Performance Report
2009 "Chimfex"

May 5, 2009

Prepared for:

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Terry,

OMNI Environmental Services, Inc. received samples for evaluation on January 26, 2009. Enclosed is the report for the performance evaluation.

Please call or email me if you have any questions.

Regards,

Lyrik Pitzman
Environmental Project Manager

Performance Evaluation
Chimney Fire Suppression Product
Project #: 419-E-01-0
May 5, 2009

Introduction

It is estimated by the National Fire Protection Association (NFPA) that creosote is a likely explanation for 25% of all home heating fires (16,500 per year). The most significant source of creosote deposits in chimneys are from poorly operated older conventional wood heaters. Generally, 70-80% of the wood heaters in use are the older conventional models. Due to the significant safety risk of a chimney fire from creosote deposits, the following testing program was designed to test the performance of a chimney fire suppressant product, "Chimfex". One week of method development was conducted to find a way to create a reproducible simulated chimney fire and a test method for measuring chimney fire suppression capabilities. The appliances/venting systems evaluated were: two conventional wood stoves (6 and 8 inch chimneys), one EPA certified wood stove (6 inch chimney) and one zero-clearance manufactured fireplace (8 inch chimney). The following evaluation provides documentation of performance and fire suppression capabilities of a chimney fire suppressant product in typical home heaters and fireplaces.

Table 1. Testing Matrix

Test*	Wood Appliance**	Flue Diameter (inches)	Number of Chimfex Sticks	Number of Firestarter Packets	Active Firebox Fire
1	Large Cast-Iron Conventional	6	1	3	No
2	Large Cast-Iron Conventional	6	2	3	No
3	Large Cast-Iron Conventional	6	3	3	No
4	Large Steel Conventional	8	1	3	No
5	Large Cast-Iron Conventional	6	1	8	Yes
6	Large Cast-Iron Conventional	6	1	8	Yes
7	Large Cast-Iron Conventional	6	1	8	Yes
8	Large Cast-Iron Conventional	6	1	8	Yes
9	Small EPA-certified	6	1	8	Yes
10	Manufactured Fireplace	8	1	10	Yes

*Three addition performance tests were conducted however are not included in the testing matrix. One test was removed due to particles clogging the sample line to the oxygen analyzer and two others were removed due to low chimney fire temperatures.

**Appliances: Large Cast-Iron (Jotul, "Elg" model #121), Large Steel Conventional (Schrader, unknown model), Small EPA-certified (Nestor Martin/FDL, model S-33), Manufactured Fireplace (Heatilator, model EL-36).

Product Instructions
During the evaluations the product instructions were followed (with the exception of test run 9):

"Directions: Before activating, stand in front of fireplace or wood burning stove. Hold Chimfex at its base so it extends over fireplace hearth or fire proof stove-board. To activate Chimfex, remove top lid to expose scratch surface on cap. Twist and remove cap to expose black button. Make sure Chimfex is positioned away from the face and body, lightly scratch black button with cap."

"For Wood Burning Stove: Activate directly in front of stove according to directions. Drop IMMEDIATELY into the stove alongside fire and close off all drafts. The natural draft will draw the generated gases up the flue and suppress the chimney fire."

"FOR FIREPLACE: Activate directly in front of fireplace according to directions. Drop IMMEDIATELY inside the fireplace alongside of fire. Reduce draft as much as possible by closing fireplace doors or covering fireplace opening with non-flammable material, leaving the flue damper open. The natural draft will draw the generated fumes up the flue and suppress the chimney fire."

Testing Notes and Sampling Methods
Tests 1-3 and 5-8 were conducted in a large cast-iron conventional wood stove with a 6 inch diameter flue size. Twelve and a half feet of single-walled chimney was installed on the appliance and vented into a dilution hood. Tests 1-3 utilized 1, 2, and 3 Chimfex sticks, respectively, to extinguish a simulated chimney fire. Test 5 was conducted in another testing booth (concurrently with the air emissions evaluation) with an active fire and one Chimfex stick. Test 6 was run in triplicate (tests 6, 7 and 8), there was an active fire in the appliance and one Chimfex stick was used to extinguish the simulated chimney fire.

Test 4 was conducted in a large steel conventional wood stove with an 8 in diameter flue size. The chimney consisted of 4 ft of single-walled chimney connecter at the base and 8.5 ft of hard-pack double-walled chimney on top, all of which vented into a dilution hood. Test 4 utilized a single Chimfex stick to extinguish the simulated chimney fire.

Test 9 was conducted in a small EPA-certified woodstove with 12.5 ft of 6 inch diameter flue vented into a dilution hood. One Chimfex stick was used to extinguish the simulated chimney fire. In this evaluation the air inlet was not closed after addition of Chimfex because the user forgot to follow instructions. The air inlet remained in the start-up position, completely opened. (This is actually a good "real world" test since in the event of an actual chimney fire, it is likely users will forget to follow specific instructions.) Figures 6 and 7 show the inside of the firebox before and after Chimfex addition.

Test 10 was conducted in a 36-inch manufactured fireplace with 10.75 ft of 8 inch diameter flue vented into a dilution hood. Total chimney length was reduced due to a greater appliance height in run 10 compared to runs 1-9. One Chimfex stick was used to extinguish the simulated chimney fire.

Percent oxygen was measured at 8 ft above the floor using a Servomex 1400 Series paramagnetic gas analyzer following EPA Method 3A. Pure nitrogen was used as the zero calibration gas and laboratory air was used as the span gas (20.95% oxygen). The instrument was calibrated daily.

Static pressure was measured at 8 ft above the floor using a Dwyer Instruments 677 Series differential pressure transmitter with a range of 0 – 0.1 inches of water column (WC). The second port of the pressure transmitter was left open to atmospheric pressure.

All temperatures were measured with type-K thermocouples. In tests 1-5 chimney temperature measurements were taken at 3.75 ft, 8 ft, and 11.25 ft above the floor. In tests 6-10 additional temperature measurements were taken at 12 ft above the floor. Static pressure, percent oxygen, and temperature measurements were data logged every ten seconds.

In tests 1-4 chimney fires were simulated by arranging three CSL Ignite-O™ Firestarter Packets in a ring around the interior of the chimney pipe. Each packet weighed 22.5 g and was held in place at 11.25 ft above the floor by aluminum hardware cloth. There were no active fires in tests 1-4.

Tests 5-10 were run with an active fire in the appliance. Additional firestarter packets were used to overcome the effects of increased draft and reduced oxygen due to the active fire. In tests 5-9 chimney fires were simulated using eight CSL Ignite-O™ Firestarter Packets, with four packets at 11.25 ft and an additional four packets at 12 ft. Test 10 utilized five packets at 11.25 ft and five packets at 12 ft, additional packets were used due to the larger flue diameter (8 inch in test 10, 6 inch in tests 5-9). In all tests each ring of firestarter packets was held in place using aluminum hardware cloth.

Results

For all tests the Chimfex suppressed and extinguished the simulated chimney fire when instructions were followed. In addition, when instructions were accidentally not completely followed (air inlets not closed) the simulated chimney fire was still extinguished, at least with one appliance. Results are reported for a number characteristics measured in the chimney in Table 2. Six parameters are reported: 1) time to extinguish 2) maximum chimney fire temperature (measured at 11.25 ft), 3) percent change in temperature in chimney at 11.25 ft from time of Chimfex addition until 2 minutes thereafter, 4) minimum percent oxygen measured after Chimfex addition, 5) percent change in measured oxygen from time of Chimfex addition until 2 minutes thereafter and 6) percent change in static pressure from pressure spike following Chimfex addition (approx. 20-30 seconds after addition) until 2 minutes thereafter.

Figures 2-7 are photographs of the appliances/venting prior, during and after the evaluation.

In addition to Table 2, 30 charts showing real-time measurements are provided for: percent oxygen at 8 feet above the floor, chimney temperature at 11.25 ft (tests 1-10) and 12 ft (tests 6-10) and static pressures at 8 feet above the floor are given for each test run. Arrows denoting time of Chimfex addition and time that chimney fire was extinguished are included on each chart. For each chart, time = 0 represents two minutes (+/- 10 seconds) prior to Chimfex addition.

Finally, the chart showing averages of the triplicate test run is provided.

Table 2. Chimfex measured parameters with percent change

		Test Run									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Chimney Fire Temps.	**Max (^{0}F)**	181	294	273	480	1156	1415	1278	1261	870	885
	% Change[1]	NA	NA	NA	NA	64.7	43.9	59.4	69.1	53.0	50.3
% Oxygen	**Min (%)**	4.67	5.57	6.01	10.51	4.97	10.50	7.03	4.49	5.41	18.08
	% Change[1]	19.0	31.8	63.1	31.8	50.1	5.2	52.3	68.2	42.3	-2.1
Static Pressure (in. WC)	**% Change[2]**	57.6	79.3	84.8	38.5	28.8	75.2	61.1	55.3	18.4	20.3
Extinguish Time	**Seconds[3]**	10-30	10-30	10-30	10-30	10	44	10-30	10	29	12

[1]Denotes % change from time of Chimfex stick addition until two minutes thereafter.
[2]Denotes % change from pressure spike following Chimfex addition until two minutes after time of spike.
[3]Test runs listed as "10-30" are estimates because the video documentation did not include Chimfex addition.
NA= Not Applicable

Notes on Results

The data for percent change in chimney fire temperature for tests 1-4 is not applicable due to low initial temperatures, likely caused by the lack of active fire, and higher temperatures at 2 minutes caused by heat from the Chimfex stick. Additionally, in tests 1-4 chimney fire temperatures were taken in the center of the chimney, rather than on the wall where temperatures were measured for tests 5-10.

For test 10, the percent change in oxygen is a negative value because the percentage of oxygen increased after Chimfex addition. The measured increase in oxygen was likely caused by more ambient air being pulled into the fireplace and up the chimney due to increased draft from the Chimfex stick. This was likely due to the fact that the fireplace doors do not have an air tight seal.

After use of the Chimfex, there are remaining residues coating the inside of the firebox and venting system from the particles emitted. Some residues are easily removed with typical hearth tools, others are not. It is unknown if the residues on the inside of the firebox or the venting are removed by subsequent fires. It is also unknown if the residues play a role in fire suppression. Due to the nature of the event when the product would be used, during a chimney fire, professional inspection/cleaning of the heater and venting system is strongly recommended. Most residues would likely be removed by professional cleaning.

Conclusions

The following conclusions can be made from the performance testing of Chimfex:

- Chimfex extinguished the simulated chimney fire in conventional wood stoves (two models), EPA certified wood stoves (one model) and manufactured fireplaces (one model).
- The simulated chimney fires were suppressed by one, or a combination of, factors including: decrease in oxygen, change in static pressure/chimney flow rate, emitted particulate/remaining residue.

Figures and Photographs

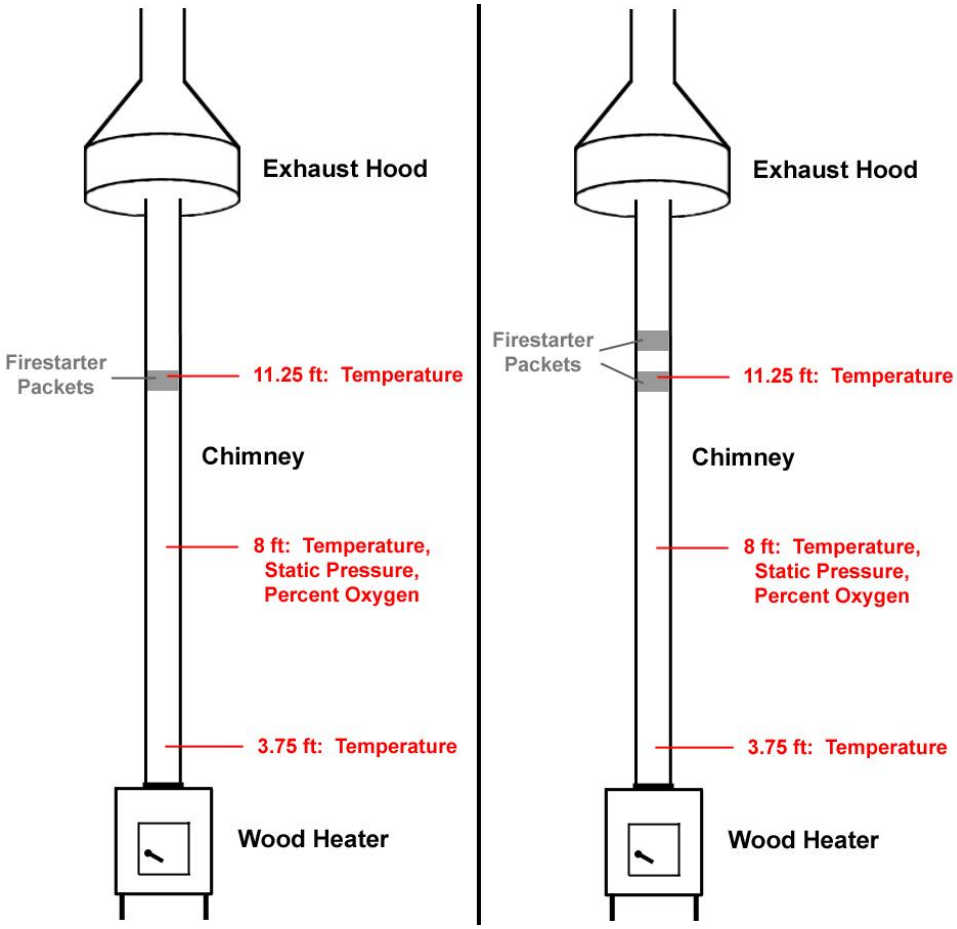


Figure 1. Heater setup for tests 1-4 (L) and test 5-10 (R).

Figures Cont.

Figure 2. Simulated chimney fire, run 2

Figure 3. Wood stove in test booth, run 3

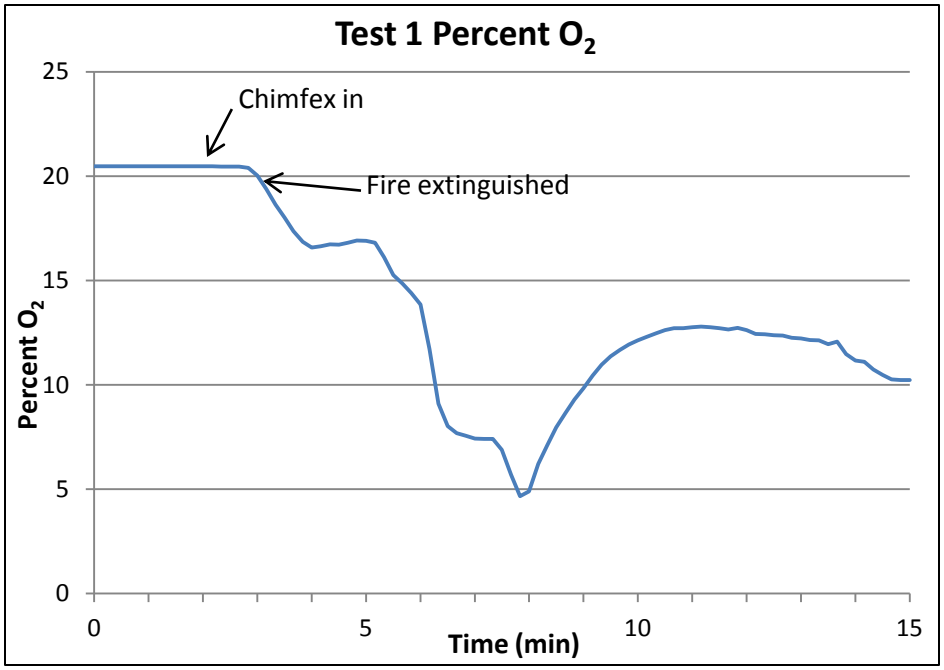
Figure 4. Chimfex smoke, run 3

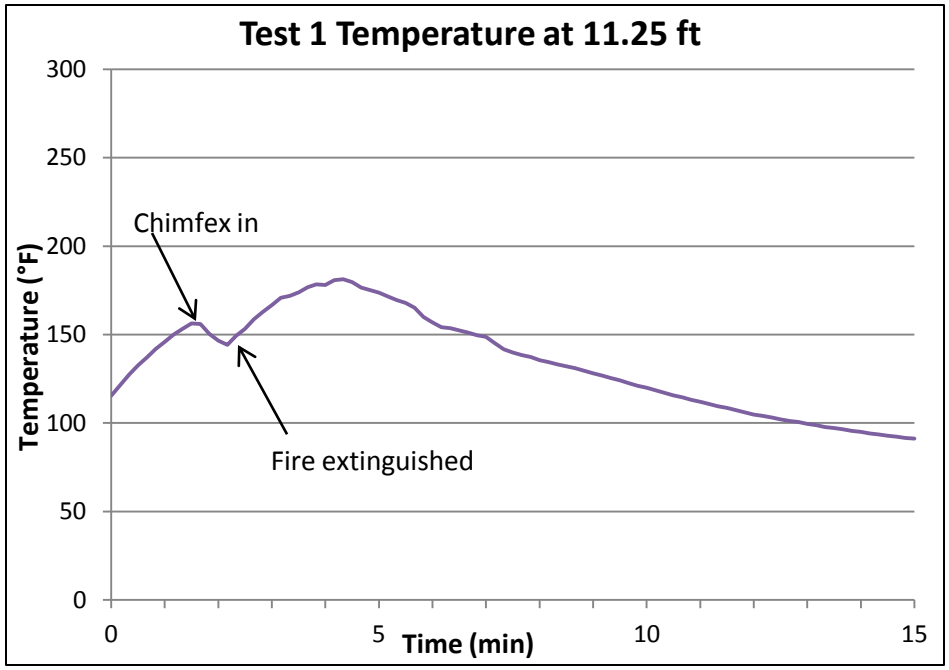
Figure 5. Chimfex residue, run 2

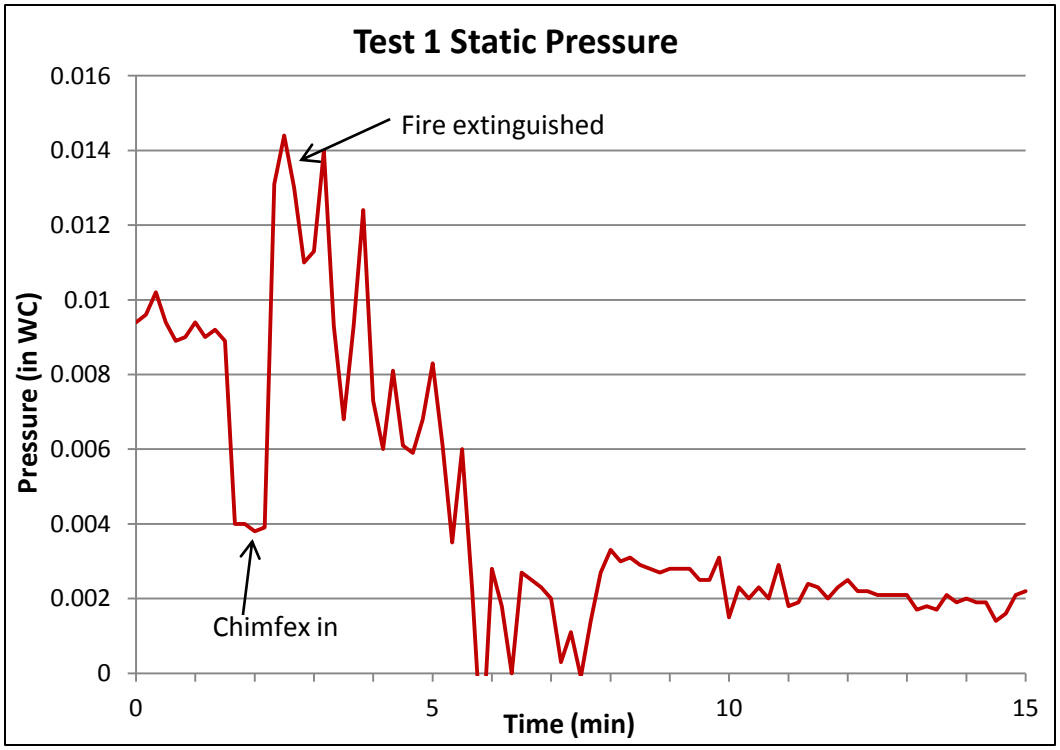
Figures Cont.

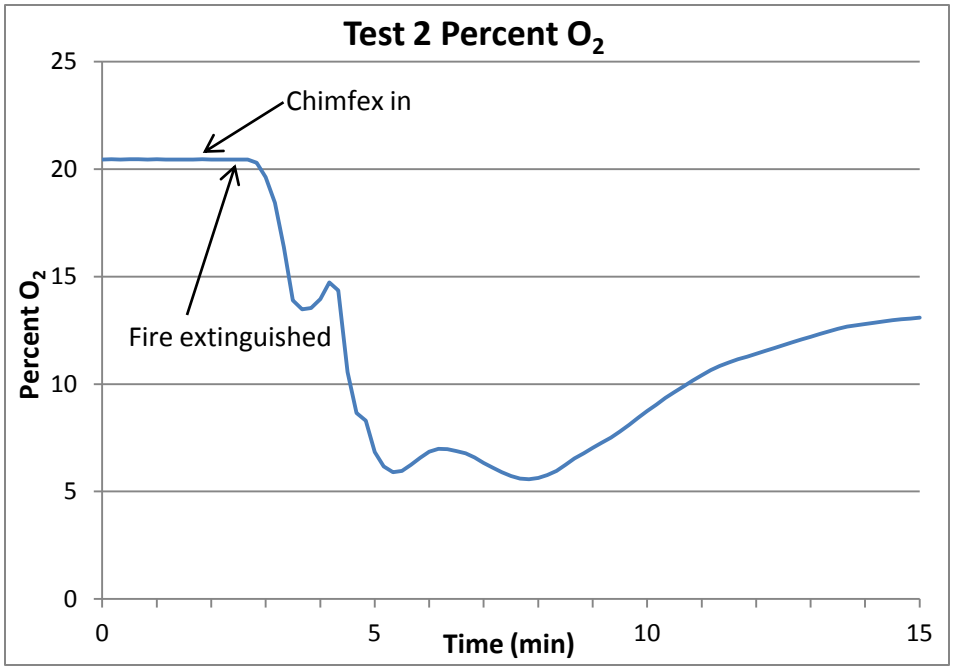
Figure 6. Pre Chimfex, run 9

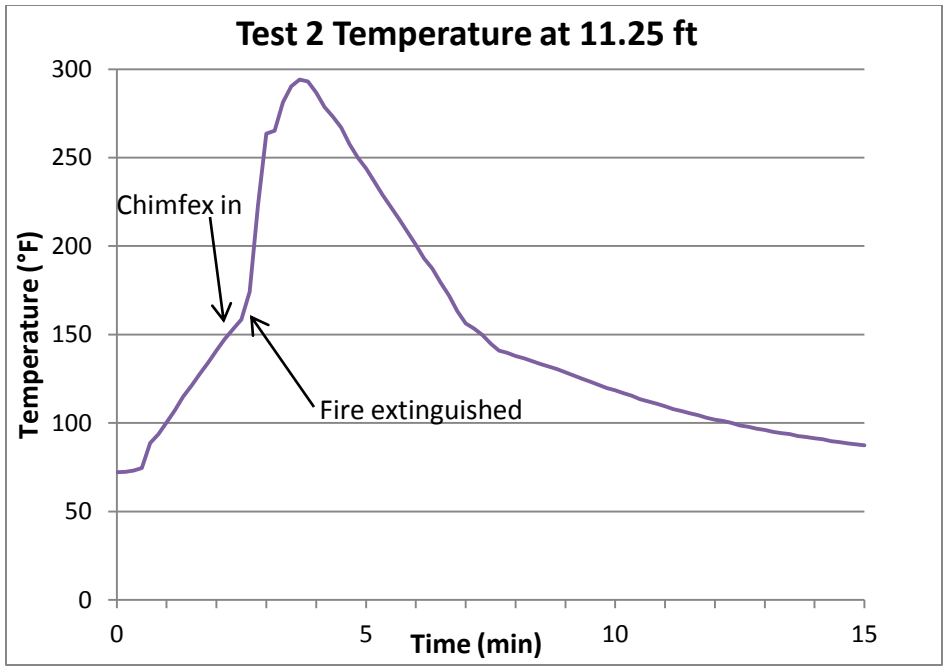
Figure 7. Post Chimfex, run 9

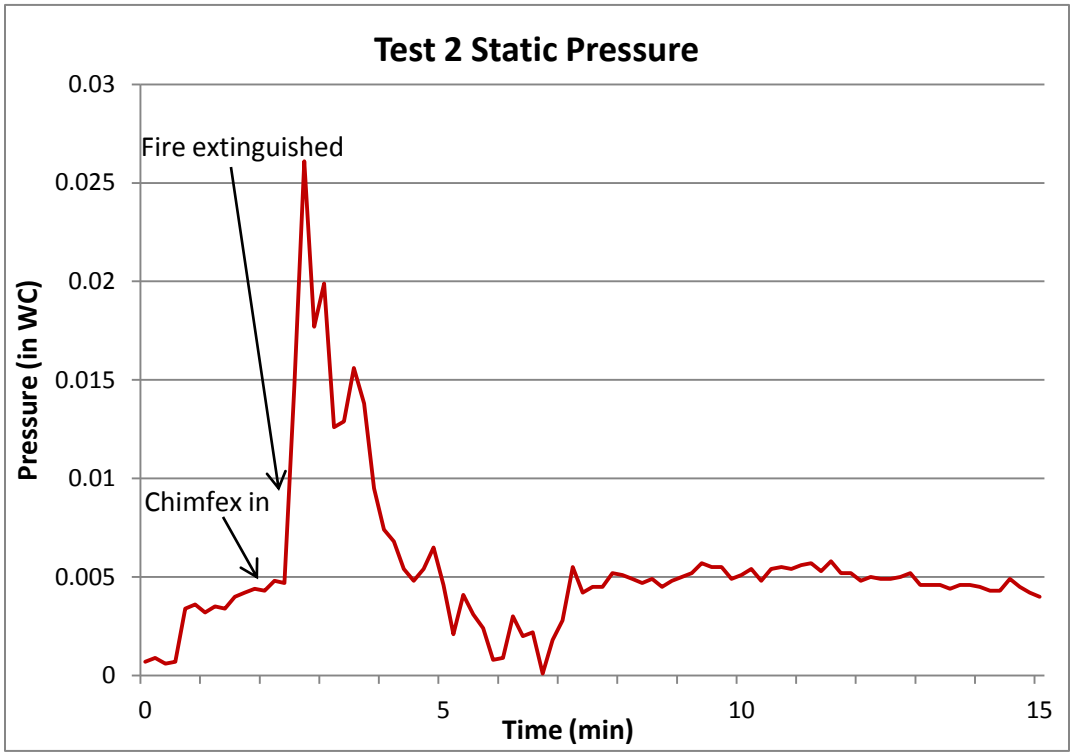

Test 1 Percent O2
Chimfex in
Fire extinguished
Percent O2
Time (min)
0
5
10
15
20
25

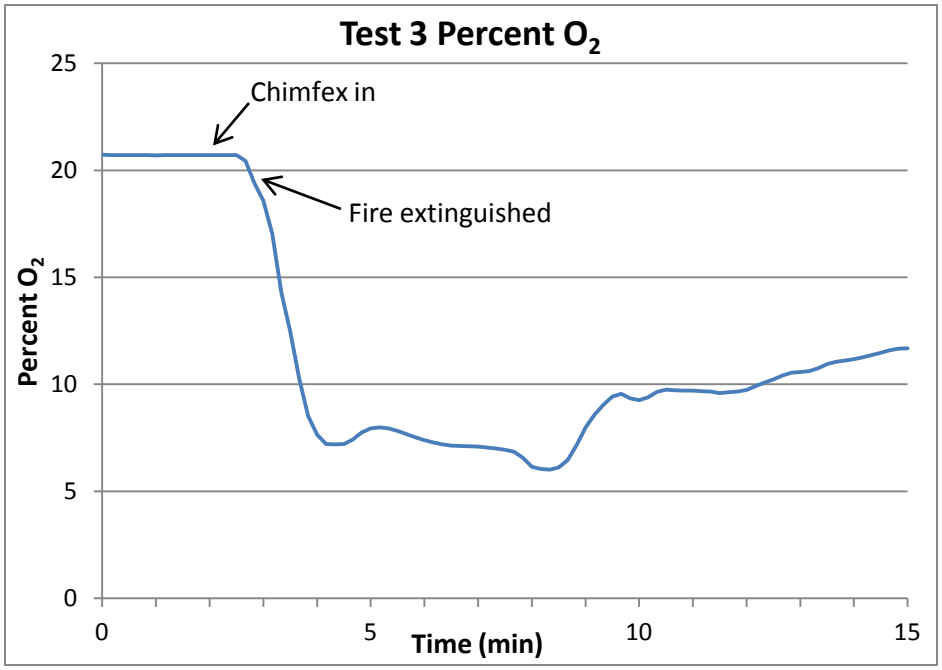

Test 1 Temperature at 11.25 ft
Chimfex in
Fire extinguished
Temperature (°F)
Time (min)
0
50
100
150
200
250
300

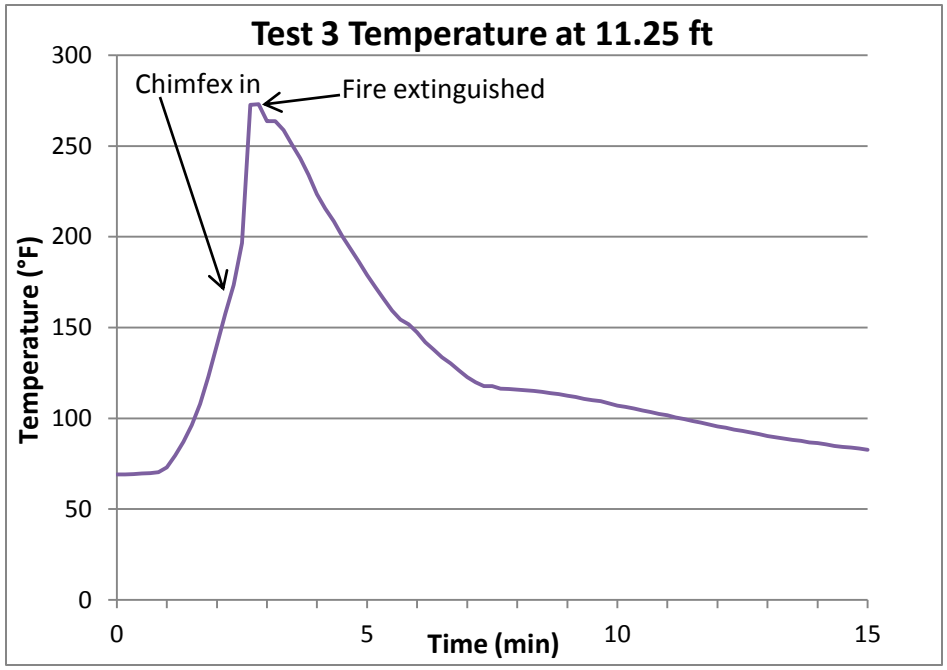

Test 1 Static Pressure
Fire extinguished
Chimfex in
Pressure (in WC)
Time (min)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016

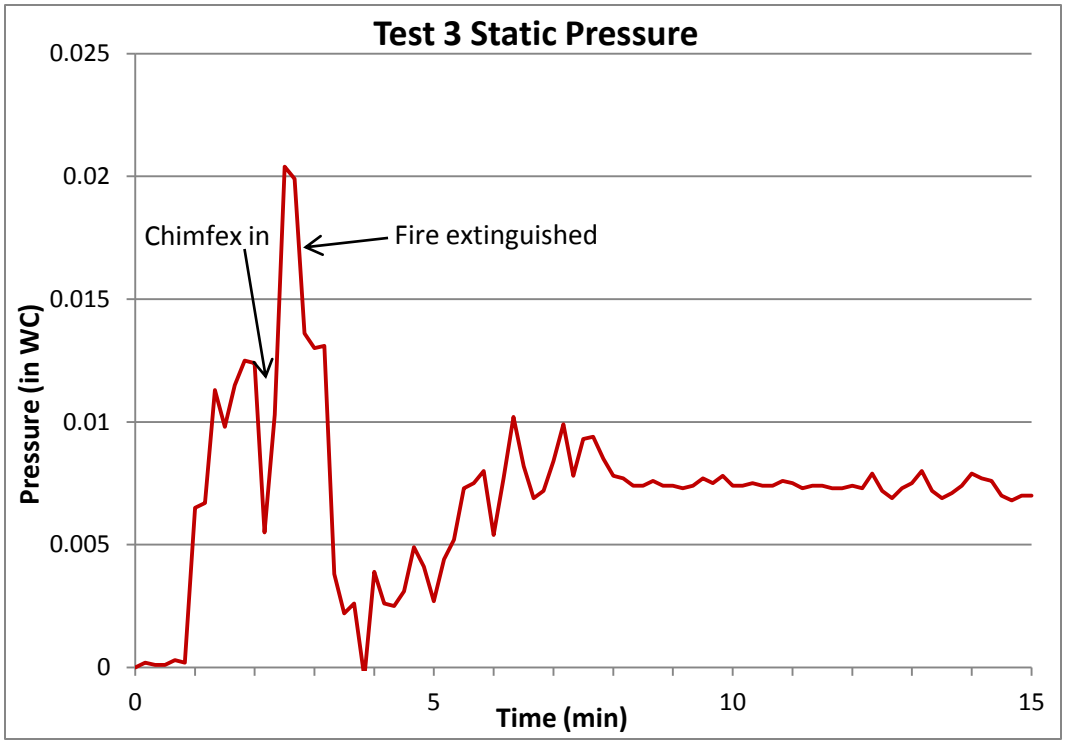

Test 2 Percent O_2
Percent O_2
25
20
15
10
5
0
0
5
10
15
Time (min)
Chimfex in
Fire extinguished

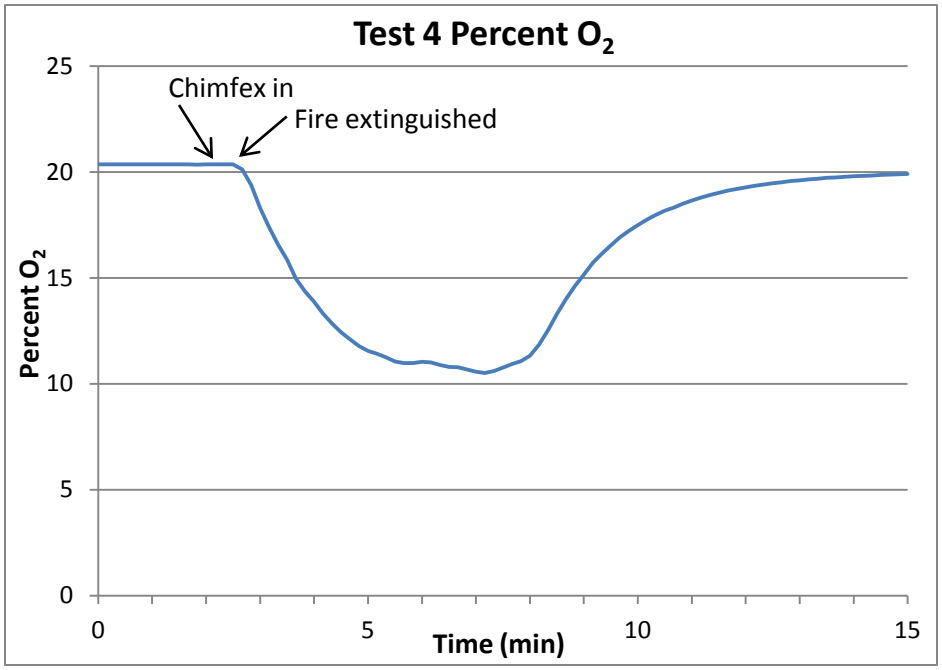

Test 2 Temperature at 11.25 ft
Temperature (°F)
300
250
200
150
100
50
0
0
5
10
15
Time (min)
Chimfex in
Fire extinguished

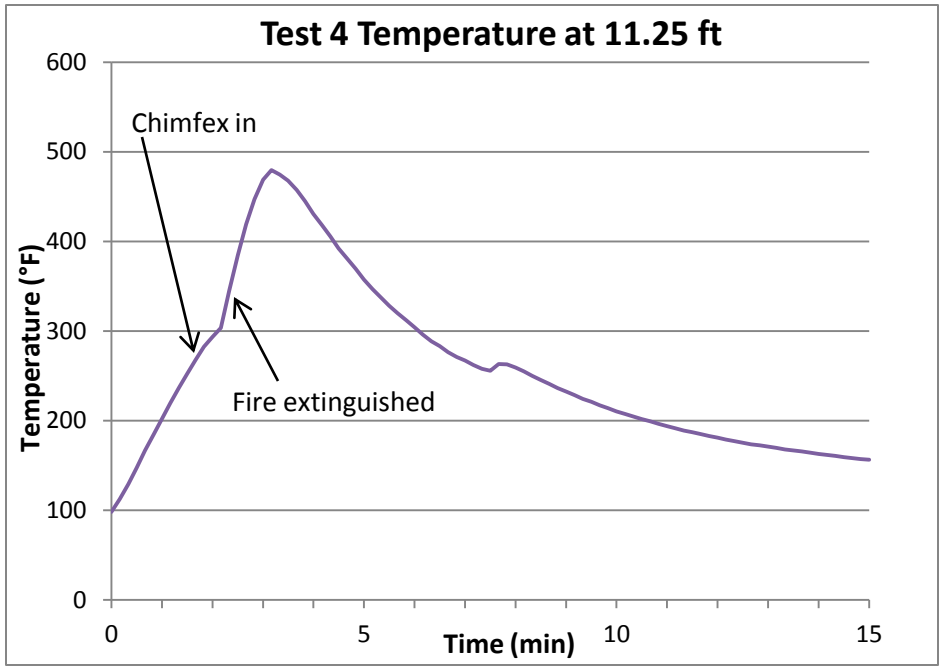

Test 2 Static Pressure
Pressure (in WC)
0.03
0.025
0.02
0.015
0.01
0.005
0
0
5
10
15
Time (min)
Fire extinguished
Chimfex in

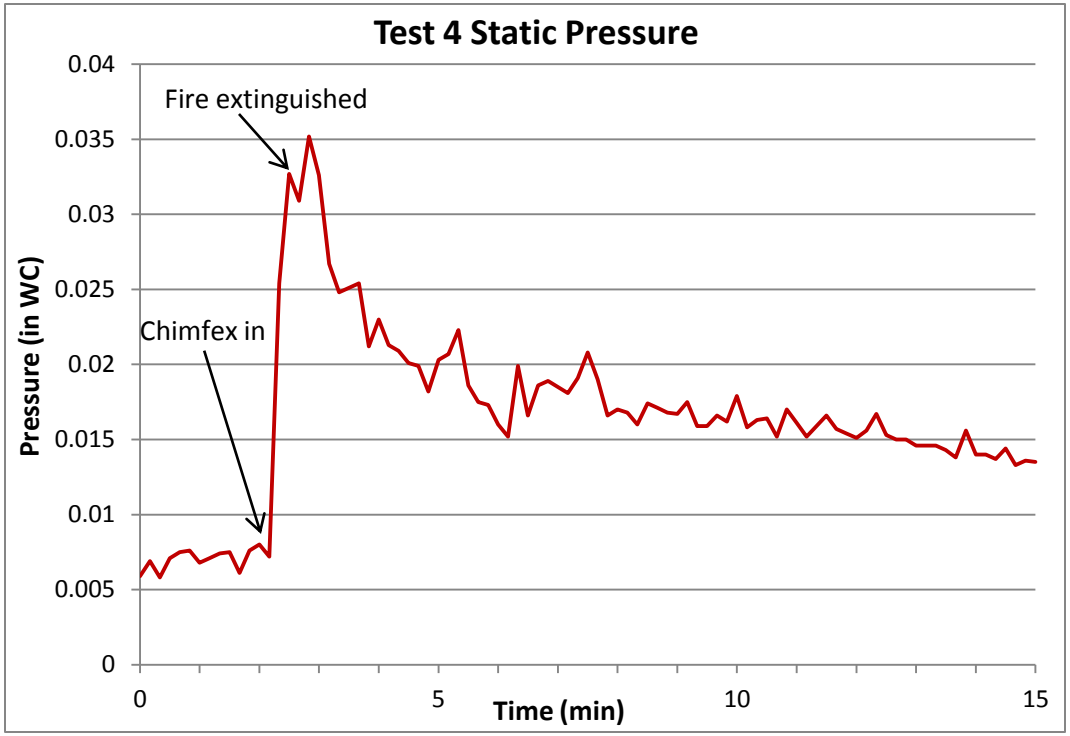

Test 3 Percent O_2
Chimfex in
Fire extinguished
Percent O_2
Time (min)
0
5
10
15
20
25

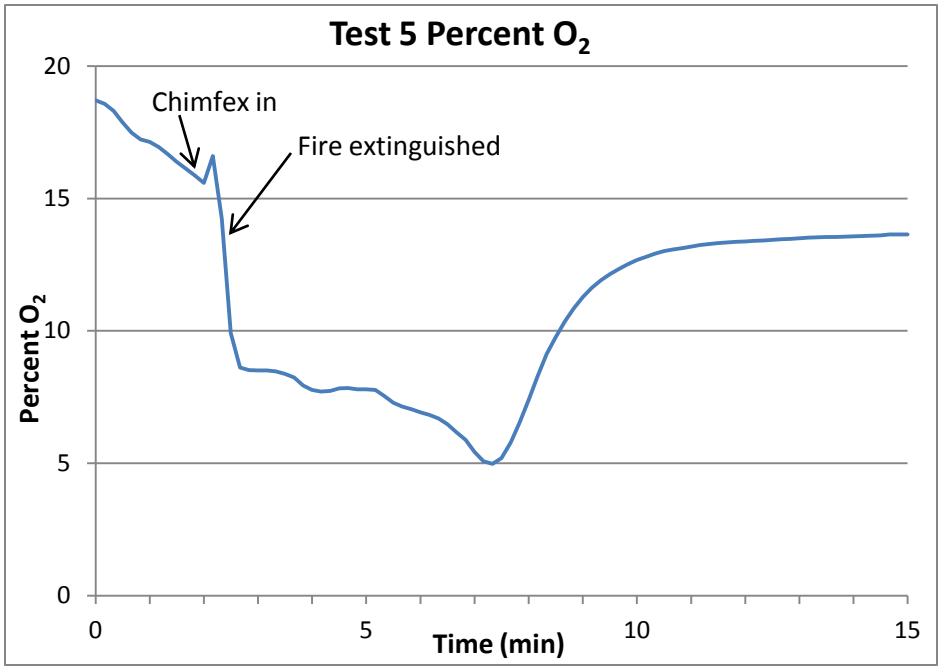

Test 3 Temperature at 11.25 ft
Chimfex in
Fire extinguished
Temperature (°F)
Time (min)
0
50
100
150
200
250
300
5
10
15

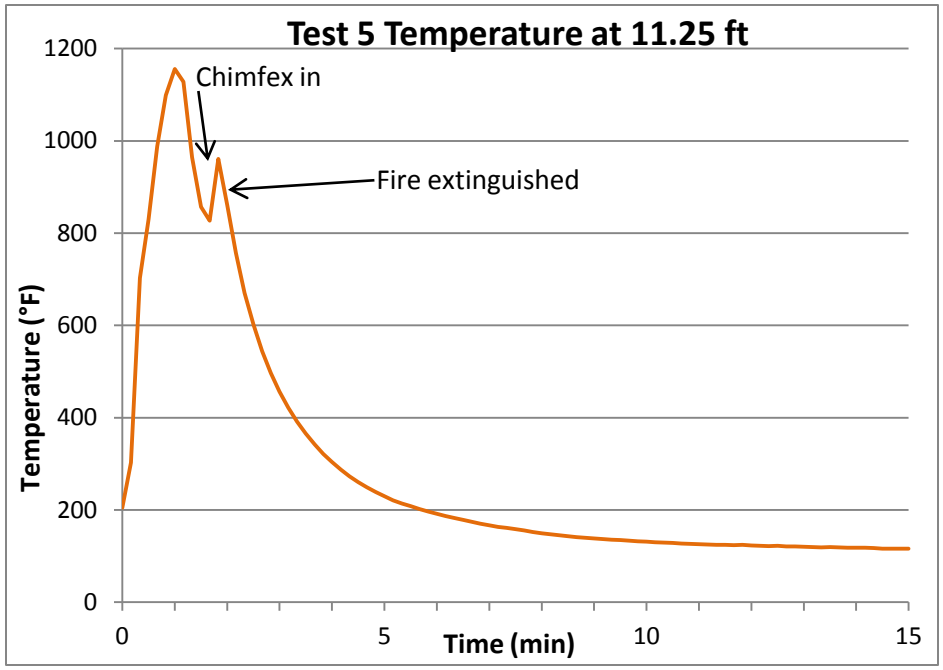

Test 3 Static Pressure
Chimfex in
Fire extinguished
Pressure (in WC)
Time (min)
0
0.005
0.01
0.015
0.02
0.025
5
10
15

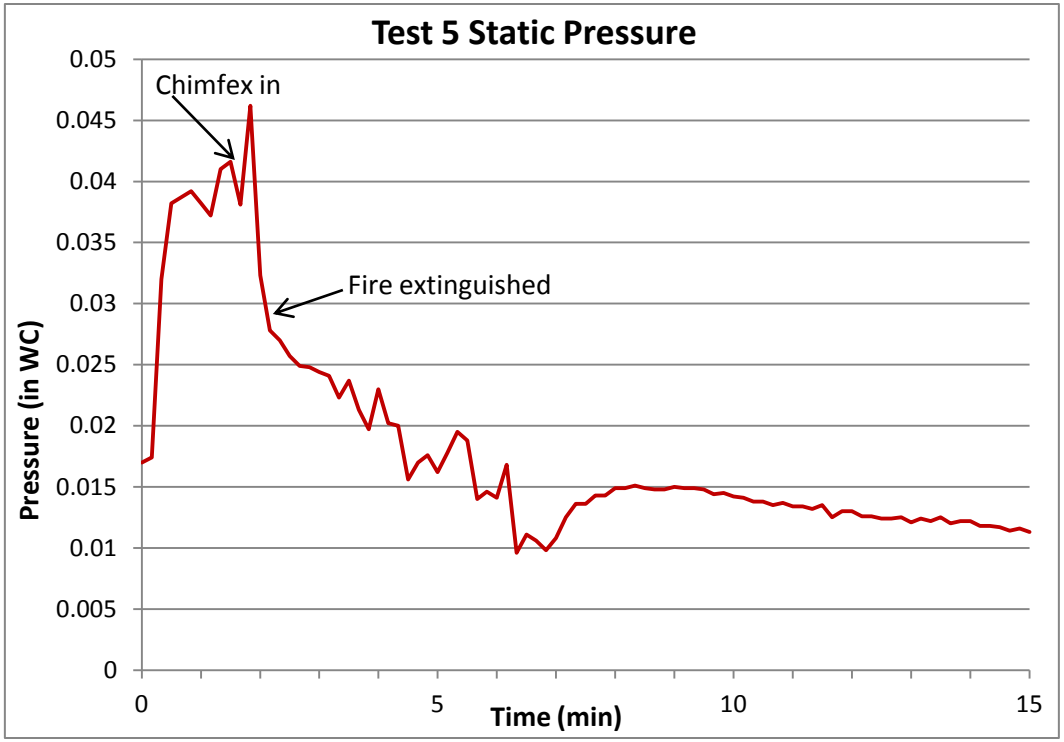

Test 4 Percent O2
Chimfex in
Fire extinguished
Percent O2
Time (min)
0
5
10
15
20
25

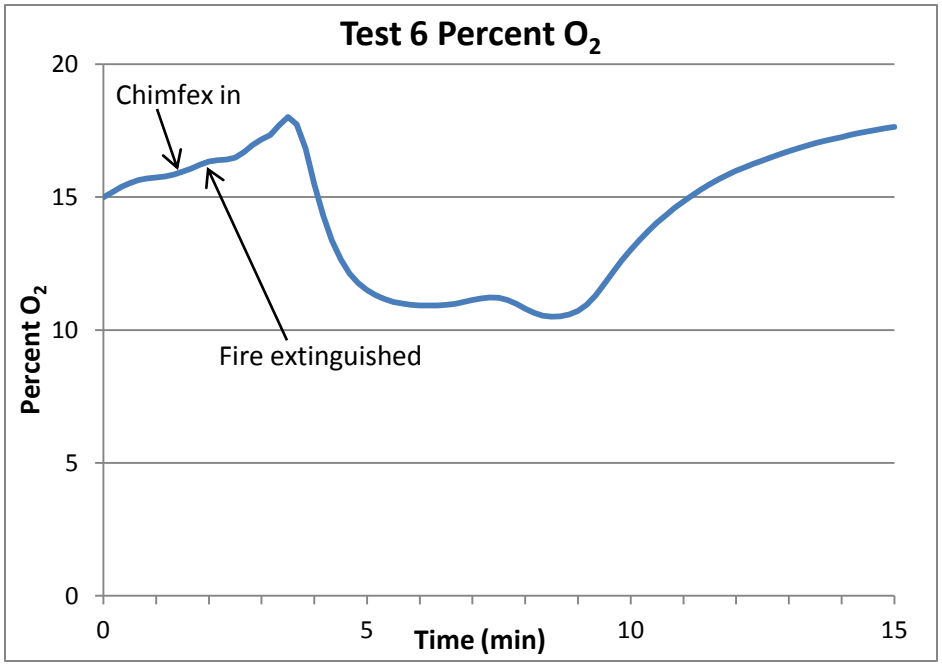

Test 4 Temperature at 11.25 ft
Chimfex in
Fire extinguished
Temperature (°F)
Time (min)
0
100
200
300
400
500
600

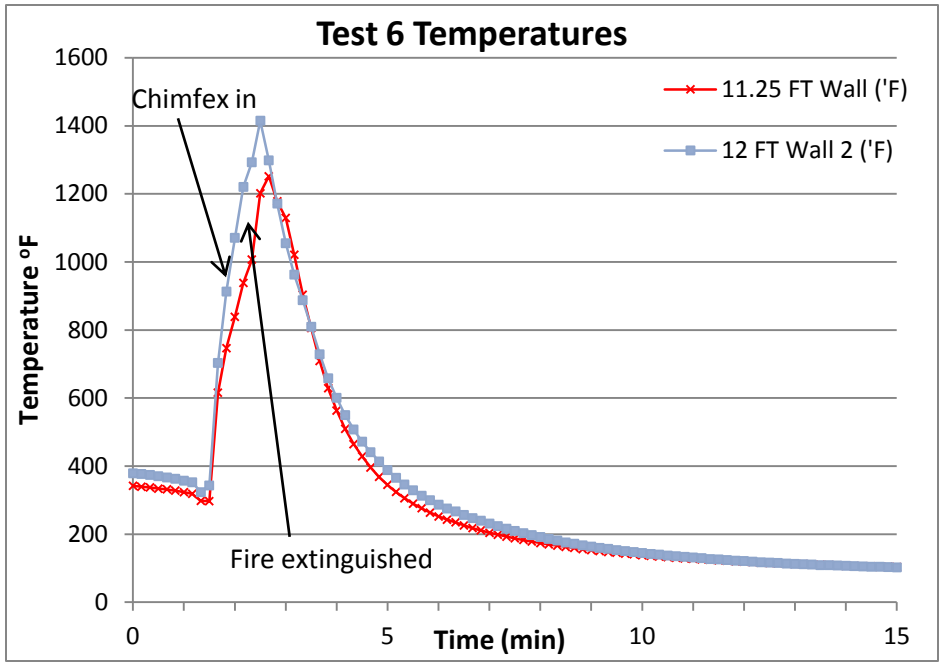

Test 4 Static Pressure
Fire extinguished
Chimfex in
Pressure (in WC)
Time (min)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04

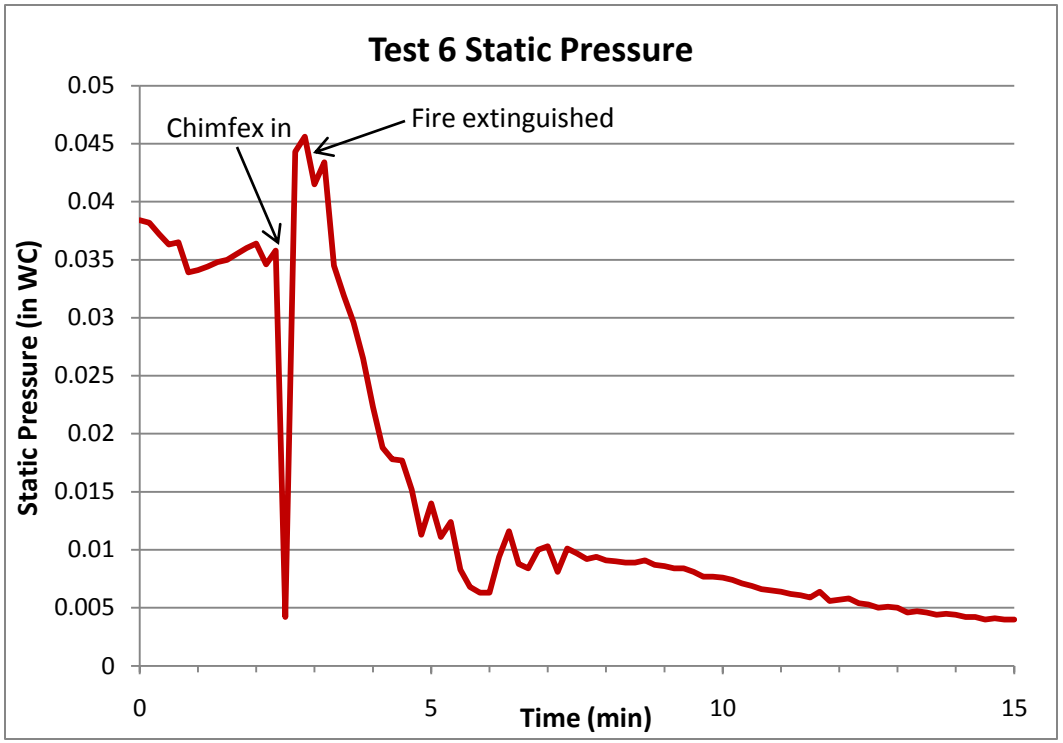

Test 5 Percent O_2
Chimfex in
Fire extinguished
Percent O_2
Time (min)
0
5
10
15
20

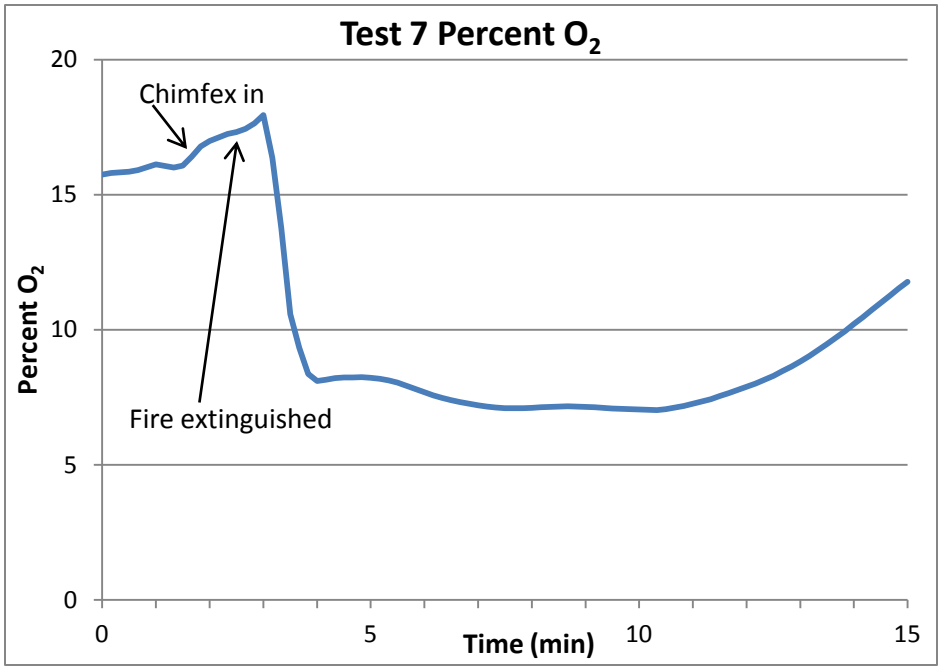

Test 5 Temperature at 11.25 ft
Chimfex in
Fire extinguished
Temperature (°F)
Time (min)
0
200
400
600
800
1000
1200
5
10
15

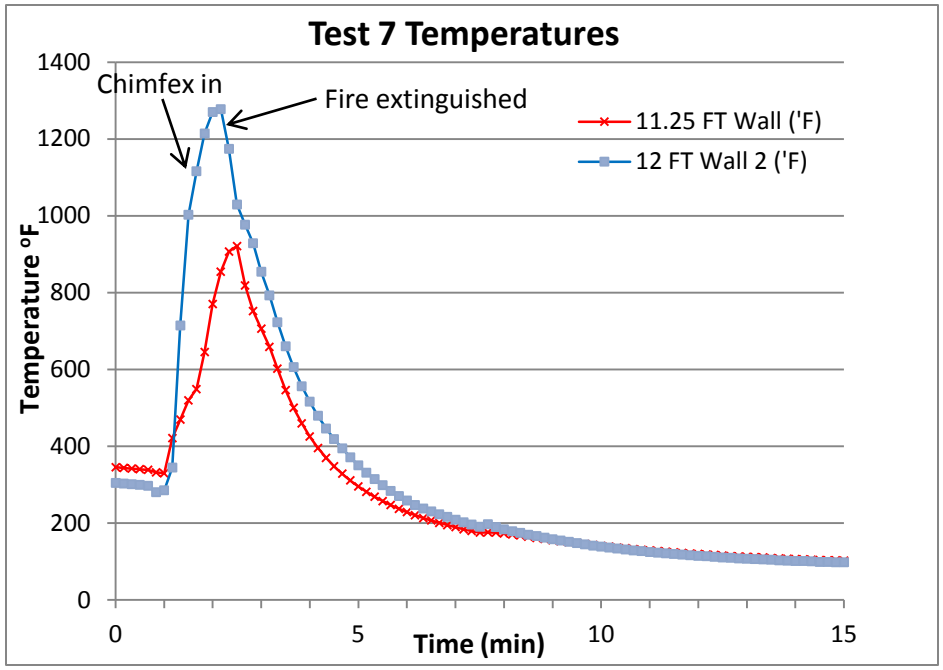

Test 5 Static Pressure
Chimfex in
Fire extinguished
Pressure (in WC)
Time (min)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
5
10
15

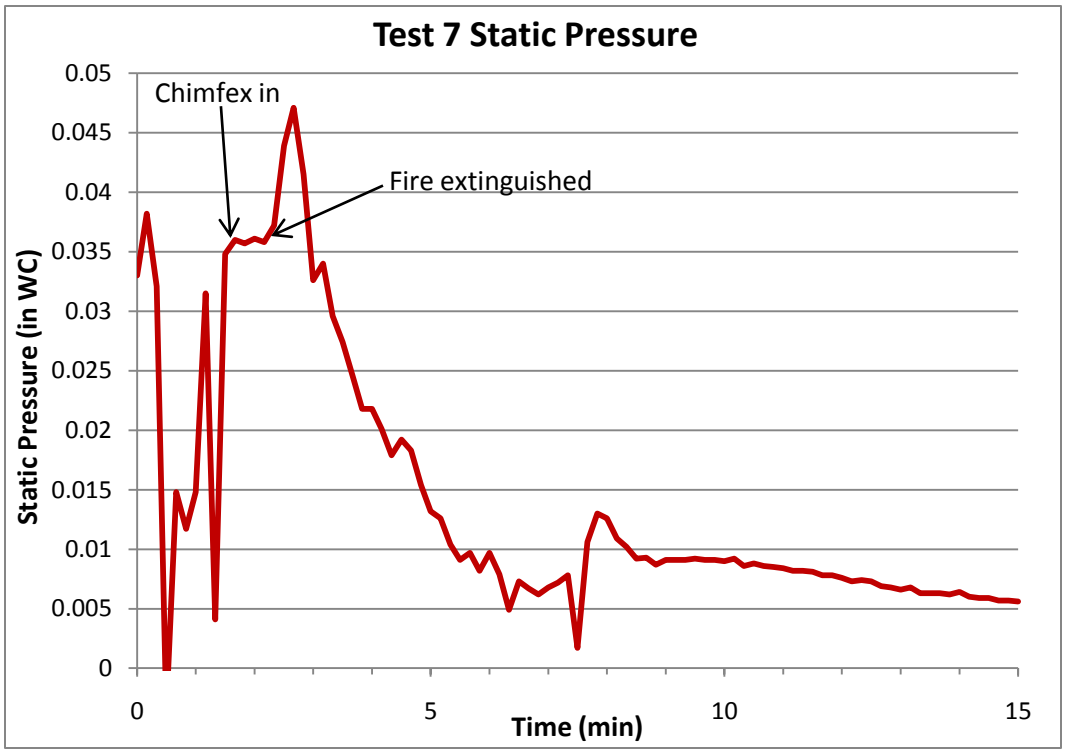

Test 6 Percent O_2
Chimfex in
Fire extinguished
Percent O_2
Time (min)
0
5
10
15
20

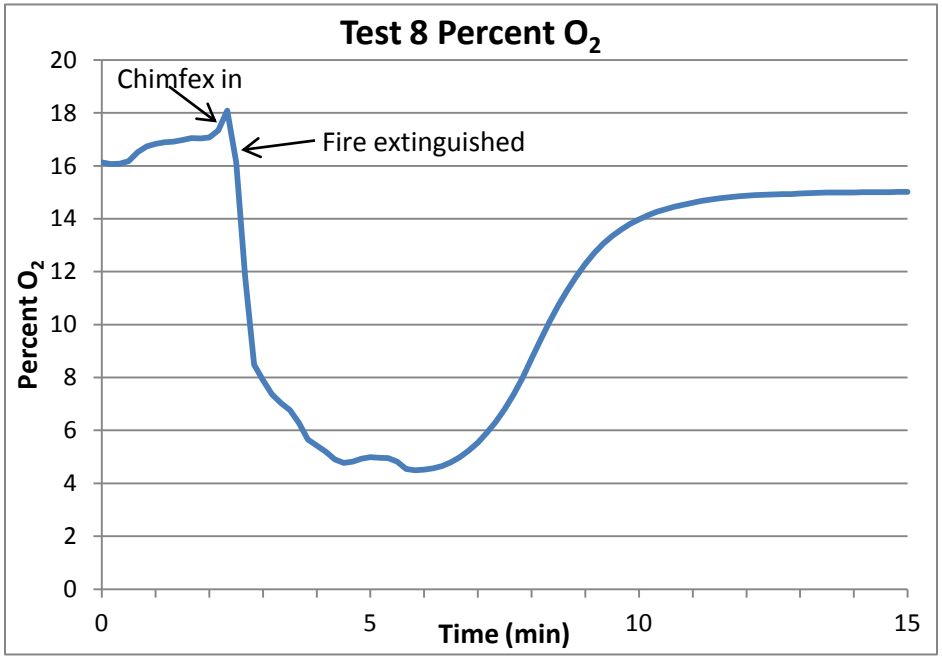

Test 6 Temperatures
Chimfex in
Fire extinguished
11.25 FT Wall ('F)
12 FT Wall 2 ('F)
Temperature °F
Time (min)
0
200
400
600
800
1000
1200
1400
1600

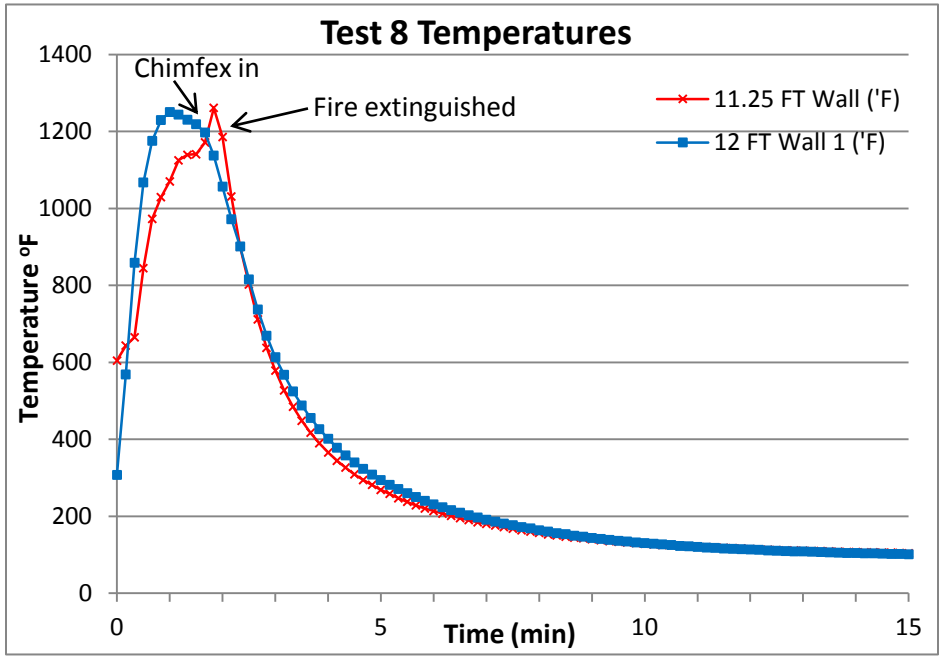

Test 6 Static Pressure
Chimfex in
Fire extinguished
Static Pressure (in WC)
Time (min)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05

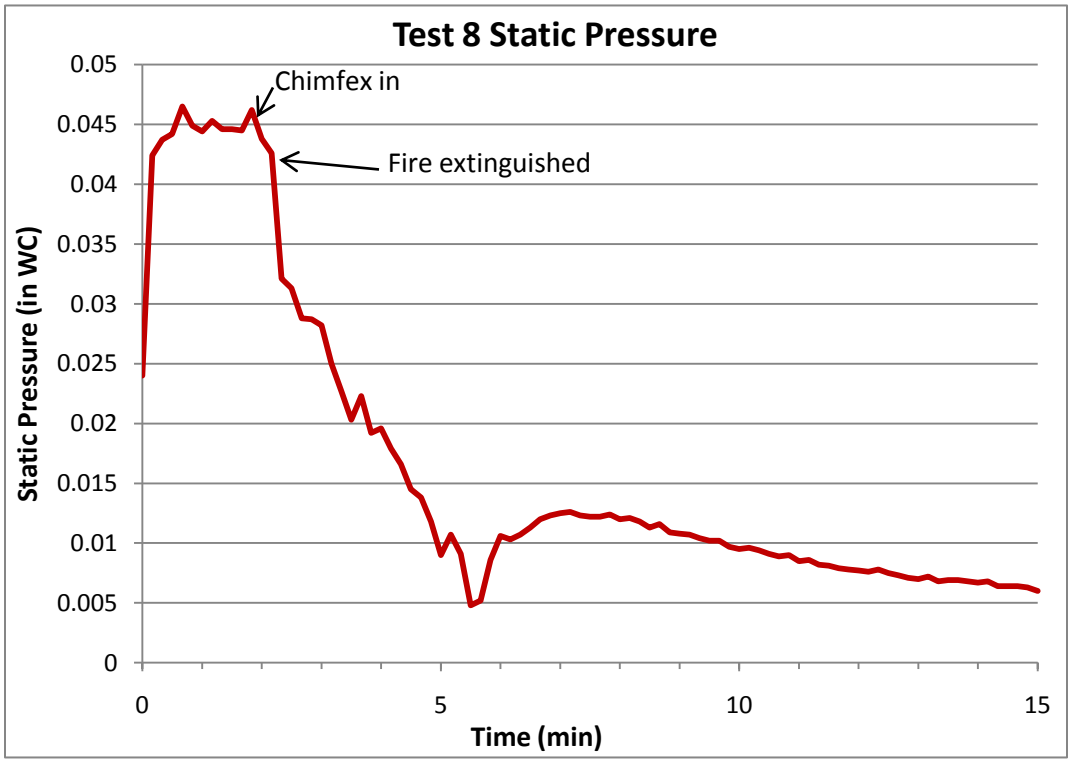

Test 7 Percent O2
Chimfex in
Fire extinguished
Percent O2
Time (min)
0
5
10
15
20

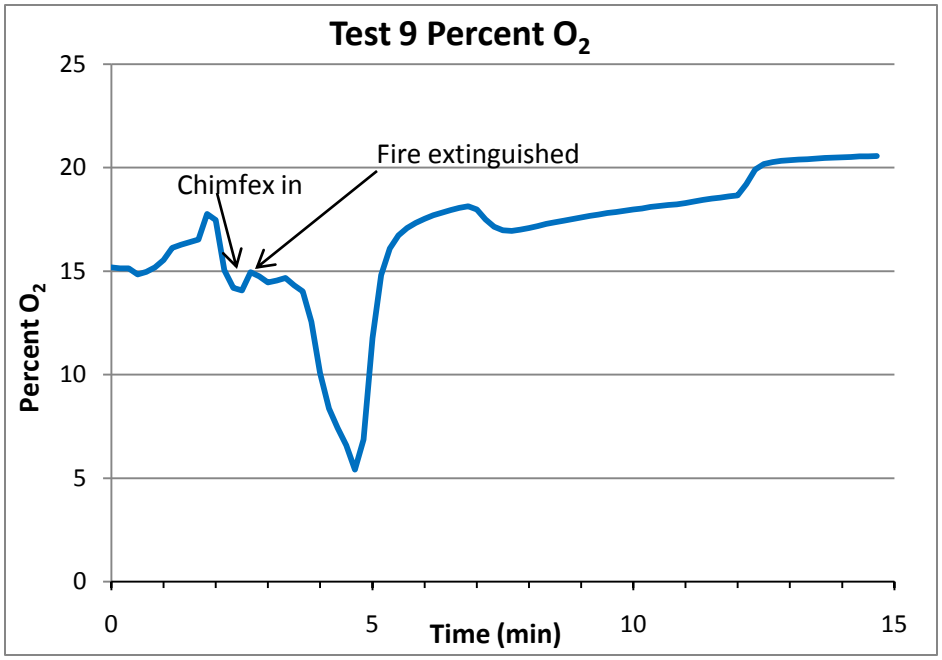

Test 7 Temperatures
Chimfex in
Fire extinguished
11.25 FT Wall ('F)
12 FT Wall 2 ('F)
Temperature °F
Time (min)
0
200
400
600
800
1000
1200
1400
5
10
15

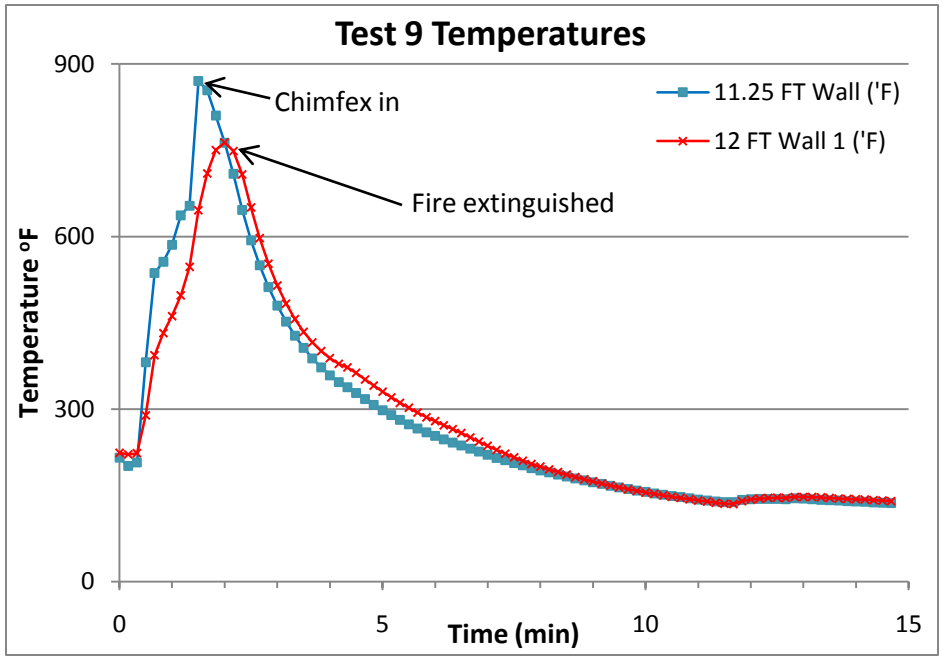

Test 7 Static Pressure
Chimfex in
Fire extinguished
Static Pressure (in WC)
Time (min)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
5
10
15

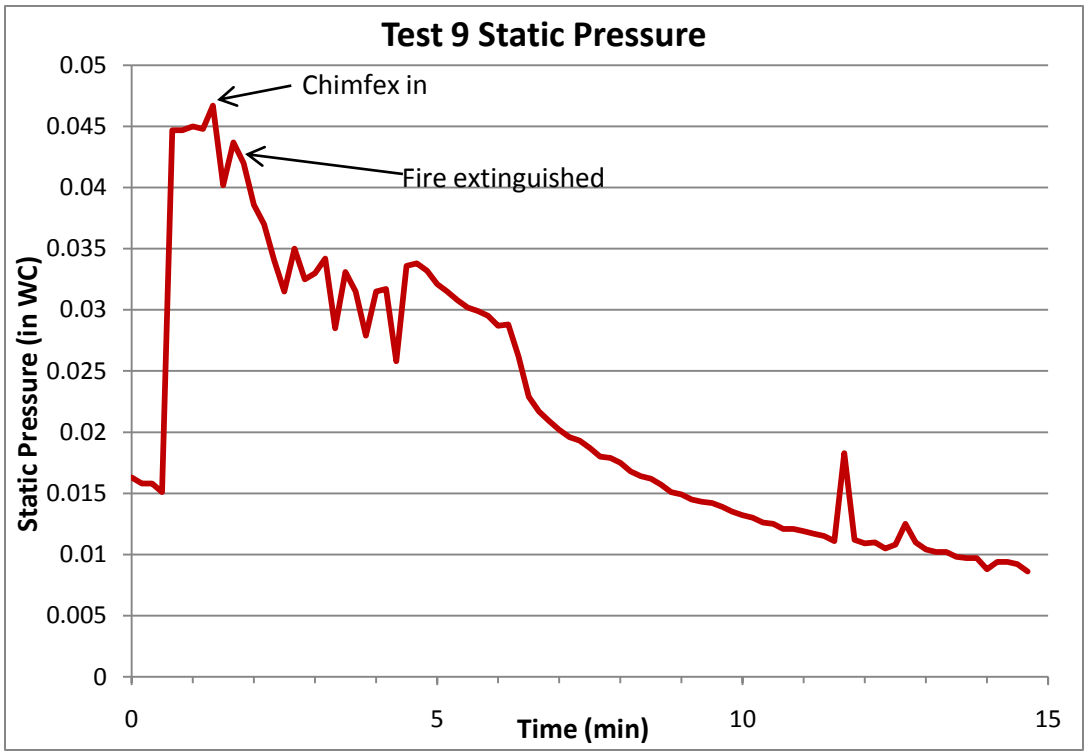

Test 8 Percent O_2
Chimfex in
Fire extinguished
Percent O_2
Time (min)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15

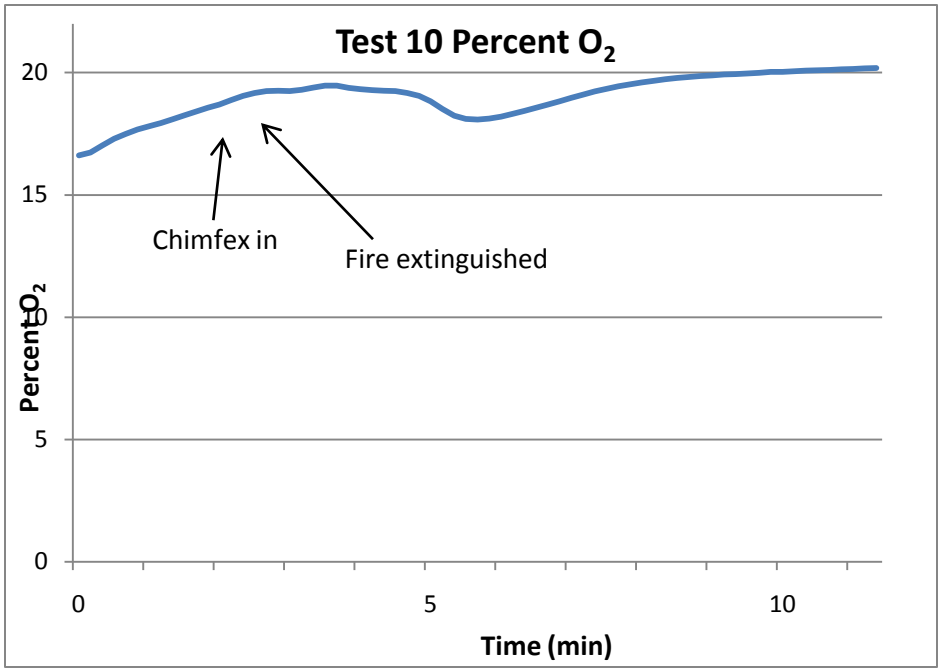

Test 8 Temperatures
Chimfex in
Fire extinguished
11.25 FT Wall ('F)
12 FT Wall 1 ('F)
Temperature °F
Time (min)
0
200
400
600
800
1000
1200
1400
0
5
10
15

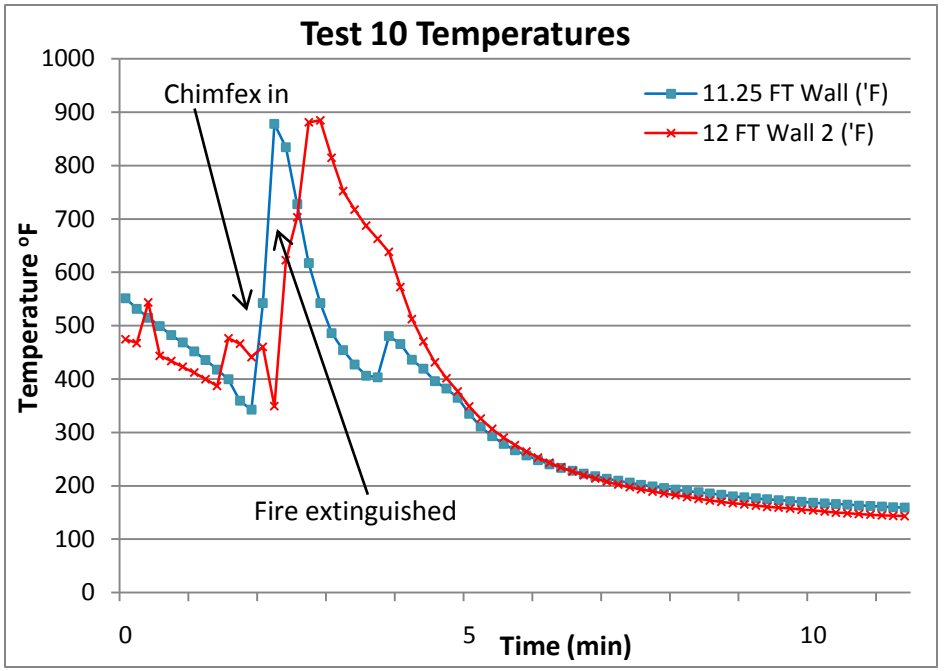

Test 8 Static Pressure
Chimfex in
Fire extinguished
Static Pressure (in WC)
Time (min)
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
0.04
0.045
0.05
0
5
10
15

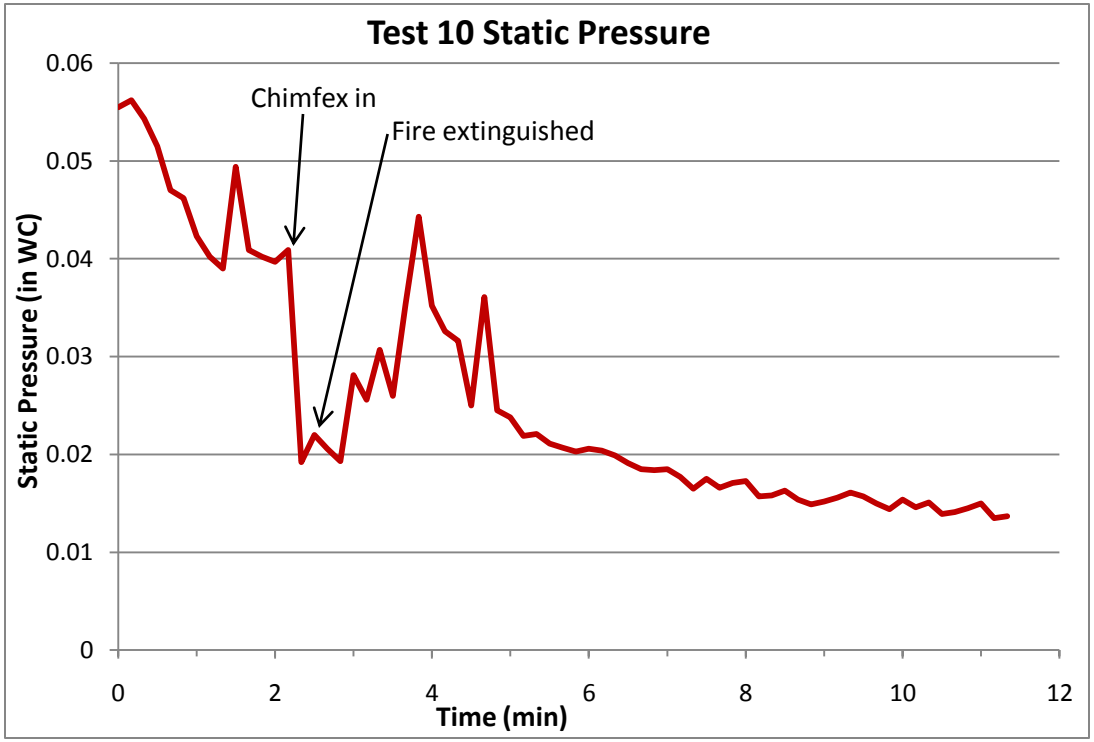

Test 9 Percent O_2
Percent O_2
25
20
15
10
5
0
0
5
10
15
Time (min)
Chimfex in
Fire extinguished

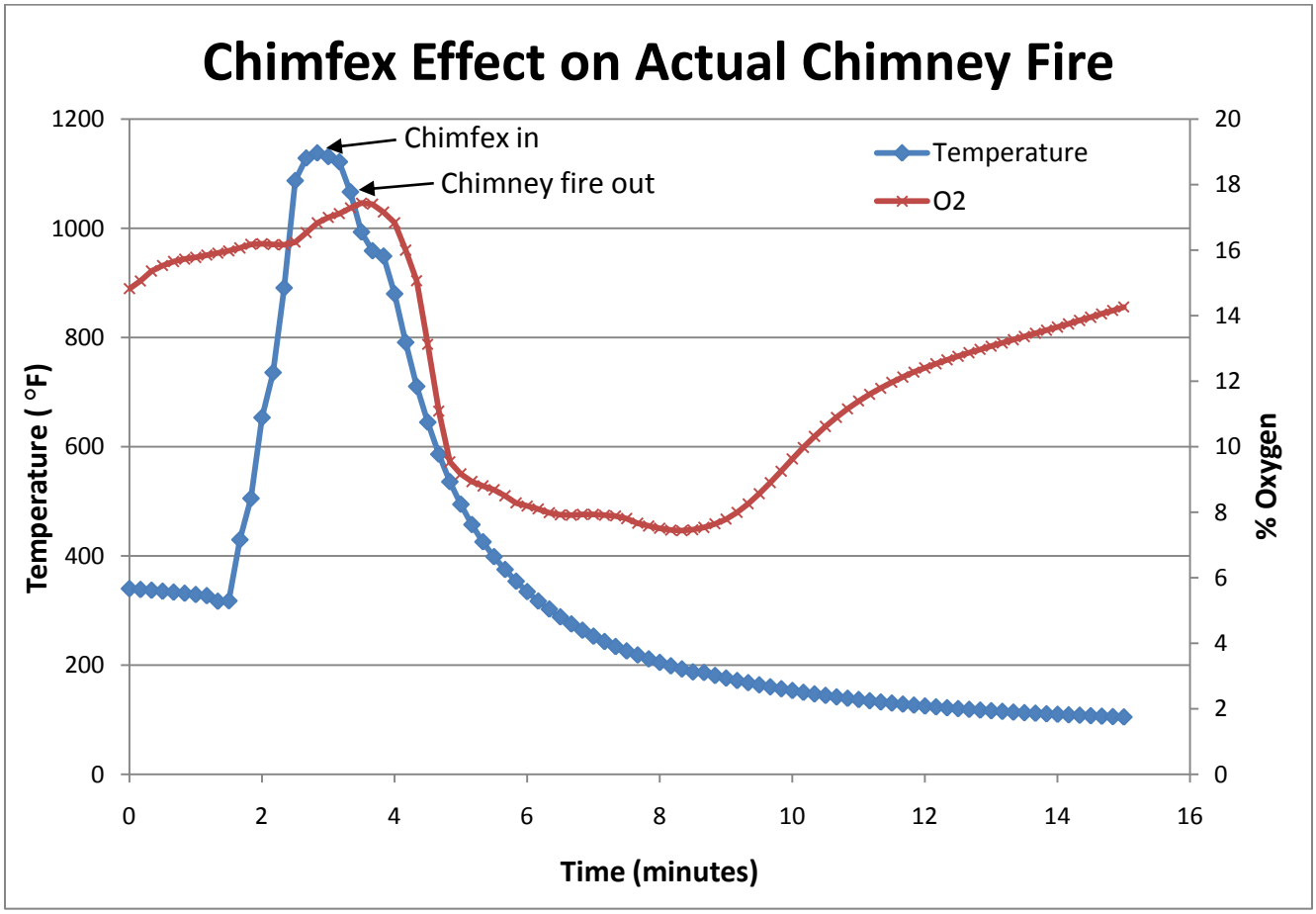

Test 9 Temperatures
Temperature °F
900
600
300
0
0
5
10
15
Time (min)
Chimfex in
Fire extinguished
11.25 FT Wall ('F)
12 FT Wall 1 ('F)


Test 9 Static Pressure
Static Pressure (in WC)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0
5
10
15
Time (min)
Chimfex in
Fire extinguished


Test 10 Percent O_2
Percent O_2
20
15
10
5
0
0
5
10
Time (min)
Chimfex in
Fire extinguished


Test 10 Temperatures
Temperature °F
1000
900
800
700
600
500
400
300
200
100
0
0
5
10
Time (min)
Chimfex in
Fire extinguished
11.25 FT Wall ('F)
12 FT Wall 2 ('F)


Test 10 Static Pressure
Static Pressure (in WC)
0.06
0.05
0.04
0.03
0.02
0.01
0
0
2
4
6
8
10
12
Time (min)
Chimfex in
Fire extinguished



*Results are averages of three tests conducted in a conventional non-catalytic wood stove

- Temperature dropped an average of 53% in 2 minutes
- Percent oxygen dropped an average of 43% in 2 minutes
- Chimney fire extinguished in an average of 22 seconds