Try $\Phi = 19000\ W$.

$$\Delta\theta_m = \frac{\Phi}{UA} = \frac{19000}{1453} = 13.1\ K.$$

$$\Phi = m_a c_a (\theta_{on} - \theta_{off}).$$

$$\theta_{off} = \frac{\Phi}{m_a c_a} + \theta_{on} = \frac{19000}{311 \times 100} + 23 = 29.04\ K.$$

$$\text{check } \Delta\theta_m = \frac{(\theta_c - \theta_{on}) - (\theta_c - \theta_{off})}{\ln\left(\frac{\theta_c - \theta_{on}}{\theta_c - \theta_{off}}\right)}.$$

$$= \frac{(38-23)-(38-29)}{\ln\left(\frac{38-23}{38-29}\right)} = 11.7\ K. \neq 13.1\ K.$$

Try $\Phi = 18000\ W$.

$$\Delta\theta_m = \frac{18000}{1453} = 12.4\ K.$$

$$\theta_{off} = \frac{18000}{3.11 * 100} + 23 = 28.7\ K.$$

$$\text{Check } \Delta\theta_m = \frac{(38-23)-(38-28.7)}{\ln\left(\frac{38-23}{38-28.7}\right)} = 11.9\ K \neq 12.4\ K$$

Try $\Phi = 17000\ W$.

$$\Delta\theta_m = \frac{17000}{1453} = 11.7\ K.$$

$$\theta_{off} = \frac{17000}{311 \times 100} = 28.4°C.$$

$$\text{Check } \Delta\theta_m = \frac{(38-23)-(38-28.4)}{\ln\left(\frac{38-23}{38-28.4}\right)} = 12.1\ K \neq 11.7\ K.$$

Try $\phi = 17500$

$$\Delta\theta_m = \frac{17500}{1453} = 12.0\,K.$$

$$\theta_{off} = \frac{17500}{3.11 \times 1010} = 28.6^{\circ}C.$$

$$\text{Check } \Delta\theta_m = \frac{(38-23)-(38-28.6)}{\ln\left(\frac{38-23}{38-28.6}\right)}$$

$$= 12.0\,K.$$ correct.

ϕ for $l_m = 17500\ W.$

$$\text{Required length} = \frac{28.6}{17.5} = 1.63\,m.$$

$$\text{No fin sheets} = \frac{1.63}{0.00635} = 257.$$