Změna stavu	Definiční rovnice	Teplo [J]	Objemová práce	Technická práce [J]	$\frac{A_{1,2}}{Q_{1,2}}$	$\frac{A_{t\,1,2}}{Q_{1,2}}$
dp = 0	$p_1 = p_2 = p$	$Q_{1,2} = m\,(h_2 - h_1)$ $= m\,c_p\,(T_2 - T_1)$ $= \frac{\kappa}{\kappa - 1}\,p\,(V_2 - V_1)$	$A_{1,2} = p\,(V_2 - V_1)$ $= m\,r\,(T_2 - T_1) = \frac{\kappa - 1}{\kappa} Q_{1,2}$ $= \frac{r}{c_p} Q_{1,2}$	$A_{t\,1,2} = 0$	$\frac{\kappa - 1}{\kappa}$	0
dV = 0	$V_1 = V_2 = V$	$Q_{1,2} = m\,(u_2 - u_1)$ $= m\,c_v\,(T_2 - T_1)$ $= \frac{1}{\kappa - 1} V\,(p_2 - p_1)$	$A_{1,2} = 0$	$A_{t\,1,2} = V\,(p_2 - p_1)$ $= m\,r\,(T_1 - T_2)$ $= (\kappa - 1)\,(-Q_{1,2})$	0	$1 - \kappa$
dT = 0	$T_1 = T_2 = T$	$Q_{1,2} = A_{1,2} = A_{t\,1,2} = m\,r\,T\,ln\frac{p_1}{p_2} = p_1 V_1\,ln\frac{V_2}{V_1}$			1	1
dq = 0 ds = 0	$Q_{1,2} = 0$ $p\,V^{\kappa} = konst.$	$Q_{1,2} = 0$	$A_{1,2} = m(u_1 - u_2) = \frac{m\,r}{\kappa - 1}\,(T_1 - T_2)$ $= \frac{1}{\kappa - 1}\,p_1 V_1 \left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{\kappa - 1}{\kappa}}\right]$ $= \frac{1}{\kappa - 1}(p_1 V_1 - p_2 V_2)$	$A_{t1,2} = \kappa\,A_{1,2} = \frac{\kappa}{\kappa - 1} m\,r\,(T_1 - T_2)$ $= \frac{\kappa}{\kappa - 1}\,p_1 V_1 \left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{\kappa - 1}{\kappa}}\right]$ $= \frac{\kappa}{\kappa - 1}(p_1 V_1 - p_2 V_2)$	∞	∞
n	$p\,V^{n} = konst.$	$Q_{1,2} = m\,c_v \frac{n - \kappa}{n - 1}(T_2 - T_1)$ $= A_{1,2} \frac{\kappa - n}{\kappa - 1}$ $= A_{t\,1,2} \frac{\kappa - n}{n\,(\kappa - 1)}$	$A_{1,2} = \frac{m\,r}{n - 1}\,(T_1 - T_2)$ $= \frac{1}{n - 1}\,p_1 V_1 \left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{n - 1}{n}}\right]$ $= \frac{1}{n - 1}(p_1 V_1 - p_2 V_2)$	$A_{t1,2} = \frac{n}{n - 1}\,m\,r\,(T_1 - T_2)$ $= \frac{n}{n - 1}\,p_1 V_1 \left[1 - \left(\frac{p_2}{p_1}\right)^{\frac{n - 1}{n}}\right]$ $= \frac{n}{n - 1}(p_1 V_1 - p_2 V_2)$ $= n\,A_{t\,1,2}$	$\frac{r}{c_v(\kappa - n)}$ $\frac{\kappa - 1}{\kappa - n}$	$\frac{n\,r}{c_v(\kappa - n)}$ $n\frac{\kappa - 1}{\kappa - n}$

$(T,v)\quad s_2 - s_1 = c_v \ln\frac{T_2}{T_1} + r \ln\frac{v_2}{v_1}$ $(T,p)\quad s_2 - s_1 = c_p \ln\frac{T_2}{T_1} - r \ln\frac{p_2}{p_1}$ $(v,p)\quad s_2 - s_1 = c_p \ln\frac{v_2}{v_1} + c_v \ln\frac{p_2}{p_1}$

	Změna teploty tlaku a objemu	**Změna entropie**	**Změna vnitřní energie**	**Změna entalpie**
dp = 0	$\frac{T_1}{V_1} = \frac{T_2}{V_2} = \frac{p}{m\,r}$	$\Delta S_{12} = S_2 - S_1 = m\,c_p \ln\frac{T_2}{T_1}$	$\Delta U_{12} = U_2 - U_1 = m\,c_v\,(T_2 - T_1)$	$\Delta H_{12} = H_2 - H_1 = m\,c_p\,(T_2 - T_1)$
dv = 0	$\frac{T_1}{p_1} = \frac{T_2}{p_2} = \frac{V}{m\,r}$	$\Delta S_{12} = S_2 - S_1 = m\,c_v \ln\frac{T_2}{T_1}$	$\Delta U_{12} = U_2 - U_1 = m\,c_v\,(T_2 - T_1)$	$\Delta H_{12} = H_2 - H_1 = m\,c_p\,(T_2 - T_1)$
dT = 0	$p_1 V_1 = p_2 V_2 = m\,r\,T$	$\Delta S_{12} = S_2 - S_1 = m\,r \ln\frac{V_2}{V_1} = m\,r \ln\frac{p_1}{p_2}$	$U_2 = U_1$	$H_2 = H_1$
dq = 0	$p_1 V_1^{\kappa} = p_2 V_2^{\kappa}$ $\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\frac{\kappa-1}{\kappa}} = \left(\frac{V_1}{V_2}\right)^{\kappa-1}$	$S_1 = S_2 = S$	$\Delta U_{12} = U_2 - U_1 = m\,c_v\,(T_2 - T_1)$	$\Delta H_{12} = H_2 - H_1 = m\,c_p\,(T_2 - T_1)$
n	$p_1 V_1^{n} = p_2 V_2^{n}$ $\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}} = \left(\frac{V_1}{V_2}\right)^{n-1}$	$\Delta S_{12} = S_2 - S_1 = m\,c_v \frac{n-\kappa}{n-1} \ln\frac{T_2}{T_1}$	$\Delta U_{12} = U_2 - U_1 = m\,c_v\,(T_2 - T_1)$	$\Delta H_{12} = H_2 - H_1 = m\,c_p\,(T_2 - T_1)$

$$p\,v = r\,T$$

$$p\,V = m\,r\,T$$

$$p\,V = n\,R_m\,T$$

NFP p = 101325 Pa T = 273,15 K $V_m = 22{,}4136\ m^3.kmol^{-1}$

Pro vzduch (směs N2 a O2) r = 287,04 J.kg-1.K-1

1-atomové plyny **$\kappa = 1{,}67$**

2-atomové plyny **$\kappa = 1{,}41$**

3-atomové plyny **$\kappa = 1{,}30$**

$$R_m = 8314{,}3\ J\ kmol^{-1}\ K^{-1}$$

$$r = \frac{R_m}{M}$$

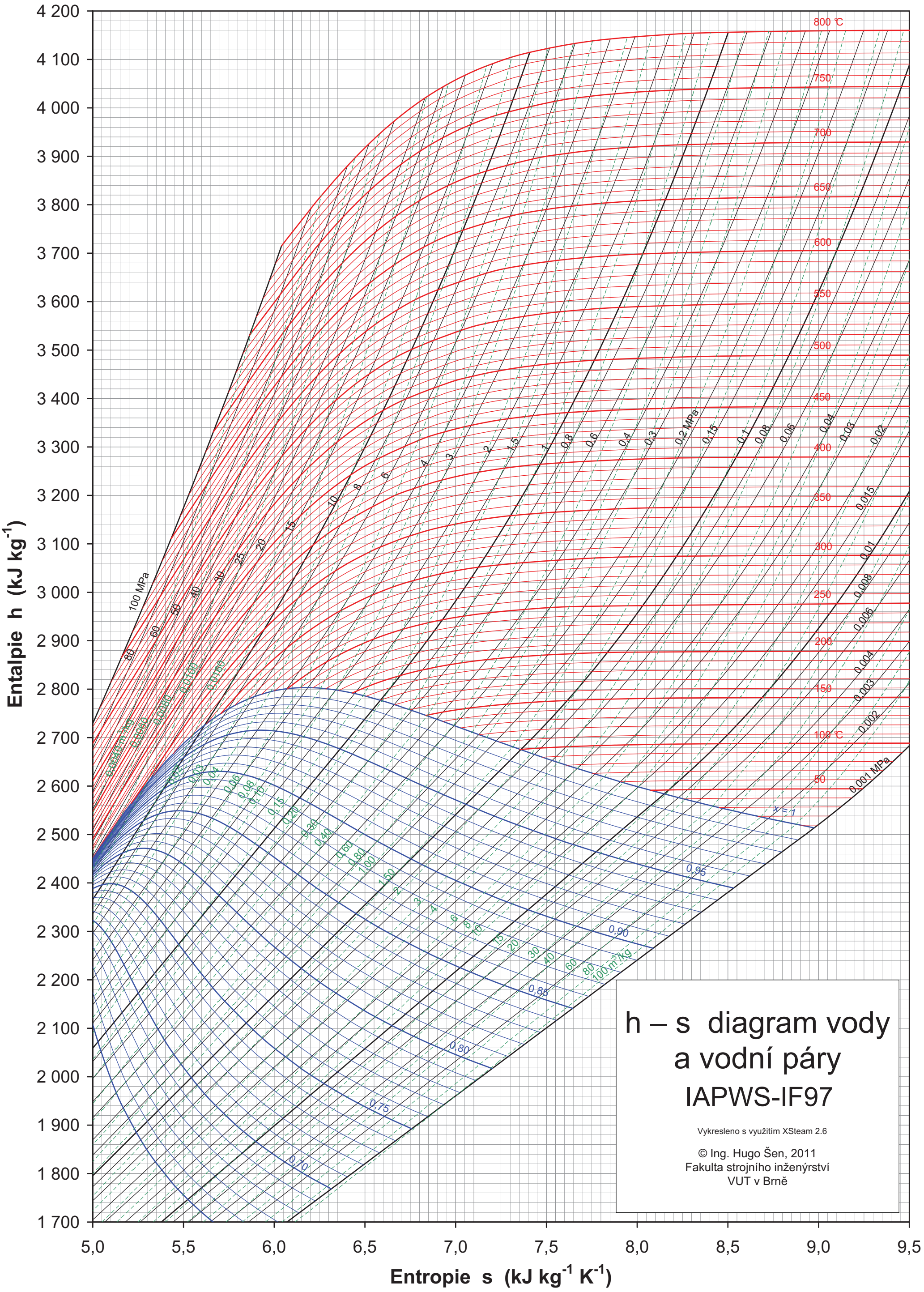
$$c_p = c_v + r$$

$$\kappa = \frac{c_p}{c_v}$$

$$c_p = \frac{\kappa}{\kappa - 1} r$$

$$c_v = \frac{1}{\kappa - 1} r$$

Plyn	M [kg.kmol^{-1}]
H_2	2
N_2	28
O_2	32
C	12
CO_2	44


Entalpie h (kJ kg-1)
Entropie s (kJ kg-1 K-1)
4 200
4 100
4 000
3 900
3 800
3 700
3 600
3 500
3 400
3 300
3 200
3 100
3 000
2 900
2 800
2 700
2 600
2 500
2 400
2 300
2 200
2 100
2 000
1 900
1 800
1 700
5,0
5,5
6,0
6,5
7,0
7,5
8,0
8,5
9,0
9,5
800 °C
750
700
650
600
550
500
450
400
350
300
250
200
150
100 °C
50
100 MPa
80
60
50
40
30
25
20
15
10
8
6
4
3
2
1,5
1
0,8
0,6
0,4
0,3
0,2 MPa
0,15
0,1
0,08
0,06
0,04
0,03
0,02
0,015
0,01
0,008
0,006
0,004
0,003
0,002
0,001 MPa
0,0010 m3/kg
0,0020
0,0040
0,0060
0,0080
0,0100
0,0120
0,0140
0,0160
0,0180
0,002
0,003
0,004
0,006
0,08
0,10
0,15
0,20
0,30
0,40
0,60
0,80
1,00
1,50
2
3
4
6
8
10
15
20
30
40
60
80
100 m3/kg
x = 1
0,95
0,90
0,85
0,80
0,75
0,70
h – s diagram vody
a vodní páry
IAPWS-IF97
Vykresleno s využitím XSteam 2.6
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