Page 134, equation (3.274)

Remember that $\mathbf{v} = \mathbf{o}$ and volume (V^o) is constant.

From Gauss theorem, cf. (3.23), follows:

$$\int_{\partial V^o} \mathbf{q}.\mathbf{n}\,\mathrm{d}a = \int_{V^o} \mathrm{div}\mathbf{q}\,\mathrm{d}v. \tag{1}$$

From definition of σ - (3.109) - it follows in this case:

$$\mathrm{div}\mathbf{q} = T^o\sigma - T^o\rho\dot{s}. \tag{2}$$

Combination of (1) and (2) gives:

$$\int_{\partial V^o} \mathbf{q}.\mathbf{n}\,\mathrm{d}a = T^o\int_{V^o}\sigma\,\mathrm{d}v - T^o\int_{V^o}\rho\dot{s}\,\mathrm{d}v. \tag{3}$$

Substituting (3) into (3.108) we obtain:

$$T^o\overline{\int_{V^o}\rho s\,\mathrm{d}v}^{\,\cdot} \geq -\int_{\partial V^o}\mathbf{q}.\mathbf{n}\,\mathrm{d}a = -T^o\int_{V^o}\sigma\,\mathrm{d}v + T^o\overline{\int_{V^o}\rho s\,\mathrm{d}v}^{\,\cdot} \tag{4}$$

where (3.68) was used. It follows from (4) immediately:

$$-T^o\int_{V^o}\sigma\,\mathrm{d}v \leq 0. \tag{5}$$

From the equality appearing in (4) we get:

$$-\int_{\partial V^o}\mathbf{q}.\mathbf{n}\,\mathrm{d}a - \overline{\int_{V^o}T^o\rho s\,\mathrm{d}v}^{\,\cdot} = -T^o\int_{V^o}\sigma\,\mathrm{d}v. \tag{6}$$

Subtracting the derivative of integral appearing in (6) from both sides of (3.273) we receive:

$$\overline{\int_{V^o}\rho(u+\tfrac{1}{2}\mathbf{v}^2+\Phi)\,\mathrm{d}v}^{\,\cdot} - \overline{\int_{V^o}T^o\rho s\,\mathrm{d}v}^{\,\cdot} \equiv \overline{\int_{V^o}\rho(u-T^o s+\tfrac{1}{2}\mathbf{v}^2+\Phi)\,\mathrm{d}v}^{\,\cdot}$$
$$= -\int_{\partial V^o}\mathbf{q}.\mathbf{n}\,\mathrm{d}a - \overline{\int_{V^o}T^o\rho s\,\mathrm{d}v}^{\,\cdot} \tag{7}$$

Combination of (5), (6), and (7) leads to (3.274).