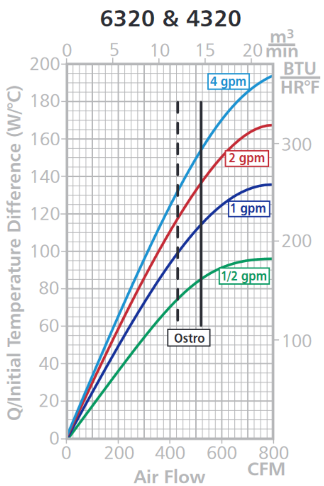
NPS: Lytron 6320 Heat Exchanger Calculations

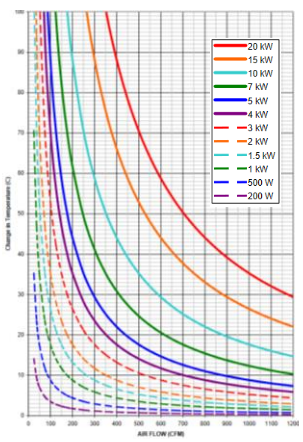
Aaron Brown
2022-05

Determining Performance Capability and Expected Air Temperatures for the NPS Lytron 6320 Heat Exchangers

Using formulas from the Lytron catalogue I performed a hand calculation to verify that the performance capability and temperature of the entering air for the Lytron 6320 heat exchanger were sufficient for NPS. For these calculations I assumed a total heat load of 1000 W, an ambient temperature of 20°C, and a coolant temperature of 10°C.

Performance capability is equal to the heat load (Q) divided by the initial temperature difference (ITD). To calculate the initial temperature difference ($T_{air\ in} - T_{liquid\ in}$) I assigned $T_{air\ in}$, which is the maximum allowed temperature inside of the detector frame, to be 18°C as this is the optimal operating temperature for NPS. $T_{liquid\ in}$ was taken to be the 10°C coolant temperature. For 18°C, the initial temperature difference was calculated to be 8°C which makes the performance capability 125 W/°C, which is more than sufficient for the two NPS chillers running at 2 and 4 gpm, Fig. 1.





- **Developed a Python to plot the performance capability and the temperature of the cooling air for the Lytron 6320 heat exchanger**
- **Calculated a performance capability of 125 W/°C for a maximum temperature of 18°C inside the detector frame**
- **Calculated the temperature of the air leaving the heat exchanger to be 15°C for a maximum temperature of 18°C inside the detector frame**

FIG. 1. Performance capability graph for model #6320 from Lytron manual (left)
FIG. 2. Temperature difference based on air flow in CFM for various values of Q (right)

NPS: Lytron 6320 Heat Exchanger Calculations

Next I calculated the temperature of the entering air from the heat exchanger by subtracting the temperature difference of 3°C (determined by the air flow rate of 525 CFM for the Ostro fans used with the Lytron 6320 heat exchanger, Fig 2.) from the maximum allowed temperature of air in the detector frame of 18°C. This made the air entering the detector frame from the heat exchanger 15°C.

I the developed a Python program (*lytron6320calcs.py*) to calculate both of these values for a range of maximum allowed temperatures from 15°C to 55°C. The program performs the calculations described above, increments the value of $T_{air\ in}$ by 1°C for each iteration, and generates a plot for each value as a function of the maximum allowed temperature, Fig. 3. This gives us a sense of what to expect for the performance of the heat exchanger if the temperature inside of the detector frame strays from the optimal operating temperature of 18°C.

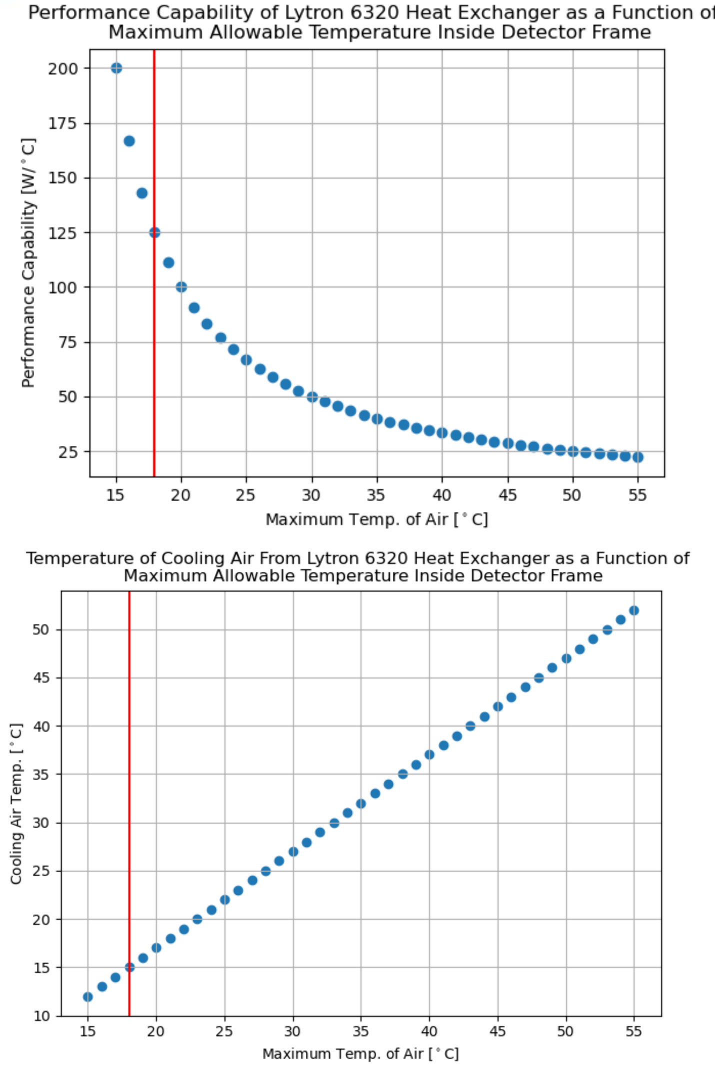


FIG.3. Plots of performance capability (top) and cooling air temperature (bottom) as a function of the maximum temperature in the detector frame