_3 - h_4 \\ & \qquad \qquad \qquad 693,52 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (3.10)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > I_K := h_2 - h_1 \\ & \qquad \qquad \qquad 269,23 \frac{\text{kJ}}{\text{kg}} \end{aligned} \quad (3.11)$$

$$\begin{aligned} & \qquad \qquad \qquad : \\ > \eta_{ITV} := \frac{I_{IT} - I_K}{q_1} \\ & \qquad \qquad \qquad 45,78\% \end{aligned} \quad (3.12)$$

()

> $p_5 := p_4 :$

- :

> $h_5 := \text{Property}(\text{enthalpy, pressure} = p_5, \text{temperature} = t_5, \text{air})$

$$530,5 \frac{\text{kJ}}{\text{kg}} \quad (4.1)$$

> $m := \frac{h_6 - h_9}{h_4 - h_5}$

$$8,265 \quad (4.2)$$

, :

> $q_1 := m \cdot (h_3 - h_2)$

$$7\,659,4 \frac{\text{kJ}}{\text{kg}} \quad (4.3)$$

:

> $I_{\text{ГТГ}} := (h_3 - h_4) - (h_2 - h_1)$

$$424,3 \frac{\text{kJ}}{\text{kg}} \quad (4.4)$$

:

> $I_{\text{ИГГ}} := (h_6 - h_7) - (h_9 - h_8)$

$$1\,323,0 \frac{\text{kJ}}{\text{kg}} \quad (4.5)$$

:

> $\eta_{\text{ИГГ}} := \frac{m \cdot I_{\text{ГТГ}} + I_{\text{ИГГ}}}{q_1}$

$$63,06\% \quad (4.6)$$