Senior Design Team 509

Environment-Controlled Test Stand Chamber

Michael Stoddard, Meghan Fonda, Donald Laughlin, & Dai (Bill) Truong

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Team Introductions

Michael Stoddard
Project Manager &
Validation Engineer

Meghan Fonda
Quality and Test Engineer

Donald Laughlin
Thermal Fluids Engineer

Dai (Bill) Truong
Design Engineer

Sponsor and Advisor

<u>Sponsor</u>

Jerry Huang

R&D Engineering Manager

FAMU-FSU College of Engineering

<u>Academic Advisor</u>

Dorr Campbell, Ph.D.

Dai(Bill) Truong

Objective

The objective of this project is to design and construct a temperature and humidity-controlled testing chamber for the TT and TG models of Danfoss Turbocor Compressors.

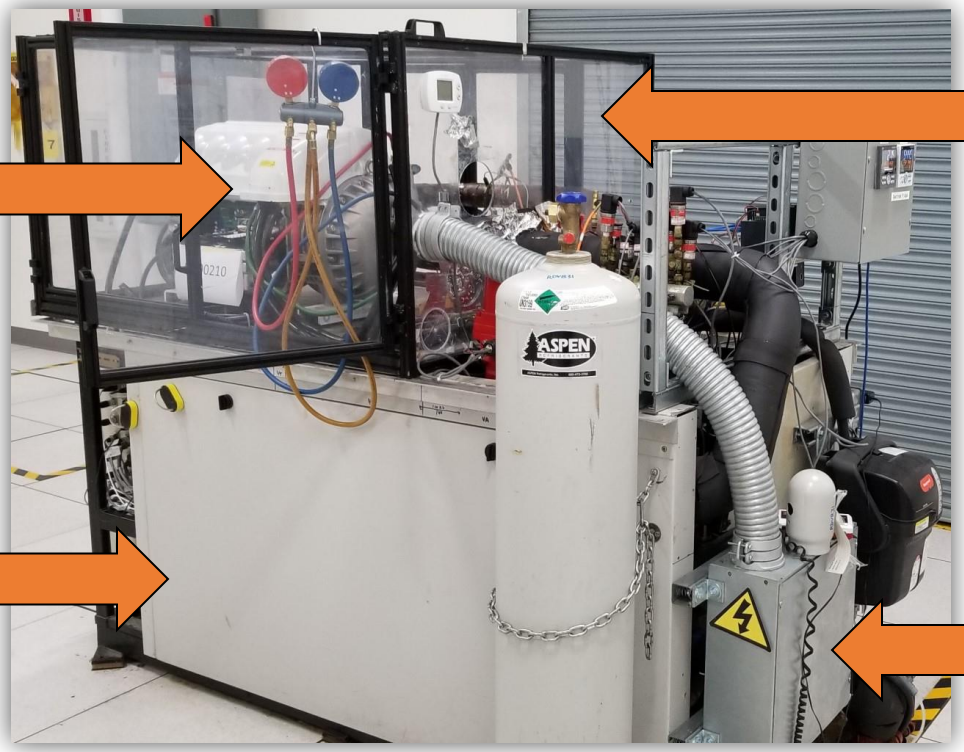
Dai(Bill) Truong

Project Background

The Current Chamber

Dai(Bill) Truong

The Current Chamber



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Markets and Stakeholders

Primary Market

- Danfoss-Turbocor
- R&D Test Facilities

Stakeholders

- Sponsor
  - Jerry Huang, Danfoss employee
- Facilitators
  - FAMU-FSU College of Engineering
  - Dr. Shayne McConomy

FAMU-FSU COLLEGE OF ENGINEERING

Dai(Bill) Truong

Customer Needs

Are there any pressure specifications?	No pressure requirements	No considerations for high pressure in material selection
How does Danfoss move the compressors into and out of the chamber?	An overhead crane with wheels is used	The chamber provides sufficient clearance
What is our budget?	The budget provided is $10,000	Total material and labor costs should not exceed $10,000
Will humidity and temperature fluctuate throughout the testing?	Controlling elements are pre-set and remain constant until changed	Controlling elements will not fluctuate throughout the duration of a test

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Danfoss Turbocor Compressors

Refrigerant: HFC134a

TT Model

- Can operate under standard water cooled and low lift chiller operation or at high lift for air cooled or heat recovery operation
- 788mm x 518mm x 487mm
- Capacity ranging from 60 tons/200 kW to 200 tons/700 kW

Refrigerant: HFO-1234ze

TG Model

- Can operate under standard water cooled and low lift chiller operation or at high lift for air cooled or heat recovery operation
- 788mm x 518mm x 487mm
- Capacity ranging from 40 tons/140 kW to 150 tons/540 kW

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Project Scope

Goals

- Achieve a temperature range of 16 to 55°C (adjusted)
- Maintain a reasonable humidity range (10 to 90%)
- Keep lab personnel safe throughout the testing procedure
- Easy to assemble and disassemble

Assumptions

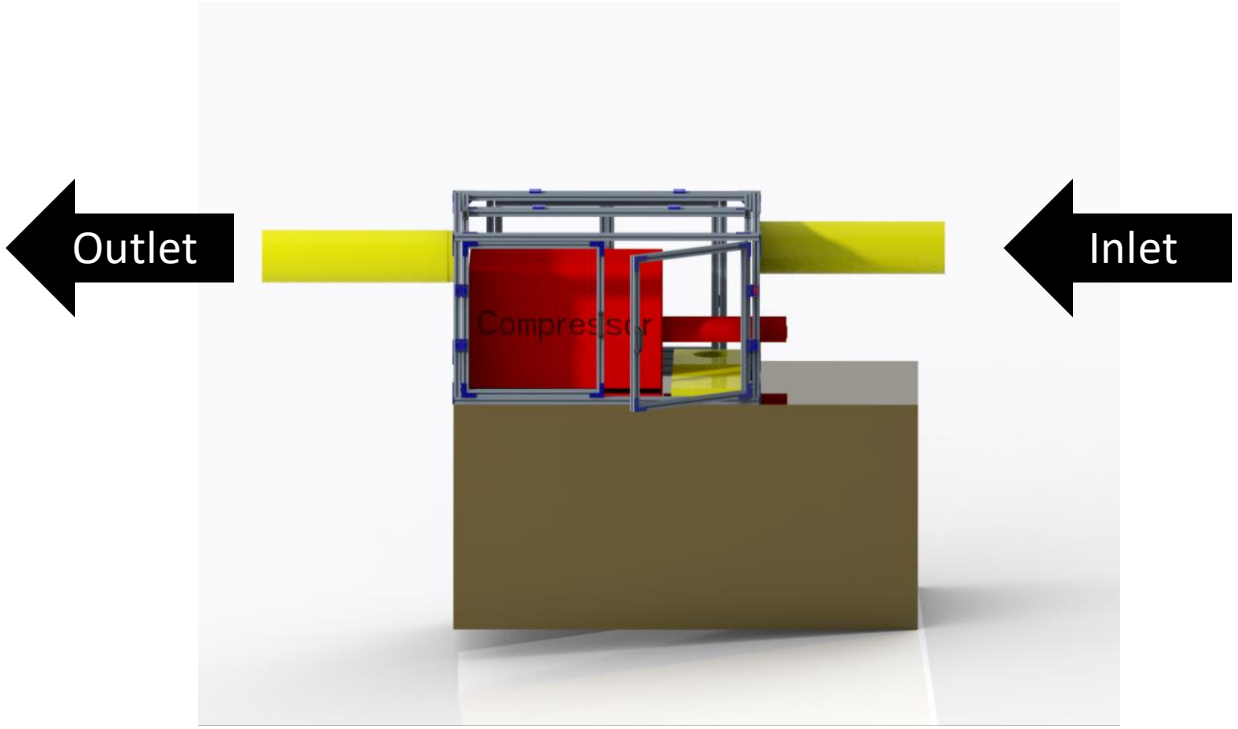
- Dimensions of compressors being tested inside the chamber are constant
- Device will be used inside a Danfoss facility
- Power comes from the testing rig
- The chamber will sit atop the rig
- The College of Engineering will provide some machining services

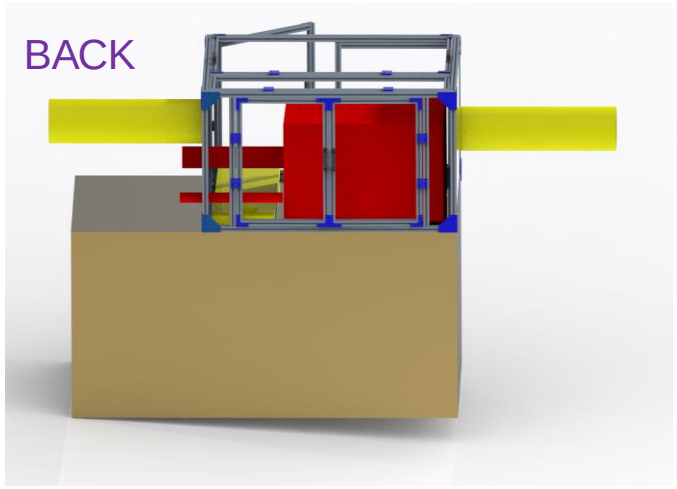
Dai(Bill) Truong

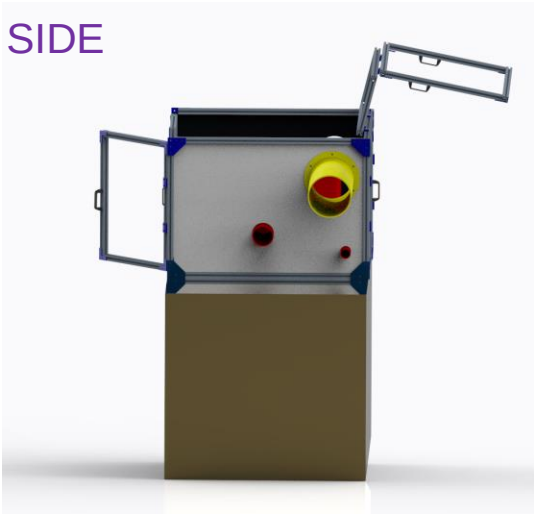
Our Design

Dai(Bill) Truong

The Chamber







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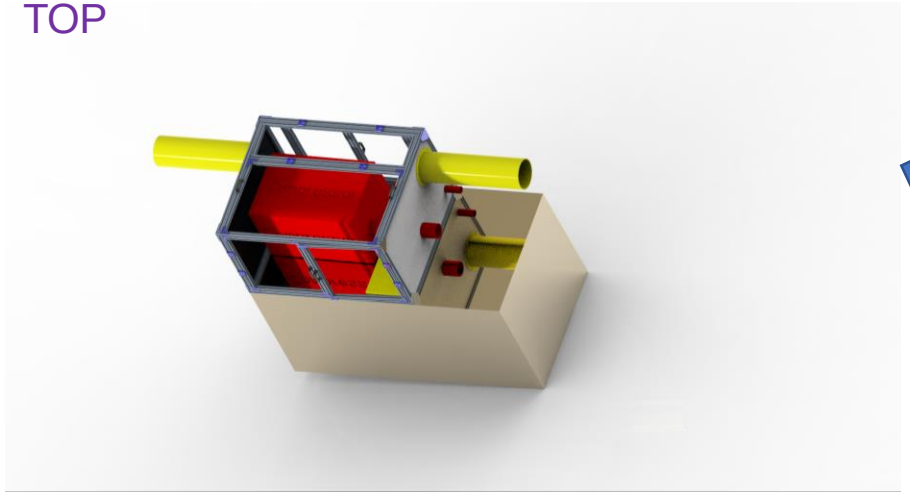
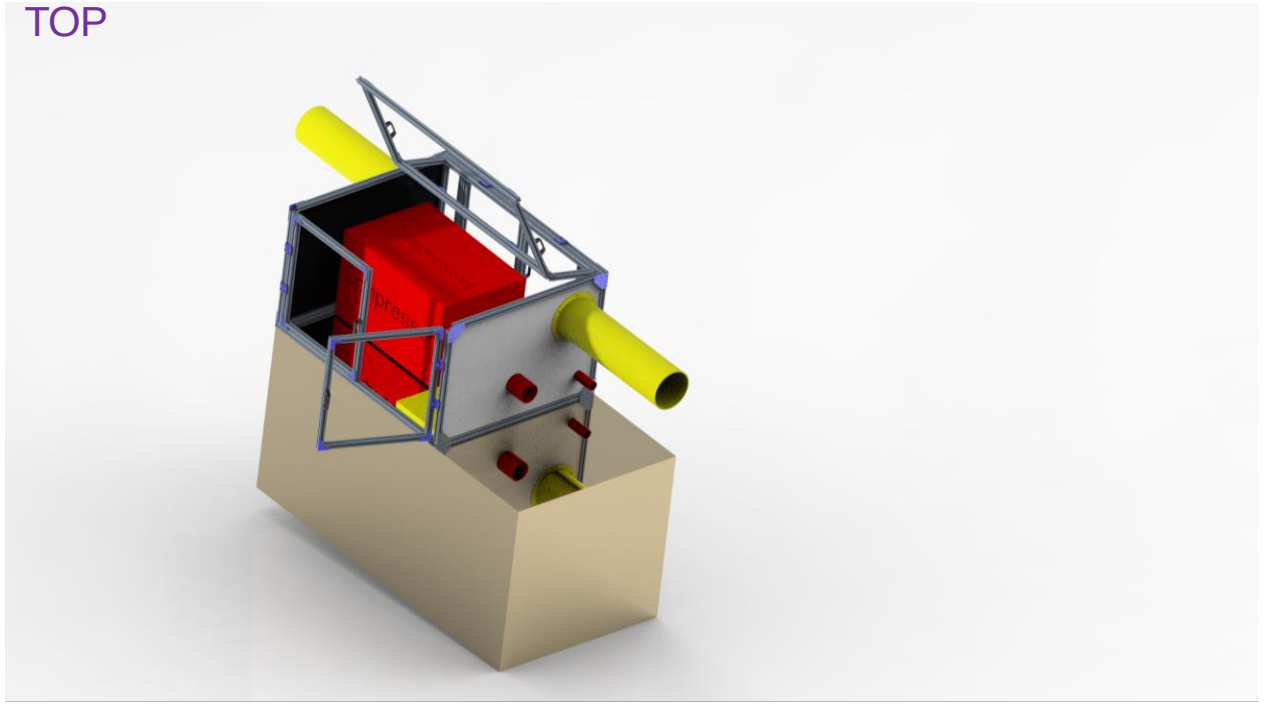
The Chamber

Allows better access for both the crane and operator when the top is fully open.

TOP





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Our Systems

1. AC Unit
2. Humidifier
3. Dehumidifier
4. Additional Heating Element

Dai(Bill) Truong

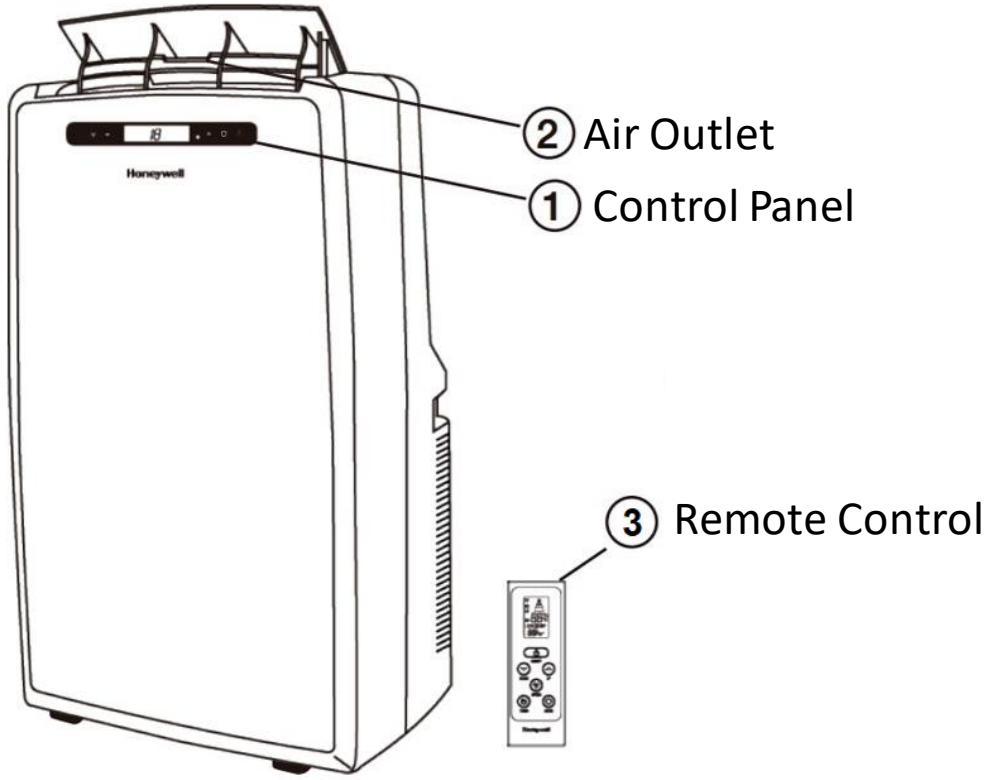
Honeywell Portable Air Conditioner & Heater; MN14CHCS

$659.95

- 14,000 BTU cooling capacity
  - Calculated 4500 BTU needed for cooling
  - Exceeds cooling capacity requirements by a factor of 3
  - Cools chamber in ~10 minutes exceeding max cooling requirement of 30 minutes
- Four modes:
  - Cooling Mode
  - Heating Mode (Max temperature of 26°C)
  - Fan-Only Mode
  - Dehumidifier Mode (90 pints/ 24 hours with continuous drain)

Donald Laughlin

Honeywell Air Conditioner Front View



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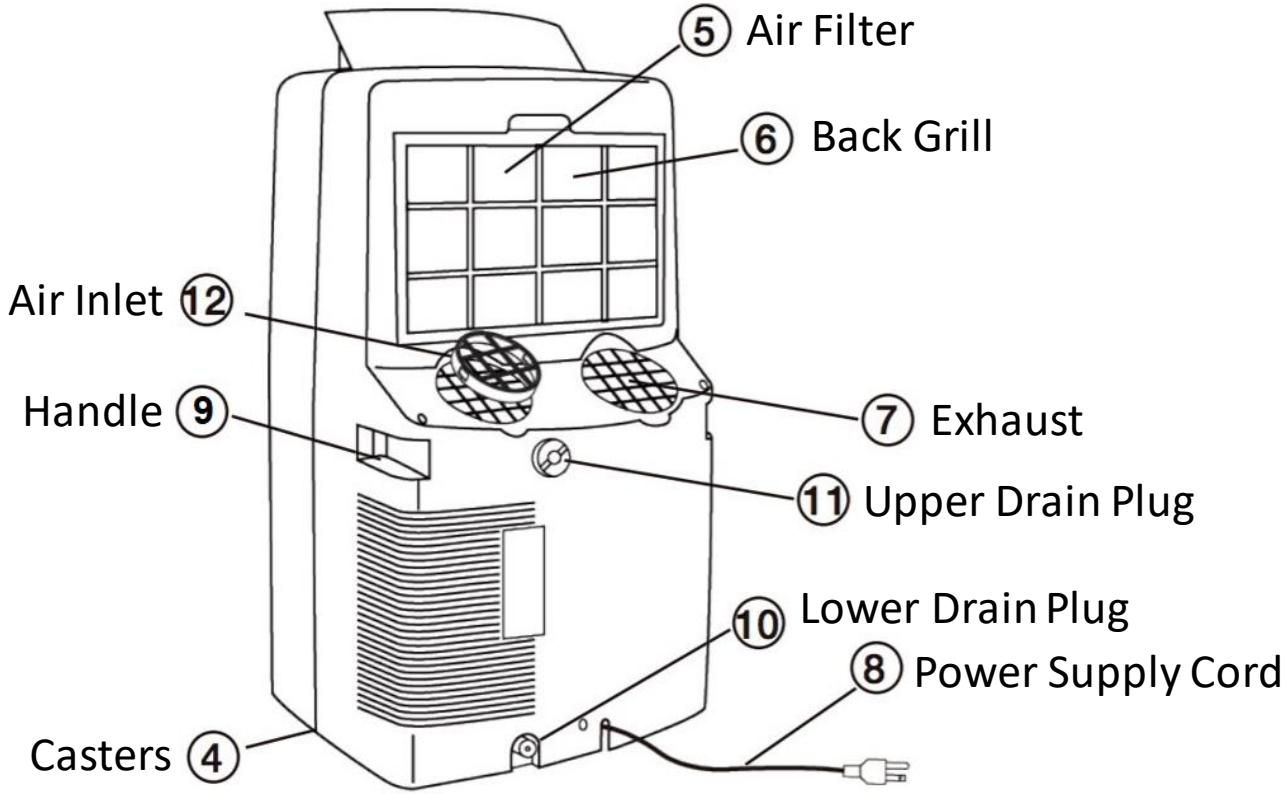
Honeywell Air Conditioner Back View



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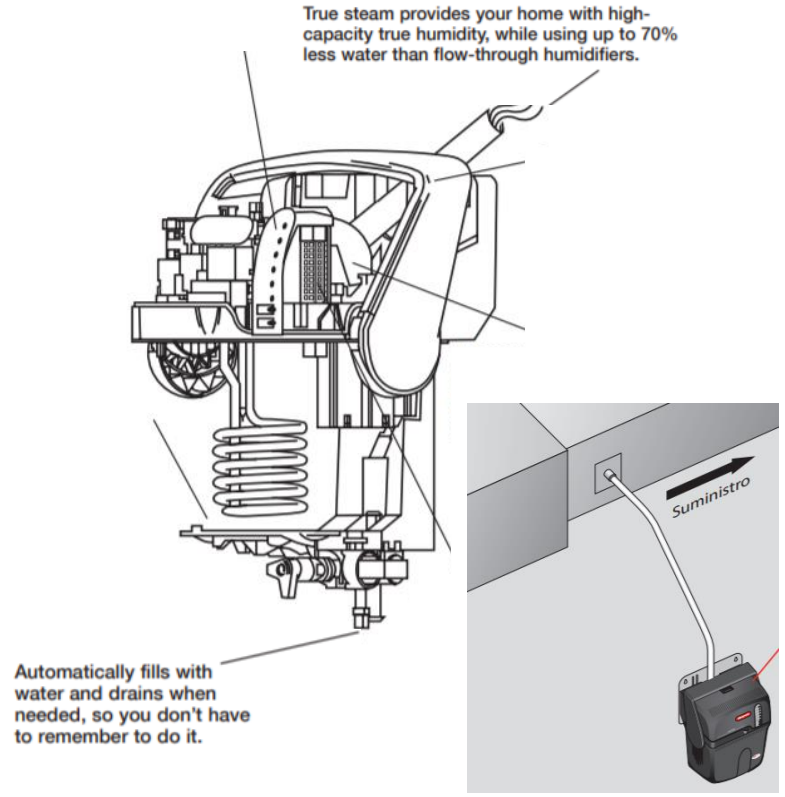
HE200 TrueEASE 17 Gallon Basic Bypass Evaporative Humidifier

$365.64

- 9 gallons/day capacity
- ¼" water supply line
- Compatible with Honeywell humidistat controller
- Requires only a 1-¾" cut into ductwork and mounts on a separate bracket.



Donald Laughlin

Honeywell Pint Dehumidifier With Built in Drain Pump

$339.95

- 70 pints/day dehumidifying capacity
- Built-in auto-drain pump
- 182 CFM
- Built-in humidistat control system

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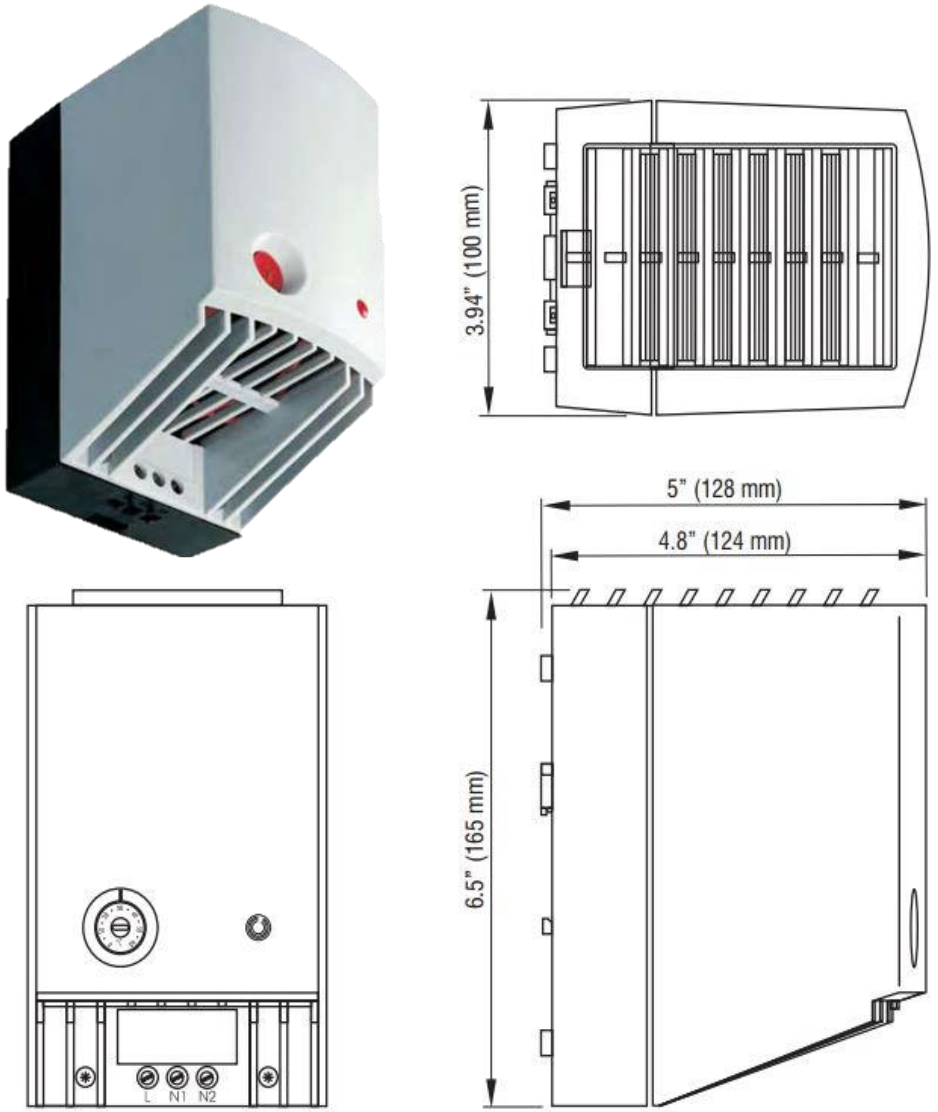
Heating Unit

- Semiconductor heater with fan
- Heating capacity up to 70°C
- Exceeds Customer Requirements by 15°C
- 650W of heating power, predicted to heat the chamber to ideal condition within 15 minutes.



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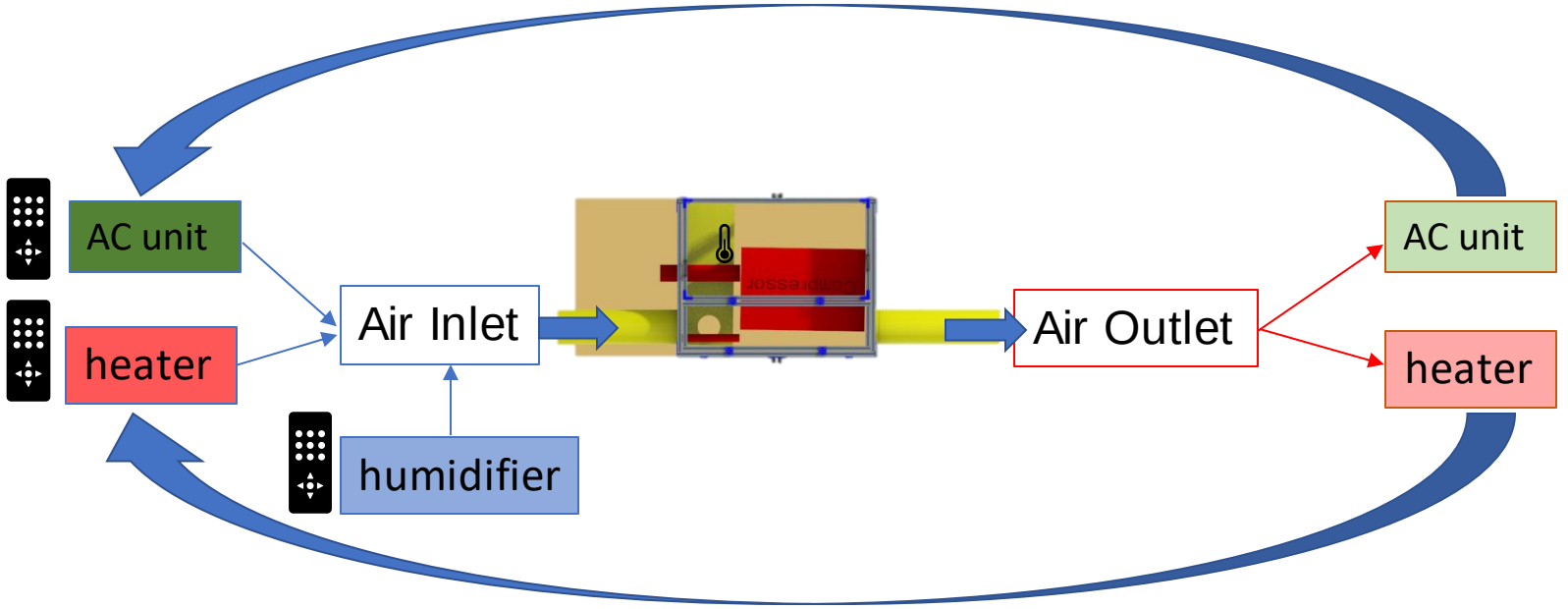
One Inlet – One Outlet

Control

Sensor



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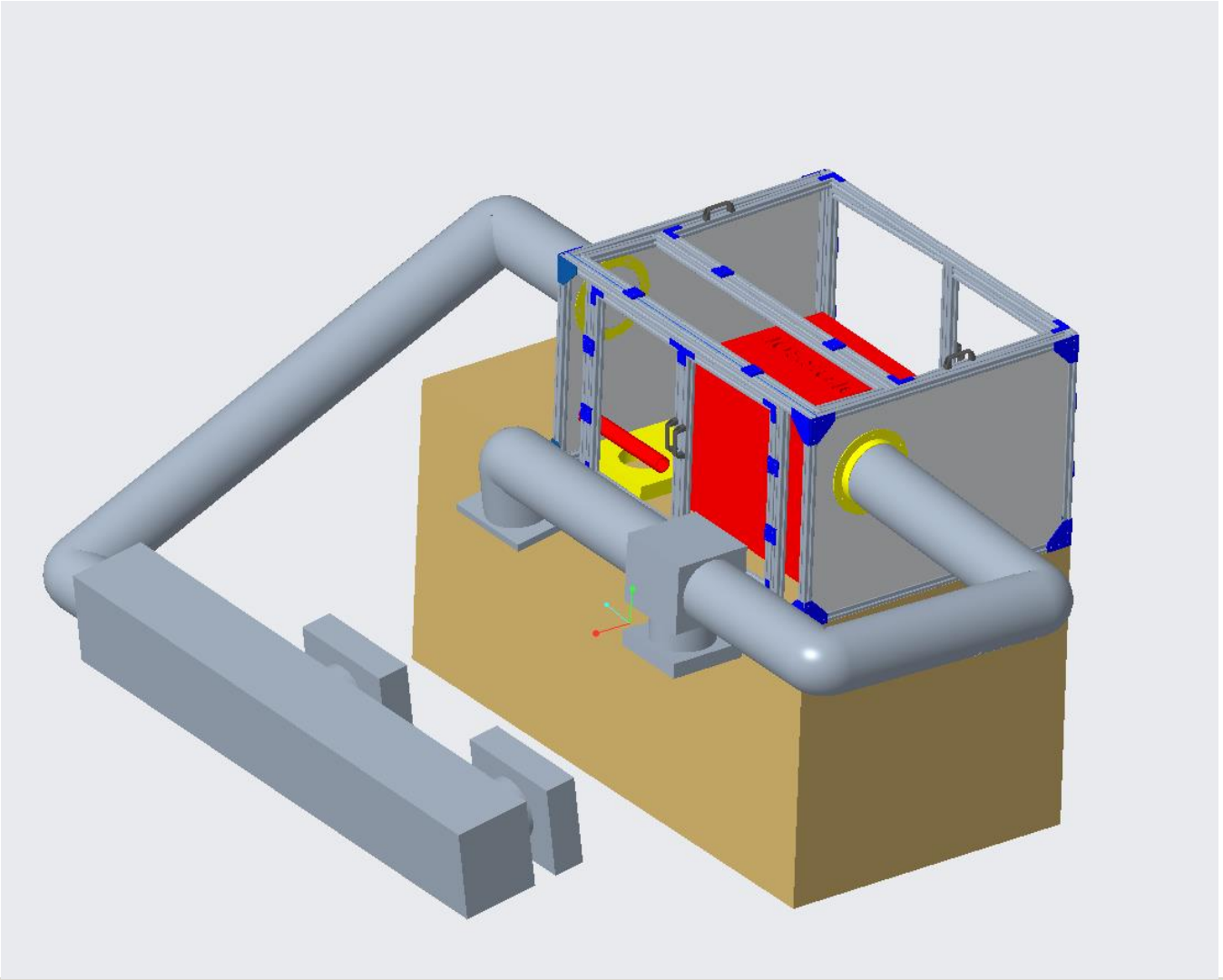
Ductwork



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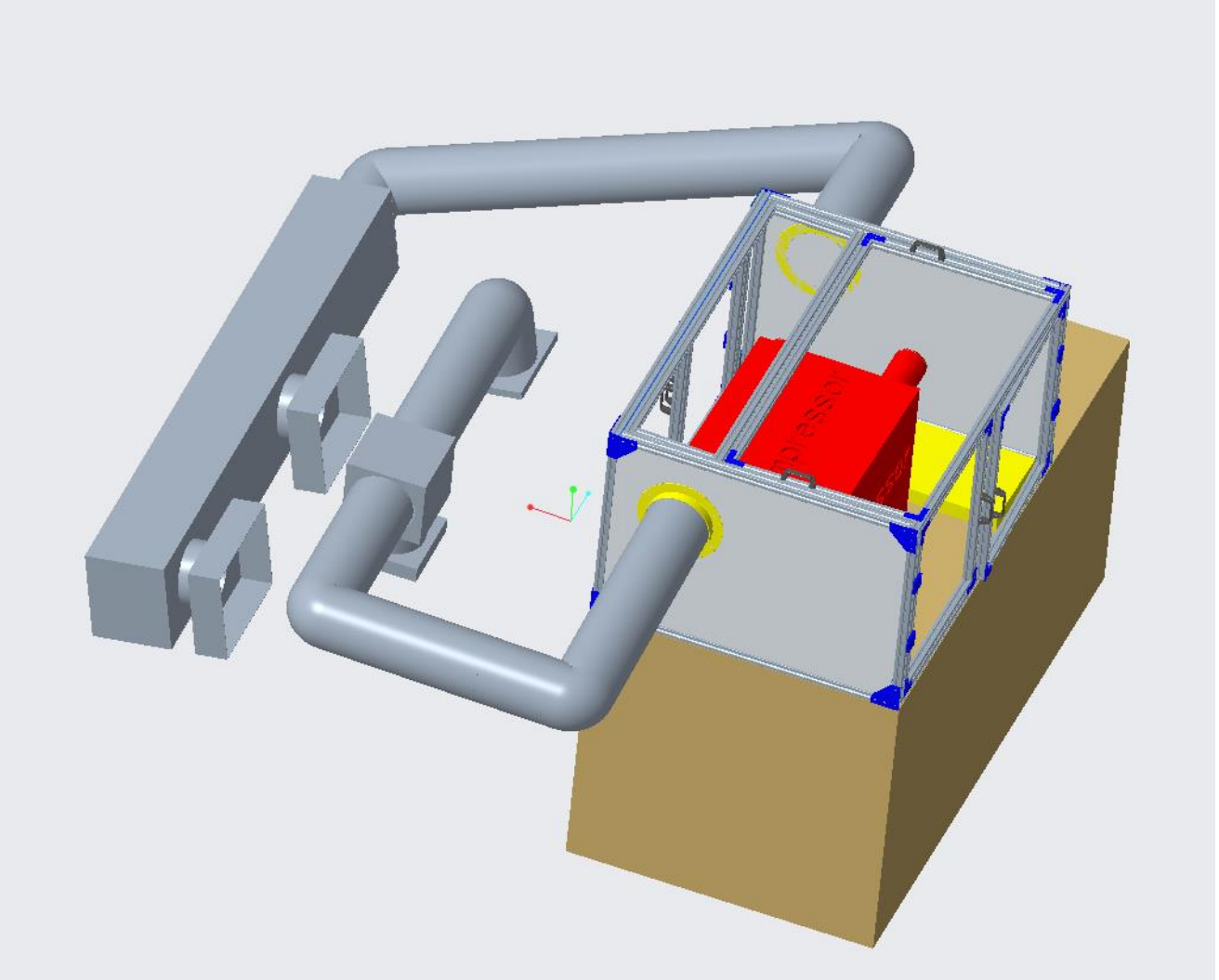

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Control System: Proposed Solutions

- **Solution 1: Universal Control Unit**
  - PID controller integrating all temperature and humidity sensors
- **Solution 2: Separate Temperature & Humidity Control Units**
  - AC and heating units controlled by thermostat, humidifier and dehumidifer controlled by humidistat
- **Solution 3: Utilize Each System's Provided Control Unit**
  - Individual AC, heater, humidifier and dehumidifier control units incorporated into HVAC mounting structure

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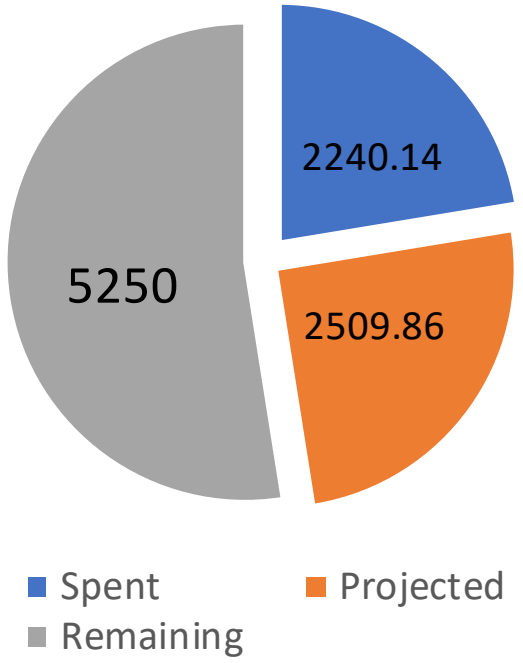
Budget

Current

Category	Cost
Chamber Frame	$ 1360.79
Fastening & Hinges	$ 315.43
HVAC Systems	$ 563.92
Duct & Framing	$ 315.05
Total	**$ 2240.14**

Projected

Category	Cost
Chamber Frame	$ 1500
Fastening & Hinges	$ 450
HVAC Systems	$ 1750
Duct & Framing	$ 1000
Total	**$ 4750**



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5. Possible solution of the control system is being discussed with the sponsor.

Donald Laughlin

References

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Donald Laughlin

Questions?