

t1 := time(0)

μrad ≡ 10⁻⁶ · rad mrad ≡ 10⁻³ · rad μm ≡ 10⁻⁶ m nm := 10⁻⁹ m

ms ≡ 10⁻³ · s μs ≡ 10⁻⁶ s ns ≡ 10⁻⁹ · s kt ≡ 1852 $\frac{\text{m}}{\text{hr}}$ nmi := 1852 · m °C ≡ K

c ≡ 2.99792458 · 10⁸ $\frac{\text{m}}{\text{s}}$ h ≡ 6.62606876 · 10⁻³⁴ J · s r_e ≡ 6378140 · m σ ≡ 5.670400 · 10⁻⁸ · $\frac{\text{watt}}{\text{m}^2 \cdot \text{K}^4}$

mJ ≡ 10⁻³ J MW ≡ 10⁶ W nW ≡ 10⁻⁹ W μW ≡ 10⁻⁶ W mW ≡ 10⁻³ W time(0) – t1 = 0.0280

q ≡ 1.602176462 · 10⁻¹⁹ · coul nA ≡ 10⁻⁹ A

D_{out} := 1.315in D_{in} := 1.063in D_{avg} := $\frac{1.315\text{in} + 1.063\text{in}}{2}$

L_{head} := 9in L_{feed} := 54in T_w := 60R T_c := 104R T_s := 90R T_f := 80R T_a := 70R

given $10 \frac{\text{W}}{\text{m}^2 \text{K}} \cdot \left(D_{\text{out}} \cdot \pi \cdot \frac{L_{\text{head}}}{2} \right) \cdot (T_{\text{c}} - T_{\text{s}}) = \left[\frac{D_{\text{avg}} \cdot \pi \cdot 126 \cdot \text{in}}{L_{\text{feed}}} \cdot \left(3.98 \cdot \frac{\text{W}}{\text{cm} \cdot \text{K}} \right) + \frac{\left(\frac{D_{\text{in}}}{2} \right)^2 \cdot \pi}{L_{\text{feed}}} \cdot 0.56 \cdot \frac{\text{W}}{\text{m} \cdot \text{K}} \right] \cdot (T_{\text{s}} - T_{\text{w}}) + 10 \frac{\text{W}}{\text{m}^2 \text{K}} \cdot \left(D_{\text{out}} \cdot \pi \cdot \frac{L_{\text{feed}} - L_{\text{head}}}{2} \right) \cdot (T_{\text{s}} - T_{\text{a}})$

T_s := find(T_s) T_s = 73.9537R

$10 \frac{\text{W}}{\text{m}^2 \text{K}} \cdot \left(\frac{1.315\text{in} + 1.063\text{in}}{2} \cdot \pi \cdot 9\text{in} \right) \cdot (T_{\text{c}} - T_{\text{s}}) = 3.6204\text{W}$