Die Erhaltungssätze für Masse, Drehmoment und Energie können jeweils in differentieller Form oder Integralform geschreiben werden:

**Differentielle Form**

$$\frac{\partial \varrho}{\partial t} + \operatorname{div} \cdot (\varrho \vec{v}) = 0$$

$$\varrho \frac{\partial \vec{v}}{\partial t} + (\varrho \vec{v} \cdot \nabla) \vec{v} = \vec{f}_0 + \operatorname{div}\mathbf{T} = \vec{f}_0 - \operatorname{grad} p + \operatorname{div}\mathbf{T}' \tag{3.33}$$

$$\varrho T \frac{\mathrm{d}s}{\mathrm{d}t} = \varrho \frac{\mathrm{d}e}{\mathrm{d}t} - \frac{p}{\varrho} \frac{\mathrm{d}\varrho}{\mathrm{d}t} = -\operatorname{div}\vec{q} + \mathbf{T}' : \mathbf{D}$$

**Integralform**

$$\frac{\partial}{\partial t} \iiint \varrho \, \mathrm{d}^3 V + \oiint \varrho (\vec{v} \cdot \vec{v}ecn) \, \mathrm{d}^2 A = 0 \tag{3.34}$$

$$\frac{\partial}{\partial t} \iiint \varrho \vec{v} \, \mathrm{d}^3 V + \oiint \varrho \vec{v} (\vec{v} \cdot \vec{n}) \, \mathrm{d}^2 A = \iiint f_0 \, \mathrm{d}^3 V + \oiint \vec{n} \cdot T \, \mathrm{d}^2 A \tag{3.35}$$

$$\frac{\partial}{\partial t} \iiint \left( \frac{1}{2} v^2 + e \right) \varrho \, \mathrm{d}^3 V + \oiint \left( \frac{1}{2} v^2 + e \right) \varrho \, (\vec{v} \cdot \vec{n}) \, \mathrm{d}^2 A = \tag{3.36}$$

$$- \oiint (\vec{q} \cdot \vec{v}ecn) \, \mathrm{d}^2 A + \iiint \left( \vec{v} \cdot \vec{f}_0 \right) \mathrm{d}^3 V + \oiint (\vec{v} \cdot \vec{n} \, \mathbf{T}) \, \mathrm{d}^2 A.$$

Der $\nabla$-Operator in kartesischen Koordinaten:

$$\vec{\nabla} = \frac{\partial}{\partial x} \vec{e}_x + \frac{\partial}{\partial y} \vec{e}_y + \frac{\partial}{\partial z} \vec{e}_z \quad , \quad \operatorname{grad} f = \vec{\nabla} f = \frac{\partial f}{\partial x} \vec{e}_x + \frac{\partial f}{\partial y} \vec{e}_y + \frac{\partial f}{\partial z} \vec{e}_z$$

$$\operatorname{div} \vec{a} = \vec{\nabla} \cdot \vec{a} = \frac{\partial a_x}{\partial x} + \frac{\partial a_y}{\partial y} + \frac{\partial a_z}{\partial z} \quad , \quad \nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2}$$

$$\operatorname{rot} \vec{a} = \vec{\nabla} \times \vec{a} = \left( \frac{\partial a_z}{\partial y} - \frac{\partial a_y}{\partial z} \right) \vec{e}_x + \left( \frac{\partial a_x}{\partial z} - \frac{\partial a_z}{\partial x} \right) \vec{e}_y + \left( \frac{\partial a_y}{\partial x} - \frac{\partial a_x}{\partial y} \right) \vec{e}_z$$