Modular Composites Curing Oven

Group 41

UNIVERSITY OF WATERLOO | FACULTY OF ENGINEERING

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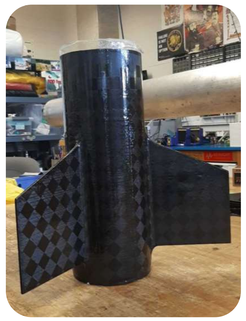
Our Project

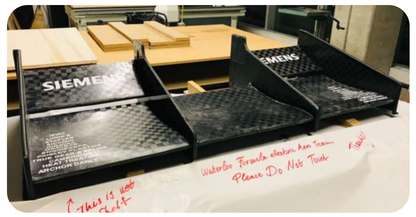
A temperature-controlled curing oven for composite materials that is modular, safe, and easy to store

Motivation

- Student design teams in the Sedra Student Design Center at UW work on composites parts that span a wide range of geometries and sizes, and lack the ability to cure parts at temperature
- Most high-performance composite materials must be cured in controlled temperature environments
- Curing ovens are generally expensive, take up large amounts of space, and can be difficult to control



Rocketry Fin Can



Formula Electric Front Wing

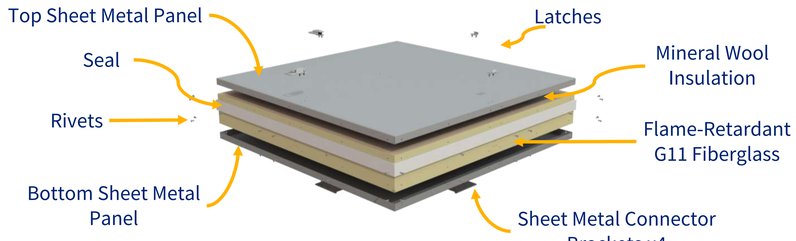
Existing Solutions:

Room-sized industrial oven

Low temp recycling bin oven

High pressure autoclave for Boeing 77X

Structure

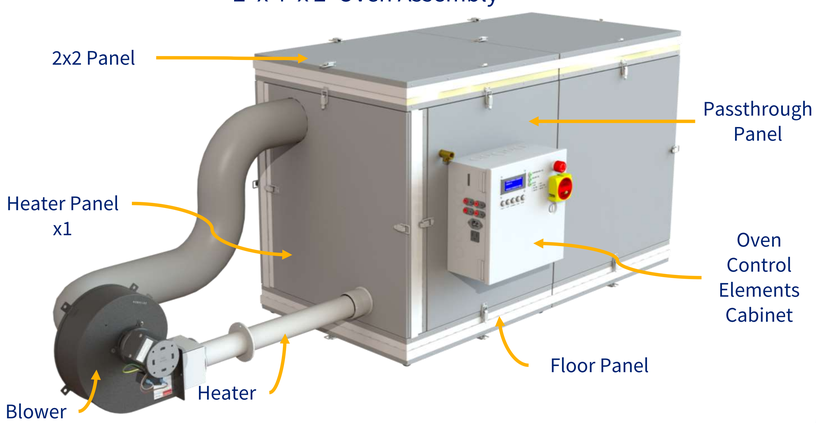


Single Panel Exploded View

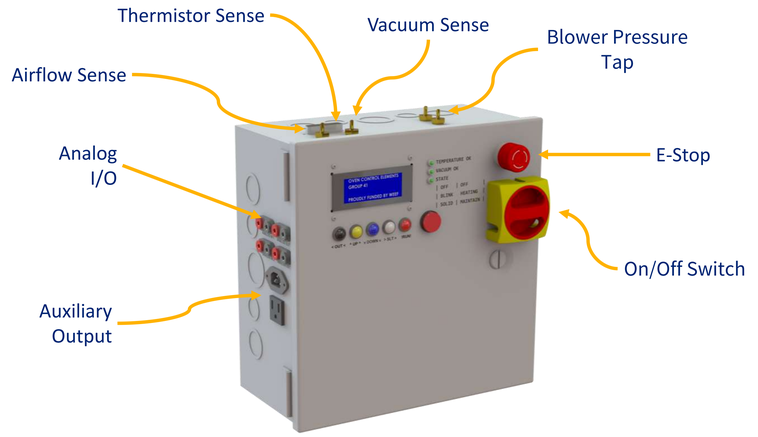
Oven Structure features:

- Passthroughs for vacuum plumbing and thermistors
- Each panel joint requires only a connector on the inside and latch on the outside
- Blower and heater recirculation system for rapid temperature ramp
- Oven size can be extended by constructing more panels

2' x 4' x 2' Oven Assembly



Electrical

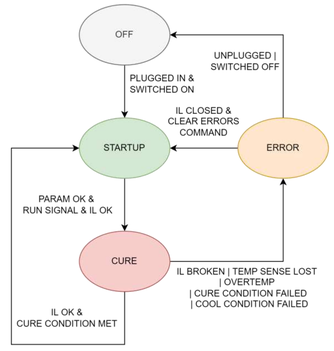


Oven Control Elements Cabinet

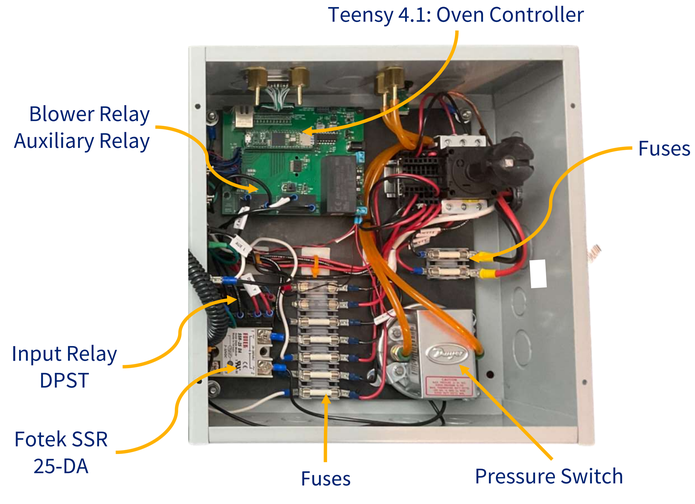
OCE features:

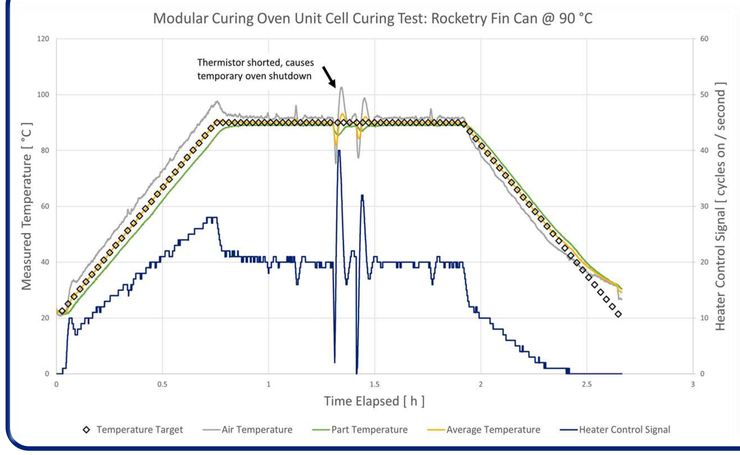
- 240 V Architecture – 2 kW
- Interlock Loop
- Solid-State-Relay for heater control
- Relay for blower and auxiliary control
- Thermistor temperature feedback
- Control and data logging at 1 Hz
- Data logged to .csv file on SD Card
- All parameters are adjustable from UI
  - Temperature and curing times
  - Number and type of thermistors
  - PID Controller Gains

OCE State Machine



Control Cabinet Interior





Testing

The rocketry fin can was post-cured in the curing oven to obtain better structural properties at the high temperatures observed in the desert at competition in New Mexico.

Power Source: 240 V
Resin: Airstone 780E
Cure Schedule: 1 hr @ 90 °C 45 min. ramp
Temperature Error: < 5 °C at steady state

Design Objectives	Specifications	Value	Unit	Results
Functionality	Temperature Uniformity	± 5	°C	Pass
Functionality	Service Life	≥ 10	year	N/A
Functionality	Temperature Ramp Rate	≥ 2	°C/min	N/A
Safety	Structure and Ducting Surface Temperature	≤ 30	°C	Fail
Safety	Maximum Air Temperature	≤ 200	°C	Pass
User Friendliness	Assembly Time	≤ 15	min	Pass

Sponsors

WEEF | intertex textiles | FASTENAL | WATERLOO ROCKETRY | WATERLOO FORMULA ELECTRIC