## 1.4 Target Summary

Development of the critical targets and metrics is necessary for all designs to determine their success once the design is completed. Targets are specific values used to design for, which are found by analyzing the required functions of the system, and metrics are the means of measuring or validating that a target is met (size, weight, temperature, etc.). The critical targets and metrics for the Environmentally Controlled Test Chamber are listed in Table 3 below. Other targets and metrics not relating to a function, but were customer requirements, are noted in Appendix C. The entire functional decomposition chart relating to each target and metric can be found in Appendix B.

Table : Critical Targets and Metrics

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| --- | --- | --- | --- |
| **Functions**  | **Metric**  | **Target**  | **Description**  |
| Increase and Decrease Humidity  | Relative Humidity  | 0-95% RH  | Relative humidity is desired to reach any value in this range  |
| Add and Remove Heat  | Temperature  | 10°C ≤ T ≤ 55°C   | Temperature is desired to reach any value in this range  |
| Regulate Air Circulation  | Volumetric Flow Rate  | 1 m3/min  | Air handling unit should be capable of providing this flow rate  |
| Maintain Structural Stability  | Deformation  | ~ 5%  | Chamber should not move or deform  |
| Provide Clearance for Overhead Crane  | Area  | OSHA requires only 2” of clearance on the side and 3” above.  | There should be no obstructions in the way of the crane  |
| Display Information  | Display Temperature and Humidity  | Yes, they are always displayed during testing  | Temperature and humidity will be always shown  |
| Adjust Temperature and Humidity Automatically  | Automatic Adjustment  | No human action required to reach the desired conditions  | Desired temperature and humidity are reached automatically by the system  |

**Determination of Critical Targets and Metrics**

The critical functions for the success of this project are summarized in Table 3 above. The critical targets and metrics were chosen because they relate directly to the key functions of the test chamber. The first critical target is for the air surrounding the compressor to be controlled in a range of 0% to 95% relative humidity. The metric (relative humidity) will be manipulated and maintained by implementing feedback control. In addition to humidity, the chamber’s temperature must be manipulated and maintained within a range of 10°C to 55°C. Feedback control will also be used to control the temperature metric recorded by a sensor within the control volume. To provide adequate heat and humidity to the control volume, the air-flow must be able to reach 1 m3/min. This target was determined by performing a heat balance analysis of the system, including the control volume, ductwork, and infiltration.

Another critical function of the design is to provide sufficient structural stability. Since the system must be stable and sturdy, its structure needs to be strong and rigid. In other words, the chamber cannot move or deform during testing and will be able to support its own weight. The metric was chosen to be deformation, the standard method of measuring structural stability, and its target is 0%. This applies not only to the base and frame of the chamber, but also the doors, which need to seal the chamber from the outside air to prevent infiltration.

It is also important to provide sufficient space for the compressor to be loaded into the chamber by an overhead crane. Based on regulations by OSHA, the target clearance is 2 inches on the sides and 3 inches above. This means that there should be an opening with at least this clearance compared to the crane on top of the control volume, and the ductwork should not be in the way of the crane during the exchange. The climate conditions of the control volume should also be displayed to the user, so the target is that the temperature and humidity values are indeed always displayed to the user during the testing process. Finally, it is key that the temperature and humidity are adjusted automatically. As a result, the design aims to require zero human interaction in order to reach the desired conditions once the temperature and humidity are chosen.

**Methods of Validation**

The means of validating each target includes the tools used as well as the methods of testing which will be conducted. The first method of validation will be a small-scale test of the controls and display of the system to make sure that all components can be easily controlled and that the temperature and relative humidity is accurately measured and displayed. The final system will then be tested once it is installed at the Danfoss Turbocor R&D Lab Facility to validate each target. An extensive test will be run to ensure that the control volume can reach any condition within 10°C to 50°C and 0% to 95% relative humidity. The flow rate will be determined by measuring the air velocity through the ductwork with a pitot-static tube and multiplying this value by the cross-sectional area of the duct.

To validate the structural stability of the design, the chamber will be bumped and pushed to observe if the components break apart or deform. When the compressor is loaded into the chamber by the overhead crane, it will be clear whether there is adequate space for installing the compressor from above. Finally, the full-scale test will indicate if the display system properly displays the climate conditions to the user and if the system automatically adjusts the temperature and relative humidity to the desired values. The control system will require tuning, which will consist of modifying the controller gains to meet the desired time limit of 15 minutes. Separate temperature and humidity sensors will be used to compare results and ensure that the control volume’s conditions are accurately measured. All measurements will be taken in SI units during testing and validation.