Zustandsänderungen idealer Gase (reversibel ($ds_{irr} = 0$), potentielle und kinetische Energie vernachlässigt, $c_n = const.$)

	Isotherme $dT = 0$	**Isobare** $dp = 0$	**Isochore** $dv = 0$	**Isentrope (reversibel adiabat)** $ds = 0$ $(dq = 0)$	**Polytrope** $\frac{dT/T}{dp/p} = \frac{n-1}{n} = const$
Vergleichsprozess für	Ăperfektñ gekühlter Verdichter, Ăperfektñbeheizte Turbine	reib.freies Kolbenï Zylinder Syst. WÜ mit reib.freier Strömung	fest verschlossener Behälter	wärmedichtes System adiabate Turbine/Verdichter	allgenmein alle Zustandsänderungen (oft: gekühlter Verdichter, beheizte Turbine)
Polytropenexponent n $p\,v^n = const.$	$n = 1$ $p\,v = const..$	$n = 0$ $p = const..$	$n = \pm\infty$ $p^{1/\infty} v = v = const.$	$n = \kappa$ $p\,v^\kappa = const.$	$0 < n < \infty$ (oft: $1 < n < \kappa$) $p\,v^n = const.$
spez. **Wärmekapazität** c_n $(R_k = c_p - c_v)$	$c_T = \infty$	$c_p = \left(\frac{\partial h}{\partial T}\right)_p$	$c_v = \left(\frac{\partial u}{\partial T}\right)_v$	$c_s = 0$ $\left[\kappa = \frac{c_p}{c_v}\right]$	$c_n = c_v \frac{n-\kappa}{n-1} = \frac{c_p}{\kappa}\frac{n-\kappa}{(n-1)}$
thermische Zustandsgleichung ideales Gas $p\,v = R_k T$ $[p\,V = m\,R_k T]$ $\frac{p_1 v_1}{T_1} = \frac{p_2 v_2}{T_2}$	$\frac{p_1}{p_2} = \frac{v_2}{v_1}$ $p_1 v_1 = p_2 v_2$	$\frac{v_1}{T_1} = \frac{v_2}{T_2}$	$\frac{p_1}{T_1} = \frac{p_2}{T_2}$	$\frac{p_2}{p_1} = \left(\frac{v_1}{v_2}\right)^\kappa$ $\frac{T_2}{T_1} = \left(\frac{v_1}{v_2}\right)^{\kappa-1}$ $\frac{p_2}{p_1} = \left(\frac{T_2}{T_1}\right)^{\frac{\kappa}{\kappa-1}}$	$\frac{v_2}{v_1} = \left(\frac{p_1}{p_2}\right)^{\frac{1}{n}}$ $\frac{v_2}{v_1} = \left(\frac{T_1}{T_2}\right)^{\frac{1}{n-1}}$ $\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}}$
spez. **physikalische Arbeit** $w_{12} = -\int p dv$ $w_{12} = \frac{w_{t12}}{n}$	$w_{12} = -R_k T \ln\left(\frac{v_2}{v_1}\right)$ $w_{12} = -p_1 v_1 \ln\left(\frac{v_2}{v_1}\right)$	$w_{12} = -p(v_2 - v_1)$ $w_{12} = -R_k(T_2 - T_1)$	$w_{12} = 0$	$w_{12} = c_v(T_2 - T_1) = \Delta u$ $w_{12} = \frac{1}{\kappa-1}(p_2 v_2 - p_1 v_1)$ $w_{12} = \frac{R_K T_1}{\kappa - 1}\left(\left(\frac{v_1}{v_2}\right)^{\kappa-1} - 1\right)$	$w_{12} = \frac{1}{n-1} R_K (T_2 - T_1)$ $w_{12} = \frac{1}{n-1}(p_2 v_2 - p_1 v_1)$ $w_{12} = \frac{p_1 v_1}{n-1}\left(\left(\frac{v_1}{v_2}\right)^{n-1} - 1\right)$ $w_{12} = \frac{\kappa-1}{n-\kappa} q_{12}$
spez. **technische Arbeit** $w_{t12} = \int v dp$ $w_{t12} = n\,w_{12}$	$w_{t12} = w_{12}$ $w_{t12} = R_k T \ln\left(\frac{p_2}{p_1}\right)$	$w_{t12} = 0$	$w_{t12} = v(p_2 - p_1)$ $w_{t12} = R_k(T_2 - T_1)$	$w_{t12} = \kappa\,w_{12}$ $w_{t12} = c_p(T_2 - T_1) = \Delta h$ $w_{t12} = c_p T_1\left(\left(\frac{p_2}{p_1}\right)^{\frac{\kappa-1}{\kappa}} - 1\right)$	$w_{t12} = n\,w_{12}$ $w_{t12} = \frac{n}{n-1} R_K (T_2 - T_1)$ $w_{t12} = \frac{n}{n-1} R_K T_1\left(\left(\frac{p_2}{p_1}\right)^{\frac{n-1}{n}} - 1\right)$
spez**. Wärme** $q_{12} = c_n(T_2 - T_1)$	$q_{12} = \infty 0 = -w_{12}$ $q_{12} = -w_{t12}$	$q_{12} = c_p \Delta T$ $q_{12} = \frac{\kappa}{\kappa-1} p\,(v_2 - v_1)$	$q_{12} = c_v \Delta T$ $q_{12} = \frac{1}{\kappa-1} v\,(p_2 - p_1)$	$q_{12} = 0$	$q_{12} = c_n \Delta T$ $q_{12} = \frac{n-\kappa}{\kappa-1} w_{12} = \frac{n-\kappa}{\kappa-1}\frac{w_{t12}}{n}$
spez. **Änderung innere Energie** $\Delta u = q_{12} + w_{12} = c_v(T_2 - T_1)$	$\Delta u = 0$	$\Delta u = q_{12} + w_{12} = c_v \Delta T$	$\Delta u = q_{12} = c_v \Delta T$	$\Delta u = w_{12} = c_v \Delta T$	$\Delta u = q_{12} + w_{12} = c_v \Delta T$
spez. **Enthalpieänderung** $\Delta h = q_{12} + w_{t12} = c_p(T_2 - T_1)$	$\Delta h = 0$	$\Delta h = q_{12} = c_p \Delta T$	$\Delta h = q_{12} + w_{t12} = c_p \Delta T$	$\Delta h = w_{t12} = c_p \Delta T$	$\Delta h = q_{12} + w_{t12} = c_p \Delta T$
spez. **Entropieänderung** $ds = \frac{dq}{T} + ds_{irr}$ hier: $(ds_{irr} = 0)$ $ds = \frac{dh - vdp}{T} = \frac{du + pdv}{T}$	$\Delta s = -R_k \ln\left(\frac{p_2}{p_1}\right) = \frac{q_{12}}{T}$	$\Delta s = c_p \ln\left(\frac{T_2}{T_1}\right)$	$\Delta s = c_v \ln\left(\frac{T_2}{T_1}\right)$	$\Delta s = 0$	$\Delta s = c_n \ln\left(\frac{T_2}{T_1}\right)$
	$\Delta s = c_p \ln\left(\frac{T_2}{T_1}\right) - R_k \ln\left(\frac{p_2}{p_1}\right) = c_v \ln\left(\frac{T_2}{T_1}\right) + R_k \ln\left(\frac{v_2}{v_1}\right)$ (gilt auch für irreversible ZÄ id. Gase)				
Besonderheiten für _reale_ Gase (auch Flüssigkeiten und Feststoffe) $dh = c_p\,dT + \left[v - T\left(\frac{\partial v}{\partial T}\right)_p\right] dp$	isotherm-isobare ZÄ. $\Delta h = \Delta^{\alpha\beta} h = q_{12}$ **mit Phasenänderung** $\Delta^{LV} h = h'' - h'$	$\Delta^{\alpha\beta} h$ Enthalpieänd.beim Verdampfen, Erstarren u.s.w $h_x = h' + x(h'' - h')$			
	inkompressible ($dv = 0$) Flüssigkeiten und Feststoffe **ohne Phasenänderung** $c_p \approx c_v$ $v = 1/\rho$				
	$w_{t12} = v \Delta p$	$\Delta h \approx \Delta u \approx c\,\Delta T$		$\Delta h = w_{t12} = v\,\Delta p$; $\Delta T \approx 0$	