Energiegleichung in integraler Form:

$$\int_V \frac{\partial}{\partial t}\left[\rho\left(e + \frac{\vec{v}^2}{2}\right)\right]dV + \int_O \rho\left(e + \frac{\vec{v}^2}{2}\right)(\vec{v}\cdot\vec{n})dO =$$

$$= \int_V \left(\rho\,\vec{v}\cdot\vec{f}^B\right)dV - \int_O \left(p\,\vec{v}\cdot\vec{n}\right)dO +$$

$$+ \int_O \left(\vec{v}\cdot\vec{\tau}_x\right)n_x dO + \int_O \left(\vec{v}\cdot\vec{\tau}_y\right)n_y dO + \int_O \left(\vec{v}\cdot\vec{\tau}_z\right)n_z dO +$$

$$- \int_O \left(\vec{q}\cdot\vec{n}\right)dO + \int_V \dot{q}_Q dV$$

Für Festkörper gilt: $\vec{v} = 0$, $\vec{\tau} = 0$

$$\Rightarrow \quad \int_V \frac{\partial}{\partial t}\left[\rho\,e\right]dV = -\int_O \left(\vec{q}\cdot\vec{n}\right)dO + \int_V \dot{q}_Q dV$$

Energiegleichung in differentieller Form:

$$\frac{\partial}{\partial t}\left[\rho\left(e + \frac{\vec{v}^2}{2}\right)\right] + \left(\vec{\nabla}\cdot\rho\vec{v}\left(e + \frac{\vec{v}^2}{2}\right)\right) =$$

$$= \rho\left(\vec{v}\cdot\vec{f}^B\right) - \left(\vec{\nabla}\cdot p\,\vec{v}\right) + \frac{\partial}{\partial x}\left(u\tau_{xx} + v\tau_{xy} + w\tau_{xz}\right) +$$

$$+ \frac{\partial}{\partial y}\left(u\tau_{yx} + v\tau_{yy} + w\tau_{yz}\right) + \frac{\partial}{\partial z}\left(u\tau_{zx} + v\tau_{zy} + w\tau_{zz}\right) - \left(\vec{\nabla}\cdot\vec{q}\right) + \dot{q}_Q$$