Characterization of Temperature and Relative Humidity Responses in an Environmental Chamber

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Abstract

Introduction: Environmental chambers are an affordable solution for testing physiological responses to various environmental conditions in a laboratory setting for human exercise research.

Purpose: To characterize the temperature (TEMP) and relative humidity (RH) responses of an environmental chamber in preparation for future studies.

Methods: Set points were selected by combining a high and low TEMP (HT & LT) and high and low RH (HH & LH) desired for future testing (HT-HH: 40°C-80°C; HT-LH: 40°C-20%; LT-HH: 5°C-80%; LT-LH: 5°C-20%). First, the chamber started at room conditions and the digital TEMP and RH readouts of the chamber were recorded as the chamber reached each set point. Next, a pair of portable TEMP and RH sensors were calibrated and placed in opposite corners of the chamber to test whether there were differences in TEMP and RH values across the chamber. Lastly, the chamber door was opened for 15 s to test the response of the TEMP and RH during personnel entry/exit.

Results: The digital readouts of the environmental chamber when set to 5°C and 20% RH (LT-LH). The chamber reached a point of stability around 120 minutes. Dashed lines indicate the set points.

Conclusions: The environmental chamber is able to reach a range of set points in 120 min, maintains an acceptable level of homogeneity in TEMP and RH across the chamber, and is minimally impacted by door opening. LT-LH requires a longer setup time and shows the largest fluctuations, likely because it is more difficult to evaporate water at low TEMP. Future studies should aim to test similar conditions while one or more subjects are exercising in the chamber to determine the impact on TEMP, RH, and O₂ and CO₂ concentration.

Materials

- Tescor environmental chamber (Tescor, Warminster, PA)
- SensorPush Bluetooth Sensors (HTI Humidity & Temperature Smart Sensor, Garrison, NY)

Table 1. Responses of the environmental chamber when set to various conditions.

Table 2. Differences of the TEMP and RH readings of opposite corners when the environmental chamber was set to 5°C and 20% relative humidity (LT-LH).

References


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