Silhouette Steel

2411-02

UNOLS COLD LAB

ENVIRONMENTAL TESTS
Summary

Sent to:

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Summary

The purpose of this experiment was to test the current cold van specification for "real-life" applications and the ability of the current temperature operating system to meet the specification. We also evaluated the abilities of the system to maintain and recover the internal lab temperature settings in different outside environmental conditions. The cold van was taken to an Environmental Test Facility at Dayton T Brown, where it was subjected to a number of tests.

Tests performed:

1. This phase was intended to determine the baseline capabilities of the cold van main chiller system. The van doors were closed, fume hood off. Van cooling systems set to 0°C, chamber ambient temperature of 35°C, increased incrementally to 50°C.
   RESULT: The lab held temperature to 40°C, as specified, but loses temperature control at 45°C.

2. This phase was intended to determine the effects of operating the fume hood as well as the effectiveness of the make-up air-cooling system. The van doors were closed, fume hood on at normal setting, with the make-up air cooling system in operation.
   RESULT: Mechanical Failure of the system made this test inconclusive.

3. This phase was intended to determine the effects scientific personnel working in the van including the opening and closing of doors and the heat load generated by occupying the van itself. Four lamp heat sources were used to simulate four human bodies in the center of the cold lab main compartment. The door actuators simulated scientific personnel entering and exiting the cold lab every 15 minutes.
   RESULT: The van can hold temperature at lower than 35°C ambient and lower than 75% relative humidity, but during this test it was apparent that the opening of the doors significantly affected the system's ability to maintain temperature.

4. This phase was intended to test the combined effects of both human influence and the fume hood on the ability of the cold lab to maintain operating temperature.
   RESULT: Test not completed due to mechanical failure of the system at phase two.

5. This phase was intended to test the "near zero" condition and the system's ability to maintain temperature in low chamber ambient temperature conditions using the heat elements and defrosts cycles. The van cooling system was set to 10° C and ambient temperature set to 0 ºC.
   RESULT: The Lab held temperature with no problems, however the hatch temperature was low.

CONCLUSIONS:

The Cold lab meets the specification as it's currently written, however it does not meet actual service conditions in harsher climates. High humidity and high temperatures combined with opening and closing of doors is simply too much for the system to handle. The Cold lab works fine at low chamber ambient temperatures. Current Limitations are:

- Closed Lab to 40°C, 50% relative humidity
- Doors opening, limits operation to 35°C, 50% relative humidity
- Fume Hood Operating: 40°C, 50% relative humidity

RECOMMENDATIONS:

A: insulate the hatch to minimize heat gains through the hatch.

B: install motorized dampers on the exhaust and makeup air to minimize infiltration.

C: re configure the PLC so coils are changed more frequently. Eliminate the air proofing switches and eliminate the electric defrost heaters.

D: Try to mix the air better by adjusting the grill fins to blow in every direction possible, and add small fans to help circulate the air, particularly in the dead spots in the lab.

E: try to reduce the amount of times the door is opened. Change vestibule area to an "air-lock". Provide HVAC into the vestibule area via an air curtain, and install lights that indicate when the air-lock can be opened. Personnel would be expected to stay in the air lock for a period of time before being able to enter or leave the lab. Add a plastic curtain in front of the door to help minimize losses when the door is opened.

F: re-design the air distribution system, use ceiling ducting and wall air curtains for a more balanced distribution and mixing of air in the room.

G: increase wall thickness for higher R-Value: 5"-6" Walls would provide R35-R42, for substantial improvement.