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ANALOG DEVICES, INC. (204556)

LETTER REPORT

SCOPE OF WORK
UL217 8th Ed Performance testing on EVAL-CN0537-ALGO Smoke sensor

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LETTER REPORT

28-July-2020

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Intertek Project No. G104358174

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Subject: UL217 8th Ed Performance testing on EVAL-CN0537-ALGO Smoke sensor

Dear Mr. Brandon Bushey

This letter report represents the results of the testing performance of the above referenced product to the requirements contained in the following standards:

Smoke Alarms [UL 217:2015 Ed.8+R:23Nov2016]

SECTION 1
SUMMARY

Intertek wishes to inform you that we have completed the research UL217 8th Ed performance testing on your EVAL-CN0537-ALGO Smoke sensor. The following list of tests were performed and resulted in a passing result.

TEST	UL 217 8th	Result
Directionality	43	Pass
Sensitivity	42	Pass
UL – Paper Fire	51.2	Pass
UL – Wood Fire	51.3	Pass
UL – Flaming polyurethane Foam Test	51.4	Pass
UL – Smoldering Smoke Test	52	Pass
UL – Smoldering Polyurethane Foam Test	53	Pass
UL – Cooking Nuisance Smoke Test	54	Pass
UL - Go/No Go Flaming Polyurethane Foam Test	54	Pass
Velocity-Sensitivity Test	44	Pass
Variable Ambient (0 & 49c)	62	Pass
Humidity	63	Pass

Please review the following sections below for the complete details of the results of these tests.

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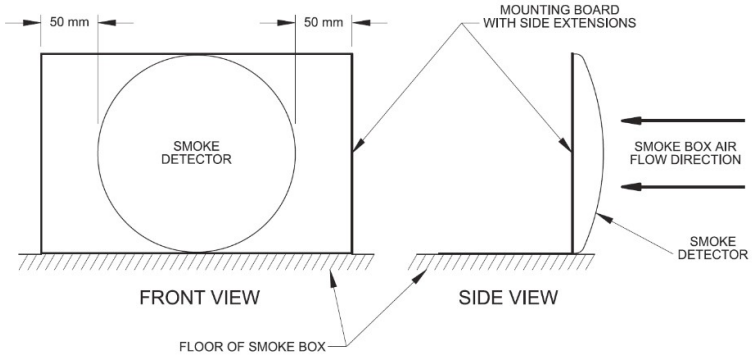
SECTION 2
TEST RESULTS

UL 217 8th Ed Directionality test:

Test Method:

The sensitivity of the smoke alarm shall comply with the requirements of Section 42, Sensitivity Test, using gray smoke/aerosol in any orientation with the air flow in the chamber. The smoke alarm is to be tested at an air velocity of 32 ± 2 fpm (0.16 ±0.01 m/s) in its least favorable position [LFP] for smoke entry and at each 45°-degree angle from this position. The positions are to include all four compass points with the smoke alarm in a horizontal position with the oncoming air directed to each of four sides and with the
smoke alarm positioned on edge with the smoke alarm front facing the oncoming air illustrated in Figure The locations of the least [LFP] and most [MFP] favorable smoke entry positions for the smoke sensors in the unit shall be marked on all smoke alarms to be used in subsequent tests. See 42.1.1, Stability Test, Section 48, and Stability Tests – Multi-Criteria Smoke Alarms Incorporating Gas Sensor(s), Section 49. The variation of the highest and lowest sensitivity position from the mean shall not exceed 50 percent.

Figure 43.1
Directionality Test



INTERTEK SMOKE BOX #3 [Cotton Wick] – Board AH06222020092150-1

Sample No.	Position	Run or Ave	MIC (pA)	Beam (µA)	Obscuration (%/ft OBS)	Time (mm:ss)
AH06222020092150-1	0	1	46.99	90.28	2.02	7.10
		2	48.53	90.50	1.98	7.83
		3	46.81	90.44	1.99	7.43
		Average	47.44	90.41	2.00	7.45
	45	1	47.68	89.97	2.09	7.93
		2	47.01	90.29	2.02	6.80
		3	47.21	90.26	2.03	7.00
		Average	47.30	90.17	2.05	7.24
	90	1	47.53	89.95	2.10	8.27
		2	47.80	90.53	1.97	7.60
		3	47.78	90.59	1.96	7.70
		Average	47.70	90.36	2.01	7.86
	135	1	46.89	90.63	1.95	7.67
		2	47.38	90.43	1.99	7.17
		3	45.33	90.56	1.96	7.63
		Average	46.53	90.54	1.97	7.49
	180	1	47.68	90.44	1.99	7.53

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		2	48.06	90.22	2.04	7.63
		3	46.27	90.11	2.06	7.70
		Average	47.34	90.26	2.03	7.62
	225	1	48.47	90.90	1.89	6.83
		2	46.27	90.31	2.02	6.90
		3	47.39	90.96	1.88	7.63
		Average	47.38	90.72	1.93	7.12
	270	1	47.58	89.84	2.12	7.63
		2	48.39	90.18	2.05	8.17
		3	47.36	90.22	2.04	7.83
		Average	47.78	90.08	2.07	7.88
	315	1	46.98	90.10	2.06	7.90
		2	48.09	90.31	2.02	7.10
		3	48.55	90.21	2.04	7.93
		Average	47.87	90.21	2.04	7.64

INTERTEK SMOKE BOX #3 [Cotton Wick] – Board AH06222020092150-2

Sample No.	Position	Run or Ave	MIC (pA)	Beam (µA)	Obscuration (%/ft OBS)	Time (mm:ss)
AH06222020092150-1	**0**	1	47.24	90.02	2.08	8.27
		2	46.20	90.34	2.01	6.53
		3	46.76	90.15	2.05	6.33
		Average	46.73	90.17	2.05	7.04
	45	1	48.51	89.96	2.09	6.97
		2	47.66	90.27	2.03	6.83
		3	46.55	90.58	1.96	6.43
		Average	47.57	90.27	2.03	6.74
	90	1	48.15	90.74	1.92	6.83
		2	49.44	90.40	2.00	6.97
		3	46.54	91.05	1.86	6.57
		Average	48.04	90.73	1.93	6.79
	135	1	48.11	90.21	2.04	7.73
		2	45.87	90.68	1.94	7.23
		3	48.72	90.55	1.97	6.53
		Average	47.57	90.48	1.98	7.16
	180	1	48.19	90.48	1.98	6.53
		2	47.74	90.74	1.92	6.80
		3	48.11	90.68	1.94	6.70
		Average	48.01	90.64	1.95	6.68
	225	1	47.25	89.98	2.09	7.27
		2	47.97	90.74	1.93	6.93
		3	47.83	91.04	1.86	6.73
		4	45.70	90.60	1.96	6.67
		5	48.24	90.82	1.91	6.63
		Average	47.40	90.63	1.95	6.85
	270	1	46.70	91.14	1.84	6.30
		2	47.32	90.89	1.89	6.47
		3	44.77	90.94	1.88	6.43
		Average	46.26	90.99	1.87	6.40
	315	1	48.68	90.57	1.96	6.57
		2	49.13	90.34	2.01	6.53
		3	48.17	90.95	1.88	6.57
		Average	48.66	90.62	1.95	6.56

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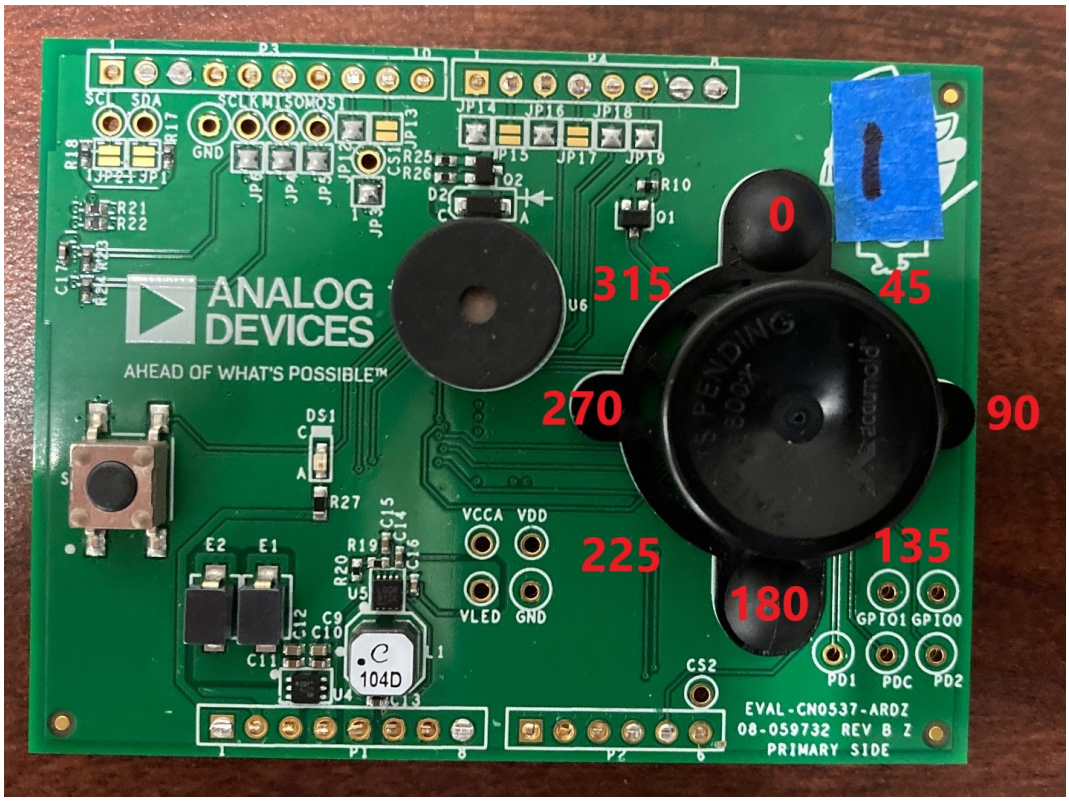
Result: The directionality test is meant to see what the least favorable position and most favorable position of smoke entry into the smoke chamber sensor is. For this test most of the time the smoke chamber sensor is inside an enclosure with its design smoke entry and really this test is to see what path will be the LFP & MFP taking into account the enclosure of the smoke alarm. Since these samples do not have an enclosure it is difficult to find the LFP & MFP directions. Based on the data above based on the 2 samples we tested you can see that LFP & MFP for both samples do not really aligned. So based on this result the LFP & MFP positions will be difficult to determine. It was discussed with the client that moving forward we will determine LFP & MFP as the following positions.

LFP – Position 270 deg.
MFP – Position 90 deg.



While performing this test client data was also being recorded thru the putty software tool. All raw data has been saved & provided to the client.

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UL 217 8th Ed Sensitivity test:

Test Method:

Samples were tested in a smoke box at 23 ± 3°C, 50 ± 20 percent relative humidity and barometric pressure of 760 ± 30mm of mercury (Hg). Each sample was placed inside a smoke box and energized. Smoke was introduced in the box until the sample went into alarm. The air velocity in the smoke box was maintained at 32 ± 3 fpm as measured 1 inch in front of the middle section of the alarm. Measuring Ionization Chamber (MIC) Meter Reading, visible aerosol obscuration (OBS), beam, and time to alarm were recorded. The smoke test was conducted three (3) times on each unit. If the trial-to-trial variation was more than ±0.2 %/ft then five (5) trials in total were conducted.

INTERTEK SMOKE BOX #3 [Cotton Wick]:

Smoke Box# 3 Model Sample #	Air Speed (ft/min)	Direction	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (min)
AH06222020092150-4	32	270	1	46.58	89.85	2.12	7.57
			2	46.40	89.65	2.16	7.93
			3	47.33	89.88	2.11	7.40
			Avg	46.77	89.79	2.13	7.63
AH06222020092150-5		270	1	47.18	90.17	2.05	7.17
			2	47.20	90.13	2.06	7.13
			3	46.38	90.31	2.02	7.20
			Avg	46.92	90.20	2.04	7.17
AH06222020092150-6		270	1	48.50	89.24	2.25	7.13
			2	48.60	88.90	2.33	6.87
			3	48.76	89.21	2.26	7.43
			Avg	48.62	89.12	2.28	7.14
AH06222020092150-7		270	1	45.90	87.64	2.60	9.47
			2	46.24	87.63	2.61	8.77
			3	45.81	88.12	2.50	8.60
			Avg	45.98	87.79	2.57	8.95
AH06222020092150-8		270	1	49.86	88.81	2.35	9.03
			2	49.78	89.25	2.25	7.40
			3	49.36	89.04	2.29	7.73
			Avg	49.67	89.03	2.30	8.05
AH06222020092150-9		270	1	46.87	88.49	2.42	7.53
			2	47.50	89.15	2.27	8.23
			3	47.17	89.13	2.28	7.93
			Avg	47.18	88.92	2.32	7.90
AH06222020092150-10		270	1	48.27	88.53	2.41	8.50
			2	48.61	88.00	2.52	9.07
			3	47.30	88.48	2.42	8.27
			Avg	48.06	88.34	2.45	8.61
AH06222020092150-11		270	1	46.40	88.58	2.40	8.27
			2	49.14	88.64	2.38	8.37
			3	49.28	89.00	2.30	7.93
			Avg	48.27	88.74	2.36	8.19
AH06222020092150-12		270	1	48.67	88.79	2.35	8.73
			2	49.26	88.77	2.36	7.30
			3	49.20	89.02	2.30	8.10
			Avg	49.04	88.86	2.33	8.04

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AH06222020092150-13		270	1	46.77	88.45	2.43	9.37
			2	47.72	89.06	2.29	8.53
			3	47.15	89.19	2.26	8.33
			Avg	47.21	88.90	2.33	8.74
AH06222020092150-14		270	1	48.91	88.83	2.34	8.57
			2	49.74	89.12	2.28	7.97
			3	49.84	88.93	2.32	8.40
			Avg	49.50	88.96	2.31	8.31
AH06222020092150-15		270	1	48.35	88.88	2.33	8.27
			2	49.28	89.51	2.19	8.00
			3	50.69	89.47	2.20	8.13
			Avg	49.44	89.29	2.24	8.13

NOTE: These samples will be used for the performance testing and will be considered as the initial sensitivity data.

While performing this test client data was also being recorded thru the putty software tool. All raw data has been saved & provided to the client.

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UL 217 8th Ed Fire Tests:

TEST	Fire test - Paper Fire	*Paragraph*	UL217/51.2

Test Method:
During the fire tests, the center ceiling unit was oriented such that least favorable position (LFP) was facing the fire source and the other two samples were oriented clockwise (CW) and counter-clockwise (CCW) by an angle of 120° with respect to the center sample. The last two samples were mounted on each side wall with the LFP facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.

LFP – Position 270 deg.

Test Results:

Sample Number	Type of Fire	Trial	Position	Response Time (mm:ss)
AH06222020092150 - 12	Paper Fire	1	South Wall	1:54
AH06222020092150 – 11			South Ceiling	1:57
AH06222020092150 – 10			Center Ceiling	1:56
AH06222020092150 – 9			North Ceiling	1:53
AH06222020092150 - 7			North Wall	1:59

Flame thru – 1:20
Test Result Findings: Pass – Samples responded before the 240 second time requirement in all locations.

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TEST	Wood Crib	*Paragraph*	UL217/51.3

Test Method:
During the fire tests, the center ceiling unit was oriented such that least favorable position (LFP) was facing the fire source and the other two samples were oriented clockwise (CW) and counterclockwise (CCW) by an angle of 120° with respect to the center sample. The last two samples were mounted on each side wall with the LFP facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.

LFP – Position 270 deg.

Test Results:

Sample Number	Type of Fire	Trial	Position	Response Time (mm:ss)
AH06222020092150 - 12	Wood Crib	2	South Wall	3:37
AH06222020092150 – 11			South Ceiling	1:47
AH06222020092150 – 10			Center Ceiling	2:04
AH06222020092150 – 9			North Ceiling	1:55
AH06222020092150 - 7			North Wall	3:13

Flame thru – 2:39
Test Result Findings: **Pass** – Samples responded before the 240 second time requirement in all locations.

TEST	Flaming Polyurethane	*Paragraph*	UL217/51.4

Test Method:
During the fire tests, the center ceiling unit was oriented such that least favorable position (LFP) was facing the fire source and the other two samples were oriented clockwise (CW) and counter-clockwise (CCW) by an angle of 120° with respect to the center sample. The last two samples were mounted on each side wall with the LFP facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.

LFP – Position 270 deg.

Sample Number	Type of Fire	Trial	Position	Response Time (mm:ss)	Response (%/ft)
AH06222020092150 - 12	Flaming Polyurethane	2	South Wall	3:11	4.35
AH06222020092150 – 11			South Ceiling	3:19	4.78
AH06222020092150 – 10			Center Ceiling	3:18	4.46
AH06222020092150 – 9			North Ceiling	3:18	4.48
AH06222020092150 - 7			North Wall	3:20	4.60

Test Result Findings: Pass All samples alarmed before the 5.00%/ft requirement. All other positions are good.

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TEST	Smoldering Wood Test	*Paragraph*	UL217/52

Test Method:
During the fire tests, the center ceiling unit was oriented such that least favorable position (LFP) was facing the fire source and the other two samples were oriented clockwise (CW) and counter-clockwise (CCW) by an angle of 120° with respect to the center sample. The last two samples were mounted on each side wall with the LFP facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.

LFP – Position 270 deg.

Test Results:

Sample Number	Type of Fire	Trial	Position	Response Time (mm:ss)	Alarm - Response threshold (%/ft)
AH06222020092150 - 12	Smoldering Wood Test	1	South Wall	56:05	4.44
AH06222020092150 – 11			South Ceiling	55:25	4.67
AH06222020092150 – 10			Center Ceiling	58:54	6.24
AH06222020092150 – 9			North Ceiling	54:49	4.57
AH06222020092150 - 7			North Wall	56:53	4.66

Test Result Findings:– **Pass - Samples responded before 10%/ft requirement in all locations**

TEST	Smoldering Polyurethane	*Paragraph*	UL217/53

Test Method:
During the fire tests, the center ceiling unit was oriented such that least favorable position (LFP) was facing the fire source and the other two samples were oriented clockwise (CW) and counter-clockwise (CCW) by an angle of 120° with respect to the center sample. The last two samples were mounted on each side wall with the LFP facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.
LFP – Position 270 deg.

Test Results:

Sample Number	Type of Fire	Trial	Position	Response threshold (%/ft)
AH06222020092150 - 12	Smoldering Polyurethane	1	South Wall	3.12
AH06222020092150 – 11			South Ceiling	2.59
AH06222020092150 – 10			Center Ceiling	3.27
AH06222020092150 – 9			North Ceiling	3.20
AH06222020092150 - 7			North Wall	2.95

Since all ceiling samples alarmed within the required profile limits shown in the image below this is considered a passing result.

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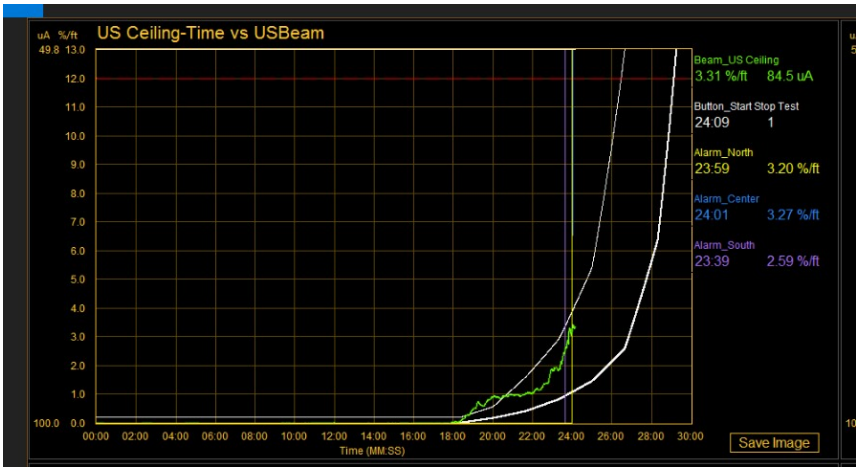
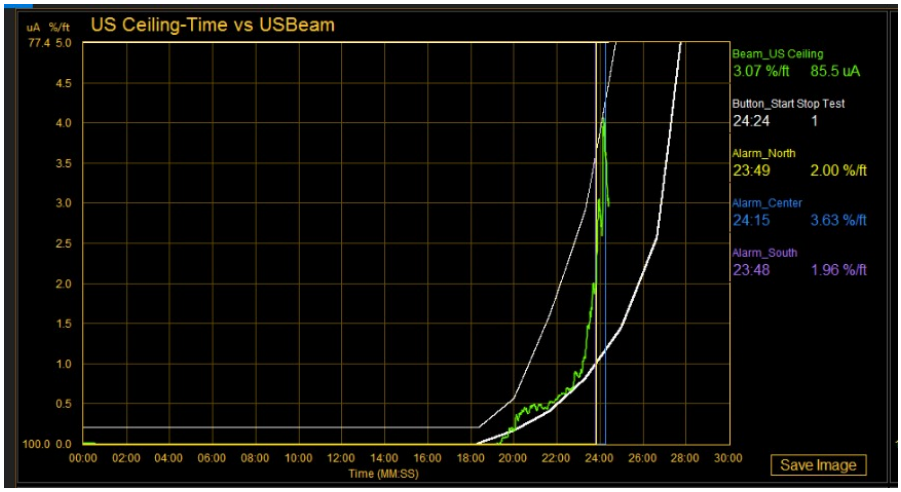


Test Result Findings: - **Pass -** Samples responded before 10%/ft requirement in all locations.
A second trial was performed to confirm if having the entire smoke build up in the profile produces the same passing result.

Results:

Sample Number	Type of Fire	Trial	Position	Response threshold (%/ft)
AH06222020092150 - 12	Smoldering Polyurethane	1	South Wall	3.44
AH06222020092150 – 11			South Ceiling	1.96
AH06222020092150 – 10			Center Ceiling	3.63
AH06222020092150 – 9			North Ceiling	2.00
AH06222020092150 - 7			North Wall	2.81



Test Result Findings: - **Pass -** Samples responded before 10%/ft requirement in all locations. Since all ceiling samples alarmed within the required profile limits shown in the image below this is considered a passing result.

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TEST	Cooking Nuisance Smoke Test –	***Paragraph***	UL217/54

Test Method:
During the fire test, all units were oriented such that most favorable position (MFP) was facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.

MFP – Position 90 deg.

A total of 3 trials were performed in order to get extra data from the sensor.

Test Results:

Sample Number	Type of Fire	Trial	Position	Alarm Response threshold (%/ft)
AH06222020092150 - 5	Cooking Nuisance Smoke Test –	1	South	2.99
AH06222020092150 – 4			South Ceiling	2.99
AH06222020092150 – 2			North Ceiling	2.89
AH06222020092150 – 1			North	3.12

Acceptance criteria: Pass – All samples alarmed **after** the 1.5%/ft obscuration requirement.

Sample Number	Type of Fire	Trial	Position	Alarm Response threshold (%/ft)
AH06222020092150 - 5	Cooking Nuisance Smoke Test –	2	South	4.45
AH06222020092150 – 4			South Ceiling	4.07
AH06222020092150 – 2			North Ceiling	3.50
AH06222020092150 – 1			North	3.74

Acceptance criteria: Pass – All samples alarmed **after** the 1.5%/ft obscuration requirement.

Sample Number	Type of Fire	Trial	Position	Alarm Response threshold (%/ft)
AH06222020092150 - 5	Cooking Nuisance Smoke Test –	2	South	2.95
AH06222020092150 – 4			South Ceiling	2.85
AH06222020092150 – 2			North Ceiling	2.79
AH06222020092150 – 1			North	3.00

Acceptance criteria: Pass – All samples alarmed **after** the 1.5%/ft obscuration requirement.

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TEST	Go/No Go Flaming Polyurethane Foam Test–	***Paragraph***	UL217/54

Test Method:
During the fire test, all units were oriented such that most favorable position (MFP) was facing the fire source. The test was conducted in an ambient temperature between 20°C and 25.5°C and a relative humidity of 50 ±10%. For fire profiles, refer to the folder.

The Flaming Polyurethane Foam test requirements outlined in 50.4 shall be conducted with the acceptance criteria applying to the 17 ft test location. Test samples shall not be located at the 17 ft location. As defined in 50.4.1 and 50.4.3, the samples located at the 10 ft test location shall produce an alarm signal before the Flaming Polyurethane Foam acceptance criteria at the 17 ft location has been reached.

While conducting the entirety of this test, the room shall remain in static mode, i. e. no air movement caused by opening doors, ventilation systems or air movement caused by sources other than the electric cooking appliance and PU foam burning.

The Cooking Nuisance test and Flaming Polyurethane acceptance criteria shall be conducted as specified in Section 54.3 except for the following: Immediately after achieving the 1.5 %/ft OBS during the Cooking Nuisance Test:
a) The samples located at the 10 ft location shall remain powered and shall not be modified via software, mechanical intervention or electrically during the entirety of the test.

b) The Flaming Polyurethane Foam Test as outlined in 50.4 shall be conducted

c) The polyurethane foam used for the Flaming Polyurethane Foam Test, 50.4 shall be ignited within 10 seconds of achieving 1.5 %/ft OBS during the Cooking Nuisance Test.

d) The electric range used for the Cooking Nuisance Smoke Test shall be turned off once ignition of
the foam has been confirmed.

When conducting the Cooking Nuisance test, the four smoke alarm samples located at the 10 ft location shall not produce an alarm signal as specified in 53.2, but all four samples located at the 10 ft location shall produce an alarm signal once the 5 %/ft OBS acceptance criteria defined in 50.4.4 has been achieved.

Sample Number	Type of Fire	Trial	Position	Alarm Response threshold (%/ft) @ 17 ft
AH06222020092150 - 5	Cooking Nuisance Smoke Test –	1	South	3.18
AH06222020092150 – 4			South Ceiling	3.41
AH06222020092150 – 2			North Ceiling	3.43
AH06222020092150 – 1			North	4.60

Acceptance criteria: Pass – All samples alarmed **before** 5%/ft obscuration requirement at the 17ft ceiling.

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Sample Number	Type of Fire	Trial	Position	Alarm Response threshold (%/ft) @ 17 ft
AH06222020092150 - 5	Cooking Nuisance Smoke Test –	2	South	3.77
AH06222020092150 – 4			South Ceiling	3.50
AH06222020092150 – 2			North Ceiling	2.68
AH06222020092150 – 1			North	3.12

Acceptance criteria: Pass – All samples alarmed **before** 5%/ft obscuration requirement at the 17ft ceiling.

Sample Number	Type of Fire	Trial	Position	Alarm Response threshold (%/ft) @ 17 ft
AH06222020092150 - 5	Cooking Nuisance Smoke Test –	3	South	3.14
AH06222020092150 – 4			South Ceiling	3.19
AH06222020092150 – 2			North Ceiling	3.22
AH06222020092150 – 1			North	3.31

Acceptance criteria: Pass – All samples alarmed **before** 5%/ft obscuration requirement at the 17ft ceiling.

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UL217 8th Ed Humidity & Variable Ambient testing:

Humidity Tests

Two smoke alarms, nominal sensitivity, shall operate for their intended signaling performance when exposed for 168 hours to air having a relative humidity of 93 ±2 percent and a temperature of 40 ±2°C (104 ±4°F) while energized from a source of 120Vac 60Hz. There shall not be false alarms during the exposure.
7-day conditioning Humidity conditioning:
Start: 7/13:11:00AM
End:7/20:11:00AM

Sensitivity testing result during high humidity conditioning:

Sample #	Air Speed (ft/min)	Direction	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-14	32	LFP	1	53.24	88.63	2.39	7.77
			2	51.78	88.62	2.39	8.70
			3	50.89	87.99	2.53	8.07
			Avg	51.97	88.41	2.43	8.18
Sample #	**Air Speed (ft/min)**	**Direction**	**Trial**	**MIC (pA)**	**Beam (uA)**	**Obscuration (%/ft)**	**Time (mm)**
AH06222020092150-15	32	LFP	1	50.72	88.49	2.42	8.10
			2	46.33	88.02	2.52	9.20
			3	48.33	88.03	2.52	9.67
			Avg	48.46	88.18	2.48	8.99

Sample	Presensitivity	sensitivity during conditioning	% shift
AH06222020092150-14	2.31	2.43	0.12
AH06222020092150-15	2.24	2.48	0.24

Result: **Pass.** sensitivity values did not vary more than 1%ft during exposure to the high humidity atmosphere.

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Variable Ambient Temperature Tests

The smoke alarm shall operate for its intended performance. Both units shall operate normally in each ambient. Sensitivity measurements shall vary not more than ±1 percent per ft, Sensitivity shift criteria, and shall be in accordance with Section 42, Sensitivity Test .For products that identify an installation temperature below 0°C and above 38°C, the following ambient test conditions shall be applied:
The smoke alarm shall operate for its intended performance when tested in an ambient temperature of 0° (Condition B) and 49°C(Condition A) (32° and 120° F).
Two smoke alarms, nominal sensitivity, are to be maintained at each ambient temperature for a minimum of 3 hours.

49c 3-hour ambient conditioning:
Start: 7/21: 3:31AM
End: 7/21: 6:31AM

Sensitivity testing result during 49c ambient conditioning:

Sample #	Sample orientation	Air Speed (ft/min)	Direction	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-14	LFP	32	LFP	1	58.22	87.60	2.61	6.77
				2	56.07	88.10	2.50	6.97
				3	56.36	88.26	2.47	6.23
				Avg	56.88	87.99	2.53	6.66
Sample #	**Sample orientation**	**Air Speed (ft/min)**	**Direction**	**Trial**	**MIC (pA)**	**Beam (uA)**	**Obscuration (%/ft)**	**Time (mm)**
AH06222020092150-15	LFP	32	LFP	1	54.06	88.20	2.48	6.80
				2	51.90	87.92	2.54	7.20
				3	57.42	87.53	2.63	7.07
				Avg	54.46	87.89	2.55	7.02

Sample	Presensitivity	sensitivity during conditioning	% shift
AH06222020092150-14	2.31	2.53	0.22
AH06222020092150-15	2.24	2.55	0.31

Result: **Pass.** sensitivity values did not vary more than 1%ft during exposure to the high ambient atmosphere.

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0c 3-hour ambient conditioning:
Start: 7/22: 4:10AM
End: 7/22: 7:10AM

Sample #	Sample orientation	Air Speed (ft/min)	Direction	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-14	LFP	32	LFP	1	41.64	85.30	3.13	6.67
				2	43.22	85.40	3.11	6.27
				3	41.00	86.94	2.76	6.67
				4	44.15	85.81	3.02	6.20
				5	42.14	85.91	2.99	6.33
				Avg	42.43	85.87	3.00	6.43
Sample #	**Sample orientation**	**Air Speed (ft/min)**	**Direction**	**Trial**	**MIC (pA)**	**Beam (uA)**	**Obscuration (%/ft)**	**Time (mm)**
AH06222020092150-15	LFP	32	LFP	1	42.54	85.92	2.99	6.10
				2	44.75	85.90	2.99	6.53
				3	42.65	86.54	2.85	6.90
				Avg	43.31	86.12	2.94	6.51

Sample	Presensitivity	sensitivity during conditioning	% shift
AH06222020092150-14	2.31	3.00	0.69
AH06222020092150-15	2.24	2.94	0.70

Result: **Pass.** sensitivity values did not vary more than 1%ft during exposure to the low ambient atmosphere.

LETTER REPORT

UL 217 8th Velocity-Sensitivity Test

Test Method:

The smoke sensitivity of the smoke alarm shall not vary more than 1 percent per ft. obscuration outside of the production window limits, using gray smoke/aerosol, when tested in accordance with the sensitivity test at air velocities of 32 and 300 fpm (0.16 and 1.52 m/s) ±10 percent.

Two smoke alarms, nominal sensitivity, shall be subjected, in turn, to the sensitivity test; first at a velocity of 32 fpm (0.16 m/s), and then at a velocity of 300 fpm (0.76 m/s).

For this test, the smoke alarms shall be oriented in the least favorable and most favorable positions for smoke entry.

Sample #	Sample orientation	Air Speed (ft/min)	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-16	LFP	32	1	42.45	87.05	2.74	8.17
			2	43.35	87.54	2.63	8.30
			3	42.89	87.93	2.54	8.20
			Avg	42.90	87.51	2.63	8.22
Sample #	**Sample orientation**	**Air Speed (ft/min)**	**Trial**	**MIC (pA)**	**Beam (uA)**	**Obscuration (%/ft)**	**Time (mm)**
AH06222020092150-17	LFP	32	1	42.13	87.83	2.56	8.63
			2	42.80	87.54	2.63	8.93
			3	42.24	87.32	2.68	7.97
			Avg	42.39	87.57	2.62	8.51

Sample #	Sample orientation	Air Speed (ft/min)	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-16	MFP	32	1	44.49	88.49	2.42	8.07
			2	43.96	88.05	2.51	7.90
			3	44.09	88.61	2.39	7.83
			Avg	44.18	88.38	2.44	7.93
Sample #	**Sample orientation**	**Air Speed (ft/min)**	**Trial**	**MIC (pA)**	**Beam (uA)**	**Obscuration (%/ft)**	**Time (mm)**
AH06222020092150-17	MFP	32	1	44.22	88.53	2.41	7.53
			2	43.40	88.28	2.46	8.37
			3	43.74	88.72	2.37	7.93
			Avg	43.79	88.51	2.41	7.94

Sample #	Sample orientation	Air Speed (ft/min)	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-16	LFP	300	1	51.36	89.40	2.22	8.83
			2	51.87	89.44	2.21	8.17
			3	50.62	89.36	2.22	7.17
			Avg	51.28	89.40	2.22	8.06

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Sample #	Sample orientation	Air Speed (ft/min)	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-17	LFP	300	1	48.90	88.31	2.46	8.80
			2	46.07	88.26	2.47	9.07
			3	51.45	89.35	2.23	8.30
			4	48.36	89.20	2.26	9.53
			5	52.25	89.17	2.27	8.63
			Avg	49.41	88.86	2.33	8.87

Sample #	Sample orientation	Air Speed (ft/min)	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-16	MFP	300	1	43.15	90.33	2.01	8.44
			2	50.02	90.43	1.99	8.50
			3	48.43	89.86	2.11	8.80
			Avg	47.20	90.21	2.04	8.58

Sample #	Sample orientation	Air Speed (ft/min)	Trial	MIC (pA)	Beam (uA)	Obscuration (%/ft)	Time (mm)
AH06222020092150-17	MFP	300	1	50.58	89.80	2.13	8.90
			2	51.60	89.32	2.23	7.03
			3	52.14	89.59	2.18	6.57
			Avg	51.44	89.57	2.18	7.50

Sample	Orientation	32fpm	300fpm	%shift
AH06222020092150-16	LFP	2.63	2.22	-0.42
AH06222020092150-17	LFP	2.62	2.33	-0.29
AH06222020092150-16	MFP	2.44	2.04	-0.40
AH06222020092150-17	MFP	2.41	2.18	-0.23

Result: Pass. Sensitivity did not vary more than 1 percent per ft. obscuration between 32 fpm & 300fpm.

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SECTION 3
PROJECT STATUS & ACTION

Issuance of this letter report completes the UL217 8th Ed performance testing covered by Intertek Project No. G104358174.

If there are any questions regarding the results contained in this report, or any of the other services offered by Intertek, please do not hesitate to contact your dedicated Intertek Project Manager.

Completed by:	Alberto Tapia	Reviewed by:	Seung Kang
Title:	Engineer	Title:	Staff Engineer
Signature:		Signature	
Date	7/28/2020	Date:	7/30/2020

Please note: this Letter Report does not represent authorization for the use of any Intertek certification marks.