

Valence Heating Investigation of Room #223



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INTRODUCTION:

- Observation: Interesting valence convector location.
- Question: How does the shape of the room generate a particular convection.
- Do convectors in the corner of the room convect?



North-South Section
Wood Hole Research Center Geman Orfery Building

HYPOTHESIS:

- Valence convectors do not convect.
- In the heating mode the valence convectors distribute heat primarily by radiation.

METHODOLOGY:

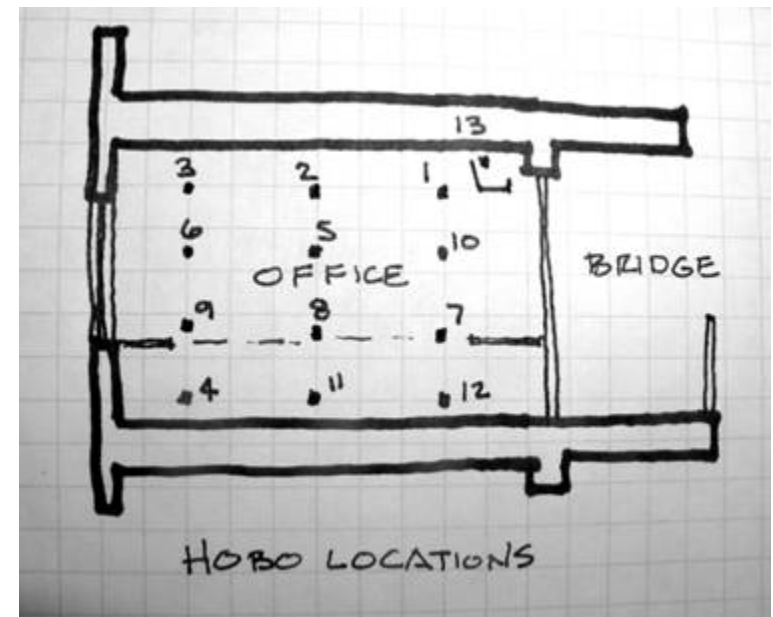
Tools:

- 13 Hobo Data Collectors
 - 13 Air temperature locations
 - 1 Surface temperature
- Raytek Gun: Measure surface temperature at 7 locations.
- Velocity Stick: Measure air flow at “in-take” and “outflow” of valence.
- Bubbles: Measure air flow at “in-take” and “outflow” of valence.
- IR Camera: Measure the heat gradient of surface temperatures.

METHODOLOGY:

Steps:

- Opened window @ 7 p.m. on 10/14 to cool down the room.
- Hung Hobos in a grid form.
- Set to start at 7 a.m. on 10/15
- Put last Hobo on valence to measure surface temperature at convector at 9:30 a.m.



METHODOLOGY:

- Joe started the ground loop heat pump.
- Heated the storage tank to 128°F, for square wave start. (20 min.)
- Took initial measurements with Raytek Gun.



METHODOLOGY:

- Closed window and turned on the convector at 10:10 a.m.
- Took a series of four measurements at slightly irregular time intervals with Raytek Gun, Velocity Stick, IR Camera, and observed bubbles.
- Opened door and took three more groups of the same measurements.



METHODOLOGY:

- Turned off the convector.
- Took down the equipment and downloaded our data.
- Conducted a graphic analysis of our data.

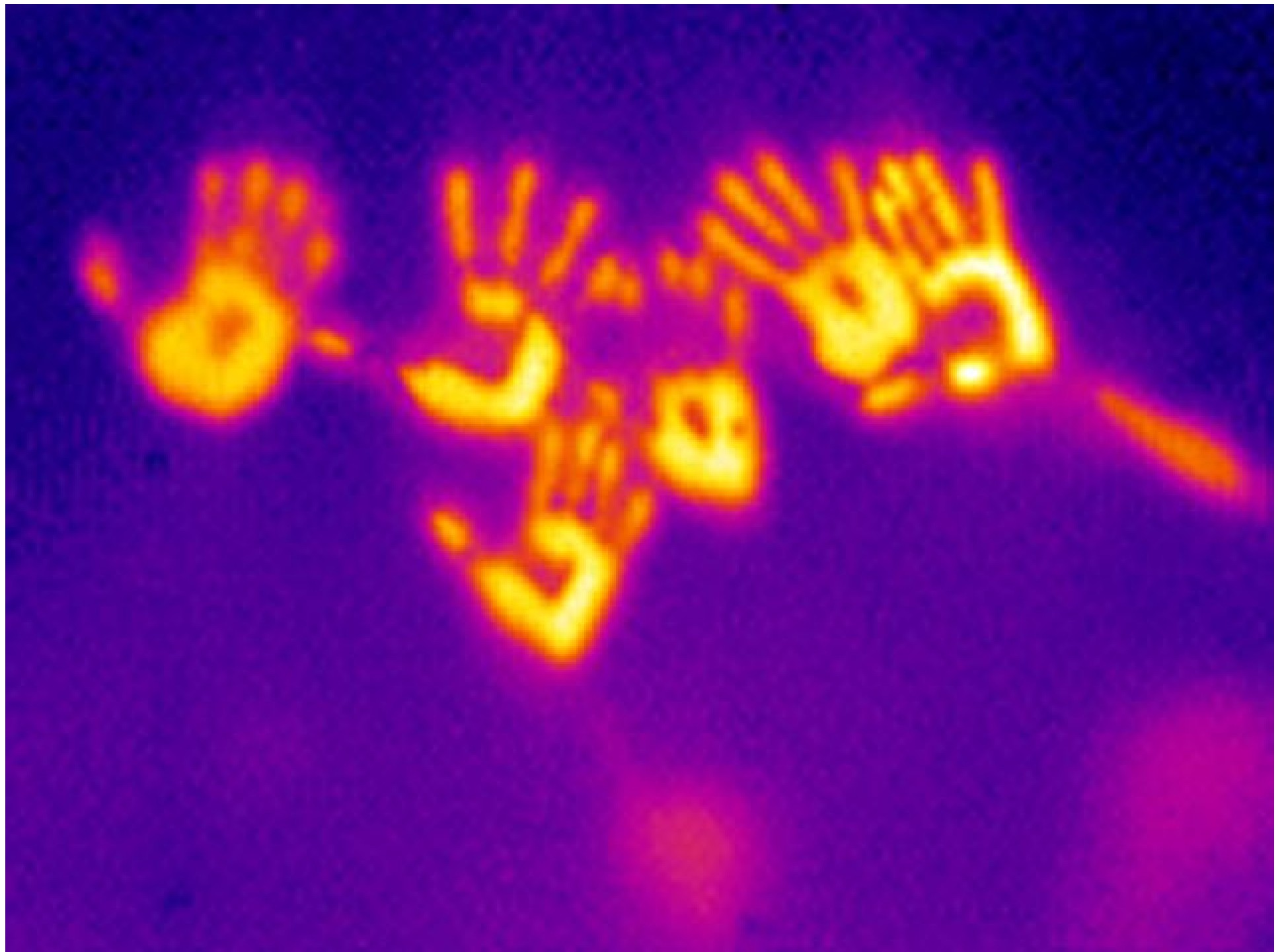


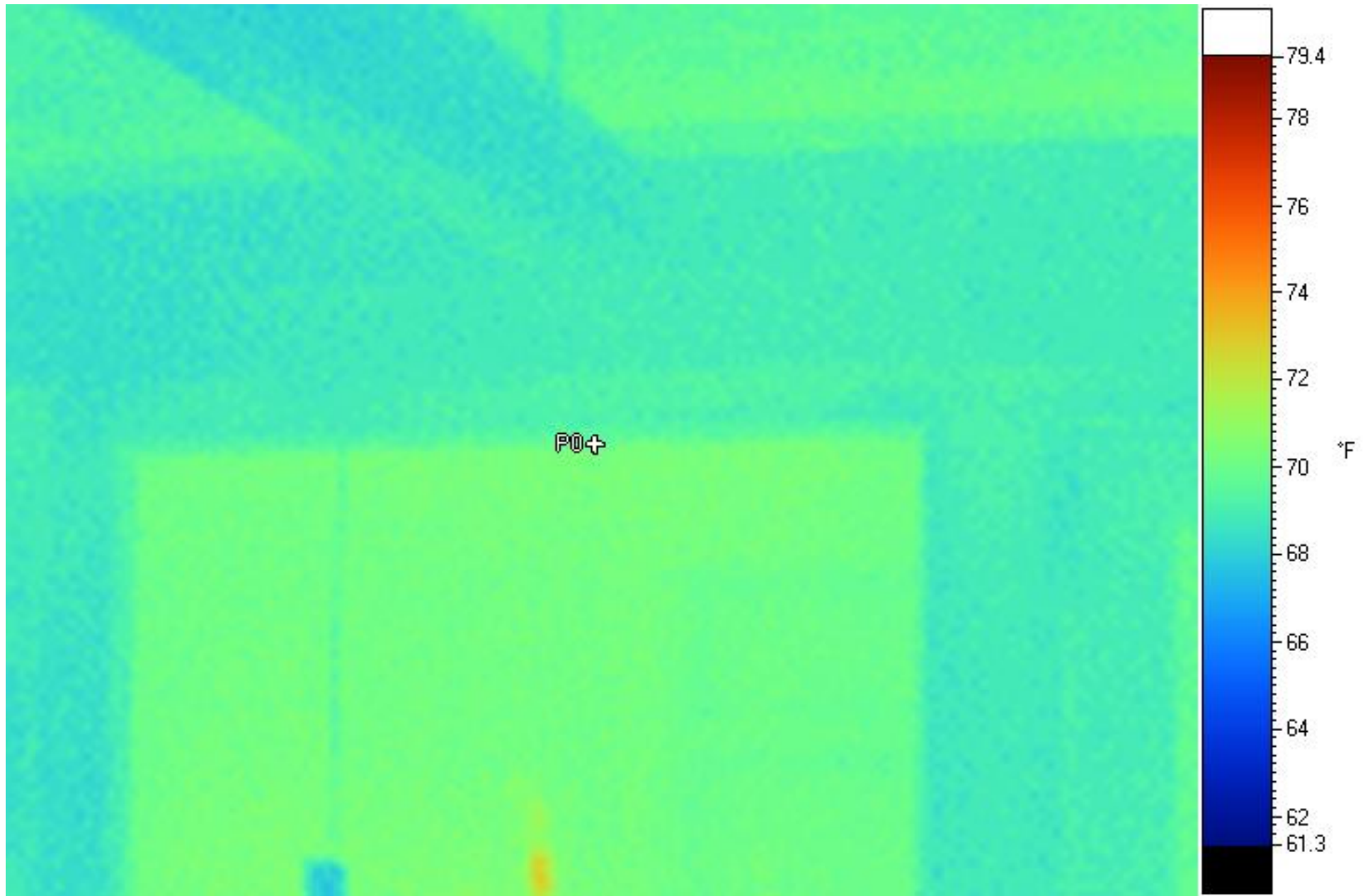
DATA ANALYSIS: HOTWIRE ANEMOMETER



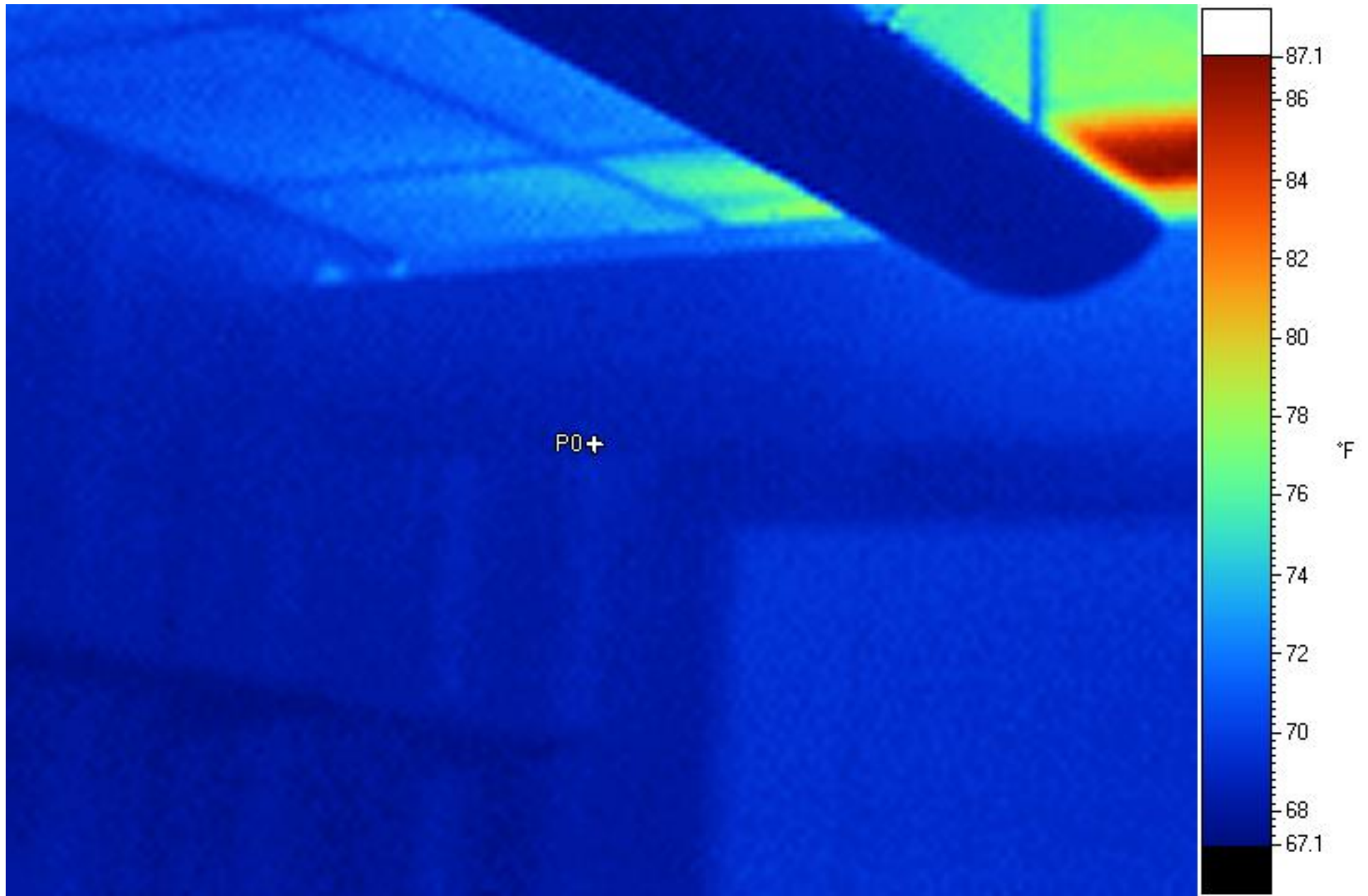
DATA ANALYSIS: IR CAMERA





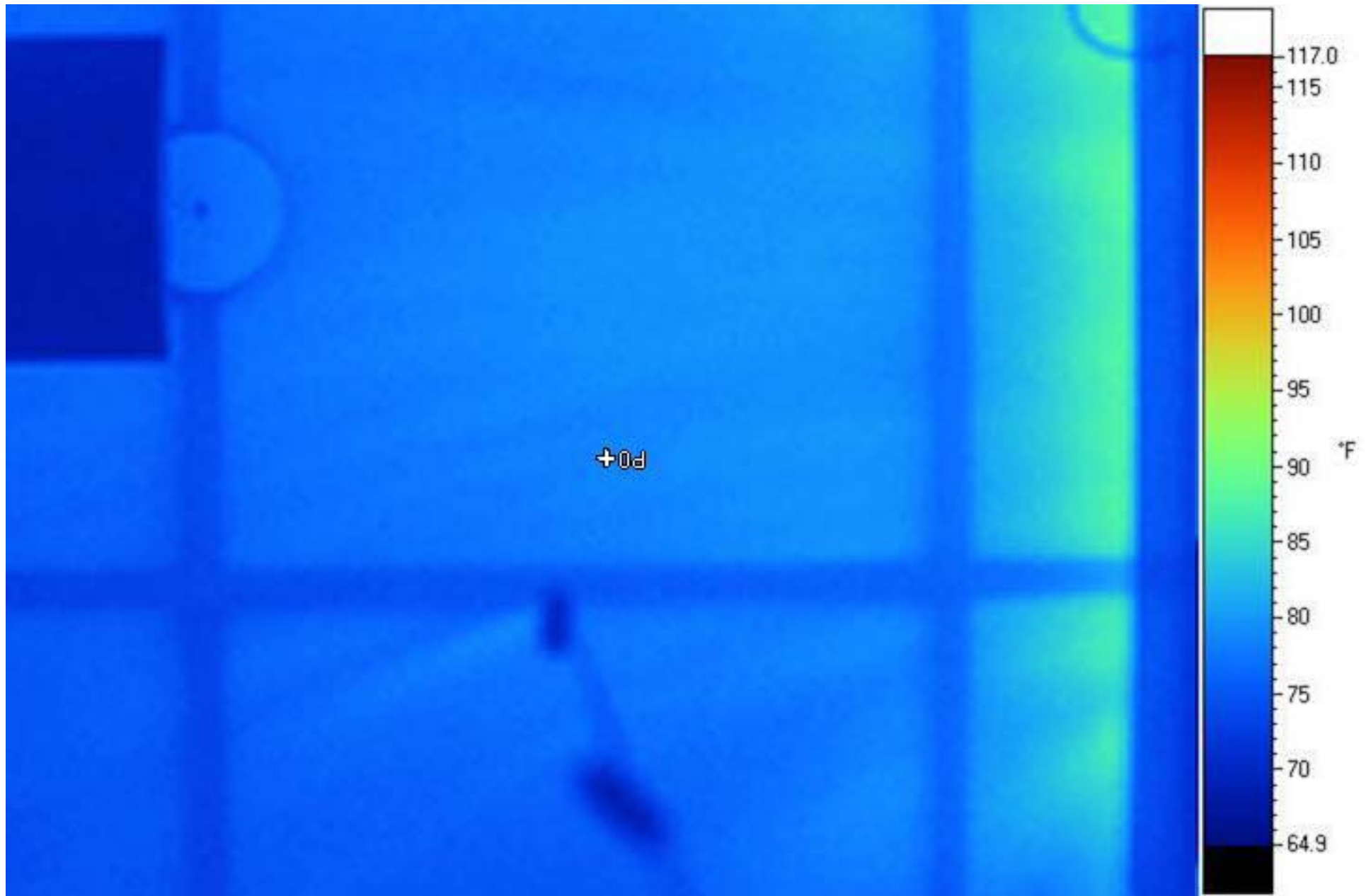


Room 223, 9:45 a.m. (before)

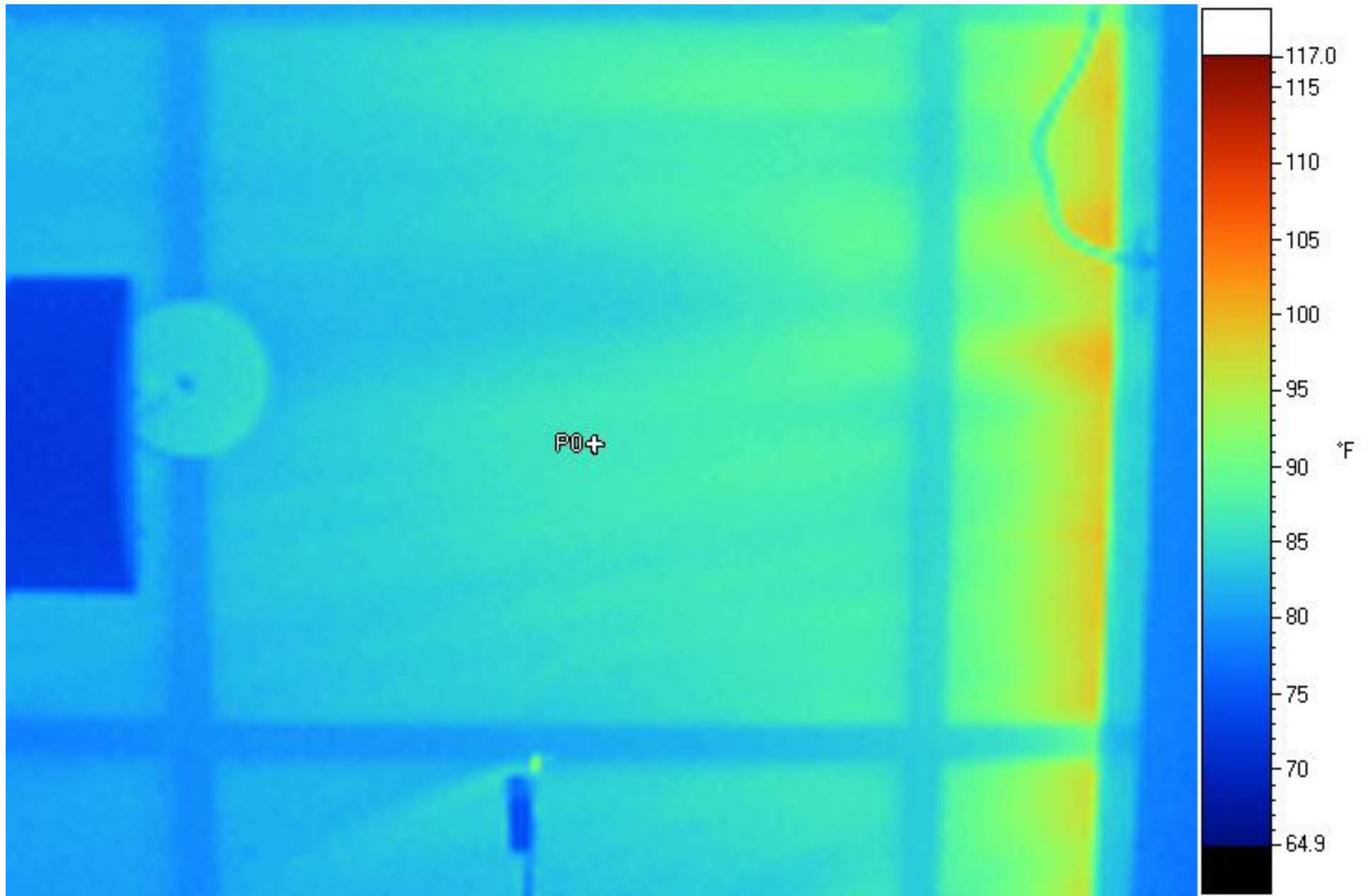


Room 223, 9:45 a.m. First recording of heating condition

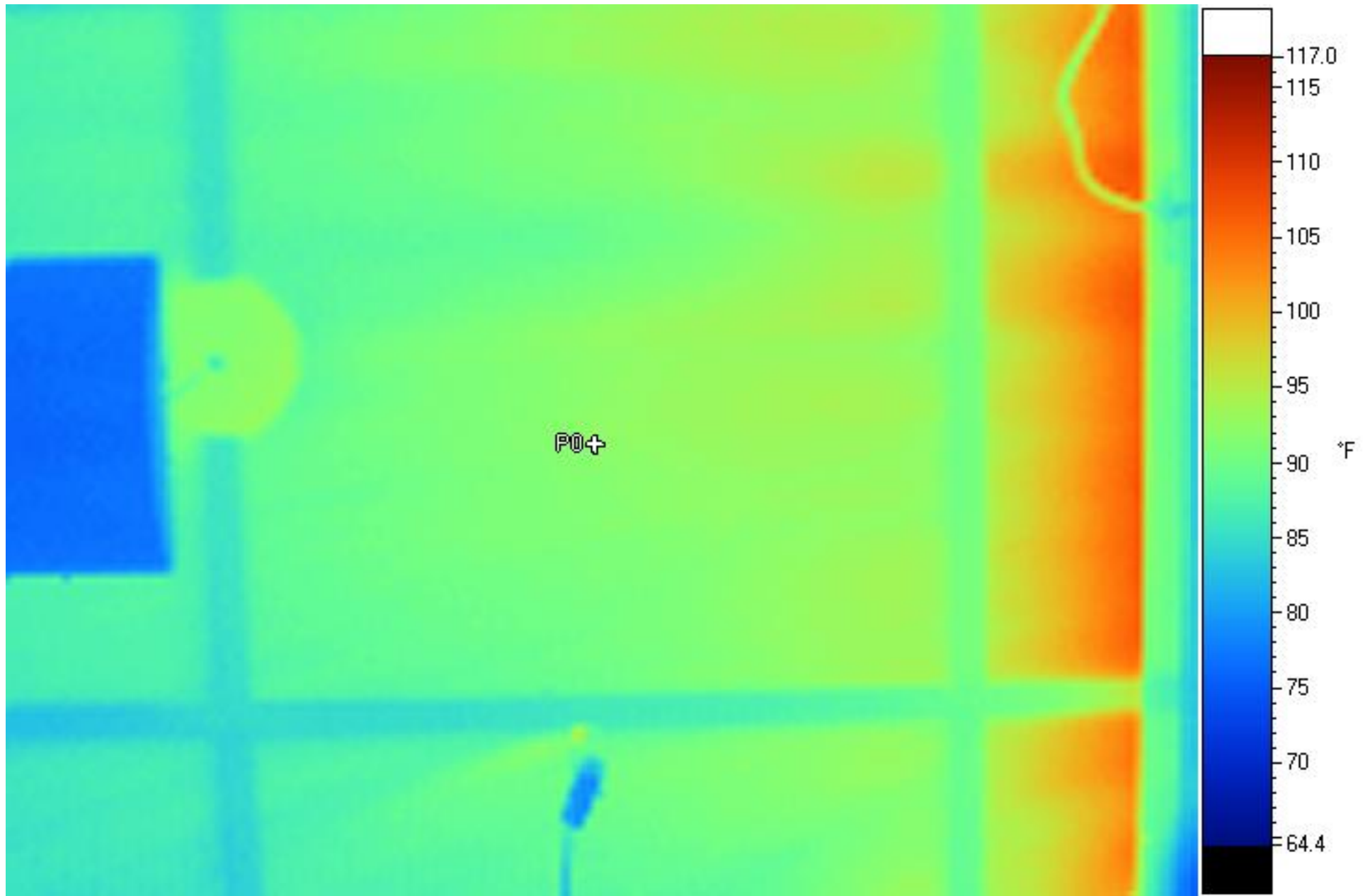
Note that the fin-tube does not extend from wall to wall



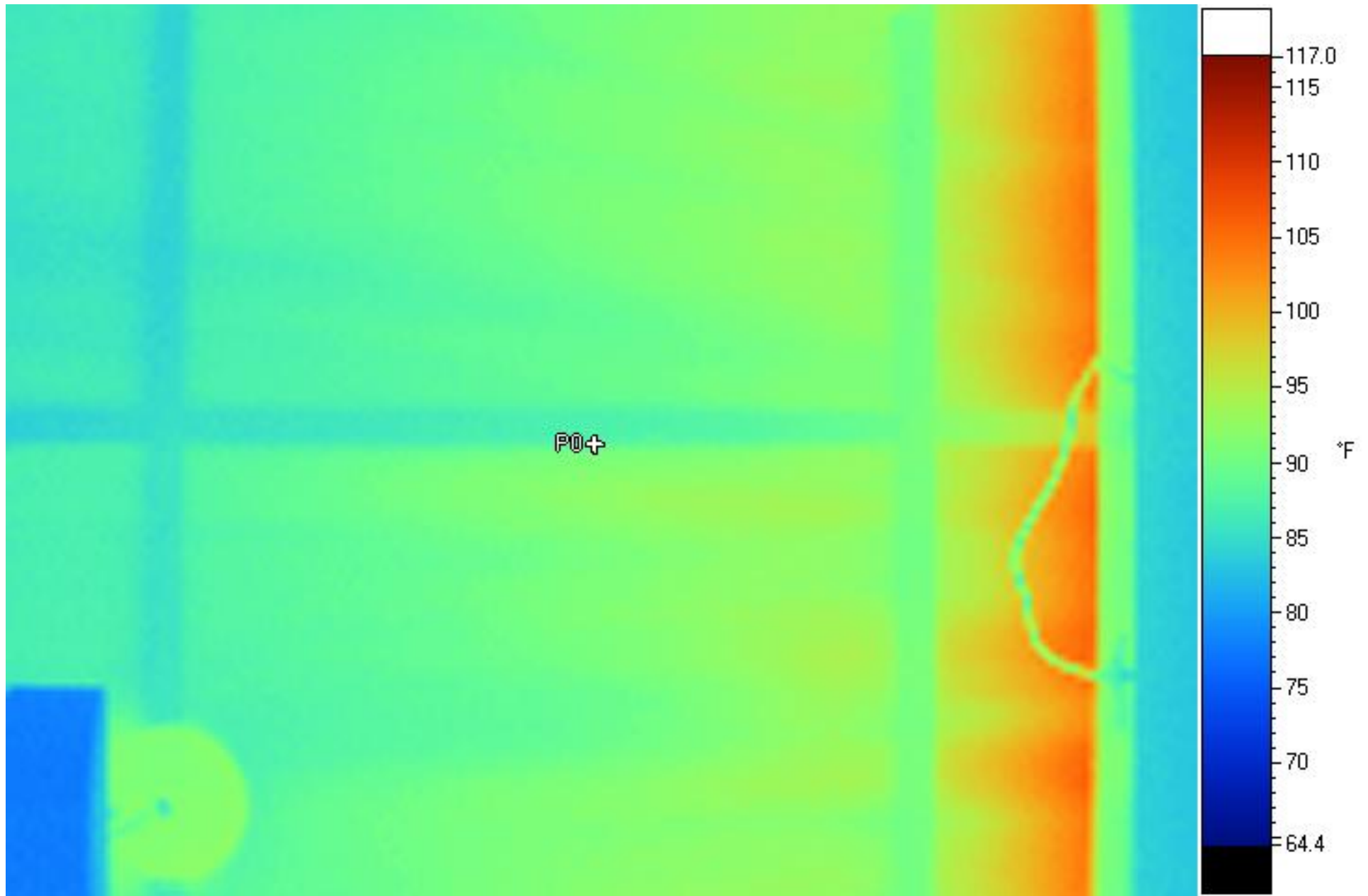
1. Room 223, 9:45 a.m. - before heat



2. Room 223, 10:25 a.m. – First heat reading.

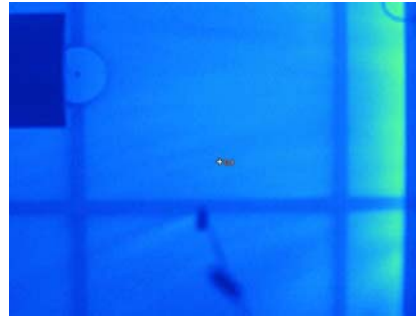


3. Room 223, 10:45 a.m. – Second heat reading.

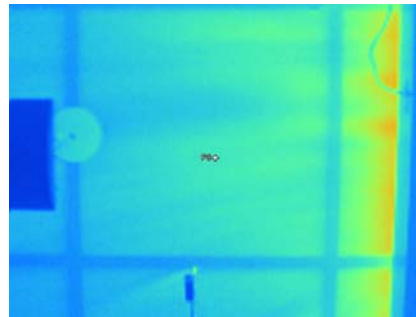


4. Room 223, 11:35 a.m. – Third heat reading. Before door opened.

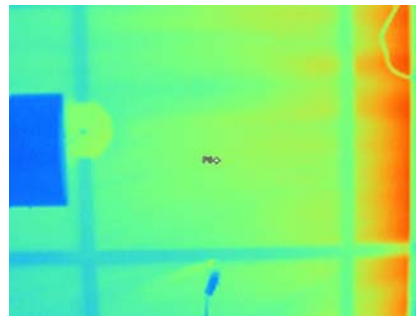
1.
9:45 a.m.
before



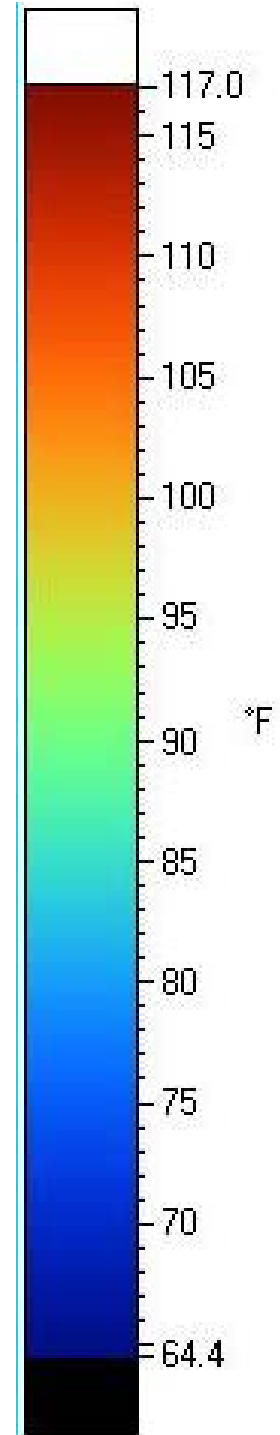
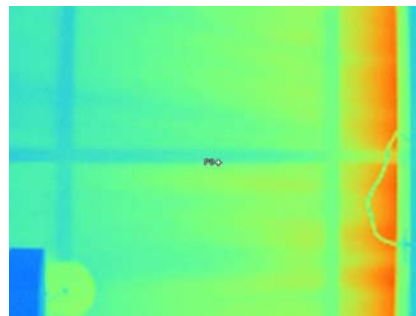
2.
10:25 a.m.

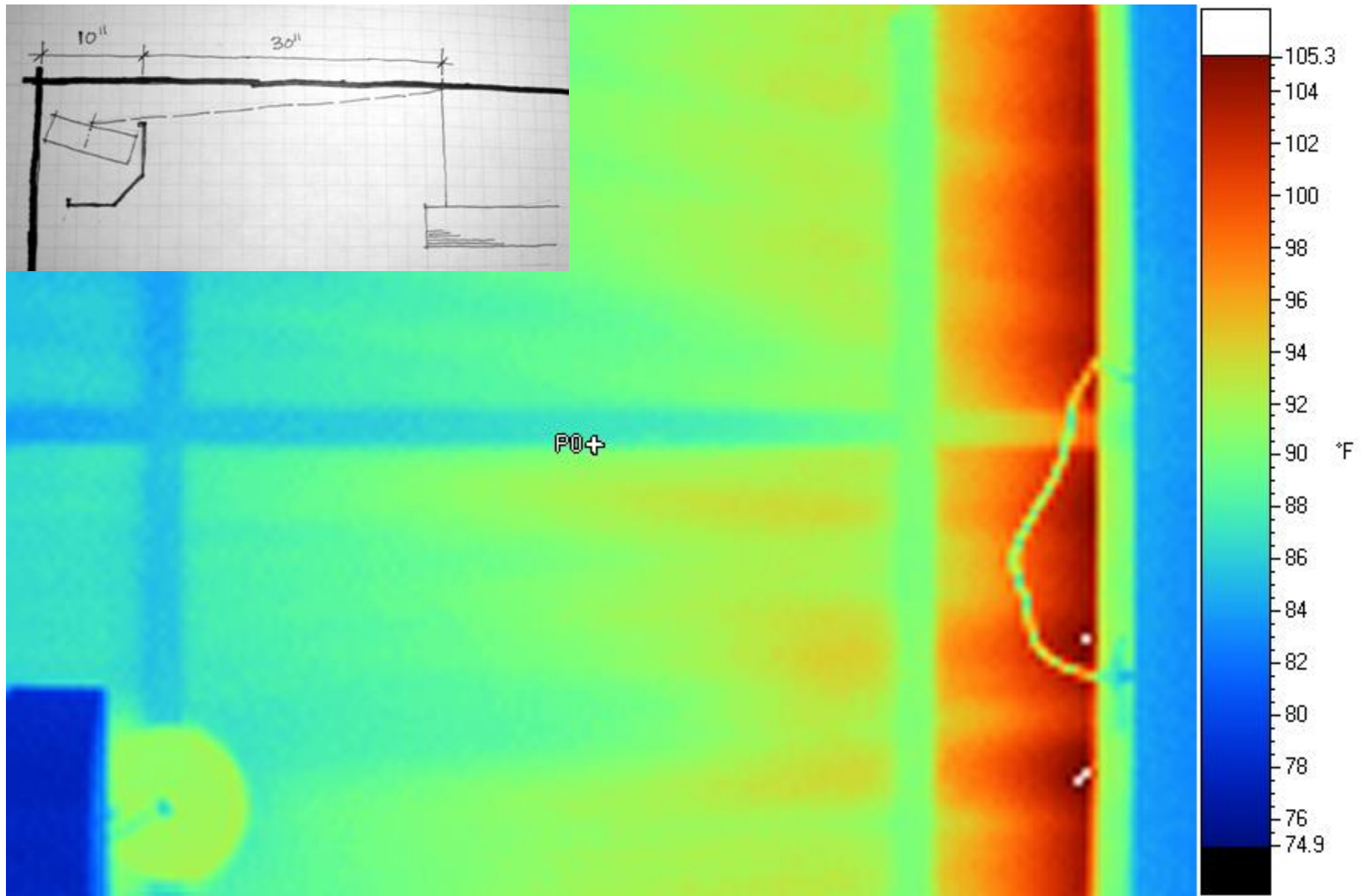


3.
10:45 a.m.



4.
11:35 a.m.





Note the striations in the heat pattern distribution.

CONCLUSIONS:

- The rapid decline in ceiling temperature moving outward from the valence is a strong indication of a radiant transfer process.
- The portion of the ceiling which is hot correlates strongly to the line of site exposure to the hot fin tube.
- When the door was opened, temperatures in the room were not affected. Further indication of a radiant phenomenon.
- Surface temperature readings at both the ceiling and the floor decline rapidly as you move away from the valence.
- Hobo data indicate that air temperatures, both horizontally and vertically, decline as you move away from the valence at three of the four levels.
- The bubble data did not indicate any air currents. The hotwire anemometer recorded low levels of air current that were unreliable.
- The single anomaly that suggests convective behavior is the Hobo data six inches above the floor, where the recording at the window is slightly higher than the other two units.

LESSONS LEARNED:

- The Hobo data is not conclusive because the critical data points in the center of the room were missing.
- The anomalous data at the floor level could have been caused by a cold air plume coming under the door.
- The variations in the Hobo data at the lowest levels could have been due to variations from unit to unit.
- Walking in and out of the room to collect data may have had a substantial impact on the convection currents in the room.