Pilot Study on Fire Effluent Condensate from Full Scale Residential Fires: Supplementary information

Supplementary information. Additional details regarding methods and results from each live-fire experiment are provided in the following sections. Detailed descriptions of the experimental structures, instrumentation, fuel load, and ventilation are provided along with laboratory detection and reporting limits for water sampling. Representative temperature and gas concentration time-histories are also provided for each experiment to describe the local conditions within the structure from which condensate samples were collected. Finally, the concentrations of all compounds detected in the condensate, baseline rinse and runoff water are provided along with laboratory dilution factors, detection limits and reporting limits.

S.1 Experiment Structures

Experiments 1–4 were conducted in purpose-built, ranch-style, single-story residential structures constructed at the Delaware County Emergency Services Training Center in Sharon Hill, PA. The structures were built for a project studying search and rescue tactics for firefighters as reported by Weinschenk and Regan [1, 2]. Those reports include thorough details about the construction of the buildings. A dimensioned floor plan of the structure is shown in Figure S1. Experiment 1 was conducted in Bedroom 3 and Experiment 2 was in Bedroom 4. Experiments 3 and 4 were both conducted in the living room. Each of these experiments were conducted with all interior bedroom doors in the closed position. The dimensions of the windows and doors are summarized in Table S1.

Fig. S1: Dimensioned floor plan for Experiments 1–4.

Table S1: Dimensions of windows and doors for Experiments 1–4.

Vent	Size [width x height] (cm)	Sill Height (cm)
Living Room Windows	183 x 152	61
Bedroom Windows	183 x 122	91
Kitchen Window	91 x 91	122
Front Door	91 x 203	—
Interior Doors	76 x 203	—

Experiment 5 was conducted in a purpose-built, two-story structure at the Delaware County Emergency Services Training Center. The structure was built for studying basement fires, as reported by Madrzykowski and Weinschenk, who describe its construction [3]. The exterior walls of the lower floor are built from 61 cm thick, interlocking concrete blocks to simulate a basement. Experiment 5 was conducted using only the basement floor after it was modified to simulate a furnished studio apartment (including a bedroom, kitchenette, office and living room) by isolating one-half of the floor away from the stairwell and the rest of the structure (Figure S2). The grey areas in the floor plan are not part of the experimental volume. The dimensions of the vents are summarized in Table S2.

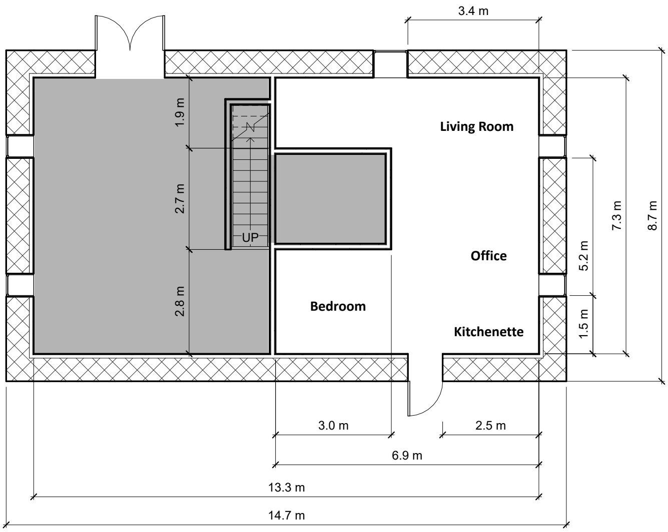

Fig. S2: Dimensioned floor plan for Experiment 5.

Table S2: Dimensions of windows and door for Experiment 5.

Vent	Size [width x height] (cm)	Sill Height (cm)
Side Wall Windows	61 x 25	198
Rear Wall Window	100 x 85	149
Front Door	91 x 203	—

S.2 Fuel Load

The structures for each experiment were fully furnished to represent a typical fuel load for a residential structure. The furnishings were dimensioned, weighed, and where possible, the base materials used in their construction were determined (Tables S3, S4, S5). Experiment 5 included additional common household items to simulate a cluttered residential fire scene, and not all items were weighed and measured. Ignition was initiated via an electric match located in the corner of the sofa in each experiment as shown on the floor plans in Figures S3 and S4.

Table S3: Furnishings and Contents for Experiments 1 and 2

Item	Dimensions (cm)	Materials	Mass (kg)
Sofa	221 x 91 x 86	Fabric PE, fill PU foam & PE, frame eng. wood	53
Box	61 x 61 x 61	2 layers of 0.5 in. plywood	–
Carpet	1.3 thick	Fiber 100% PET, PP backing with latex	3.3 kg/m^2
Carpet Padding	1.1 thick	PU rebond foam	3.1 kg/m^2
OSB Subfloor	1.1 thick	Wood and PF resin	6.8 kg/m^2

PE = polyethylene, PET = polyethylene terephthalate, PF = phenol formaldehyde, PP = polypropylene, PU = polyurethane

Table S4: Furnishings and Contents for Experiments 3 and 4

Item	Dimensions (cm)	Materials	Mass (kg)
Sofa (2)	221 x 91 x 86	Fabric PE, fill PU foam & PE, frame eng. wood	53.0
Ottoman	74 x 41 x 58	Fabric PE, fill PU foam & PE, frame eng. wood	8.4
Coffee Table	140 x 107 x 42	Vinyl over particle board	40.6
End Table	66 x 56 x 66	Vinyl over particle board	27.9
TV Stand	127 x 51 x 76	Wood, particle wood with wood veneer	65.5
TV	97 x 56 x 10	PE shell, glass screen electronic circuits, metal components	79
Lamp	30 dia x 64	Body cast vinyl, shade fabric over plastic film	1.5
Curtains (2 pair)	213 x 213	100% PE	2.3
Carpet	1.3 thick	Fiber 100% PET, PP backing with latex	3.3 kg/m^2
Padding	1.1 thick	PU rebond foam	3.1 kg/m^2
OSB	1.1 thick	Wood and PF resin	6.8 kg/m^2

PE = polyethylene, PET = polyethylene terephthalate, PF = phenol formaldehyde, PP = polypropylene, PU = polyurethane

Table S5: Furnishings and Contents for Experiment 5

Item	Dimensions (cm)	Materials	Mass (kg)
Throughout Compartment			
Carpet	1.3 thick	Fiber 100% PET, PP backing with latex	3.3 kg/m^2
Padding	1.1 thick	PU rebond foam	3.1 kg/m^2
OSB	1.1 thick	Wood and PF resin	6.8 kg/m^2
Wall Paneling	1.5 thick	Plywood	–
Living Room			
Sofa (2)	221 x 91 x 86	Fabric PE, fill PU foam & PE, frame eng. wood	53.0
Ottoman	74 x 41 x 58	Fabric PE, fill PU foam & PE, frame eng. wood	8.4
Chair	–	Fabric PE, fill PU foam & PE, frame eng. wood	8.4
Coffee Table	140 x 107 x 42	Vinyl over particle board	40.6
End Table	66 x 56 x 66	Vinyl over particle board	27.9
TV Stand	127 x 51 x 76	Wood, particle wood with wood veneer	65.5
TV	97 x 56 x 10	PE shell, glass screen electronic circuits, metal components	79
Lamp	30 dia x 64	Body cast vinyl, shade fabric over plastic film	1.5
Holiday Tree	–	PVC and steel	–
CD player	–	Polycarbonate, ABS	–
DVD player	–	Styrene acrylonitrile	–
Toy Bike	–	Plastic	–
Toy w/ Battery	–	–	–
Storage Bins	–	PP	–
Storage Boxes	–	Cardboard, plastic packing material	–
Bedroom			
Mattress	188 x 97 x 30	90% PU foam, 10% blended rayon & PE	–
Mattress Topper	188 x 97 x 10	PU foam	–
Bed Foundation	188 x 97 x 23	PE padded fabric, wood	–
Bedding	Twin size	100% PE	–
Pillow (2)	69 x 43 x 10	Shell 52% PE & 48% cotton, fill 100% PE	1.2

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Table S5 – *Continued from previous page*

Item	Dimensions (cm)	Materials	Mass (kg)
Curtains (2 pair)	213 x 213	100% PE	1.1
Dresser	157 x 43 x 91	Vinyl over particle board w/cardboard back	49.5
Body Wash	–	–	–
Shampoo	–	–	–
Deodorant	–	–	–
Toothpaste	–	–	–
Nail Polish	–	–	–
Nail Polish Remover	– –	Acetone, plastic container	–
Fabric Softener	–	–	–
Kitchenette			
Recycling Bin	–	LDPE	–
Waste Bin	–	LDPE	–
Utensils	–	Nylon	–
Kitchen Containers	–	Polycarbonate	–
Laundry Hamper	–	PE	–
T-Shirts	–	Cotton	–
Air Fryer	–	–	–
Microwave	–	PE and steel	–
Coffee Maker	–	PP	–
Toilet Paper	–	–	–
Paper towels	–	–	–
Office			
Office Desk	–	Particle board, vinyl	–
Bookcase	–	Particle board, vinyl	–
Laptop w/ Battery	–	–	–
Computer	–	PVC	–
Stick Vacuum	–	PP	–
Shop Vacuum	–	PP	–
Baby Gate	–	PBT	–
Cork Board	–	–	–

ABS = acrylonitrile butadiene styrene, LDPE = low density polyethylene, PBT = polybutylene terephthalate, PE = polyethylene, PET = polyethylene terephthalate, PF = phenol formaldehyde, PP = polypropylene, PU = polyurethane

S.3 Instrumentation

The structures for all five experiments were instrumented to measure gas temperature, gas velocity, gas concentration, pressure, and heat flux. Only the gas temperature and gas concentration measurements were used in the analysis for this study. The locations for these measurements are shown by Figures S3 and S4 for Experiments 1–4 and Experiment 5, respectively.

Experiment 1 and 2 were conducted in bedrooms with a thermocouple array centered in the room and gas probes at two locations: centered along the window wall (Position B) and centered along the wall opposite the sofa (Position A). The elevations of the gas probes used to collect condensate were 10 cm, 61 cm, 122 cm, and 183 cm at Position A, and 81 cm and 239 cm at Position B.

Experiments 3 and 4 were conducted in the living room and included six gas probes for condensate collection. Three of these were located in the living room at Position C with elevations of 61 cm, 122 cm, and 183 cm. Positions D, E, and F were spread along the hallway and included one gas probe each. The elevation was 122 cm at Positions D and E, and 91 cm at Position F.

Experiment 5 included four gas probes for condensate collection. These were grouped in two locations as shown in Figure S4 with elevations of 10 cm and 122 cm at each location.

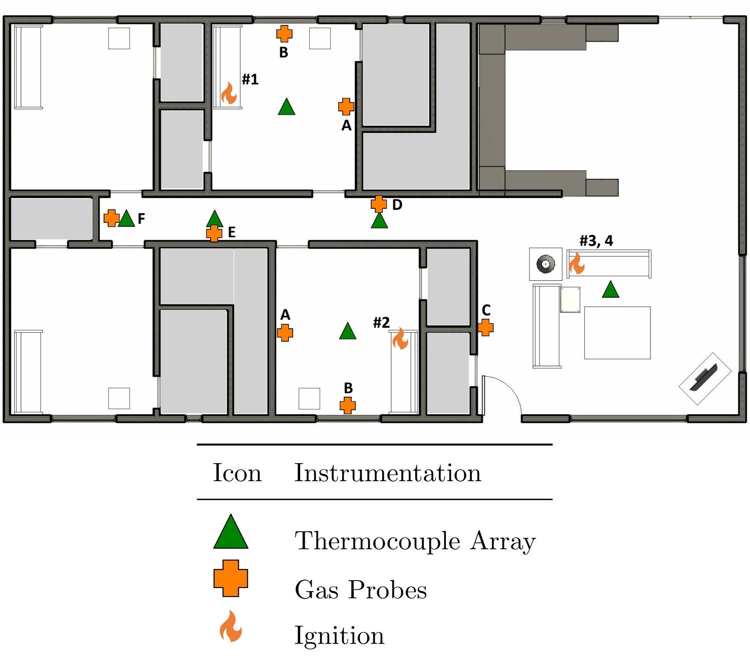
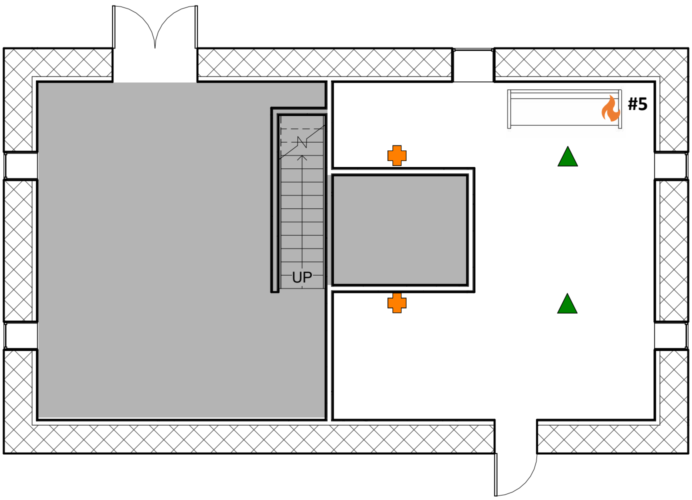


Fig. S3: Instrumentation and ignition locations for Experiments 1–4.



Icon	Description
▲	Thermocouple Array
✚	Gas Probes
🔥	Ignition

Fig. S4: Instrumentation and ignition locations for Experiment 5.

S.4 Laboratory method detection and reporting limits

Table S6: Laboratory method detection limit and reporting limit for Volatile Organic Compounds (EPA 8260B).

Compound	Minimum Detection Limit (μg/L)	Reporting Limit (μg/L)
1,1,1,2-Tetrachloroethane	0.33	2.0
1,1,1-Trichloroethane	0.32	1.0
1,1,2,2-Tetrachloroethane	0.20	1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	0.58	10
1,1,2-Trichloroethane	0.30	1.0
1,1-Dichloroethane	0.37	1.0
1,1-Dichloroethene	0.33	1.0
1,1-Dichloropropene	0.45	1.0
1,2,3-Trichlorobenzene	0.43	1.0
1,2,3-Trichloropropane	0.27	5.0
1,2,4-Trichlorobenzene	0.36	1.0
1,2,4-Trimethylbenzene	0.34	1.0
1,2-Dibromo-3-Chloropropane	1.5	10
1,2-Dibromoethane	0.38	1.0
1,2-Dichlorobenzene	0.28	1.0
1,2-Dichloroethane	0.22	0.50
1,2-Dichloropropane	0.39	1.0
1,3,5-Trimethylbenzene	0.34	1.0
1,3-Dichlorobenzene	0.26	1.0
1,3-Dichloropropane	0.30	1.0
1,4-Dichlorobenzene	0.24	1.0
2,2-Dichloropropane	0.55	1.0
2-Butanone	3.6	20
2-Chlorotoluene	0.27	1.0
2-Hexanone	3.1	10
4-Chlorotoluene	0.32	1.0
4-Methyl-2-pentanone	2.9	10
Acetone	10	20
Benzene	0.20	0.50
Bromobenzene	0.30	1.0
Bromochloromethane	0.30	2.0
Bromodichloromethane	0.28	1.0
Bromoform	1.5	5.0
Bromomethane	15	25
Carbon disulfide	0.40	10

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Table S6 – *Continued from previous page*

Compound	Minimum Detection Limit (μg/L)	Reporting Limit (μg/L)
Carbon tetrachloride	0.34	0.50
Chlorobenzene	0.21	1.0
Chloroethane	2.4	5.0
Chloroform	0.50	1.0
Chloromethane	2.3	10
cis-1,2-Dichloroethene	0.51	1.0
cis-1,3-Dichloropropene	0.23	0.50
Dibromochloromethane	0.34	2.0
Dibromomethane	0.38	1.0
Dichlorodifluoromethane	0.56	5.0
Di-isopropyl ether (DIPE)	0.36	2.0
Ethanol	60	100
Ethylbenzene	0.33	1.0
Ethyl-t-butyl ether (ETBE)	0.49	2.0
Isopropylbenzene	0.37	1.0
m,p-Xylene	0.48	2.0
Methylene Chloride	4.0	10
Methyl-t-Butyl Ether (MTBE)	0.34	1.0
Naphthalene	5.0	10
n-Butylbenzene	0.29	1.0
N-Propylbenzene	0.41	1.0
o-Xylene	0.26	1.0
p-Isopropyltoluene	0.38	1.0
sec-Butylbenzene	0.29	1.0
Styrene	0.38	1.0
Tert-amyl-methyl ether (TAME)	0.56	2.0
tert-Butyl alcohol (TBA)	3.9	10
tert-Butylbenzene	0.36	1.0
Tetrachloroethene	0.35	1.0
Toluene	0.34	1.0
trans-1,2-Dichloroethene	0.31	1.0
trans-1,3-Dichloropropene	0.30	0.50
Trichloroethene	0.35	1.0
Trichlorofluoromethane	0.36	10
Vinyl acetate	4.6	10
Vinyl chloride	0.26	0.50

Table S7: Laboratory reporting limit for Anions (EPA 300.0)

Compound	Reporting Limit (mg/L)
Fluoride	0.20
Chloride	1.0
Nitrogen,Nitrite	0.10
Bromide	0.30
Nitrogen,Nitrate	0.10
Sulfate	1.0

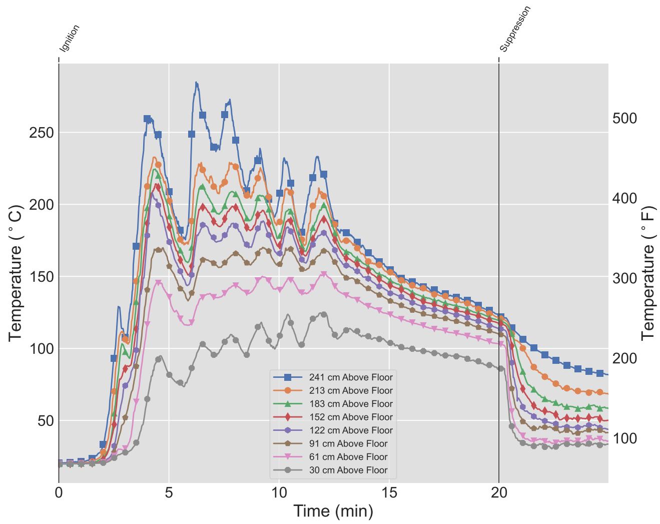
S.5 Temperature and Gas Concentration Time-History

Representative temperature and gas concentration time-history plots are provided for each experiment in Figures S5 – S9. The representative temperatures were measured by the thermocouple array located in the center of the fire room, while the gas concentrations were reported from the 122 cm elevation gas probe in the fire room.

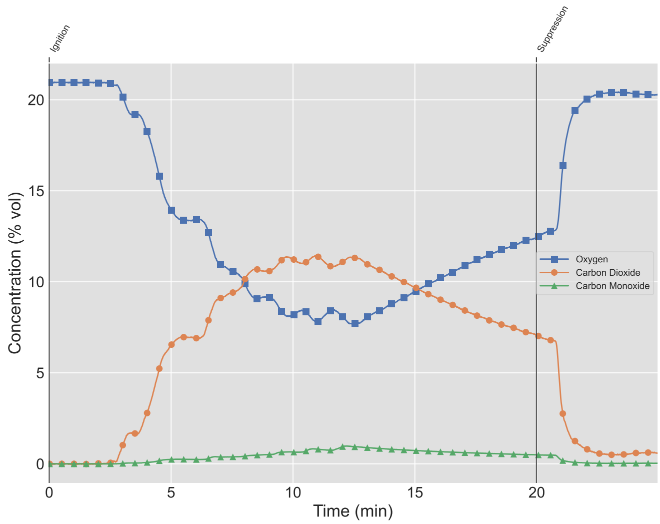
Experiments 1–4 started with all doors and windows closed, and therefore followed similar initial fire development: the fires grew for the first few minutes after ignition until becoming ventilation limited, then remained in a quasi-steady state. The fires in Experiments 2-4 were then provided with additional ventilation, either by window failure or manually opening the exterior door, which caused the fires to transition through flashover. Experiment 5 was unique from the others by having the exterior door open at the start of the experiment, and transitioned through flashover earlier in the experiment timeline. Further details of each experiment is provided with the representative temperature and gas concentration plots.

The fire in Experiment 1 grew for about 4 minutes before becoming ventilation limited, at which point the temperatures and gas concentrations reached peak values, then plateaued (Figure S5). By about 12 minutes after ignition, the temperatures began to decline indicating the fire was in decay. The fire was extinguished via suppression at 20 minutes after ignition. The gas concentrations reflect the growth and decay phases of the fire by the gradual decrease of O_2 concentration and increase in CO and CO_2 concentrations until 12 minutes after ignition. Then the trends reverse direction as the gas concentrations return to ambient conditions in response to the decay of the fire.

The fire scenario for Experiment 2 was similar to Experiment 1, but resulted in failure of the bedroom window at about 33 minutes after ignition. The open vent allowed for exchange of exhausting fire gases with incoming fresh air, causing the bedroom to transition through flashover 2 minutes later. Flashover is noted by the temperature time-history in Figure S6 when the temperatures at all elevations increased to above 600 °C. The fire caused failure of the bedroom door at about 38 minutes after ignition, followed by suppression at 41 minutes. The fire timeline is also reflected by the gas concentration time-histories in Figure S6. The concentrations becoming quasi-steady at about 7 minutes, after the fire becomes ventilation-limited. Then the O_2 concentration depletes to near 0%, and the CO and CO_2 concentrations increase to their maximum measurement ranges in response to the rapid fire growth after the window begins to fail.

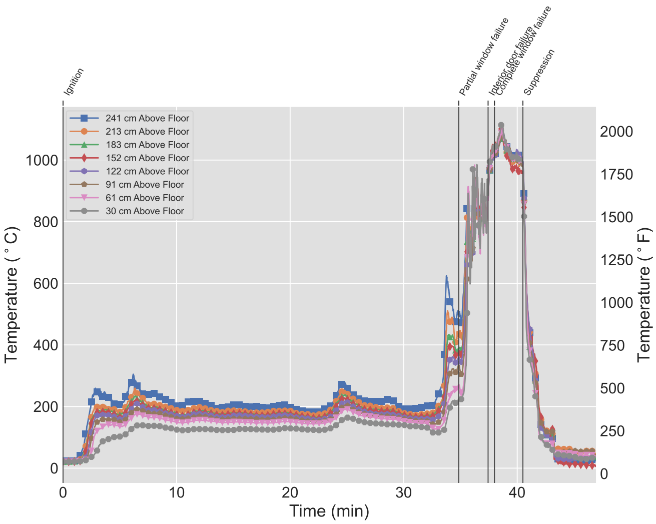


(a) Temperature

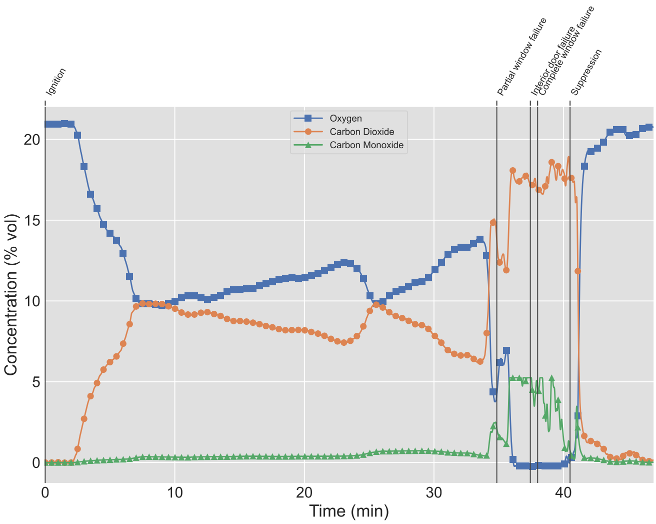


(b) Gas Concentrations – 122 cm (4 ft) elevation

Fig. S5: Representative temperature and gas concentration time-histories measured in the fire room in Experiment 1.



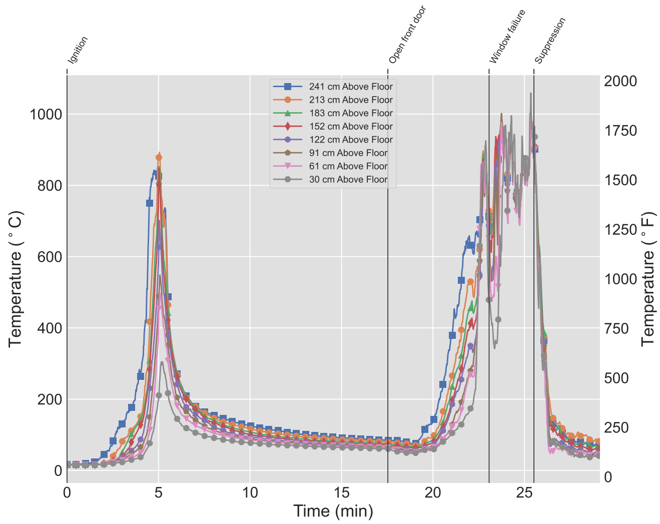
(a) Temperature



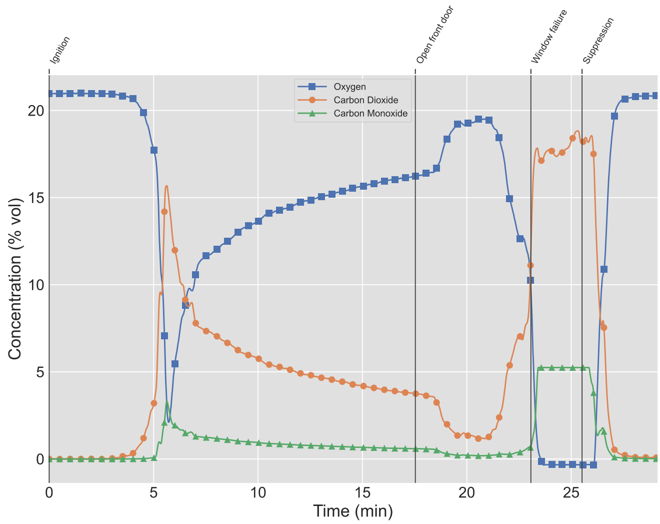
(b) Gas Concentrations – 122 cm (4 ft) elevation

Fig. S6: Representative temperature and gas concentration time-histories measured in the fire room in Experiment 2.

Experiments 3 and 4 followed similar timelines: the fires grew until becoming ventilation-limited around 5 minutes after ignition, then quickly decayed and remained in a steady-state until the exterior door was opened. This is shown by the temperature time-histories in Figures S7 and S8 with peak temperatures occurring at 5 minutes, corresponding to values ranging between 200 °C and 900 °C. The temperatures at all elevations then decreased to below 200 °C when the fires decayed. The front door was opened at 18 minutes in Experiment 3 and at 12 minutes in Experiment 4. The open vent allowed the fires to regrow and transition through flashover about 5 minutes after the door was opened. The living room window failed at 23 minutes in Experiment 3 and at 20 minutes in Experiment 4.The temperatures at all elevations increased to above 800 °C and remained elevated until suppression began. The gas concentrations followed similar trends to the temperature time-histories, with O_2 decreasing and CO and CO_2 increasing in response to fire growth. During the post-flashover phase of the fires there were several minutes of sustained peak gas concentrations (approximately 0% O_2, >5% CO, and >20% CO_2) for every gas probe used in the condensate collection for both experiments.

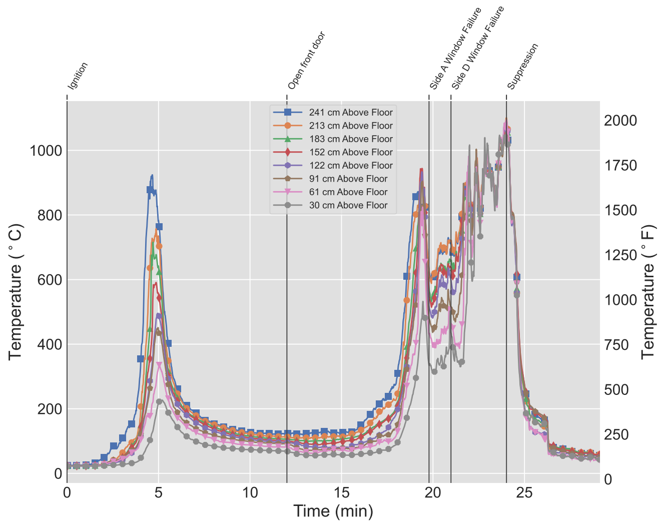


(a) Temperature

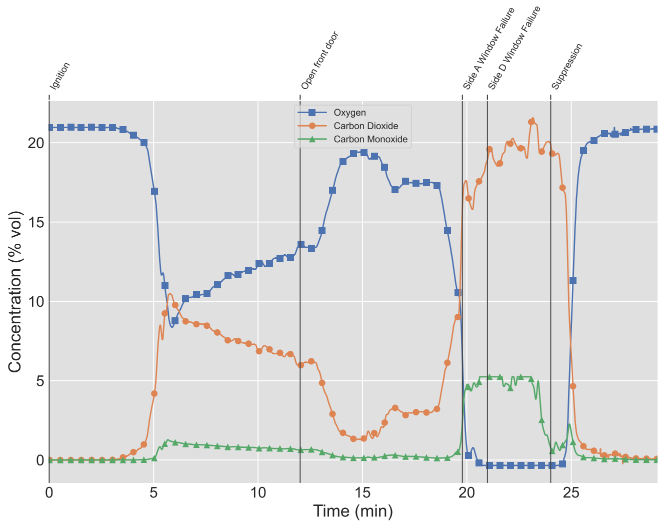


(b) Gas Concentrations – 122 cm (4 ft) elevation

Fig. S7: Representative temperature and gas concentration time-histories measured in the fire room in Experiment 3.



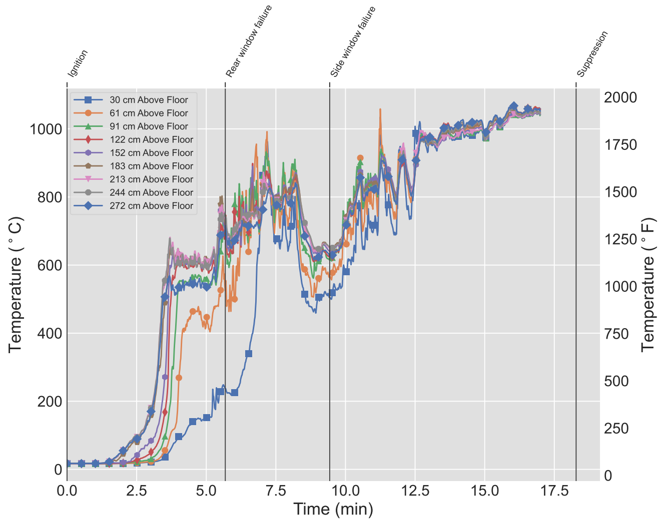
(a) Temperature



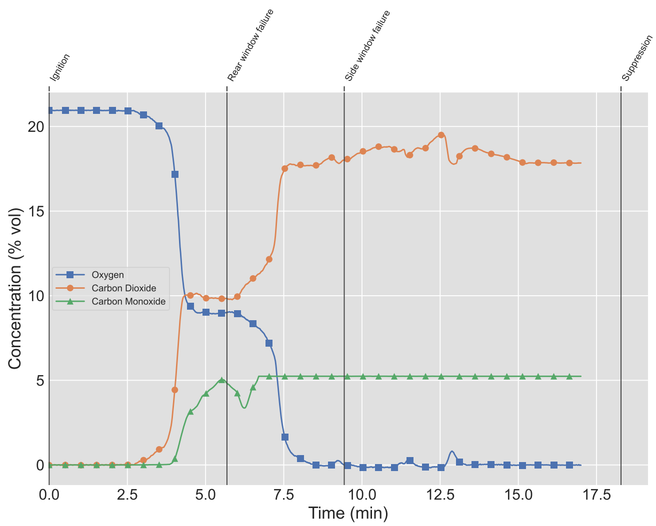
(b) Gas Concentrations – 122 cm (4 ft) elevation

Fig. S8: Representative temperature and gas concentration time-histories measured in the fire room in Experiment 4.

Experiment 5 began with the exterior door open, allowing for continued fire growth until the compartment transitioned through flashover at 8 minutes after ignition. The rear window fails at approximately 5.5 minutes and side window fails at 9.5 minutes. The temperature and gas concentration data shown in Figure S9 are from the measurement locations in the rear of the structure, closer to the ignition location but further from the front door. The compartment remained in a fully-involved, post-flashover state until suppression at 18 minutes after ignition.



(a) Temperature



(b) Gas Concentrations – 122 cm (4 ft) elevation

Fig. S9: Representative temperature and gas concentration time-histories measured in Experiment 5. Data after 17 minutes (1020 s) is not included due to disruption of the data acquisition system after that time.

S.6 Complete listing of detectable compounds

Table S8: Complete listing of condensate VOC detections (μg/L)

Exp.	Compound	Result	Reporting Limit (RL)	Min Detection Limit (MDL)	Dilution Factor
1	2-Butanone	2100*	8000	1400	400
	Acetone	57000	8000	4000	400
	Benzene	1100	200	79	400
	Ethanol	ND	40000	24000	400
	Naphthalene	2700*	4000	2000	400
	o-Xylene	ND	400	100	400
	Styrene	ND	400	150	400
	Toluene	180*	400	140	400
2	2-Butanone	3600*	8000	1400	400
	Acetone	31000	8000	4000	400
	Benzene	6400	200	79	400
	Ethanol	ND	40000	24000	400
	Naphthalene	8100	4000	2000	400
	o-Xylene	110*	400	100	400
	Styrene	1200	400	150	400
	Toluene	1000	400	140	400
3	2-Butanone	7300*	20000	3600	1000
	Acetone	74000	20000	10000	1000
	Benzene	2600	500	200	1000
	Ethanol	67000*	100000	60000	1000
	Naphthalene	7400*	10000	5000	1000
	o-Xylene	ND	1000	260	1000
	Styrene	470*	1000	380	1000
	Toluene	ND	1000	340	1000
4	2-Butanone	13000	4000	710	200
	2-Hexanone	170*	400	130	40
	Acetone	110000	40000	20000	2000
	Benzene	3600	20	7.9	40
	Chloromethane	170*	400	93	40
	Ethanol	49000	4000	2400	40
	Ethylbenzene	54	40	13	40
	m,p-Xylene	89	80	19	40
	Naphthalene	8100	2000	1000	200
	o-Xylene	64	40	10	40
	Styrene	1400	40	15	40
	Toluene	660	40	14	40
5	1,2,4-Trimethylbenzene	610*	800	270	800
	2-Butanone	31000	16000	2800	800
	Acetone	250000	40000	20000	2000
	Benzene	33000	400	160	800
	Ethanol	61000*	80000	48000	800
	m,p-Xylene	400*	1600	390	800
	Naphthalene	10000	8000	4000	800
	o-Xylene	510*	800	210	800
	Styrene	1800	800	300	800
	Toluene	3900	800	270	800

*Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table S9: Complete listing of condensate pH and anion detections (mg/L)

Experiment	Analyte	Result	Reporting Limit (RL)	Dilution Factor
1	pH	2.56		1
	Bromide	ND	3.0	10
	Chloride	270	50	10
	Nitrogen,Nitrate	13	1.0	10
	Sulfate	330	10	10
2	pH	1.10		1
	Bromide	5.5	3.0	10
	Chloride	39,000	1000	200
	Fluoride	6.4	5.0	25
	Nitrogen,Nitrate	2.4	1.0	10
	Sulfate	9,200	100	100
3	pH	1.93		1
	Bromide	6.6	3.0	10
	Chloride	3,000	1000	200
	Nitrogen,Nitrate	5.7	1.0	10
	Sulfate	2,700	200	200
4	pH	1.96		1
	Bromide	9.8	3.0	10
	Chloride	2,400	250	50
	Nitrogen,Nitrate	ND	1.0	10
	Sulfate	2,100	50	50
5	pH	1.59		1
	Bromide	13	3.0	10
	Chloride	4,700	250	50
	Nitrogen,Nitrate	6.4	1.0	10
	Sulfate	2,300	50	50

Table S10: Complete listing of baseline rinse VOC detections (μg/L)

Exp.	Compound	Result	Reporting Limit (RL)	Min Detection Limit (MDL)	Dilution Factor
Pre 1	1,2,4-Trimethylbenzene	1.4	1.0	0.34	1
	1,3,5-Trimethylbenzene	0.67*	1.0	0.34	1
	1,4-Dichlorobenzene	0.46*	1.0	0.24	1
	2-Butanone	12*	20	3.6	1
	Acetone	ND	20	10	1
	Benzene	29	0.50	0.20	1
	Ethylbenzene	0.42*	1.0	0.33	1
	m,p-Xylene	1.6*	2.0	0.48	1
	N-Propylbenzene	1.3	1.0	0.41	1
	o-Xylene	2.7	1.0	0.26	1
	Toluene	32	1.0	0.34	1
Pre 2	1,4-Dichlorobenzene	0.75*	1.0	0.24	1
	Acetone	ND	20	10	1
	Ethanol	93*	100	60	1
	Toluene	1.4	1.0	0.34	1
Pre 3	Acetone	170	40	20	2
	o-Xylene	0.54*	2.0	0.51	2
	Toluene	0.80*	2.0	0.68	2
Pre 4	1,4-Dichlorobenzene	0.26*	1.0	0.24	1
	Acetone	15*	20	10	1
	Toluene	ND	1.0	0.34	1
Pre 5	Acetone	620	200	100	10
	Benzene	2.0	0.50	0.20	1
	Styrene	1.3	1.0	0.38	1
	Toluene	0.89*	1.0	0.34	1
Post 4	Acetone	ND	20	10	1
	Toluene	ND	1.0	0.34	1
Post 5	Acetone	26	20	10	1
	Toluene	ND	1.0	0.34	1
Distilled Water (Control)	Acetone	ND	20	10	1
	Toluene	ND	1.0	0.34	1

*Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table S11: Complete listing of baseline rinse pH and anion detections (mg/L)

Experiment	Analyte	Result	Reporting Limit (RL)	Dilution Factor
Pre 1	pH	5.87		1
	Chloride	1.4	1.0	1
	Sulfate	1.4	1.0	1
Pre 2	pH	5.55		1
	Chloride	2.3	1.0	1
	Sulfate	1.2	1.0	1
Pre 3	pH	5.95		1
	Chloride	2.9	1.0	1
	Sulfate	2.3	1.0	1
Pre 4	pH	5.78		1
	Chloride	9.8	1.0	1
	Sulfate	3.1	1.0	1
Pre 5	pH	5.52		1
	Chloride	1,100	100	20
	Flouride	0.21	0.20	1
	Nitrogen, Nitrate	0.18	0.10	1
	Sulfate	3.9	1.0	1
Post 4	pH	7.03		1
	Chloride	3.8	1.0	1
	Sulfate	1.1	1.0	1
Post 5	pH	6.78		1
	Chloride	5.4	1.0	1
	Sulfate	2.2	1.0	1
Distilled Water	pH	7.32		1
(Control)	Chloride	ND	1.0	1
	Sulfate	ND	1.0	1

Table S12: Complete listing of runoff VOC detections (μg/L)

Exp.	Compound	Result	Reporting Limit (RL)	Min Detection Limit (MDL)	Dilution Factor
2	Acetone	ND	8000	4000	400
	Benzene	ND	200	79	400
	Styrene	ND	400	150	400
3	Acetone	1100	200	100	10
	Benzene	11	5.0	2.0	10
	Styrene	8.0*	10	3.8	10
4	Acetone	1900	800	400	40
	Benzene	10*	20	7.9	40
	Carbon disulfide	24*	400	16	40
	Styrene	ND	40	15	40
	Trichloroethene	17*	40	14	40
5	2-Butanone	120*	400	71	20
	Acetone	1900	400	200	20
	Benzene	68	10	3.9	20
	Ethanol	2500	2000	1200	20
	Ethylbenzene	9.5*	20	6.6	20
	Styrene	98	20	7.5	20
	Toluene	35	20	6.8	20
Nozzle	Acetone	ND	20	10	1
(Control)	Benzene	ND	0.50	0.20	1
	Bromodichloromethane	9.2	1.0	0.28	1
	Chloroform	17	1.0	0.50	1
	Dibromochloromethane	2.6	2.0	0.34	1
	Styrene	ND	1.0	0.38	1

*Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Table S13: Complete listing of runoff pH and anion detections (mg/L)

Experiment	Analyte	Result	Reporting Limit (RL)	Dilution Factor
2	pH	12.04		1
	Bromide	ND	7.5	25
	Chloride	280	130	25
	Nitrogen,Nitrate	ND	2.5	25
	Sulfate	1,500	25	25
3	pH	9.38		1
	Bromide	3.4	3.0	10
	Chloride	230	50	10
	Nitrogen,Nitrate	1.3	1.0	10
	Sulfate	7,700	200	200
4	pH	10.39		1
	Bromide	ND	3.0	10
	Chloride	660	50	10
	Nitrogen,Nitrate	1.9	1.0	10
	Sulfate	3,000	50	50
5	pH	11.61		1
	Bromide	4.6	3.0	10
	Chloride	230	50	10
	Nitrogen,Nitrate	3.2	1.0	10
	Sulfate	2,200	50	50
Nozzle	pH	6.80		1
(Control)	Bromide	ND	0.30	1
	Chloride	79	1.0	1
	Nitrogen,Nitrate	0.69	0.10	1
	Sulfate	13	1.0	1

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[1] Weinschenk, C.: Analysis of Search and Rescue Tactics in Single-Story Single-Family Homes Part I: Bedroom Fires. Technical report, UL's Fire Safety Research Institute (2022). https://doi.org/10.54206/102376/DPTN2682. https://fsri.org/research-update/search-part-i-update

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