XPLORLABS

FIRE FORENSICS: CLAIMS & EVIDENCE

STUDENT

INVESTIGATION 4:
FIRE LAB DATA ANALYSIS

CASE STUDY OF SCIENCE AND ENGINEERING

SCIENTISTS ASK WHY. ENGINEERS ASK HOW.

YOUR NAME

OPEN OR CLOSED DOOR?

Researchers in the Firefighter Safety Research Institute (FSRI) have an amazing fire lab the size of two football fields near Chicago, Illinois. These fire scientists and engineers use this lab to answer the questions about how to keep firefighters safe and how to read a fire scene to solve a fire case.

In 2017, fire scientists and engineers worked in the fire lab for one month to answer one question: "What is the impact of **ventilation** on a house fire?"

To answer this question, they built a one-story house in the lab and set it on fire under two conditions – with a **closed front door (unvented)** and with an **open front door (vented)**. This house had a kitchen, living room, and two bedrooms, just like a house that we could find in any town in the United States. The house was furnished – it had beds, chairs, sofas, and appliances. The fire set by the researchers always started in the corner of the sofa in the living room.

This data was collected using highly sensitive sensors placed around the structure from the floor to the ceiling every four inches up from the floor. The tests were controlled, down to the exact placement and weight of the furniture and furnishings in the structure. The only variable was the front door – open (vented) or closed (unvented).

Three of the variables in this fire lab investigation are:

1. **Oxygen levels.** This is measured as percentages. Our atmosphere is 21% oxygen.

2. **Air pressure.** This is measured as units of pressure (Pascals) written as Pa.

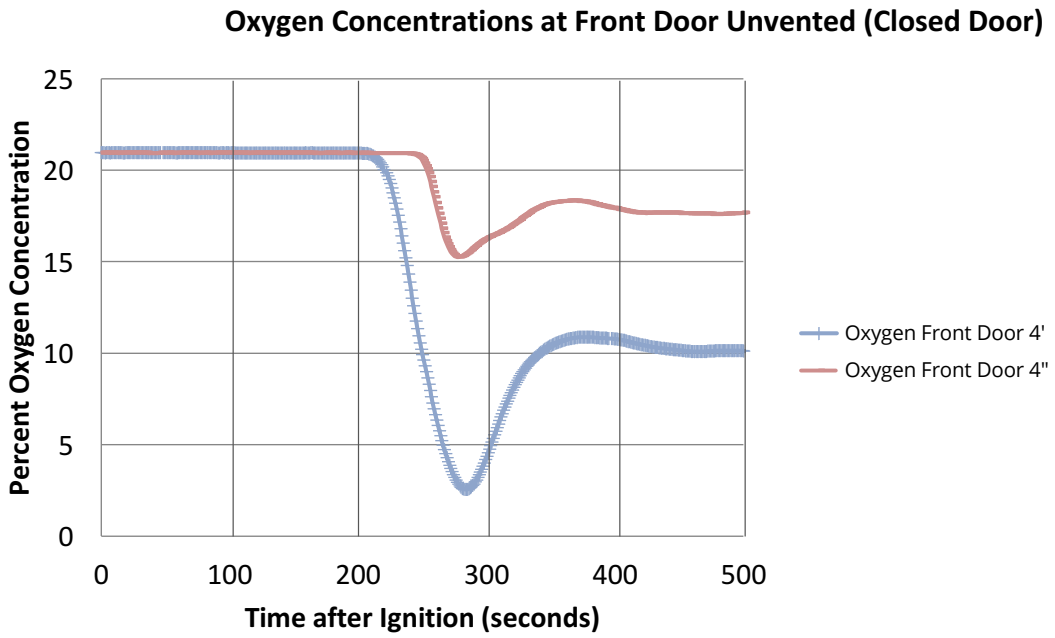
3. **Temperature.** This is measured in degrees Celsius. The average human body temperature is 98.6 degrees Fahrenheit, which is 37 degrees Celsius. The average room temperature is 70 degrees Fahrenheit, which is 21.11 degrees Celsius.

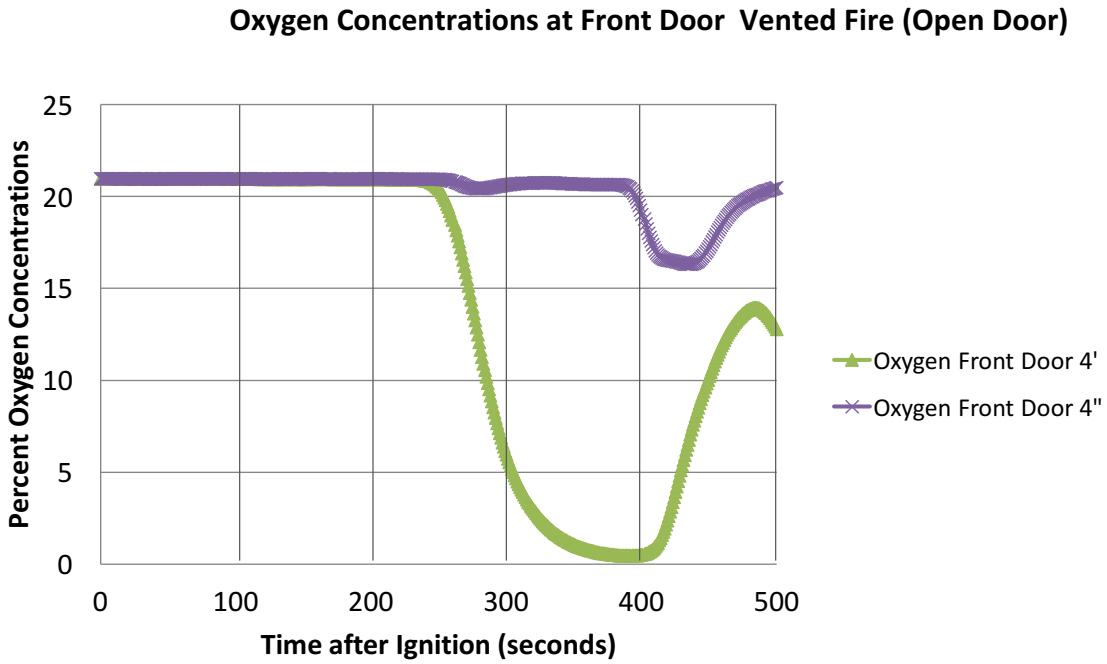
Why spend an entire month doing repeated burns to test one question? Why is this an important question for fire fighters and fire investigators to know the answer to?

Look through the data collected at the fire lab on oxygen, air pressure, and temperature and see what claims you can make about the difference between an open door and a closed one.

INVESTIGATION 4: FIRE LAB DATA ANALYSIS

OXYGEN





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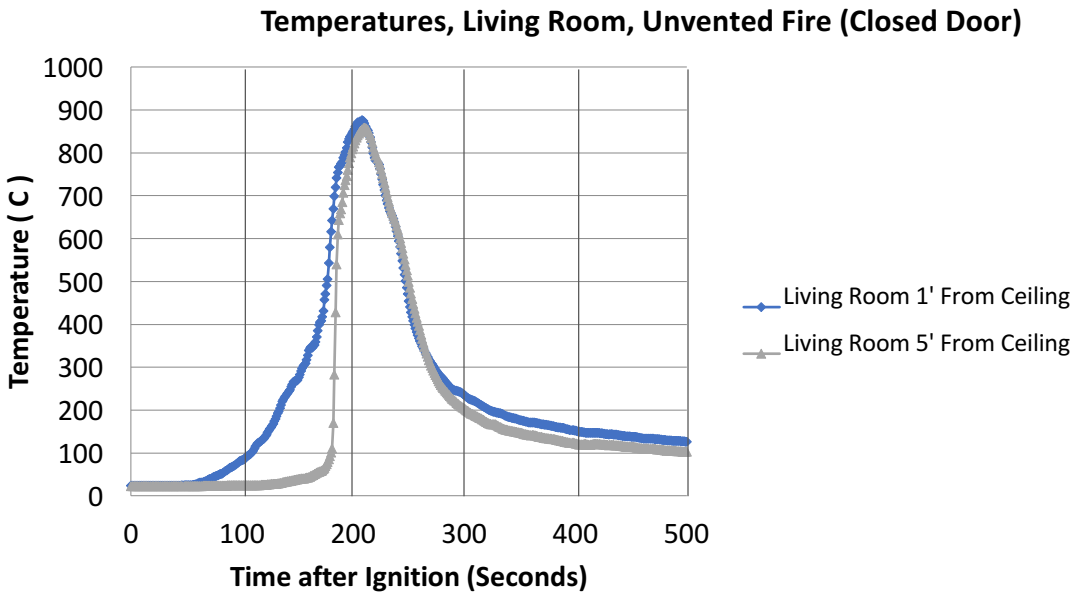
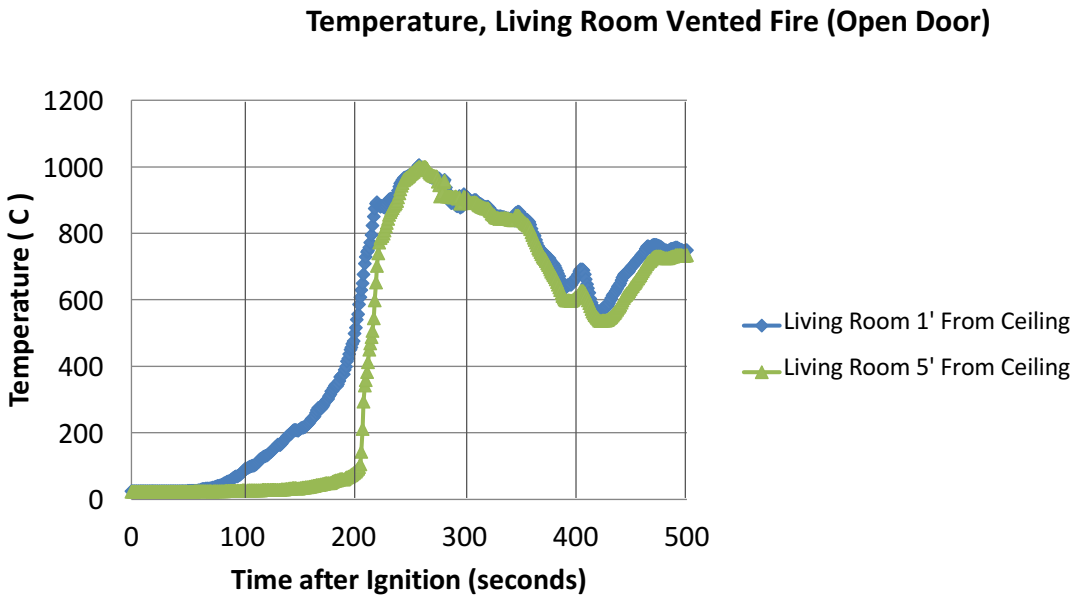
TEMPERATURE





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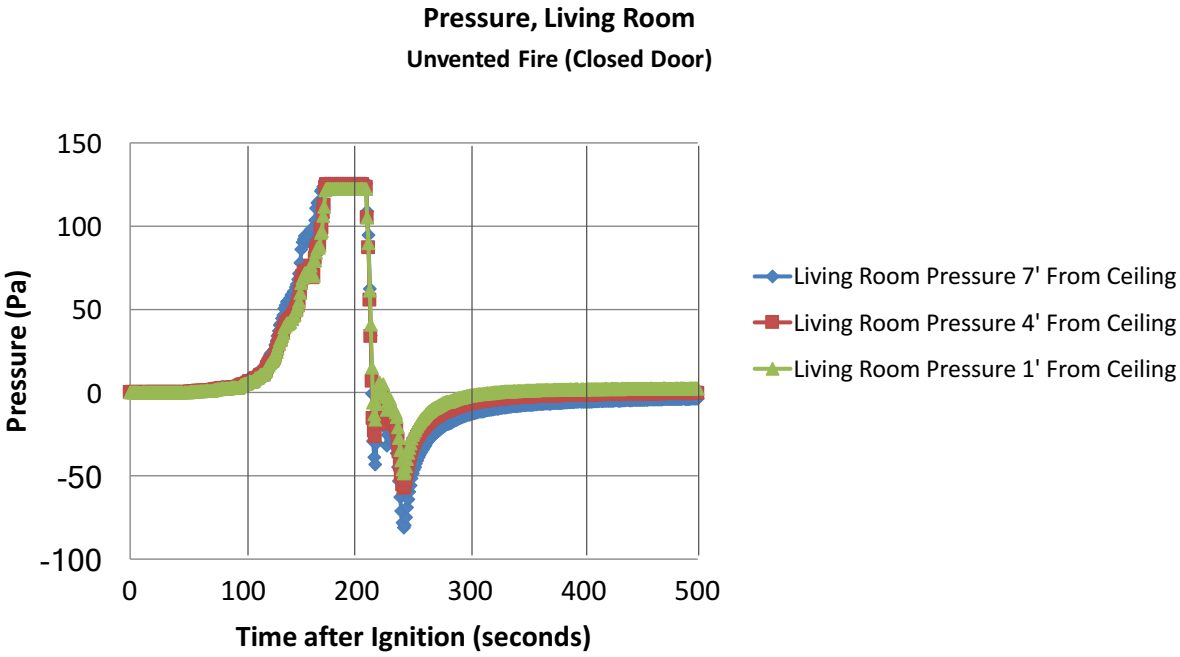
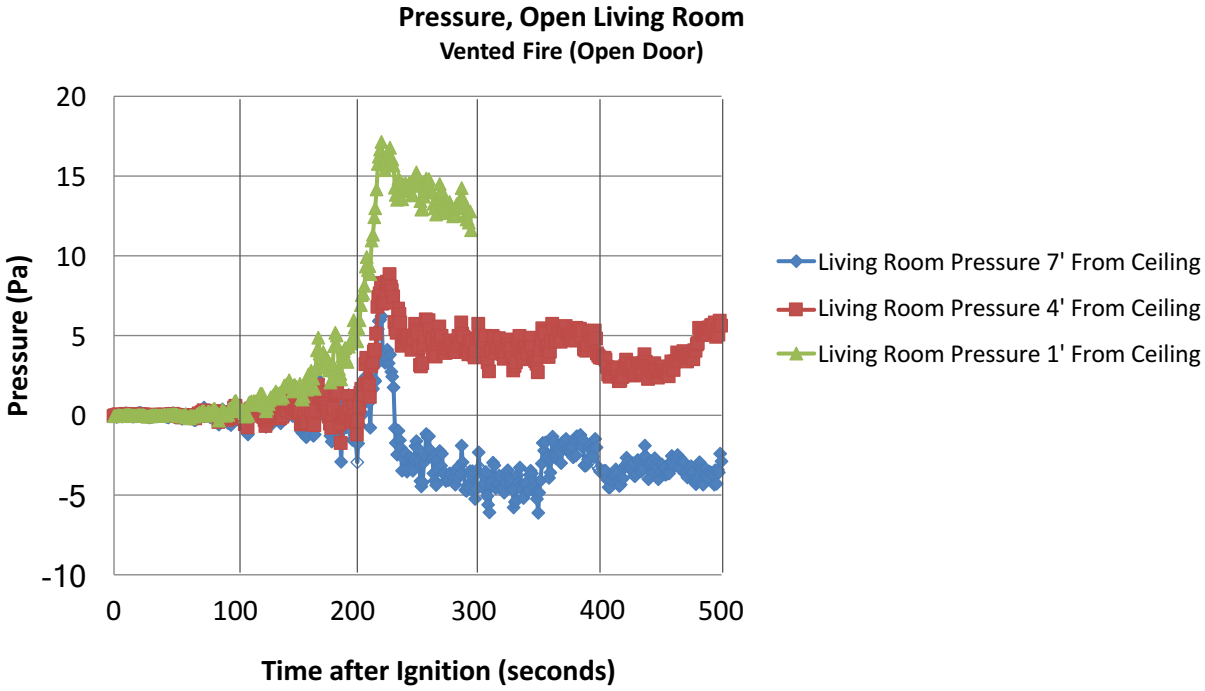
PRESSURE





TIMELINE - (ONE COPY PER GROUP (ALL GROUPS))

UNVENTED (CLOSED DOOR) FIRE

SECONDS	EVENT IN CLOSED DOOR FIRE
0	Ignition – fire starts.
35	Flame extends up the back of the sofa cushion.
75	A hot gas layer begins to form – hot gases in the room are trying to expand. Air pressure begins to increase.
90	Light smoke begins leaking out of a small gap around the closed door because the air pressure inside of the house is higher than the outside air pressure.
150	Fire spreads across the sofa. The hot gas layer is getting lower to the floor. The cool air layer is getting lower to the floor.
188	The gases coming from the heated sofa ignite. The hot gas layer is now burning. The air pressure is forcing flames out of gaps in the top and bottom of the window.
200	Smoke is pushing out of the gap under the bottom of the door, indicating that the hot gas layer has reached the floor and there is little to no oxygen left in the house for combustion.
210	The house is full of thick smoke.
215	The gases inside are cooling. The air pressure inside is equalizing with the air pressure outside.
225	Almost all of the smoke outside of the house is gone.

TIMELINE - (ONE COPY PER GROUP (ALL GROUPS))

VENTED (OPEN DOOR) FIRE

SECONDS	EVENT IN CLOSED DOOR FIRE
0	Ignition – fire starts.
35	Flame extends up the back of the sofa cushion.
75	A hot gas layer begins to form – hot gases in the room are trying to expand. Air pressure begins to increase.
90	Smoke is flowing from the upper portion of the door while fresh air is being drawn in the lower portion of the door. The door is serving as a bi-directional vent. The upper portion is exhausting (pushing out) hot smoke. The lower portion is taking in fresh oxygen to the house and to the fire.
150	Fire spreads across the sofa. The hot gas layer is getting lower to the floor. The cool air layer is getting lower to the floor.
188	Fire growth rate is increasing. In the infrared (IR) view notice how the lamp to the left of the sofa is heating up and off gassing (pyrolyzing) The gases from the lampshade auto ignite.
200	Heavy smoke flowing out of front door.
210	Flames at doorway.
215	Flashover. The gases are burning from the ceiling down to the floor. Every exposed fuel surface is putting off gases and providing a mixture of rich fuel. Since there is little to no oxygen in the house the only oxygen available for combustion (burning) is coming in from the open front door.
225	Fire will continue until it runs out of fuel.