5.1
\[ TC = 138 \text{ MBtu/h} \]
\[ SC = 99 \text{ MBtu/h} \]
\[ W = 10.2 \text{ kW} \]

5.2
\[ @ 5000 \text{ cfm} \]
\[ \text{ESP} = 1.0'' \quad BHP = 2.95 \quad kW = 2.57 \]
\[ \text{ESP} = 1.5'' \quad BHP = 3.67 \quad kW = 3.19 \]
\[ \text{by interpolation to ESP=1.2''} \quad BHP = 3.24 \quad kW = 2.82 \]

5.3
\[ @ 5000 \text{ cfm} \quad 95^\circ\text{F AHT} \quad 80^\circ\text{F/62^\circ}\text{R} = \]

Correct TC for wb
\[ TC_{wb} = 131 \text{ MBtu/h} \]

SC \[ 80 = 122 \text{ MBtu/h} \]

Correct SC for db
\[ SC_{74} = SC_{80} + 1.1 \times (1-BE) \times (\text{cfm/1000}) \times (\text{AHT-80}) \]
\[ = 122 + 1.1 \times (1-.05) \times (5000/1000) \times (74-80) \]
\[ SC_{74} = 90.7 \text{ MBtu/h} \]

Correct kW for wb
\[ kW_{wb} = 10.1 \]

5.4
\[ TC_{net} = TC_{gross} - 3.41 \text{ kW/ton} \]
\[ = 131 \text{ (MBtu/h)} - 3.41 \times 2.82 = \]
\[ TC = 121.4 \text{ MBtu/h} \]

SC = 90.7 - 3.41 \times 2.82
\[ SC = 81.1 \text{ MBtu/h} \]

SHR/unit = \[ \frac{SC}{TC} = \frac{81.1}{121.4} = 0.67 \]
\[ q = 33 \text{ MBtu/h} \quad q_e = 24 \quad \text{SHR}_{\text{LOAD}} = \frac{q_e}{q} = 0.73 \]

Model 031:
\[ @ 1200 \text{ cfm} @ 95^\circ \text{OAT} \]
\[ TC = 36.8 \text{ MBtu/h} \quad SC = 25.2 \text{ MBtu/h/kW} \quad kW = 3.17 \]

\[ @ 85^\circ \text{OAT} \quad TC = 34.5 \quad SC = 24.4 \quad kW = 3.43 \]

\[ \text{Intp.} @ 97^\circ \text{OAT} \quad TC = 36.3 \quad SC = 25.0 \quad kW = 3.22 \]
\[ \text{SHR}_{\text{UNIT}} = \frac{TC}{SC} = \frac{36.3}{25.0} = 1.45 \quad \text{OK} \]
\[ \text{EER} = \frac{TC}{kW} = \frac{36.3}{3.22} = 11.3 \text{ MBtu/h/kW} \]

Option: Airflow can be increased since SHR_{UNIT} < SHR_{LOAD}

Try: 110\% \quad Q = 1.10 \times 1200 = 1320 \text{ cfm}

\[ TC = 1.01 \times 36.3 = 36.7 \text{ MBtu/h} \]
\[ SC = 1.04 \times 25.0 = 26 \text{ MBtu/h/kW} \]
\[ kW = 1.02 \times 3.22 = 3.28 \]
\[ \text{EER} = \frac{36.7}{3.28} = 11.2 \text{ MBtu/h/kW} \]

Model 034 @ 1200 cfm
\[ @ 95^\circ \text{OAT} \]
\[ TC = 34.1 \quad SC = 24.5 \quad kW = 3.12 \]

\[ @ 105^\circ \text{OAT} \]
\[ TC = 32.0 \quad SC = 23.6 \quad kW = 3.38 \]

\[ \text{Intp.} @ 97^\circ \text{OAT} \]
\[ TC = 33.7 \quad SC = 24.3 \quad kW = 3.17 \]
\[ \text{SHR}_{\text{UNIT}} = \frac{24.3}{33.7} = 0.72 \quad \text{OK} \]
\[ Q = 1200 \text{ cfm} \]
\[ \text{EER} = \frac{33.7}{3.17} = 10.6 \text{ MBtu/h/kW} \]
5.7 a) $85\text{%} \text{ OPT} \quad TC = 36.0 \quad SC = 25.2$
\[ \text{SHR}_{\text{unit}} = \frac{25.7}{36.0} = 0.70 \quad \text{Too Large} \]
Go to 90% rotod flow
\[ Q = 0.80 \times 1200 = 960 \text{cfm} \]
\[ TC = 0.97 \times 36 = 34.9 \]
\[ SC = 0.90 \times 25.2 = 22.7 \]
\[ \text{SHR}_{\text{unit}} = \frac{22.7}{34.9} = 0.65 \quad \text{Good but a little low} \]
But also try 90% Q = 1080 cf
\[ TC = 0.98 \times 36 = 35.3 \]
\[ SC = 0.95 \times 25.2 = 23.9 \]
\[ \text{SHR}_{\text{unit}} = \frac{23.9}{35.3} = 0.68 \quad \text{Better Match} \]

5.8 a) 1200 cfm & 27°F TH = 22.6 $\text{kW} = 2.59$
 b) 27°F TH = 19.8 $\text{kW} = 2.46$
 c) 20°F TH = 20.6 $\text{kW} = 2.50$
 d) 90% Q = 1080 cf $\text{CF for TH} = .99 \times 20.6 = 20.4$
\[ \text{kW}_h = 1.02 \times 20.4 = 2.05 \]
Deduct 10% for defrost $\text{TH} = 20.4 (1.0 - 0.10) = 18.4 \text{ MBtu/h}$
\[ \text{Q}_{\text{aux}} = 37.0 - \text{TH} = 37.0 - 18.4 = 18.6 \text{ MBtu/h} \]
\[ \text{kW}_{\text{aux}} = \frac{18.6}{3.41} = 5.45 \text{ kW} \]
\[ \text{COP} = \frac{\text{TH} + \text{Q}_{\text{aux}}}{\text{kW} + \text{kW}_{\text{aux}}} = \frac{18.4 + 18.6}{2.55 + 5.45} = 1.36 \]
\[ \text{COP}_{\text{HIL}} = 1.36 \]
* for Q = 80% (960 cf) $\text{CF for TH} = .99$ for $\text{kW}_h = 1.05$
\[ \text{TH} = 18.2 \quad \text{kW} = 2.63 \quad \text{Q}_{\text{aux}} = 18.8 \quad \text{kW}_{\text{aux}} = 5.5 \quad \text{COP} = 1.33 \]
\[ q = 37 \text{ MBtu/h} \]

Need furnace with cfm between 960 & 1080 cfm

* A Model 060 non-cond furnace provides 47 MBtu/h & 1080 cfm
  @ ESP=0.4" & motor speed @ med, low
  Duct loss is greater (0.8") speed, high is required for 1020 cfm (A.H.U.E=92%)

* A Model 060 condensing furnace provides 56 MBtu/h
  @ 1030 cfm @ 0.4" ESP fan on med, low and 950 cfm @ 0.8" ESP fan on high