

For TEKUCE PLUTO d.o.o.

TEST REPORT

SCOPE OF WORK

ULC-S135:1992, *STANDARD TEST METHOD FOR THE DETERMINATION OF COMBUSTIBILITY PARAMETERS OF BUILDING MATERIALS USING AN OXYGEN CONSUMPTION CALORIMETER (CONE CALORIMETER) ON CORKSHEILD*

REPORT NUMBER

103749915MID-001

TEST DATE(S)

01/08/19

ISSUE DATE [REVISED DATE]

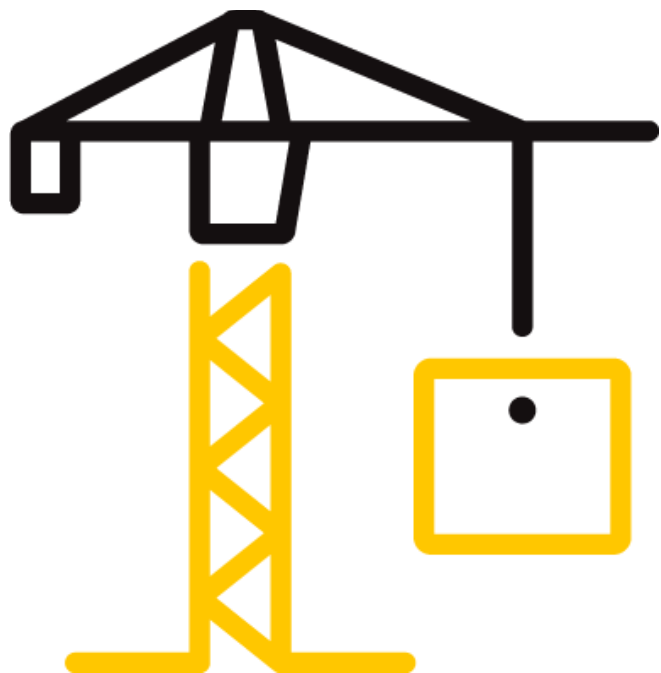
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PAGES

126

DOCUMENT CONTROL NUMBER

GFT-OP-10c (AUGUST 27, 2018)



Report No.: 103749915MID-001
Date: 01/08/19

SECTION 1 SCOPE

Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter), on Painted Plywood with Metal. Results obtained are tested values and were secured by using the designated test method.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. ITR - OP B&C will service this report for the entire test record retention period. The test record retention period ends four years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation, will be retained for the entire test record retention period.

COMPLETED BY:	Bryan Bowman
TITLE:	Chemist
SIGNATURE:	
DATE:	01/08/19

REVIEWED BY:	Mark Crawford
TITLE:	Engineering Team Lead
SIGNATURE:	
DATE:	01/08/19

SECTION 2 TEST METHOD(S)

The specimens were evaluated in accordance with the following:

ULC-S135:1992, *Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter)*

SECTION 3 MATERIAL SOURCE

The specimens were provided by the client. Samples were received at the Evaluation Center on December 19, 2018 in good condition. Sample ID is MID1812191254-001

SECTION 4 EQUIPMENT

EQUIPMENT			
DESCRIPTION - ASSET #:	Cone Calorimeter - 1199	CALIBRATION DUE:	V/BU
DESCRIPTION - ASSET #:	Scale - 1482	CALIBRATION DUE:	4/4/2019
DESCRIPTION - ASSET #:	Flow Meter - 1270	CALIBRATION DUE:	11/11/2019
DESCRIPTION - ASSET #:	Heat Flux Transducer - 1405	CALIBRATION DUE:	10/8/2019
DESCRIPTION - ASSET #:	Balance - 1396	CALIBRATION DUE:	4/4/2019
DESCRIPTION - ASSET #:	Caliper - 1248	CALIBRATION DUE:	4/3/2019
DESCRIPTION - ASSET #:	Room Temp/Humidity - 1456	CALIBRATION DUE:	3/28/2019
DESCRIPTION - ASSET #:	Conditioning Chamber - 1451	CALIBRATION DUE:	12/4/2019

SECTION 5 TEST PROCEDURE

The cone calorimeter test was run as written in ULC S135 section 8 – Procedure.

SECTION 6 TEST CALCULATIONS

The cone calorimeter calculations were performed as written in ULC S135 section 10 – Calculations.

SECTION 7 TEST SPECIMEN DESCRIPTION

The samples were prepared and cut by the client into 100 x 100 mm samples. The samples are a tan colored rough surface coated on an inflammable substrate. Specimens were conditioned to moisture equilibrium (constant mass) at an ambient temperature of $23 \pm 3^{\circ}\text{C}$ and a relative humidity of $50 \pm 5\%$.

SECTION 8 TEST RESULTS

Specimen information		Specimen number		Conditioned?	
E	13.1 MJ/kg	1		Yes	
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	100.32 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test		Pre-test conditions		Test times	
Standard used	ULC S135	Ambient temperature	22°C	Time to ignition	19 s
Date of test	08/01/2019	Ambient pressure	98.416 kPa	Time to flameout	80 s
Time of test	10:16	Relative humidity	27%	End of test criterion	User entered
Date of report	08/01/2019			End of test time	900 s
				(for calculations)	

Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.04381	Baseline ambient oxygen	20.797%	THR (0-300)	4.41 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.950%	THR (0-600)	5.15 MJ/m ²
O ₂ delay time	15 s	Baseline carbon dioxide	0.0485%	THR (0-1200)	-
CO ₂ delay time	15 s	Mass at sustained flaming	99.8 g	Fuel load	0.48 MJ/kg
CO delay time	15 s				
OD corr. factor	1.0055				

Test results (between 19 and 900 s)				Mean	Peak	at time (s)
Total heat release	5.5 MJ/m ²	Heat release rate (kW/m ²)		6.04	75.00	34
Total oxygen consumed	4.1 g	Effective heat of comb. (MJ/kg)		3.54	77.33	55
Mass lost	13.3 g	Mass loss rate (g/s)		0.015	0.198	180
Average specific MLR	2.30 g/(s·m ²)	Specific extinction area (m ² /kg)		-132.42	3933.10	357
Total smoke release	26.5 m ² /m ²	Carbon monoxide yield (kg/kg)		0.0920	11.6454	133
Total smoke production	0.2 m ²	Carbon dioxide yield (kg/kg)		0.32	41.15	95
MAHRE	41.1 kW/m ²					

Test averages								0 s - 916 s	0 s - 916 s
from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min			
Heat release rate (kW/m ²)	53.37	31.97	22.62	17.65	14.75	12.58	5.89	5.89	
Effective heat of comb. (MJ/kg)	12.81	8.49	6.23	5.27	4.77	4.35	3.45	3.45	
Mass loss rate (g/s)	0.037	0.033	0.032	0.029	0.027	0.026	0.015	0.015	
Specific extinction area (m ² /kg)	5.16	1.92	-10.19	-21.70	-30.36	-39.66	-131.04	-131.04	
Carbon monoxide yield (kg/kg)	0.0374	0.0498	0.0535	0.0578	0.0612	0.0648	0.0889	0.0889	
Carbon dioxide yield (kg/kg)	0.90	0.59	0.45	0.39	0.36	0.34	0.31	0.31	

Smoke results	
Total smoke release: non-flaming phase (0 s - 19 s)	2.1 m ² /m ²
Total smoke release: flaming phase (19 s - 900 s)	26.5 m ² /m ²
Total smoke release: whole test (0 s - 900 s)	28.6 m ² /m ²

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Specimen information		Specimen number		Conditioned?	
E	13.1 MJ/kg	2	2	Yes	
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	99.28 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test		Pre-test conditions		Test times	
Standard used	ULC S135	Ambient temperature	22°C	Time to ignition	18 s
Date of test	08/01/2019	Ambient pressure	98.428 kPa	Time to flameout	79 s
Time of test	10:36	Relative humidity	27%	End of test criterion	User entered
Date of report	08/01/2019			End of test time	900 s
				(for calculations)	

Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.04381	Baseline ambient oxygen	20.797%	THR (0-300)	4.40 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.950%	THR (0-600)	4.90 MJ/m ²
O ₂ delay time	15 s	Baseline carbon dioxide	0.0476%	THR (0-1200)	-
CO ₂ delay time	15 s	Mass at sustained flaming	99.4 g	Fuel load	0.49 MJ/kg
CO delay time	15 s				
OD corr. factor	1.0055				

Test results (between 18 and 900 s)						
		Mean	Peak	at time (s)		
Total heat release	5.5 MJ/m ²	Heat release rate (kW/m ²)	6.07	81.83	34	
Total oxygen consumed	4.1 g	Effective heat of comb. (MJ/kg)	3.67	69.33	718	
Mass lost	12.9 g	Mass loss rate (g/s)	0.015	0.168	52	
Average specific MLR	2.20 g/(s·m ²)	Specific extinction area (m ² /kg)	-25.16	3530.19	845	
Total smoke release	63.5 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0999	757.5276	601	
Total smoke production	0.6 m ²	Carbon dioxide yield (kg/kg)	0.34	1614.92	601	
MAHRE	43.4 kW/m ²					

Test averages									
from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 914 s	0 s - 914 s	
Heat release rate (kW/m ²)	55.51	31.96	22.31	17.59	14.61	12.49	5.94	5.94	
Effective heat of comb. (MJ/kg)	13.27	8.31	6.23	5.41	4.91	4.47	3.75	3.75	
Mass loss rate (g/s)	0.037	0.034	0.032	0.029	0.026	0.025	0.014	0.014	
Specific extinction area (m ² /kg)	30.47	40.44	26.74	15.87	9.74	8.15	-25.97	-25.97	
Carbon monoxide yield (kg/kg)	0.0399	0.0497	0.0554	0.0611	0.0656	0.0694	0.1012	0.1012	
Carbon dioxide yield (kg/kg)	0.94	0.59	0.46	0.41	0.38	0.36	0.35	0.35	

Smoke results	
Total smoke release: non-flaming phase (0 s - 18 s)	3.9 m ² /m ²
Total smoke release: flaming phase (18 s - 900 s)	63.5 m ² /m ²
Total smoke release: whole test (0 s - 900 s)	67.4 m ² /m ²

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Specimen information		Specimen number		Conditioned?	Yes
E	13.1 MJ/kg	Specimen number	3	Temperature	23°C
Thickness	12 mm	Nominal duct flow rate	24 l/s	RH	50%
Initial mass	96.86 g	Edge frame used?	Yes		
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test		Pre-test conditions		Test times	
Standard used	ULC S135	Ambient temperature	22°C	Time to ignition	22 s
Date of test	08/01/2019	Ambient pressure	98.424 kPa	Time to flameout	77 s
Time of test	10:56	Relative humidity	27%	End of test criterion	User entered
Date of report	08/01/2019			End of test time	900 s
				(for calculations)	

Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.04381	Baseline ambient oxygen	20.795%	THR (0-300)	4.47 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.948%	THR (0-600)	5.25 MJ/m ²
O ₂ delay time	15 s	Baseline carbon dioxide	0.0474%	THR (0-1200)	-
CO ₂ delay time	15 s	Mass at sustained flaming	96.6 g	Fuel load	0.54 MJ/kg
CO delay time	15 s				
OD corr. factor	1.0055				

Test results (between 22 and 900 s)					
			Mean	Peak	at time (s)
Total heat release	5.9 MJ/m ²	Heat release rate (kW/m ²)	6.65	84.56	40
Total oxygen consumed	4.3 g	Effective heat of comb. (MJ/kg)	4.30	73.29	256
Mass lost	12.0 g	Mass loss rate (g/s)	0.014	0.204	149
Average specific MLR	2.00 g/(s·m ²)	Specific extinction area (m ² /kg)	-14.64	2309.47	256
Total smoke release	68.7 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0946	10.2716	632
Total smoke production	0.6 m ²	Carbon dioxide yield (kg/kg)	0.36	15.54	632
MAHRE	42.5 kW/m ²				

Test averages								
from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 1074 s	0 s - 1074 s
Heat release rate (kW/m ²)	56.95	33.08	23.47	18.26	15.00	12.98	5.50	5.50
Effective heat of comb. (MJ/kg)	13.81	8.72	6.68	5.87	5.30	4.89	4.14	4.14
Mass loss rate (g/s)	0.036	0.034	0.031	0.027	0.025	0.023	0.012	0.012
Specific extinction area (m ² /kg)	37.82	37.46	22.11	17.64	14.29	13.06	-24.08	-24.08
Carbon monoxide yield (kg/kg)	0.0428	0.0531	0.0582	0.0636	0.0674	0.0696	0.0949	0.0949
Carbon dioxide yield (kg/kg)	0.99	0.64	0.50	0.45	0.42	0.39	0.36	0.36

Smoke results	
Total smoke release: non-flaming phase (0 s - 22 s)	6.7 m ² /m ²
Total smoke release: flaming phase (22 s - 900 s)	68.7 m ² /m ²
Total smoke release: whole test (0 s - 900 s)	75.4 m ² /m ²

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Summary Results




Heat flux	50 kW/m ²	Surface area	88.4 cm ²
Orientation	Horizontal	Retainer frame used?	Yes

Test averages

Test	t(iq) (s)	t(fo) (s)	t(end) (s)	HRR(peak) (kW/m ²)	tpeak (s)	THR (MJ/m ²)	HRR(60) (kW/m ²)	HRR(180) (kW/m ²)	HRR(300) (kW/m ²)
Mean	19.7	78.7	900	80.47	36	5.60	55.28	22.80	14.78
1	19	80	900	75.00	34	5.47	53.37	22.62	14.75
2	18	79	900	81.83	34	5.46	55.51	22.31	14.61
3	22	77	900	84.56	40	5.87	56.95	23.47	15.00

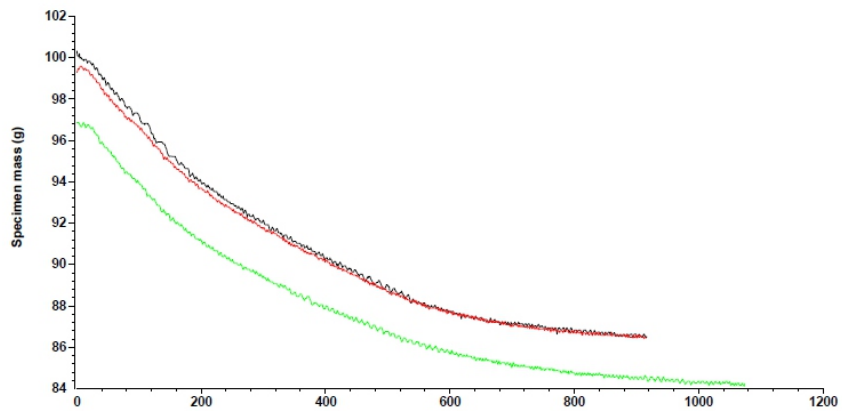
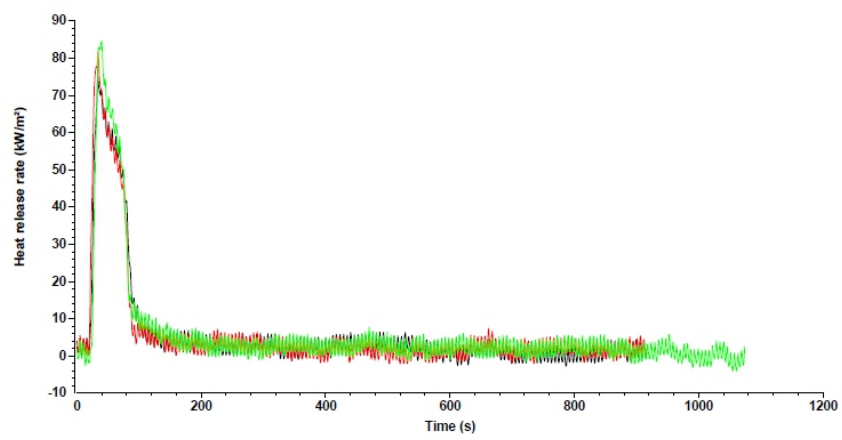
Test	Flux (kW/m ²)	t (mm)	Area (cm ²)	m(i) (g)	m(s) (g)	m(f) (g)	Δm (g)	Ave MLR (g/s·m ²)	EHC(av) (MJ/kg)
Mean		12		98.8	98.6	85.9	12.7	2.2	3.84
1	50	12	88.4	100.32	99.8	86.5	13.3	2.3	3.54
2	50	12	88.4	99.28	99.4	86.5	12.9	2.2	3.67
3	50	12	88.4	96.86	96.6	84.6	12.0	2.0	4.30

Test	THR(0-300) (MJ/m ²)	THR(0-600) (MJ/m ²)	THR(0-1200) (MJ/m ²)	SPR(av) (m ² /s)	SEA(av) (m ² /kg)	Fuel load (MJ/kg)	MARHE (kW/m ²)
Mean	4.42	5.10	-	-0.0009	-57.41	0.50	42.33
1	4.41	5.15	-	-0.0020	-132.42	0.48	41.13
2	4.40	4.90	-	-0.0004	-25.16	0.49	43.36
3	4.47	5.25	-	-0.0002	-14.64	0.54	42.51

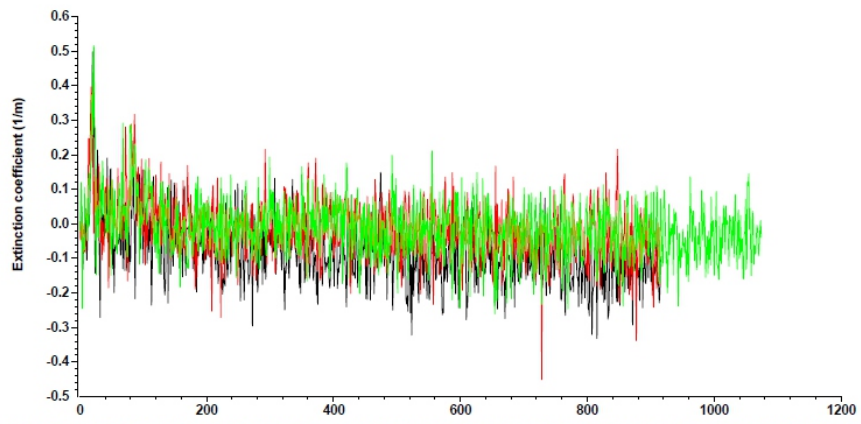
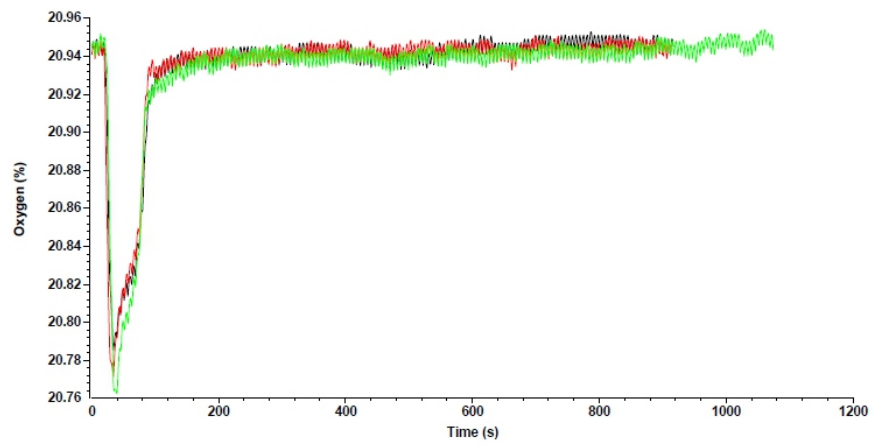
Test	Date	Specimen #	Line colour	Filename
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2	08/01/2019	2		ULCS135-2.csv
3	08/01/2019	3		ULCS135-3.csv

Ignition with orange flames.

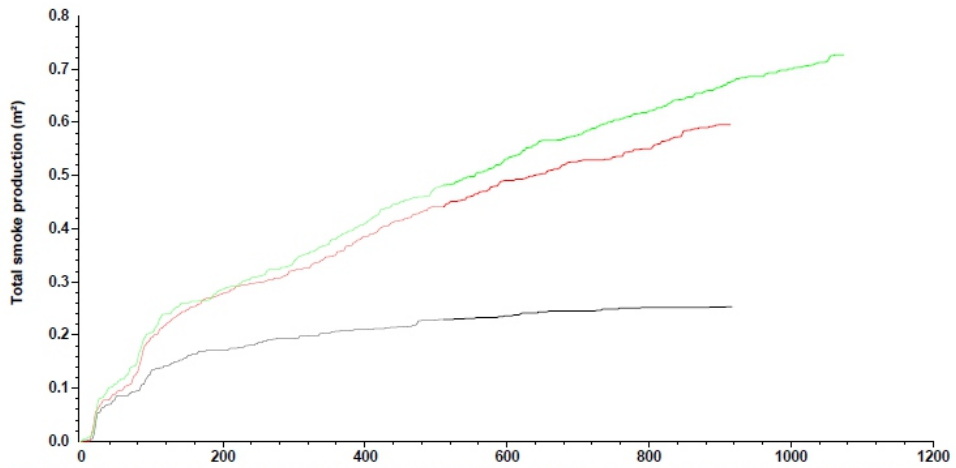
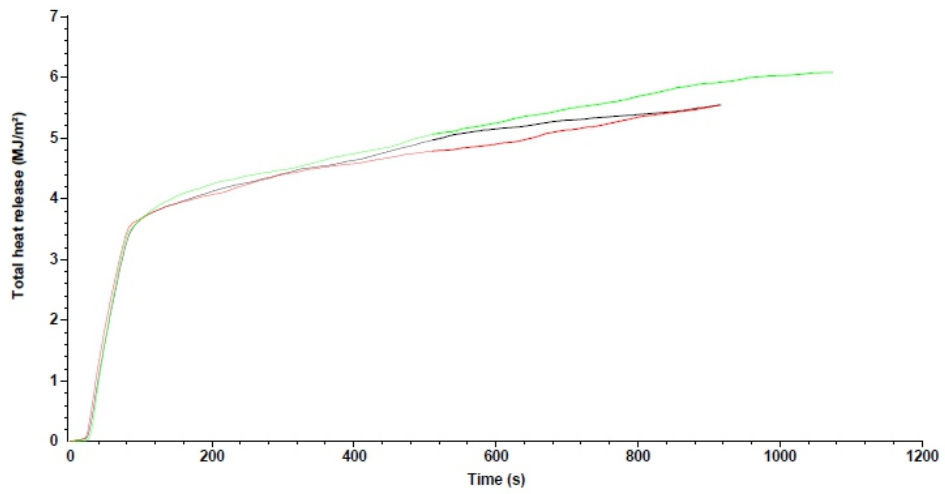
Graphs



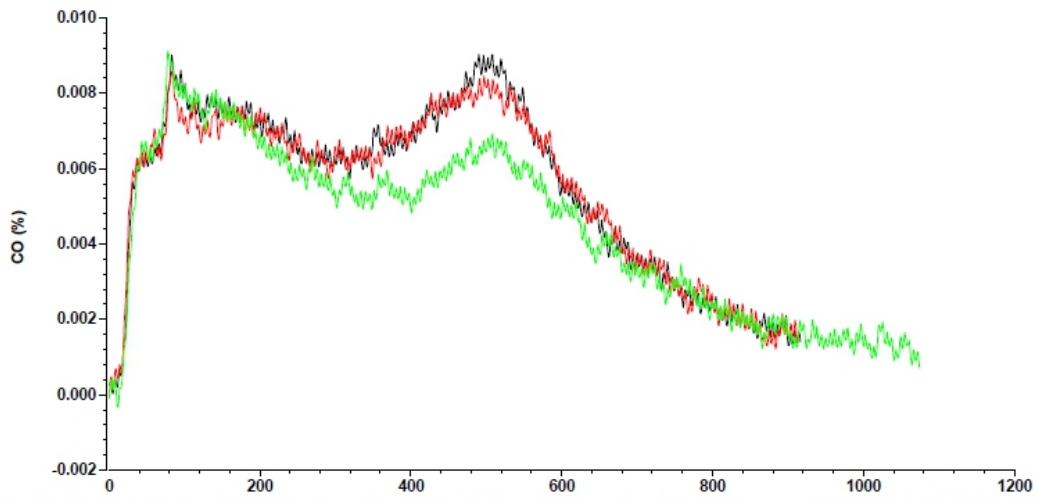
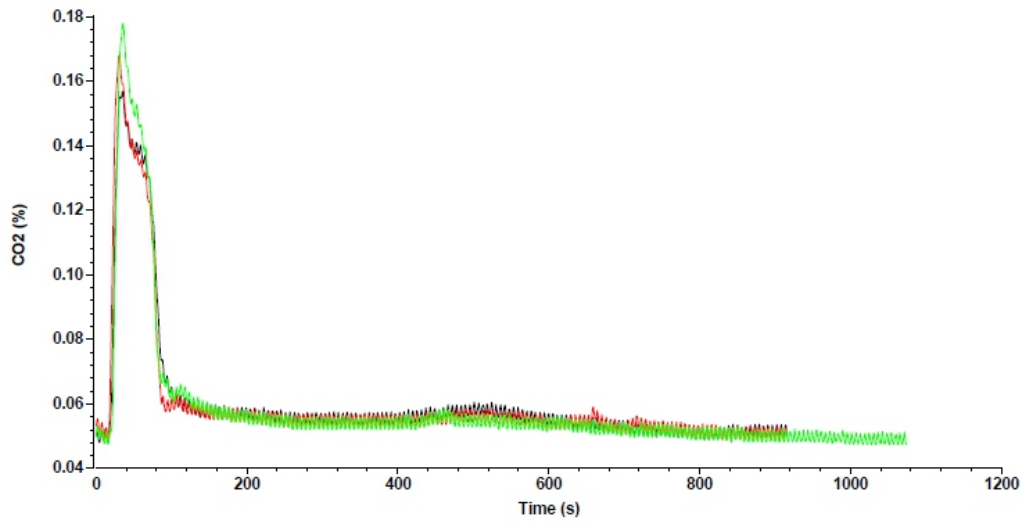
The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.



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SECTION 9
CONCLUSION

There is no pass fail requirements for the ULC S135. There were no deviations to the standard.

SECTION 10
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	01/08/19	12	Original Report Issue

SECTION 1
SCOPE

Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter, on their Corksheild. Results obtained are tested values and were secured by using the designated test method.

COMPLETED BY:	Bryan Bowman
TITLE:	Chemist
SIGNATURE:	
DATE:	01/08/19

REVIEWED BY:	Mark Crawford
TITLE:	Engineering Team Lead
SIGNATURE:	
DATE:	01/08/19

SECTION 2
TEST METHOD(S)

The specimens were evaluated in accordance with the following:

ASTM E1354-15a, Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter, ASTM International.

SECTION 3
MATERIAL SOURCE

The specimens were provided by the client. Samples were received at the Evaluation Center on December 19, 2018 in good condition. Sample ID is MID1812191254-001

SECTION 4
EQUIPMENT

EQUIPMENT		
DESCRIPTION - ASSET #:	Cone Calorimeter - 1199	CALIBRATION DUE: √BU
DESCRIPTION - ASSET #:	Scale - 1482	CALIBRATION DUE: 4/4/2019
DESCRIPTION - ASSET #:	Flow Meter - 1270	CALIBRATION DUE: 11/11/2019
DESCRIPTION - ASSET #:	Heat Flux Transducer - 1405	CALIBRATION DUE: 10/8/2019
DESCRIPTION - ASSET #:	Balance - 1396	CALIBRATION DUE: 4/4/2019
DESCRIPTION - ASSET #:	Caliper - 1248	CALIBRATION DUE: 4/3/2019
DESCRIPTION - ASSET #:	Room Temp/Humidity - 1456	CALIBRATION DUE: 3/28/2019
DESCRIPTION - ASSET #:	Conditioning Chamber - 1451	CALIBRATION DUE: 12/4/2019

SECTION 5
TEST PROCEDURE

The cone calorimeter test was run as written in ASTM E1354 section 11 – Procedure.

SECTION 6
TEST CALCULATIONS

The cone calorimeter calculations were performed as written in ASTM E1354 section 13 – Calculations.

SECTION 7
TEST SPECIMEN DESCRIPTION

The samples were prepared and cut by the client into 100 x 100 mm samples. The samples are a tan colored rough surface coated on an inflammable substrate. Specimens were conditioned to moisture equilibrium (constant mass) at an ambient temperature of 23 ± 3°C and a relative humidity of 50 ± 5%.

SECTION 8 TEST RESULTS

Specimen information		Specimen number		Conditioned?	
E	13.1 MJ/kg	1		Yes	
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	100.29 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test		Pre-test conditions		Test times	
Standard used	ASTM E1354	Ambient temperature	21°C	Time to ignition	21 s
Date of test	08/01/2019	Ambient pressure	98.256 kPa	Time to flameout	72 s
Time of test	08:41	Relative humidity	28%	End of test criterion	User entered
Date of report	08/01/2019			End of test time	192 s
				(for calculations)	

Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.04371	Baseline ambient oxygen	20.800%	THR (0-300)	4.31 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.949%	THR (0-600)	-
O ₂ delay time	15 s	Baseline carbon dioxide	0.0463%	THR (0-1200)	-
CO ₂ delay time	15 s	Mass at sustained flaming	100.3 g	Fuel load	0.34 MJ/kg
CO delay time	15 s				
OD corr. factor	1.0055				

Test results (between 21 and 192 s)						
			Mean	Peak	at time (s)	
Total heat release	3.9 MJ/m ²	Heat release rate (kW/m ²)	22.70	80.80	34	
Total oxygen consumed	2.7 g	Effective heat of comb. (MJ/kg)	6.14	73.38	54	
Mass lost	5.6 g	Mass loss rate (g/s)	0.032	0.350	78	
Average specific MLR	3.80 g/(s·m ²)	Specific extinction area (m ² /kg)	46.40	2555.24	147	
Total smoke release	37.1 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0561	31.0653	183	
Total smoke production	0.3 m ²	Carbon dioxide yield (kg/kg)	0.48	79.32	114	
MAHRE	43.0 kW/m ²					

Test averages								
from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 383 s	0 s - 383 s
Heat release rate (kW/m ²)	54.09	30.52	-	-	-	-	11.94	11.94
Effective heat of comb. (MJ/kg)	11.41	7.55	-	-	-	-	4.49	4.49
Mass loss rate (g/s)	0.042	0.035	-	-	-	-	0.023	0.023
Specific extinction area (m ² /kg)	59.77	56.77	-	-	-	-	48.74	48.74
Carbon monoxide yield (kg/kg)	0.0361	0.0494	-	-	-	-	0.0704	0.0704
Carbon dioxide yield (kg/kg)	0.81	0.57	-	-	-	-	0.39	0.39

Smoke results	
Total smoke release: non-flaming phase (0 s - 21 s)	7.6 m ² /m ²
Total smoke release: flaming phase (21 s - 192 s)	37.1 m ² /m ²
Total smoke release: whole test (0 s - 192 s)	44.7 m ² /m ²

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Specimen information			
E	13.1 MJ/kg	Specimen number	2
Thickness	12 mm	Nominal duct flow rate	24 l/s
Initial mass	104.17 g	Edge frame used?	Yes
Surface area	88.4 cm ²	Grid used?	No
Heat flux	50 kW/m ²	Fixed to substrate?	Yes
Separation	25 mm	Substrate	0.5 inch Ca Silicate
Orientation	Horizontal	Manufacturer	
		Sponsor	
		Conditioned?	Yes
		Temperature	23°C
		RH	50%

Test		Pre-test conditions		Test times	
Standard used	ASTM E1354	Ambient temperature	21°C	Time to ignition	19 s
Date of test	08/01/2019	Ambient pressure	98.295 kPa	Time to flameout	89 s
Time of test	08:53	Relative humidity	28%	End of test criterion	User entered
Date of report	08/01/2019			End of test time	209 s
				(for calculations)	
Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.04371	Baseline ambient oxygen	20.802%	THR (0-300)	5.52 MJ/m ²
Duct diameter	0.114 m	Baseline oxygen	20.951%	THR (0-600)	-
O ₂ delay time	15 s	Baseline carbon dioxide	0.0474%	THR (0-1200)	-
CO ₂ delay time	15 s	Mass at sustained flaming	104.0 g	Fuel load	0.44 MJ/kg
CO delay time	15 s				
OD corr. factor	1.0055				

Test results (between 19 and 209 s)				
		Mean	Peak	at time (s)
Total heat release	5.2 MJ/m ²	Heat release rate (kW/m ²)	27.12	85.84
Total oxygen consumed	3.4 g	Effective heat of comb. (MJ/kg)	7.23	52.34
Mass lost	6.3 g	Mass loss rate (g/s)	0.033	0.199
Average specific MLR	3.85 g/(s·m ²)	Specific extinction area (m ² /kg)	61.70	3816.23
Total smoke release	47.7 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0523	10.7373
Total smoke production	0.4 m ²	Carbon dioxide yield (kg/kg)	0.52	94.44
MAHRE	49.2 kW/m ²			

Test averages								
from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 320 s	0 s - 320 s
Heat release rate (kW/m ²)	63.61	39.91	28.45	-	-	-	17.55	17.55
Effective heat of comb. (MJ/kg)	14.34	10.07	7.32	-	-	-	5.78	5.78
Mass loss rate (g/s)	0.039	0.035	0.034	-	-	-	0.027	0.027
Specific extinction area (m ² /kg)	52.23	69.96	58.99	-	-	-	62.02	62.02
Carbon monoxide yield (kg/kg)	0.0355	0.0482	0.0504	-	-	-	0.0583	0.0583
Carbon dioxide yield (kg/kg)	1.00	0.70	0.52	-	-	-	0.43	0.43

Smoke results	
Total smoke release: non-flaming phase (0 s - 19 s)	6.2 m ² /m ²
Total smoke release: flaming phase (19 s - 209 s)	47.7 m ² /m ²
Total smoke release: whole test (0 s - 209 s)	53.9 m ² /m ²

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Specimen information								
E	13.1 MJ/kg	Specimen number	2					
Thickness	12 mm	Nominal duct flow rate	24 l/s					
Initial mass	104.17 g	Edge frame used?	Yes					
Surface area	88.4 cm ²	Grid used?	No					
Heat flux	50 kW/m ²	Fixed to substrate?	Yes					
Separation	25 mm	Substrate	0.5 inch Ca Silicate					
Orientation	Horizontal	Manufacturer						
		Sponsor						
Test Standard used ASTM E1354 Date of test 08/01/2019 Time of test 08:53 Date of report 08/01/2019		Pre-test conditions Ambient temperature 21°C Ambient pressure 98.295 kPa Relative humidity 28%						
Apparatus specifications C-factor 0.04371 Duct diameter 0.114 m O ₂ delay time 15 s CO ₂ delay time 15 s CO delay time 15 s OD corr. factor 1.0055		Initial conditions Baseline ambient oxygen 20.802% Baseline oxygen 20.951% Baseline carbon dioxide 0.0474% Mass at sustained flaming 104.0 g						
		Test times Time to ignition 19 s Time to flameout 89 s End of test criterion User entered End of test time 209 s (for calculations)						
		Heat Release Results THR (0-300) 5.52 MJ/m ² THR (0-600) - THR (0-1200) - Fuel load 0.44 MJ/kg						
Test results (between 19 and 209 s)								
Total heat release	5.2 MJ/m ²							
Total oxygen consumed	3.4 g							
Mass lost	6.3 g							
Average specific MLR	3.85 g/(s·m ²)							
Total smoke release	47.7 m ² /m ²							
Total smoke production	0.4 m ²							
MAHRE	49.2 kW/m ²							
		Mean	Peak					
			at time (s)					
		Heat release rate (kW/m ²)	27.12 85.84 35					
		Effective heat of comb. (MJ/kg)	7.23 52.34 75					
		Mass loss rate (g/s)	0.033 0.199 29					
		Specific extinction area (m ² /kg)	61.70 3816.23 126					
		Carbon monoxide yield (kg/kg)	0.0523 10.7373 117					
		Carbon dioxide yield (kg/kg)	0.52 94.44 76					
Test averages								
from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 320 s	0 s - 320 s
Heat release rate (kW/m ²)	63.61	39.91	28.45	-	-	-	17.55	17.55
Effective heat of comb. (MJ/kg)	14.34	10.07	7.32	-	-	-	5.78	5.78
Mass loss rate (g/s)	0.039	0.035	0.034	-	-	-	0.027	0.027
Specific extinction area (m ² /kg)	52.23	69.96	58.99	-	-	-	62.02	62.02
Carbon monoxide yield (kg/kg)	0.0355	0.0482	0.0504	-	-	-	0.0583	0.0583
Carbon dioxide yield (kg/kg)	1.00	0.70	0.52	-	-	-	0.43	0.43
Smoke results								
Total smoke release: non-flaming phase (0 s - 19 s)	6.2 m ² /m ²							
Total smoke release: flaming phase (19 s - 209 s)	47.7 m ² /m ²							
Total smoke release: whole test (0 s - 209 s)	53.9 m ² /m ²							

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Specimen information

E	13.1 MJ/kg	Specimen number	3	Conditioned?	Yes
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	99.03 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test

Standard used	ASTM E1354
Date of test	08/01/2019
Time of test	09:08
Date of report	08/01/2019

Pre-test conditions

Ambient temperature	21°C
Ambient pressure	98.306 kPa
Relative humidity	28%

Test times

Time to ignition	17 s
Time to flameout	82 s
End of test criterion	User entered
End of test time	202 s
	(for calculations)

Apparatus specifications

C-factor	0.04371
Duct diameter	0.114 m
O2 delay time	15 s
CO2 delay time	15 s
CO delay time	15 s
OD corr. factor	1.0055

Initial conditions

Baseline ambient oxygen	20.803%
Baseline oxygen	20.952%
Baseline carbon dioxide	0.0466%
Mass at sustained flaming	99.1 g

Heat Release Results

THR (0-300)	4.49 MJ/m ²
THR (0-600)	-
THR (0-1200)	-
Fuel load	0.38 MJ/kg

Test results (between 17 and 202 s)

		Mean	Peak	at time (s)	
Total heat release	4.2 MJ/m ²	Heat release rate (kW/m ²)	22.94	78.47	34
Total oxygen consumed	2.9 g	Effective heat of comb. (MJ/kg)	6.36	48.36	46
Mass lost	5.9 g	Mass loss rate (g/s)	0.032	0.166	58
Average specific MLR	3.73 g/(s·m ²)	Specific extinction area (m ² /kg)	18.22	1873.28	194
Total smoke release	25.7 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0587	11.9397	194
Total smoke production	0.2 m ²	Carbon dioxide yield (kg/kg)	0.49	42.53	32
MAHRE	43.7 kW/m ²				

Test averages

from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 340 s	0 s - 340 s
Heat release rate (kW/m ²)	55.47	32.63	23.46	-	-	-	13.37	13.37
Effective heat of comb. (MJ/kg)	12.85	7.81	6.25	-	-	-	4.79	4.79
Mass loss rate (g/s)	0.038	0.036	0.033	-	-	-	0.025	0.025
Specific extinction area (m ² /kg)	25.51	22.67	18.30	-	-	-	14.16	14.16
Carbon monoxide yield (kg/kg)	0.0433	0.0491	0.0564	-	-	-	0.0690	0.0690
Carbon dioxide yield (kg/kg)	0.92	0.58	0.48	-	-	-	0.41	0.41

Smoke results

Total smoke release: non-flaming phase (0 s - 17 s)	5.1 m ² /m ²
Total smoke release: flaming phase (17 s - 202 s)	25.7 m ² /m ²
Total smoke release: whole test (0 s - 202 s)	30.8 m ² /m ²

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Specimen information

E	13.1 MJ/kg	Specimen number	4	Conditioned?	Yes
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	100.4 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test

Standard used	ASTM E1354
Date of test	08/01/2019
Time of test	09:22
Date of report	08/01/2019

Pre-test conditions

Ambient temperature	21°C
Ambient pressure	98.322 kPa
Relative humidity	28%

Test times

Time to ignition	17 s
Time to flameout	78 s
End of test criterion	User entered
End of test time	198 s
	(for calculations)

Apparatus specifications

C-factor	0.04371
Duct diameter	0.114 m
O ₂ delay time	15 s
CO ₂ delay time	15 s
CO delay time	15 s
OD corr. factor	1.0055

Initial conditions

Baseline ambient oxygen	20.795%
Baseline oxygen	20.944%
Baseline carbon dioxide	0.0470%
Mass at sustained flaming	100.3 g

Heat Release Results

THR (0-300)	4.11 MJ/m ²
THR (0-600)	-
THR (0-1200)	-
Fuel load	0.34 MJ/kg

Test results (between 17 and 198 s)

		Mean	Peak	at time (s)	
Total heat release	3.8 MJ/m ²				
Total oxygen consumed	2.6 g	Heat release rate (kW/m ²)	21.04	74.87	32
Mass lost	5.8 g	Effective heat of comb. (MJ/kg)	5.82	53.04	28
Average specific MLR	3.66 q/(s·m ²)	Mass loss rate (g/s)	0.032	0.203	142
Total smoke release	21.5 m ² /m ²	Specific extinction area (m ² /kg)	8.63	2034.02	94
Total smoke production	0.2 m ²	Carbon monoxide yield (kg/kg)	0.0560	1.6542	133
MAHRE	41.4 kW/m ²	Carbon dioxide yield (kg/kg)	0.46	15.37	59

Test averages

from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 355 s	0 s - 355 s
Heat release rate (kW/m ²)	52.23	30.07	21.15	-	-	-	11.67	11.67
Effective heat of comb. (MJ/kg)	12.61	7.64	5.83	-	-	-	4.23	4.23
Mass loss rate (g/s)	0.037	0.035	0.032	-	-	-	0.025	0.025
Specific extinction area (m ² /kg)	23.22	26.01	9.40	-	-	-	-4.68	-4.68
Carbon monoxide yield (kg/kg)	0.0404	0.0502	0.0557	-	-	-	0.0668	0.0668
Carbon dioxide yield (kg/kg)	0.92	0.58	0.46	-	-	-	0.38	0.38

Smoke results

Total smoke release: non-flaming phase (0 s - 17 s)	2.4 m ² /m ²
Total smoke release: flaming phase (17 s - 198 s)	21.5 m ² /m ²
Total smoke release: whole test (0 s - 198 s)	23.9 m ² /m ²

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Specimen information

E	13.1 MJ/kg	Specimen number	5	Conditioned?	Yes
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	99.95 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test

Standard used	ASTM E1354
Date of test	08/01/2019
Time of test	09:33
Date of report	08/01/2019

Pre-test conditions

Ambient temperature	21°C
Ambient pressure	98.341 kPa
Relative humidity	28%

Test times

Time to ignition	19 s
Time to flameout	86 s
End of test criterion	User entered
End of test time (for calculations)	206 s

Apparatus specifications

C-factor	0.04371
Duct diameter	0.114 m
O ₂ delay time	15 s
CO ₂ delay time	15 s
CO delay time	15 s
OD corr. factor	1.0055

Initial conditions

Baseline ambient oxygen	20.811%
Baseline oxygen	20.960%
Baseline carbon dioxide	0.0475%
Mass at sustained flaming	99.7 g

Heat Release Results

THR (0-300)	-
THR (0-600)	-
THR (0-1200)	-
Fuel load	0.39 MJ/kg

Test results (between 19 and 206 s)

		Mean	Peak	at time (s)
Total heat release	4.4 MJ/m ²	Heat release rate (kW/m ²)	23.64	83.87
Total oxygen consumed	3.0 g	Effective heat of comb. (MJ/kg)	6.78	58.94
Mass lost	5.8 g	Mass loss rate (g/s)	0.031	0.232
Average specific MLR	3.73 g/(s·m ²)	Specific extinction area (m ² /kg)	-39.60	1534.28
Total smoke release	9.4 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0575	148.5967
Total smoke production	0.1 m ²	Carbon dioxide yield (kg/kg)	0.52	399.98
MAHRE	45.4 kW/m ²			113

Test averages

from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 248 s	0 s - 248 s
Heat release rate (kW/m ²)	58.25	35.03	24.44	-	-	-	18.78	18.78
Effective heat of comb. (MJ/kg)	14.92	9.35	6.96	-	-	-	6.15	6.15
Mass loss rate (g/s)	0.035	0.033	0.031	-	-	-	0.027	0.027
Specific extinction area (m ² /kg)	-21.06	-24.87	-36.40	-	-	-	-51.95	-51.95
Carbon monoxide yield (kg/kg)	0.0406	0.0511	0.0570	-	-	-	0.0604	0.0604
Carbon dioxide yield (kg/kg)	1.06	0.68	0.53	-	-	-	0.47	0.47

Smoke results

Total smoke release: non-flaming phase (0 s - 19 s)	1.6 m ² /m ²
Total smoke release: flaming phase (19 s - 206 s)	9.4 m ² /m ²
Total smoke release: whole test (0 s - 206 s)	11.0 m ² /m ²

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Specimen information

E	13.1 MJ/kg	Specimen number	6	Conditioned?	Yes
Thickness	12 mm	Nominal duct flow rate	24 l/s	Temperature	23°C
Initial mass	100.95 g	Edge frame used?	Yes	RH	50%
Surface area	88.4 cm ²	Grid used?	No		
Heat flux	50 kW/m ²	Fixed to substrate?	Yes		
Separation	25 mm	Substrate	0.5 inch Ca Silicate		
Orientation	Horizontal	Manufacturer			
		Sponsor			

Test		Pre-test conditions		Test times	
Standard used	ASTM E1354	Ambient temperature	21°C	Time to ignition	19 s
Date of test	08/01/2019	Ambient pressure	98.365 kPa	Time to flameout	90 s
Time of test	09:44	Relative humidity	28%	End of test criterion	User entered
Date of report	08/01/2019			End of test time	210 s
				(for calculations)	
Apparatus specifications		Initial conditions		Heat Release Results	
C-factor	0.04371	Baseline ambient oxygen	20.801%	THR (0-300)	-
Duct diameter	0.114 m	Baseline oxygen	20.950%	THR (0-600)	-
O2 delay time	15 s	Baseline carbon dioxide	0.0486%	THR (0-1200)	-
CO2 delay time	15 s	Mass at sustained flaming	100.7 g	Fuel load	0.38 MJ/kg
CO delay time	15 s				
OD corr. factor	1.0055				

Test results (between 19 and 210 s)

		Mean	Peak	at time (s)
Total heat release	4.3 MJ/m ²	Heat release rate (kW/m ²)	22.57	84.61
Total oxygen consumed	2.9 g	Effective heat of comb. (MJ/kg)	6.17	64.66
Mass lost	6.2 g	Mass loss rate (g/s)	0.032	0.212
Average specific MLR	3.83 q/(s·m ²)	Specific extinction area (m ² /kg)	19.21	2025.45
Total smoke release	27.8 m ² /m ²	Carbon monoxide yield (kg/kg)	0.0540	71.3903
Total smoke production	0.2 m ²	Carbon dioxide yield (kg/kg)	0.49	226.03
MAHRE	43.5 kW/m ²			

Test averages

from ignition to ignition plus...	1 min	2 min	3 min	4 min	5 min	6 min	0 s - 246 s	0 s - 246 s
Heat release rate (kW/m ²)	56.70	33.84	23.77	-	-	-	18.20	18.20
Effective heat of comb. (MJ/kg)	12.56	8.37	6.43	-	-	-	5.59	5.59
Mass loss rate (g/s)	0.040	0.036	0.033	-	-	-	0.029	0.029
Specific extinction area (m ² /kg)	35.45	32.96	21.21	-	-	-	18.10	18.10
Carbon monoxide yield (kg/kg)	0.0343	0.0461	0.0532	-	-	-	0.0564	0.0564
Carbon dioxide yield (kg/kg)	0.92	0.63	0.51	-	-	-	0.46	0.46

Smoke results

Total smoke release: non-flaming phase (0 s - 19 s)	5.0 m ² /m ²
Total smoke release: flaming phase (19 s - 210 s)	27.8 m ² /m ²
Total smoke release: whole test (0 s - 210 s)	32.8 m ² /m ²

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Summary

Heat flux	50 kW/m ²	Surface area	88.4 cm ²
Orientation	Horizontal	Retainer frame used?	Yes

Test averages

Test	t(iq) (s)	t(fo) (s)	t(end) (s)	HRR(peak) (kW/m ²)	tpeak (s)	THR (MJ/m ²)	HRR(60) (kW/m ²)	HRR(180) (kW/m ²)	HRR(300) (kW/m ²)
Mean	18.7	82.8	202.8	81.41	34.5	4.30	56.72	23.84	10.22
1	21	72	192	80.80	34	3.88	54.09	21.74	14.28
2	19	89	209	85.84	35	5.15	63.61	28.45	18.48
3	17	82	202	78.47	34	4.24	55.47	23.46	14.97
4	17	78	198	74.87	32	3.81	52.23	21.15	13.61
5	19	86	206	83.87	35	4.42	58.25	24.44	0.00
6	19	90	210	84.61	37	4.31	56.70	23.77	0.00

Test	Flux (kW/m ²)	t (mm)	Area (cm ²)	m(i) (g)	m(s) (g)	m(f) (g)	Δm (g)	Ave MLR (g/s·m ²)	EHC(av) (MJ/kg)
Mean		12		100.8	100.7	94.8	5.9	3.8	6.42
1	50	12	88.4	100.29	100.3	94.7	5.6	3.8	6.14
2	50	12	88.4	104.17	104.0	97.7	6.3	3.9	7.23
3	50	12	88.4	99.03	99.1	93.2	5.9	3.7	6.36
4	50	12	88.4	100.4	100.3	94.5	5.8	3.7	5.82
5	50	12	88.4	99.95	99.7	94.0	5.8	3.7	6.78
6	50	12	88.4	100.95	100.7	94.6	6.2	3.8	6.17

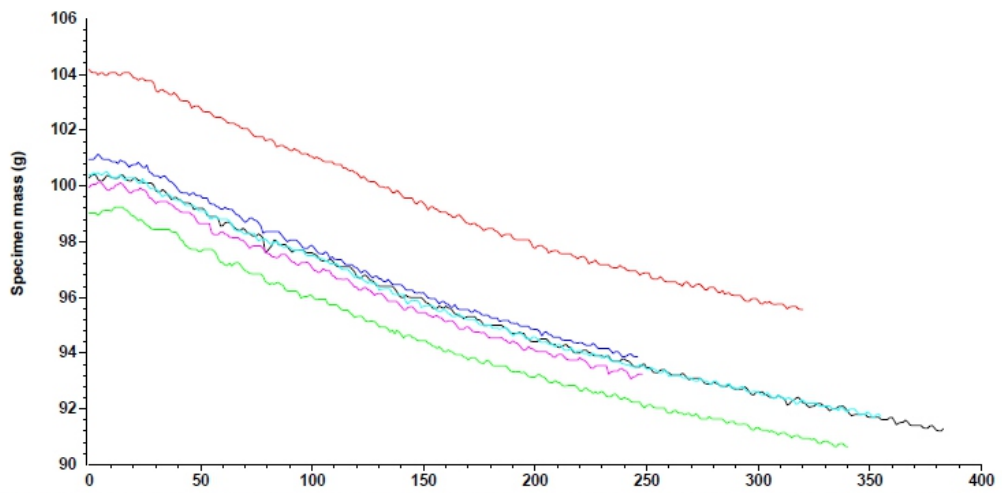
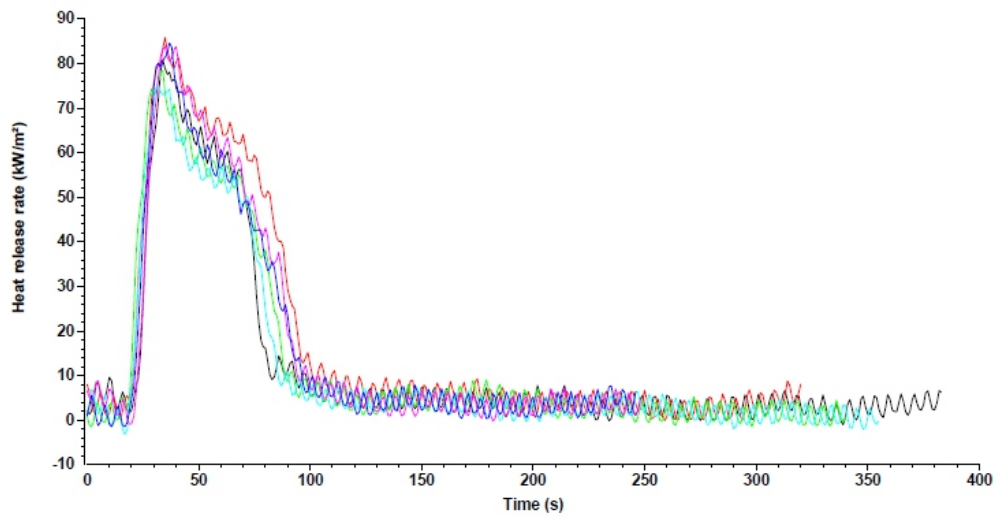
Test	THR(0-300) (MJ/m ²)	THR(0-600) (MJ/m ²)	THR(0-1200) (MJ/m ²)	SPR(av) (m ² /s)	SEA(av) (m ² /kg)	Fuel load (MJ/kg)	MARHE (kW/m ²)
Mean	-	-	-	0.0006	19.10	0.38	44.38
1	4.31	-	-	0.0015	46.40	0.34	43.04
2	5.52	-	-	0.0020	61.70	0.44	49.21
3	4.49	-	-	0.0006	18.22	0.38	43.67
4	4.11	-	-	0.0003	8.63	0.34	41.41
5	-	-	-	-0.0012	-39.60	0.39	45.43
6	-	-	-	0.0006	19.21	0.38	43.49

Test	Date	Specimen #	Line colour	Filename
1	08/01/2019	1	—	
2	08/01/2019	2	—	
3	08/01/2019	3	—	
4	08/01/2019	4	—	
5	08/01/2019	5	—	
6	08/01/2019	6	—	

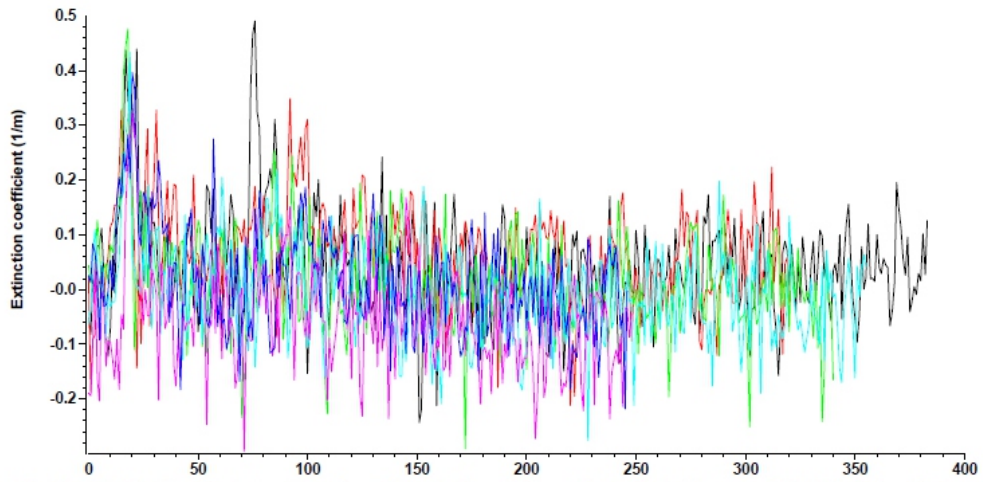
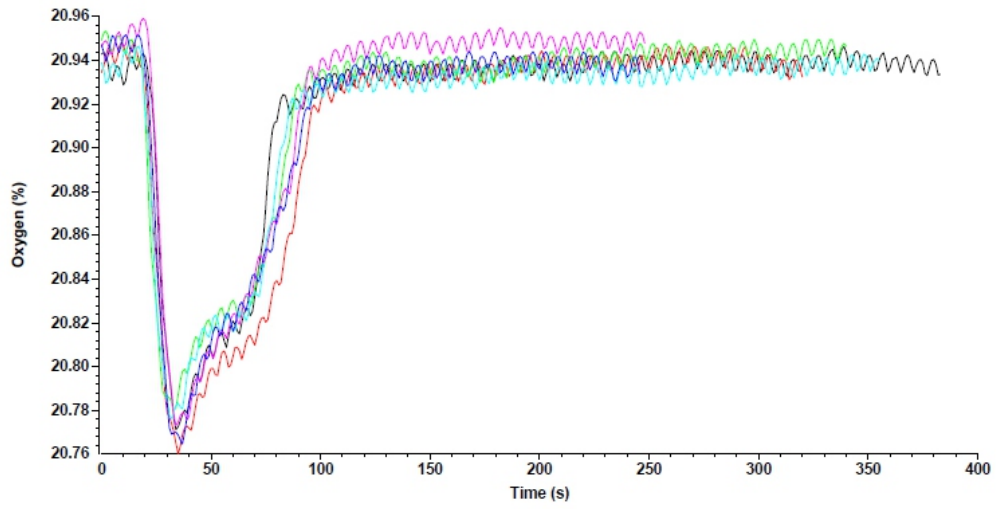
The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

General Observations:

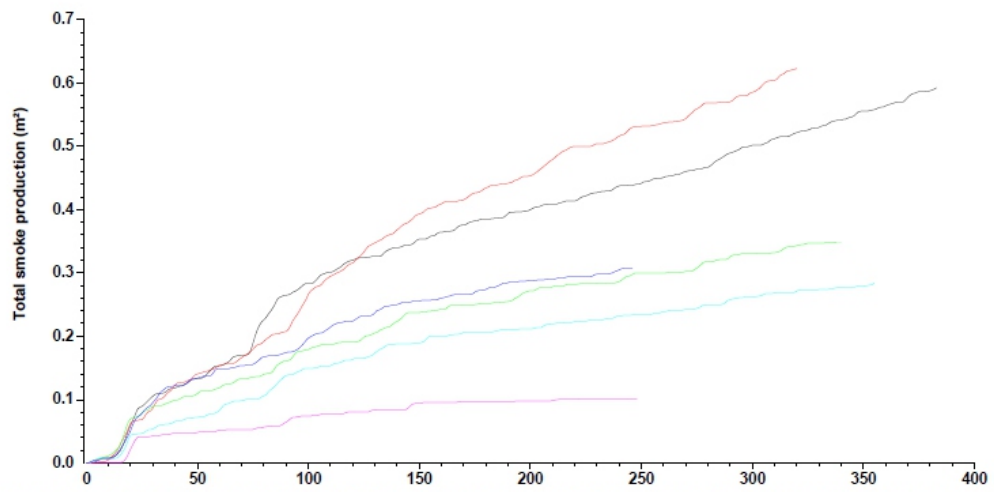
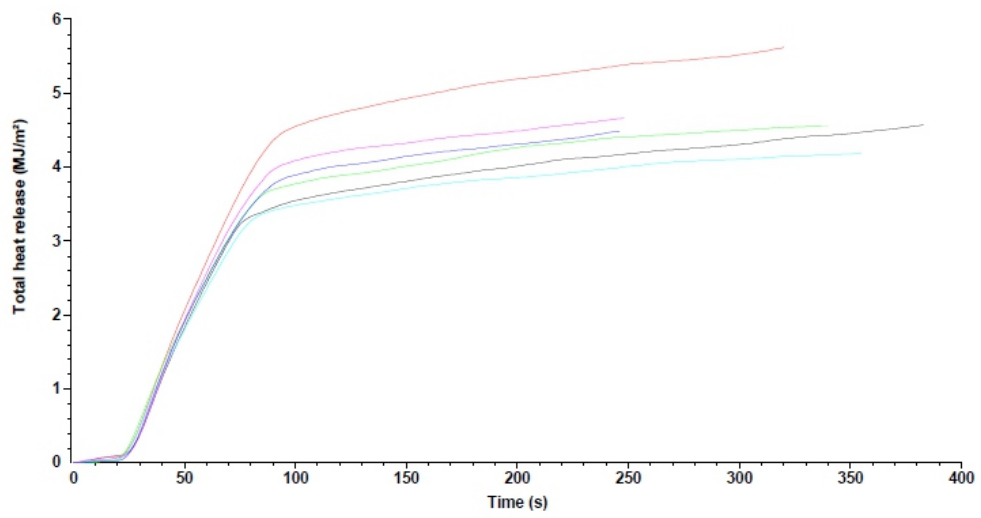
Ignition with orange flames. The heat release rate at 180 seconds for the first three specimens was not within 10% of the average heat release. Therefore, an addition three specimens were run and the average of the 6 specimens was used.



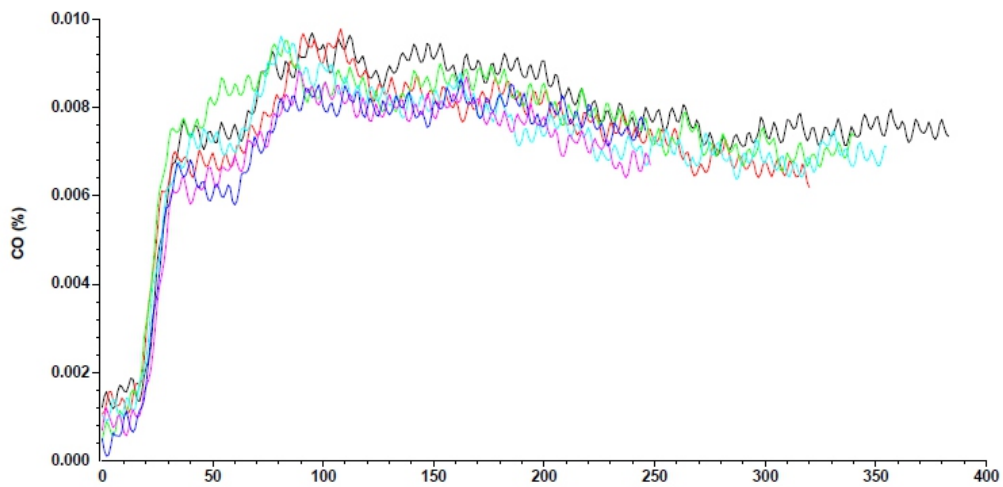
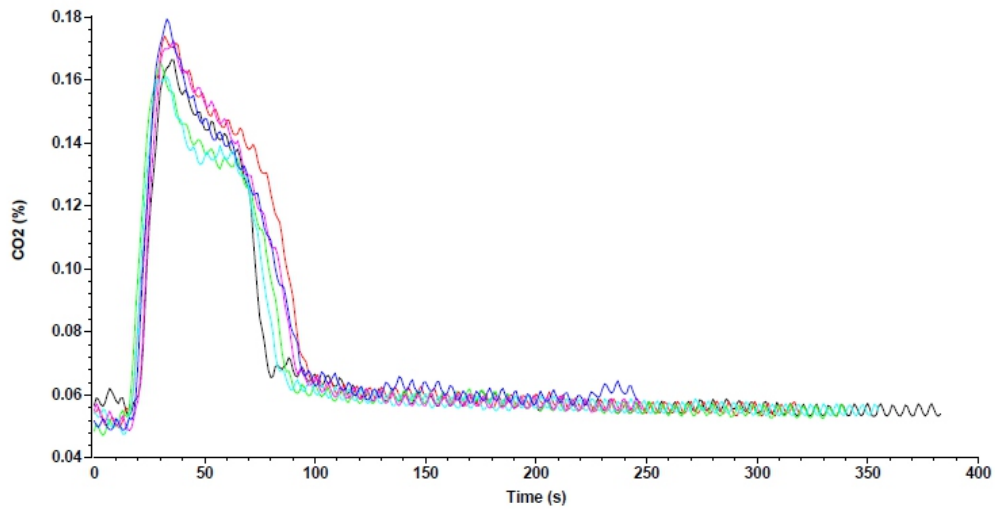
The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.



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SECTION 9
CONCLUSION

There are no pass/fail criteria with the ASTM E1354 standard.

There were no deviations from the test standard.

SECTION 10
REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	01/08/19	15	Original Report Issue

Order No. 103739533

Date: November 16, 2018

REPORT

REPORT NO. 103739533CRT-001

SOUND ABSORPTION TEST

INTRODUCTION

This report gives the results of a Sound Absorption test and the determination of the Corkshield. The test specimen was selected and supplied by the client and received on November 15, 2018.

The sample appeared to be in a new, unused condition.

AUTHORIZATION

Signed Intertek Quotation No. Qu-00898213

TEST METHOD

Absorption and Sound Absorption Coefficients by the Reverberation Room Method".

GENERAL

Testing Services Acoustical Facilities utilizes a 16,640 cu. ft. (470 cubic meter) reverberation room.

GENERAL - Cont'd

The sound absorption coefficient is ideally defined as the fraction of the randomly incident sound power absorbed by the material. The greater the coefficient, the greater the sound absorption.

The Noise Reduction Coefficient (NRC) is a single number rating obtained by taking the arithmetic average of the absorption coefficients at 250, 500, 1000, and 2000 Hz rounded to the nearest multiple of 0.05.

The Sound Absorption Average (SAA) is a single number rating obtained by taking the arithmetic average of the one-third octave bands from 200 through 2500 Hz rounded to the nearest 0.01.

DESCRIPTION OF TEST SPECIMEN

The test specimen consisted of a 10.5 m² test area (consisting of fourteen 750x1000 mm pieces) covered with material identified as: Sprayrd Corkshield laid on the concrete floor of our 16,640 cu. ft. reverberation room. The sample weighed approximately 1.75 kilograms per square meter. The sample measured a nominal 5 mm thick.

RESULTS OF TEST

CORKSHIELD 5 mm THICK

<u>One Third Octave Band Center Frequency, Hz</u>	<u>Absorption Coefficients Sabins/m²</u>	<u>Repeatability, R</u>	<u>Reproducibility, r</u>
80	0.00	0.14	0.14
100	0.05	0.15	0.27
125	<u>0.04</u>	0.11	0.22
160	0.00	0.11	0.23
200	0.02	0.09	0.17
250	<u>0.00</u>	0.07	0.15
315	0.11	0.09	0.22
400	0.05	0.14	0.16
500	<u>0.03</u>	0.09	0.14
630	0.03	0.06	0.14
800	0.02	0.07	0.14
1000	<u>0.02</u>	0.06	0.12
1250	0.06	0.05	0.13
1600	0.13	0.05	0.14
2000	<u>0.17</u>	0.05	0.13
2500	0.17	0.06	0.14
3150	0.17	0.08	0.15
4000	<u>0.17</u>	0.11	0.16
5000	0.15	0.15	0.21
<u>Sound Absorption Average (SAA)</u>	0.07	0.08	0.03

Absorption Coefficients – Sabins/m.²
One-Third Octave Band Center Frequency, Hz

<u>IDENTIFICATION</u>	<u>125</u>	<u>250</u>	<u>500</u>	<u>1000</u>	<u>2000</u>	<u>4000</u>	<u>NRC</u>
	0.04	0.00	0.03	0.02	0.17	0.17	0.05

MOUNTING: Type “A” per ASTM Designation E795-16

REMARKS

1. Aging Period: None
2. Ambient Temperature: 69°F
3. Relative Humidity: 42%

CONCLUSION

The test method employed for this test has no pass-fail criteria, therefore, the evaluation of the test results is left to the discretion of the client.

Date of Test: November 16, 2018

Report Approved by:



Brian Cyr
Engineer
Acoustical Testing

Report Reviewed By:



James R. Kline
Engineer/Quality Supervisor
Acoustical Testing

Attachments: None